Weaver Consultants Group

April 22, 2025
Project No. 0086-364-11-19

Hillary Young, P.E.
Land Protection Division
Oklahoma Department of Environmental Quality (ODEQ)
707 N. Robinson Ave.
Oklahoma City, OK 73102

Re: 2nd Response to Comments – Revised Supplemental Information
Tier III Permit Modification
Muskogee Community Recycling and Disposal Facility – Permit No. 3551020
Muskogee County, Oklahoma

Dear Ms. Young:

On behalf of Waste Management of Oklahoma, Inc. (WMO), please find enclosed replacement pages for the referenced Tier III Permit Modification. The replacement pages were developed to provided supplemental information to our January 10, 2025 Response to Comments and to revise the supplemental information submitted on February 27, 2025.

Based on a meeting that occurred with ODEQ on April 18, 2025, it was determined the ODEQ would like WMO to include piezometer installations as part of all groundwater separation verification prior to construction to verify the subsurface investigation findings unless WMO chooses to revise the top of liner grades to allow for 5-foot separation with respect to the Attachment E-1-12, Highest Measured Groundwater Potentiometric Head Surface Contour Map, included in Attachment E-1 of the Tier III Permit Modification. Therefore, WMO is providing this supplemental information response to update the groundwater separation verification process submitted on February 27, 2025.

Section 7.2 has been added to Appendix L Leachate Collection System Design, to provide groundwater separation verification process. Section 2.2.1B of Appendix K Quality Assurance/Quality Control Plan for Liner and Leachate Collection System Installation and Testing, has also been revised to reference Appendix L.

The replacement pages have been developed in redline/strikeout format to facilitate your review.

During the course of your review, if you need additional information or have any questions, please call.

Sincerely,
Weaver Consultants Group, LLC

Johnna P. Ignaski
Project Manager

Jonathan V. Queen, P.E.
Project Director

Attachments: Attachment 1 – Tier III Permit Modification Replacement Pages

cc: Pete Schultze, Waste Management of Oklahoma, Inc.
Guy R. Campbell, Waste Management of Oklahoma, Inc.

ATTACHMENT 1

TIER III PERMIT MODIFICATION REPLACEMENT PAGES

MUSKOGEE COMMUNITY RECYCLING AND DISPOSAL FACILITY
MUSKOGEE COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3551020

TIER III PERMIT MODIFICATION
LANDFILL EXPANSION

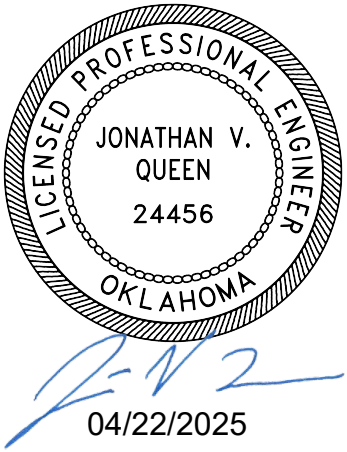
VOLUME 3 OF 4

Prepared for

Waste Management of Oklahoma, Inc.

October 2023
Revised July 2024
Revised January 2025

Revised April 2025



Prepared by

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MUSKOGEE COMMUNITY
RECYCLING AND DISPOSAL FACILITY
MUSKOGEE COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3551020

APPENDIX K

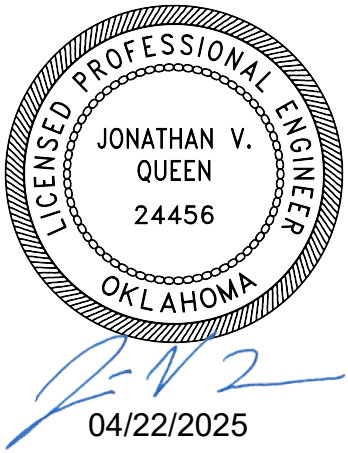
QUALITY ASSURANCE/QUALITY CONTROL PLAN FOR LINER AND LEACHATE COLLECTION SYSTEM INSTALLATION AND TESTING

Prepared for

Waste Management of Oklahoma, Inc.

October 2023
Revised July 2024
Revised January 2025

Revised April 2025



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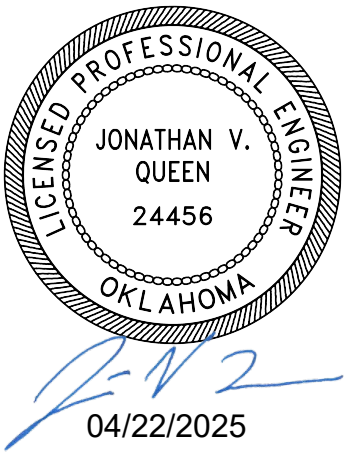

2 CONSTRUCTION QUALITY ASSURANCE FOR EARTHWORK

2.1 Introduction

This section of the Quality Assurance/Quality Control (QA/QC) Plan addresses the construction of the earthwork components of the liner system and outlines the QA/QC Plan program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements, and treatment of problems.

The landfill is designed to include a Subtitle D composite liner for the undeveloped liner area. The liner system for the undeveloped area will consist of a 2-foot-thick compacted clay liner and a 60-mil-thick high density polyethylene (HDPE) Flexible Membrane Liner (FML). An alternative liner option is also available for the which consists of replacing the 2 foot compacted clay layer with a geosynthetic clay liner (GCL) and a 1-foot-thick compacted clay layer ($k \leq 1x10^{-7}$ cm/s). Refer to Section 3 of this QA/QC Plan for more information regarding the Construction Quality Assurance for the FML and GCL.

2.2 Earthwork Construction

The following paragraphs describe general construction procedures to be used for various earthwork components within the landfill. The earthwork construction specifications will be developed based on the material and construction procedures outlined in this section of the QA/QC Plan for each specific liner construction.

2.2.1A Subgrade

Subgrade refers to a surface which is exposed after stripping topsoil or excavating to establish the grade directly beneath the composite liner. The subgrade must be constructed to allow for the composite liner to conform to the permitted Top of Liner Plan.

Prior to beginning liner construction, the subgrade area will be stripped to a depth sufficient to remove all loose surface soils or soft zones within the exposed excavation. The upper 6 inches of the subgrade will be compacted to a minimum of 90 percent of the maximum dry density as determined by the Standard Proctor (ASTM D698), unless the subgrade is part of the perimeter berm. Perimeter berm soils shall be compacted to 95 percent of the maximum dry density. The liner

subgrade area will be proof rolled with heavy, rubber tired construction equipment to detect unstable areas. Unstable areas will be undercut to firm material and backfilled with suitable compacted general fill. The subgrade will also be scarified prior to placement of the first lift of clay liner.

Subgrade voids and cracks are expected to be minor. However, the subgrade will be re-worked as necessary to provide a foundation suitable for soil liner placement. Visual examination of the subgrade preparation by the CQA monitor will generally be sufficient to evaluate its suitability as a foundation for the subgrade. The CQA monitor may find that physical testing is necessary to evaluate the prepared subgrade or general fill placed in large voids.

The POR will approve the prepared subgrade prior to the placement of soil liner or general fill. Approval will be based on a review of test information, if applicable, and CQA monitoring of the subgrade preparation.

2.2.1B ~~Observation Pit Excavation~~Groundwater Separation Verification Prior to Construction

~~Observation pits will be dug in each cells sump area prior to initiating construction activities. The observation pits will be excavated 5 feet below the sump elevation and verified by 3rd party COA. The observation pits will be used to verify that groundwater is not present within 5 feet of the sump elevation. This information will be included as part of the cell's construction notice. ODEQ shall be notified at least 48 hours in advance of observation pit excavation activities to allow for observation of excavation activities. If groundwater is encountered in the observation pit, a permit modification will be submitted to ODEQ to revise the cell grades.~~ A groundwater separation verification prior to cell construction will be completed in accordance with Section 7.2 of Appendix L.

2.2.2 General Fill

General fill material placed below the floor of the composite liner will be placed in uniform lifts to an elevation of subgrade minus 1 foot and proof-rolled with a heavy, rubber tired construction equipment to detect unstable areas. Unstable areas will be undercut to firm material and backfilled with suitable compacted general fill. The remaining 1 foot will be placed in uniform lifts that do not exceed 9 inches in loose thickness and are compacted to at least 90 percent of the maximum dry density as determined by the Standard Proctor (ASTM D698) at a moisture content equal to or greater than the optimum moisture content.

General fill material placed as part of the perimeter berm will be placed in uniform lifts that do not exceed 9 inches in loose thickness and are compacted to at least 95 percent of the maximum dry density as determined by the Standard Proctor (ASTM D698) at a moisture content equal to or greater than the optimum moisture content.

General fill material will be relatively homogeneous clay, silty clay, sandy clay, or clayey sand. The material shall classified as CL, CH, ML, SM, or SC according to the Unified Soil Classification System (USCS). General fill shall be tested to determine

the USCS classification at a frequency of 1 per 50,000 cy. The general fill material interface strength parameters will be verified by the Design Engineer prior to construction by review of existing data or completion of additional testing to verify the assumed strength parameter values utilized in the site slope stability analysis. The analysis was developed using peak strength values and a factor of safety of 1.5 (long-term condition), 1.3 (short-term condition), and 1.15 (seismic condition). If test results differ from assumed values, the analysis will be updated to meet these minimum factor of safety values and the additional analysis will be placed in the Site Operating Record.

2.2.3 Soil Liner

The soil liner will consist of a minimum 2-foot-thick (or 1-foot minimum thickness if the GCL alternative liner system is used) compacted clay liner (measured perpendicular to the subgrade surface) that will extend along the floor and side slopes of the landfill. The soil liner will be constructed in continuous, single, compacted lifts (6 inches thick) parallel to the floor and sideslope subgrades with a permeability of $1x10^{-7}$ cm/s or less.

Surveying will be performed to verify that the excavation/bottom of clay liner grades is to the lines and grades specified in the design with a vertical tolerance of -0.2 feet to +0.0 feet to ensure that the clay liner will achieve a 2-foot minimum thickness (or 1-foot minimum thickness if the GCL alternative liner system is used).

2.2.3.1 Soil Liner Material

Adequate clayey soil liner material will be available from landfill excavations and/or onsite borrow sources. The liner soil will be free of debris, rock greater than 1 inch in diameter, vegetative matter, frozen materials, foreign objects, and organics. Laboratory tests will verify that materials are adequate to meet the compacted clay liner requirements prior to liner construction. As necessary, an off-site borrow source can be used for soil liner and protective cover construction. Representative samples from onsite and/or offsite borrow sources will be subject to the minimum pre-construction testing program shown in Table 2-1.

MUSKOGEE COMMUNITY RECYCLING AND DISPOSAL FACILITY
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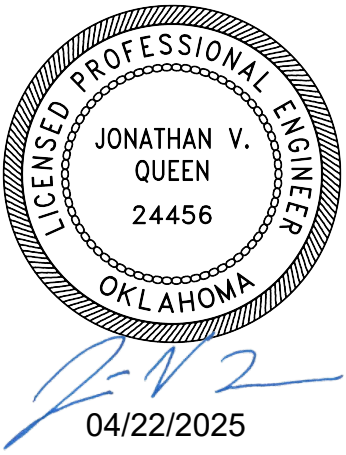

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MUSKOGEE COUNTY, OKLAHOMA
ODEQ PERMIT NO. 3551020

APPENDIX L

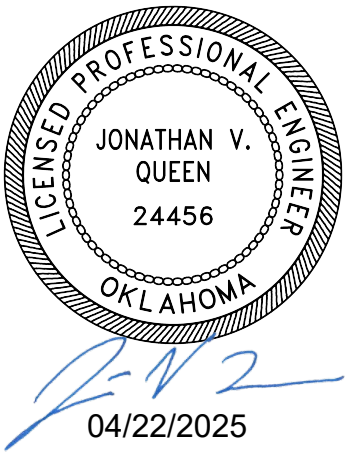
LEACHATE COLLECTION SYSTEM DESIGN

Prepared for

Waste Management of Oklahoma, Inc.

October 2023
Revised July 2024

Revised April 2025



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CONTENTS

04/22/2025

2.3 Excavation Plan Design

As shown in Table 2-1 and on the Top of Liner Plan included in Appendix L-1, the top of liner grades are designed to maintain a 5-foot minimum separation between highest groundwater elevations beneath the site and the top of liner elevations.

Table 2-1
Difference Between Top of Liner Grades and Top of Uppermost Aquifer

Cell	Top of Liner Elevation in Sump (ft-msl)	Top of Uppermost Aquifer Elevation (ft-msl)[(1)]	Depth Above Groundwater (ft)
14	630.2	598.0	32.2
15	616.9	596.7	20.2
16	630.2	599.4	30.8
17	616.9	597.2	19.7
18	630.2	601.0	29.2
19	617.8	597.7	20.1
20	630.5	601.2	29.3
21	618.8	598.3	20.5
22	630.3	600.7	29.6
23	618.8	599.1	19.7
24	630.2	599.9	30.3
25	620.8	598.9	21.9
26	620.8	598.2	22.6
27	622.7	597.9	24.6

(1) See Attachment E-1-11 for top of uppermost aquifer contour map and Section 7 for compliance with OAC 252:515-11-3(a).

However, WMO is willing to provide a groundwater separation verification prior to construction to verify the subsurface investigation findings that groundwater is not present within 5 feet of the lowermost surface on which waste (included leachate) will be placed. See Section 7.2 in this Appendix for more information.

7 COMPLIANCE WITH OAC 252:515-11-3(A)

7.1 Introduction

The purpose of this section is to set forth how the Western Landfill Unit liner system is in compliance with OAC 252:515-11-3(a), which requires the following:

> *"Liner system shall be designed and constructed to maintain a minimum five-foot vertical separation between the highest groundwater elevation and the lowermost surface on which waste, including leachate, will be placed."*

The lowermost surface on which waste, including leachate, will be placed is defined by the elevation of the top of the geomembrane liner given that this surface forms the bottom of the leachate collection system.

The "highest groundwater elevation" is not defined in OAC 252:515-1-2. However, according to OAC 252:515-1-2 (Definitions), "groundwater" is defined as "water below the land surface in a zone of saturation" and "Zone of Saturation" is defined as "a subsurface zone in which essentially all the interstices are filled with water under pressure greater than that of the atmosphere".

As discussed in Appendix E, a subsurface investigation has been completed for the expansion area at the Muskogee RDF. This subsurface investigation indicates the site stratigraphy consists of surficial sediments that overlay a Weathered Shale Zone that overlays an Unweathered Shale Zone. As indicated in Section 3.3.2 (Appendix E) the Weathered Shale Zone sediments are mostly dry with some moist intervals and with less frequent extents of saturated fractured shale present in limited intervals near the base of the Weathered Shale Zone. This uppermost zone of saturation is contained exclusively within these limited intervals of Weathered Shale Zone which exhibit confined fracture-porosity conditions.

Groundwater within this uppermost zone of saturation is isolated by a unsaturated Weathered Shale Zone above and the Unweathered Shale Zone below. The sediments in the unsaturated portion of the Weathered Shale Zone consist of dense, hard, indurated, plastic, mudstone and claystone shale exhibiting varying degrees of moisture content and fracturing, and occasional thin seams of interbedded clay. As indicated in Table 3-5 of Appendix E, the mean vertical hydraulic conductivity of the unsaturated portion of the Weathered Shale Zone is 4.23×10^{-8} cm/sec. This unsaturated portion of the Weathered Shale Zone forms an aquitard that confines

groundwater in the saturated portion of the Weathered Shale Zone. This saturated portion of the Weathered Shale Zone exhibits horizontal hydraulic conductivity mean of 5.18×10^{-4} cm/sec as indicated on Table 3-4 of Appendix E.

The sediments in the Unweathered Shale Zone consist of dense, hard, indurated, mudstone and claystone shale exhibiting varying degrees of plasticity and fracturing, and occasional minor discontinues thin seams of interbedded coal and limestone. These seams have no significant hydrogeologic significance due to their dry and discontinuous nature. The Unweathered Shale Zone forms an aquitard that confines groundwater in the saturated portion of the Weathered Shale Zone.

Therefore, given unsaturated portion of the Weathered Shale Zone aquitard above and the Unweathered Shale Zone aquitard below the saturated Weathered Shale Zone meets the definition of a subsurface zone in which essentially all interstices are filled with water under pressure greater than that of the atmosphere.

This conclusion is further confirmed by review of the potentiometric head differential shown on Table 3-2 in Appendix E. The table indicates that confined groundwater exhibits a potentiometric head ranging from about 11 to 36 feet higher than the top of the uppermost saturated zone. If this was a potentiometric surface representing a zone of saturation, the upper portions of the Weathered Shale Zone would have been saturated, which was not observed during the subsurface field investigation.

Therefore, the top of the uppermost saturated zone observed at time of drilling constitutes the highest groundwater elevation for evaluating groundwater/waste separation pursuant to OAC 252:515-7-54(a) and 252:515-11-3(a).

7.2 Groundwater Separation Verification Prior to Construction

7.2.1 Purpose and Overview

Section 7.1 and Appendix E indicate that the subsurface investigation, groundwater information, and piezometer information provided is in accordance with Oklahoma Administrative Code (OAC) regulatory definitions and requirements. Therefore, the liner system is designed in accordance with OAC 252:515-11-3(a). However, WMO is willing to provide a groundwater separation verification prior to construction. The verification will be provided through one of the following options:

1. Raise the liner system elevation or,

2. Provide an additional groundwater study.

7.2.2 Raise the Liner System Elevation Option

This option would include raising the floor of a cell area to provide separation from highest measured potentiometric head groundwater elevations (Appendix E, Attachment E-1, Attachment E-1-12) and lowermost surface on which waste (including leachate) will be placed, is a minimum of 5-feet.

Prior to cell construction, a construction notification will be submitted to ODEQ in compliance with OAC 252:515-11-5. The construction notification will include the cell construction plans along with the groundwater elevation information that verifies separation from highest measured potentiometric head groundwater elevations and the lowermost surface on which waste (including leachate) will be placed is a 5-feet minimum.

7.2.3 Provide an Additional Groundwater Study

This option would provide an additional groundwater study prior to the construction of the initial new expansion area cells, to verify the subsurface investigation findings that groundwater is not present within 5 feet of the lowermost surface on which waste (including leachate) will be placed.

In summary, the additional groundwater study will include the following.

- A notification to ODEQ submitted prior to cell construction identifying the location of the next cell to be developed and the groundwater monitoring method to be implemented. The notification will include the proposed temporary piezometer locations and installation date pursuant to obtaining 12 months of groundwater observations.
- Implementation of temporary piezometers installations and monthly groundwater observations.
- Prior to cell construction, a construction notification will be submitted to ODEQ in compliance with OAC 252:515-11-5. The construction notification will include the cell construction plans along with the groundwater elevation information verifying that groundwater is not present within 5 feet and the lowermost surface on which waste (including leachate) will be placed. The required ODEQ submittals are discussed in Section 7.2.3.3.

7.2.3.1 Temporary Piezometer Requirements

If temporary piezometers are utilized for the groundwater monitoring method, the temporary piezometers will be installed and constructed as follows to comply with OAC requirements:

Locations

- Three temporary piezometers will be installed prior to construction in the first construction event for the expansion area. One of the three temporary piezometers will be installed in the sump location to verify that groundwater is not present within 5 feet of the lowermost surface on which waste (including leachate) will be placed. The other two temporary piezometers will be located within the cell at locations which will allow for verification of separation in the cell area. Subsequent cells will include one temporary piezometer installed in the sump area. As discussed in Section 7.2.3.2, groundwater elevation information will be collected for a 12-month period.

Installation

- Borehole diameter will be a minimum of 3 inches greater than the diameter of the casing and screen from surface to total depth (OWRB 785:35-7-2(b)(1)). The screen will extend to an elevation at least 5-feet below the proposed top of liner elevation.
- Well casing material will consist of 2-inch-diameter schedule 40 PVC, flush threaded with screw joints and o-rings (OWRB 785:35-7-2(b)(2)).
- Well screens will be a 5-foot section, factory slotted with 0.010-inch slots (OWRB 785:35-7-2(b)(4)).
- Filter pack will be inert 20-40 silica sand extending approximately 2 feet above the top of the screen (OWRB 785:35-7-2(b)(5)).
- Filter pack seal will be a minimum of 2 feet of hydrated sodium bentonite pellets (OWRB 785:35-7-2(b)(6)(B)).
- Annular seal will be cement grout, bentonite grout, cement/bentonite grout mixture, or bentonite chips and placed from the top of filter pack seal to within 2 feet of ground surface (OWRB 785:35-7-2(b)(6)(C)).
- Concrete surface pad or donut will be installed around the piezometers casings at surface grade.
- A 2-inch compression seal top cap and locking aluminum or steel protective casing will be provided ((OWRB 785:35-7-2(b)(8) – (9)).

Decommissioning

After 12 months of groundwater elevation information have been collected and prior to the construction of the cell, the temporary piezometers will be plugged in accordance with OWRB rules and regulations. The plugging reports will be included in the ODEQ submittal discussed in Section 7.2.3.3.

7.2.3.2 Groundwater Observation Measurements

A notification to ODEQ submitted prior to cell construction identifying the location of the next cell to be developed and the groundwater monitoring method to be implemented. The notification will include the proposed temporary piezometer locations and installation date pursuant to obtaining 12 months of groundwater observations.

Groundwater levels in the temporary piezometers will be measured once per month for 12 consecutive months following specifications of ASTM D4750 in accordance with OAC 252:515-7-54(d).

7.2.3.3 Required ODEQ Groundwater Submittals

Muskogee Community RDF will submit the additional groundwater study results with the construction plans to ODEQ for approval. The submittal will include the following information.

- A drawing or drawings showing the cell location, location of piezometers, other ODEQ approved groundwater monitoring locations, top of geomembrane contours, and groundwater elevation information collected. This drawing or drawings will be used to establish compliance with OAC 252:515-11-3(a).
- A summary of groundwater elevation information collected during the minimum 12-month monitoring period.
- Piezometer installation and plugging details including boring logs for each temporary piezometer (if required).
- A summary of the geology and hydrogeology information in the area of the cell. This summary will also include a discussion of historical subsurface information obtained at the site and the additional information obtained as part of this additional groundwater study.
- The additional groundwater study results will verify that groundwater is not present within 5 feet of the lowermost surface on which waste (including leachate) will be placed. If 5 feet of separation cannot be verified, then a permit modification will be submitted to increase the cell top of liner grades.