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Office of Environmental Management – Grand Junction

UMTRA Project

Moab UMTRA Project
Crescent Junction Disposal Cell Interim Completion Report Addendum - J

Revision 0

December 2020

U.S. Department of Energy

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Moab UMTRA Project
Crescent Junction Disposal Cell Interim Completion Report
Addendum J

Revision 0

Review and Approval

12/14/2020

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Revision History

Revision	Date	Reason for Revision
0	December 2020	Initial issue.

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Acronyms and Abbreviations

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials International
CAT	Caterpillar
CBCS	Computer Based Compaction System
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DOE O	DOE Order
ft	foot/feet
GPS	Global Positioning System
NQA	Nuclear Quality Assurance
QA	quality assurance
Ra-226	radium-226
RAC	Remedial Action Contract or Contractor
RAIP	Remedial Action Inspection Plan
RAP	Remedial Action Plan
RRM	residual radioactive material
TAC	Technical Assistance Contractor
UMTRA	Uranium Mill Tailings Remedial Action
yd^3	cubic yard(s)

Executive Summary

This Interim Completion Report, Addendum J, documents the construction of a portion of the disposal cell near Crescent Junction, Utah. The disposal cell is being constructed under the U.S. Department of Energy (DOE) Moab Uranium Mill Tailings Remedial Action (UMTRA) Project. The purpose of the disposal cell is to isolate and stabilize uranium mill tailings and other contaminated materials, known as residual radioactive material (RRM), removed from the former mill site in Moab, Utah. The disposal cell is designed to be effective for 1,000 years to the extent reasonably achievable, with a minimum performance period of 200 years.

The Crescent Junction disposal cell will require many years to construct. Multiple Interim Completion Reports will be prepared to compile and document data collected during the ongoing construction process. These Interim Completion Reports will be written in the format of sequential addenda referenced in a Final Completion Report that will be prepared to address the entire cell construction.

This Addendum addresses activities performed by North Wind Portage, the DOE Remedial Action Contractor (RAC) for the Moab Project, from October 1, 2019, through September 30, 2020. This Report includes excavation of cubic yards 219,180 cubic yards (yd^3) of Phase 3 of the disposal cell and placement of 521,096 yd^3 of RRM and 17,114 yd^3 of final cover materials.

This Addendum also demonstrates that the referenced portion of the disposal cell was constructed in accordance with the *Moab UMTRA Project Final Remedial Action Plan and Site Design for Stabilization of Moab Title I Uranium Mill Tailings at the Crescent Junction, Utah, Disposal Site* (RAP) (DOE-EM/GJ1547). The RAP received conditional concurrence from the U.S. Nuclear Regulatory Commission. Included in this Report are a critical review, design assessment, and remedial action assessment of activities performed during this Report period. Also provided are associated data tables, photographs, laboratory results, and other supporting documentation.

The Moab Project follows the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance-1 (NQA-1) requirements for quality assurance (QA), including conducting audits and surveillances during the design and construction of the cell.

1.0 Introduction

The scope of the Moab Project is to relocate RRM from the former uranium ore-processing facility and from off-site properties known as vicinity properties in Moab, Utah, to an engineered disposal cell constructed near Crescent Junction, Utah. Most of the processing buildings at the Moab site were demolished and placed in the southern corner of the tailings pile. An interim cover was placed over the tailings pile as part of decommissioning activities between 1988 and 1995. The estimated volume of the tailings pile before relocation began was 12 million yd^3 (16 million tons). The RRM is being transported to Crescent Junction primarily by rail.

The Moab site is located about 3 miles northwest of the city of Moab in Grand County. The Crescent Junction site is located northeast of the junction of Interstate 70 and U.S. Highway 191, approximately 30 miles north of the Moab site, also in Grand County (see Figure 1). The completed disposal cell will generally be rectangular and will encompass approximately 230 acres. Figure 2 shows general features of the Crescent Junction site.

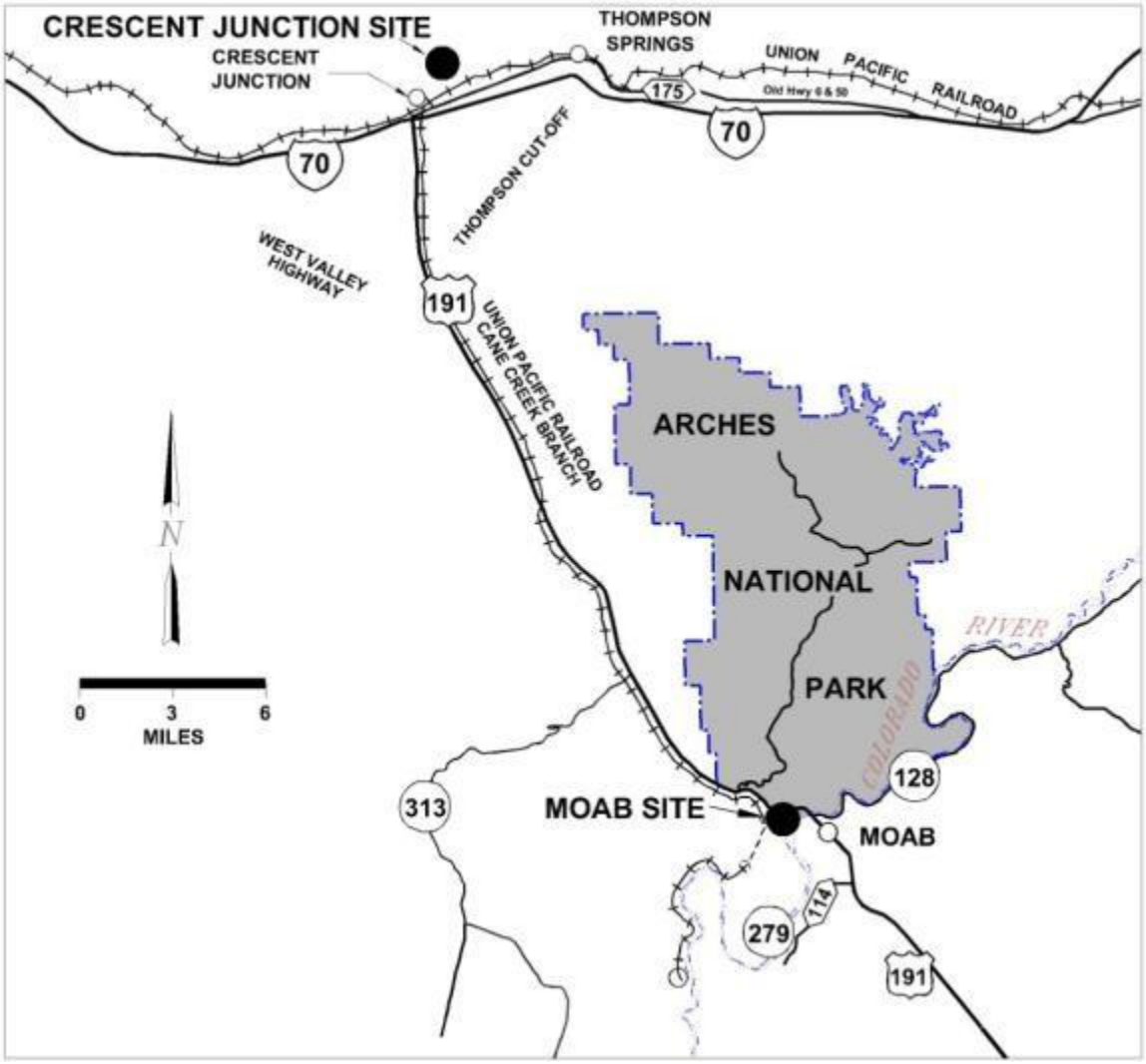

Figure 1. Location of Moab and Crescent Junction Sites

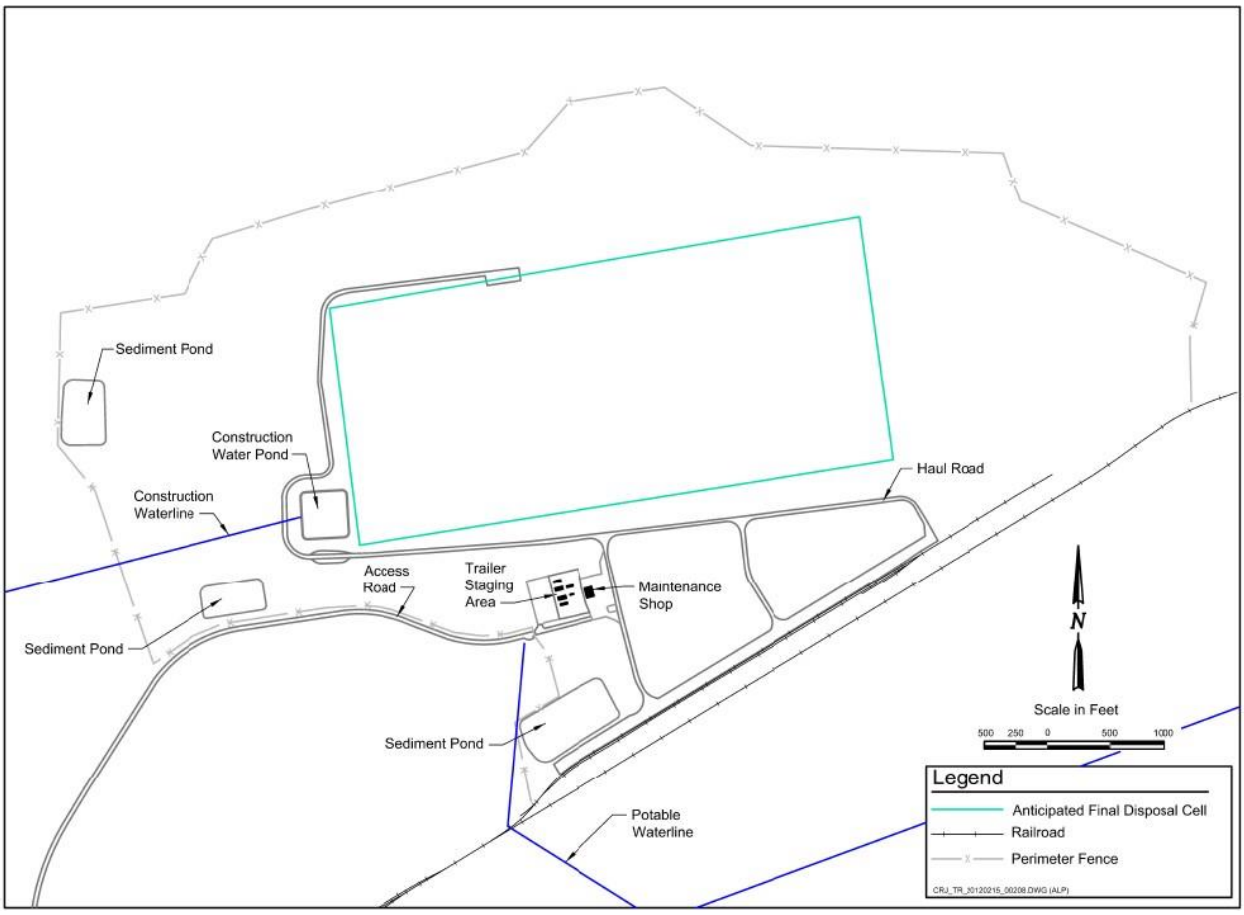

Figure 2. Crescent Junction Site Features

This Addendum documents activities performed by the RAC for the Project from October 1, 2019, through September 30, 2020.

Addendum J sections are outlined below.

- Section 2.0 summarizes the results of critical aspects of the disposal cell construction and provides tables and figures summarizing data found in Appendix A.
- Section 3.0 describes any differences in the completed design from design requirements in the RAP.
- Section 4.0 provides verification that placement of RRM and interim cover was conducted according to RAP requirements.
- Section 5.0 is a list of references for this document.
- Appendix A includes test results to demonstrate compliance with compaction requirements.
- Appendix B contains photographs of the various stages of cell construction.
- Attachment 1 contains revised procedures and design specifications associated with constructing the cell.

2.0 Critical Review

The Critical Review provides key technical information about the disposal cell construction. This section contains tables summarizing inspections or tests for cell excavation, embankment construction, RRM placement, and cell cover material placement as appropriate for this report period. The tables reference criteria and material testing procedures used to verify cell excavation and placement of each type of material, performed in accordance with design specifications or drawings and with Addendum E of the RAP, the *Remedial Action Inspection Plan* (RAIP). The distribution survey associated with each material type is also included in this section, as appropriate. Figure 3 shows the general extent of cell cover layers as of the end of this Addendum period.

Information regarding total lifts of compacted material, tests performed, and geotechnical data is summarized in Table 1. Additional geotechnical data, including proctor test result summaries, lift approval summaries, and lift approval packages, as appropriate, are located in Appendix A. A lift approval package consists of documentation of tests conducted to demonstrate that the lift met requirements. A package could include lift approval forms and associated figures, slope elevation surveys, and field density tests.

Table 1. Lifts/Testing Totals

Area/ Material	Total Volume Placed (yd^3)	Total Number of Lifts Approved	Lifts Approved Using CBCS	Lifts Approved Not Using CBCS	Total Number of Standard Proctor Tests	Total Number of In-place Density/Moisture Tests	Total Average for All In-place Density Tests Performed (%)	Total Average CBCS Passes that Meet Compaction Criteria (%)	Total Number of Soil Classifications	Total Number of Durability Tests	Total Number of Gradation Tests
Cell Perimeter Embankment	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RRM	521,096	432	422	10	7	20	92.9	99.8	N/A	N/A	N/A
Interim Cover	17,114	3	0	3	4	22	96.4	N/A	N/A	N/A	N/A
Radon Barrier	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Infiltration and Biointrusion Barrier	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Frost Protection Layer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2-in. Cap Rock	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

CBCS = Computer Based Compaction System; in. = inch

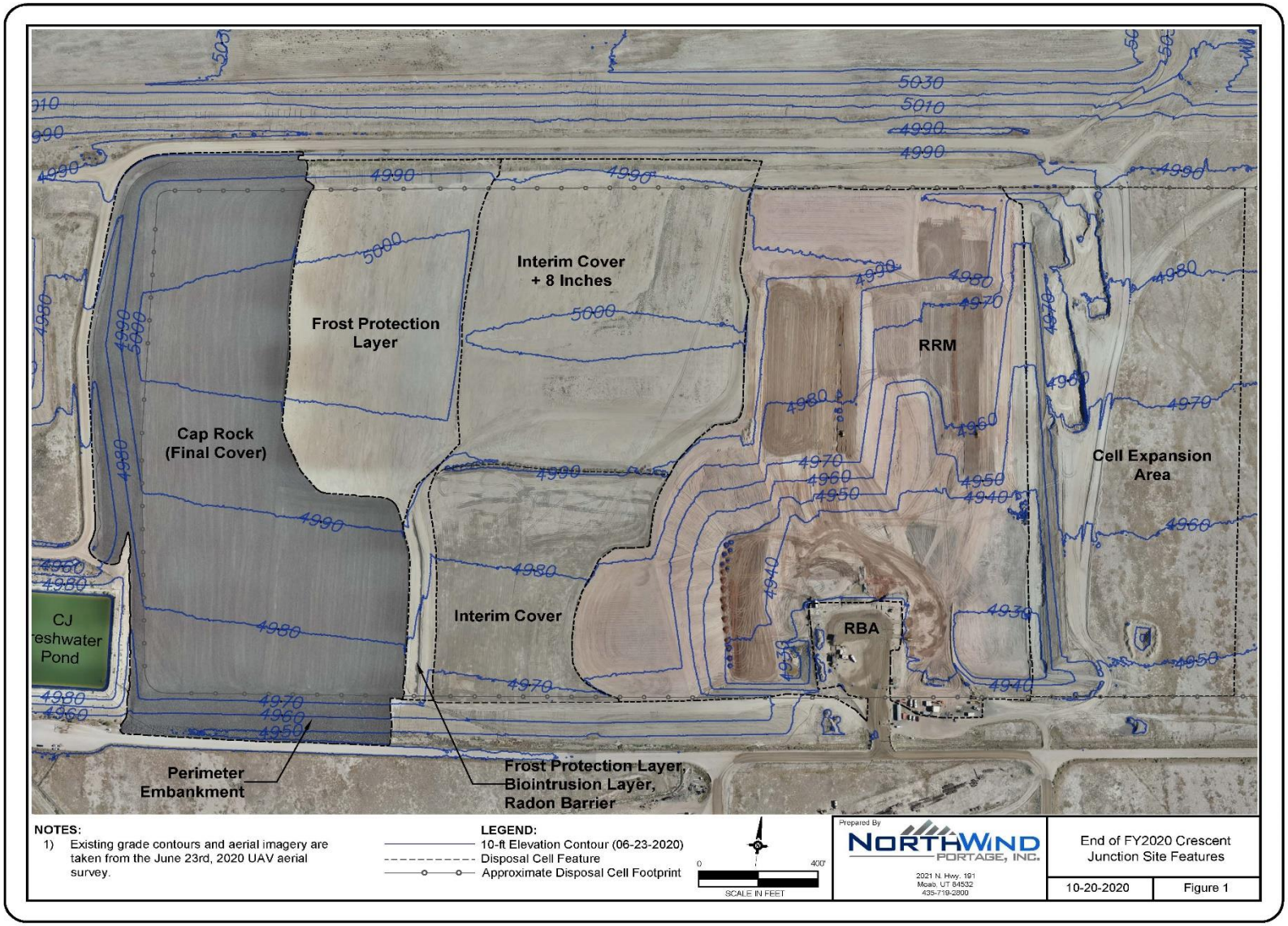

Figure 3. General Extent of Cover Layers

2.1 Cell Excavation

In October, November and April, Operations began preparing the cell floor for RRM placement by reestablishing design grade. These areas were found to be below grade. Four lifts of Mancos Shale were tested and approved to bring the cell floor to design grade. Table 2 lists the lifts, quantity placed, percent compaction, and lift thickness.

Table 2. Cell Floor Lifts

Date	Lift ID #	Quantity Approved (yd^3)	CBCS Screen Passing Pixels (%)	Average Thickness (ft)
10/08/19	UCF2B19191008-00	127,182	100	0.3
10/09/19	UCF2B19191008-01	303	100	0.5
11/06/19	UCF2B19191101-00	416	99.9	0.7
4/07/20	UCF2B19191119-00	297	97.9	0.5

Cell excavation to complete Phase 3 started September 1, 2020 with approximately 219,180 cubic yards of material excavated through September 30, 2020. The excavated material was used to extend the spoils embankment to the east.

2.2 Perimeter Embankment

No activities associated with the perimeter embankment were conducted during this period.

2.3 RRM

2.3.1 Computer Based Compaction System Performance Verification Testing

The Project used machines equipped with a Computer Based Compaction System (CBCS) to meet RRM compaction requirements as specified in Section 6.4.3 of the RAIP. Additional information about the computer-based compaction system verification testing is provided in Section 4.3 of this Addendum.

The RAIP also requires periodic verification of the CBCS compaction by comparing the results to in-place, nuclear density gauge test results. Table 3 shows the results of the comparison tests performed during this Report period.

Table 3. CBCS Performance Verification Testing

Lift ID Number	Test Performance Date	In-place Density Compaction (%)	Lift Area Meeting CBCS Compaction Criteria (%)
UW1T13191126-01	2/27/20	94.2	100
UW2C01191218-00	2/27/20	96.3	100
UW2A04200507-00	5/12/20	92.0	99.7
UW1Q23200603-00	6/04/20	90.2	100

2.3.2 RRM Placement

RRM inspections and tests are shown in Table 4. The distribution of survey points is shown in Figure 4. The standard proctor test results summary, lift approval summaries, one lift approval package for RRM, and top-of-waste buyoff surveys are provided in Appendix A2.

In October 2019, revision 6 to Specification 31 00 20 Section 3.2.1 revised the minimum thickness of an average uncompacted lift from 12 to 14 inches for Interim Cover and 24 inches for RRM, and Section 3.4.1.2. to require, "When verification in-place density and moisture content tests are performed on a soil layer, a minimum of two tests shall be performed per 5,000 cubic yards of fill material placed. Compaction testing should alternate between checking compaction in the top half of each lift and the bottom half of each lift."

Table 4. RRM Inspection and Testing

Inspection or Test Type	Criteria and Method Number	RAP Specification Section or Drawing Number	RAIP Section Number	Verification Results
Visual Observation	Scarify, at a minimum, the top 1 in. of subsoil or preceding RRM lift using a footed roller or a dozer before placing subsequent RRM layers. Fill materials shall be placed in continuous and planar lifts. The method of dumping and spreading RRM shall result in loose lifts of nearly uniform thickness, with average thickness not to exceed 24 in. Compaction equipment shall consist of footed rollers or dozers. Footed rollers shall have a minimum weight of 45,000 lbs., and at least one tamping foot shall be provided for each 110 $in.^2$ of drum surface. The length of each tamping foot from the outside surface of the drum shall be at least 6 in. After lift placement, moisture content shall be maintained until the next lift is placed. Erosion that occurs in RRM layers shall be repaired and grades re-established. If freezing or desiccation occurs, the affected soil shall be reconditioned.	Specification 31-00-20 Sections 1.3.2, 3.2.1, 3.2.4, 3.5.1, and 3.5.2	6.4.2, 6.4.3	Visually verified throughout material preparation, ground preparation, and RRM placement. Documented in lift approval packages.
Laboratory Compaction Characteristics	Assessment tests shall be performed on RRM to ensure compliance with specified requirements and to develop compaction requirements for placement. Perform tests (standard proctor) in accordance with the following standards, as applicable: *ASTM D698 and D2216.	Specification 31-00-20 Section 3.1.1 And 3.4.1	6.4.3	Seven tests were performed to determine compaction characteristics.
Visual Observation	RRM shall be placed and compacted within the moisture content range needed to achieve 90% of the laboratory determined maximum dry density of each type of material. The range in moisture content shall be maintained uniform throughout each lift as necessary to achieve 90% compaction and dust control. The moisture content shall be maintained uniform throughout each lift.	Specification 31-00-20 Section 3.2.2	6.4.3	Daily observations were performed during placement.

Table 4. RRM Inspection and Testing (continued)

Inspection or Test Type	Criteria and Method Number	RAP Specification Section or Drawing Number	RAIP Section Number	Verification Results
In-place Density/ Moisture Test	Density tests must meet at least 90% of the material's maximum dry density in accordance with *ASTM D698. Perform in accordance with the following standards, as applicable: *ASTM D1556, D2216, D4643, and D6938.	Specification 31-00-20 Sections 3.2.2, 3.2.3	6.4.3	Twenty tests were performed with average in-place density of 92.9% of the laboratory-determined maximum dry density. Two lifts were approved using in-place density/moisture tests with average in-place density of 90.8% (2 tests) Four 2-foot lifts were approved using in-place density/moisture tests with average in-place density of 94.4% (18 tests)
Compaction by CBCS	QC shall monitor CBCS compaction by visually inspecting the process and reviewing the computer records for each layer of soil placed.	Specification 31-00-20 Section 3.4.1	6.4.3	422 lifts were approved using the CBCS.
Visual Observation	Each container of demolition debris shall be in the cell along with RRM. Debris shall not contain free liquids. Debris shall be sized to minimize voids. Pipes and ducts that are 6 in. or greater in diameter shall be crushed, filled, or cut.	Specification 31-00-20 Section 3.2.5	6.4.4	Debris inspections performed during debris placement. Inspections documented in lift approval packages.
Visual Inspection	Debris may be placed as a sacrificial lift at the bottom of the disposal cell in a 2-ft lift. Debris in sacrificial lifts shall contain no free liquids and shall be oriented in a manner that minimizes voids, and contained within the 2-ft lift profile. Sacrificial debris lifts are not subject to moisture and compaction criteria.	Specification 31-00-20 Section 3.2.5	6.4.4	Debris inspections performed during debris placement. Inspections documented in lift approval packages.

ASTM = ASTM International; in. = inches; in^2 = square inches; lb = pounds; lb/ft^2 = pounds per square foot; QC = quality control.
*ASTM Standard titles are included in the References (see Section 5.0).

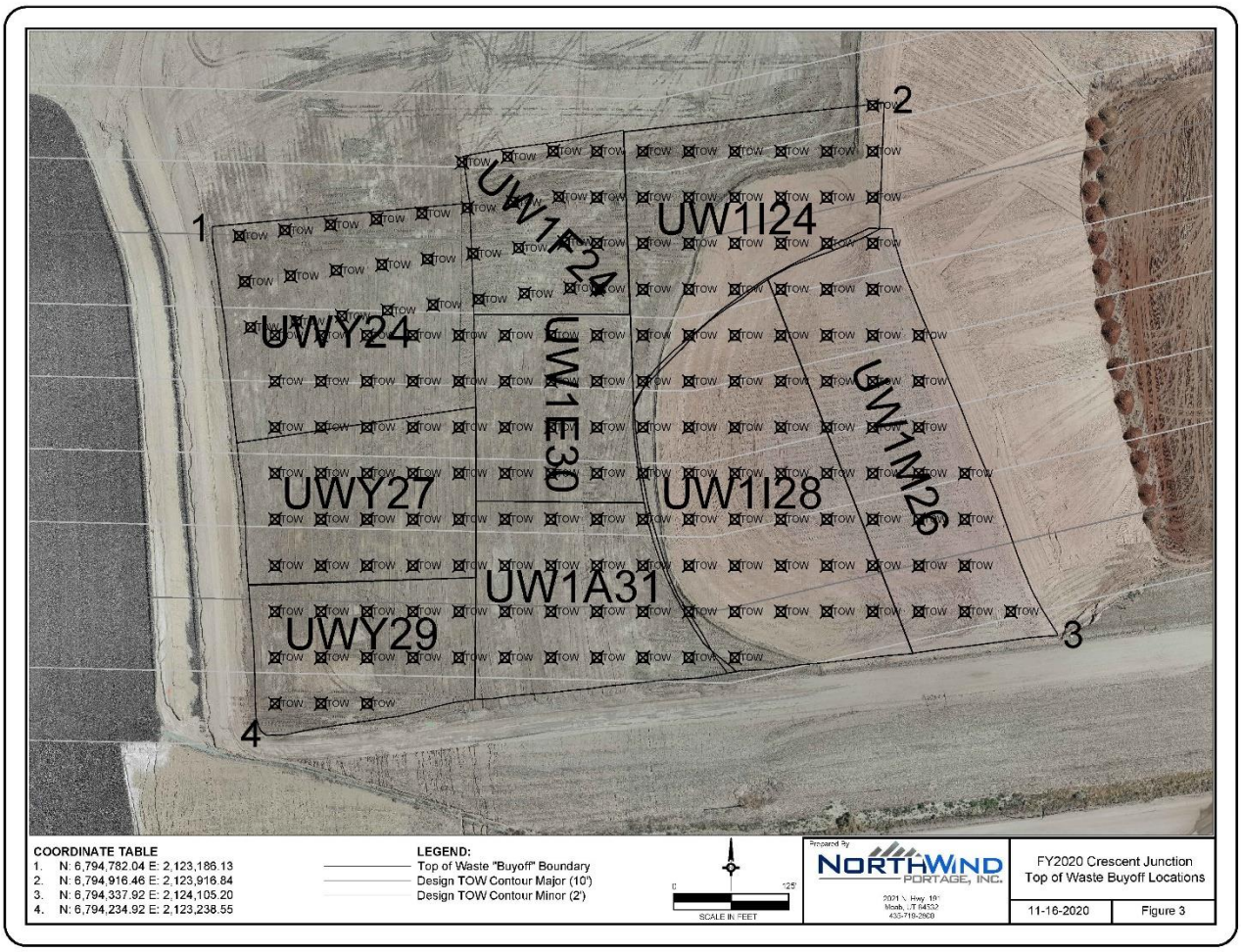

Figure 4. Distribution of Survey Points to Verify Compliance with RRM Specifications

2.4 Interim Cover

The inspection and testing for the interim cover can be found in Table 5. The distribution of survey points is shown in Figure 5. The standard Proctor test results summary, lift approval summaries, one lift approval package, and buyoff surveys for the interim cover are provided in Appendix A3.

Table 5. Interim Cover Inspection and Testing

Inspection or Test Type	Criteria and Method #	RAP Specification Section or Drawing #	RAIP Section #	Verification Results
Visual Observation	Common fill (1 ft. clean compacted): loose lifts with an average thickness not to exceed 14 in. Interim cover is placed in continuous and approximately horizontal lifts. Soil shall be free of roots, debris, and organic or frozen material. After lift placement, moisture content shall be maintained until the next lift is placed. Erosion that occurs in the RRM layers shall be repaired and grades re-established. Freezing and desiccation of the RRM shall be prevented. If freezing or desiccation occurs, the affected soil shall be reconditioned, as directed.	Specification 31-00-20 Section 3.2.1	6.5.4	Visually verified throughout material preparation, ground preparation, and interim cover placement. Documented on lift approvals.
Visual Observation	Visual inspection of the process and review of computer records.	Specification 31-00-20 Section 3.4.1	6.5	Lift approvals document the approval process.
High-Accuracy GPS Survey	The top surface of the interim cover shall be no greater than 2 in. above the lines and grades shown on the drawings. No minus tolerance will be permitted.	Specification 31-00-20 Section 3.3	6.5.5	Completed using high-accuracy GPS.
In-Place Density/ Moisture Test	Compaction and moisture content tests shall be performed in accordance with the following as applicable: ASTM D1556, D2216, D4643, and D6938.	Specification 31-00-20 Section 3.4.1	6.5.4	3 approved lifts; using in-place density/moisture testing. 22 in-place tests were performed with average density 96.4% of laboratory-determined maximum dry density.
Laboratory Compaction Characteristics	Common fill. Perform in accordance with the following as applicable: ASTM D698 and D2216.	Specification 31-00-20 Section 3.1.1	6.5.4	4 tests performed to determine compaction characteristics.

Table 5. Interim Cover Inspection and Testing (continued)

Inspection or Test Type	Criteria and Method Number	RAP Specification Section or Drawing Number	RAIP Section Number	Verification Results
Visual Observation	A smooth, non-vibratory steel-wheeled roller shall be used to produce a smooth compacted surface on the top of the completed interim cover layer, such that direct rainfall causes minimal erosion. Steel-wheeled rollers shall weigh a minimum of 20,000 lb. The final lift shall be rolled smooth with at least 3 passes of the smooth steel-wheeled roller to provide a smooth surface or proof rolled with rubber-tired construction equipment, such as a loaded dump truck or loaded scraper, with a minimum weight of 45,000 lbs. to produce a smooth compacted surface on the top of the completed interim cover layers, such that direct rainfall causes minimal erosion	Specification 31-00-20 Section 1.3.2, 1.3.3 and 3.2.4	6.5.5	Visually verified cover compaction using rubber tired construction equipment performed on the final lift of the interim cover.

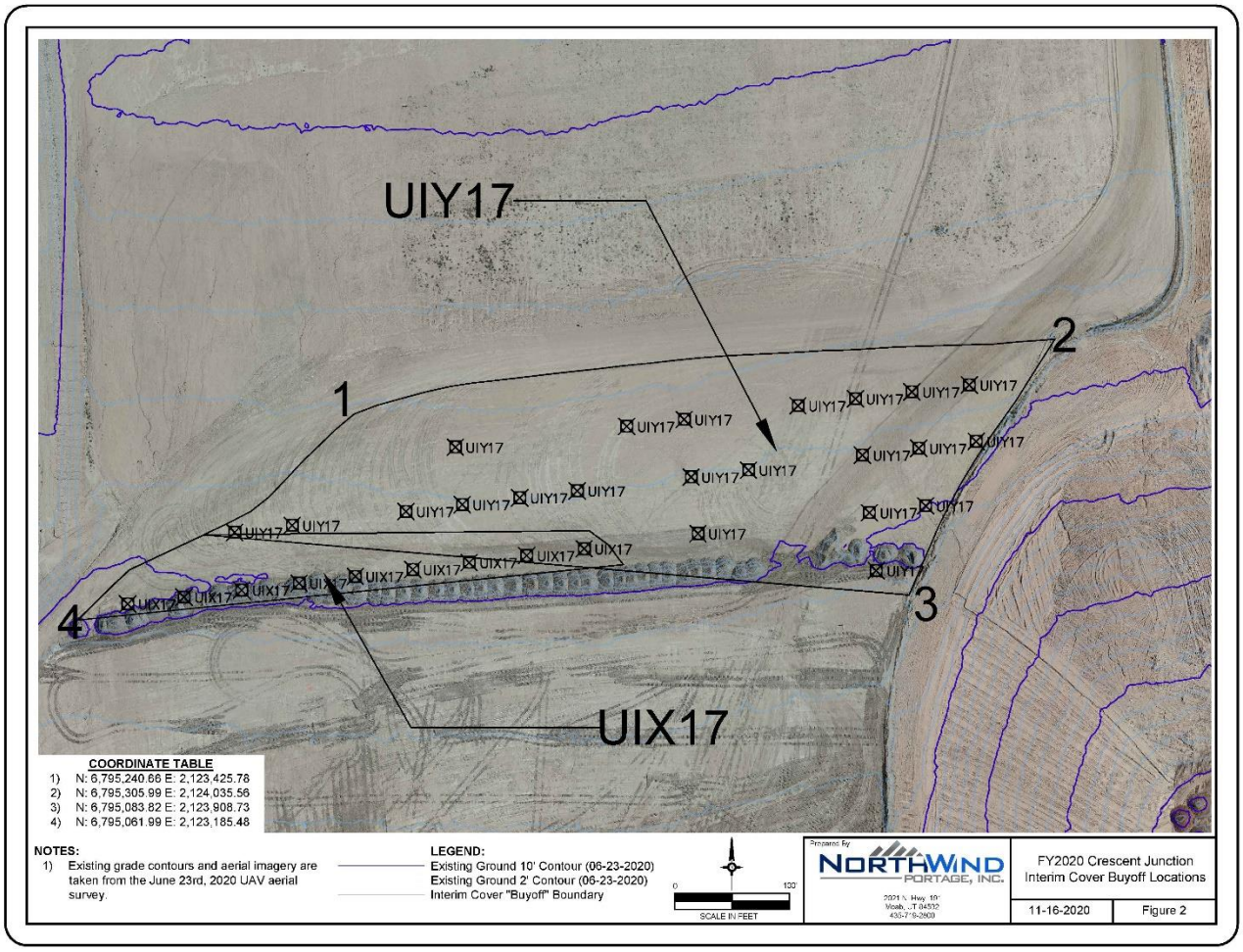

Figure 5. Distribution of Survey Points to Verify Compliance with Interim Cover Specifications

2.5 Radon Barrier

No activities associated with this material layer were conducted during this period.

2.6 Infiltration and Biointrusion Barrier

No activities associated with this material layer were conducted during this period.

2.7 Frost Protection Layer

No activities associated with this material layer were conducted during this period.

2.8 Cap Rock and Armoring

No activities associated with this material layer were conducted during this period.

3.0 Design Assessment

The disposal cell design incorporates established design criteria, drawings and specifications, and calculations, all of which are included in the RAP and in Interim Completion Report addenda.

This section discusses design criteria changes, changes to the design of the disposal cell and associated erosion control features, fulfillment of QA requirements, and compliance with permit requirements.

3.1 Design Criteria Changes

No changes to the design criteria were made during this period.

3.2 Design Changes

No changes to the design were made during the period.

3.3 QA Requirements

There were no QA requirements for design changes during this period.

QA activities were conducted in accordance with the *Moab UMTRA Project Quality Assurance Plan for the Remedial Action Contractor* (DOE-EM/GJRAC1766), which complies with:

- ASME NQA-1 2008 and addenda through 2009 consensus standard, "Quality Assurance Requirements for Nuclear Facility Applications."
- DOE Order (O) 226.1B, "Implementation of Department of Energy Oversight Policy."
- Title 10 Code of Federal Regulations Part 830 (10 CFR 830) Subpart A, "Nuclear Safety Management, Quality Assurance Requirements."
- DOE Office of Environmental Management EM-QA-001, "EM Quality Assurance Program."
- DOE O 414.1D, Admin Chg 1, "Quality Assurance."

3.4 Permits and Agreements

The Project is in compliance with permits and agreements applicable to the Crescent Junction site. The permits and agreements are summarized in Table 6.

Table 6. Crescent Junction Site Permits and Agreements

Agreement Number	Document Name or Description	Issuing Agency	Purpose
400-00177	Easement for Green River Pump Station	Utah Division of Forestry, Fire, and State Lands	ROW easement to construct and operate water pipeline in the Green River.
4P-082364-0	UDOT Encroachment Permit	UDOT	To construct waterline within UDOT 60-ft ROW and operate within 20-ft ROW for State Route 19 near City of Green River.
6-UT-06-F-014	Biological Opinion	U.S. Fish and Wildlife Service	U.S. Fish and Wildlife Service issued Biological Opinion for Green River Pump Station.
1-92-677	Green River Water Right	State Water Engineer	Gives DOE right to divert 323 acre-feet or ~200 gallons per minute from Green River for Crescent Junction disposal site.

Table 6. Crescent Junction Site Permits and Agreements (continued)

Agreement Number	Document Name or Description	Issuing Agency	Purpose
DE-RO01-06GJ68009	Access Roadway Contract and Grant of Easement	Private Owner	Perpetual easement and ROW for construction of an access roadway and related utilities at the disposal site.
ESMT 463	Waterline Easement	SITLA	Easement across state land for potable waterline.
Folder No. 02392-96	Pipeline Crossing Agreement	Union Pacific Railroad	Agreement grants right to construct, maintain, and operate one underground waterline and access for phone line and 1.5-in. conduit across Union Pacific Railroad's property at mile post 533.2, Green River Subdivision.
Folder No. 02399-44	Pipeline Crossing Agreement	Union Pacific Railroad	Agreement grants right to construct, maintain, and operate one underground waterline and access for phone line and 1.25-in. conduit at mile post 0.25, Cane Creek Subdivision, Thompson Springs, for the disposal site.
Folder No. 2537-02	Industrial Track Contract	Union Pacific Railroad	Covers construction, maintenance, and operation of 5,209-ft Track A, 3,524-ft Track B, and 617-ft Track C at mile post 533.21, Green River Subdivision line.
Property No. 70-4; 189A: AEQ	Easement	UDOT	Easement for waterline across UDOT property near Floy Wash that allows 60-ft construction ROW and 20-ft permanent ROW.
Public Land Order 7697	Permanent Land Transfer	BLM	Order permanently transferred 500 acres of BLM public domain land to DOE for disposal cell.
REEMCBCDOE-3-15-0702	Real Estate License	Rocky Mountain Power	Power line extension to dump ramp.
REEMCBCDOE-6-08-0302	Waterline Easement	Grand County	Easement within County Road 175 or old Highway 6 and 50 and Hastings Lane ROWs to construct waterline within 60-ft ROW and operate within 20-ft ROW.
REEMCBCDOE-6-08-0304	Waterline Easement	Private Owner	Easement across private land near the Green River to construct waterline within 60-ft ROW and operate within 20-ft ROW and pump station.
REEMCBCDOE-6-08-0308 SITLA No. 1345	Waterline Easement	SITLA	Easement to construct waterline within 60-ft ROW and operate within 20-ft ROW on three parcels of SITLA land near Green River and Crescent Junction.
REEMCBCDOE-6-08-0309	Waterline Easement	City of Green River	Easement to construct waterline within 60 ft. of County Road 175 or old Highway 6 and 50 ROWs within Green River city limits and operate within 20-ft ROWs.

Table 6. Crescent Junction Site Permits and Agreements (continued)

Agreement Number	Document Name or Description	Issuing Agency	Purpose
REEMCBCDOE-6-12-0302	Waterline Easement	Private Owner	Permanent easement across private land near Crescent Junction to construct waterline within 60-ft ROW and operate within 20-ft ROW.
REEMCBCDOE-7-15-0104	Access Agreement	Private Owner	For installation and maintenance of air monitoring equipment and collection of air quality data for monitoring station MPS-0306.
REEMCBCDOE-7-15-0106	Access Agreement	Private Owner	For installation and maintenance of air monitoring equipment and collection of air quality data for monitoring station MPS-0307.
Resolution 2006-2741	Grand County Council Resolution	Grand County	Approves conditional use permit for the Project.
Statewide Utility License Agreement No. 8439	Utility License	UDOT	License with state of Utah to construct waterline across UDOT property.
U.S. DOT No. 050217 551 021ZB	Hazardous Materials Certificate of Registration	U.S. DOT	For shippers of hazardous materials through 06/2020.
U.S. DOT-SP 14283	Special Permit	U.S. DOT	Permit to transport mill tailings from Moab site to the disposal site.
UTR359187	Storm Water Permit	Utah Division of Water Quality	To limit the discharge of pollutants from disposal cell construction activities.
UT-SES-GR-17001	MOU	Utah Dept. of Natural Resources and BLM	MOU outlines terms and conditions for helicopter use of pond for wildland fire fighting.
UTU-83354	Waterline ROW	BLM Moab Field Office	For construction of 14.5 miles of waterline on BLM land from Green River to disposal site.
UTU-83396	Utility ROW	BLM Moab Field Office	For buried telephone line at the disposal site.
UTU-83450	Utility ROW	BLM Moab Field Office	ROW for power line to the disposal site.
Not assigned	Memorandum of Agreement	BLM Moab Field Office	Between DOE and BLM for management of existing uses on lands withdrawn in conjunction with the Project.
Not assigned	Water Use Agreement	Thompson Special Service District	Water use agreement among Thompson Special Service District in Grand County, Crescent Junction Properties, Inc., and DOE to install potable waterline from Thompson Springs, Utah, to the disposal site.

BLM = U.S. Bureau of Land Management; ft = feet; in. = inches; MOU = Memorandum of Understanding; ROW = right-of-way; SITLA = School and Institutional Trust Lands Administration; UDOT = Utah Department of Transportation; U.S. DOT = U.S. Department of Transportation.

4.0 Remedial Action Assessment

This section describes pre-excavation site conditions, construction activities, and verifications performed at the Crescent Junction disposal site.

4.1 Pre-excavation Site Conditions

Pre-excavation site conditions were discussed in Addendum A of the *Moab UMTRA Project Crescent Junction Disposal Cell Interim Completion Report* (DOE-EM/GJRAC2040-A).

4.2 Cell Construction

Cell construction during this period included four major activities:

- Excavation of soils to the design depth to ensure a competent surface for placement of RRM.
- Placement of RRM to the design thickness, and assuring that the radium-226 (Ra-226) activity in the upper 7 feet (ft.) of placed material does not exceed design criteria.
- Placement of Interim Cover to the design thickness.
- Construction of the spoils embankment.

The *Moab UMTRA Project Lift Approval Procedure* (DOE-EM/GJRAC1803) was used to ensure that the material placed met the compaction criteria. Descriptions of compaction equipment used during the above cell construction activities are provided in Table 7.

Each activity performed as part of this Addendum is further described in the following subsections. Photographs representative of the cell construction activities are included in Appendix B.

Table 7. Compaction Equipment Used during Cell Construction

Compaction Equipment	Machine Weight (lbs.)	Equipped with CBCS	Material Layer						
			RRM	Interim Cover	Radon Barrier	Infiltration and Biointrusion Barrier	Frost Protection	Perimeter Embankment	Spoils Embankment
CAT 825H Soils Compactor	69,000	X	X						
CAT D8 Bulldozer	84,850	X	X						
Komatsu 275AX Bulldozer	112,466	X	X						
CAT D6 Bulldozer	34,361			X					
CAT 140G Road Grader	27,822			X					

CAT = Caterpillar; lbs. = pounds

4.2.1 Excavation
The disposal cell is being excavated in phases. Excavation of the last portion of Phase 3 began in September 2020. Approximately 219,180 yd^3 have been excavated through September 30th; excavated material was used to construct the Spoils Wedge.

4.2.2 Perimeter Embankment Construction
There were no perimeter embankment construction activities during this period.

4.2.3 RRM Placement
Placement of RRM in the disposal cell continued east from the placement area previously reported in Addendum I of the *Moab UMTRA Project Crescent Junction Disposal Cell Interim Completion Report* (DOE-EM/GJ2040-I). The RRM was loaded into dump trucks and driven to the placement area, where it was spread for compaction using a bulldozer. A Caterpillar (CAT) 825H soils compactor, CAT D8 bulldozer, and Komatsu 275AX bulldozer were used to compact the RRM in place.

4.2.4 Cover and Rock Armoring Placement
There were no cover or rock armoring activities during this period.

4.2.5 Spoils Embankment Construction
Material excavated on site was used to create a spoils embankment, or wedge, between the northern side of the cell and the Book Cliffs mountain range. The spoils embankment helps control drainage of storm water around the cell perimeter.

The inspection and testing for the spoils embankment can be found in Table 8. The standard proctor test results summary, lift approval summary, and one lift approval package for the spoils embankment are provided in Appendix A8.

Table 8. Spoils Embankment Inspection and Testing

Inspection or Test Type	Criteria and Method Number	RAP Specification Section or Drawing Number	RAIP Section Number	Verification Results
Visual Observation	Common fill: fill material is placed in continuous and approximately horizontal lifts. The method of dumping and spreading material shall result in loose lifts of nearly uniform thickness, not to exceed 12 in. Compaction: embankment fill shall be compacted with rollers, equipment tracks, or successive passes of scrapers with a minimum 45,000-lbs. static weight. Fill material shall be properly moisture conditioned near optimum moisture content levels.	Specification 31-00-00 Section 3.11.1.2	6.3.5	Visual inspection performed throughout placement to verify compaction and lift thickness. Compaction performed using a CAT 631G scraper. Thickness was visually verified. Each lift was documented.

Table 8. Spoils Embankment Inspection and Testing (continued)

Inspection or Test Type	Criteria and Method Number	RAP Specification Section or Drawing Number	RAIP Section Number	Verification Results
Laboratory Compaction Characteristics	Common fill: spoil material shall be tested to determine maximum dry density, and the moisture content shall be modified to bring fill to near optimum for compaction. Perform in accordance with the following as applicable: *ASTM D698.	Specification 31-00-00 Section 3.11.1.2	6.3.5	Eleven tests performed to determine compaction characteristics.
In-place Density/ Moisture Test	One test per 100,000 ft^2 or 3,700 yd^3 of material placed for material compacted by other than hand-operated machines. One test per 500 ft^2, or fraction thereof, of each lift of fill or backfill areas for material compacted by hand-operated machines. Common fill: Density tests must meet at least 90% of the material's maximum dry density in accordance with ASTM D698. 90% of a standard proctor. Perform in accordance with the following as applicable: *ASTM D1556, D2216, D4643, and D6938	Specification 31-00-00 Section 3.14.1.2	6.3.5	Eighty in-place density/moisture tests performed with an average density of >94.7% of the laboratory-determined maximum dry density.
Moisture Correlation Test	One correlation test for moisture every 20 tests per *ASTM D6938 will be performed in accordance to ASTM D2216 or D4643.	Specification 31-00-00 Section 3.14.2	6.3.5	Three moisture correlation tests performed, meeting requirements.
Laboratory Compaction Characteristics	Perform laboratory density and moisture content tests for each type of fill material to determine the optimum moisture and laboratory maximum density values. One representative density test per material type and every 20,000 yd^3, thereafter, or when any change in material occurs that may affect the optimum moisture content or laboratory maximum dry density. Perform in accordance with the following as applicable: *ASTM D698 and D2216.	Specification 31-00-00 Section 3.14.3	6.3.5	Eleven tests performed to determine compaction characteristics.

ASTM = ASTM International; ft^2 = square feet, GPS = global positioning system; in. = inches; lbs. = pounds.

4.3 Soil Compaction and Testing

Initial CBCS compaction setup and verification is documented in Crescent Junction *Interim Completion Report* Addendum H. The CBCS compaction is periodically verified by performing in-place tests using a nuclear density gauge manufactured by Troxler Electronic Laboratories, Inc., following ASTM methods and in compliance with the RAIP. The individual nuclear density tests verify that the compaction achieved with the CBCS is greater than or equal to the required 90 percent. The CBCS compaction results are compared to the nuclear density gauge results in Table 3.

4.4 Lift Approval

The *Lift Approval Procedure* and Addenda B and E of the RAP were followed to verify that each lift met established criteria. Results of lifts are documented in lift approval packages. A sample lift approval package for RRM placed during this Report period is provided in Appendix A.

4.5 Geotechnical Testing

The RAIP describes methods and frequencies for performing tests to verify that material placed in the cell meets the requirements. Geotechnical tests fall within two general categories: soils testing and aggregate testing. The *Moab UMTRA Project Moisture/Density Testing Procedure* (DOE-EM/GJRAC1783) provides requirements and methods for the proper moisture/density testing of soils placed in the cell. Only soils testing was used during this Addendum period, as described below.

4.5.1 Soils Testing

Laboratory and/or field soils geotechnical tests were conducted on every lift of each material layer placed to support verification that specified compaction requirements were met. Test requirements varied depending on whether the CBCS was used for demonstrating compaction. Because the soils in the RRM can vary in composition, compaction curves were developed to determine the maximum dry density and optimum moisture content for that material to achieve compaction.

Results of tests conducted are shown in the standard proctor test results summary tables included in Appendix A. Over time, the RRM was found to have a consistent soil type, so the need for sets of standard proctor tests was eliminated, and standard proctors were completed in the frequency required by the RAIP. The tables also summarize the tests performed to determine soil type and geotechnical properties.

Material is compacted to meet 90 percent of the laboratory-determined maximum dry density in accordance with ASTM D698. The thickness of each lift was surveyed and verified using a high-accuracy GPS, when practical; otherwise, manual measurements were taken.

4.5.2 Aggregate Testing

There were no aggregate testing activities during this period.

4.6 Radiological Verification

Section 5 of the Remedial Action Selection Report of the RAP, *Radon Attenuation*, identifies two primary verification criteria associated with construction of the disposal cell: radium-226 (Ra-226) measurements in RRM placed in the upper 7 ft., and radon flux measurements to verify the integrity of the radon barrier. Addendum A of this Report provides an explanation of this verification process.

During this Addendum period, 364 samples of RRM were taken in 13 lifts in the upper 7 ft. of the disposal cell. The Ra-226 activity of the material ranged from 242 to 548 picocuries per gram (pCi/g). Table 9 shows the average results for material placed in each lift tested.

Table 9. Results of Ra-226 Activity in Upper 7 Feet of Placed RRM

Lift Identification No.	Samples Taken	Lift Average (pCi/g)	Lift Area (m^2)
UWY24	28	313	5785
UWY27	28	313	3986
UWY29	28	270	3372
UW1F24	28	267	2952
UW1E30	28	244	3269
UW1I28	28	503	2452
UW1M26	28	548	6991
UW1A31	28	242	4357
UW1I24	28	548	5047
UWY23	28	308	3479
UWZ20	28	320	5230
UWB18	28	242	5260
UW1K21	28	548	7100

4.7 QA Requirements

QA activities were conducted in accordance with documents identified in Section 3.3. During construction activities, surveillances and assessments were performed by the RAC to verify and ensure that these activities were performed in accordance with established plans, drawings, instructions, procedures, specifications, and other applicable documents.

In addition, the Technical Assistance Contractor (TAC) supports the DOE in the assessment of the RAC.

During the period of this Addendum, multiple oversight inspections, one management assessments, and three assessments were performed (see Table 10). Corrective actions are developed to address any deficiencies identified during the assessments.

Table 10. Inspections and Assessments Conducted during Construction

Date	Conducted By	Type	Assessment Number	Scope
11/25-27/19, 12/2-5/19 and 3/11/20	TAC	Assessment	DOE-20-A-002	Evaluate the sample verification process utilized to meet Final Remedial Action Plan (RAP) requirements for ensuring that the radium activity in the upper seven feet of the disposal cell does not exceed 707 pCi/g
08/20/2020	RAC	Management Assessment	MA-20-020	Evaluate the implementation and effectiveness of the Moab UMTRA Project Quality Control (QC) Operations and implementing procedures
8/31/2020	RAC	Assessment	MB-20-A-015	Evaluate and verify proper implementation of Disposal Cell Operations
April 2020 – June 2020	TAC	Assessment	DOE-20-MA-023	Survey planned cell excavation area to verify absence of the Western Burrowing Owl (Utah Sensitive Species) prior to excavation

Table 10. Inspections and Assessments Conducted during Construction (continued)

Date	Conducted By	Type	Assessment Number	Scope
Daily/Weekly	DOE/TAC	Oversight	NA	Operational awareness oversight "boots-on-the-ground": conducted to verify compliance to Project/contractual requirements including Remedial Action Plan specifications

ISMS = Integrated Safety Management System.

4.8 Monitoring Free Liquid Presence

Table 11 provides the results of the standpipe (location shown on Figure 6) monitoring for the presence of free liquids in the disposal cell. During this reporting period no water was present in the standpipe, and no additional standpipes were installed during this period.

Table 11. Monitoring Results for the Presence of Fluids in Standpipe 01

Date Monitored	Presence or Level of Fluids (ft)
02/26/20	Dry
06/25/20	Dry
09/21/20	Dry

Dry = no fluids present.

4.9 Monitoring Groundwater Presence

In addition to monitoring the standpipe, monitoring wells 0202, 0203, 0205, and 0210 (Figure 6) were also checked for the presence of groundwater. These results are presented in Table 12. Groundwater has consistently been detected in wells 0202 and 0205 since June 2019 and June 2015, respectively. Wells 0203 and 0210 were dry throughout this Report period.

Table 12. Monitoring Results for Presence of Groundwater

Date Monitored	Monitor Well Number			
	0202	0203	0205	0210
10/22/19	DTW = 49.37 TD = 63.05	-	DTW = 47.70 TD = 70.36	-
02/26/20	DTW = 49.27 TD = 61.11	Dry TD = 61.46	DTW = 46.90 TD = 70.16	Dry TD = 54.85
06/25/20	DTW = 49.47 TD = 60.68	Dry TD = 61.12	DTW = 46.61	Dry TD = 54.58
09/21/20	DTW = 49.96 TD = 61.00	Dry TD = 61.45	DTW = 46.90 TD = 70.04	Dry TD = 54.82

Notes: All measurements are feet below top of casing, Dry = no fluids present; DTW = depth to water; TD = total depth; Wells 0203 and 0210 not checked in October 2019; TD not measured for well 0205 on 06/25/20

As part of the quarterly monitoring, a sample may be collected of any water present in sufficient quantity and submitted to a laboratory for analysis of various anions, cations, inorganics, and radionuclides. During this reporting period, two groundwater samples (one from well 0202 and the other from well 0205) were collected in February 2020. All water quality data are presented and discussed in the *Moab UMTRA Project Groundwater and Surface Water Monitoring Report July through December 2019* (DOE-EM/GJTAC3011) and the *Moab UMTRA Project Groundwater and Surface Water Monitoring Report January through June 2020* (DOE-EM/GJTAC3043).

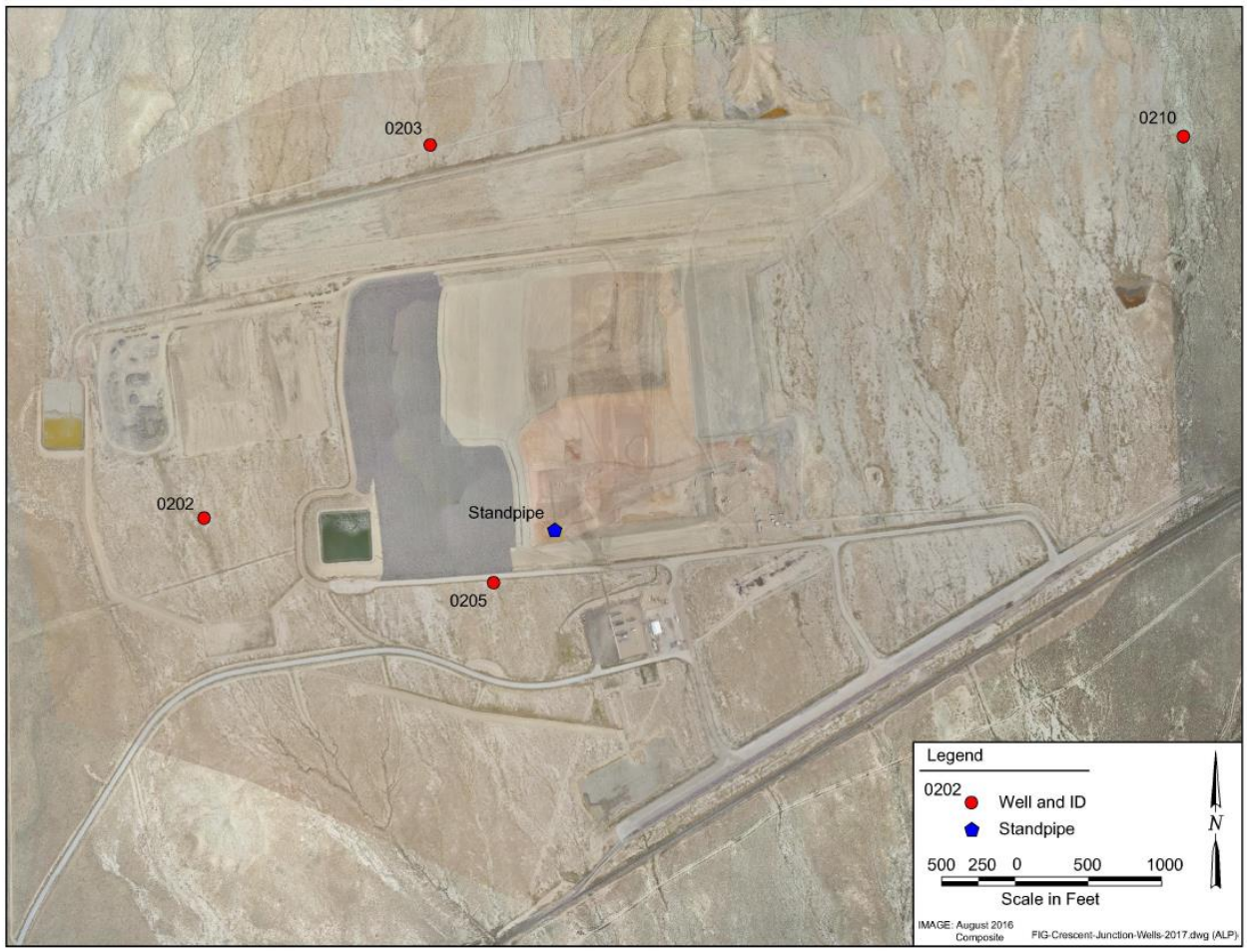

Figure 6. Locations of Monitoring Wells and Standpipe

Two short-term recovery tests (one from well 0202 and one from 0205) were completed to determine the water source and recharge rates. Analysis of the October 2019 recovery data collected from well 0202 indicated the recharge rate was only 0.002 gpm, which indicates the well slowly recharges after groundwater is withdrawn from the well. Based on the results of the well 0205 test completed in February 2020, the recharge rate was 0.036 gpm, which is within the historical range of recharge rates measured at this location.

Water level, precipitation, and recovery test data along with the analytical results continue to suggest that the groundwater source is surface runoff flowing off the cover, and not associated with leakage from the disposal cell.

5.0 References

10 CFR 830 Subpart A (Code of Federal Regulations), "Nuclear Safety Management, Quality Assurance Requirements."

ASME (American Society of Mechanical Engineers), Nuclear Quality Assurance (NQA)-1 2008 and addenda through 2009 consensus standard, "Quality Assurance Requirements for Nuclear Facility Applications (QA)."

ASTM (ASTM International) Standard D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort."

ASTM Standard D1556, "Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method."

ASTM Standard D2216, "Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass."

ASTM Standard D4643, "Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating."

ASTM Standard D6938, "Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)."

DOE (U.S. Department of Energy), *Moab UMTRA Project Crescent Junction Disposal Cell Interim Completion Report*, Addendum A (DOE-EM/GJRAC2040-A).

DOE, *Moab UMTRA Project Crescent Junction Disposal Cell Interim Completion Report*, Addendum I (DOE-EM/GJRAC2040-I).

DOE, *Moab UMTRA Project Final Remedial Action Plan and Site Design for Stabilization of Moab Title I Uranium Mill Tailings at the Crescent Junction, Utah, Disposal Site,* Addendum E, *Remedial Action Inspection Plan* (DOE-EM/GJ1547).

Moab UMTRA Project Groundwater and Surface Water Monitoring Report July through December 2019 (DOE-EM/GJTAC3011)

Moab UMTRA Project Groundwater and Surface Water Monitoring Report January through June 2020 (DOE-EM/GJTAC3043)

DOE, *Moab UMTRA Project Lift Approval Procedure* (DOE-EM/GJRAC1803).

DOE, *Moab UMTRA Project Moisture/Density Testing Procedure* (DOE-EM/GJRAC1783).

DOE, *Moab UMTRA Project Quality Assurance Plan for the Remedial Action Contractor* (DOE-EM/GJRAC1766).

DOE Office of Environmental Management, "EM Quality Assurance Program" (EM-QA-001).

DOE, Order 226.1B, "Implementation of Department of Energy Oversight Policy."

DOE, Order 414.1D, Admin Chg 1, "Quality Assurance."