

Office of Environmental Management – Grand Junction



Environmental Air Monitoring Data
Quarterly Report for the Moab and
Crescent Junction, Utah, Sites
Fourth Quarter 2018
(October through December 2018)

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**Moab UMTRA Project
Environmental Air Monitoring Data Quarterly Report
for the Moab and Crescent Junction, Utah, Sites Fourth Quarter 2018
(October – December 2018)**

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Review and Approval

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1.0 Introduction

The purpose of this Report is to present the results of 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 2018. The Project sites consist of the former uranium ore-processing mill located three miles north of Moab, Utah, and the disposal site located near Crescent Junction, Utah.

2.0 Regulatory Requirements

This report demonstrates compliance with DOE Order (O) 458.1, Admin Chg 3, “Radiation Protection of the Public and the Environment,” which states DOE radiological activities must be conducted in a manner that does not cause a total effective dose to the public that exceeds 100 millirems (mrem) in a year. This limit excludes doses from background radiation, radon gas and its decay products in air, occupational doses, and medical exposures.

For the Project, the total effective dose is the sum of the direct gamma radiation and radioactive particulate material (radioparticulate) exposure. DOE O 458.1 also specifies releases of radioactive material to the atmosphere from DOE activities shall not exceed an annual average concentration of 3 picocuries per liter (pCi/L) of radon or its decay products, excluding background, at the site boundary.

Compliance with DOE O 458.1 may be demonstrated by calculating the dose to the maximally exposed individual (MEI) or the representative person or group from the public likely to receive the highest radiation dose based on exposure pathways and parameters. The Project established an MEI for each of the Project sites.

3.0 Results for October through December 2018

Monitoring data are reported quarterly for radon, direct gamma radiation, and select radioparticulates. Off-site monitoring locations for the Moab site are shown on Figure 1, and on-site and MEI locations are shown on Figure 2. Monitoring locations for the Crescent Junction site are shown on Figure 3.

3.1 Moab Site

A total of 15 air monitoring stations are equipped with radon and gamma detectors located on-site; another 12 off-site stations also have these detectors. Of these 27 stations, three on-site and six off-site stations are also equipped with air sampling pumps to measure air radioparticulates. Location 0114 was established the beginning of the 2018 fourth quarter to measure the radioparticulate and gamma doses and the radon concentration in the vicinity of the interim action (IA) well field, near groundwater extraction well 0810. The radon and gamma detectors were inadvertently removed during deconstruction activities at the former City of Moab Wastewater Treatment Plant at some point during the fourth quarter. These detectors could not be recovered, and there are no results to report associated with location 0121 for this quarter.

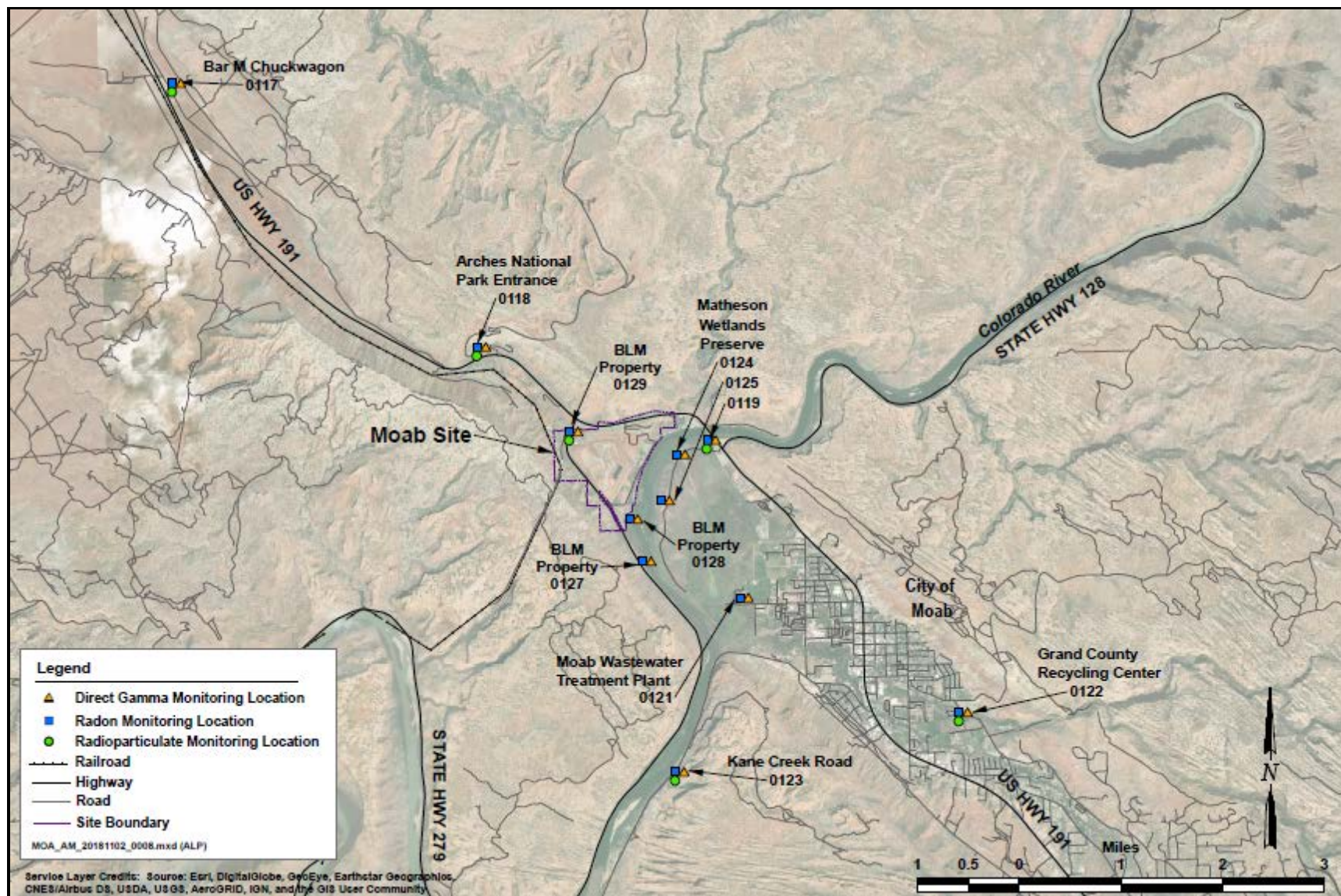


Figure 1. Moab Off-site Environmental Air Monitoring Locations

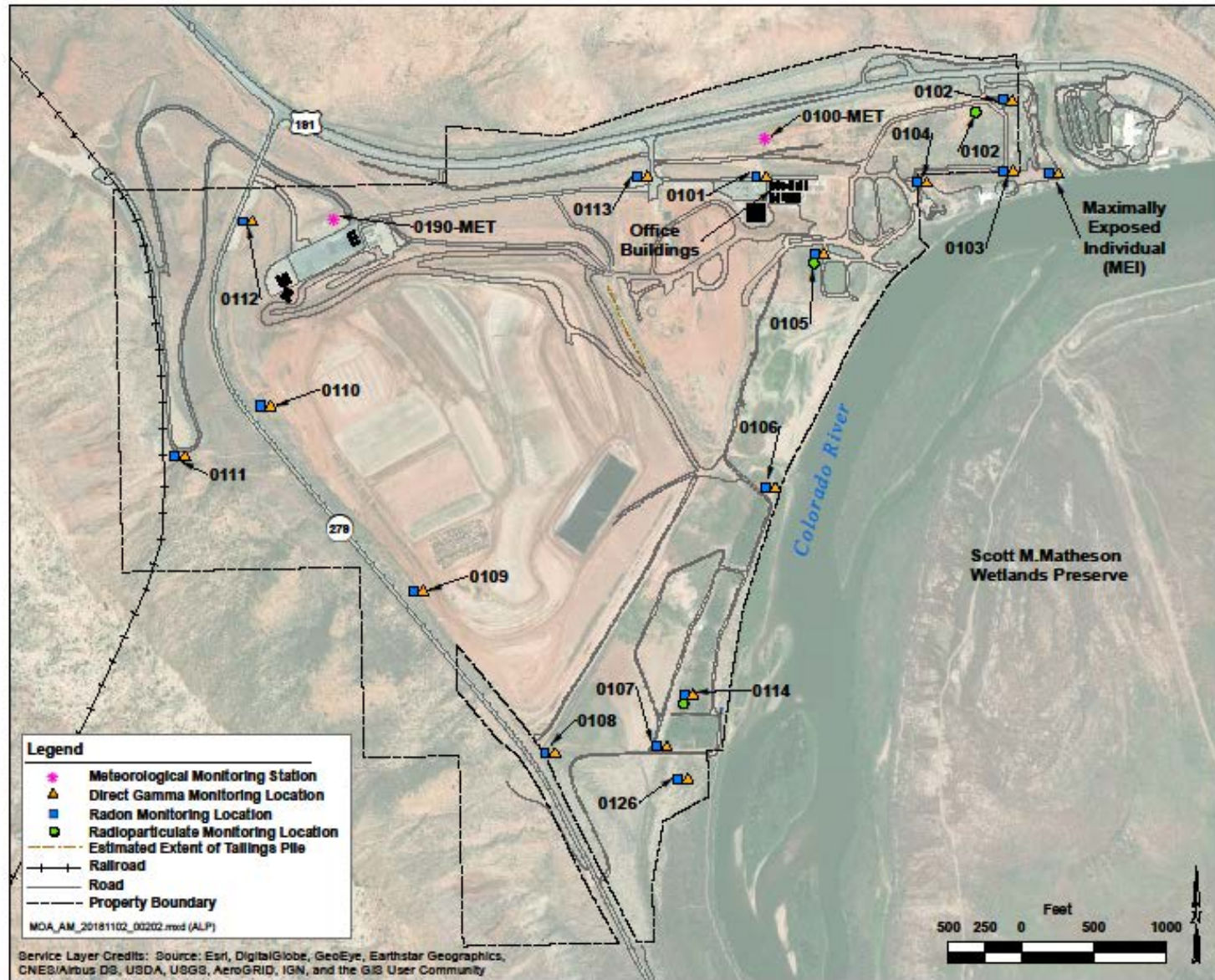


Figure 2. Moab On-site and Maximally Exposed Individual Environmental Air Monitoring Locations

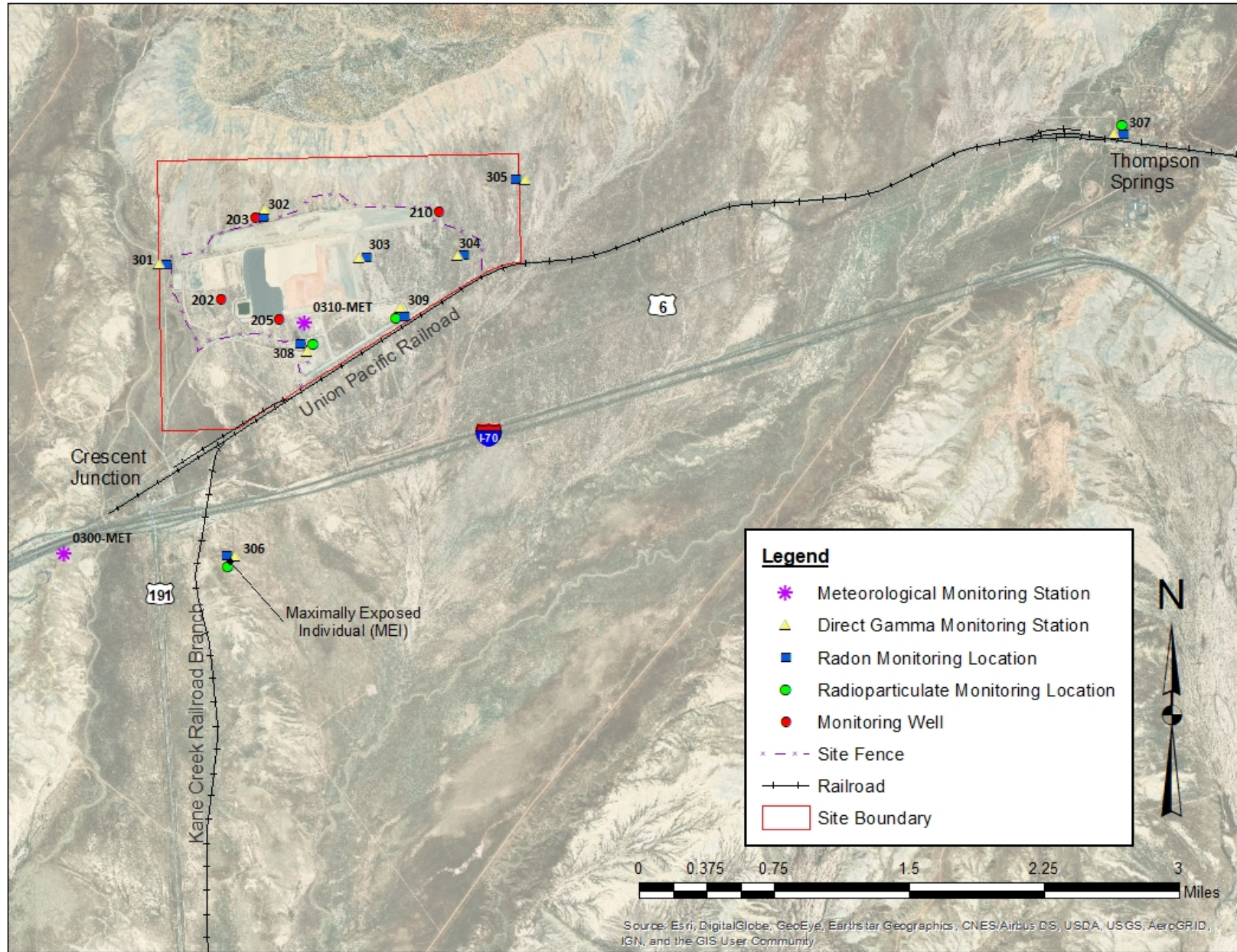


Figure 3. Crescent Junction Site Environmental Air Monitoring Locations

3.1.1 Radon

Based on five years of data between 2003 and 2008 from stations 0117 and 0123, the average background concentration of radon in the Moab area was established as 0.7 pCi/L; therefore, the Project annual average radon emission limit at the Moab site boundary is 3.7 pCi/L. On-site monitoring locations close to the site boundary or publically accessible areas are used to demonstrate compliance at the boundary. Table 1 shows quarterly and annual radon results for the past year (including background) for on- and off-site locations, none of which exceeded the 3.7 pCi/L annual average.

Table 1. Radon Concentrations for the Moab Site for the Past Year

Station Number	1st Quarter 2018 (pCi/L)	2nd Quarter 2018 (pCi/L)	3rd Quarter 2018 (pCi/L)	4th Quarter 2018 (pCi/L)	Annual Average Concentration Based on Four Quarters (pCi/L)
On-site Locations					
0101	2.6	1.9	1.9	4.2	2.7
0102	1.6	0.7	0.9	2.8	1.5
0103	1.7	1.0	1.0	2.7	1.6
0104	2.5	1.1	1.4	3.8	2.2
0105	2.6	1.4	1.7	4.2	2.5
0106	3.6	1.9	1.7	5.4	3.2
0107	3.2	1.8	1.8	5.1	3.0
0108	3.2	2.4	2.8	5.9	3.6
0109	1.4	1.3	2.0	2.4	1.8
0110	1.1	1.0	1.7	2.0	1.5
0111	0.6	0.5	0.7	0.9	0.7
0112	1.3	1.7	2.0	3.3	2.1
0113	3.1	2.6	2.8	4.4	3.2
0114	ND	ND	ND	5.3	NA
0126	2.7	1.4	1.4	4.4	2.5
Off-site Locations					
0117	<0.4	<0.4	<0.4	0.6	0.5
0118	1.5	0.5	0.5	0.7	0.8
0119	1.0	0.5	0.5	1.4	0.9
0121	0.4	<0.4	<0.4	ND	NA
0122	0.4	<0.4	<0.4	0.4	0.4
0123	<0.4	<0.4	<0.4	0.4	0.4
0124	1.4	0.5	0.6	2.1	1.2
0125	1.5	0.8	0.8	2.3	1.4
0127	0.8	0.7	0.8	1.5	1.0
0128	2.3	1.3	1.4	4.0	2.3
0129	1.5	1.2	1.9	3.0	1.9
MEI	1.9	0.6	0.6	2.4	1.4

ND = No Data collected at this location

NA = Not Applicable, insufficient data to calculate a representative annual average

The five Moab locations that had the highest annual average radon concentrations as of the fourth quarter of 2018 (0101, 0106, 0107, 0108, and 0113) are displayed on Figure 4. This graph displays the annual average concentrations since the first quarter of 2016 for these locations.

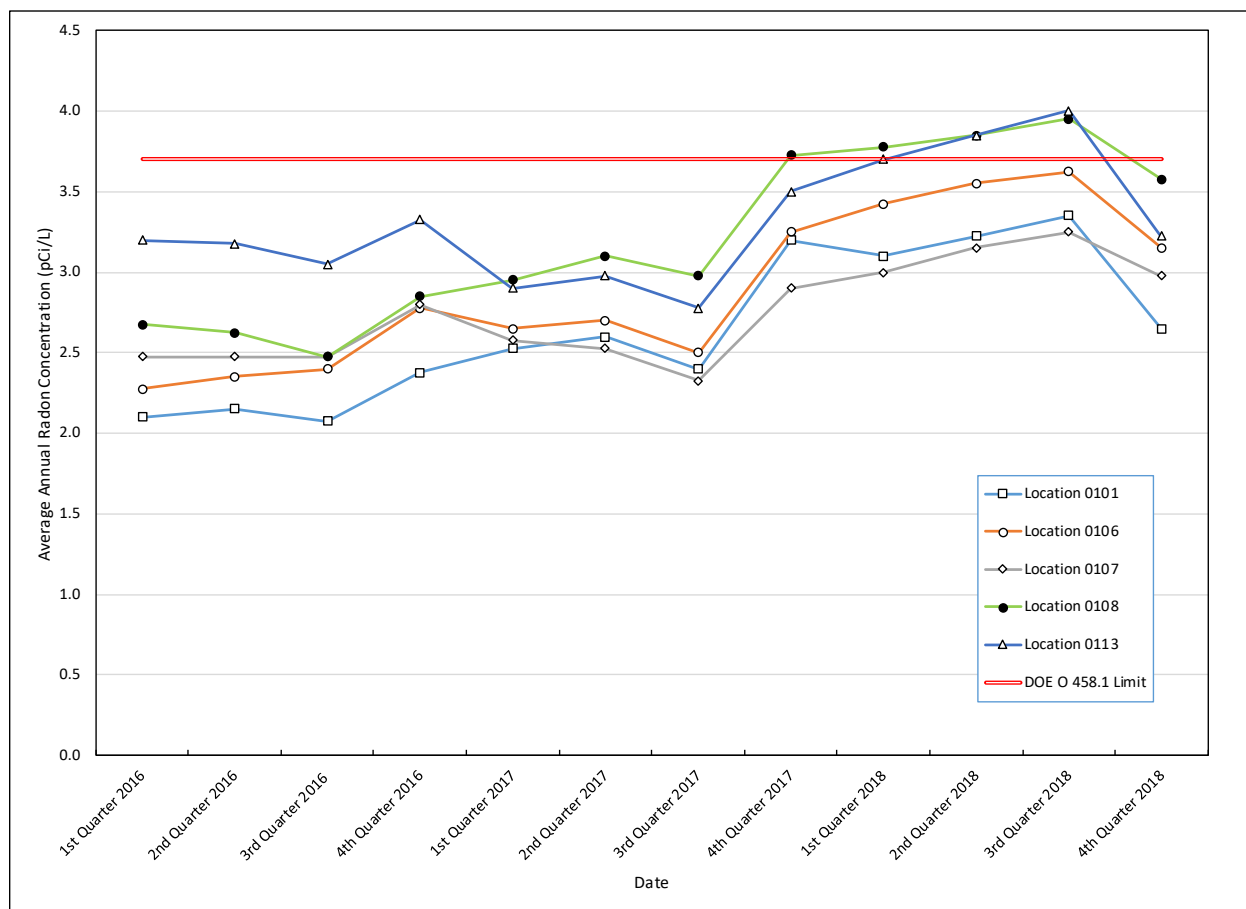


Figure 4. Moab Locations with Highest Fourth Quarter 2018 Average Annual Radon Concentrations

Radon concentrations have historically peaked during the fourth quarter for any year. When compared to the previous quarter, the data indicate the fourth quarter 2018 concentrations increased (up to 3.7 pCi/L) for 23 of the 25 stations, and did not change at locations 0122 and 0123 (both of which were below the 0.4 pCi/L detection limit).

3.1.2 Direct Gamma Radiation

The average annual background (based on five years of data between 2003 and 2008) direct gamma radiation effective dose for the Moab area was established as 82 mrem. Table 2 shows quarterly and annual gamma results for the past year, including background, at on- and off-site locations. These samples were sent to a new laboratory for analysis starting in the second quarter of 2018, and the results are reported rounded off to the nearest mrem.

These readings represent the gamma dose an individual would receive from occupying a location for an entire year. The fourth quarter analytical results indicated the dose decreased up to 14 mrem at 21 of the 25 locations compared to the third quarter, and did not change at the remaining 4 locations.

Table 2. Gamma Radiation Effective Doses for the Moab Site for the Past Year

Station Number	1st Quarter 2018 (mrem)	2nd Quarter 2018 (mrem)	3rd Quarter 2018 (mrem)	4th Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations					
0101	43.1	40	46	43	172.1
0102	22.1	23	28	26	99.1
0103	25.3	23	27	27	102.3
0104	29.4	26	30	29	114.4
0105	25.1	23	30	28	106.1
0106	36.6	32	38	35	141.6
0107	31.7	27	31	31	120.7
0108	46.9	40	46	44	176.9
0109	117.3	116	120	113	466.3
0110	98.2	104	113	99	414.2
0111	34.6	36	42	38	150.6
0112	51.9	45	54	49	199.9
0113	43.7	40	48	42	173.7
0114	ND	ND	ND	35	NA
0126	27.5	28	32	30	117.5
Off-site Locations					
0117	26.5	24	28	27	105.5
0118	24.6	22	27	26	99.6
0119	23.3	25	26	26	100.3
0121	24.1	22	25	ND	NA
0122	16.6	21	24	22	83.6
0123	22.0	21	24	22	89
0124	27.3	23	29	27	106.3
0125	26.3	27	31	30	114.3
0127	25.8	25	29	28	107.8
0128	25.4	25	28	29	107.4
0129	31.4	30	35	33	129.4
MEI	27.7	24	27	27	105.7

ND = No Data collected at this location

NA = Not Applicable, insufficient data to calculate a representative annual average.

Consider getting rid of the decimal points for the first quarter.

3.1.3 Radioparticulates

The effective background dose from inhalation of radioparticulates was not determined, so all effective dose from radioparticulates measured at the Project's monitoring stations is assumed to be from the Project.

Table 3 provides the calculated quarterly and annual effective dose from inhalation of radioparticulates for the past year for the Moab site. Samples were collected at or near the Moab site to measure the concentrations of total uranium, actinium-227, thorium-230, radium-226, and polonium-210. Because actinium-227 and protactinium-231 are assumed to be in equilibrium, the concentration of protactinium-231 is estimated by dividing the analyzed actinium-227 concentration by a correction factor of 0.614, which is consistent with the *Moab UMTRA Project Health Physics Plan* (DOE-EM/GJ3003). These analytical results are used to calculate effective dose from the inhalation of radioparticulates.

Table 3. Radioparticulate Effective Doses for the Moab Site for the Past Year

Station Number	Isotope	1st Quarter 2018 (mrem)	2nd Quarter 2018 (mrem)	3rd Quarter 2018 (mrem)	4th Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations						
0102-RP ¹	Total Uranium	0.002	0.003	0.004	0.003	4.17
	Thorium-230	0.020	0.029	0.043	0.043	
	Radium-226	0.029	0.066	0.036	0.053	
	Polonium-210	0.895	0.374	0.488	0.716	
	Actinium-227	0.100	0.396	0.149	0.466	
	Protactinium-231	0.023	0.091	0.034	0.107	
0105-RP	Total Uranium	0.002	0.004	0.006	0.004	5.90
	Thorium-230	0.029	0.077	0.109	0.085	
	Radium-226	0.048	0.176	0.029	0.079	
	Polonium-210	0.741	0.399	0.513	0.814	
	Actinium-227	0.000	0.420	1.352	0.490	
	Protactinium-231	0.000	0.097	0.311	0.113	
0114-RP ²	Total Uranium	ND	ND	ND	0.006	NA
	Thorium-230	ND	ND	ND	0.192	
	Radium-226	ND	ND	ND	0.354	
	Polonium-210	ND	ND	ND	0.792	
	Actinium-227	ND	ND	ND	0.691	
	Protactinium-231	ND	ND	ND	0.159	
Off-site Locations						
0117-RP	Total Uranium	0.002	0.003	0.003	0.003	2.92
	Thorium-230	0.010	0.026	0.021	0.021	
	Radium-226	0.025	0.034	0.003	0.185	
	Polonium-210	0.537	0.315	0.472	0.554	
	Actinium-227	0.170	0.028	0.280	0.098	
	Protactinium-231	0.039	0.006	0.064	0.023	
0118-RP	Total Uranium	0.003	0.003	0.004	0.002	3.60
	Thorium-230	0.032	0.069	0.067	0.019	
	Radium-226	0.053	0.022	0.021	0.066	
	Polonium-210	0.684	0.366	0.529	0.529	
	Actinium-227	0.156	0.280	0.280	0.200	
	Protactinium-231	0.036	0.064	0.064	0.046	
0119-RP	Total Uranium	0.002	0.003	0.003	0.002	3.42
	Thorium-230	0.016	0.025	0.029	0.021	
	Radium-226	0.044	0.066	0.014	0.030	
	Polonium-210	0.480	0.350	0.529	0.578	
	Actinium-227	0.079	0.350	0.172	0.396	
	Protactinium-231	0.018	0.080	0.040	0.091	
0122-RP	Total Uranium	0.002	0.003	0.003	0.002	3.39
	Thorium-230	0.015	0.024	0.011	0.016	
	Radium-226	0.031	0.029	0.015	0.026	
	Polonium-210	0.562	0.342	0.423	0.472	
	Actinium-227	0.326	0.303	0.217	0.303	
	Protactinium-231	0.075	0.070	0.050	0.070	

¹ = MEI location, ² = Dose values increased 6% due to air pump operating only 94% of the quarter

ND = No Data collected from this location

NA = Not Applicable, insufficient data available to calculate Annual Dose

Table 3. Radioparticulate Effective Doses for the Moab Site for the Past Year (continued)

Station Number	Isotope	1st Quarter 2018 (mrem)	2nd Quarter 2018 (mrem)	3rd Quarter 2018 (mrem)	4th Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
Off-site Locations (continued)						
0123-RP	Total Uranium	0.002	0.003	0.003	0.002	2.93
	Thorium-230	0.011	0.032	0.015	0.022	
	Radium-226	0.019	0.048	0.026	0.026	
	Polonium-210	0.480	0.358	0.423	0.554	
	Actinium-227	0.000	0.325	0.131	0.280	
	Protactinium-231	0.000	0.075	0.030	0.064	
0129-RP	Total Uranium	0.004	0.006	0.009	0.004	9.13
	Thorium-230	0.099	0.293	0.346	0.125	
	Radium-226	0.132	0.422	0.070	0.211	
	Polonium-210	0.733	0.399	0.602	0.627	
	Actinium-227	0.466	1.445	1.585	0.606	
	Protactinium-231	0.107	0.333	0.365	0.139	

As previously mentioned, the location 0114 air particulate sampling equipment was installed at the beginning of the fourth quarter, and the results provided in Table 3 only display the dose for this most recent quarter and not the annual dose. In addition, due to lockout/tagout (LO/TO) applied to the well field for maintenance issues during the fourth quarter, the air particulate sampling pump operated only 94 percent of the time. To provide a representative dose associated with this location, the value provided in Table 3 has been increased by 6 percent.

The annual dose associated with the stations closest to the site operations (0102, 0105, and 0129) is higher compared to the remaining stations, as expected. Compared to the previous quarter, the results indicate the dose decreased at locations 0105, 0118, and 0129 (location 0105 is located on site, and 0118 and 0129 are located northwest of the site) an average of 0.09 mrem. The dose increased at the six remaining locations an average of 0.14 mrem. On site, primarily because of changes in the actinium-227 concentrations, the dose measured from the samples collected from location 0102 (along the site eastern boundary) increased 0.04 mrem, while the dose measured from location 0105 (off the freshwater pond) decreased 0.07 mrem.

The data also indicate that from the third to the fourth quarter, the dose associated with radium-226 and polonium-210 increased or did not change at all sampling locations (an average of 0.06 and 0.11 mrem, respectively), while the dose associated with uranium decreased or did not change at each of the nine locations an average of only 0.002 mrem). There was no trend evident with the doses calculated based on the actinium-227, thorium-230, and protactinium-231 results.

3.1.4 Total Effective Dose

The Project must ensure the annual effective dose to gamma radiation and radioparticulates from Project activities does not exceed 100 mrem above background. The annual total effective dose to the MEI was 27.87 mrem, which is well below the DOE limit. This value was calculated by subtracting the background dose of 82 mrem from the MEI gamma radiation dose of 105.7 mrem and then adding the radioparticulate dose of 4.17 mrem for location 0102, the closest radioparticulate station to the MEI.

Compared to the previous quarter, as shown in the *Moab UMTRA Project Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Third Quarter 2018 (July – September 2018)* (DOE-EM/GJTAC3006), the total effective dose decreased 1.56 mrem.

3.2 Crescent Junction Site

There are nine air monitoring stations associated with the Crescent Junction site, two located off site and seven on site. All nine are equipped with radon and gamma detectors, and two of the on-site and the two off-site stations also measure air radioparticulates. After mill tailings disposal began in the second quarter of 2009, Crescent Junction monitoring location 0306 became the MEI.

3.2.1 Radon

Based on three 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 Project must limit radon emissions at the Crescent Junction site boundary (withdrawal area) to 3.9 pCi/L.

Table 4. Radon Concentrations for the Crescent Junction Site for the Past Year

Station Number	1st Quarter 2018 (pCi/L)	2nd Quarter 2018 (pCi/L)	3rd Quarter 2018 (pCi/L)	4th Quarter 2018 (pCi/L)	Annual Average Concentration Based on Four Quarters (pCi/L)
On-site Locations					
0301	0.6	0.5	0.4	0.7	0.6
0302	0.7	<0.4	<0.4	0.8	0.6
0303	1.1	0.7	0.5	1.3	0.9
0304	0.7	<0.4	0.4	1.2	0.7
0305	0.5	<0.4	<0.4	1.1	0.6
0308	3.0	2.1	2.6	3.0	2.7
0309	1.3	0.8	1.0	1.5	1.2
Off-site Locations					
0306¹	0.6	<0.4	<0.4	0.9	0.6
0307	<0.4	<0.4	<0.4	0.6	0.5

¹MEI location

Locations 0301, 0305, and 0309 are used to demonstrate compliance with the public dose limit in DOE O 458.1 at the site boundary. Table 4 shows quarterly and annual radon results for the past year, including background, for on- and off-site locations. The four Crescent Junction locations that had the highest annual average radon concentrations by the fourth quarter of 2018 (0303, 0304, 0308, and 0309) are displayed on Figure 5. This graph displays the annual average concentrations for these locations since the first quarter of 2016.

None of the on- or off-site stations exceeded the limit of 3.0 pCi/L above background. Compared to the previous quarter the radon concentrations increased up to 0.8 pCi/L at each of the nine locations.

3.2.2 Direct Gamma Radiation

The average annual background direct gamma radiation exposure dose for the Crescent Junction area was established as 92.5 mrem based on three years of data from 2006 to 2009. Table 5 shows quarterly and annual results for the past year, including background, for on- and off-site locations.

These readings represent the gamma dose an individual would receive from occupying a location for an entire year.

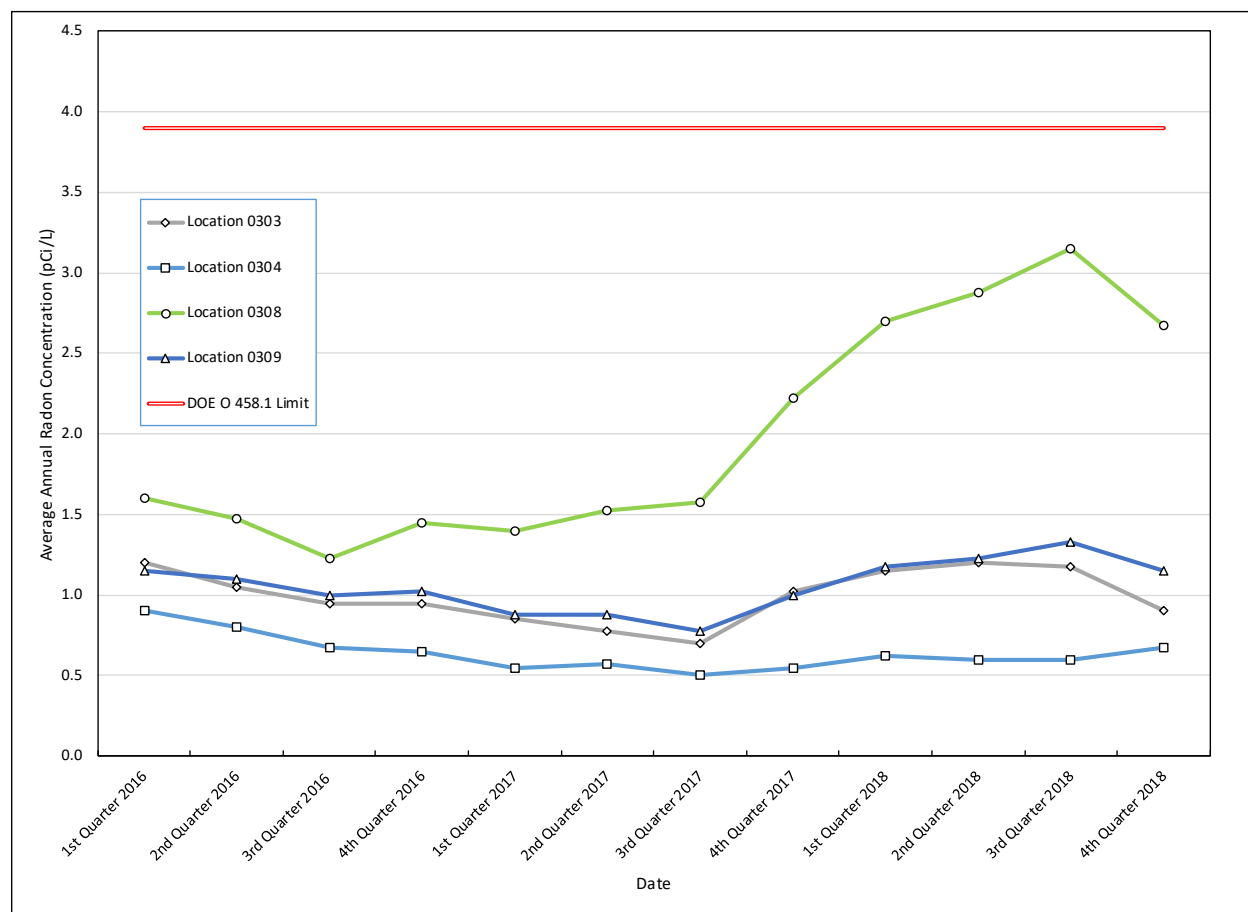


Figure 5. Crescent Junction Locations with Highest Fourth Quarter 2018 Average Annual Radon Concentrations

Table 5. Gamma Radiation Effective Doses for the Crescent Junction Site for the Past Year

Station Number	1st Quarter 2018 (mrem)	2nd Quarter 2018 (mrem)	3rd Quarter 2018 (mrem)	4th Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations					
0301	31.6	24	28	27	110.6
0302	28.3	24	28	28	108.3
0303	31.6	31	34	33	129.6
0304	26.6	25	29	27	107.6
0305	27.3	25	29	29	110.3
0308	30.1	25	30	28	113.1
0309	24.9	24	36	27	111.9
Off-site Locations					
0306¹	25.0	23	28	27	103.0
0307	30.3	25	31	28	114.3

¹MEI location

Following the same general trend shown by the Moab site, the fourth quarter analytical results indicated the dose decreased at seven of the nine locations (up to 9 mrem) and did not change at the remaining two locations (0302 and 0305) compared to the previous quarter.

3.2.3 Radioparticulates

As with the Moab sampling results, the effective background dose from inhalation of radioparticulates at the Crescent Junction site was not determined, so all effective dose measured at the Project's monitoring stations is assumed to be from the Project. Samples were collected at the four monitoring locations at or near the Crescent Junction site to determine the air particulate concentrations of total uranium, thorium-230, radium-226, polonium-210, actinium-227, and protactinium-231 (based on the actinium-227 concentration, as described in Section 3.1.3).

The analytical results are used to calculate effective dose from the inhalation of radioparticulates. Table 6 shows quarterly and annual radioparticulate doses for the past year for the Crescent Junction site. Compared to the previous quarter, the results indicate the dose measured at the off-site location 0306 (the MEI) decreased by 0.12 mrem and increased 0.28 mrem at location 0307 (Thompson Springs). On site, the dose measured from the samples collected from both locations 0308 (at the guard shack) and 0309 (eastern end of the rail bench) decreased less than 0.2 mrem.

Table 6. Radioparticulate Effective Doses for the Crescent Junction Site for the Past Year

Station Number	Isotope	1st Quarter 2018 (mrem)	2nd Quarter 2018 (mrem)	3rd Quarter 2018 (mrem)	4th Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations						
0308-RP	Total Uranium	0.002	0.003	0.004	0.002	4.70
	Thorium-230	0.032	0.061	0.077	0.037	
	Radium-226	0.097	0.092	0.048	0.066	
	Polonium-210	0.627	0.374	0.554	0.505	
	Actinium-227	0.280	0.490	0.629	0.326	
	Protactinium-231	0.064	0.113	0.145	0.075	
0309-RP	Total Uranium	0.003	0.004	0.003	0.003	4.71
	Thorium-230	0.115	0.117	0.064	0.080	
	Radium-226	0.172	0.229	0.026	0.167	
	Polonium-210	0.627	0.383	0.488	0.537	
	Actinium-227	0.303	0.373	0.233	0.466	
	Protactinium-231	0.070	0.086	0.054	0.107	
Off-site Locations						
0306-RP ¹	Total Uranium	0.002	0.002	0.002	0.002	3.30
	Thorium-230	0.009	0.019	0.009	0.014	
	Radium-226	0.022	0.032	0.003	0.037	
	Polonium-210	0.602	0.334	0.472	0.529	
	Actinium-227	0.676	0.147	0.070	0.089	
	Protactinium-231	0.156	0.034	0.016	0.020	
0307-RP	Total Uranium	0.002	0.003	0.003	0.003	3.68
	Thorium-230	0.009	0.032	0.014	0.021	
	Radium-226	0.036	0.038	0.000	0.009	
	Polonium-210	0.692	0.326	0.529	0.472	
	Actinium-227	0.163	0.350	0.326	0.373	
	Protactinium-231	0.038	0.080	0.075	0.086	

¹MEI location

Similar to the results associated with the Moab site, the data indicate that from the third to the fourth quarter, the dose associated with radium-226 increased at all four sampling locations (an average of 0.05 mrem), while the dose from uranium essentially did not change. The doses calculated from the actinium-227, thorium-230, and protactinium-231 results all increased at locations 0306, 0307, and 0309, but decreased at location 0308. The dose associated with polonium-210 increased at locations 0306 and 0309 (an average of 0.05 mrem) and decreased the same amount in the samples collected from 0307 and 0308.

3.2.4 Total Effective Dose

The annual total effective dose to the MEI was 13.80 mrem, which is well below the annual limit of 100 mrem above background. This is calculated by subtracting the background dose of 92.5 mrem from the MEI (location 0306) gamma radiation dose of 103.0 mrem and then adding the radioparticulate dose of 3.30 mrem for the MEI.

The total effective dose increased 2.18 mrem compared to the third quarter 2018.

4.0 Data Assessment

Radon detectors, thermoluminescent dosimeters used for continuous dose measurements, and radioparticulate sample filters were sent to certified off-site laboratories for analyses in accordance with the *Moab UMTRA Project Environmental Air Monitoring Sampling and Analysis Plan* (DOE-EM/GJTAC2219) (SAP). Qualified Project personnel evaluated the analytical data received for consistency with other data points and Quality Assurance/Quality Control samples.

Location 0114 was established at the beginning of the 2018 fourth quarter to measure the radioparticulate and gamma doses and the radon concentration in the vicinity of the IA well field, near groundwater extraction well 0810. Because this station was recently established, only quarterly results are presented in this report, and the annual average radon concentration, annual total gamma dose, and annual dose associated with radioparticulates for this location were not included in this report.

In addition, due to LO/TO applied to the well field for maintenance issues, the dose reported for location 0114 reflects a 6 percent increase. All other air particulate sampling pumps operated more than 98 percent of the time, and it was not necessary to adjust the reported dose associated with these locations.

The radon and gamma detectors were inadvertently removed during deconstruction activities at the City of Moab Wastewater Treatment Plant at some point during the fourth quarter. These detectors could not be recovered, and there are no results to report associated with location 0121 for this quarter. Neither the annual average radon concentration nor the annual gamma dose were calculated for this report.

4.1 Quality Assurance/Quality Control Sampling

Duplicate samples for radon were collected at Moab locations 0102, 0108, and 0111, and at Crescent Junction locations 0303 and 0308. In addition, duplicate direct gamma samples were collected at Moab locations 0102, 0108, and 0129 and Crescent Junction locations 0301 and 0305. All results associated with the duplicate sampling are provided in Table 7. No duplicate samples were collected for radioparticulate samples, per the SAP.

Table 7. Duplicate Results for Fourth Quarter 2018

Location	Result	Duplicate Result
Moab		
Radon:	pCi/L	pCi/L
0102	2.8	2.3
0108	5.9	5.9
0111	0.9	0.7
Gamma:	mrem	mrem
0102	26	27
0108	44	47
0129	33	33
Crescent Junction		
Radon:	pCi/L	pCi/L
0303	1.3	1.1
0308	3.0	3.5
Gamma:	mrem	mrem
0301	27	27
0305	29	28

As Table 7 displays, the five locations that included duplicate radon samples were within 0.5 pCi/L of each other. The five locations that were equipped with duplicate gamma detectors were all within 3 mrem of each other. These radon and gamma duplicate results are within the acceptable ranges, and the data are considered valid based on these results.

Control samples measure the dose (for gamma) the detectors are exposed to while being shipped from the site to the respective analytical laboratories. The two gamma control samples were -1 mrem; therefore, it was not necessary to adjust any of the gamma results.

*Table 8. Shipment Control Sample Results
for Fourth Quarter 2018*

Sample	Result
Gamma:	mrem
Control	-1
Control-Daily	-1

4.2 Suspected Anomalies

All analytical data are reviewed for anomalous or outlying data points. Monitoring data are evaluated 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 2018.

4.3 Summary

Data collected during the fourth quarter of 2018 met the applicable laboratory control criteria for their respective analyses. The results were within the acceptable limits associated with each matrix. Data in this Report are considered validated and may be treated as final results.

5.0 References

DOE (U.S. Department of Energy), *Moab UMTRA Project Environmental Air Monitoring Sampling and Analysis Plan* (DOE-EM/GJTAC2219).

DOE (U.S. Department of Energy), *Moab UMTRA Project Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Third Quarter 2018 (July – September 2018)* (DOE-EM/GJTAC3006).

DOE (U.S. Department of Energy), *Moab UMTRA Project Health Physics Plan* (DOE-EM/GJ3003).

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