TETRA TECH

March 23, 2007

Tom McLaughlin, Project Manager
U.S. Nuclear Regulatory Commission
Mail Stop T-7-E18
Washington, DC 20555

RE: Request for Additional Information – License Amendment Request for Reduction in Ground Water Monitoring
Docket No. 40-8102
License No. SUA-1139
ExxonMobil Highland Facility

Dear Mr. McLaughlin:

Please find attached the responses to the subject request for additional information dated October 26, 2006 regarding the Highland Reclamation Project. The attached technical memo has been prepared on behalf of ExxonMobil by Tetra Tech - MM. The attached responses follow the numbering organization as presented in your initial letter requesting the additional information.

Please feel free to contact me at (970) 487-3768 or Dan Burnham at (703) 846-3272 if you have any questions regarding this response.

Sincerely,

Mark Plessinger, P.E.
Senior Engineer

cc: Dan E. Burnham, Project Manager - Exxon Mobil
Dave Roberson, Project Manager - demaximis
Mahesh Vidyasagar, P.E. - Tetra Tech MM
Rebecca Lindeman, P.E. - Arcadis, Inc.
File - Groundwater

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Technical Memorandum

To:	Tom McLaughlin, Project Manager	**From:**	Mark Plessinger, P.E.
Agency:	U.S. Nuclear Regulatory Commission	**Date:**	March 15, 2007
Re:	Response to Request for Additional Information (RAI) letter dated Oct. 26, 2006 Highland Reclamation Project TAC LU0131	**Project #:**	180549
CC:	Rebecca Lindeman, P.E. – Arcadis, Inc. Dan E. Burnham, P.G. – Exxon Mobil		

1. **ExxonMobil requested that the requirement for monitoring ground water at wells 15, 117, 127, 148, 177, and 180 be deleted from the license. ExxonMobil stated that those wells are dry. In order for us to evaluate this request, please provide the following:**
   a. ***Provide graphical and/or tabular summary of water level data for wells 015,117, 127, 148, 177, and 180 to establish the entire time period these wells have been dry:***

   Groundwater elevations for wells 15, 117, 127, 148, 177 and 180 are available since 1981. Figures 1.1 through 1.6 illustrate a graphical summary of the historical ground water level measurements since monitoring was initiated. These data clearly show that all the specified wells are currently dry and have been dry between 3 and 15 years. The observed historic groundwater level trends at the wells are consistent with the ground water model predictions (Long-Term Pit Lake and Groundwater Hydrology at Highland Mine Site; February 2006) for post-mining conditions. Continued inclusion of these wells in the monitoring program provides no benefit to the NRC or Exxon. Displayed in Figures 1.1-1.6, the dark blue points indicate that a water elevation was measured, and the light blue circles indicate that the well was dry.

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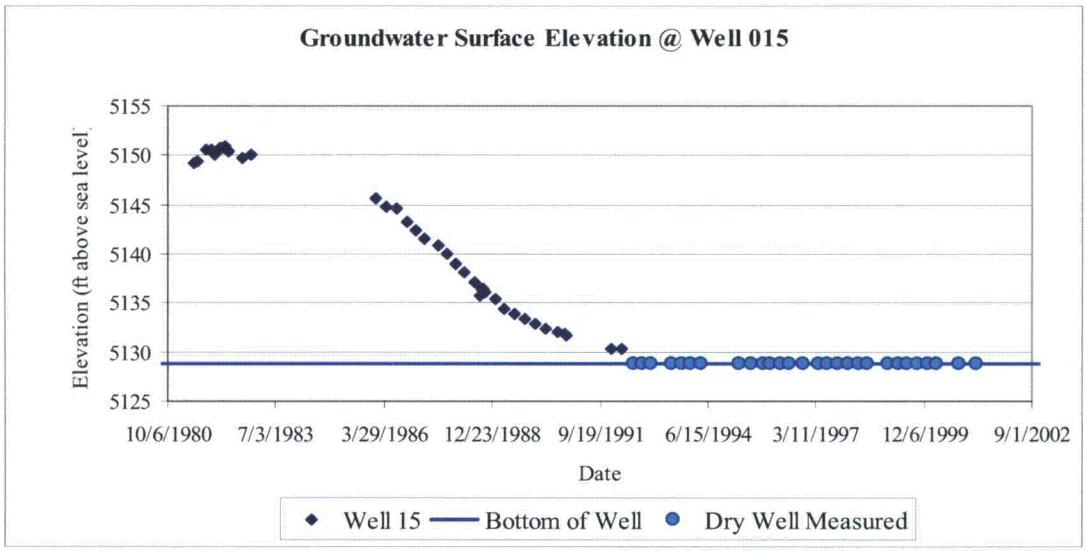

Figure 1.1 Graphical Summary of Historical Ground Water Surface Elevations @ Well 15

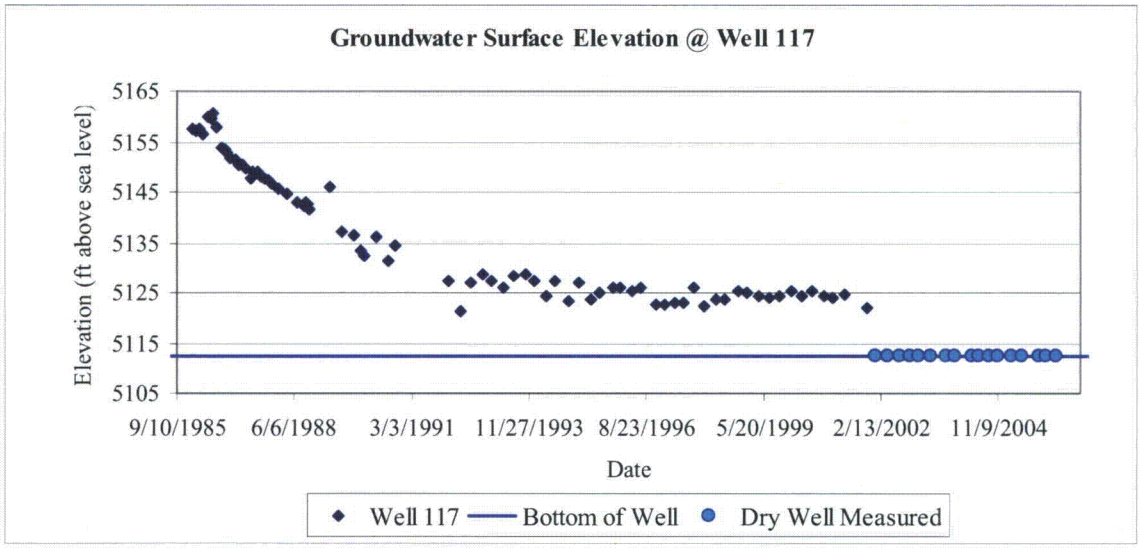

Figure 1.2 Graphical Summary of Historical Ground Water Surface Elevations @ Well 117

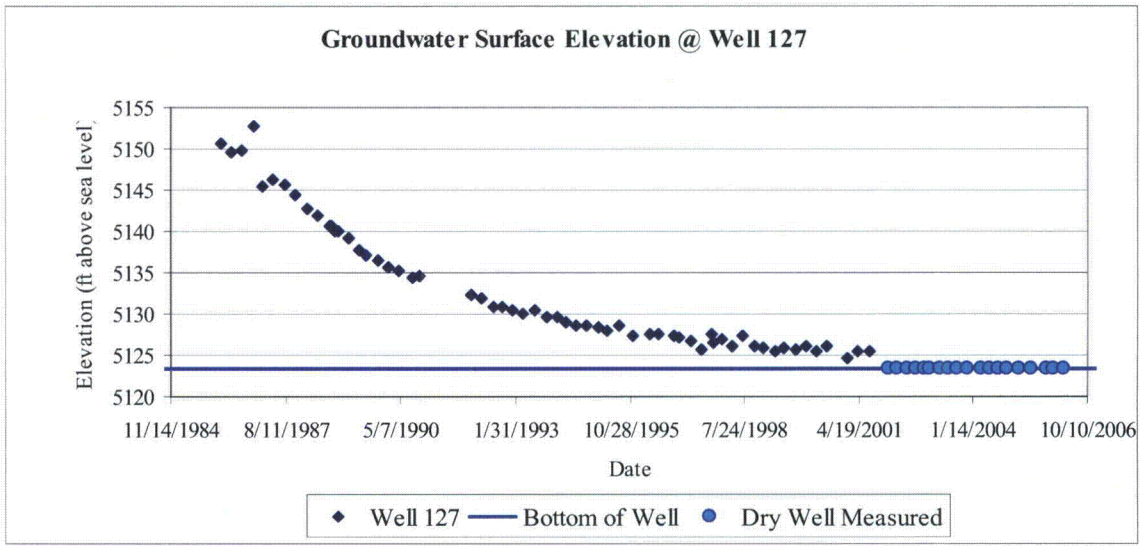

Figure 1.3 Graphical Summary of Historical Ground Water Surface Elevations @ Well 127

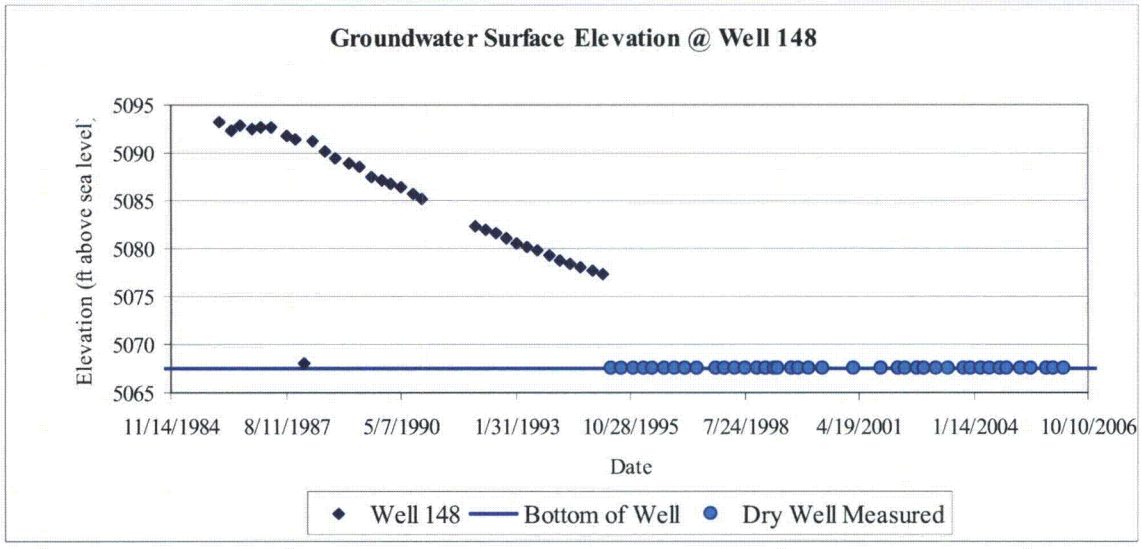

Figure 1.4 Graphical Summary of Historical Ground Water Surface Elevations @ Well 148

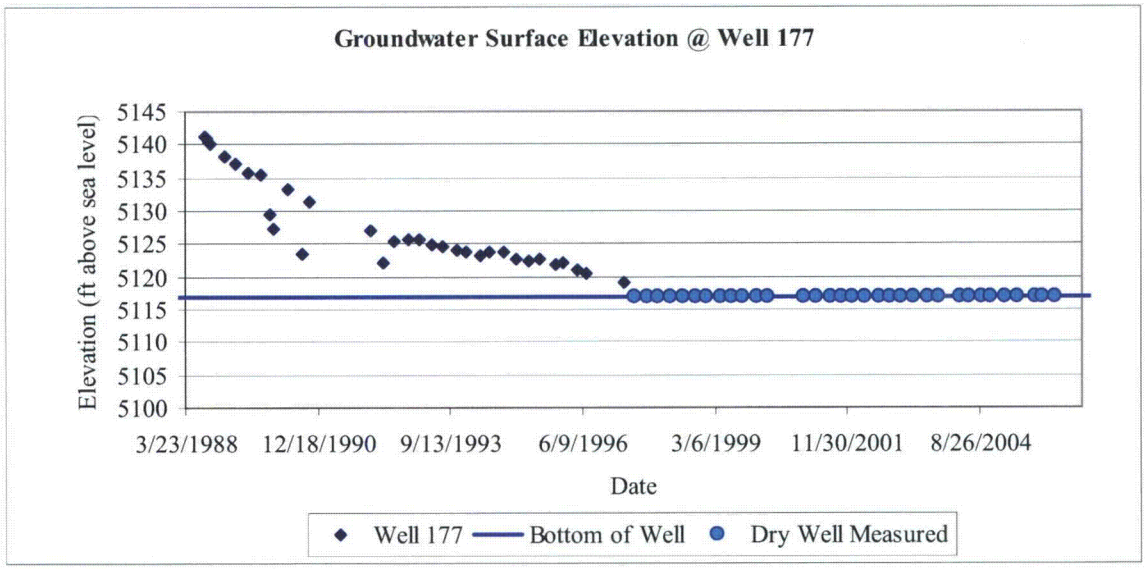

Figure 1.5 Graphical Summary of Historical Ground Water Surface Elevations @ Well 177

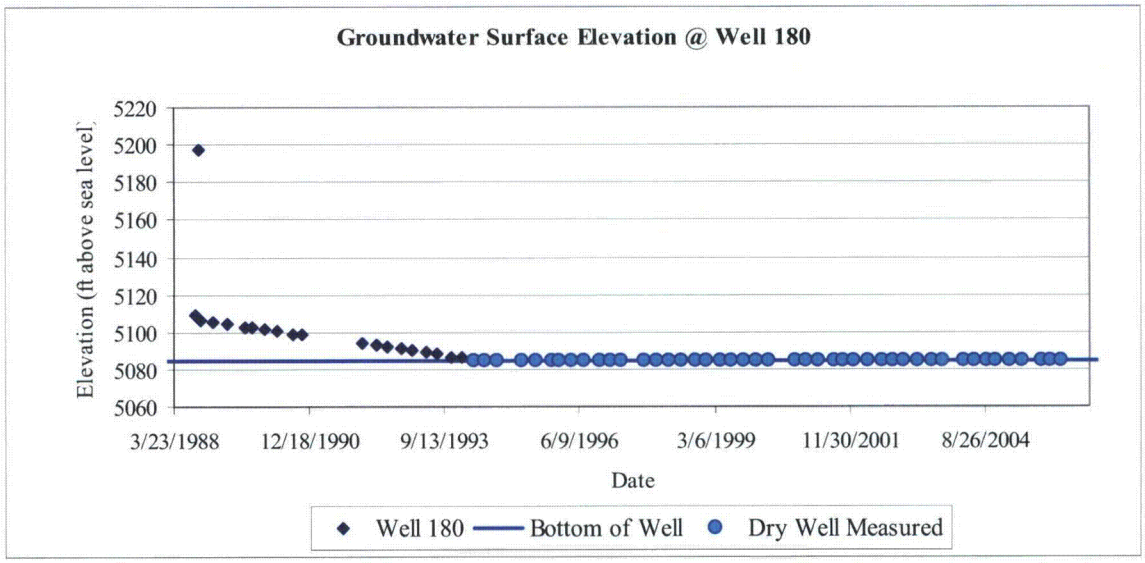

Figure 1.6 Graphical Summary of Historical Ground Water Surface Elevations @ Well 180

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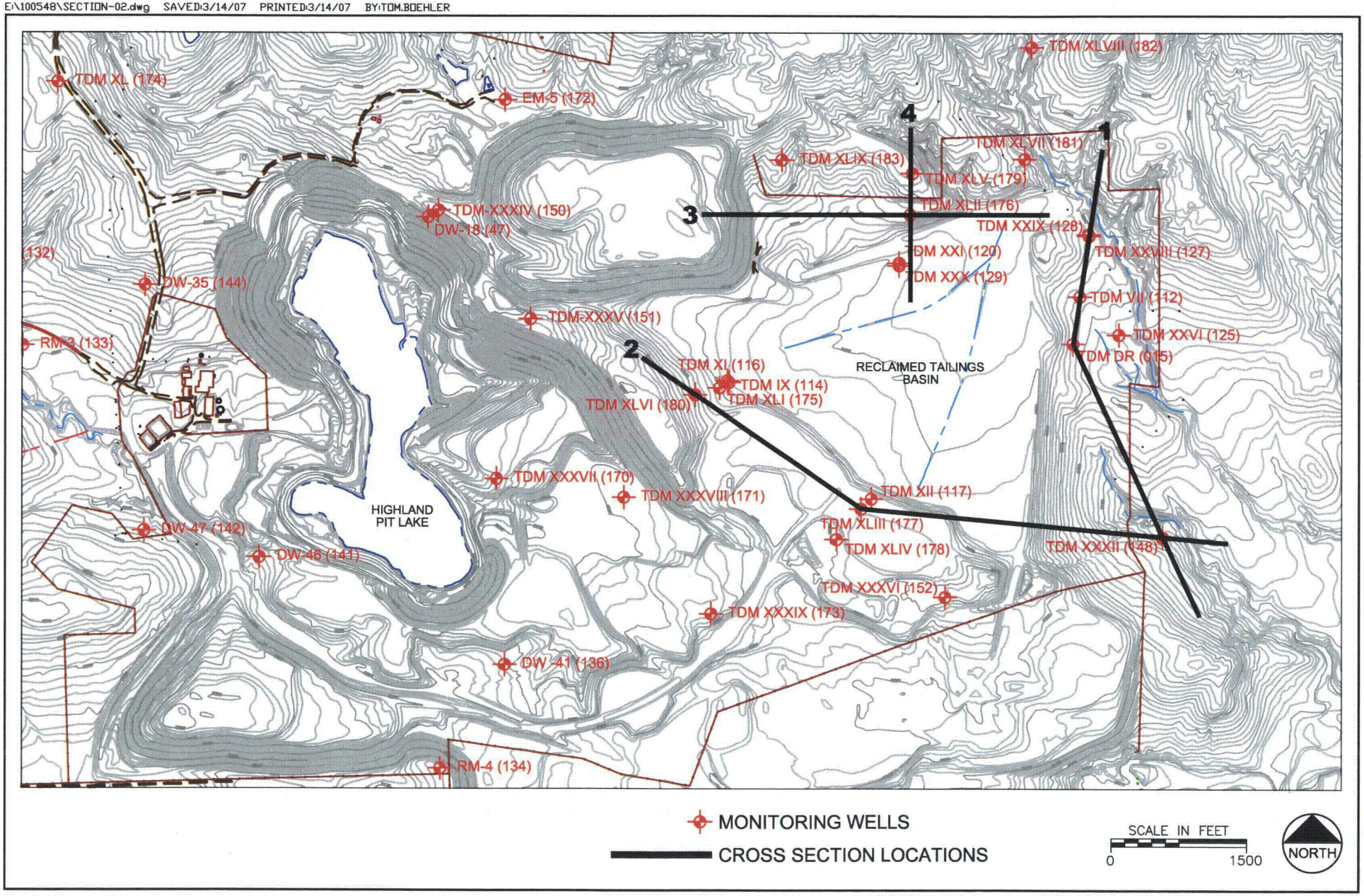

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FIGURE 1.7
CROSS SECTION LOCATION MAP

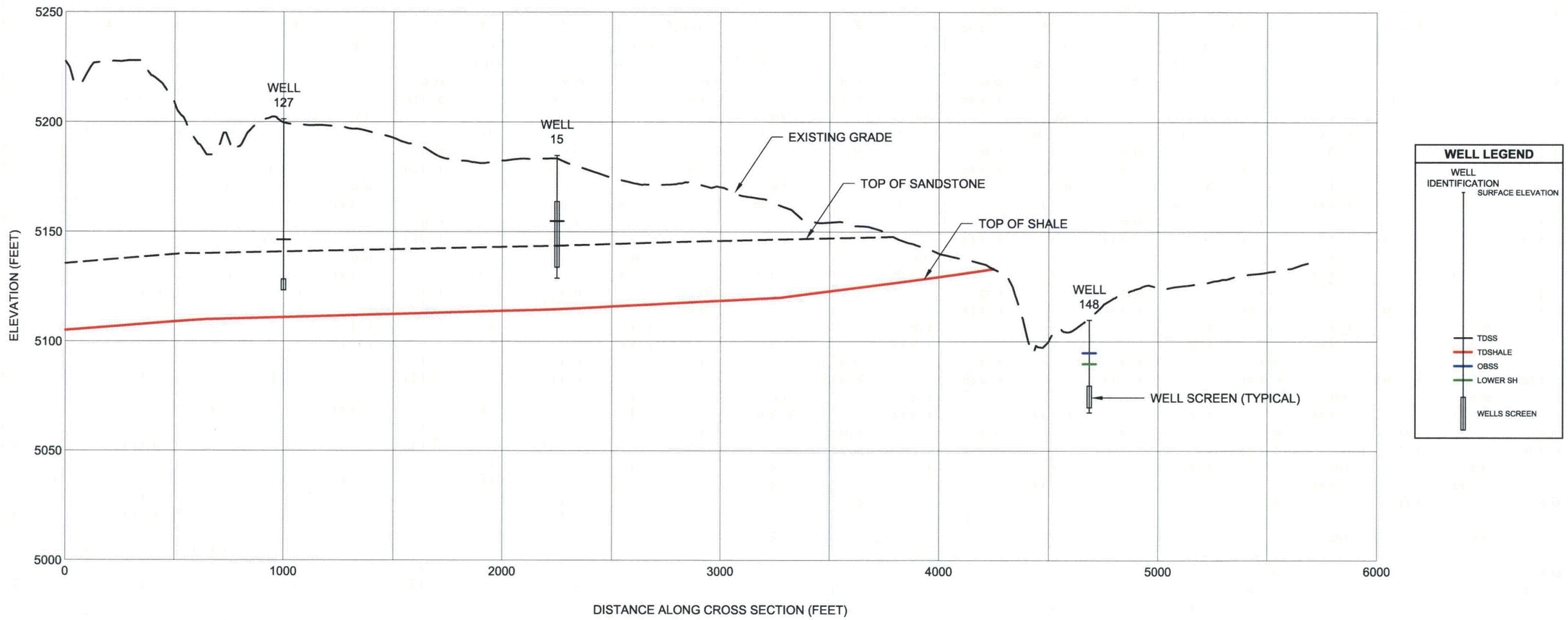

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FIGURE 1.8
CROSS SECTION 1

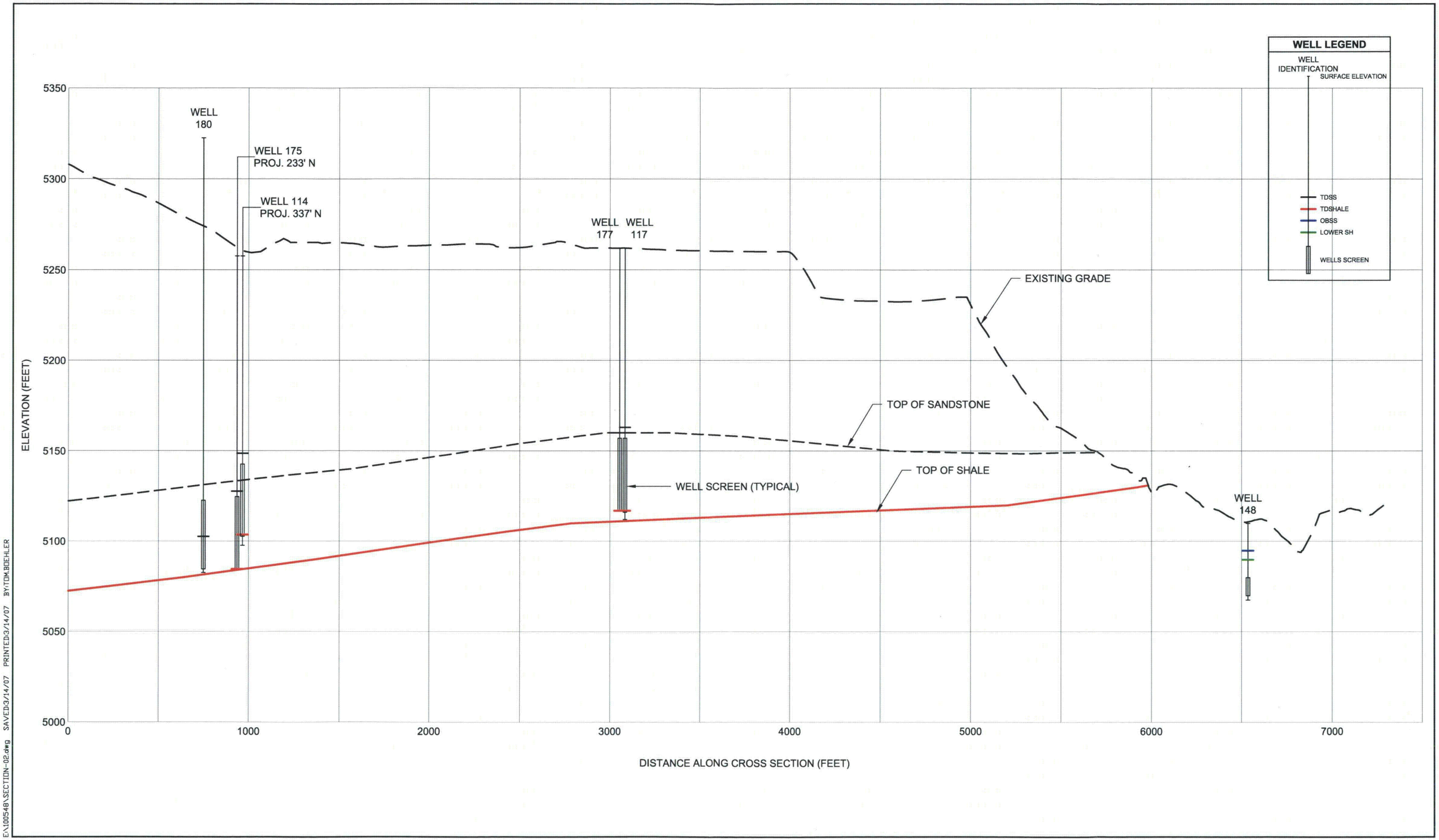

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FIGURE 1.9
CROSS SECTION 2

b. Provide (a)stratigraphic cross section(s) that shows the location of well screens for wells 15, 117, 127, 148, 177 and 180 with respect to important site features and, if possible, with respect to the current depth of the groundwater mound around the reclaimed tailings impoundment:

Figure 1.7 shows the location of the stratigraphic cross sections of the well locations. Figures 1.8 and 1.9 show the geologic formations they fall in, and the screen interval for each specified well. Figure 1.8 shows the cross-sections for wells 15, 127, and 148. Figure 1.9 shows the cross-sections for wells 117, 177, and 180. These wells all fall within the Tailings Dam Sand Stone (TDSS) geologic formation. The bottom elevations of these wells range from 42 feet below ground surface (bgs) to 238 feet bgs.

c. Provide a detailed narrative describing the action(s) to be implemented on monitor wells 15, 117, 127, 148, 177 and 180 upon elimination from the license.

The Wyoming Department of Environmental Quality, Water Quality Division (WDEQ/WQD) administers the regulations and instructions governing the construction and plugging of public water supply wells. The WDEQ/WQD "Groundwater Rules & Regulations, Chapter 11 Part G Section 70, Plugging and Abandonment" and the WDEQ/WQD Rural Wellhead Protection Fact Sheet "Plugging Abandoned Wells" were also reviewed and considered when specifying the following abandonment procedure.

The recommended well abandonment procedure includes:

- Before well abandonment the well permit number, location, depth, water level, construction specifications (screened intervals, casing diameter, etc.) shall be determined to the best extent possible.
- Wells will be abandoned by pressure grouting from the bottom of the well to near ground surface.
- Grout mixture can consist of cement-based mixtures, bentonite mixtures, or concrete. A cement/bentonite mixture with not more than five percent bentonite by weight and enough water to yield a pumpable mixture is recommended.
- Pressure grouting shall pump grout to a sufficient elevation such that an uninterrupted seal may be emplaced to the land surface.
- The drill rig will be used to pull/break the well casing below grade if possible. If unsuccessful the well will be cut off as low as reasonably possible. The area will be back-filled with enough clean soil material to allow for settling.
- Volume of abandonment materials installed will be compared to calculated well volume to demonstrate that the well is filled and there has been no bridging.
- Upon completion of plugging and abandonment of all the wells an abandonment report (one report including all wells) shall be filed with the State Engineer. The report shall include the permit number issued for the well, well name, location, method of abandonment, volume of abandonment materials, and available well construction specifications (depth, diameter, screened interval, etc.) for all wells abandoned.
- Well drillers are not registered in Wyoming. Well abandonment work can be performed by anyone provided they sign the Abandonment Notice.

2. ***ExxonMobil requested that two of the four wells used to define background be deleted from the license, stating that the remaining two wells will be adequate to define background. In order for us to evaluate this request, please provide the following:***

   a. ***Provide a ground water contour map that shows the upgradient location of wells 134, 172, 174, and 182 with respect to important site features including the tailings basin, pits reservoirs, and spoil piles.***

      Figure 2.1 presents the requested water level contour map for all wells falling in the TDSS geologic formation. The groundwater contour map was constructed using all the most recent data from 2006, and averaged the 1st and 4th quarter to gain a seasonal average. Figure 2.1 shows the upgradient locations of wells 134, 172, 174, and 182. These wells are shown with respect to the important site features. All four wells fall in the TDSS geologic formation and upgradient of the water level within the pit lake.

   b. ***As a supplement to figures 2 through 4 provide a statistical or other analysis of ground water quality data for all tested parameters from wells 134, 172, 174, and 182 to support the assertion that the existing data from wells 134 and 174, along with continuing data from wells 172 and 182, is adequate to define background ground water quality conditions.***

      The tested parameters included in this analysis are primarily hazardous constituents and they include: Arsenic, Cadmium, Chloride (not typically hazardous), Chromium, Nickel, Lead, Radium 226/228, Selenium, Sulfate (not typically hazardous), Thorium, Uranium, and Gross-Alpha. Table 2.1 presents the summary statistics for only the hazardous constituents tested at each well and the license condition standard. The statistical method chosen for this analysis is the boxplot or whisker method. A boxplot analysis shows a graphical representation that compares the spread of one or more sets of data, regardless of their distribution. The median of the data is represented by the horizontal line within the rectangular box and a small circle with an "X" through it. The estimated mean of the data is represented by a circle with a cross contained with the boundary. The box represents the inner quartile range or middle 50% of data, and the two ends of the box represent upper quartile and the lower quartile, separated by the median line. The lines (whiskers) extending from the box represent the lowest and highest observations, showing the range of the data. The boxplot is also useful for indicating whether a distribution is skewed, and whether there are potential outliers (represented by asterisks) within the data.

      The water quality data typically contained a large amount of non-detect results. One method used for estimating descriptive statistics, taking into account the non-detect data, is the Robust Regression on Order Statistics (ROS) method. It is robust in that it is not sensitive to choice of distribution of the data. It calculates a regression line on a probability plot, and based on that picks values off the regression line to estimate the non-detect data. It is particularly useful in that it allows for multiple detection limits. Data shown below the minimum detection limit in the boxplots was estimated using the ROS method.

At well locations 134, 172, 174, and 182; the concentrations of Arsenic, Cadmium, Chromium, Gross-Alpha, Lead, and Nickel all exhibit a distribution that falls near or below the detectable limit for each chemical analysis. Figures 2.2-2.7 show the boxplot analysis for each of the parameters listed. The mean and median are identical for each of these six hazardous constituents, with the exception of Gross-Alpha (well 172 has a higher mean). A majority of the data collected for the six parameters primarily fell below the detection limits (Table 2.1). Figures 2.3, 2.4, and 2.6 only show the boxplot analysis for some of the wells (because of the large number of non-detect data); please refer to Table 2.1 for the statistics of the missing wells. Using the ROS method, the mean concentrations for arsenic (Figure 2.8-2.11) and nickel (Figure 2.12) are determined for some of the wells. Because the majority of the data fell below detection limits at wells 134 and 174, no additional information is gained by keeping wells those wells in the monitoring program.

Figures 2.13-2.17 provide a boxplot analysis for the concentrations of Chloride, Radium, Selenium, Thorium, and Uranium, respectively, at wells 134, 172, 174, and 182. The results from the analysis show that wells 134 and 174 both fall within the same range as wells 172 and 182, with the exception of Radium and Thorium. The estimated mean and median are very similar for each well. Figures 2.18 and 2.19 show the Uranium concentrations for the individual wells 134 and 172, where the mean is estimated using the ROS method because a large amount of the data fell below detection limits. However, there the estimated mean for both wells are close. For the parameters in Figure 2.13-2.17 there is no additional relevant information that can be gained from well 134 and 174.

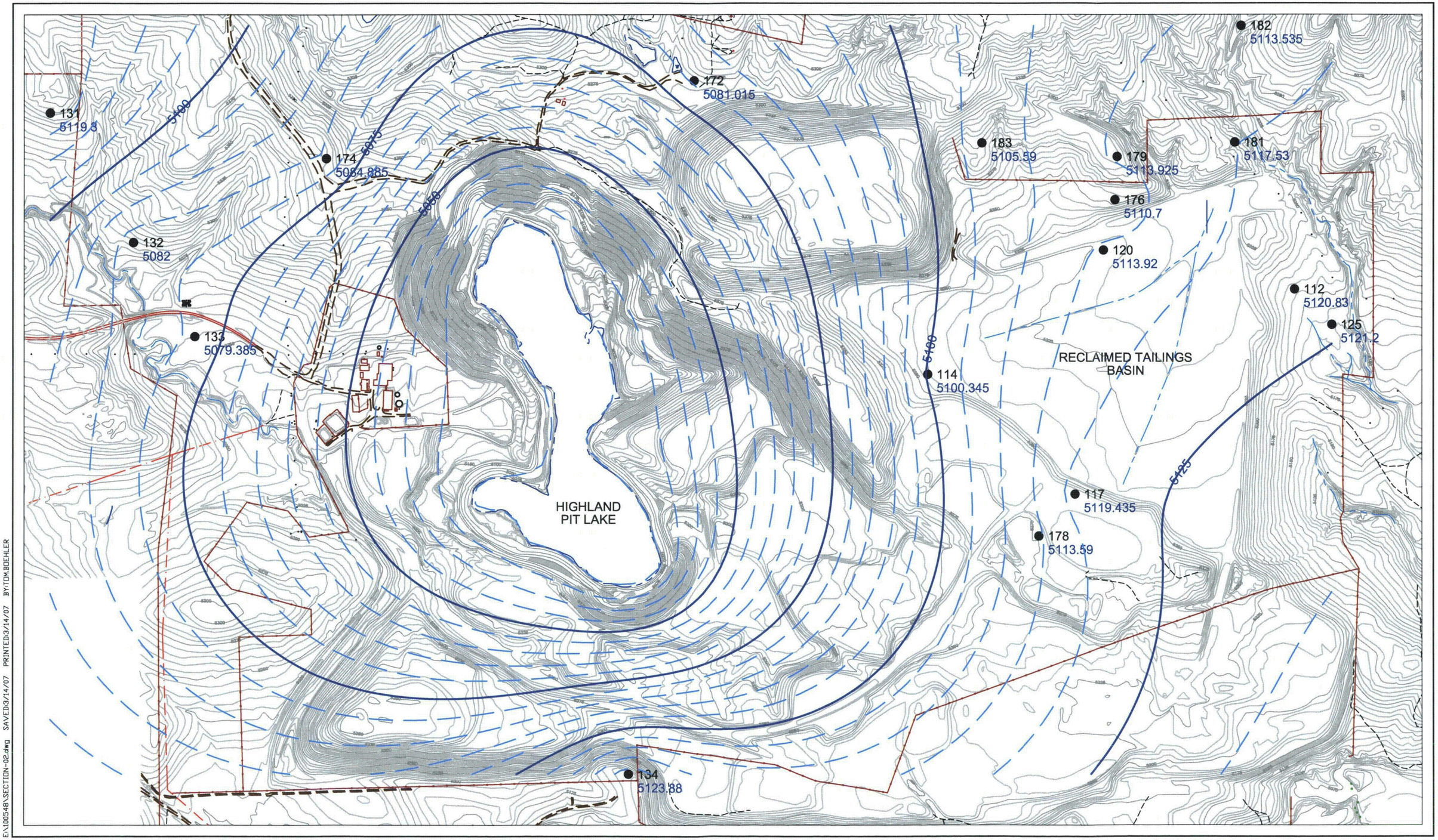
Figure 2.20-2.21 present the Radium and Thorium concentrations over time observed for each well since the beginning of monitoring. Figure 2.20 shows the Thorium concentrations at each well for the monitoring period, the trend of Thorium concentrations is identical for each well for the last 10 years, with primarily non-detectable levels observed. Similarly, Figure 2.21 shows the combined Radium-226 and Radium-228 concentrations for the monitoring period. The concentrations of Radium are all similar in each well, with the exception of a few outliers, and fall below the license standard of 5.0 pCi/L. The trend of Radium and Thorium for the last ten years indicates that there is no additional relevant information that can be gained from well 134 and 174, and all four wells have concentrations lower than the license standard.

Figure 2.22 shows the boxplot analysis for Sulfate concentrations for the specified wells. Sulfate is the only constituent where the distribution of concentration values is dissimilar for all the wells. Well 134 and well 172 have a similar distribution; similarly, well 174 and 182 have a similar distribution. Sulfate is not considered a hazardous constituent and the dissimilar relationship between the wells should not be as important.

To conclude, wells 134 and 174 should be removed from the existing monitoring plan. Based on the statistical analysis for the hazardous constituents in the ground water wells, the water quality data from wells 134 and 174 provide no additional or relevant information that wells 172 and 182 could provide. The inclusion of wells 134 and 174 are of no benefit to the NRC or Exxon and should be deleted from the license condition.

Table 2.1 Descriptive Statistics for Hazardous Water Quality Constituents

Analyte		Well				NRC License Condition
		134	172	174	182	
As	n	65	44	41	38	0.05 mg/L
	%ND	92	86	88	89	
	mean	<0.01	<0.01	<0.01	<0.01	
	median	<0.01	<0.01	<0.01	<0.01	
Cd	n	48	38	41	38	0.01 mg/L
	%ND	96	97	98	100	
	mean	<0.01	<0.01	<0.01	<0.01	
	median	<0.01	<0.01	<0.01	<0.01	
Cr	n	49	38	41	38	0.1 mg/L
	%ND	96	95	98	100	
	mean	<0.05	<0.05	<0.05	<0.05	
	median	<0.05	<0.05	<0.05	<0.05	
Ni	n	40	38	41	38	0.1 mg/L
	%ND	80	97	95	100	
	mean	<0.05	<0.05	<0.05	<0.05	
	median	<0.05	<0.05	<0.05	<0.05	
Pb	n	49	38	41	38	0.05 mg/L
	%ND	98	100	100	100	
	mean	<0.05	<0.05	<0.05	<0.05	
	median	<0.05	<0.05	<0.05	<0.05	
Ra (226+228)	n	46	42	39	37	5.0 pCi/L
	%ND	13	0	41	49	
	mean	1.57	2.75	1.13	0.83	
	median	1.05	2.19	0.3	0.2	
Se	n	65	43	41	38	0.05 mg/L
	%ND	63	72	85	79	
	mean	0.0021	0.0006	0.000002	0.0006	
	median	0.0003	0.0003	0.000002	0.0003	
Th230	n	41	29	36	34	0.55 pCi/L
	%ND	46	79	72	68	
	mean	0.58	0.18	0.2	0.2	
	median	0.28	0.03	0.11	0.09	
Unat	n	46	41	39	37	0.03 mg/L
	%ND	7	12	62	62	
	mean	0.0062	0.0024	<0.015	<0.015	
	median	0.0017	0.00075	<0.015	<0.015	
Gross-Alpha	n	29	27	32	31	15.0 pCi/L
	%ND	51.72414	25.92593	71.875	61.29032	
	mean	1.810345	2.433333	1.2375	1.232258	
	median	1.00	2.40	1.00	1.00	



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Project No. 180549

February 2007

● MONITORING WELLS

5113.59 WATER LEVELS

CROSS SECTION LOCATIONS

NORTH

SCALE IN FEET

0 1000

FIGURE 2.1
TDSS 2006 GW CONTOURS

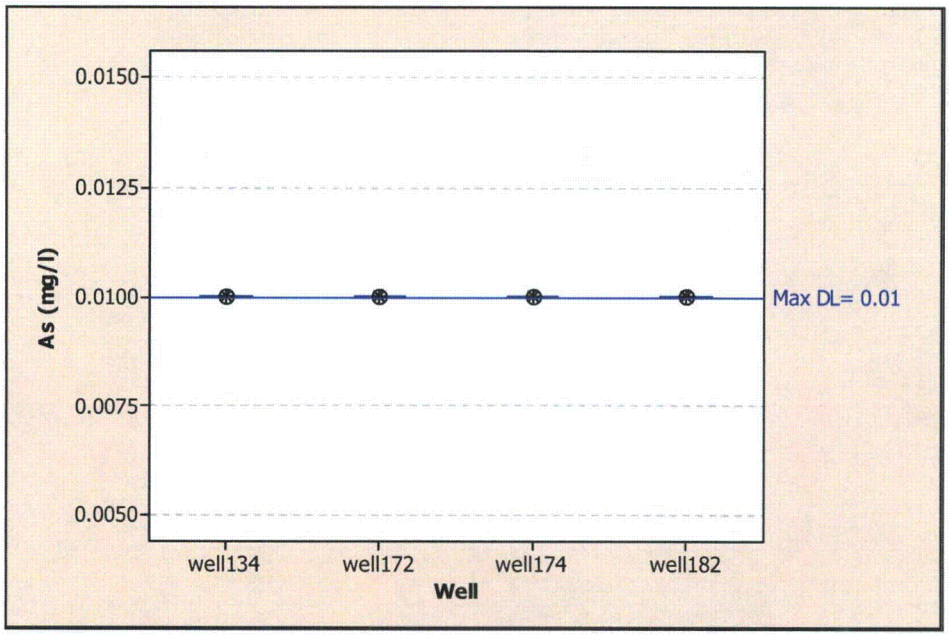


Figure 2.2 Boxplot Analysis for Arsenic Concentrations in Wells 134, 172, 174 and 182

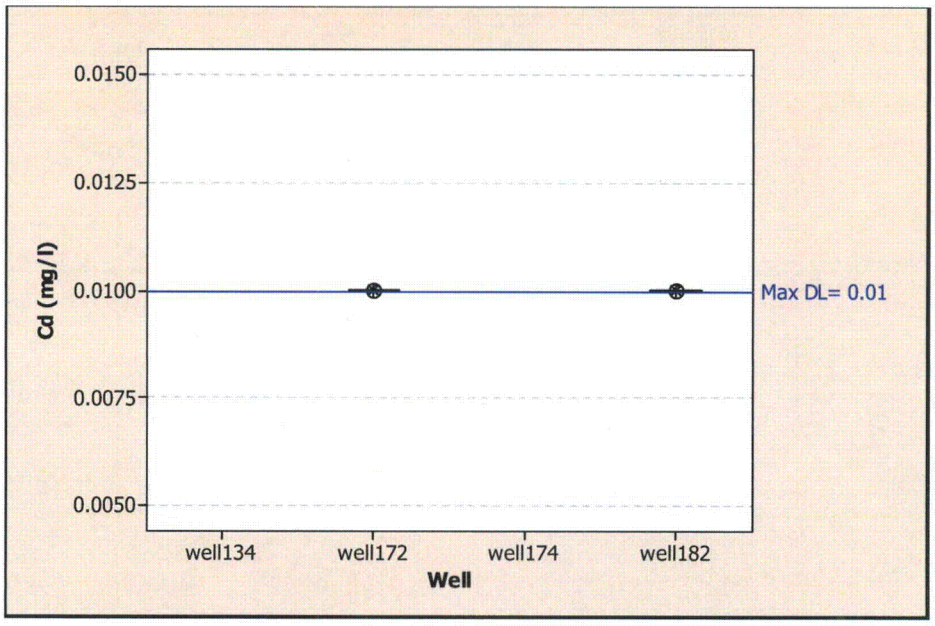


Figure 2.3 Boxplot Analysis for Cadmium Concentrations in Wells 172, 182

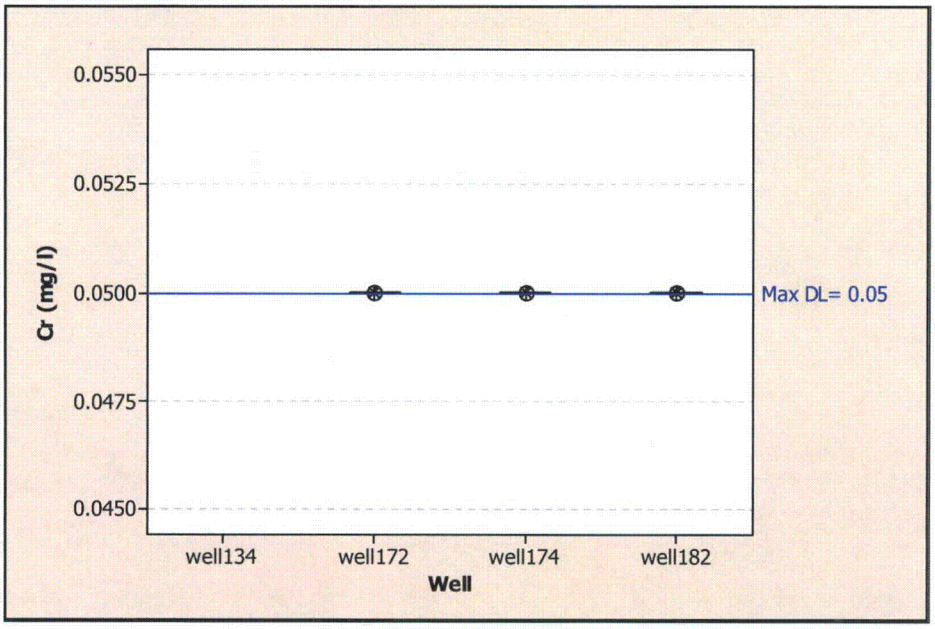


Figure 2.4 Boxplot Analysis for Chromium Concentrations in Wells 172, 174, 182

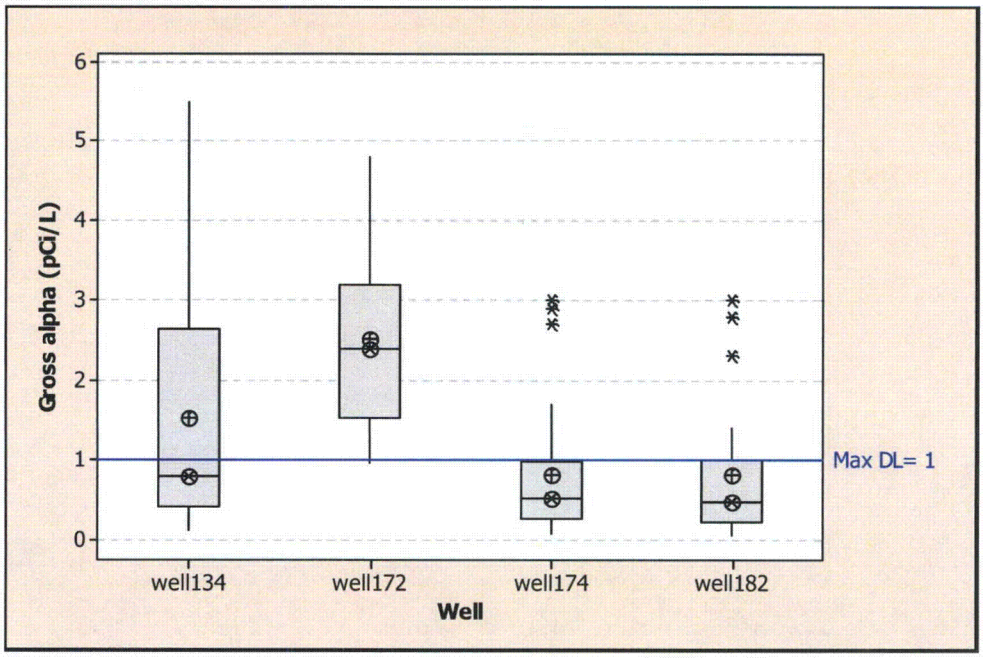


Figure 2.5 Boxplot Analysis for Gross Alpha Concentrations in Wells 134, 172, 174, 182

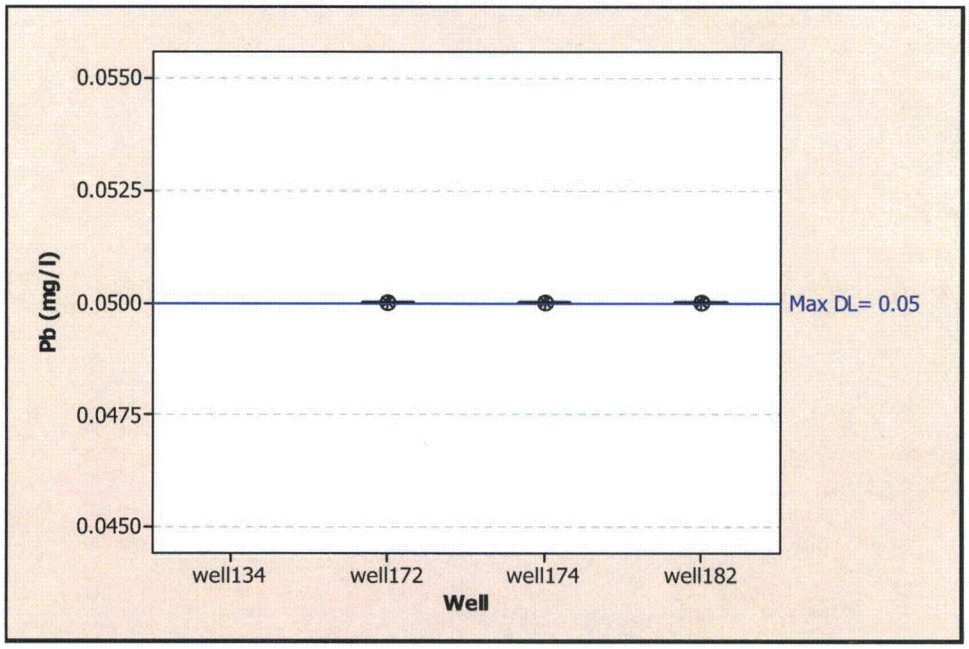


Figure 2.6 Boxplot Analysis for Lead Concentrations in Wells 172, 174, 182

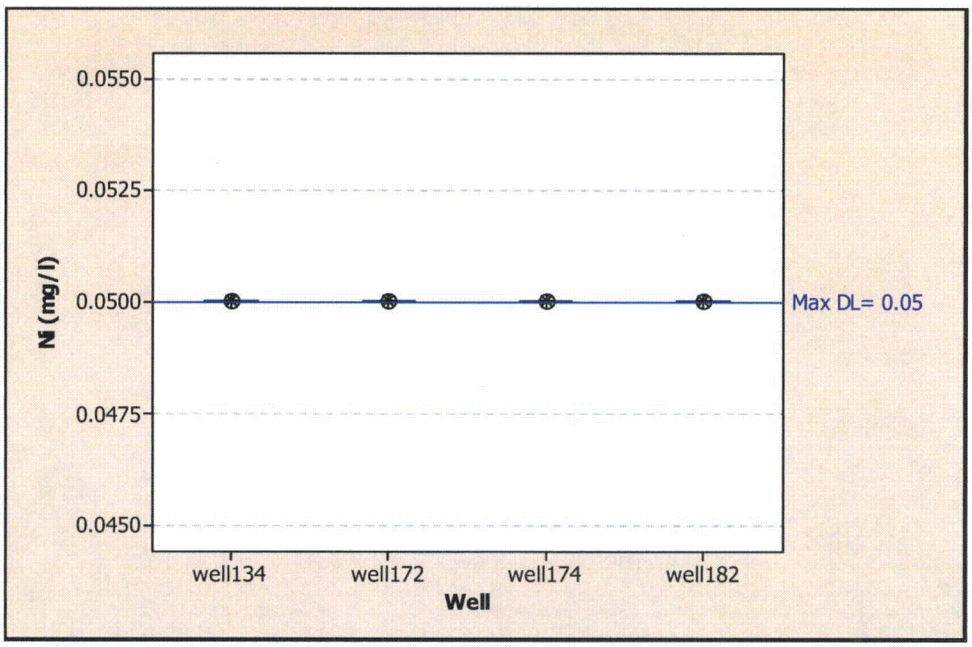


Figure 2.7 Boxplot Analysis for Nickel Concentrations in Wells 134, 172, 174, 182

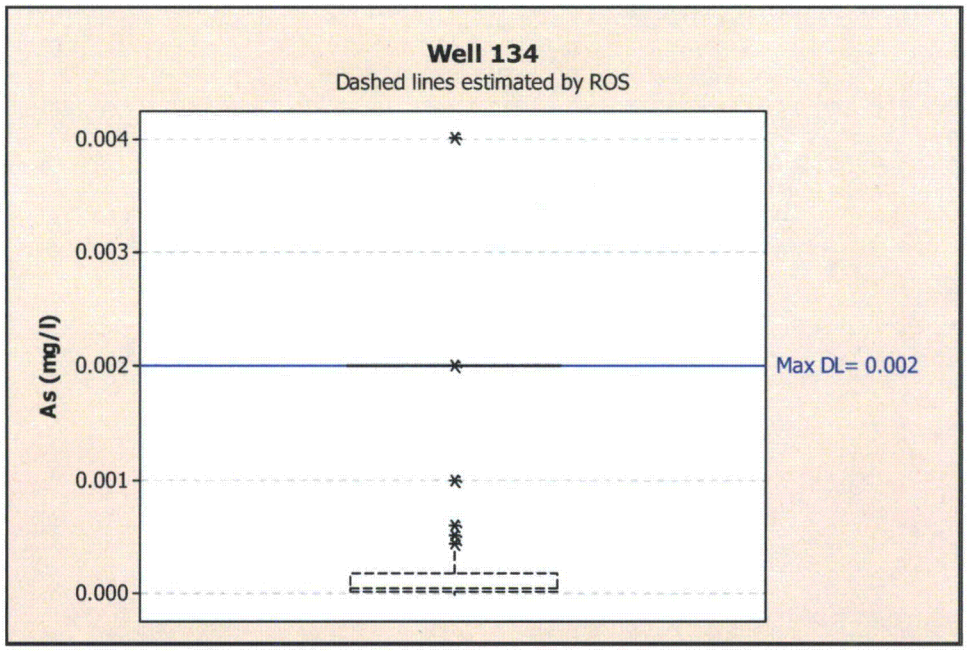


Figure 2.8 Boxplot Analysis for Arsenic Concentrations in Wells 134

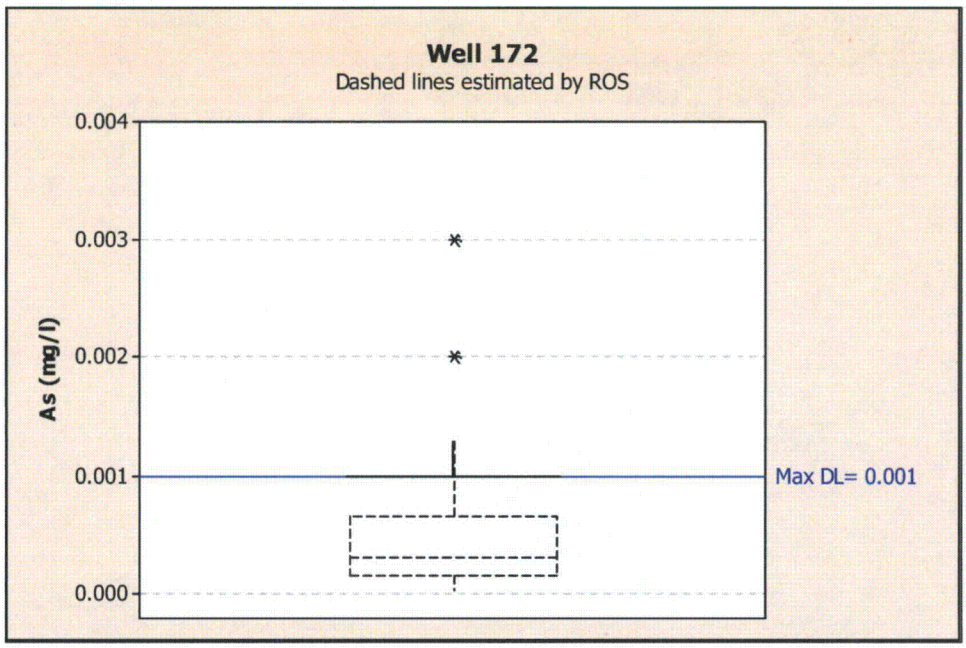


Figure 2.9 Boxplot Analysis for Arsenic Concentrations in Wells 172

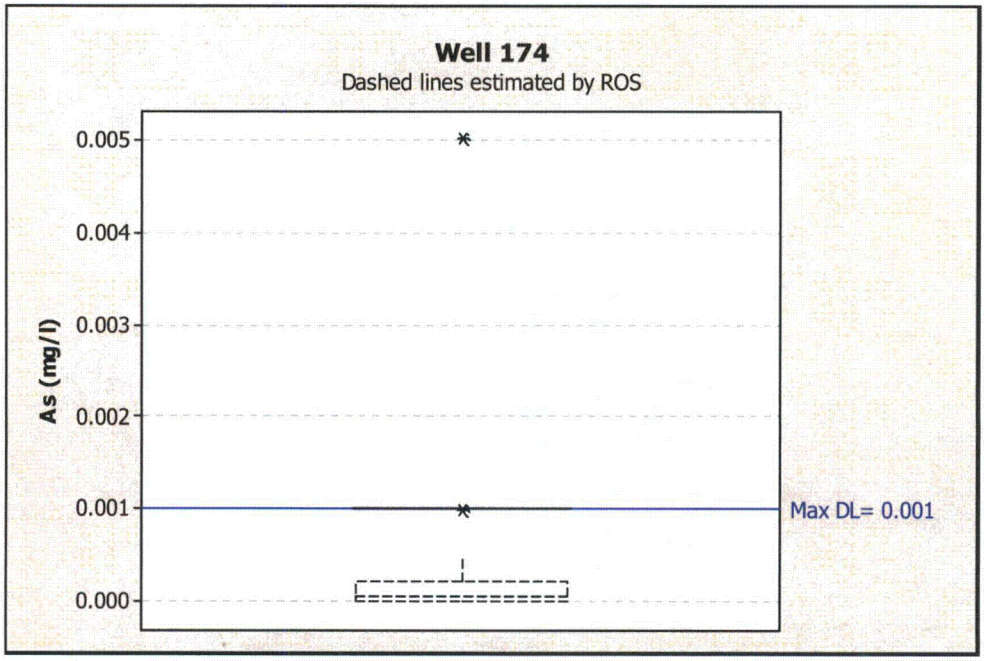


Figure 2.10 Boxplot Analysis for Arsenic Concentrations in Wells 174

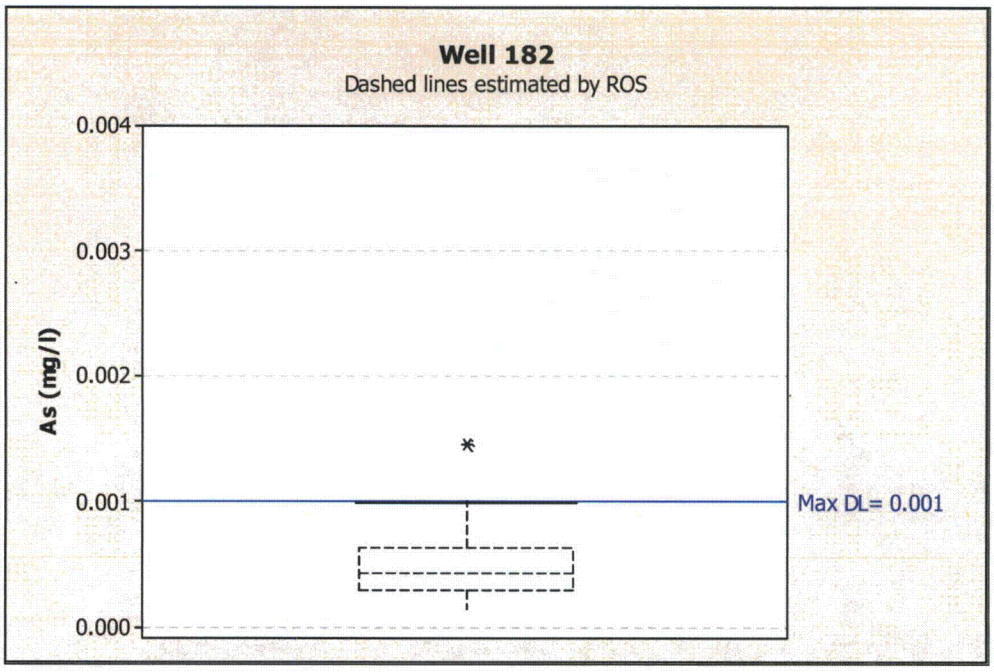


Figure 2.11 Boxplot Analysis for Arsenic Concentrations in Well 182

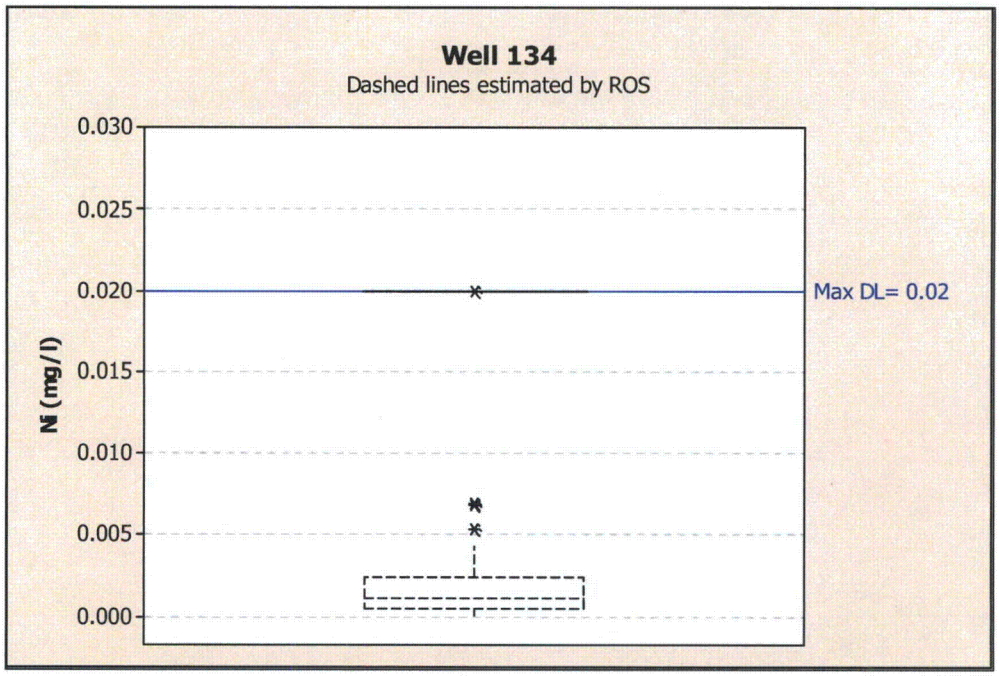


Figure 2.12 Boxplot Analysis for Nickel Concentrations in Wells 134

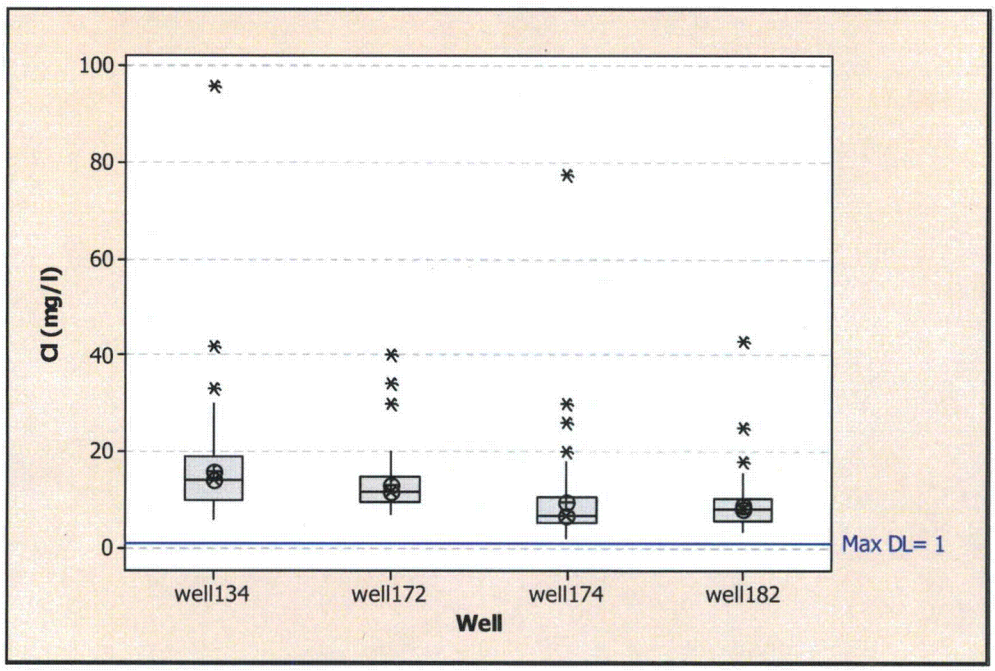


Figure 2.13 Boxplot Analysis for Chloride Concentrations in Wells 134, 172, 174, 182

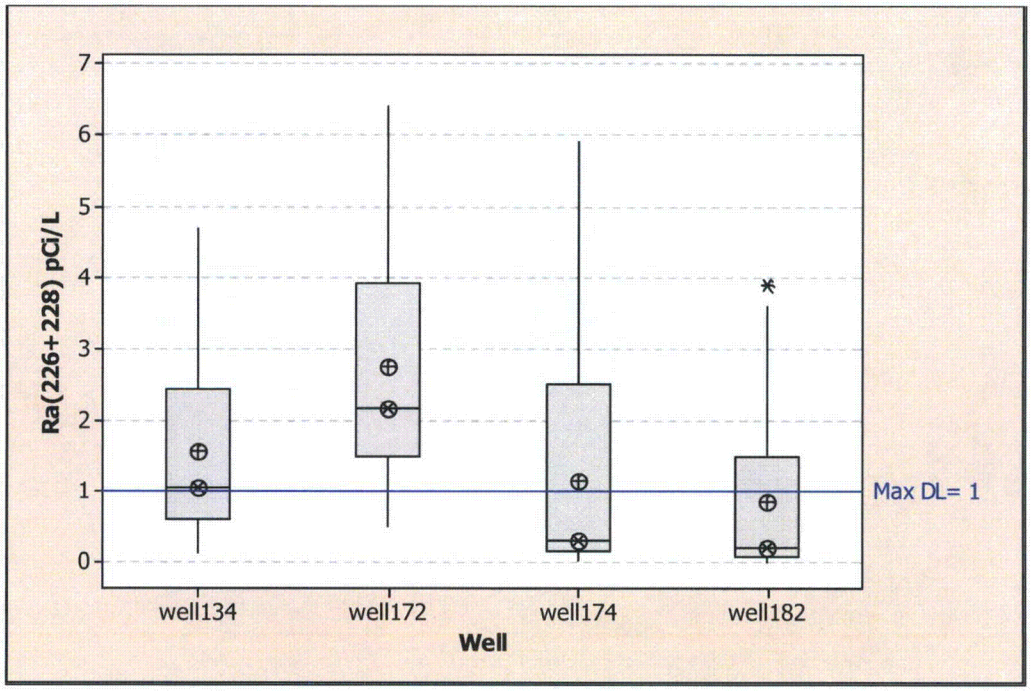


Figure 2.14 Boxplot Analysis for Ra-226/228 Concentrations in Wells 172, 174, 182

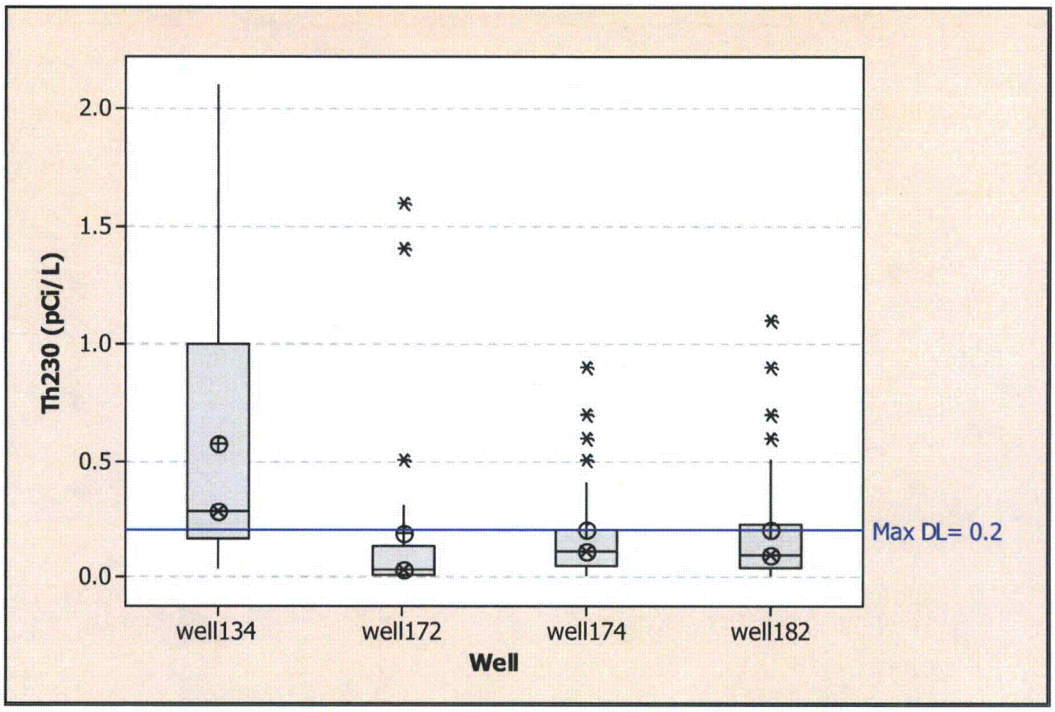


Figure 2.15 Boxplot Analysis for Th-230 Concentrations in Wells 172, 174, 182

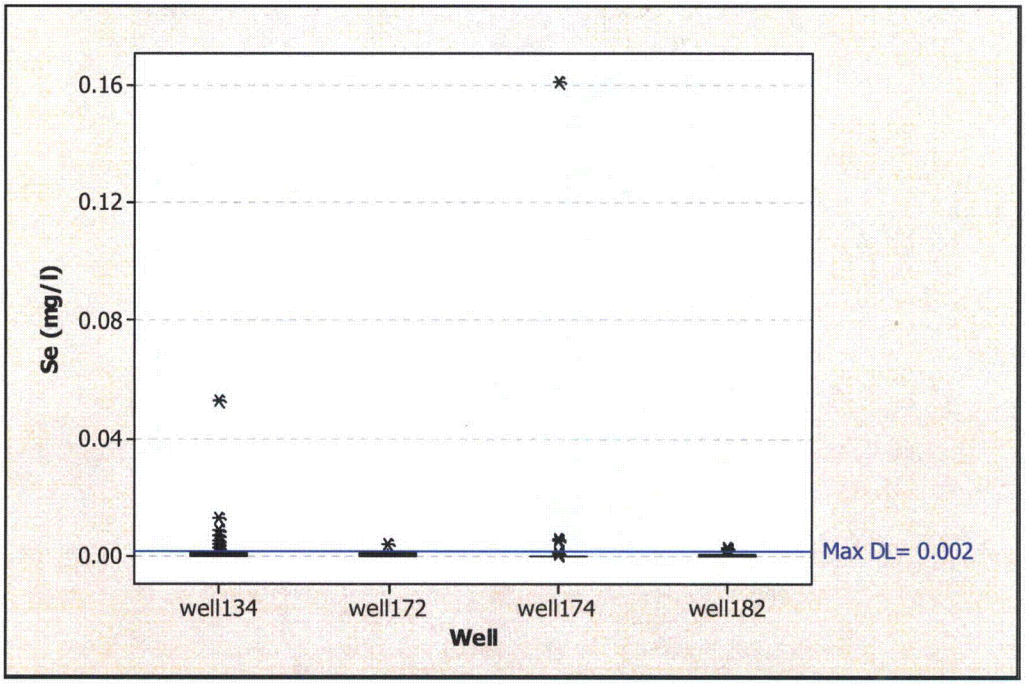


Figure 2.16 Boxplot Analysis for Selenium Concentrations in Wells 172, 174, 182

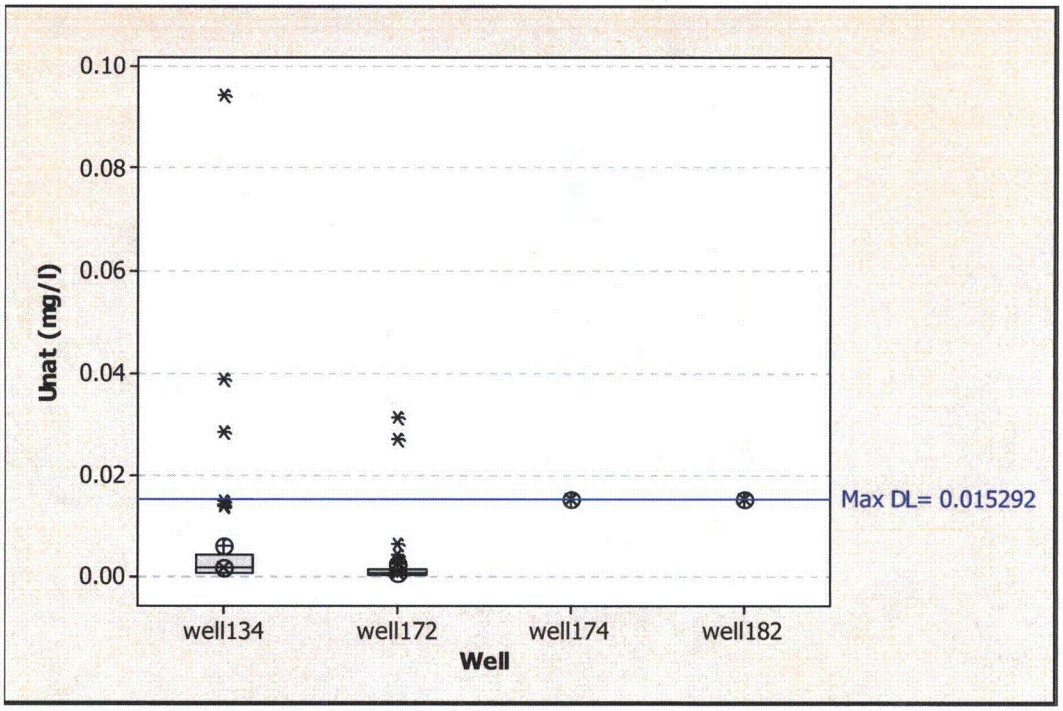


Figure 2.17 Boxplot Analysis for Uranium Concentrations in Wells 134, 172, 174, 182

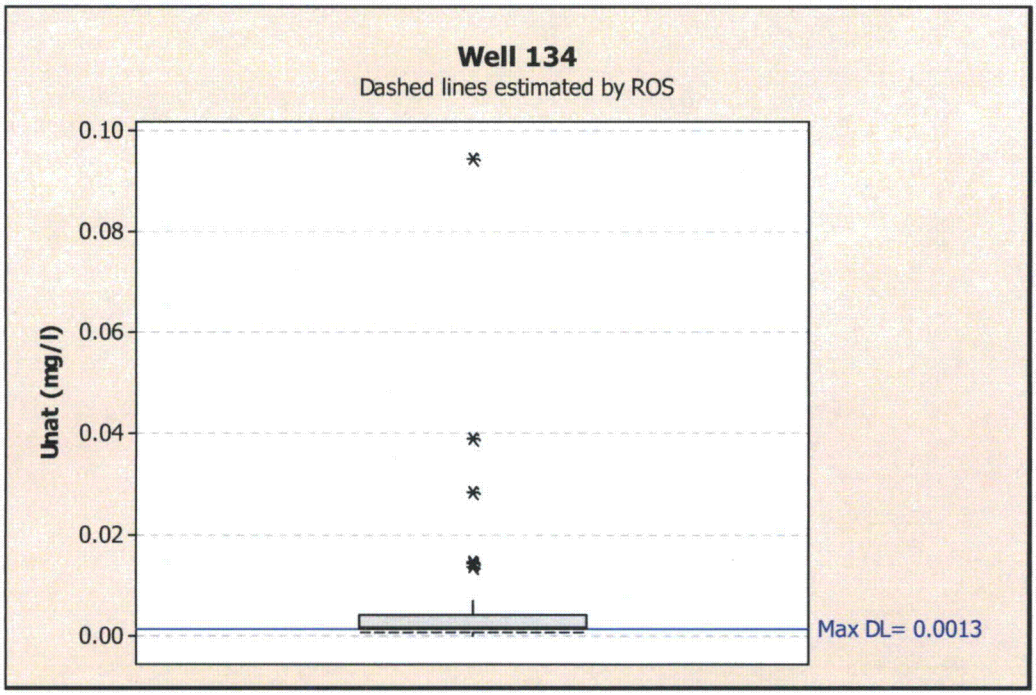


Figure 2.18 Boxplot Analysis for Uranium Concentrations in Well 134

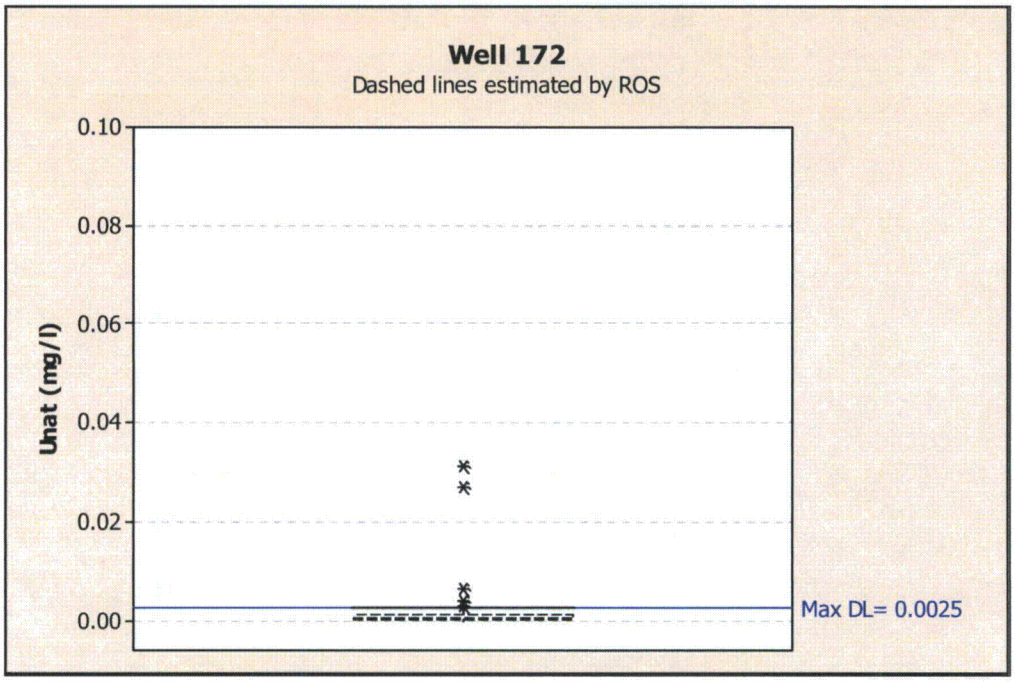


Figure 2.19 Boxplot Analysis for Uranium Concentrations in Well 172

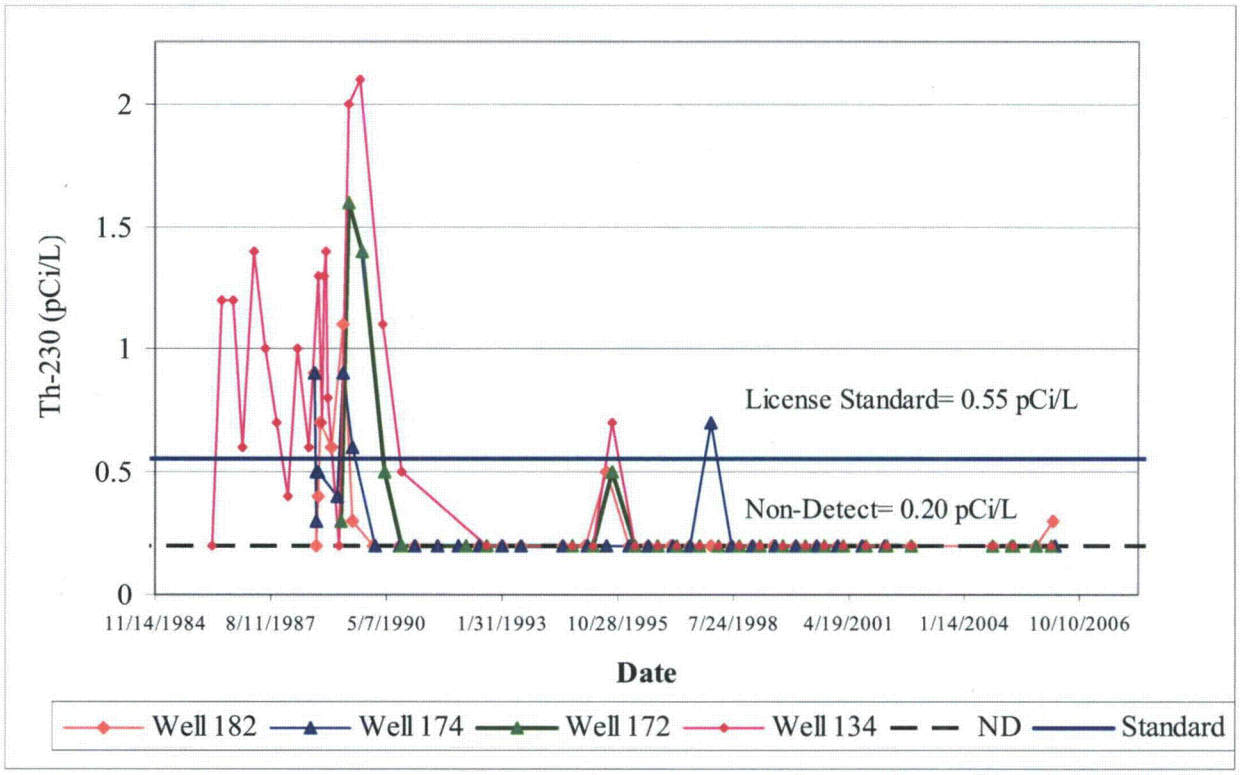


Figure 2.20 Thorium-230 Concentrations vs. Time

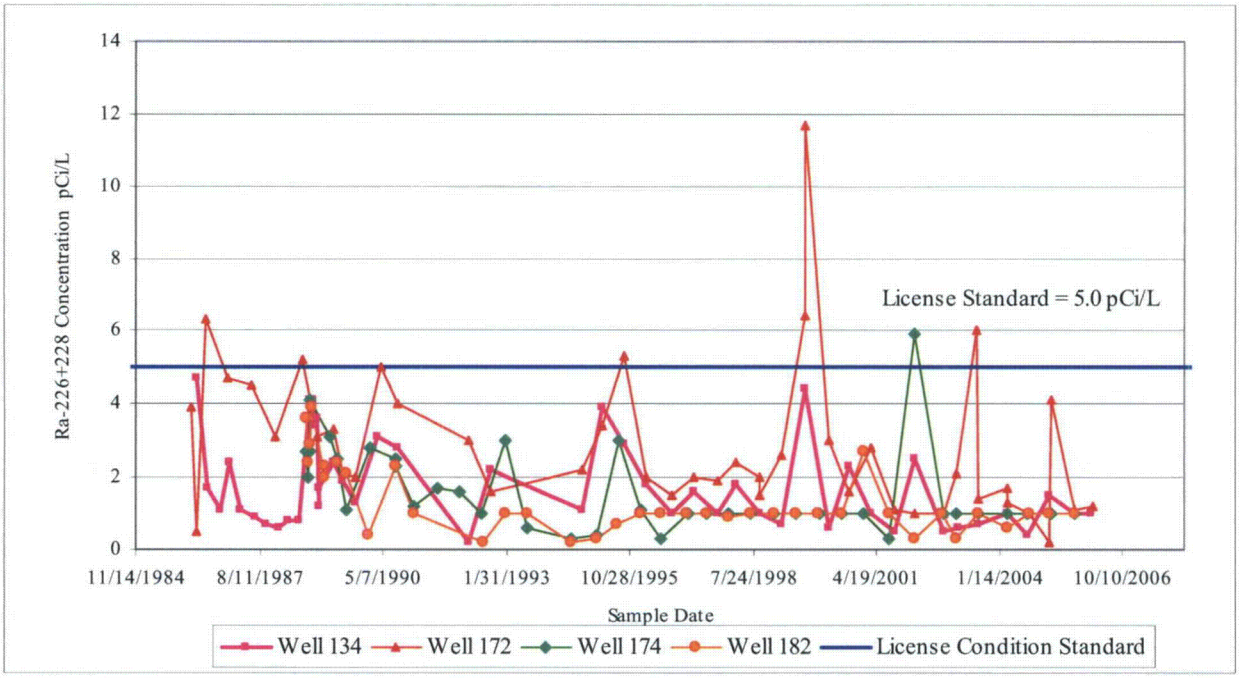


Figure 2.21 Combined Radium-226/228 vs. Time

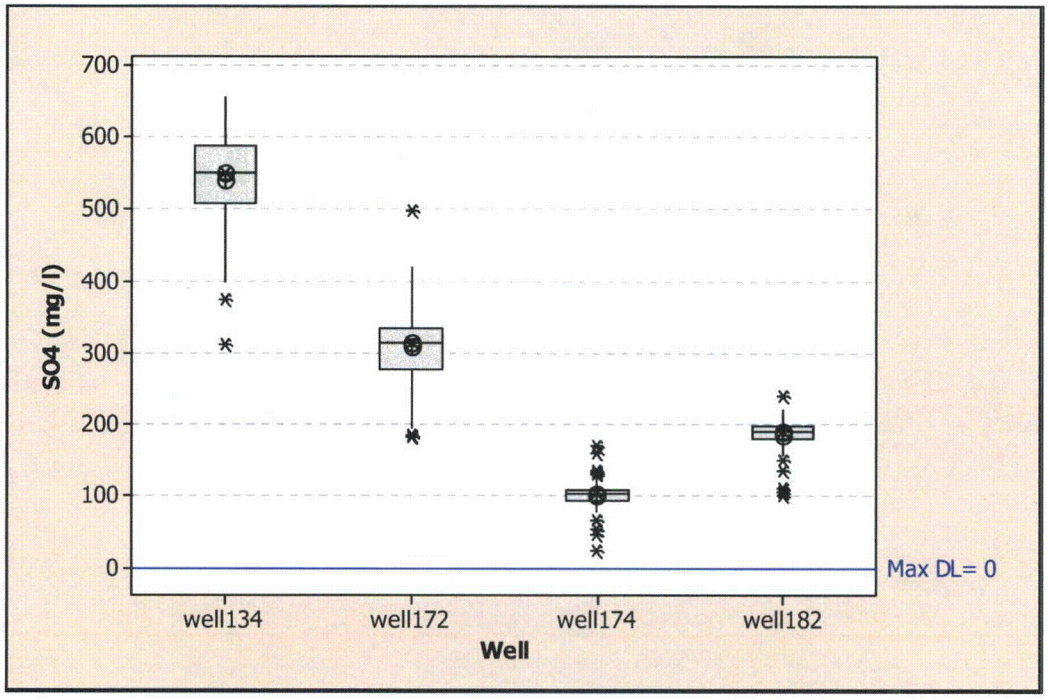


Figure 2.22 Boxplot Analysis for Sulfate Concentrations in Wells 134, 172, 174, 182

c. ***Provide a detailed narrative describing the action(s) to be implemented on monitor wells 134 and 174 upon elimination from the license.***

Please refer to question 1c for proper well abandonment procedures.

3. ***ExxonMobil requested that the requirement for monitoring ground water at wells 120, 179, and 183 be deleted from the license. ExxonMobil stated that those three wells do not provide any additional information than well 176. In order for us to evaluate this request, please provide the following:***

a. ***Provide a ground water contour map that shows the hydraulic relationship among wells 120, 179, 183, and 176 with respect to each other and with other important site features, including the tailings basin and spoil piles.***

Figure 1.7 shows the location of wells 120, 179, 183 and 176 as cross section 3 and 4. Figure 2.1 provides a ground water contour map; this map shows the hydraulic relationship among wells 120, 179, 183, and 176 with respect to important site features. All wells are screening the TDSS as shown in stratigraphic cross-section in Figure 3.1. Well 179 is located upgradient from the tailings impoundment, well 183 is located at a distant cross-gradient, and well 120 is located between the tailings impoundment and the point of compliance (POC). By keeping these wells in the license there is no benefit to NRC or to Exxon. Well 176 is located in the center of the three wells; 176 is downgradient of wells 179 and 120, and upgradient of well 183.

b. Provide a stratigraphic cross section(s) that shows the location of well screens for wells 120, 179, 183 and 176 with respect to important site features, including the tailings basin.

Figures 3.1 and 3.2 show the stratigraphic cross section for wells 120, 176, 179, and 183. As shown in the figure, each well's screen interval can be represented by keeping well 176 and removing the remaining wells. Each well was constructed to monitor ground water flow within the TDSS layer, and ground water quality can be represented by well 176 alone. The location of well 176 will represent the water quality for wells 120, 179, and 183; the inclusion of those wells provides no benefit to NRC or Exxon.

c. As a supplement to Figures 5 through 7, provide a statistical or other analysis of ground water quality data for all tested parameters from wells 120, 179, 183, and 176 to support the assertion that wells 120, 179, and 183 "do not provide any additional data and can be eliminated from the monitoring program with no impact."

As a supplement to Figures 5-7 from the License Amendment Request (May 18, 2006), and to help in the evaluation of this request in more detail, a statistical analysis was performed on the ground water quality data for the specified wells (120,179,183,176), a boxplot analysis (see section 2 for description) was chosen as the statistical tool. The tested parameters included in this analysis are primarily hazardous constituents and they include: Arsenic, Cadmium, Chloride (not typically hazardous), Chromium, Nickel, Lead, Radium 226/228, Selenium, Sulfate (not typically hazardous), Thorium, Uranium, and Gross-Alpha. Table 3.1 presents the summary statistics for only the hazardous constituents tested at each well and the license condition standard.

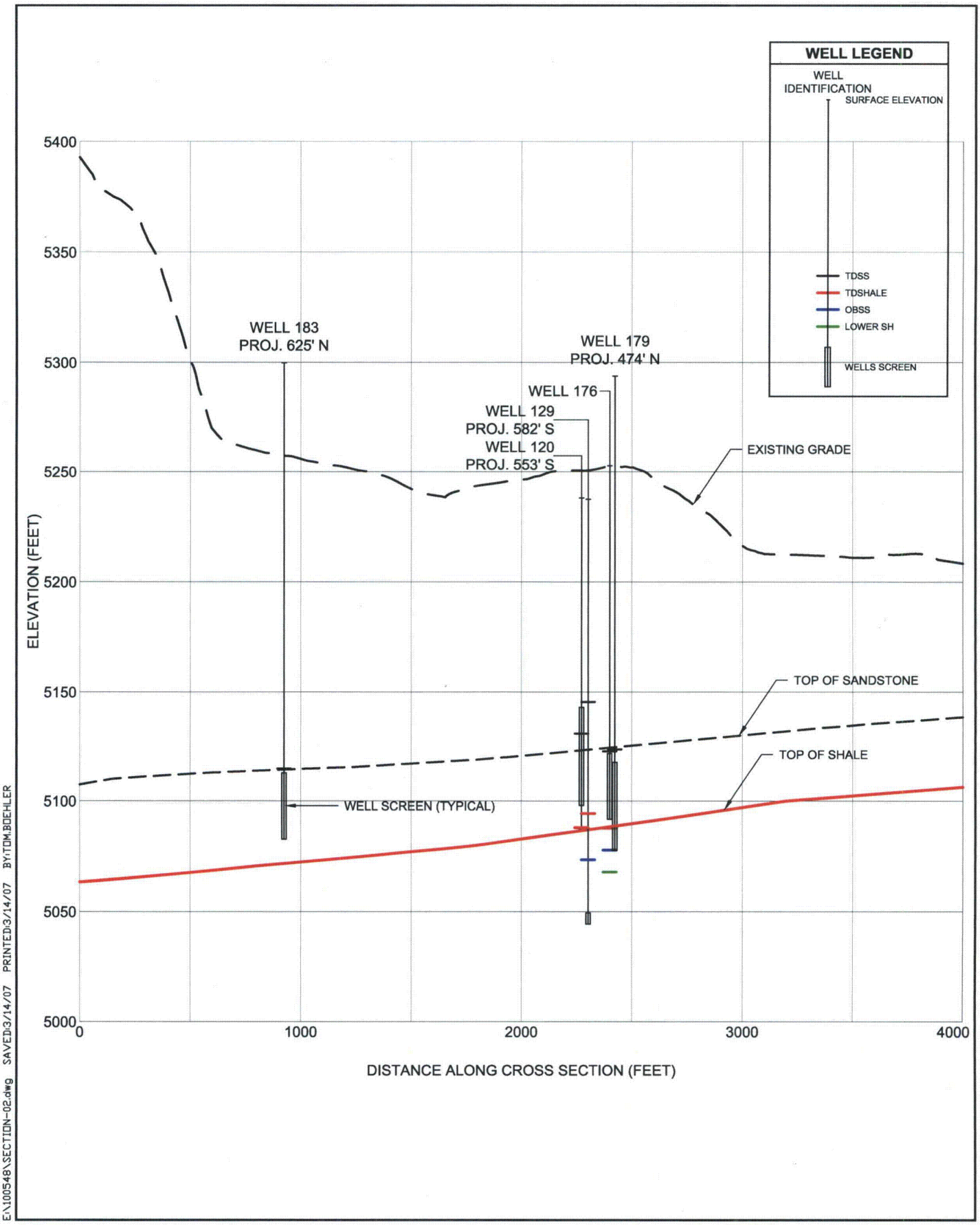
Figure 3.3-3.6 shows a boxplot analysis for the radionuclide concentrations in wells 120, 179, 183, and 176 for three contaminants Uranium, Thorium, Radium, and Gross Alpha. The mean radium concentration is identical in well 176 as for well 120 (3.8 pCi/L). The radium concentrations are slightly lower in wells 179 and 183, with concentrations of 1.9 pCi/L and 1.7 pCi/L, respectively. These two wells are located upgradient of the POC wells. The mean concentrations for all three radionuclides meet or fall below the License Condition Standard (5 pCi/L). Well 176 provides sufficient information regarding radionuclide contamination in the groundwater, to represent the other three wells of concern. Figure 3.6 shows the box-plot for Gross Alpha, well 176 encompasses the spread of data for wells 120, 179 and 183.

For the non-radionuclide water quality parameters: Arsenic, Chromium, Nickel, Lead, Selenium and Cadmium; the mean concentrations fell below the License Condition Standards for all four wells (Table 3.1). Figure 3.7-3.11 shows the boxplot analysis for Arsenic, Chromium, Nickel, Lead, and Cadmium, respectively. Figure 3.12 shows the Selenium concentrations, however well 120 has an outlier. Figure 3.13 shows the same boxplot analysis without the outlier in well 120, and the distribution of the wells is very close. Figures 3.14-3.15 show a boxplot analysis for the Chloride and Sulfate concentrations observed in the four wells. Well 176 provides enough information to represent the maximum spread of Sulfate and Chloride concentrations of the other three wells.

A statistical analysis of the ground water quality data indicated that the information from wells 120, 179, and 183 do not provide any additional data that can't be provided from POC well 176 and should be eliminated from the existing license. Wells 120, 179, and 183 are in close proximity and completed in the same formation (TDSS) as POC well 176. Based on these factors wells 120, 179 and 183 may be eliminated from the monitoring program without adverse effects. The inclusion of wells 120, 179, and 183 are of no benefit to the NRC or Exxon.

Table 3.1 Descriptive Statistics of Boxplot Method for Wells 120, 176, 179 and 183

Analyte		Well				NRC License Condition
		120	179	183	176	
As	n	67	40	38	42	0.05 mg/L
	%ND	51	93	95	88	
	mean	0.0016	<0.002	0.0004	<0.002	
	median	0.0009	<0.002	0.00016	<0.002	
Cd	n	52	40	38	42	0.01 mg/L
	%ND	65	95	97	79	
	mean	0.0057	<0.01	<0.01	0.0037	
	median	0.0045	<0.01	<0.01	0.003	
Cr	n	52	40	38	42	0.1 mg/L
	%ND	77	98	100	88	
	mean	<0.1	<0.1	<0.1	<0.1	
	median	<0.1	<0.1	<0.1	<0.1	
Ni	n	41	40	38	42	0.1 mg/L
	%ND	54	85	87	57	
	mean	0.015	<0.14	<0.14	0.037	
	median	0.005	<0.14	<0.14	0.0064	
Pb	n	52	40	38	42	0.05 mg/L
	%ND	83	100	100	98	
	mean	0.0116	<0.05	<0.05	<0.05	
	median	0.0003	<0.05	<0.05	<0.05	
Ra (226+228)	n	49	38	37	40	5.0 pCi/L
	%ND	2	18	16	0	
	mean	3.8	1.9	1.7	3.8	
	median	3.0	0.9	1.0	4.1	
Se	n	67	40	38	42	0.05 mg/L
	%ND	52	63	71	62	
	mean	0.0039	0.0009	0.0008	0.0015	
	median	0.00075	0.00067	0.00056	0.00062	
Th230	n	46	34	34	37	0.55 pCi/L
	%ND	50	76	74	73	
	mean	0.66	0.17	0.19	0.21	
	median	0.38	0.04	0.04	0.07	
Unat	n	49	38	37	40	0.03 mg/L
	%ND	12	71	68	60	
	mean	0.03	<0.004	0.00007	0.00008	
	median	0.0078	<0.004	0.00007	0.00008	
Gross- Alpha	n	32	33	32	31	15.0 pCi/L
	%ND	37.5	45.45455	53.125	54.83871	
	mean	3.484375	2.60303	1.959375	1.741935	
	median	1.35	1.4	1	1	



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Project No. 180549

February 2007

FIGURE 3.1
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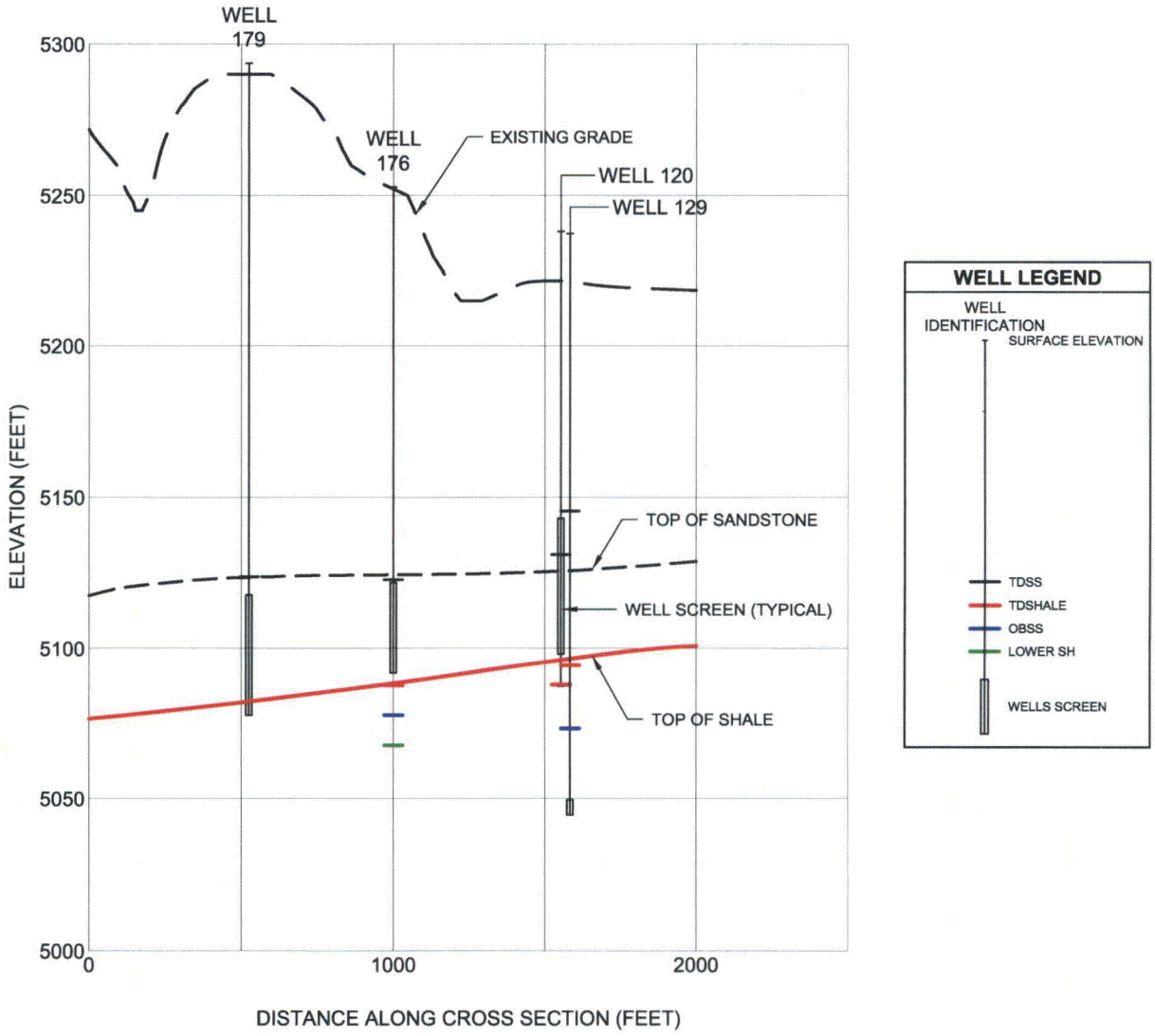

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Project No. 180549

February 2007

FIGURE 3.2
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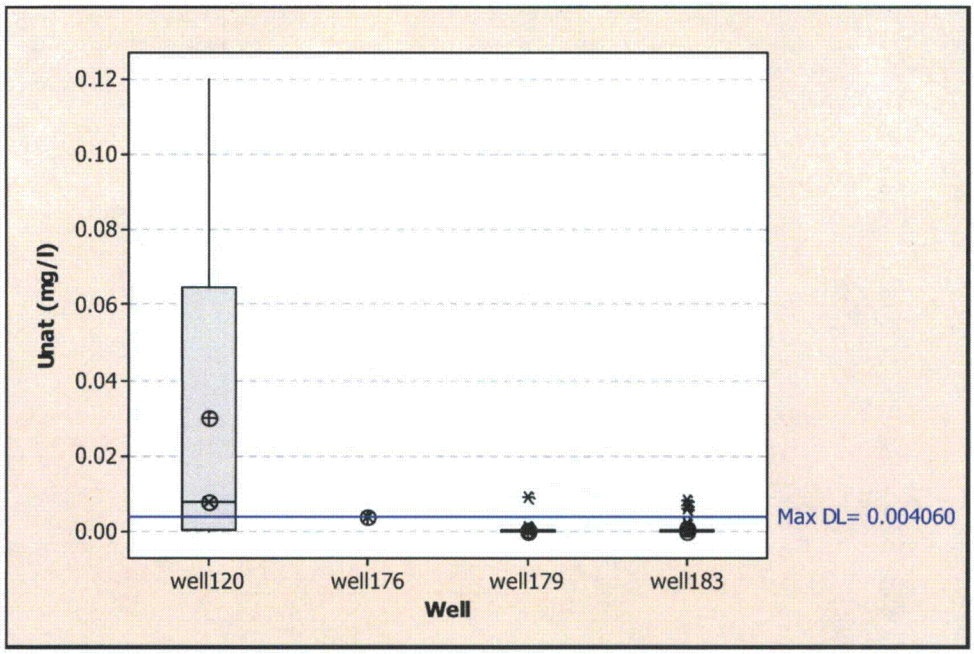

Figure 3.3 Whisker-Boxplot Analysis for Uranium-238 Concentrations in Wells 120, 176, 179 and 183

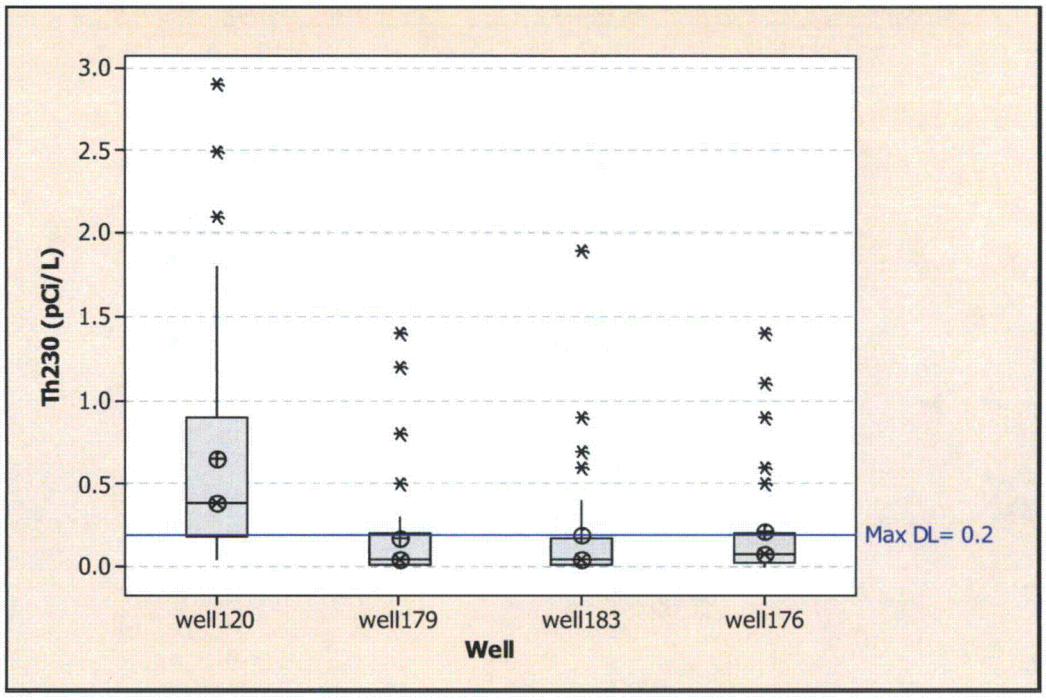

Figure 3.4 Whisker-Boxplot Analysis for Thorium-230 Concentrations in Wells 120, 179, 179 and 176

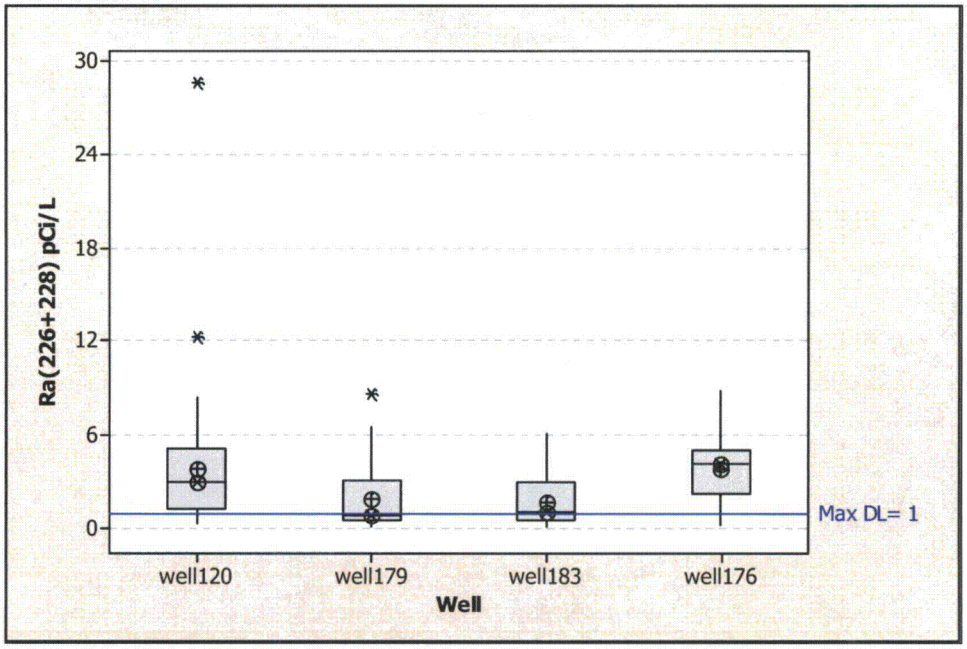

Figure 3.5 Boxplot Analysis for Radium-226/228 Combined Concentrations in Wells 120, 176, 179 and 176

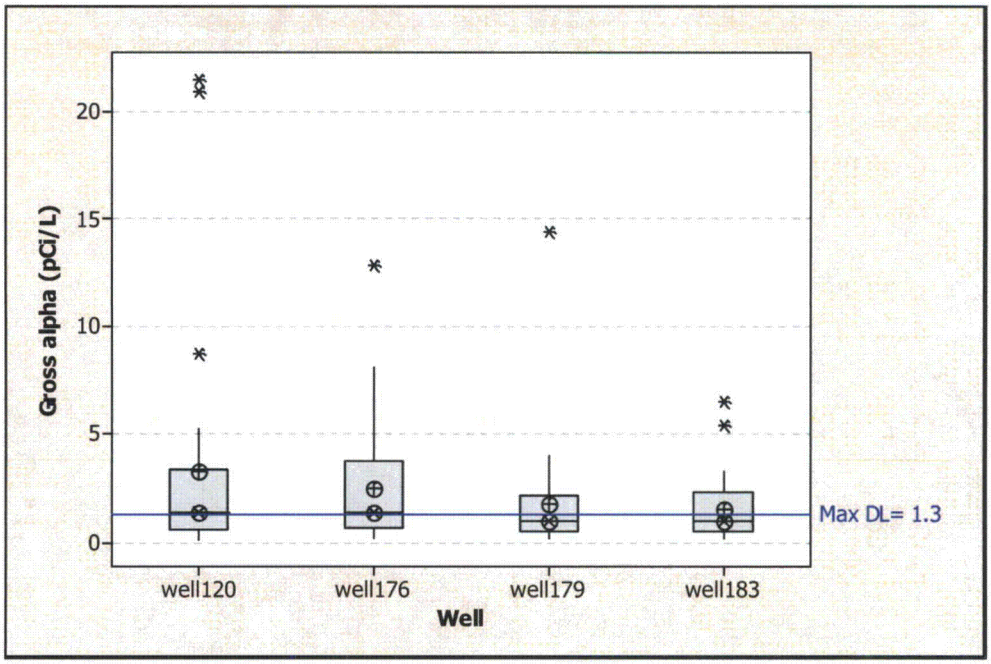

Figure 3.6 Boxplot Analysis for Gross Alpha Concentrations in Wells 120, 176, 179 and 176

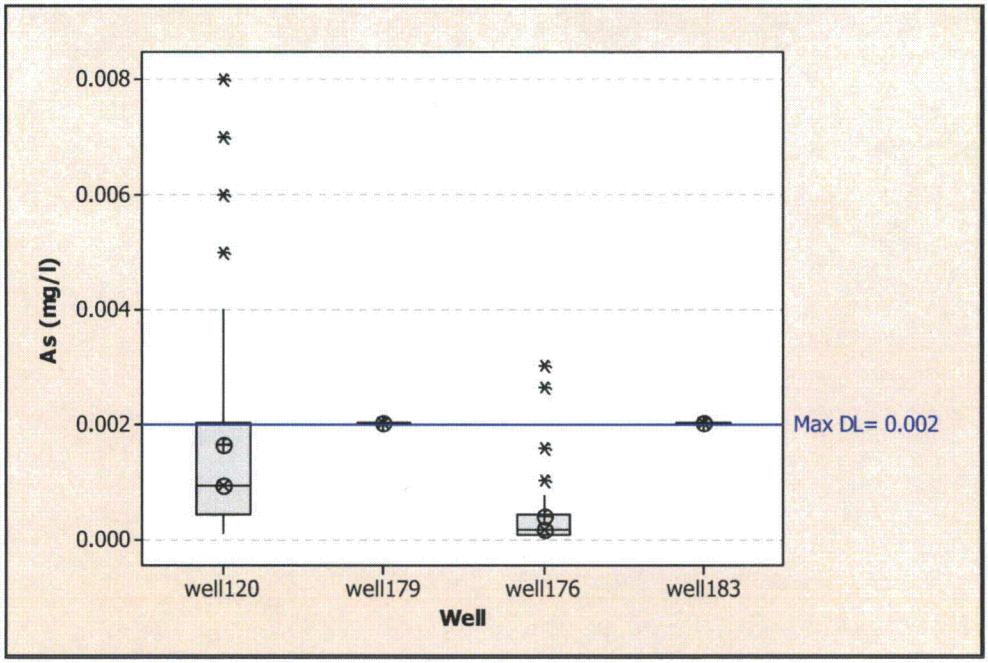

Figure 3.7 Boxplot Analysis for Arsenic Concentrations in Wells 120, 176, 179 and 176

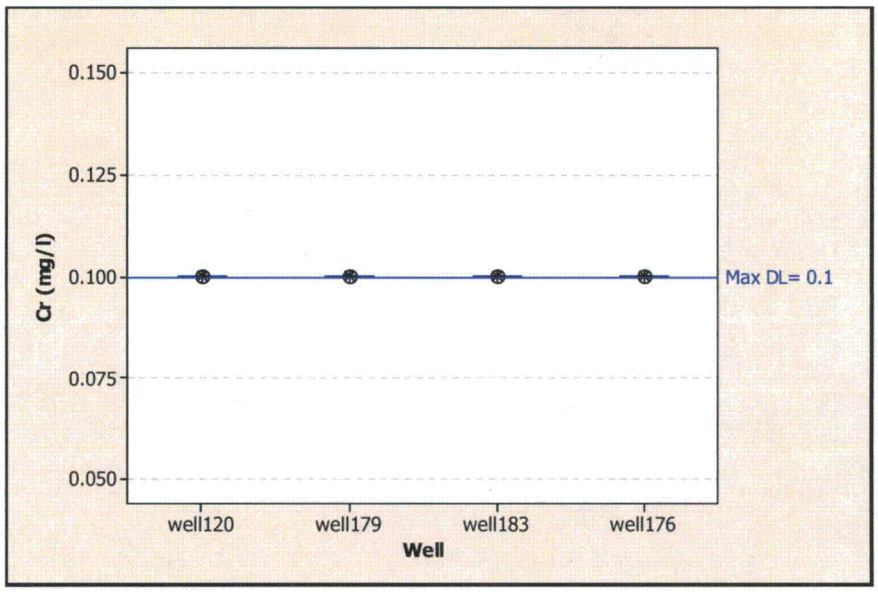

Figure 3.8 Boxplot Analysis for Chromium Concentrations in Wells 120, 179, 183 and 176

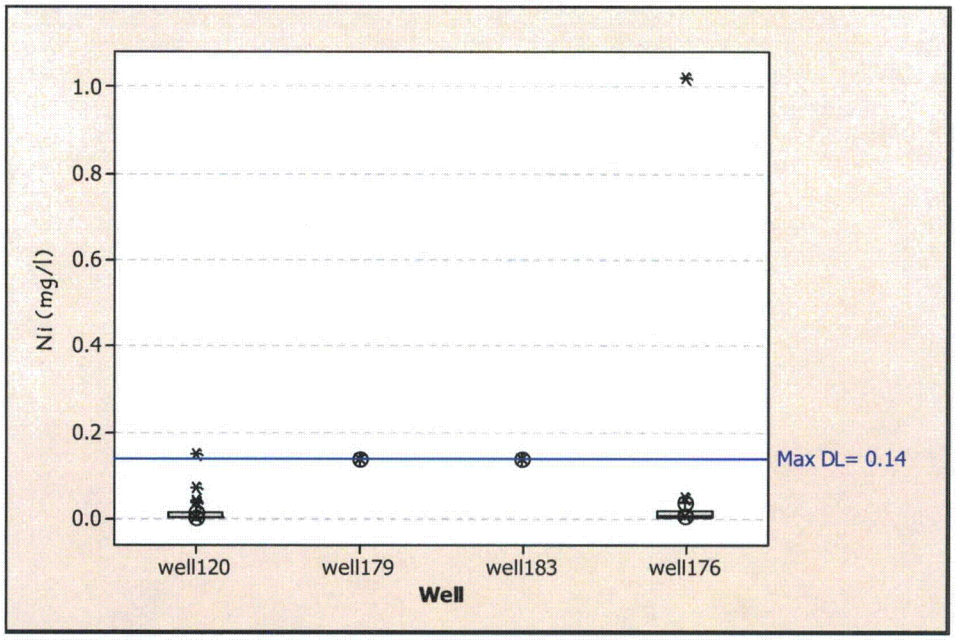

Figure 3.9 Boxplot Analysis for Nickel Concentrations in Wells 120, 179, 183 and 176

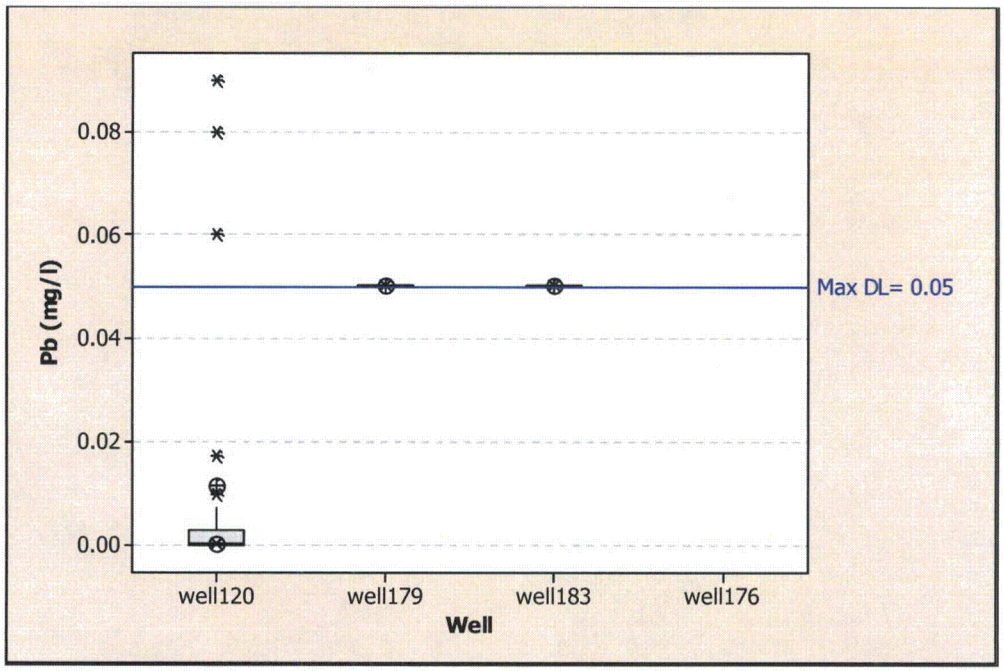

Figure 3.10 Boxplot Analysis for Lead Concentrations in Wells 120, 179, 183 and 176

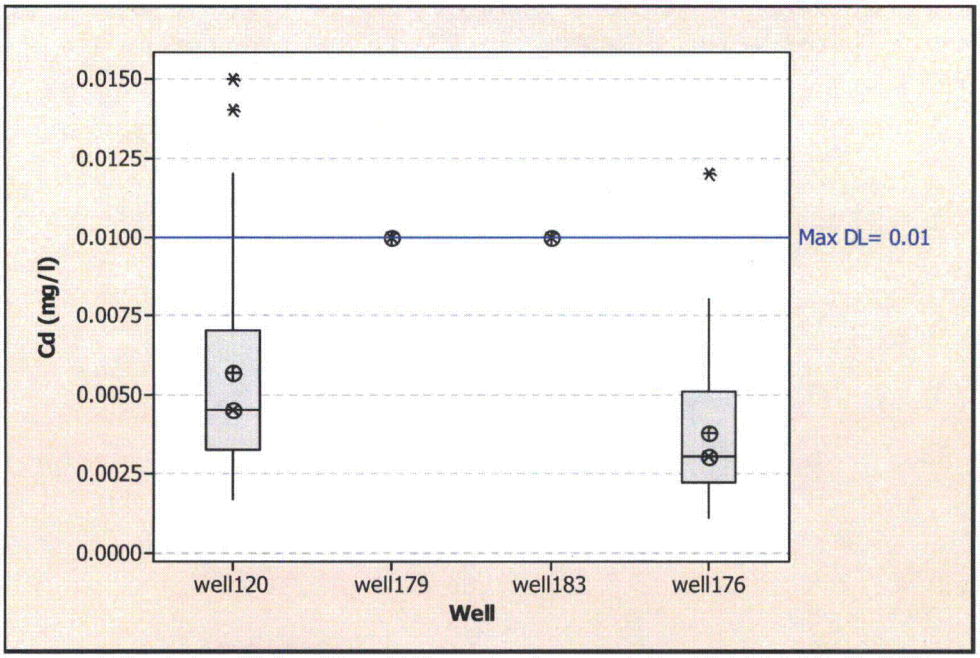

Figure 3.11 Whisker-Boxplot Analysis for Cadmium Concentrations in Wells 120, 176, 179 and 176

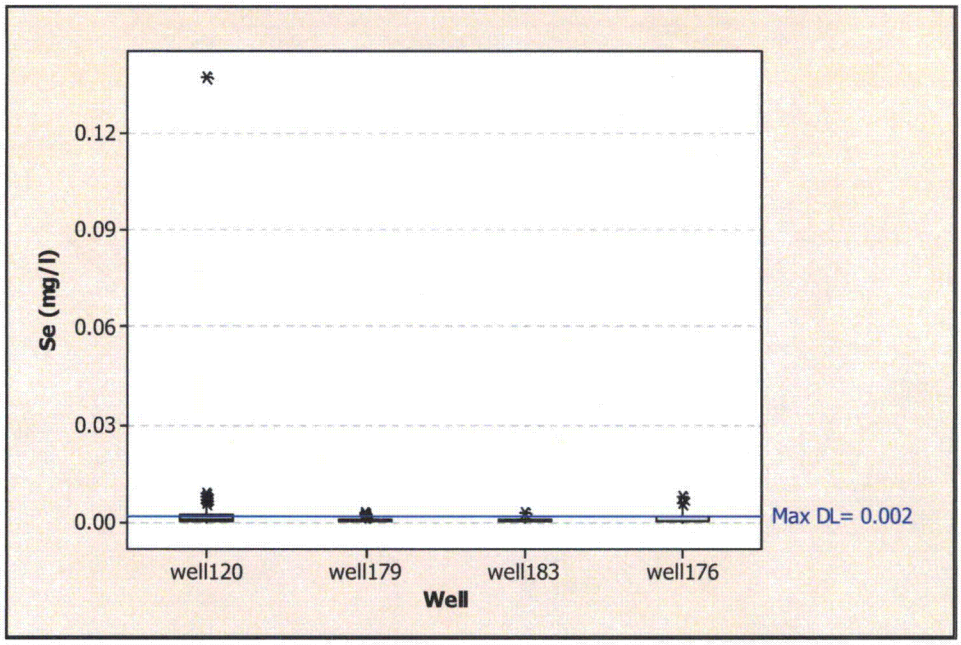

Figure 3.12 Whisker-Boxplot Analysis for Selenium Concentrations in Wells 120, 176, 179 and 176

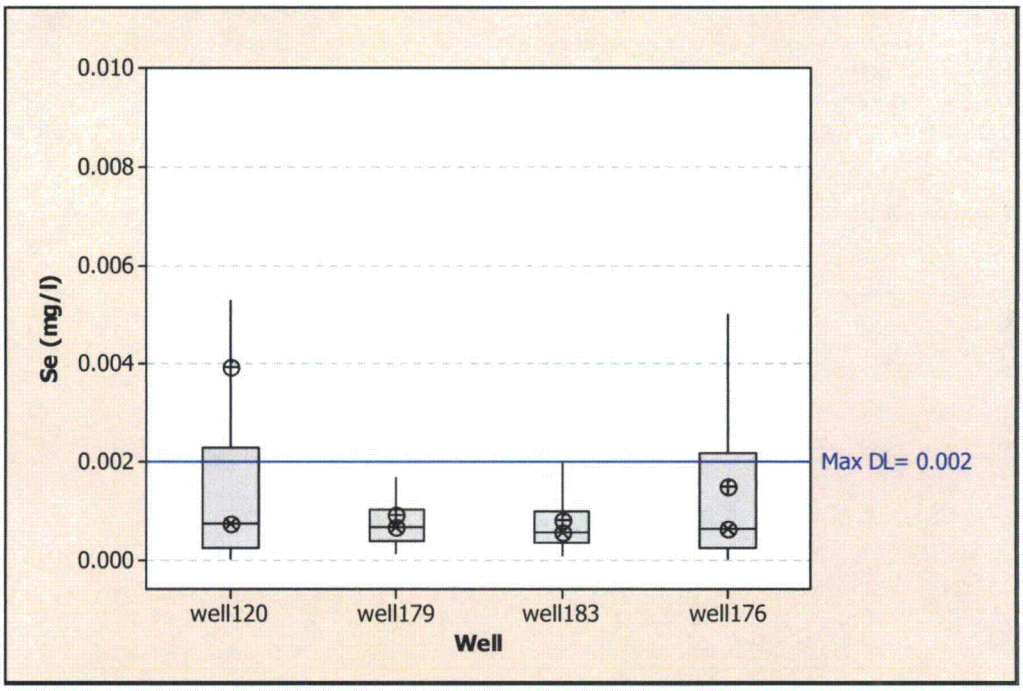

Figure 3.13 Whisker-Boxplot Analysis for Selenium (w/o well 120 outlier) Concentrations in Wells 120, 176, 179 and 176

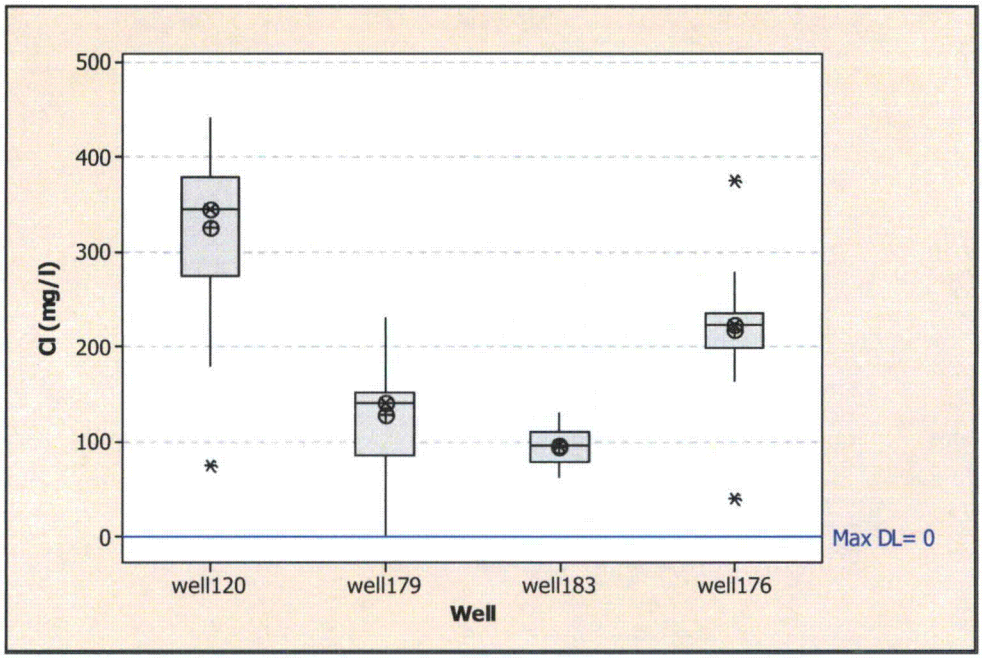

Figure 3.14 Boxplot Analysis for Chloride Concentrations in Wells 120, 176, 179 and 175

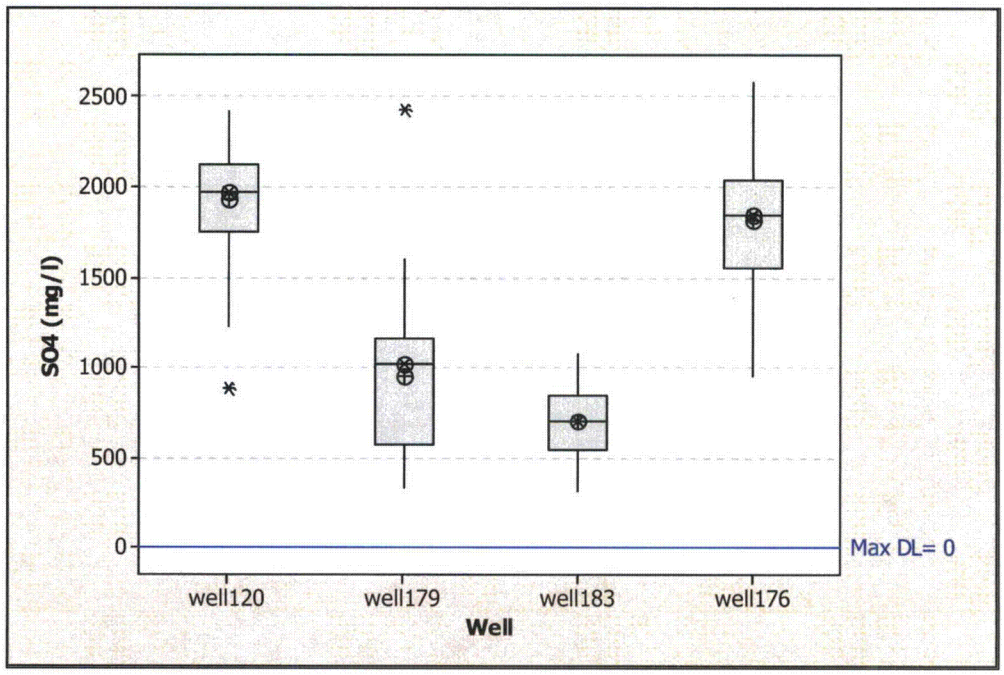

Figure 3.15 Boxplot Analysis for Sulfate Concentrations in Wells 120, 179, 183 and 176

d. Provide a detailed narrative describing the action(s) to be implemented on monitor wells 120, 179, 183, and 176 upon elimination from the license.

Please refer to section 1c for proper well abandonment procedures.

4. ExxonMobil requested that the requirement for monitoring ground water at well 114 be deleted from the license. ExxonMobil stated that this well does not provide any additional information than well 175. In order for us to evaluate this request please provide the following:

a. Provide (a)stratigraphic cross section(s) that shows the location of well screens for wells 114 and 175 with respect to each other and important site features including the tailings basin and spoil piles.

Figure 1.9 shows a stratigraphic cross-section for wells 114 and 175, the location of this cross-section is shown on Figure 1.7. This figure gives a conceptual idea of how close proximity these two wells fall and the geologic formation they both end at. The screen interval for both wells is located in the TDSS geologic formation. Well 175 represents the water quality and quantity of flow of well 114, and the screen interval goes an additional 18 feet below well 114. The horizontal distance between the two wells is 27.9 feet.

b. As a supplement to Figures 8 through 10, provide a statistical or other analysis of ground water quality data for all tested parameters from wells 114 and 175 to support the assertion that well 114 "can be eliminated from the monitoring program with no impact"

As a supplement to Figures 8-10 from the License Amendment Request (May 18, 2006), and to help evaluate the statistical similarity to well 175 in more detail, a statistical analysis was performed on the groundwater quality data for the specified wells (114,175). A boxplot analysis (see section 2 for description) was chosen as the statistical tool. The tested parameters included in this analysis are primarily hazardous constituents and they include: Arsenic, Cadmium, Chloride (not typically hazardous), Chromium, Nickel, Lead, Radium 226/228, Selenium, Sulfate (not typically hazardous), Thorium, Uranium, and Gross-Alpha. Table 4.1 presents the summary statistics for only the hazardous constituents tested at each well and the license condition standard.

The ground water monitoring well 114 is located in a similar location (27.9 feet apart) and completed in the same formation TDSS as well 175. Both of these wells are currently part of the existing License Condition 33 A and are sampled quarterly for listed water quality parameters and semi-annually for hazardous constituents. It has been requested that well 114 be removed from ExxonMobil's current monitoring plan for several reasons. Some of these reasons include:

1. The similar ground water quality concentrations of hazardous constituents observed at each well;
2. both wells are in a close proximity of each other (27.9 feet), and
3. both wells are screened in the same geologic formation, (TDSS) (Figure 1.9).

The concentrations at wells 114 and 175 fell below License Condition Standards for two of the four radionuclides analyzed in the current monitoring plan. Using the boxplot analysis; the distribution and spread of Uranium, Thorium, Radium, and Gross Alpha are closely related in both well 114 and 175. Figures 4.1-4.5 provide a graphical summary of the distribution of radionuclide concentrations found in the groundwater. Figure 4.1 and 4.2 show that the median and median of the Uranium concentrations for both wells are identical. Many of the observed Uranium concentrations have been below detection limits for the wells, 39% and 33% for wells 114 and 175, respectively. The boxplot in Figure 4.3 shows that the data sets for both wells exhibit a similar statistical distribution of Thorium concentrations. Radium 226-228 concentrations have been above detectable limits for the duration of this study. Figure 4.4 shows the distribution of Radium 226 and Radium 228 combined, for both wells. Retaining well 175 provides a conservative estimate for well 114. As indicated in the figure, the spread or range of the data overlaps, but the mean radium concentrations is slightly higher (2.2 pCi/L) in well 175 (8.3 pCi/L). Figure 4.5 shows the spread of Gross Alpha data is similar in both wells; again, retaining well 175 represents a conservative estimate for well 114.

The distribution of Chloride and Sulfate data for wells 114 and 175 are closely related. Figure 4.6 and Figure 4.7 indicate these two constituents are statistically representative of one another. Figure 9 in the original submittal illustrates how both wells show a similar trend in Sulfate. Little additional data is provided from well 114, when compared to well 175 for Chloride and Sulfate.

The hazardous water quality parameters: Arsenic, Cadmium, and Selenium exhibited mean and median concentration values that fell below License Condition Standards, and below detectable limits. Figure 4.8-4.11 show the boxplot results for Arsenic, Cadmium, and Selenium. Figure 4.8 shows the Arsenic concentrations at both wells; more than

84% of the data fell below detectable limits at each well. Figure 4.9 shows that the Cadmium concentrations fell below the detection limits, but the scale of the plot is smaller because a major outlier is observed in well 114. When constructing a box plot after removing the outlier, a better scale may be observed (Figure 4.10), indicating the range of cadmium concentration overlaps each other for both wells. Figure 4.11 compares the observed Selenium concentrations for the two wells. For both wells, the Selenium concentration is below detectable for many of the points, and below License Condition Standards.

Figure 4.12 and Figure 4.13, show the comparison of Chromium and Nickel concentrations for the two wells, respectively. The average concentrations for Nickel fell above the License Condition Standard for national primary drinking standards. By retaining well 175, a conservative estimate for Nickel concentrations in well 114 will be provided. The estimated mean Chromium concentrations fell below the standards at both wells.

The overall distribution of Lead concentrations observed in the two wells differed slightly as observed in Figure 4.14. The mean and median concentrations were slightly higher in the water samples taken from well 114 than in well 175. Well 114 maintained slightly higher concentrations than the License Standard of 0.05 mg/L.

The water quality analysis provided a statistical and graphical summary of the hazardous constituents analyzed at both wells 114 and 175. The results of this analysis indicate that for all of the water quality parameters tested (except Lead), the statistical distributions between the two wells are closely related. The estimated mean values for well 175 fell within the range of the two middle quartiles of well 114, except Lead. The general trends observed in the water quality data for both wells, can be inferred by monitoring well 175 individually. Little additional data is provided by well 114 that cannot be achieved from the inclusion of monitoring of well 175 in the monitoring program. It is assumed that the removal of well 114 will not provide any additional data, and may be amended in accordance with the current monitoring plan License Condition 33 A. The statistical analysis, geologic screening interval, and close proximity all indicate that well 114 be deleted from the license with no adverse effects on the existing monitoring plan.

Table 4.1 Descriptive Statistics of Boxplot Method for Wells 114 and 175

Analyte		Well		NRC License Condition
		114	175	
As	n	68	43	0.05 mg/L
	%ND	84	86	
	mean	0.0004	<0.0067	
	median	0.00018	<0.0067	
Cd	n	54	43	0.01 mg/L
	%ND	57	79	
	mean	0.00086	0.0073	
	median	0.00086	0.0073	
Cr	n	53	42	0.1 mg/L
	%ND	58	76	
	mean	0.208	0.176	
	median	0.005	0.007	
Ni	n	42	42	0.1 mg/L
	%ND	2	0	
	mean	0.87	1.13	
	median	0.95	1.1	
Pb	n	53	43	0.05 mg/L
	%ND	85	90	
	mean	0.057	0.017	
	median	0.052	0.008	
Ra (226+228)	n	51	41	5.0 pCi/L
	%ND	0	0	
	mean	6.1	8.3	
	median	5.2	8.3	
Se	n	68	43	0.05 mg/L
	%ND	49	60	
	mean	0.0022	0.0014	
	median	0.0009	0.0008	
Th230	n	46	38	0.55 pCi/L
	%ND	50	68	
	mean	0.90	0.27	
	median	0.33	0.10	
Unat	n	51	40	0.03 mg/L
	%ND	39	33	
	mean	<0.02	<0.02	
	median	<0.02	<0.02	
Gross- Alpha	n	33	34	15.0 pCi/L
	%ND	24.24	23.53	
	mean	5.33	5.35	
	median	2.30	2.90	

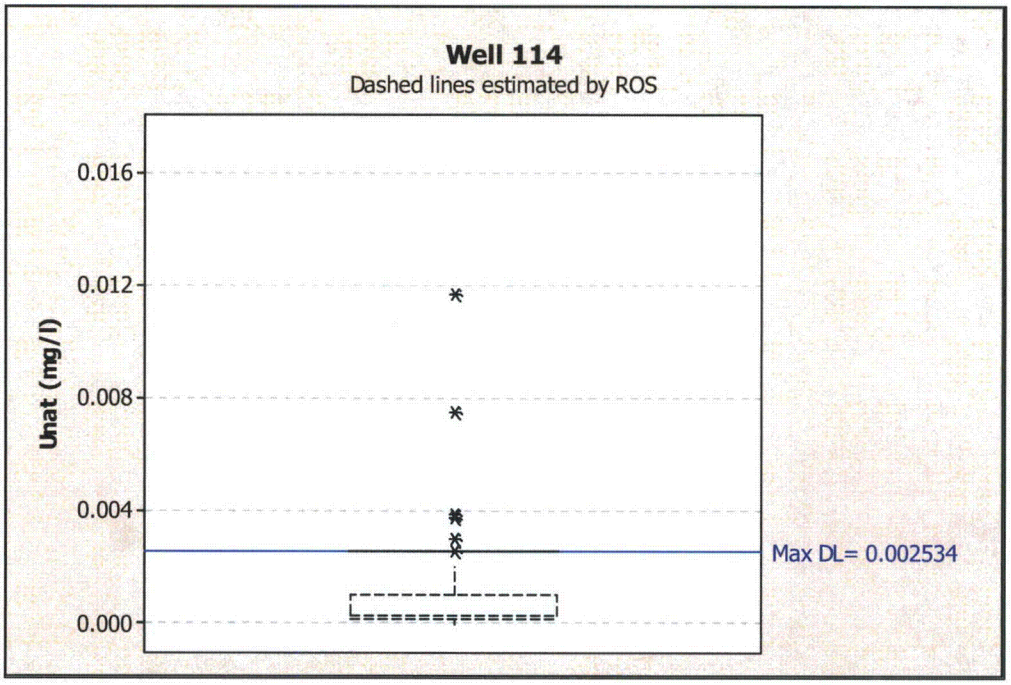

Figure 4.1 Whisker-Boxplot Analysis for Uranium Concentrations in Well 114 and 175

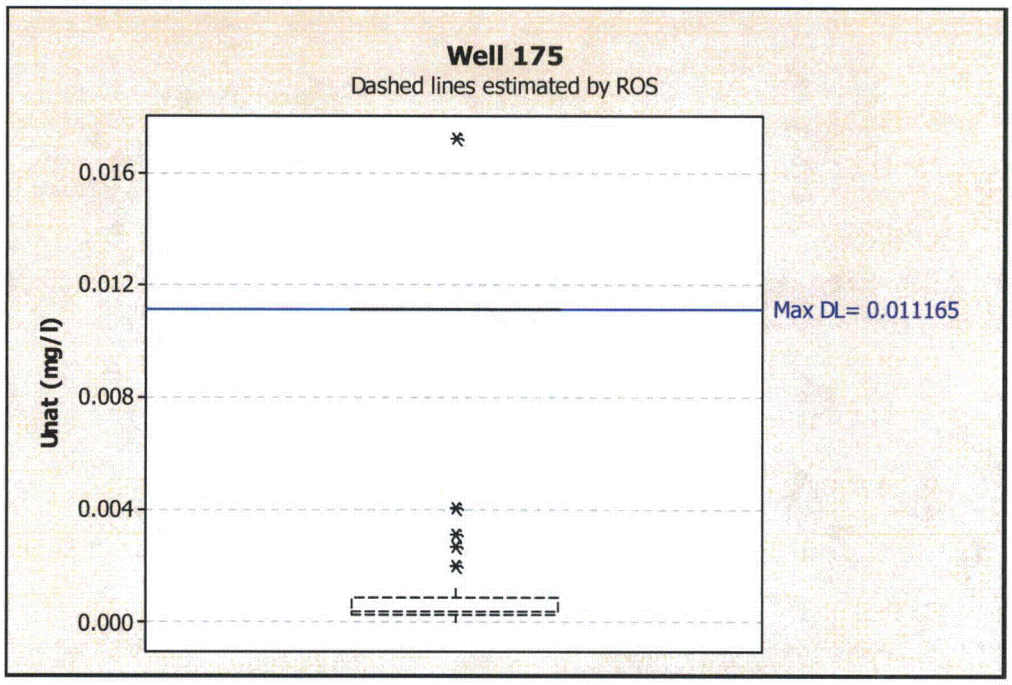

Figure 4.2 Whisker-Boxplot Analysis for Uranium Concentrations in Well 114 and 175

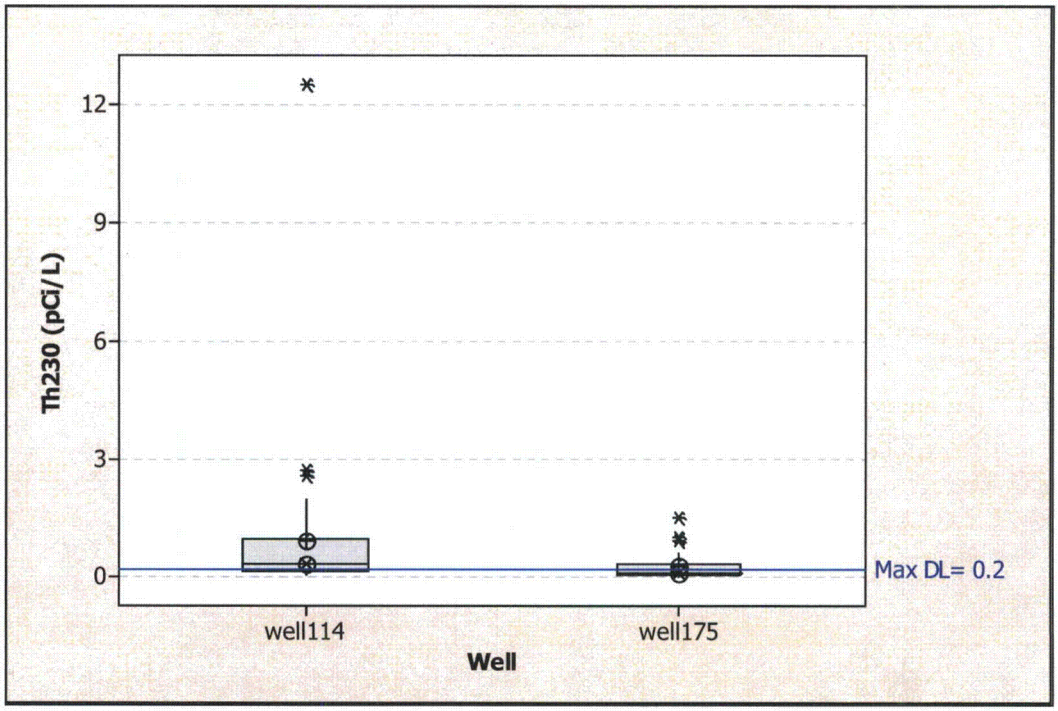

Figure 4.3 Whisker-Boxplot Analysis for Thorium-230 Concentrations in Well 114 and 175

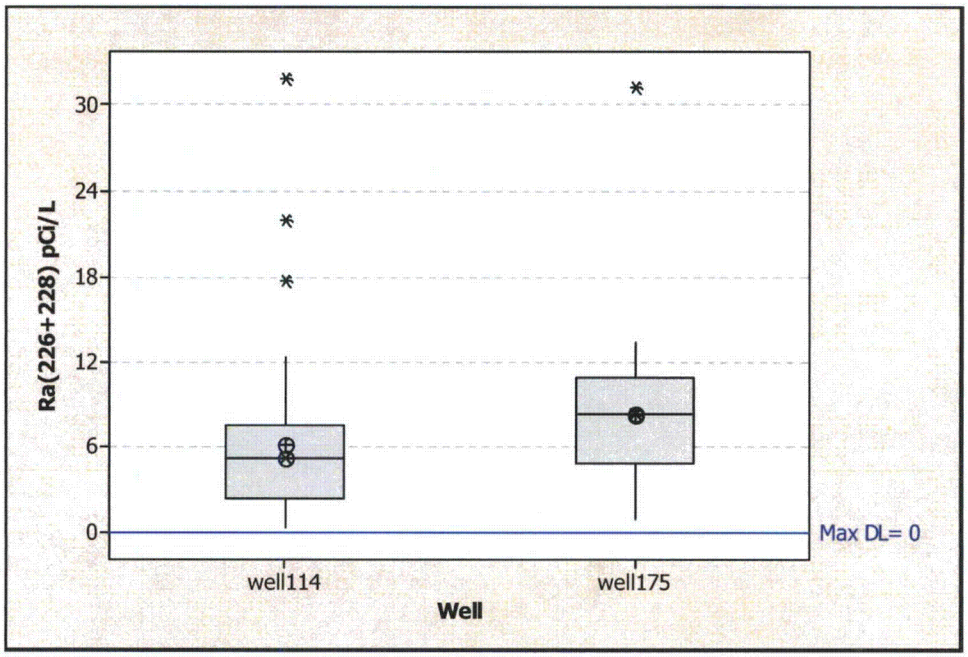

Figure 4.4 Whisker-Boxplot Analysis for Ra-226/228 Concentration in Well 114 and 175

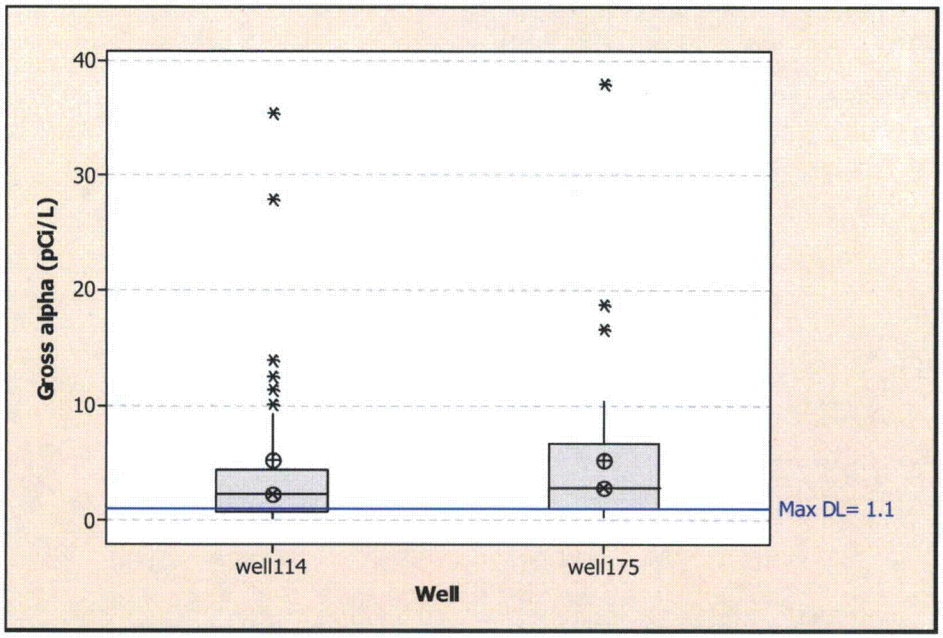

Figure 4.5 Whisker-Boxplot Analysis for Gross Alpha Concentration in Well 114 and 175

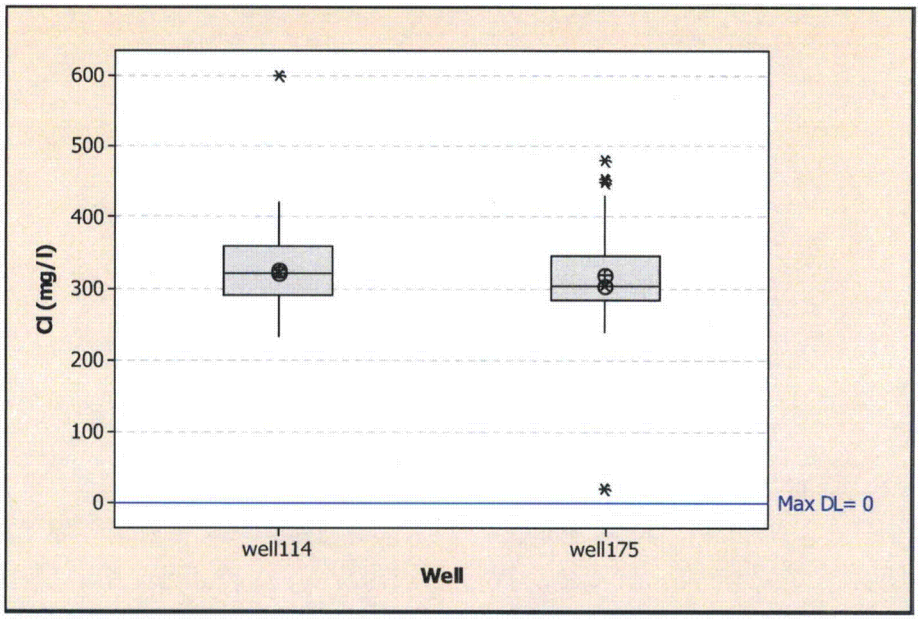

Figure 4.6 Whisker-Boxplot Analysis for Chloride (Cl) Concentrations in Well 114 and 175

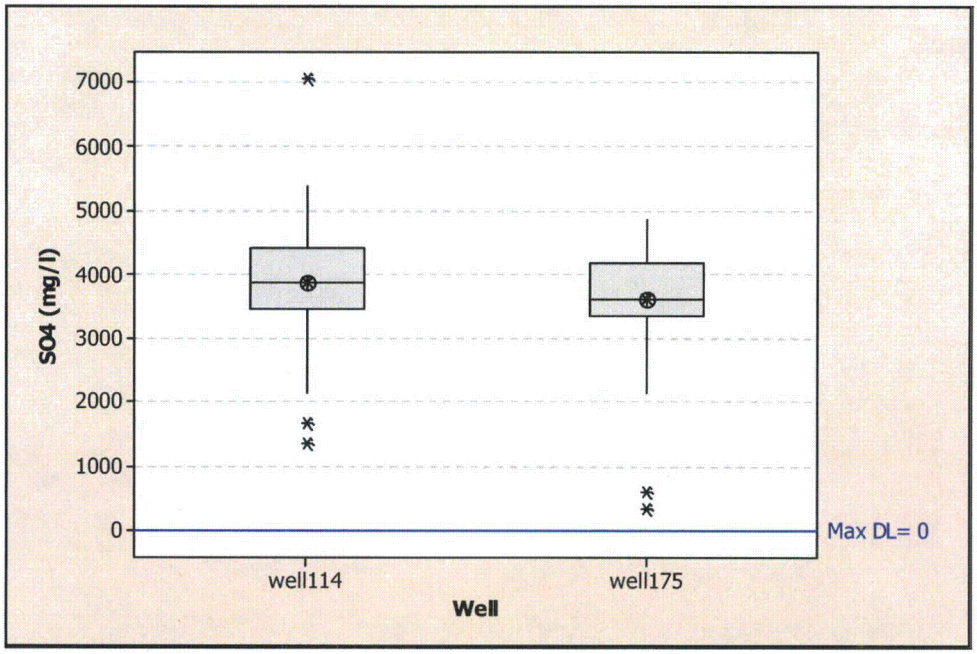

Figure 4.7 Whisker-Boxplot Analysis for Sulfate (SO_4) Concentration in Well 114 and 175

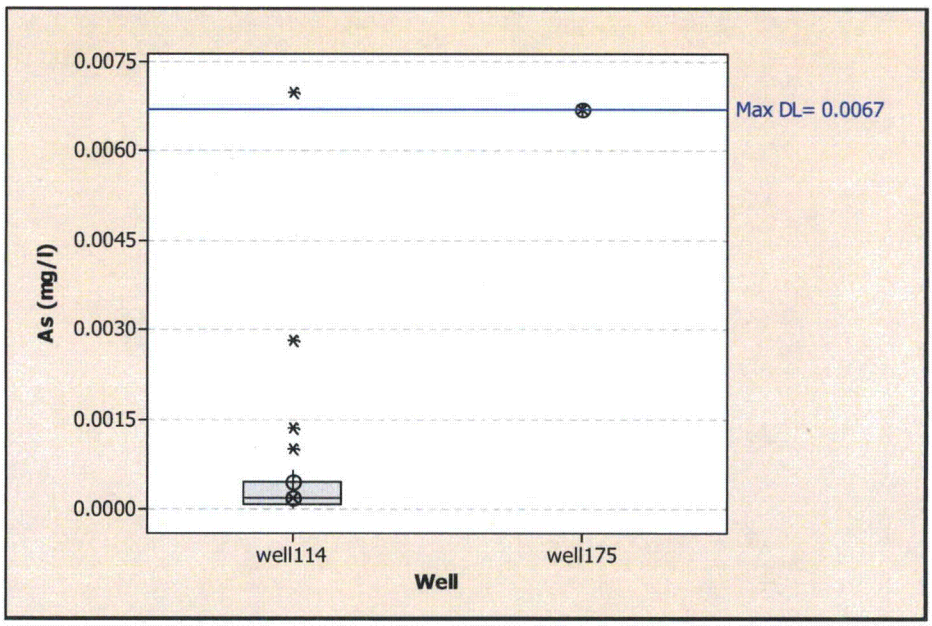

Figure 4.8 Whisker-Boxplot Analysis for Arsenic Concentration in Well 114 and 175

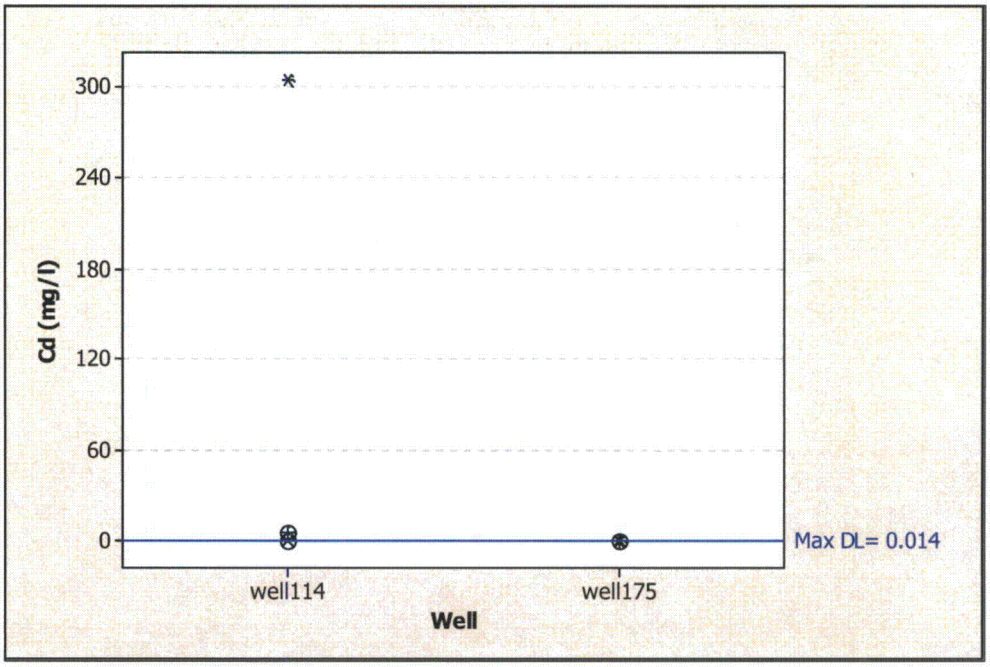

Figure 4.9 Whisker-Boxplot Analysis for Cadmium Concentration in Well 114 and 175

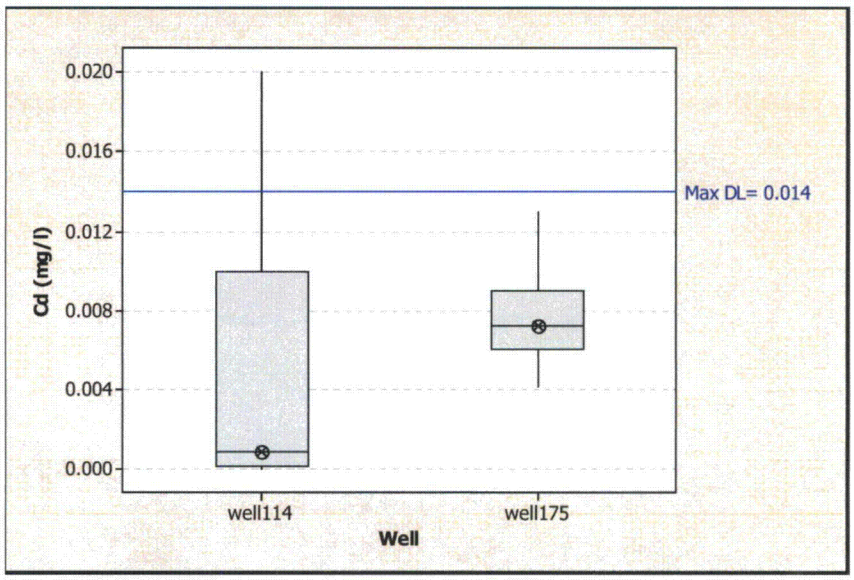

Figure 4.10 Whisker-Boxplot Analysis for Cadmium Concentration w/o Outlier in Well 114 and 175

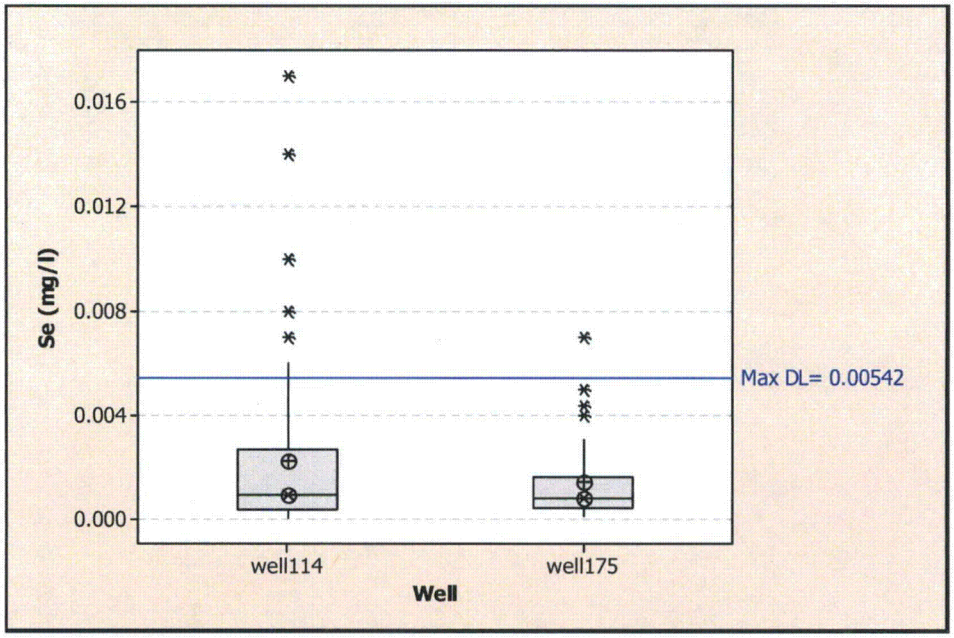

Figure 4.11 Whisker-Boxplot Analysis for Selenium Concentration in Well 114 and 175

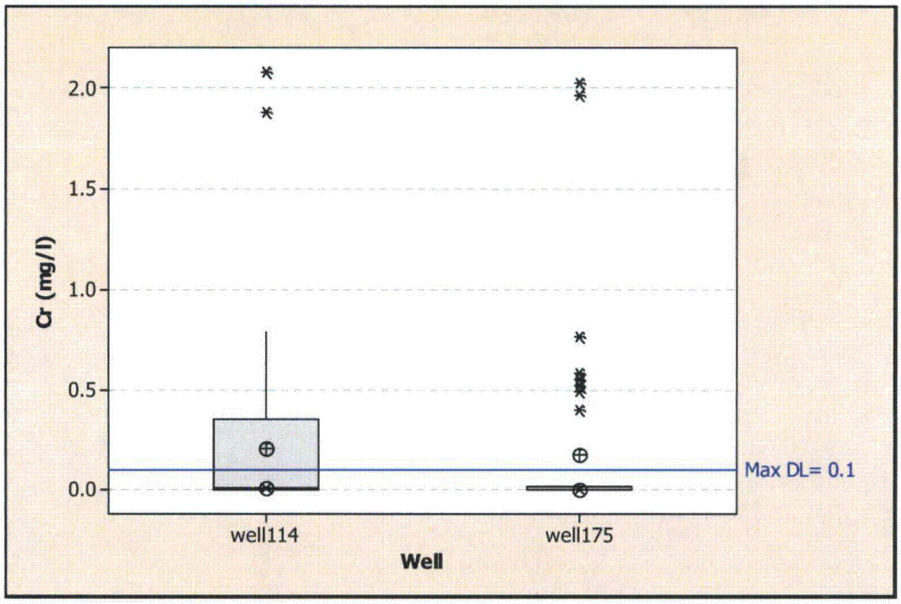

Figure 4.12 Whisker-Boxplot Analysis for Chromium Concentration in Well 114 and 175

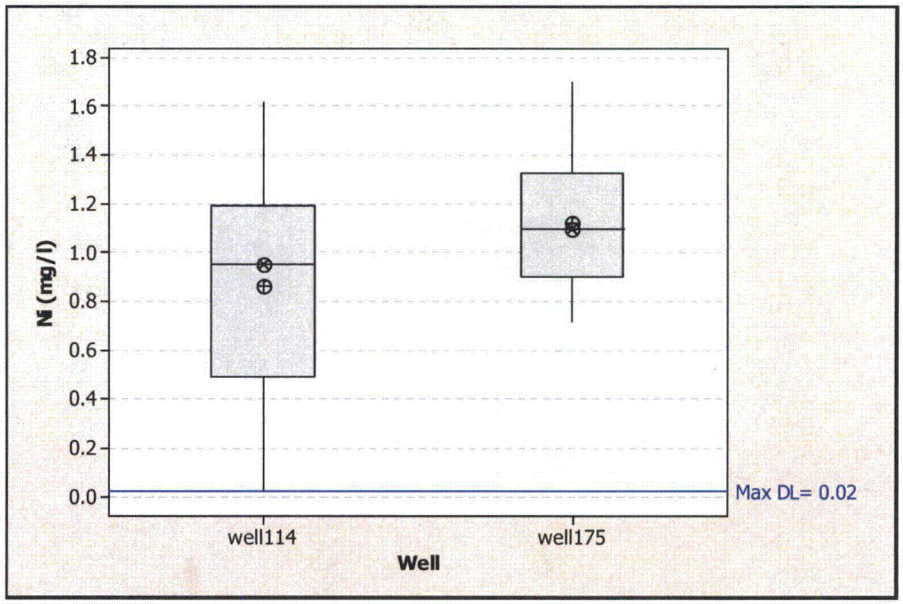

Figure 4.13 Whisker-Boxplot Analysis for Nickel Concentrations in Well 114 and 175

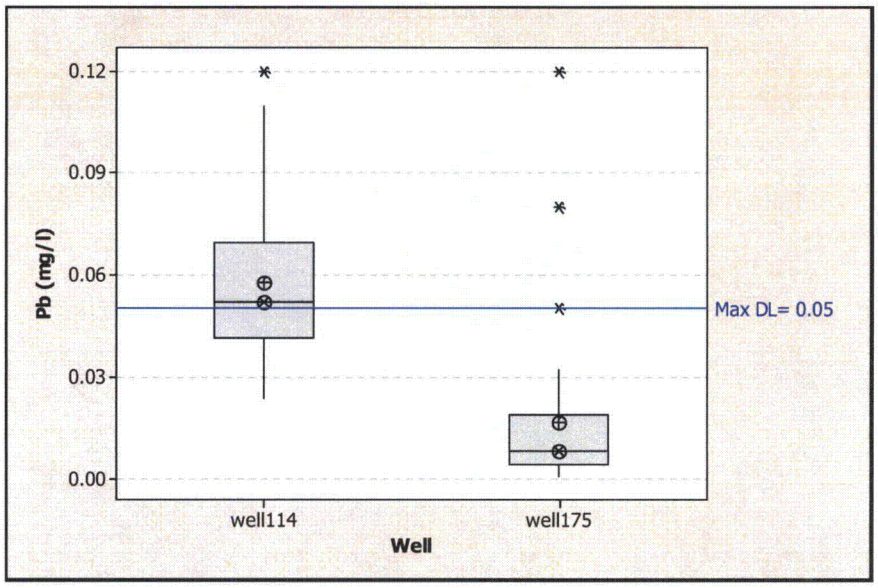

Figure 4.14 Whisker-Boxplot Analysis for Lead (Pb) Concentrations in Well 114 and 175

c. ***Provide a detailed narrative describing the action(s) to be implemented on monitor wells 120, 179, 183, and 176 upon elimination from the license.***

Please refer to question 1c for proper well abandonment procedures.

5. ***ExxonMobil requested that the required frequency of monitoring ground water at the various wells be revised in the license. These wells include 112, 116, 128, 129, 171, 172, 173, 178, and 181. In order for us to evaluate this request, please provide a statistical or other analysis of ground water quality data for all tested parameters to support the assertion that "the last five years of data have indicated that changes in water quality are very small and the changes occur very slowly." As indicated in the quote, such an analysis should include a temporal component. In addition, the analysis should address the time period in which "hazardous constituents in non-POC wells have been below detection and well below any standards" and the basis for the short list of indicator parameters proposed for wells 112, 116, 128, 129, 171, 172, 173, 178 and 181:***

An analysis of ground water quality data is provided. This analysis will assist in the evaluation of the proposed changes in the ground water monitoring frequency at the specified locations. The last five years of data indicate that changes in water quality are small and occur slowly. The majority of the hazardous constituents in the non-POC wells are below detection limits and well below license standards. Exxon proposes to reduce the monitoring frequency to semi-annual for POC wells (125, 175, and 176) and the back ground well (182). Additionally, it is proposed that the remaining nine non-POC wells (112, 116, 128, 129, 171, 172, 173, 178, and 181) be sampled annually for the short list of indicator parameters. This analysis includes graphical summaries of water quality data for the POC, background, and non-POC wells for the last five years. Figures 5.1-5.10 illustrate the concentrations of hazardous constituents for the non-POC wells. Figures 5.11-5.16 illustrate the short list of indicator parameters for the non-POC wells, and Figures 5.17-5.25 illustrate the hazardous constituents concentrations for the past five years in the POC and background wells. For each graph, the license standard is illustrated graphically with a blue dotted line.

For non-POC wells, the Arsenic (Figure 5.1), Cadmium (Figure 5.2), Chromium (Figure 5.3), Lead (Figure 5.5), and Thorium (Figure 5.9) concentrations at each of the wells have remained consistently lower than any license standard during the last 5 years. There is little substantial variance observed for any contaminant at any of the wells.

The Gross-Alpha, Selenium, Nickel and Uranium concentrations fall below the License standards in every well monitored except for unique well(s) for each contaminant. Figure 5.7 illustrates that each well was below the acceptable standard for Selenium excluding well 129. At well 129 there have been three measured data points where the concentration of selenium exceeded the license condition standard. Figure 5.10 displays each well tested for Uranium; every well meets the standard excluding well 112, which has exceeded the standard four times in the last 5 years. Gross-Alpha had one measured outlier in well 178 in March 2004. Similarly, Nickel concentrations have remained consistently below the license standard excluding well 178.

The trend of combined Radium concentrations has shown little substantial change in magnitude during the last five years of monitoring. The standard of 5 pCi/L is exceeded

by 4 different wells based on the past five years of data. Figure 5.8 shows the concentrations of combined Radium in the ground water at each well. Wells 112, 116, 172, and 173 have all exceeded the limit at least once in this time period. However, the most recent monitoring date indicates no well is exceeding the license standard.

Figures 5.11-5.16 show the short list of indicated parameters for non-POC wells. The last five years of data indicate little or gradual change in water quality conditions for each non-POC well. It is proposed to reduce the monitoring of the remaining non-POC wells to an annual basis for only the short term indicator parameters.

As mentioned above, Figures 5.17-5.25 show the concentrations of all hazardous constituents measured in POC wells during the past five years. All hazardous constituents monitored in POC wells have maintained concentrations below license standards, with the exception of unique wells and contaminants. Gross-Alpha and Uranium violated license standards on one occasion at one well each, during the last five years. It is proposed that the monitoring frequency be changed to semi-annually for POC and background wells (125,175,176, and 182). It is suggested the current constituents will be analyzed under the new monitoring schedule.

The last five years of data indicate that changes in water quality are very small and occur very slowly. For both POC and non-POC, almost all the hazardous constituents analyzed fell well below any primary or secondary standards, and often below detectable limits. It is requested that the frequency of monitoring of the non-POC wells 112, 116, 128, 129, 171, 172, 173, 178, and 181 be changed to annual sampling of the short list of parameters. It is also requested that the monitoring frequency be changed to semi-annually for POC wells 125, 175, and 176 and official background well 182. The POC and background wells should still be analyzed for all of the current constituents.

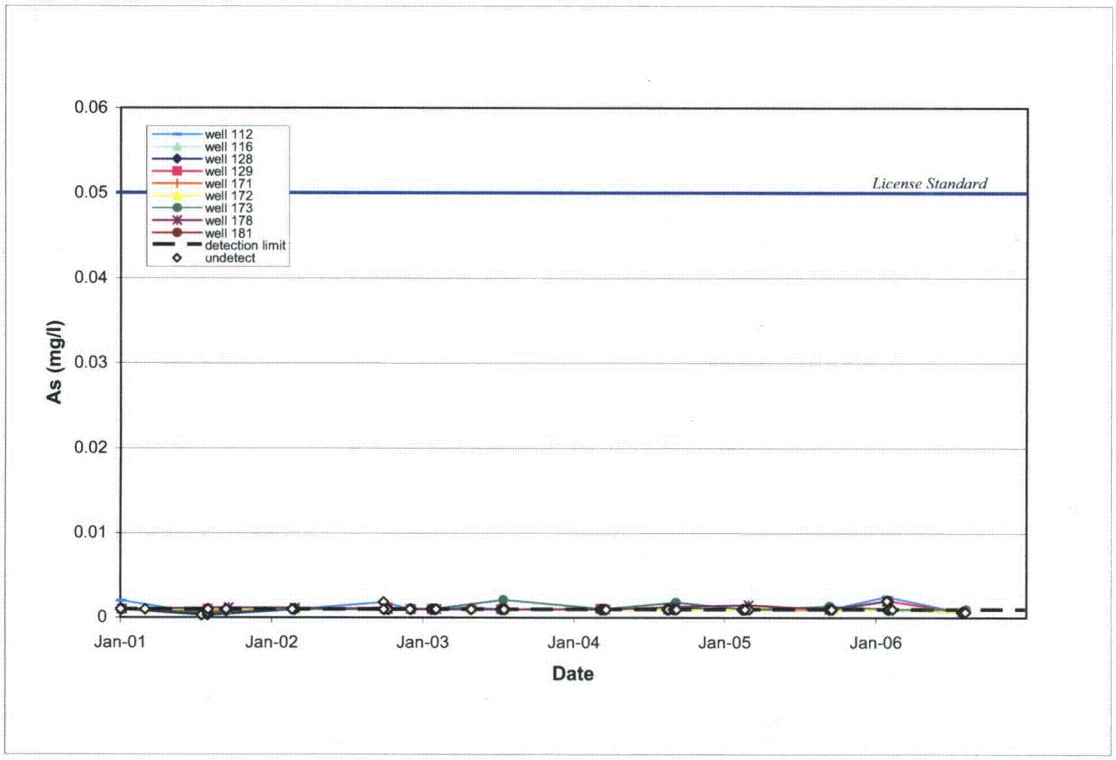

Figure 5.1 Arsenic Concentrations in non-POC Wells

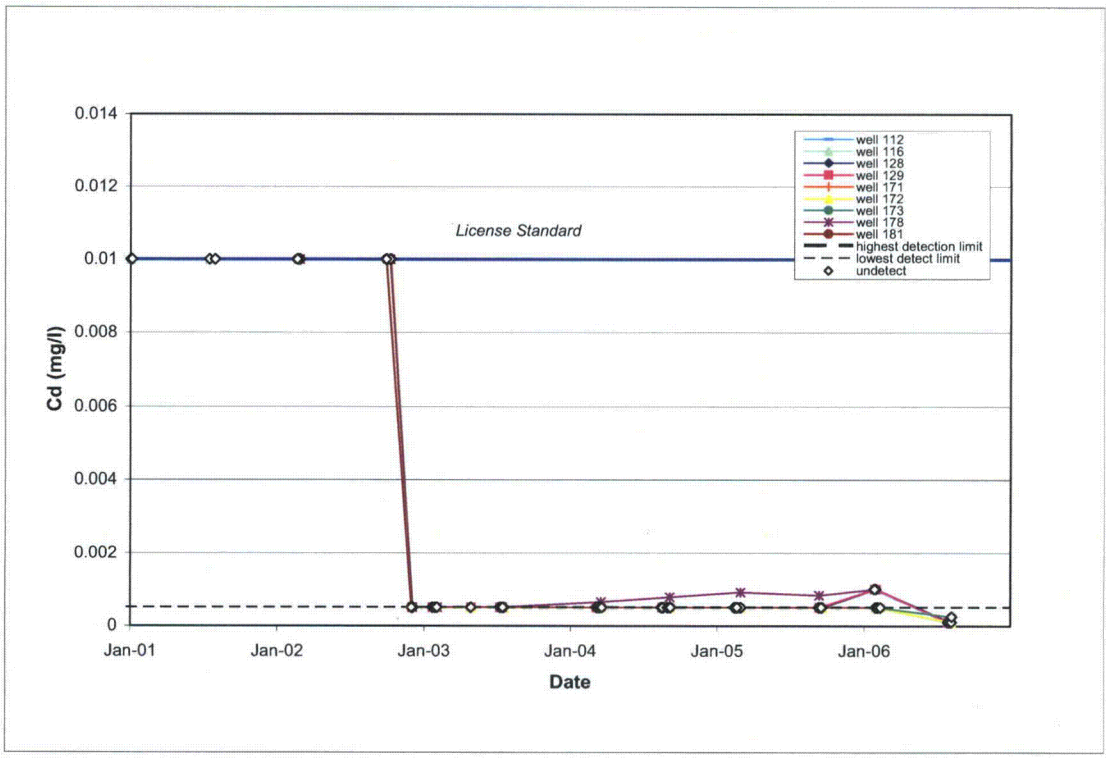

Figure 5.2 Cadmium Concentrations in non-POC Wells

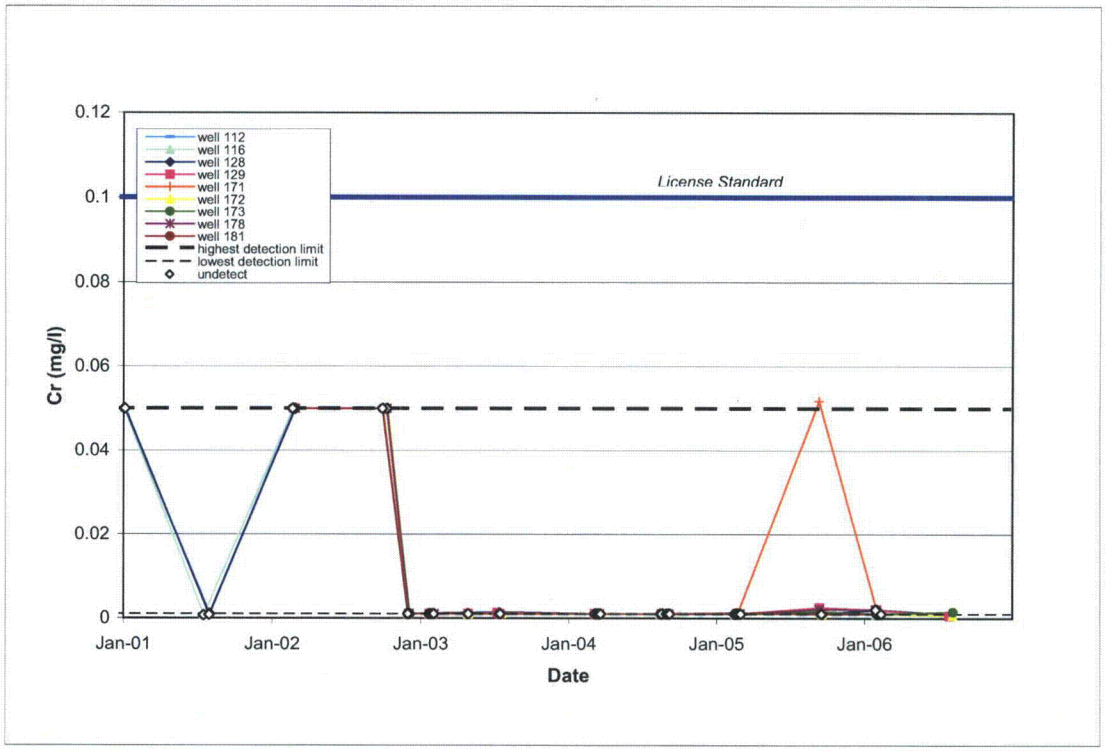

Figure 5.3 Chromium Concentrations in non-POC Wells

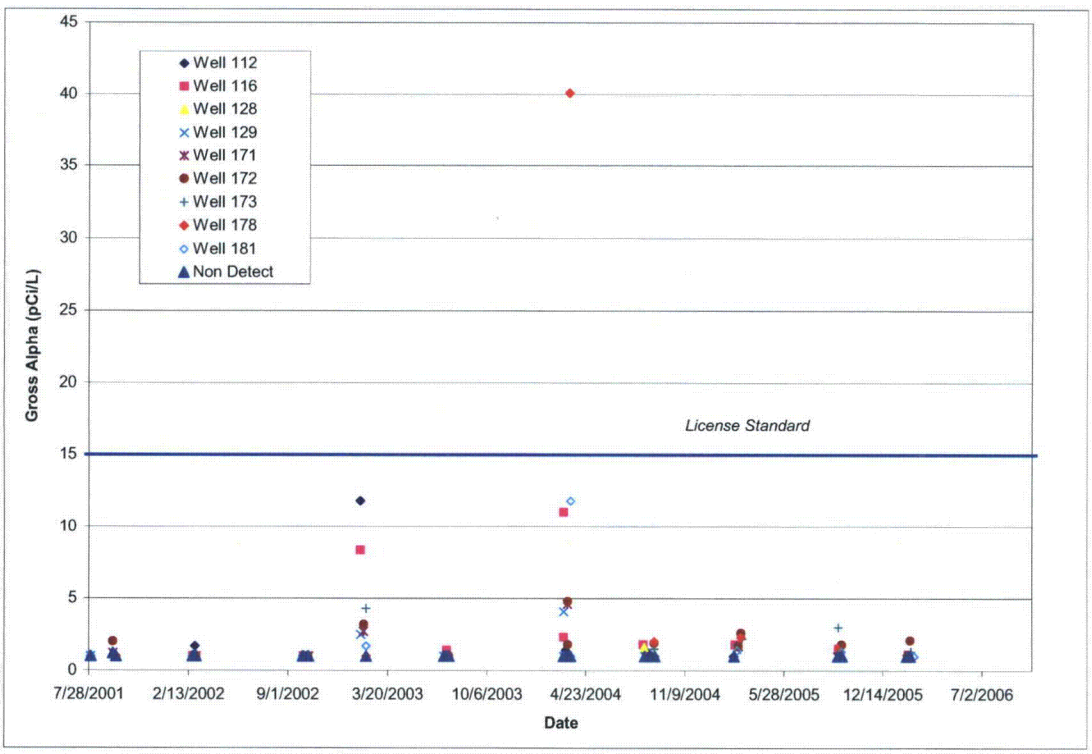

Figure 5.4 Gross-Alpha Concentrations in non-POC Wells

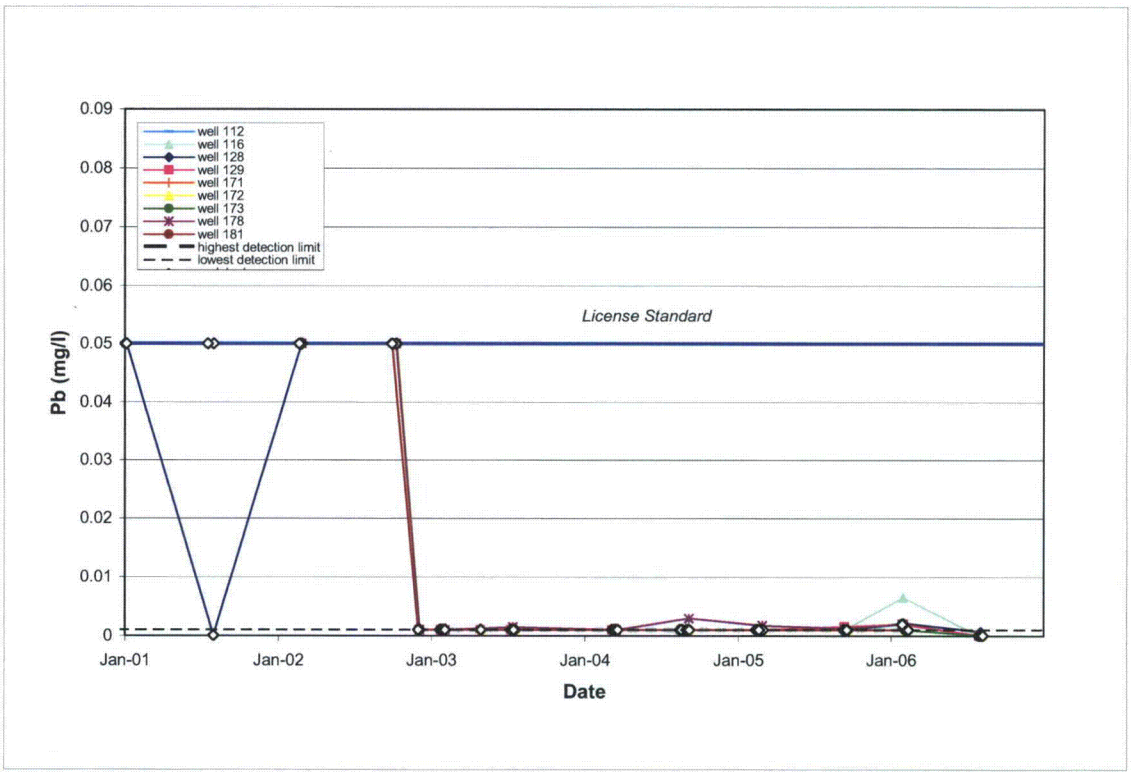

Figure 5.5 Lead Concentrations in non-POC Wells

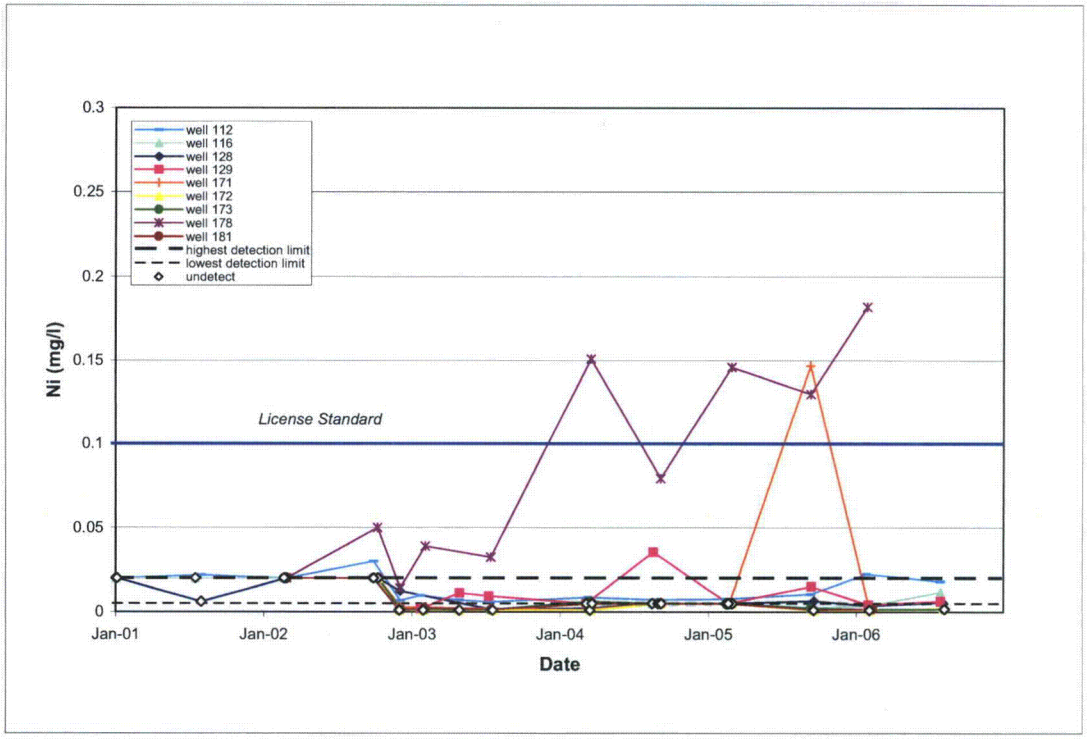

Figure 5.6 Nickel Concentrations in non-POC Wells

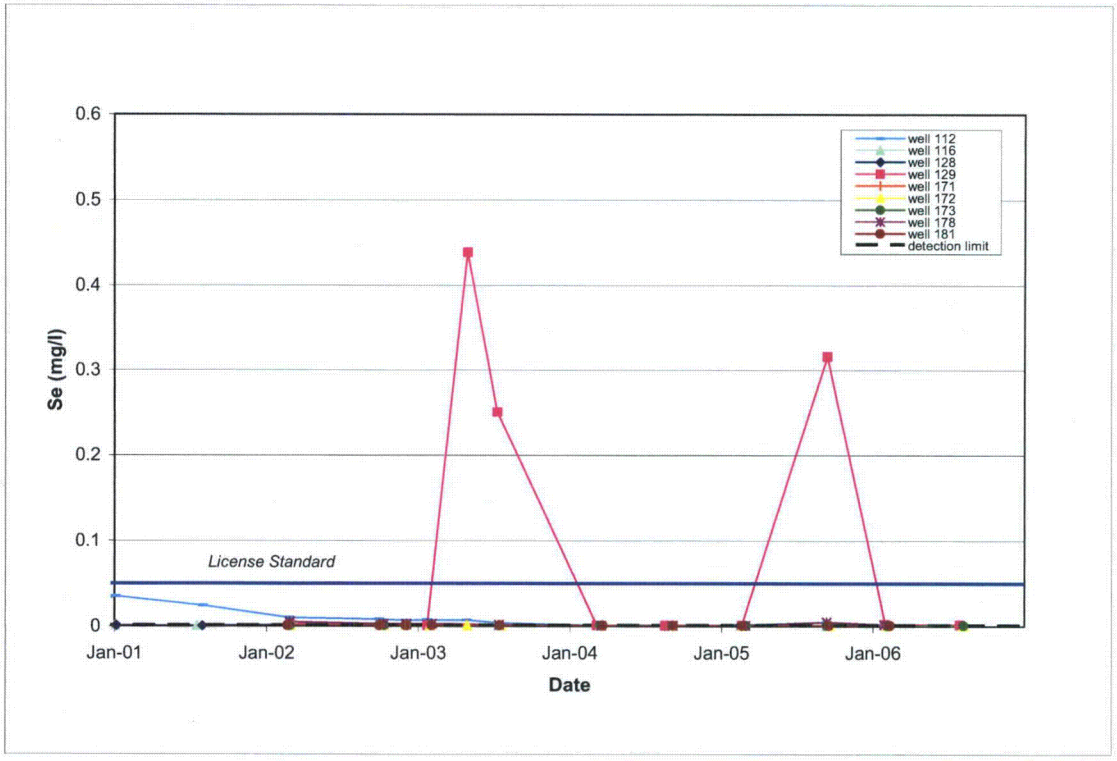

Figure 5.7 Selenium Concentrations in non-POC Wells

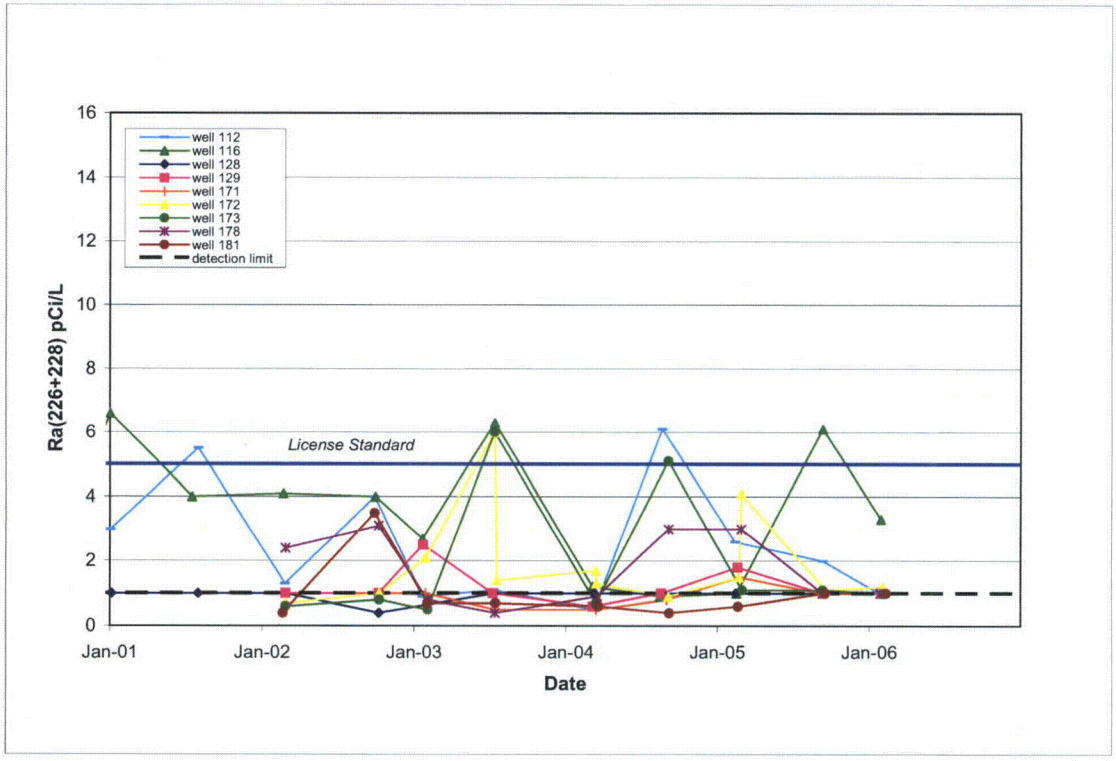

Figure 5.8 Radium (226+228) Concentrations in non-POC Wells

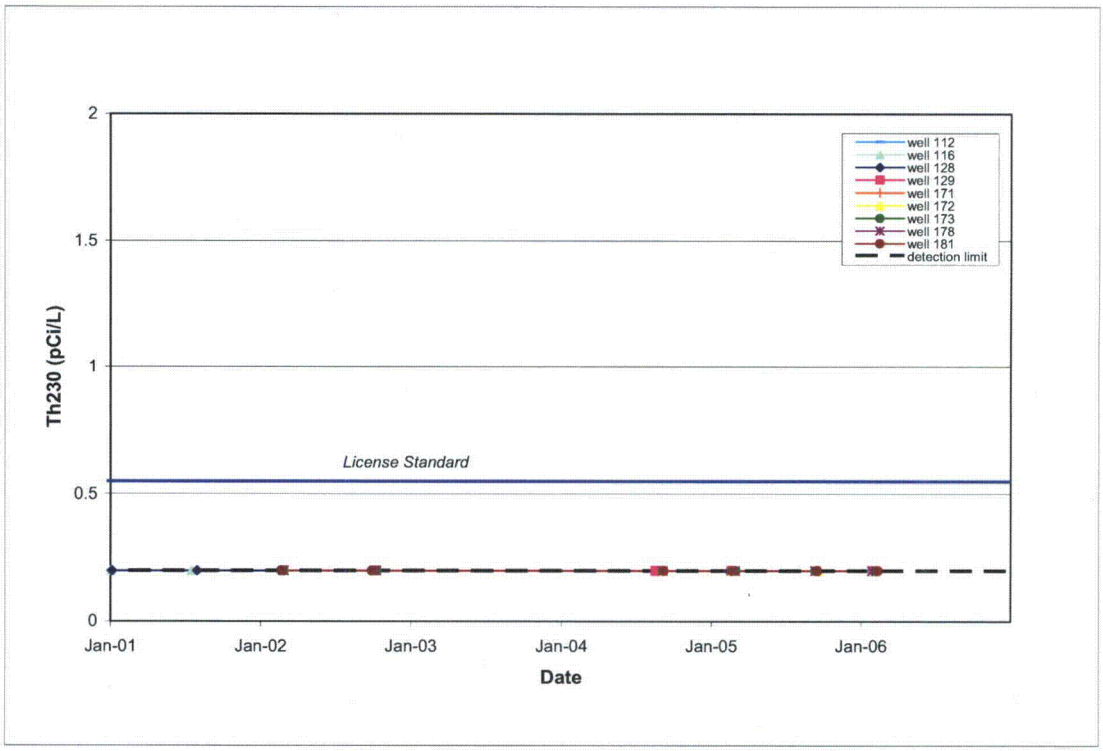

Figure 5.9 Thorium-230 Concentrations in non-POC Well

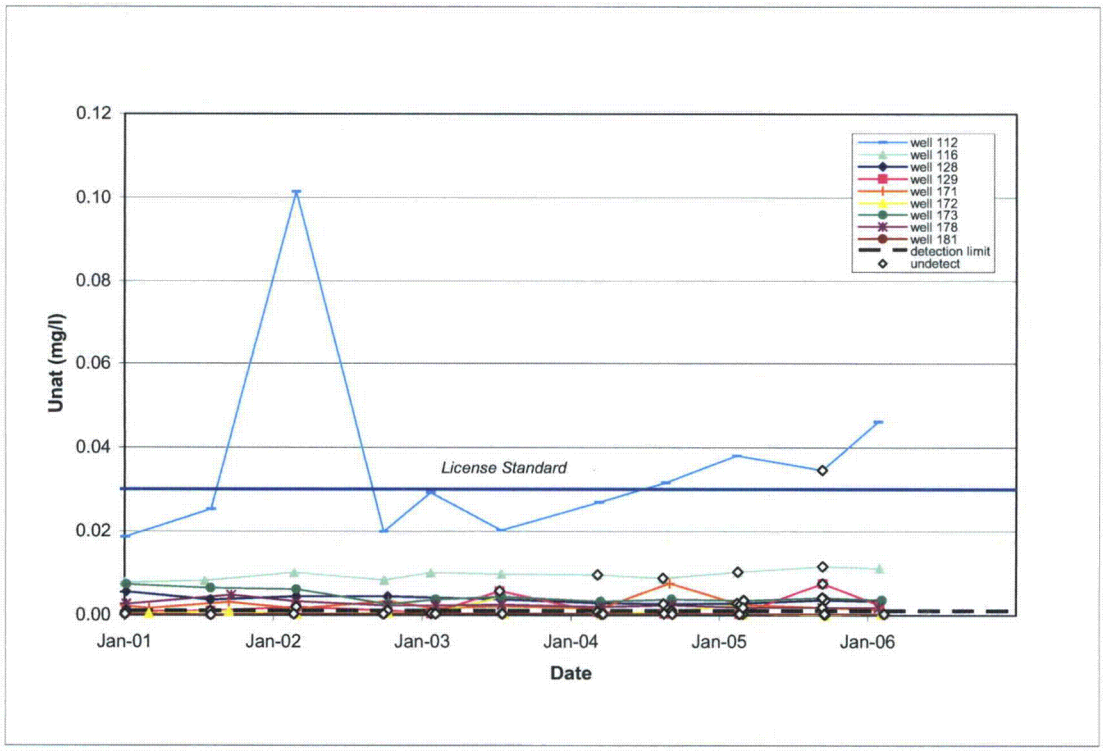

Figure 5.10 Uranium Concentrations in non-POC Wells

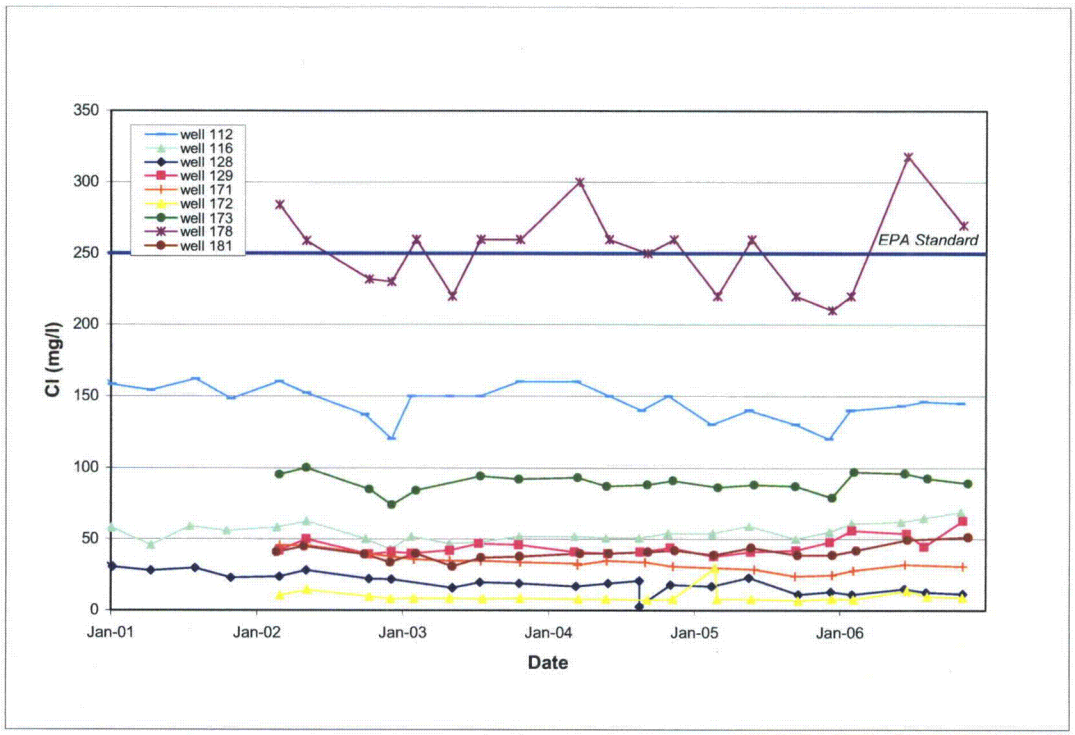

Figure 5.11 Chloride Concentrations in non-POC Wells

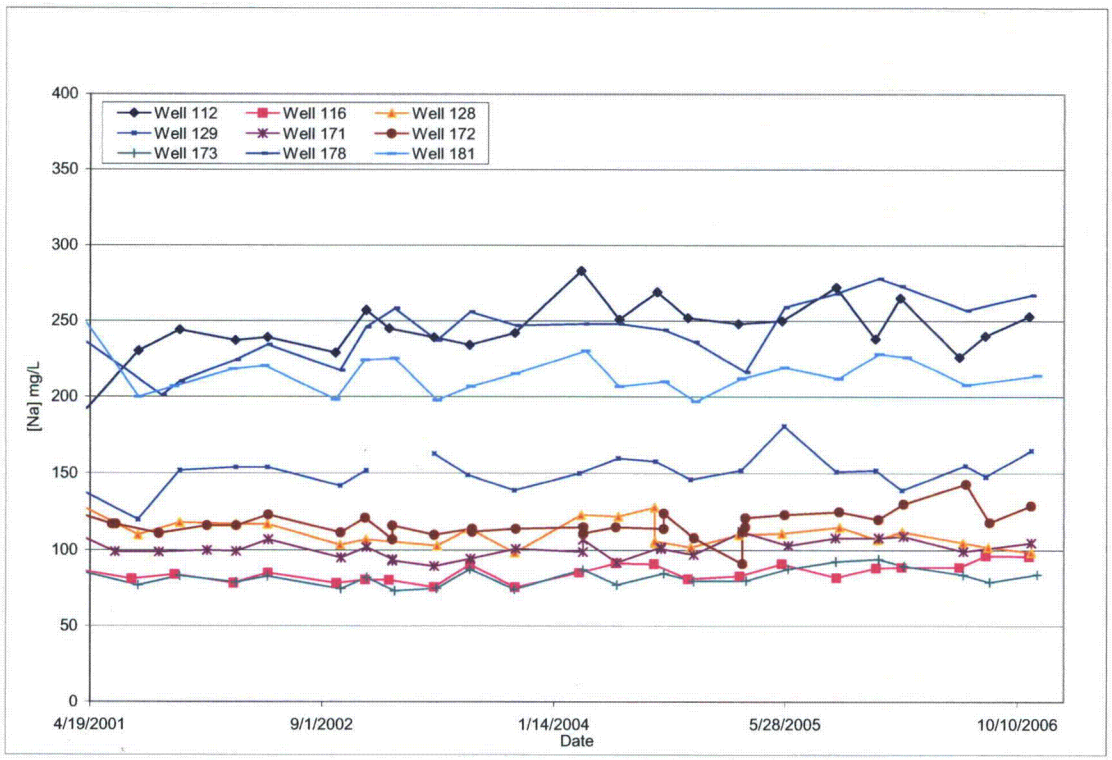

Figure 5.12 Sodium Concentrations in non-POC Wells

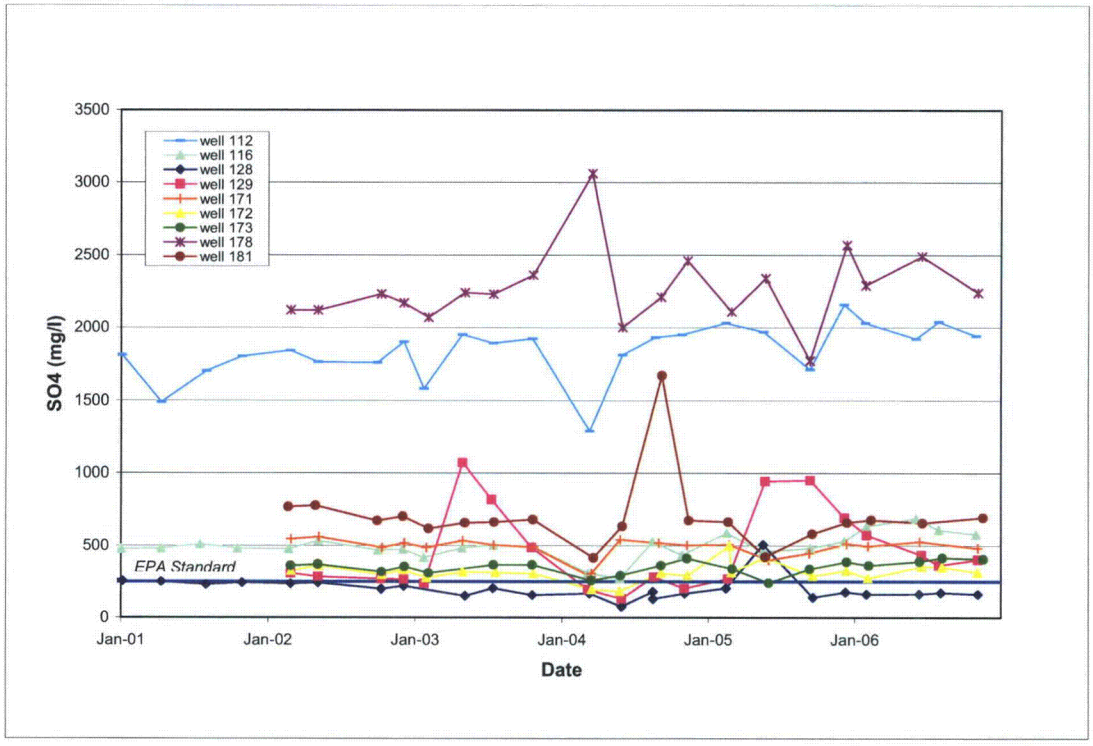

Figure 5.13 Sulfate Concentrations In non-POC Wells

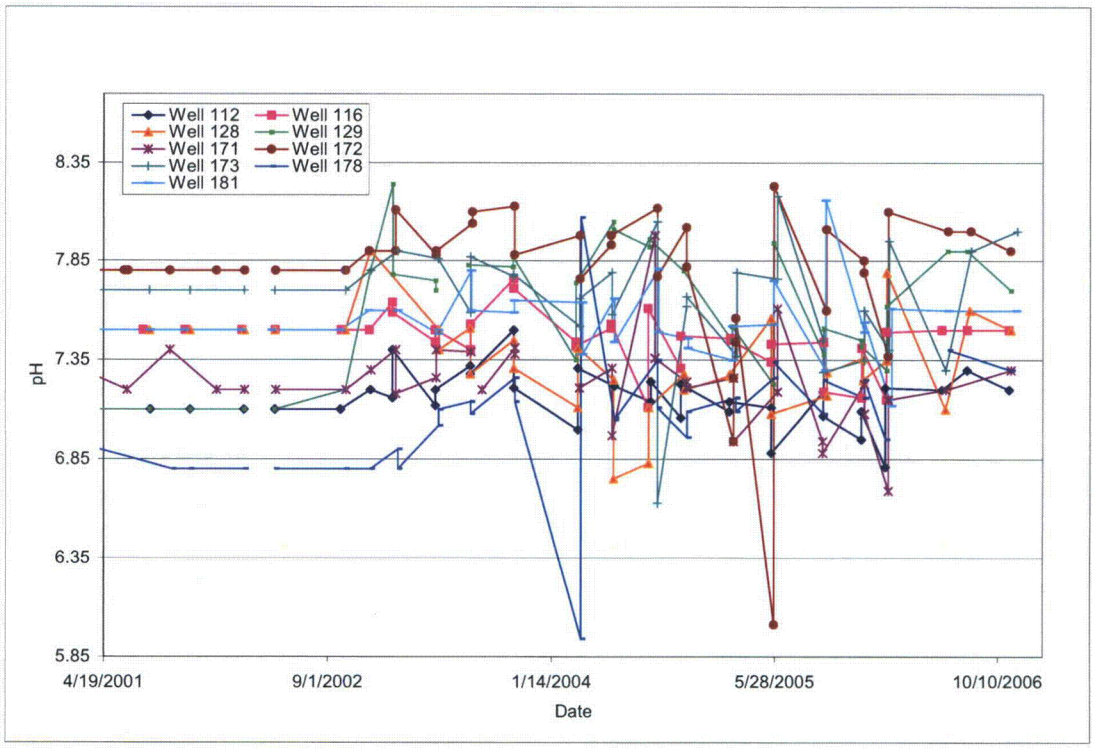

Figure 5.14 pH Values In non-POC Wells

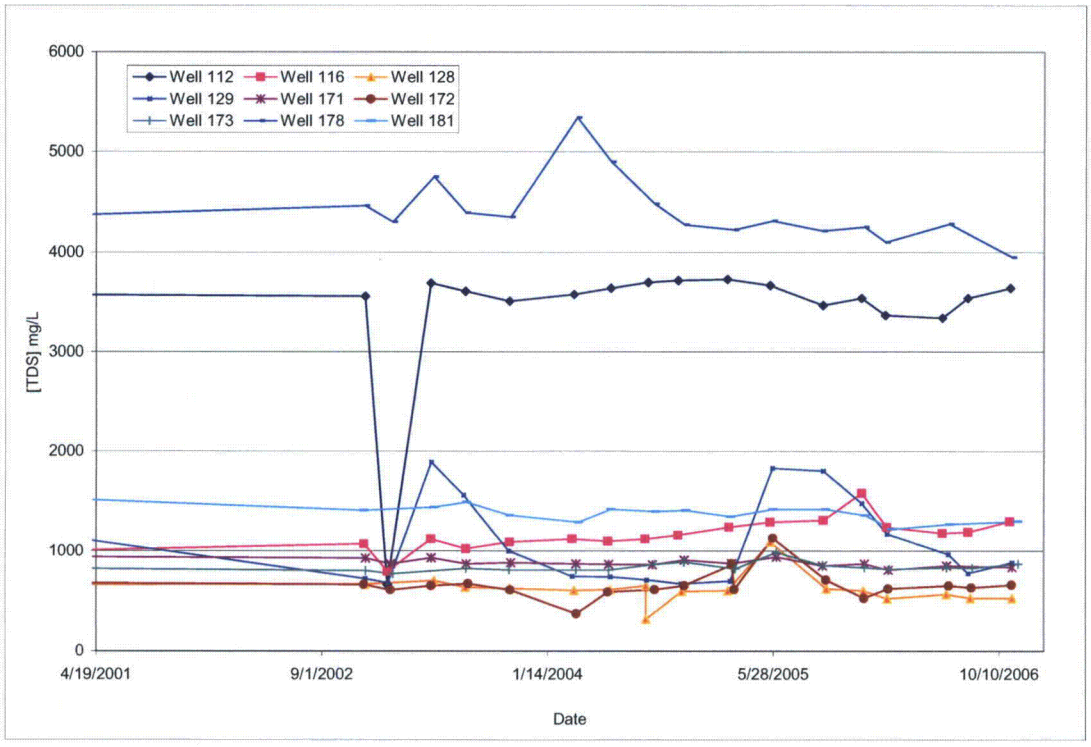

Figure 5.15 TDS Concentrations In non-POC Wells

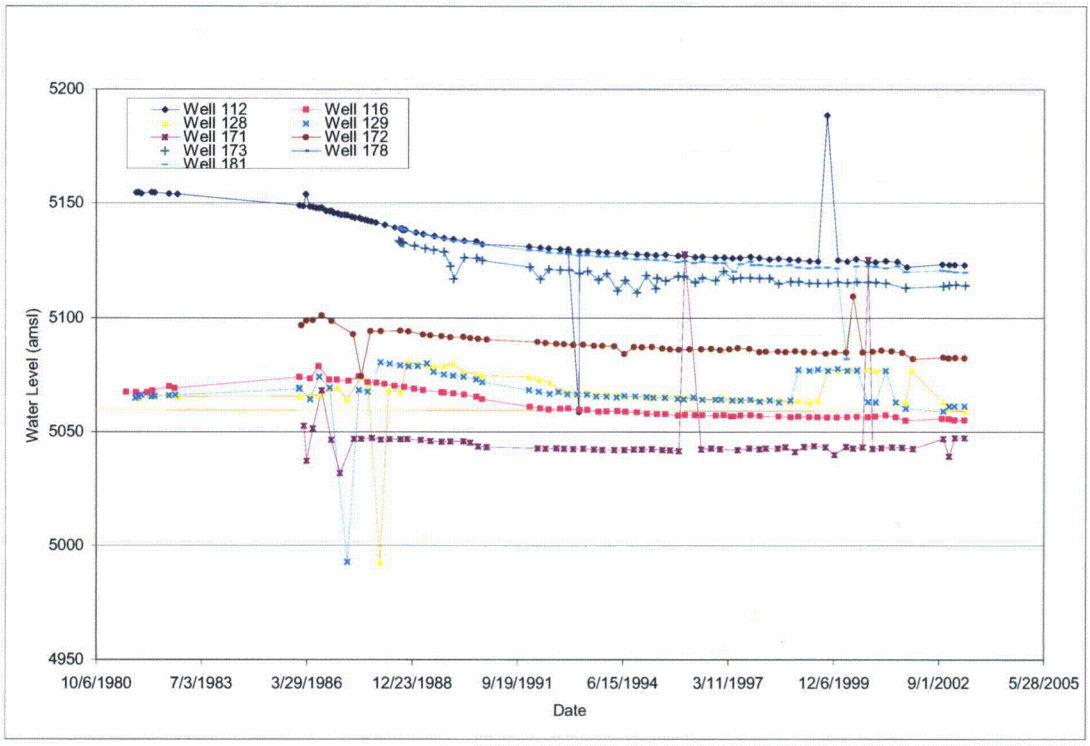

Figure 5.16 Water Level Elevations In non-POC Wells

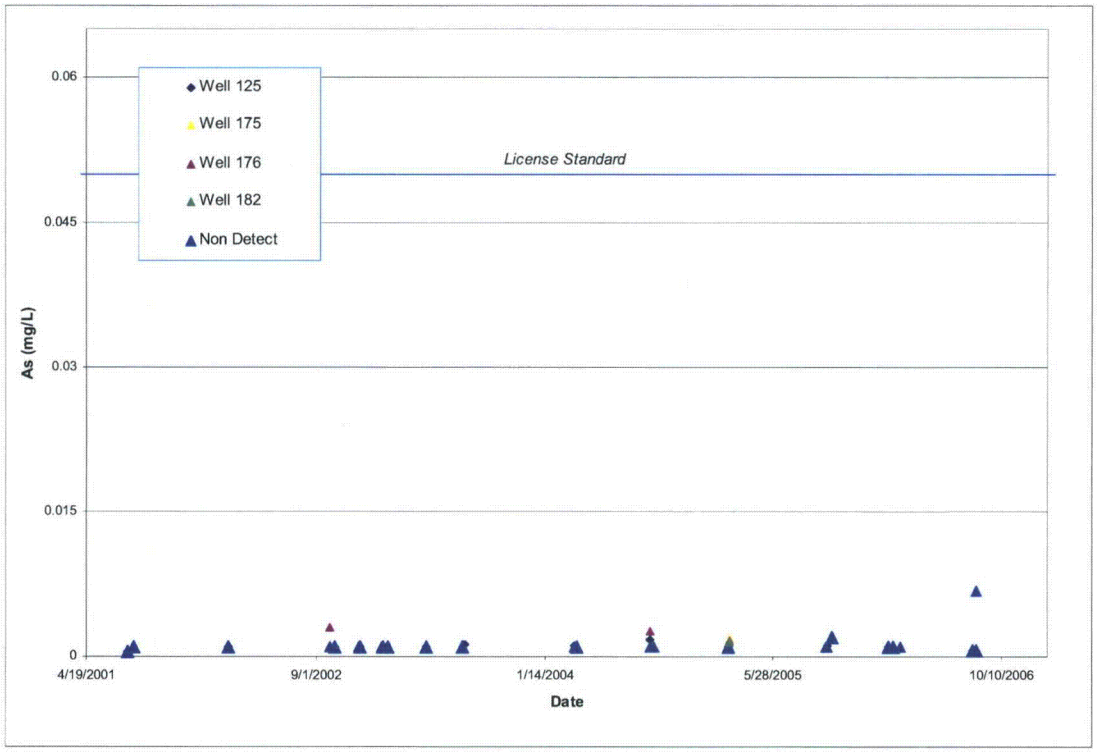

Figure 5.17 Arsenic Concentrations In POC Wells

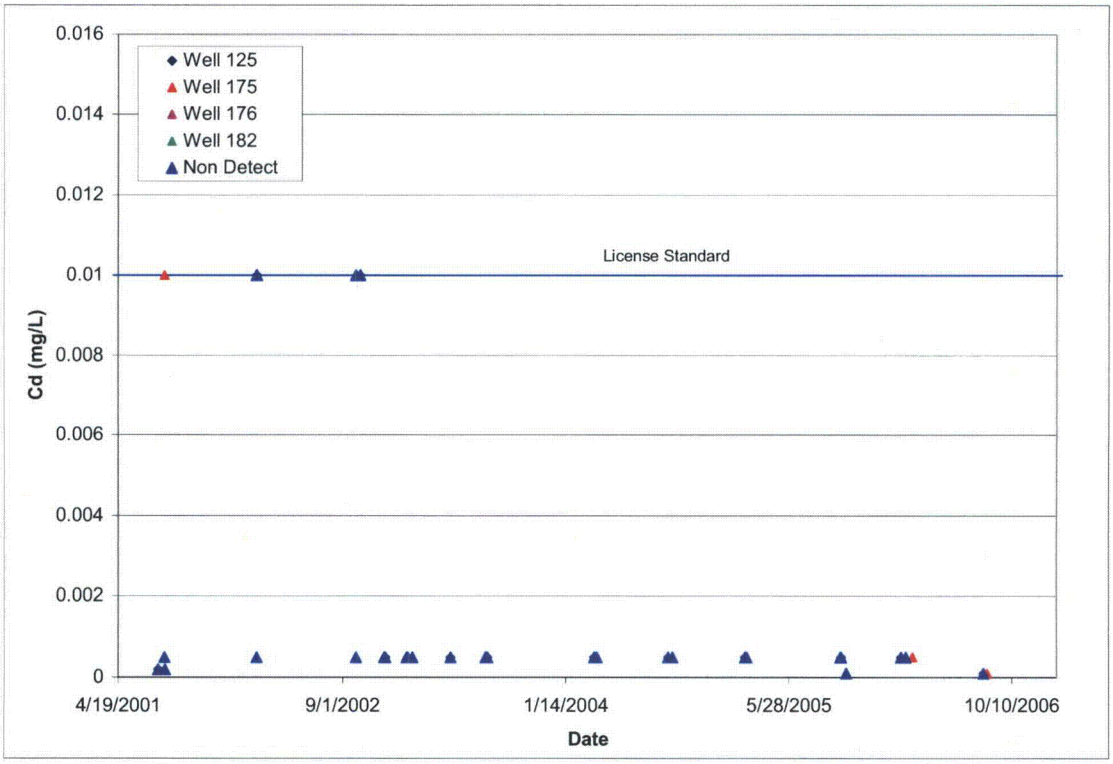

Figure 5.18 Cadmium Concentrations POC Wells

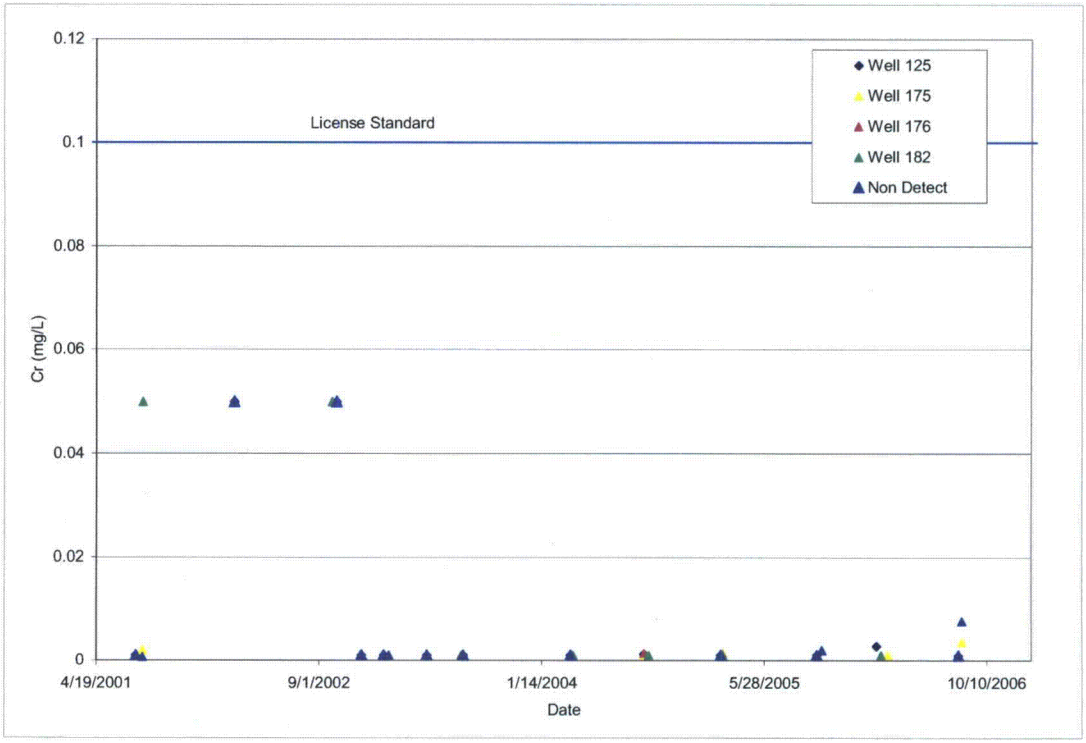

Figure 5.19 Chromium Concentrations in POC Wells

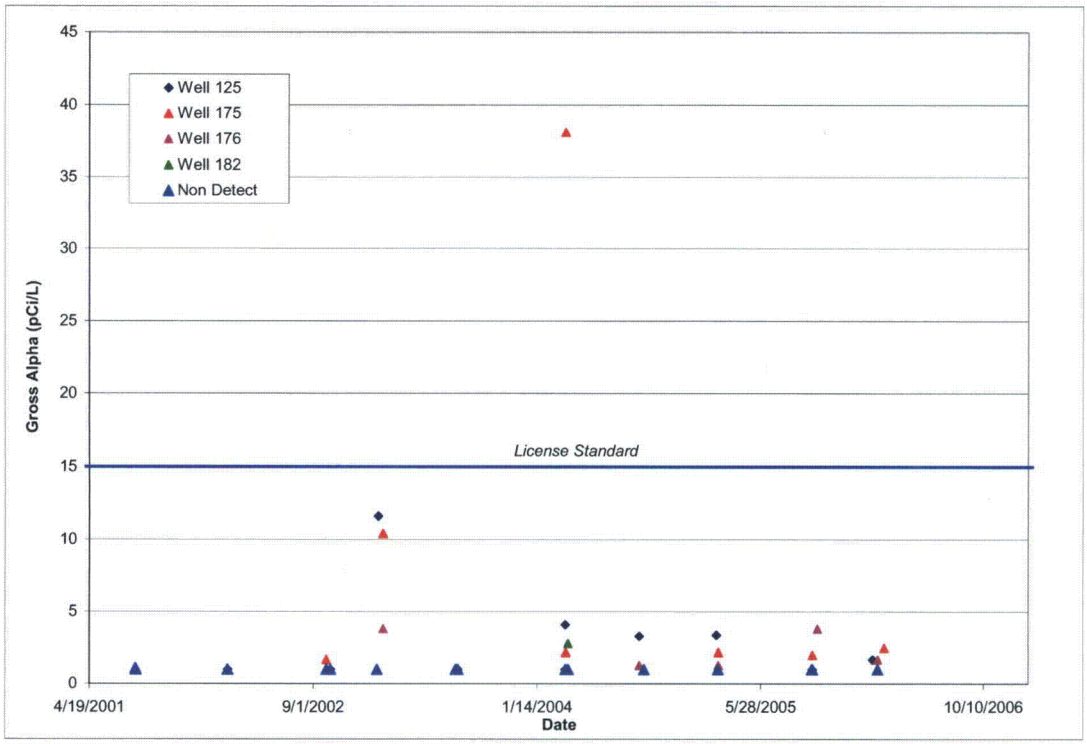

Figure 5.20 Gross-Alpha Concentrations in POC Wells

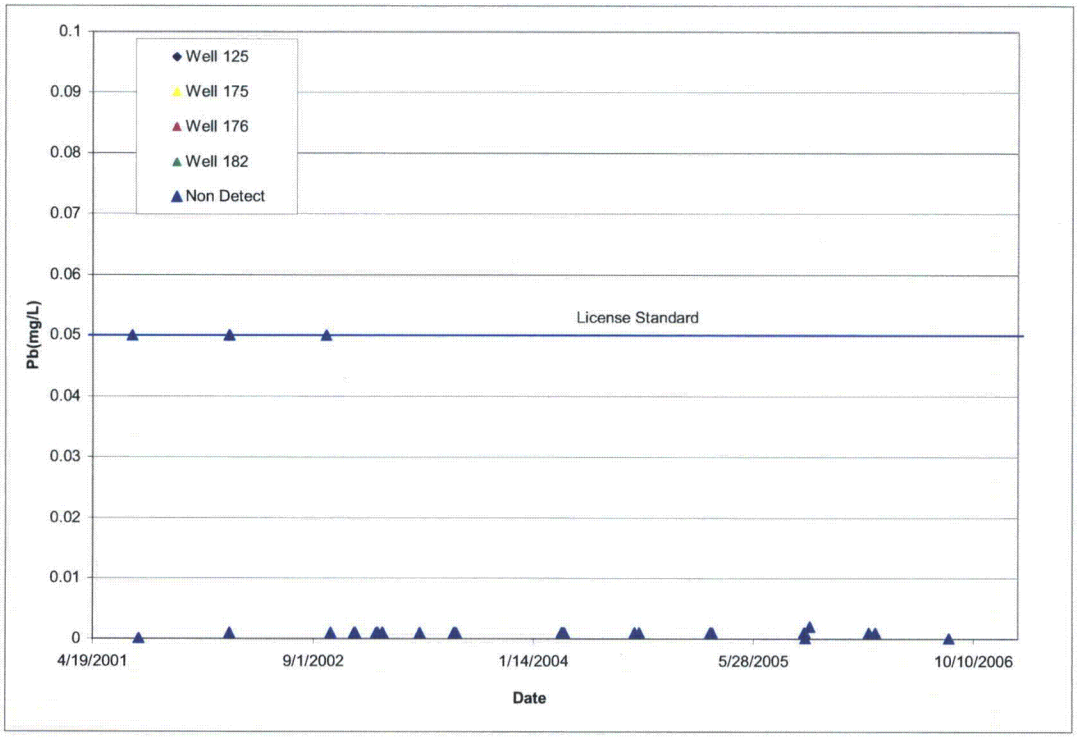

Figure 5.21 Lead Concentrations in POC Wells

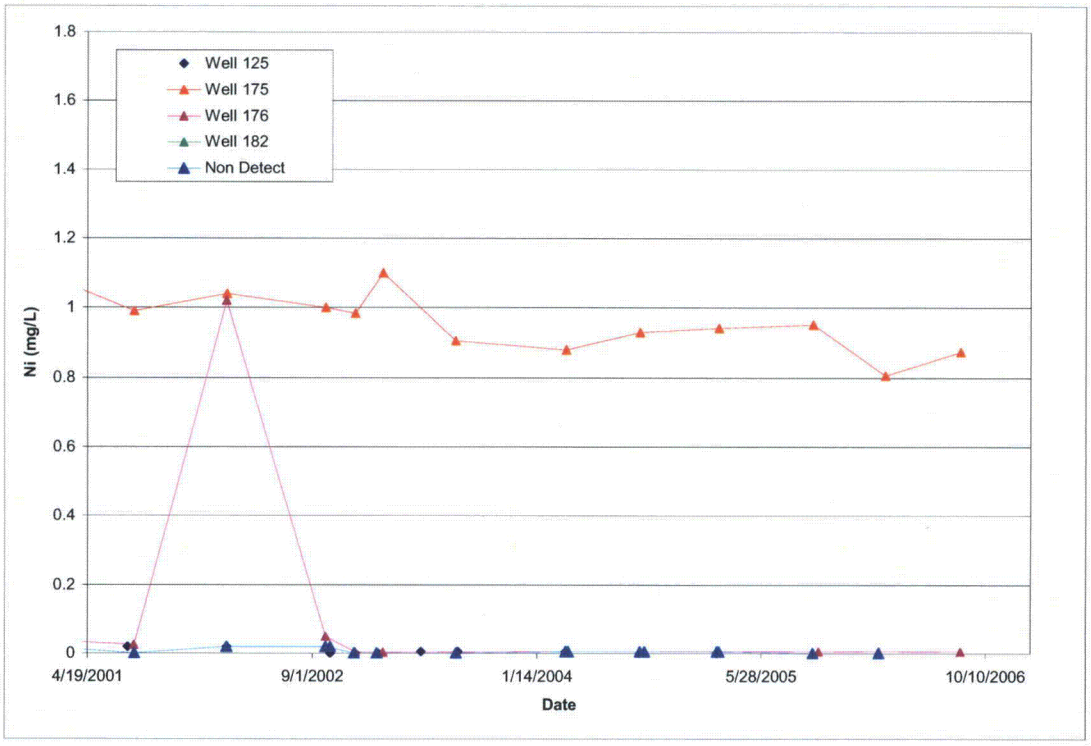

Figure 5.22 Nickel Concentrations in POC Wells

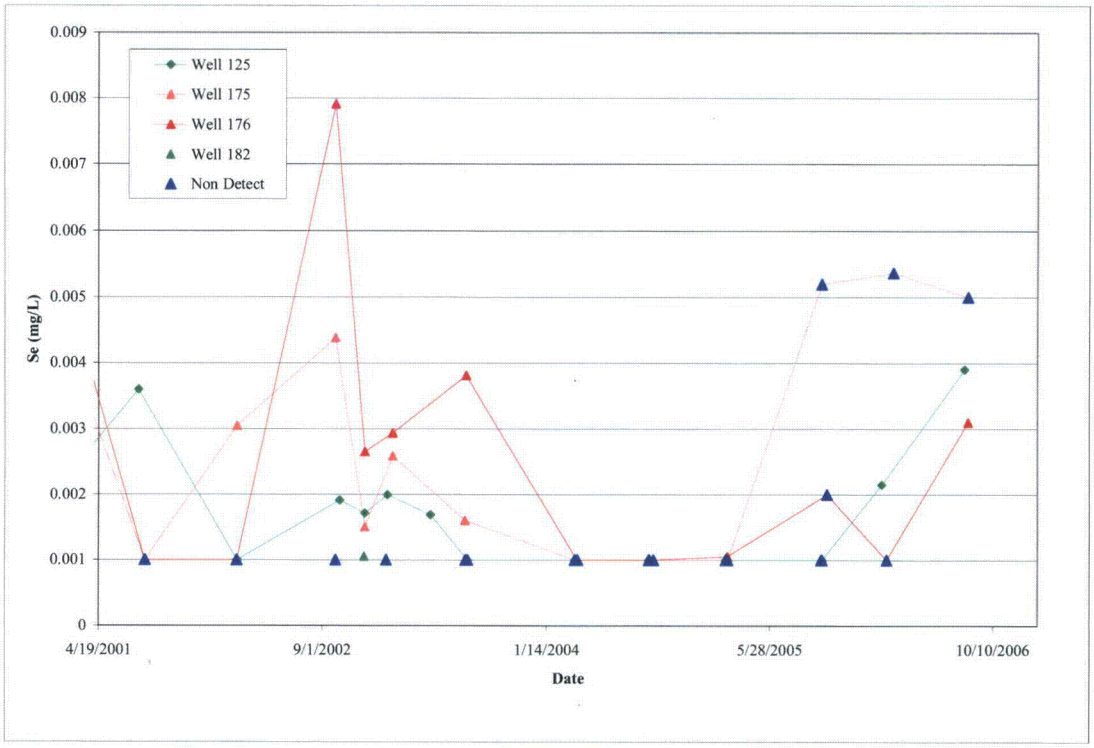

Figure 5.23 Selenium Concentrations in POC Wells

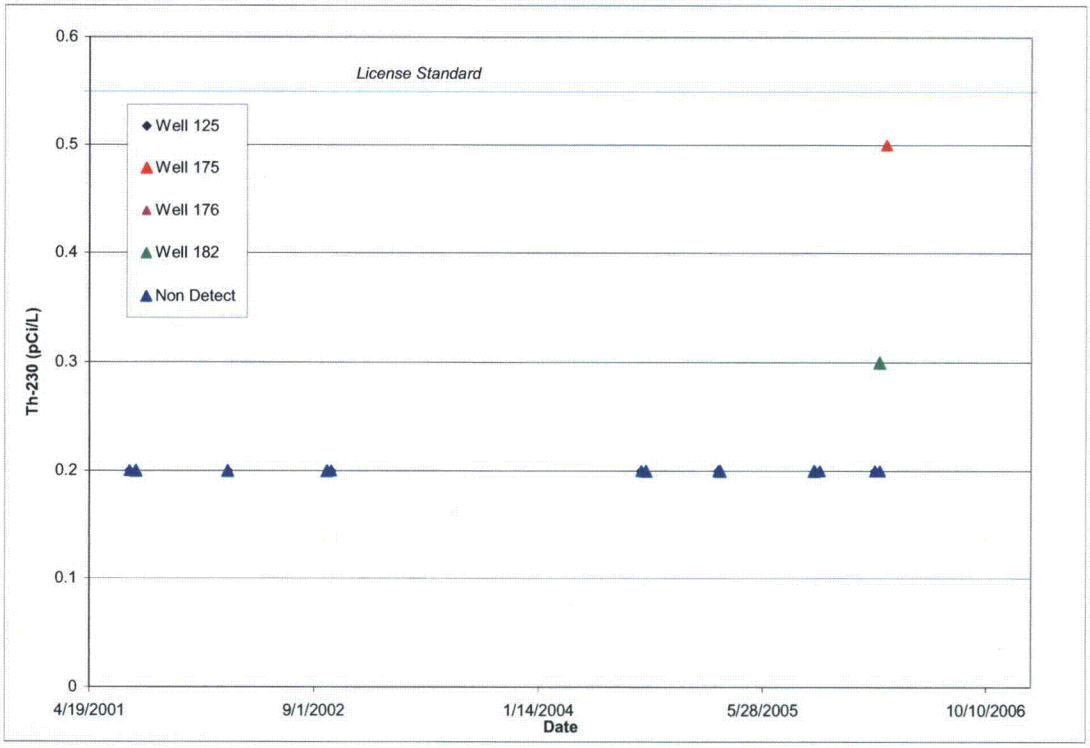

Figure 5.24 Thorium-230 Concentrations in POC Wells

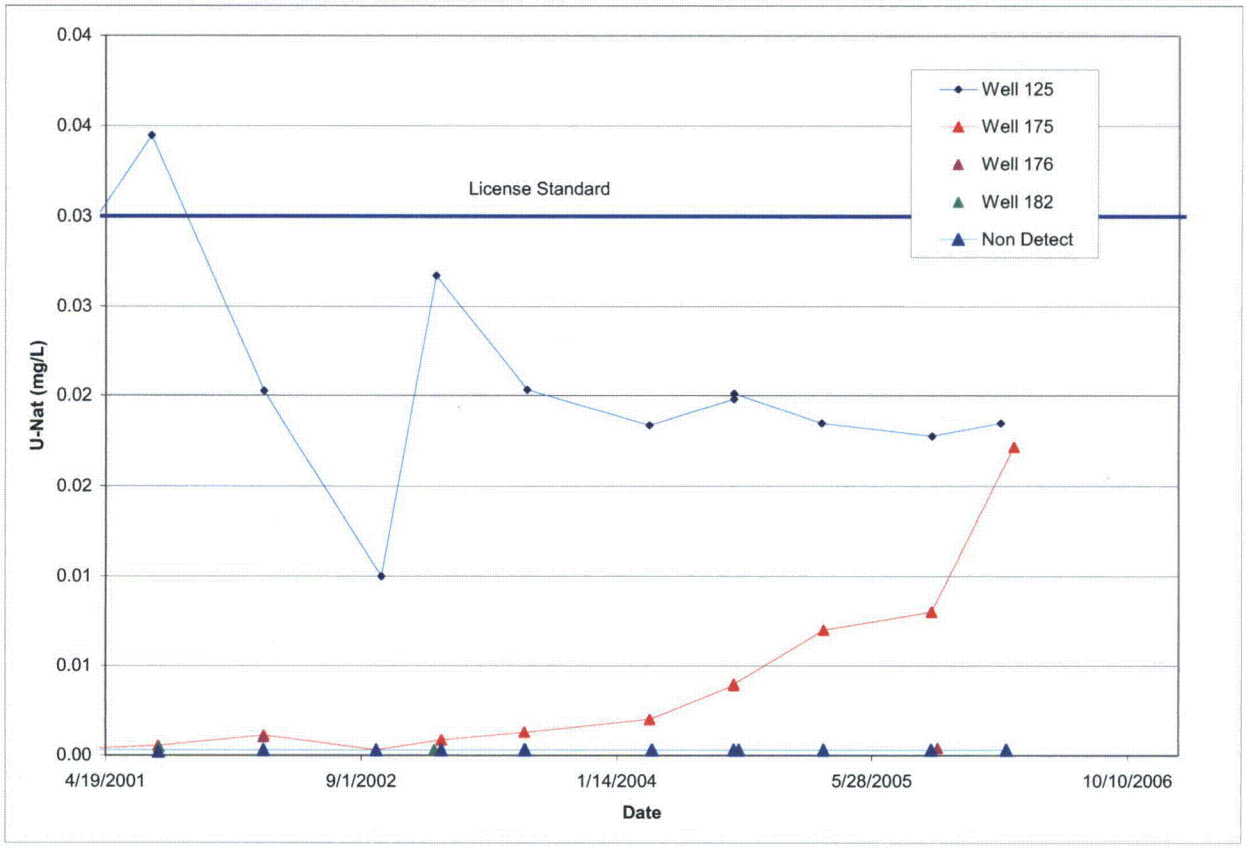

Figure 5.25 Uranium Concentrations in POC Wells