DOE–EM/GJRAC2040-C

Office of Environmental Management – Grand Junction

UMTRA Project

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

Revision 1

January 2014

U.S. Department of Energy

Office of Environmental Management

Prepared by the Remedial Action Contractor Contractor under contract number DE-DT0002936
for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

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Review and Approval

Kathy Turvy — 1/21/2014
Kathy Turvy — Date
RAC Quality Assurance/Quality Control Manager

1-21-2014
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RAC Project Manager

In concurrence:

1-22-2014
Donald R. Metzler — Date
DOE Moab Federal Project Director

Revision History

Revision No.	Date	Reason/Basis for Revision
0	December 2013	Initial issue.
1	January 2014	Revisions include clarification of content in various sections.

Contents

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Tables

Appendices

Attachment

Acronyms and Abbreviations

CAES	Computer Aided Earthmoving System
DOE	U.S. Department of Energy
DOE O	DOE Order
ft	foot/feet
NQA	Nuclear Quality Assurance
NRC	U.S. Nuclear Regulatory Commission
pCi/g	picocuries per gram
QA	quality assurance
QAP	Quality Assurance Plan
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 Contract or Contractor
UMTRA	Uranium Mill Tailings Remedial Action
yd^3	cubic yards

Executive Summary

This Interim Completion Report Addendum C documents the construction of a portion of a 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 millsite 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 that are referenced in a Final Completion Report that will be prepared to address the entire cell construction.

This Addendum C addresses activities performed by Portage, Inc., the DOE Remedial Action Contractor (RAC) for the Moab Project, from October 1, 2012, through September 30, 2013, and includes placement of 392,121 cubic yards (yd^3) of RRM and placement of 7,473 yd^3 of interim cover materials. Disposal operations were curtailed from December 1, 2012, through March 6, 2013.

This Addendum C 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* (DOE-EM/GJ1547). The *Final Remedial Action Plan* (RAP) received conditional concurrence from the U.S. Nuclear Regulatory Commission (NRC). 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 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 southeastern 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 is 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 be generally rectangular and will encompass approximately 230 acres. Figure 2 shows general features of the Crescent Junction site.

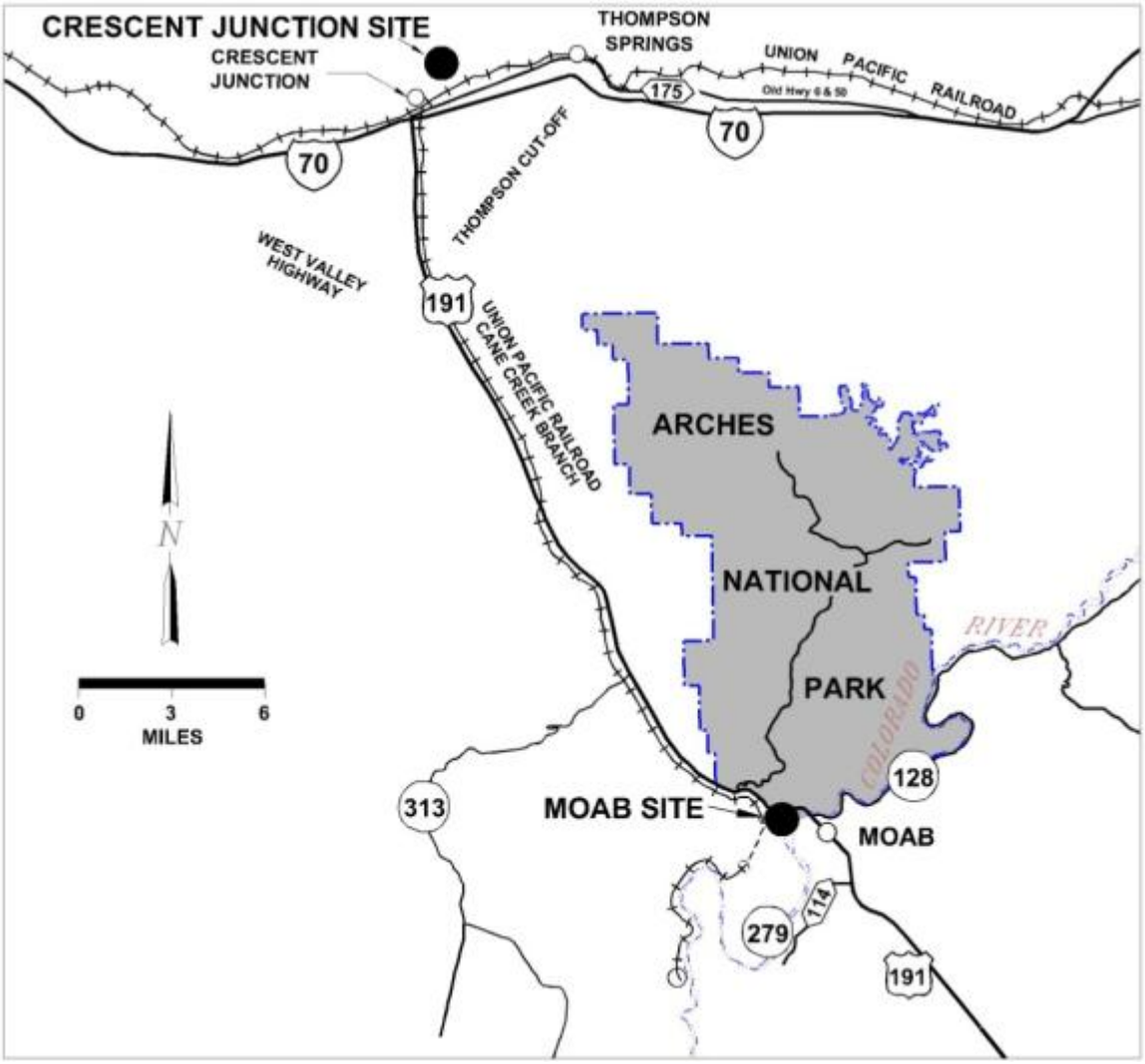

Figure 1. Location of Moab and Crescent Junction Sites

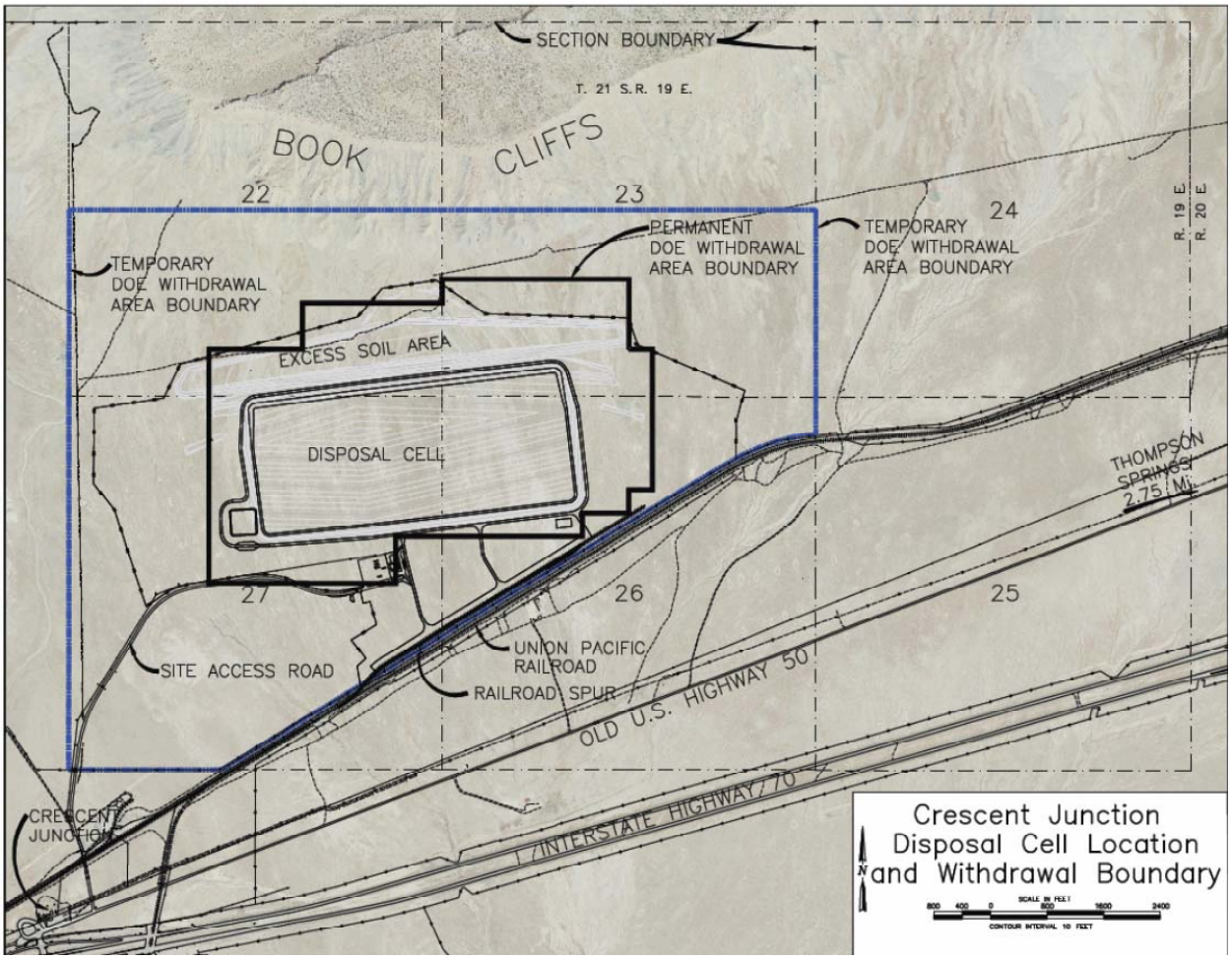

Figure 2. Crescent Junction Site Features

This Addendum C of this Interim Completion Report also documents activities performed by the RAC for the Project from October 1, 2012, through September 30, 2013.

Addendum C 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 to the design requirements in the RAP.
- Section 4.0 provides verification that placement of RRM and interim cover were 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 placement of RRM and interim cover.
- Attachment 1 contains revised procedures associated with RRM placement.

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 interim cover placement as appropriate for the report period. The tables reference the criteria and material-testing procedures used to verify that the cell excavation and placement of each type of material was performed in accordance with design specifications or drawings and with the RAP Addendum E, "Remedial Action Inspection Plan" (RAIP). The distribution survey associated with each material type is also included in this section, as appropriate.

Information regarding total lifts of compacted material, tests performed, and geotechnical data is outlined in Table 1. Additional geotechnical data are located in Appendix A.

Table 1. Lifts/Testing Totals

	Total Volume Placed (yd^3)	Total Number of Lifts Approved	Lifts Approved Using CAES	Lifts Approved Not Using CAES	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 CAES Passes that Meet Compaction Criteria (%)	Total Number of Soil Classifications	Total Number of Durability Tests	Total Number of Gradation Tests
Cell-perimeter Embankment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RRM	392,121	284	281	3	54	15	92.6	98.3	NA	NA	NA
Interim Cover	7,473	4	0	4	0	4	95.3	NA	NA	NA	NA
Radon Barrier	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Infiltration and Biointrusion Barrier	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Frost-protection Layer	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-in. Cap Rock	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

CAES = Computer Aided Earthmoving System; in. = inch; NA = not applicable

2.1 Cell Excavation

No cell-excavation activities were conducted during this period.

2.2 Perimeter Embankment

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

2.3 RRM

2.3.1 Computer Aided Earthmoving System Performance Verification Testing

The Project utilized machines equipped with a Computer Aided Earthmoving System (CAES) to meet RRM-compaction requirements as specified in Section 6.4.3 of the RAIP. Additional information about the CAES-verification testing is provided in Section 4.3 of this Addendum. The RAIP also requires periodic verification of the CAES compaction by comparing the results to in-place, nuclear density-gauge test results. Table 2 shows the results of the comparison tests performed during this report period.

Table 2. CAES Performance-verification Testing

Lift ID Number	Test Performance Date	In-place Density Compaction (%)	Lift Area Meeting CAES Compaction Criteria (%)
UW1A12121011-00	10/18/12	91.9	99.3
UW1E08130327-00	03/28/13	91.2	97.9
UWY01130328-00	03/28/13	90.2	99.3
UW1A05121128-00	04/04/13	93.0	96.1
UW1C08130409-00	04/09/13	97.8	98.0
UW1A12121114-00	04/10/13	92.6	98.9
UW1D01130408-00	04/11/13	93.3	96.0
UW1D19121128-00	04/18/13	95.8	97.6
UW1E08130919-00	09/19/13	91.4	96.9

2.3.2 RRM Placement

RRM inspections and tests are shown in Table 3. The distribution of survey points is shown in Figure 3. The standard proctor test-results summary, lift-approval summaries, one lift-approval package, and the top-of-waste buyoff survey for the RRM are provided in Appendix A2.

Table 3. RRM Inspection and Testing

Inspection or Test Type	Criteria and Method Number	RAP Specification Section or Drawing #	RAIP Section #	Verification Results
Visual Observation	At a minimum, scarify the top 1 in. of subsoil or preceding RRM lift, using a footed roller or a dozer, before placement of subsequent RRM layers. Fill material is placed in continuous and planar lifts. The method of dumping and spreading RRM shall result in loose lifts. Average thickness of fill area is not to exceed 12 in. Dozers shall have a minimum ground pressure of 1,650 lb/ft^2. Compaction equipment shall be footed rollers or dozers. Footed rollers shall have a minimum weight of 45,000 lb and at least one tamping foot 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 the RRM layers shall be repaired and grades re-established. If freezing or desiccation occurs, the affected soil shall be reconditioned, as directed.	Specification 31-00-20 Sections 1.3.2, 3.2.1, and 3.2.4	6.4.2	Documented on 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	6.4.3	54 tests were performed to determine compaction characteristics.
Sand-cone and Moisture-correlation Test	Companion sand-cone tests and moisture tests must be performed with nuclear tests until a sufficient number have been performed to demonstrate a clear correlation. Perform in accordance with the following standards, as applicable: *ASTM D1556, D2216, and D4643.	Specification 31-00-20 Section 3.4.1	6.4.3	Sand-cone and moisture tests performed for correlation.
Moisture Test	Fill material is properly moisture conditioned. Optimum moisture content is ±3%. Perform in accordance with the following standards, as applicable: *ASTM D4643, D4944, and D4959.	Specification 31-00-20 Section 3.4.2	6.4.3	Moisture tests performed daily and documented in lift-approval packages.

Table 3. RRM Inspection and Testing (continued)

Inspection or Test Type	Criteria and Method Number	RAP Specification Section or Drawing #	RAIP Section #	Verification Results
In-place Density/ Moisture Test	Must meet 90% of maximum dry density standard proctor. Optimum moisture content is ±3%. Perform in accordance with the following standards, as applicable: *ASTM D1556, D2216, D4643, and D6938.	Specification 31-00-20 Section 3.2.2	6.4.3	284 lifts were approved; 3 lifts were approved using in-place density/moisture testing; 15 tests were performed with average in-place density of 92.6%, the laboratory-determined maximum dry density.
Compaction by CAES	QC shall monitor CAES 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	281 lifts were approved using CAES.
High-accuracy GPS	The top surface of the RRM shall be no greater than 2 in. above the lines and grades shown on the drawings and verified by survey or the use of the CAES. No minus tolerance is permitted.	Specification 31-00-20 Section 3.3	6.4.5	Completed using high-accuracy GPS. See Appendix A2 for top-of-waste survey.

ASTM = ASTM International; ft^2 = square feet; GPS = global positioning system; 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 section.

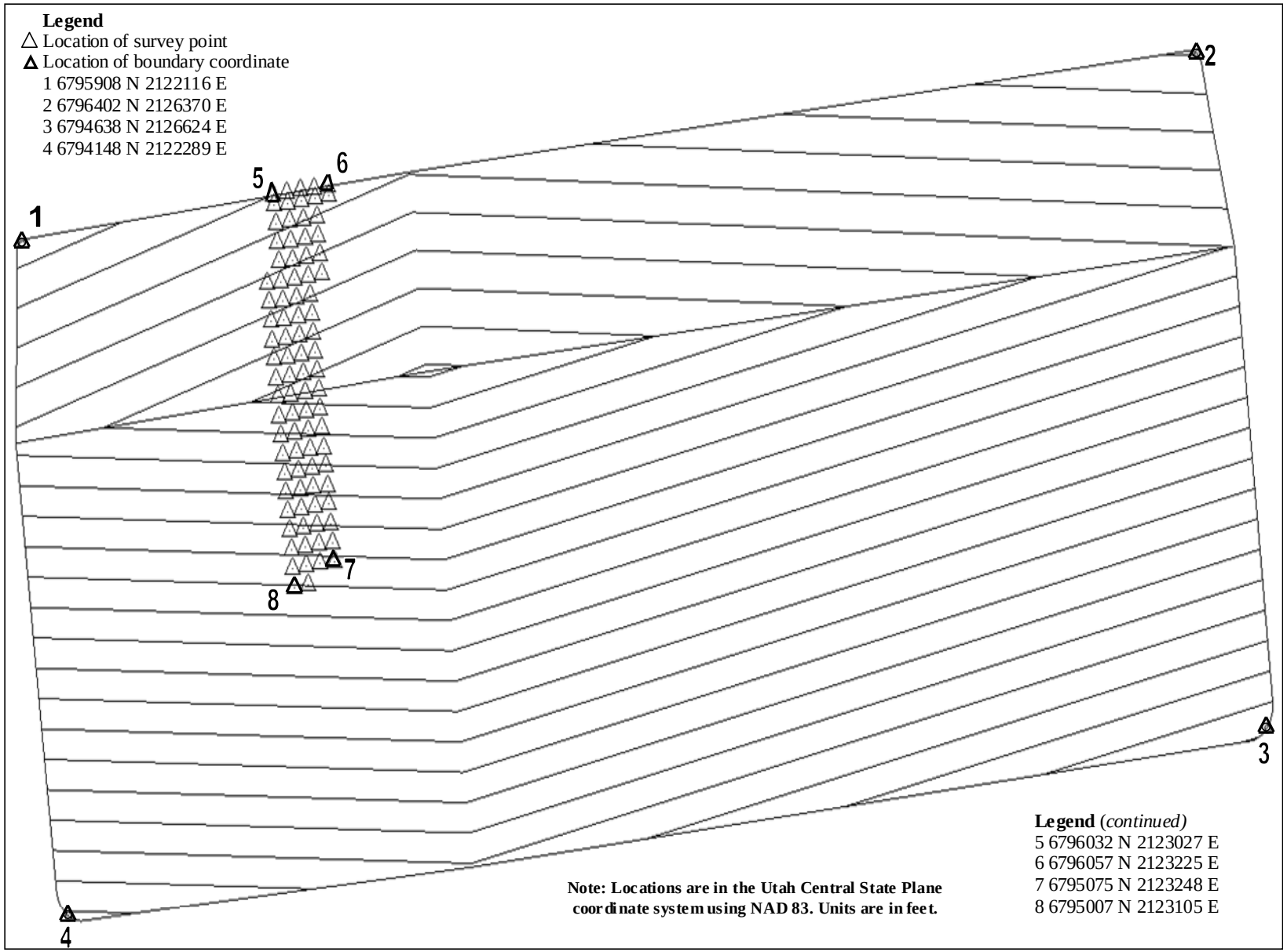

Figure 3. Distribution of Survey Points to Verify Compliance with RRM Placement Specifications

2.4 Interim Cover

The inspection and testing for the interim cover is shown in Table 4. The CAES was not used for compaction of interim cover lifts; therefore, inspections and associated criteria for the CAES are not included in the table. The distribution of survey points is shown in Figure 4. 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 4. Interim Cover 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 (1 ft clean compacted): loose lifts with an average thickness not to exceed 12 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 in lift-approval packages.
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 is permitted.	Specification 31-00-20 Section 3.3	6.5.5	Completed using high-accuracy GPS.
In-place Density/ Moisture Test	Common fill: 90% of maximum dry density standard proctor test. Optimum ±5%. Perform in accordance with the following standards, as applicable: *ASTM D1556, D2216, D4643, and D6938.	Specification 31-00-20 Section 3.4.1	6.5.4	The soils used were of the same character as materials previously tested; therefore, previous standard proctor test results were used. Four approved lifts using in-place density/ moisture testing. Four in-place tests were performed with an average density 95.3% of laboratory-determined maximum dry density.

Table 4. 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
Sand-cone and Moisture-correlation Test	Companion sand-cone tests and moisture tests must be performed with nuclear tests until a sufficient number have been performed to demonstrate a clear correlation. Perform in accordance with the following standards, as applicable: *ASTM D1556, D2216, and D4643.	Specification 31-00-20 Section 3.4.1	6.5.4	Sand-cone and moisture-correlation testing performed.
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 three passes of the steel-wheeled roller or proof rolled with rubber-tired construction equipment, such as a loaded dump truck or loaded scraper with a minimum weight of 45,000 lb.	Specification 31-00-20 Section 1.3.3 and 3.2.4	6.5.5	Visually verified cover compaction using rubber-tired construction equipment or a smooth drum roller performed on the final lift.

ASTM = ASTM International; ft = foot; GPS = global positioning system; in. = inches; lb = pounds; QC = quality control
*ASTM Standard titles are included with References (Section 5.0).

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.

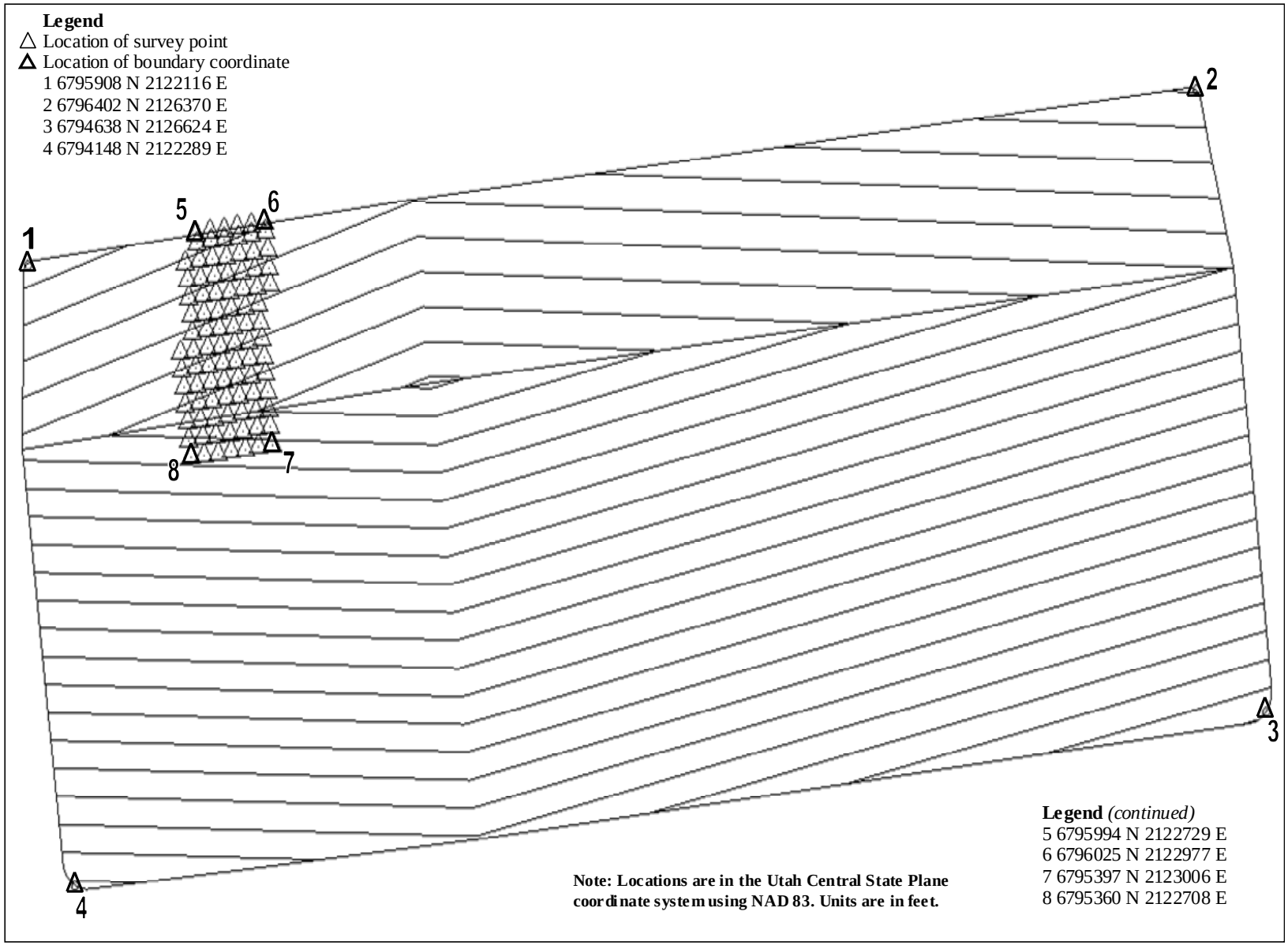

Figure 4. Distribution of Survey Points to Verify Compliance with Interim Cover Specifications

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. 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 the 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) (QAP), which complies with:

- American Society of Mechanical Engineers -1 2004 and addenda through 2007 consensus standard, "Quality Assurance Requirements for Nuclear Facility Applications (QA)."
- DOE Order (O) 226.1B, "Implementation of Department of Energy Oversight Policy."
- Title 10 Code of Federal Regulations Part 830 Subpart A, "Nuclear Safety Management, Quality Assurance Requirements."
- DOE O 414.1D, "Quality Assurance."

3.4 Permits and Agreements

The Project is in compliance with permits and agreements applicable to the Crescent Junction site. These are summarized in Table 5.

Table 5. Crescent Junction Site Permits and Agreements

Agreement Number	Document Name or Description	Issuing Agency	Purpose
Resolution 2006-2741	Grand County Council Resolution	Grand County	Approves Conditional Use Permit for the Project.
DE-RO01-05GJ68003	Access Agreement	DOE EMCBC	For installation and maintenance of air-monitoring equipment and collection of air-quality data for monitoring station MPS-0306.
DE-RO01-05GJ68004	Access Agreement	DOE EMCBC	For installation and maintenance of air-monitoring equipment and collection of air-quality data for monitoring station MPS-0307.
Public Land Order 7697	Permanent Land Transfer	BLM	Order permanently transferred; 500 acres of BLM public domain land to DOE for disposal cell.

Table 5. Crescent Junction Site Permits and Agreements (continued)

Agreement Number	Document Name or Description	Issuing Agency	Purpose
Public Land Order 7734	Public Land Withdrawal	BLM	Order withdrew 936 acres of public land for activities to support disposal of mill tailings at the Crescent Junction disposal site. The withdrawal is for 20 years to support Public Land Order 7697.
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.
UTU-83353	ROW	BLM, Moab Field Office	ROW for 3-in. service culinary waterline and a 2-in. delivery culinary waterline to the disposal site.
UTU-83450	ROW	BLM, Moab Field Office	ROW for power line to the disposal site.
Case No. 11-0028	Memorandum of Agreement	BLM, Utah State Preservation Office	Among DOE, BLM, and Utah State Historic Preservation Office regarding cultural-resource issues related to development of 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.
UTR359187	Storm Water Permit	Utah Division of Water Quality	For the disposal site.
UTU-83396	ROW	BLM, Moab Field Office	For buried telephone line at the disposal site.
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. 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.
U.S. DOT-SP 14283	Special Permit Authorization	U.S. DOT	Permit to transport mill tailings from Moab site to the disposal site.
U.S. DOT No. 041012550006TV	U.S. DOT Hazardous Materials Certificate of Registration	U.S. DOT	For shippers of hazardous materials through 2014.
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.

Table 5. Crescent Junction Site Permits and Agreements (continued)

Agreement Number	Document Name or Description	Issuing Agency	Purpose
REECBCDOE-6-08-0302	Waterline Easement	Grand County	Easement within CR-175 or old Highway 6 and 50 and Hastings Lane ROWs to construct waterline within 60-ft ROW and operate within 20-ft ROW.
REECBCDOE-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.
REECBCDOE-6-08-0301-1	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.
REECBCDOE-6-08-0309	Waterline Easement	City of Green River	Easement to construct waterline within 60 ft of CR-175 or old Highway 6 and 50 ROWs within Green River city limits and operate within 20-ft ROWs.
REECBCDOE-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 on SITLA land near Green River and Crescent Junction.
ESMT 463	Waterline Easement	SITLA	Easement across state land for potable waterline.
400 00177	Waterline Easement	Utah Division of Forestry, Fire, and State Lands	ROW easement to construct and operate waterline in the Green River.
Statewide Utility License Agreement No. 8439	UDOT Utility License	Permits Officer	License with state of Utah to construct waterline across UDOT property.
Property No. 70-4;189A: AEQ	UDOT Easement	Permits Officer	Easement for waterline across UDOT property near Floy Wash that allows 60-ft construction ROW and 20-ft permanent ROW.
4P-082341-1	UDOT Encroachment Permit	UDOT	To construct waterline within UDOT 60-ft ROW and operate within 20-ft ROW near Floy Wash.
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.
SPK-2007-632	U.S. Army Corps of Engineers 404 Permit	U.S. Army Corps of Engineers	To construct pump station on the Green River.
08-92-01SA	Stream Channel Alteration Permit	Utah Division of Water Rights	To construct pump station on the Green River.
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.
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.

Table 5. Crescent Junction Site Permits and Agreements (continued)

Agreement Number	Document Name or Description	Issuing Agency	Purpose
DAQC-1110-2006	Fugitive Dust Control Plan (08/07/06) UAC R307-309-6 "Fugitive Emissions and Fugitive Dust-Fugitive Dust Control Plan-Uranium Mill Tailings Repository (UMTRA) Project near Crescent Junction, Grand County"	Utah Division of Air Quality	Approval letter from the state of Utah for the Fugitive Dust Control Plan for the Crescent Junction disposal cell.

BLM = Bureau of Land Management; CR = County Road; EMCBC = Office of Environmental Management Consolidated Business Center; ft = feet; in. = inches; ROW = right-of-way; SITLA = School and Institutional Trust Lands Administration; UAC = Utah Administrative Code; UDOT = Utah Department of Transportation; U.S. DOT = U.S. Department of Transportation

4.0 Remedial Action Assessment

A description of the pre-excavation site conditions, construction activities, and verification performed at the Crescent Junction disposal site is provided in this section.

4.1 Pre-excavation Site Conditions

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

4.2 Cell Construction

The only cell-construction activities during this period were placement of RRM and the interim cover.

The *Moab UMTRA Project Lift Approval Procedure* (DOE-EM/GJRAC1803) was used to ensure the material placed met the compaction criteria. Descriptions of compaction equipment used during RRM and interim cover placement are provided in Table 6.

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 6. Descriptions of Compaction Equipment Used during Cell Construction

Compaction Equipment	Machine Weight (lb)	Equipped with CAES	Material Layer Equipment Used On							
			RRM	Interim Cover	Radon Barrier	Infiltration and Biointrusion Barrier	Frost Protection	Rock Armor	Spoils Embankment	Perimeter Embankment
CAT 825H Soils Compactor	69,000	X	X							
CAT D8 Bulldozer	84,850		X							
Komatsu 275X Bulldozer	112,466	X	X							
CAT 815 Soils Compactor	45,765			X						
CAT 637G Scraper	118,084			X						

CAT = Caterpillar, Inc., lb = pounds

4.2.1 Excavation

There were no excavation activities during this period.

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 where it ended, as shown in *Moab UMTRA Project Crescent Junction Disposal Cell Interim Completion Report Addendum B* (DOE-EM/GJ2040-B). The RRM end-dumped from haul trucks o was loaded into dump trucks and driven to the disposal area, where it was spread for compaction using a bulldozer. A CAT 825H Soils Compactor, CAT D8 Bulldozer, and Komatsu 275X Bulldozer were then used to compact the RRM in place.

4.2.4 Cover and Rock-armoring Placement

The cover on the disposal cell consists of multiple layers of soil and rock as illustrated in Figure 5-1 of the Remedial Action Selection Report of the RAP. Once the RRM placed in the cell has reached the design thickness, a minimum of 1 foot (ft) of interim cover is placed over the RRM. The interim cover material comes from soils excavated to create the cell that have been stockpiled on site. During this Addendum, there were 7,473 yd^3 of interim cover placed. No additional cover layers were placed during this period.

4.2.5 Spoils-embankment Construction

There were no spoils-embankment construction activities during this period.

4.3 Soil Compaction and Testing

Initial CAES compaction set-up and verification is documented in the *Crescent Junction Disposal Cell Interim Completion Report Addendum A.* The CAES compaction is periodically verified by performing in-place tests using a nuclear-density gauge manufactured by Troxler Electronic Laboratories, Inc., following ASTM International methods. The individual nuclear density tests verify that the compaction achieved with the CAES is greater than the required 90 percent. The CAES compaction results compared to the nuclear-density gauge are provided in Table 2 of Section 2.3.1.

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. The procedure was modified during the period covered by this Addendum, and the revised version is provided in Attachment 1. Sample lift-approval packages for RRM and the interim cover are provided in Appendices A2 and A3, respectively.

4.5 Geotechnical Testing

The RAIP describes the methods and frequencies for performing tests to verify that the material placed in the cell meet the requirements. Geotechnical tests performed 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. The procedure was modified during the period covered by this Addendum, and the revised version is provided in Attachment 1. 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 RRM and interim cover placed to support demonstration that specified compaction requirements were met. Test requirements varied depending on whether the CAES was used for demonstrating compaction. Because the soils in the RRM can vary in composition, multiple compaction curves were prepared to determine the optimum moisture content for that material to achieve compaction. Results of the tests conducted are shown in the standard proctor test-results summary tables included in Appendices A2 and A3. When multiple standard proctor tests, or "sets," were performed, the test selected to represent that soil type appears in red in the table. These tables also summarize the tests performed to determine soil type and geotechnical properties.

Moisture-content testing was performed daily for RRM placed to verify that the moisture content met the requirements before the lifts were approved. The thickness of each lift was surveyed and verified using a high-accuracy global positioning system, 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 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. The *Crescent Junction Disposal Cell Interim Completion Report Addendum A* provides an explanation of this verification process.

During this Addendum period, 84 samples of RRM were taken in three lifts in the upper 7 ft of the disposal cell. The Ra-226 activity of the material ranged from 333.2 to 780.2 picocuries per gram (pCi/g). Table 7 shows the average result for material placed in each lift tested.

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

Lift ID MNumber	Quantity of Samples Taken	Average Ra-226 Activity (pCi/g)	Lift Area (m^2)
UWT01	28	543.7	7,524
UWW07	28	571.5	4,302
UWX15	28	563.2	5,436

m^2 = square meters

There were no radon-flux measurements taken during this period to verify the integrity of the radon barrier.

4.7 QA Requirements

QA activities were conducted in accordance with documents identified in Section 3.3. All personnel who performed work addressed in this Addendum were qualified in accordance with the requirements of the QAP.

During construction activities, audits, surveillances, and a management assessment were performed by the RAC to verify and provide assurance that these activities were performed in accordance with established plans, drawings, instructions, procedures, specifications, and other applicable documents. In addition, DOE and the Technical Assistance Contractor (TAC) performed audits and surveillances of these activities.

During the period of this Addendum, two audits, three surveillances, and one assessment were performed (see Table 8). Any issues identified during these audits, surveillances, and one assessment have been addressed.

Table 8. Audits, Surveillances, and Assessments Conducted during Construction

Date	Conducted By	Type	Assessment Number	Scope
10/22/12 – 11/02/12	DOE EMCBC	Audit	Moab UMTRA Project ISMS 2012	Assess ISMS Phases 1 and 2 (management structure, documents, and operations).
12/10/12 –12/19/12	RAC	Surveillance	MB-13-S-005	Evaluate and verify the implementation of radiological-control monitoring.
12/18/12	TAC	Surveillance	DOE-13-SUR-006	Review of the *Crescent Junction Disposal Cell Completion Report Addendum A* to evaluate its adequacy in documenting completion of disposal cell-construction activities.
3/27/13	TAC	Surveillance	DOE-13-SUR-014	Evaluate a sampling of RAC QC activities used to verify compliance with the RAP, Addendum B, "Final Design Specifications," and the RAIP.
04/10/13 – 05/05/13	RAC	Management Assessment	MA-13-015	Evaluate current state of the QC program by reviewing the QC plans and procedures followed in performing work on the Project.
7/23/13	TAC	Surveillance	DOE-13-SUR-018	Evaluate a sampling of RAC QC activities used to verify compliance to the RAP, Addendum B, "Final Design Specifications," and the RAIP.
8/26/13 – 8/29/13	DOE EMCBC	Audit	EM-PA-13-04	Evaluate the effectiveness of the Project's implementation of the "EM Quality Assurance Program" (EM-QA-001), Revision 1.
9/19/13	TAC	Surveillance	DOE-13-SUR-026	Evaluate a sampling of RAC QC activities used to verify compliance with the RAP, Addendum B, "Final Design Specifications," and the RAIP.

EMCBC = Office of Environmental Management Consolidated Business Center; ISMS = Integrated Safety Management System; QC = Quality Control

4.8 Monitoring for Presence of Free Liquids

The results of monitoring during this period of the one existing standpipe (see Figure 5) for the presence of free liquids in the disposal cell are shown in Table 9. No additional standpipes were installed during this period.

Table 9. Results of Monitoring for the Presence of Fluids in Standpipe 01

Date Monitored	Presence or Level of Fluids (ft)
10/23/12	Dry
01/22/13	Dry
05/01/13	Dry
07/09/13	Dry
09/25/13	Dry

Dry = no fluids present

4.9 Monitoring for Presence of Ground Water

Four wells were monitored for the presence of ground water outside of the disposal-cell footprint (see Figure 5). Results of the monitoring are shown in Table 10.

Table 10. Results of Monitoring for Presence of Ground Water

Date Monitored	Monitor Well Number			
	202	203	205	210
10/23/12	Dry	Dry	Dry	Dry
01/22/13	Dry	Dry	Dry	Dry
05/01/13	Dry	Dry	Dry	Dry
07/09/13	Dry	Dry	Dry	Dry
09/25/13	Dry	Dry	Dry	Dry

Dry = no fluids present

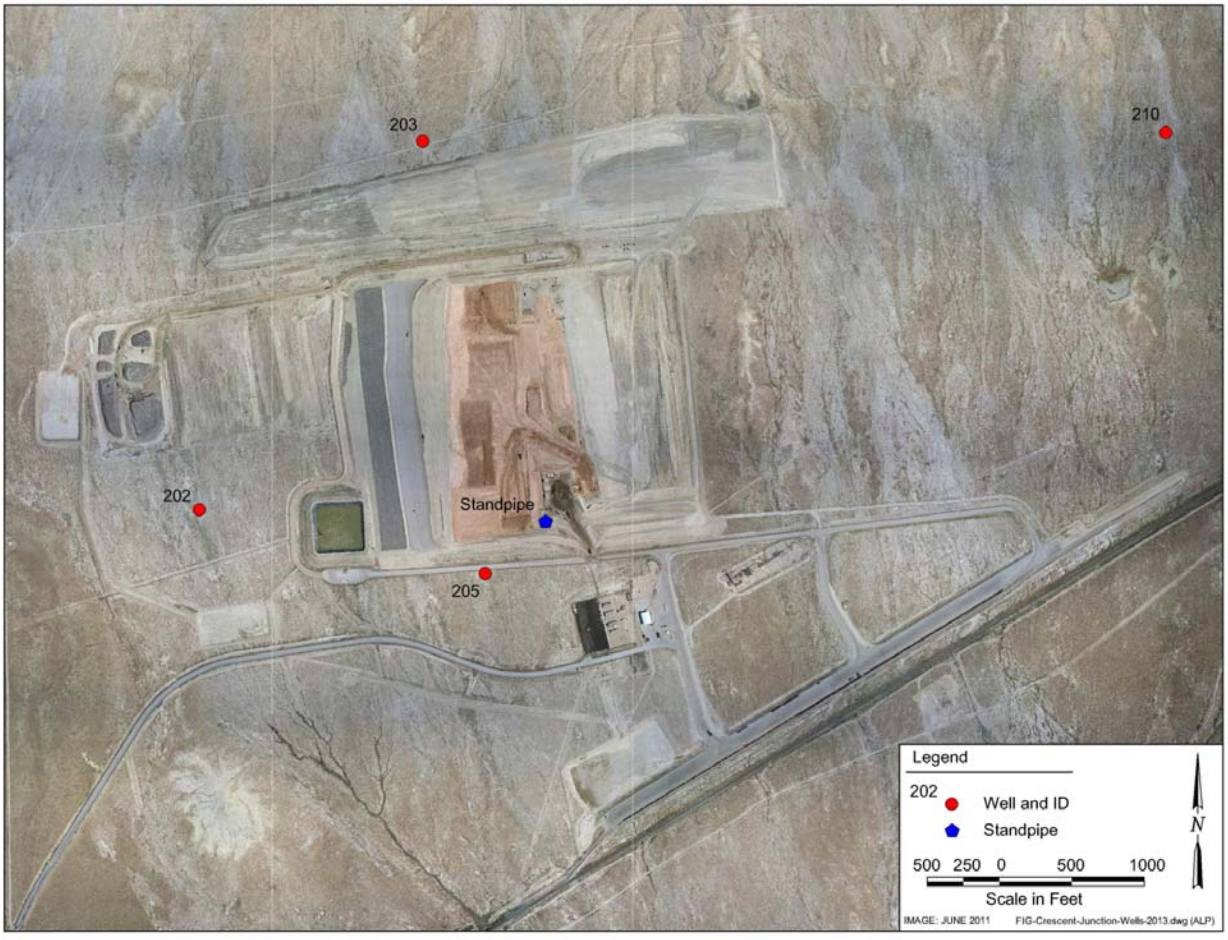

Figure 5. Locations of Monitoring Wells and Standpipe

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 2004 and addenda through 2007 consensus standard, "Quality Assurance Requirements for Nuclear Facility Applications (QA)."

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

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

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

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

ASTM (ASTM International) Standard D4944, "Standard Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester."

ASTM (ASTM International) Standard D4959, "Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method."

ASTM (ASTM International) Standard D6938, "Standard Test Method 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), December 2012.

DOE (U.S. Department of Energy), *Moab UMTRA Project Crescent Junction Disposal Cell Interim Completion Report Addendum B* (DOE-EM/GJRAC2040-B), December 2012.

DOE (U.S. Department of Energy), *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* (DOE-EM/GJ1547), July 2008 (updated December 2012).

DOE (U.S. Department of Energy), *Moab UMTRA Project Lift Approval Procedure* (DOE-EM/GJRAC1803), January 2013.

DOE (U.S. Department of Energy), *Moab UMTRA Project Moisture/Density Testing Procedure* (DOE-EM/GJRAC1783), January 2013.

DOE (U.S. Department of Energy), *Moab UMTRA Project Quality Assurance Plan for the Remedial Action Contractor* (DOE-EM/GJRAC1766), July 2013.

DOE (U.S. Department of Energy) Office of Environmental Management, "EM Quality Assurance Program" (EM-QA-001), June 2012.

DOE (U.S. Department of Energy), Order 226.1B, "Implementation of Department of Energy Oversight Policy."

DOE (U.S. Department of Energy), Order 414.1D, "Quality Assurance."

Appendix A.
Construction Verification Data

Appendix A. Construction Verification Data

Contents

NOTE: Appendices A1, and A4 through A8 are not included as they are not relevant to the period covered in this Addendum.

Appendix A2.
RRM

Standard Proctor Test-results Summary
Lift-approval Summaries
Lift-approval Package
Top-of-Waste Buyoff Survey

Appendix A2. RRM Standard Proctor Test-results Summary

Set	Proctor ID #	Date Sampled	Date Approved	Maximum Dry Density (lb/ft³)	Optimum Moisture Content (%)	Soils Description
Set # 117	RRM # 355	10/2/12	10/25/12	115.4	15.6	Light reddish brown (5YR6/34) very fine to fine, moderately graded, sub round, sand with abundant clay
	RRM # 356	10/2/12	10/25/12	116.4	14.6	Light reddish brown (5YR6/34) very fine to fine, moderately graded, sub round, sand with abundant clay
	RRM # 357	10/2/12	10/25/12	116.5	14.7	Light reddish brown (5YR6/34) very fine to fine, moderately graded, sub round, sand with abundant clay
Set # 118	RRM # 358	10/23/12	11/28/12	118.7	13.1	Reddish brown (5YR5/4) very fine to fine, moderately graded, sub round, sand
	RRM # 359	10/23/12	11/28/12	119.0	13.3	Reddish brown (5YR5/4) very fine to fine, moderately graded, sub round, sand
	RRM # 360	10/23/12	11/28/12	119.4	13.0	Reddish brown (5YR5/4) very fine to fine, moderately graded, sub round, sand
Set # 119	RRM # 361	10/25/13	11/14/12	110.7	16.8	Light brown (7.5YR6/3) slightly sand, lean clay.
	RRM # 362	10/25/13	11/14/12	114.0	16.1	Light brown (7.5YR6/3) slightly sand, lean clay.
	RRM # 363	10/25/13	11/14/12	112.2	16.6	Light brown (7.5YR6/3) slightly sand, lean clay.
Set # 120	RRM # 364	11/12/12	4/8/13	115.0	16.1	Reddish brown (5YR5/3) sand, lean clay.
	RRM # 365	11/12/12	4/8/13	114.4	15.9	Reddish brown (5YR5/3) sand, lean clay.
	RRM # 366	11/12/12	4/8/13	113.7	16.0	Reddish brown (5YR5/3) sand, lean clay.
Set # 121	RRM # 367	3/7/13	3/28/13	118.2	12.9	Reddish brown (5YR5/3) very fine to medium, well graded, sub round sand.
	RRM # 368	3/7/13	3/28/13	117.5	13.7	Reddish brown (5YR5/3) very fine to medium, well graded, sub round sand.
	RRM # 369	3/7/13	3/28/13	117.1	14.1	Reddish brown (5YR5/3) very fine to medium, well graded, sub round sand.
Set # 122	RRM # 370	3/11/13	4/8/13	117.7	13.5	Light Brown (7.5YR 6/3) very fine to medium, well graded, sub round, sand, some clay.
	RRM # 371	3/11/13	4/8/13	118.3	13.2	Light Brown (7.5YR 6/3) very fine to medium, well graded, sub round, sand, some clay.
	RRM # 372	3/11/13	4/8/13	115.9	14.1	Light Brown (7.5YR 6/3) very fine to medium, well graded, sub round, sand, some clay.
Set # 123	RRM # 373	3/18/13	4/25/13	117.8	13.3	(7.5YR 6/3) Light brown, very fine to fine, subround, poorly graded, sand with clay.)
	RRM # 374	3/18/13	4/25/13	113.8	13.4	(7.5YR 6/3) Light brown, very fine to fine, subround, poorly graded, sand with clay.)
	RRM # 375	3/18/13	4/25/13	114.4	15.3	(7.5YR 6/3) Light brown, very fine to fine, subround, poorly graded, sand with clay.)
Set # 124	RRM # 376	3/26/13	5/15/13	117.1	12.8	(7.5YR 6/3) Light brown, very fine to fine, subround, poorly graded, sand with some clay.)
	RRM # 377	3/26/13	5/15/13	118.3	13.0	(7.5YR 6/3) Light brown, very fine to fine, subround, poorly graded, sand with some clay.)
	RRM # 378	3/26/13	5/15/13	116.3	13.1	(7.5YR 6/3) Light brown, very fine to fine, subround, poorly graded, sand with some clay.)
Set # 125	RRM # 379	4/2/13	5/15/13	119.5	12.1	(5YR 6/3) Light reddish brown, very fine to medium, subround, well graded, sand with some clay.
	RRM # 380	4/2/13	5/15/13	120.8	11.9	(5YR 6/3) Light reddish brown, very fine to medium, subround, well graded, sand with some clay.
	RRM # 381	4/2/13	5/15/13	119.1	12.7	(5YR 6/3) Light reddish brown, very fine to medium, subround, well graded, sand with some clay.

Appendix A2. RRM Standard Proctor Test-results Summary (continued)

Set	Proctor ID #	Date Sampled	Date Approved	Maximum Dry Density (lb/ft³)	Optimum Moisture Content (%)	Soils Description
Set # 126	RRM # 382	4/8/13	5/15/13	115.7	14.3	(7.5YR 6/3) Light brown, very fine to medium, subround, well graded, sand with clay
	RRM # 383	4/8/13	5/15/13	117.8	13.3	(7.5YR 6/3) Light brown, very fine to medium, subround, well graded, sand with clay
	RRM # 384	4/8/13	5/15/13	115.0	14.8	(7.5YR 6/3) Light brown, very fine to medium, subround, well graded, sand with clay
Set # 127	RRM # 385	4/16/13	5/16/13	119.1	12.5	(5YR 6/3) Light reddish brown, very fine to medium, subround, moderatly graded, sand with clay
	RRM # 386	4/16/13	5/16/13	118.3	13.0	(5YR 6/3) Light reddish brown, very fine to medium, subround, moderatly graded, sand with clay
	RRM # 387	4/16/13	5/16/13	118.7	12.5	(5YR 6/3) Light reddish brown, very fine to medium, subround, moderatly graded, sand with clay
Set # 128	RRM # 388	4/22/13	5/22/13	118.6	12.8	(5YR 6/4) Light reddish brown, very fine to fine, subround, moderatly graded. Sand with some clay.
	RRM # 389	4/22/13	5/22/13	117.8	13.9	(5YR 6/4) Light reddish brown, very fine to fine, subround, moderatly graded. Sand with some clay.
	RRM # 390	4/22/13	5/22/13	117.6	13.5	(5YR 6/4) Light reddish brown, very fine to fine, subround, moderatly graded. Sand with some clay.
Set # 129	RRM # 391	5/1/13	7/8/13	110.8	16.9	Clay with sand. Very fine to fine, sub round poorly graded.
	RRM # 392	5/1/13	7/8/13	109.3	18.0	Clay with sand. Very fine to fine, sub round poorly graded.
	RRM # 393	5/1/13	7/8/13	108.3	16.4	Clay with sand. Very fine to fine, sub round poorly graded.
Set # 130	RRM # 394	5/20/13	7/24/13	103.5	20.9	Clay very fine to fine, subangular, w ell graded.
	RRM # 395	5/20/13	7/24/13	104.3	19.2	Clay very fine to fine, subangular, w ell graded.
	RRM # 396	5/20/13	7/24/13	103.0	20.0	Clay very fine to fine, subangular, w ell graded.
Set # 131	RRM # 397	6/10/13	7/23/13	113.7	15.4	Clay sand very fine - fine, sub angular w ell graded
	RRM # 398	6/10/13	7/23/13	114.3	14.7	Clay sand very fine - fine, sub angular w ell graded
	RRM # 399	6/10/13	7/23/13	112.9	15.9	Clay sand very fine - fine, sub angular w ell graded
Set # 132	RRM # 400	6/26/13	8/21/13	100.2	22.9	Clay very fine to medium subangular, well graded
	RRM # 401	6/26/13	8/21/13	97.9	22.4	Clay very fine to medium subangular, well graded
	RRM # 402	6/26/13	8/21/13	99.9	23.4	Clay very fine to medium subangular, well graded
Set # 133	RRM # 403	8/1/13	9/5/13	111.8	16.8	Sand clay mixture, very fine to medium, subangular, w ell graded.
	RRM # 404	8/1/13	9/5/13	112.1	16.0	Sand clay mixture, very fine to medium, subangular, w ell graded.
	RRM # 405	8/1/13	9/5/13	108.9	17.9	Sand clay mixture, very fine to medium, subangular, w ell graded.
Set # 134	RRM # 406	9/3/13	10/16/13	112.5	15.9	Clay/Sand Mixture, Fine, Very Well Graded, Rounded.
	RRM # 407	9/3/13	10/16/13	113.0	15.8	Clay/Sand Mixture, Fine, Very Well Graded, Rounded.
	RRM # 408	9/3/13	10/16/13	133.3	14.5	Clay/Sand Mixture, Fine, Very Well Graded, Rounded.

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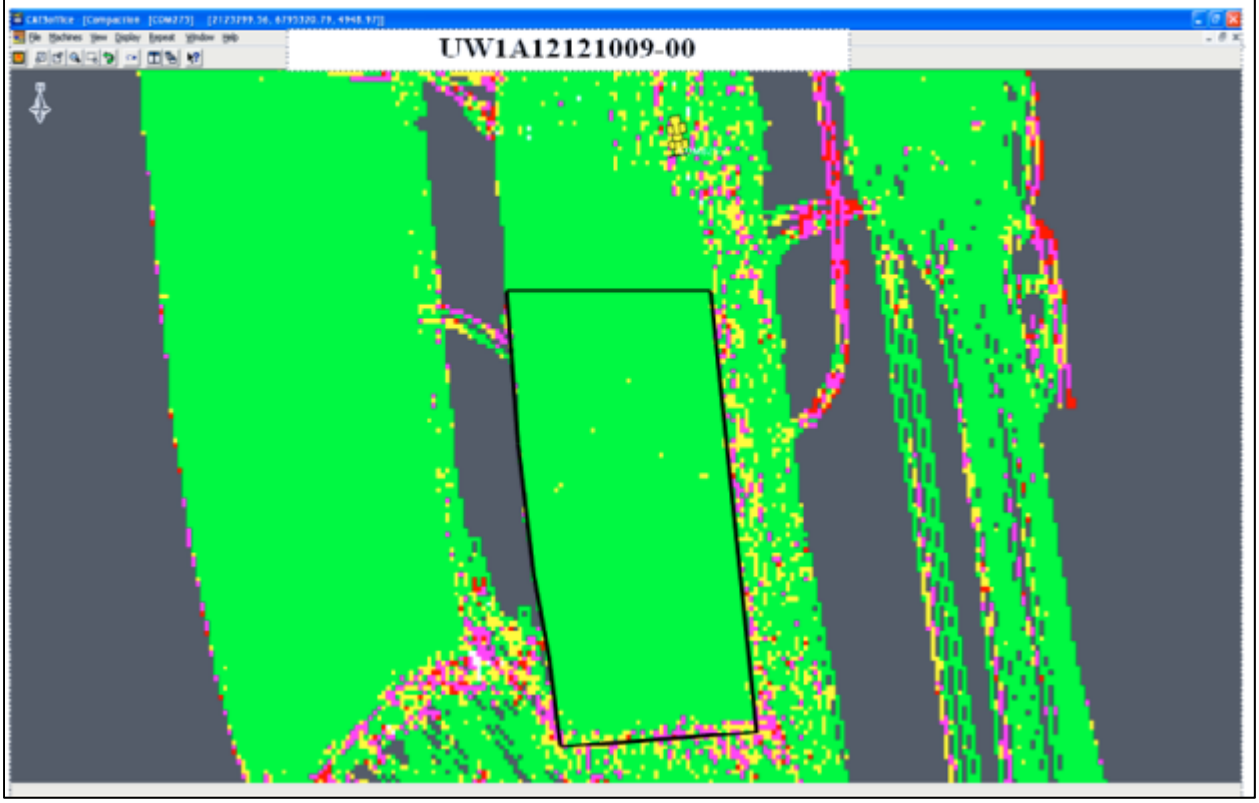
Appendix A2. RRM Lift-approval Summaries

October 2012										
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
10/01/12	UWZ06121001-00	1	1,616	1,616	94.5	0.8	307	0	0	N/A
10/01/12	UW1A12121001-00	0	1,261	2,877	96.8	0.8	N/A	0	0	N/A
10/02/12	UW1A12121002-00	0	1,635	4,512	98.4	1.0	N/A	0	0	N/A
10/03/12	UWT01120927-00	0	2,066	6,578	97.3	0.6	N/A	0	0	N/A
10/04/12	UWW07121003-00	1	1,154	7,732	99.2	0.6	307	0	0	N/A
10/04/12	UWZ06121002-00	1	1,761	9,493	97.5	0.8	307	0	0	N/A
10/08/12	UW1A12121004-00	0	1,635	11,128	96.8	1.0	N/A	0	0	N/A
10/09/12	UWX15121003-00	1	1,746	12,874	98.6	0.9	307	0	0	N/A
10/09/12	UWZ06121008-00	1	1,541	14,415	96.4	0.7	307	0	0	N/A
10/09/12	UW1A12121009-00	0	1,471	15,886	95.7	0.9	N/A	0	0	N/A
10/10/12	UWZ06121009-00	1	1,981	17,867	94.2	0.9	307	0	0	N/A
10/10/12	UW1A12121010-00	1	1,328	19,195	99.0	0.9	307	0	0	N/A
10/11/12	UWZ06121010-00	1	1,883	21,078	97.4	0.9	307	0	0	N/A
10/15/12	UW1C08121015-00	1	1,885	22,963	98.9	1.0	307	0	0	N/A
10/16/12	UW1C08121016-00	1	1,508	24,471	98.1	0.8	307	0	0	N/A
10/17/12	UW1C08121016-01	1	1,508	25,979	97.0	0.8	307	0	0	N/A
10/18/12	UW1A12121011-00	2	1,328	27,307	99.3	0.8	307, 329	1	0	91.9
10/18/12	UW1C08121017-00	1	1,319	28,626	95.9	0.7	307	0	0	N/A
10/22/12	UWZ06121022-00	0	1,883	30,509	97.0	0.9	N/A	0	0	N/A
10/23/12	UW1A12121022-00	1	1,328	31,837	99.0	0.9	307	0	0	N/A
10/23/12	UWZ06121023-00	0	1,935	33,772	99.1	0.9	N/A	0	0	N/A
10/24/12	UW1C08121018-00	0	1,822	35,594	99.2	0.9	N/A	0	0	N/A
10/24/12	UW1A12121023-00	1	1,472	37,066	99.1	1.0	307	0	0	N/A
10/25/12	UWZ06121024-00	1	1,720	38,786	98.0	0.8	307	0	0	N/A
10/25/12	UW1A12121025-00	0	1,472	40,258	98.0	1.0	N/A	0	0	N/A
10/29/12	UWZ06121025-00	1	1,935	42,193	94.6	0.9	307	0	0	N/A
10/29/12	UW1A12121029-00	0	1,378	43,571	98.2	1.0	307	0	0	N/A
10/30/12	UWZ06121029-00	0	1,686	45,257	98.5	0.8	N/A	0	0	N/A
10/31/12	UW1A12121030-00	1	1,240	46,497	99.5	0.9	307	0	0	N/A
10/31/12	UWZ06121030-00	0	1,420	47,917	99.4	0.8	N/A	0	0	N/A

Average CAES Screen Passing Pixels (%)= 97.7
Total Quantity Approved (yd^3) = 47,917
Total # of Nuclear Density Guage Tests = 1
Total # of Moisture Tests = 19
Quantity per Moisture Test (yd^3) = 2,522
Total Average Thickness (ft.)= 0.9

Appendix A2. RRM Lift-approval Summaries (continued)

CAES compaction screen example from October 2012. There are compaction screens for each lift approved on record. The number of passing pixels reported refers to the percentage of the lift which has green pixels. A green pixel verifies that the minimum of six wheel passes with the compactor has been recorded.



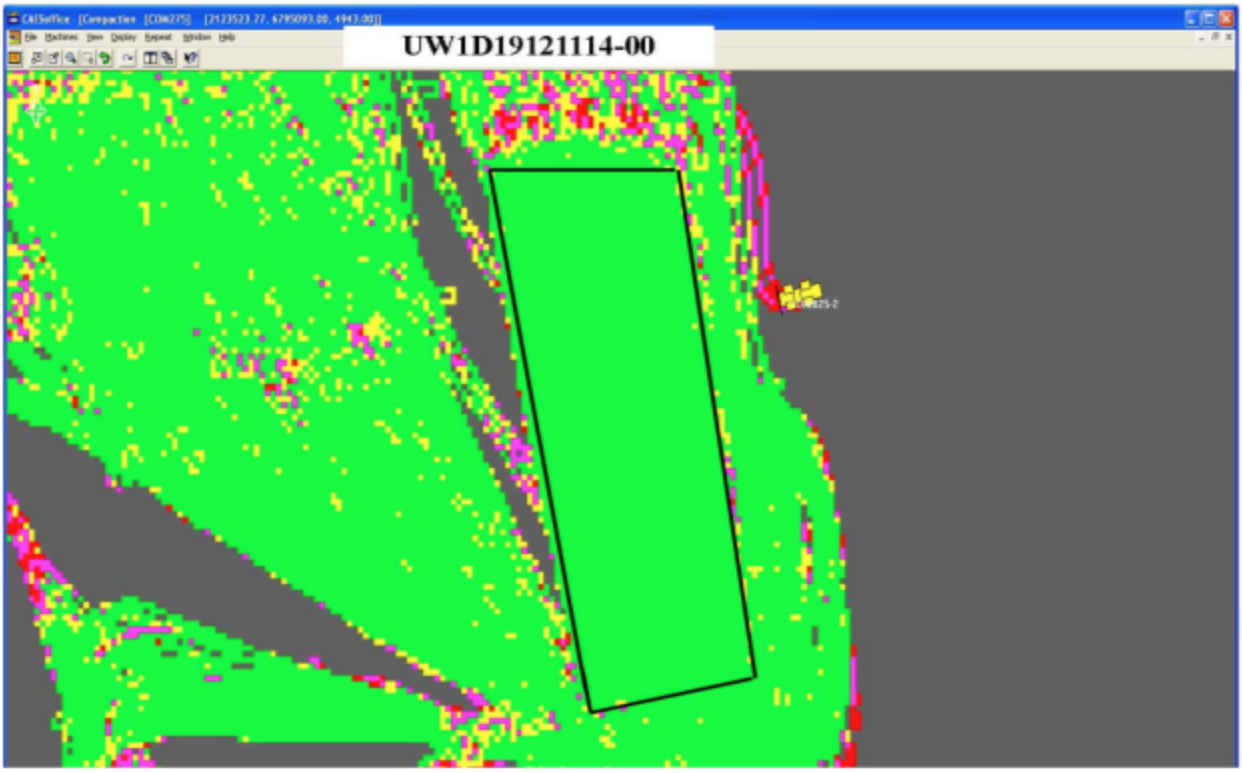
Appendix A2. RRM Lift-approval Summaries (continued)

November 2012										
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
11/01/12	UW1A12121031-00	1	1,240	1,240	98.6	0.9	307	0	0	N/A
11/01/12	UWZ06121031-00	0	1,775	3,015	98.7	1.0	N/A	0	0	N/A
11/05/12	UW1A12121101-00	1	1,378	4,393	95.6	1.0	307	0	0	N/A
11/05/12	UWZ06121105-00	0	1,420	5,813	97.0	0.8	N/A	0	0	N/A
11/05/12	UWZ06121105-01	1	500	6,313	97.3	0.7	307	0	0	N/A
11/06/12	UWZ06121106-00	0	357	6,670	99.3	0.5	N/A	0	0	N/A
11/06/12	UW1A12121105-00	1	1,240	7,910	95.6	0.9	307	0	0	N/A
11/06/12	UWY01121106-00	0	2,228	10,138	95.9	1.0	N/A	0	0	N/A
11/07/12	UW1C08121106-00	1	1,518	11,656	99.6	0.8	307	0	0	N/A
11/07/12	UWZ06121106-01	0	2,097	13,753	99.6	1.0	N/A	0	0	N/A
11/08/12	UW1A05121107-00	0	741	14,494	98.5	0.9	N/A	0	0	N/A
11/08/12	UW1D01121108-00	0	72	14,566	89.2	0.4	N/A	0	0	N/A
11/08/12	UWY01121108-00	1	2,218	16,784	99.2	1.0	307	0	0	N/A
11/12/12	UW1A05121112-00	0	823	17,607	99.5	1.0	N/A	0	0	N/A
11/12/12	UW1D01121112-00	0	162	17,769	96.0	0.9	N/A	0	0	N/A
11/12/12	UWY01121112-00	1	1,546	19,315	99.9	1.0	307	0	0	N/A
11/13/12	UW1A05121112-01	0	1,361	20,676	99.3	0.9	N/A	0	0	N/A
11/14/12	UWY01121113-00	1	1,499	22,175	99.8	1.0	307	0	0	N/A
11/14/12	UW1D01121113-00	0	278	22,453	95.6	0.9	N/A	0	0	N/A
11/19/12	UW1D19121114-00	1	1,129	23,582	97.2	0.9	363	0	0	N/A
11/19/12	UW1A05121119-00	1	1,761	25,343	99.0	1.0	363	0	0	N/A
11/20/12	UWY01121119-00	0	1,535	26,878	98.3	0.9	N/A	0	0	N/A
11/20/12	UW1A05121120-00	1	1,585	28,463	98.4	0.9	170	0	0	N/A
11/21/12	UWY01121120-00	0	1,705	30,168	98.7	1.0	N/A	0	0	N/A
11/21/12	UW1D01121120-00	0	368	30,536	98.0	1.0	N/A	0	0	N/A
11/26/12	UW1A05121121-00	1	1,585	32,121	98.2	0.9	170	0	0	N/A
11/26/12	UW1D01121126-00	0	392	32,513	97.9	0.9	N/A	0	0	N/A
11/26/12	UW1C08121115-00	1	1,676	34,189	99.0	0.9	307	0	0	N/A
11/26/12	UWY01121126-00	1	1,705	35,894	99.3	1.0	363	0	0	N/A
11/27/12	UW1A05121126-00	0	1,409	37,303	97.6	0.8	N/A	0	0	N/A
11/27/12	UW1D19121127-00	0	753	38,056	95.7	0.6	N/A	0	0	N/A
11/28/12	UW1C08121127-00	1	1,117	39,173	98.6	0.6	363	0	0	N/A
11/28/12	UWY01121128-00	0	1,194	40,367	98.8	0.7	N/A	0	0	N/A

Average CAES Screen Passing Pixels (%)= 97.8
Total Quantity Approved (yd^3) = 40,367
Total # of Nuclear Density Guage Tests = 0
Total # of Moisture Tests = 15
Quantity per Moisture Test (yd^3) = 2,691
Total Average Thickness (ft.)= 0.8

Appendix A2. RRM Lift-approval Summaries (continued)

CAES compaction screen example from November 2012. There are compaction screens for each lift approved on record. The number of passing pixels reported refers to the percentage of the lift which has green pixels. A green pixel verifies that the minimum of six wheel passes with the compactor has been recorded.



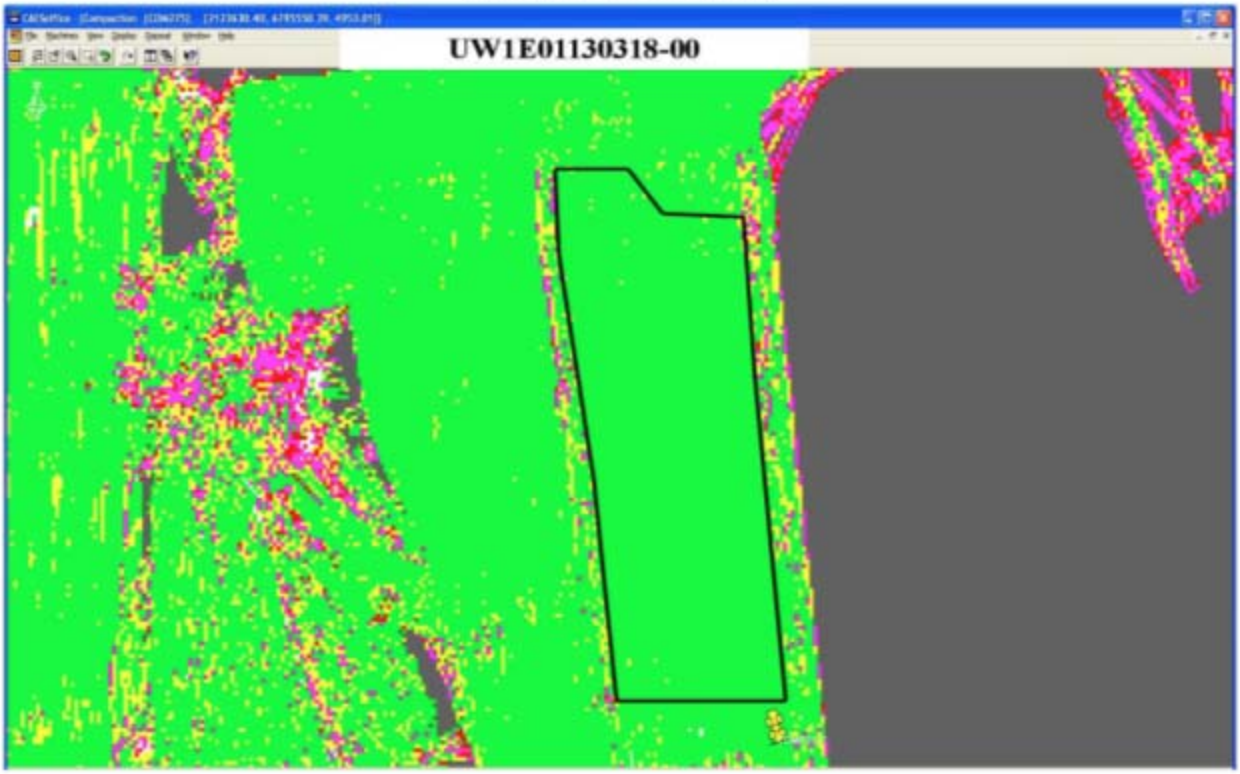
Appendix A2. RRM Lift-approval Summaries (continued)

March 2013										
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
03/11/13	UW1E01130311-00	1	1,651	1,651	96.8	0.7	343	0	0	N/A
03/12/13	UW1E08130311-00	1	1,511	3,162	96.5	0.7	343	0	0	N/A
03/13/13	UW1E01130312-00	0	2,123	5,285	97.7	0.9	N/A	0	0	N/A
03/13/13	UW1E08130313-00	1	2,159	7,444	96.3	1.0	343	0	0	N/A
03/14/13	UW1E01130313-00	1	2,359	9,803	96.5	1.0	343	0	0	N/A
03/18/13	UW1E08130314-00	1	1,960	11,763	99.1	1.0	343	0	0	N/A
03/19/13	UW1E01130318-00	0	2,183	13,946	99.1	1.0	N/A	0	0	N/A
03/19/13	UW1E08130319-00	1	1,764	15,710	99.2	0.9	348	0	0	N/A
03/20/13	UW1E01130319-00	1	2,183	17,893	98.5	1.0	348	0	0	N/A
03/21/13	UW1E08130320-00	0	1,764	19,657	99.0	0.9	N/A	0	0	N/A
03/25/13	UW1E08130325-00	0	1,764	21,421	95.9	0.9	N/A	0	0	N/A
03/25/13	UW1E01130321-00	1	2,183	23,604	98.2	1.0	348	0	0	N/A
03/26/13	UW1E01130325-00	1	1,746	25,350	95.2	0.8	348	0	0	N/A
03/26/13	UW1E08130326-00	1	1,169	26,519	98.7	0.7	348	0	0	N/A
03/27/13	UW1E01130326-00	0	1,894	28,413	97.4	0.9	N/A	0	0	N/A
03/28/13	UW1E08130327-00	2	1,503	29,916	97.9	0.9	350	1	0	91.2
03/28/13	UWY01130328-00	2	1,023	30,939	99.3	0.6	307	1	1	90.2
03/28/13	UW1E01130327-00	1	1,894	32,833	95.5	0.9	348	0	0	N/A

Average CAES Screen Passing Pixels (%)= 97.6
Total Quantity Approved (yd^3) = 32,833
Total # of Nuclear Density Guage Tests = 2
Total # of Moisture Tests = 15
Quantity per Moisture Test (yd^3) = 2,189
Total Average Thickness (ft.)= 0.9

Appendix A2. RRM Lift-approval Summaries (continued)

CAES compaction screen example from March 2013. There are compaction screens for each lift approved on record. The number of passing pixels reported refers to the percentage of the lift which has green pixels. A green pixel verifies that the minimum of six wheel passes with the compactor has been recorded.



Appendix A2. RRM Lift-approval Summaries (continued)

April 2013										
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
04/01/13	UW1E08130328-00	0	1,503	1,503	96.5	0.9	N/A	0	0	N/A
04/01/13	UWY01130401-00	1	1,680	3,183	99.3	0.9	354	0	0	N/A
04/02/13	UW1E08130401-00	0	1,336	4,519	96.4	0.8	N/A	0	0	N/A
04/02/13	UW1E01130402-00	1	1,684	6,203	96.6	0.8	354	0	0	N/A
04/03/13	UWY01130403-00	1	1,866	8,069	97.8	1.0	354	0	0	N/A
04/04/13	UW1E08130403-00	0	1,336	9,405	99.8	0.8	N/A	0	0	N/A
04/04/13	UW1A05121128-00	2	882	10,287	96.1	0.6	307	1	0	93.0
04/04/13	UW1E01130404-00	1	1,380	11,667	98.6	0.8	363	0	0	N/A
04/08/13	UWY01130404-00	0	1,675	13,342	98.7	0.9	N/A	0	0	N/A
04/08/13	UW1A05130408-00	0	1,470	14,812	98.4	1.0	N/A	0	0	N/A
04/09/13	UW1C08130409-00	2	465	15,277	98.0	0.2	307	1	0	97.8
04/10/13	UW1A12121114-00	2	1,162	16,439	98.9	0.9	363	2	0	92.6
04/10/13	UWZ06121115-00	2	2,097	18,536	98.7	1.0	307, 363	1	0	91.4
04/11/13	UW1D01130411-00	0	438	18,974	96.4	0.7	N/A	0	0	N/A
04/11/13	UW1D01130408-00	3	304	19,278	96.0	0.6	307, 350	1	0	93.3
04/11/13	UWY01130408-00	3	1,861	21,139	97.6	1.0	338, 307	0	0	N/A
04/11/13	UW1C08130410-00	1	2,093	23,232	98.0	0.9	307	0	0	N/A
04/15/13	UW1D01130415-00	0	563	23,795	99.4	0.9	N/A	0	0	N/A
04/16/13	UWY01130415-00	0	1,994	25,789	94.5	1.0	N/A	0	0	N/A
04/16/13	UW1C08130415-00	0	1,668	27,457	98.2	0.7	N/A	0	0	N/A
04/16/13	UW1A12130410-00	0	890	28,347	97.6	0.7	N/A	0	0	N/A
04/16/13	UW1A05130411-00	1	1,429	29,776	99.4	1.0	368	0	0	N/A
04/17/13	UW1E01130411-00	2	1,728	31,504	96.3	1.0	363, 368	0	0	N/A
04/17/13	UWZ06130415-00	2	1,969	33,473	99.1	0.9	370	0	0	N/A
04/17/13	UW1A05130417-00	1	1,429	34,902	99.6	1.0	354	0	0	N/A
04/18/13	UW1C08130417-00	1	2,244	37,146	98.3	0.9	338	0	0	N/A
04/18/13	UW1D01130418-00	0	638	37,784	99.0	0.9	N/A	0	0	N/A
04/18/13	UW1D19121128-00	2	915	38,699	97.6	0.7	307	1	0	95.8
04/22/13	UW1A05130418-00	0	1,404	40,103	99.7	0.9	N/A	0	0	N/A
04/22/13	UW1C08130422-00	0	1,995	42,098	99.7	0.8	N/A	0	0	N/A
04/23/13	UW1D19130422-00	1	915	43,013	98.6	0.7	365	0	0	N/A
04/23/13	UW1A05130423-00	0	1,560	44,573	99.6	1.0	N/A	0	0	N/A
04/24/13	UW1C08130423-00	1	2,244	46,817	99.7	0.9	354	0	0	N/A
04/24/13	UW1D19130424-00	1	1,307	48,124	98.8	1.0	370	0	0	N/A

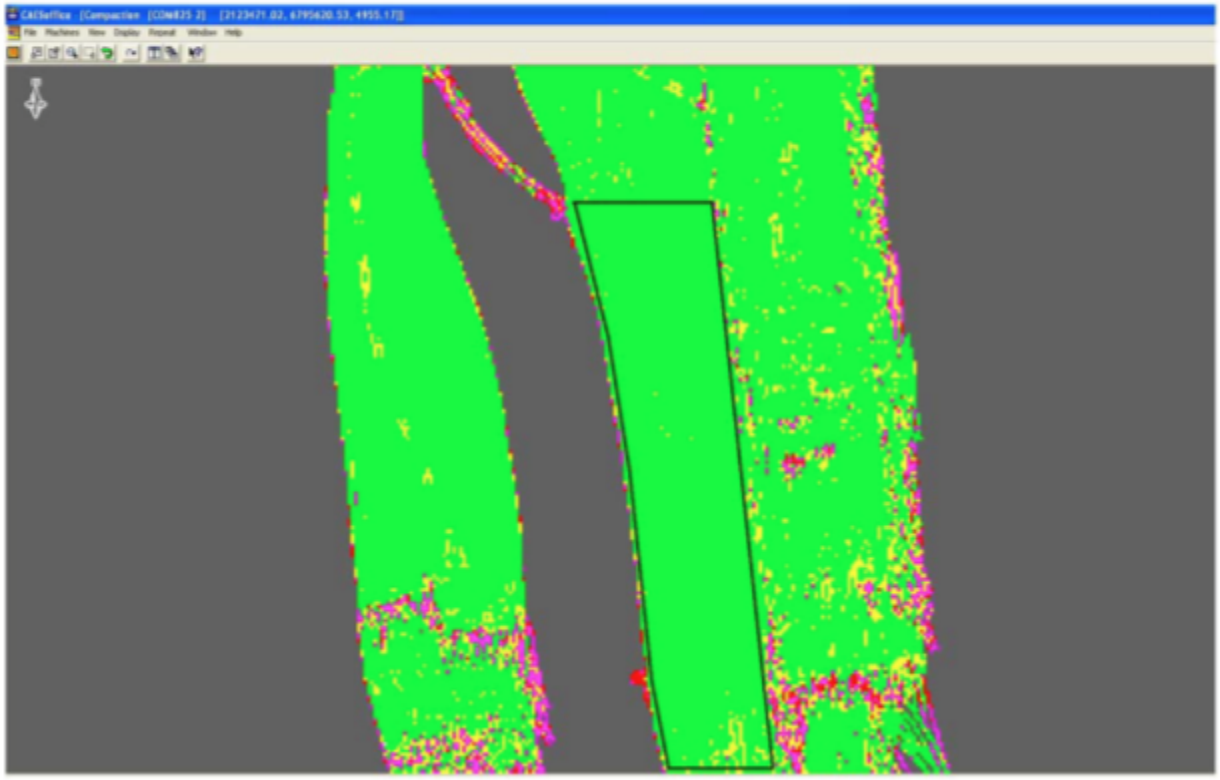
Appendix A2. RRM Lift-approval Summaries (continued)

Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
04/25/13	UW1D01130424-00	0	638	48,762	97.6	0.9	N/A	0	0	N/A
04/25/13	UWY01130425-00	1	1,836	50,598	98.8	0.9	356	0	0	N/A
04/29/13	UW1A05130425-00	0	1,560	52,158	100.0	1.0	N/A	0	0	N/A
04/29/13	UW1C08130429-00	1	2,340	54,498	99.4	0.9	365	0	0	N/A
04/30/13	UW1D01130430-00	0	735	55,233	99.3	0.8	N/A	0	0	N/A
					Average Lift Thickness (ft.)=	1				
					Average CAES Screen Passing Pixels (%)=	98				
					Total Quantity Approved (yd^3) =	56,374				
					Total # of Nuclear Density Guage Tests =	7				
					Total # of Moisture Tests =	33				
					Quantity per Moisture Test (yd^3) =	1,708				
					Total Average Thickness (ft.)=	1				

Appendix A2. RRM Lift-approval Summaries (continued)

CAES compaction screen example from April 2013. There are compaction screens for each lift approved on record. The number of passing pixels reported refers to the percentage of the lift which has green pixels. A green pixel verifies that the minimum of six wheel passes with the compactor has been recorded.

UW1C08130410-00



App Appendix A2. RRM Lift-approval Summaries (continued)

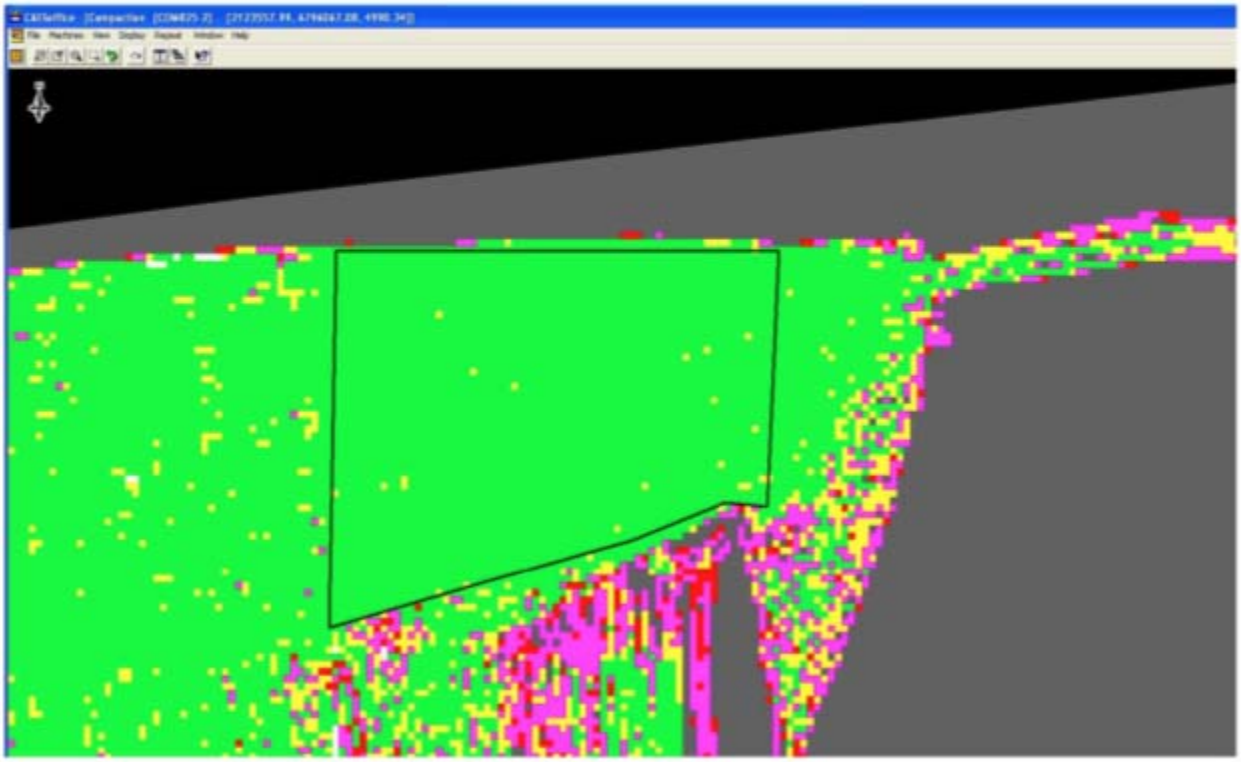
May 2013										
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
05/01/13	UWY01130430-00	1	1,781	1,781	99.7	0.8	370	0	0	N/A
05/01/13	UW1A05130501-00	0	1,602	3,383	100.0	1.0	N/A	0	0	N/A
05/02/13	UW1C08130501-00	1	2,340	5,723	100.0	0.9	368	0	0	N/A
05/06/13	UW1D19130502-00	0	1,141	6,864	97.4	0.9	N/A	0	0	N/A
05/06/13	UW1D01130502-00	1	827	7,691	98.4	0.9	307	0	0	N/A
05/07/13	UWY01130502-00	0	2,227	9,918	99.9	1.0	N/A	0	0	N/A
05/07/13	UW1A05130506-00	1	1,602	11,520	99.7	1.0	365	0	0	N/A
05/07/13	UW1C08130506-00	1	2,340	13,860	98.1	0.9	370	0	0	N/A
05/09/13	UWY01130508-00	1	2,227	16,087	99.6	1.0	365	0	0	N/A
05/09/13	UW1D19130507-00	0	1,015	17,102	96.6	0.8	N/A	0	0	N/A
05/09/13	UW1D01130507-00	2	918	18,020	98.1	1.0	307, 365	0	0	N/A
05/14/13	UW1A05130509-00	1	1,501	19,521	99.3	1.0	307	0	0	N/A
05/14/13	UW1C08130513-00	1	1,919	21,440	99.1	0.8	363	0	0	N/A
05/15/13	UW1D01130514-00	0	950	22,390	98.9	0.9	N/A	0	0	N/A
05/15/13	UW1D19130513-00	0	1,002	23,392	98.9	0.8	N/A	0	0	N/A
05/16/13	UWY01130514-00	1	2,320	25,712	99.0	1.0	363	0	0	N/A
05/16/13	UW1E08130516-00	0	39	25,751	92.9	0.3	N/A	0	0	N/A
05/16/13	UW1E08130516-01	0	52	25,803	98.5	0.4	N/A	0	0	N/A
05/20/13	UW1A05130515-00	1	1,501	27,304	99.9	1.0	368	0	0	N/A
05/20/13	UW1C08130515-00	0	2,398	29,702	100.0	1.0	N/A	0	0	N/A
05/20/13	UW1D19130516-00	1	1,002	30,704	98.6	0.8	365	0	0	N/A
05/20/13	UW1D01130520-00	0	950	31,654	99.5	0.9	N/A	0	0	N/A
05/20/13	UW1E01130513-00	0	1,711	33,365	92.8	1.0	N/A	0	0	N/A
05/22/13	UWY01130520-00	1	2,320	35,685	99.4	1.0	365	0	0	N/A
05/22/13	UW1E01130522-00	0	47	35,732	99.5	0.6	N/A	0	0	N/A
05/22/13	UW1A05130521-00	1	1,377	37,109	99.8	0.9	363	0	0	N/A
05/22/13	UW1C08130521-00	0	2,219	39,328	100.0	0.9	N/A	0	0	N/A
05/22/13	UW1D19130521-00	1	910	40,238	99.4	0.8	307	0	0	N/A
05/22/13	UW1E01130522-01	0	31	40,269	100.0	0.4	N/A	0	0	N/A
05/28/13	UW1D01130522-00	0	1,242	41,511	98.3	0.9	N/A	0	0	N/A
05/29/13	UWY01130523-00	1	2,321	43,832	99.6	1.0	307	0	0	N/A
05/29/13	UW1A05130528-00	1	1,530	45,362	98.9	1.0	307	0	0	N/A
05/30/13	UW1D19130523-00	0	1,023	46,385	99.3	0.9	N/A	0	0	N/A
05/30/13	UW1D01130529-00	1	1,478	47,863	99.4	1.0	307	0	0	N/A
05/30/13	UW1C08130528-00	0	2,219	50,082	98.8	0.9	N/A	0	0	N/A

Average CAES Screen Passing Pixels (%)= 98.8
Total Quantity Approved (yd^3) = 50,082
Total # of Nuclear Density Guage Tests = 0
Total # of Moisture Tests = 19
Quantity per Moisture Test (yd^3) = 2,636
Total Average Thickness (ft.)= 0.8

Appendix A2. RRM Lift-approval Summaries (continued)

CAES compaction screen example from May 2013. There are compaction screens for each lift approved on record. The number of passing pixels reported refers to the percentage of the lift which has green pixels. A green pixel verifies that the minimum of six wheel passes with the compactor has been recorded.

UW1D01130514-00



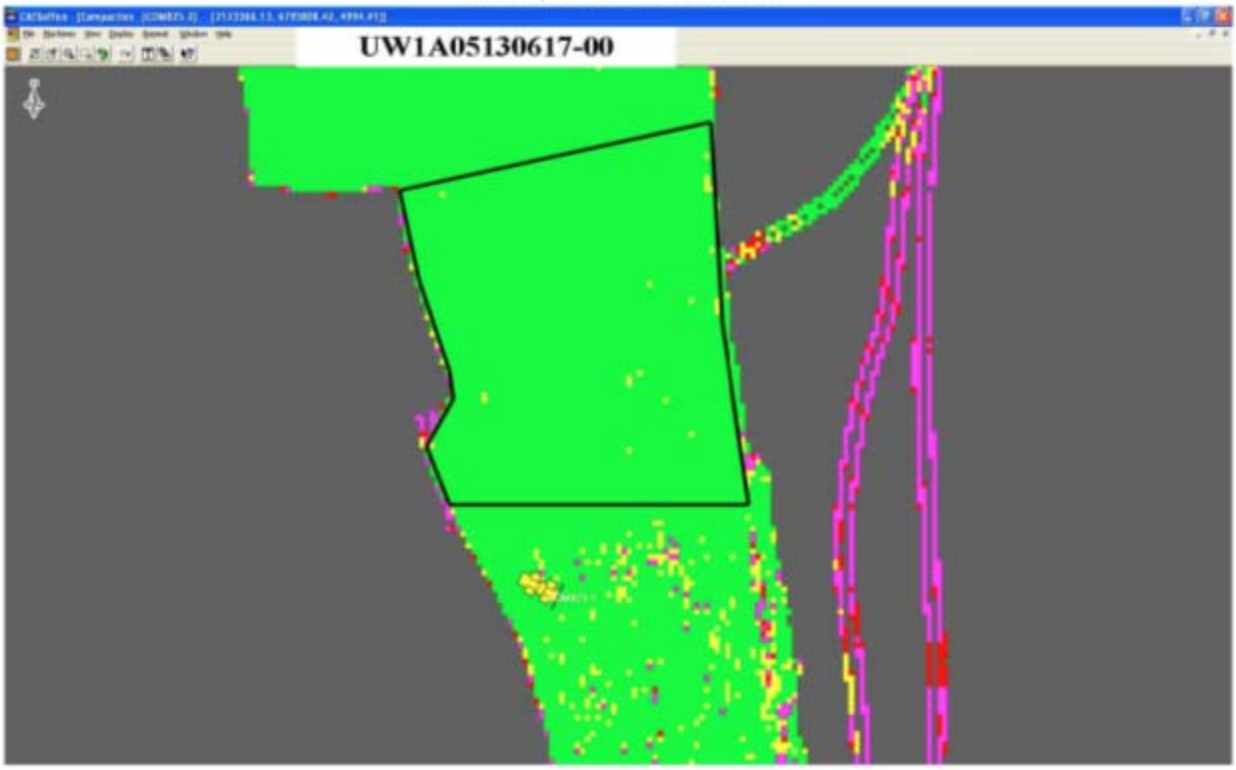
Appendix A2. RRM Lift-approval Summaries (continued)

June 2013										
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
06/03/13	UWY01130530-00	0	2,289	2,289	99.4	1.0	N/A	0	0	N/A
06/03/13	UW1A05130530-00	1	1,308	3,597	99.6	0.9	307	0	0	N/A
06/04/13	UW1C08130603-00	1	2,121	5,718	99.8	0.9	365	0	0	N/A
06/04/13	UW1D19130604-00	0	973	6,691	99.6	0.8	N/A	0	0	N/A
06/05/13	UW1D01130604-00	1	1,330	8,021	98.0	0.9	363	0	0	N/A
06/06/13	UWY01130605-00	1	2,061	10,082	99.3	0.9	307	0	0	N/A
06/06/13	UW1A05130615-00	0	1,454	11,536	99.7	1.0	N/A	0	0	N/A
06/10/13	UW1D19130610-00	0	1,094	12,630	98.0	0.9	N/A	0	0	N/A
06/11/13	UW1C08130606-00	1	2,121	14,751	99.9	0.9	363	0	0	N/A
06/11/13	UW1D01130610-00	1	1,478	16,229	99.3	1.0	363	0	0	N/A
06/12/13	UWY01130610-00	0	2,061	18,290	98.9	0.9	N/A	0	0	N/A
06/12/13	UW1A05130611-00	1	1,454	19,744	99.9	1.0	363	0	0	N/A
06/12/13	UW1C08130612-00	0	2,187	21,931	99.6	0.9	N/A	0	0	N/A
06/13/13	UW1D19130612-00	1	1,052	22,983	98.9	0.9	307	0	0	N/A
06/17/13	UWY01130613-00	1	2,194	25,177	98.7	0.9	307	0	0	N/A
06/17/13	UW1D01130613-00	1	1,221	26,398	98.1	0.8	307	0	0	N/A
06/18/13	UW1A05130617-00	1	1,453	27,851	99.3	1.0	307	0	0	N/A
06/18/13	UW1C08130617-00	1	2,432	30,283	99.8	1.0	307	0	0	N/A
06/19/13	UW1D19130618-00	0	1,052	31,335	99.0	0.9	N/A	0	0	N/A
06/19/13	UW1D01130618-00	0	1,526	32,861	96.9	1.0	N/A	0	0	N/A
06/24/13	UWY01130619-00	1	1,950	34,811	99.5	0.8	307	0	0	N/A
06/24/13	UW1A05130620-00	1	1,402	36,213	99.0	1.0	307	0	0	N/A
06/26/13	UW1C08130620-00	2	2,188	38,401	96.5	0.9	307, 363	0	0	N/A
06/26/13	UW1D19130624-00	1	804	39,205	98.9	0.7	307	0	0	N/A
06/27/13	No lifts approved	0	0	39,205	0.0	0.0	N/A	0	0	N/A

Average CAES Screen Passing Pixels (%)= 99.00
Total Quantity Approved (yd^3) = 39,205
Total # of Nuclear Density Guage Tests = 0
Total # of Moisture Tests = 17
Quantity per Moisture Test (yd^3) = 2,306
Total Average Thickness (ft.)= 0.8

Appendix A2. RRM Lift-approval Summaries (continued)

CAES compaction screen example from June 2013. There are compaction screens for each lift approved on record. The number of passing pixels reported refers to the percentage of the lift which has green pixels. A green pixel verifies that the minimum of six wheel passes with the compactor has been recorded.



Appendix A2. RRM Lift-approval Summaries (continued)

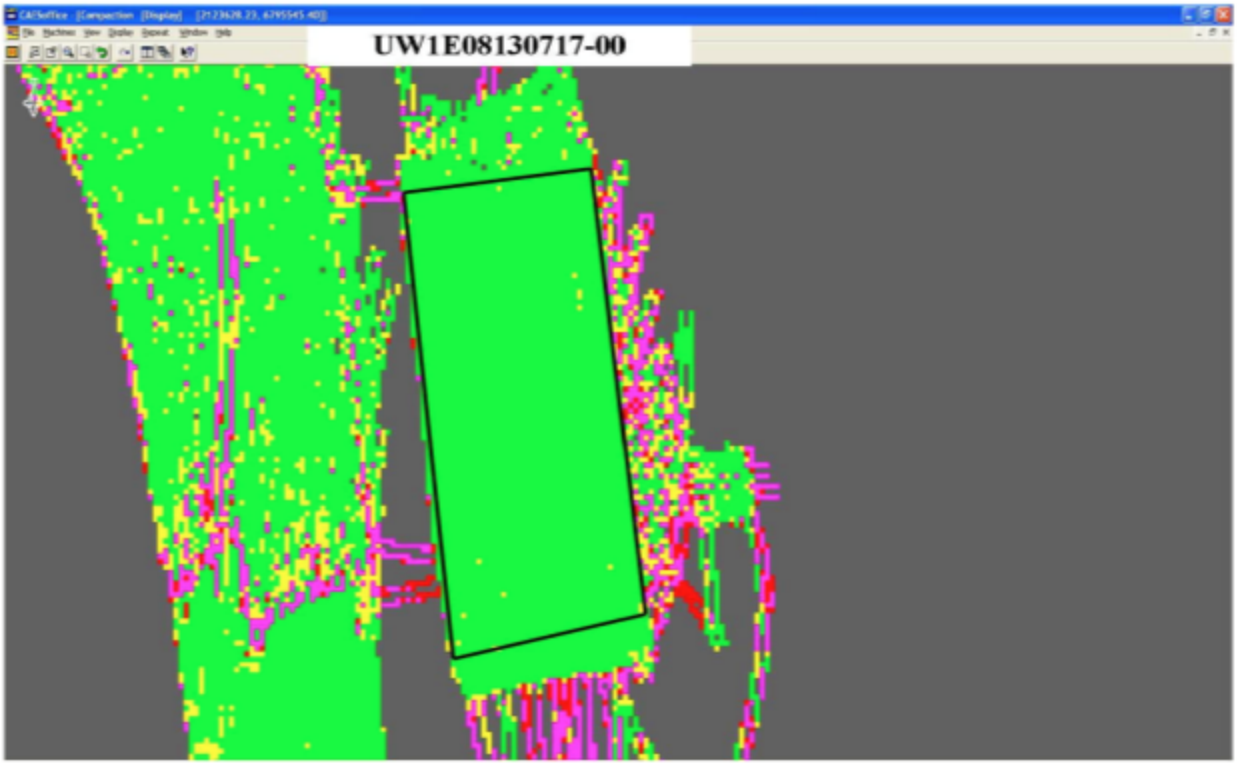
July 2013										
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
07/01/13	UW1D01130624-00	2	1,583	1,583	98.8	1.0	307, 363	0	0	N/A
07/01/13	UWY01130625-00	1	1,690	3,273	98.8	0.9	307, 363	0	0	N/A
07/02/13	UW1A05130625-00	1	1,878	5,151	99.5	1.0	307, 363	0	0	N/A
07/02/13	UW1C08130627-00	1	1,919	7,070	99.0	0.8	307	0	0	N/A
07/02/13	UW1D19130701-00	1	881	7,951	99.0	0.8	307	0	0	N/A
07/02/13	UW1D01130701-00	0	1,439	9,390	99.2	0.9	N/A	0	0	N/A
07/03/13	UWY01130702-00	1	1,502	10,892	99.3	0.9	307	0	0	N/A
07/03/13	UW1A05130702-00	0	1,109	12,001	99.4	0.8	N/A	0	0	N/A
07/03/13	UW1E08130626-00	1	802	12,803	97.3	0.6	307	0	0	N/A
07/08/13	UW1C08130703-00	0	1,919	14,722	99.2	0.8	N/A	0	0	N/A
07/08/13	UW1D19130703-00	1	850	15,572	99.7	0.8	307	0	0	N/A
07/09/13	UWY01130708-00	1	1,502	17,074	98.1	0.9	392	0	0	N/A
07/09/13	UW1D01130703-00	0	1,598	18,672	99.2	1.0	N/A	0	0	N/A
07/10/13	UW1A05130709-00	0	1,356	20,028	99.7	1.0	N/A	0	0	N/A
07/10/13	UW1C08130709-00	1	1,902	21,930	99.6	0.8	392	0	0	N/A
07/10/13	UW1D19130710-00	0	796	22,726	97.9	0.8	N/A	0	0	N/A
07/11/13	UW1A05130710-00	1	1,220	23,946	99.3	0.9	392	0	0	N/A
07/11/13	UWY01130710-00	0	965	24,911	99.0	0.9	N/A	0	0	N/A
07/16/13	UW1D01130715-00	2	1,044	25,955	0.0	0.7	363	1	0	91.7
07/17/13	UW1D19130715-00	1	696	26,651	0.0	0.7	363	1	0	92.5
07/17/13	UW1C08130711-00	2	2,378	29,029	0.0	1.0	363	1	0	91.4
07/17/13	UW1D01130716-00	0	1,621	30,650	98.9	1.0	N/A	0	0	N/A
07/18/13	UW1E08130715-00	1	1,159	31,809	99.5	0.9	363	0	0	N/A
07/18/13	UW1C08130717-00	0	2,067	33,876	99.4	0.9	N/A	0	0	N/A
07/22/13	UW1D19130718-00	1	743	34,619	99.8	0.7	363	0	0	N/A
07/22/13	UW1D01130718-00	0	1,459	36,078	98.2	0.9	N/A	0	0	N/A
07/23/13	UWY01130715-00	0	424	36,502	100.0	0.5	N/A	0	0	N/A
07/23/13	UW1A05130716-00	1	1,286	37,788	99.6	1.0	363	0	0	N/A
07/23/13	UW1E01130722-00	1	1,241	39,029	99.2	0.8	363	0	0	N/A
07/23/13	UW1E08130722-00	0	1,296	40,325	99.2	1.0	N/A	0	0	N/A
07/23/13	UW1D19130722-00	0	539	40,864	99.5	0.7	N/A	0	0	N/A
07/24/13	UW1C08130723-00	1	2,156	43,020	100.0	0.9	363	0	0	N/A
07/24/13	UWY01130724-00	1	1,633	44,653	99.4	0.9	363	0	0	N/A

Appendix A2. RRM Lift-approval Summaries (continued)

Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
07/25/13	UW1E08130724-00	0	1,296	45,949	98.5	1.0	N/A	0	0	N/A
07/25/13	UW1E01130725-00	1	1,203	47,152	99.8	0.8	392	0	0	N/A
07/25/13	UW1E01130725-01	0	106	47,258	99.2	0.7	N/A	0	0	N/A
07/29/13	UW1C08130729-00	1	2,396	49,654	99.4	1.0	392	0	0	N/A
07/29/13	UWY01130725-00	0	1,633	51,287	98.6	0.9	N/A	0	0	N/A
07/30/13	UW1D19130729-00	0	770	52,057	99.9	1.0	N/A	0	0	N/A
07/30/13	UW1E08130730-00	0	1,296	53,353	99.0	1.0	N/A	0	0	N/A
07/31/13	UW1E01130730-00	1	1,499	54,852	99.3	1.0	363	0	0	N/A
	Average CAES Screen Passing Pixels (%)=					99.1				
	Total Quantity Approved (yd^3) =					56,139				
	Total # of Nuclear Density Guage Tests =					3				
	Total # of Moisture Tests =					27				
	Quantity per Moisture Test (yd^3) =					2,079				
	Total Average Thickness (ft.)=					0.8				

Appendix A2. RRM Lift-approval Summaries (continued)

CAES compaction screen example from July 2013. There are compaction screens for each lift approved on record. The number of passing pixels reported refers to the percentage of the lift which has green pixels. A green pixel verifies that the minimum of six wheel passes with the compactor has been recorded.



Appendix A2. RRM Lift-approval Summaries (continued)

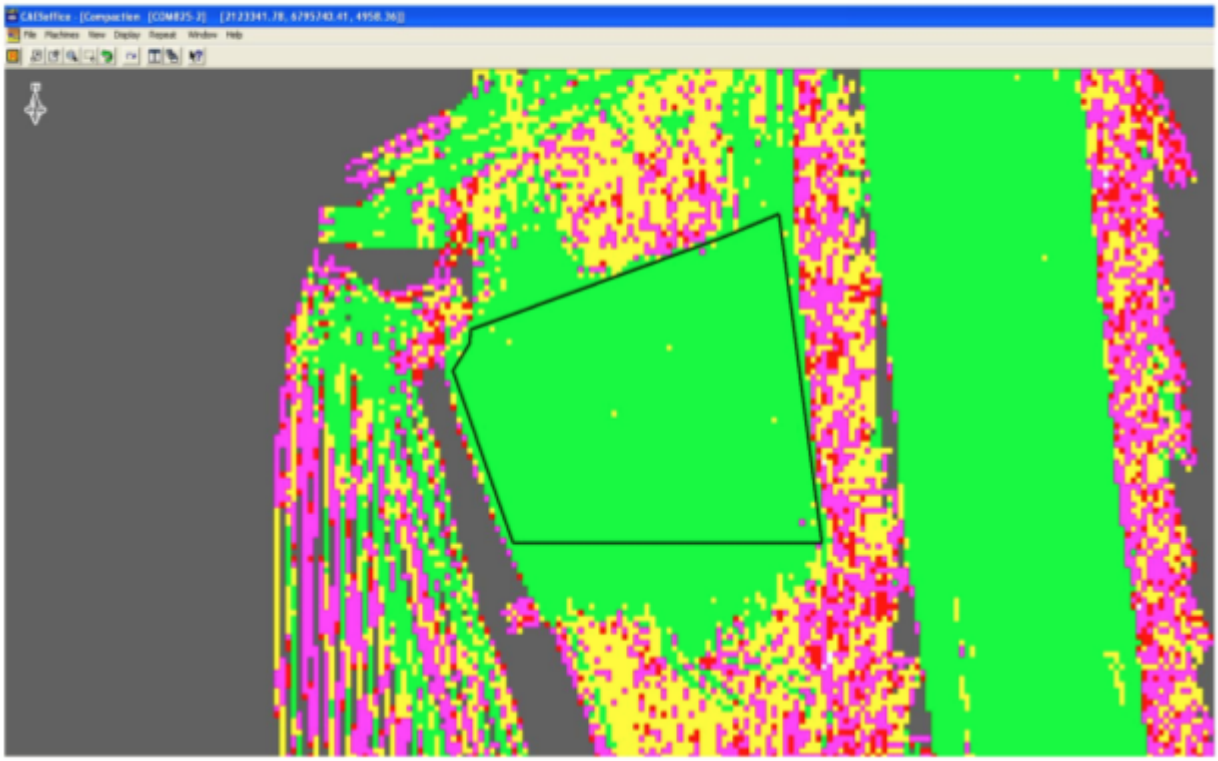
August 2013										
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
08/01/13	UW1C08130731-00	0	1,487	1,487	99.7	0.9	N/A	0	0	N/A
08/05/13	UW1D19130801-00	1	1,326	2,813	99.4	0.9	363	0	0	N/A
08/05/13	UW1E08130801-00	0	1,088	3,901	99.8	0.9	N/A	0	0	N/A
08/06/13	UW1E01130805-00	1	1,349	5,250	99.8	0.9	363	0	0	N/A
08/06/13	UWY01130805-00	0	1,287	6,537	98.6	0.9	N/A	0	0	N/A
08/07/13	UW1C08130806-00	1	1,487	8,024	98.2	0.9	363	0	0	N/A
08/07/13	UW1D19130806-00	0	1,179	9,203	98.7	0.8	N/A	0	0	N/A
08/07/13	UW1E08130807-00	1	1,209	10,412	99.3	1.0	363	0	0	N/A
08/08/13	UW1E01130807-00	0	1,558	11,970	98.3	1.0	N/A	0	0	N/A
08/12/13	UW1D19130812-00	0	1,283	13,253	99.8	0.9	N/A	0	0	N/A
08/12/13	UW1C08130808-00	0	1,607	14,860	100.0	1.0	N/A	0	0	N/A
08/12/13	UWY01130808-00	1	1,146	16,006	99.9	1.0	363	0	0	N/A
08/13/13	UW1E01130813-00	1	1,558	17,564	99.2	1.0	396	0	0	N/A
08/13/13	UW1E08130812-00	1	1,098	18,662	99.4	0.9	363	0	0	N/A
08/14/13	UW1C08130814-00	1	1,446	20,108	99.9	0.9	392	0	0	N/A
08/14/13	UWY01130813-00	0	1,146	21,254	99.8	1.0	N/A	0	0	N/A
08/15/13	UW1D19130814-00	0	1,141	22,395	98.3	0.8	N/A	0	0	N/A
08/15/13	UW1E08130815-00	0	1,098	23,493	98.5	0.9	N/A	0	0	N/A
08/19/13	UW1E01130815-00	1	1,558	25,051	99.5	1.0	363	0	0	N/A
08/19/13	UWY01130815-00	0	1,146	26,197	98.1	1.0	N/A	0	0	N/A
08/20/13	UW1C08130819-00	1	1,356	27,553	99.2	1.0	392	0	0	N/A
08/20/13	UW1D19130819-00	1	977	28,530	99.4	0.8	392	0	0	N/A
08/20/13	UW1E08130820-00	0	987	29,517	99.2	0.9	N/A	0	0	N/A
08/21/13	UW1E08130821-00	0	987	30,504	97.3	0.9	N/A	0	0	N/A
08/21/13	UW1E01130820-00	0	1,726	32,230	99.1	1.0	N/A	0	0	N/A
08/22/13	UW1E01130821-00	1	1,554	33,784	98.0	0.9	392	0	0	N/A
08/22/13	UW1E08130822-00	0	987	34,771	93.4	0.9	N/A	0	0	N/A
08/27/13	UW1D01130826-00	2	1,030	35,801	97.9	0.7	363, 392	0	0	N/A
08/27/13	UW1D19130827-00	1	1,320	37,121	99.0	0.9	392	0	0	N/A
08/28/13	UW1C08130827-00	1	1,214	38,335	99.1	0.9	392	0	0	N/A
08/28/13	UWY01130827-00	1	745	39,080	97.9	0.7	392	0	0	N/A
08/29/13	UW1D19130828-00	1	1,320	40,400	98.6	0.9	392	0	0	N/A
08/29/13	UW1C08130829-00	1	1,214	41,614	99.5	0.9	392	0	0	N/A

Average CAES Screen Passing Pixels (%)= 98.8
Total Quantity Approved (yd^3) = 41,614
Total # of Nuclear Density Guage Tests = 0
Total # of Moisture Tests = 19
Quantity per Moisture Test (yd^3) = 2,190
Total Average Thickness (ft.)= 0.9

Appendix A2. RRM Lift-approval Summaries (continued)

CAES compaction screen example from August 2013. There are compaction screens for each lift approved on record. The number of passing pixels reported refers to the percentage of the lift which has green pixels. A green pixel verifies that the minimum of six wheel passes with the compactor has been recorded.

UWY01130815-00



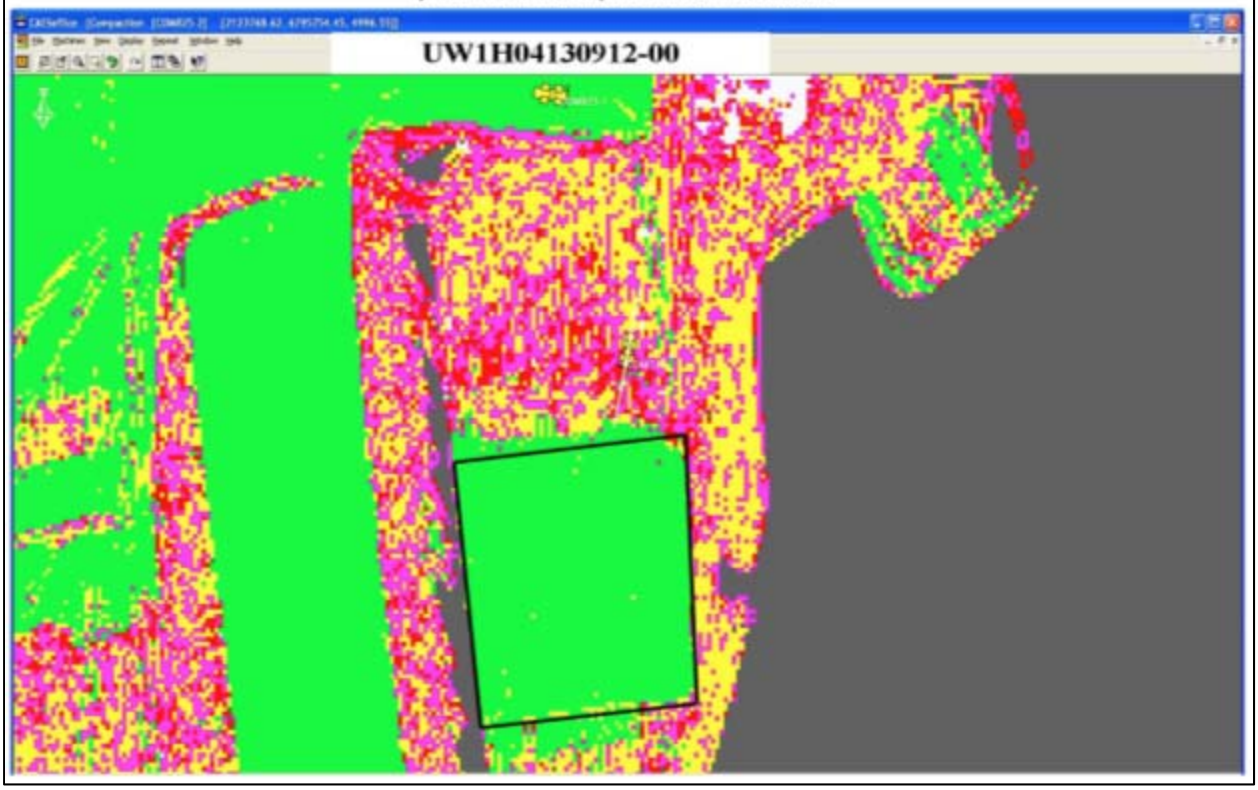
Appendix A2. RRM Lift-approval Summaries (continued)

September 2013										
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Cumulative Quantity Approved (yd^3)	CAES Screen Passing Pixels (%)	Average Thickness (ft)	Proctor ID #	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications	Verified Compaction (%)
09/03/13	UWY01130829-00	0	851	851	92.9	0.8	N/A	0	0	N/A
09/03/13	UW1E01130822-00	2	1,554	2,405	97.5	0.9	363	0	0	N/A
09/03/13	UW1D19130903-00	1	1,320	3,725	99.2	0.9	392	0	0	N/A
09/04/13	UW1C08130903-00	0	1,297	5,022	99.3	1.0	N/A	0	0	N/A
09/04/13	UWY01130903-00	0	745	5,767	99.8	0.7	N/A	0	0	N/A
09/04/13	UW1E08130903-00	2	683	6,450	99.1	0.7	363, 392	0	0	N/A
09/05/13	UW1E01130904-00	0	1,370	7,820	99.8	0.8	N/A	0	0	N/A
09/12/13	UW1G01130911-00	2	1,256	9,076	98.7	0.9	396	0	0	N/A
09/16/13	UW1H04130912-00	0	986	10,062	97.3	0.8	N/A	0	0	N/A
09/16/13	UW1G01130912-00	1	1,396	11,458	97.1	1.0	392	0	0	N/A
09/16/13	UW1H04130916-00	0	1,066	12,524	98.6	0.9	N/A	0	0	N/A
09/17/13	UWG01130916-00	0	1,424	13,948	95.2	1.0	N/A	0	0	N/A
09/17/13	UW1H04130917-00	0	948	14,896	96.7	0.8	N/A	0	0	N/A
09/17/13	UW1D19130905-00	2	1,193	16,089	99.2	0.9	392	0	0	N/A
09/18/13	UW1E08130918-00	1	0	16,089	99.4	0.0	392	0	0	N/A
09/18/13	UW1C08130905-00	1	1,297	17,386	99.2	1.0	392	0	0	N/A
09/19/13	UW1D19130918-00	2	1,061	18,447	97.2	0.8	392	0	0	N/A
09/19/13	UW1C08130919-00	1	1,076	19,523	96.9	0.8	392	1	0	91.4
09/19/13	UW1E08130919-00	0	878	20,401	91.6	0.9	N/A	0	0	N/A
09/25/13	UW1H08130925-00	1	537	20,938	99.6	0.8	403	0	0	N/A
09/25/13	UW1J07130925-00	0	537	21,475	97.4	0.9	N/A	0	0	N/A
09/26/13	UW1D19130919-00	2	1,061	22,536	97.2	0.8	392	0	0	N/A
09/26/13	UW1H08130925-01	0	604	23,140	96.9	0.9	N/A	0	0	N/A
09/26/13	UW1J07130926-00	0	477	23,617	95.0	0.7	N/A	0	0	N/A
09/26/13	UW1E01130917-00	1	0	23,617	98.3	0.0	N/A	0	0	N/A
09/26/13	UW1D19130926-00	1	728	24,345	95.9	0.7	403	0	0	N/A
09/30/13	UW1H08130926-00	0	1,152	25,497	99.4	0.9	N/A	0	0	N/A
09/30/13	UW1E01130926-00	1	1,260	26,757	99.8	0.7	392	0	0	N/A
09/30/13	UW1D19130930-00	0	833	27,590	95.6	0.8	N/A	0	0	N/A

Average CAES Screen Passing Pixels (%)= 97.6
Total Quantity Approved (yd^3) = 27,590
Total # of Nuclear Density Guage Tests = 1
Total # of Moisture Tests = 21
Quantity per Moisture Test (yd^3) = 1,314
Total Average Thickness (ft.)= 0.7

Appendix A2. RRM Lift-approval Summaries (continued)

CAES compaction screen example from September 2013. There are compaction screens for each lift approved on record. The number of passing pixels reported refers to the percentage of the lift which has green pixels. A green pixel verifies that the minimum of six wheel passes with the compactor has been recorded.

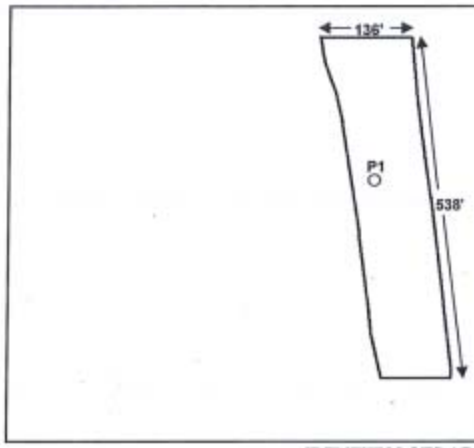


Appendix A2. RRM Lift Approval Package

LIFT APPROVAL FORM

PROJECT: Moab UMTRA OTHER

NW CORNER DATE: 4/9/2013



P 1	6795398 N. 2123541 E.			
EW:	136	X 0.516	=	70
NS:	538	X 0.412	=	222
P 2				
EW:		X	=	
NS:		X	=	
P 3				
EW:		X	=	
NS:		X	=	
P 4				
EW:		X	=	
NS:		X	=	
P 5				
EW:		X	=	
NS:		X	=	

Page 2 attached: Y N

IDENTIFY LOTS ABOVE

LIFT ID: UW1C08130409-00 NW CORNER: 6795620 N. 2123471 E.

Uncompacted Thickness: 0.2 Compacted Thickness: N/A Debris Insp. By: N/A Date: N/A Time: N/A

NW CORNER of debris placement: N/A EW Dimension N/A NS Dimension N/A

Lift Area (ft²): 62,797 Lift Volume (yd³): 465

Comments: QC verified that the lift area was scarified prior to placement. This lift was approved on 11/27/2012. After a 3 month curtailment, QC inspected the lift area and identified frozen material approximately 1.5' to 2' below the surface. The surface matieral was also too dry. QC monitored the material and on 3/26/2013 QC found no frozen material present. Operations ripped the lift area on 4/8/2013 and an over night rain storm added moisture to the surface mateiral. On 4/9/2013 QC performed a moisture /density test on the underlying lift with satisfactory results. QC then performed a moisture test on the surface matieral and verified that the moisture was throughout the depth of the lift. These tests were satisfactory. Operations then compacted the lift area.

Attached Forms: Grid Slope X Compaction Macro X Print Screen X Moisture/ Density X

KEYING IN NOTES: N E S [W] Satisfactory MOISTURE/ DENSITY TESTS ID # (S): 1 and 2

LIFT APPROVED BY: Mitch Hogan/ DATE: 4/9/2013 TIME: 1638

QA/QC APPROVAL 04/25/13 DATE

✓

Density Testing
DOE-EM/GJRAC1783
Rev. 1

QC-F-001
File index No. 43.8.2
Page 1 of 6

Slope Elevation Survey

	Average lift thickness=	0.2	Bounding Box	Northing	Easting
	Grid Size=	45'	Lower Left	N	
Lift ID:	UW1C08130409-00		Upper Right		A

Last Lift Elevations			Lift Approval Elevations			Lift Thickness	
Northing	Easting	Elevation	Northing	Easting	Elevation	Thickness	
6795454	2123522	4957.7	6795454	2123522	4957.7	0.0	OK
6795499	2123522	4958.6	6795499	2123522	4958.9	0.3	OK
6795094	2123567	4948.8	6795094	2123567	4948.6	-0.2	OK
6795139	2123567	4950.4	6795139	2123567	4950.7	0.3	OK
6795184	2123567	4951.2	6795184	2123567	4951.3	0.1	OK
6795229	2123567	4952.0	6795229	2123567	4952.1	0.2	OK
6795274	2123567	4952.9	6795274	2123567	4953.0	0.1	OK
6795319	2123567	4954.0	6795319	2123567	4954.0	0.1	OK
6795364	2123567	4955.1	6795364	2123567	4955.3	0.3	OK
6795409	2123567	4956.5	6795409	2123567	4956.6	0.1	OK
6795454	2123567	4957.9	6795454	2123567	4957.8	-0.1	OK
6795499	2123567	4959.0	6795499	2123567	4958.9	-0.1	OK
6795094	2123612	4948.5	6795094	2123612	4948.3	-0.1	OK
6795139	2123612	4950.5	6795139	2123612	4950.7	0.2	OK
6795184	2123612	4951.4	6795184	2123612	4951.5	0.1	OK
6795229	2123612	4952.0	6795229	2123612	4952.0	0.0	OK
6795274	2123612	4952.7	6795274	2123612	4952.8	0.0	OK
6795319	2123612	4953.8	6795319	2123612	4953.8	0.0	OK
6795364	2123612	4955.2	6795364	2123612	4955.3	0.1	OK
6795409	2123612	4956.7	6795409	2123612	4956.7	0.1	OK
6795454	2123612	4957.9	6795454	2123612	4958.1	0.3	OK
6795499	2123612	4958.4	6795499	2123612	4959.5	1.0	OK
6795094	2123657	4948.3	6795094	2123657	4948.2	0.0	OK
6795139	2123657	4950.3	6795139	2123657	4950.4	0.1	OK
6795184	2123657	4951.0	6795184	2123657	4951.2	0.2	OK
6795229	2123657	4951.2	6795229	2123657	4952.3	1.1	OK
6795553	2123518	4959.7	6795553	2123518	4960.1	0.4	OK
6795598	2123518	4960.8	6795598	2123518	4961.4	0.6	OK
6795553	2123563	4959.8	6795553	2123563	4959.9	0.2	OK
6795598	2123563	4960.7	6795598	2123563	4961.3	0.7	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK

% =6	98.0%
Elevation Avg	4955.4
Total =6	5676
Total Lines	5791

Pass

Minimum Number of Machine Passes
3

Lift ID: UW1C08130409-00

Northing	Easting	Elevation	# of Passes	Passes =6	Count
6795611	2123473	4962.7	6	1	1
6795614	2123473	4962.9	6	1	1
6795617	2123473	4963.0	6	1	1
6795621	2123473	4963.2	6	1	1
6795591	2123477	4961.6	6	1	1
6795594	2123477	4961.8	6	1	1
6795598	2123477	4961.9	6	1	1
6795601	2123477	4962.1	5		1
6795604	2123477	4962.2	6	1	1
6795608	2123477	4962.3	4		1
6795611	2123477	4962.5	6	1	1
6795614	2123477	4962.7	6	1	1
6795617	2123477	4962.8	6	1	1
6795621	2123477	4963.1	6	1	1
6795581	2123480	4961.2	6	1	1
6795585	2123480	4961.4	6	1	1
6795588	2123480	4961.5	6	1	1
6795591	2123480	4961.6	6	1	1
6795594	2123480	4961.7	6	1	1
6795598	2123480	4961.9	6	1	1
6795601	2123480	4962.0	5		1
6795604	2123480	4962.1	6	1	1
6795608	2123480	4962.3	6	1	1
6795611	2123480	4962.4	6	1	1
6795614	2123480	4962.7	6	1	1
6795617	2123480	4962.8	6	1	1
6795621	2123480	4962.9	6	1	1
6795571	2123483	4960.9	2		1
6795575	2123483	4961.0	6	1	1
6795578	2123483	4961.1	6	1	1
6795581	2123483	4961.2	6	1	1
6795585	2123483	4961.2	6	1	1
6795588	2123483	4961.4	6	1	1
6795591	2123483	4961.5	6	1	1
6795594	2123483	4961.6	6	1	1
6795598	2123483	4961.8	6	1	1
6795601	2123483	4962.0	6	1	1
6795604	2123483	4962.1	6	1	1
6795608	2123483	4962.3	6	1	1
6795611	2123483	4962.4	6	1	1
6795614	2123483	4962.6	6	1	1
6795617	2123483	4962.7	6	1	1
6795621	2123483	4962.9	6	1	1
6795562	2123487	4960.6	2		1

Lift Height
1' 0"

Thick Lift Threshold
2' 0"

Last Lift Elevation
N/A

Min. # of Wheel Passes
6

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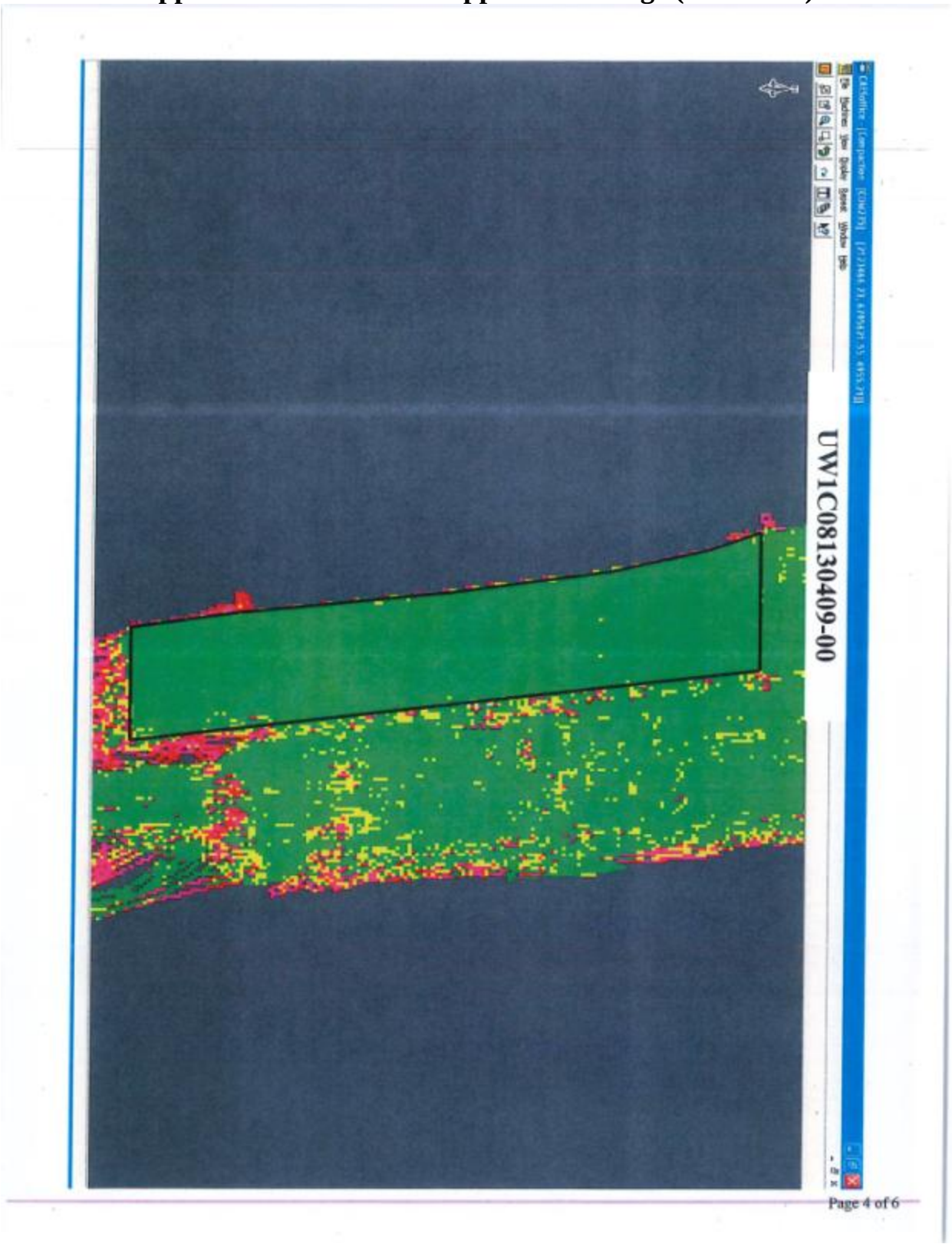
UW1C08130409-00
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FIELD DENSITY TEST

PROJECT: Moab UMTRA Project **OTHER** _____

LIFT IDENTIFICATION: UW1C08130409-00 DATE: 4/9/2013

TEST ID NUMBER(S): # 1

TEST LOCATION: 6795398 N. 2123541 E. TEST METHOD: ____ D1556 X D6938

ASTM D6938 (DENSITY DETERMINATION)

Make/Model Troxler 3430 Gauge Serial # 28098

Last Calibration Date: 3/8/13

Daily Standard Counts: *On-Cell Standard*

Density 3251 Moisture 673

Method A (Direct Transmission)

Depth Setting 6 *(inches)* Count Time 1 *(minutes)*

Moisture Count 207 Density Count 3033

Wet Density (ρ_w) 123.3 *(lbs/ft³)* Dry Density 105.3 *(lbs/ft³)*

Moisture Density 17.9 *(lbs/ft³)* Moisture Fraction 17.0 *(%)*

ASTM D1556 (DENSITY DETERMINATION)

Testing Apparatus ____ Calibrated Vol. *(lbs/ft³)* ____

Bulk Density of sand (ρ_1) ____ *g/cm³* ____ *lbs/ft³*

Mass of Sand to Fill Cone & Plate (M_2) ____ g

Mass of bottle & cone **before** filling cone, plate & hole		g
Mass of bottle & cone **after** filling cone, plate & hole		g
Mass of sand to fill cone, plate, & hole (M_1)		g
Mass of sand to fill hole		g
Mass of wet soil & container		g
Mass of container		g
Mass of wet soil (M_3)		g

N A

Test Hole Volume

$V = (M_1 - M_2) / \rho_1$ ____ cm^3

Dry Mass of soil

$M_4 = 100\ M_3 / (w + 100)$ ____ g

Wet Density

$\rho_w = (M_3 / V) \times 62.43$ ____ lbs/ft^3

Dry Density

$\rho_d = M_4 / V$ ____ g/cm^3

Dry Unit Weight

$\gamma_d = \rho_d \times 62.43$ ____ lbs/ft^3

MOISTURE DETERMINATION

ASTM D4643

Container ID D-2

Mass of container & wet specimen (M_{cws})	406.4	g
Mass of container & dry specimen (M_{cds})	370.0	g
Mass of water (M_w) $M_w = M_{cws} - M_{cds}$	36.4	g
Mass of container (M_c)	163.7	g
Mass of dry specimen (M_s) $M_s = M_{cds} - M_c$	206.3	g
Moisture content (w) $w = (M_w / M_s) \times 100$	17.6	%

Dry Density (ρ_d) $= (100 \times \rho_w)/(100 + w)$

$\rho d = (\ 100 \times 123.3\ ) / (100 + 17.6 = 104.8\ lbs/ft^3$

Note: Wet Density from ASTM D 1556 (ρ_w) takes precedence over ASTM D 6938 (ρ_w)

Percent Compaction = ρ_d / $\gamma_d max \times 100$

104.8 / 107.2 x 100 = 97.8 %

Soil Description: **Brown very fine to fine, poorly graded, subround sand with clay.**

Proctor ID: RRM # 307

Standard Proctor (ASTM D698)

Maximum Dry Density ($\gamma_d max$) 107.2 (lbs/ft³)

Optimum Moisture (w_{opt}) 18.2 (%)

Required Moisture: 15.2 % to 21.2 %

Required Percent Compaction: 90.0 (%)

Comments:

Off cell standard: DS- 2406 MS- 675. Microwave oven power setting on HIGH. Initial time setting of 3 minutes and subsequent incremental drying periods of 1 minute until a change of 0.1 % or less of the initial wet mass of the soil.

TEST RESULTS:

X Pass Date: 4/9/13

Failed Moisture

Failed Compaction Time: 1402

By: Mitch Hogan / *(print)* *(signature)*

QA/QC APPROVAL 04/25/13 DATE

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FIELD DENSITY TEST

PROJECT: Moab UMTRA Project **OTHER** _____

LIFT IDENTIFICATION: UW1C08130409-00 DATE: 4/9/2013

TEST ID NUMBER(S): #2

TEST LOCATION: Lift Area TEST METHOD: N?A D1556 N/A D6938

ASTM D6938 (DENSITY DETERMINATION)

Make/Model _____ Gauge Serial # _____

Last Calibration Date: N/A

Daily Standard Counts:

Density _____ Moisture _____

_____ Method A (Direct Transmission) or _____ Method B (Backscatter)

Depth Setting _____ (inches) Count Time _____ (minutes)

N A

Moisture Count _____ Density Count _____

Wet Density (ρ_m) _____ (lbs/ft^3) Dry Density _____ (lbs/ft^3)

Moisture Density _____ (lbs/ft^3) Moisture Fraction _____ (%)

ASTM D1556 (DENSITY DETERMINATION)

Testing Apparatus _____ Calibrated Vol. (lbs/ft^3) _____

Bulk Density of sand (ρ_1) _____ g/cm^3 _____ lbs/ft^3

Mass of Sand to Fill Cone & Plate (M_2) _____ g

Mass of bottle & cone **before** filling cone, plate & hole		g
Mass of bottle & cone **after** filling cone, plate & hole		g
Mass of sand to fill cone, plate, & hole (M_1)		g
Mass of sand to fill hole		g
Mass of wet soil & container		g
Mass of container		g
Mass of wet soil (M_3)		g

N A

Test Hole Volume
$V = (M_1 - M_2) / \rho_1$ _____ cm^3

Dry Mass of soil
$M_4 = 100\ M_3 / (w + 100)$ _____ g

Wet Density
$\rho_m = (M_3 / V) \times 62.43$ _____ lbs/ft^3

Dry Density
$\rho_d = M_4 / V$ _____ g/cm^3

Dry Unit Weight
$\gamma_d = \rho_d \times 62.43$ _____ lbs/ft^3

MOISTURE DETERMINATION

ASTM D4643

Container ID D-3

Mass of container & wet specimen (M_{cms})	359.6	g
Mass of container & dry specimen (M_{cds})	329.4	g
Mass of water (M_w) $M_w = M_{cms} - M_{cds}$	30.2	g
Mass of container (M_c)	164.4	g
Mass of dry specimen (M_s) $M_s = M_{cds} - M_c$	165.0	g
Moisture content (w) $w = (M_w / M_s) \times 100$	18.3	%

Soil Description: **Brown very fine to fine, poorly graded, subround sand with clay.**

Proctor ID: **RRM # 307**

Standard Proctor (ASTM D698)

Maximum Dry Density ($\gamma_d max$) 107.2 (lbs/ft^3)

Optimum Moisture (w_{opt}) 18.2 (%)

Required Moisture: 15.2 % to 21.2 %

Required Percent Compaction: 90.0 (%)

Dry Density $(\rho_d) = (100 \times \rho_m)/(100 + w)$

$\rho d = (100 \times$ ##### $) / (100 +$ 18.3 $) =$ 0.0 lbs/ft^3

Note: Wet Density from ASTM D [illegible] (ρ_m) takes precedence over ASTM D 6938 (ρ_m)

N A

Percent Compaction = ρ_d / $\gamma_d max \times 100$

0.0 / 107.2 x 100 = 0.0 %

Comments:

Microwave oven power setting on HIGH. Initial time setting of 3 minutes and subsequent incremental drying periods of 1 minute until a change of 0.1 % or less of the initial wet mass of the soil.

TEST RESULTS:

X Pass Date: 4/9/13

_____ Failed Moisture

_____ Failed Compaction Time: 1415

By: Mitch Hogan / _____

(print) (signature)

[signature] 04/25/13

QA/QC APPROVAL DATE

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Appendix A2. RRM Top-of-Waste Buyoff Survey

Environmental Management - Grand Junction Office
MOAB UMTRA Project

Top of Waste Buyoff Form

CRJ 001312

Client: Department of Energy
Project: Moab UMTRA Project
Date: 10-11-2012

In signing this document, the signatory agrees that the lift is complete and meets both the project specifications and RAIP requirements.

Lift Area	Lift Area
UWS01	

Approver Name/Title	Signature	Sign Date
Craig Niemeyer / Crescent Junction Site Manager		10-11-2012
Todd McFarland / Landfill Operations Supervisor		10-11-2012
Beachem Bosh / QA/QC Representative		10-11-2012
Comments		
UWS01 buy off survey includes the following RRM lift areas: UWT01, UWW07 and UWX15		

RECORD COPY

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Rev 0, August 2010

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7-9-13 cs

Top Of Waste Buyoff Survey

Lift Area Buyoff ID:			UWS01		Date:	10/11/2012
Point #	Northing	Easting	Surveyed Elevation	Design Elevation	Difference in feet	Difference in inches
8761	6796032	2123027	4988.03	4988.00	0.0	0.3
8799	6796038	2123076	4988.25	4988.18	0.1	0.9
8837	6796044	2123126	4988.51	4988.37	0.1	1.7
8875	6796050	2123175	4988.64	4988.55	0.1	1.1
8913	6796057	2123225	4988.81	4988.74	0.1	0.8
8914	6796030	2123228	4989.33	4989.28	0.0	0.6
8876	6796024	2123179	4989.11	4989.09	0.0	0.2
8838	6796017	2123129	4988.95	4988.91	0.0	0.5
8800	6796011	2123080	4988.73	4988.72	0.0	0.1
8762	6796005	2123030	4988.61	4988.54	0.1	0.8
8763	6795955	2123036	4989.59	4989.54	0.0	0.6
8801	6795962	2123086	4989.80	4989.72	0.1	1.0
8839	6795968	2123135	4989.93	4989.91	0.0	0.2
8877	6795974	2123185	4990.12	4990.09	0.0	0.3
8878	6795924	2123191	4991.12	4991.09	0.0	0.4
8840	6795918	2123142	4990.92	4990.91	0.0	0.2
8802	6795912	2123092	4990.77	4990.72	0.1	0.6
8764	6795906	2123042	4990.56	4990.54	0.0	0.3
8765	6795856	2123049	4991.64	4991.54	0.1	1.2
8803	6795862	2123098	4991.80	4991.72	0.1	0.9
8841	6795869	2123148	4992.01	4991.91	0.1	1.2
8879	6795875	2123198	4992.18	4992.09	0.1	1.1
8880	6795825	2123204	4993.17	4993.09	0.1	1.0
8842	6795819	2123154	4993.01	4992.91	0.1	1.2
8804	6795813	2123104	4992.75	4992.72	0.0	0.4
8766	6795806	2123055	4992.63	4992.54	0.1	1.0
8728	6795800	2123005	4992.42	4992.35	0.1	0.8
8729	6795751	2123011	4993.40	4993.35	0.0	0.6
8767	6795757	2123061	4993.69	4993.54	0.1	1.8
8805	6795763	2123111	4993.74	4993.72	0.0	0.2
8843	6795769	2123160	4994.04	4993.91	0.1	1.5
8844	6795720	2123167	4995.01	4994.91	0.1	1.2
8806	6795714	2123117	4994.80	4994.72	0.1	1.0
8768	6795707	2123067	4994.67	4994.54	0.1	1.6
8730	6795701	2123018	4994.40	4994.35	0.0	0.6
8731	6795651	2123024	4995.36	4995.35	0.0	0.1
8769	6795658	2123074	4995.69	4995.54	0.1	1.8
8807	6795664	2123123	4995.78	4995.72	0.1	0.7
8845	6795670	2123173	4995.99	4995.91	0.1	0.9
8846	6795621	2123179	4997.05	4996.91	0.1	1.6
8808	6795614	2123129	4996.84	4996.72	0.1	1.4
8770	6795608	2123080	4996.56	4996.54	0.0	0.3
8732	6795602	2123030	4996.39	4996.35	0.0	0.5
8733	6795552	2123037	4997.40	4997.35	0.0	0.5
8734	6795503	2123043	4998.41	4998.35	0.1	0.7
8735	6795453	2123049	4997.16	4997.10	0.1	0.8
8736	6795403	2123055	4995.99	4995.85	0.1	1.6
8737	6795354	2123061	4994.75	4994.60	0.1	1.8
8738	6795304	2123068	4993.42	4993.35	0.1	0.9
8739	6795255	2123074	4992.22	4992.10	0.1	1.4
8740	6795205	2123080	4990.87	4990.85	0.0	0.2
8741	6795155	2123086	4989.63	4989.60	0.0	0.3
8742	6795106	2123093	4988.36	4988.35	0.0	0.1
8847	6795571	2123185	4997.98	4997.91	0.1	0.9
8809	6795565	2123136	4997.75	4997.72	0.0	0.3
8771	6795558	2123086	4997.66	4997.54	0.1	1.4
8772	6795509	2123092	4998.54	4998.53	0.0	0.1
8773	6795459	2123099	4997.36	4997.28	0.1	0.9
8810	6795515	2123142	4998.72	4998.72	0.0	0.0
8848	6795521	2123192	4998.97	4998.91	0.1	0.7
8849	6795472	2123198	4997.75	4997.66	0.1	1.1
8811	6795465	2123148	4997.56	4997.47	0.1	1.1
8774	6795410	2123105	4996.10	4996.03	0.1	0.8
8812	6795416	2123154	4996.26	4996.22	0.0	0.5

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Appendix A2. RRM Top-of-Waste Buyoff Survey (continued)

8850	6795422	2123204	4996.45	4996.41	0.0	0.5
8851	6795372	2123210	4995.25	4995.16	0.1	1.1
8813	6795366	2123161	4995.01	4994.97	0.0	0.4
8775	6795360	2123111	4994.79	4994.78	0.0	0.2
8776	6795310	2123117	4993.63	4993.53	0.1	1.1
8814	6795317	2123167	4993.78	4993.72	0.1	0.7
8852	6795323	2123216	4993.97	4993.91	0.1	0.7
8853	6795273	2123223	4992.74	4992.66	0.1	0.9
8815	6795267	2123173	4992.49	4992.47	0.0	0.2
8777	6795261	2123124	4992.36	4992.28	0.1	0.9
8778	6795211	2123130	4991.06	4991.03	0.0	0.3
8816	6795217	2123179	4991.25	4991.22	0.0	0.3
8854	6795224	2123229	4991.49	4991.41	0.1	1.0
8855	6795174	2123235	4990.21	4990.16	0.1	0.6
8817	6795168	2123186	4990.02	4989.97	0.0	0.5
8779	6795162	2123136	4989.81	4989.78	0.0	0.4
8780	6795112	2123142	4988.62	4988.53	0.1	1.1
8818	6795118	2123192	4988.79	4988.72	0.1	0.8
8856	6795124	2123241	4988.96	4988.91	0.0	0.6
8857	6795075	2123248	4987.70	4987.66	0.0	0.4
8819	6795069	2123198	4987.50	4987.47	0.0	0.3
8781	6795062	2123148	4987.34	4987.28	0.1	0.7
8743	6795056	2123099	4987.13	4987.10	0.0	0.4
8744	6795007	2123105	4985.89	4985.85	0.0	0.5
8782	6795013	2123155	4986.06	4986.03	0.0	0.3

Comments: QC performed a visual inspection of the final surface with satisfactory results. Visual inspection notes: The area was free of humping, thickened edges and defects. The layer uniform thickness was satisfactory see above survey results for layer thickness. This buy off area included the following lift areas: UWT01, UWW07 and UWX15.

Approval Date: 10/11/2012 **Total Square Feet:** 200,772ft²

North West Corner: 6796030 North 2123017 East

QC Signature: Beachem Bosh **Reviewed By: Mitch Hogan**

KF 10/30/13

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Appendix A3.
Interim Cover

Standard Proctor Test-results Summary
Lift-approval Summary
Lift-approval Package
Buyoff Surveys

Appendix A3. Interim Cover Standard Proctor Test Results Summary

Proctor ID #	Date Sampled	Date Approved	Maximum Dry Density (lb/ft^3)	Optimum Moisture Content (%)	Soils Description
Interim Cover #2	8/5/11	8/11/11	115.6	13.5	Greyish in color and consists mostly fines

Appendix A3. Interim Cover Lift Approval Summary

October 2012									
Date	Lift ID #	# of Passing Moisture Tests	Quantity Approved (yd^3)	Commulative Quantity Approved (yd^3)	Average Lift Thickness (ft)	Northing	Easting	# of Nuclear Density Gauge Verifications	# of Sandcone Verifications
10/17/12	UIS09121016-00	1	2,182	2182	0.7	6795493	2123002	1	0
10/18/12	UIR01121018-00	1	2,831	5013	0.7	6796030	2122972	1	0
10/22/12	UIR01121022-00	1	1,213	6226	0.3	6796030	2122972	1	0
10/23/12	UIS09121022-00	1	1,247	7473	0.4	6795493	2123002	1	0

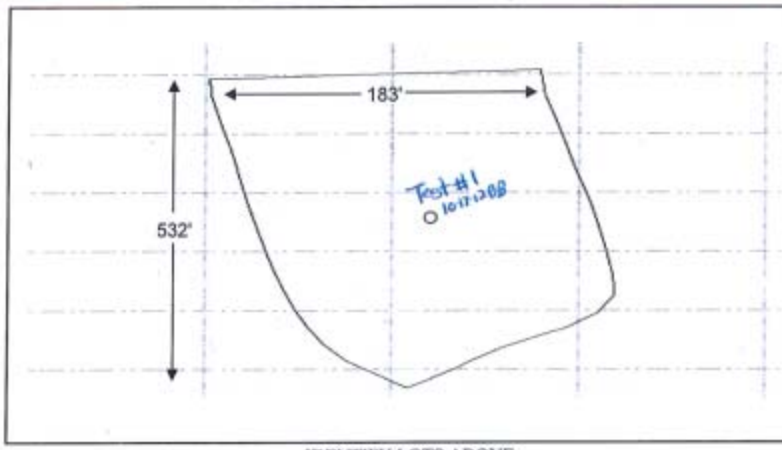
Total Quantity Approved (yd^3) = 7473
Total # of Nuclear Density Gauge Tests = 4
Total # of passing Moisture Tests = 4
Quantity Per Moisture Test (yd^3) = 1868
Total Average Thickness (ft) = 0.5

Appendix A3. Interim Cover Lift-approval Package

LIFT APPROVAL FORM

PROJECT: Moab UMTRA OTHER

NW CORNER DATE: 10/16/2012



P 1	# 1			
EW:	183	X 0.636	=	116
NS:	532	X 0.451	=	240
P 2				
EW:		X	=	
NS:		X	=	
P 3				
EW:		X	=	
NS:		X	=	
P 4				
EW:		X	=	
NS:		X	=	
P 5				
EW:		X	=	
NS:		X	=	

Page 2 attached: Y N

IDENTIFY LOTS ABOVE

LIFT ID: UIS09121016-00 NW CORNER: 6795493 N 2123002 E

Uncompacted Thickness: 0.7 Compacted Thickness: N/A Debris Insp. By: N/A Date: N/A Time: N/A

NW CORNER of debris placement: N/A EW Dimension N/A NS Dimension N/A

Lift Area (ft²): 84,178 Lift Volume (yd³): 2,182

Comments: This is the 1st lift of interim cover placed in this area. QC verified that the underlying layer of RRM was scarified prior to placement of this lift. The CAES system was not used to approve this lift,. This lift was approved by performing a high accuracy hand held GPS survey and performing and in field moisture density test. See attached for testing and survey results. Square footage is based off a field survey performed, not by the dimensions displayed on the lift map.

Attached Forms: Grid Slope X Compaction Macro N/A Print Screen N/A Moisture/ Density X

KEYING IN NOTES: N E S [W] Satisfactory MOISTURE/ DENSITY TESTS ID # (S): # 1

LIFT APPROVED BY: Beachem Bosh DATE: 10/17/2012 TIME: 1506

QA/QC APPROVAL 10/25/2012 DATE

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Slope Elevation Survey

Average lift thickness=	0.7	Bounding Box	Northing	Easting	
Grid Size=	50'	Lower Left	N		
Lift ID:	UIS09121016-00	Upper Right		A	

Last Lift Elevations			Lift Approval Elevations			Lift Thickness	
Northing	Easting	Elevation	Northing	Easting	Elevation	Thickness	
6795007	2123105	4985.9	6795007	2123105	4986.6	0.8	OK
6795056	2123099	4987.1	6795056	2123099	4987.8	0.7	OK
6795062	2123148	4987.3	6795062	2123148	4988.1	0.8	OK
6795118	2123192	4988.8	6795118	2123192	4989.5	0.7	OK
6795112	2123142	4988.6	6795112	2123142	4989.3	0.7	OK
6795106	2123093	4988.4	6795106	2123093	4989.1	0.7	OK
6795155	2123086	4989.6	6795155	2123086	4990.3	0.7	OK
6795162	2123136	4989.8	6795162	2123136	4990.6	0.7	OK
6795168	2123186	4990.0	6795168	2123186	4990.7	0.7	OK
6795217	2123179	4991.3	6795217	2123179	4992.0	0.7	OK
6795211	2123130	4991.1	6795211	2123130	4991.8	0.7	OK
6795205	2123080	4990.9	6795205	2123080	4991.6	0.7	OK
6795255	2123074	4992.2	6795255	2123074	4992.8	0.6	OK
6795261	2123124	4992.4	6795261	2123124	4993.1	0.7	OK
6795267	2123173	4992.5	6795267	2123173	4993.3	0.8	OK
6795317	2123167	4993.8	6795317	2123167	4994.5	0.7	OK
6795310	2123117	4993.6	6795310	2123117	4994.3	0.7	OK
6795304	2123068	4993.4	6795304	2123068	4994.1	0.7	OK
6795354	2123061	4994.8	6795354	2123061	4995.4	0.6	OK
6795360	2123111	4994.8	6795360	2123111	4995.5	0.7	OK
6795366	2123161	4995.0	6795366	2123161	4995.7	0.7	OK
6795416	2123154	4996.3	6795416	2123154	4996.9	0.6	OK
6795410	2123105	4996.1	6795410	2123105	4996.8	0.7	OK
6795403	2123055	4996.0	6795403	2123055	4996.6	0.6	OK
6795453	2123049	4997.2	6795453	2123049	4997.9	0.8	OK
6795459	2123099	4997.4	6795459	2123099	4998.0	0.6	OK
6795465	2123148	4997.6	6795465	2123148	4998.2	0.7	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK
						0.0	OK

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FIELD DENSITY TEST

PROJECT: Moab UMTRA Project **OTHER** _____

LIFT IDENTIFICATION: UIS09121016-00 DATE: 10/17/2012

TEST ID NUMBER(S): # 1

TEST LOCATION: 6795253 N 2123118 E TEST METHOD: N/A D1556 X D6938

ASTM D6938 (DENSITY DETERMINATION)

Make/Model Troxler 3450 Gauge Serial # 573

Last Calibration Date: 1/26/11

Daily Standard Counts: *On-Cell Standard*

Density 5394 / 2070 Moisture 1166

Method A (Direct Transmission)

Depth Setting 6 *(inches)* Count Time 1 *(minutes)*

Moisture Count 235 Density Count 11764 / 3747

Wet Density (ρ_m) 124.7 *(lbs/ft³)* Dry Density 114.9 *(lbs/ft³)*

Moisture Density 9.7 *(lbs/ft³)* Moisture Fraction 8.5 *(%)*

ASTM D1556 (DENSITY DETERMINATION)

Testing Apparatus _____ Calibrated Vol. *(lbs/ft³)* _____

Bulk Density of sand (ρ_1) _____ g/cm³ _____ lbs/ft³

Mass of Sand to Fill Cone & Plate (M_2) _____ g

Mass of bottle & cone **before** filling cone, plate & hole		g
Mass of bottle & cone **after** filling cone, plate & hole		g
Mass of sand to fill cone, plate, & hole (M_1)		g
Mass of sand to fill hole		g
Mass of wet soil & container		g
Mass of container		g
Mass of wet soil (M_3)		g

Test Hole Volume
$V = (M_1 - M_2) / \rho_1$ _____ cm³

Dry Mass of soil
$M_4 = 100\ M_3 / (w + 100)$ _____ g

Wet Density
$\rho_m = (M_3 / V) \times 62.43$ _____ lbs/ft³

Dry Density
$\rho_d = M_4 / V$ _____ g/cm³

Dry Unit Weight
$\gamma_d = \rho_d \times 62.43$ _____ lbs/ft³

MOISTURE DETERMINATION

ASTM D4643

Container ID D-7

Mass of container & wet specimen (M_{cms})	469.8	g
Mass of container & dry specimen (M_{cds})	447.4	g
Mass of water (M_w) $M_w = M_{cms} - M_{cds}$	22.4	g
Mass of container (M_c)	211.4	g
Mass of dry specimen (M_s) $M_s = M_{cds} - M_c$	236.0	g
Moisture content (w) $w = (M_w / M_s) \times 100$	9.5	%

Soil Description: Greyish in color and comnsists mostly fines

Proctor ID: Interim Cover # 2 (2011)

Standard Proctor (ASTM D698)

Maximum Dry Density ($\gamma_d max$) 115.6 (lbs/ft³)

Optimum Moisture (w_{opt}) 13.5 (%)

Required Moisture: 8.5 % to 18.5 %

Required Percent Compaction: ~~95.0~~ 90.0 (%)

Dry Density $(\rho_d) = (100 \times \rho_m)/(100 + w)$

$\rho d = (\ 100 \times 124.7\ ) / (100 + 9.5) = 113.9$ lbs/ft³

Note: Wet Density from ASTM D 1556 (ρ_m) takes precedence over ASTM D 6938 (ρ_m)

Percent Compaction = ρ_d / $\gamma_d max$ x 100

113.9 / 115.6 x 100 = 98.5 %

Comments:

Off cell Standard counts = DS # 1 5317 DS # 2 1887 M 1169Microwave oven power setting on HIGH. Initial time setting of 3 minutes and subsequent incremental drying periods of 1 minute until a change of 0.1 % or less of the initial wet mass of the soil.

TEST RESULTS:

[x] Pass Date: 10/17/12

[ ] Failed Moisture

[ ] Failed Compaction Time: 1430

By: Beachem Bosh / *(print)* *(signature)*

QA/QC APPROVAL 10.25.2012 DATE

Density Testing
DOE-EM/GJRAC1783
Rev. 0

QC-F-002
File Index No. 43.8.2
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Appendix A3. Interim Cover Buyoff Surveys

Environmental Management - Grand Junction Office
MOAB UMTRA Project

Interim Cover Buyoff Form

Client: Department of Energy
Project: Moab UMTRA Project
Date: 10-22-2012

In signing this document, the signatory agrees that the lift is complete and meets both the project specifications and RAIP requirements.

Lift Area	Lift Area
UIR01	

Approver Name/Title	Signature	Sign Date
Craig Niemeyer Crescent Junction Operations / Site Manager		10-22-2012
Beachem Bosh QA/QC Representative		10-22-2012
Comments		
Total square footage for this area is 109,204ft²		

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7-9-13 cs

Interim Cover Buyoff Survey

Lift Area Buyoff ID:			UIR01		Date:	10/22/2012
Point #	Northing	Easting	Surveyed Elevation	Design Elevation	Difference in feet	Difference in inches
8724	6795999	2122980	4989.5	4989.4	0.1	1.7
8726	6795900	2122993	4991.5	4991.4	0.2	1.9
8727	6795850	2122999	4992.5	4992.4	0.1	1.5
8728	6795800	2123005	4993.4	4993.35	0.1	1.0
8729	6795751	2123012	4994.5	4994.35	0.1	1.2
8730	6795701	2123018	4995.5	4995.35	0.1	1.3
8731	6795651	2123024	4996.5	4996.35	0.1	1.4
8732	6795602	2123030	4997.5	4997.35	0.1	1.3
8733	6795552	2123036	4998.5	4998.35	0.1	1.6
8734	6795503	2123043	4999.4	4999.35	0.1	0.6
8735	6795453	2123049	4998.2	4998.10	0.1	1.6
8761	6796032	2123027	4989.1	4989.00	0.1	1.2
8762	6796005	2123030	4989.6	4989.54	0.1	1.3
8763	6795955	2123036	4990.6	4990.54	0.1	1.2
8764	6795906	2123042	4991.7	4991.54	0.1	1.6
8765	6795856	2123049	4992.7	4992.54	0.2	1.9
8766	6795807	2123055	4993.6	4993.54	0.1	0.9
8767	6795757	2123061	4994.6	4994.54	0.0	0.3
8768	6795707	2123067	4995.5	4995.54	0.0	0.1
8769	6795658	2123074	4996.6	4996.54	0.1	0.8
8770	6795608	2123080	4997.6	4997.54	0.1	1.1
8771	6795558	2123086	4998.7	4998.54	0.1	1.4
8772	6795509	2123092	4999.5	4999.53	0.0	0.2
8773	6795459	2123099	4998.4	4998.28	0.1	1.3
8799	6796038	2123076	4989.2	4989.18	0.0	0.5
8800	6796011	2123080	4989.8	4989.72	0.0	0.5
8801	6795962	2123086	4990.8	4990.72	0.1	1.5
8802	6795912	2123092	4991.7	4991.72	0.0	0.2
8803	6795862	2123098	4992.8	4992.72	0.1	1.3
8804	6795813	2123104	4993.8	4993.72	0.1	1.1
8805	6795763	2123111	4994.7	4994.72	0.0	0.2
8806	6795714	2123117	4995.8	4995.72	0.0	0.5
8807	6795664	2123123	4996.8	4996.72	0.1	0.9
8808	6795614	2123129	4997.7	4997.72	0.0	0.2
8809	6795565	2123136	4998.8	4998.72	0.0	0.4
8810	6795515	2123142	4999.7	4999.72	0.0	0.1
8811	6795466	2123148	4998.5	4998.47	0.0	0.4
8837	6796044	2123126	4989.4	4989.37	0.0	0.2
8838	6796017	2123129	4989.9	4989.91	0.0	0.1
8839	6795968	2123136	4990.9	4990.91	0.0	0.1
8840	6795918	2123142	4992.0	4991.91	0.1	1.2
8841	6795869	2123148	4993.0	4992.91	0.1	1.6
8842	6795819	2123154	4994.0	4993.91	0.1	1.0
8843	6795769	2123160	4994.9	4994.91	0.0	0.0
8844	6795720	2123167	4995.9	4995.91	0.0	0.1
8845	6795670	2123173	4996.9	4996.91	0.0	0.0
8875	6796050	2123175	4989.7	4989.55	0.1	1.2
8876	6796024	2123179	4990.1	4990.09	0.0	0.0
8877	6795974	2123185	4991.1	4991.09	0.0	0.0
			N/A			

Comments:	QC performed a visual inspection of the final surface with satisfactory results. Visual inspection notes: The area was free of humping, thickened edges and defects. The layer uniform thickness was satisfactory see above survey results for layer thickness.
Approval Date:	10/22/2012
Total Square Feet:	109,204

North West Corner: 6796030 North 2122972 East

QC Signature: Mitch Hogan Reviewed By: Beecher Bash

EnergySolutions

RECORD COPY 1 of 3
43.8.3.1
7-9-13 cs

Environmental Management - Grand Junction Office
MOAB
UMTRA Project

Interim Cover Buyoff Form

Client: Department of Energy
Project: Moab UMTRA Project
Date: 10-22-2012

In signing this document, the signatory agrees that the lift is complete and meets both the project specifications and RAIP requirements.

Lift Area	Lift Area
UIS09	

Approver Name/Title	Signature	Sign Date
Craig Niemeyer Crescent Junction Operations / Site Manager		10-23-2012
Beachem Bosh QA/QC Representative		10-23-2012
Comments		
Total square footage for this area is 84,178 ft²		

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Interim Cover Buyoff Survey

Lift Area Buyoff ID:			UIS09		Date:	10/23/2012
Point #	Northing	Easting	Surveyed Elevation	Design Elevation	Difference in feet	Difference in inches
8811	6795465	2123148	4998.5	4998.5	0.1	0.8
8773	6795459	2123099	4998.4	4998.3	0.1	1.4
8735	6795453	2123049	4998.2	4998.1	0.1	1.4
8736	6795403	2123055	4997.0	4996.9	0.1	1.7
8774	6795410	2123105	4997.2	4997.0	0.1	1.6
8812	6795416	2123154	4997.3	4997.2	0.1	1.2
8813	6795366	2123161	4996.1	4996.0	0.1	1.3
8775	6795360	2123111	4995.9	4995.8	0.1	1.7
8737	6795354	2123061	4995.7	4995.6	0.1	1.8
8738	6795304	2123068	4994.5	4994.4	0.1	1.7
8776	6795310	2123117	4994.6	4994.5	0.1	1.2
8814	6795317	2123167	4994.9	4994.7	0.1	1.7
8815	6795267	2123173	4993.5	4993.5	0.1	0.7
8777	6795261	2123124	4993.4	4993.3	0.1	1.3
8739	6795255	2123074	4993.2	4993.1	0.1	1.5
8740	6795205	2123080	4992.0	4991.9	0.1	1.5
8778	6795211	2123130	4992.1	4992.0	0.1	1.2
8816	6795217	2123179	4992.4	4992.2	0.2	1.8
8817	6795168	2123186	4991.1	4991.0	0.1	1.3
8779	6795162	2123136	4990.9	4990.8	0.1	1.6
8741	6795155	2123086	4990.7	4990.6	0.1	1.5
8742	6795106	2123093	4989.5	4989.4	0.1	1.6
8780	6795112	2123142	4989.7	4989.5	0.1	1.5
8818	6795118	2123192	4989.8	4989.7	0.1	1.3
8819	6795069	2123198	4988.6	4988.5	0.1	1.8
8781	6795062	2123148	4988.3	4988.3	0.1	0.7
8743	6795056	2123099	4988.2	4988.1	0.1	1.2
8744	6795006	2123105	4987.0	4986.9	0.1	1.7
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0
					0.0	0.0

10/23/2012 BB

N/A

Comments:	QC performed a visual inspection of the final surface with satisfactory results. Visual inspection notes: The area was free of humping, thickened edges and defects. The layer uniform thickness was satisfactory see above survey results for layer thickness.
Approval Date: 10/23/2012	Total Square Feet: 84,178
North West Corner:	
QC Signature: Beachem Bosh	Reviewed By: Mitch Hayden

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Appendix B.
Photographs

RRM Placement
Interim Cover

Appendix B. Photographs RRM Placement

Photo 1. RRM Placement November 2012

Photo 2. RRM Placement November 2012

Appendix B. Photographs RRM Placement (continued)

Photo 3. RRM Placement November 2012

Photo 4. RRM Placement March 2013

Appendix B. Photographs RRM Placement (continued)

Photo 5. Container Dumping April 2013

Photo 6. RRM Placement April 2013

Appendix B. Photographs RRM Placement (continued)

Photo 7. RRM Compaction May 2013

Photo 8. RRM Placement May 2013

Appendix B. Photographs RRM Placement (continued)

Photo 9. Conditioning RRM June 2013

Photo 10. RRM Placement June 2013

Appendix B. Photographs RRM Placement (continued)

Photo 11. RRM Placement June 2013

Photo 12. Density Testing September 2013

Appendix B. Photographs
Interim Cover

Photo 13. Interim Cover Placement October 2012

Photo 14.Interim Cover Placement October 2012

Attachment 1.
Procedures

Moab UMTRA Project Lift Approval Procedure
Moab UMTRA Project Moisture/Density Testing Procedure

Attachment 1.Moab UMTRA Project Lift Approval Procedure

DOE–EM/GJRAC1803

Office of Environmental Management – Grand Junction

MOAB UTAH
UMTRA Project

Moab UMTRA Project Lift Approval

Revision 6

January 2013

U.S. Department of Energy

Office of Environmental Management

Prepared by the Remedial Action Contractor under contract number DE-DT0002936 for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

Attachment 1. Moab UMTRA Project Lift Approval Procedure (continued)

DOE-EM/GJRAC1803

Moab UMTRA Project
Lift Approval Procedure

Revision 6

January 2013

Prepared by the Remedial Action Contractor under contract number DE-DT0002936
for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

Attachment 1. Moab UMTRA Project Lift Approval Procedure (continued)

DOE-EM/GJRAC1803

Moab UMTRA Project
Lift Approval Procedure

Revision 6

Review and Approval

1/29/2013
Beachem Bosh — Date
RAC Quality Assurance Representative

1/29/2013
Kathy Turvy — Date
RAC Quality Assurance Manager

29JAN13
Craig Niemeyer — Date
RAC Crescent Junction Operations/Site Manager

2Feb13
Steve Rima — Date
RAC Environmental, Safety, Health, and Quality Manager

Attachment 1. Moab UMTRA Project Lift Approval Procedure (continued)

Revision History

Revision No.	Date	Reason/Basis for Revision
0	April 16, 2009	Initial issue.
1	April 23, 2009	Revision update includes correction of lift approval percentage.
2	December 2009	Revision updates include machine parameter changes, compactor information, cold weather placement, and surveying methods.
3	November 2010	Revision updates include updated forms, reference to testing in accordance with DOE-EM/GJRAC1783, horizontal lift compaction requirements, and survey documentation requirements.
4	July 2011	Revision updates include new verbiage to section 3.2.4 Lift Survey.
5	August 2012	Revision updates include adding the correct machine weights and updated forms.
6	January 2013	Revision updates includes new verbiage and deletion of Source Documentation section.

Contents

Attachments

1.0 Purpose and Scope

1.1 Purpose

The purpose of this procedure is to provide a consistent and practical method for compacting residual radioactive material (RRM) on the Moab Uranium Mill Tailings Remedial Action (UMTRA) Project using a machine equipped with a computer-aided earthmoving system (CAES) and to provide methods for approving RRM lifts.

1.2 Scope

This procedure applies to RRM lifts using a machine equipped with a CAES and the approval of RRM lifts.

2.0 General

2.1 Definitions

Computer-aided earthmoving system (CAES) – Machine guidance system that delivers real-time productivity information to machine operators on an in-cab display using satellite navigation technology, machine-mounted components, a radio network, and office-management software.

Layer of snow – Blanket of snow that covers working lift areas without any voids in the snow.

Lift Area – Area of the embankment identified for material placement.

Lift Identification – Discrete number that consists of:
- Moab UMTRA Project (e.g., U for UMTRA Project cell).
- Work Element (e.g., W for RRM placement, I for interim cover placement, R for radon barrier placement, B for biointrusion placement, F for frost protection placement, C for cap rock placement, E for embankment placement, CF for cell floor).
- Lift Area – (e.g., A1, B1, C1) year, month, and day (e.g., UWA1090117, UIA1090117, URA1090117, UBA1090117, UFA1090117, UCA1090117).
- Number of lifts tested and approved for a specific lift area on the same day (e.g., 1st lift -00, 2nd lift -01).

Example: U for Moab UMTRA Project, W for RRM lift, A1 for lift area, 121206 date for day lift was first tested, and -00 for 1st lift tested that day (e.g., UWA1121206-00).

NOTE: The day the lift area is first tested will be the date used for lift identification.

Machine – Heavy equipment that is greater than or equal to 56,669 pounds (lb) in weight.

Machine pass – Movement of a machine across an area of the lift in any direction that meets compaction criteria calculated by an algorithm in the CAES. Movement of the machine from one side of the lift to the opposite side of the lift (which meets compaction criteria calculated by an algorithm in the CAES) constitutes one pass; the return trip from the opposite side of the lift (which also meets compaction criteria calculated by an algorithm in the compactor's system) constitutes a second pass.

Wheel pass – Movement of the machine rear or front axle/wheels across an area of the lift that meets compaction criteria calculated by an algorithm in the compactor's system. The CAES reports one wheel pass for each end of the machine (i.e., two wheel passes equals one machine pass).

2.2 Responsibilities

2.2.1 Quality Assurance Manager

The Quality Assurance (QA) Manager is responsible for:

- Implementing and directing Quality Control (QC) activities contained within this procedure.
- Identifying QC problems.
- Initiating, recommending, and/or providing QC solutions.

2.2.2 QA/QC Representative

The QA/QC Representative or designee is responsible for the proper implementation of this procedure and for approving lifts in accordance with this procedure.

2.2.3 Operations/Site Manager

The Operations/Site Manager or designee is responsible for issuing directives to equipment operators.

2.2.4 Equipment Operators

Equipment operators are responsible for compacting lifts with the compaction machine in accordance with this procedure.

2.2.5 All Personnel

When involved in compacting RRM lifts using the compaction machine, all employees are responsible for identifying any safety hazards and complying with the applicable Radiological Work Permits and Integrated Work Plans.

2.3 Precautions and Limitations

2.3.1 Stop Work

Work shall be immediately terminated by any personnel who feel the activity in progress is unsafe and/or may create an unsafe condition. Work will be resumed when the condition is corrected.

2.3.2 Safety Protocols

All personnel shall remain clear of any operating equipment and maintain good communication with the equipment operator.

Personnel observing compaction using the compaction machine shall always be in visual view of the operator and shall be in front of the machine and never behind the machine working area while machine is in operation.

2.3.3 Training and Procedures

All personnel using the Troxler Nuclear Density Gauge shall attend 8 hours of Nuclear Moisture/Density Gauge training and shall perform all testing in accordance with Project procedures.

2.4 Records

The compactor screen printout and the calculations of the exported terrain data shall be attached to the Lift Approval Form (QC-F-001) (see Attachment 1).

Following QA/QC approval of the QC documents, copies shall be made to be maintained on site as a reference file and the original documentation transmitted to Records Management in accordance with the *Moab UMTRA Project Records Management Manual* (DOE-EM/GJ1545).

3.0 Requirements and Guidance

3.1 Compliance

3.1.1 Lift Identification

Each lift shall be given a discrete lift identification number. The lift identification number shall be used to identify all documentation for that lift.

3.1.2 RRM Disposal

No RRM shall be disposed of on a lift until the previous lift is approved, with the exception of management of stockpile material

3.1.3 Lift Thickness

Lift thickness shall not exceed an average uncompacted thickness of 12 inches.

3.1.4 Debris

In accordance with this procedure, debris placement shall be in a single layer, shall be distributed across the lift, and shall comply with the debris size requirements found in Addendum E, "Remedial Action Inspection Plan," of the *Moab UMTRA Project Remedial Action Plan* (DOE-EM/GJ1547).

3.1.5 Machine Properties

The machine properties (see Attachments 2 and 3) under the machine parameters tab for the machines shall be as follows:

- Number of levels (the number of machine passes) shall be set at three or four depending on machine weight and/or type. Four machine passes are required for machines weighing between 56,669 and 84,850 lb. Three machine passes are required for 825H Caterpillar compactors and machines weighing greater than or equal to 84,850 lb.
- Lift height shall be set at 12 inches.
- Thick lift threshold shall be set at 2 feet.

3.2 Procedures

3.2.1 Moisture Testing

When performing moisture testing, a representative sample shall be obtained from material placed that day. The QC Technician (or qualified personnel) shall perform a moisture test in accordance with applicable ASTM International (ASTM) standards for each day that material is placed. Test results shall be documented on the Field Density Test Form (QC-F-002) (see Attachment 4).

3.2.2 Debris Inspection

The QC Technician (or qualified personnel) shall inspect the debris once it is spread out across the lift. The debris shall be spread out uniformly across the lift in a manner that minimizes void spaces and shall not exceed debris size requirements. The debris inspection shall be documented on the Lift Approval Form.

3.2.3 Visual Inspection

The QC Technician (or qualified personnel) shall visually inspect the lift areas for frozen material, frost, and snow prior to placement of RRM. No soil that is frozen, has frost, or is under a layer of snow shall be approved for placement. The inspection shall be documented on the Lift Approval Form under the comment section.

3.2.4 Lift Surveys

Each lift shall be surveyed using a high-accuracy, hand-held global positioning system (GPS) or CAES. When determining the lift thickness of a lift area less than 3,000 square feet, one survey point should be performed for every 15 feet. When determining the lift thickness of a lift area greater than or equal to 3,000 square feet, the survey for each lift shall have a minimum of 10 points. The lift thickness will be determined by comparing the current lift elevations to the previous lift elevations located on the same northing and easting locations.

When calculating the loose-lift thickness, no survey point shall be greater than 1.3 feet, as long as the average loose thickness is less than or equal to 1 foot. QC shall perform a visual inspection to ensure the lift is placed with uniform thickness. Surveys shall be documented on the appropriate form and attached to the Lift Approval Form.

3.2.5 CAES Terrain Data

Each lift shall be compacted by a minimum of three or four machine passes depending on weight and type of machine used. To ensure the lift area meets the three or four machine pass requirement, print the compaction screen and identify the lift, and export the terrain data for the lift using the CAES.

3.2.6 Requirements for Lift Approval

Lifts that meet the following requirements shall be approved:

- Seventy percent of the pixels have greater than or equal to three or four machine passes depending on weight of machine (green pixels) when placing material on slopes.
- Eighty percent of the pixels have greater than or equal to three or four machine passes depending on weight of machine (green pixels) when placing material on approximately horizontal lifts.

- The average lift thickness is less than or equal to 12 inches with no white pixels on the compactor screen printout.
- The compactor screen print out shows uniform compaction over the entire lift area.

3.2.7 Reworking of Lifts

Lifts shall be reworked (e.g., adding additional compaction, cutting the lift, adding more moisture) that do not meet the Moab UMTRA Project requirements.

3.2.8 Troxler Gauge Testing

The QC Technician (or qualified personnel) shall perform in-place density tests every 6 months in accordance with ASTM D6938 and ASTM D1556 to verify the CAES is working correctly.

If the CAES is not used to verify compaction and the lift thickness, then the lift shall be tested in accordance with *Moab UMTRA Project Moisture/Density Testing Procedure* (DOE-EM/GJRAC1783). The testing frequency, inspections, and required reporting shall comply with the RAIP and surveying shall be performed using a hand-held GPS or a level survey.

4.0 References

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

ASTM (American Society for Testing of Materials) Standard D1556, "Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method."

DOE (U.S. Department of Energy) *Moab UMTRA Project Moisture/Density Testing Procedure* (DOE-EM/GJRAC1783), January 2013.

DOE (U.S. Department of Energy) *Moab UMTRA Project Records Management Manual* (DOE-EM/GJ1545), November 2012.

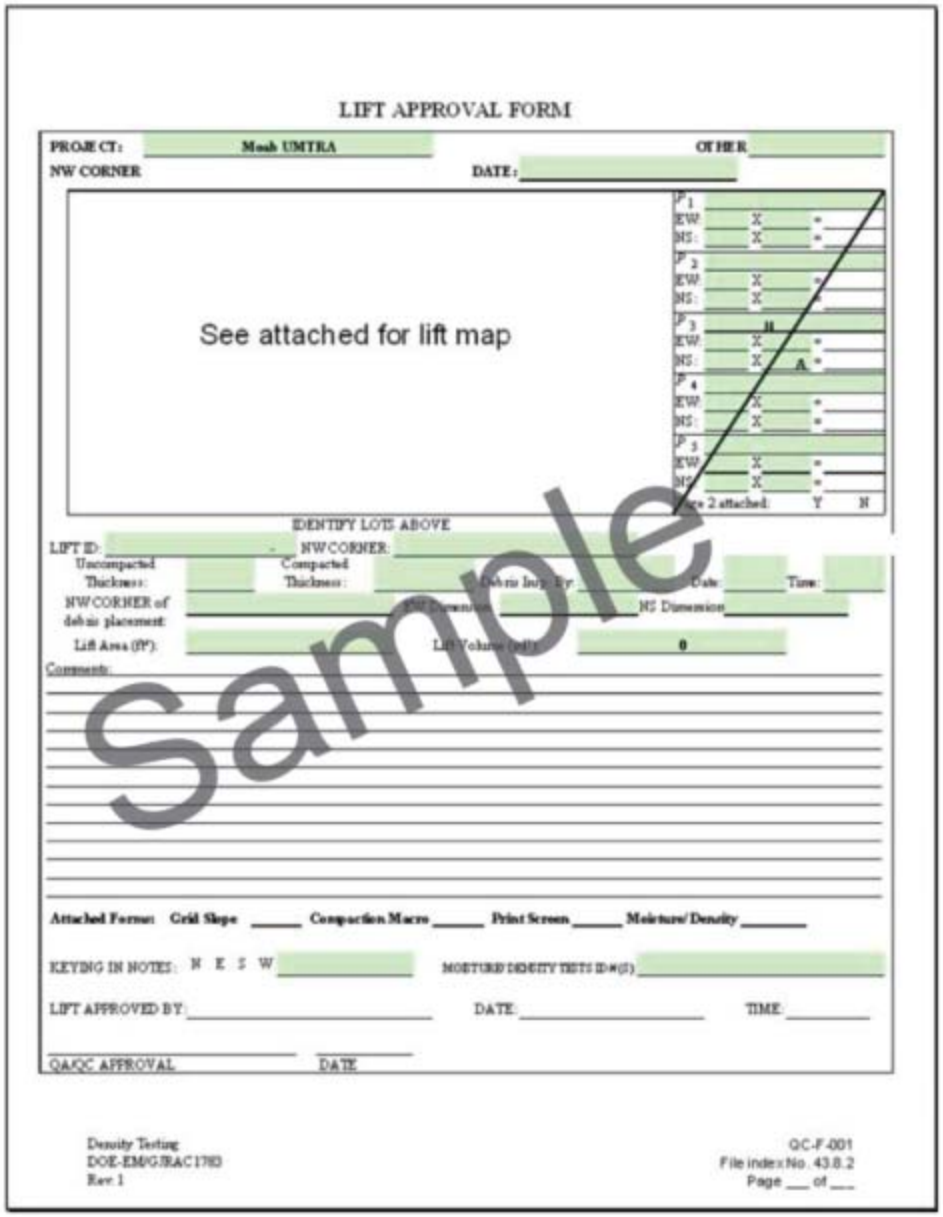
DOE (U.S. Department of Energy) *Moab UMTRA Project Remedial Action Plan* (DOE-EM/GJ1547), July 2008.

Attachment 1. Moab UMTRA Project Lift Approval Procedure (continued)

Attachment 1.
Lift Approval Form (QC-F-001)

Attachment 1. Moab UMTRA Project Lift Approval Procedure (continued)

Attachment 1. Lift Approval Form (QC-F-001)



LIFT APPROVAL FORM

PROJECT: Moab UMTRA OTHER

NW CORNER DATE:

See attached for lift map

P 1 EW: X = NS: X =
P 2 EW: X = NS: X =
P 3 EW: X = NS: X =
P 4 EW: X = NS: X =
P 5 EW: X = NS: X =
Page 2 attached: Y N

IDENTIFY LOTS ABOVE

LIFT ID: NW CORNER:

Uncompacted Thickness: Compacted Thickness: Debris Insp. By: Date: Time:

NW CORNER of debris placement: EW Dimension: NS Dimension:

Lift Area (ft²): Lift Volume (yd³): 0

Comments:

Attached Forms: Grid Slope _____ Compaction Macro _____ Print Screen _____ Moisture/Density _____

KEYING IN NOTES: N E S W MOISTURE DENSITY TESTS ID#(S):

LIFT APPROVED BY: DATE: TIME:

QA/QC APPROVAL DATE

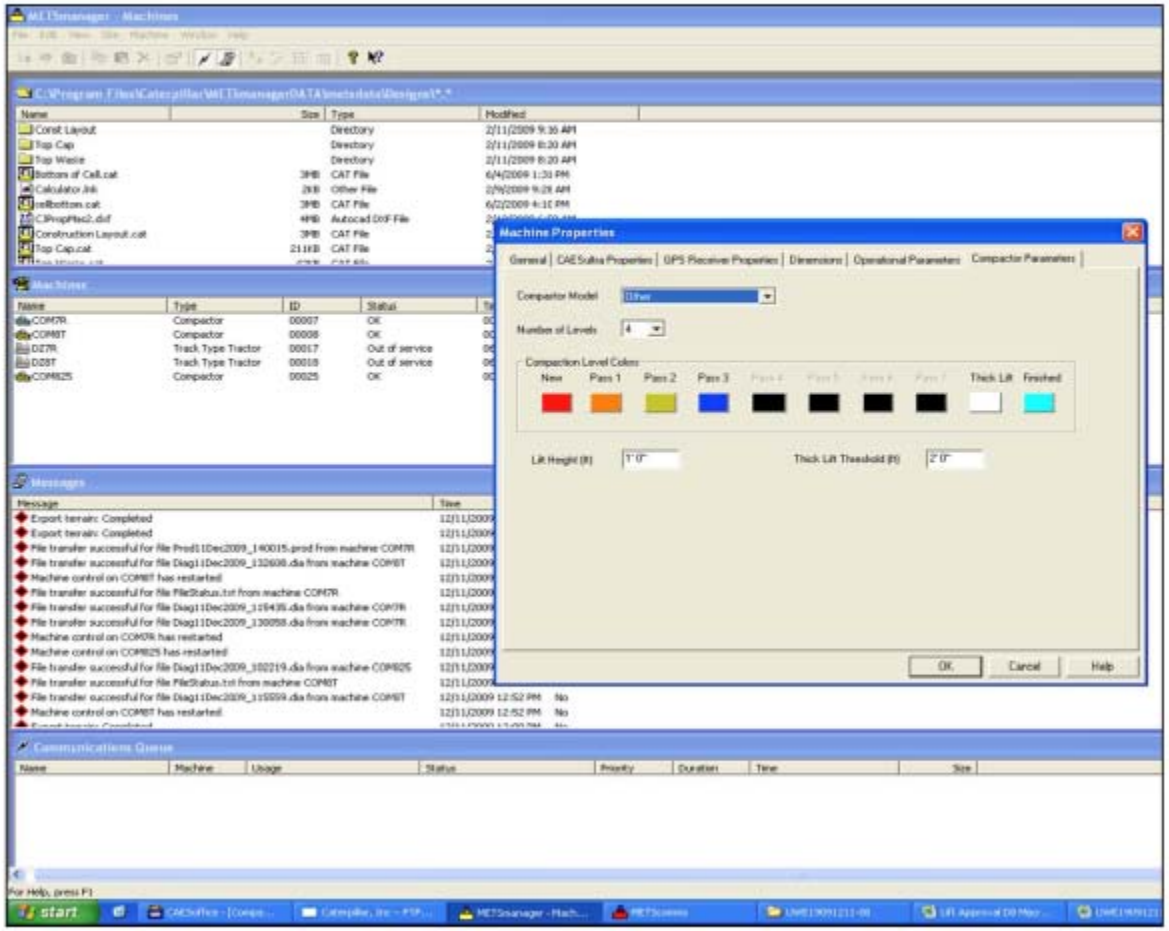
Sample

Density Testing
DOE-EM/GJ/RAC 1781
Rev 1

QC-F-001
File index No. 43.8.2
Page ___ of ___

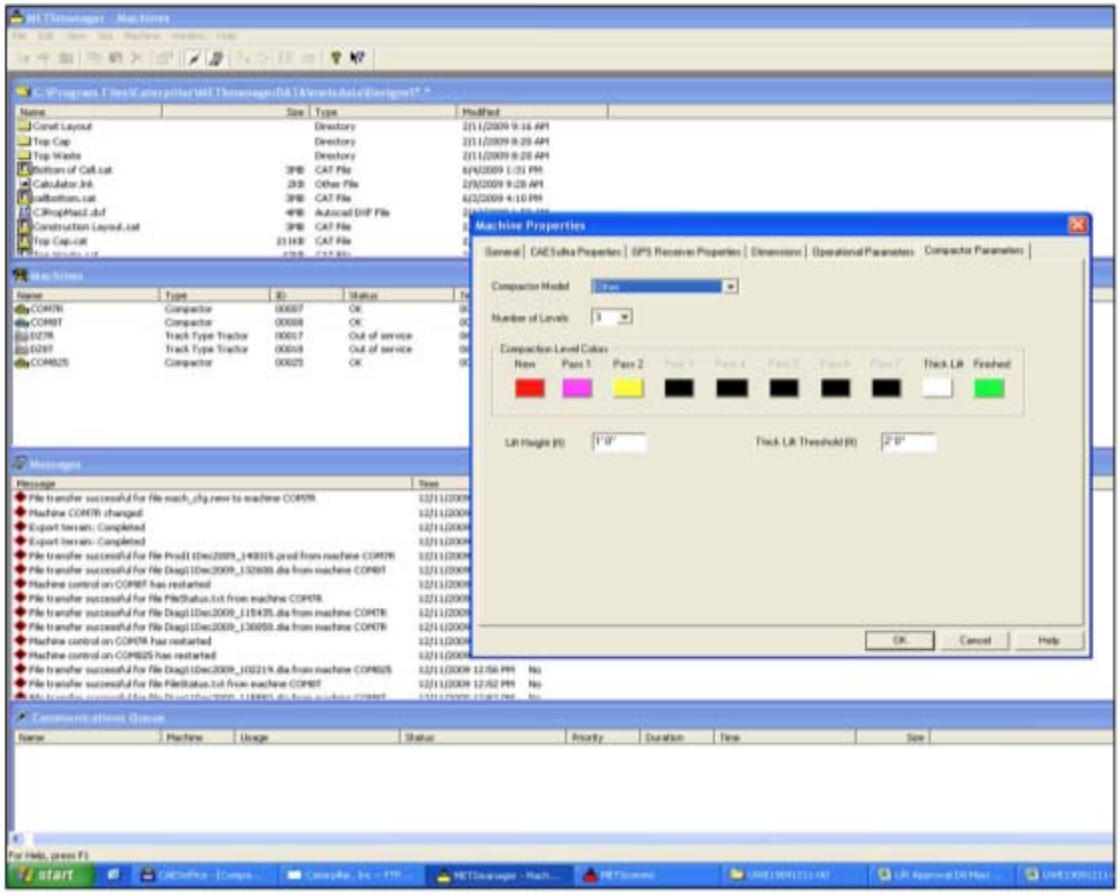
Attachment 2.
Machine Parameters for Machines Weighing 56,669 to 84,850 lb

Attachment 2. Machine Parameters for Machines Weighing 56,669 to 84,850 lb



Attachment 3.
Machine Parameters for CAT 825H Compactors and Machines Weighing Greater Than or Equal to 84,850 lb

Attachment 3. Machine Parameters for CAT 825H Compactors and Machines Weighing Greater Than or Equal to 84,850 lb



Attachment 4.
Field Density Test Form (QC-F-002)

Attachment 4. Field Density Test Form (QC-F-002)

Moab UMTRA Project

FIELD DENSITY TEST

PROJECT: _____ OTHER _____

LIFT IDENTIFICATION: _____ DATE: _____

TEST ID NUMBER(S): _____

TEST LOCATION: _____ ____D1556 ____D6938

ASTM D6938 (DENSITY DETERMINATION)

Make/Model _____ Gauge Serial # _____

Last Calibration Date: N/A

Daily Standard Counts:

Density _____ Moisture _____

____Method A (Direct Transmission) or ____Method B (Backscatter)

Depth Setting ____ (inches) Count Time ____ (minutes)

Moisture Count _____ Density Count _____

Wet Density (ρ_w) _____ (lbs/ft^3) Dry Density _____ (lbs/ft^3)

Moisture Density _____ (lbs/ft^3) Moisture Fraction _____ (%)

MOISTURE DETERMINATION

____ASTM D2216 @ 110° C or ____ASTM D4643

Container ID _____

Mass of container & wet specimen (M_{cws})		g
Mass of container & dry specimen (M_{cds})		g
Mass of water (M_w) $M_w = M_{cws} - M_{cds}$		g
Mass of container (M_c)		g
Mass of dry specimen (M_s) $M_s = M_{cds} - M_c$		g
Moisture content (w) $w = (M_w / M_s) \times 100$		%

Dry Density ($\rho_d = (100 \times \rho_w)/(100 + w)$

$\rho d = ($ 100 $\times$ _____ $) / (100 +$ _____ $) =$ _____ lbs/ft^3

Note: Wet Density from ASTM D 1556 (γ_w) takes precedence over ASTM D 6938 (ρ_w)

Percent Compaction = ρ_d / $\gamma_d max \times 100$

_____ / _____ $\times$ 100 = _____ %

Comments:

ASTM D1556 (DENSITY DETERMINATION)

Testing Apparatus _____ Calibrated Vol. (lbs/ft^3) _____

Bulk Density of sand (ρ_s) _____ g/cm^3 _____ lbs/ft^3

Mass of Sand to Fill Cone & Plate (M_3) _____ g

Mass of bottle & cone **before** filling cone, plate & hole		g
Mass of bottle & cone **after** filling cone, plate & hole		g
Mass of sand to fill cone, plate, & hole (M_1)		g
Mass of sand to fill hole		g
Mass of wet soil & container		g
Mass of container		g
Mass of wet soil (M_2)		g

Test Hole Volume $V = (M_1 - M_3) / \rho_s$ _____ cm^3

Dry Mass of soil $M_d = 100\ M_2 / (w + 100)$ _____ g

Wet Density $\rho_w = (M_2 / V) \times 62.43$ _____ lbs/ft^3

Dry Density $\rho_d = M_d / V$ _____ g/cm^3

Dry Unit Weight $\gamma_d = \rho_d \times 62.43$ _____ lbs/ft^3

Soil Description: _____

Proctor ID: _____

____ ASTM D698 or ____ ASTM D1557

Maximum Dry Density ($\gamma_w max$) _____ (lbs/ft^3)

Optimum Moisture (w_{opt}) _____ (%)

Required Moisture: _____ % to _____ %

Required Percent Compaction: 90.0 (%)

TEST RESULTS:

_____ Pass Date: _____

_____ Failed Moisture

_____ Failed Compaction Time: _____

By: _____ / _____

(print) (signature)

_____ _____

QA/QC APPROVAL DATE

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure

DOE–EM/GJRAC1783

Office of Environmental Management – Grand Junction

MOAB UTAH
UMTRA Project

Moab UMTRA Project Moisture/Density Testing Procedure

Revision 2

January 2013

U.S. Department of Energy

Office of Environmental Management

Prepared by the Remedial Action Contractor under contract number DE-DT0002936 for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure (continued)

DOE-EM/GJRAC1783

Moab UMTRA Project
Moisture/Density Testing Procedure

Revision 2

January 2013

Prepared by the Remedial Action Contractor under contract number DE–DT0002936 for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure (continued)

DOE-EM/GJRAC1783

Moab UMTRA Project
Moisture/Density Testing Procedure

Revision 2

Review and Approval

1/29/2013
Beachem Bosh — Date
RAC Quality Assurance/Quality Control Representative

1/29/2013
Kathy Turvy — Date
RAC Quality Assurance Manager

1-30-2013
Ronald Daily — Date
RAC Radiological Control Manager

2 Feb 13
Steve Rima — Date
RAC Environmental, Safety, Health, and Quality Manager

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure (continued)

Revision History

Revision	Date	Reason for Revision
0	February 2009	Initial issue.
1	April 2011	Added revised Lift Approval Form and added Emergency Procedure for Troxler gauge damage.
2	January 2013	Revision includes updated text and forms.

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure (continued)

Table of Contents

Attachments

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure (continued)

1.0 Purpose and Scope

1.1 Purpose

This procedure provides requirements and methods for the proper moisture/density testing of soils placed at the Moab Uranium Mill Tailings Remedial Action (UMTRA) Project.

1.2 Scope

This procedure applies to the moisture/density testing of all soil materials placed at the Moab UMTRA Project.

2.0 General

2.1 Definitions

Authorized user – One who has met the training requirements in Section 2.3 of this procedure, has the proper thermoluminescent dosimeter (TLD) (or equivalent) with neutron dosimetry, and is authorized to use the Troxler by the Radiological Control Manager.

Compactable soils – Having a bulk density greater than 70 pounds per cubic foot dry weight in accordance with ASTM International (ASTM) D698, "Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))." Compactable soils are also graded material that will pass through a 4-inch grizzly and have soil-like properties.

Frozen material – Material that contains frost or ice or cannot meet the compaction requirements because of frozen water inside the material.

Lift area – An area of the embankment identified for placement.

Lift identification – A discrete number that consists of the following:

- Moab UMTRA Project (i.e., U for UMTRA project cell)
- Work Element (i.e., W for residual radioactive material [RRM] placement, I for interim cover placement, R for radon barrier placement, B for biointrusion placement, F for frost protection placement, C for cap rock placement, E for embankment placement, CF for cell floor).
- Lift Area –A1, B1, C1, year, month, and day. (e.g., UWA1090117, UIA1090117, URA1090117, UBA1090117, UFA1090117, UCA1090117).
- Number of lifts tested and approved for a specific lift area on the same day (e.g., 1st lift -00, 2nd lift -01)

Example: U for Moab UMTRA project, W for RRM lift, A1 for lift area, 121206 date for day lift was first tested, -00 for 1st lift tested that day. (e.g., UWA1121206-00)

NOTE: The day the lift area is first tested will be the date used for lift identification.

Lot – A portion of a lift area that shall be tested individually to ensure it meets compaction requirements.

Old/new lift interface – The intersection of the old lift and the new lift.

Random number – A number between 0.001 and 0.999 that is generated from a calculator or computer with a random generator.

Standard count – A measurement of a known reference to ensure accurate gauge readings.

Standard proctor – ASTM D698.

Troxler – A moisture/density gauge that uses radioactive materials to determine in-place moisture and density. Special requirements are employed for use and security maintenance of the Troxler.

2.2 Responsibilities

2.2.1 Quality Assurance Manager

The Quality Assurance (QA) Manager is responsible for:

- Implementing and directing Quality Control (QC) activities contained within this procedure.
- Identifying QC problems.
- Initiating, recommending, or providing QC solutions.

2.2.2 QA/QC Representative

The QA/QC representative is responsible for proper implementation of this procedure.

2.2.3 QC Technician or Qualified Personnel

The QC technician or qualified personnel is responsible for following the testing and disposal process of this procedure.

2.2.4 Radiation Control Technician

The Radiation Control Technician is responsible for:

- Performing necessary surveys to minimize workers' exposure in accordance with the *Moab UMTRA Project ALARA Program* (DOE-EM/GJRAC1922).
- Posting radiation hazards in accordance with *Moab UMTRA Project Radiological Posting and Access Control* (DOE-EM/GJRAC1748).
- Posting requirements for radiation hazards.
- Briefing radiation workers that enter a controlled area under a radiological work permit (RWP).

2.2.5 Equipment Operator

The equipment operator is responsible for handling and placing the waste.

2.2.6 Authorized User

The authorized user is responsible for:

- Maintaining Troxler security.
- Keeping compliance with the requirements of this procedure
- Minimizing any radiation exposures from the Troxler.

2.2.7 Radiological Control Manager

The Radiological Control Manager is responsible for:

- Overseeing the Radiation Protection Program at the UMTRA Moab Project.
- Designating, in writing, personnel authorized to use the nuclear density gauge (i.e., the Troxler).

2.3 Precautions and Limitations

- Work shall be immediately terminated by any personnel who feel the activity in progress is unsafe and/or may cause an unsafe condition. Work will be resumed when the condition is corrected.
- All workers are responsible to ensure they have met the requirement of the appropriate Integrated Work Plan and RWP.
- All personnel shall remain clear of any operating equipment.
- All personnel using the Troxler shall attend the 8-hour Nuclear Moisture/Density Gauge training prior to use.
- New users shall be required to contact the Radiological Control Manager to add their name to the authorized users list.
- Before removing the Troxler from its designated storage location, the responsible authorized user shall ensure the gauge source rod is in the shielded, locked position and that the transport case is locked.
- The Troxler gauge shall be kept under constant surveillance by the authorized user for as low as reasonably achievable (ALARA) and security purposes.
- The Troxler gauge shall not be chained to a post, chained in the back of an open bed truck, or secured in a similar manner when not in constant surveillance, transport, or in storage.
- Troxler gauge users are required to use a minimum of two independent physical controls that form tangible barriers to secure portable gauges from unauthorized removal whenever the portable gauges are not under the control and constant surveillance of the licensee (i.e., the Troxler shall be locked in the cab of a vehicle and chained to the steering wheel, locked in a secured box and chained in the back of a truck, or locked in the cab of the vehicle inside the restricted area).
- The source rod on the Troxler shall not be touched with fingers, hands, or any part of the body, unless needed maintenance is performed by a trained service technician.
- All personnel shall minimize their exposure from the unshielded source rod. Authorized users shall embrace the ALARA principles of time, distance, and shielding to accomplish this and shall limit the access of unnecessary personnel to the Troxler. Never look directly under the gauge when lowering the rod into the ground.
- Authorized users shall comply with the *Moab UMTRA Project Radiation Protection Program Manual* (DOE-EM/GJRAC1885).
- Authorized users shall always wear their assigned TLD (or equivalent) when using the Troxler.
- Authorized users shall always return the source to the locked and shielded position after each measurement is taken.
- Troxler gauges shall be stored only in approved storage. Gauges are kept in an approved storage location when not under constant surveillance by an authorized user.
- The *Moab UMTRA Project Emergency Response Plan* (DOE-EM/GJ1520) shall be initiated should the source rod fail to return to the locked position or should the Troxler be damaged in any way that endangers others (a 25-foot area shall be cordoned off around any damaged Troxler gauge).

2.4 Records

All Field Density Test Forms QC-F-002 (Attachment 1) shall be attached to the appropriate Lift Approval Form QC-F-001 (Attachment 2).

Records shall be reviewed and approved before being sent to Records Management.

The Troxler Sign-Out Log Form QC-F-003 (Attachment 3) will be reviewed by the QA/QC representative or QA Manager each quarter and transmitted to Records Management each year.

3.0 Requirements and Guidance

3.1 Compliance

- Each lift shall be given a discrete designation (lift identification number) for testing and surveying purposes.
- Each lift shall be tested to meet the specifications.
- Radon barriers shall be compacted to at least 95 percent of a standard proctor (ASTM D698) and have a moisture content of ±3 percent of the optimum moisture.
- RRM shall be compacted to at least 90 percent of a standard proctor (ASTM D698) and have a moisture content of ±3 percent of the optimum moisture. Moisture/density testing shall be performed for each waste or fill material in the lift.
- Perimeter embankments shall be compacted to at least 95 percent of a standard proctor (ASTM D698) and have a moisture content of ±5 percent of the optimum moisture.
- Spoils embankments shall be compacted to at least 90 percent of a standard proctor (ASTM D698) and have a moisture content of ±5 percent of the optimum moisture.
- Construction projects shall be in accordance with specifications in each project construction plan-associated documentation.
- Frost protection shall be compacted to at least 90 percent of a standard proctor (ASTM D698) and have a moisture content of ±5 percent of the optimum moisture.
- All soil density and moisture tests shall be performed with a calibrated nuclear moisture/density gauge in accordance with ASTM D6938, "Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)" or by the sand-cone method in accordance with ASTM D1556, "Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-cone Method."
- Proficiency testing of the nuclear moisture/density gauge shall be completed by performing a sand-cone density test and an oven or microwave drying test.
- A sand-cone density test (ASTM D1556) shall be performed jointly with 5 percent of all nuclear density tests.
- An oven or microwave drying test in accordance with ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass," or ASTM D4643, "Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating," shall be performed jointly with 10 percent of all nuclear moisture tests.
- A standard count shall be performed at the start of each day.
- Standard counts must be within the ranges established.

NOTE: If the moisture standard count is not within the indicated range, a moisture dry back shall be performed to determine the moisture of any material tested (ASTM D2216 or ASTM D4643).

- Soils shall only be placed in cold weather (< 32° F) when the required moisture and compaction requirements can be met.
- Troxler gauge security and accountability is kept through use of the Troxler Sign-Out Log Form.
- Lost, damaged, or unaccounted sources require immediate (within 2 hours) notification to the Radiological Control Manager. If the Troxler gauge is damaged, follow the emergency procedure in Attachement 4 for damaged Troxler gauges.
- All applicable U.S. Department of Transportation requirements shall be followed when transporting the Troxler gauge in accordance with Title 49 Code of Federal Regulations Part 173.24 (49 CFR 173.24), "Pipeline and Hazardous Materials Safety Administration, Department of Transportation, General Requirements for Shipments and Packagings," and 49 CFR 173.465, "Pipeline and Hazardous Materials Safety Administration, Department of Transportation, Type A packaging tests."
- Authorized users shall take precautions to protect gauges from damage from heavy equipment and shall ensure there is no heavy equipment operation on a lift during testing. If heavy equipment is being used on an adjacent lift and equipment will be operating close to a Troxler, a flag high enough to be seen shall be posted by the Troxler.

3.2 Procedure

1. Calculate the approximate area of the lift then sketch the lift area on the Lift Approval Form.
2. Divide the lift into lots (see Addendum E, Remedial Action Inspection Plan, of the *Moab UMTRA Project Remedial Action Plan* (DOE-EM/GJ1547) for testing frequencies)
3. Generate random numbers for the in-place moisture/density test coordinates as follows:
   - Generate two random numbers for each lot using a calculator or computer with a random number generator.
   - Multiply one random number by the approximate north/south dimension of the lot and the other random number by the approximate east/west dimension of the lot as measured in feet.
   - Locate the test locations specified by the random numbers.
   - If the sample location is outside the lot, generate two new random numbers.
   - Record this on the Lift Approval Form.
4. Prepare the testing site for the nuclear gauge and/or sand-cone test by leveling the area and removing any loose material from the surface.
5. When testing density and moisture with a nuclear gauge, follow the density gauge manual for operation and ASTM D6938 for the proper testing methods. When testing density by the sand-cone method, follow ASTM D1556.

NOTE: The density gauge manual is located in the transport case for the Troxler.

6. When the lift does not meet compaction or moisture requirements, record the results on the Field Density Test Form, and notify the equipment operator to re-work the material.
7. After the equipment operator has reworked the material, retest the material.
8. The QC representative or qualified personnel shall approve lots that meet compaction and moisture requirements. Document results on the Field Density Form.

NOTE: Conditional approval can be given in the field from gauge readings if the QC representative is confident that moisture dry-back results will not produce a failing moisture or density.

NOTE: If the QC representative gives conditional approval and the moisture results produce failing moisture or density a condition report shall be written unless the lift had no additional material disposed on that particular lift area.

4.0 References

49 CFR 173.24 (Code of Federal Regulations), "Pipeline and Hazardous Materials Safety Administration, Department of Transportation, General Requirements for Shipments and Packagings."

49 CFR 173.465 (Code of Federal Regulations), "Pipeline and Hazardous Materials Safety Administration, Department of Transportation, Type A packaging tests."

ASTM (ASTM International) D698, "Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))."

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

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

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

ASTM (ASTM International) D6938, "Standard Test Method 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 ALARA Program* (DOE-EM/GJRAC1922), October 2010.

DOE (U.S. Department of Energy), *Moab UMTRA Project Emergency Response Plan* (DOE-EM/GJ1520), September 2012.

DOE (U.S. Department of Energy), *Moab UMTRA Project Radiation Protection Program Manual* (DOE-EM/GJRAC1885), October 2012.

DOE (U.S. Department of Energy), *Moab UMTRA Project Radiological Posting and Access Control* (DOE-EM/GJRAC1748), September 2011.

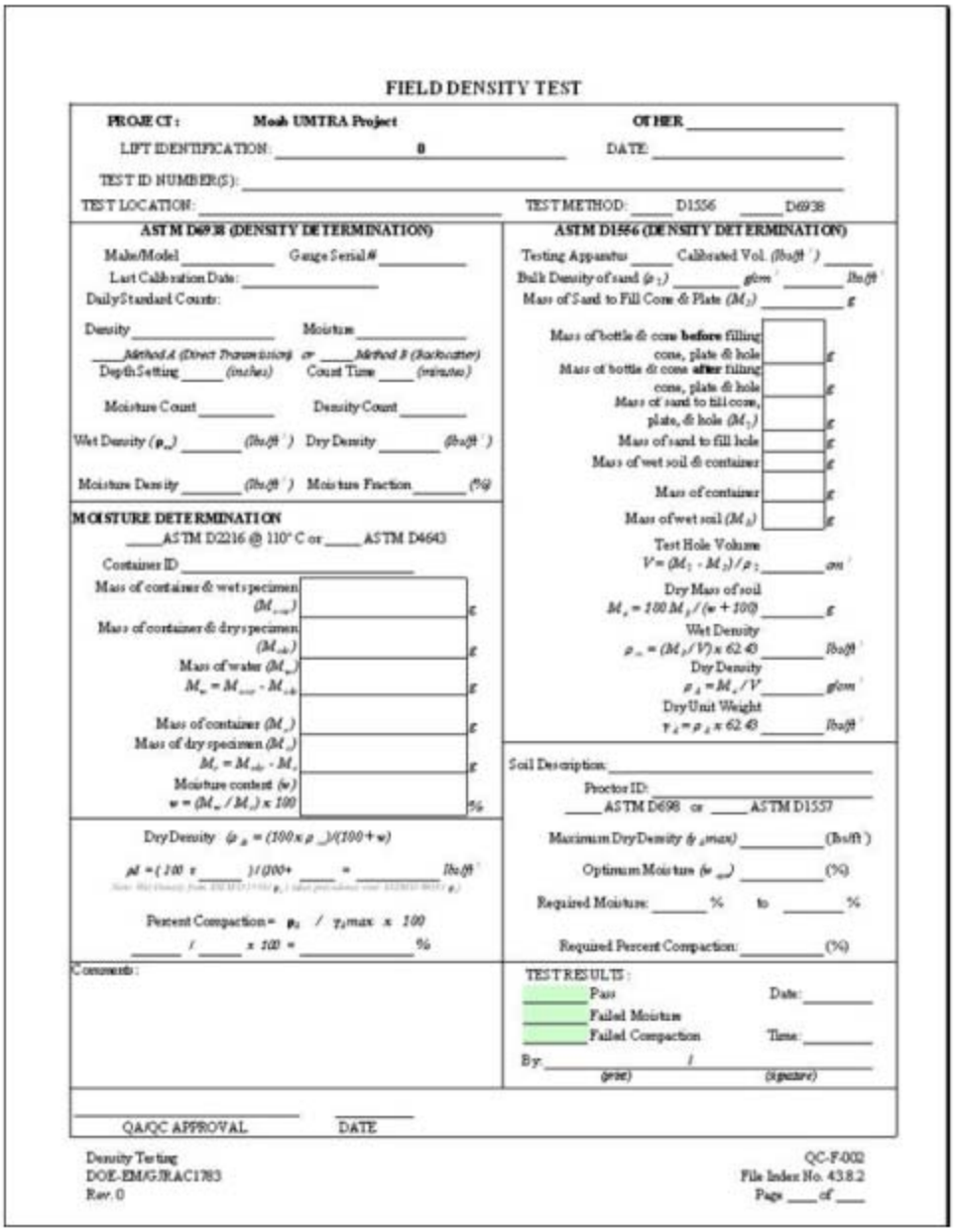
DOE (U.S. Department of Energy), *Moab UMTRA Project Remedial Action Plan* (DOE-EM/GJ1547), July 2008.

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure (continued)

Attachment 1.
Field Density Test Form QC-F-002

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure (continued)

Attachment 1. Field Density Test Form QC-F-002



FIELD DENSITY TEST

PROJECT: Moab UMTRA Project OTHER _____

LIFT IDENTIFICATION: 8 DATE: _____

TEST ID NUMBER(S): _____

TEST LOCATION: _____ TEST METHOD: ____ D1556 ____ D6938

ASTM D6938 (DENSITY DETERMINATION)

Make/Model _____ Gauge Serial # _____

Last Calibration Date: _____

Daily Standard Counts:

Density _____ Moisture _____

____Method A (Direct Transmission) or ____Method B (Backscatter)

Depth Setting ____ (inches) Count Time ____ (minutes)

Moisture Count _____ Density Count _____

Wet Density (ρ_w) _____ (lb/ft^3) Dry Density _____ (lb/ft^3)

Moisture Density _____ (lb/ft^3) Moisture Fraction _____ (%)

MOISTURE DETERMINATION

____ASTM D2216 @ 110° C or ____ASTM D4643

Container ID: _____

Mass of container & wet specimen (M_{c+w})		g
Mass of container & dry specimen (M_{c+s})		g
Mass of water (M_w) $M_w = M_{c+w} - M_{c+s}$		g
Mass of container (M_c)		g
Mass of dry specimen (M_s) $M_s = M_{c+s} - M_c$		g
Moisture content (w) $w = (M_w / M_s) \times 100$		%

Dry Density $\rho_d = (100 \times \rho_w)/(100+w)$

$\rho d = (100 \times$ ____ $)/(100+$ ____ $=$ _____ lb/ft^3

Percent Compaction = ρ_d / $\gamma_d max \times 100$

____ / ____ x 100 = _____ %

ASTM D1556 (DENSITY DETERMINATION)

Testing Apparatus ____ Calibrated Vol. (lb/ft^3) ____

Bulk Density of sand (ρ_s) _____ g/cm^3 _____ lb/ft^3

Mass of Sand to Fill Cone & Plate (M_2) _____ g

Mass of bottle & cone **before** filling cone, plate & hole		g
Mass of bottle & cone **after** filling cone, plate & hole		g
Mass of sand to fill cone, plate, & hole (M_1)		g
Mass of sand to fill hole		g
Mass of wet soil & container		g
Mass of container		g
Mass of wet soil (M_t)		g

Test Hole Volume

$V = (M_1 - M_2)/\rho_s$ _____ cm^3

Dry Mass of soil

$M_s = 100 M_t/(w + 100)$ _____ g

Wet Density

$\rho_w = (M_t/V) \times 62.43$ _____ lb/ft^3

Dry Density

$\rho_d = M_s/V$ _____ g/cm^3

Dry Unit Weight

$\gamma_d = \rho_d \times 62.43$ _____ lb/ft^3

Soil Description: _____

Proctor ID: _____

____ASTM D698 or ____ASTM D1557

Maximum Dry Density ($\rho_d max$) _____ (lb/ft^3)

Optimum Moisture (w_{opt}) _____ (%)

Required Moisture: _____ % to _____ %

Required Percent Compaction: _____ (%)

Comments:

TEST RESULTS:

_____ Pass Date: _____

_____ Failed Moisture

_____ Failed Compaction Time: _____

By: _____ / _____

(print) (signature)

_____ _____

QA/QC APPROVAL DATE

Density Testing
DOE-EMG/RAC1783
Rev. 0

QC-F-002
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Attachment 2.
Lift Approval Form QC-F-001

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure (continued)

Attachment 2. Lift Approval Form QC-F-001

LIFT APPROVAL FORM

PROJECT: _____ OTHER _____

NW CORNER DATE: _____

P 1			
EW:	X	=	
NS:	X	=	
P 2			
EW:	X	=	
NS:	X	=	
P 3			
EW:	X	=	
NS:	X	=	
P 4			
EW:	X	=	
NS:	X	=	
P 5			
EW:	X	=	
NS:	X	=	

Page 2 attached: Y N

IDENTIFY LOTS ABOVE

LIFT ID: _____ - _____ NW CORNER: _____

Uncompacted Thickness: _____ Compacted Thickness: _____ Verified By: _____ Date: _____ Time: _____

NW CORNER of debris placement: _____ EW Dimension _____ NS Dimension _____

Lift Area (ft²): _____ Lift Volume (yd³): _____

Comments:

KEYING IN NOTES: N E S W _____ MOISTURE/ DENSITY TESTS ID # (S): _____

LIFT APPROVED BY _____ DATE: _____ TIME: _____

_____ _____

QA/QC APPROVAL DATE

QC-F-001
Rev 1, November 2010

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Attachment 3.
Troxler Sign-Out Log Form QC-F-003

Attachment 1. Moab UMTRA Project Moisture/Density Testing Procedure (continued)

Attachment 3. Troxler Sign-Out Log Form QC-F-003

Moab UMTRA Project

Troxler Sign-out Log

Date	Name of Responsible User	Gauge Serial No.	Location of Where Gauge will be Used	Sign-out *(time & date)*	Sign-in *(time & date)*

QC-F-003
Rev 1, June 2011

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Attachment 4.
Emergency Procedure for Troxler Gauge Damage

Attachment 4. Emergency Procedure for Troxler Gauge Damage

Emergency Procedure for Troxler Gauge Damage
The following procedures apply when the source fails to return to a shielded position (e.g., as a result of being damaged, source becomes struck below the surface) or if any other emergency or unusual situation arises (e.g., the gauge is struck by a moving vehicle or is in an accident involving a vehicle).

1. Immediately secure the area and keep people at least 25 feet from the gauge in all directions until the situation is assessed and radiation levels are known, notify Radiological Control of situation. However, if any personnel are injured contact site Health and Safety and immediate supervisors.
2. If any heavy equipment is involved, detain the equipment and operator until it is determined there is no contamination present.
3. Gauge users and other potentially contaminated individuals should not leave the scene until emergency assistance arrives.
4. Visually inspect the gauge to determine the position of the source rod practice ALARA and ensure your safety prior to performing inspection (exposed or shielded) and the position of the source shutters (open or closed), and the extent of damage, if any, to the source housing and/or shielding.
5. Notify the following persons listed below, but do not leave the scene to make notifications if needed; get someone to assist:
   - Radiological Controls Manager
   - Operations Manager
   - QA Manager

Radiological Controls Supervisor

6. Follow the directions provided by the Radiological Controls Manager.
7. The Radiological Controls Manager must:
   - Arrange for a radiation survey to be conducted as soon as possible by a knowledgeable person using the appropriate radiation detection instrumentation (the person performing the survey must be competent in the use of the survey instrument).
   - Make necessary notifications.

Reports to the U.S. Nuclear Regulatory Commission and/or the U.S. Department of Energy must be made within the reporting timeframes specified in regulations. Reporting requirements are found in 10 CFR 20.220102203 and 10 CFR 30.50.

NOTE: Before shipping a damaged gauge:
- Send close-up photographs of the damaged gauge to Troxler.
- Send leak test sample to Troxler for analysis or send leak test results.
- Obtain returned goods authorization number from Troxler.