

Office of Environmental Management – Grand Junction



Environmental Air Monitoring Data
Quarterly Report for the Moab and
Crescent Junction, Utah, Sites
First Quarter 2018
(January through March 2018)

Revision 0

October 2018



U.S. Department
of Energy

Office of Environmental Management

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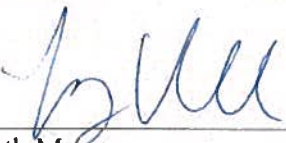
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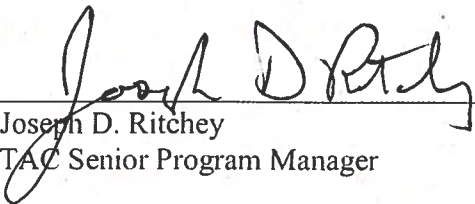
**Moab UMTRA Project
Environmental Air Monitoring Data Quarterly Report
for the Moab and Crescent Junction, Utah, Sites First Quarter 2018
(January – March 2018)**

Revision 0

Review and Approval


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10/30/18
Date


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Date

Revision History

Revision	Date	Reason for Revision
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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 first 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 exceeding 100 millirems (mrem) in a year (yr). 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 three 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 January through March 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

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.

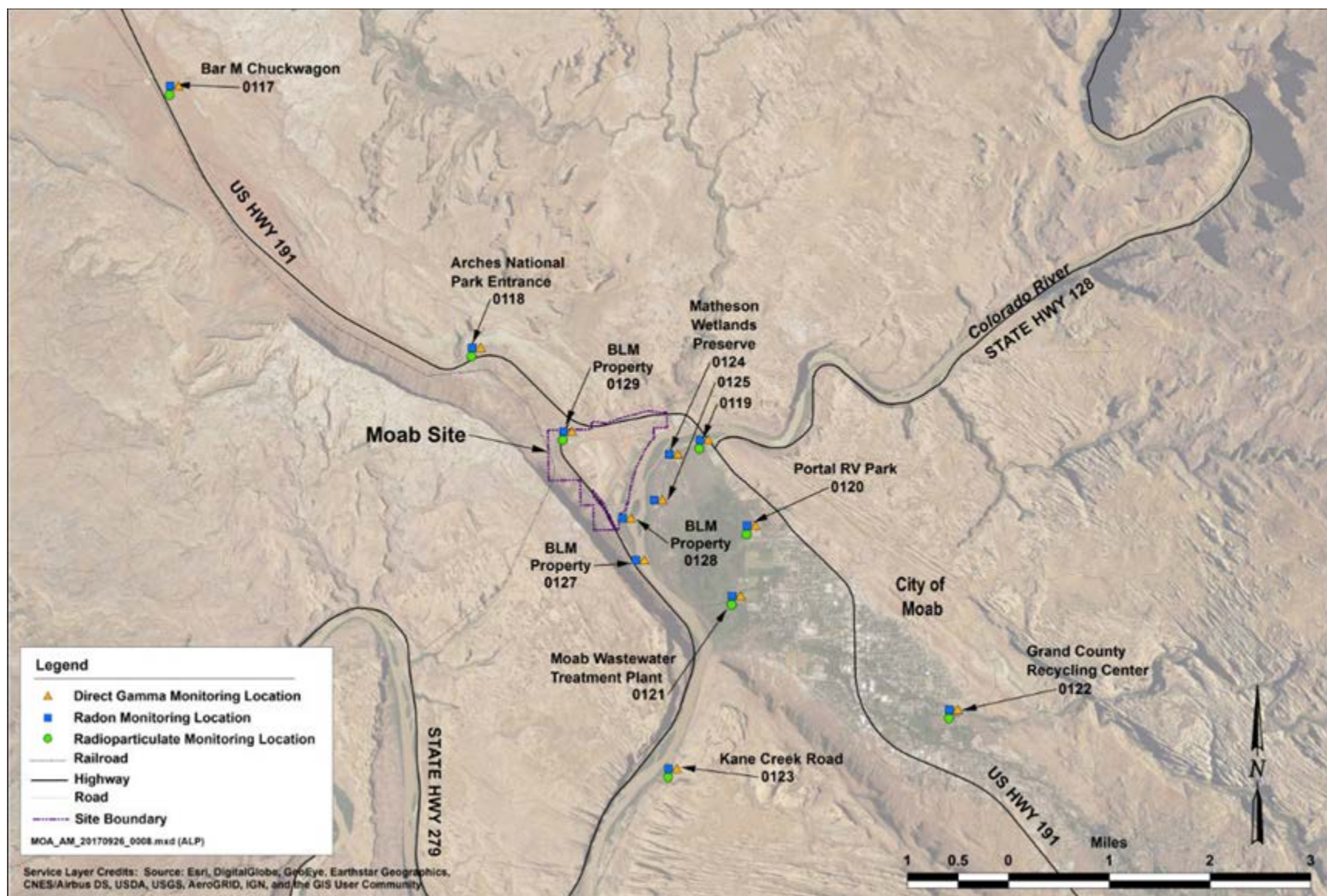


Figure 1. Moab Off-site Environmental Air Monitoring Locations

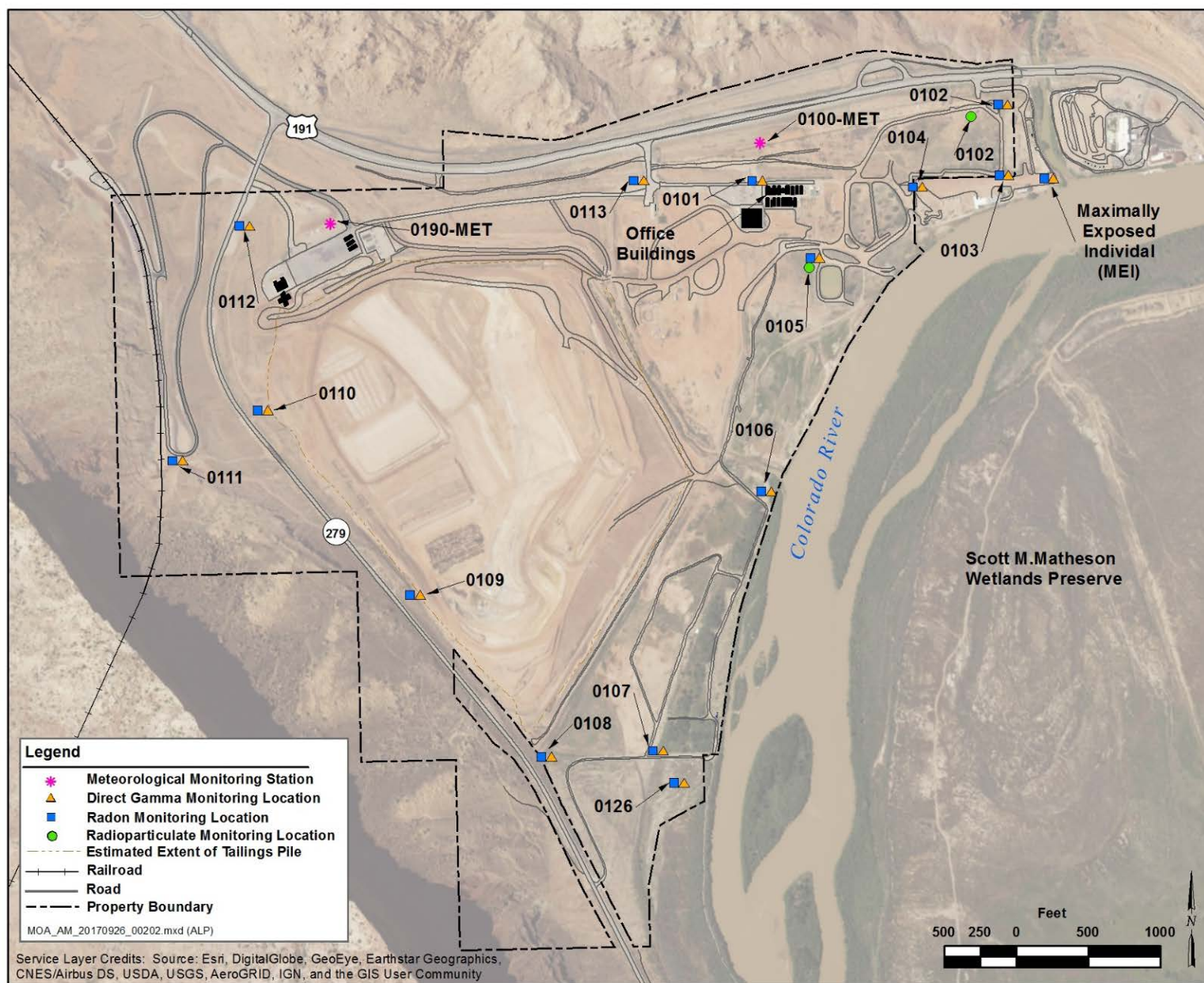


Figure 2. Moab On-site and MEI Environmental Air Monitoring Locations

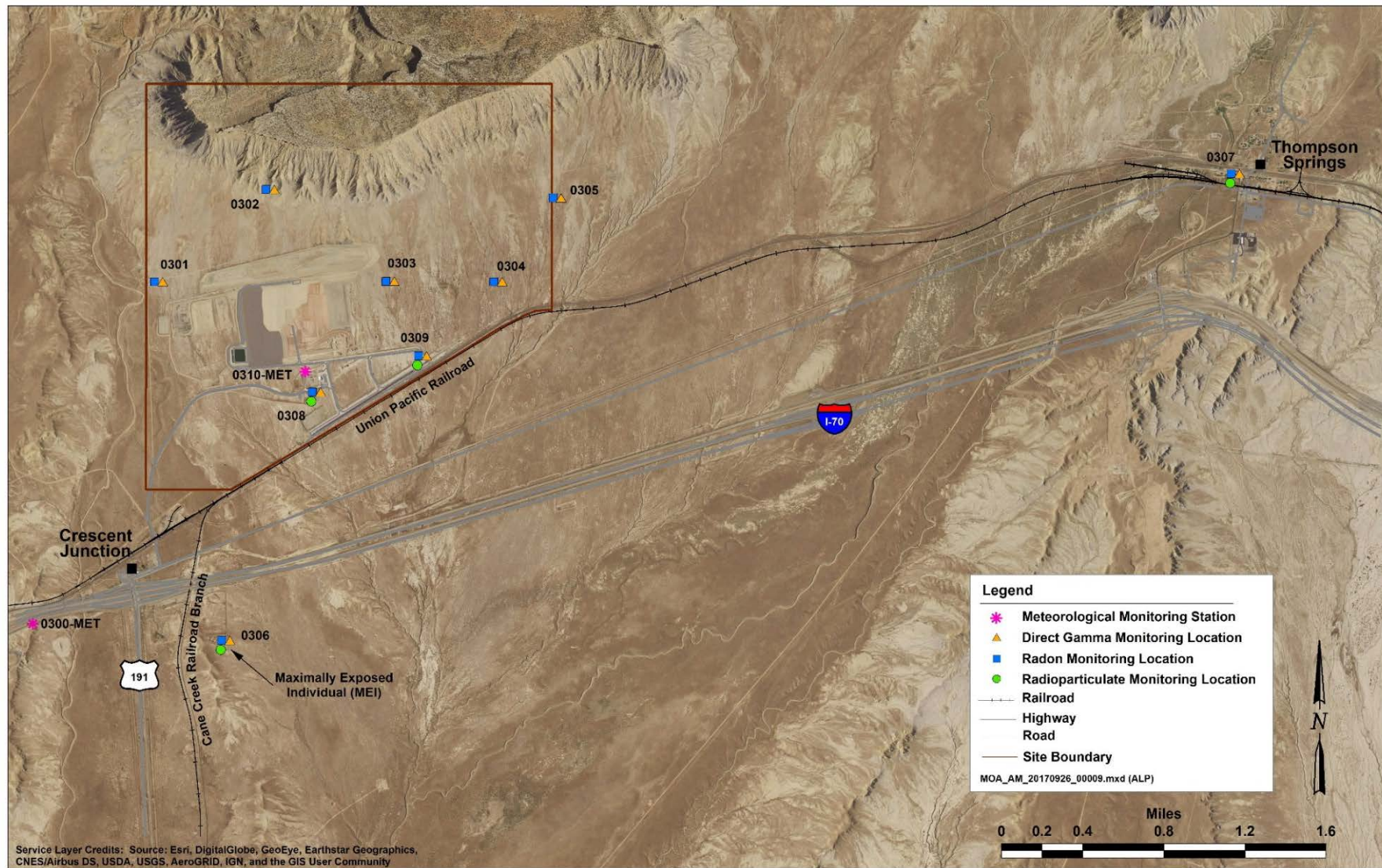


Figure 3. Crescent Junction Site Environmental Air Monitoring Locations

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

Station Number	2nd Quarter 2017 (pCi/L)	3rd Quarter 2017 (pCi/L)	4th Quarter 2017 (pCi/L)	1st Quarter 2018 (pCi/L)	Annual Average Concentration Based on Four Quarters (pCi/L)
On-site Locations					
0101	1.4	1.4	7.0	2.6	3.1
0102	0.8	0.6	3.4	1.6	1.6
0103	0.6	0.7	4.2	1.7	1.8
0104	1.3	1.1	5.4	2.5	2.6
0105	1.4	1.2	6.4	2.6	2.9
0106	1.4	1.4	7.3	3.6	3.4
0107	1.2	1.4	6.2	3.2	3.0
0108	2.1	2.4	7.4	3.2	3.8
0109	1.4	1.8	2.7	1.4	1.8
0110	2.2	1.4	2.2	1.1	1.7
0111	0.4	NDA	1.1	0.6	0.7
0112	1.3	2.1	3.3	1.3	2.0
0113	1.8	2.2	7.5	3.1	3.7
0126	1.1	1.2	5.5	2.7	2.6
Off-site Locations					
0117	<0.4	<0.4	0.6	<0.4	0.5
0118	<0.4	0.7	1.1	1.5	0.9
0119	0.5	0.5	1.7	1.0	0.9
0120	<0.4	0.5	1.2	0.4	0.6
0121	<0.4	<0.4	0.9	0.4	0.5
0122	0.5	<0.4	<0.4	0.4	0.4
0123	<0.4	<0.4	1.2	<0.4	0.7
0124	0.5	0.5	2.6	1.4	1.3
0125	0.6	0.7	2.4	1.5	1.3
0127	<0.4	0.5	1.8	0.8	0.9
0128	1.2	1.4	5.2	2.3	2.5
0129	1.2	1.6	3.3	1.5	1.9
MEI	0.5	0.5	3.5	1.9	1.6

NDA= No data available, sensor missing or damaged

As displayed in Table 1, on-site location 0108 (3.8 pCi/L annual average) exceeded the 3.7 pCi/L annual average, and the annual average for location 0113 was equal to the 3.7 pCi/L standard. These two high annual average values are the result of the significantly higher radon concentrations measured at these two locations during the fourth quarter 2017 (7.4 and 7.5 pCi/L, respectively).

As discussed in the *Moab UMTRA Project Environmental Air Monitoring Data Quarterly Report for the Moab and Crescent Junction, Utah, Sites Fourth Quarter 2017 (October – December 2017)* (DOE-EM/GJTAC2260), radon concentrations typically peak during the fourth quarter. Drought conditions likely further impacted the results, as relative humidity data in the fourth quarter 2017 was on average one-half of the relative humidity measured during the 2013 through 2016 fourth quarters. No member of the public occupies any of these locations for a sufficient amount of time to cause the individual to receive a dose in excess of the annual limit.

First quarter data show the results were lower compared to the previous quarter. No annual off-site average concentration exceeded the 3.0 pCi/L plus background annual limit. The five Moab locations that have the highest annual average radon concentrations in the first quarter of 2018 (0101, 0106, 0107, 0108, and 0113) are displayed in Figure 4. This graph displays the annual average concentrations since the first quarter of 2016 for these locations.

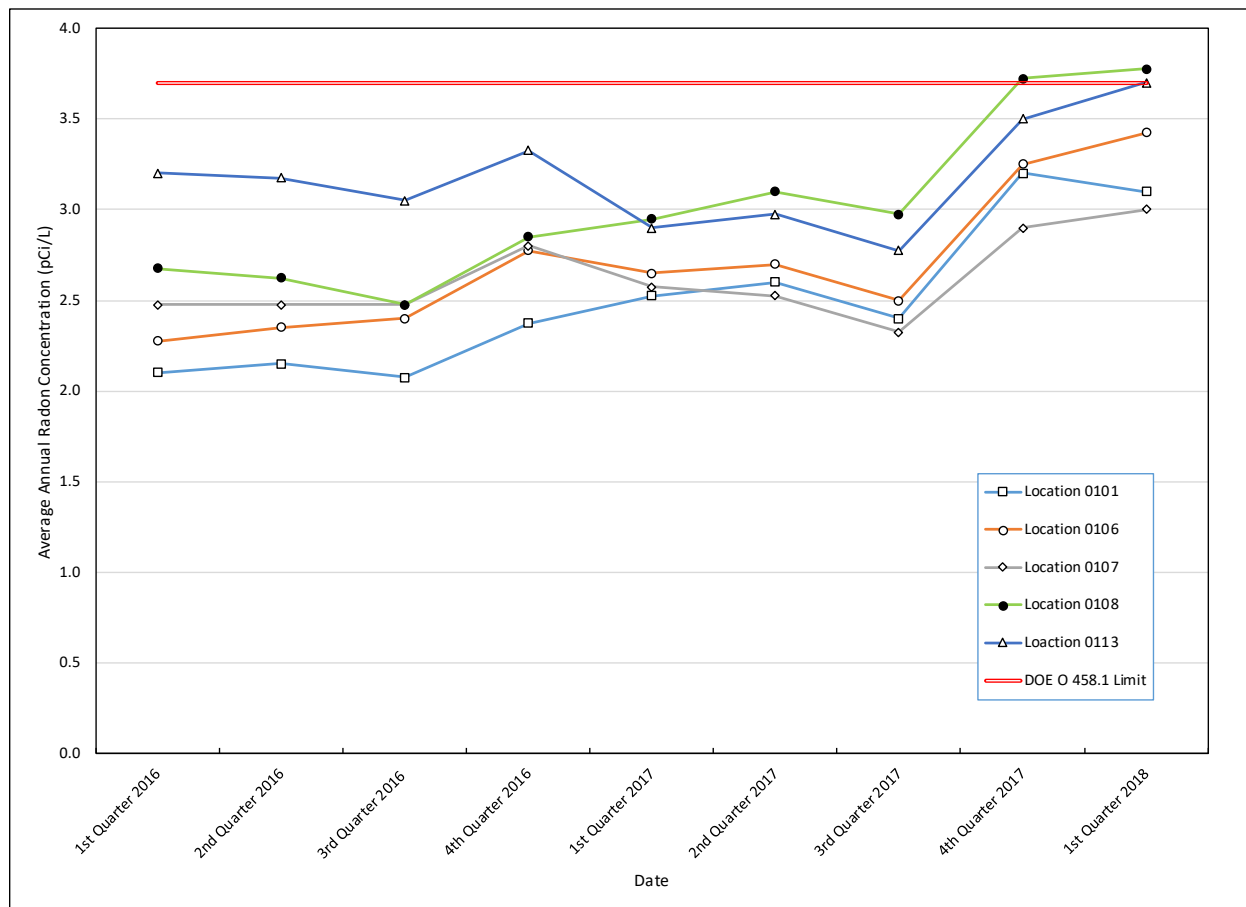


Figure 4. Moab Locations with the Highest First Quarter 2018 Average Annual Radon Concentrations

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. First quarter analytical results were lower compared to those from the fourth quarter 2017.

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

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 considered to be from the Project.

Samples to determine the concentrations of total uranium, actinium-227, thorium-230, radium-226, and polonium-210 are collected at nine monitoring locations at or near the Moab site. 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). The analytical results are used to calculate effective dose from the inhalation of radioparticulates.

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

Station Number	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	4th Quarter 2017 (mrem)	1st Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations					
0101	40.5	42.2	47.5	43.1	173.3
0102	25.0	21.4	29.0	22.1	97.5
0103	21.5	21.6	27.5	25.3	95.9
0104	27.5	25.7	33.8	29.4	116.4
0105	25.5	21.5	29.5	25.1	101.6
0106	37.8	33.5	44.1	36.6	152.0
0107	24.5	27.6	31.1	31.7	114.9
0108	45.1	44.8	52.2	46.9	189.0
0109	120.4	119.0	129.1	117.3	485.8
0110	105.7	99.8	105.8	98.2	409.5
0111	39.8	39.3	42.6	34.6	156.3
0112	49.0	46.2	61.7	51.9	208.8
0113	41.7	40.0	53.9	43.7	179.3
0126	25.3	25.1	32.6	27.5	110.5
Off-site Locations					
0117	22.9	23.8	26.6	26.5	99.8
0118	21.9	22.4	25.5	24.6	94.4
0119	20.4	21.0	26.1	23.3	90.8
0120	21.1	18.3	25.5	21.1	86.0
0121	20.5	22.4	25.9	24.1	92.9
0122	17.6	14.3	21.7	16.6	70.2
0123	17.4	19.6	22.8	22.0	81.8
0124	22.5	24.4	31.2	27.3	105.4
0125	26.7	26.6	36.3	26.3	115.9
0127	24.5	22.9	30.1	25.8	103.3
0128	26.1	22.7	33.0	25.4	107.2
0129	31.4	28.6	37.6	31.4	129.0
MEI	21.4	20.7	28.6	27.7	98.4

Table 3 shows calculated quarterly and annual effective dose from inhalation of radioparticulates for the past year for the Moab site. As expected, stations closest to the site operations (0105 and 0129) show higher results compared to the nearby surrounding stations (0118 and 0119). Results for the first quarter 2018 are lower compared to the previous quarter.

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 19.81 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 98.4 mrem and then adding the radioparticulate dose of 3.41 mrem for location 0102, the closest radioparticulate station to the MEI.

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

Station Number	Isotope	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	4th Quarter 2017 (mrem)	1st Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations						
0102-RP ¹	Total Uranium	0.022	0.002	0.004	0.002	3.41
	Thorium-230	0.043	0.037	0.043	0.020	
	Radium-226	0.011	0.044	0.048	0.029	
	Polonium-210	0.383	0.236	1.058	0.895	
	Actinium-227	0.087	0.035	0.159	0.100	
	Protactinium-231	0.082	0.008	0.036	0.023	
0105-RP	Total Uranium	0.031	0.005	0.005	0.002	4.49
	Thorium-230	0.143	0.115	0.061	0.029	
	Radium-226	0.020	0.097	0.079	0.048	
	Polonium-210	0.445	0.326	1.221	0.741	
	Actinium-227	0.165	0.420	0.233	0.000	
	Protactinium-231	0.156	0.097	0.054	0.000	
Off-site Locations						
0117-RP	Total Uranium	0.021	0.002	0.004	0.002	2.32
	Thorium-230	0.027	0.017	0.016	0.010	
	Radium-226	0.009	0.002	0.003	0.025	
	Polonium-210	0.334	0.187	0.708	0.537	
	Actinium-227	0.039	0.179	0.000	0.170	
	Protactinium-231	0.036	0.041	0.000	0.039	
0118-RP	Total Uranium	0.031	0.002	0.003	0.003	3.20
	Thorium-230	0.125	0.048	0.024	0.032	
	Radium-226	0.026	0.070	0.030	0.053	
	Polonium-210	0.400	0.228	0.724	0.684	
	Actinium-227	0.093	0.114	0.163	0.156	
	Protactinium-231	0.088	0.026	0.038	0.036	
0119-RP	Total Uranium	0.021	0.003	0.003	0.002	2.92
	Thorium-230	0.046	0.032	0.021	0.016	
	Radium-226	0.021	0.057	0.007	0.044	
	Polonium-210	0.360	0.317	0.684	0.480	
	Actinium-227	0.143	0.221	0.128	0.079	
	Protactinium-231	0.136	0.051	0.029	0.018	
0121-RP	Total Uranium	0.025	0.003	0.003	0.002	2.98
	Thorium-230	0.055	0.032	0.023	0.018	
	Radium-226	0.006	0.038	0.039	0.057	
	Polonium-210	0.327	0.228	0.659	0.627	
	Actinium-227	0.035	0.256	0.210	0.161	
	Protactinium-231	0.034	0.059	0.048	0.037	
0122-RP	Total Uranium	0.025	0.003	0.003	0.002	3.13
	Thorium-230	0.042	0.021	0.010	0.015	
	Radium-226	0.005	0.224	0.018	0.031	
	Polonium-210	0.350	0.252	0.651	0.562	
	Actinium-227	0.139	0.147	0.051	0.326	
	Protactinium-231	0.131	0.034	0.012	0.075	

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

Station Number	Isotope	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	4th Quarter 2017 (mrem)	1st Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
Off-site Locations (continued)						
0123-RP	Total Uranium	0.025	0.002	0.003	0.002	2.79
	Thorium-230	0.050	0.019	0.014	0.011	
	Radium-226	0.009	0.207	0.036	0.019	
	Polonium-210	0.383	0.260	0.676	0.480	
	Actinium-227	0.117	0.182	0.114	0.000	
	Protactinium-231	0.111	0.042	0.026	0.000	
0129-RP	Total Uranium	0.053	0.006	0.005	0.004	7.34
	Thorium-230	0.636	0.264	0.093	0.099	
	Radium-226	0.103	0.202	0.092	0.132	
	Polonium-210	0.439	0.407	0.814	0.733	
	Actinium-227	0.305	1.072	0.629	0.466	
	Protactinium-231	0.289	0.247	0.145	0.107	

¹MEI location

3.2 Crescent Junction Site

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 annual average radon emission limit at the Crescent Junction site boundary (withdrawal area) is 3.9 pCi/L. 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. None of the on- or off-site stations exceeded the limit of 3.0 pCi/L above background and, in general, all results were lower compared to the previous quarter.

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

Station Number	2nd Quarter 2017 (pCi/L)	3rd Quarter 2017 (pCi/L)	4th Quarter 2017 (pCi/L)	1st Quarter 2018 (pCi/L)	Annual Average Concentration Based on Four Quarters (pCi/L)
On-site Locations					
0301	0.8	0.4	1.1	0.6	0.7
0302	<0.4	0.6	1.1	0.7	0.7
0303	0.5	0.6	2.4	1.1	1.2
0304	0.5	<0.4	0.9	0.7	0.6
0305	<0.4	0.5	0.8	0.5	0.6
0308	1.4	1.5	4.9	3.0	2.7
0309	0.6	0.6	2.2	1.3	1.2
Off-site Locations					
0306¹	0.4	<0.4	0.7	0.6	0.5
0307	<0.4	<0.4	0.5	<0.4	0.4

The five Crescent Junction locations that have the highest annual average radon concentrations in the first quarter of 2018 (0301, 0302, 0303, 0308, and 0309) are displayed in Figure 5. Similar to Figure 4, this graph displays the annual average concentrations for these locations since the first quarter of 2016.

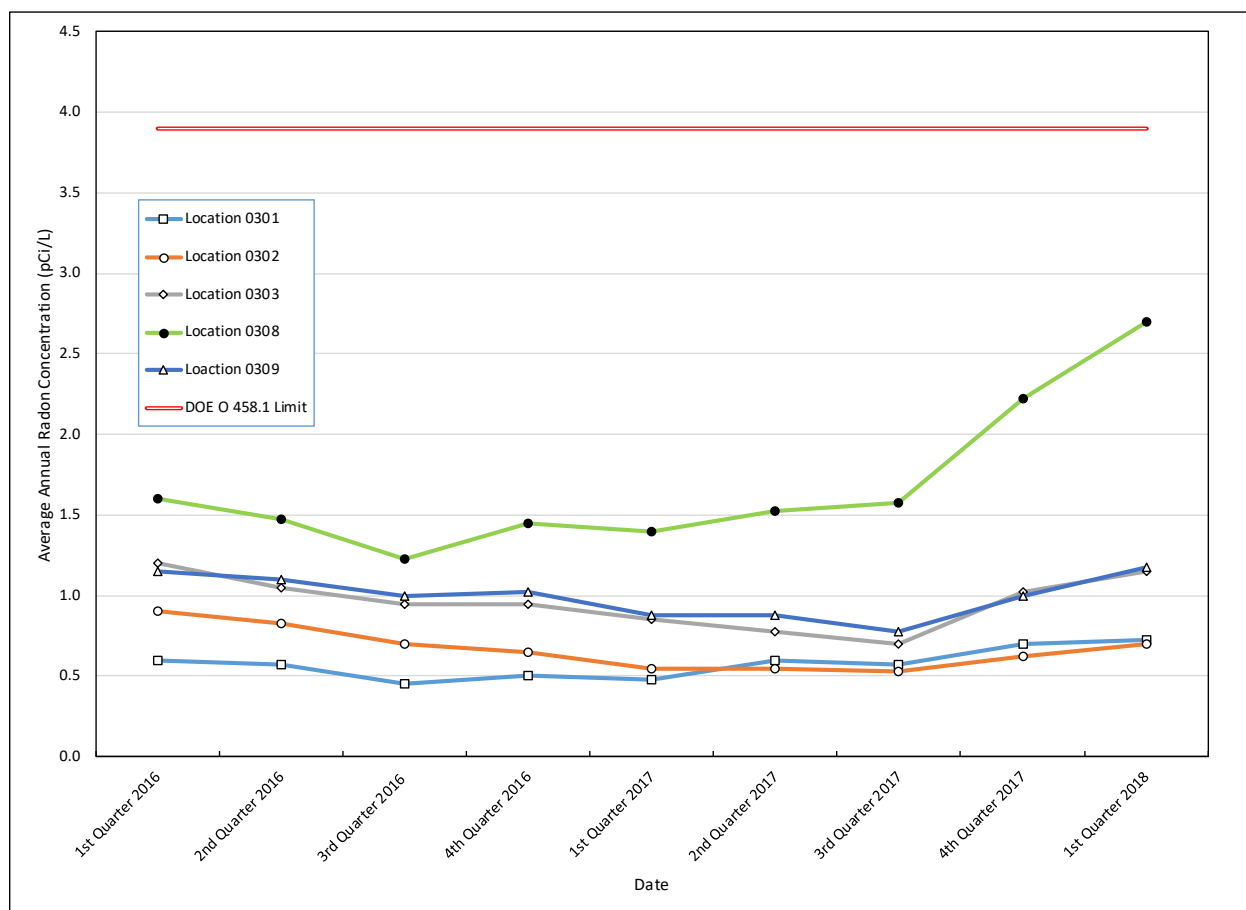


Figure 5. Crescent Junction Locations with the Highest First Quarter 2018 Average Annual Radon Concentrations

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.

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 from radioparticulates measured at the Project's monitoring stations is considered to be from the Project. Samples to determine the 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) are collected at the four monitoring locations at or near the Crescent Junction site.

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

Station Number	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	4th Quarter 2017 (mrem)	1st Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations					
0301	22.9	22.7	27.4	31.6	104.6
0302	22.0	24.5	25.3	28.3	100.1
0303	28.6	27.6	31.8	31.6	119.6
0304	21.2	24.5	24.9	26.6	97.2
0305	25.7	24.3	28.0	27.3	105.3
0308	23.9	26.4	27.8	30.1	108.2
0309	22.6	21.3	26.1	24.9	94.9
Off-site Locations					
0306¹	20.7	22.5	24.7	25.0	92.9
0307	24.7	26.3	28.0	30.3	109.3

¹MEI location

These 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. The first quarter 2018 dose results are similar to previous quarters.

3.2.4 Total Effective Dose

The annual total effective dose to the MEI was 4.0 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 92.9 mrem and then adding the radioparticulate dose of 3.60 mrem for the MEI.

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

Station Number	Isotope	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	4th Quarter 2017 (mrem)	1st Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations						
0308-RP	Total Uranium	0.024	0.002	0.003	0.002	3.38
	Thorium-230	0.130	0.059	0.040	0.032	
	Radium-226	0.020	0.022	0.070	0.097	
	Polonium-210	0.355	0.260	0.684	0.627	
	Actinium-227	0.052	0.196	0.212	0.280	
	Protactinium-231	0.050	0.045	0.049	0.064	
0309-RP	Total Uranium	0.040	0.003	0.004	0.003	5.11
	Thorium-230	0.338	0.093	0.088	0.115	
	Radium-226	0.050	0.106	0.158	0.172	
	Polonium-210	0.443	0.301	0.765	0.627	
	Actinium-227	0.207	0.396	0.443	0.303	
	Protactinium-231	0.196	0.091	0.102	0.070	

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

Station Number	Isotope	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	4th Quarter 2017 (mrem)	1st Quarter 2018 (mrem)	Annual Dose Based on Four Quarters (mrem)
Off-site Locations						
0306-RP¹	Total Uranium	0.017	0.002	0.002	0.002	3.60
	Thorium-230	0.022	0.014	0.007	0.009	
	Radium-226	0.000	0.017	0.000	0.022	
	Polonium-210	0.319	0.269	0.643	0.602	
	Actinium-227	0.167	0.280	0.128	0.676	
	Protactinium-231	0.158	0.064	0.029	0.156	
0307-RP	Total Uranium	0.023	0.002	0.003	0.002	2.98
	Thorium-230	0.044	0.014	0.016	0.009	
	Radium-226	0.001	0.079	0.010	0.036	
	Polonium-210	0.368	0.269	0.545	0.692	
	Actinium-227	0.151	0.212	0.091	0.163	
	Protactinium-231	0.143	0.049	0.021	0.038	

¹MEI location

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). Qualified Project personnel evaluated the analytical data received for consistency with other data points and sample duplicates.

4.1 Duplicate Sampling

Duplicate samples for radon were collected at Moab locations 0108 and 0121 and at Crescent Junction locations 0303 and 0308. In addition, duplicate direct gamma samples were collected at Moab locations 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.

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 first quarter of 2018.

4.3 Summary

Data collected during the first 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.

Table 7. Duplicate Results for First Quarter 2018

Location	Result	Duplicate Result
Moab		
Radon:	pCi/L	pCi/L
0108	3.2	3.1
0121	0.4	0.6
Gamma:	mrem	mrem
0108	46.9	44.0
0129	31.4	35.4
Crescent Junction		
Radon:	pCi/L	pCi/L
0303	1.1	1.0
0308	3.0	3.1
Gamma:	mrem	mrem
0301	31.6	27.9
0305	27.3	27.5

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 Fourth Quarter 2017 (October – December 2017)* (DOE-EM/GJTAC2260).

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.”