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PART 36 PERMIT APPLICATION

Volume 2

3 of 3

REVISED APPLICATION

June 26, 2019

Attachment G

Slope Stability Analysis

Slope Stability Analysis

North Ranch Surface Waste Management Facility
Lea County, New Mexico

April 19, 2019
Project No. 35187378

Prepared for:

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1.0 INTRODUCTION

Terracon has completed Stability analyses for the proposed NGL Waste Services, LLC (NGL) North Ranch Surface Waste Management Facility (Facility) located in Lea County, New Mexico. The main purpose of this report is to present a slope stability analyses for the critical crosssections located in the landfill for the final cover system, the top of waste, the top of protective cover, and the top of geosynthetic layer of the base liner system.

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	See **EXHIBIT A**, **FIGURE A-1**, Site Layout Plan
Critical Cross Sections	See **EXHIBIT B**, **FIGURE B-1**, Cross Section Phase I and Phase II

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The facility is in Lea County, New Mexico
Existing improvements	Greenfield Facility - add Surface Waste Management System
Current ground cover	--

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

The subsurface information and the laboratory test results used in Terracon's analysis were obtained from the documents 'Terracon GeoReport" dated January 25, 2019. The subsurface profile is typically comprised of poorly graded sands, caliche lenses, and sandstone. The borings were terminated at 165 feet below ground surface with no groundwater encountered.

4.0 CRITICAL SECTIONS AND LINER CONFIGURATIONS

Two critical cross sections were analyzed as part of this slope stability analysis. The locations of the cross-sections are shown on **FIGURE B-1** attached in **EXHIBIT B**. The cross-sections were selected because they represented the landfill's maximum height of the waste and the steepest slope of the fill. The top and the bottom liner configurations are summarized below.

Configuration No. 1	
Final Cover System (From top to bottom)	• 1' Thick Vegetation/Erosion Layer • 1.5' Thick Protective Cover Layer • Double-Sided Geocomposite • 60-mil Double Sided Textured HDPE Liner • Double-Sided Geocomposite • 1' Thick Interim Cover
Bottom Liner System (From top to bottom)	• 2' Thick Protective Cover Layer • Double-Sided Geocomposite • 60-mil Double Sided Textured HDPE Liner • Double-Sided Geocomposite • 60-mil Double Sided Textured HDPE Liner • Reinforced Geosynthetic Clay Liner (GCL) • 6" Prepared Subgrade

4.1 Material Properties

Table 4.1 below presents the strength parameters used for the slope stability analyses for all the conditions analyzed (effective stress). These parameters were selected based on review of the subsurface data and laboratory tests were obtained from the document 'Terracon GeoReport" dated January 25, 2019 and on our experience with similar soils and materials where test results were not available for site-specific materials.

Table 4.1 Material Properties Summary

Soil/Material Type	Unit Weight	Effective Strength Parameters	
	(pcf)	C (psf)	ϕ (degrees)
60 mil textured HDPE	65	25	21
Compacted Subgrade	120	100	23
Double Sided Geocomposite	40	100	17
Poorly Graded Sand	120	25	22
Protective Cover	110	0	23
Sandstone	120	25	23
Vegetated Soil Layer	100	100	15
Waste	70	0	28

5.0 ANALYSIS SUMMARY

5.1 General Discussion

The computer program SLOPE/W® 2018 (R2) developed by Geo-Slope International was used to evaluate stability of the landfill. This program has several methods available that allow the user to model both circular and block-type failure surfaces (modes). The stability analysis is typically characterized by its calculated factor of safety against failure. The factor of safety may be generally defined as the ratio of the resisting forces to the driving forces. A factor of safety of 1.0 indicates the resisting forces are in equilibrium with the driving forces; therefore, the higher the safety factor, the more stable the slope. Further discussion of the trial failure modes that were analyzed is provided below.

In the program SLOPE/W®, the Morgenstern-Price method with half-sine function was selected to calculate the factor of safety. The Morgenstern-Price method is similar to the Spencer method but allows for various user-specified interslice force functions. The block method function was specified to locate the critical slip surface, and then optimization of the failure plane was performed by the software to "probe" the possibility of a lower safety factor. The soil parameters used for this project are in the **Table 4.1**. The safety factor is shown on the respective cross-section and in the adjoining SLOPE/W analysis in **EXHIBIT C**.

5.2 Results of Static Analyses

The stability analyses were performed by inputting shear strength, friction angles, and unit weight parameters into SLOPE/W®. The long-term stability conditions were considered for these analyses. Figures showing the failure plane and the corresponding factor of safety are presented in **EXHIBIT C**. The factor of safety shown on the graphical plot corresponds to the optimized failure surface.

5.2.1 Stability of the North Ranch Facility

Stability analyses were performed for the final cover system, the top of waste, the top of protective cover, and the top of geosynthetic layer for Phase I and Phase II cross sections. The cross-sections for the landfill were taken at the critical sections. A circular failure was used to describe the lowest factors of safety for the waste stability. **Table 5.1** below summarizes the results of the slope stability analysis for the different phases of construction.

Table 5.1 Final Fill Slope Stability Summary
Final Cover Slope

Cross Section	Calculated Factor of Safety	Minimum Factor of Safety
Phase I (circular)	2.4	1.5
Phase II (circular)	2.2	1.5

Top of Waste Slope

Cross Section	Calculated Factor of Safety	Minimum Factor of Safety
Phase I (circular)	2.4	1.5
Phase II (circular)	2.3	1.5

As noted in **Table 5.1,** the calculated factors of safety for the proposed configurations exceeded the minimum allowable factor of safety established.

The North Ranch Facility is not located in a seismic impact zone since the maximum horizontal acceleration in lithified material at the facility is less than 0.1g (See **EXHIBIT D**). Therefore, a seismic analysis is not required.

A stability run was also performed to confirm the factor of safety for the interim conditions when the landfill has the protective cover in place and with the geosynthetic layers prior to placing the protective cover in **EXHIBIT C**. Table 5.2 summarizes the stability of the cut slopes in relation to the base liner system

Table 5.2 Cut Slope and Base Liner Stability Summary
Top of Protective Cover Slope

Cross Section	Calculated Factor of Safety	Minimum Factor of Safety
Phase I (circular)	2.0	1.5
Phase II (circular)	1.6	1.5

Top of Geosynthetic Layer Slope

Cross Section	Calculated Factor of Safety	Minimum Factor of Safety
Phase I (circular)	2.0	1.5
Phase II (circular)	1.6	1.5

6.0 GENERAL COMMENTS

The analyses and any recommendations presented in this report are based upon the subsurface information obtained from the report prepared by Terracon GeoReport" dated January 25, 2019 and from other information discussed in this report. This report does not reflect variations that may occur due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided. Provisions to verify strength of utilized soil and geosynthetic materials and interfaces may be added as part of the construction quality assurance process as applicable.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted engineering practices. No warranties, express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. If changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

EXHIBIT A
LOCATION DIAGRAM

LEGEND:

- PERMIT BOUNDARY AND SECURITY FENCELINE
- BOREHOLE LOCATIONS
- NGL PROPERTY LINE
- CELL BOUNDARIES
- SITE ROAD

SITE ENTRANCE

NORTH STORMWATER POND

BH 1

LEACHATE EVAP POND

CELL E-1 (9.6 AC.)

CELL E-2 (9.6 AC.)

CELL E-3 (28.2 AC.)

CELL E-4 (18.4 AC.)

CELL E-5 (18.6 AC.)

CELL E-6 (21.6 AC.)

PHASE 1

PHASE 2

PHASE 3

CELL W-1 (15.3 AC.)

CELL W-2 (11.8 AC.)

CELL W-3 (15.2 AC.)

CELL W-4 (23.9 AC.)

CELL W-5 (24.7 AC.)

BH 2

BH 3

BH 4

BH 5

BH 7

WEST STORMWATER POND

EAST STORMWATER POND

BATTLE AXE ROAD (HWY 2)

N

500 0 250 500

SCALE IN FEET

REV	DATE	BY	DESCRIPTION

SITE LAYOUT PLAN

SLOPE STABILITY ANALYSIS

SURFACE WASTE MANAGEMENT FACILITY

NORTH RANCH

LEA COUNTY ARKANSAS

Terracon
Consulting Engineers and Scientists
BRYANT, AR 72022
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FIGURE A-1

DESIGNED BY:	MPB
DRAWN BY:	TLB
APPVD. BY:	DCM
SCALE:	1" = 500'
DATE:	03/28/2019
JOB NO.	572-002-3518737
ACAD NO.	102
SHEET NO.:	- OF -

N:\GEOARCHIVE\CAD\572\002\ACMCLOY\3518737\BIDESIGN\PERMITTING\SLOPE STABILITY\102 - FIG A-1 - SITE LAYOUT.DWG