NM1 - __67____

PART 36 PERMIT APPLICATION

Volume 2

2 of 3

June 27, 2019

Permit Application For Surface Waste Management Facility

South Ranch Surface Waste Management Facility
Lea County, New Mexico

June 2019
Project No. 35187378

MICHAEL P. BRADFORD
NEW MEXICO
19240
6-14-19
PROFESSIONAL ENGINEER

Prepared for:
NGL Waste Services, LLC
3773 Cherry Creek Dr., Suite 1000
Denver, CO 80209
303-815-1010

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

Volume 2 of 2

Appendix I
Hydrogeological Report

Hydrogeological Report

South Ranch Surface Waste Management Facility
Lea County, New Mexico
June 2019
Project No. 35187378

Prepared for:
NGL Waste Services, LLC
3773 Cherry Creek Dr., Suite 1000
Denver, CO 80209
303-815-1010

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

Table of Contents

List of Figures

List of Attachments

1.0 INTRODUCTION

This Hydrogeological Report documents investigations conducted for the proposed NGL Waste Services, LLC (NGL) South Ranch Surface Waste Management Facility (Facility) located southwest of Jal near Bennett, Lea County, New Mexico. Data were compiled by Terracon Consultants, Inc. (Terracon), in accordance with the Energy, Minerals and Natural Resources Department, Oil Conservation Division (NMOCD or Division) requirements and the *New Mexico Administrative Code (NMAC)* Section **19.15**. NGL owns the property proposed for the landfill and associated facilities.

Section 2.0 of this report describes the regional geologic and hydrogeological characterization for the area surrounding the NGL South Ranch facility. Section 3.0 references site-specific information gathered for the generation of this document. Section 4.0 lists the references used.

1.1 SITE LOCATION

The NGL South Ranch SWMF site is located within Section 27 of T26S, R36E approximately 4.25 miles southwest of the City of Bennett in Lea County, New Mexico as seen in **Figure 1**.

1.2 BACKGROUND

NGL is currently preparing a Permit Application to develop a new Surface Waste Management Facility (SWMF). The location of the site and the proposed development areas are shown on **Figure 1**. This application will establish an oil field solid waste landfill footprint area consisting of approximately 112 acres with a waste capacity of approximately 22,144,871 cubic yards. **Figure 2** illustrates the site layout within the permitted boundary. The NMOCD requires a review and summary of the hydrogeology and geology of the region and facility that illustrates the location of the SWMF facilities.

2.0 REGIONAL CHARACTERIZATION

This section discusses the regional hydrogeologic setting of the area surrounding the SWMF including hydrology, geology, hydrogeology, and groundwater quality. This information was compiled from published sources including sections of the 1961 Geology and Ground-Water Condition in Southern Lea County, New Mexico report by the State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology and Terracon's January 2019 Geotechnical Engineering Report of the site.

2.1 REGIONAL HYDROLOGY

The SWMF landfill is located within the Pecos watershed of the Rio Grande Region. Surface drainage from the landfill property generally flows downward towards the east. No integrated drainage is present in southern Lea County, thus there is no discharge to the Pecos River, which is located southwest of the area. Tributaries of the Pecos River are located approximately 20 miles southwest of the landfill site in southwestern Lea County. The Pecos River flows south and merges with the Rio Grande in southern Texas along the Texas-Mexico border.

2.2 REGIONAL GEOLOGY

This section describes the geologic setting of the region, including soils, regional stratigraphy, and regional structural geology and geomorphology. A geologic map of New Mexico is provided in **Figure 3.** A map showing the location of water wells within a one-mile radius of the site is presented in **Figure 4**, and a local depth to groundwater surface map is provided in **Figure 5**.

The New Mexico State Geologic Map (1:500 000) indicates the general surfacial geology of the landfill site consists of Quaternary eolian and piedmont deposits (Qep) (Holocene to middle Pleistocene). Qep is comprised of interlayered eolian sands and piedmont-slope deposits. The unconsolidated eolian sands consist of sands and loess; the piedmont-slope deposits include deposits of higher gradient tributaries near major stream valleys, alluvial veneers of the piedmont slope, and alluvial fans, and may locally include uppermost Pliocene deposits.

2.2.1 Regional Soils

Based on the information provided by the Web Soil Survey (March 26, 2019) and the United States Department of Agriculture Soil Conservation Service, the predominant soils underlying the development area at the site are the Kermit-Wink complex, 0 to 3 percent slopes (KE) throughout central and northern portions of the site (59%), Pyote and Maljamar fine sands (PU) in southwest portions (24%), with Jal Association (JA) soils areas lying north of the proposed landfill footprint (14%).

The Kermit-Wink Complex is about 70 percent Kermit fine sand, about 20 percent Wink fine sand and about 10 percent minor components. These are deep sandy soils subject to severe soil blowing. The landscape is one of hummocks and dunes, resulting from the accumulation and removal of sands. The Kermit soil is on stabilized sand dunes, and the Wink soil is in depressions. The complex consists of fine sands to 60 inches that are Hydrologic Soil Group A with a high capacity to transmit water (2.00 to 6.00 in/hr). The depth to water is greater than 80 inches.

The Pyote and Maljamar fine sands consist of Maljamar fine sand from 0 to 24 inches, sandy clay loam from 24 to 50 inches, and cemented (caliche) material from 50 to 60 inches; and Pyote fine sand from 0 to 30 inches underlain by fine sandy loam from 30 to 60 inches.. The Maljamar, a Hydrologic Soil Group B soil, is well drained with a very low to moderately low capacity to transmit water through the most limiting layer (0.00 to 0.06 in/hr). The Pyote, a Hydrologic Soil Group A soil, is well drained with a high capacity to transmit water through the most limiting layer (2.00 to 6.00 in/hr).The depth to water is reported to be greater than 80 inches.

The Jal Association consist of sandy loam from 0 to 12 inches and loam from 12 to 60 inches. It consists of about 55 percent Jal and similar soils, about 30 percent Drake and similar soils and about 15 percent minor components. The Jal Association, a Hydrologic Soil Group B soil, is well drained with a moderately high to high capacity to transmit water through the most limiting layer (0.06 to 2.00 in/hr). The depth to water is reported to be greater than 80 inches.

Based on the January 2019 Geotechnical Engineering report, encountered soils during drilling activities at the site were divided into three strata: the first stratum consisted of clayey sand, silty sand, silty sand with interbedded layers of caliche, poorly graded sand with silt and interbedded layers of caliche and ranged in depths from 26 to 47 feet bgs; the second stratum consisted of silty sand, poorly graded sand, interbedded caliche layers classified as silty sand and poorly graded sand and ranged in depth from 26 to 100 feet bgs; the third stratum ranged in depths between 50 to 100 feet bgs and consisted of fine-grained, poorly to moderately compacted sandstone.

The observed caliche materials are underlain by medium to finely weathered sandstone extending to boring-termination depths of 150 feet below existing grades. Soil porosity and intrinsic permeability observed during drilling ranged from 0.32 to 0.37 and 9.69×10^{-12} to 1.67×10^{-10} cm^2, respectively, and hydraulic conductivity ranged from 9.46×10^{-07} to 1.63×10^{-05} cm/sec.

2.2.2 Regional Stratigraphy

The surface geology of the landfill site consists of the Quaternary Eolian and Piedmont Deposits (Qep) (Holocene to middle Pleistocene), which is the primary geologic formation at the surface in this area. Small outcrops of Quaternary Piedmont Alluvial Deposits (Qp) (Holocene to lower Pleistocene) are located to the north of the site and overlie the Qep deposits. The Tertiary Ogallala Formation (To) (lower Pliocene and middle Miocene) is exposed northeast of the site but was not noted in the site investigation. The Ogallala consists of alluvial and eolian deposits and petrocalcic soils of the southern high plains.

Triassic rocks of the Chinle Formation and Santa Rosa Sandstone of the Dockum Group underlie southern Lea County and is exposed southwest of the site. The Chinle Formation is described as a red to green claystone with minor fine-grained sandstone and siltstones. The Chinle is present in all of the eastern part of southern Lea County but thins westward and is absent in extreme western portions. Thickness of the Chinle varies from 0 to 1,270 feet. The Santa Rosa Sandstone is described as a primarily red, fine-to-coarse grained sandstone, is exposed only in minor outcrops, and the thickness ranges from 140 to 300 feet.

Undifferentiated Paleozoic rocks, consisting of siltstone, shale and sandstone, underlie the Dockum Group in southern Lea County. Thickness of these undifferentiated rocks is approximately 90 to 400 feet.

2.2.3 Regional Structural Geology and Geomorphology

The major structure features of southern Lea County are the Permian age Delaware Basin and the Central Basin Platform in the subsurface. Few structural features are present in the area due to the lack of tectonic movement within the basin since the close of the Permian.

The landfill site is located within the Southern High Plains physiographic region of the state. The High Plains covers the eastern quarter of the state and consists of mildly deformed Permian and Triassic sedimentary rocks capped by the late Miocene-Pliocene Ogallala Formation and Quaternary deposits, which are exposed in the southeastern and east-central parts of the state. Furthermore, the northwest part of the oil and gas-rich Permian Basin underlies southeastern New Mexico. No major surface faults or structural features are located in the vicinity of the landfill site.

Geomorphic features consist of windblown eolian and loess deposits in generally flat terrain that typically lacks integrated drainage systems.

2.3 REGIONAL HYDROGEOLOGY

Potable groundwater in southern Lea County comes from three principal geologic units: the Dockum Group, Tertiary Ogallala Formation, and Quaternary Alluvium. The Triassic Santa Rosa sandstone, or the basal unit of the Dockum Group, is the principal aquifer in the western third of southern Lea County and underlies the landfill area. The Ogallala Formation and Quaternary Alluvium aquifers are the principal aquifers in the eastern portion of Lea County and are considered unsaturated in the western portion.

According to published data, the Santa Rosa Sandstone yields an average of about 47 gallons per minute (gpm); however, some wells are reported to yield as much as 100 gpm in some areas. The Sandstone is recharged by precipitation on sand dunes, by precipitation and runoff on outcrops, and groundwater flow from the overlying Ogallala Formation and Quaternary Alluvium. Porosity of the Santa Rosa Sandstone is reported at around 13 percent with very low permeability, and incomplete well-test data indicate a specific capacity of less than 0.2 gpm per foot of drawdown.

Depth to water reported for water wells within the Township and Range of the landfill vary from approximately 150 feet in the southern portion to 175 feet in the northern portion.

2.4 REGIONAL GROUNDWATER QUALITY

The Dockum Group is the principal potable aquifer in the landfill area. Several domestic and municipal wells penetrate this aquifer in the western portion of the region. Groundwater from the Triassic rocks of the Dockum Group are typically low in silica, vary in range in calcium and magnesium, high in sodium, moderately high in sulfate, and moderately low in chloride. The dissolved solid concentrations are typically higher than water derived from the Ogallala Formation.

3.0 SITE HYDROGEOLOGIC INVESTIGATION

The material presented in this section describes site-specific information gathered for the generation of this document.

3.1 GEOTECHNICAL ENGINEERING REPORT

A Geotechnical Engineering Report was prepared by Terracon to present subsurface exploration, geologic, hydrogeologic and geotechnical engineering findings. A number of recommendations related to subsurface soil/rock conditions, groundwater conditions, seismic site classification, site preparation and earthwork and site excavation are presented and were generated in conformance with the Siting and Subsurface Investigation Work Plan dated October 17, 2018 submitted to and approved by the NMOCD. A copy of the Geotechnical Engineering Report is attached to this narrative in **Attachment A**.

3.2 Site Geology

The NGL South Ranch SWMF is located within an area of historical oil and gas production, largely in undeveloped ranch areas covered with creosote and mesquite trees. The area is underlain by interlayered eolian sands and piedmont-slope deposits which are underlain by the Dockum Group. Subsurface soil and rock are illustrated on geological cross-section figures attached to this report. **Figure 6** shows the alignments of the cross-sections on a Facility map. **Figure 7a** through **Figure 7c** show geologic cross-sections based on the boring data collected in the Geotechnical Engineering Report in **Attachment A**.

3.3 Site Hydrogeology

Groundwater was not encountered at the site during the boring program which advanced four (4) borings to a depth of approximately 150 feet and one (1) boring to a depth of approximately 100 feet below ground surface. The uppermost aquifer is estimated to be encountered at depths greater than 150 feet below ground surface. **Figure 5** shows the approximate depth to groundwater in the Facility area.

4.0 REFERENCES

New Mexico Bureau of Geology and Mineral Resources, Scholle, Peter A., State Geologist, Geologic Map of New Mexico (1:500 000), 2003.

New Mexico Bureau of Geology and Mineral Resources. Provinces of New Mexico – Geologic Tour of the High Plains, https://geoinfo.nmt.edu/tour/provinces/high_plains/home.html, accessed March 2019.

New Mexico Department of Agriculture. Watersheds in New Mexico - http://www.nmda.nmsu.edu/wp-content/uploads/2012/07/Watershed-info-and-NM-watersheds-7-9-2012-phd.pdf, accessed March 2019.

New Mexico Institute of Mining and Technology, State Bureau of Mines and Mineral Resources Division and the New Mexico State Engineer. Geology and Ground-Water Conditions in Southern Lea County, New Mexico – 1961

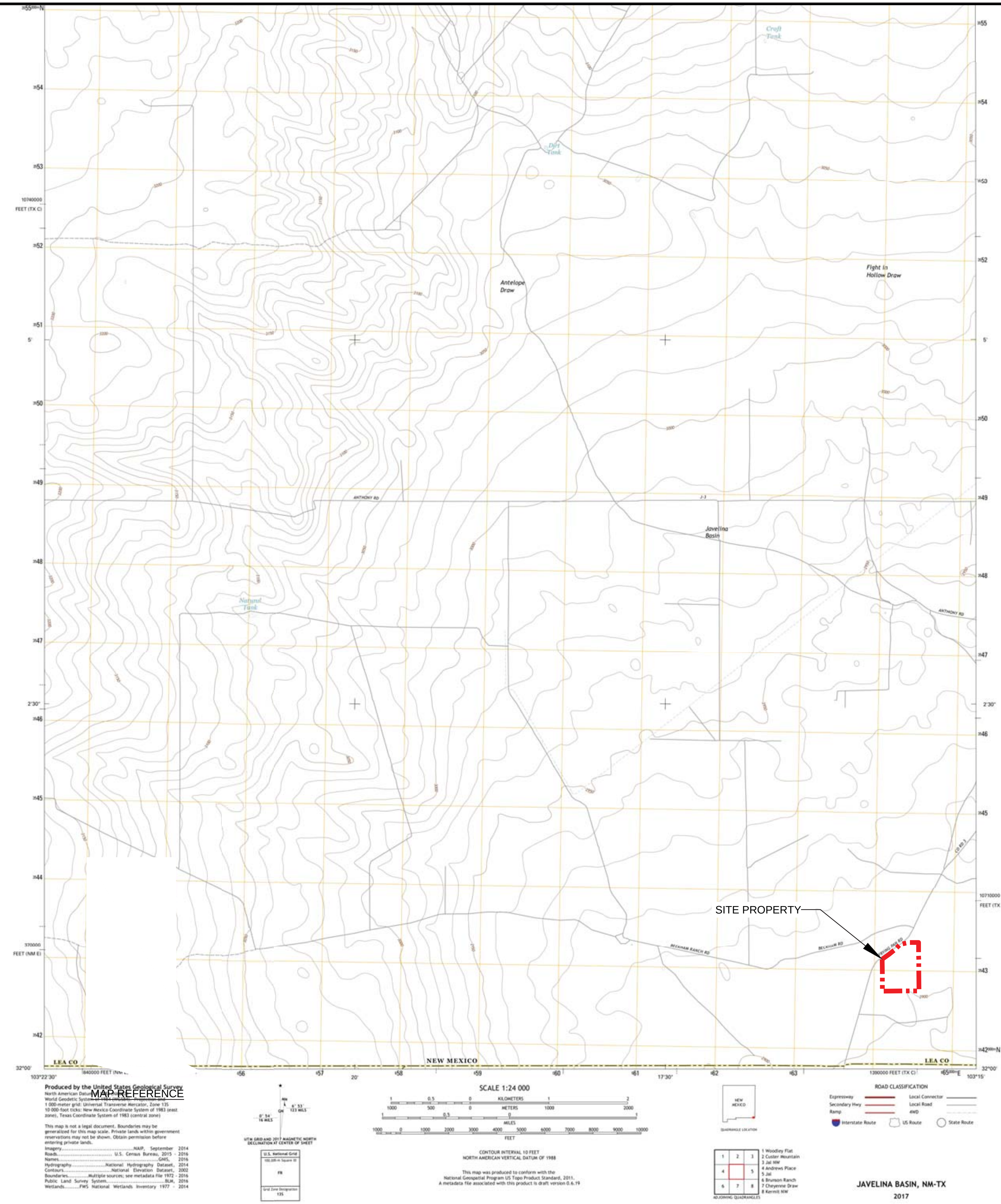
New Mexico Office of the State Engineer, New Mexico Water Rights Reporting System, http://nmwrrs.ose.state.nm.us/nmwrrs/meterReport.html, accessed March 2019.

Terracon, Geotechnical Engineering Report, Beckham Ranch Landfill – January 2019 (Non-technical revision May 2019).

United State Department of Agriculture (USDA) Soil Conservation Service. Soil Survey of Lea County, New Mexico – March 2019.

Web Soil Survey, Beckham Ranch Landfill – March 2019.

Figures



MAP REFERENCE

UNITED STATES GEOLOGICAL SURVEY
NORTH AMERICAN DATUM OF 1988 (NAD88)
WORLD GEODETIC SYSTEM OF 1984 (WGS84)

(EDITED BY TERRACON CONSULTANTS)

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION

SITE LOCATION MAP

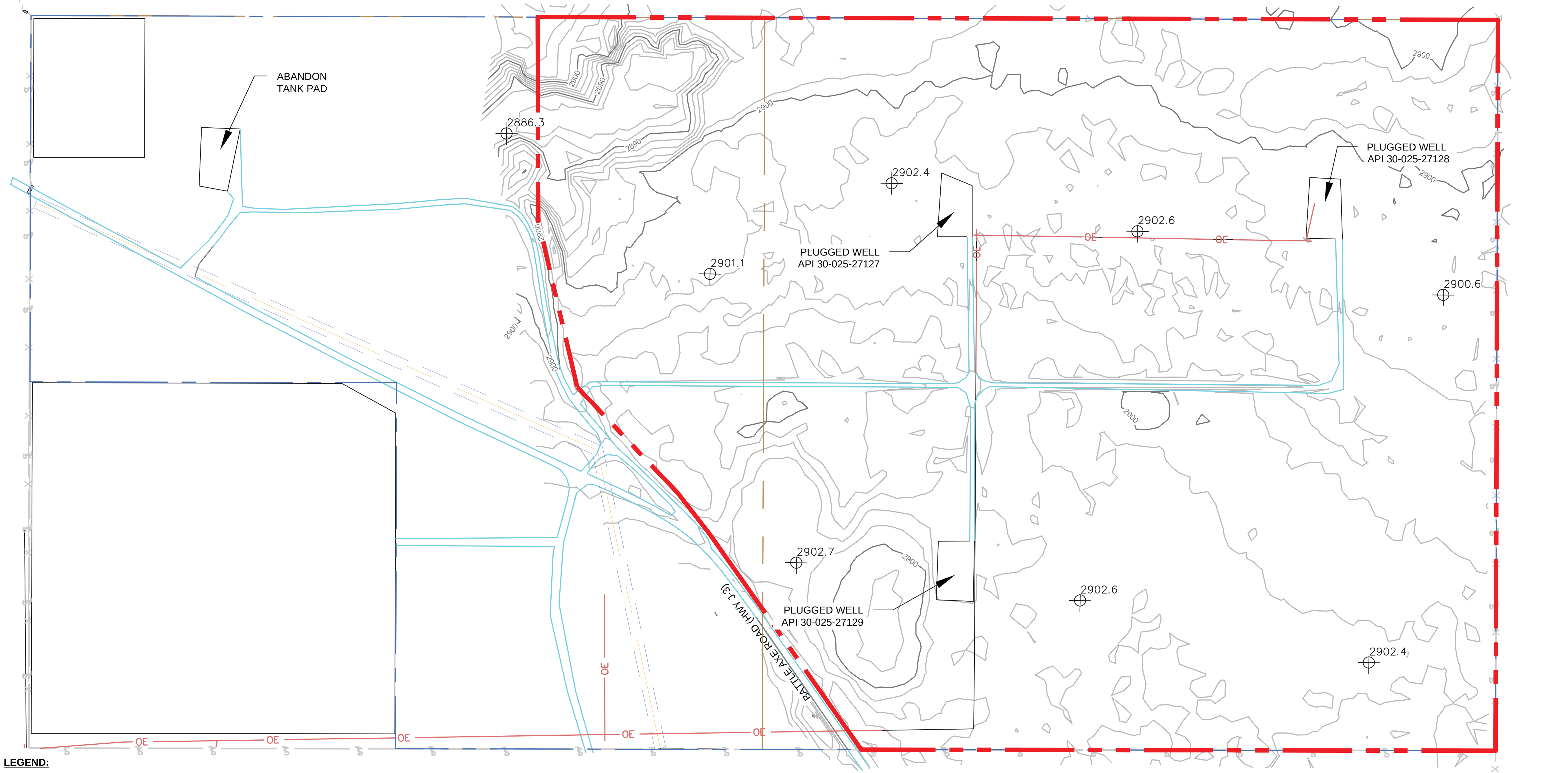
SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIG 1

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF



LEGEND:

3300	EXISTING GRADE CONTOURS (2' CONTOURS)
	PERMIT BOUNDARY AND SECURITY FENCELINE
OE	OVERHEAD ELECTRIC
G G G	EXISTING GAS LINES / GAS EASEMENT
X X	EXISTING FENCE LINE
	EXISTING EDGE OF ROADS
	SITE INVESTIGATION GEOTECHNICAL BOREHOLE LOCATIONS
3000	SPOT ELEVATIONS
N: E:	PERMIT BOUNDARY CORNERS
30-02-30458 (PLUGGED)	EXISTING WELLS
	NGL PROPERTY LINE
	SURVEY SECTION LINE

NOTES:

1. EXISTING TOPOGRAPHY WAS PERFORMED NOVEMBER 30, 2018 AND VERTICAL ELEVATIONS ARE BASED ON THE NAVD 88 NM_E.

N

400 0 200 400

SCALE IN FEET

FOR PERMITTING PURPOSES ONLY

REV | DATE | BY | DESCRIPTION

FACILITY LAYOUT AND TOPOGRAPHIC MAP

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

Terracon

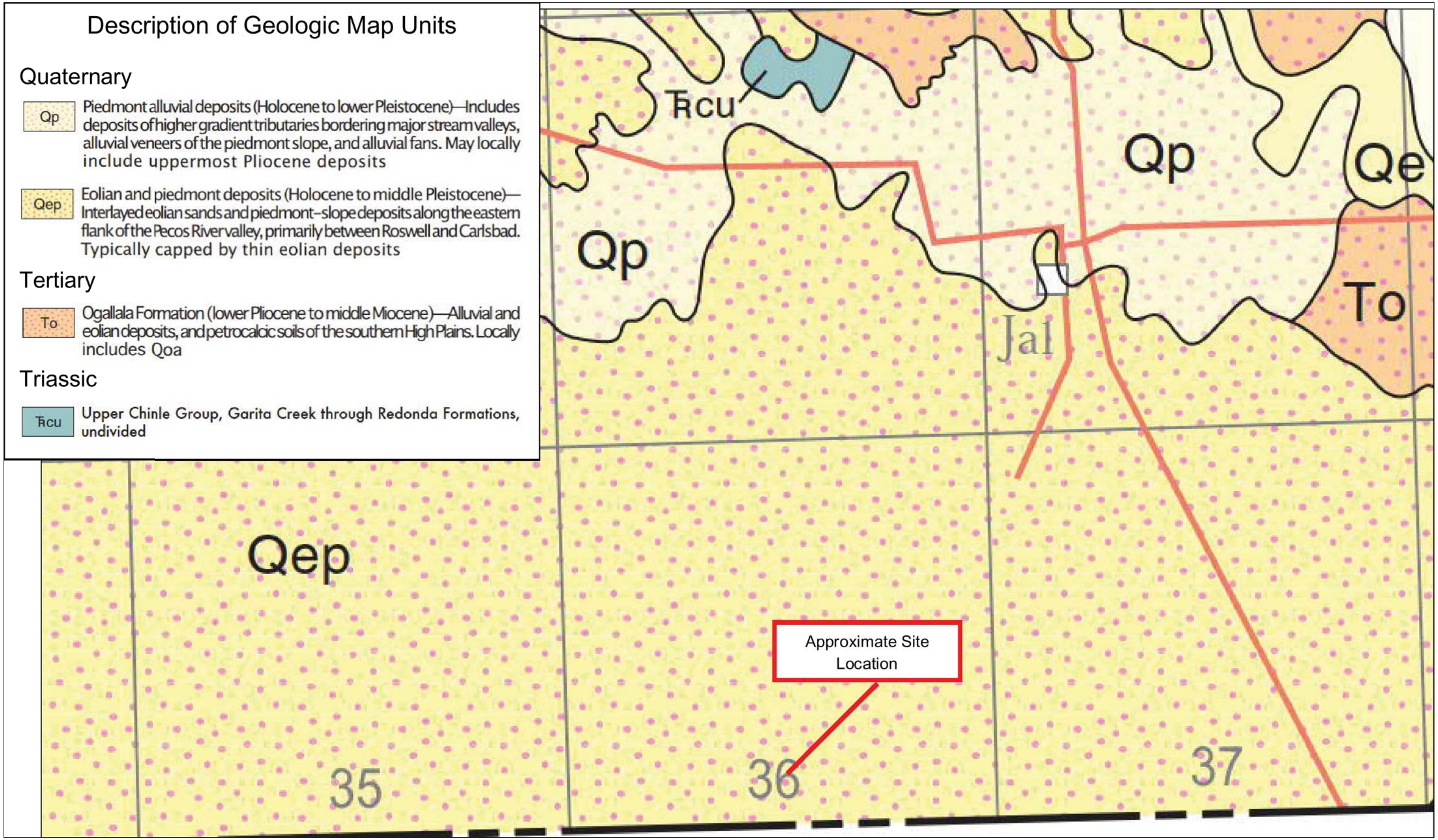
Consulting Engineers and Scientists

25809 I-30 SOUTH BRYANT, AR 72022

PH. (501) 847-9292 FAX. (501) 847-9210

FIG 2

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF



SITE GEOLOGIC MAP
SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

REV	DATE	BY	DESCRIPTION

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIG 3

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

FOR PERMITTING PURPOSES ONLY

NOTES:
1. NO WATER WELLS LOCATED WITHING 1 MILE OF PROPERTY BOUNDARY

FOR PERMITTING PURPOSES ONLY

REV	DATE	BY	DESCRIPTION

WATER WELL LOCATION MAP

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

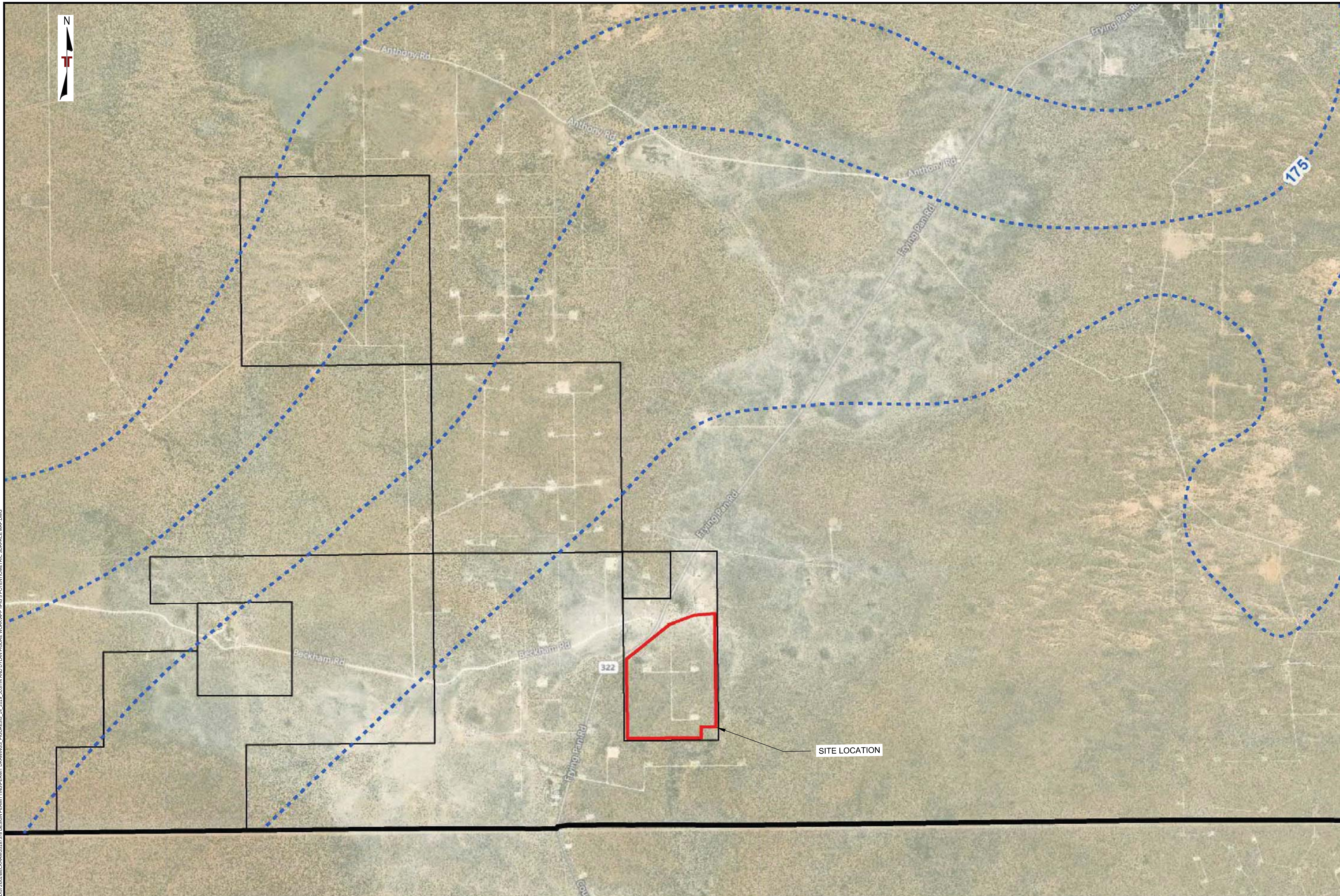
PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIGURE 4

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF



FOR PERMITTING PURPOSES ONLY

REV	DATE	BY	DESCRIPTION

LOCAL GROUNDWATER POTENTIOMECTRIC SURFACE MAP

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

PERMIT APPLICATION DRAWING

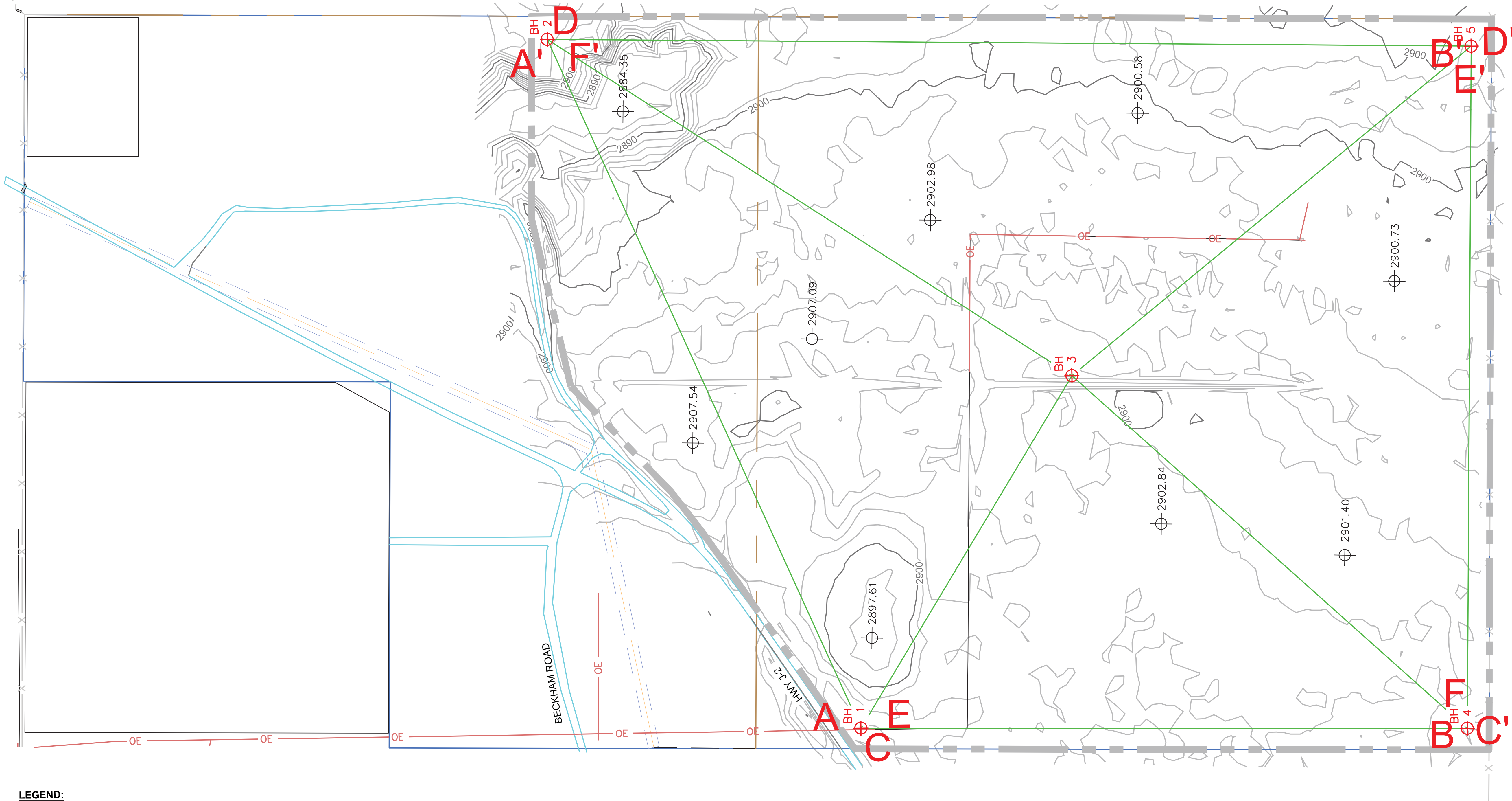
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIG 5

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

N:\GEOARCHIVE\CAD\572\002\BECKHAM\35187378 DESIGN PERMITTING\PERMIT DRAWINGS_FIGURES\5_14_2019_JUSTIN AND DYLAN FIGURE WORK\APP IF\FIG 5 POTENTIOMETRIC SURFACE MAP.DWG



LEGEND:

3300	EXISTING GRADE CONTOURS (11-30-2018, 2' CONTOURS)
	PERMIT BOUNDARY AND SECURITY FENCELINE
OE	OVERHEAD ELECTRIC
G G G	EXISTING GAS LINES / GAS EASEMENT
X X	EXISTING WATER LINE
	EXISTING CENTERLINE
BH #	BOREHOLE LOCATIONS
	NGL PROPERTY LINE
	CROSS-SECTION CUT LINE
3000	SPOT ELEVATIONS

NOTES:

1. EXISTING TOPOGRAPHY WAS PERFORMED NOVEMBER 30, 2018 AND VERTICAL ELEVATIONS ARE BASED ON THE NAVD 88 NM_E.
2. GAS AND OVERHEAD ELECTRIC TO BE RELOCATED BY OWNER PRIOR TO CELL CONSTRUCTION IN THIS AREA

N

400 0 200 400

SCALE IN FEET

FOR PERMITTING PURPOSES ONLY

REV.	DATE	BY	DESCRIPTION

GEOLOGICAL CROSS-SECTION ALIGNMENTS

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

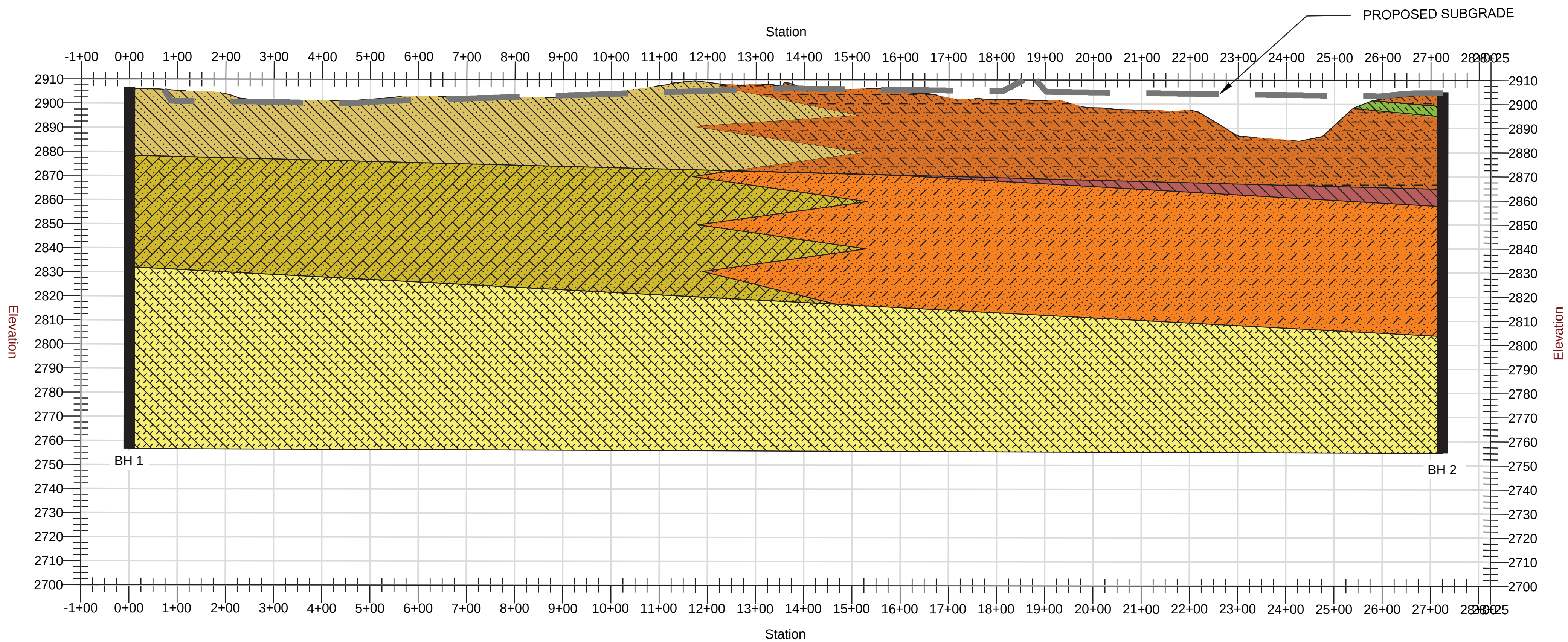
PERMIT APPLICATION DRAWING

LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

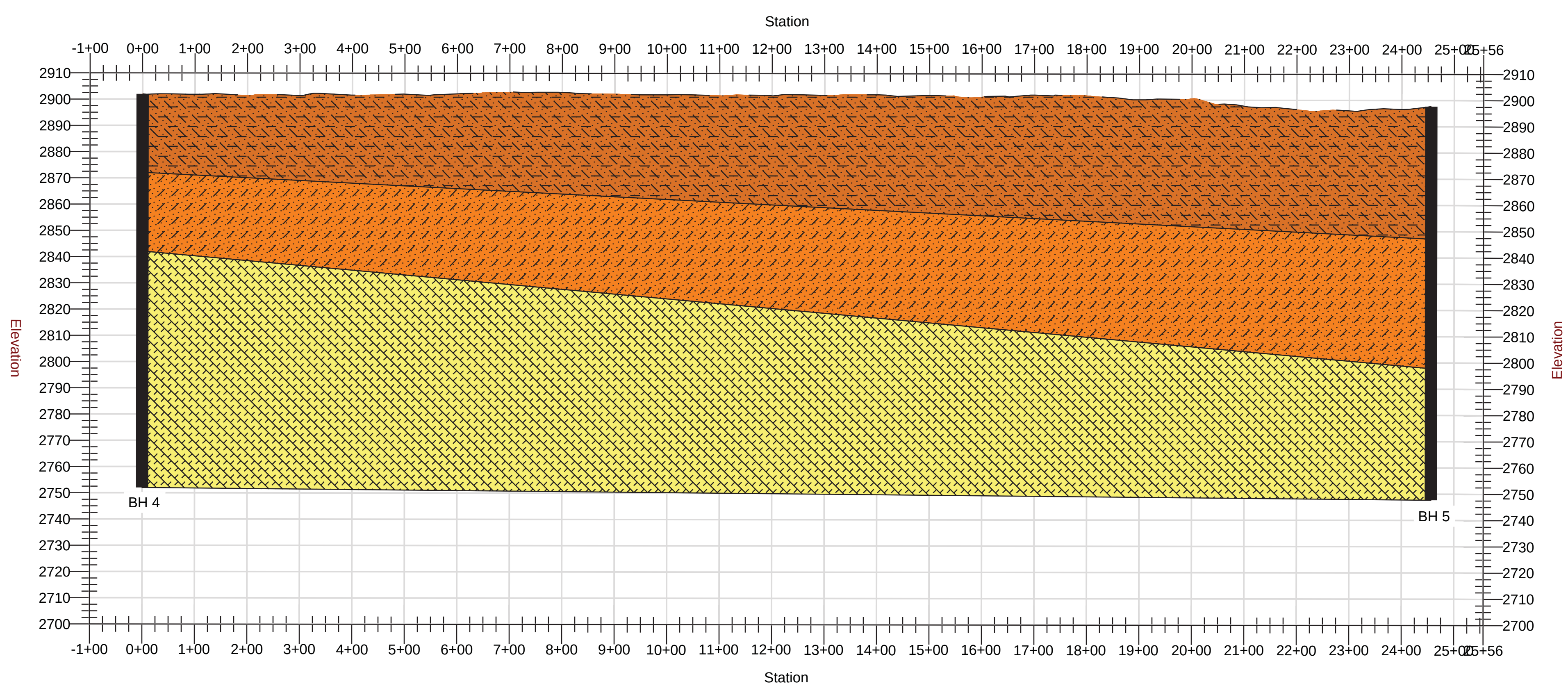
-

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF



ALIGN - A-A'

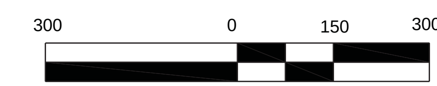
SECTION A / 7A



ALIGN - B-B'

SECTION B / 7A

SCALES:
1" = 300' (HORIZONTAL)
1" = 60' (VERTICAL)
VERTICAL EXAGGERATION = x 5



SCALE IN FEET

Silty Sand with Interbedded Caliche

Clayey Sand

Caliche

Poorly Graded Sand with Silt

Poorly Graded Sand with Silt and Interbedded Caliche

Silty Sand

Sandstone

BH # Bore Hole

REV	DATE	BY	DESCRIPTION

GEOLOGICAL CROSS-SECTION A-A' AND B-B'

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

PERMIT APPLICATION DRAWING

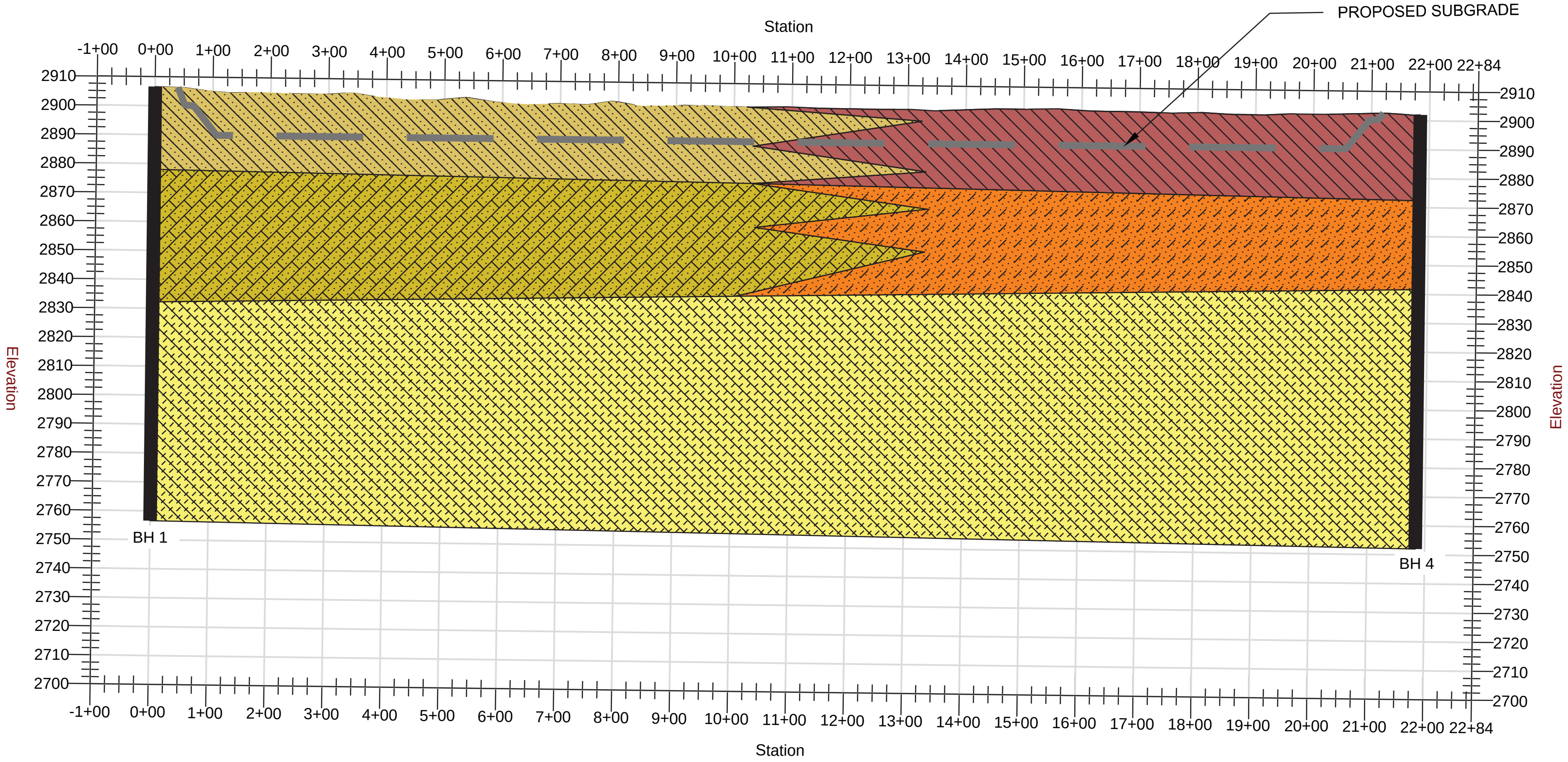
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 7A

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

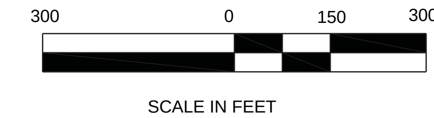
FOR PERMITTING PURPOSES ONLY

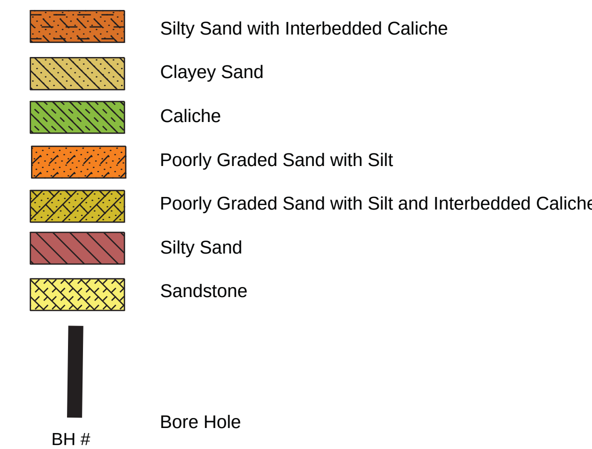


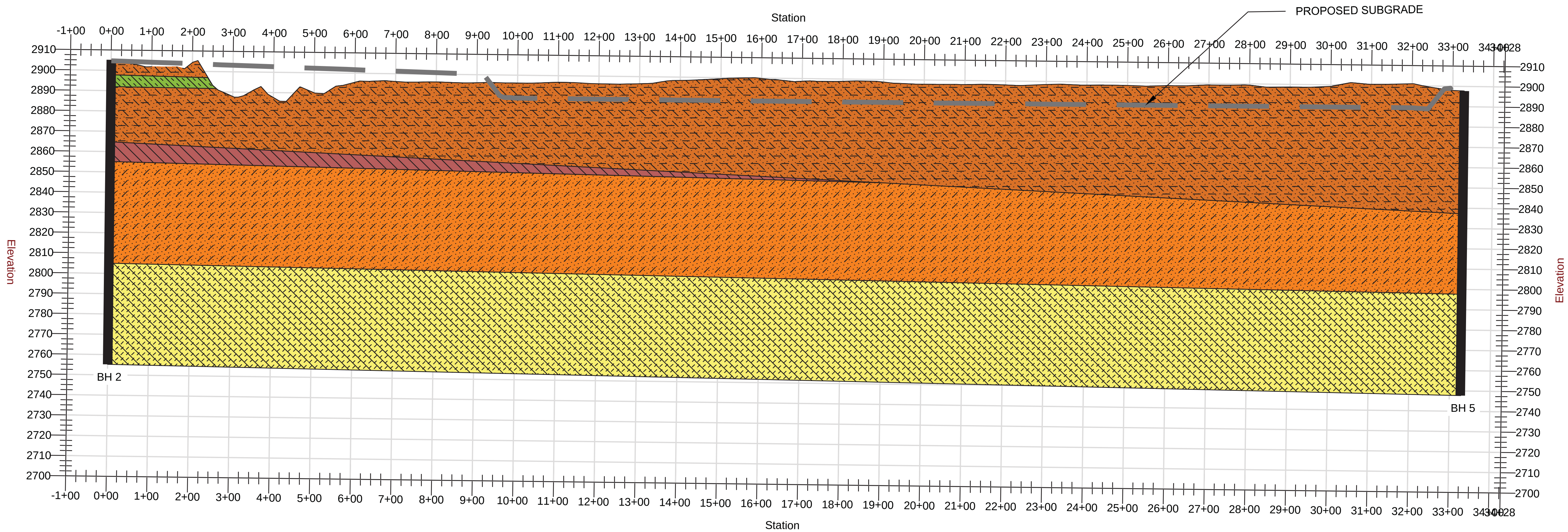
ALIGN - C-C'

SECTION C / 7B

SCALES:
1" = 300' (HORIZONTAL)
1" = 60' (VERTICAL)
VERTICAL EXAGGERATION = x 5







ALIGN - D-D'

SECTION D / 7B

FOR PERMITTING PURPOSES ONLY

REV	DATE	BY	DESCRIPTION

GEOLOGICAL CROSS-SECTION C-C' AND D-D'

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY

NGL WASTE SERVICES, LLC

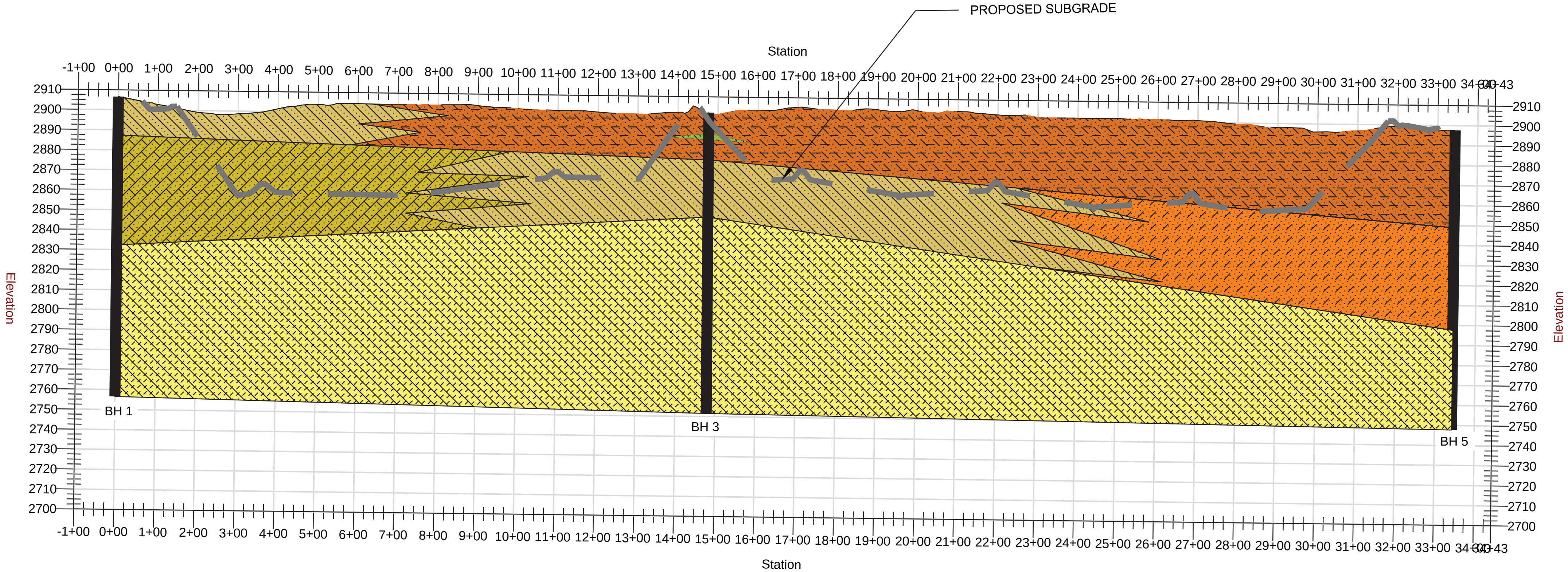
PERMIT APPLICATION DRAWING

LEA COUNTY — NEW MEXICO

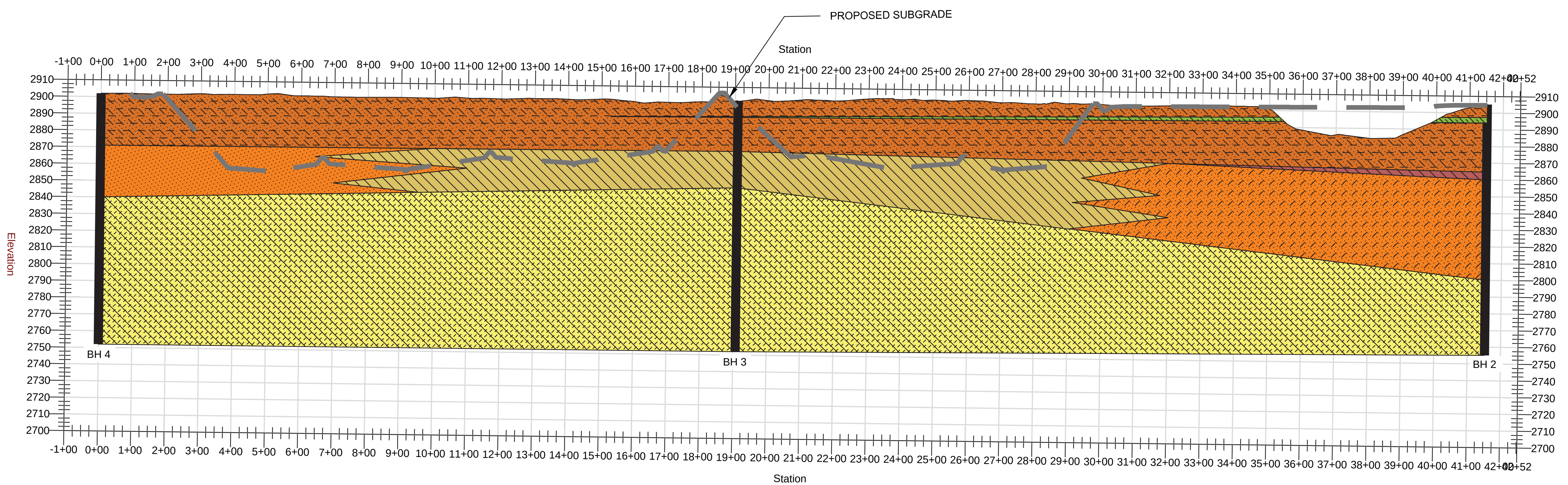
Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH, BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 7B

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

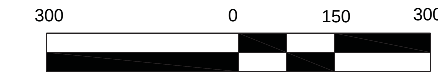


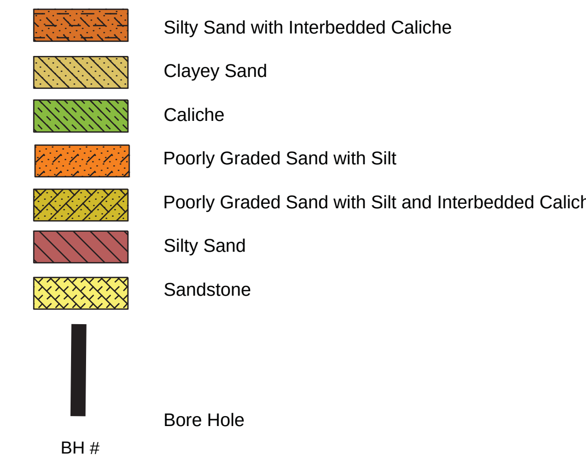
ALIGN - E-E'
SECTION E 7C



ALIGN - F-F'
SECTION F 7C

SCALES:
1" = 350' (HORIZONTAL)
1" = 70' (VERTICAL)
VERTICAL EXAGGERATION = x 5





REV	DATE	BY	DESCRIPTION

GEOLOGICAL CROSS-SECTION E-E' AND F-F'

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY
NGL WASTE SERVICES, LLC
PERMIT APPLICATION DRAWING
LEA COUNTY NEW MEXICO

Terracon
Consulting Engineers and Scientists
25809 I-30 SOUTH BRYANT, AR 72022
PH. (501) 847-9292 FAX. (501) 847-9210

DRAWING 7C

DESIGNED BY:	MPB
DRAWN BY:	DEW
APPVD. BY:	MPB
SCALE:	SEE SCALEBAR
DATE:	MAY 2019
JOB NO.	35187378
ACAD NO.	572-002
SHEET NO.:	OF

FOR PERMITTING PURPOSES ONLY

Attachment A

Geotechnical Engineering Report (Terracon - January 2019, Non-technical Revision May 2019)

Geotechnical Engineering Report

Beckham Ranch Landfill

Jal, Lea County, New Mexico

May 6, 2019

Terracon Project No. A4187129

Prepared for:

Trammco Environmental Solutions, LLC

Fernandina Beach, FL

Prepared by:

Terracon Consultants, Inc.

Midland, Texas

Terracon GeoReport

January 25, 2019

Trammco Environmental Solutions, LLC
P.O. Box 2283
Fernandina Beach, FL 79760

Attn: Mr. Matthew Trammell
E: matt@trammco.com

Re: Geotechnical Engineering Report
Beckham Ranch Landfill
Jal, Lea County, New Mexico
Terracon Project No. A4187129

Dear Mr. Trammell:

We have completed the Hydrogeological/Geotechnical investigations for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P35187312 dated October 17, 2018. This report presents the findings of the subsurface exploration and provides hydrological/geotechnical recommendations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

JAMES D. COSPER, II
NEW MEXICO
14477
REGISTERED PROFESSIONAL ENGINEER
1-25-19

Naga Velpuri
Staff Geotechnical Engineer

J. Dan Cosper, P.E.
Senior Associate/Office Manager

Copy: file

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	Landfill facility will be constructed on a 190-acre surface waste disposal facility within Section 27 of, T26S, R36E approximately 7 miles southwest of the City of Jal in Lea County, New Mexico.
Geotechnical Characterization	▪ Based on the field exploration, we classified the soils we encountered into three soil strata, first stratum with depths ranging between 26 feet to 47 feet below grade surface (bgs) consisting of clayey sand, silty sand, silty sand with interbedded layers of caliche, poorly graded sand with silt and interbedded layers of caliche. The second stratum was penetrated at depths ranging between 26 feet to 100 feet bgs consisting of silty sand, poorly graded sand, interbedded caliche layers classified as, silty sand, poorly graded sand. The third stratum was penetrated at depths ranging between 50 feet to 100 feet bgs and consisted of fine-grain, poorly to moderately compacted sandstone. ▪ Very dense/hard calcareous materials with varying degrees of cementation, or locally called "caliche" materials, which are typically classified as silty sand, poorly graded sand, were encountered in all the borings ranging from the upper approximately 7 to 100 feet of existing grades. Caliche interval thicknesses ranged from 1 inch to over 10 feet. The overburden materials are underlain by medium to finely weathered sandstone extending to boring-termination depths of 150 feet below existing grades. On-site subsurface soils are not expected to experience substantial volumetric changes (shrink/swell) with fluctuations in moisture content. Potential vertical rise (PVR) of on-site soils is estimated to be less than 1 inch. On-site soils are generally suitable for use as structural fill. ▪ Caliche bears a strong resemblance to rock and is therefore difficult to excavate. Based on the conditions encountered, we believe landfill excavations in the upper 7 to 50 feet of existing grades will require a hoe ram, a heavy dozer equipped with a ripper, a rock saw or a jack hammer. Bedrock was encountered beneath caliche materials, thus rock excavation by means of ripping and blasting is expected. Recommendations regarding excavation conditions of on-site subsurface materials and definitions of rock in various conditions are included in section Excavations Conditions of this report. ▪ The 2012 International Building Code (Section 1613.3.2) seismic site classification for this site is estimated to be C. ▪ No groundwater was encountered in any of the borings within the drilling depths of 150 feet below existing grades at the time of drilling. Based on these data, we do not expect groundwater would impact the landfill development. ▪ Laboratory permeability were measured on samples. Results of laboratory permeability measurements on samples collected from B-1, B-3 and B-5 were in a range of 1.63×10^{-5} to 9.46×10^{-7} cm/sec. Detailed permeability measurement results are presented in Geotechnical Characterization section of this report. ▪ Bedrocks (sandstone) were encountered at depths of 50 to 150 feet below existing grades. Please refer to boring logs and subsurface profiles provided in the Appendices.

Topic [1]	Overview Statement [2]
Below Grade Structures	The landfill development itself is considered a below grade structure.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

Beckham Ranch Landfill
IH-20 and FM-866
Jal, Lea County, New Mexico
Terracon Project No. A4187129
May 6, 2019

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Landfill to be located within Section 27 of, T26S, R36E approximately 7 miles southwest of the City of Jal in Lea County, New Mexico. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil (and rock) conditions
- Groundwater conditions
- Seismic site classification per IBC
- Site preparation and earthwork
- Excavation considerations

The geotechnical engineering scope of services for this project included the advancement of four test borings (B-1 to B-4) to depths approximately 150 feet and one boring (B-5) to a depth of 100 feet below existing site grades. **Please note that boring B-5 was terminated prior to proposed depth due to soil caving, after discussions with the client.** Although the original scope consists a total of fourteen soil testing samples, due to the homogeneity of soils and based on the project coordination with the client during the site exploration, only a total of three samples were collected for lab testing.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section of this report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project site is located within Section 27 of, T26S, R36E approximately 7 miles southwest of the City of Jal in Lea County, New Mexico. See **Site Location** for site location information.
Existing Improvements	Undeveloped ranch covered with creosote and mesquite trees. The site formerly was improved with 3 oil well production pads and a caliche/sand barrow pit.
Current Ground Cover	Site covered with sparse vegetation and mesquite trees
Existing Topography	The site slopes down towards the east.
Geology	■ Expected Geologic Conditions: o Pecos alluvium overlying Dockum Group ■ Geologic Map Details: o Unconsolidated, interlayered eolian sands and piedmont-slope deposits: ▪ Unconsolidated, interlayered eolian sands • Sands, loesses ▪ Piedmont-slope deposits • Includes deposits of higher gradient tributaries bordering major stream valleys, alluvial veneers of the piedmont slope, and alluvial fans. May locally include uppermost Pliocene deposits. ■ Underlying Upper Chinle Group, Garita Creek through Redonda Formations, undivided (Upper Triassic) ▪ Major mudstone, sandstone and minor conglomerate

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed in the project planning stage. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Project Description	One recycling and landfill facility will be constructed on a 190-acre tract of land.
Finished Floor Elevation	Elevation of deepest excavation is expected to be 50 feet below existing grade.
Below Grade Structures	Landfill

DRILLING PROCEDURES

▪ FIELD SUBSURFACE BORING INVESTIGATION WORK PLAN

Five boring locations were identified for drilling within the property. The boring program was designed to evaluate the lithology and subsurface conditions throughout the property. Terracon mobilized a sonic drilling unit to the site. However, due to drilling requirements, rock coring and/or air rotary drilling was required to advance the borings to final depth.

The drilling activities at this location was completed by a State of New Mexico licensed well driller. Oversight of the drilling program and the logging of the lithology was conducted by a field geologist.

▪ Drilling Methodology

Soil borings were performed using sonic drilling methods to the proposed maximum depth of the landfill (50 ft bgs) in accordance with ASTM D-6914/D6914M-16. The drilling rig was equipped with coring tools capable of providing a minimum borehole diameter of 6 inches with a core barrel 4 inches, 5 or 10 feet in length as drilling depth dictates. Borings B-1, B-2, B-3, and B-4 were advance to a total depth of 150 feet bgs. Boring B-5 was advanced to a depth of 100 feet bgs, due to the continual collapsing of the hole as noted above. Continuous cores were collected from boring B-2 to a depth of 150 feet bgs. Borings B-1, B-3, B-4 and B-5 were advanced from 50 to boring terminus using compressed air-rotary drilling after receiving approval from the State of New Mexico.

▪ Soil Boring Advancement

Each soil boring was advanced to a depth of 150 feet bgs, except boring B-5 which advanced to 100 feet bgs. This is over 100 feet below the proposed maximum depth of the landfill, if a landfill cell were to be located in the area of the soil boring. If a potential groundwater bearing zone (moist to saturated soils) was visible in any of the core samples, the depth was noted and the drill casing would be raised to a depth of 2 feet above the potential groundwater bearing zone. The boring would be gauged every hour for 3 hours. If no measurable amount of water had accumulated as measured with a water level meter (less than 0.01 feet) drilling would continue past this zone until either another potential groundwater bearing zone was encountered or the total depth of the boring was reached.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

Subsurface conditions encountered at the boring locations are described on the boring logs. Stratification boundaries on the boring logs represent the approximate locations of changes in soil types; in-situ, the transition between materials may be gradual. Details for the boring locations can be found on the boring logs of this report. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

As noted in **General Comments**, the characterization is based upon field descriptions of cores and cuttings by the field geologist, and variations in stratum are likely due to the widely spaced exploration points across the site.

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Encountered[1]	Consistency/Density
Stratum I	26 to 47	silty sand, poorly graded sand; brown	Loose to medium
Stratum II	50 to 100	silty sand, poorly graded sand, CALICHE classified as, silty sand, poorly graded sand; brown, light brown, reddish brown	Medium dense to very dense
Stratum III	>100 to 150	Sandstone, light brown, brown, tannish brown, to tan, reddish brown	Fine to medium, poorly to well Cemented

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

Groundwater was not identified in the 5 borings during boring advancement. In addition, each boring was allowed to recharge for a period of 24 hours to determine if groundwater was present. Prior to plugging each boring, the boring was gauged with a water level probe to evaluate the boring for the presence of groundwater. No measurable groundwater infiltration (greater than 0.01 feet) was present; therefore, the installation of monitoring wells was not required.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Laboratory Permeability Tests

Terracon conducted 3 laboratory permeability tests on cored stratum samples, the results are tabulated in the following table:

Test Number	Boring Number	Sample Depth (feet)	Permeability, K (cm/sec)
1	B-1	0 to 26	2.17×10^{-5}
2	B-3	27 to 50	9.46×10^{-7}
3	B-5	0 to 50	1.63×10^{-5}

Laboratory Direct Shear Tests

Terracon conducted three laboratory direct shear tests on samples, the results are tabulated in the following table:

Test Number	Boring Number	Sample Depth (feet)	Strain rate, (in./min.)	Cohesion (psi)	Friction Angle (degrees)
1	B-1	0 to 26	0.003	0.35	31.9
2	B-3	27 to 50	0.002	0.01	34
3	B-5	0 to 50	0.003	3.77	29.2

GEOTECHNICAL OVERVIEW

On-site soils generally consist of fine to medium sandy soils and strongly cemented, with calcareous interbedded caliche materials in the upper approximately 7 to 100 feet of existing grades, underlain by sandstone extending to boring termination depths of 150 feet bgs. On-site subsurface soils are not expected to experience substantial volumetric changes (shrink/swell) with fluctuations in moisture content. Potential vertical rise (PVR) of on-site soils is estimated to be less than 1 inch. On-site soils are generally suitable for use as structural fill.

The 2012 International Building Code (Section 1613.3.2) seismic site classification for this site is C.

Groundwater was not encountered in any of the borings within the drilling depths at the time of boring advancements. Based on site exploration, we do not expect groundwater would impact the landfill development, provided EDE is kept at 50 feet below existing grades.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork will include clearing and grubbing, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for landfill construction.

Site Preparation

Any topsoil or vegetation within areas to receive new fill or structures foundation footprint should be stripped and grubbed and removed. Subsequently, the exposed subgrade should be proof-rolled prior to the placement of any fill or base materials. The proof-rolling should be performed with a fully loaded, tandem-axle dump truck or other equipment providing an equivalent subgrade loading. A minimum gross weight of 20 tons is recommended for the proof-rolling equipment. The proof-rolling should consist of several overlapping passes in mutually perpendicular directions over a given area. Any soft or pumping areas should be excavated to firm ground. Excavated areas should be backfilled with properly placed and compacted fill as discussed in Section **Fill Compaction Requirements**.

Fill Material Types

The on-site subsurface materials, which are free of vegetation, debris, and rocks greater than 4 inches in maximum dimension, are generally suitable to be used for structural fill. Cemented caliche materials that look like rock are present on the project site. Caliche materials need to be crushed into sizes less than 4 inches in maximum dimension and thoroughly mixed with soils before they can be used for structural fill. Structural fill should be clean soil with a Liquid Limit (LL) of less than 35 and a Plasticity Index (PI) less than 15.

Fill Compaction Requirements

Recommendations for compaction are presented in the following table. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

Item	Description
General subgrade preparation to receive fill	Surface scarified to a minimum depth of 6 inches, moisture conditioned and compacted
Lift thickness	9 inches or less loose lift thickness
Compaction	At least 95% maximum standard Proctor dry density (ASTM D 698) in the range of ±2 percentage points of optimum moisture

Utilities

Care should be taken that utility trenches are properly backfilled. Backfilling should be accomplished with properly compacted engineered fill with loose lift thickness of generally 9 inches except for the first lift above the utility pipes that can be relaxed to 12 inches. Compaction should be accomplished with a hand-held compaction device inside utility trenches. Engineered fill should be compacted to at least 95% maximum standard Proctor dry density (ASTM D 698) in the range of ±2 percentage points of optimum moisture for the engineered fill.

Excavation Conditions and Construction Slopes

We understand that EDE in landfill is expected to be 50 feet below ground surface and construction of the proposed waste facility will involve mass excavation of subsurface materials. For this reason, we aim to determine the expected excavation conditions and rippability of the on-site subsurface materials within 50 feet bgs. We note that actual rippability will depend heavily on the equipment and tools used as well as the skill and experience of operators, among other factors. There is no method more effective to determine material rippability than a field production test with equipment similar or identical to that planned for use in project construction.

Caliche materials were encountered from existing grade to depths of about 7 to 100 feet bgs. Interbedded caliche layer underlain by sandstone bedrock extending to the borings termination depths of 150 feet bgs in all borings except B-5. Caliche bears a strong resemblance to rock and is therefore difficult to excavate. Based on the conditions encountered, we believe excavation of caliche may require a hoe ram, a heavy dozer equipped with a ripper, a rock saw or a jack hammer or with rock-excavation or blasting equipment. Excavation of rock, sandstone, will likely require controlled blasting.

Soils can generally be excavated by conventional scrapers and loaders. Caliche, partially weathered rock (PWR) or heavily fractured rock typically requires loosening by ripping with large dozers pulling single tooth rippers in mass excavation or blasting in confined (trench) excavation. Relatively sound, massive, rock typically requires blasting for removal in mass or trench excavation.

All excavations must comply with the applicable Federal, State, and local safety regulations and codes, and especially with the excavation standards of the Occupational Safety and Health Administration (OSHA). According to the OSHA soil classification, the on-site materials are generally classified as Type B soils. Temporary slopes of 1H:1V and permanent slopes of 3H:1V may be used. Construction site safety, including excavation safety, is the sole responsibility of the Contractor as part of its overall responsibility for the mean, methods, and sequencing of construction operations.

These descriptions are a guide to conditions generally encountered. Excavation techniques will vary based on the weathering of the materials, fracturing and jointing in the rock, and the overall stratigraphy of the feature. Actual field conditions usually display a gradual weathering progression with poorly defined and uneven boundaries between layers of different materials.

We recommend that the following definitions for rock in earthwork excavation construction be included in bid documents:

Mass Excavation: Any material occupying an original volume of more than 1 cubic yard which cannot be excavated with a single-toothed ripper drawn by a crawler tractor having a minimum draw bar pull rating of not less than 80,000 pounds (Caterpillar D-8 or larger).

Trench Excavation: Any material occupying an original volume of more than 1/2 cubic yard which cannot be excavated with a backhoe having a bucket curling rate of not less than 40,000 pounds, using a rock bucket and rock teeth (a John Deere 790 or larger).

In applicable areas, we recommend that soils which can be excavated with conventional equipment be removed first. Then, if necessary, heavy-duty or oversized equipment can be used to excavate cemented caliche by ripping. Blasting should only be conducted where materials cannot be excavated by other trench excavation techniques such as ripping.

Grading and Drainage

All grades must provide effective drainage away from structures during and after construction and should be maintained throughout the life of the structures. Water retained next to structures can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from structures

Exposed ground should be sloped and maintained at a minimum 5 percent away from structures for at least 10 feet beyond the perimeter of the structures. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After construction and landscaping, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving or flatwork abuts the structure a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations, for the landfill structures and buildings, are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SEISMIC CONSIDERATIONS

Description	Value
2012 International Building Code Site Classification	C [1, 2]
Site Latitude	32.011149°
Site Longitude	- 103.2572°
S_{DS} Spectral Acceleration for a Short Period [3]	0.164g
S_{D1} Spectral Acceleration for a 1-Second Period [3]	0.053g

1. Seismic site classification in general accordance with the *2012 International Building Code*, which refers to ASCE 7-10.
2. The 2012 International Building Code (IBC) uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 165 feet.
3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).

GENERAL COMMENTS

As the project progresses, we address assumptions by incorporating information provided by the design team, if any. Revised project information that reflects actual conditions important to our services is reflected in the final report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or 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. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Borings

As client requested, Terracon conducted a total of five (5) soil borings as tabulated in the following table:

Boring Location	Number of Borings	Boring Depth (feet)[1]	Drilling Footage (feet)[1]
Beckham Ranch Landfill	B-1 through B-4	150	600
Beckham Ranch Landfill	1 (B-5)	100	100

[1] The borings at the proposed center were extended to auger refusal/rock depths, and then rock coring was conducted.

Boring Layout and Elevations: Location of soil borings are provided on our **Site Location and Exploration Plans**. Location is established in the field by Terracon's exploration team using a measuring wheel/tape and/or a hand-held GPS unit to establish boring location with reference to known points. The accuracy of the exploration points is usually within 10 feet of the noted location.

Subsurface Exploration Procedures: All borings were advanced using sonic drilling methods to the minimum depth of 50 feet bgs in accordance with ASTM D-6914/D6914M-16. Boring B-5 was advanced using sonic drilling methods to a depth of 150 feet bgs. The sonic drilling rig was equipped with coring tools capable of providing a minimum borehole diameter of 6 inches with a core barrel 4 inches, 5 or 10 feet in length as drilling depth dictates. The drill casing and coring barrel was advanced into the subsurface to collect an undisturbed soil core. Prior to placing an additional core casing section onto the drill stem, the soil core was removed from the core barrel and the undisturbed soil core was extracted, characterized for geological lithology, and logged. The empty coring barrel was replaced inside the drill casing, and the drilling continued. This process was continued until either a boring depth of 50 feet bgs (150 feet bgs for B-5) was achieved or until groundwater was encountered. Compressed air-rotary drillingand plain water was utilized to remove the cores and/or cuttings and speed up the operation further, depending on subsurface conditions.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a geotechnical engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

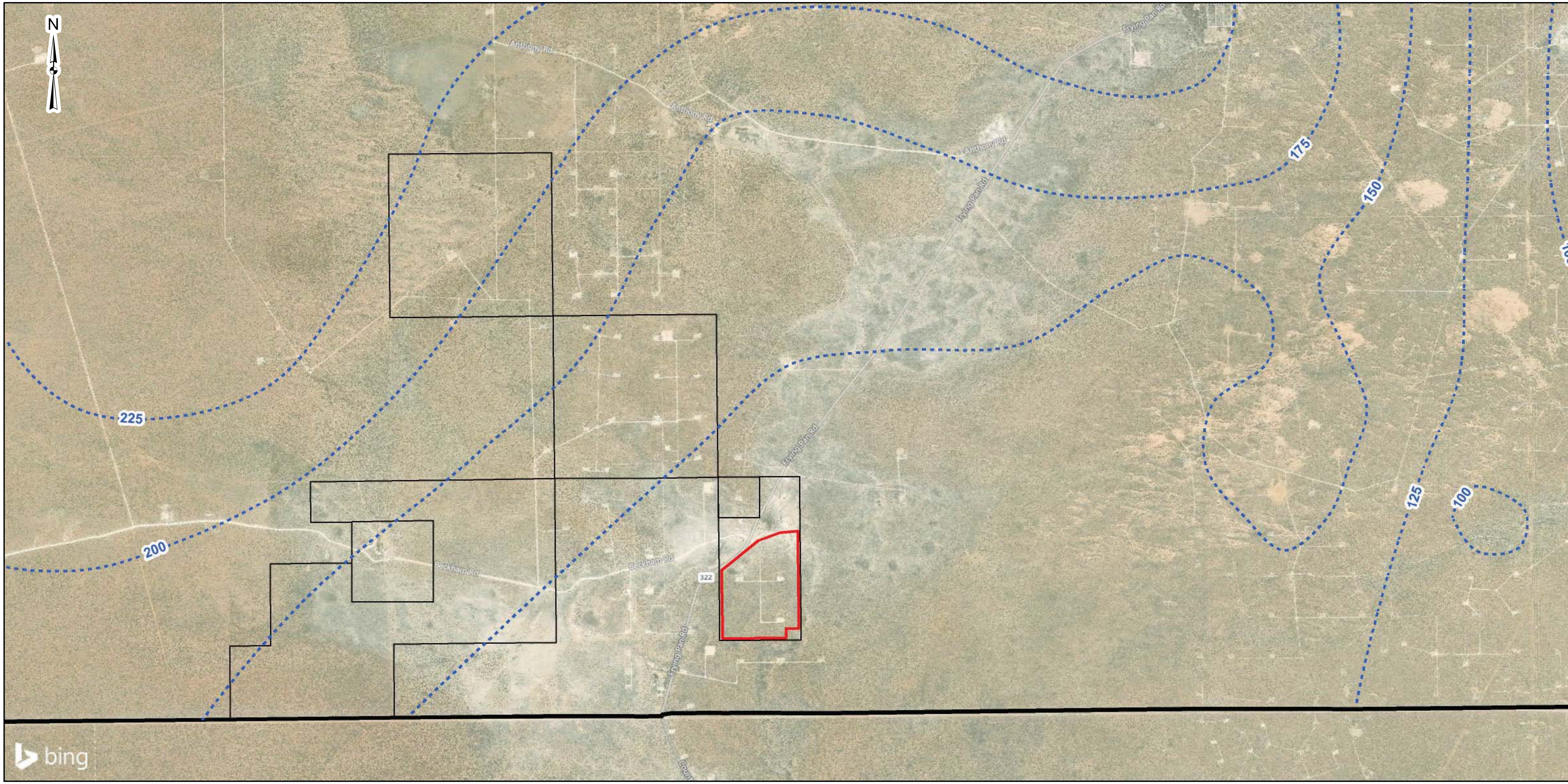
The project engineer reviews the field data and assigns various laboratory tests to better understand the engineering properties of the various soil and rock strata as necessary for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods are applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

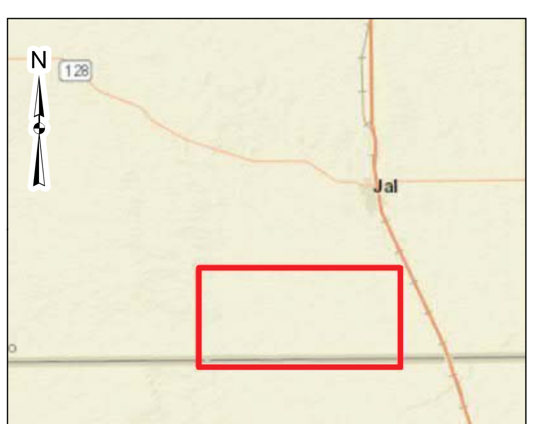
- Moisture Content (ASTM D854)
- Particle Size (ASTM D1140, D422)
- Atterberg Limits (ASTM D4318)
- Laboratory Compaction (ASTM D698)
- ASTM D5084 Standard Test Method for Permeability Tests
- Direct Sheer of Soil (ASTM D3080)

The laboratory testing program often includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we describe and classify the soil samples in accordance with the Unified Soil Classification System (USCS).

Rock classification is conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification is determined using the Description of Rock Properties.

SITE LOCATION AND EXPLORATION PLANS





Proposed Landfill

- Inferred Depth to Groundwater Contour (ft. bgs)
- Proposed Landfill
- Beckham Ranch Boundaries
- Texas-New Mexico State Boundary

Notes:
-Exhibit is for general location only, is not indended for construction purposes, and should not be used seperatedly from original report.

Miles: 0, 0.5, 1, 2

Fractional Scale: 1:38,286

DATA SOURCES:
Bing Maps - Aerial Imagery, World Street Map

Project No.:	35187313
Date:	Sep 2018
Drawn By:	SW
Reviewed By:	MB

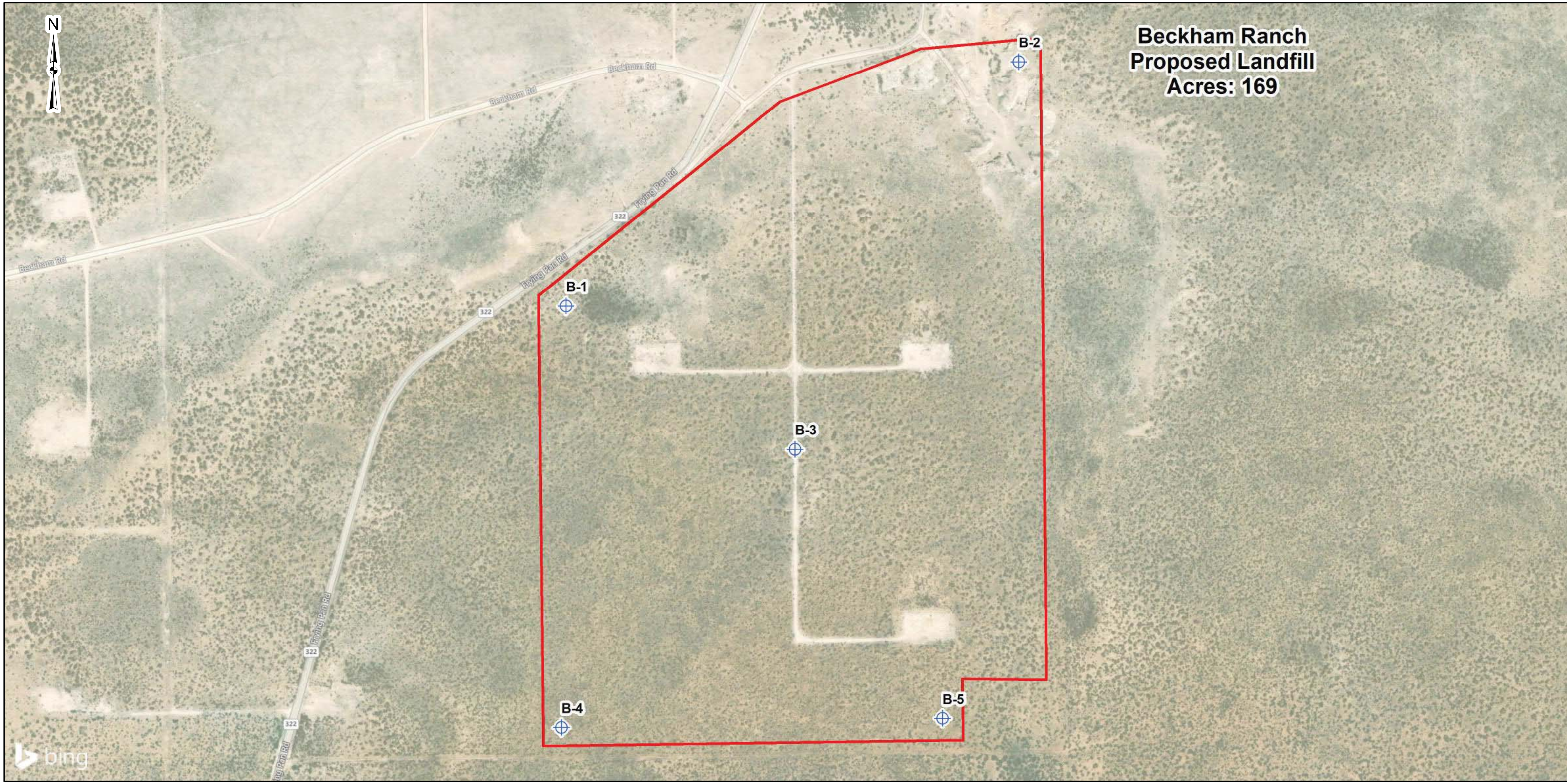
Terracon
10400 Highway 191 Midland, TX 79707
PH. (432) 684-9600 terracon.com

Proposed Landfill Map

Project Name
Beckham Ranch
Project Address
Lea County, New Mexico
GPS: 32.011219°, -103.257025°

Exhibit

1



Proposed Landfill

- Soil Boring (B)
- Proposed Landfill

Notes:
-Exhibit is for general location only, is not indended for construction purposes, and should not be used seperatedly from original report.

Feet
0 375 750 1,500

Fractional Scale: 1:5,814

DATA SOURCES:
Bing Maps - Aerial Imagery, World Street Map

Project No.:	A4187129
Date:	Jan 2019
Drawn By:	SW
Reviewed By:	DC

Terracon
10400 Highway 191 Midland, TX 79707
PH. (432) 684-9600 terracon.com

Proposed Landfill Map

Trammco Environmental Solutions
Beckham Ranch - Proposed Landfill
Project Address
Lea County, New Mexico
GPS: 32.011219°, -103.257025°

Exhibit

2

C:\Users\jswagner\Desktop\GIS_Midland_Projects\LSI GIS Projects\A41870##_NM_BeckhamRanch_GIS\A41870##_NM_BeckhamRanch_Ex2_SampleLocMap.mxd

EXPLORATION RESULTS

BORING LOG NO. B-1

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.0133° Longitude: -103.2615°

Approximate Surface Elev.: 2903 (Ft.) +/-

DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), brown to light brown, dry, -Loose to very dense							
			12.5		Hand	3	29-15-14	48
26.0		2877+/-						
	POORLY GRADED SAND WITH SILT, with interbedded CALICHE (SP-SM), reddish brown to light brown, dry, -Medium dense to very dense							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 12-03-2018	Boring Completed: 12-11-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-1

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.0133° Longitude: -103.2615°

Approximate Surface Elev.: 2903 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	POORLY GRADED SAND WITH SILT, with interbedded CALICHE (SP-SM), reddish brown to light brown, dry, -Medium dense to very dense *(continued)*		65					
	70.0	2833+/-	70					
	SANDSTONE, reddish brown, dry, -Moderately to highly weathered		75, 80, 85, 90, 95, 100, 105, 110, 115, 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 12-03-2018	Boring Completed: 12-11-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-1

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.0133° Longitude: -103.2615° Approximate Surface Elev.: 2903 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, reddish brown, dry, -Moderately to highly weathered *(continued)*	125 130 135 140 145					
	150.0 / 2753+/-	150					
	Boring Terminated at 150 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 12-03-2018	Boring Completed: 12-11-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-2

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.0166° Longitude: -103.2531°

Approximate Surface Elev.: 2904 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
7.0	**SILTY SAND (SM)**, light brown, dry, -Loose to medium dense	2897+/-						
10.0	**CALICHE**, white, dry	2894+/-						
40.0	**SILTY SAND, with interbedded CALICHE (SM)**, light brown to brown, dry, -Medium dense to very dense	2864+/-						
47.0	**SILTY SAND (SM)**, light brown to brown, dry, -Medium dense to very dense	2857+/-						
	POORLY GRADED SAND WITH SILT (SP-SM), brown to gray, dry, -Medium dense to very dense							

Depth scale (Ft.): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-30-2018	Boring Completed: 11-30-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-2

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.0166° Longitude: -103.2531° Approximate Surface Elev.: 2904 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	POORLY GRADED SAND WITH SILT (SP-SM), brown to gray, dry, -Medium dense to very dense *(continued)*	65, 70, 75, 80, 85, 90, 95					
	100.0 / 2804+/-	100					
	SANDSTONE, reddish brown, dry, -Moderately to highly weathered	105, 110, 115, 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-30-2018	Boring Completed: 11-30-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-2

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.0166° Longitude: -103.2531° Approximate Surface Elev.: 2904 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, reddish brown, dry, -Moderately to highly weathered *(continued)*	125 130 135 140 145					
	150.0 — 2754+/-	150					
	Boring Terminated at 150 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-30-2018	Boring Completed: 11-30-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-3

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.0111° Longitude: -103.2572°

Approximate Surface Elev.: 2900 (Ft.) +/-

DEPTH (Ft.)	MATERIAL DESCRIPTION	ELEVATION (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.0–8.0	**SILTY SAND (SM)**, light brown, dry, -Loose to medium dense	2892+/-					
8.0–10.0	**CALICHE**, white, dry	2890+/-					
10.0–27.0	**SILTY SAND, with interbedded CALICHE (SM)**, light brown to brown, dry, -Loose to medium dense	2873+/-					
27.0–50.0	**CLAYEY SAND (SC)**, brown, dry, -Medium dense to very dense	2850+/-		(hand sample, ~38 ft)	11	27-18-9	35
50.0–	**SANDSTONE**, brown to reddish brown, dry, -Moderately to highly weathered						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-29-2018	Boring Completed: 12-06-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-3

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.0111° Longitude: -103.2572° Approximate Surface Elev.: 2900 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to reddish brown, dry, -Moderately to highly weathered *(continued)*	65 70 75 80 85 90 95 100 105 110 115 120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-29-2018	Boring Completed: 12-06-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-3

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.0111° Longitude: -103.2572° Approximate Surface Elev.: 2900 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, brown to reddish brown, dry, -Moderately to highly weathered *(continued)*	125 130 135 140 145					
	150.0 / 2750+/-	150					
	Boring Terminated at 150 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 11-29-2018	Boring Completed: 12-06-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-4

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.007° Longitude: -103.2615°

Approximate Surface Elev.: 2902 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
3.0	**POORLY GRADED SAND (SP)**, dark brown, dry, -Loose	2899+/-						
30.0	**SILTY SAND, with interbedded CALICHE (SM)**, light brown to brown, dry, -Loose to medium dense	2872+/-						
60.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, light brown to gray, dry, -Medium dense to very dense	2842+/-						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 12-03-2018	Boring Completed: 12-07-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-4

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.007° Longitude: -103.2615°

Approximate Surface Elev.: 2902 (Ft.) +/-

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, light brown to reddish brown, dry, -Moderately to highly weathered	65					
		70					
		75					
		80					
		85					
		90					
		95					
		100					
		105					
		110					
		115					
		120					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 12-03-2018	Boring Completed: 12-07-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-4

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.007° Longitude: -103.2615°

Approximate Surface Elev.: 2902 (Ft.) +/-

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDSTONE, light brown to reddish brown, dry, -Moderately to highly weathered *(continued)*	125, 130, 135, 140, 145					
	150.0 — 2752+/-	150					
	Boring Terminated at 150 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 12-03-2018	Boring Completed: 12-07-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-5

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.007° Longitude: -103.2531°

Approximate Surface Elev.: 2898 (Ft.) +/-

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND, with interbedded CALICHE (SM), light brown to brown, dry, -Loose to very dense						
		25		Hand	5	20-17-3	29
	50.0 / 2848+/-	50					
	POORLY GRADED SAND WITH SILT (SP-SM), light brown to gray, dry, -Medium dense to very dense						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 12-01-2018	Boring Completed: 12-12-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

BORING LOG NO. B-5

PROJECT: Beckham Ranch Landfill

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

LOCATION See Exploration Plan

Latitude: 32.007° Longitude: -103.2531°

Approximate Surface Elev.: 2898 (Ft.) +/-

GRAPHIC LOG	DEPTH / DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	POORLY GRADED SAND WITH SILT (SP-SM), light brown to gray, dry, -Medium dense to very dense *(continued)*		65, 70, 75, 80, 85, 90, 95					
	100.0	2798+/-	100					
	Boring Terminated at 100 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Sonic/Coring

Abandonment Method:
Boring backfilled with bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No groundwater encountered during drilling

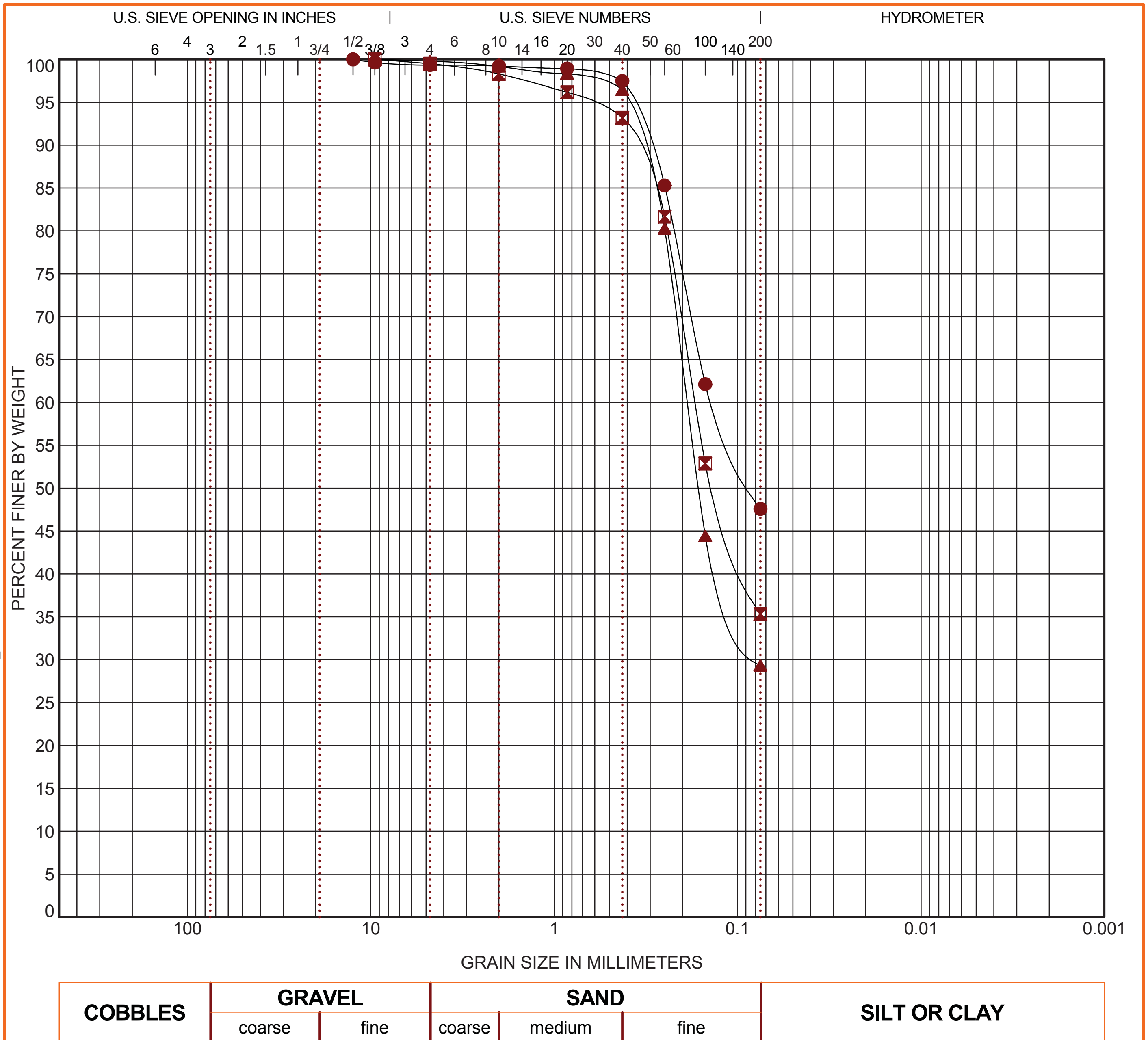
Dry after 24 hours of drilling

Terracon
10400 State Highway 191
Midland, TX

Boring Started: 12-01-2018	Boring Completed: 12-12-2018
Drill Rig: CME 75	Driller: Alec
Project No.: A4187129	

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B-1	0 - 26	CLAYEY SAND (SC)	3	29	15	14		
⊠	B-3	27 - 50	CLAYEY SAND (SC)	11	27	18	9		
▲	B-5	0 - 50	SILTY SAND (SM)	5	20	17	3		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B-1	0 - 26	12.5	0.136			0.7	51.8		47.6	
⊠	B-3	27 - 50	9.5	0.17			0.5	64.2		35.3	
▲	B-5	0 - 50	9.5	0.187	0.077		0.2	70.5		29.3	

PROJECT: Beckham Ranch Landfill

SITE: Section 9 and 10 of, T25S, R34E
Jal, Lea County, New Mexico

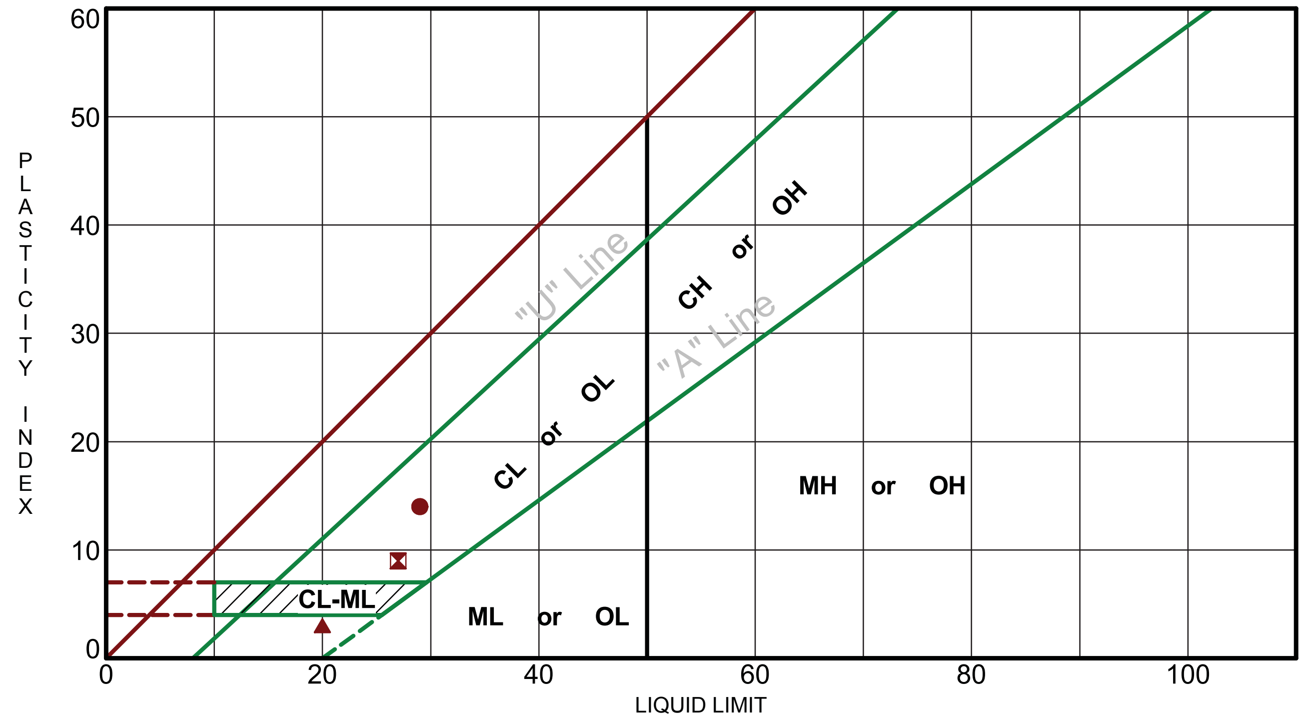
Terracon
10400 State Highway 191
Midland, TX

PROJECT NUMBER: A4187129

CLIENT: Trammco Environmental Solutions LLC
Fermandina Beach, Florida

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-1	0 - 26	29	15	14	48	SC	CLAYEY SAND
⊠	B-3	27 - 50	27	18	9	35	SC	CLAYEY SAND
▲	B-5	0 - 50	20	17	3	29	SM	SILTY SAND

PROJECT: Beckham Ranch Landfill	PROJECT NUMBER: A4187129
SITE: Section 9 and 10 of, T25S, R34E Jal, Lea County, New Mexico	CLIENT: Trammco Environmental Solutions LLC Fermandina Beach, Florida

Terracon
10400 State Highway 191
Midland, TX

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Beckham and McCloy Landfill						
Date:	12/21/2018			Panel Number :	P-1		
Project No. :	A4187129			Permometer Data			
Boring No.:	B-1	a_p =	0.031416 cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	composite	a_a =	0.767120 cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	0.0-26.0	M_1 =	0.030180	C = 0.0004288	Annulus **Ra**	1.0	cm^3
Other Location:	Beckham Site	M_2 =	1.040953	T = 0.0658646			

Material Description : light brown sandy clay

SAMPLE DATA

Wet Wt. sample + ring or tare :			568.83	g					
Tare or ring Wt. :			0.0	g	Before Test		After Test		
Wet Wt: of Sample :			568.83	g	Tare No.:	101	Tare No.:	N/A	
Diameter :	2.80	in	7.11	cm^2	Wet Wt.+tare:	114.30	Wet Wt.+tare:	581.29	
Length :	2.80	in	7.11	cm	Dry Wt.+tare:	100.00	Dry Wt.+tare:	486.00	
Area:	6.16	in^2	39.73	cm^2	Tare Wt:	0.00	Tare Wt:	0.00	
Volume :	17.24	in^3	282.53	cm^3	Dry Wt.:	100	Dry Wt.:	486	
Unit Wt.(wet):	**125.63**	pcf	**2.01**	g/cm^3	Water Wt.:	14.3	Water Wt.:	95.29	
Unit Wt.(dry):	**109.91**	pcf	**1.76**	g/cm^3	% moist.:	**14.3**	% moist.:	**19.6**	

Assumed Specific Gravity:	**2.70**	Max Dry Density(pcf) =	115.7	OMC =	12.3
		% of max =	95.0	+/- OMC =	2.00
Calculated % saturation:	99.22	Void ratio (e) =	**0.53**	Porosity (n)=	**0.35**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/3/2019	2	15.4	1.382666	21	0.977	2.00E-05	5.67E-02	
1/3/2019	4	14	2.782666	21	0.977	2.12E-05	6.01E-02	
1/3/2019	6	12.5	4.282666	21	0.977	2.31E-05	6.56E-02	
1/3/2019	8	11.5	5.282666	21	0.977	2.24E-05	6.35E-02	

SUMMARY

ka = 2.17E-05 cm/sec Acceptance criteria = 50 %

ki			Vm	
k1 =	2.00E-05	cm/sec	7.8	%
k2 =	2.12E-05	cm/sec	2.2	%
k3 =	2.31E-05	cm/sec	6.7	%
k4 =	2.24E-05	cm/sec	3.3	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**2.17E-05**	cm/sec	**6.15E-02**	ft/day
Void Ratio	e =	**0.53**			
Porosity	n =	**0.35**			
Bulk Density	γ =	**2.01**	g/cm^3	**125.6**	pcf
Water Content	W =	**0.25**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**2.22E-10**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Beckham and McCloy Landfill

Date: 12/21/2018 Panel Number : P-1

Project No. : A4187129

Permometer Data

Boring No.:	B-3	a_p =	0.031416 cm^2	Set Mercury to Pipet Rp at beginning		Equilibrium	1.6 cm^3
Sample:	composite	a_a =	0.767120 cm^2			Pipet **Rp**	**16.8** cm^3
Depth (ft):	27.0-50.0	M_1 =	0.030180	C =	0.0004288	Annulus **Ra**	1.0 cm^3
Other Location:	Beckham Site	M_2 =	1.040953	T =	0.0658646		

Material Description : light reddish brown sandy silt

SAMPLE DATA

Wet Wt. sample + ring or tare :			566.51	g
Tare or ring Wt. :			0.0	g
Wet Wt: of Sample :			566.51	g
Diameter :	2.80	in	7.11	cm^2
Length :	2.80	in	7.11	cm
Area:	6.16	in^2	39.73	cm^2
Volume :	17.24	in^3	282.53	cm^3
Unit Wt.(wet):	**125.12**	pcf	**2.01**	g/cm^3
Unit Wt.(dry):	**106.30**	pcf	**1.70**	g/cm^3

	Before Test		After Test
Tare No.:	102	Tare No.:	N/A
Wet Wt.+tare:	117.70	Wet Wt.+tare:	573.66
Dry Wt.+tare:	100.00	Dry Wt.+tare:	472.66
Tare Wt:	0.00	Tare Wt:	0.00
Dry Wt.:	100	Dry Wt.:	472.66
Water Wt.:	17.7	Water Wt.:	101
% moist.:	**17.7**	% moist.:	**21.4**

Assumed Specific Gravity:	**2.70**	Max Dry Density(pcf) =	111.9	OMC =	15.7
		% of max =	95.0	+/- OMC =	2.00
Calculated % saturation:	98.51	Void ratio (e) =	**0.59**	Porosity (n)=	**0.37**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/3/2019	10	16.5	0.282666	21	0.977	7.87E-07	2.23E-03	
1/3/2019	20	16.1	0.682666	21	0.977	9.63E-07	2.73E-03	
1/3/2019	30	15.7	1.082666	21	0.977	1.03E-06	2.93E-03	
1/3/2019	40	15.4	1.382666	21	0.977	1.00E-06	2.83E-03	

SUMMARY

ka = 9.46E-07 cm/sec Acceptance criteria = 50 %

ki			Vm	
k1 =	7.87E-07	cm/sec	16.8	%
k2 =	9.63E-07	cm/sec	1.9	%
k3 =	1.03E-06	cm/sec	9.2	%
k4 =	1.00E-06	cm/sec	5.7	%

$$Vm = \frac{|ka - ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**9.46E-07**	cm/sec	**2.68E-03**	ft/day
Void Ratio	e =	**0.59**			
Porosity	n =	**0.37**			
Bulk Density	γ =	**2.01**	g/cm^3	**125.1**	pcf
Water Content	W =	**0.30**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**9.69E-12**	cm^2	(at 20 deg C)	

Terracon

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project :	Beckham and McCloy Landfill						
Date:	12/21/2018		Panel Number : P-1				
Project No. :	A4187129		Permometer Data				
Boring No.:	B-5	a_p =	0.031416 cm^2	Set Mercury to Pipet Rp at beginning	Equilibrium	1.6	cm^3
Sample:	composite	a_a =	0.767120 cm^2		Pipet **Rp**	**16.8**	cm^3
Depth (ft):	0.0-50.0	M_1 =	0.030180	C = 0.0004288	Annulus **Ra**	1.0	cm^3
Other Location:	Beckham Site	M_2 =	1.040953	T = 0.0658646			

Material Description : light brown sandy silt

SAMPLE DATA

Wet Wt. sample + ring or tare :			587.33	g					
Tare or ring Wt. :			0.0	g		Before Test		After Test	
Wet Wt: of Sample :			587.33	g		Tare No.:	103	Tare No.:	N/A
Diameter :	2.80	in	7.11	cm^2		Wet Wt.+tare:	113.60	Wet Wt.+tare:	594.70
Length :	2.80	in	7.11	cm		Dry Wt.+tare:	100.00	Dry Wt.+tare:	506.48
Area:	6.16	in^2	39.73	cm^2		Tare Wt:	0.00	Tare Wt:	0.00
Volume :	17.24	in^3	282.53	cm^3		Dry Wt.:	100	Dry Wt.:	506.48
Unit Wt.(wet):	**129.72**	pcf	**2.08**	g/cm^3		Water Wt.:	13.6	Water Wt.:	88.22
Unit Wt.(dry):	**114.19**	pcf	**1.83**	g/cm^3		% moist.:	**13.6**	% moist.:	**17.4**

Assumed Specific Gravity:	**2.70**	Max Dry Density(pcf) =	120.2	OMC =	11.6
		% of max =	95.0	+/- OMC =	2.00
Calculated % saturation:	98.77	Void ratio (e) =	**0.48**	Porosity (n)=	**0.32**

Test Pressures During Hydraulic Conductivity Test

Cell Pressure (psi) = 55.00 Back Pressure (psi) = 50.00 Confining Pressure = 5.00 psi

Note: The above value is Effective Confining Pressure

TEST READINGS

Z_1(Mercury Height Difference @ t_1): 15.8 cm Hydraulic Gradient = 28.00

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZp (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
1/3/2019	2	16	0.782666	21	0.977	1.11E-05	3.14E-02	
1/3/2019	4	14.8	1.982666	21	0.977	1.47E-05	4.15E-02	
1/3/2019	6	13.4	3.382666	21	0.977	1.76E-05	4.99E-02	
1/3/2019	8	11.6	5.182666	21	0.977	2.19E-05	6.20E-02	

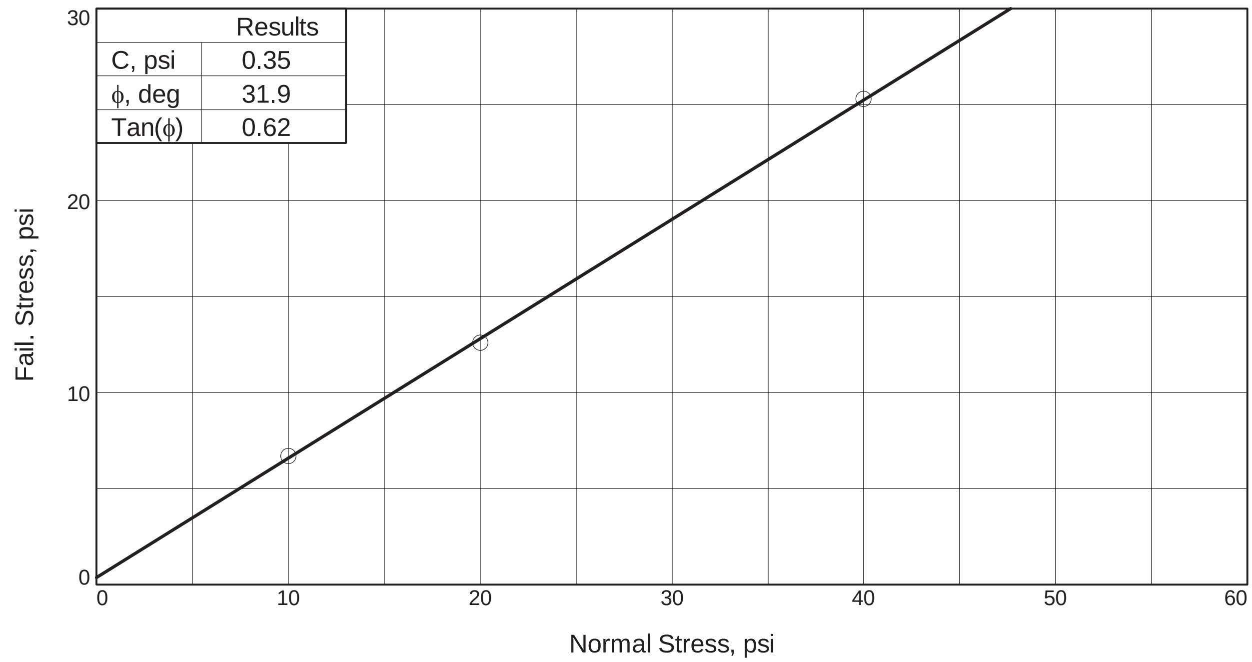
SUMMARY

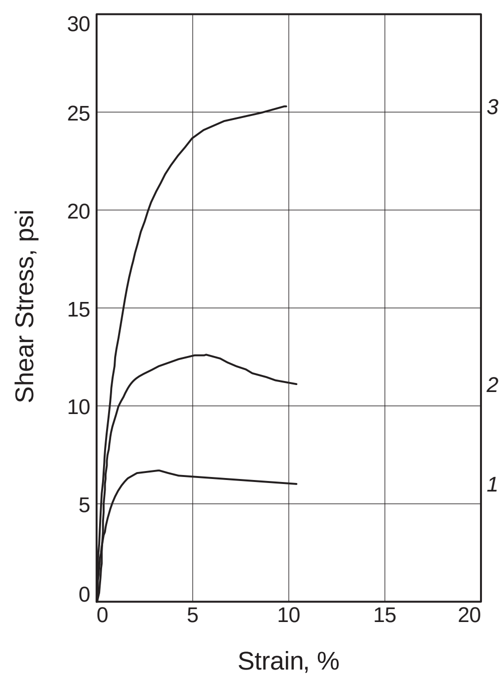
ka = 1.63E-05 cm/sec   Acceptance criteria = 50 %

ki			Vm	
k1 =	1.11E-05	cm/sec	32.0	%
k2 =	1.47E-05	cm/sec	10.1	%
k3 =	1.76E-05	cm/sec	8.0	%
k4 =	2.19E-05	cm/sec	34.1	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**1.63E-05**	cm/sec	**4.62E-02**	ft/day
Void Ratio	e =	**0.48**			
Porosity	n =	**0.32**			
Bulk Density	γ =	**2.08**	g/cm^3	**129.7**	pcf
Water Content	W =	**0.25**	cm^3/cm^3	(at 20 deg C)	
Intrinsic Permeability	k_{int} =	**1.67E-10**	cm^2	(at 20 deg C)	





Sample No.		1	2	3
Initial	Water Content, %	14.3	14.3	14.3
	Dry Density, pcf	109.9	109.9	109.9
	Saturation, %	72.4	72.4	72.4
	Void Ratio	0.5333	0.5333	0.5333
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	18.3	18.0	16.2
	Dry Density, pcf	112.7	112.4	116.4
	Saturation, %	99.5	97.3	97.7
	Void Ratio	0.4956	0.4993	0.4476
	Diameter, in.	2.500	2.500	2.500
	Height, in.	0.975	0.978	0.944
Normal Stress, psi		10.00	20.00	40.00
Fail. Stress, psi		6.70	12.60	25.30
Strain, %		3.2	5.7	9.8
Ult. Stress, psi				
Strain, %				
Strain rate, in./min.		0.003	0.003	0.003

Sample Type: Remold
Description: clayey sand (SC)

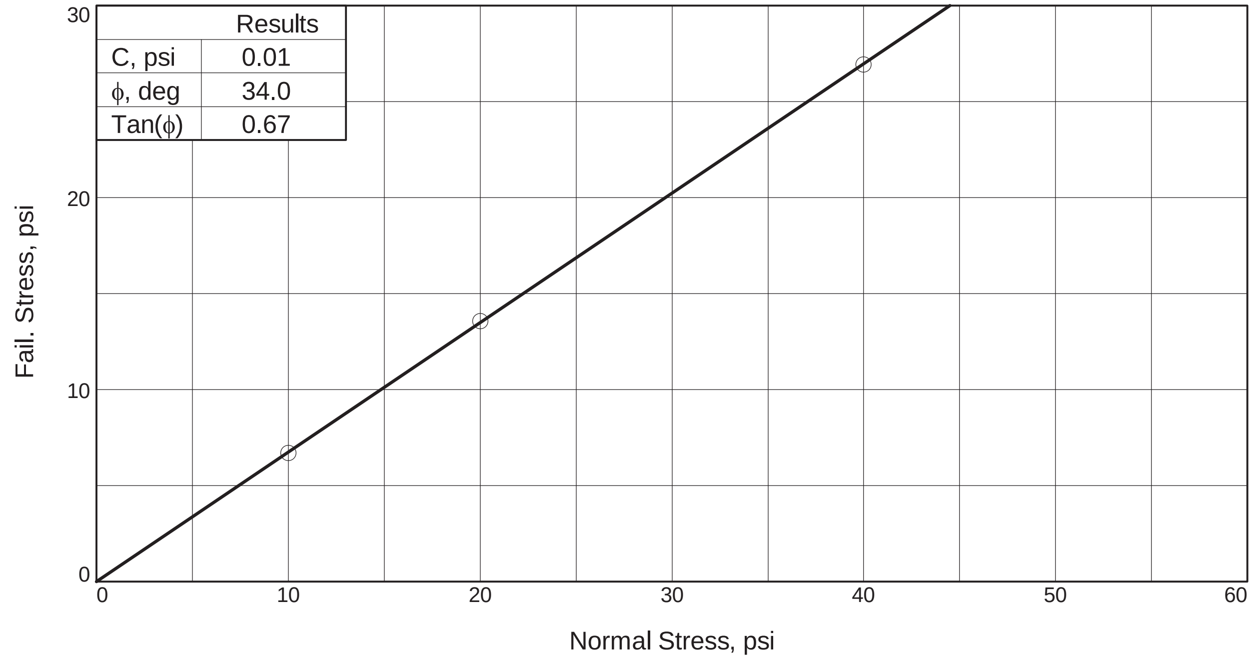
LL= 29 **PL=** 15 **PI=** 14
Assumed Specific Gravity= 2.7
Remarks: Compaction based on D698 efforts. Specimens compacted to 95% maximum dry density at +2% of optimum moisture.

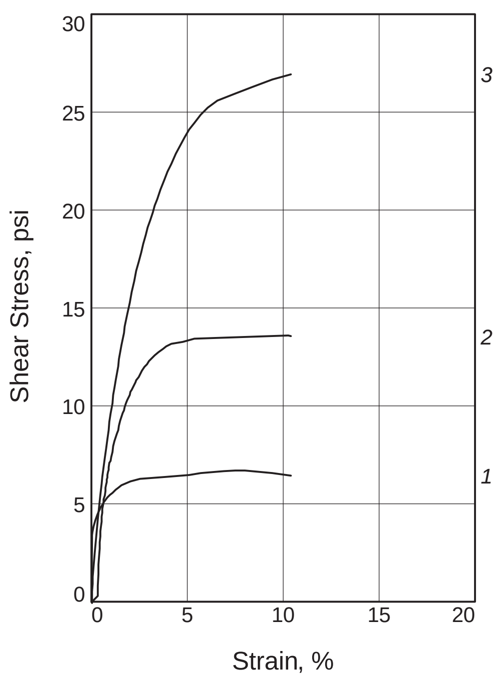
Client: Trammco Environmental Solutions LLC

Project: McCloy and Beckham Landfill

Source of Sample: B-1 **Depth:** 0.0-26.0 ft
Sample Number: composite
Proj. No.: A4187129 **Date Sampled:** N/A

DIRECT SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN





Sample No.		1	2	3
Initial	Water Content, %	17.7	17.7	17.7
	Dry Density, pcf	106.3	106.3	106.3
	Saturation, %	81.6	81.6	81.6
	Void Ratio	0.5858	0.5858	0.5858
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	20.1	19.2	17.5
	Dry Density, pcf	108.8	110.4	113.9
	Saturation, %	98.9	98.1	98.6
	Void Ratio	0.5493	0.5273	0.4792
	Diameter, in.	2.500	2.500	2.500
	Height, in.	0.977	0.963	0.933
Normal Stress, psi		10.00	20.00	40.00
Fail. Stress, psi		6.69	13.57	26.94
Strain, %		7.5	10.3	10.4
Ult. Stress, psi				
Strain, %				
Strain rate, in./min.		0.002	0.002	0.002

Sample Type: Remold
Description: clayey sand (SC)

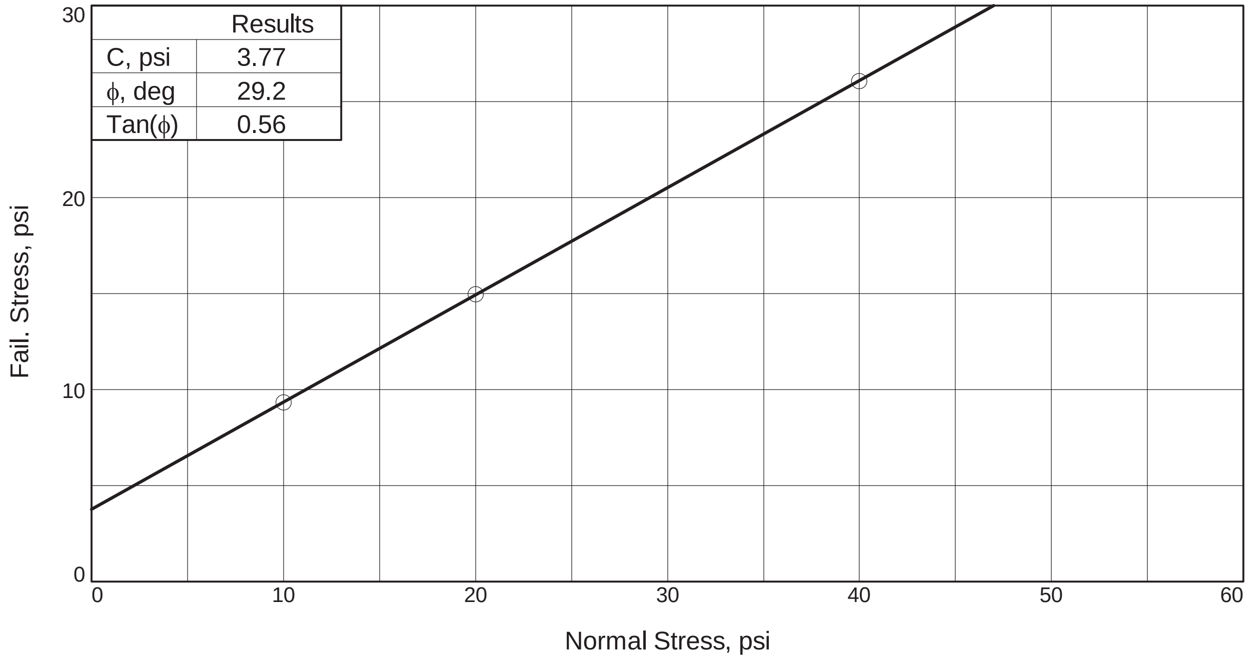
LL= 27 **PL=** 18 **PI=** 9
Assumed Specific Gravity= 2.7
Remarks: Compaction based on D698 efforts. Specimens compacted to 95% maximum dry density at +2% of optimum moisture.

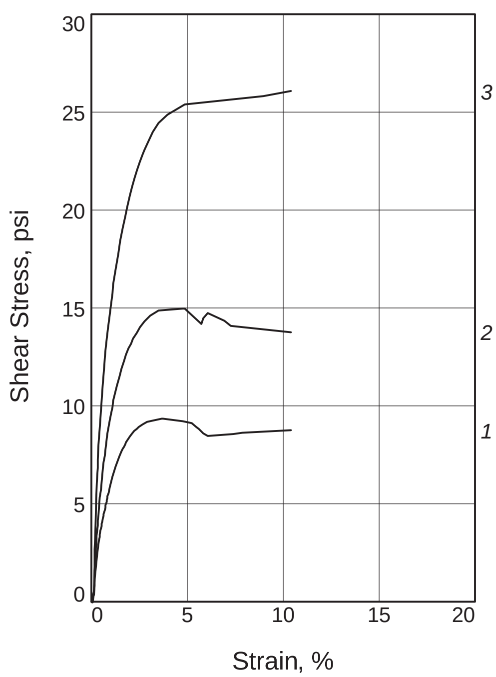
Client: Trammco Environmental Solutions LLC

Project: McCloy and Beckham Landfill

Source of Sample: B-3 **Depth:** 27.0-50.0 ft
Sample Number: composite
Proj. No.: A4187129 **Date Sampled:** N/A

DIRECT SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN





Sample No.		1	2	3
Initial	Water Content, %	13.6	13.6	13.6
	Dry Density, pcf	114.2	114.2	114.2
	Saturation, %	77.1	77.1	77.1
	Void Ratio	0.4765	0.4765	0.4765
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	15.5	14.3	14.2
	Dry Density, pcf	118.8	120.7	121.1
	Saturation, %	99.7	97.5	97.9
	Void Ratio	0.4194	0.3962	0.3922
	Diameter, in.	2.500	2.500	2.500
	Height, in.	0.961	0.946	0.943
Normal Stress, psi		10.00	20.00	40.00
Fail. Stress, psi		9.33	14.96	26.08
Strain, %		3.7	4.8	10.4
Ult. Stress, psi				
Strain, %				
Strain rate, in./min.		0.003	0.003	0.003

Sample Type: Remold
Description: silty sand (SM)

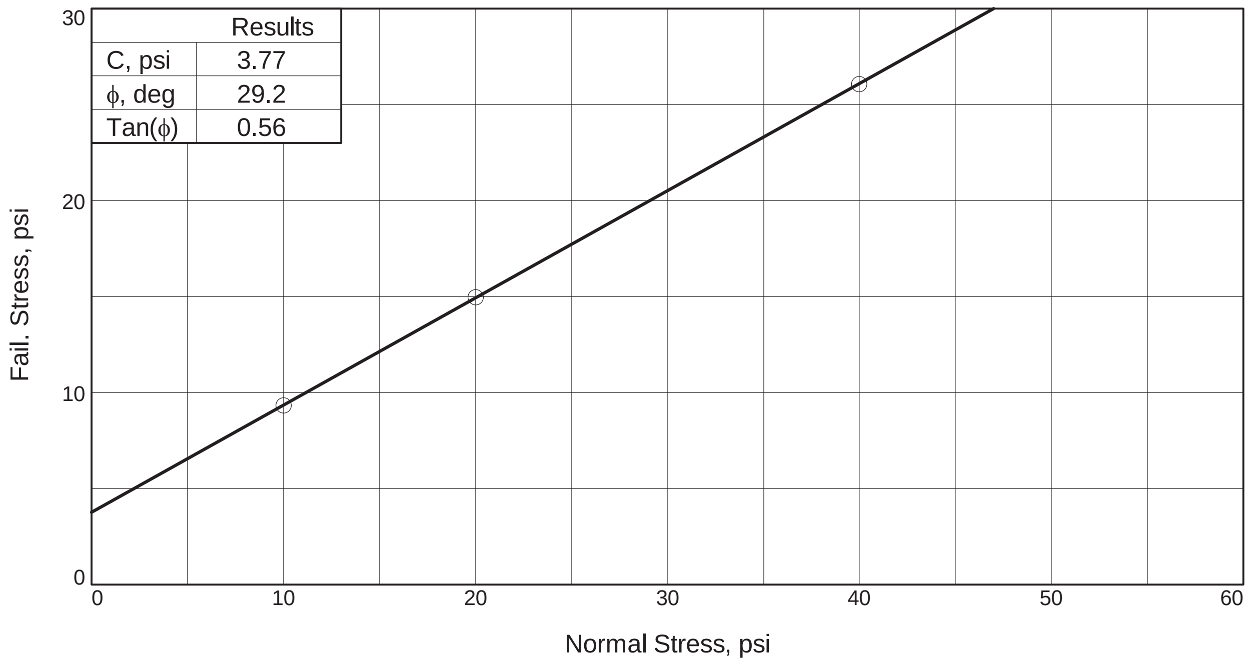
LL= 20 **PL=** 17 **PI=** 3
Assumed Specific Gravity= 2.7
Remarks: Compaction based on D698 efforts. Specimens compacted to 95% maximum dry density and +2% of optimum moisture.

Client: Trammco Environmental Solutions LLC

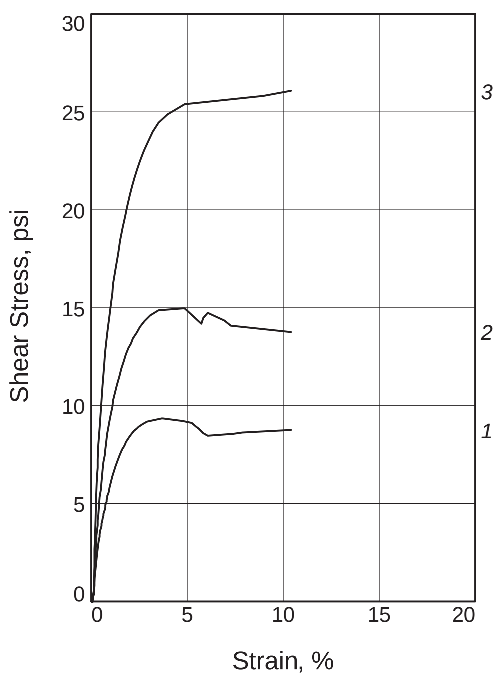
Project: McCloy and Beckham Landfill

Source of Sample: B-5 **Depth:** 0.0-50.0 ft
Sample Number: composite
Proj. No.: A4187129 **Date Sampled:** N/A

DIRECT SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN



Results	
C, psi	3.77
ϕ, deg	29.2
Tan(ϕ)	0.56



Sample No.		1	2	3
Initial	Water Content, %	13.6	13.6	13.6
	Dry Density, pcf	114.2	114.2	114.2
	Saturation, %	77.1	77.1	77.1
	Void Ratio	0.4765	0.4765	0.4765
	Diameter, in.	2.500	2.500	2.500
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	15.5	14.3	14.2
	Dry Density, pcf	118.8	120.7	121.1
	Saturation, %	99.7	97.5	97.9
	Void Ratio	0.4194	0.3962	0.3922
	Diameter, in.	2.500	2.500	2.500
	Height, in.	0.961	0.946	0.943
Normal Stress, psi		10.00	20.00	40.00
Fail. Stress, psi		9.33	14.96	26.08
Strain, %		3.7	4.8	10.4
Ult. Stress, psi				
Strain, %				
Strain rate, in./min.		0.003	0.003	0.003

Sample Type: Remold
Description: silty sand (SM)

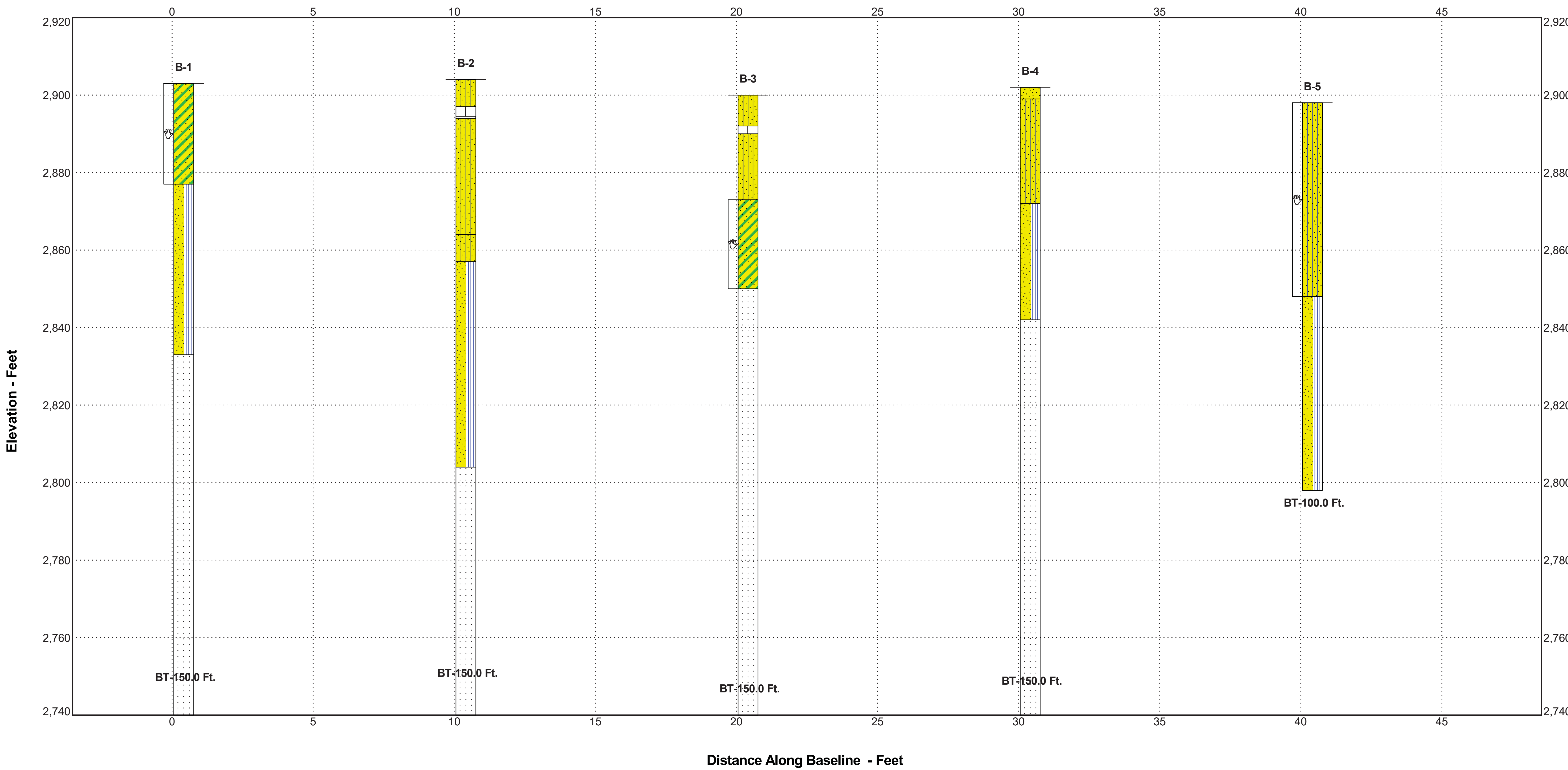
LL= 20 **PL=** 17 **PI=** 3
Assumed Specific Gravity= 2.7
Remarks: Compaction based on D698 efforts. Specimens compacted to 95% maximum dry density and +2% of optimum moisture.

Client: Trammco Environmental Solutions LLC

Project: McCloy and Beckham Landfill

Source of Sample: B-5 **Depth:** 0.0-50.0 ft
Sample Number: composite
Proj. No.: A4187129 **Date Sampled:** N/A

DIRECT SHEAR TEST REPORT
Terracon Consultants, Inc.
Chattanooga, TN



Clayey Sand | Poorly-graded Sand with Silt | Sandstone | Silty Sand | CALICHE - USGS Standard | Poorly-graded Sand

Explanation

B-1 — Borehole Number
Moisture Content — %w
LL PL — Liquid and Plastic Limits
Sampling (See General Notes)
Borehole Lithology
AR BT — Borehole Termination Type

Water Level Reading at time of drilling.

Water Level Reading after drilling.

NOTES:

See Exploration Plan for orientation of soil profile.
See General Notes in Supporting Information for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project No.: A4187129	Terracon 10400 State Highway 191 Midland, TX	**SUBSURFACE PROFILE**
Date: 5/6/2019		BECKHAM RANCH LANDFILL SECTION 9 AND 10 OF, T25S, R34E JAL, LEA COUNTY, NEW MEXICO
Scale: N.T.S		

SUPPORTING INFORMATION

UNIFIED SOIL CLASSIFICATION SYSTEM

Beckham Ranch Landfill ■ Jal, Lea County, New Mexico

May 6, 2019 ■ Terracon Project No. A4187129

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	**Group Name** [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or 1 > Cc > 3 [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or 1 > Cc > 3 [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

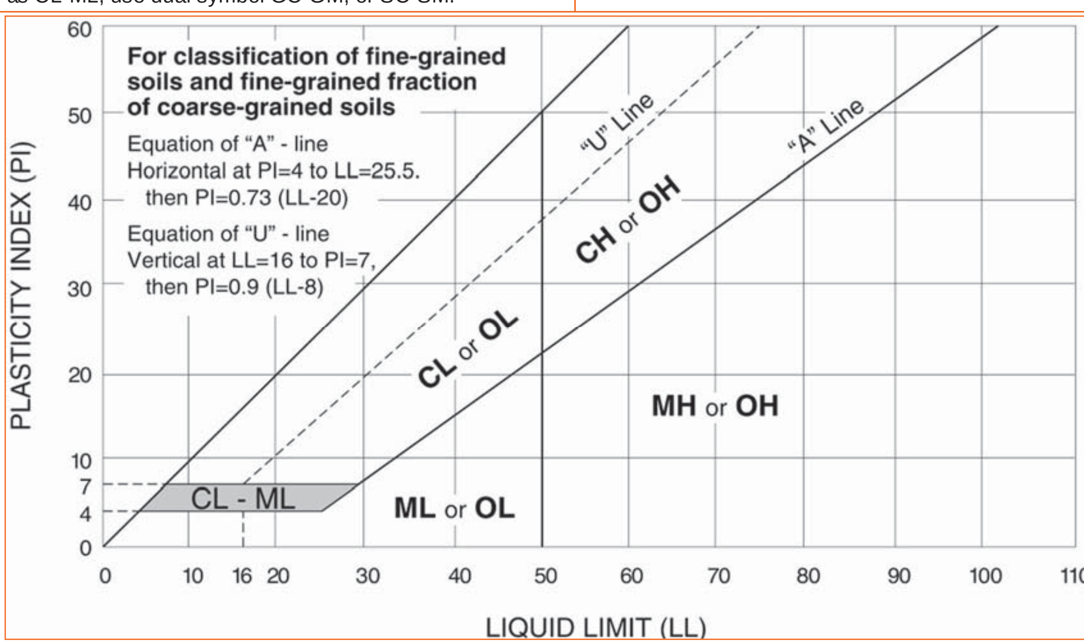
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

Beckham Ranch Landfill ■ Jal, Lea County, New Mexico

May 6, 2019 ■ Terracon Project No. A4187129

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements

WEATHERING	
Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" no discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)	
Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding, and Foliation Spacing in Rock [1]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

1. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

Rock Quality Designator (RQD) [1]

RQD, as a percentage	Diagnostic description
Exceeding 90	Excellent
90 – 75	Good
75 – 50	Fair
50 – 25	Poor
Less than 25	Very poor

1. RQD (given as a percentage) = length of core in pieces 4 inches and longer / length of run

Joint Openness Descriptors

Openness	Descriptor
No Visible Separation	Tight
Less than 1/32 in.	Slightly Open
1/32 to 1/8 in.	Moderately Open
1/8 to 3/8 in.	Open
3/8 in. to 0.1 ft.	Moderately Wide
Greater than 0.1 ft.	Wide

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976. U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.

Appendix J
Design and Construction Plan

Engineering Design Report

South Ranch Surface Waste Management Facility
Lea County, New Mexico

June 2019
Project No. 35187378

Prepared for:
NGL Waste Services, LLC
3773 Cherry Creek Dr., Suite 1000
Denver, CO 80209
303-815-1010

Prepared by:
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

Table of Contents

Tables

Attachments

1.0 INTRODUCTION

This engineering design report (EDR) was prepared by Terracon Consultants, Inc. (Terracon) for NGL Waste Services, LLC (NGL) to support the Permit Application for the proposed South Ranch Surface Waste Management Facility (Facility) located near Bennett, Lea County, New Mexico. The following sections and appendices provide backup engineering calculations and documentation for the proposed landfill configuration as presented on the permit drawings in **Appendix K** of the Permit Application (PA).

1.1 Regulatory Oversight

Due to its function the Facility will be regulated by New Mexico Administrative Code, Title 19 – Natural Resources and Wildlife, Chapter 15 – Oil and Gas, Part 36 – Surface Waste Management Facilities, or 19.15.36. The Facility is defined as a commercial landfill facility by **19.15.36.7.A(2)** and **(4)** accepting exempt upstream oil and gas exploration and production waste (E&PW) from nearby oil field development customers. In general, this EDR will focus on providing the engineering calculations and documentation to satisfy design requirements specified in **19.15.36.14.C** – **19.15.36.14.F**. In addition, NGL proposes to manage and dispose of the Facility's leachate with an evaporation pond. Therefore, this EDR will also provide engineering calculations for the proposed evaporation pond in compliance with **19.15.36.17.A** and **19.15.36.17.B**.

1.2 General Facility Description

The Facility consists of approximately (~) 187 acres of which ~111 acres will be dedicated for lined landfill disposal cells. The remaining ~76 acres consists of a ~43-acre entrance and waste acceptance area including an ~2.2-acre leachate evaporation pond; ~13 acres making up two stormwater retention ponds; and ~18 acres of ancillary space for perimeter roadways, drainage channels and landfill structural berms.

The landfill area will be subdivided in to two phases. Phase 1 will have six disposal cells ranging in size from 8.4 acres to 9.7 acres for a total disposal area of ~55 acres. Phase 2 will have six disposal cells ranging in size from 7.6 acres, to 9.6 acres for a total disposal area ~56 acres. Phase 1 and 2 have maximum depths below existing grade of ~51.6-feet. Phase 1 and 2 are separated by approximately 10 feet and the base liner system for Phase 2 will overlap and tie directly to the Phase 1 liner system.

Each of the Phase 1 and 2 disposal cells will be separated by a 4-foot tall soil divider berm. All disposal areas will be lined with a multilayered geosynthetic liner system with both leachate collection and recovery and leak detection systems. Final waste surfaces will be covered with a geosynthetic and soil based final cover system. Full descriptions of the liner and cover systems are provided in this EDR. Ultimately the proposed configuration of the landfill area will result in a total design operational capacity (waste and routine soil) of ~22,144,500 Cubic Yards (CY).

Detailed design of the Facility is presented within this EDR and attached including supporting calculations and analyses.

2.0 PROPOSED FACILITY DESIGN

2.1 Landfill Geometry

In general compliance with **19.15.36.C** and **19.15.36.D**, all landfill cells have been designed with 3H:1V side slopes. Each cell floor will be graded at a minimum of 3% laterally to a center leachate collection pipeline which is sloped at 1.5% towards a central leachate collection sump. The liner system and leachate collection lines will be protected with 2-feet of protective soil, see Section 2.7 for greater details regarding the liner system design. Cell depths ranging from 41 feet at the high end of the cell to ~50 feet, the maximum excavation depth below existing grade is ~51.6 feet at the leachate collection sump.

Note that maximum depth of waste placement is approximately 4-feet above maximum excavation depth, or approximately 48.6 feet below grade. Based on information provided in **Appendix I** of the **PA this will provide,** investigatory drilling of five-test pits explored to a depth of 150-feet below grade and did not encounter groundwater. Therefore, the proposed cell depths are in compliance with **19.15.36.A.(1).**

The intermediate, final waste and final cover slopes will be nominally 4H:1V and the top deck will have a minimum grade of 4%. The final cover system will include 2.5 feet of soil over the liner system. The landfill will have a maximum final waste grade of 3,108 feet above mean sea level (AMSL), and maximum final cover grade will be 3,110.5 feet AMSL. See **Permit Drawings** in **Appendix K** of the PA for visual representation of the proposed geometry.

2.2 Landfill Design Capacity

The following Table 2.1 provides the design operational capacity (waste and routine and intermediate soil cover), routine and intermediate soil cover volume assuming 15% soil to waste ratio, and waste capacity of each disposal cell, phase and overall landfill. Per-cell capacities assume an intermediate waste fill slope of 4V:1H and that fill sequencing occurs as shown on **Drawing 24** of **Appendix K** of the PA. Operational capacities were calculated using AutoDesk© Civil3D® 2019 (Civil 3D) software.

Table 2.1 Design Capacity Summary

Cell	Operational Capacity (CY)	Routine and Intermediate Soil Cover [15% of Operational Waste Capacity] (CY)	Waste Capacity [85% of Operational Capacity] (CY)
		PHASE 1	
E-1	380,154	57,023	323,131
E-2	1,142,546	171,382	971,164
E-3	1,500,084	225,013	1,275,071
E-4	1,569,644	235,447	1,334,197
E-5	1,571,988	235,798	1,336,190
E-6	1,944,869	291,730	1,653,139
PHASE 1	**8,109,285**	**1,216,393**	**6,892,892**
		PHASE 2	
W-1	2,985,590	447,839	2,537,752
W-2	3,361,364	504,205	2,857,159
W-3	3,079,808	461,971	2,617,837
W-4	2,463,211	369,482	2,093,729
W-5	1,601,837	240,276	1,361,561
W-6	543,409	81,511	461,898
PHASE 2	**14,035,219**	**2,105,289**	**11,929,941**
TOTAL	**22,144,504**	**3,321,676**	**18,822,828**

2.3 Site Soil Balance

Landfill cell construction, routine operations, and closure will require large quantities of soil over the life of the landfill. The proposed Facility-wide grading plan shown in the **Permit Drawings** in **Appendix K** of the PA, which includes all grading activities for landfill cells, roads, stormwater infrastructure (channels and ponds), and the leachate evaporation pond, will generate soils for these activities. Table 2.2 below summarizes the soil balance for known operational and construction activities through buildout of the Facility. All cut and fill volumes provided in Table 2.2 are calculated using Civil 3D.

Table 2.2 Soil Balance Summary

Area	Cut (CY)	Fill (CY)
Facility Wide Grading	6,229,031	304,612
Base Liner Protective Cover	0	368,612
Operational Cover (Routine and Intermediate, From Table 2.1)	0	3,321,676
Final Cover System	0	617,556
TOTALS	**6,229,031**	**4,612,456**
FACILITY SOIL BALANCE = +1,616,575 CY EXCESS SOIL		

2.4 Stormwater Management System

The proposed surface-water management system for both run-on and run-off for the Facility is shown on the **Permit Drawings** in **Appendix K** of the PA. The proposed configuration of the run-off management system was modeled in AutoDesk© Storm and Sanitary Analysis® 2019 (SSA) software. The run-on management system has been sized using the USDA, NRCS, Technical Release 55 (TR-55) method. Both the SAA and TR-55 simulated the 25-year, 24-hour storm (design storm) event for the Lea County, New Mexico area.

Facility Storm Run-off Management System Design

All proposed stormwater run-off conveyance structures (channels, berms, letdowns, culverts) have been designed to handle the peak flow from the design storm. The three stormwater ponds have been designed to retain at least the total run-off volume from the design storm. The Facility also has a 2-foot earth berm at the permit boundary to retain onsite any potential storm pond over flow during greater storm events. In short, the Facility has been designed to be a non-discharging facility.

Facility Run-on Management System Design

Review of regional topographic maps from various sources indicate that the topography surrounding the Facility is a essentially flat with very slight gradient of 0.2% from north to south. Further, Terracon performed an engineering site reconnaissance visit to the proposed facility and identified that Highway J-3 (Frying Pan Road) and Beckham Road which immediately parallel the norther Facility boundary are set lower than the site and effectively cut-off and manage any stormwater drainage approaching the Facility's norther boundary. In addition, Terracon observed no evidence of stormwater drainage towards the Facility from the East, South, or West directions, which verifies the topographic map review. Therefore, no stormwater run-on management system is necessary.

Attachment A provides a detailed report of the SSA, including figures and modeling results.

2.5 Erosion Loss (RUSLE)

The purpose of the erosion calculation is to determine potential soil losses due to rainfall erosion under closure conditions. Using the Revised Universal Soil Loss Equation (RUSLE), projected soil loss from rainfall is approximately 4.93 tons/acre/year (t/a/y), which is below the NRCS established criterion of 5.0 t/a/y. Detailed RUSLE calculations are provided in **Attachment B**.

2.6 Leachate Evaporation Pond Geometry and Sizing

Geometry

A proposed leachate evaporation pond (LEP) is to be located near the site entrance in the northeast portion of the Facility. In general, the LEP geometry is in compliance with **19.15.36.17.A** and **19.15.36.17.B** having 3H:1V side slopes and a floor sloped laterally at 2% towards a central leak detection sump. In addition, the LEP has a 2-3-foot-high perimeter berm to prevent external surface water intrusion. The LEP plan footprint is approximately 2.25 acres with depths varying from 3.25 feet – 13.3 feet, with a 2-foot deep leak detection sump at the lowest point.

The LEP was sized assuming a worst-case condition defined as follows:

- Assumes the Facility will only construct and operate one disposal cell at a time. In this case:
- The largest Cell (W-2, 9.61 acres) has been constructed and hasn't received waste.
- Run-off from the intermediate 4H:1V waste slope from the previous Cells (W-1, E-5 and E-6) are draining into the new cell (W-2) leachate collection system.
- Little to no waste has been placed over the new cell's liner system.

Under this condition leachate generation is governed by incidental precipitation, thus two calculation methods to determine the require storage in the LEP are considered:

- 25-year, 24-hour precipitation volume incidental to the open area defined above, which totals to 25.7 acres.
- Leachate generation from the open cell (28.2 acres).

To be conservative, the LEP is sized to fully contain the greater of the volumes generated from the two sources. **Attachment C** provides a TR-55 run-off volume calculation from the 25.7 acre area indicating that 5.6 acre-feet of storage is required to contain incidental precipitation volume. A Hydraulic Evaluation of Landfill Performance (HELP) analysis was performed to determine the leachate generation rate from the open cell. The HELP analysis indicated that ~0.1 acre-feet of storage is required to contain the leachate generation volume. A HELP analysis summary memo and results are provided in **Attachment D**. In either case, the LEP must also provide storage for incidental precipitation over the 2-acre pond footprint, requiring an additional 0.77 acre-feet.

The LEP has a design storage capacity of 9.3 acre-feet. The LEP will also have three feet of freeboard above the design waterline which is not included in the design capacity. This complies with **19.15.36.17.B(12)** requiring three feet of freeboard and **19.15.36.17.B(12)** limiting the maximum size of evaporation ponds to 10 acre-feet.

2.7 Base Liner System

The Facility is proposing two base liner systems one for the landfill cells and one for the leachate evaporation pond. Details showing the bottom liner systems can be found in the **Permit Drawings** in **Appendix K** of the PA.

The typical landfill liner system will consist of (from bottom to top):

- A prepared subgrade layer on the cell floor and on the side slopes to provide a smooth surface for geosynthetic deployment;
- Low Permeability Clay Base Layer. The field geologic/hydrogeological investigation (See **Appendix I** of the PA) generally characterized the potential excavated soil as sandy with permeabilities ranging from 1.09×10^{-6} cm/sec to 6.5×10^{-5} cm/s. Thus, this soil is not favorable for a compacted clay liner. In addition, groundwater was not encountered within 100 feet of the lowest proposed landfill cell elevation. Therefore, NGL proposes to install a geosynthetic clay liner (GCL) in lieu of the prescriptive base layer (**19.15.36.14.C(1)**) two-feet of compacted clay with hydraulic conductivity of 1×10^{-7} cm/s or less. GCLs are commonly installed in landfill liner systems as an alternative to compacted clay in similar conditions, and have hydraulic conductivities as low as 1×10^{-8} – 1×10^{-10} cm/s (Daniel 1993)
- A secondary 60-mil thick textured high-density polyethylene (HDPE) geomembrane liner, in compliance with **19.15.36.14.C(2)**;
- Leak detection drainage layer. For ease of construction and to maximize potential landfill airspace, NGL proposes using a 200-mil HDPE bi-planar geonet composite (Geocomposite) leak detection drainage layer in lieu of the prescriptive (**19.15.36.14.C(3)**) two feet of compacted soil with a hydraulic conductivity of 1×10^{-5} cm/s or greater. Drainage geocomposites consist of a biplanar geonet with geotextile filters heat bonded to both sides and are commonly installed in landfill liner leak detection systems as an alternative to a soil drainage layer due to their superior hydraulic performance obtaining hydraulic conductivities of up to 10 cm/s. The geocomposite, in conjunction with the textured geomembrane, also provides additional friction for greater slope stability;
- A primary 60-mil thick textured HDPE geomembrane liner in compliance with **19.15.36.14.C(4)**);
- Leachate collection and removal system. For ease of construction and to maximize potential landfill airspace, NGL proposes 200-mil HDPE bi-planar geocomposite leachate drainage layer in lieu of the prescriptive (**19.15.36.14.C(5)**) two-feet of compacted soil with a hydraulic conductivity of 1×10^{-2} cm/s or greater. This concept provides a high transmissivity (K up to 10 cm/s) blanket over the entire cell rather than intermittent collection laterals, giving greater leachate collection coverage;

- 2-feet of highly permeable protective cover soil, $1x10^{-2}$ cm/s or greater, in compliance with (**19.15.36.14.C(6)**).

The typical leachate evaporation pond liner system will consist of (from bottom to top):

- A prepared subgrade layer on the cell floor and on the side slopes to provide a smooth surface for geosynthetic deployment;
- Secondary 60-mil thick HDPE geomembrane liner, in compliance with **19.15.36.17.B(8)**.
- Leak detection drainage layer. For ease of construction, NGL proposes a 200-mil Geocomposite leak detection drainage layer in lieu of the prescriptive (**19.15.36.17.B(9)**) two-feet of compacted soil with a hydraulic conductivity of $1x10^{-5}$ cm/s or greater. Geocomposites are commonly installed in leak detection systems as an alternative to soil drainage layers due to their superior hydraulic performance obtaining hydraulic conductivities of up to 1-5 cm/s;
- Primary 60-mil thick textured HDPE geomembrane liner in compliance with **19.15.36.17.B(7)**).

See **Attachment E** for liner design calculations of the following:

- E1 - Foundation and Waste Settlement and resulting tensile stresses on the base liner and final cover systems
- E2 - Tensile Stress due to equipment loading
- E3 - Anchor trench pullout
- E4 - Geocomposite performance under overburden compression

2.8 Leachate and Leak Detection Collection and Recovery System

Landfill

The leachate and leak detection collection and recovery systems follow identical flow paths. Leachate generated from each landfill cell and leaks (if any) through the primary liner will flow through the associated lateral geocomposite drainage layer sloped at a minimum of 3% and directed towards a leachate and leak detection collection sump. The leachate collection system incorporates a perforated six-inch HDPE SDR-11 collection pipe embedded in a gravel trench one foot deep, generally along the cell centerline, with flow towards and terminating in the leachate collection sump.

The leachate collection sumps have a top dimension of 35 feet by 35 feet and are two feet deep with 3H:1V side slopes. The leak detection sumps sit directly below the leachate collection sumps and are a continuation of the leachate sump geometry another two feet deeper. The leachate sump and leak detection sump are separated by the 60-mil HDPE primary geomembrane. Each sump is equipped with an 18-inch HDPE SDR-17 leachate pump side-slope riser pipe, a 6-inch HDPE SDR-11 collection line cleanout riser, and a 12-inch HDPE SDR-17 leak detection witness riser. The riser pipes will be embedded into a side-slope trench for protection of the pipes and the liner system. The risers will daylight at the top of landfill cell slope and be protected by a concrete headwall and capped with blind flanges. The 18-inch riser will be equipped with a submersible pump that will transfer the liquids collected in the sump via a flexible hose to a force main/carrier pipe. The force main/carrier pipe will transfer the liquids to the on-site leachate evaporation pond.

Leachate Evaporation Pond

The leak detection collection and recovery system for the leachate evaporation pond will collect leaks (if any) through the primary liner. Liquids collected will flow through the associated lateral geocomposite drainage layer sloped at a minimum of 2% and directly towards a leachate and leak detection collection sump.

The leak detection collection sump has a top dimension of 20-feet by 20-feet and is 2-feet deep with 3H:1V side slopes. The sump is equipped with a 12-inch HDPE SDR-17 leak detection witness riser.

Details I-O of the Permit Drawings in **Appendix K** of the PA depict the general configuration of the leachate and leak detection systems for both the landfill cells and the leachate evaporation pond.

See **Attachment F** for pipe design calculations of the following:

- Leachate Pipe Size and Perforation Design
- Drainage Rock sizing and Bedding Strain
- Pipe Ring Deflection
- HDPE pipe wall buckling under waste compression
- HDPE pipe wall crushing under waste compression

2.9 Final Cover System

Final waste slopes will be no steeper than 4H:1V. A final cover system will be installed over the final waste surface which will include surface-water control berms that will be constructed on the final cover system with approximately 25 ft. of vertical spacing between benches. While the interior of the berms will be 4H:1V, the exterior bench slope will be 3H:1V. The berms will be directed to rip-rap lined let-down structures built into the final cover system. The typical final cover system for the landfill will consist of (from top to bottom):

- 1-ft thick erosion layer consisting of fertile top soil, in compliance with **19.15.36.14.C(8)**;
- 18-inch thick protective soil layer, in compliance with **19.15.36.14.C(8)**;
- Drainage Layer. For ease of construction, NGL proposes a 200-mil geocomposite drainage layer in lieu of the prescriptive (**19.15.36.14.C(8)**) 12 inches of sand or gravel with hydraulic conductivity of $1x10^{-2}$ cm/s or greater. Geocomposites are commonly

installed in landfill final cover systems as an alternative to soil drainage layer due to their superior hydraulic performance obtaining hydraulic conductivities of up to 1-5 cm/s.

- Hydraulic barrier layer consisting of 60-mil thick HDPE geomembrane liner, in compliance with **19.15.36.14.C(8)**.
- Gas Vent Layer. For ease of construction, NGL proposes a 200-mil Geocomposite drainage layer in lieu of the prescriptive (**19.15.36.14.C(8)**) 12-inches of sand or gravel. Geocomposites are commonly installed in landfill final cover systems as an alternative to soil vent layers due to their superior hydraulic performance obtaining hydraulic conductivities of up to 1-5 cm/s.

2.10 Slope Stability Analysis

Terracon has performed a comprehensive slope stability analysis of the cell excavation side slopes, base liner configuration, final waste slopes, and final cover system configuration as defined in previous sections. This analysis was performed using Geo-Slope International SLOPE-W® software. In summary, the 3H:1V excavation slope is stable upon placement of the base liner system with a minimum factor of safety of 1.6 in either the east or west slopes, the North and South slopes have a safety factor of 10.4. The 4H:1V waste fill slopes and final cover system are stable with a minimum factor of safety of 2.1 on the north or south slopes, with a safety factor of 2.2 on the east/west slopes. Please see **Attachment G** for a comprehensive slope stability report and summary of modeling results.

3.0 19.15.36 DESIGN COMPLIANCE SUMMARY

The New Mexico design criteria for surface waste management landfills are contained in **19.15.36.14** and the design criteria for leachate evaporation ponds are contained in **19.15.36.17**. The following discussion lists the design criteria contained in these regulations and how the proposed Facility design complies.

Landfill Base Liner Design Requirements:
19.15.36.14.C Landfill Design Specification

As discussed in Sections 2.7 – 2.9, the proposed landfill has been designed with the required components.

19.15.36.14.C(1) Base Layer

As discussed in Section 2.7, due to the absence of suitable clayey materials onsite, and the groundwater setting, NGL proposes an alternative base layer consisting of a reinforced geosynthetic clay liner. Typical GCLs specified for landfill liner systems have hydraulic conductivities less than $1x10^{-9}$ cm/s (EPA 2001).

19.15.36.14.C(2) Lower Geomembrane

As discussed in Section 2.7, the lower membrane shall consist of 60-mil HDPE, in compliance with this regulation.

19.15.36.14.C(3) Leak Detection System

As discussed in Sections 2.6 - 2.8 NGL proposes to install an alternative leak detection system comprised of a 200-mil HDPE geocomposite blanket drainage collection system in lieu of soil and piping as prescribed. HDPE has high chemical resistance to oil field wastes and the leak detection system is sloped at 3% in the lateral direction compliant with this regulation.

19.15.36.14.C(4) Upper Geomembrane

As discussed in Sections 2.7 the upper membrane shall consist of 60-mil HDPE, in compliance with this regulation.

19.15.36.14.C(5) Leachate Collection and Removal System

As discussed in Sections 2.6 - 2.8 NGL proposes to install an alternative leachate collection and removal system comprised of a 200-mil HDPE Geocomposite blanket drainage collection system in lieu of soil and piping as prescribed.

In compliance with this regulation, HDPE is the material proposed for geomembrane and piping, which has high chemical resistance and is proven to withstand attack from oil field wastes. The leachate collection and removal systems are sloped at 3% in the lateral direction. The central collection trench pipe is a perforated 6-inch HDPE pipe, which will be protected by a drainage rock backfill and equipped with a solid cleanout riser embedded into a side slope riser trench. The leachate is collected in a centralized sump and conveyed to a leachate evaporation pond outside of landfill perimeter within a double-walled HDPE force main.

19.15.36.14.C(6) Liner Protection Layer

As discussed Section 2.7 the liner system will be overlain with two-feet of protective soil cover with a saturated hydraulic conductivity of $1x10^{-2}$ cm/s or greater, in compliance with this regulation.

Landfill Final Cover System Design Requirements:

19.15.36.14.C(8) Final Cover System

As discussed in Section 2.6, 2.7, and 2.9, the final waste slopes shall not exceed 4H:1V or be less than 4% in compliance with this regulation. The final cover system shall include the prescribed 12-inch top soil erosion layer, 18-inch soil protection layer, and 60-mil HDPE geomembrane barrier layer in compliance with this regulation. However, NGL proposes the use of 200-mil HDPE geocomposite as an alternate material for both the surface drainage and gas vent/foundation layer in lieu of the prescribed high permeability soils.

19.15.36.14.C(9) Alternative materials

NGL is proposing the use of reinforced GCL as the base foundation layer in place of two feet of compacted clay and 200-mil HDPE geocomposite in place of high permeability soils for drainage. **Attachment E** provides a demonstration of geocomposite hydraulic performance under these conditions.

19.15.36.14.C(10) External Piping

All leachate and leak detection riser piping will be installed along the side slopes of the cells in compliance with this regulation. Liner penetrations are not proposed.

19.15.36.14.D(1) Liner Specifications and Requirements - Geomembranes

(a) In compliance with this regulation, all geomembranes are specified as 60-mil textured HDPE. HDPE geomembranes have published permeabilities as low as $1x10^{-15}$ cm/s (Webber 2005) and have high chemical resistance with proven resistance to hydrocarbons, salts, acidic and alkaline solutions. HDPE also has a high UV resistance when exposed to sunlight.

(b) As provided in **Attachment E,** the membrane is designed to withstand projected stresses and settling from overlying waste and equipment operations.

(c) As designed, the base liner system maintains a minimum 3% lateral slope to promote positive drainage and to facilitate leachate collection and leak detection.

19.15.36.14.D(2) Liner Specifications and Requirements – Additional Geomembrane Requirements

(a) HDPE geomembranes have published and field proven high chemical resistance with resistance to chemical attack from oil field waste and resulting leachate.

(b) The base liner system has a maximum slope of 3H:1V which has been shown to be stable in the slope stability analysis in **Attachment G,** which considers the soil-geosynthetic and geosynthetic-geosynthetic interface friction angles.

(c) In general, all HDPE liner systems will be installed in compliance with this regulation as specified in the Construction Quality Assurance Plan provided in **Attachment H**.

19.15.36.14.E Requirements for Soil Components

(1) The prepared subgrade for the base liner system will be compacted to at least 90% standard Proctor (ASTM D-698), see **Attachment H**.

(2) All soil surfaces to receive geosynthetics will be prepared in compliance with this regulation, See **Attachment H.**

(3) As previously discussed, NGL proposes to replace the compacted clay foundation layer with a reinforced GCL, thus this regulation in not applicable.

19.15.36.14.F Soil Material Requirements for the Leachate Collection and Recovery System and Leak Detection System

(1) As previously discussed, NGL proposes to replace the prescribed soil drainage materials with a 200-mil HDPE geocomposite, thus this regulation in not applicable.

19.15.36.14.G Landfill Gas Control System

NGL is not required to, nor is proposing to install a landfill gas control system for this landfill at this time.

Leachate Evaporation Pond (LEP) Construction Standards:

19.15.36.17.A Engineering Design Plan

This EDR includes design information for the LEP and its liner system, which is certified by Michael Bradford, P.E. The overall PA for the Facility incorporates and integrates the LEP operation and maintenance procedures (**Appendices D** and **E** of the PA), closure planning (**Appendix G** of the PA), and hydrologic information (**Appendix I** of the PA). Thus, the overall PA demonstrates compliance with this regulation.

19.15.36.17.B Construction Standards

(1) The LEP has been designed as prescribed in the Regulations, thus protective of fresh water, public health, and the environment.

(2) The proposed LEP is designed with a primary and secondary 60-mil HDPE geomembrane with a leak detection layer between them.

(3) In compliance with this regulation, the primary and secondary liners are specified as 60-mil textured HDPE. HDPE geomembranes have published permeabilities as low as $1x10^{-13}$ cm/s (Webber 2005) and have high chemical resistance with proven resistance to hydrocarbons, salts, acidic and alkaline solutions. HDPE with carbon black also has a high UV resistance when exposed to sunlight.

(4) NGL is proposing to use 200-mil HDPE geocomposite in place of high permeability soils for drainage. **Attachment E** provides a demonstration of geocomposite hydraulic performance under these conditions.

(5) As discussed in Section 2.6 and **Attachment H,** the pond has been designed and will be constructed in compliance with this regulation.

(6) The discharge point of the leachate force main into the pond will be reinforced to protect the liner system from excessive hydrostatic force. No liner penetrations are proposed.

(7) As discussed in Section 2.7 the primary liner shall consist of 60-mil HDPE, in compliance with this regulation.

(8) As discussed in Section 2.7 the secondary liner shall consist of 60-mil HDPE, in compliance with this regulation.

(9) As discussed in Sections 2.6 - 2.8 NGL proposes to install an alternative leak detection system comprised of a 200-mil HDPE geocomposite blanket drainage collection system in lieu of soil and piping as prescribed. HDPE has high chemical resistance to oil field wastes and the leak detection system is sloped at 2% in the lateral direction, compliant with this regulation. Discharge from this pond is not proposed.

(10) Not applicable

(11) The LEP has been designed with 3-feet of freeboard under the worst-case leachate generation condition, See **Attachment C.**

(12) The LEP has a leachate storage capacity of approximately 9.3 acre-feet, in compliance with this regulation which limits the capacity of evaporation ponds to 10 acre-feet.

4.0 REFERENCES

Daniel, D.E. and Estornell P. (1991) “Hydraulic Conductivity of Three Geosynthetic Clay Liners” *Journal of Civil Engineering* 118(10) 2605.

U.S. EPA. 2001. **Geosynthetic Clay Liners Used in Municipal Solid Waste Landfills**. EPA530-F-97-002. Solid Waste and Emergency Response. December.

Weber, C.T., and Zornberg, J.G. (2005). Leakage through Liners under High Hydraulic Heads." Geosynthetics Research and Development in Progress, Eighteenth Geosynthetic Research Institute Conference (GRI-18), Austin, Texas, January 26

Attachment A
Run-on and Run-off Surface Water Management Report

Exhibit A.1
Run-off Design Results
Storm and Sanitary Analysis Results

CALCULATIONS BY: Michael P. Bradford, P.E. – Senior Project Manager
Terracon Consultants, Inc.
25809 Interstate 30 South
Bryant, Arkansas 72022
(501) 847-9292

I. RUN OFF SURFACE WATER MODELING

MODELING METHOD

Autodesk Storm and Sanitary Analysis 2019 (SSA)

ANALYSIS

A detailed engineering analysis was performed on the components that comprise the stormwater management system for surface water runoff within the facility boundaries. The components analyzed for this permit modification include:

1. Stormwater Letdown Structures
2. Slope Integrated diversion channels
3. Perimeter Ditches
4. Stormwater Ponds

As required by ***NMAC 19.15.36***, the hydrologic analysis was performed utilizing a 25-year, 24-hour rainfall event. SSA was utilized to perform the engineering analysis to assure compliance with the above regulations. The analysis was performed for the post development conditions of the Facility. This is considered to be a conservative approach for the design capacity of the stormwater pond and other conveyance features.

SSA was utilized to illustrate the capacity of the stormwater letdown structures, slope integrated berms, and perimeter ditches. These results were generated to assure that the conveyance parameters of stormwater design elements are adequate.

PARAMETERS USED IN THE ANALYSES

The following are the lists of parameters that were considered for stormwater management:

Based on ***NMAC 19.15.36,*** a 25-year, 24-hour rainfall event was considered for design of the proposed landfill permit area. The proposed disposal area was first segregated into 60 sub-basins, 95 nodes, and 93 links, then the areas were determined. It was concluded that the Landfill would fall into the Type II rainfall distribution as published by the Nation Resource Conservation Service (NRCS). The 25-year, 24- rainfall data for Lea County was available within the SSA. The EPA SWMM hydrology method was used due to its flexibility, such as allowances for existing soil moisture and evaporation.

For each element in the design, the following parameters, if applicable, were input or calculated using the SSA software and dialogue box selections, typical values or site design information:

- Runoff Curve Number
  - Data gathered from NRCS Web Soil Survey and TR-55 Tables
    - Kermit-Wink Fine Sandy Loams and Kermit-Palomas Fine Sands.
      - Hydraulic Soil Group A.
    - CN = 77 from Table 2-2a of the TR-55 Manual for "Newly Graded, Pervious Areas, No Vegetation"
- Area (Ac);
  - Automatically calculated based on site design
- Impervious Area (%);
  - 0% assumed globally this site is not expected to have significant areas of pavement
- Drying Time (days);
  - 2 days assumed globally
- Average Slope (%);
  - 1.0% for side slope berms
  - 0.5% min for perimeter channels
  - 4 horizontal to 1 Vertical for waste side slopes
  - 4% waste top deck
  - 0.5% for entrance/admin/staging area
- Equivalent Width (ft)
  - Critical flow path as determined by site design
- Pervious Area Manning's Roughness, taken from SSA databases;
  - 0.027 for Landfill – "poor grass cover, moderately rough surface"
  - 0.015 for Entrance/Admin/Staging area – "Gravel"
  - 0.035 for Let Down Structures, "rip-rap"
  - 0.011 for Culverts – "concrete"
- Link Invert Information (elevation)
  - Taken from site design
- Link Cross Section
  - V-ditch for all side slope diversion channels
    - Manning's n = 0.027
  - Trapezoidal ditch for all letdown structures and perimeter ditches
    - Manning's n =
  - Circular for all culverts
    - Manning's n = 0.011

SUMMARY OF RESULTS

Stormwater Letdown Structures

Four (4) stormwater letdown structures are planned for the final landfill configuration, beginning with letdown structure 1 in the north landfill face of the finished landfill and distributed clockwise around the landfill to letdown structure 4 on the west face of the landfill. Each of these letdown structures has been designed with a 10-foot bottom width, 2' depth, 3:1 side slopes, and 25% traverse slope. The flow capacity of these let down structures is approximately 950 cubic feet per second (cfs). The SSA calculated maximum peak flow values from a 25-year, 24-hour rainfall event for lower most design segments of the letdown structures range from 70 CFS to 100 cfs. The SSA generated output tables for the stormwater analysis can be found in **Exhibit A.1, also see Figures depicting links, junctions, basins, and storage nodes for visual reference** .

Slope Integrated Berms

The landfill slope integrated berms were designed assuming that the berms would collect and transfer the entire area of each letdown sub-basin runoff volume. With this assumption, the maximum flow to be carried in a slope integrated berm is ~34 cubic feet per second (cfs). Each letdown has at least six slope integrated berms with contributing drainage areas varying in size. The slope integrated berms will be sloped at 1.0 percent and have a depth of 1.5-feet, providing a maximum flow capacity of approximately ~42 cfs. The side slopes of the berms will be 4:1 (using the 4:1 final cover system of the landfill for one side).

Perimeter Ditches

The perimeter channels along the west, south, and north sides have been designed with a 10-foot bottom width, 3-foot depth, 4:1 side slopes, and a traverse slope of 1.5% minimum. The perimeter channel along the east side has been designed with a 6-foot bottom width, 3-foot depth and 4:1 side slope.

- North-to-West Ditch (Link 74)
  - Design Capacity ~117 cfs
  - Peak Flow during design storm ~66 cfs
- North-to-East Ditch – 1 (Link 21)
  - Design Capacity ~131cfs
  - Peak Flow during design storm ~72 cfs
- South-to-West Ditch – 2 (Link 68)
  - Design Capacity ~320 cfs
  - Peak Flow during design storm ~44 cfs
- South-to-East Ditch (Link 18 and Link 59)
  - Design Capacity ~228 cfs
  - Peak Flow during design storm ~43 cfs

See **Exhibit A.1** for results

Culverts

Each of the perimeter ditches must transition through a culvert below the main access/haul roads prior to entering one of the two retention ponds. The following is a summary of the culverts proposed:

- Northwest Culvert (Link 93)
  - 2 barrel, 24-inch concrete pipe
  - Design Flow = 128 cfs
  - Peak Flow during design storm = 67 cfs
- Northeast Culvert (Link 102)
  - 1 barrel, 36-inch concrete pipe
  - Design Flow = 194 cfs
  - Peak Flow during design storm = 118 cfs
- East Letdown Culvert (Link 32)
  - 3 barrel, 18-inch concrete pipe
  - Design Flow = 134 cfs
  - Peak Flow during design storm = 82 cfs
- East Perimeter Road Culvert (Link 98)
  - 1 barrel, 24-inch concrete pipe
  - Design Flow = 141 cfs
  - Peak Flow during design storm = 82 cfs
- Southeast Culvert (Link 25)
  - 1 barrel, 24-inch concrete pipe
  - Design Flow = 78 cfs
  - Peak Flow during design storm = 43 cfs
- Southwest Culvert (Link 94)
  - 1 barrel, 24-inch concrete pipe
  - Design Flow = 53 cfs
  - Peak Flow during design storm = 44 cfs
- West Letdown Culvert (Link 91)
  - 1 barrel, 30-inch concrete pipe
  - Design Flow = 178 cfs
  - Peak Flow during design storm = 77 cfs

Stormwater culvert sizing is presented in **Exhibit A.1, also see Figures depicting links, junctions, basins, and storage nodes for visual reference**.

Stormwater/Sedimentation Pond

The facility will be required to hold the run-off from a 25-year, 24-hour storm. As shown in **Exhibit A.1,** the three proposed ponds will provide sufficient capacity to retain the entire runoff volume from their associated contributing basins from the 25-year, 24-hour storm event. Each pond has been size to be 10-feet deep with 4:1 side slopes in order to maximize borrow soil generation. These ponds will each have a minimum of 3' freeboard, and some additional capacity in the case that the pond is retaining some liquids already at the time of the design storm event.

Exhibit A.1
Run-off Design Results
Storm and Sanitary Analysis Results

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY 05-17-2019

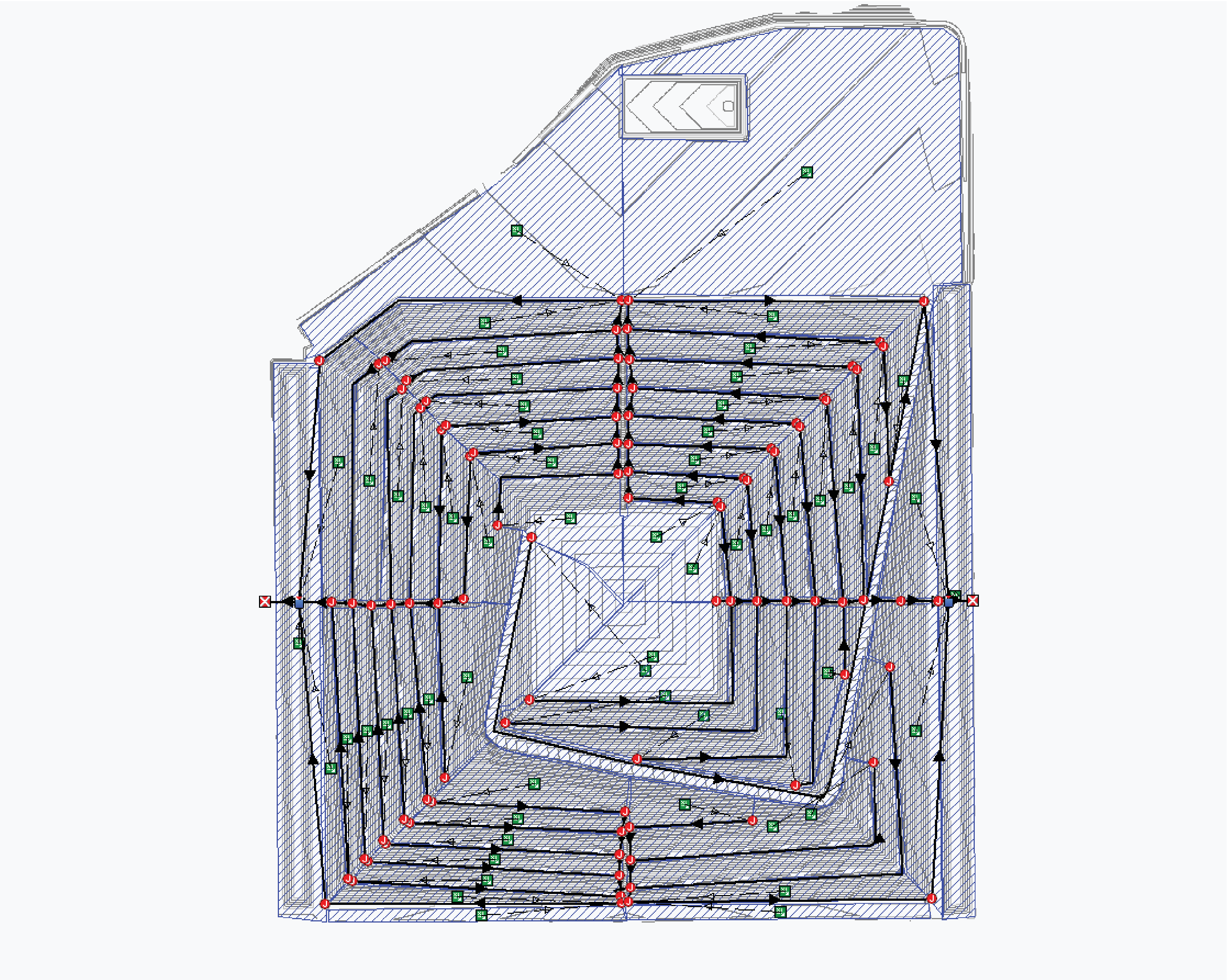


FIGURE 1 - WHOLE SITE

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY

05-17-2019

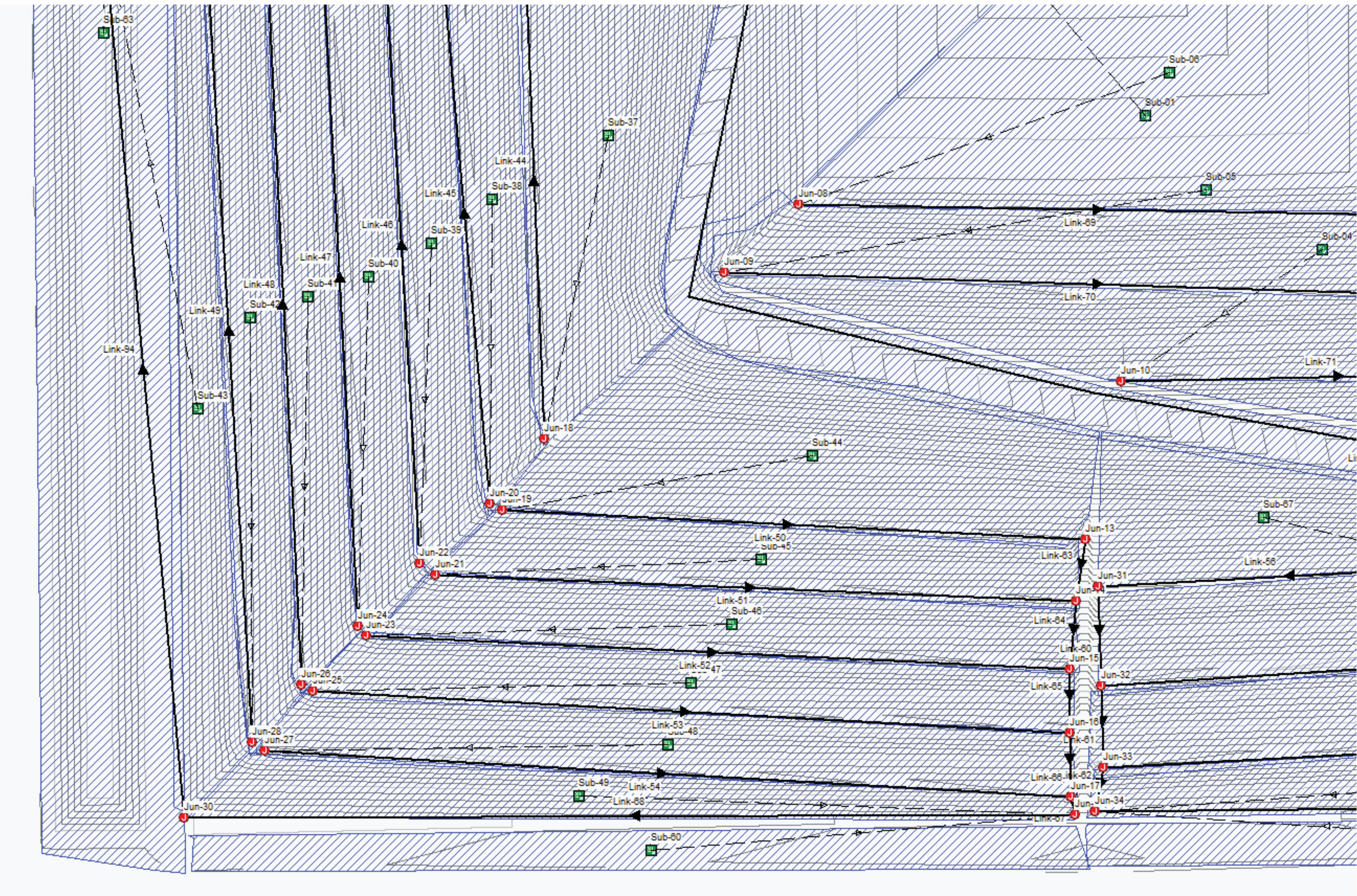


FIGURE 2 - PHASE 2 SOUTHWEST

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY 05-17-2019

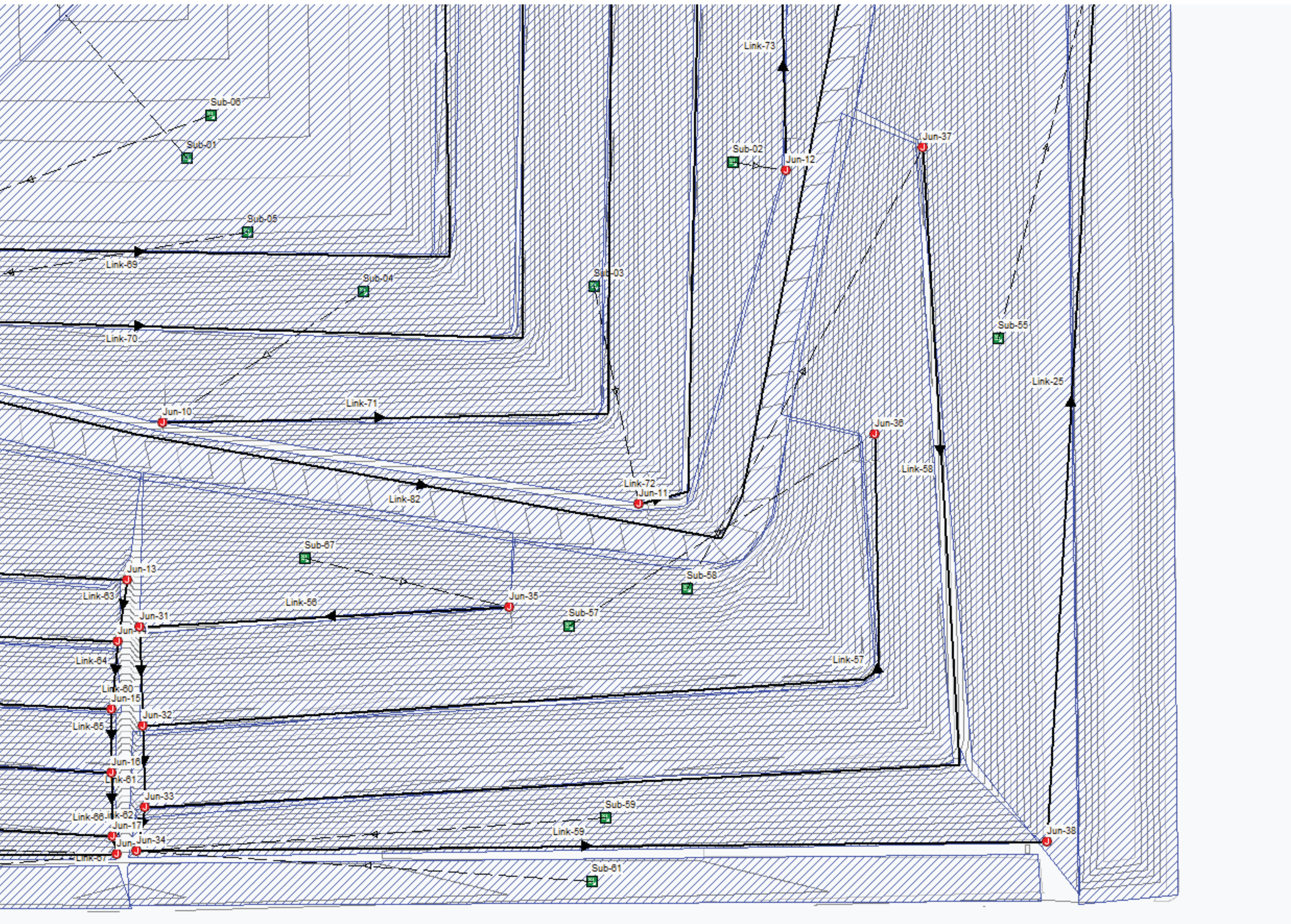


FIGURE 3 - PHASE 1 SOUTHEAST

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY

05-17-2019

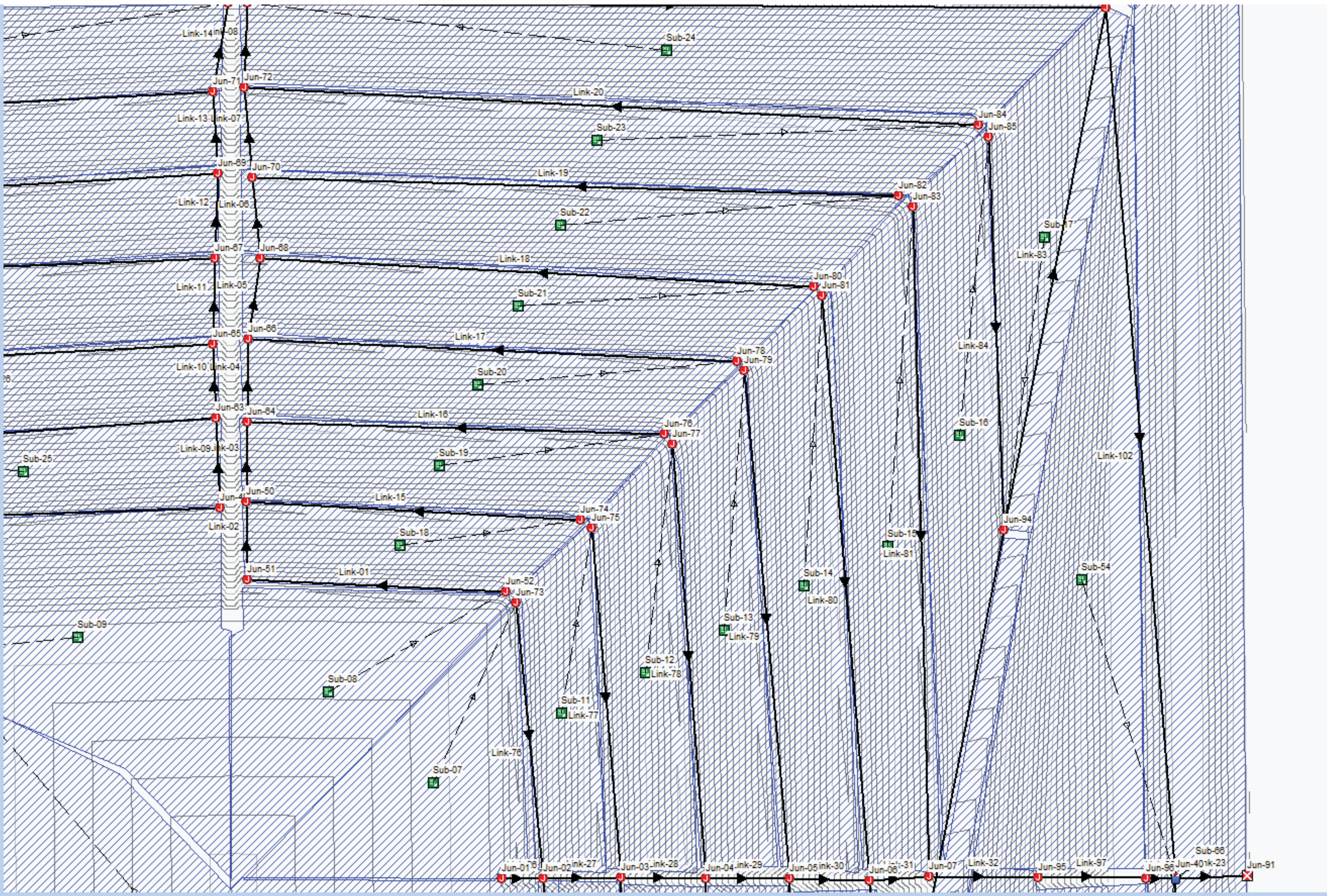


FIGURE 4 - PHASE 4 NORTHEAST

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY 05-17-2019

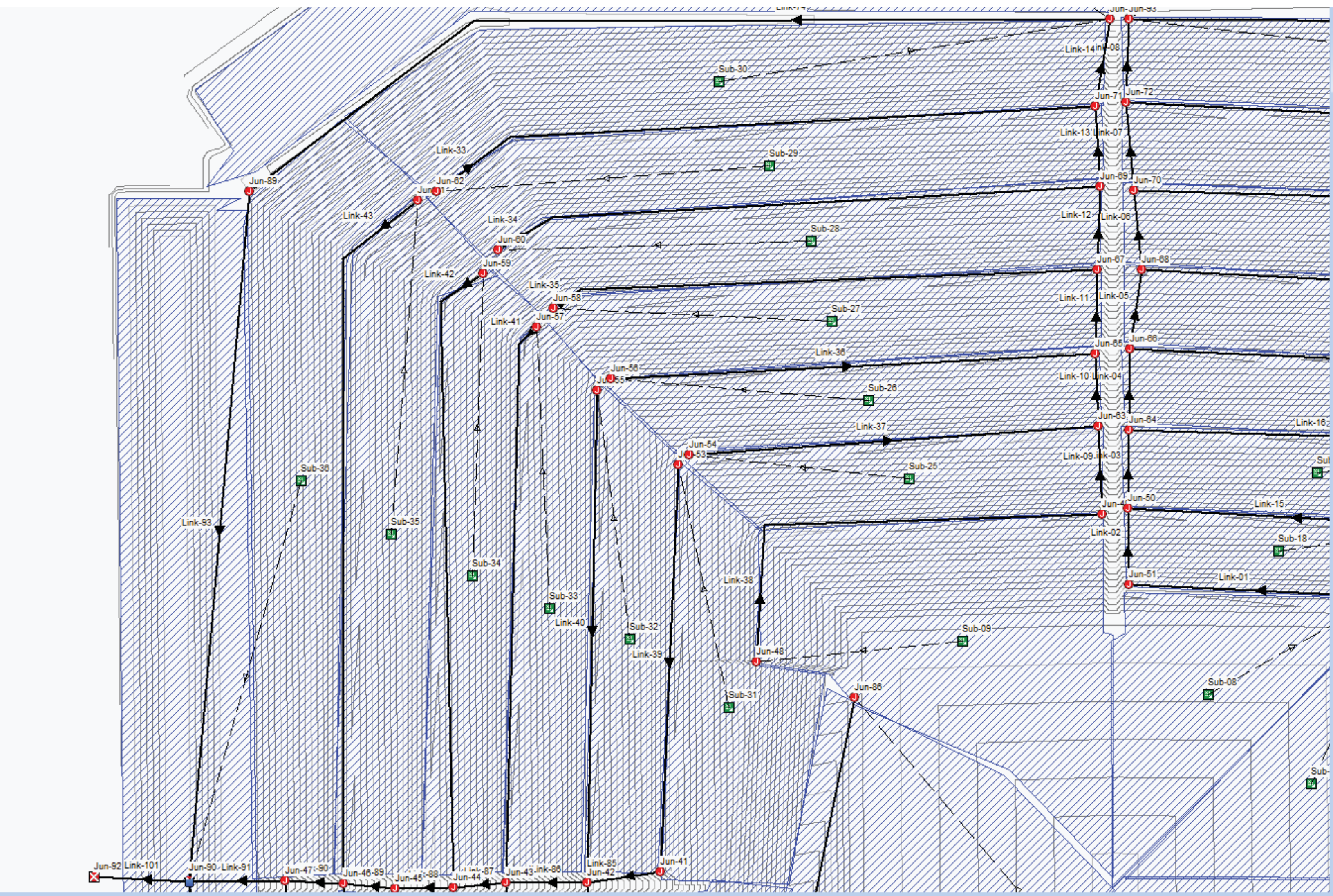


FIGURE 5 - PHASE 2 NORTHWEST

SOUTH RANCH SURFACE WASTE MANAGEMENT FACILITY

05-17-2019

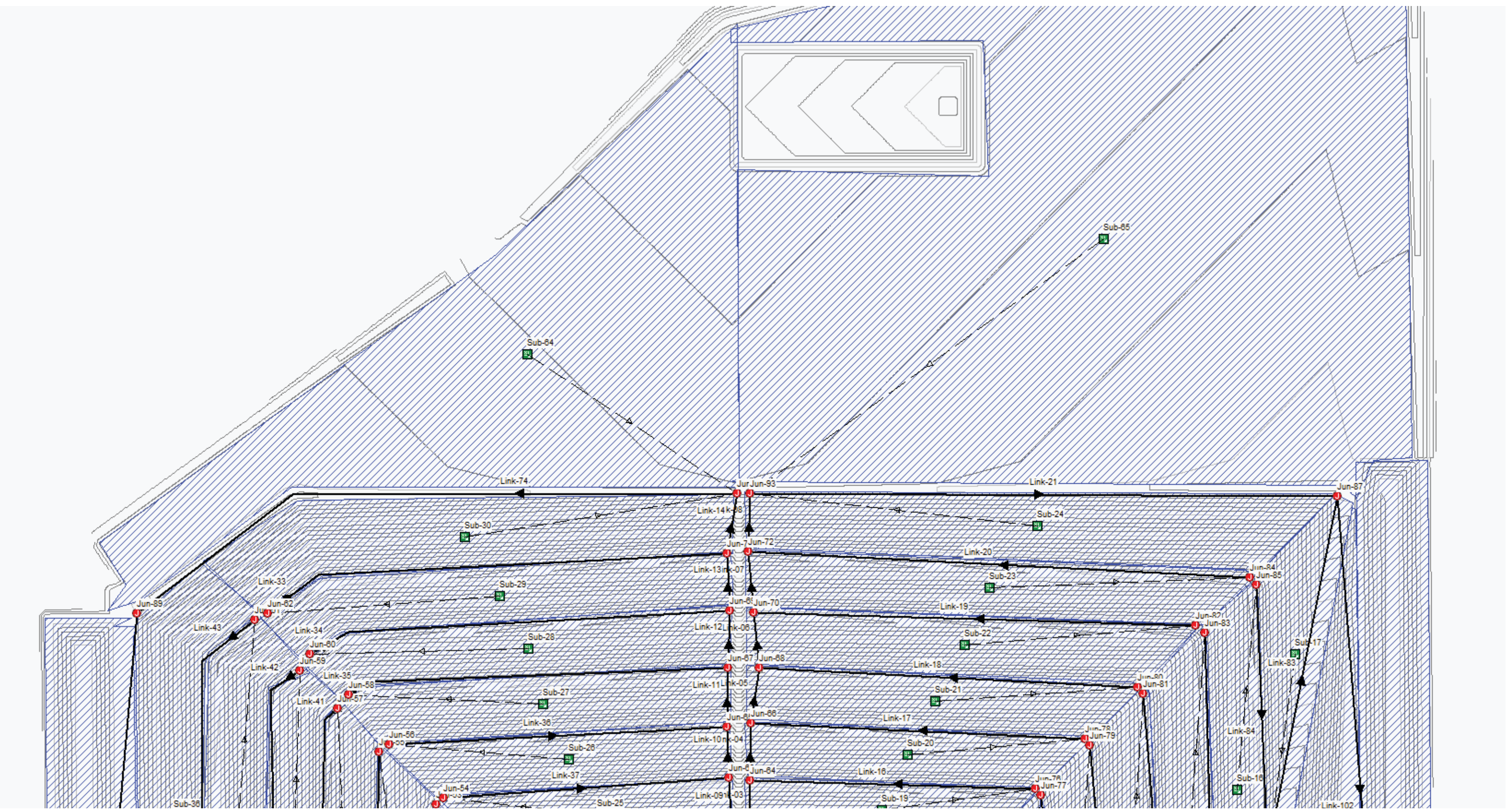


FIGURE 6 - PHASE 1 & 2 NORTH

South Ranch Surface Waste Management Facility

SSA RESULTS

5/17/2019

SN	Element ID	Description	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Pipe Width (inches)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	Lengthening Factor	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth / Total Depth Ratio	Total Time Surcharged (min)	Max Flow Depth (ft)	Reported Condition
1	Link-102		64	64	100.00	2895.30	-2.00	2889.24	0.24	6.06	6.0600	CIRCULAR	36.000	36.00	0.0110	0.5000	0.5000	0.0000	0.00	NO	1.00	105.70	0 12:09	31.21	0.05	223.79	0.47	0.48	0.00	1.45	Calculated
2	Link-25		64	64	1114.55	2898.05	0.00	2889.24	0.24	8.81	0.7900	CIRCULAR	30.000	30.00	0.0110	0.5000	0.5000	0.0000	0.00	NO	1.00	42.14	0 12:11	8.90	2.09	86.20	0.49	0.49	0.00	1.23	Calculated
3	Link-32		64	64	139.61	2956.11	0.00	2922.50	0.00	33.61	24.0700	CIRCULAR	18.000	18.00	0.0150	0.5000	0.5000	0.0000	0.00	NO	1.00	81.54	0 12:07	26.50	0.09	134.00	0.61	0.56	0.00	0.84	Calculated
4	Link-91		64	64	126.70	2907.19	0.00	2890.00	0.00	17.19	13.5700	CIRCULAR	30.000	30.00	0.0110	0.5000	0.5000	0.0000	0.00	NO	1.00	76.93	0 12:03	35.02	0.06	178.55	0.43	0.46	0.00	1.14	Calculated
5	Link-93		64	64	909.05	2896.02	-2.00	2890.00	0.00	6.02	0.6600	CIRCULAR	30.000	30.00	0.0110	0.5000	0.5000	0.0000	0.00	NO	1.00	66.06	0 12:11	10.22	1.48	91.06	0.73	0.63	0.00	1.57	Calculated
6	Link-94		64	64	1131.28	2897.78	8.03	2890.00	0.00	7.78	0.6900	CIRCULAR	30.000	30.00	0.0150	0.5000	0.5000	0.0000	0.00	NO	1.00	44.18	0 12:10	6.90	2.73	58.96	0.75	0.64	0.00	1.59	Calculated
7	Link-98		64	64	37.79	2900.28	0.00	2889.63	0.63	10.65	28.1800	CIRCULAR	24.000	24.00	0.0110	0.5000	0.5000	0.0000	0.00	NO	1.00	81.47	0 12:07	46.70	0.01	141.93	0.57	0.54	0.00	1.08	Calculated

South Ranch Surface Waste Management Facility
SSA RESULTS

05/17/2019

SN	Element ID	Description	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Channel Type	Channel Height (ft)	Channel Width (ft)	Left Overbank Manning's Roughness	Channel Manning's Roughness	Right Overbank Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	Lengthening Factor	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth / Total Depth Ratio	Total Time Surcharged (min)	Max Flow Depth (ft)	Reported Condition
1	Link-01		64	64	333.05	3096.93	0.00	3091.97	0.00	4.96	1.4900	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.02	0 12:02	3.31	1.68	48.90	0.12	0.46	0.00	0.68	Calculated
2	Link-02		64	64	100.76	3091.97	0.00	3065.40	0.00	26.57	26.3700	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.02	0 12:02	5.04	0.33	878.45	0.01	0.06	0.00	0.11	Calculated
3	Link-03		64	64	102.56	3065.40	0.00	3040.00	0.00	25.40	24.7700	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.26	0 12:02	6.06	0.28	851.32	0.01	0.08	0.00	0.16	Calculated
4	Link-04		64	64	106.24	3040.00	0.00	3012.79	0.00	27.21	25.6100	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	15.57	0 12:02	7.16	0.25	865.74	0.02	0.10	0.00	0.20	Calculated
5	Link-05		64	64	105.15	3012.79	0.00	2986.69	0.00	26.10	24.8200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	21.43	0 12:02	7.98	0.22	852.28	0.03	0.12	0.00	0.24	Calculated
6	Link-06		64	64	104.65	2986.69	0.00	2959.92	0.00	26.77	25.5800	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	28.33	0 12:03	8.93	0.20	865.21	0.03	0.15	0.00	0.29	Calculated
7	Link-07		64	64	115.01	2959.92	0.00	2933.66	0.00	26.26	22.8300	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	36.45	0 12:03	9.43	0.20	817.42	0.04	0.18	0.00	0.34	Calculated
8	Link-08		64	64	109.01	2933.66	0.00	2902.69	0.00	30.97	28.4100	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	44.88	0 12:03	10.89	0.17	911.81	0.05	0.19	0.00	0.37	Calculated
9	Link-09		64	64	115.03	3065.93	0.00	3039.99	0.00	25.94	22.5500	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.04	0 12:07	5.84	0.33	812.36	0.01	0.08	0.00	0.16	Calculated
10	Link-10		64	64	95.89	3039.99	0.00	3012.73	0.00	27.26	28.4300	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	14.94	0 12:07	7.29	0.22	912.10	0.02	0.10	0.00	0.19	Calculated
11	Link-101		64	64	124.64	2890.00	0.00	2887.00	2887.00	3.00	2.4100	Trapezoidal	10.000	92.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	179.18	0 12:12	6.82	0.30	18456.24	0.01	0.08	0.00	0.76	Calculated
12	Link-11		64	64	110.40	3012.73	0.00	2985.81	0.00	26.92	24.3800	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	20.41	0 12:07	7.80	0.24	844.73	0.02	0.12	0.00	0.24	Calculated
13	Link-12		64	64	108.37	2985.81	0.00	2959.64	0.00	26.17	24.1500	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	27.17	0 12:04	8.63	0.21	840.65	0.03	0.14	0.00	0.29	Calculated
14	Link-13		64	64	106.39	2959.64	0.00	2933.89	0.00	25.75	24.2000	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	34.72	0 12:04	9.44	0.19	841.60	0.04	0.17	0.00	0.33	Calculated
15	Link-14		64	64	115.38	2933.89	0.00	2902.69	0.00	31.20	27.0400	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	42.55	0 12:04	10.52	0.18	889.57	0.05	0.18	0.00	0.36	Calculated
16	Link-15		64	64	430.85	3074.34	0.00	3065.40	0.00	8.94	2.0700	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	4.29	0 12:01	3.42	2.10	57.72	0.07	0.38	0.00	0.56	Calculated
17	Link-16		64	64	536.26	3044.49	0.00	3040.00	0.00	4.49	0.8400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.32	0 12:02	2.88	3.10	36.67	0.15	0.48	0.00	0.71	Calculated
18	Link-17		64	64	628.31	3019.32	0.00	3012.79	0.00	6.53	1.0400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.87	0 12:03	3.22	3.25	40.85	0.14	0.48	0.00	0.71	Calculated
19	Link-18		64	64	713.60	2994.25	0.00	2986.69	0.00	7.56	1.0600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.92	0 12:03	3.41	3.49	41.24	0.17	0.51	0.00	0.75	Calculated
20	Link-19		64	64	832.36	2969.37	0.00	2959.92	0.00	9.45	1.1400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.18	0 12:04	3.68	3.77	42.70	0.19	0.54	0.00	0.79	Calculated
21	Link-20		64	64	945.57	2942.80	0.00	2933.66	0.00	9.14	0.9700	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.56	0 12:07	3.62	4.35	39.40	0.22	0.56	0.00	0.84	Calculated
22	Link-21		64	64	1105.08	2902.69	0.00	2897.30	0.00	5.39	0.4900	Trapezoidal	2.000	26.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	72.36	0 12:09	3.34	5.51	130.96	0.55	0.73	0.00	1.43	Calculated
23	Link-23		64	64	92.52	2888.56	-0.44	2885.56	2885.56	3.00	3.2400	Trapezoidal	10.000	92.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	241.51	0 12:11	8.73	0.18	22938.91	0.01	0.08	0.00	0.80	Calculated
24	Link-26		64	64	53.08	3096.42	0.00	3081.70	0.00	14.72	27.7300	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	0.00	0 00:00	0.00		900.86	0.00	0.00	0.00	0.00	Calculated
25	Link-27		64	64	99.93	3081.70	0.00	3060.94	0.00	20.76	20.7700	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	19.29	0 12:07	7.26	0.23	779.71	0.02	0.12	0.00	0.24	Calculated
26	Link-28		64	64	109.30	3060.94	0.00	3035.63	0.00	25.31	23.1600	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	33.03	0 12:07	9.14	0.20	823.19	0.04	0.16	0.00	0.32	Calculated
27	Link-29		64	64	107.73	3035.63	0.00	3007.60	0.00	28.03	26.0200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	49.75	0 12:07	10.98	0.16	872.59	0.06	0.20	0.00	0.39	Calculated
28	Link-30		64	64	103.06	3007.60	0.00	2982.83	4.83	24.77	24.0300	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	63.23	0 12:07	11.63	0.15	838.66	0.08	0.24	0.00	0.47	Calculated
29	Link-31		64	64	76.64	2982.83	4.83	2956.11	0.00	26.72	34.8600	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	73.89	0 12:07	13.87	0.09	1010.08	0.07	0.23	0.00	0.46	Calculated
30	Link-33		64	64	888.73	2941.05	0.00	2933.89	0.00	7.16	0.8100	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.84	0 12:07	3.36	4.41	35.97	0.22	0.56	0.00	0.84	Calculated
31	Link-34		64	64	803.01	2968.95	0.00	2959.64	0.00	9.31	1.1600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.59	0 12:03	3.64	3.68	43.15	0.18	0.52	0.00	0.77	Calculated
32	Link-35		64	64	721.12	2994.05	0.00	2985.81	0.00	8.24	1.1400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.08	0 12:03	3.50	3.43	42.83	0.17	0.51	0.00	0.75	Calculated
33	Link-36		64	64	636.17	3018.95	0.00	3012.73	0.00	6.22	0.9800	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.98	0 12:03	3.18	3.33	39.62	0.15	0.49	0.00	0.72	Calculated
34	Link-37		64	64	538.88	3043.85	0.00	3039.99	0.00	3.86	0.7200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.43	0 12:02	2.77	3.24	33.91	0.16	0.50	0.00	0.74	Calculated
35	Link-38		64	64	622.26	3068.71	0.00	3065.93	0.00	2.78	0.4500	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.05	0 12:07	2.52	4.12	26.78	0.38	0.69	0.00	1.02	Calculated
36	Link-39		64	64	533.52	3044.64	0.00	3040.27	0.00	4.37	0.8200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.34	0 12:02	2.98	2.98	36.27	0.20	0.55	0.00	0.81	Calculated
37	Link-40		64	64	646.12	3018.95	0.00	3010.54	0.00	8.41	1.3000	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.92	0 12:02	3.46	3.11	45.72	0.13	0.46	0.00	0.68	Calculated
38	Link-41		64	64	739.57	2993.67	0.00	2984.94	0.00	8.73	1.1800	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.57	0 12:03	3.52	3.50	43.54	0.15	0.49	0.00	0.72	Calculated
39	Link-42		64	64	835.39	2968.54	0.00	2955.99	0.00	12.55	1.5000	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.56	0 12:03	3.95	3.52	49.11	0.15	0.49	0.00	0.73	Calculated
40	Link-43		64	64	944.17	2942.84	0.00	2930.04	0.00	12.80	1.3600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	9.05	0 12:04	4.03	3.90	46.66	0.19	0.54	0.00	0.80	Calculated
41	Link-44		64	64	655.74	3018.23	0.00	3010.54	0.00	7.69	1.1700	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.67	0 12:03	3.67	2.98	43.39	0.25	0.59	0.00	0.87	Calculated
42	Link-45		64	64	738.07	2997.91	0.00	2984.94	0.00	12.97	1.7600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.35	0 12:02	3.85	3.20	53.12	0.10	0.42	0.00	0.62	Calculated
43	Link-46		64	64	804.68	2979.20	0.00	2955.99	0.00	23.21	2.8800	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.56	0 12:02	4.54	2.95	68.05	0.08	0.39	0.00	0.58	Calculated
44	Link-47		64	64	881.19	2960.06	0.00	2947.19	0.00	12.87	1.4600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.99	0 12:03	3.86	3.80	48.43	0.12	0.45	0.00	0.67	Calculated
45	Link-48		64	64	959.63	2942.18	0.00	2930.04	0.00	12.14	1.2700	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.20	0 12:04	3.80	4.21	45.07	0.14	0.47	0.00	0.70	Calculated
46	Link-49		64	64	1036.15	2923.00	0.00	2907.19	0.00	15.81	1.5300	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.87	0 12:04	4.12	4.19	49.50	0.14	0.47	0.00	0.70	Calculated
47	Link-50		64	64	723.72	2998.96	0.00	2991.31	0.00	7.65	1.0600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.75	0 12:03	3.63	3.32	41.20	0.26	0.60	0.00	0.89	Calculated
48	Link-51		64	64	794.68	2979.95	0.00	2971.70	0.00	8.25	1.0400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.84	0 12:03	3.41	3.88	40.83	0.14	0.48	0.00	0.70	Calculated
49	Link-52		64	64	874.47	2960.06	0.00	2948.18	0.00	11.88	1.3600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.35	0 12:03	3.80	3.84	46.71	0.14	0.47	0.00	0.69	Calculated
50	Link-53		64	64	941.01	2942.18	0.00	2932.22	0.00	9.96	1.0600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.49	0 12:04	3.61	4.34	41.23	0.16	0.50	0.00	0.74	Calculated
51	Link-54		64	64	1002.26	2923.00	0.00	2913.89	0.00	9.11	0.9100	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.18	0 12:07	3.53	4.73	38.20	0.19	0.53	0.00	0.79	Calculated
52	Link-56		64	64	460.10	2979.07	0.00	2974.37	0.00	4.70	1.0200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.29	0 12:02	3.00	2.56	40.50	0.16	0.50	0.00	0.74	Calculated
53	Link-57		64	64	1213.95	2959.22	0.00	2946.81	0.00	12.41	1.0200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	13.00	0 12:07	4.03	5.02	40.51	0.32	0.64	0.00	0.96	Calculated
54	Link-58		64	64	1785.84	2937.79	0.00	2920.66	0.00	17.13	0.9600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	14.97	0 12:09	4.19	7.10	39.25	0.38	0.68	0.00	1.02	Calculated
55	Link-59		64	64	1133.21	2908.02	0.00	2898.05	0.00	9.97	0.8800	Trapezoidal	2.000	26.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	42.51	0 12:09	4.13	4.57	228.00	0.19	0.41	0.00	0.80	Calculated
56	Link-60		64	64	123.28	2974.37	0.00	2946.81	0.00	27.56	22.3600	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.28	0 12:02	4.88	0.42	808.83	0.01	0.06	0.00	0.12	Calculated
57	Link-61		64	64	101.57	2946.81	0.00	2920.66	0.00	26.15	25.7500	Trapezoidal	2.000	22.00	0.0000	0.0330	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	18.49	0 12:07	7.94	0.21	920.61	0.02	0.11	0.00	0.22	Calculated
58	Link-62		64	64	55.63	2920.66	0.00	2908.02	0.00	12.64	22.7200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	33.15	0 12:08	9.10	0.10	815.43	0.04	0.17	0.00	0.32	Calculated
59	Link-63		64	64	76.84	2991.31	0.00	2971.70	0.00	19.61	25.5200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.75	0 12:03	6.23	0.21	864.19	0.01	0.08	0.00	0.16	Calculated
60	Link-64		64	64	84.67	2971.70	0.00	2948.18	0.00	23.52	27.7800	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	16.58	0 12:04	7.52	0.19	901.61	0.02	0.10	0.00	0.21	Calculated
61	Link-65		64	64	79.10	2948.18	0.00	2932.22	0.00	15.96	20.1800	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	22.93	0 12:04	7.66	0.17	768.41	0.03	0.14	0.00	0.27	Calculated
62	Link-66		64	64	79.12	2932.22	0.00	2913.89	0.00	18.33	23.1700	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	29.41	0 12:04	8.77	0.15	823.39	0.04	0.15	0.00	0.31	Calculated
63	Link-67		64	64	23.27	2913.89	0.00	2908.98	0.00	4.91	21.1000	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	36.48	0 12:04	9.19	0.04	785.79	0.05	0.18	0.00	0.36	Calculated
64	Link-68		64	64	1105.50	2908.98	0.00	2889.75	0.00	19.23	1.7400	Trapezoidal	2.000	26.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	44.39	0 12:06	5.20	3.54	320.59	0.14	0.35	0.00	0.70	Calculated
65	Link-69		64	64	1139.17	3095.62	0.00	3081.70	0.00	13.92	1.2200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	14.06	0 12:08	3.94	4.82	44.29	0.32	0.65	0.00	0.95	Calculated
66	Link-70		64	64	1425.34	3070.95	0.00	3060.94	0.00	10.01	0.7000	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	10.69	0 12:08	3.57	6.65	33.58	0.32	0.64	0.00	0.95	Calculated
67	Link-71		64	64	1131.67	3042.70	0.00	3035.63	0.00	7.07	0.6200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	11.83	0 12:08	3.38	5.58	31.67	0.37	0.68	0.00	1.02	Calculated
68	Link-72		64	64	737.77	3010.69	0.00	3007.60	0.00	3.09	0.4200	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	8.35	0 12:07	2.67	4.61	25.93	0.32	0.65	0.00	0.97	Calculated

69	Link-73	64	64	273.57	2979.45	0.00	2978.00	0.00	1.45	0.5300	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.02	0	12:01	2.13	2.14	29.17	0.17	0.52	0.00	0.77	Calculated
70	Link-74	64	64	1204.45	2902.69	0.00	2898.02	0.00	4.67	0.3900	Trapezoidal	2.000	26.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	66.30	0	12:10	3.06	6.56	116.76	0.57	0.74	0.00	1.45	Calculated
71	Link-76	64	64	357.23	3096.93	0.00	3081.70	0.00	15.23	4.2600	Triangular	1.500	12.00	0.0000	0.0320	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.85	0	12:02	4.25	1.40	69.81	0.08	0.39	0.00	0.59	Calculated
72	Link-77	64	64	451.48	3074.34	0.00	3060.94	0.00	13.40	2.9700	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	4.08	0	12:01	3.85	1.95	69.03	0.06	0.35	0.00	0.52	Calculated
73	Link-78	64	64	560.95	3044.49	0.00	3035.63	0.00	8.86	1.5800	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.72	0	12:02	3.52	2.66	50.36	0.11	0.44	0.00	0.66	Calculated
74	Link-79	64	64	656.78	3019.32	0.00	3007.60	0.00	11.72	1.7800	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	5.87	0	12:02	3.80	2.88	53.53	0.11	0.44	0.00	0.64	Calculated
75	Link-80	64	64	754.35	2994.25	0.00	2982.83	4.83	11.42	1.5100	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.18	0	12:03	3.84	3.27	49.30	0.15	0.48	0.00	0.71	Calculated
76	Link-81	64	64	862.17	2969.37	0.00	2956.11	0.00	13.26	1.5400	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.96	0	12:03	4.04	3.56	49.69	0.16	0.50	0.00	0.74	Calculated
77	Link-82	64	64	3202.50	3096.16	0.00	2937.42	0.00	158.74	4.9600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	24.51	0	12:09	8.14	6.56	89.21	0.27	0.61	0.00	0.90	Calculated
78	Link-83	64	64	684.44	2937.42	0.00	2897.30	0.00	40.12	5.8600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	33.79	0	12:08	8.36	1.36	97.02	0.35	0.67	0.00	0.99	Calculated
79	Link-84	64	64	505.74	2942.80	0.00	2937.42	0.00	5.38	1.0600	Triangular	1.500	12.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	6.62	0	12:02	3.13	2.69	41.33	0.16	0.50	0.00	0.74	Calculated
80	Link-85	64	64	96.90	3040.27	0.00	3010.54	0.00	29.73	30.6800	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	7.33	0	12:03	5.70	0.28	947.55	0.01	0.06	0.00	0.12	Calculated
81	Link-86	64	64	106.20	3010.54	0.00	2984.94	0.00	25.60	24.1100	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	23.92	0	12:03	8.23	0.22	839.89	0.03	0.13	0.00	0.26	Calculated
82	Link-87	64	64	69.01	2984.94	0.00	2955.99	0.00	28.95	41.9500	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	35.83	0	12:03	11.38	0.10	1107.99	0.03	0.14	0.00	0.28	Calculated
83	Link-88	64	64	77.08	2955.99	0.00	2947.19	0.00	8.80	11.4200	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	48.91	0	12:03	8.34	0.15	578.01	0.08	0.25	0.00	0.50	Calculated
84	Link-89	64	64	68.13	2947.19	0.00	2930.04	0.00	17.15	25.1700	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	54.86	0	12:03	11.24	0.10	858.28	0.06	0.22	0.00	0.43	Calculated
85	Link-90	64	64	76.29	2930.04	0.00	2907.19	0.00	22.85	29.9500	Trapezoidal	2.000	22.00	0.0000	0.0350	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	70.06	0	12:03	12.95	0.10	936.22	0.07	0.24	0.00	0.47	Calculated
86	Link-97	64	64	140.25	2922.50	0.00	2900.28	0.00	22.22	15.8400	Trapezoidal	2.000	22.00	0.0000	0.0270	0.0000	0.5000	0.5000	0.0000	0.00	NO	1.00	81.48	0	12:07	13.12	0.18	882.66	0.09	0.27	0.00	0.53	Calculated

SN	Element ID	X Coordinate	Y Coordinate	Description	Invert Elevation (ft)	Boundary Type	Flap Gate	Fixed Water Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Maximum HGL Depth Attained (ft)	Maximum HGL Elevation Attained (ft)
1	64	876169.79	369257.07		0.00	NORMAL	NO		241.51	0.00	2886.36	2886.36
2	64	873526.22	369253.36		0.00	NORMAL	NO		179.18	0.00	2887.77	2887.77