

Environmental Management - Grand Junction Office



Environmental Air Monitoring Data
Quarterly Report for the Moab and
Crescent Junction, Utah, Sites
Fourth Quarter 2007
(October through December 2007)

March 2008



U.S. Department
of Energy

Office of Environmental Management

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Fourth Quarter 2007
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Moab UMTRA Project

March 2008

Moab/Crescent Junction, Utah
Environmental Air Monitoring Results
October through December 2007

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Summary of Results

Site: Moab, Utah

Sampling Period: October through December 2007

Atmospheric Radon-222: U.S. Department of Energy (DOE) Order 5400.5, *Radiation Protection of the Public and Environment*, establishes a guideline for atmospheric emissions of radon-222 gas that is applicable to the Moab Uranium Mill Tailings Remedial Action (UMTRA) Project site (Moab site). This guideline is 3.0 picocuries per liter (pCi/L) above background. Based on four years of data from 2003 through 2006, background concentrations of radon-222 in the Moab area have been established at 0.64 pCi/L; therefore, the guideline for radon-222 emissions at the Moab site is 3.64 pCi/L. Monitoring data collected during the fourth quarter of 2007 indicate that this guideline was exceeded at four on-site monitoring locations, both in close proximity to the tailings pile. The DOE guideline concentration of radon-222 was exceeded at one of the off-site locations near the south property boundary on vacant land, a new station, 0128. Refer to Table 1 and Table 2 for a review of radon-222 data for the Moab site. Sample locations for the Moab site are presented in Figure 1 and Figure 2.

Direct Environmental Gamma Radiation: DOE Order 5400.5, *Radiation Protection of the Public and Environment*, establishes a dose limit of 100 millirem per year (mrem/yr) above naturally occurring gamma levels (background). Background gamma radiation for the Moab area has been established at 82 mrem/yr; therefore, the 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 2007, four on-site monitoring locations exceeded the gamma dose limit, while none of the off-site monitoring locations exceeded the quarterly gamma radiation dose limit. Refer to Table 1 and Table 2 for a review of gamma data for the Moab site.

Although the exposure rates were exceeded at several locations along the DOE site property boundary, this does not reflect expected doses to the public. These data represent the dose that a member of the public could receive if he or she resided at the point where the data were collected for an entire year. This is not a realistic representation of actual or expected public exposure conditions because no member of the public permanently resides at or near these locations of elevated readings. Initial results for the two stations (0107 and 0108) near private property south of the tailings pile indicate lower readings since property was remediated in January 2007. Monitoring data observed at the maximum exposed individual (MEI) location, just east of the Moab site, represents the greatest potential exposure to a member of the public. The gamma dose limit established by DOE was not exceeded at the MEI location.

Radioparticulates: No standards or radiological exposure limits were exceeded at any of the nine radioparticulate monitoring locations at the Moab site during the fourth quarter of 2007. Analytical data for all analytes (radium-226, thorium-230, polonium-210, and uranium-total) were below their respective Derived Concentration Guidelines (DCGs), as found in DOE Order 5400.5, *Radiation Protection of the Public and Environment* (Figure III-1). Concentrations of the radioparticulates have been consistently below DCGs since DOE assumed ownership of the site in 2001. DOE Order 5400.5 also requires that the radiological dose resulting from airborne emissions be less than 10 mrem/yr. All off-site sampling location concentrations, when converted to dose, using the relationship: (measured concentration)/(DCG concentration) x (100 mrem/yr), were indistinguishable from the average background value of 0.8 mrem/yr.

During the fourth quarter 2007, the on-site dose resulting from airborne emissions, including background, was 1.00 mrem/yr at location 0102 and 1.73 mrem/yr at location 0105. Refer to Table 3 for a review of radioparticulate air monitoring data for the Moab site.

Table 1. Moab Environmental Air Monitoring Locations with Samples that Exceeded Applicable Regulatory Standards, Limits, or Guidelines During 2007

Analyte	Standard/Guideline	Sample Locations Exceeding Standards/Guidelines During the Fourth Quarter	Sampling Locations Exceeding Standards/Guidelines During 2007[‡]
Radon-222	3.7 pCi/L	0105, 0106, 0107, 0108, 0128	0105, 0106, 0107, 0108, 0109, 0128
Direct Gamma Radiation	182 mrem/yr (45.5 mrem/qtr)	0106, 0109, 0110, 0111	0105, 0106, 0107, 0108, 0109, 0110, 0111

[‡] Annual exceedance is estimated based on calculated year of data.

Site: Crescent Junction, Utah

Sampling Period: October through December 2007

Atmospheric Radon-222: DOE Order 5400.5, *Radiation Protection of the Public and Environment*, establishes a guideline for atmospheric emissions of radon-222 gas that will be applicable to the Crescent Junction site (3.0 pCi/L above background). Because the uranium mill tailings have yet to be placed at the disposal site, all sampling results to date represent baseline conditions (i.e., natural background). The data collected before tailing placement begins will be used to calculate a background value and ultimately a site-specific radon standard. Sample locations for the Crescent Junction site are presented in Figure 3. Refer to Table 4 for a review of radon-222 data for the Crescent Junction site.

Direct Environmental Gamma Radiation: DOE Order 5400.5, *Radiation Protection of the Public and Environment*, establishes a dose limit of 100 mrem/yr above naturally occurring gamma levels (background). Because the uranium mill tailings have yet to be placed at the disposal site, all sampling results to date represent baseline conditions (i.e., natural background conditions). The data collected before tailing placement begins will be used to calculate a background value and ultimately a site-specific gamma radiation standard. Refer to Table 4 for a review of gamma data for the Crescent Junction site.

Radioparticulates: DOE Order 5400.5, *Radiation Protection of the Public and Environment*, establishes DCGs for concentrations of radioparticulates in air. Because the uranium mill tailings have yet to be placed at the disposal site, all sampling data results to date represent baseline conditions (i.e., natural background conditions). The data collected before tailing placement begins will be used to calculate a background value and ultimately a site-specific radioparticulate standard. Refer to Table 5 for a review of radioparticulate air monitoring data for the Crescent Junction site.



Jeff Stevens, Moab Project Manager

March 31, 2008

Date

Data Assessment

Environmental Air Monitoring Field Activities Verification Checklist

Project	<u>Moab/Crescent Junction, Utah</u>	Date(s) of Air Sampling	<u>October through December 2007</u>
Date(s) of Verification	<u>February 15, 2008</u>	Name of Verifier	<u>Ed Baker</u>

	Response (Yes, No, NA)	Comments
1. Is the SAP the primary document directing field procedures?	Yes	
2. Were the sampling locations specified in the SAP?	Yes	
3. Were low-volume air samplers operating at or near 60 Liters/minute \pm 10%?	Yes	
4. Did any of the samplers require airflow adjustment?	No	No adjustments were required during the sampling period; however, all pumps were reset 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 in undisturbed and operable condition upon arrival?	Yes	
6. Were the hourly clocks on the low-volume air samplers operational upon arrival?	Yes	
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. Concentration of uranium slightly above detection; contribution of uranium in filter matrix, if any, would be subtracted when correcting for background concentrations.
10. Were trip blanks (for radon-222 and gamma radiation) included with each shipment?	No	A trip blank was not used for the radon-222 monitoring; however, a trip blank was used for the direct gamma radiation monitoring.
11. Was the identity of the QC sample locations protected?	Yes	

Environmental Air Monitoring Field Activities Verification Checklist (continued)

Project	<u>Moab/Crescent Junction, Utah</u>	Date(s) of Air Sampling	<u>October through December 2007</u>
Date(s) of Verification	<u>February 15, 2008</u>	Name of Verifier	<u>Ed Baker</u>

	Response (Yes, No, NA)	Comments
12. Were the true locations of the QC samples recorded in the Field Log Book?	<u>Yes</u>	
13. Were all samples collected as specified in the SAP?	<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>	

Data Assessment Summary

Atmospheric Radon-222 Analyses

Radon detectors were analyzed by Landauer Inc. in accordance with Landauer's *Quality Assurance Manual for Radon Monitoring Services, Revision Number 9*, March, 2004. Fourth quarter 2007 analytical radon-222 data were received in a report dated January 21, 2008. Unlike radioparticulate analyses, radon-222 data are not reported with qualifiers from the laboratory. In the event that the detectors are either missing, damaged, or cannot be read, the laboratory would make a special comment. After the data report was received, the data were evaluated for consistency with other data points and with sample duplicates. All radon results were considered useable. A new station, 0128, was added for the fourth quarter. This station is located approximately 400 feet south of the DOE property boundary.

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 their analytical procedure *Preparation and Readout of Teledyne Isotopes TLD Card, TIML-TLD-01, Revision 7* (Teledyne Isotopes 2001). Fourth quarter 2007 environmental gamma radiation data were received in a report dated February 7, 2008. After the laboratory results were received, the data were evaluated for consistency with other results collected previously at each monitoring location and also compared against duplicates. All of the TLD data were considered useable. A new station, 0128, was added for the fourth quarter.

Radioparticulate Analyses

Paragon Analytics Laboratory, Fort Collins, Colorado, analyzed the radioparticulate samples for radium-226, thorium-230, polonium-210, and total uranium. Results for the fourth quarter 2007 sampling period are in Report Identification Number (RIN) 0710015. Polonium-210 and isotopic thorium (includes thorium-230) were analyzed by alpha spectroscopy, method PA-SOP714R10. Radium-226 was analyzed by radon emanation methods, EPA method 903.1(m). Total uranium was analyzed by inductively coupled plasma-mass spectrometry, EPA method SW-846 6020A, procedure PA SOP827 Rev. 5. Radioparticulate analytical data for samples collected during the fourth quarter of 2007 were reviewed, validated, and summarized in the *Data Review and Validation Report for RIN 0710015* (March 2008).

Field Activities

Duplicate samples for radon-222 monitoring were collected at three locations: (1) 0108, an on-site location at the southern property line of the Moab site; (2) 0111, an on-site location at the western property line near the rail load-out location; and (3) 0121, a background monitoring location approximately two miles southeast of the Moab site. Duplicate measurements of direct gamma were made at two Moab locations: (1) 0108, an on-site location with consistently elevated readings; and (2) 0111, an on-site location along the western property line of the Moab site. Duplicate radon-222 measurements were made at Crescent Junction locations 0301, 0303, and 0306. Duplicate direct-gamma measurements were made at Crescent Junction locations 0301, 0303, and 0305.

Duplicates are not being collected for radioparticulate samples per Sampling Analysis Plan. All of the radioparticulate isotopes collected to date are below their respective DCGs. Consequently, the costs associated with purchasing a duplicate sampler, providing additional electrical power, and incurring additional analytical expenses are not justified.

Suspected Anomalies

All analytical data are reviewed for anomalous or outlying data points. No data anomalies were detected during this quarter. This 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 2007 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.

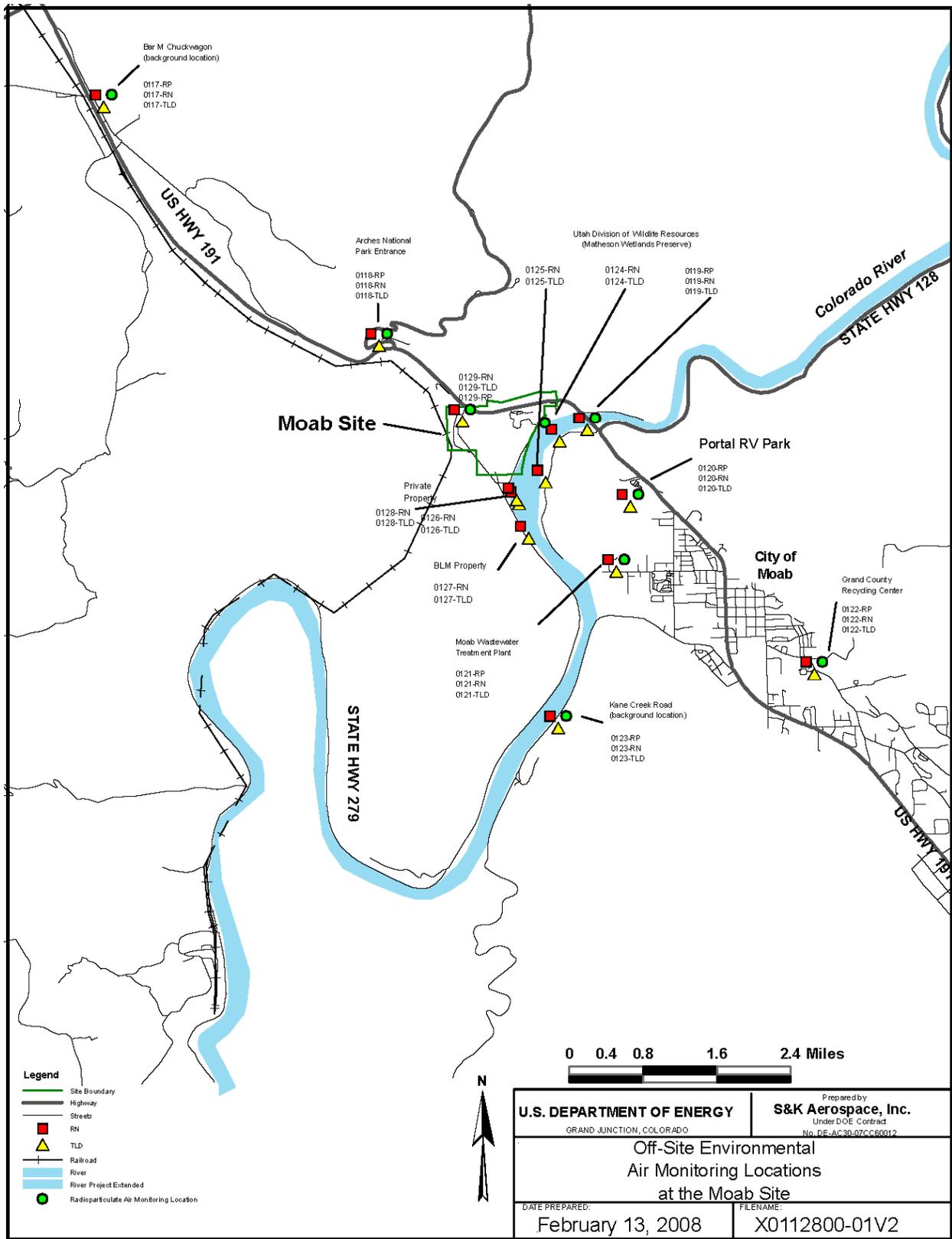


Ed Baker
Permits and Compliance Engineer



Date

Sample Location Maps



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Figure 1. Off-site Radon, Direct Gamma, and Radioparticulate Monitoring Locations, 2007

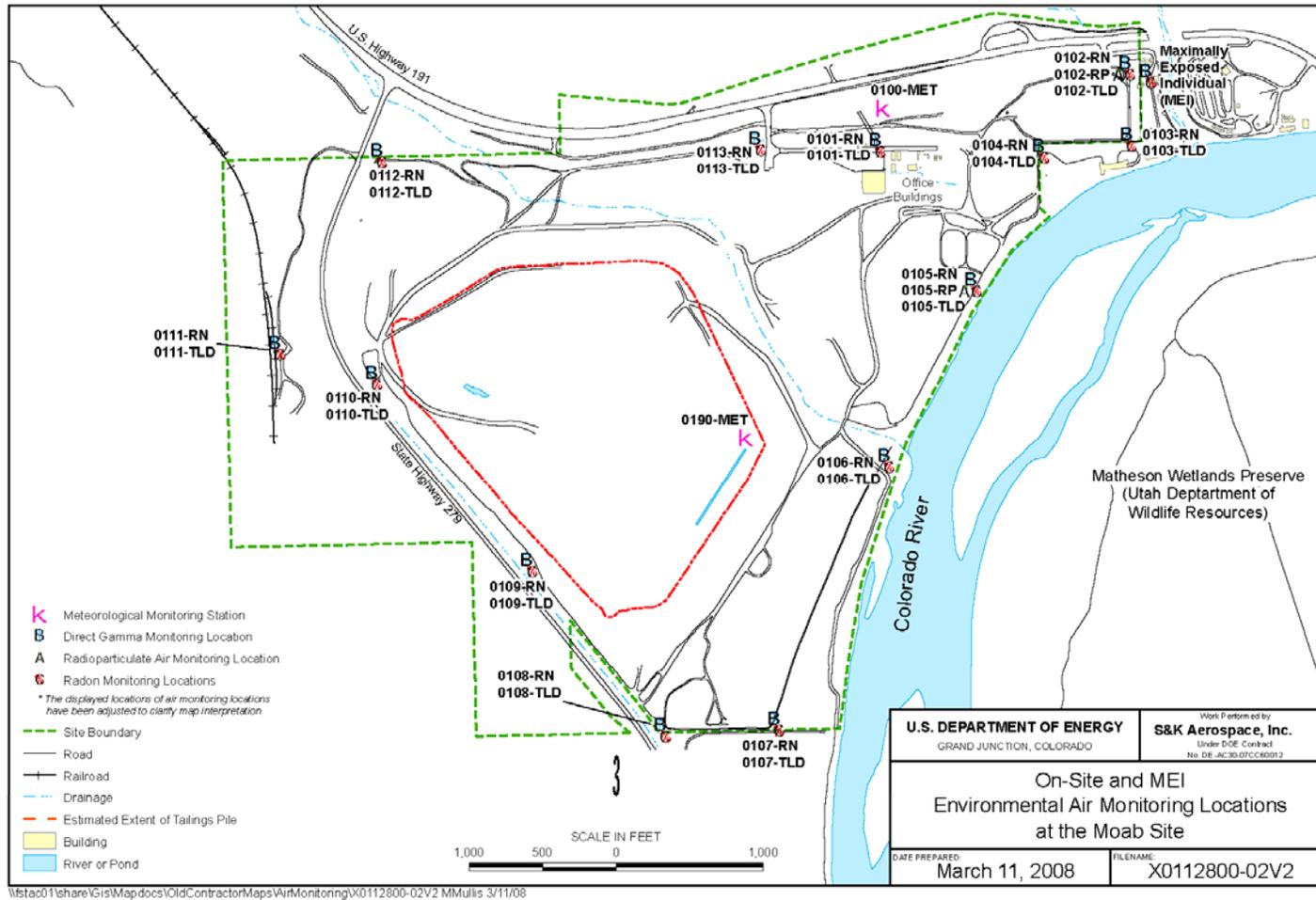


Figure 2. On-site Radon, Direct Gamma, and Radioparticulate Monitoring Locations, 2007

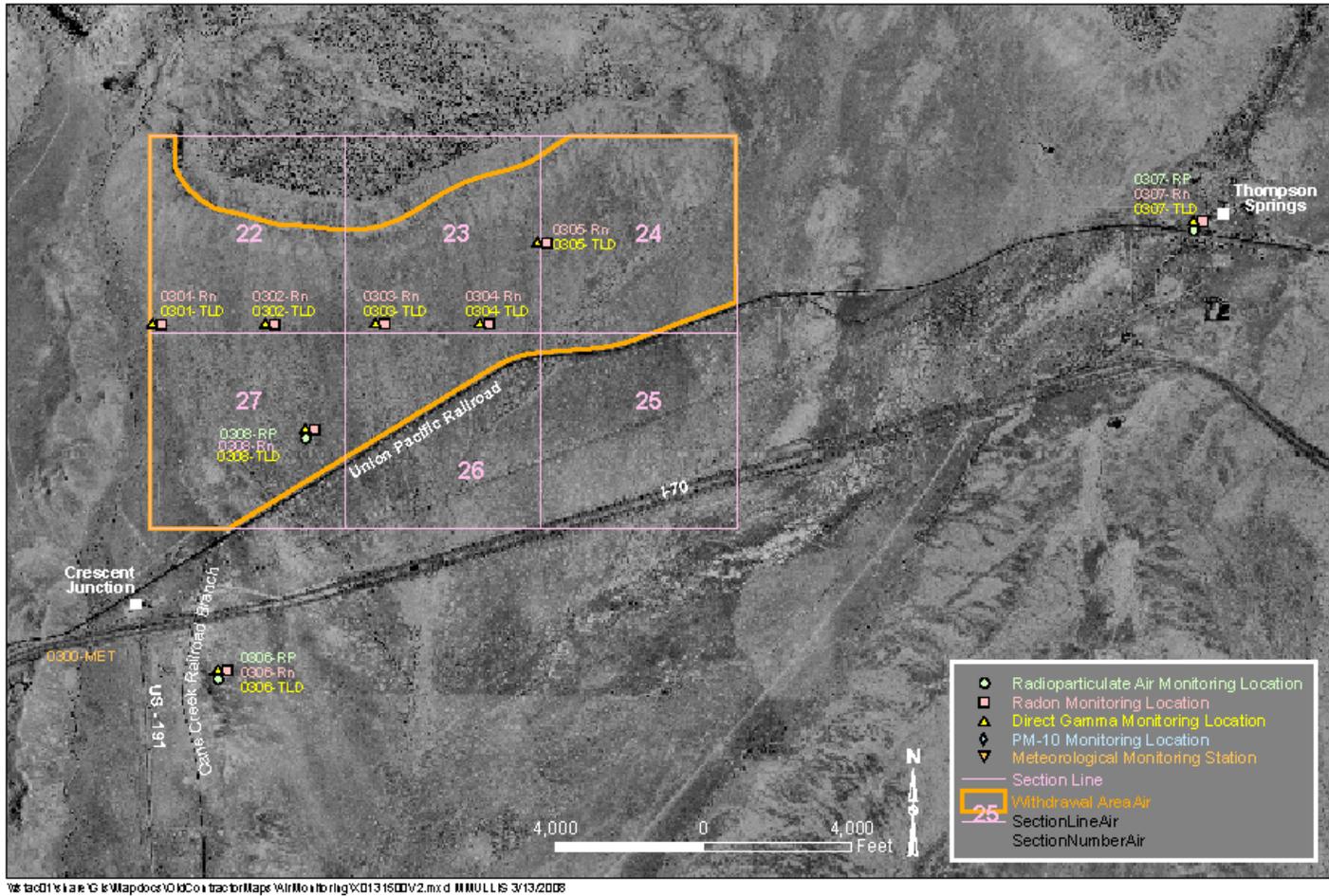


Figure 3. Sampling Location Map for the Crescent Junction Site

Environmental Air Monitoring Data

Environmental Air Monitoring Data Summary

This section contains data summary tables for each environmental air-monitoring constituent. Radon-222 and direct gamma radiation for the Moab site are summarized in Table 2 and radioparticulate data for the Moab site are summarized in Table 3. Radon-222 and direct gamma radiation for the Crescent Junction site are summarized in Table 4 and radioparticulate data for the Crescent Junction site are summarized in Table 5.

Time-concentration graphs for each analyte sampled at the Moab site are presented in Figure 4 through Figure 9. Time-concentration graphs for each analyte sampled at the Crescent Junction site are presented in Figure 10 through Figure 15. After mill tailings disposal begins, location 0306 could become the MEI location. Location 0307, approximately five miles east of the disposal site, will probably represent the second greatest risk, and locations 0301 through 0305 will provide property line data for the disposal site. Time-concentration graphs have been plotted only for selected locations for each matrix. The rationale used for selecting each location is summarized below.

Radon-222 and Direct Gamma Radiation

Radon-222 and gamma radiation data have been graphed (Figure 8 and Figure 9, respectively) for the following Moab site locations: (1) Location MEI, which is considered to represent the greatest potential exposure scenario to a member of the public; (2) Location 0108, which is on the southern property boundary of the Moab site and occasionally has high radon levels; (3) Location 0106, which is along the southeastern property boundary and has recorded high direct gamma radiation during 2007; (4) Location 0117, which is approximately five miles northwest of the Moab site property, is a background monitoring location; (5) Location 0120, which is near the Portal RV Park, approximately one mile southeast of the Moab site, and represents the second potential exposure to the public, second to the MEI location, for off-site exposure to a member of the public.

Radioparticulates

Radioparticulate monitoring data have been graphed (Figure 4) for the following Moab site locations: (1) Location 0102, one of two on-site radioparticulate monitoring locations, is the radioparticulate sampling location closest to the MEI; (2) Location 0105, is closest to the emissions source (i.e., the mill tailings pile) and is at the site boundary adjacent to the Colorado River and the Matheson Wetlands Preserve; (3) Location 0117 (near the Bar-M Chuckwagon) is a background monitoring location approximately five miles northwest of the Moab site property and represents ambient or naturally occurring conditions; (4) Location 0120 (near the Portal RV Park) is approximately one mile southeast of the Moab site and represents the second greatest risk (second to the MEI location) for off-site exposure to a member of the public.

Table 2. Summary of Environmental Radon-222 and Gamma Radiation Monitoring Data for the Moab Site through Fourth Quarter, Calendar Year 2007

Station Number	1st Quarter 2007		2nd Quarter 2007		3rd Quarter 2007		4th Quarter 2007		2007 Annual Average	
	Radon pCi/L	Gamma mrem/91 d ³	Radon pCi/L	Gamma mrem/yr						
On-Site Locations										
0101	2.5	39.0	1.4	37.5	1.8	31.5	2.3	31.0	2.0	139.0
0102	1.5	23.0	1.0	27.9	0.7	20.3	1.6	22.4	1.2	93.6
0103	1.3	21.5	0.6	26.3	1.3	19.6	2.0	21.9	1.3	89.3
0104	1.6	22.6	1.1	30.2	1.5	22.6	2.9	24.4	1.8	99.8
0105	2.5	40.4	1.7	50.1	2.0	42.6	3.8	42.1	2.5	175.2
0106	6.3	34.0	3.7	55.5	4.3	43.5	8.7	46.1	5.8	179.1
0107	5.8	45.6	3.5	41.9	3.8	31.0	8.9	35.8	5.5	154.3
0108	2.8	96.4	3.5	49.4	3.4	39.1	6.7	42.8	4.1	227.7
0109	7.8	46.0	2.2	68.6	1.3	51.9	2.4	55.0	3.4	221.5
0110	3.6	66.3	2.8	87.9	2.2	66.4	2.3	66.4	2.7	287.0
0111	1.0	55.5	0.8	72.7	1.1	56.5	1.1	55.6	1.0	240.3
0112	1.1	36.2	NDA	37.7	1.5	33.3	3.1	29.6	1.9	136.8
0113	2.5	31.1	1.7	36.6	2.0	26.9	3.2	28.6	2.4	123.2
Off-Site Locations										
0117 ¹	<0.3	23.8	0.5	30.7	0.9	19.7	0.9	23.4	0.7	97.6
0118	0.6	21.1	0.5	26.6	0.8	18.2	1.2	20.4	0.8	86.3
0119	1.0	27.0	0.9	29.0	1.2	17.8	0.9	22.8	1.0	96.6
0120	0.8	21.7	0.5	23.2	0.7	15.5	1.0	18.2	0.8	78.6
0121	0.8	20.7	0.4	24.6	1.2	17.4	1.0	19.2	0.9	81.9
0122	0.4	17.5	0.5	22.8	0.8	16.9	0.7	17.4	0.6	74.6
0123 ¹	<0.3	15.2	0.5	22.6	0.5	16.7	0.8	16.5	0.5	71.0
0124	1.1	22.6	1.1	28.9	1.6	19.3	1.9	23.0	1.4	93.8
0125	1.7	23.4	1.3	30.7	1.6	22.2	2.1	24.7	1.7	101.0
0126	2.3	23.6	0.8	29.7	1.5	21.3	2.8	23.7	1.9	98.3
0127	1.1	22.6	0.7	29.2	1.0	19.3	1.7	23.7	1.1	94.8
0128	N/A	N/A	N/A	N/A	N/A	N/A	4.6	23.7	4.6	23.7
MEI ²	1.1	14.3	0.9	19.7	0.7	15.6	2.2	16.4	1.2	66.0

¹Designated background monitoring locations. Background locations are sufficiently distant from the millsite to be free from any affects or influences from potential site contaminants.

²The maximally exposed individual (MEI) is the continually occupied residential property that is closest to the DOE property boundary.

³mrem value is prorated to a 91-day exposure period.

NA = Not Applicable.

NDA = No Data Available.

Table 3. Summary of Radioparticulate Air Monitoring Data for the Moab Site for Calendar Year 2007

Station Number	Isotope	1st Quarter 2007 (μCi/mL) ⁵	2nd Quarter 2007 (μCi/mL)	3rd Quarter 2007 (μCi/mL)	4th Quarter 2007 (μCi/mL)	Annual Average (μCi/mL)
On-Site Locations						
0102-RP	Uranium ¹	1.5E-16	1.3E-16	1.1E-16	7.00E-17	1.3E-16
	Thorium-230 ²	3.7E-16	8.3E-17	7.4E-17	7.7E-17	1.8E-16
	Radium-226 ³	1.1E-16	1.0E-16	1.1E-16	7.8E-17	1.1E-16
	Polonium-210 ⁴	8.8E-15	1.3E-15	2.2E-15	8.0E-15	4.1E-15
0105-RP	Uranium ¹	7.5E-16	5.7E-16	2.9E-16	2.1E-16	5.4E-16
	Thorium-230 ²	1.1E-15	3.6E-16	1.7E-16	2.4E-16	5.4E-16
	Radium-226 ³	3.4E-16	1.2E-16	1.6E-16	1.7E-16	2.1E-16
	Polonium-210 ⁴	1.3E-14	8.3E-16	1.7E-15	1.0E-14	5.0E-15
Off-Site Locations						
0117-RP	Uranium ¹	9.7E-17	9.8E-17	9.4E-17	3.9E-17	9.6E-17
	Thorium-230 ²	3.9E-16	5.2E-17	5.1E-17	9.8E-17	1.6E-16
	Radium-226 ³	5.8E-17	8.1E-17	8.5E-17	1.1E-16	7.5E-17
	Polonium-210 ⁴	8.9E-15	9.5E-16	1.7E-15	7.8E-15	3.8E-15
0118-RP	Uranium ¹	1.2E-16	1.5E-16	1.4E-16	3.6E-17	1.4E-16
	Thorium-230 ²	3.9E-16	7.6E-17	1.1E-16	1.4E-16	1.9E-16
	Radium-226 ³	7.2E-17	1.4E-16	1.3E-16	5.1E-17	1.2E-16
	Polonium-210 ⁴	8.7E-15	1.6E-15	2.1E-15	1.0E-14	4.1E-15
0119-RP	Uranium ¹	9.6E-17	1.4E-16	9.3E-17	8.4E-17	1.1E-16
	Thorium-230 ²	3.9E-16	8.4E-17	5.8E-17	2.0E-16	1.80E-16
	Radium-226 ³	1.2E-16	1.1E-16	7.3E-17	1.4E-16	9.9E-17
	Polonium-210 ⁴	7.9E-15	9.1E-16	1.6E-15	8.8E-15	3.5E-15
0120-RP	Uranium ¹	1.1E-16	1.2E-16	1.0E-16	5.7E-17	1.1E-16
	Thorium-230 ²	3.8E-16	9.5E-17	4.9E-17	1.1E-16	1.7E-16
	Radium-226 ³	7.2E-17	7.9E-17	9.4E-17	8.1E-17	8.2E-17
	Polonium-210 ⁴	7.7E-15	1.1E-15	1.8E-15	9.8E-15	3.5E-15
0121-RP	Uranium ¹	1.1E-16	9.6E-17	8.9E-17	6.0E-17	9.7E-17
	Thorium-230 ²	4.0E-16	3.8E-17	7.1E-17	8.4E-17	1.7E-16
	Radium-226 ³	8.5E-17	1.7E-16	9.2E-17	4.5E-17	1.2E-16
	Polonium-210 ⁴	7.5E-15	1.0E-15	1.7E-15	6.9E-15	3.4E-15
0122-RP	Uranium ¹	9.6E-17	8.1E-17	9.3E-17	2.7E-17	9.0E-17
	Thorium-230 ²	3.9E-16	5.2E-17	5.2E-17	3.5E-17	1.6E-16
	Radium-226 ³	7.3E-17	8.6E-17	1.2E-16	4.6E-17	9.4E-17
	Polonium-210 ⁴	7.5E-15	9.3E-16	1.9E-15	8.1E-15	3.4E-15
0123-RP	Uranium ¹	8.8E-17	1.1E-16	8.9E-17	4.7E-17	9.4E-17
	Thorium-230 ²	3.8E-16	7.3E-17	4.8E-17	1.1E-16	1.7E-16
	Radium-226 ³	9.2E-17	1.0E-16	7.4E-17	8.6E-17	8.9E-17
	Polonium-210 ⁴	7.3E-15	1.3E-15	1.7E-15	7.4E-15	3.4E-15

¹DOE DCG for Total Uranium = 2.E-12

²DOE DCG for Thorium-230 = 4.E-14

⁵μCi/mL = microCuries per milliliter

³DOE DCG for Radium-226 = 1.E-12

⁴DOE DCG for Polonium-210 = 1.E-12

Table 4. Summary of Environmental Radon-222 and Gamma Radiation Monitoring Data for the Crescent Junction Site through Fourth Quarter, Calendar Year 2007

Station Number	1st Quarter 2007		2nd Quarter 2007		3rd Quarter 2007		4th Quarter 2007		2007 Annual Average	
	Radon pCi/L	Gamma mrem/91 d ¹	Radon pCi/L	Gamma mrem/yr						
0301	NDA	NDA	0.5	25.2	1.1	21.7	1.2	23.3	0.9	93.6
0302	1.3	23.9	0.5	26.5	0.9	20.4	1.3	23.8	1.0	94.6
0303	0.7	23.6	0.6	27.9	1.2	22.1	1.1	24.5	0.9	98.1
0304	1.0	25.8	0.5	23.5	0.7	21.4	1.1	21.2	0.8	91.9
0305	1.1	26.7	0.5	27.2	NDA	23.1	1.2	24.1	0.9	101.1
0306	0.6	24.2	0.7R	27.0	1.2	20.3	0.8	24.2	0.8	95.7
0307	0.8	25.8	0.3	27.3	0.8	21.2	0.8	24.3	0.7	98.6

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

NDA = No Data Available

R = Sample result unusable due to compromised condition of station.

Table 5. Summary of Radioparticulate Air Monitoring Data for the Crescent Junction Site Through Fourth Quarter Calendar Year 2007

Station Number	Isotope	1st Quarter 2007 ($\mu\text{Ci/mL}$) ⁵	2nd Quarter 2007 ($\mu\text{Ci/mL}$) ⁵	3rd Quarter 2007 ($\mu\text{Ci/mL}$) ⁵	4th Quarter 2007 ($\mu\text{Ci/mL}$)	Annual Average ($\mu\text{Ci/mL}$) ⁵
0306-RP	Uranium ¹	7.7E-17	6.7E-17	8.1E-17	3.8E-17	6.6E-17
	Thorium-230 ²	3.8E-16	5.5E-17	7.9E-17	8.2E-17	1.5E-16
	Radium-226 ³	6.2E-17	4.9E-17	7.5E-17	9.3E-17	7.0E-17
	Polonium-210 ⁴	8.4E-15	1.2E-15	2.6E-15	8.4E-15	5.1E-15
0307-RP	Uranium ¹	9.6E-17	1.0E-16	1.9E-16	4.6E-17	1.1E-16
	Thorium-230 ²	3.8E-16	4.7E-17	1.2E-16	8.1E-17	1.6E-16
	Radium-226 ³	1.8E-16	2.0E-16	1.0E-16	7.3E-17	1.4E-16
	Polonium-210 ⁴	7.4E-15	9.8E-16	2.4E-15	8.1E-15	4.7E-15

¹DOE DCG for Total Uranium = 2.E-12

²DOE DCG for Thorium-230 = 4.E-14

⁵ $\mu\text{Ci/mL}$ = microCuries per milliliter

³DOE DCG for Radium-226 = 1.E-12

⁴DOE DCG for Polonium-210 = 1.E-12

Moab Radioparticulate Concentration (Po-210)

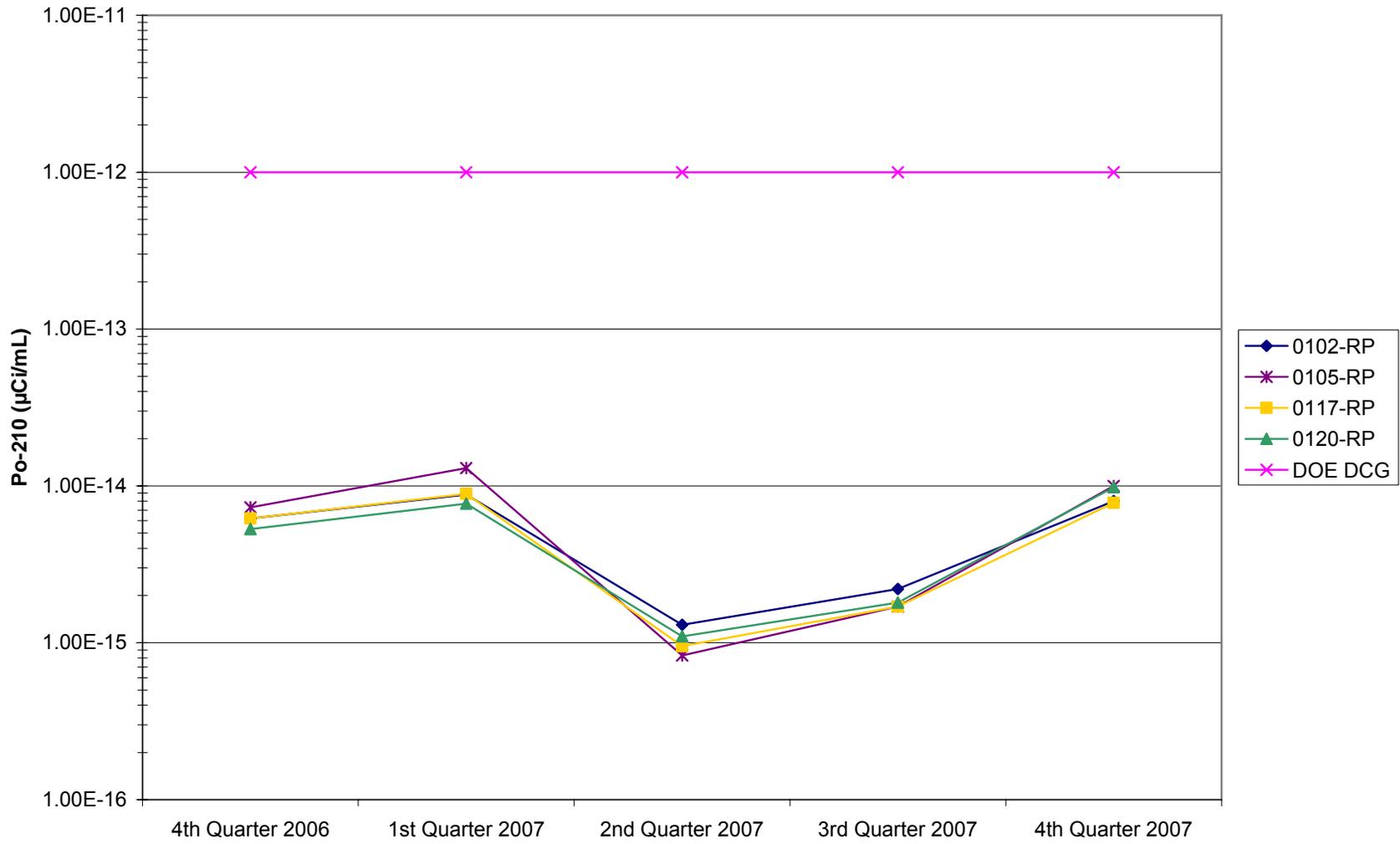


Figure 4. Moab Radioparticulate Concentration (Po-210)

Moab Radioparticulate Concentration (Th-230)

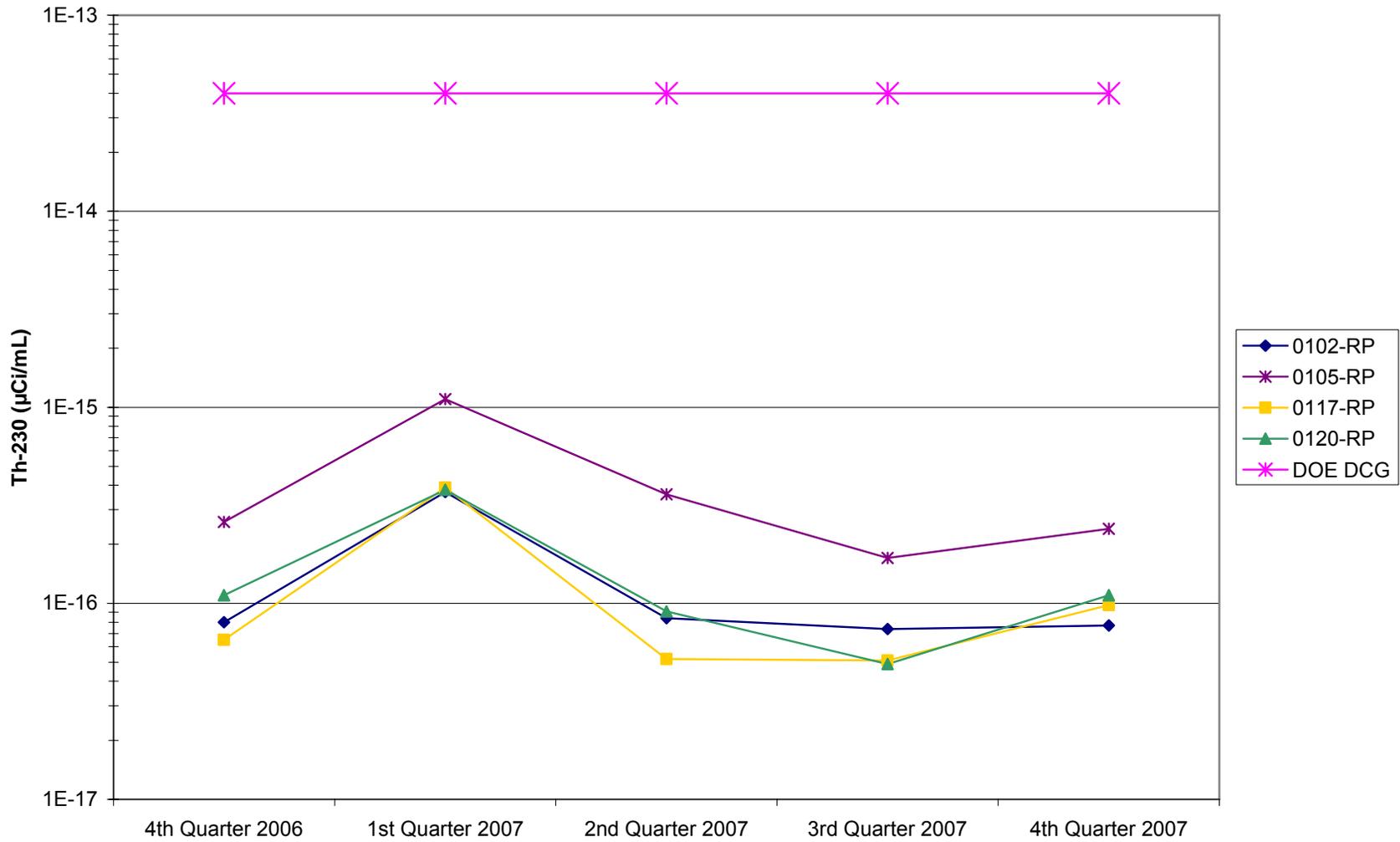


Figure 5. Moab Radioparticulate Concentration (Th-230)

Moab Radioparticulate Concentration (Ra-226)

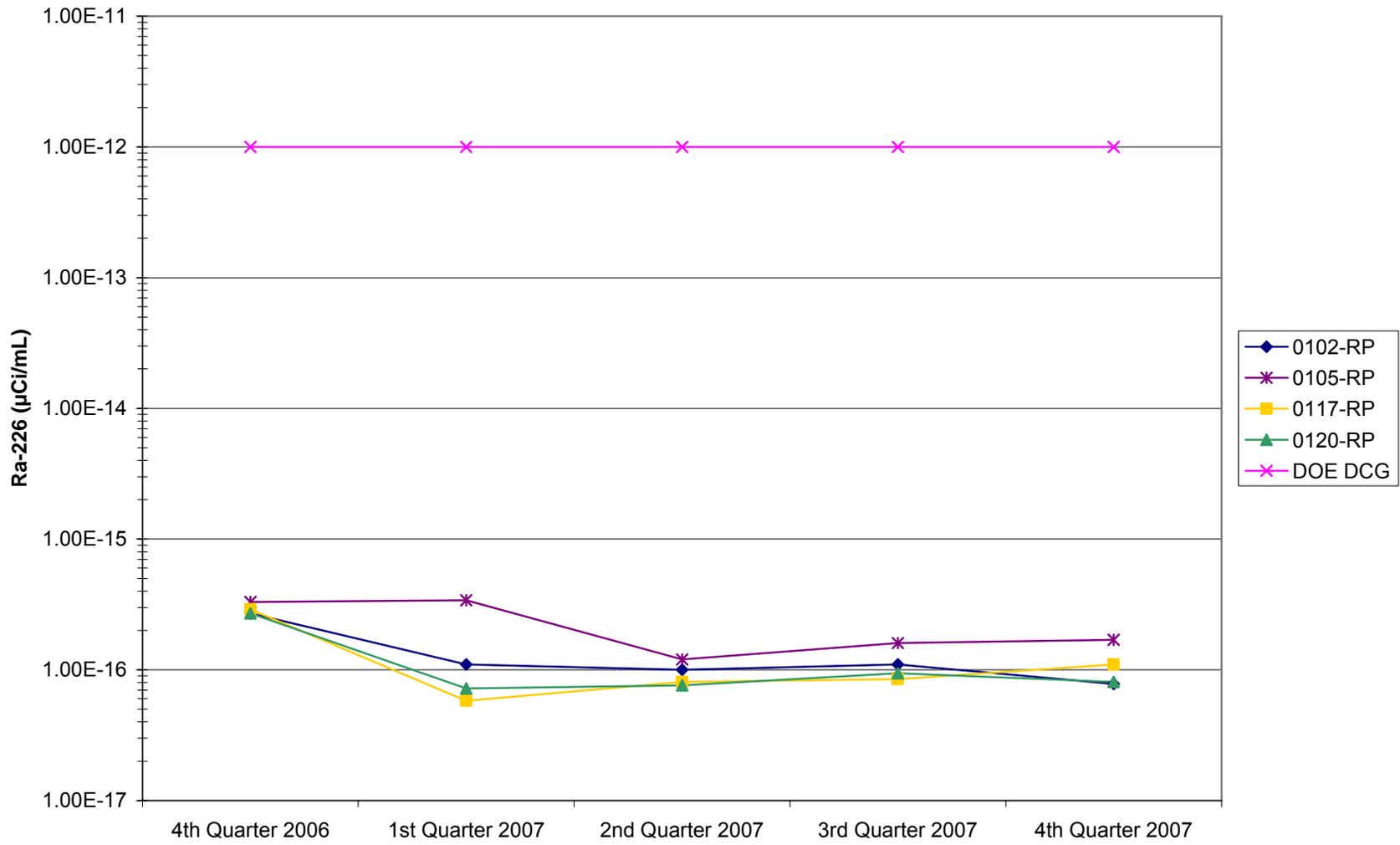


Figure 6. Moab Radioparticulate Concentration (Ra-226)

Moab Radioparticulate Concentration (Uranium)

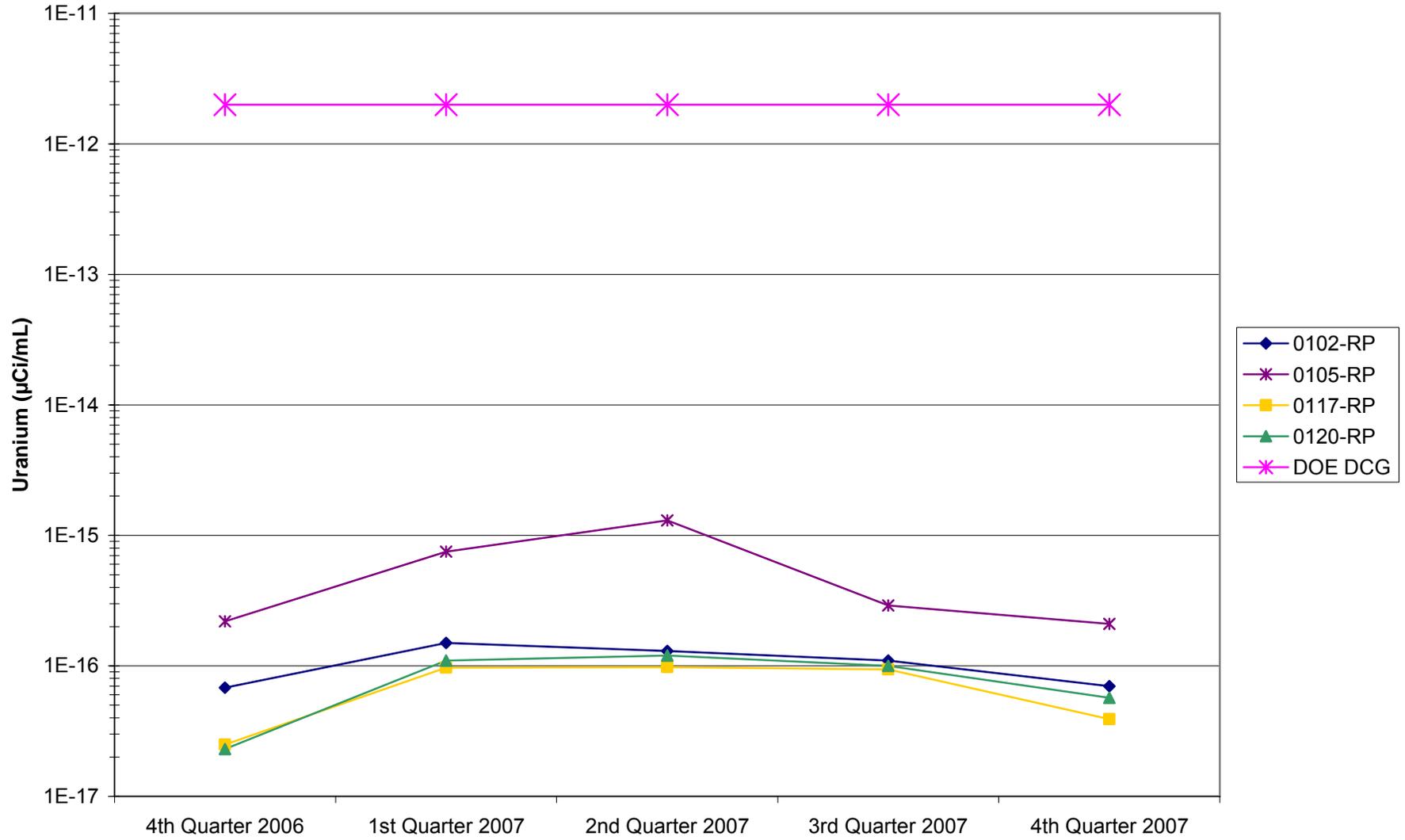


Figure 7. Moab Radioparticulate Concentration (Uranium)

Moab Atmospheric Radon-222 Concentration

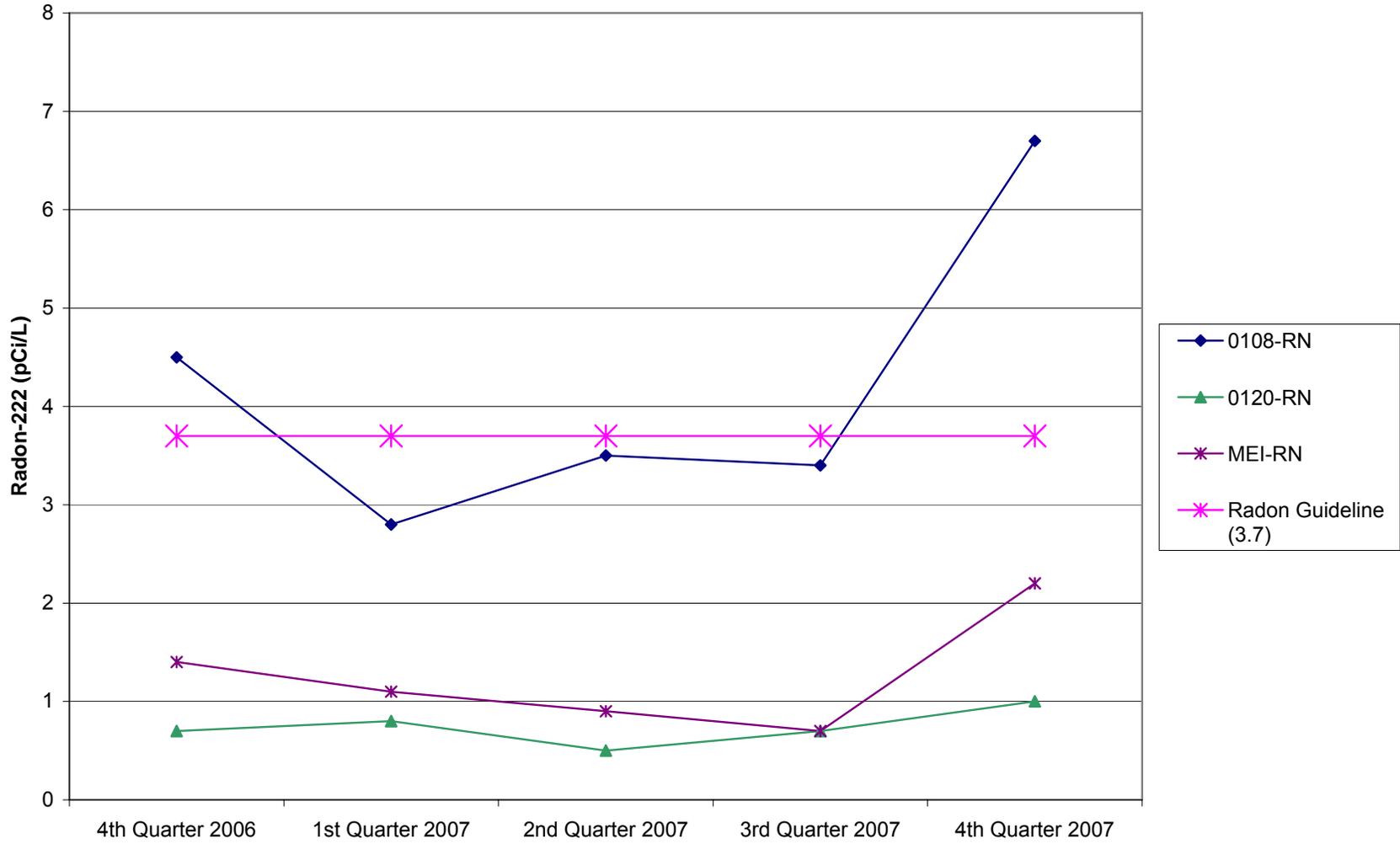


Figure 8. Moab Atmospheric Radon-222 Concentration

Moab Direct Gamma Radiation Dose

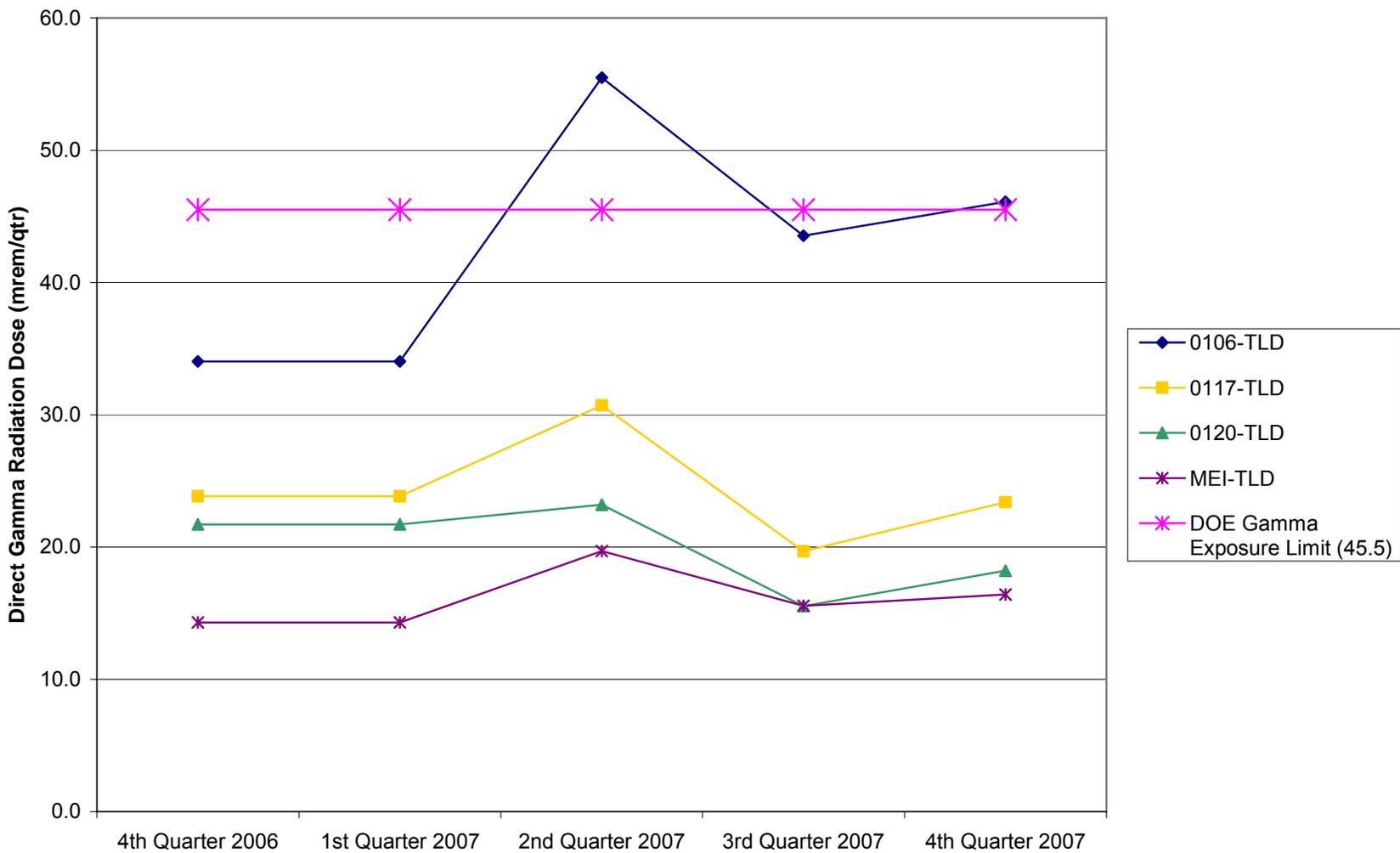


Figure 9. Moab Direct Gamma Radiation Dose

Crescent Junction Radioparticulate Concentration (Po-210)

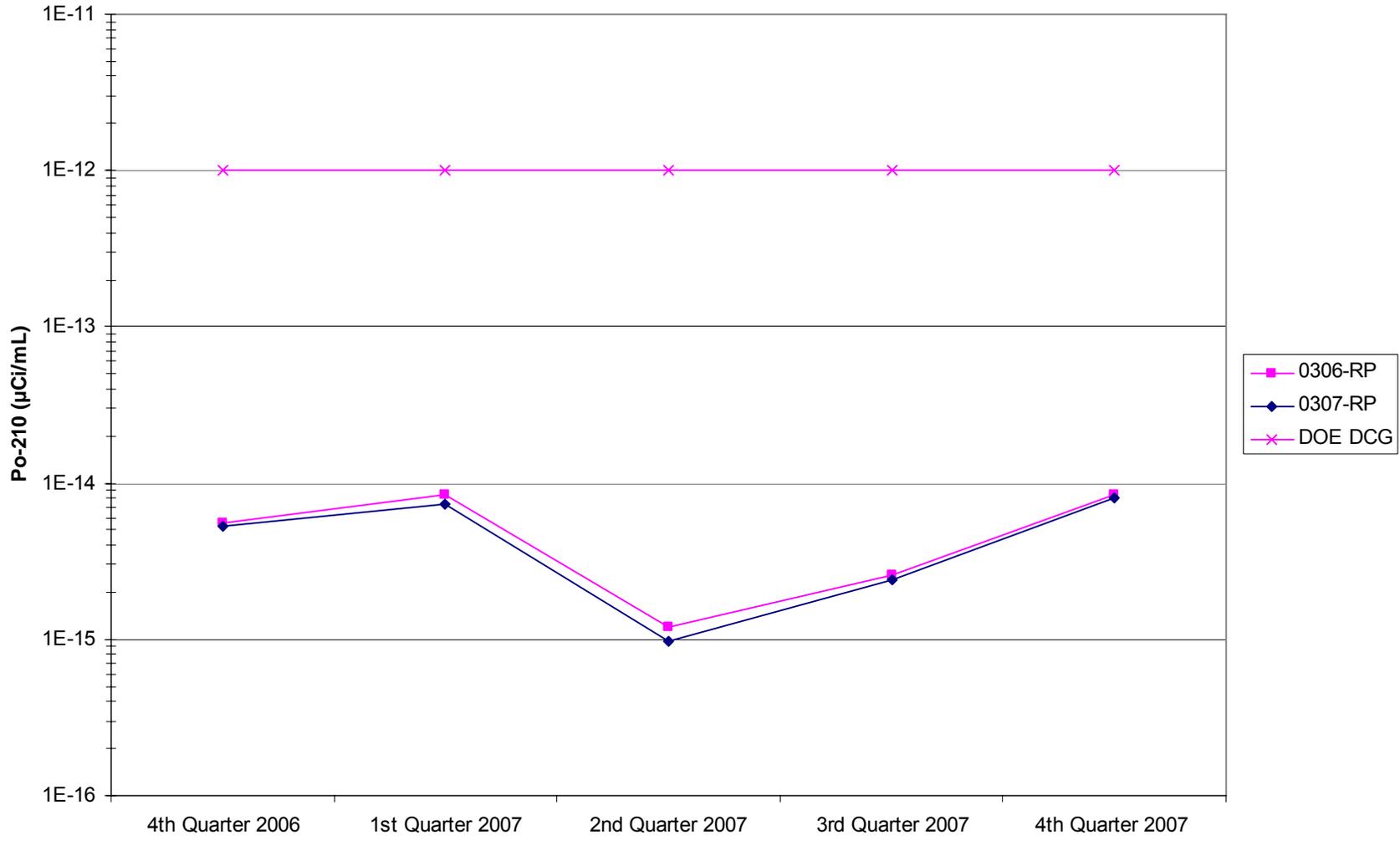


Figure 10. Crescent Junction Radioparticulate Concentration (Po-210)

Crescent Junction Radioparticulate Concentration (Th-230)

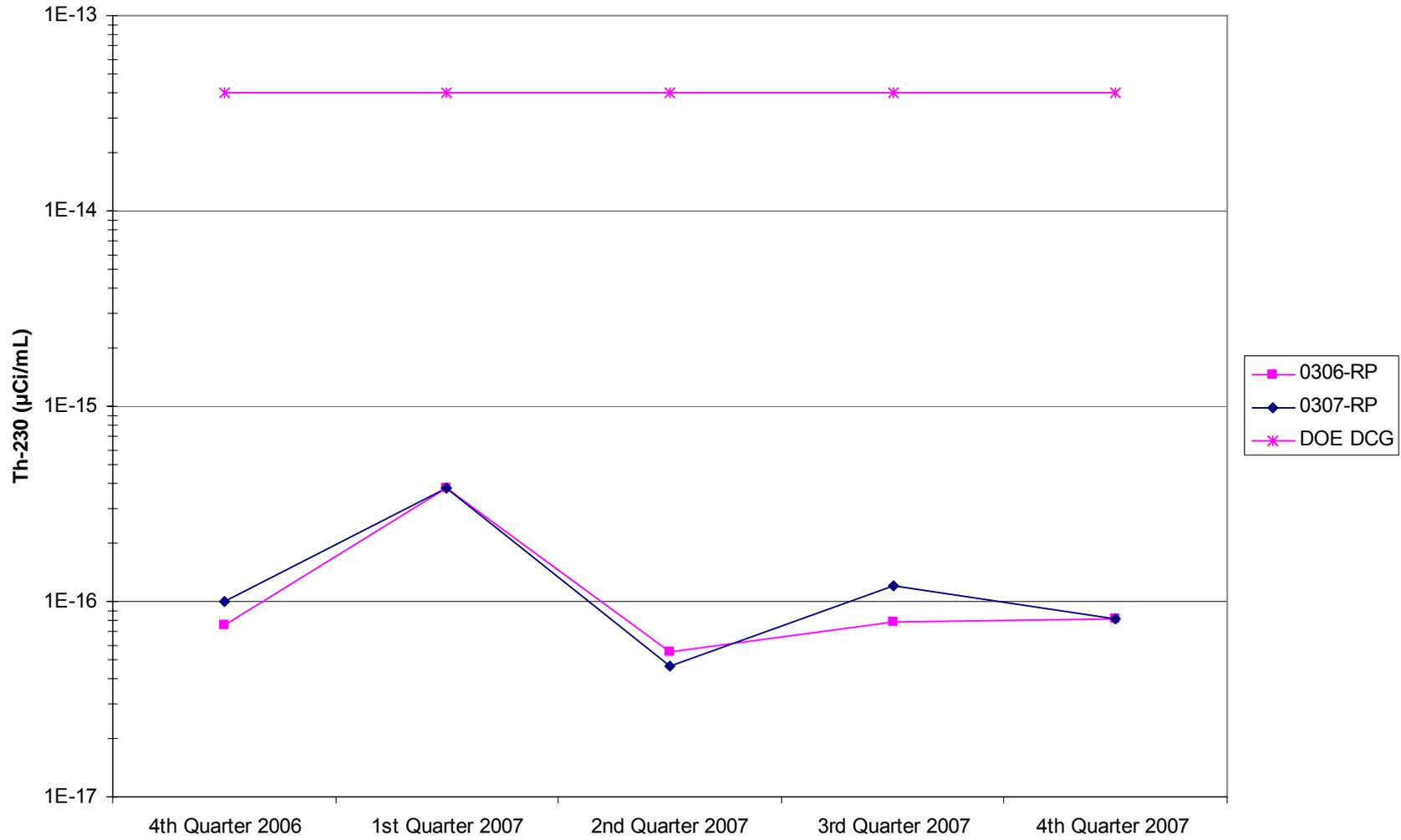


Figure 11. Crescent Junction Radioparticulate Concentration (Th-230)

Crescent Junction Radioparticulate Concentration (Ra-226)

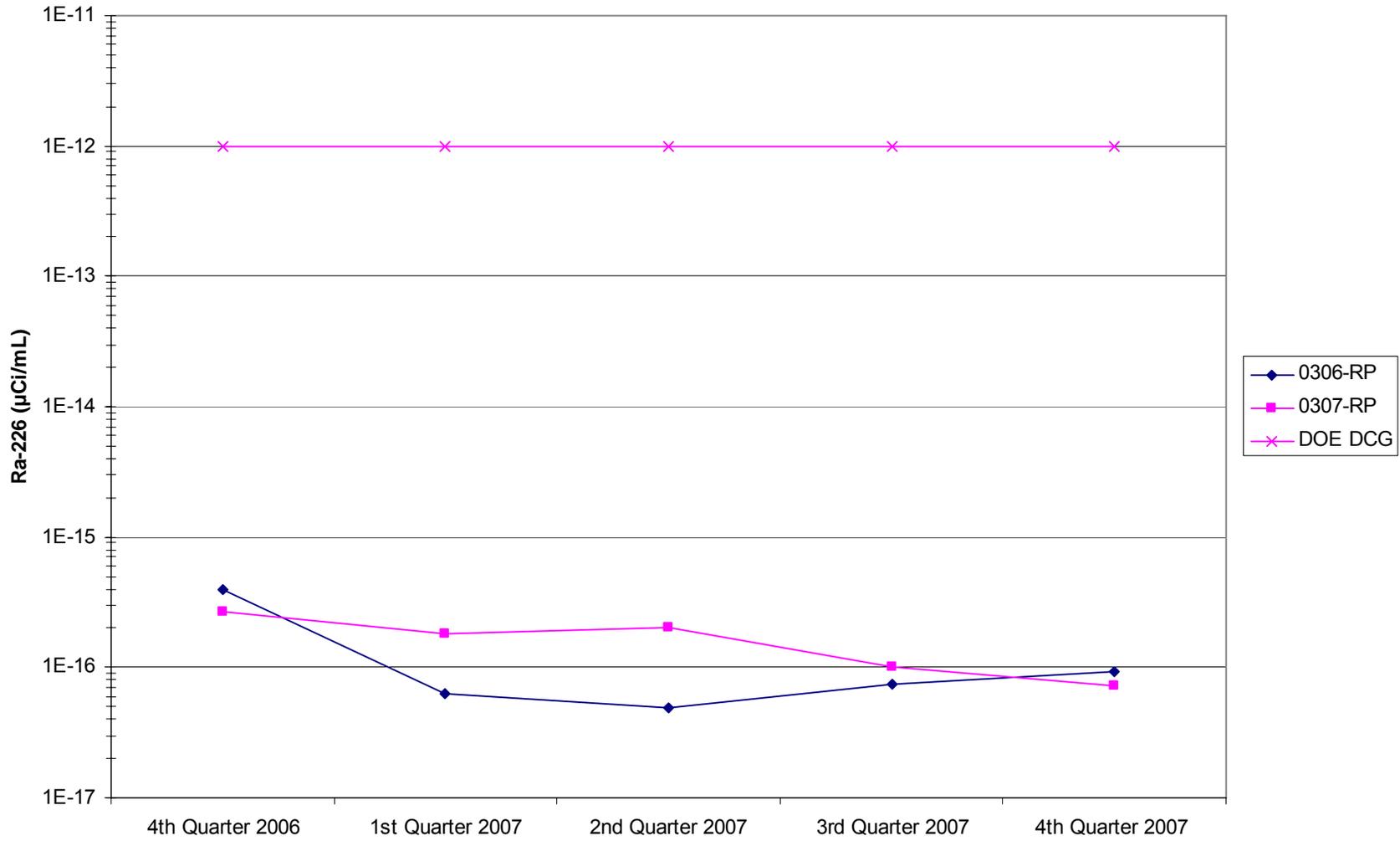


Figure 12. Crescent Junction Radioparticulate Concentration (Ra-226)

Crescent Junction Radioparticulate Concentration (Uranium)

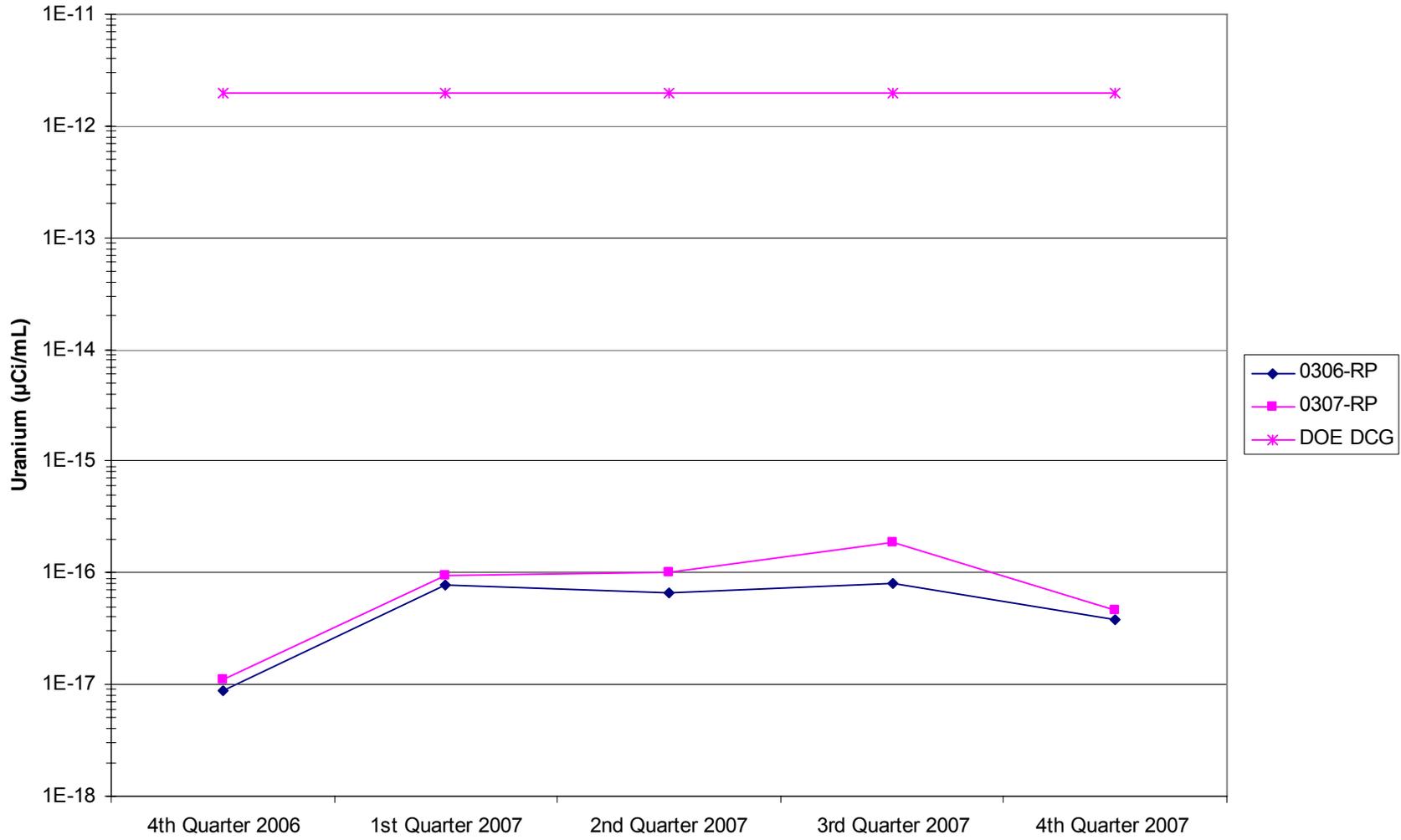


Figure 13. Crescent Junction Radioparticulate Concentration (Uranium)

Crescent Junction Atmospheric Radon-222 Concentration

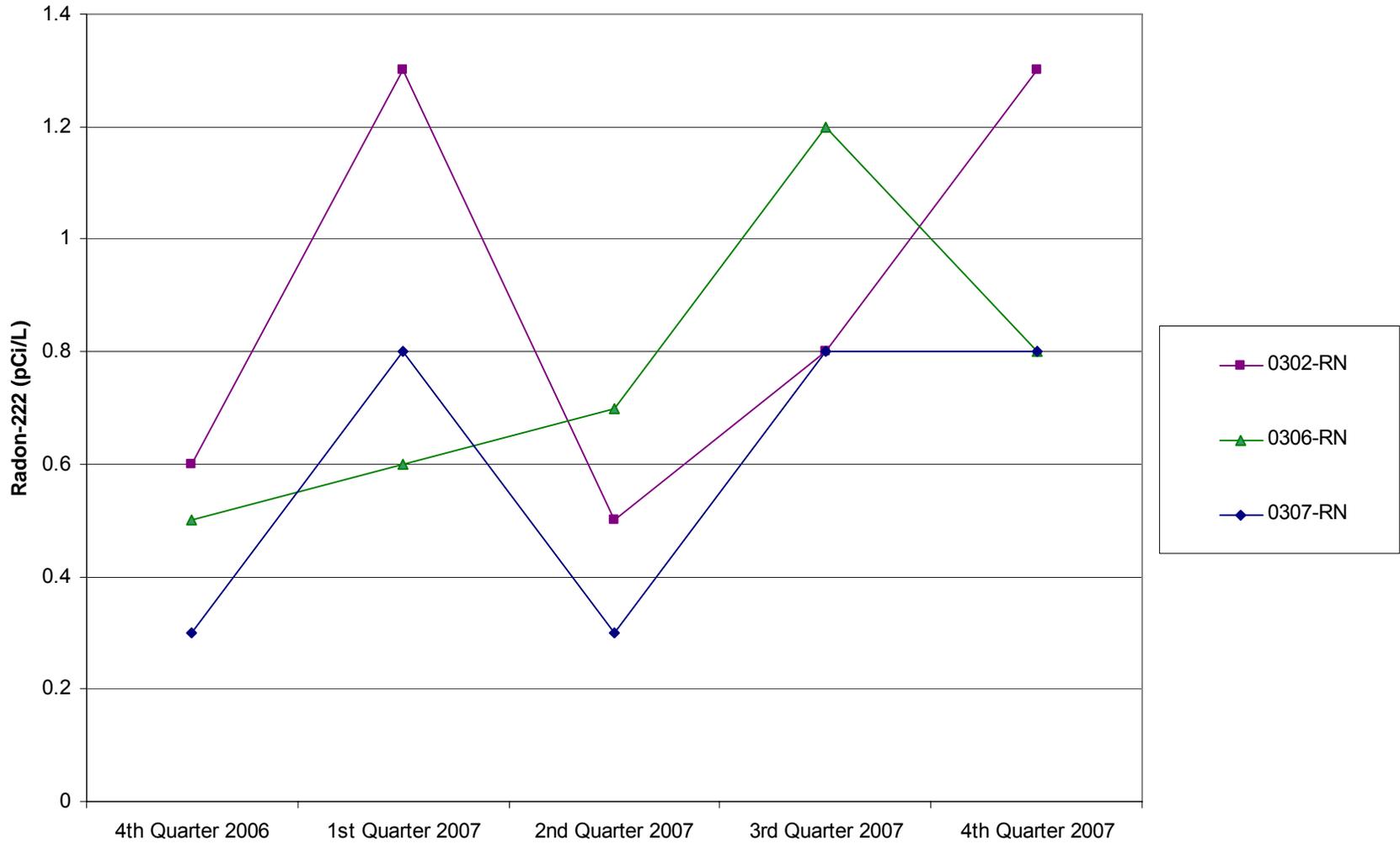


Figure 14. Crescent Junction Atmospheric Radon-222 Concentration

Crescent Junction Direct Gamma Radiation Dose



Figure 15. Crescent Junction Direct Gamma Radiation Dose