

Office of Environmental Management – Grand Junction



Environmental Air Monitoring Data
Quarterly Report for the Moab and
Crescent Junction, Utah, Sites
Third Quarter 2017
(July through September 2017)

May 2018



Office of Environmental Management

**Moab UMTRA Project
Environmental Air Monitoring Data Quarterly Report
for the Moab and Crescent Junction, Utah, Sites
Third Quarter 2017
(July – September 2017)**

Revision 0

May 2018

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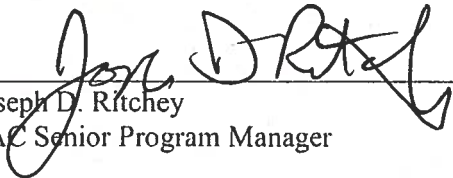
Revision 0

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Revision History

Revision	Date	Reason for Revision
0	May 2018	Initial issue.

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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 third quarter of 2017. The Project sites consist of the former uranium ore-processing mill located 3 miles north of Moab, Utah, and the disposal site located near Crescent Junction, Utah.

2.0 Regulatory Requirements

This Report demonstrates compliance with DOE 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 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 most radiation dose based on exposure pathways and parameters. The Project established an MEI for both the Moab and Crescent Junction sites.

3.0 Results for July through September 2017

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 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 Project must limit radon emissions at the Moab site boundary to 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. Monitoring data for the third quarter of 2017, off and on-site locations were similar to historical data. No annual average concentration exceeded the 3.0 pCi/L plus background annual limit.

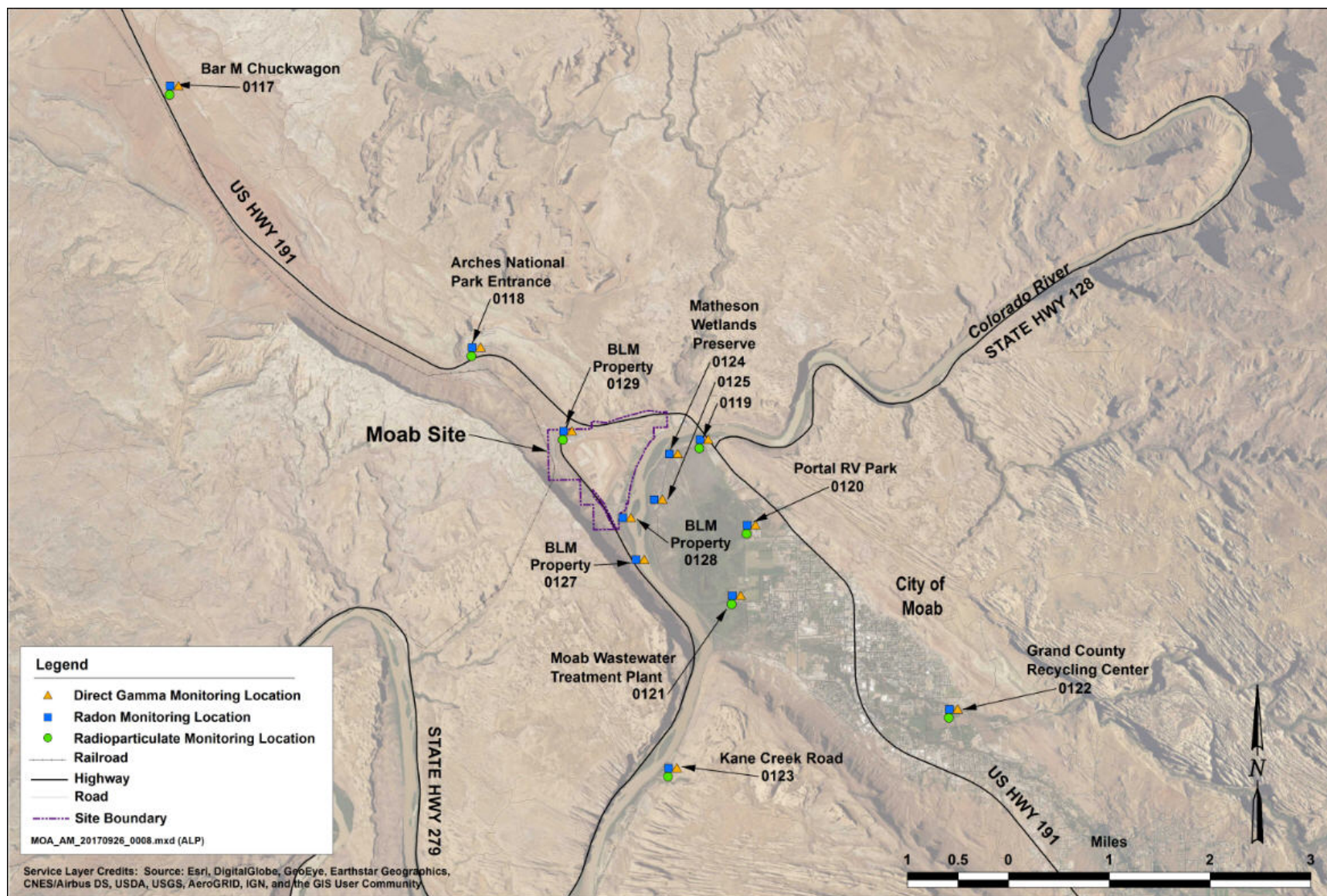


Figure 1. Moab Off-site Environmental Air Monitoring Locations

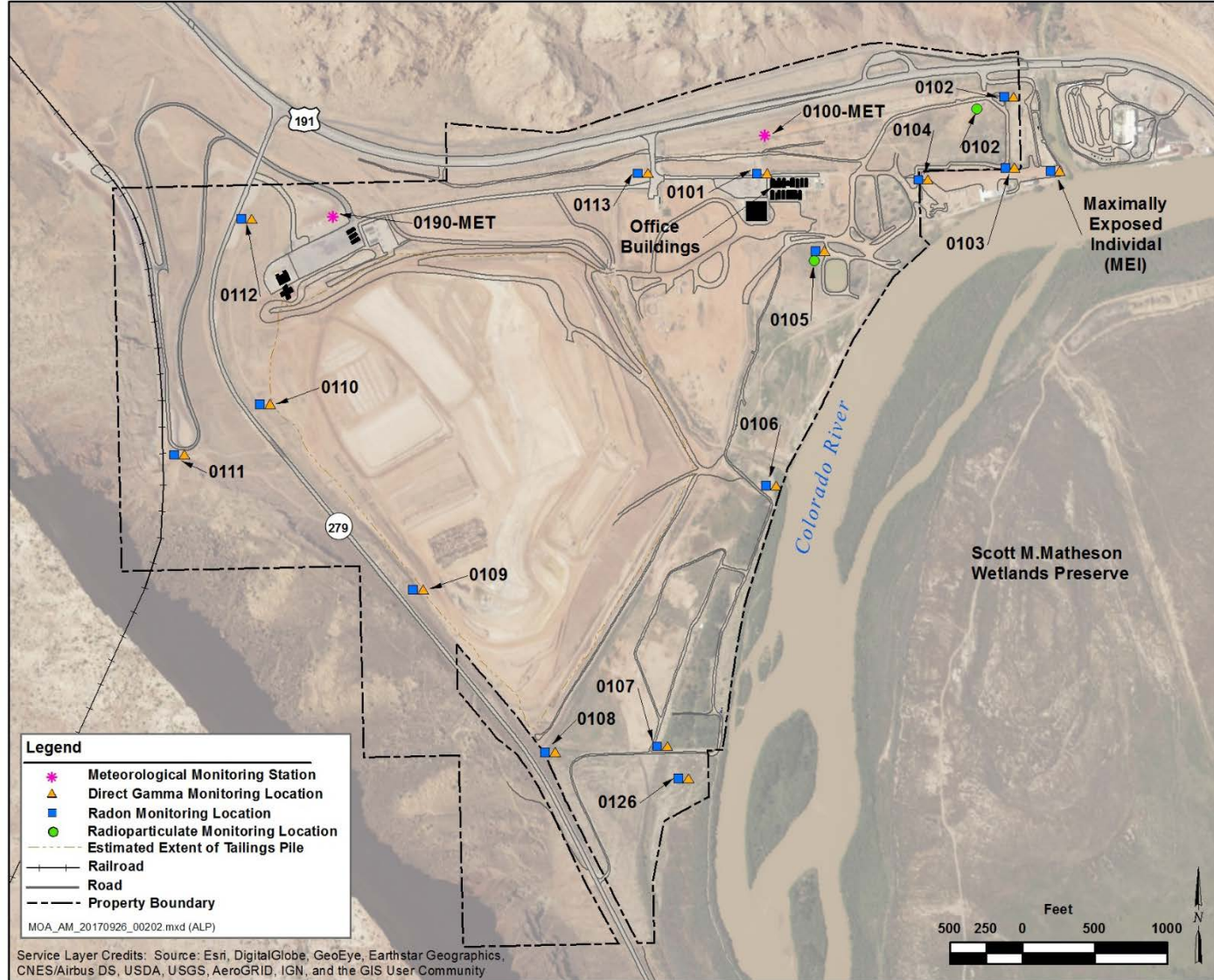


Figure 2. Moab On-site and MEI Environmental Air Monitoring Locations

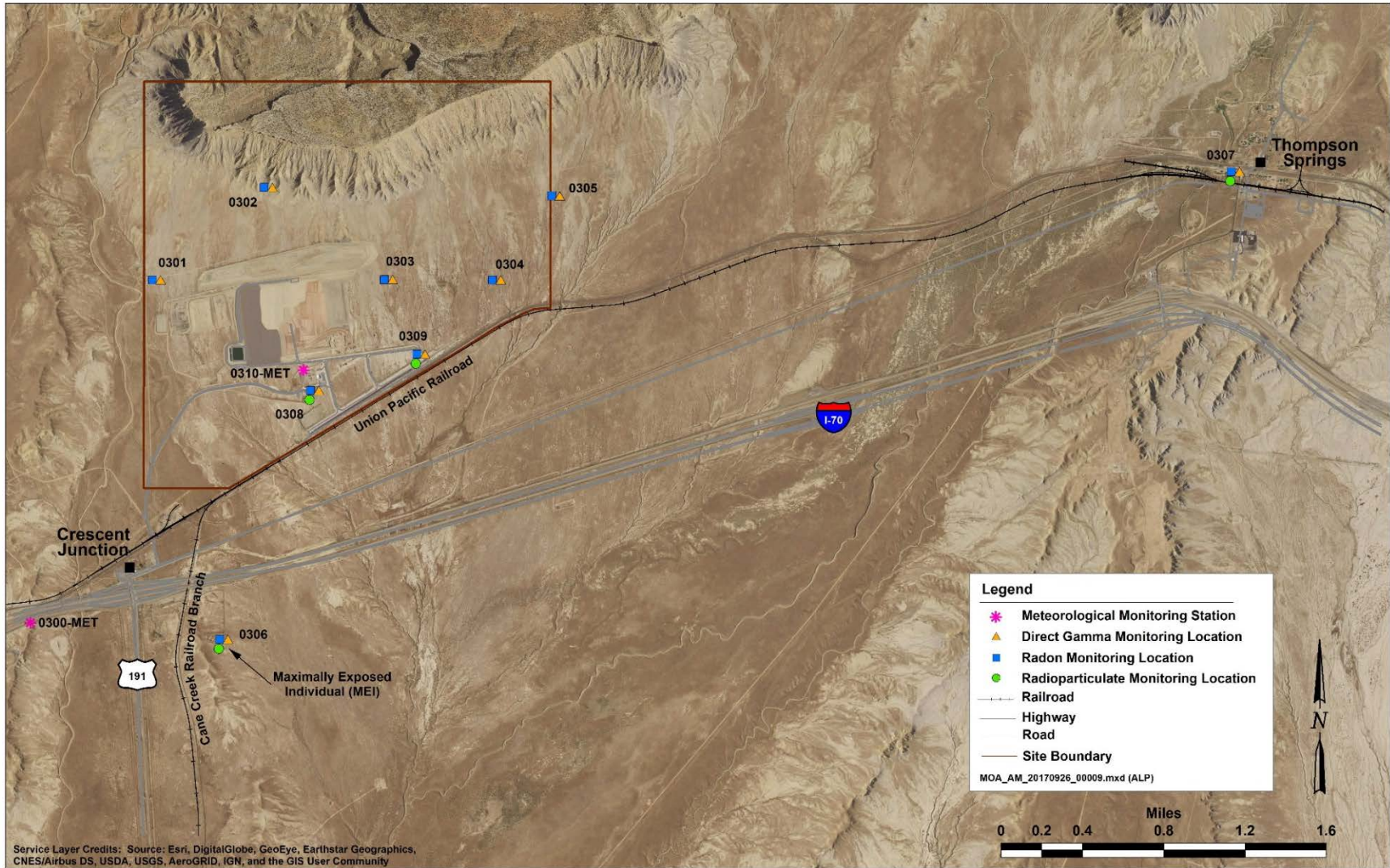


Figure 3. Crescent Junction Site Environmental Air Monitoring Locations

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

Station Number	4th Quarter 2016 (pCi/L)	1st Quarter 2017 (pCi/L)	2nd Quarter 2017 (pCi/L)	3rd Quarter 2017 (pCi/L)	Annual Average Concentration Based on Four Quarters (pCi/L)
On-site Locations					
0101	3.8	3.0	1.4	1.4	2.4
0102	1.8	1.1	0.8	0.6	1.1
0103	2.1	1.7	0.6	0.7	1.3
0104	3.6	1.9	1.3	1.1	2.0
0105	3.7	2.0	1.4	1.2	2.1
0106	4.3	2.9	1.4	1.4	2.5
0107	3.9	2.8	1.2	1.4	2.3
0108	4.4	3.0	2.1	2.4	3.0
0109	2.2	1.2	1.4	1.8	1.7
0110	1.9	1.1	2.2	1.4	1.7
0111	0.9	0.6	0.4	NDA	0.6
0112	2.8	1.6	1.3	2.1	2.0
0113	4.6	2.5	1.8	2.2	2.8
0126	3.6	2.5	1.1	1.2	2.1
Off-site Locations					
0117	0.5	0.6	<0.4	<0.4	0.5
0118	0.7	0.4	<0.4	0.7	0.6
0119	1.1	0.7	0.5	0.5	0.7
0120	0.6	0.6	<0.4	0.5	0.5
0121	0.8	<0.4	<0.4	<0.4	0.5
0122	<0.4	<0.4	0.5	<0.4	0.4
0123	0.5	<0.6	<0.4	<0.4	0.5
0124	1.4	0.7	0.5	0.5	0.8
0125	1.9	1.2	0.6	0.7	1.1
0127	1.1	0.8	<0.4	0.5	0.7
0128	3.8	2.3	1.2	1.4	2.2
0129	2.7	1.6	1.2	1.6	1.8
MEI	1.9	1.1	0.5	0.5	1.0

NDA= No data available, sensor missing or damaged

Radon data were plotted on a graph (Figure 4) for Moab site monitoring locations 0108, 0109, 0110, 0112, and 0113, which demonstrates compliance with the DOE O 458.1 public dose limit.

3.1.2 Direct Gamma Radiation

The average annual background 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. Third quarter analytical results were similar to those of the second quarter of 2017.

These readings represent the gamma dose an individual would receive from occupying a location for an entire year. Although several monitoring locations in Table 2 show annual readings greater than the 100 mrem above background limit, 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.

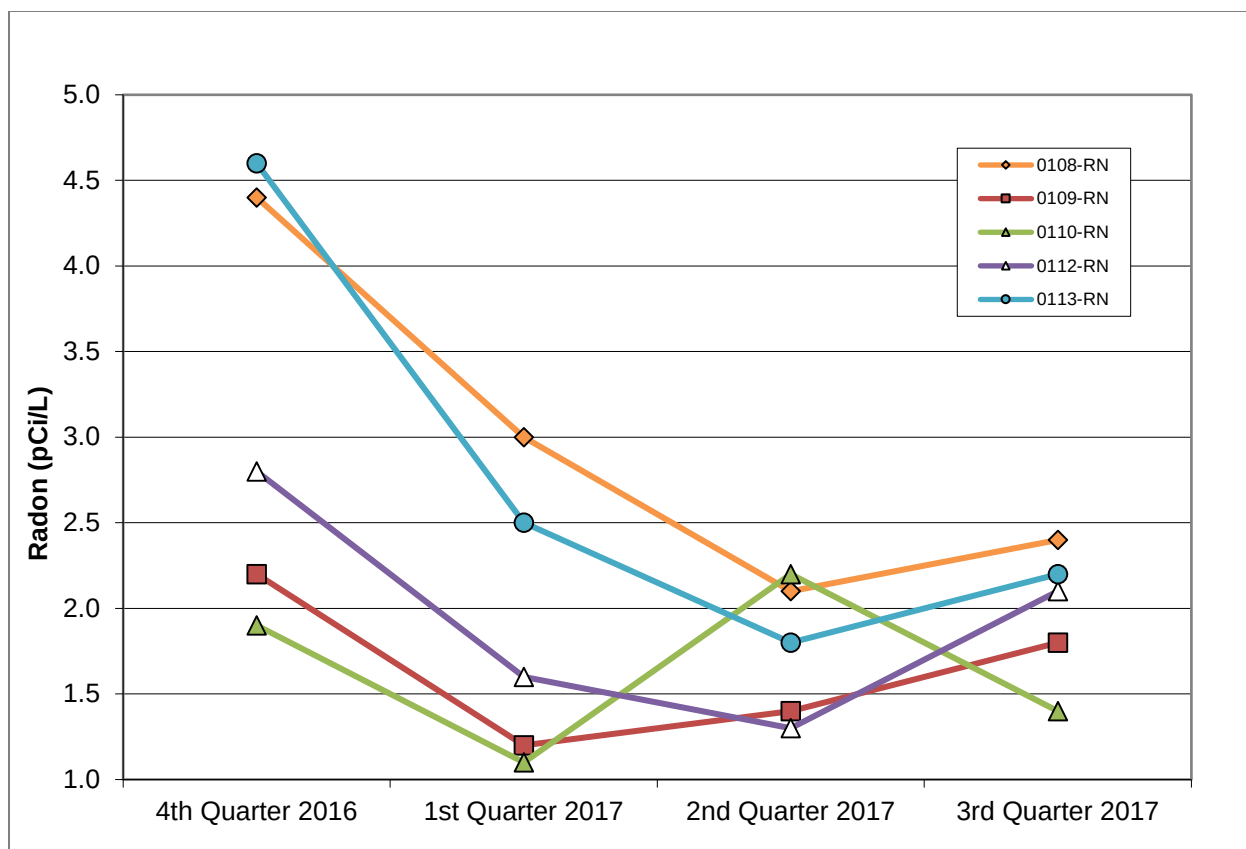


Figure 4. Radon Concentrations at Select Moab Monitoring Locations

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, thorium-230, radium-226, and polonium-210 are collected at nine monitoring locations at or near the Moab site. Actinium-227 and protactinium-231 were added in the fourth quarter of 2016 to better represent the potential dose associated with airborne emissions. Because these two isotopes 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 3 shows calculated quarterly and annual effective dose from inhalation of radioparticulates for the past year for the Moab site. Although all results are below the limit, stations closer to the site operations (0105 and 0129) show higher results than more distant stations (0102 and 0117), as would be expected. The third quarter 2017 effective dose from radioparticulates decreased compared to the second quarter 2017 results. Seasonal air particulate analyte concentrations and corresponding dose fluctuations have historically occurred.

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

Station Number	4th Quarter 2016 (mrem)	1st Quarter 2017 (mrem)	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations					
0101	48.5	45.2	40.5	42.2	176.4
0102	30.6	23.1	25.0	21.4	100.1
0103	27.3	23.4	21.5	21.6	93.8
0104	29.0	26.4	27.5	25.7	108.6
0105	29.7	22.9	25.5	21.5	99.6
0106	36.8	33.9	37.8	33.5	142.0
0107	30.0	27.9	24.5	27.6	110.0
0108	50.0	44.2	45.1	44.8	184.1
0109	135.9	124.9	120.4	119.0	500.2
0110	108.3	92.0	105.7	99.8	405.8
0111	45.4	41.5	39.8	39.3	166.0
0112	53.9	46.1	49.0	46.2	195.2
0113	48.3	39.4	41.7	40.0	169.4
0126	31.0	24.1	25.3	25.1	105.5
Off-site Locations					
0117	27.0	28.3	22.9	23.8	102.0
0118	25.7	22.4	21.9	22.4	92.4
0119	26.6	21.4	20.4	21.0	89.4
0120	25.3	19.1	21.1	18.3	83.8
0121	25.1	23.3	20.5	22.4	91.3
0122	22.1	15.1	17.6	14.3	69.1
0123	21.9	20.1	17.4	19.6	79.0
0124	29.3	26.4	22.5	24.4	102.6
0125	32.9	28.2	26.7	26.6	114.4
0127	29.6	24.3	24.5	22.9	101.3
0128	31.1	25.9	26.1	22.7	105.8
0129	35.8	29.8	31.4	28.6	125.6
MEI	27.6	22.6	21.4	20.7	92.3

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 13.1 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 92.3 mrem and then adding the radioparticulate dose of 2.76 mrem for location 0102, the closest radioparticulate station to the MEI.

3.2 Crescent Junction Site

After mill tailings disposal began in the second quarter of 2009, Crescent Junction monitoring location 0306 became the MEI.

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

Station Number	Isotope	4th Quarter 2016 (mrem)	1st Quarter 2017 (mrem)	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations						
0102-RP ¹	Total Uranium	0.012	0.011	0.022	0.002	2.76
	Thorium-230	0.045	0.034	0.043	0.037	
	Radium-226	0.008	ND	0.011	0.044	
	Polonium-210	0.891	0.579	0.383	0.236	
	Actinium-227	0.061	0.036	0.087	0.035	
	Protactinium-231	0.058	0.034	0.082	0.008	
0105-RP	Total Uranium	0.014	0.013	0.031	0.005	3.86
	Thorium-230	0.095	0.050	0.143	0.115	
	Radium-226	0.008	0.009	0.020	0.097	
	Polonium-210	0.984	0.566	0.445	0.326	
	Actinium-227	0.050	ND	0.165	0.420	
	Protactinium-231	0.048	ND	0.156	0.097	
Off-site Locations						
0117-RP	Total Uranium	0.009	0.009	0.021	0.002	1.85
	Thorium-230	0.025	0.015	0.027	0.017	
	Radium-226	0.003	0.002	0.009	0.002	
	Polonium-210	0.393	0.325	0.334	0.187	
	Actinium-227	0.056	0.032	0.039	0.179	
	Protactinium-231	0.053	0.030	0.036	0.041	
0118-RP	Total Uranium	0.010	0.013	0.031	0.002	2.95
	Thorium-230	0.069	0.077	0.125	0.048	
	Radium-226	ND	0.045	0.026	0.070	
	Polonium-210	0.751	0.463	0.400	0.228	
	Actinium-227	0.139	ND	0.093	0.114	
	Protactinium-231	0.132	ND	0.088	0.026	
0119-RP	Total Uranium	0.010	0.009	0.021	0.003	2.64
	Thorium-230	0.017	0.019	0.046	0.032	
	Radium-226	0.003	0.003	0.021	0.057	
	Polonium-210	0.614	0.393	0.360	0.317	
	Actinium-227	0.045	0.037	0.143	0.221	
	Protactinium-231	0.042	0.035	0.136	0.051	
0120-RP	Total Uranium	0.010	0.009	0.025	0.002	2.37
	Thorium-230	0.026	0.026	0.044	0.025	
	Radium-226	0.006	0.006	0.004	0.028	
	Polonium-210	0.705	0.405	0.338	0.260	
	Actinium-227	0.025	ND	0.080	0.200	
	Protactinium-231	0.024	ND	0.075	0.046	
0121-RP	Total Uranium	0.011	0.010	0.025	0.003	2.55
	Thorium-230	0.035	0.025	0.055	0.032	
	Radium-226	0.003	0.004	0.006	0.038	
	Polonium-210	0.717	0.457	0.327	0.228	
	Actinium-227	0.051	0.047	0.035	0.256	
	Protactinium-231	0.048	0.044	0.034	0.059	

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

Station Number	Isotope	4th Quarter 2016 (mrem)	1st Quarter 2017 (mrem)	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	Annual Dose Based on Four Quarters (mrem)
Off-site Locations (continued)						
0122-RP	Total Uranium	0.009	0.009	0.025	0.003	2.47
	Thorium-230	0.022	0.015	0.042	0.021	
	Radium-226	0.004	0.004	0.005	0.224	
	Polonium-210	0.567	0.367	0.350	0.252	
	Actinium-227	0.032	0.018	0.139	0.147	
	Protactinium-231	0.030	0.017	0.131	0.034	
0123-RP	Total Uranium	0.008	0.009	0.025	0.002	2.43
	Thorium-230	0.026	0.023	0.050	0.019	
	Radium-226	0.003	0.002	0.009	0.207	
	Polonium-210	0.494	0.411	0.383	0.260	
	Actinium-227	0.019	0.007	0.117	0.182	
	Protactinium-231	0.018	0.006	0.111	0.042	
0129-RP	Total Uranium	0.015	0.017	0.053	0.006	6.09
	Thorium-230	0.187	0.177	0.636	0.264	
	Radium-226	0.022	0.021	0.103	0.202	
	Polonium-210	0.719	0.404	0.439	0.407	
	Actinium-227	0.107	0.152	0.305	1.072	
	Protactinium-231	0.101	0.144	0.289	0.247	

NA = Sample not analyzed for this isotope during this quarter; ND = Isotope not present in a detectable concentration

¹MEI location

3.2.1 Radon

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 Project must limit radon emissions at the Crescent Junction site boundary (withdrawal area) to 3.9 pCi/L. Locations 0301, 0305, and 0309 are used to demonstrate compliance 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 stations exceeded the limit of 3.0 pCi/L above background, and these results were generally similar to previous data.

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

Station Number	4th Quarter 2016 (pCi/L)	1st Quarter 2017 (pCi/L)	2nd Quarter 2017 (pCi/L)	3rd Quarter 2017 (pCi/L)	Annual Average Concentration Based on Four Quarters (pCi/L)
On-site Locations					
0301	0.6	0.5	0.8	0.4	0.6
0302	0.7	<0.4	<0.4	0.6	0.5
0303	1.1	0.6	0.5	0.6	0.7
0304	0.7	<0.4	0.5	<0.4	0.5
0305	0.9	1.0	<0.4	0.5	0.7
0308	2.3	1.1	1.4	1.5	1.6
0309	1.3	0.6	0.6	0.6	0.8
Off-site Locations					
0306¹	0.5	0.6	0.4	<0.4	0.5
0307	0.6	0.5	<0.4	<0.4	0.5

¹MEI location

Radon data were plotted on a graph (Figure 5) for Crescent Junction monitoring locations 0301, 0305, and 0309, which demonstrates compliance with the public dose limit in DOE O 458.1.

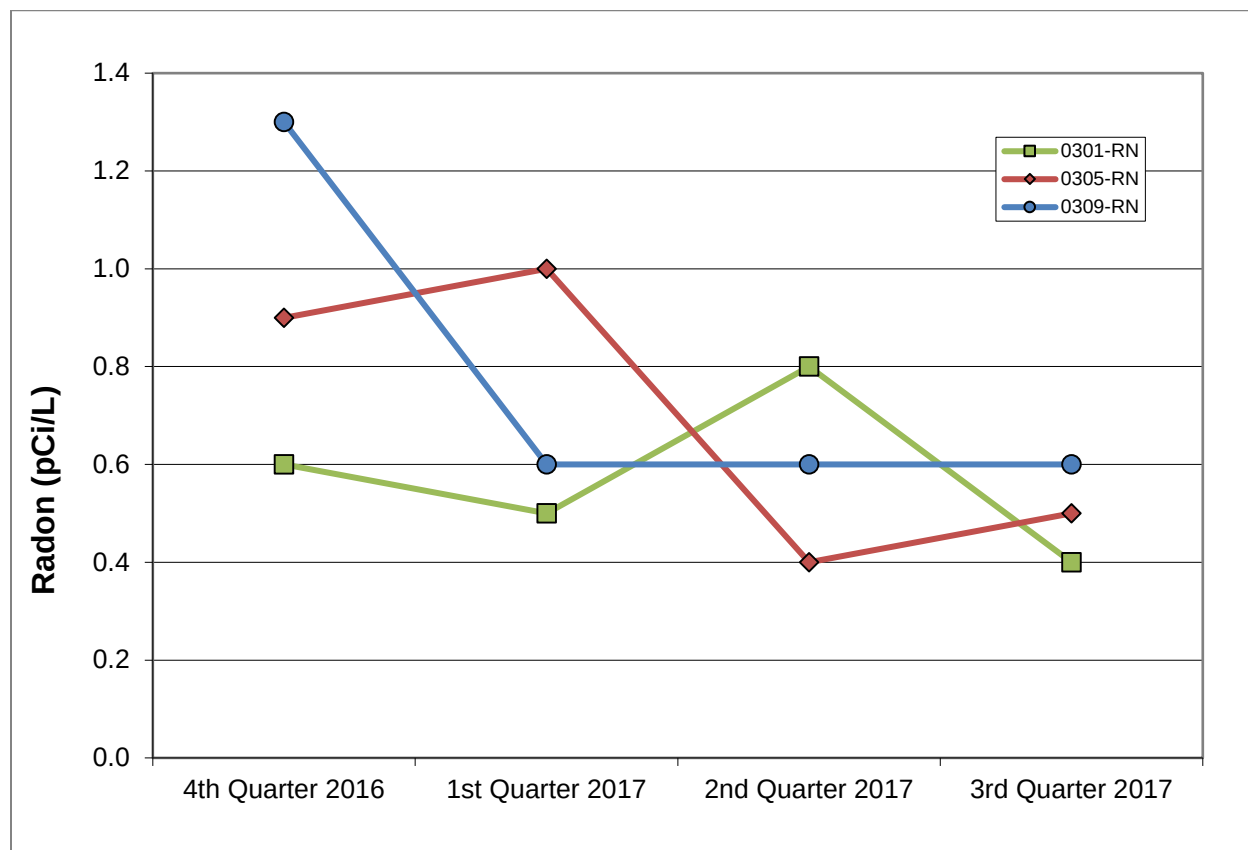


Figure 5. Radon Concentrations at Select Crescent Junction Monitoring Locations

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. Table 5 shows quarterly and annual results for the past year, including background, for on- and off-site locations.

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

Station Number	4th Quarter 2016 (mrem)	1st Quarter 2017 (mrem)	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations					
0301	29.2	29.5	22.9	22.7	104.3
0302	29.0	26.9	22.0	24.5	102.4
0303	32.6	27.8	28.6	27.6	116.6
0304	29.0	25.1	21.2	24.5	99.8
0305	32.3	25.3	25.7	24.3	107.6
0308	33.0	32.6	23.9	26.4	115.9
0309	27.9	22.5	22.6	21.3	94.3
Off-site Locations					
0306¹	28.5	23.4	20.7	22.5	95.1
0307	30.6	29.7	24.7	26.3	111.3

¹MEI location

3.2.3 Radioparticulates

As with the Moab sampling results, actinium-227 and protactinium-231 were added to the evaluation of dose for Crescent Junction locations beginning with the 2016 fourth quarter sample collection. Refer to Section 3.1.3 for more information regarding these isotopes. Table 6 shows quarterly and annual radioparticulate doses for the past year for the Crescent Junction site. The 2017 third quarter dose results are similar to previous quarters.

3.2.4 Total Effective Dose

The annual total effective dose to the MEI was 5.3 mrem, which is well below the annual limit of 100 mrem above background. This value was calculated by subtracting the background dose of 92.5 mrem from the MEI (location 0306) gamma radiation dose of 95.1 mrem and then adding the radioparticulate dose of 2.65 mrem for the MEI.

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

Station Number	Isotope	4th Quarter 2016 (mrem)	1st Quarter 2017 (mrem)	2nd Quarter 2017 (mrem)	3rd Quarter 2017 (mrem)	Annual Dose Based on Four Quarters (mrem)
On-site Locations						
0308-RP	Total Uranium	0.013	0.010	0.024	0.002	2.83
	Thorium-230	0.109	0.103	0.130	0.059	
	Radium-226	0.010	0.004	0.020	0.022	
	Polonium-210	0.795	0.351	0.355	0.260	
	Actinium-227	0.037	0.077	0.052	0.196	
	Protactinium-231	0.035	0.073	0.050	0.045	
0309-RP	Total Uranium	0.017	0.012	0.040	0.003	4.45
	Thorium-230	0.255	0.116	0.338	0.093	
	Radium-226	0.020	0.020	0.050	0.106	
	Polonium-210	0.781	0.406	0.443	0.301	
	Actinium-227	0.192	0.097	0.207	0.396	
	Protactinium-231	0.182	0.091	0.196	0.091	
Off-site Locations						
0306-RP ¹	Total Uranium	0.011	0.009	0.017	0.002	2.65
	Thorium-230	0.019	0.015	0.022	0.014	
	Radium-226	0.006	0.003	0.000	0.017	
	Polonium-210	0.843	0.417	0.319	0.269	
	Actinium-227	ND	ND	0.167	0.280	
	Protactinium-231	ND	ND	0.158	0.064	
0307-RP	Total Uranium	0.010	0.008	0.023	0.002	2.52
	Thorium-230	0.013	0.015	0.044	0.014	
	Radium-226	0.004	0.003	0.001	0.079	
	Polonium-210	0.666	0.362	0.368	0.269	
	Actinium-227	0.016	0.028	0.151	0.212	
	Protactinium-231	0.015	0.026	0.143	0.049	

NA = Sample not analyzed for this isotope during this quarter

¹MEI location

4.0 Data Assessment

Radon detectors, thermoluminescent dosimeters (TLDs) 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* (SAP) (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. Duplicate direct gamma measurements were taken at locations 0108 and 0129. Duplicate radon measurements were collected at Crescent Junction locations 0303 and 0308. Duplicate direct gamma measurements were taken at locations 0301 and 0305. The results of the duplicates can be found in Table 7. Duplicates were not collected for radioparticulate samples in accordance with the SAP.

Table 7. Duplicate Results for Third Quarter 2017

Location	Result	Duplicate Result
Moab		
Radon:	pCi/L	pCi/L
0108	2.4	2.4
0121	<0.4	<0.4
Gamma:	mrem	mrem
0108	44.8	44.7
0129	28.6	32.7
Crescent Junction		
Radon:	pCi/L	pCi/L
0303	0.6	0.6
0308	1.5	1.6
Gamma:	mrem	mrem
0301	23.0	24.7
0305	24.5	24.3

4.2 Suspected Anomalies

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 third quarter of 2017.

4.3 Summary

Data collected during the third quarter of 2017 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 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.”