

*Office of Environmental Management – Grand Junction*



Environmental Air Monitoring Data  
Quarterly Report for the Moab and  
Crescent Junction, Utah, Sites  
Fourth Quarter 2012  
(October through December 2012)

March 2013



U.S. Department  
of Energy

**Office of Environmental Management**

**Moab UMTRA Project  
Environmental Air Monitoring Data Quarterly Report  
for the Moab and Crescent Junction, Utah, Sites  
Fourth Quarter 2012  
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**Revision 0**

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**Review and Approval**



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## 1.0 Summary of Results

### 1.1 Moab, Utah, Site

**Monitoring Period:** October through December 2012

#### Atmospheric Radon-222

U.S. Department of Energy (DOE) Order (O) 458.1, Administrative Change 2, “Radiation Protection of the Public and Environment,” establishes a guideline for atmospheric emissions of radon-222 that is applicable to the Moab Uranium Mill Tailings Remedial Action (UMTRA) Project. This guideline is 3.0 picocuries per liter (pCi/L) above background (established from stations 0117 and 0123). Based on 5 years of data from 2003 through 2008, the average background concentration of radon-222 in the Moab area was established as 0.7 pCi/L; therefore, the guideline for radon-222 emissions at the Moab site is 3.7 pCi/L. Monitoring data collected during the fourth quarter of 2012 indicate that this quarterly guideline was exceeded at location 0113, an on-site station near the site entrance. In general, fourth quarter results were similar to the previous winter quarterly data for locations near or on the Moab site, with higher levels normally recorded in the winter months. Stations 0106, 0107, and 0108 were lower than previous fourth quarter data. Remote locations were in line with historical data. Table 1 shows that one of the monitoring locations exceeded the quarterly limit, but the annual guideline was not exceeded. Table 2 shows summary radon-222 data for the Moab site. Monitoring locations for the Moab site are presented in Figures 1 and 2.

#### Direct Environmental Gamma Radiation

DOE O 458.1 establishes a public dose limit of 100 millirems per year (mrem/yr) above naturally occurring gamma levels (background). Average background gamma radiation for the Moab area was established as 82 mrem/yr; therefore, the public gamma dose limit for the Moab site is 182 mrem/yr (45.5 mrem/quarter [qtr]). Based on the monitoring data collected during the fourth quarter of 2012, three on-site monitoring locations exceeded the quarterly gamma dose guideline. No off-site monitoring location exceeded this limit.

Fourth quarter analytical results were similar to the third quarter of 2012. The results for stations immediately adjacent to the tailings pile have been elevated since the second quarter of 2009, indicating tailings pile influence within the DOE property as expected. Table 1 shows monitoring locations where the gamma dose guideline was exceeded, and Table 2 shows a summary of gamma data for the Moab site.

*Table 1. Moab Environmental Air Monitoring Locations with Samples that Exceeded Applicable Regulatory Standards, Limits, or Guidelines During the Past 12 Months*

Analyte	Guideline/Limit	Monitoring Locations Exceeding Quarterly Limit During 4th Quarter 2012	Monitoring Locations Exceeding Annual Guideline/Limit for the Past 12 Months
Radon-222	3.7 pCi/L	0113	0113
Direct Gamma Radiation	182 mrem/yr (45.5 mrem/qtr)	0109, 0110, 0112	0109, 0110, 0112

Table 2. Summary of Environmental Radon-222 and Gamma Radiation Monitoring Data for the Moab Site for the Past Year Through Fourth Quarter 2012

Station Number	1st Quarter 2012		2nd Quarter 2012		3rd Quarter 2012		4th Quarter 2012		Annual	
	Radon (pCi/L)	Gamma (mrem/91 d <sup>3</sup> )	Radon (pCi/L)	Gamma (mrem/91 d <sup>3</sup> )	Radon (pCi/L)	Gamma (mrem/91 d <sup>3</sup> )	Radon (pCi/L)	Gamma (mrem/91 d <sup>3</sup> )	Radon (pCi/L)	Total Gamma (mrem/yr)
<b>On-site Locations</b>										
0101	2.4	38.2	1.5	36.6	1.4	36.2	2.8	43.8	2.9803	154.8
0102	1.4	26.6	0.6	25.5	0.6	22.3	1.4	30.7	1.00	105.1
0103	1.6	25.9	0.6	23.9	0.7	21.9	2.3	28.8	1.30	100.5
0104	2.0	29.7	1.3	27.8	0.9	25.2	2.4	34.6	1.65	117.3
0105	2.5	26.9	1.8	25.4	0.9	22.9	3.2	31.5	2.10	106.7
0106	3.8	37.4	1.4	38.3	1.5	34.0	3.5	44.5	2.55	154.2
0107	4.1	31.5	2.0	31.7	1.2	27.6	3.3	36.9	2.65	127.7
0108	2.8	44.1	2.1	43.8	2.3	42.2	3.4*	52.0	2.65	182.1
0109	2.6	161.0	2.5	164.6	1.8	177.7	3.3	182.1	2.55	685.4
0110	1.5	94.4	1.5	92.6	1.6	99.2	1.5	100.8	1.53	387.0
0111	0.7	40.0	0.6	36.4	0.9	39.3	0.6	41.8	0.70	157.5
0112	1.9	51.3	1.5	50.6	1.3	48.7	2.2	56.7	1.73	207.3
0113	2.2	31.4	2.0	34.0	1.6	30.2	4.0	40.1	2.45	135.7
<b>Off-site Location</b>										
0117 <sup>1</sup>	0.7	24.5	0.4	23.6	<0.3	21.9	0.6	26.0	0.50	96.0
0118	0.6	22.6	0.3	23.0	0.4	20.3	0.4	27.0	0.43	92.9
0119 <sup>2</sup>	0.7	21.9	0.4	25.0	0.4	18.7	0.8	27.8	0.58	93.4
0120	0.4	20.8	0.3	24.0	0.3	18.1	0.7	27.6	0.43	90.5
0121	0.6	22.6	0.3	23.2	<0.3	19.5	0.8	26.4	0.50	91.2
0122	0.4	21.4	0.4	21.2	<0.3	18.2	0.3	23.8	0.35	84.6
0123 <sup>1</sup>	0.7	21.3	0.3	21.4	<0.3	18.9	0.4	23.4	0.43	85.0
0124	1.5	26.7	0.8	28.1	0.7	23.4	1.7	31.8	1.18	110.0
0125	1.9	29.9	0.9	32.4	0.7	27.0	1.6	35.0	1.28	124.3
0126	2.3	27.7	1.5	29.1	1.1	26.0	2.6	33.	1.88	116.4
0127	1.1	25.6	0.3	27.3	0.6	23.6	1.2	31.5	0.80	108.0
0128	2.4	27.9	1.1	24.7	1.1	23.0	2.4	28.5	1.75	104.1
0129	1.6	28.1	1.2	28.9	1.5	25.6	2.6	31.5	1.73	114.1
MEI <sup>2</sup>	1.2	21.9	0.8	20.6	0.6	18.6	2.0	23.5	1.15	84.6

MEI = maximally exposed individual; NDA = no data available (found on ground).

<sup>1</sup>Designated background monitoring locations. Background locations are sufficiently distant from the millsite to be free of any influences from potential site contaminants.

<sup>2</sup>The MEI is the continually occupied residential property that is closest to the DOE property boundary.

<sup>3</sup>mrem value is prorated to a 91-day (quarter) exposure period

\*Note – The duplicate radon reading for 0108 was 5.1, but primary unit was reported.

### Radon-222 and Direct Gamma Conclusion

Radon-222 results were below the annual guideline; however, one station exceeded the quarterly limit. Although radon and direct gamma exposure rates exceeded the quarterly or annual guidelines at several locations on the DOE property, these do not reflect elevated doses to the public. These data represent the exposure a member of the public could receive if he or she resided for an entire year at the point where the data were collected. However, no member of the public permanently resides at or near these locations. Monitoring data observed at the maximally exposed individual (MEI) location, just east of the Moab site, represent the greatest potential exposure to a member of the public. Neither the radon-222 guideline nor the public gamma dose limit established by DOE was exceeded at the MEI location.

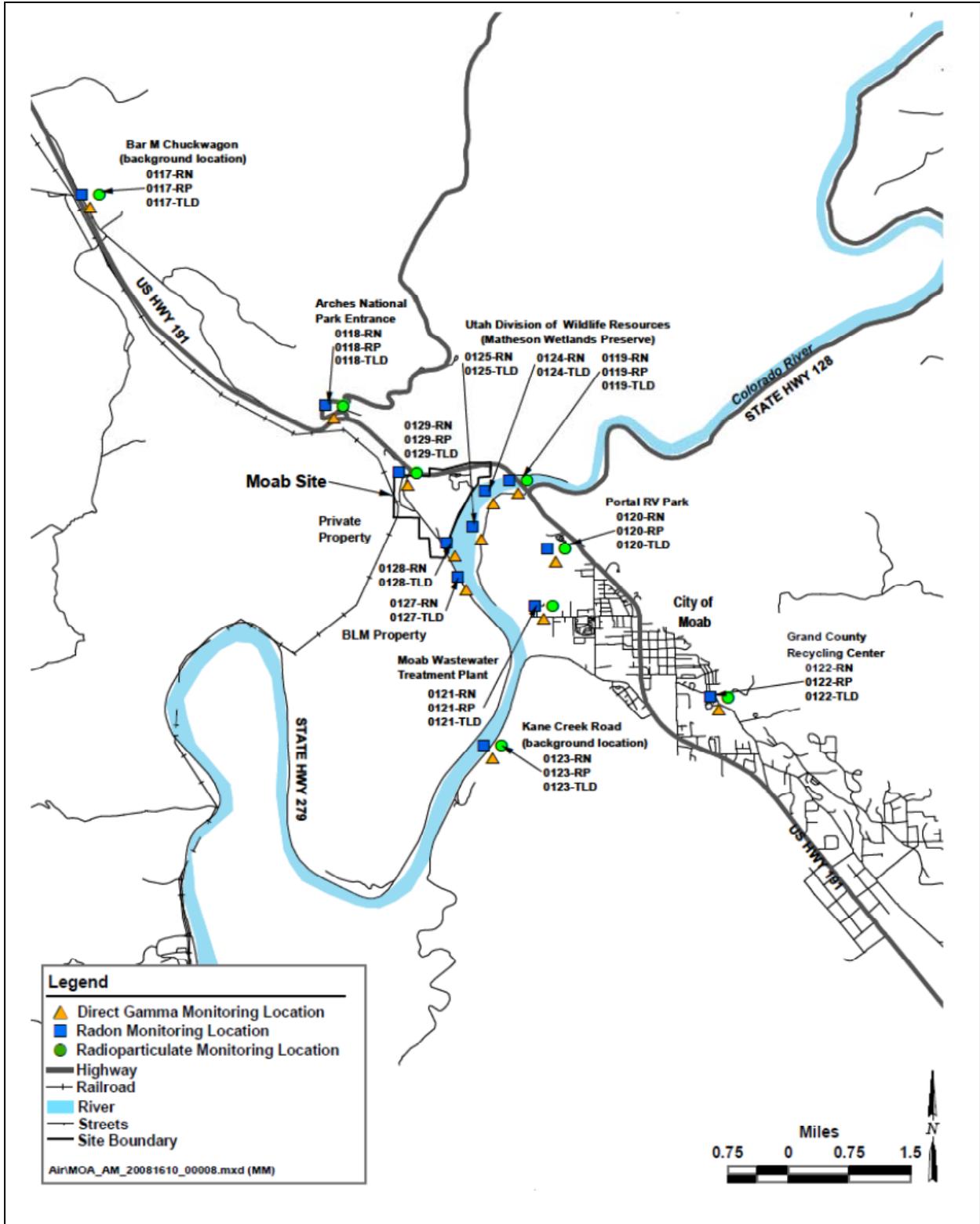


Figure 1. Moab Off-site Environmental Air Monitoring Locations

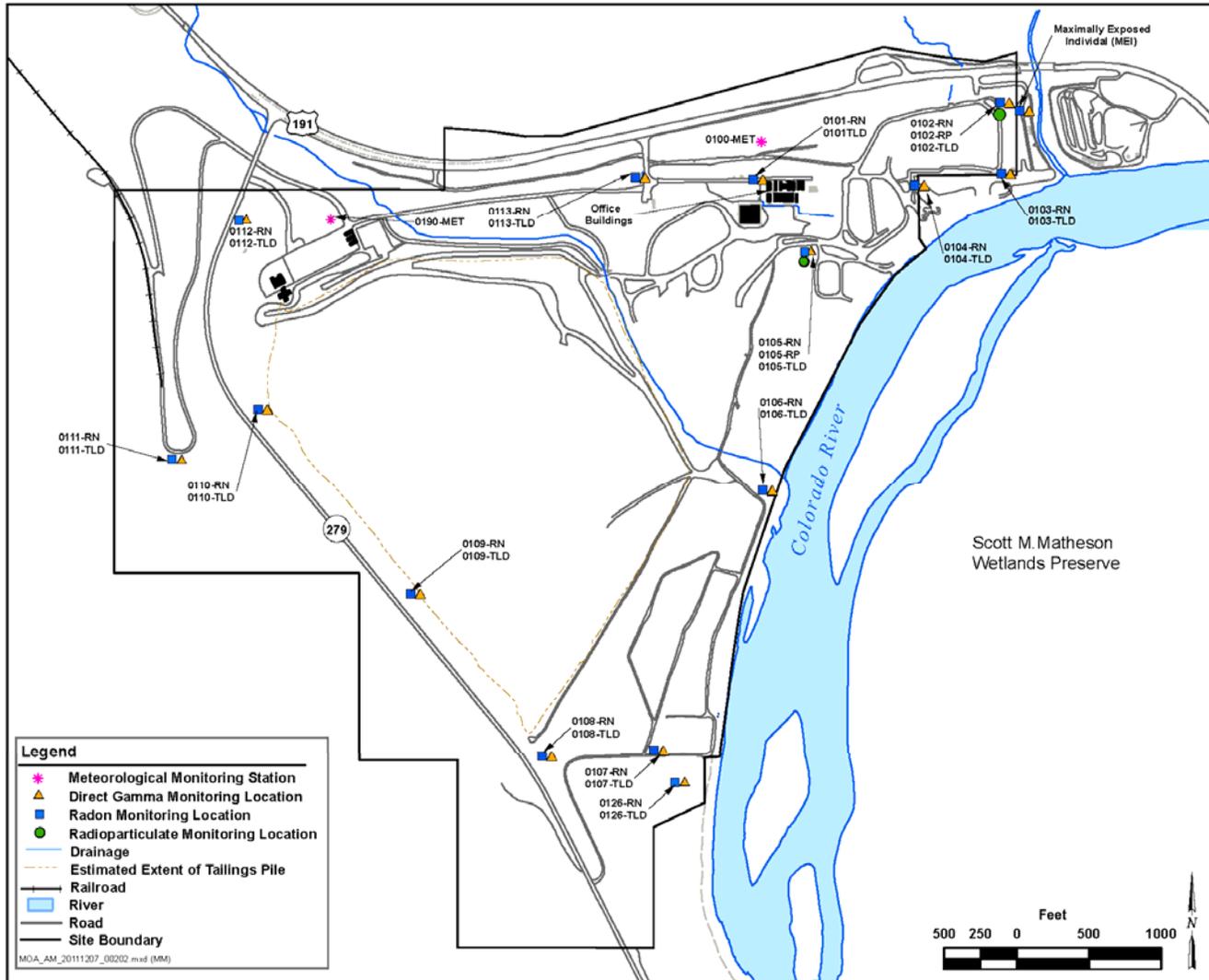


Figure 2. Moab On-site and MEI Environmental Air Monitoring Locations

## **Radioparticulates**

No radiological exposure limits were exceeded at any of the 10 radioparticulate monitoring locations at or near the Moab site during the fourth quarter of 2012. Analytical data for all analytes (total uranium, thorium-230, radium-226, and polonium-210) were below their respective derived concentration guidelines (DCGs), as found in Chapter 3 of DOE O 5400.1, "Environmental Protection Program," as shown in Table 3.

Concentrations of the radioparticulate have been consistently below DCGs since DOE assumed ownership of the site in 2001. DOE O 458.1 requires that the radiological public dose resulting from all airborne emissions is less than 10 mrem/yr (2.5 mrem/qtr). All on-site and off-site sampling results were lower than this dose limit during the fourth quarter of 2012.

During the fourth quarter of 2012, the on-site dose resulting from airborne emissions, excluding background, was 0.33 mrem (1.15 mrem/yr) at on-site location 0102 and 0.48 mrem (1.69 mrem/yr) at location 0105. Off-site locations 0117 and 0129 were 0.21 mrem (0.86 mrem/yr) and 0.74 mrem (3.64 mrem/yr), respectively, as shown in Table 3. Station 0129 is immediately downwind of the site operations. Although results are below the dose limit, stations closer to the site operations (0105 and 0129) indicate higher results than more remote stations (0102 and 0117), as would be expected. The DCG trend is down during the last year.

### **1.2 Crescent Junction, Utah, Site**

**Monitoring Period:** October through December 2012

Monitoring locations for the Crescent Junction site are presented in Figure 3. After mill tailings disposal began in 2009, monitoring location 0308 at the Crescent Junction site became the closest to operations, and station 0306 became the MEI location. Location 0307, approximately 5 miles east of the disposal site, represents the second greatest risk to the public after the MEI location, and locations 0301, 0305, and 0309 provide property line data for the disposal site. Stations 0306, 0307, and 0308 were utilized as background locations from the period before tailings disposal.

#### **Atmospheric Radon-222**

DOE O 458.1 establishes a guideline of 3.0 pCi/L above background for atmospheric emissions of radon-222 that is applicable to the Crescent Junction site. Shipment of uranium mill tailings to the Crescent Junction disposal cell commenced in the second quarter of 2009. Based on 3 years of data from 2006 to 2009, the background concentrations of radon-222 in the Crescent Junction area was established as 0.9 pCi/L; therefore, the guideline for radon-222 emissions at the Crescent Junction site is 3.9 pCi/L. During the fourth quarter of 2012, none of the on-site or off-site stations exceeded the guideline. Radon-222 data for the Crescent Junction site are summarized in Table 4.

#### **Direct Environmental Gamma Radiation**

DOE O 458.1 establishes a dose limit of 100 mrem/yr above naturally occurring gamma levels (background). Therefore, the gamma dose limit for the Crescent Junction site is 192.5 mrem/yr (48.1 mrem/qtr), including background. During the fourth quarter of 2012, no on-site or off-site station results exceeded the annual or quarterly gamma radiation dose limit. Refer to Table 5 for a summary of gamma data for the Crescent Junction site.

Table 3. Summary of Radioparticulate Air Monitoring Data  
for the Moab Site for the Past Year Through Fourth Quarter 2012

Station Number	Isotope	1st Quarter 2012 (μCi/mL)	2nd Quarter 2012 (μCi/mL)	3rd Quarter 2012 (μCi/mL)	4th Quarter 2012 (μCi/mL)	Annual Average (μCi/mL)	Annual Dose Based on Four Quarters (mrem/yr)
<b>On-site Locations</b>							
0102-RP	Uranium <sup>1</sup>	1.4E-16	2.2E-16	1.7E-16	1.5E-16	1.7E-16	1.15
	Thorium-230 <sup>2</sup>	1.4E-16	1.4E-16	1.7E-16	1.4E-16	1.5E-16	
	Radium-226 <sup>3</sup>	8.8E-17	1.4E-16	4.4E-17	2.1E-16	1.2E-16	
	Polonium-210 <sup>4</sup>	1.0E-14	4.9E-15	6.0E-15	9.3E-15	7.6E-15	
0105-RP	Uranium <sup>1</sup>	1.7E-16	2.5E-16	2.4E-16	2.2E-16	2.2E-16	1.69
	Thorium-230 <sup>2</sup>	2.7E-16	3.2E-16	3.7E-16	3.6E-16	3.3E-16	
	Radium-226 <sup>3</sup>	1.8E-16	2.0E-16	2.7E-16	2.3E-16	2.2E-16	
	Polonium-210 <sup>4</sup>	1.1E-14	6.2E-15	6.3E-15	9.8E-15	8.3E-15	
<b>Off-site Locations</b>							
0117-RP	Uranium <sup>1</sup>	1.1E-16	1.9E-16	1.5E-16	1.6E-16	1.5E-16	0.86
	Thorium-230 <sup>2</sup>	7.4E-17	1.1E-16	1.1E-16	6.5E-17	9.0E-17	
	Radium-226 <sup>3</sup>	2.6E-17	1.2E-16	6.9E-17	4.2E-17	6.4E-17	
	Polonium-210 <sup>4</sup>	7.9E-15	4.1E-15	6.2E-15	6.6E-15	6.2E-15	
0118-RP	Uranium <sup>1</sup>	1.6E-16	2.4E-16	1.7E-16	1.5E-16	1.8E-16	1.33
	Thorium-230 <sup>2</sup>	3.1E-16	2.6E-16	2.6E-16	1.8E-16	2.5E-16	
	Radium-226 <sup>3</sup>	8.4E-17	2.8E-16	5.6E-16	9.8E-17	2.6E-16	
	Polonium-210 <sup>4</sup>	8.7E-15	4.7E-15	6.3E-15	6.8E-15	6.6E-15	
0119-RP	Uranium <sup>1</sup>	1.2E-16	1.6E-16	1.5E-16	1.4E-16	1.4E-16	1.19
	Thorium-230 <sup>2</sup>	8.3E-17	2.6E-16	2.6E-16	1.8E-16	2.0E-16	
	Radium-226 <sup>3</sup>	7.5E-17	1.4E-16	6.8E-17	6.5E-17	8.7E-17	
	Polonium-210 <sup>4</sup>	9.4E-15	3.9E-15	6.3E-15	7.7E-15	6.8E-15	
0120-RP	Uranium <sup>1</sup>	1.2E-16	2.0E-16	1.6E-16	1.5E-16	1.6E-16	0.80
	Thorium-230 <sup>2</sup>	8.3E-17	1.2E-16	1.1E-16	7.7E-17	9.7E-17	
	Radium-226 <sup>3</sup>	6.8E-17	8.2E-17	2.9E-17	8.8E-17	6.7E-17	
	Polonium-210 <sup>4</sup>	6.9E-15	3.7E-15	5.3E-15	5.9E-15	5.4E-15	
0121-RP	Uranium <sup>1</sup>	1.2E-16	1.8E-16	1.7E-16	1.5E-16	1.5E-16	0.86
	Thorium-230 <sup>2</sup>	7.3E-17	1.3E-16	1.3E-16	6.4E-17	9.9E-17	
	Radium-226 <sup>3</sup>	1.1E-16	1.2E-16	1.1E-16	6.0E-17	1.0E-16	
	Polonium-210 <sup>4</sup>	7.7E-15	4.3E-15	5.9E-15	5.7E-15	5.9E-15	
0122-RP	Uranium <sup>1</sup>	1.2E-16	1.8E-16	1.3E-16	1.4E-16	1.4E-16	0.84
	Thorium-230 <sup>2</sup>	2.7E-17	8.7E-17	1.2E-16	1.1E-16	8.6E-17	
	Radium-226 <sup>3</sup>	1.1E-17	1.4E-16	2.8E-17	7.3E-17	6.3E-17	
	Polonium-210 <sup>4</sup>	8.0E-15	4.6E-15	5.9E-15	6.0E-15	6.1E-15	
0123-RP	Uranium <sup>1</sup>	1.2E-16	1.8E-16	1.4E-16	1.2E-16	1.4E-16	0.89
	Thorium-230 <sup>2</sup>	6.9E-17	1.1E-16	8.5E-17	1.1E-16	9.4E-17	
	Radium-226 <sup>3</sup>	8.4E-18	9.6E-17	5.0E-17	4.9E-17	5.1E-17	
	Polonium-210 <sup>4</sup>	8.5E-15	4.3E-15	6.0E-15	6.8E-15	6.4E-15	

Table 3. Summary of Radioparticulate Air Monitoring Data for the Moab Site for the Past Year Through Fourth Quarter 2012 (continued)

Station Number	Isotope	1st Quarter 2012 (µCi/mL)	2nd Quarter 2012 (µCi/mL)	3rd Quarter 2012 (µCi/mL)	4th Quarter 2012 (µCi/mL)	Annual Average (µCi/mL)	Annual Dose Based on Four Quarters (mrem/yr)
Off-site Locations (continued)							
0129-RP	Uranium <sup>1</sup>	2.8E-16	4.5E-16	2.8E-16	2.4E-16	3.1E-16	3.64
	Thorium-230 <sup>2</sup>	1.2E-15	1.4E-15	1.0E-15	7.6E-16	1.1E-15	
	Radium-226 <sup>3</sup>	1.0E-16	9.4E-16	6.3E-16	3.1E-16	5.0E-16	
	Polonium-210 <sup>4</sup>	9.6E-15	6.3E-15	7.9E-15	9.9E-15	8.4E-15	

µCi/mL = microcuries per milliliter

<sup>1</sup>DOE DCG for total uranium = 2.E-12

<sup>2</sup>DOE DCG for thorium-230 = 4.E-14

<sup>3</sup>DOE DCG for radium-226 = 1.E-12

<sup>4</sup>DOE DCG for polonium-210 = 1.E-12

## Radioparticulates

DOE O 5400.1 establishes DCGs for concentrations of radioparticulates in air. Concentrations of the radioparticulates have been consistently below DCGs since DOE began collecting radioparticulate data for the Crescent Junction site in 2006. The on-site dose resulting from airborne emissions was 1.28 mrem/yr at location 0308. The dose at location 0308 has trended downward since engineering controls were implemented to reduce the level of radioparticulates in this area and disposal activities were completed near this station.

Location 0306, the MEI, had a result of 0.75 mrem/yr. The other two Crescent Junction station results were similar to past data. Refer to Table 5 for a summary of radioparticulate air monitoring data for the Crescent Junction site.

## 2.0 Data Assessment

### 2.1 Data Assessment Summary

#### Atmospheric Radon-222 Analyses

Radon detectors were analyzed by LANDAUER, Inc., “Quality Assurance Manual for Radon Monitoring Services.” Fourth quarter 2012 analytical radon-222 data were received in a report dated January 10, 2013. When detectors were missing, damaged, or could not be read, the laboratory noted an explanation for the stations. After the data report was received, Project personnel evaluated the data for consistency with other data points and sample duplicates.

#### Direct Environmental Gamma Radiation Analyses

Thermoluminescent dosimeters (TLDs) are used for continuous dose measurements and are analyzed by Environmental, Inc., Midwest Laboratory in accordance with its analytical procedures, “Preparation and Readout of Teledyne Isotopes TLD Card, TIML-TLD-01.” Fourth quarter 2012 environmental gamma radiation data were received in a report dated January 25, 2013. After the laboratory results were received, the Project evaluated the data for consistency and compared it to historical data and sample duplicates.

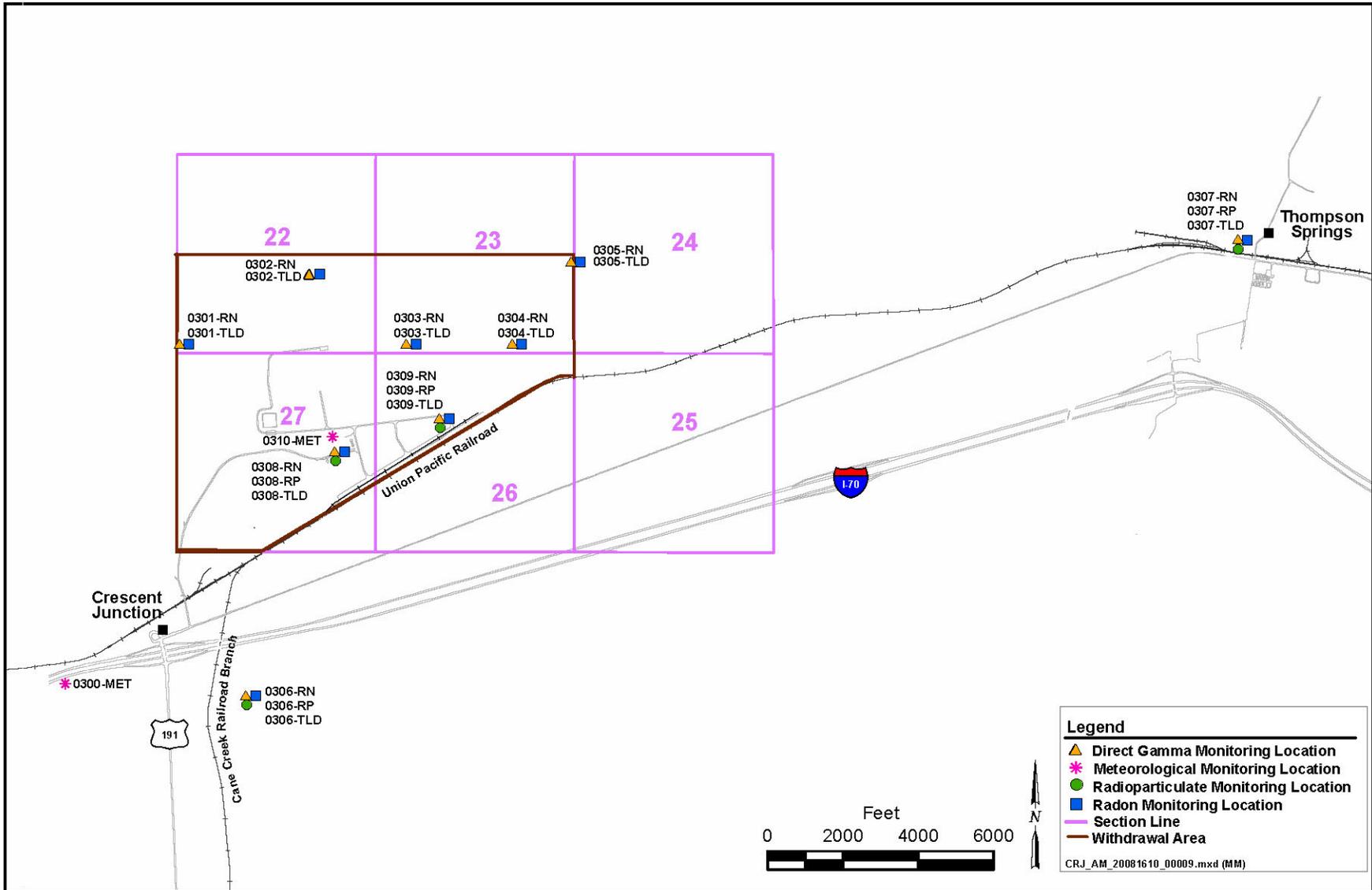


Figure 3. Crescent Junction Site Environmental Air Monitoring Locations

Table 4. Summary of Environmental Radon-222 and Gamma Radiation Monitoring Data for the Crescent Junction Site for the Past Year Through Fourth Quarter 2012

Station Number	1st Quarter 2012		2nd Quarter 2012		3rd Quarter 2012		4th Quarter 2012		Annual	
	Radon (pCi/L)	Gamma (mrem/91 d <sup>1</sup> )	Radon (pCi/L)	Gamma (mrem/91 d <sup>1</sup> )	Radon (pCi/L)	Gamma (mrem/91 d <sup>1</sup> )	Radon (pCi/L)	Gamma (mrem/91 d <sup>1</sup> )	Average Radon (pCi/L)	Total Gamma (mrem/yr)
0301	0.7	23.5	0.5	23.2	0.7	23.5	0.7	24.725.5	0.65	95.7
0302	0.6	24.1	0.8	24.1	0.4	24.4	0.7	25.727.1	0.63	99.7
0303	1.0	26.5	0.6	25.5	0.4	27.6	0.9	28.9	0.73	108.5
0304	0.9	27.5	0.6	23.3	0.6	28.7	0.9	26.8	0.75	106.3
0305	1.1	29.2	1.2	26.3	0.8	29.7	1.1	29.6	10.5	114.8
0306 <sup>2</sup>	0.4	26.8	0.3	25.5	0.4	27.9	0.8	28.3	0.48	108.5
0307	0.5	28.0	0.4	27.2	<0.3	29.6	0.7	29.6	0.48	114.4
0308	1.1	22.3	1.1	23.2	1.0	23.9	2.2	27.2	1.3	96.6
0309	1.2	22.9	0.7	25.5	0.6	24.1	1.2	27.8	0.93	100.3

<sup>1</sup>mrem/91 d = value is prorated to a 91-day (quarter) exposure period.

<sup>2</sup>MEI location.

Table 5. Summary of Radioparticulate Air Monitoring Data for the Crescent Junction Site for the Past Year Through Fourth Quarter 2012

Station Number	Isotope	1st Quarter 2012 (μCi/mL)	2nd Quarter 2012 (μCi/mL)	3rd Quarter 2012 (μCi/mL)	4th Quarter 2012 (μCi/mL)	Annual Average (μCi/mL)	Annual Dose Based on Four Quarters (mrem/yr)
MEI or 0306-RP	Uranium <sup>1</sup>	1.1E-16	1.3E-16	1.3E-16	1.2E-16	1.2E-16	0.75
	Thorium-230 <sup>2</sup>	6.3E-17	7.5E-17	5.7E-17	6.1E-17	6.4E-17	
	Radium-226 <sup>3</sup>	3.6E-17	2.2E-17	3.8E-17	8.8E-17	4.6E-17	
	Polonium-210 <sup>4</sup>	6.4E-15	4.1E-15	6.4E-15	6.3E-15	5.8E-15	
0307-RP	Uranium <sup>1</sup>	1.1E-16	1.6E-16	1.5E-16	1.1E-16	1.3E-16	0.71
	Thorium-230 <sup>2</sup>	5.8E-17	8.0E-17	7.3E-17	4.6E-17	6.4E-17	
	Radium-226 <sup>3</sup>	1.3E-16	6.5E-17	3.0E-17	6.7E-17	7.3E-17	
	Polonium-210 <sup>4</sup>	6.5E-15	3.8E-15	6.1E-15	5.2E-15	5.4E-15	
0308-RP	Uranium <sup>1</sup>	1.5E-16	1.4E-16	1.7E-16	1.1E-16	1.4E-16	1.28
	Thorium-230 <sup>2</sup>	3.1E-16	1.3E-16	3.3E-16	1.8E-16	2.4E-16	
	Radium-226 <sup>3</sup>	1.5E-16	1.1E-16	1.6E-16	1.1E-16	1.3E-16	
	Polonium-210 <sup>4</sup>	8.7E-15	4.1E-15	7.2E-15	6.3E-15	6.6E-15	
0309-RP	Uranium <sup>1</sup>	1.20E-16	1.2E-16	1.4E-16	1.5E-16	1.3E-16	1.50
	Thorium-230 <sup>2</sup>	2.2E-16	1.3E-16	1.8E-16	2.4E-16	1.9E-16	
	Radium-226 <sup>3</sup>	6.7E-17	1.3E-16	6.0E-17	9.5E-17	8.8E-17	
	Polonium-210 <sup>4</sup>	6.9E-15	1.1E-14	1.1E-14	1.1E-14	1.0E-14	

<sup>1</sup>DOE DCG for Total Uranium = 2.E-12

<sup>2</sup>DOE DCG for Thorium-230 = 4.E-14

<sup>3</sup>DOE DCG for Radium-226 = 1.E-12

<sup>4</sup>DOE DCG for Polonium-210 = 1.E-1

### **Radioparticulate Analyses**

ALS Environmental analyzed the radioparticulate samples. Total uranium was analyzed by inductively coupled plasma-mass spectrometry, Environmental Protection Agency (EPA) method SW-846 6020A, procedure PA SOP827, Revision 5. Isotopic thorium (includes thorium-230) and polonium-210 were analyzed by alpha spectroscopy, method PA-SOP714R10. Radium-226 was analyzed by radon emanation method, EPA method 903.1(m). Fourth quarter 2012 radioparticulate analytical data were received in report identification number 1212327 dated January 28, 2013. The Project reviewed and validated the data for consistency and compared results to historical data.

### **Duplicate Sampling**

Duplicate samples for radon-222 were collected at three Moab locations: (1) 0108, an on-site location near the southern toe of the tailings pile; (2) 0111, an on-site location at the western property line near the rail load-out area; and (3) 0121, a location approximately 2 miles southeast of the Moab site. Duplicate measurements of direct gamma were taken at two Moab locations: (1) 0108, an on-site location with elevated readings; and (2) 0129, an off-site location near the northern property boundary. Duplicate radon-222 measurements were collected at Crescent Junction locations 0303 and 0308. Duplicate direct gamma measurements were taken at Crescent Junction locations 0301 and 0305, which were random locations with potentially high readings.

Duplicates are not being collected for radioparticulate samples per the *Moab UMTRA Project Environmental Air Monitoring Sampling and Analysis Plan* (DOE-EM/GJRAC1434). Results of isotopic analysis for all of the radioparticulate samples collected to date have been below their respective DCGs. Consequently, the additional costs associated with purchasing a duplicate sampler, providing electrical power, and procuring analytical analyses are not justified.

### **Suspected Anomalies**

All analytical data are reviewed for anomalous or outlying data points. No anomalous data were noted for the fourth quarter of 2012; however, the duplicate for station 0108 was significantly higher (5.1 versus 3.48) than reported result and will be checked in the future. A high quarterly radon reading (4.0) for station 0113 was noted, and will be watched to see if it was an anomaly. Direct gamma data was similar to historic data, with continued elevated gamma readings for stations 0108, 0109, 0110, and 0112 (since tailings pile excavation started), which are close to the excavation activity. The quarterly review consists of evaluating monitoring data against historical and minimum/maximum values to determine if the reported data are within reasonable expected ranges.

### **Summary**

Data collected during the fourth quarter of 2012 met the applicable laboratory control criteria for their respective analyses, and all data were reviewed by qualified personnel. The results were found to be within the acceptable limits associated with each matrix. Data reported in this environmental air monitoring report are considered validated and may be treated as final results. The checklist protocol summary of field observation for the fourth quarter of 2012 is shown in Section 4.0.

## 3.0 Environmental Air Monitoring Data

### 3.1 Environmental Air Monitoring Data Summary

Tables 2 through 5 summarize radon-222, direct gamma radiation, and radioparticulate data for the Moab and Crescent Junction sites. Time-concentration graphs have been plotted for selected locations for each component of the monitoring program. The rationale used for selecting each location is summarized below.

#### Radon-222 and Direct Gamma Radiation

Radon-222 data were plotted on a graph (Figure 8) for the following Moab site monitoring locations: (1) 0108, which occasionally has elevated radon levels; (2) location 0120, which is near the Portal RV Park, approximately 1 mile southeast of the Moab site, and represents potential exposure to the public; (3) 0129, which is directly downwind of operations; and (4) the MEI.

Gamma radiation data were plotted on a graph (Figure 9) for the following Moab site monitoring locations: (1) 0106, which is along the eastern property boundary and has previously recorded elevated direct gamma radiation; (2) 0110 and 0112, which were both plotted as on-site locations directly adjacent to the tailings pile with high readings; (3) 0117, which is approximately 5 miles northwest of the Moab site property and is a background monitoring location; (4) 0120, an off-site location between the site and city of Moab; (5) 0129, which is downwind and near the northern property boundary; and (6) the MEI.

Radon-222 and gamma radiation data were plotted on graphs (Figures 14 and 15, respectively) for the following Crescent Junction monitoring locations: (1) 0302, which is close to the northern side of operations; (2) 0306 and 0307, which are off-site stations closest to members of the public; (3) 0308, which is close to the southern side of operations; and (4) 0309, which is downwind of operations.

#### Radioparticulates

Radioparticulate monitoring data were plotted on graphs (Figures 4 through 7) for the following Moab site locations: (1) 0102, which is the station closest to the MEI; (2) 0105, which is closest to the emissions source (i.e., the mill tailings pile); (3) 0117, which is a background monitoring location approximately 5 miles northwest of the Moab site property and represents ambient or naturally occurring conditions; (4) 0120, which is approximately 1 mile southeast of the Moab site and represents an off-site location between the site and Moab; and (5) 0129, which is directly downwind of operations with the greatest potential impact from operations.

Radioparticulate monitoring data were plotted on graphs (Figures 10 through 13) for the following Crescent Junction site locations: 0306, 0307, 0308, and 0309. These locations were selected for the same reasons as stated for radon-222 and gamma radiation.

## 4.0 Environmental Air Monitoring Field Activities Verification Checklist

Project	Moab/Crescent Junction, Utah	Date(s) of Air Sampling	October-December 2012
Date(s) of Verification	February 22, 2013	Name of Verifier	Ed Baker
	Response (Yes, No, NA)	Comments	
1. Is the Sampling and Analysis Plan the primary document directing field procedures?	Yes		
2. Were the sampling locations specified in the Sampling and Analysis Plan?	Yes		
3. Were low-volume air samplers on and operating at or near 60 liters/minute $\pm$ 10%?	No	Power outage at stations 118, 119, and 123, required GFI reset	
4. Did any of the samplers require airflow adjustment?	No	All pumps were recalibrated to 60 liters/minute both at the beginning and the end of the sampling period.	
5. Were detectors (radon cups, TLDs) and monitoring equipment found to be undisturbed and in operable condition upon arrival?	Yes		
6. Were the hourly clocks on the low-volume air samplers operational upon arrival?	No	Hour meter at 123 was replaced, and hours were estimated for the week.	
7. Were the run times recorded for each radioparticulate monitoring location?	Yes		
8. Were duplicates (for radon-222 and gamma radiation) taken at a frequency of one per 20 samples?	Yes		
9. Were filter blanks (for radioparticulates) taken at a frequency of one per 20 samples?	No	Not required per the Sampling and Analysis Plan.	
10. Were trip blanks (for radon-222 and gamma radiation) included with each shipment?	No	A trip blank is not used for the radon-222 monitoring because units are sealed; however, a trip blank was used for the direct gamma radiation monitoring.	
11. Was the identity of the quality-control sample locations protected?	Yes		
12. Were the true locations of the quality-control samples recorded in the Field Log Book?	Yes		
13. Were all samples collected as specified in the Sampling and Analysis Plan?	Yes		
14. Were chain of custody records completed, and was sample custody maintained?	Yes		
15. Are field data sheets signed and dated by sampling personnel?	Yes		
16. Was all other pertinent information documented on the field data sheets?	Yes		

## 4.0 Environmental Air Monitoring Field Activities Verification Checklist (continued)

<b>Project</b>	Moab/Crescent Junction, Utah	<b>Date(s) of Air Sampling</b>	October-December 2012
<b>Date(s) of Verification</b>	February 22, 2013	<b>Name of Verifier</b>	Ed Baker

	<b>Response (Yes, No, NA)</b>	<b>Comments</b>
17. Were the true locations of the quality-control samples recorded in the Field Log Book?	Yes	
18. Were all samples collected as specified in the Sampling and Analysis Plan?	Yes	
19. Were chain of custody records completed, and was sample custody maintained?	Yes	
20. Are field data sheets signed and dated by sampling personnel?	Yes	
21. Was all other pertinent information documented on the field data sheets?	Yes	

## 5.0 References

*Data Review and Validation Report for RIN 1212327*, ALS Environmental, Inc., Fort Collins, Colorado, January 28, 2013.

DOE (U.S. Department of Energy), *Moab UMTRA Project Environmental Air Monitoring Sampling and Analysis Plan* (DOE-EM/GJRAC1434), July 2010.

DOE (U.S. Department of Energy), Order 458.1, Administrative Change 2, "Radiation Protection of the Public and Environment."

DOE (U.S. Department of Energy), Order 5400.1, "Environmental Protection Program."

Environmental, Inc., Midwest Laboratory, "Preparation and Readout of Teledyne Isotopes TLD Card," TIML-TLD-01, Revision 7 Teledyne Isotopes, 2001.

LANDAUER, Inc., "Quality Assurance Manual for Radon Monitoring Services," March, 2004.

### Moab Radioparticulate Concentration (Po-210)

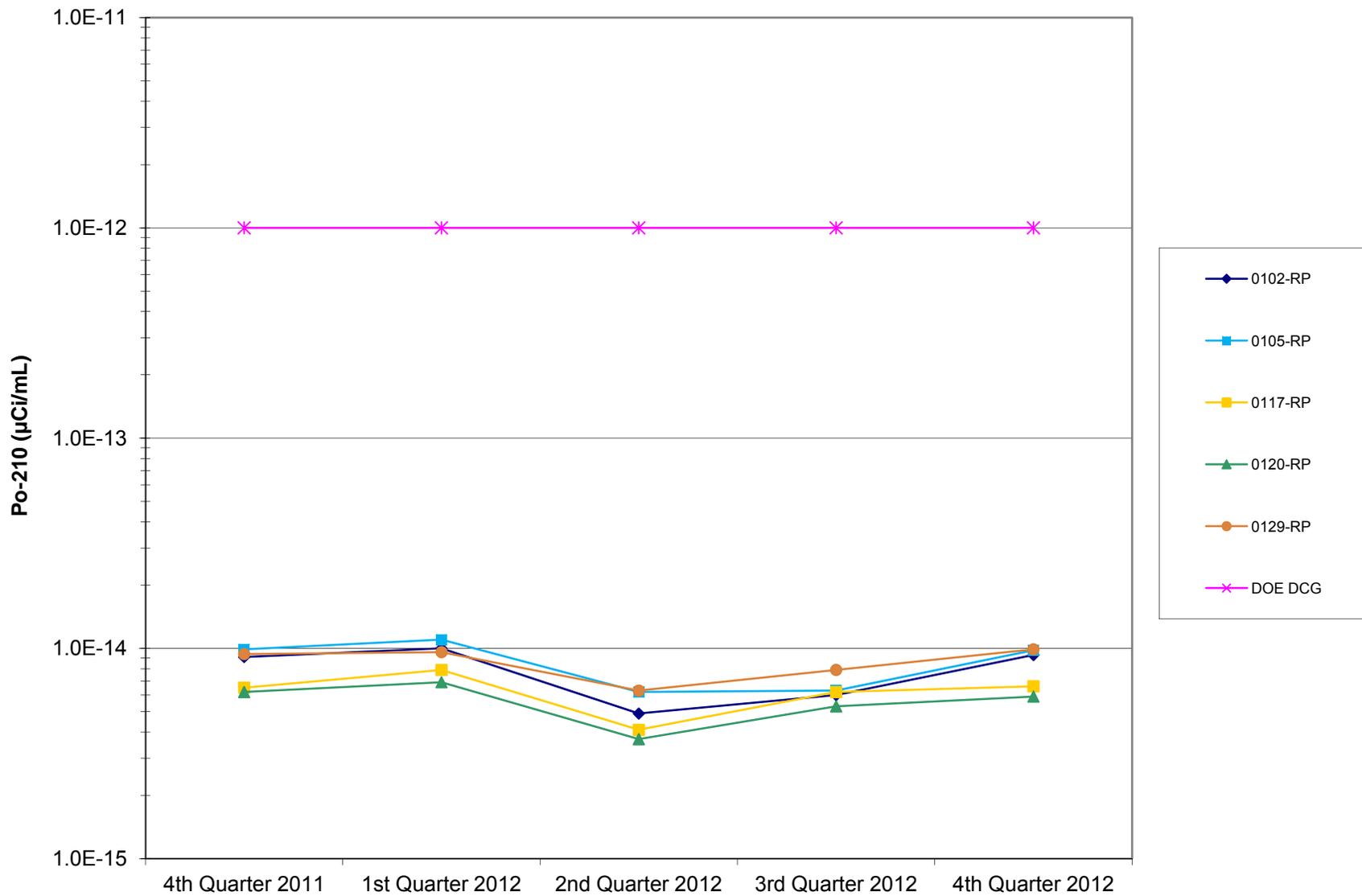


Figure 4. Polonium-210 Concentrations at Select Moab Monitoring Locations

### Moab Radioparticulate Concentration (Th-230)

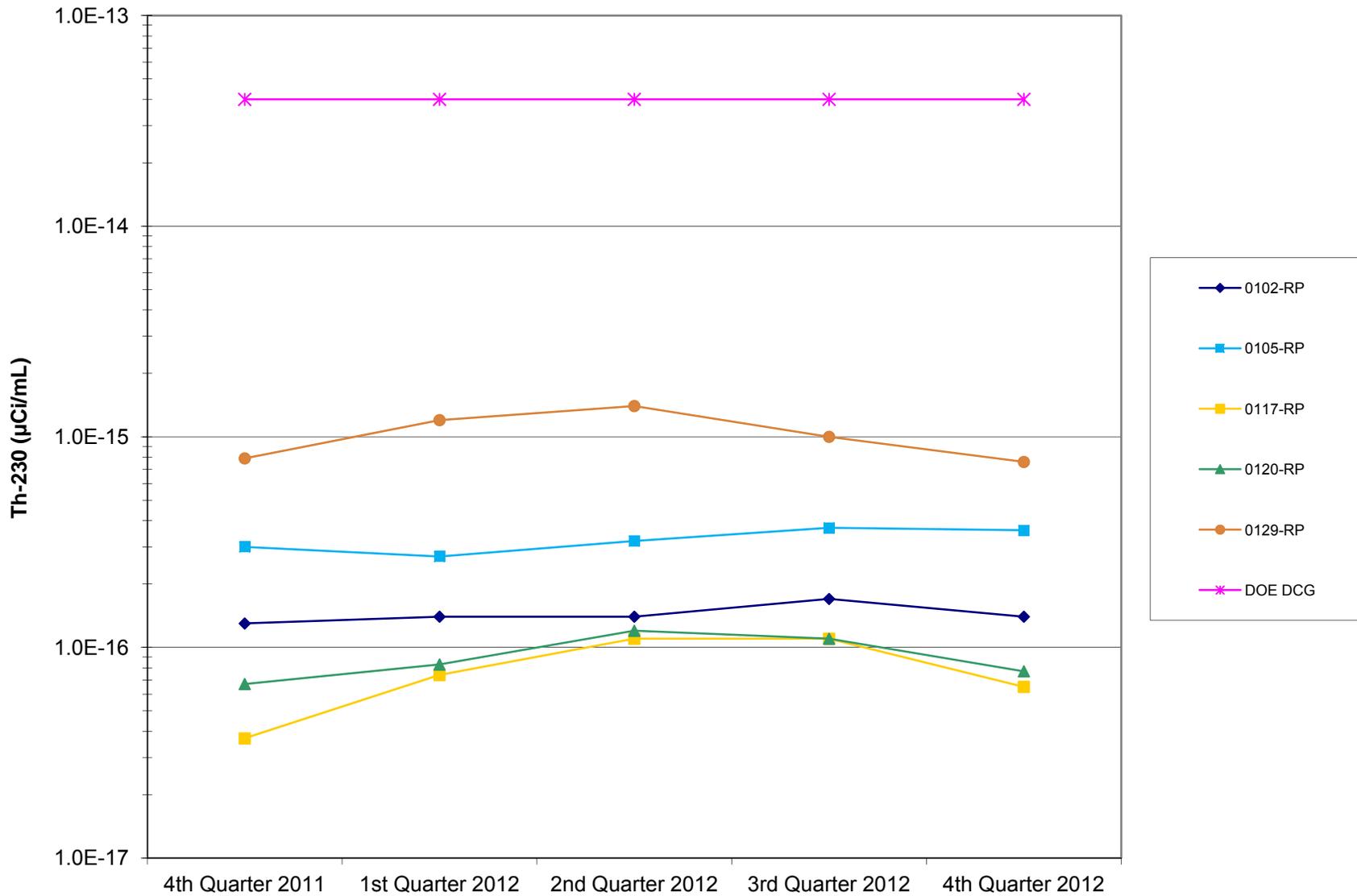


Figure 5. Thorium-230 Concentrations at Select Moab Monitoring Locations

### Moab Radioparticulate Concentration (Ra-226)

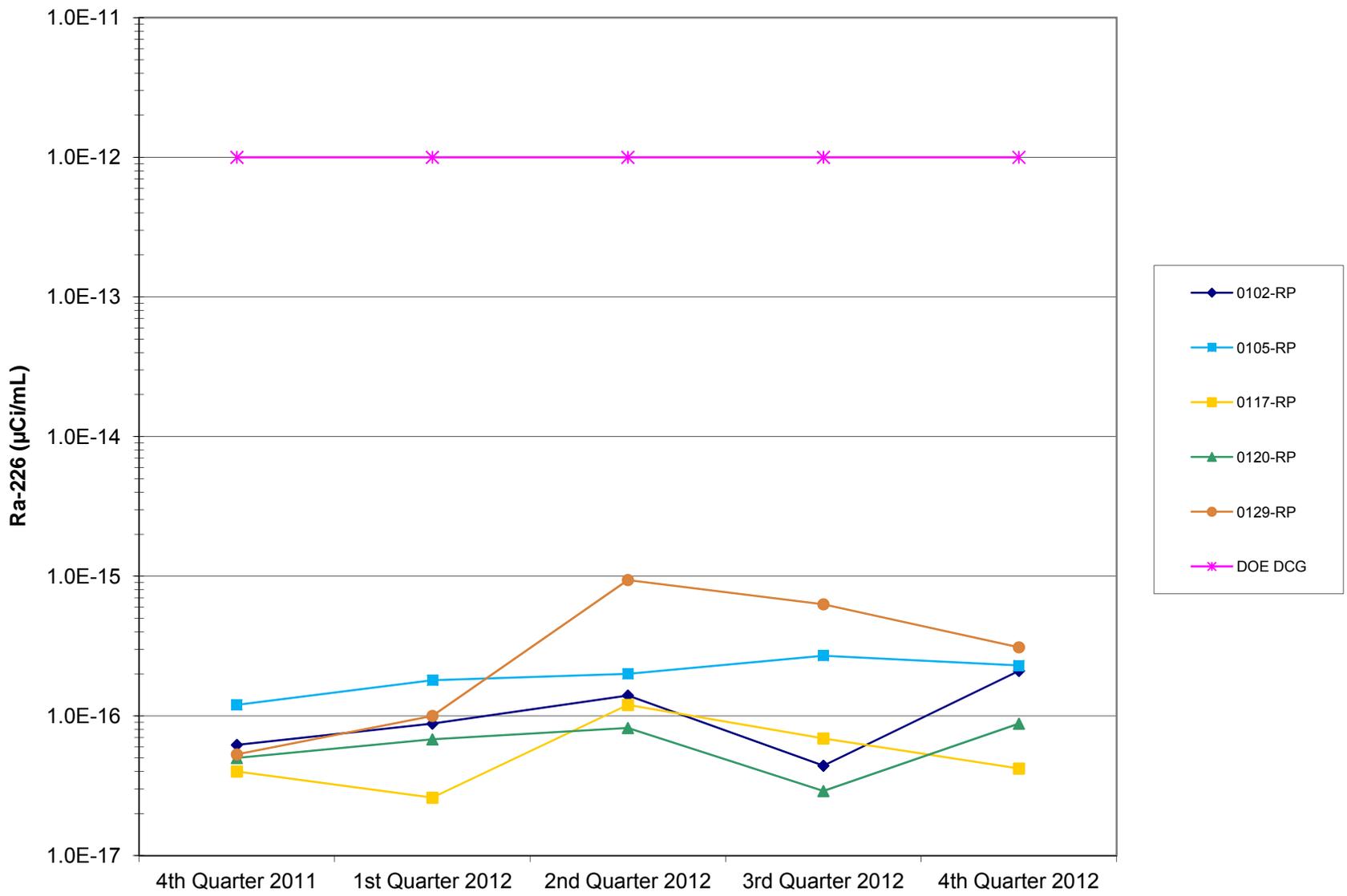


Figure 6. Radium-226 Concentrations at Select Moab Monitoring Locations

### Moab Radioparticulate Concentration (Uranium)

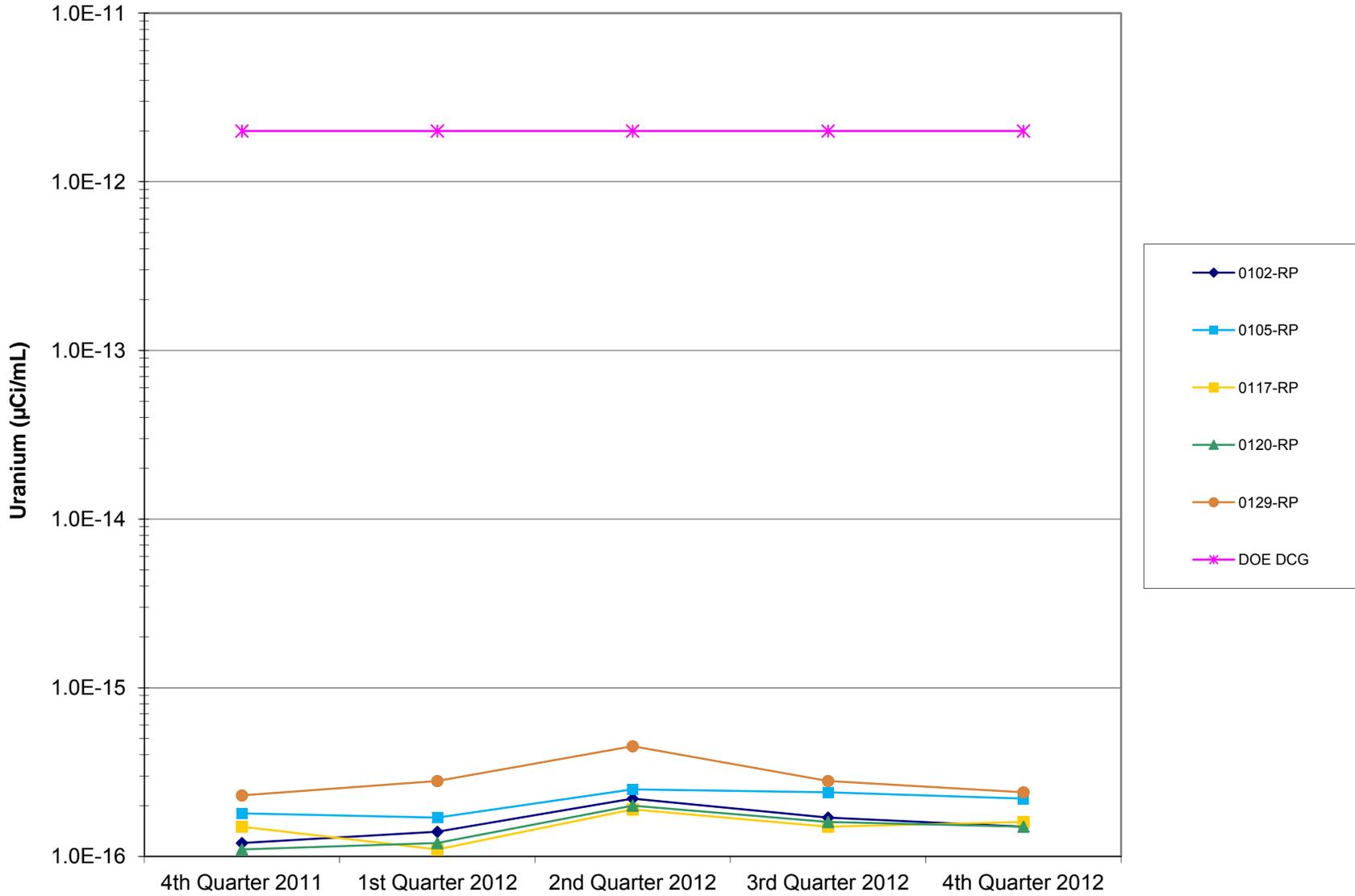


Figure 7. Total Uranium Concentrations at Select Moab Monitoring Locations

### Moab Atmospheric Radon-222 Concentration

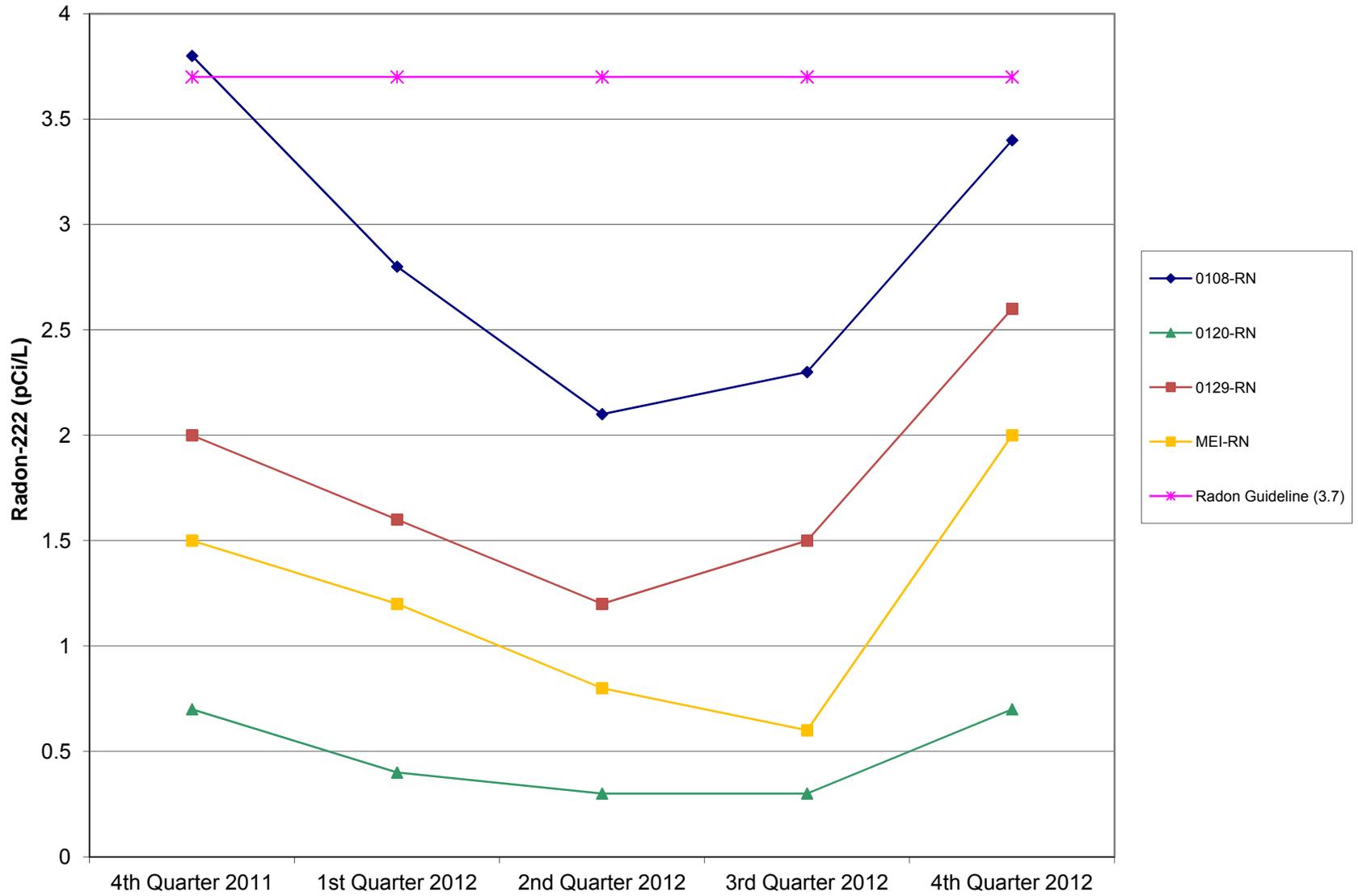


Figure 8. Atmospheric Radon-222 Concentrations at Select Moab Monitoring Locations

### Moab Direct Gamma Radiation Dose

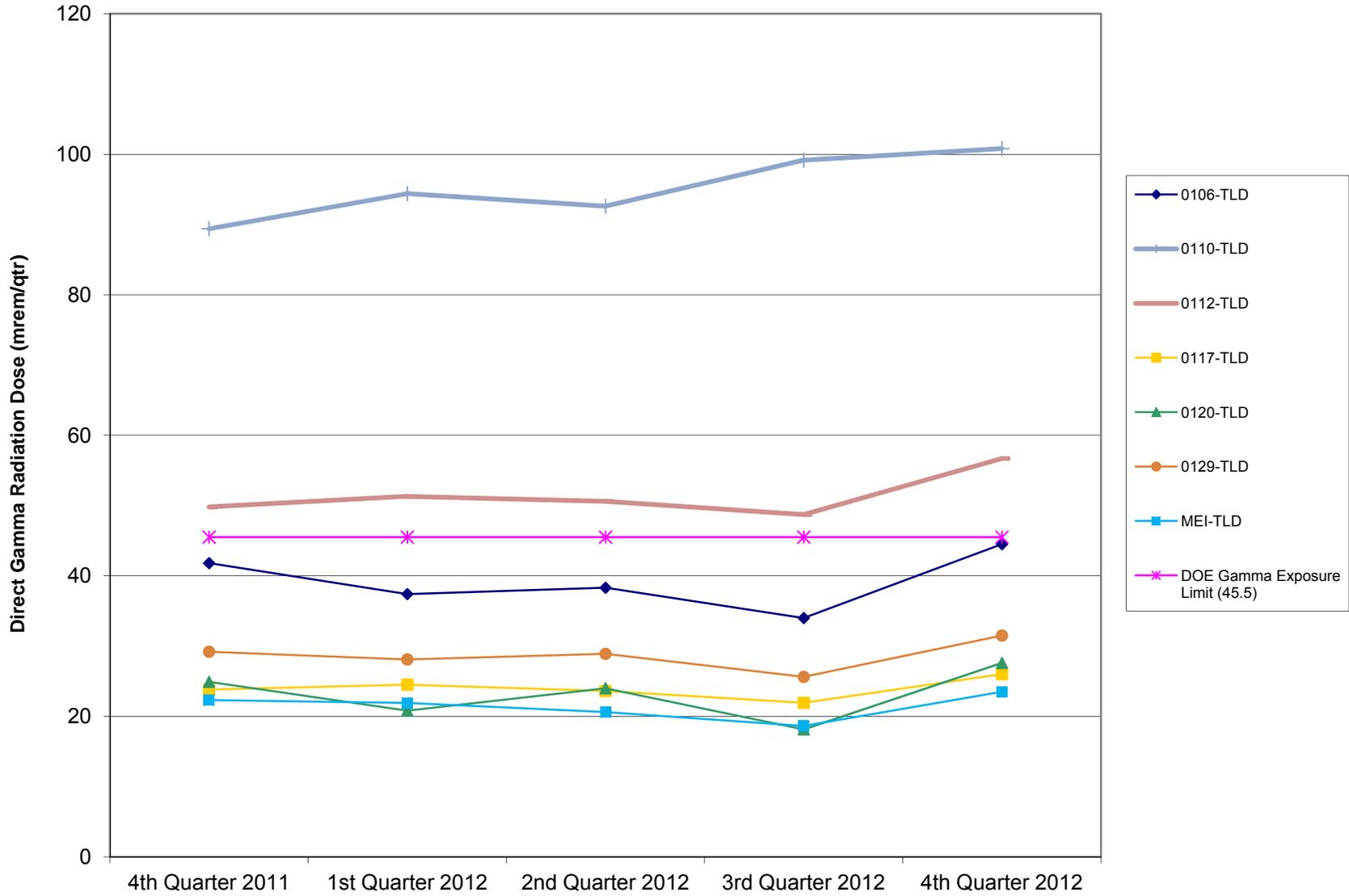


Figure 9. Direct Gamma Radiation Dose at Select Moab Monitoring Locations

### Crescent Junction Radioparticulate Concentration (Po-210)

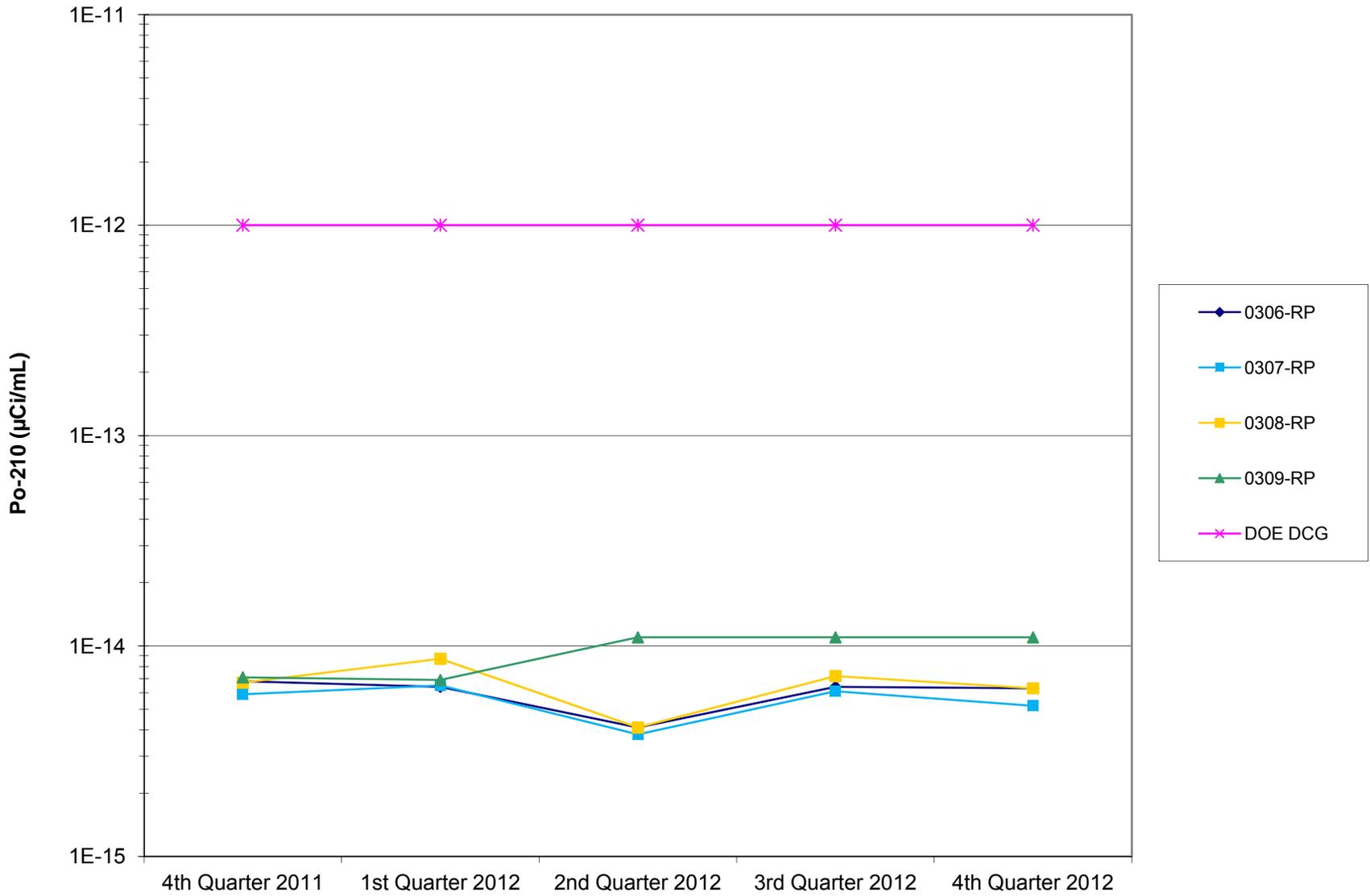


Figure 10. Polonium-210 Concentrations at Select Crescent Junction Monitoring Locations

### Crescent Junction Radioparticulate Concentration (Th-230)

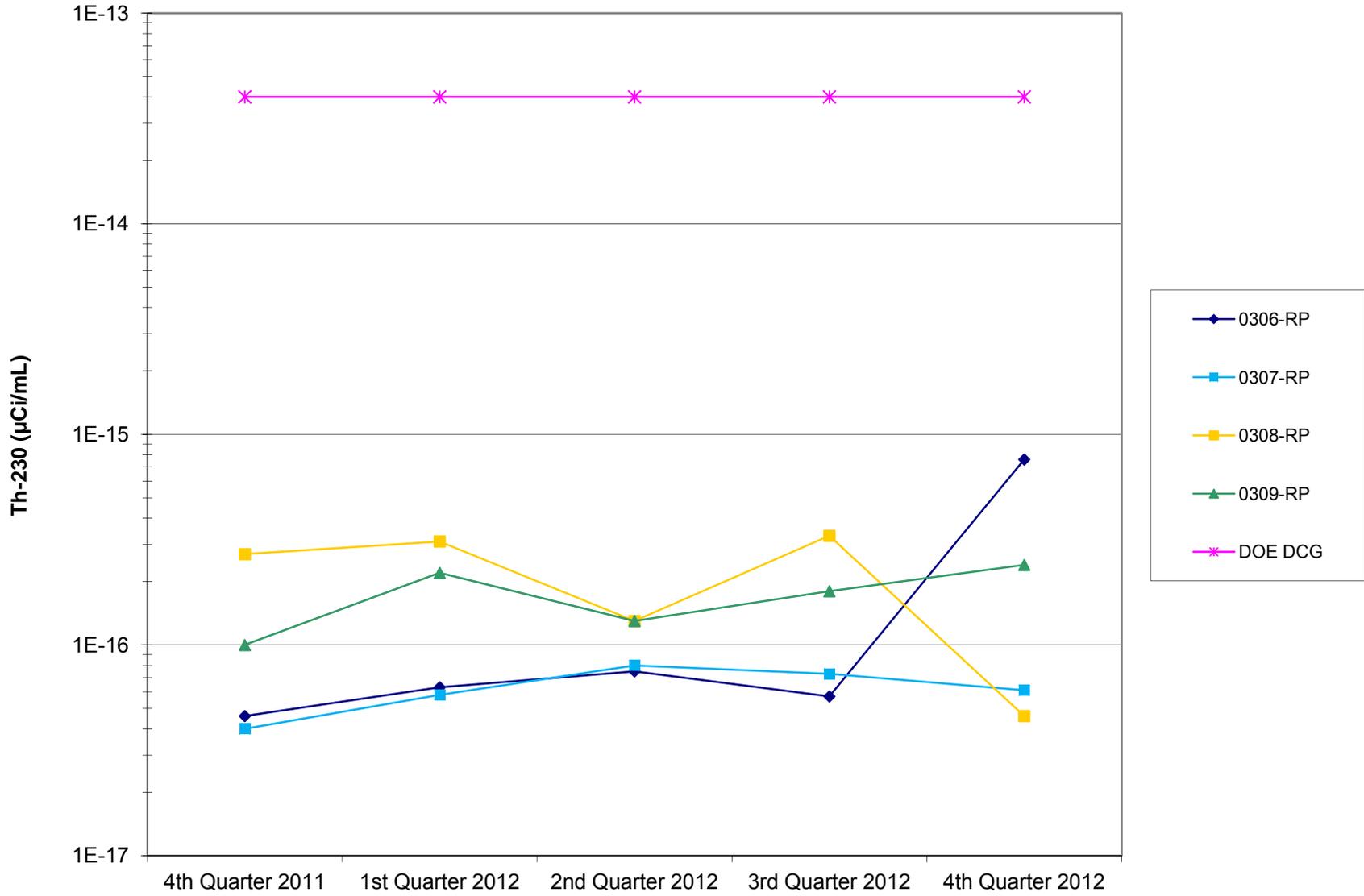


Figure 11. Thorium-230 Concentrations at Select Crescent Junction Monitoring Locations

### Crescent Junction Radioparticulate Concentration (Ra-226)

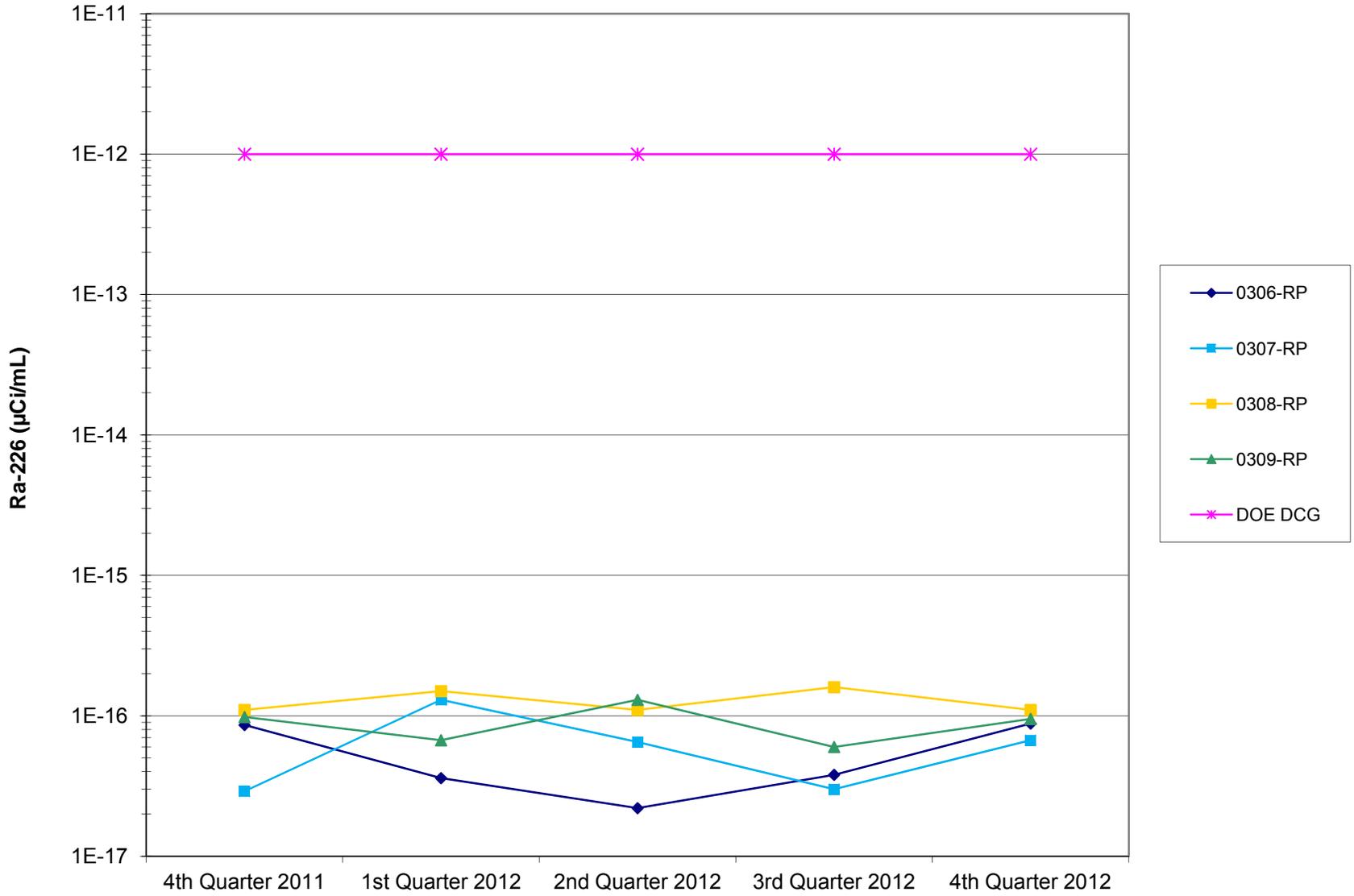


Figure 12. Radium-226 Concentrations at Select Crescent Junction Monitoring Locations

### Crescent Junction Radioparticulate Concentration (Uranium)

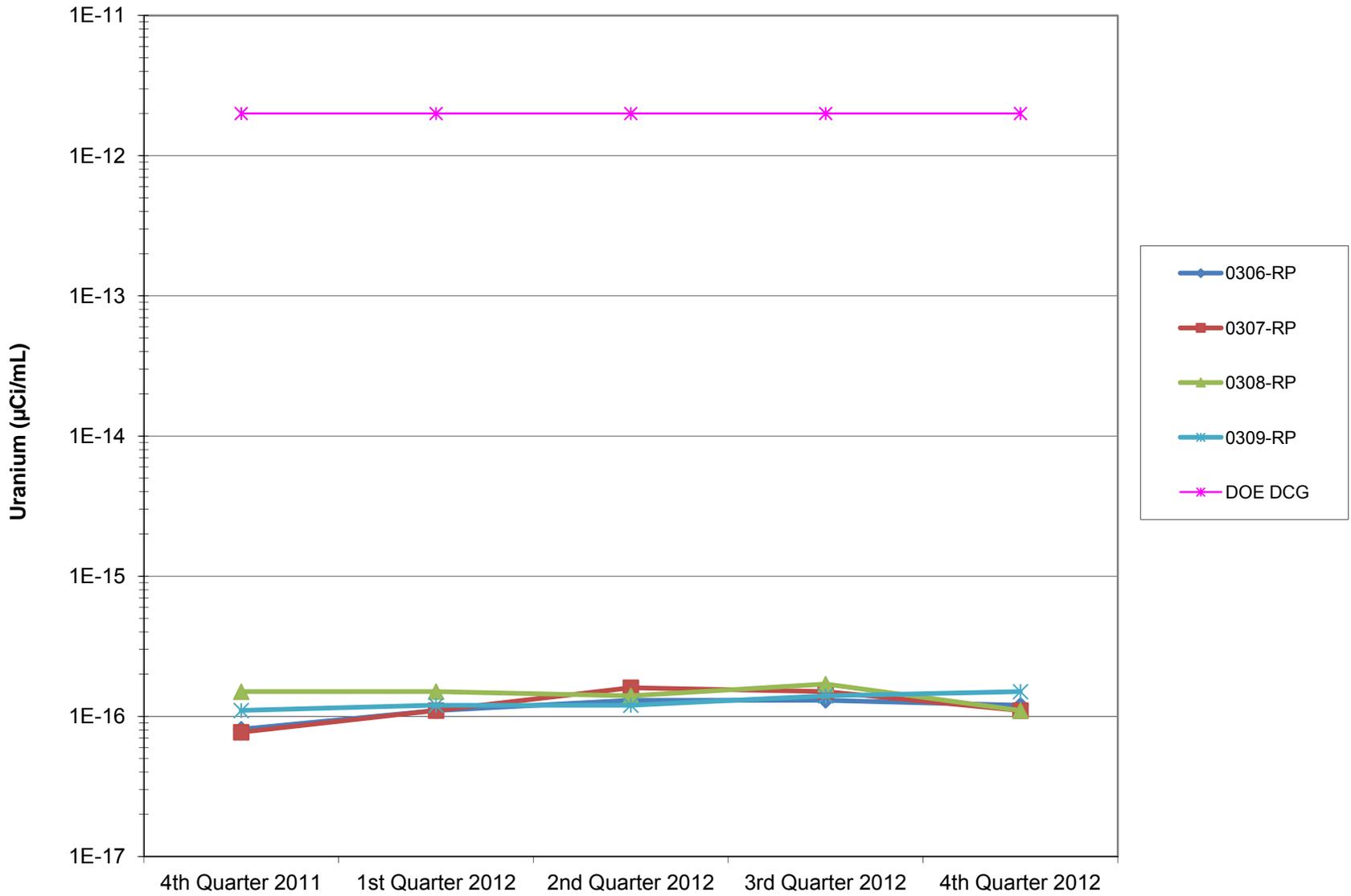


Figure 13. Total Uranium Concentrations at Select Crescent Junction Monitoring Locations

### Crescent Junction Atmospheric Radon-222 Concentration

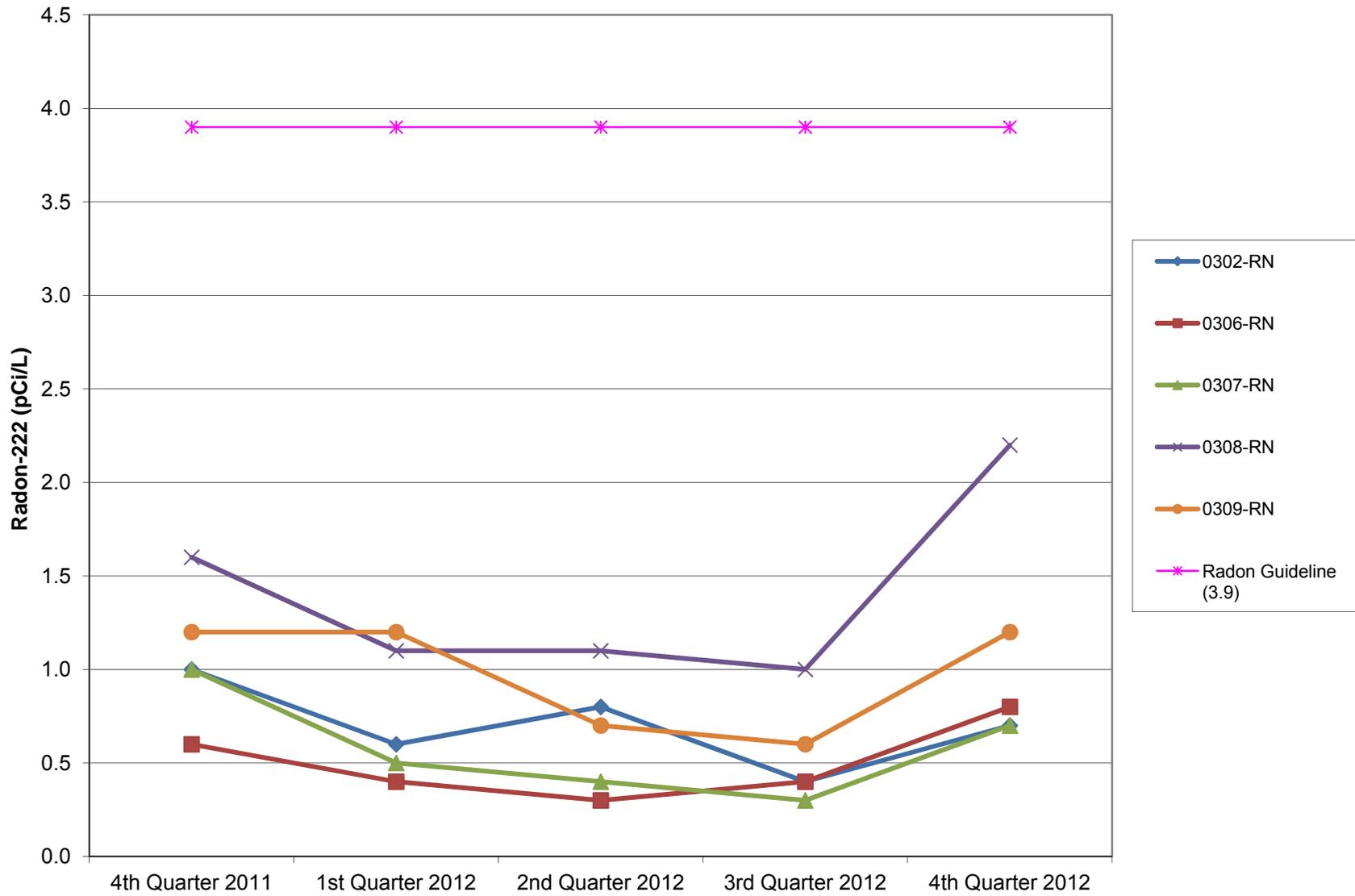


Figure 14. Atmospheric Radon-222 Concentrations at Select Crescent Junction Monitoring Locations

### Crescent Junction Direct Gamma Radiation Dose

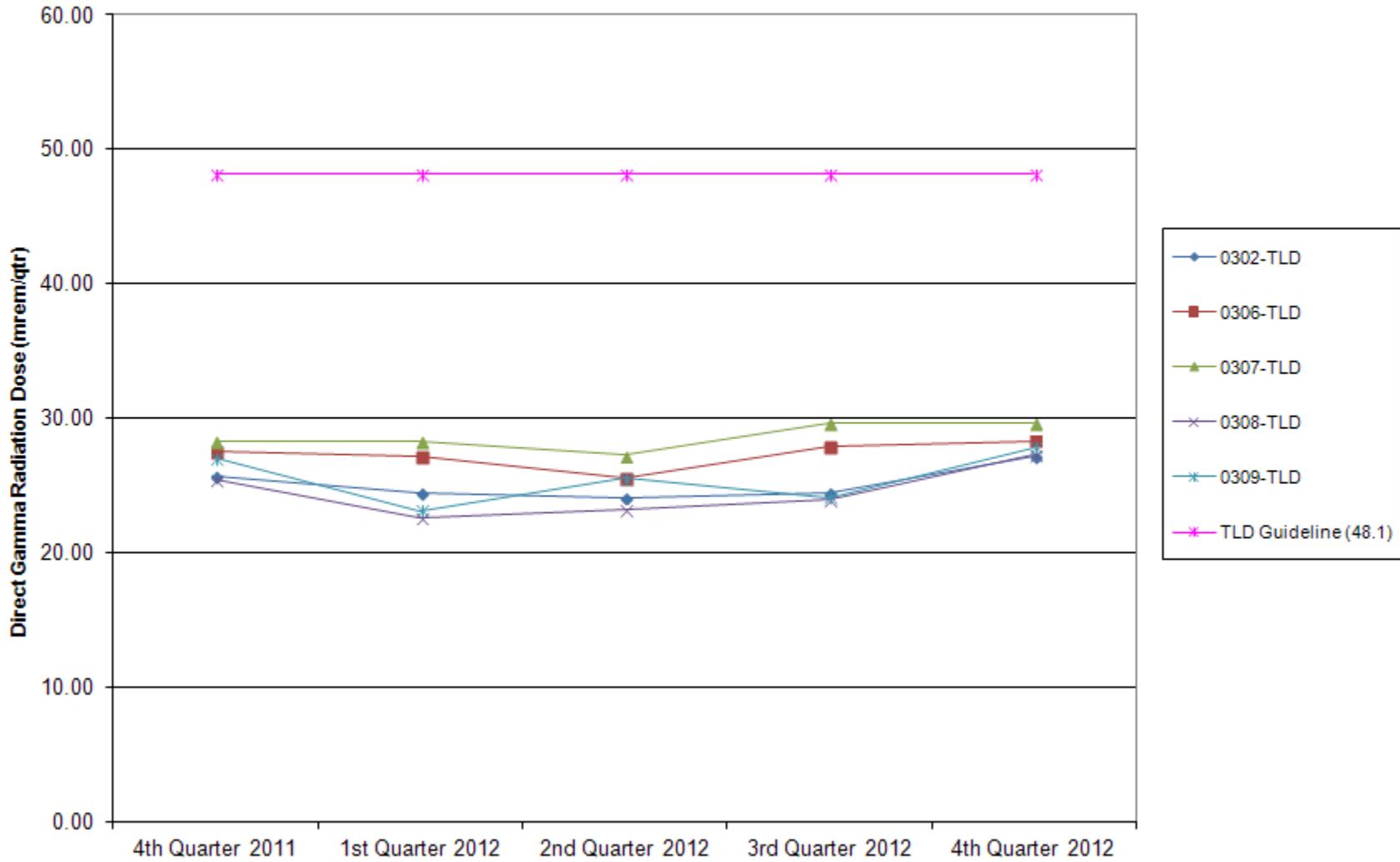


Figure 15. Direct Gamma Radiation Dose at Select Crescent Junction Monitoring Locations