

Office of Environmental Management – Grand Junction



Environmental Air Monitoring Data
Quarterly Report for the Moab and
Crescent Junction, Utah, Sites
Fourth Quarter 2015
(October through December 2015)

March 2016



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 2015
(October – December 2015)**

Revision 0

March 2016

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Revision 0

Review and Approval



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Acronyms and Abbreviations

DCS	derived concentration standard
DOE	U.S. Department of Energy
DOE O	DOE Order
DOE STD	DOE Standard
EPA	U.S. Environmental Protection Agency
MEI	maximally exposed individual
mrem	millirems
pCi/L	picocuries per liter
qtr	quarter
TLD	thermoluminescent dosimeter
UMTRA	Uranium Mill Tailings Remedial Action
yr	year

1.0 Introduction

The purpose of this quarterly report is to present the results associated with environmental air monitoring at the U.S. Department of Energy (DOE) Moab Uranium Mill Tailings Remedial Action (UMTRA) Project sites during the fourth quarter of 2015. The Project sites consist of the former uranium processing mill located 3 miles north of Moab, Utah, and the disposal site located near Crescent Junction, Utah. This report demonstrates the public and the environment are protected against undue risk from radiation associated with activities at the Project sites.

Environmental air monitoring data reported here are collected quarterly for radon, direct gamma radiation, and select radioparticulates. All off-site monitoring locations for the Moab site are shown on Figure 1, and on-site locations are shown in Figure 2. Monitoring locations for the Crescent Junction site are shown in Figure 3.

2.0 Summary of Results

2.1 Moab, Utah, Site

Monitoring Period: October – December 2015

Radon

DOE Order (O) 458.1, Admin Chg 3, “Radiation Protection of the Public and the Environment,” requires the annual average concentration of atmospheric emissions of radon to not exceed 3.0 picocuries per liter (pCi/L) above background at the Moab site boundary. Based on 5 years of data from stations 0117 and 0123 between 2003 and 2008, the average background concentration of radon in the Moab area was established as 0.7 pCi/L; therefore, the limit for radon emissions at the Moab site boundary is 3.7 pCi/L. Because the Project collects and reports monitoring data quarterly, it sets a quarterly Project guideline for radon equal to the annual average limit for reporting purposes.

Monitoring data collected during the fourth quarter of 2015 generally indicate on-site results were lower than third quarter 2015 data, and all stations were lower than normal for winter months. Results of off-site locations were similar to historical data. To be conservative in its reporting, the Project considers on-site stations to reflect concentrations at the Moab site boundary. Table 1 shows locations were below 3.7 pCi/L during the quarter, and no station exceeded the annual radon limit. Table 2 shows a summary of radon data for the Moab site.

Direct 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. The Project guideline of 45.5 mrem/quarter (qtr) is used for reporting purposes. Based on the monitoring data collected during the fourth quarter of 2015, four on-site locations exceeded the Project quarterly guideline, and three exceeded the annual limit.

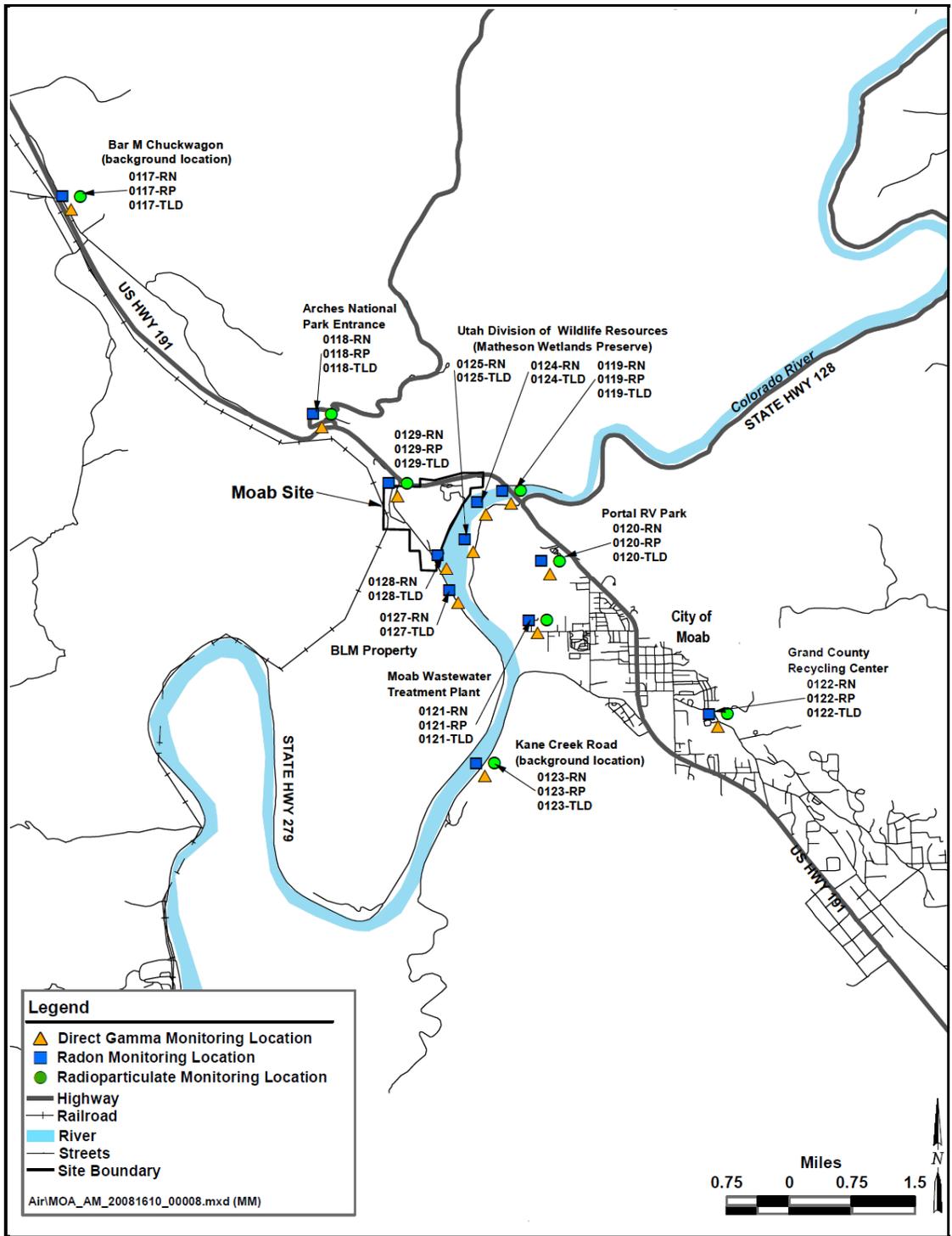


Figure 1. Moab Off-site Environmental Air Monitoring Locations

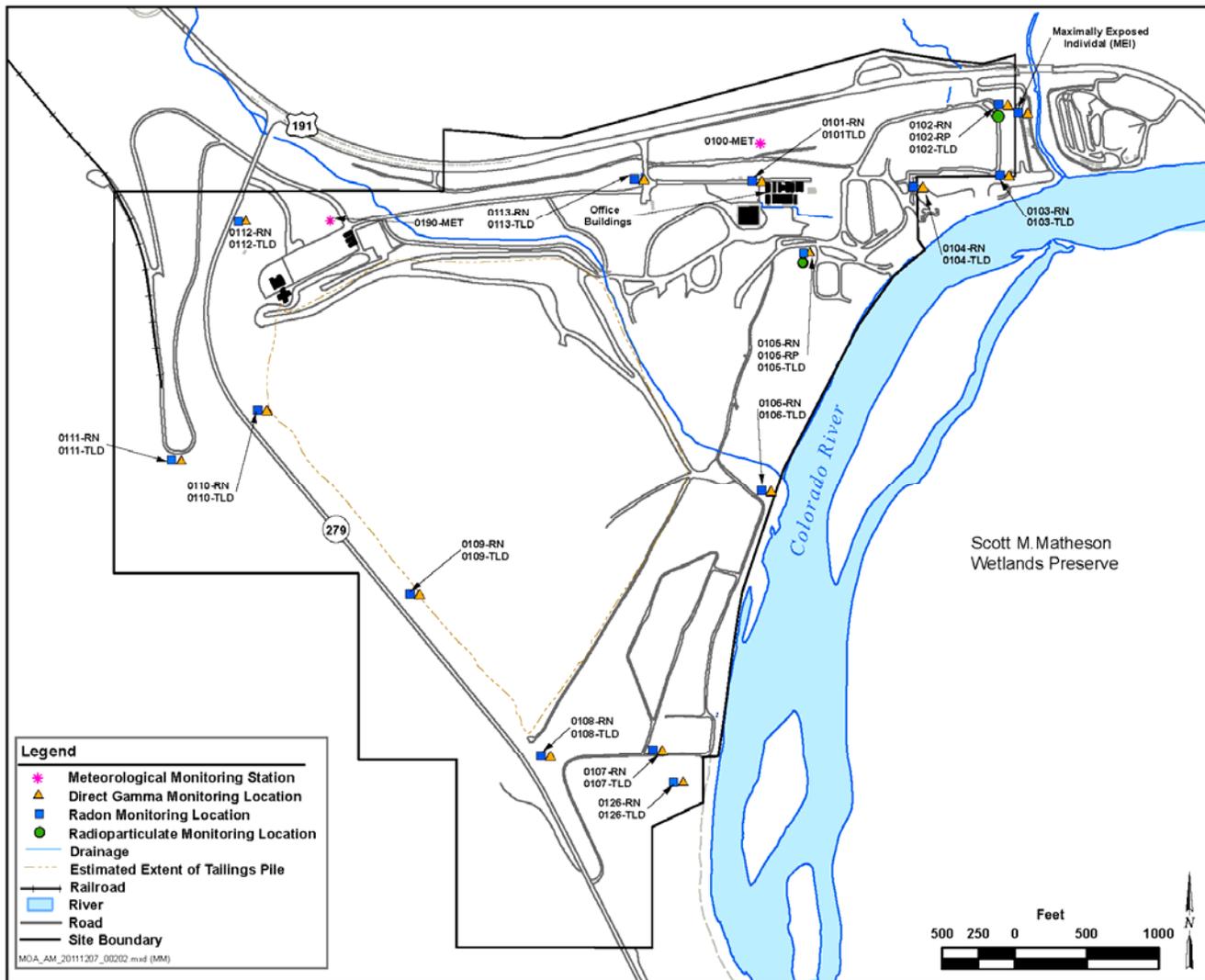


Figure 2. Moab On-site and MEI Environmental Air Monitoring Locations

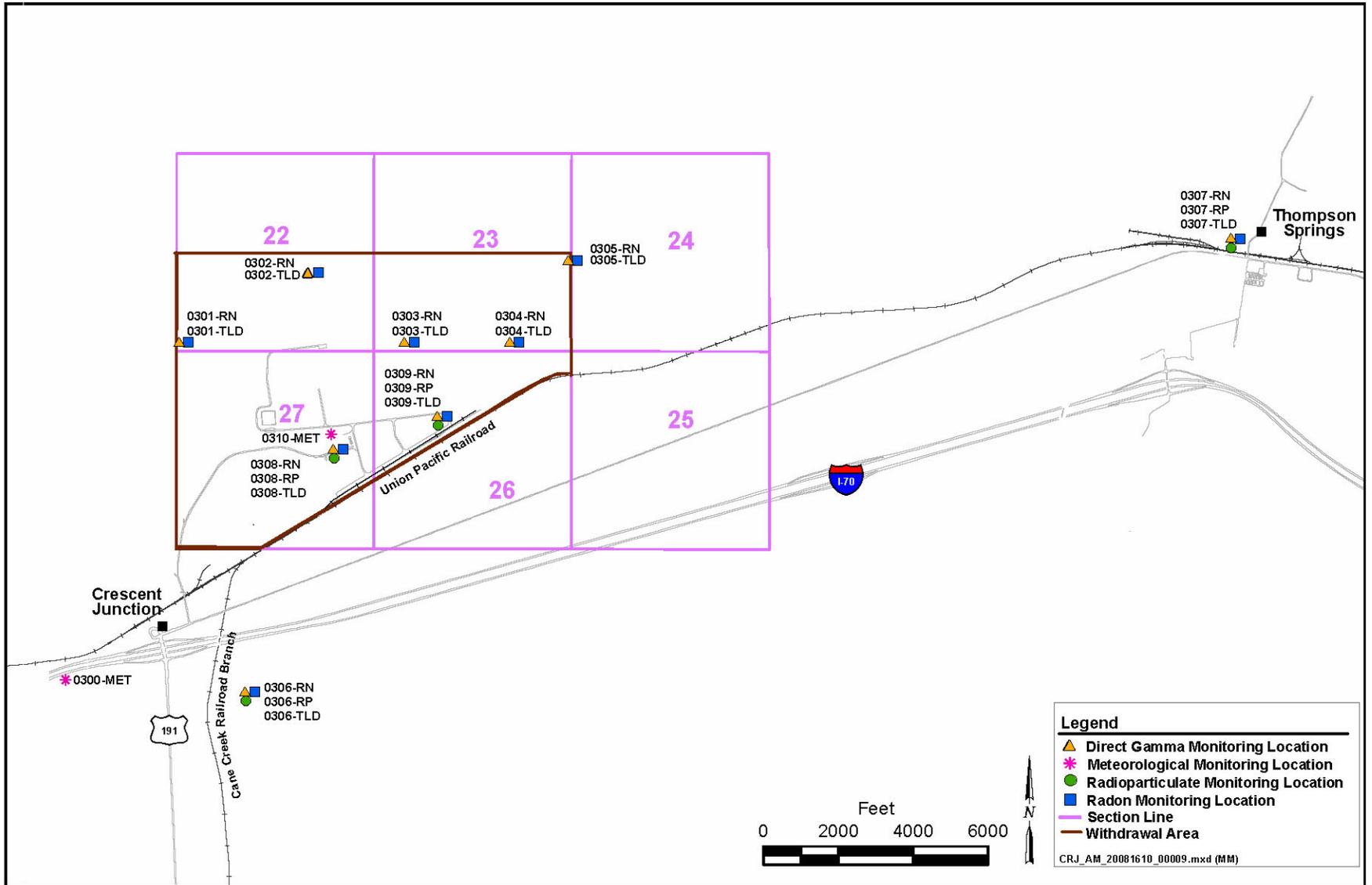


Figure 3. Crescent Junction Site Environmental Air Monitoring Locations

No off-site monitoring locations exceeded the guideline or limit. Fourth quarter analytical results were generally higher than the third quarter of 2015. The quarterly 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 or limit was exceeded, and Table 2 shows a summary of gamma data for the Moab site.

Table 1. Moab Air Monitoring Locations with Samples that Exceeded Applicable Project Guidelines or Regulatory Limits during the Past Quarter and 12 Months

Analyte	Guideline/Limit	Monitoring Locations Exceeding Quarterly Guideline During 4th Quarter 2015	Monitoring Locations Exceeding Annual Limit for the Past 12 Months
Radon	3.7 pCi/L	None	None
Direct Gamma Radiation	182 mrem/yr (45.5 mrem/qtr)	0109, 0110, 0112, 0113	0109, 0110, 0112

Table 2. Summary of Radon and Gamma Radiation Monitoring Data for the Moab Site for the Past Year through Fourth Quarter 2015

Station Number	1st Quarter 2015		2nd Quarter 2015		3rd Quarter 2015		4th Quarter 2015		Annual	
	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Average Radon (pCi/L)	Total Gamma (mrem/yr)
On-site Locations										
0101	3.7	35.6	0.9	36.5	2.5	45.1	2.6	45.3	2.4	162.5
0102	1.6	21.8	0.4	23.4	1.1	19.9	1.0	27.6	1.0	92.7
0103	2.3	25.9	0.4	22.0	1.3	23.4	1.7	25.1	1.4	96.5
0104	2.5	25.8	0.7	22.2	1.6	24.4	1.9	26.6	1.7	99.1
0105	3.1	22.7	1.0	20.3	1.8	20.9	2.2	26.1	2.0	90.1
0106	4.4	29.6	0.9	30.1	2.0	28.2	2.8	33.7	2.5	121.6
0107	3.9	28.2	1.4	23.9	2.2	25.4	2.6	28.2	2.5	105.7
0108	3.4	33.9	1.7	39.0	3.5	33.3	2.9	45.3	2.9	151.6
0109	1.7	146.1	1.4	108.9	2.3	154.4	1.9	133.3	1.8	542.7
0110	1.7	78.8	1.1	89.7	2.7	83.3	1.5	106.7	1.8	358.4
0111	0.8	37.9	0.6	37.9	1.4	39.6	0.6	43.4	0.9	158.9
0112	2.0	54.9	1.0	50.8	3.0	55.8	2.7	61.0	2.2	222.6
0113	3.0	37.4	1.6	40.7	3.5	34.9	3.5	45.6	2.9	158.6
0126	2.4	29.5	0.8	25.9	1.7	26.7	2.2	29.6	1.8	111.7
0117 ²	0.7	29.2	0.4	22.4	0.7	26.1	0.3	24.1	0.5	101.7
0118	0.4	23.1	0.4	23.9	0.9	21.7	0.7	25.7	0.6	94.5
0119	0.8	18.3	0.4	20.7	1.5	17.2	0.5	22.1	0.8	78.3
0120	0.5	23.0	0.4	20.3	0.7	20.5	0.3	23.7	0.5	87.4
0121	0.6	22.7	0.4	21.5	0.8	20.1	0.3	22.9	0.5	87.1
0122	0.3	23.0	0.4	19.7	0.7	20.4	0.3	20.9	0.4	84.0
0123 ²	0.3	21.8	0.4	18.2	0.7	20.5	0.3	18.7	0.4	79.2
0124	1.4	28.6	0.5	24.3	1.3	25.3	0.9	26.5	1.0	104.7
0125	1.7	31.8	0.8	28.8	1.8	27.1	0.8	30.0	1.3	117.7

Table 2. Summary of Radon and Gamma Radiation Monitoring Data for the Moab Site for the Past Year through Fourth Quarter 2015 (continued)

Station Number	1st Quarter 2015		2nd Quarter 2015		3rd Quarter 2015		4th Quarter 2015		Annual	
	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Average Radon (pCi/L)	Total Gamma (mrem/yr)
Off-site Locations										
0127	1.1	24.7	0.5	26.2	1.0	23.4	0.8	26.7	0.9	100.9
0128	3.3	26.7	0.8	26.8	1.9	25.5	2.6	26.7	2.2	105.7
0129	1.8	26.8	1.0	32.5	2.9	25.4	2.2	34.0	2.0	118.7
MEI³	1.6	22.8	0.4	20.6	1.1	18.1	1.0	22.2	1.0	83.7

MEI = maximally exposed individual

¹mrem value is prorated to a 91-day (quarter) exposure period.

²Designated background monitoring location. Background locations are sufficiently distant from the millsite to be free of any influences from potential site contaminants.

³The MEI is the continually occupied residential property that is closest to the DOE property boundary.

Radon and Direct Gamma Conclusion

Radon and direct gamma limits are based on 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 the locations where exceedances occurred, so the gamma exceedances do not reflect exposure to the public.

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 limit nor the public gamma dose limit has been exceeded at the MEI location during the history of the Project.

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 2015. Analytical data for all analytes (total uranium, thorium-230, radium-226, and polonium-210) were below their respective derived concentration standard (DCS), as found in DOE Standard (STD)-1196-2011, "Derived Concentration Technical Standard," and as shown in Table 3.

Concentrations of radioparticulates have been consistently below the DCS values since DOE assumed ownership of the site in 2001. DOE O 458.1 requires the radiological public dose resulting from all airborne emissions to be less than 10 mrem/yr (Project guideline of 2.5 mrem/qtr for reporting purposes). All on- and off-site sampling results were lower than the dose guideline during the fourth quarter of 2015 and the limit for the past four quarters, as shown in Table 3.

During the fourth quarter of 2015, the on-site dose resulting from airborne emissions was 0.20 mrem (0.94 mrem/yr) at location 0102 and 0.32 mrem (1.27 mrem/yr) at location 0105. Off-site locations 0117 and 0129 were 0.21 mrem (0.67 mrem/yr) and 0.41 mrem (2.17 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 radiological exposure from radioparticulates has been relatively stable during the last year.

Table 3. Summary of Radioparticulate Air Monitoring Data for the Moab Site for the Past Year through Fourth Quarter 2015

Station Number	Isotope	1st Quarter 2015 (µCi/mL)	2nd Quarter 2015 (µCi/mL)	3rd Quarter 2015 (µCi/mL)	4th Quarter 2015 (µCi/mL)	Annual Average (µCi/mL)	Annual Dose Based on Four Quarters (mrem/yr)
On-site Locations							
0102-RP	Uranium ¹	9.7E-17	1.5E-16	1.7E-16	1.3E-16	1.4E-16	0.94
	Thorium-230 ²	9.9E-17	7.4E-17	1.2E-16	7.0E-17	9.1E-17	
	Radium-226 ³	1.1E-16	1.1E-16	1.0E-16	7.2E-17	1.0E-16	
	Polonium-210 ⁴	1.4E-14	3.2E-15	4.4E-15	6.1E-15	7.0E-15	
0105-RP	Uranium ¹	1.3E-16	1.6E-16	2.7E-16	1.6E-16	1.8E-16	1.27
	Thorium-230 ²	2.4E-16	1.4E-16	3.5E-16	1.7E-16	2.2E-16	
	Radium-226 ³	1.8E-16	8.7E-17	3.3E-16	9.3E-17	1.7E-16	
	Polonium-210 ⁴	1.1E-14	3.1E-15	4.6E-15	8.4E-15	6.9E-15	
Off-site Locations							
0117-RP	Uranium ¹	8.8E-17	1.2E-16	1.6E-16	1.5E-16	1.3E-16	0.67
	Thorium-230 ²	4.9E-17	5.9E-17	5.2E-17	8.8E-17	6.2E-17	
	Radium-226 ³	1.2E-16	4.3E-17	8.3E-17	8.0E-17	8.1E-17	
	Polonium-210 ⁴	7.8E-15	2.5E-15	3.7E-15	5.9E-15	5.0E-15	
0118-RP	Uranium ¹	9.6E-17	1.3E-16	2.0E-16	1.3E-16	1.4E-16	1.01
	Thorium-230 ²	1.1E-16	1.5E-16	2.1E-16	9.5E-17	1.4E-16	
	Radium-226 ³	1.8E-16	1.1E-16	2.1E-16	1.1E-16	1.5E-16	
	Polonium-210 ⁴	1.1E-14	2.9E-15	4.4E-15	7.2E-15	6.3E-15	
0119-RP	Uranium ¹	6.9E-17	1.1E-16	1.4E-16	1.8E-16	1.2E-16	0.86
	Thorium-230 ²	1.1E-16	1.5E-16	2.1E-16	9.5E-17	1.4E-16	
	Radium-226 ³	3.7E-17	1.1E-16	1.2E-16	4.6E-17	7.7E-17	
	Polonium-210 ⁴	7.5E-15	2.9E-15	3.0E-15	6.0E-15	4.9E-15	
0120-RP	Uranium ¹	9.5E-17	1.3E-16	1.6E-16	1.3E-16	1.3E-16	0.72
	Thorium-230 ²	3.8E-17	6.7E-17	8.4E-17	5.4E-17	6.1E-17	
	Radium-226 ³	1.1E-16	3.3E-17	1.4E-16	6.9E-17	8.9E-17	
	Polonium-210 ⁴	1.0E-14	2.9E-15	3.8E-15	5.5E-15	5.6E-15	
0121-RP	Uranium ¹	8.6E-17	1.5E-16	1.7E-16	1.2E-16	1.3E-16	0.76
	Thorium-230 ²	8.5E-17	1.1E-16	9.2E-17	4.1E-17	8.1E-17	
	Radium-226 ³	1.2E-16	7.8E-17	1.6E-16	8.9E-17	1.1E-16	
	Polonium-210 ⁴	9.3E-15	3.0E-15	3.8E-15	5.3E-15	5.4E-15	
0122-RP	Uranium ¹	8.2E-17	1.2E-16	1.5E-16	1.3E-16	1.2E-16	0.61
	Thorium-230 ²	3.4E-17	5.0E-17	6.3E-17	5.7E-17	5.1E-17	
	Radium-226 ³	1.1E-16	4.7E-17	4.4E-17	6.4E-17	6.5E-17	
	Polonium-210 ⁴	7.5E-15	3.0E-15	3.1E-15	5.0E-15	4.7E-15	
0123-RP	Uranium ¹	9.4E-17	1.3E-16	1.4E-16	1.3E-16	1.2E-16	0.78
	Thorium-230 ²	6.8E-17	6.2E-17	1.1E-16	6.8E-17	7.6E-17	
	Radium-226 ³	9.5E-17	4.2E-17	7.6E-17	1.1E-16	8.1E-17	
	Polonium-210 ⁴	1.0E-14	3.3E-15	3.5E-15	6.3E-15	5.8E-15	

Table 3. Summary of Radioparticulate Air Monitoring Data for the Moab Site for the Past Year through Fourth Quarter 2015 (continued)

Station Number	Isotope	1st Quarter 2015 (µCi/mL)	2nd Quarter 2015 (µCi/mL)	3rd Quarter 2015 (µCi/mL)	4th Quarter 2015 (µCi/mL)	Annual Average (µCi/mL)	Annual Dose Based on Four Quarters (mrem/yr)
Off-site Locations (continued)							
0129-RP	Uranium ¹	1.1E-16	2.4E-16	4.4E-16	2.0E-16	2.5E-16	2.17
	Thorium-230 ²	3.4E-16	5.6E-16	1.1E-15	3.6E-16	6.0E-16	
	Radium-226 ³	1.7E-16	4.2E-16	8.8E-16	3.3E-16	4.5E-16	
	Polonium-210 ⁴	8.3E-15	3.5E-15	5.5E-15	7.1E-15	6.1E-15	

µCi/mL = microcuries per milliliter

¹DOE DCS for total uranium = 4.7E-13

²DOE DCS for thorium-230 = 9.4E-14

³DOE DCS for radium-226 = 4.0E-13

⁴DOE DCS for polonium-210 = 8.7E-13

2.2 Crescent Junction, Utah, Site

Monitoring Period: October – December 2015

After mill tailings disposal began in the second quarter of 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 boundary data for the disposal site. Stations 0306, 0307, and 0308 were utilized as background locations from the period before tailings disposal.

Radon

DOE O 458.1 requires the annual average concentration of atmospheric emissions of radon not exceed 3.0 pCi/L above background at the Crescent Junction site boundary. Based on 3 years of data from 2006 to 2009, the background concentration of radon in the Crescent Junction area was established as 0.9 pCi/L; therefore, the limit for radon emissions at the Crescent Junction site boundary is 3.9 pCi/L. None of the on- or off-site stations exceeded the quarterly guideline or annual limit, and these results were generally similar to previous data. Radon data for the Crescent Junction site are summarized in Table 4.

Direct 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 Project guideline for reporting purposes), including background. No on- or off-site station results exceeded the quarterly guideline or annual gamma radiation dose limit. Refer to Table 4 for a summary of gamma data for the Crescent Junction site.

Radioparticulates

DOE-STD-1196-2011 establishes DCSs for concentrations of radioparticulates in air. Concentrations of the radioparticulates have been consistently below their DCSs since DOE began collecting radioparticulate data for the Crescent Junction site in 2006. Refer to Table 5 for a summary of radioparticulate air monitoring data for the Crescent Junction site.

The on-site dose resulting from airborne emissions was 0.85 mrem/yr at location 0308 and 0.97 mrem/yr at location 0309, which is downwind of operations.

Location 0306, the MEI, had an annual dose of 0.67 mrem/yr, and location 0307 was 0.62 mrem/yr. All the location results were similar to past data.

Table 4. Summary of Radon and Gamma Radiation Monitoring Data for the Crescent Junction Site for the Past Year through Fourth Quarter 2015

Station Number	1st Quarter 2015		2nd Quarter 2015		3rd Quarter 2015		4th Quarter 2015		Annual	
	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Radon (pCi/L)	Gamma (mrem/91 d ¹)	Average Radon (pCi/L)	Total Gamma (mrem/yr)
0301	0.8	27.6	0.4	23.8	1.0	25.7	0.4	26.1	0.7	103.3
0302	1.0	21.5	0.7	21.1	1.2	20.6	0.9	23.2	1.0	86.4
0303	1.5	32.0	1.4	25.8	1.3	31.5	1.1	29.5	1.3	118.8
0304	0.8	29.5	0.8	21.0	1.2	27.1	0.8	23.0	0.9	100.6
0305	1.9	29.9	0.5	25.7	1.3	27.6	0.6	28.3	1.1	111.5
0306 ²	0.9	30.0	0.4	22.6	1.1	28.1	0.7	24.0	0.8	104.7
0307	0.6	26.0	0.4	25.1	1.1	24.3	0.5	27.8	0.7	103.2
0308	1.9	28.2	1.4	22.7	2.3	26.8	1.4	26.0	1.8	103.7
0309	0.9	22.4	0.8	22.2	1.4	20.4	1.2	25.1	1.1	90.1

¹mrem value is prorated to a 91-day (quarter) exposure period

²MEI location

3.0 Data Assessment

3.1 Data Assessment Summary

Radon Analyses

Radon detectors were analyzed by Landauer, Inc., in accordance with its “Quality Assurance Manual for Radon Monitoring Services.” Fourth quarter 2015 analytical radon data were received in a report dated January 12, 2016. When detectors were missing, damaged, or could not be read, the laboratory noted an explanation. After the data report was received, Project personnel evaluated the data for consistency with other data points and sample duplicates.

Direct Gamma Radiation Analyses

Thermoluminescent dosimeters (TLDs) are used for continuous dose measurements and are analyzed by ATI Environmental, Inc., Midwest Laboratory, in accordance with its analytical procedures, “Preparation and Readout of Teledyne Isotopes TLD Card, TIML-TLD-01.” Fourth quarter 2015 environmental gamma radiation data were received in a report dated January 25, 2016. After the laboratory results were received, the Project evaluated the data for consistency and compared it to historical data and sample duplicates.

Table 5. Summary of Radioparticulate Air Monitoring Data for the Crescent Junction Site for the Past Year through Fourth Quarter 2015

Station Number	Isotope	1st Quarter 2015 (μCi/mL)	2nd Quarter 2015 (μCi/mL)	3rd Quarter 2015 (μCi/mL)	4th Quarter 2015 (μCi/mL)	Annual Average (μCi/mL)	Annual Dose Based on Four Quarters (mrem/yr)
Off-site Locations							
MEI or 0306-RP	Uranium ¹	8.0E-17	1.0E-16	1.2E-16	1.2E-16	1.1E-16	0.67
	Thorium-230 ²	6.4E-17	3.8E-17	4.2E-17	6.1E-17	5.1E-17	
	Radium-226 ³	3.0E-17	8.9E-17	1.1E-16	4.7E-17	7.0E-17	
	Polonium-210 ⁴	8.3E-15	3.6E-15	3.4E-15	5.9E-15	5.3E-15	
0307-RP	Uranium ¹	7.2E-17	1.1E-16	1.3E-16	1.3E-16	1.1E-16	0.62
	Thorium-230 ²	3.9E-17	2.5E-17	9.3E-17	6.6E-17	5.6E-17	
	Radium-226 ³	1.1E-16	1.1E-16	1.6E-17	7.2E-17	7.6E-17	
	Polonium-210 ⁴	6.8E-15	2.8E-15	3.7E-15	5.6E-15	4.7E-15	
On-site Locations							
0308-RP	Uranium ¹	8.2E-17	1.0E-16	1.4E-16	1.4E-16	1.2E-16	0.85
	Thorium-230 ²	1.8E-16	1.2E-16	1.4E-16	1.1E-16	1.4E-16	
	Radium-226 ³	2.0E-16	5.9E-17	8.2E-17	1.4E-16	1.2E-16	
	Polonium-210 ⁴	7.2E-15	2.9E-15	4.2E-15	5.6E-15	5.0E-15	
0309-RP	Uranium ¹	8.2E-17	1.2E-16	1.5E-16	1.5E-16	1.3E-16	0.97
	Thorium-230 ²	1.9E-16	1.2E-16	2.2E-16	2.4E-16	1.9E-16	
	Radium-226 ³	3.0E-17	1.1E-16	1.5E-16	2.5E-16	1.4E-16	
	Polonium-210 ⁴	7.1E-15	2.8E-15	4.1E-15	5.1E-15	4.8E-15	

μCi/mL = microcuries per milliliter

¹DOE DCS for total uranium = 4.7E-13

²DOE DCS for thorium-230 = 9.4E-14

³DOE DCS for radium-226 = 4.0E-13

⁴DOE DCS for polonium-210 = 8.7E-13

Radioparticulate Analyses

ALS Global, Inc., laboratory analyzed the radioparticulate samples. Total uranium was analyzed by inductively coupled plasma mass spectrometry, U.S. Environmental Protection Agency (EPA) method SW-846 6020.

Isotopic thorium (includes thorium-230) and polonium-210 were analyzed by alpha spectroscopy, method ASTM D3972. Radium-226 was analyzed by the radon method, EPA method 903.1(m).

Fourth quarter 2015 radioparticulate analytical data were received in report identification number 1512444, dated January 20, 2016. The Project reviewed and validated the data for consistency and compared results to historical data.

Duplicate Sampling

Duplicate samples for radon were collected at three Moab locations: 0108, an on-site location near the southern toe of the tailings pile; 0111, an on-site location at the western property line near the rail load-out area; and 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 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 DCSs. Consequently, the additional costs associated with purchasing a duplicate sampler, providing electrical power, and procuring analytical analyses are not justified.

Suspected Anomalies

Analytical data are reviewed for anomalous or outlying data points. 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.

No anomalous data were noted for the fourth quarter of 2015. Radon data levels were normal for all locations—including background locations. Direct gamma and radioparticulate data were similar to historical data, with continued elevated gamma readings for stations 0109, 0110, 0112, and for the first time, 0113. All are close to the excavation activity.

Summary

Data collected during the fourth quarter of 2015 met the applicable laboratory control criteria for their respective analyses, and data were reviewed by qualified personnel. The results were 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 observations for the fourth quarter of 2015 is shown in Section 5.0.

4.0 Environmental Air Monitoring Data

4.1 Environmental Air Monitoring Data Summary

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

Radon and Direct Gamma Radiation

Radon data were plotted on a graph (Figure 4) for the following Moab site monitoring locations: 0107 and 0108, which have historically had elevated quarterly radon levels; 0120, approximately 1 mile southeast of the Moab site, and represents potential exposure to the public; 0129, which is downwind of operations; and the MEI.

Gamma radiation data were plotted on a graph (Figure 5) for the following Moab site monitoring locations: 0106, which has previously had elevated readings; 0109, 0110, and 0112, which are adjacent to the tailings pile and have elevated readings; 0117, a background monitoring location; 0120, an off-site location between the site and the town of Moab; 0129, off-site near the northern property boundary; and the MEI.

Radon and gamma radiation data were plotted on graphs (Figures 6 and 7, respectively) for the following Crescent Junction monitoring locations: 0302, which is close to the northern side of operations; 0306 and 0307, off-site stations closest to members of the public; 0308, which is close to the southern side of operations; and 0309, which is downwind of operations.

Radioparticulates

Radioparticulate monitoring data were plotted on graphs (Figures 8 through 11) for the following Moab site locations: 0102, which is the on-site station closest to the MEI; 0105, which is closest to the emissions source (i.e., the mill tailings pile); 0117, a background monitoring location; 0120, an off-site location between the site and Moab; and 0129, which is directly downwind of operations with the greatest potential impact from operations.

Radioparticulate monitoring data were plotted on graphs (Figures 12 through 15) for the following Crescent Junction site locations: 0306, 0307, 0308, and 0309. These locations were selected for the same reasons stated for radon and gamma radiation.

5.0 Environmental Air Monitoring Field Activities Verification Checklist

Project	<u>Moab/Crescent Junction, Utah</u>	Date(s) of Air Sampling	<u>October-December 2015</u>
Date(s) of Verification	<u>January 13, 2016</u>	Name of Verifier	<u>Ed Baker</u>
		Response (Yes, No,NA)	Comments
1. Is the <i>Air Monitoring Sampling and Analysis Plan</i> the primary document directing field procedures?		<u>Yes</u>	
2. Were the sampling locations specified in the <i>Air Monitoring Sampling and Analysis Plan</i> ?		<u>Yes</u>	
3. Were low-volume air samplers on and operating at or near 60 liters/minute $\pm 10\%$?		<u>No</u>	<u>308 was not running; re-set GFI after lightning problem</u>
4. Did any of the samplers require airflow adjustment?		<u>Yes</u>	<u>Normal quarterly calibration with all units within proper range</u>
5. Were detectors (radon cups, TLDs) and monitoring equipment found to be undisturbed and in operable condition upon arrival?		<u>Yes</u>	
6. Were the hourly clocks on the low-volume air samplers operational upon arrival?		<u>No</u>	<u>Stations 105 and 308 were not operational; hours were estimated for 118 and 122 due to power outage.</u>
7. Were the run times recorded for each radioparticulate monitoring location?		<u>Yes</u>	
8. Were duplicates (for radon and gamma radiation) taken at a frequency of one per 20 samples?		<u>Yes</u>	
9. Were filter blanks (for radioparticulates) taken at a frequency of one per 20 samples?		<u>No</u>	<u>Not required per the <i>Air Monitoring Sampling and Analysis Plan</i>.</u>
10. Were trip blanks (for gamma radiation) included with each shipment?		<u>No</u>	<u>A trip blank is not used for the radon monitoring because units are sealed; however, a trip blank was used for the direct gamma radiation monitoring.</u>
11. Was the identity of the quality-control sample locations protected?		<u>Yes</u>	
12. Were the true locations of the quality-control samples recorded in the Field Log Book?		<u>Yes</u>	
13. Were all samples collected as specified in the <i>Air Monitoring Sampling and Analysis Plan</i> ?		<u>Yes</u>	
14. Were chain-of-custody records completed, and was sample custody maintained?		<u>Yes</u>	
15. Are field data sheets signed and dated by sampling personnel?		<u>Yes</u>	
16. Was all other pertinent information documented on the field data sheets?		<u>Yes</u>	

6.0 References

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

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

DOE (U.S. Department of Energy) Order 458.1, Admin Chg 3, "Radiation Protection of the Public and the Environment."

DOE (U.S. Department of Energy) Standard-1196-2011, "Derived Concentration Technical Standard."

Landauer, Inc., "Quality Assurance Manual for Radon Monitoring Services."

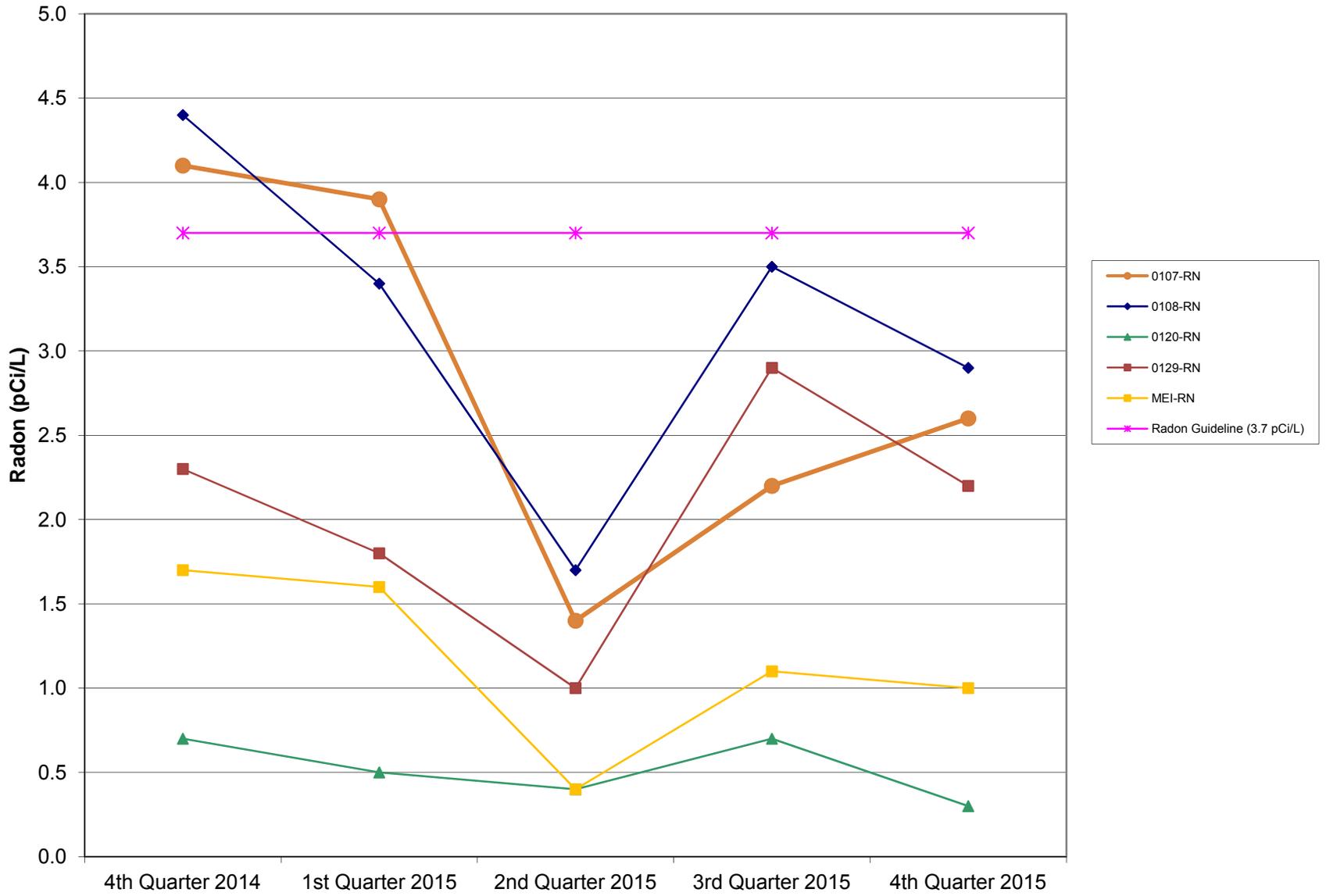


Figure 4. Radon Concentrations at Select Moab Monitoring Locations

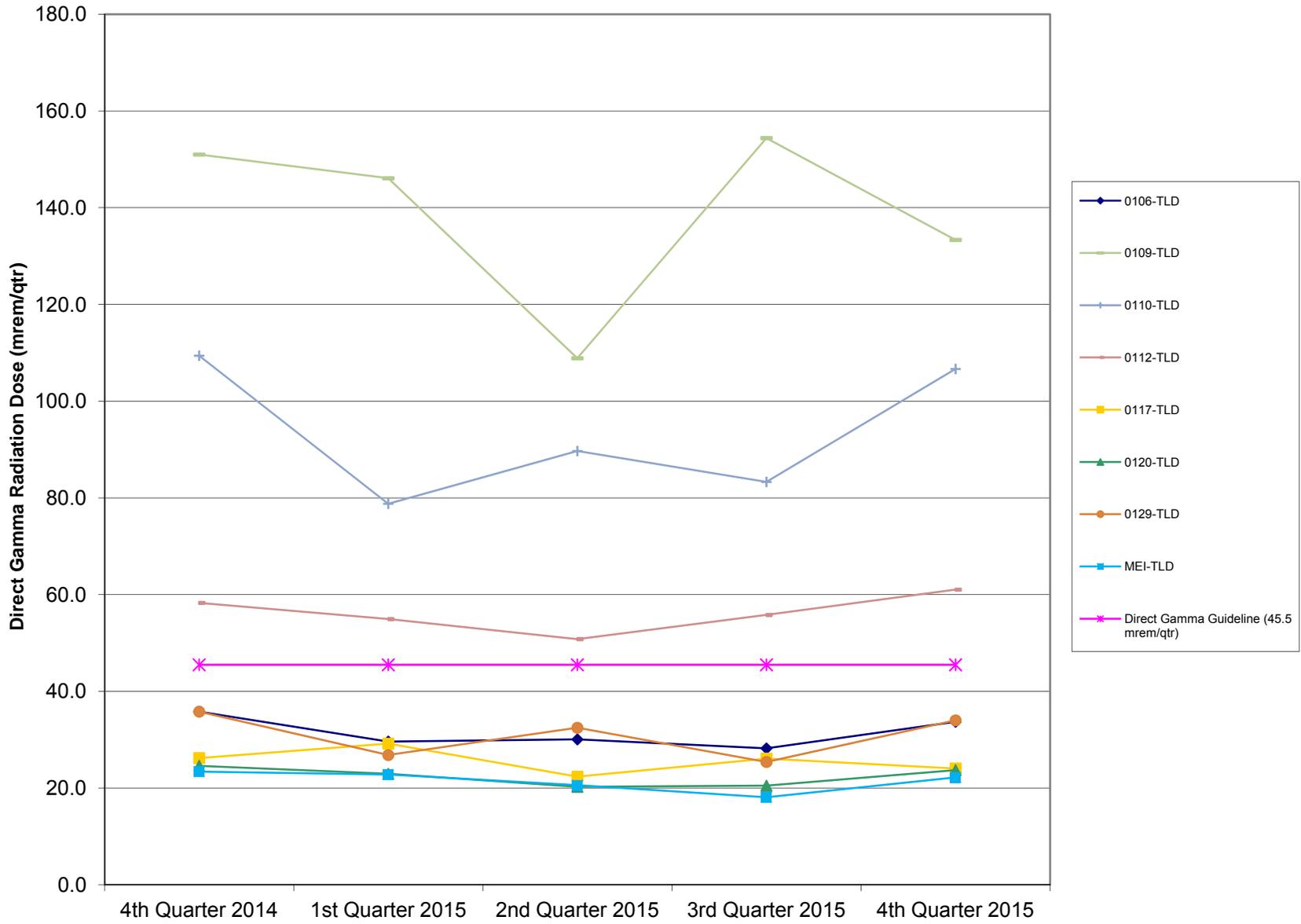


Figure 5. Direct Gamma Radiation Dose at Select Moab Monitoring Locations

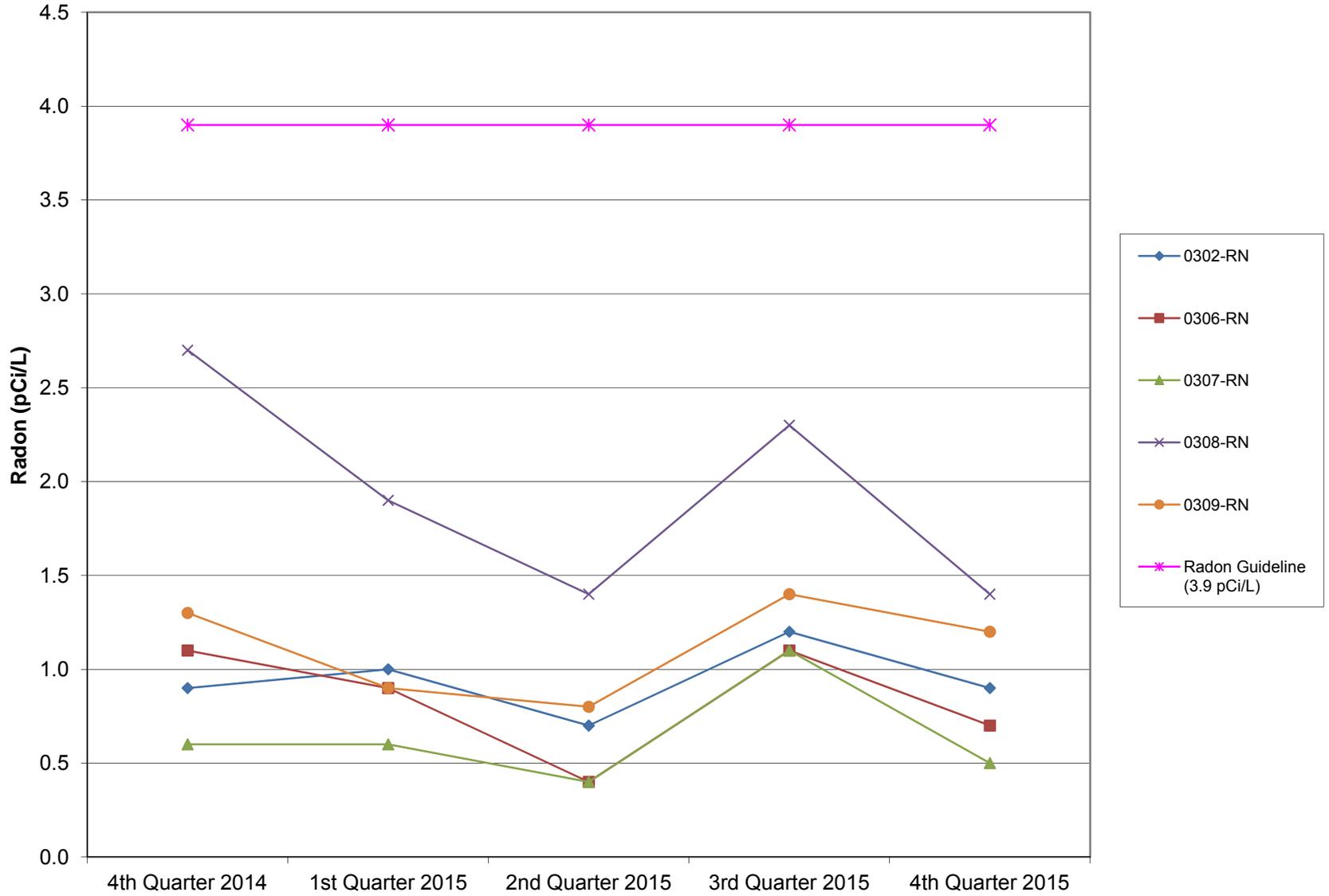


Figure 6. Radon Concentrations at Select Crescent Junction Monitoring Locations

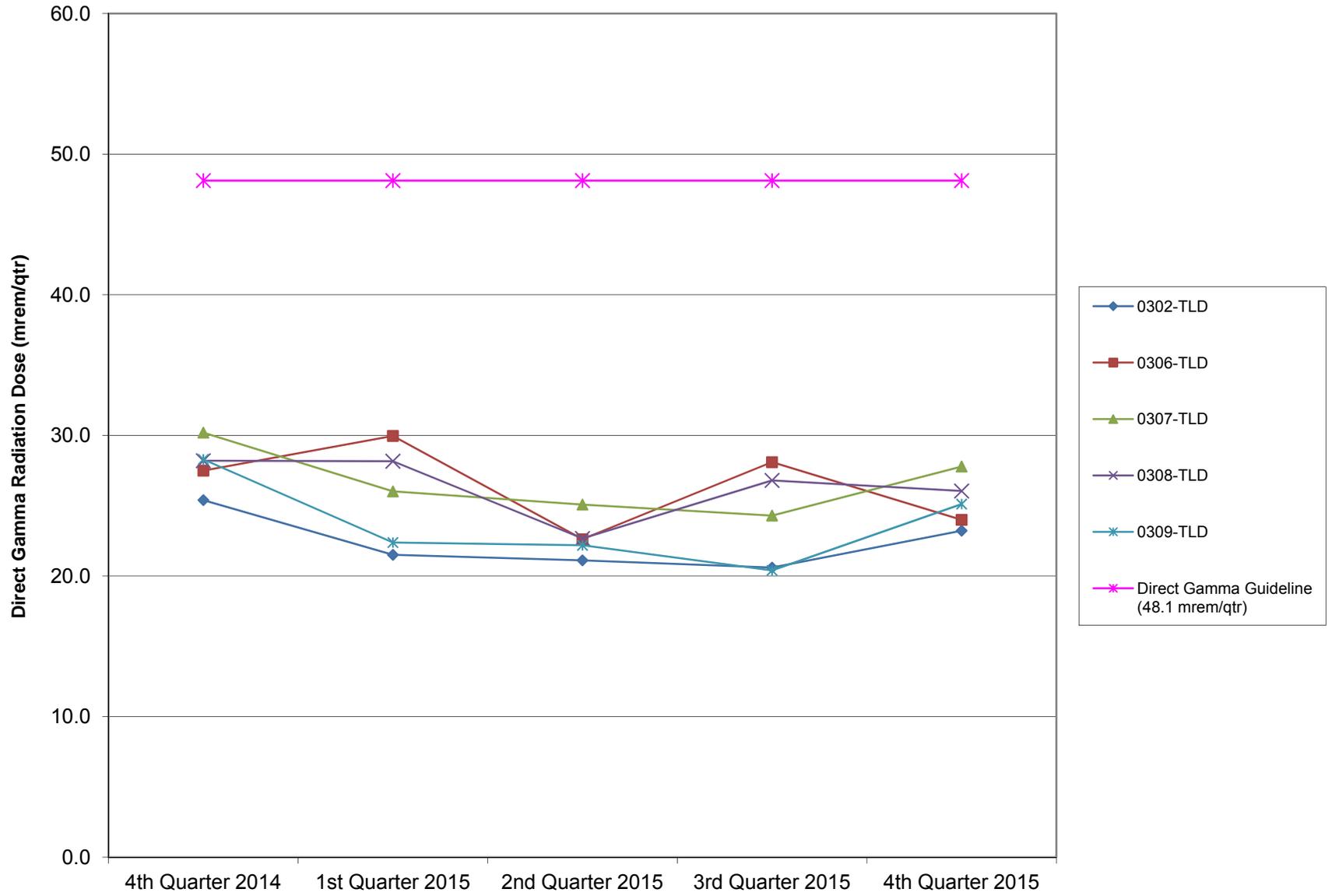


Figure 7. Direct Gamma Radiation Dose at Select Crescent Junction Monitoring Locations

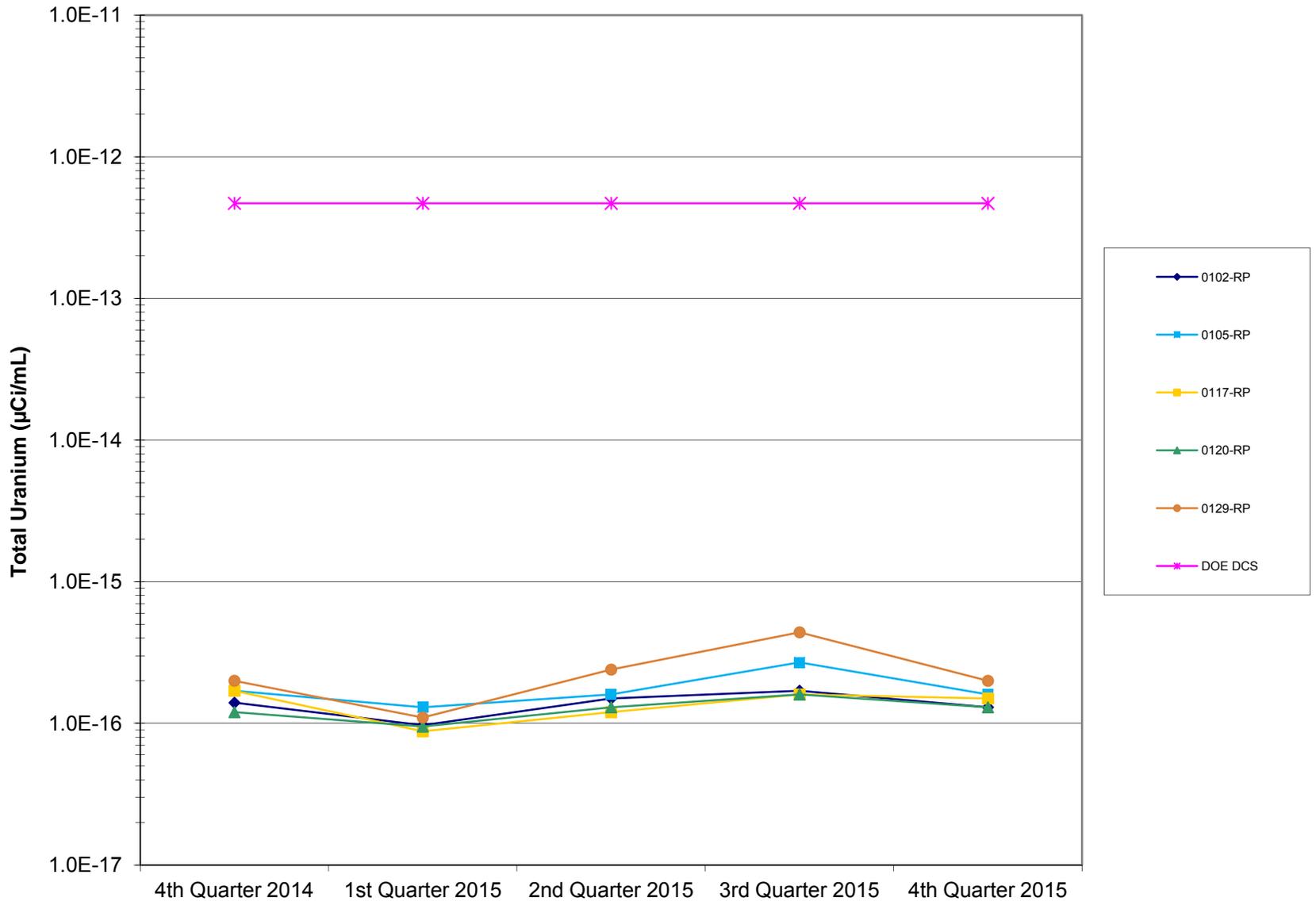


Figure 8. Total Uranium Concentrations at Select Moab Monitoring Locations

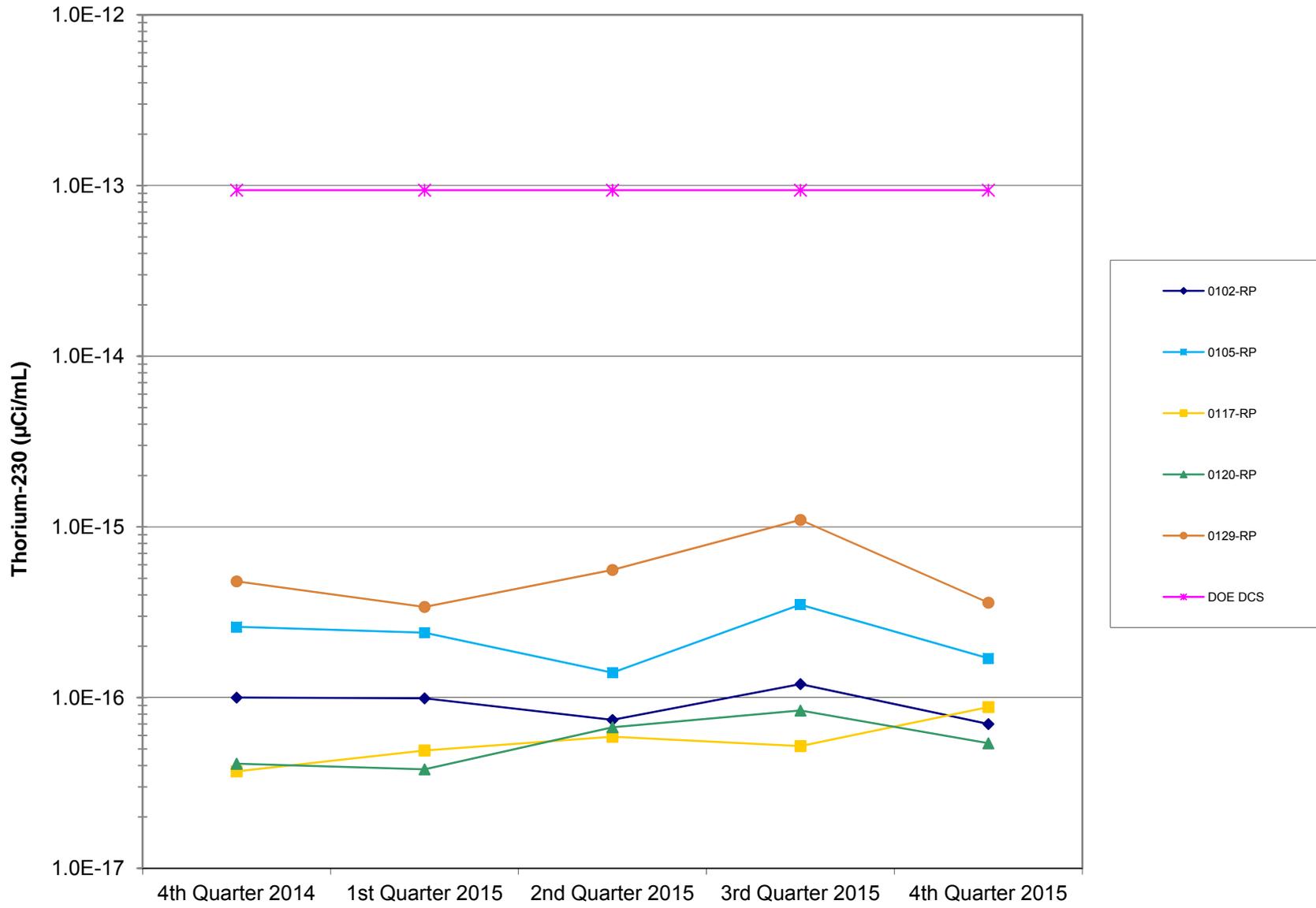


Figure 9. Thorium-230 Concentrations at Select Moab Monitoring Locations

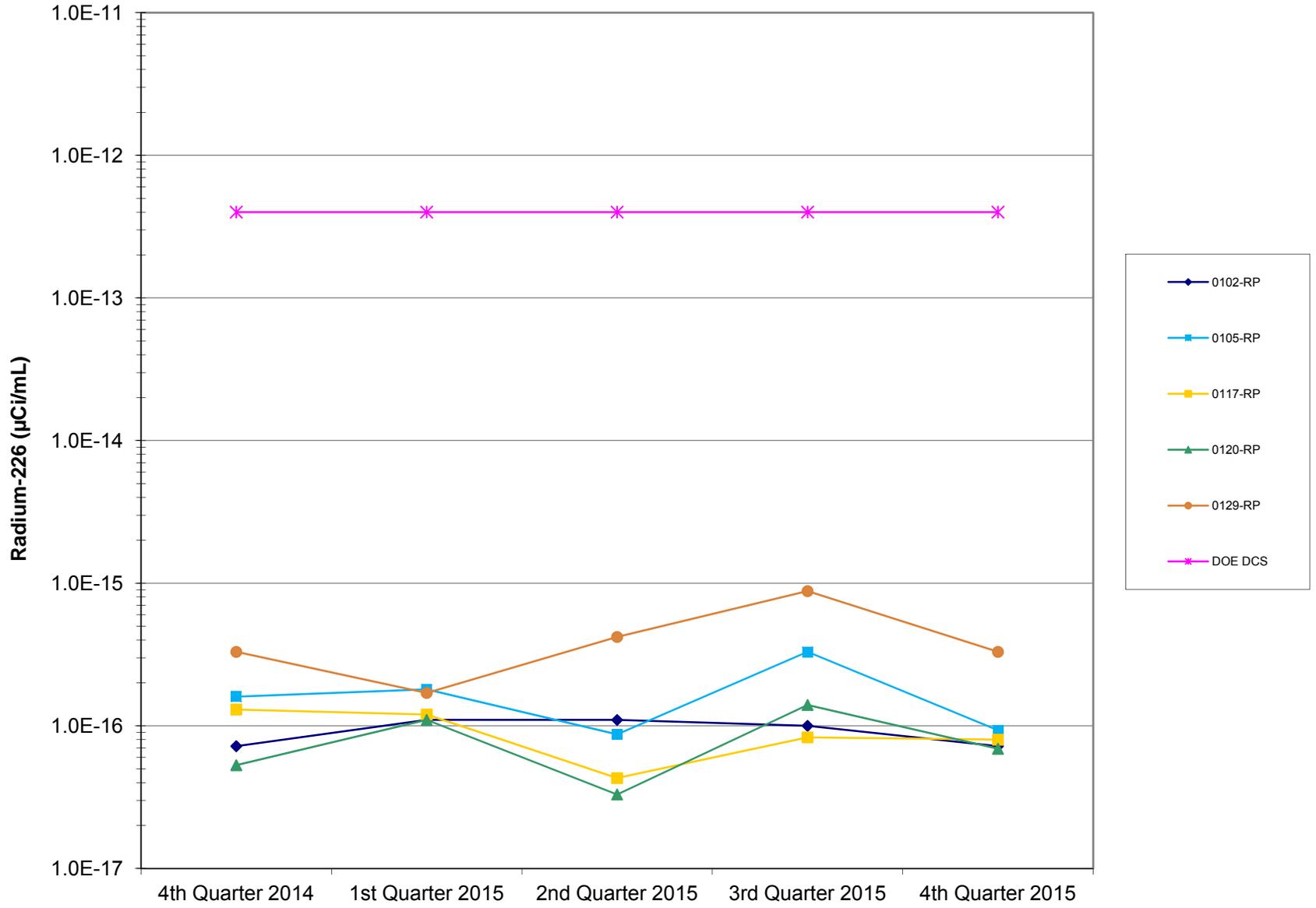


Figure 10. Radium-226 Concentrations at Select Moab Monitoring Locations

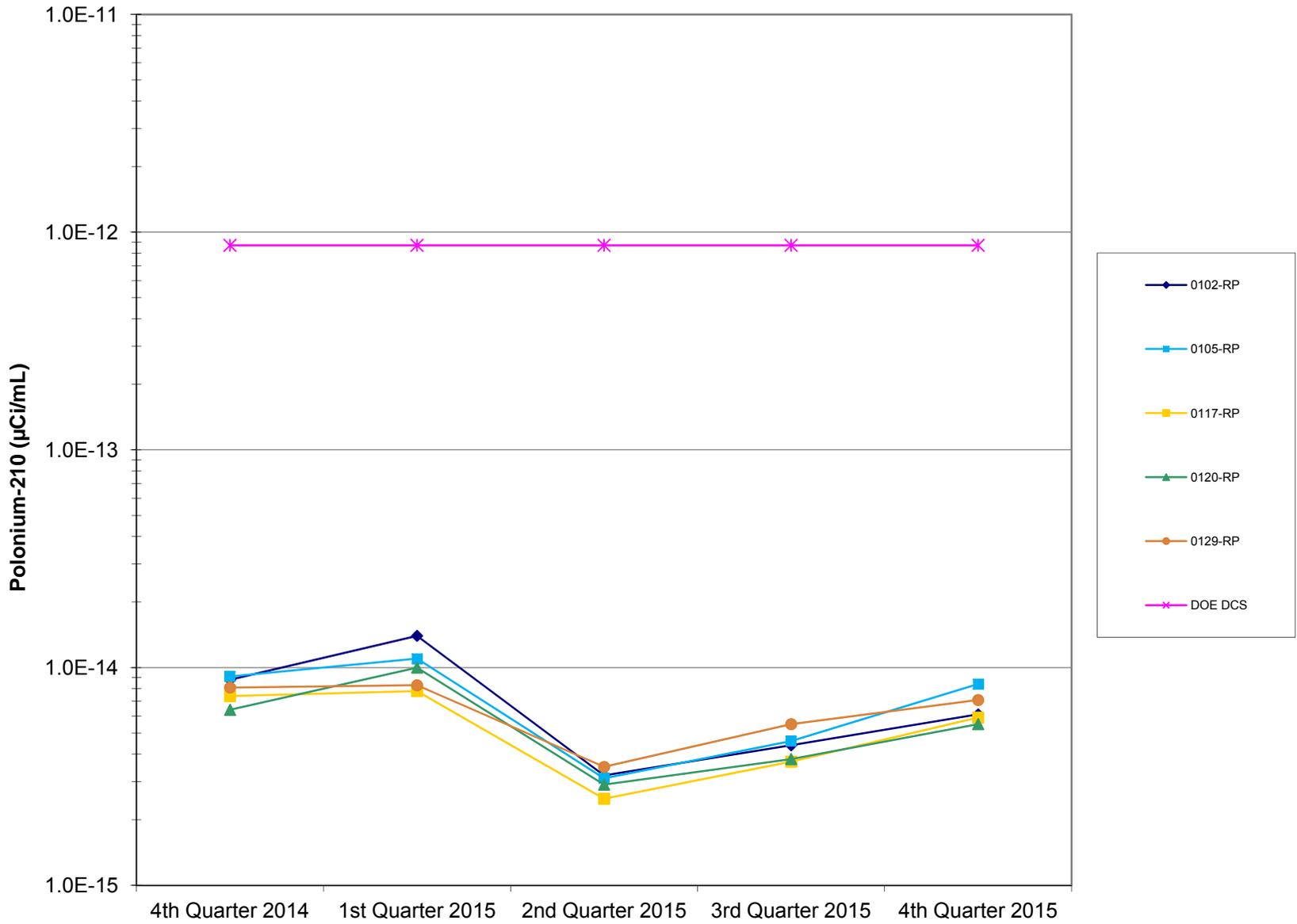


Figure 11. Polonium-210 Concentrations at Select Moab Monitoring Locations

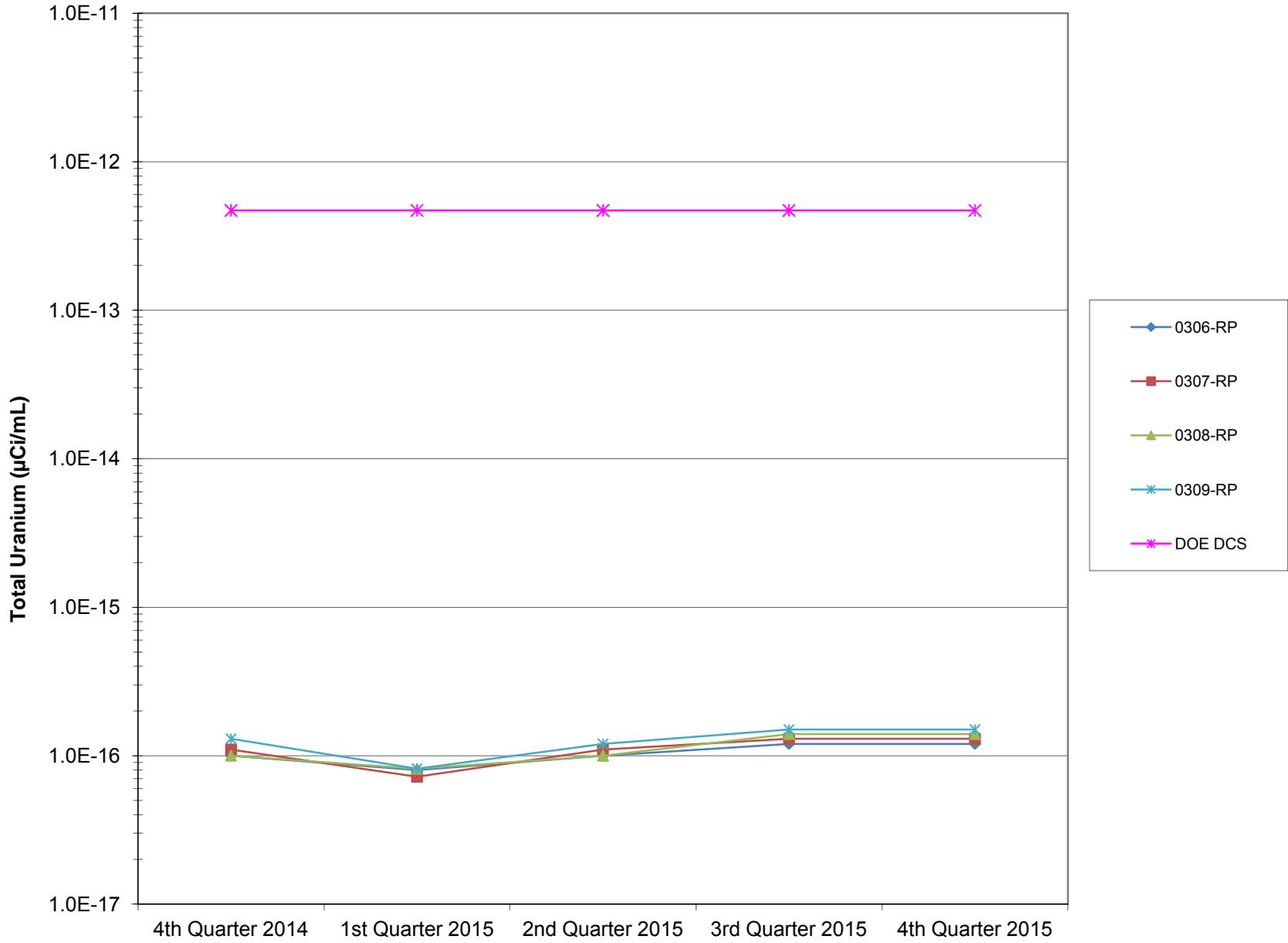


Figure 12. Total Uranium Concentrations at Select Crescent Junction Monitoring Locations

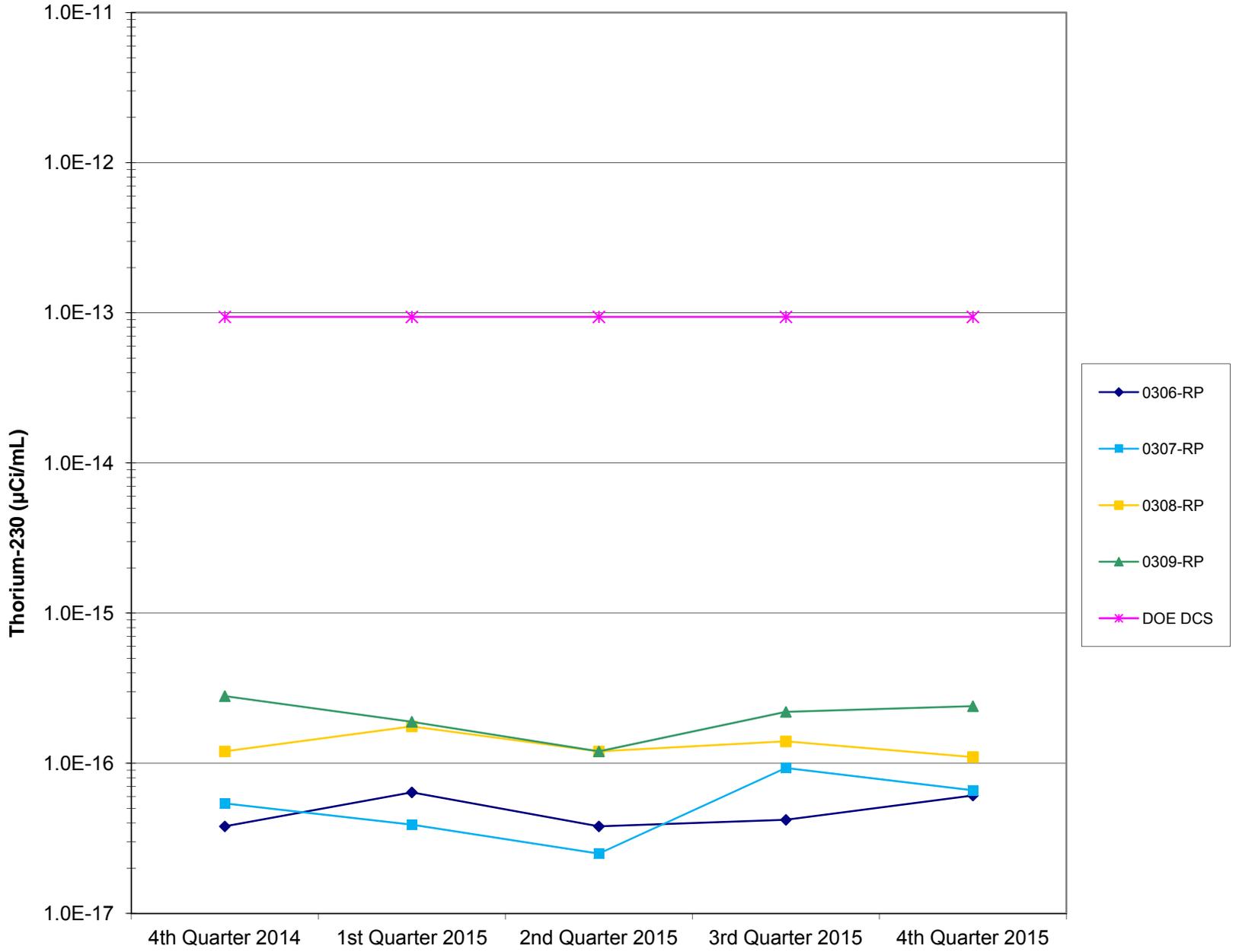


Figure 13. Thorium-230 Concentrations at Select Crescent Junction Monitoring Locations

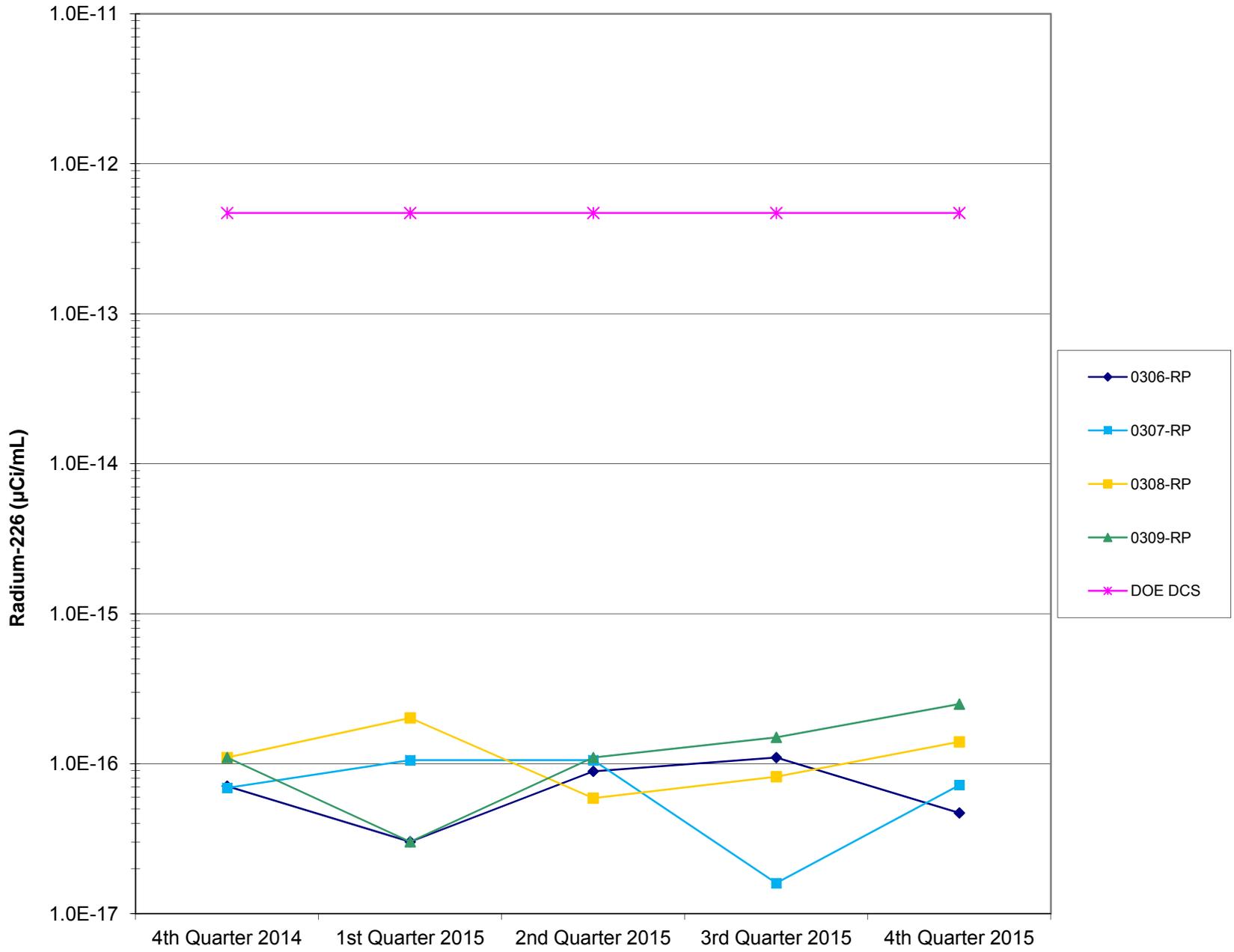


Figure 14. Radium-226 Concentrations at Select Crescent Junction Monitoring Locations

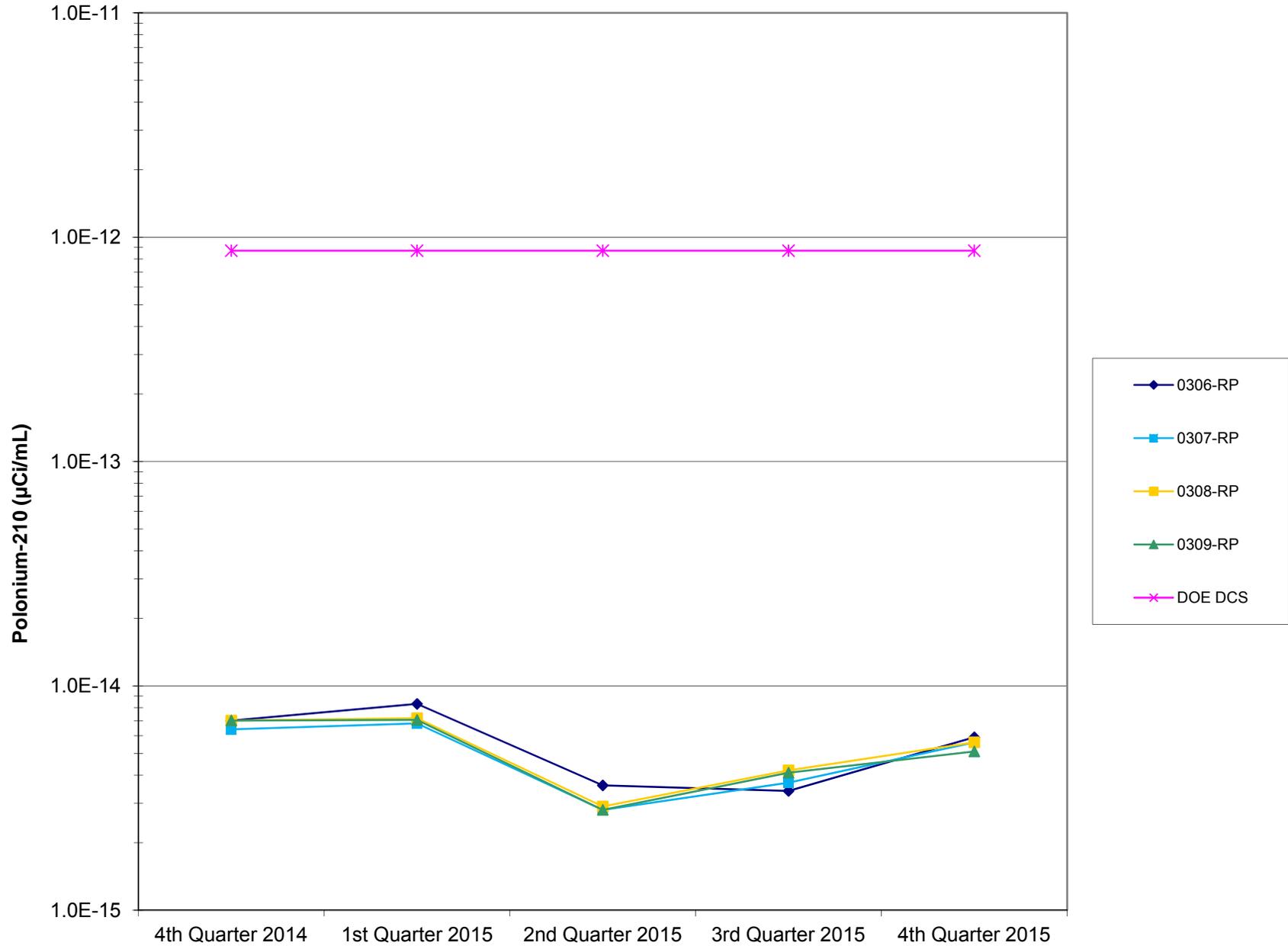


Figure 15. Polonium-210 Concentrations at Select Crescent Junction Monitoring Locations