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Fernald 2006 Site Environmental Report

2006 Environmental Summary (Appendixes A Through D)

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Appendix A

Supplemental Groundwater Information

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List of Acronyms

AMSL	above mean sea level
AWWT	advanced wastewater treatment facility
BRSR	Baseline Remedial Strategy Report
CAWWT	converted advanced wastewater treatment facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMT	Continuous Multi-channel Tubing
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
EW	Extraction Well
FRL	final remediation level
GMA-D	Great Miami Aquifer downgradient
GMA-U	Great Miami Aquifer upgradient
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
HTW	horizontal till well
IAWWT	Interim Advanced Waste Water Treatment
IEMP	Integrated Environmental Monitoring Plan
IW	Re-injection Well
LCS	leachate collection system
LDS	leak detection system
OAC	Ohio Administrative Code
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
SCL	Shewhart control limit
UCL	upper confidence level
WRS	Wilcoxon Rank Sum

List of 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

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Appendix A presents additional groundwater data and analysis in support of Chapter 3 of this 2006 Site Environmental Report. 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 2006.
- Attachment A.2 provides total uranium data (including summary statistics) and plume maps for the first and second halves of 2006.
- Attachment A.3 evaluates the capture zone by reviewing groundwater flow directions based on groundwater elevation data. It includes groundwater elevation maps from all four quarters of 2006 and hydrographs for specific wells.
- Attachment A.4 provides an analysis of the 2006 non-uranium final remediation level (FRL) exceedances both inside and outside the Waste Storage Area (Phase II) design remediation footprint.
- Attachment A.5 presents 2006 leak detection and leachate monitoring results associated with the On-site Disposal Facility Monitoring program.

References

Dixon, Wilfrid J., and Massey, Frank J., Jr., 1969. "Introduction to Statistical Analysis," 3rd ed., McGraw-Hill Book Company, New York.

ERM Midwest, Inc., 1994. "Remedial Investigation and Risk Assessment, Paddys Run Road Site," Revision 1, Volumes 1 through 5, Crosby Township, Hamilton, Ohio.

Gilbert, Richard, O., 1987. "Statistical Methods for Environmental Pollution Monitoring," Van Nostrand Reinhold, New York.

Mandansky, Albert, 1988. "Prescription for Working Statisticians," Springer-Verlag New York, Inc., New York.

DOE (U.S. Department of Energy), 2006. "Groundwater/Leak Detection and Leachate Monitoring Plan; On-site Disposal Facility," 20100-PL-009, Revision 2, Draft Final, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 2005a. "IEMP Mid-Year Data Summary Report for 2004," 51350-RP-0025, Revision 0, Final, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, November.

DOE (U.S. Department of Energy), 2005b. "2004 Site Environmental Report," 51350-RP-0026, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, May.

DOE (U.S. Department of Energy), 2005c. "Transmittal of Responses to U.S. and Ohio Environmental Protection Agency Comments on the Waste Storage Area Phase II Design Report, Revision A, and an Addendum to the Waste Storage Area Phase II Design Report, Revision A," letter #DOE-0038-06, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, December 6.

DOE (U.S. Department of Energy), 2005d. “Waste Storage Area Phase II Design Report,” 52424-RP-0004, Revision A, Draft Final, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, May.

DOE (U.S. Department of Energy), 2004a. “Groundwater Remedy Evaluation and Field Verification,” 52460-PL-0001, Revision 0, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, October.

DOE (U.S. Department of Energy), 2004b. “2003 Site Environmental Report,” 51350-RP-0024, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2003. “Integrated Environmental Monitoring Plan,” 2505-WP-0022, Revision 3, Final, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 2002a. “Design for Remediation for the Great Miami Aquifer South Field (Phase II) Module,” 52462-RP-0001, Revision A, Draft Final, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, May.

DOE (U.S. Department of Energy), 2002b. “Technical Memorandum for the On-site Disposal Facility, Cells 1, 2, and 3 Baseline Groundwater Conditions,” Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 2001. “2000 Integrated Site Environmental Report,” 51350-RP-0015, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, May.

DOE (U.S. Department of Energy), 1998. “Restoration Area Verification Sampling Program Summary Report,” Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1997a. “Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration,” 2505-RP-0003, Revision 0, Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 1997b. “On-site Disposal Facility Final Design Calculation Package,” Volume 2 of 4, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1997c. “Restoration Area Verification Sampling Program Project-Specific Plan,” Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, Ohio.

DOE (U.S. Department of Energy), 1995. “Remedial Investigation Report for Operable Unit 5,” Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, Ohio, March.

EPA (U.S. Environmental Protection Agency). 1996, “Report on the 1995 Workshop on Geosynthetic Clay Liners,” EPA/600/R-96/149, Washington, D.C., June.

EPA (U.S. Environmental Protection Agency), 1992a. “General Methods for Remedial Operation Performance Evaluations,” U.S. Environmental Protection Agency, Environmental Research Laboratory, Ada, Oklahoma, January.

EPA (U.S. Environmental Protection Agency), 1992b. “Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities – Addendum to Interim Final Guidance,” July.

EPA (U.S. Environmental Protection Agency), 1989. “Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities – Interim Final Guidance,” EPA/530-SW-89-026, February.

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Attachment A.1

A.1.0 Operational Assessment

At the start of 2006 all extraction systems modules were operational. Figures A.1−1A and A.1−1B depict the locations of extraction and former reinjection wells and identify surrounding monitoring wells. Table A.1−1 provides summaries of gallons pumped, total uranium removed, and uranium removal indices for 2006 and for August 1993 through December 2006.

The operation assessment 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

The South Field Module was built in two phases. Phase I began operating in July 1998 and Phase II began operating in July 2003. At the end of 2006, the South Field Module included 13 active extraction wells, six inactive extraction wells, two inactive reinjection wells, and one inactive Injection Pond.

- The 13 active extraction wells are Extraction Wells 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 six inactive extraction wells are Extraction Wells 31564 (EW-14), inactive since December 19, 2001; 31565 (EW-13), inactive since May 22, 2001; 31566 (EW-15), inactive since August 7, 1998; 31562 (EW-21), inactive since March 13, 2003 to facilitate installation of a replacement well; 31563 (EW-16), inactive since December 9, 2002 to facilitate conversion to a reinjection well as part of the South Field (Phase II) Project, and 31567 (EW-17) inactive since September 6, 2005 to facilitate installation of a replacement well.
- The two inactive reinjection wells are 31563 (IW 16), which was converted from Extraction Well 31563 (EW-16); and 33263 (IW 29). South Field Module wells are located near the Southern Waste Unit excavations and the storm sewer outfall ditch in the South Field area of the Fernald site, from Paddys Run to just west of the site's South Access Road.
- The inactive Injection Pond was located in the western portion of the southern waste unit excavations area.

The target combined pumping rate for the online South Field Module wells in 2006 was 2,575 gallons per minute (gpm). This target 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 the South Field Module extraction wells that were operational in 2006. 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 2006, 1,105.42 million gallons of groundwater were pumped by the active extraction wells in the South Field Module resulting in the removal of 423.693 pounds (lbs) of uranium from the Great Miami Aquifer. Since startup of the South Field Module in July 1998, the module has removed 8.583 billion gallons of water and 4,598.3 lbs of uranium from the Great Miami Aquifer.

A.1.2 South Plume Module

At the end of 2006, the South Plume Module included six active recovery wells and one inactive recovery well. 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). Recovery Wells 32308 (RW 6) and 32309 (RW 7) were installed as the South Plume Optimization Module. The one inactive recovery well is 3928 (RW 5), inactive since September 11, 1994. 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 2006 was 1,400 gpm. This target is consistent with the Waste Storage Area Phase II Model Design with the exception of RW-4. The pumping rate of RW-4 was set higher than what was defined in the Waste Storage Area Phase II Model Design to assure capture of a lobe of the uranium plume just south of Willey Road along the eastern side of the plume. Tables A.1−15 through A.1−20 provide individual extraction well performance data for the South Plume Module extraction wells that were operational in 2006. 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 2006, 583.28 million gallons of groundwater were pumped by the six wells in the South Plume Module resulting in the removal of 110.92 lbs of uranium from the Great Miami Aquifer. Since startup of the South Plume Module in August 1993, the module has removed 9.992 billion gallons of groundwater and 2,122.91 lbs of uranium from the Great Miami Aquifer.

During 2006, 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 (Extraction Wells 3924 [RW 1], 3925 [RW 2], 3926 [RW 3], and 3927 [RW 4]).
- Actively remediating the higher concentration region of the off property plume (Extraction Wells 32308 [RW 6] and 32309 [RW 7]).

Attachment A.3 presents additional details concerning capture, along with supporting data. In 2006, as in previous years, Paddys Run Road Site (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 Figures A.1−1A).

Consistent with previous reporting, the Mann Kendall test for trend was run on PRRS data collected from these wells. As indicated in Table A.1−21, two wells monitored for PRRS constituents of concern had an “up, significant” trend for two constituents based on the Mann Kendall test for trend:

- 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. This indicates that the increasing potassium concentrations at these two locations were 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 2006.

A.1.3 Waste Storage Area Module

Phase-I of the Waste Storage Area Module became operational on May 8, 2002. The module consisted of three extraction wells: 32761 (EW-26), 33062 (EW-27), and 33063 (EW-28). Extraction Well 33063 (EW-28) was turned off in July 2004 and was plugged and abandoned to make way for surface remediation activities. Four groundwater monitoring wells surrounding EW-28 (63121, 63122, 83120, and 83123) were also plugged and abandoned. The two remaining extraction wells resumed operation in March 2005, after pumping was suspended for the duration of CAWWT Stage I construction. The target combined pumping rate was 700 gpm. The pumping rate of EW-27 was set higher than what was defined in the Waste Storage Area Phase II Model Design in order to compensate for the temporary loss of EW-28. On June 29, 2006 a replacement well for extraction well EW-28 (EW-28a, 33334) became operational. On October 5, 2006 a new extraction well became operational (EW-33a, 33347) as part of the Waste Storage Area Phase II Design. The target pumping rate for the Waste Storage Area Module following the start up of extraction well EW-33a was 1000 gpm. This target pumping rates 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 2006, 339.25 million gallons of groundwater were pumped from extraction wells in the Waste Storage Area Module resulting in the removal of 137.890 lbs of uranium from the Great Miami Aquifer. Since startup of the Waste Storage Area Module in May 2002, 1.79 billion gallons of water and 1,151.27 lbs of uranium have been removed from the Great Miami Aquifer.

A.1.4 Total Uranium Data

Process control water samples are collected weekly from the extraction wells and analyzed for total uranium. The weekly total uranium concentrations are used to 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.1−4 provides a graph of the monthly gallons of groundwater extracted versus the monthly gallons of groundwater treated for 2006.

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.1−5 through A.1−27 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 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. 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.1−5 through A.1−27 indicate when the actual measured concentrations and the 95 percent UCL calculated concentrations will reach the 30 µg/L final remediation level (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 2008 (trend for the measured data set) or approximately 2023 (trend for the 95 percent UCL data).

Figures A.1−5 through A.1−27 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.

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, 2006 are summarized in Table A.1−26.

At the end of December 2006, approximately 7,796 net lbs of uranium had been removed from the Great Miami Aquifer by the pump-and-treat remedy. Modeled performance metrics for the Waste Storage Area (Phase II) design are provided in Table A.1−27. Model predictions indicate that an additional 6,386 lbs of uranium will be removed from the Great Miami Aquifer by operating the system according to the Waste Storage Area (Phase II) Design through 2024. Performance metrics based on the measured uranium concentration data set collected at the extraction wells are provided in Table A.1−28. The concentration data set indicates that an additional 5,371 lbs of uranium will be removed from the Great Miami Aquifer based on regression analyses of the individual well data. Performance metrics based on the 95 percent UCL of the measured uranium

concentration data set are provided in Table A.1−29. The 95 percent UCL measured concentration data set indicates that an additional 15,896 lbs of uranium will be removed from the Great Miami Aquifer based on regression analyses of the individual well data. Figure A.1−28 illustrates the relationship between the results. The predictions are also summarized below.

	Data	Model	95% UCL
Net pounds of uranium extracted through December 2006	7796	7796	7796
Predicted pounds of U to be extracted between 07 and the end of the remedy	5371	6386	15896
Total predicted pounds of uranium to be removed	**13167**	**14182**	**23692**
Estimated Percent Complete (based on lbs of uranium to be removed)	**59.21**	**54.97**	**32.91**

Results indicate that as of January 1, 2007, the estimated percent complete for the aquifer remedy is approximately 59 percent (based on the uranium concentration data set) or 55 percent (based on the model predictions) equaling a difference of approximately 4 percent. The remedy is approximately 33 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 DOE Office of Legacy Management's website under the Fernald site (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 2006 are provided in Table A.1−30. The target pumping rates shown in Table A.1−30 are consistent with rates defined by the Waste Storage Area Phase II Model Design with the exception of Extraction Well 3927 (RW 4) in the South Plume The target pumping rate for Extraction Well 3927 in the South Plume Module was set at 400 gpm in 2006 to ensure capture of the east side of the South Plume. In 2007, the target pumping rate for Extraction Well 3927 will be decreased to 200 gpm, to be in accordance with` the Waste Storage Area Phase II Design. As explained further in Attachment A.3, new particle path modeling indicates that east side of the South Plume is being captured under Waste Storage Area Phase II pumping schedules. The target pumping rate for Extraction Well 33062 (EW-27) in the waste storage area was increased to 400 gpm in the first half of 2006 in order to help compensate for the temporary loss of Extraction Well 33063 (EW-28). Extraction Well 33063 (EW-28) in the waste storage area was shut down in July 2004 to make way for soil remediation activities. A replacement well for Extraction Well 33063 (EW-28) became operational on June 29, 2006. As additional operational experience is gained, pumping rate changes may occur as efforts to maximize the effectiveness of each module are made.

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

	Reporting Period					
	January 2006 through December 2006			August 1993 through December 2006		
	Gallons Pumped/ Re-injected (M gal)[a]	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	1,105.422	423.693	0.38	8,582.618	4,598.330	0.54
Waste Storage Area Module	339.250	137.890	0.41	1,795.809	1,151.270	0.64
South Plume Module	583.282	110.918	0.19	9,991.944	2,122.908	0.21
Re-injection Module[c]	0	0	NA	1,936.478	76.27	NA
Aquifer Restoration Systems Totals						
Extraction Wells	2,027.953	672.502	0.33	20,370.070	7,872.509	0.39
(Re-injection Wells)	0	0	NA	(1,936.478)	(76.27)	NA
Net	2,027.953	672.502	NA	18,433.592	7,796.239	NA

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

Table A.1–2. Extraction Well 31550 (EW-18) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 7484 Target pumping rate – 100 gpm
Hours not pumped – 1276 Operational percent – 85.43

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/Million Gallons Pumped)
1/06	21.6 [a]	0.963	39.4	0.33
2/06	88.0 [b]	3.548	47.4	0.40
3/06	105.4 [b]	4.703	41.9	0.35
4/06	111.2	4.803	39.3	0.33
5/06	93.7 [c]	4.184	42.4	0.35
6/06	104.2 [c]	4.501	45.9	0.38
7/06	98.8 [d]	4.410	44.4	0.37
8/06	96.9 [e]	4.324	42.7	0.36
9/06	107.8	4.657	40.7	0.34
10/06	97.0 [f]	4.330	42.0	0.35
11/06	79.8 [g]	3.448	42.6	0.36
12/06	98.4	4.391	42.1	0.35
Average	91.9	Total 48.261	Average 42.6	Average 0.36

[a] Well shut down from January 1 to January 29 for maintenance and to facilitate construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, and 27 to March 2 to facilitate construction tie-ins to the discharge header.
[c] Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, removal of DO line and CAWWT power outage.
[d] Downtime for well in July was due to chlorination.
[e] Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage.
[f] Well shut down on October 20 and from October 24 to October 27 due to a power outage at the Parshall Flume.
[g] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.

Table A.1–3. Extraction Well 31560 (EW-19) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 7786 Target pumping rate –100 gpm
Hours not pumped – 974 Operational percent – 88.88

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/Million Gallons Pumped)
1/06	63.8 [a]	2.847	43.7	0.36
2/06	85.0 [b]	3.425	40.5	0.34
3/06	104.7 [b]	4.672	36.5	0.30
4/06	106.9	4.619	36.3	0.30
5/06	92.2 [c]	4.116	36.8	0.31
6/06	103.2 [cd]	4.457	35.9	0.30
7/06	105.3 [d]	4.699	32.7	0.27
8/06	94.9 [e]	4.235	31.4	0.26
9/06	108.2	4.673	30.5	0.25
10/06	99.9 [f]	4.461	34.2	0.29
11/06	71.9 [g]	3.104	34.6	0.29
12/06	98.7 [h]	4.405	35.5	0.30
	Average 94.5	Total 49.714	Average 35.7	Average 0.30

[a] Well shut down January 5 to January 15 to reduce the uranium concentration at the Parshall Flume. Well shut down January 23 to January 29 due to construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, February 27 to March 2 facilitate construction tie-ins to the discharge header.
[c] Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[d] The flow meter failed on June 22. Daily flow was estimated through July 11 from the set point.
[e] Well shut down from August 5 to August 6 due to a local power outage. Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage.
[f] Well shut down on October 20, and from October 24 to October 27 due to a power outage at the Parshall Flume.
[g] Well shut down on November 18 for a site wide power outage. Well shut down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.
[h] Wells shut down on December 12 and December 13 for check valve cleaning.

Table A.1–4. Extraction Well 31561 (EW-20) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 5857 | Target pumping rate – 100 gpm
Hours not pumped – 2903 | Operational percent – 66.86

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration [a] (µg/L)	Uranium Removal Index [a] (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	63.7 [b]	2.846	30.6	0.25
2/06	88.1 [c]	3.551	29.7	0.25
3/06	102.3 [c]	4.567	28.8	0.24
4/06	8.3 [d]	0.358	28.8	0.24
5/06	0.0 [e]	0.0	NS	NS
6/06	30.4 [e]	1.313	25.0	0.21
7/06	102.7	4.583	31.8	0.27
8/06	97.8 [f]	4.367	30.3	0.25
9/06	91.4 [g]	3.949	31.5	0.26
10/06	97.6 [h]	4.357	33.6	0.28
11/06	80.6 [i]	3.480	33.1	0.28
12/06	98.9 [j]	4.416	32.2	0.27
	Average 71.8	Total 37.786	Average 30.5	Average 0.25

[a] NS = not sampled
[b] Well shut down from January 5 to January 15 to reduce the uranium concentration at the Parshall Flume. Well shut down January 23 to January 29 due to construction tie-ins at CAWWT.
[c] Well shut down February 11, 17, and February 27 to March 2 to facilitate construction tie-ins to the discharge header.
[d] Well shut down April 3 to the end of the month for rehab and pump replacement.
[e] Well shut down from May 1 to June 22 for rehab and pump replacement.
[f] Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage.
[g] Well shut down from September 15 to September 20 due to a power outage and re-start problems.
[h] Well shut down on October 19 for maintenance on IX 2B. Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[i] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.
[j] Wells shut down on December 12 and December 13 for check valve cleaning.

Table A.1–5. Extraction Well 31567 (EW-17) and 33326 (EW-17a) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 7524 Target pumping rate – 175 gpm
Hours not pumped – 1237 Operational percent – 85.88

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	120.5 [a]	5.378	31.2	0.26
2/06	166.7 [b]	6.722	38.1	0.32
3/06	201.9 [b]	9.014	31.1	0.26
4/06	208.8	9.021	31.9	0.27
5/06	159.7 [c]	7.128	30.9	0.26
6/06	166.8 [c]	7.204	30.8	0.26
7/06	149.9 [d]	6.692	34.1	0.28
8/06	121.0 [e]	5.400	27.7	0.23
9/06	99.1 [f]	4.281	26.8	0.22
10/06	129.6 [g]	5.784	27.2	0.23
11/06	100.4 [h]	4.336	28.5	0.24
12/06	114.0 [i]	5.090	28.5	0.24
Average	144.9	Total 76.050	Average 30.6	Average 0.26

[a] Well shut down January 5 to January15 to reduce the uranium concentration at the Parshall Flume. Well shut down January 23 to January 29 due to construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, and February 27 to March 2 to facilitate construction tie-ins to the discharge header.
[c] Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[d] All downtime for well in July was due to chlorination.
[e] Well shut down from August 5 to August 6 due to a local power outage. Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage
[f] Well shut down from September 9 to September 20 due to fluctuating flow rates.
[g] Well shut down on October 20 and from October 24 to October 27 due to a power outage at the Parshall Flume.
[h] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI.
[i] Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.

Table A.1–6. Extraction Well 32276 (EW-22) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 7911 Target pumping rate – 300 gpm
Hours not pumped – 850 Operational percent – 90.30

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	264.2 [a]	11.794	50.1	0.42
2/06	230.5 [b]	9.293	58.2	0.49
3/06	261.8 [c]	11.687	50.1	0.42
4/06	273.3	11.806	53.9	0.45
5/06	259.3 [d]	11.573	56.4	0.47
6/06	288.3 [d]	12.455	55.2	0.46
7/06	305.6	13.643	55.3	0.46
8/06	288.8 [e]	12.894	53.0	0.44
9/06	325.8	14.075	47.8	0.40
10/06	292.5 [f]	13.057	48.5	0.40
11/06	230.3 [g]	9.948	48.9	0.41
12/06	304.7	13.600	46.8	0.39
Average	277.1	Total 145.823	Average 52.0	Average 0.43

[a] Well shut down January 23 to January 29 due to construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well shut down March 1 due to construction tie-ins to the discharge header.
[d] Wells shut down on May 25 due to lightning. Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[e] Well shut down from August 5 to August 6 due to a local power outage. Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage
[f] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[g] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.

Table A.1–7. Extraction Well 32446 (EW-24) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 6639.5 | Target pumping rate – 300 gpm
Hours not pumped – 2120.5 | Operational percent – 75.79

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration [a] (µg/L)	Uranium Removal Index [a] (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	0.0 [b]	0.000	NS	NS
2/06	0.0 [b]	0.000	NS	NS
3/06	291.3 [c]	13.005	50.1	0.42
4/06	302.6	13.074	52.0	0.43
5/06	239.6 [d]	10.695	52.7	0.44
6/06	264.0 [d]	11.404	50.7	0.42
7/06	230.3 [e]	10.279	47.8	0.40
8/06	215.9 [f]	9.638	47.2	0.39
9/06	237.6 [g]	10.265	49.5	0.41
10/06	196.0 [h]	8.748	48.3	0.40
11/06	176.1 [i]	7.607	50.5	0.42
12/06	228.5 [j]	10.201	47.5	0.40
	Average 198.5	Total 104.917	Average 49.6	Average 0.41

[a] NS = not sampled
[b] Well shut down in January and February waiting repairs to motor.
[c] Well shut down March 1 due to construction tie-ins to the discharge header.
[d] Well shut down on May 25 due to lightning. Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[e] All downtime for well in July was due to chlorination.
[f] Well shut down from August 5 to August 6 due to a local power outage. Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage.
[g] Wells shut down on September 11 due to a lightning strike.
[h] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down October 22 due to fluctuating flows. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[i] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.
[j] Well down 14 hours per day starting on December 4 because communication antenna was down.

Table A.1–8. Extraction Well 32447 (EW-23) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 6969 Target pumping rate – 300 gpm
Hours not pumped – 1791 Operational percent – 79.55

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	68.5 [a]	3.056	68.7	0.57
2/06	60.0 [b]	2.418	80.4	0.67
3/06	65.1 [c]	2.907	72.4	0.60
4/06	26.3 [d]	1.136	72.8	0.61
5/06	72.4 [e]	3.231	73.0	0.61
6/06	139.7 [e,f]	6.035	74.7	0.62
7/06	306.5	13.683	74.9	0.63
8/06	291.4 [g]	13.010	74.6	0.62
9/06	319.2	13.791	76.2	0.64
10/06	284.3 [h]	12.690	72.8	0.61
11/06	235.0 [i]	10.154	76.2	0.64
12/06	311.4	13.900	73.7	0.62
	Average 181.7	Total 98.012	Average 74.2	Average 0.62

[a] Well shut down January 23 to January 29 due to construction tie ins at CAWWT.
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well shut down March 1 due to construction tie-ins to the discharge header. Well shut down March 13 to March 22 for mini-rehabilitation.
[d] Well shut down most of April due to a bad pressure sensor.
[e] Well shut down May 1 to May 10 for repair of the pressure sensor. Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[f] Well shut down on June 28 so a new pump could be installed.
[g] Well shut down from August 5 to August 6 due to a local power outage. Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage.
[h] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[i] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.

Table A.1–9. Extraction Well 33061 (EW-25) Operational Summary Sheet for 2006

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

Hours in reporting period – 8760 | Hours pumped – 7817 | Target pumping rate – 100 gpm
Hours not pumped – 943 | Operational percent – 89.24

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	86.3 [a]	3.853	62.15	0.52
2/06	116.8 [b]	4.707	48.00	0.40
3/06	143.7 [c]	6.414	40.67	0.34
4/06	148.4	6.412	50.93	0.43
5/06	128.5 [d]	5.737	53.25	0.44
6/06	142.6 [d]	6.158	53.83	0.45
7/06	141.2	6.301	64.87	0.54
8/06	129.7 [e]	5.792	57.25	0.48
9/06	149.1	6.440	34.15	0.29
10/06	133.8 [f]	5.972	34.35	0.29
11/06	108.6 [g]	4.692	36.76	0.31
12/06	140.6	6.278	41.38	0.35
Average	131.0	Total 68.756	Average 48.1	Average 0.41

[a] Well shut down January 5 to January15 to reduce the uranium concentration at the Parshall Flume. Well shut down January 23 to January 29 due to construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well shut down March 1 due to construction tie-ins to the discharge header.
[d] Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[e] Well shut down from August 5 to August 6 due to a local power outage. Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage.
[f] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[g] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.

Table A.1–10. Extraction Well 33262 (EW-15a) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 7866 Target pumping rate – 200 gpm
Hours not pumped – 894 Operational percent – 89.79

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	172.5 [a]	7.702	48.6	0.41
2/06	163.4 [b]	6.587	51.3	0.43
3/06	185.3 [c]	8.273	51.1	0.43
4/06	200.9	8.677	41.8	0.35
5/06	185.8 [d]	8.295	49.3	0.41
6/06	209.2 [d]	9.038	51.4	0.43
7/06	206.7	9.225	47.5	0.40
8/06	194.4 [e]	8.679	43.4	0.36
9/06	215.4	9.304	39.6	0.33
10/06	197.2 [f]	8.802	37.8	0.32
11/06	153.2 [g]	6.617	41.1	0.34
12/06	204.5	9.128	39.2	0.33
Average	190.7	Total 100.327	Average 45.2	Average 0.38

[a] Well shut down January 23 to January 29 due to construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well shut down March 1 due to construction tie-ins to the discharge header.
[d] Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[e] Well down August 8 to August10 for Well 33 tie-in and other maintenance. Well down from August 18 to August 19 for a site wide electrical outage.
[f] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[g] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.

Table A.1–11. Extraction Well 33264 (EW-30) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 6707.5 Target pumping rate–200 gpm
Hours not pumped – 2052.5 Operational percent – 76.57

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	121.2 [a]	5.410	80.8	0.67
2/06	11.8 [b]	0.476	80.8	0.67
3/06	118.8 [b]	5.302	71.8	0.60
4/06	193.5 [c]	8.359	87.6	0.73
5/06	126.7 [c, d]	5.655	81.8	0.68
6/06	245.2 [d]	10.594	83.7	0.70
7/06	209.4	9.347	83.5	0.70
8/06	192.5 [e]	8.595	82.7	0.69
9/06	209.4	9.048	83.1	0.69
10/06	170.5 [f]	7.613	85.2	0.71
11/06	221.6 [g,h]	5.251	83.7	0.70
12/06	140.0	6.249	81.0	0.68
Average	155.1	Total 81.900	Average 82.1	Average 0.69

[a] Well shut down January 23 to January 29 due to construction tie in at CAWWT.
[b] Well shut down February 4 to March 2 for mini-rehab.
[c] Well shut down April 28 to May 10 for check valve replacement.
[d] Well shut down on May 25 due to lightning. Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[e] Well shut down from August 5 to August 6 due to a local power outage. Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage.
[f] Well shut down on October 19 for maintenance on IX 2B. Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[g] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI.
[h] Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume. Wells shut down on November 28 for check valve preventive maintenance.

Table A.1–12. Extraction Well 33265 (EW-31) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 7959.5 Target pumping rate – 300 gpm
Hours not pumped – 800.5 Operational percent – 90.86

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	201.5 [a]	8.995	49.3	0.41
2/06	174.3 [b]	7.029	25.3	0.21
3/06	201.3 [c]	8.985	21.3	0.18
4/06	216.5	9.354	22.0	0.18
5/06	183.3 [d]	8.183	22.6	0.19
6/06	214.2 [d]	9.251	22.3	0.19
7/06	292.6	13.064	21.1	0.18
8/06	287.2 [e]	12.818	20.8	0.17
9/06	317.2	13.704	19.6	0.16
10/06	291.5 [f]	13.012	18.7	0.16
11/06	222.9 [g]	9.630	20.2	0.17
12/06	289.8 [h]	12.937	18.4	0.15
	Average 241.0	Total 126.961	Average 23.4	Average 0.20

[a] Well shut down January 23 to January 29 due to construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well shut down March 1 due to construction tie-ins to the discharge header.
[d] Well shut down on May 25 due to lightning. Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[e] Well shut down from August 5 to August 6 due to a local power outage. Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage.
[f] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[g] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume.
[h] Well shut down on December 17 for maintenance.

Table A.1–13. Extraction Well 33266 (EW-32) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 7663 Target pumping rate – 200 gpm
Hours not pumped – 1097 Operational percent – 87.48

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	92.5 [a]	4.127	19.7	0.16
2/06	154.7 [b]	6.239	20.2	0.17
3/06	198.2 [c]	8.850	17.2	0.14
4/06	199.2 [d]	8.607	17.5	0.15
5/06	165.5 [e]	7.386	17.4	0.15
6/06	185.9 [e]	8.031	16.8	0.14
7/06	173.9 [f]	7.764	15.7	0.13
8/06	156.3 [g]	6.978	17.4	0.15
9/06	167.2 [h]	7.225	13.5	0.11
10/06	147.7 [i]	6.595	12.8	0.11
11/06	117.6 [j]	5.079	13.7	0.11
12/06	134.3	5.994	11.9	0.10
	Average 157.8	Total 82.877	Average 16.1	Average 0.13

[a] Well shut down January 19 through the end of the month for a mini-rehab.
[b] Well shut down February 1 & 2 for a mini-rehabilitation. Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well shut down March 1 due to construction tie-ins to the discharge header.
[d] Well shut down April 26 to April 27 for maintenance.
[e] Well shut down on May 25 due to lightning. Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[f] All downtime for well in July was due to chlorination.
[g] Well shut down August 8 to August10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage. Well shut down from August 5 to August 6 due to a local power outage.
[h] Wells shut down on September 11 due to a lightning strike.
[i] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[j] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume. Wells shut down on November 28 for check valve preventive maintenance.

Table A.1–14. Extraction Well 33298 (EW-21a) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 7508 Target pumping rate –200 gpm
Hours not pumped – 1253 Operational percent – 85.70

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	176.5 [a]	7.879	53.2	0.44
2/06	139.9 [b]	5.639	61.9	0.52
3/06	82.2 [c]	3.668	55.9	0.47
4/06	172.6 [d]	7.454	56.0	0.47
5/06	178.3 [e]	7.957	62.2	0.52
6/06	197.9 [e]	8.551	63.2	0.53
7/06	193.8	8.651	56.6	0.47
8/06	158.5 [f]	7.076	51.7	0.43
9/06	183.1	7.909	51.2	0.43
10/06	172.2 [g]	7.688	47.8	0.40
11/06	127.9 [h]	5.524	48.9	0.41
12/06	180.1	8.041	48.1	0.40
	Average 163.6	Total 86.036	Average 54.7	Average 0.46

[a] Well shut down January 23 to January 29 due to construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well shut down March 1 due to construction tie-ins to the discharge header. Well shut down March 18 to the end of the month for a mini-rehab.
[d] Well shut down from April 1 to April 7 for mini-rehab.
[e] Well shut down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[f] Well shut down August 8 to August10 for Well 33 tie-in and other maintenance. Well shut down from August 18 to August 19 for a site wide electrical outage.
[g] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume.
[h] Well shut down on November 18 for a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communications with HMI. Well shut down from November 20 to November 21 due to a power outage at the Parshall Flume. Well shut down November 28 and November 29 for check valve PM.

Table A.1–15. Extraction Well 3924 (RW-1) Operational Summary Sheet for 2006

Reference Elevation (feet 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 – 7895.5 Target pumping rate – 200 gpm
Hours not pumped – 864.5 Operational percent – 90.13

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	173.0 [a]	7.166	24.9	0.21
2/06	181.9 [b]	7.220	28.0	0.232
3/06	214.5	9.575	24.1	0.20
4/06	218.6	9.442	23.5	0.20
5/06	189.3 [c]	8.452	21.8	0.18
6/06	210.0[c]	9.074	20.3	0.17
7/06	206.1 [d]	9.201	19.1	0.16
8/06	194.9 [e]	8.700	19.3	0.16
9/06	210.1	9.078	22.0	0.18
10/06	191.5 [f]	8.547	21.6	0.18
11/06	159.0 [g]	6.870	24.3	0.20
12/06	213.0 [h]	9.507	24.8	0.21
Average	196.8	Total 102.830	Average 22.8	Average 0.19

[a] Well shut down from January 1 to January 3 for repairs. Well shut down from January 22 to January 23 to facilitate construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, removal of DO line, and CAWWT power outage.
[d] Well down from July 17 to July 19 due to an electrical outage caused by a hawk on the wires. Well flow totalizer was not working in July. Flow was estimated from set point.
[e] Well down from August 8 to August 10 to facilitate the tie-in of Well 33 and other maintenance. Well down from August 18 to August 19 due to a site wide electrical outage.
[f] Well down on October 20 due to a power outage at the Parshall flume. Well down from October 24 to October 27 due to a power outage at the Parshall flume.
[g] Well down November 8 due to a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communication with HMI. Well down November 20 due to a power outage at the Parshall Flume.
[h] Well down 14 hours/day starting on December 4 because communication antenna was down.

Table A.1–16. Extraction Well 3925 (RW-2) Operational Summary Sheet for 2006

Reference Elevation (feet 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 – 6861.5 Target pumping rate – 200 gpm
Hours not pumped – 1898.5 Operational percent – 78.33

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	153.6 [a]	6.856	12.4	0.10
2/06	6.2 [b]	0.250	12.4	0.10
3/06	41.9 [c]	1.870	21.2	0.18
4/06	99.5 [d]	4.298	18.4	0.15
5/06	98.3 [e]	4.389	17.5	0.15
6/06	100.3 [e]	4.332	15.8	0.13
7/06	81.9 [f]	3.657	19.7	0.16
8/06	188.2 [g]	8.403	18.3	0.15
9/06	219.3	9.472	17.9	0.15
10/06	192.3 [h]	8.583	15.8	0.13
11/06	153.2 [i]	6.617	18.3	0.15
12/06	177.7 [j]	7.931	9.5	0.08
Average	126.0	Total 66.659	Average 16.4	Average 0.14

[a] Well shut down from January 28 to January 30 for repairs.
[b] Well shut down from February 3 through the end of the month for rehabilitation.
[c] Well down from March 1to March 16 for rehabilitation and pump replacement.
[d] Well down from April 18 to April 19 due to problems with the flow controller.
[e] Well down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, removal of DO line, and CAWWT power outage.
[f] Well down from July 17 to July 24 due to an electrical outage caused by a hawk on the wires. Well flow totalizer was not working in July. Flow was estimated from the set point.
[g] Well down from August 8 to August 10 to facilitate the tie-in of Well 33 and other maintenance. Well down from August 18 to August 19 due to a site wide electrical outage.
[h] Well down on October 20 due to a power outage at the Parshall flume. Well down from October 24 to October 27 due to a power outage at the Parshall flume.
[i] Well down November 8 due to a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communication with HMI. Well down November 20 due to a power outage at the Parshall Flume.
[j] Well down 14 hours/day starting on December 4 because communication antenna was down.

Table A.1–17. Extraction Well 3926 (RW-3) Operational Summary Sheet for 2006

Reference Elevation (feet 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 – 7246 Target pumping rate – 200 gpm
Hours not pumped – 1514 Operational percent – 82.72

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	205.0	9.150	28.2	0.24
2/06	73.1 [a]	2.948	28.2	0.24
3/06	150.4 [b]	6.714	30.3	0.25
4/06	215.5	9.311	26.4	0.22
5/06	181.6 [c]	8.107	27.7	0.23
6/06	204.4[c]	8.829	28.4	0.24
7/06	171.1 [d]	7.639	27.2	0.23
8/06	156.0 [e]	6.966	25.0	0.21
9/06	148.4	6.412	24.6	0.21
10/06	112.9 [f]	5.038	24.7	0.21
11/06	83.0 [g]	3.587	27.5	0.23
12/06	62.5 [h]	2.790	27.2	0.23
Average	147.0	Total 77.490	Average 27.1	Average 0.23

[a] Well shut down from February 11 through the end of the month because it couldn't reach its set point.
[b] Well down from March 1to March 9 for maintenance.
[c] Well down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, removal of DO line, and CAWWT power outage.
[d] Well down from July 17 to July 19 due to an electrical outage caused by a hawk on the wires. Well flow totalizer was not working in July. Flow was estimated using the set point. Well down from July 22 to July 23 due to a power outage caused by a lightning strike.
[e] Well down from August 8 to August 10 to facilitate the tie-in of Well 33 and other maintenance. Well down from August 18 to August 19 due to a site wide electrical outage.
[f] Well down on October 20 due to a power outage at the Parshall flume. Well down from October 24 to October 27 due to a power outage at the Parshall flume.
[g] Well down November 8 due to a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communication with HMI. Well down November 20 due to a power outage at the Parshall Flume.
[h] Well down 14 hours/day starting on December 4 because communication antenna was down. Well down on December 24 due to fluctuating flow rate.

Table A.1–18. Extraction Well 3927 (RW-4) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 6593.5 Target pumping rate–400 gpm
Hours not pumped – 2166.5 Operational percent – 75.27

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	230.6 [a]	10.294	2.2	0.02
2/06	350.9 [b]	14.147	3.2	0.03
3/06	405.0 [c]	18.078	2.5	0.02
4/06	127.7 [d]	5.518	3.0	0.03
5/06	304.1 [e]	13.576	2.9	0.02
6/06	417.9 [e]	18.053	3.0	0.03
7/06	366.8 [f]	16.373	2.8	0.02
8/06	347.6 [g]	15.518	2.8	0.02
9/06	380.9	16.453	2.9	0.02
10/06	216.9 [h]	9.683	2.5	0.02
11/06	15.6 [i]	0.675	2.6	0.02
12/06	369.9 [j]	16.511	2.7	0.02
Average	294.5	Total 154.878	Average 2.8	Average 0.02

[a] Well shut down from January 1 to January 5 for rehabilitation. Well shut down from January 22 to January 23 to facilitate construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well down March 1 to facilitate construction tie-ins to the discharge header.
[d] Well down from April 11 to the end of the month to repair a leaking pipe.
[e] Well down from May 1 to May 6 to repair a leaking pipe. Well down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, removal of DO line, and CAWWT power outage.
[f] Well down from July 17 to July 19 due to an electrical outage caused by a hawk on the wires. Well down from July 22 to July 23 due to a power outage caused by a lightning strike.
[g] Well down from August 8 to August 10 to facilitate the tie-in of Well 33 and other maintenance. Well down from August 18 to August 19 due to a site wide electrical outage.
[h] Well down most of October due to maintenance problems. Well down on October 20 due to a power outage at the Parshall flume. Well down October 22 through the end of the month due to a blown fuse.
[i] Well down November 8 due to a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communication with HMI. Well down November 20 due to a power outage at the Parshall Flume.
[j] Well down 14 hours/day starting on December 4 because communication antenna was down.

Table A.1–19. Extraction Well 32308 (RW-6) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 6793.5 Target pumping rate –200 gpm
Hours not pumped – 1966.5 Operational percent – 77.55

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	118.9 [a]	5.307	50.0	0.42
2/06	174.1 [b]	7.018	48.1	0.40
3/06	207.8	9.276	39.2	0.33
4/06	222.8	9.626	40.0	0.33
5/06	183.7 [c]	8.200	40.0	0.33
6/06	194.8 [c]	8.416	39.2	0.33
7/06	179.0 [d]	7.989	40.9	0.34
8/06	157.4 [e]	7.027	38.3	0.32
9/06	117.9 [f]	5.094	41.0	0.34
10/06	27.6 [g]	1.233	41.0	0.34
11/06	69.7 [h]	3.013	47.3	0.40
12/06	207.4 [i]	9.258	40.3	0.34
Average	155.1	Total 81.459	Average 42.1	Average 0.35

[a] Well shut down from January 5 to January 15 to reduce uranium concentrations at the Parshall Flume. Well shut down from January 22 to January 23 to facilitate construction tie-ins at CAWWT.
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header.
[c] Well down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, removal of DO line, and CAWWT power outage.
[d] Well down from July 17 to July 19 due to an electrical outage caused by a hawk on the wires. Well down from July 22 to July 23 due to a power outage caused by a lightning strike.
[e] Well down from August 8 to August 10 to facilitate the tie-in of Well 33 and other maintenance. Well down from August 18 to August 19 due to a site wide electrical outage.
[f] Well down from September 11 to the end of the month due to a leak from the pitless adapter.
[g] Well shut down most of October due to a leak from the pitless adapter . Well down on October 20 due to a power outage at the Parshall flume. Well down from October 24 to October 27 due to a power outage at the Parshall flume.
[h] Well down November 8 due to a site wide power outage. Well down for 14 hours/day from November 9 to November 20 due to no power for offsite communication with HMI. Well down on November 15 to replace the pitless adapter. Well down November 20 due to a power outage at the Parshall Flume
[i] Well down 14 hours/day starting on December 4 because communication antenna was down

Table A.1–20. Extraction Well 32309 (RW-7) Operational Summary Sheet for 2006

Reference Elevation (feet 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 pumped – 7655 Target pumping rate –200 gpm
Hours not pumped – 1105 Operational percent – 87.39

Monthly Measurements at Wellfield							
Month	Monthly Average Pumping Rate (gpm)		Million Gallons Pumped		Monthly Average Total Uranium Concentration (µg/L)		Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	127.4 [a]		5.688		43.5		0.36
2/06	174.2 [b]		7.025		44.3		0.37
3/06	207.4 [c]		9.261		36.3		0.30
4/06	212.4		9.175		36.9		0.31
5/06	189.9 [d]		8.475		38.7		0.32
6/06	205.2 [d]		8.863		39.2		0.33
7/06	214.3 [e]		9.564		40.9		0.34
8/06	196.4 [f]		8.766		39.6		0.33
9/06	214.7		9.276		39.2		0.33
10/06	210.9 [g]		9.417		41.1		0.34
11/06	126.1 [h]		5.448		41.5		0.35
12/06	201.8 [i]		9.008		38.6		0.32
Average	190.1	Total	99.966	Average	40.0	Average	0.33

[a] Well shut down from January 5 to January 15 to reduce uranium concentrations at the Parshall Flume. Well shut down from January 22 to January 23 to facilitate construction tie-ins at CAWWT
[b] Well shut down February 11, 17, 27 & 28 to facilitate construction tie-ins to the discharge header
[c] Well down March 1 to facilitate construction tie-ins to the discharge header
[d] Well down from May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, removal of DO line, and CAWWT power outage
[e] Well down from July 17 to July 19 due to an electrical outage caused by a hawk on the wires
[f] Well down from August 8 to August 10 to facilitate the tie-in of Well 33 and other maintenance. Well down from August 18 to August 19 due to a site wide electrical outage
[g] Well down on October 20 due to a power outage at the Parshall flume. Well down from October 24 to October 27 due to a power outage at the Parshall flume
[h] Well down November 8 due to a site wide power outage. Well down for 14 hours/day starting November 9 due to no power for offsite communication with HMI. Well down November 20 to facilitate replacement of the pitless adapter in Well 6.
[i] Well down 14 hours/day starting on December 4 because communication antenna was down

Table A.1–21. Paddys Run Road Site Groundwater Summary Statistics and Trend Analysis

Constituent	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] (mg/L)	Trend[a,b,c,d]
Arsenic	2128	228	0.000195	0.188	0.0118	0.0214	Down, Significant
	2625	205	0.00110	0.0595	0.0117	0.0090	Down, Significant
	2636	175	0.010	0.0939	0.0444	0.0188	No Significant Trend
	2898	45	0.000147	0.082	0.0038	0.0124	No Significant Trend
	2899	38	0.00032	0.0032	0.0012	0.0007	Down, Significant
	2900	227	0.00032	0.0609	0.0052	0.0063	Down, Significant
	3128	48	0.0004	0.234	0.0078	0.0336	Down, Significant
	3636	47	0.0005	0.014	0.0020	0.0022	No Significant Trend
	3898	45	0.0005	0.010	0.0026	0.0017	Up, Marginal
	3899	46	0.000147	0.010	0.0014	0.0015	No Significant Trend
	3900	46	0.000375	0.010	0.0022	0.0015	Down, Significant
Phosphorus	2128	54	0.025	16.2	1.63	2.6	Down, Significant
	2625	29	0.307	12.3	3.12	3.01	No Significant Trend
	2636	27	9.6	170	92.7	46.9	No Significant Trend
	2898	46	0.005	9.95	0.327	1.48	No Significant Trend
	2899	37	0.005	0.831	0.067	0.14	No Significant Trend
	2900	44	0.050	4.74	0.555	0.74	Down, Marginal
	3128	55	0.005	13	0.292	1.75	No Significant Trend
	3636	46	0.00955	1.1	0.082	0.162	No Significant Trend
	3898	44	0.00955	1.24	0.109	0.193	No Significant Trend
	3899	45	0.00955	0.83	0.107	0.165	No Significant Trend
	3900	46	0.005	1.38	0.107	0.267	No Significant Trend
Potassium	2128	46	0.83	18	3.69	3.73	No Significant Trend
	2625	30	0.64	9.49	3.33	2.02	No Significant Trend
	2636	27	8.51	218	77.0	53.2	Down, Significant
	2898	46	1.11	9.64	4.30	1.38	**Up, Significant**
	2899	38	1.36	8.85	3.97	1.12	**Up, Significant**
	2900	45	0.0095	6.0	2.04	1.17	No Significant Trend
	3128	48	1.085	3.7	2.08	0.66	Down, Significant
	3636	46	1.09	4.24	2.33	0.54	Down, Significant
	3898	45	0.61	3.93	2.34	0.55	Up, Marginal
	3899	46	0.875	3.22	2.43	0.37	No Significant Trend
	3900	46	0.975	3.19	1.77	0.44	Down, Significant
Sodium	2128	46	12.3	75.2	35.3	11.9	Down, Significant
	2625	30	16.5	50.7	33.0	7.6	Down, Significant
	2636	27	23	148	52.4	24.8	Down, Significant
	2898	46	4.95	29.2	17.7	3.8	Down, Significant
	2899	38	11.2	22.9	16.7	2.7	Down, Significant
	2900	45	0.0136	43.3	27.5	7.9	No Significant Trend
	3128	48	3.56	13.4	5.95	2.79	Down, Significant
	3636	46	3.14	13.0	6.37	2.95	Down, Significant
	3898	45	7.29	14.6	9.68	1.64	No significant Trend
	3899	46	6.24	12.1	8.73	1.27	No Significant Trend
	3900	46	3.13	10.8	5.17	1.92	Down, Significant

[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 2006 groundwater data (unfiltered and filtered for 2001 through 2006).
[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.

Table A.1–22. Extraction Well 32761 (EW-26) Operational Summary Sheet for 2006

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

Hours in reporting period – 8760 | Hours pumped – 7172 | Target pumping rate – 300 gpm
Hours not pumped – 1588 | Operational percent – 81.87

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	64.0 [a]	2.858	52.0	0.43
2/06	247.0 [b]	9.957	68.2	0.57
3/06	259.9 [c]	11.601	57.2	0.48
4/06	287.1 [d]	12.403	56.7	0.47
5/06	254.8 [e]	11.374	55.5	0.46
6/06	313.8 [e]	13.557	52.6	0.44
7/06	329.3	14.699	46.1	0.38
8/06	288.1 [f]	12.863	44.7	0.37
9/06	320.9 [g]	13.862	39.7	0.33
10/06	291.4 [h]	13.008	43.2	0.36
11/06	184.0 [i]	7.950	47.3	0.39
12/06	285.9 [j]	12.764	44.2	0.37
Average	260.5	Total 136.895	Average 50.6	Average 0.42

[a] Well shut down from January 1 to January 18 for pump and motor installation. Wells shut down from January 23 to January 29 to facilitate construction tie-ins at CAWWT
[b] Well shut down February 11, 17, 27, & 28 to facilitate construction tie-ins to the discharge header.
[c] Well shut down March 18 to March 21 to facilitate bypassing Area 4B water
[d] Well shut down April 20 for maintenance
[e] Well shut down May 23 to May 25 to connect Well 33 to the treatment header. Well shut down May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[f] Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down August 18 to August 19 for a site wide electrical outage
[g] Well shut down at September 15 due to a power outage
[h] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume
[i] Well shut down on November 8 due to a site wide power outage. Well shut down for 14 hours/day from November 9 to November 19 due to an offsite communication problem with the HMI. Well shut down on November 21 due to a power outage at the Parshall Flume
[j] Well shut down from December 4 to December 7 due to blown fuses in the power line

Table A.1–23. Extraction Well 33062 (EW-27) Operational Summary Sheet for 2006

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

Hours in reporting period – 8760 Hours pumped – 7602 Target pumping rate–200 gpm
Hours not pumped – 1158 Operational percent – 86.78

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	320.5 [a]	14.309	51.4	0.43
2/06	317.8 [b]	12.815	63.0	0.53
3/06	323.0 [c]	14.419	52.1	0.43
4/06	293.8	12.690	56.6	0.47
5/06	308.7 [d]	13.779	51.4	0.43
6/06	365.2 [d]	15.778	49.4	0.41
7/06	216.2	9.652	48.8	0.41
8/06	181.9 [e]	8.118	49.2	0.41
9/06	213.6 [f]	9.229	46.7	0.39
10/06	196.2 [g]	8.757	48.4	0.40
11/06	118.6 [h]	5.126	47.9	0.40
12/06	187.2 [i]	8.357	48.6	0.41
Average	253.6	Total 133.029	Average 51.14	Average 0.43

[a] Wells shut down from January 23 to January 29 to facilitate construction tie-ins at CAWWT
[b] Well shut down February 11, 17, 27, & 28 and March 1 to facilitate construction tie-ins to the discharge header.
[c] Well shut down March 18 to March 21 to facilitate bypassing Area 4B water
[d] Well shut down May 23 to May 25 to connect Well 33 to the treatment header. Well shut down May 28 to June 2 for SPIT safe shutdown, CAWWT compressor repairs, soils removal of DO line and CAWWT power outage.
[e] Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down August 18 to August 19 for a site wide electrical outage
[f] Well shut down at September 15 due to a power outage
[g] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume
[h] Well shut down on November 8 due to a site wide power outage. Well shut down for 14 hours/day from November 9 to November 19 due to an offsite communication problem with the HMI. Well shut down on November 21 due to a power outage at the Parshall Flume
[i] Well shut down from December 4 to December 7 due to blown fuses in the power line

Table A.1–24. Extraction Well 33334 (EW-28a) Operational Summary Sheet for 2006

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

Hours in reporting period – 8760 | Hours pumped – 3738 | Target pumping rate–200 gpm
Hours not pumped – 5022 | Operational percent – 42.67

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration [a] (µg/L)	Uranium Removal Index [a] (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	0.0	0.000	NS	NS
2/06	0.0	0.000	NS	NS
3/06	0.0	0.000	NS	NS
4/06	0.0	0.000	NS	NS
5/06	0.0	0.000	NS	NS
6/06	11.9 [b]	0.516	45.0	0.38
7/06	197.5 [c]	8.818	45.0	0.38
8/06	177.9 [d]	7.939	38.2	0.32
9/06	226.5 [e]	9.784	28.8	0.24
10/06	192.7 [f]	8.603	28.0	0.23
11/06	124.9 [g]	5.395	27.5	0.23
12/06	188.3 [h]	8.406	22.8	0.19
Average	93.3	Total 49.461	Average 33.6	Average 0.28

[a] NS = not sampled
[b] Well began operating on June 29. The totalizer did not work. Daily flow was estimated using the set point.
[c] Well shut down July 1 due to access issues with radiation postings. Well shut down July 22 to July 23 due to a power outage
[d] Well shut down August 5 to August 6 due to a local power outage. Well shut down August 8 to August 10 for Well 33 tie-in and other maintenance. Well shut down August 18 to August 19 for a site wide electrical outage
[e] Well shut down at September 15 due to a power outage
[f] Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume
[g] Well shut down on November 8 due to a site wide power outage. Well shut down for 14 hours/day from November 9 to November 19 due to an offsite communication problem with the HMI. Well shut down on November 21 due to a power outage at the Parshall Flume
[h] Well shut down from December 4 to December 7 due to blown fuses in the power line

Table A.1–25. Extraction Well 33347 (EW-33a) Operational Summary Sheet for 2006

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

Hours in reporting period – 8760 | Hours pumped – 1032 | Target pumping rate–300 gpm
Hours not pumped – 7728 | Operational percent – 11.78

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration [a] (µg/L)	Uranium Removal Index [a] (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/06	0.0	0.000	NS	NS
2/06	0.0	0.000	NS	NS
3/06	0.0	0.000	NS	NS
4/06	0.0	0.000	NS	NS
5/06	0.0	0.000	NS	NS
6/06	0.0	0.000	NS	NS
7/06	0.0	0.000	NS	NS
8/06	0.0	0.000	NS	NS
9/06	0.0	0.000	NS	NS
10/06	195 [b]	8.703	87.2	0.73
11/06	0.0 [c]	0.0	NS	NS
12/06	250 [d]	11.162	41.6	0.35
Average	222.5	Total 19.865	Average 64.4	Average 0.54

[a] NS = not sampled
[b] Well began operating on October 5. Well shut down on October 20 due to a power outage at the Parshall Flume. Well shut down from October 24 to October 27 due to a power outage at the Parshall Flume. Well shut down on October 28 because the flow controller was not controlling the flow rate
[c] Well shut down in November due to operational problems.
[d] Well shut down from December 4 to December 7 due to blown fuses in the power line

Table A.1–26. Regression Equations for Uranium Concentration Data Collected at Extraction Wells
Data Collected Through December 31, 2006

Well-ID	SED-ID	Data Trend	95% UCL	Function Type
RW-1	3924	$y = 3.12E+05e^{-2.0E-04x}$	$y = 9.70E+03e^{-1.0E-04x}$	Exponential Function
RW-2	3925	y = -6.13E-03x + 2.56E+02	y = -6.13E-03x + 2.71E+02	Linear
RW-3	3926	$y = -1.131E-09x^3 + 1.222E-04x^2 - 4.384x + 5.232E+04$	$y = -1.131E-09x^3 + 1.222E-04x^2 - 4.384x + 5.233E+04$	Polynomial
RW-4	3927	$y = 1.28E-34x^{7.49}$	$y = 4.09E-15x^{3.30}$	Power Function
RW-6	32308	$y = 2.66E+05e^{-2.26E-04x}$	$y = 2.57E+04e^{-1.53E-04x}$	Exponential Function
RW-7	32309	$y = 1.06E+06e^{-2.63E-04x}$	$y = 4.63E+04e^{-1.66E-04x}$	Exponential Function
EW-15a	33262	$y = 4.96E+82x^{-1.77E+01}$	$y = 9.12E+58x^{-1.24E+01}$	Power Function
EW-17a	33326	$y = 4.81E+03e^{-1.34E-04x}$	$y = 1.56E+03e^{-9.28E-05x}$	Exponential Function
EW-18	31550	$y = 4.15E+05e^{-2.41E-04x}$	$y = 2.06E+04e^{-1.45E-04x}$	Exponential Function
EW-19	31560	$y = 3.52E+09e^{-4.78E-04x}$	$y = 7.23E+05e^{-2.29E-04x}$	Exponential Function
EW-20	31561	$y = 1.08E+04e^{-1.48E-04x}$	$y = 2.67E+03e^{-1.01E-04x}$	Exponential Function
EW-21a	32398	$y = 3.64E+07e^{-3.49E-04x}$	$y = 2.17E+05e^{-1.96E-04x}$	Exponential Function
EW-22	32276	$y = 4.14E+10e^{-5.29E-04x}$	$y = 2.46E+06e^{-2.48E-04x}$	Exponential Function
EW-23	32447	$y = 2.18E+10e^{-5.04E-04x}$	$y = 8.23E+06e^{-2.78E-04x}$	Exponential Function
EW-24	32446	$y = 3.58E+06e^{-2.89E-04x}$	$y = 1.13E+05e^{-1.85E-04x}$	Exponential Function
EW-25	33061	$y = 9.90E+03e^{-1.40E-04x}$	$y = 2.22E+03e^{-9.19E-05x}$	Exponential Function
EW-30	33264	$y = 1.60E+11e^{-5.50E-04x}$	$y = 1.78E+08e^{-3.62E-04x}$	Exponential Function
EW-31	33265	$y = 1.23E+08e^{-4.00E-04x}$	$y = 5.24E+05e^{-2.46E-04x}$	Exponential Function
EW-32	33266	$y = 3.20E+12e^{-6.70E-04x}$	$y = 3.25E+08e^{-4.17E-04x}$	Exponential Function
EW-26	32761	$y = 2.38E+12e^{-6.34E-04x}$	$y = 9.92E+07e^{-3.54E-04x}$	Exponential Function
EW-27	33062	$y = 1.64E+15e^{-8.03E-04x}$	$y = 5.62E+08e^{-3.92E-04x}$	Exponential Function
EW-28a	33334	$y = 7.62E+18e^{-1.04E-03x}$	$y = 8.172E+08e^{-4.07E-04}$	Exponential Function
EW-33a	33347			

Table A.1–27. Modeled Performance Metrics
Based on the Waste Storage Area (Phase II) Design

	Predicted								
Year	Total Water Pumped (gpm)	Stormwater to Treatment (gpm)	Groundwater to Treatment (gpm)	Groundwater not Treated (gpm)	Concentration to Treatment (ug/L)	Concentration not Treated (ug/L)	Concentration Discharged to GMR (ug/L)	Annual Mass Discharged to GMR (pounds)	**Annual Uranium Extracted from GMA (pounds)**
2007	**4775**	**25**	**600**	**4175**	**171.8**	**28.1**	**25.8**	**542**	**925**
2008	**4775**	**25**	**300**	**4475**	**168.6**	**25.4**	**24.4**	**513**	**697**
2009	4775	0	0	4775	0	28.6	28.6	598	**586**
2010	4775	0	0	4775	0	24.6	24.6	516	**509**
2011	4775	0	0	4775	0	21.6	21.6	452	**450**
2012	4775	0	0	4775	0	19.3	19.3	403	**404**
2013	4775	0	0	4775	0	17.4	17.4	363	**366**
2014	4775	0	0	4775	0	15.8	15.8	330	**335**
2015	4775	0	0	4775	0	14.5	14.5	302	**307**
2016	4775	0	0	4775	0	13.5	13.5	264	**276**
2017	4775	0	0	4775	0	12.1	12.1	237	**247**
2018	4775	0	0	4775	0	11.0	11.0	216	**225**
2019	4775	0	0	4775	0	10.1	10.1	199	**208**
2020	4775	0	0	4775	0	9.4	9.4	184	**193**
2021	4775	0	0	4775	0	8.8	8.8	172	**180**
2022	4775	0	0	4775	0	8.2	8.2	161	**169**
2023	4775	0	0	4775	0	7.7	7.7	152	**159**
2024	4775	0	0	4775	0	7.3	7.3	143	**150**
Predicted Pounds of Uranium to be Extracted between 2007 and the End of the Remedy (2024)									**6386**
Pounds of Uranium Extracted Thru December 2006									**7796**
Total Predicted Pounds of Uranium to be Removed									**14182**

Assumptions: **Train 1 & 2 Effluent @ 10 ug/L**
Train 3 Effluent @ 15 ug/L

Table A.1–28. Data Trend Performance Metrics
Based on Data Through December 31, 2006

	Predicted								
Year	Total Water Pumped (gpm)	Stormwater to Treatment (gpm)	Groundwater to Treatment (gpm)	Groundwater not Treated (gpm)	Concentration to Treatment (ug/L)	Concentration not Treated (ug/L)	Concentration Discharged to GMR (ug/L)	Annual Mass Discharged to GMR (pounds)	**Annual Uranium Extracted From GMA (pounds)**
2007	**4775**	**25**	**500**	**4275**	**66.0**	**30.3**	**28.1**	**590**	**761**
2008	4775	0	0	4775	0	28.9	28.9	605	**654**
2009	4775	0	0	4775	0	24.5	24.5	513	**560**
2010	4775	0	0	4775	0	21.3	21.3	446	**492**
2011	4775	0	0	4775	0	18.7	18.7	391	**435**
2012	4775	0	0	4775	0	16.4	16.4	343	**386**
2013	4775	0	0	4775	0	14.5	14.5	303	**345**
2014	4775	0	0	4775	0	12.8	12.8	268	**308**
2015	4775	0	0	4775	0	11.4	11.4	238	**276**
2016	4775	0	0	4775	0	10.1	10.1	198	**198**
2017	4775	0	0	4775	0	8.9	8.9	174	**174**
2018	4775	0	0	4775	0	7.8	7.8	153	**154**
2019	4775	0	0	4775	0	7.0	7.0	136	**136**
2020	4775	0	0	4775	0	6.2	6.2	121	**121**
2021	4775	0	0	4775	0	5.5	5.5	108	**108**
2022	4775	0	0	4775	0	5.0	5.0	97	**97**
2023	4775	0	0	4775	0	4.5	4.5	88	**87**
2024	4775	0	0	4775	0	4.0	4.0	79	**79**
Predicted Pounds of Uranium to be Extracted between 2007 and the End of the Remedy (2024)									**5371**
Pounds of Uranium Extracted Thru December 2006									**7796**
Total Predicted Pounds of Uranium to be Removed									**13167**

Assumptions: **Train 1 & 2 Effluent @ 10 ug/L**
Train 3 Effluent @ 15 ug/L

Table A.1–29. UCL Trend Performance Metrics
Based on Data Through December 31, 2006

	Predicted								
Year	Total Water Pumped (gpm)	Stormwater to Treatment (gpm)	Groundwater to Treatment (gpm)	Groundwater not Treated (gpm)	Concentration to Treatment (ug/L)	Concentration not Treated (ug/L)	Concentration Discharged to GMR (ug/L)	Annual Mass Discharged to GMR (pounds)	Annual Uranium Extracted From GMA (pounds)
2007	**4775**	**25**	**1800**	**2975**	**128.0**	**53.7**	**37.8**	**827**	**1703**
2008	**4775**	**25**	**1800**	**2975**	**112.9**	**48.2**	**34.0**	**730**	**1547**
2009	**4775**	**25**	**1800**	**2975**	**99.8**	**42.9**	**30.4**	**640**	**1395**
2010	**4775**	**25**	**1800**	**2975**	**89.8**	**39.5**	**28.3**	**596**	**1278**
2011	**4775**	**25**	**1800**	**2975**	**81.3**	**36.6**	**26.5**	**558**	**1171**
2012	**4775**	**25**	**1700**	**3075**	**76.8**	**36.2**	**27.2**	**595**	**1075**
2013	**4775**	**25**	**1400**	**3375**	**70.8**	**34.1**	**27.0**	**567**	**988**
2014	**4775**	**25**	**1200**	**3575**	**66.9**	**32.5**	**26.8**	**563**	**909**
2015	**4775**	**25**	**800**	**3975**	**68.2**	**31.6**	**27.9**	**588**	**822**
2016	**4775**	**25**	**800**	**3975**	**65.2**	**34.0**	**29.7**	**585**	**775**
2017	**4775**	**25**	**800**	**3975**	**59.2**	**31.1**	**27.3**	**538**	**708**
2018	**4775**	**25**	**700**	**4075**	**56.1**	**30.7**	**27.6**	**581**	**646**
2019	**4775**	**25**	**400**	**4375**	**51.3**	**28.1**	**26.4**	**521**	**591**
2020	4775	0	0	4775	0	27.6	27.6	542	**541**
2021	4775	0	0	4775	0	25.4	25.4	497	**496**
2022	4775	0	0	4775	0	23.3	23.3	456	**455**
2023	4775	0	0	4775	0	21.4	21.4	419	**418**
2024	4775	0	0	4775	0	19.7	19.7	385	**376**
Predicted Pounds of Uranium to be Extracted between 2007 and the End of the Remedy									**15896**
Pounds of Uranium Extracted Thru December 2006									**7796**
Total Predicted Pounds of Uranium to be Removed									**23692**

Assumptions: Train 1 & 2 Effluent @ 10 ug/L
Train 3 Effluent @ 15 ug/L

Table A.1–30. 2006 Extraction Well Target Pumping Rates

Module	Extraction Well	January 1 to December 31[a] (gpm)
South Plume	3924 (RW-1)	200
	3925 (RW-2)	200
	3926 (RW-3)	200
	3927 (RW-4)	400
	32308 (RW-6)	200
	32309 (RW-7)	200
Sub-Total		1400
Waste Storage Area	32761 (EW-26)	300
	33062 (EW-27)	200
	33334 (EW-28a)	200
	33347 (EW-33a)	300
Sub-Total		1000
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
Sub-Total		2575
Total Pumping		4975

[a]The target pumping rates are from the Waste Storage Area Phase II Design with the following exception: The pumping rate of RW-4 in the South Plume was increased from 200 gpm to 400 gpm to assure capture of a lobe of uranium contamination extending south of Willey Road along the eastern side of the plume.

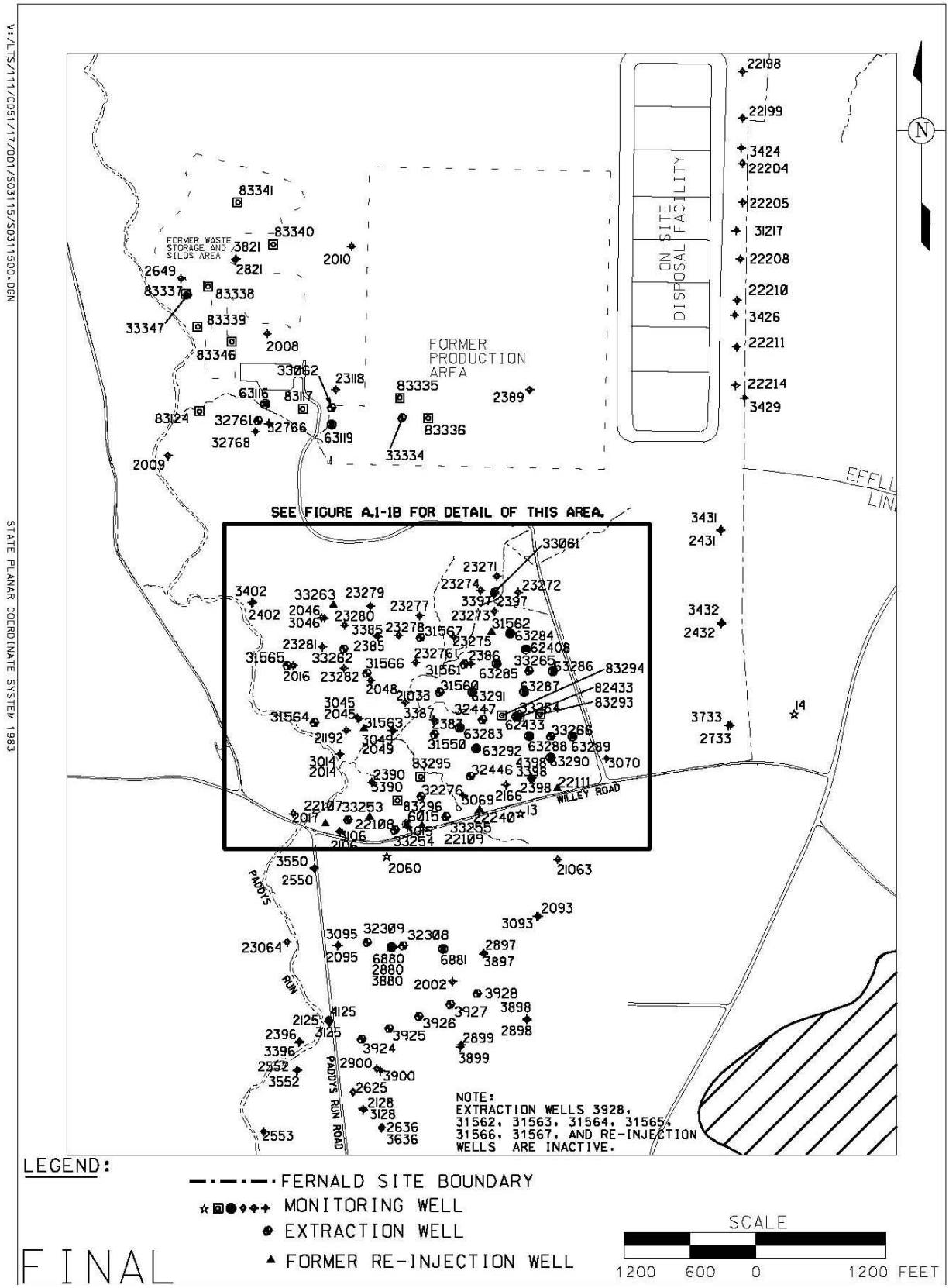

Figure A.1–1A. Well Locations for South Plume, South Field, Waste Storage Area, and Paddys Run Road Site Monitoring Activities

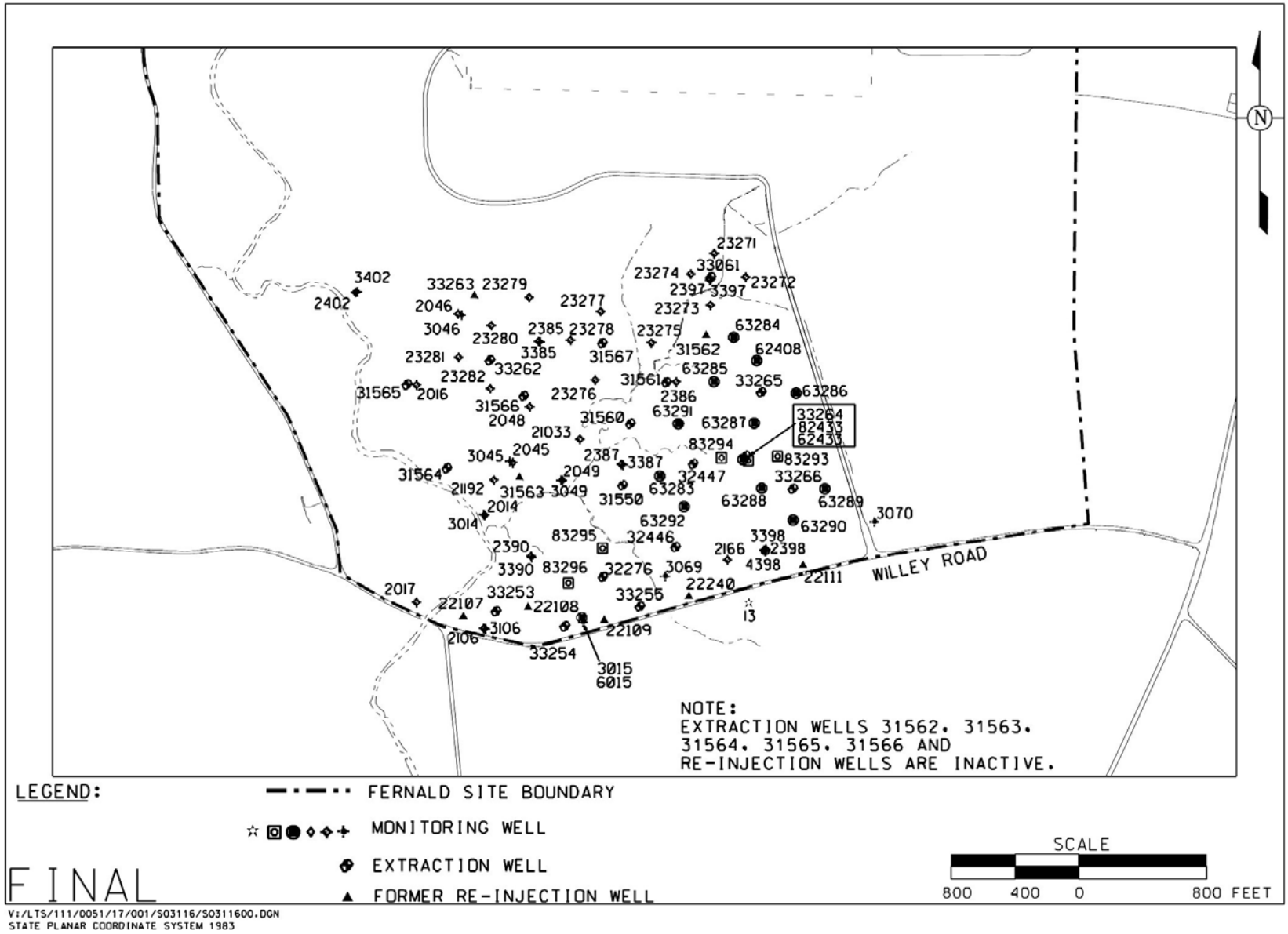

Figure A.1–1B. Well Locations for South Field

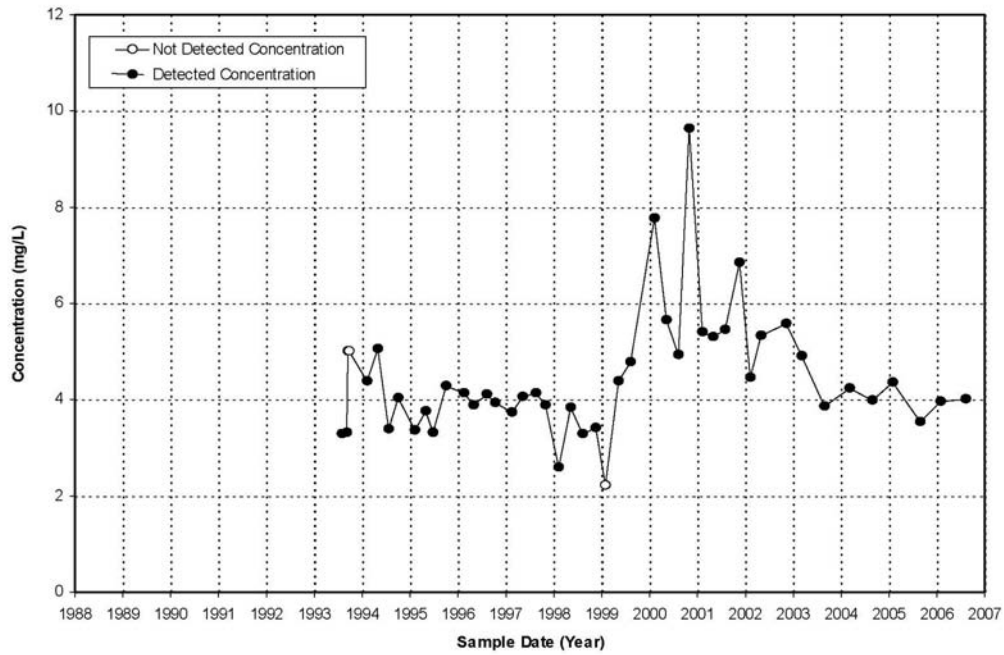

FIGURE A.1-2. POTASSIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2898

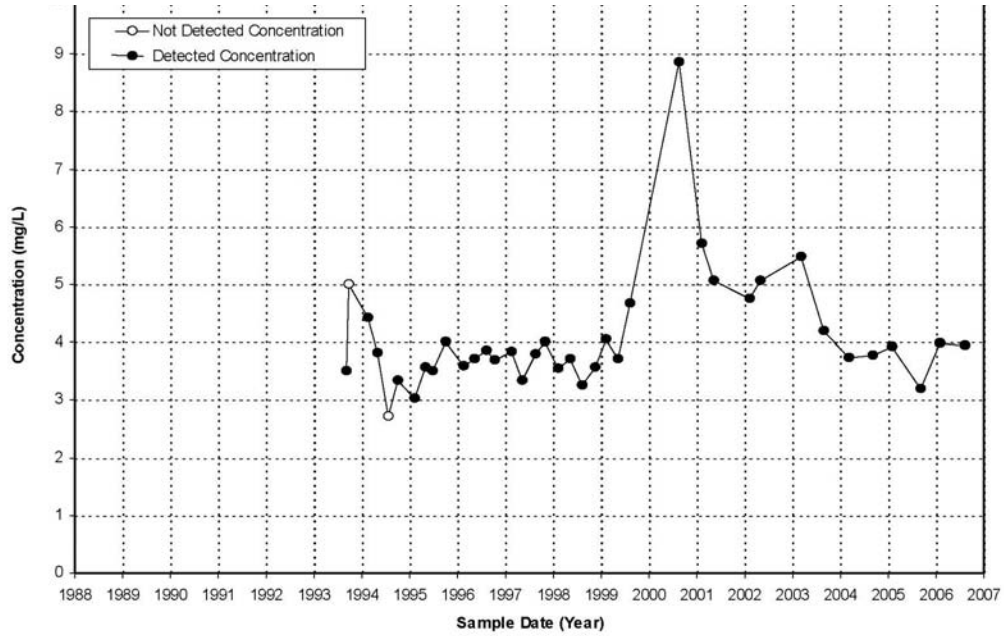

FIGURE A.1-3. POTASSIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2899

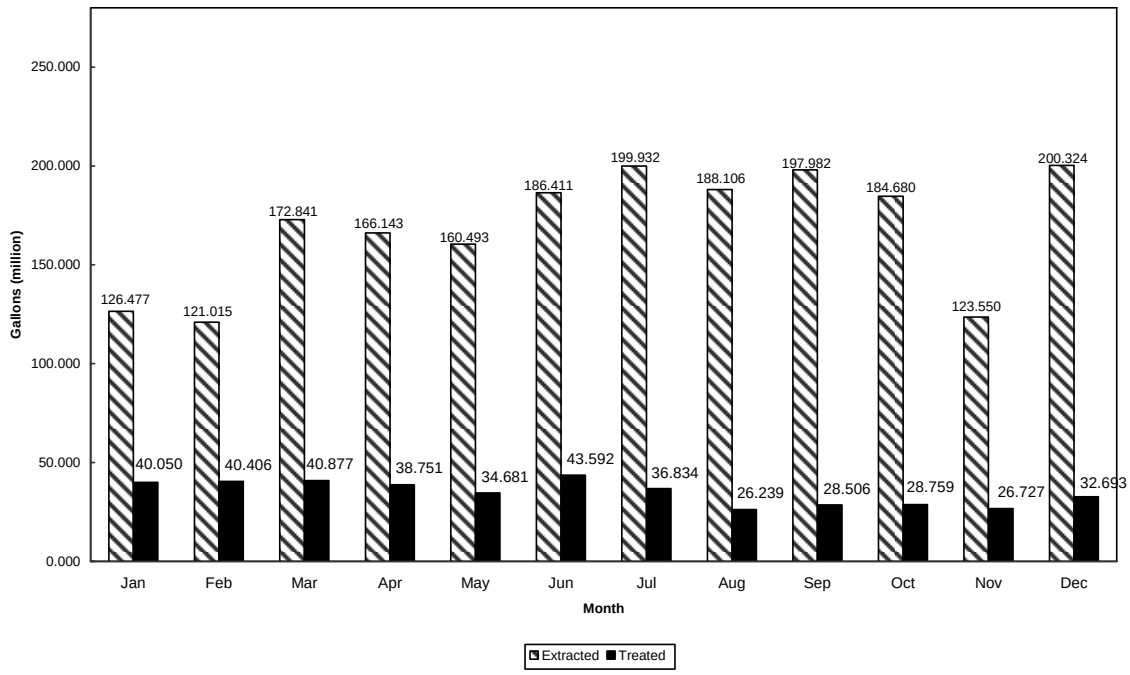

Figure A.1-4. Total Groundwater Extracted vs. Groundwater Treated for 2006

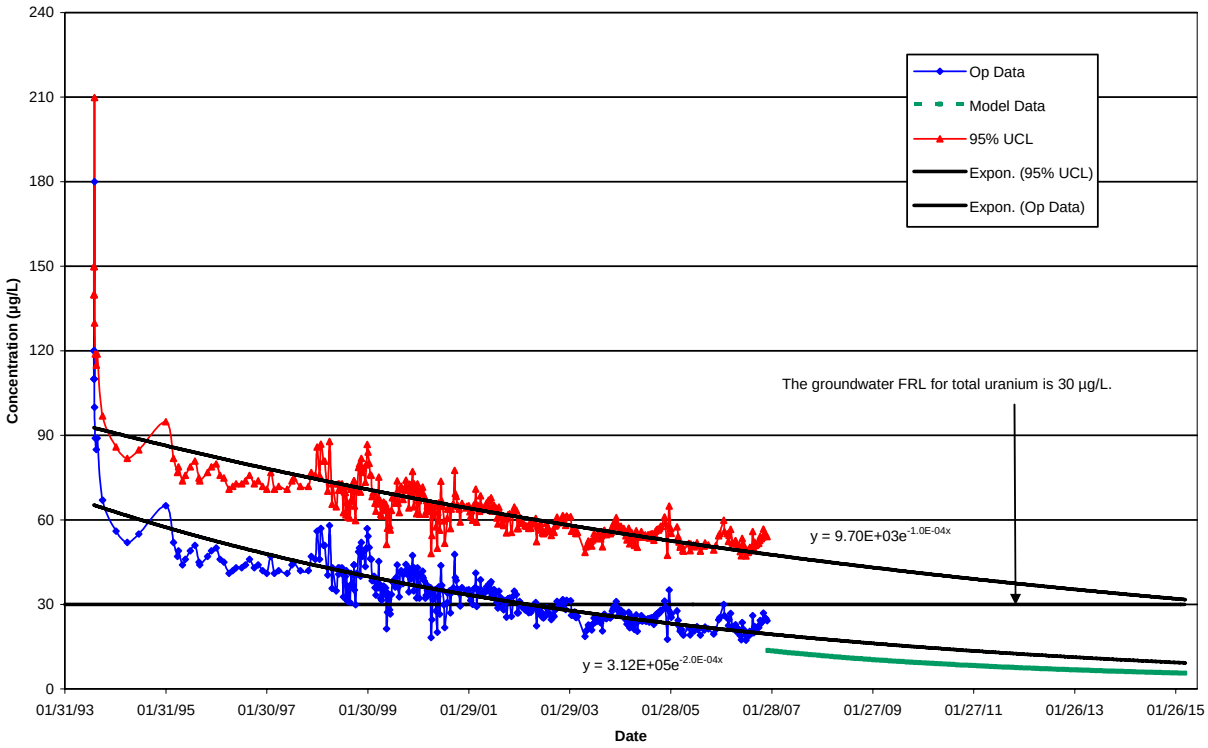

Figure A.1-5. Total Uranium Concentration vs. Time Plot for Extraction Well 3924 (RW-1) with Regression Analysis

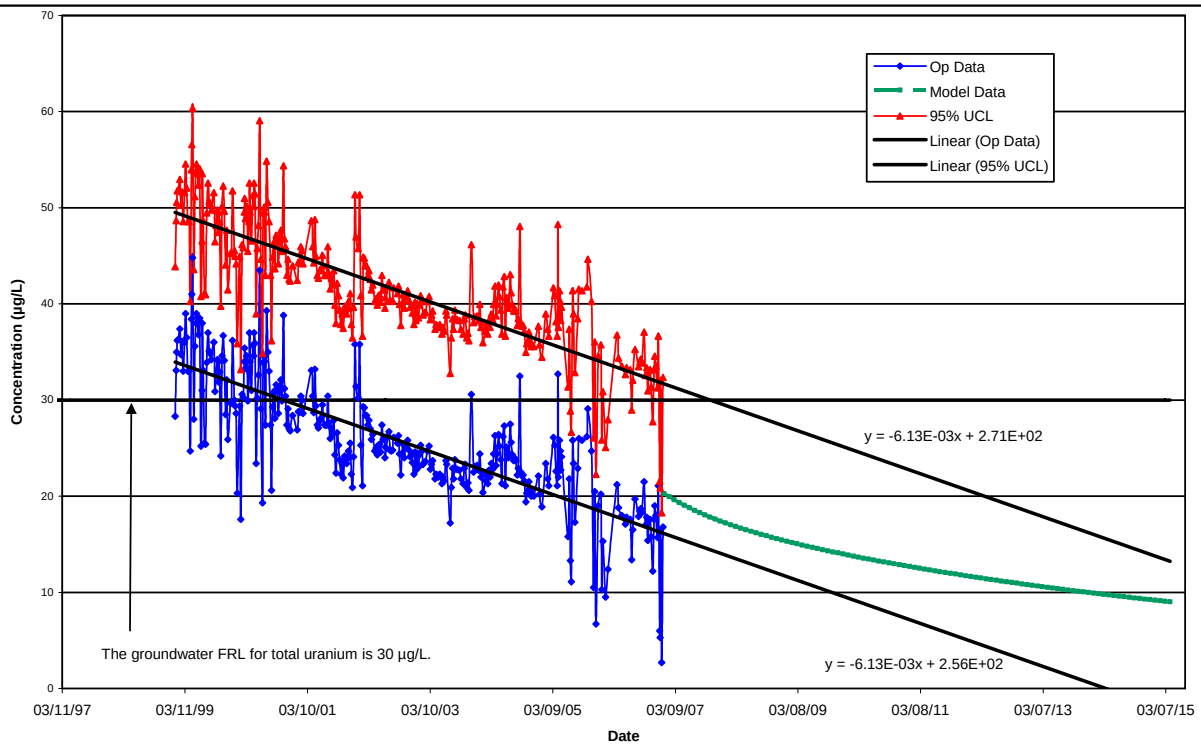

Figure A.1-6. Total Uranium Concentration vs. Time Plot for Extraction Well 3925 (RW-2) with Regression Analysis

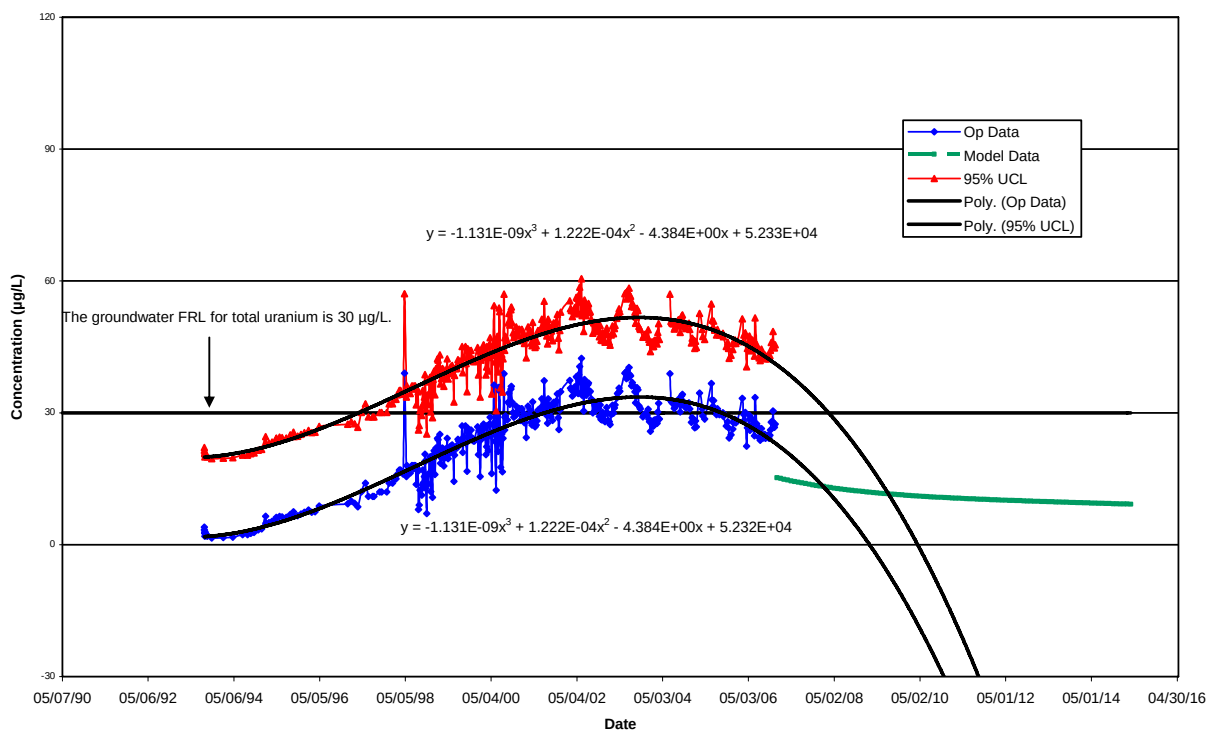

Figure A.1-7. Total Uranium Concentration vs. Time Plot for Extraction Well 3926 (RW-3) with Regression Analysis

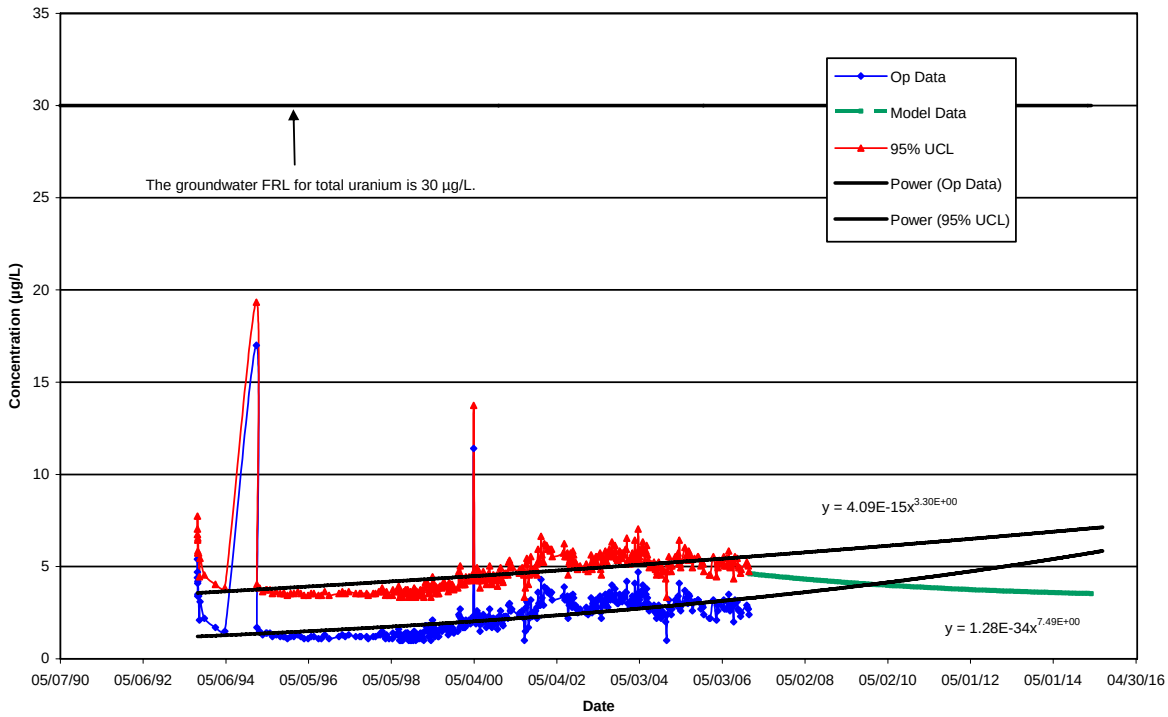

Figure A.1-8. Total Uranium Concentration vs. Time Plot for Extraction Well 3927 (RW-4) with Regression Analysis

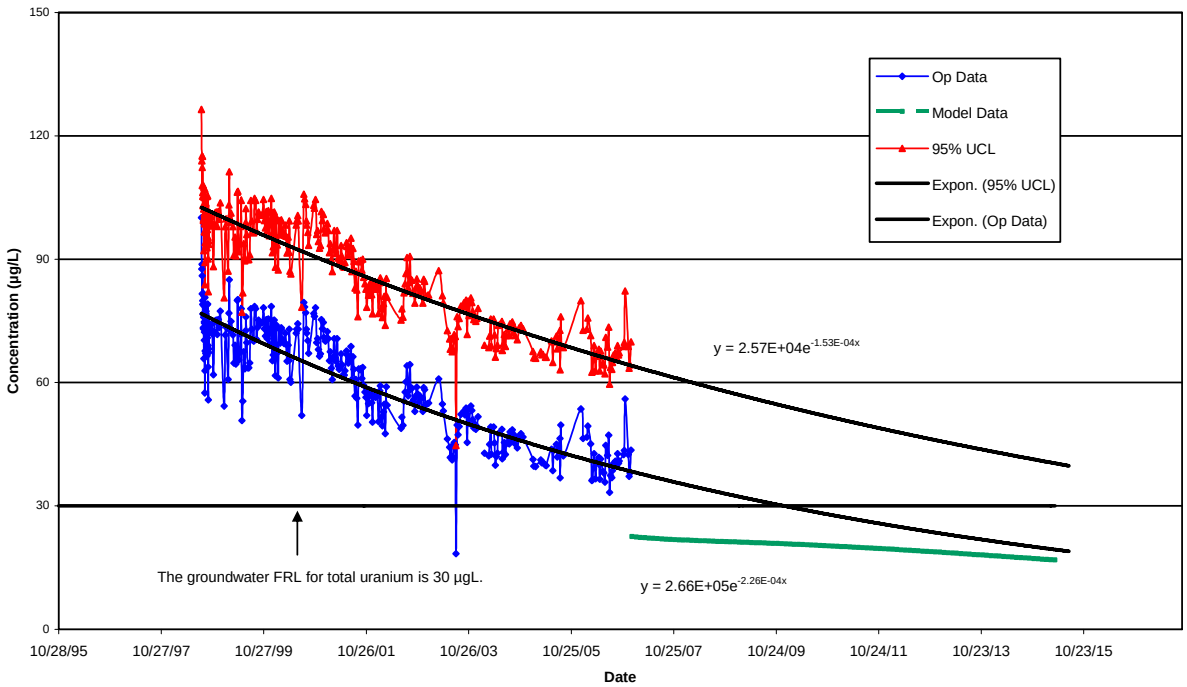

Figure A.1-9. Total Uranium Concentration vs. Time Plot for Extraction Well 32308 (RW-6) with Regression Analysis

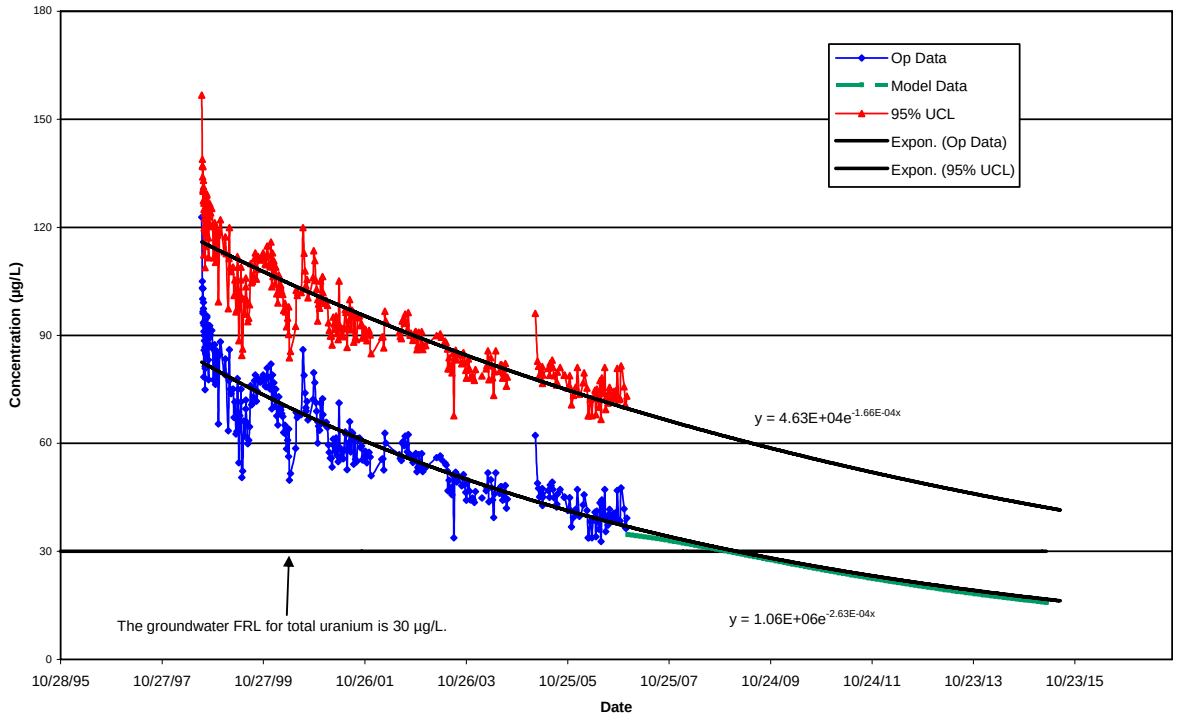

Figure A.1-10. Total Uranium Concentration vs. Time Plot for Extraction Well 32309 (RW-7) With Regression Analysis

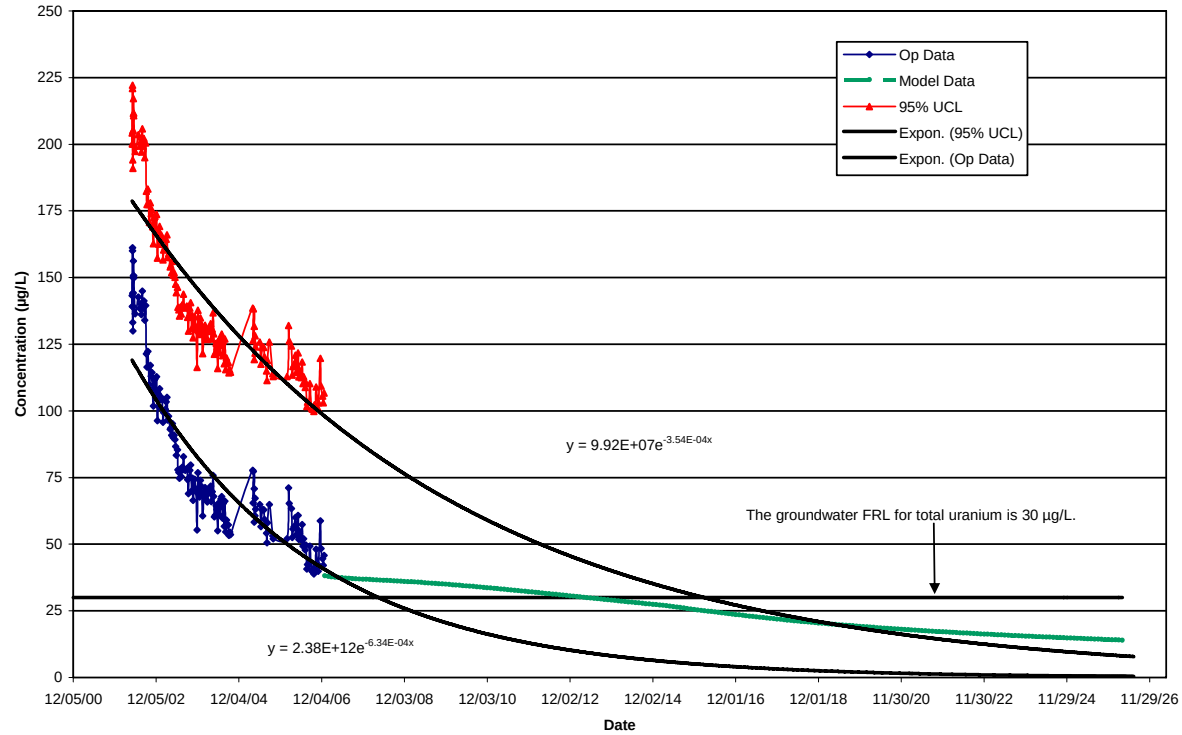

Figure A.1-11. Total Uranium Concentration vs. Time Plot for Extraction Well 32761 (EW-26) with Regression Analysis

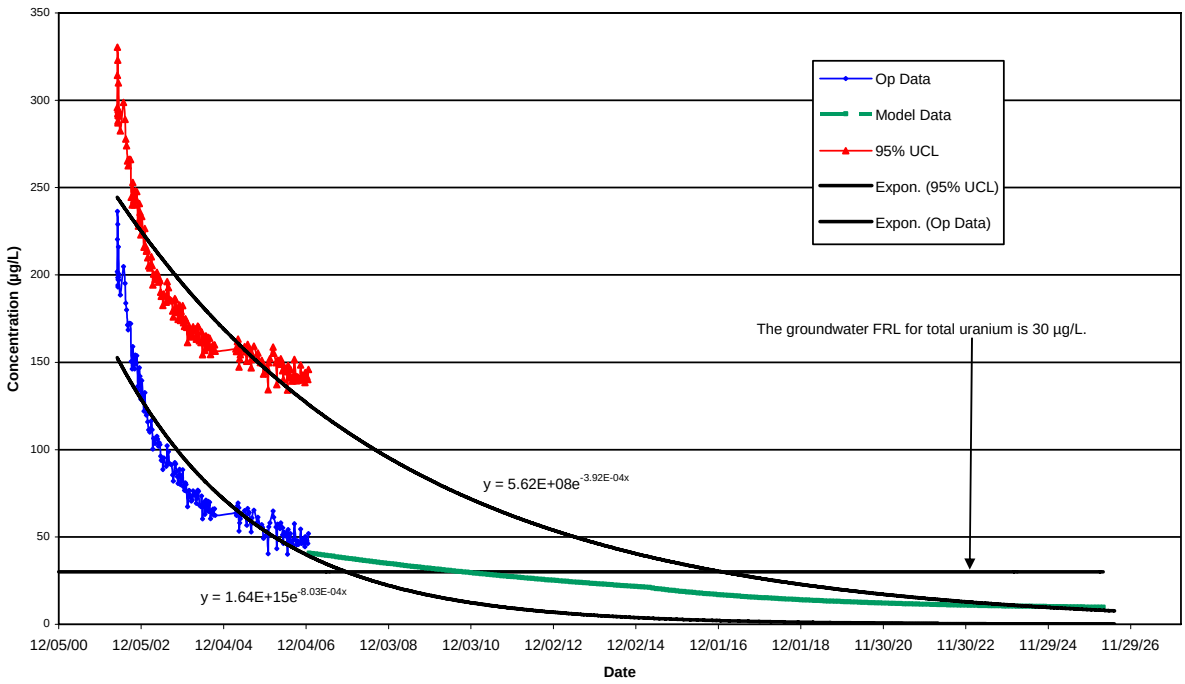

Figure A.1-12. Total Uranium Concentration vs. Time Plot for Extraction Well 33062 (EW-27) with Regression Analysis

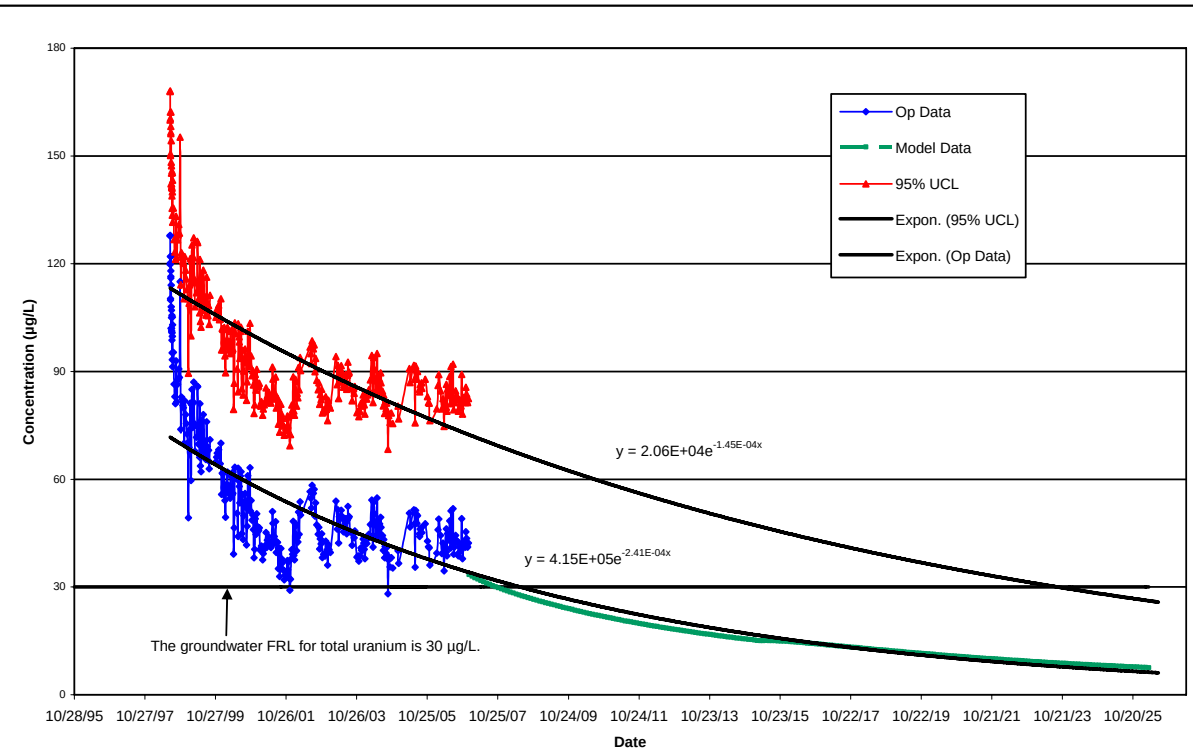

Figure A.1-13. Total Uranium Concentration vs. Time Plot for Extraction Well 31550 (EW-18) with Regression Analysis

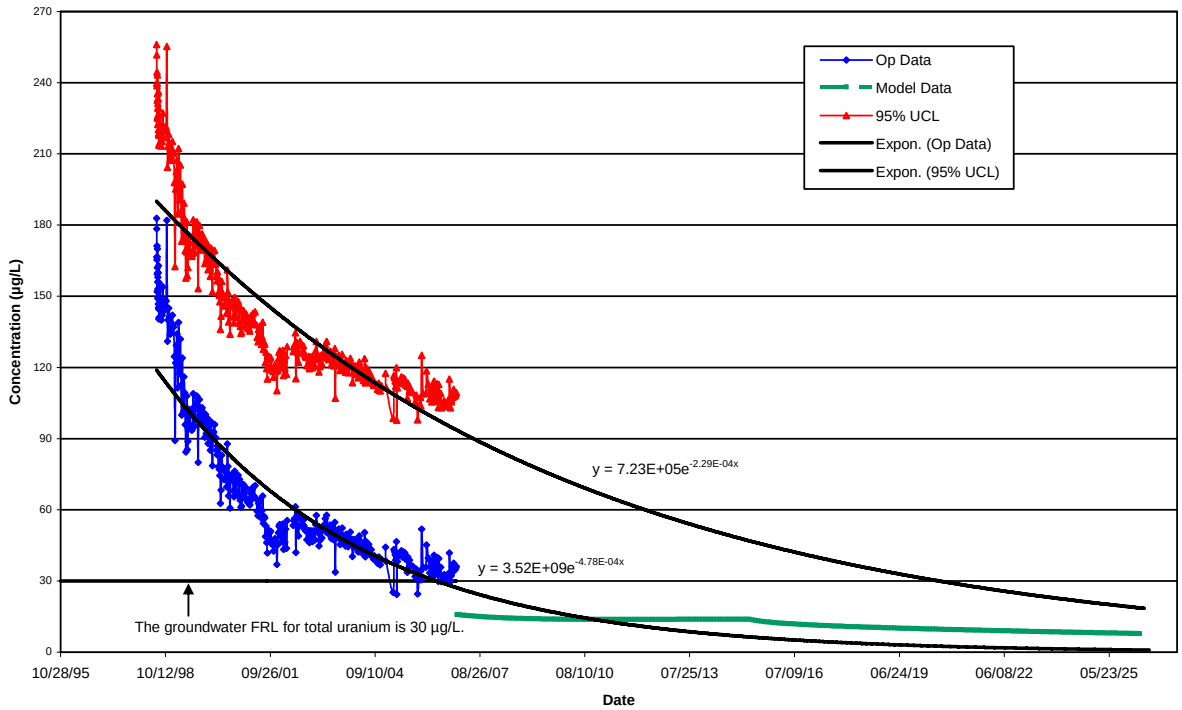

Figure A.1-14. Total Uranium Concentration vs. Time Plot for Extraction Well 31560 (EW-19) with Regression Analysis

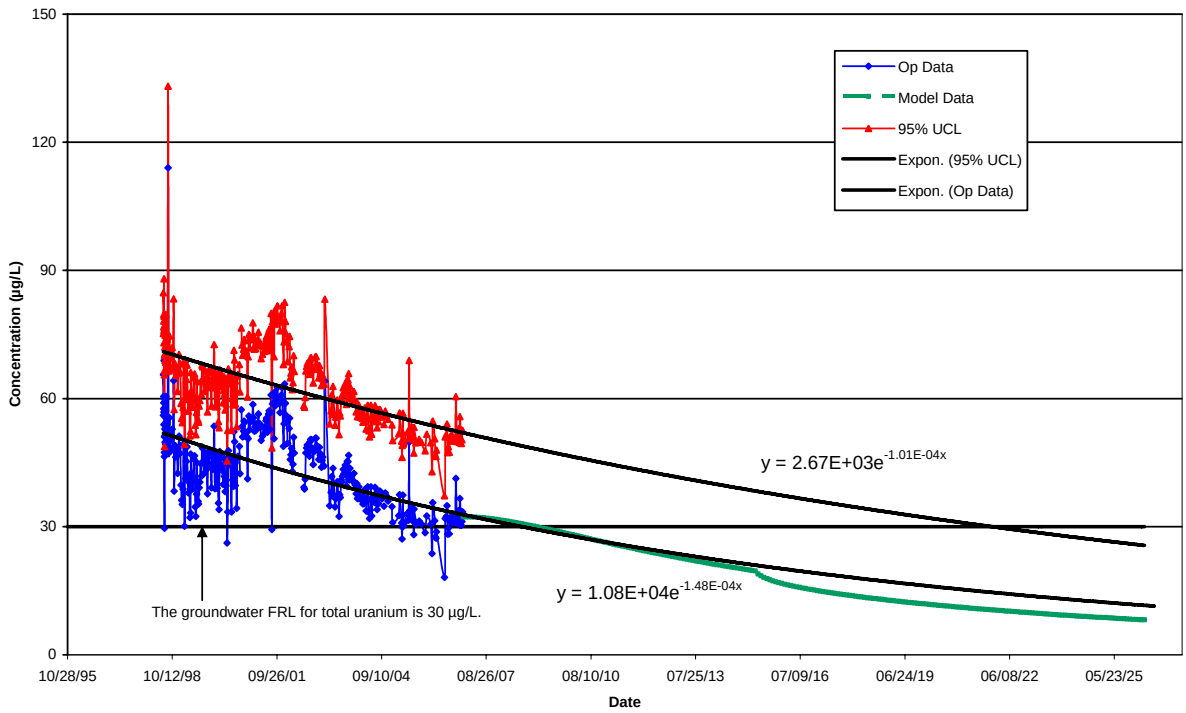

Figure A.1-15. Total Uranium Concentration vs. Time Plot for Extraction Well 31561 (EW-20) with Regression Analysis

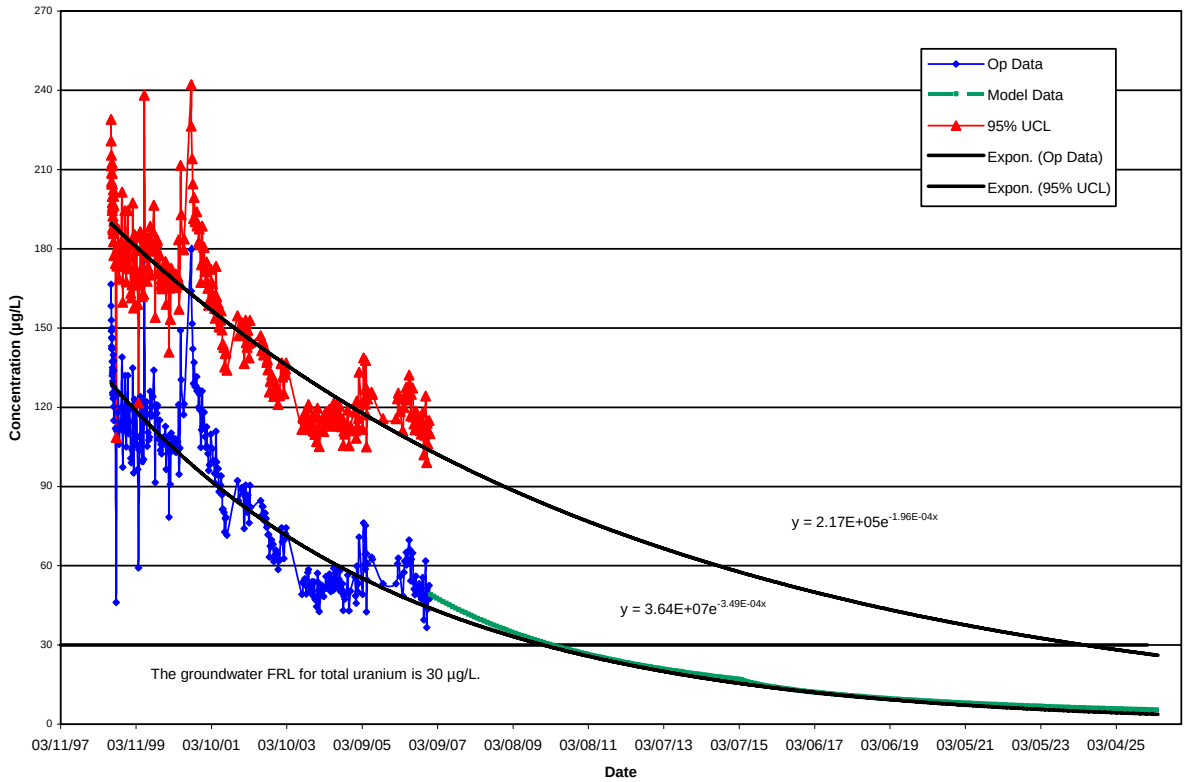

Figure A.1-16. Total Uranium Concentration vs. Time Plot for Extraction Well 31562 (EW-21) / 33298 (EW-21a) with Regression Analysis

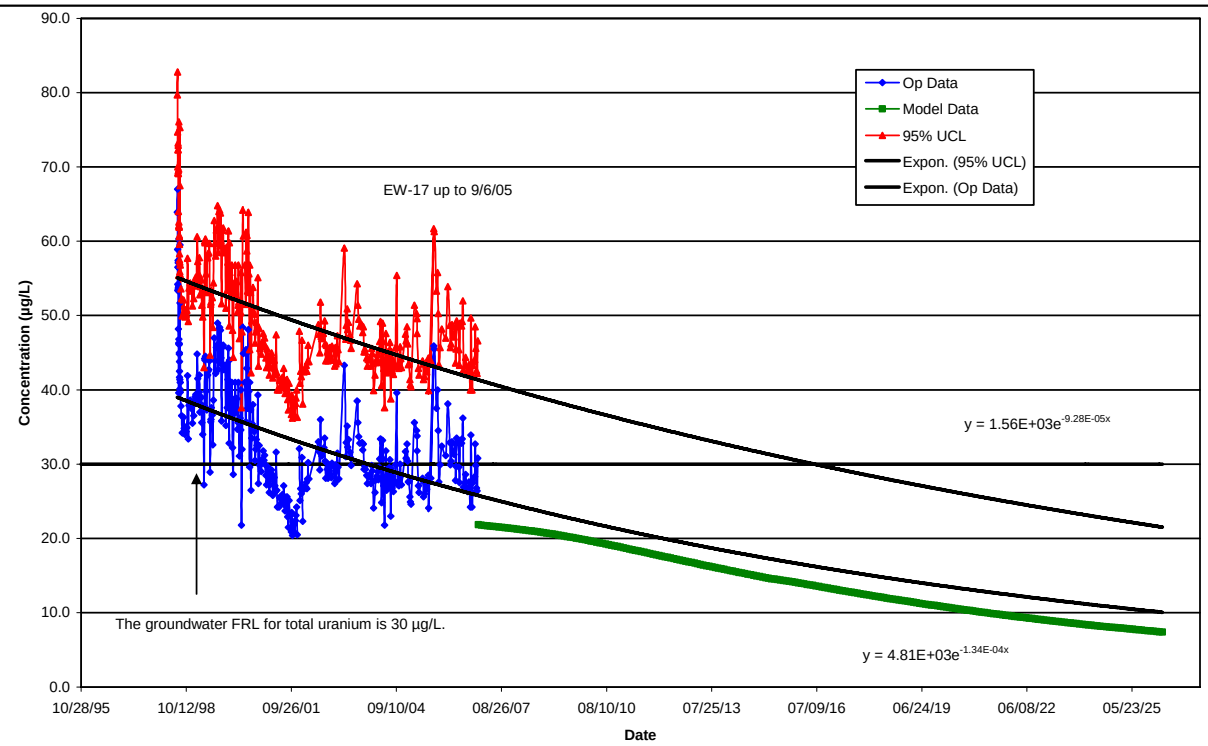

Figure A.1-17. Total Uranium Concentration vs. Time Plot for Extraction Well 31567 (EW-17)/ 33326 (EW-17a) with Regression Analysis

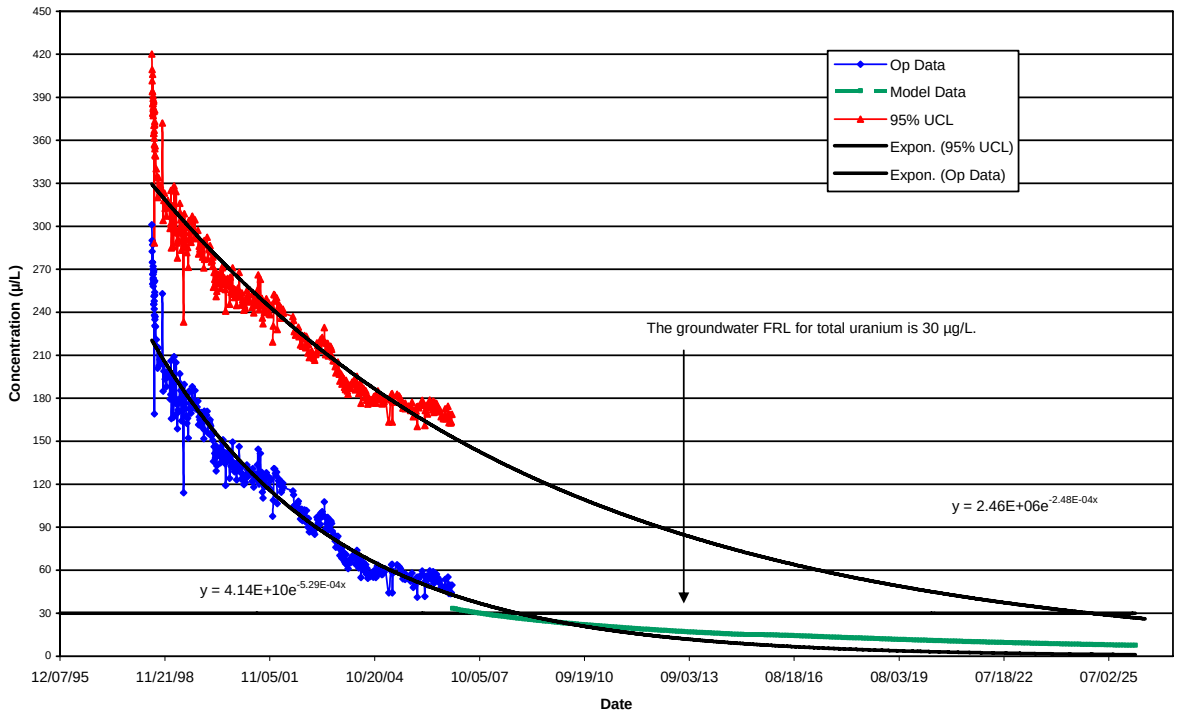

Figure A.1-18. Total Uranium Concentration vs. Time Plot for Extraction Well 32276 (EW-22) with Regression Analysis

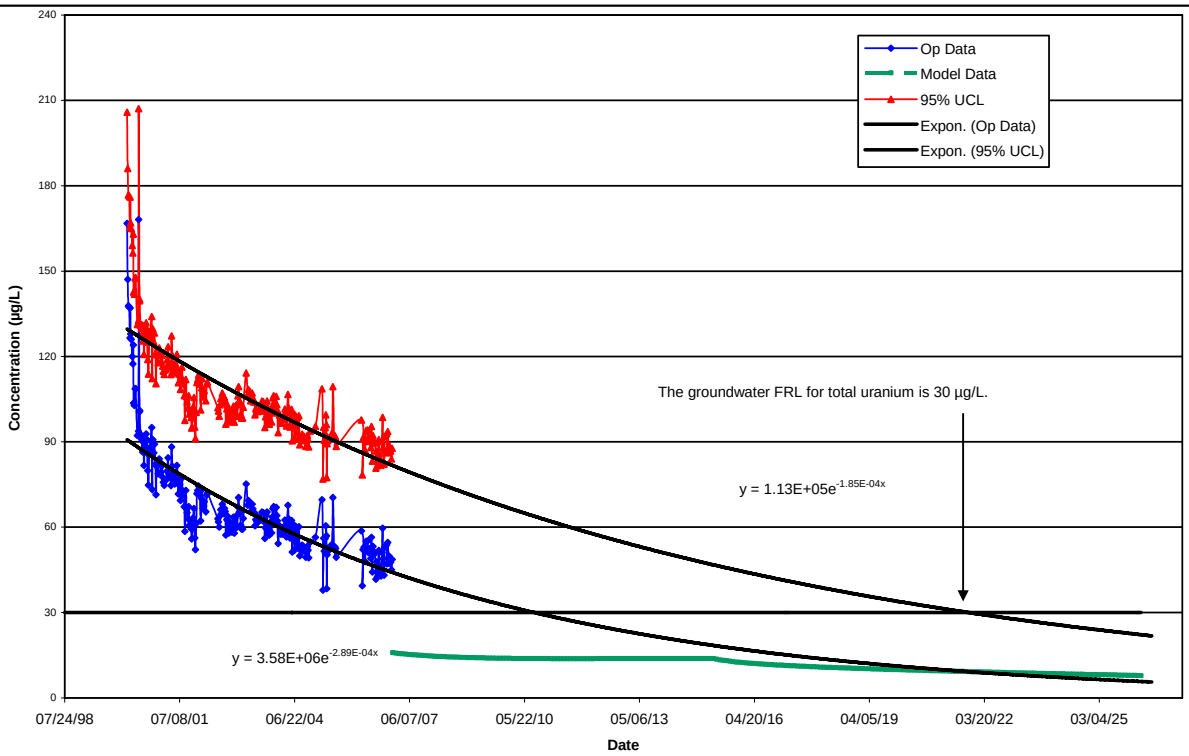

Figure A.1-19. Total Uranium Concentration vs. Time Plot for Extraction Well 32446 (EW-24) with Regression Analysis

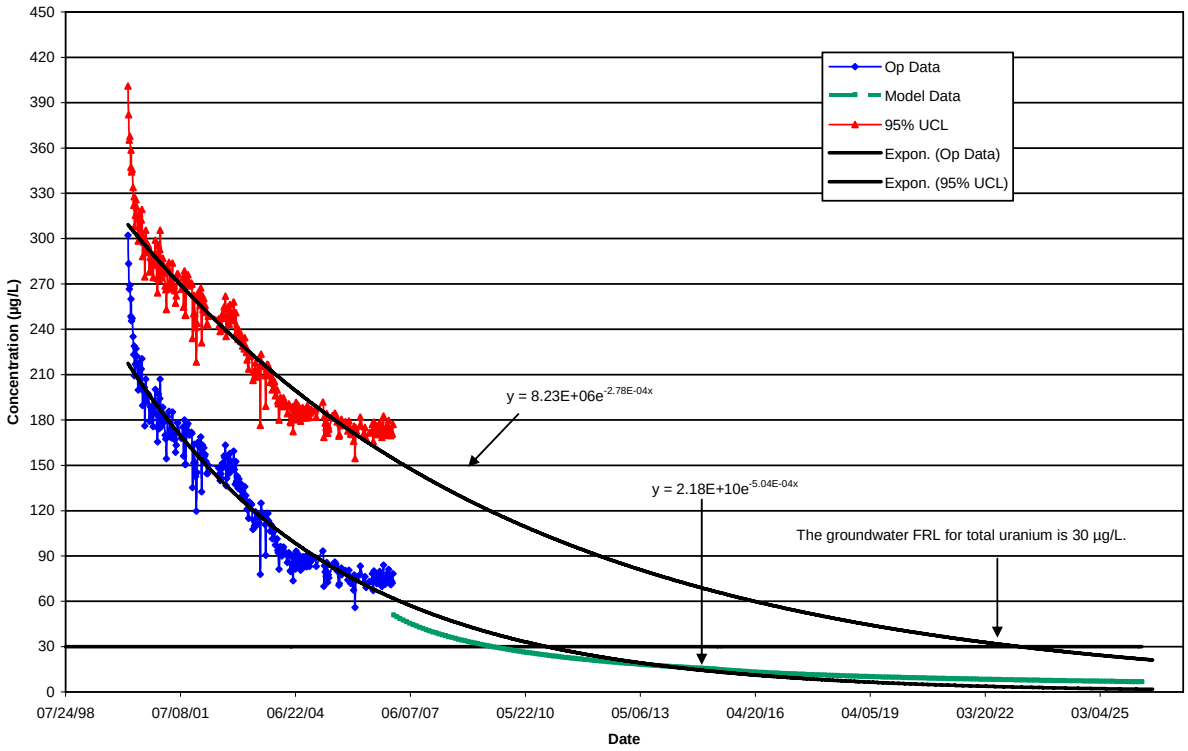

Figure A.1-20. Total Uranium Concentration vs. Time Plot for Extraction Well 32447 (EW-23) with Regression Analysis

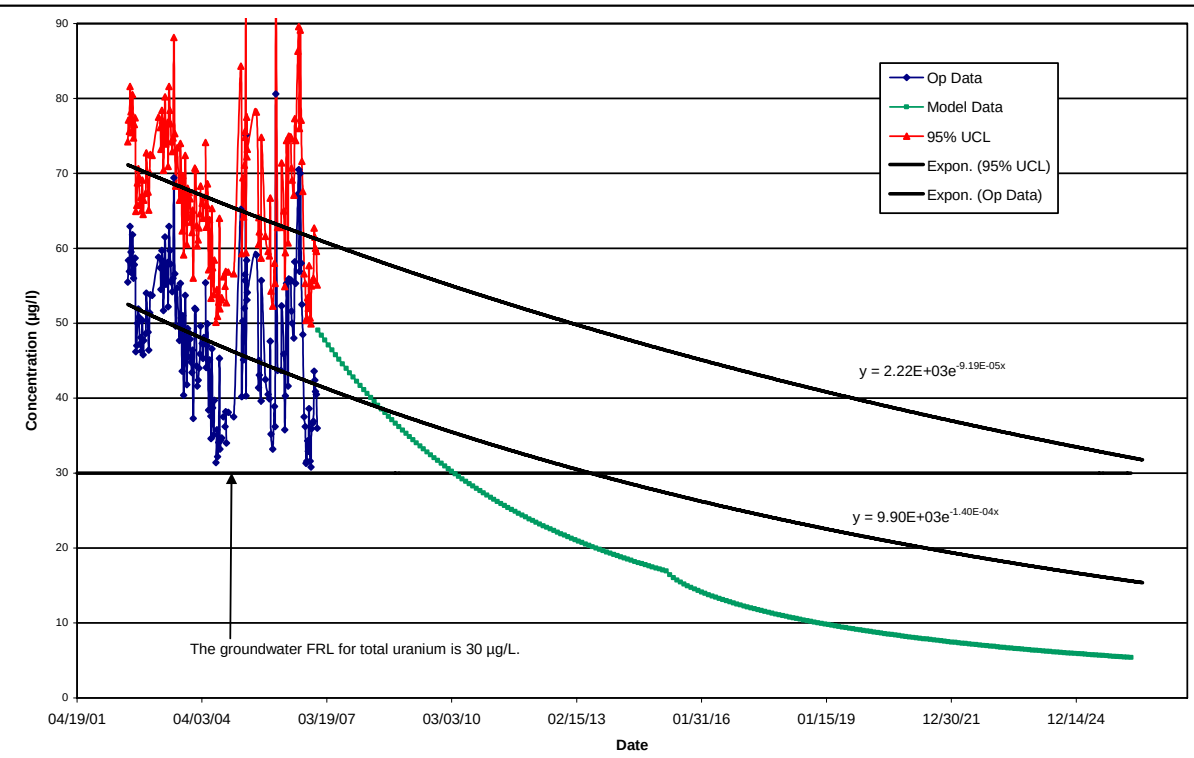

Figure A.1-21. Total Uranium Concentration vs. Time Plot for Extraction Well 33061 (EW-25) with Regression Analysis

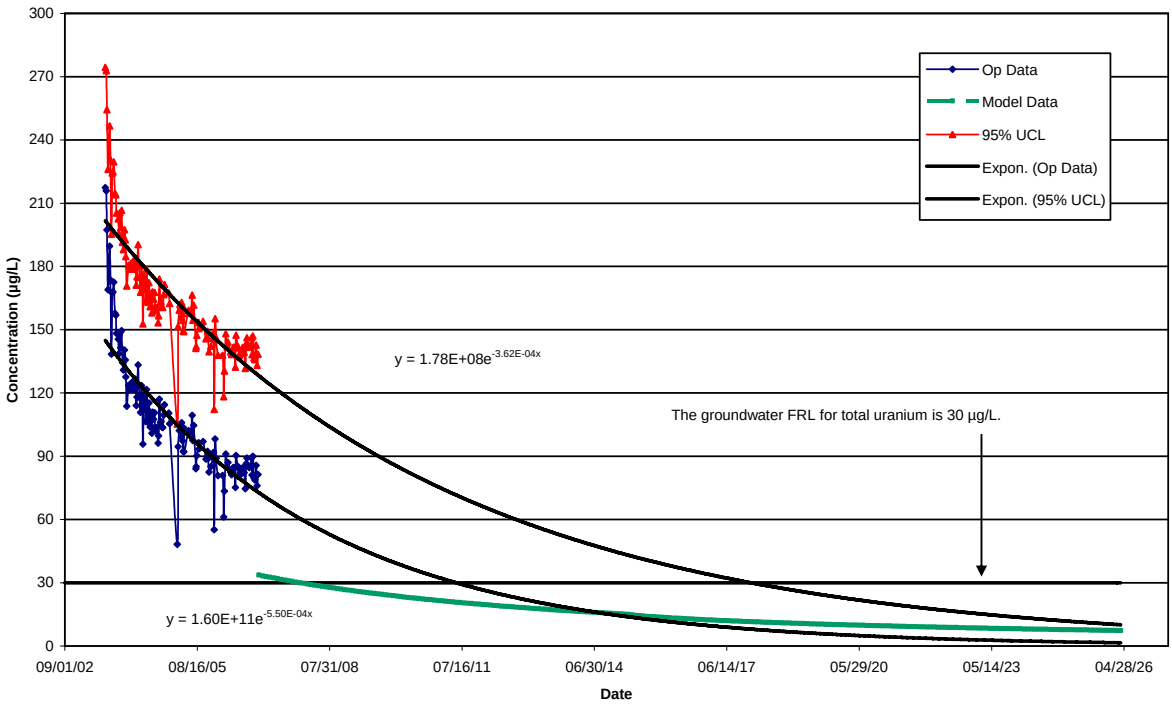

Figure A.1.22. Total Uranium Concentration vs. Time Plot for Extraction Well 33264 (EW-30) with Regression Analysis

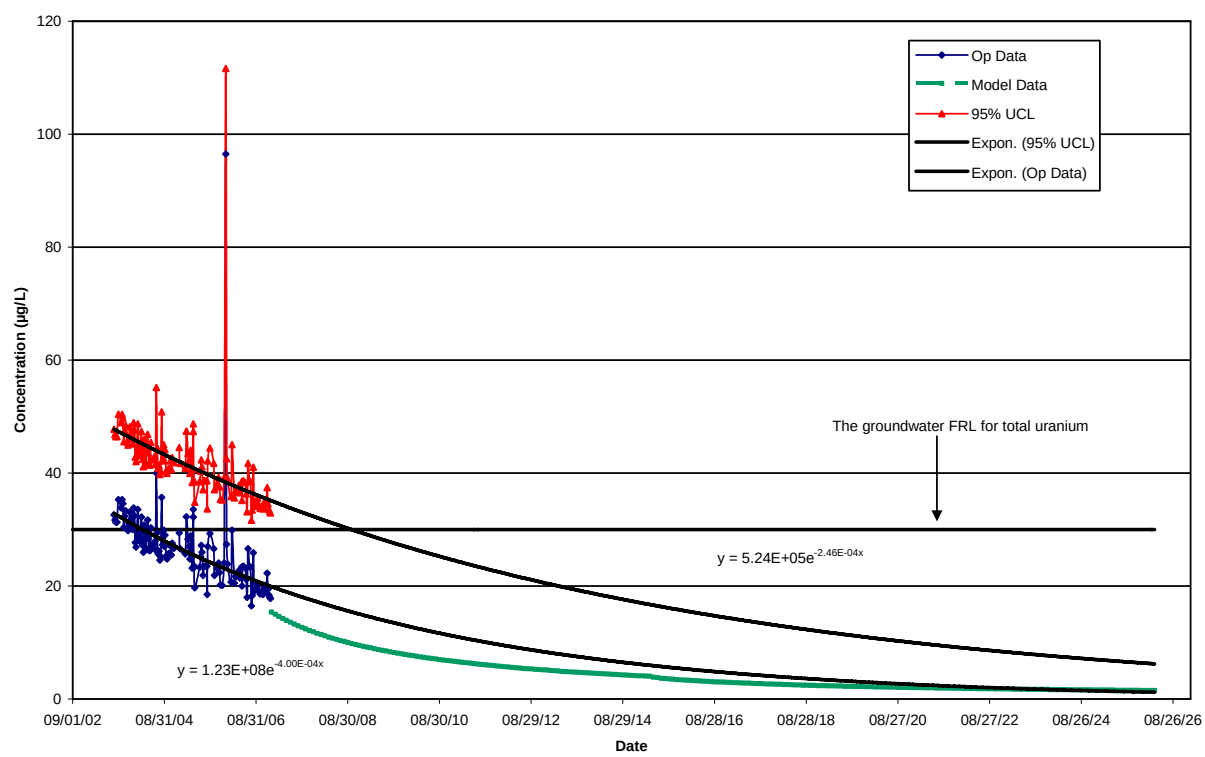

Figure A.1-23. Total Uranium Concentration vs. Time Plot for Extraction Well 33265 (EW-31) with Regression Analysis

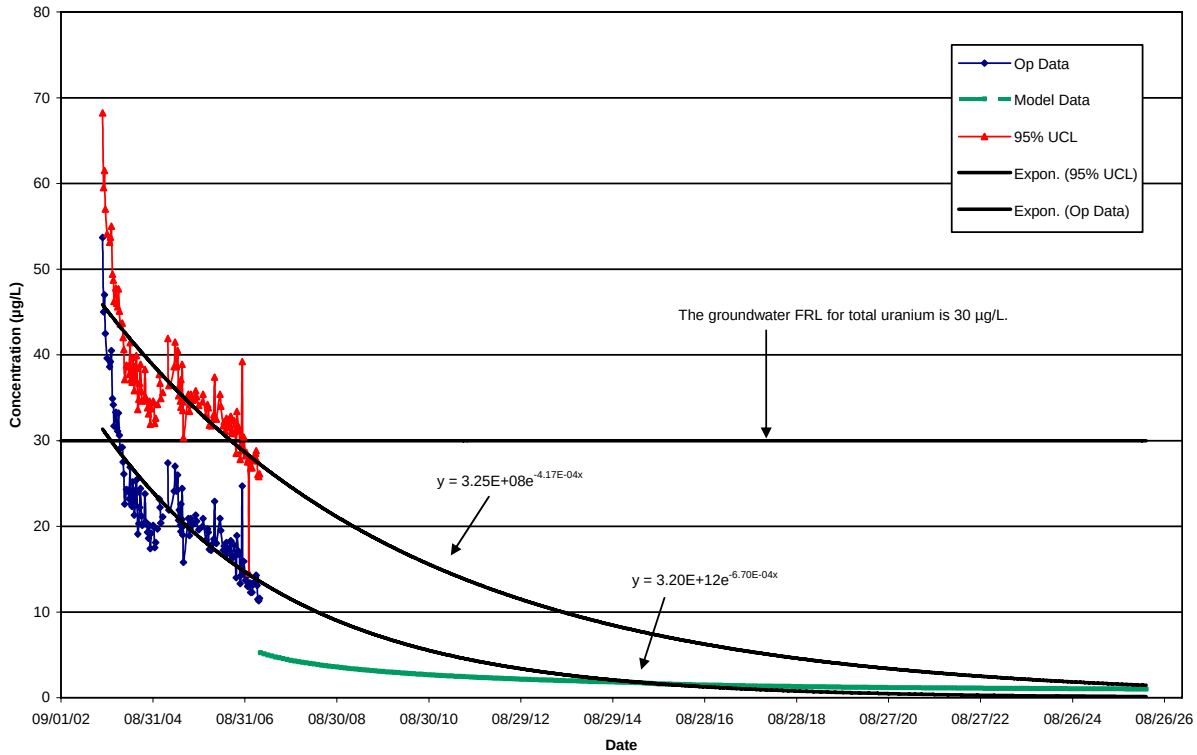

Figure A.1-24. Total Uranium Concentration vs. Time Plot for Extraction Well 33266 (EW-32) with Regression Analysis

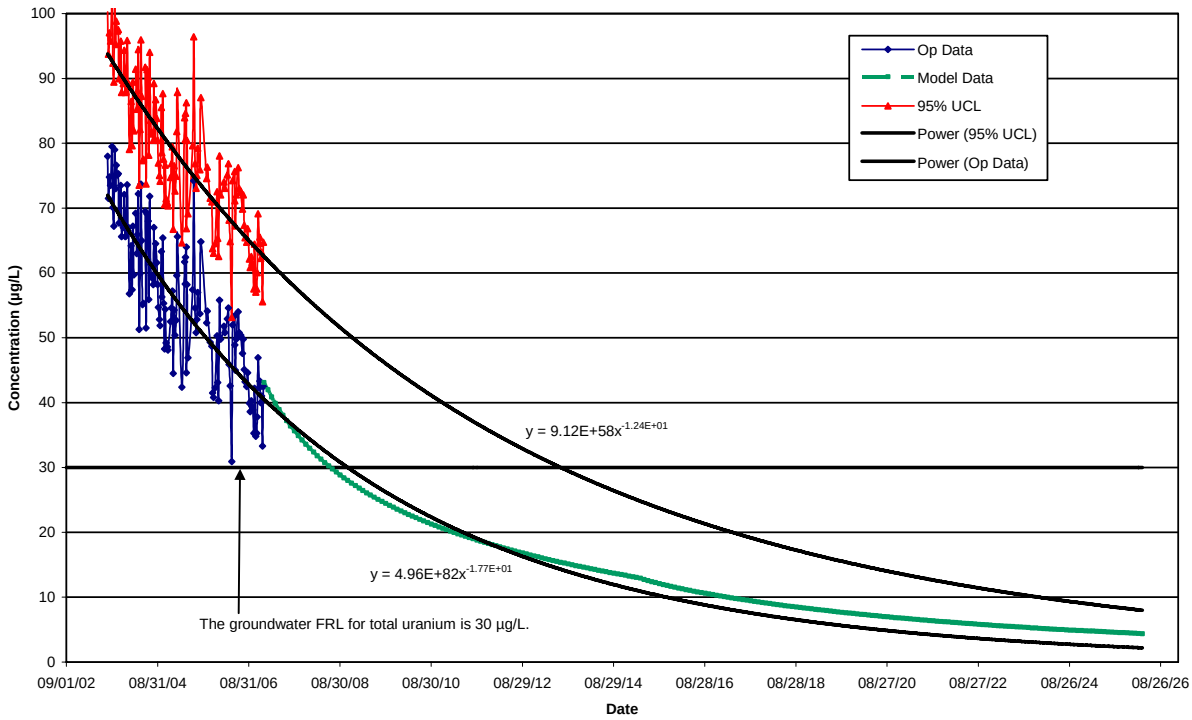

Figure A.1-25. Total Uranium Concentration vs. Time Plot for Extraction Well 33262 (EW-15a) with Regression Analysis

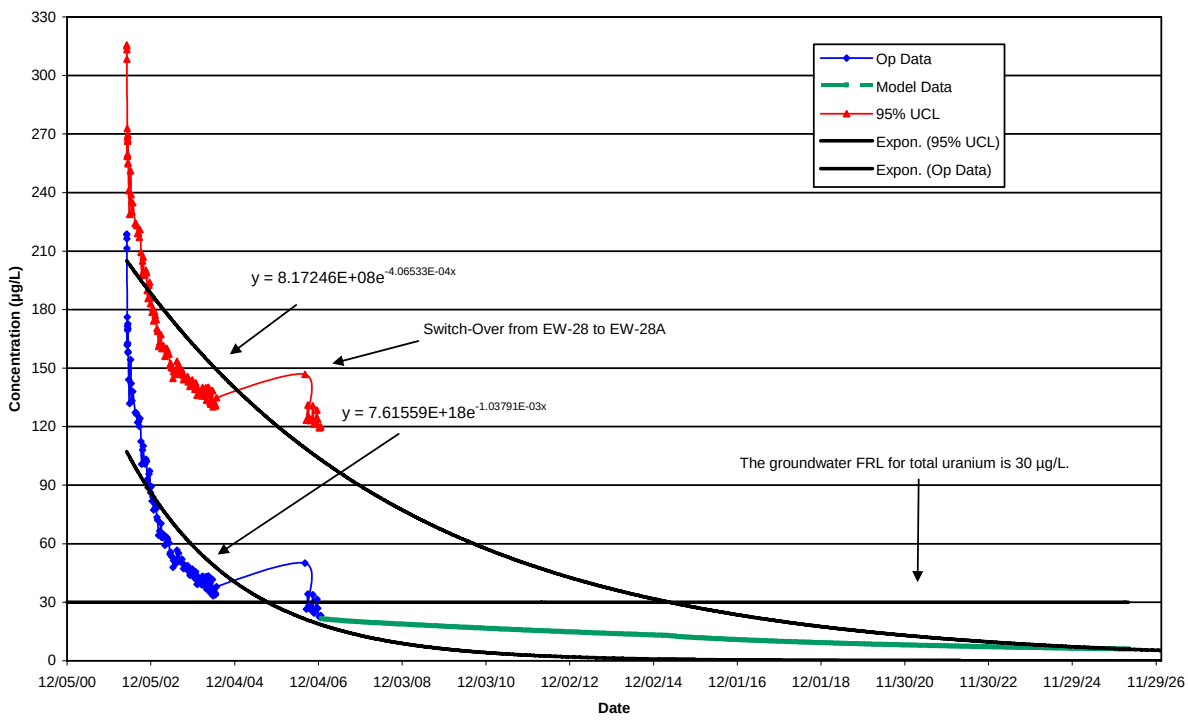

Figure A.1-26. Total Uranium Concentration vs. Time Plot for Extraction Well 33063 (EW-28) / 33334 (EW-28a) with Regression Analysis

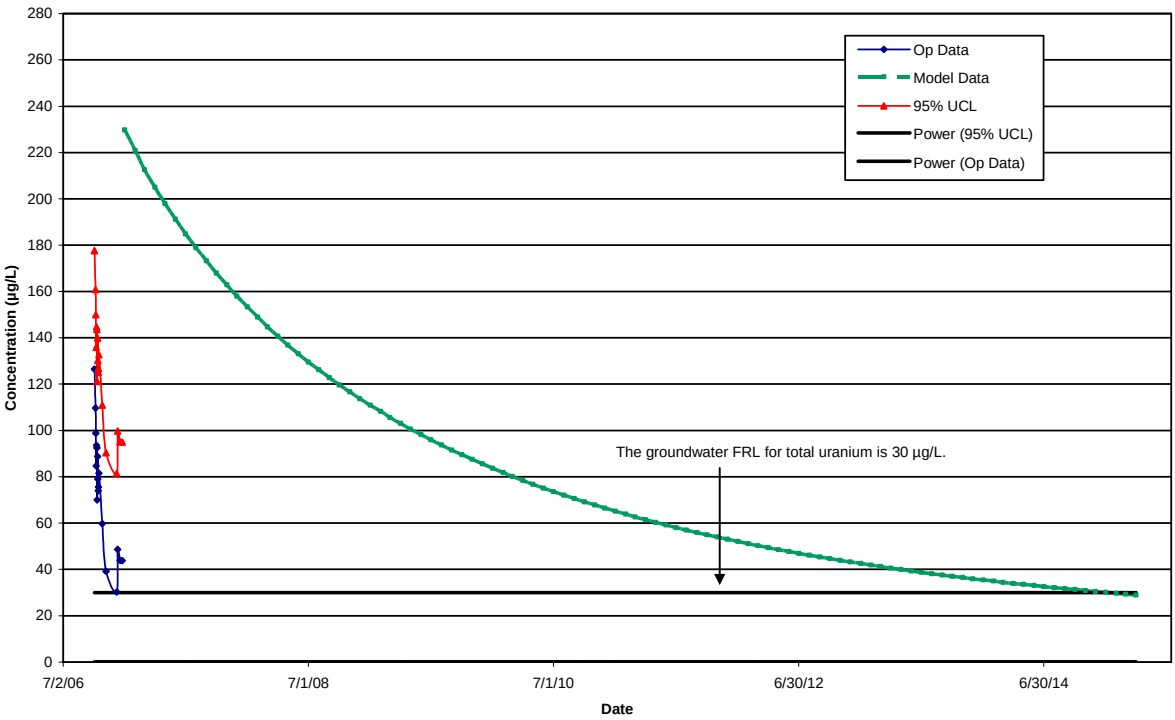

Figure A.1-27. Total Uranium Concentration vs. Time Plot for Extraction Well 33347 (EW-33a) with Regression Analysis

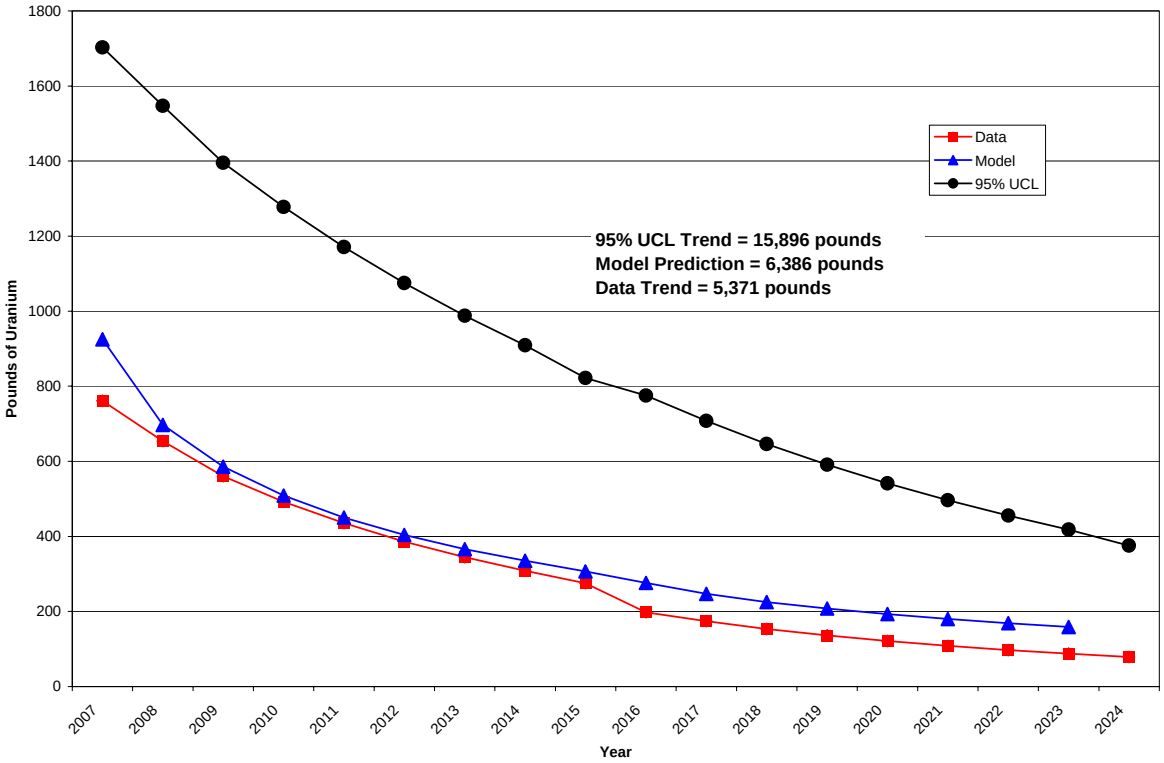

Figure-A.1-28. Estimate of Yearly Pounds of Uranium to be Removed from the Aquifer to Meet Cleanup Dates Predicted by the Groundwater Model
(Model Predictions versus Measured Concentrations, Data Current Through December 2006)

End of current text

Attachment A.2

A.2.0 Assessment of Total Uranium Results

This attachment discusses groundwater total uranium results for 2006 in context with results collected prior to 2006. Monitoring well locations associated with the IEMP are listed in Table A.2−1. Monitoring and extraction well locations associated with the IEMP are shown in Figure A.2−1. For integration purposes, the on site disposal facility monitoring well locations are also shown on Figure A.2−1 and Table A.2−1.

Figures A.2−2A, A.2−2B, A.2−2C; and A.2−3A, A.2−3B, A.2−3C show maximum total uranium plume maps for the first and second halves of 2006, respectively. The maps are posted in three parts to show all of the data in an 8½ by 11 inch format. The first part shows direct push (i.e., Geoprobe®) data, the second part shows monitoring well and extraction well data, and the third part shows a detailed expansion of monitoring well and extraction well data in the South Field. Data collected from the aquifer are used to progressively update the 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 recontoured to honor the higher value.
- If the most recent concentration measurement from a well is less than the previous contoured 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 recontoured 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 2006. Included in the table are total uranium statistical summaries for each well including 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 s A.2−2 and A.2−3 (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.2−147 present total uranium concentration versus time plots for those wells listed in Table A.2−1, with the exception of wells 22217, 83337, 83338, 83339, 83340, 83341, and 83346. These wells were installed in 2007 and not enough data is available this year to produce meaningful plots. These plots also show the screen interval for Type 2 wells (if available) and water levels.

The topics listed below are deemed to be important based on a review of the total uranium data:

- Uranium plume changes in the waste storage area (Section A.2.1)
- Uranium plume changes in the Plant 6 area (Section A.2.2)
- Uranium plume changes in the South Field and off-property South Plume Areas (Section A.2.3)
- 2006 Plugging and abandonment activities (Section A.2.4)
- Flow Monitoring in the Storm Sewer Outfall Ditch (SSOD) (Section A.2.5)

A.2.1 Uranium Plume Changes in the Waste Storage Area

The maximum total uranium plume map for the Waste Storage Area did not change from the second half of 2005 to the first half of 2006. The maximum total uranium plume map for the first half of 2006 is presented in Figures A.2−2A, A.2−2B, and A.2−2C.

The maximum total uranium plume map for the Waste Storage Area did change from the first half of 2006 to the second half of 2006 based on a new uranium FRL exceedance being measured at Monitoring Well 83341. The maximum total uranium plume map for the second half of 2006 is presented in Figures A.2−3A, A.2−3B, and A.2−3C.

The following highlights for the Waste Storage Area are discussed below:

- Monitoring Well 83341- Uranium FRL exceedance
- Monitoring Well 2649 - Uranium fluctuations
- Monitoring Well 2008 - No uranium FRL exceedance in 2006
- Monitoring Well 2010 - Reporting of filtered uranium
- Direct Push Sampling

A.2.1.1 Monitoring Well 83341

This new Type-8 groundwater monitoring well, with three sampling channels, was installed in the waste storage area in 2006 to monitor the aquifer off the northeast corner of where waste pit 3 was previously located. The northeast corner of waste pit 3 was a low point in the pit so if the pit had leaked prior to source removal this would be a logical location. The new monitoring well was sampled for the first time in July of 2006. The upper-most sampling channel had an unfiltered uranium result of 33.4 µg/L and a filtered result of 37 ug/L. The largest uranium concentration measured below the 33.4 µg/L concentration was 9.3 ug/L. Therefore, a small uranium plume was positioned at Monitoring Well 83341 on the second half 2006 maximum total uranium plume map (Figure A.2−3A and Figure A.2−3B). Additional direct push sampling is needed to determine if this exceedance is connected to the larger plume located to the south. It is possible that this is a separate small plume, sourced from former waste pit 3. If this interpretation is correct, it is expected that the thin uranium exceedance at this location will dissipate rather quickly on its own now that the source excavation activities in the 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).

A.2.1.2 Monitoring Well 2649

In the 2005 SER, it was noted that the uranium concentration for the past two years fluctuated at Monitoring Well 2649. This fluctuation pattern was not observed in 2006. Monitoring Well 2649 is located at the southeast corner of where the clearwell was once located. Surface grading completed in 2006 near this well directs surface water runoff to an area close to the well where it is allowed to infiltrate into the ground and serve as a source of recharge to the aquifer. Increased recharge in this area in 2006 is evident by the highest water level being recorded at this well since 1998 (Figure A.2−41). As reported in the 2005 SER, the uranium concentration at

monitoring well 2649 was high during the first half of the year, and low during the second half of the year in both 2004 and 2005 (Figure A.2−41). During 2004 and 2005 the water level measured at well 2649 remained relatively steady. In the first half of 2006, the water level was up and uranium concentrations remained low. The decision was made not to sample this well during the second half of 2006 so as not to disturb freshly seeded ground surrounding the well. The fact that the uranium concentration measured in the first half of 2006 was low, indicates that the up-down pattern of the previous two years did not repeat in 2006. On October 5, 2006, a new Extraction Well (EW-33a) began pumping at a target pumping rate of 300 gpm in close proximity to Monitoring Well 2649. This new pumping should result in lower water levels in Monitoring Well 2649. The observed water level impact will be reported in the 2007 SER. It is anticipated that with the combined impact of completed source removal, new surface water infiltration, and new pumping, uranium concentrations measured in Monitoring Well 2649 will remain low.

A.2.1.3 Monitoring Well 2008

In the 2005 SER, it was reported that during 2004 a uranium FRL exceedance was reported at Monitoring Well 2008 for the first time. Monitoring well 2008 is located east of the former silos area and south of the former bio-surge lagoon. An exceedance was not measured in 2005 and an exceedance was not measured in 2006 (Figure A.2−8). The exceedance recorded in 2004 will continue to be honored on the maximum uranium plume maps until direct-push sampling is conducted to confirm that all depths at this location are below the groundwater uranium FRL.

A.2.1.4 Monitoring Well 2010

Monitoring Well 2010 is located east of the former waste storage area. In the Addendum to the Waste Storage Area (Phase II) Design Report (DOE 2005d) it was reported that bio-fouling is occurring at Monitoring Well 2010 and concentrating manganese around the well screen. Unfiltered water samples collected in 2006 yielded higher uranium concentrations than filtered samples did. Sampling results from January 18, 2006 were 93 ug/L uranium (unfiltered) and 8.63 ug/L uranium (filtered). Sampling results from December 6, 2006 were 119 ug/L (unfiltered) and 10 ug/L (filtered). Due to the suspected biofouling at this well, the filtered uranium results were posted on the maximum total uranium plume maps for 2006. Because this well shows such drastic differences between filtered and unfiltered samples, filtering of groundwater samples will continue at this location. The filtered results for 2006 are posted on Figure A.2-10.

A.2.1.5 Direct Push Sampling

In 2006, direct-push sampling was conducted at one location in the Waste Storage Area, Location 13351. As shown in Figure A.2−3A, this location is on the western edge of the Pilot Plant Drainage Ditch Plume, west of Paddys Run. Sampling results for total uranium indicate that the maximum uranium concentration at this location remains above 30 ug/L (i.e., 36.3 ug/L uranium at a depth of 20 to 30 feet below the water table, 492.32 feet amsl). Sampling results are provided in Table A.2−4.

A.2.2 Uranium Plume Changes in the Plant 6 Area

A thin layer of uranium contamination is present in the upper foot or so of the aquifer at Monitoring Well 2389. As discussed in past SERs, this thin layer of contamination is evident at

Monitoring Well 2389 where sporadic uranium FRL exceedances have been detected since 2002. Monitoring in 2006 provides an update on the uranium concentration FRL exceedance in this 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 Great Miami Aquifer 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. All other monitoring wells in the area were plugged and abandoned as part of source removal activities. As indicated in Figure A.2−28, sporadic uranium FRL exceedances have been detected since 2002 at Monitoring Well 2389. As reported in the 2005 SER, it appears that a thin layer of contamination is present in the upper foot or so of the aquifer. Prior to 2006, only unfiltered groundwater samples were collected from Well 2389. Beginning in 2006, both unfiltered and filtered groundwater samples were collected from this well. As expected, uranium concentrations of the filtered samples were slightly below the uranium concentrations of the unfiltered samples. In April of 2006 the unfiltered sample and duplicate had a uranium concentration of 30.1 ug/L and 30.9 ug/L, respectively. The filtered sample and duplicate had a uranium concentration of 21.6 ug/L and 21.3 ug/L, respectively. In October of 2006 an unfiltered sample and duplicate had a uranium concentration of 20.3 ug/L and 20.7 ug/L, respectively. The filtered sample and duplicate were 18.6 ug/L and 17.6 ug/L respectively. Filtered results for 2006 are posted on Figure A.2−27. It is expected that over time the uranium concentration at this location will decrease. Monitoring at this location will continue.

A.2.3 Uranium Plume Changes in the South Field and the Off-Property South Plume Areas

The maximum total uranium plume map for the South Field and South Plume did not change from the second half of 2005 to the first half of 2006. The maximum total uranium plume map for the first half of 2006 is presented in Figures A.2−2A, A.2−2B, and A.2−2C.

The maximum total uranium plume map for the South Field and South Plume did change from the first half to the second half of 2006, based on new uranium concentration data collected at direct-push sampling locations. The maximum total uranium plume map for the second half of 2006 is presented in Figures A.2−3A, A.2−3B, and A.2−3C.

The following highlights for the South Field and South Plume are discussed below:

- Direct-push data – Uranium Plume Updates
- Monitoring Well 2397 – Dry in second half of 2006
- Area around the former Inactive Fly Ash Pile

A.2.3.1 Direct Push Sampling

During 2006, direct-push sampling was conducted at ten locations (13355, 13356, 13358, 13359, 13235a, 13226b, 12367h, 12368h, 12372l, and 12373l) in the South Field and South Plume. The

ten locations are shown in Figure A.2−3A. Sampling results for each location, broken down by sampling depth, are provided in Tables A.2−5 through A.2−14.

Direct-push sampling in 2006 was focused at assessing the western edge of the uranium plume and evaluating changes to the plume along Willey Road. Direct-push sampling data collected at locations 13358, 12372l, 12368h, 3226b, 13235A, and 13359 indicate that the uranium concentrations along the western edge of the plume have decreased below 30 ug/L. This new profile data was used to re-map the western edge of the uranium plume. In the second half of 2005, the South Field and South Plume Uranium Plume covered a combined area of 145.9 acres. Direct-push data collected in 2006 were used to reduce the size of the mapped maximum uranium plume in the South Field and South Plume combined to an area equal to 138.8 acres, which is a reduction of 7.1 acres.

Each year seven locations along Willey Road (Locations 12367, 12368, 12369, 12370, 12371, 12372, and 12373) are re-sampled using direct-push sampling tools. These locations were originally sampled to track re-injection progress along Willey Road. Re-sampling the 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 South Plume Extraction Wells to the south placing the area in a stagnation zone. Re-injection (when it was occurring) helped to break up this stagnation zone.

Only four of these locations were sampled in 2006 (12367H, 12368H, 12372L, and 12373L). A decision was made to drop annual re-sampling at location 12371H because it is outside of the uranium plume. Sampling in 2006 was conducted in September and October. The two remaining locations not sampled in 2006 were sampled in 2007 (Locations 12369L in March 2007 and Location 12370H in January of 2007). Data from 2006 and 2007 were used to create two cross sections (Figure A.2−148 and Figure A.2−149). In addition to the water levels measured at the time of sampling (either 2006 or 2007), the water levels measured during the 2005 sampling event are also noted on the sections.

The thin units of the maximum uranium plumes that were detected in 2005 at Locations 12368 and 12372 were not detected in 2006. The thick maximum uranium plume detected in 2005 at Location 12373 was much reduced in thickness and concentration in 2006. As illustrated in the cross sections, water levels measured in 2006 and early 2007 were lower than the levels measured in 2005. As discussed below, it is possible that monitoring in 2006/2007 missed the thin layer of above FRL contamination that was detected in the aquifer at the water table in 2005.

Direct-Push Location 12373L exhibits the greatest uranium concentration change since 2005. In 2005, this location was sampled in July when seasonal water levels are high. The maximum uranium plume in 2005 was approximately 40 feet thick (515.298 feet amsl to 476.298 feet amsl) and the highest uranium concentration was 170.6 ug/L measured in a sample collected at an elevation of 515.3 feet amsl. In October of 2006 the water level was 512.5 feet amsl. The maximum uranium concentration measured was 32.1 ug/L at an elevation of 508 feet amsl. Given the potential that higher uranium concentrations were not measured in 2006 due to a lower water table, the maximum uranium plume was not re-mapped at this location to reflect the lower values measured in 2006. The maximum uranium plume map for the second half of 2006 continues to honor previous maximum uranium values at Location 12373L. The location will be re-sampled in the future.

Based on the discussion above concerning water levels at Location 12373L, an effort will be made to conduct as much future direct-push sampling as possible during the late spring and early summer when water levels are at there seasonal high.

A.2.3.2 Monitoring Well 2397

Monitoring Well 2397 is located in the northeast section of the South Field near Extraction Well 33061 (EW-25). Pumping in EW-25 began in 2002. As shown in Figure A.2−31, the base of the well screen is set at an elevation of approximately 513 feet amsl. In 2006 this monitoring well was dry. Pumping from EW-25 and seasonal water table fluctuations lowered the water level below the base of the screen.

A.2.3.3 Area Around the Former Inactive Fly Ash Pile

Groundwater monitoring results in 2006 indicate that uranium concentrations in the former Inactive Fly Ash Pile area are considerably lower than the mapped maximum uranium plume (i.e., Monitoring Well 2046 and Monitoring Well 23281, on Figure A.2−3B). The maximum uranium plume contours in this area are based on direct push sampling results that are approximately 6 years old. Additional direct-push sampling is being planned in 2007 to update the maximum uranium plume in this area.

A.2.4 2006 Plugging and Abandonment Activities

Eight groundwater-monitoring wells were plugged and abandoned in 2006 to facilitate site remediation activities or because they were no longer needed to track the performance of the groundwater remedy:

- Four in the South Plume Area (2127, 3127, 2557, 2554)
- One in the Waste Storage Area (2648)
- Three in the OSDF Area (22216, 2429, and 4446)

None of these monitoring wells were part of the current IEMP (Revision 5A).

A.2.5 Flow Monitoring in the Storm Sewer Outfall Ditch

A test was conducted in 2005 to gauge seasonal flow of water in the Storm Sewer Outfall Ditch (SSOD) and to determine if recharge to the Great Miami Aquifer through the SSOD at a rate of 500 gallons per minute was feasible (DOE 2005). As reported in the Groundwater Remedy Evaluation and field Verification Plan (DOE 2004), a modeled infiltration rate of 500 gpm in the SSOD decreased the predicted cleanup time by one year. 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. The agreement was to pump clean groundwater into the SSOD to supplement natural storm water runoff in an attempt to accelerate remediation of the South Plume. Three existing construction water supply wells on the east side of the site will be utilized to deliver as much clean groundwater as is needed to maintain a flow of approximately 500 gpm into the SSOD.

As shown in Figure A.2−150, six Parshall flumes are installed in the SSOD. These flumes are used to measure flow into and out-of the SSOD. Water is supplied from a group of three water wells located on the east side of the site (42202, 42471, and 43309). 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.

The six Parshall flumes in the SSOD were 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 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 decided to continue using the flumes without design modifications for the longer term operation. As discussed below, the designs are not intended for long-term use.

Pumping of clean groundwater into the SSOD could not begin until December of 2006 because the water from the supply wells was needed for dust suppression to support site closure activities.

From January 1, 2006 through December 14, 2006, flow in the flumes was monitored to assess seasonal flow patterns. Operating the flumes over the course of a year involved a couple of challenges that were not faced during the initial test (i.e. freezing temperatures in the winter months and beavers constructing dams in the SSOD). Most of the beaver activity occurred immediately down gradient of Flume 6, but flow in the SSOD has not been disrupted enough to influence the hydraulic drop in Flume 6.

Two very heavy rain events occurred in 2006, one in March and one in April. From March 8 to March 12, approximately 4.62 inches of rain fell. From April 13 to April 21, approximately 4.2 inches of rain fell. The force of the flow in the SSOD created by this much precipitation in such a short period of time damaged the wing walls on Flume 1, allowing water to flow around and under the flume. Temporary repairs to the flume were made both times. A more permanent solution is being developed.

Figure A.2−151 illustrates the average monthly input to the SSOD versus the average monthly precipitation. Pumping into the SSOD began on December 14, 2006, using Well 43309. Based on the data presented in this graph, it is not necessary to pump water to the SSOD in the winter and early spring as natural flow is > 500 gpm. Therefore, DOE will reduce pumping from the construction wells during these months.

Figure A.2−152 illustrates the average monthly inflow, outflow, and precipitation. A concern is that the measured outflow rate exceeds the measured inflow rate in July and September through December resulting in a negative infiltration calculation (i.e., subtracting outflow from inflow). This indicates that unmeasured flow is entering the SSOD. The most likely location for this to occur is the ditch where Flume 4 is installed. The post closure configuration of the ditch, in which Flume 4 is installed, is too large for the size of the flume. The flow appears to be going under and around the flume.

The average pumping rate for December 14 – 31 was 334 gpm. The flow rate in Flume 6 gradually increased after December 14. It rose above 500 gpm on December 22. With the exception of December 30, it remained above 500 gpm for the rest of the month. On December 30, the average Flume 6 flow rate was 454 gpm (see Figure A.2−153).

Groundwater will continue to be pumped into the SSOD in 2007 and flow will continue to be monitored. Efforts are being made to implement more permanent repairs to Flume 1 and to improve monitoring of the ditch in which Flume 4 is installed, by either installing an additional larger flume at the mouth of the ditch or enlarging Flume 4. Once problems at Flume 1 and Flume 4 have been addressed, it is anticipated that a better infiltration calculation can be obtained.

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 2006 Results Above Final Remediation Levels

Well	No. of Samples Since 1988[a,b,c]	Minimum[a,b,c,d] (µg/L)	Maximum[a,b,c,d,e] (µg/L)	Average[a,b,c,d,e,f] (µg/L)	Standard Deviation[a,b,c,d,e,f] (µg/L)	Trend[a,b,c,d,e,f,g]
2045	42	12.034	462	145.61	129.09	No Significant Trend
2046	40	20	907	218.88	246.27	Down, Marginal
2049	40	3	177.893	86.52	44.95	Down, Significant
2060	53	8.4	332	83.82	66.44	Down, Marginal
2095	52	27	208	115.59	42.50	Down, Significant
2166	41	28.3	95.1	60.38	15.35	Down, Significant
23271	10	49.1	144.3	98.41	28.71	No Significant Trend
23273	10	172	402	268.65	59.62	No Significant Trend
23274	10	141	348.3	231.85	62.25	Down, Significant
23275	9	119	168	138.69	14.80	Down, Marginal
23276	10	60.4	94	78.12	10.27	No Significant Trend
23278	10	89.4	201.4	133.66	40.42	Down, Significant
23280	10	67.3	700	247.12	183.80	No Significant Trend
23281	10	95.8	366.6	202.70	75.36	Down, Significant
2385	33	76.648	592.164	255.68	116.87	No Significant Trend
2386	33	6.67	43.431	21.15	8.49	No Significant Trend
2387	33	18.1	492	133.68	92.23	No Significant Trend
2390	32	39.5	163	86.6	26.4	Down, Significant
2397	25	212	737	397.87	129.72	Up, Marginal
2550	43	3.3	120	65.52	19	Down, Significant
3069	59	0.5	398.33	133.70	102.45	Down, Significant
3095	53	2.0	94	21.77	15.56	Down, Significant
32766	11	40.3	79.9	54.71	13.23	Down, Significant
62408	21	49.1	157	102.31	39.52	Down, Significant
62433	22	277	844.991	460.81	135.01	Down, Significant
63119	12	22.7	151	73.07	44.96	Down, Significant
63285	10	74.9	246	185.22	55.24	**Up, Significant**
63287	10	174	315.7	214.11	42.73	Down, Marginal
63288	10	41.3	267	124.95	79.49	Down, Marginal
63291	10	41.7	96.7	57.08	17	Down, Significant
6880	20	62.8	145	95.96	24.88	Down, Significant
82433_C2	7	55.8	214	138.24	64.94	Down, Marginal
82433_C3	13	164	506	305.77	126.71	Down, Significant
82433_C4	7	48	311	184.03	117.68	Down, Significant
82433_C5	7	2.66	85.4	44.91	32.13	No Significant Trend
83117_C1	12	655	1230	883.83	181.74	Up, Marginal
83117_C2	6	105	330	237.33	98.93	Down, Marginal
83117_C3	6	73.1	128	105.38	24.55	Down, Significant

Table A.2–2 (continued) Summary Statistics and Trend Analysis of Monitoring Wells for Total Uranium With 2006 Results Above Final Remediation Levels

Well	No. of Samples Since 1988[a,b,c]	Minimum[a,b,c,d] (µg/L)	Maximum[a,b,c,d,e] (µg/L)	Average[a,b,c,d,e,f] (µg/L)	Standard Deviation[a,b,c,d,e,f] (µg/L)	Trend[a,b,c,d,e,f,g]
83117_C4	6	71.3	99	80.62	9.88	Up, Marginal
83124_C1	12	185	1070	512.50	266.71	No Significant Trend
83124_C2	6	59	103	74.45	17.41	Down, Significant
83124_C4	6	25.4	41.2	33.03	7.68	No Significant Trend
83124_C5	6	24.4	58.7	48.47	12.45	No Significant Trend
83293_C3	6	3.8	62.7	41.75	20.01	No Significant Trend
83293_C4	10	30.1	115	60.05	24.58	Down, Significant
83294_C1	4	98.5	166	128.63	33.61	**Up, Significant**
83294_C2	8	256	575	394.85	109.41	Up, Marginal
83294_C3	8	330	538.8	436.61	79.93	Down, Significant
83294_C4	6	98.5	298.6	206.82	88.92	Down, Significant
83295_C2	8	92.3	178	142.24	30.98	**Up, Significant**
83295_C3	7	128	175	155	15.86	No Significant Trend
83295_C4	7	77.2	199.1	145.41	53.27	Down, Significant
83295_C5	6	78.9	155	104.65	29.71	Down, Marginal
83296_C2	9	41.1	117	71.98	24.94	Down, Significant
83296_C3	7	16.5	75	52.54	22.04	Down, Significant
83296_C4	6	23.6	62.7	43.43	15.09	No Significant Trend
83337_C1	4	371.8	1240	924.75	403.64	No Significant Trend
83337_C2	3	591	835.1	749.43	137.36	No Significant Trend
83337_C3	2	3.7	30.5	17.10	18.95	No Significant Trend
83338_C1	2	454.5	582	518.25	90.16	No Significant Trend
83338_C2	2	310.5	648	479.25	238.65	No Significant Trend
83338_C3	3	20.1	36.2	25.53	9.24	No Significant Trend
83341_C1	1	37	NA	NA	NA	NA
83346_C1	1	45.6	NA	NA	NA	NA
83346_C2	1	31.1	NA	NA	NA	NA

[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 2005 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]NA = not applicable
[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]Mann-Kendall test for trend is performed using data from third quarter 1998 through 2006.

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

Well	No. 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 (August 27, 1993 through December 31, 2006)						
3924	458	1.8	180	33.70	15.23	Down, Significant
3925	457	0.5	84	26.11	7.93	Down, Significant
3926	448	1.5	42.4	25.13	9.17	**Up, Significant**
3927	450	1	17	2.46	1.2	**Up, Significant**
South Plume Optimization Module (August 9, 1998 through December 31, 2006)						
32308	386	18.4	100.1	59.60	13.46	Down, Significant
32309	382	32.7	122.8	62.09	17.15	Down, Significant
South Field Module (July 13, 1998 through December 31, 2006)						
31550	398	28.1	127.9	55,07	19.98	Down, Significant
31560	423	24.4	182.8	70.30	37.34	Down, Significant
31561	398	18.1	114[d]	43.91	9.73	Down, Significant
32276	440	41.1	290.2	120.67	59.54	Down, Significant
32446	298	37.9	168.1	67.84	19.44	Down, Significant
32447	314	55.9	302.3	129.82	49.54	Down, Significant
33061	199	30.8	98.5	50.91	12.65	Down, Significant
33262	149	30.9	79.5	55.41	11.13	Down, Significant
33264	147	48.2	217.3	106.38	29.09	Down, Significant
33265	148	16.5	96.5	26.10	7.55	Down, Significant
33266	145	11.3	53.7	21.40	7.24	Down, Significant
33298	108	36.6	76.2	54.75	7.23	No Significant Trend
33326	55	24.2	45.9	31.07	4.42	Down, Significant
Waste Storage Area Module (May 8, 2002 through December 31, 2006)						
32761	192	38.9	161.2	79.68	30.88	Down, Significant
33062	200	40.1	236.4	90.67	47.72	Down, Significant
33334	18	22.6	50	29.26	7.47	Down, significant
33347	18	30.2	126.5	74.43	26.11	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 13351

Easting '83:	**1346475**	Feet
Northing '83:	**480122.9**	Feet
Ground Elevation:	**550.32**	Feet AMSL
Depth to Water Table:	**33**	Feet bgs
Water Table Elevation:	**517.32**	Feet AMSL
Work Completed:	**10/31/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	512	38	0 feet - 10 feet	23.9	19.2	7.54	7.130	170	6.13
2	502.32	48	10 feet - 20 feet	23.3	16.6	7.66	0.809	566	5.91
3	502.32	48	10 feet - 20 feet	21.5	16.6	7.66	0.809	566	5.91
4	492.32	58	20-feet - 30 feet	36.3	12.1	7.43	0.692	91	5.04
5	482.32	68	30 feet - 40 feet	23.6	12.4	7.56	0.652	999	6.44
6	472.32	78	40 feet - 50 feet	19.9	12.7	7.58	0.621	824	6.58
Rinsate				< 1.0					

Max	19.2	7.66	7.130	999	6.58
Min	12.1	7.43	0.621	91	5.04
Range	7.1	0.23	6.509	908	1.54
Average	14.9	7.57	1.786	536	6.00

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.

Table A.2–5. Geoprobe Location 12367H

Easting '83:	**1347990**	Feet
Northing '83:	**476146**	Feet
Ground Elevation:	**536**	Feet AMSL
Depth to Water Table:	**23**	Feet bgs
Water Table Elevation:	**513**	Feet AMSL
Work Completed:	**10/16/2006**	

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 us/cm	Turb 5-micron NTU	DO 5-micron mg/L
1	508	28	0 feet - 10 feet	8.9	12.9	7.02	0.677	511	4.08
2	498	38	10 feet - 20 feet	15.2	13.3	7.13	0.843	386	4.07
3	498	38	10 feet - 20 feet	15.0	13.3	7.13	0.843	386	4.07
4	488	48	20-feet - 30 feet	10.5	13.4	7.20	0.681	255	4.31
5	478	58	30 feet - 40 feet	7.1	13.0	7.30	0.677	434	4.33
Rinsate				< 1.0					

Max	13.4	7.30	0.843	511	4.33
Min	12.9	7.02	0.677	255	4.07
Range	0.5	0.28	0.166	256	0.26
Average	13.2	7.16	0.744	394	4.17

Table A.2–6. Geoprobe Location 12368H

Easting '83:	**1348470**	Feet
Northing '83:	**476172.4**	Feet
Ground Elevation:	**576.7**	Feet AMSL
Depth to Water Table:	**63**	Feet bgs
Water Table Elevation:	**513.7**	Feet AMSL
Work Completed:	**9/11/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	509	68	0 feet - 10 feet	25.4	17.4	7.44	0.728	NA[b]	5.29
2	498.7	78	10 feet - 20 feet	28.2	20.0	7.63	0.698	958	7.44
3	488.7	88	20 feet - 30 feet	11.6	17.4	7.80	0.603	489	6.29
4	488.7	88	20-feet - 30 feet	11.7	17.4	7.80	0.603	489	6.29
5	478.7	98	30 feet - 40 feet	15.2	19.0	7.80	0.660	999	6.92
6	468.7	108	40 feet - 50 feet	14.0	17.3	7.47	0.825	999	6.36
Rinsate				< 1.0					

Max	20.0	7.80	0.825	999	7.44
Min	17.3	7.44	0.603	489	5.29
Range	2.7	0.36	0.222	510	2.15
Average	18.1	7.66	0.686	787	6.43

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.
[b] Turbidity reading not taken.

Table A.2–7. Geoprobe Location 12372L

Easting '83:	**1348559**	Feet
Northing '83:	**476215.8**	Feet
Ground Elevation:	**576.528**	Feet AMSL
Depth to Water Table:	**64**	Feet bgs
Water Table Elevation:	**512.528**	Feet AMSL
Work Completed:	**10/10/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	508	69	0 feet - 10 feet	21.8	16.7	7.23	0.951	379	5.91
2	497.528	79	10 feet - 20 feet	7.8	16.1	7.67	0.678	338	5.33
3	497.528	79	10 feet - 20 feet	7.9	16.1	7.67	0.678	338	5.33
4	487.528	89	20-feet - 30 feet	7.9	17.9	7.57	0.804	999	5.83
5	477.528	99	30 feet - 40 feet	8.7	16.3	7.69	0.637	798	5.52
Rinsate				< 1.0					

Max	17.9	7.69	0.951	999	5.91
Min	16.1	7.23	0.637	338	5.33
Range	1.8	0.46	0.314	661	0.58
Average	16.6	7.57	0.750	570	5.58

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.

Table A.2–8. Geoprobe Location 12373L

Easting '83:	**1349024.582**	Feet
Northing '83:	**576240.519**	Feet
Ground Elevation:	**564.547**	Feet AMSL
Depth to Water Table:	**52**	Feet bgs
Water Table Elevation:	**512.547**	Feet AMSL
Work Completed:	**10/17/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	508	57	0 feet - 10 feet	32.1	17.1	7.47	0.727	137	6.04
2	497.547	67	10 feet - 20 feet	9.5	17.2	7.77	0.692	999	6.56
3	497.547	67	10 feet - 20 feet	11.4	17.2	7.77	0.692	999	6.56
4	487.547	77	20-feet - 30 feet	10.4	16.8	7.77	0.720	999	5.66
5	477.547	87	30 feet - 40 feet	6.4	16.8	7.65	0.728	999	5.54
6	467.547	97	40 feet - 50 feet	7.0	16.7	7.57	0.724	999	5.83
7	457.547	107	50 feet - 60 feet	9.4	16.6	7.45	0.722	999	5.76
Rinsate				< 1.0					

* Borehole moved approx. 30 feet north and 2 feet lower than posted coordinates.

Max	17.2	7.77	0.728	999	6.56
Min	16.6	7.45	0.692	137	5.54
Range	0.6	0.32	0.036	862	1.02
Average	16.9	7.64	0.715	876	5.99

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.

Table A.2–9. Geoprobe Location 13226B

Easting '83:	**1348198.48**	Feet
Northing '83:	**475958.18**	Feet
Ground Elevation:	**539.18**	Feet AMSL
Depth to Water Table:	**24**	Feet bgs
Water Table Elevation:	**515.18**	Feet AMSL
Work Completed:	**12/18/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	510	29	0 feet - 10 feet	29.7	12.8	6.80	1.030	527	6.12
2	500.18	39	10 feet - 20 feet	7.7	13.3	7.15	0.725	383	4.97
3	500.18	39	10 feet - 20 feet	8.0	13.3	7.15	0.725	383	4.97
4	490.18	49	20-feet - 30 feet	4.1	13.5	7.10	0.666	863	4.94
5	480.18	59	30 feet - 40 feet	5.1	12.9	7.04	0.688	648	4.99
6	470.18	69	40 feet - 50 feet	1.9	13.3	6.92	0.752	666	3.78
Rinsate				< 1.0					
				Max	13.5	7.15	1.030	863	6.12
				Min	12.8	6.80	0.666	383	3.78
				Range	0.7	0.35	0.364	480	2.34
				Average	13.2	7.03	0.764	578	4.96

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.

Table A.2–10. Geoprobe Location 13235A

Easting '83:	**1348047.97**	Feet
Northing '83:	**475816.03**	Feet
Ground Elevation:	**536.2**	Feet AMSL
Depth to Water Table:	**21**	Feet bgs
Water Table Elevation:	**515.2**	Feet AMSL
Work Completed:	**12/19/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	510	26	0 feet - 10 feet	31.5	12.2	6.69	0.705	737	6.02
2	500.2	36	10 feet - 20 feet	9.8	11.6	6.95	0.668	695	5.55
3	500.2	36	10 feet - 20 feet	9.6	10.9	7.06	0.622	999	6.25
4	490.2	46	20-feet - 30 feet	7.2	10.9	7.06	0.622	999	6.25
5	480.2	56	30 feet - 40 feet	5.5	10.7	7.08	0.638	410	5.71
6	470.2	66	40 feet - 50 feet	3.1	10.5	7.20	0.612	423	5.21
Rinsate				< 1.0					
				Max	12.2	7.20	0.705	999	6.25
				Min	10.5	6.69	0.612	410	5.21
				Range	1.7	0.51	0.093	589	1.04
				Average	11.1	7.01	0.645	711	5.83

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.

Table A.2–11. Geoprobe Location 13355

Easting '83:	**1348975**	Feet
Northing '83:	**477354**	Feet
Ground Elevation:	**567.165**	Feet AMSL
Depth to Water Table:	**56**	Feet bgs
Water Table Elevation:	**511.165**	Feet AMSL
Work Completed:	**10/23/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	506	61	0 feet - 10 feet	79.3	8.9	7.37	0.966	325	7.74
2	496.165	71	10 feet - 20 feet	39.4	10.0	7.18	0.782	537	7.56
3	496.165	71	10 feet - 20 feet	39.1	10.0	7.18	0.782	537	7.56
4	486.165	81	20-feet - 30 feet	10.4	9.6	7.44	0.699	999	7.47
5	476.165	91	30 feet - 40 feet [b]						
6	466.165	101	40 feet - 50 feet	1.7	10.1	7.20	0.657	533	7.41
7	456.165	111	50 feet - 60 feet	< 1.0	9.9	7.24	0.658	625	6.37
Rinsate				< 1.0					

Max	10.1	7.44	0.966	999	7.74
Min	8.9	7.18	0.657	325	6.37
Range	1.2	0.26	0.309	674	1.37
Average	9.8	7.27	0.757	593	7.35

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.
[b] Sample from 30-40 feet not collected

Table A.2–12. Geoprobe Location 13356

Easting '83:	**1349685.76**	Feet
Northing '83:	**476445.76**	Feet
Ground Elevation:	**580.99**	Feet AMSL
Depth to Water Table:	**67**	Feet bgs
Water Table Elevation:	**513.99**	Feet AMSL
Work Completed:	**11/21/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	509	72	0 feet - 10 feet	30.7	12.5	7.43	0.821	247	5.53
2	498.99	82	10 feet - 20 feet	56.3	12.7	7.38	0.833	999	5.03
3	498.99	82	10 feet - 20 feet	45.6	12.7	7.38	0.833	999	5.03
4	488.99	92	20-feet - 30 feet	18.8	12.7	7.41	0.784	244	4.34
5	478.99	102	30 feet - 40 feet	5.8	13.1	7.28	0.774	999	5.55
6	468.99	112	40 feet - 50 feet	1.5	12.5	7.36	0.764	999	5.92
7	458.99	122	50 feet - 60 feet	1.6	13.6	7.42	0.758	999	5.10
Rinsate				< 1.0					

Max	13.6	7.43	0.833	999	5.92
Min	12.5	7.28	0.758	244	4.34
Range	1.1	0.15	0.075	755	1.58
Average	12.8	7.38	0.795	784	5.21

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.

Table A.2–13. Geoprobe Location 13358

Easting '83:	**1348216**	Feet
Northing '83:	**476772.8**	Feet
Ground Elevation:	**528.8**	Feet AMSL
Depth to Water Table:	**15**	Feet bgs
Water Table Elevation:	**513.8**	Feet AMSL
Work Completed:	**10/25/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	509	20	0 feet - 10 feet	9.0	14.9	7.48	1.080	999	5.29
2	498.8	30	10 feet - 20 feet	5.9	12.1	7.57	1.050	655	6.01
3	498.8	30	10 feet - 20 feet	5.9	12.1	7.57	1.050	655	6.01
4	488.8	40	20-feet - 30 feet	4.9	14.7	7.49	1.050	576	4.67
5	478.8	50	30 feet - 40 feet	3.2	12.6	7.40	0.840	479	4.85
6	468.8	60	40 feet - 50 feet	9.0	11.5	7.37	0.656	731	6.41
7	458.8	70	50 feet - 60 feet	9.6	13.3	7.33	0.666	929	6.33
Rinsate				1.5					

Max	14.9	7.57	1.080	999	6.41
Min	11.5	7.33	0.656	479	4.67
Range	3.4	0.24	0.424	520	1.74
Average	13.0	7.46	0.913	718	5.65

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.

Table A.2–14. Geoprobe Location 13359

Easting '83:	**1347883**	Feet
Northing '83:	**475449**	Feet
Ground Elevation:	**532.62**	Feet AMSL
Depth to Water Table:	**18**	Feet bgs
Water Table Elevation:	**514.62**	Feet AMSL
Work Completed:	**12/14/2006**	

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 us/cm	Turb[a] 5-micron NTU	DO 5-micron mg/L
1	510	23	0 feet - 10 feet	17.2	12.1	7.35	0.708	109	6.55
2	499.62	33	10 feet - 20 feet	9.6	11.7	7.55	0.687	646	4.50
3	499.62	33	10 feet - 20 feet	9.4	11.7	7.55	0.687	646	4.50
4	489.62	43	20-feet - 30 feet	4.6	11.6	7.57	0.657	999	5.60
5	479.62	53	30 feet - 40 feet	5.4	11.3	7.60	0.591	673	4.44
6	469.62	63	40 feet - 50 feet	6.4	11.4	7.55	0.615	583	6.53
Rinsate				< 1.0					
				Max	12.1	7.60	0.708	999	6.55
				Min	11.3	7.35	0.591	109	4.44
				Range	0.8	0.25	0.117	890	2.11
				Average	11.6	7.53	0.658	609	5.35

[a] Turbidity reading of 999 NTU is the maximum possible for the meter used.

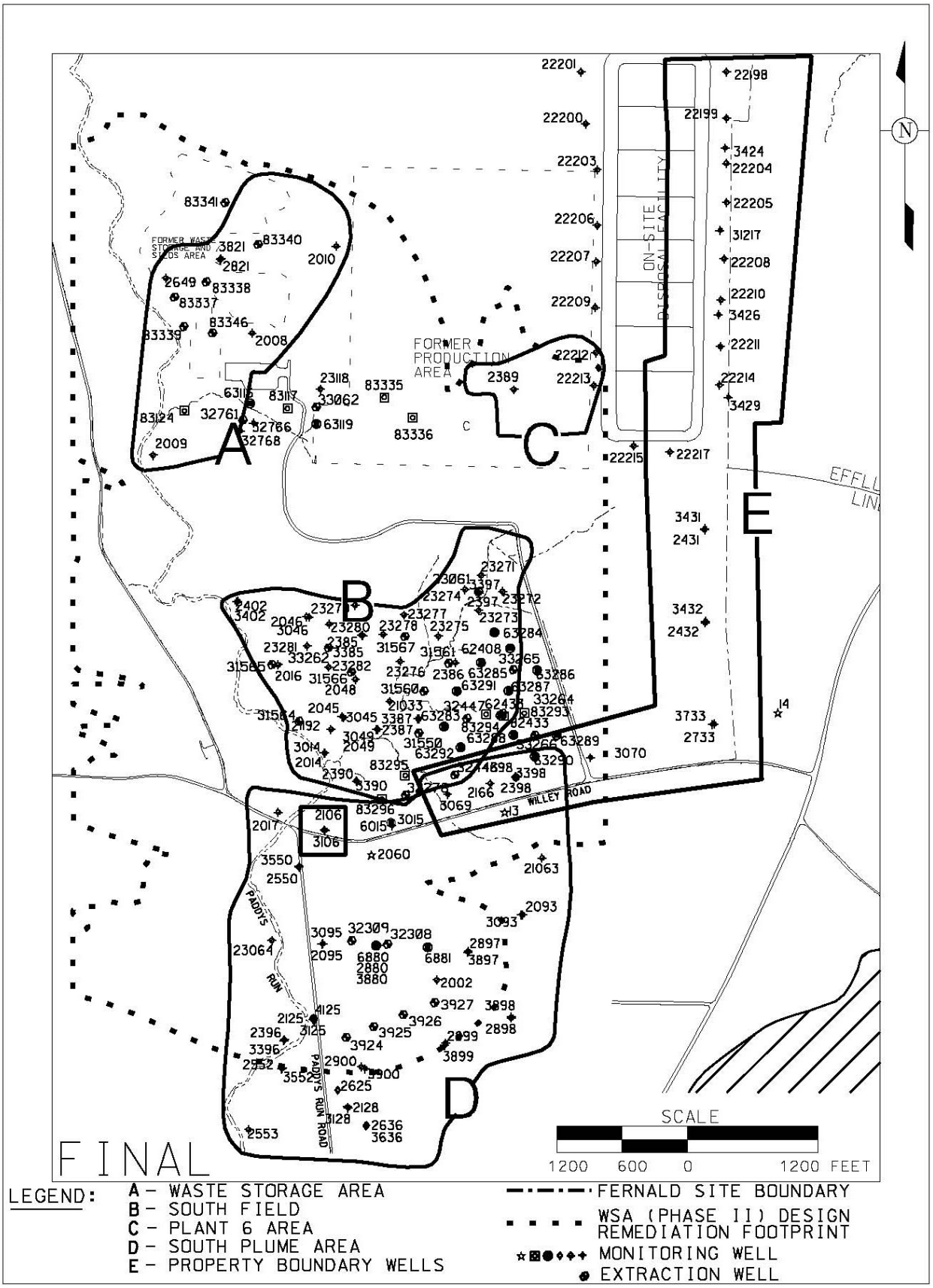

Figure A.2–1. IEMP Water Quality Monitoring Wells and Extraction Wells

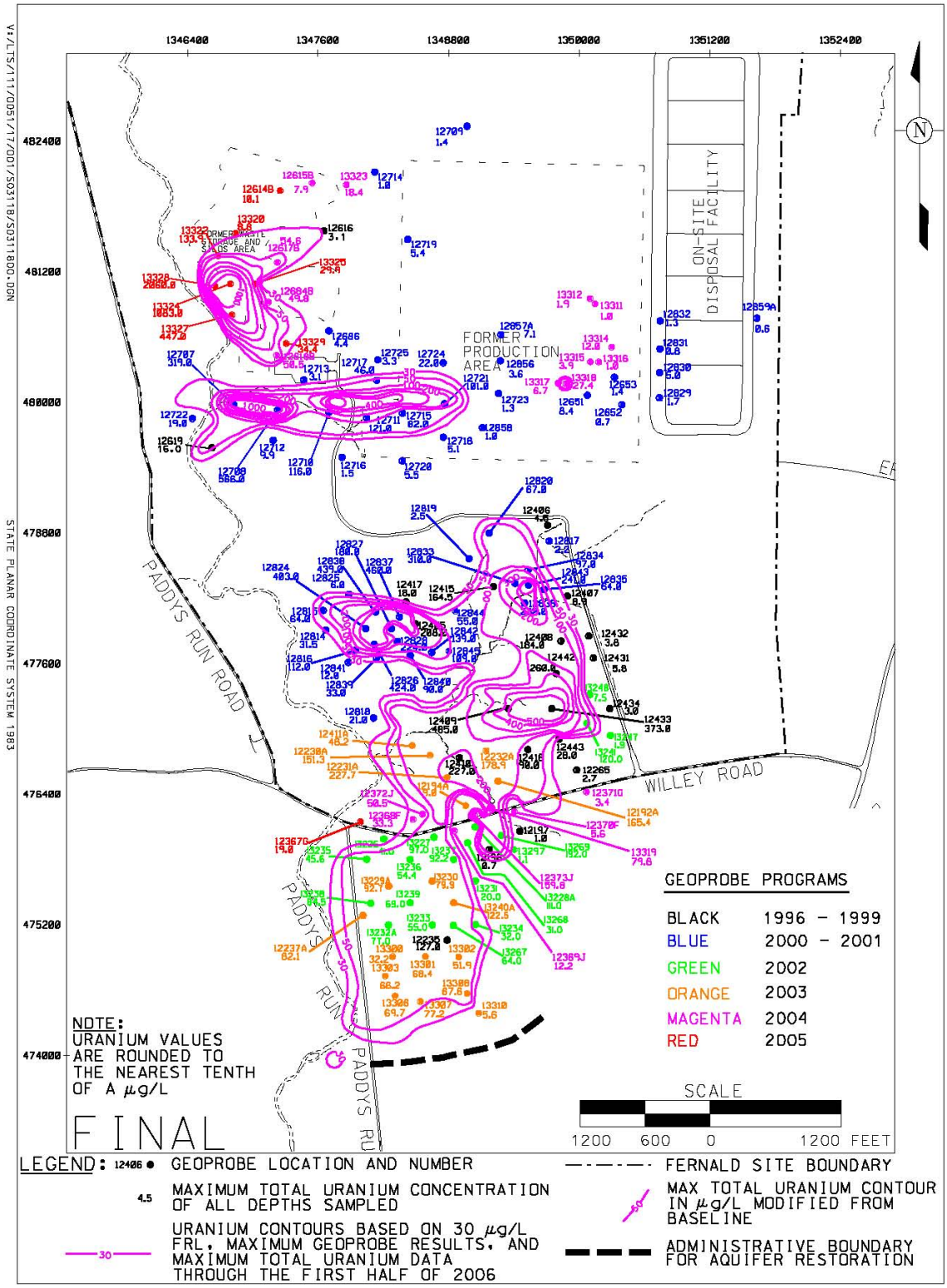

Figure A.2–2A. Direct-Push Data and Maximum Total Uranium Plume Through the First Half of 2006

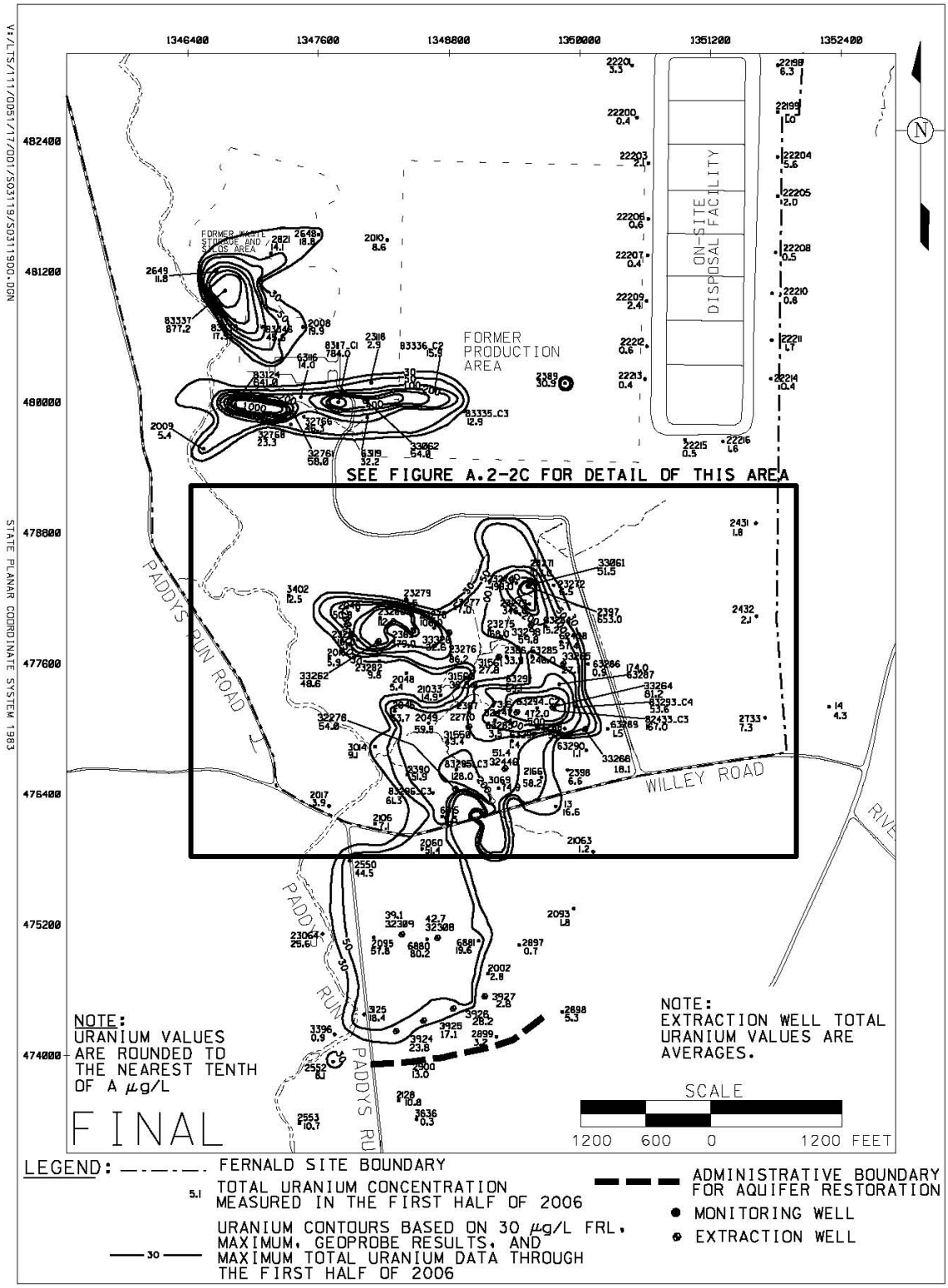

Figure A.2−2B. Monitoring Well Data and Maximum Total Uranium Plume Through the First Half of 2006

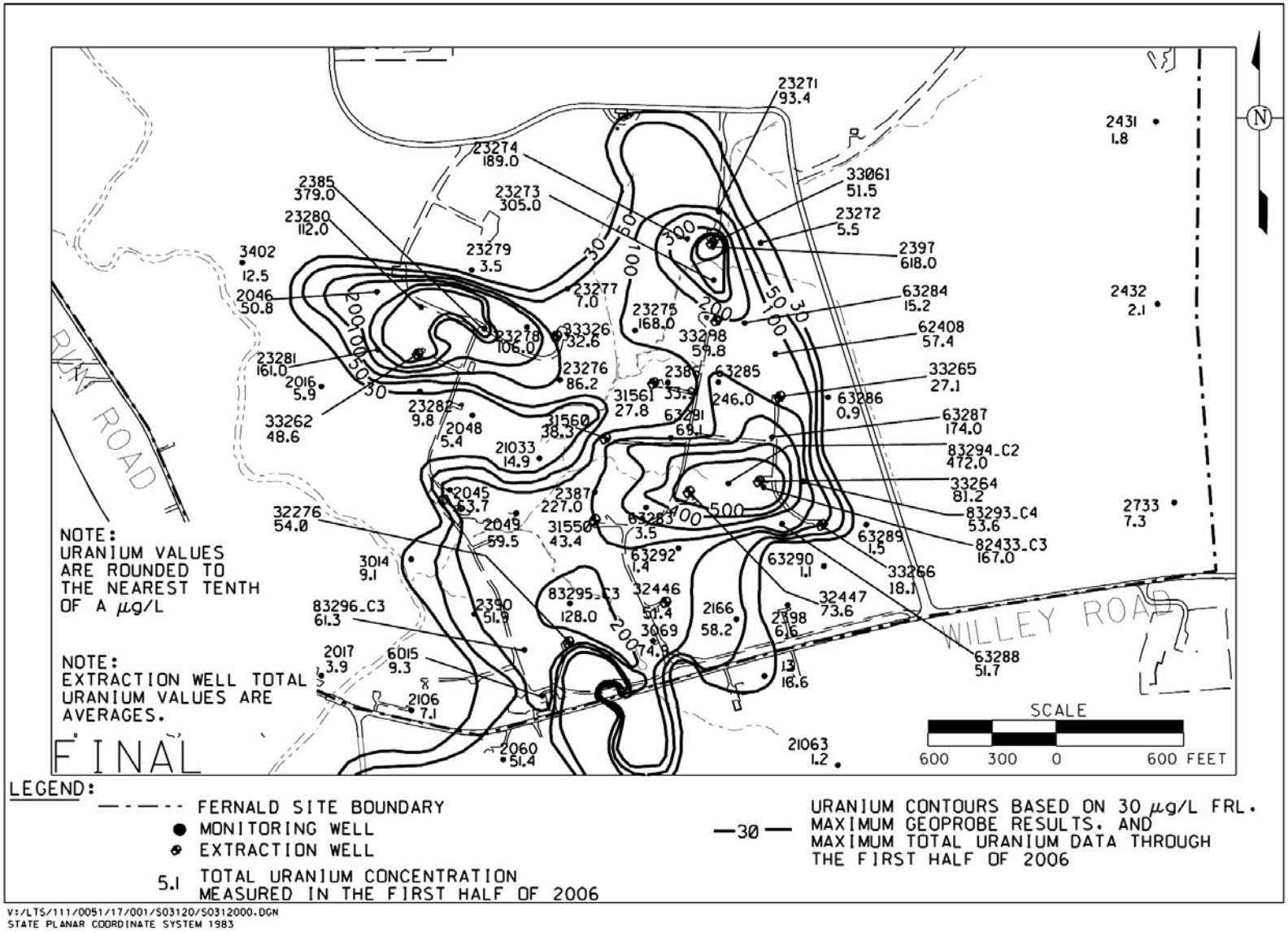

Figure A.2−2C. Monitoring Well Data and Maximum Total Uranium Plume South Field Through the First Half of 2006

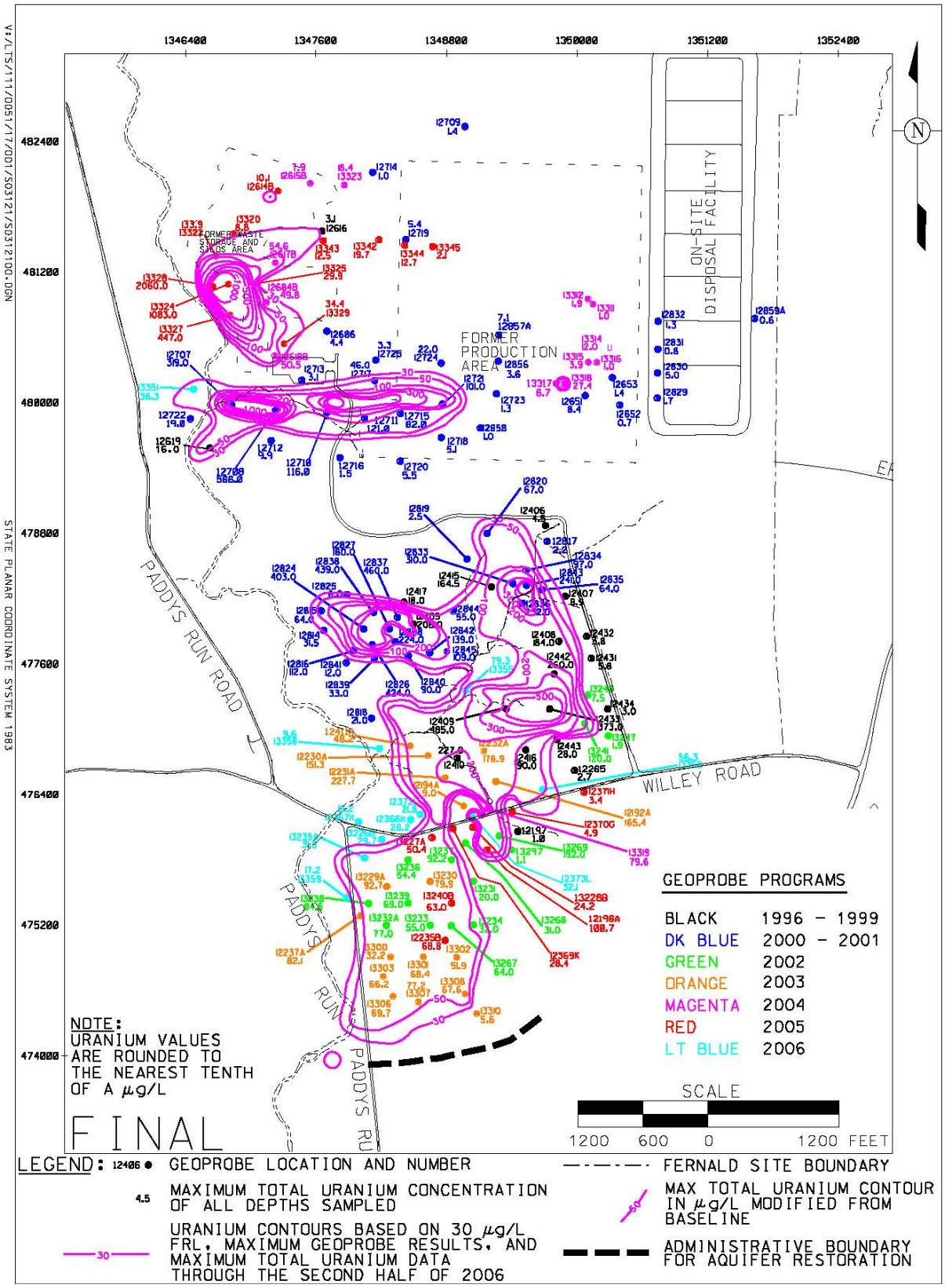

Figure A.2–3A. Direct-Push Data and Maximum Total Uranium Plume Through the Second Half of 2006

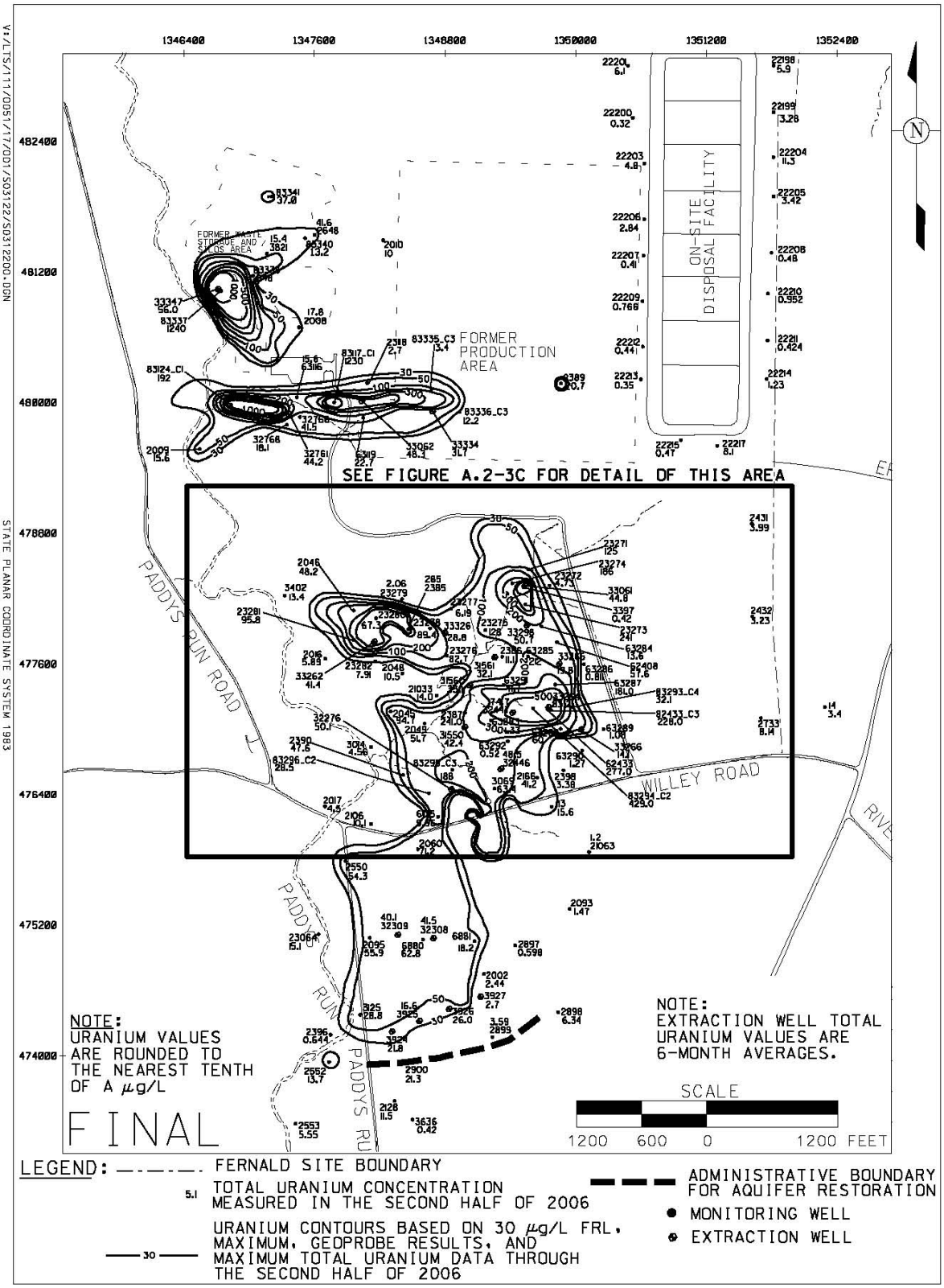

Figure A.2−3B. Monitoring Well Data and Maximum Total Uranium Plume Through the Second Half of 2006

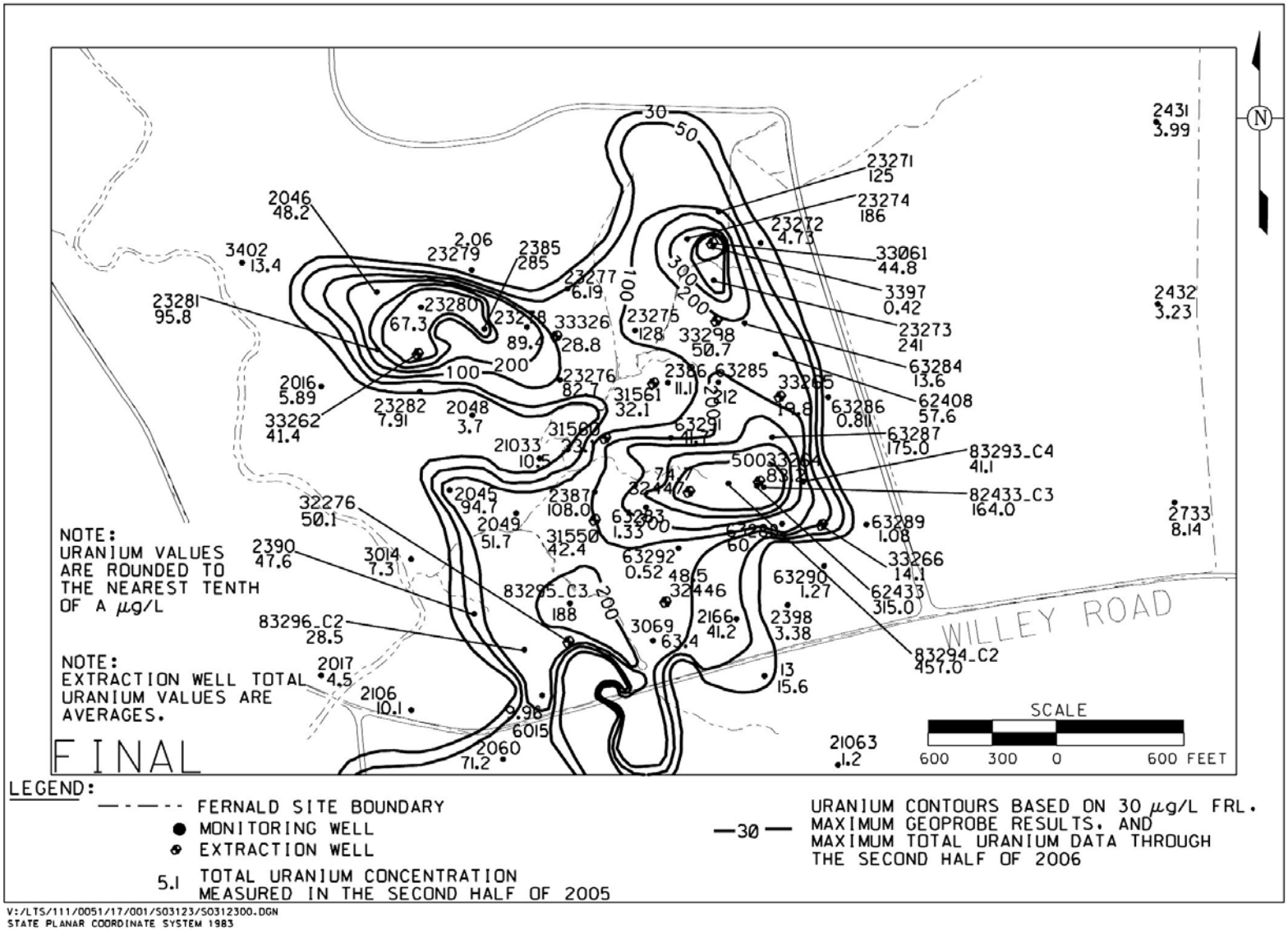

Figure A.2−3C. Monitoring Well Data and Maximum Total Uranium Plume Through the Second Half of 2006

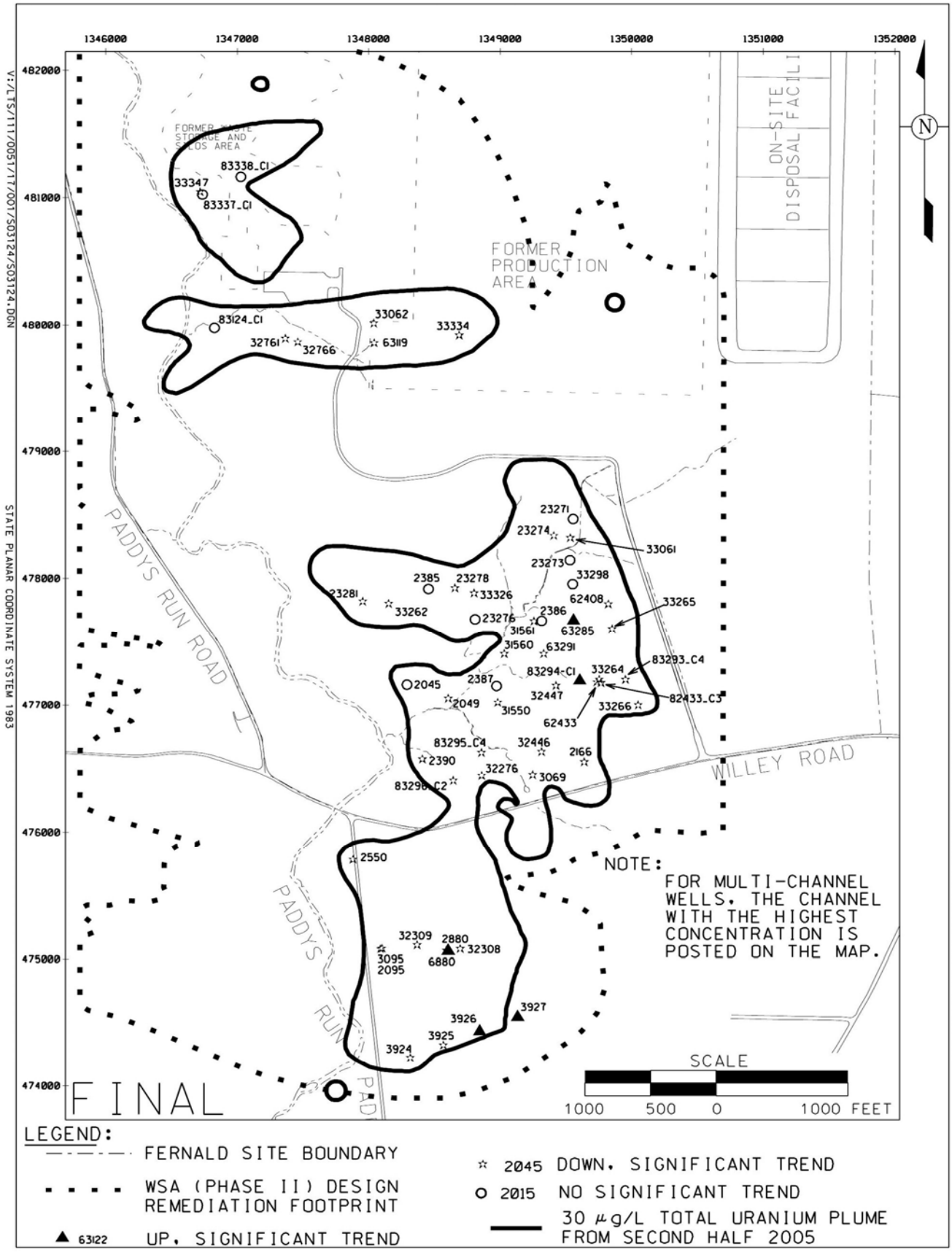

Figure A.2−4. Wells with 2006 FRL Exceedances for Total Uranium with Up, Down, or no Significant Trends

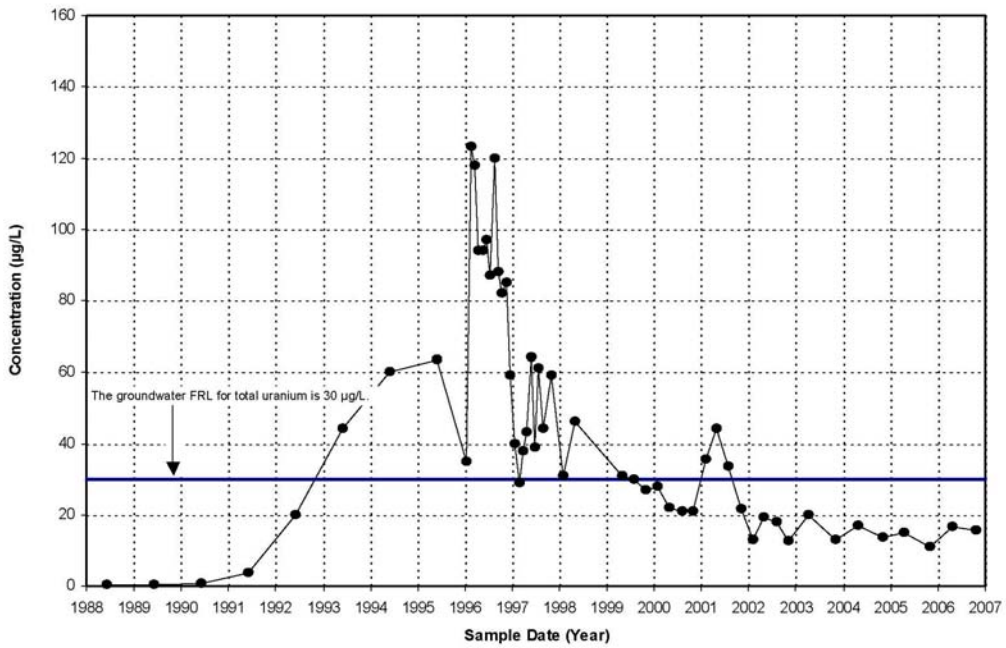

FIGURE A.2-5. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 13

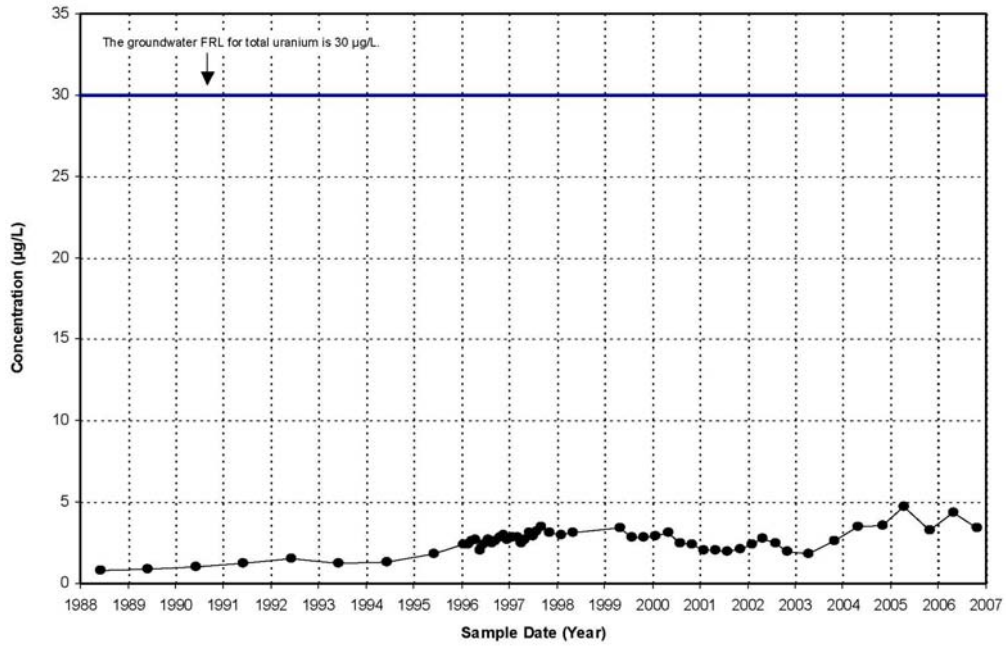

FIGURE A.2-6. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 14

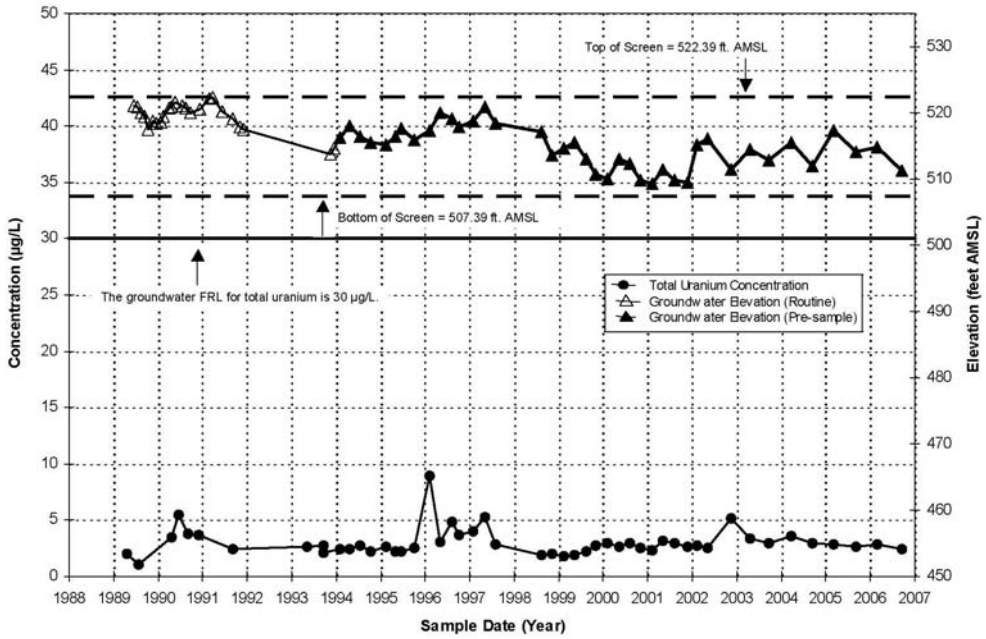

FIGURE A.2-7. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2002

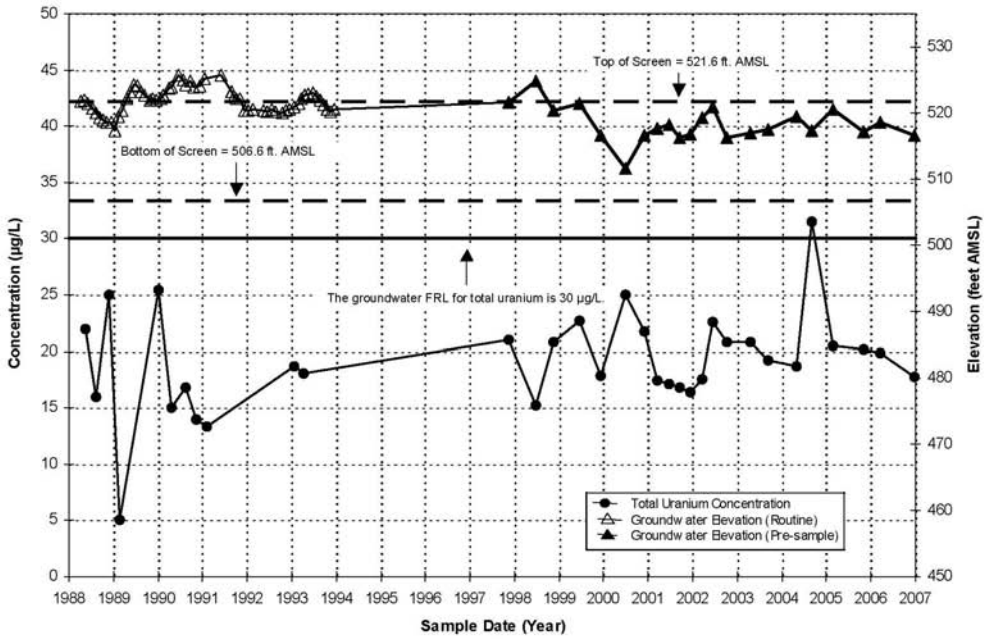

FIGURE A.2-8. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2008

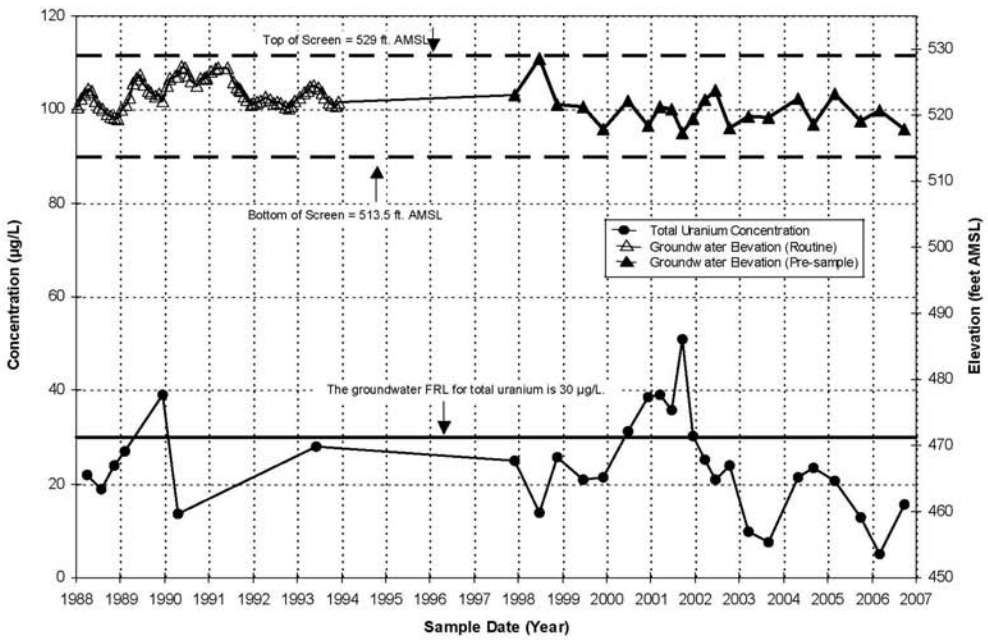

FIGURE A.2-9. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2009

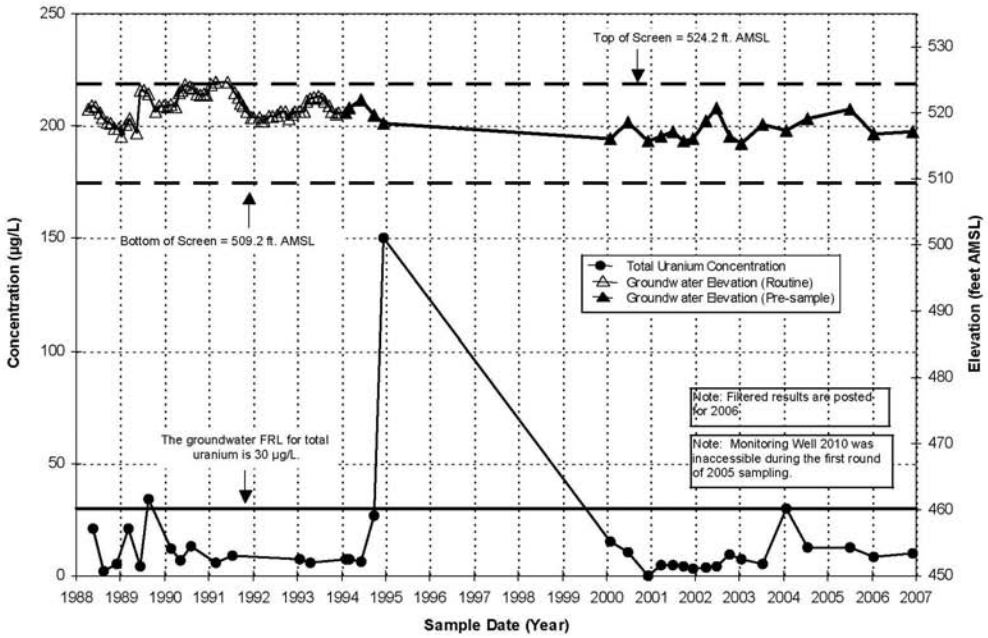

FIGURE A.2-10. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2010

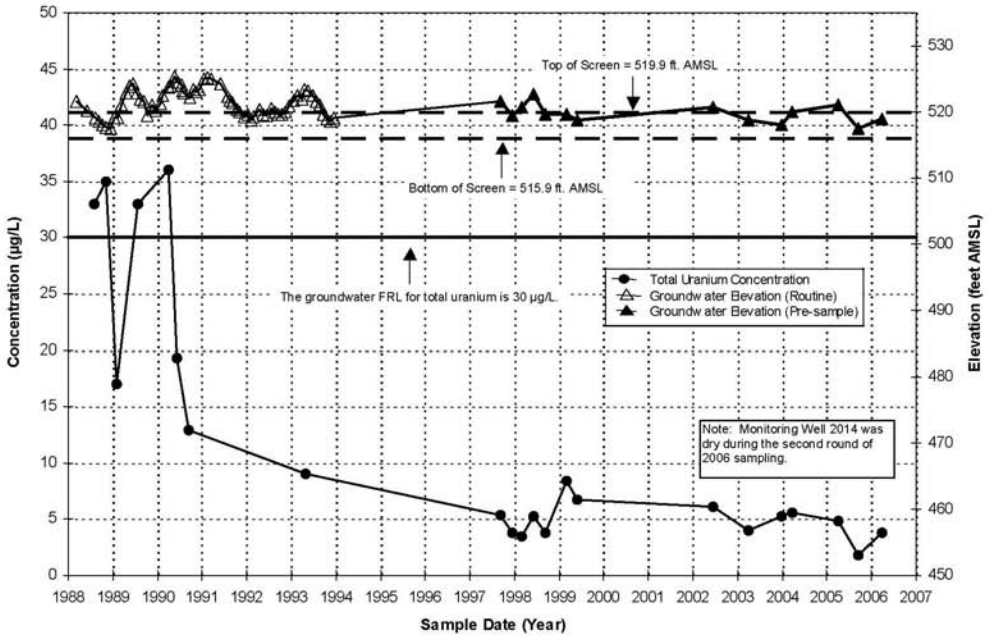

FIGURE A.2-11. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2014

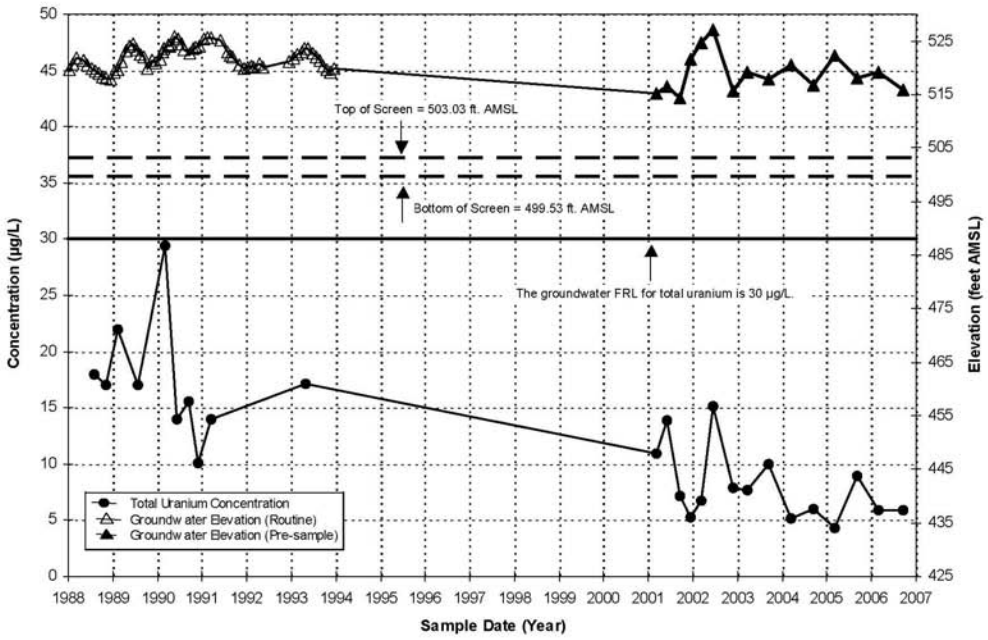

FIGURE A.2-12. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2016

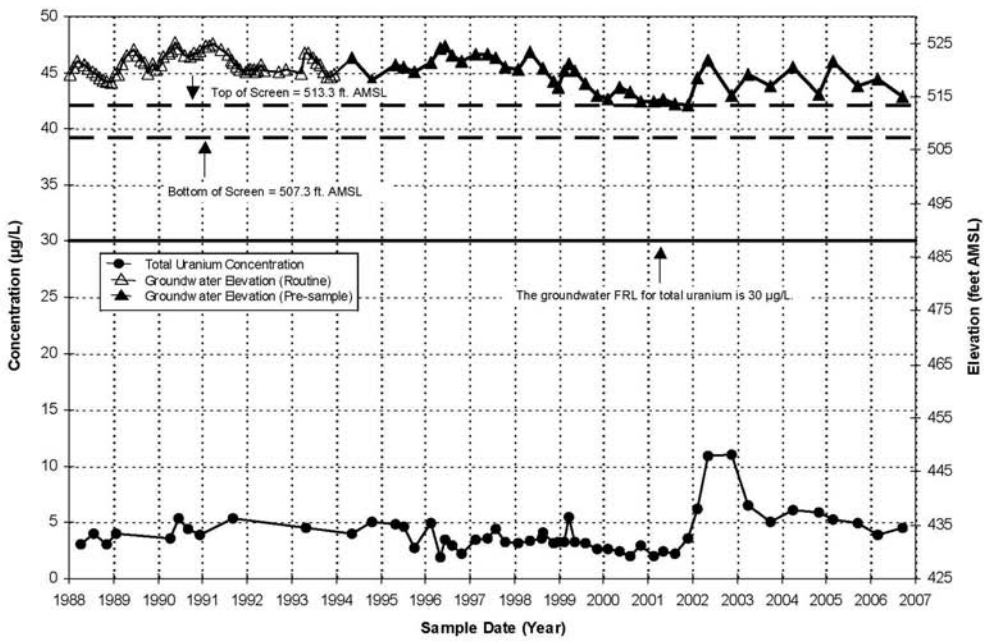

FIGURE A.2-13. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2017

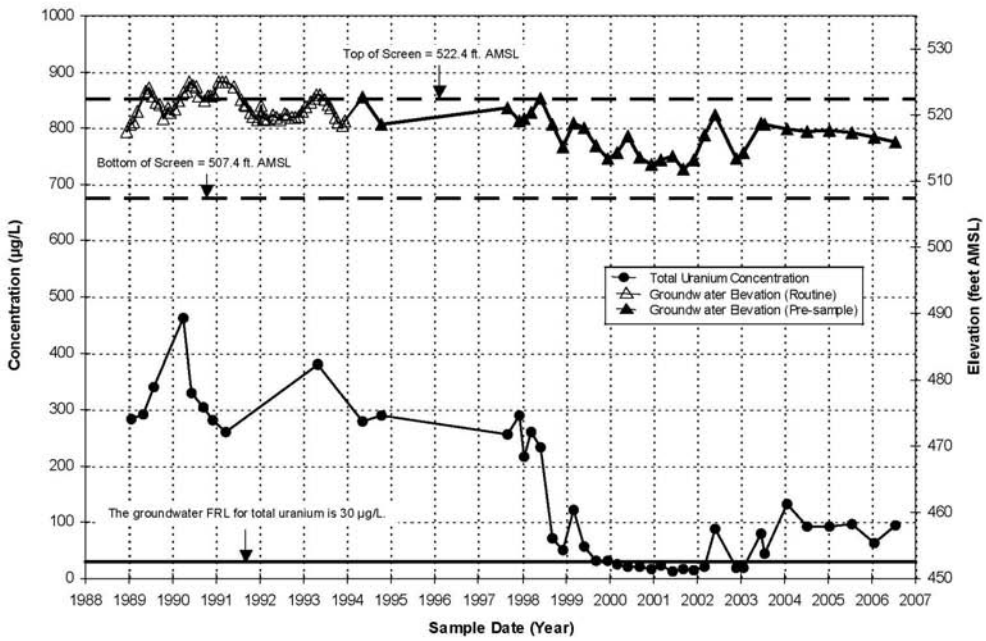

FIGURE A.2-14. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2045

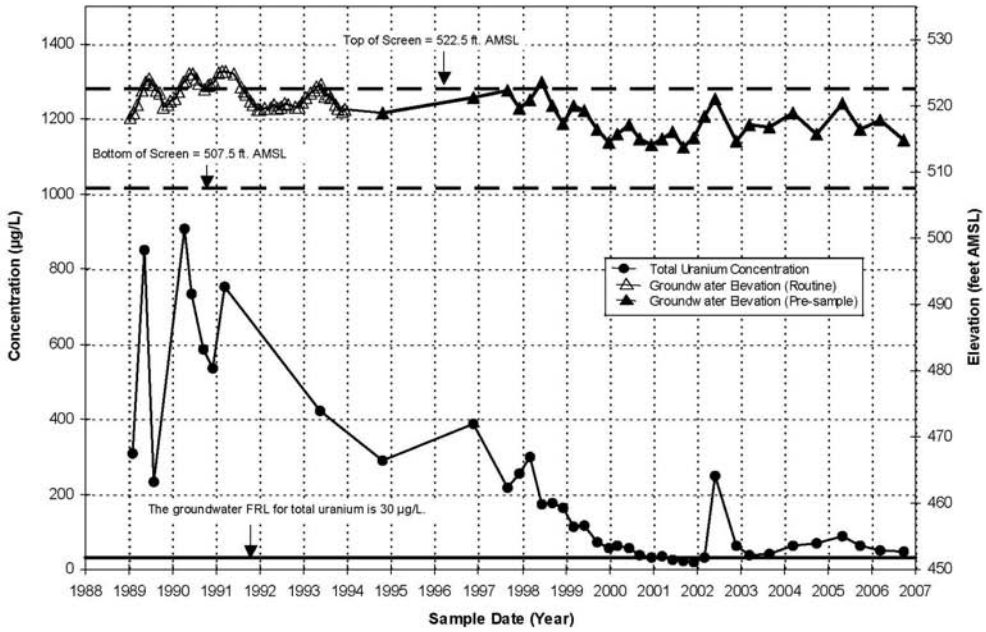

FIGURE A.2-15. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2046

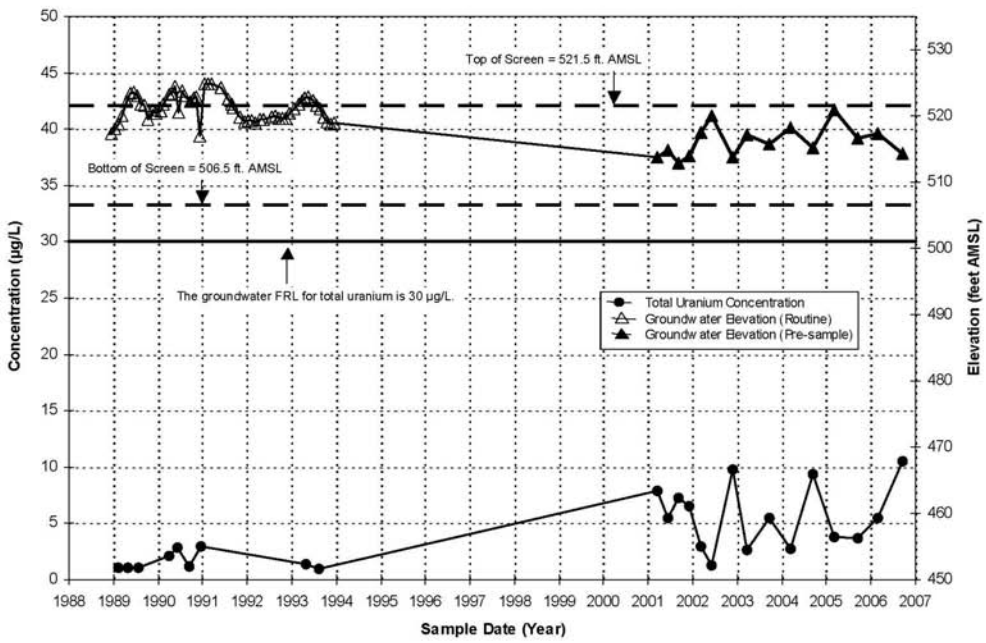

FIGURE A.2-16. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2048

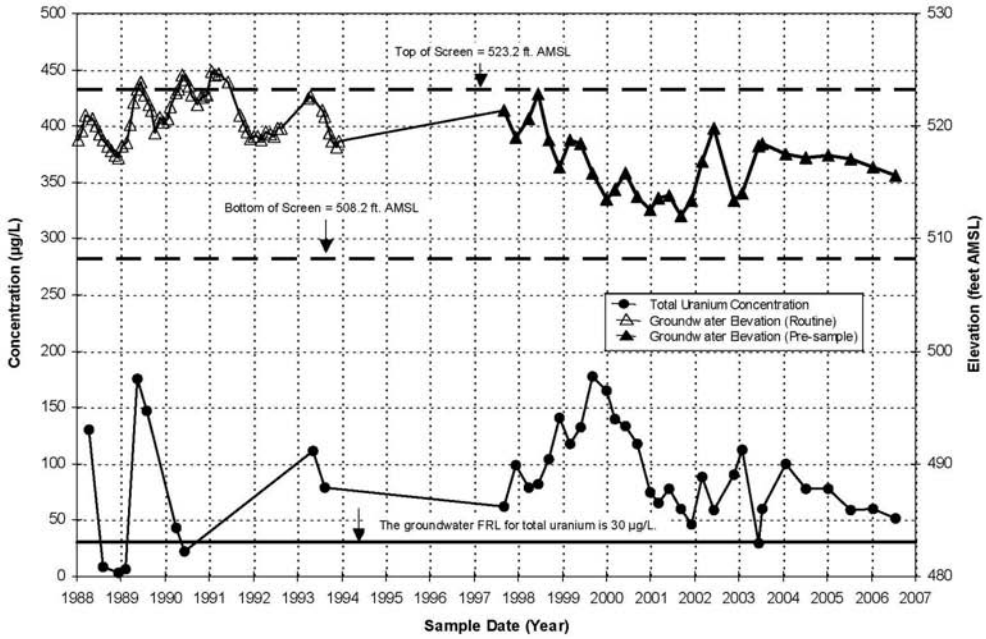

FIGURE A.2-17. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2049

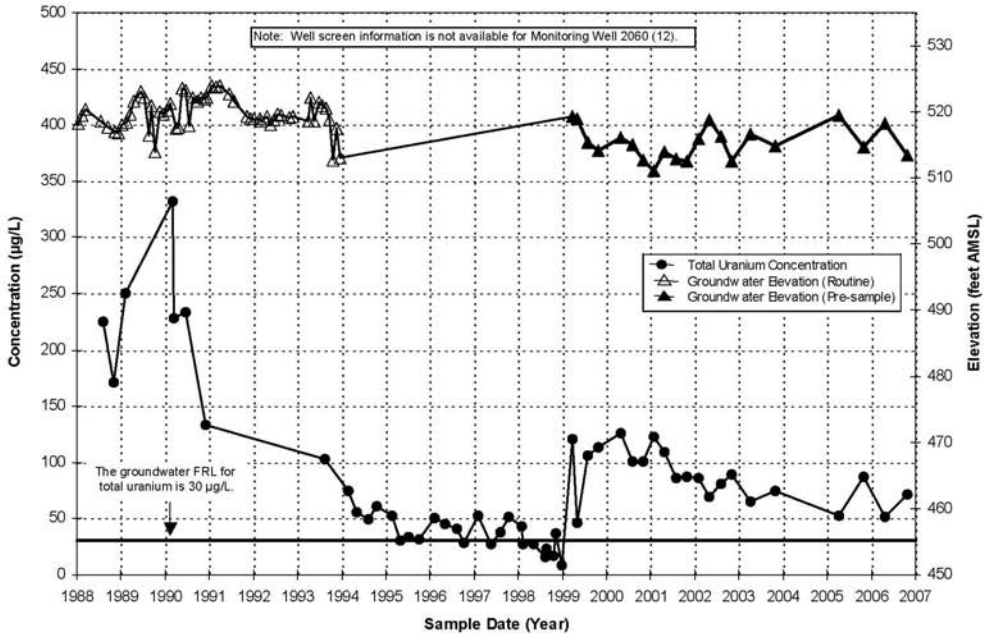

FIGURE A.2-18. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2060 (12)

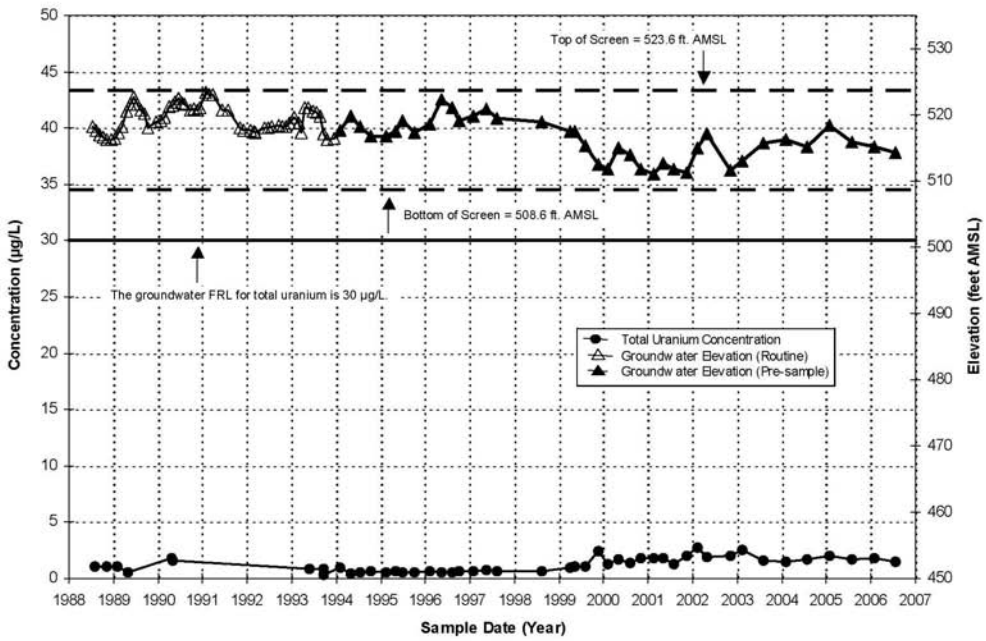

FIGURE A.2-19. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2093

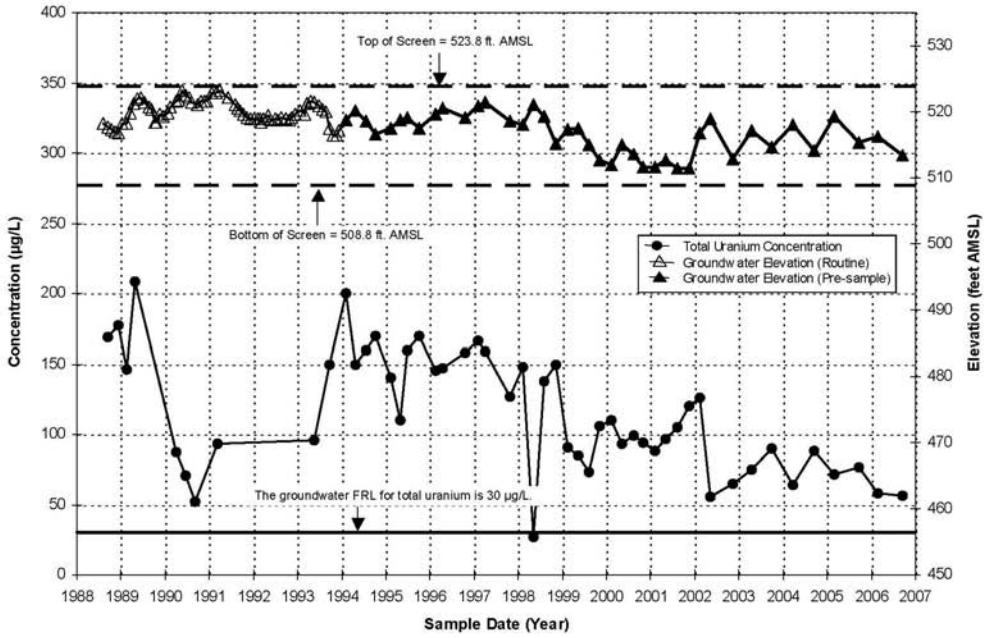

FIGURE A.2-20. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2095

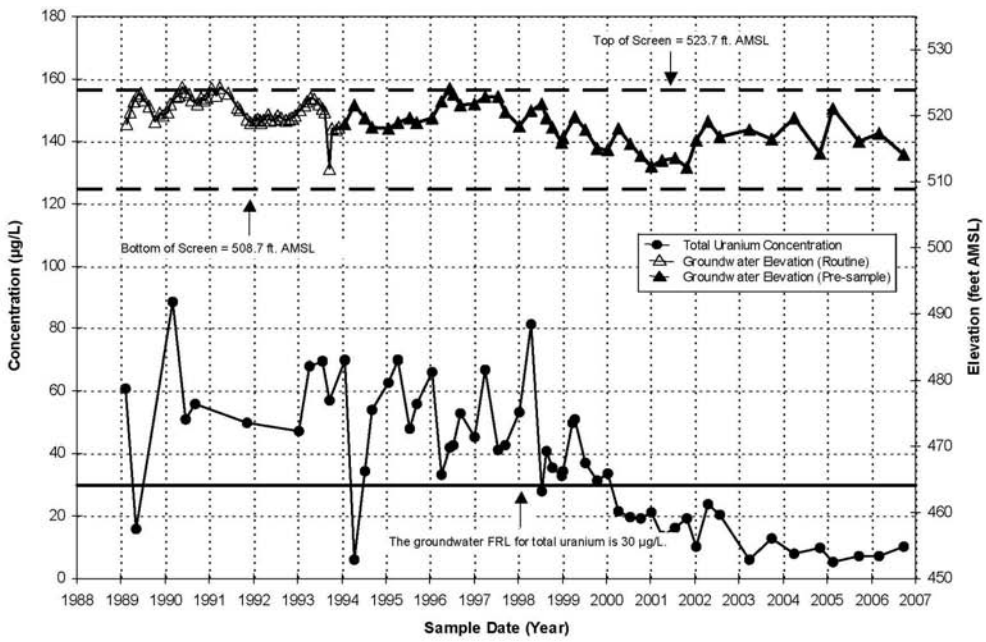

FIGURE A.2-21. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2106

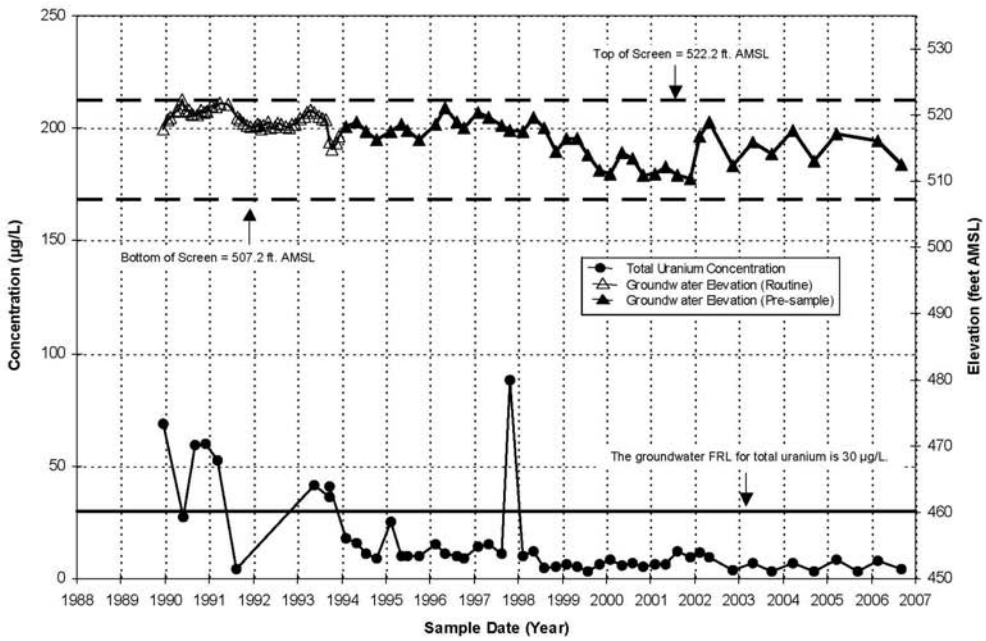

FIGURE A.2-22. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2125

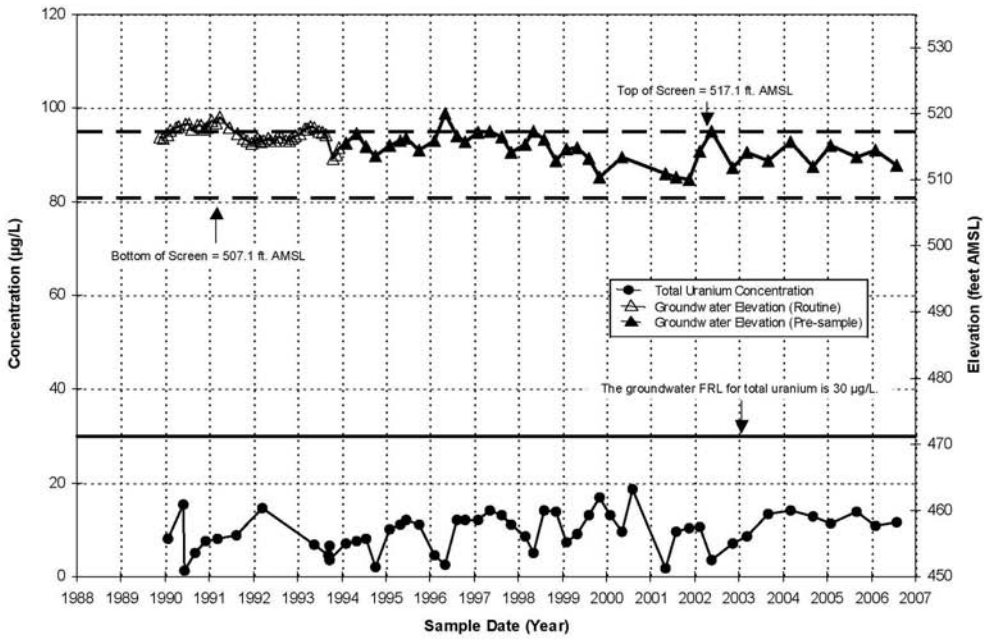

FIGURE A.2-23. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2128

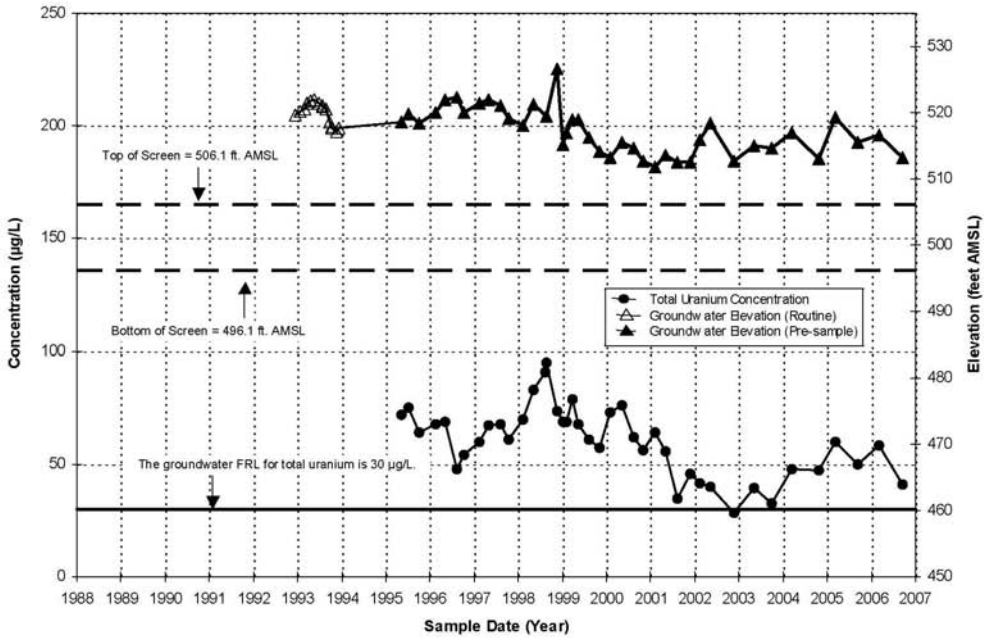

FIGURE A.2-24. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2166

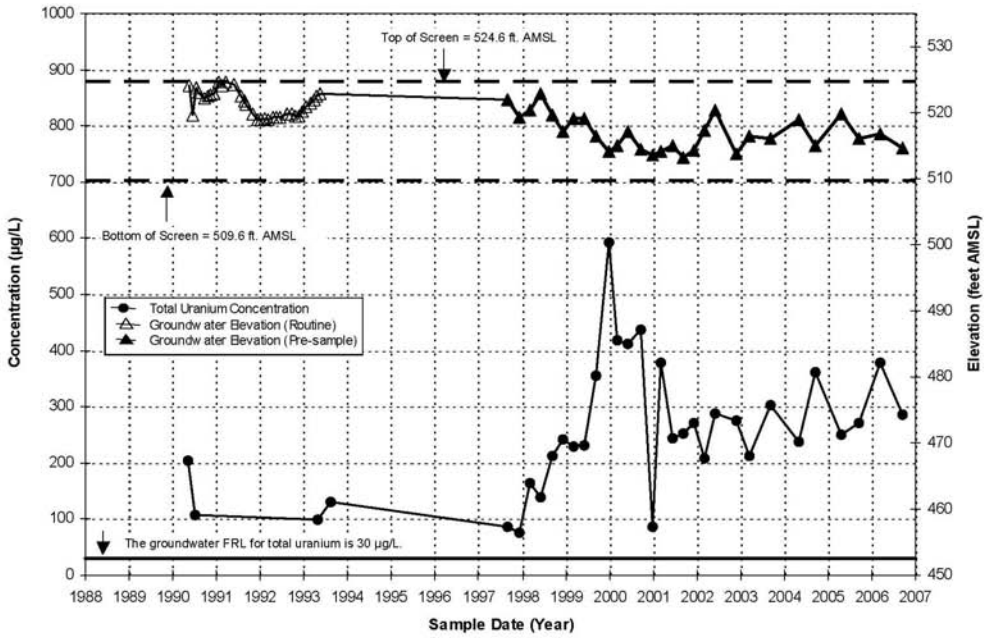

FIGURE A.2-25. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2385

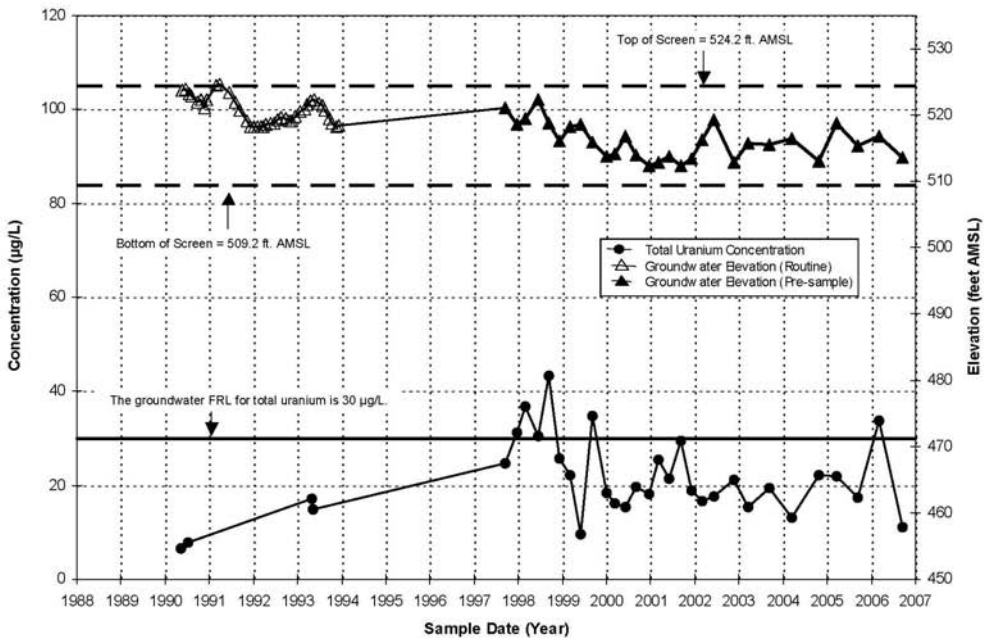

FIGURE A.2-26. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2386

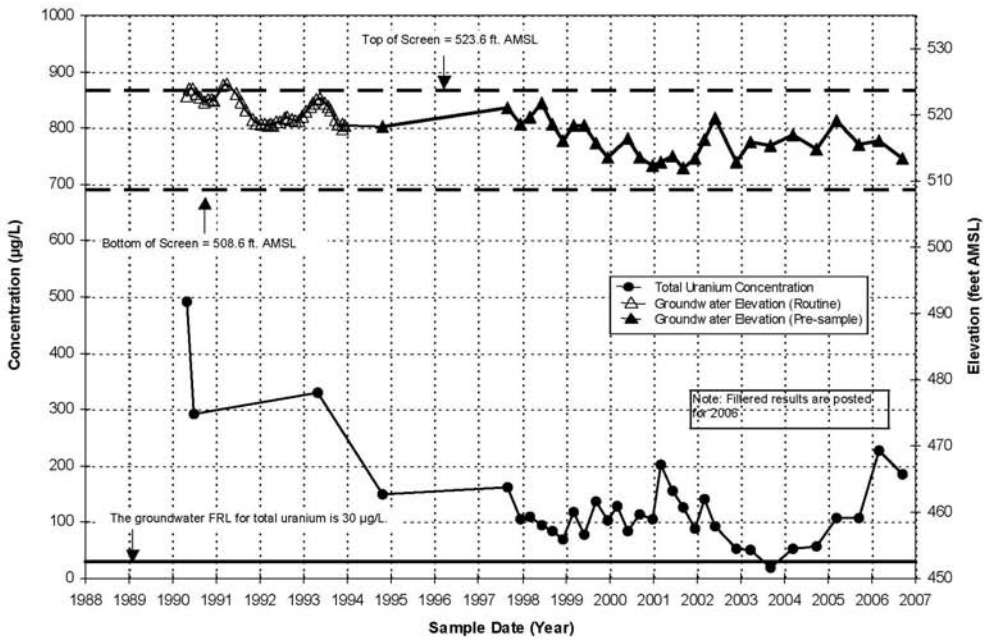

FIGURE A.2-27. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2387

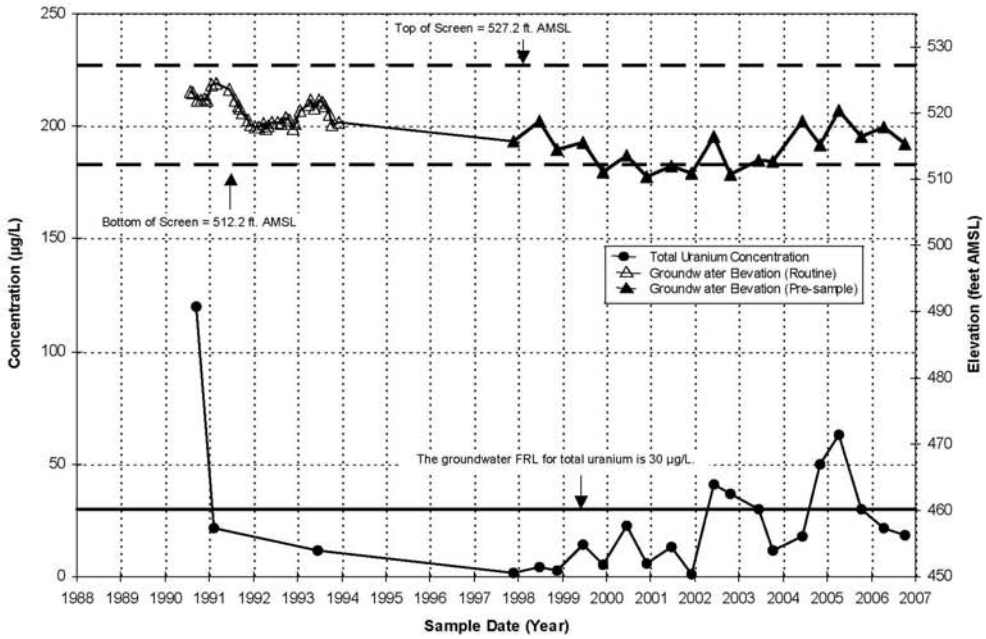

FIGURE A.2-28. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2389

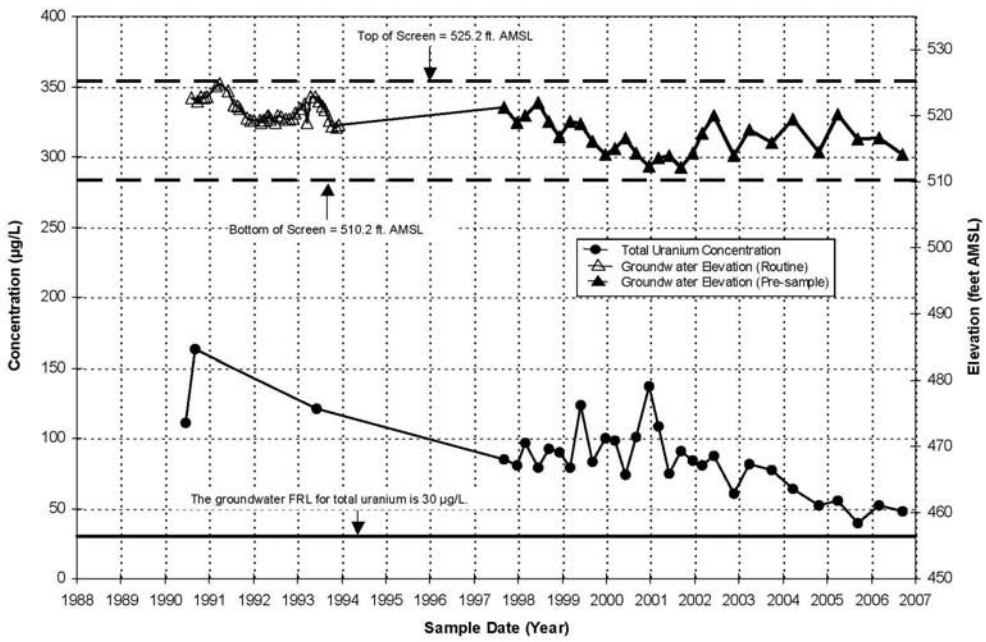

FIGURE A.2-29. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2390

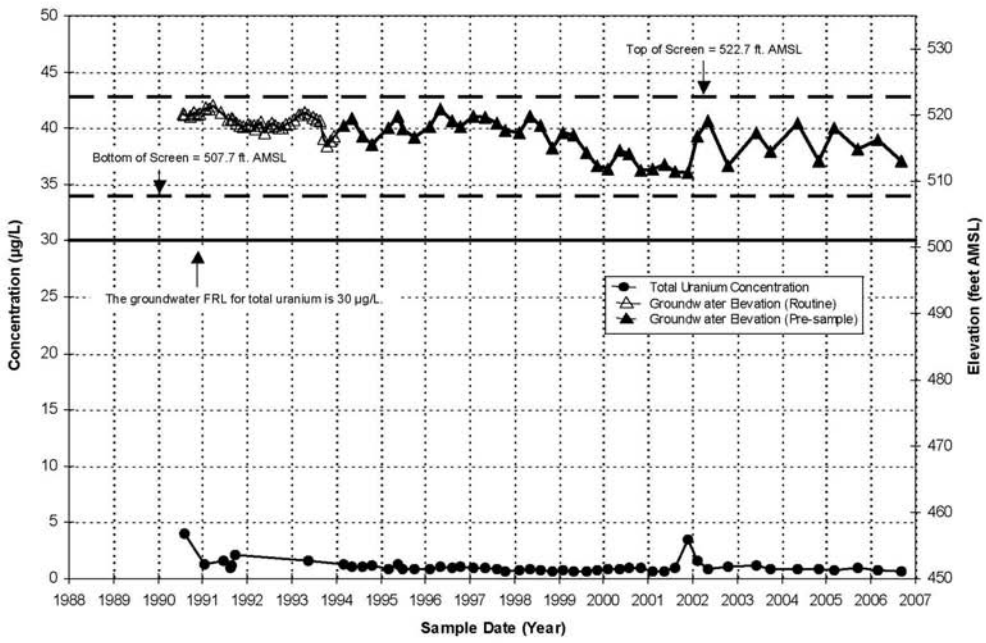

FIGURE A.2-30. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2396

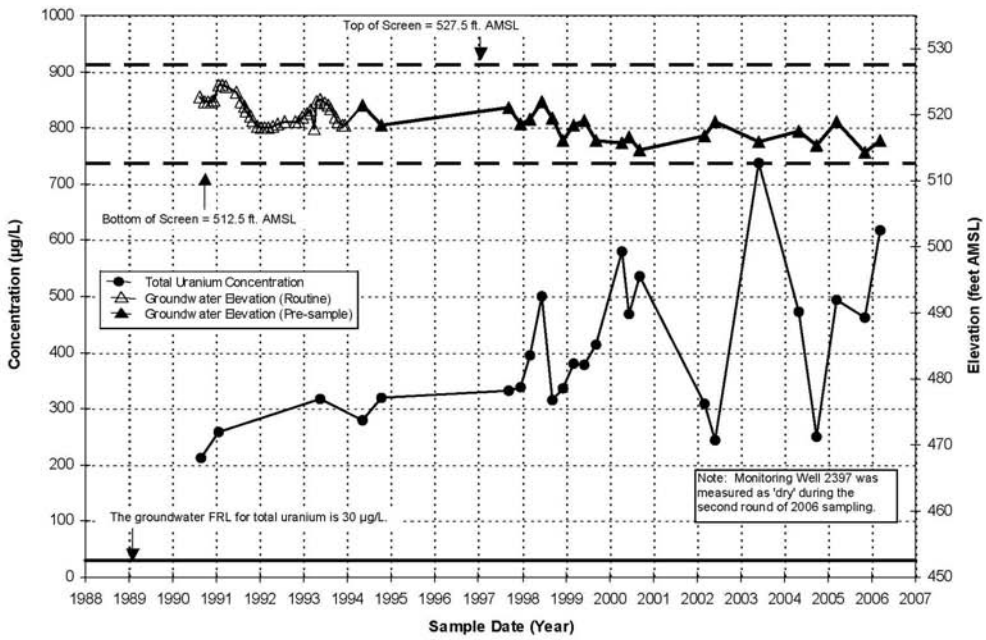

FIGURE A.2-31. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2397

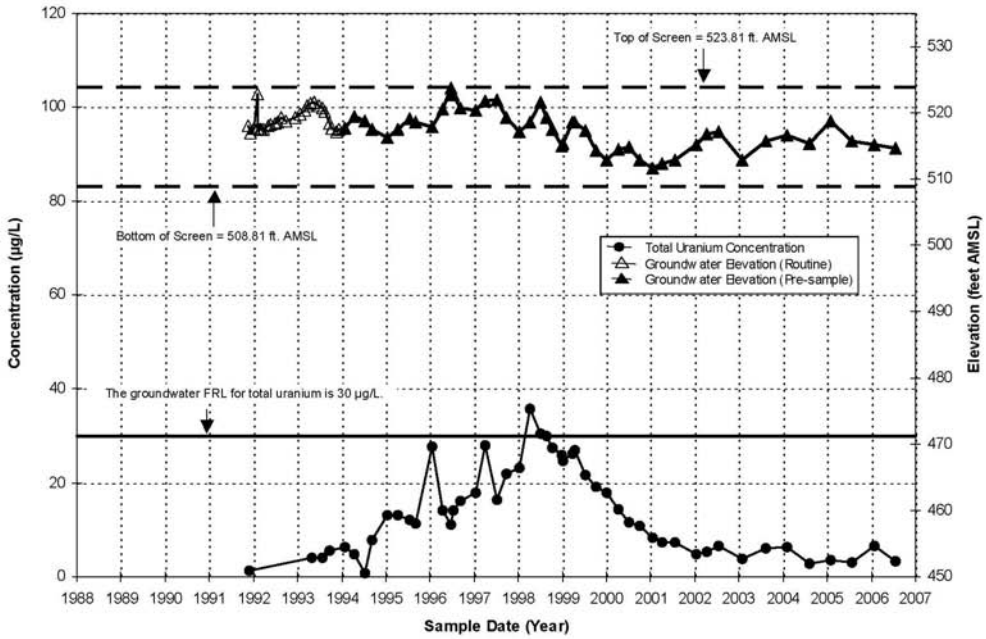

FIGURE A.2-32. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2398

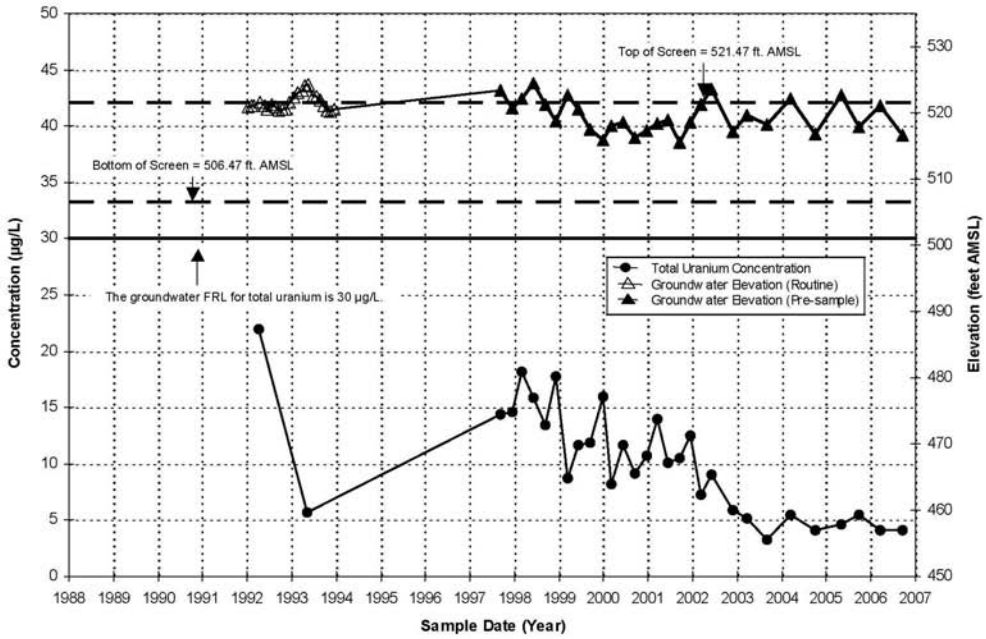

FIGURE A.2-33. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2402

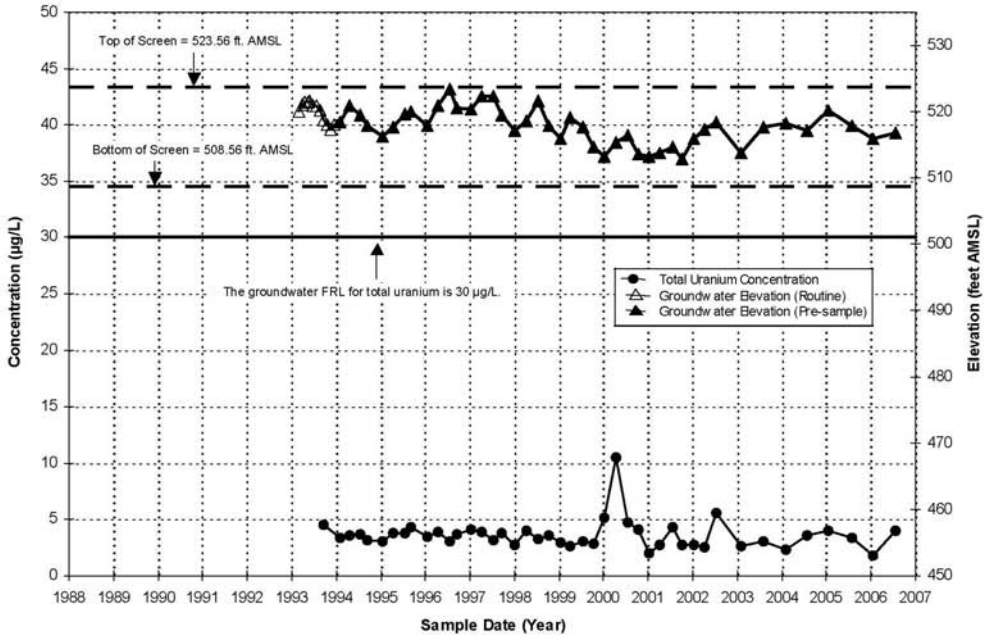

FIGURE A.2-34. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2431

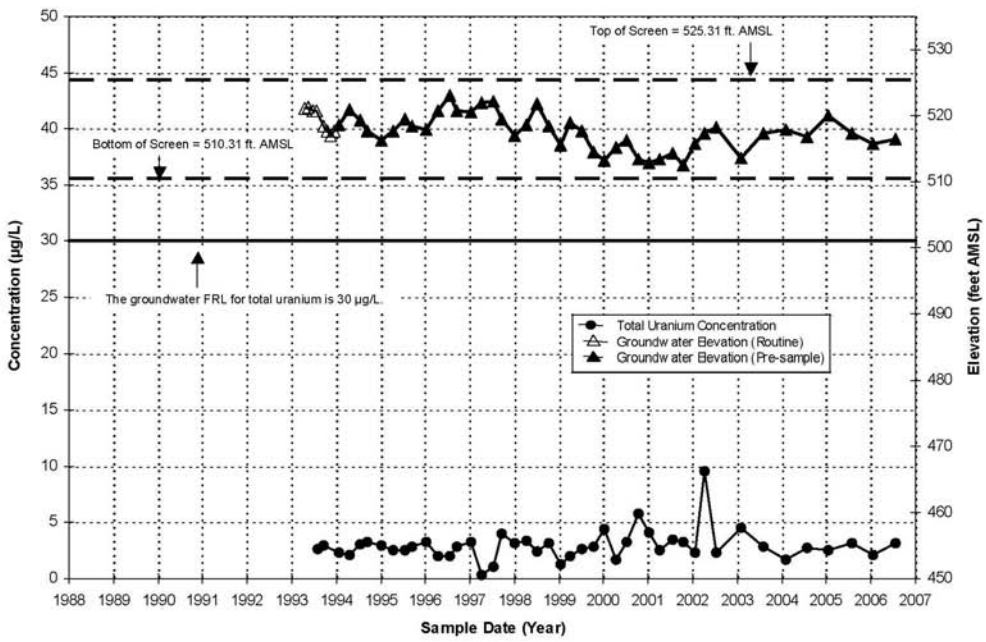

FIGURE A.2-35. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2432

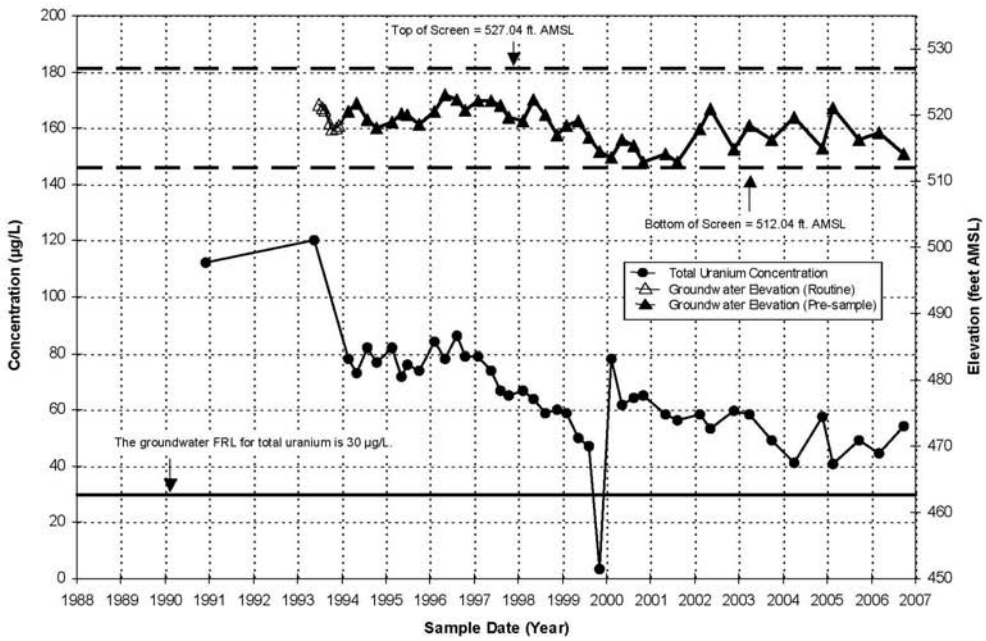

FIGURE A.2-36. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2550

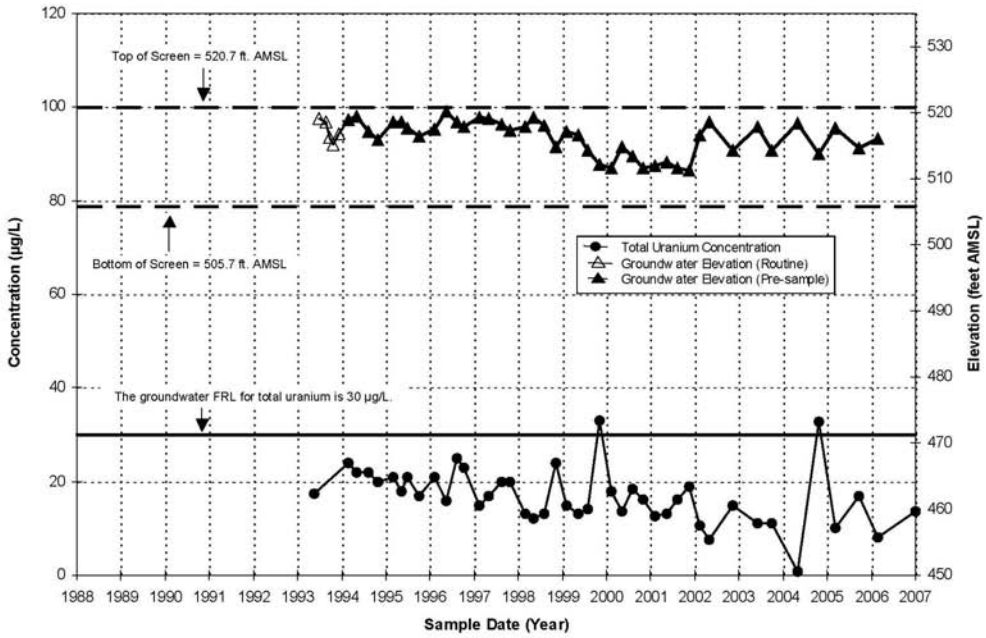

FIGURE A.2-37. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2552

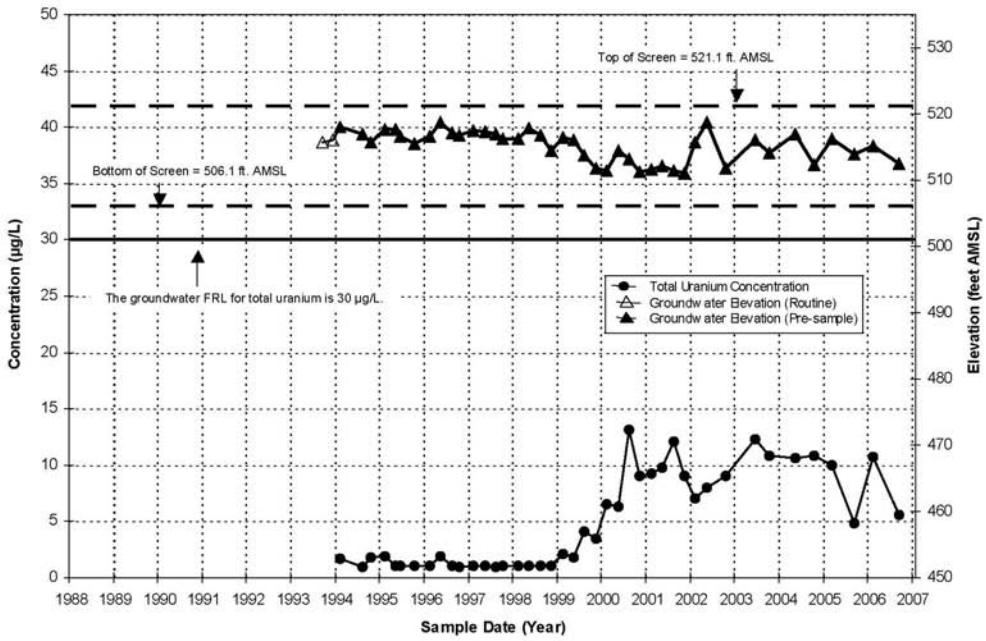

FIGURE A.2-38. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2553

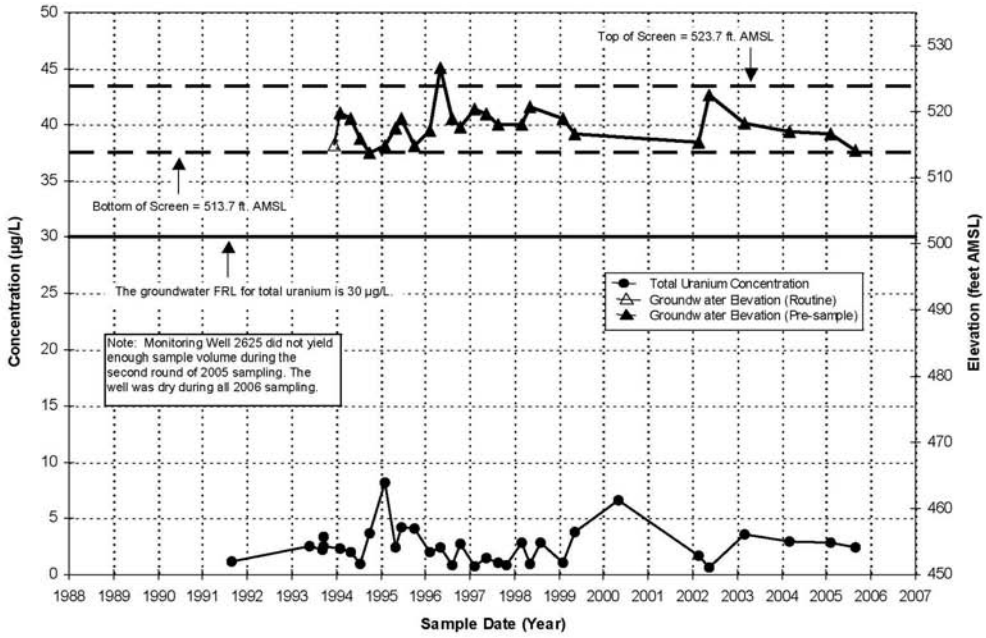

FIGURE A.2-39. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2625

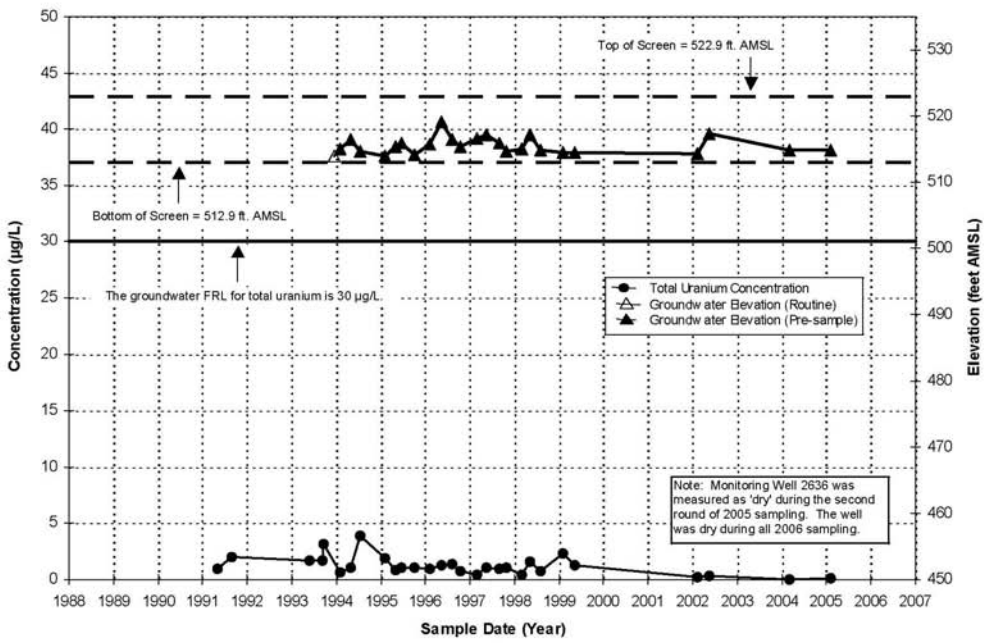

FIGURE A.2-40. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

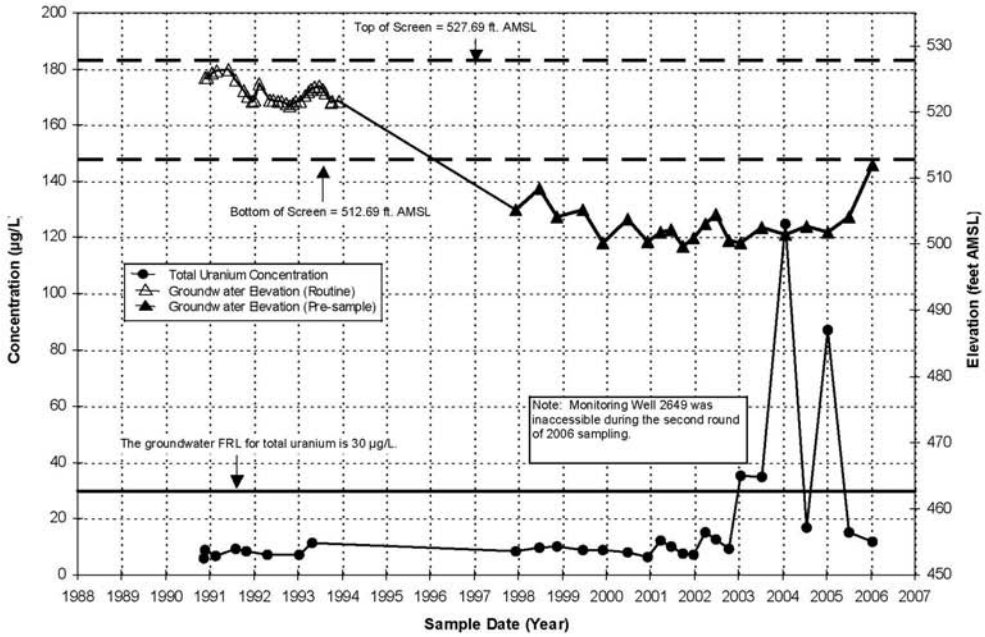

FIGURE A.2-41. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2649

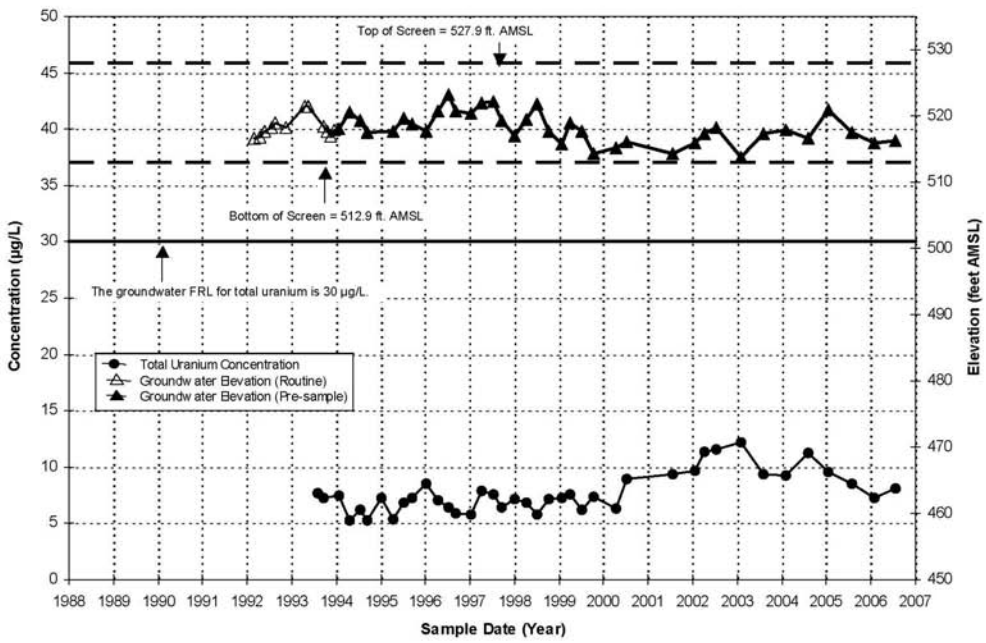

FIGURE A.2-42. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2733

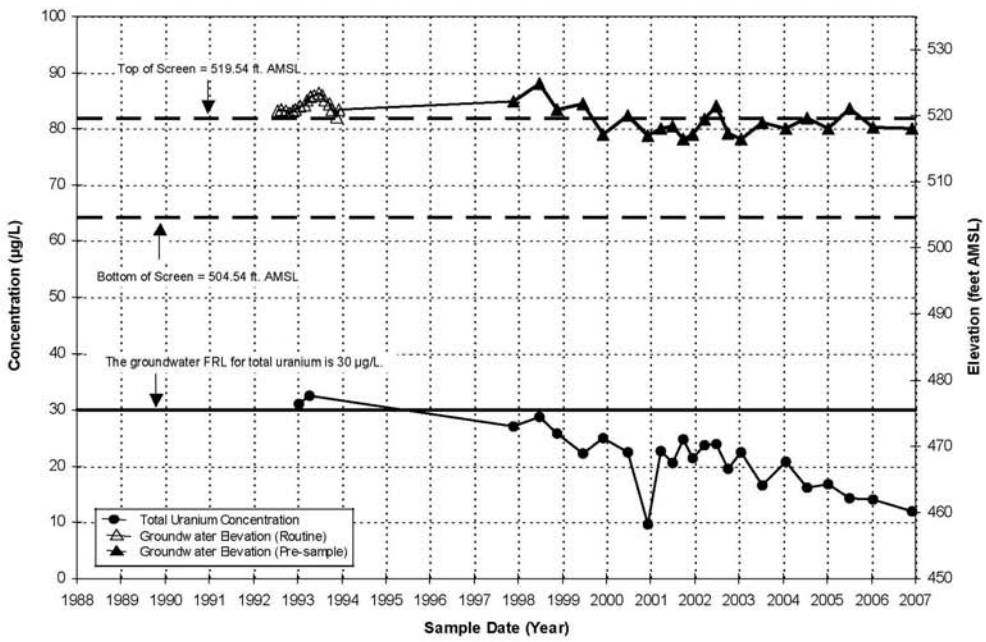

FIGURE A.2-43. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2821

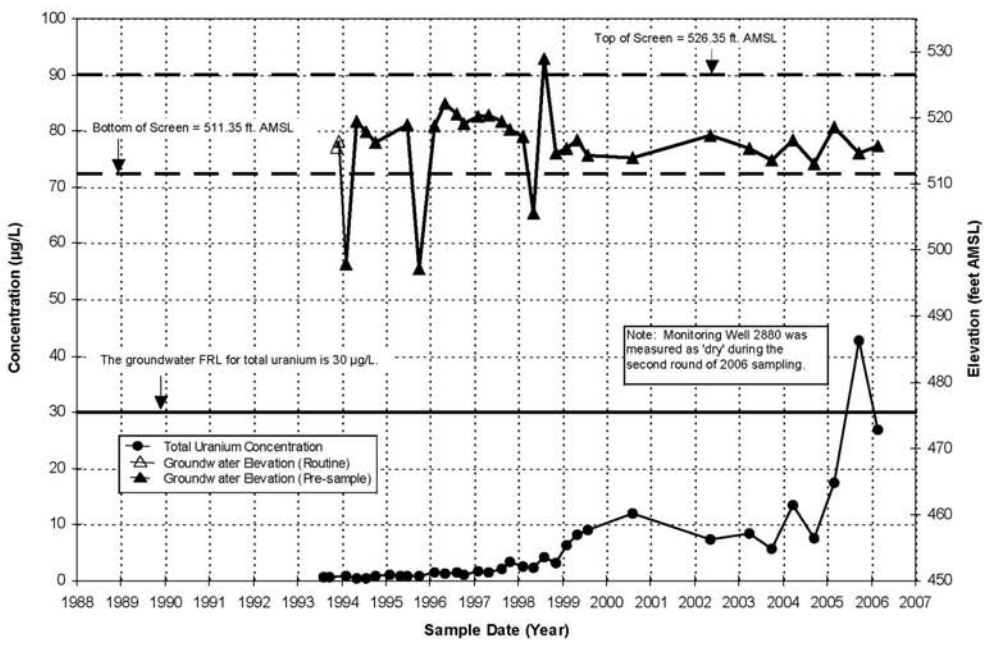

FIGURE A.2-44. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2880

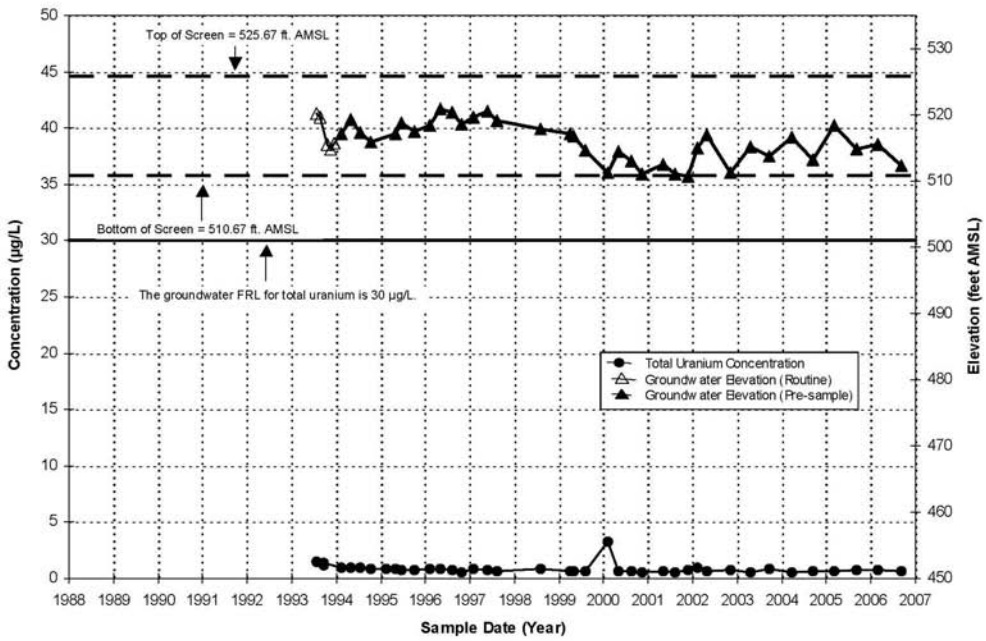

FIGURE A.2-45. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2897

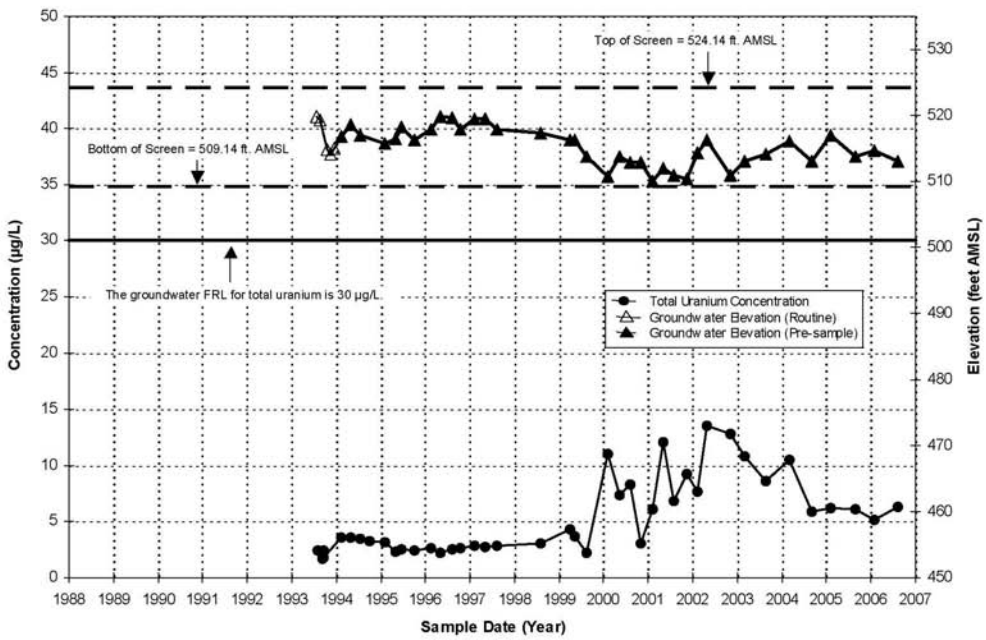

FIGURE A.2-46. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2898

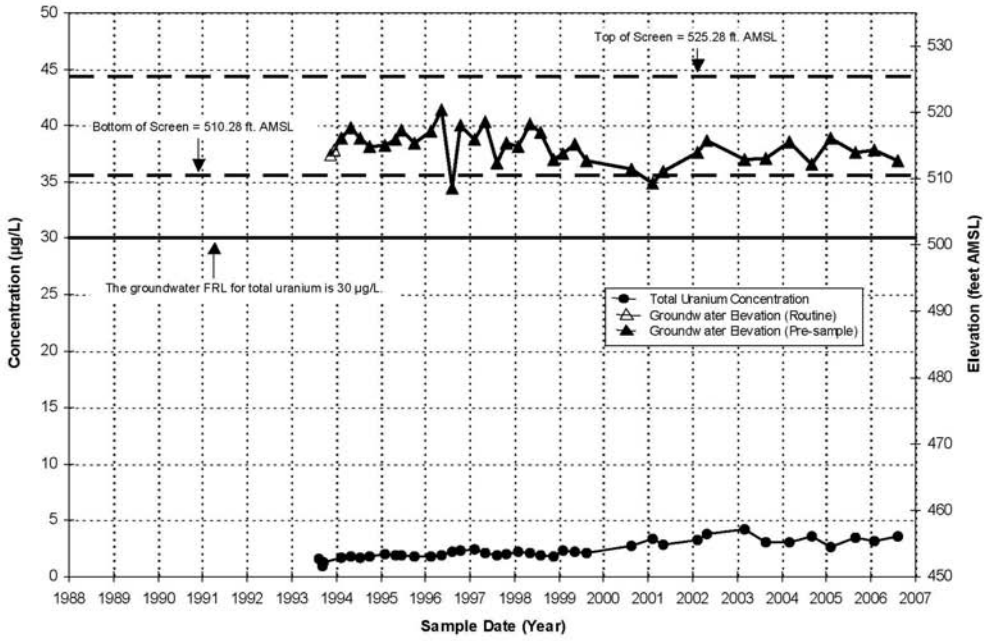

FIGURE A.2-47. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2899

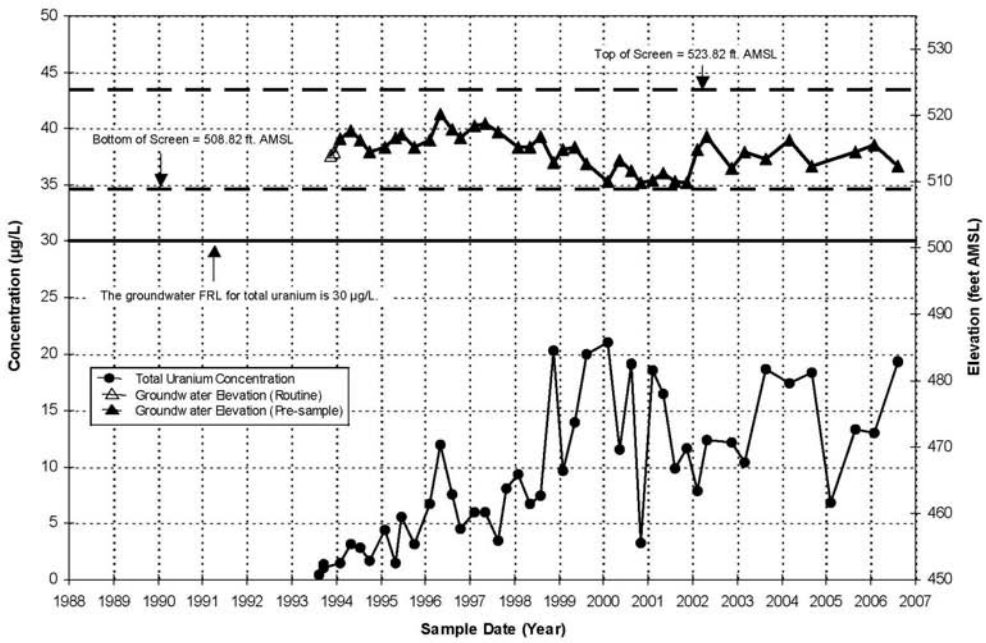

FIGURE A.2-48. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2900

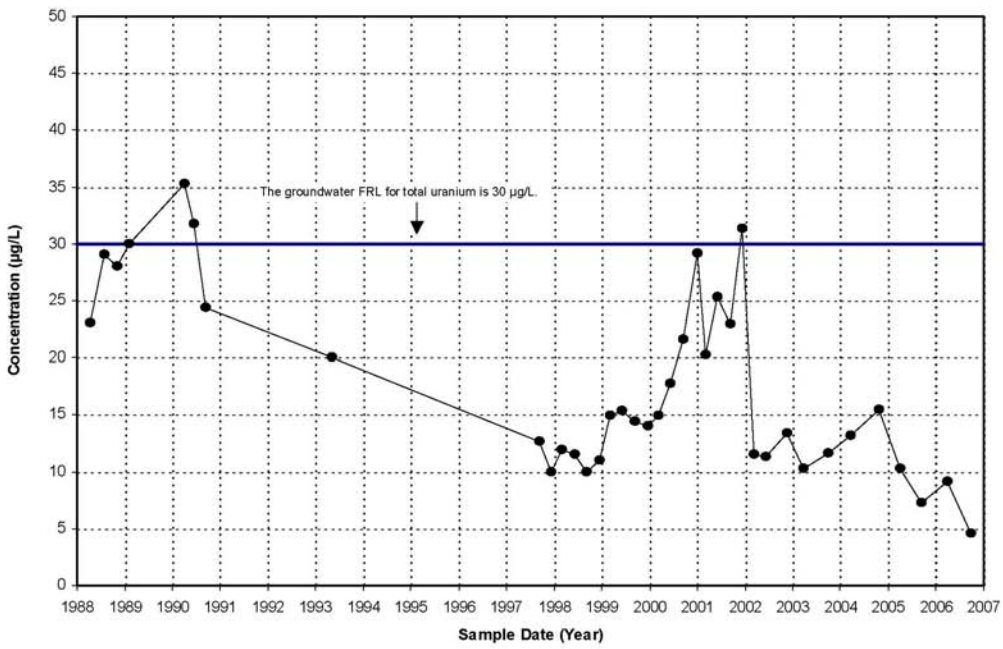

FIGURE A.2-49. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3014

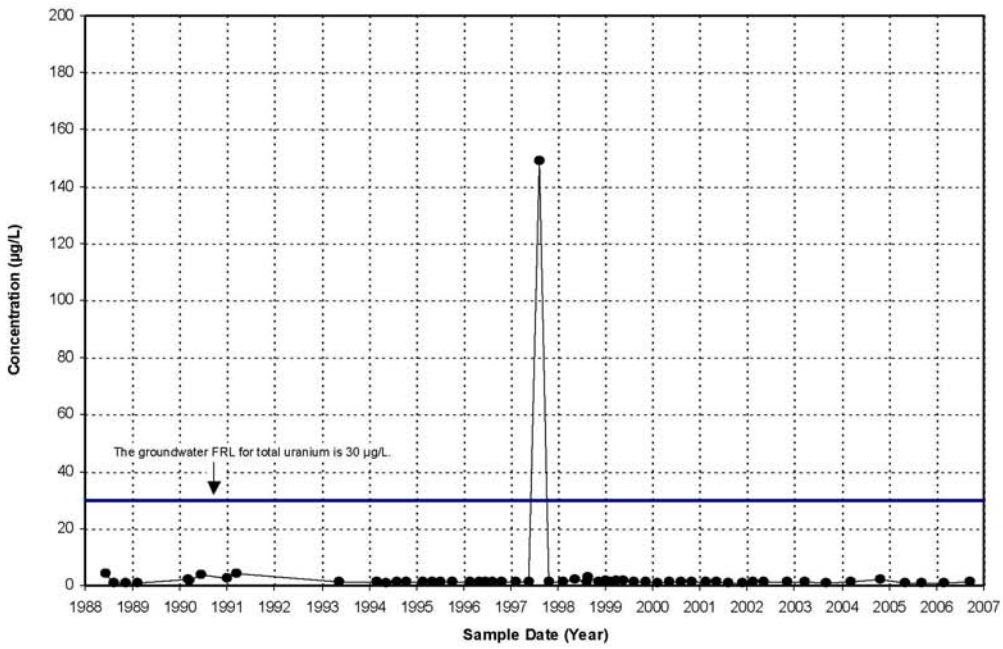

FIGURE A.2-50. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3015

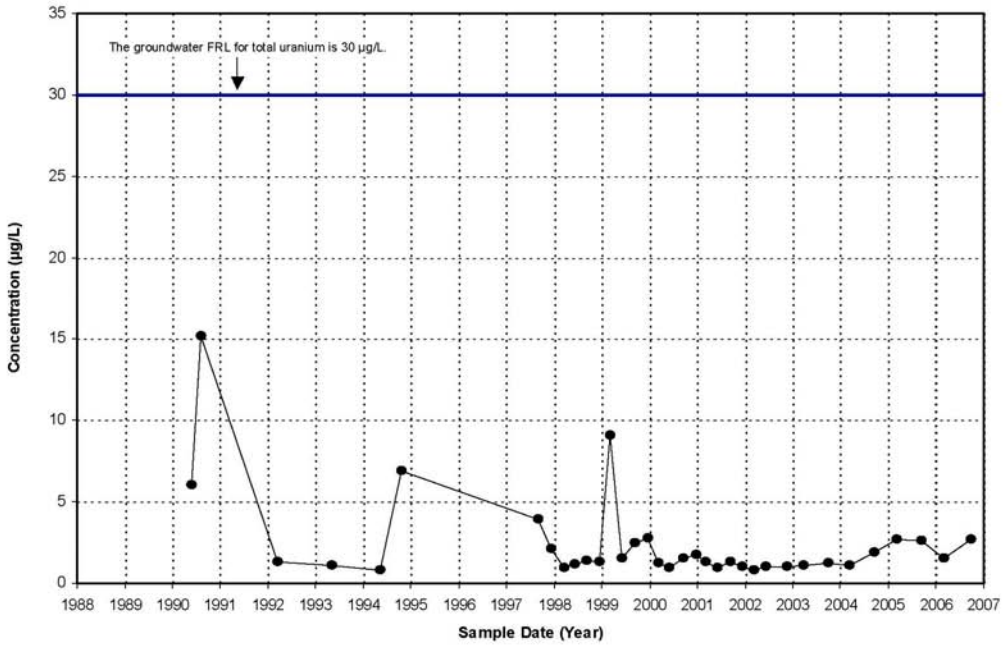

FIGURE A.2-51. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3045

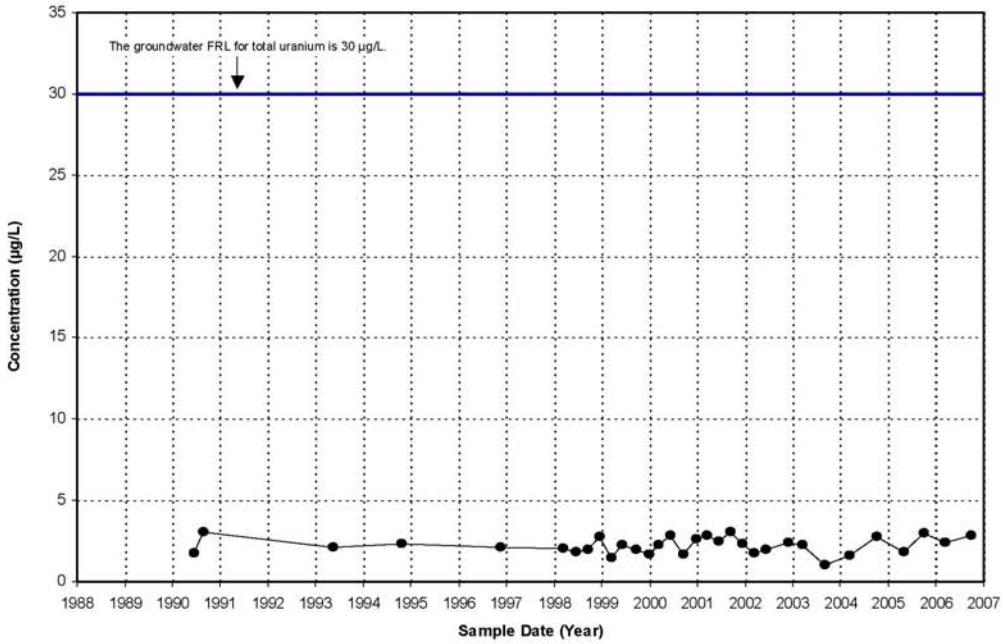

FIGURE A.2-52. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3046

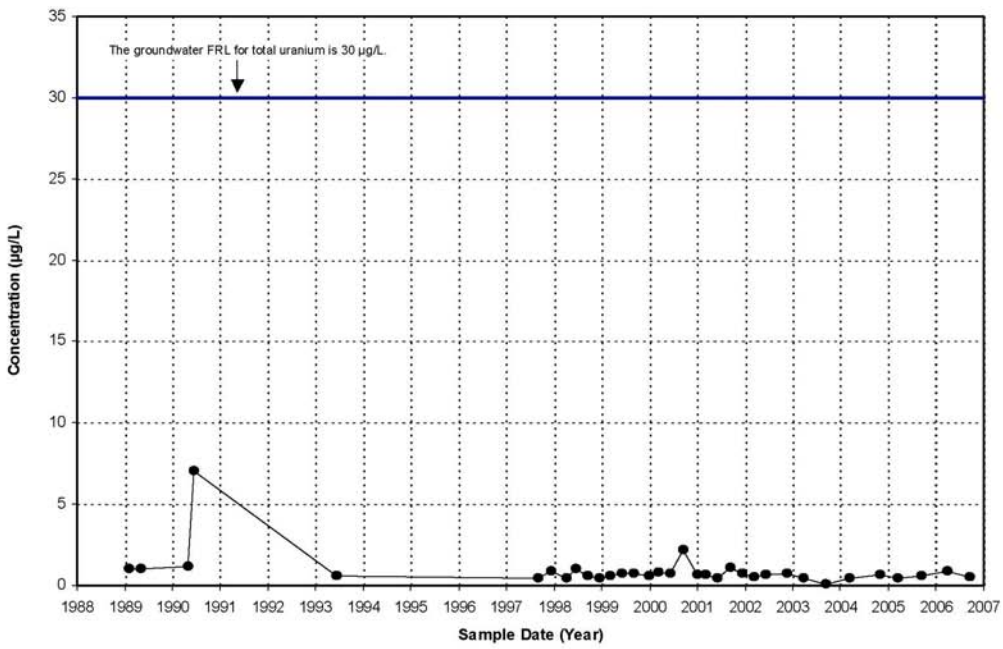

FIGURE A.2-53. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3049

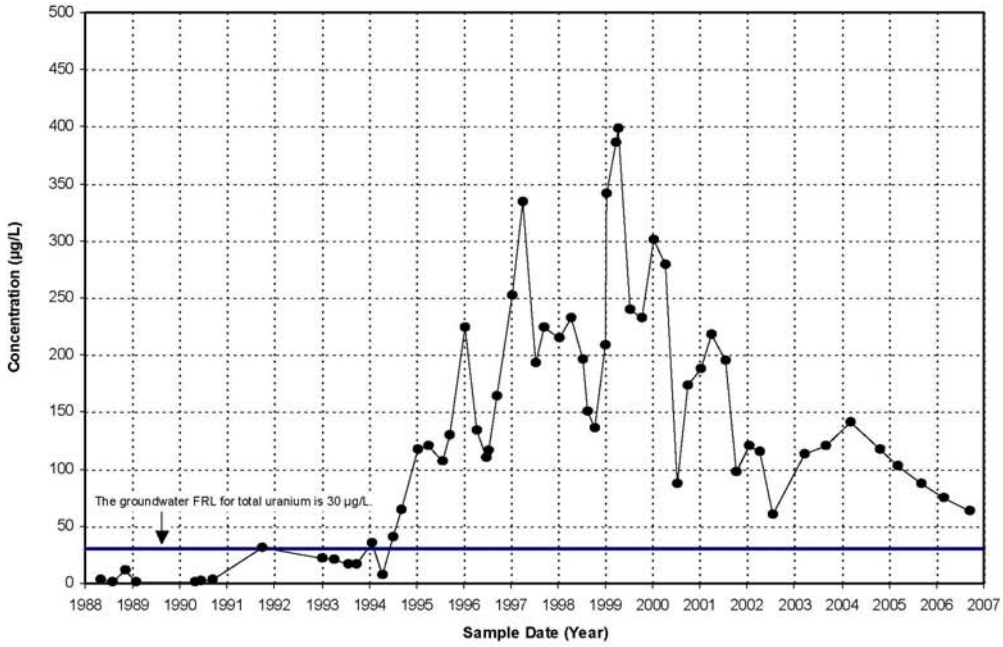

FIGURE A.2-54. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3069

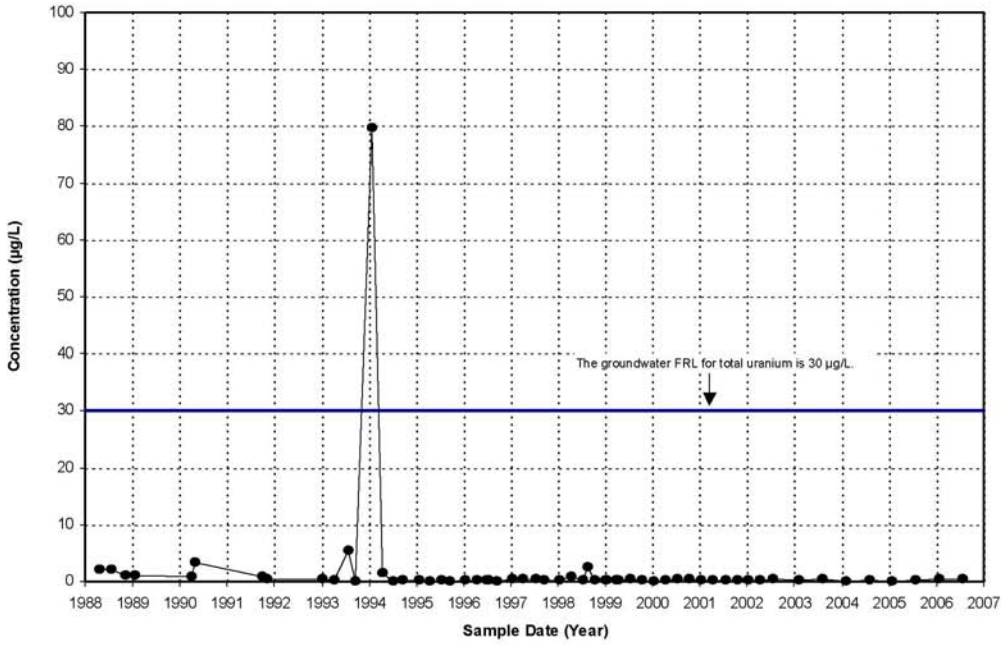

FIGURE A.2-55. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3070

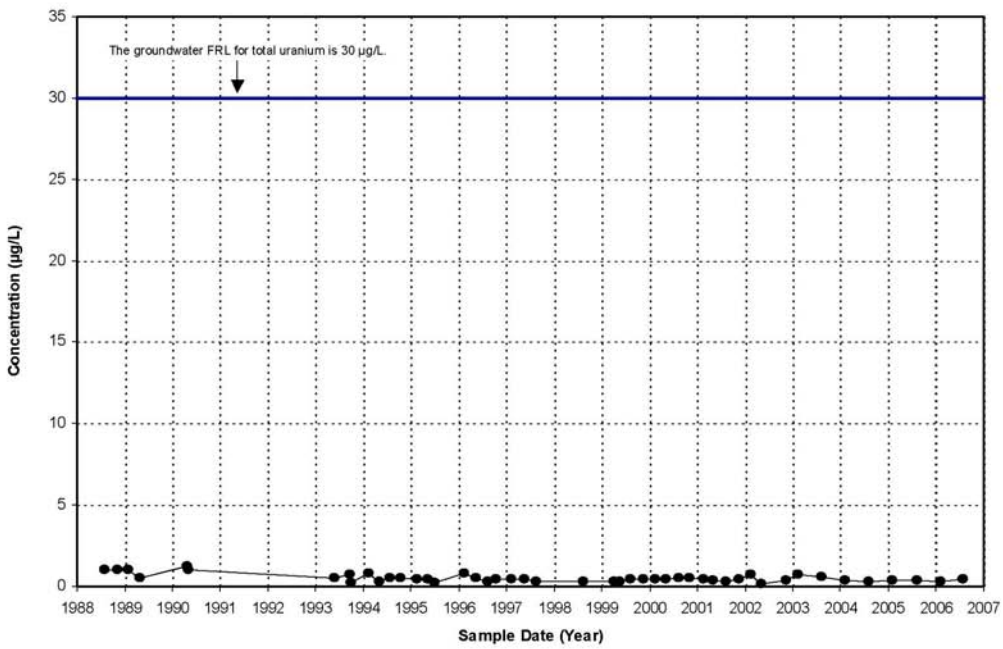

FIGURE A.2-56. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3093

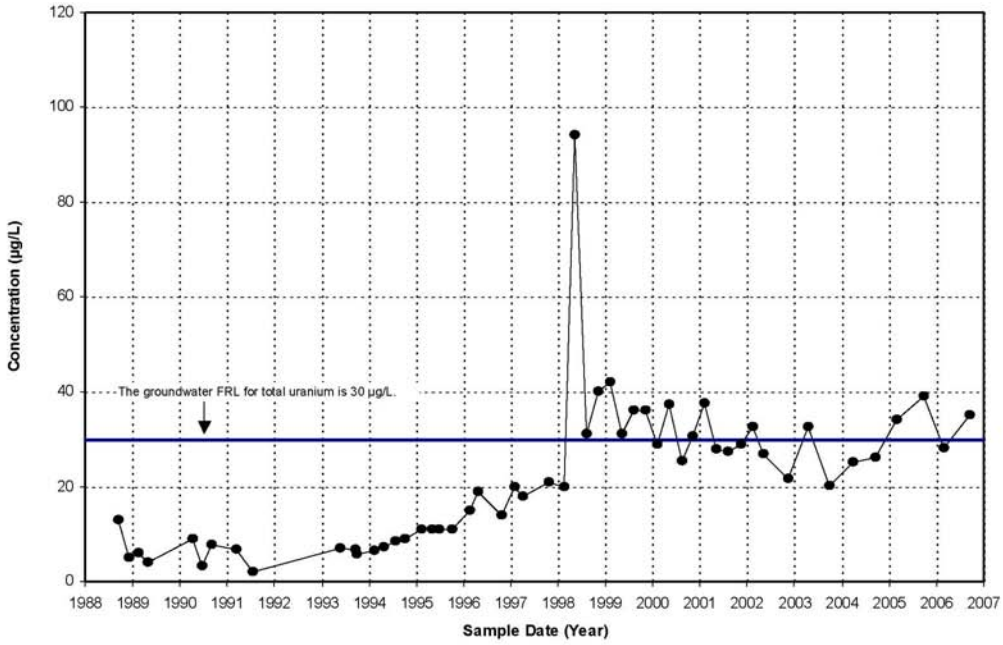

FIGURE A.2-57. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3095

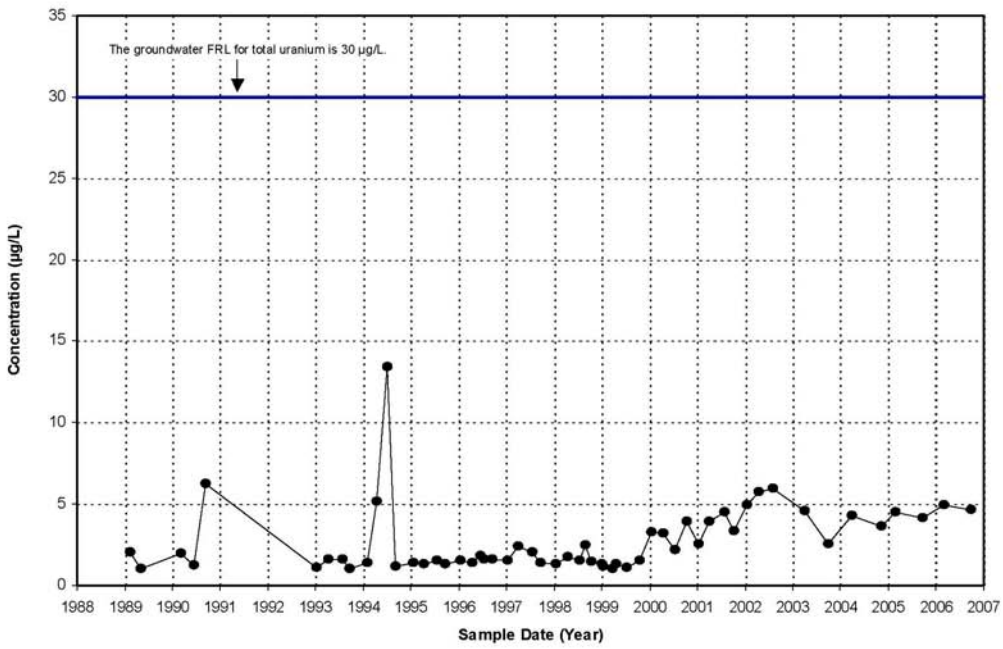

FIGURE A.2-58. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3106

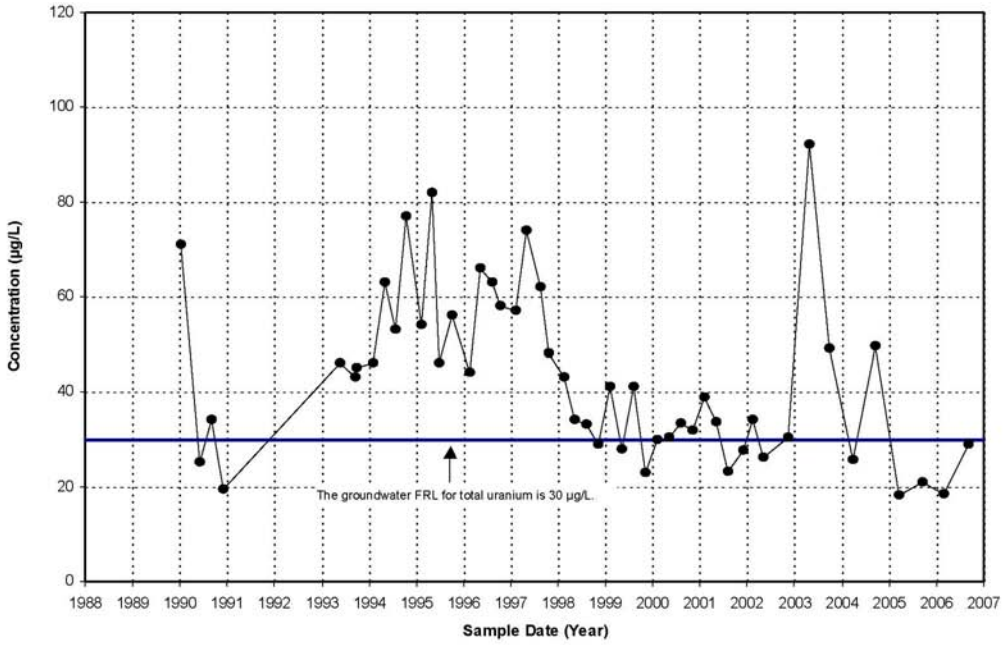

FIGURE A.2-59. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3125

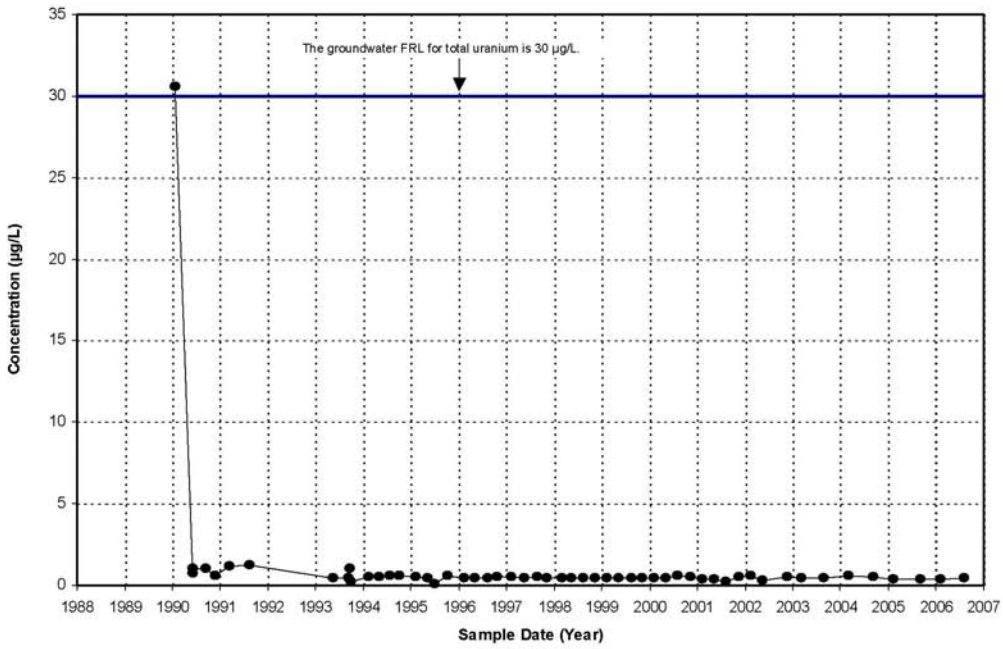

FIGURE A.2-60. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3128

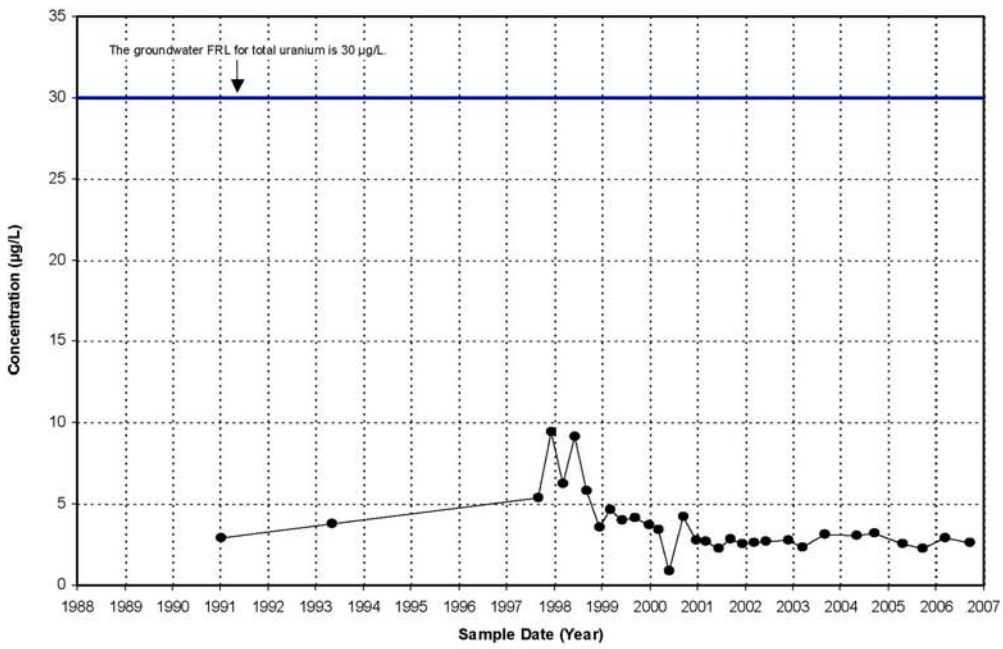

FIGURE A.2-61. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3385

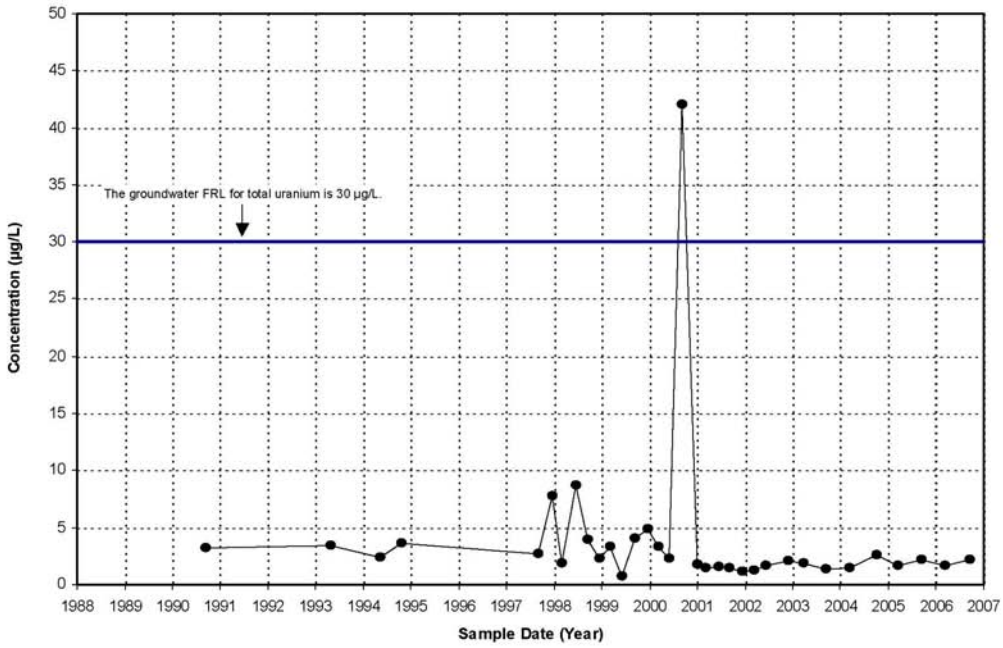

FIGURE A.2-62. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3387

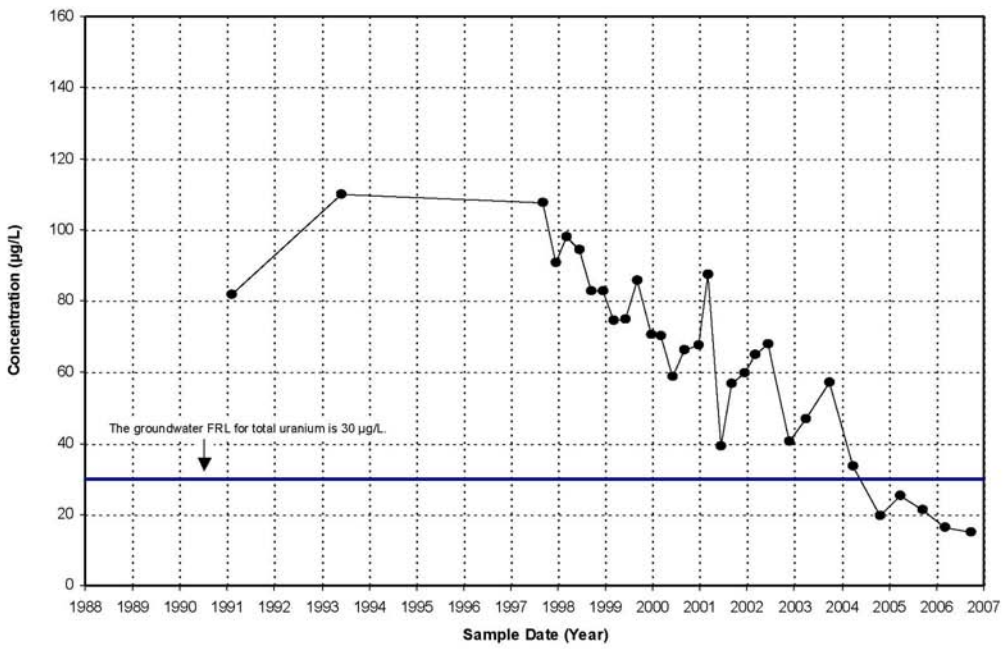

FIGURE A.2-63. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3390

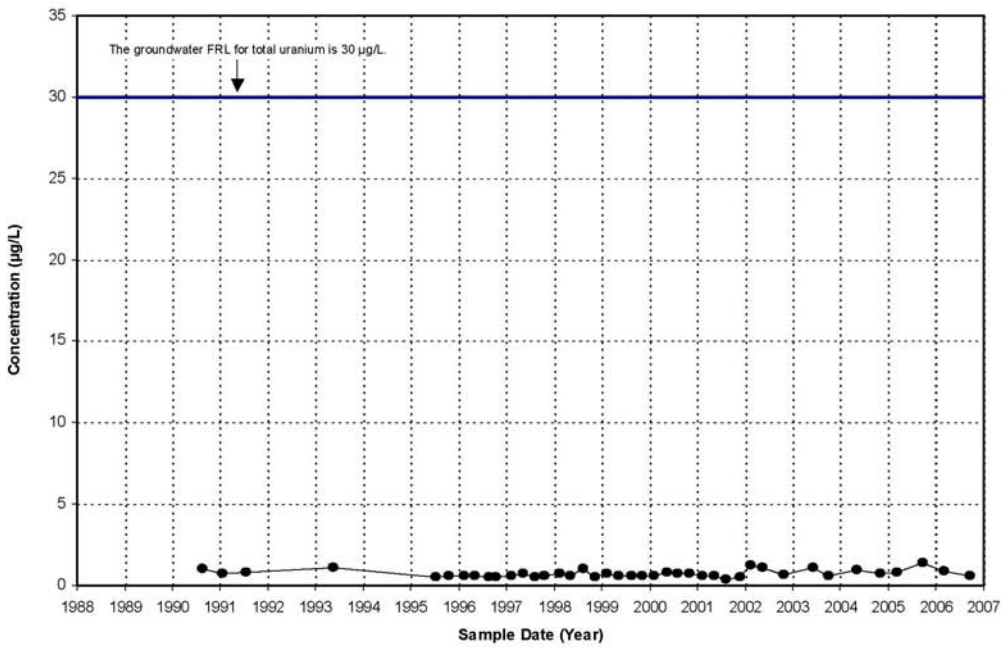

FIGURE A.2-64. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3396

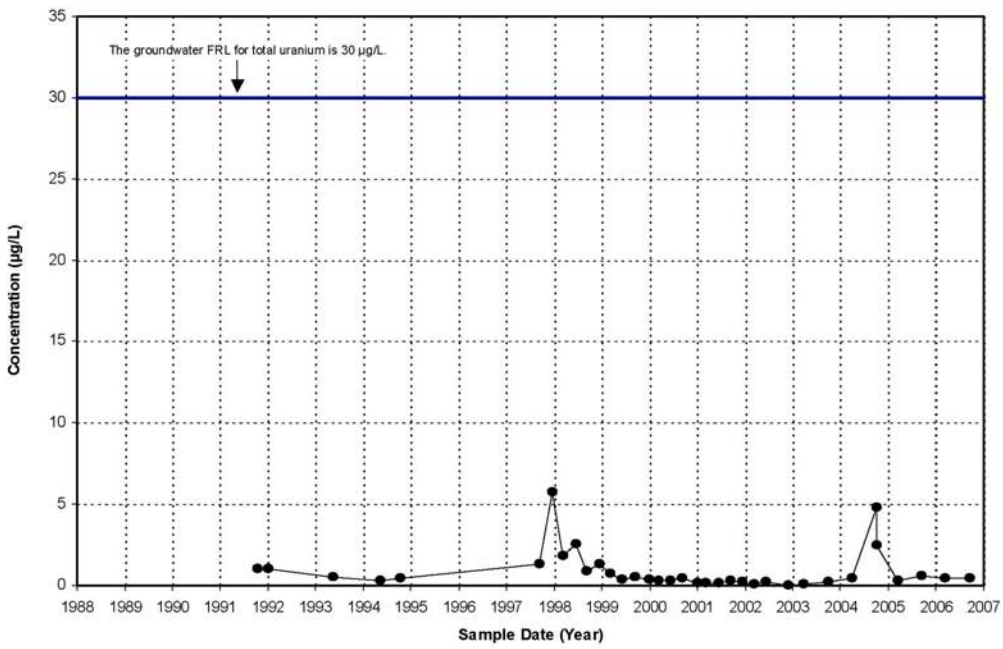

FIGURE A.2-65. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3397

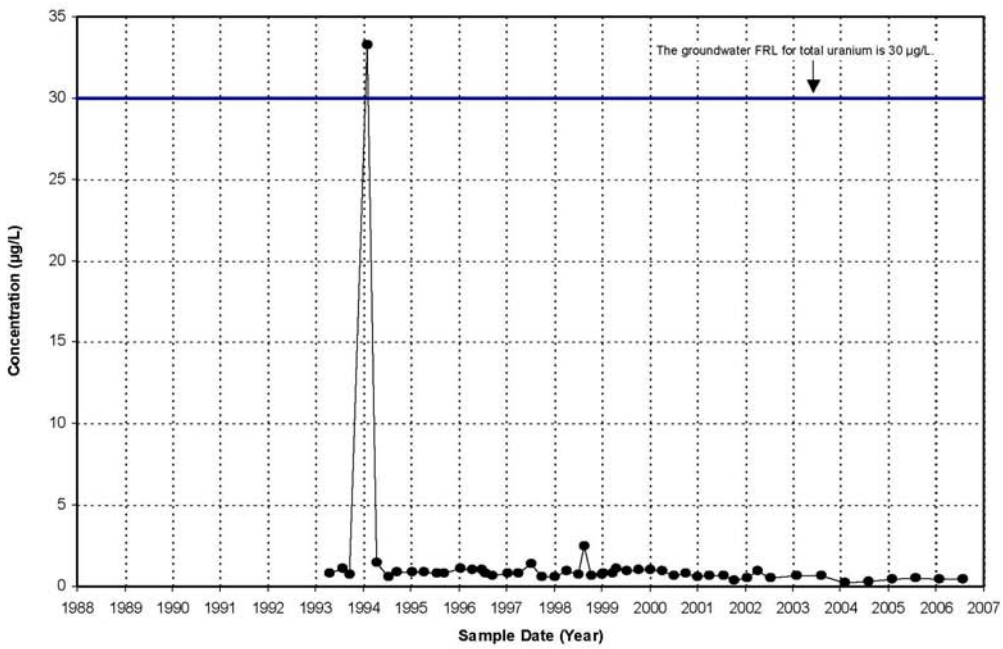

FIGURE A.2-66. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3398

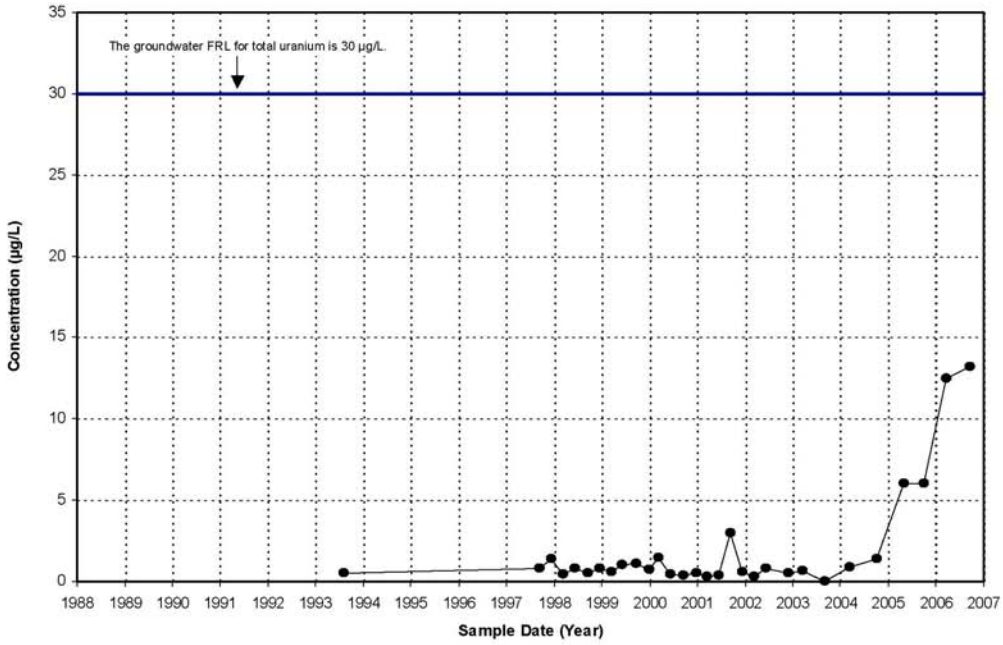

FIGURE A.2-67. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3402

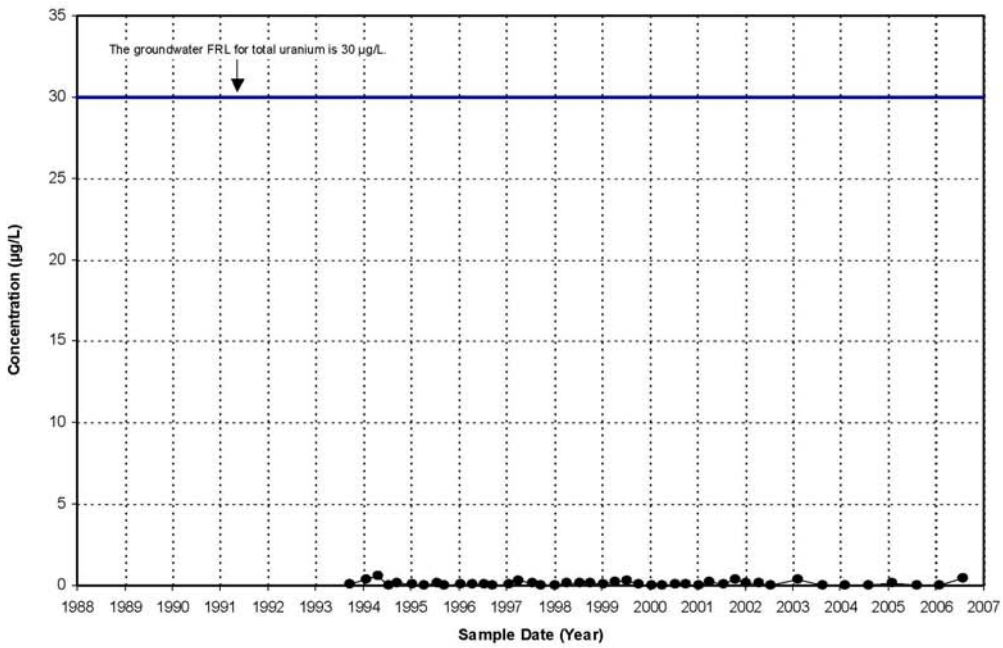

FIGURE A.2-68. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3424

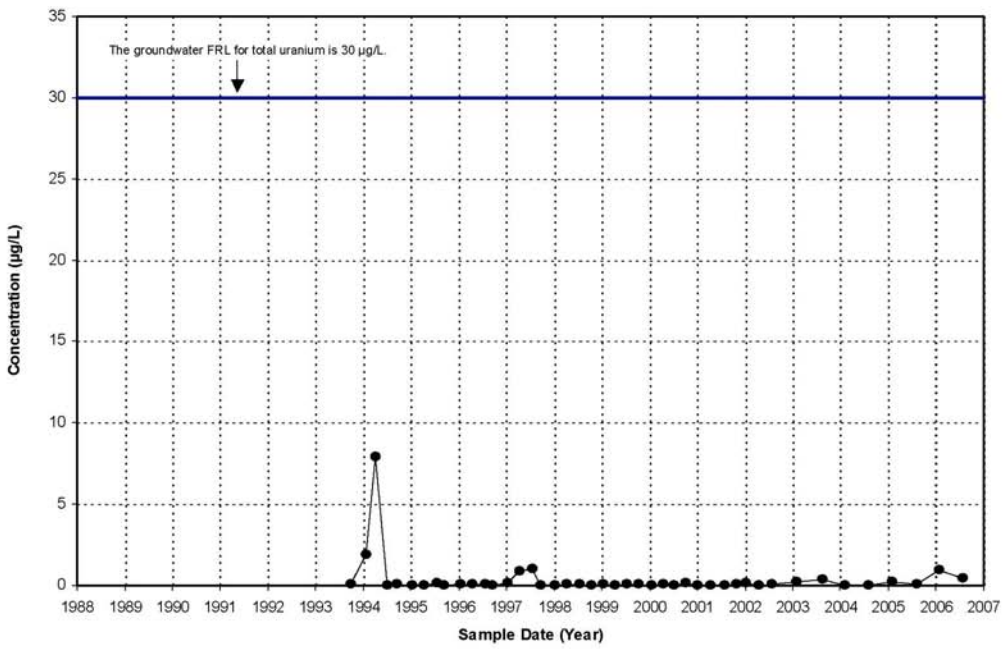

FIGURE A.2-69. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3426

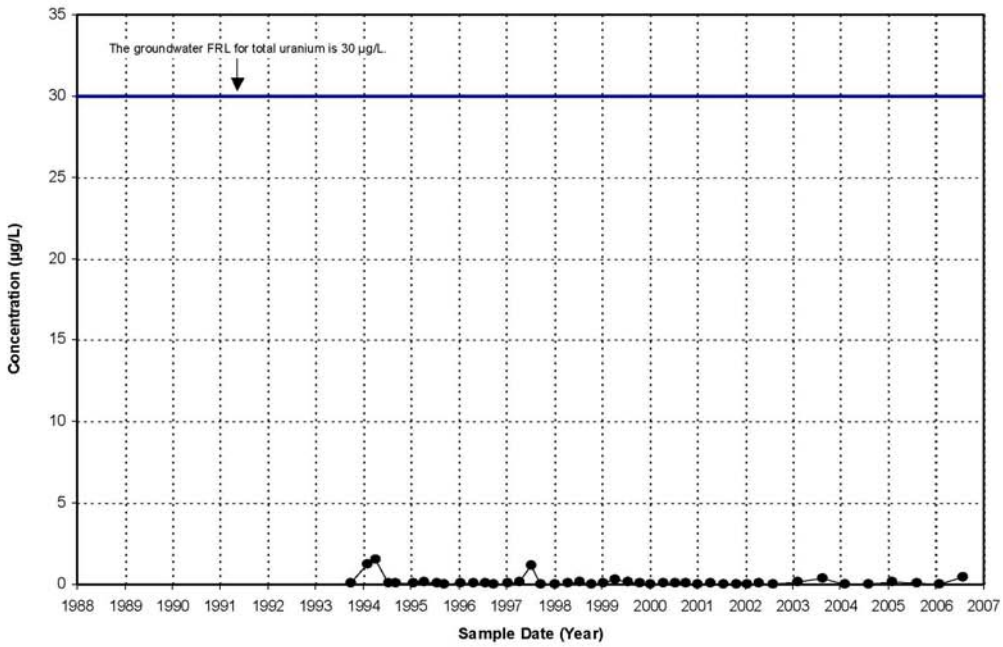

FIGURE A.2-70. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3429

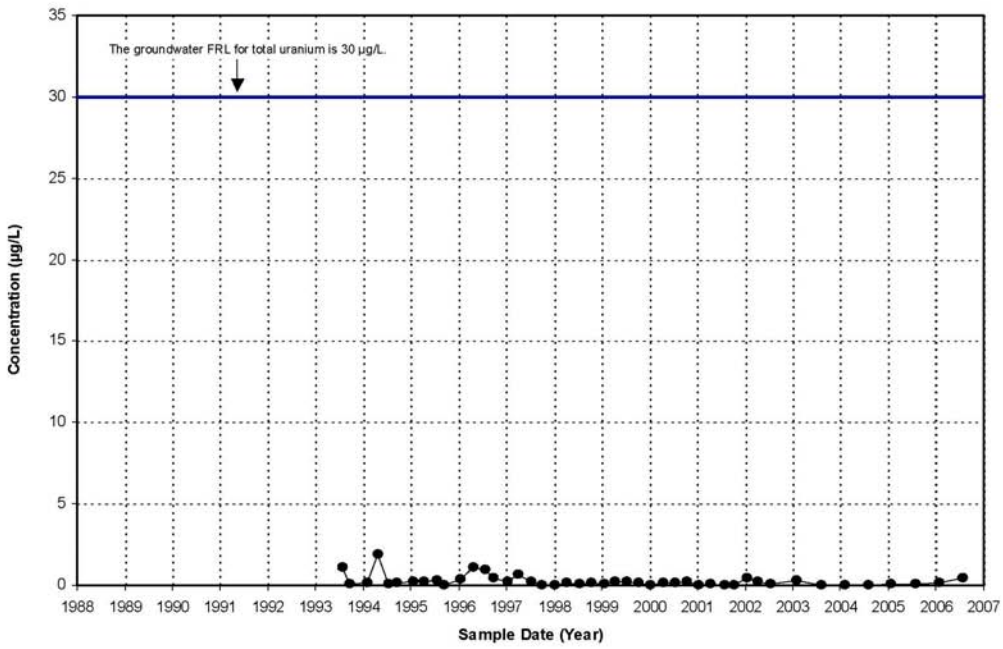

FIGURE A.2-71. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3431

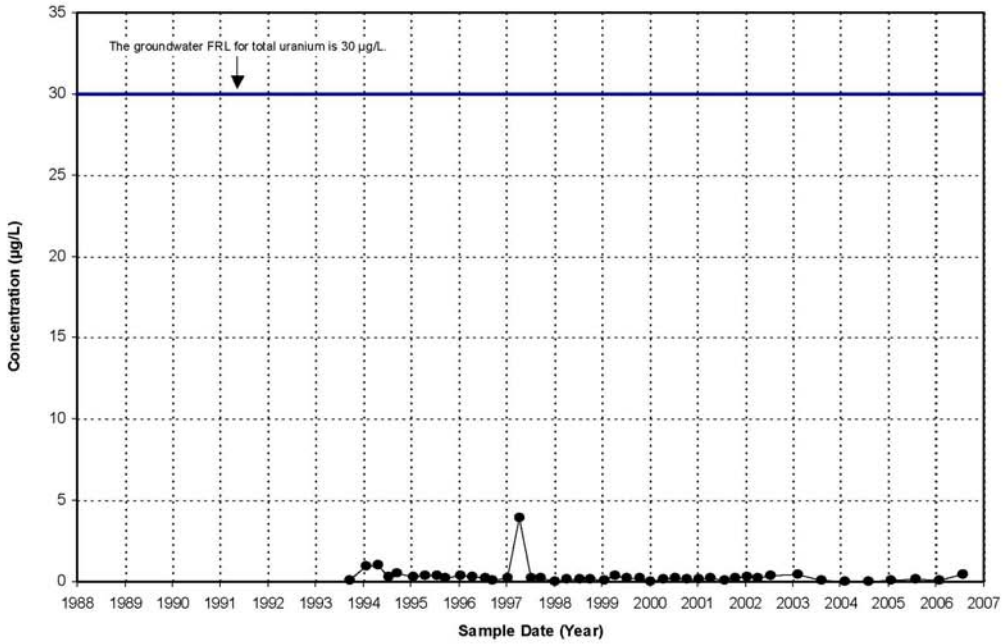

FIGURE A.2-72. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3432

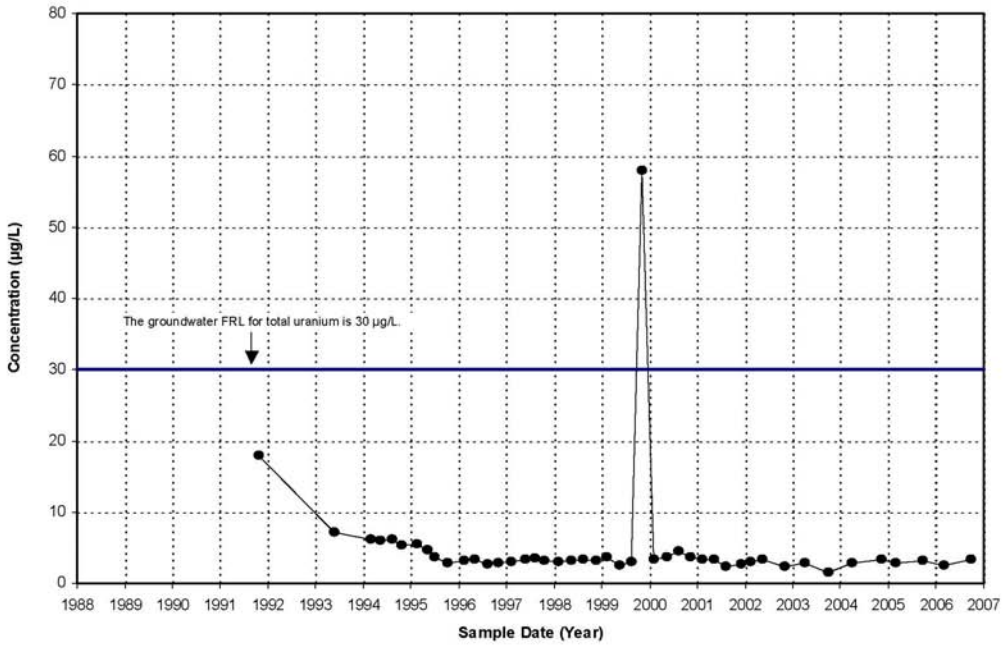

FIGURE A.2-73. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3550

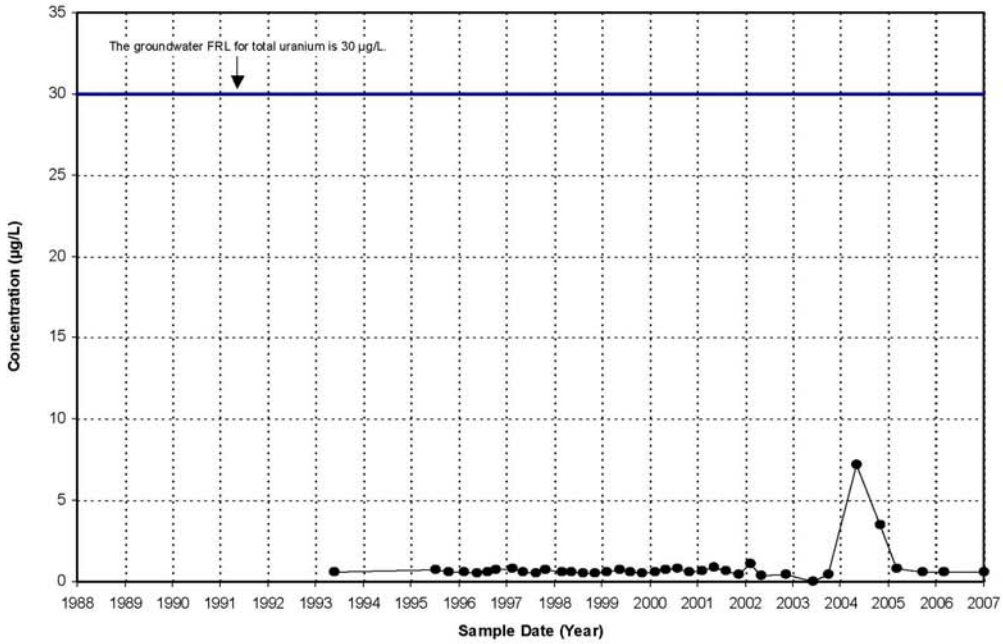

FIGURE A.2-74. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3552

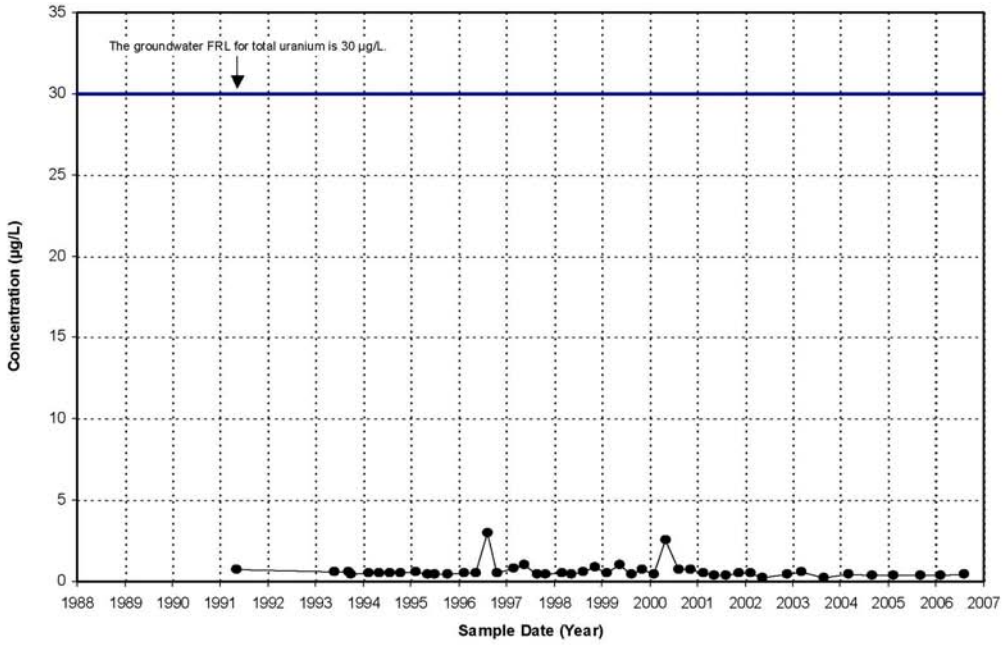

FIGURE A.2-75. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3636

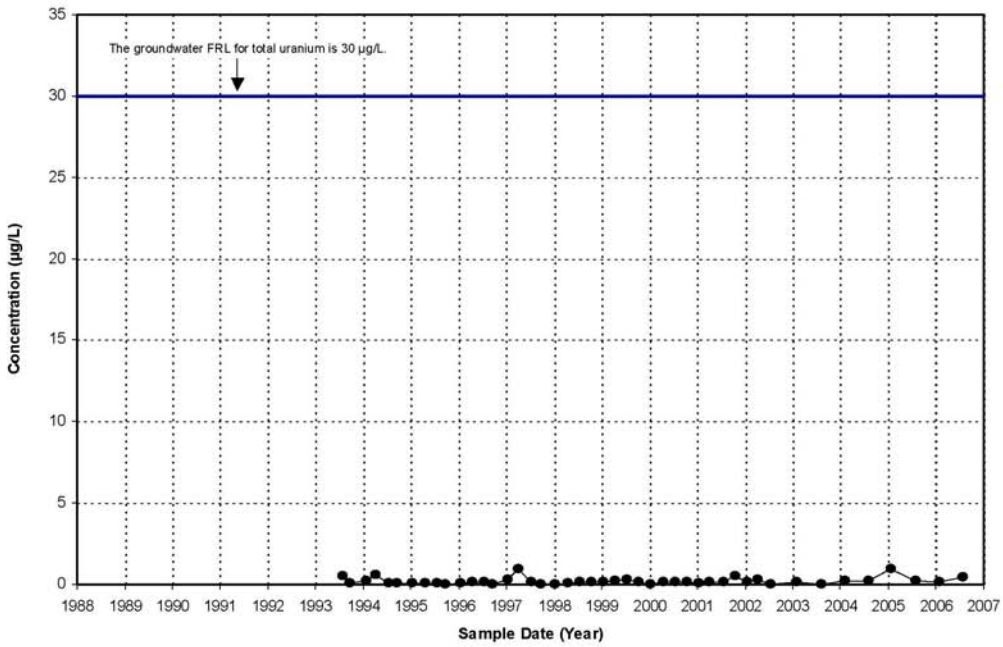

FIGURE A.2-76. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3733

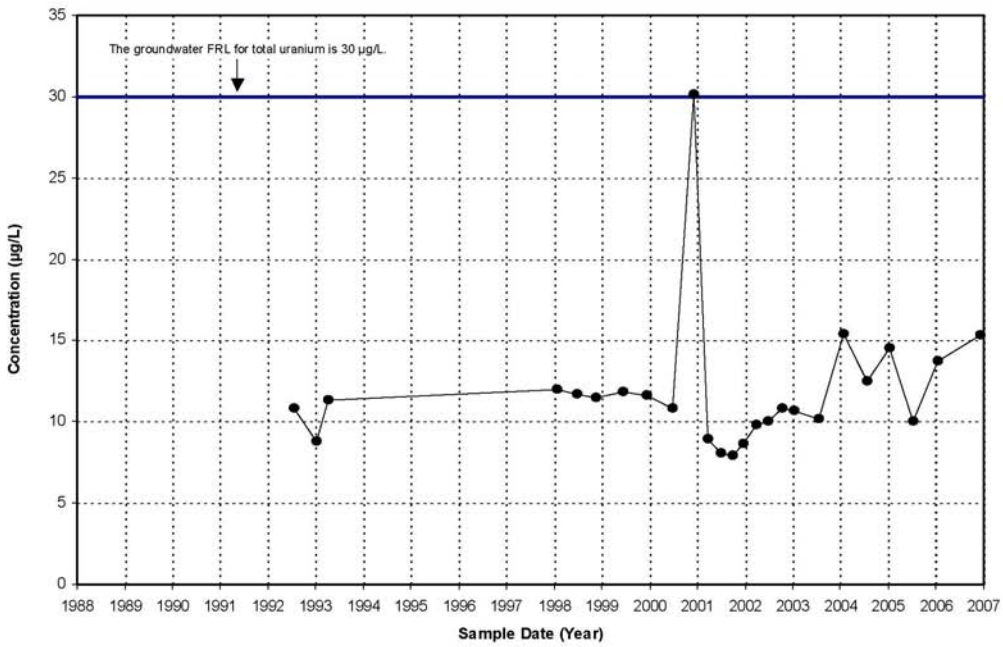

FIGURE A.2-77. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3821

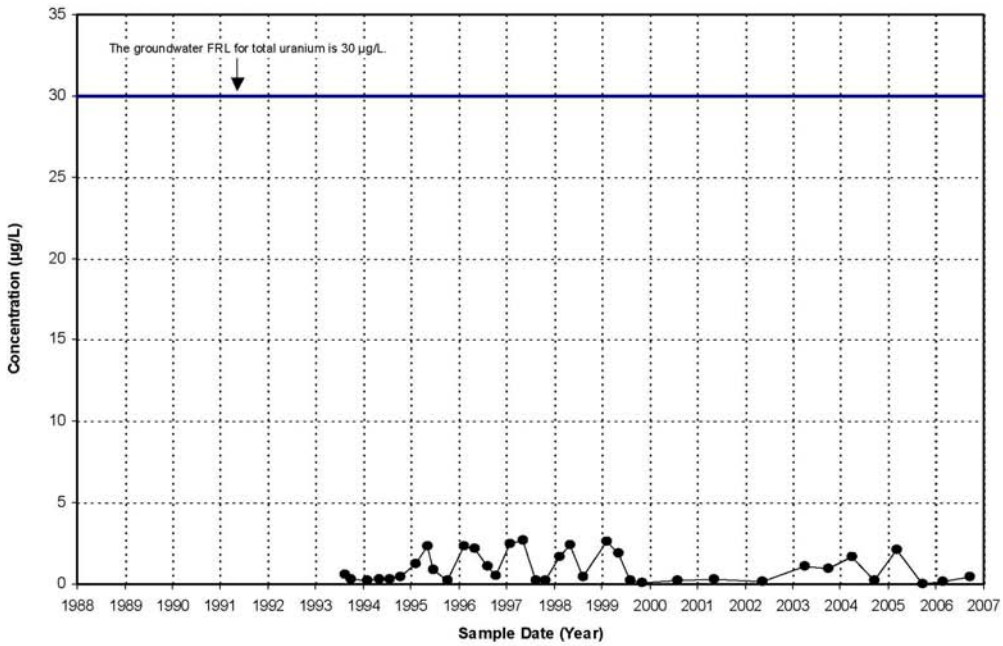

FIGURE A.2-78. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3880

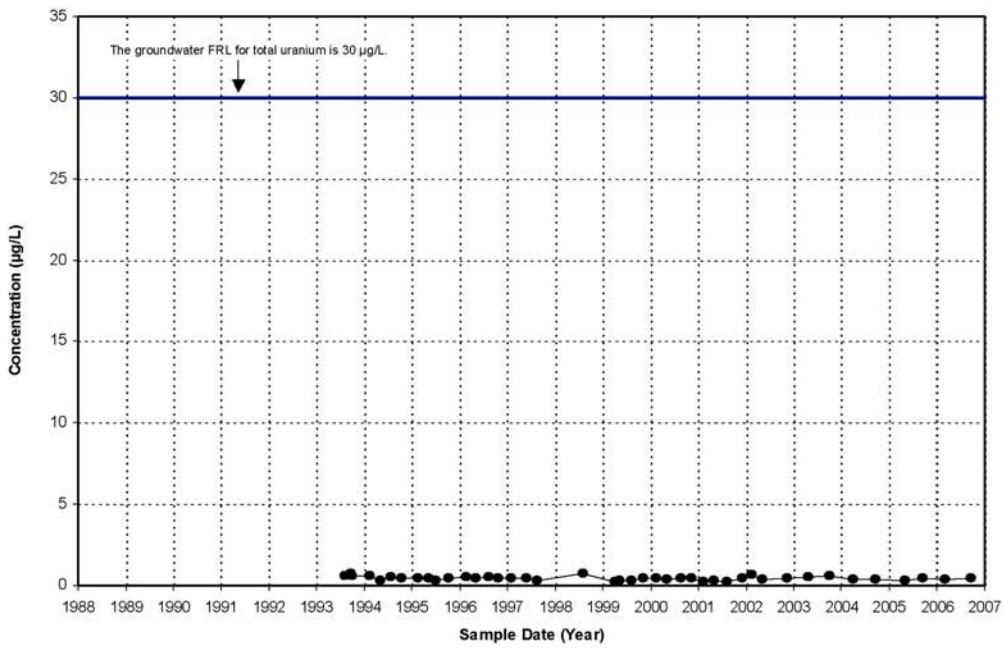

FIGURE A.2-79. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3897

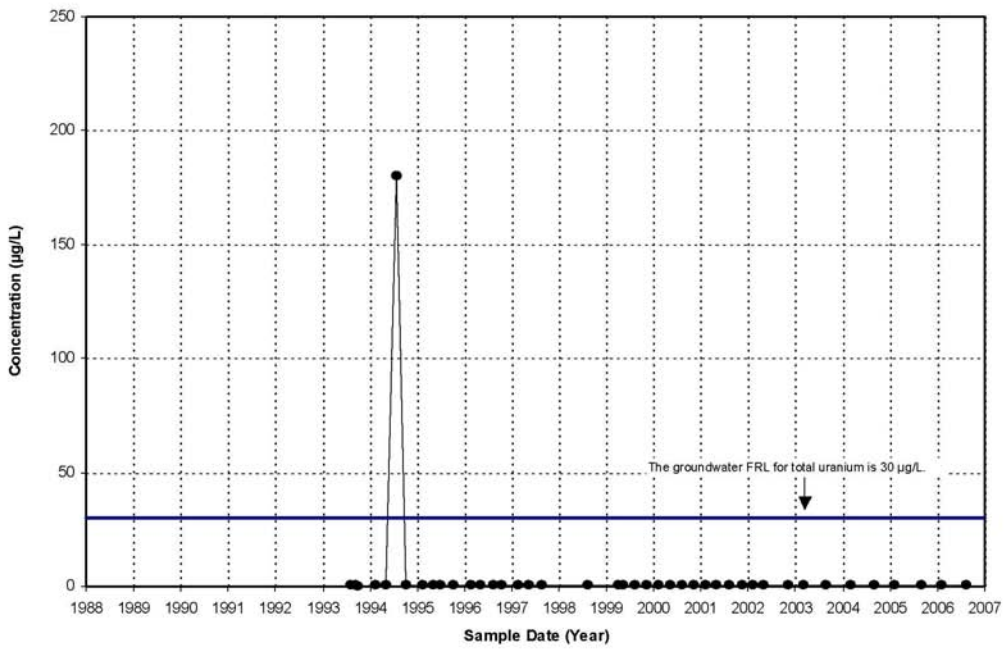

FIGURE A.2-80. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3898

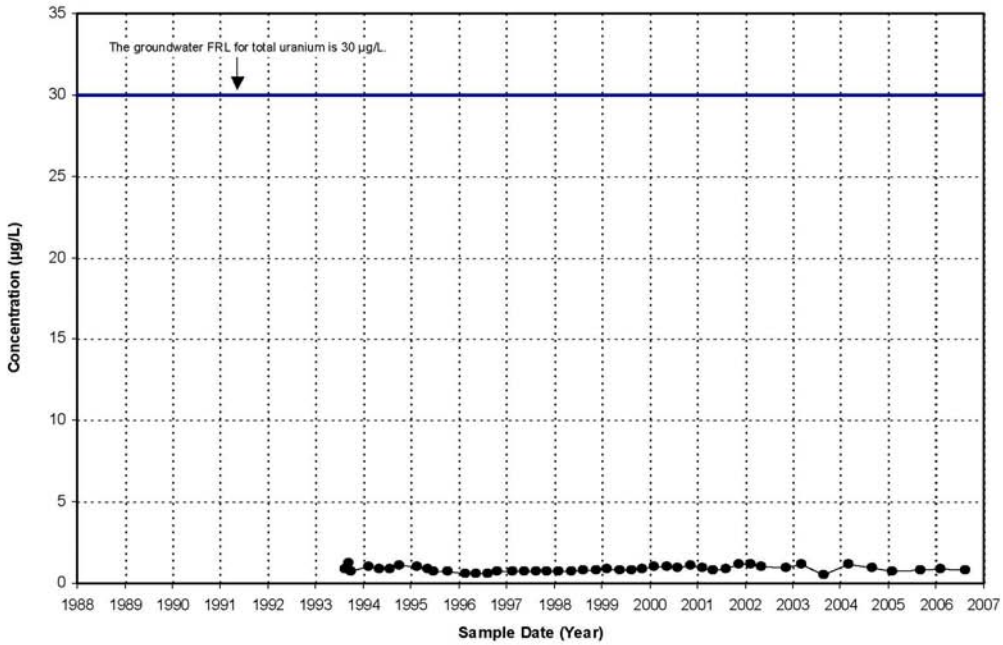

FIGURE A.2-81. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3899

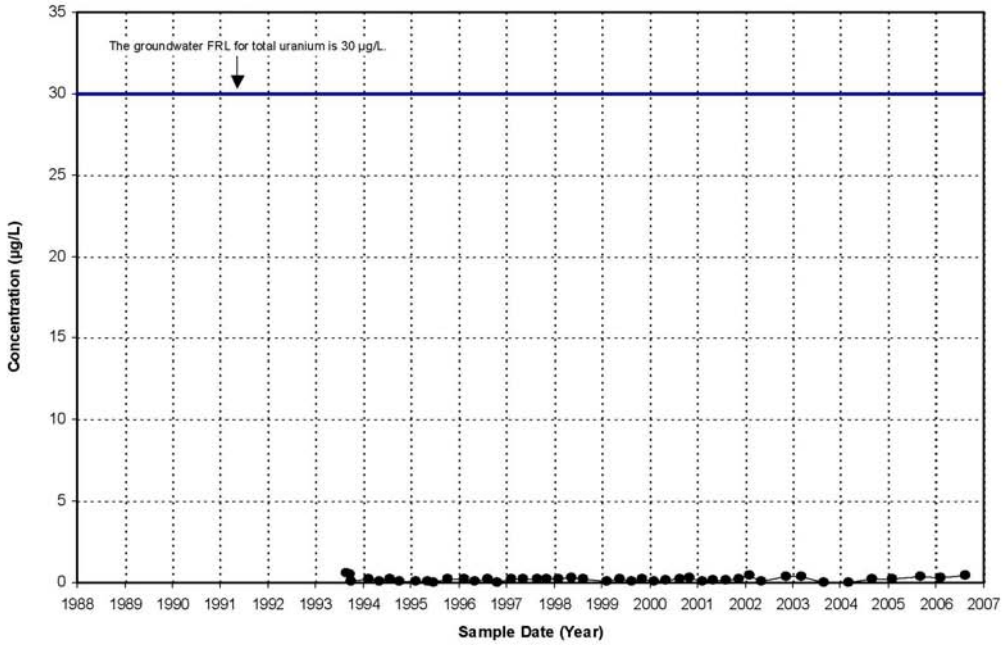

FIGURE A.2-82. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3900

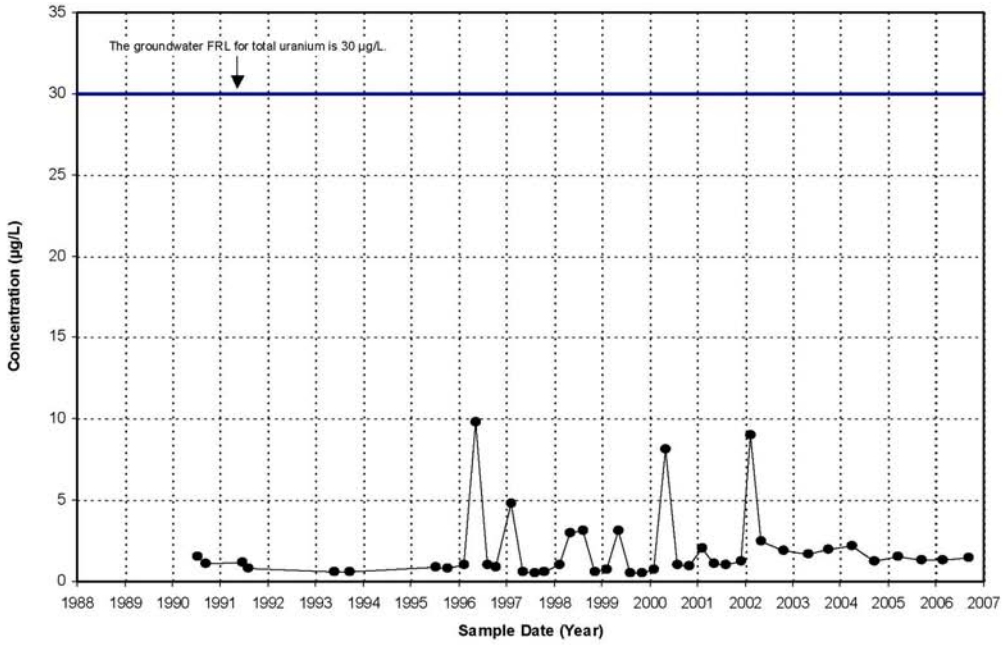

FIGURE A.2-83. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 4125

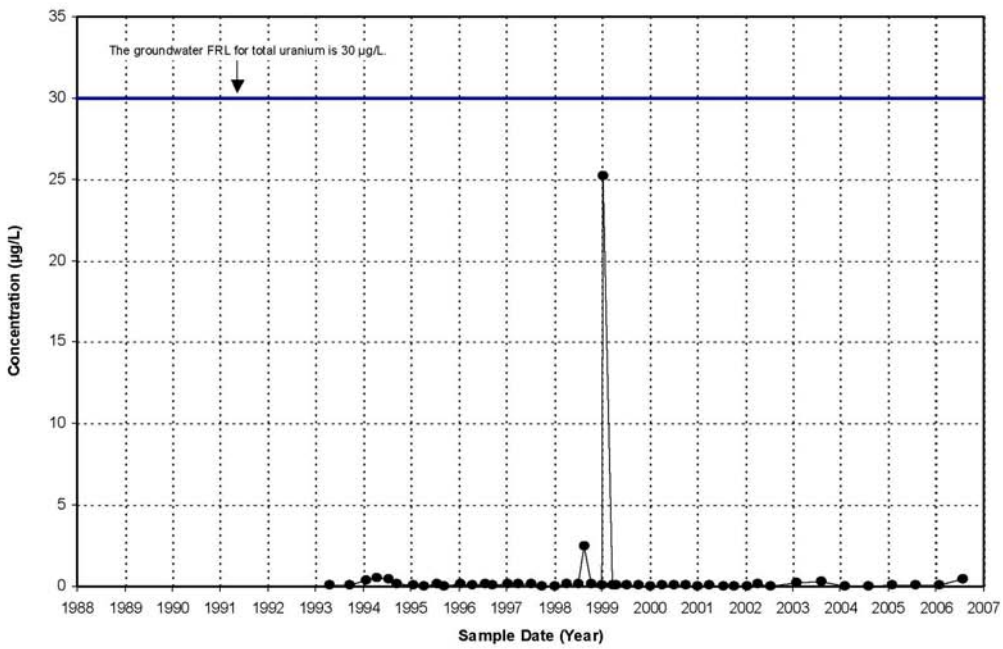

FIGURE A.2-84. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 4398

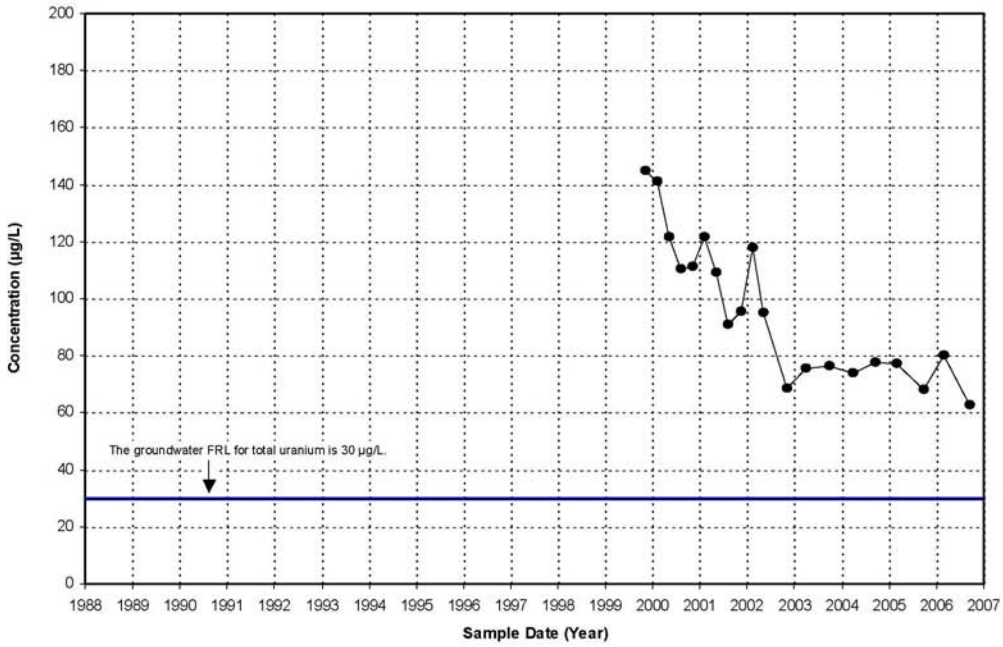

FIGURE A.2-85. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 6880

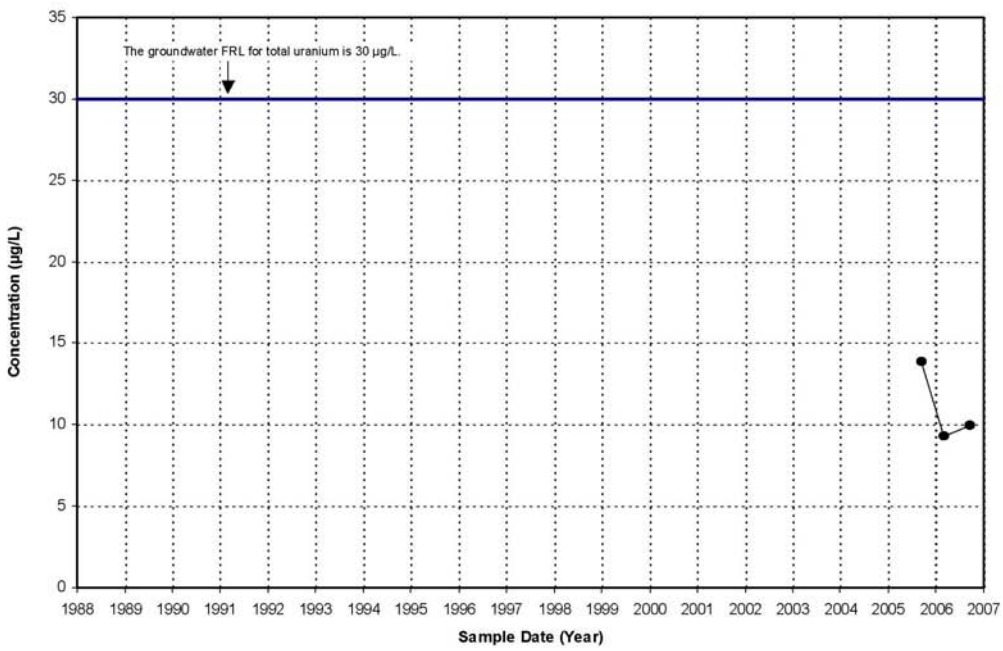

FIGURE A.2-86. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 6015

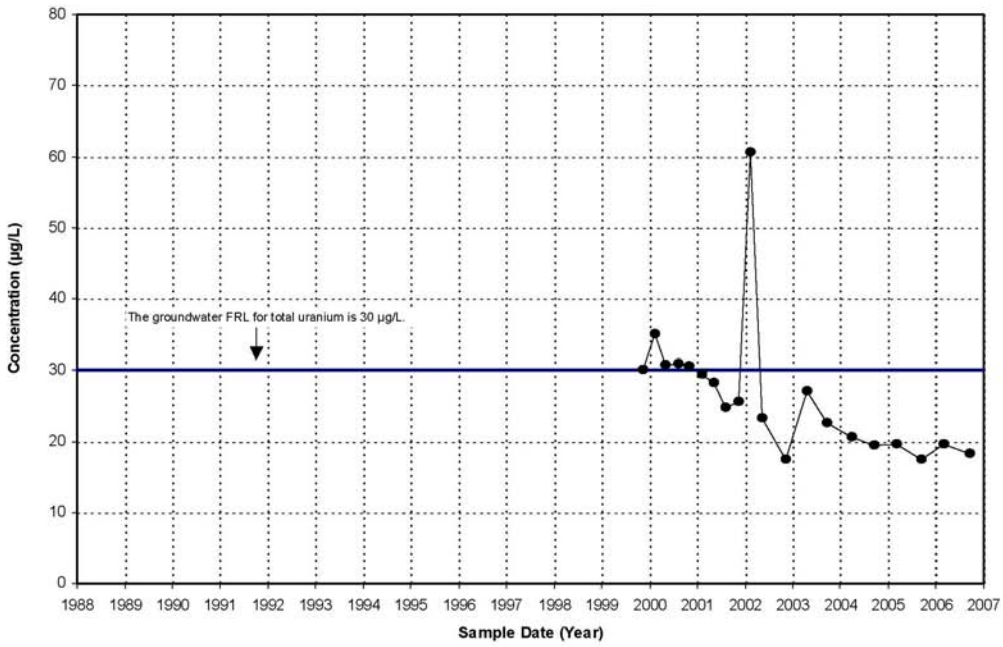

FIGURE A.2-87. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 6881

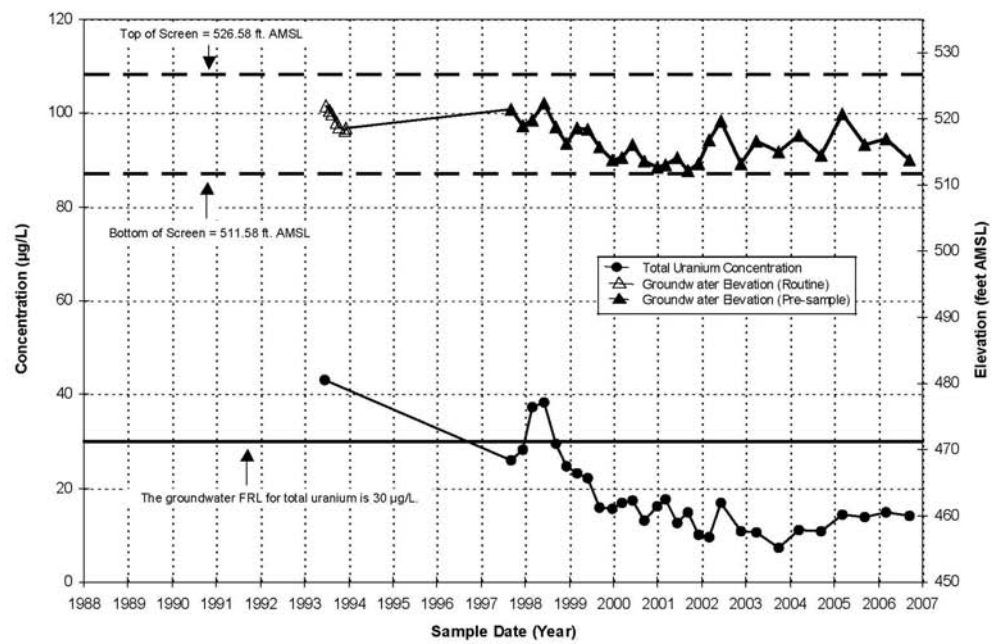

FIGURE A.2-88. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 21033

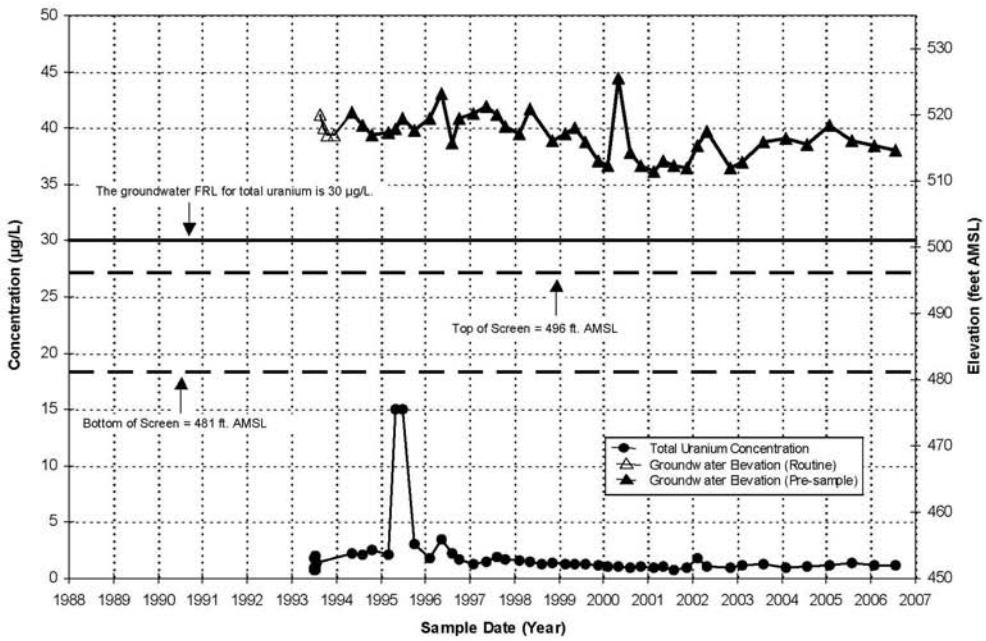

FIGURE A.2-89. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 21063

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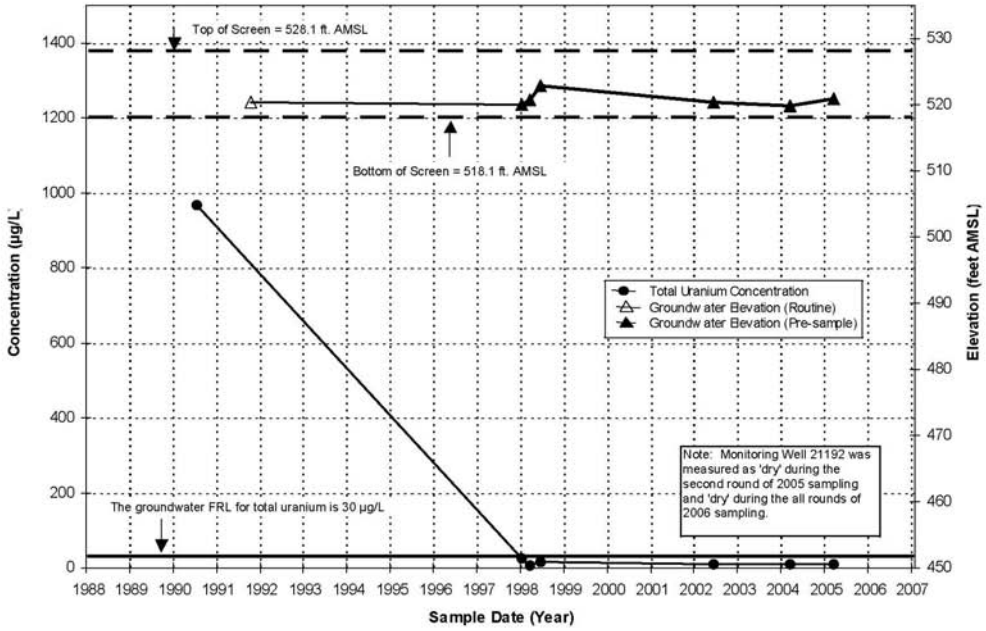

FIGURE A.2-90. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 21192

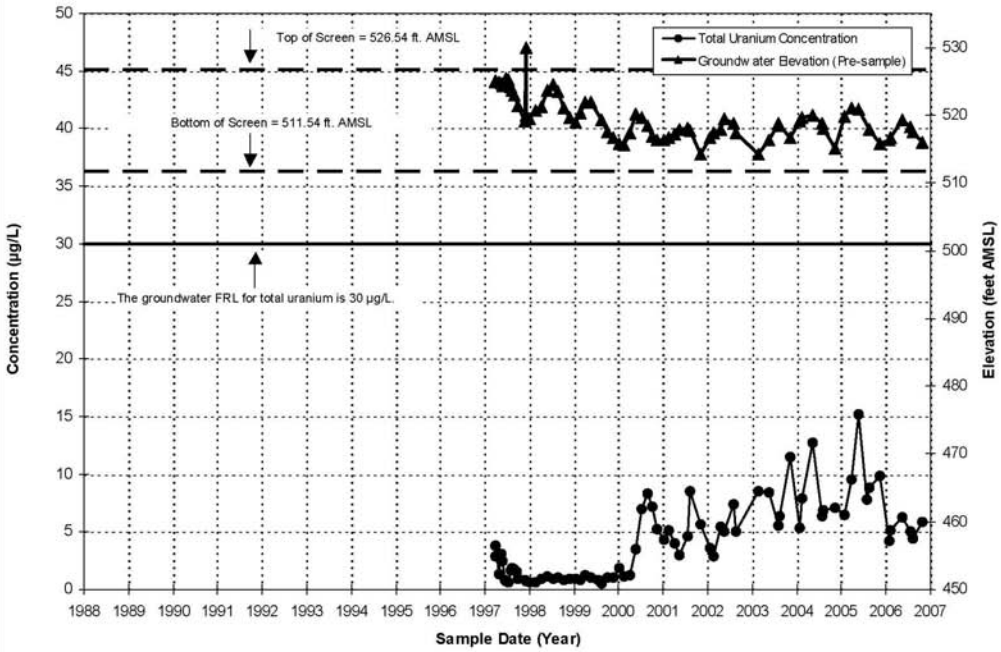

FIGURE A.2-91. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22198

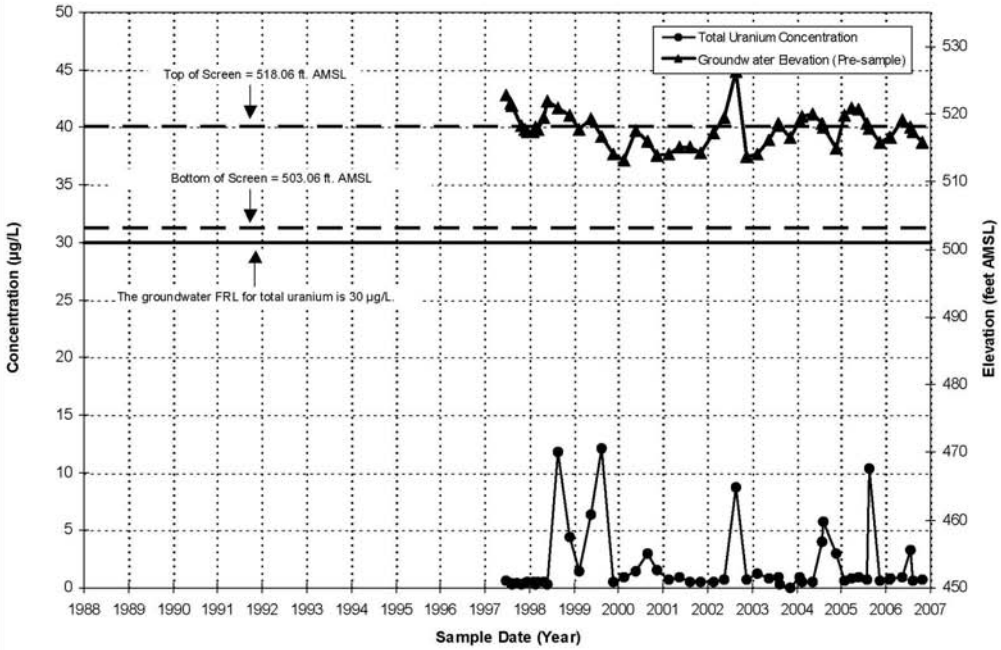

FIGURE A.2-92. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22199

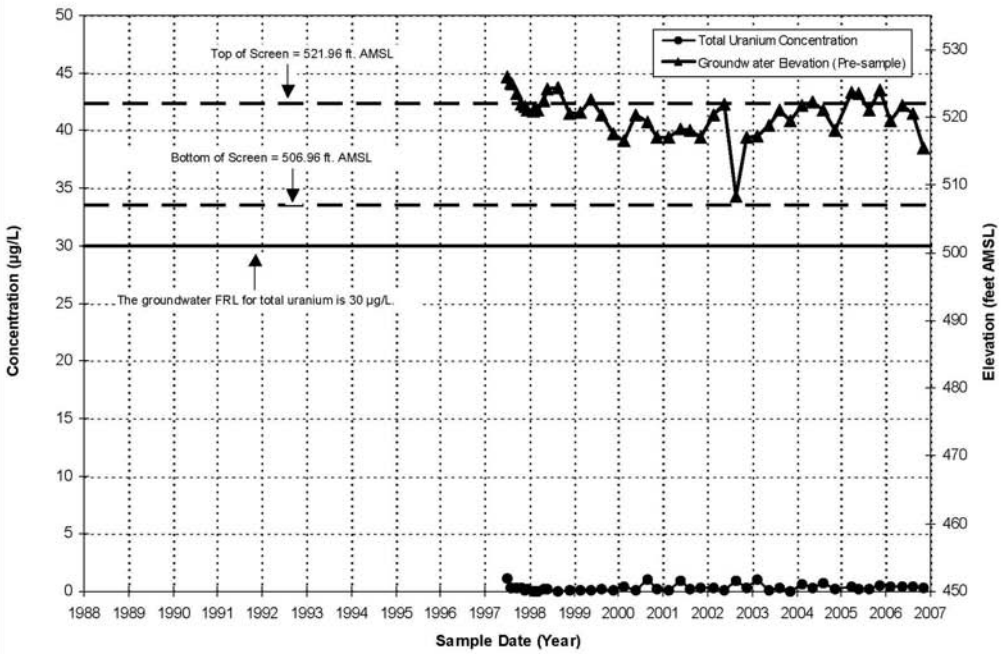

FIGURE A.2-93. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22200

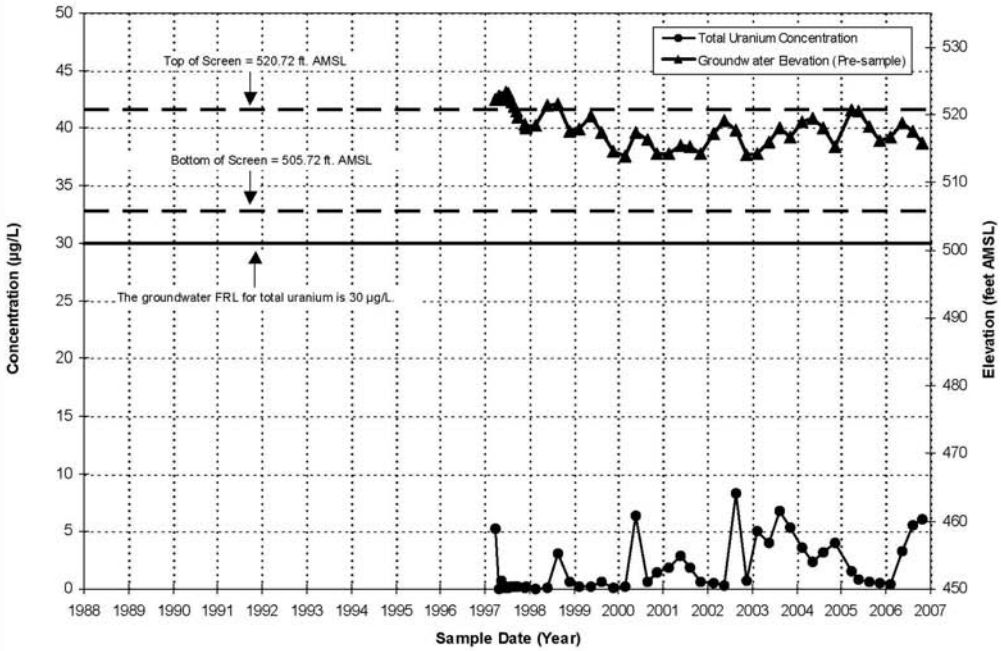

FIGURE A.2-94. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22201

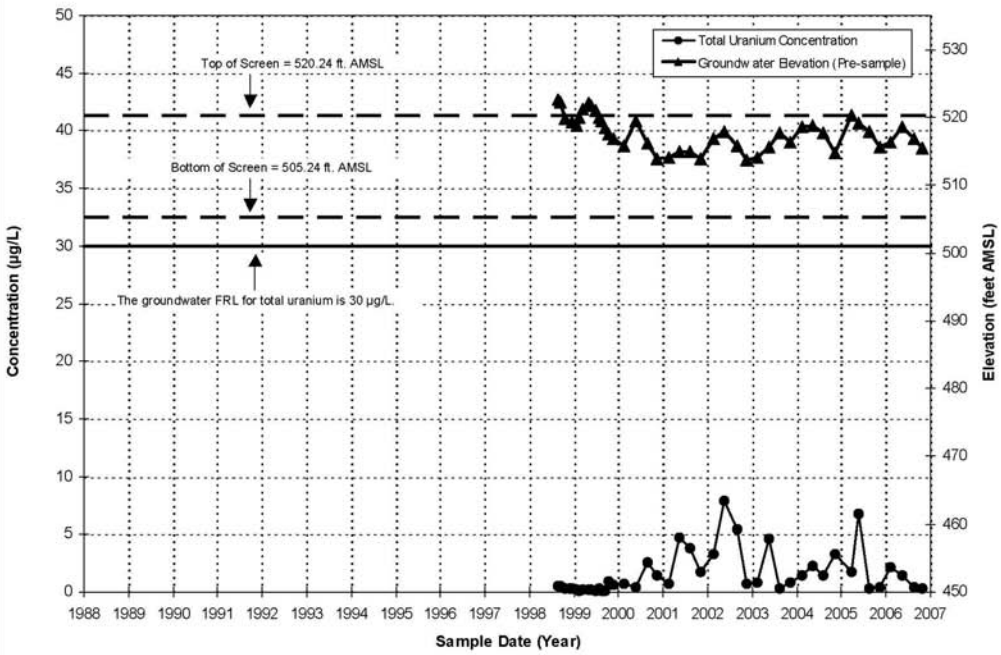

FIGURE A.2-95. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22203

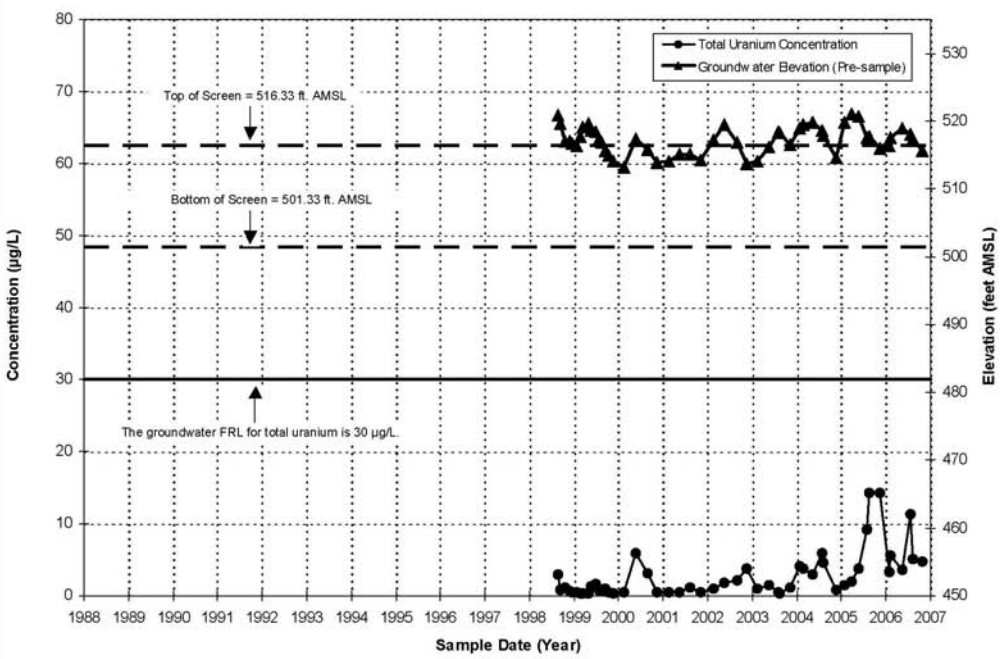

FIGURE A.2-96. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22204

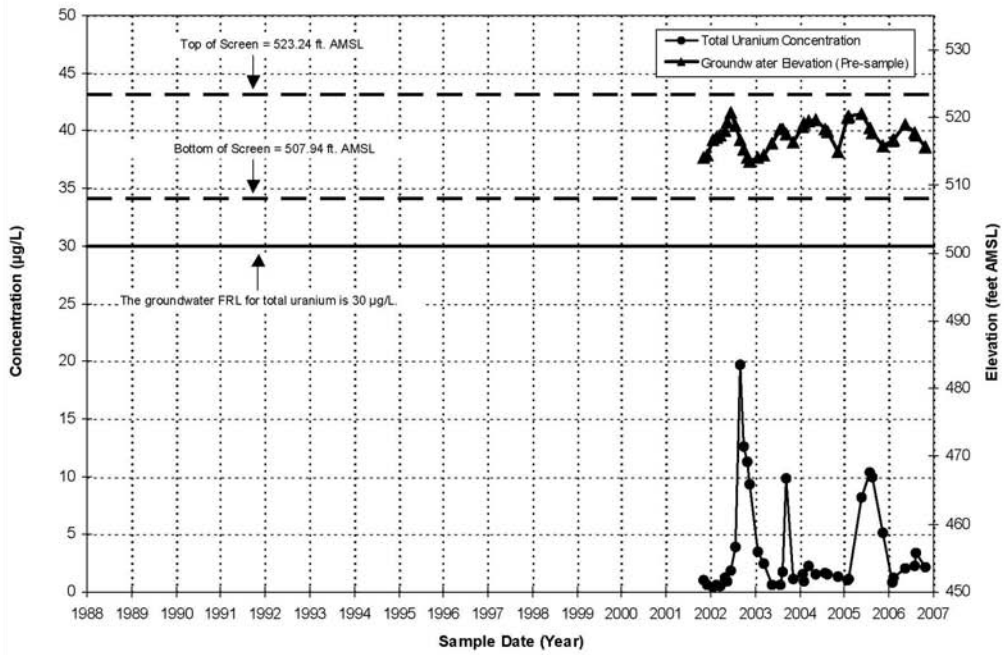

FIGURE A.2-97. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22205

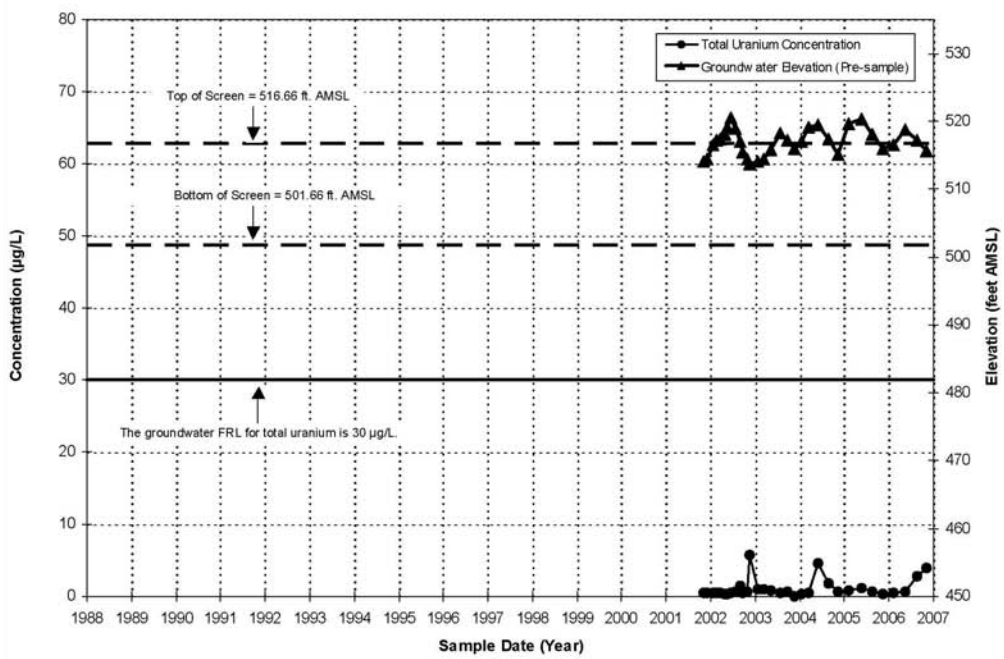

FIGURE A.2-98. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22206

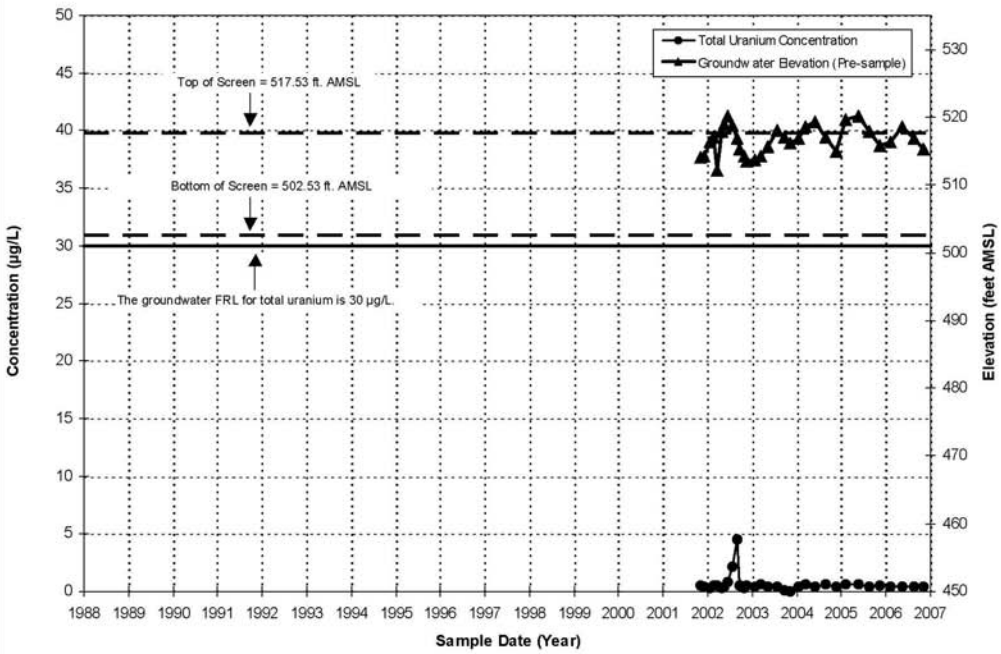

FIGURE A.2-99. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22207

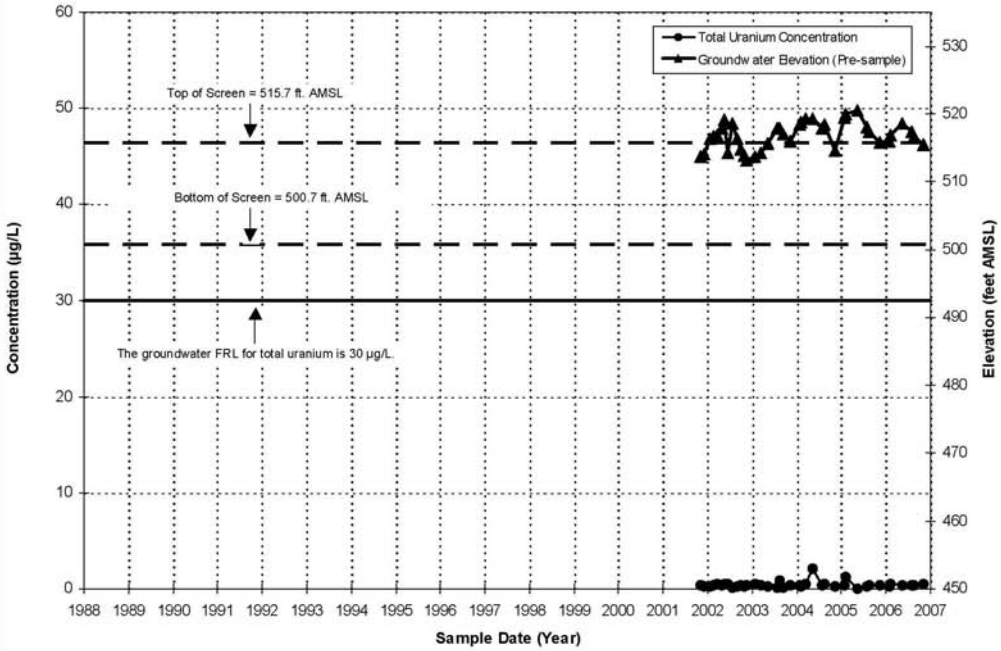

FIGURE A.2-100. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22208

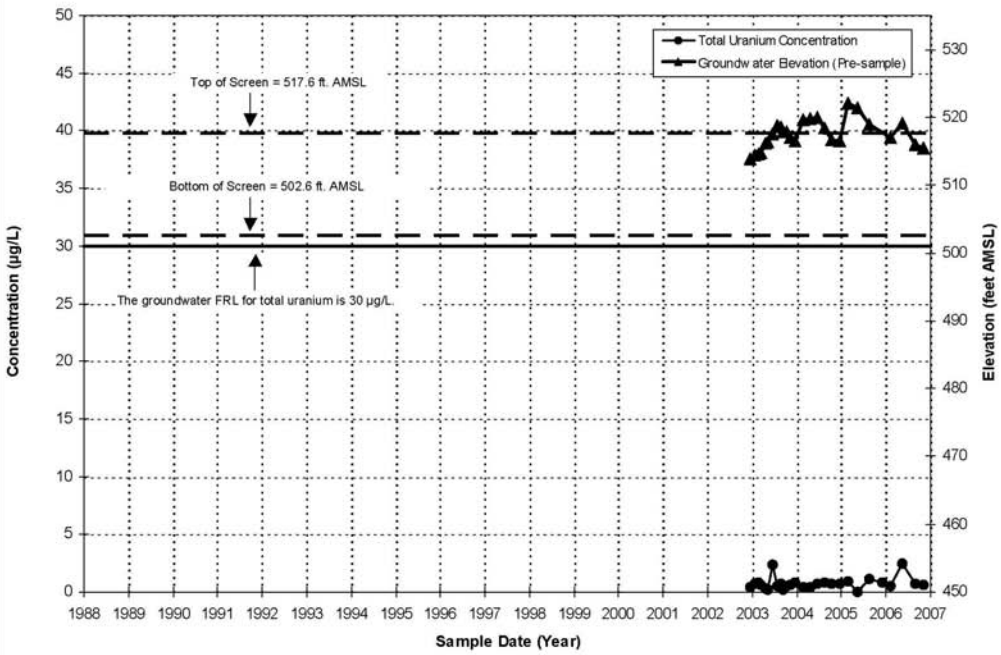

FIGURE A.2-101. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22209

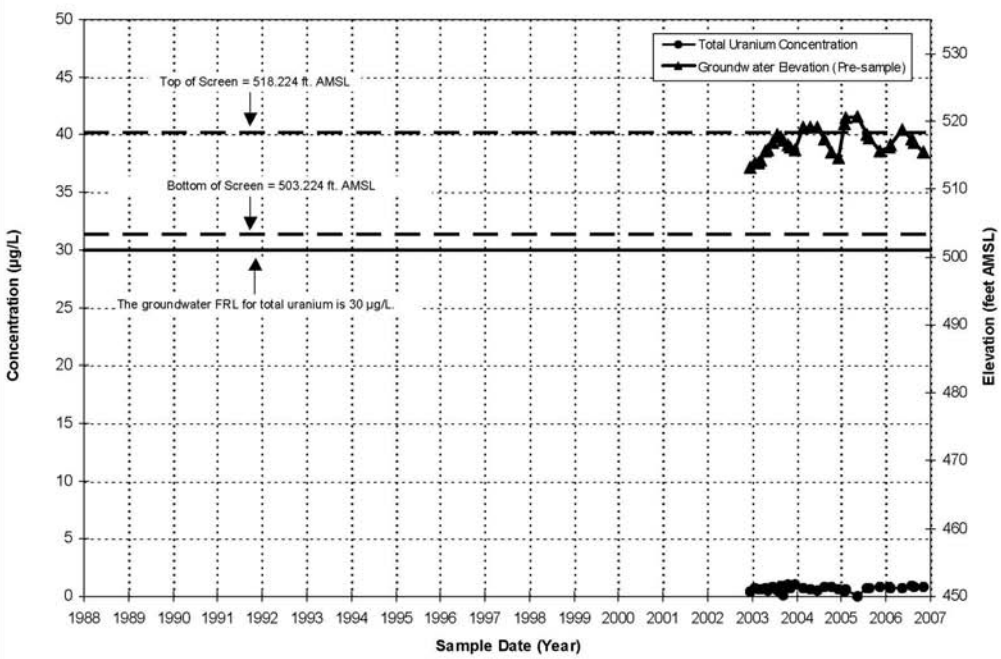

FIGURE A.2-102. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22210

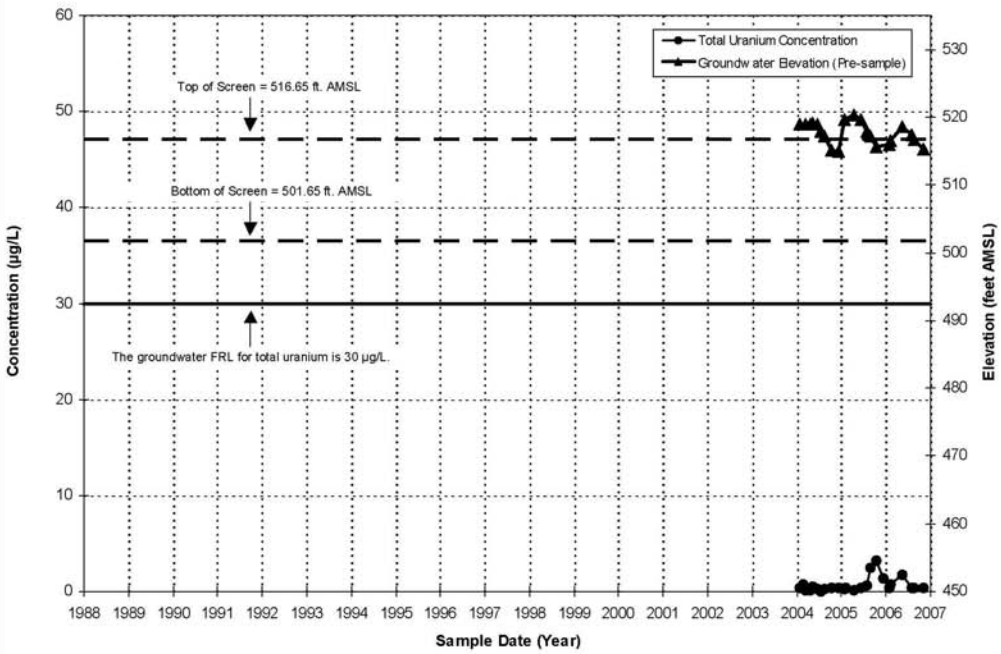

FIGURE A.2-103. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22211

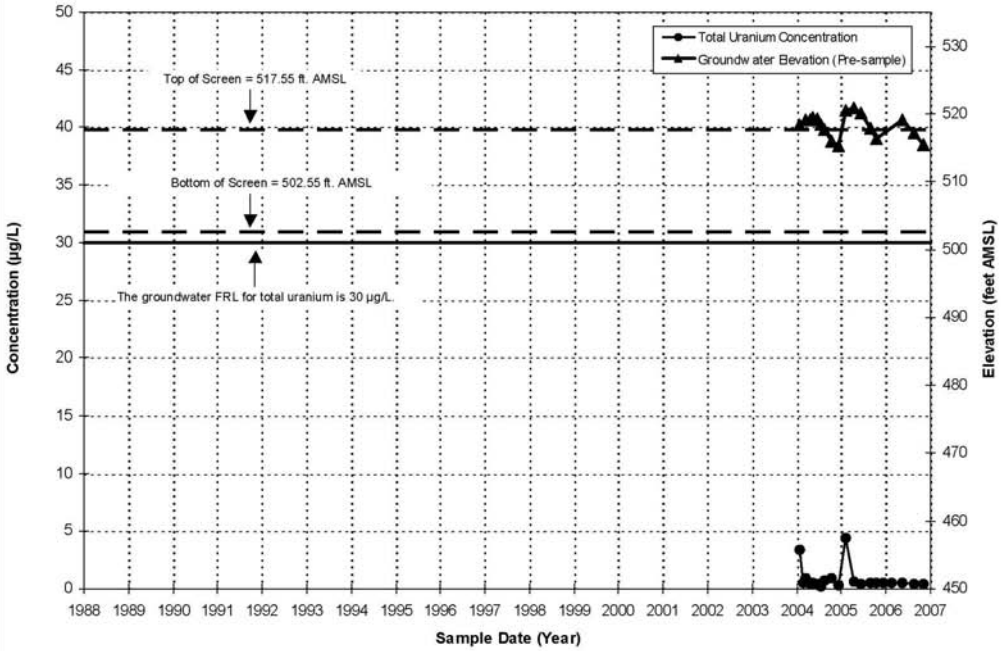

FIGURE A.2-104. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22212

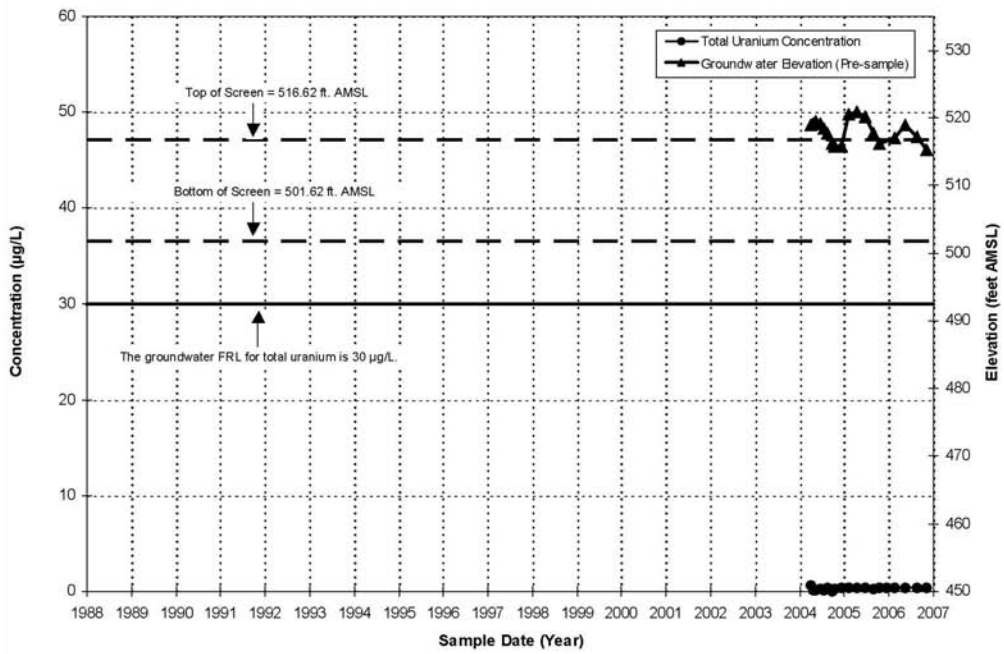

FIGURE A.2-105. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22213

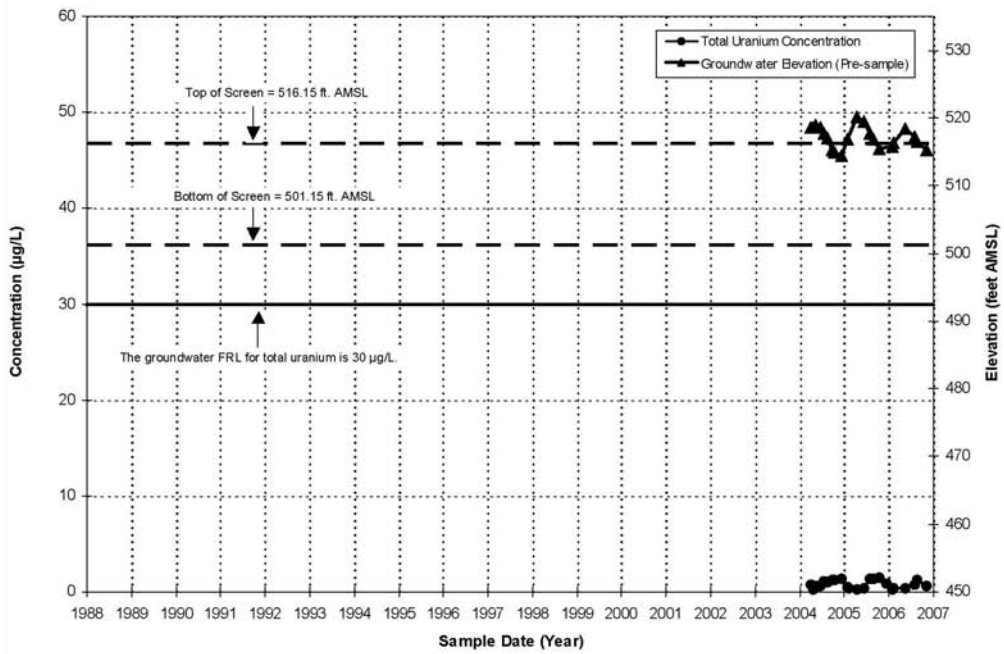

FIGURE A.2-106. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22214

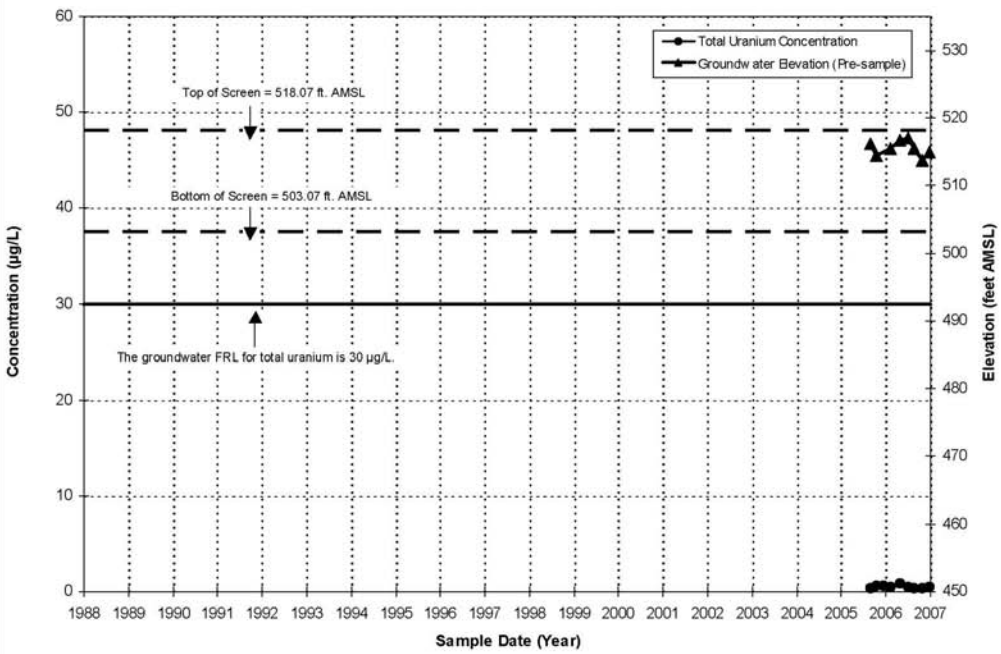

FIGURE A.2-107. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22215

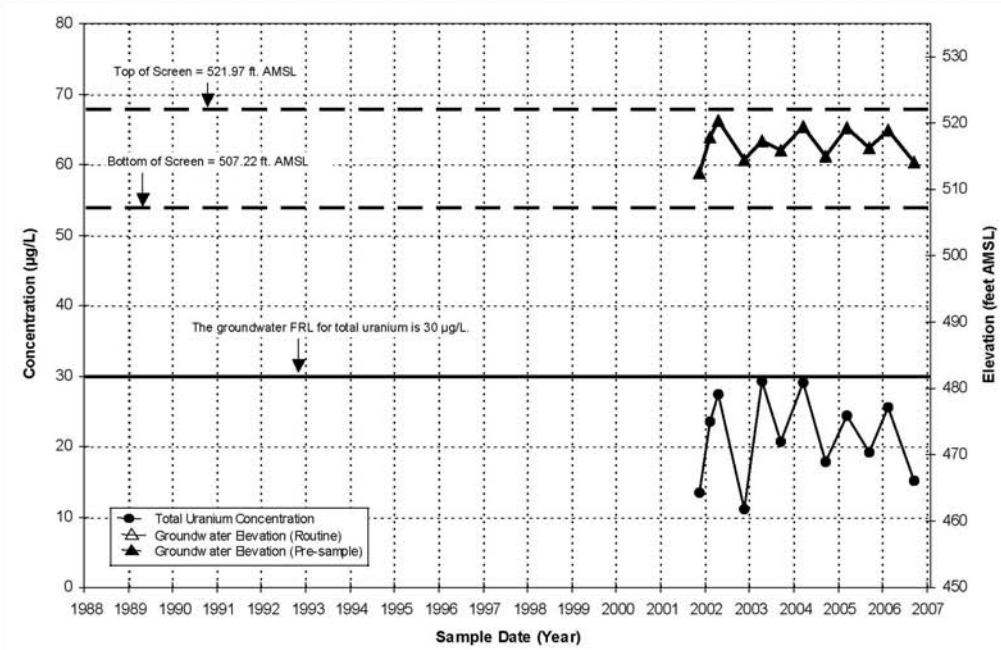

FIGURE A.2-108. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23064

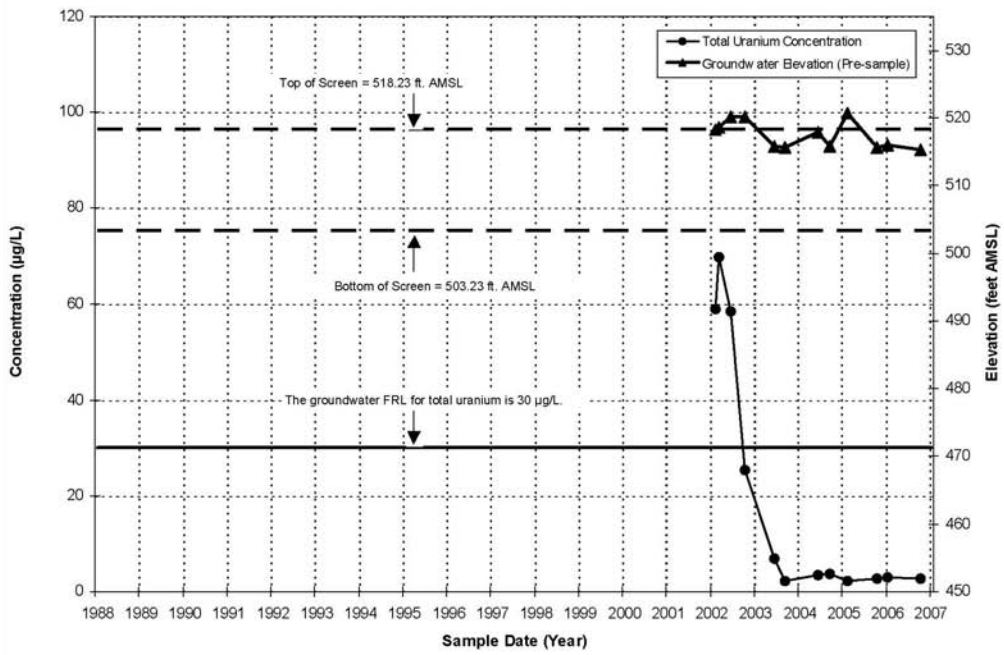

FIGURE A.2-109. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23118

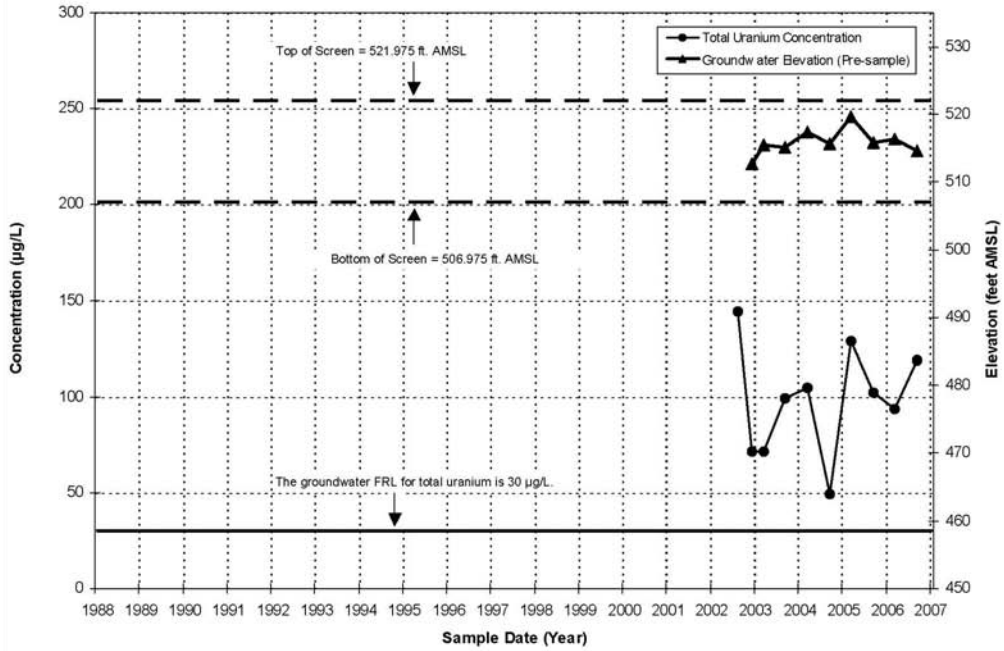

FIGURE A.2-110. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23271

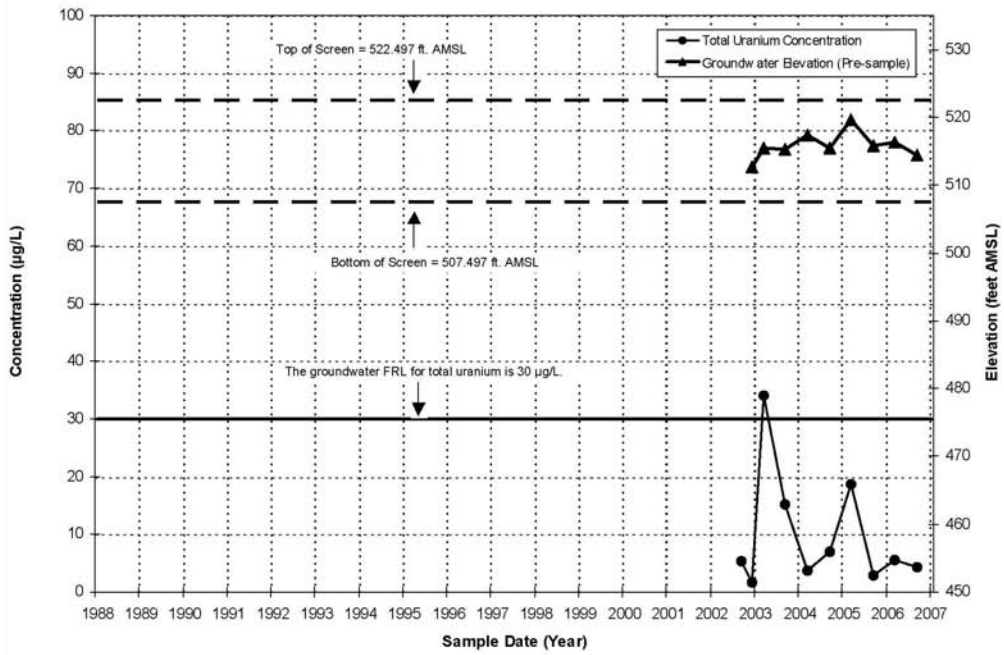

FIGURE A.2-111. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23272

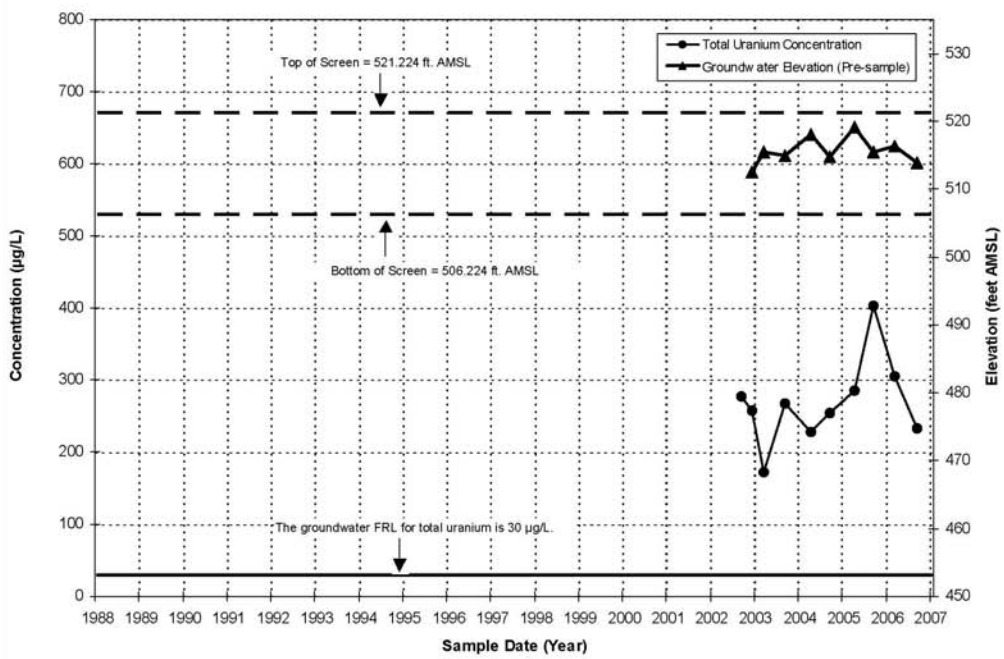

FIGURE A.2-112. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23273

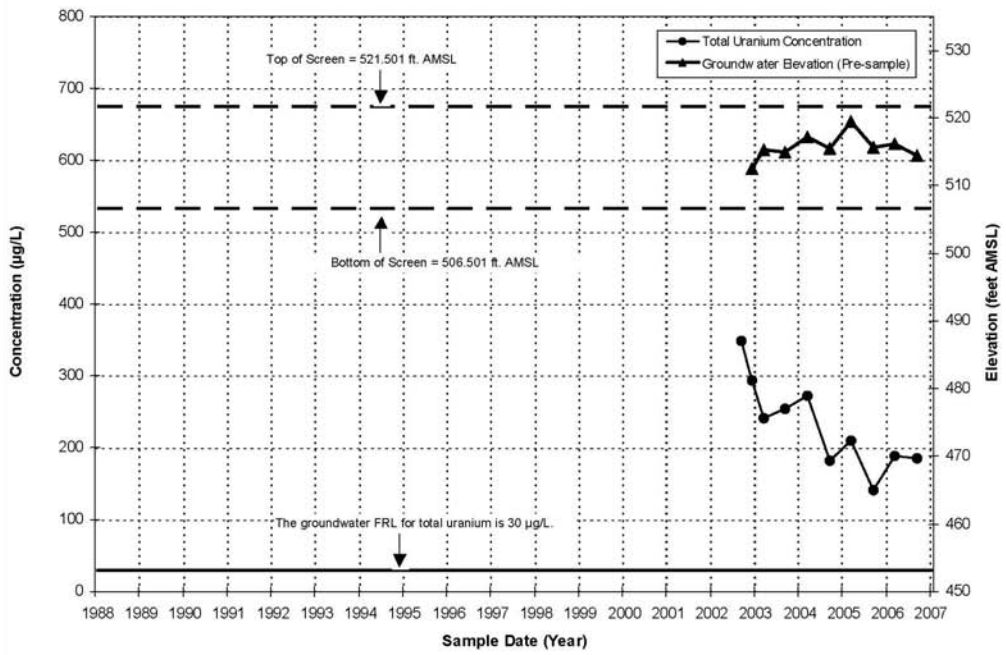

FIGURE A.2-113. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23274

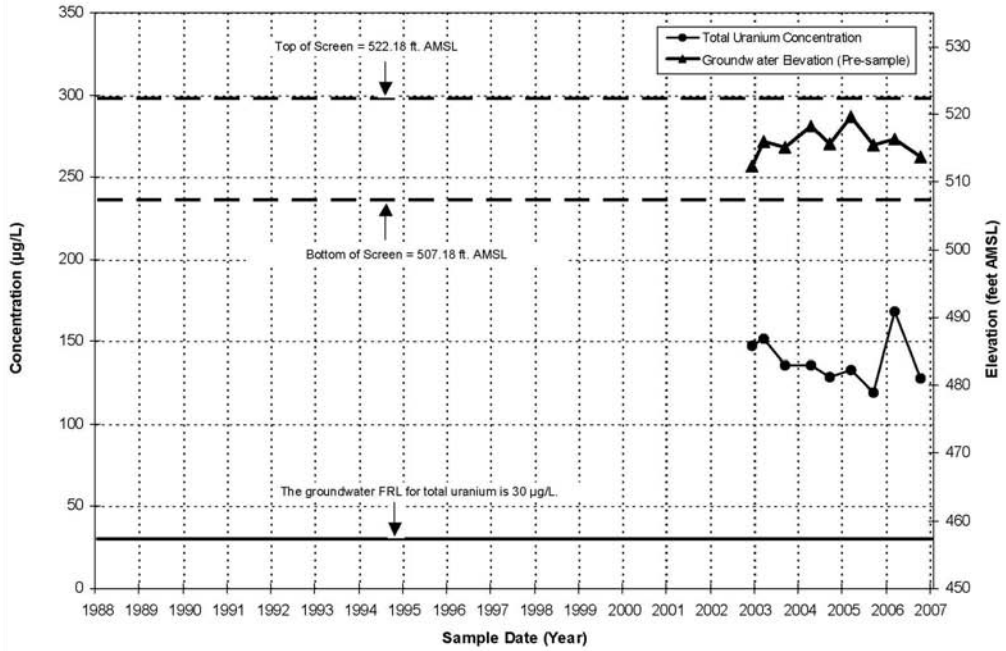

FIGURE A.2-114. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23275

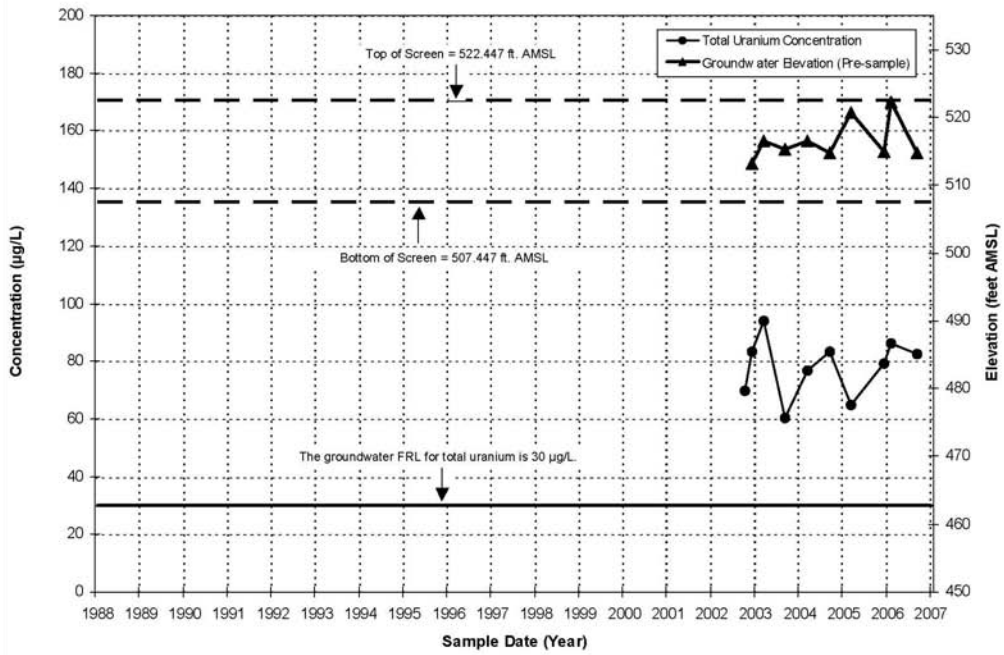

FIGURE A.2-115. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23276

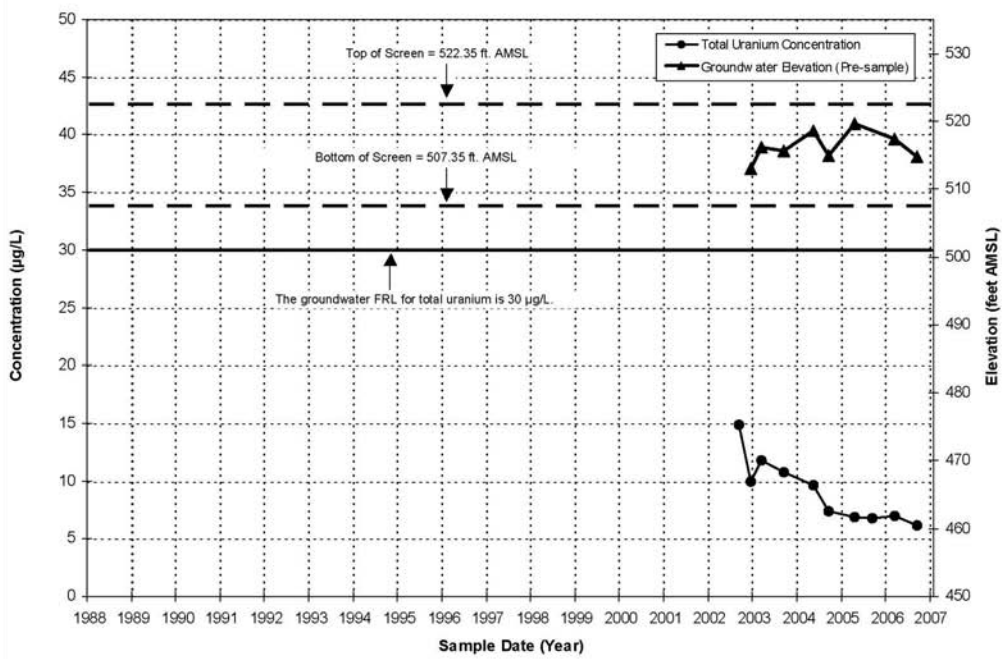

FIGURE A.2-116. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23277

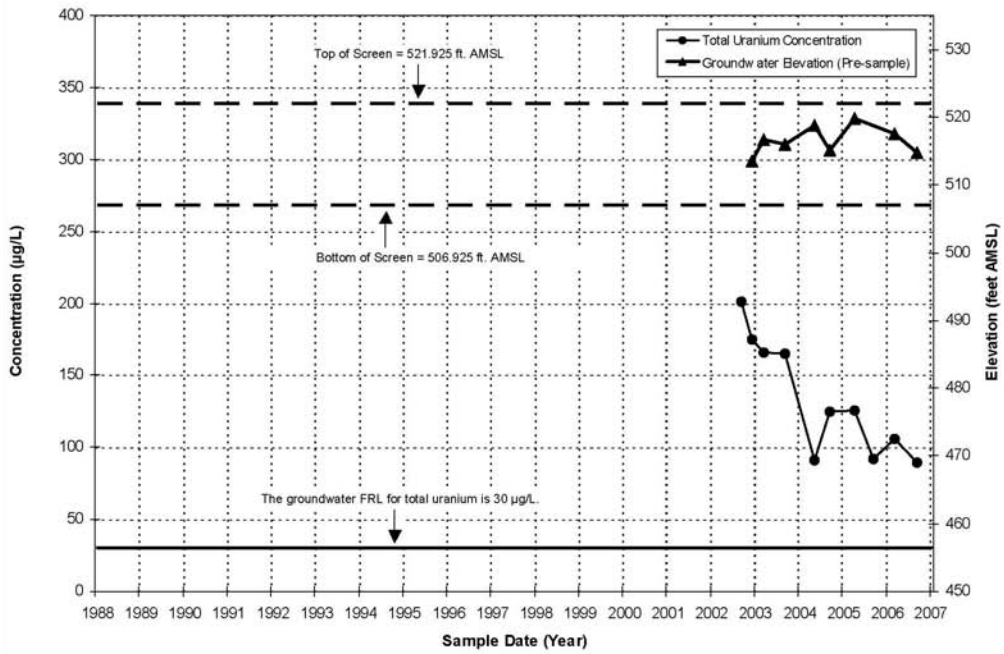

FIGURE A.2-117. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23278

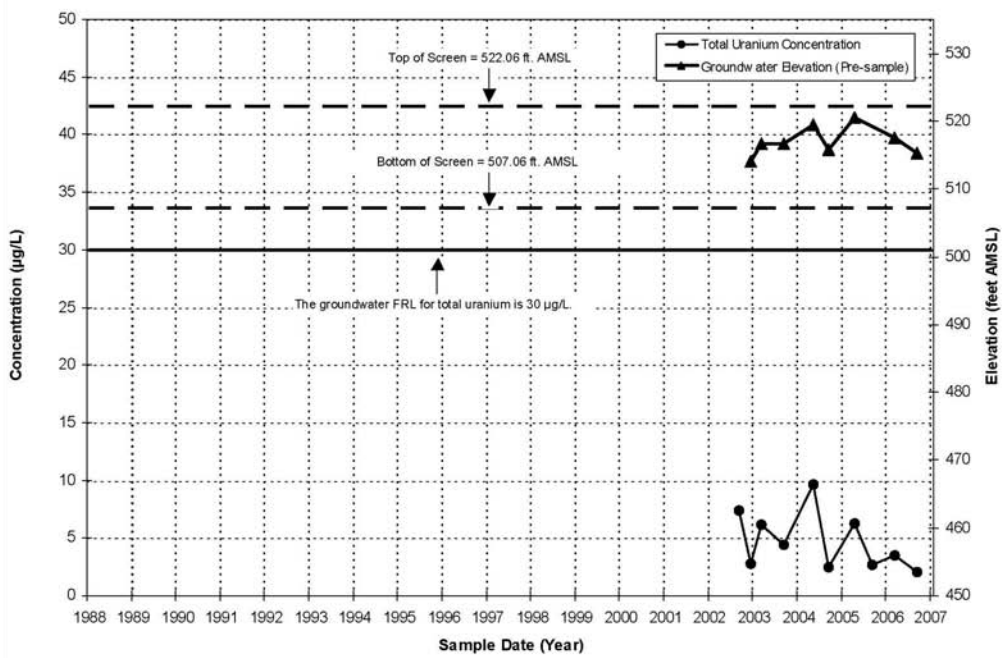

FIGURE A.2-118. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23279

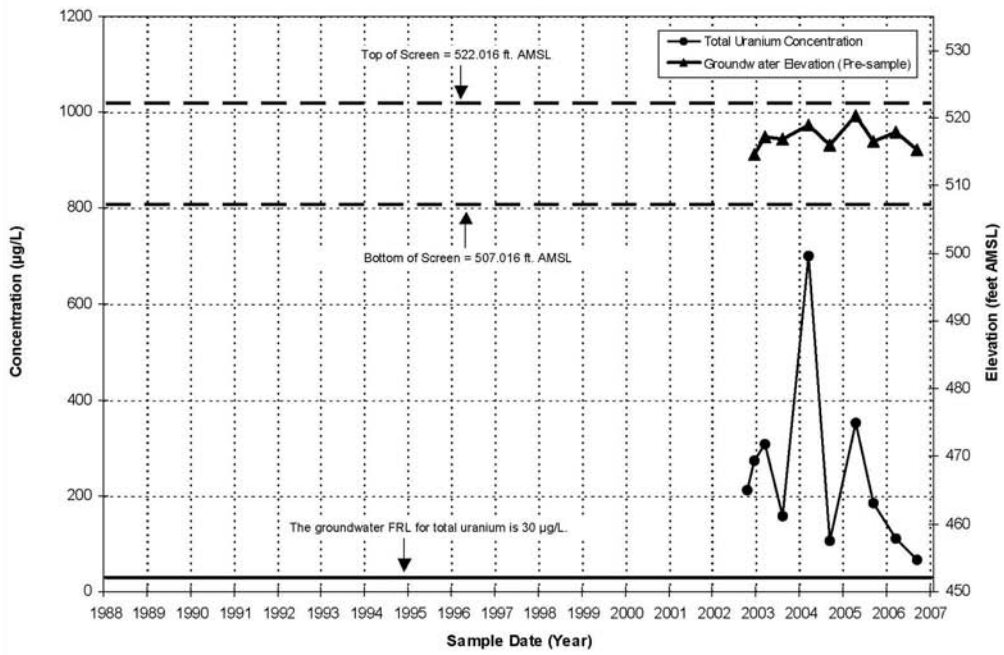

FIGURE A.2-119. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23280

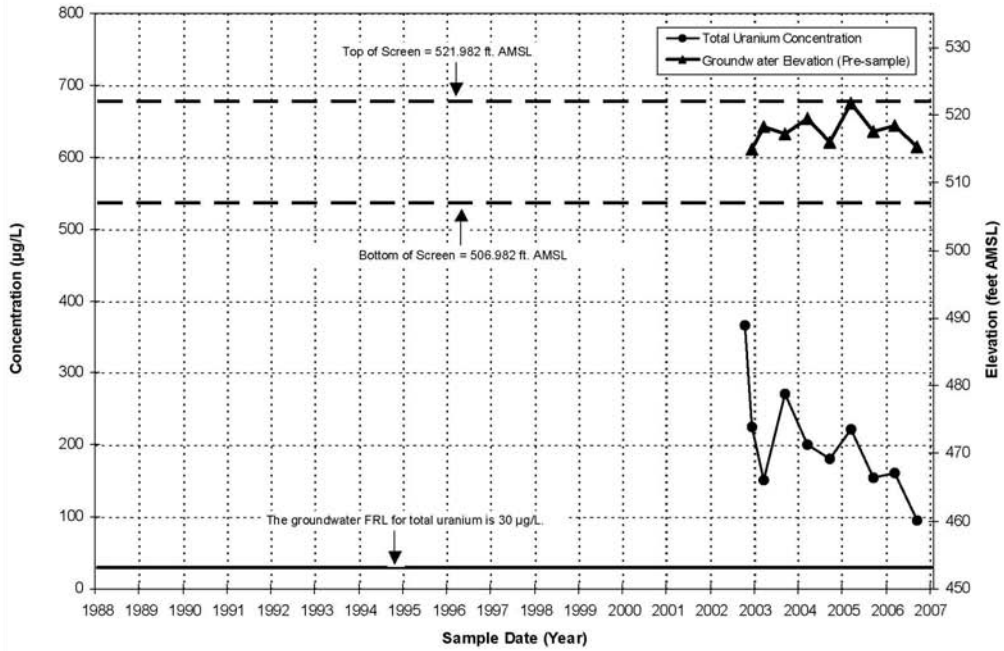

FIGURE A.2-120. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23281

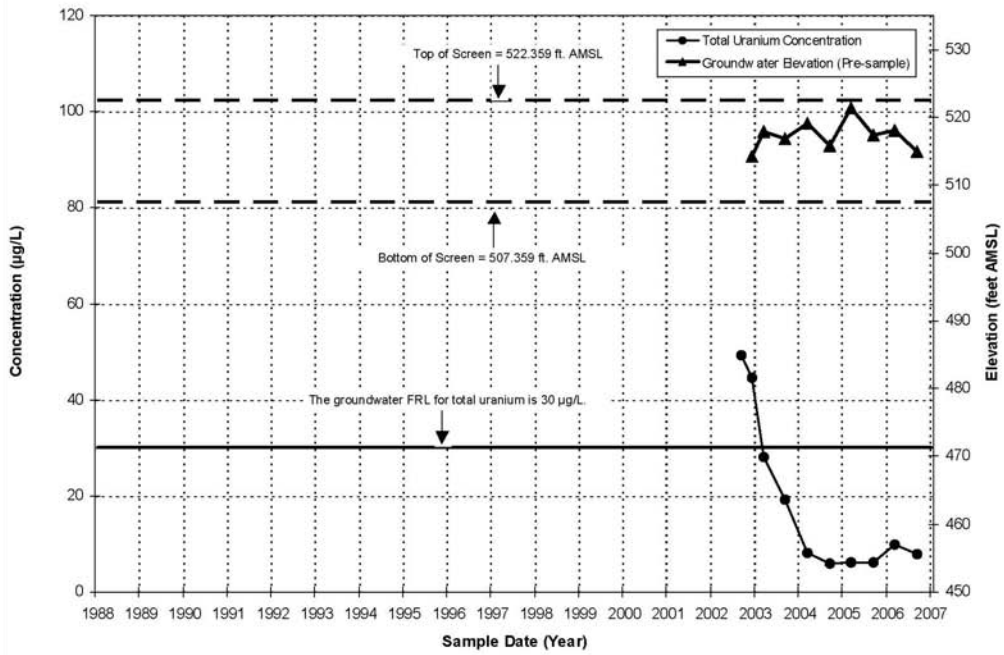

FIGURE A.2-121. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23282

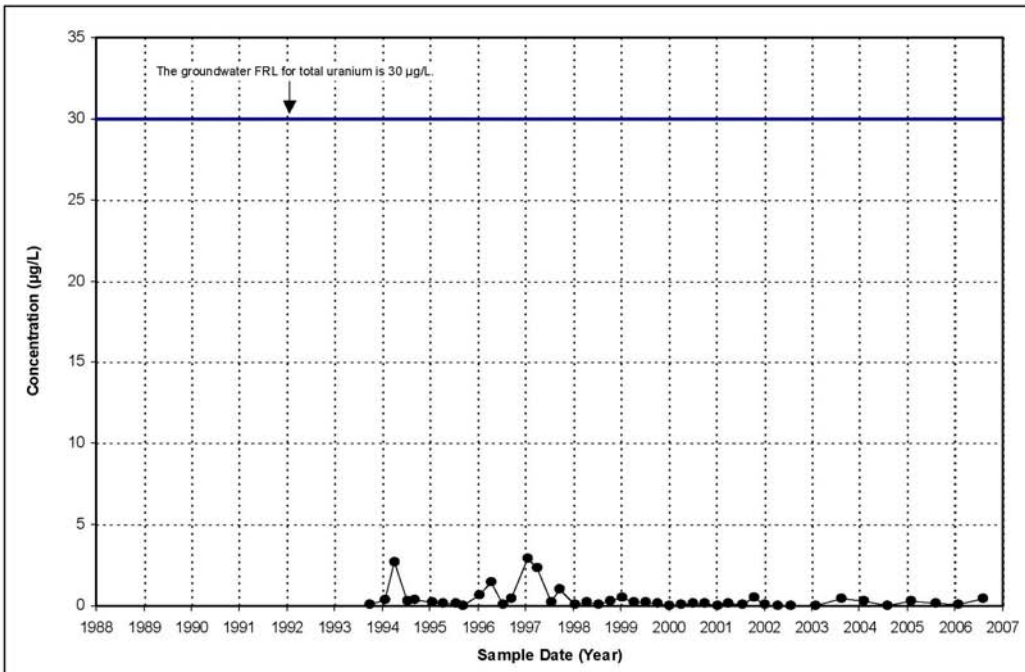

FIGURE A.2-122. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 31217

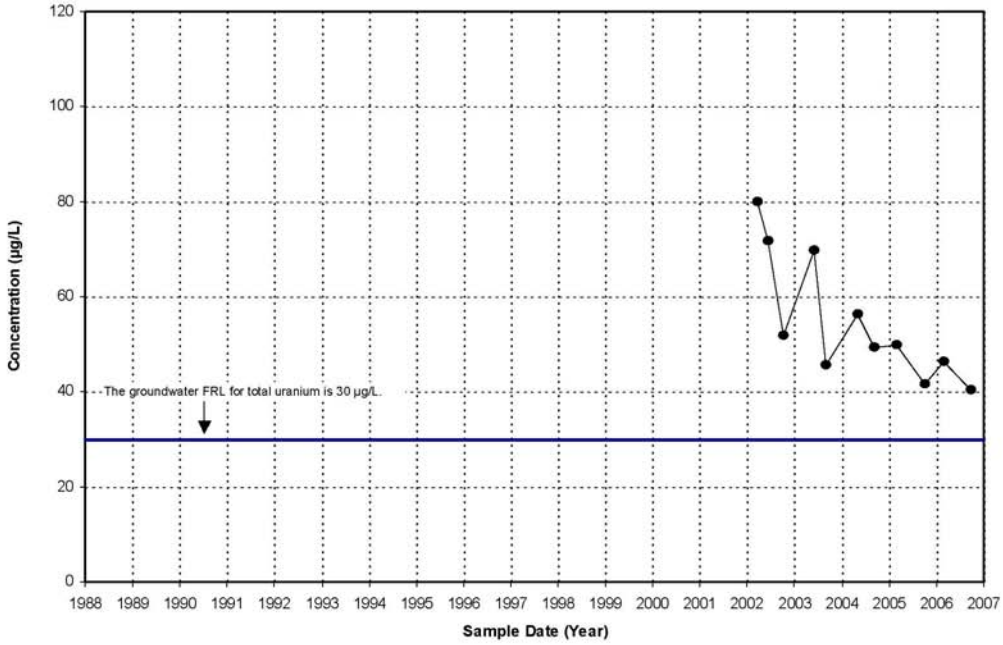

FIGURE A.2-123. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 32766

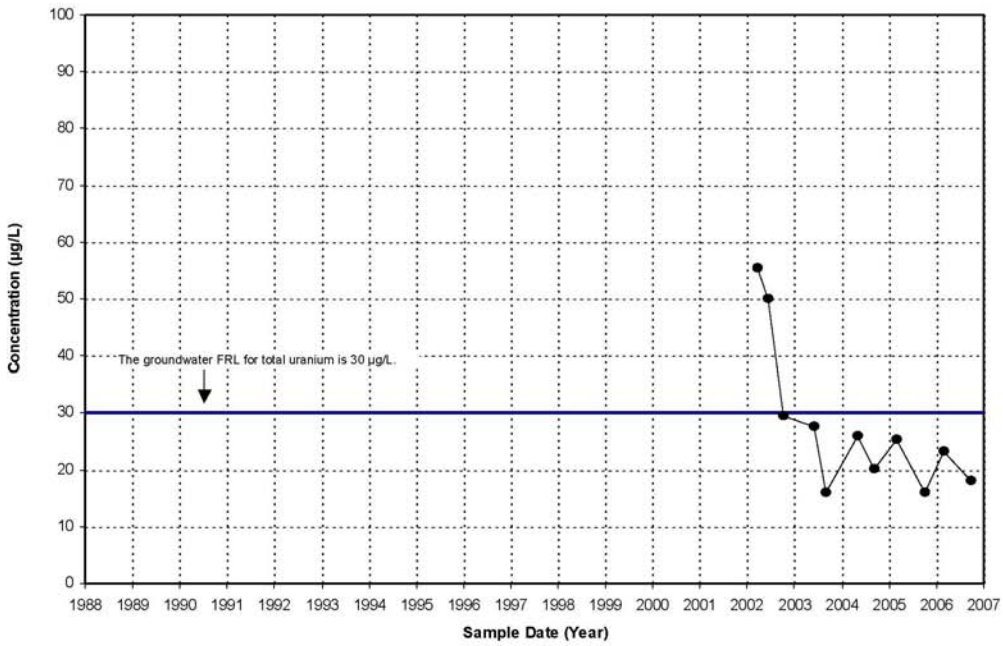

FIGURE A.2-124. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 32768

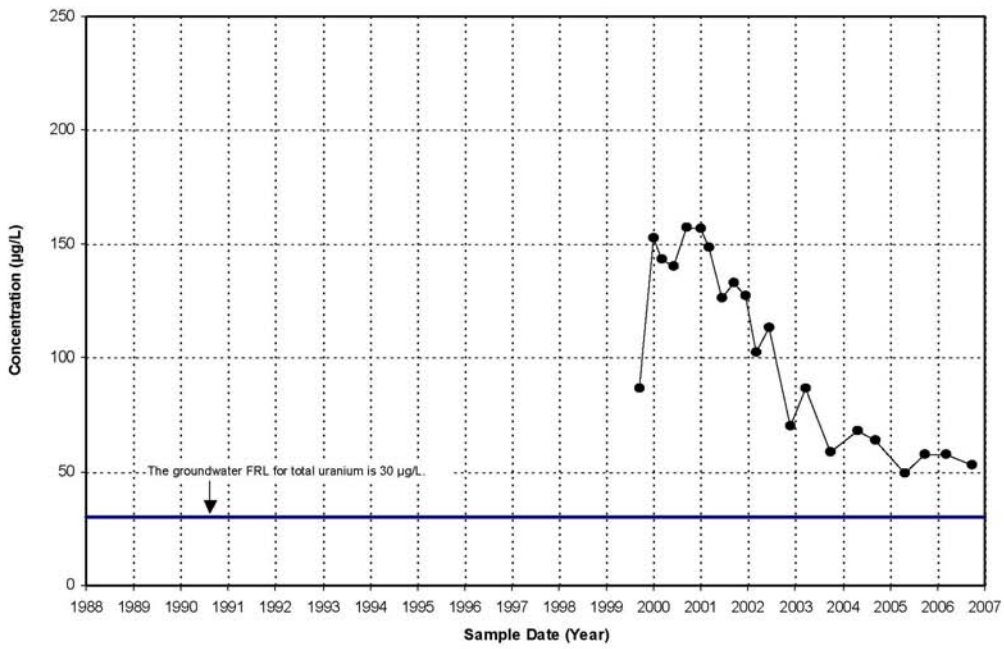

FIGURE A.2-125. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 62408

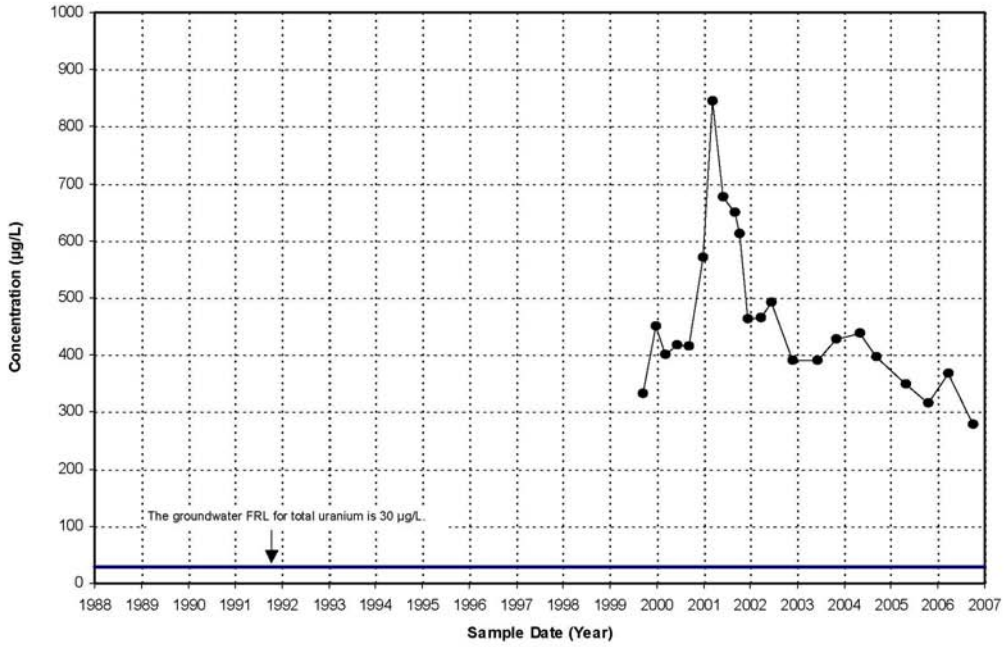

FIGURE A.2-126. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 62433

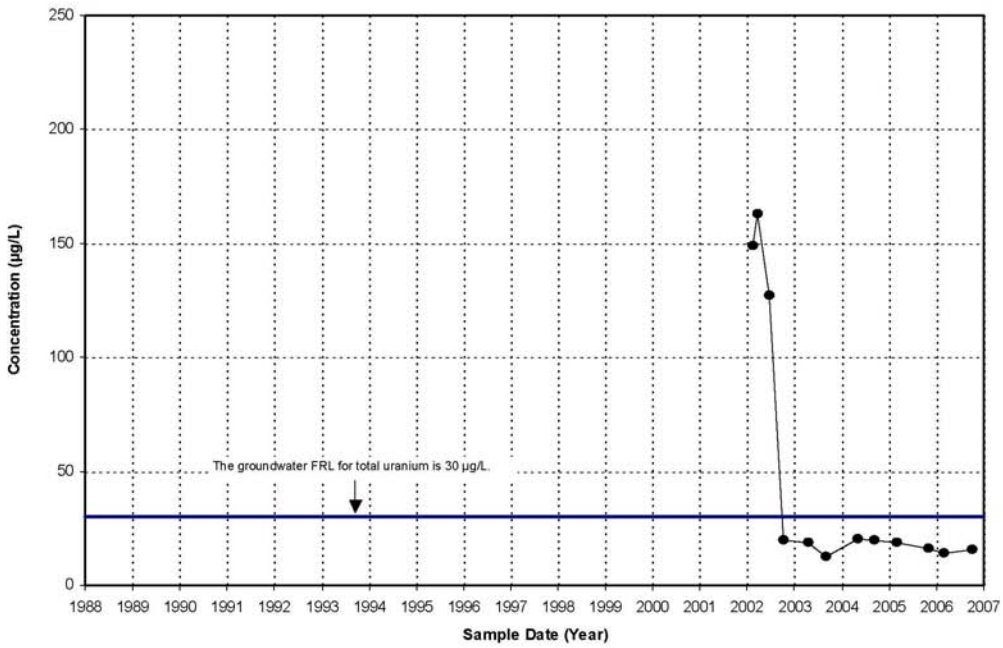

FIGURE A.2-127. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63116

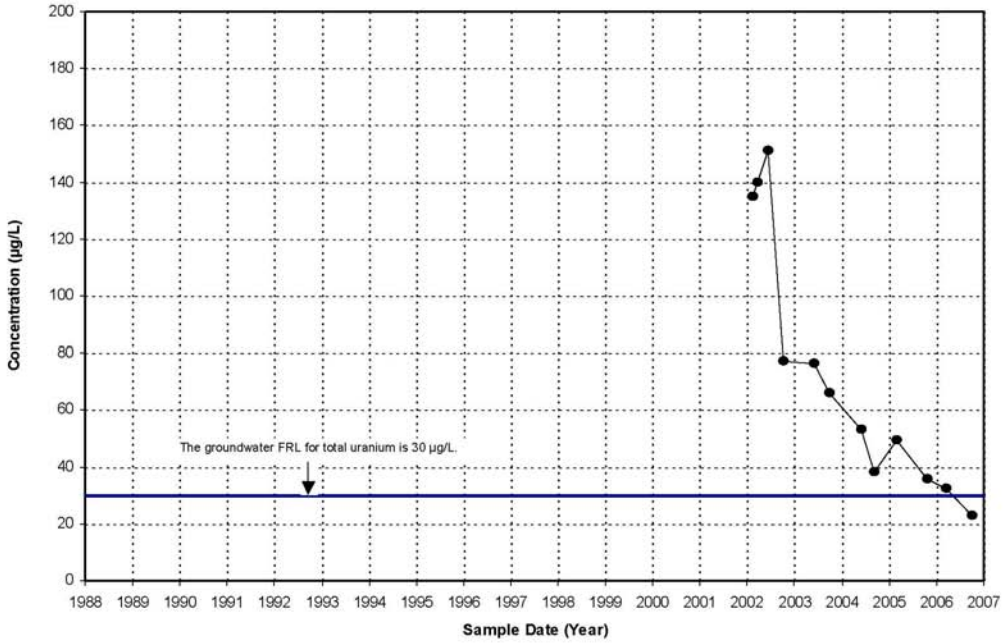

FIGURE A.2-128. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63119

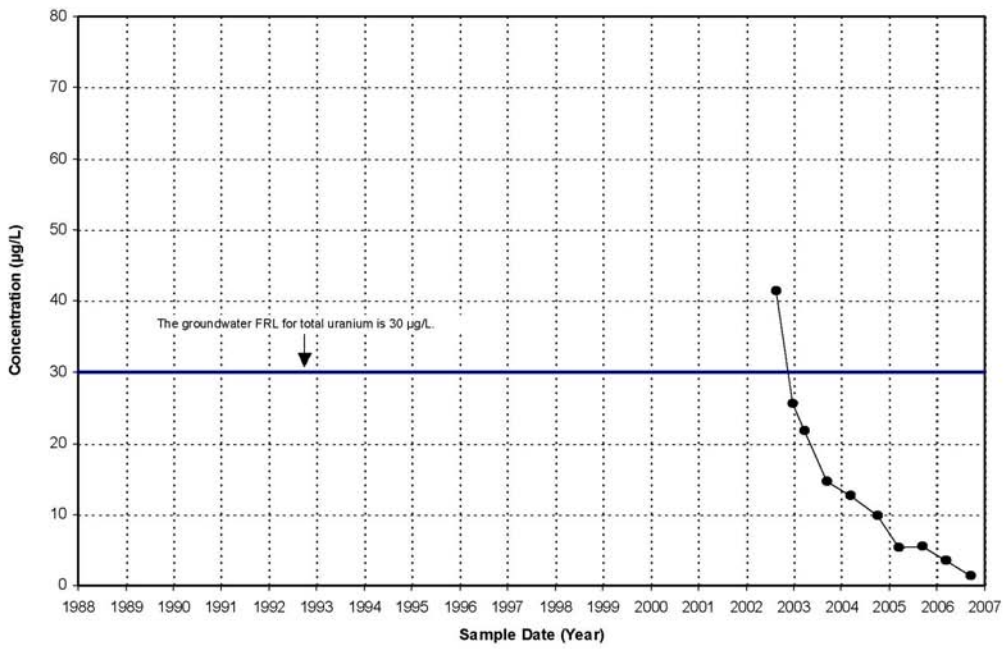

FIGURE A.2-129. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63283

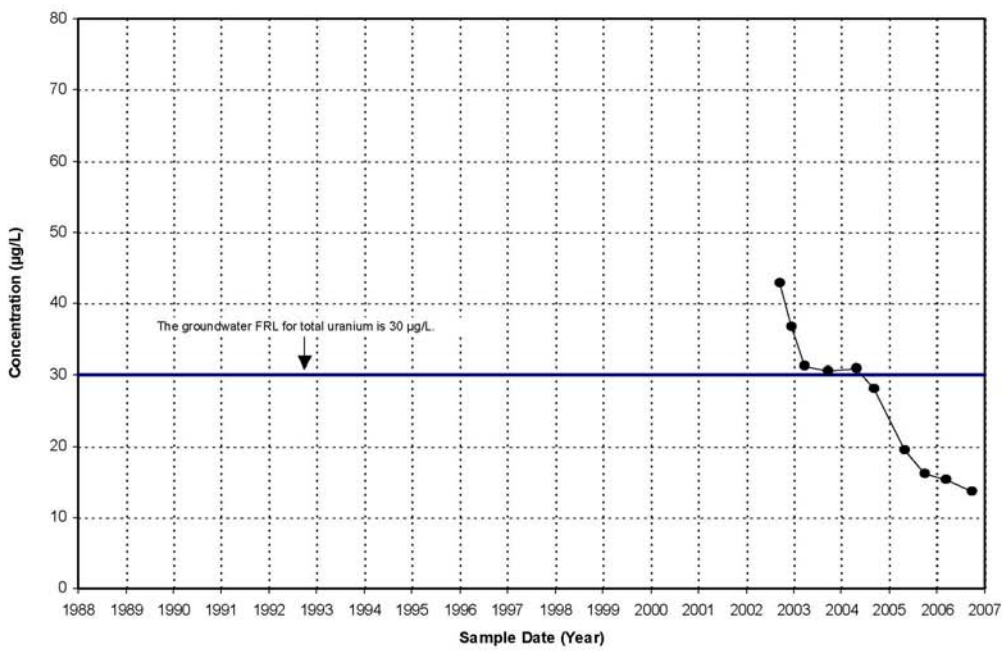

FIGURE A.2-130. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63284

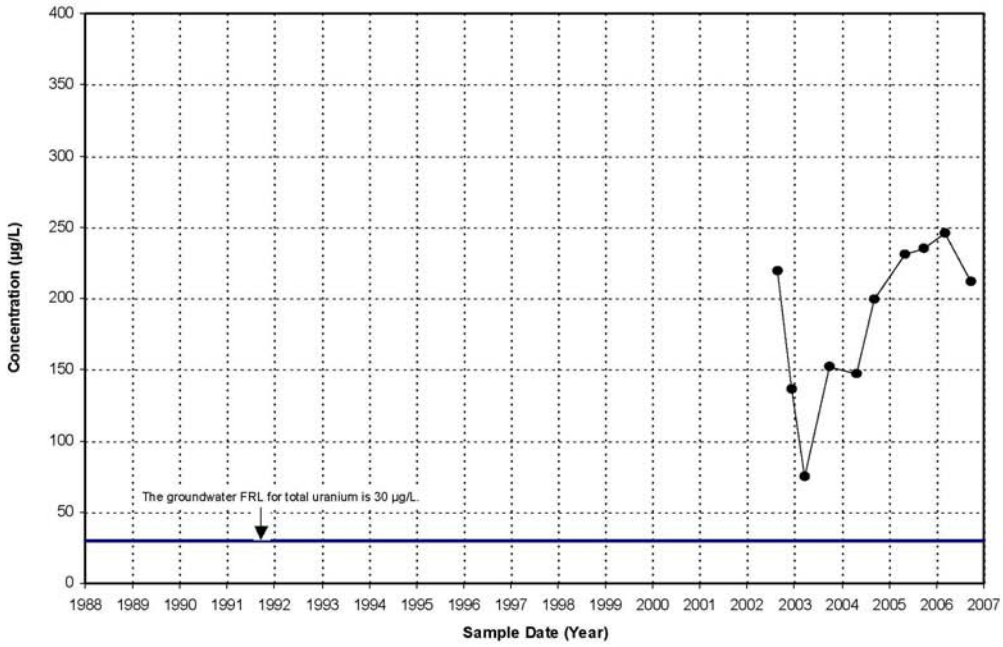

FIGURE A.2-131. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63285

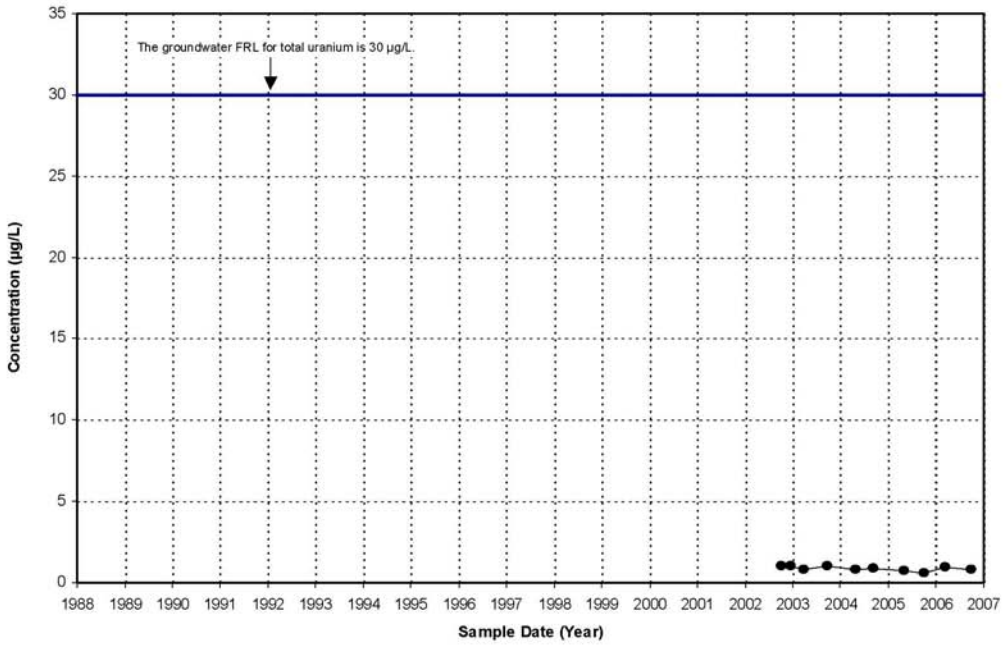

FIGURE A.2-132. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63286

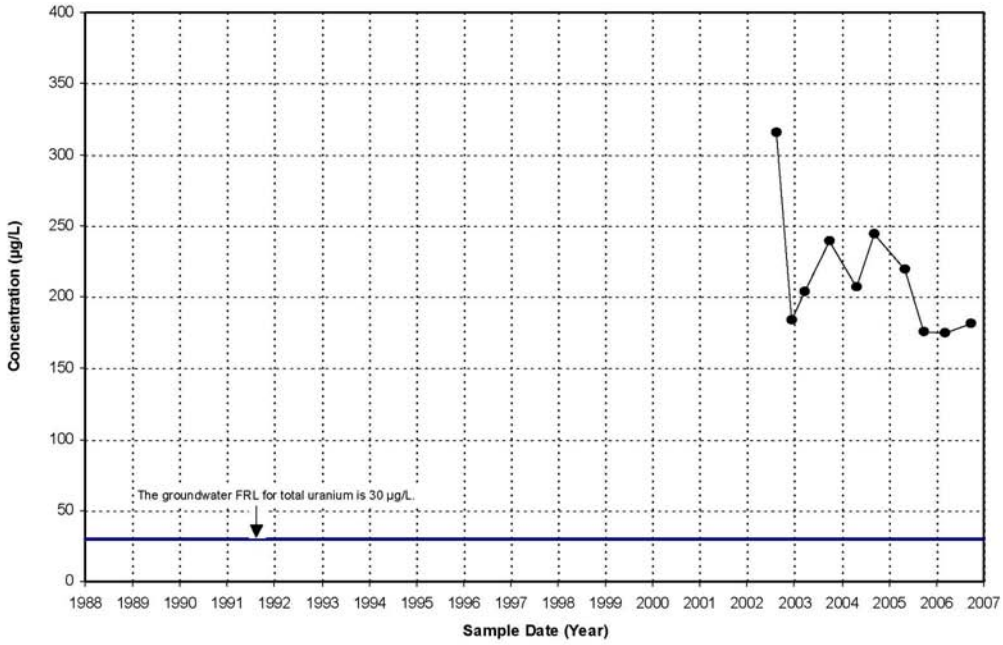

FIGURE A.2-133. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63287

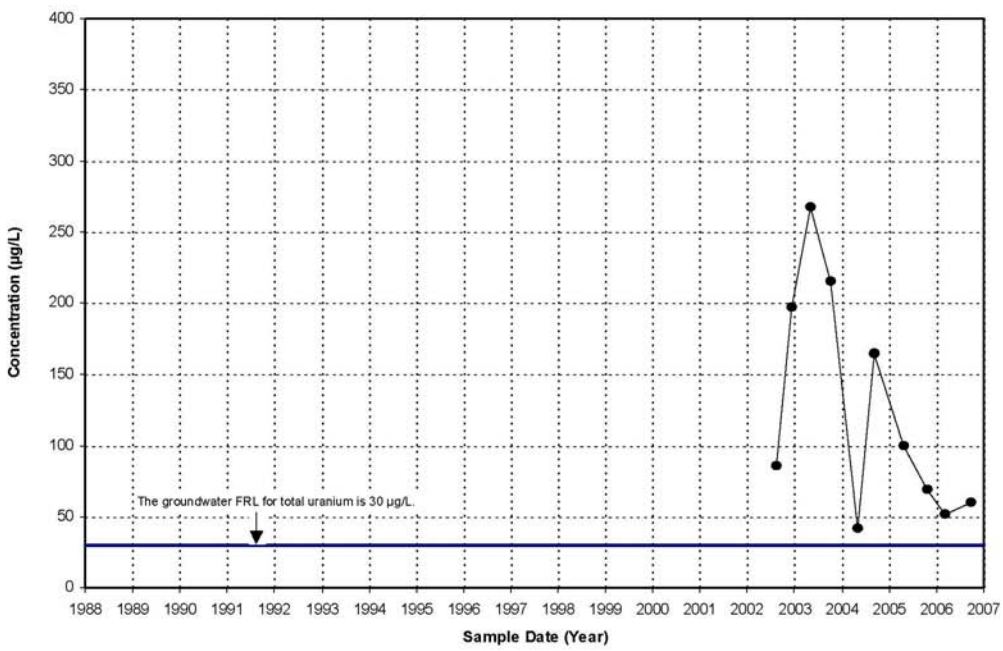

FIGURE A.2-134. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63288

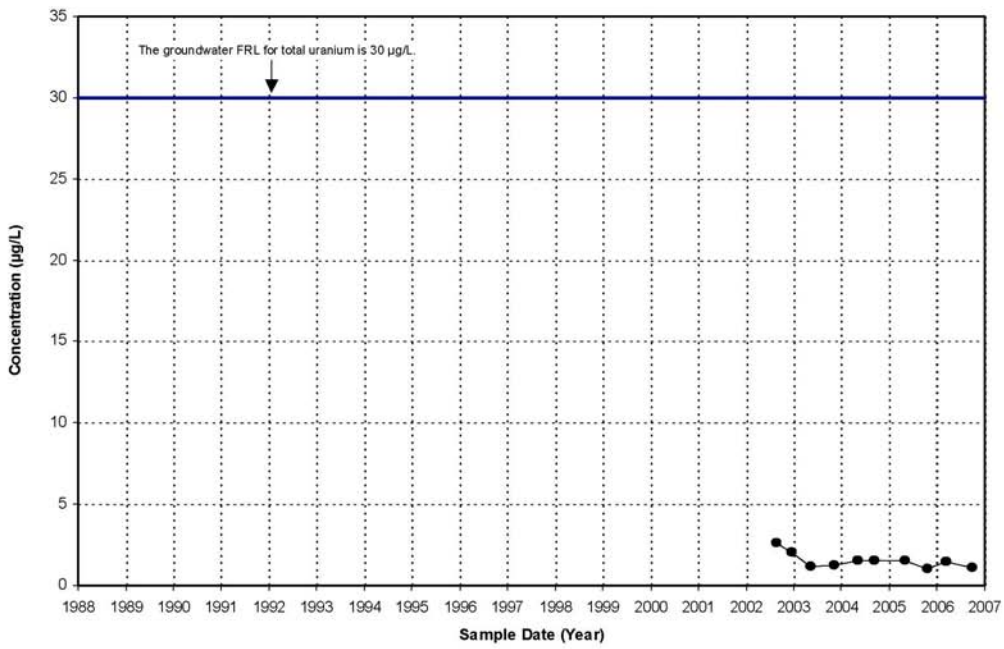

FIGURE A.2-135. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63289

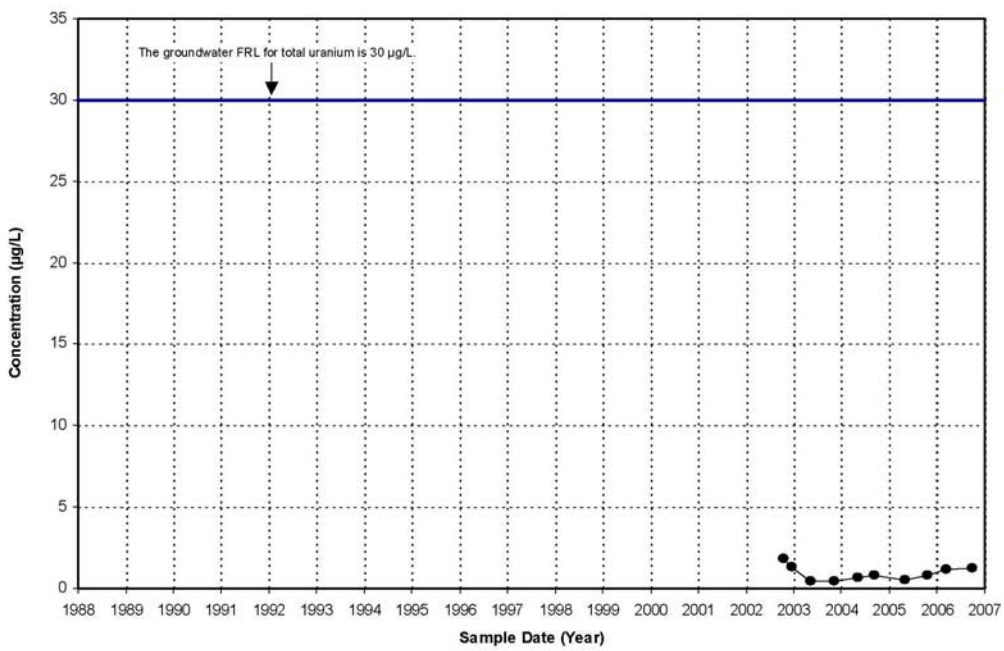

FIGURE A.2-136. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63290

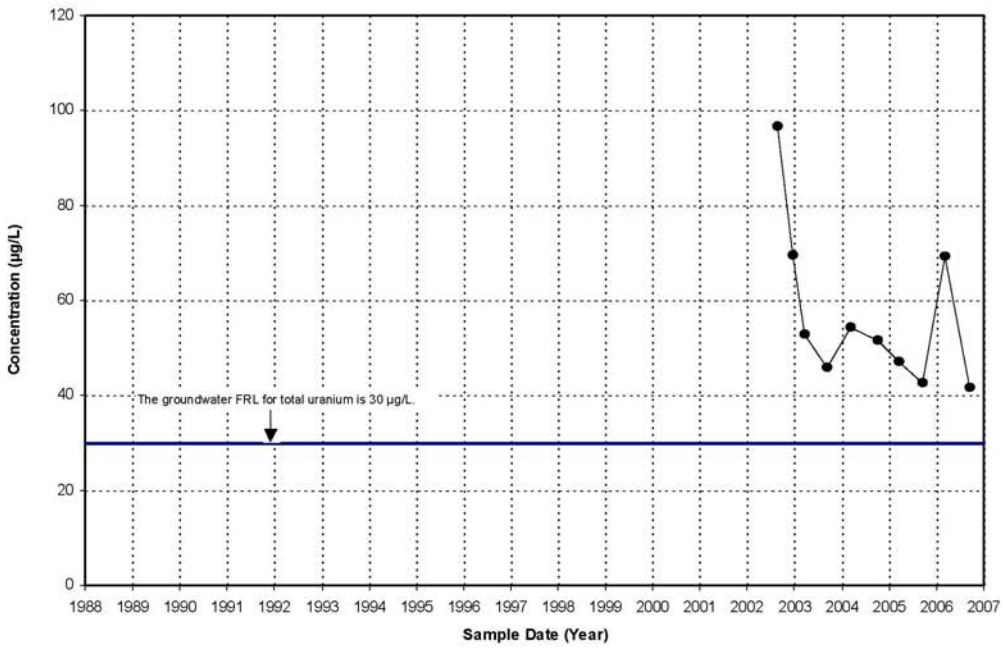

FIGURE A.2-137. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63291

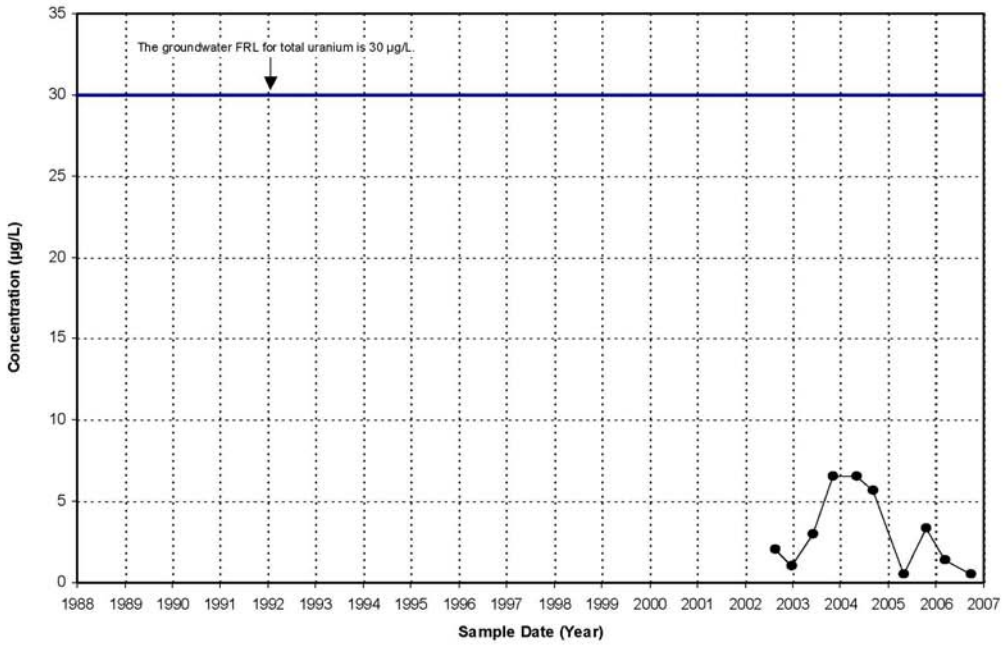

FIGURE A.2-138. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63292

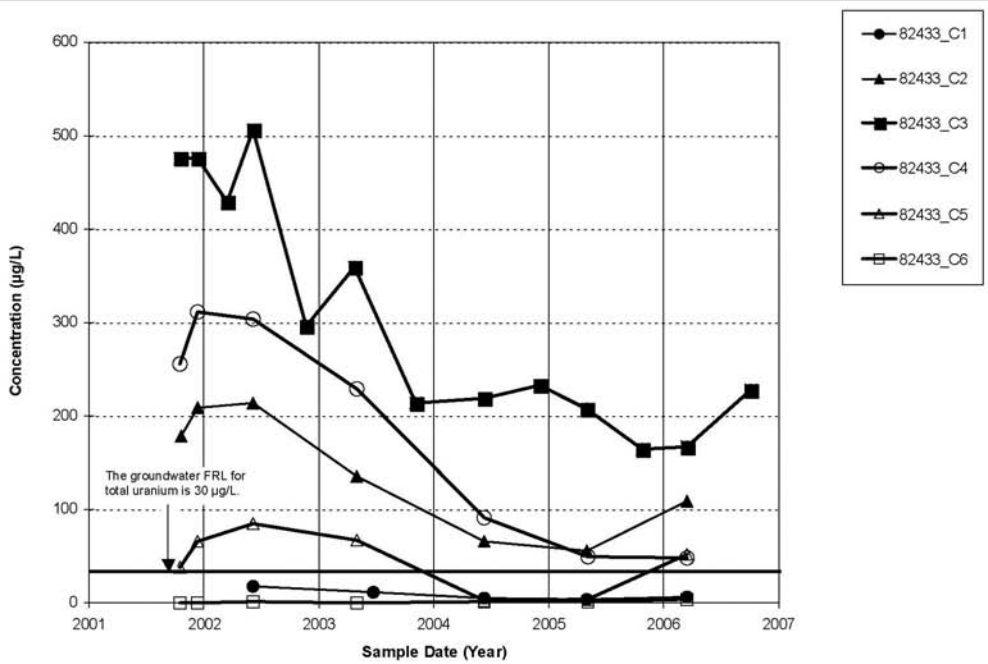

FIGURE A.2-139. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 82433

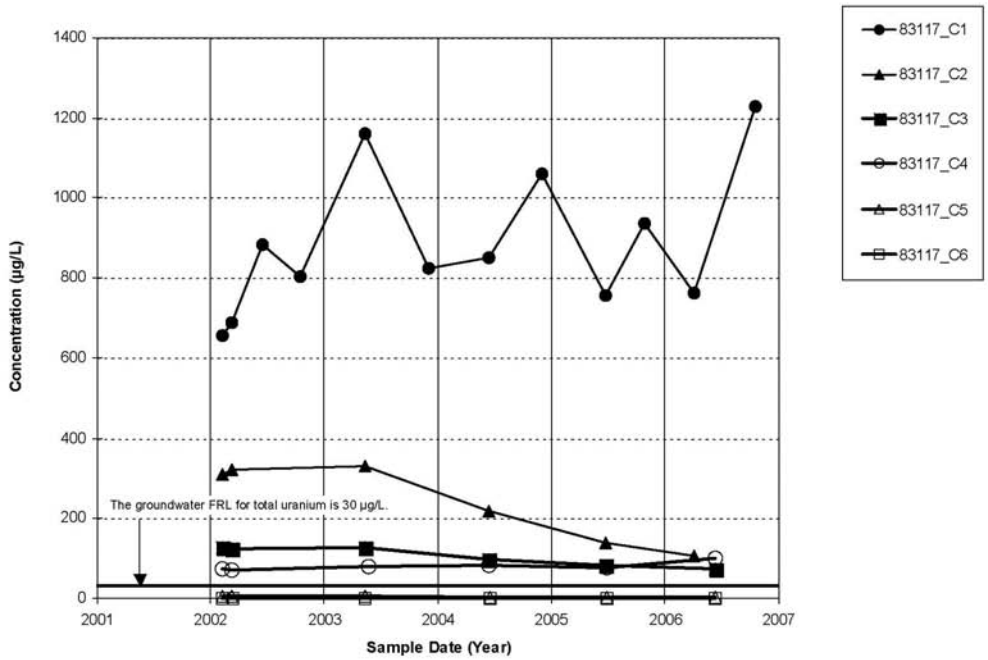

FIGURE A.2-140. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83117

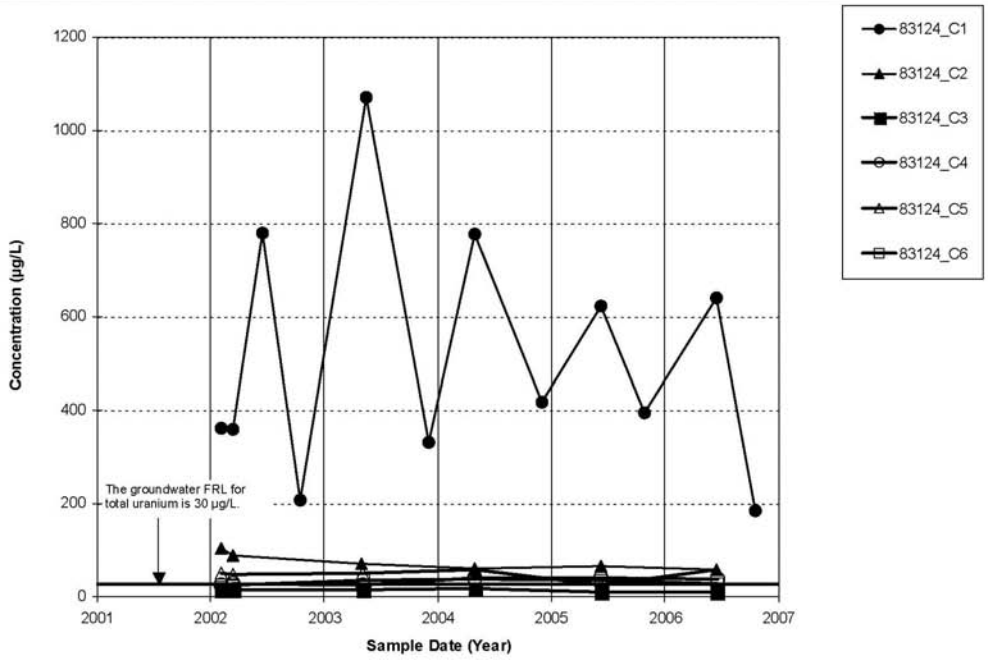

FIGURE A.2-141. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83124

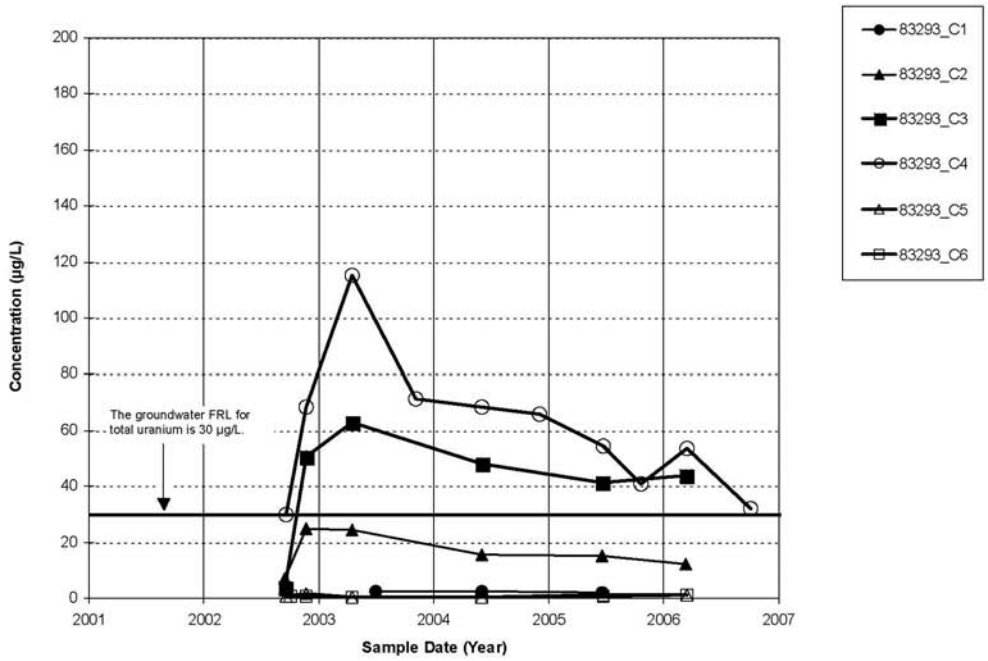

FIGURE A.2-142. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83293

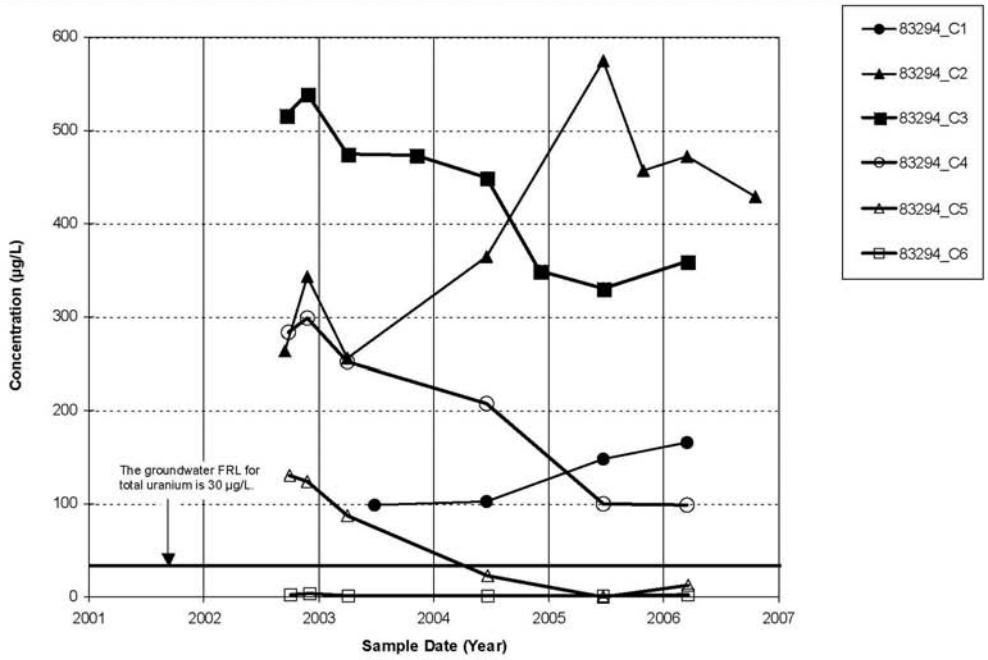

FIGURE A.2-143. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83294

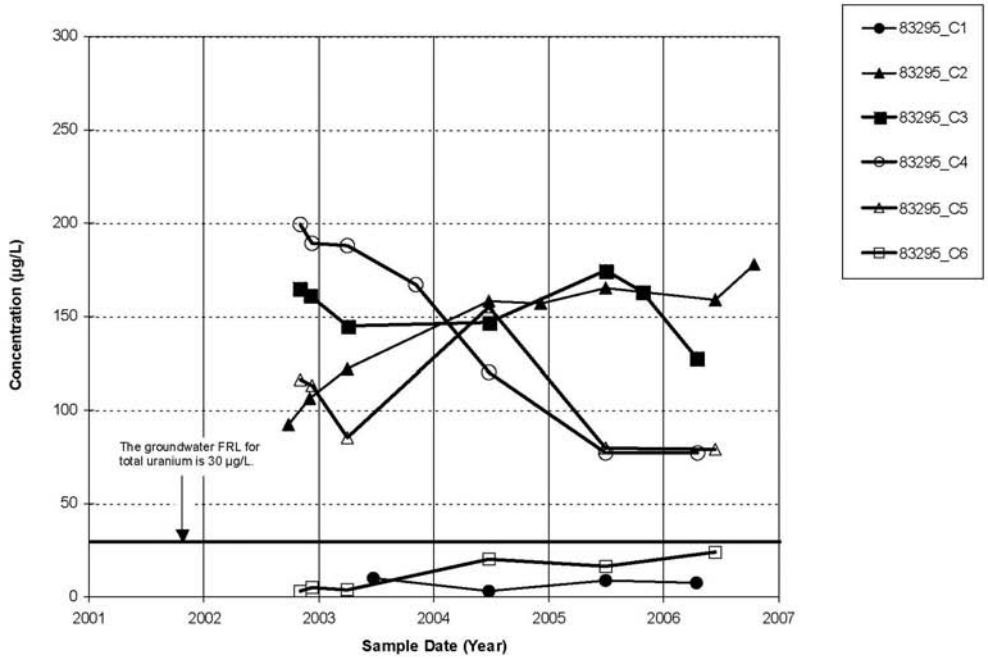

FIGURE A.2-144. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83295

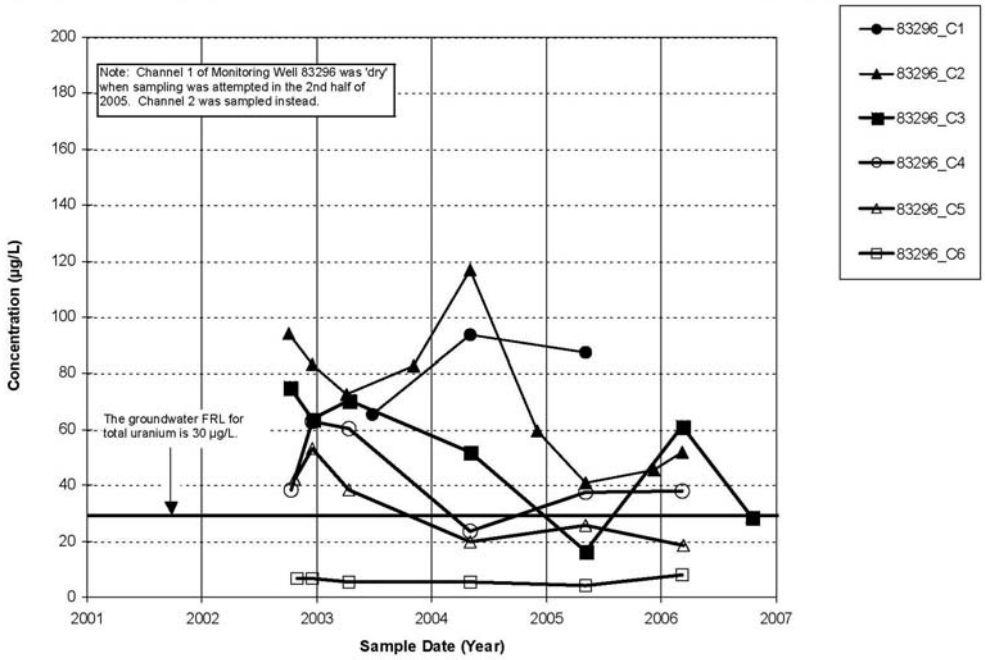

FIGURE A.2-145. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83296

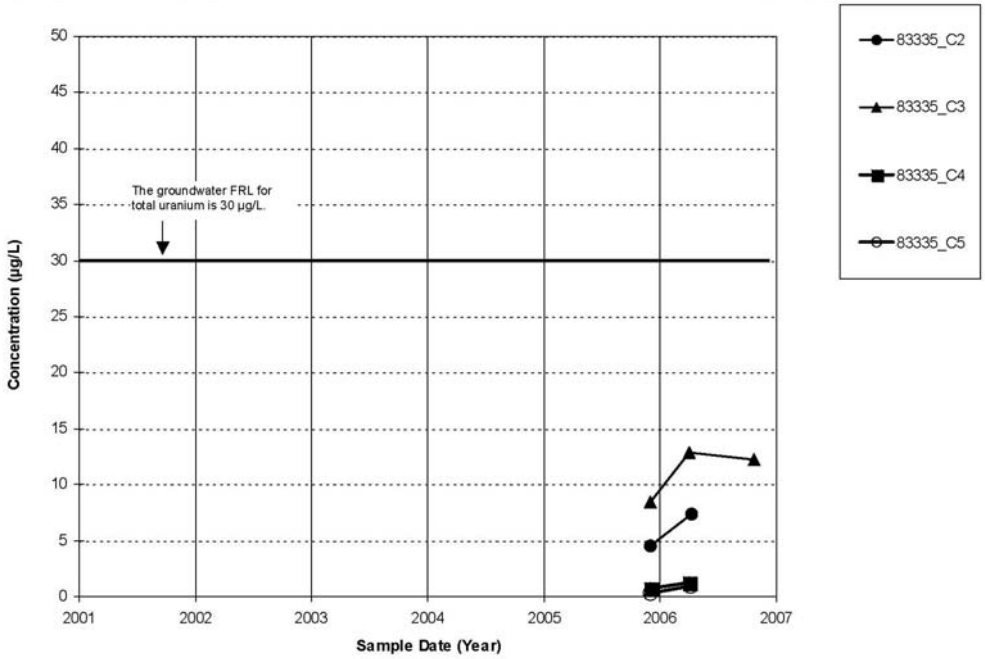

FIGURE A.2-146. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83335

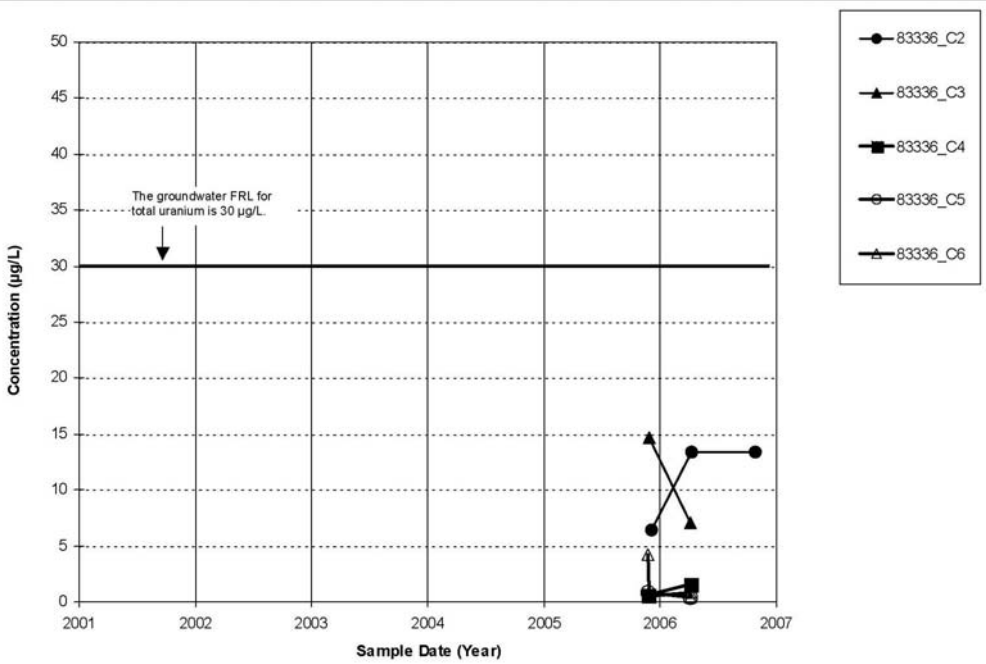

FIGURE A.2-147. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83336

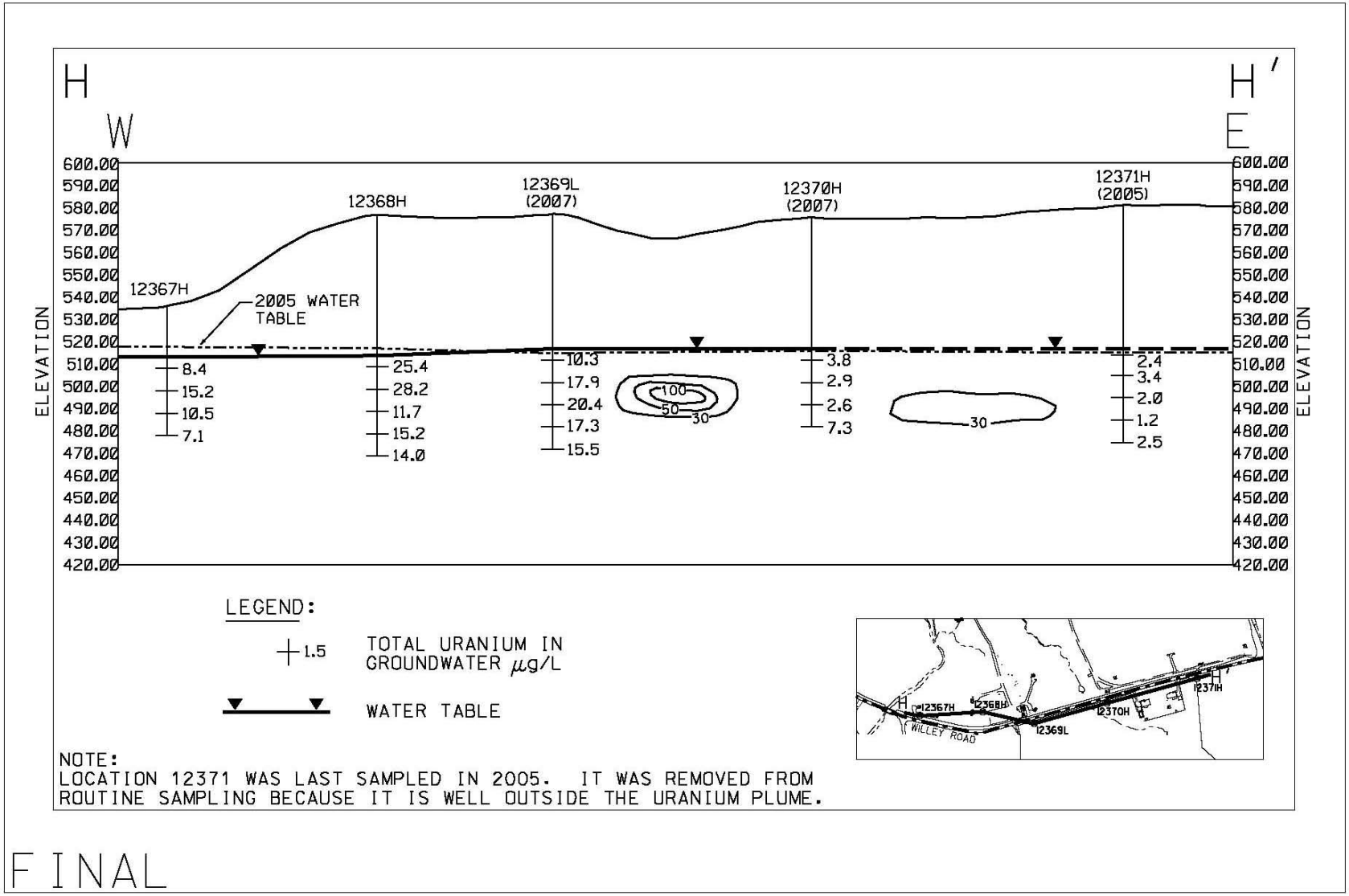

Figure A.2−148. Total Uranium in Ground Water (2006/2007) South of Former Re-Injection Wells

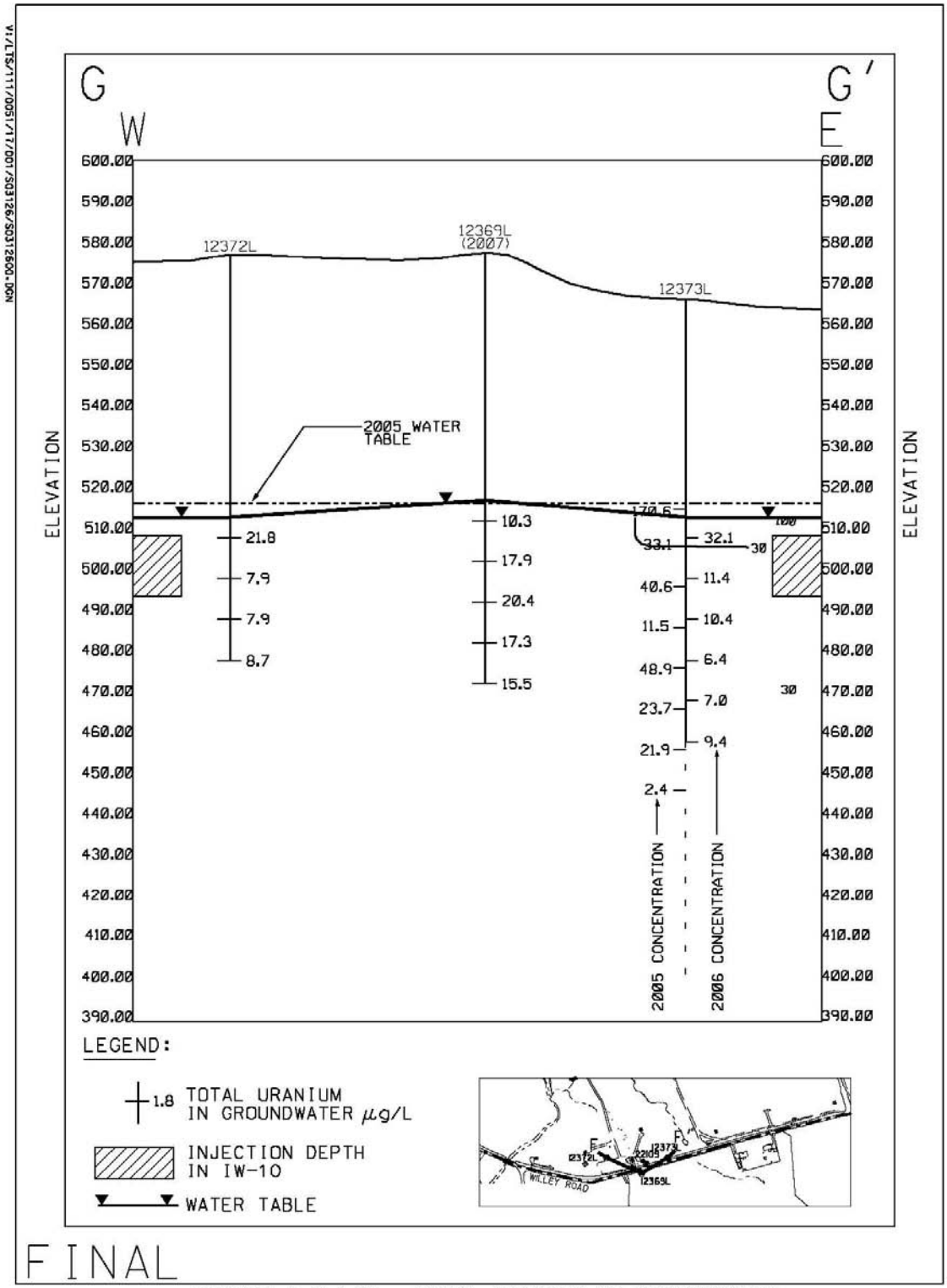

Figure A.2−149. Total Uranium in Ground Water (2006/2007) Next to and South of IW-10

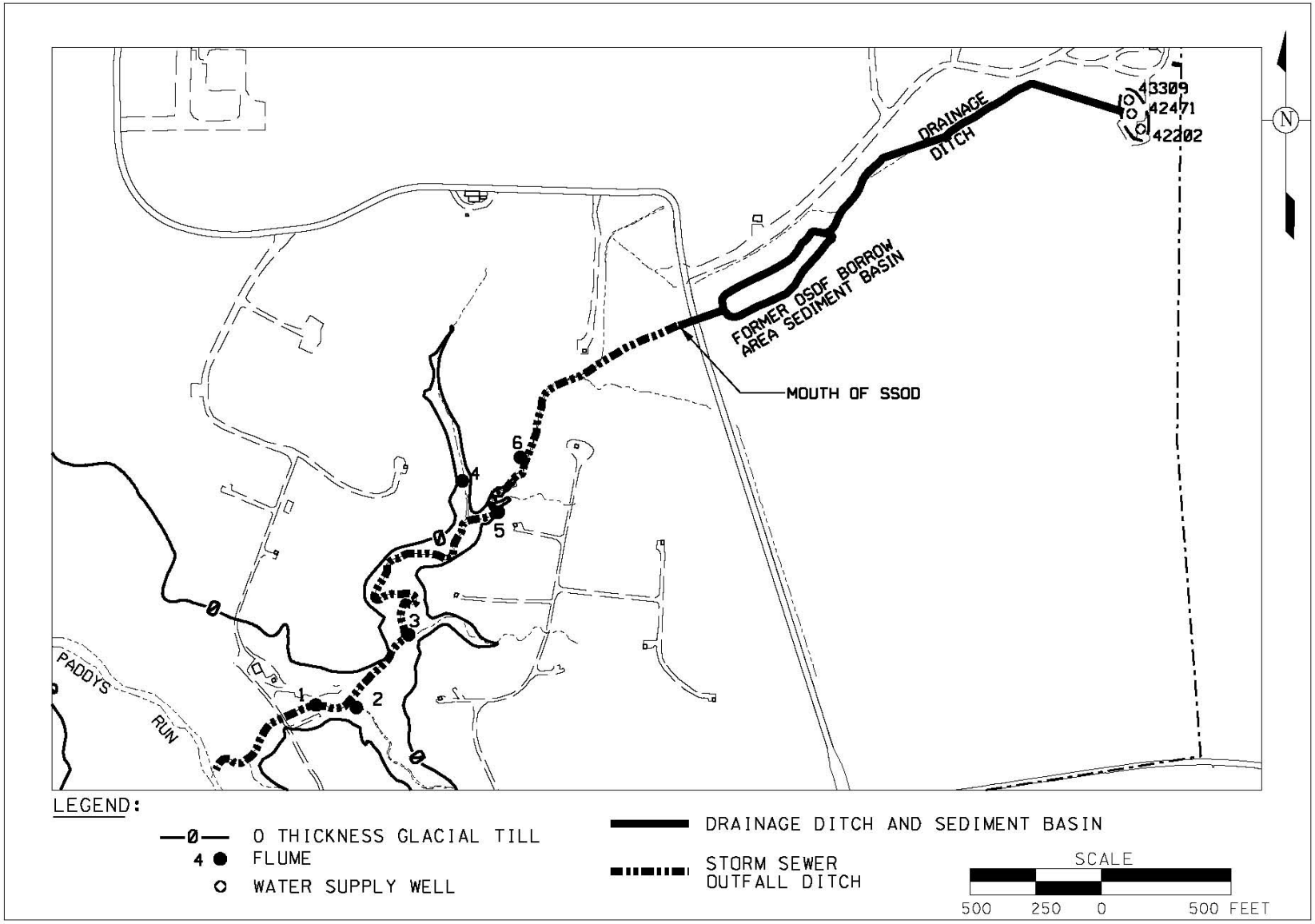

Figure A.2−150. SSOD Flumes and Water Supply Wells

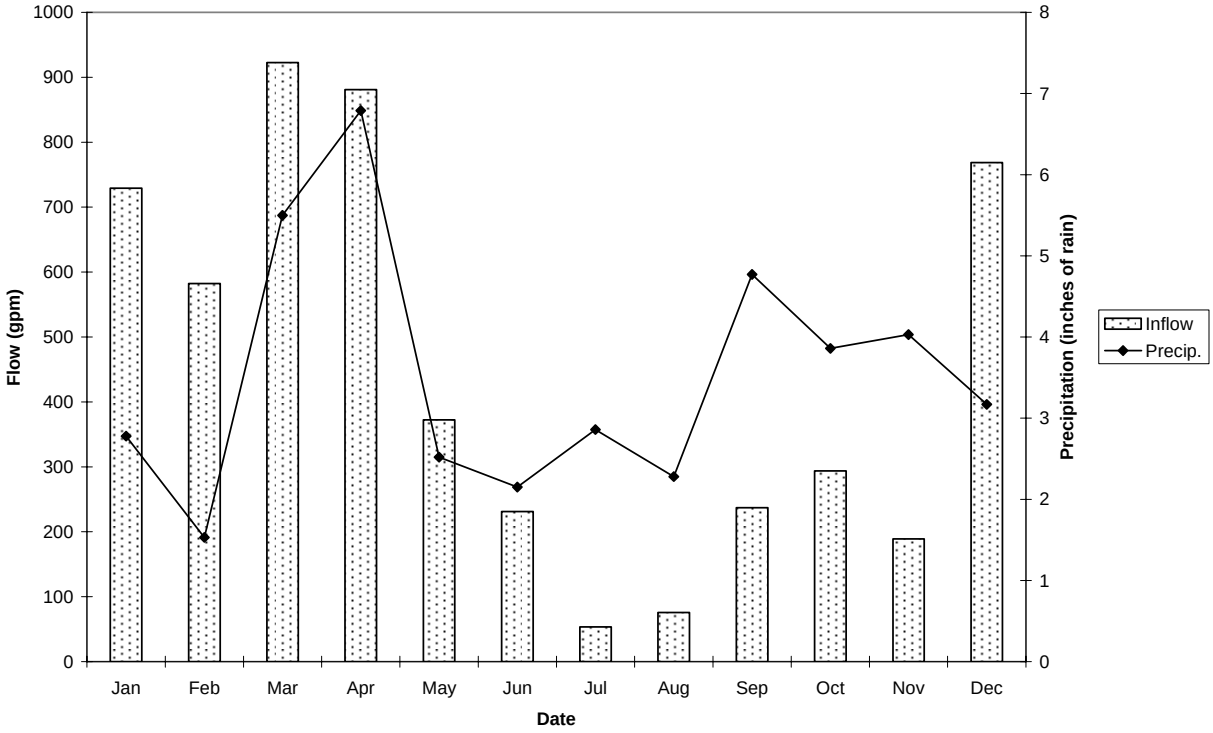

Figure A2-151
Average Monthly Input versus Average Monthly Precipitation

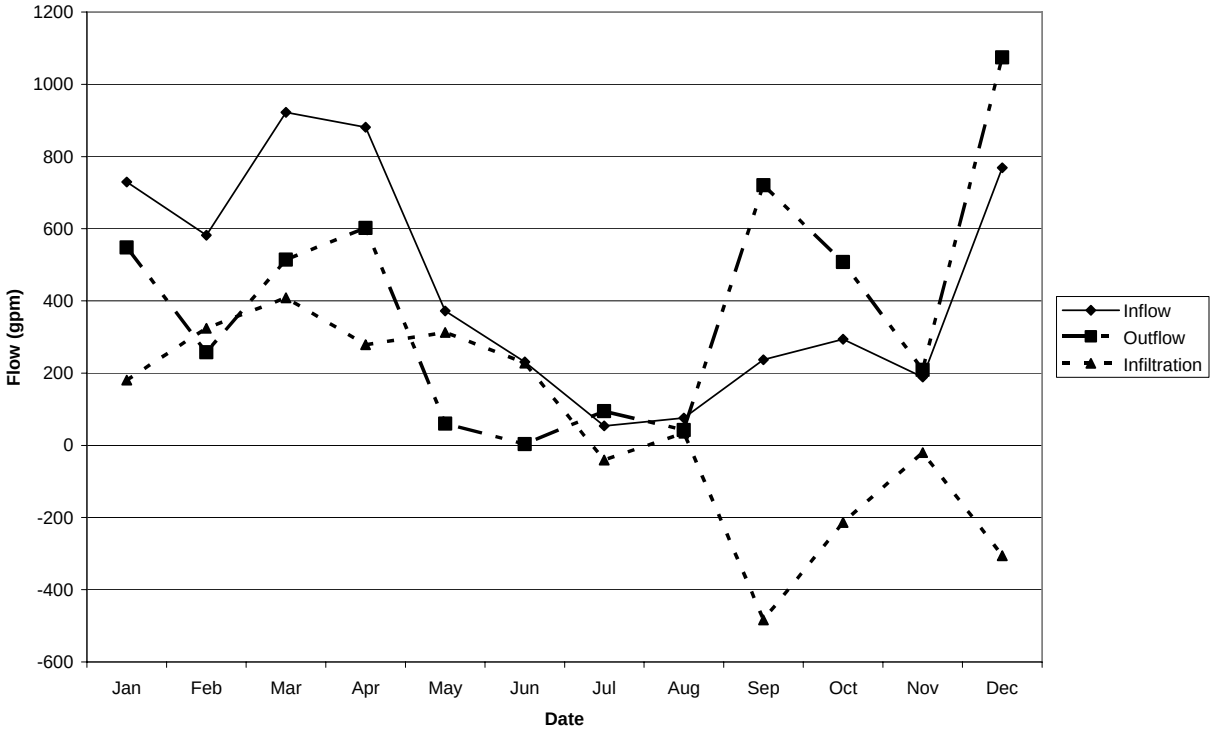

Figure A.2-152
Inflow, Outflow, and Infiltration versus Time

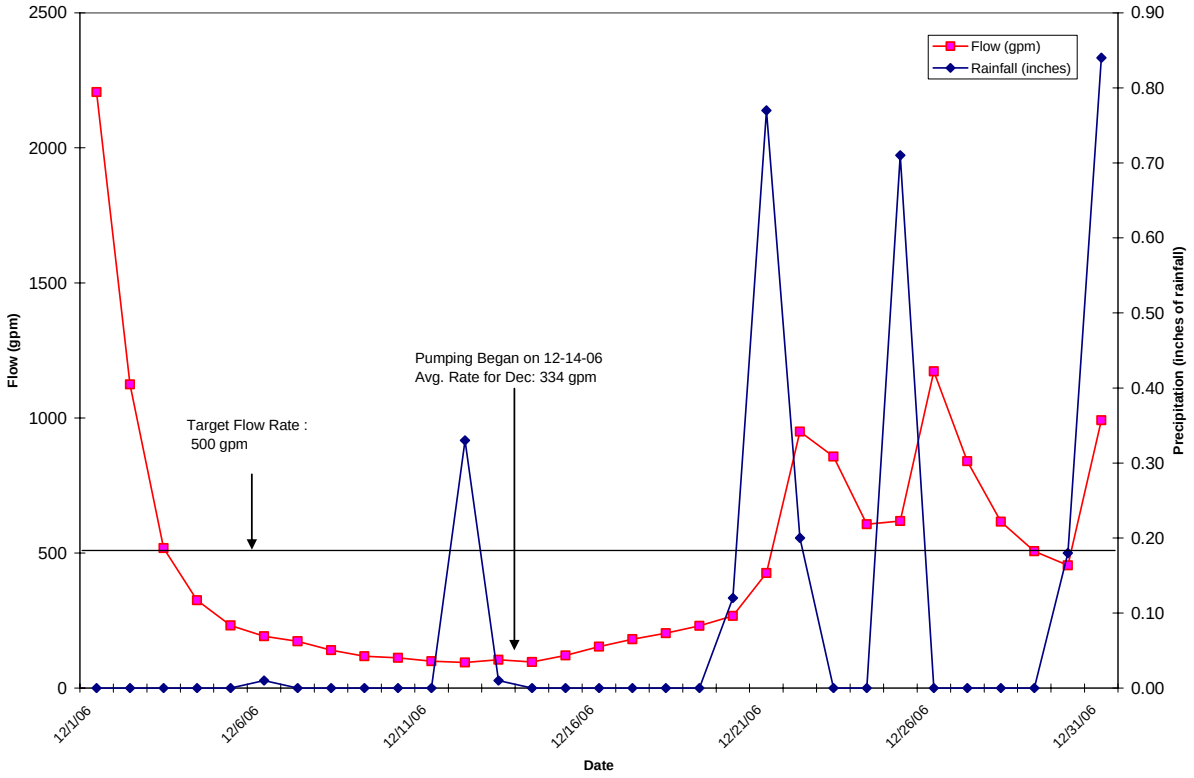

Figure A.2-153
Daily Flow in Flume 6 and Daily Precipitation in December 2006

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Attachment A.3

A.3.0 Groundwater Elevations and Capture Assessment

This attachment discusses groundwater elevation and capture assessment. Figures A.3−1 through A.3−4 present groundwater elevation maps for the four quarters of 2006. 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 2006 were measured in the first and second quarter at 173 locations, as specified in the IEMP, Rev. 4B. Water levels were measured in the third and fourth quarters at 178 locations, as specified in the IEMP, Rev. 5A. Measurements were collected over a time period of 3 to 9 days, as noted below.

Quarter	Measurement Dates	Number of Days	Average Water Level
1	1/4/06 to 1/12/06	9	515.80 feet amsl
2	4/7/06 to 4/12/06	6	517.55 feet amsl
3	7/10/06 to 7/17/06	8	516.46 feet amsl
4	10/9/06 to 10/11/06	3	514.15 feet amsl

Fifteen monitoring wells were not measured at various times in 2006 either because the wells were dry, not accessible, or plugged and abandoned. A summary is provided below.

Well	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
2014			Dry	Dry
2544				Dry
2552				Not Accessible
2625				Dry
2636			Dry	Dry
2648			Not Accessible	Not Accessible
2649		Not Accessible	Not Accessible	Not Accessible
3011	Not Accessible			
3552				Not Accessible
21192	Dry	Dry	Dry	Dry
22209			Not Accessible	
22212			Not Accessible	
22213			Not Accessible	
22216		Abandoned	Abandoned	Abandoned
23118			Not Accessible	

Water level assessments in 2006 were impacted by operational disruptions and pumping rate changes. Most of these disruptions/pumping rate changes resulted from site remediation activities. The number of wells pumping in each restoration module and the average pumping rate for each restoration module 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 in 2006. An example of this is water level measurements collected during the first quarter of 2006 from January 4 through January 12 (refer to Figure A.3−1). The number of extraction wells pumping in the South Field went from 11 to seven during this time period. This is noted on Figure A.3−1 by "11/7" 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. The disruptions and pumping rate changes noted on the water level maps for 2006 are the ones that could not be avoided, due to the numerous remediation activities that took place in 2006.

During 2006 the water table in the measurement area fluctuated on average approximately 3.4 feet. The fluctuation range was approximately 2 feet to 7.1 feet depending on the location of the well being measured and its proximity to recharge areas. Six wells in 2006 had a measured water level variance over the course of the year of 5 feet or more (Well 2044 – 5 feet, Well 2107 – 5.6 feet, Well 3402 – 5.6 feet, Well 2402 – 5.6 feet, Well 2017 – 5.8 feet, and Well 23281 – 7.1 feet). All of these wells are located along the western half of the plume near recharge from Paddy's Run.

Uranium contamination bound to aquifer sediments in the unsaturated portions of the Great Miami Aquifer has been identified under some source areas. An annual exercise is being planned to shut down all extraction wells (with the exception of the four leading edge South Plume Recovery Wells) from June 15 to July 15 to allow water levels within the aquifer to rise. Based on evaluation of aquifer water levels collected since 1988, during June and July seasonal water levels are usually at their highest level. Shutting down the extraction wells during the same time period that seasonal water levels are high will maximize the saturation of as much aquifer sediment as possible.

The 2006 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 contoured water table gradients.

It should be noted that 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 of 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.

Quarterly capture zone interpretations were added to the maps for each quarter in areas where the data indicated they were present (i.e., Waste Storage Area and South Plume).

Due to the discontinuance of re-injection along Willey Road, capture delineation between the South Field and South Plume could not be determined. In past years, re-injection along Willey Road created small areas of elevated water levels, which could be connected to illustrate the extent of the South Field capture. The groundwater flow divide between Paddys Run Outlet and the New Baltimore Outlet was not readily distinguishable in 2006.

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 2006.

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 2006 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 2006 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, transcription, or error during data collection and processing.

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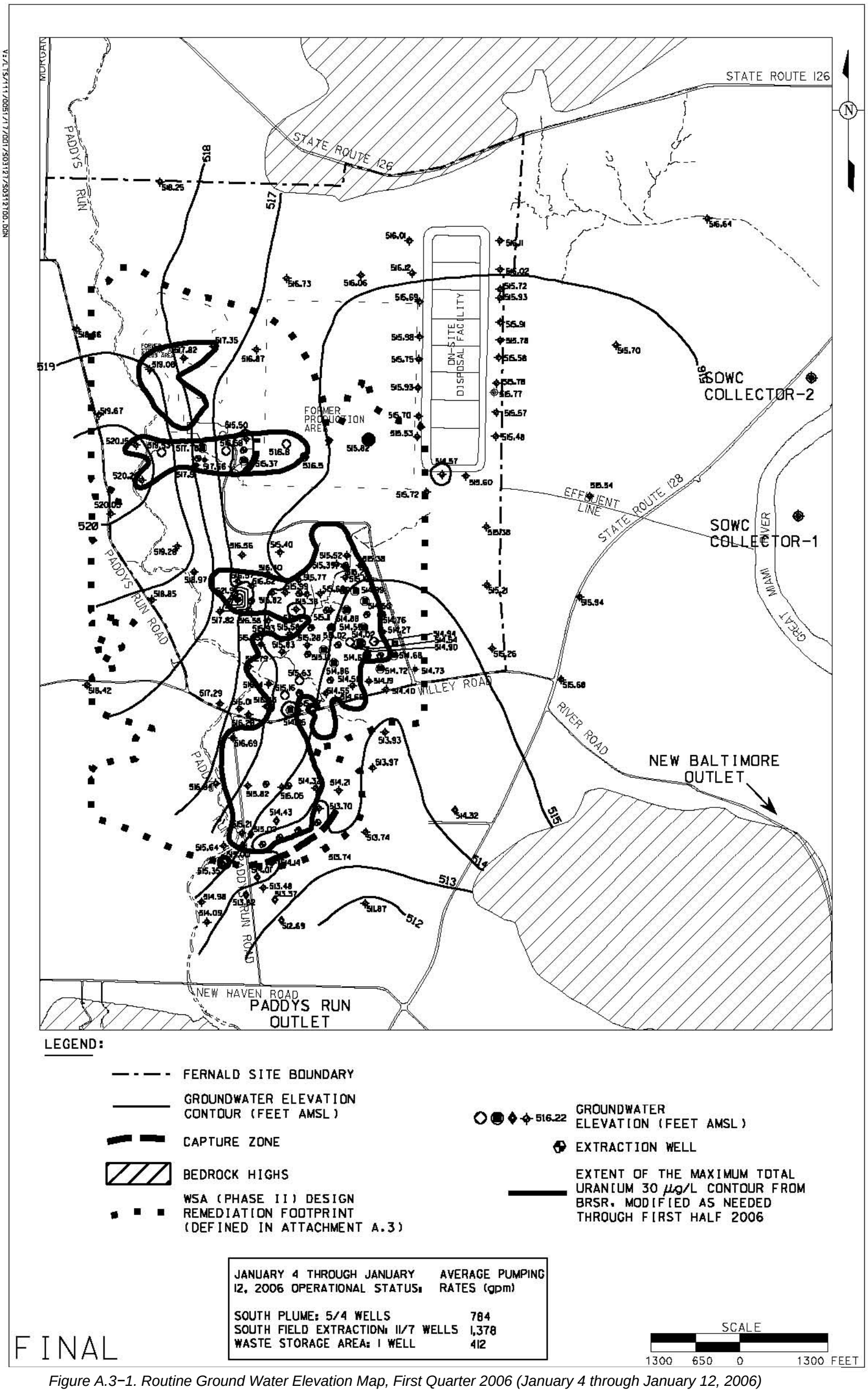


Figure A.3−1. Routine Ground Water Elevation Map, First Quarter 2006 (January 4 through January 12, 2006)

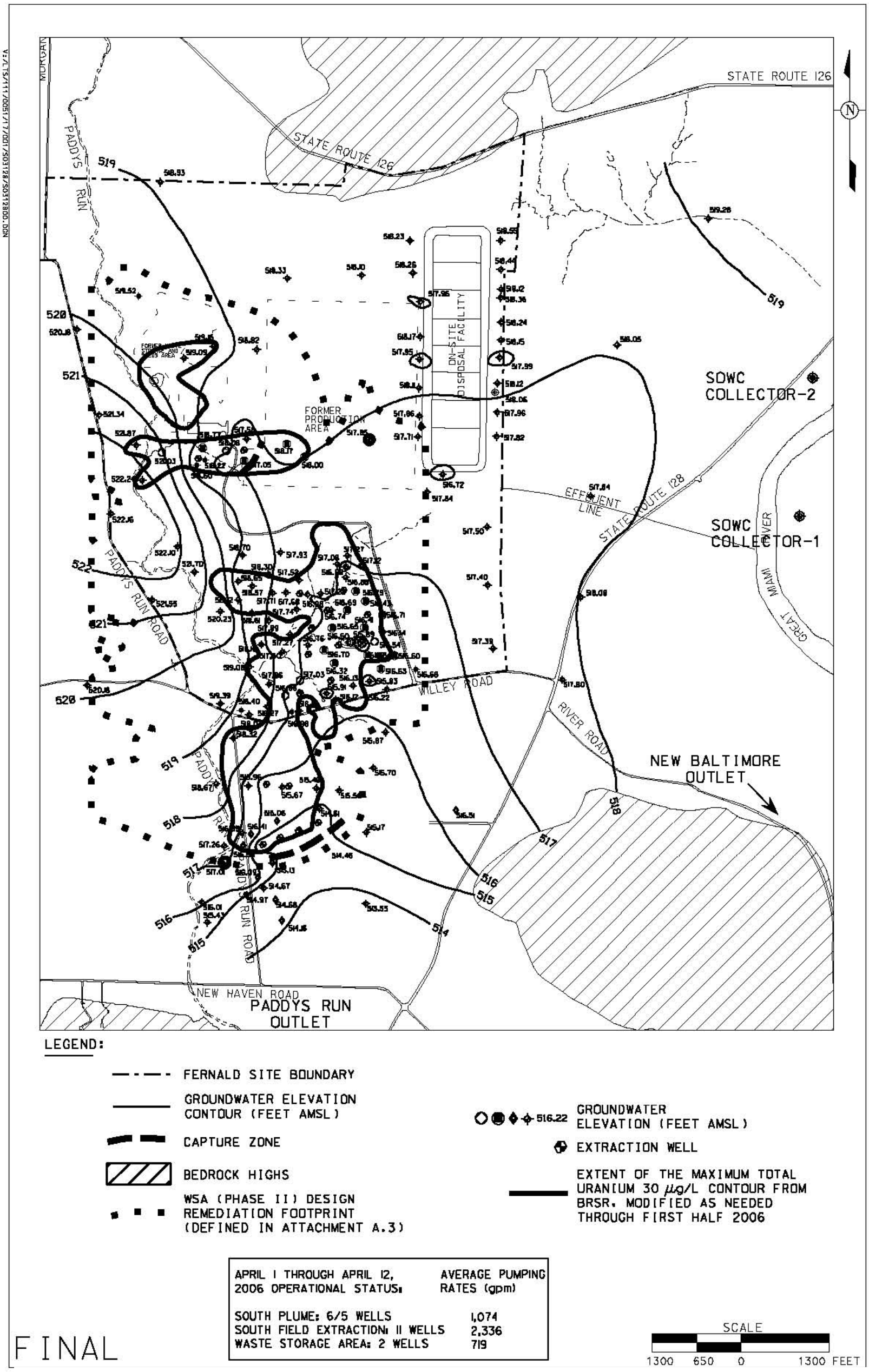


Figure A.3−2. Routine Ground Water Elevation Map, Second Quarter 2006 (April 1 through April 12, 2006)

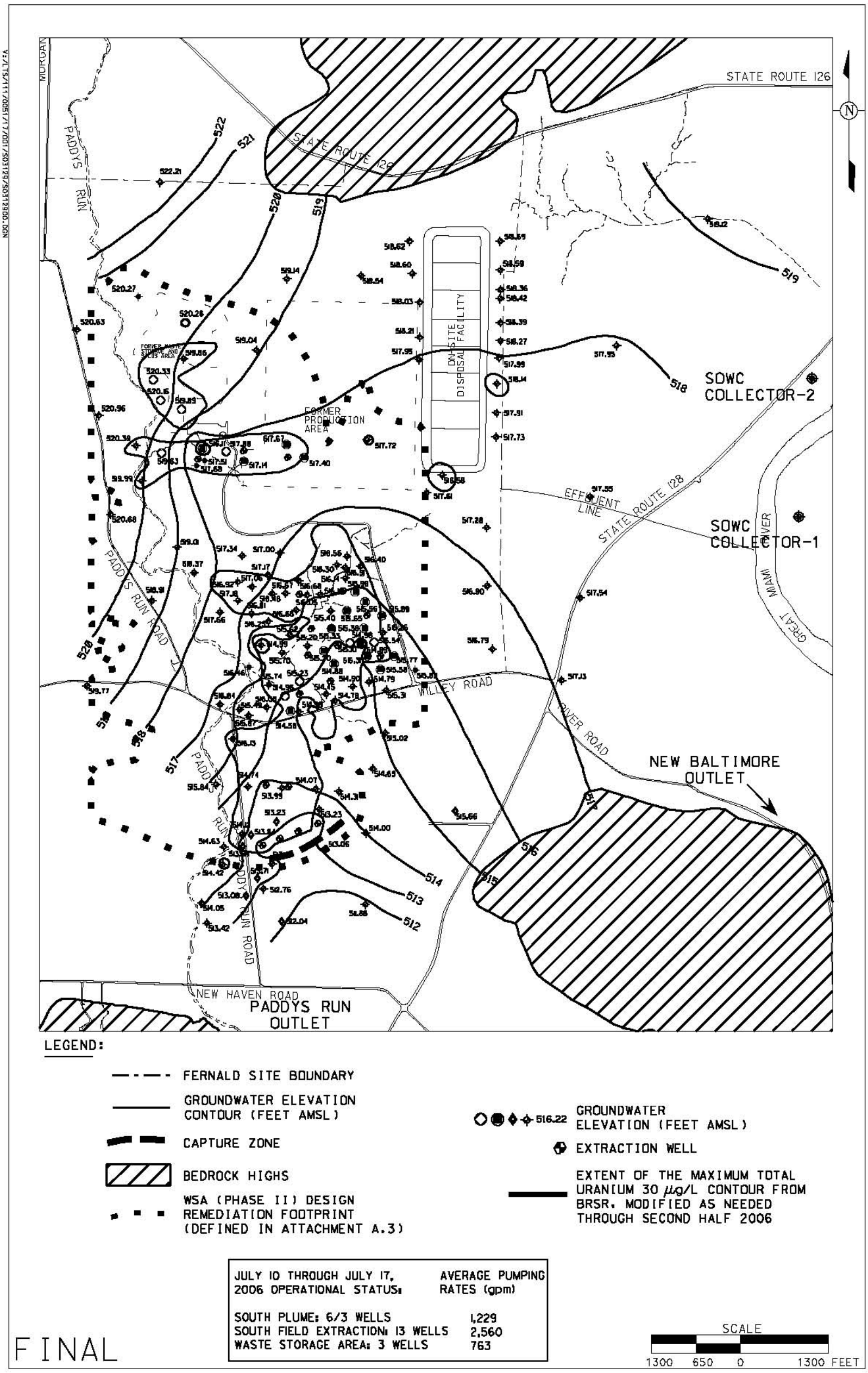


Figure A.3−3. Routine Ground Water Elevation Map, Third Quarter 2006 (July 10 through July 17, 2006)

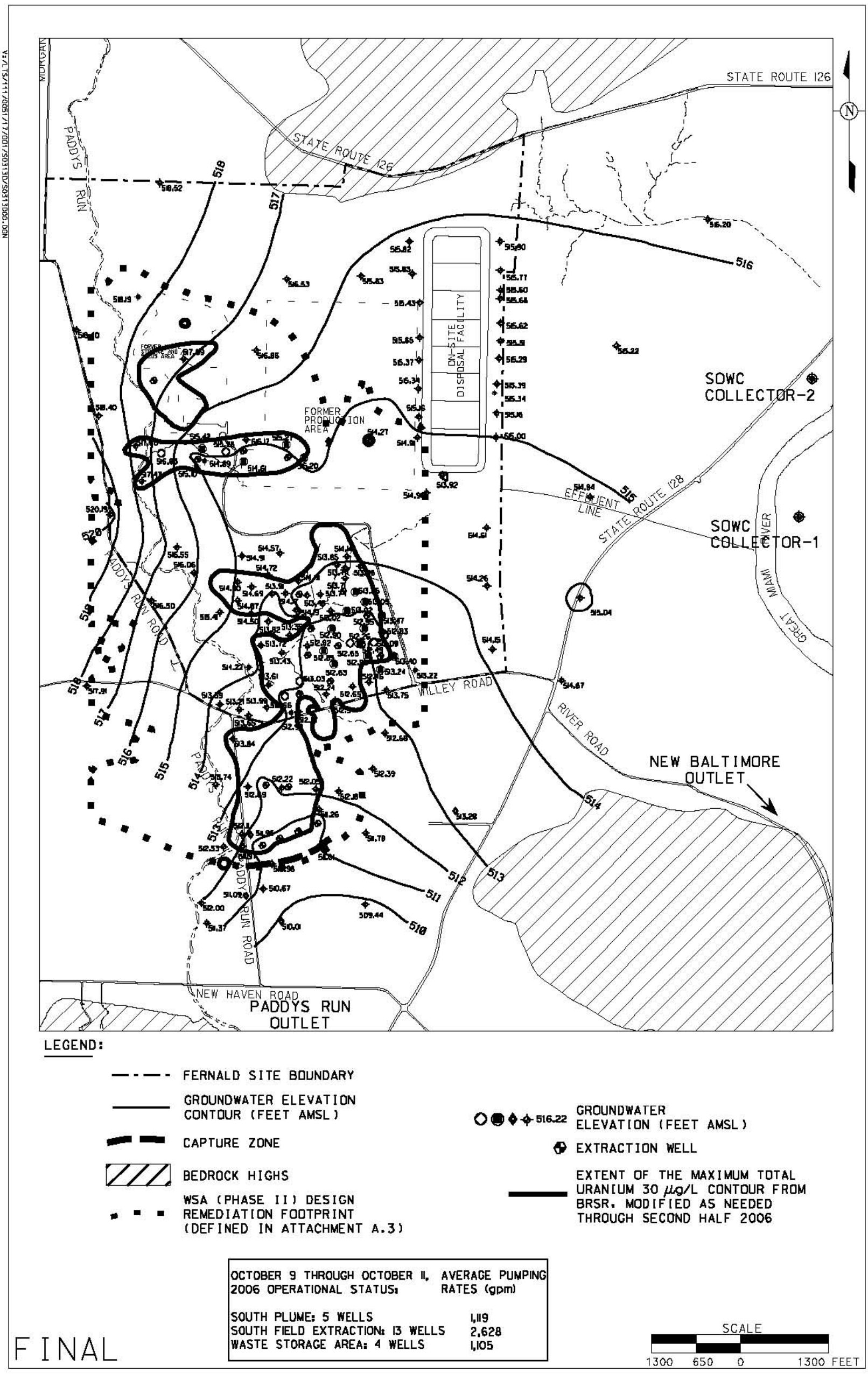


Figure A.3−4. Routine Ground Water Elevation Map, Fourth Quarter 2006 (October 09 through October 11, 2006)

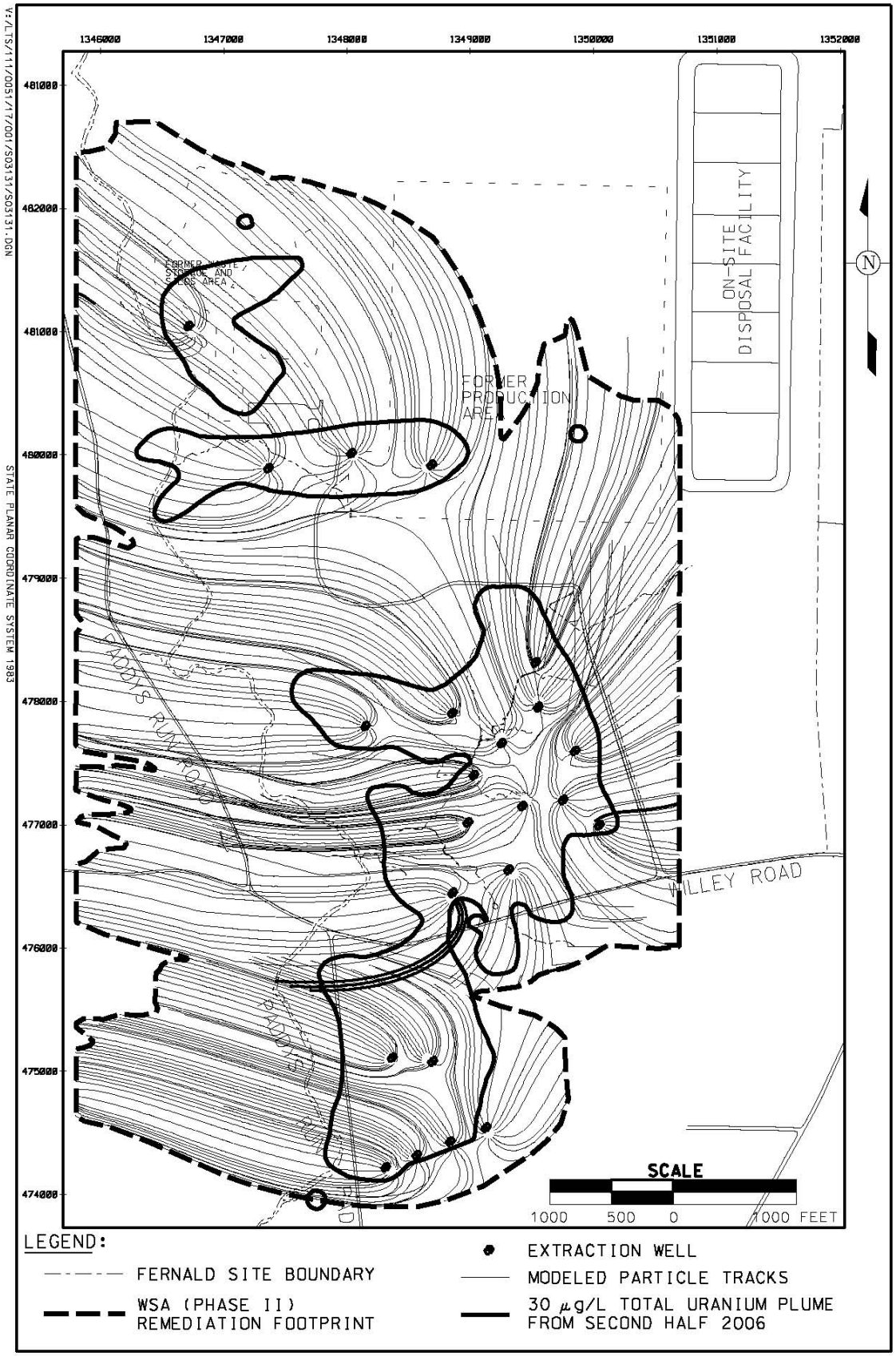


FIGURE A.3-5. WSA (PHASE-II) DESIGN REMEDIATION FOOTPRINT

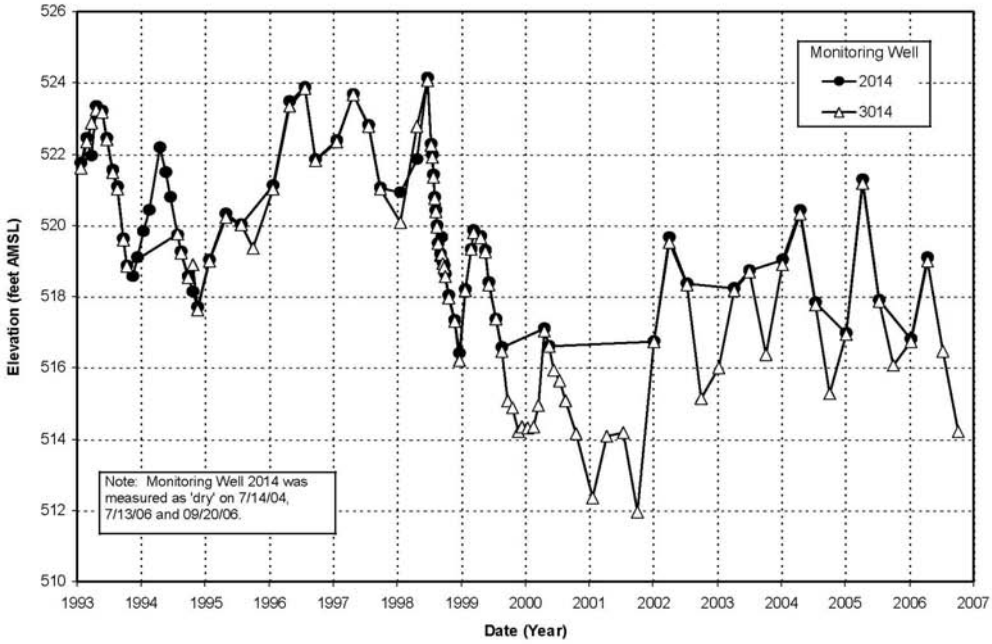


FIGURE A.3-6. HYDROGRAPH FOR WELL CLUSTER 014

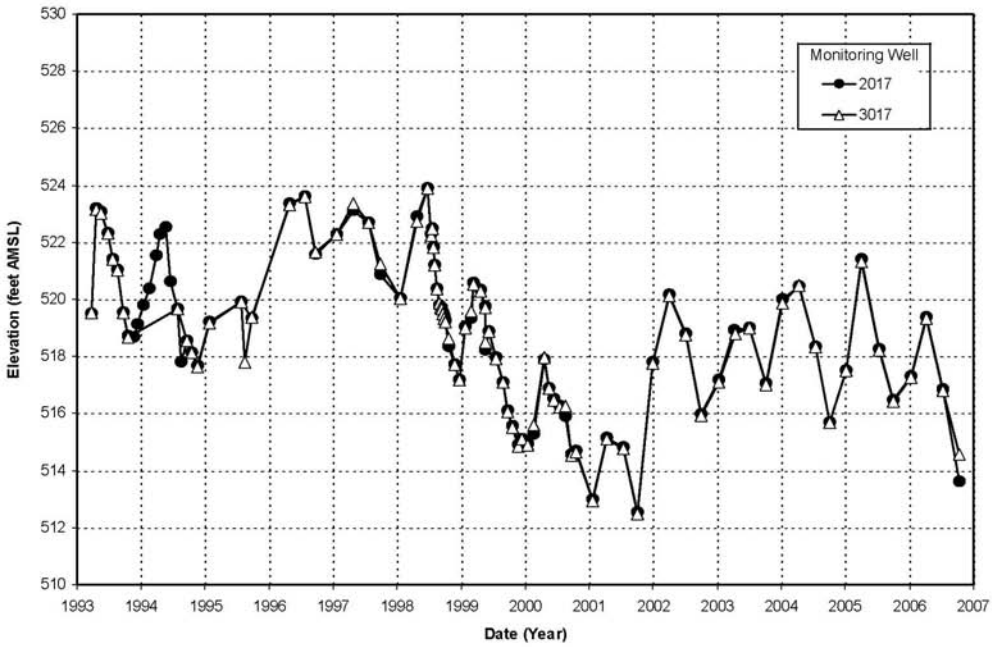


FIGURE A.3-7. HYDROGRAPH FOR WELL CLUSTER 017

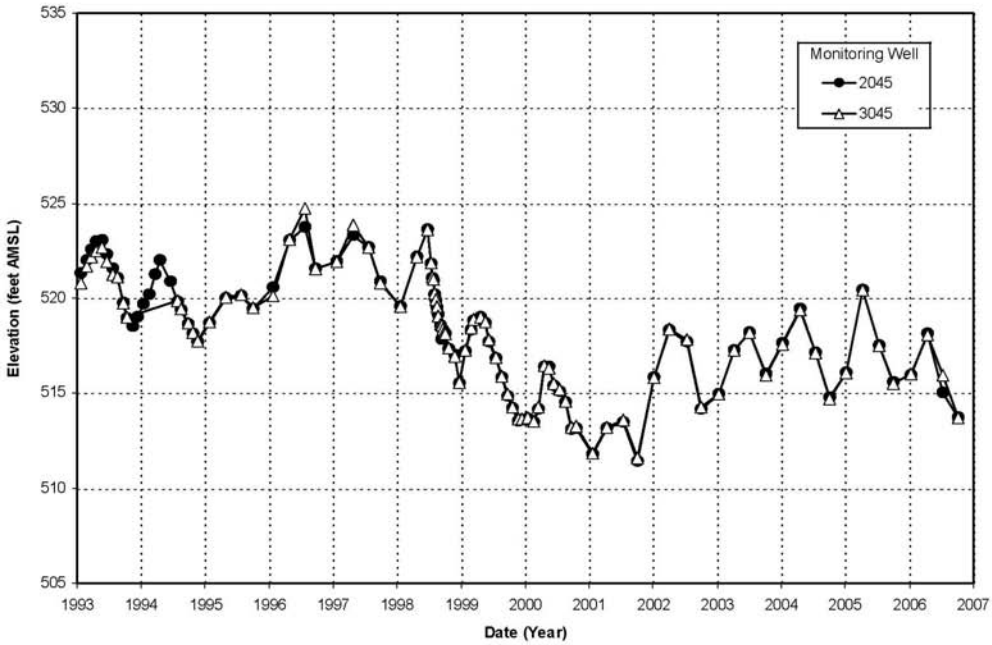


FIGURE A.3-8. HYDROGRAPH FOR WELL CLUSTER 045

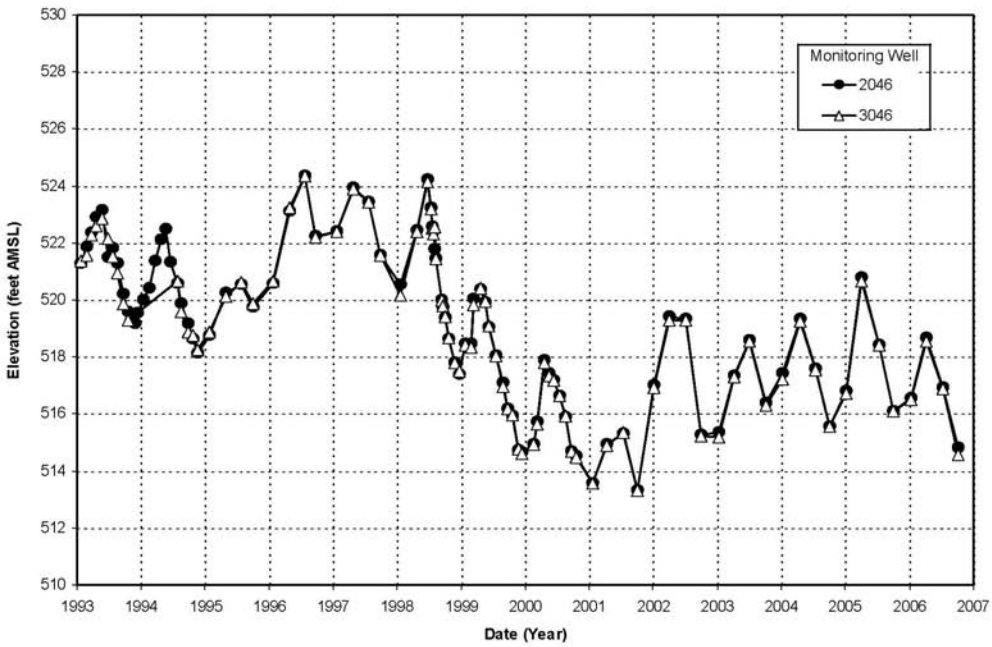


FIGURE A.3-9. HYDROGRAPH FOR WELL CLUSTER 046

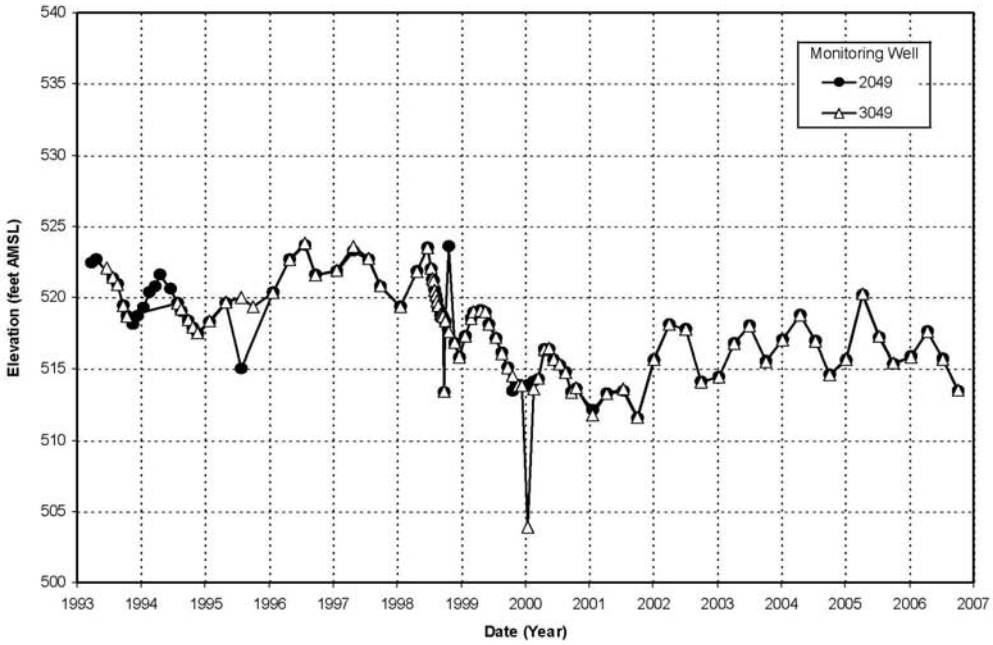


FIGURE A.3-10. HYDROGRAPH FOR WELL CLUSTER 049

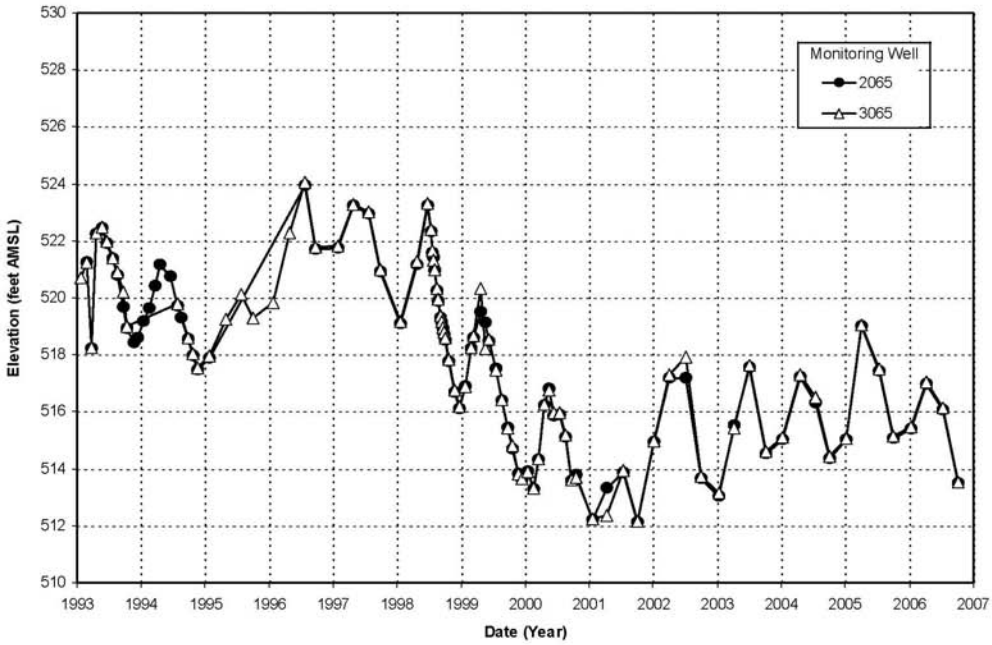


FIGURE A.3-11. HYDROGRAPH FOR WELL CLUSTER 065

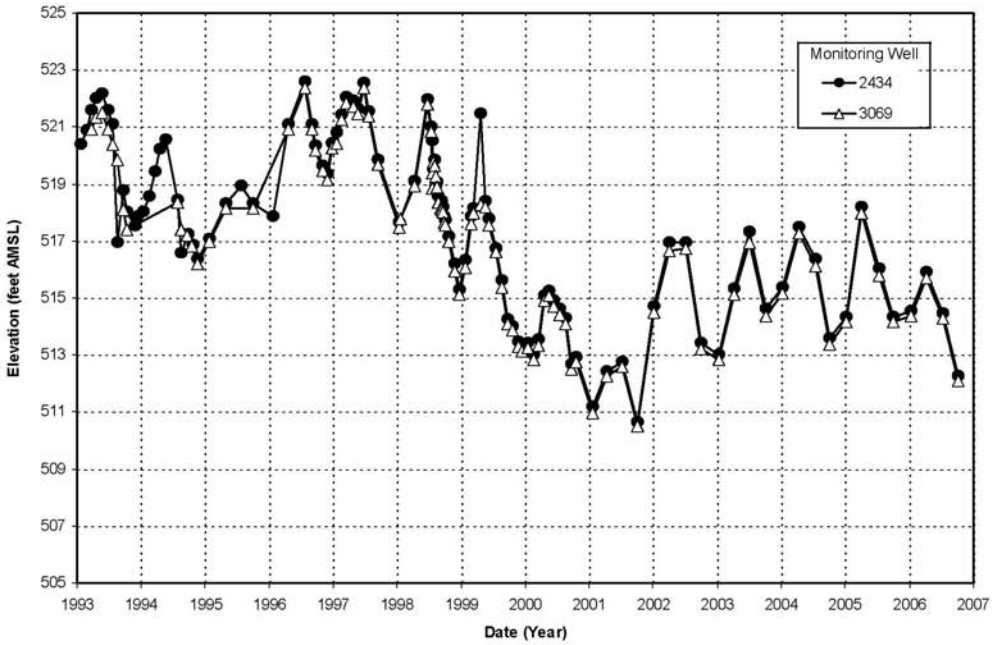


FIGURE A.3-12. HYDROGRAPH FOR WELLS 2434 AND 3069

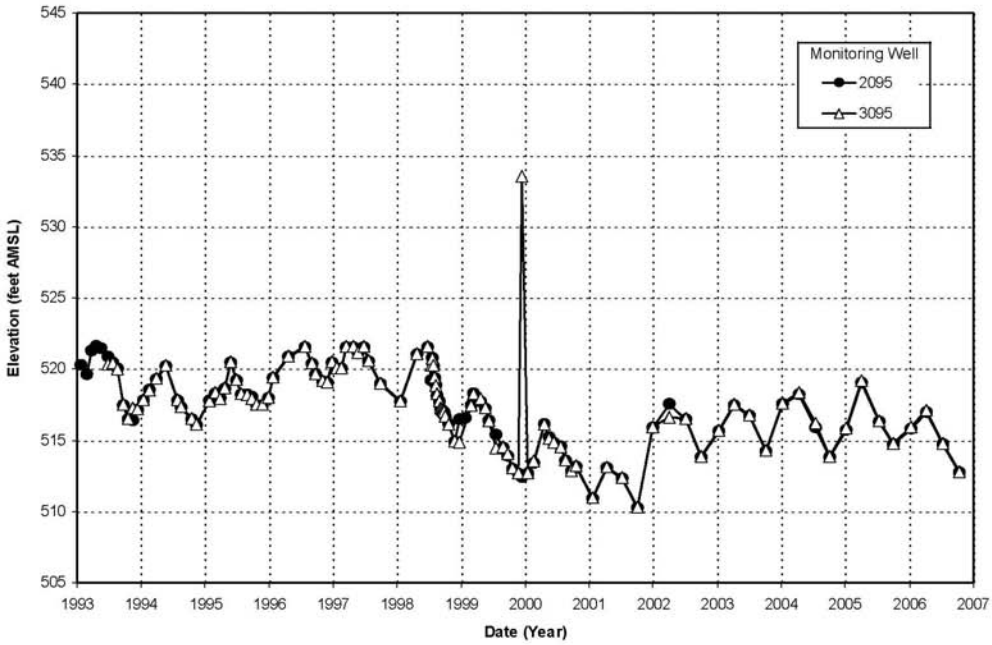


FIGURE A.3-13. HYDROGRAPH FOR WELL CLUSTER 095

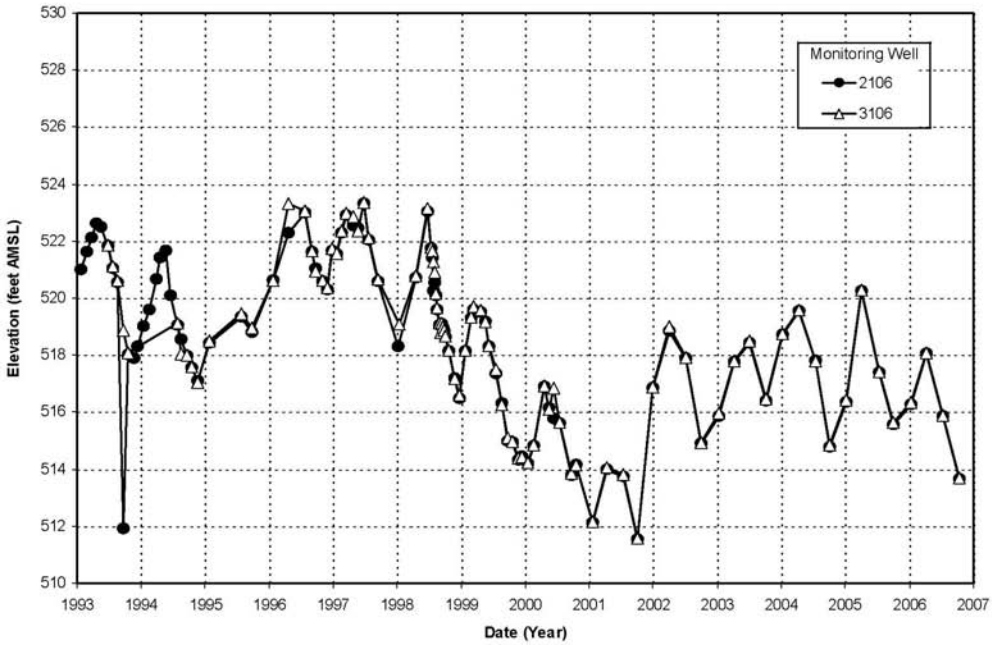


FIGURE A.3-14. HYDROGRAPH FOR WELL CLUSTER 106

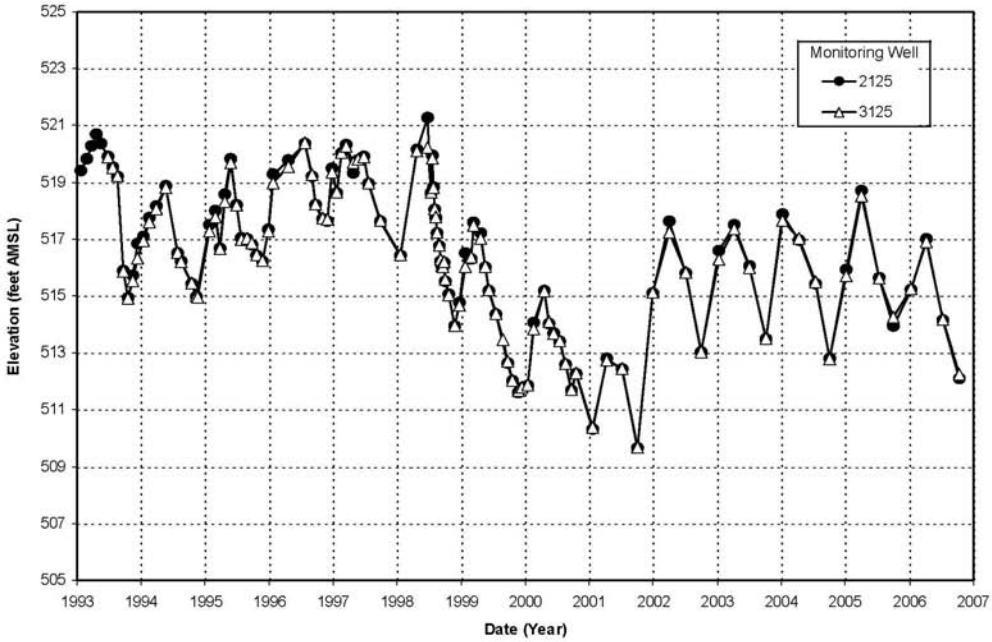


FIGURE A.3-15. HYDROGRAPH FOR WELL CLUSTER 125

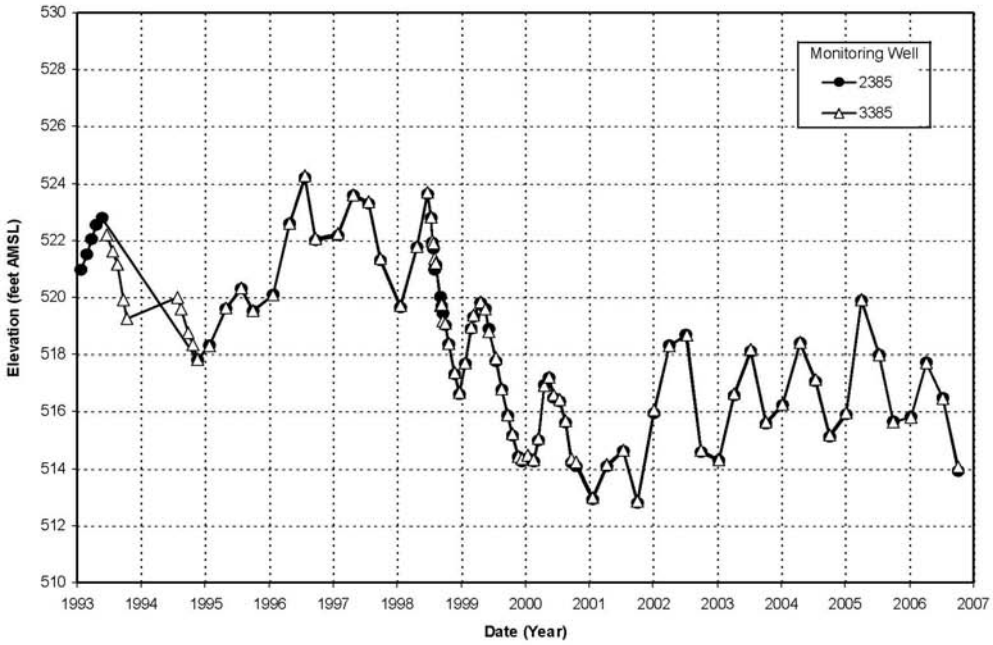


FIGURE A.3-16. HYDROGRAPH FOR WELL CLUSTER 385

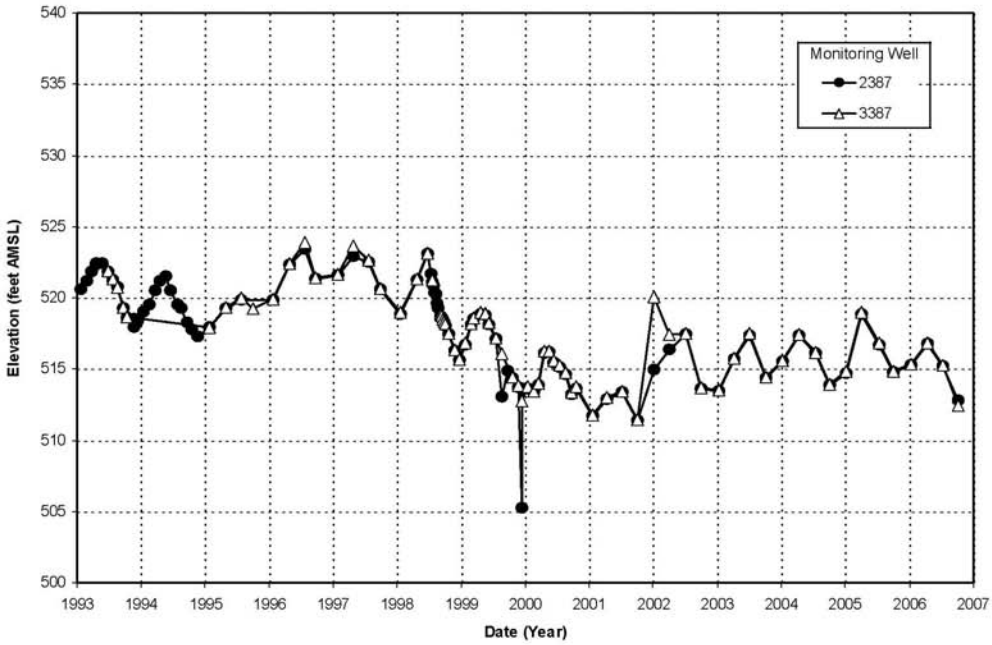


FIGURE A.3-17. HYDROGRAPH FOR WELL CLUSTER 387

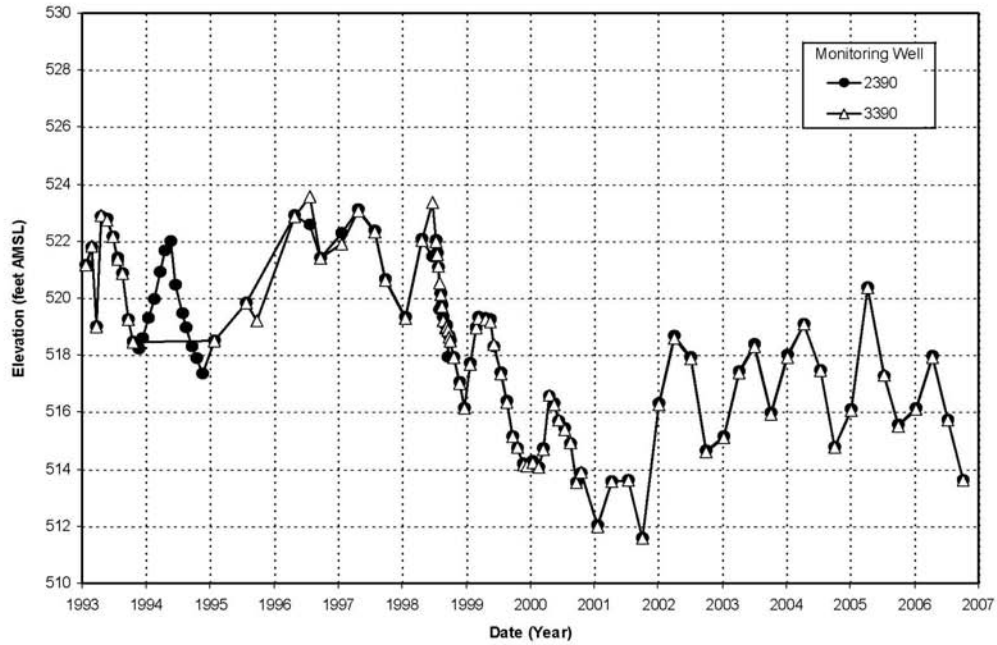


FIGURE A.3-18. HYDROGRAPH FOR WELL CLUSTER 390

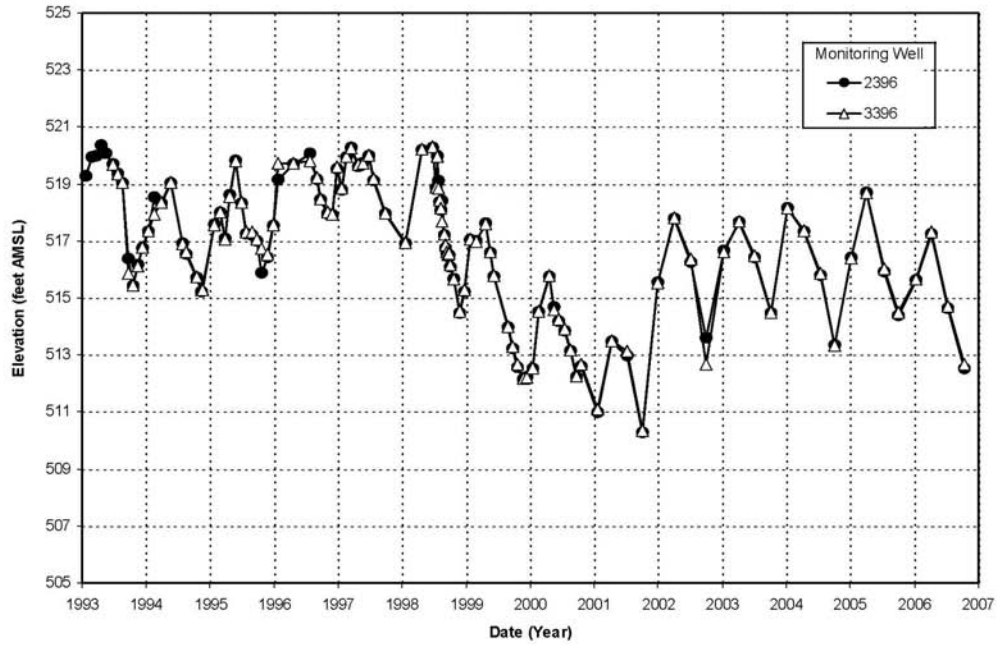


FIGURE A.3-19. HYDROGRAPH FOR WELL CLUSTER 396

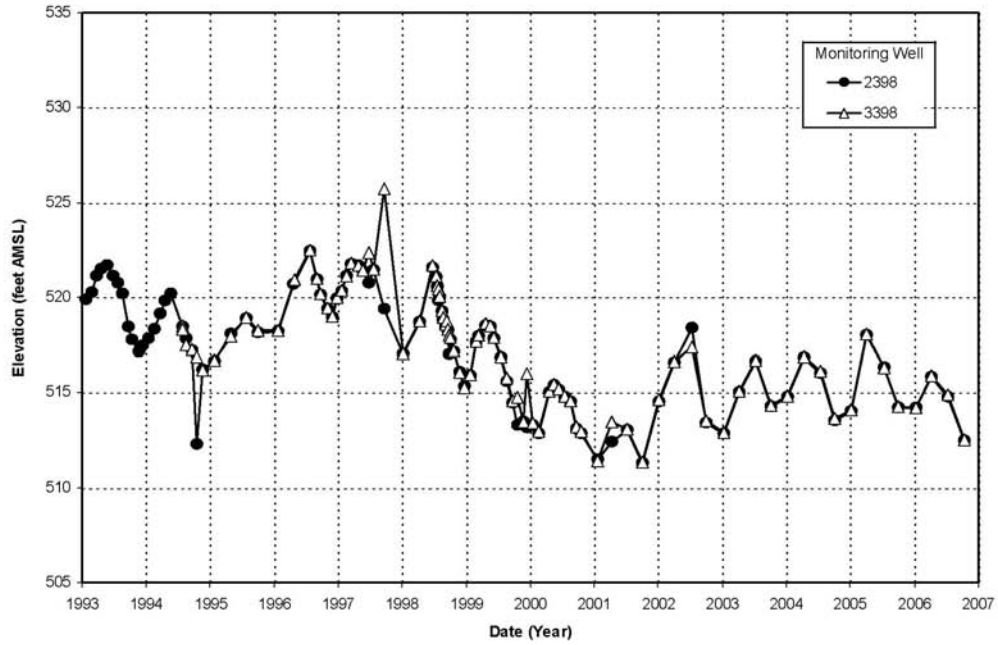


FIGURE A.3-20. HYDROGRAPH FOR WELL CLUSTER 398

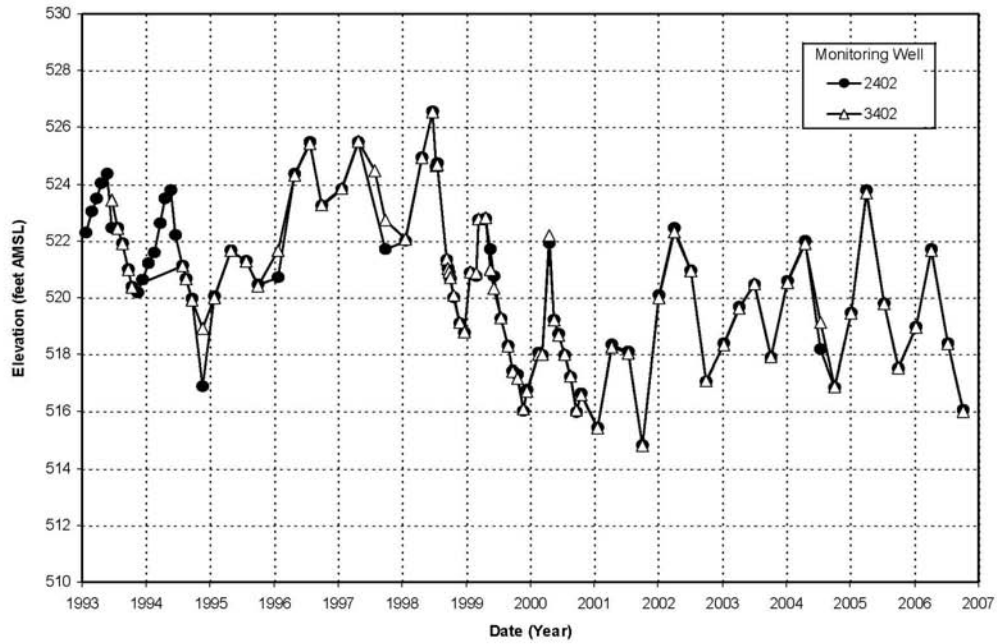


FIGURE A.3-21. HYDROGRAPH FOR WELL CLUSTER 402

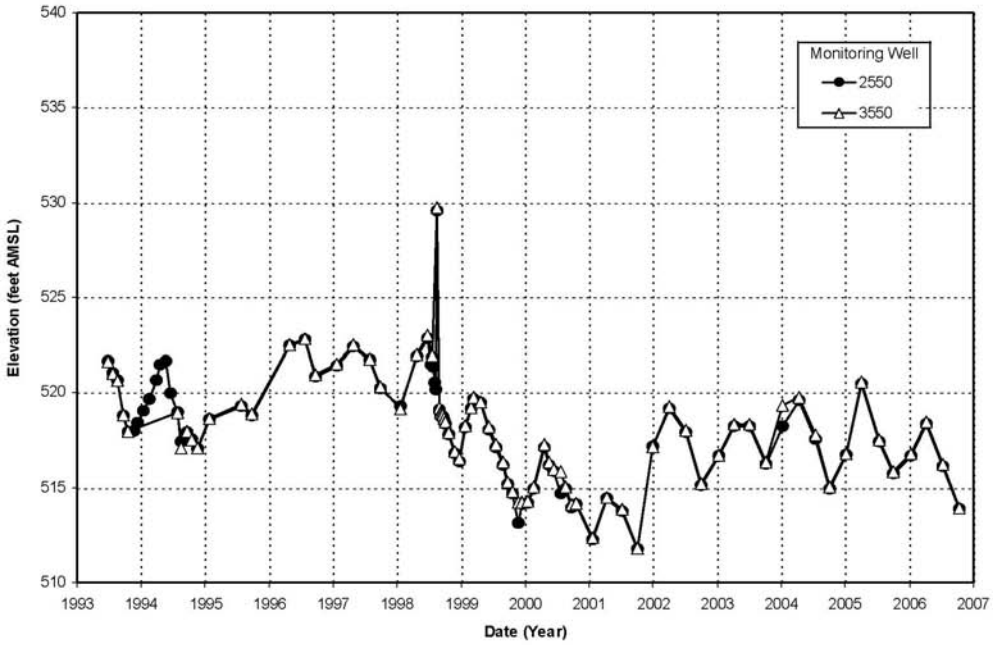


FIGURE A.3-22. HYDROGRAPH FOR WELL CLUSTER 550

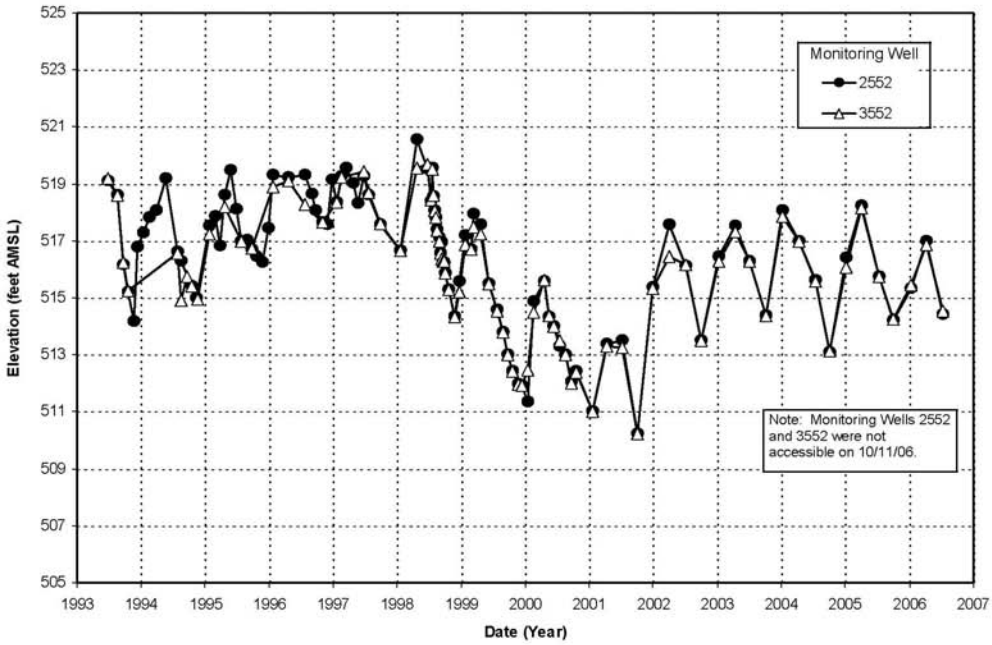


FIGURE A.3-23. HYDROGRAPH FOR WELL CLUSTER 552

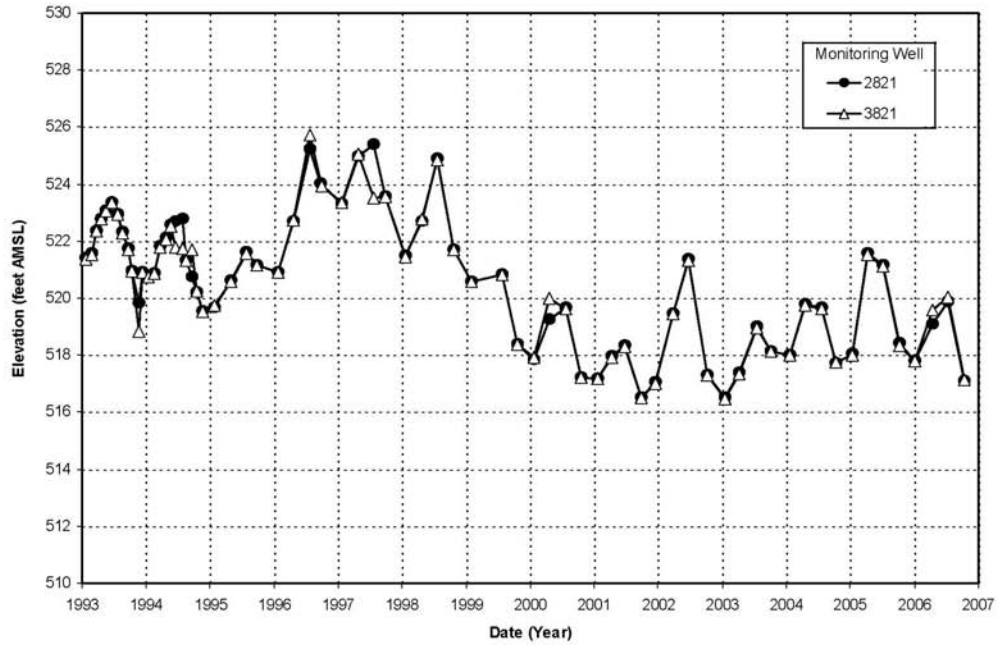


FIGURE A.3-24. HYDROGRAPH FOR WELL CLUSTER 821

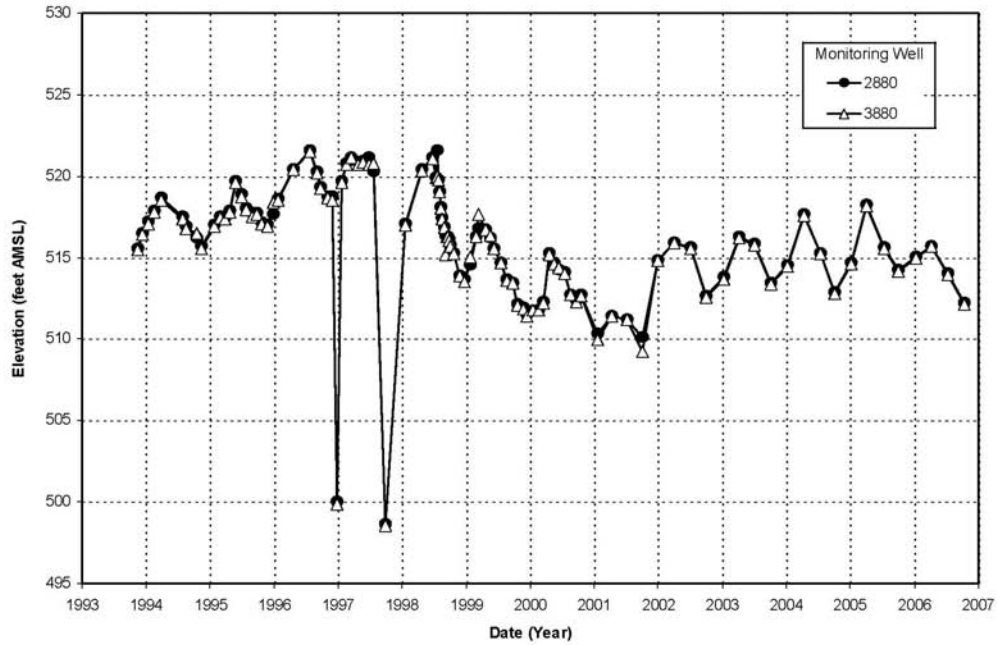


FIGURE A.3-25. HYDROGRAPH FOR WELL CLUSTER 880

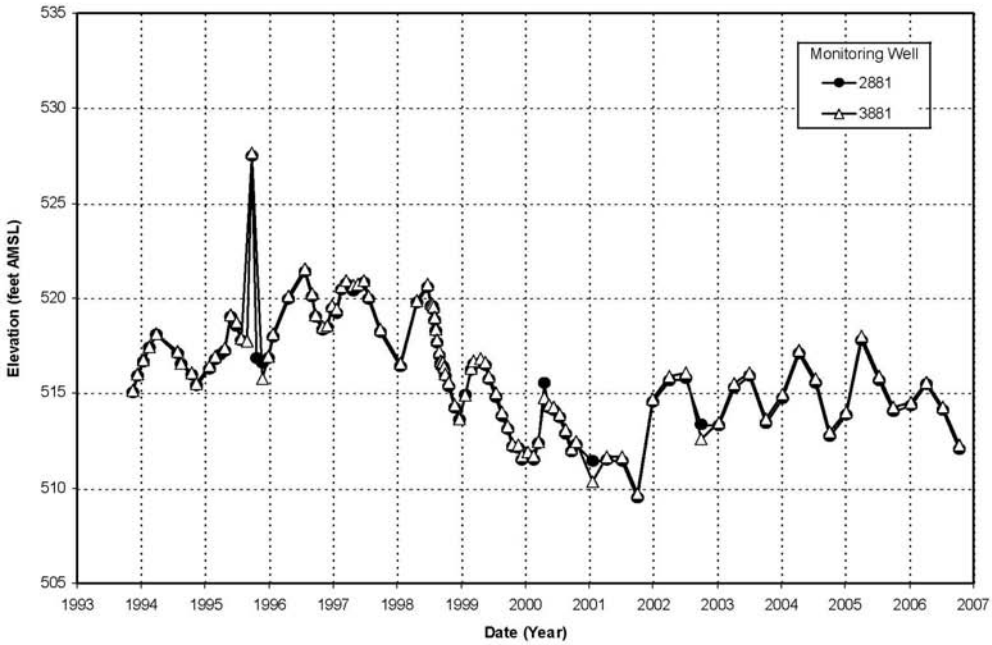


FIGURE A.3-26. HYDROGRAPH FOR WELL CLUSTER 881

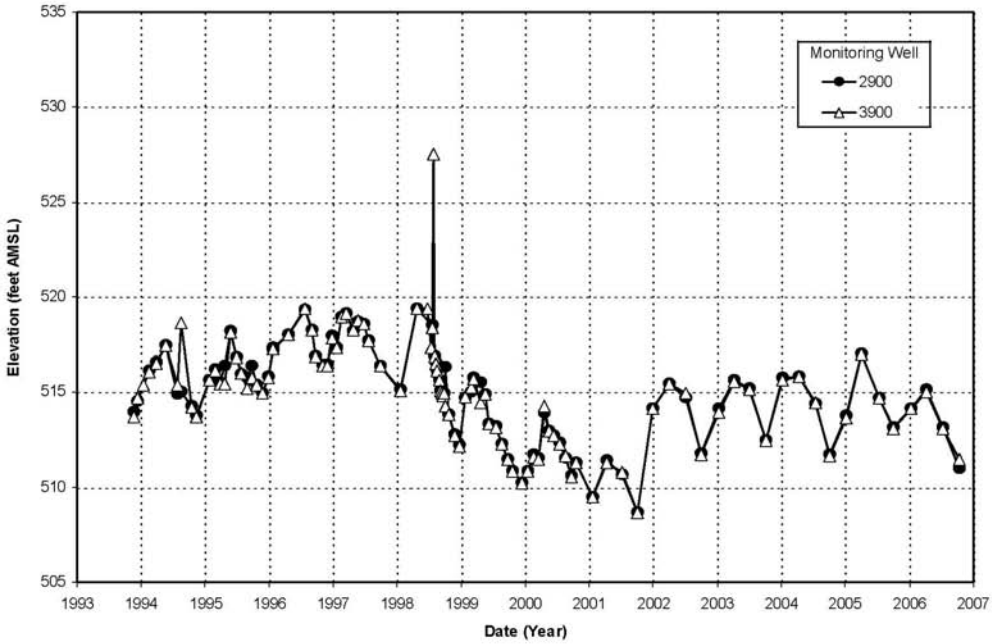


FIGURE A.3-27. HYDROGRAPH FOR WELL CLUSTER 900

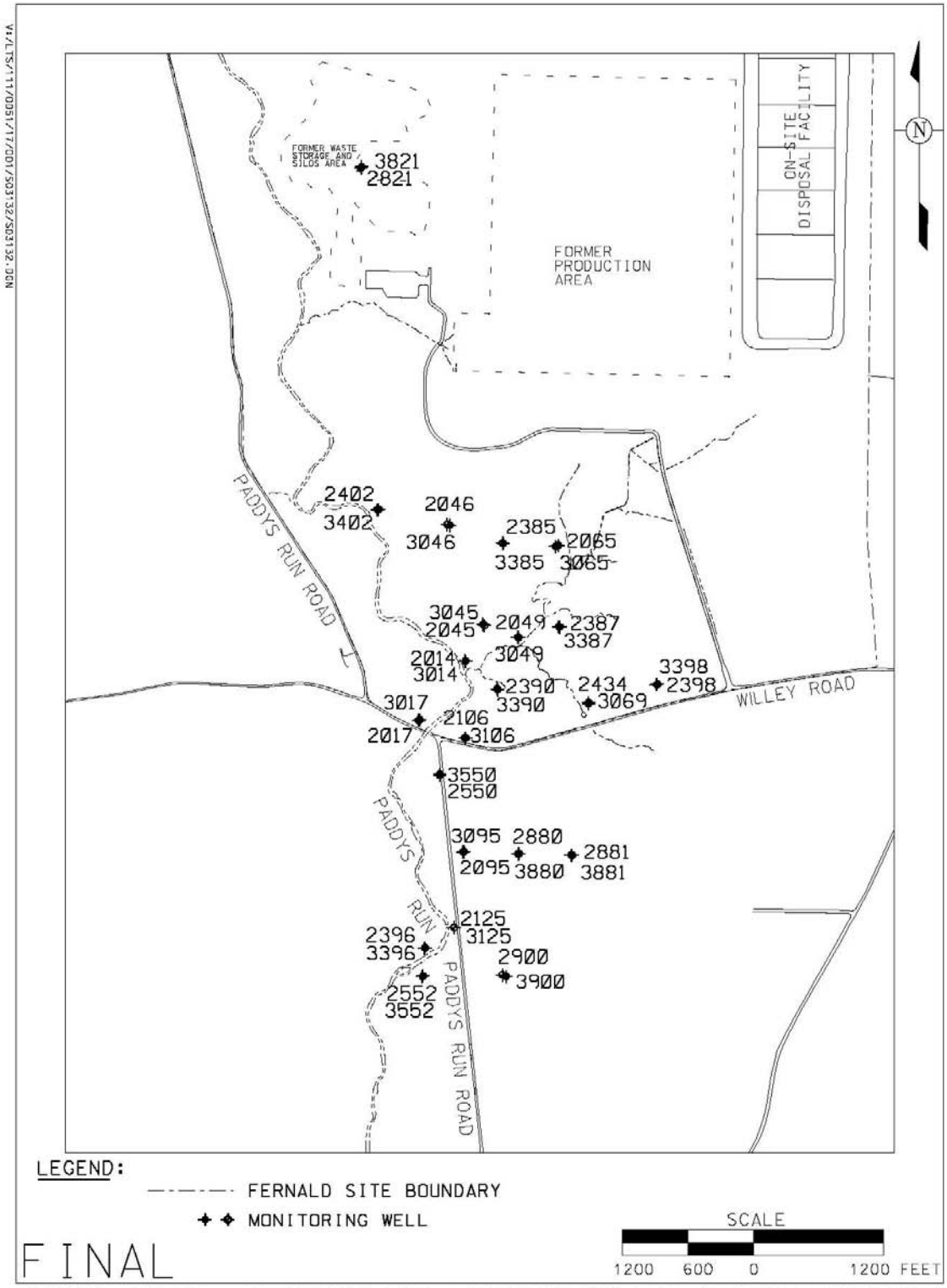


Figure A.3−28. Monitoring Well Locations for Well Cluster Hydrographs

End of current text

Attachment A.4

A.4.0 Non-Uranium FRL Results

This attachment evaluates non-uranium FRL results for 2006. The purpose of the evaluation is to:

- Identify 2006 non-uranium FRL exceedances and determine if monitoring locations should be added or removed based on 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).

A.4.1 Non-Uranium FRL Exceedances For 2006

Table A.4−1 identifies the summary statistics and trend analysis for the 2006 non-uranium FRL exceedances from monitoring wells both inside and outside the Waste Storage Area (Phase II) design. As indicated in Table A.4−1, six non-uranium FRL constituents had one or more FRL exceedances during 2006. Figure A.4−1 identifies the location of these FRL exceedances. Figure A.4−1 shows that the non-uranium FRL exceedances in 2006 for monitoring wells were located in the waste storage area, and along the eastern site boundary. Those in the waste storage area were within the Waste Storage Area (Phase II) design remediation footprint, while those along the eastern property boundary 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.

A revised groundwater monitoring approach was implemented in January 2003. In support of that change, a table was presented in the IEMP, Revision 3 (DOE 2003), which identified all non-uranium FRL exceedances from 1997 through 2002. In Table A.4-2 was revised to present all locations and constituents that are monitored and the location of all non-uranium exceedances for each year. Prior to 2003, only the locations where exceedances occurred were presented; but by showing all of the monitoring locations and constituents, it is possible to see the limited number of exceedances that actually occur with respect to the monitoring programs. Table A.4-2 has been updated to include the data from 2006.

The first column in Table A.4−2 lists the groundwater FRL constituents monitored in 2006. The second column identifies the wells monitored 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 2006 and, as indicated above, six had exceedances. The following summarizes the 2006 non-uranium monitoring information:

Constituent	Monitoring Program	2006 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 three waste storage area wells and one well along the eastern site boundary
Molybdenum	Waste Storage Area	Exceedance in one waste storage area well
Nickel	Property/Plume Boundary	No exceedances
Nitrate/Nitrite	Waste Storage Area	Exceedances in three waste storage area wells
Technetium 99	Waste Storage Area	Exceedances in two waste storage area wells
Trichloroethene	Waste Storage Area	Exceedances in one waste storage area well
Zinc	Property/Plume Boundary	Exceedance in one well along the eastern site boundary

Wells with exceedances inside the footprint consist of Monitoring Wells 2649, 2821, 3821, 2648, and 2010, which are located in the waste storage area where active source remediation was taking place during 2006.

Table A.4−2 shows while a few of the exceedances were present one year, in subsequent years the concentration was once again below the associated groundwater FRL. Table A.4−2 illustrates that the monitoring approach is conservative in that there are very few exceedances with respect to the overall monitoring program, and that many wells continue to have no non-uranium exceedances. This table will be updated annually and determinations will be made through the annual report and IEMP revisions as to whether constituent monitoring frequencies can be reduced.

With the implementation of the streamlined monitoring approach in 2003, it is important to track the wells that are being plugged and abandoned. During 2006, it was necessary to plug and abandon Monitoring Well 2648 (which was sampled for non-uranium constituents) to support source removal excavation activities in the former waste storage area. If a well is plugged due to well integrity issues, this decision is documented through EPA and OEPA conference calls and through the annual letter to the Ohio Department of Natural Resources. Monitoring Well 2648 was located on the south east side of the former waste pit 4 and was plugged and abandoned on October 14, 2006. The monitoring well was replaced in the IEMP by Monitoring Well 83340.

A.4.2 Evaluation of 2006 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 Site Environmental Report (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 report, 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 IEMP, Revision 4. 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

Five possible persistent FRL exceedances were identified in 2005 requiring additional data collection in 2006. The exceedances were: antimony in Monitoring Well 2636; arsenic in Monitoring Well 2636, manganese in Monitoring Wells 22205; and zinc in Monitoring Wells 22210 and 3128. The non-uranium FRL exceedances for 2006 along with the possible persistent exceedances identified in 2005 are addressed below.

Figure A.4−1 and Table A.4−1 identify the 2006 non-uranium FRL exceedances outside the Waste Storage Area (Phase II) design remediation footprint. These wells are shaded in Table A.4−1. In 2006, two constituents had one or more FRL exceedance at two wells located outside the Waste Storage Area (Phase II) design remediation footprint:

- Manganese at Monitoring Well 22204
- Zinc at Monitoring Well 22210

Table A.4−3 is used as an evaluation tool to address the possible persistent FRL exceedances for those that occur outside the Waste Storage Area (Phase II) design remediation footprint. It includes the exceedances for 2006 listed in the bullets above, as well as those still being evaluated or deemed persistent from the 2005 Site Environmental Report (DOE 2005b). 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 2006 for manganese at Monitoring Well 22204.

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

- Additional data, to be collected in 2007, are necessary to determine the persistence of the following FRL exceedances:
  - Antimony at Monitoring Well 2636
  - Arsenic at Monitoring Well 2636
  - Zinc at Monitoring Well 22210
- The following FRL exceedances in 2005 were not persistent:
  - Manganese at Monitoring Well 22205
  - Zinc at Monitoring Well 3128.
- The FRL exceedance recorded for manganese at Monitoring Well 22204 in 2006 was persistent.
- The exceedance for manganese at Monitoring Well 22210 that was judged as persistent in 2005 was not persistent in 2006.

Figures A.4−2 through A.4−8 present individual concentration versus time graphs for all monitoring wells and constituents identified above.

The evaluation for persistence of non-uranium FRL exceedances in wells located outside the Waste Storage Area (Phase II) design remediation footprint in 2006 marks the tenth 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. Continued monitoring will determine if the exceedance remains persistent. At this time, no change to the aquifer remedy is planned to address the exceedance at this monitoring well.

Note that Monitoring Well 2636 had a persistent FRL exceedance for arsenic in 2004 and an exceedance for antimony in the first half of 2004. This well is often dry and cannot be sampled, as was the case for the second half of 2005 and all of 2006. Additional data is required to determine if the 2004 exceedances are still present/persistent. This well is located south of the administrative boundary in the Paddys Run Road Site contaminant plume area. The administrative boundary is located between the Fernald site uranium plume and the Paddys Run Road Site contaminant plume area. The Paddys Run Road Site consists of documented releases of inorganic constituents (including arsenic), volatile organic compounds, and semivolatile organic compounds. Groundwater monitoring is occurring south of the administrative boundary to assess the impact of pumping the South Plume extraction wells on the Paddys Run Road Site plumes.

A.4.3 Conclusions

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

- Groundwater exceedances will continue to be monitored to determine if monitoring frequencies can be reduced (Table A.4−2 will continue to be updated annually).
- Non-uranium FRL exceedances occurring in the 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 2006: manganese at Monitoring Well 22204. A change in the design of the aquifer remedy to address the exceedance at this monitoring well is not required at this time.
- Additional data are needed to verify whether antimony, arsenic, and zinc FRL exceedances outside the Waste Storage Area (Phase II) design footprint are persistent.

Table A.4−1. Summary Statistics and Trend Analysis for Non-Uranium Constituents With 2006 Results Above Final Remediation Levels

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 2006[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]	Trend[b,c,d,e,f,g]
Manganese (0.90 mg/L)	2010	10	9	2	0.600	6.14	3.19	2.08	Up, Marginal
	22204	8	6	2	0.418	3.01	1.33	0.78	Up, Marginal
	2648	13	9	1	0.347	4.08	1.59	1.14	Down, Significant
	3821	14	9	1	0.145	6.07	1.95	1.79	No Significant Trend
Molybdenum (0.10 mg/L)	2649	13	13	1	0.207	0.69	0.46	0.14	No Significant Trend
Nitrate/Nitrite (11 mg/L)[h]	2648	21	8	1	0.150	27.4	9.59	7.69	No Significant Trend
	2649	21	20	1	0.805	102	53.4	26.5	**Up, Significant**
	2821	22	5	2	1.38	30.9	8.63	7.48	**Up, Significant**
Zinc (0.021 mg/L)	22210	4	2	1	0.0077	0.0244	0.018	0.008	No Significant Trend
					(pCi/L)	(pCi/L)	(pCi/L)	(pCi/L)	
Technetium-99 (94 pCi/L)	2649	21	21	1	101	1350	611	398	No Significant Trend
	2821	22	10	2	0.253	651	143	186	**Up, Significant**
					(µg/L)	(µg/L)	(µg/L)	(µg/L)	
Trichloroethene (5.0 µg/L)	2649	13	12	1	0.50	120	65	27	No Significant Trend

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

[a]From Operable Unit 5 Record of Decision, Table 9-4.
[b]Based on samples from August 1997 through 2006.
[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. NA = not applicable.
[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]Mann-Kendall test for trend is performed using data from third quarter 1998 through 2006.
[h]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

Table A.4−2. Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				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
Antimony																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																								x						
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB																														
	2431	0	P/PB																								x						
	2432	0	P/PB																														
	2625	4	PRRS																														
	2636	4	PRRS																									x		x			
	2733	0	P/PB																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB																														

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				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
Arsenic																																	
	2093	4	PRRS																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB																														
	2431	0	P/PB																														
	2432	0	P/PB																														
	2625	4	PRRS												x																		
	2636	4	PRRS		x	x				x	x											x						x					
	2733	0	P/PB																														
	2898	4	PRRS											x																			
	2899	4	PRRS																														
	2900	4	PRRS											x																			
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB																														

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				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
Benzene																																	
	2128	4	PRRS																														
	2625	4	PRRS																														
	2636	4	PRRS																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3128	4	PRRS																														
	3636	4	PRRS																														
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
Boron																																	
	2045	2	SF								x		x		x																		
	2049	2	SF	x	x			x	x	x	x	x	x	x	x		x								x								
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Bromodichloromethane																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Carbazole																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				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
Carbon disulfide																																	
	2010	1	WSA																														
	2648	1	WSA																														
	2649	1	WSA						x																								
	2821	1	WSA																														
	3821	1	WSA										x																x				
Alpha-Chlordane																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Bis(2-Chloroisopropyl)ether																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
1,1-Dichloroethene																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF										x																				
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Fluoride																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				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
Fluoride (Contd)	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB																														
	2431	0	P/PB						x																								
	2432	0	P/PB																														
	2625	4	PRRS																														
	2636	4	PRRS																														
	2733	0	P/PB																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														
	3898	4	P/PB																														
	3899	4	P/PB																														
	3900	4	P/PB																														
	4398	2	P/PB																														
Lead																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				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
Lead (Cont.)																																	
	2398	2	PRRS																														
	2431	0	PRRS											x																			
	2432	0	PRRS																														
	2625	4	PRRS																														
	2636	4	PRRS																														
	2733	0	PRRS																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB	x													x																
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB																														
Manganese																																	
	2010	1	WSA													x				x						x	x	x	x		x	x	x
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																					x									
	22199	0	OSDF																														
	22204	0	OSDF																							x			x	x	x	x	x
	22205	0	OSDF																												x		
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				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
Manganese (Cont.)	2398	2	P/PB																														
	2431	0	P/PB			x	x																										
	2432	0	P/PB														x			x	x		x			x							
	2625	4	PRRS																														
	2636	4	PRRS																														
	2648	1	WSA		x				x				x		x				x				x						x	x		x	
	2649	1	WSA																														
	2733	0	P/PB																														
	2821	1	WSA																														
	2898	4	PRRS																				x					x					
	2899	4	PRRS													x																	
	2900	4	PRRS													x																	
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														
	3821	1	WSA										x		x				x				x			x	x	x			x	x	
	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB																														
Mercury																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				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
Molybdenum																																	
	2010	1	WSA																														
	2648	1	WSA																														
	2649	1	WSA	x					x				x		x				x				x			x	x	x	x	x	x	x	
	2821	1	WSA																														
	3821	1	WSA																														
Nickel																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF										x																				
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB	x		x	x	x	x			x	x																				
	2431	0	P/PB																														
	2432	0	P/PB																														
	2625	4	PRRS																														
	2636	4	PRRS																														
	2733	0	P/PB																														
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS																														
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																														
	3398	2	P/PB																														
	3424	0	P/PB																														
	3426	0	P/PB																														
	3429	0	P/PB																														
	3431	0	P/PB																														
	3432	0	P/PB																														
	3636	4	PRRS																														
	3733	0	P/PB																														

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Wella	Aquifer Zone	Projectb	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				3c	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
Nickel (Cont.)	3898	4	PRRS																														
	3899	4	PRRS																														
	3900	4	PRRS																														
	4398	2	P/PB							x				x																			
Nitrate/Nitrite																																	
	2010	1	WSA																														
	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	
	2821	1	WSA										x													x				x		x	x
	3821	1	WSA														x				x										x		
Technetium-99																																	
	2010	1	WSA																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	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	
	2821	1	WSA										x												x	x	x	x	x	x	x	x	x
	3821	1	WSA																														
Trichloroethene																																	
	2010	1	WSA																														
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
	2648	1	WSA																														
	2649	1	WSA						x				x		x				x				x			x	x	x	x	x	x	x	
	2821	1	WSA																														
	3821	1	WSA																														

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006	
				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
Vinyl Chloride																																	
	22198	0	OSDF																														
	22199	0	OSDF																														
	22204	0	OSDF																														
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																														
	22211	0	OSDF																														
	22214	0	OSDF																														
Zinc																																	
	2093	4	P/PB																														
	2128	4	PRRS																														
	21063	4	P/PB																														
	22198	0	OSDF																														
	22199	0	OSDF																							x							
	22204	0	OSDF																							x							
	22205	0	OSDF																														
	22208	0	OSDF																														
	22210	0	OSDF																											x		x	
	22211	0	OSDF																														
	22214	0	OSDF																														
	2398	2	P/PB				x																										
	2431	0	P/PB					x	x					x																			
	2432	0	P/PB							x				x			x																
	2625	4	PRRS																														
	2636	4	PRRS																														
	2733	0	P/PB								x																						
	2898	4	PRRS																														
	2899	4	PRRS																														
	2900	4	PRRS													x												x					
	3070	2	P/PB																														
	3093	4	P/PB																														
	31217	0	P/PB																														
	3128	4	PRRS																											x			

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2006 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006
				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
Zinc (Cont.)																																
	3398	2	P/PB																													
	3424	0	P/PB																													
	3426	0	P/PB								x		x																			
	3429	0	P/PB							x	x																					
	3431	0	P/PB																			x										
	3432	0	P/PB																													
	3636	4	PRRS																													
	3733	0	P/PB																							x						
	3898	4	PRRS																													
	3899	4	PRRS																x													
	3900	4	PRRS																													
	4398	2	P/PB																													

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 now semiannual. Well numbers that are **bold** have historical FRL exceedances.
[b]WSA = Waste Storage Area
[c]Sampling for the IEMP was initiated in August 1997.

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

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 2005 Results	2006 FRL Exceedance[a]		Evaluation Results for 2006	Figure No.
			1st Semiannual	2rd Semiannual		
Antimony	2636[b]	Additional Data Required Exceedance in the first half of 2004	NS	NS	Additional Data Required	A.4-2
Arsenic	2636[b]	Additional Data Required Persistent in 2004	NS	NS	Additional Data Required	A.4-3
Manganese	22204	Persistent	Yes	Yes	**Persistent**	A.4-4
	22205	Additional Data Required	No	No	Not Persistent	A.4-5
	22210[c]	Persistent	No	No	Not Persistent	A.4-6
Zinc	22210	Additional Data Required No exceedance in 2nd half of 2005	Yes	No	Additional Data Required	A.4-7
	3128	Additional Data Required	No	No	Not Persistent	A.4-8

[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, and all of 2006.
[c]Monitoring Well 22210 replaced Monitoring Well 2426 which was plugged and abandoned August 2, 2005.

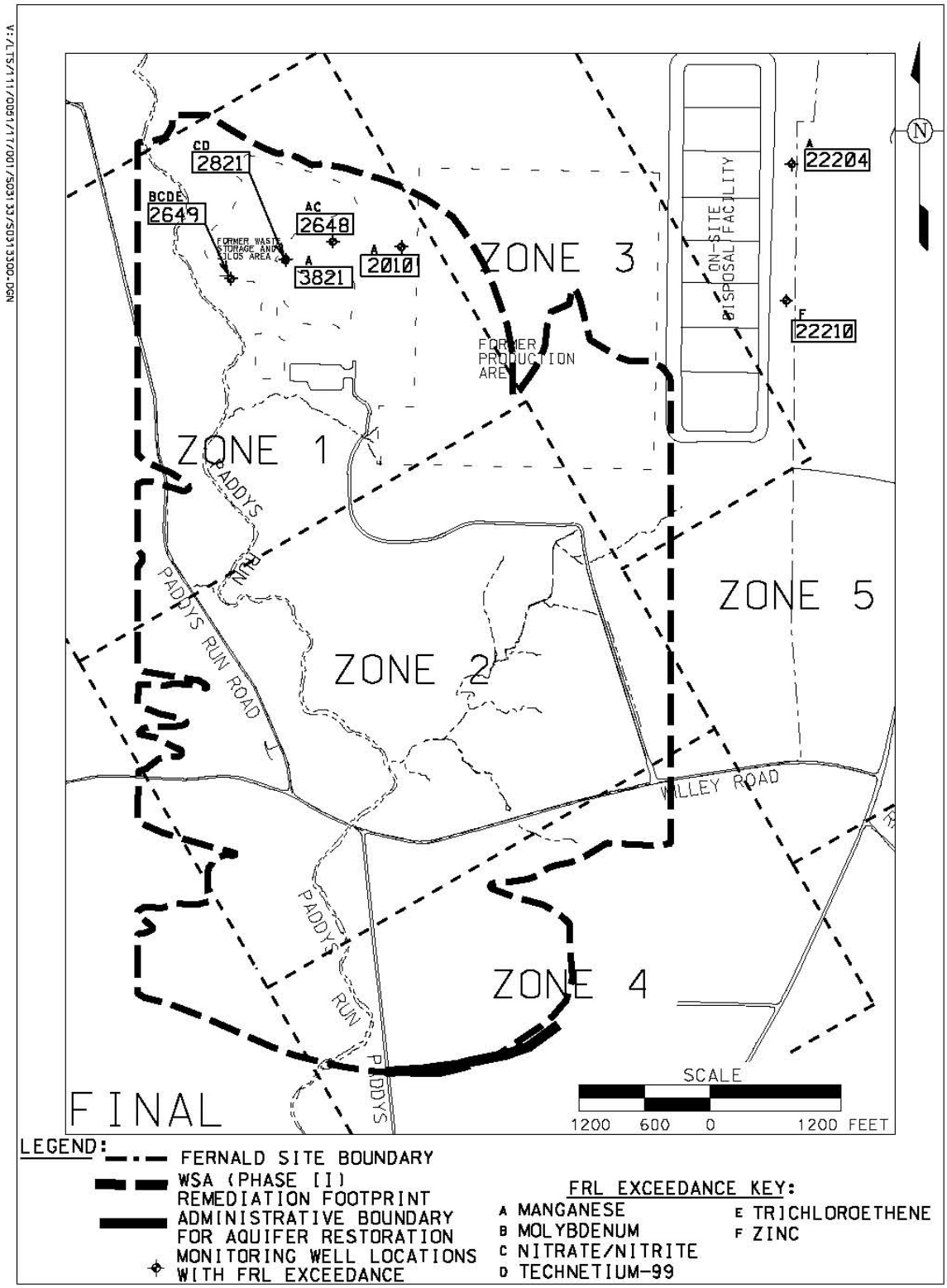


Figure A.4−1. Non-uranium Constituents with 2006 Results Above Final Remediation Levels

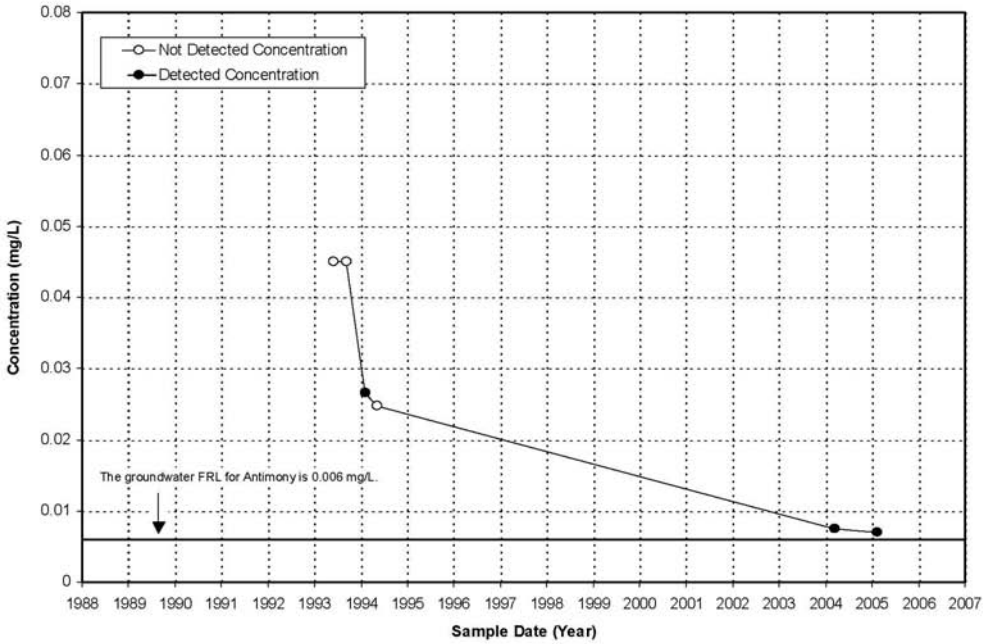


FIGURE A.4-2. ANTIMONY CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

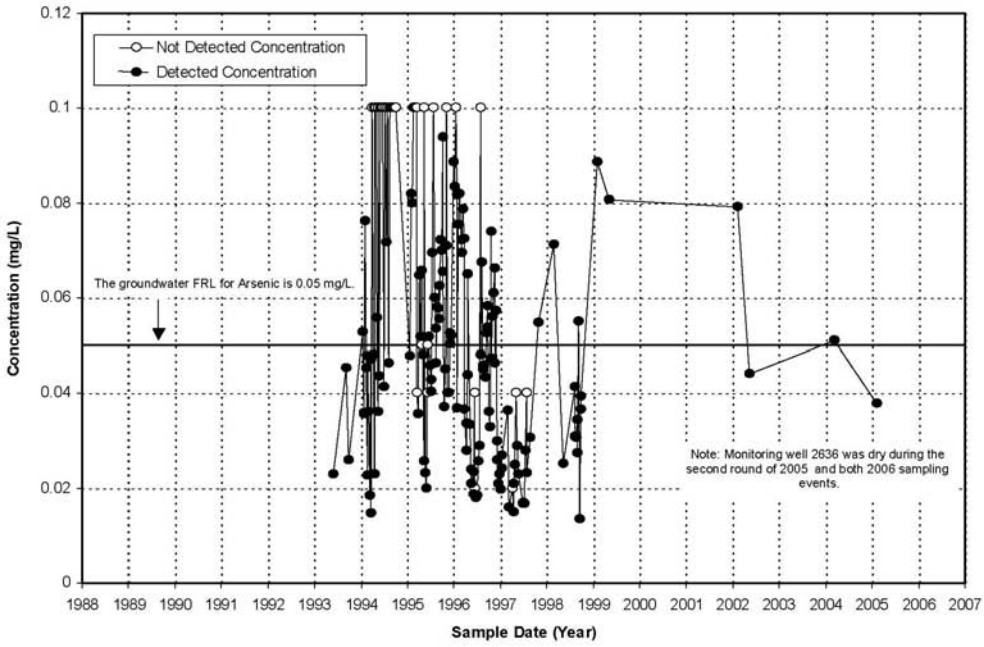


FIGURE A.4-3. ARSENIC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

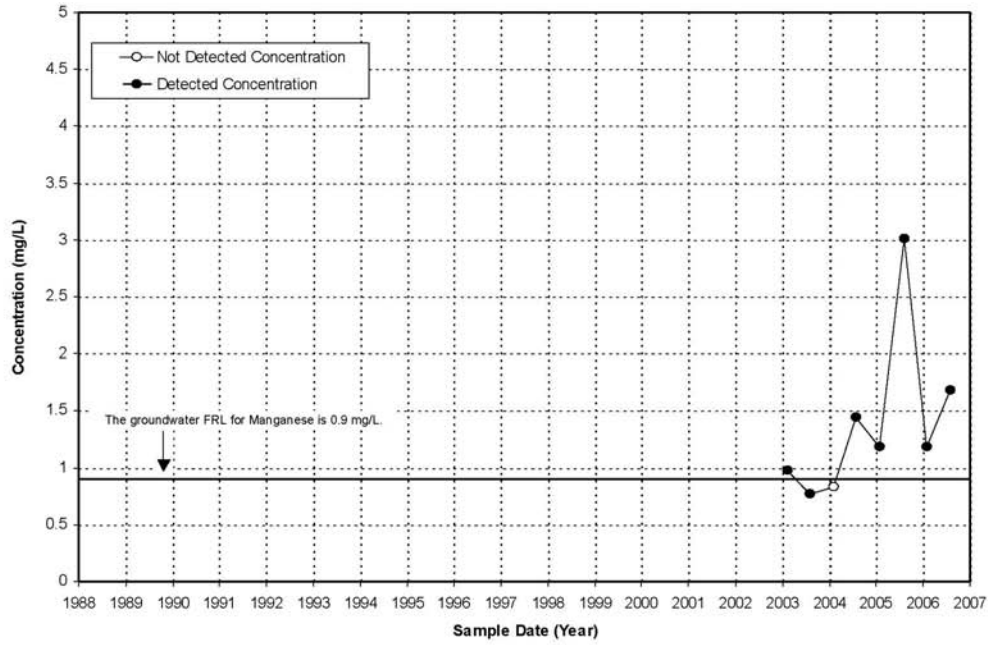


FIGURE A.4-4. MANGANESE CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22204

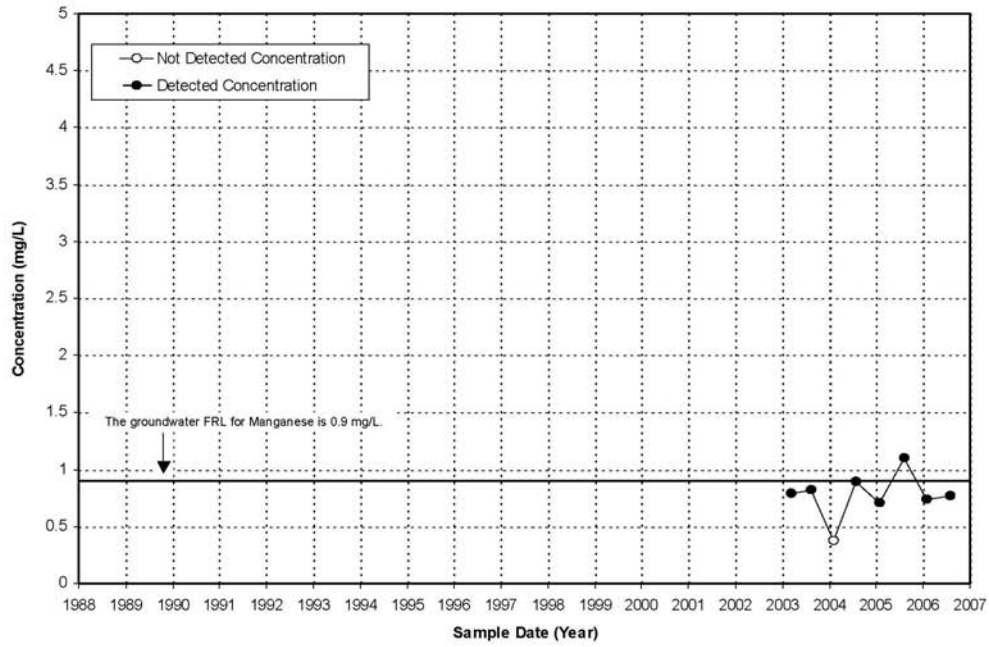


FIGURE A.4-5. MANGANESE CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22205

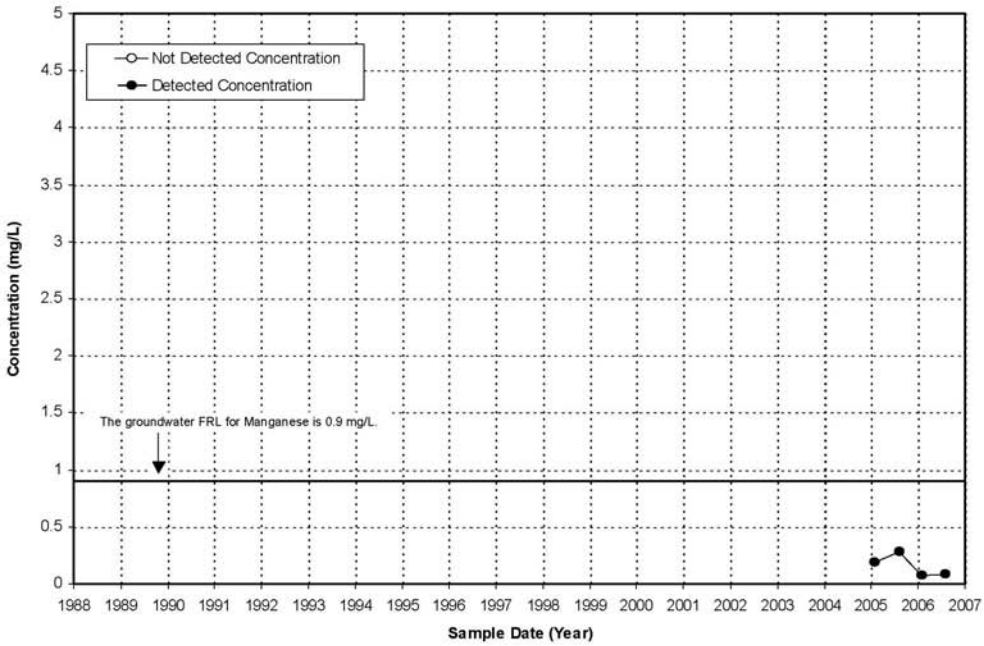


FIGURE A.4-6. MANGANESE CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22210

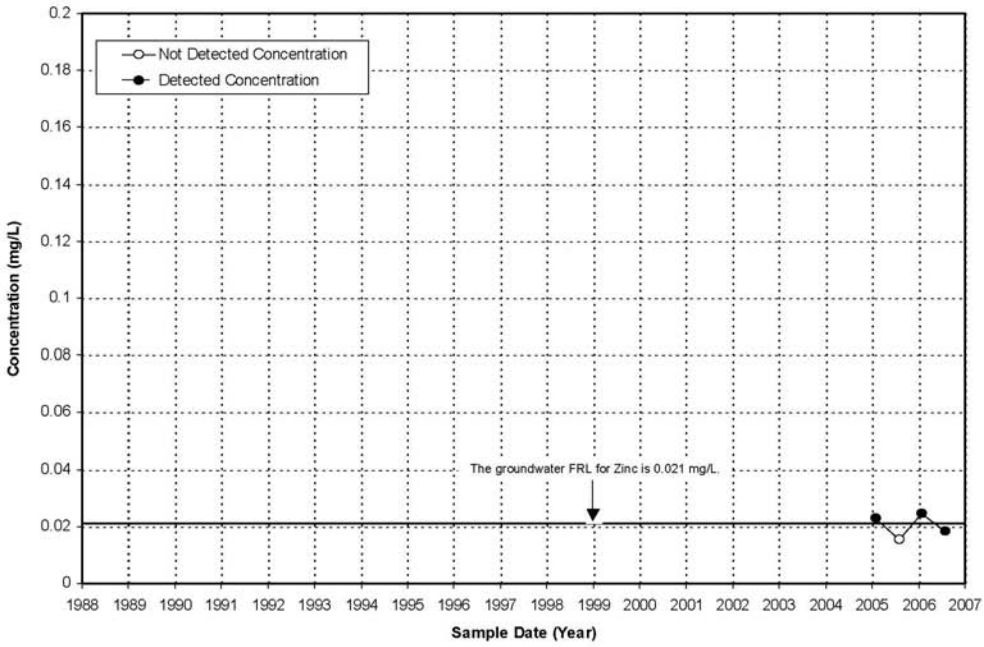


FIGURE A.4-7. ZINC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22210

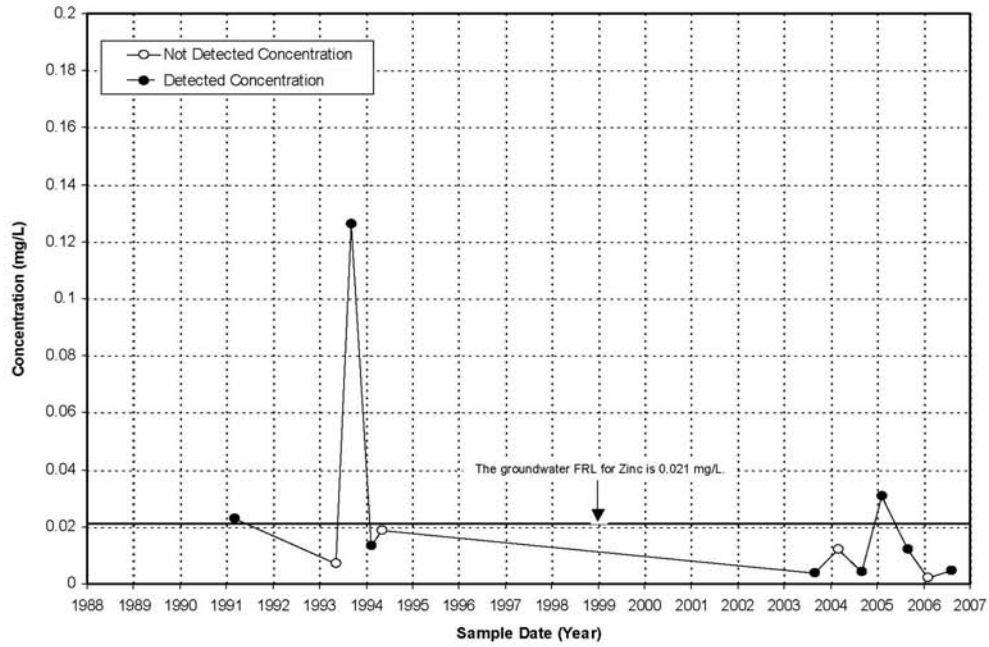


FIGURE A.4-8. ZINC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3128

End of current text

Attachment A.5

A.5.0 On-Site Disposal Facility Monitoring Results

The on-site disposal facility (OSDF) monitoring program described in the OSDF Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP) (DOE 2006) fulfills two primary purposes: leak detection and leachate monitoring. This attachment provides the 2006 results for the leak detection monitoring program to meet regulatory requirements for groundwater detection monitoring in the Great Miami Aquifer and perched groundwater system and to provide leachate monitoring information.

Protection of the Great Miami Aquifer 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)
- Leak detection system (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 comes in contact with the waste during cell construction and additional moisture that drains 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 from 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.

Horizontal till wells (HTWs) are set beneath the compacted clay liner of each cell. These wells provide monitoring of the perched groundwater quality beneath the point where the LCS and LDS pipes exit the liner system. The Great Miami Aquifer 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.

The final on-site disposal facility dimensions are: capacity of 2.96 million cubic yards (yd^3) (2.26 cubic meters [m^3]); maximum height of approximately 65 feet (ft) (20 meters [m]); and an estimated area coverage of 90 acres (36 hectares) of the northeastern area of the Fernald site. At the end of 2006, approximately 2.96 million in-place yd^3 (2.26 m^3) of waste were placed in the on-site disposal facility, of which in 2006 approximately 202,061 in-place yd^3 (154,487 m^3) of waste (including some excavated material, debris, etc.) were placed in Cells 7 and 8 of the on-site disposal facility. Cells 1 through 6 were 100 percent full and capped as of the end of January 2006. In 2006, Cell 7 was filled to its capacity (from 94 percent at the end of 2005) and the final cover system construction was completed by October 2006. In addition, Cell 8 was filled to its capacity (from 63 percent at the end of 2005) and the final cover system was completed by October 2006.

The 2006 OSDF leak detection and leachate monitoring information is organized in the following sections: Water Balance (Section A.5.1), Analytical (Section A.5.2), Additional OSDF Information (Section A.5.3), and Overall Performance and Recommendations (Section A.5.4). Subattachments are also included to provide cell-specific information:

- Cell 1 (Subattachment A.5.1)
- Cell 2 (Subattachment A.5.2)
- Cell 3 (Subattachment A.5.3)
- Cell 4 (Subattachment A.5.4)
- Cell 5 (Subattachment A.5.5)
- Cell 6 (Subattachment A.5.6)
- Cell 7 (Subattachment A.5.7)
- Cell 8 (Subattachment A.5.8).

Each subattachment includes figures, tables, and analytical information.

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.5.1 Water Balance

This section provides the following information:

- Overall LCS volumes (A.5.1.1)
- LDS accumulation rates and volumes (A.5.1.2)
- Liner efficiencies (A.5.1.3)
- HTW water yields (A.5.1.4)
- Perched water level investigation (A.5.1.5)
- Great Miami Aquifer water levels versus total uranium (A.5.1.6).

A.5.1.1 Overall LCS Volumes

Leachate volumes were measured in 2006 at a meter located within the OSDF leachate conveyance system lift station located immediately south of the valve houses. Leachate was derived from precipitation and use of dust suppression water on the active cells. In addition to leachate from active cells, the volumes measured include water pumped from the LDS tanks from each cell. The LDS flows are subtracted from the total meter reading to obtain a

measurement that represents the collective leachate volume from all OSDF cells containing waste materials.

The volume of precipitation that fell on the active cells in 2006 was approximately 10.6 million gallons. As noted above, another source of water that generated leachate was the dust suppression water obtained from any of three OSDF construction wells. From January through the end of September 2006, a total of 25.9 million gallons were pumped from these wells for dust suppression, a portion of which was used as dust suppression water on Cells 7 and 8.

Leachate was collected from Cells 1 through 8 for the entire year. Leachate volumes have been measured in all cells since waste placement was initiated.

According to the data collected in 2006, approximately 7.6 million gallons of leachate were collected and pumped to the Storm Water Retention Basin and Backwash Basin for subsequent treatment at the Converted Advanced Wastewater Treatment Facility (CAWWT). This value represents about 20.8 percent of the precipitation and dust suppression water that fell on the active cells. The remainder of the precipitation/dust suppression water evaporated or was retained in the waste material.

Figure A.5−3 provides monthly LCS-to-Backwash Basin flow volumes (and previously LCS-to-Storm Water Retention Basin flow volumes). Precipitation amounts corresponding to each accumulation period are displayed to show the correlation between precipitation and the LCS accumulation rate. As presented in Figure A.5−3, leachate volumes fluctuated throughout the year but generally correlate to precipitation. These fluctuations were expected during the active waste placement period that occurred prior to final capping. The leachate volumes during this period primarily reflected the amount of precipitation that fell on the active cells and was subsequently collected in the LCS. As the cells were capped, the leachate volume from the capped cells are expected to stabilize and diminish over time as in Cells 1, 2, and 3.

The OSDF 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. Figures in Subattachments A.5.1 through A.5.3 for Cells 1 through 3 show weekly and monthly LCS accumulation volumes for capped cells (e.g., Cells 1, 2, and 3). As identified above, the leachate volumes from Cells 1, 2, and 3 (i.e., the capped cells) have stabilized and diminished over time. Cells 4 and 5 were capped during 2005, and Cell 6 was capped in January 2006. These cells have similar trends to those observed in Cells 1 through 3. Subattachments A.5.4 through A.5.6 show weekly and monthly LCS accumulation volumes for Cells 4, 5, and 6, respectively.

A.5.1.2 LDS Accumulation Rates and Volumes

Quantitative measurement of the volumes accumulating in and pumped from the LDS was initiated according to the various dates in Table A.5−1. These measurements are taken from a pressure transducer installed in the primary containment vessel and attached to a data logger that measures and records water levels hourly. The water level data are downloaded weekly and converted into 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 gallons per acre per day [gpad]) and accumulation volumes (in gallons) for each cell’s LDS.

In each cell-specific subattachment (Subattachments A.5.1 through A.5.8), weekly and monthly accumulation rates along with corresponding precipitation amounts are graphically displayed. Precipitation amounts corresponding to each accumulation period are used to determine whether a correlation exists between precipitation and the LDS accumulation rate. Based on a review of the figures, it does not appear that there is a strong correlation between precipitation and the cell LDS accumulation rates. This is not surprising as a geosynthetic liner and various amounts and types of material above the liner retard the movement of precipitation into the LDS. Figures are also provided in the cell-specific subattachments to show LDS monthly accumulation rates versus waste placement volume. Now that all waste cells have been capped and it has been documented through this and past SERs that there is not a strong correlation between precipitation and the Cell LDS accumulation rates it is no longer necessary to track LDS accumulation rates on a weekly basis. With next year's SER, DOE recommends going to reporting of only monthly LDS accumulation rates.

The OSDF 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. Weekly and monthly accumulation volumes are shown for capped Cells 1 through 6 in Subattachments A.5.1 through A.5.6.

Additionally, the OSDF Final Design Calculation Package (DOE 1997b) concludes that an initial response leakage rate for individual cells should be 20 gallons per acre per day (gpad). The 2006 maximum LDS accumulation rates and the percent of the initial response leakage rate for each cell is as follows:

- Cell 1 − 0.07 gpad (0.4 percent)
- Cell 2 − 0.09 gpad (0.5 percent)
- Cell 3 − 0.59 gpad (3.0 percent)
- Cell 4 − 2.61 gpad (13.1 percent)
- Cell 5 − 9.47 gpad (47.4 percent)
- Cell 6 − 10.16 gpad (50.8 percent)
- Cell 7 − 13.08 gpad (65.4 percent)
- Cell 8 − 9.85 gpad (49.3 percent).

These rates indicate that the liner systems for the cells that are capped (Cells 1 through 8) are performing well within the specifications outlined in the approved cell design. Note that Cells 4 and 5 were capped during 2005 (April and August, respectively), Cell 6 was capped in January 2006, Cell 7 and Cell 8 were capped in October 2006. Over time, with the capping and closure of the cells, the water yield from each cell's LDS is expected to diminish (refer to individual cell subattachments). The volume of water removed from each cell's LDS will continue to be closely tracked to determine if the primary liner systems continue to perform as expected.

A.5.1.3 Liner Efficiencies

Cell-specific apparent liner hydraulic efficiencies can be calculated via 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, and 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 liner efficiencies were consistently greater than 99 percent for Cell 1, 96 percent for Cell 2 and Cell 3, 83 percent for Cell 4, 73 percent for Cell 5 and 78 percent for Cell 6. Monthly liner efficiencies (in percentages) are provided for capped Cells 1 through 6 in Subattachments A.5.1 through A.5.6. Data for cells 7 and 8 are not available for 2006.

A.5.1.4 HTW Water Yields

HTW water yields are being reviewed to determine if trends exist in perched water purge volumes. Average monthly water yields from the HTWs ranged from 141 gallons below Cell 6 to 1,088 gallons below Cell 1. The Cell 3 HTW water yield, which had been trending upward from 2001 through 2005, showed a reduction in average monthly yield of 54 gallons. The HTW water yields will continue to be tracked and factored into the OSDF leak detection evaluation, where appropriate. The water-yield graphs, provided in each cell's subattachment, are updated with purge volume data collected prior to each sampling event.

A.5.1.5 Perched Water Level Investigation

The purpose of this monitoring was to determine whether the perched water levels beneath the cells were high enough to come in contact with the secondary liner of the cells. The water levels were measured and stored electronically on an hourly basis and were reviewed monthly. HTW water level monitoring was initiated in February 2002 for Cells 1 through 3; in March 2002 for Cells 4 and 5; in October 2003 for Cell 6; in January 2005 for Cell 7; and in August 2005 for Cell 8. Specific graphs for Cells 1 through 8 are provided in Subattachments A.5.1 through A.5.8. In addition to the HTW water level monitoring, five Type 1 wells (13249, 13250, 13251, 13252, and 13261) were installed around Cell 1 in the spring of 2002 to evaluate perched water levels around the cell with respect to those found in the HTW for Cell 1 (Well 12338). Monitoring of these wells ceased in 2005 after approval EPA and OEPA.

Based on the HTW water level monitoring and known water level gradients, it appears in past years that perched water levels may have been high enough at certain times of the year to come in contact with portions of the liners beneath Cells 1 and 5. This information is important to the

OSDF leak detection program because it indicates that perched water may be a source for flow into the LDS layer. The perched water levels in the vicinity of Cells 1 through 5, and their implications for contributing fluid to the LDS, have been discussed periodically with EPA and OEPA during the weekly conference calls, site visits, and meetings. Note that during 2005, Cell 1 water levels were not high enough to come in contact with the liners (i.e., primary or secondary); however, Cell 5 water levels were high enough to come into contact with its secondary liner. Data indicate that perched water levels in the area of Cells 6 through 8 are not high enough to be directly in contact with their associated liners.

Sufficient data has been gathered to conclude that perched water could be a source for flow into the LDS layer of Cells 1 through 5. Water level information will continue to be collected prior to sampling HTWs; however, the electronic downloads were discontinued during 2005 after approval from EPA and OEPA. Note that the pressure transducers/dataloggers were removed from the wells in early 2006.

A.5.1.6 Great Miami Aquifer Water Levels Versus Total Uranium

Time plots of total uranium versus water level are prepared for the Great Miami Aquifer wells for Cells 1 through 8 and are provided in the cell-specific subattachments. It is important to review these plots with respect to the overall OSDF data evaluation process. In general, as groundwater elevations increase, uranium concentrations increase; and as groundwater elevations decrease, the uranium concentrations decrease. Groundwater elevations around the OSDF are typically about 520 ft above mean sea level (AMSL), and total uranium concentrations remain below the total uranium groundwater FRL of 30 μg/L, with concentrations typically less than 10 μg/L.

A.5.2 Analytical

This section provides the following information:

- Data presentations and evaluations (Section A.5.2.1)
- Parameter modification criteria (Section A.5.2.2).

Detailed text for each cell is also provided in the cell-specific subattachments.

A.5.2.1 Data Presentations and Evaluations

At this time, the number of samples collected from each OSDF cell determines how the data are presented. The OSDF GWLMP states that, based on the current understanding of pre-existing levels of contaminants in the OSDF subsurface, the Fernald site is electing to perform up to 12 rounds of initial baseline sampling for both the perched system and the Great Miami Aquifer for all initial site-specific leak detection monitoring parameters.

Sufficient samples have been collected to evaluate initial baseline conditions in Cells 1 through 7, and monitoring in these cells is utilizing a refined baseline list of constituents. Concentration plots are prepared and provided for these cells. Since sufficient samples have not been collected to evaluate baseline conditions in Cell 8, concentration plots are not provided in this report for Cell 8. Instead a data summary table is provided.

The following subsections describe specifics pertaining to the different types of data presentations:

- Summary tables (Section A.5.2.1.1)
- Concentration plots (Section A.5.2.1.2).

A.5.2.1.1 Summary Tables

Summary tables are used to evaluate initial baseline conditions and to also summarize analytical data prior to evaluating initial baseline conditions. A summary table is presented for Cell 8 in Subattachment A.5.8. This summary table includes overall sample numbers, number of detections, and sample ranges. Trend analysis prior to establishment of baseline is only required for the LCS and LDS per the OSDF GWLMP; however, it is provided for all horizons, where possible. It should be noted that the same seven constituents detected in Cells 1 through 7 have also been detected in Cell 8 (i.e., total organic carbon, total organic halogens, boron, mercury, technetium-99, sulfate, and total uranium).

A.5.2.1.2 Concentration Plots

There have been at least 12 samples collected from the HTWs and Great Miami Aquifer wells for Cells 1 through 7. Therefore, concentration plots are provided for these cells in Subattachments A.5.1 through A.5.7.

In previous SERs control charts have also been provided for informational purposes only. Technically though, it does not make sense to continue providing control charts until it has been determined that constituent-specific steady state conditions have been established. A common ion study is underway to address the steady state issue. Data collection for the common ion study is scheduled to be completed in 2007. Once it has been demonstrated that steady state conditions have been established, control charts will once again be provided in the SERs.

Summary statistics tables for Cells 1 through 7 are provided in each cell-specific subattachment. Each table summarizes, for constituents detected greater than 25 percent of the time the: average, distribution type, trend, presence of serial correlation, and outliers. The information provided in each table is based on a standardized sampling frequency, which is quarterly for all cells. Information in each table is also included on the concentration plots provided in the cell-specific subattachments. 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.

Concentration plots (for those constituents detected more than 25 percent of the time) for each cell are provided on two plots: one showing the LCS, LDS, and HTW; and one showing the HTW and Great Miami Aquifer wells. The HTW is provided on both plots to serve as a reference horizon.

With respect to trend analysis, it is not unexpected that concentrations in any one or a number of horizons might be trending upward. Upward trends are not necessarily indicative of a leak, but possibly an indication of the changes in the environment surrounding the system. For example, the LCS concentrations could reflect more concentrated water as the leachate ages and infiltration into the capped cells decreases. Also, there is the pre-existing contamination in the Great Miami Aquifer, which could cause upward trends in concentrations as well. It is important to look at the overall LCS and LDS flow trends and concentration levels to evaluate the integrity of all components in the system.

For Cells 1 through 7, four of the 16 original leak detection indicator parameters (i.e., total organic carbon, total organic halogens, boron, and total uranium) were detected more than 25 percent of the time. In 2003, sulfate was added to the leak detection indicator parameter list due to its high mobility and the presence of a sulfate source in the crushed stone placed in the LCS and LDS layers. Sulfate was also detected more than 25 percent of the time.

A.5.2.2 Parameter Modification Criteria

As identified in the OSDF GWLMP, it is anticipated that during the data collection process, recommended refinements to the monitoring lists will be made periodically. The following subsections describe the current considerations for future additions and deletions to the parameter lists.

A.5.2.2.1 Eliminating Monitoring Parameters

An indicator parameter (sampled at least eight times) will be eliminated from the long-term leak detection monitoring program if it is not detected more than 25 percent of the time during the initial baseline period in the LCS, LDS, HTW, and GMA wells. This approach will be implemented on a cell-by-cell basis. Based on this approach, to date four constituents (total organic carbon, total organic halogens, boron, and total uranium) have been identified for long-term leak detection monitoring at Cells 1 through 7. The reduction in monitoring for Cells 1, 2, and 3 was approved through the Cells 1, 2, and 3 Technical Memorandum. The reduction in monitoring for Cells 4, 5, and 6 was approved through the 2004 Site Environmental Report. The reduction in monitoring for Cell 7 was approved through the 2005 Environmental Report.

A.5.2.2.2 Adding Monitoring Parameters

Based on the analytical results for the annual grab sample of leachate collected from the LCS for the Appendix I and polychlorinated biphenyl (PCB) parameters specified in the Ohio Administrative Code (OAC) 3745-27-10 and 19, detected constituents are evaluated to determine whether the initial site specific indicator parameters list is sufficient for leak detection purposes. Results of the evaluations are reported in the annual site environmental reports in accordance with the OAC 3745-27-19(M) reporting requirement.

Most of the Appendix I constituents have already been detected in perched groundwater at the Fernald site and were considered when selecting the initial site specific leak detection indicator parameters. It is expected that these constituents will also be detected in future OSDF leachate samples. Although constituents that are not part of the initial site specific indicator parameter list

for leak detection may be detected in the annual grab samples; it is not anticipated that the concentrations will be high enough to warrant revision of the initial site specific leak detection parameter list. Therefore, constituents detected in the annual OSDF LCS samples will not be added to the initial site specific leak detection indicator parameters list until the detections have been confirmed and criteria discussed below have been met.

The need to add a new initial site specific parameter will be considered when its detected concentration in the annual OSDF LCS samples are higher than the concentrations that exist currently in the contaminated media underlying the facility (i.e., above the range of Fernald site perched water concentrations as defined in the Remedial Investigation Report for Operable Unit 5 [DOE 1995]). A constituent will be added if: (1) the concentrations observed in the annual sample are much higher than the perched water concentrations at the Fernald site; and (2) routine analysis of the constituent can significantly enhance early detection capability. Additionally, concentrations will be compared to perched water and Great Miami Aquifer background values and the Great Miami Aquifer FRL values. Comparisons will be provided through the annual site environmental reports.

The refined baseline monitoring list currently consists of uranium, boron, total organic carbon (TOC), total organic halogens (TOX) sulfate, and the common ion constituents. The common ion constituents are being monitored temporarily to support a common ion study. Continued sampling for common ion constituents will be decided based upon the results of the study. Based on comments received on the 2006 SER, DOE and Geotrans over the course of 2006 have discussed ideas to develop a more systematic approach to determine how an annual LCS monitoring parameter will be added to the site specific monitoring list. The resulting selection approach is presented in the attached flow charts (FiguresA.5−4A and A.5−4B). The selection approach calls for any Appendix I or PCB constituent that has been sampled for eight times and has a 25 percent detection rate to be considered a “potential” site specific monitoring constituent. Incorporation to the site specific monitoring list would only be done if it can be demonstrated that adding the constituent would significantly enhance the early detection capability of the monitoring program.

Adding a constituent to the site specific monitoring list will be based on a statistical test to determine if there is a significant difference between the potential site-specific parameter concentration and either the pre-design or background data sets that are specific to the Fernald site. Statistical tests proposed include a T-test, Wilcoxen Rank Sum and Quantile Test, and Poisson Prediction Limits Test. Use of a specific test depends upon dataset conditions presented in Figure A.5−4B. It is possible that some Appendix I or PCB constituents that have no site-specific pre-design or background data will meet the eight sample, and >25 percent detect criteria. If this occurs, inclusion of the constituents on the site specific monitoring list will need to be considered on a case-by-case basis to determine if adding the constituent would significantly enhance the early detection capability of the monitoring program.

Potential site specific leak detection monitoring constituents are identified in the cell specific subattachments of this report. Once it has been documented that EPA/OEPA agrees with the proposed evaluation approach presented in Figures A.5−4A and A.5−4B, DOE will assess the potential leak detection monitoring constituents that are identified in the cell specific subattachments of this report. Results of the assessment will be presented to the EPA/OEPA as soon as they are available and they will also be reported in next year’s SER.

A.5.2.2.3 Confirmatory Sampling

As recommended in the Cells 1, 2, and 3 Technical Memorandum, when cell monitoring is refined (i.e., changed to those constituents detected more than 25 percent of the time during initial baseline sampling), annual samples collected from the LCS and LDS will be analyzed for all site-specific leak detection indicator constituents. If a site-specific constituent (not on the refined list) is detected in either the LCS or LDS, then confirmatory sampling for that constituent will consist of three consecutive sample events from the horizon in which it was detected. Depending on the magnitude and/or persistence of the constituent detected in the LCS or LDS, sampling for the detected constituent in the next lower horizon may occur. If the constituent is detected in the next lower horizon, then confirmatory sampling will again be conducted for three consecutive sampling events to determine if the sampling needs to progress to the next horizon.

Confirmatory Sampling for 1,1-dichloroethene in the LCS and LDS of Cell 3

In 2006 confirmatory sampling took place for 1,1-dichloroethene in the LCS and LDS of Cell 3. On May 16, 2005, a concentration of 9.2 µg/L was detected in the Cell 3 LCS. The groundwater FRL is 7 µg/L. Confirmatory sampling began in the fourth quarter of 2005. Results are as follows.

- Nov 28, 2005 13 µg /L
- Feb 20, 2006 3.2 µg /L
- May 23, 2006 12 µg /L
- Aug 25, 2006 2.1 µg /L
- Nov 1, 2006 2.5 µg /L
- Feb 20, 2007 0.737 µg/L

The annual Cell 3 LDS result from May 30, 2006 was a non-detect. Based on LCS results though, it was decided to conduct confirmatory sampling in the LDS. Results are as follows:

- Aug 25, 2006 Non-detect
- Nov 1, 2006 Non-detect
- Feb 20, 2007 Non-detect

Confirmatory sampling at the Cell 3 LCS for 1,1-dichloroethene will continue in 2007 until the constituent is evaluated using the site specific parameter selection approach presented in Figures A.5−4A and A.5−4B. Confirmatory sampling at Cell 3 LDS for 1,1-dichloroethene will be discontinued.

A.5.3 Additional OSDF Information

The following information on the common ion study, construction material, leach tests, and cell cap inspections has been included in this report to assist with the overall leak detection evaluation.

A.5.3.1 Common-Ion Study

At the March 8, 2005, TIE meeting, it was agreed upon by DOE, EPA, and OEPA that common ion monitoring would be conducted for eight rounds in the LCS, LDS, and horizontal till wells for each cell. Common ions, which are being sampled and analyzed, include: calcium, iron, magnesium, manganese, phosphorous, potassium, silicon, sodium, alkalinity, chloride, fluoride, nitrate/nitrite, and oxidation reduction potential. This monitoring was initiated in May 2005. It is anticipated that the 8 rounds of sampling will be completed for the majority of the locations in August 2007. Once the 8 rounds of common ion data have been collected, sampling for common ion constituents will stop. A decision concerning the resumption of common ion monitoring activities will be determined based upon the results of the common ion study.

A.5.3.2 Construction Information and Leach Tests

As indicated in the 2004 Site Environmental Report, crushed limestone with dolomite was used in the construction of the OSDF for the LCS, LDS, and cap drainage layers. This rock is primarily composed of carbonate, calcium, and magnesium, but contains minor and trace quantities of almost every constituent that is present in seawater, including sulfate and boron. When the rock was crushed to prepare the size fraction dictated by the construction specification, a large surface area of fresh rock became available to react with the water that eventually contacts the stone. The composition of the leachate generated when water contacts the crushed stone was determined with leach tests performed in 2005. Results of the leach tests will be evaluated along with the results of the common ion monitoring discussed above.

A.5.3.3 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; Ohio Department of Health; 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 digging 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 generated for DOE that documents that the inspection was conducted and any findings that were reported. In 2006, inspections were conducted in February, June, September, and December.

A.5.4 Overall Performance and Recommendations

Based on the information provided in the previous subsections and in the following cell-specific subattachments, during 2006 the liners for Cells 1 through 8 all appear to be performing within the specifications detailed in the OSDF design documents. Over time, with the capping and closure of the cells, the water yield from each cell's LDS is expected to diminish. The volume of water removed from each cell's LDS will continue to be closely tracked to determine if the primary liner systems continue to perform as expected.

A.5.4.1 Parameter Modification Recommendation Summary

No modifications are recommended at this time.

Future parameter modifications will be made, as necessary, according to the criteria defined in the OSDF GWLMP and based on information collected for the common ion sampling.

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: November 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; GMASW = 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.

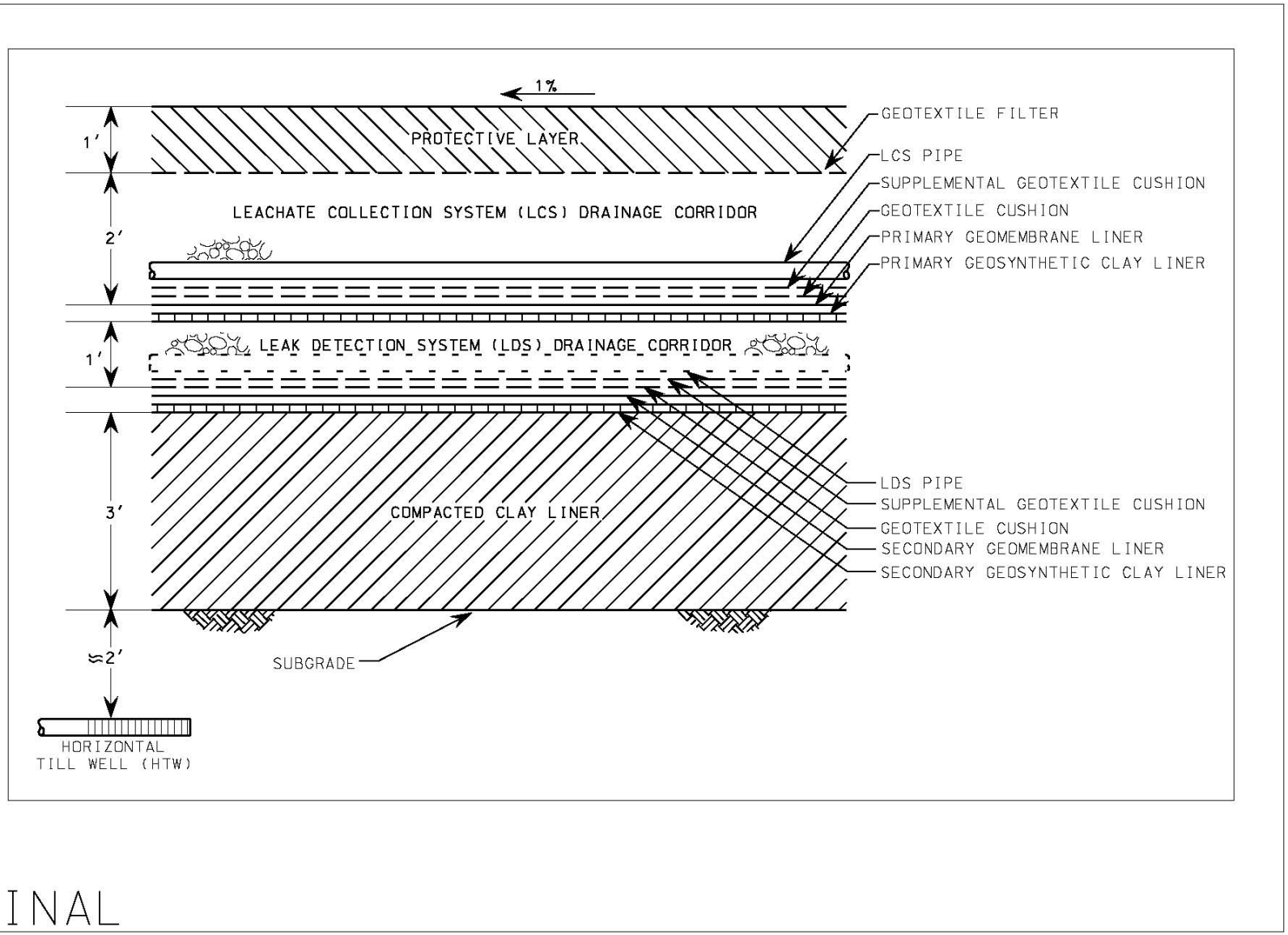


Figure A.5−1. On-Site Disposal Facility Liner System with HTW at the Drainage Corridor

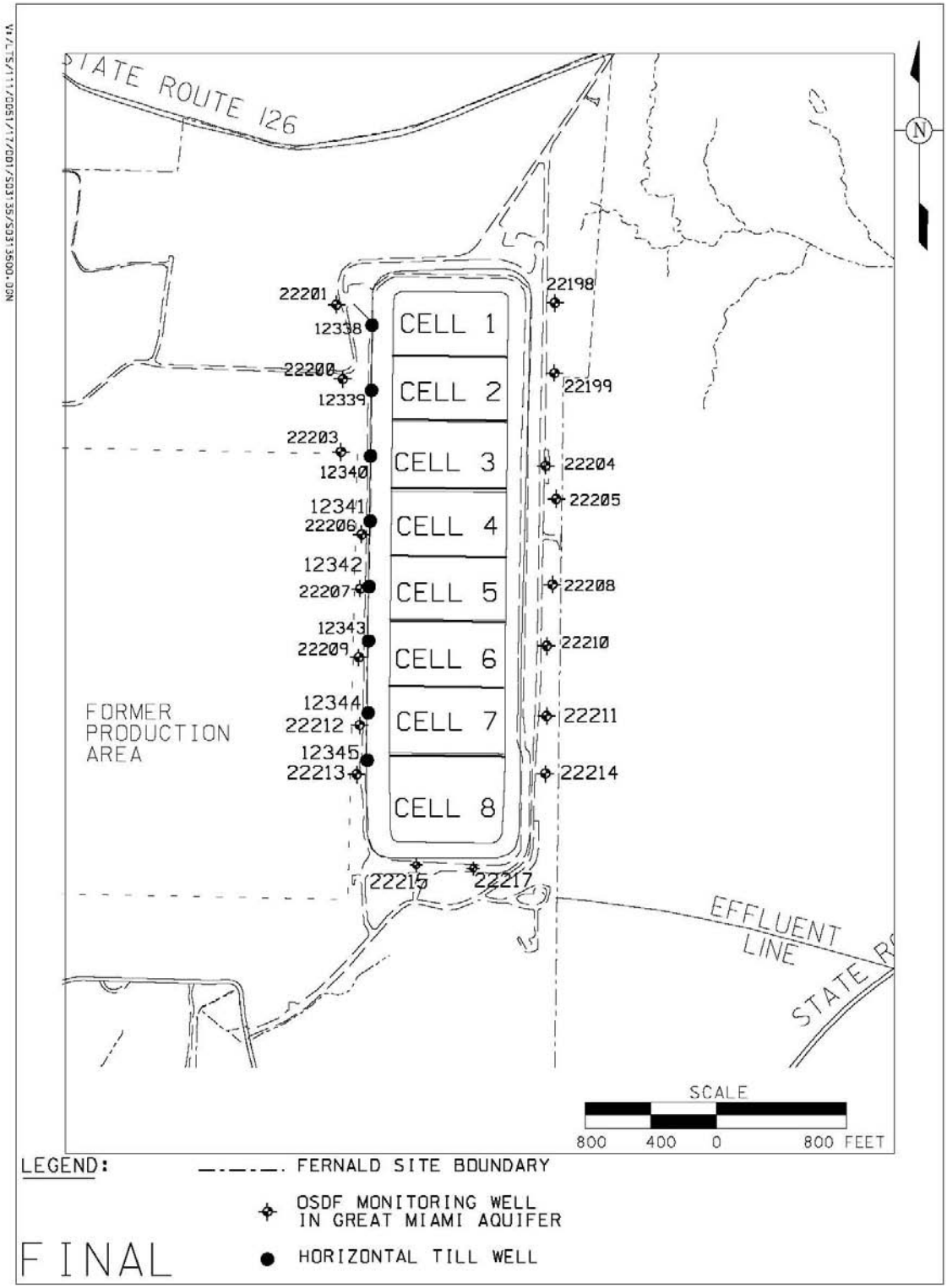


Figure A.5−2. On-Site Disposal Facility Footprint and Monitoring Well Locations

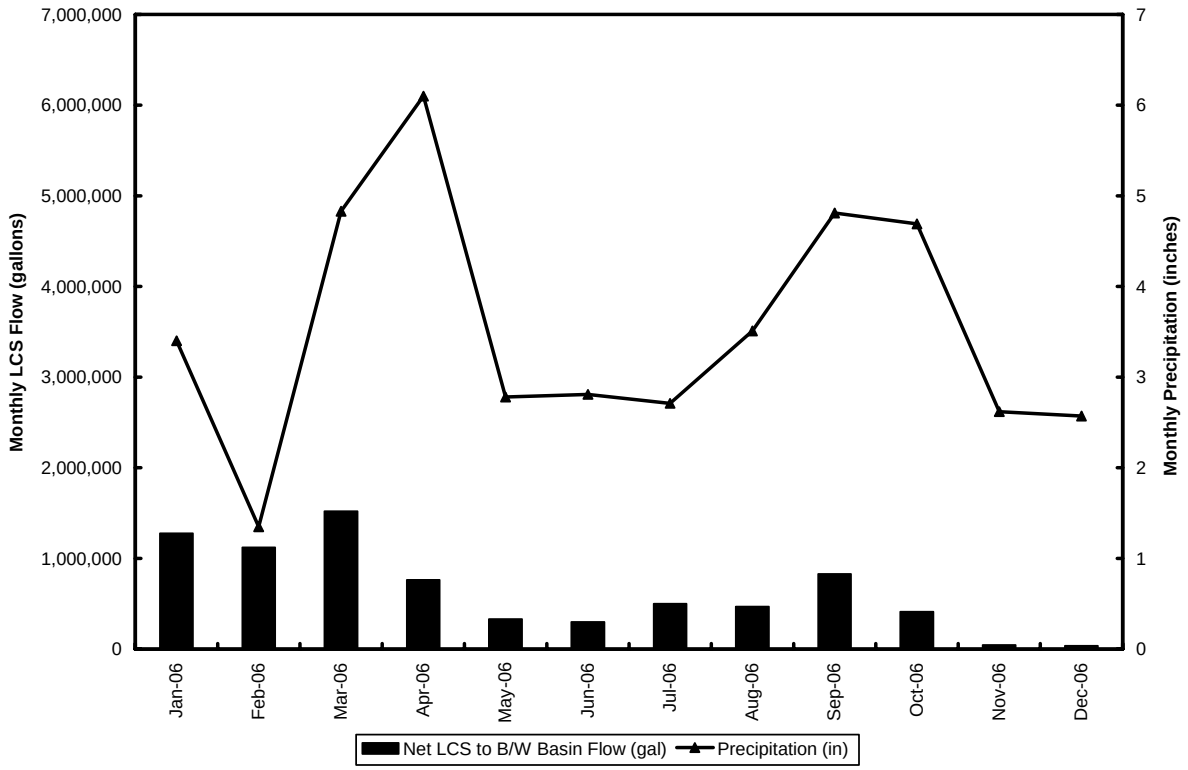


FIGURE A.5-3. OSDF LCS to Backwash Basin Flow and Precipitation

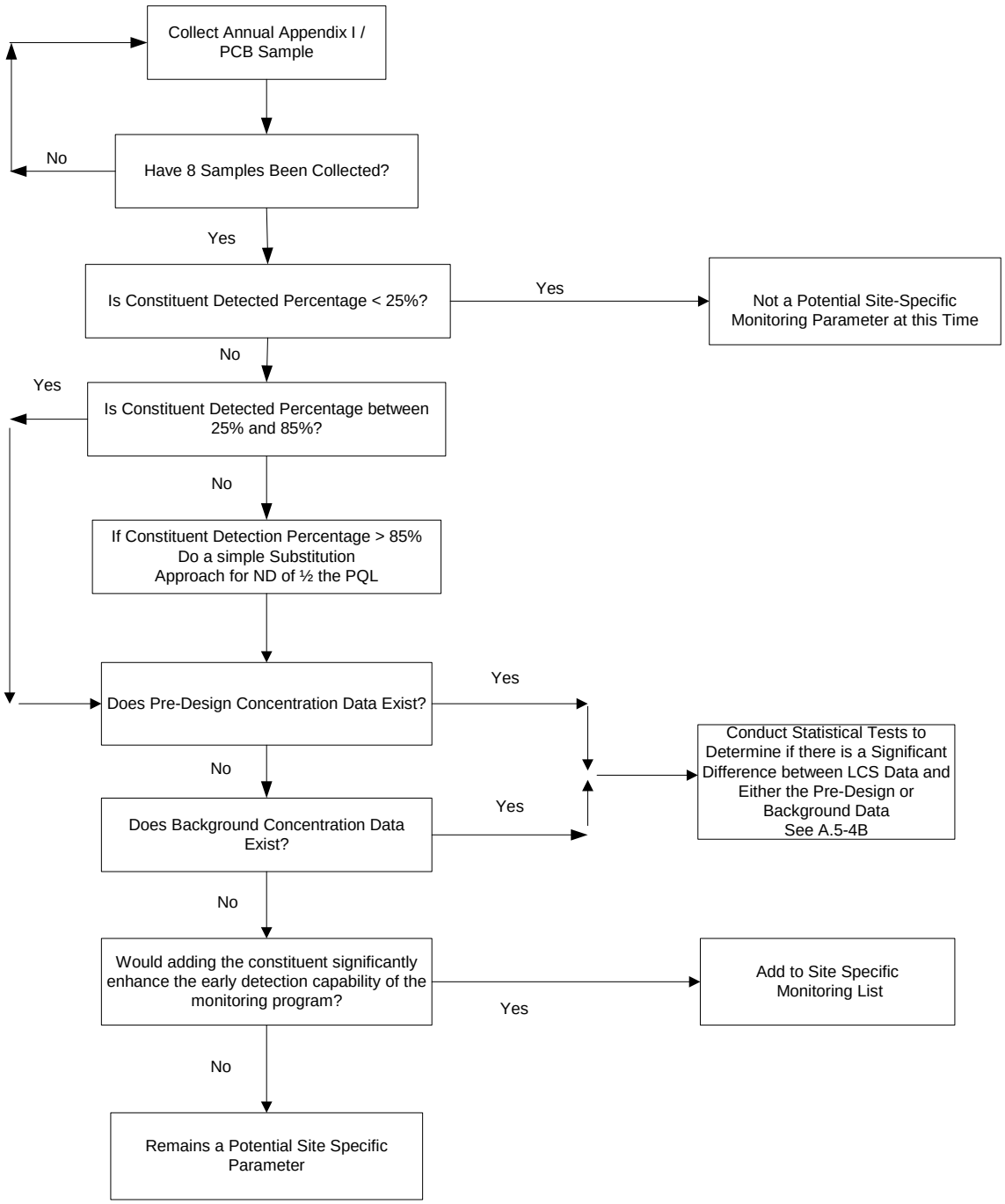


Figure A.5−4A. OSDF Site-Specific Leachate Monitoring Parameter Selection Approach

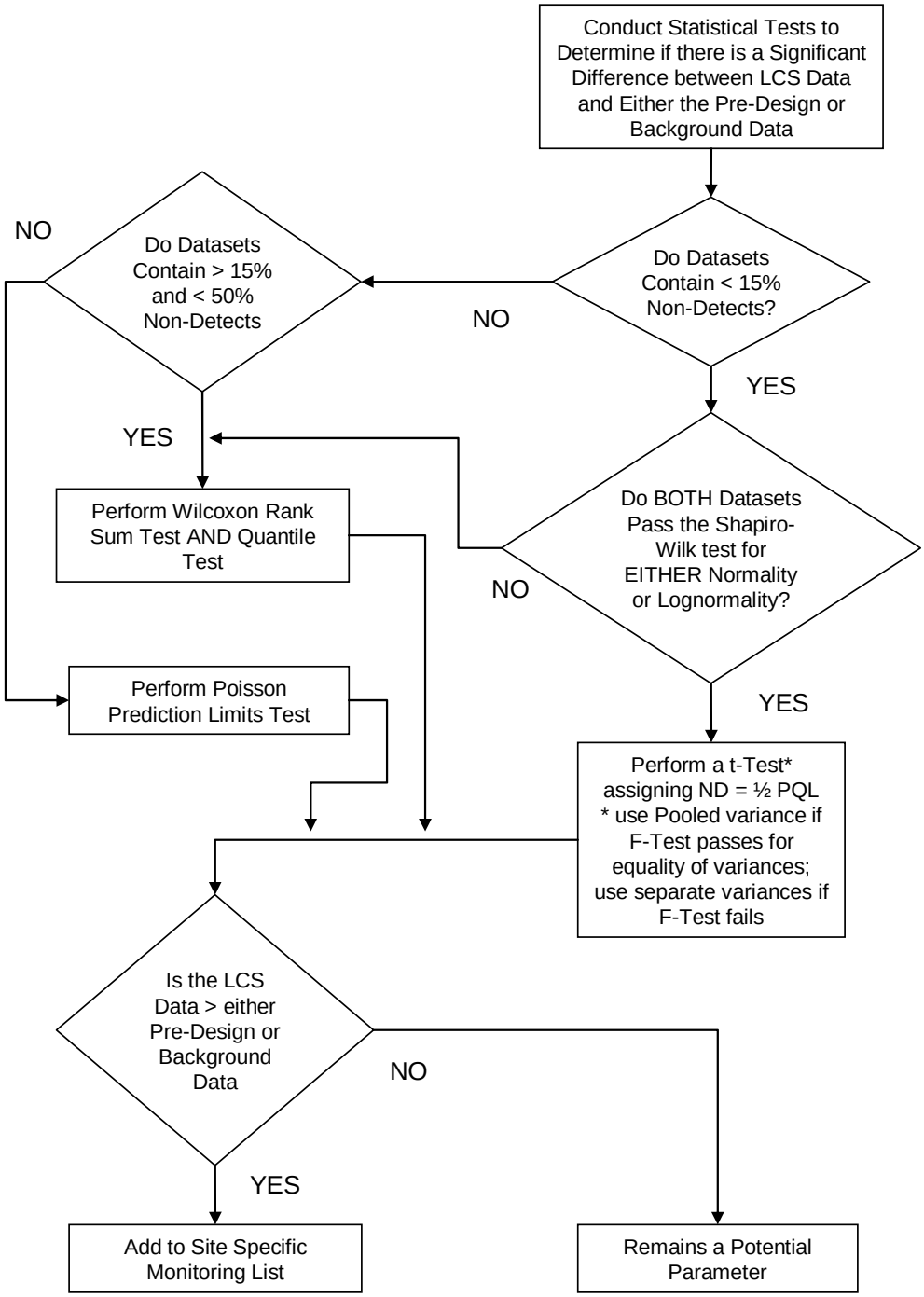


Figure A.5-4B (continued). OSDF Site Specific Leachate Monitoring Parameter Selection Approach

End of current text

Subattachment A.5.1

Cell 1

The following information is provided in this subattachment:

- LCS weekly and monthly accumulation volumes (refer to Figures A.5.1−1 and A.5.1−2)
- LDS weekly and monthly accumulation volumes (refer to Figures A.5.1−3 and A.5.1−4)
- LDS weekly and monthly accumulation rates and precipitation (refer to Figures A.5.1−5 and A.5.1−6)
- LDS monthly average accumulation rates and waste placement volumes (refer to Figure A.5.1−7)
- Monthly liner efficiencies (refer to Table A.5.1−1)
- HTW Water Yield (refer to Figure A.5.1−8)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.1−9 and A.5.1−10)
- Summary statistics for refined baseline constituents (refer to Section A.5.1.1 and Table A.5.1−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.1.1 and Figures A.5.1−11A through A.5.1−15B)
- Annual LCS monitoring results (refer to Section A.5.1.2 and Table A.5.1−3)
- Annual LDS monitoring results (refer to Section A.5.1.3)

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2006, all samples were collected for Cell 1 monitoring horizons with the exception of the LDS which was dry in the third and fourth quarters.

A.5.1.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled for at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (refer to Table A.5.1−2), and concentration plots (Figures A.5.1−11A through A.5.1−15B) are provided for the five baseline constituents of Cell 1. For Cell 1, these five constituents are total uranium, boron, total organic carbon, total organic halogens, and sulfate. Note that with the addition of data since 2005, total organic halogens concentrations are now detected less than 25 percent of the time in Well 22198.

A.5.1.2 LCS Monitoring Results

Ohio Solid Waste regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and polychlorinated biphenyl (PCB) parameters listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2006, annual sampling of the Cell 1 LCS took place in May.

Table A.5.1−3 summarizes the annual LCS sampling results for Cell 1, along with data collected in previous years.

Of the non-refined baseline site specific constituents that have been sampled for at least eight times, 19 have been detected at least 25 percent of the time. Ten of these 19 constituents are common ion constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, silicon, and sodium). Sampling for common ion constituents is temporary. Eight rounds of sampling are being conducted to support the common ion study. It is anticipated that eight rounds of sampling will be completed for all cells in August 2007. A decision concerning what common ion constituents (if any) will be added to the site specific leak detection monitoring list for Cell 1 will be determined based upon results of the common ion study.

The remaining nine constituents (considered to be "*potential*" site-specific leak detection monitoring constituents for Cell 1) are: ammonia, arsenic, barium, cobalt, copper, nickel, selenium, TDS, and zinc. These potential Cell 1 site specific leak detection monitoring constituents will be assessed using the approach presented in Figure A.5−4A and A.5−4B, once final approval of the approach has been obtained from the EPA and OEPA. The assessment will be used to determine what potential constituent (if any) will be added to the Cell 1 site specific leak detection monitoring constituent list. Results of the assessment will be presented to the EPA/OEPA as soon as they are available and they will also be reported in next year's SER.

Mercury and technetium-99 are both site specific leak detection parameters; however, they are not on the refined baseline list for Cell 1. If a site specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.1−3, mercury and technetium-99 have been detected in the Cell 1 LCS, but these detections occurred prior to the establishment of the refined baseline for Cell 1. Therefore, confirmatory sampling for mercury and technetium-99 in the Cell 1 LCS is not required.

A.5.1.3 LDS Monitoring Results

Each year the LDS of Cell 1 is sampled for site-specific baseline parameters listed in Table 2−1 of Appendix B of the OSDF GWLMP. As with the LCS, the objective of the annual LDS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. In 2006, annual sampling of the Cell-1 LDS took place in May.

Of the non-refined baseline constituents that have been sampled at least eight times in the Cell 8 LDS, none of the constituents have been detected at least 25 percent of the time.

Table A.5.1-1. Cell 1 – 2006 Monthly Liner Efficiencies

Month	Cell 1 Apparent Liner Efficiency (%)
January	100.00
February	99.55
March	99.64
April	99.67
May	99.56
June	100.00
July	100.00
August	100.00
September	100.00
October	100.00
November	99.88
December	99.60

Table A.5.1−2. Summary Statistics for Cell 1

Note: The data used in this table has been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]		
Total Uranium (µg/L)	LCS	12338C	34	34	100%	69.7	Lognormal	None	Detected	0 U (1Q-99)	8.75 (Q3-03)	
	LDS	12338D	32	32	100%	12.0	Lognormal	None	Detected	1.5 (Q1-98)		
	HTW	12338	30	32	94%	3.95	Lognormal	Upward	Detected	0.608 (Q2-05)		
	GMA-U	22201	36	39	92%	1.42	Undefined	Upward	Detected	0 U (Q1-98)		
	GMA-D	22198	39	39	100%	5.22	Undefined	Upward	Detected			
Boron (mg/L)	LCS	12338C	32	33	97%	1.37	Lognormal	None	Not Detected	0.0642 (Q1-98)	0.128 (Q2-98)	0.337 (Q3-98)
	LDS	12338D	31	31	100%	0.238	Lognormal	None	Not Detected	0.002 U (Q3-00)	0.0296 (Q1-98)	
	HTW	12338	30	33	91%	0.175	Undefined	Upward	Detected			
	GMA-U	22201	38	40	95%	0.101	Normal	None	Detected			
	GMA-D	22198	36	39	92%	0.0608	Undefined	Upward	Marg. Detect			
Total Organic Carbon (mg/L)	LCS	12338C	32	32	100%	25.9	Lognormal	None	Detected	1.7 U (Q2-99)	1.8 U (Q1-99)	123 (Q2-98)
	LDS	12338D	27	31	87%	6.13	Normal	None	Marg. Detect	80.9 (Q2-98)	15.7 (Q1-00)	
	HTW	12338	17	29	59%	1.56	Lognormal	None	Detected	4.25 (Q1-04)	7.24 (Q1-00)	3.21 (Q3-99)
	GMA-U	22201	27	39	69%	2.67	Undefined	Downward	Detected	59.7 (Q2-98)		
	GMA-D	22198	20	38	53%	1.37	Undefined	Downward	Not Detected	52.5 (Q2-98)		
Total Organic Halogens (mg/L)	LCS	12338C	30	33	91%	0.205	Undefined	Upward	Detected	1.52 (Q3-02)		
	LDS	12338D	24	33	73%	0.0463	Lognormal	Marg. Up.	Marg. Detect			
	HTW	12338	14	33	42%	0.0090	Undefined	None	Marg. Detect			
	GMA-U	22201	12	39	31%	0.0125	Undefined	Downward	Detected	0.308 (Q2-00)		
	GMA-D	22198	8	39	21%	0.0111	Undefined	Downward	Detected			
Sulfate (mg/L)	LCS	12338C	21	21	100%	1070	Lognormal	Upward	Not Detected			
	LDS	12338D	14	14	100%	1500	Normal	Upward	Detected			
	HTW	12338	16	16	100%	776	Lognormal	None	Marg. Detect			
	GMA-U	22201	16	16	100%	405	Lognormal	Marg. Down.	Detected			
	GMA-D	22198	16	16	100%	287	Lognormal	Marg. Down.	Not Detected			

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptiions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down." is a marginally downward trend and "Marg. Up." is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

U = Not Detected at that concentration

Table A.5.1−3. Cell 1 and LCS Sample Summary Information

PARAMETER (UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (#OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
4-Nitroaniline (ug/L)	22	1	4.5%	1.01	-	-	-	-	-	-	3 ug/L[h]
Alkalinity as CaCO3 (mg/L)	14	14	100.0%	274	658	480	-	422 mg/L (9)	430 mg/L (8)	-	10 mg/L
Ammonia (mg/L)	9	6	66.7%	0.03	4.5	1.2	-	4.2 mg/L (1)	4.34 mg/L (1)	220 mg/L (0)	0.1 mg/L
Arsenic (mg/L)	9	4	44.4%	0.0038	0.0786	0.0248	0.05 mg/L (1)	0.029 mg/L (1)	0.019 mg/L (1)	0.191 mg/L (0)	0.02 mg/L
Barium (mg/L)	9	9	100.0%	0.0434	0.205	0.082	2 mg/L (0)	0.77 mg/L (0)	0.45 mg/L (0)	0.589 mg/L (0)	0.029 mg/L
Beryllium (mg/L)	9	2	22.2%	0.0000674	0.00012	-	0.004 mg/L (0)	-	-	0.0343 mg/L (0)	0.001 mg/L
Cadmium (mg/L)	9	2	22.2%	0.00033	0.00084	-	0.014 mg/L (0)	0.014 mg/L (0)	-	0.05 mg/L (0)	0.002 mg/L
Calcium (mg/L)	14	14	100.0%	377	1500	620	-	159 mg/L (14)	172 mg/L (14)	1800 mg/L (0)	5 mg/L
Chloride (mg/L)	14	14	100.0%	21.8	40.9	35.1	-	7.3 mg/L (14)	45 mg/L (0)	6300 mg/L (0)	5 mg/L
Chromium (mg/L)	9	2	22.2%	0.0012	0.0016	-	0.022 mg/L (0)	0.021 mg/L (0)	0.0046 mg/L (0)	0.818 mg/L (0)	0.005 mg/L
Cobalt (mg/L)	9	8	88.9%	0.0033	0.0575	0.0205	0.17 mg/L (0)	0.0086 mg/L (5)	-	0.0886 mg/L (0)	0.034 mg/L
Copper (mg/L)	9	9	100.0%	0.00094	0.0157	0.0083	1.3 mg/L (0)	0.035 mg/L (0)	0.029 mg/L (0)	0.298 mg/L (0)	0.008 mg/L
Fluoride (mg/L)	7	7	100.0%	0.173	0.26	0.21	4 mg/L (0)	0.89 mg/L (0)	1.3 mg/L (0)	6.8 mg/L (0)	0.2 mg/L
Iron (mg/L)	14	14	100.0%	0.475	101	14	-	5.72 mg/L (7)	6.35 mg/L (7)	21.3 mg/L (2)	0.1 mg/L
Lead (mg/L)	9	1	11.1%	0.00066	-	-	0.015 mg/L (0)	0.022 mg/L (0)	0.0016 mg/L (0)	0.0114 mg/L (0)	0.008 mg/L
Magnesium (mg/L)	14	14	100.0%	71.4	319	159	-	38.5 mg/L (13)	50.7 mg/L (13)	690 mg/L (0)	5 mg/L
Manganese (mg/L)	14	14	100.0%	0.0104	7.7	2.2	0.9 mg/L (9)	0.9 mg/L (9)	0.21 mg/L (13)	35 mg/L (0)	0.09 mg/L
Mercury (mg/L)	22	2	9.1%	0.00000024	0.00047	-	0.002 mg/L (0)	-	-	0.0018 mg/L (0)	0.0002 mg/L
Nickel (mg/L)	9	9	100.0%	0.0119	0.0535	0.0330	0.1 mg/L (0)	0.0514 mg/L (1)	0.0072 mg/L (9)	0.981 mg/L (0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	24	13	54.2%	0.00793	7	1.9	11[g] mg/L (0)	11 mg/L (0)	0.29 mg/L (8)	2670 mg/L (0)	1.1 mg/L
Phosphorus (mg/L)	7	4	57.1%	0.0873	0.19	0.13	-	-	-	-	0.1 mg/L
Potassium (mg/L)	14	14	100.0%	10.8	25.9	17.2	-	1.96 mg/L (14)	17.2 mg/L (6)	12400 mg/L (0)	5 mg/L
Selenium (mg/L)	9	3	33.3%	0.0048	0.017	0.0097	0.05 mg/L (0)	0.00075 mg/L (3)	-	0.0494 mg/L (0)	0.005 mg/L
Silicon (mg/L)	7	7	100.0%	5.09	7.39	6.11	-	-	-	15 mg/L (0)	0.015 mg/L
Silver (mg/L)	9	1	11.1%	0.00014	-	-	0.05 mg/L (0)	0.0117 mg/L (0)	0.0031 mg/L (0)	0.264 mg/L (0)	0.005 mg/L
Sodium (mg/L)	14	14	100.0%	11.7	29.3	16.1	-	47.1 mg/L (0)	50 mg/L (0)	1300 mg/L (0)	5 mg/L
Technetium-99 (pCi/L)	22	5	22.7%	10.1	18.3	12.7	94 pCi/L (0)	22 pCi/L (0)	30 pCi/L (0)	6130 pCi/L (0)	10 pCi/L
Thallium (mg/L)	9	1	11.1%	0.00756	-	-	-	-	-	0.0028 mg/L (1)	0.02 mg/L
Total Dissolved Solids (mg/L)	18	18	100.0%	1940	2660	2310	-	-	-	-	10 mg/L
Zinc (mg/L)	9	6	66.7%	0.0162	0.575	0.130	0.021 mg/L (4)	0.02 mg/L (4)	0.35 mg/L (1)	1.78 mg/L (0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information.
[b]Rejected data qualified with an R or Z were not included.
[c]If the number of detected samples is equal to two, then the minumun and maximumn are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.
[d]From Operable Unit 5 Record of Decision, Table 9-4.
[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.
[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.
[g]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.
[h]Detection Limit of 4-Nitroaniline is sometimes less than the value, depending on the laboratory doing the analysis.

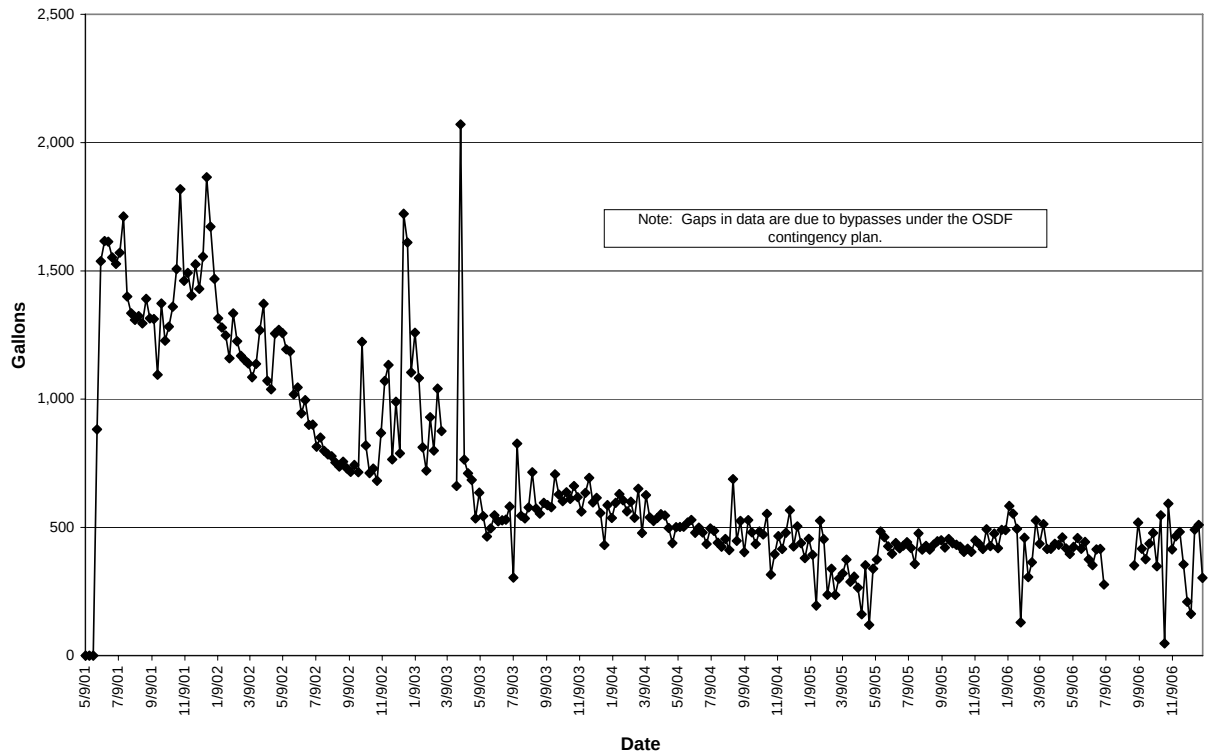


FIGURE A.5.1-1. Weekly Accumulation Volumes for Cell 1 LCS

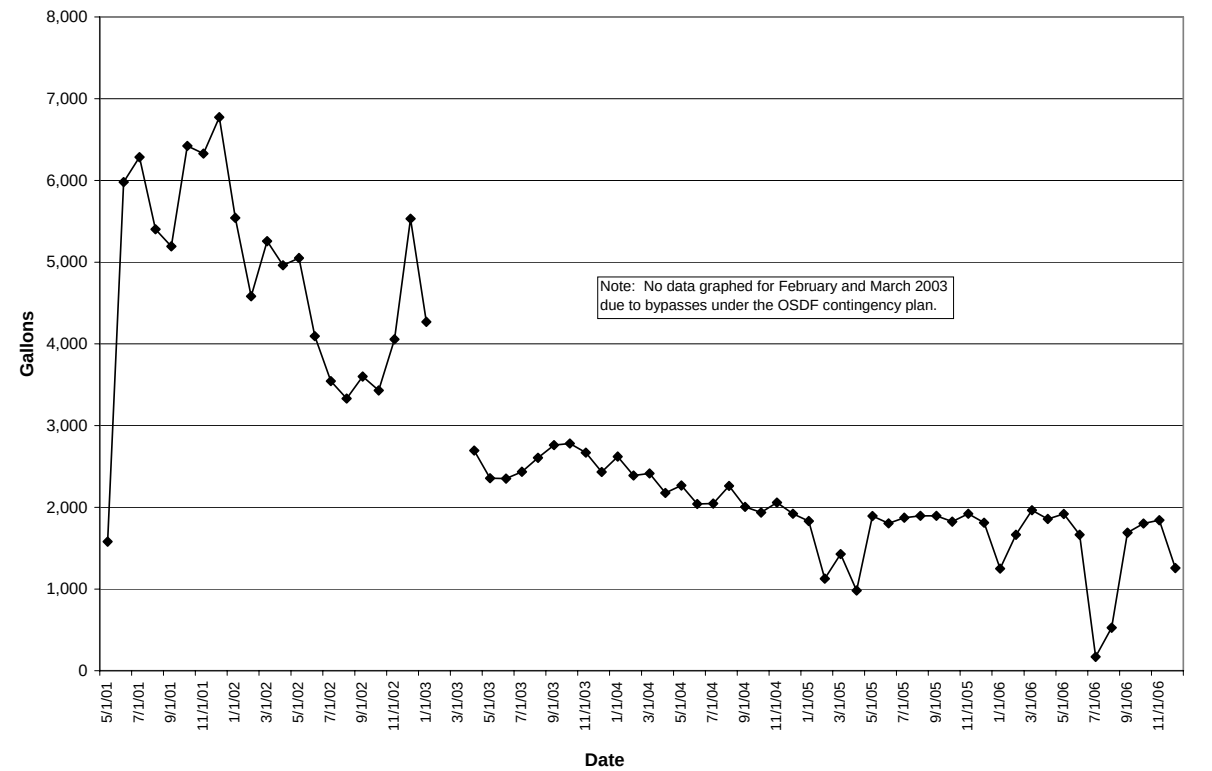


FIGURE A.5.1-2. Monthly Accumulation Volumes for Cell 1 LCS

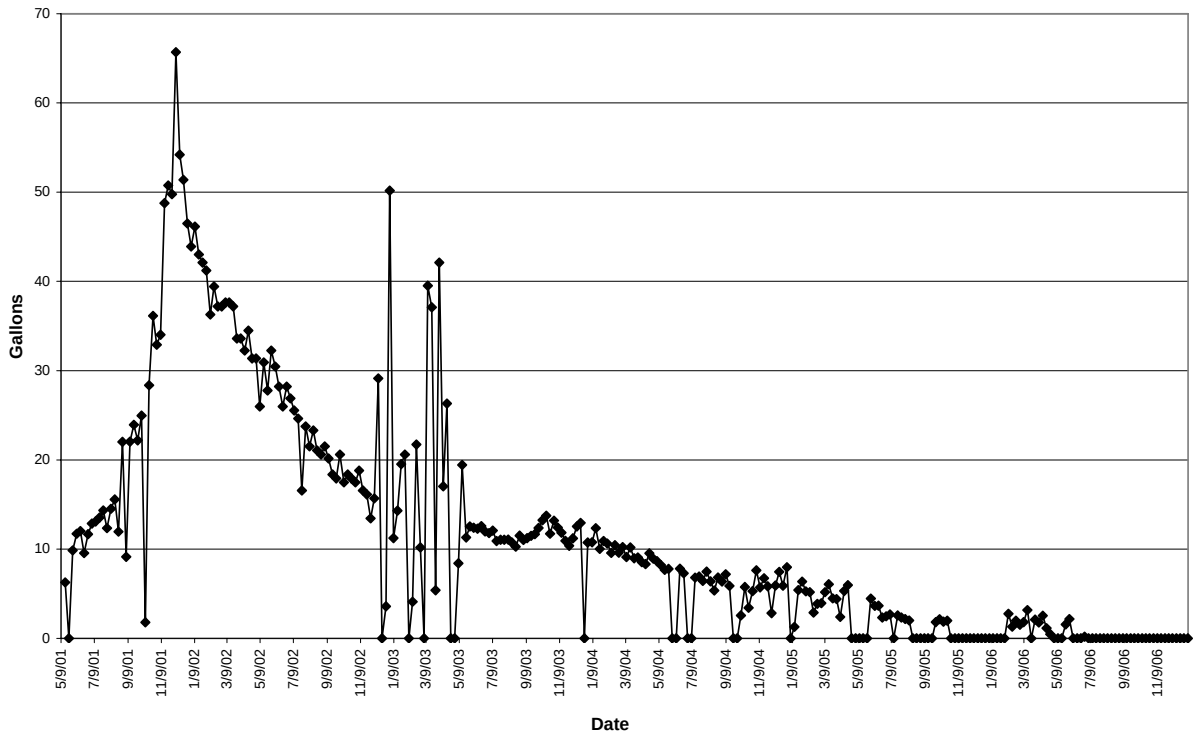


FIGURE A.5.1-3. Weekly Accumulation Volumes for Cell 1 LDS

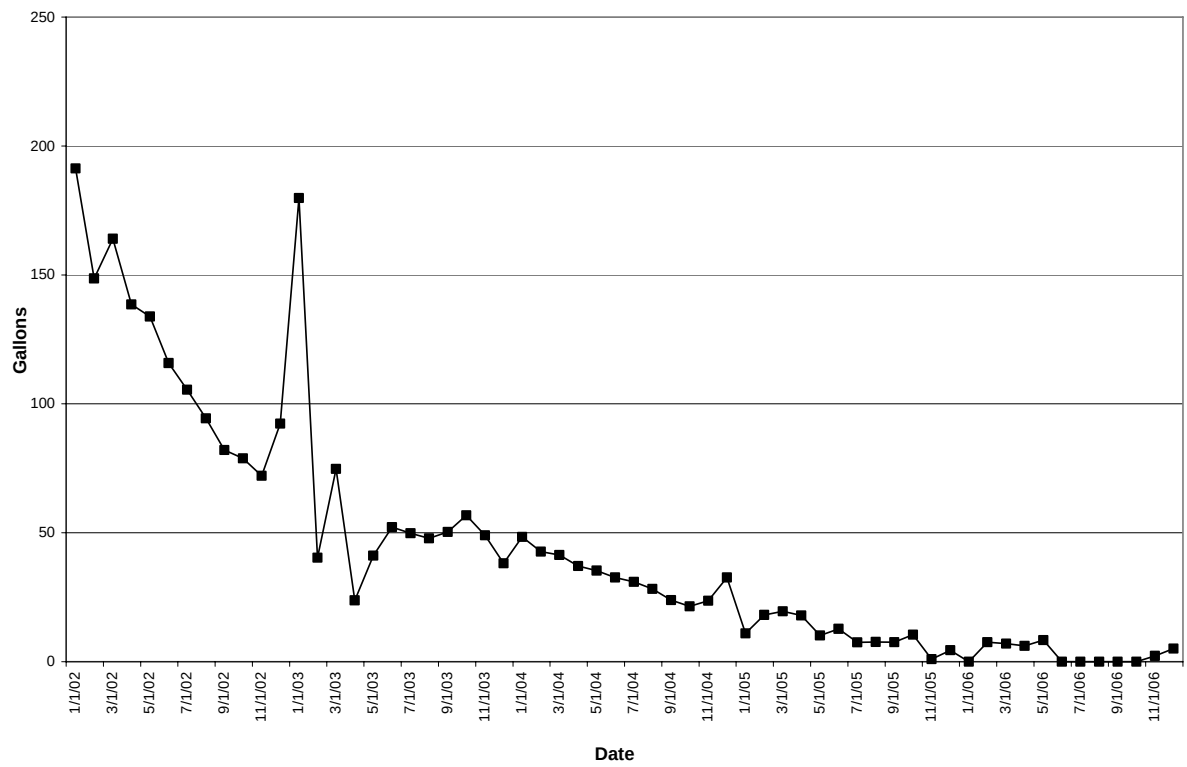


FIGURE A.5.1-4. Monthly Accumulation Volumes for Cell 1 LDS

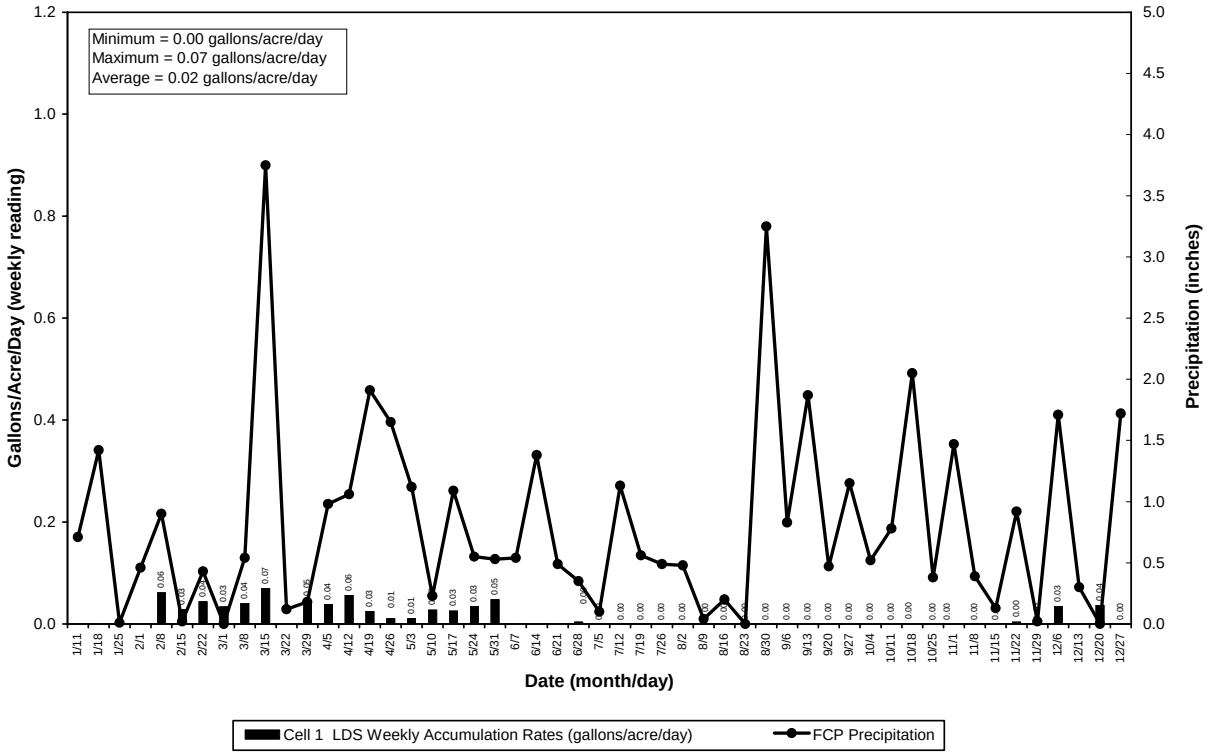


FIGURE A.5.1-5. 2006 OSDF LDS Weekly Accumulation Rates and Precipitation for Cell 1

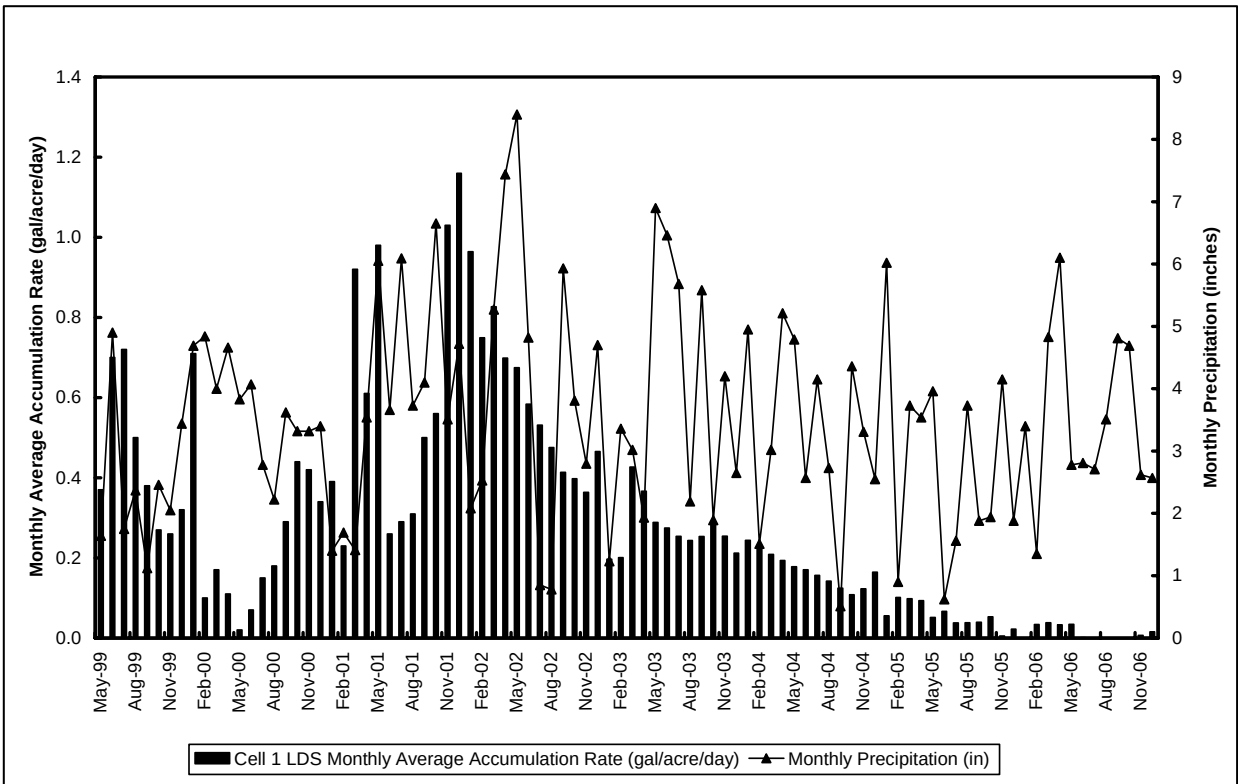


FIGURE A.5.1-6. OSDF Cell 1 LDS Monthly Average Accumulation Rates and Monthly Precipitation

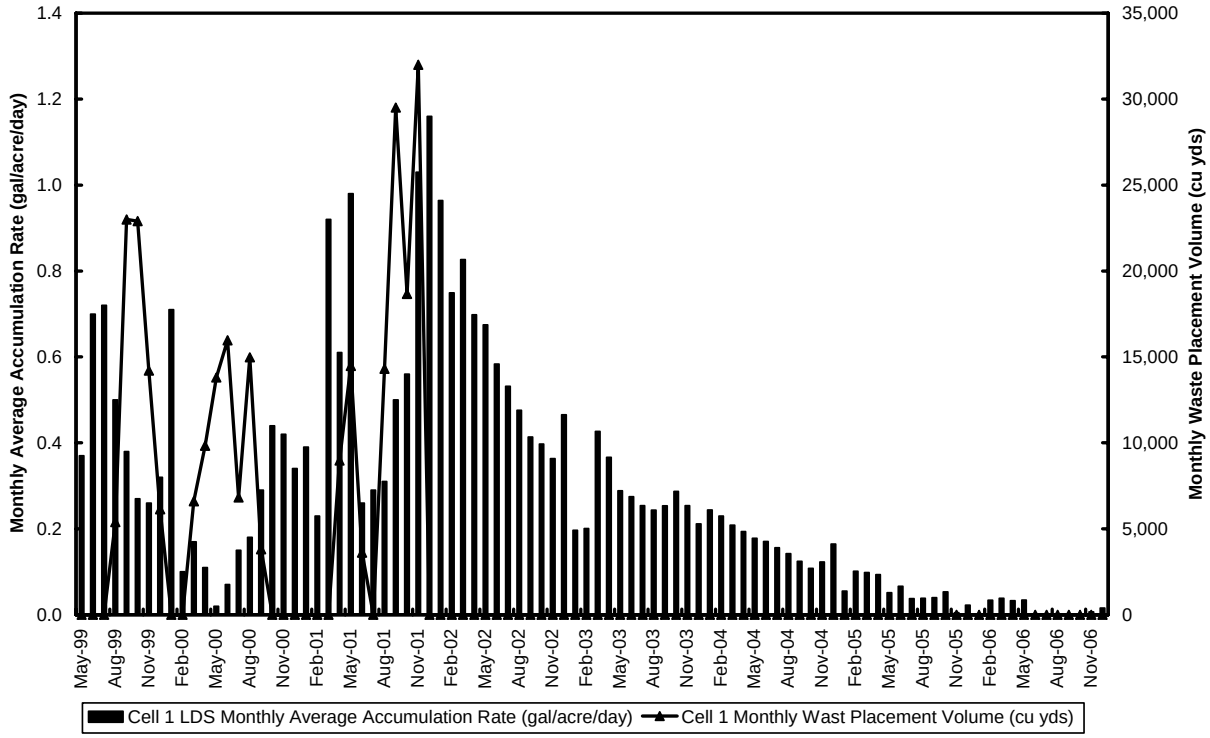
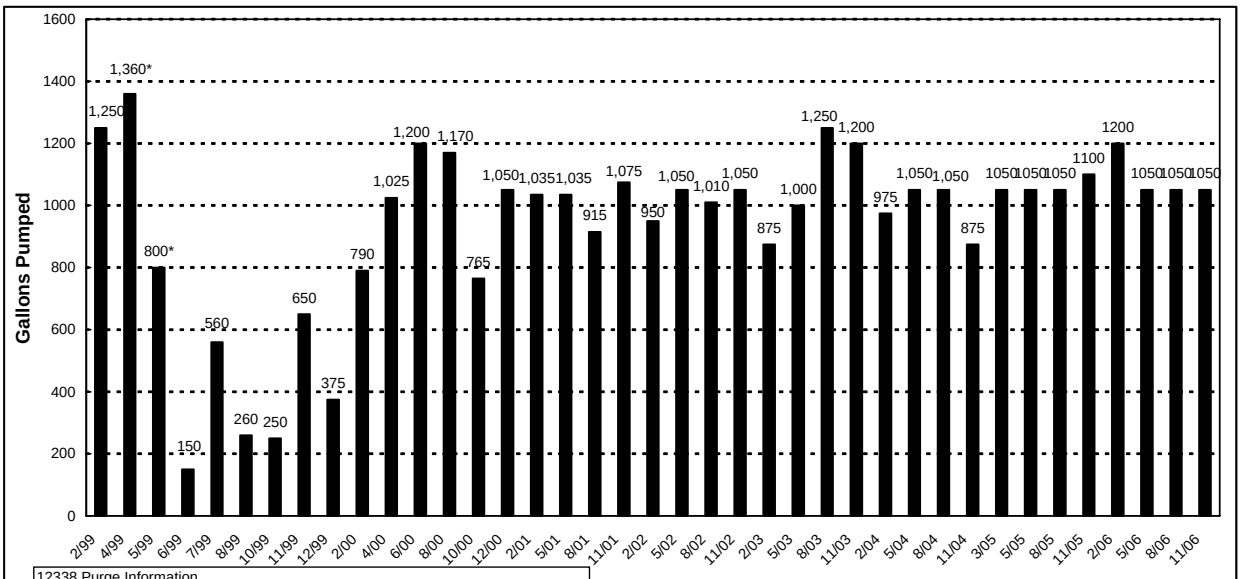


FIGURE A.5.1-7. OSDF Cell 1 LDS Monthly Average Accumulation Rates and Monthly Waste Placement Volumes



12338 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
1999:	5655	n=9	628
2000:	6000	n=6	1000
2001:	4060	n=4	1015
2002:	4060	n=4	1015
2003:	4325	n=4	1081
2004:	3950	n=4	988
2005:	4250	n=4	1063
2006:	4350	n=4	1088
Overall:			940

*More than one purge of the well was completed during these months to help evaluate well yield.

FIGURE A.5.1-8. OSDF Horizontal Till Well 12338 (Cell 1) Water Yield

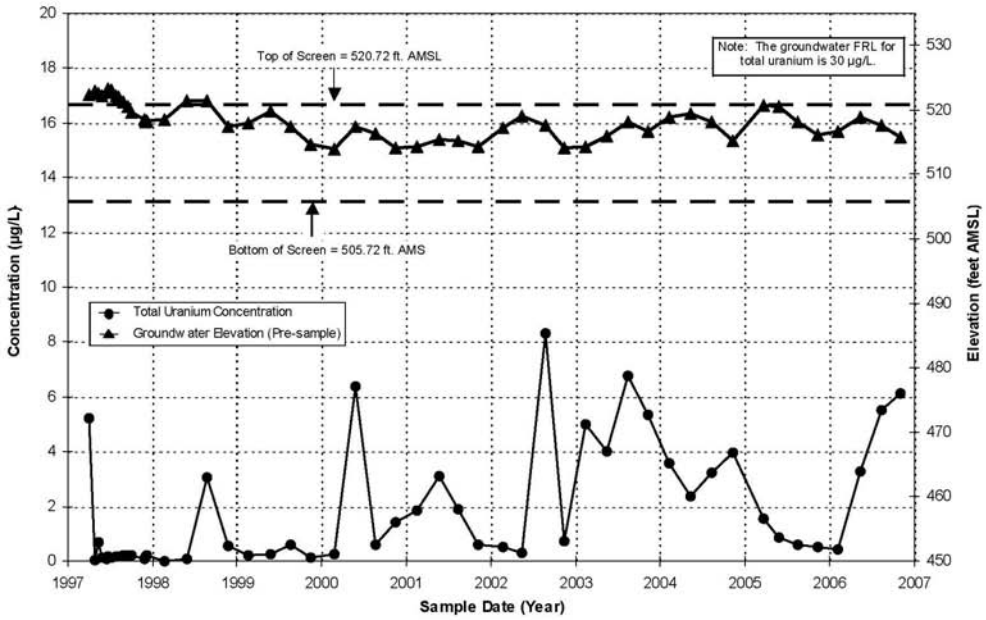


Figure A.5.1-9. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 1 Upgradient Monitoring Well 22201

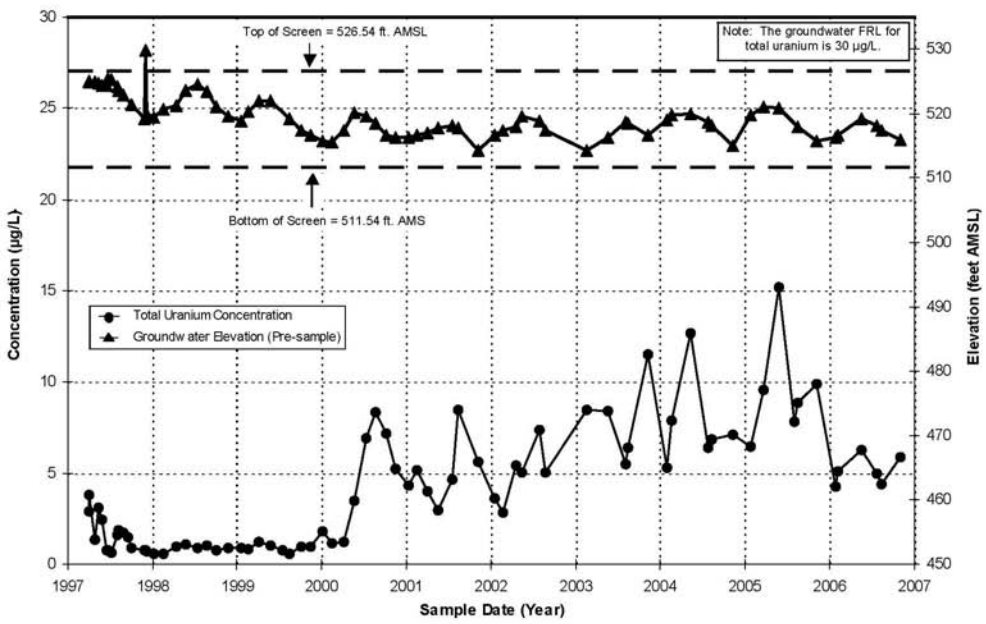


Figure A.5.1-10. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 1 Downgradient Monitoring Well 22198

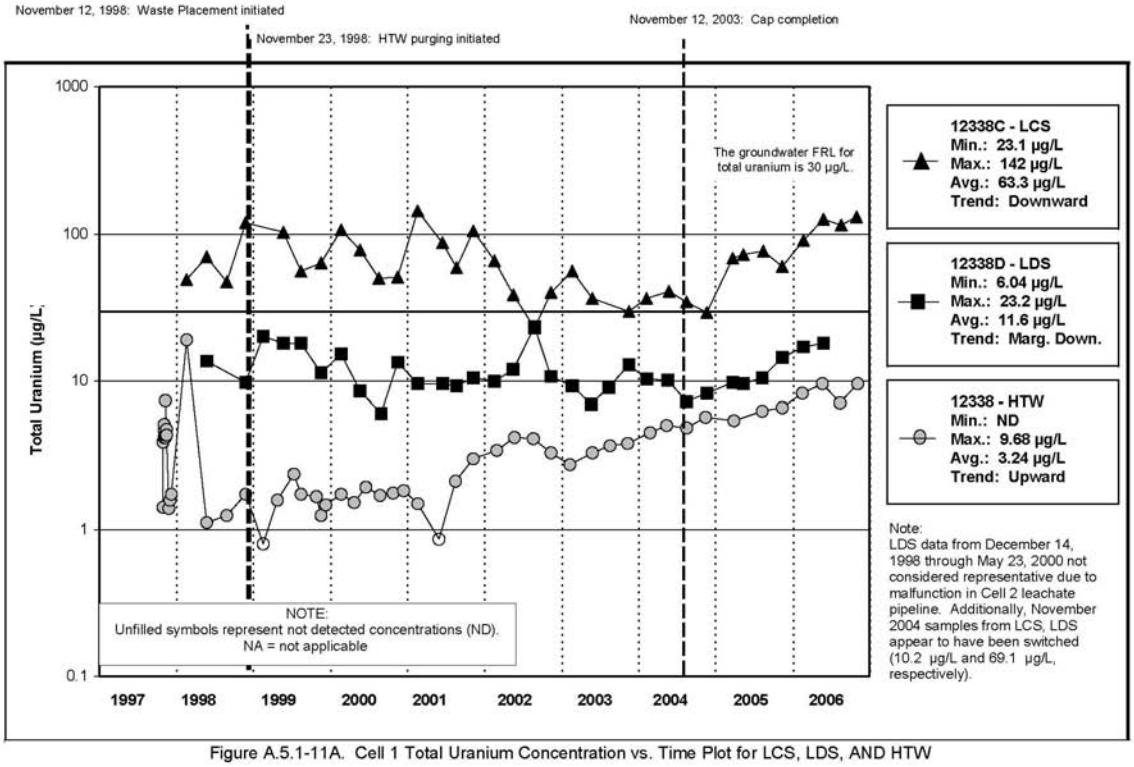


Figure A.5.1-11A. Cell 1 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

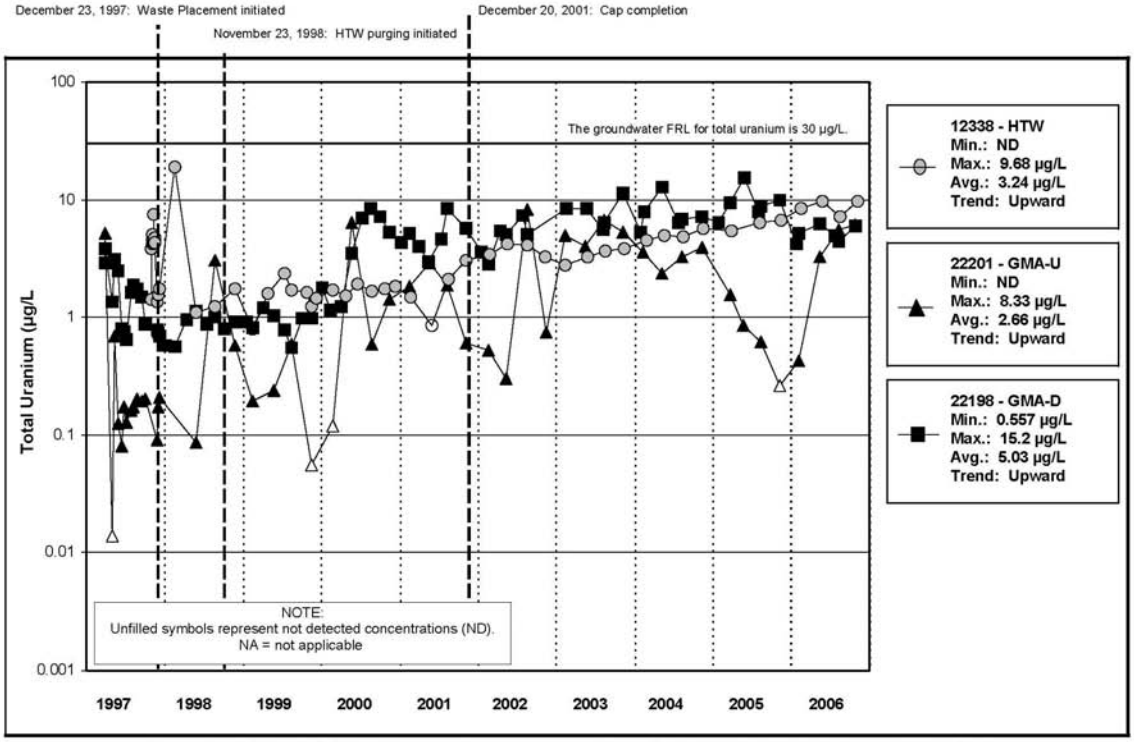


Figure A.5.1-11B. Cell 1 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

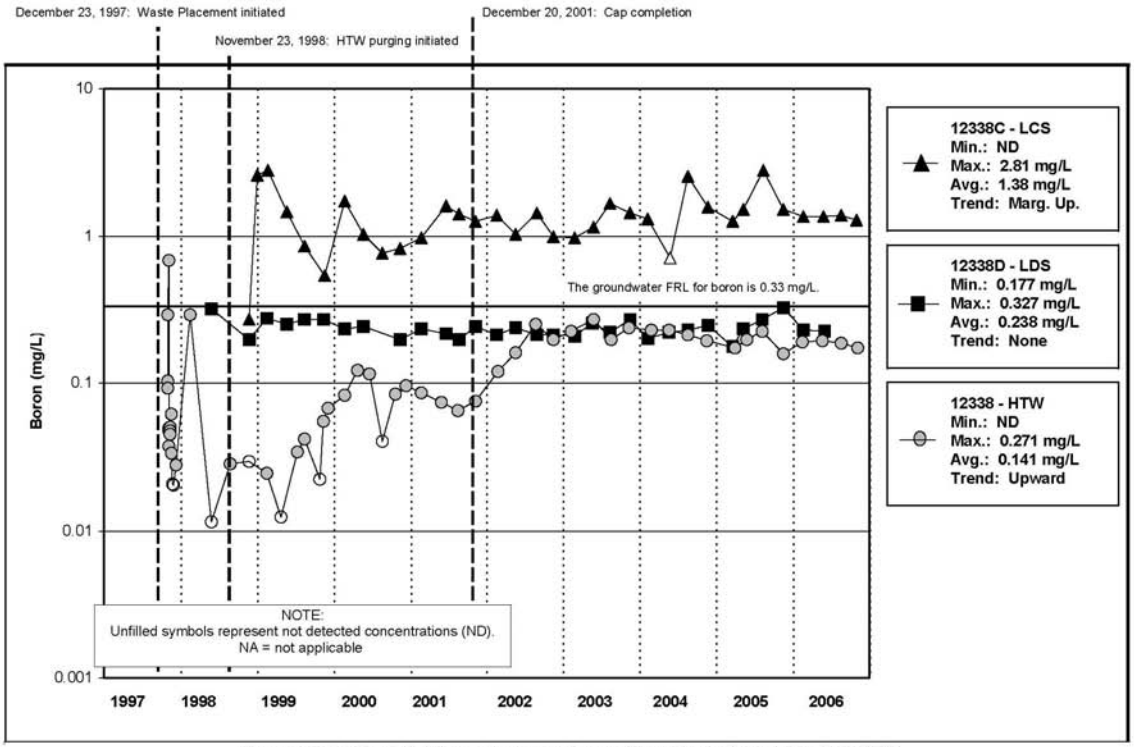


Figure A.5.1-12A. Cell 1 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

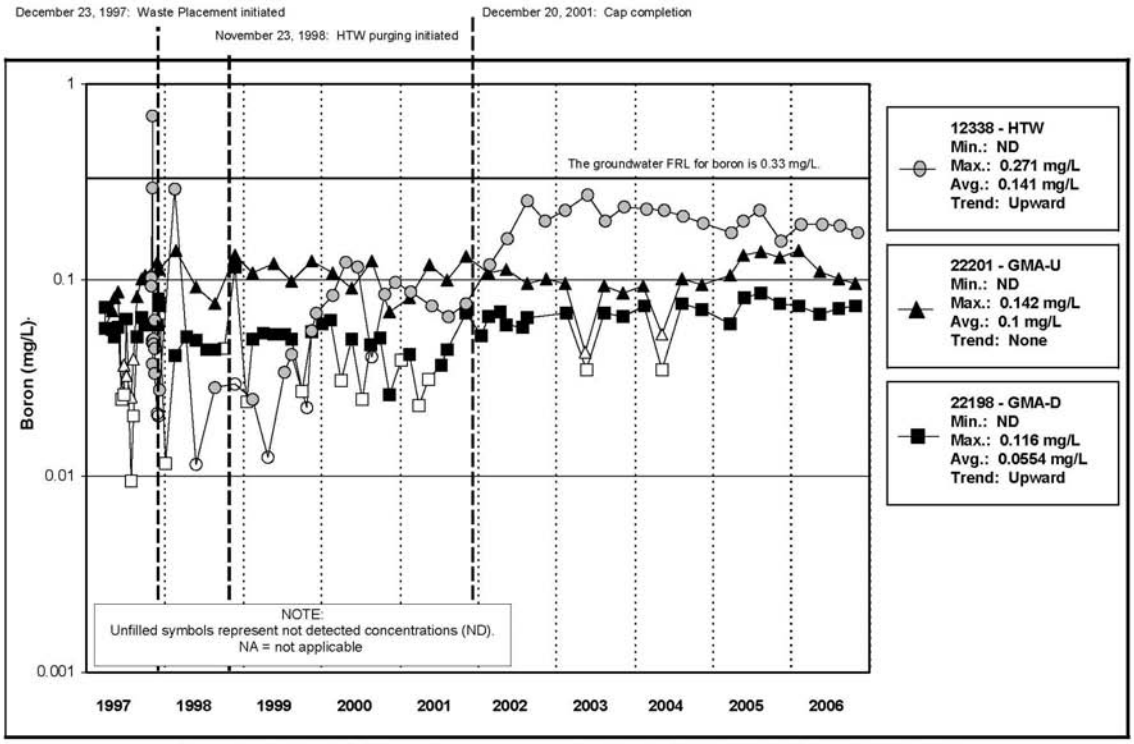


Figure A.5.1-12B. Cell 1 Boron Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

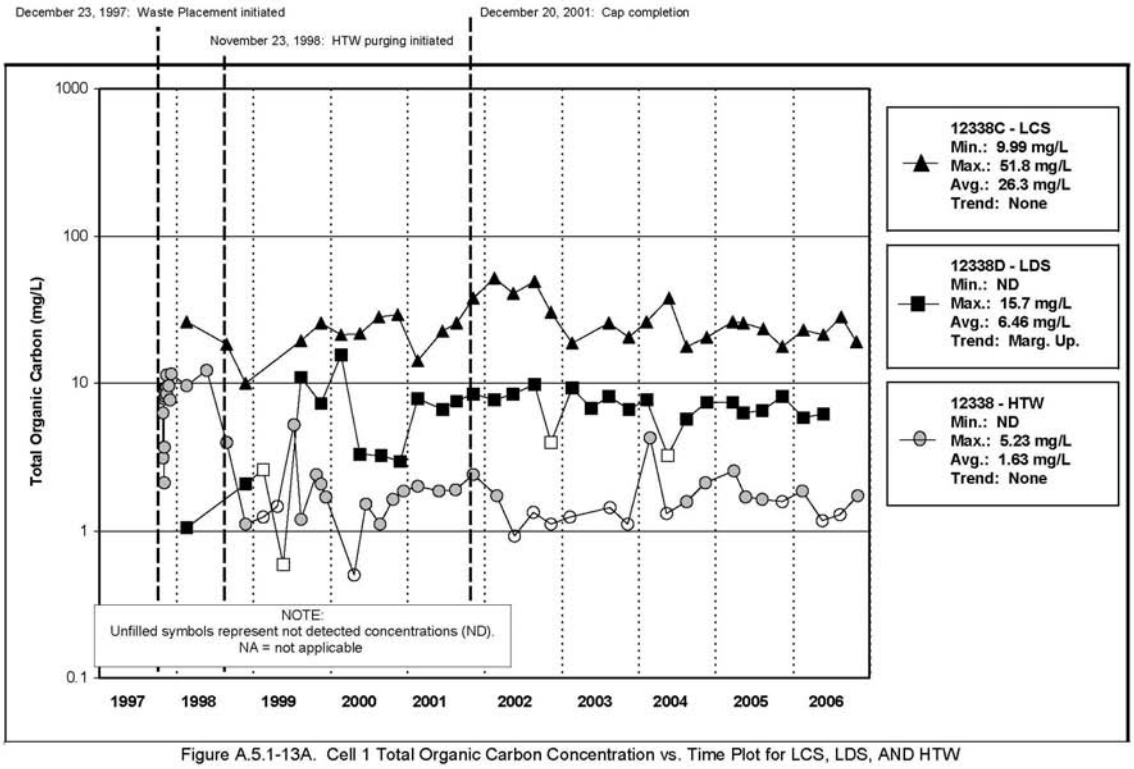


Figure A.5.1-13A. Cell 1 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

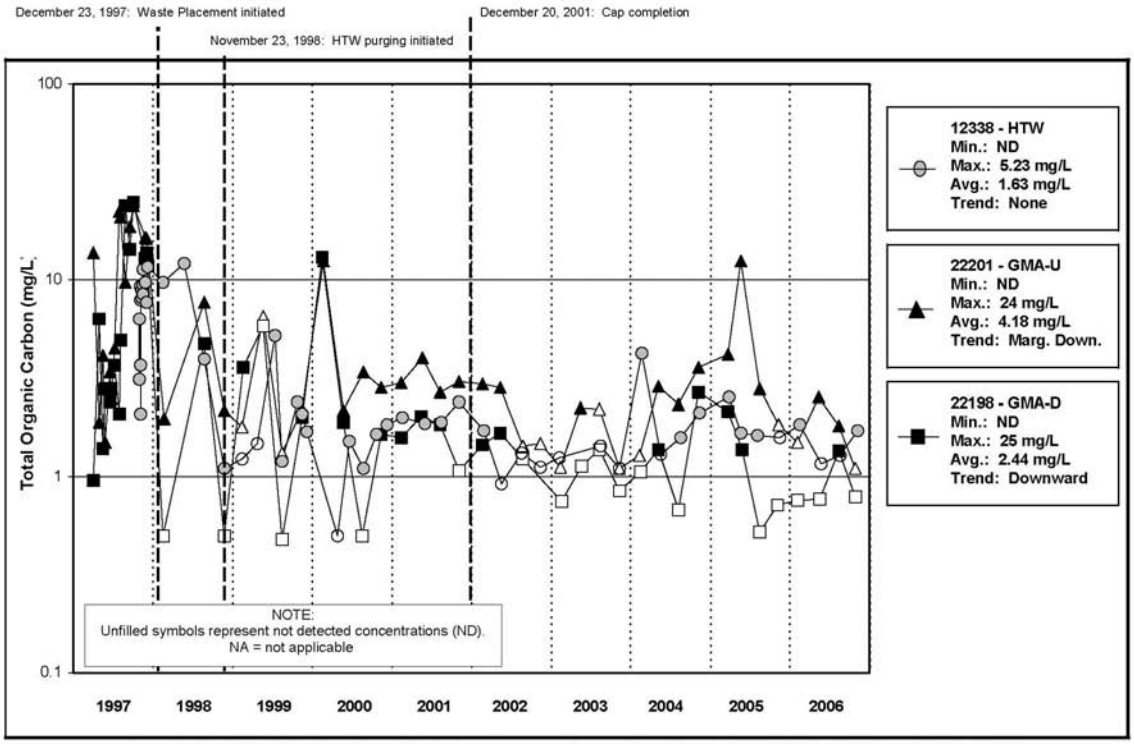


Figure A.5.1-13B. Cell 1 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

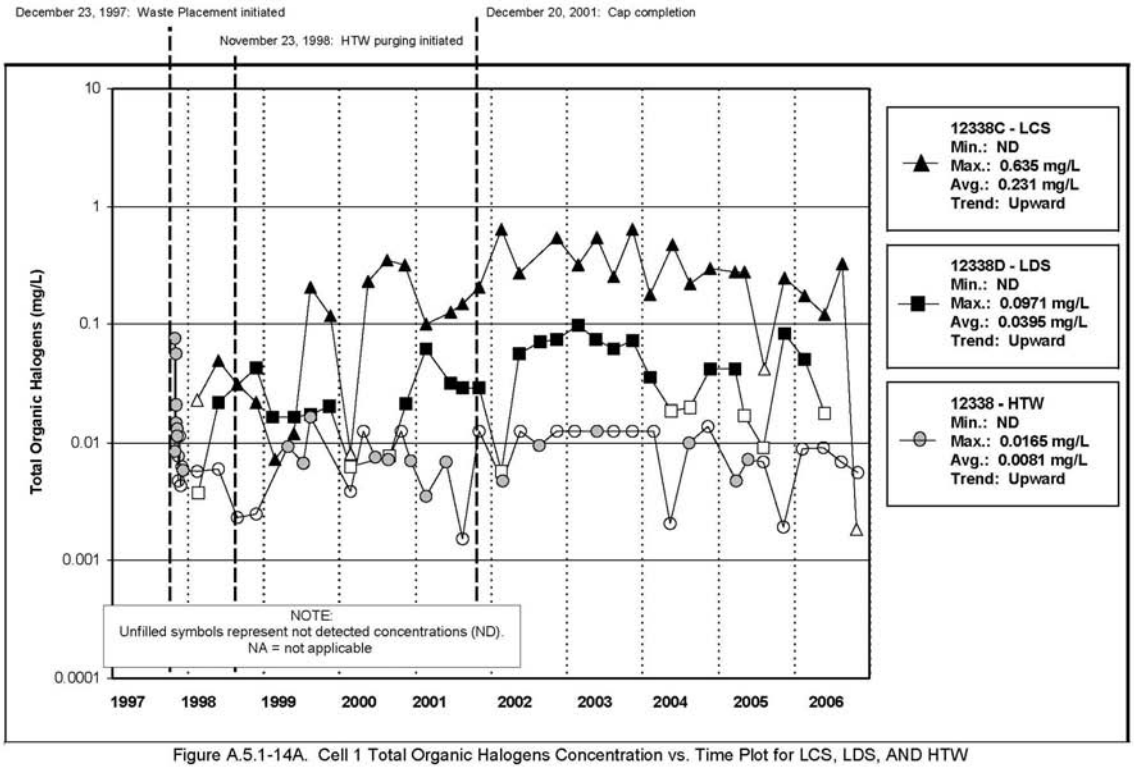


Figure A.5.1-14A. Cell 1 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

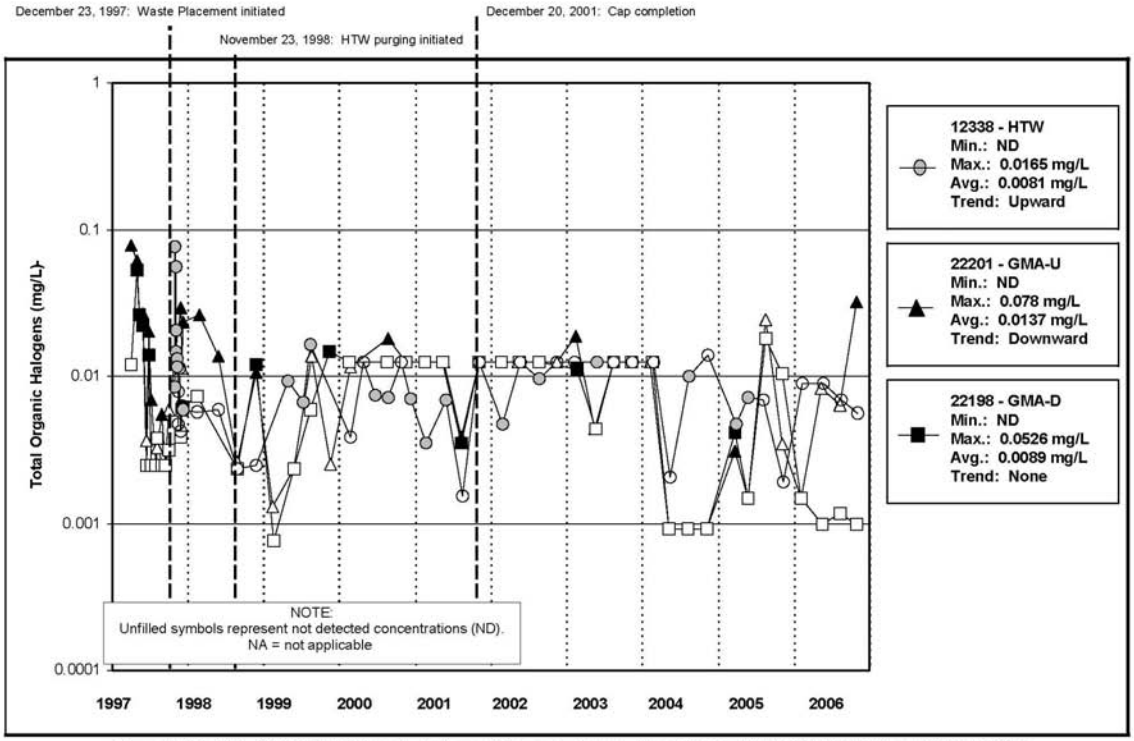


Figure A.5.1-14B. Cell 1 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

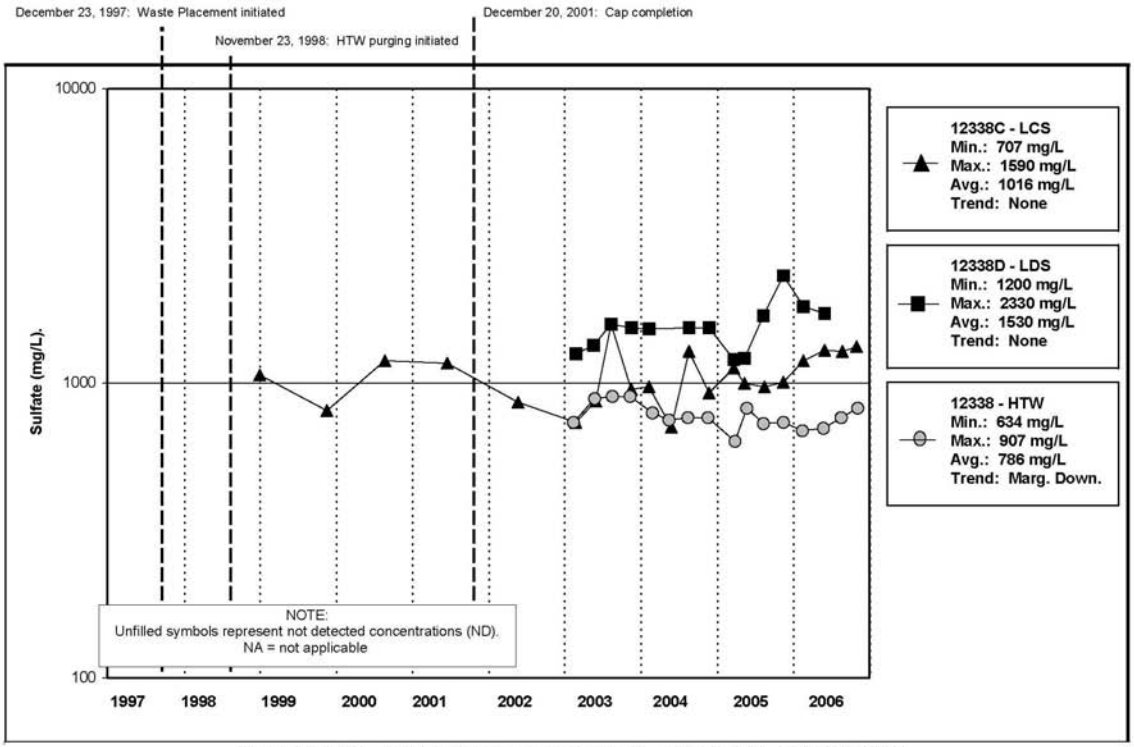


Figure A.5.1-15A. Cell 1 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

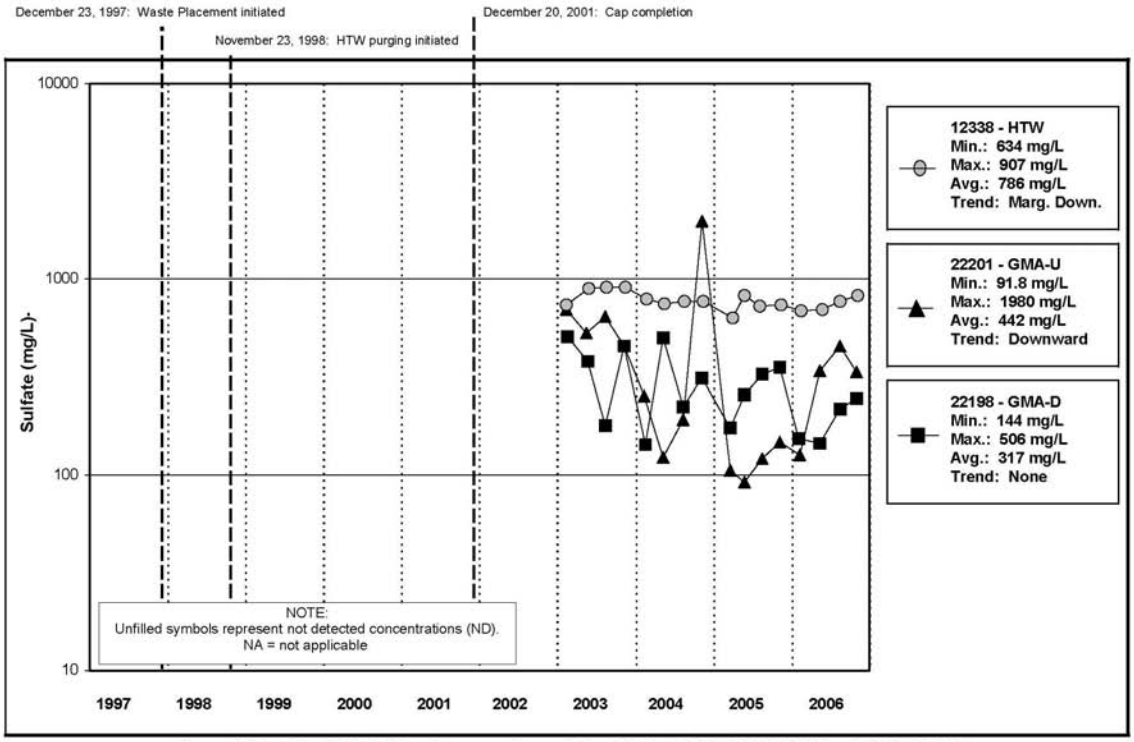


Figure A.5.1-15B. Cell 1 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

End of current text

Subattachment A.5.2

Cell 2

The following information is provided in this subattachment:

- LCS weekly and monthly accumulation volumes (refer to Figures A.5.2−1 and A.5.2−2)
- LDS weekly and monthly accumulation volumes (refer to Figures A.5.2−3 and A.5.2−4)
- LDS weekly and monthly accumulation rates and precipitation (refer to Figures A.5.2−5 and A.5.2−6)
- LDS monthly average accumulation rates and waste placement volumes (refer to Figure A.5.2−7)
- Monthly liner efficiencies (refer to Table A.5.2−1)
- HTW Water Yield (refer to Figure A.5.2−8)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.2−9 and A.5.2−10)
- Summary statistics for refined baseline constituents (refer to Section A.5.2.1 and Table A.5.2−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.2.1 and Figures A.5.2−11A through A.5.2−15B)
- Annual LCS monitoring results (refer to Section A.5.2.2 and Table A.5.2−3)
- Annual LDS monitoring results (refer to Section A.5.2.3)

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2006, the Cell 2 LDS was dry during all four sampling quarters. All samples were collected from the other Cell 2 monitoring horizons.

A.5.2.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled for at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table for Cell 2 (Table A.5.2−2) and concentration plots (Figures A.5.2−11A through A.5.2−15B) are provided for the five refined baseline constituents of Cell 2. For Cell 2, these five constituents are: total uranium, boron, total organic carbon, total organic halogens, and sulfate. Note, with incorporation of 2006 sampling results, total organic halogens now has less than 25 percent detects in the GMA wells.

A.5.2.2 LCS Monitoring Results

Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and polychlorinated biphenyl (PCB) parameters listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2006, annual sampling of the Cell 2 LCS took place in May.

Table A.5.2−3 summarizes the annual LCS sampling results for Cell 2, along with data collected in previous years.

Of the non-refined site specific baseline constituents that have been sampled at least 8 times in Cell 2, 21 have been detected at least 25 percent of the time. Twelve of the 21 constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, phosphorous, potassium, silicon, and sodium). Sampling for common ion constituents is temporary. Eight rounds of sampling are being conducted to support the common ion study. It is anticipated that eight rounds of sampling will be completed for all cells in August 2007. A decision concerning what common ion constituents (if any) will be added to the site specific leak detection monitoring list for Cell 2 will be determined based upon the results of the common ion study.

The remaining nine constituents (considered to be "*potential*" site specific leak detection monitoring constituents for Cell 2) are: ammonia, barium, chromium, cobalt, copper, nickel, selenium, TDS, and zinc). These potential Cell 2 site specific leak detection monitoring constituents will be assessed using the approach presented in Figures A.5−4A and A.5−4B, once final approval of the approach has been obtained from EPA and OEPA. The assessment will be used to determine what potential constituent (if any) will be added to the Cell 2 site specific leak detection monitoring constituent list. Results of the assessment will be presented to the EPA/OEPA as soon as they are available and they will also be reported in next year's SER.

Technetium-99 is a site specific leak detection parameter; however, it is not on the refined baseline list for Cell 2. If a site specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.2−3, technetium-99 has been detected in the Cell 2 LCS, but this detection occurred prior to the establishment of the refined baseline for Cell 2. Therefore, confirmatory sampling for technetium-99 in the Cell 2 LCS is not required.

A.5.2.3 LDS Monitoring Results

Each year the LDS of each cell is sampled for site-specific baseline parameters listed in Table 2−1 of Appendix B of the OSDF GWLMP. As with the LCS, the objective of the annual LDS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. In 2006, annual sampling of the Cell-2 LDS was scheduled for May. In May the LDS was dry. Two other attempts were made in 2006 to sample the LDS for Table 2−1 constituents (August and November). The LDS was dry both times.

Table A.5.2-1. Cell 2 – 2006 Monthly Liner Efficiencies

Month	Cell 2 Apparent Liner Efficiency (%)
January	100.00
February	100.00
March	100.00
April	100.00
May	100.00
June	100.00
July	96.57
August	97.92
September	99.91
October	100.00
November	100.00
December	100.00

Table A.5.2−2. Summary Statistics for Cell 2

Note: The data used in this table has been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]			
Total Uranium (µg/L)	LCS	12339C	31	31	100%	54.7	Lognormal	Upward	Detected	4.51 (Q3-99)			
	LDS	12339D	23	23	100%	14.5	Normal	None	Detected	71 (Q4-98)	50.37 (Q1-99)	41.5 (Q2-99)	
	HTW	12339	32	33	97%	5.77	Undefined	Upward	Detected				
	GMA-U	22200	23	37	62%	0.33	Lognormal	None	Not Detected	0 U (Q1-98)	0 U (Q4-03)		
	GMA-D	22199	37	39	95%	0.74	Undefined	None	Detected				
Boron (mg/L)	LCS	12339C	33	33	100%	1.69	Undefined	Upward	Detected				
	LDS	12339D	19	19	100%	0.380	Normal	None	Not Detected	0.841 (Q2-99)	0.865 (Q2-04)	0.904 (Q4-98)	2.22 (Q1-99)
	HTW	12339	31	33	94%	0.069	Lognormal	Upward	Detected				
	GMA-U	22200	28	39	72%	0.0446	Normal	None	Not Detected				
	GMA-D	22199	31	39	79%	0.0417	Normal	Upward	Detected				
Total Organic Carbon (mg/L)	LCS	12339C	22	32	69%	2.6	Lognormal	Upward	Not Detected				
	LDS	12339D	17	25	68%	3.40	Lognormal	Downward	Detected	26.1 (Q3-99)			
	HTW	12339	18	30	60%	1.61	Lognormal	None	Not Detected	11.1 (Q1-00)			
	GMA-U	22200	23	34	68%	1.78	Lognormal	Downward	Not Detected				
	GMA-D	22199	19	35	54%	1.52	Lognormal	Downward	Not Detected	9.68 (Q1-00)	10.5 (Q4-97)	16.5 (Q3-97)	48.1 (Q2-98)
Total Organic Halogens (mg/L)	LCS	12339C	10	33	30%	0.013	Undefined	None	Detected				
	LDS	12339D	8	27	30%	0.0123	Undefined	Marg. Down.	Marg. Detect	0.138 U (Q2-00)			
	HTW	12339	21	33	64%	0.0229	Normal	Downward	Not Detected				
	GMA-U	22200	9	37	24%	0.0073	Undefined	Marg. Down.	Detected	0.124 (Q4-98)	0.177 (Q2-00)		
	GMA-D	22199	9	39	23%	0.0093	Undefined	Downward	Detected				
Sulfate (mg/L)	LCS	12339C	21	21	100%	1350	Undefined	None	Detected				
	LDS	12339D	8	8	100%	2910	Normal	Upward	Insuff. Data	8110 (Q4-05)			
	HTW	12339	16	16	100%	684	Normal	Downward	Detected				
	GMA-U	22200	16	16	100%	240	Normal	Marg. Up.	Not Detected				
	GMA-D	22199	16	16	100%	234	Lognormal	None	Not Detected				

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptiions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down." is a marginally downward trend and "Marg. Up." is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

U = Not Detected at that concentration

Table A.5.2−3. Cell 2 Annual LCS Sample Summary Information

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (#OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
Alkalinity as CaCO3 (mg/L)	14	14	100.0%	60.5	683	428	-	422 mg/L (8)	430 mg/L (8)	-	10 mg/L
Ammonia (mg/L)	9	3	33.3%	0.109	0.2	0.14	-	4.2 mg/L (0)	4.34 mg/L (0)	220 mg/L (0)	0.1 mg/L
Antimony (mg/L)	9	1	11.1%	0.00053	-	-	0.006 mg/L (0)	-	-	0.0987 mg/L (0)	0.005 mg/L
Arsenic (mg/L)	9	2	22.2%	0.00091	0.14	-	0.05 mg/L (1)	0.029 mg/L (1)	0.019 mg/L (1)	0.191 mg/L (0)	0.02 mg/L
Barium (mg/L)	9	9	100.0%	0.0367	0.228	0.078	2 mg/L (0)	0.77 mg/L (0)	0.45 mg/L (0)	0.589 mg/L (0)	0.029 mg/L
Cadmium (mg/L)	9	2	22.2%	0.000091	0.00041	-	0.014 mg/L (0)	0.014 mg/L (0)	-	0.05 mg/L (0)	0.002 mg/L
Calcium (mg/L)	15	15	100.0%	165	984	537	-	159 mg/L (14)	172 mg/L (13)	1800 mg/L (0)	5 mg/L
Chloride (mg/L)	14	14	100.0%	3.95	41.2	14.5	-	7.3 mg/L (11)	45 mg/L (0)	6300 mg/L (0)	5 mg/L
Chromium (mg/L)	9	3	33.3%	0.0009	0.0047	0.0027	0.022 mg/L (0)	0.021 mg/L (0)	0.0046 mg/L (1)	0.818 mg/L (0)	0.005 mg/L
Cobalt (mg/L)	9	5	55.6%	0.000283	0.17	0.039	0.17 mg/L (1)	0.0086 mg/L (3)	-	0.0886 mg/L (1)	0.034 mg/L
Copper (mg/L)	9	8	88.9%	0.00093	0.017	0.0067	1.3 mg/L (0)	0.035 mg/L (0)	0.029 mg/L (0)	0.298 mg/L (0)	0.008 mg/L
Fluoride (mg/L)	7	7	100.0%	0.092	0.245	0.166	4 mg/L (0)	0.89 mg/L (0)	1.3 mg/L (0)	6.8 mg/L (0)	0.2 mg/L
Iron (mg/L)	15	14	93.3%	0.088	213	38	-	5.72 mg/L (8)	6.35 mg/L (8)	21.3 mg/L (4)	0.1 mg/L
Lead (mg/L)	9	1	11.1%	0.0046	-	-	0.015 mg/L (0)	0.022 mg/L (0)	0.0016 mg/L (1)	0.0114 mg/L (0)	0.008 mg/L
Magnesium (mg/L)	15	15	100.0%	32.4	375	178	-	38.5 mg/L (12)	50.7 mg/L (11)	690 mg/L (0)	5 mg/L
Manganese (mg/L)	15	13	86.7%	0.0106	12.7	4.8	0.9 mg/L (9)	0.9 mg/L (9)	0.21 mg/L (9)	35 mg/L (0)	0.09 mg/L
Nickel (mg/L)	9	9	100.0%	0.00495	0.133	0.037	0.1 mg/L (1)	0.0514 mg/L (3)	0.0072 mg/L (7)	0.981 mg/L (0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	23	15	65.2%	0.0439	3.58	1.64	11 mg/L[g] (0)	11 mg/L (0)	0.29 mg/L (13)	2670 mg/L (0)	1.1 mg/L
Phosphorus (mg/L)	8	5	62.5%	0.0361	0.438	0.190	-	-	-	-	0.1 mg/L
Potassium (mg/L)	15	15	100.0%	3.93	22.6	16.8	-	1.96 mg/L (14)	17.2 mg/L (9)	12400 mg/L (0)	5 mg/L
Selenium (mg/L)	9	6	66.7%	0.00417	0.0422	0.0150	0.05 mg/L (0)	0.00075 mg/L (6)	-	0.0494 mg/L (0)	0.005 mg/L
Silicon (mg/L)	8	8	100.0%	8.42	17.1	11.8	-	-	-	15 mg/L (2)	0.015 mg/L
Sodium (mg/L)	15	15	100.0%	3.32	26.7	15.1	-	47.1 mg/L (0)	50 mg/L (0)	1300 mg/L (0)	5 mg/L
Technetium-99 (pCi/L)	19	1	5.3%	21.25	-	-	94 pCi/L (0)	22 pCi/L (0)	30 pCi/L (0)	6130 pCi/L (0)	10 pCi/L
Thallium (mg/L)	9	2	22.2%	0.00057	0.0107	-	-	-	-	0.0028 mg/L (1)	0.02 mg/L
Total Dissolved Solids (mg/L)	18	18	100.0%	557	2840	1680	-	-	-	-	10 mg/L
Trichlorofluoromethane (ug/L)	9	1	11.1%	0.27	-	-	-	-	-	-	1 ug/L
Vanadium (mg/L)	9	2	22.2%	0.00158	0.0066	-	0.038 mg/L (0)	0.012 mg/L (0)	0.005 mg/L (1)	0.299 mg/L (0)	0.02 mg/L
Zinc (mg/L)	9	3	33.3%	0.016	0.178	0.073	0.021 mg/L (2)	0.02 mg/L (2)	0.35 mg/L (0)	1.78 mg/L (0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information
[b]Rejected data qualified with an R or Z were not included.
[c]If the number of detected samples is equal to two, then the minumun and maximumn are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.
[d]From Operable Unit 5 Record of Decision, Table 9-4.
[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.
[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.
[g]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

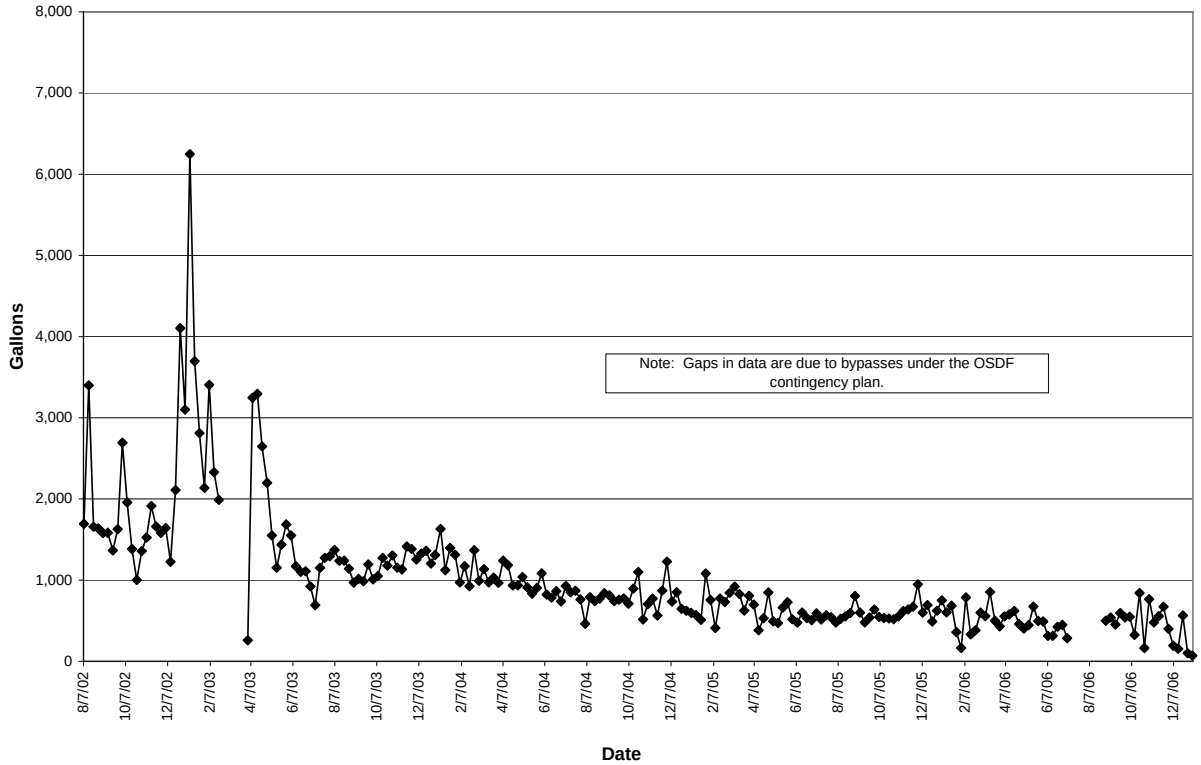


FIGURE A.5.2-1. Weekly Accumulation Volumes for Cell 2 LCS

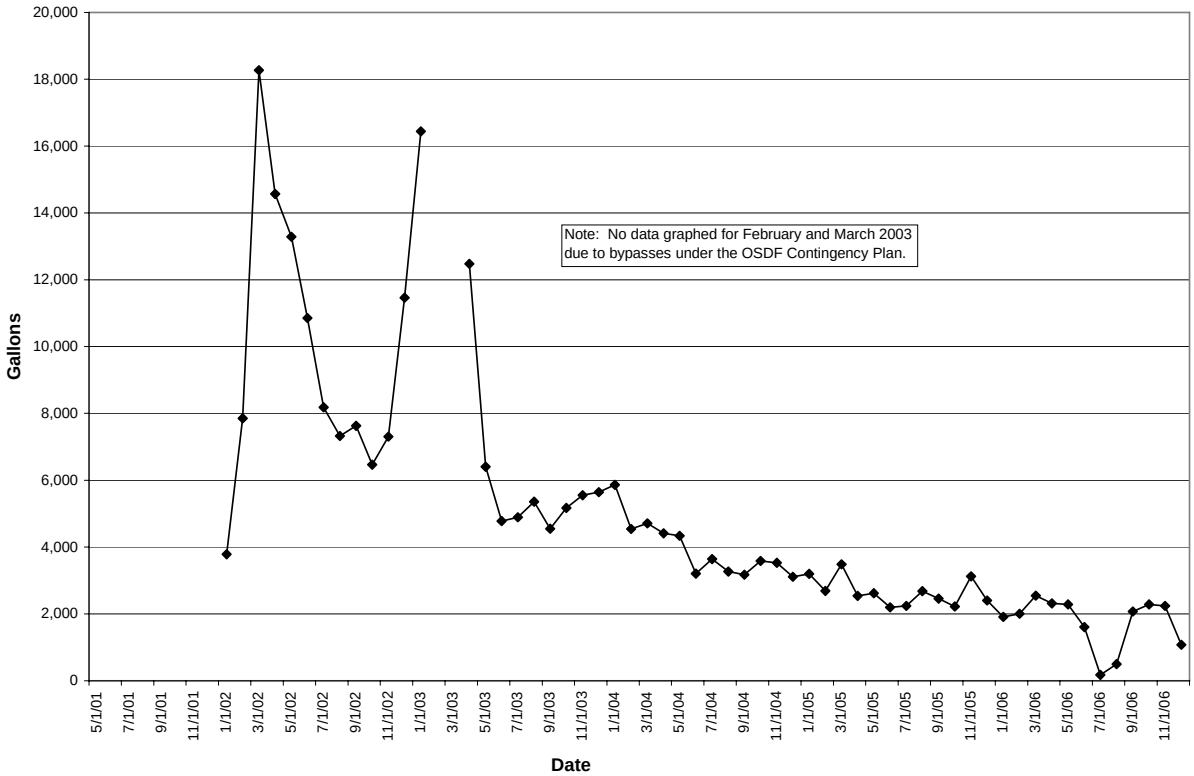


FIGURE A.5.2-2. Monthly Accumulation Volumes for Cell 2 LCS

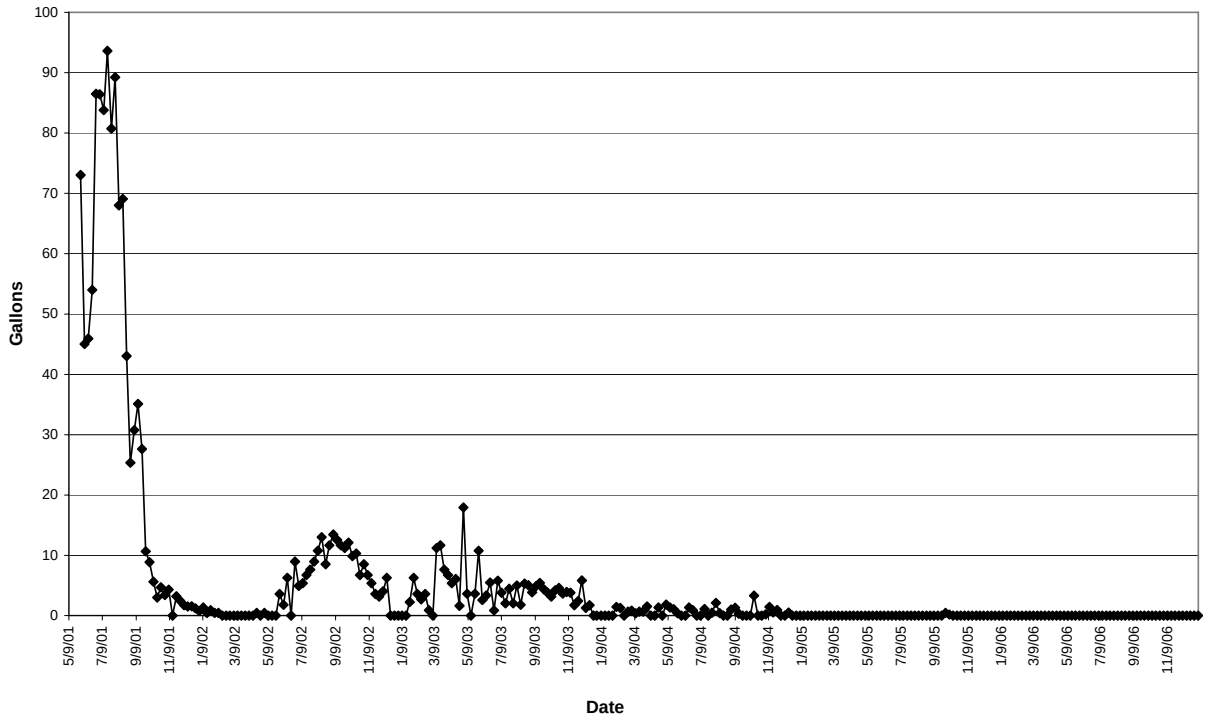


FIGURE A.5.2-3. Weekly Accumulation Volumes for Cell 2 LDS

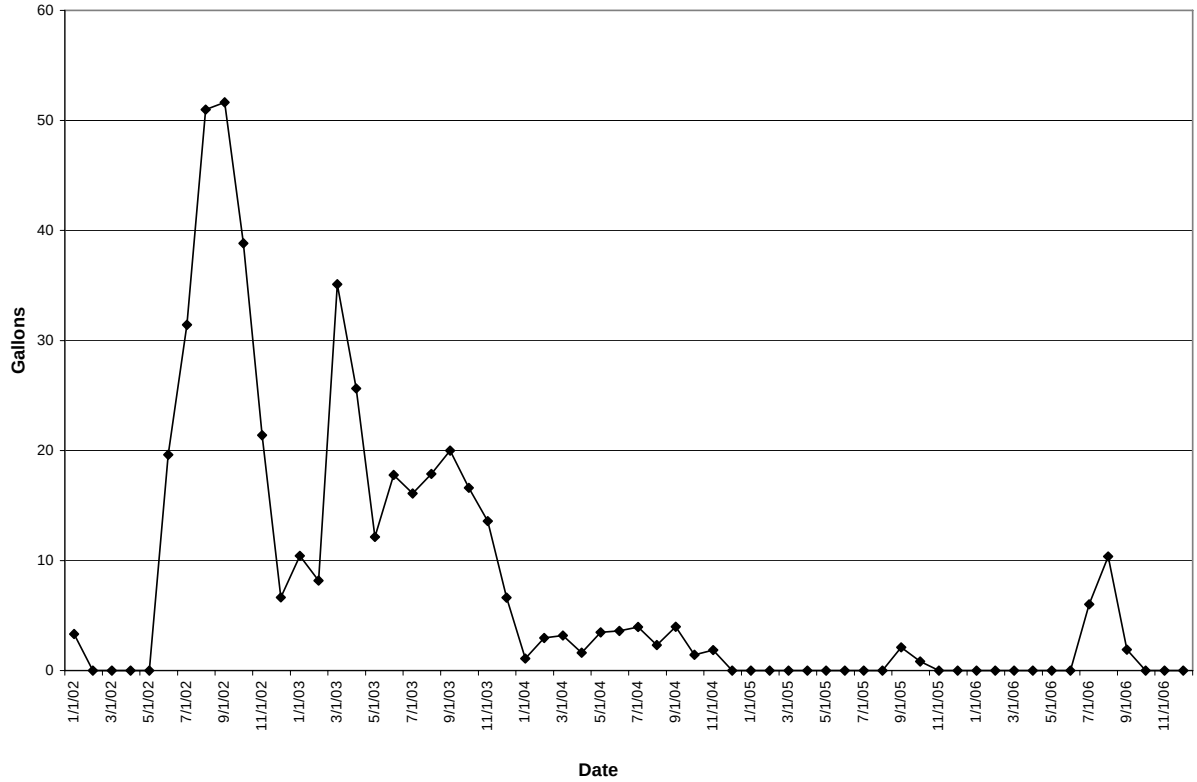


FIGURE A.5.2-4. Monthly Accumulation Volumes for Cell 2 LDS

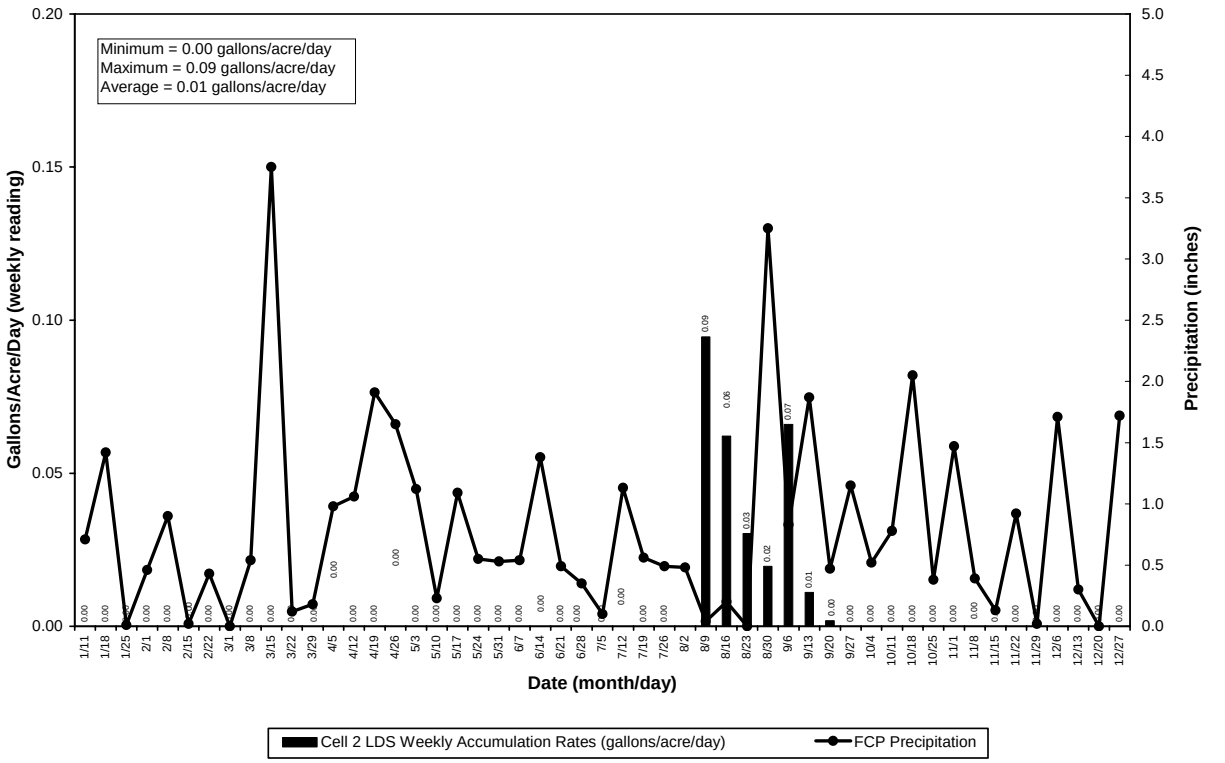


FIGURE A.5.2-5. 2006 OSDF LDS Weekly Accumulation Rates and Precipitation for Cell 2

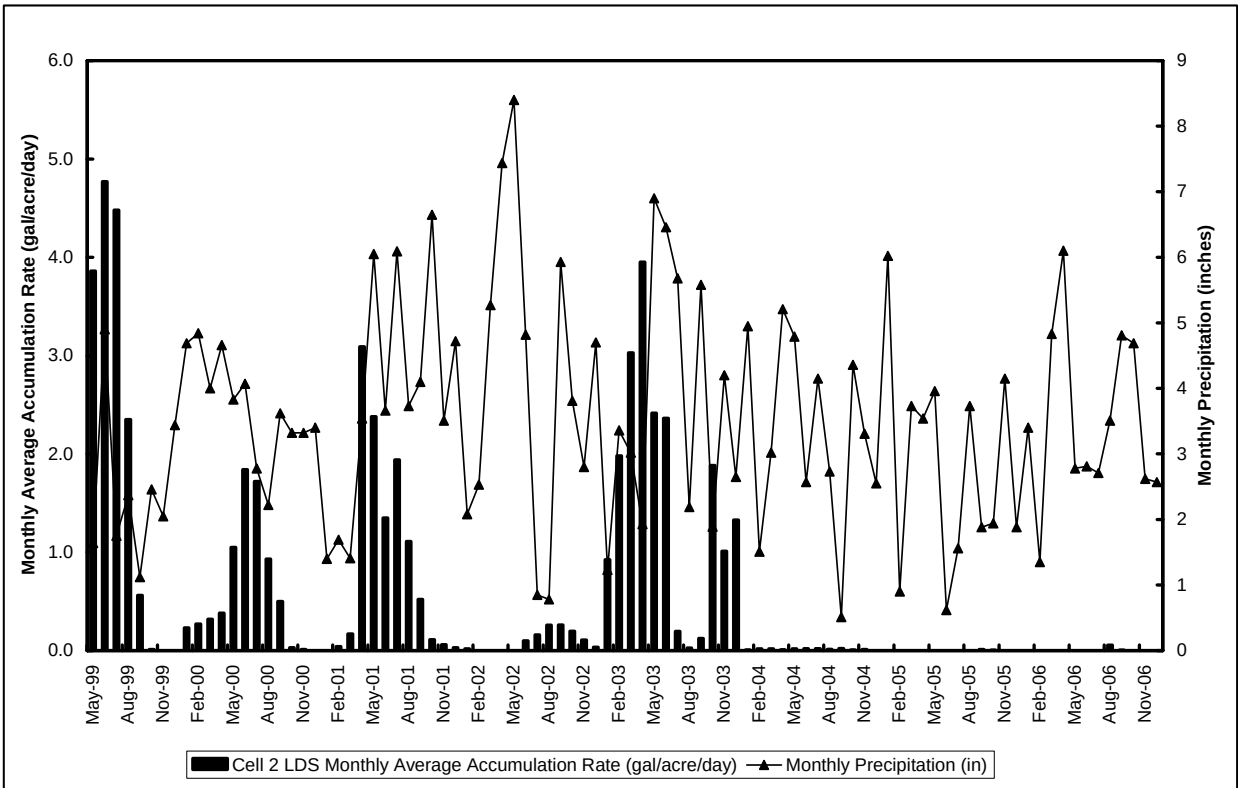


FIGURE A.5.2-6. OSDF Cell 2 LDS Monthly Average Accumulation Rates and Monthly Precipitation

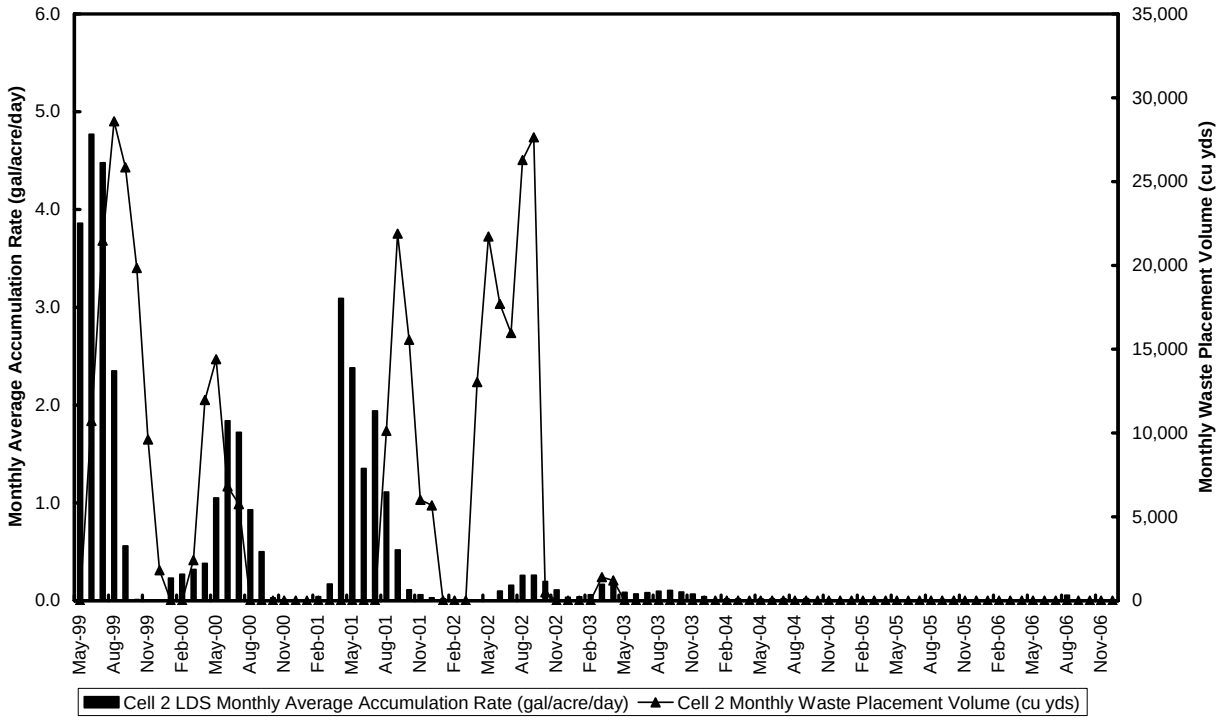
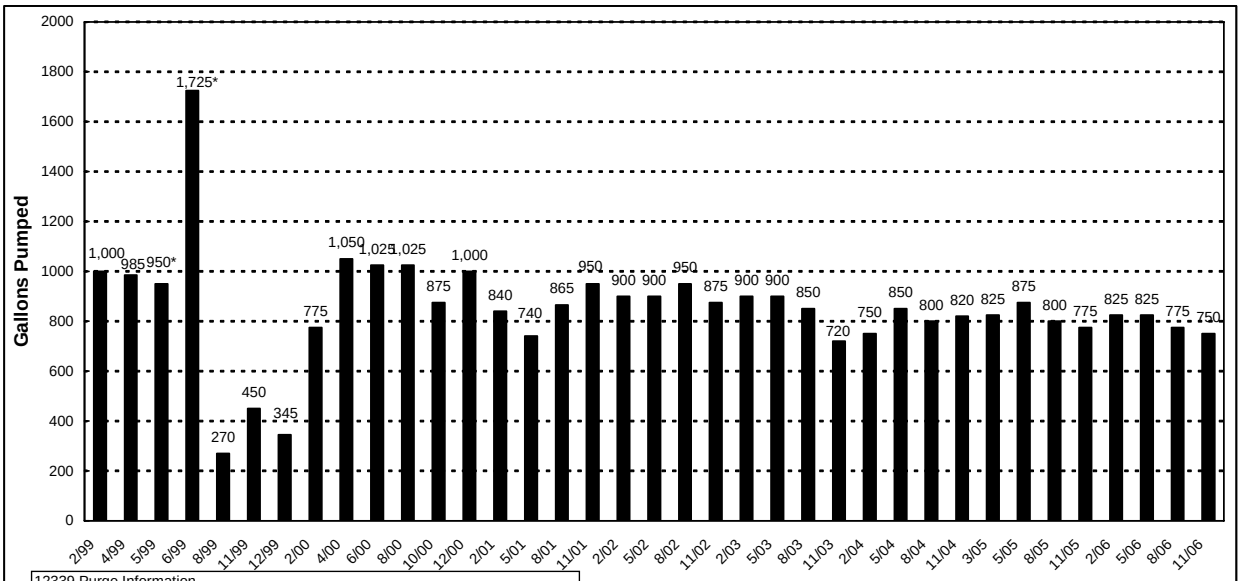


FIGURE A.5.2-7. OSDF Cell 2 LDS Monthly Average Accumulation Rates and Monthly Waste Placement Volumes



12339 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
1999:	5725	n=7	818
2000:	5750	n=6	958
2001:	3395	n=4	849
2002:	3625	n=4	906
2003:	3370	n=4	843
2004:	3220	n=4	805
2005:	3275	n=4	819
2006:	3175	n=4	794
Overall:			852

*More than one purge of the well was completed during these months to help evaluate well yield.

FIGURE A.5.2-8. OSDF Horizontal Till Well 12339 (Cell 2) Water Yield

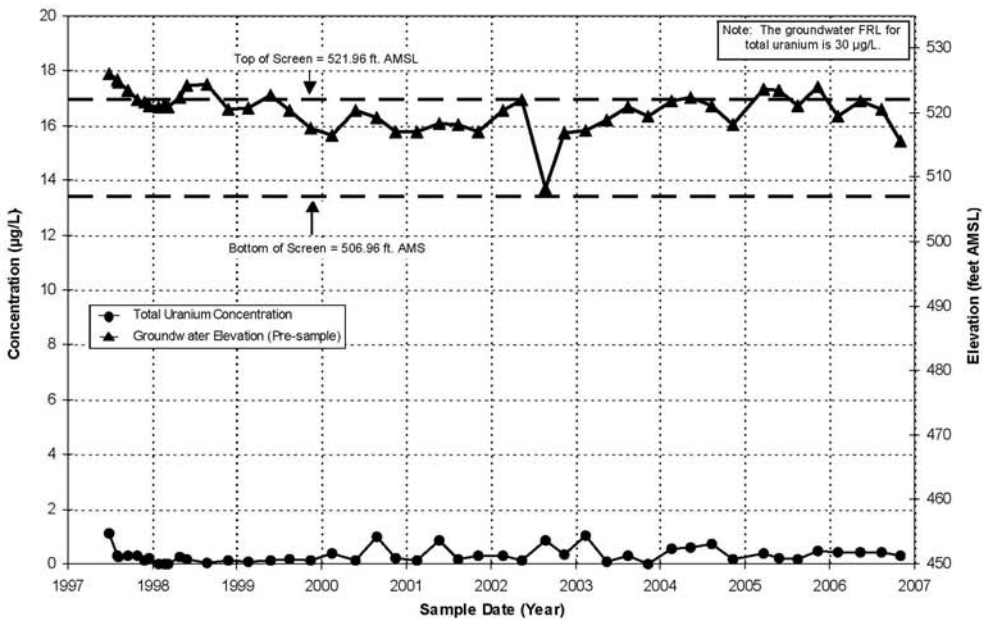


Figure A.5.2-9. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 2 Upgradient Monitoring Well 22200

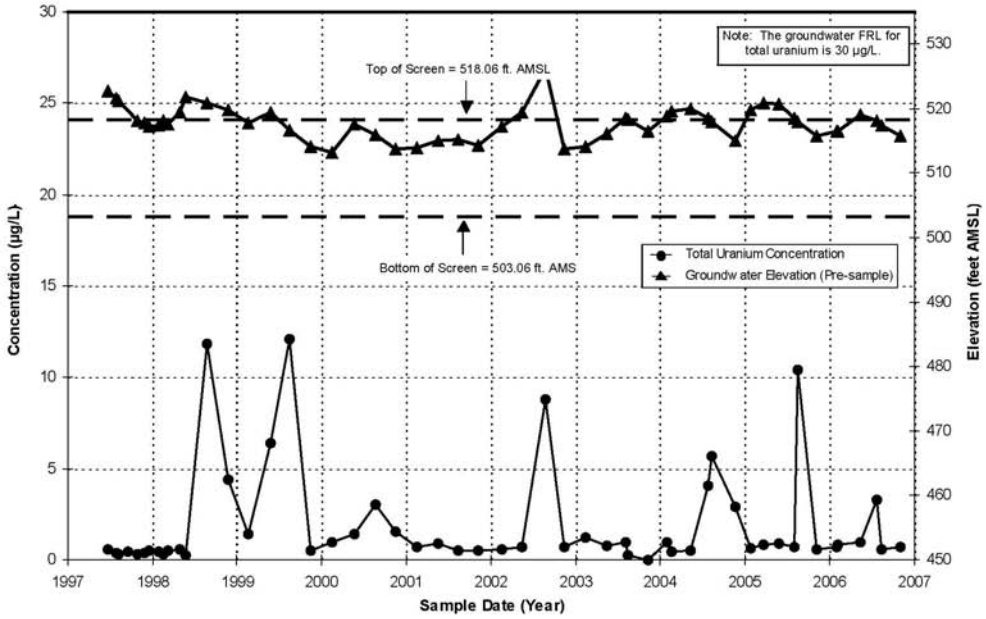


Figure A.5.2-10. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 2 Downgradient Monitoring Well 22199

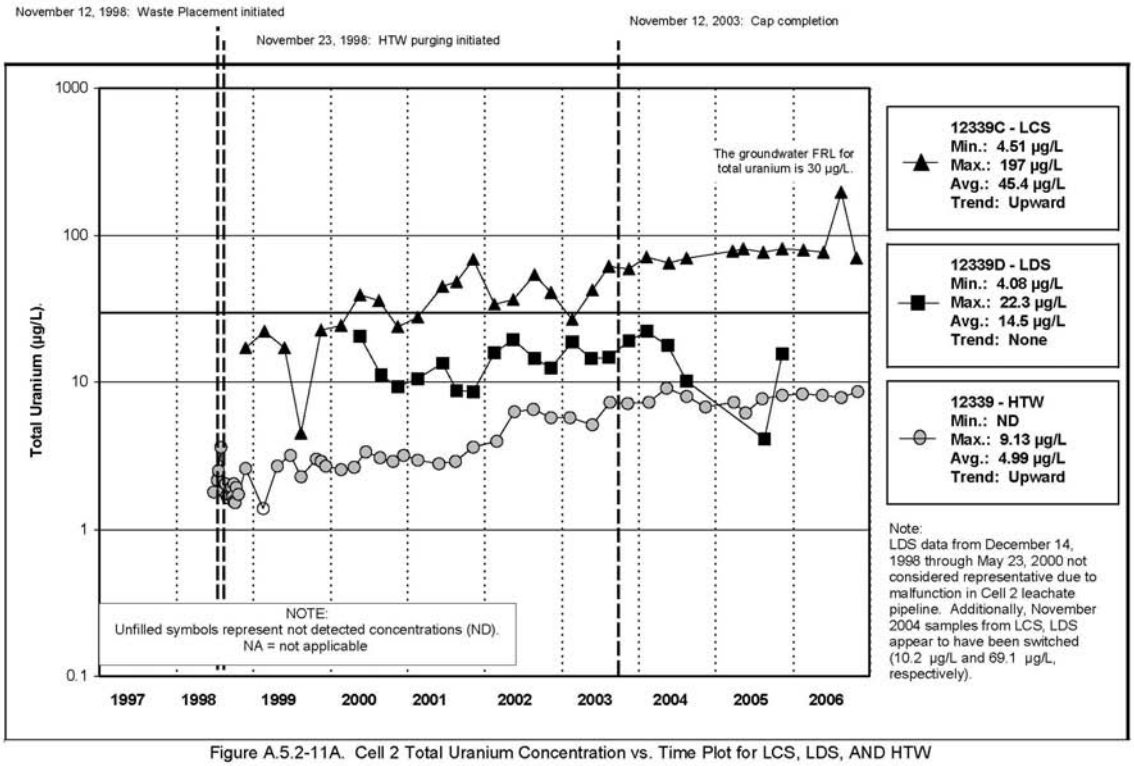


Figure A.5.2-11A. Cell 2 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

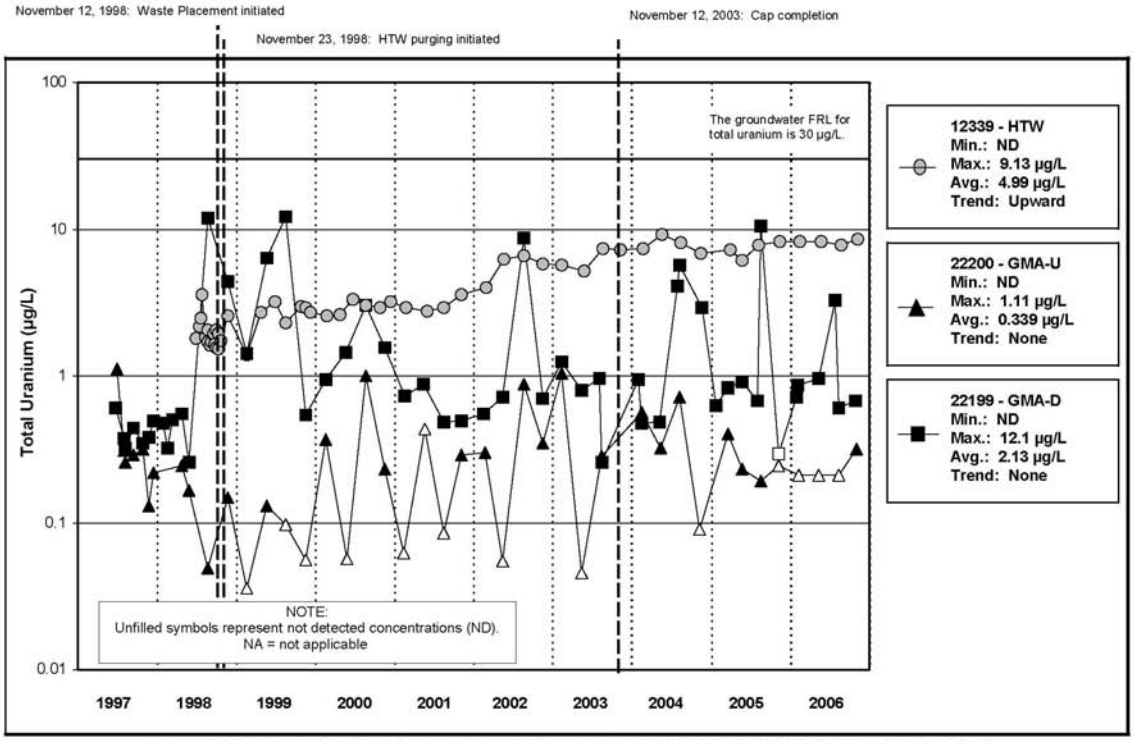


Figure A.5.2-11B. Cell 2 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

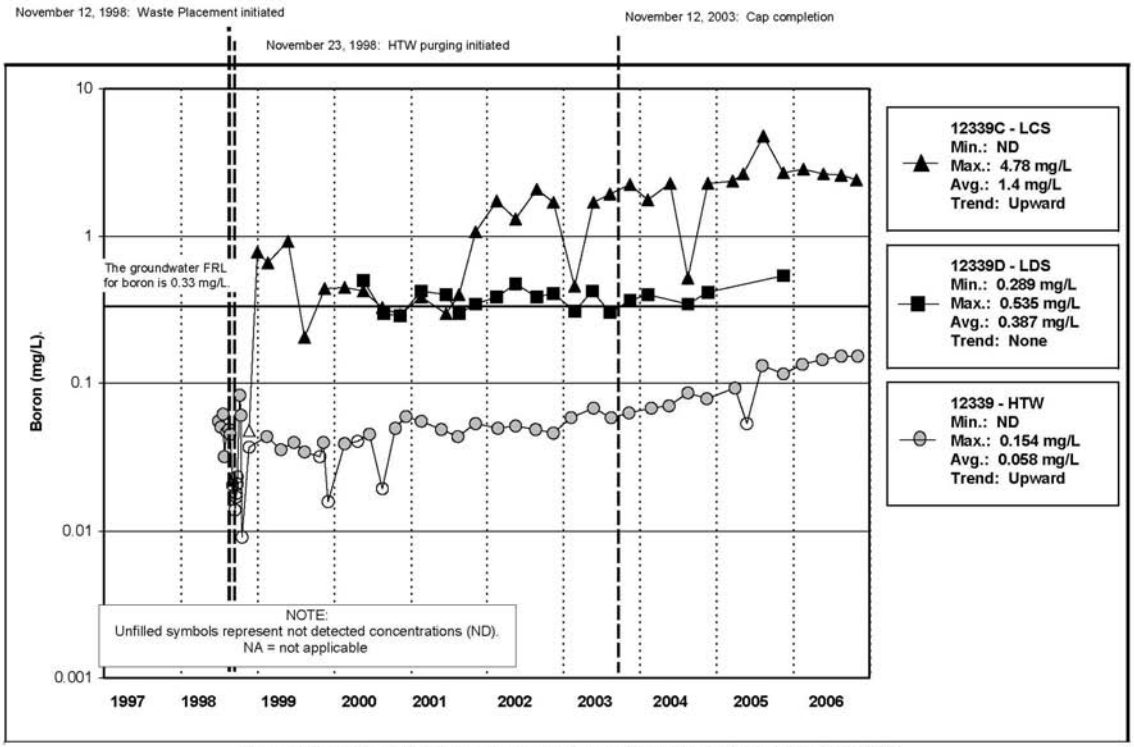


Figure A.5.2-12A. Cell 2 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

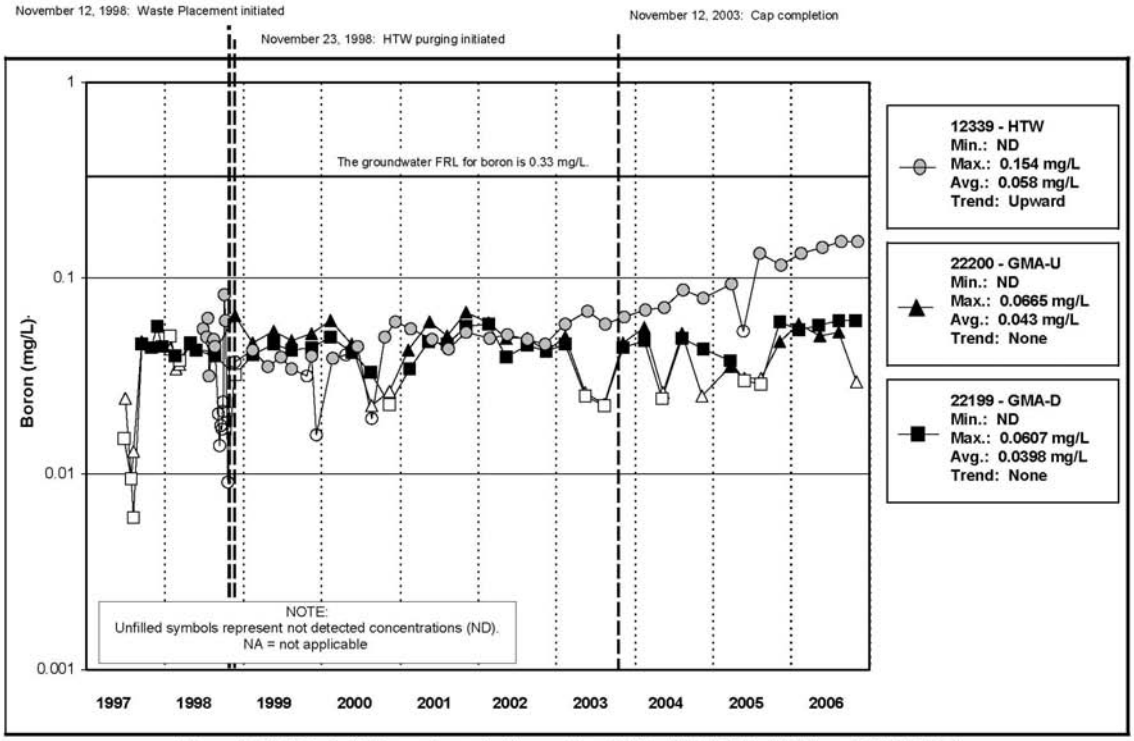


Figure A.5.2-12B. Cell 2 Boron Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

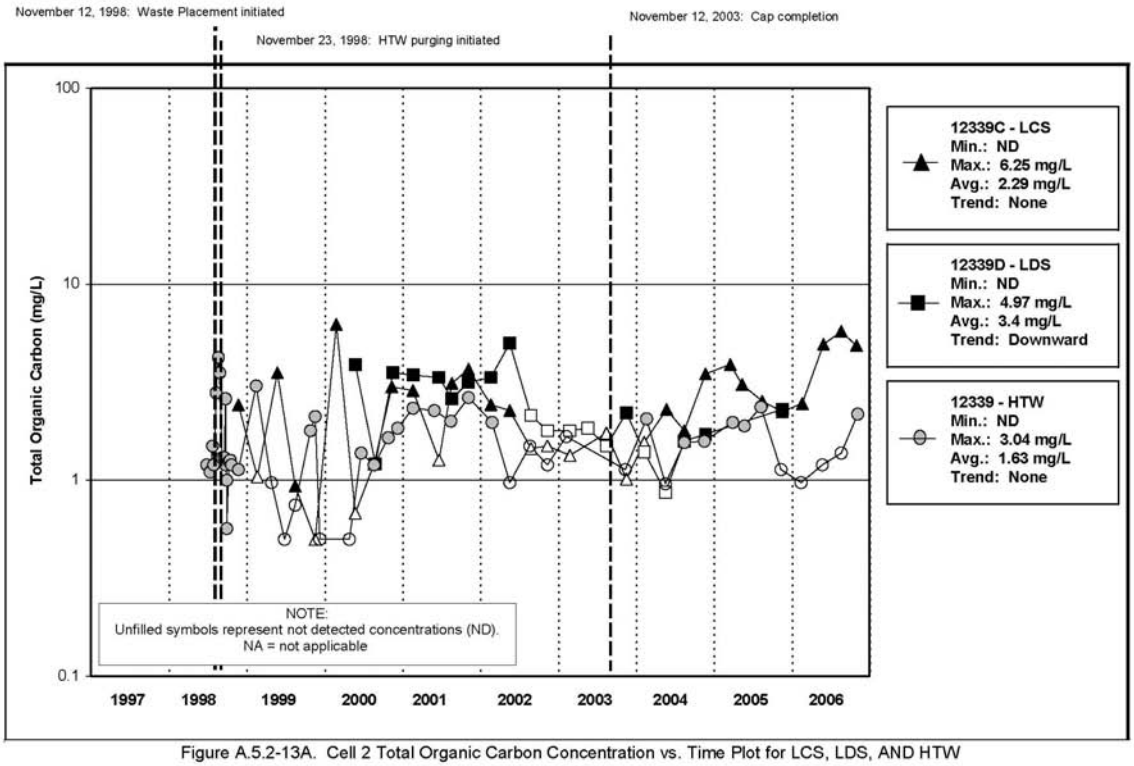


Figure A.5.2-13A. Cell 2 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

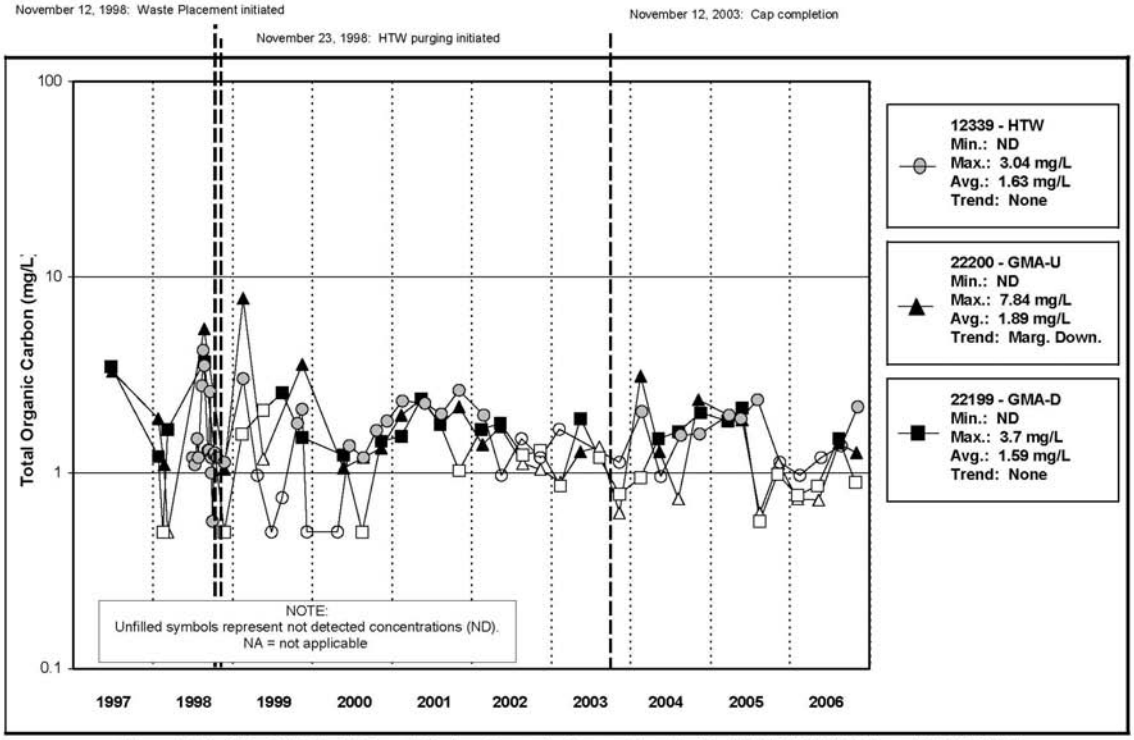


Figure A.5.2-13B. Cell 2 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

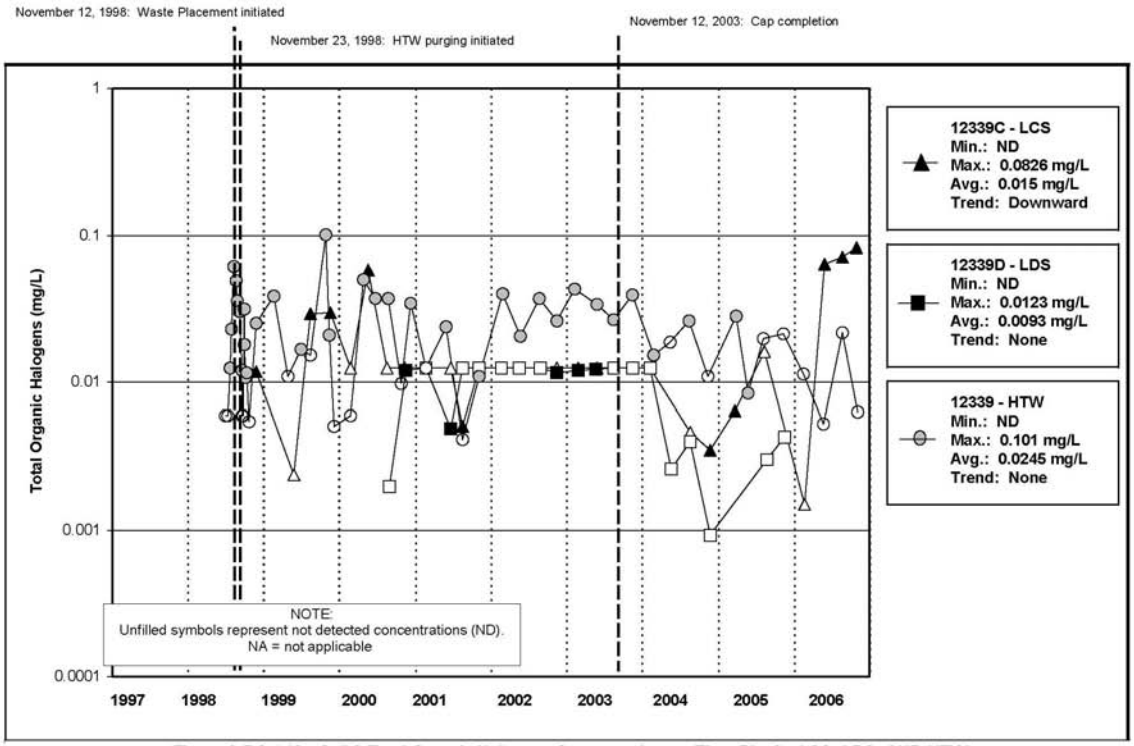


Figure A.5.2-14A. Cell 2 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

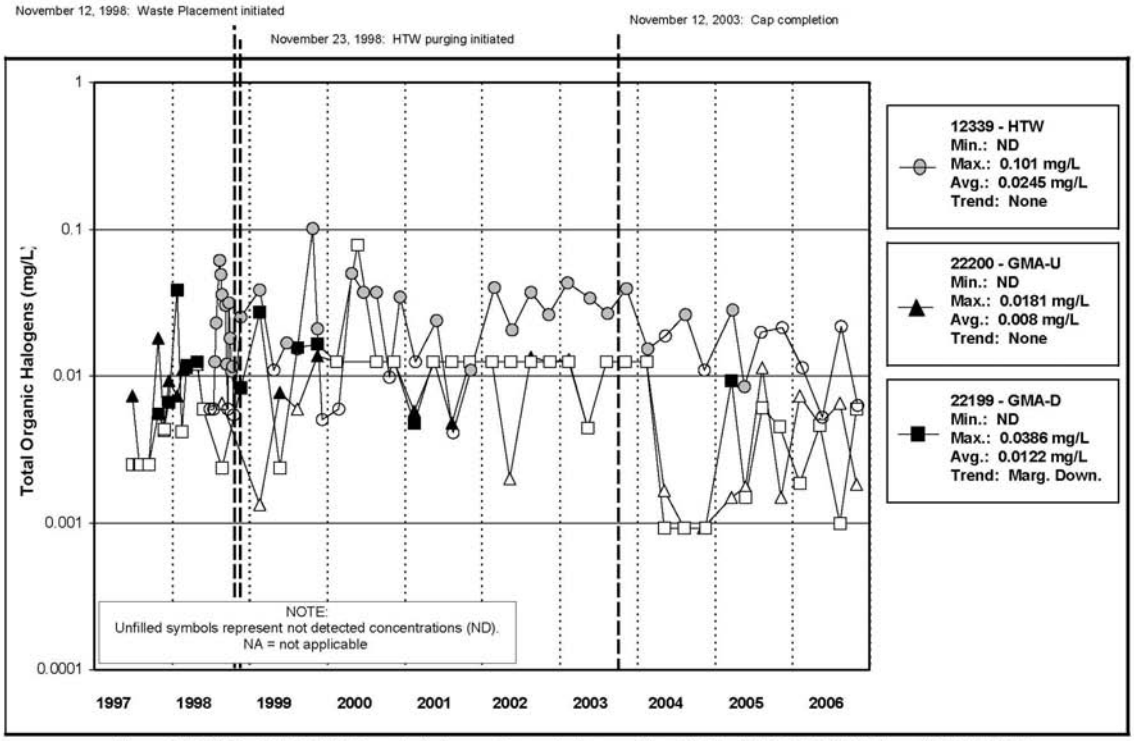


Figure A.5.2-14B. Cell 2 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

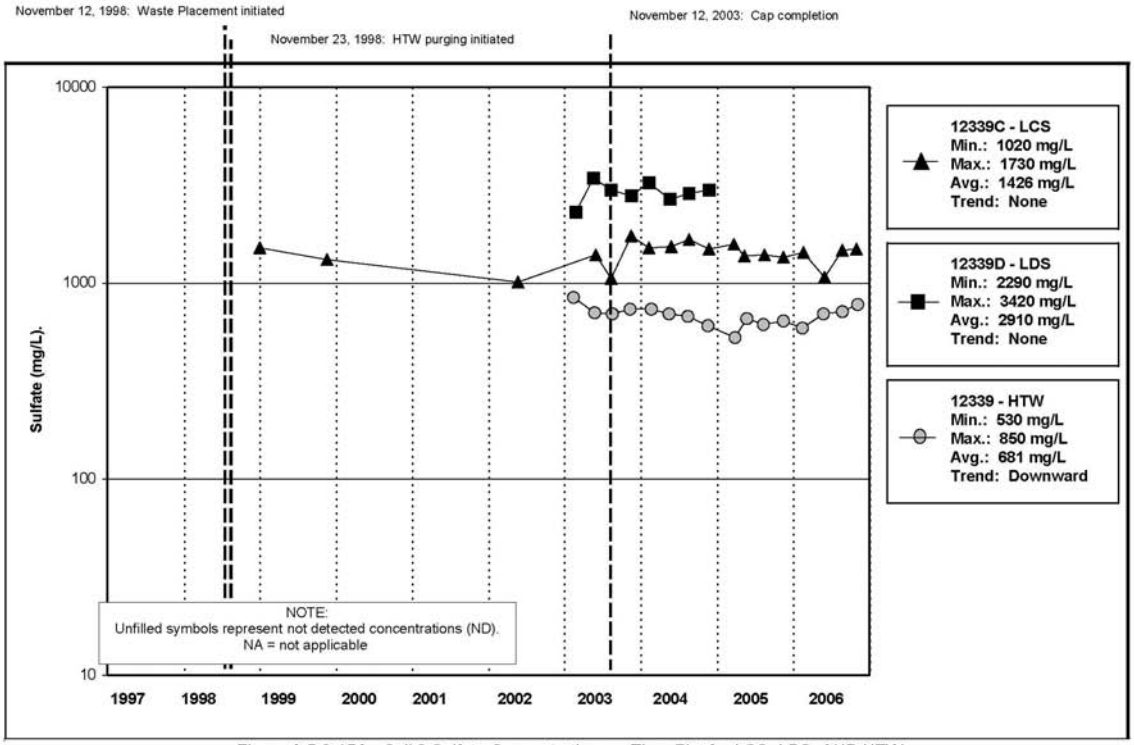


Figure A.5.2-15A. Cell 2 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

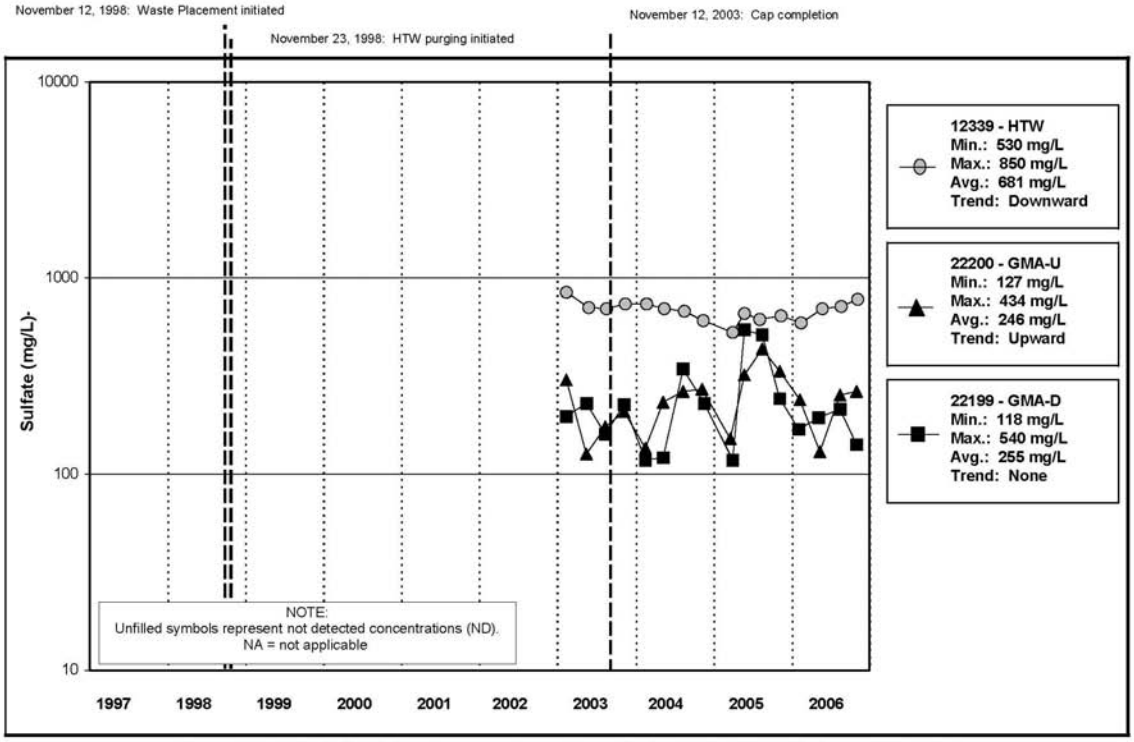


Figure A.5.2-15B. Cell 2 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

End of current text

Subattachment A.5.3

Cell 3

The following information is provided in this subattachment:

- LCS weekly and monthly accumulation volumes (refer to Figures A.5.3−1 and A.5.3−2)
- LDS weekly and monthly accumulation volumes (refer to Figures A.5.3−3 and A.5.3−4)
- LDS weekly and monthly accumulation rates and precipitation (refer to Figures A.5.3−5 and A.5.3−6)
- LDS monthly average accumulation rates and waste placement volumes (refer to Figure A.5.3−7)
- Monthly liner efficiencies (refer to Table A.5.3−1)
- HTW Water Yield (refer to Figure A.5.3−8)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.3−9 and A.5.3−10)
- Summary statistics for refined baseline constituents (refer to Section A.5.3.1 and Table A.5.3−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.3.1 and Figures A.5.3−11A through A.5.3−15B)
- Annual LCS monitoring results (refer to Section A.5.3.2 and Table A.5.3−3).
- Annual LDS monitoring results (refer to Section A.5.3.3)

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. The LCS and LDS constituent sampling list for Cell 3 also includes 1,1-dichloroethene. In 2006, all samples were collected for the Cell 3 monitoring horizons.

A.5.3.1 Refined Baseline Results

Refined baseline constituents are those constituents that have been sampled for at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also listed in Table 2−3 are common ion constituents. A summary statistics table (Table A.5.3−2), and concentration plots are provided for the five refined baseline constituents of Cell 3. For Cell 3, these five constituents are: total uranium, boron, total organic carbon, total organic halogens, and sulfate. Note that with the addition of the 2006 data, total organic halogens concentrations are now detected less than 25 percent of the time in the down gradient GMA well.

A.5.3.2 LCS Monitoring Results

Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and polychlorinated (PCB) parameters listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2006, annual sampling of the Cell 3 LCS took place in May.

Table A.5.3−3 summarizes the annual LCS sampling results for Cell 3 along with data collected in previous years.

Of the non-refined site specific baseline constituents that have been sampled at least eight times in Cell 3, 23 have been detected at least 25 percent of the time. Eleven of the 23 constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, potassium, silicon, and sodium). Sampling for common ion constituents is temporary. Eight rounds of sampling are being conducted to support the common ion study. It is anticipated that eight rounds of sampling will be completed for all cells in August 2007. A decision concerning what common ion constituents (if any) will be added to the site specific leak detection monitoring list for Cell 3 will be determined based upon results of the common ion study.

Eleven of the 12 constituents (considered to be "*potential*" site-specific leak detection monitoring constituents for Cell 3) are: 1,1,1-trichloroethane, barium, cadmium, chromium, cobalt, copper, nickel, selenium, total dissolved solids, vanadium, and zinc). These potential Cell 3 site-specific leak detection monitoring constituents will be assessed using the approach presented in Figures A.5−4A and A.5−4B, once final approval of the approach has been obtained from the EPA and OEPA. The assessment will be used to determine what potential constituent (if any) will be added to the Cell 3 site specific leak detection monitoring constituent list. Results of the assessment will be presented to the EPA/OEPA as soon as they are available and they will also be reported in next year's SER.

The remaining constituent (1,1-dichloroethene) is a site specific leak detection parameter; however, it is not on the refined baseline list for Cell 3. If a site specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.3−3; 1,1-dichloroethene has been detected in the Cell 3 LCS. On May 16, 2005, a concentration of 9.2 µg/L was detected. The groundwater FRL is 7 µg/L. Confirmatory sampling began in the fourth quarter of 2005. Results are as follows:

- Nov 28, 2005 13 µg/L
- Feb 20, 2006 3.2 µg /L
- May 23, 2006 12 µg /L
- Aug 25, 2006 2.1 µg /L
- Nov 1, 2006 2.5 µg /L
- Feb 20, 2007 0.737 µg/L

The annual Cell 3 LDS result from May 30, 2006, was a non-detect. Based on the LCS results, it was decided to conduct confirmatory sampling in the LDS. Results are as follows:

- Aug 25, 2006 Non-detect
- Nov 1, 2006 Non-detect
- Feb 20, 2006 Non-detect

Confirmatory sampling at the Cell 3 LCS for 1,1-dichloroethene will continue in 2007 until the constituent is evaluated using the site specific parameter selection approach presented in Figures A.5−4A and A.5−4B. Confirmatory sampling at the Cell 3 LDS for 1,1-dichloroethene will be discontinued.

As shown in Figure A.5.3−3, technetium-99 is a site specific leak detection parameter that has been detected 11.1 percent of the time in the Cell 3 LCS; however, it is not on the refined baseline list for Cell 3. If a site specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.3−3, technetium-99 has been detected in the Cell 3 LCS, but these detections occurred prior to the establishment or the refined baseline for Cell 3. Therefore, confirmatory sampling for technetium-99 in the Cell 3 LCS is not required.

A.5.3.3 LDS Annual Monitoring Results

Each year the LDS of Cell 3 is sampled for site specific parameters listed in Table 2−1 of Appendix B of the OSDF GWLMP. As with the LCS, the objective of the annual LDS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. In 2006, annual sampling of the Cell-3 LDS took place in May.

Of the non-refined baseline constituents that have been sampled at least eight times, two have been detected at least 25 percent of the time: (alkalinity and calcium). Both are common ion constituents.

Table A.5.3−1. Cell 3 – 2006 Monthly Liner Efficiencies

Month	Cell 3 Apparent Liner Efficiency (%)
January	96.52
February	97.32
March	98.21
April	98.20
May	98.24
June	98.16
July	NA[a]
August	NA[a]
September	98.87
October	98.74
November	98.86
December	99.22

[a]OSDF contingency plan executed due to inaccessibility of valve houses. Valve house road was closed to support site remediation activities. No data available

Table A.5.3.2. Summary Statistics for Cell 3

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]			
Total Uranium (µg/L)	LCS	12340C	28	28	100%	49.8	Normal	Upward	Not Detected				
	LDS	12340D	16	16	100%	18.3	Lognormal	Downward	Not Detected				
	HTW	12340	32	32	100%	18.2	Undefined	Upward	Detected				
	GMA-U	22203	31	34	91%	2.10	Lognormal	None	Detected				
	GMA-D	22204	33	34	97%	2.86	Lognormal	Upward	Detected				
Boron (mg/L)	LCS	12340C	29	30	97%	1.70	Undefined	Upward	Detected				
	LDS	12340D	16	17	94%	0.245	Lognormal	Downward	Detected				
	HTW	12340	31	31	100%	0.112	Lognormal	Downward	Detected	0.96 (Q3-06)			
	GMA-U	22203	25	34	74%	0.0367	Normal	None	Detected				
	GMA-D	22204	27	33	82%	0.0360	Undefined	None	Marg. Detect				
Total Organic Carbon (mg/L)	LCS	12340C	16	27	59%	2.0	Lognormal	None	Not Detected	17.35 (Q4-99)			
	LDS	12340D	13	17	76%	6.49	Undefined	Marg. Up.	Not Detected				
	HTW	12340	21	30	70%	1.90	Normal	None	Detected	9.81 (Q1-00)			
	GMA-U	22203	19	32	59%	1.48	Lognormal	Downward	Detected	14.1 (Q4-00)	5.66 (Q1-00)		
	GMA-D	22204	16	33	48%	1.40	Lognormal	None	Not Detected	8.83 (Q1-00)			
Total Organic Halogens (mg/L)	LCS	12340C	7	27	26%	0.013	Undefined	Marg. Up.	Not Detected	0.141 (Q4-99)	0.057 (Q3-06)		
	LDS	12340D	7	17	41%	0.0257	Lognormal	Upward	Not Detected				
	HTW	12340	22	32	69%	0.0204	Normal	None	Detected	0.067 (Q4-99)			
	GMA-U	22203	11	33	33%	0.0072	Undefined	Downward	Detected	0.213 (Q2-00)			
	GMA-D	22204	8	34	24%	0.0125	Undefined	None	Not Detected	0.165 (Q2-00)	0.00184 U (Q2-04)	0.00184 U (Q2-03)	0.00184 U (Q2-02)
Sulfate (mg/L)	LCS	12340C	21	21	100%	1600	Undefined	Upward	Detected				
	LDS	12340D	15	15	100%	1610	Normal	Downward	Detected				
	HTW	12340	16	16	100%	667	Normal	Downward	Marg. Detect				
	GMA-U	22203	16	16	100%	340	Lognormal	Downward	Detected				
	GMA-D	22204	14	14	100%	581	Lognormal	None	Not Detected	319 (Q2-06)	338 (Q2-03)		

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.
Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.
Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the normal destribution better than the lognormal distribution.
Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the lognormal destribution better than the normal distribution.
Undefined: Normal and Lognormal Distribution assumptiions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down." is a marginally downward trend and "Marg. Up." is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly
U = Not Detected at that concentration

Table A.5.3−3. Cell 3 Annual LCS Sample Summary Information

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (#OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
1,1,1-Trichloroethane (ug/L)	8	2	25.0%	0.54	0.64	-	-	-	-	-	1 ug/L
1,1-Dichloroethane (ug/L)	8	1	12.5%	0.79	-	-	280 ug/L (0)	-	-	-	1 ug/L
1,1-Dichloroethene (ug/L)	20	7	35.0%	1.3	13.1	6.2	7 ug/L (3)	-	-	-	1 ug/L
Alkalinity as CaCO3 (mg/L)	13	13	100.0%	72	1080	450	-	422 mg/L (8)	430 mg/L (8)	-	10 mg/L
Arsenic (mg/L)	8	1	12.5%	0.0013	-	-	0.05 mg/L (0)	0.029 mg/L (0)	0.019 mg/L (0)	0.191 mg/L (0)	0.02 mg/L
Barium (mg/L)	8	8	100.0%	0.0375	0.118	0.057	2 mg/L (0)	0.77 mg/L (0)	0.45 mg/L (0)	0.589 mg/L (0)	0.029 mg/L
Beryllium (mg/L)	8	1	12.5%	0.0002	-	-	0.004 mg/L (0)	-	-	0.0343 mg/L (0)	0.001 mg/L
Cadmium (mg/L)	8	2	25.0%	0.000065	0.00044	-	0.014 mg/L (0)	0.014 mg/L (0)	-	0.05 mg/L (0)	0.002 mg/L
Calcium (mg/L)	16	16	100.0%	96	1200	510	-	159 mg/L (13)	172 mg/L (13)	1800 mg/L (0)	5 mg/L
Chloride (mg/L)	13	13	100.0%	4.7	42.8	26.8	-	7.3 mg/L (11)	45 mg/L (0)	6300 mg/L (0)	5 mg/L
Chromium (mg/L)	8	3	37.5%	0.00093	0.00564	0.00259	0.022 mg/L (0)	0.021 mg/L (0)	0.0046 mg/L (1)	0.818 mg/L (0)	0.005 mg/L
Cobalt (mg/L)	8	4	50.0%	0.000288	0.0309	0.0112	0.17 mg/L (0)	0.0086 mg/L (2)	-	0.0886 mg/L (0)	0.034 mg/L
Copper (mg/L)	8	8	100.0%	0.00118	0.0122	0.0074	1.3 mg/L (0)	0.035 mg/L (0)	0.029 mg/L (0)	0.298 mg/L (0)	0.008 mg/L
Fluoride (mg/L)	7	5	71.4%	0.056	0.197	0.141	4 mg/L (0)	0.89 mg/L (0)	1.3 mg/L (0)	6.8 mg/L (0)	0.2 mg/L
Iron (mg/L)	16	16	100.0%	0.205	16.6	4.2	-	5.72 mg/L (3)	6.35 mg/L (2)	21.3 mg/L (0)	0.1 mg/L
Lead (mg/L)	8	1	12.5%	0.00146	-	-	0.015 mg/L (0)	0.022 mg/L (0)	0.0016 mg/L (0)	0.0114 mg/L (0)	0.008 mg/L
Magnesium (mg/L)	16	16	100.0%	19.2	380	155	-	38.5 mg/L (12)	50.7 mg/L (12)	690 mg/L (0)	5 mg/L
Manganese (mg/L)	16	15	93.8%	0.0014	7.27	3.83	0.9 mg/L (10)	0.9 mg/L (10)	0.21 mg/L (10)	35 mg/L (0)	0.09 mg/L
Nickel (mg/L)	8	8	100.0%	0.00298	0.0918	0.0278	0.1 mg/L (0)	0.0514 mg/L (2)	0.0072 mg/L (5)	0.981 mg/L (0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	20	14	70.0%	0.238	2.2	0.96	11 mg/L[g] (0)	11 mg/L (0)	0.29 mg/L (12)	2670 mg/L (0)	1.1 mg/L
Phosphorus (mg/L)	9	1	11.1%	0.0853	-	-	-	-	-	-	0.1 mg/L
Potassium (mg/L)	16	16	100.0%	3.96	31.9	21.0	-	1.96 mg/L (16)	17.2 mg/L (12)	12400 mg/L (0)	5 mg/L
Selenium (mg/L)	8	3	37.5%	0.0019	0.0133	0.0065	0.05 mg/L (0)	0.00075 mg/L (3)	-	0.0494 mg/L (0)	0.005 mg/L
Silicon (mg/L)	10	10	100.0%	9.75	11.3	10.5	-	-	-	15 mg/L (0)	0.015 mg/L
Sodium (mg/L)	16	16	100.0%	4.79	49.9	21.6	-	47.1 mg/L (1)	50 mg/L (0)	1300 mg/L (0)	5 mg/L
Technetium-99 (pCi/L)	18	2	11.1%	3.84	9.89	-	94 pCi/L (0)	22 pCi/L (0)	30 pCi/L (0)	6130 pCi/L (0)	10 pCi/L
Thallium (mg/L)	8	1	12.5%	0.0021	-	-	-	-	-	0.0028 mg/L (0)	0.02 mg/L
Total Dissolved Solids (mg/L)	15	15	100.0%	342	3210	1590	-	-	-	-	10 mg/L
trans-1,3-Dichloropropene (ug/L)	8	1	12.5%	1	-	-	-	-	-	-	1 ug/L
Vanadium (mg/L)	8	2	25.0%	0.00371	0.00959	-	0.038 mg/L (0)	0.012 mg/L (0)	0.005 mg/L (1)	0.299 mg/L (0)	0.02 mg/L
Vinyl chloride (ug/L)	16	1	6.3%	16.1	-	-	2 ug/L (1)	-	-	-	1 ug/L
Zinc (mg/L)	8	4	50.0%	0.0144	0.0278	0.0208	0.021 mg/L (2)	0.02 mg/L (2)	0.35 mg/L (0)	1.78 mg/L (0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information
[b]Rejected data qualified with an R or Z were not included.
[c]If the number of detected samples is equal to two, then the minumun and maximumn are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.
[d]From Operable Unit 5 Record of Decision, Table 9-4.
[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.
[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.
[g]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

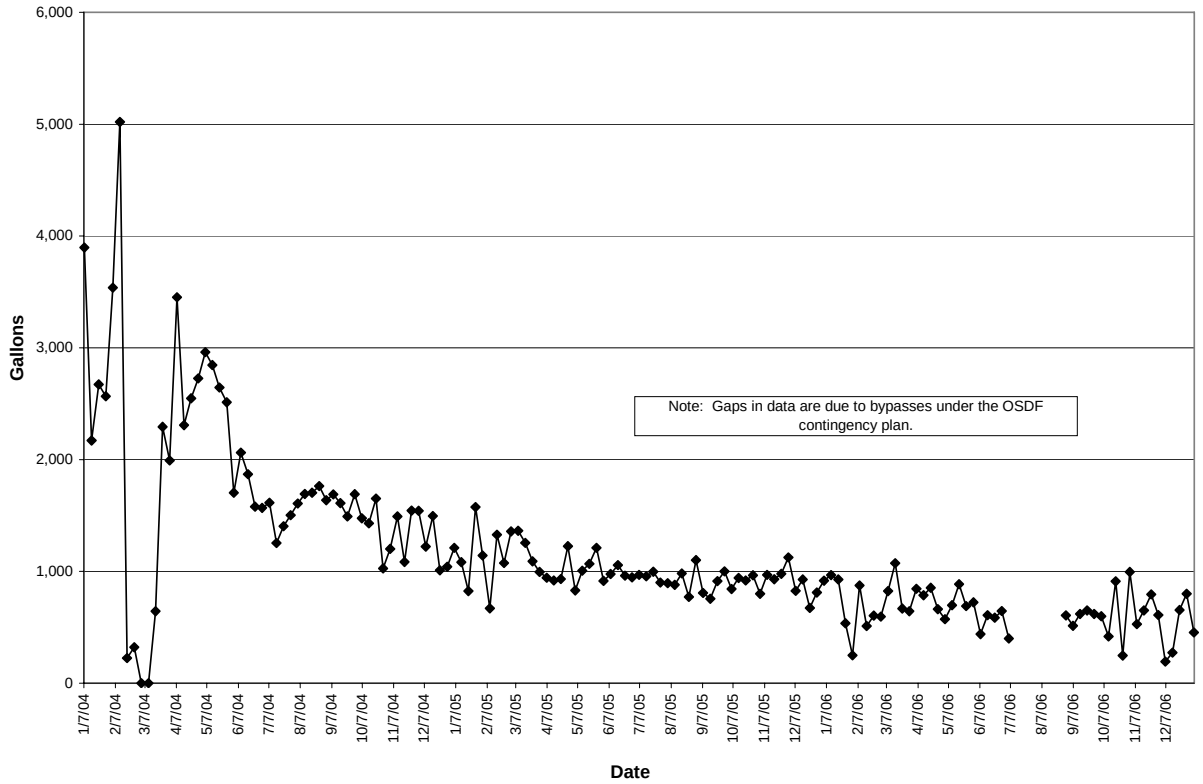


FIGURE A.5.3-1. Weekly Accumulation Volumes for Cell 3 LCS

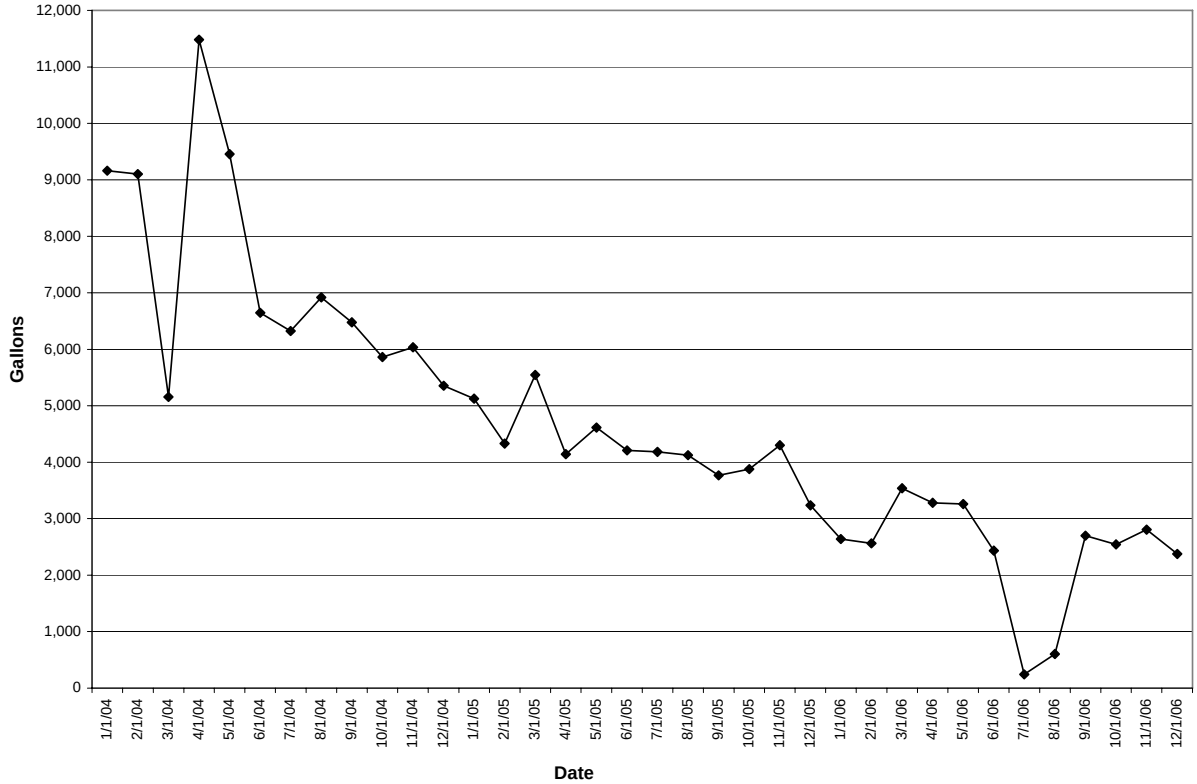


FIGURE A.5.3-2. Monthly Accumulation Volumes for Cell 3 LCS

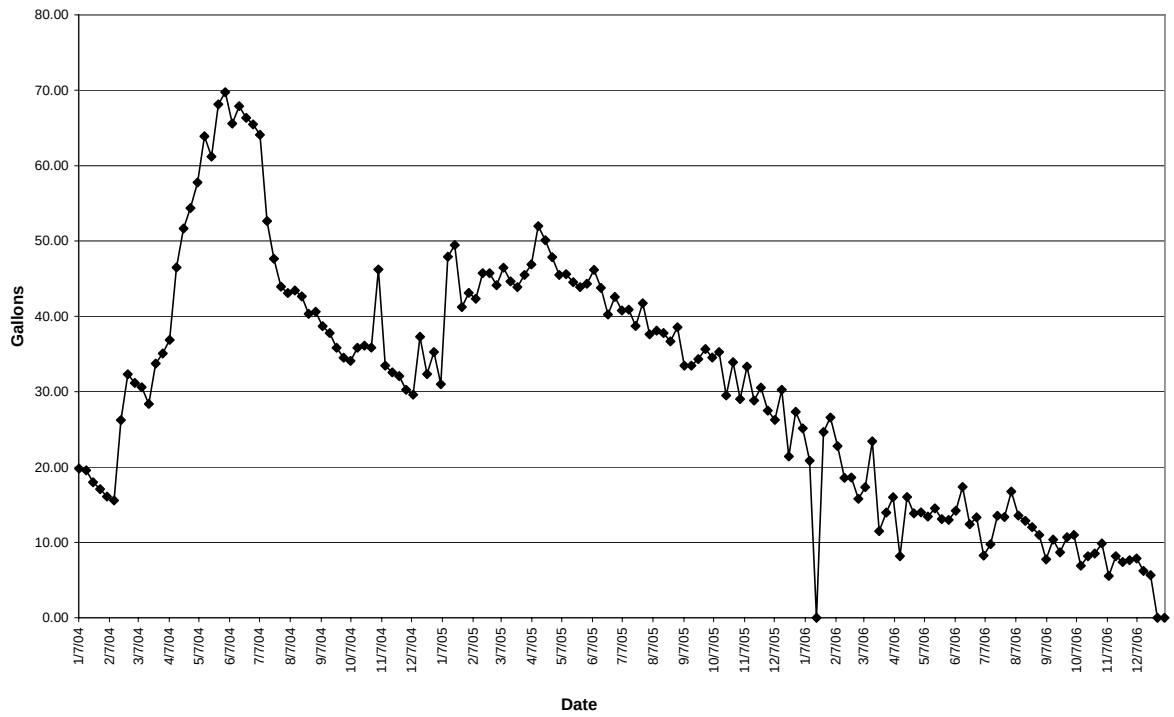


FIGURE A.5.3-3. Weekly Accumulation Volumes for Cell 3 LDS

FIGURE A.5.3-4. Monthly Accumulation Volumes for Cell 3 LDS

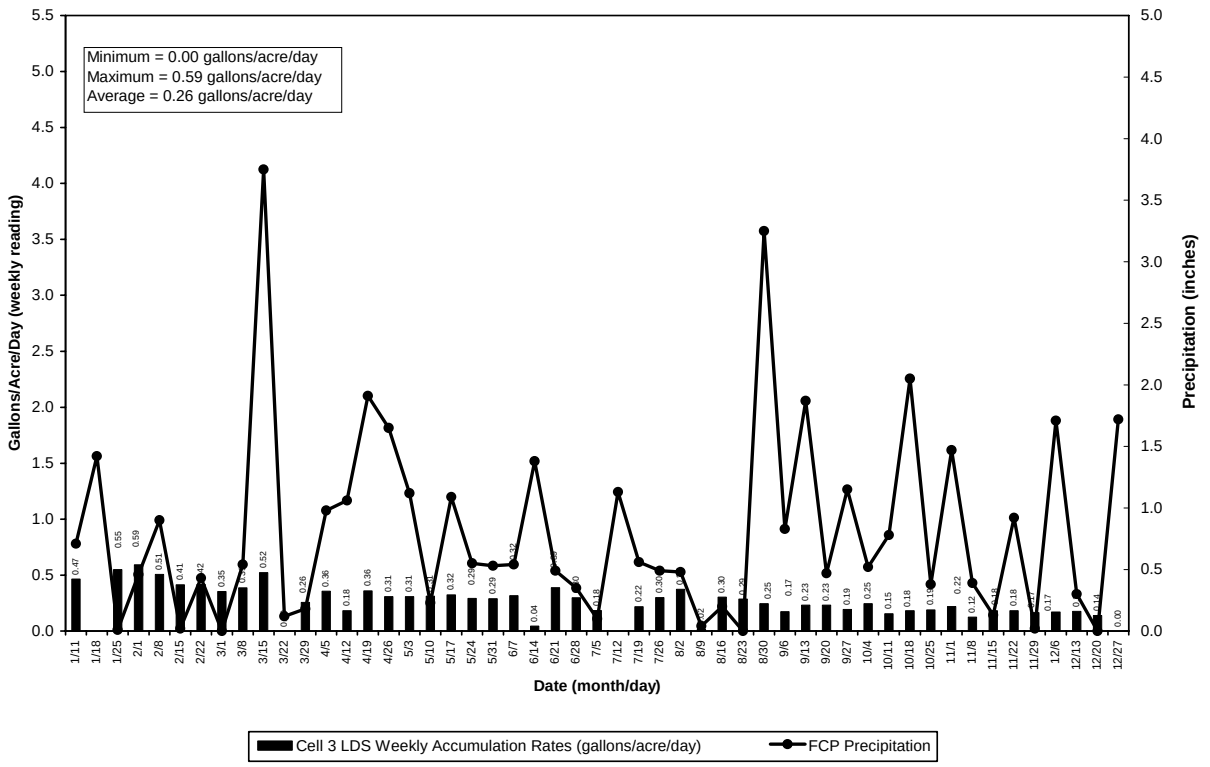


FIGURE A.5.3-5. 2006 OSDF LDS Weekly Accumulation Rates and Precipitation for Cell 3

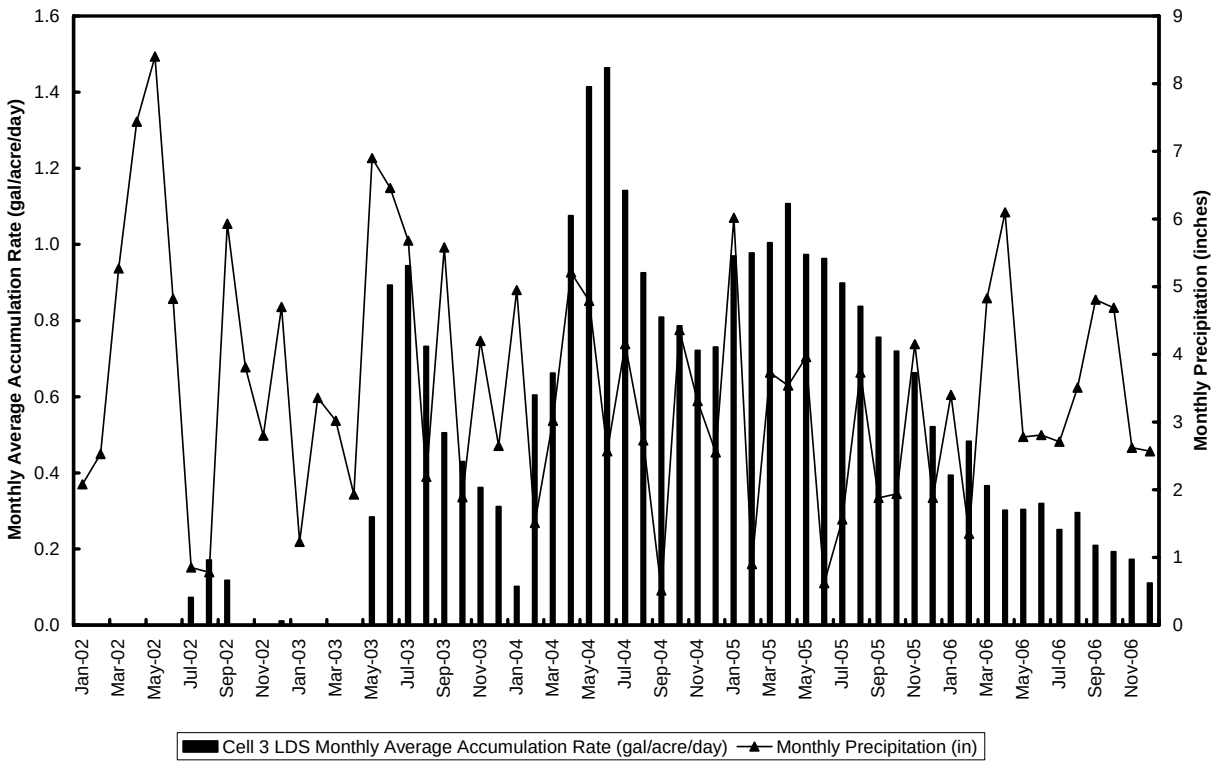


FIGURE A.5.3-6. OSDF Cell 3 LDS Monthly Average Accumulation Rates and Monthly Precipitation

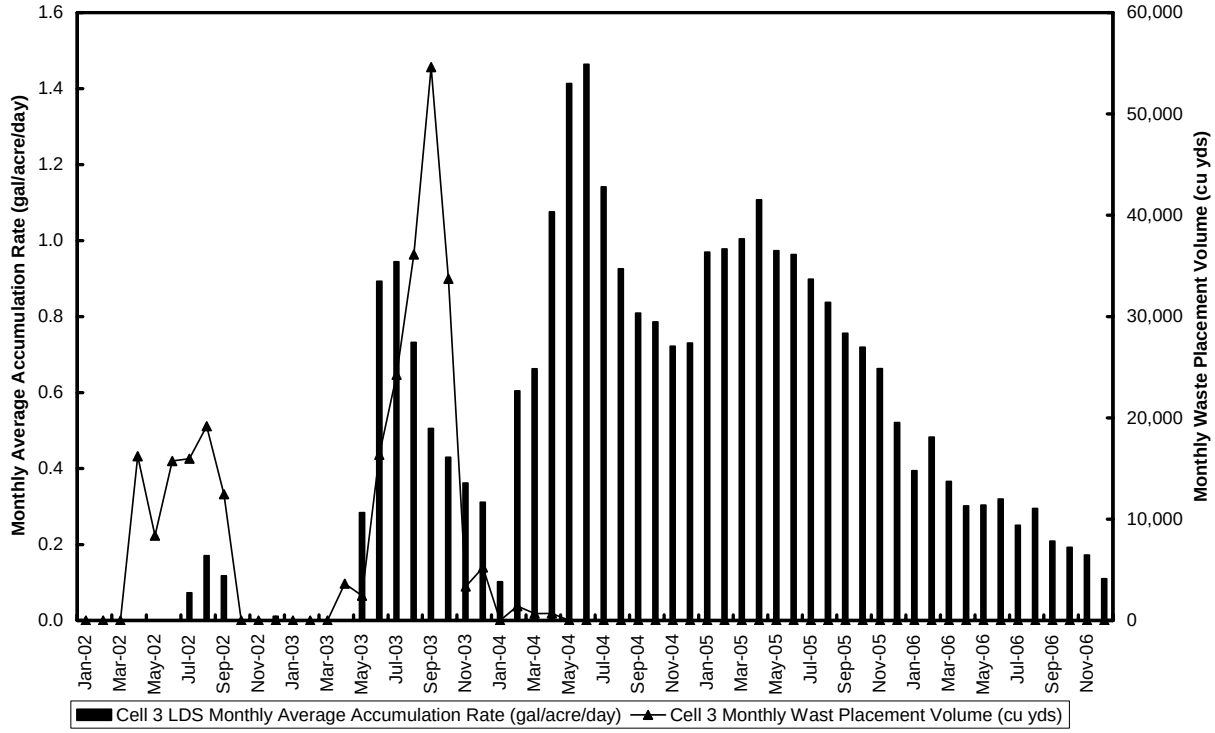
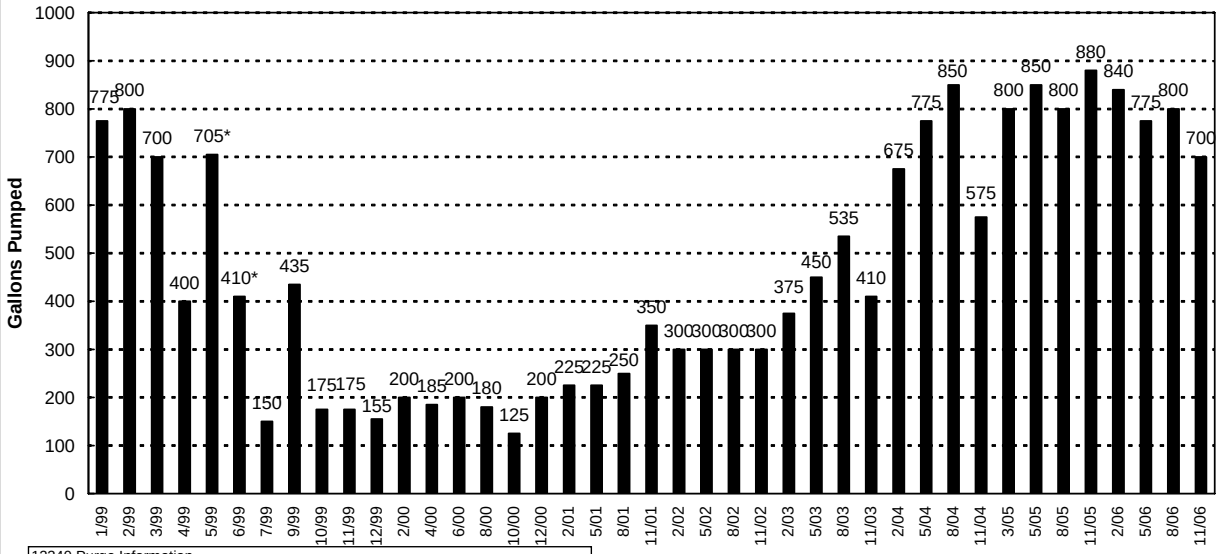


FIGURE A.5.3-7. OSDF Cell 3 LDS Monthly Average Accumulation Rates and Monthly Waste Placement Volumes



12340 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
1999:	4880	n=11	444
2000:	1090	n= 6	182
2001:	1050	n= 4	263
2002:	1200	n= 4	300
2003:	1770	n= 4	443
2004:	2875	n= 4	719
2005:	3330	n=4	833
2006:	3115	n=4	779
Overall:			471

*More than one purge of the well was completed during these months to help evaluate well yield.

FIGURE A.5.3-8. OSDF Horizontal Till Well 12340 (Cell 3) Water Yield

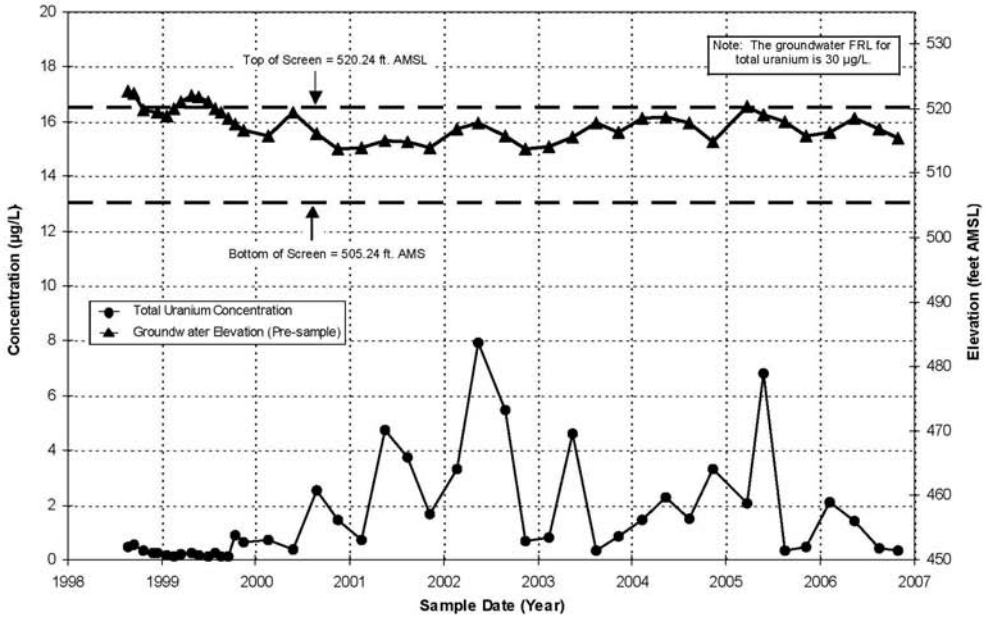


Figure A.5.3-9. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 3 Upgradient Monitoring Well 22203

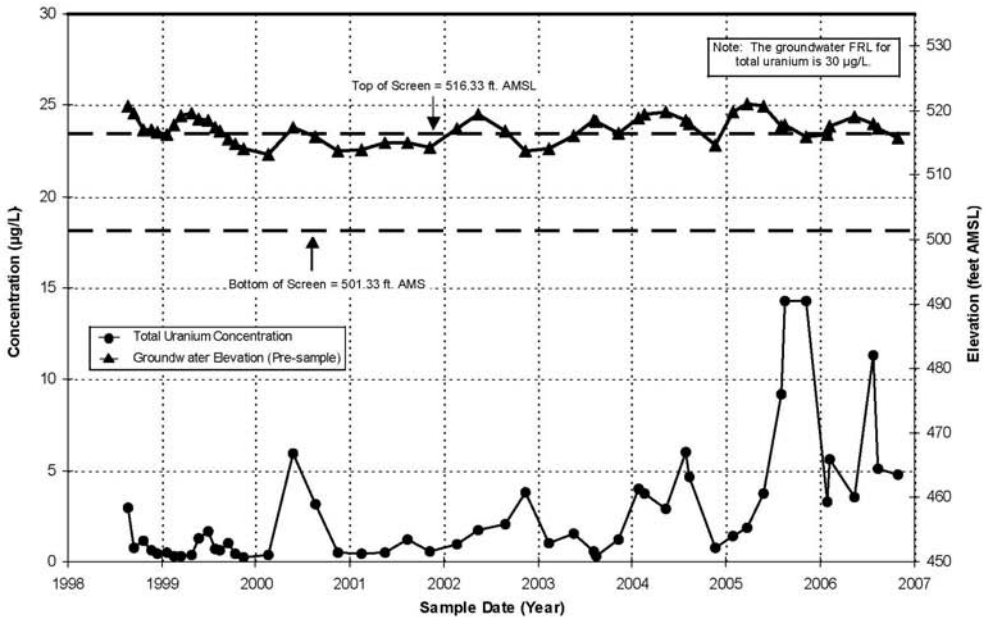


Figure A.5.3-10. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 3 Downgradient Monitoring Well 22204

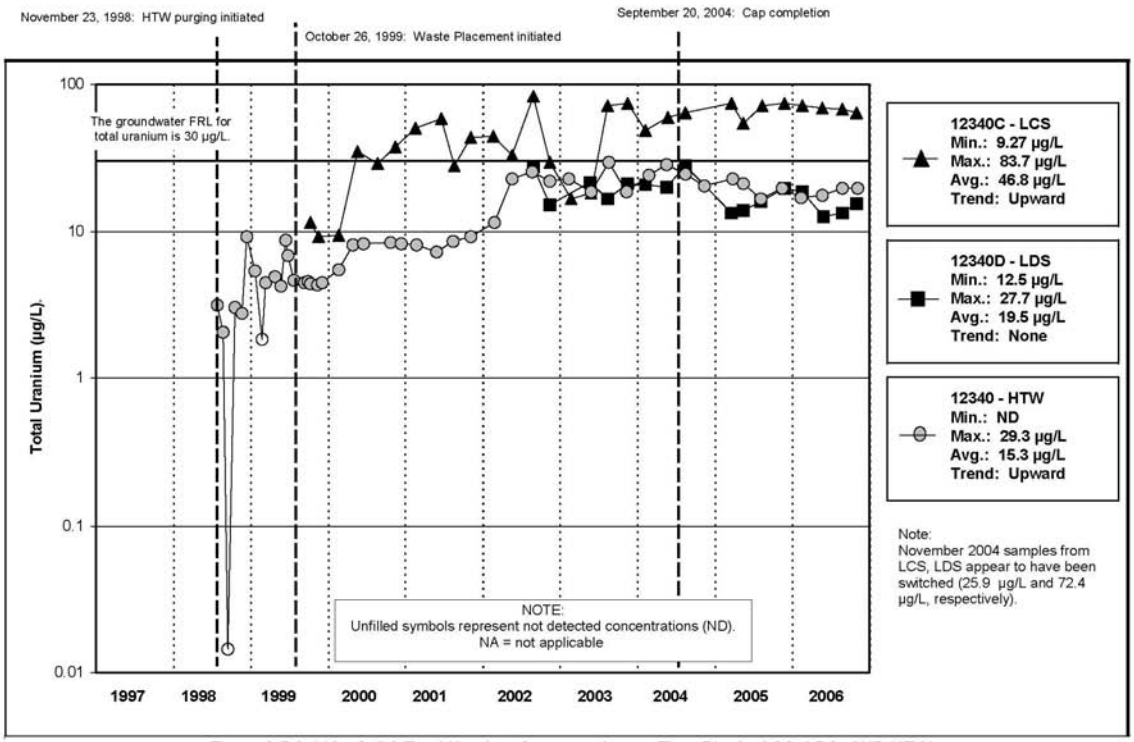


Figure A.5.3-11A. Cell 3 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

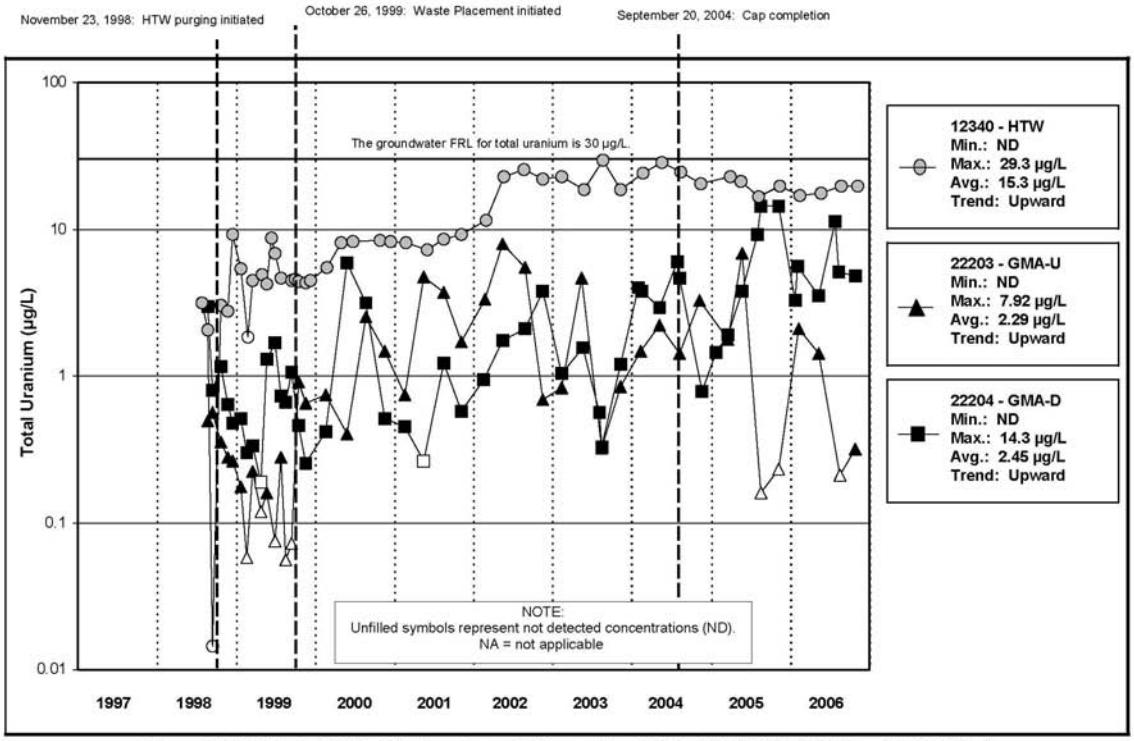


Figure A.5.3-11B. Cell 3 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

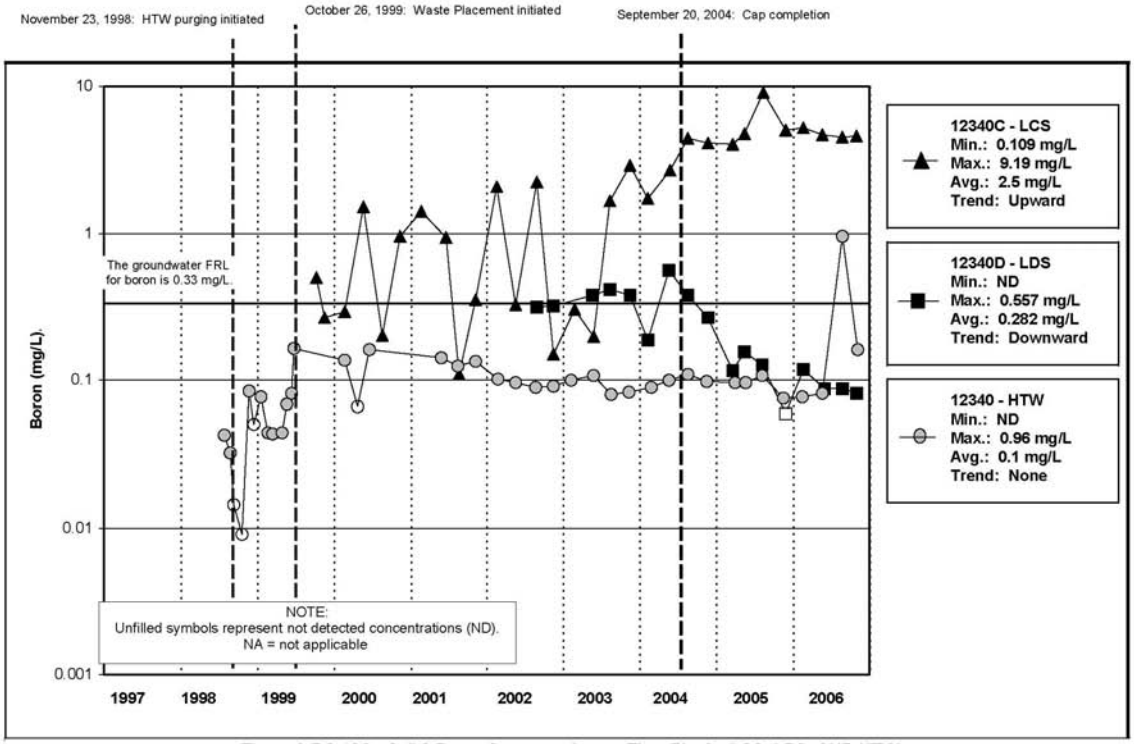


Figure A.5.3-12A. Cell 3 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

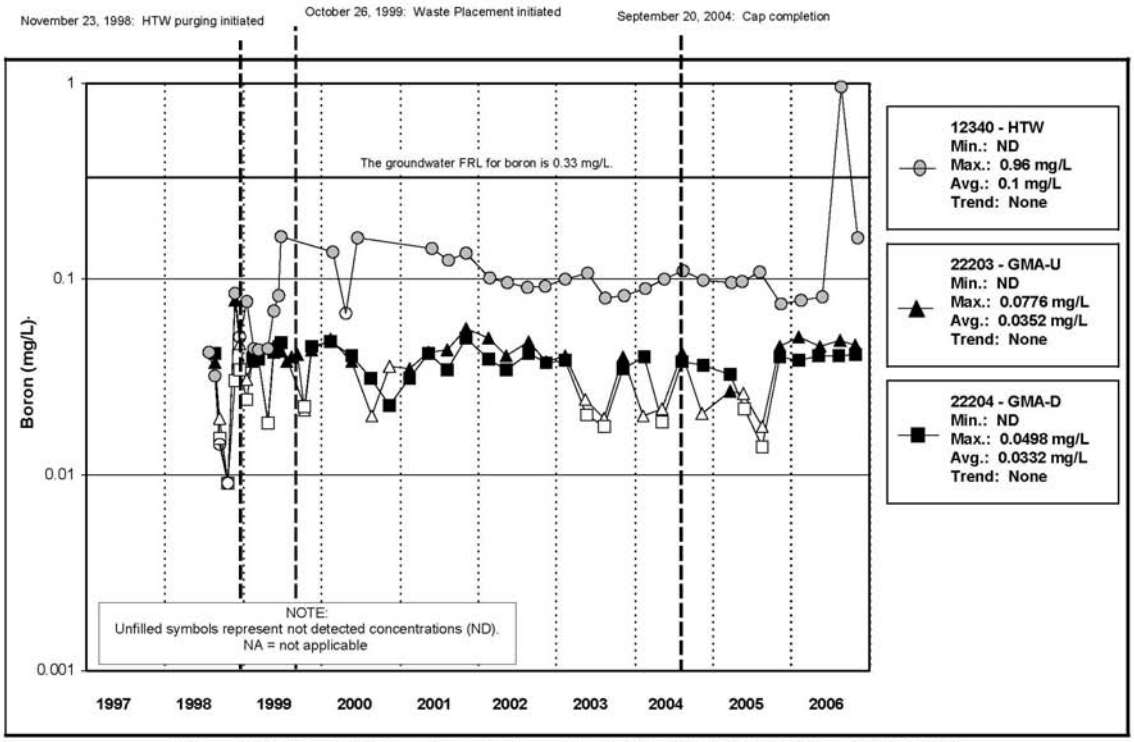


Figure A.5.3-12B. Cell 3 Boron Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

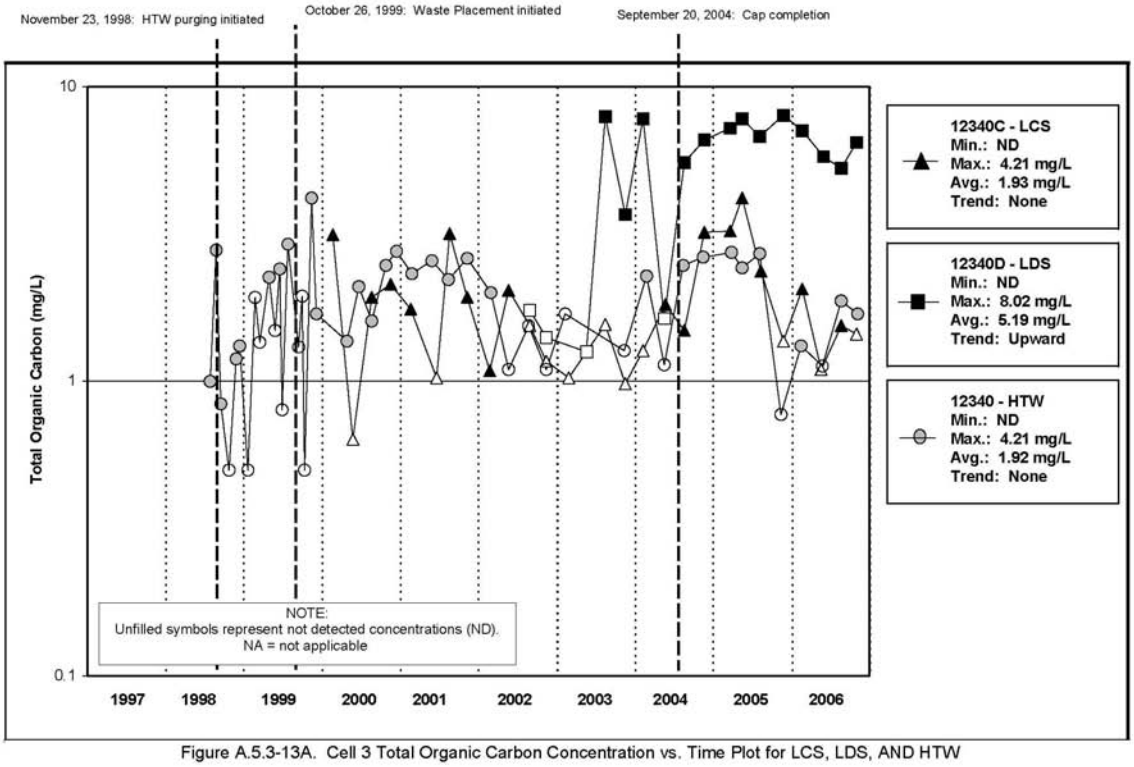


Figure A.5.3-13A. Cell 3 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

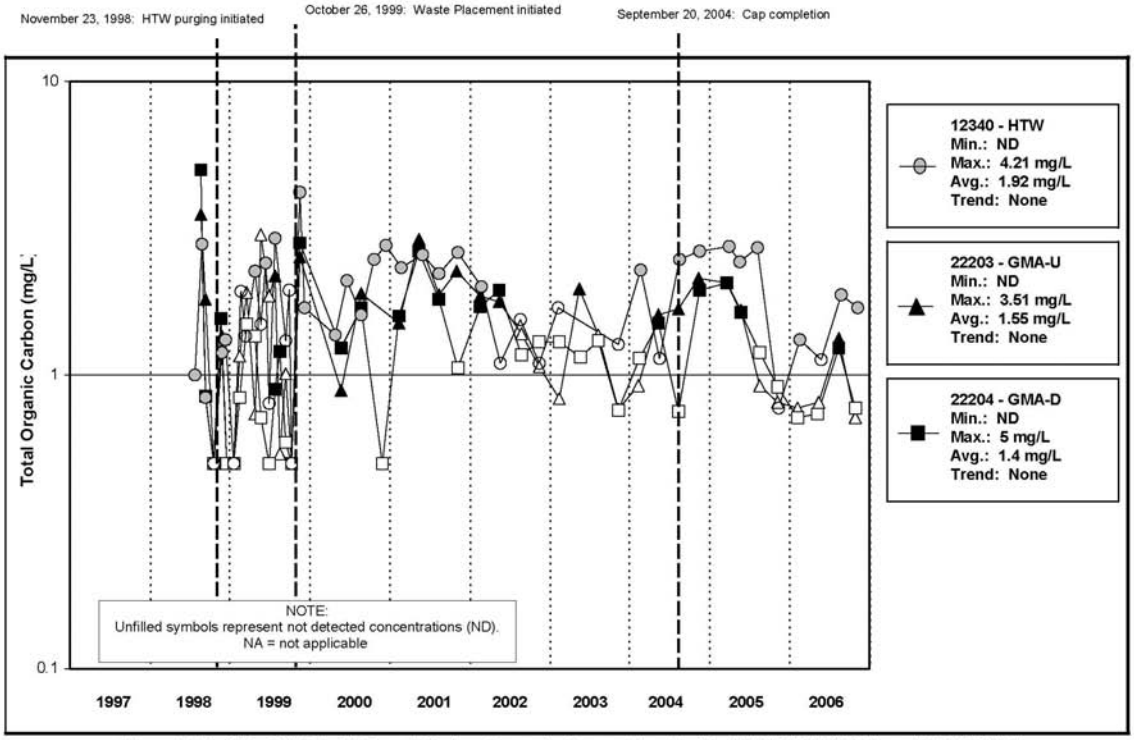


Figure A.5.3-13B. Cell 3 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

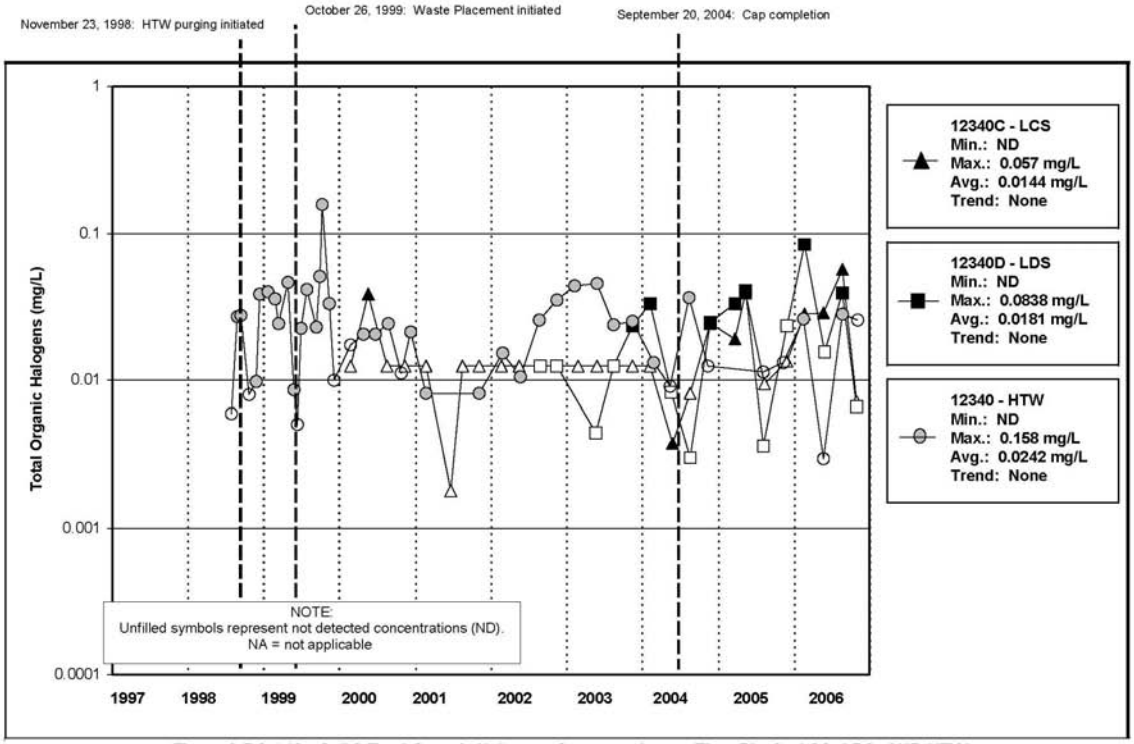


Figure A.5.3-14A. Cell 3 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

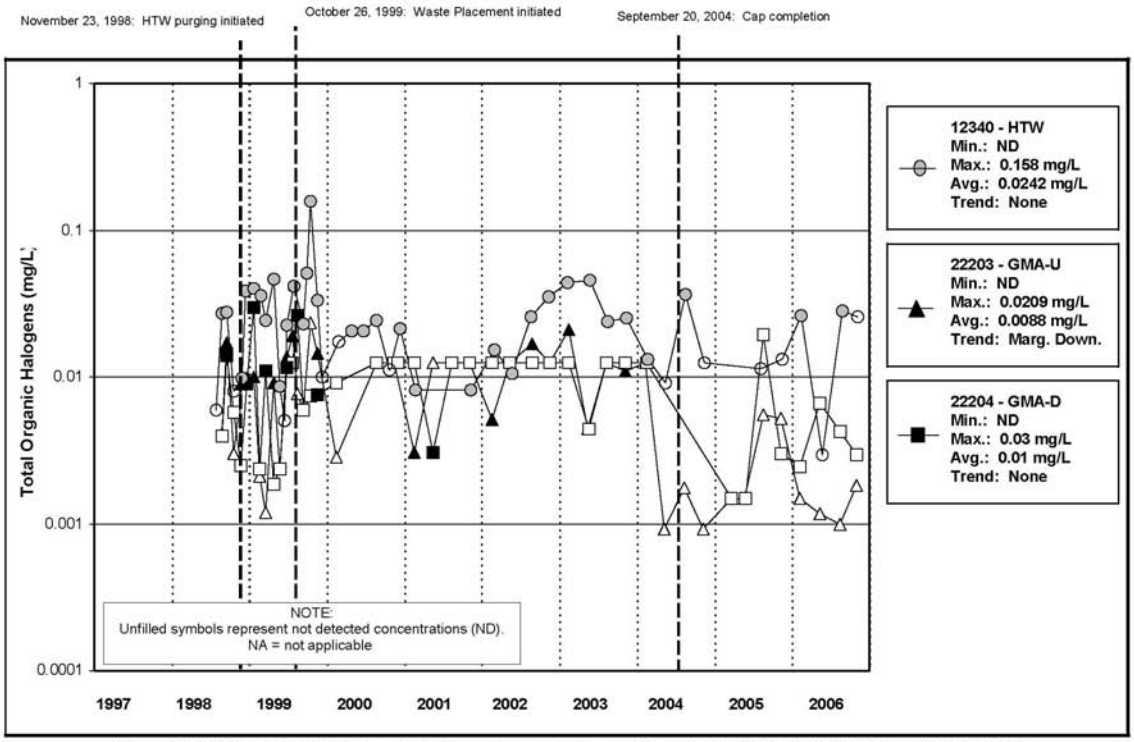


Figure A.5.3-14B. Cell 3 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

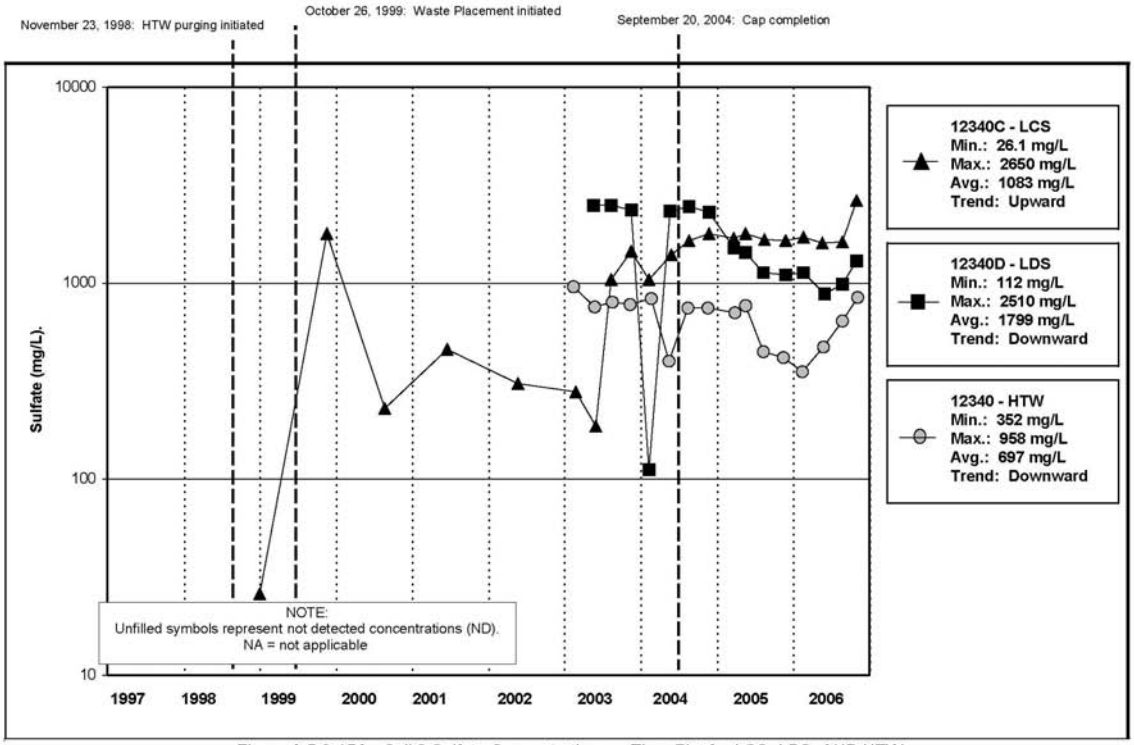


Figure A.5.3-15A. Cell 3 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

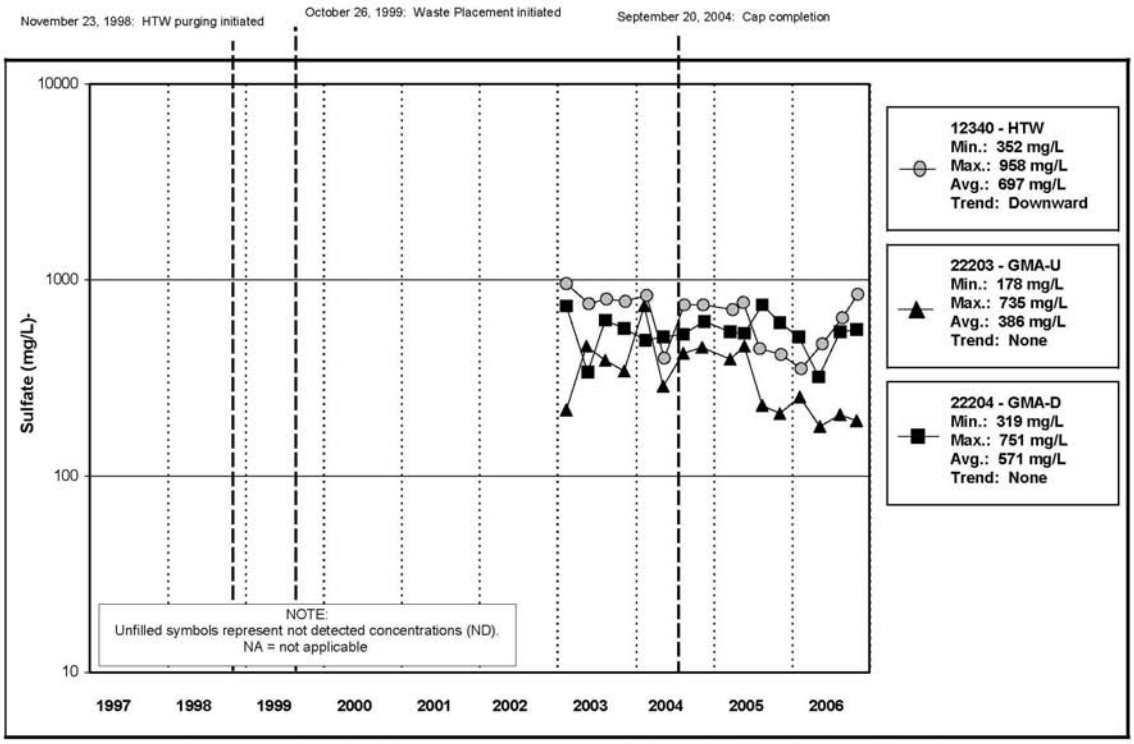


Figure A.5.3-15B. Cell 3 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

Subattachment A.5.4

Cell 4

The following information is provided in this subattachment:

- LCS weekly and monthly accumulation volumes (refer to Figures A.5.4−1 and A.5.4−2).
- LDS weekly and monthly accumulation volumes (refer to Figures A.5.4−3 and A.5.4−4).
- LDS weekly and monthly accumulation rates and precipitation (refer to Figures A.5.4−5 and A.5.4−6).
- LDS monthly average accumulation rates and waste placement volumes (refer to Figure A.5.4−7).
- Monthly liner efficiencies (refer to Table A.5.4−1).
- HTW Water Yield (refer to Figure A.5.4−8).
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.4−9 and A.5.4−10).
- Summary statistics for refined baseline constituents (refer to Section A.5.4.1 and Table A.5.4−2).
- Concentration plots for refined baseline constituents (refer to Section A.5.4.1 and Figures A.5.4−11A through A.5.4−15B).
- Annual LCS monitoring results (refer to Section A.5.4.2 and Table A.5.4−3).
- Annual LDS monitoring results (refer to Section A.5.4.3)

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2006, all samples were collected for Cell 4 monitoring horizons. Note: The 2004 Site Environmental Report, submitted in June 2005, recommended sampling continue in Cells 4 through 6 using a refined baseline constituent list based on initial baseline results. Refined baseline monitoring in Cells 4 through 6 was initiated in August 2005.

A.5.4.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (Table A.5.4−2) and concentration plots (Figures A.5−4−11A through A.5.4−15B) are provided for the five refined baseline constituents of Cell 4. For Cell 4, these five constituents are: total uranium, boron, total organic carbon, total organic halogens, and sulfate. Note that with the addition of the 2006 data, total organic halogens concentrations are detected less than 25 percent of the time in the Great Miami Aquifer well 22205.

A.5.4.2 LCS Monitoring Results

Ohio Solid Waste regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and polychlorinated biphenyl (PCB) parameters listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the

facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2006, annual sampling of the Cell 4 LCS took place in May. Table A.5.4−3 summarizes the annual LCS sampling results for Cell 4, along with the data collected in previous years.

Of the non-refined baseline site specific constituents that have been sampled at least eight times in the Cell 4 LCS, 11 have been detected at least 25 percent of the time. Nine of the 11 constituents are common ion constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium). Sampling for common ion constituents is temporary. Eight rounds of sampling are being conducted to support the common ion study. It is anticipated that eight rounds of sampling will be completed for all cells in August 2007. A decision concerning what common ion constituents (if any) will be added to the site specific leak detection monitoring list for Cell 4 will be determined based upon results of the common ion study.

The remaining two constituents are total dissolved solids (TDS) and technetium-99. TDS will be assessed using the approach presented in Figures A.5−4A and A.5−4B, once final approval of the approach has been obtained from the EPA and OEPA. The assessment will be used to determine if TDS will be added to the site specific leak detection parameter list. Results of the assessment will be presented to the EPA/OEPA as soon as they are available and they will also be reported in next year's SER.

Technetium-99 is a site specific leak detection parameter; however, it is not on the refined baseline list of Cell 4. If a site specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.4−3, technetium-99 has been detected in the Cell 4 LCS, but these detections occurred prior to the establishment of the refined baseline for Cell 4. Therefore, confirmatory sampling for technetium-99 in the Cell 4 LCS is not required.

A.5.4.3 LDS Monitoring Results

Each year the LDS of Cell 4 is sampled for site-specific parameters listed in Table 2−1 of Appendix B of the OSDF GWLMP. As with the LCS, the objective of the annual LDS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. In 2006, annual sampling of the Cell-4 LDS took place in May.

Of the non-refined baseline constituents that have been sampled at least eight times, eight have been detected at least 25 percent of the time. All eight of the constituents are common ion constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, potassium, and sodium).

Table A.5.4−1. Cell 4 – 2006 Monthly Liner Efficiencies

Month	Cell 4 Apparent Liner Efficiency (%)
January	83.61
February	91.90
March	93.10
April	93.02
May	93.64
June	93.95
July	NA[a]
August	NA[a]
September	96.21
October	97.41
November	96.53
December	92.82

[a]OSDF contingency plan executed due to inaccessibility of valve houses. Valve house road was closed to support site remediation activities. No data available.

Table A.5.4−2. Summary Statistics for Cell 4

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]
Total Uranium (µg/L)	LCS	12341C	15	15	100%	90.9	Normal	Marg. Up.	Detected	
	LDS	12341D	15	15	100%	15.1	Lognormal	None	Not Detected	5.74 (Q4-02)
	HTW	12341	20	20	100%	6.13	Lognormal	Downward	Not Detected	
	GMA-U	22206	17	20	85%	1.27	Lognormal	None	Detected	0 U (Q4-03)
	GMA-D	22205	21	21	100%	3.51	Lognormal	None	Not Detected	
Boron (mg/L)	LCS	12341C	15	15	100%	0.81	Normal	Upward	Detected	
	LDS	12341D	16	16	100%	0.857	Lognormal	Downward	Detected	
	HTW	12341	16	18	89%	0.153	Normal	Downward	Detected	1.245 (Q1-02) 0.9085 (Q2-02)
	GMA-U	22206	19	21	90%	0.0398	Normal	Downward	Not Detected	
	GMA-D	22205	17	21	81%	0.0383	Undefined	None	Detected	
Total Organic Carbon (mg/L)	LCS	12341C	9	15	60%	2.9	Normal	None	Not Detected	
	LDS	12341D	13	16	81%	5.05	Normal	None	Detected	
	HTW	12341	14	19	74%	2.28	Lognormal	Marg. Down.	Detected	
	GMA-U	22206	10	20	50%	1.26	Lognormal	Marg. Down.	Not Detected	9.84 (Q2-03)
	GMA-D	22205	11	21	52%	1.40	Lognormal	None	Detected	
Total Organic Halogens (mg/L)	LCS	12341C	7	14	50%	0.017	Lognormal	Upward	Not Detected	0.00184 U (Q3-04)
	LDS	12341D	9	16	56%	0.0198	Normal	None	Marg. Detect	
	HTW	12341	14	20	70%	0.0113	Lognormal	None	Not Detected	
	GMA-U	22206	6	21	29%	0.0091	Lognormal	Marg. Down.	Not Detected	
	GMA-D	22205	3	21	14%	0.0086	Undefined	Marg. Down.	Detected	
Sulfate (mg/L)	LCS	12341C	15	15	100%	1870	Undefined	Upward	Detected	
	LDS	12341D	16	16	100%	1900	Lognormal	Downward	Detected	
	HTW	12341	15	15	100%	197	Normal	Downward	Detected	313 (Q3-05)
	GMA-U	22206	16	16	100%	317	Lognormal	Marg. Down.	Not Detected	
	GMA-D	22205	16	16	100%	352	Lognormal	None	Not Detected	

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptiions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down." is a marginally downward trend and "Marg. Up." is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

U = Not Detected at that concentration

Table A.5.4−3. Cell 4 Annual LCS Sample Summary Information

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (#OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
Alkalinity as CaCO3 (mg/L)	10	10	100.0%	48	583	337	-	422 mg/L (3)	430 mg/L (3)	-	10 mg/L
Ammonia (mg/L)	5	1	20.0%	0.0328	-	-	-	4.2 mg/L (0)	4.34 mg/L (0)	220 mg/L (0)	0.1 mg/L
Barium (mg/L)	5	5	100.0%	0.0266	0.0580	0.0390	2 mg/L (0)	0.77 mg/L (0)	0.45 mg/L (0)	0.589 mg/L (0)	0.029 mg/L
Calcium (mg/L)	10	10	100.0%	52.9	1110	500	-	159 mg/L (9)	172 mg/L (9)	1800 mg/L (0)	5 mg/L
Chloride (mg/L)	10	9	90.0%	26	103	75	-	7.3 mg/L (9)	45 mg/L (7)	6300 mg/L (0)	5 mg/L
Chromium (mg/L)	5	1	20.0%	0.0137	-	-	0.022 mg/L (0)	0.021 mg/L (0)	0.0046 mg/L (1)	0.818 mg/L (0)	0.005 mg/L
Cobalt (mg/L)	5	4	80.0%	0.00046	0.0019	0.0012	0.17 mg/L (0)	0.0086 mg/L (0)	-	0.0886 mg/L (0)	0.034 mg/L
Copper (mg/L)	5	3	60.0%	0.00076	0.0134	0.0079	1.3 mg/L (0)	0.035 mg/L (0)	0.029 mg/L (0)	0.298 mg/L (0)	0.008 mg/L
Fluoride (mg/L)	7	6	85.7%	0.177	0.430	0.303	4 mg/L (0)	0.89 mg/L (0)	1.3 mg/L (0)	6.8 mg/L (0)	0.2 mg/L
Iron (mg/L)	10	9	90.0%	0.543	4.18	2.35	-	5.72 mg/L (0)	6.35 mg/L (0)	21.3 mg/L (0)	0.1 mg/L
Magnesium (mg/L)	10	10	100.0%	15	732	322	-	38.5 mg/L (9)	50.7 mg/L (9)	690 mg/L (1)	5 mg/L
Manganese (mg/L)	10	10	100.0%	0.00563	2.14	0.28	0.9 mg/L (1)	0.9 mg/L (1)	0.21 mg/L (2)	35 mg/L (0)	0.09 mg/L
Nickel (mg/L)	5	5	100.0%	0.00112	0.0154	0.0088	0.1 mg/L (0)	0.0514 mg/L (0)	0.0072 mg/L (3)	0.981 mg/L (0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	14	6	42.9%	0.351	3.62	1.74	11 mg/L[g] (0)	11 mg/L (0)	0.29 mg/L (6)	2670 mg/L (0)	1.1 mg/L
Potassium (mg/L)	10	10	100.0%	3.81	78.4	25.0	-	1.96 mg/L (9)	17.2 mg/L (7)	12400 mg/L (0)	5 mg/L
Selenium (mg/L)	5	3	60.0%	0.0025	0.0178	0.0077	0.05 mg/L (0)	0.00075 mg/L (3)	-	0.0494 mg/L (0)	0.005 mg/L
Silicon (mg/L)	7	7	100.0%	3.11	4.58	3.89	-	-	-	15 mg/L (0)	0.015 mg/L
Sodium (mg/L)	10	10	100.0%	22	117	53	-	47.1 mg/L (3)	50 mg/L (2)	1300 mg/L (0)	5 mg/L
Technetium-99 (pCi/L)	10	4	40.0%	8.16	37.8	17.9	94 pCi/L (0)	22 pCi/L (1)	30 pCi/L (1)	6130 pCi/L (0)	10 pCi/L
Total Dissolved Solids (mg/L)	9	9	1	351	4240	2130	-	-	-	-	10 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information
[b]Rejected data qualified with an R or Z were not included.
[c]If the number of detected samples is equal to two, then the minumun and maximumn are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.
[d]From Operable Unit 5 Record of Decision, Table 9-4.
[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.
[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.
[g]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

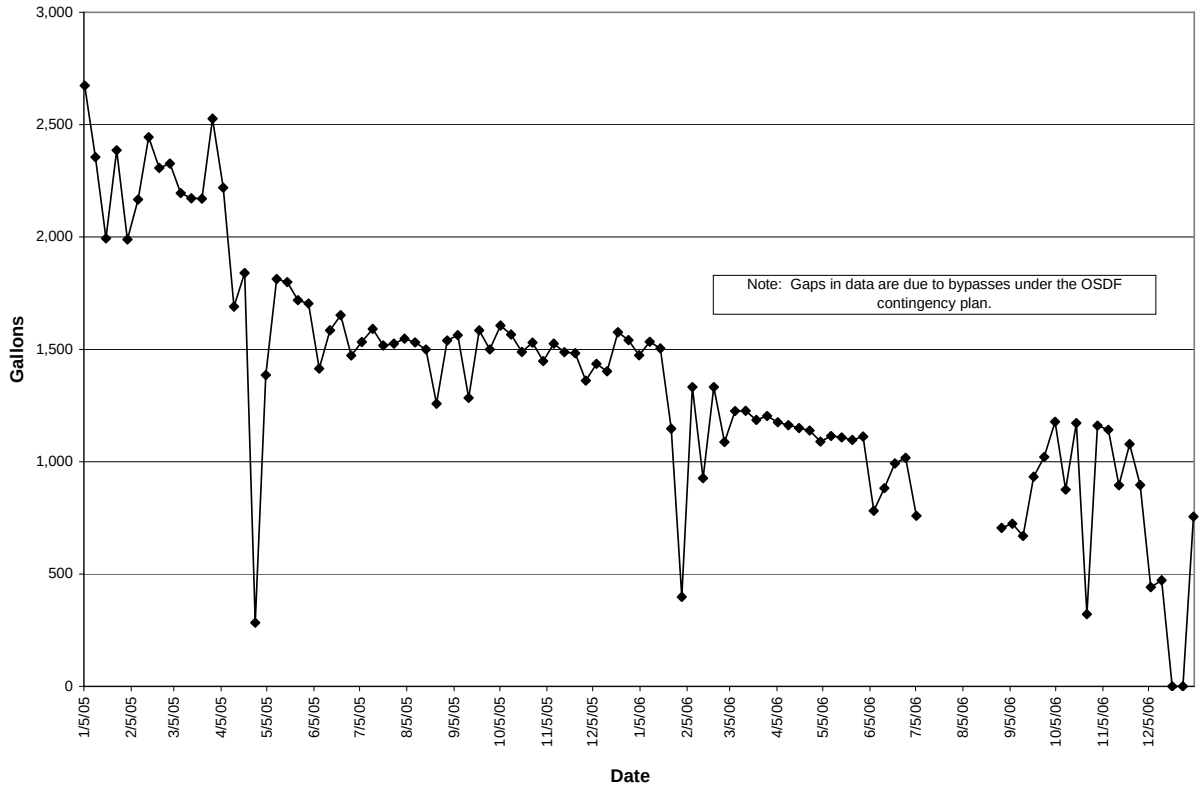


FIGURE A.5.4-1. Weekly Accumulation Volumes for Cell 4 LCS

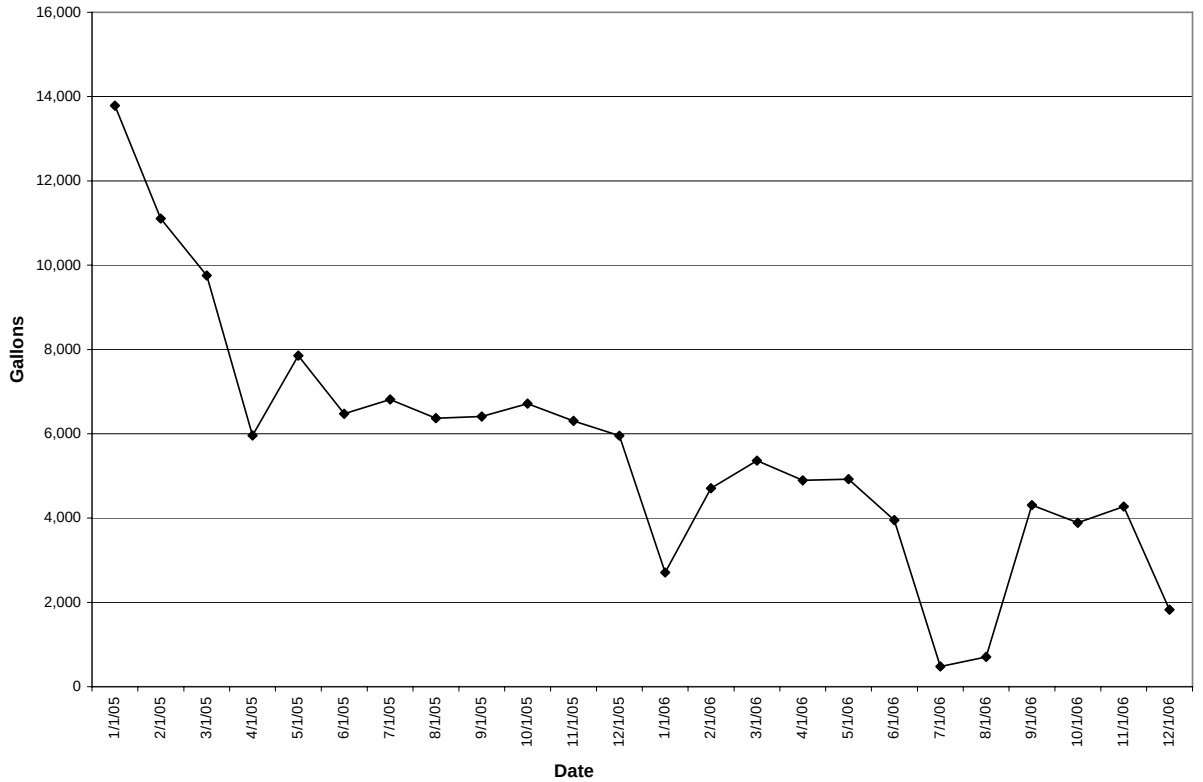


FIGURE A.5.4-2. Monthly Accumulation Volumes for Cell 4 LCS

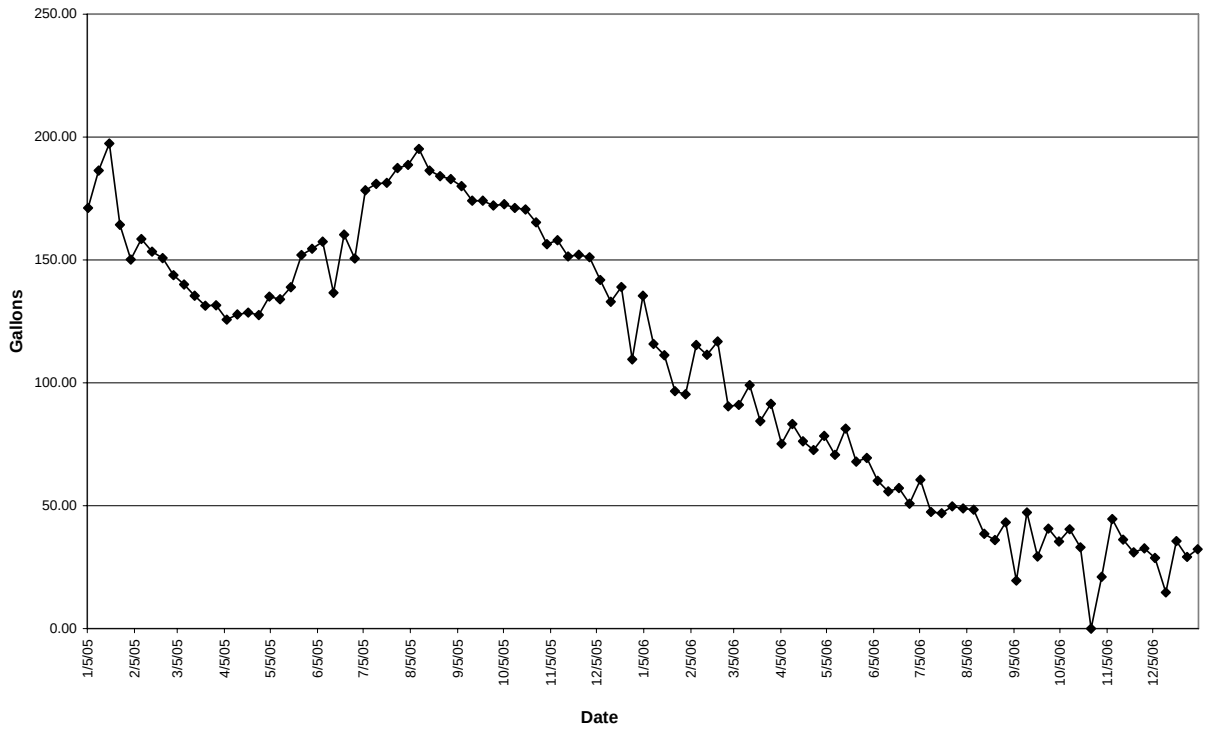


FIGURE A.5.4-3. Weekly Accumulation Volumes for Cell 4 LDS

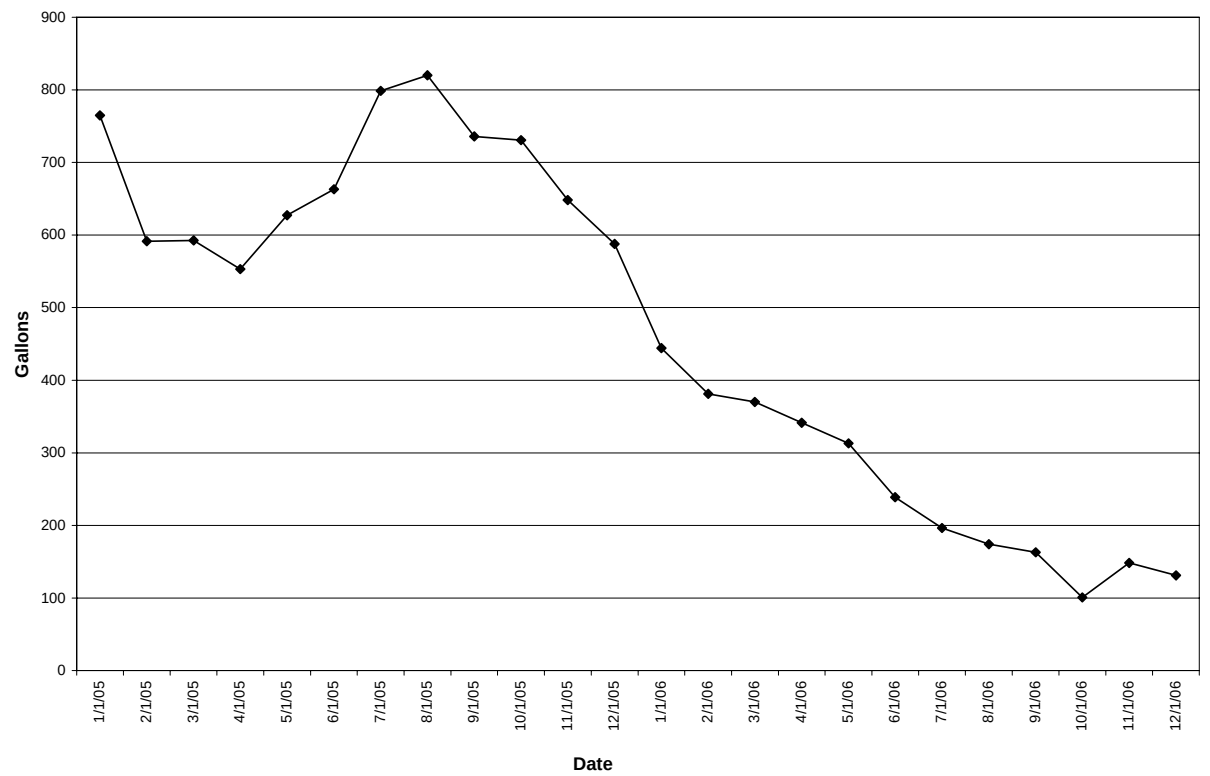


FIGURE A.5.4-4. Monthly Accumulation Volumes for Cell 4 LDS

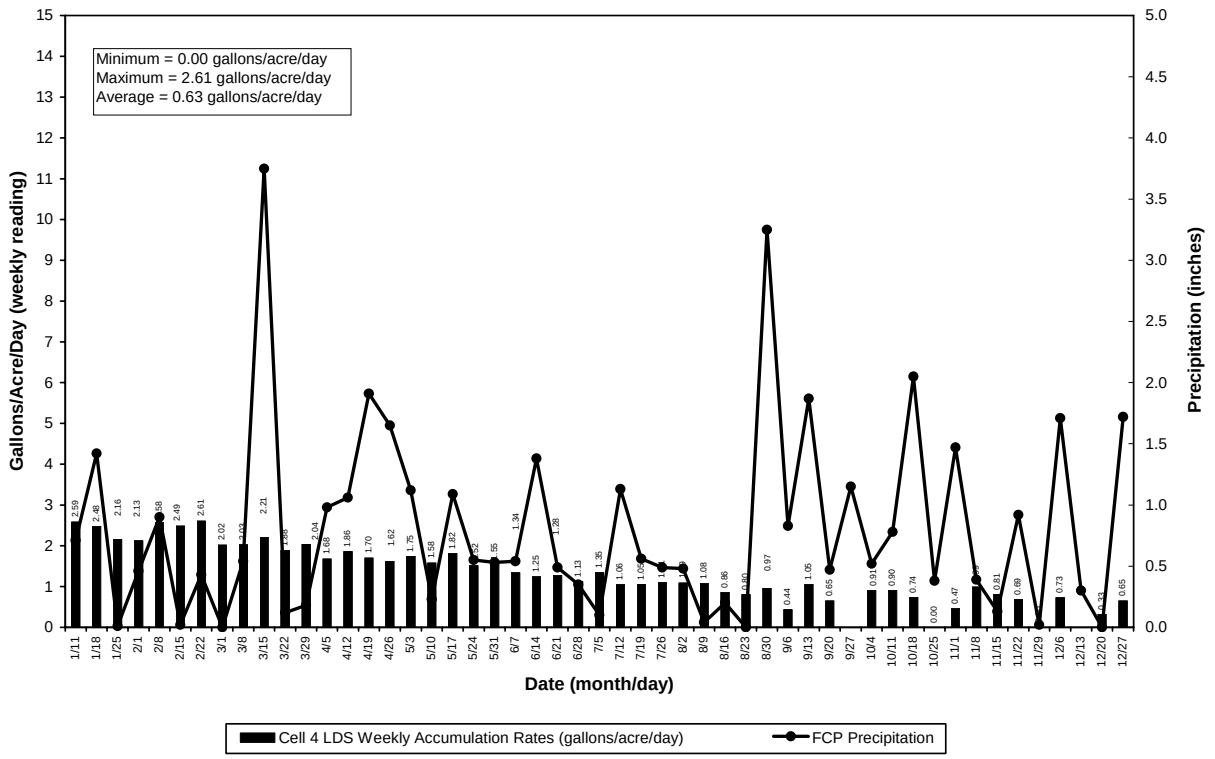


FIGURE A.5.4-5. 2006 OSDF LDS Weekly Accumulation Rates and Precipitation for Cell 4

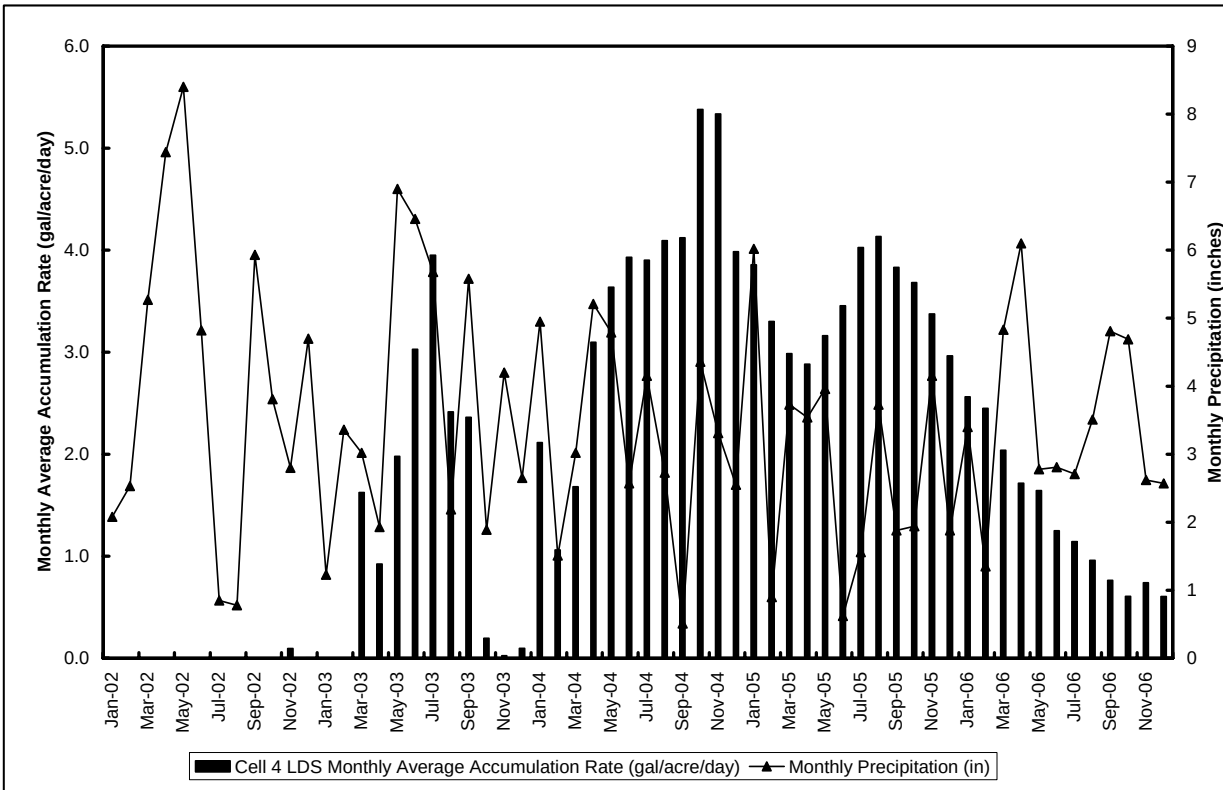


FIGURE A.5.4-6. OSDF Cell 4 LDS Monthly Average Accumulation Rates and Monthly Precipitation

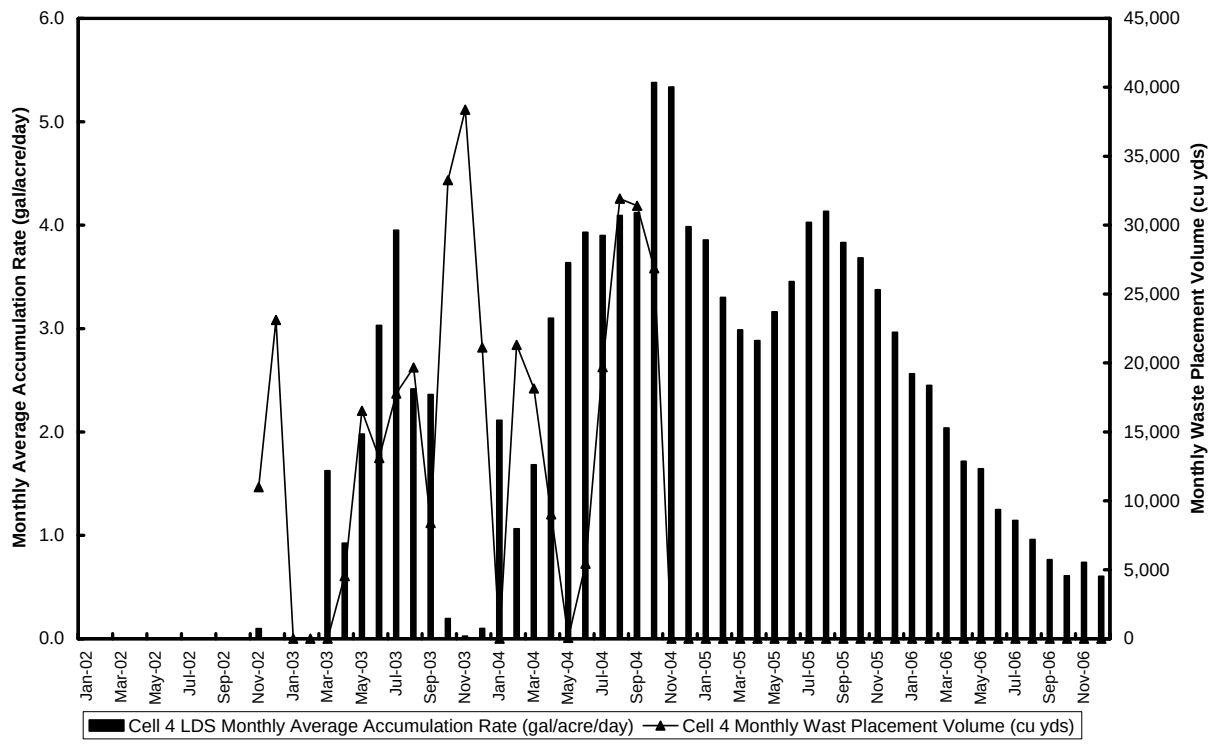
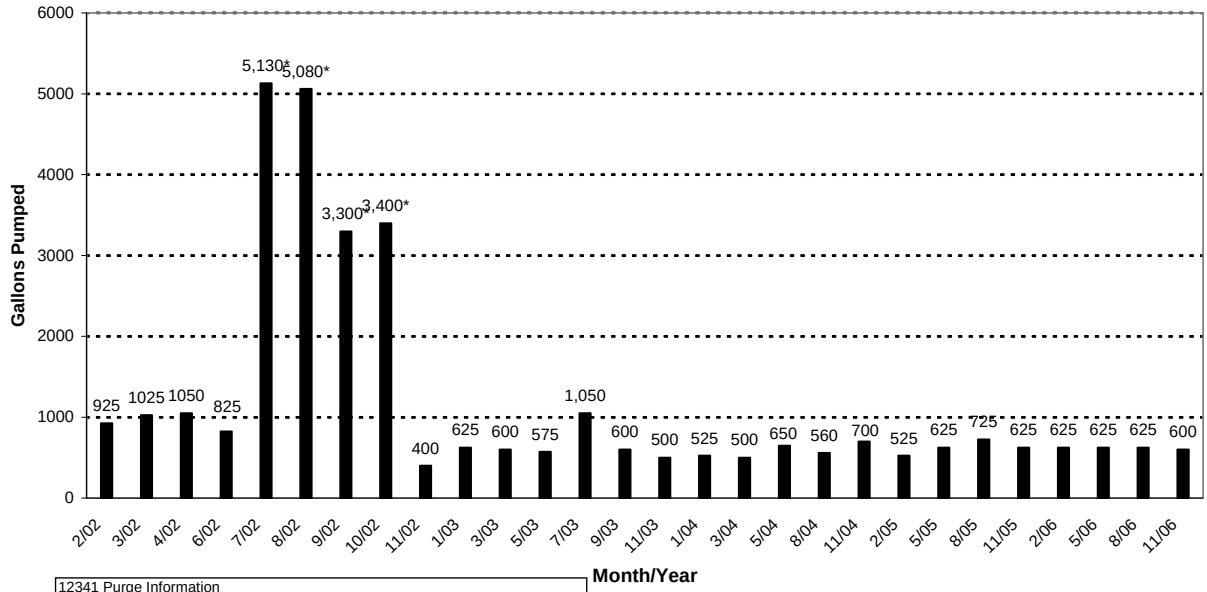


FIGURE A.5.4-7. OSDF Cell 4 LDS Monthly Average Accumulation Rates and Monthly Waste Placement Volumes



12341 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2002:	21115	n=9	2346
2003:	3950	n=6	658
2004:	2935	n=5	587
2005:	2500	n=4	625
2006:	2475	n=4	619
Overall:			1178

*More than one purge of the well was completed during these months to drain perched water and infiltrating surface water so the compacted clay liner could be constructed.

FIGURE A.5.4-8. OSDF Horizontal Till Well 12341 (Cell 4) Water Yield

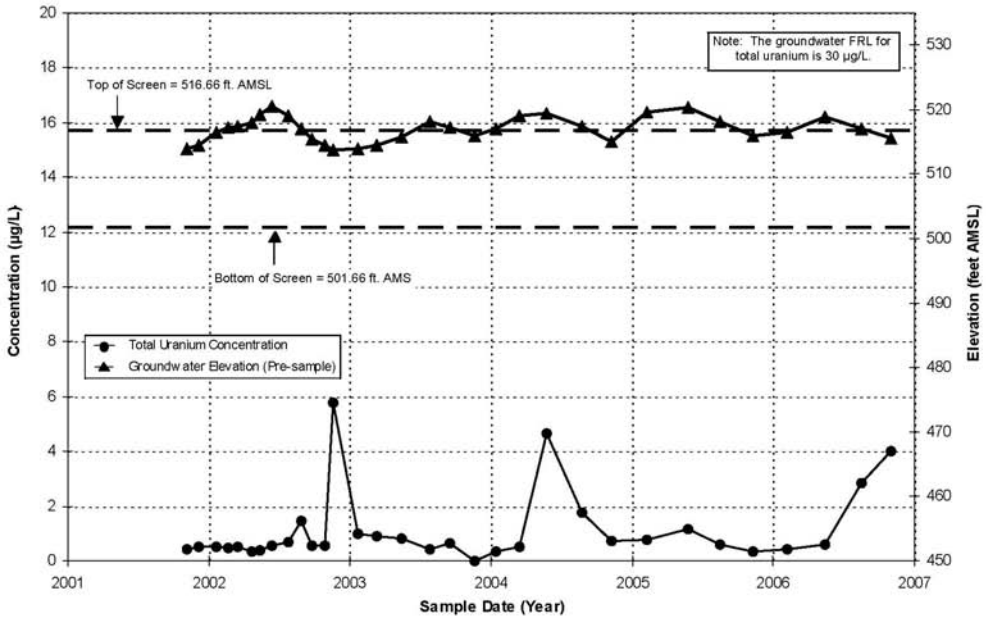


Figure A.5.4-9. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 4 Upgradient Monitoring Well 22206

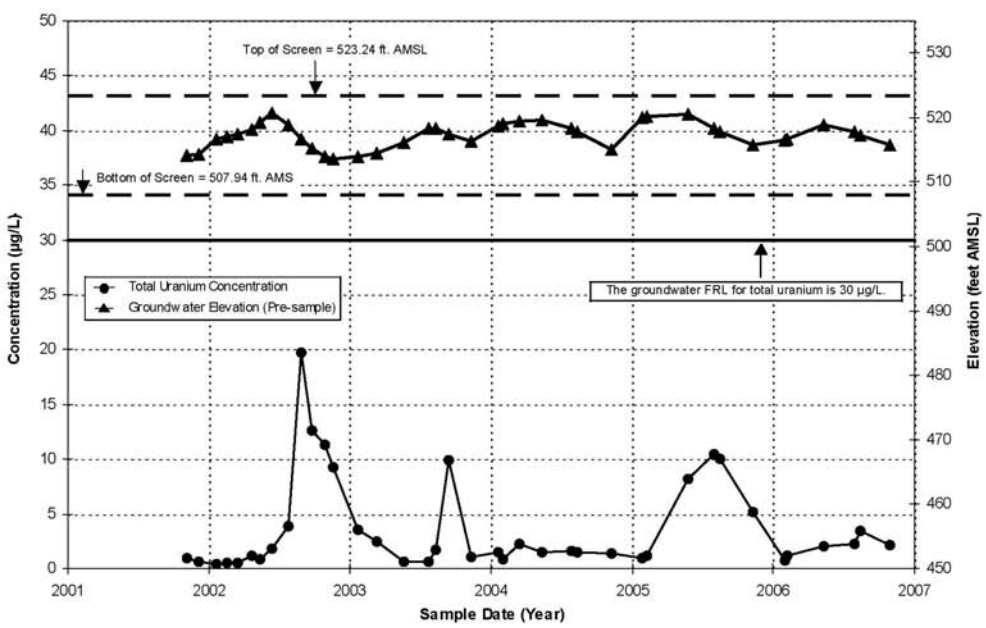


Figure A.5.4-10. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 4 Downgradient Monitoring Well 22205

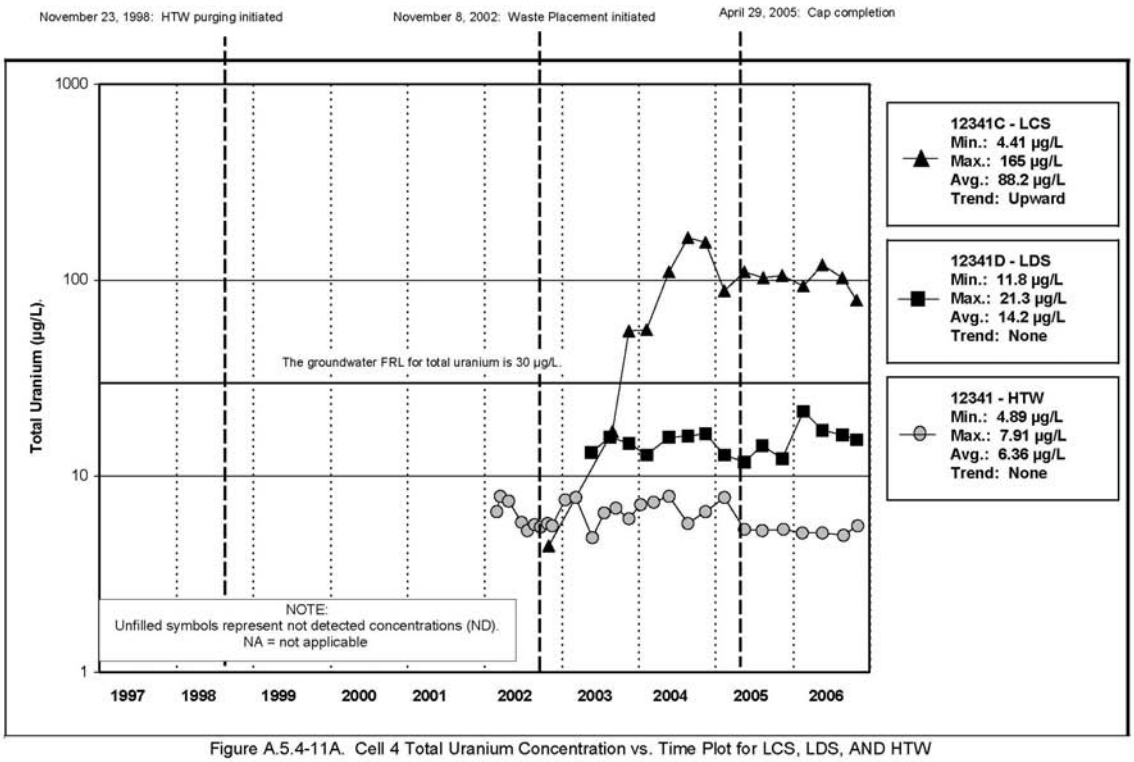


Figure A.5.4-11A. Cell 4 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

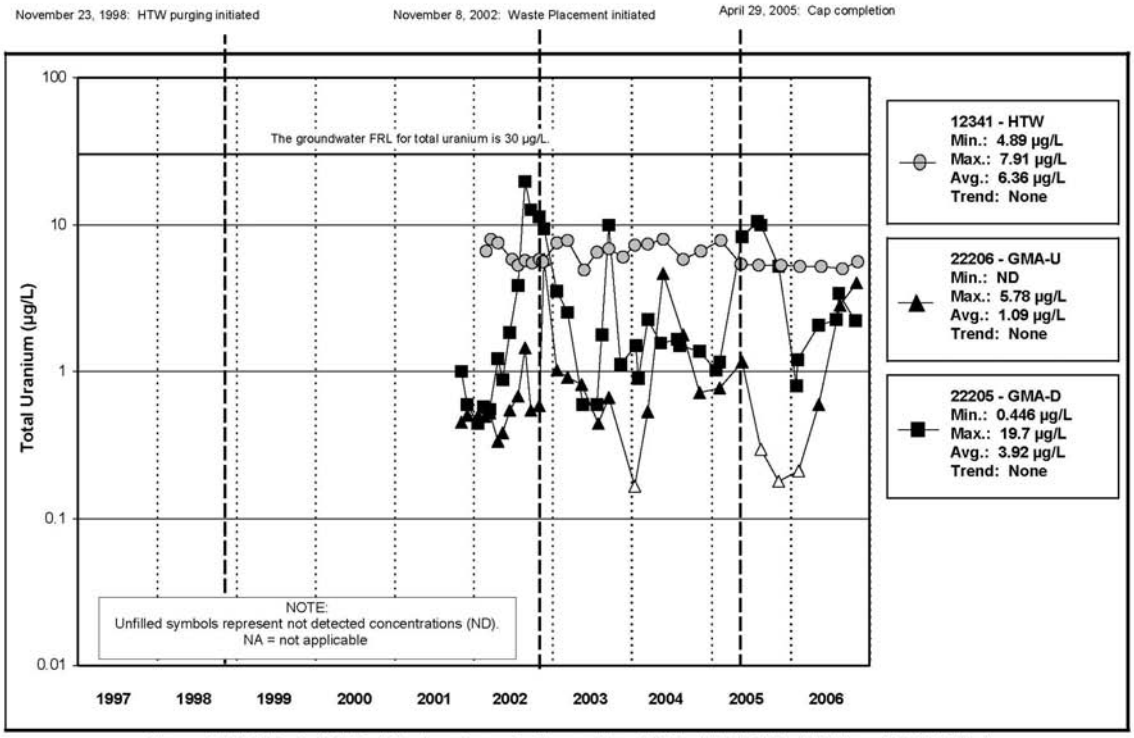


Figure A.5.4-11B. Cell 4 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

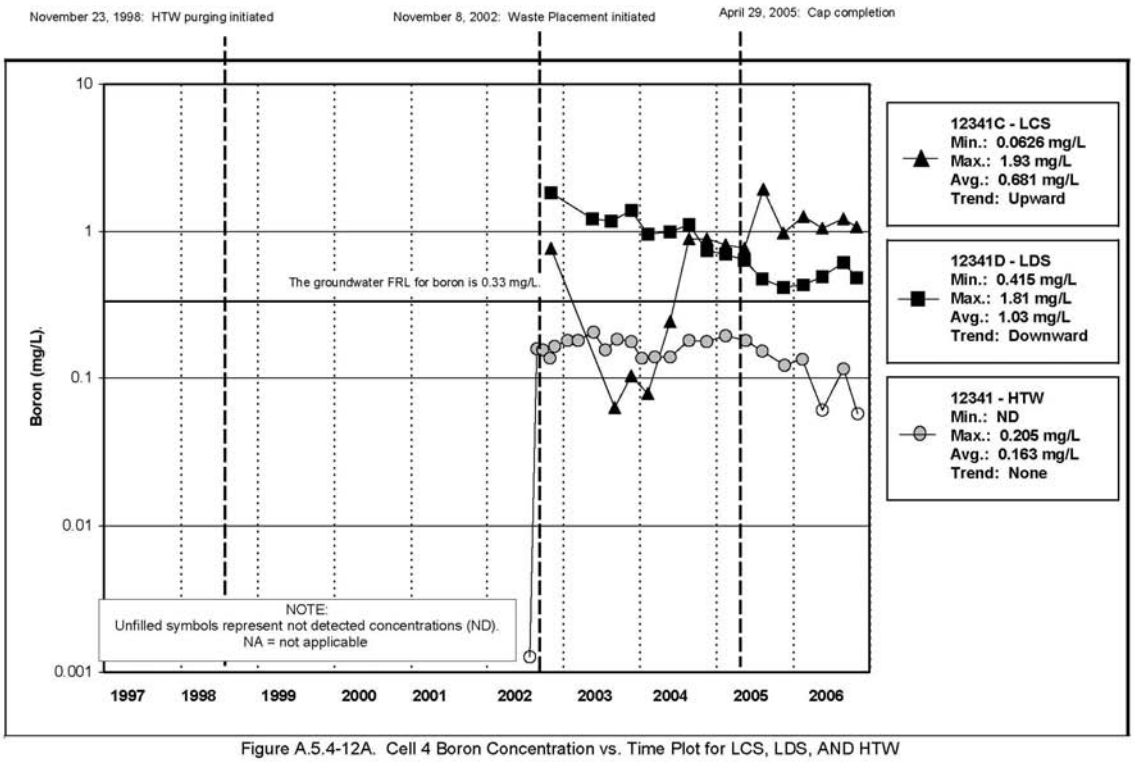


Figure A.5.4-12A. Cell 4 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

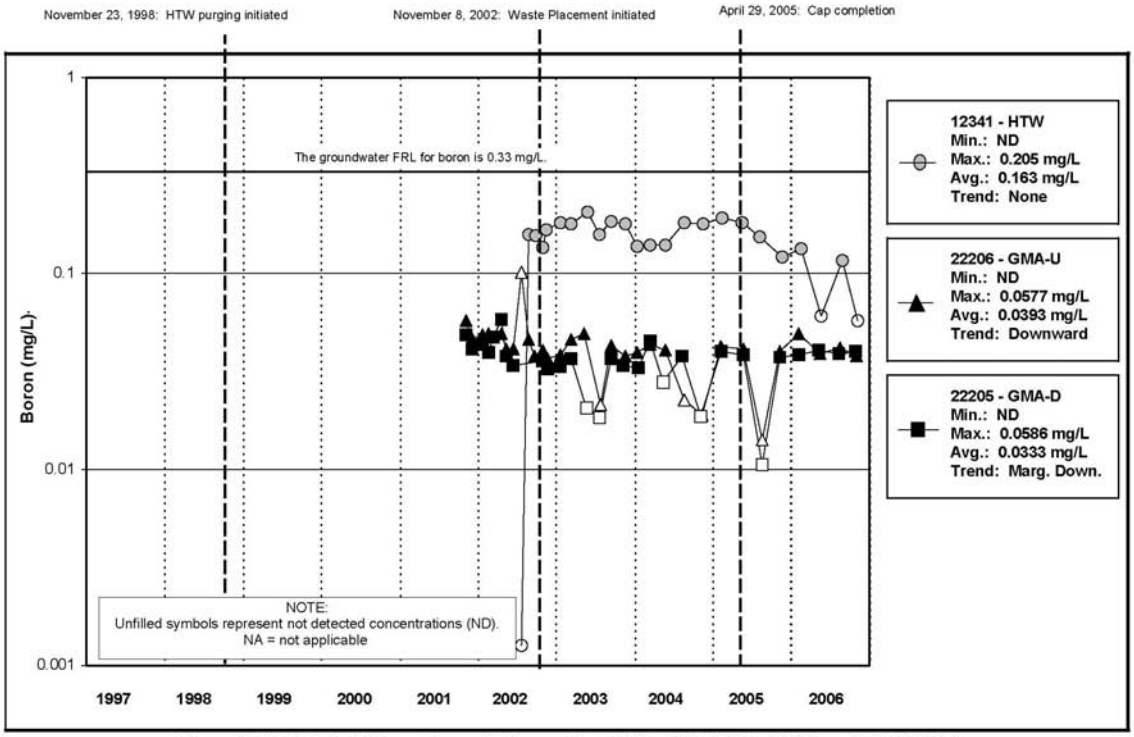


Figure A.5.4-12B. Cell 4 Boron Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

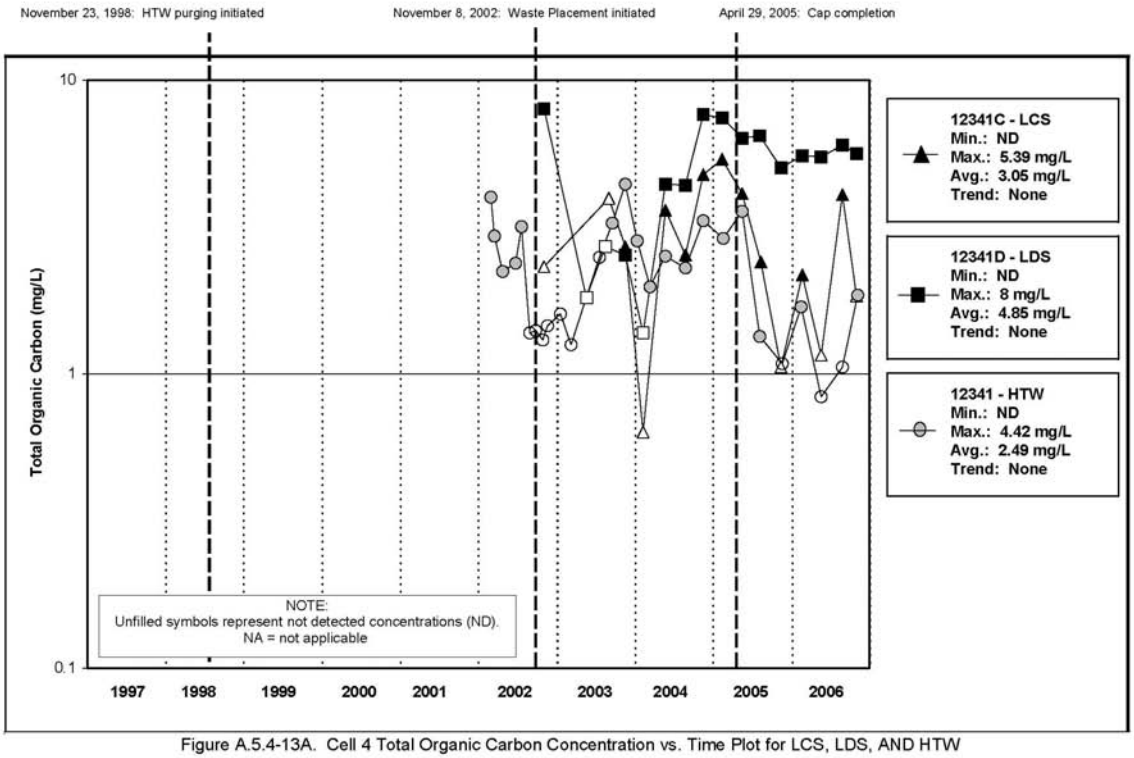


Figure A.5.4-13A. Cell 4 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

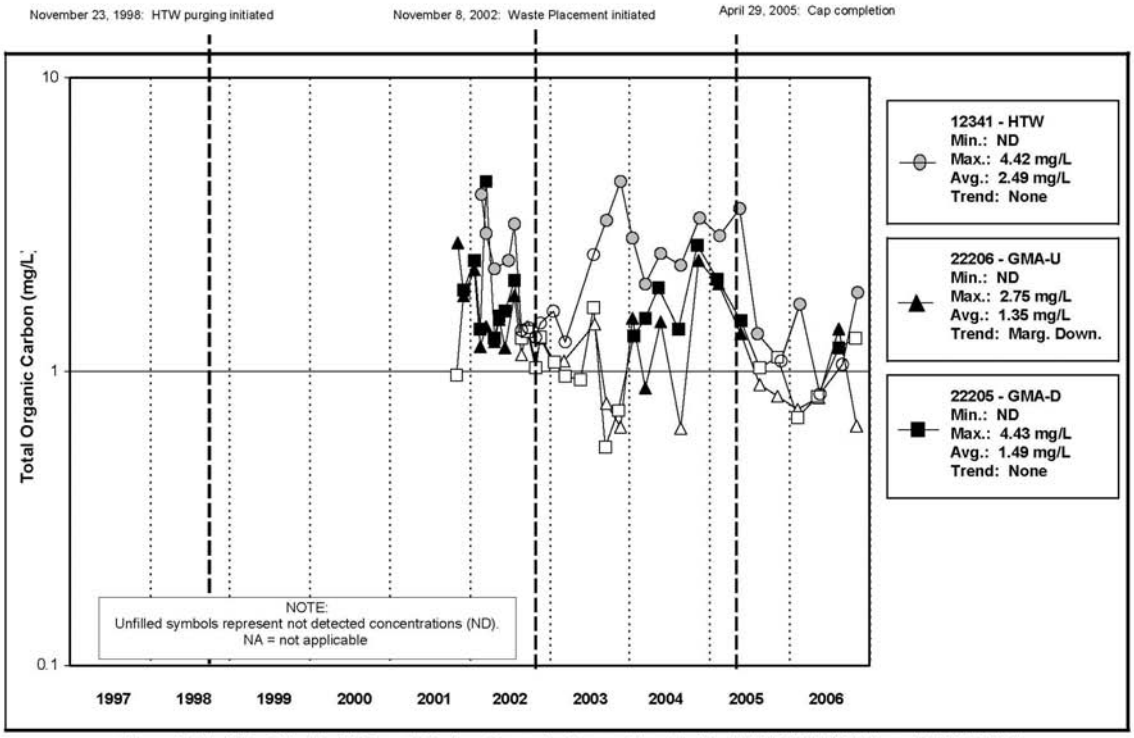


Figure A.5.4-13B. Cell 4 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

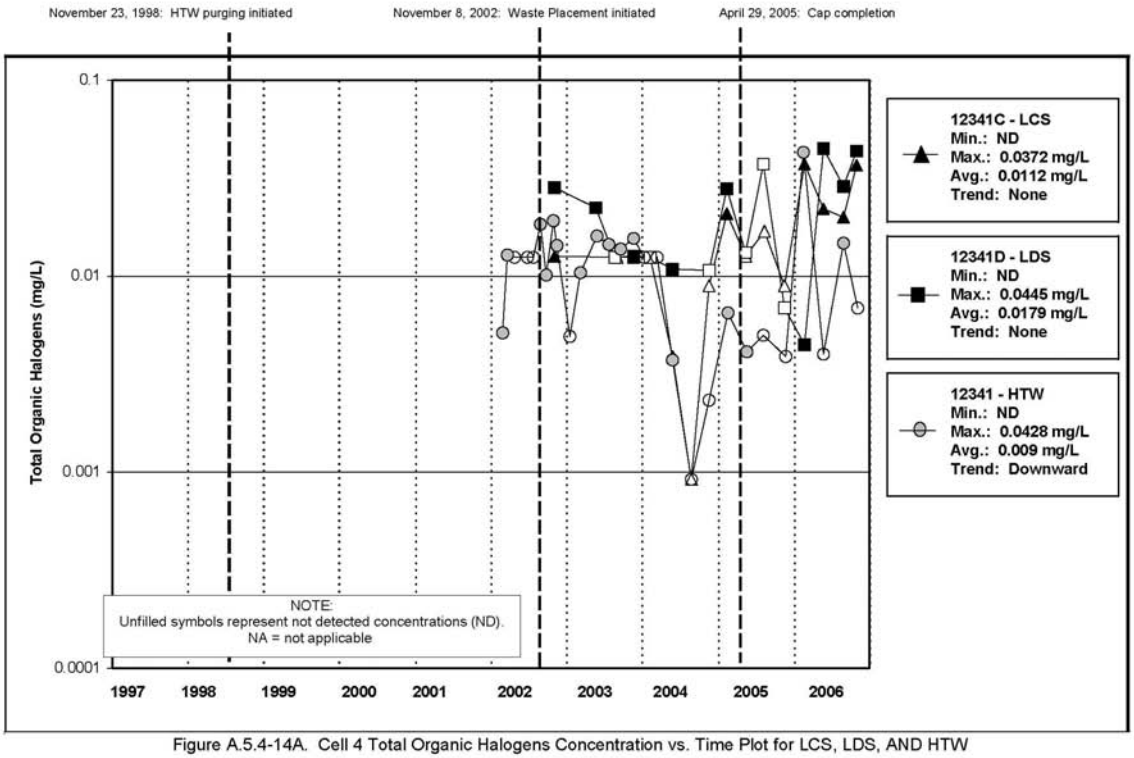


Figure A.5.4-14A. Cell 4 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

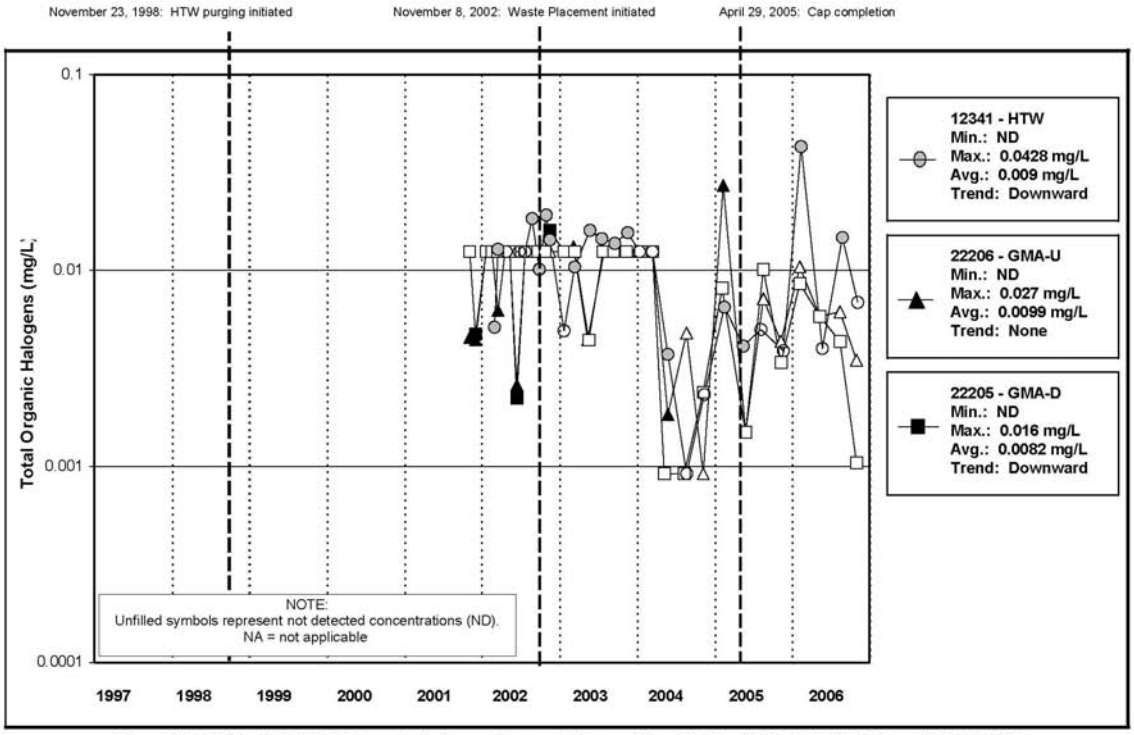


Figure A.5.4-14B. Cell 4 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

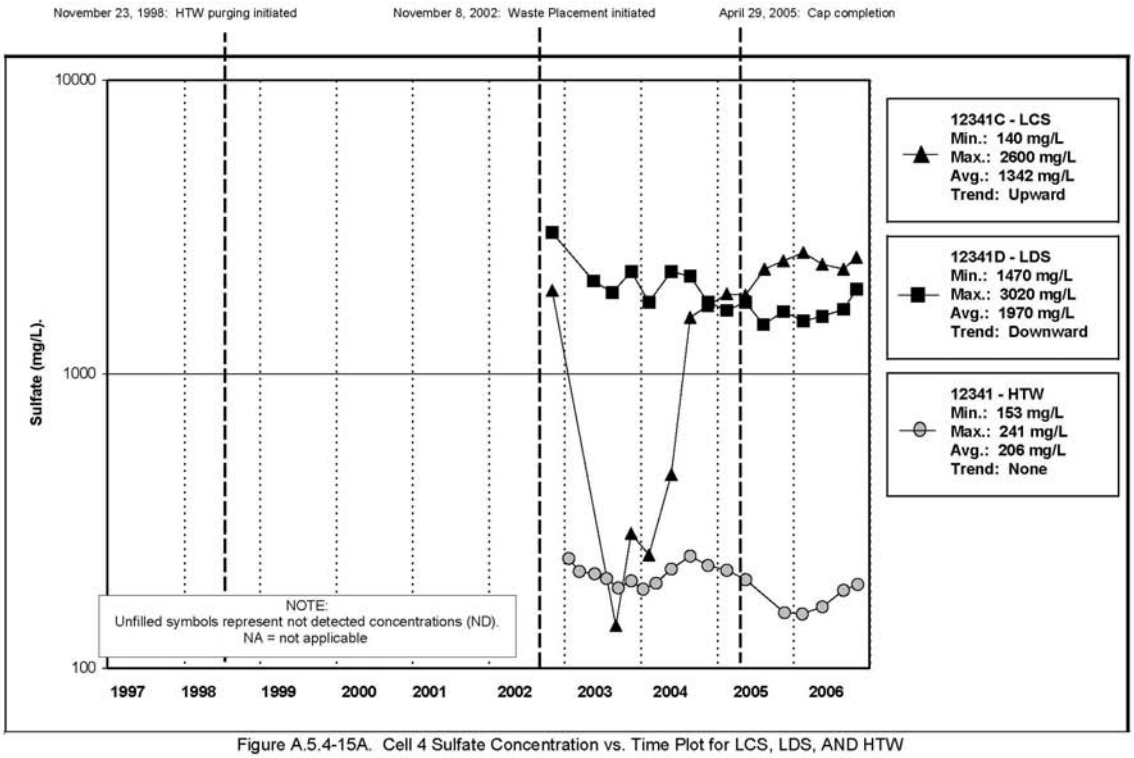


Figure A.5.4-15A. Cell 4 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

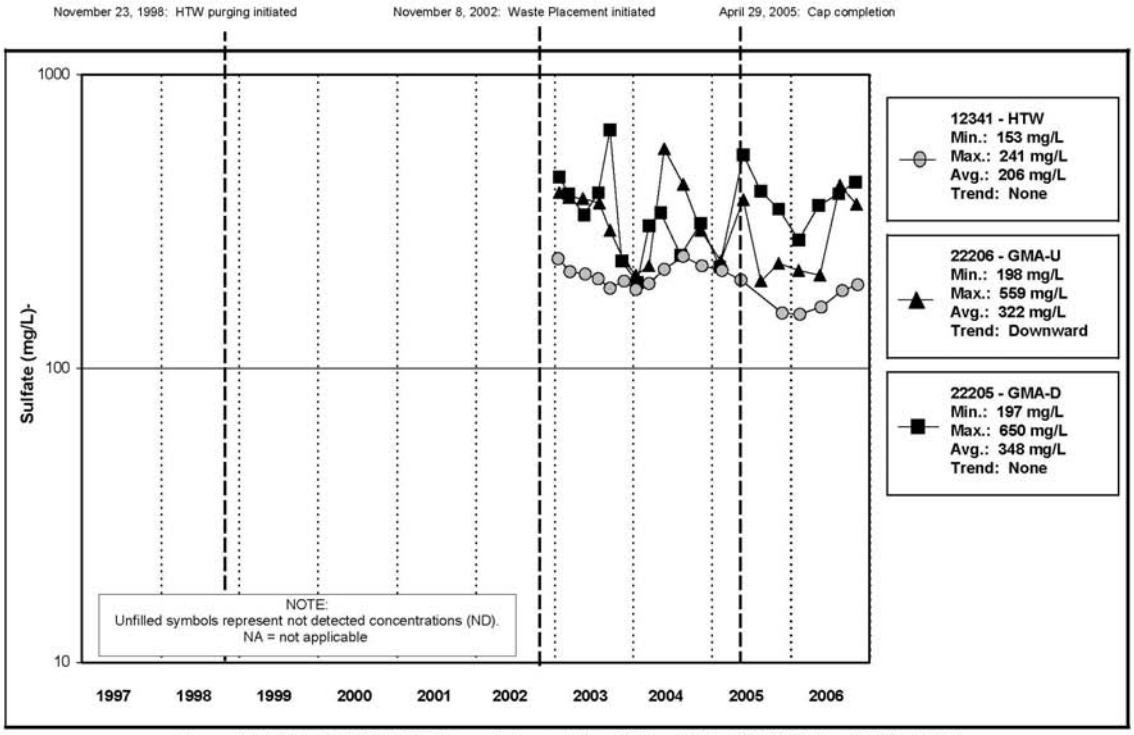


Figure A.5.4-15B. Cell 4 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

End of current text

Subattachment A.5.5

Cell 5

The following information is provided in this subattachment:

- LCS weekly and monthly accumulation volumes (refer to Figures A.5.5−1 and A.5.5−2)
- LDS weekly and monthly accumulation volumes (refer to Figures A.5.5−3 and A.5.5−4)
- LDS weekly and monthly accumulation rates and precipitation (refer to Figures A.5.5−5 and A.5.5−6)
- LDS monthly average accumulation rates and waste placement volumes (refer to Figure A.5.5−7)
- Monthly liner efficiencies (refer to Table A.5.5−1)
- HTW Water Yield (refer to Figure A.5.5−8)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.5−9 and A.5.5−10)
- Summary statistics for refined baseline constituents (refer to Section A.5.5.1 and Table A.5.5−2)
- Concentration plots refined baseline constituents (refer to Section A.5.5.1 and Figures A.5.5−11A through A.5.5−15B)
- Annual LCS monitoring results (refer to Section A.5.5.2 and Table A.5.5−3)
- Annual LDS monitoring results (refer to Section A.5.5.3)

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2006, all samples were collected for Cell 5 monitoring horizons. Note: refined baseline monitoring in Cells 4 through 6 was initiated in August 2005.

A.5.5.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled for at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (refer to Table A.5.5−2) and concentration plots (Figures A.5.5−11A through A.5.5−15B) are provided for the five baseline constituents of Cell-5. For Cell 5, those five constituents are total uranium, boron, total organic carbon, total organic halogens, and sulfate. Note that with the addition of the 2006 data, total organic halogens concentrations are detected less than 25 percent of the time in the LCS and downgradient Great Miami Aquifer well 22208.

A.5.5.2 LCS Monitoring Results

Ohio solid Waste regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and polychlorinated biphenyl (PCB) parameters listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of

the OSDF GWLMP. In 2006, annual sampling of the Cell 5 LCS took place in May. Table A.5.5−3 summarizes the annual LCS sampling results for Cell 5, along with data collected in previous years.

Of the non-refined site specific baseline constituents that have been sampled at least eight times, 11 have been detected at least 25 percent of the time. Nine of the 11 constituents are common ion constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium). Sampling for common ion constituents is temporary. Eight rounds of sampling are being conducted to support the common ion study. It is anticipated that eight rounds of sampling will be completed for all cells in August. A decision concerning what common ion constituents (if any) will be added to the site specific leak detection monitoring list for Cell 5 will be determined based upon results of the common ion study.

The remaining two constituents are total dissolved solids (TDS) and technetium-99. TDS will be assessed using the approach presented in Figures A.5−4A and A.5−4B, once final approval of the approach has been obtained from the EPA and OEPA. The assessment will be used to determine if TDS will be added to the site specific leak detection parameter list. Results of the assessment will be presented to the EPA/OEPA as soon as they are available and they will also be reported in next year's SER.

Technetium-99 is a site specific leak detection parameter; however, it is not on the refined baseline list for Cell 5. If a site specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.5−3, technetium-99 has been detected in the Cell 5 LCS, but these detections were prior to the establishment of the refined baseline for Cell 5. Therefore, confirmatory sampling for technetium-99 in the Cell 5 LCS is not required.

A.5.5.3 LDS Monitoring Results

Each year the LDS of Cell 5 is sampled for site specific baseline parameters listed in Table 2−1 of Appendix B of the OSDF GWLMP. As with the LCS, the objective of the annual LDS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility.

In 2006, of the non-refined baseline constituents that have been sampled at least eight times, eight have been detected at least 25 percent of the time: (alkalinity, calcium, chloride, iron, magnesium, manganese, potassium and sodium). All eight of these constituents are common ion constituents.

Table A.5.5−1. Cell 5 – 2006 Monthly Liner Efficiencies

Month	Cell 5 Apparent Liner Efficiency (%)
January	NA[a]
February	NA[a]
March	NA[a]
April	79.56
May	75.92
June	NA[b]
July	NA[b]
August	NA[b]
September	76.28
October	77.25
November	79.76
December	73.77

[a]LCS flow not yet directed to tank. No data available.
[b]OSDF contingency plan executed due to inaccessibility of valve houses. Valve house road was closed to support site remediation activities. No data available.

Table A.5.5−2. Summary Statistics for Cell 5

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]
Total Uranium (µg/L)	LCS	12342C	17	17	100%	125	Normal	Upward	Detected	
	LDS	12342D	15	15	100%	16.8	Normal	Upward	Detected	
	HTW	12342	20	20	100%	10.9	Lognormal	Downward	Detected	
	GMA-U	22207	14	20	70%	0.378	Normal	Downward	Marg. Detect	2.389 (Q3-02)
	GMA-D	22208	15	20	75%	0.347	Lognormal	None	Not Detected	0.012 U (Q2-05) 2.1 (Q2-04)[h]
Boron (mg/L)	LCS	12342C	15	17	88%	0.588	Normal	Upward	Detected	
	LDS	12342D	15	15	100%	0.539	Undefined	Downward	Detected	
	HTW	12342	19	20	95%	0.121	Lognormal	Downward	Detected	
	GMA-U	22207	18	21	86%	0.0357	Undefined	None	Detected	
	GMA-D	22208	16	21	76%	0.0268	Normal	None	Detected	
Total Organic Carbon (mg/L)	LCS	12342C	8	16	50%	1.84	Normal	Upward	Not Detected	
	LDS	12342D	12	15	80%	6.27	Normal	Upward	Detected	
	HTW	12342	15	19	79%	2.79	Lognormal	None	Marg. Detect	
	GMA-U	22207	11	21	52%	1.37	Lognormal	Downward	Marg. Detect	
	GMA-D	22208	11	20	55%	1.26	Lognormal	Marg. Down.	Detected	8.93 (Q4-01)
Total Organic Halogens (mg/L)	LCS	12342C	3	17	18%	0.0097	Undefined	None	Not Detected	
	LDS	12342D	6	15	40%	0.0307	Lognormal	Upward	Not Detected	
	HTW	12342	11	20	55%	0.0083	Normal	None	Not Detected	
	GMA-U	22207	6	21	29%	0.0094	Undefined	Downward	Detected	
	GMA-D	22208	4	21	19%	0.0054	Undefined	Downward	Detected	
Sulfate (mg/L)	LCS	12342C	17	17	100%	1140	Undefined	Upward	Detected	
	LDS	12342D	15	15	100%	1570	Lognormal	Downward	Detected	
	HTW	12342	16	16	100%	142	Undefined	Downward	Detected	
	GMA-U	22207	15	15	100%	300	Lognormal	None	Detected	770 (Q2-05)[i]
	GMA-D	22208	16	16	100%	442	Undefined	Marg. Up.	Marg. Detect	

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.
Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.
Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the normal destribution better than the lognormal distribution.
Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the lognormal destribution better than the normal distribution.
Undefined: Normal and Lognormal Distribution assumptiions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down." is a marginally downward trend and "Marg. Up." is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly
U = Not Detected at that concentration

[h]This result is an outlier. It is a higher concentration duplicate result, where the other duplicate result would not be an outlier. This outlier has been replace with the lower concetration duplicate result.

[i]This outlier is a "marginal outlier" rejected based on statistical judgement.

Table A.5.5−3. Cell 5 Annual LCS Sample Summary Information

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (#OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
4-Methyl-2-pentanone (ug/L)	5	1	20.0%	0.46	-	-	-	-	-	-	5 ug/L
Alkalinity as CaCO3 (mg/L)	10	10	100.0%	58	563	400	-	422 mg/L (6)	430 mg/L (5)	-	10 mg/L
Barium (mg/L)	5	5	100.0%	0.0226	0.0707	0.0448	2 mg/L (0)	0.77 mg/L (0)	0.45 mg/L (0)	0.589 mg/L (0)	0.029 mg/L
Beryllium (mg/L)	5	1	20.0%	0.000038	-	-	0.004 mg/L (0)	-	-	0.0343 mg/L (0)	0.001 mg/L
Calcium (mg/L)	10	10	100.0%	163	990	497	-	159 mg/L (10)	172 mg/L (9)	1800 mg/L (0)	5 mg/L
Carbon disulfide (ug/L)	5	1	20.0%	0.33	-	-	5.5 ug/L (0)	-	-	-	5 ug/L
Chloride (mg/L)	10	10	100.0%	16.9	88.9	62.0	-	7.3 mg/L (10)	45 mg/L (7)	6300 mg/L (0)	5 mg/L
Chromium (mg/L)	5	1	20.0%	0.0013	-	-	0.022 mg/L (0)	0.021 mg/L (0)	0.0046 mg/L (0)	0.818 mg/L (0)	0.005 mg/L
Cobalt (mg/L)	5	4	80.0%	0.00035	0.0028	0.0013	0.17 mg/L (0)	0.0086 mg/L (0)	-	0.0886 mg/L (0)	0.034 mg/L
Copper (mg/L)	5	3	60.0%	0.0097	0.0862	0.0357	1.3 mg/L (0)	0.035 mg/L (1)	0.029 mg/L (1)	0.298 mg/L (0)	0.008 mg/L
Fluoride (mg/L)	7	6	85.7%	0.204	0.333	0.266	4 mg/L (0)	0.89 mg/L (0)	1.3 mg/L (0)	6.8 mg/L (0)	0.2 mg/L
Iron (mg/L)	10	10	100.0%	0.652	4.61	2.75	-	5.72 mg/L (0)	6.35 mg/L (0)	21.3 mg/L (0)	0.1 mg/L
Magnesium (mg/L)	10	10	100.0%	57.7	913	378	-	38.5 mg/L (10)	50.7 mg/L (10)	690 mg/L (1)	5 mg/L
Manganese (mg/L)	10	7	70.0%	0.0061	2.51	0.84	0.9 mg/L (3)	0.9 mg/L (3)	0.21 mg/L (3)	35 mg/L (0)	0.09 mg/L
Nickel (mg/L)	5	5	100.0%	0.00403	0.0377	0.0138	0.1 mg/L (0)	0.0514 mg/L (0)	0.0072 mg/L (2)	0.981 mg/L (0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	16	9	56.3%	0.00366	4.18	1.51	11[g] mg/L (0)	11 mg/L (0)	0.29 mg/L (8)	2670 mg/L (0)	1.1 mg/L
Potassium (mg/L)	10	10	100.0%	6.22	65.5	25.0	-	1.96 mg/L (10)	17.2 mg/L (8)	12400 mg/L (0)	5 mg/L
Selenium (mg/L)	5	2	40.0%	0.0027	0.0194	-	0.05 mg/L (0)	0.00075 mg/L (2)	-	0.0494 mg/L (0)	0.005 mg/L
Silicon (mg/L)	7	7	100.0%	2.92	3.84	3.28	-	-	-	15 mg/L (0)	0.015 mg/L
Sodium (mg/L)	10	9	90.0%	16.4	108	61	-	47.1 mg/L (7)	50 mg/L (7)	1300 mg/L (0)	5 mg/L
Technetium-99 (pCi/L)	12	7	58.3%	7.77	19	11.5	94 pCi/L (0)	22 pCi/L (0)	30 pCi/L (0)	6130 pCi/L (0)	10 pCi/L
Toluene (ug/L)	5	1	20.0%	0.416	-	-	-	-	-	-	1 ug/L
Total Dissolved Solids (mg/L)	11	11	100.0%	436	4640	1890	-	-	-	-	10 mg/L
Vanadium (mg/L)	5	2	40.0%	0.00089	0.00157	-	0.038 mg/L (0)	0.012 mg/L (0)	0.005 mg/L (0)	0.299 mg/L (0)	0.02 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information
[b]Rejected data qualified with an R or Z were not included.
[c]If the number of detected samples is equal to two, then the minumun and maximumn are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.
[d]From Operable Unit 5 Record of Decision, Table 9-4.
[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.
[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.
[g]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

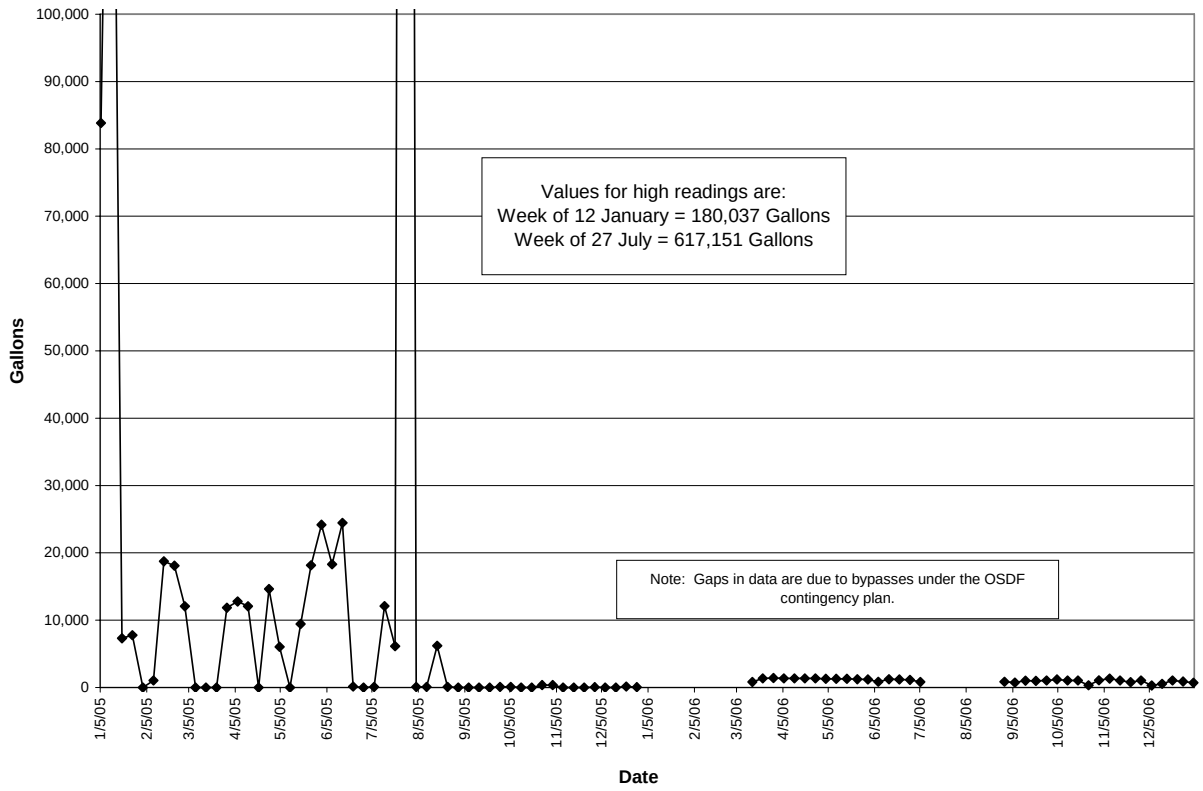


FIGURE A.5.5-1. Weekly Accumulation Volumes for Cell 5 LCS

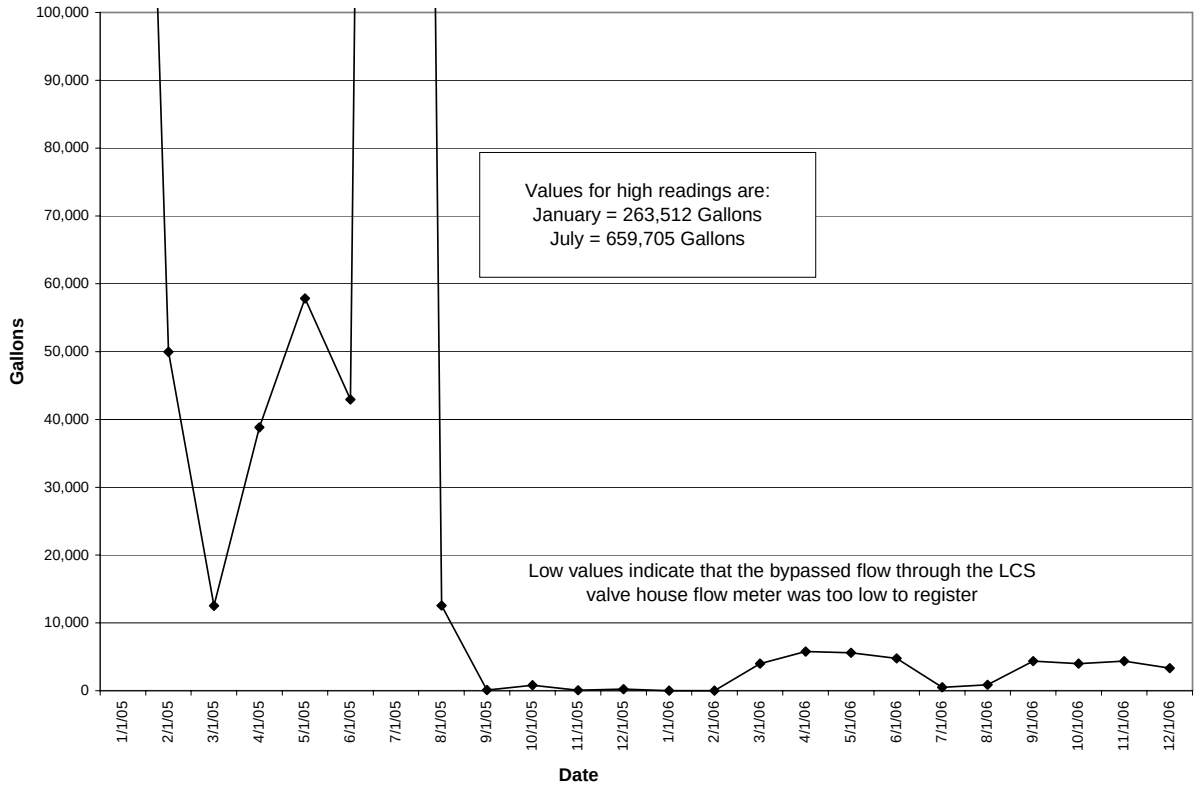


FIGURE A.5.5-2. Monthly Accumulation Volumes for Cell 5 LCS

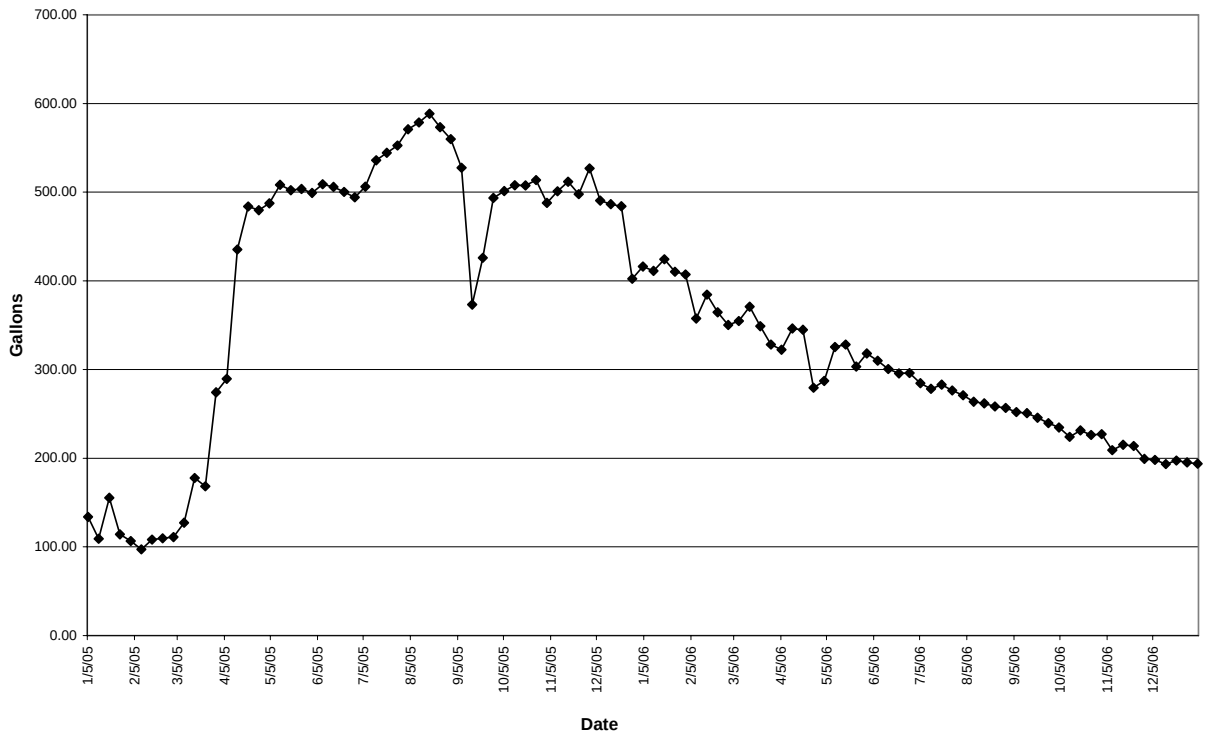


FIGURE A.5.5-3. Weekly Accumulation Volumes for Cell 5 LDS

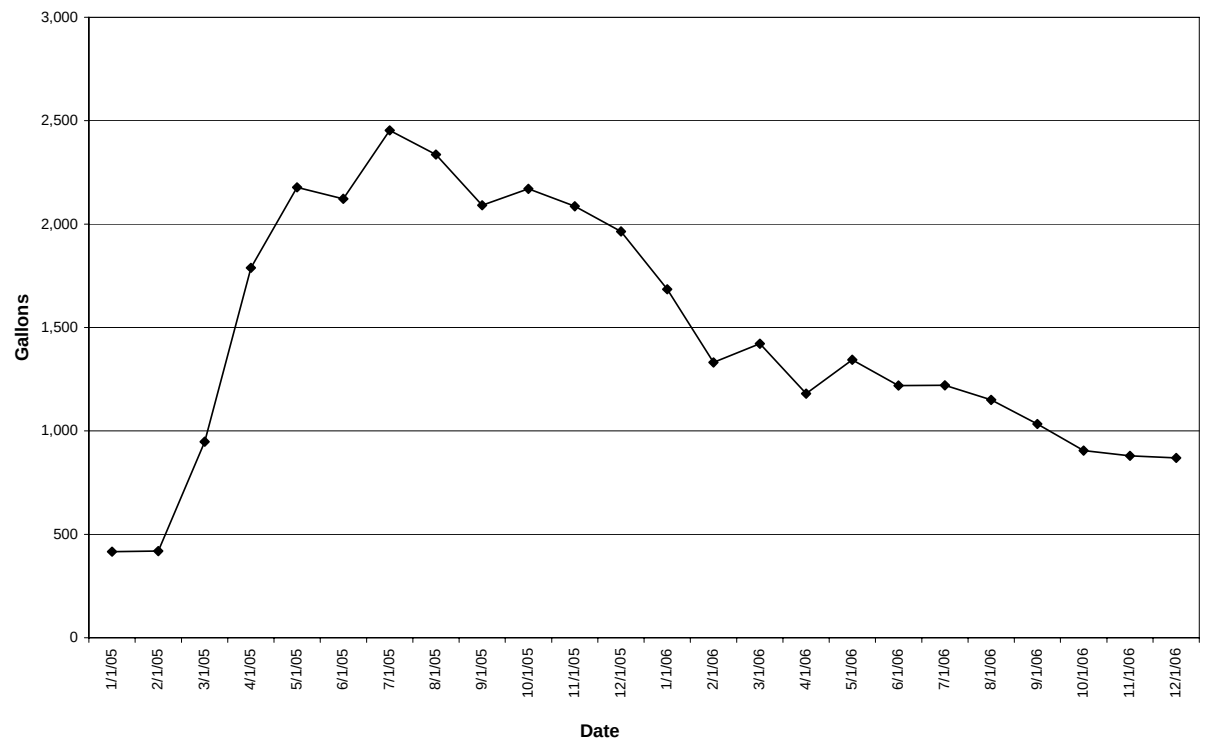


FIGURE A.5.5-4. Monthly Accumulation Volumes for Cell 5 LDS

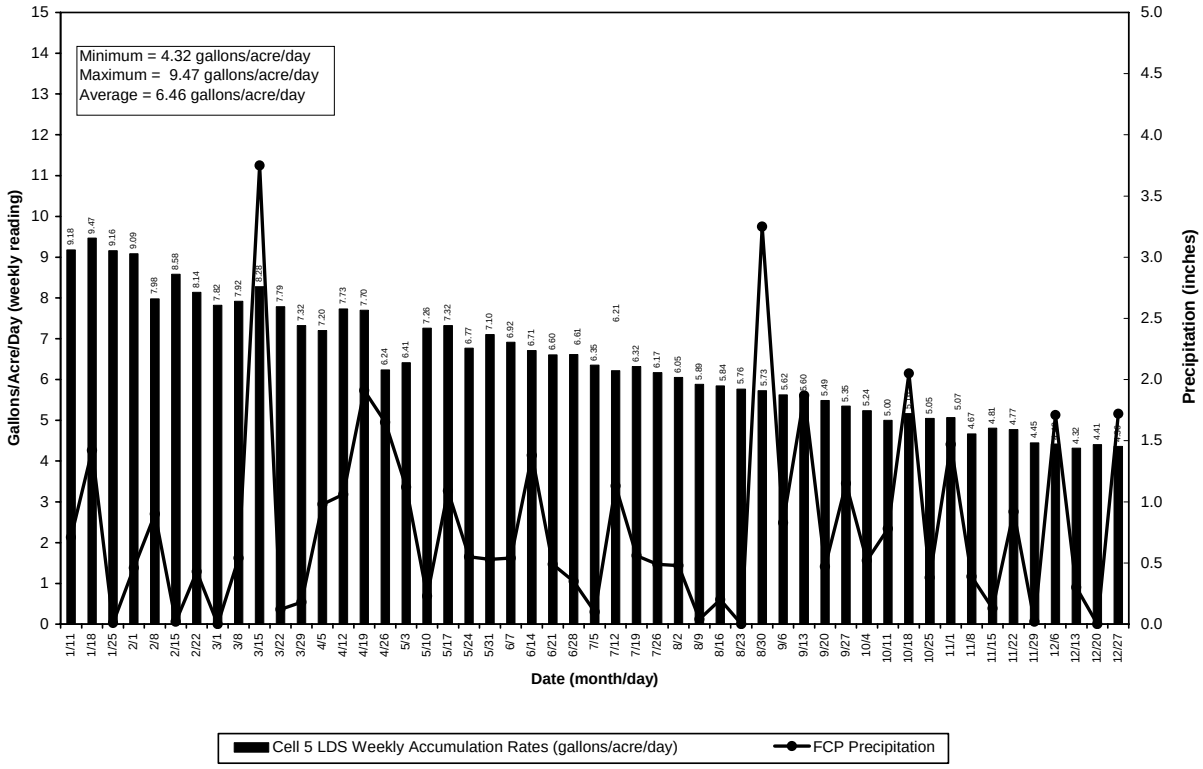


FIGURE A.5.5-5. 2006 OSDF LDSWeekly Accumulation Rates and Precipitation for Cell 5

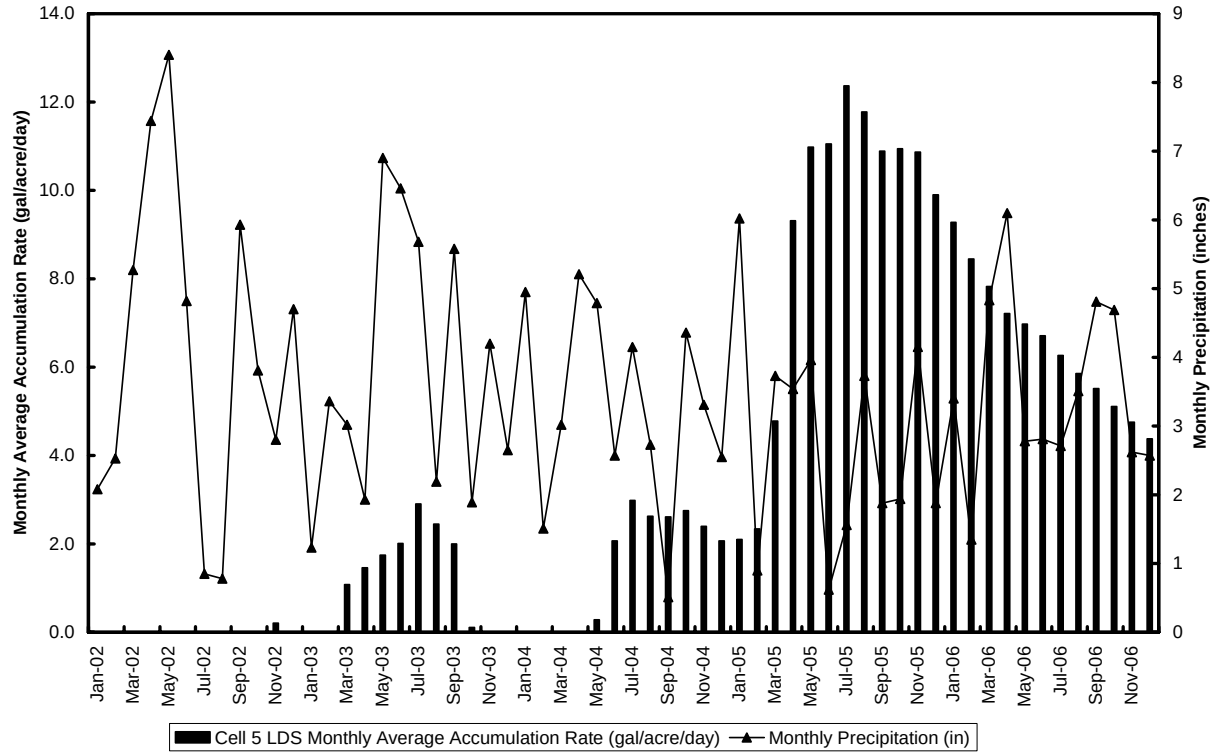


FIGURE A.5.5-6. OSDF Cell 5 LDS Monthly Average Accumulation Rates and Monthly Precipitation

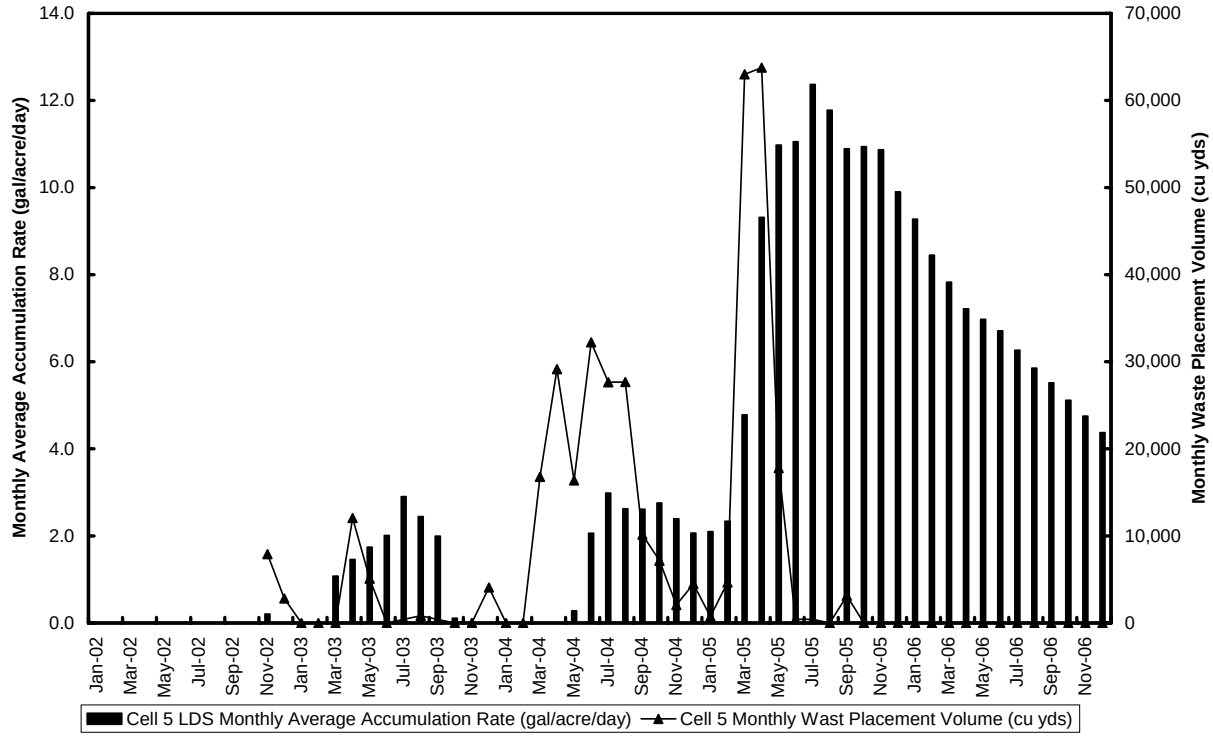
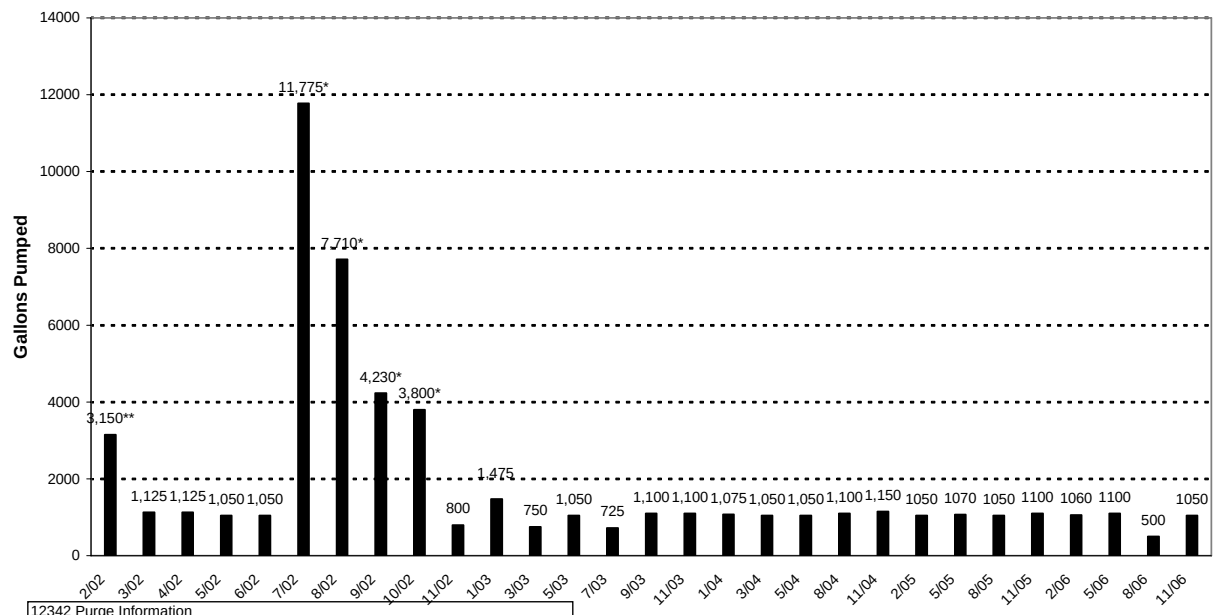


FIGURE A.5.5-7. OSDF Cell 5 LDS Monthly Average Accumulation Rates and Monthly Waste Placement Volumes



12342 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2002:	35815	n=10	3582
2003:	6200	n= 6	1033
2004:	5425	n= 5	1085
2005:	4270	n=4	1068
2006:	3710	n=4	928
Overall:			1911

*More than one purge of the well was completed during these months to drain perched water and infiltrating surface water so the compacted clay liner could be constructed.

**Excess water was pumped from this well in February 2002 for well development.

FIGURE A.5.5-8. OSDF Horizontal Till Well 12342 (Cell 5) Water Yield

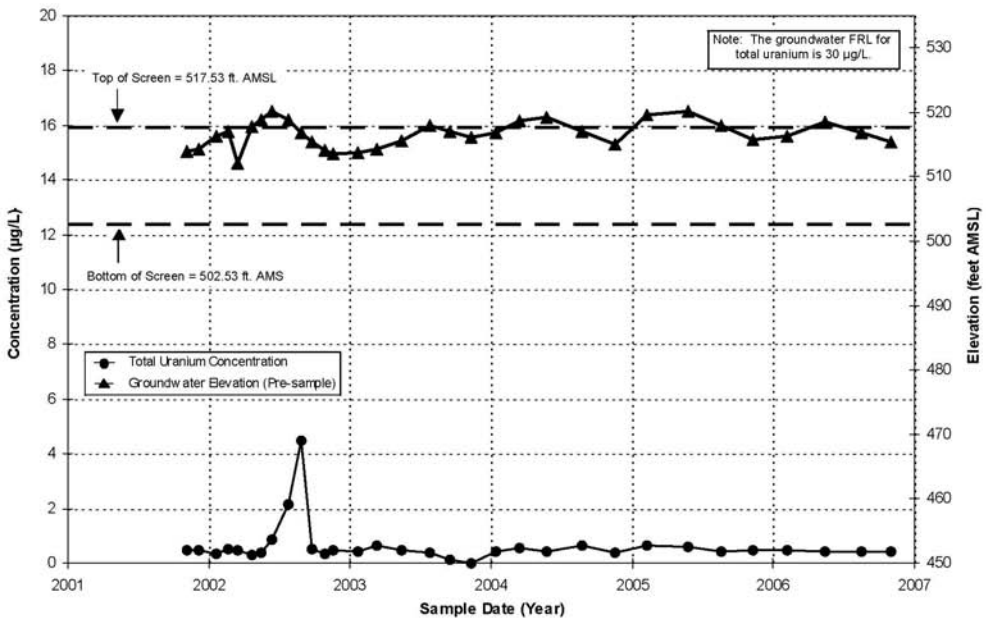


Figure A.5.5-9. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 5 Upgradient Monitoring Well 22207

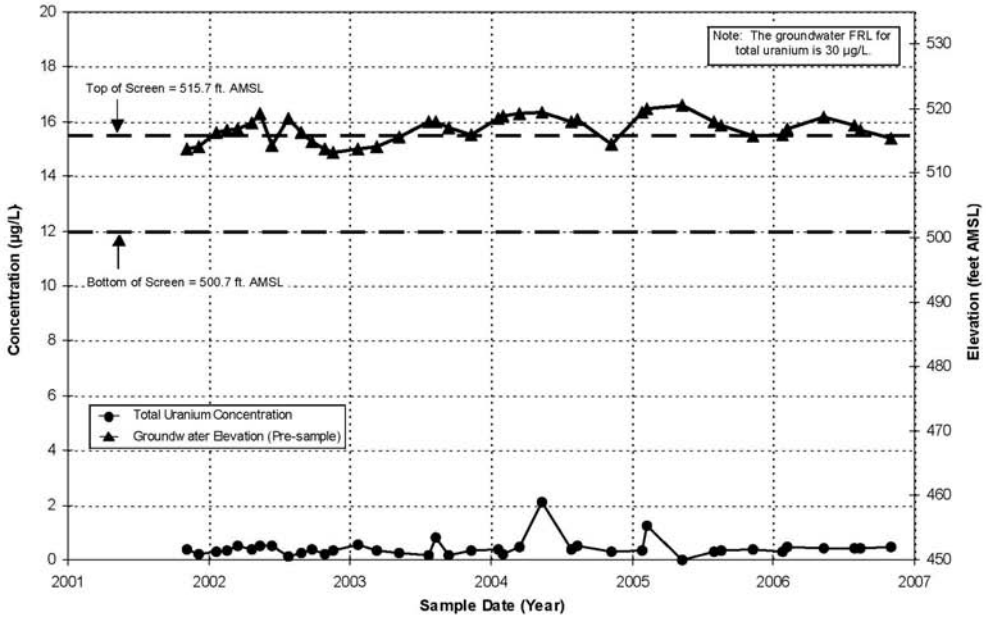


Figure A.5.5-10. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 5 Downgradient Monitoring Well 22208

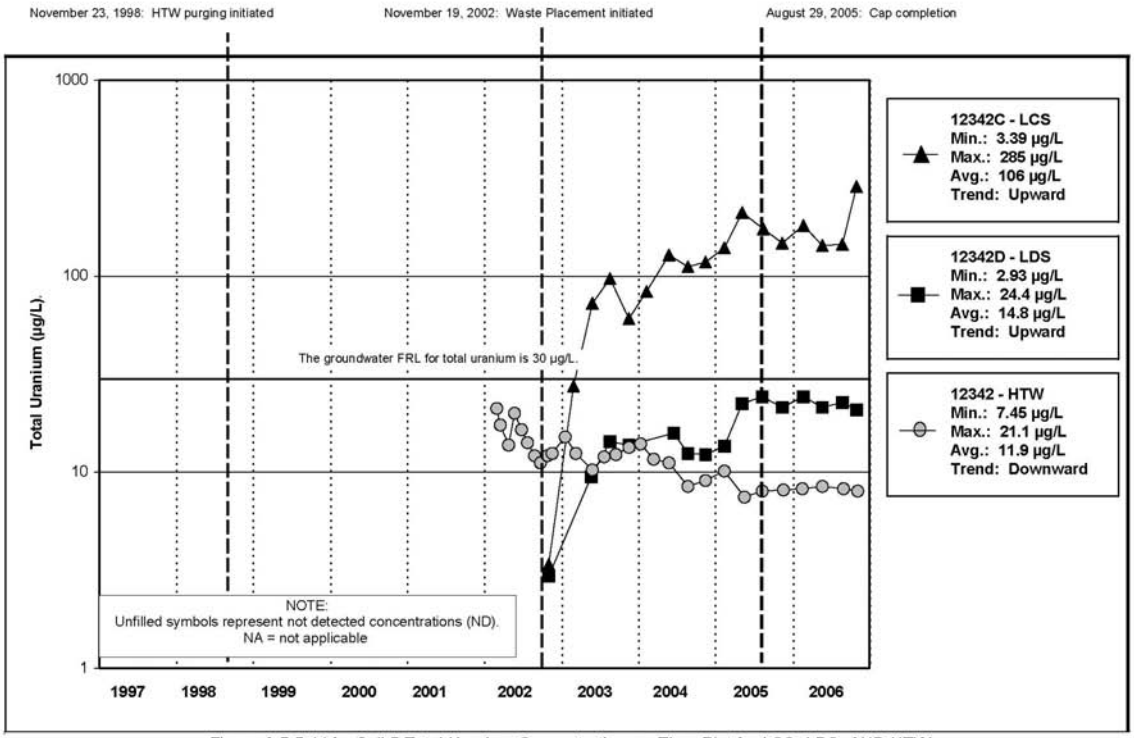


Figure A.5.5-11A. Cell 5 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

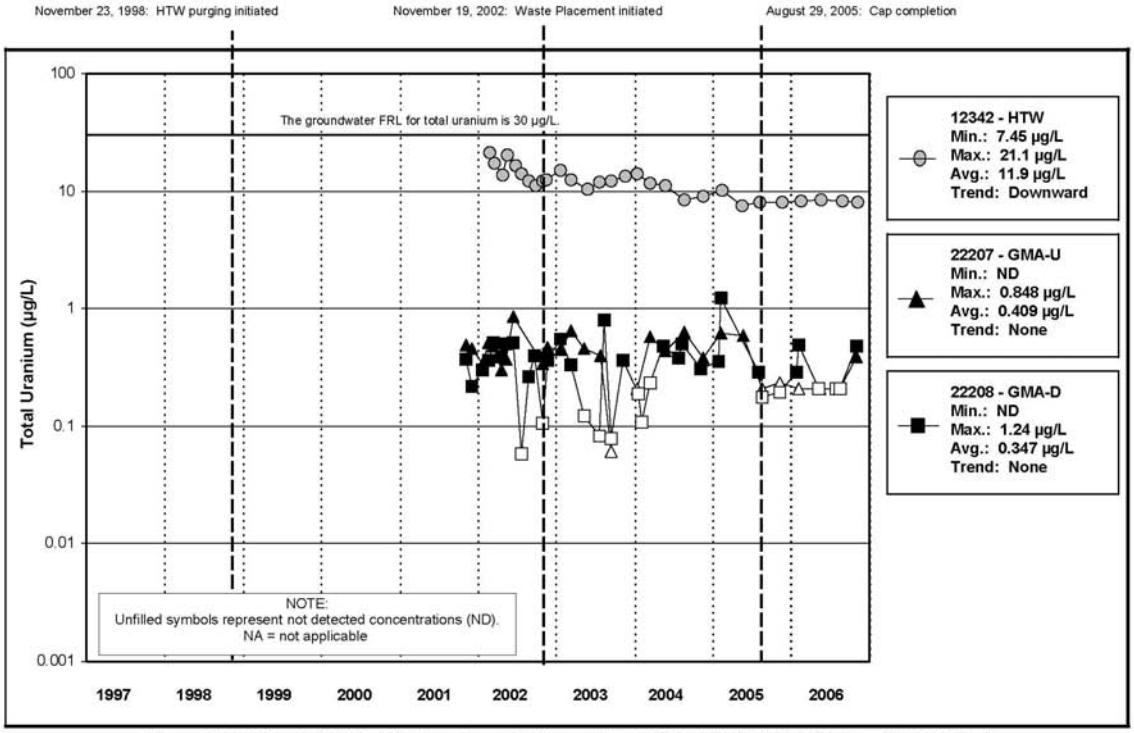


Figure A.5.5-11B. Cell 5 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

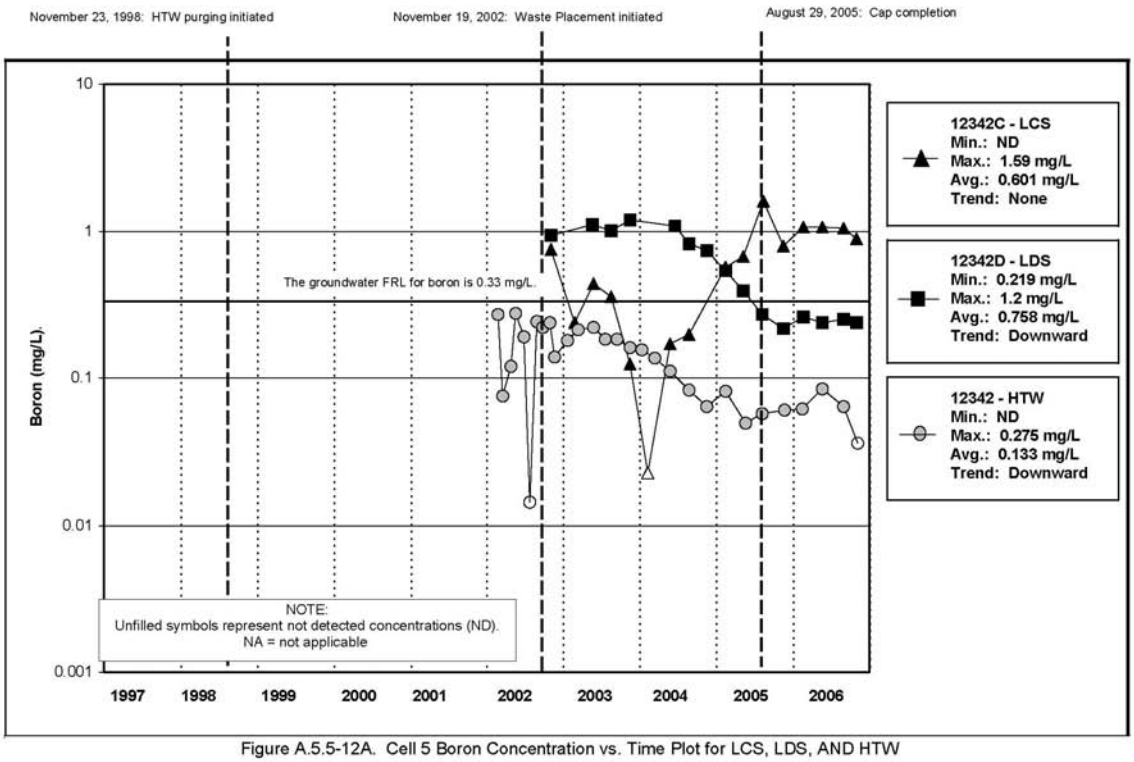


Figure A.5.5-12A. Cell 5 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

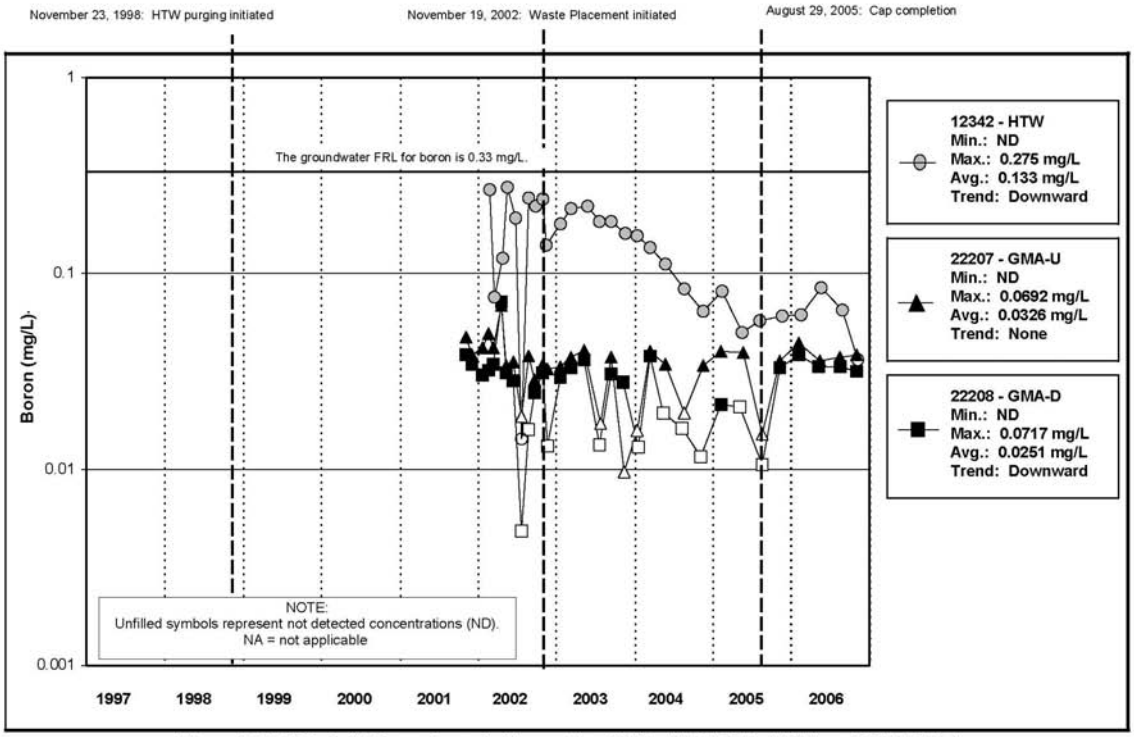


Figure A.5.5-12B. Cell 5 Boron Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

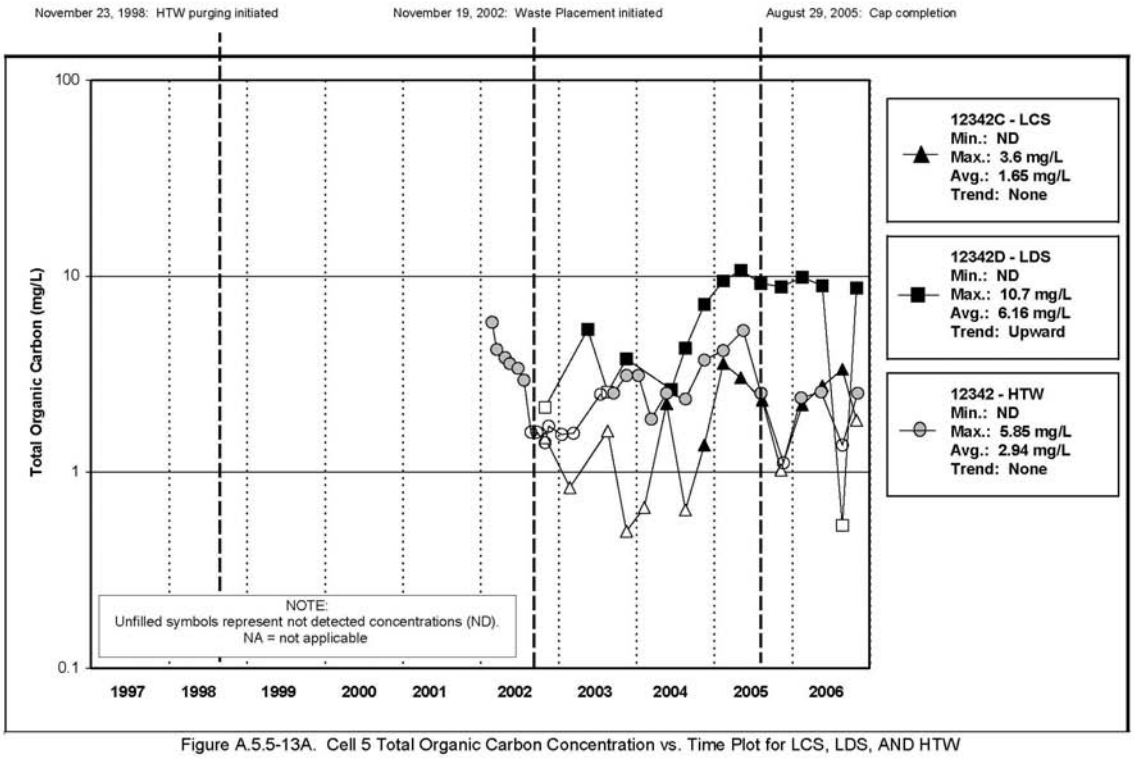


Figure A.5.5-13A. Cell 5 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

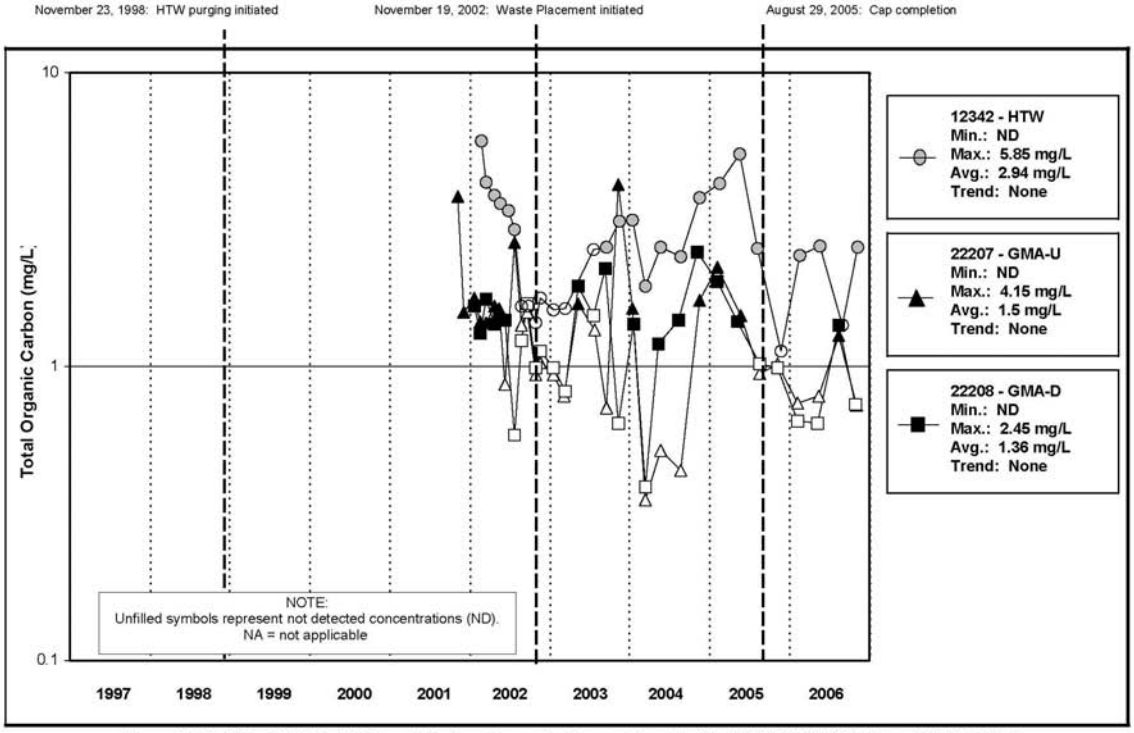


Figure A.5.5-13B. Cell 5 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

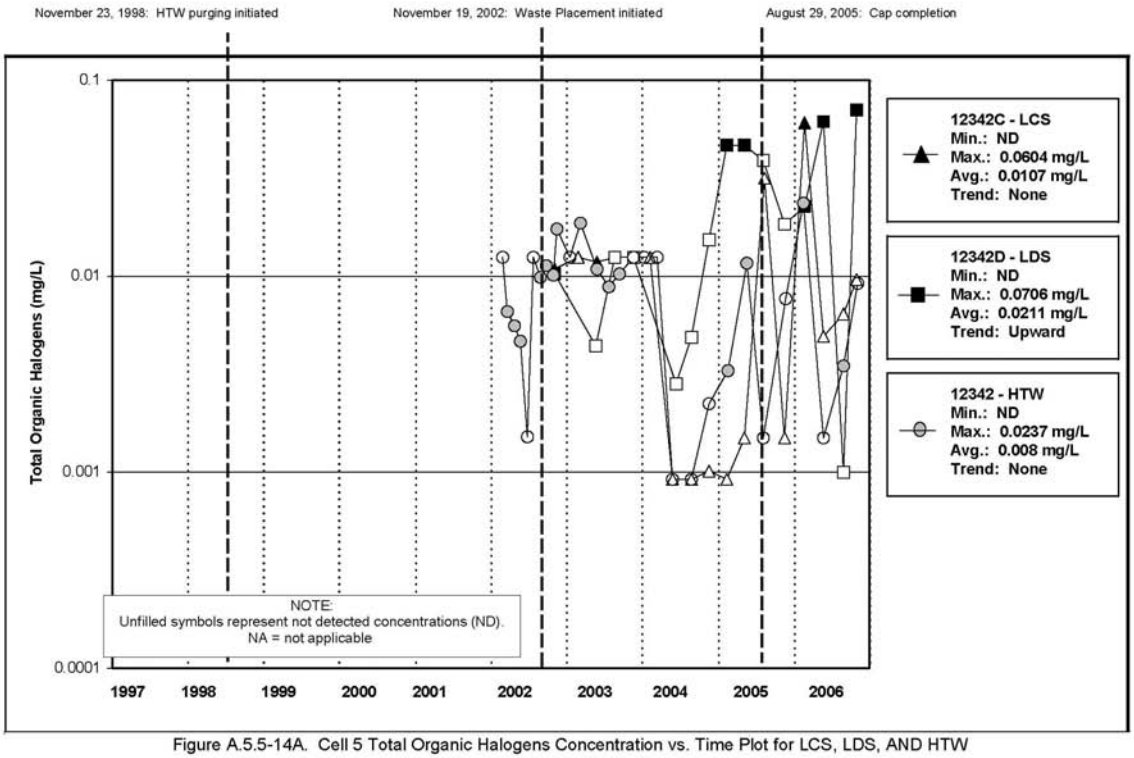


Figure A.5.5-14A. Cell 5 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

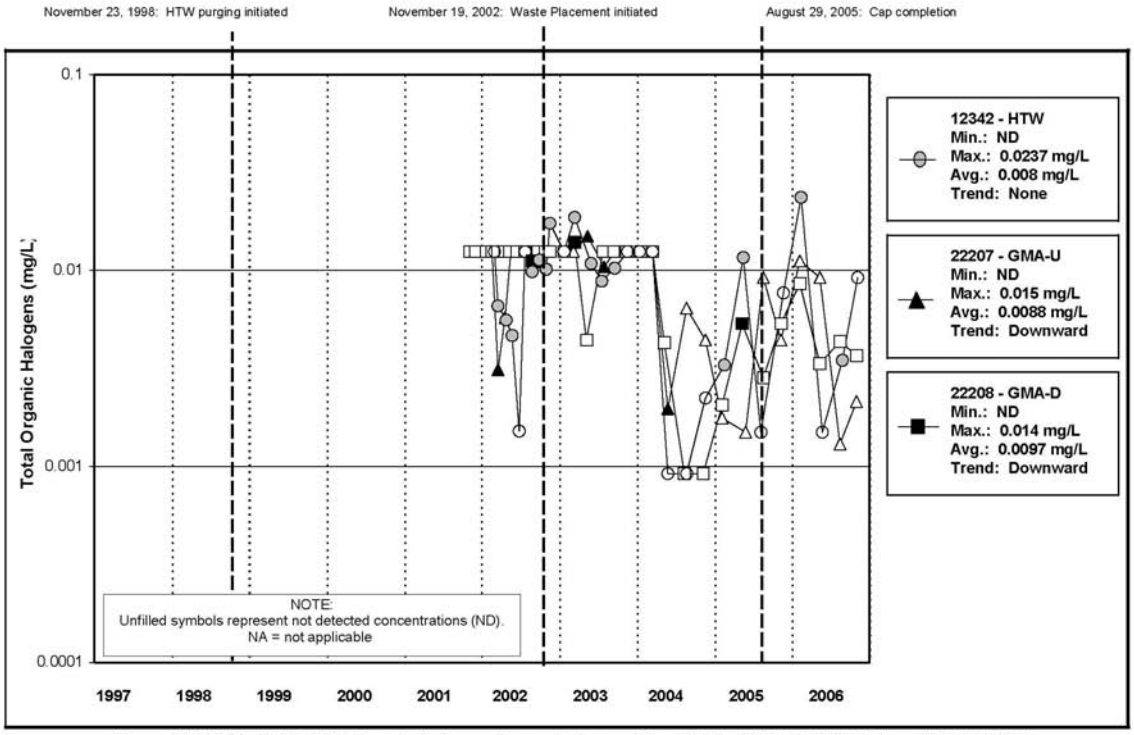


Figure A.5.5-14B. Cell 5 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

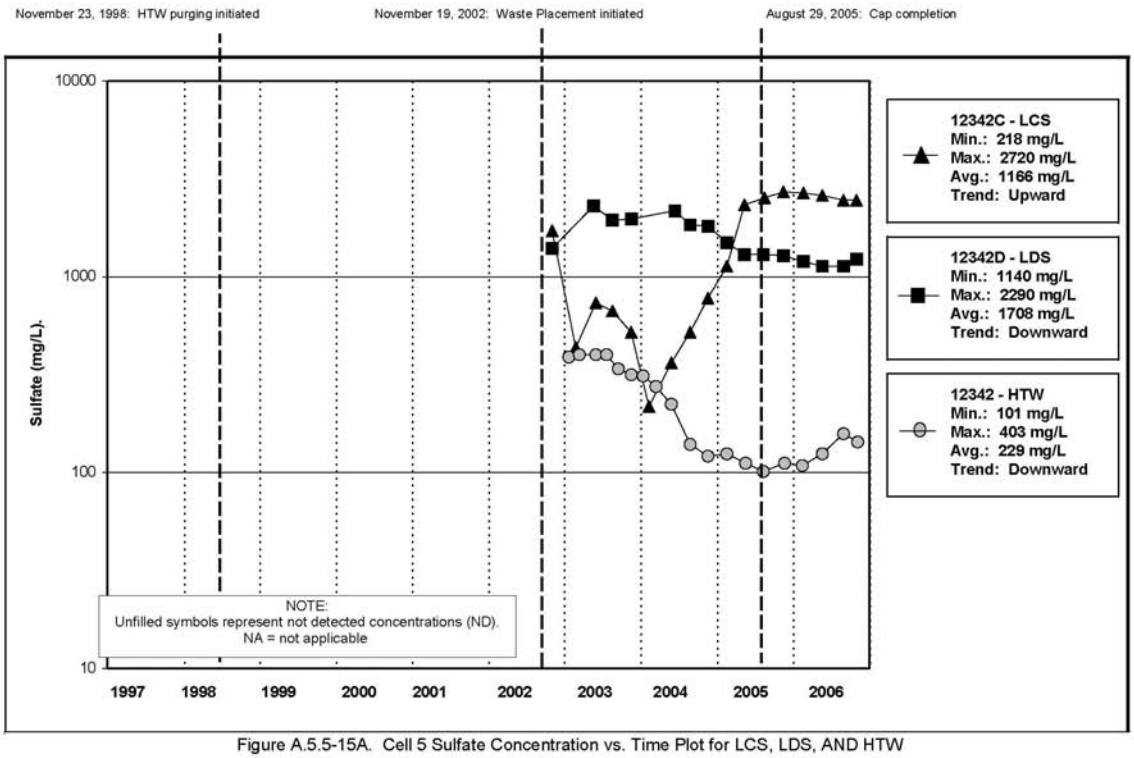


Figure A.5.5-15A. Cell 5 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

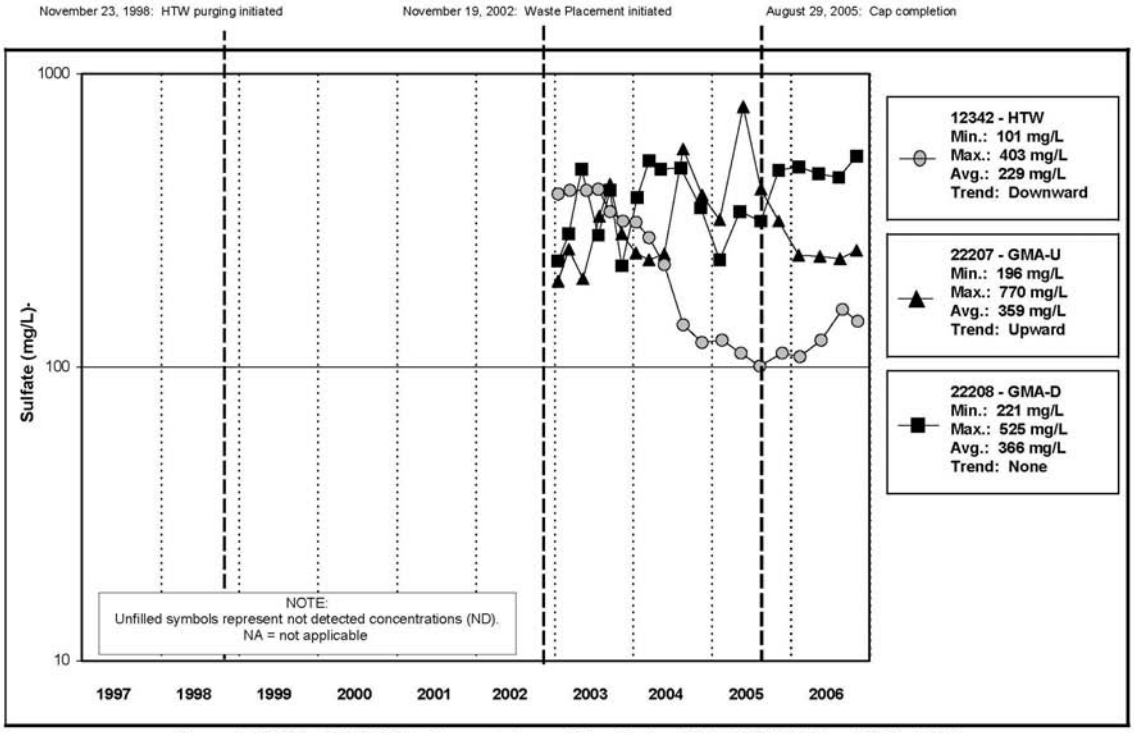


Figure A.5.5-15B. Cell 5 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

End of current text

Subattachment A.5.6

Cell 6

The following information is provided in this subattachment:

- LCS weekly and monthly average accumulation volumes (refer to Figures A.5.6−1 and A.5.6−2)
- LDS weekly and monthly accumulation rates and precipitation (refer to Figures A.5.6−3 and A.5.6−4)
- LDS weekly and monthly accumulation rates and precipitation (refer to Figures A.5.6−5 and A.5.6−6)
- LDS monthly accumulation rates and waste placement volumes (refer to Figure A.5.6−7)
- Monthly liner efficiencies (refer to Table A.5.6−1)
- HTW Water Yield (refer to Figure A.5.6−8)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.6−9 and A.5.6−10)
- Liner Efficiencies (refer to Table A.6.1−1)
- Summary statistics for refined baseline constituents (refer to Section A.5.6.1 and Table A.5.6−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.6.1 and Figures A.5.6−11A through A.5.6−15B)
- Annual LCS monitoring results (refer to Section A.5.6.2 Table A.5.6−3)
- Annual LDS monitoring results (refer to Section A.5.6.3)

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2006, all samples were collected for Cell 6 monitoring horizons. Refined baseline monitoring in Cells 4 through 6 was initiated in August 2005.

A.5.6.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled for at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (refer to Table A.5.6−2) and concentration plots (Figures A.5.6−11A through A.5.6−15B) are provided for the five baseline constituents of Cell 6. For Cell 6, those five constituents are: total uranium, boron, total organic carbon, total organic halogens, and sulfate. Since 2005, total organic halogens concentrations have been detected less than 25 percent of the time in the Great Miami Aquifer wells 22209 and 22210.

A.5.6.2 LCS Monitoring Results

Ohio Solid Waste regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and polychlorinated biphenyl (PCB) parameters listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition

of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2006, annual sampling of the Cell 6 LCS took place in May. Table A.5.6−3 summarizes the annual LCS sampling results for Cell 6, along with data collected in previous years.

Of the non-refined baseline site specific constituents that have been sampled for at least eight times, 11 have been detected at least 25 percent of the time. Nine of the 11 constituents are common ions (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium). Sampling for common ion constituents is temporary. Eight rounds of sampling are being conducted to support the common ion study. It is anticipated that eight rounds of sampling will be completed for all cells in August 2007. A decision concerning what common ion constituents (if any) will be added to the site specific leak detection monitoring list for Cell 6 will be determined based upon results of the common ion study.

The remaining two constituents are total dissolved solids (TDS) and technetium-99. TDS will be assessed using the approach presented in Figures A.5−4A and A.5−4B, once final approval of the approach has been obtained from the EPA and OEPA. The assessment will be used to determine if TDS will be added to the site specific leak detection parameter list. Results of the assessment will be presented to the EPA/OEPA as soon as they are available and they will also be reported in next year's SER.

Technetium-99 is a site specific leak detection parameter; however, it is not on the refined baseline list for Cell 6. If a site specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.6−3, technetium-99 has been detected in the Cell 6 LCS, but these detections occurred prior to the establishment of the refined baseline for Cell 6. Therefore, confirmatory sampling for technetium-99 in the Cell 6 LCS is not required.

Mercury has been detected in the Cell 6 LCS 11.1 percent of the time. Because these detections were made prior to the establishment of the refined baseline list for Cell 6, confirmatory sampling for mercury in Cell 6 is not required.

A.5.6.3 LDS Monitoring Results

Each year the LDS of Cell 6 is sampled for site specific baseline parameters listed in Table 2−1 of Appendix B of the OSDF GWLMP. As with the LCS, the objective of the annual LDS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility.

In 2006, of the non-refined baseline constituents that have been sampled at least eight times, nine have been detected at least 25 percent of the time (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium). All nine are common ion constituents.

Table A.5.6−1. Cell 6 – 2006 Monthly Liner Efficiencies

Month	Cell 6 Apparent Liner Efficiency (%)
January	NA[a]
February	NA[a]
March	NA[a]
April	79.41
May	78.01
June	NA[b]
July	NA[b]
August	NA[b]
September	87.35
October	85.07
November	82.71
December	81.78

[a]LCS flow not yet directed to tank. No data available.
[b]OSDF contingency plan executed due to inaccessibility of valve houses. Valve house road was closed to support site remediation activities. No data available.

Table A.5.6−2. Summary Statistics for Cell 6

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]		
Total Uranium (µg/L)	LCS	12343C	13	13	100%	126	Normal	Upward	Detected			
	LDS	12343D	13	13	100%	18.8	Normal	Upward	Detected			
	HTW	12343	13	13	100%	9.63	Normal	Marg. Up.	Not Detected	6.32 (Q2-03)		
	GMA-U	22209	13	15	87%	0.64	Lognormal	None	Not Detected	2.43 (Q2-06)	0.005 U (Q2-05)	
	GMA-D	22210	15	16	94%	0.64	Lognormal	Marg. Up.	Not Detected	0 U (Q2-05)		
Boron (mg/L)	LCS	12343C	13	13	100%	0.692	Normal	Upward	Not Detected			
	LDS	12343D	11	11	100%	0.470	Normal	Downward	Not Detected	1.22 (Q4-03)	2.38 (Q3-04)	
	HTW	12343	12	14	86%	0.084	Normal	Downward	Detected			
	GMA-U	22209	13	17	76%	0.0351	Undefined	None	Not Detected			
	GMA-D	22210	15	17	88%	0.0325	Undefined	None	Marg. Detect			
Total Organic Carbon (mg/L)	LCS	12343C	10	12	83%	2.25	Normal	Upward	Marg. Detect	14.6 (Q4-03)		
	LDS	12343D	11	11	100%	7.25	Lognormal	Downward	Detected	0.292 (Q2-04)	3.08 (Q1-04)	
	HTW	12343	10	14	71%	2.19	Normal	None	Not Detected			
	GMA-U	22209	6	17	35%	0.94	Lognormal	Marg. Down.	Detected			
	GMA-D	22210	7	17	41%	1.05	Lognormal	None	Not Detected			
Total Organic Halogens (mg/L)	LCS	12343C	5	13	38%	0.0117	Lognormal	None	Detected			
	LDS	12343D	7	13	54%	0.0265	Normal	None	Not Detected			
	HTW	12343	8	14	57%	0.0086	Normal	Marg. Down.	Not Detected			
	GMA-U	22209	4	17	24%	0.0097	Undefined	None	Marg. Detect			
	GMA-D	22210	1	17	6%	0.0071	Undefined	Marg. Down.	Detected			
Sulfate (mg/L)	LCS	12343C	11	11	100%	1760	Lognormal	Marg. Up.	Not Detected	491 (Q2-05)	690 (Q2-04)	
	LDS	12343D	13	13	100%	1660	Lognormal	None	Not Detected			
	HTW	12343	13	13	100%	418	Lognormal	None	Detected	383 U (Q1-03)		
	GMA-U	22209	13	13	100%	163	Normal	Upward	Detected	406 (Q2-06)	311 (Q2-03)	2.07 (Q3-06)
	GMA-D	22210	16	16	100%	188	Lognormal	Upward	Detected			

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptiions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down." is a marginally downward trend and "Marg. Up." is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

U = Not Detected at that concentration

Table A.5.6−3. Cell 6 Annual LCS Sample Summary Information

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (#OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
Alkalinity as CaCO3 (mg/L)	9	9	100.0%	64	557	440	-	422 mg/L (6)	430 mg/L (6)	-	10 mg/L
Ammonia (mg/L)	4	1	25.0%	0.0882	-	-	-	4.2 mg/L (0)	4.34 mg/L (0)	220 mg/L (0)	0.1 mg/L
Barium (mg/L)	4	4	100.0%	0.0309	0.0868	0.0628	2 mg/L (0)	0.77 mg/L (0)	0.45 mg/L (0)	0.589 mg/L (0)	0.029 mg/L
Calcium (mg/L)	9	9	100.0%	225	996	493	-	159 mg/L (9)	172 mg/L (9)	1800 mg/L (0)	5 mg/L
Chloride (mg/L)	9	9	100.0%	20.1	139	86	-	7.3 mg/L (8)	45 mg/L (6)	6300 mg/L (0)	5 mg/L
Cobalt (mg/L)	4	3	75.0%	0.0006	0.0016	0.0010	0.17 mg/L (0)	0.0086 mg/L (0)	-	0.0886 mg/L (0)	0.034 mg/L
Copper (mg/L)	4	4	100.0%	0.00421	0.0082	0.0057	1.3 mg/L (0)	0.035 mg/L (0)	0.029 mg/L (0)	0.298 mg/L (0)	0.008 mg/L
Fluoride (mg/L)	7	6	85.7%	0.240	0.379	0.299	4 mg/L (0)	0.89 mg/L (0)	1.3 mg/L (0)	6.8 mg/L (0)	0.2 mg/L
Iron (mg/L)	9	9	100.0%	0.989	4.48	2.81	-	5.72 mg/L (0)	6.35 mg/L (0)	21.3 mg/L (0)	0.1 mg/L
Magnesium (mg/L)	9	9	100.0%	92.4	609	302	-	38.5 mg/L (9)	50.7 mg/L (9)	690 mg/L (0)	5 mg/L
Manganese (mg/L)	9	8	88.9%	0.0073	1.41	0.32	0.9 mg/L (1)	0.9 mg/L (1)	0.21 mg/L (4)	35 mg/L (0)	0.09 mg/L
Mercury (mg/L)	9	1	11.1%	0.000338	-	-	0.002 mg/L (0)	-	-	0.0018 mg/L (0)	0.0002 mg/L
Nickel (mg/L)	4	4	100.0%	0.007	0.0285	0.014	0.1 mg/L (0)	0.0514 mg/L (0)	0.0072 mg/L (2)	0.981 mg/L (0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	13	7	53.8%	0.153	4.67	1.79	11 mg/L[g] (0)	11 mg/L (0)	0.29 mg/L (6)	2670 mg/L (0)	1.1 mg/L
Potassium (mg/L)	9	9	100.0%	9	75.5	25.1	-	1.96 mg/L (8)	17.2 mg/L (6)	12400 mg/L (0)	5 mg/L
Selenium (mg/L)	4	1	25.0%	0.0097	-	-	0.05 mg/L (0)	0.00075 mg/L (1)	-	0.0494 mg/L (0)	0.005 mg/L
Silicon (mg/L)	7	7	100.0%	3.42	4.89	4.05	-	-	-	15 mg/L (0)	0.015 mg/L
Sodium (mg/L)	9	9	100.0%	23.1	107	53	-	47.1 mg/L (5)	50 mg/L (3)	1300 mg/L (0)	5 mg/L
Technetium-99 (pCi/L)	9	3	33.3%	6.54	11.7	9.0	94 pCi/L (0)	22 pCi/L (0)	30 pCi/L (0)	6130 pCi/L (0)	10 pCi/L
Total Dissolved Solids (mg/L)	8	8	100.0%	267	4140	2160	-	-	-	-	10 mg/L
Vanadium (mg/L)	4	1	25.0%	0.00088	-	-	0.038 mg/L (0)	0.012 mg/L (0)	0.005 mg/L (0)	0.299 mg/L (0)	0.02 mg/L
Zinc (mg/L)	4	1	25.0%	0.0253	-	-	0.021 mg/L (1)	0.02 mg/L (1)	0.35 mg/L (0)	1.78 mg/L (0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information
[b]Rejected data qualified with an R or Z were not included.
[c]If the number of detected samples is equal to two, then the minumun and maximumn are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.
[d]From Operable Unit 5 Record of Decision, Table 9-4.
[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.
[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.
[g]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

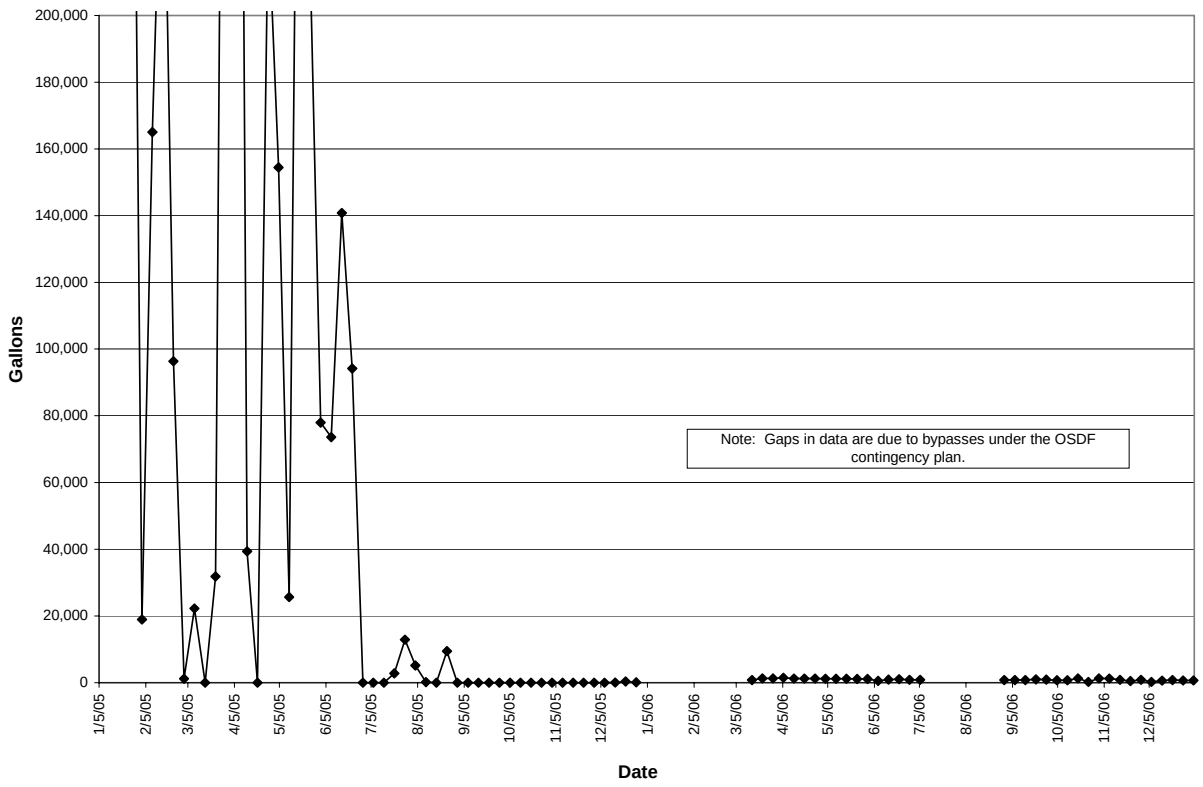


FIGURE A.5.6-1. Weekly Accumulation Volumes for Cell 6 LCS

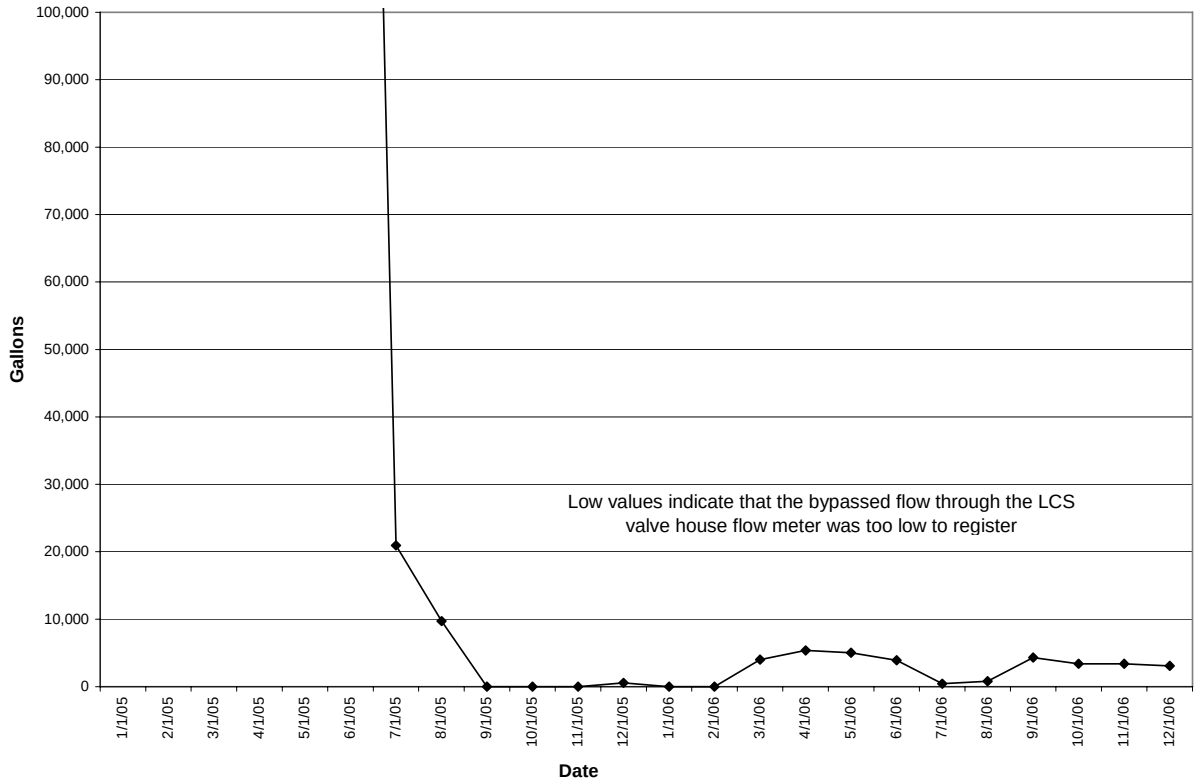


FIGURE A.5.6-2. Monthly Accumulation Volumes for Cell 6 LCS

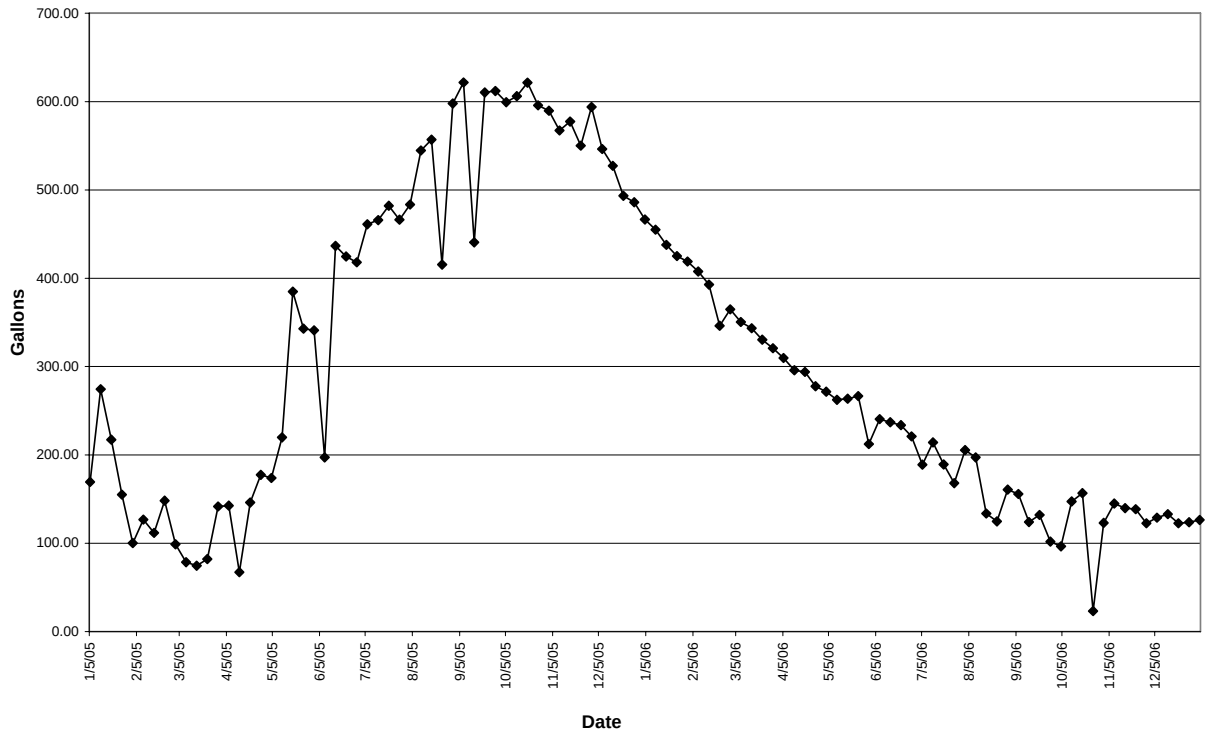


FIGURE A.5.6-3. Weekly Accumulation Volumes for Cell 6 LDS

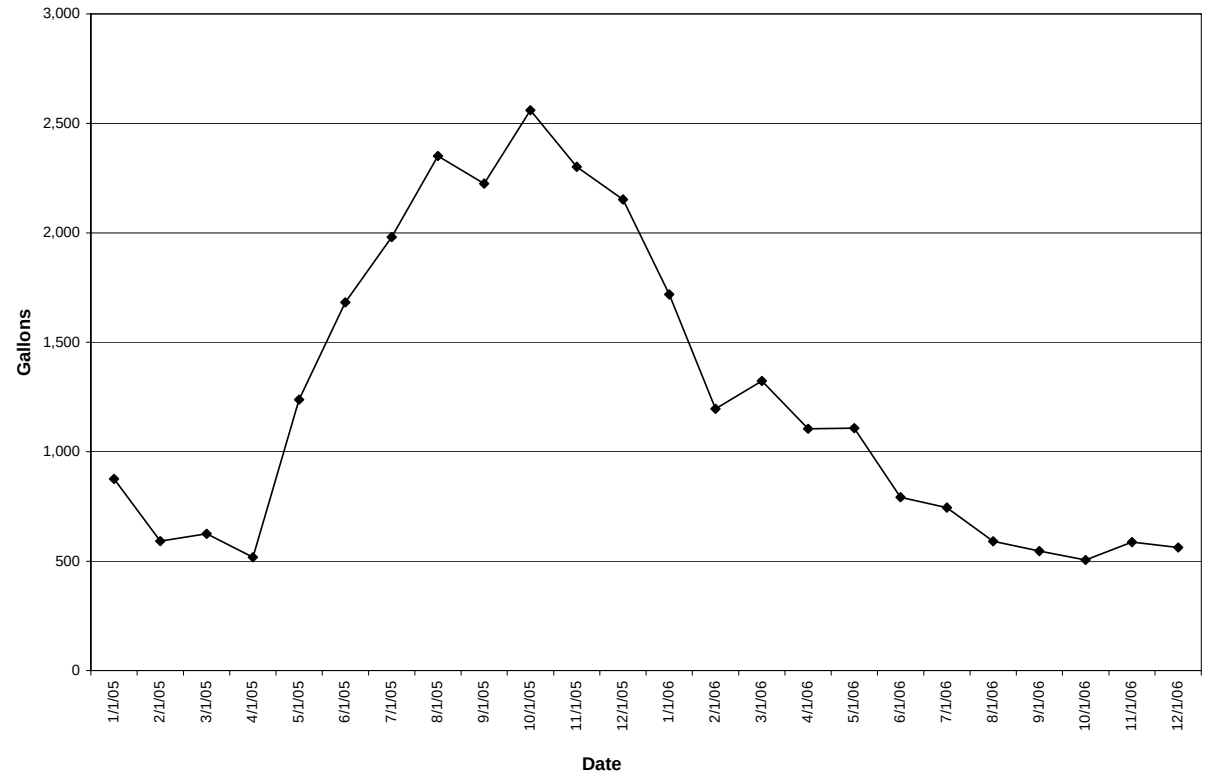


FIGURE A.5.6-4. Monthly Accumulation Volumes for Cell 6 LDS

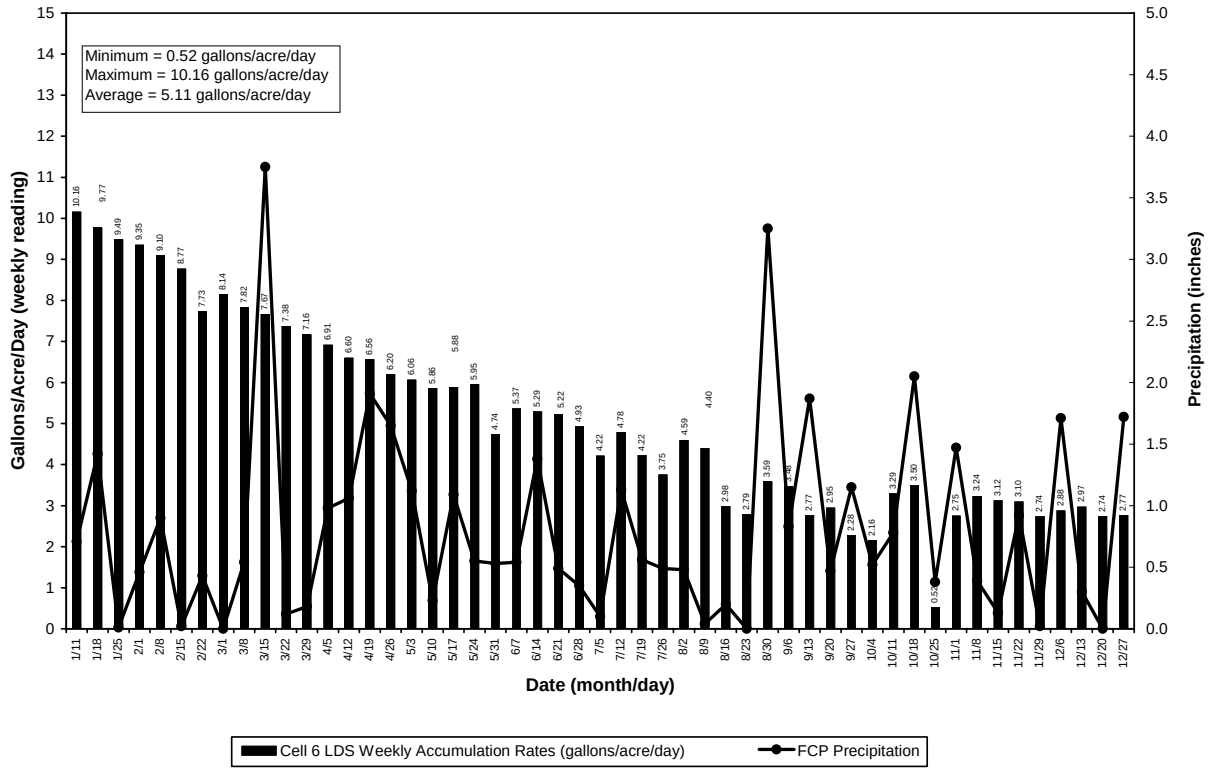


FIGURE A.5.6-5. 2006 OSDF LDS Weekly Accumulation Rates and Precipitation for Cell 6

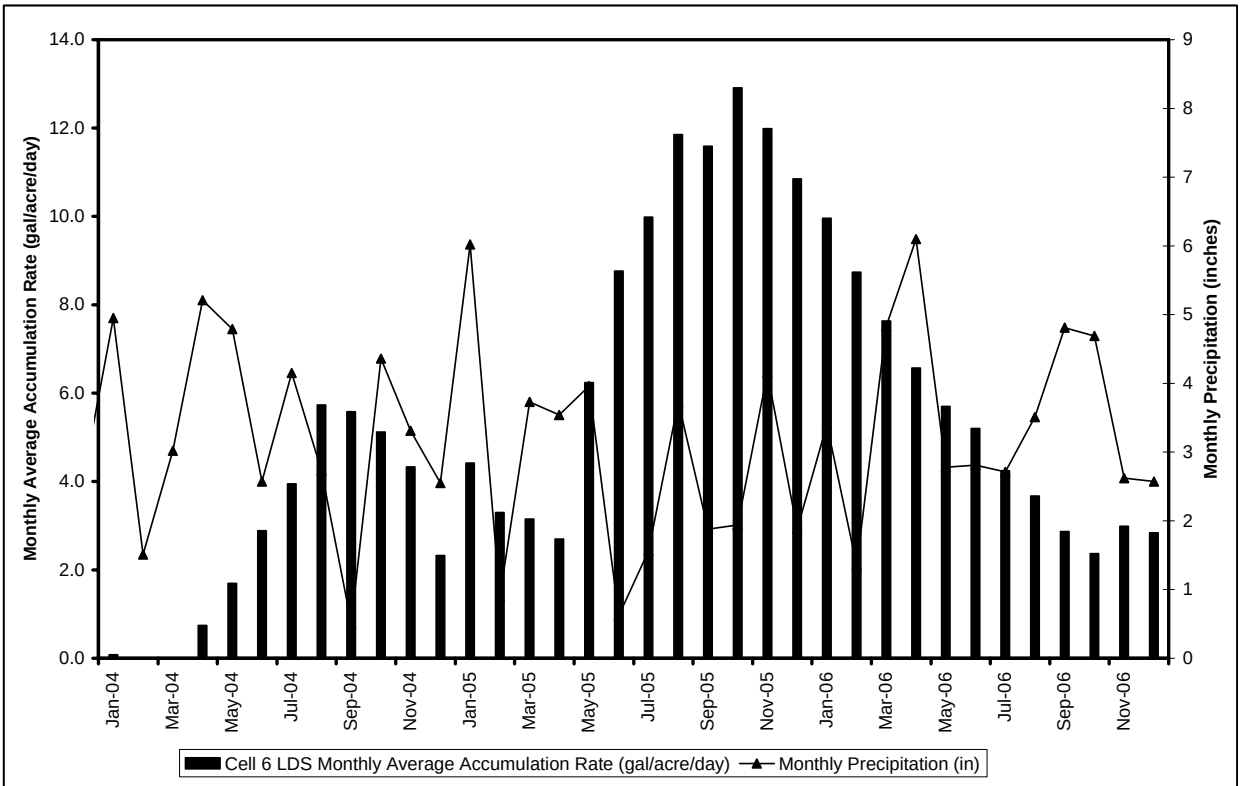


FIGURE A.5.6-6. OSDF Cell 6 LDS Monthly Average Accumulation Rates and Monthly Precipitation

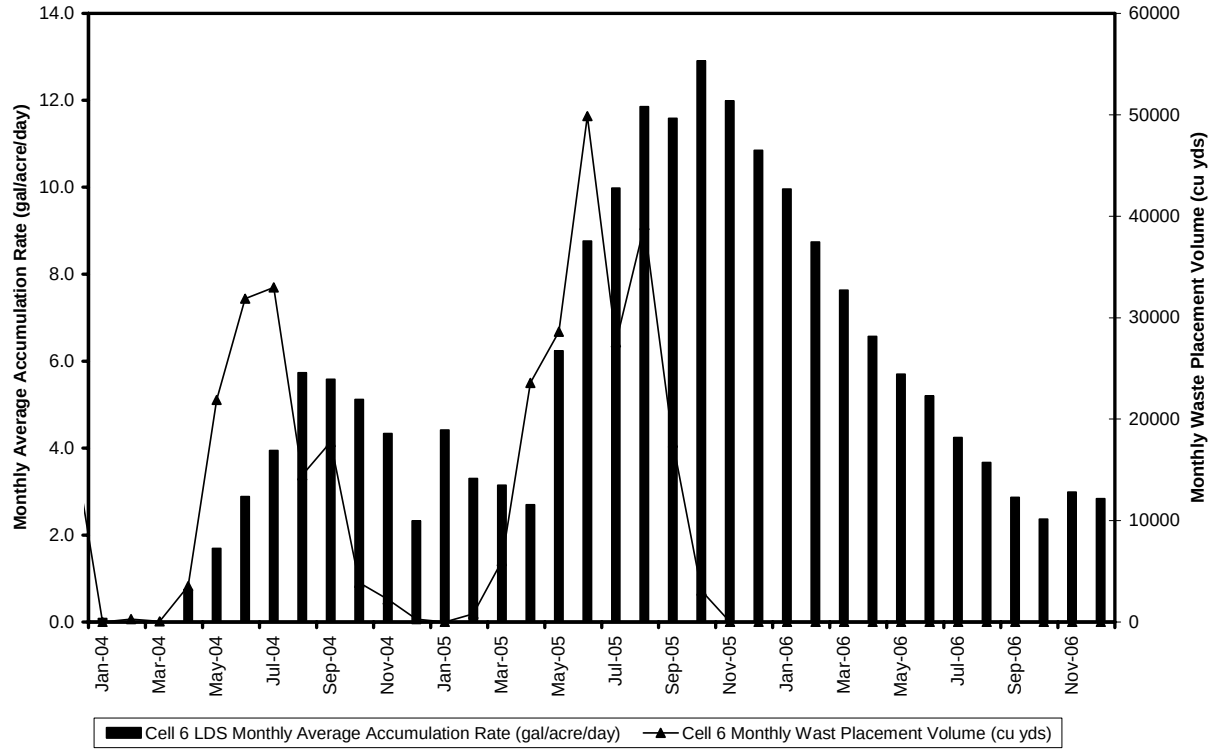
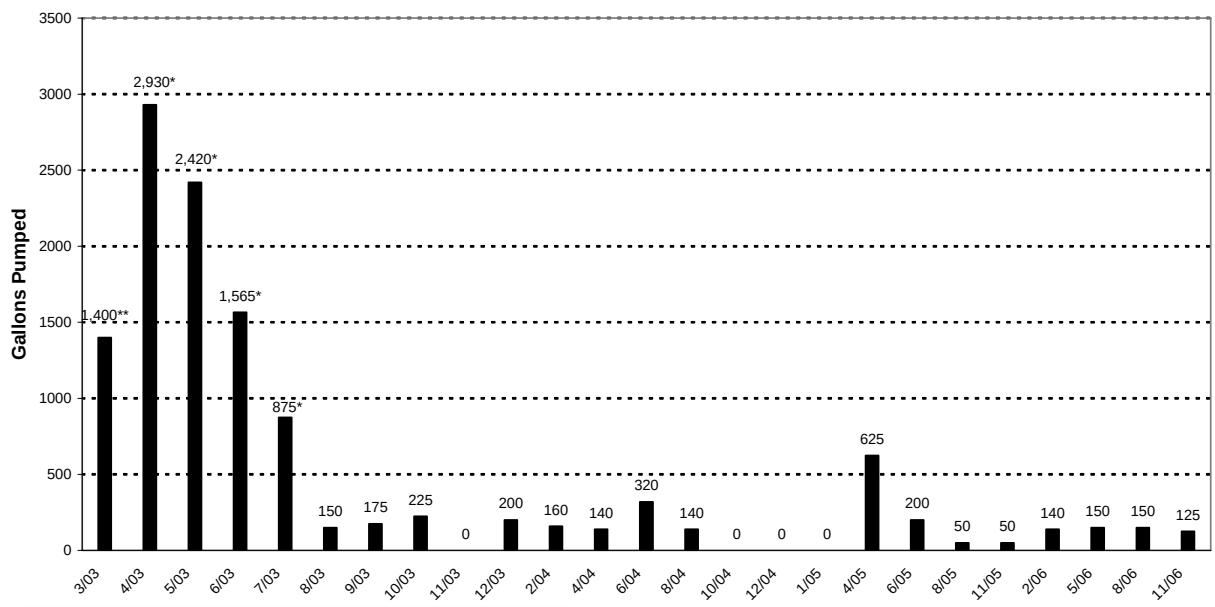


FIGURE A.5.6-7. OSDF Cell 6 LDS Monthly Average Accumulation Rates and Monthly Waste Placement Volumes



12343 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2003:	9940	n=10	994
2004:	760	n= 6	127
2005:	925	n=5	185
2006:	565	n=4	141
Overall:			488

*More than one purge of the well was completed during these months to drain perched water and infiltrating surface water so the compacted clay liner could be constructed.

**Excess water was pumped from this well in March 2003 for well development.

FIGURE A.5.6-8. OSDF Horizontal Till Well 12343 (Cell 6) Water Yield

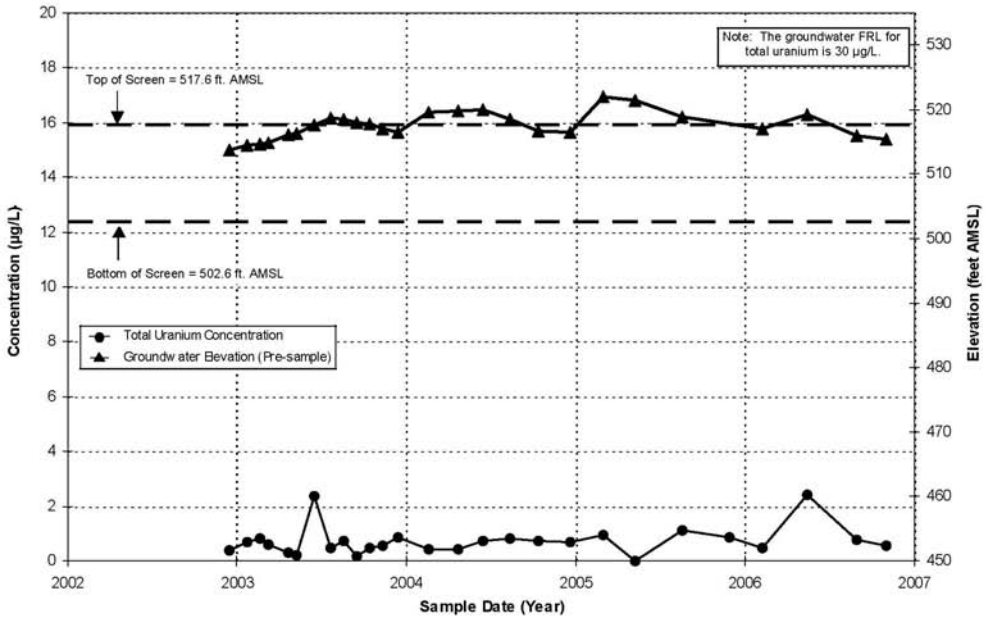


Figure A.5.6-9. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 6 Upgradient Monitoring Well 22209

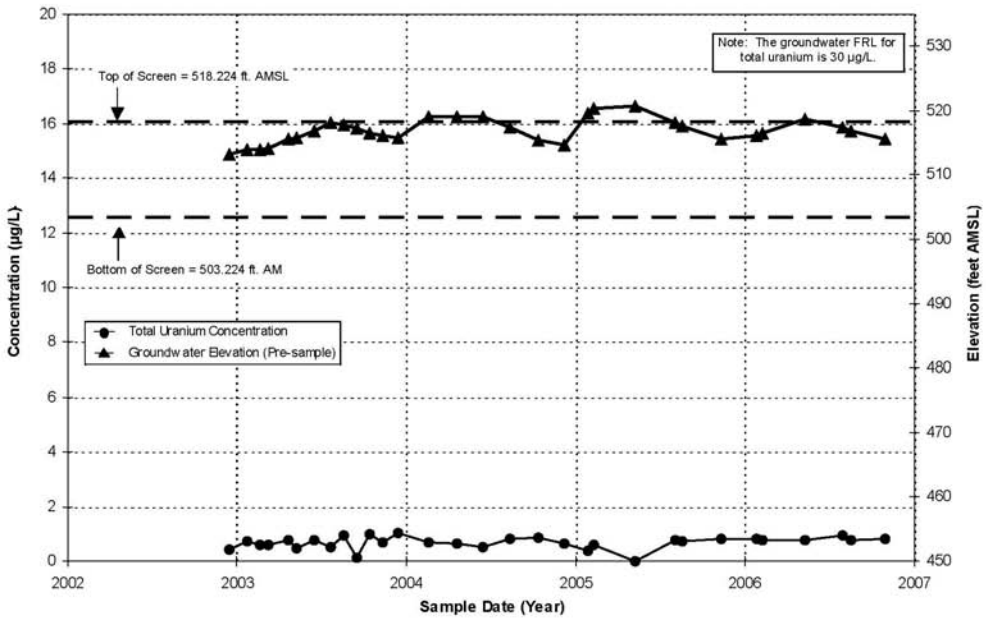


Figure A.5.6-10. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 6 Downgradient Monitoring Well 22210

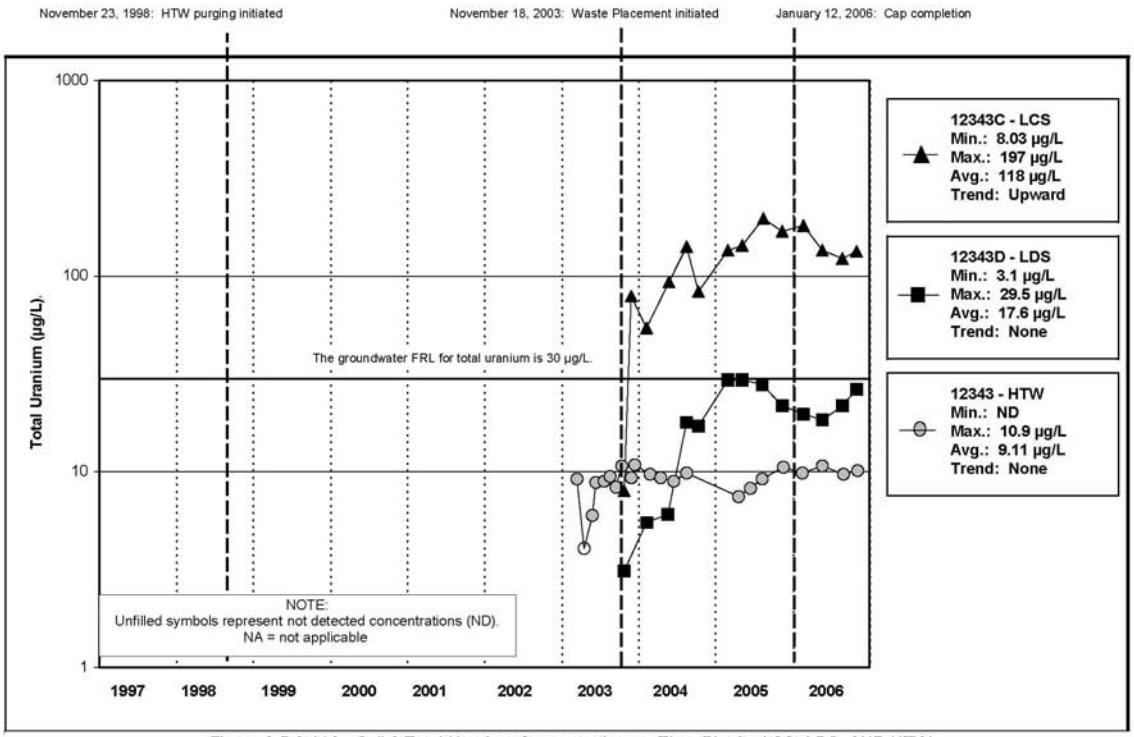


Figure A.5.6-11A. Cell 6 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

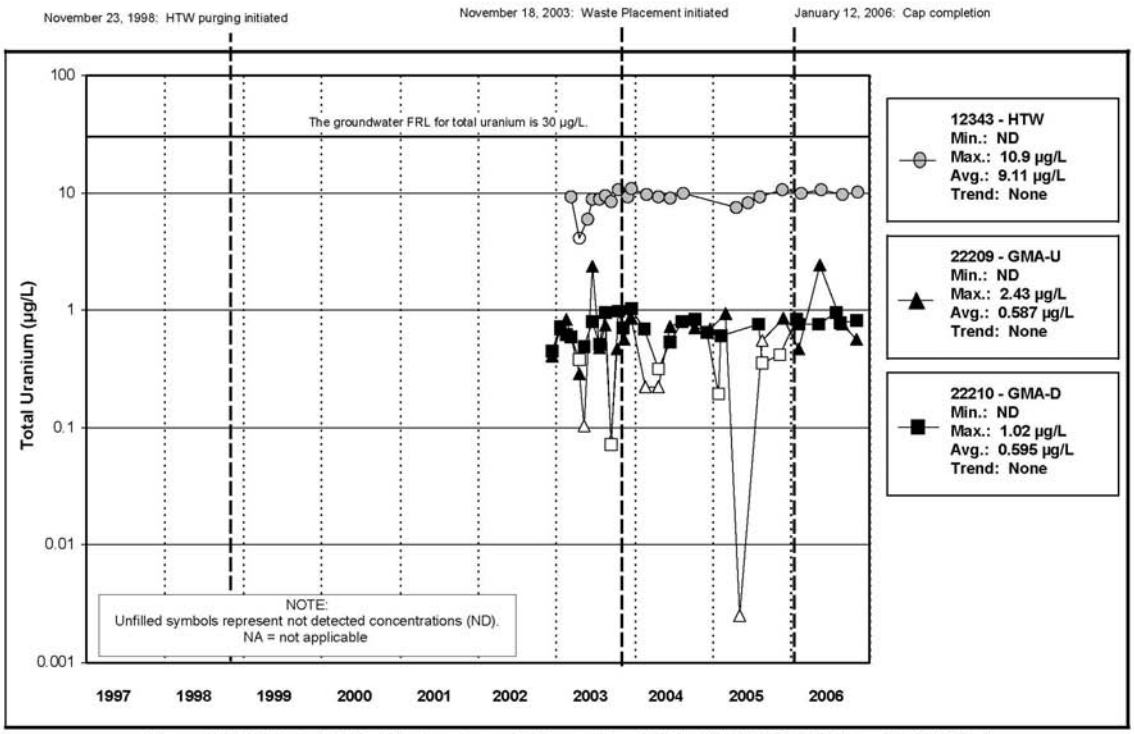


Figure A.5.6-11B. Cell 6 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

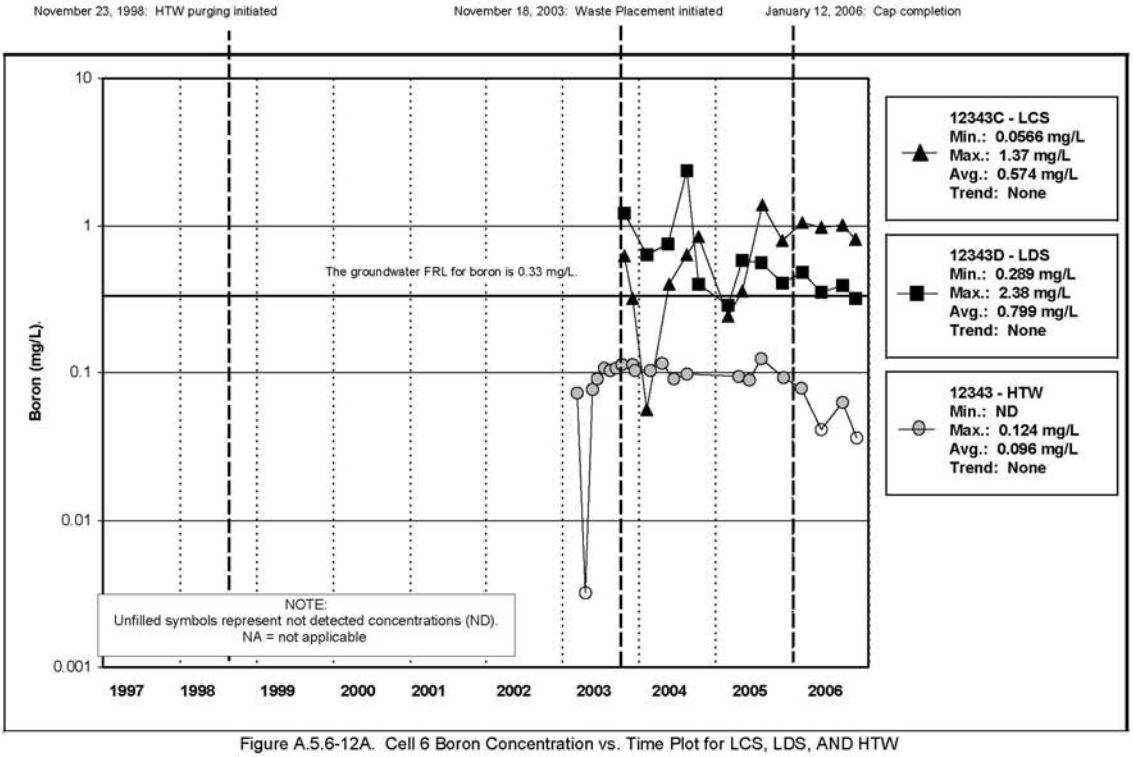


Figure A.5.6-12A. Cell 6 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

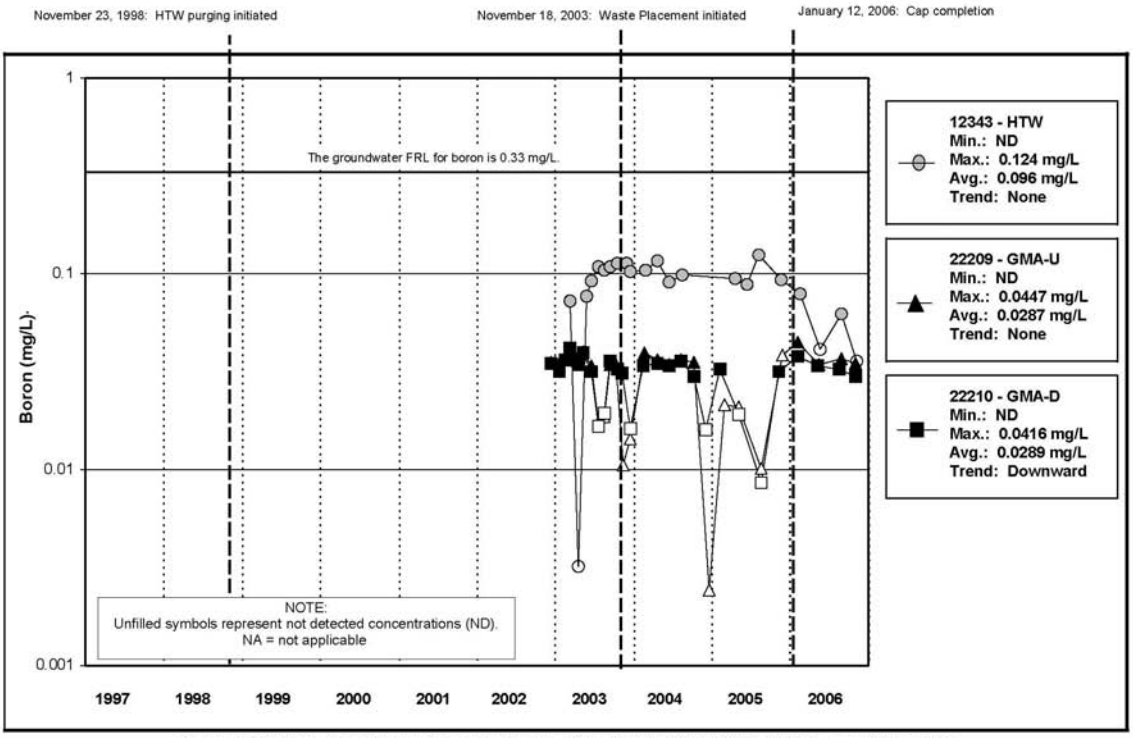


Figure A.5.6-12B. Cell 6 Boron Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

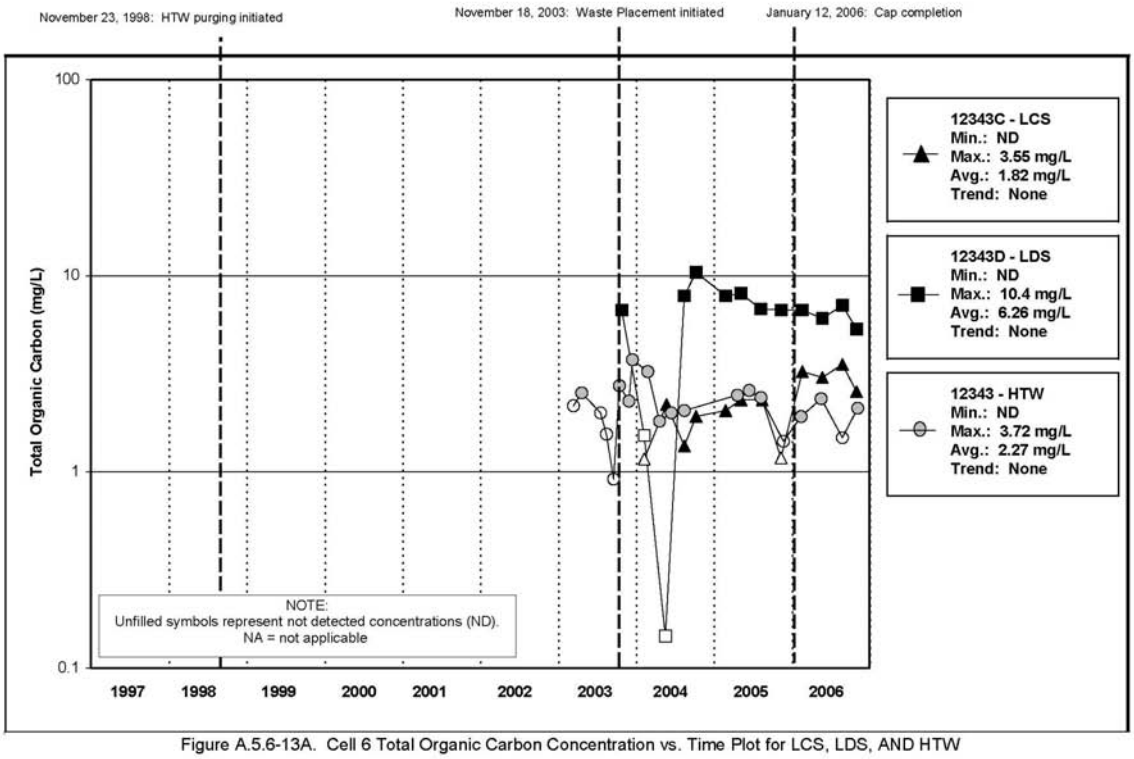


Figure A.5.6-13A. Cell 6 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

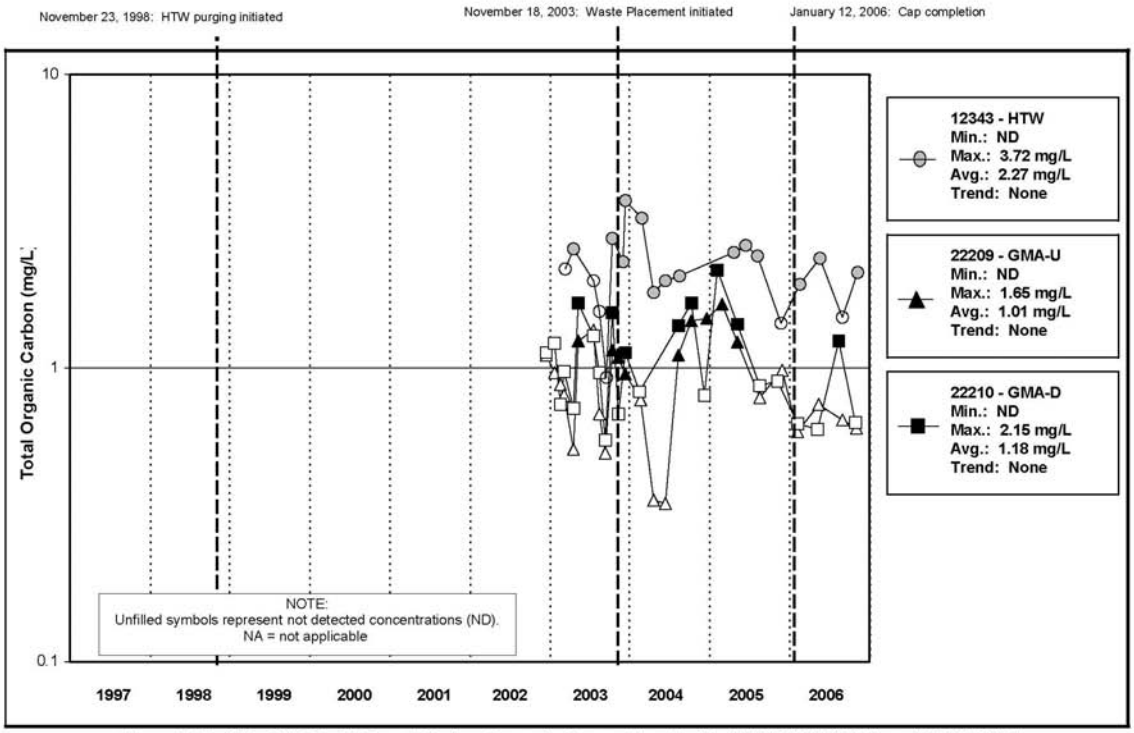


Figure A.5.6-13B. Cell 6 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

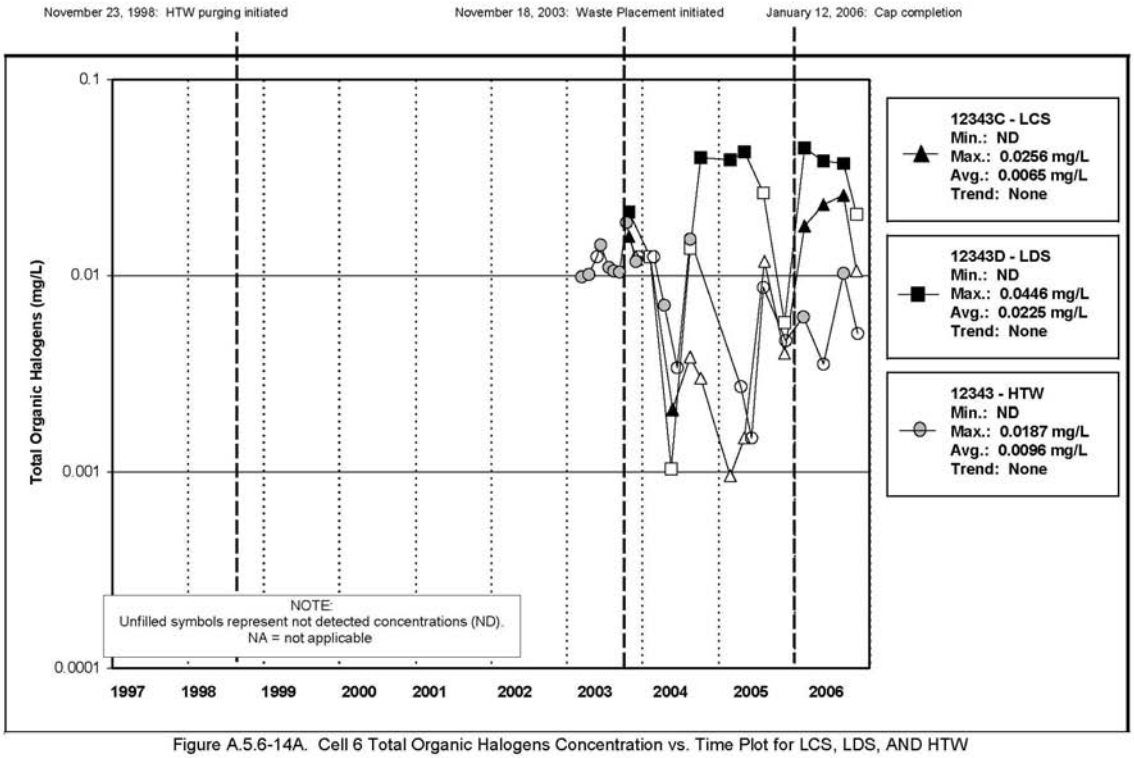


Figure A.5.6-14A. Cell 6 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

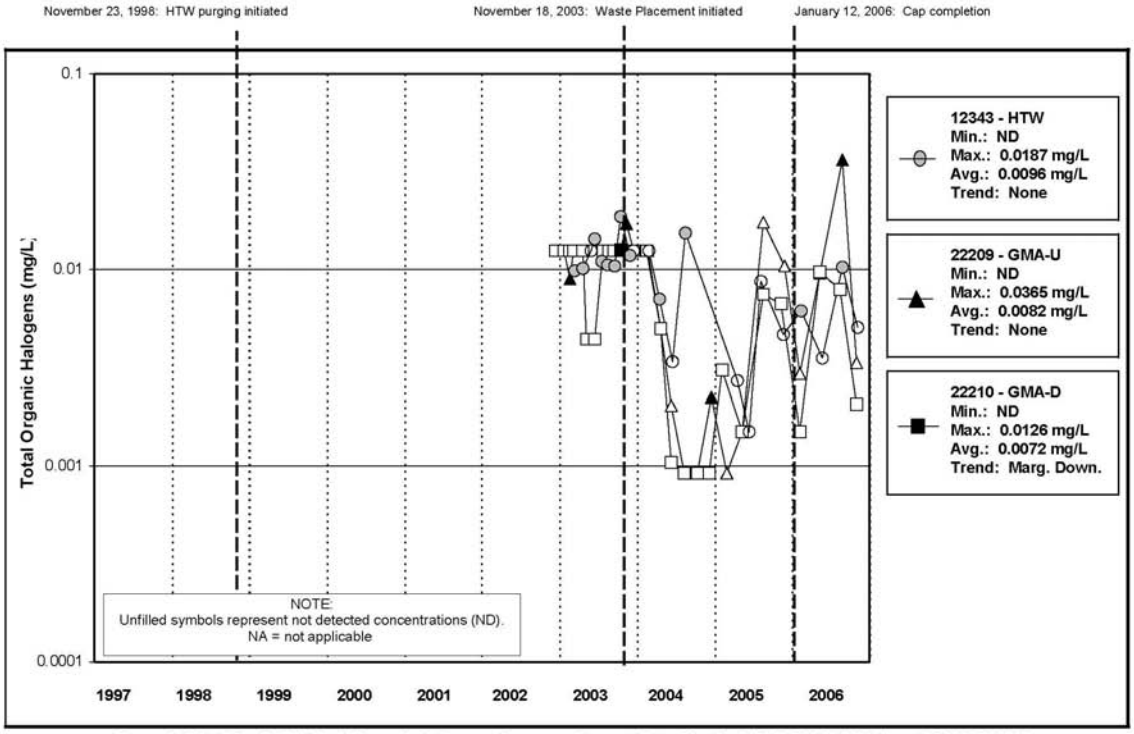


Figure A.5.6-14B. Cell 6 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

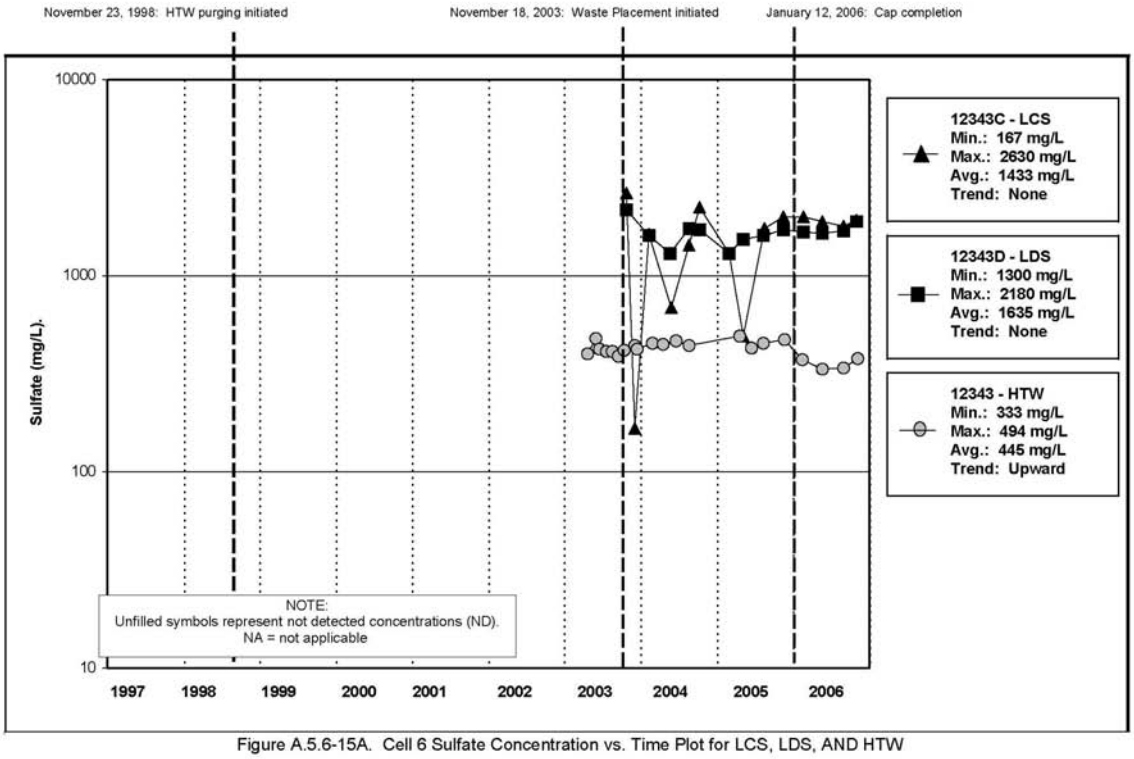


Figure A.5.6-15A. Cell 6 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

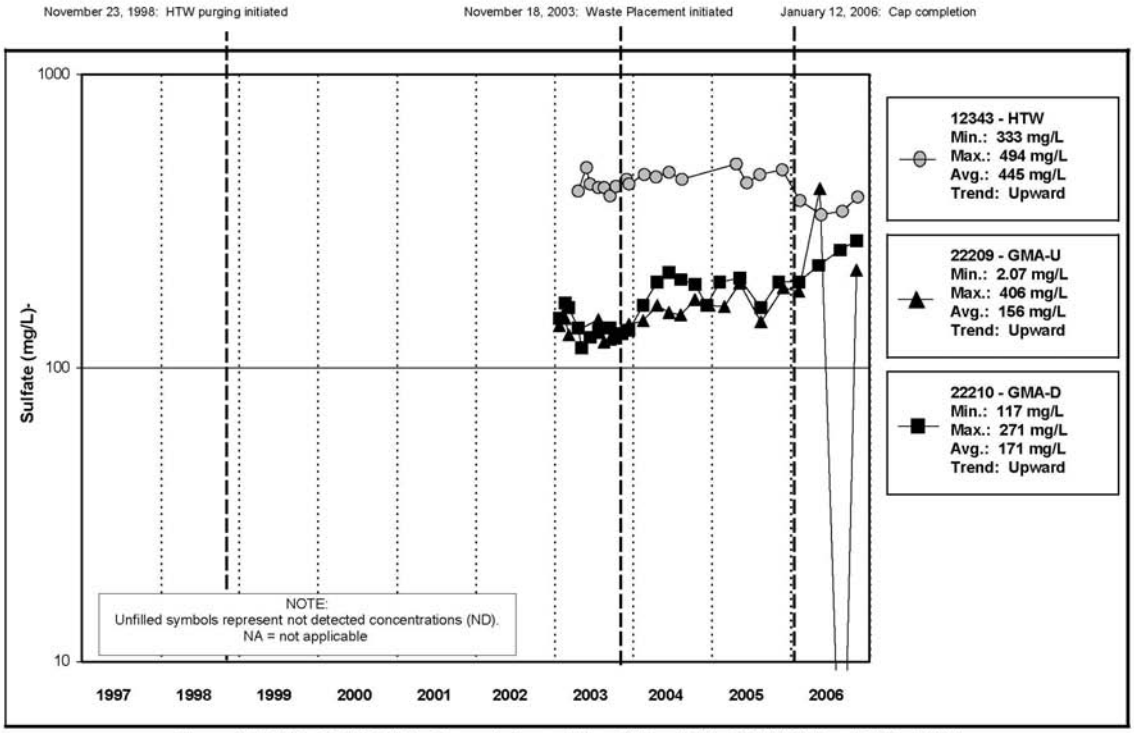


Figure A.5.6-15B. Cell 6 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

End of current text

Attachment A.5.7

Cell 7

The following information is provided in this subattachment:

- LCS weekly and monthly accumulation volumes (refer to Figures A.5.7−1 and A.5.7−2)
- LDS weekly and monthly accumulation volumes (refer to Figures A.5.7−3 and A.5.7−4)
- LDS weekly and monthly accumulation rates and precipitation (refer to Figures A.5.7−5 and A.5.7−6)
- LDS monthly average accumulation rates and waste placement volumes (refer to Figure A.5.7−7)
- HTW Water Yield (refer to Figure A.5.7−8)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.7−9 and A.5.7−10)
- Summary statistics for refined baseline constituents (refer to Section A.5.7.1 and Table A.5.7−1)
- Concentration plots for refined baseline constituents (refer to Section A.5.7.1, and Figures A.5.7−11A through A.5.7−15B)
- Annual LCS monitoring results (refer to Section A.5.7.2 and Table A.5.7−2).
- Annual LDS monitoring results (refer to Section A.5.7.3)

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. At the end of 2005, sufficient data existed to evaluate initial baseline conditions and determine the refined baseline for Cell 7. The data review presented in the 2005 SER concluded that the constituents detected more than 25 percent of the time in the Cell 7 LCS, LDS, HTW, and GMA wells were the same five constituents that had been detected more than 25 percent of the time in Cells 1 through 6. Therefore, the recommendation to change to refined baseline monitoring in Cell 7 was requested in the 2005 SER. This monitoring change was approved by the EPA on July 6, 2006, and by OEPA on August 7, 2006 (via an email). In 2006, all samples were collected for Cell 7 monitoring horizons.

A.5.7.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (refer to Table A.5.7−1) and concentration plots (Figures A.5.7−11A through A.5.7−15B) are provided for the five baseline constituents of Cell 7. For Cell 7, the five constituents are: total uranium, boron, total organic carbon, total organic halogen, and sulfate. Since 2005, total organic halogens concentrations are detected less than 25 percent of the time in the Great Miami Aquifer wells 22211 and 22212.

A.5.7.2 LCS Monitoring Results

Ohio Solid Waste regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and polychlorinated biphenyl (PCB) parameters listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2006, annual sampling of the Cell 7 LCS took place in May. Table A.5.7−3 summarizes the annual LCS sampling results for Cell 7, along with data collected in previous years.

Of the non refined baseline site specific constituents that have been sampled at least eight times, 10 have been detected at lest 25 percent of the time. Nine of the 10 constituents are common ion constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium). Sampling for common ion constituents is temporary. Eight rounds of sampling are being conducted to support the common ion study. It is anticipated that eight rounds of sampling will be completed for all cells in August 2007. A decision concerning what common ion constituents (if any) will be added to the site specific leak detection monitoring list for Cell 7 will be determined based upon results of the common ion study.

The remaining constituent is technetium-99. Technetium-99 is a site specific leak detection parameter. It is not on the refined baseline list for Cell 7. If a site specific constituent (not of the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.7−3, technetium-99 has been detected in the Cell 7 LCS, but these detections were prior to the establishment of the refined baseline for Cell 7. Therefore confirmatory sampling for technetium-99 in the Cell 7 LCS is not required.

A.5.7.3 LDS Monitoring Results

Each year the LDS of Cell 7 is sampled for site specific baseline parameters listed in Table 2−1 of Appendix B of the OSDF GWLMP. As with the LCS, the objective of the annual LDS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility.

In 2006, of the non-refined baseline constituents that have been sampled at least eight times, 10 have been detected at least 25 percent of the time (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, phosphorous, potassium, and sodium). All ten of these constituents are common ion constituents.

Table A.5.7−1. Summary Statistics for Cell 7

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]
Total Uranium (µg/L)	LCS	12344C	10	10	100%	147	Normal	Upward	Marg. Detect	
	LDS	12344D	9	9	100%	22.6	Normal	None	Insuff. Data	
	HTW	12344	12	12	100%	2.61	Lognormal	None	Not Detected	
	GMA-U	22212	9	10	90%	0.44	Normal	None	Not Detected	1.64 (Q1-04) 4.46 (Q1-05)
	GMA-D	22211	12	12	100%	0.80	Lognormal	None	Not Detected	
Boron (mg/L)	LCS	12344C	10	10	100%	0.821	Lognormal	None	Not Detected	
	LDS	12344D	9	9	100%	0.603	Lognormal	Downward	Insuff. Data	
	HTW	12344	7	12	58%	0.0225	Lognormal	Downward	Marg. Detect	
	GMA-U	22212	10	10	100%	0.0350	Normal	None	Not Detected	0.0247 (Q3-04) 0.0269 (Q4-04)
	GMA-D	22211	10	10	100%	0.0269	Normal	None	Not Detected	0.0230 U (Q3-04) 0.0276 U (Q4-04)
Total Organic Carbon (mg/L)	LCS	12344C	6	9	67%	1.84	Normal	None	Insuff. Data	
	LDS	12344D	9	9	100%	6.20	Normal	None	Insuff. Data	
	HTW	12344	10	12	83%	2.09	Lognormal	Marg. Down.	Detected	
	GMA-U	22212	8	12	67%	0.91	Lognormal	None	Not Detected	
	GMA-D	22211	7	12	58%	0.70	Undefined	None	Not Detected	
Total Organic Halogens (mg/L)	LCS	12344C	3	10	30%	0.0066	Lognormal	None	Not Detected	
	LDS	12344D	3	9	33%	0.0211	Lognormal	None	Insuff. Data	
	HTW	12344	4	12	33%	0.0128	Lognormal	None	Not Detected	
	GMA-U	22212	2	12	17%	0.0050	Undefined	None	Not Detected	
	GMA-D	22211	1	12	8%	0.0031	Undefined	None	Not Detected	
Sulfate (mg/L)	LCS	12344C	10	10	100%	1340	Normal	Upward	Detected	
	LDS	12344D	9	9	100%	1670	Lognormal	Downward	Insuff. Data	
	HTW	12344	12	12	100%	114	Normal	Downward	Detected	
	GMA-U	22212	11	11	100%	145	Normal	Upward	Detected	352 (Q1-05)
	GMA-D	22211	12	12	100%	219	Lognormal	Marg. Up.	Not Detected	

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptiions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down." is a marginally downward trend and "Marg. Up." is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

U = Not Detected at that concentration

Table A.5.7−2. Cell 7 Annual LCS Sample Summary Information

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (#OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
Alkalinity as CaCO3 (mg/L)	8	8	100.0%	86	822	330	-	422 mg/L (2)	430 mg/L (2)	-	10 mg/L
Ammonia (mg/L)	3	1	33.3%	0.254	-	-	-	4.2 mg/L (0)	4.34 mg/L (0)	220 mg/L (0)	0.1 mg/L
Arsenic (mg/L)	3	1	33.3%	0.0015	-	-	0.05 mg/L (0)	0.029 mg/L (0)	0.019 mg/L (0)	0.191 mg/L (0)	0.02 mg/L
Barium (mg/L)	3	3	100.0%	0.0347	0.112	0.073	2 mg/L (0)	0.77 mg/L (0)	0.45 mg/L (0)	0.589 mg/L (0)	0.029 mg/L
Beryllium (mg/L)	3	2	66.7%	0.00017	0.00025	-	0.004 mg/L (0)	-	-	0.0343 mg/L (0)	0.001 mg/L
Cadmium (mg/L)	3	1	33.3%	0.0002	-	-	0.014 mg/L (0)	0.014 mg/L (0)	-	0.05 mg/L (0)	0.002 mg/L
Calcium (mg/L)	8	8	100.0%	153	650	401	-	159 mg/L (7)	172 mg/L (6)	1800 mg/L (0)	5 mg/L
Chloride (mg/L)	8	8	100.0%	26.7	109	67	-	7.3 mg/L (7)	45 mg/L (4)	6300 mg/L (0)	5 mg/L
Cobalt (mg/L)	3	3	100.0%	0.0016	0.0050	0.0028	0.17 mg/L (0)	0.0086 mg/L (0)	-	0.0886 mg/L (0)	0.034 mg/L
Copper (mg/L)	3	3	100.0%	0.0059	0.0138	0.0104	1.3 mg/L (0)	0.035 mg/L (0)	0.029 mg/L (0)	0.298 mg/L (0)	0.008 mg/L
Fluoride (mg/L)	7	7	100.0%	0.210	0.536	0.364	4 mg/L (0)	0.89 mg/L (0)	1.3 mg/L (0)	6.8 mg/L (0)	0.2 mg/L
Iron (mg/L)	8	8	100.0%	1.84	18.7	6.1	-	5.72 mg/L (2)	6.35 mg/L (2)	21.3 mg/L (0)	0.1 mg/L
Lead (mg/L)	3	1	33.3%	0.0061	-	-	0.015 mg/L (0)	0.022 mg/L (0)	0.0016 mg/L (1)	0.0114 mg/L (0)	0.008 mg/L
Magnesium (mg/L)	8	8	100.0%	60.5	380	208	-	38.5 mg/L (8)	50.7 mg/L (8)	690 mg/L (0)	5 mg/L
Manganese (mg/L)	8	8	100.0%	0.0226	0.898	0.225	0.9 mg/L (0)	0.9 mg/L (0)	0.21 mg/L (3)	35 mg/L (0)	0.09 mg/L
Nickel (mg/L)	3	3	100.0%	0.0063	0.0175	0.0117	0.1 mg/L (0)	0.0514 mg/L (0)	0.0072 mg/L (2)	0.981 mg/L (0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	9	5	55.6%	0.117	10.7	3.4	11[g] mg/L (0)	11 mg/L (0)	0.29 mg/L (4)	2670 mg/L (0)	1.1 mg/L
Phosphorus (mg/L)	7	3	42.9%	0.11	0.254	0.17	-	-	-	-	0.1 mg/L
Potassium (mg/L)	8	8	100.0%	8.12	61.4	30.9	-	1.96 mg/L (8)	17.2 mg/L (5)	12400 mg/L (0)	5 mg/L
Silicon (mg/L)	7	7	100.0%	2.84	10.6	6.0	-	-	-	15 mg/L (0)	0.015 mg/L
Sodium (mg/L)	8	8	100.0%	18.1	75.2	50.1	-	47.1 mg/L (5)	50 mg/L (5)	1300 mg/L (0)	5 mg/L
Technetium-99 (pCi/L)	8	4	50.0%	10.8	16.2	13.0	94 pCi/L (0)	22 pCi/L (0)	30 pCi/L (0)	6130 pCi/L (0)	10 pCi/L
Thallium (mg/L)	3	1	33.3%	0.00046	-	-	-	-	-	0.0028 mg/L (0)	0.02 mg/L
Total Dissolved Solids (mg/L)	4	4	100.0%	960	3840	2080	-	-	-	-	10 mg/L
Vanadium (mg/L)	3	1	33.3%	0.0051	-	-	0.038 mg/L (0)	0.012 mg/L (0)	0.005 mg/L (1)	0.299 mg/L (0)	0.02 mg/L
Zinc (mg/L)	3	3	100.0%	0.0142	0.154	0.063	0.021 mg/L (1)	0.02 mg/L (2)	0.35 mg/L (0)	1.78 mg/L (0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information
[b]Rejected data qualified with an R or Z were not included.
[c]If the number of detected samples is equal to two, then the minumun and maximumn are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.
[d]From Operable Unit 5 Record of Decision, Table 9-4.
[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.
[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.
[g]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

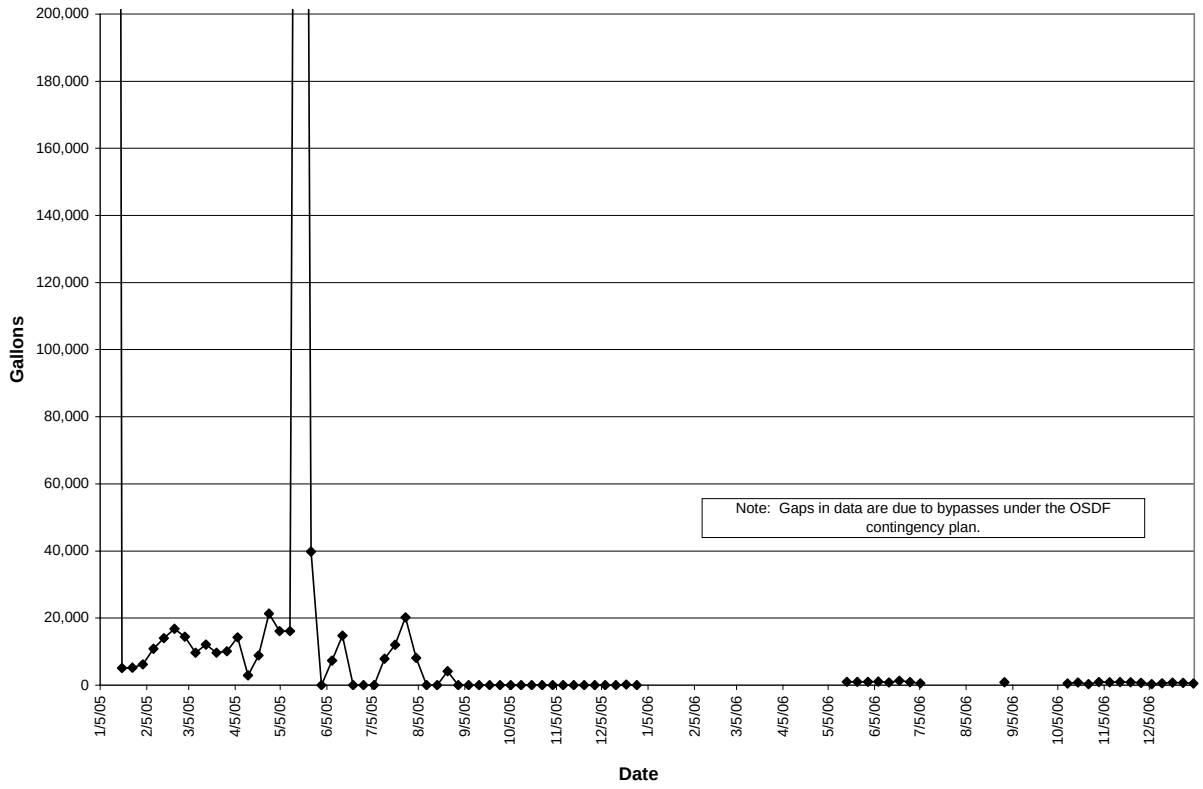


FIGURE A.5.7-1. Weekly Accumulation Volumes for Cell 7 LCS

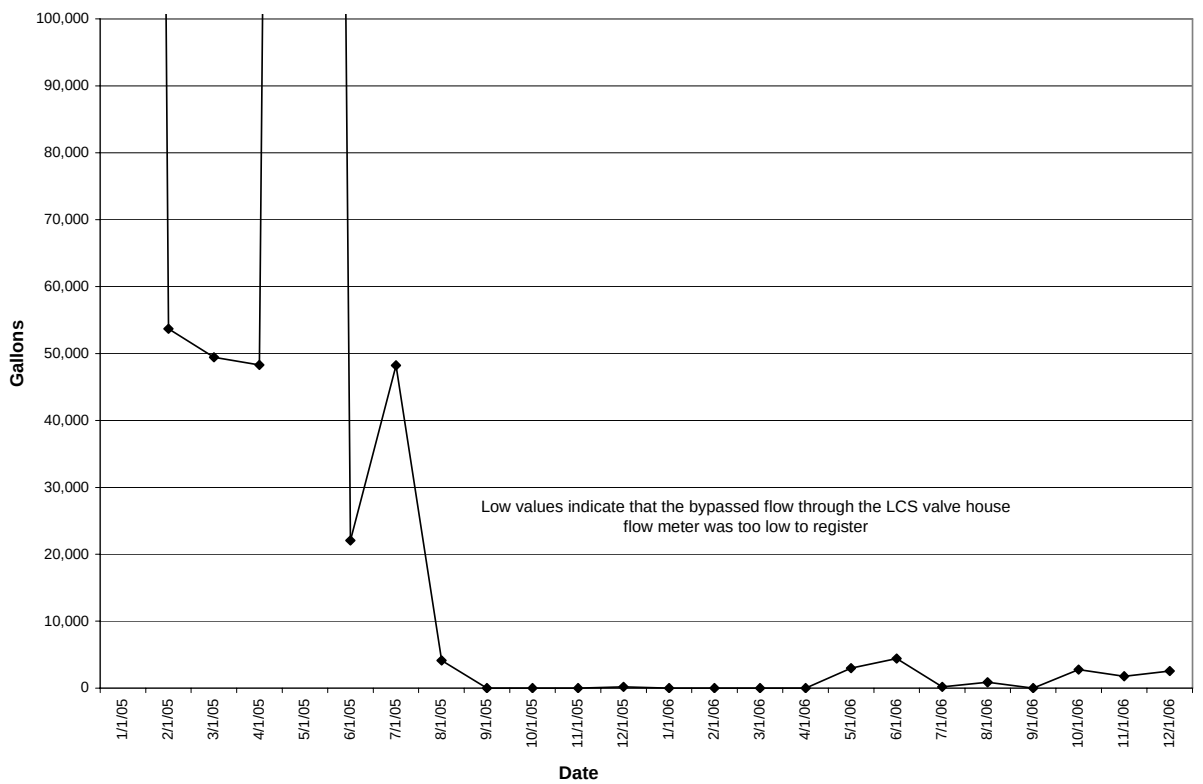


FIGURE A.5.7-2. Monthly Accumulation Volumes for Cell 7 LCS

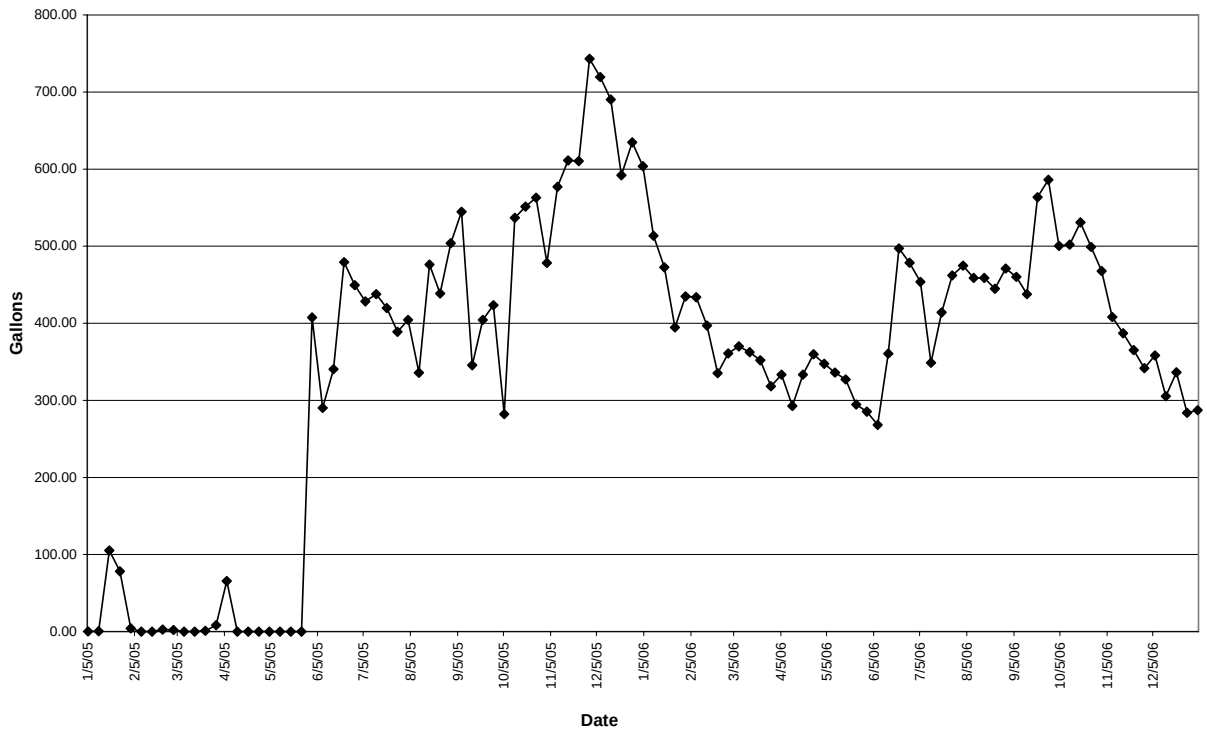


FIGURE A.5.7-3. Weekly Accumulation Volumes for Cell 7 LDS

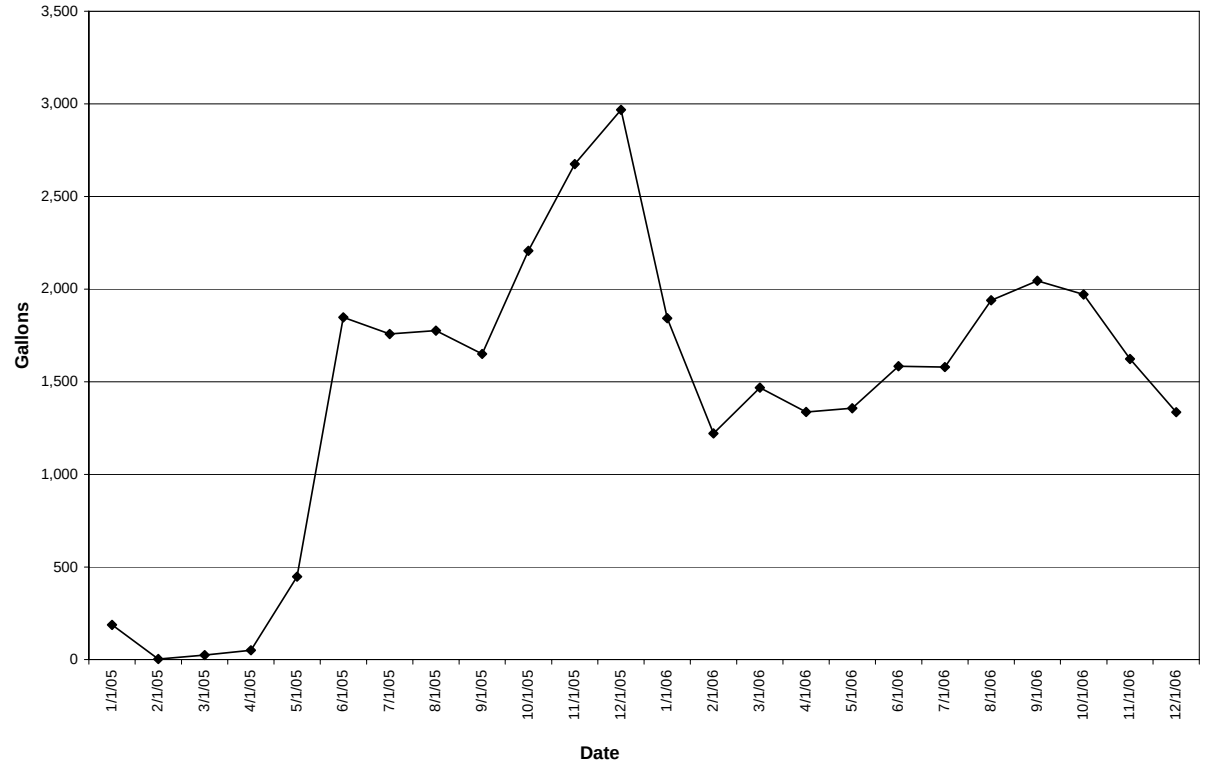


FIGURE A.5.7-4. Monthly Accumulation Volumes for Cell 7 LDS

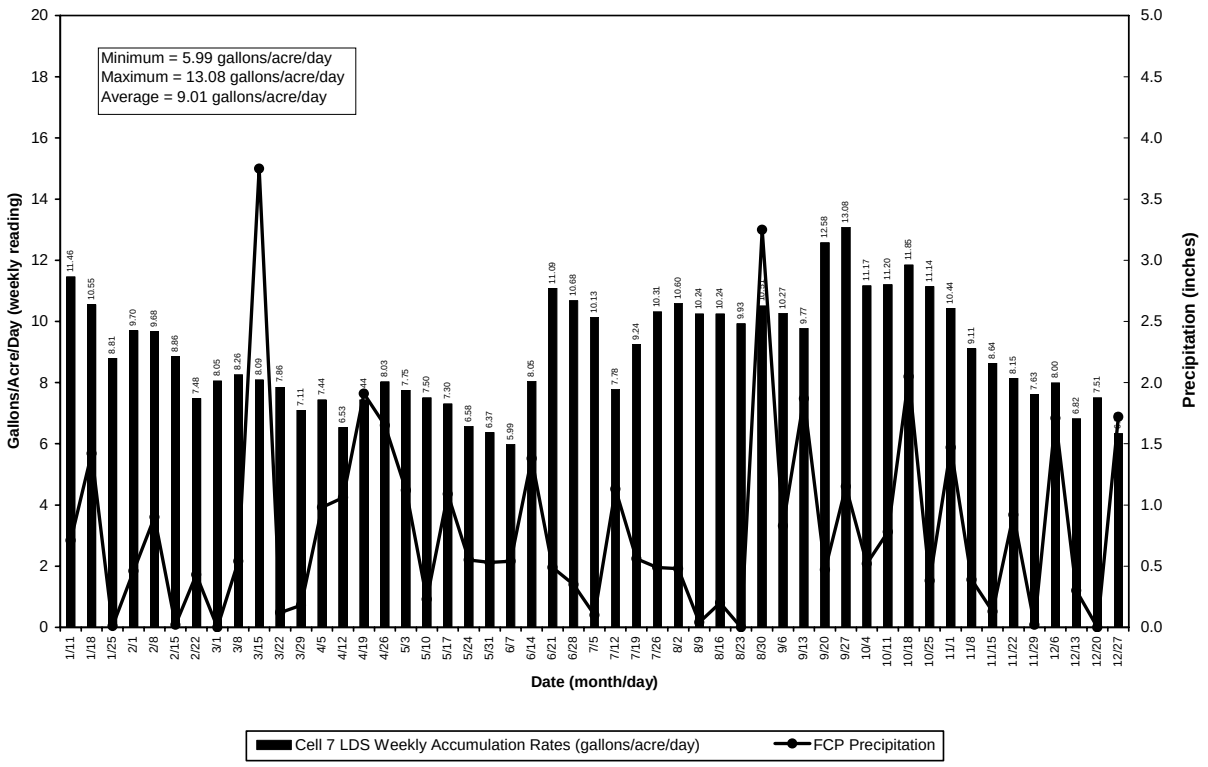


FIGURE A.5.7-5. 2006 OSDF LDS Weekly Accumulation Rates and Precipitation for Cell 7

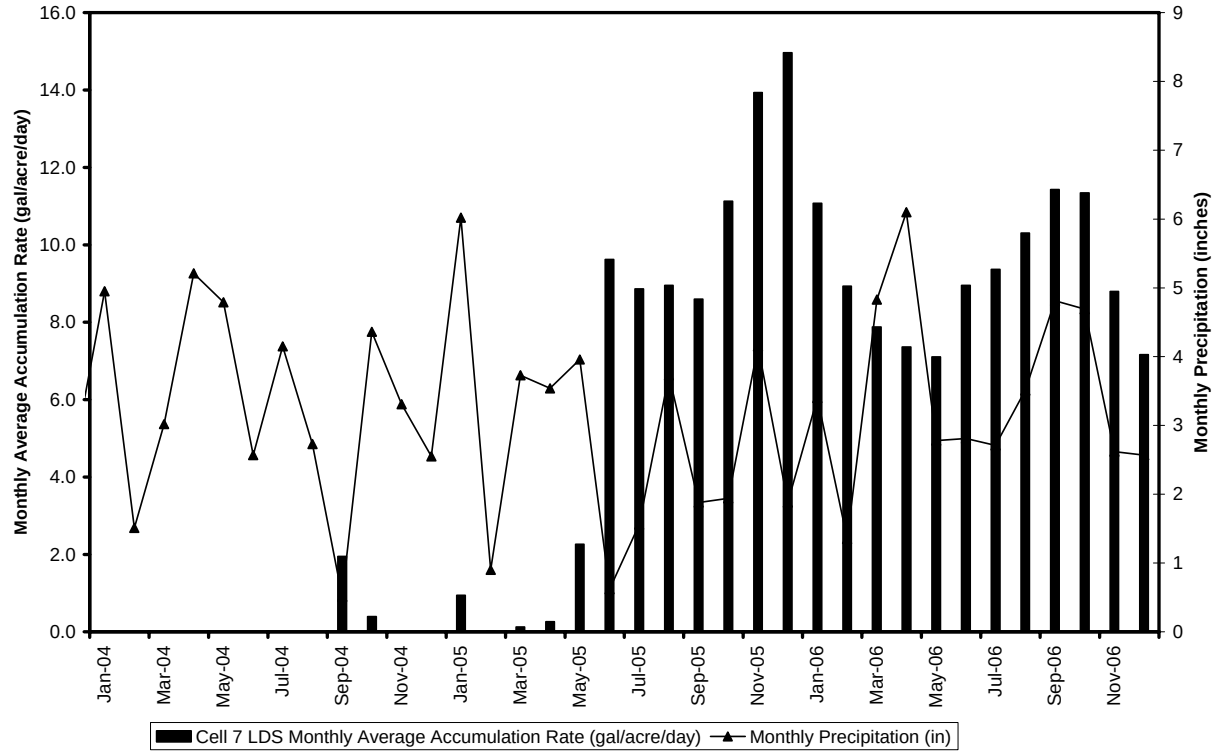


FIGURE A.5.7-6. OSDF Cell 7 LDS Monthly Average Accumulation Rates and Monthly Precipitation

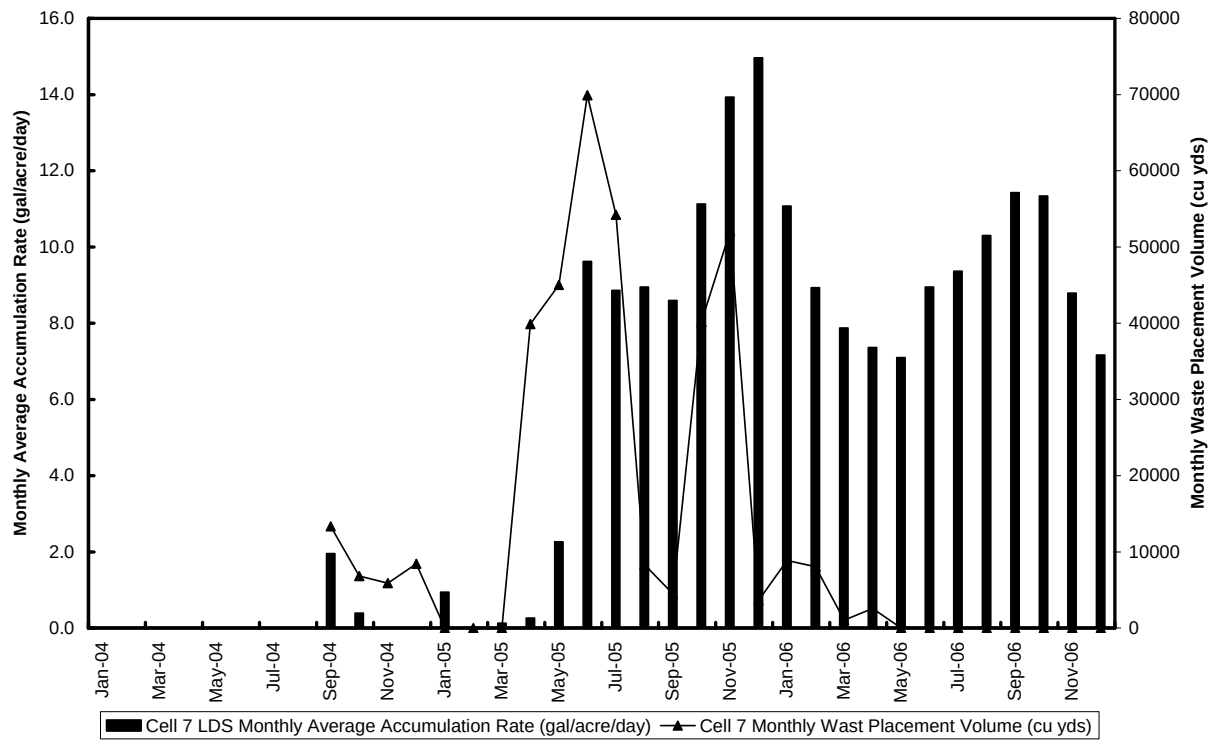
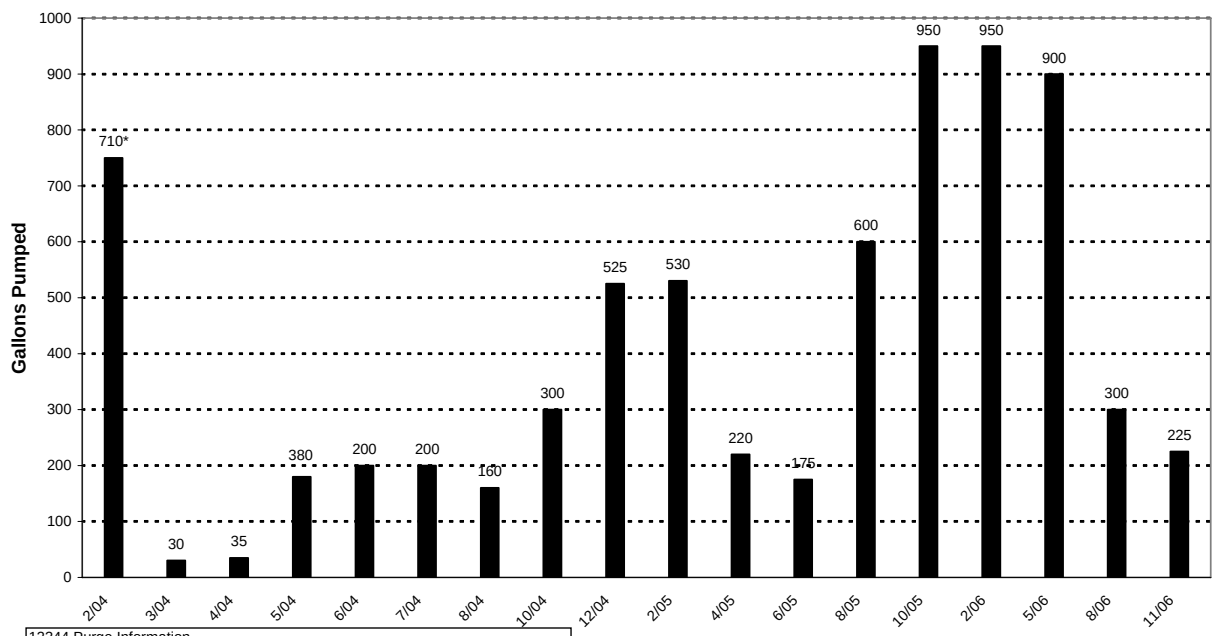


FIGURE A.5.7-7. OSDF Cell 7 LDS Monthly Average Accumulation Rates and Monthly Waste Placement Volumes



12344 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2004:	2380	n=9	264
2005:	2475	n=5	495
2006:	2375	n=4	594
Overall:			402

*More than one purge of the well was completed during this month to drain perched water and infiltrating surface water so the compacted clay liner could be constructed.

FIGURE A.5.7-8. OSDF Horizontal Till Well 12344 (Cell 7) Water Yield

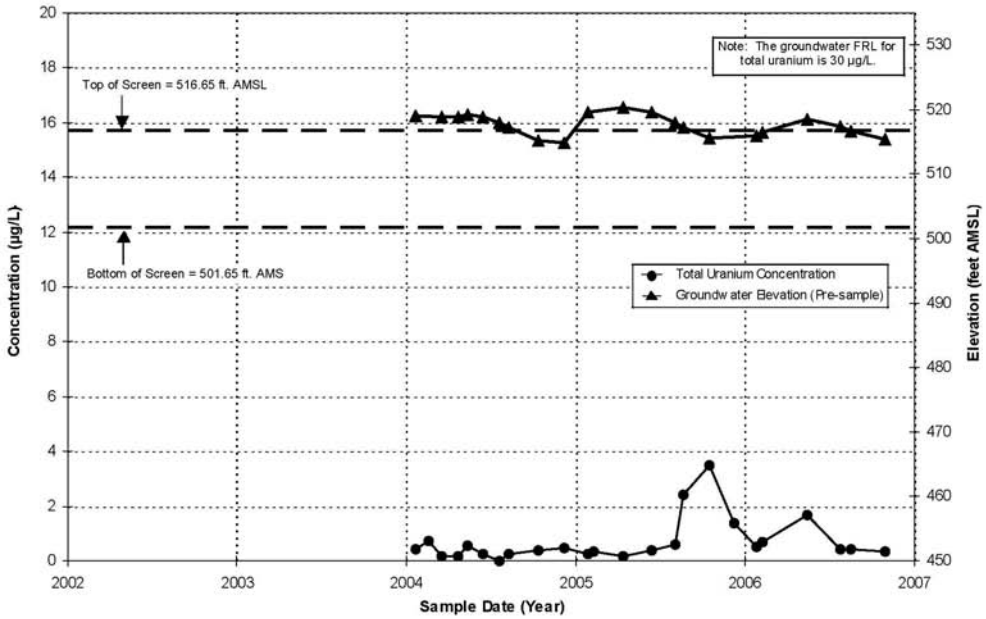


Figure A.5.7-9. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 7 Upgradient Monitoring Well 22212

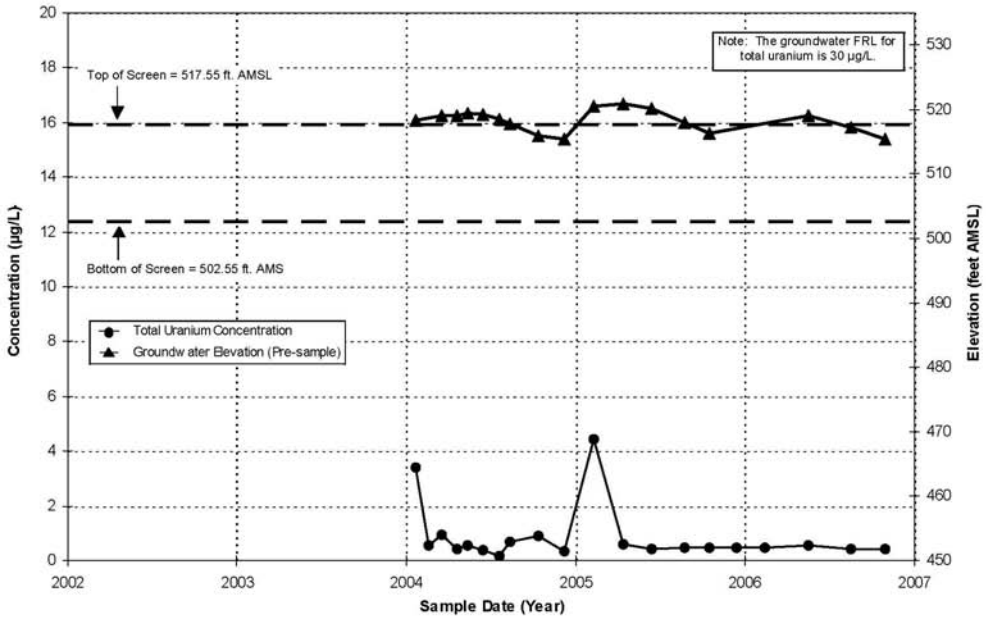


Figure A.5.7-10. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 7 Downgradient Monitoring Well 22211

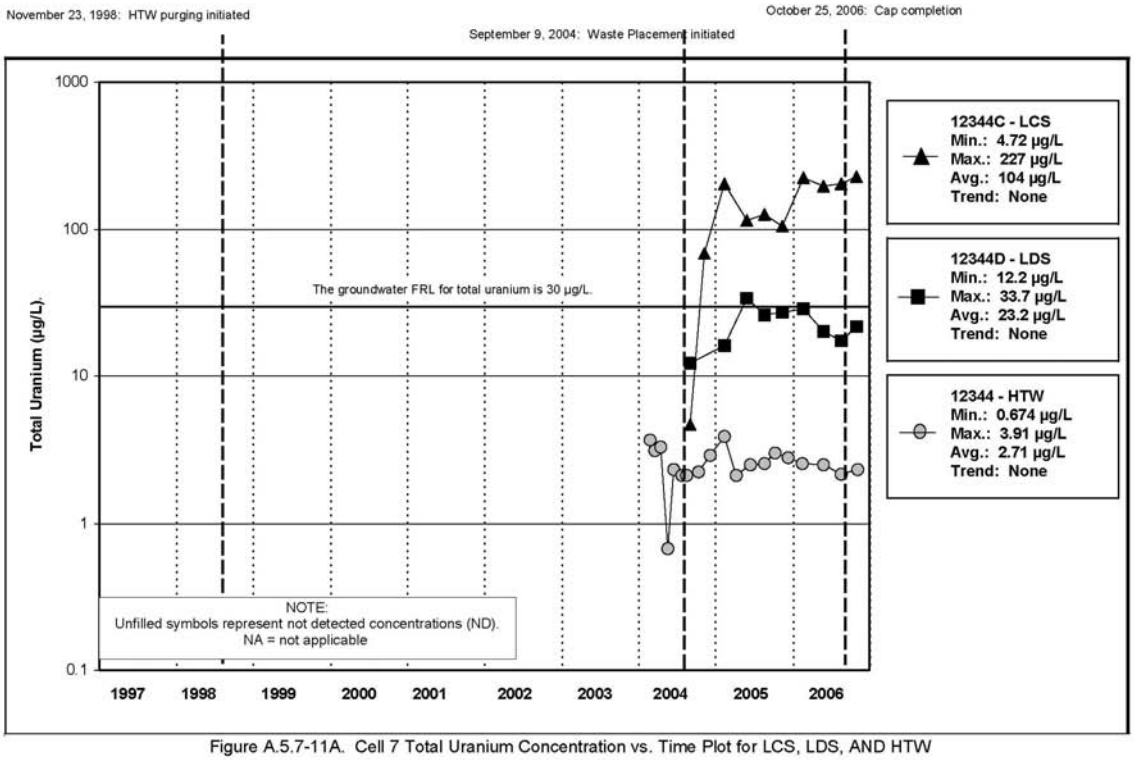


Figure A.5.7-11A. Cell 7 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

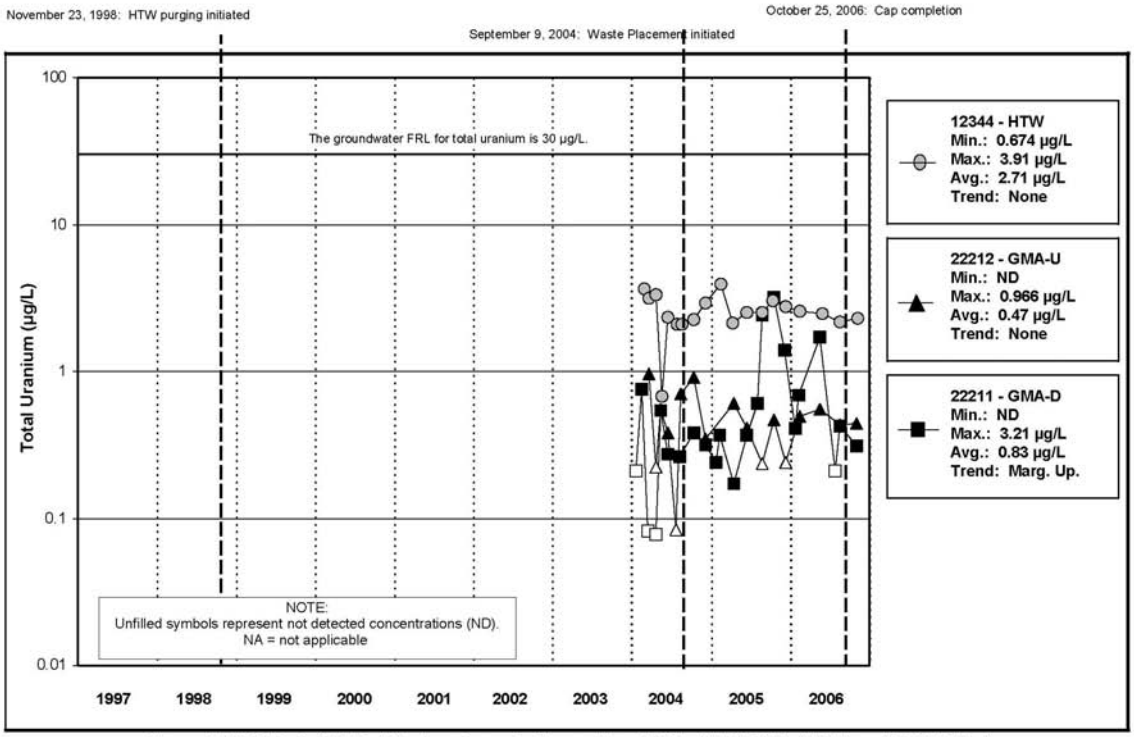


Figure A.5.7-11B. Cell 7 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

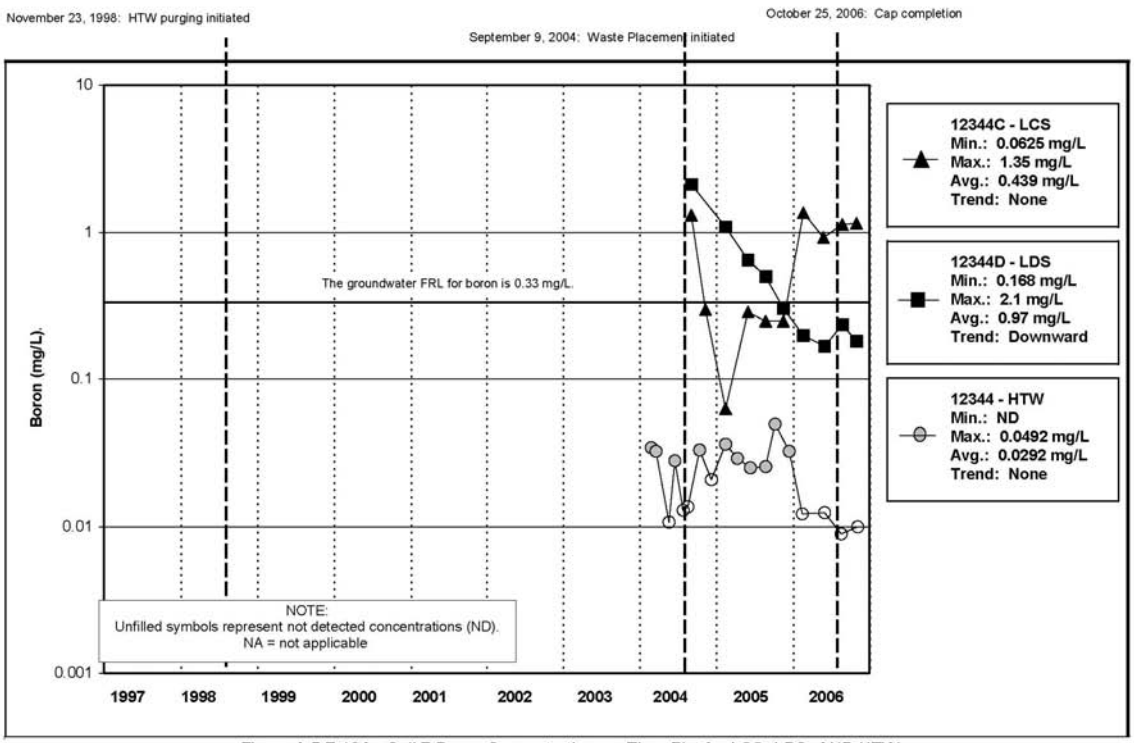


Figure A.5.7-12A. Cell 7 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

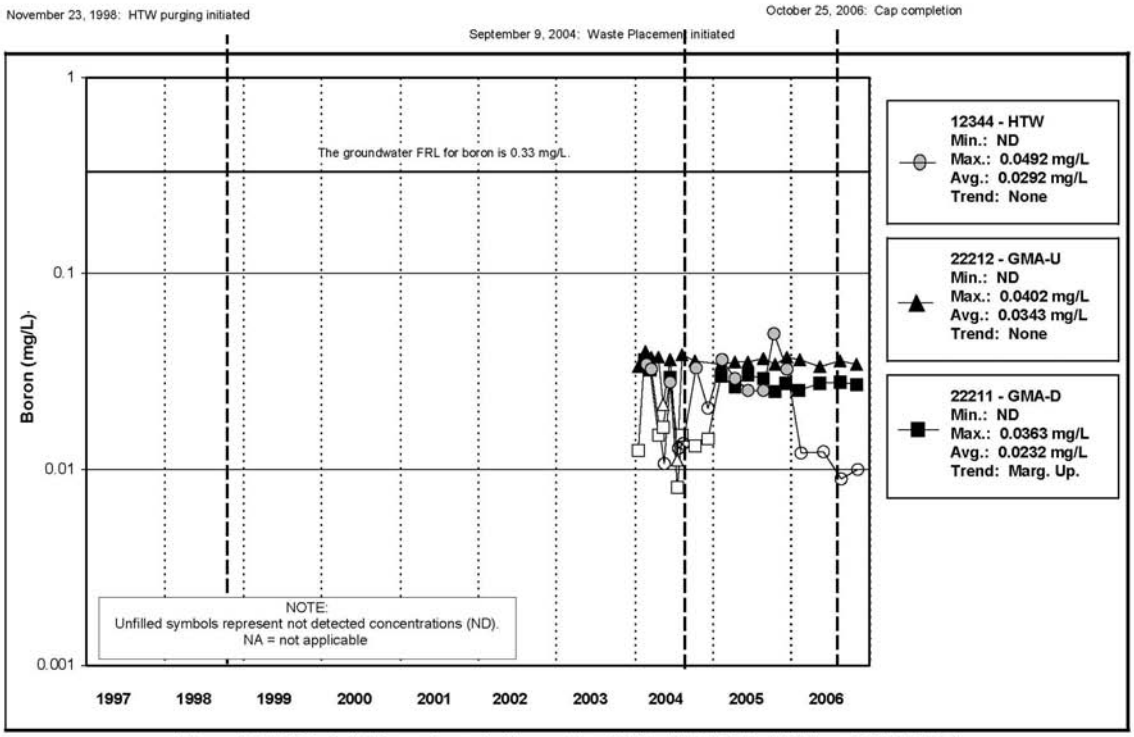


Figure A.5.7-12B. Cell 7 Boron Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

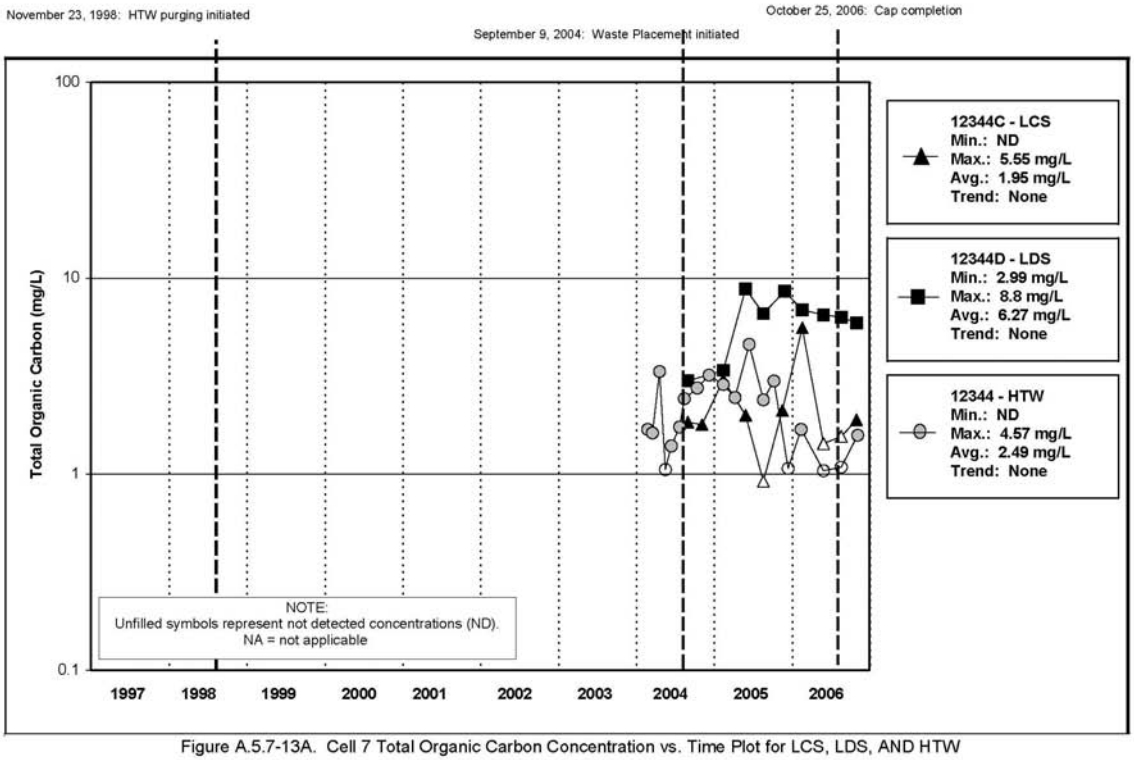


Figure A.5.7-13A. Cell 7 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

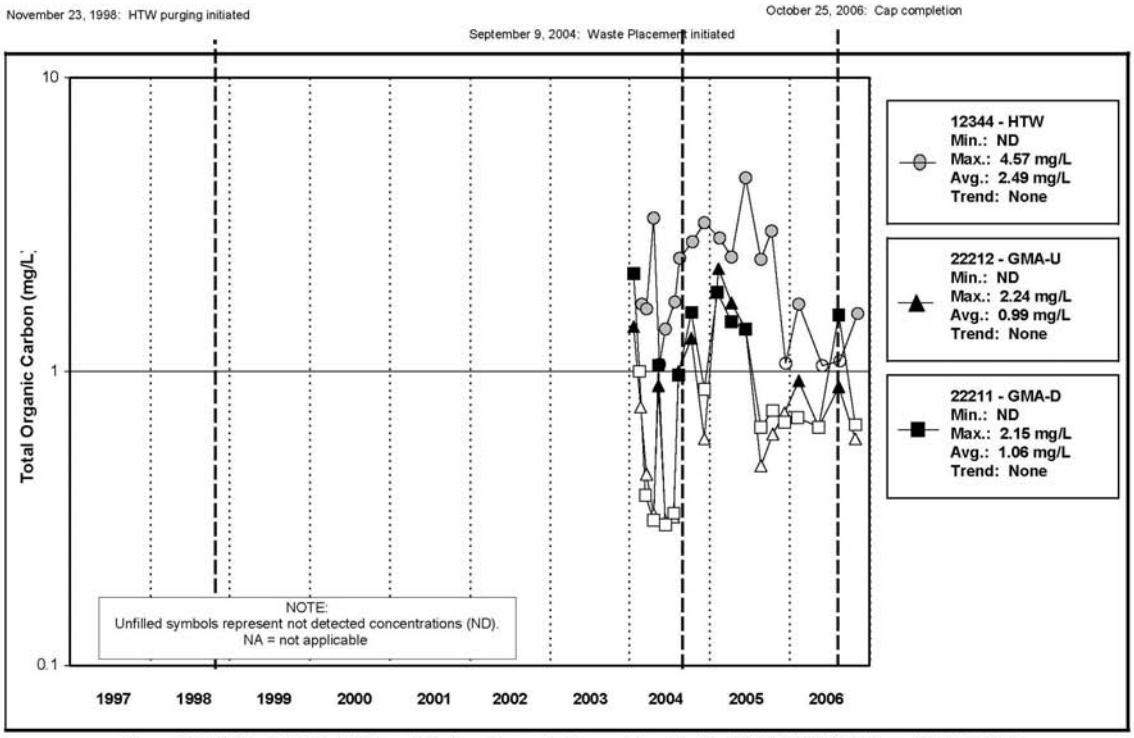


Figure A.5.7-13B. Cell 7 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

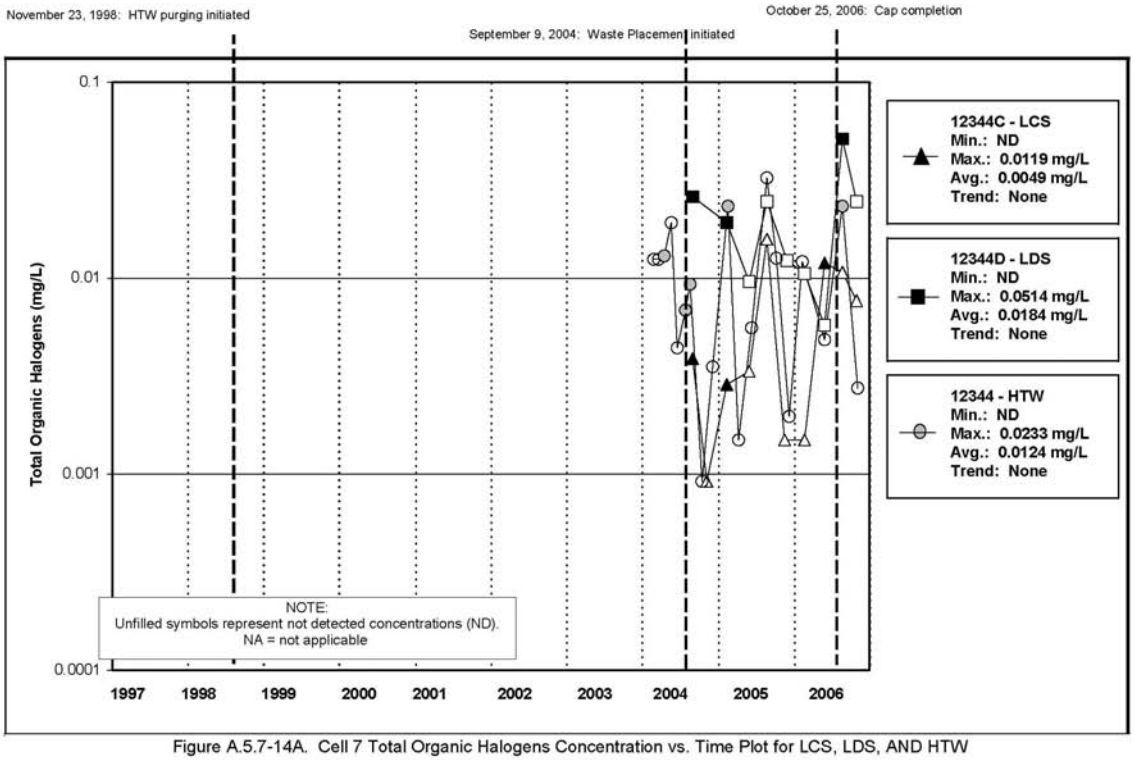


Figure A.5.7-14A. Cell 7 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

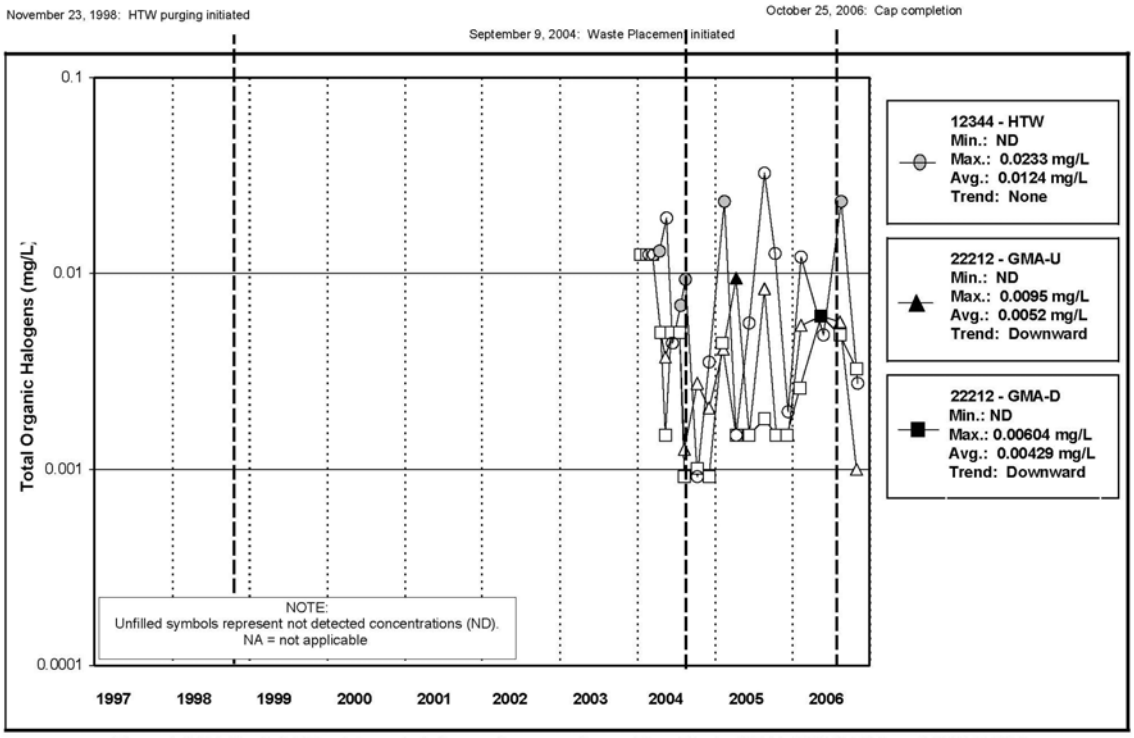


Figure A.5.7-14B. Cell 7 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

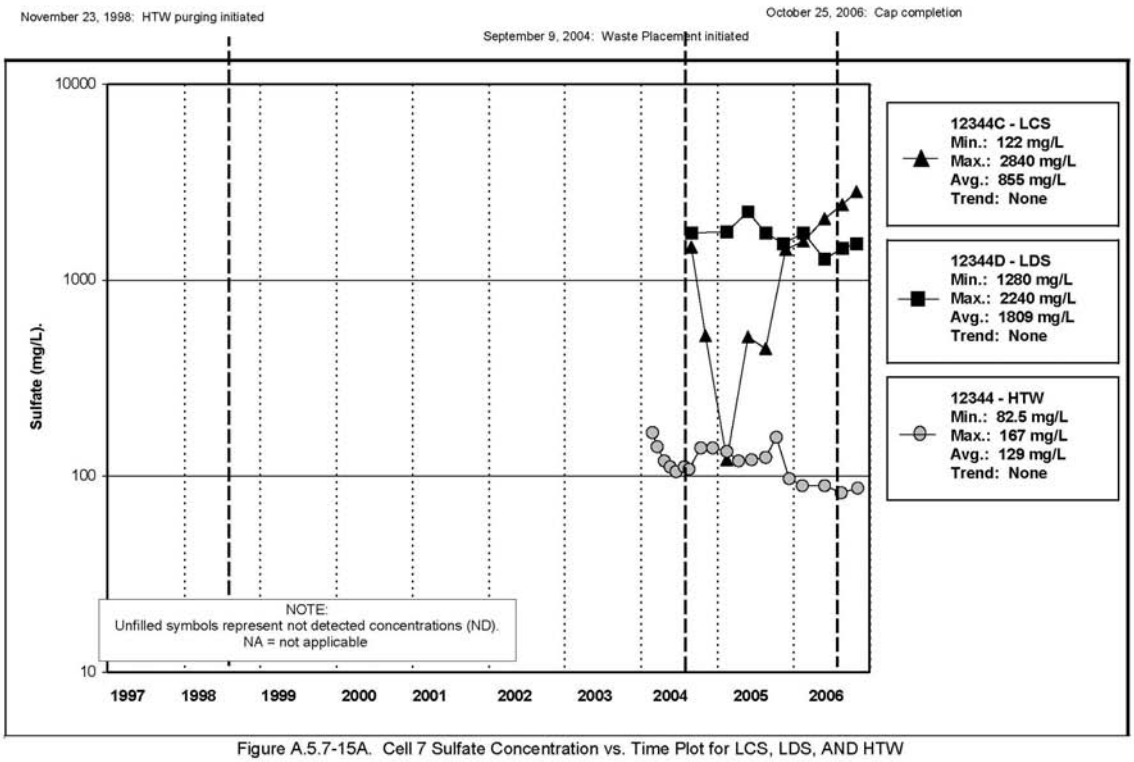


Figure A.5.7-15A. Cell 7 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

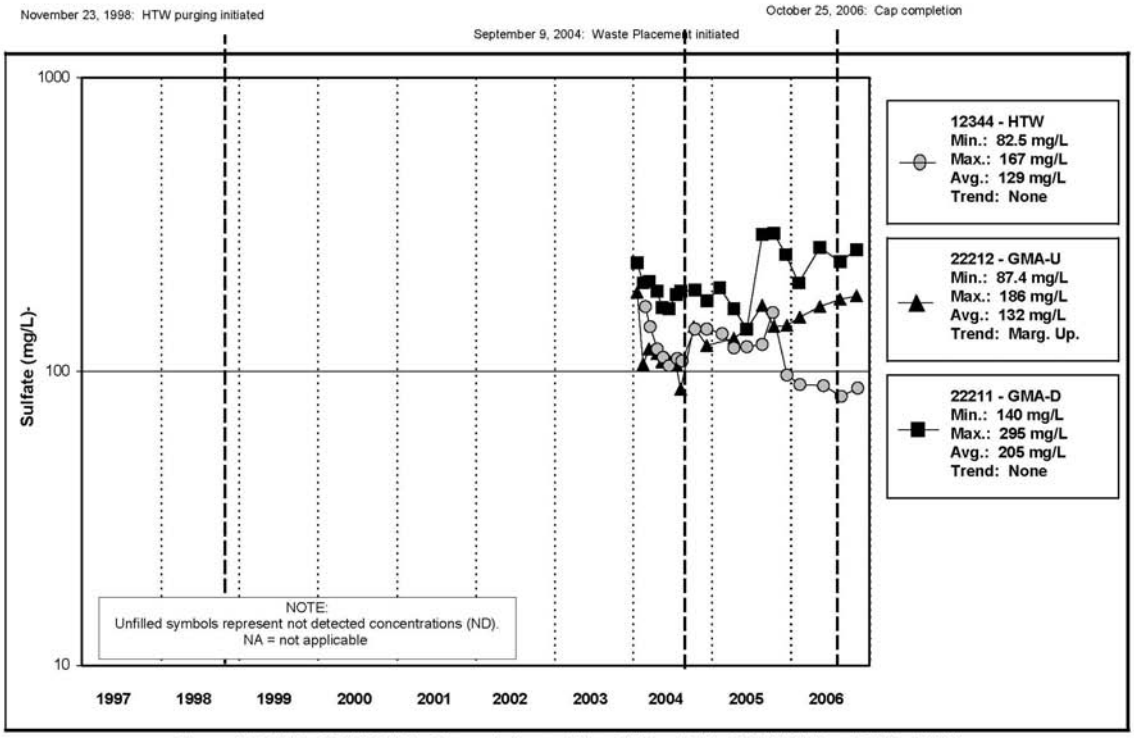


Figure A.5.7-15B. Cell 7 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, and GMA-D Well

Attachment A.5.8

Cell 8

The following information is provided in this subattachment:

- LCS weekly and monthly accumulation volumes (refer to Figures A.5.8−1 and A.5.8−2)
- LDS weekly and monthly accumulation volumes (refer to Figures A.5.8−3 and A.5.8−4)
- LDS weekly and monthly accumulation rates and precipitation (refer to Figures A.5.8−5 and A.5.8−6)
- LDS monthly average accumulation rates and waste placement volumes (refer to Figure A.5.8−7)
- HTW Water Yield (refer to Figure A.5.8−8)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.8−9 and A.5.8−10)
- Summary of initial baseline constituents (refer to Section A.5.8.1 Table A.5.8−1)
- Annual LCS monitoring results (refer to Section A.5.8.2, and Table A.5.8−2)
- Annual LDS monitoring results (refer to Section A.5.8.3).

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2006, Cell 8 was sampled for initial baseline constituents. All samples were collected from Cell 8 monitoring horizons.

A.5.8.1 Initial Baseline Monitoring Results

Initial baseline constituents are listed in Table 2−1 of Appendix B of the OSDF GWLMP. Table A.5.8−1 presents summary analytical information for Cell 8. The table shows that seven constituents were detected (i.e., total organic carbon, total organic halogens, boron, mercury, sulfate, technetium-99, and total uranium). Six of these constituents were detected more than 25 percent of the time. Mercury has not been detected more than 25 percent of the time and it has only been detected in the up gradient and down gradient GMA wells. Completion of 12 rounds of sampling for initial baseline constituents in all monitoring horizons of Cell 8 is scheduled for 2007. If the results for 2007 are similar to results through 2006, it appears that Cell 8 will have the same refined baseline list of sampling constituents as has Cell 1 through Cell 7.

A.5.8.2 LCS Sampling Results

Ohio solid Waste regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and polychlorinated biphenyl (PCB) parameters listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2006, annual sampling of the Cell 8 LCS took place in May. Table A.5.8−2 summarizes the annual LCS sampling results for Cell 8, along with data collected in previous years.

Of the non refined baseline site specific constituents that have been sampled at least eight times, four have been detected at least 25 percent of the time. Three of the four constituents are

common ion constituents (alkalinity, chloride, and nitrate/nitrite). Sampling for common ion constituents is temporary. Eight rounds of sampling are being conducted to support the common ion study. It is anticipated that eight rounds of sampling will be completed for all cells in August 2007. A decision concerning what common ion constituents (if any) will be added to the site specific leak detection monitoring list for Cell 8 will be determined based upon the results of the common ion study.

The remaining constituent is technetium-99. Technetium-99 is a site-specific leak detection parameter. A refined baseline list of Cell 8 has not yet been developed.

Two additional constituents (tetrachloroethene and trichloroethene) are also site specific detection constituents that have been detected in the Cell 8 LCS; however, the detection percentage for both constituents is only 11.1.

A.5.8.3 LDS Monitoring Results

Each year the LDS in Cell 8 is sampled for site specific baseline parameters listed in Table 2−1 of Appendix B of the OSDF GWLMP. As with the LCS, the objective of the annual LDS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility.

In 2006, of the non-refined baseline constituents sampled, only one (alkalinity) has been sampled at least eight times and detected at least 25 percent of the time. Alkalinity is a common ion constituent.

Table A.5.8−1. Cell 8 Data Summary for Constituents Detected Through 2006

Constituent (FRL)[a,b]	LCS [b,c,d] (12345C) No. of Samples with Detections No. of Samples	Range	LDS [b,c,d] (12345D) No. of Samples with Detections No. of Samples	Range	HTW [b,c,d] (12345) No. of Samples with Detections No. of Samples	Range	Upgradient [b,c,d] (22213) No. of Samples with Detections No. of Samples	Range	Downgradient [b,c,d] (22214) No. of Samples with Detections No. of Samples	Range	Southwest [b,c,d,e] (22215) No. of Samples with Detections No. of Samples	Range	Southeast [b,c,d,e] (22216) No. of Samples with Detections No. of Samples	Range	Southeast [b,c,d,e,f] (22217) No. of Samples with Detections No. of Samples	Range
Boron	9/9	0.0681 to 0.74	8/8	0.659 to 2.4	14/14	0.0683 to 0.101	16/19	ND to 0.0392	13/19	ND to 0.0327	8/9	ND to 0.0347	4/4	0.0258 to 0.0321	2/3	ND to 0.0288
(0.33 mg/L)	***4/4***	***0.15 to 0.74***	***4/4***	***0.659 to 1.37***	***5/5***	***0.0683 to 0.0853***	***4/4***	***0.0346 to 0.0392***	***4/4***	***0.0255 to 0.0294***	***5/6***	***ND to 0.0347***	***1/1***	***0.0258***	***2/3***	***ND to 0.0288***
Trend	Up, Significant		Down, Significant		Down, Significant		No Significant Trend		No Significant Trend		Up, Significant		No Significant Trend		NA	
Mercury	0/9	ND	0/8	ND	0/14	ND	2/19	ND to 0.000085	1/19	ND to 0.000085	0/9	ND	0/4	ND	0/3	ND
(0.002 mg/L)	***0/4***	***ND***	***0/4***	***ND***	***0/5***	***ND***	***0/4***	***ND***	***0/4***	***ND***	***0/6***	***ND***	***0/1***	***ND***	***0/3***	***ND***
Trend	No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		NA	
Sulfate	9/9	146 to 2020	9/9	1730 to 2870	14/14	92.4 to 152	19/19	84.4 to 147	19/19	177 to 282	8/9	ND to 118	4/4	209 to 311	3/3	163 to 468
(N/A mg/L)	***4/4***	***317 to 2020***	***4/4***	***1730 to 2700***	***5/5***	***95.5 to 152***	***4/4***	***114 to 147***	***4/4***	***191 to 254***	***5/6***	***ND to 118***	***1/1***	***209***	***3/3***	***163 to 468***
Trend	Up, Marginal		No Significant Trend		No Significant Trend		Up, Significant		No Significant Trend		No Significant Trend		No Significant Trend		NA	
Technetium-99	5/9	ND to 70.2	0/8	ND	0/14	ND	4/19	ND to 24.8	3/19	ND to 11.8	0/9	ND	2/4	ND to 8.9	0/3	ND
(94 pCi/L)	***4/4***	***8.39 to 70.2***	***0/4***	***ND***	***0/5***	***ND***	***2/4***	***ND to 24.8***	***2/4***	***ND to 11.8***	***0/6***	***ND***	***1/1***	***8.9***	***0/3***	***ND***
Trend	Up, Significant		No Significant Trend		No Significant Trend		Up, Significant		Up, Significant		No Significant Trend		Up, Significant		NA	
Total Organic Carbon	7/9	ND to 5.31	7/8	ND to 5.45	6/14	ND to 2.14	11/19	ND to 3.77	10/19	ND to 3.28	2/9	ND to 1.19	0/4	ND	2/3	ND to 1.15
(N/A mg/L)	***2/4***	***ND to 3.68***	***4/4***	***3.24 to 5.45***	***1/5***	***ND to 1.62***	***2/4***	***ND to 1.1***	***1/4***	***ND to 1.28***	***2/6***	***ND to 1.19***	***0/1***	***ND***	***2/3***	***ND to 1.15***
Trend	No Significant Trend		Up, Significant		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		NA	
Total Organic Halogens	2/9	ND to 0.0449	3/8	ND to 0.0794	8/14	ND to 0.0947	1/19	ND to 0.00622	2/19	ND to 0.00736	1/9	ND to 0.0121	0/4	ND	1/3	ND to 0.0199
(N/A mg/L)	***2/4***	***ND to 0.0449***	***0/4***	***ND***	***1/5***	***ND to 0.0439***	***0/4***	***ND***	***0/4***	***ND***	***1/6***	***ND to 0.0121***	***0/1***	***ND***	***1/3***	***ND to 0.0199***
Trend	Up, Marginal		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		Up, Marginal		No Significant Trend		NA	
Uranium, Total	9/9	1.51 to 181	8/8	9.38 to 30.1	14/14	3.48 to 5.89	9/19	ND to 0.421	19/23	ND to 1.53	5/9	ND to 0.625	3/4	ND to 1.65	3/3	1.3 to 8.1
(30 ug/L)	***4/4***	***78.5 to 181***	***4/4***	***14.3 to 30.1***	***5/5***	***3.8 to 4.72***	***2/4***	***ND to 0.421***	***2/4***	***ND to 1.23***	***4/6***	***ND to 0.486***	***1/1***	***1.65***	***3/3***	***1.3 to 8.1***
Trend	Up, Significant		Up, Significant		No Significant Trend		Up, Significant		No Significant Trend		No Significant Trend		Up, Significant		NA	

Note: Non-italicized pertains to total number of samples. ***Italicized/bold*** pertains to samples collected in 2006 only. ***Italicized/bold/larger font size*** pertains to new maximums.
Note: Shading indicates at least 25% detections for that constituent at that location.

[a]From Operable Unit 5 Record of Decision, Table 9-4.
[b]NA = not applicable; ND = not detected; LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well
[c]If there was more than one sample result per day (e.g., a duplicate sample), only the maximum sample concentration was counted and compared to the FRL.
[d]Rejected data qualified with either an R or Z were not used in this comparison.
[e]Southwest (22215) and Southeast (22216 and 22217) Great Maimi Aquifer wells close-out the south side of the OSDF.
[f]There must be at least four samples for trend to be computed.

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Table A.5.8−2. Cell 8 LCS Sample Summary Information

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (#OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
Alkalinity as CaCO3 (mg/L)	8	8	100.0%	64.9	418	222	-	422 mg/L (0)	430 mg/L (0)	-	10 mg/L
Aroclor-1260 (ug/L)	3	1	33.3%	0.058	-	-	-	-	-	-	0.1 ug/L
Barium (mg/L)	3	3	100.0%	0.046	0.103	0.073	2 mg/L (0)	0.77 mg/L (0)	0.45 mg/L (0)	0.589 mg/L (0)	0.029 mg/L
Calcium (mg/L)	6	6	100.0%	65.4	340	192	-	159 mg/L (4)	172 mg/L (3)	1800 mg/L (0)	5 mg/L
Chloride (mg/L)	8	8	100.0%	18.9	166	77	-	7.3 mg/L (8)	45 mg/L (5)	6300 mg/L (0)	5 mg/L
Cobalt (mg/L)	3	3	100.0%	0.00067	0.0019	0.0011	0.17 mg/L (0)	0.0086 mg/L (0)	-	0.0886 mg/L (0)	0.034 mg/L
Copper (mg/L)	3	2	66.7%	0.0035	0.005	-	1.3 mg/L (0)	0.035 mg/L (0)	0.029 mg/L (0)	0.298 mg/L (0)	0.008 mg/L
Fluoride (mg/L)	7	7	100.0%	0.105	0.519	0.325	4 mg/L (0)	0.89 mg/L (0)	1.3 mg/L (0)	6.8 mg/L (0)	0.2 mg/L
Iron (mg/L)	6	6	100.0%	0.735	2.09	1.70	-	5.72 mg/L (0)	6.35 mg/L (0)	21.3 mg/L (0)	0.1 mg/L
Magnesium (mg/L)	6	6	100.0%	21.9	117	68	-	38.5 mg/L (4)	50.7 mg/L (2)	690 mg/L (0)	5 mg/L
Manganese (mg/L)	6	6	100.0%	0.0157	0.170	0.067	0.9 mg/L (0)	0.9 mg/L (0)	0.21 mg/L (0)	35 mg/L (0)	0.09 mg/L
Nickel (mg/L)	3	3	100.0%	0.0049	0.0096	0.0072	0.1 mg/L (0)	0.0514 mg/L (0)	0.0072 mg/L (2)	0.981 mg/L (0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	8	7	87.5%	1.52	44.6	18.4	11 mg/L[g] (3)	11 mg/L (3)	0.29 mg/L (7)	2670 mg/L (0)	1.1 mg/L
Phosphorus (mg/L)	5	2	40.0%	0.0511	0.103	-	-	-	-	-	0.1 mg/L
Potassium (mg/L)	6	6	100.0%	4.86	16.4	10.8	-	1.96 mg/L (6)	17.2 mg/L (0)	12400 mg/L (0)	5 mg/L
Silicon (mg/L)	5	5	100.0%	1.76	12.4	5.7	-	-	-	15 mg/L (0)	0.015 mg/L
Sodium (mg/L)	6	6	100.0%	16.8	46.7	28.0	-	47.1 mg/L (0)	50 mg/L (0)	1300 mg/L (0)	5 mg/L
Technetium-99 (pCi/L)	9	5	55.6%	8.39	70.2	40.8	94 pCi/L (0)	22 pCi/L (3)	30 pCi/L (3)	6130 pCi/L (0)	10 pCi/L
Tetrachloroethene (ug/L)	9	1	11.1%	1.24	-	-	-	-	-	-	1 ug/L
Thallium (mg/L)	3	1	33.3%	0.00057	-	-	-	-	-	0.0028 mg/L (0)	0.02 mg/L
Total Dissolved Solids (mg/L)	3	3	100.0%	882	1820	1380	-	-	-	-	10 mg/L
Trichloroethene (ug/L)	9	1	11.1%	1.11	-	-	5 ug/L (0)	-	-	-	1 ug/L
Vanadium (mg/L)	3	1	33.3%	0.016	-	-	0.038 mg/L (0)	0.012 mg/L (1)	0.005 mg/L (1)	0.299 mg/L (0)	0.02 mg/L
Zinc (mg/L)	3	1	33.3%	0.0138	-	-	0.021 mg/L (0)	0.02 mg/L (0)	0.35 mg/L (0)	1.78 mg/L (0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information
[b]Rejected data qualified with an R or Z were not included.
[c]If the number of detected samples is equal to two, then the minumun and maximumn are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.
[d]From Operable Unit 5 Record of Decision, Table 9-4.
[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.
[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.
[g]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

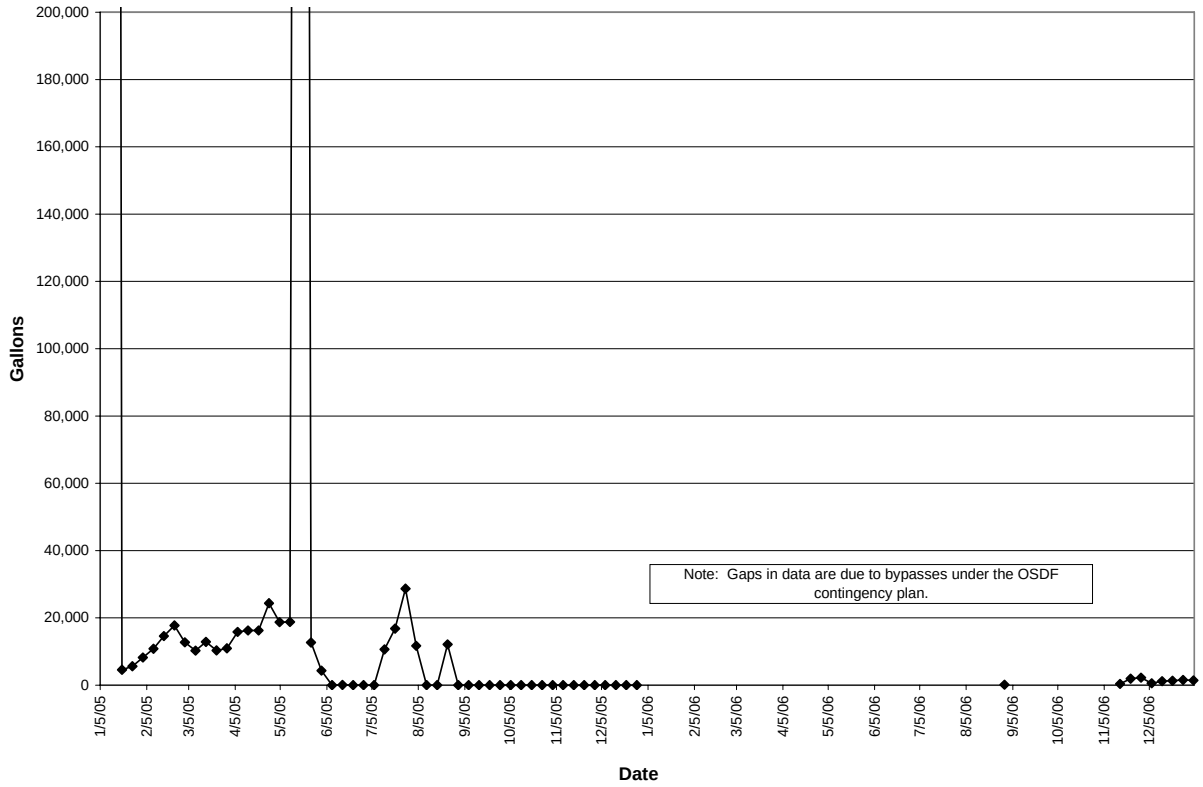


FIGURE A.5.8-1. Weekly Accumulation Volumes for Cell 8 LCS

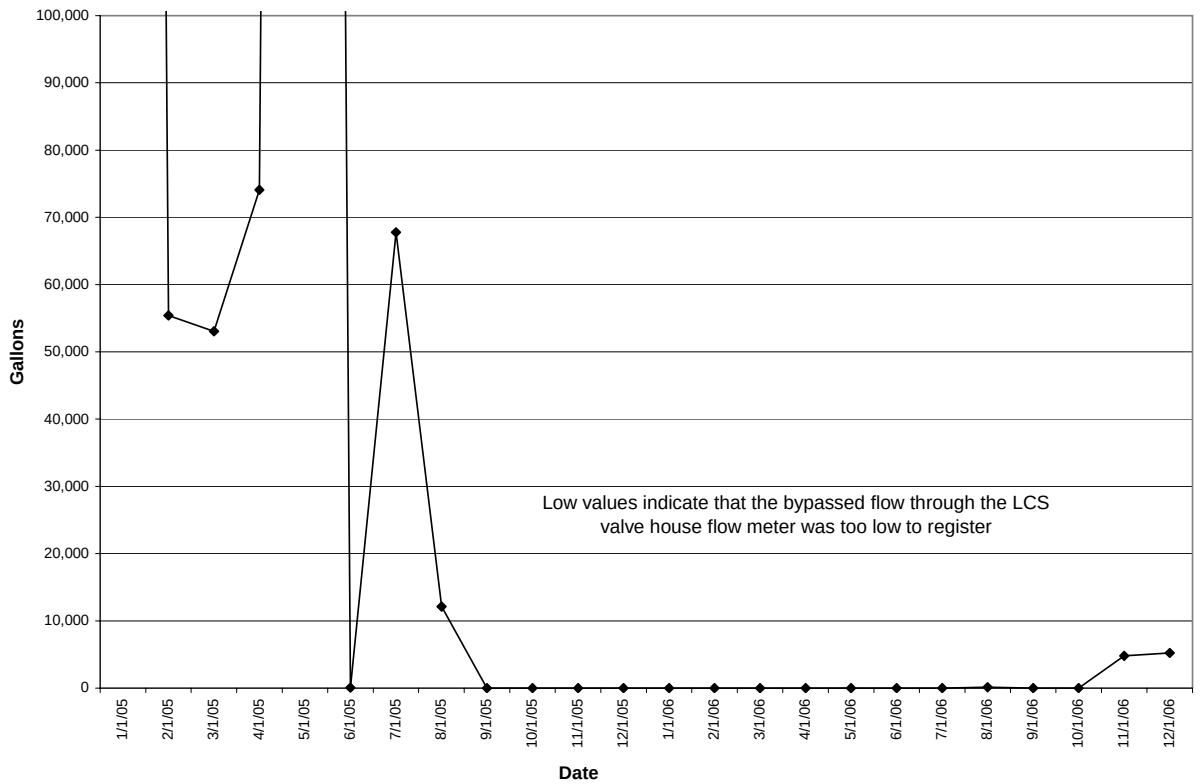


FIGURE A.5.8-2. Monthly Accumulation Volumes for Cell 8 LCS

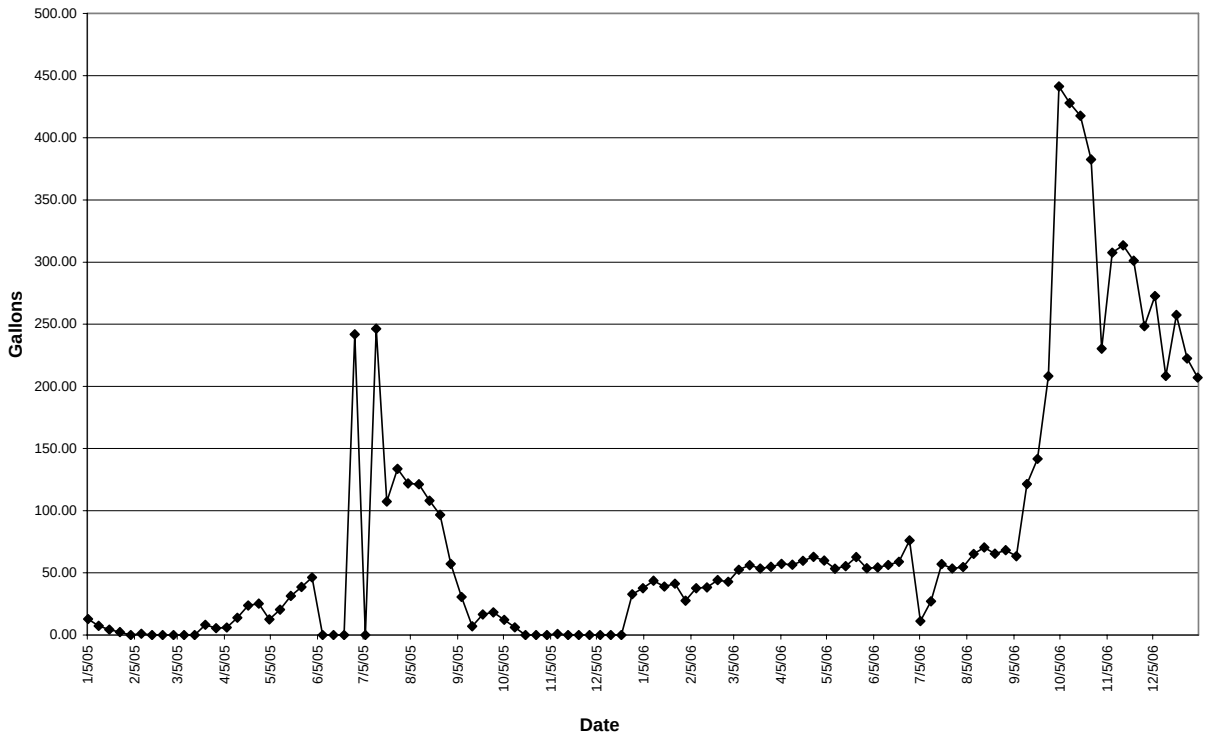


FIGURE A.5.8-3. Weekly Accumulation Volumes for Cell 8 LDS

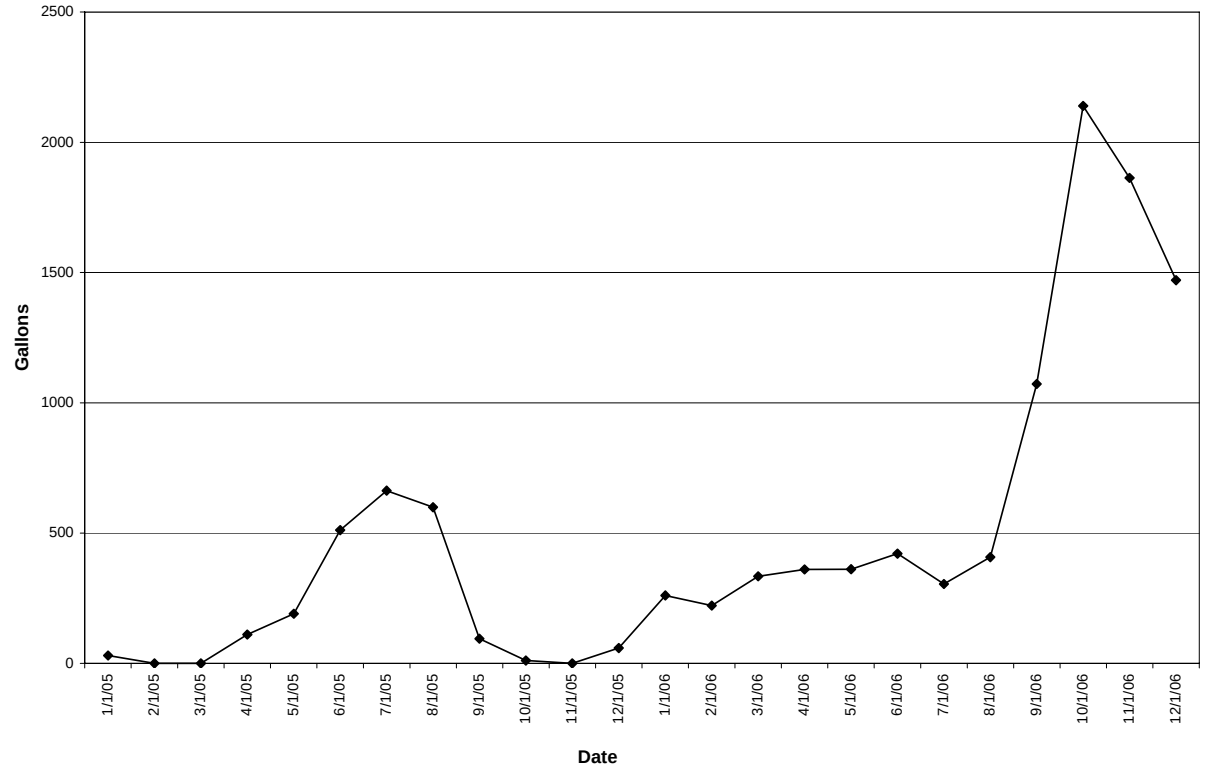


FIGURE A.5.8-4. Monthly Accumulation Volumes for Cell 8 LDS

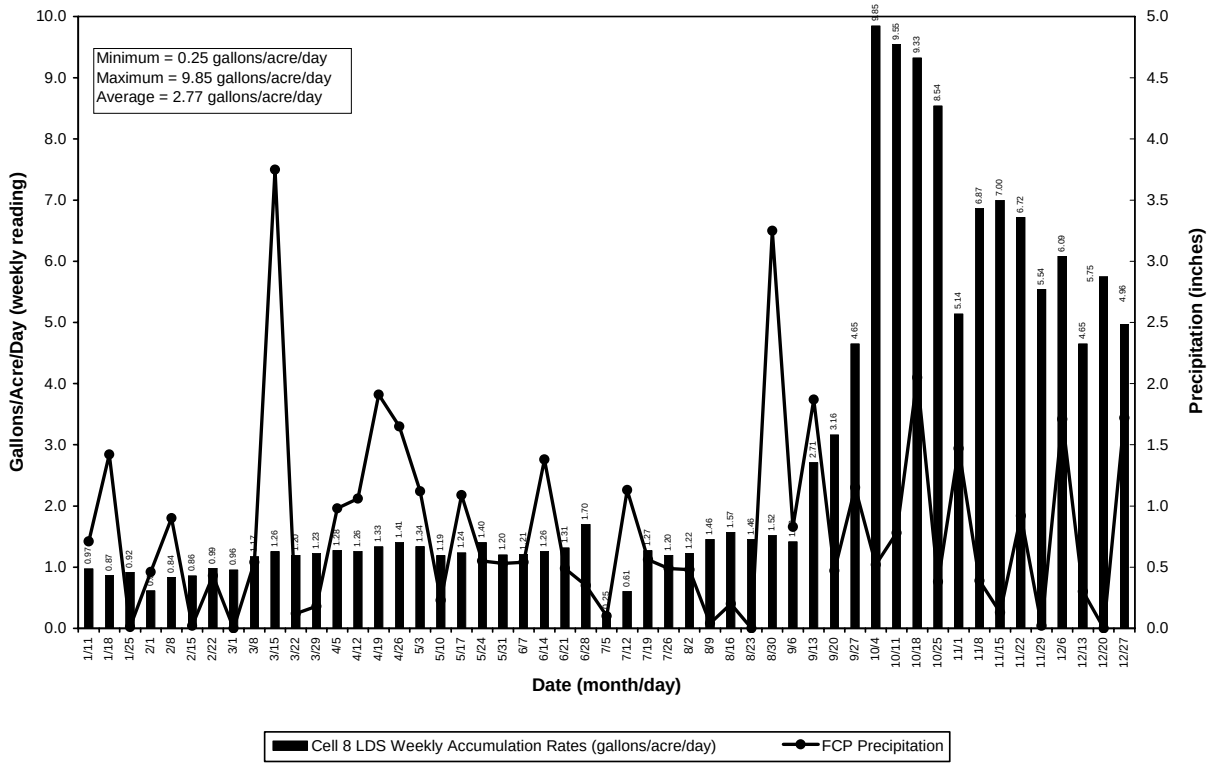


FIGURE A.5.8-5. 2006 OSDF LDS Weekly Accumulation Rates and Precipitation for Cell 8

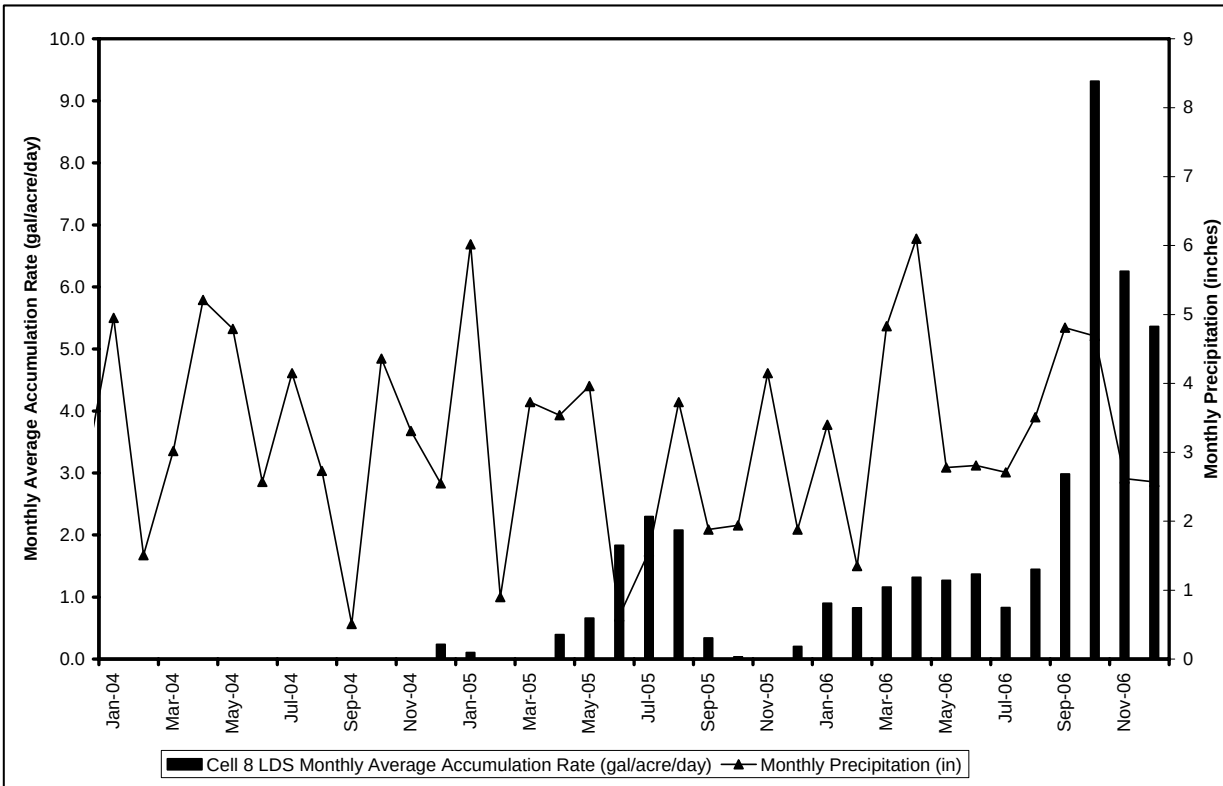


FIGURE A.5.8-6. OSDF Cell 8 LDS Monthly Average Accumulation Rates and Monthly Precipitation

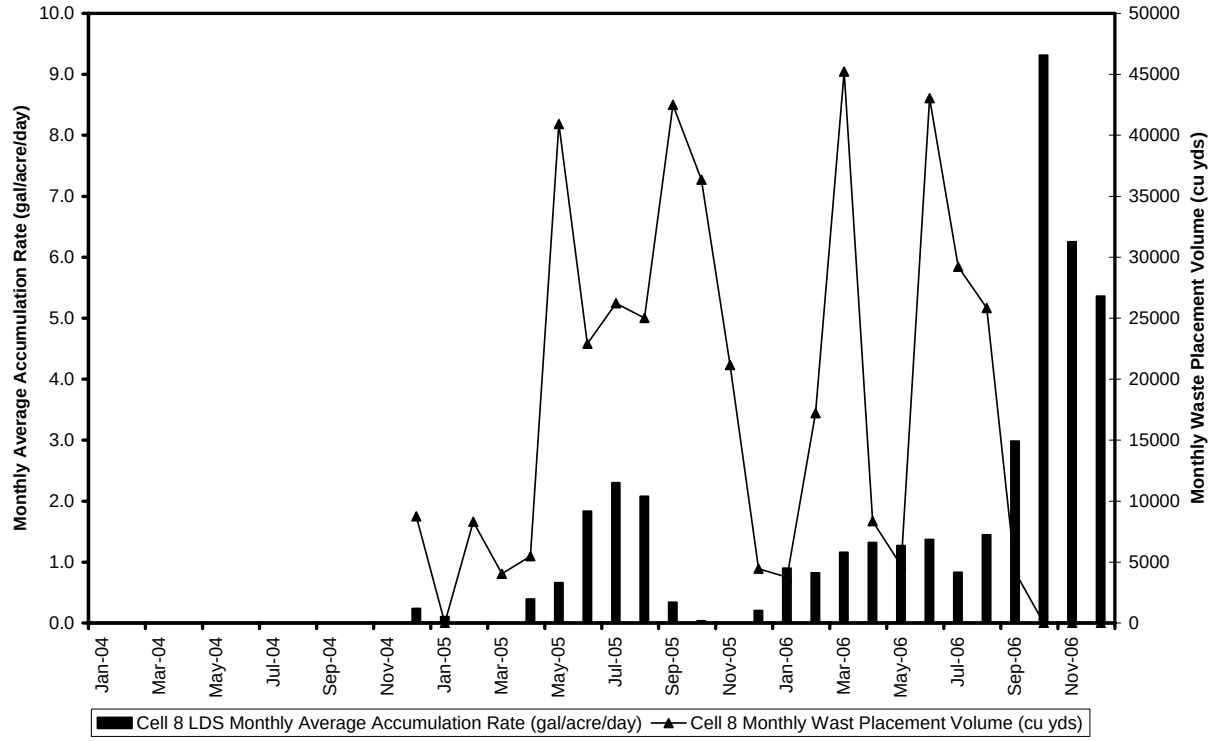
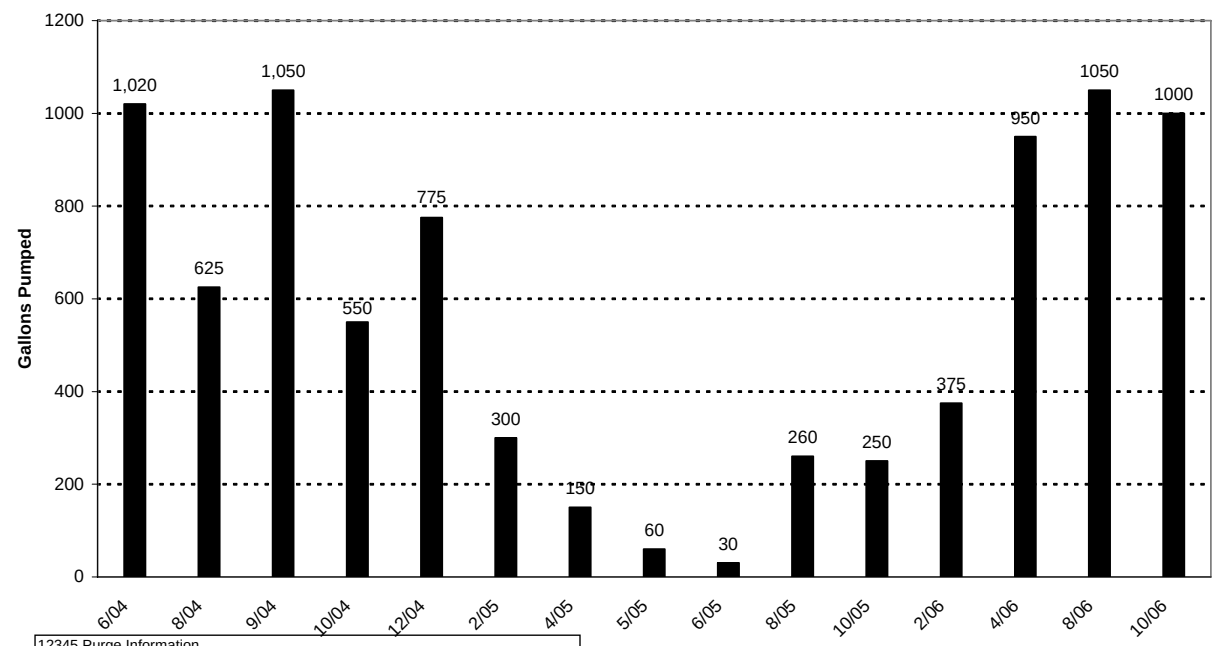


FIGURE A.5.8-7. OSDF Cell 8 LDS Monthly Average Accumulation Rates and Monthly Waste Placement Volumes



12345 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2004:	4020	n=5	804
2005:	1050	n=6	175
2006:	3375	n=4	844
Overall:			563

FIGURE A.5.8-8. OSDF Horizontal Till Well 12345 (Cell 8) Water Yield

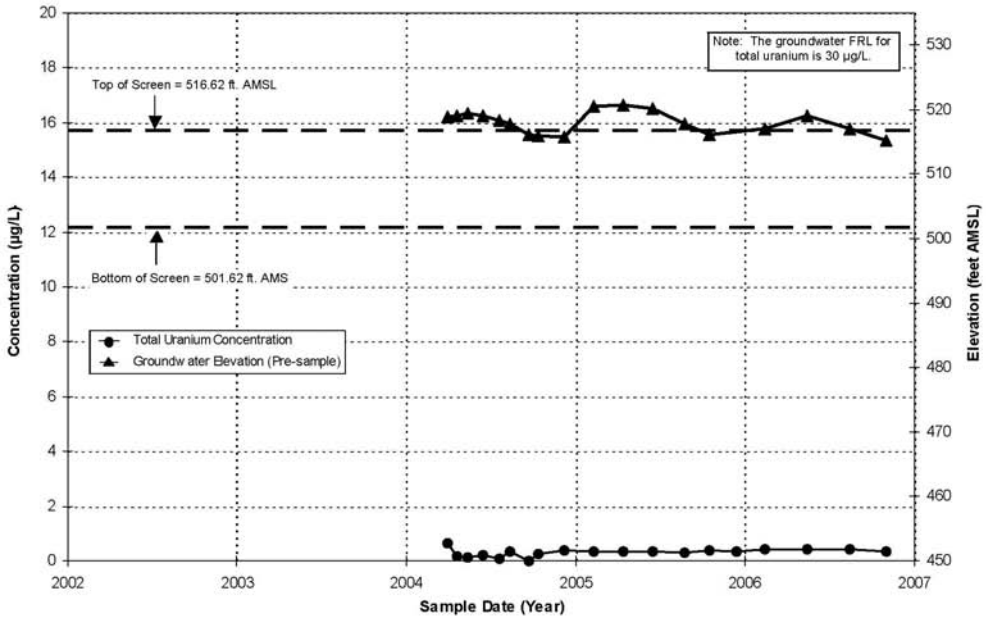


Figure A.5.8-9. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 8 Upgradient Monitoring Well 22213

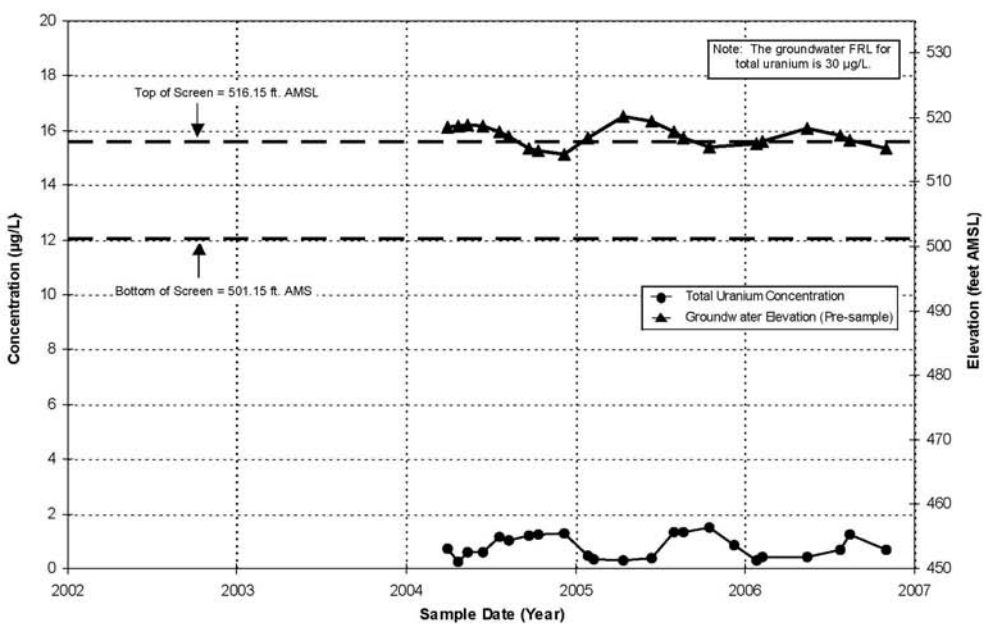


Figure A.5.8-10. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 8 Downgradient Monitoring Well 22214

Appendix B

Supplemental Surface Water, Treated Effluent, and Sediment Information

Contents

Attachment B.1 Surface Water and Treated Effluent
Attachment B.2 Sediment

End of current text

List of Acronyms

AWWT	advanced wastewater treatment facility
CAWWT	converted advanced wastewater treatment facility
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FFCA	Federal Facilities Compliance Agreement
FRL	final remediation level
IEMP	Integrated Environmental Monitoring Plan
NPDES	National Pollutant Discharge Elimination System
OEPA	Ohio Environmental Protection Agency
PF	Parshall Flume
STP	sewage treatment plant
SWM Pond	Storm Water Management Pond
SWRB	Storm Water Retention Basin

List of Measurement Abbreviations

cfs	cubic feet per second
gpm	gallons per minute
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter

End of current text

Appendix B presents additional surface water, treated effluent, and sediment data in support of Chapter 4 of this 2006 Site Environmental Report. This appendix consists of two attachments as follows:

- Attachment B.1 provides an evaluation of the final remediation level (FRLs) exceedances for surface water and treated effluent including an assessment of potential cross-media impacts to the groundwater pathway. This attachment also provides information on any storm water-related bypasses pertaining to compliance with the Record of Decision for Remedial Actions at Operable Unit 5 (DOE 1996) total uranium treated effluent discharge limits.
- Attachment B.2 provides additional details pertaining to the 2006 sediment analytical results and historical results for comparison purposes.

References

DOE (U.S. Department of Energy), 1995. "Remedial Investigation Report for Operable Unit 5," Final, Fernald Environmental Management Project, Cincinnati, Ohio, March.

DOE (U.S. Department of Energy), 1996. "Final Record of Decision for Remedial Actions at Operable Unit 5," 7478 U-007-501.4, Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 2006. "Comprehensive Legacy Management and Institutional Controls Plan, Revision 1," Fernald Closure Project, DOE, Fernald Office, Cincinnati, Ohio, November.

End of current text

Attachment B.1

B.1.0 Surface Water and Treated Effluent

During 2006, surface water and treated effluent samples were collected under the Integrated Environmental Monitoring Plan (IEMP) which is Attachment D of the Comprehensive Legacy Management and Institutional Controls Plan (DOE 2006). Figures B.1−1 and B.1−2 show all surface water monitoring locations. The following information is discussed in this attachment:

- Surveillance monitoring (Section B.1.1)
- Federal Facilities Compliance Agreement (FFCA)/Operable Unit 5 Record of Decision compliance (Section B.1.2)
- Controlled and uncontrolled areas (Section B.1.3).

The National Pollutant Discharge Elimination System (NPDES) Permit sampling is not discussed in this attachment as it is discussed in sufficient detail in Chapter 4 of this report.

B.1.1 Surveillance Monitoring

Surveillance monitoring is the comparison of surface water and treated effluent analytical results to the surface water FRLs in order to determine effects of remediation activities on the surface water pathway. Surveillance monitoring also includes an assessment of the effects surface water may have on the groundwater pathway (referred to as cross-media impacts).

All 2006 data were compared to FRLs. Samples collected at the Parshall Flume (PF 4001) are used in the surveillance evaluation because this is the last point treated effluent is sampled prior to discharge to the Great Miami River.

Water discharges to the Great Miami River are required to be below the FRLs at the point where discharged water is completely mixed with water in the Great Miami River (i.e., outside the mixing zone). To make a determination of the concentration of each constituent at this point in the Great Miami River for comparison to the FRLs, the following calculation was applied to data from the Parshall Flume (PF 4001):

$$C_{PF\,4001} = \frac{[Q_{10}][C_{GMR}]+[Q_{PF}][C_{PF}]}{[Q_{10}]+[Q_{PF}]}$$

where:

C_{PF4001} = Flow-weighted average concentration outside the mixing zone in the Great Miami River, picoCuries per liter (pCi/L) or milligrams per liter (mg/L)

Q_{10} = 7-day, 10-year low flow, 706 cubic feet per second (cfs)

C_{GMR} = Background concentration in Great Miami River from the Remedial Investigation Report for Operable Unit 5 (DOE 1995), pCi/L or mg/L (zero was used when no background concentration was available)

Q_{PF} = Daily flow at Parshall Flume (PF 4001), cfs

C_{PF} = Daily concentration at Parshall Flume (PF 4001), pCi/L or mg/L

Note: Flow conditions at the Hamilton Dam gauge are periodically reviewed to determine if there is a lower flow than the 7-day, 10-year low flow of 706 cfs. The lowest daily flow measured at the Hamilton Dam gauge (if lower than 706 cfs) is used in the equation to see if an exceedance could potentially occur. The low flow of 706 cfs went into effect during the 2003 NPDES Permit renewal process.

B.1.1.1 Evaluation of Constituents Above FRLs for 2006

Table B.1−1 lists the surface water FRL exceedances at corresponding sample locations and the exceedance locations can be found on Figure B.1-1. The following are general observations:

- No FRL exceedances occurred in the Great Miami River using the mixing equation and Parshall Flume (PF 4001) concentrations. The lowest daily flow at the Hamilton Dam gauge during 2006 was 743 cfs. No further evaluation of FRLs was conducted beyond the previously described low flow condition (706 cfs).
- No exceedances of the surface water FRL for total uranium occurred at any surface water sample location. Figures B.1-3 through B.1-13 are plots of the total uranium concentration versus time for the surface water sample locations.

There was one FRL exceedance at the waste storage area location SWD-03. It occurred on July 29, 2006 (0.0129 mg/L versus the surface water FRL of 0.012 mg/L); however, no additional FRL exceedances occurred at this location and constituent for the year.

B.1.1.2 Evaluation of Cross-Media Impacts for 2006

Another objective of the IEMP surveillance monitoring program is to provide an ongoing assessment of the potential for cross-media impacts from surface water to the underlying Great Miami Aquifer. To conduct this assessment, sample locations were selected to evaluate contaminant concentrations in surface water just upstream from those areas where site drainages have eroded through the protective glacial overburden (e.g., the storm sewer outfall ditch, Pilot Plant Drainage Ditch, and certain reaches of Paddys Run). In areas where the glacial overburden is absent, a direct pathway exists for contaminants to reach the aquifer. Key sample locations associated with these areas of direct infiltration are SWP-02, SWD-02, STRM 4005, SWD-03, and the Storm Water Retention Basin overflow (SWRB 4002O). (Now that the Storm Water Retention Basin has been removed from service and excavated, SWRB2O is no longer a monitored point.)

Because it is the primary contaminant at the site, total uranium is used as an indicator to evaluate the impact of surface water on the Great Miami Aquifer. A conservative assumption is used in this assessment, which considers the total uranium concentration (and all other constituent concentrations) in the surface water to be at the same concentration when the water reaches the Great Miami Aquifer through infiltration. However, the more likely scenario is that the total uranium concentration (and all other constituent concentrations) would decrease because dilution and adsorption occur as the water infiltrates through the ground and is mixed with the groundwater in the Great Miami Aquifer.

The results of the cross-media impact assessment for 2006 indicates none of the five surface water locations evaluated had results that exceeded the total uranium groundwater FRL of 30 µg/L. Figures B.1−10 through B.1−13 present the total uranium concentrations for all cross-media impact sample locations.

Of the locations evaluated, only SWD-03 had results that exceeded the groundwater FRL for a constituent other than uranium. These groundwater FRL exceedances were for zinc from samples collected on March 9, 2006 (0.0438 mg/L), April 23, 2006 (0.0255 mg/L), and July 29, 2006 (0.0855 mg/L). The groundwater FRL for zinc is 0.021 mg/L.

The design of the groundwater restoration systems has accounted for this potential contaminant pathway by installing extraction wells downgradient of these areas where direct infiltration can occur.

B.1.2 FFCA/Operable Unit 5 Record of Decision Compliance

The Operable Unit 5 Record of Decision and subsequent Explanation of Significant Differences stipulate compliance with a monthly flow-weighted average total uranium concentration of 30 µg/L at the Great Miami River via the Parshall Flume (PF 4001). In addition to the concentration limitation, the Operable Unit 5 Record of Decision stipulated that the total mass discharged during a year not exceed 600 pounds.

During 2006, the total uranium concentrations were monitored daily at the Parshall Flume (PF 4001) to demonstrate compliance with these limitations. The Fernald site was in compliance with the total mass limitation as uranium discharges totaled 476.36 pounds, which is below the 600-pound limit. The Fernald site was in compliance with the monthly flow-weighted concentration limit every month in 2006, as identified on Figure B.1−14.

B.1.2.1 Storm Water-Related Bypasses

The Operable Unit 5 Record of Decision allowed the Fernald site to directly discharge water collected in the Storm Water Retention Basin to the Great Miami River during periods of significant precipitation (up to 10 days each year). These were referred to as bypass events (when storm water bypasses treatment and goes directly to the Great Miami River). The Operable Unit 5 Record of Decision allowed the Fernald site to eliminate the flow-weighted concentration for these bypass days due to significant precipitation in order to comply with the flow-weighted concentration total uranium limit.

As noted above, the Storm Water Retention Basins were removed from service in February 2006 so no direct precipitation or maintenance related bypasses occurred from the Storm Water Retention Basins during 2006. However, there was an occasion where the direct discharge of storm water to the Great Miami River was required. From March 17 through March 21, 2006, storm water was discharged from a large excavation within Remediation Area 4B. This effort was required to mitigate against the potential loss of control of the water within the excavation and the possible recontamination of other adjacent certified areas. Approval for this bypass was obtained from the regulatory agencies.

B.1.2.2 Maintenance-Related Bypasses

Bypassing during scheduled treatment plant maintenance was permissible under the Operable Unit 5 Record of Decision, provided prior notice is given to the U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (OEPA). For those days when a maintenance activity was performed, the uranium concentration could be eliminated from the monthly total uranium concentration calculation. There were no such bypasses in 2006.

B.1.3 Controlled and Uncontrolled Storm Water Runoff Areas

In 2006, there were no previously uncontrolled areas that were added to the Fernald site controlled storm water system (refer to Figure B.1−15). At the conclusion of remediation in October 2006, control of storm water runoff is no longer required. The only storm water collected for treatment is that which falls on the controlled pad of the CAWWT.

Table B.1−1. Summary Statistics and Trend Analysis for Constituents with 2006 Results above Final Remediation Levels

Location[a]	Constituent	No. of Samples[b,c,d]	No. of Samples Above FRL[b,c,d]	No. of Samples Above FRL for 2004[c,d]	FRL[e]	Min.[b,c,d,f]	Max.[b,c,d,f]	Avg.[b,c,d,f]	SD[b,c,d,f]	Trend[b,c,d,f]
SWD-03 (Waste Storage Area)	Copper	51	4	1	0.012 mg/L	0.00065 mg/L	0.0426 mg/L	0.00489 mg/L	0.00806 mg/L	Up, Significant

[a]Refer to Figure B.1-1.
[b]Based on samples collected from 1997 through 2006.
[c]If more than one sample is collected per surface water location per day (e.g., duplicate, grab, composite), then only one sample is counted for the number of samples, and the sample with the maximum concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation), Mann-Kendall test for trend, and in determining FRL exceedances.
[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]From Operable Unit 5 Record of Decision, Table 9-5.
[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.

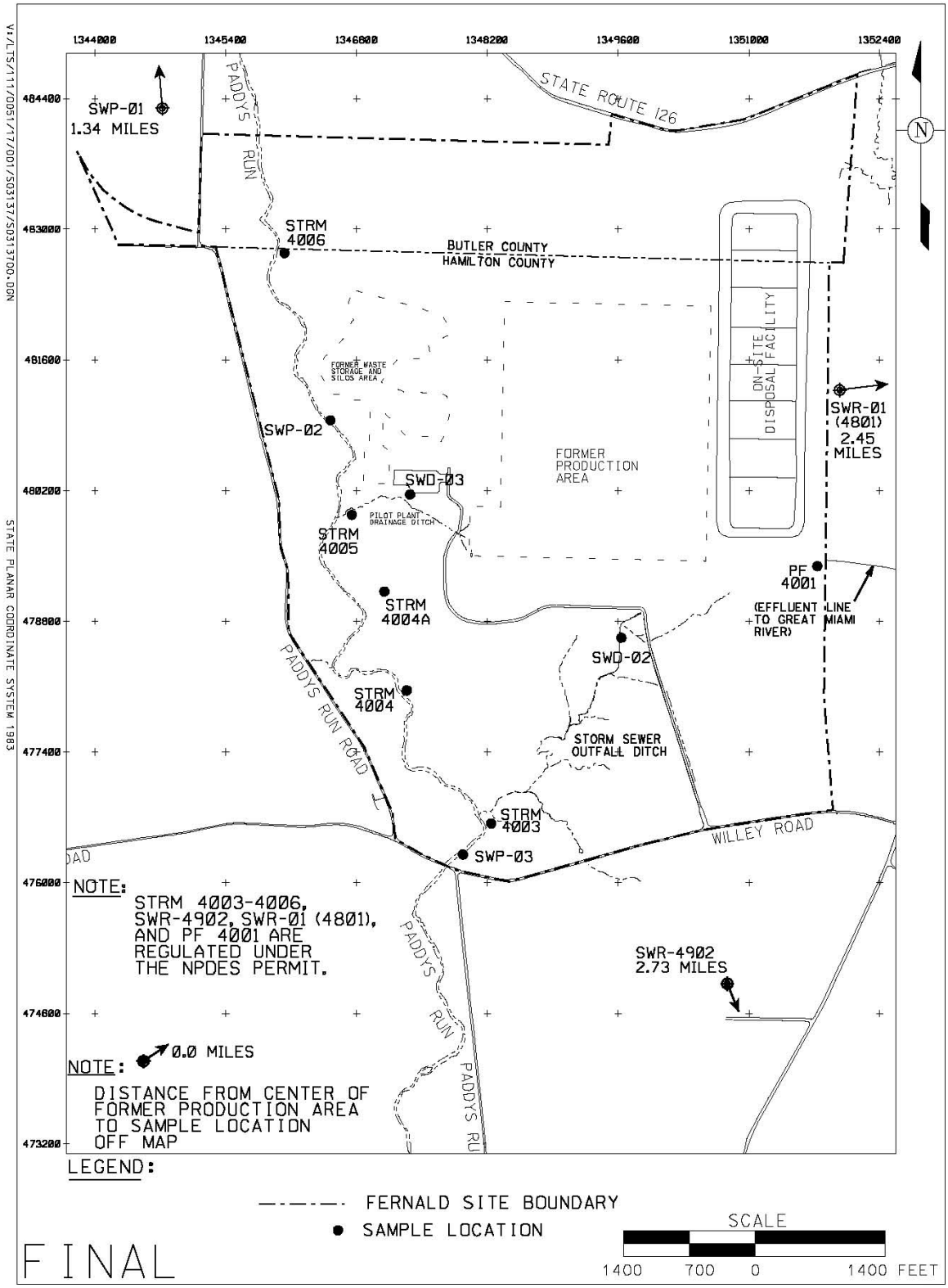


Figure B.1−1. IEMP Surface Water and Treated Effluent Sample Locations

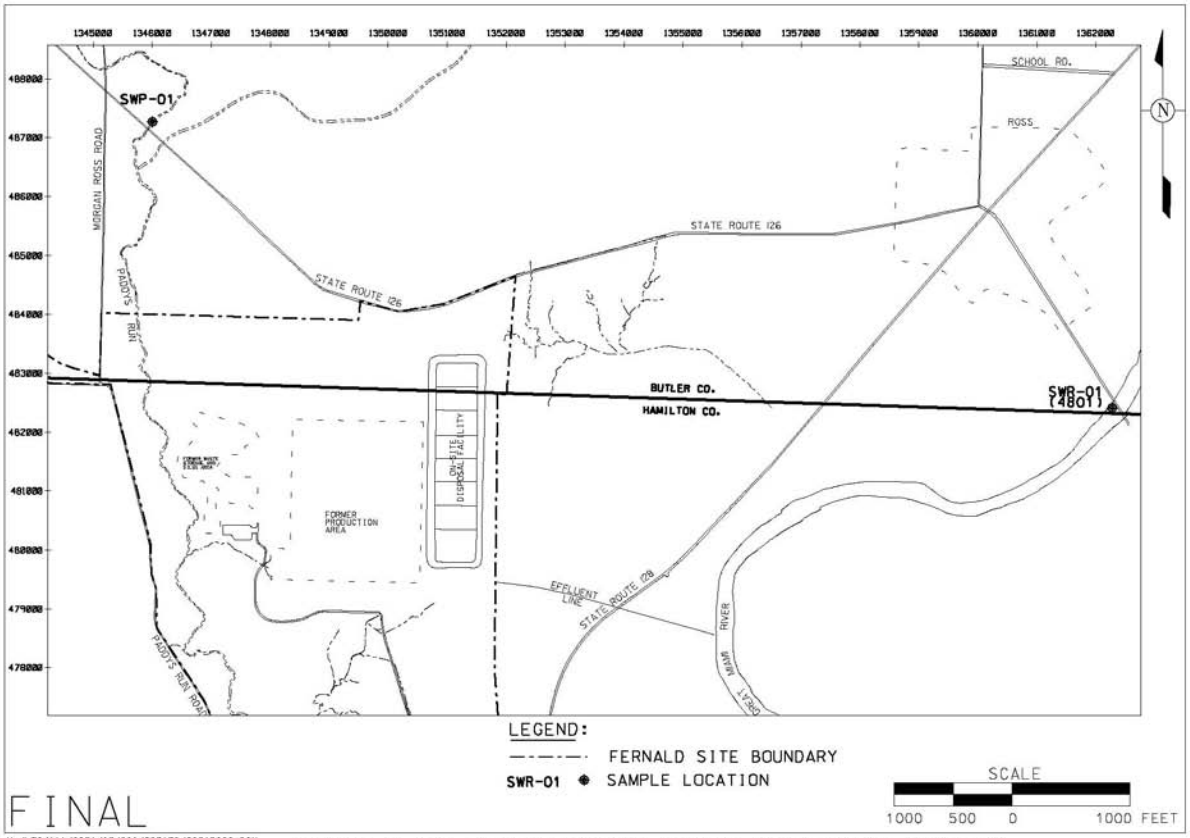


FIGURE B.1-2. IEMP BACKGROUND SURFACE WATER SAMPLE LOCATIONS

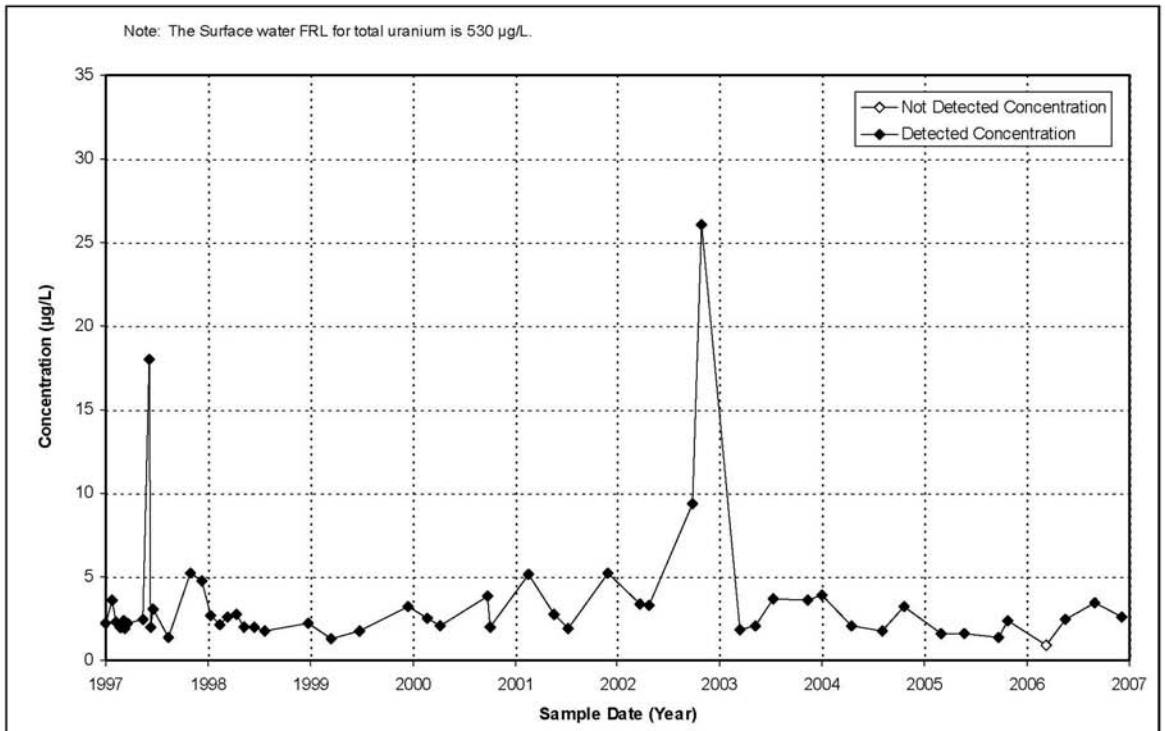


FIGURE B.1-3. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR LOCATION SWP-03 (PADDYS RUN AT DOWNSTREAM PROPERTY BOUNDRY)

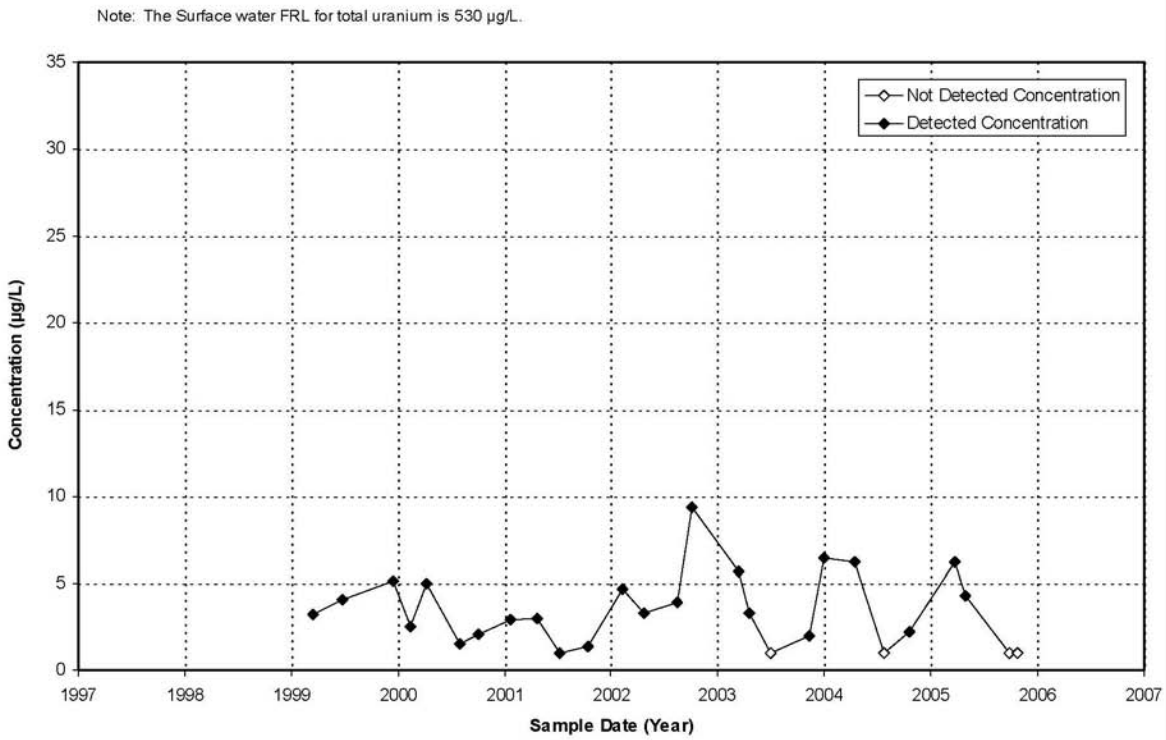


FIGURE B.1-4. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR LOCATION SWD-01 (NORTHEAST DRAINAGE)

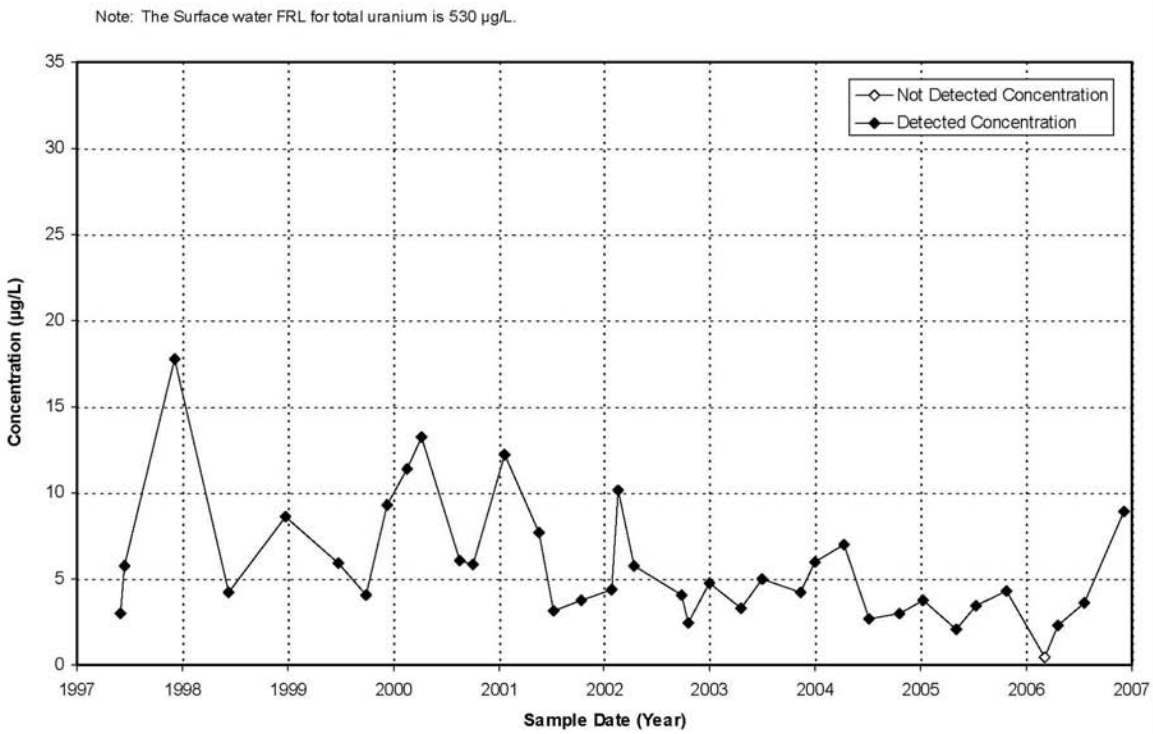


FIGURE B.1-5. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR LOCATION STRM 4003 (DRAINAGE TO PADDYS RUN)

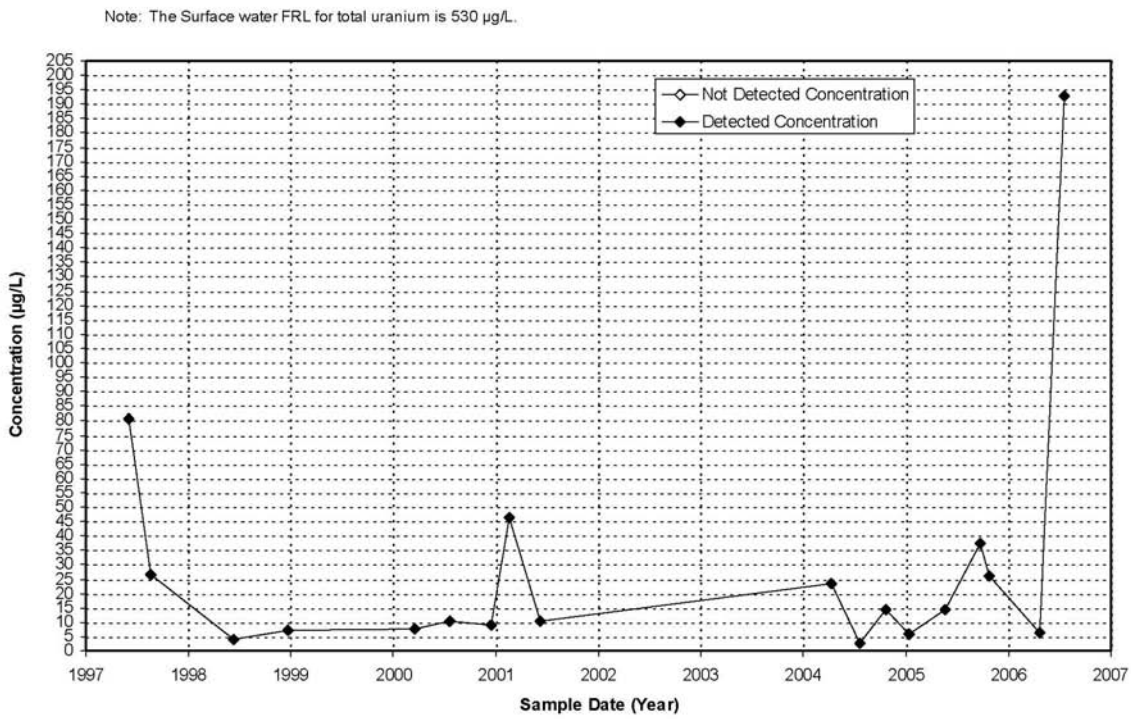


FIGURE B.1-6. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR LOCATION STRM 4004/4004A (DRAINAGE TO PADDYS RUN)

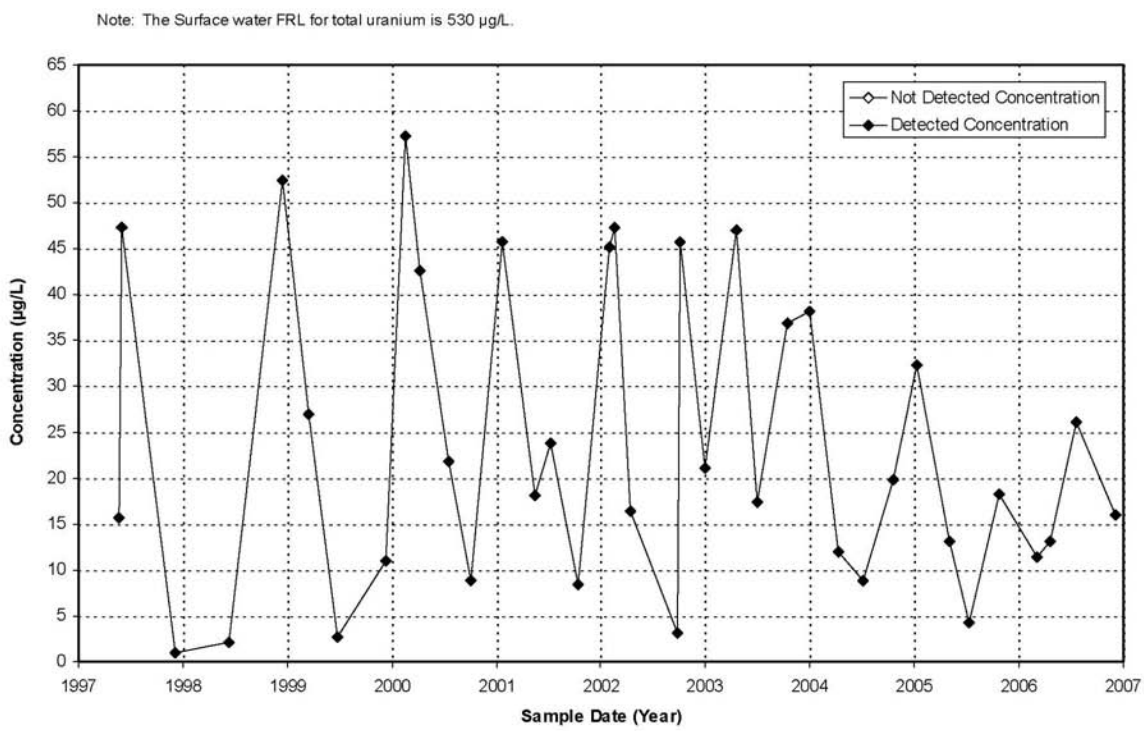


FIGURE B.1-7. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR LOCATION STRM 4006 (DRAINAGE TO PADDYS RUN)

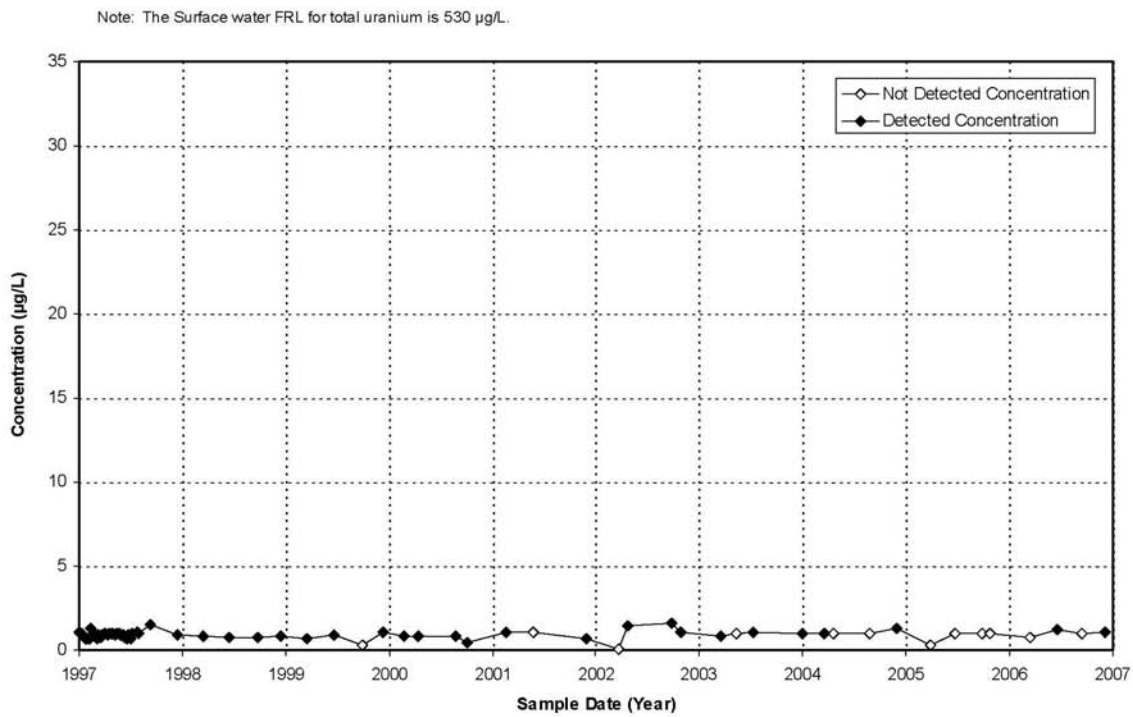


FIGURE B.1-8. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR LOCATION SWP-01 (PADDYS RUN BACKGROUND)

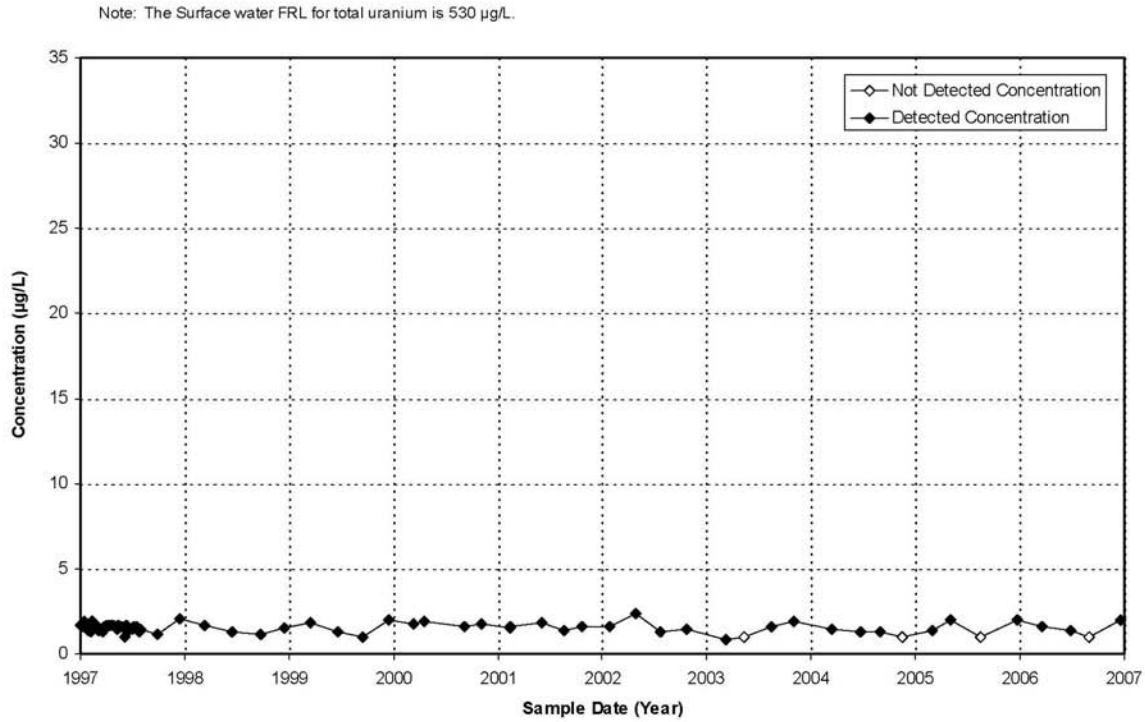


FIGURE B.1-9. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR LOCATION SWR-01 (GREAT MIAMI RIVER BACKGROUND)

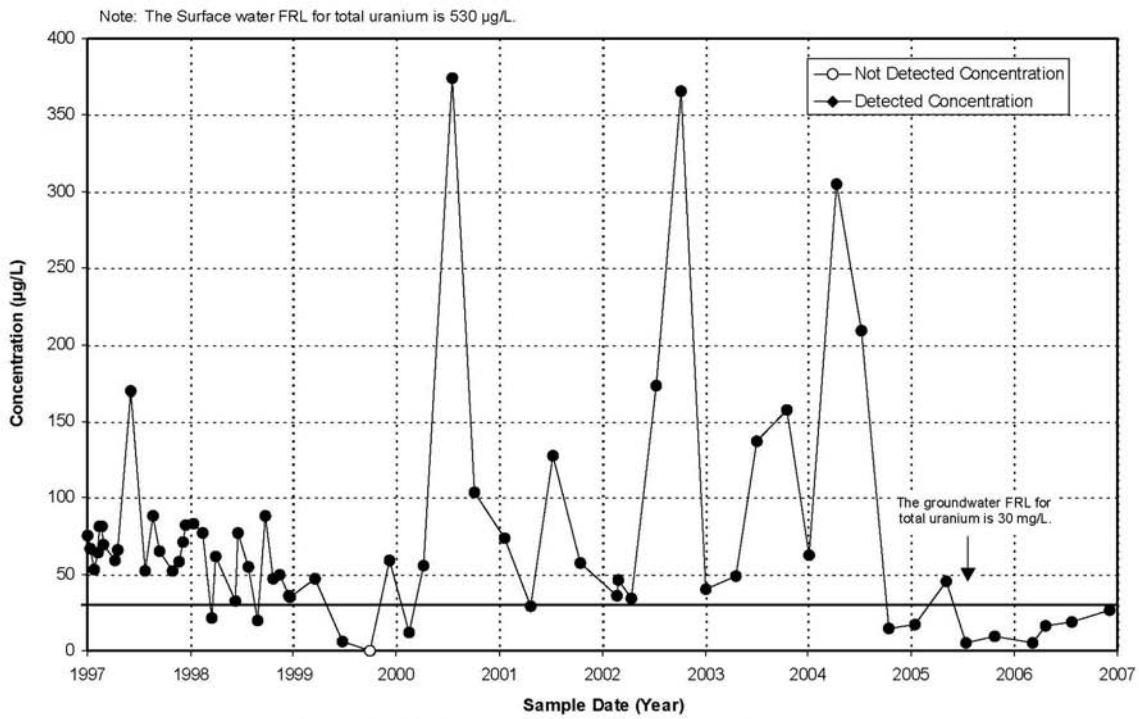


FIGURE B.1-10. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR LOCATION STRM 4005 (DRAINAGE TO PADDYS RUN) FOR CROSS-MEDIA IMPACT EVALUATION

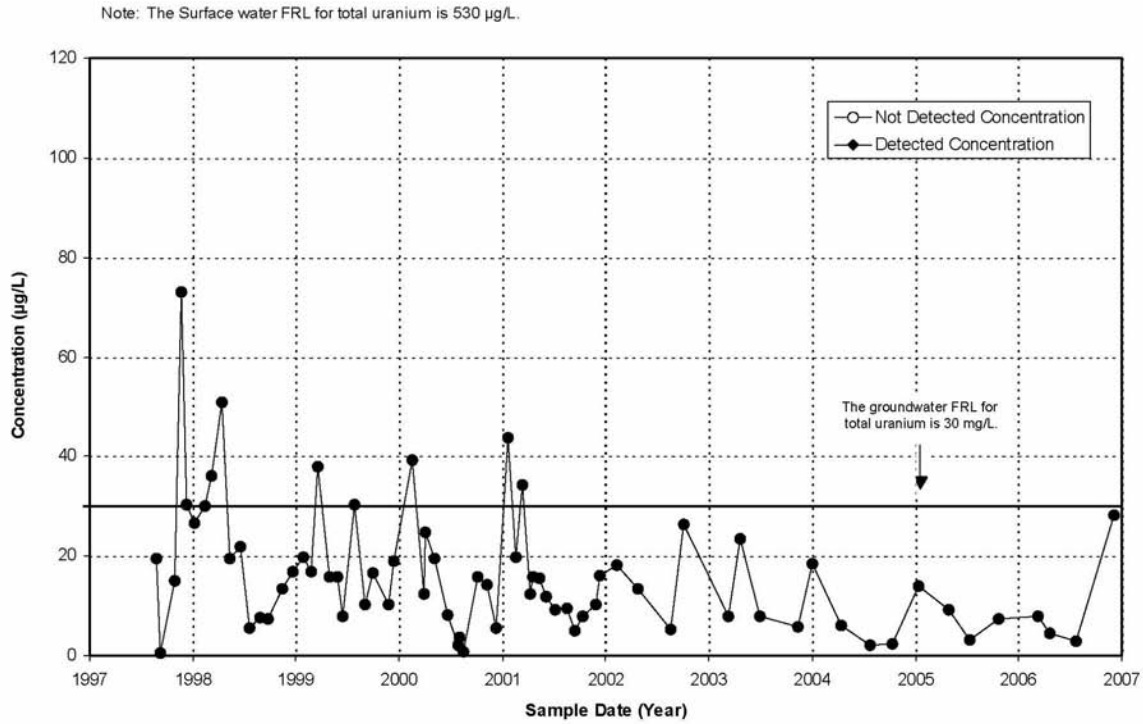


FIGURE B.1-11. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR LOCATION SWD-02 (STORM SEWER OUTFALL DITCH) FOR CROSS-MEDIA IMPACT EVALUATION

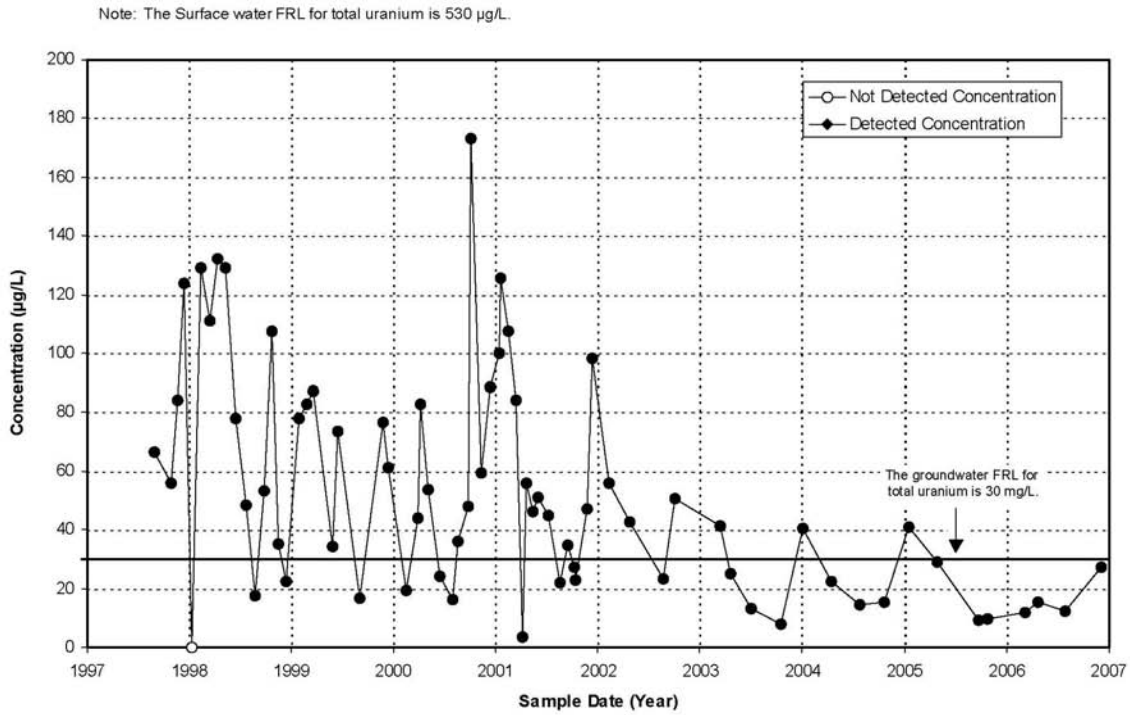


FIGURE B.1-12. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR LOCATION SWD-03 (WASTE STORAGE AREA) FOR CROSS-MEDIA IMPACT EVALUATION

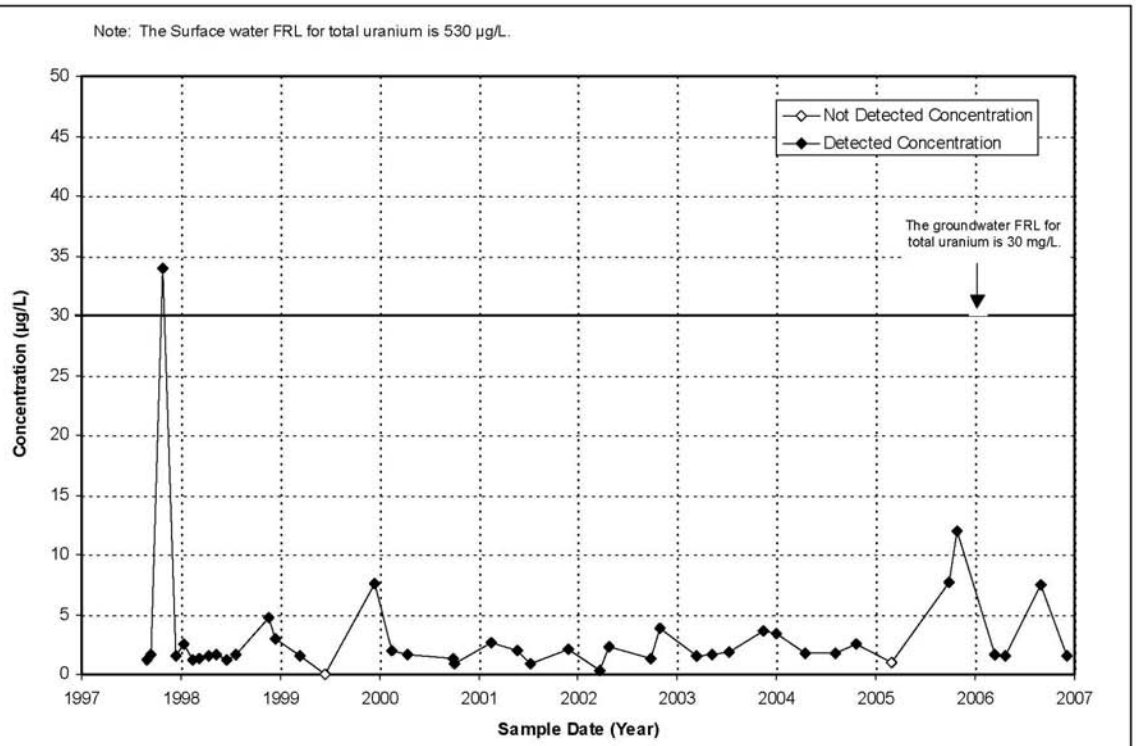


FIGURE B.1-13. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR LOCATION SWP-02 (PADDYS RUN) FOR CROSS-MEDIA IMPACT EVALUATION

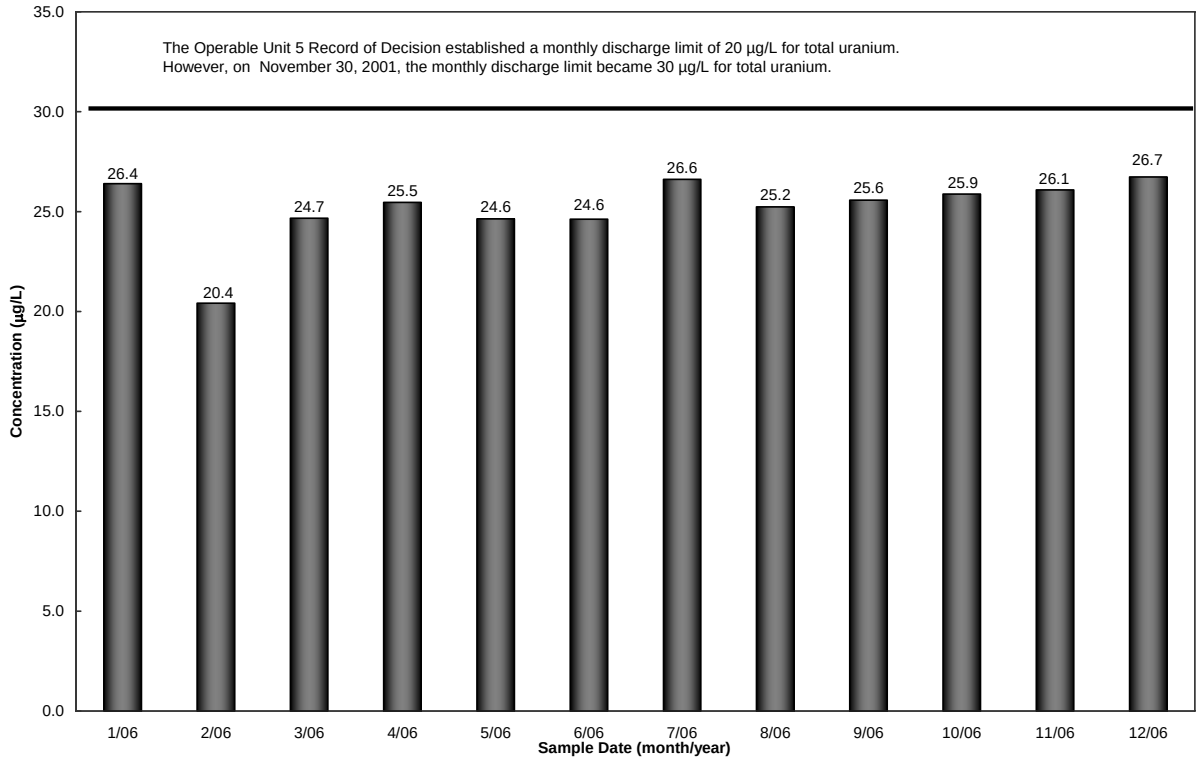


FIGURE B.1-14. 2006 MONTHLY AVERAGE TOTAL URANIUM CONCENTRATION
IN WATER DISCHARGED FROM THE PARSHALL FLUME (PF 4001) TO THE GREAT MIAMI RIVER

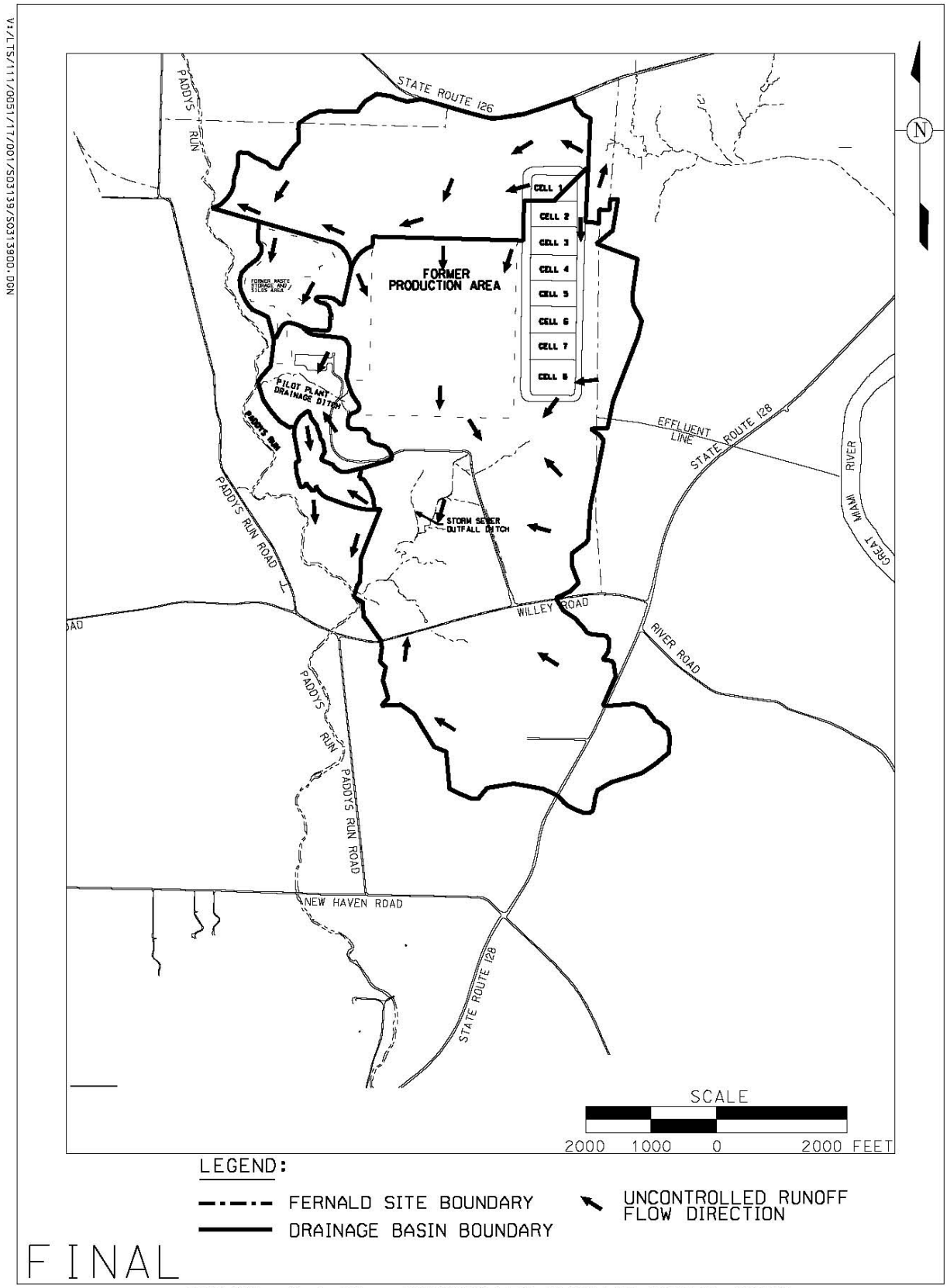


Figure B.1−15. Controlled Surface Water Areas and Uncontrolled Runoff Flow Directions

Attachment B.2

B.2.0 Sediment

Sediment is a secondary exposure pathway and is monitored annually to assess the impact of remediation activities on sediments deposited along surface water drainages. In 2006 sediment was collected at strategic locations in the Great Miami River (i.e., upgradient and downgradient of the effluent line). The year 2006 marks the eighth year that sediment was collected under the IEMP.

Sediment samples in the Great Miami River were collected in October of 2006 at two locations (refer to Figure B.2−1) in accordance with the IEMP. Samples collected at these locations were analyzed for total uranium. Table B.2−1 and Figure B.2−2 identifies the 2006 uranium results and historical uranium results from the Great Miami River. Uranium results from the river were approximately 1 milligram per kilogram (mg/kg), which are comparable to historical results. The sediment FRL for uranium is 200 mg/kg.

Table B.2−1. Summary Statistics For Sediment Monitoring Program

Radionuclide	No. of Samples[a]	2006 Results – Concentration (mg/kg)	No. of Samples[a]	2005 Results – Concentration (mg/kg)
Great Miami River, North of the Effluent Line (G2)				
Uranium, Total	1	0.739	1	3.3
Great Miami River, South of The Effluent Line (G4)				
Uranium, Total	1	1.60	1	3.03

[a]If more than one sample is collected per sample location (e.g., split or duplicate), then only one sample is counted for the number of samples, and the sample with the maximum concentration is used for determining the summary statistics (minimum and maximum).

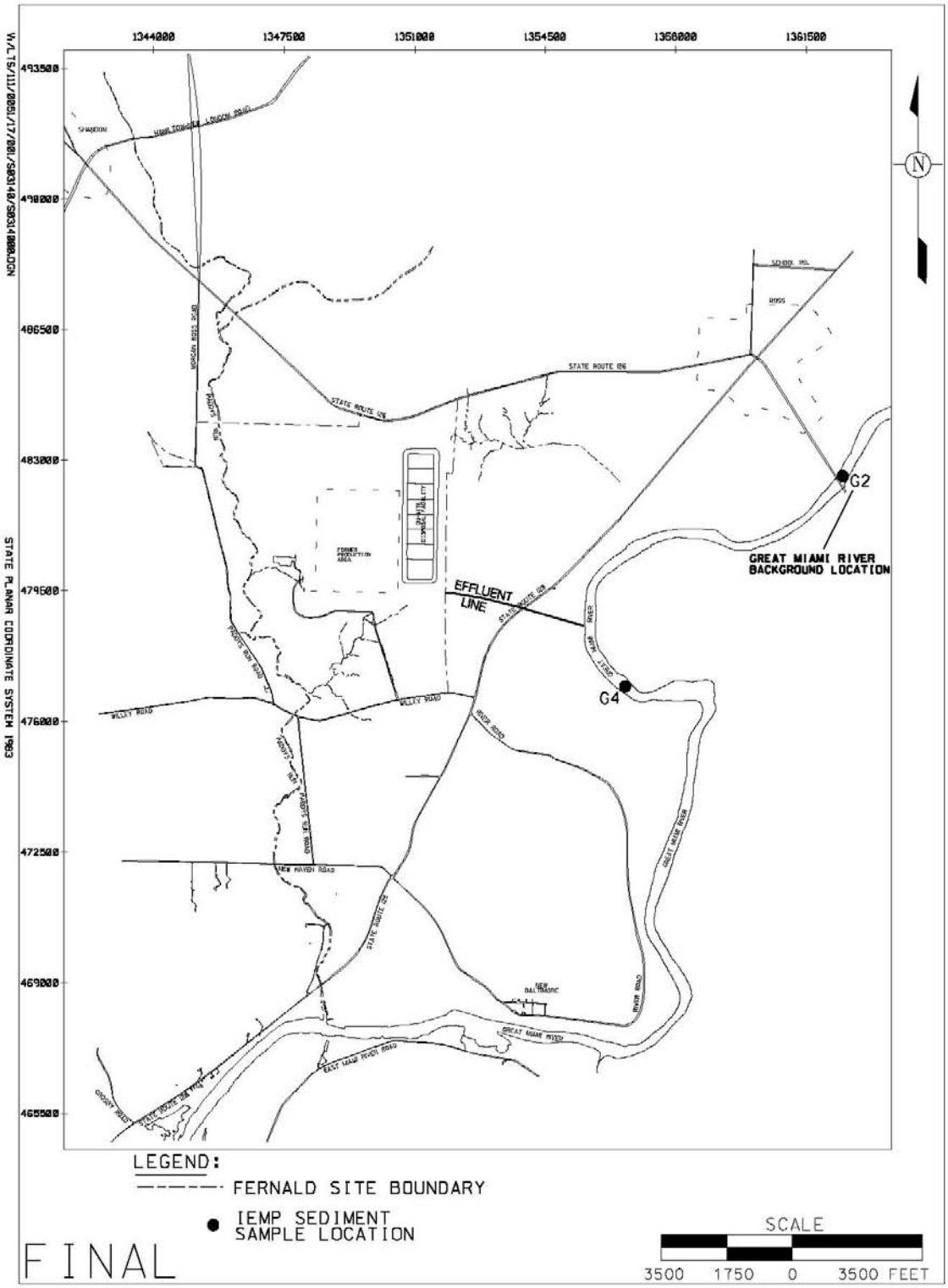


Figure B.2−1. 2006 Sediment Sample Locations

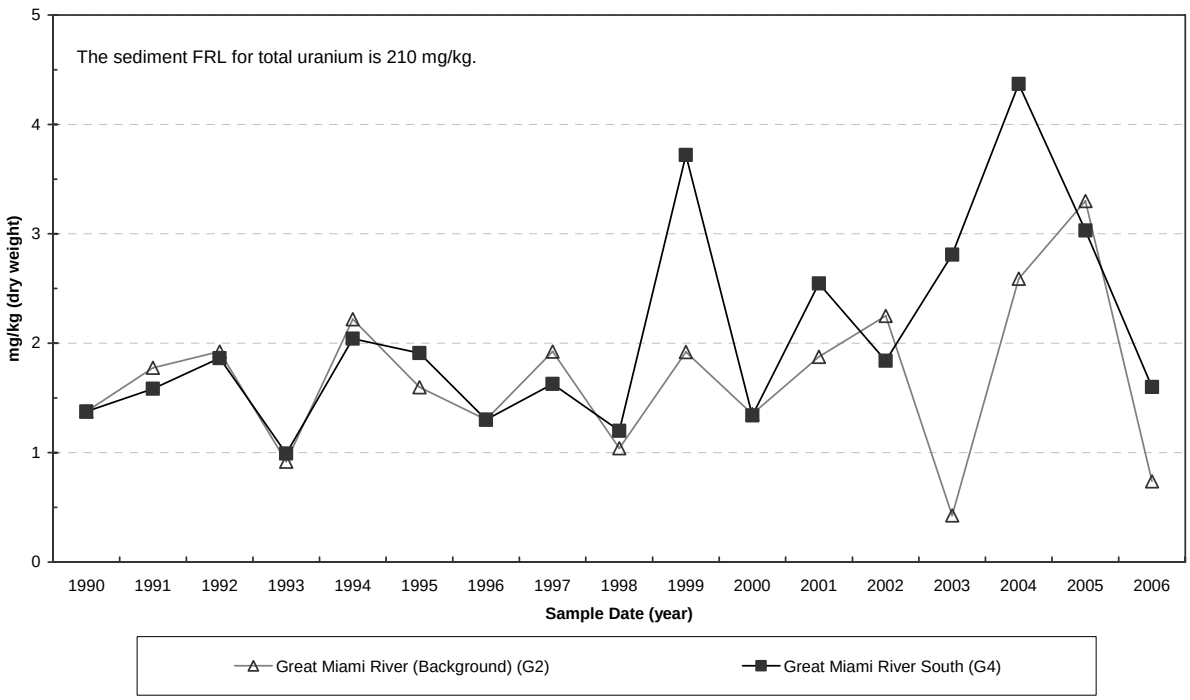


FIGURE B.2-2. AVERAGE TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR SEDIMENT

Appendix C

Supplemental Air Information

Contents

Attachment C.1 Radiological Air Particulate
Attachment C.2 Radon
Attachment C.3 Direct Radiation
Attachment C.4 Meteorological Data
Attachment C.5 Supplemental Dose Assessments

End of current text

Acronyms

BCG	Biota Concentration Guide
CFR	Code of Federal Regulations
DCG	derived concentration guidelines
DOE	U.S. Department of Energy
FCP	Fernald Closure Project
IEMP	Integrated Environmental Monitoring Plan
NESHAP	National Emissions Standards for Hazardous Air Pollutants
RCS	Radon Control System
TLD	thermoluminescent dosimeter

List of Measurement Abbreviations

cm	centimeters
m^3	cubic meters
°C	degrees Celsius
°F	degrees Fahrenheit
km	kilometer
kph	kilometers per hour
µCi	microCuries
µCi/hr	microCuries per hour
µCi/mL	microCuries per milliliter
$\mu g/m^3$	micrograms per cubic meter
mph	miles per hour
mCi	milliCuries
mrem	millirem
mSv	milliSievert
pCi/m^3	picoCuries per cubic meter
pCi/L	picoCuries per liter

End of current text

Appendix C presents additional air monitoring data and analysis in support of Chapter 5 of this 2006 Site Environmental Report. This appendix consists of five attachments as follows:

- Attachment C.1 provides the results of the radiological air particulate monitoring program, including an assessment of 2006 results with respect to historical data and concentration versus time plots of the total uranium, total particulate, and thorium data for 2006.
- Attachment C.2 provides the results of the radon monitoring program, including an assessment of radon data relative to continuous radon monitors. This discussion focuses on the U.S. Department of Energy (DOE) standards contained in DOE Order 5400.5, Radiation Protection of the Public and the Environment (DOE 1993), proposed 10 CFR 834, and an evaluation of trends observed in the 2006 data.
- Attachment C.3 provides the results of the direct radiation monitoring program including an assessment of 2006 results with respect to historical data.
- Attachment C.4 provides a summary of the meteorological data measured at the Fernald site during 2006.
- Attachment C.5 provides the results of supplemental dose assessments that are part of the standards and requirements contained in DOE Order 5400.5. The methods and data sources used for the population dose assessment and a biota dose assessment are explained. In addition, an evaluation of trends observed in the dose assessments over the past 7 years is also provided.

References

DOE (U.S. Department of Energy), 1993. “Radiation Protection of the Public and the Environment,” DOE Order 5400.5, Change 2, Washington, D.C., January.

DOE (U.S. Department of Energy), 1997. “1996 Site Environmental Report,” DE-A24-92OR21972, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 1988. “Internal Dose-Rate Conversion Factors for Calculation of Dose to the Public,” DOE/EH-0071, Washington, D.C., July.

DOE (U.S. Department of Energy), 2002. “A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota,” Final Technical Standard, Project No. ENVR-0011, Washington, D.C.

DOE (U.S. Department of Energy), 2006a. “Integrated Environmental Monitoring Plan (IEMP) Boundary Air Monitors – Phase 1 Reduction,” DOE-0102-06, DOE, Fernald Area Office, Cincinnati, Ohio, March 30, 2006.

DOE (U.S. Department of Energy), 2006b. “Recommended Reduction for Environmental Air Monitors (DOE 2006b),” DOE-0172-06, DOE, Fernald Area Office, Cincinnati, Ohio, July 24, 2006.

DOE (U.S. Department of Energy), 2006c. “Recommendation for Air Monitoring Phase II Site Boundary Reductions (DOE 2006c),” DOE-0032-07, DOE, Fernald Area Office, Cincinnati, Ohio, July 24, 2006.

International Commission on Radiological Protection (ICRP), 1975, Reference Manual: "Anatomical, Physiological, and Metabolic Characteristics," ICRP Publication 23.

Attachment C.1

C.1.0 Radiological Air Particulate

In 2006, the Fernald site operated 18 monitoring stations (Figure C.1−1) as part of the Integrated Environmental Monitoring Plan (IEMP) Radiological Air Particulate Monitoring Program. The data from 16 boundary monitoring stations and one background monitoring station are used to demonstrate compliance with the National Emissions Standards for Hazardous Air Pollutants (NESHAP) Subpart H. Data from the project specific air monitoring station (WPTH 2) are used to supplement the boundary monitoring of thorium emissions from the excavation of the waste pits.

The final year of soil remediation at the Fernald site was 2006. As the number of sources of airborne contamination decreased throughout 2006, so did the number of active air monitoring stations (AMS). The reductions to the air monitoring program were as follows:

- AMS-4, 5, 7, 23, 25, and 28 were removed from service in April 2006, which was documented in DOE letter, Integrated Environmental Monitoring Plan (IEMP) Boundary Air Monitors – Phase 1 Reduction (DOE 2006a)
- Thorium monitor WPTH-2 was removed from service in August 2006, which was documented in DOE letter, Recommended Reduction for Environmental Air Monitors (DOE 2006b)
- AMS-9C, 22, 26, 27, and 29 were removed from service in December 2006, which was documented in DOE letter, Recommendation for Air Monitoring Phase II Site Boundary Reductions (DOE 2006c).

All air monitoring stations that were active in 2006 are shown in Figure C.1-1.

Table C.1−1 provides an operational summary for the IEMP air monitoring stations in 2006. Most instruments operated nearly 100 percent of the time, with the worst performance being 96.8 percent at AMS-29. Although the stations are shut down for about 5 minutes when the filters are changed out, this does not accumulate a sufficient amount of time to account for down time in the calculation. Therefore, some monitors show 100 percent operational time. Periodic electrical outages and equipment malfunctions created short periods of down time that result in operation times of less than 100 percent.

C.1.1 Particulate Monitoring Results

Air filters were exchanged in each instrument every two weeks, but this was discontinued at six boundary locations in April, five boundary locations in December, and at WPTH-2 in August. The biweekly filters from the 16 boundary monitors and background monitor were analyzed for total uranium and total particulate, and monthly composites (two times per quarter; eight times per year) were analyzed for isotopic thorium. The biweekly filters from the project specific monitor (WPTH-2) were not analyzed for total uranium.

Figures C.1−2 through C.1−19 summarize the total uranium, total particulate, and isotopic thorium measurements for each location. In general, particulate concentrations were highest at the eastern boundary monitors adjacent to the active OSDF cells (AMS-3 and AMS-9C) and the borrow area (AMS-29). This observation is consistent with the prevailing winds blowing from southwest to northeast. The highest uranium and thorium concentrations were observed at

AMS-3, which is the closest downwind monitor to the OSDF cells active in 2006 (Cells 7 and 8). Sharp decreases in thorium-228 (AMS-12, Figure C.1−10, and AMS-26, Figure C.1−15, on August 1) and thorium-232 (AMS-22, Figure C.1−11, on February 28) reflect analytical results at the monitor location that are similar to results reported for the blank. When the blank result is subtracted from the monitor result, a very low value is obtained, which accounts for the dip along the trend line on the charts.

Tables C.1−2 through C.1−6 tabulate information for total uranium, particulate, thorium-228, thorium-230, and thorium-232, respectively. The information summarizes minimum, maximum, and average values for 2006 and 2005 at each location, and also presents minimum and maximum values over the 1990 to 2006 time period. Relative to the 2005 results, all parameters decreased in 2006, which reflects the decrease in demolition and excavation activities as the site moved toward closure in October of 2006. The annual average thorium-230 concentration reached a maximum of 0.00003 picoCuries per square meter (pCi/m^3) at AMS-6, which remains well below the criterion of less than one percent of the DOE derived concentration guideline (DCG) for thorium-230 (0.04 pCi/m3).

Aliquots of the 16 boundary and background filters collected biweekly were combined every three months to produce a quarterly composite sample. The composite samples were analyzed for isotopes of uranium, thorium, and radium-226 (Table C.1−7), and all results are below the DOE DCG values. Data in Table C.1−7 are used to calculate the dose delivered to human receptors, using values listed in 40 CFR 61 (NESHAP) Subpart H, Appendix E, Table 2. The NESHAP analysis in Appendix D indicates that the results in Table C.1−7 are well below the NESHAP guidelines.

C.1.2 Evaluation of Isotopic Dose from Airborne Emissions

The 2006 particulate data from 16 boundary monitors indicates uranium isotopes (U-234/235/236/238) contributed an average of 22 percent of the dose at the boundary, thorium (Th-228/230/231/232) about 57 percent, and radium (Ra-224/226/228) approximately 21 percent. The 2006 background dose (AMS-12) is distributed as 3 percent uranium, 6 percent thorium and 81 percent radium, which differs from the 2005 distribution of 6 percent uranium, 40 percent thorium, and 54 percent radium. Background results for 2005 are similar to 2006 for radium and lower for thorium, which account for the percentage differences. An increase in radium activity on the particulate at AMS-12 was not observed in 2006. A comprehensive discussion of the dose is presented in Appendix D (the 2006 NESHAP annual report).

Figure C.1−20 shows the percentage contribution to dose from uranium, thorium, and radium isotopes at each boundary and background monitor. The boundary locations have been corrected for the background results at monitor AMS-12 prior to calculating the percent dose. Radium isotopes contribute to most of the dose at AMS-9C and a large share at AMS-3. These locations are on the east side of the OSDF and the only boundary points were radium-226 exceeded background levels. This is consistent with AMS-3 and AMS-9C being downwind from the OSDF cells and stockpiles that held radium contaminated soil and debris. The radium contribution for the other boundary monitors is low because radium-224 and radium-228 are the only above-background contributors to the radium dose. AMS-25 has no radium dose because all radium isotopes on the particulate were less than the background. AMS-26 has no thorium and radium dose because the activities for thorium and radium isotopes at this location were less than background.

Table C.1−1. Operational Summary for Air Particulate Monitoring Stations

Location	Number of Samples	Sample Start Date	Sample End Date	Operating Time (hours)	percent of Operation
Boundary					
AMS-2	27	20-Dec-05	02-Jan-07	8908	98.2
AMS-3	27	20-Dec-05	02-Jan-07	8872	97.8
AMS-4	8	20-Dec-05	11-Apr-06	2688	100
AMS-5	8	20-Dec-05	11-Apr-06	2686	99.9
AMS-6	27	20-Dec-05	02-Jan-07	9035	99.6
AMS-7	8	20-Dec-05	11-Apr-06	2686	99.9
AMS-8A	27	20-Dec-05	02-Jan-07	8840	97.4
AMS-9C	25	20-Dec-05	05-Dec-06	8399	100.0
AMS-22	25	20-Dec-05	05-Dec-06	8392	99.9
AMS-23	8	20-Dec-05	11-Apr-06	2686	99.9
AMS-24	27	20-Dec-05	02-Jan-07	8971	98.9
AMS-25	8	20-Dec-05	11-Apr-06	2685	99.9
AMS-26	25	20-Dec-05	05-Dec-06	8373	99.7
AMS-27	25	20-Dec-05	05-Dec-06	8393	99.9
AMS-28	8	20-Dec-05	11-Apr-06	2686	99.9
AMS-29	25	20-Dec-05	05-Dec-06	8131	96.8
Background					
AMS-12	27	20-Dec-05	02-Jan-07	9068	100
Project-Specific					
WPTH-2	16	20-Dec-05	01-Aug-06	5369	99.9

Table C.1−2. Total Uranium Particulate Concentrations in Air[a]

	2006 Results pCi/m^3 x 1E-06				2005 Results pCi/m^3 x 1E-06				1990 through 2006 pCi/m^3 x 1E-06	
Location	Number of Samples	minimum	maximum	average	Number of Samples	minimum	maximum	average	minimum	maximum
Boundary										
AMS-2	27	1.7	83	28	25	1.6	120	42	0.0	9060
AMS-3	27	2.7	260	83	25	4.3	350	113	0.0	17000
AMS-4[b]	8	1.6	42	20	25	2.3	81	34	0.0	2300
AMS-5[b]	8	0.91	28	13	25	1.8	71	29	0.0	4400
AMS-6	27	1.2	53	23	25	0.0	190	59	0.0	3200
AMS-7[b]	8	1.6	28	16	25	2.4	81	33	0.0	7800
AMS-8A	27	1.5	110	35	25	2.1	200	62	0.0	2100
AMS-9C[c]	25	1.7	130	52	25	3.2	240	87	0.0	1700
AMS-22[c]	25	1.5	260	36	25	1.7	180	61	0.0	8100
AMS-23[b]	8	1.4	65	20	25	1.6	160	48	0.0	13000
AMS-24	27	1.6	57	30	25	2.5	120	33	0.0	200
AMS-25[b]	8	0.69	19	11	25	1.0	45	20	0.0	400
AMS-26[c]	25	1.2	110	35	25	1.7	230	48	0.0	1500
AMS-27[c]	25	1.6	66	29	25	1.7	150	51	0.0	1300
AMS-28[b]	8	1.0	60	20	25	0.9	160	49	0.0	3000
AMS-29[c]	25	1.1	110	40	25	3.2	110	53	0.0	1900
Background										
AMS-12	27	0.78	23	11	25	0.0	23	12	0.0	480

[a]Biweekly samples (total U activity calculated assuming natural isotopic distribution)
[b]AMS-4, 5, 7, 23, 25 and 28 were taken out of service on April 11, 2006.
[c]AMS-9C, 22, 26, 27, and 29 were taken out of service on December 5, 2006.

Table C.1−3. Total Particulate Concentrations in Air[a]

	2006 Results (ug/m^3)				2005 Results (ug/m^3)				1990 through 2006 (ug/m^3)	
Location	Number of Samples	minimum	maximum	average	Number of Samples	minimum	maximum	average	minimum	maximum
Boundary										
AMS-2	27	0.0	50	30	26	14	73	34	7.0	77
AMS-3	27	20	110	56	26	17	110	48	8.0	160
AMS-4[b]	8	23	33	29	26	17	63	39	13	81
AMS-5[b]	8	15	30	20	26	13	43	29	9.6	48
AMS-6	27	0.0	39	27	26	15	49	34	8.0	62
AMS-7[b]	8	16	24	20	26	14	71	31	6.8	84
AMS-8A	27	11	53	30	26	14	57	34	8.6	89
AMS-9C[d]	25	19	90	46	26	21	69	42	7.1	140
AMS-22[d]	25	20	70	31	26	20	45	34	13	57
AMS-23[b]	8	16	28	22	26	13	49	31	11	75
AMS-24	27	16	61	38	26	12	78	34	5.4	110
AMS-25[b]	8	12	20	16	26	11	43	24	11	69
AMS-26[d]	25	16	47	30	26	16	42	30	5.5	120
AMS-27[d]	25	19	73	48	26	21	79	50	16	92
AMS-28[b]	8	13	24	18	26	13	43	27	8.1	69
AMS-29[d]	25	0	81	41	26	17	67	42	11	93
Background										
AMS-12	27	14	67	25	26	11	43	26	6.0	4100
Project Specific										
WPTH-2[c]	8	23	34	28	26	18	54	26	25	77

[a]Biweekly samples
[b]AMS-4, 5, 7, 23, 25 and 28 were taken out of service on April 11, 2006.
[c]WPTH-2 was taken out of service on August 2, 2006.
[d]AMS-9C, 22, 26, 27, and 29 were taken out of service on December 5, 2006.

Table C.1−4. Total Thorium-228 Particulate Concentrations in Air[a]

	2006 Results (pCi/m^3 x 1E-06)				2005 Results (pCi/m^3 x 1E-06)				1990 through 2006 (pCi/m^3 x 1E-06)	
Location	Number of Samples	minimum	maximum	average	Number of Samples	minimum	maximum	average	minimum	maximum
Boundary										
AMS-2	18	0.084	17	5.3	17	5.8	25	13	0.0	38
AMS-3	18	0.55	31	10	17	7.7	35	23	0.0	30
AMS-4[b]	5	8.0	8.6	8.3	17	5.9	35	17	0.0	22
AMS-5[b]	5	4.1	7.2	5.4	17	4.8	21	13	0.0	18
AMS-6	18	0.0	14	5.0	17	4.4	25	15	0.0	21
AMS-7[b]	5	4.1	8.9	7.0	17	4.2	29	15	0.0	17
AMS-8A	18	0.094	24	6.3	17	3.5	26	14	0.0	39
AMS-9C[d]	18	0.15	19	5.7	17	9.6	26	15	0.0	50
AMS-22[d]	18	0.0	14	6.0	17	1.1	20	12	0.0	30
AMS-23[b]	5	7.0	7.6	7.4	17	2.4	31	17	0.0	22
AMS-24	18	0.080	12	5.0	17	6.4	25	14	0.0	27
AMS-25[b]	5	7.5	7.7	7.6	17	3.6	15	10	0.0	17
AMS-26[d]	18	0.0	14	5.6	17	6.5	24	14	0.0	24
AMS-27[d]	18	0.0	22	5.9	17	7.3	34	18	0.0	25
AMS-28[b]	5	6.2	16	10	17	3.9	15	9.4	0.0	39
AMS-29[d]	18	0.10	20	7.5	17	3.9	31	18	0.0	46
Background										
AMS-12	18	0.0	14	5.4	17	0.0	17	7.9	0.0	17
Project-Specific										
WPTH-2[c]	12	0.15	19	9.4	17	9.7	29	17	0.0	38

[a]Monthly composites (there are 2 to 3 sample filters in each composite)
[b]AMS-4, 5, 7, 23, 25 and 28 were taken out of service on April 11, 2006.
[c]WPTH-2 was taken out of service on August 2, 2006.
[d]AMS-9C, 22, 26, 27, and 29 were taken out of service on December 5, 2006.

Table C.1−5. Total Thorium-230 Particulate Concentrations in Air[a]

	2006 Results (pCi/m^3 x 1E-06)				2005 Results (pCi/m^3 x 1E-06)				1990 through 2006 (pCi/m^3 x 1E-06)	
Location	Number of Samples	minimum	maximum	average	Number of Samples	minimum	maximum	average	minimum	maximum
Boundary										
AMS-2	18	0.04	12	4.4	17	0.0	24	12	0.0	140
AMS-3	18	0.47	25	7.9	17	9.7	53	32	0.0	740
AMS-4[b]	5	4.3	8.9	7.1	17	0.0	20	13	0.0	91
AMS-5[b]	5	0.75	6.5	4.2	17	2.1	19	8.4	0.0	620
AMS-6	18	0.16	30	8.4	17	6.4	78	33	0.0	490
AMS-7[b]	5	0.15	2.4	1.5	17	0.0	13	7.4	0.0	77
AMS-8A	18	0.21	19	7.3	17	0.0	32	18	0.0	460
AMS-9C[d]	18	0.11	29	8.5	17	6.6	43	26	0.0	410
AMS-22[d]	18	0.12	12	3.9	17	0.1	40	18	0.0	490
AMS-23[b]	5	2.3	5.1	3.4	17	0.0	31	17	0.0	210
AMS-24	18	0.26	13	5.7	17	1.9	21	11	0.0	130
AMS-25[b]	5	1.9	2.5	2.2	17	0.0	19	8.9	0.0	220
AMS-26[d]	18	0.11	17	5.0	17	3.4	18	13	0.0	230
AMS-27[d]	18	0.28	17	6.5	17	13	51	24	0.0	190
AMS-28[b]	5	1.0	1.4	1.2	17	0.0	23	10	0.0	400
AMS-29[d]	18	0.31	19	7.3	17	6.4	32	22	0.0	540
Background										
AMS-12	18	0.0	6.8	2.0	17	0.0	11	4.8	0.0	42
Project-Specific										
WPTH-2[c]	12	0.24	16	7.2	17	4.9	78	31	0.0	580

[a]Monthly composites (there are 2 to 3 sample filters in each composite)
[b]AMS-4, 5, 7, 23, 25 and 28 were taken out of service on April 11, 2006.
[c]WPTH-2 was taken out of service on August 2, 2006.
[d]AMS-9C, 22, 26, 27, and 29 were taken out of service on December 5, 2006.

Table C.1−6. Total Thorium-232 Particulate Concentrations in Air[a]

	2006 Result (pCi/m^3 x 1E-06)				2005 Results (pCi/m^3 x 1E-06)				1990 through 2006 (pCi/m^3 x 1E-06)	
Location	Number of Samples	minimum	maximum	average	Number of Samples	minimum	maximum	average	minimum	maximum
Boundary										
AMS-2	18	0.10	12	3.8	17	1.7	9.5	5.5	0.0	22
AMS-3	18	0.40	15	4.8	17	0.6	20	11	0.0	25
AMS-4[b]	5	0.00	3.6	1.4	17	1.9	15	7.4	0.0	22
AMS-5[b]	5	0.95	1.6	1.3	17	0.0	13	4.1	0.0	25
AMS-6	18	0.072	5.5	2.3	17	3.9	17	8.7	0.0	22
AMS-7[b]	5	1.2	5.3	3.7	17	0.0	7.5	3.8	0.0	16
AMS-8A	18	0.15	6.6	2.9	17	3.1	14	6.9	0.0	33
AMS-9C[d]	18	0.24	16	4.3	17	2.8	19	10	0.0	36
AMS-22[d]	18	0.018	13	2.2	17	1.8	12	7.2	0.0	35
AMS-23[b]	5	3.8	6.6	5.5	17	0.9	16	8.9	0.0	75
AMS-24	18	0.055	9.1	3.6	17	0.4	12	6.9	0.0	16
AMS-25[b]	5	0.37	3.2	1.5	17	1.1	7.6	3.6	0.0	14
AMS-26[d]	18	0.077	8.7	2.8	17	2.1	10	6.3	0.0	14
AMS-27[d]	18	0.059	16	3.8	17	5	12	7.9	0.0	22
AMS-28[b]	5	0.52	2.3	1.2	17	0.1	12	3.7	0.0	33
AMS-29[d]	18	0.10	12	4.5	17	2.3	18	10	0.0	31
Background										
AMS-12	18	0.00	6.6	2.5	17	1.5	7.8	3.4	0.0	34
Project-Specific										
WPTH-2[c]	12	0.13	7.7	4.6	17	2.8	14	6.8	0.0	43

[a]Monthly composites (there are 2 to 3 sample filters in each composite)
[b]AMS-4, 5, 7, 23, 25 and 28 were taken out of service on April 11, 2006.
[c]WPTH-2 was taken out of service on August 2, 2006.
[d]AMS-9C, 22, 26, 27, and 29 were taken out of service on December 5, 2006.

Table C.1−7. 2006 Annual Average Radionuclide Particulate concentrations in Air[ac]

	Gross Concentration (pCi/m^3)											
Location	U-238	U-234	U-235/6	Th-228	Th-230	Th-232	Ra-226	Th-234[b]	Ra-228[b]	Ac-228[b]	Ra-224[b]	Th-231[b]
Boundary												
AMS-2	4.60E-06	4.47E-06	0.00E+00	3.81E-06	9.56E-07	2.22E-06	1.92E-05	4.60E-06	2.22E-06	2.22E-06	2.22E-06	0.00E+00
AMS-3	1.16E-05	9.78E-06	1.32E-07	6.50E-06	5.51E-06	4.97E-06	7.08E-05	1.16E-05	4.97E-06	4.97E-06	4.97E-06	1.32E-07
AMS-4[d]	1.19E-05	9.26E-06	0.00E+00	7.19E-06	6.48E-09	5.22E-06	1.39E-05	1.19E-05	5.22E-06	5.22E-06	5.22E-06	0.00E+00
AMS-5[d]	6.12E-06	6.12E-06	0.00E+00	4.67E-06	6.20E-09	2.55E-06	3.73E-05	6.12E-06	2.55E-06	2.55E-06	2.55E-06	0.00E+00
AMS-6	4.26E-06	4.01E-06	6.65E-08	3.21E-06	1.34E-06	1.58E-06	3.32E-05	4.26E-06	1.58E-06	1.58E-06	1.58E-06	6.65E-08
AMS-7[d]	9.21E-06	6.54E-06	0.00E+00	5.84E-06	2.79E-08	2.28E-06	2.64E-05	9.21E-06	2.28E-06	2.28E-06	2.28E-06	0.00E+00
AMS-8A	6.04E-06	5.68E-06	4.57E-08	3.87E-06	2.26E-06	2.39E-06	2.46E-05	6.04E-06	2.39E-06	2.39E-06	2.39E-06	4.57E-08
AMS-9C[e]	7.43E-06	7.86E-06	6.33E-08	3.79E-06	1.68E-06	2.39E-06	7.80E-05	7.43E-06	2.39E-06	2.39E-06	2.39E-06	6.33E-08
AMS-22[e]	5.25E-06	5.98E-06	6.56E-07	3.28E-06	1.01E-06	1.78E-06	2.94E-05	5.25E-06	1.78E-06	1.78E-06	1.78E-06	6.56E-07
AMS-23[d]	1.12E-05	1.19E-05	1.74E-06	8.34E-06	5.51E-07	4.26E-06	2.60E-05	1.12E-05	4.26E-06	4.26E-06	4.26E-06	1.74E-06
AMS-24	6.00E-06	5.60E-06	0.00E+00	4.54E-06	2.93E-06	3.35E-06	1.95E-05	6.00E-06	3.35E-06	3.35E-06	3.35E-06	0.00E+00
AMS-25[d]	7.23E-06	6.52E-06	0.00E+00	3.73E-06	0.00E+00	3.73E-08	1.19E-05	7.23E-06	3.73E-08	3.73E-08	3.73E-08	0.00E+00
AMS-26[e]	1.46E-06	1.32E-06	5.37E-08	1.26E-06	6.37E-07	5.31E-07	9.31E-06	1.46E-06	5.31E-07	5.31E-07	5.31E-07	5.37E-08
AMS-27[e]	4.71E-06	4.46E-06	7.31E-08	4.70E-06	2.10E-06	2.92E-06	4.54E-05	4.71E-06	2.92E-06	2.92E-06	2.92E-06	7.31E-08
AMS-28[d]	8.42E-06	9.11E-06	0.00E+00	3.72E-06	4.91E-08	2.35E-06	4.26E-05	8.42E-06	2.35E-06	2.35E-06	2.35E-06	0.00E+00
AMS-29[e]	9.20E-06	7.40E-06	8.32E-08	5.56E-06	2.95E-06	3.72E-06	5.29E-05	9.20E-06	3.72E-06	3.72E-06	3.72E-06	8.32E-08
Background												
AMS-12	2.13E-06	1.89E-06	0.00E+00	2.99E-06	1.01E-06	1.18E-06	5.09E-05	2.13E-06	1.18E-06	1.18E-06	1.18E-06	0.00E+00
Compliance Limit												
DCGs	1.00E-01	9.00E-02	1.00E-01	4.00E-02	4.00E-02	7.00E-03	1.00E+00	4.00E+02	3.00E+00	4.00E+01	4.00E+00	1.00E+04

[a]A concentration of 0.0 indicates either the filter results were equal to or less than the blank results.
[b]Isotopes assumed to be in equilibrium with their parents.
[c]Annual Average obtained from sum of quarter results for total activity divided by total air volume through the monitor.
[d]AMS-4, 5, 7, 23, 25 and 28 were taken out of service on April 11, 2006.
[e]AMS-9C, 22, 26, 27, and 29 were taken out of service on December 5, 2006.

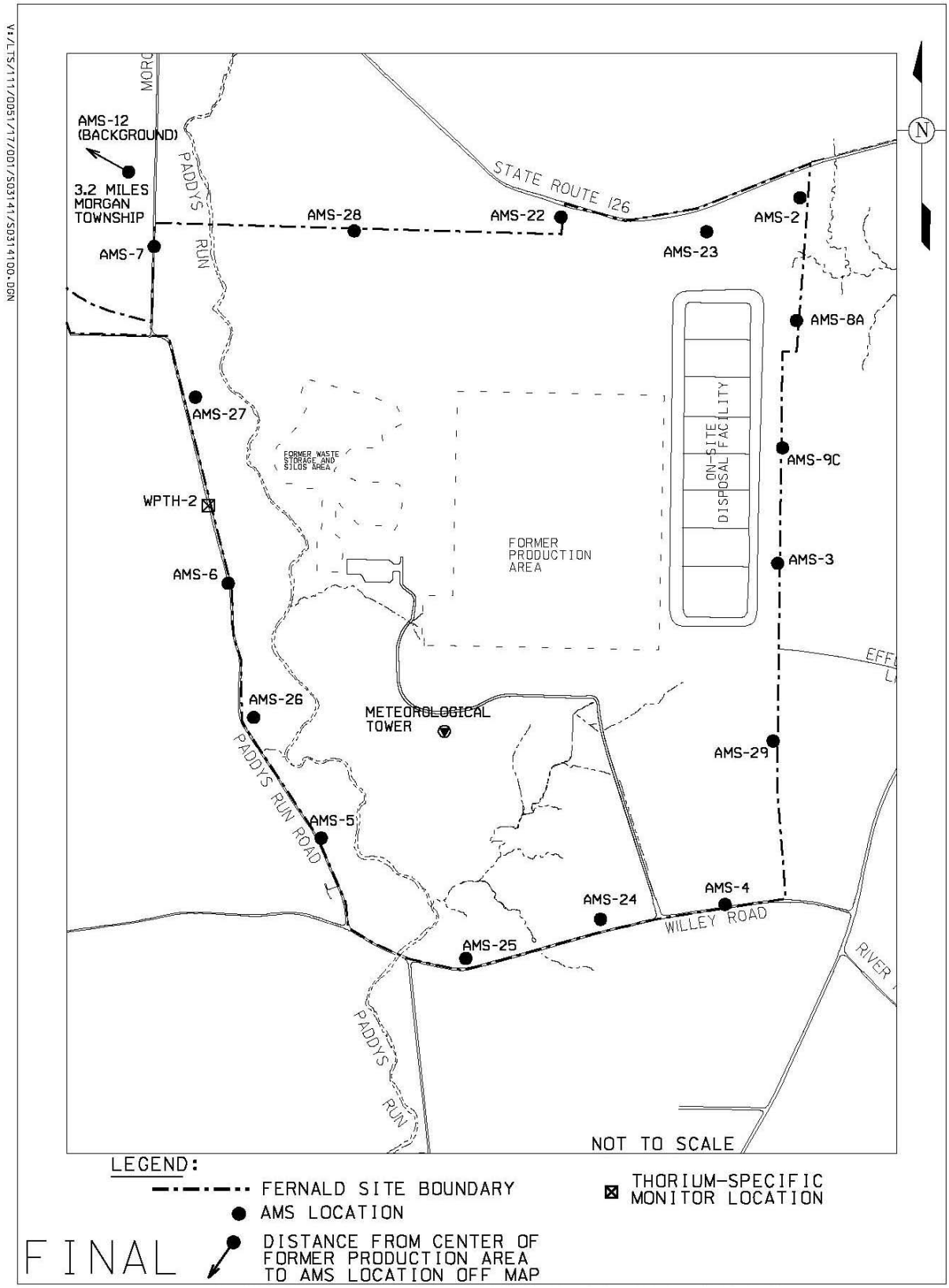


Figure C.1–1. IEMP Air Monitoring Locations

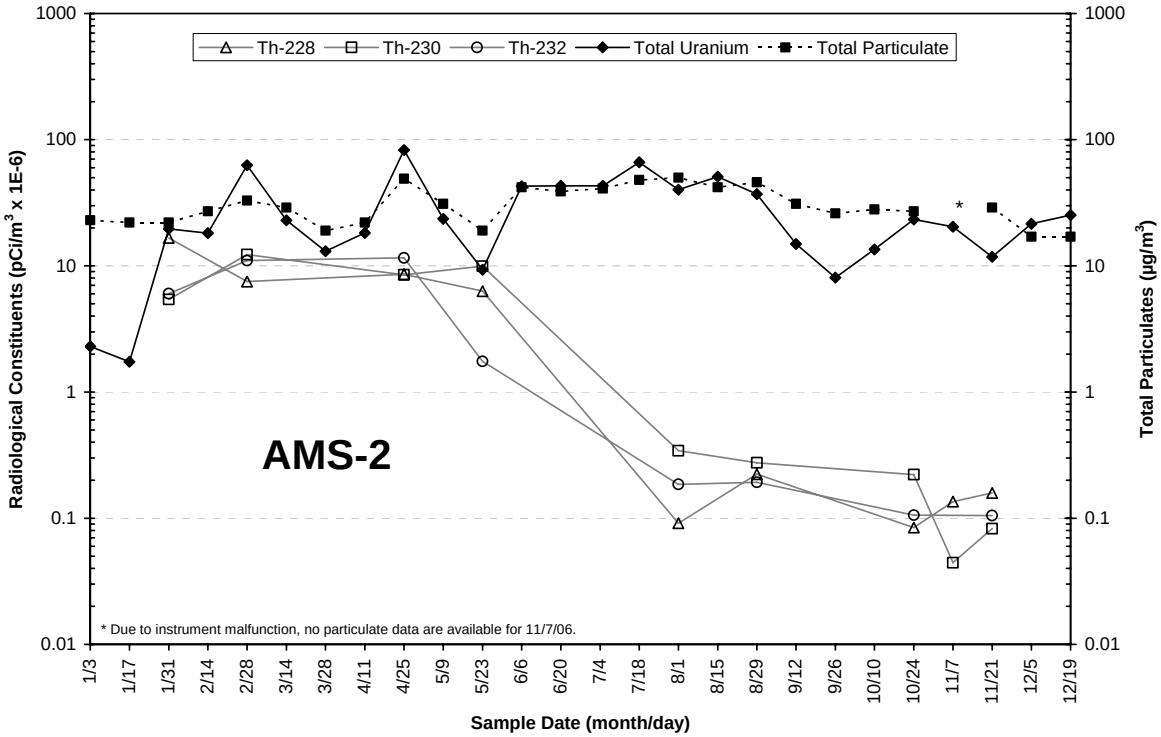


Figure C.1–2. 2006 Radiological and Particulate Concentrations in Air (AMS-2)

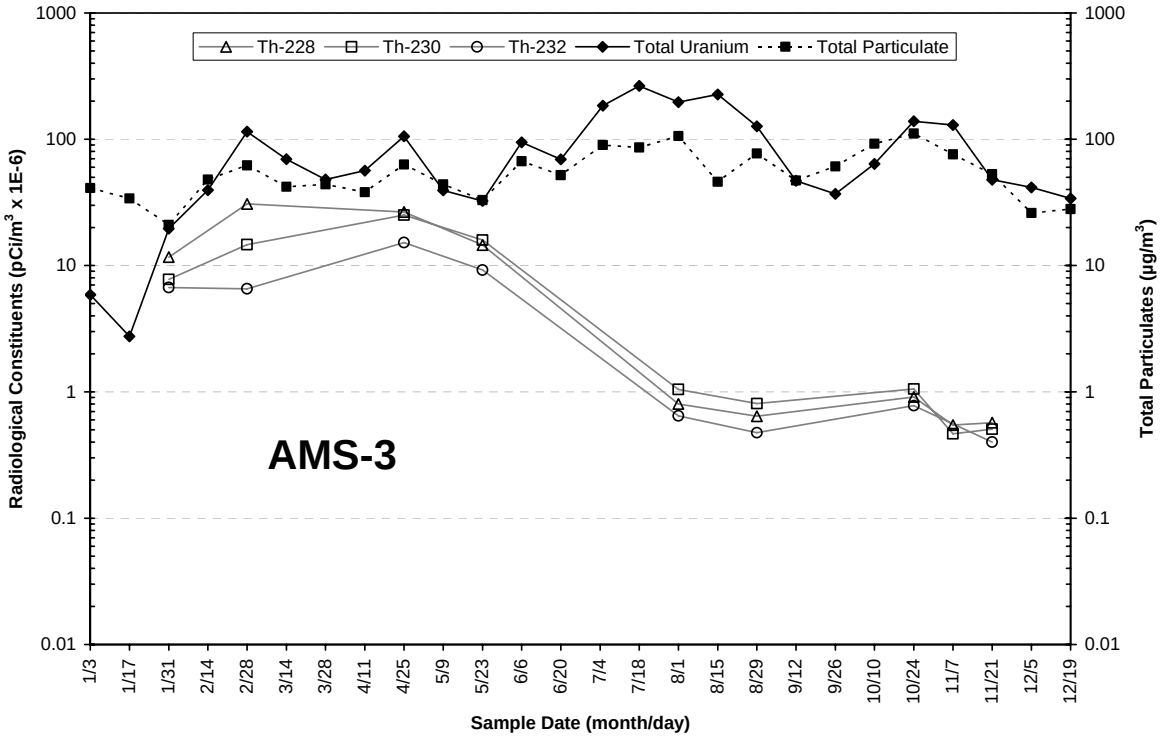


Figure C.1–3. 2006 Radiological and Particulate Concentrations in Air (AMS-3)

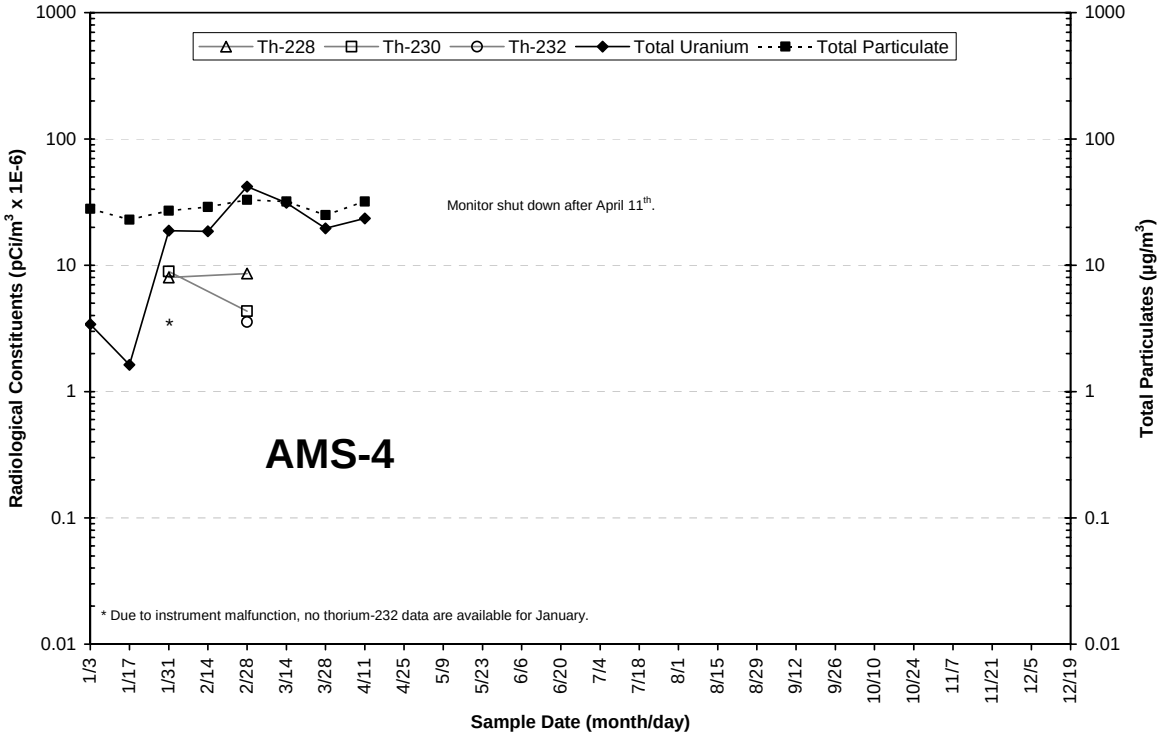


Figure C.1–4. 2006 Radiological and Particulate Concentrations in Air (AMS-4)

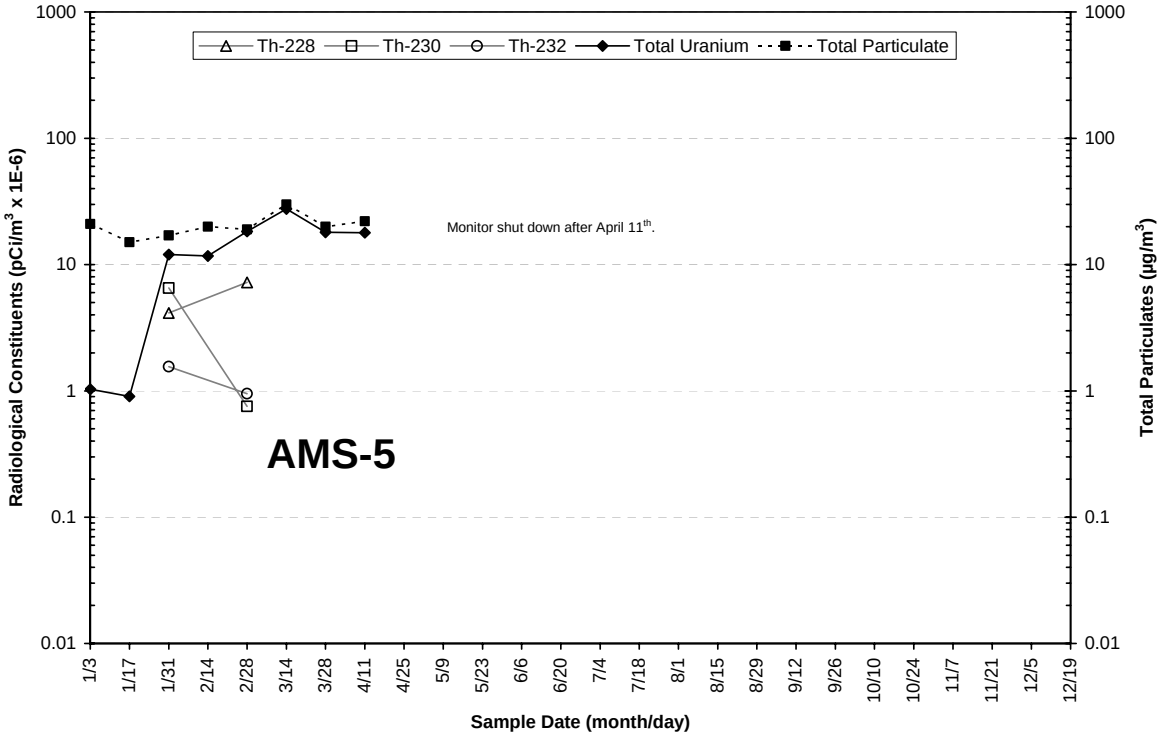


Figure C.1–5. 2006 Radiological and Particulate Concentrations in Air (AMS-5)

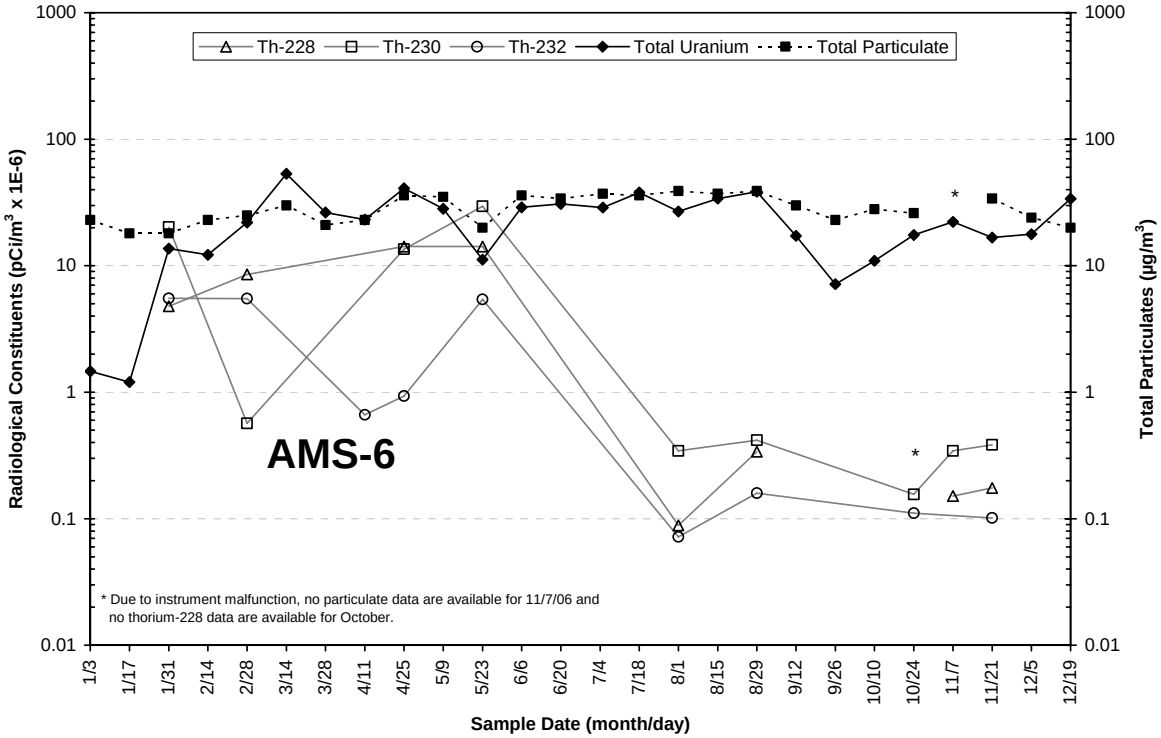


Figure C.1–6. 2006 Radiological and Particulate Concentrations in Air (AMS-6)

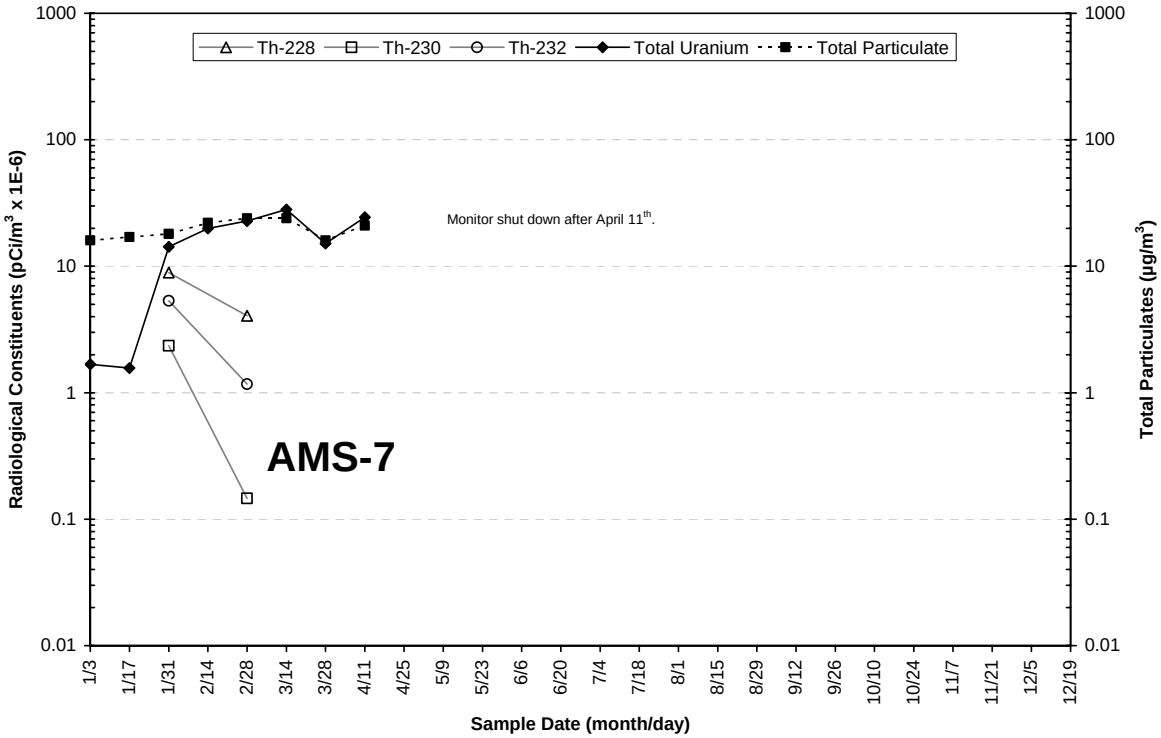


Figure C.1–7. 2006 Radiological and Particulate Concentrations in Air (AMS-7)

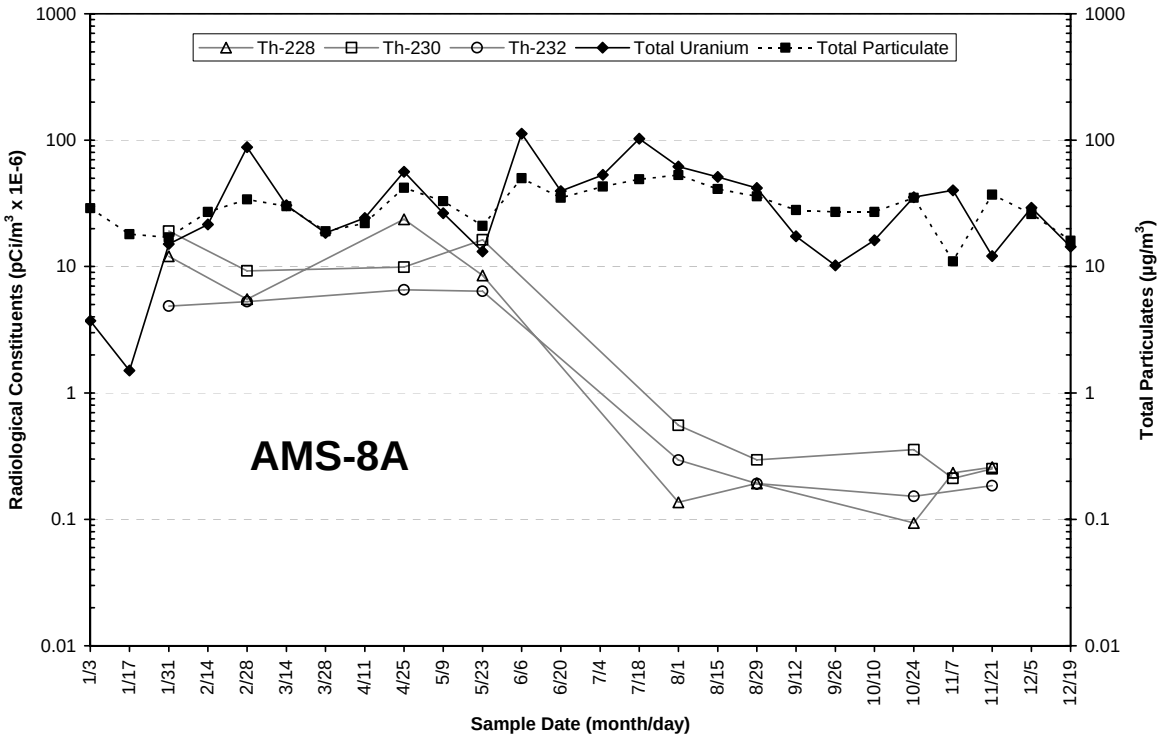


Figure C.1–8. 2006 Radiological and Particulate Concentrations in Air (AMS-8)

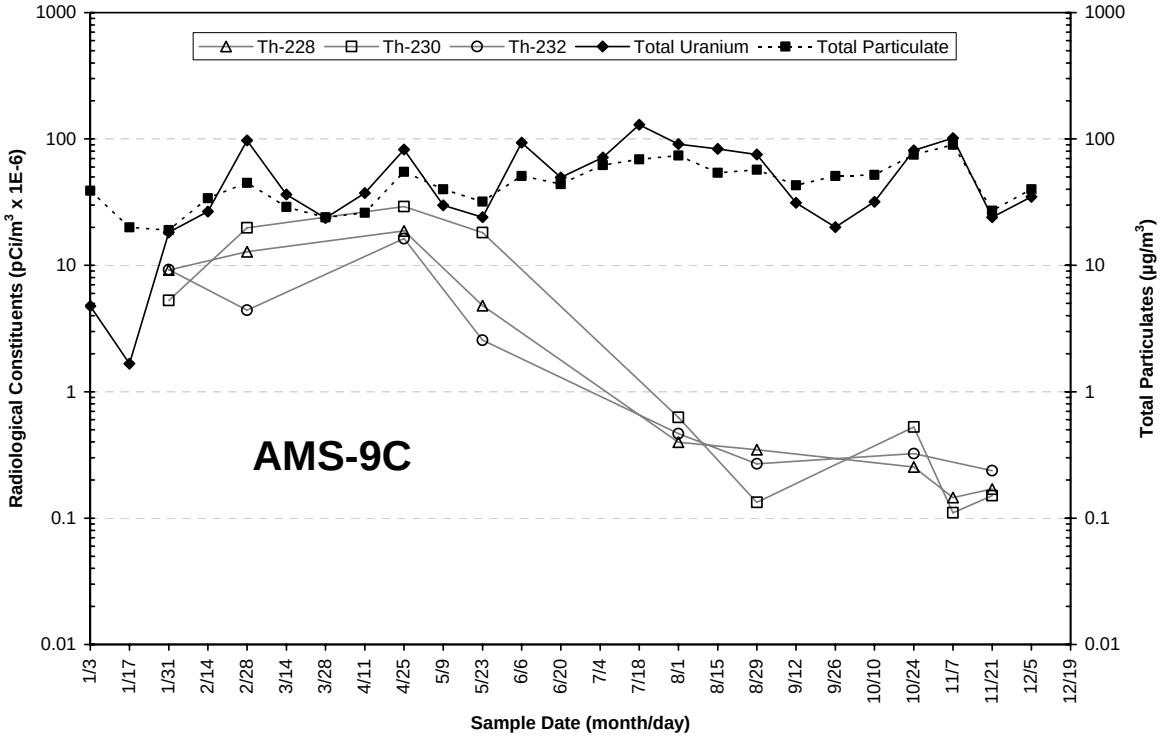


Figure C.1–9. 2006 Radiological and Particulate Concentrations in Air (AMS-9)

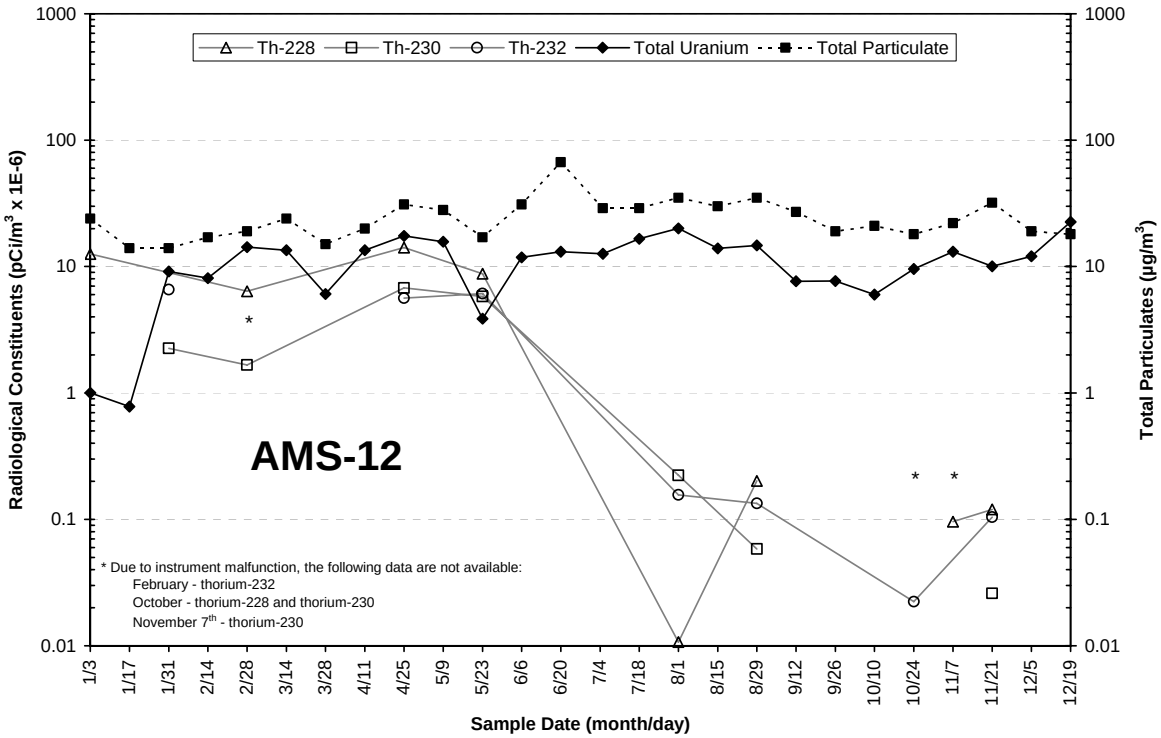


Figure C.1–10. 2006 Radiological and Particulate Concentrations in Air (AMS-12)

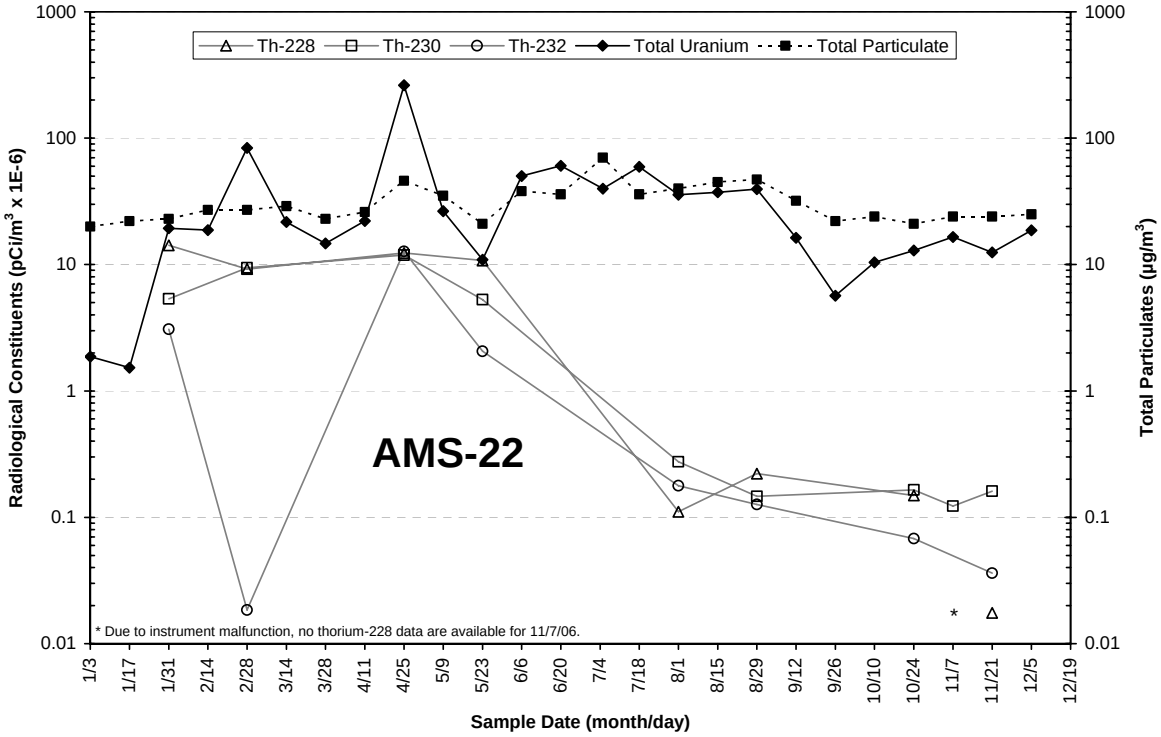


Figure C.1–11. 2006 Radiological and Particulate Concentrations in Air (AMS-22)

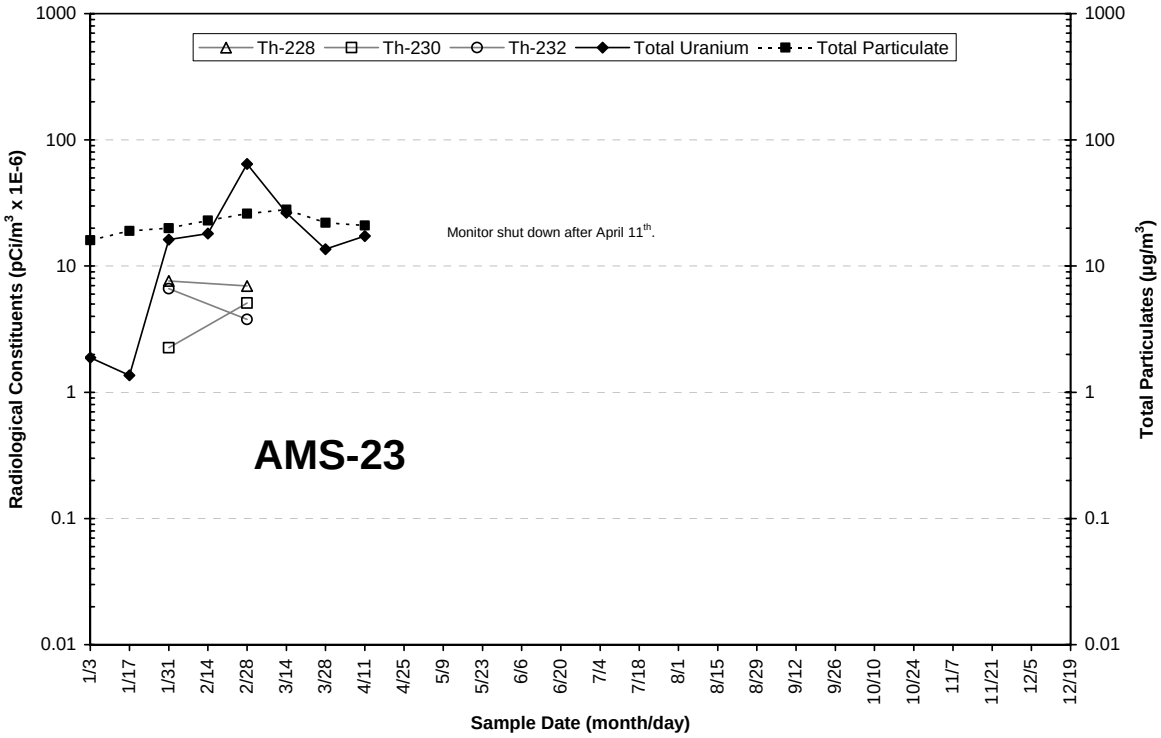


Figure C.1–12. 2006 Radiological and Particulate Concentrations in Air (AMS-23)

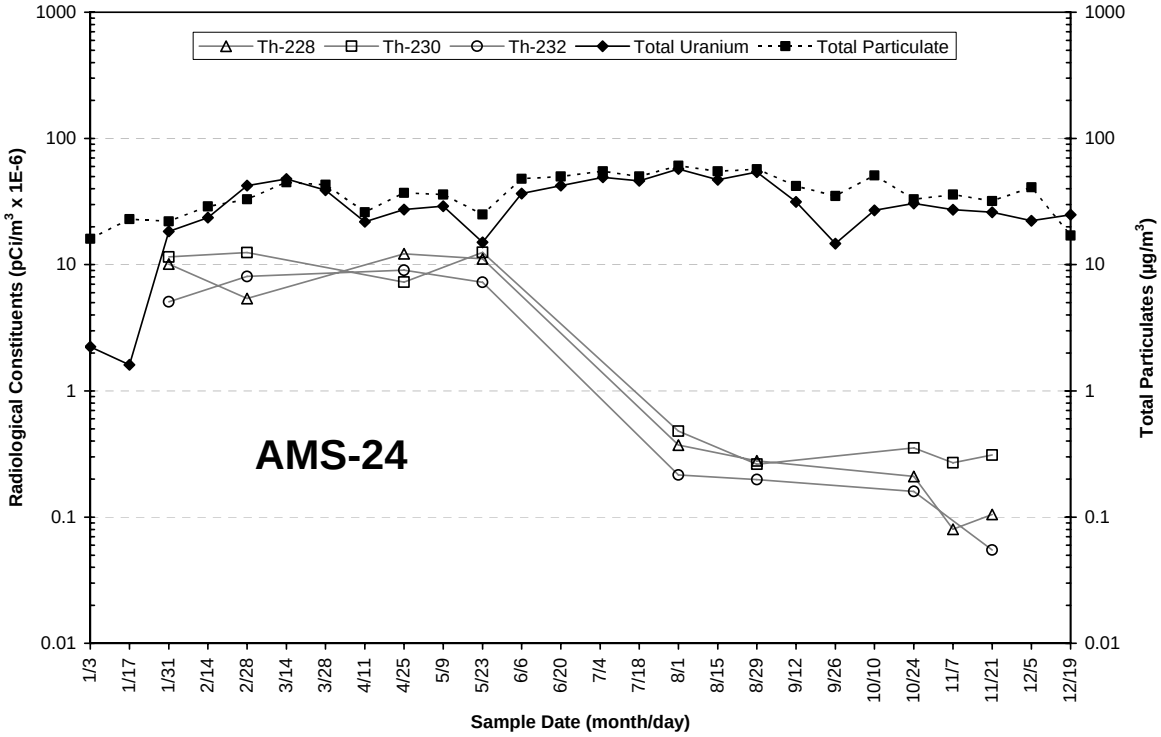


Figure C.1–13. 2006 Radiological and Particulate Concentrations in Air (AMS-24)

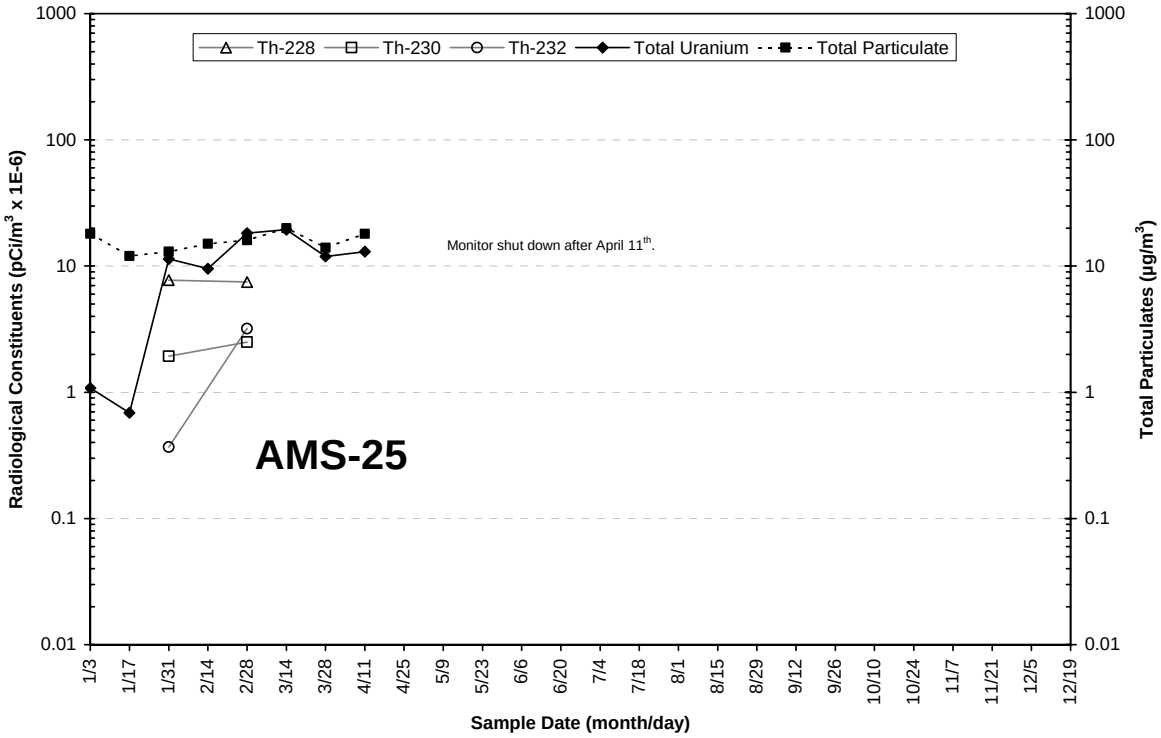


Figure C.1–14. 2006 Radiological and Particulate Concentrations in Air (AMS-25)

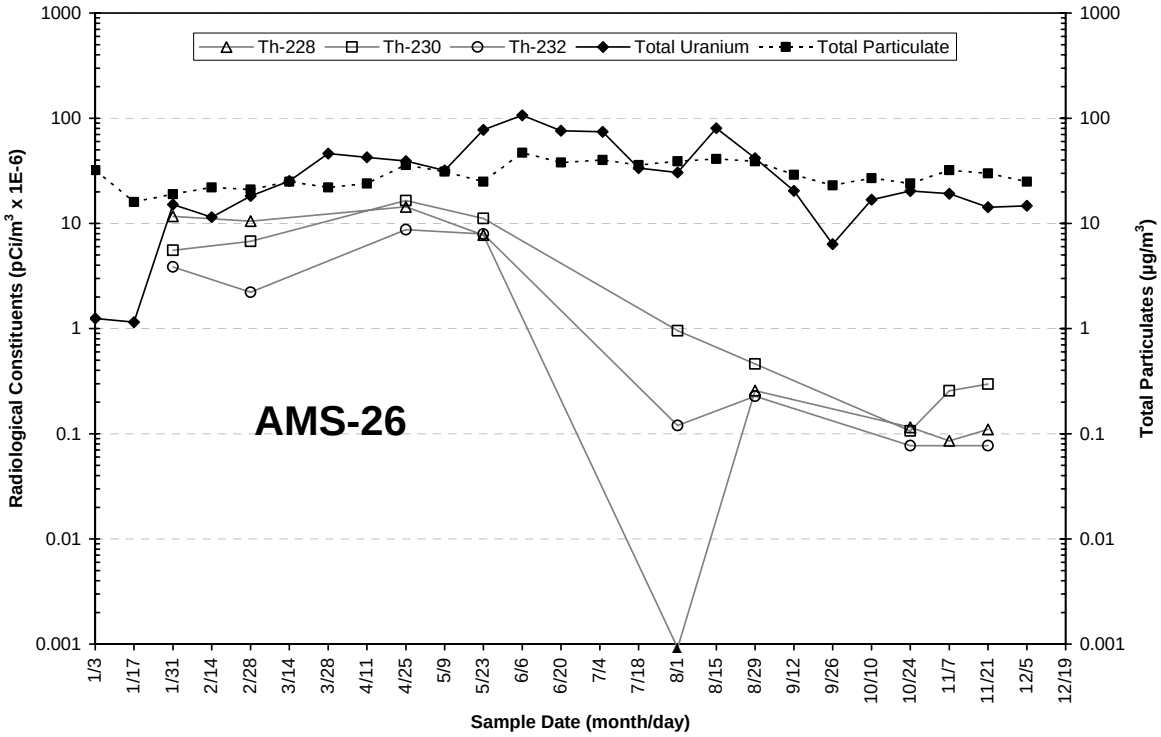


Figure C.1–15. 2006 Radiological and Particulate Concentrations in Air (AMS-62)

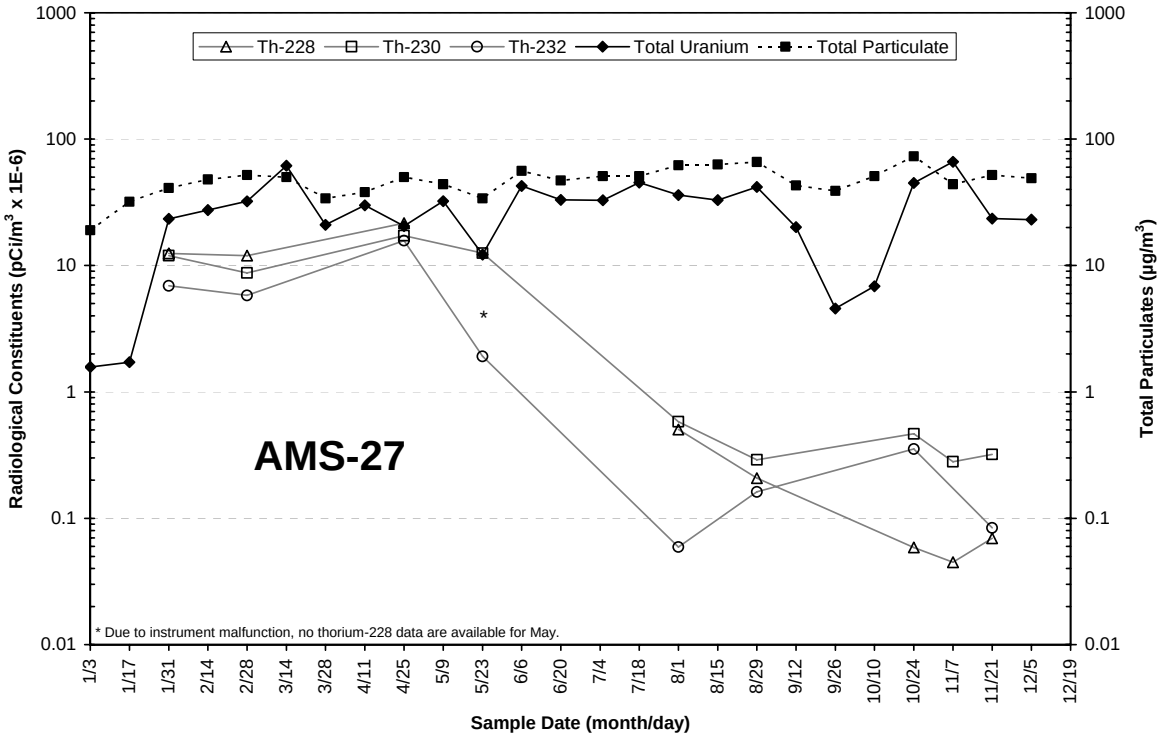


Figure C.1–16. 2006 Radiological and Particulate Concentrations in Air (AMS-27)

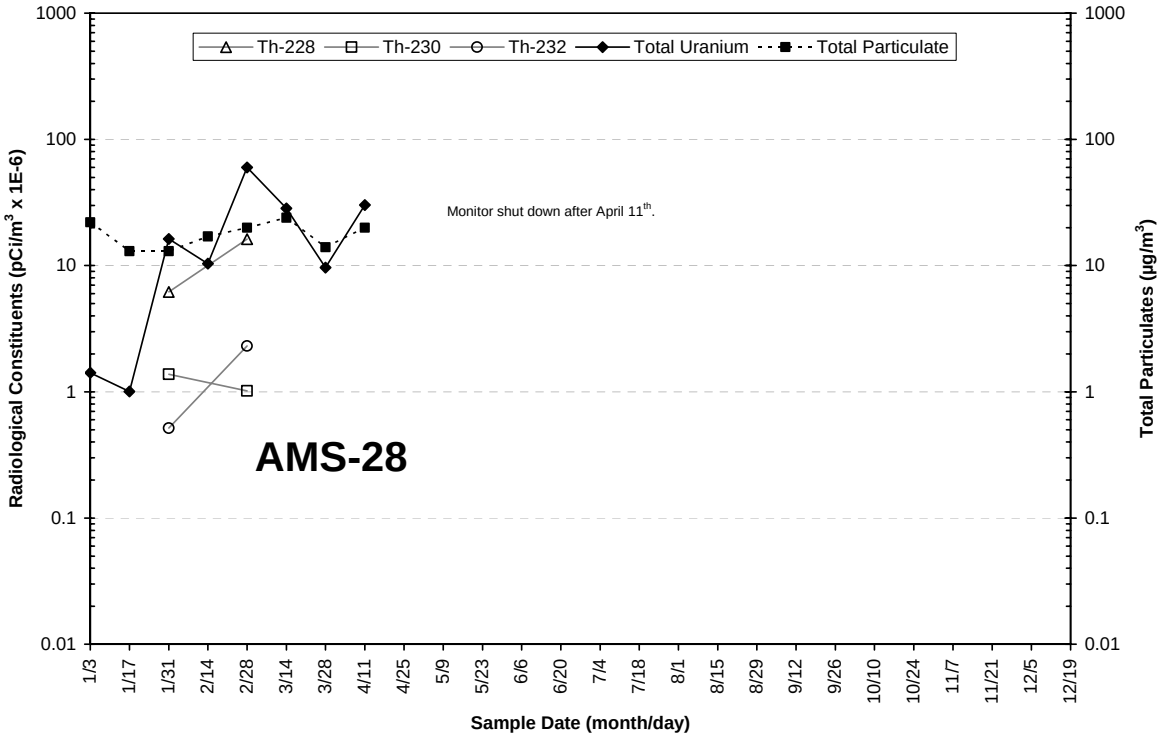


Figure C.1–17. 2006 Radiological and Particulate Concentrations in Air (AMS-28)

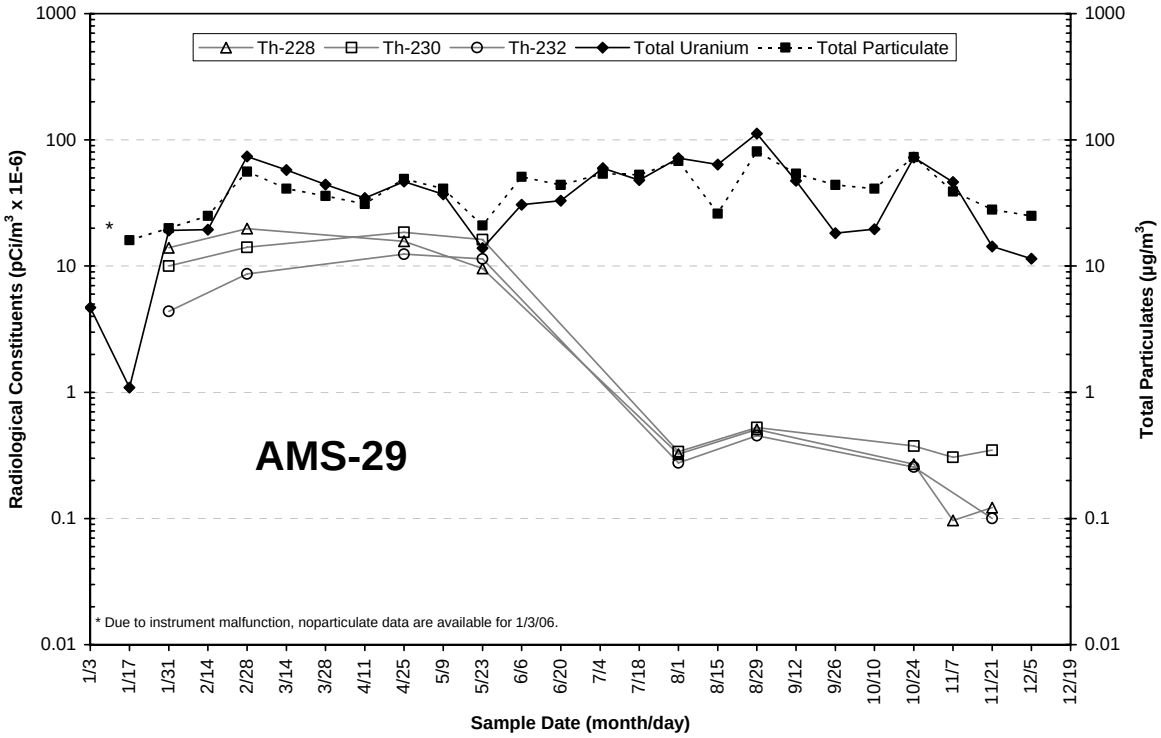


Figure C.1–18. 2006 Radiological and Particulate Concentrations in Air (AMS-29)

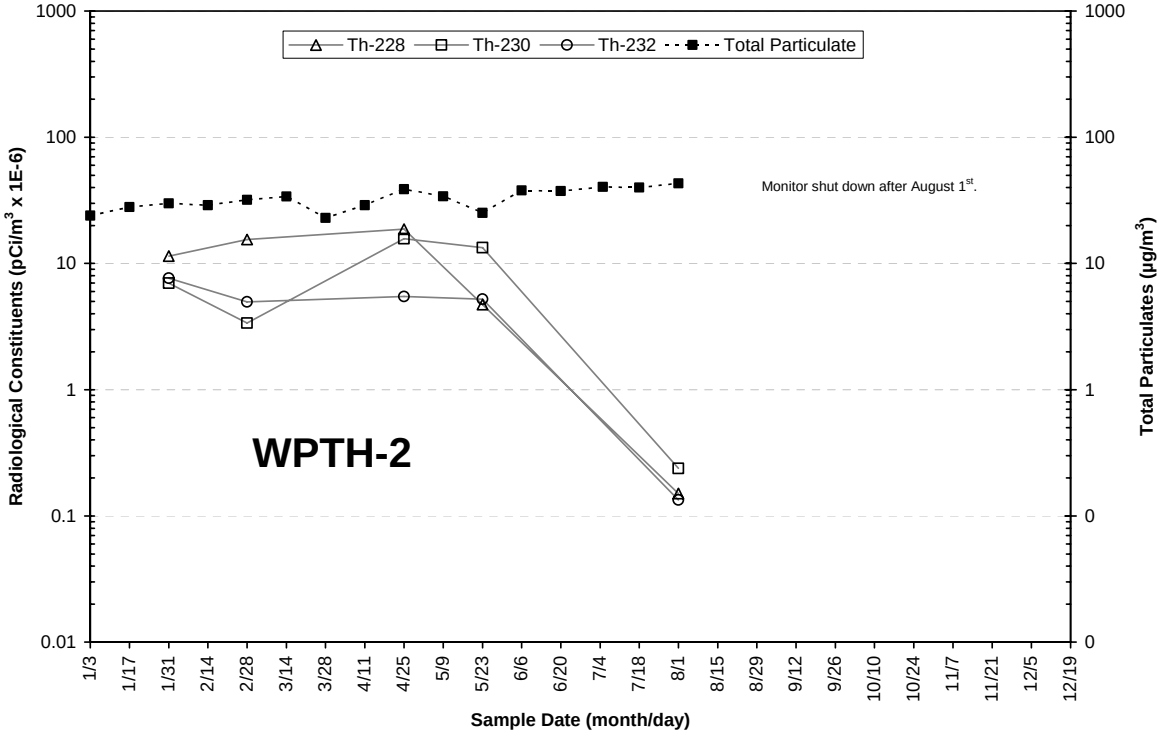


Figure C.1–19. 2006 Radiological and Particulate Concentrations in Air (WPTH-2)

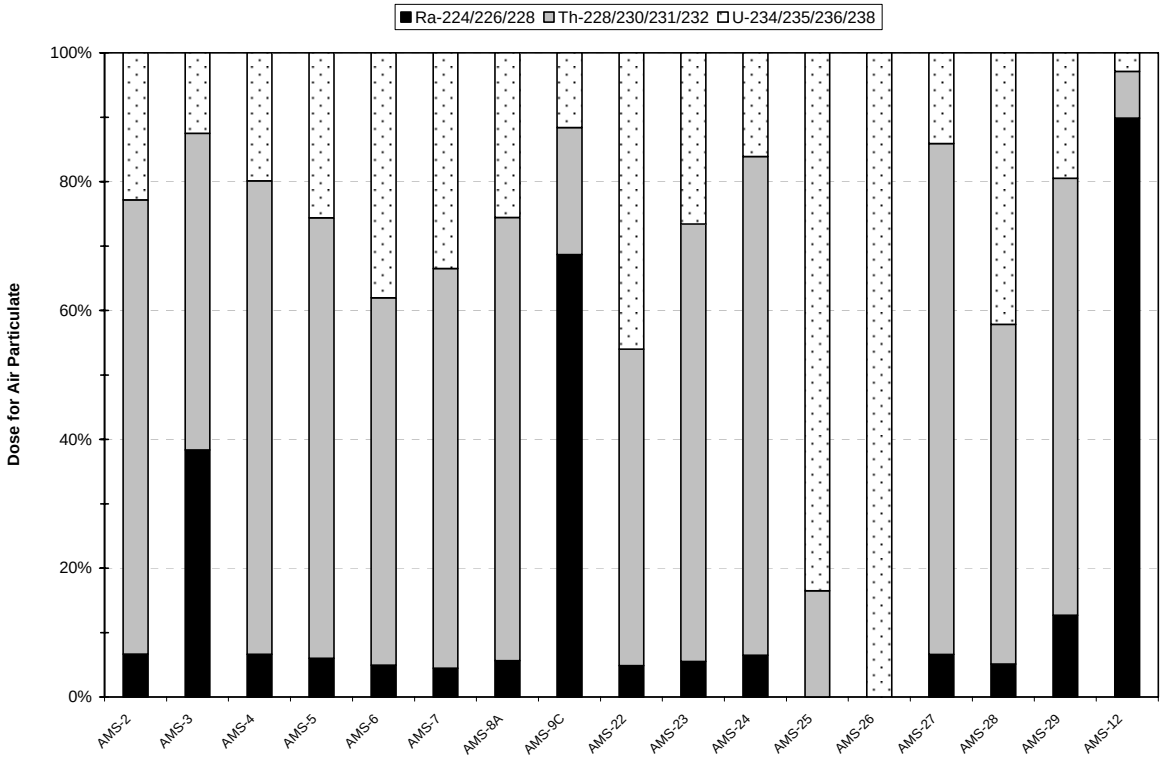


Figure C.1–20. 2006 Isotopic Dose Contributions at AMS Locations

Attachment C.2

C.2.0 Radon

The Fernald site's 2006 radon monitoring program evaluated the effects of radon emissions, from the silos treatment facilities and radon control system (RCS), on the surrounding environment. Radon data collected under the program are compared to the radon concentration standards contained in DOE Order 5400.5 (DOE 1993) and proposed 10 Code of Federal Regulations (CFR) 834. The pertinent standards and associated 2006 compliance status are as follows:

- The proposed 10 CFR 834 annual average limit at and beyond the facility boundary is 0.5 picoCuries per liter (pCi/L) above background; there were no exceedances in 2006.
- The DOE annual average limit within the site is 30 pCi/L above background; this limit was not exceeded in 2006.
- The DOE limit measured at any point over the facility is 100 pCi/L above background; there were no exceedances in 2006.

C.2.1 Boundary Monitors

Continuous monitors are used at the Fernald site to track daily changes in the radon levels and determine compliance with the noted standards. In 2006, the radon monitoring program sustained a 99 percent run-time for radon monitors at the site boundary. The one percent down time was associated with downloading instrument data, interruptions due to extremely cold temperatures, power interruptions, and/or an increase in routine maintenance or project activities. Table C.2−1 provides a summary of the minimum, maximum and average radon concentrations for 2006 and 2005. The 2006 values are similar to those reported in 2005.

Figure C.2−1 identifies the radon monitoring locations, and Figure C.2−2 compares the annual average values (uncorrected and background corrected) to the 10 CFR 834 proposed limit for the annual average radon level at the off-site location immediately adjacent to the site boundary. All locations show background corrected values that are below the 10 CFR 834 proposed limit. Figures C.2−3 through C.2−28 show the monthly average radon concentrations for each location (uncorrected and background corrected). In general, all boundary monitors maintained monthly averages less than 1 pCi/L, exceptions being AMS-6, AMS-26 and PR-1. The noted exceptions lie to the west of the silos project, and an increase in the radon readings for July and August are attributed to the demolition of the silos treatment facilities during the summer of 2006. This increasing trend for July and August is also observed for on-site radon monitors in the vicinity of the remediation work (Figures C.2−21 through C.2−28).

C.2.2 Stack Monitors

All stack monitoring was completed in April of 2006, and the 2006 results for the Silos Project RCS and the silos treatment facilities were discussed in the 2005 site environmental report. Therefore, they will not be addressed here.

Table C.2−1. Continuous Radon Monitors[a]

	2006 Summary Results (pCi/L)			2005 Summary Results (pCi/L)		
Location	Minimum	Maximum	Average	Minimum	Maximum	Average
Boundary						
AMS-2	0.2	0.8	0.5	0.2	0.9	0.5
AMS-3	0.2	0.6	0.4	0.2	0.7	0.4
AMS-4[b]	0.2	0.3	0.3	0.1	0.6	0.4
AMS-5[b]	0.1	0.6	0.4	0.2	1.1	0.6
AMS-6	0.3	1.1	0.6	0.1	1.0	0.5
AMS-7[b]	0.3	0.5	0.4	0.2	1.1	0.6
AMS-8A	0.2	0.7	0.4	0.3	0.6	0.4
AMS-9C[d]	0.3	0.9	0.5	0.2	0.6	0.4
AMS-22[d]	0.2	0.5	0.3	0.2	0.5	0.3
AMS-23[b]	0.2	0.3	0.3	0.3	0.5	0.4
AMS-24	0.2	0.9	0.6	0.2	0.8	0.5
AMS-25[b]	0.4	0.6	0.5	0.3	0.8	0.6
AMS-26[d]	0.3	0.7	0.4	0.1	0.7	0.4
AMS-27[d]	0.5	0.9	0.6	0.2	1.0	0.5
AMS-28[b]	0.2	0.2	0.2	0.1	0.7	0.4
AMS-29[d]	0.2	0.6	0.4	0.3	0.6	0.4
Background						
AMS-12	0.1	0.5	0.3	0.2	0.6	0.4
On Site						
KNE-B[c]	0.2	1.1	0.4	0.3	1.7	0.9
KSE-A[c]	0.3	1.3	0.5	0.2	1.5	0.8
KSO-A[c]	0.1	1.0	0.5	0.2	0.7	0.5
LP2[c]	0.1	1.2	0.4	0.1	0.6	0.3
PR-1[c]	0.3	2.2	0.7	0.2	1.3	0.6
Rally Point 4[c]	0.3	1.0	0.4	0.3	0.7	0.4
BSL-A[c]	0.3	1.3	0.5	0.1	0.6	0.3
T117A[c]	0.4	1.1	0.5	0.3	0.8	0.5
T28A[c]	0.3	1.3	0.6	0.3	0.9	0.6

[a]monthy averages used to calculate annual minimum, maximum and average
[b]AMS-04, 05, 07, 23, 25 & 28 taken off line in April 2006
[c]KNE-B, KSE-A, KSO-A, LP2, PR-1, Rally Point 4, BSL-A, T117A, and T28A taken off line in August 2006
[d]AMS-09C, 22, 26, 27 & 29 taken off line in November 2006

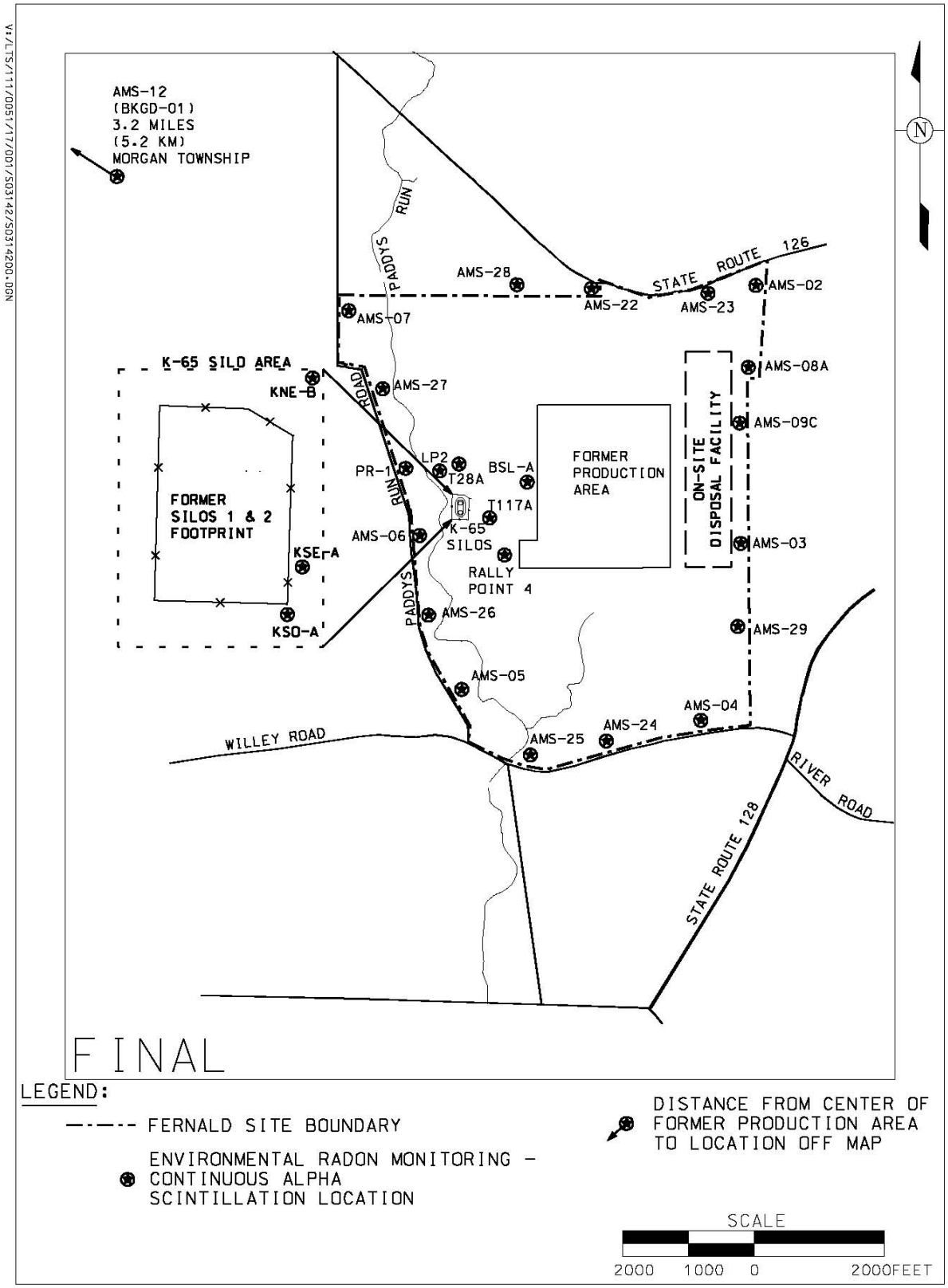


Figure C.2–1. Radon Monitoring Locations

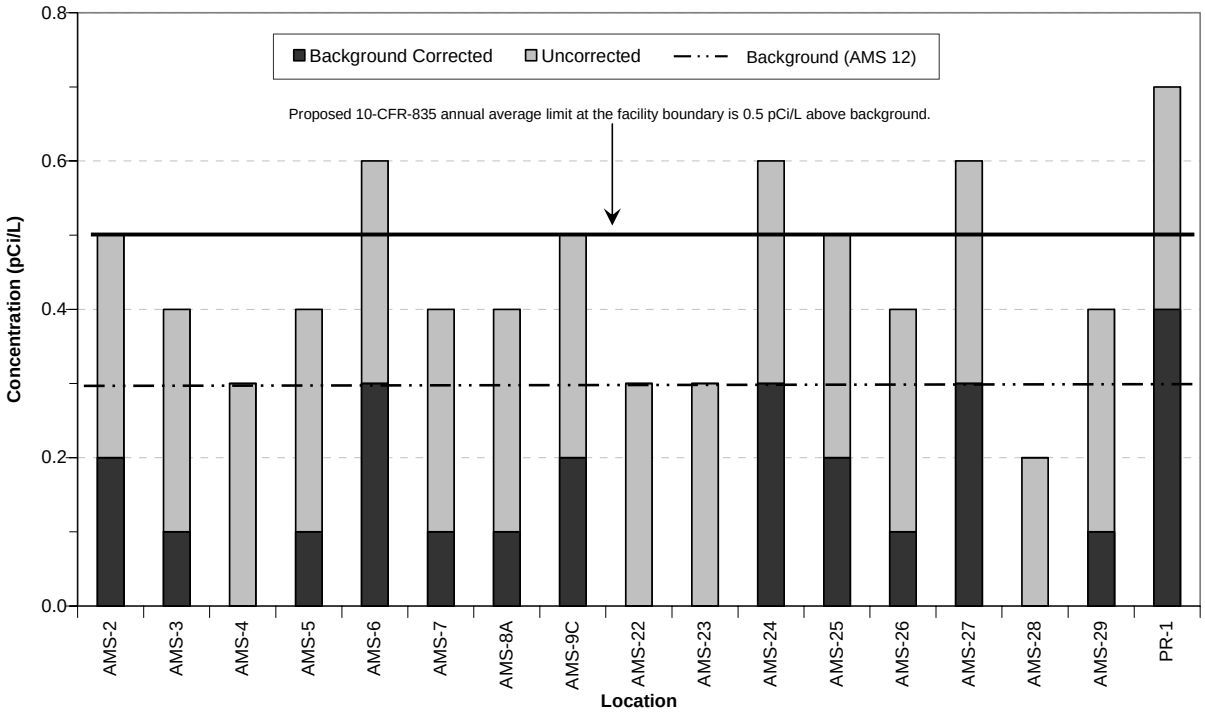


Figure C.2–2. 2006 Average Annual Radon Concentration for each Facility Boundary Monitor

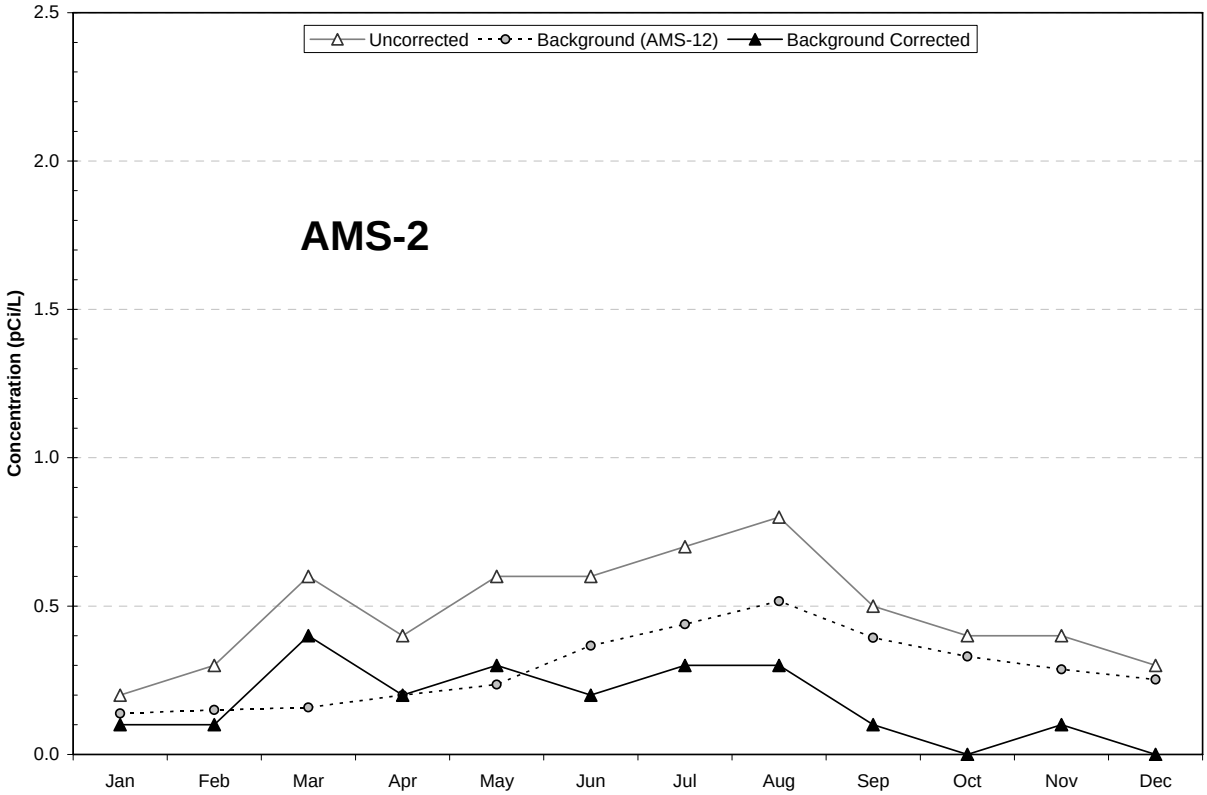


Figure C.2–3. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-2

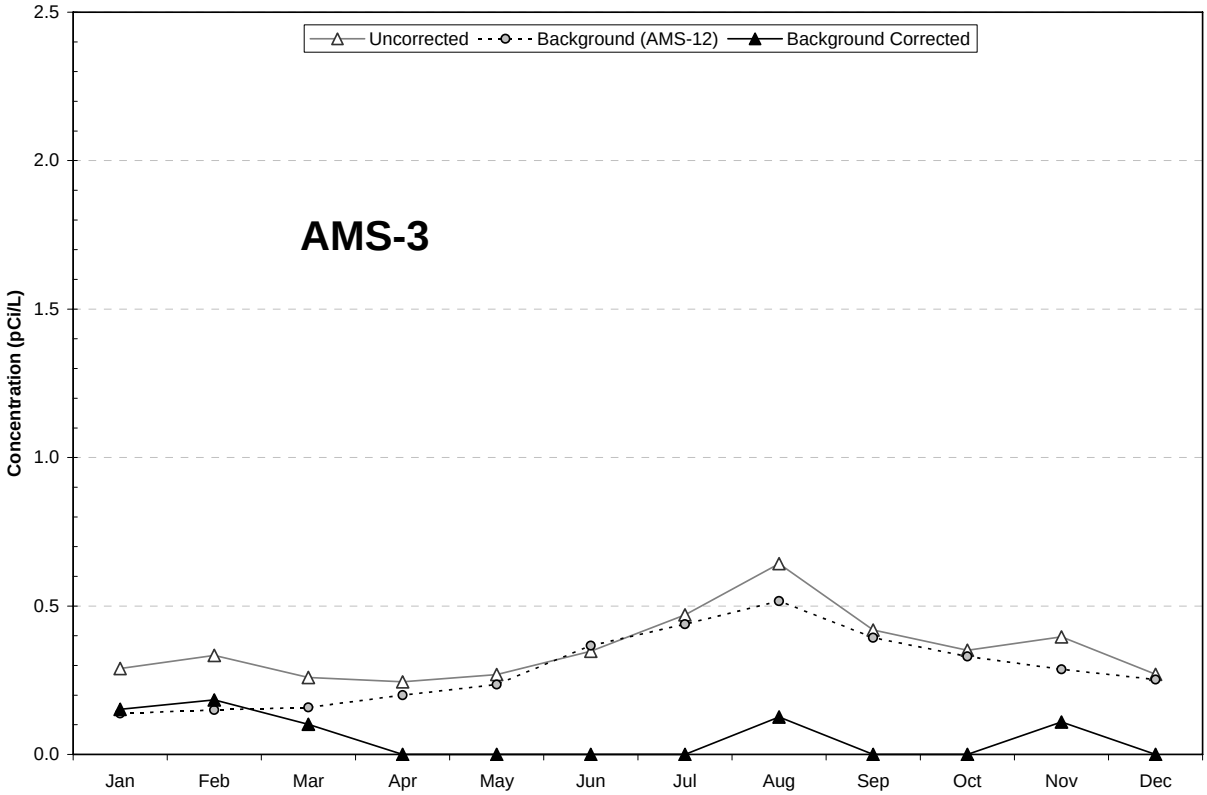


Figure C.2–4. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-3

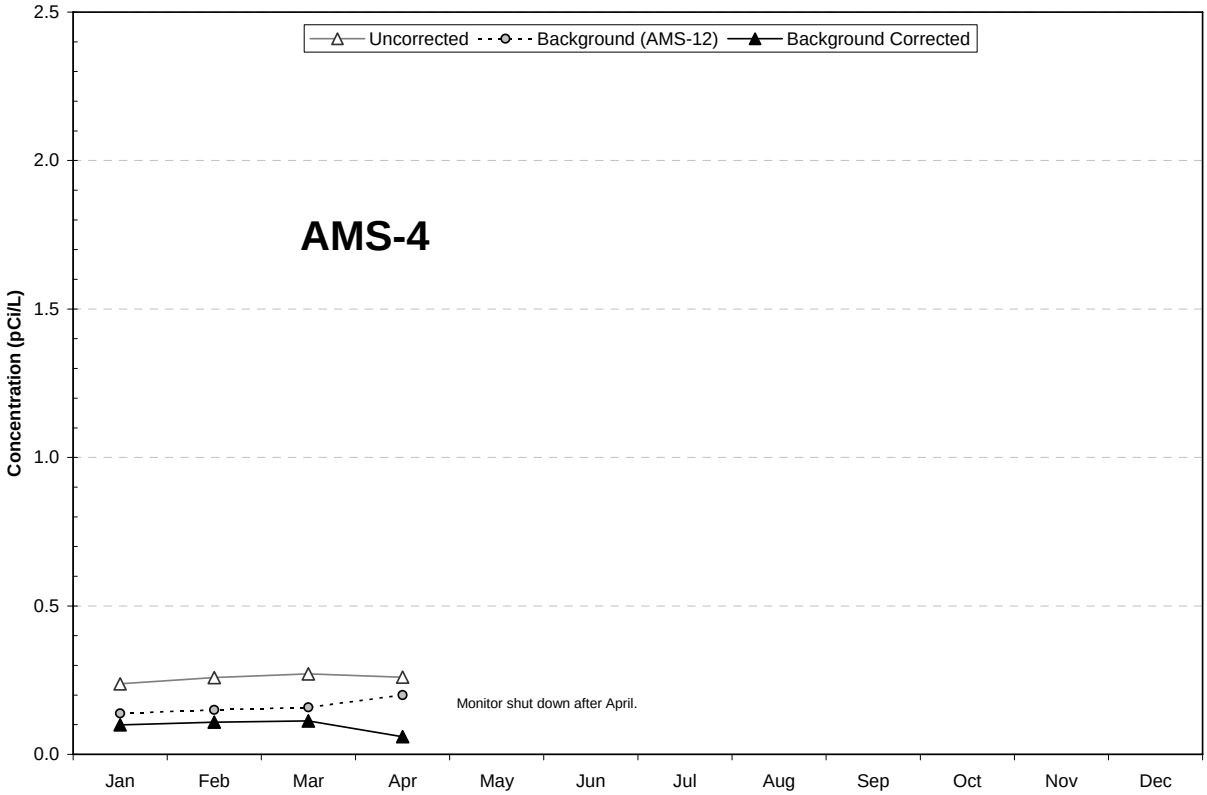


Figure C.2–5. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-4

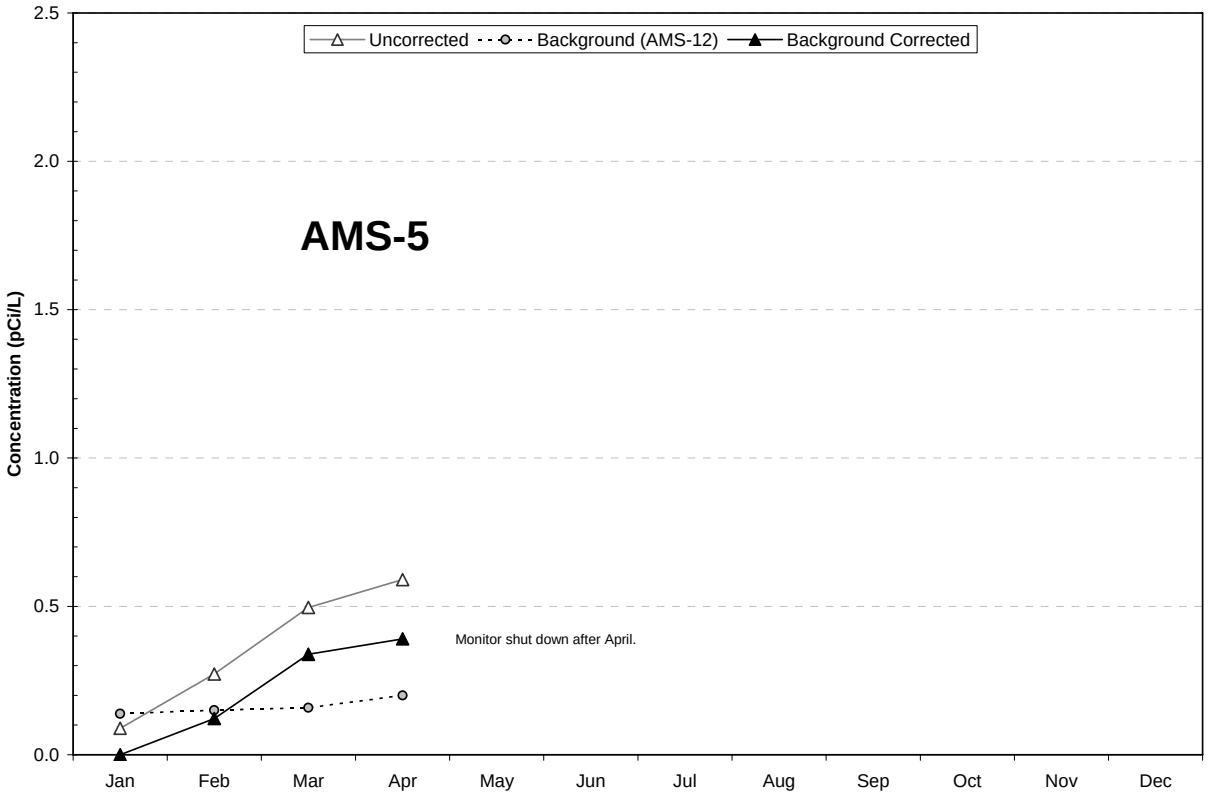


Figure C.2–6. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-5

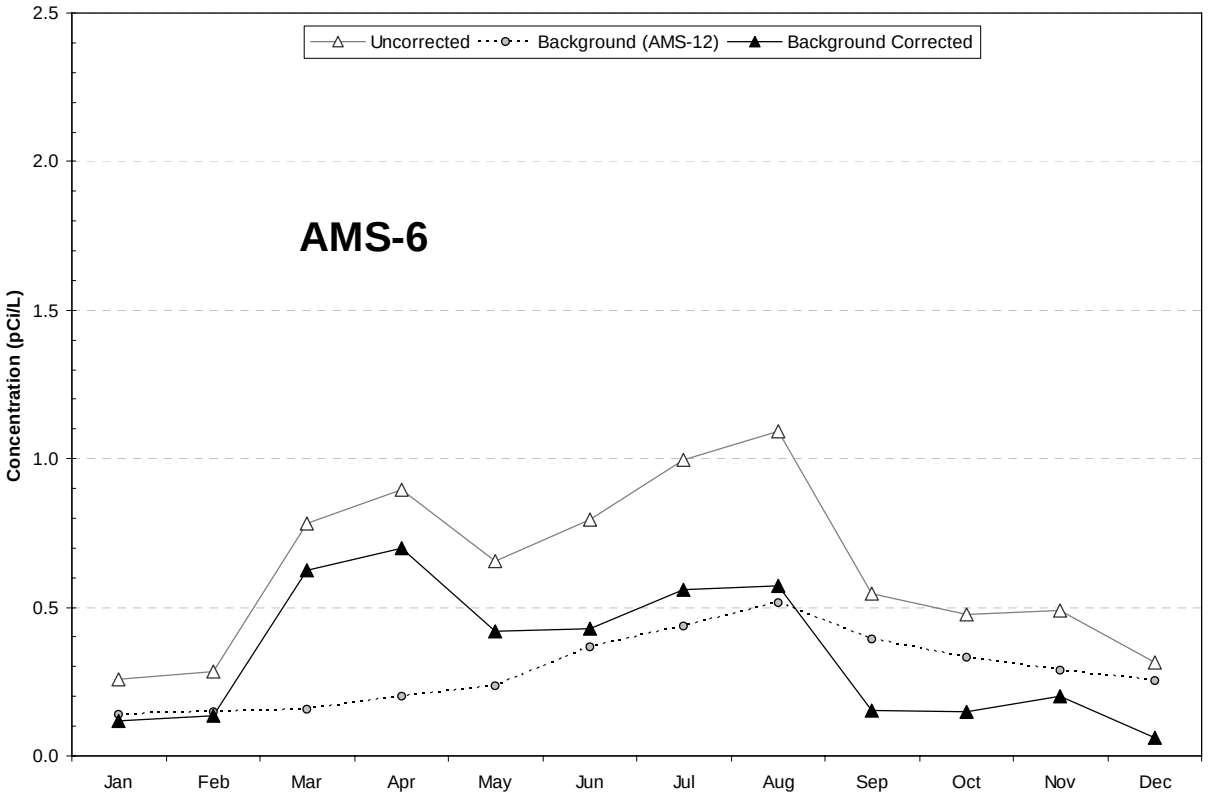


Figure C.2–7. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-6

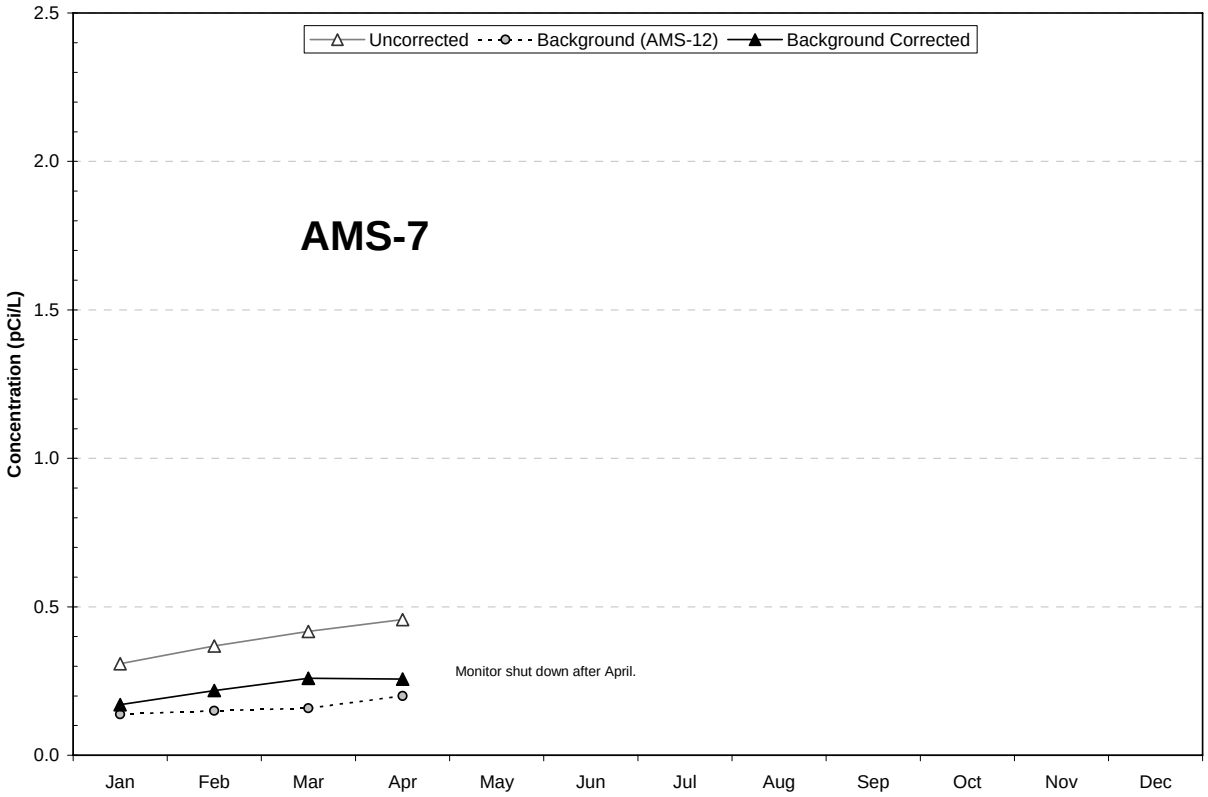


Figure C.2–8. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-7

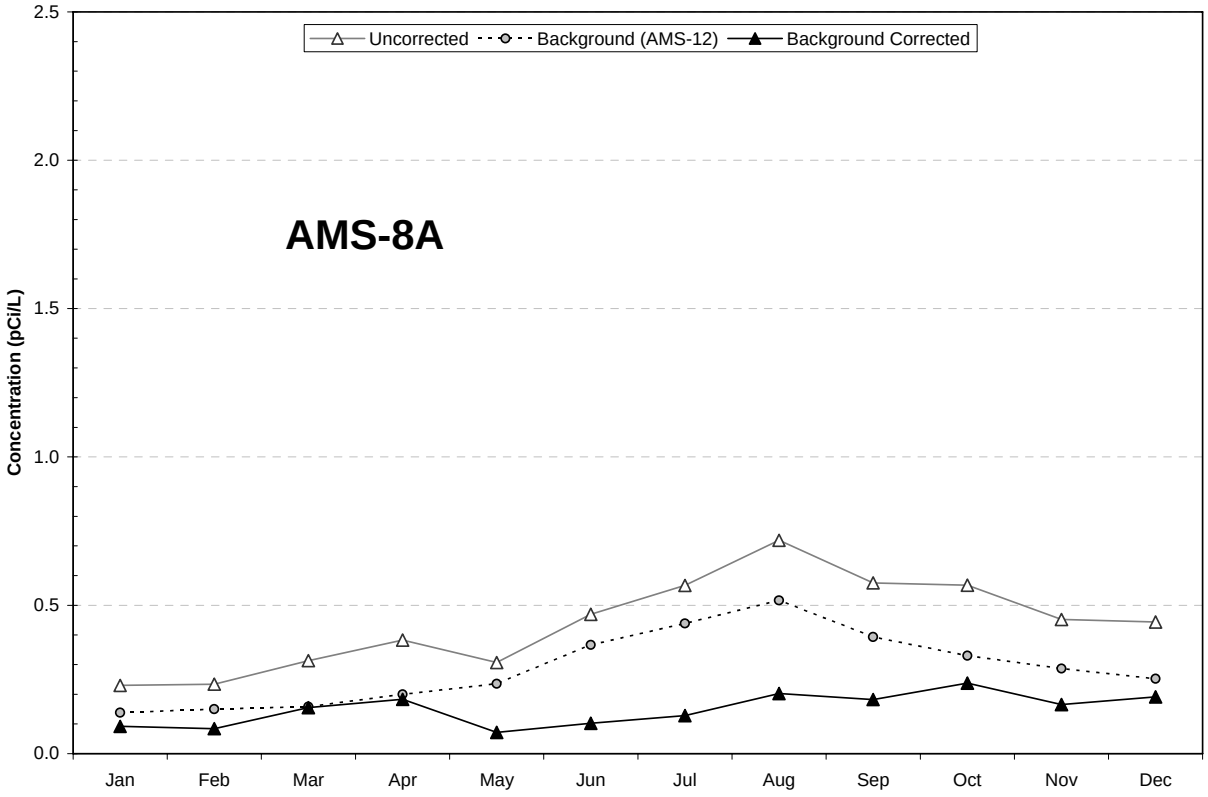


Figure C.2–9. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-8A

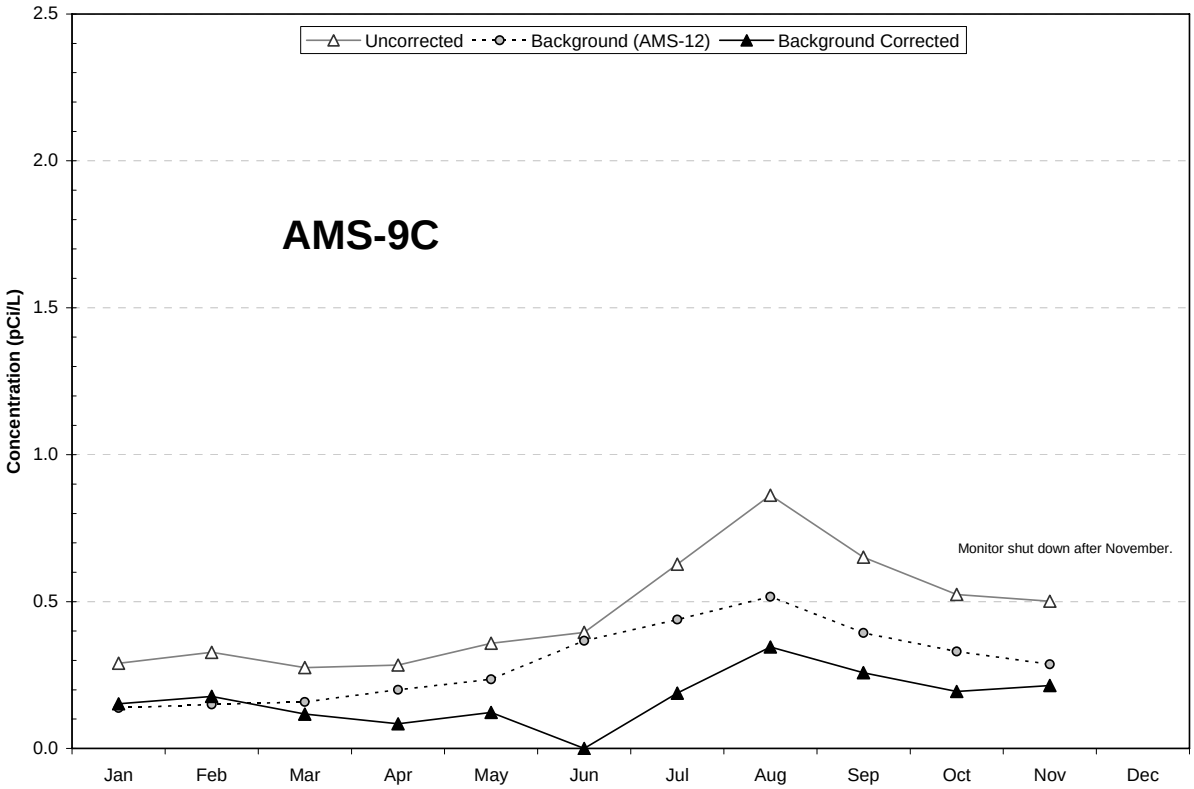


Figure C.2–10. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-9C

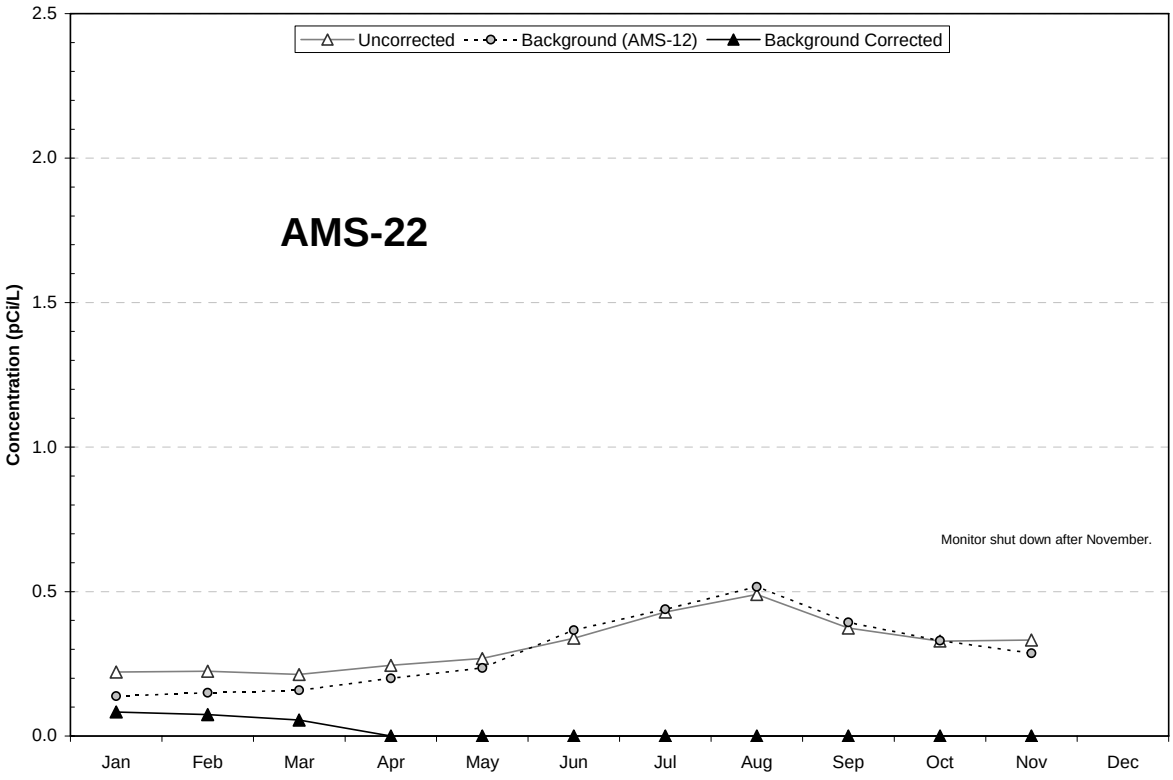


Figure C.2–11. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS 22

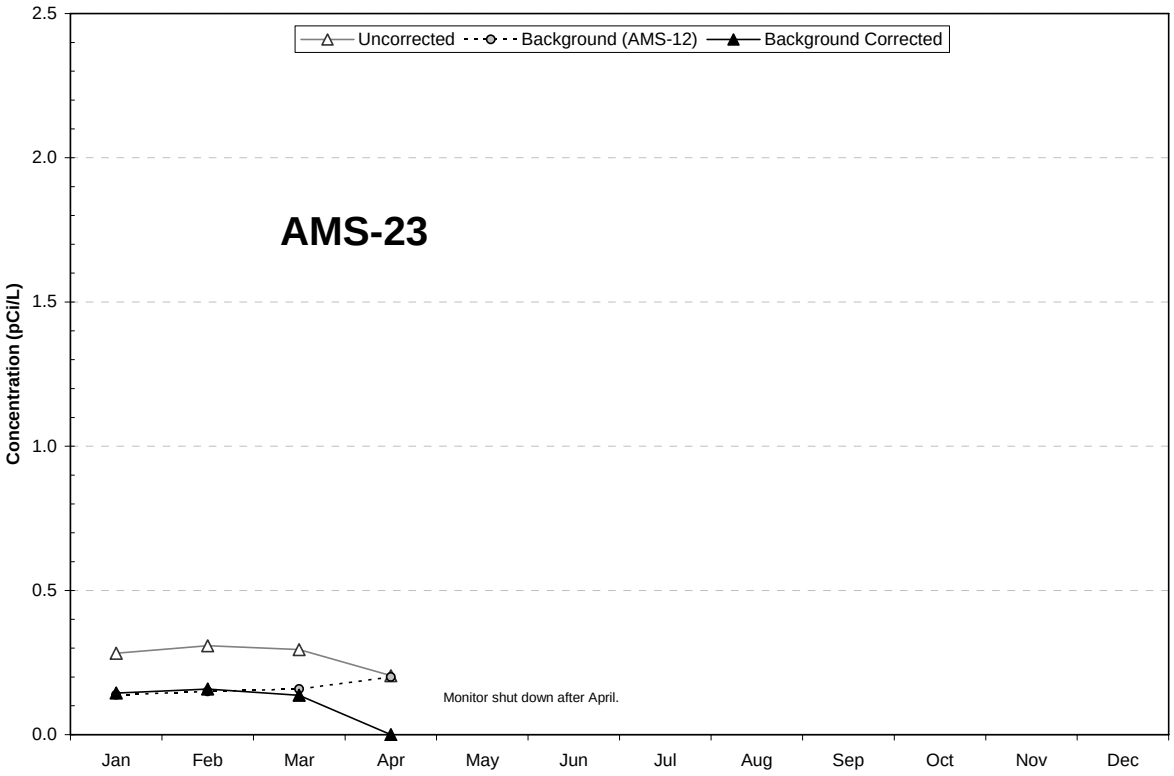


Figure C.2–12. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-23

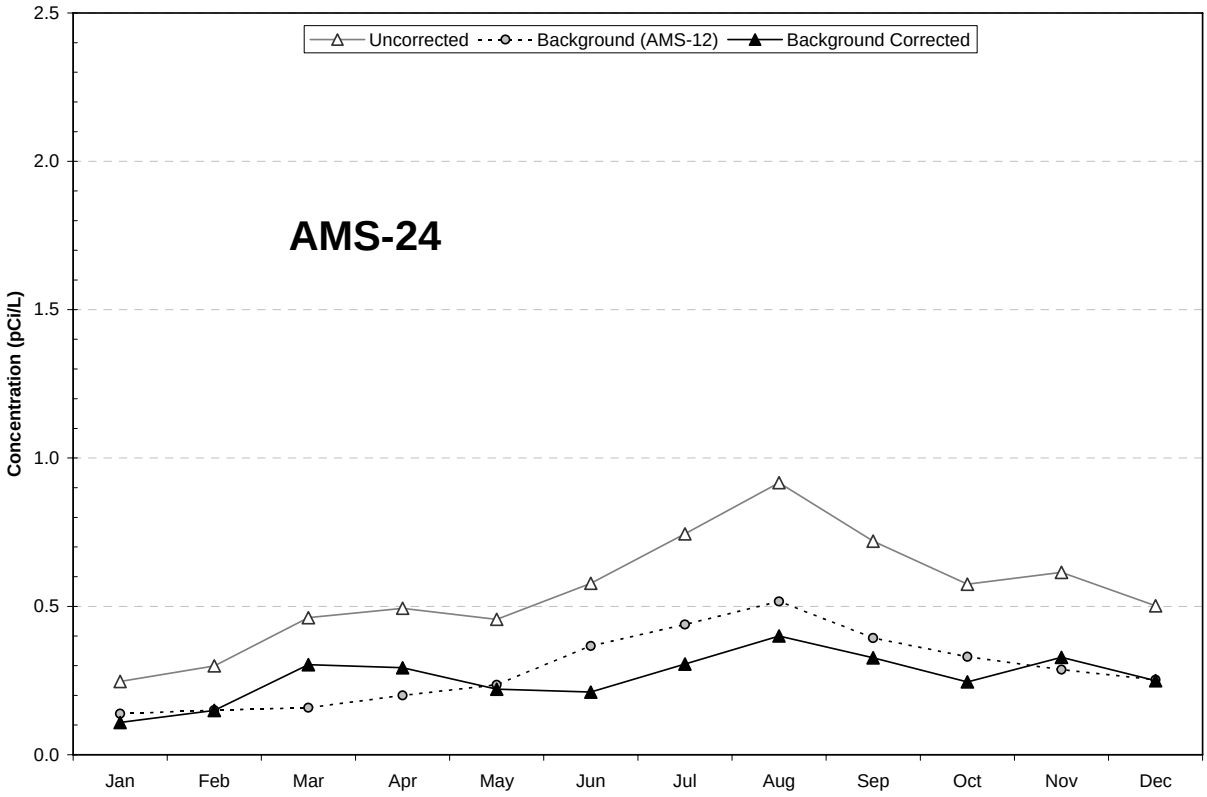


Figure C.2–13. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-24

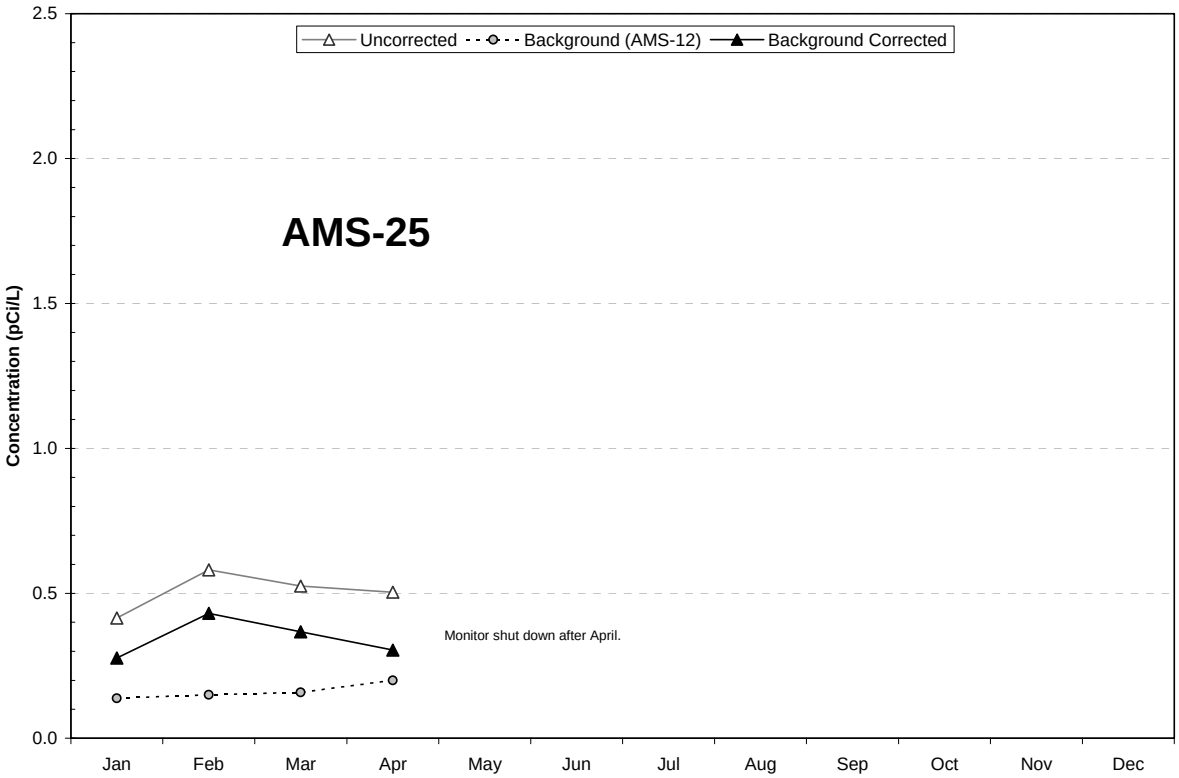


Figure C.2–14. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-25

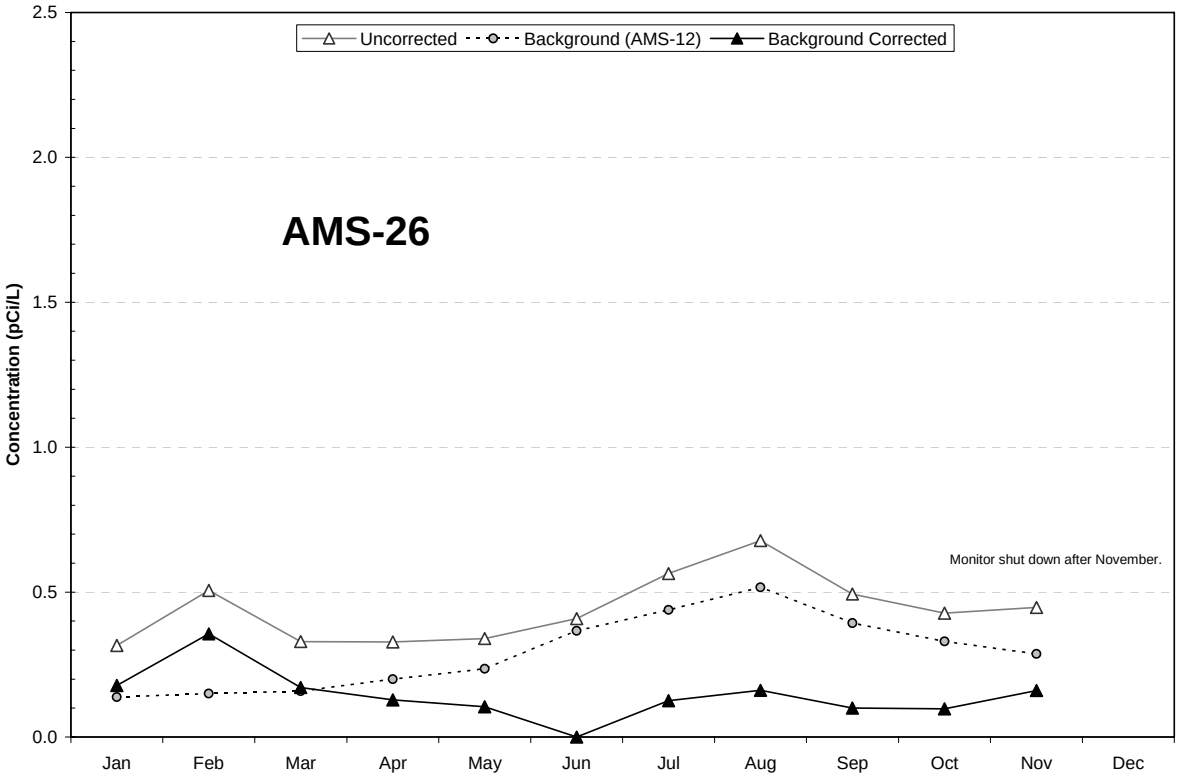


Figure C.2–15. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-26

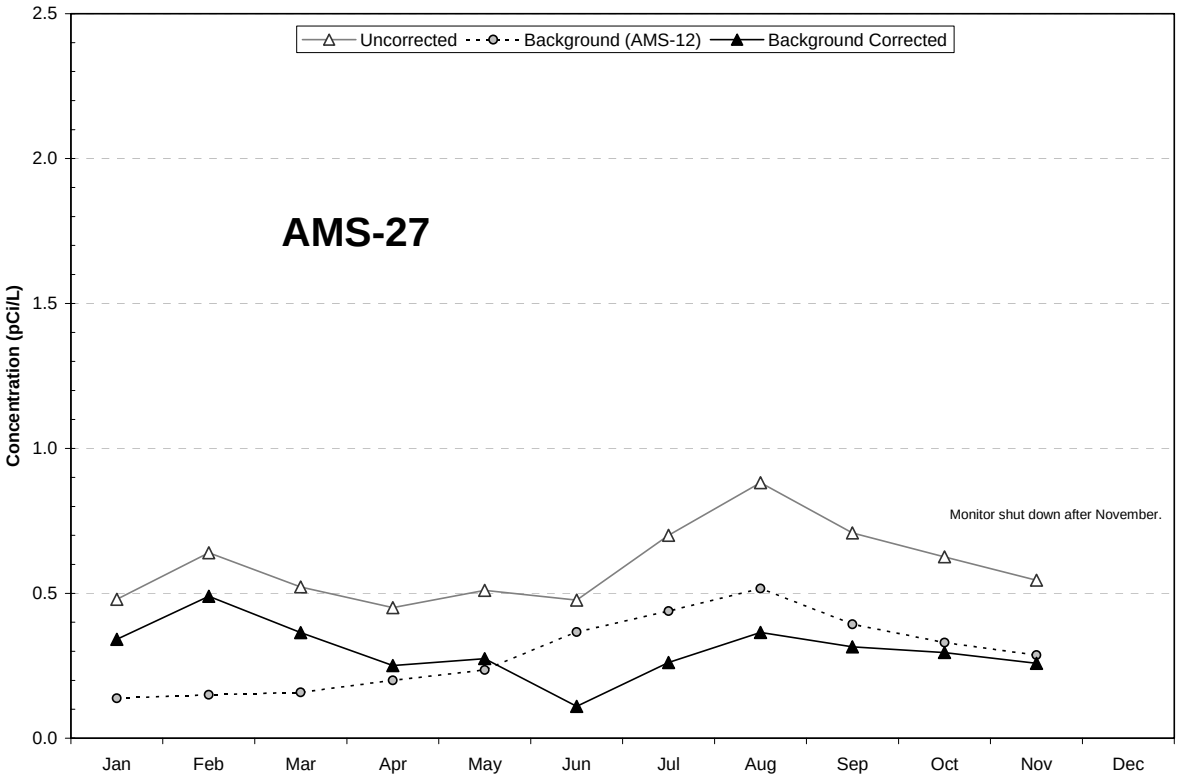


Figure C.2–16. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-27

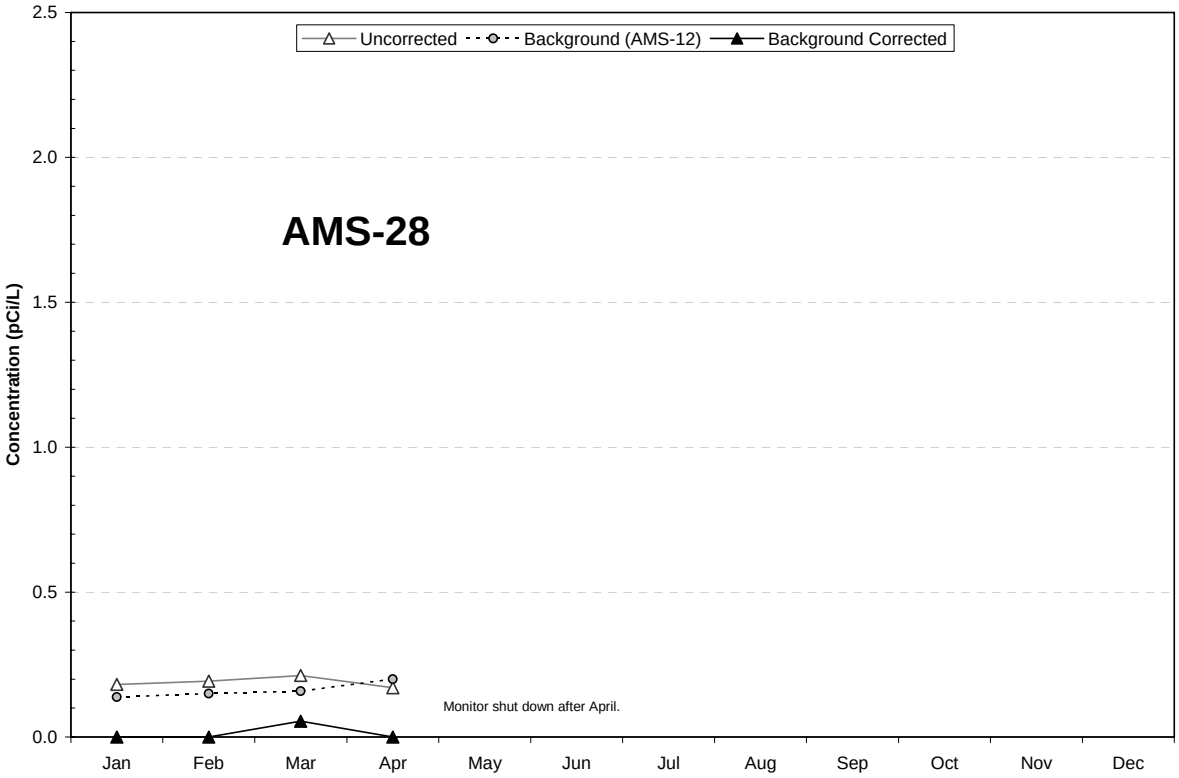


Figure C.2–17. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-28

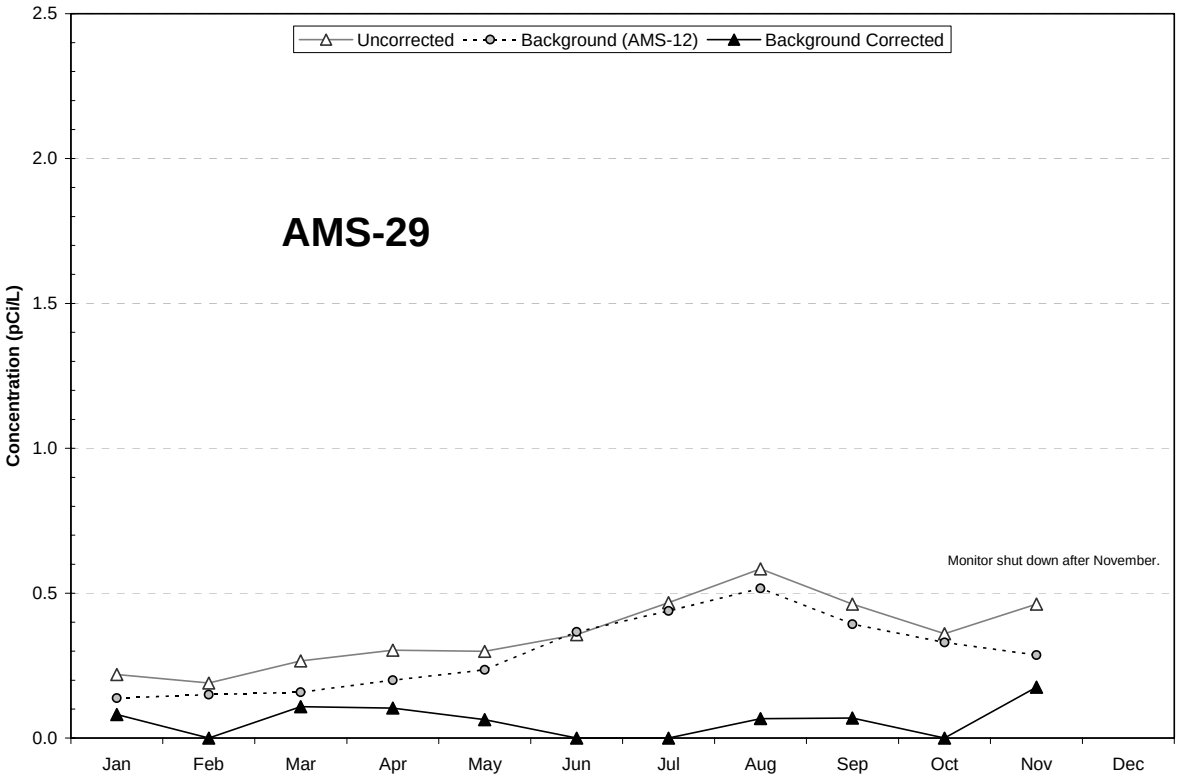


Figure C.2–18. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor AMS-29

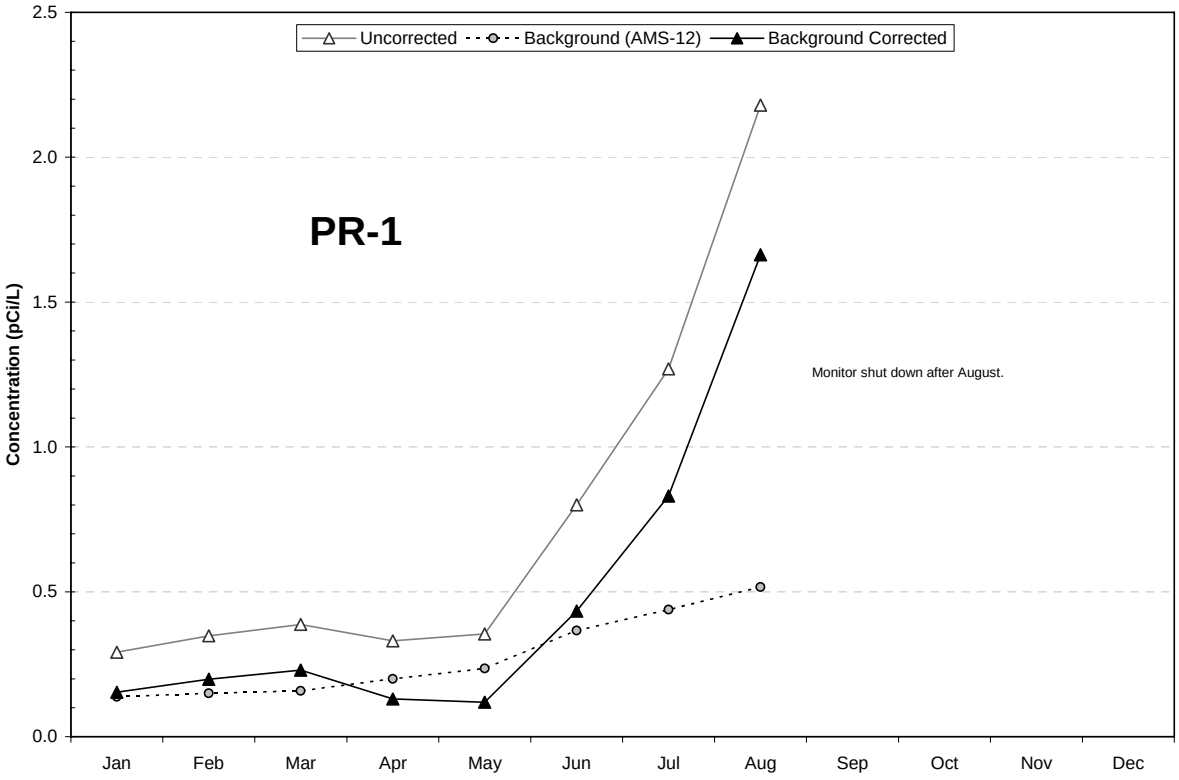


Figure C.2–19. 2006 Monthly Average Annual Radon Concentration for Facility Boundary Monitor PR-1

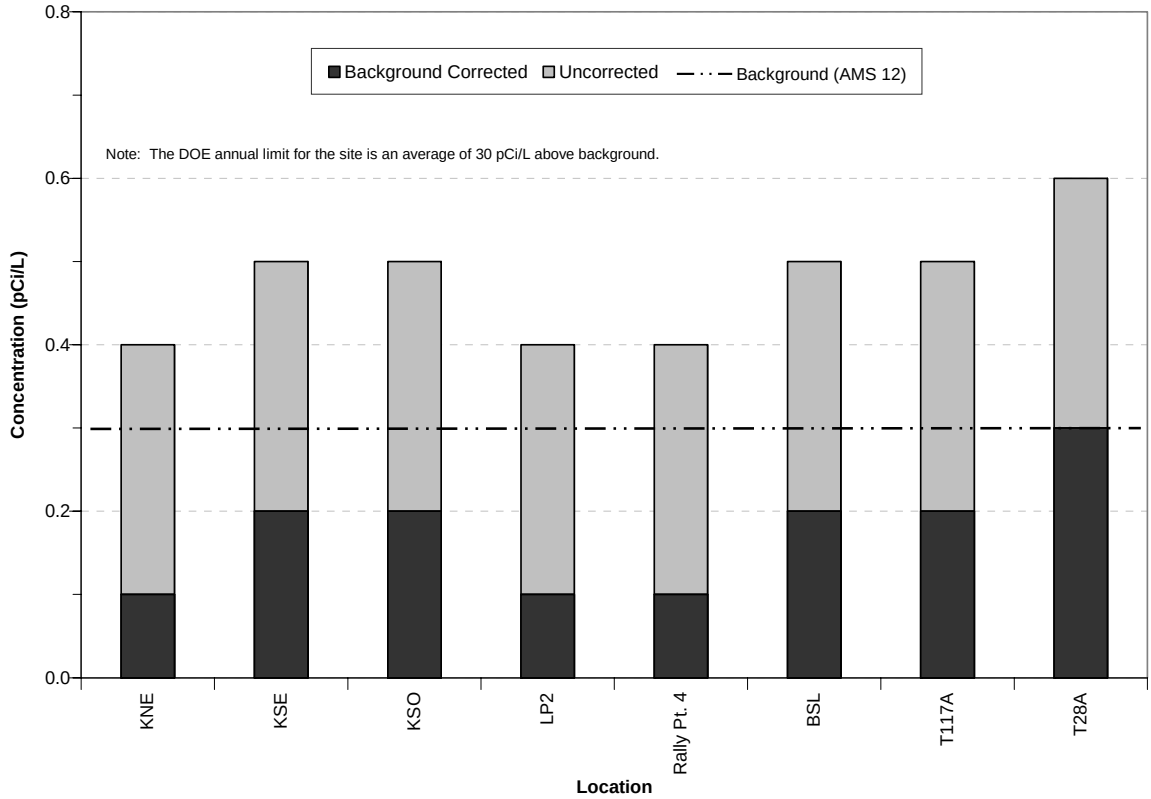


Figure C.2–20. 2006 Average Annual Radon Concentration for each Site Marker

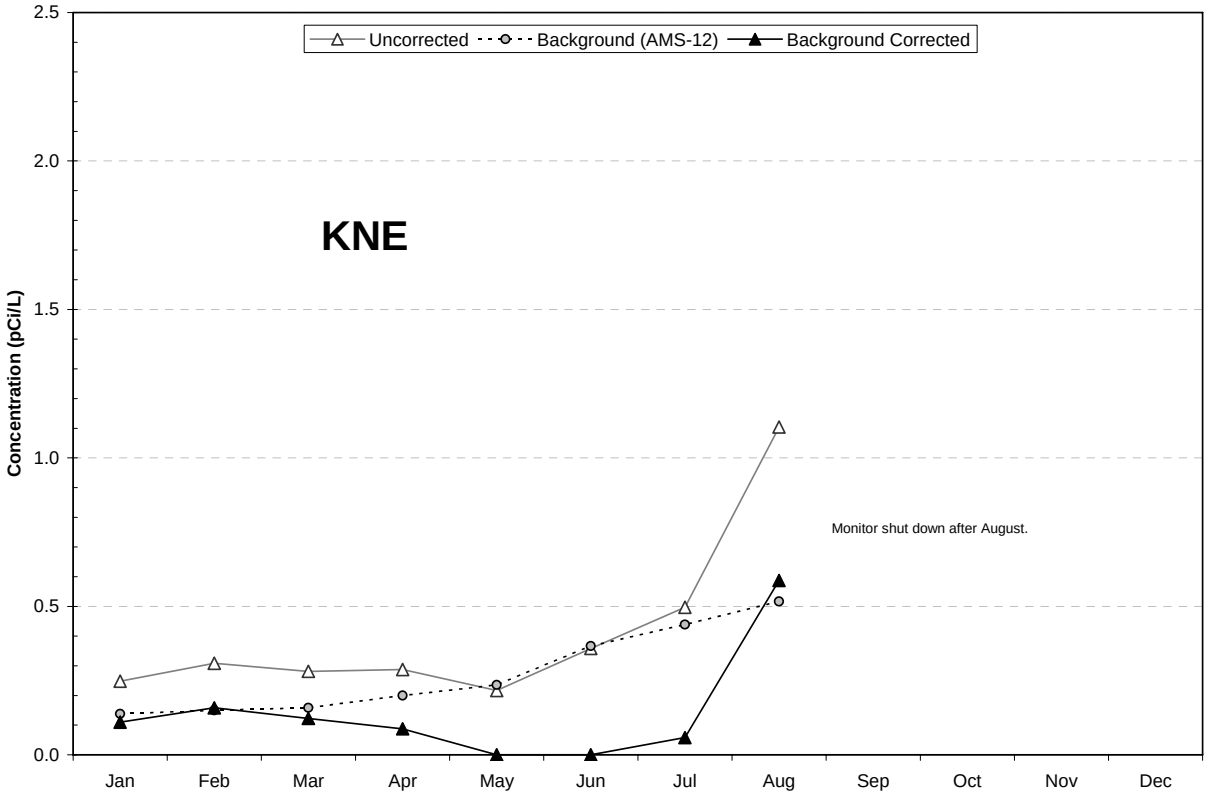


Figure C.2–21. 2006 Average Annual Radon Concentration for Site Marker KNE

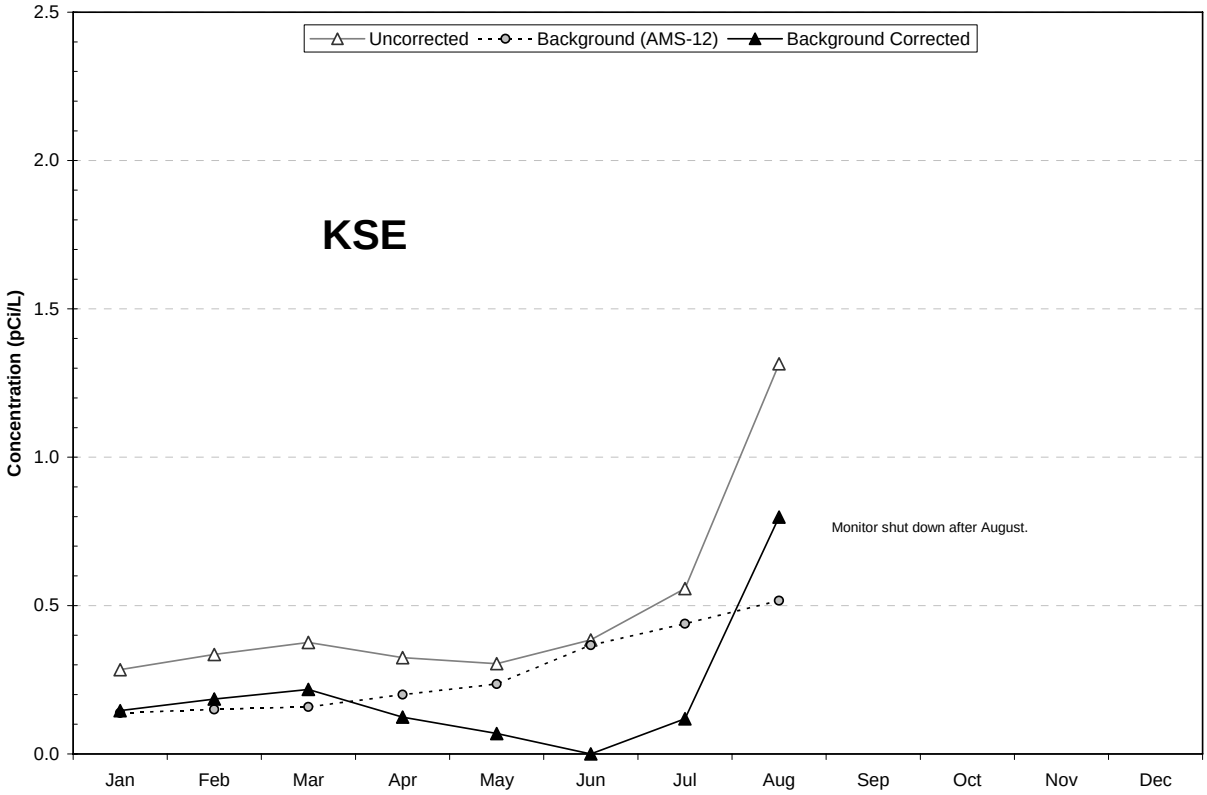


Figure C.2–22. 2006 Average Annual Radon Concentration for Site Marker KSE

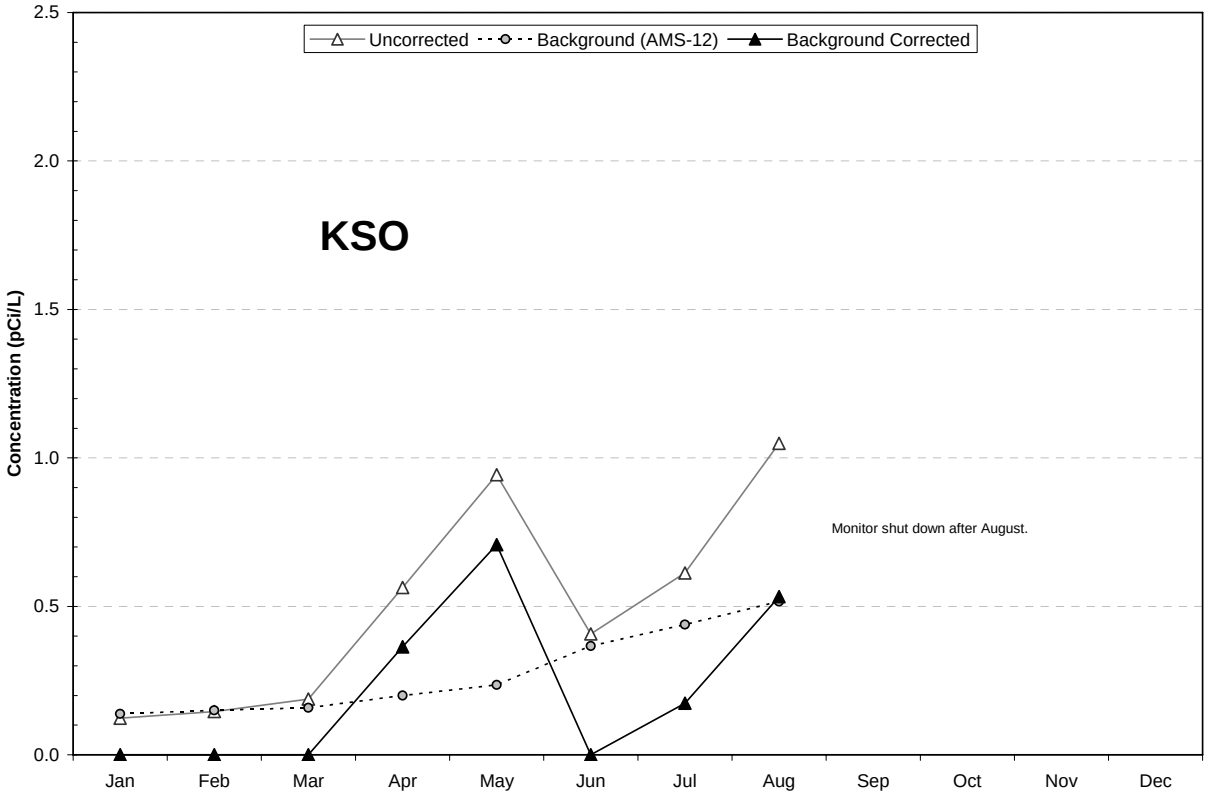


Figure C.2–23. 2006 Average Annual Radon Concentration for Site Marker KSO

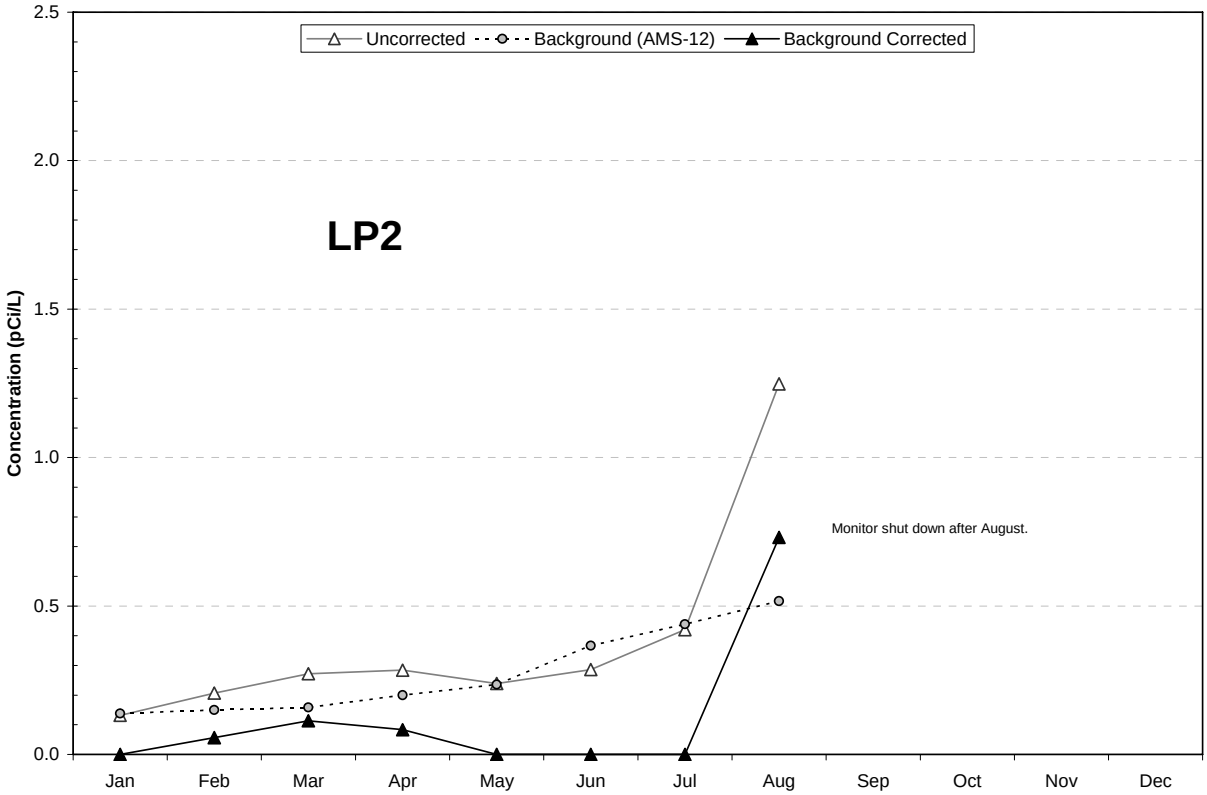


Figure C.2–24. 2006 Average Annual Radon Concentration for Site Marker LP2

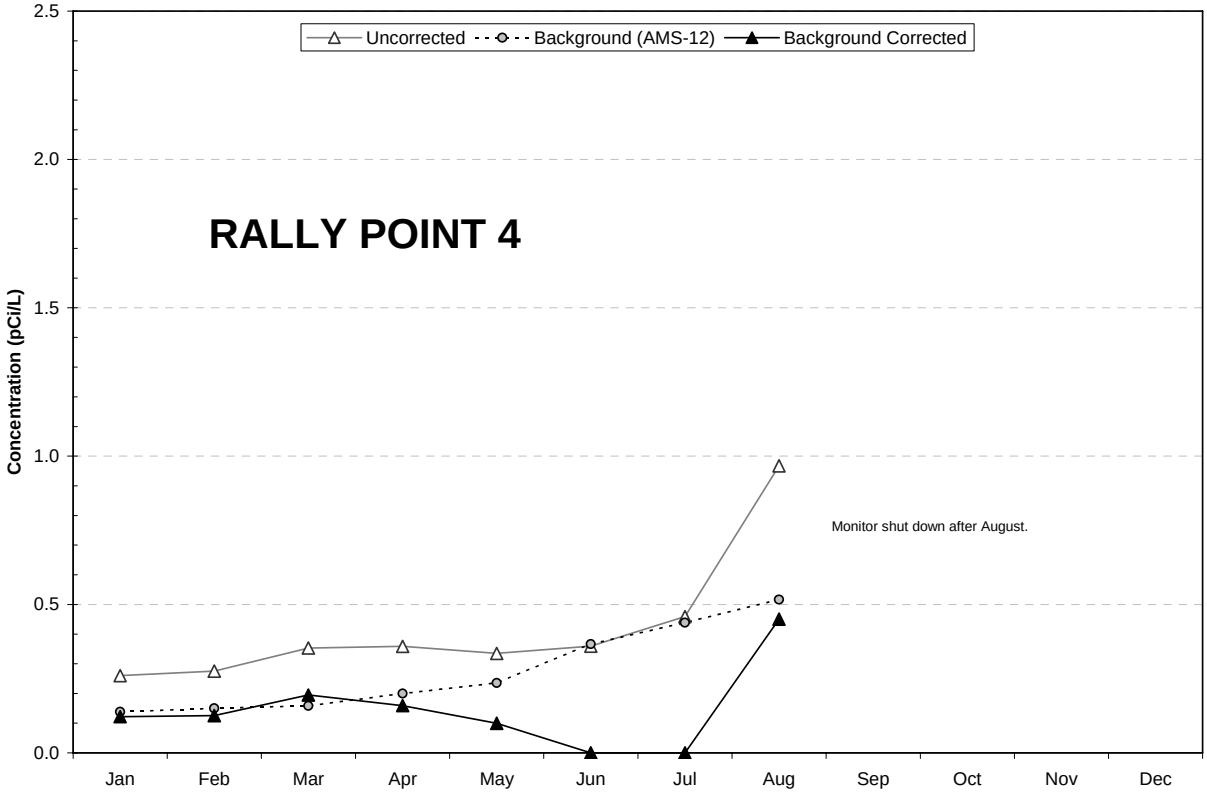


Figure C.2–25. 2006 Average Annual Radon Concentration for Site Marker Rally Point 4

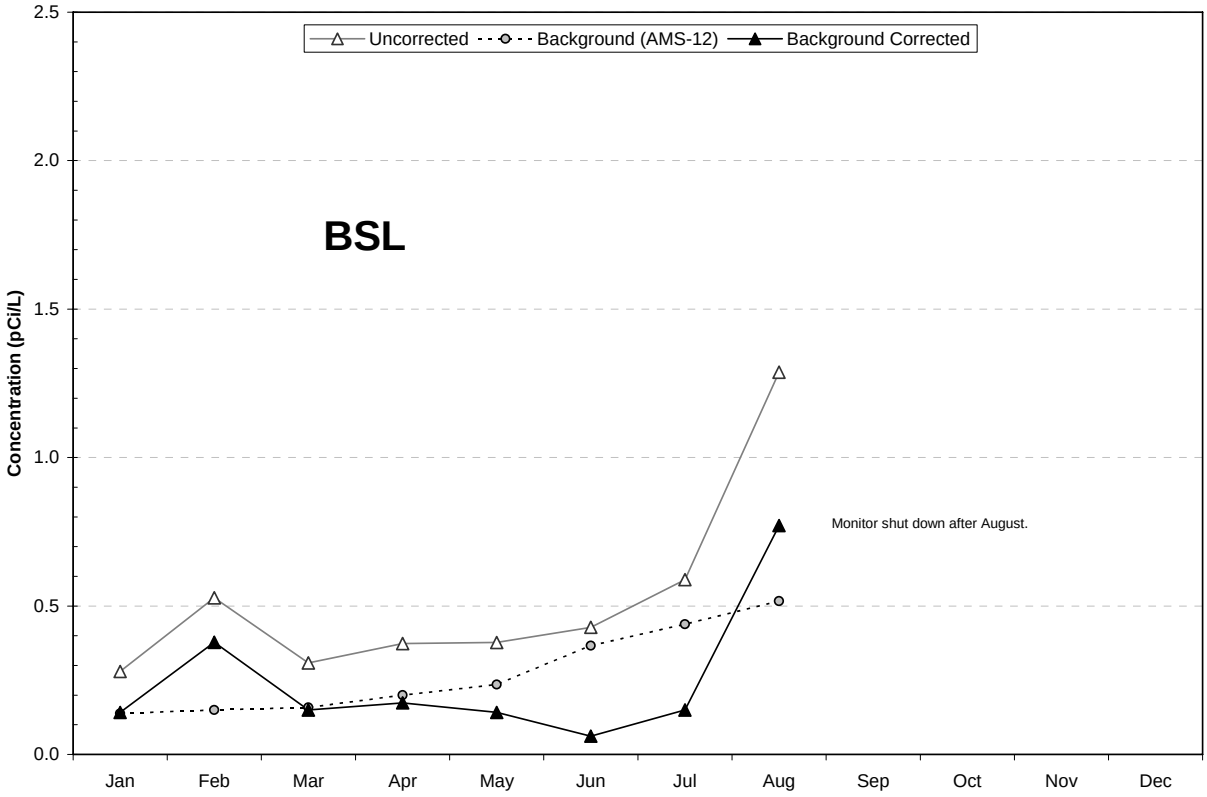


Figure C.2–26. 2006 Average Annual Radon Concentration for Site Marker BSL

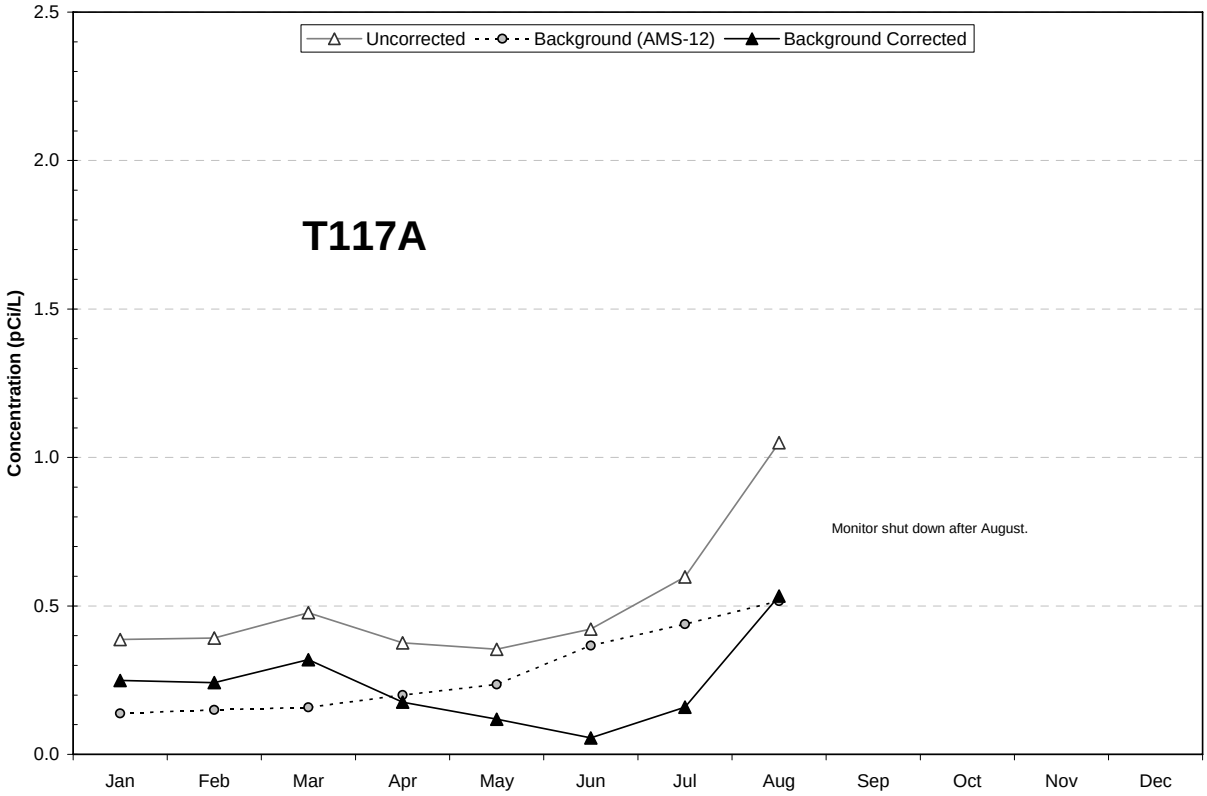


Figure C.2–27. 2006 Average Annual Radon Concentration for Site Marker T117A

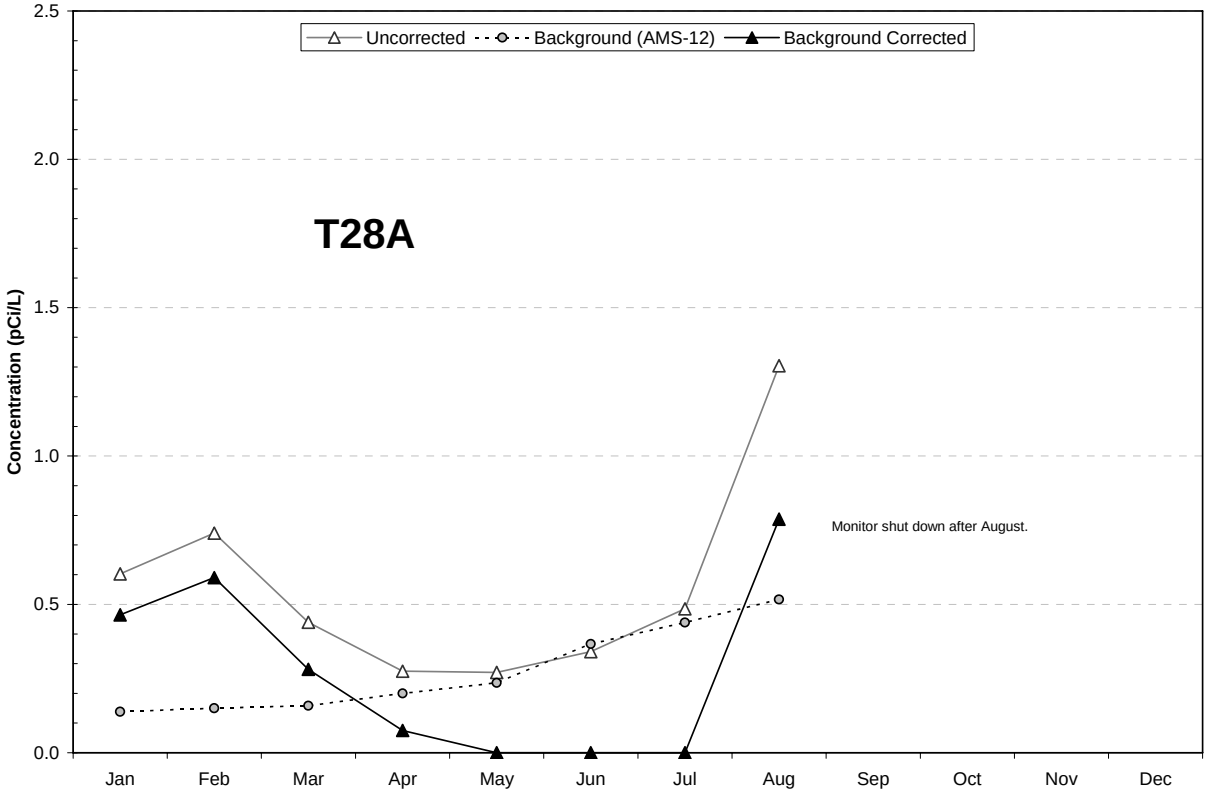


Figure C.2–28. 2006 Average Annual Radon Concentration for Site Marker T28A

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Attachment C.3

C.3.0 Direct Radiation

Direct radiation measurements were collected at monitoring locations using thermoluminescent dosimeters (TLDs). TLD stations are located on-site, at the site boundary and at background stations in the surrounding communities (Figure C.3−1). Three TLDs are deployed at each location to track and evaluate direct radiation, and the measurements from each TLD are averaged on a quarterly basis. However, monitoring was discontinued at locations 23A, 24, 25, 26, 43, 44, 45 and 46 in 2005, at locations 4, 5, 7, 36, 37 and 39 after the 2nd quarter of 2006, and stations 13, 14, 15, 16, 17, 19, 20, 22, 33, 36, 37, 39, 42 and 47 were removed after the 3rd quarter of 2006. Therefore, four quarters of 2006 monitoring data are available only at locations 2, 3, 6, 8A, 9A, 27, 34, 35, 38, 40 and 41.

Table C.3−1 provides a summary of the annual average dose for 2006, 2005 and 2004. Locations that have four quarters of 2006 data (bold font in the table) can be compared to the annual averages for 2005 and 2004. There are no on-site locations that have four quarters of data for 2006. Nine boundary locations and one background location indicate that the measurements for 2006 are all lower than results for 2005, and slightly higher than measurements collected in 2004.

In 2005, direct radiation dose was calculated using the average value from TLD elements 2, 3, and 4. Using element 2 to calculate the average dose is incorrect, as element 2 is a lithium borate crystal and elements 3 and 4 are calcium sulfate crystals. The lithium borate element estimates skin dose, while the calcium sulfate crystals measure deeper tissue dose. Therefore, average dose must be calculated using similar elements (i.e., elements 3 & 4, as in 2004). However, as the dose readings on the lithium borate crystal are high relative to the calcium sulfate crystal, the effect of this error on the 2005 dose assessment of deep tissue is to bias the annual dose to high values. That is, the annual dose was not underestimated by using the results from the lithium borate element.

Results for 2006 are slightly higher than those in 2004, and part of this increase could be due to a change in the vendor that provided the TLDs and counting services. Beginning in 2005, the Fernald site TLD services were contracted to the Savannah River site. However, note that the maximum values for the boundary and background locations are similar for 2006 and 2004, and much higher for 2005. The higher 2005 result is due to the inclusion of dose from the lithium borate crystal, as noted above. Therefore, 2006 data will be compared to 2004 results.

For the nine boundary detectors with four quarters of 2006 data (bold text in Table C.3−1), six locations have annual averages that exceed the annual average at background location 27, two are at background levels (west boundary, generally up wind from the site), and location 38 is lower than background. In 2004, eight of the nine locations were above background (location 38 was below background). The difference obtained when the background value is subtracted from the boundary monitors is similar for 2006 and 2004. However, fewer locations recorded above background readings in 2006, and this may reflect the completion of remedial activities in October of 2006.

Table C.3−1. Direct Radiation (TLD) Measurements

Location	Direct Radiation Summary Results (mrem) 2006	2005	2004
Boundary			
2	83	101	74
3	83	102	68
4[a]	38	100	69
5[a]	37	101	73
6	79	96	69
7[a]	37	97	71
8A	84	98	75
9C[c]	81	96	75
13[b]	55	91	64
14[b]	58	100	69
15[b]	62	99	73
16[b]	59	96	72
17[b]	60	97	70
34[c]	81	103	74
35	80	94	65
36[a]	36	92	65
37[a]	38	102	78
38[c]	77	91	64
39[a]	40	110	81
40[c]	79	94	68
41[c]	79	93	68
Minimum	**36**	**91**	**64**
Maximum	**84**	**110**	**81**
On site			
22[b]	96	272	209
47[b]	71	103	59
Minimum	**71**	**103**	**59**
Maximum	**96**	**272**	**216**
Background			
19[b]	58	94	66
20[b]	56	93	63
27	79	93	64
33[b]	62	101	69
42[b]	62	104	75
Minimum	**56**	**93**	**63**
Maximum	**79**	**104**	**75**

[a] Locations 4, 5, 7, 36, 37, & 39 discontinued after 2nd Quarter

[b] Locations 13, 14, 15, 16, 17, 19, 20, 22, 33, 42, & 47 discontinued after 3rd Quarter

[c] Locations 9C, 34, 38, 40, & 41 discontinued after 4th Quarter

NOTE: 2006 max values are lower than 2005 because 2005 included TLD results from element 2. Element 2 is a lithium borate crystal, and 2005 data from this detector should not have been averaged with elements 3 and 4, which are calcium sulfate crystals.

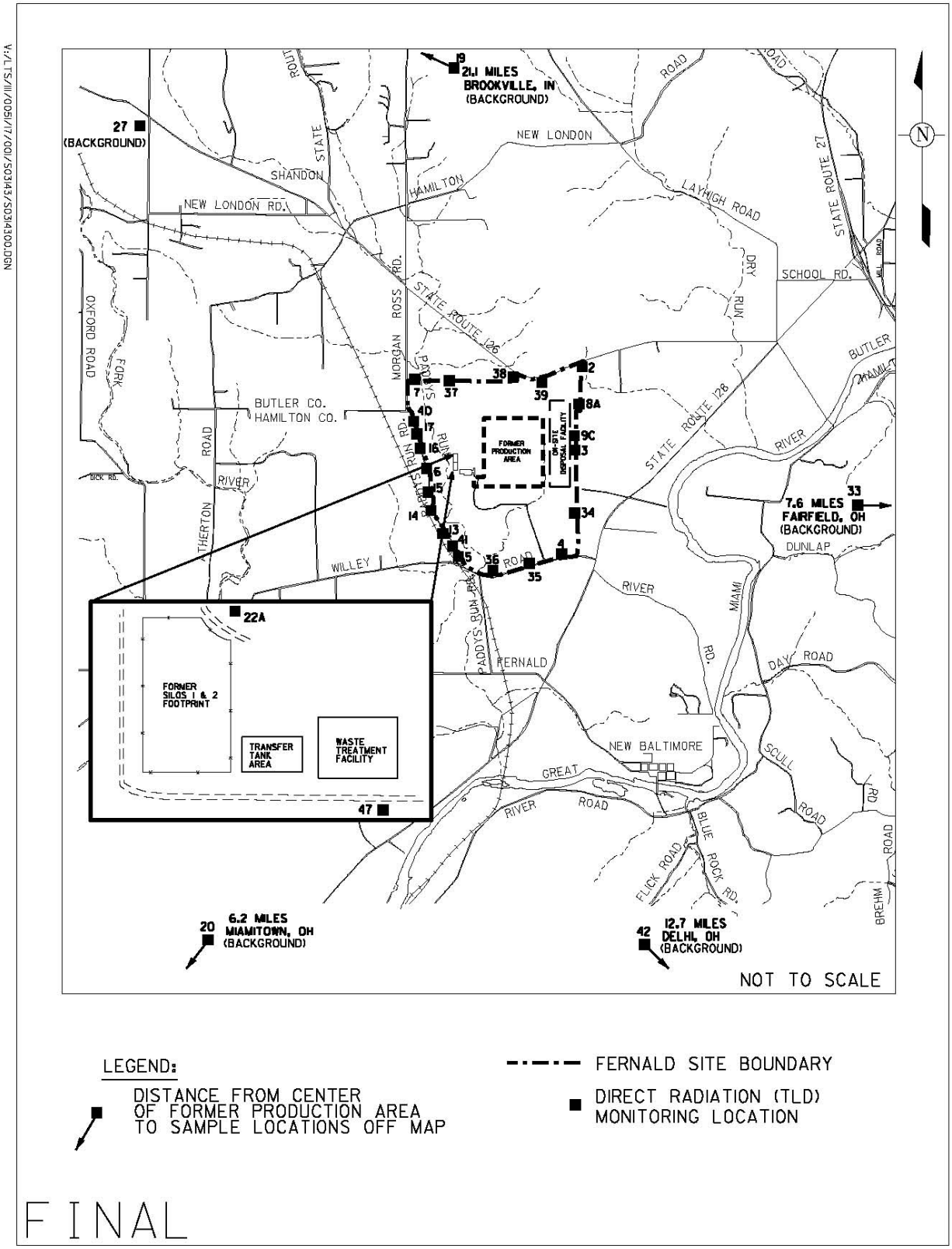

Figure C.3−1. Direct Radiation (Thermoluminescent Dosimeter) Monitoring Locations

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Attachment C.4

C.4.0 Meteorological Data

Meteorological data were recorded at the Fernald site's meteorological station from January 1, 2006 through May 16, 2006, when the station was shut down. A summary of the data for the first 4 ½ months of 2006 (based on hourly readings) is presented in Tables C.4−1 and C.4−2.

Wind speed data from the 10-meter and 60-meter elevations (Table C.4−1) are summarized as monthly maximum and minimum, with the largest range occurring in February (47 and 0.3 mph; 10-meter) and January (65 and 0.3 mph; 60-meter). Ambient air temperature at the 10-meter level includes monthly average, maximum and minimum. The yearly (4.5 months of data) maximum and minimum temperatures were recorded in April and February, respectively. Precipitation information includes the monthly total and daily maximum values, with April being the wettest month.

Table C.4−2 indicates the prevailing winds were from the southwest about 16 percent of the time at the 10 meter height and out of the south-southwest about 13 percent of the time for the 60-meter height. The winds out of the north were least predominant (less than one percent of the time at both heights). Average wind speed was the highest out of the north-northwest and north-northeast at the 10-meter height and out of the north-northwest and south-southwest for the 60-meter height.

Although meteorological data were collected only through May16, the 2006 wind speeds and directions are similar to 12-month data collected in 2005. Therefore, the 2006 summary in Table C.4−2 was used for the dose assessments presented in Attachment C.5.

Table C.4−1. 2006 Meteorological Data

	Units	Jan	Feb	Mar	Apr	May*
10-Meter Wind Speed						
Maximum (hourly average)	mph	42	47	41	41	37
	kph	67	75	66	66	59
Minimum (hourly average)	mph	0.3	0.3	0.3	0.3	0.3
	kph	0.5	0.5	0.5	0.5	0.5
60-Meter Wind Speed						
Maximum (hourly average)	mph	65	60	51	52	42
	kph	104	96	82	83	67
Minimum (hourly average)	mph	0.3	0.3	0.3	0.3	0.3
	kph	0.5	0.5	0.5	0.5	0.5
Ambient Air Temperature						
Average	^{o}F	43	35	42	59	59
	^{o}C	6	2	6	15	15
Daily Maximum	^{o}F	62	66	74	85	78
	^{o}C	17	19	23	29	26
Daily Minimum	^{o}F	22	7	13	33	46
	^{o}C	-6	-14	-11	1	8
Precipitation						
Total	in	3.4	1.4	4.8	6.5	1.0
	cm	8.6	3.6	12.2	16.5	2.5
Daily Maximum	in	0.4	0.3	0.4	0.9	0.2
	cm	1.0	0.8	1.0	2.3	0.5

*May data collected through May 16, when met tower was shut down.

Table C.4−2. 2006 Average Wind Speed and Percent of Time from Direction at 10 and 60 Meters Above Ground Level

Direction	Average 10-meter Wind Speed (mph)	Average 10-meter Wind Speed (kph)	Percent of Time from Direction	Average 60-meter Wind Speed (mph)	Average 60-meter Wind Speed (kph)	Percent of Time from Direction
N	6	9	0.0	10	16	0.1
NNE	9	14	1.3	12	19	2.3
NE	6	10	3.7	9	14	4.9
ENE	6	9	6.3	8	13	7.4
E	3	5	4.0	7	11	3.2
ESE	3	5	2.5	6	10	2.6
SE	3	5	3.8	6	10	3.3
SSE	4	6	4.4	7	12	5.1
S	5	8	7.7	9	15	9.3
SSW	7	11	13.2	12	19	12.7
SW	7	11	15.7	11	18	10.5
WSW	5	7	12.1	10	17	11.3
W	5	8	9.2	11	17	9.3
WNW	6	10	7.3	11	17	7.4
NW	6	10	6.3	10	16	7.2
NNW	9	15	2.5	11	18	3.4

End of current text

Attachment C.5

C.5.0 Supplemental Dose Assessments

This attachment contains a detailed discussion of the supplemental dose assessments performed for calendar year 2006, and compares the 2006 results to those from 1999 through 2005. The population and biota dose assessments comprise the supplemental dose assessment, which provides required information for compliance with the DOE standards contained in DOE Order 5400.5 (DOE 1993).

A population dose assessment provides an aggregate measure of the impact of airborne emissions and direct radiation from sources at the Fernald site to the population in the area. A biota dose assessment provides information related to the Fernald site's compliance with dose limits to aquatic organisms in the Great Miami River.

C.5.1 Population Dose Assessment

Computation of a population dose is a requirement of DOE Order 5400.5, which defines population dose as the collective effective dose equivalent. For 2006, the effective dose equivalent was 0.52 person rem/year. This includes 0.49 person rem/year from site airborne emissions (excluding radon) and 0.03 person rem/year from the direct radiation component (Table C.5−1). There was no estimated biota dose to the population from consumption of produce, as the produce monitoring program was terminated in 2003.

Table C.5−1. Estimated Population Doses

	1999	2000	2001	2002	2003	2004	2005	2006
Air Inhalation	1.19	3.29	3.35	3.47	3.84	3.87	1.2	0.485
Direct radiation	0.127	0.108	0.159	0.23	0.155	0.47	0.35	0.030
Biota[a,b]	NA	0.48	NA	NA	0.002	NA	NA	NA
Total	**1.317**	**3.88**	**3.51**	**3.70**	**4.00**	**4.34**	**1.55**	**0.515**

[a]NA = not applicable.
[b]Produce for biota dose was sampled every three years and program was completed in 2003.

The air inhalation dose component was estimated by using the 1990 census information for the population within 50 miles of the site, as distributed between four equally sized quadrants (NE, SE, SW, NW). A dose is estimated for each population quadrant based on the annual average air concentration in the quadrant at the site boundary, the population at varying distances from the site, and the dose conversion factors. The following conservative assumptions are used in the calculations:

- Inhalation rate of 1.2 cubic meters (m^3) per hour for 8,760 hours per year (ICRP 1975)
- Population distribution in area (DOE 1997)
- Wind rose data (refer to Appendix D, Figure D−2 of this report)

- Annual average boundary concentrations are applied out to a distance of three miles from the site boundary (the nearest site background monitor). For populations beyond three miles, the annual average concentration is diluted as the inverse square of the distance ($1/d^2$) from the boundary to account for dispersion of the site-generated particulate (e.g., between 3 and 4 miles from the boundary, the dose calculation uses the annual average concentration divided by 9).
- Inhalation dose conversion factors (DOE 1988).

The direct radiation dose component was estimated by using the population distribution within 50 miles of the site, as distributed between 16 equally sized compass sectors (N, NNE, NE, ENE, etc). A dose is estimated for each population sector based on the net increase in direct radiation levels at the site boundary, as measured by TLDs, and the distance between the location of the population and the major source of radiation at the Fernald site (e.g., silos project area). The following conservative assumptions are used in the calculations:

- Population lives 8,760 hours per year in area (DOE 1997)
- The number of people per household is estimated by total population per sector per mile divided by number of households per sector per mile
- The silo project area is modeled as a point source of radiation
- The net direct radiation levels are calculated from site boundary TLD results minus the background result
- The direct radiation levels attributable to the silos project area extends up to 6,000 feet away from the silos project area.

The decrease in the collective effective population dose from 2005 to 2006 reflects completion of remedial actions for the waste pits and silos project areas, which resulted in lower radionuclide concentrations in particulate samples and less direct radiation as silo waste was removed from the site. Air inhalation is the largest component of the collective population dose, because particulate emissions from the Fernald site are suspended in the wind and are generally distributed over a much larger area, relative to direct radiation. The total collective population doses attributed to remedial actions at the Fernald site, over the years 1999 through 2006 (Table C.5−1), are very low relative to background dose values. Background radiation, from the sun and naturally occurring radionuclides in the earth and food products, delivered an estimated collective effective dose of 300,000 person rem to the population within 50 miles of the Fernald site.

C.5.2 Biota Dose Assessment

DOE Order 5400.5 requires that populations of aquatic biota be protected at a dose limit of 1 rad/day. The DOE has issued a technical standard entitled, “A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota” (DOE 2002), and supporting software (RAD BCG) for use in the evaluation and reporting of biota dose limits. A biota dose assessment divides the radionuclide concentrations in surface water and/or sediment samples to pre established biota concentration guides (BCGs) for specific radionuclides and sums the fractions for each radionuclide. If the resulting sum of fractions is less than 1.0, compliance with the biota dose limit is assured. BCGs have been established for radionuclides that are relatively common constituents in past radionuclide releases to the environment from DOE facilities. For

the isotopes at the Fernald site, the radium isotopes have the lowest BCG values, hence they account for most of the weight in the sum of fractions presented here.

For 1999 through 2005, the Fernald site determined compliance with the biota dose limit to aquatic biota using the RAD-BCG code and the diluted (i.e., mixed) concentration for each applicable radionuclide discharged to the Great Miami River at the Parshall Flume (refer to Chapter 4 of this report). However, only a single discharge point was evaluated when two discharge points (Paddys Run and the Parshall Flume) are delivering mass to the Great Miami River. In 2003, OEPA published a fact sheet that provided the harmonic mean flow for Paddys Run (0.19 cfs; OEPA 2003), allowing this discharge point to be evaluated in addition to the Parshall Flume. Therefore, the biota assessments for 2003 through 2006 were performed using the mass delivered from both discharge points to determine the annual average mixing concentration in the Great Miami River. Note that these assessments only evaluate the contaminant contribution from the Fernald site (i.e., the contribution that is above background).

The maximum measured concentration for each radionuclide at the Parshall Flume (PF-4001) and Paddys Run (SWP-03) monitoring locations was multiplied by the annual volume of water discharged to the Great Miami River at the Parshall Flume and Paddys Run to obtain an estimate of the maximum mass of each radionuclide delivered to the river at each discharge point (e.g., pCi/L * L = total pCi). For each radionuclide, the mass discharged at the Parshall Flume was added to the mass discharged at Paddys Run to obtain the annual total mass delivered to the river. The annual total mass delivered to the river was divided by the annual total volume of mixed water (Parshall Flume + Paddys Run + Great Miami River) to obtain the annual radionuclide concentrations used in the RAD-BCG model for the biota dose assessment (as noted above, this concentration represents the concentration above background).

Table C.5−2 contains a summary of the output from the RAD BCG computer model for 1999 through 2006, showing results for one discharge point (1999 through 2005) and two discharge points (2003 through 2006). Results for 2006 show the sum of fractions (0.062) is well below the compliance threshold value of 1.0, but above the results reported for every previous year. The increase in 2006 is due primarily to the radium-228 maximum concentration at the Parshall Flume (13.5 pCi/L), which is about 3 times greater than the radium-228 concentration used in previous calculations. Recalculated results for 2003 and 2004, for two discharge points, are identical to the initial results calculated for one discharge point. This indicates that the mass delivered from Paddys Run is insignificant relative to the mass delivered at the Parshall Flume. As discussed below, if the contaminant concentration is similar at the two discharge points, the contaminant mass delivered to the Great Miami River from Paddys Run will be much less than the mass delivered to the river at the Parshall Flume because of the large difference in discharge volume.

Table C.5−2. Estimated Sum-of-the-Fractions for Biota Dose*

	1999	2000	2001	2002	2003	2004	2005	2006
A	0.015	0.035	0.038	0.023	0.035	0.059	0.017	NA[b]
B	NA[b]	NA[b]	NA[b]	NA[b]	0.035	0.059	0.005	0.062

Note: A = 1999 through 2005 calculated using one discharge point (Parshall Flume)
B = 2003 through 2006 calculated using two discharge points (Paddys Run and Parshall Flume)

[a]Sum-of-the-fractions calculated with the RAD-BCG code.
[b]NA = not applicable.

When the 2005 concentration data are re-evaluated using two discharge points, the sum of fractions for 2005 decreases to 0.005, which is about three times less than the value of 0.017 reported in the 2005 SER. The basis for this decrease is that the radium-228 mass delivered to the river in the 2005 assessment was overestimated. A radium-228 activity of 3.15 pCi/L was obtained from a Paddys Run monitoring location and it was multiplied by the Parshall Flume annual water volume to obtain the mass of radium-228 delivered to the Great Miami River at the Parshall Flume. If the maximum radium-228 value at the Parshall Flume had been inserted into the evaluation for the 2005 SER, rather than the value from Paddys Run, the sum of fractions would have been 0.004, rather than 0.017. Therefore, the single-discharge-point calculation for 2005 should have yielded 0.004 for the sum of fractions, which indicates the contribution from the Parshall Flume. As noted above, the present evaluation with two point sources yields a result of 0.005, which indicates that Paddys Run contributes about 0.001 to the sum of fractions. Based on the harmonic mean flow for Paddys Run (0.19 cfs; OEPA 2003), the annual volume of water discharged to the Great Miami River is 1.70E+08 L, compared to 7.28E+09 L for the 2005 Parshall Flume data. Therefore, due to the large difference in the discharge volumes, the mass delivered from Paddys Run only becomes important if the radium concentrations in Paddys Run are much greater than those at the Parshall Flume.

Appendix D

2006 National Emissions Standards for Hazardous Air Pollutants (NESHAP) Annual Report

U.S. Department of Energy
Radionuclide Air Emissions Annual Report
(Under Subpart H of 40 Code of Federal Regulations Part 61)
Calendar Year 2006

Site Name: **Fernald Preserve, Fernald, Ohio**

Field Office Information:

Office:	Fernald Area Office (FN), U.S. Department of Energy (DOE)	
Address:	Post Office Box 538705 Mail Stop SDC Cincinnati, Ohio 45253-8705	
Contact:	Ed Skintik	Phone: (513) 246-0602

Site Information

Operating Contractor:	S.M. Stoller, Inc	
Address:	7400 Willey Road Fernald, Ohio 45030 (site location) 10995 Hamilton-Cleves Highway Harrison, OH 45030 (mailing address)	
Contact:	Frank Johnston	Phone: (513) 648-5294

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End of current text

Acronyms

ALARA	as low as reasonably achievable
AMS	air monitoring station
BAT	best available technology
°C	degrees Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeter
CY	calendar year
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
ft^3/min.	cubic feet per minute
HEPA	high efficiency particulate air
IEMP	Integrated Environmental Monitoring Plan
km	kilometer
m^3/min.	cubic meters per minute
mrem	millirem
mSv	milliSieverts
NESHAP	National Emission Standards for Hazardous Air Pollutants
OEPA	Ohio Environmental Protection Agency
pCi/m^3	picoCuries per cubic meter
USC	United States Code
WPP	Waste Pits Project

End of current text

Preamble

On May 23, 1997, the U.S. Department of Energy (DOE) Fernald Closure Project submitted a written request to the U.S. Environmental Protection Agency (EPA) for approval to use an alternate approach for demonstrating compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H requirements (DOE 1997). The alternate approach uses environmental measurements of airborne radionuclide concentrations (as provided for under 40 CFR 61.93[b][5]) rather than air dispersion modeling to demonstrate that radionuclide emissions resulting from Fernald site operations remain below the annual NESHAP Subpart H standard. The request for approval of the alternative approach was driven by the recognition that the dominant sources of radiological emissions at the Fernald site had changed as the mission of the site changed from uranium metal production (which ended in 1989) to environmental remediation. During production, the primary emission sources from the facility were point sources (stacks and vents). However, under the current mission of full scale environmental remediation, the dominant emission sources are fugitive emissions from diffuse sources (e.g., large scale excavations, wind erosion from stockpiled materials, decontamination and dismantling, etc.). Because there is a high degree of uncertainty associated with modeling fugitive emissions, environmental measurements were proposed as an alternative to provide a more accurate assessment of site's emissions.

On August 11, 1997, the EPA granted approval to use environmental measurements as an alternative methodology for demonstrating NESHAP compliance (EPA 1997). The Fernald site began using environmental measurements for NESHAP compliance purposes in 1998.

Summary

For calendar year (CY) 2006, the maximum effective dose equivalent from emissions of radionuclides to the ambient air is estimated to be 0.17 millirem (mrem/yr) (0.0017 millisieverts [mSv/yr]) above background, which is in compliance with the Subpart H standard of less than 10 mrem/yr (0.1 mSv/yr) above background. This estimation is based on the Fernald site's radiological air particulate monitoring program, which consists of a network of high volume air monitoring stations (AMS) operated at the Fernald site boundary (16 locations) and a background location. As the site remedial actions associated with building demolition and soil excavation decreased through 2006, monitoring at six boundary stations was discontinued in April, and an additional five boundary stations were shut down in December as agreed upon in consultation with USEPA and OEPA.

End of current text

D.1.0 Facility Information

D.1.1 Site Description

The Fernald site is located on a 1,050-acre (425 hectare) area approximately 18 miles (29 kilometers [km]) northwest of downtown Cincinnati, Ohio, just north of the small farming community of Fernald, Ohio. The former production area covers approximately 136 acres (55 hectares) in the center of the site.

The area immediately surrounding the site is rural in nature and characterized by the predominance of agriculture, with some light industry and private residences. The site is located on a relatively level plain, outside of the 500-year flood plain of the Great Miami River, in an ancestral river valley known as the New Haven Trough.

The climate is characterized as continental/subtropical depending on the seasons, with average temperatures ranging from approximately 31 °F (−0.7 °C) in December to 76 °F (25 °C) in July. Average annual precipitation was approximately 40 inches (102 centimeters [cm]). Prevailing wind flow is from the southwest.

For 37 years, the former Feed Materials Production Center (the Fernald site) produced uranium metals for DOE and its predecessors. On July 10, 1989, uranium metals production was suspended. Management responsibilities of the Fernald site were transferred from the Defense Programs organization to the DOE's Office of Environmental Restoration and Waste Management.

Remedial action activities at the Fernald site are conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). These activities included sample analysis; waste characterization; the management, treatment, storage, and disposal of hazardous, mixed, low level, and solid wastes; and the decontamination and cleanup of radioactively contaminated buildings, equipment, soil, and ground water. The site also managed containerized thorium wastes and K 65 Silos waste material, which contained radium and produced radon gas. All remedial actions, with the exception of ground water restoration, were completed in 2006.

D.1.2 Source Descriptions

The majority of the radioactive airborne contaminants at the Fernald site consisted of thorium and uranium isotopes. Additional radioactive airborne contaminants consisted of daughter products from the uranium, actinium, and thorium series decay chains.

For CY 2006, potential radionuclide emissions sources at the Fernald site included:

- Stockpiles; fugitive emission from wind erosion.
- Former production area and waste pit area; fugitive emission from continued excavation of contaminated soils and debris.
- On-site disposal facility waste placement and material transfer areas; fugitive emissions from size-reducing material prior to and during placement in the cells.

- Silos 1, 2 and 3; fugitive emissions generated from decontamination and dismantling of treatment facilities.
- Continued operation of the Radon Control System (until April 2006).

Stack monitoring of the RCS and silo treatment facilities was completed in early 2006 and reported in the 2005 NESHAP annual report (Appendix D of the 2005 SER); therefore it will not be repeated here.

D.1.3 Radiological Air Particulate Monitoring Program Description

The Fernald site's radiological air monitoring program for CY 2006 is defined in the Integrated Environmental Monitoring Plan (IEMP), Revision 4 (DOE 2005). The program design, as approved by the EPA, is summarized below.

D.1.3.1 Monitoring Equipment and Locations

- A network of 17 high-volume environmental AMSs comprise the Fernald site's radiological air particulate monitoring program for NESHAP compliance (Figure D−1). The monitors draw air continuously through 8-inch by 10-inch filters at a rate of 40 to 50 cubic feet per minute (ft^3/min.) (1.13−1.42 cubic meters per minute [m^3/min.]). Each AMS contains a flow rate chart recorder and a hour meter that provide a record of the monitor's operational run time over the sampling period. Additionally, each AMS is equipped with flow controllers that maintain a constant airflow through the monitor by automatically adjusting blower/motor speed to correct for variations in line voltage, temperature, pressure, or filter loading.
- The 17 AMSs are divided among boundary and background monitoring locations. Sixteen monitors are located on the Fernald site boundary, generally corresponding to the 16 wind rose sectors (Figure D-2). One monitor collects background data and is located in the northwest direction, approximately 3.2 miles (5.2 km) from the center of the Fernald site. The EPA siting criteria (40 CFR 58, Appendix E) were considered when selecting these locations.

D.1.3.2 Analytical Regime and Sampling Frequency

The analytical regime and sampling frequency for this program were designed to collect defensible data, account for the major dose sources, and demonstrate compliance with NESHAP Subpart H, as defined in 40 CFR 61.93(b)(5)(ii).

- Filters were exchanged biweekly throughout the year and analyzed for total uranium and total particulates. Analytical results are used to document site emissions and demonstrate that the emission controls at the Fernald site were operating effectively.
- A portion of each biweekly filter was retained and used to form a monthly composite sample for the analysis of thorium isotopes. This was done to supplement the thorium data from the quarterly composites (i.e., two monthly thorium composites per quarter). Analytical results from the monthly and quarterly thorium composites are used to document thorium emissions and demonstrate that process controls at the Fernald site were operating effectively.

- The remaining portion of each biweekly filter was retained and used to form a quarterly composite sample. This composite sample is analyzed for the radionuclides expected to be the major contributors to dose from site emissions. Results from the quarterly composite samples are used to track compliance against the NESHAP Subpart H standard for the calendar year.
- Isotopes that comprise the quarterly composite analysis were selected based on the following considerations:
  - Radionuclides that are stored in large quantities at the Fernald site and were handled or processed during the remediation effort (uranium-234, uranium-235, uranium-238, thorium-228, thorium-230, thorium-232, and radium-226)
  - Radionuclides that were the major contributors to dose based on environmental and stack filter measurements (uranium-234, uranium-235 and uranium-238)
  - Radionuclides that, due to their concentrations in waste and contaminated soil, were the major contributors to dose (uranium-234, uranium-235, uranium-238, thorium-228, and thorium-230).

Uranium-238, thorium-232, and uranium-235 are initial radionuclides in the uranium, thorium, and actinide decay chains, respectively. The majority of uranium and thorium isotopes received and processed during the production era of the Fernald site had been separated from their decay chain progeny prior to shipment to the site. As a result, all decay chain progeny are not in equilibrium with the parent activity, but short half-life progeny are expected to be in equilibrium with the parent. Because some of the progeny are difficult to quantify using standard radiochemistry analytical techniques, in part due to the limited sample volume and low environmental concentrations of all radionuclides in the quarterly composite samples, a number of progeny radionuclides can be considered to be present in equilibrium with their parents (i.e., thorium-234, radium-228, actinium-228, radium-224, and thorium-231). The progeny nuclides noted above are used in the dose assessment.

Net air concentrations for measured isotopes are summarized in Table D−1. For the boundary monitors, the net air concentration is defined as the gross result minus the blank and background values. The net air concentration at the background location is the gross result minus the blank.

D.1.3.3 Air Emission Data Reporting

In addition to this report, the environmental data from the Fernald site are available on the DOE Office of Legacy Management website: www.gjo.doe.gov/LM.

D.2.0 Air Emissions Data

D.2.1 Air Monitoring Data Completeness Status

During CY 2006, there were no concerns about data quality of the quarterly composite results. Blank filter results were within their historical limits, and observed positive detects on the blank samples were subtracted from the composite result.

D.2.2 Air Monitoring Station Operational Performance

During CY 2006, operational run times for the 17 NESHAP AMSs exceeded 96.8 percent (Table D−2). In general, interruptions in monitor operations that were encountered during CY 2006 were the result of short-term power failures and/or equipment failures.

D.3.0 Dose Assessment

Based on the sum of the quarterly isotopic results and annual air volumes, the net measured concentration for each radionuclide was calculated at each boundary (fence line) monitor to determine annual average concentrations. The annual average concentrations at each boundary air monitor are divided by the corresponding values listed in Subpart H of 40 CFR 61, Appendix E Table 2 to form a radionuclide specific compliance ratio. For each boundary monitor, the sum of the radionuclide compliance ratios was calculated (Table D−3), and the maximum value of the sum of the ratios was 0.017 at AMS-3. AMS-3 operated 97.8 percent of the time during 2006.

In accordance with 40 CFR 61.107, compliance with the NESHAP standard is demonstrated when the sum of the ratios is less than 1. Based on this approach for demonstrating compliance, the 40 CFR 61, Appendix E, Table 2 values represent the annual average radionuclide concentrations that correspond to a 10 mrem/yr effective dose equivalent. It follows that a fraction of the 40 CFR 61, Appendix E Table 2 values would correspond to an equivalent fraction of a 10 mrem/yr effective dose equivalent. Therefore, the ratio sum for each monitor, derived from all radionuclide ratios, is converted to a dose by multiplying the ratio sum by 10 mrem/yr (Table D−3). The maximum value of the sum of the ratios (0.017) is observed at AMS-3, and this converts to a maximum effective dose equivalent of 0.17 mrem/yr (0.0017 mSv/yr) at the Fernald site boundary.

Because the nearest residences are located approximately 1,555 feet (474 meters) downwind (east southeast) from AMS-3, the actual dose received by this receptor would be substantially lower than 0.17 mrem/yr (0.0017 mSv/yr).

D.4.0 Compliance Assessment

For CY 2006, the maximum effective dose equivalent from emissions of radionuclides to the ambient air, based on samples collected at the Fernald site boundary, is estimated to be 0.17 mrem/yr (0.0017mSv/yr), which is in compliance with the Subpart H standard of less than 10 mrem/yr (0.1 mSv/yr).

D.5.0 Additional Information

D.5.1 Meteorological Data

Meteorological data were collected from the Fernald site until May 16, 2006 when the meteorological tower was taken out of service and demolished. Meteorological data are currently being collected from the Butler County Regional Airport because it is the closest location that provides the most comprehensive meteorological data set. These data are used to evaluate site-specific climatic conditions.

Refer to Figure 2 for the CY 2006 wind rose data.

D.5.2 Construction/Modifications at the Fernald Site

In CY 2006, there were no project changes that resulted in a need to apply to the EPA for approval (under the provisions of 40 CFR 61.96) to construct or modify operations that control source emissions.

D.6.0 References

DOE (U.S. Department of Energy), 2005. "Integrated Environmental Monitoring Plan," 2505 WP 0022, Revision 4, Final, Fluor Fernald, DOE, Fernald Area Office, Cincinnati, OH, January.

DOE (U.S. Department of Energy), 1997. "Application for Approval to Use Environmental Measurements to Demonstrate Compliance with the National Emission Standards for Hazardous Air Pollutants Subpart H," letter #DOE 0980 97, Johnny Reising to James Saric and Michael Murphy, May 23.

EPA (U.S. Environmental Protection Agency). 1997, "Application for Approval to Use Environmental Measurements to Demonstrate Compliance with the National Emission Standards for Hazardous Air Pollutants Subpart H," letter from Jack Barnett to Johnny Reising, August 11.

D.7.0 Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment (see 18 USC 1001).

Name: Johnny Reising

Signature: Signature on file Date: _____

Table D−1. CY 2006 Net Air Concentrations

	Radium (pCi/m^3)	Thorium (pCi/m^3)			Uranium (pCi/m^3)		
Location	226	228	230	232	234	235/236	238
Boundary [a,b]							
AMS-2	0	8.2E-07	0	1.0E-06	2.6E-06	0	2.5E-06
AMS-3	2.0E-05	3.5E-06	4.5E-06	3.8E-06	7.9E-06	1.3E-07	9.4E-06
AMS-4	0	4.2E-06	0	4.0E-06	7.4E-06	0	9.7E-06
AMS-5	0	1.7E-06	0	1.4E-06	4.2E-06	0	4.0E-06
AMS-6	0	2.2E-07	3.2E-07	4.0E-07	2.1E-06	6.7E-08	2.1E-06
AMS-7	0	2.8E-06	0	1.1E-06	4.7E-06	0	7.1E-06
AMS-8A	0	8.9E-07	1.2E-06	1.2E-06	3.8E-06	4.6E-08	3.9E-06
AMS-9C	2.7E-05	8.0E-07	6.7E-07	1.2E-06	6.0E-06	6.3E-08	5.3E-06
AMS-22	0	2.9E-07	0	6.0E-07	4.1E-06	6.6E-07	3.1E-06
AMS-23	0	5.4E-06	0	3.1E-06	1.0E-05	1.7E-06	9.0E-06
AMS-24	0	1.5E-06	1.9E-06	2.2E-06	3.7E-06	0	3.9E-06
AMS-25	0	7.4E-07	0	0	4.6E-06	0	5.1E-06
AMS-26	0	0	0	0	0	5.4E-08	0
AMS-27	0	1.7E-06	1.1E-06	1.7E-06	2.6E-06	7.3E-08	2.6E-06
AMS-28	0	7.3E-07	0	1.2E-06	7.2E-06	0	6.3E-06
AMS-29	1.9E-06	2.6E-06	1.9E-06	2.5E-06	5.5E-06	8.3E-08	7.1E-06
Background							
AMS-12	1.5E-02	9.6E-04	3.0E-04	1.9E-03	2.5E-04	0	2.6E-04

[a]For fenceline monitors, net = total - blank - background (0 if net is negative)
[b]AMS-4, 5, 7, 23, 25 and 28 were taken out of service on April 11, 2006.
AMS-9C, 22, 26, 27, and 29 were taken out of service on December 5, 2006.

Table D−2. CY 2006 Operational Summary for Air Particulate Monitoring Stations

Location	Number of Samples	Sample Start Date	Last Sample Collection Date	Operating Time (hours)	Percent of Operation
Boundary [a]					
AMS-2	27	20-Dec-05	02-Jan-07	8908	98.2
AMS-3	27	20-Dec-05	02-Jan-07	8872	97.8
AMS-4	8	20-Dec-05	11-Apr-06	2688	100
AMS-5	8	20-Dec-05	11-Apr-06	2686	99.9
AMS-6	27	20-Dec-05	02-Jan-07	9035	99.6
AMS-7	8	20-Dec-05	11-Apr-06	2686	99.9
AMS-8A	27	20-Dec-05	02-Jan-07	8840	97.4
AMS-9C	25	20-Dec-05	05-Dec-06	8399	100
AMS-22	25	20-Dec-05	05-Dec-06	8392	99.9
AMS-23	8	20-Dec-05	11-Apr-06	2686	99.9
AMS-24	27	20-Dec-05	02-Jan-07	8971	98.9
AMS-25	8	20-Dec-05	11-Apr-06	2685	99.9
AMS-26	25	20-Dec-05	05-Dec-06	8373	99.7
AMS-27	25	20-Dec-05	05-Dec-06	8393	99.9
AMS-28	8	20-Dec-05	11-Apr-06	2686	99.9
AMS-29	25	20-Dec-05	05-Dec-06	8131	96.8
Background					
AMS-12	27	20-Dec-05	02-Jan-07	9068	100

[a]AMS-4, 5, 7, 23, 25 and 28 were taken out of service on April 11, 2006.
AMS-9C, 22, 26, 27, and 29 were taken out of service on December 5, 2006.

Table D−3. 2006 Annual NESHAP Compliance Ratios

Location	Ac-228[a]	Ra-224[a]	Ra-226	Ra-228[a]	Th-228	Th-230	Th-231[a]	Th-232	Th-234[a]	U-234	U-235/6	U-238	Annual Total	Annual Dose[b] (mrem/yr)
Boundary [c,d]														
AMS-2	2.8E-07	7.0E-06	0	1.8E-04	2.7E-04	0	0	1.7E-03	1.1E-06	3.3E-04	0	3.0E-04	2.8E-03	2.8E-02
AMS-3	1.0E-06	2.5E-05	6.0E-03	6.4E-04	1.1E-03	1.3E-03	4.6E-10	6.1E-03	4.3E-06	1.0E-03	1.8E-05	1.1E-03	1.7E-02	1.7E-01
AMS-4	1.1E-06	2.7E-05	0	6.8E-04	1.4E-03	0	0	6.5E-03	4.4E-06	9.6E-04	0	1.2E-03	1.1E-02	1.1E-01
AMS-5	3.7E-07	9.1E-06	0	2.3E-04	5.4E-04	0	0	2.2E-03	1.8E-06	5.5E-04	0	4.8E-04	4.0E-03	4.0E-02
AMS-6	1.1E-07	2.7E-06	0	6.8E-05	7.2E-05	9.5E-05	2.3E-10	6.4E-04	9.6E-07	2.8E-04	9.0E-06	2.6E-04	1.4E-03	1.4E-02
AMS-7	3.0E-07	7.4E-06	0	1.9E-04	9.2E-04	0	0	1.8E-03	3.2E-06	6.0E-04	0	8.5E-04	4.4E-03	4.4E-02
AMS-8A	3.3E-07	8.1E-06	0	2.1E-04	2.9E-04	3.7E-04	1.6E-10	2.0E-03	1.8E-06	4.9E-04	6.2E-06	4.7E-04	3.8E-03	3.8E-02
AMS-9C	3.3E-07	8.1E-06	8.2E-03	2.1E-04	2.6E-04	2.0E-04	2.2E-10	2.0E-03	2.4E-06	7.7E-04	8.6E-06	6.4E-04	1.2E-02	1.2E-01
AMS-22	1.6E-07	4.0E-06	0	1.0E-04	9.5E-05	0	2.3E-09	9.7E-04	1.4E-06	5.3E-04	8.9E-05	3.8E-04	2.2E-03	2.2E-02
AMS-23	8.3E-07	2.1E-05	0	5.2E-04	1.7E-03	0	6.0E-09	5.0E-03	4.1E-06	1.3E-03	2.4E-04	1.1E-03	9.9E-03	9.9E-02
AMS-24	5.9E-07	1.4E-05	0	3.7E-04	5.0E-04	5.6E-04	0	3.5E-03	1.8E-06	4.8E-04	0	4.7E-04	5.9E-03	5.9E-02
AMS-25	0	0	0	0	2.4E-04	0	0	0	2.3E-06	6.0E-04	0	6.1E-04	1.5E-03	1.5E-02
AMS-26	0	0	0	0	0	0	1.9E-10	0	0	0	7.3E-06	0	7.3E-06	7.3E-05
AMS-27	4.7E-07	1.2E-05	0	3.0E-04	5.5E-04	3.2E-04	2.5E-10	2.8E-03	1.2E-06	3.3E-04	9.9E-06	3.1E-04	4.6E-03	4.6E-02
AMS-28	3.2E-07	7.8E-06	0	2.0E-04	2.4E-04	0	0	1.9E-03	2.9E-06	9.4E-04	0	7.6E-04	4.0E-03	4.0E-02
AMS-29	6.9E-07	1.7E-05	5.8E-04	4.3E-04	8.3E-04	5.7E-04	2.9E-10	4.1E-03	3.2E-06	7.2E-04	1.1E-05	8.5E-04	8.1E-03	8.1E-02
Background														
AMS-12	3.2E-07	7.9E-06	1.5E-02	2.0E-04	9.6E-04	3.0E-04	0	1.9E-03	9.7E-07	2.5E-04	0	2.6E-04	NA[e]	NA[e]

Note: Compliance ratios are calculated with net concentrations (i.e., gross result - blank - background)

[a]Ratio determined by assuming air concentration is in secular equilibrium with the parent nuclide.
[b]Dose is based on the NESHAP standard of 10 mrem/yr multiplied by the annual total for all isotopes.
[c]For fenceline monitors, net = total - blank - background (0 if net is negative)
[d]AMS-4, 5, 7, 23, 25 and 28 were taken out of service on April 11, 2006. AMS-9C, 22, 26, 27, and 29 were taken out of service on December 5, 2006.
[e]NA = not applicable

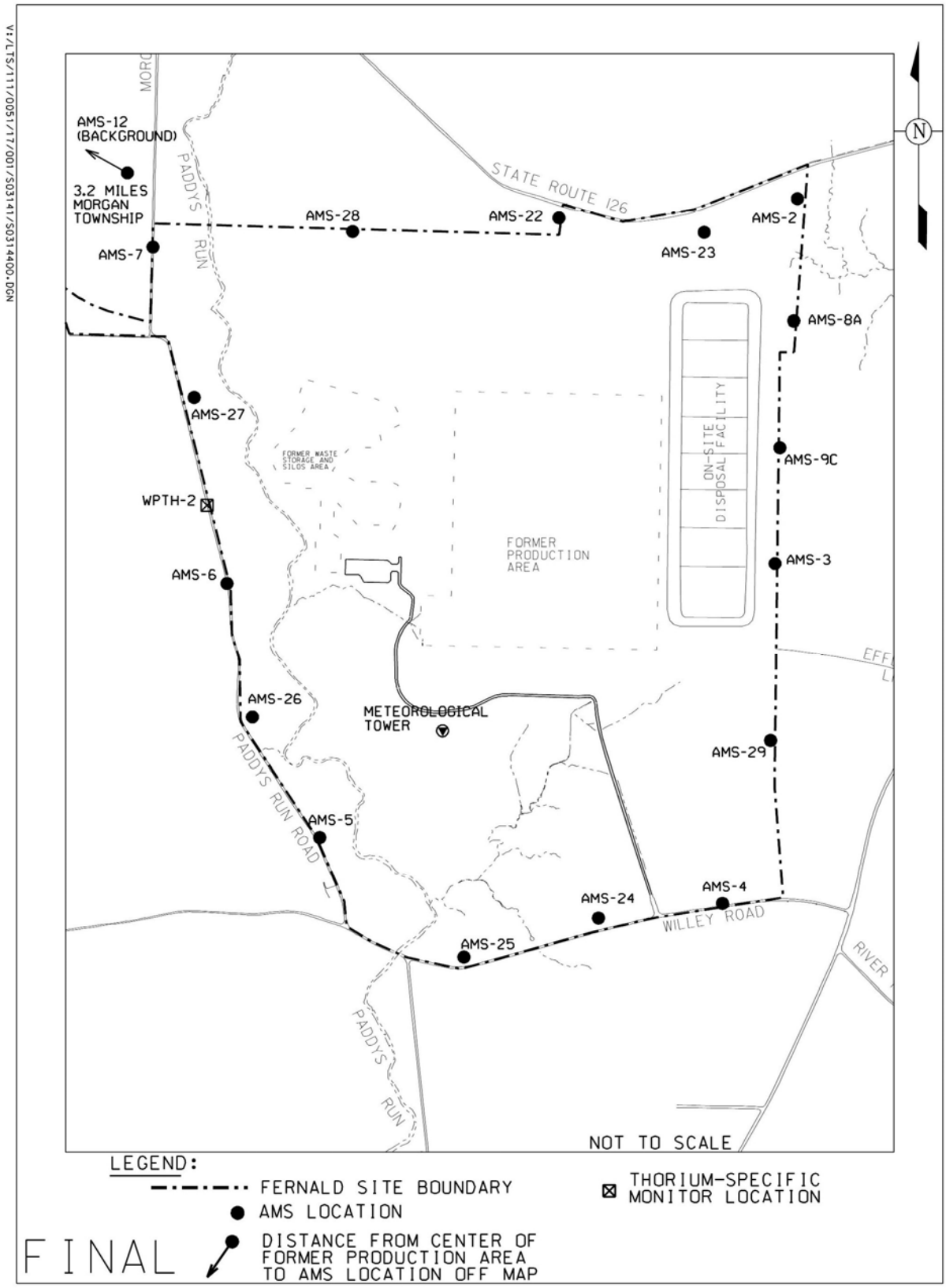

Figure D–1. Radiological Air Monitoring Locations

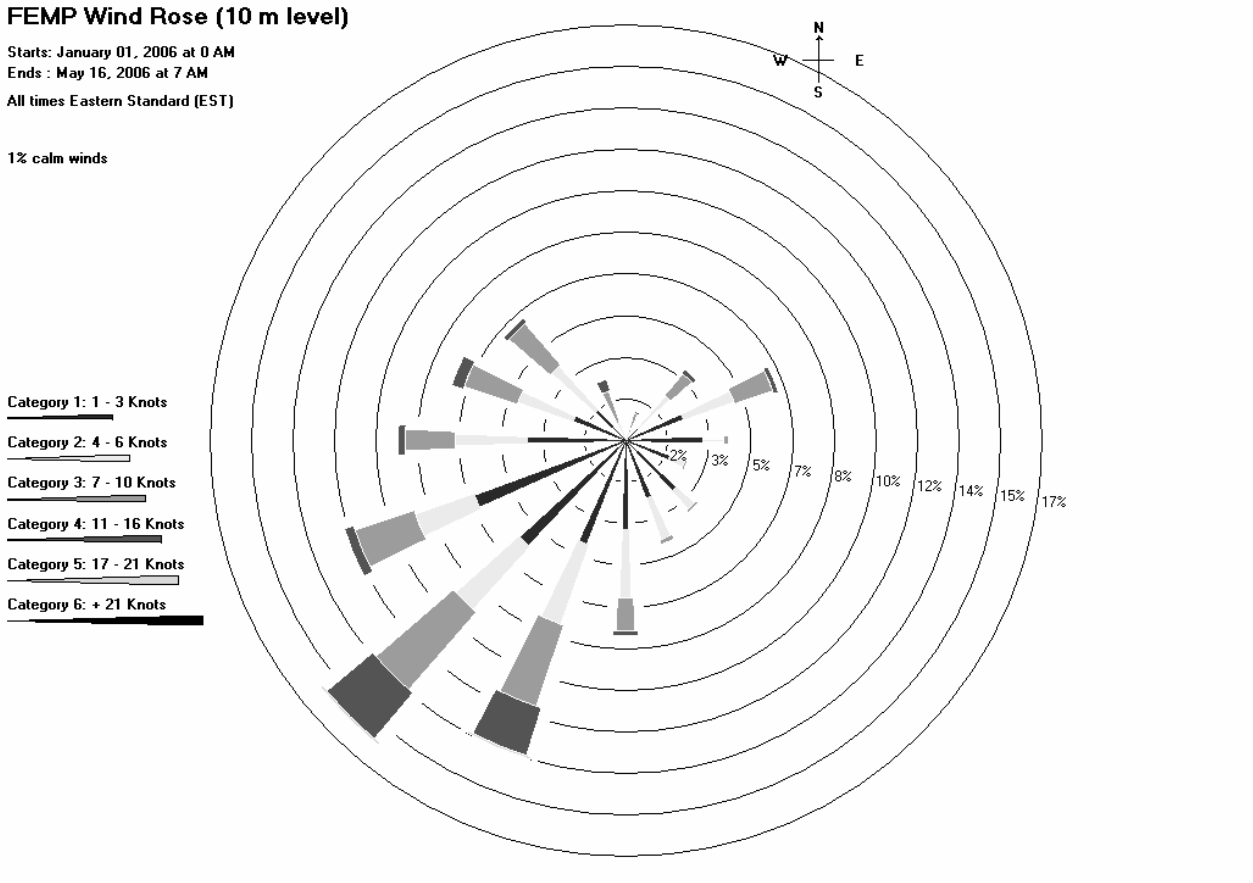

Figure D–2. Wind Rose Diagram

End of current text