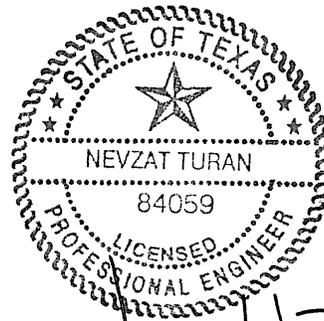


**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417D**

MAJOR PERMIT AMENDMENT APPLICATION

VOLUME 6 OF 6

Prepared for
Texas Regional Landfill Company, LP
February 2022



Prepared by

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WCG Project No. 0771-368-11-123

This document is intended for permitting purposes only.

**TURKEY CREEK LANDFILL
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**MAJOR PERMIT AMENDMENT APPLICATION
VOLUME 6 OF 6**

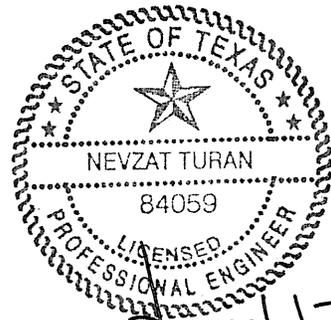
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02/22/22

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417D**

MAJOR PERMIT AMENDMENT APPLICATION

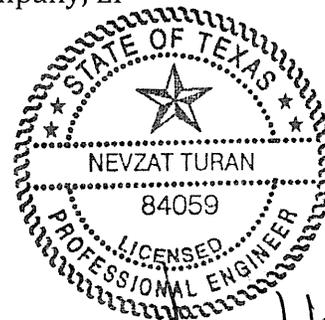
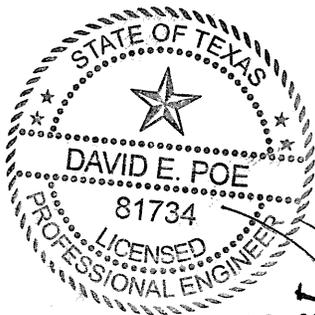
PART III – SITE DEVELOPMENT PLAN

**APPENDIX IIIM
GEOTECHNICAL REPORT**

Prepared for

Texas Regional Landfill Company, LP

February 2022



Prepared by

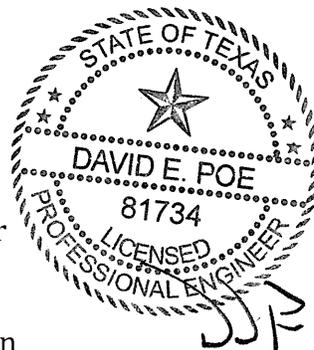
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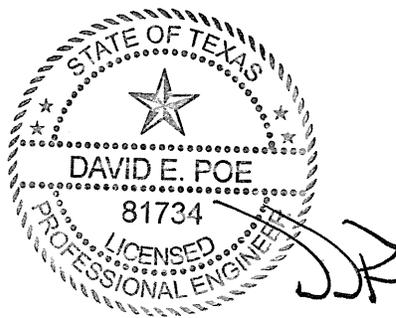
Slope Stability Analysis

APPENDIX IIIM-B

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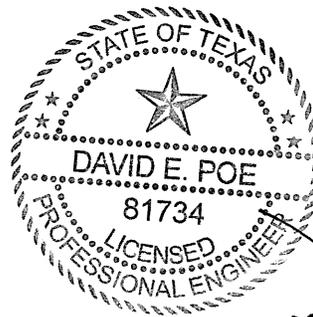
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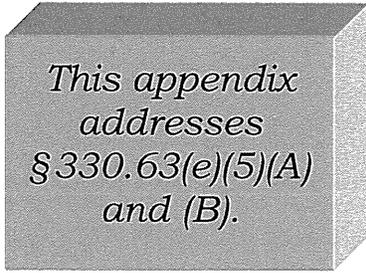
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02-22-2022

1 INTRODUCTION

The purpose of this report is to present the geotechnical analysis and design for the proposed major permit amendment for the vertical and lateral expansion of the Turkey Creek Landfill. This report is based on the geotechnical testing information that has previously been compiled from the subsurface investigations at the site and additional information obtained during recent investigations.



*This appendix
addresses
§330.63(e)(5)(A)
and (B).*

This report contains a compilation of geotechnical testing and design information, including:

- Slope stability analyses based on the geotechnical testing results and subsurface conditions, including groundwater, for landfill excavations, landfill completion, overliner systems, and sequence of development (interim condition analysis) plans; and
- Settlement and heave analyses, which are also based on the landfill excavation and completion plans.

This report also provides geotechnical recommendations for construction of the landfill components, including bottom liner, overliner, and final cover systems with geosynthetic materials. Geotechnical stability of above-grade Class 1 waste fill Option 2 – Containment Dikes and Option 2A – Soil Cover System is provided in Appendix IIIA-C. The construction quality control and material and construction specifications for the groundwater protection components of the landfill are provided in Appendix IIID – Liner Quality Control Plan.

2 LABORATORY TESTING

2.1 Introduction

Numerous geological investigations have been performed at the Turkey Creek Landfill, and included the sampling and geotechnical testing of samples obtained during the investigations. A brief description of the geological/geotechnical characteristics of the site are provided in the next paragraphs. Additional geological and hydrogeological discussion is provided in Appendix IIIG of this application.

The uppermost unit is the Upper Sand unit. The Upper Sand is characterized as predominately loose sandy clay, sandy silt, and sand deposits associated with alluvium and weathered Woodbine Formation sediments.

The Bounding Shale unit underlies the Upper Sand unit throughout the site. The Bounding Shale is comprised wholly of Woodbine Formation sediments. The sediments within this unit are predominately sandy shale, clayey shale, and silty shale commonly interbedded with thin seams and laminations of silt/siltstone and sand/sandstone, and interrupted by larger sand bodies of the Lower Sand unit. Within the Bounding Shale lies the Lower Sand unit. The Lower Sand is characterized as discontinuous lenticular bodies of predominately sand and sandstone in a shale matrix.

Laboratory tests were conducted on select samples recovered from the borings drilled to evaluate the physical and engineering properties of the different strata. Laboratory tests were performed in general accordance with ASTM procedures. Available laboratory testing results from the previous investigations are provided in Appendix IIIM-C, and on boring logs included in Appendix G–Geology Report. A summary of the laboratory tests performed is given in Table 2-1. The results of laboratory testing are summarized in Table 3-1.

**Table 2-1
Geotechnical Test Methods Performed**

Test	Test Method
Sieve Analysis (Passing No. 200)	ASTM D 1140
Atterberg Limits (Liquid & Plastic Limit)	ASTM D 4318
Moisture Content	ASTM D 2216
Unconfined Compression	ASTM D 2166 & Pocket Penetrometer
Triaxial Compression Test	ASTM D 4767
Coefficient of Permeability (Hydraulic Conductivity)	ASTM D 5084 Method F
Consolidation	ASTM D 2435
Hand Penetrometer Testing	ASTM D 2573
Standard Proctor	ASTM D 698

2.2 Classification Tests

Classification tests consisting of Atterberg limits, percent passing the number 200 sieve, dry unit weight, and moisture content were performed on selected soil samples recovered from boreholes. These test results are presented in Appendix IIIM-C and are summarized in Table 3-1. Classification tests were used to characterize the soils according to the Unified Soil Classification System (USCS) and to evaluate physical properties of the soils.

2.2.1 Material Strength Tests

Material strength tests were performed to provide generalized strength parameters that were used to evaluate the soils at the site. Unconfined compression tests were performed in the field using a hand penetrometer. Additional laboratory unconfined compression tests (ASTM D 3080) were conducted for selected bounded shale samples. Shear strength correlations for each layer were developed from correlating the field and laboratory test results. Additionally, extensive field penetrometer testing was performed during investigations, as documented on boring logs included in Appendix IIIG. The results of field penetrometer testing was initially used to develop total and effective stress parameters required for stability testing of the landfill and foundation strata, which was confirmed by triaxial shear testing of samples obtained during the 2021 investigations.

In 2021, additional triaxial testing was performed to confirm the shear strength values used in previous and the 2021 stability analyses. The results of the 2021 testing are presented in Appendix IIIM-C. The results demonstrate that the values used in the previous and current analyses are conservative. No change to the selected parameters for the analyses (from previous permit amendment applications) was required for this amendment application.

2.2.2 Coefficient of Permeability Tests

Laboratory hydraulic conductivity tests were performed to evaluate the hydrogeological properties of the soils and shale at the site (limited to testing of the bounded shale unit). These tests were performed by Baker-Shiflett (1981) and The Carel Corporation (2012) to assist in evaluation of the hydrogeologic properties of the geological units at the site. The 1981 Baker-Shiflett testing does not reference a specific methodology. The 2012 The Carel Corporation testing references ASTM D 5084 Method F. The results are summarized in Table 3-1 and provided in Appendix IIIG-D (Site Hydrogeologic Data) in Appendix IIIG-Geology Report.

Additional laboratory analysis of subsurface permeabilities was performed in 2021 in support of this application. The results of the additional testing is presented in Appendix IIIG-Geology Report, and summarized in Table 3-1. Demonstration of compliance with the groundwater separation requirements also is included in Appendix IIIG.

2.2.3 Consolidation Tests

Previous applications for this facility incorporated conservative consolidation values for the soil and shale layers developed by correlating unconfined compression test results (laboratory) and field penetrometer results with known consolidation values. This information was used to calculate the settlement and heave characteristics of the landfill and underlying foundation strata.

For this 2021 application, undisturbed samples were collected of the Bounding Shale unit and subjected to laboratory testing. The results of the consolidation testing are presented in Appendix IIIM-C. The analyses presented in Appendix IIIM-B incorporate the test results from the 2021 laboratory testing.

2.2.4 Moisture-Density Relationships

Standard Proctor laboratory compaction tests were performed during previous liner construction activities at the site. The tests were performed to evaluate the moisture-density relationship of the materials. Remolded samples for coefficient of permeability tests were compacted by static loading the sample to approximately 95 percent of the Standard Proctor maximum dry density at approximately the optimum moisture content determined from the Proctor test. These values were reviewed for comparison with typical landfill liner properties incorporated into the stability analyses. The results to date demonstrate that the upper clays are suitable for liner construction, and able to achieve the 1×10^{-7} cm/sec permeability criteria. Sufficient soil quantities suitable for liner and final cover construction is available on-site, although alternatively clayey soils may be imported from off-site borrow areas.

2.3 Conclusion of Laboratory Testing

Classification testing along with unit weight, moisture content, and sieve analysis results were used to support field observations during subsurface explorations. Testing results were also used to support the subsurface characterization which includes the three formations that exist generally across the site. Additionally, soil strength parameters from both field and laboratory were conservatively generalized and selected for use in the geotechnical stability analysis.

3 PROPERTIES OF SITE SOILS AND LANDFILL COMPONENTS

3.1 General

This section of the report includes the generalized stratigraphy for the site, typical properties of subsurface soils, potential uses of materials that may be excavated during construction, and soil material requirements for various components of the landfill. The results of the geotechnical testing performed on site soils are included in Appendix IIIM-C.

The laboratory test results for soil samples obtained from the site are summarized in Table 3-1. Laboratory testing information is presented in Appendix IIIM-C.

3.2 Generalized Site Stratigraphy

The subsurface materials encountered at the site are discussed in detail in Section 3 of Appendix IIIG – Geology Report. In general, the subsurface at the site is characterized by three units. The site-specific geologic stratigraphic characterization of the 219.6-acre landfill unit includes two site-specific sand units formally titled the Upper Sand and Lower Sand which are bound by a “perching clay/shale”. The “perching clay/shale” is herein referred to as the Bounding Shale unit.

3.2.1 Upper Sand

The uppermost unit is the Upper Sand. The Upper Sand is characterized as predominately loose sandy clay, sandy silt, and sand deposits associated with alluvium and weathered Woodbine Formation sediments. According to the existing borehole data, the Upper Sand was continuous across the site (prior to landfill development) and ranged in thickness from 1.5 to 32.5 feet within the landfill permit boundary. The Upper Sand sediments within the limits of waste have since been removed by excavation from site development. The remaining Upper Sand sediments are present in the areas between the limits of waste and the permit boundary. According to the existing borehole data, the Upper Sand sediments exhibit varying degrees of saturation from dry to wet.

3.2.2 Bounding Shale

The Bounding Shale unit underlies the Upper Sand unit throughout the site. The Bounding Shale is comprised wholly of Woodbine Formation sediments. The sediments within this unit are predominately sandy shale, clayey shale, and silty shale commonly interbedded with thin seams and laminations of silt/siltstone and sand/sandstone, and interrupted by larger sand bodies of the Lower Sand unit. The Bounding Shale sediments exhibit varying degrees of saturation from dry to wet. Available laboratory permeability testing data for the Bounding Shale sediments indicate a horizontal permeability of 4.5×10^{-9} to 5.9×10^{-6} cm/sec and vertical permeability of 1.9×10^{-9} to 9.1×10^{-8} cm/sec (Baker-Shiflett, 1991, The Carel Corporation, 2012, and WCG, 2021).

3.2.3 Lower Sand

Within the Bounding Shale lies the Lower Sand unit. The Lower Sand is characterized as discontinuous lenticular bodies of predominately sand and sandstone in a shale matrix. According to existing borehole data, the Lower Sand is interbedded within the Bounding Shale with individual sand bodies up to about 25 feet in thickness. The sand bodies within the Lower Sand unit are difficult, if not impossible, to correlate between boreholes, but are interconnected hydraulically through fractures, fissures, and joints within the surrounding shale (Bounding Shale). According to the existing borehole data, the Lower Sand sediments are predominately moist to wet. Field slug test data from piezometers screened within the Lower Sand sediments indicate a permeability range of 2×10^{-5} to 1×10^{-4} cm/sec (Baker-Shiflett, 1991).

3.3 Material Requirements for Landfill Components

Construction of the landfill will require clay or clayey soils which can be compacted to have an in-place hydraulic conductivity of 1×10^{-7} cm/sec or less for the soil liner portion of the composite liner, overliner, and an in-place hydraulic conductivity of 1×10^{-5} cm/s for the soil infiltration layer of the composite final cover system.

Soil will also be required for protective cover on the liner and overliner, operational cover (daily cover, intermediate cover, and barrier layer), the infiltration and erosion layer components of the composite final cover, berm construction, and other miscellaneous general fill. Granular material (i.e., gravel) will be used for the leachate collection sumps, leachate collection chimneys and may be used for groundwater dewatering collection trenches. Typical material requirements for various soil structures are summarized in Table 3-2.

Testing requirements and construction quality control and quality assurance for liner soils are detailed in Appendix IIID – Liner Quality Control Plan (LQCP). Testing

requirements and construction quality control and quality assurance for final cover soils are detailed in Appendix IIIJ – Closure Plan and in Appendix IIIE – Final Cover System Quality Control Plan (FCSQCP). Liner and final cover details are presented in Appendix IIIA-A – Liner, Overliner, and Final Cover System Details.

**Table 3-1
Summary of Existing Geotechnical Data**

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Testing on Upper Sand Unit Sediments												
1981 Borings by Baker-Shiflett, Inc.												
B-3	1.5 - 2.5	-	-	-	99	18	116	-	-	-	4.5	-
B-4	4.5 - 5.5	51	13	38	-	-	-	-	-	-	-	-
B-5	1.5 - 2.5	30	11	19	71	28	-	-	-	-	3	-
B-8	1.5 - 3.0	-	-	-	42	-	-	-	-	-	4.5+	-
B-8	15.0 - 16.0	-	-	-	-	-	-	-	-	-	-	7
B-9	0.0 - 1.5	-	-	-	10	-	-	-	-	-	-	-
1986 Borings by Baker-Shiflett, Inc.												
B-16	1.5 - 3.0	55	22	33	93	-	-	-	-	-	4.5	-
B-16	6.0 - 7.0	57	23	34	98	-	-	-	-	-	4.5+	-
B-16	9.0 - 10.0	-	-	-	-	-	-	-	-	-	-	50/2"
B-16	13.5 - 15.0	45	18	27	84	-	-	-	-	-	4.00	-
B-16	19.0 - 20.0	-	-	-	-	-	-	-	-	-	-	50/3"
B-16	23.0 - 24.0	-	-	-	-	-	-	-	-	-	-	50/4"
B-17	5.0 - 6.5	-	-	-	97	-	-	-	-	-	-	44
B-17	7.0 - 8.5	-	-	-	-	-	-	-	-	-	-	50/5"
B-17	8.5 - 10.0	-	-	-	-	-	-	-	-	-	-	50/5"
B-17	14.0 - 15.0	-	-	-	-	-	-	-	-	-	-	50/2"
B-17	1.5 - 3.0	29	13	16	68	-	-	-	-	-	4.5+	38
B-18	3.0 - 4.5	34	13	21	58	-	-	-	-	-	4.5+	-
B-18	7.0 - 8.5	-	-	-	53	-	-	-	-	-	4.5+	35
B-18	13.5 - 15.0	-	-	-	27	-	-	-	-	-	-	11
B-19	0 - 1.5	-	-	-	-	-	-	-	-	-	-	5
B-19	3.5 - 9.0	58	20	38	89	-	-	-	-	-	4.5	-
B-19	8.0 - 9.5	-	-	-	92	-	-	-	-	-	2.5	60
B-20	1.5 - 3.0	20	17	3	42	-	-	-	-	-	4.5+	-
B-20	7.5 - 9.0	52	21	31	88	-	-	-	-	-	4.5+	-

**Table 3-1 (Continued)
Summary of Existing Geotechnical Data**

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Testing on Upper Sand Unit Sediments (Continued)												
1986 Borings by Baker-Shiflett, Inc. (Continued)												
B-20	12.5 - 14.0	-	-	-	32	-	-	-	-	-	-	-
B-20	18.5 - 19.5	-	-	-	52	-	-	-	-	-	-	-
B-21	4.5 - 6.0	56	21	35	94	-	-	-	-	-	4.0	-
B-21	7.5 - 9.0	58	22	36	-	-	-	-	-	-	4.5	-
B-21	13.5 - 15.0	52	20	32	-	-	-	-	-	-	4.5+	-
B-22	3.0 - 3.5	45	13	32	48	-	-	-	-	-	4.5	-
B-22	6.0 - 7.5	-	-	-	30	-	-	-	-	-	4.5	-
B-23	0.0 - 1.5	-	-	-	10	-	-	-	-	-	-	-
B-23	8.0 - 10.0	-	-	-	10	-	-	-	-	-	-	-
B-24	0.0 - 1.5	-	-	-	52	-	-	-	-	-	2.5	-
B-24	4.5 - 6.0	62	18	44	98	-	-	-	-	-	4.5+	-
B-25	0.0 - 1.5	-	-	-	65	-	-	-	-	-	4.5+	-
B-25	1.5 - 3.0	-	-	-	97	-	-	-	-	-	4.5+	-
B-26	0.0 - 1.5	-	-	-	46	-	-	-	-	-	2	-
B-26	1.5 - 3.0	46	23	23	-	-	-	-	-	-	4.5	-
B-26	6.0 - 7.5	-	-	-	26	-	-	-	-	-	3	-
B-26	10.5 - 12.0	-	-	-	43	-	-	-	-	-	4.5	-
B-27	4.5 - 6.0	-	-	-	41	-	-	-	-	-	2	-
B-27	15.5 - 16.5	-	-	-	50	-	-	-	-	-	4.5	-
B-27	18.5 - 20.0	34	14	20	-	-	-	-	-	-	4.5	-
B-28	1.5 - 3.0	-	-	-	18	-	-	-	-	-	-	-
B-28	7.0 - 8.5	-	-	-	42	-	-	-	-	-	4.5+	-
B-29	0.0 - 1.5	-	-	-	4	-	-	-	-	-	4.5	-
B-29	1.5 - 3.0	46	22	24	46	-	-	-	-	-	4.5	-
B-29	18.5 - 19.5	-	-	-	78	-	-	-	-	-	4.5	-
B-30	0.0 - 1.5	-	-	-	70	-	-	-	-	-	4.5	-
B-30	1.5 - 3.0	72	23	49	-	-	-	-	-	-	4.5	-
B-30	6.0 - 7.5	-	-	-	63	-	-	-	-	-	4.5+	-

**Table 3-1 (Continued)
Summary of Existing Geotechnical Data**

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Testing on Upper Sand Unit Sediments (Continued)												
1988-1989 Borings by Baker-Shiflett, Inc.												
B-31	3.0 - 3.5	65	18	47	87	17	112	-	-	-	4.5	-
B-31	4.5 - 6.0	63	23	40	95	23	103	-	-	-	4.5	-
B-32	0.0 - 1.5	45	18	27	63	20	97	-	-	-	2	-
B-32	3.0 - 4.5	37	14	23	39	16	113	-	-	-	3	-
B-33	2.5 - 4.0	50	20	30	48	-	-	-	-	-	4.5+	-
B-33	4.0 - 4.5	30	21	9	27	-	-	-	-	-	4.5+	-
B-34	1.5 - 2.5	21	16	5	19	-	-	-	-	-	4.5+	-
B-35	3.0 - 4.5	NON-PLASTIC			21	6	102	-	-	-	3.5	-
B-35	7.5 - 8.4	26	13	13	23	-	-	-	-	-	4.5	-
B-35	14.1 - 14.8	22	18	4	41	-	-	-	-	-	-	-
B-36	3.0 - 4.5	NON-PLASTIC			20	16	-	-	-	-	3	-
B-36	8.0 - 8.7	30	16	14	21	-	-	-	-	-	-	-
B-37	3.0 - 4.5	42	19	23	39	12	-	-	-	-	4.5+	-
B-37	9.0 - 10.0	20	14	6	30	-	-	-	-	-	4.5+	-
B-37	13.5 - 14.8	29	13	16	37	11	-	-	-	-	4.5+	-
B-37	22.8 - 23.2	28	16	12	76	-	-	-	-	-	-	-
B-38	1.5 - 3.0	67	23	44	63	25	99	-	-	-	2.5	-
B-38	7.0 - 8.0	36	13	23	62	10	121	-	-	-	4.5+	-
B-42	6.0 - 7.5	62	20	42	97	18	-	-	-	-	4.5+	-
B-42	16.4 - 16.7	27	13	14	60	-	-	-	-	-	4.5+	-

**Table 3-1 (Continued)
Summary of Existing Geotechnical Data**

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Testing on Upper Sand Unit Sediments (Continued)												
1992-1993 Borings by Baker-Shiflett, Inc.												
MW-1C	3.0 - 4.0	-	-	-	83	7	-	-	-	-	-	-
MW-1C	7.5 - 8.5	-	-	-	93	11	-	-	-	-	-	-
MW-5B	15.0 - 16.0	-	-	-	84	-	-	-	-	-	-	-
MW-5B	16.5 - 17.5	-	-	-	-	18	-	-	-	-	-	-
MW-7	21.0 - 22.0	45	18	27	25	-	-	-	-	-	-	-
MW-8	2.0 - 3.0	45	14	31	45	15	-	-	-	-	-	-
MW-8	16.0 - 17.0	-	-	-	92	24	-	-	-	-	-	-
MW-9	2.0 - 3.0	45	14	31	45	15	108	-	-	-	-	-
MW-9	16.0 - 17.0	-	-	-	92	24	-	-	-	-	-	-
MW-12	6.0 - 7.0	23	15	8	79	18	-	-	-	-	-	-
MW-12	13.5 - 14.5	-	-	-	45	16	-	-	-	-	-	-
MW-13	6.0 - 7.0	23	16	8	79	18	-	-	-	-	-	-
MW-13	13.0 - 14.0	-	-	-	45	16	-	-	-	-	-	-
MW-16	5.0 - 6.0	36	13	23	45	10	-	-	-	-	-	-

**Table 3-1 (Continued)
Summary of Existing Geotechnical Data**

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Testing on Bounding Shale Unit Sediments												
1981 Borings by Baker-Shifflett, Inc.												
B-1	10.0 - 11.0	42	18	24	82	24	-	-	-	-	2.5	-
B-1	15.0 - 16.5	-	-	-	-	20	108	3.80E-08	-	4.59	4.5+	-
B-2	4.5 - 5.5	-	-	-	-	-	-	2.70E-07	-	-	4.5	-
B-3	5.5 - 7.5	-	-	-	-	16	-	-	-	-	4	-
B-3	8.5 - 10.0	59	20	39	-	-	-	-	-	-	3	-
B-3	15.0 - 16.5	-	-	-	-	24	103	-	-	1.19	3.5	-
B-3	26.5 - 27.5	-	-	-	-	16	124	-	-	-	-	-
B-3	27.5 - 28.5	-	-	-	-	17	121	-	-	-	-	-
B-3	32.5 - 33.0	-	-	-	-	15	120	-	-	-	-	-
B-3	33.0 - 34.0	-	-	-	-	15	123	-	-	-	-	-
B-4	6.5 - 8.0	-	-	-	-	23	99	-	-	0.99	-	3
B-5	5.5 - 6.5	-	-	-	-	20	109	-	-	-	4.5+	-
B-5	9.0 - 10.5	-	-	-	-	25	-	5.90E-06	5.60E-08	-	3.5	-
B-5	15.0 - 15.5	57	20	37	-	-	-	-	-	-	4.5+	-
B-6	9.0 - 10.0	50	20	30	63	-	-	-	-	-	4.5+	-
B-7	4.0 - 5.5	50	13	37	-	-	-	-	-	-	2	-
B-7	8.0 - 9.0	-	-	-	-	-	-	-	-	-	-	4
B-8	20 - 21	-	-	-	-	-	-	7.30E-07	-	-	4.5+	-
B-9	5.0 - 5.75	-	-	-	-	-	-	4.50E-09	-	-	4.5+	-
B-9	8.0 - 9.0	-	-	-	-	15	116	-	-	1.54	4.5+	-
B-9	23.0 - 24.0	-	-	-	-	-	-	-	-	-	-	1
B-10	3.0 - 4.0	51	15	36	89	15	-	-	-	-	4.5	-
B-10	4.0 - 5.0	-	-	-	-	-	-	5.30E-08	-	-	4.5	-
B-10	15.0 - 15.5	-	-	-	-	15	123	-	-	-	4.5+	-
B-10	24.5 - 25.0	-	-	-	77	-	-	-	-	-	-	-

Table 3-1 (Continued)
Summary of Existing Geotechnical Data

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Testing on Bounding Shale Unit Sediments (Continued)												
1981 Borings by Baker-Shifflett, Inc. (Continued)												
B-11	2.0 - 3.0	38	15	23	61	18	-	-	-	-	4.5	-
B-11	6.0 - 7.0	-	-	-	-	23	106	-	-	0.83	-	-
B-11	10.0 - 11.0	-	-	-	-	-	-	-	-	-	-	3.5
B-12	5.0 - 5.5	31	14	17	74	20	-	-	-	-	4.5+	-
B-12	10.0 - 11.0	-	-	-	-	-	-	-	-	2.28	3.5	-
B-12	15.0 - 15.5	59	22	37	-	-	-	2.00E-07	-	-	4.5+	-
B-12	34.0 - 35.0	-	-	-	84	-	-	-	-	-	-	-
B-13	10.0 - 10.5	48	12	36	82	18	114	-	-	2.19	4.5+	-
B-13	15.0 - 15.5	-	-	-	-	21	116	-	-	5.39	4.5+	-
B-14	4.5 - 6.0	-	-	-	-	-	-	-	-	-	3.5	-
B-14	7.5 - 9.0	-	-	-	-	-	-	-	-	-	3	-
1986 Borings by Baker-Shifflett, Inc.												
B-16	29.0 - 30.0	-	-	-	-	-	-	-	-	-	-	50/2"
B-16	37.4 - 38.0	47	21	26	97	-	-	-	-	-	-	-
B-17	25.2 - 26.2	26	13	13	63	-	-	-	-	-	-	50/5"
B-18	20.0 - 21.5	35	17	18	82	-	-	-	-	-	4.5	25
B-18	37.3 - 38.0	45	19	26	99	-	-	-	-	-	-	-
B-19	26.3 - 26.8	38	18	2	99	-	-	-	-	-	-	-
B-20	30.0 - 31.0	45	19	26	98	-	-	-	-	-	-	-
B-21	47.0 - 47.5	33	14	19	-	-	-	-	-	-	-	-
B-23	17.0 - 18.5	48	19	29	-	-	-	-	-	-	-	-
B-24	10.5 - 11.5	-	-	-	93	-	-	-	-	-	4.5+	-
B-25	7.0 - 8.5	58	22	36	-	-	-	-	-	-	4.5+	-

**Table 3-1 (Continued)
Summary of Existing Geotechnical Data**

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Testing on Bounding Shale Unit Sediments (Continued)												
1988-1989 Borings by Baker-Shiflett, Inc.												
B-31	12.0 - 13.5	55	21	34	74	21	104	-	-	-	4.5	-
B-31	21.2 - 22.0	51	18	33	100	-	-	-	-	-	-	-
B-31	36.5 - 37.2	46	17	29	98	-	-	-	-	-	-	-
B-32	30.5 - 31.4	53	20	33	96	17	116	-	-	-	-	-
B-33	47.6 - 48.6	67	21	46	100	20	115	-	-	-	-	-
B-34	30.6 - 31.5	29	13	16	95	17	128	-	-	-	-	-
B-34	32.8 - 33.6	45	17	28	96	-	-	-	-	-	-	-
B-34	36.1 - 37.3	55	21	34	100	18	-	-	-	-	-	-
B-35	21.6 - 22.9	53	19	34	100	-	-	-	-	-	-	-
B-35	31.4 - 32.0	47	19	28	96	16	119	-	-	-	-	-
B-36	23.6 - 24.5	34	13	21	66	-	-	-	-	-	-	-
B-36	35.4 - 36.0	25	15	10	92	-	-	-	-	-	-	-
B-36	41.4 - 42.4	58	21	37	100	18	116	-	-	-	-	-
B-37	31.3 - 32.0	58	22	36	100	19	127	-	-	-	-	-
B-38	14.2 - 14.7	38	14	24	75	-	-	-	-	-	4.5	-
B-38	21.2 - 21.6	42	15	27	83	-	-	-	-	-	-	-
B-38	38.7 - 39.3	50	19	31	100	-	-	-	-	-	-	-
B-40	29.7 - 30.3	56	19	37	98	-	-	-	-	-	-	-
B-40	44.7 - 46.0	43	14	29	83	13	130	-	-	-	-	-
B-41	20.7 - 21.3	50	16	34	94	-	-	-	-	-	-	-
B-41	31.7 - 32.8	57	22	35	99	-	-	-	-	-	-	-
B-41	37.0 - 37.4	50	20	30	97	-	-	-	-	-	-	-
B-42	19.5 - 20.0	49	17	32	93	-	-	-	-	-	-	-
B-42	25.5 - 25.8	28	13	15	83	-	-	-	-	-	-	-
B-43	21.2 - 21.8	33	14	19	88	16	120	-	-	-	-	-
B-43	41.1 - 41.8	58	19	38	89	14	126	-	-	-	-	-
B-43	52.1 - 52.8	55	21	34	99	-	-	-	-	-	-	-

**Table 3-1 (Continued)
Summary of Existing Geotechnical Data**

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
1992-1993 Borings by EMCON Baker-Shiflett, Inc.												
MW-1C	11.0 - 12.0	34	14	20	38	18	-	-	-	-	-	-
MW-1C	12.5 - 13.5	46	19	27	16	19	-	-	-	-	-	-
MW-4B	27.5 - 28.5	54	22	32	1	-	-	-	-	-	-	-
MW-7	52.0 - 53.0	46	18	28	26	-	-	-	-	-	-	-
MW-7	67.5 - 68.5	38	15	23	4	-	-	-	-	-	-	-
MW-9	24.0 - 25.0	39	16	23	22	26	-	-	-	-	-	-
MW-9	31.0 - 32.0	46	18	28	6	25	-	-	-	-	-	-
MW-9	44.0 - 45.0	28	16	12	51	20	-	-	-	-	-	-
MW-9	56.0 - 57.0	-	-	-	5	16	-	-	-	-	-	-
MW-9	72.5 - 73.5	29	14	15	25	19	-	-	-	-	-	-
MW-10	19.0 - 20.0	39	14	25	2	-	-	-	-	-	-	-
MW-11	19.0 - 20.0	39	14	25	2	-	-	-	-	-	-	-
MW-11	45.0 - 46.0	-	-	-	20	-	-	-	-	-	-	-
MW-13	18.0 - 19.0	32	14	18	10	16	-	-	-	-	-	-
MW-13	27.0 - 28.0	58	23	35	1	19	-	-	-	-	-	-
MW-13	35.0 - 36.0	46	17	29	5	14	-	-	-	-	-	-
MW-13	41.0 - 42.0	-	-	-	16	13	-	-	-	-	-	-
MW-13	44.0 - 45.0	27	14	13	17	14	-	-	-	-	-	-
MW-14	17.5 - 18.5	34	15	19	4	-	-	-	-	-	-	-
MW-15	16.7 - 17.2	34	15	19	4	-	-	-	-	-	-	-
MW-15	53.5 - 54.5	46	18	28	26	-	-	-	-	-	-	-
MW-15	68.0 - 69.0	38	15	23	4	-	-	-	-	-	-	-
MW-16	12.0 - 13.0	59	20	39	3	18	-	-	-	-	-	-
MW-16	18.5 - 19.5	44	14	30	10	17	-	-	-	-	-	-

Table 3-1 (Continued)
Summary of Existing Geotechnical Data

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Testing on Bounding Shale Unit Sediments (Continued)												
2012 Borings by The Carel Corporation												
B9-1	11.0 - 12.0	59	24	35	0.6	-	116	-	1.40E-08	-	-	-
B9-2	12.0 - 13.0	58	23	35	0.1	-	109	-	5.70E-09	-	-	-
B10-1	58.5 - 60.0	41	15	26	29.6	-	116	-	7.80E-08	-	-	-
B10-1	65.0 - 66.0	57	21	36	7.9	-	117	-	1.90E-09	-	-	-
B10-2	50.0 - 52.0	33	15	18	3.4	-	115	-	3.00E-08	-	-	-
B11-1	55.0 - 57.0	61	22	39	0.4	-	117	-	1.10E-08	-	-	84
B11-1	65.0 - 66.0	56	23	33	4.4	-	117	-	2.20E-09	-	-	-
B12-1	35.0 - 36.0	61	21	40	0.2	-	110	-	7.90E-09	-	-	-
2021 Geotechnical Testing by ML Testing												
PWCG-01	25	43	18	25	92	16.3	109.2	-	-	2.87	-	-
PWCG-01	27.5	46	19	27	96	17.1	113.3	-	-	1.75	-	-
PWCG-09	50	38	17	21	98	12.0	130.9	-	-	3.8	-	-
PWCG-09	52.5	39	17	22	98	12.7	129.7	-	-	8.11	-	-
PWCG-010	80	56	20	36	99	15.5	-	-	1.20E-08	-	-	-
PWCG-06	38	55	20	35	100	20.7	-	-	1.90E-08	-	-	-
PWCG-07	36	66	21	45	100	16.5	-	-	-	-	-	-
PWCG-07	36	65	21	44	99	16.7	-	-	1.40E-08	-	-	-
PWCG-08	40	33	17	16	52	15.6	-	-	1.50E-08	-	-	-
PWCG-08	26	43	18	25	91	16.1	-	-	9.10E-08	-	-	-

**Table 3-1 (Continued)
Summary of Existing Geotechnical Data**

Boring Number	Depth (ft-bgs)	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Testing on Lower Sand Unit Sediments												
1988-1989 Borings by Baker-Shifflett, Inc.												
B-35	37.4 - 37.9	30	13	17	38	-	-	-	-	-	-	-
B-42	32.5 - 32.8	45	17	28	89	-	-	-	-	-	-	-
1991 Borings by Baker-Shifflett, Inc.												
B-36A	66.0 - 71.0	-	-	-	-	-	-	2.00E-05	-	-	-	-
B-42	30.0 - 40.0	-	-	-	-	-	-	2.00E-05	-	-	-	-
B-44A	57.0 - 62.0	-	-	-	-	-	-	1.00E-04	-	-	-	-
1992-1993 Borings by EMCON Baker-Shifflett, Inc.												
MW-4B	47.5 - 48.5	25	22	3	90	-	-	-	-	-	-	-
MW-4B	51.2 - 52.2	35	15	20	33	-	-	-	-	-	-	-
MW-5B	6.0 - 6.9	29	15	14	92	17	-	-	-	-	-	-
MW-9	68.5 - 69.5	-	-	-	83	26	-	-	-	-	-	-
MW-11	51.0 - 52.0	-	-	-	14	-	-	-	-	-	-	-
MW-13	38.0 - 39.0	-	-	-	52	13	-	-	-	-	-	-
MW-15	64.0 - 65.0	-	-	-	86	-	-	-	-	-	-	-
MW-16	21.0 - 22.0	-	-	-	87	21	-	-	-	-	-	-
MW-16	30.0 - 31.0	-	-	-	82	22	-	-	-	-	-	-

Table 3-1 (Continued)
Summary of Existing Geotechnical Data

Computation	LL	PL	PI	Passing #200 Sieve (%)	Moisture Content (%)	Dry Weight (pcf)	Horizontal Permeability (cm/s)	Vertical Permeability (cm/s)	Unconfined Compression (tsf)	Pocket Penetrometer Reading (tsf)	Penetration Blows/Ft
Summary of Upper Sand Unit Data											
Mean	42.3	17.3	25.0	56.2	16.5	107.9	-	-	-	3.8	>50
Minimum	20.0	11.0	3.0	4.0	6.0	97.0	-	-	-	2.0	1.0
Maximum	72.0	23.0	49.0	99.0	28.0	121.0	-	-	-	4.5	>50
Standard Deviation	14.7	3.7	12.5	27.4	5.6	8.2	-	-	-	0.9	>50
Number of Tests	43	43	43	72	25	9	0	0	0	31	8
Summary of Bounding Shale Unit Data											
Mean	44.7	17.5	27.1	41.2	17.5	116.4	1.5E-07	1.4E-08	2.4	3.8	>50
Minimum	25	12	10	1	12	99	4.5E-09	1.9E-09	0.8	2.0	1.0
Maximum	67	24	46	100	26	130.9	5.9E-06	9.1E-08	8.1	4.5	>50
Standard Deviation	10.5	3.1	8.1	37.6	3.3	7.8	2.0E-06	2.8E-08	2.1	0.8	>50
Number of Tests	85	85	85	76	54	35	7	14	12	16	8
Summary of Lower Sand Unit Data											
Mean	32.8	16.4	16.4	67.8	19.8	-	4.67E-05	-	-	-	-
Minimum	25.0	13.0	3.0	14.0	13.0	-	2.00E-05	-	-	-	-
Maximum	45.0	22.0	28.0	92.0	26.0	-	1.00E-04	-	-	-	-
Standard Deviation	7.7	3.4	9.1	28.1	5.0	-	4.62E-05	-	-	-	-
Number of Tests	5	5	5	11	5	0	3	0	0	0	0

**Table 3-2
Typical Soil Requirements for Landfill Construction**

Landfill Component	Soil Description	Classification	Test Parameters				Material Source
			LL	PI	% - 200	Coefficient of Permeability cm/s	
Soil Liner	clayey sand, sandy clay, or clay	SC, CL, CH	30 min	15 min	30 min	1x10 ⁻⁷ max	On site ¹
Final Cover Infiltration Layer	clayey sand, sandy clay, or clay	SC, CL, CH	30 min	15 min	30 min	1x10 ⁻⁵ max ²	On site
Liner Protective Cover	sand or sand with silt and clay	SP-SM, SP, SP-SC, SW, SM or SM-SC				1x10 ⁻⁴ min	On site ³
Final Cover Erosion Layer	clayey sand, sandy clay, or clay	SC, CL, SM	Suitable to support plant growth				On Site
Operational Cover ² (Daily Cover and Intermediate Cover)	sand, clayey sand, sandy clay, or clay	SP, SC, CL, CH	(2)	(2)	(2)	(2)	On Site
Earth Fill: Perimeter Berm, Subgrade Preparation, and Soil Barrier Layer for Class 1 Waste	clayey sand, sandy clay, or clay	SC, CL, CH	--	--	--	--	On Site

¹ If onsite materials meeting the required properties do not exist, an off-site material source can be used for liner soil.

² Refer to Section 4 for material requirements for the various final cover components.

³ If onsite material does not meet the hydraulic conductivity criteria, leachate collection chimney drains will be extended through the protective cover at selected locations and will be exposed adequately for transmission of leachate to the collection system.

4 CONSTRUCTION CONSIDERATIONS

4.1 General

This section contains recommendations for excavation of the landfill, and soil liner, leachate collection layer, overliner, and final cover materials and construction. Additionally, operational cover soils, final cover construction, and perimeter embankment construction related recommendations are included in this section.

The landfill currently has a permitted footprint of 219.6 acres and a waste disposal footprint of approximately 146.4 acres. The waste disposal footprint will be expanded to 172.0 acres for this permit amendment.

Sectors 1 through 10B have been completely constructed, and a portion of Sector 11 remaining unconstructed. The overliner shown in Sectors 1A and 1B also has not been constructed at the time of preparing this permit amendment application. The sectors comprising this expansion (Sectors 12, 13 and 14) also have not been constructed. Sectors 13 and 14 will be constructed in compliance with Subtitle D-compliant liners, and Sector 12 will be constructed with either a Subtitle D-compliant bottom liner, or a 3-foot thick compacted clay liner system suitable for disposal of Class 1 non-hazardous industrial waste.

The floor of the excavation of the landfill is generally founded in Stratum II bounding shale. Several The currently developed Subtitle D liners of the landfill do not include groundwater dewatering systems for temporary groundwater hydrostatic uplift pressure relief. Sector 11, 12, 13 and 14 will require temporary groundwater uplift control in the sideslopes of the excavation as presented in the 2019 permit amendment application, and as described in Appendix IIID-B and IIID-C of the Liner Quality Control Plan.

4.2 Landfill Excavation

The landfill base grades in the lateral expansion areas will be founded primarily in Stratum II Bounding Shale. The excavation for the liner construction will be performed in a manner that will achieve reasonable segregation of liner quality material from soils that are not suitable for a liner. Soil materials to be used for liner construction will be stockpiled separately, according to construction material properties outlined in Section 3 and visual observation during excavation.

Excavation of the soils encountered will be achieved with equipment such as excavators. Local areas of the hard shale or cemented sands may be encountered intermittently within the excavation and/or as the depth of excavation into Stratum II Bounding Shale. These zones can be broken up with an excavator equipped with a hydraulic hammer tool or ripped. The hydraulic hammer may be fitted with a pointed chisel or moil for the hard shale or a blunt tool for harder cemented material. Blasting of hard rock will not be required and will not be used at this site.

Excavation side slopes will be graded no steeper than 3 horizontal to 1 vertical (3H:1V). Excavation cut slopes within the future sector construction areas may require erosion protection if an extended period of time occurs between excavation and liner construction. Interim erosion protection can be accomplished by diverting runoff away from the slopes. "Track walking" with a bulldozer up and down the slopes will create the effect of "mini-dikes" with the bulldozer tracks, which will reduce erosion.

Prior to beginning construction of the liner components, the subgrade area will be stripped to a depth sufficient to remove all loose surface soils or soft zones within the exposed excavation. The liner base grades will be proof-rolled with heavy, rubber-tired construction equipment or equivalent to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted clay fill, as discussed in Section 2 of Appendix IIID – LQCP. Preparation of the liner base grades will result in a surface that is stable and that does not exhibit significant rutting from the construction traffic. The prepared liner base grades will be approved by a Professional of Record (POR), tested to verify that it meets the requirements outlined in Section 4.3, and surveyed to verify grades.

4.3 Soil Liner Construction

The bottom and sides of the landfill excavation consists of 2-foot-thick (MSW bottom of overliner areas) and 3-foot-thick (Class 1 waste areas) compacted soil liner. The clay liner will have a maximum hydraulic conductivity of 1×10^{-7} cm/s. Details for the liner system are provided in Appendix IIIA (Appendix IIIA-A). Adequate soil liner material will be available from proposed landfill excavations, onsite, or offsite borrow sources to provide material for the liner construction. Preconstruction laboratory tests may be performed to verify that a borrow source soil material is adequate to meet the compacted clay liner requirements listed in Title 30 TAC §330.339(c)(5) prior to using any soil borrow source as liner.

The overliner will be constructed with a soil liner or an alternative geosynthetic clay liner (GCL). Requirements for the GCL are set forth in Section 4 of Appendix IIID – Liner Quality Control Plan.

The soils used for liner and overliner construction will have the minimum soil property values listed in Table 4-1 that will be verified by preconstruction testing in

a soils laboratory. The following soil liner properties are included in Appendix IIID – LQCP.

**Table 4-1
Soil Liner and Overliner Properties**

Test	Specifications
Hydraulic Conductivity of Remolded Soils ¹	1.0x10 ⁻⁷ cm/s or less
Plasticity Index	15 minimum
Liquid Limit	30 minimum
Percent Passing No. 200 Mesh Sieve	30 minimum
Percent Passing 1-inch Sieve	100

¹ A hydraulic conductivity test will be performed on soil samples remolded per ASTM D 698 in accordance with Appendix IIID – LQCP.

Representative preliminary sampling will be performed on the materials that will be used for soil liner construction. Laboratory tests of samples recovered from soil borings as well as previous testing during liner construction indicate that soils which will achieve a coefficient of permeability of less than 1x10⁻⁷ cm/s are present at the site (refer to Table 3-1). Prior to construction of each new liner area, conformance tests that include liquid limit, plastic limit, percent passing the No. 200 sieve, Standard Proctor (ASTM D698) and remolded hydraulic conductivity tests will be performed for the soils used for liner. Additional conformance tests will be conducted if there are visual changes in the borrow material or the liquid limit or plasticity index vary by more than 10 points. The soil liner construction and testing procedures are outlined in Appendix IIID – LQCP.

4.4 Drainage Materials

The LCS drainage material will consist of a drainage geocomposite over the entire liner bottom and side slopes. Each sector will have a bottom slope toward an LCS trench (i.e., pipe enveloped in gravel and geotextile) that will collect leachate from the bottom and sideslopes. The leachate collection system details are illustrated in Appendix IIIA (Appendix IIIA-A). The material specifications and construction procedures for the LCS components are presented in Appendix IIID – LQCP. The LCS design and demonstrations are provided in Appendix IIIC – Leachate and Contaminated Water Management Plan.

4.5 Liner and Overliner Protective Cover

The liner protective cover is required to be a minimum of 24 inches thick for both liner and overliner. The purpose of the protective cover is to protect the geosynthetics (i.e., geomembrane and drainage geocomposite) from solid waste

placed over the liner system. To ensure passage of leachate into the leachate collection system, drainage passages (chimney drains) will be constructed through the protective cover. The chimney drains will be installed over the LCS collection pipes as shown in Appendix IIIA (Appendix IIIA-A). The protective cover will be placed with construction equipment in one lift such that it covers the leachate collection layer completely. The protective cover material will be free of solid waste and will not require compaction under the density-controlled construction procedures.

4.6 Operational Cover Soils

Operational cover soils include daily cover (placed over the waste each day), intermediate cover (placed over waste in areas that will not receive additional fill for at least 6 months), and the 4-foot-thick clay-rich barrier layer over Class 1 waste. All soils excavated at the site may be used for operational cover, including bounding shale that is broken down by equipment or weathering.

4.7 Composite Final Cover Construction

4.7.1 Final Cover Infiltration Layer Construction

The infiltration layer of the final cover system will be constructed with clayey material and will be a minimum of 18 inches thick. As specified in Appendix IIIJ – Closure Plan, for areas of the landfill with a synthetic bottom liner, the infiltration layer will consist of 18 inches of earthen material with a coefficient of permeability equal to or less than 1×10^{-5} cm/s overlain by a synthetic membrane. The infiltration layer thickness will be increased to 4 feet with a coefficient of permeability of less than or equal to 1×10^{-7} cm/s and will be placed on top of the outside slope of the Class 1 containment dike or soil cover system options up to the elevation of the top of the barrier layer. The purpose of this layer is to reduce infiltration of surface water into the fill. The final cover components material and construction requirements will be in accordance with Appendix IIIE – FCSQCP.

4.7.2 Final Cover Erosion Layer Construction

As shown in Appendix IIIA-A, the composite final cover system will include a 12-inch-thick erosion layer. The erosion layer will protect the infiltration layer and will support vegetative growth. The erosion layer may be spread and placed as a 12-inch thick lift (with soils that will support vegetation) or with two 6-inch-thick lifts (with the upper 6 inches capable of supporting vegetation) over the entire final cover area as the final cover is constructed. After spreading, each lift will be rolled lightly to reduce future erosion but not to the extent that compaction would inhibit plant growth. The top 6 inches of the erosion layer will consist of (1) topsoil stockpiled during the excavation process, (2) other on-site excavated soils amended

as necessary to be capable of sustaining vegetation, and/or (3) imported soil materials. Whether placed in a single lift or two lifts, the erosion layer (top of final cover) will sustain vegetative growth.

4.8 Perimeter Embankment Construction

Perimeter embankments (berms) previously were constructed at the landfill, and will be constructed at future Sectors (11 (partial), 12, 13, and 14) as required to prevent surface water flow from entering the landfill excavation. Constructed embankments will have side slopes no steeper than 3H:1V. A sufficient amount of soil is available from the landfill excavations to construct the perimeter embankment and other features that require stable soil fill material.

Containment dikes for Class 1 aerial fill areas, if used, will be constructed with clay-rich soils that are compacted to a minimum of 95 percent of maximum dry density as determined by Standard Proctor (ASTM D698) in accordance with Section 6.4.1 in Appendix IIIA. The Soil Cover System for Class 1 aerial fill areas, if used, will be constructed in accordance with Section 6.4.2 in Appendix IIIA.

Prior to beginning embankment fill, the subgrade area will be stripped to a depth sufficient to remove all topsoil and vegetation. Topsoil will be stockpiled for later use. The subgrade area will be proof-rolled with heavy, rubber-tired construction equipment to detect soft areas. Soft areas will be undercut to firm material and backfilled with suitable compacted clay fill. The subgrade preparation will result in a subgrade surface that is stable and does not exhibit significant rutting from construction equipment traffic.

The embankments will be constructed of onsite soils free of organic or other objectionable materials. The general fill placed below the composite liner (i.e., over excavated areas within the liner construction area) will be spread in maximum 8-inch-thick loose lift, placed horizontally and compacted to a minimum of 95 percent of the maximum dry density as determined by Standard Proctor testing with a moisture content at or above the optimum moisture content determined by the Standard Proctor testing. A minimum of one Standard Proctor test (ASTM D698) will be performed on each representative soil used as clay fill material. Each lift will receive a minimum of four passes with a heavy tamping roller unless adequate compaction can be demonstrated with fewer passes. Moisture-density field testing and full-time third party CQA monitoring during construction will be performed in accordance with Appendix IIID – LQCP. As necessary, the outside slope of all embankment construction will be vegetated to minimize erosion and desiccation.

4.9 Overliner System Construction

The overliner system consists of a 2-ft compacted clay liner (CCL), a 40-mil-thick LLDPE geomembrane textured on both sides, a drainage geocomposite, and a 24-inch-thick protective cover soil layer. The geomembrane will be placed over CCL. Alternatively, a GCL may be substituted for the 2-ft CCL. Requirements for the GCL are set forth in Section 4 of Appendix IIID – Liner Quality Control Plan.

The layout and detail drawings of the overliner system are presented in Appendix IIIA-A. Details of the overliner material and construction requirements are provided in Appendix IIID – LQCP.

4.10 General Earth Fill Construction

Earthen fill material may be required for subgrade preparation, embankments, haul roads, and other miscellaneous fill. Material availability, compactability, and long-term maintenance requirements will be considered when evaluating the excavated soils for use as earth fill. Most soils that will be excavated for landfill development are suitable for use as earth fill. General fill material placed below the composite liner (i.e., over-excavated areas within the liner construction area) will be placed in uniform loose lifts not exceeding 9 inches in thickness. General fill material for structural fill (e.g., perimeter berm construction and liner anchor trench backfill) will be placed in uniform loose lifts not exceeding 12 inches in thickness. General and structural fill will be compacted to at least 95 percent of Standard Proctor maximum dry density (ASTM D698) at a moisture content at or above the optimum moisture content when it is used for backfill below the soil liner.

4.11 Class 1 Liner Separation Layer

Title 30 TAC §335.584(b)(2) requires that the base of a containment structure be separated from the underlying Regional Aquifer by a minimum of 10 feet of material not exceeding 1×10^{-7} cm/s towards the aquifer. The Turkey Creek Landfill containment structures (bottom liner systems) are separated from the underlying Regional Aquifer by a thickness of approximately 70 feet, most with permeabilities less than 1×10^{-7} cm/sec, as discussed in Appendix G, Section 4.4.2 of this application. Therefore, this requirement does not affect the design and construction of containment structures (disposal cells) at the Turkey Creek Landfill.

Title 30 TAC §335.584(b)(1) requires that containment structures have a minimum of 5 feet of separation from sands and gravels, sandy or gravelly soils, or soils with a permeability greater than 1×10^{-5} cm/sec. This requirement is being met in areas the bottom liner excavations encounter the Upper Sand unit by the installation of a 5-foot-thick compacted clay separation layer between the base of the bottom liner system and the underlying Upper Sand unit. The 5-foot-thick separation layer will be

installed with a permeability of not greater than 1×10^{-5} cm/sec (refer to Section 3.2.1 of the LQCP in Appendix IIID for additional information).

5 SLOPE STABILITY ANALYSIS

5.1 General

This slope stability analysis has been developed to analyze excavation slopes, interim slopes, and landfill completion slopes using critical sections for each condition. The computer model SLIDE2 (RocScience, Inc., 2020) was used to analyze the stability of excavation slopes, interim fill slopes, and the final configuration of the site. SLIDE2 is an industry standard computer program developed by RocScience, Inc.

SLIDE2 is a two-dimensional slope stability program for evaluating the safety factor or probability of failure of circular and non-circular failure surfaces in soil or rock slopes. SLIDE2 analyzes the stability of slip surfaces using vertical slice or non-vertical slice limit equilibrium methods like Bishop, Janbu, Spencer, and Sarma, among others. Individual slip surfaces can be analyzed, or search methods can be applied to locate the critical slip surface for a given slope. SLIDE2 incorporates a windows-based interface that allows input of analysis sections and geological conditions from AutoCAD design drawings. The input file for the SLIDE2 program includes:

- Slope surface geometry.
- Subsurface information to identify different types of soil materials in horizontal and vertical directions so that each subsurface segment is identified with corresponding soil strength parameters.
- Groundwater information. The program is capable of modeling multiple groundwater surfaces that may be applicable to various subsurface soil components identified in the second bullet.
- Material strength information. Each soil section (horizontal or vertical) identified in the second bullet is assigned with strength parameters including cohesion and friction angle for both total and effective stresses.
- Model control and simulation user interface of the model that allows selection of the method of analysis (e.g., Simplified Bishop) and identifying simulation control parameters.

Automatic failure surface generation functions, that use either initiation/termination ranges of the failure surface or use search boxes to define failure

surface location, are used to locate the critical failure surface. The two methods employed for this slope stability analysis are described below.

1. Simplified Janbu Method – This method uses the method of slices to determine the stability of the mass above a failure surface.
2. Simplified Bishop Method – This method uses the method of slices to discretize the soil mass for determining the factor of safety.

In general, the stability of various critical sections were analyzed under static conditions for short-term (excavation and construction) and long-term (after construction) safety. The slope stability analyses are provided in Appendix IIIM-A. The stability of the various liner and final cover configurations with the geosynthetic components were also evaluated by using infinite slope stability analysis (refer to Appendix IIIM-A).

The stability analysis has been developed using demonstrations showing that, for each analyzed section, the forces resisting movement of the slopes are higher than the forces that potentially create movement. Therefore, the ratio of forces resisting movement to the forces potentially creating movement is defined as the factor of safety (FS). When the FS is equal to or greater than 1.0, it means that the slope is stable. In the slope stability analysis a factor of safety greater than 1.0 is desired. The FS value is increased for the increased uncertainty for the system analyzed. A factor of safety of 1.5 has been used for slopes that will stay in place long-term, including final cover configurations. A factor of safety of 1.3 is acceptable for total stress conditions that will be applicable for short periods of time, including interim and excavation slopes. A factor of safety of 1.0 is acceptable for residual or large deformation strength conditions (typical of Rankine-Block analyses).

5.2 Sections Selected for Analysis

Slope stability analyses were performed on critical sections to evaluate the stability of the excavation, interim fill, overliner, and final cover configuration slopes. The geometries of the slopes analyzed were determined by reviewing the proposed excavation plan and final contour plan. The evaluation locations were selected to analyze critical slopes consisting of profiles that include the landfill configuration as well as natural materials at the toe and below the landfill excavation. The interim fill slope was analyzed using an assumed profile as discussed in Section 4.3. Figures showing the location of the cross sections are included in Appendix IIIM-A (refer to Appendix IIIM-A-1 for the excavation slope stability, Appendix IIIM-A-2 for the interim conditions, and Appendix IIIM-A-3 for overliner and final landfill slope stability analyses).

5.3 Configurations Analyzed

The excavation, interim, overliner, and final landfill configurations were modeled to represent critical slope conditions, and the analysis was performed using circular and block failure surfaces. The maximum final fill and overliner slopes will be 3:5H:1V, while interim slopes, liner slopes, and excavation slopes will be as steep as 3H:1V. The excavation, liner, and interim fill slopes were analyzed with a slope angle of 3H:1V and a 3.5:1V final side slope was used to evaluate final cover and overliner. A copy of the top of liner plan and final completion plan showing the locations of the cross sections selected for analysis are included in Appendix IIIM-A. Additionally, the configurations analyzed are graphically illustrated in Appendix IIIM-A. The interim condition was analyzed considering a 3H:1V slope with a horizontal length of approximately 600 feet (200 feet vertically). If the horizontal length of actual interim slopes longer than 600 feet is developed during site operations, an additional analysis will be completed at that time and maintained in the Site Operating Record.

5.4 Input Parameters

The cross sections for slope stability analysis were developed from the proposed excavation plan and the landfill completion plan (see Figures included in Appendix IIIM-A). The soil parameters were selected based on a review of the boring logs and laboratory test results from the subsurface investigation studies at the site and upon engineering judgment and experience with similar materials. The groundwater surface indicated in the analysis is obtained from Appendix IIIG - Geology Report. For global analysis of the foundation bounded shale, a groundwater level approximately 10 feet below the top of the excavation grade was assumed. For analysis of the exterior berm or slope (excavation slope analysis) a perched groundwater level above the sector excavation grade was assumed (as representative of groundwater in the upper sand unit, exposed on the excavation sideslopes), and represents the highest measured groundwater levels. Table 5-1 summarizes the unit weights and strength parameters used for the stability analyses for the evaluated landfill slopes (excavation, interim, overliner, and final cover slopes).

**Table 5-1
Summary of Material Weight and Strength Parameters Used in the Slope Stability Analysis**

Strength Parameters					Comments
Final Cover System					<p>The final cover system includes the erosion layer, drainage geocomposite (single-sided on top slopes and double-sided on 4H:1V sideslopes), geomembrane liner (smooth on topslopes and textured on 4H:1V sideslopes), and compacted clay infiltration layer. An infinite stability analysis was performed to establish the minimum interface strength requirements for each layer of the final cover system. The minimum interface strength requirements specified are used for the stability analysis in Appendix IIIM-A.</p> <p>For the rotational global stability analysis, the final cover system is modeled as a single layer and the strength parameters represent the compacted clay infiltration layer and the erosion layer. The two geosynthetic layers (i.e., geomembrane and geocomposite) are not included in the global analysis because they provide a negligible contribution to the forces that are resisting movement. The strength values selected for the final cover system represent strength values typically used in the industry and these same strength values have been used in various permit applications approved by TCEQ. The global stability analysis for rotational failure analysis uses the soil material strength parameters (i.e., cohesion of 100 lb/ft² and a friction angle of 16 degrees). The global stability analysis is included in Appendix IIIM-A-3.</p> <p>The interface slope stability analysis for the final cover system was performed using an infinite slope stability analysis procedure by Duncan, Buchianani, and De Wet. The purpose of this analysis was to show that the final cover components that are placed on top of each other, such as a geomembrane and compacted clay layer (or geomembrane and geocomposite), will not experience sliding failure due to the lack of strength between these components. The interface strength parameters shown are based on compacted clay internal on the sideslope and smooth geomembrane and compacted clay on the top deck. The interface strength parameters were developed from Geosynthetic Research Institute (GRI) publications (e.g., "Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces" by George R. Koerner, GRI, Folsom, PA, June 14, 2005). Although the strength parameters (i.e., adhesion and interface friction) used for the application were selected based on published data, it should be noted that these strength parameters will also be tested and verified at the time of each final cover construction event to ensure that the as-built strength parameters meet or exceed the strength parameters used for the design (as discussed in Appendix IIIM-A). As noted in Appendix IIIM-A, the strength parameters listed are for the weakest interface (or internal) to provide for a conservative design.</p>
Soil Material Strength Parameters			Interface Strength Parameters		
Cohesion (lb/ft²)	Friction Angle (degrees)	Unit Weight (lb/ft³)	Adhesion (lb/ft²)	Friction Angle (degrees)	
100	16	116	Topslope 100 4H:1V Sideslope 100	13 16	
Solid Waste					<p>As noted in Appendix IIIM-A, the strength parameters for solid waste were based on information contained in the following references: Pagotto and Rimoldi (1987), Landva and Clark (1990), and Richardson and Reynolds (1991). These sources list cohesion and friction angle values that range from 210 lb/ft² to 605 lb/ft² and 18° (for residual strength or large displacement for direct shear test which requires a factor of safety of 1) to 43°, respectively. Refer to Appendix IIIM-A-1 for more information. The selected strength values are consistent with numerous analysis and permit amendment applications in Texas. The unit weight of waste used for stability analyses is also consistent with numerous analyses and permit amendment applications in Texas.</p>
Material Strength Parameters			Interface Strength Parameters		
Cohesion (lb/ft²)	Friction Angle (degrees)	Unit Weight (lb/ft³)	Adhesion (lb/ft²)	Friction Angle (degrees)	
For $\phi_p < 625$ psf C = 500 psf For $\phi_p > 625$ psf C = 0	0 33	65	Interface strength parameters are not applicable to the solid waste layer because the interface between the waste and final cover and overliner systems is not a critical interface.		
Overliner					<p>The overliner system includes a 2-ft CCL, geomembrane liner (textured on all slopes), drainage geocomposite (double-sided), and 2-foot-thick protective cover layer. Similar to the final cover system discussed above, the overliner system is modeled as a single layer for the global stability analysis (i.e., 2-ft clay liner and 2-ft protective cover were not considered separately). In addition, both a translational (using Simplified Janbu and Rankine Blocks) and an infinite stability analysis were performed to establish the minimum interface strength requirements for each layer of the overliner system. The minimum interface strength requirements are specified in Appendix IIID.</p> <p>For the rotational global stability analysis, the overliner system is modeled as a single layer and the strength parameters represent the protective cover layer (for this analysis the material strength parameters are used). The two geosynthetic layers are not included in the global analysis because they provide a negligible contribution to the forces that are resisting movement. The strength values selected for the overliner system represent strength values typically used in the industry for liner systems (see liner system discussion below). The unit weight of the overliner system is consistent with that selected for the liner system and is based on experience with liner system construction. The global stability analysis is included in Appendix IIIM-A-2 (interim condition) and IIIM-A-3 (final landfill conditions).</p> <p>The interface slope stability analysis, which is performed using an infinite slope stability analysis procedure by Duncan, Buchianani, and De Wet for the overliner system, was developed to show that overliner components that are placed on top of each other, such as the geomembrane and geocomposite, will not experience sliding failure due to the lack of strength between these components. The interface strength parameters were developed using materials from Geosynthetic Research Institute (GRI) publications (e.g., "Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces" by George R. Koerner, GRI, Folsom, PA, June 14, 2005). Although the strength parameters (i.e., adhesion and interface friction) used for the application were selected based on published data, it should be noted that these strength parameters will also be tested and verified at the time of each overliner construction event to ensure that the as-built strength parameters meet or exceed the strength parameters used for the design (refer to Appendix IIID). As noted in Appendix IIID, Table 6-1, the strength parameters listed are for the weakest interface to provide for a conservative design.</p> <p>The translational slope stability analysis was performed using Simplified Janbu Method using Rankine Blocks. This analysis is similar to the interface slope stability analysis discussed above. The purpose of this analysis is to test the critical interfaces under a variety of loading conditions (refer to Appendix IIIM-A-3 for more information – i.e., the loading conditions reflect different landfill configurations). However, for the translational analysis the overliner system strength parameters are modified to reflect the strength parameters (adhesion and friction angle) for the interfaces with the lowest strength parameters (i.e., textured geomembrane and GCL interface on both sideslopes and the top slopes). As noted above, these strength parameters will also be tested and verified at the time of each overliner construction event to ensure that the as-built strength parameters meet or exceed the strength parameters used for the design.</p>
Material Strength Parameters			Interface Strength Parameters		
Cohesion (lb/ft²)	Friction Angle (degrees)	Unit Weight (lb/ft³)	Adhesion (lb/ft²)	Friction Angle (degrees)	
100	18	120	100	18	

Table 5-1 (Continued)
Summary of Material Weight and Strength Parameters Used in the Slope Stability Analysis

Strength Parameters					Comments
Liner System					<p>The liner system includes a 2-foot-thick compacted clay (compacted clay is 3 feet thick for the Class 1 liner) layer, 60-mil geomembrane (smooth geomembrane on the floor of the landfill and textured on the 3H:1V sideslopes), drainage geocomposite (single-sided on floor grades and double-sided on 3H:1V sideslopes), and a 2-foot-thick protective cover soil layer. This system is modeled as two layers for the global stability analysis: the 3-foot-thick compacted clay liner and the soil protective cover. In addition, both a translational and an infinite stability analysis were performed to establish the minimum interface strength requirements for each layer of the liner system. The minimum interface strength requirements are specified in Appendix IIID.</p> <p>For the rotational global stability analysis, the liner system is modeled as two layers: the compacted clay liner and the soil protective cover layer. The two geosynthetic layers are not included in the global analysis because they provide a negligible contribution to the forces that are resisting movement. The strength values selected for the liner system represent strength values typically used in the industry and these same strength values have been used in various permit applications approved by TCEQ. Duncan and Wright (2005) provides a comprehensive discussion regarding strength parameters for a liner system. In Chapter 5 – Shear Strengths of Soil and Municipal Solid Waste, a significant amount of data are presented and evaluated for compacted clay liners. The results indicate that the lowest cohesion value for compacted cohesive soils is 9 kPa (187 lb/ft²) and the lowest reported friction angle value is 19 degrees. Therefore, selected values of 100 lb/ft² for cohesion and 18 degrees of friction angle conservatively represent the liner system. Soil properties used in the slope stability analysis are subject to verification at the time of each liner construction. Section 2.4.3 in Appendix IIID – LQCP includes the material strength tests required for soil used for liner construction. Protective cover and compacted clay liner soil unit weight values are based on experience with liner system construction. The global stability analysis is included in Appendices IIIM-A-1 and IIIM-A-3.</p> <p>The interface slope stability analysis, which is performed using an infinite slope stability analysis procedure by Duncan, Buchianani, and De Wet for the liner system, was developed to show that certain landfill components that are placed on top of each other, such as a geomembrane and compacted clay layer will not experience sliding failure due to the lack of strength between these components. The interface strength values presented in this table represent compacted clay liner internal on the sideslopes, and smooth geomembrane and compacted clay liner interface on floor grades. These strength values represent the interfaces with the lowest strength at the floor and sideslopes (refer to Appendix IIIM-A-4 for the complete evaluation of interfaces that will occur for the liner system 3H:1V sideslope and the bottom liner interface strength value is obtained from the document referenced in this paragraph). The strength parameters were developed using materials from Geosynthetic Research Institute (GRI) publications (e.g., “Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces” by George R. Koerner, GRI, Folsom, PA, June 14, 2005). Although the strength parameters (i.e., adhesion and interface friction) used for the application were selected based on published data, it should be noted that these strength parameters will also be tested and verified at the time of each liner construction event to ensure that the as-built strength parameters meet or exceed the strength parameters used for the design (refer to Appendix IIID).</p> <p>The translational slope stability analysis was performed using simplified Janbu Method using the Rankine Blocks. This analysis is similar to the interface slope stability analysis discussed above. The purpose of this analysis is to test the critical interfaces under a variety of loading conditions (refer to Appendices IIIM-A-1, IIIM-A-2, and IIIM-A-3 for more information – i.e., the loading conditions reflect different landfill configurations). SLIDE2 is also used for this analysis. However, for the translational analysis, the liner system strength parameters are modified to reflect the interface strength parameters. The translational stability analysis uses modified liner system strength parameters to reflect the interface strength parameters. As noted above, these strength parameters will also be tested and verified at the time of each liner construction event to ensure that the as-built strength parameters meet or exceed the strength parameters used for the design.</p>
Material Strength Parameters			Interface Strength Parameters		
Cohesion (lb/ft ²)	Friction Angle (degrees)	Unit Weight (lb/ft ³)	Adhesion (lb/ft ²)	Friction Angle (degrees)	
Protective Cover		120	Floor Grades (Modeled as Liner)	0	22
Effective Stress	100				
Friction Angle	18				
Liner System		120	3H:1V Sideslope	100	18
Effective Stress	100				
Friction Angle	18				
Residual Stress	80				
Friction Angle	10				

¹ Liners on the sideslopes and floor grades are listed separately due to different strength characteristics for clay/smooth geomembrane and clay/textured geomembrane interfaces. The overliner was modeled with clay/textured geomembrane interface for sideslope and top deck areas.

Table 5-1 (Continued)
Summary of Material Weight and Strength Parameters Used in the Slope Stability Analysis

Strength Parameters					Comments
Stratum I / Upper Sand (Sand, Silty Sand and Clayey Sand)					The uppermost stratum (i.e., Stratum I, referred to as the Upper Sand) consists of sand, silty sand and clayey sand discussed in Section 3.2.1. Throughout the history of the landfill development, Stratum I has been excavated to establish landfill excavation side slopes successfully for several liner construction events. As supported by the strength test results and the historical excavation events, Stratum I will be stable during the future liner construction events.
Material Strength Parameters			Interface Strength Parameters		
Cohesion (lb/ft ²)	Friction Angle (degrees)	Unit Weight (lb/ft ³)	Adhesion (lb/ft ²)	Friction Angle (degrees)	
Effective 1000 Total 2500	Effective 39.1 Total 0	125.9 129.7 (SAT)	Interface strength parameters are not applicable to the Upper Sand layer because the interface between the waste and final cover and overliner systems is not a critical interface.		
Stratum II / Bounding Shale (Shale, Interbedded Lower Sands)					
Material Strength Parameters			Interface Strength Parameters		
Cohesion (lb/ft ²)	Friction Angle (degrees)	Unit Weight (lb/ft ³)	Adhesion (lb/ft ²)	Friction Angle (degrees)	
Effective 1000 Total 4100	Effective 38.6 Total 0	133.0 135.0 (SAT)	Interface strength parameters are not applicable to the Bounding Shale layer because the interface between the waste and final cover and overliner systems is not a critical interface.		

¹ Liners on the sideslopes and floor grades are listed separately due to different strength characteristics for clay/smooth geomembrane and clay/textured geomembrane interfaces. The overliner was modeled with clay/textured geomembrane interface for sideslope and top deck areas.

5.5 Results of Stability Analysis

5.5.1 Stability Analysis Using SLIDE2

The results of the stability analyses using SLIDE2 computer program indicate that the proposed excavation, liner, interim, overliner, and final configuration slopes are stable under the conditions analyzed. Table 5-2 summarizes the results of the stability analyses for the landfill slopes and compares the calculated factor of safety to the recommended minimum factor of safety. The recommended minimum factors of safety for the conditions analyzed were determined using recommendations from the Corps of Engineers "Design and Construction of Levees" manual (EM 1110-2-1913) and the EPA's "Technical Guidance Manual for Design of Solid Waste Disposal Facilities," as 1.3 for short-term slope stability (excavation slopes) and 1.5 for long-term slope stability (interim and final cover slopes).

**Table 5-2
Summary of Slope Stability Analyses
for the Excavation Configuration**

Analyzed Section-Run	Failure Type	Minimum Factor of Safety Generated ¹		Factor of Safety Acceptable
		Effective Stress	Total Stress	
		1.5	1.3 ³	
Excavation Slope A-1	Bishop-Circular	1.78	1.78	YES
Excavation Slope A-2	Rankine-Block	5.70 (peak) ²	4.45 (residual) ^{3,4}	YES

¹ Recommended Minimum Factor of Safety for long-term stability analysis using effective stress is 1.5 and short-term stability analysis using total stress is 1.3. Rankine Block analysis uses interface strength values where applicable and if the interface strength values are lower than internal strength values of adjoining landfill components.

² Peak stress for Rankine-Block.

³ Residual stress for Rankine-Block.

⁴ An acceptable Factor of Safety for residual stress is 1.0.

**Table 5-3
Summary of Slope Stability Analysis for
Interim Cover Slopes**

Slope Designation	Method of Analysis	Minimum Factor of Safety Generated ¹		Factor of Safety Acceptable	
		Effective Stress	Total Stress	Effective	Total
		1.5	1.3		
Interim Fill Slope B-1	Bishop-Circular	1.97	1.97	YES	YES
Interim Fill Slope B-2	Rankine-Block	1.72 (peak) ²	1.28 (residual) ^{3,4}	YES	YES

¹ Long-term factor of safety for temporary slopes is 1.5.

² Peak stress for Rankine-Block.

³ Residual stress for Rankine-Block.

⁴ An acceptable Factor of Safety for residual stress is 1.0.

**Table 5-4
Summary of Slope Stability Analysis
for the Final Landfill Configuration**

Slope Designation	Method of Analysis	Minimum Factor of Safety Generated ^{1,2}		Acceptable Factor of Safety	
		Effective Stress	Total Stress	Effective	Total
Overliner Slope C-1	Bishop-Circular	1.88	1.55	YES	YES
Overliner Slope C-2	Rankine-Block ³	1.55 (peak)	1.06 (residual)	YES	YES
Final Cover Slope D-1 ⁴	Bishop-Circular	2.05	1.51	YES	YES
Final Cover Slope D-2 ⁴	Rankine-Block	1.56 (peak)	1.25 (residual)	YES	YES
Final Cover Slope E-1	Bishop-Circular	2.57	1.77	YES	YES
Final Cover Slope E-2	Rankine-Block	2.12 (peak)	1.53 (residual)	YES	YES

¹ Recommended Minimum Factor of Safety for long-term stability analysis using effective stress is 1.5 and short-term stability analysis using total stress is 1.3.

² Recommended Minimum Factor of Safety for stability analysis using peak stress is 1.5 and residual stress is 1.0.

³ Rankine Block analysis uses interface strength values where applicable.

⁴ Section D-1 and D-2 were analyzed for smooth geomembrane. The remainder of analyses used textured geomembrane.

Computer-generated slope stability analysis output is included in Appendix IIIM-A. The minimum calculated factor of safety for the closed condition is 1.51, which is greater than the recommended minimum factor of safety of 1.5 for long-term slope stability.

5.5.2 Infinite Slope Stability Analysis

Infinite slope stability analysis for the liner and final cover systems has been included in this design in addition to block method analysis discussed in the previous section. The infinite liner and overliner stability analyses address anchor trench design, stability of cover and drainage material on anchored geosynthetics, and shear forces within the liner system. The infinite final cover slope stability analysis addresses the shear forces within the final cover system. These calculations are presented in Appendix IIIM-A-4. As demonstrated in Appendix IIIM-A-4, the liner and cover systems are structurally stable using the strength parameters shown, which will be verified during each construction event. Prior to each construction event for liner, overliner, and final cover, the POR will perform interface strength testing using the actual material that will be used for each construction event.

5.5.3 Overliner and Bottom Liner Interface Shear Strength Conformance Testing

Prior to each construction event, conformance testing will be required for the specific geosynthetic and soil liner components to be incorporated into the project. The required interface shear strength conformance testing requirements (for both bottom liner and overliner conditions) have been established for the project based on stability analyses performed for the expansion. The description of the interface shear strength conformance testing requirements and supporting stability analyses is presented in Appendix IIIM-A-5. As discussed in the appendix, the conformance testing requirements are applicable to both laboratory stack testing and single interface testing results and will be incorporated into the Geosynthetic Liner Evaluation Report (GLER) prepared for the respective construction event.

6 SETTLEMENT, STRAIN, AND HEAVE ANALYSIS

6.1 General

The purpose of the settlement and heave analysis is to demonstrate that the liner and overliner system will not be adversely impacted by foundation settlement and settlement of waste below the overliner. The settlement analysis also addresses the settlement of the final cover system to demonstrate that the proposed final cover is designed to withstand the potential strain induced by waste settlement.

Settlement of the liner system will occur due to consolidation of the foundation materials from the weight of the landfill components (i.e., protective cover, solid waste and daily cover, and final cover systems). Laboratory consolidation tests indicate that the foundation soils have low compressibility. Settlement of the overliner system occurs due to consolidation of the waste below the overliner and foundation soils as a result of the weight of the landfill components above the overliner. Settlement of the final cover system will occur due to consolidation of foundation soils and consolidation within the solid waste. Total consolidation of final cover consists of primary and secondary consolidation of deposited waste. Appendix IIIM-B includes details for the foundation heave and settlement as well as overliner and final cover settlement analyses.

6.2 Foundation/Bottom Liner Settlement and Strain

The Foundation/Bottom Liner Settlement Analysis is presented in Appendix IIIM-B-1. Foundation settlement potential has been assessed using estimates of consolidation properties for Stratum II, the primary formation underlying the constructed cells.

Settlement calculations were performed using SETTLE3, a computer-based model developed by RocScience, Inc. (2021). Input parameters include surfaces representing the subsurface strata, vertical loads representing the waste placed in the cell, and the settlement characteristics of the subsurface strata (from laboratory consolidation testing). The SETTLE3 model creates an isopach of the settlement of the bottom liner system, which then can be used to calculate strain within the bottom liner components.

The analysis is performed by creating a horizontal plane within the SETTLE3 program, with subsurface data input from available boring logs that has been normalized to the excavation grades (i.e., grades below the bottom liner system)

designed for the landfill. Thus, the horizontal plane within the model represents the soil conditions beneath the excavation grade contours. Vertical fill loads are then calculated by subtracting the final landfill elevation from the excavation grades, and then multiplying the fill height by the unit weight assumed at each fill point. Unit weight values are adjusted based on the total waste thickness, and assume that deeper waste fill heights result in higher waste densities.

For the analysis, a conservative approach of assuming pre-consolidation pressures as equal to the overburden stress was used. This is a conservative approach, in that it results in greater settlement at each analysis point when compared to analyses performed using an assumed or calculated higher pre-consolidation stress value. The results of the analyses are presented in Appendix IIIM-B. As demonstrated in Appendix IIIM-B, even with this more conservative approach the settlement at the site is negligible and will not adversely affect the performance of the leachate collection system and will not result in detrimental strain on the liner system components.

6.3 Final Cover Settlement and Strain

The Final Cover Settlement Analysis is presented in Appendix IIIM-B-2. Landfill final cover settlement occurs due to settlement of foundation soils and the settlement of waste materials. In general, foundation settlement is insignificant in comparison to the settlement of deposited waste. Waste settlement consists of primary and secondary settlement.

Settlement of solid waste generally begins rapidly as the waste load is placed and continues to occur for long periods of time after the initial placement. Initially, municipal solid waste will undergo primary settlement due to its own weight, final cover, equipment, etc. Primary settlement occurs quickly, generally within the first month after loading. Therefore, the weight of the final cover system is the only remaining factor that contributes to primary consolidation. By the time the construction of the final cover is complete, settlement of the waste due to the weight of the final cover will be complete.

Secondary settlement continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physico-chemical reaction, and bio-chemical decay.

A strain analysis has been incorporated into the final cover settlement analysis presented in Appendix IIIM-B-2. The purpose of the settlement and strain analysis is to demonstrate that the final cover system will be stable as designed and maintain positive drainage. If it is considered that the waste settlement is uniform, then the sideslopes are expected to maintain positive drainage. Based on the estimates of settlement for the maximum waste thickness (where maximum waste settlement is expected to occur on the top deck of the landfill) and minimum waste thickness (where minimum settlement is expected to occur on the top deck of the landfill), the

landfill final cover will be subject to a (compressive) strain of -0.41 percent. That is less than the allowable strain for the final cover soil infiltration layer. A strain demonstration in Appendix IIIM-B-2 shows that the top deck areas of the final cover will be stable and maintain positive drainage after settlement.

6.4 Overliner Settlement

The Overliner Settlement Analysis is presented in Appendix IIIM-B-3. Overliner settlement occurs as foundation materials and underlying in-place solid waste consolidate due to the additional weight of the landfill. In general, foundation settlement is insignificant in comparison to the settlement of underlying in-place solid waste, and therefore the analysis was limited to settlement occurring within the waste. Waste settlement consists of primary and secondary settlement.

Settlement of solid waste generally begins rapidly as the waste load is placed and continues to occur for long periods of time after the initial placement. Initially, municipal solid waste will undergo primary settlement due to its own weight, final cover, equipment, etc. Primary settlement occurs quickly, generally within the first month after loading. Therefore, the weight of the final cover system is the only remaining factor that contributes to primary consolidation. By the time the construction of the final cover is complete, settlement of the waste due to the weight of the final cover will be complete. Secondary settlement continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physico-chemical reaction, and biochemical decay. Settlement analysis for the overliner system is presented in Appendix IIIM-B-3.

The purpose of the overliner system settlement analysis is to (1) show that positive drainage is maintained for the overliner system consistent with the demonstration included in Appendix IIIC and (2) to verify that the strain induced on the overliner system components due to differential settlement is within acceptable limits. The post-settlement slopes of the overliner system were used to demonstrate that the overliner leachate collection system will maintain the depth of leachate to within the thickness of the leachate collection layer.

A strain analysis has been incorporated into the overliner settlement analysis presented in Appendix IIIM-B-3. The purpose of the settlement and strain analysis is to demonstrate that the overliner system will be stable as designed and maintain positive drainage. A strain demonstration in Appendix IIIM-B-3 shows that the maximum calculated strain is significantly lower than the allowable strain for the overliner system components. The areas of the overliner and overliner leachate drain pipes will be stable and maintain positive drainage after settlement. Based on the foregoing discussion, it is concluded that settlement will not adversely affect the overliner system, and the overliner system will perform as designed.

6.5 Foundation Heave

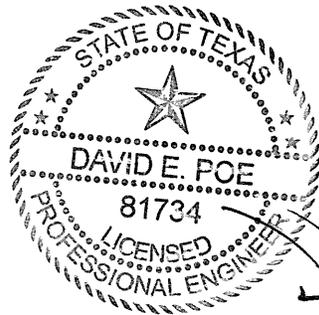
The foundation heave analysis is presented in Appendix IIIM-B-4. Potential heave (rebound) due to excavation of overburden above the excavation base was estimated using the standard consolidation theory for soils and the recompression index obtained from the rebound portion of the consolidation tests. In order to estimate potential for heave, the load is decreased, instead of increasing the load on the soils, to correspond with the projected weight of excavated soil. Using a maximum excavation depth of approximately 21.2 feet (existing ground elevation minus bottom of excavation at a given location), a heave of approximately 15 inches was calculated. The depth of floor grade excavation for each individual sector (liner area draining to an LCS sump) is generally uniform (i.e., depth of soil to be removed from the floor grades does not change drastically within a given sector). Where the excavation depth is less, heave will also be less and therefore negligible. These calculations are included in Appendix IIIM-B-4. Heave will occur soon after excavation (before and during liner construction) and will not adversely affect the performance of the liner system.

7 CONCLUSIONS AND RECOMMENDATIONS

This geotechnical analysis has been developed using (1) various geotechnical data obtained from field and laboratory testing performed on the soil samples recovered at the site; (2) general soil stratigraphy of the project area; and (3) known geotechnical characteristics of the founding geological formation, of solid waste, of geosynthetic materials commonly used for landfill development, and of soils used for various components of landfills. It is concluded, based on this geotechnical analysis, that the proposed landfill and its components (e.g., leachate collection system, liner systems, cover systems, excavation and interim fill slopes) will be geotechnically stable and will function as designed. The following summarizes various findings of the geotechnical analysis.

- Geotechnical engineering tests were performed in accordance with industry practice and recognized procedures (e.g., ASTM standards).
- Stability of the proposed landfill excavation slopes, constructed liner slopes, interim fill slopes, overliner slopes, and the final cover are acceptable as designed (see Appendix IIIM-A).
- Stability of the liner, overliner, and final cover system components is acceptable as designed (see Appendix IIIM-A).
- Foundation settlement after filling is expected to be negligible and within the strain limits of the liner system (refer to Appendix IIIM-B).
- Settlement of the final cover system will not adversely affect the final cover system, and the final cover system will function as designed (refer to Appendix IIIM-B).
- Settlement of the overliner system will not adversely affect the overliner system, and the overliner system will perform as designed (i.e., maintain positive drainage to the LCS sumps).
- Foundation heave during excavation is expected to be negligible and is within the strain limits of the liner system (refer to Appendix IIIM-B). Settlement of the liner system will not adversely affect the liner system, and the liner system will perform as designed (i.e., maintain positive drainage to the LCS sumps).

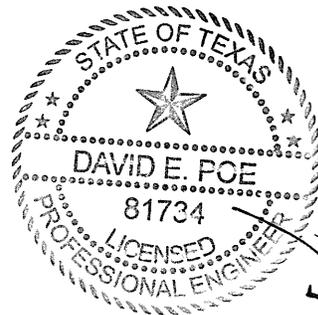
APPENDIX IIIM-A
SLOPE STABILITY ANALYSIS



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CONTENTS

INTRODUCTION	IIIM-A-1
APPENDIX IIIM-A-1 Landfill Excavation Configuration Stability Analysis	
APPENDIX IIIM-A-2 Interim Landfill Configuration Stability Analysis	
APPENDIX IIIM-A-3 Overliner and Final Landfill Configuration Stability Analysis	
APPENDIX IIIM-A-4 Infinite Slope Stability Analysis	
APPENDIX IIIM-A-5 Interface Shear Strength Conformance Testing Requirements	



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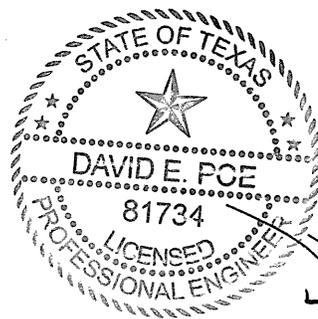
INTRODUCTION

This appendix includes the slope stability analysis for the landfill slopes during various phases of the site development and the final landfill configuration. General slope stability for the excavation and interim and closed conditions were evaluated by using the SLIDE2 computer program, as developed by RocScience, Inc. (2020). The Simplified Bishop method was used for circular failure surfaces, and the Simplified Janbu method using Rankine Block was used for the translational (block) slope stability analysis. Infinite slope stability has also been analyzed for the liner and final cover system. Soil profiles analyzed for each configuration for the slope stability analysis are provided in the sub-appendices, along with SLIDE2 computer output files as applicable. The stability analysis for the site is provided in the following four appendices.

- Appendix IIIM-A-1 includes the slope stability analysis for the excavated landfill condition.
- Appendix IIIM-A-2 includes the slope stability analysis for the interim slope landfill condition.
- Appendix IIIM-A-3 includes the slope stability analysis of the final cover overliner configuration.
- Appendix IIIM-A-4 includes the infinite slope stability evaluation.
- Appendix IIIM-A-5 includes the interface shear strength conformance testing requirements (for use during future cell overliner and bottom liner designs and construction).

APPENDIX IIIM-A-1
LANDFILL EXCAVATION CONFIGURATION
STABILITY ANALYSIS

Includes pages IIIM-A-1-1 through IIIM-A-1-28



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EXCAVATION CONFIGURATION SLOPE STABILITY ANALYSIS

Required: Evaluate the slope stability of the proposed excavation slopes. Future excavation slopes are limited to Sectors 12, 13, and 14, the remaining unconstructed sectors at the landfill. The slope in Sector 12 was analyzed for this appendix.

Given: The slope stability analyses section location is provided on Sheet IIIM-A-1-5. The section dimensions and analysis results are shown on Sheet IIIM-A-1-6.

Method:

A. Evaluate the stability of the proposed typical excavation slope shown on Sheet IIIM-A-1-5.

1. Determine the critical excavation slope for the proposed design.
2. Develop a soil profile for the critical section using available boring logs near the sections. Use the highest measured groundwater in upper sand unit of Stratum I.
3. Select material properties using average unit weights and strength parameters developed during field and laboratory investigations (laboratory testing summaries for site soils are provided in Appendix IIIM-C, and field results are shown on boring logs included in Appendix IIIG), and further described in Appendix IIIM, Table 3-1.
4. Perform stability analyses.
 - a. Analyze the excavation slopes using SLIDE2, Simplified Bishop method for circular failure surfaces and Simplified Janbu method with Rankine Blocks for translational failure surfaces. Use both total and effective stress strength parameters to model excavation conditions to evaluate short and long term slope stability. Translational failure surfaces were analyzed for peak and residual stress conditions.

References:

1. SLIDE2 Modeler (v.9.018) (slope stability analyses computer program), RocScience, Inc., 2021.
2. Day, Robert W., *Geotechnical Engineer's Portable Handbook*, McGraw-Hill, 2000.
3. Koerner, Robert M., *Designing with Geosynthetics*, 5th Ed., Prentice-Hall, Inc., 2005.
4. Appendix IIIG - Geology Report

EXCAVATION CONFIGURATION SLOPE STABILITY ANALYSIS

- Solution:**
- A. Slope stability analysis of proposed excavation slopes in Sector 12 prior to waste placement.
1. The locations of the critical section selected for the stability analysis for the proposed slopes are shown on Figure IIIM-A-1-5. Sections analyzed are shown with the most critical failure surfaces on Sheet IIIM-A-1-6.
 2. The soil profile used for each analysis was based on boring log data from previous site investigations (see Appendix IIIG-B) from the undeveloped area of the site and the geologic cross sections (see Appendix IIIG-C).
 3. A summary table of the assumed material weight and strength properties is provided on Sheets IIIM-A-1-3 and IIIM-A-1-4. The material weight and strength parameter determination for each material type was based on previous laboratory testing results (Atterburg limits, natural moisture contents, unit weight, percent passing #200 sieve, standard Proctor, and strength testing), field strength testing (pocket penetrometer and standard penetration testing (SPT)), and engineering judgment from previous experience with similar materials. Additionally, limited triaxial testing was performed of the bounding shale to confirm the assumptions used in the analysis, and the results are presented in Appendix IIIM-C. Laboratory testing results for the site soils are included in Appendix IIIM-C.
 4. The output from the slope stability analyses on the excavation slopes are provided on Sheets IIIM-A-1-6. The output for the critical failure surface of each section is included, while only graphics of the failure surfaces are included on Sheet IIIM-A-1-6. A summary of analysis output is provided on Sheet IIIM-A-1-4.

Conclusion: Based on the above slope stability analyses (and as presented on Sheet IIIM-A-1-4) the proposed excavation slopes have adequate factors of safety for both short term (total stress) and long term (effective stress) to be considered stable. Analysis of translational (block)-type failure surfaces for peak and residual stress conditions also demonstrate adequate factors of safety.

EXCAVATION CONFIGURATION SLOPE STABILITY ANALYSIS

Derivation of Slope Stability Parameters

Laboratory testing data are provided in Appendix IIIM-C, and field testing results are provided on logs included in Appendix IIIG-B. The following includes material strength properties based on the laboratory testing results and field test results for each subsurface unit.

Material/Unit	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)
Stratum I (Upper Sand)	125.9	129.7
Stratum II (Bounding Shale and Lower Sand)	133.0	135.0

The strength parameters used for analysis of the in-situ soils were selected based on the following:

Stratum I (Upper Sand) Input Parameters

Soil Penetration Tests (SPT) and hand penetrometer testing was performed on Stratum I during previous subsurface investigations. The cohesion and friction angle values listed in the table below are conservative strength representations for dense sand stratum, and were calculated from review of previous pocket penetrometer readings. Moist unit weight and saturated unit weight values are calculated from the dry unit weight, the moisture content, and the void ratio calculated assuming a specific gravity of 2.65 for sands. These unit weight values conservatively compare to the mean value obtained from previous field and laboratory testing performed on the material. The strength values below are considered conservative for sands and clayey sands.

	Total Stress		Effective Stress	
	Cohesion (lb/ft ²)	Friction Angle (phi)	Cohesion (lb/ft ²)	Friction Angle (phi)
Stratum I (Upper Sand)	2500	0.0	1000	39.1

Stratum II (Bounding Shale and Lower Sand) Input Parameters

Unconfined compression tests and hand penetrometer tests previously were performed on Stratum II, which is comprised of the shale unit underlying Stratum I (Upper Sand) interbedded with sand lenses (Lower Sand). The Lower Sand is discontinuous and lenticular bodies of predominately sand and sandstone in a shale matrix. The Lower Sand is difficult to differentiate during investigations. For the stability analyses, the Bounding Shale and Lower Sand were considered as one stratum, and distinguishing the sand lenses within the shale for stability analyses was deemed unnecessary due to the difficulty in defining the separate units, and the generally hard nature of both the shale and the Lower Sand. The cohesion and friction angle values in the below table are conservative representations of hard shale units. Moist unit weight and saturated unit weight values are calculated from the dry unit weight, the moisture content, and the void ratio calculated assuming a specific gravity of 2.65 for shales. These moist unit weight values were then averaged and this value is used in the slope stability analysis.

	Total Stress		Effective Stress	
	Cohesion (lb/ft ²)	Friction Angle (phi)	Cohesion (lb/ft ²)	Friction Angle (phi)
Stratum II (Bounding Shale and Lower Sand)	4100	0.0	1000	38.6

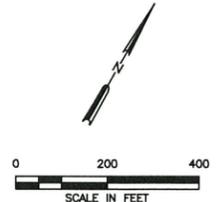
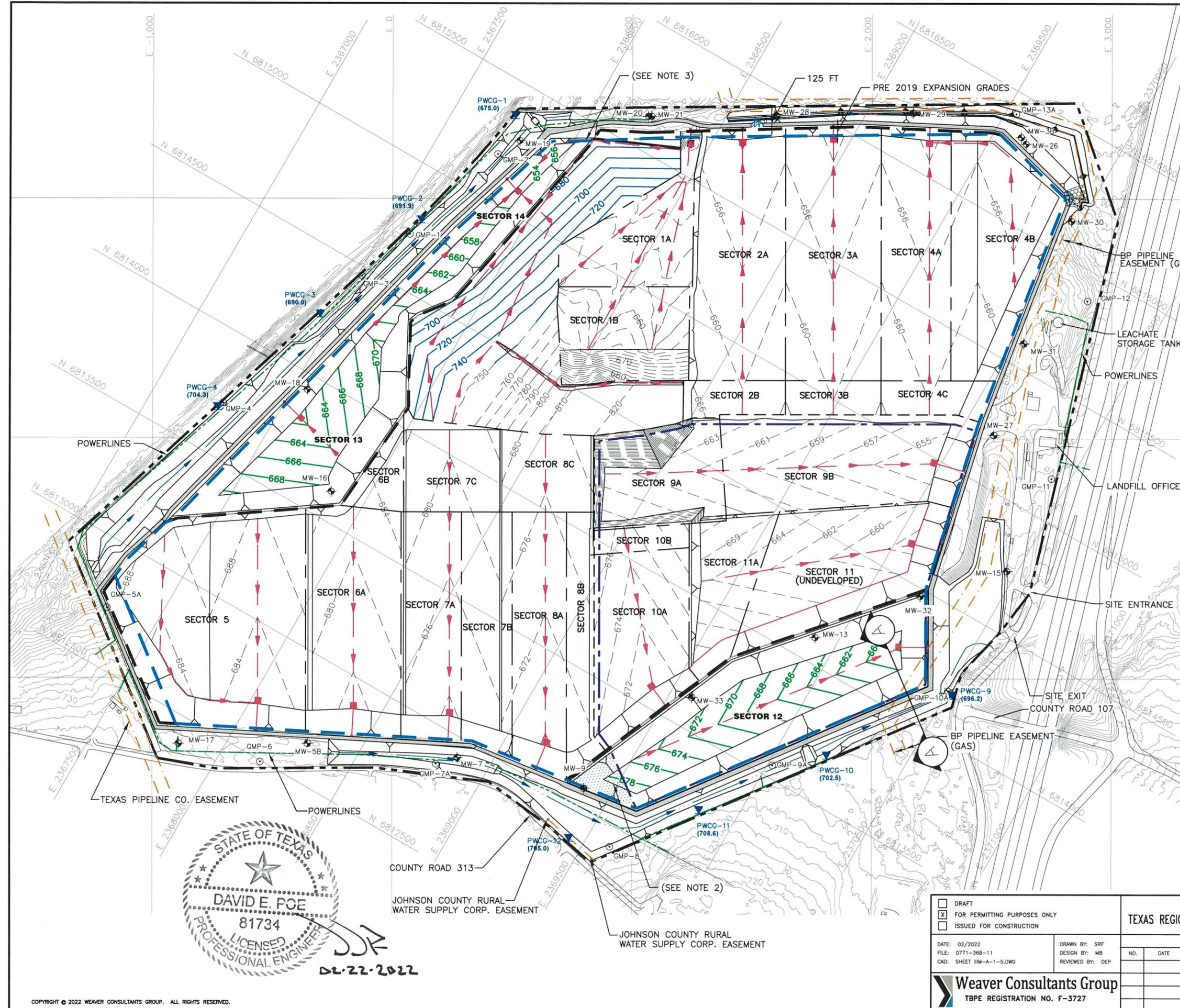
EXCAVATION CONFIGURATION SLOPE STABILITY ANALYSIS

Factor of Safety Summary for Excavation Slope Stability

Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety ²		Acceptable Factor of Safety
Slope Designation	Method of Analysis ¹	Effective Stress	Total Stress	Effective Stress	Total Stress	
Excavation A-1	Bishop-Circular	1.78	1.78	1.5	1.3	YES
Excavation A-2	Rankine-Block	5.70	4.45 (residual)	1.5	1.3	YES

¹ Refer to infinite slope stability in Appendix IIIM-A-4 for liner interface stability.

² For bottom liner side slopes excavated to receive liner and protective cover in a short period of time, a factor of safety of 1.3 is acceptable for total stress conditions.



LEGEND

	PERMIT BOUNDARY
	EXPANSION LIMIT OF WASTE (SEE NOTE 3)
	HISTORICAL LIMIT OF WASTE
	STATE PLANE GRID
	EXISTING CONTOUR
	EXISTING EXCAVATION/OVERLINER CONTOUR
	PROPOSED EXCAVATION CONTOUR
	LEACHATE COLLECTION PIPE
	LEACHATE COLLECTION SUMP
	CLASS 1 LIMIT (SEE NOTE 5)
	EXPANSION OVERLINER CONTOUR
	BELOW GRADE CLASS I AREA (SEE NOTE 2)
	EASEMENT
	POWERLINE LOCATION
	EXCAVATION SIDESLOPE 3H:1V OTHERWISE INDICATED
	EXISTING GROUNDWATER MONITORING WELL
	EXISTING GAS MONITORING PROBE
	PROPOSED 2021 EXPANSION BORING WITH PIEZOMETER INSTALLATION

- NOTES:**
- EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS FROM AERIAL PHOTOGRAPHY FLOWN ON 01-08-2021. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.
 - A SMALL PORTION OF SECTOR 12 (0.7 ACRE) WILL BE LIMITED TO BELOW-GRADE CLASS 1 AIRSPACE DUE TO THE ADJOINING MSW SECTOR 8B. THIS AREA MAY EITHER BE DEVELOPED WITH CLASS 1 LINER AND RECEIVE BELOW GRADE CLASS 1 OR BE DEVELOPED AS STANDARD SUBTITLE D LINER THAT WILL BE UTILIZED ONLY FOR MSW WASTE PLACEMENT.
 - THE EXPANSION LIMIT OF WASTE IS LOCATED A MINIMUM OF 125 FT FROM THE PERMIT BOUNDARY. NO WASTE IS PROPOSED TO BE PLACED OR RELOCATED BETWEEN THE HISTORICAL LIMIT OF WASTE AND THE EXPANSION LIMIT OF WASTE.
 - CLASS 1 LIMIT IS SHOWN WITH A 25 FOOT SETBACK FROM THE EDGE OF CLASS 1 LINER AS APPROVED BY TCEQ. THE 25 FOOT SETBACK WILL NOT BE APPLICABLE TO THE 0.7 ACRE AREA IN SECTOR 12 IF THE AREA IS CONSTRUCTED WITH A CLASS 1 LINER.



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Weaver Consultants Group		
TBPE REGISTRATION NO. F-3727		

PREPARED FOR		
TEXAS REGIONAL LANDFILL COMPANY, LP		
REVISIONS		
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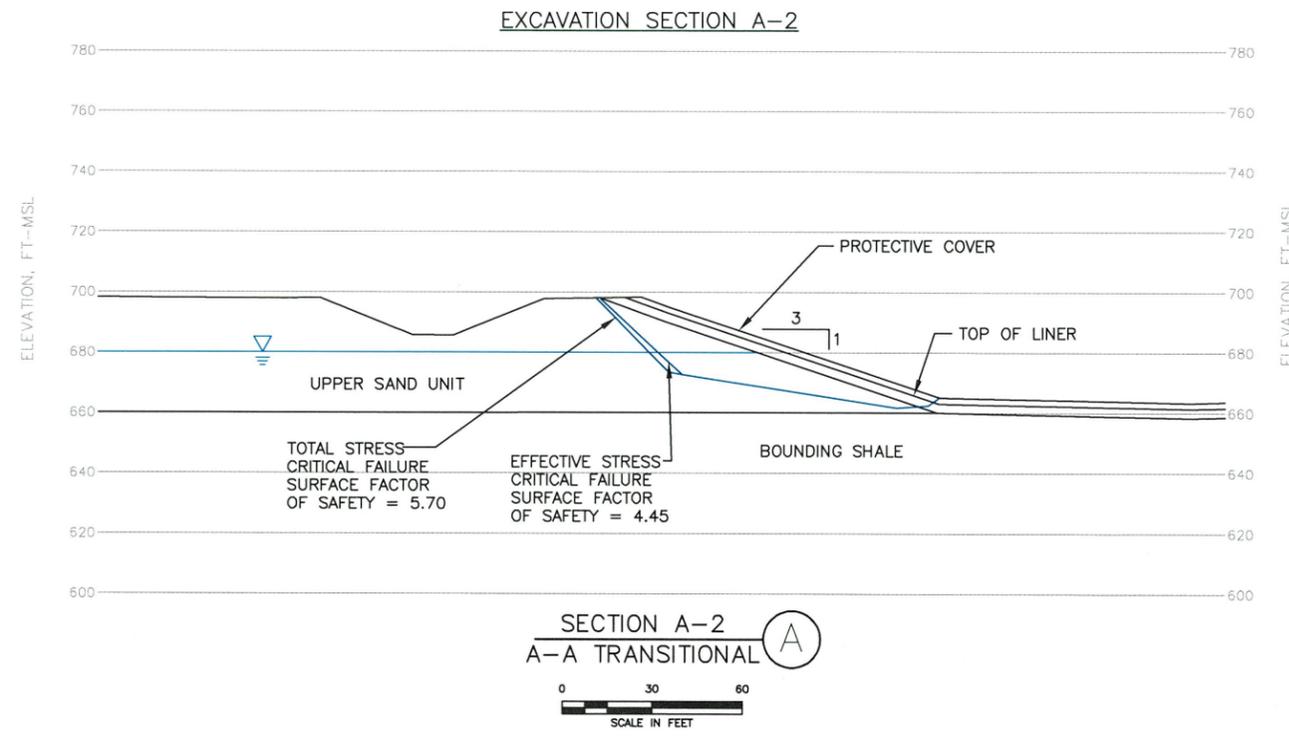
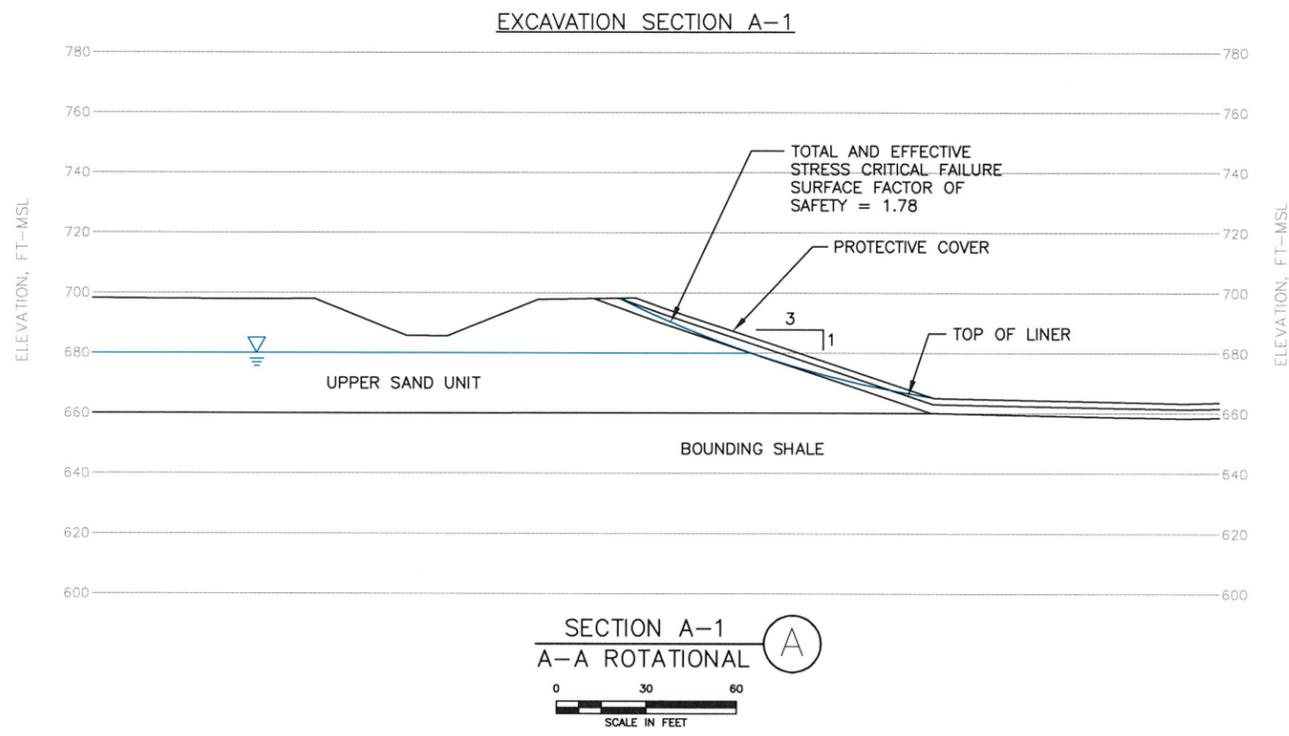
**MAJOR PERMIT AMENDMENT
SLOPE STABILITY ANALYSIS
EXCAVATION SECTION PLAN**

TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS

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Weaver Consultants Group	
TBPE REGISTRATION NO. F-3727	

REVISIONS		
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**MAJOR PERMIT AMENDMENT
SLOPE STABILITY ANALYSIS
EXCAVATION SECTIONS**

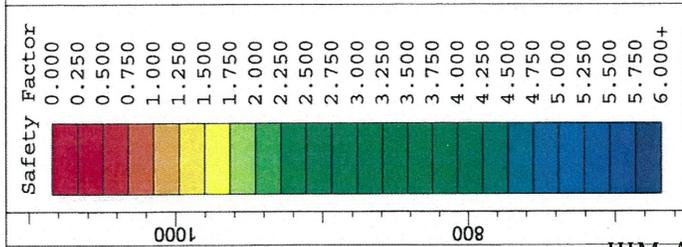
TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS

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**TURKEY CREEK LANDFILL
MAJOR PERMIT AMENDMENT APPLICATION
SLOPE STABILITY ANALYSIS**

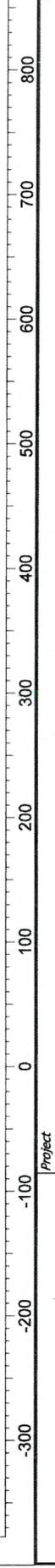
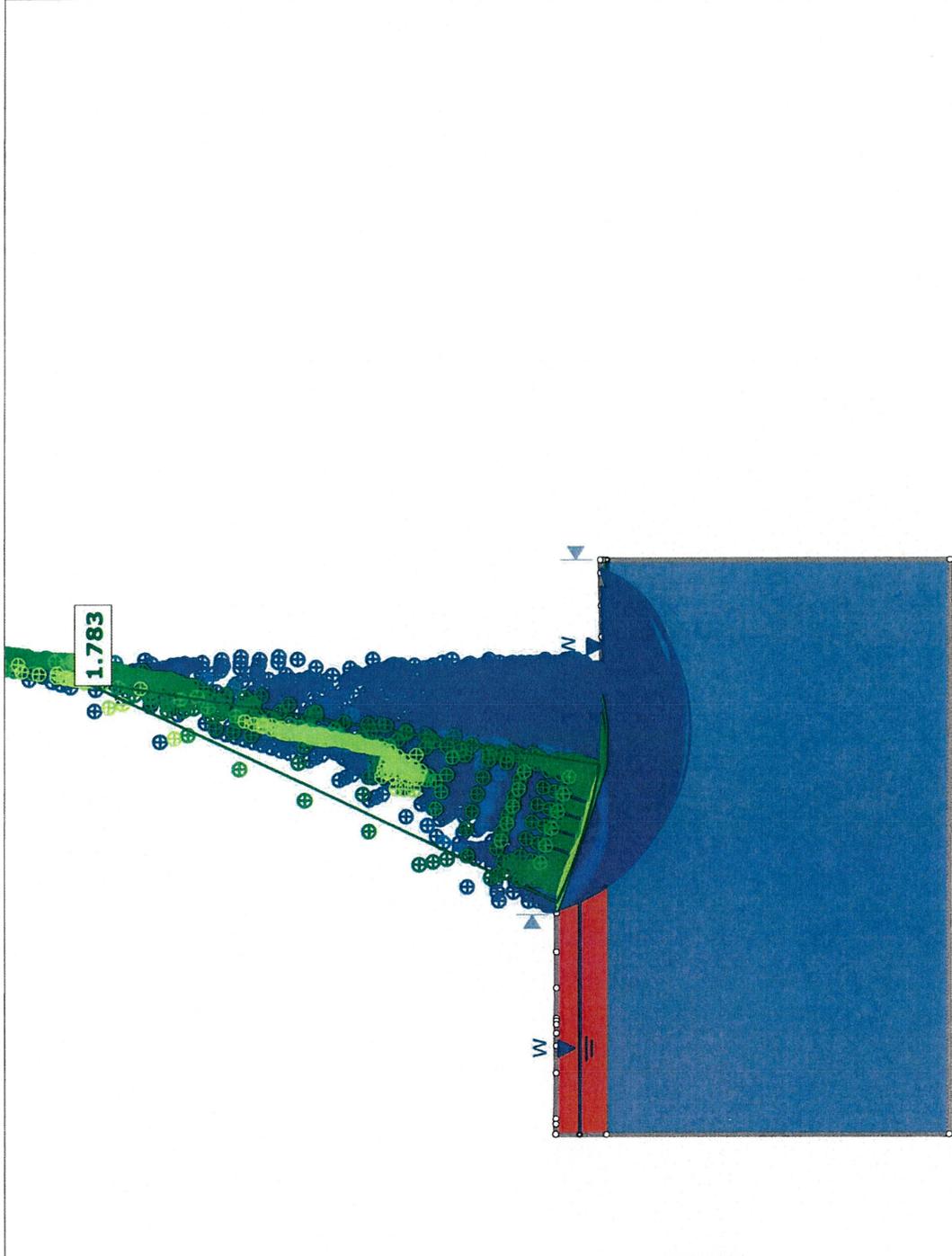
**APPENDIX IIIM-A-1
SLIDE2 COMPUTER MODEL OUTPUT FILES
EXCAVATION CONFIGURATION**

**EXCAVATION CONFIGURATION
SECTION A-A**



III-M-A-1-1-6

Method Name	Min FS
Bishop simplified	1.783



Project	
TURKEY CREEK LANDFILL	
Group	ENGINEERING
Scenario	TOTAL STRESS - BLOCK SEARCH
Drawn By	PREP BY: MB
Company	WEAVER CONSULTANTS GROUP
Date	10/20/2021
File Name	Section_A_Total.slmd



SLIDEINTERPRET 9.018

Slide Analysis Information

Section_A_Total

Project Summary

File Name:	Section_A_Total.slmd
Slide Modeler Version:	9.012
Compute Time:	00h:00m:04.285s
Project Title:	Section A - Total Stress
Company:	WEAVER CONSULTANTS GROUP
Date Created:	8/26/2021, 10:38:39 AM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

UPPER SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

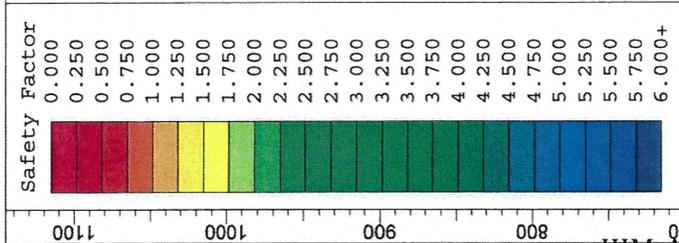
BOUNDING SHALE

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

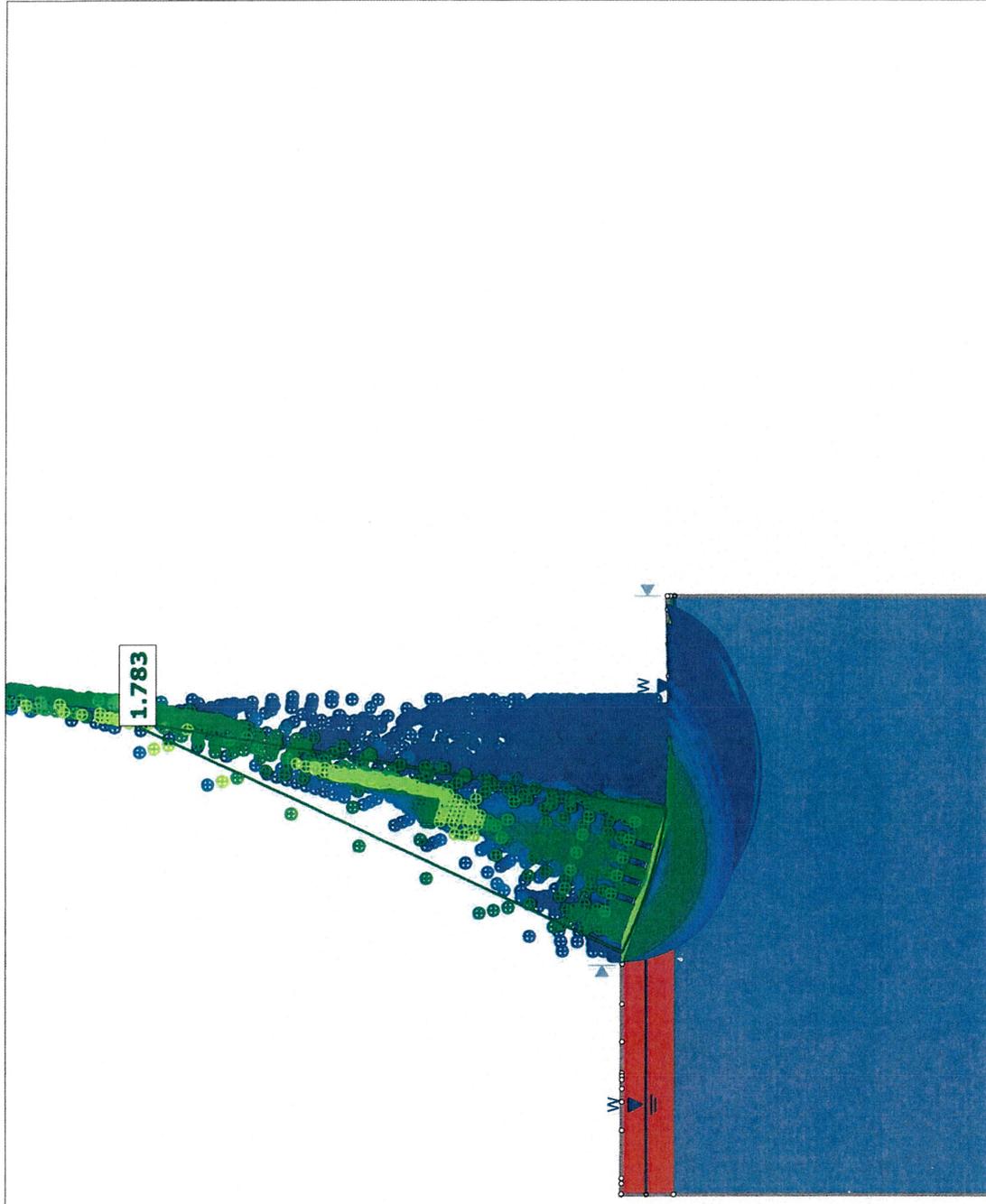
Global Minimums

Method: bishop simplified

	FS	1.782510
Center:		344.265, 1058.788
Radius:		399.016
Left Slip Surface Endpoint:		175.478, 697.230
Right Slip Surface Endpoint:		279.394, 665.081
Resisting Moment:		1.01594e+07 lb-ft
Driving Moment:		5.69946e+06 lb-ft
Total Slice Area:		390.299 ft ²
Surface Horizontal Width:		103.916 ft
Surface Average Height:		3.75592 ft



Method Name	Min FS
Bishop simplified	1.783



TURKEY CREEK LANDFILL	
Group	ENGINEERING
Scenario	EFFECTIVE STRESS - BLOCK SEARCH
Drawn By	PREP BY: MB CHKD BY: DEP
Company	WEAVER CONSULTANTS GROUP
Date	10/20/2021
File Name	Section_A_Effective.slmd



Slide Analysis Information

Section_A_Effective

Project Summary

File Name:	Section_A_Effective.slmd
Slide Modeler Version:	9.012
Compute Time:	00h:00m:01.159s
Project Title:	Section A - Effective Stress
Date Created:	8/26/2021, 10:38:39 AM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

UPPER SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	Water Table
Hu Value	1

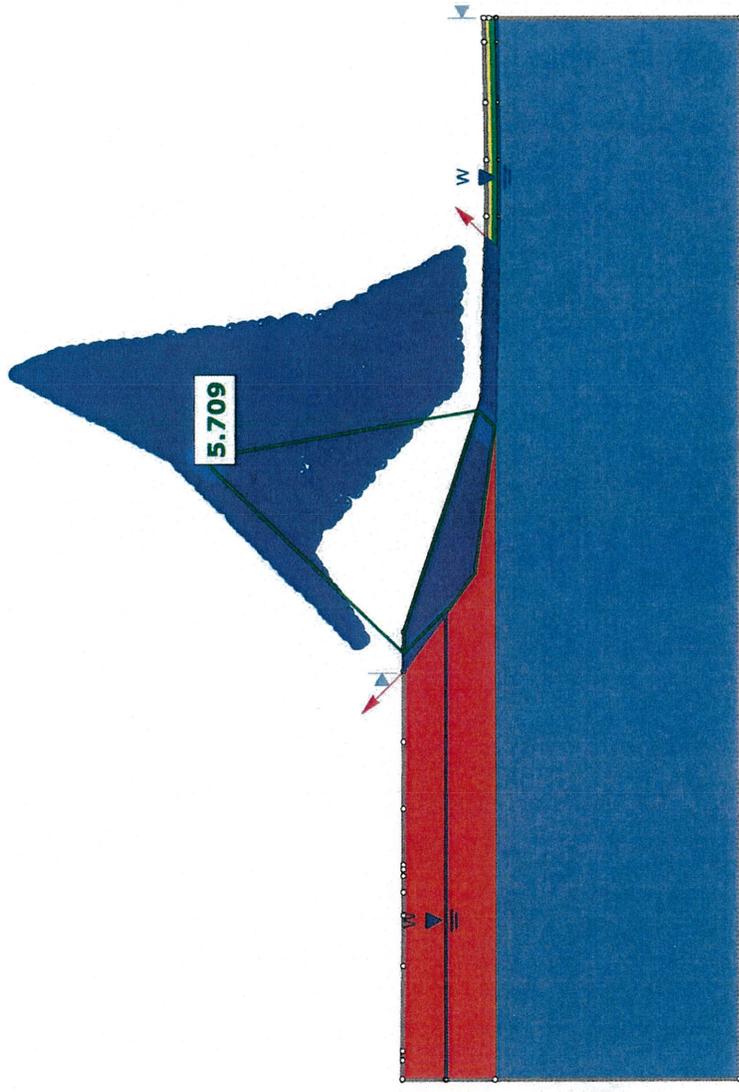
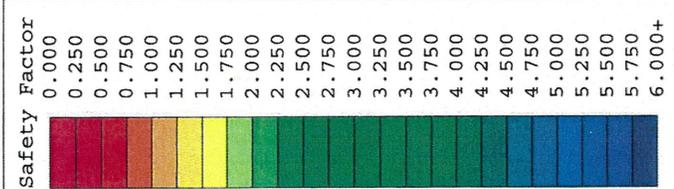
BOUNDING SHALE

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

Global Minimums

Method: bishop simplified

	FS	1.782510
Center:		344.265, 1058.788
Radius:		399.016
Left Slip Surface Endpoint:		175.478, 697.230
Right Slip Surface Endpoint:		279.394, 665.081
Resisting Moment:		1.01594e+07 lb-ft
Driving Moment:		5.69946e+06 lb-ft
Total Slice Area:		390.299 ft ²
Surface Horizontal Width:		103.916 ft
Surface Average Height:		3.75592 ft



Method Name	Min FS
Bishop simplified	5.709



III-M-A-1-19

Project

TURKEY CREEK LANDFILL

Group

ENGINEERING

Scenario

TOTAL STRESS - BLOCK SEARCH

Drawn By

PREP BY: MB

Company

WEAVER CONSULTANTS GROUP

Date

10/20/2021

File Name

Section_A_Total_Block.slm



Slide Analysis Information

Section_A_Total_Block

Project Summary

File Name:	Section_A_Total_Block.slmd
Slide Modeler Version:	9,018
Compute Time:	00h:00m:00.404s
Project Title:	SECTION A-TOTAL STRESS-BLOCK
Date Created:	8/26/2021, 10:38:39 AM

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check $m\alpha < 0.2$:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

UPPER SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

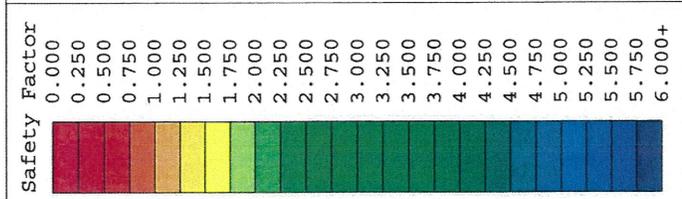
BOUNDING SHALE

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

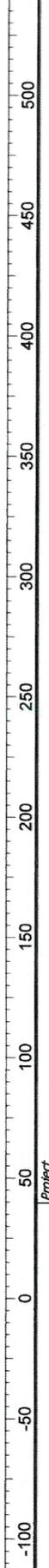
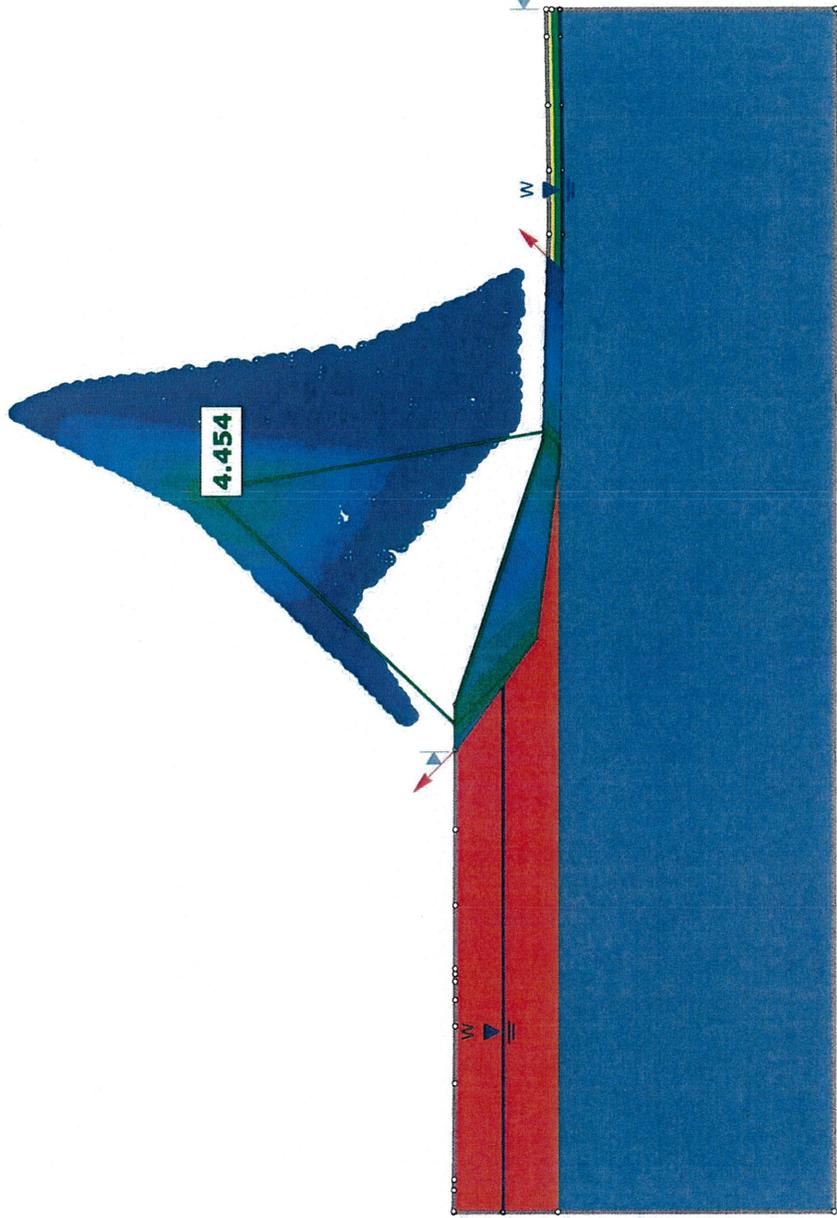
Global Minimums

Method: bishop simplified

	FS	5.708510
Axis Location:		254.112, 781.495
Left Slip Surface Endpoint:		174.213, 697.233
Right Slip Surface Endpoint:		273.582, 667.018
Resisting Moment:		3.04807e+07 lb-ft
Driving Moment:		5.33951e+06 lb-ft
Total Slice Area:		1348.33 ft ²
Surface Horizontal Width:		99.369 ft
Surface Average Height:		13.5689 ft



Method Name	Min FS
Bishop simplified	4.454



SLIDEINTERPRET 9.018

Project

TURKEY CREEK LANDFILL

Group	ENGINEERING	Scenario	EFFECTIVE STRESS - BLOCK SEARCH
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	10/20/2021	File Name	Section_A_Effective_Block.sldm

IIIIM-A-1-24

Slide Analysis Information

Section_A_Effective_Block

Project Summary

File Name:	Section_A_Effective_Block.slmd 9.018
Slide Modeler Version:	00h:00m:00.395s
Compute Time:	SECTION A-EFFECTIVE STRESS-BLOCK
Project Title:	8/26/2021, 10:38:39 AM
Date Created:	

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check $m\alpha < 0.2$:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	10
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	10
Water Surface	None
Ru Value	0

UPPER SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	Water Table
Hu Value	1

BOUNDING SHALE

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

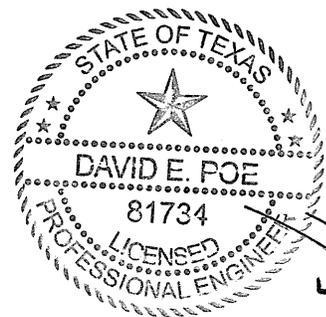
Global Minimums

Method: bishop simplified

	FS	4.453950
Axis Location:		260.785, 787.246
Left Slip Surface Endpoint:		175.533, 697.230
Right Slip Surface Endpoint:		281.647, 665.034
Resisting Moment:		2.6468e+07 lb-ft
Driving Moment:		5.94259e+06 lb-ft
Total Slice Area:		1378.18 ft2
Surface Horizontal Width:		106.114 ft
Surface Average Height:		12.9878 ft

APPENDIX IIIM-A-2
INTERIM LANDFILL CONFIGURATION
STABILITY ANALYSIS

Includes pages IIIM-A-2-1 through IIIM-A-2-29



DJE
02-22-2022

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIM-A-2
INTERIM CONFIGURATION SLOPE STABILITY ANALYSIS

- Required:** Evaluate the slope stability of the landfill interim slopes for the undeveloped area.
- Given:** The typical interim slope section location is shown on Sheet IIIM-A-2-6. The section dimensions and analysis results are shown on Sheet IIIM-A-2-7.
- Method:**
- A. Evaluate the stability of the landfill interim fill slopes.
1. Develop the critical interim slope in the proposed design.
 2. Generalize a soil profile for the critical section using available boring logs and sections.
 3. Select material properties using average unit weights and strength parameters developed during field and laboratory investigations (laboratory testing summaries for site soils are provided in Appendix IIIM-C, and field results are shown on boring logs included in Appendix IIIG, and further described in Table Appendix IIIM, Table 3-1).
 4. Perform stability analyses.
 - a. Analyze the interim slopes using SLIDE2, Simplified Bishop method for circular failure surfaces and Simplified Janbu method with Rankine Blocks for translational failure surfaces. Use both total and effective stress strength parameters to model interim slope conditions for short and long term slope stability. Peak and residual stress parameters were used to analyze the geosynthetic bottom liner interfaces under translational (block) failure.
- References:**
1. SLIDE2 Modeler (v.9.018) (slope stability analyses computer program), RocScience, Inc., 2021.
 2. Day, Robert W., *Geotechnical Engineer's Portable Handbook*, McGraw-Hill, 2000.
 3. Koerner, Robert M., *Designing with Geosynthetics*, 5th Ed., Prentice-Hall, Inc., 2005.
 4. Appendix IIIG - Geology Report
 5. Geosynthetic Research Institute (Koerner et.al.), *Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces*, GRI Report #30, 2005.

INTERIM CONFIGURATION SLOPE STABILITY ANALYSIS

Solution:

- A. Slope stability analyses of the proposed interim slopes.
1. The locations of the critical sections selected for the stability analysis for the proposed interim slope is shown on Sheet IIIM-A-2-6. Sections analyzed are shown with the most critical failure surfaces on Sheet IIIM-A-2-7.
 2. The soil profile used for each analysis was based on boring log data from previous site investigations (see Appendix IIIG-B) from the undeveloped area of the site and the geologic cross sections (see Appendix IIIG-C).
 3. A summary table of the assumed material weight and strength properties is provided on Sheets IIIM-A-2-3 through IIIM-A-2-5. The material weight and strength parameter determination for each material type was based on previous laboratory testing results (Atterburg limits, natural moisture contents, unit weight, percent passing #200 sieve, standard Proctor, and strength testing), field strength testing (pocket penetrometer and standard penetration testing (SPT)), and engineering judgment from previous experience with similar materials. Laboratory testing results for the site soils are included in Appendix IIIM-C.
 4. The output from the slope stability analyses on the interim slopes are provided on Sheet IIIM-A-2-5. The output for the critical failure surface of each section is included. A summary of analysis output is provided on Sheet IIIM-A-2-7.

Conclusion:

Based on the above slope stability analyses, the proposed interim slopes have adequate factors of safety to be considered stable. The analysis was run with an interim slope of 3H:1V, to a maximum crest height of approximately 200 feet. In the event higher or steeper interim slopes are constructed, additional stability analysis should be performed incorporating the actual field conditions.

INTERIM CONFIGURATION SLOPE STABILITY ANALYSIS

Derivation of Slope Stability Parameters

Laboratory testing data are provided in Appendix IIIM-C, and field testing results are provided on logs included in Appendix IIIG. The following includes material strength properties based on the laboratory testing results and field test results for each subsurface unit.

Material/Unit	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)
Stratum I (Upper Sand)	125.9	129.7
Stratum II (Bounding Shale and Lower Sand)	133.0	135.0

The strength parameters used for analysis of the in-situ soils were selected based on the following:

Stratum I (Upper Sand) Input Parameters

Soil Penetration Tests (SPT) and hand penetrometer testing was performed on Stratum I during previous subsurface investigations. The cohesion and friction angle values listed in the table below are conservative strength representations for dense sand stratum, and were calculated from review of previous pocket penetrometer readings. Moist unit weight and saturated unit weight values are calculated from the dry unit weight, the moisture content, and the void ratio calculated assuming a specific gravity of 2.65 for sands. These unit weight values conservatively compare to the mean value obtained from previous field and laboratory testing performed on the material. The strength values below are considered conservative for sands and clayey sands.

	Total Stress		Effective Stress	
	Cohesion (lb/ft ²)	Friction Angle (phi)	Cohesion (lb/ft ²)	Friction Angle (phi)
Stratum I (Upper Sand)	2500	0.0	1000	39.1

Stratum II (Bounding Shale and Lower Sand) Input Parameters

Unconfined compression tests and hand penetrometer tests previously were performed on Stratum II, which is comprised of the shale unit underlying Stratum I (Upper Sand) interbedded with sand lenses (Lower Sand). The Lower Sand is discontinuous and lenticular bodies of predominately sand and sandstone in a shale matrix. The Lower Sand is difficult to differentiate during investigations. For the stability analyses, the Bounding Shale and Lower Sand were considered as one stratum, and distinguishing the sand lenses within the shale for stability analyses was deemed unnecessary due to the difficulty in defining the separate units, and the generally hard nature of both the shale and the Lower Sand. The cohesion and friction angle values in the below table are conservative representations of hard shale units. Moist unit weight and saturated unit weight values are calculated from the dry unit weight, the moisture content, and the void ratio calculated assuming a specific gravity of 2.65 for shales. These moist unit weight values were then averaged and this value is used in the slope stability analysis.

	Total Stress		Effective Stress	
	Cohesion (lb/ft ²)	Friction Angle (phi)	Cohesion (lb/ft ²)	Friction Angle (phi)
Stratum II (Bounding Shale and Lower Sand)	4100	0.0	1000	38.6

INTERIM CONFIGURATION SLOPE STABILITY ANALYSIS

Solid Waste Input Parameters

Soil Description	Overburden Pressure (psf)	Moist Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Solid Waste	< 30 kPa	65	500	0
	> 30 kPa	65	0	33

The above information was derived from several references. Reference 3 provides a summary of several studies that have been completed to develop the shear strength parameters for MSW (refer to Chapter 6.7 in Ref. 3). MSW shear strength parameters reported in technical literature references vary widely, with friction angles as low as 10° and as high as 53°, and cohesion values varying from 0 psf to 1,400 psf. Many of the lower values are directly contradicted by observations of actual stable landfill slopes. A summary list of a few of the studies completed is provided below.

Reference	Data Type	Results
Pagotto & Rimoldi (1987)	Back-calculation from plate bearing tests	$\phi = 22^\circ$ $c = 605 \text{ psf (29 kPa)}$
Landva & Clark (1990)	Laboratory direct shear tests on MSW	$\phi = 24^\circ, c = 460 \text{ psf (22 kPa)}$ to $\phi = 39^\circ, c = 400 \text{ psf (19 kPa)}$
Richardson & Reynolds (1991)	Large direct shear tests performed in-situ	$\phi = 18^\circ \text{ to } 43^\circ$ $c = 210 \text{ psf (10 kPa)}$
Kavazanjian, Bonaparte, et.al. (1995)	Back-calculation from multiple authors and sites	Normal Stress < 30 kPa: $\phi = 0^\circ$ and $c = 500 \text{ psf}$ Normal Stress > 30 kPa: $\phi = 33^\circ$ and $c = 0 \text{ psf}$

The results presented by Kavazanjian, et.al. above were utilized in the analysis as representative of MSW.

The moist unit weight is estimated at the midpoint of the average depth to represent the average unit weight of waste/cover soil within the landfill, generally consistent with what is used in the site life calculations in Appendix IIIM.

Liner and Protective Cover Input Parameters

Slope stability strength parameters for constructed soil materials were selected as follows based on engineering judgment. Prior to construction, laboratory tests will be performed to verify the assumed strength parameter values using project-specific soil materials. If test results differ from the assumed values, this analysis will be updated for acceptable factors of safety.

Material	Moist Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Clay Liner - Total Stress, Bishops ⁽¹⁾	120	100	18
Clay Liner - Effective Stress, Bishops ⁽¹⁾	120	100	18
Liner System - Peak Stress - Rankine ⁽²⁾	120	100	18
Liner System - Residual Stress - Rankine ⁽²⁾	120	80	10
Protective Cover (Bishops and Rankine) (modeled as liner system)	120	--	--

INTERIM CONFIGURATION SLOPE STABILITY ANALYSIS

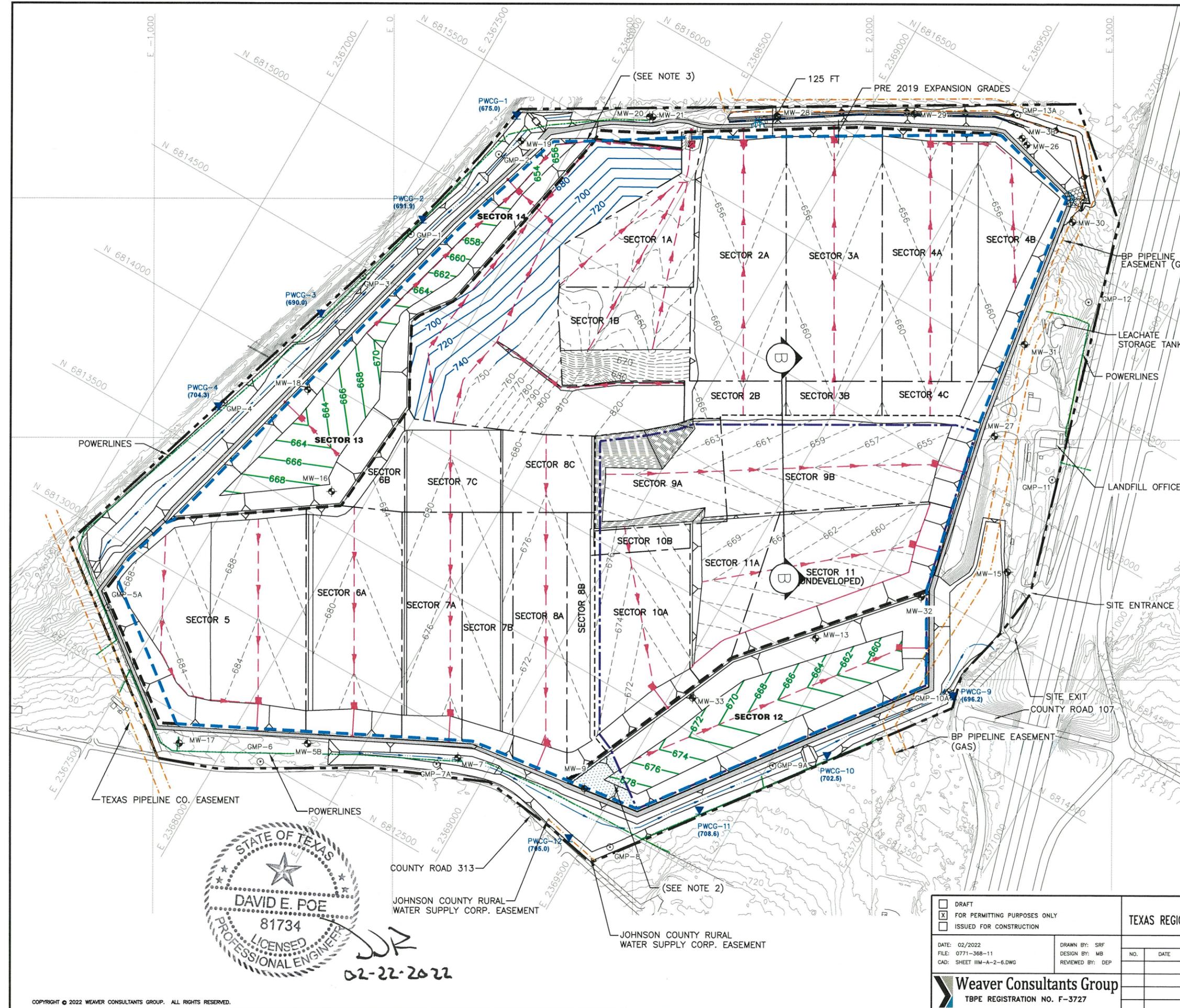
1. A cohesion of 100 psf and internal friction angle of 18 degrees (effective and total stress) for Simplified Bishop method of the slope stability analysis. Assumption assumes that pore pressures within the liner system dissipated for total stress conditions.
2. For global translational stability analysis (Janbu/Rankine Block), the strength parameters of the weakest interface were used to model the clay liner, as presented in the below table of Minimum Interface Strength Parameters. For peak values, an adhesion of 100 psf and an interface friction angle of 18 degrees (GCL/textured geomembrane) is used in the Janbu/Rankine method of the slope stability analysis to represent the weakest interface. For residual values, an adhesion of 80 psf and an interface friction angle of 10 degrees (GCL/textured geomembrane) is used.

Factor of Safety Summary for Interim Slope Stability Analysis

Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Total	Effective	Total	Effective	Total	Effective
		Interim B-1	Bishop-Circular	1.97	1.97	1.3	1.5

Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Peak	Residual	Peak	Residual	Peak	Residual
		Interim B-2	Rankine-Block	1.72	1.28	1.5	1.0

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- LEGEND**
- PERMIT BOUNDARY
 - EXPANSION LIMIT OF WASTE (SEE NOTE 3)
 - HISTORICAL LIMIT OF WASTE
 - STATE PLANE GRID
 - 730 EXISTING CONTOUR
 - 664 EXISTING EXCAVATION/OVERLINER CONTOUR
 - 664 PROPOSED EXCAVATION CONTOUR
 - LEACHATE COLLECTION PIPE
 - LEACHATE COLLECTION SUMP
 - CLASS 1 LIMIT (SEE NOTE 5)
 - 700 EXPANSION OVERLINER CONTOUR
 - BELOW GRADE CLASS I AREA (SEE NOTE 2)
 - EASEMENT
 - POWERLINE LOCATION
 - EXCAVATION SIDESLOPE 3H:1V OTHERWISE INDICATED
 - MW-7 (708.4) EXISTING GROUNDWATER MONITORING WELL
 - GMP-12 (673.6) EXISTING GAS MONITORING PROBE
 - PWCG-1 (675.0) PROPOSED 2021 EXPANSION BORING WITH PIEZOMETER INSTALLATION

- NOTES:**
1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS FROM AERIAL PHOTOGRAPHY FLOWN ON 01-08-2021. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.
 2. A SMALL PORTION OF SECTOR 12 (0.7 ACRE) WILL BE LIMITED TO BELOW-GRADE CLASS 1 AIRSPACE DUE TO THE ADJOINING MSW SECTOR 8B. THIS AREA MAY EITHER BE DEVELOPED WITH CLASS 1 LINER AND RECEIVE BELOW GRADE CLASS 1 OR BE DEVELOPED AS STANDARD SUBTITLE D LINER THAT WILL BE UTILIZED ONLY FOR MSW WASTE PLACEMENT.
 3. THE EXPANSION LIMIT OF WASTE IS LOCATED A MINIMUM OF 125 FT FROM THE PERMIT BOUNDARY. NO WASTE IS PROPOSED TO BE PLACED OR RELOCATED BETWEEN THE HISTORICAL LIMIT OF WASTE AND THE EXPANSION LIMIT OF WASTE.
 4. CLASS 1 LIMIT IS SHOWN WITH A 25 FOOT SETBACK FROM THE EDGE OF CLASS 1 LINER AS APPROVED BY TCEQ. THE 25 FOOT SETBACK WILL NOT BE APPLICABLE TO THE 0.7 ACRE AREA IN SECTOR 12 IF THE AREA IS CONSTRUCTED WITH A CLASS 1 LINER.

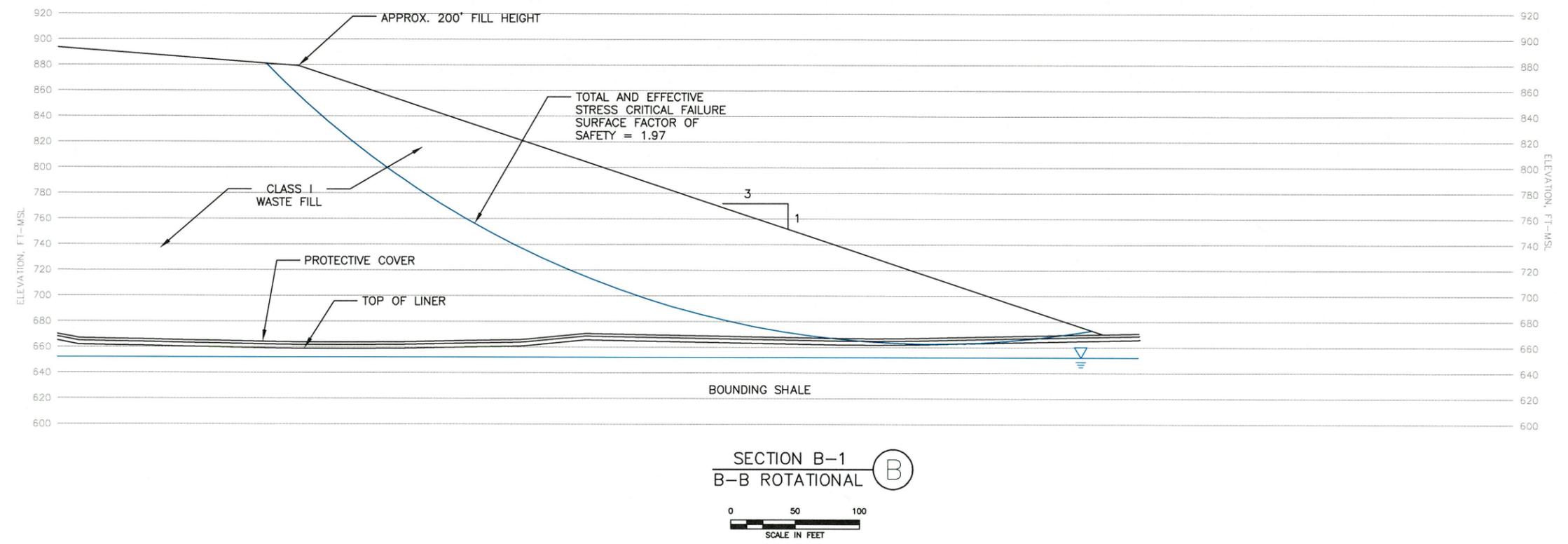


JR
02-22-2022

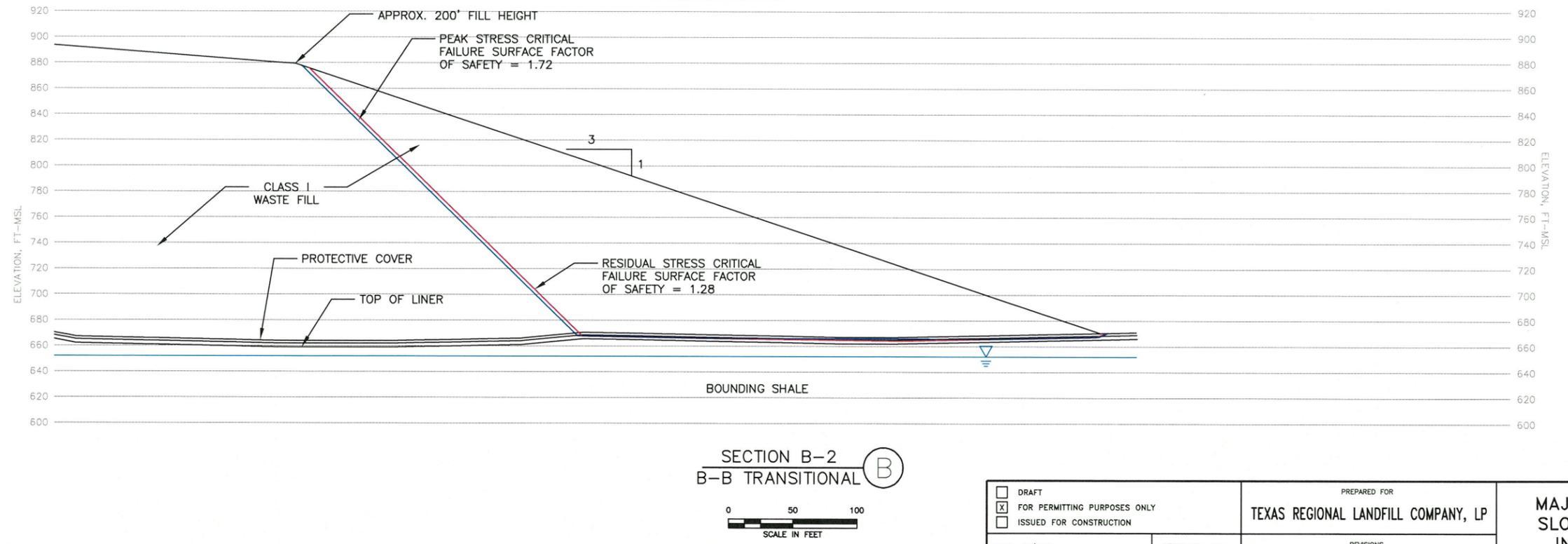
<input type="checkbox"/> DRAFT <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR TEXAS REGIONAL LANDFILL COMPANY, LP	MAJOR PERMIT AMENDMENT SLOPE STABILITY ANALYSIS INTERIM FILL SECTION PLAN
DATE: 02/2022 FILE: 0771-368-11 CAD: SHEET IIM-A-2-6.DWG	DRAWN BY: SRF DESIGN BY: MB REVIEWED BY: DEP	TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCRP.COM SHEET IIM-A-2-6

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INTERIM SECTION B-1



INTERIM SECTION B-2

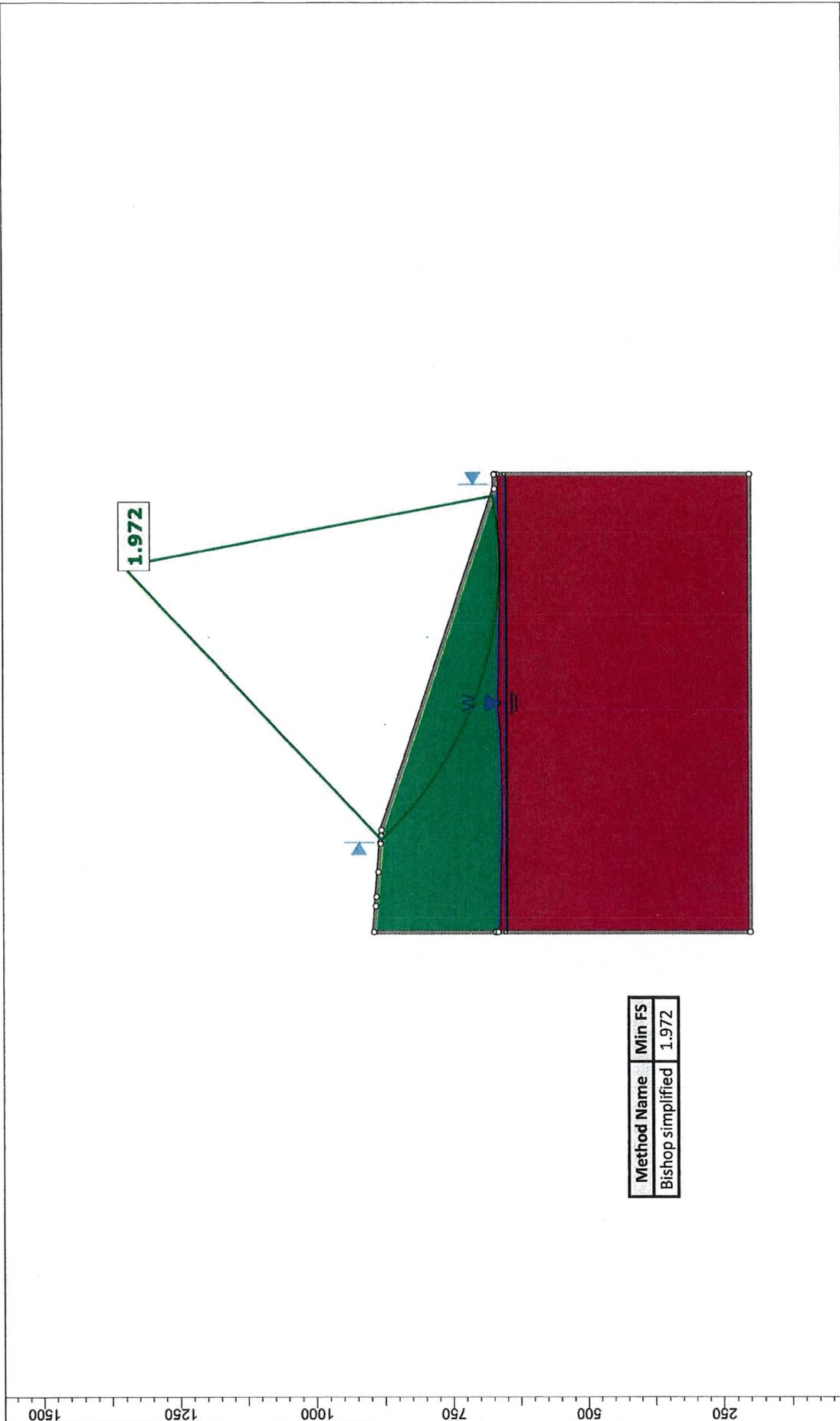


<input type="checkbox"/> DRAFT <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR		TEXAS REGIONAL LANDFILL COMPANY, LP MAJOR PERMIT AMENDMENT SLOPE STABILITY ANALYSIS INTERIM FILL SECTIONS TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS											
	DATE: 02/2022 FILE: 0771-368-11 CAD: SHEET IIM-A-2-7.DWG			REVISIONS <table border="1"> <thead> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	NO.	DATE	DESCRIPTION							
NO.	DATE	DESCRIPTION												
DRAWN BY: SRF DESIGN BY: MB REVIEWED BY: DEP		WWW.WGRP.COM SHEET IIM-A-2-7												
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		MAJOR PERMIT AMENDMENT SLOPE STABILITY ANALYSIS INTERIM FILL SECTIONS												

**TURKEY CREEK LANDFILL
MAJOR PERMIT AMENDMENT APPLICATION
SLOPE STABILITY ANALYSIS**

**APPENDIX IIIM-A-2
SLIDE2 COMPUTER MODEL OUTPUT FILES
INTERIM CONFIGURATION**

**INTERIM CONFIGURATION
SECTION B-B**



SLIDEINTERPLOT 9.018

Project

TURKEY CREEK LANDFILL

Group	ENGINEERING	Scenario	EFFECTIVE STRESS - CIRCULAR
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	2/18/2022	File Name	Section_B_Effective_Stress.slmd

Slide Analysis Information

Section_B_Effective_Stress

Project Summary

File Name:	Section_B_Effective_Stress.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:01.57s
Project Title:	SECTION B - EFFECTIVE STRESS-CIRCULAR
Date Created:	8/26/2021, 1:18:02 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

BOUNDING SHALE

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

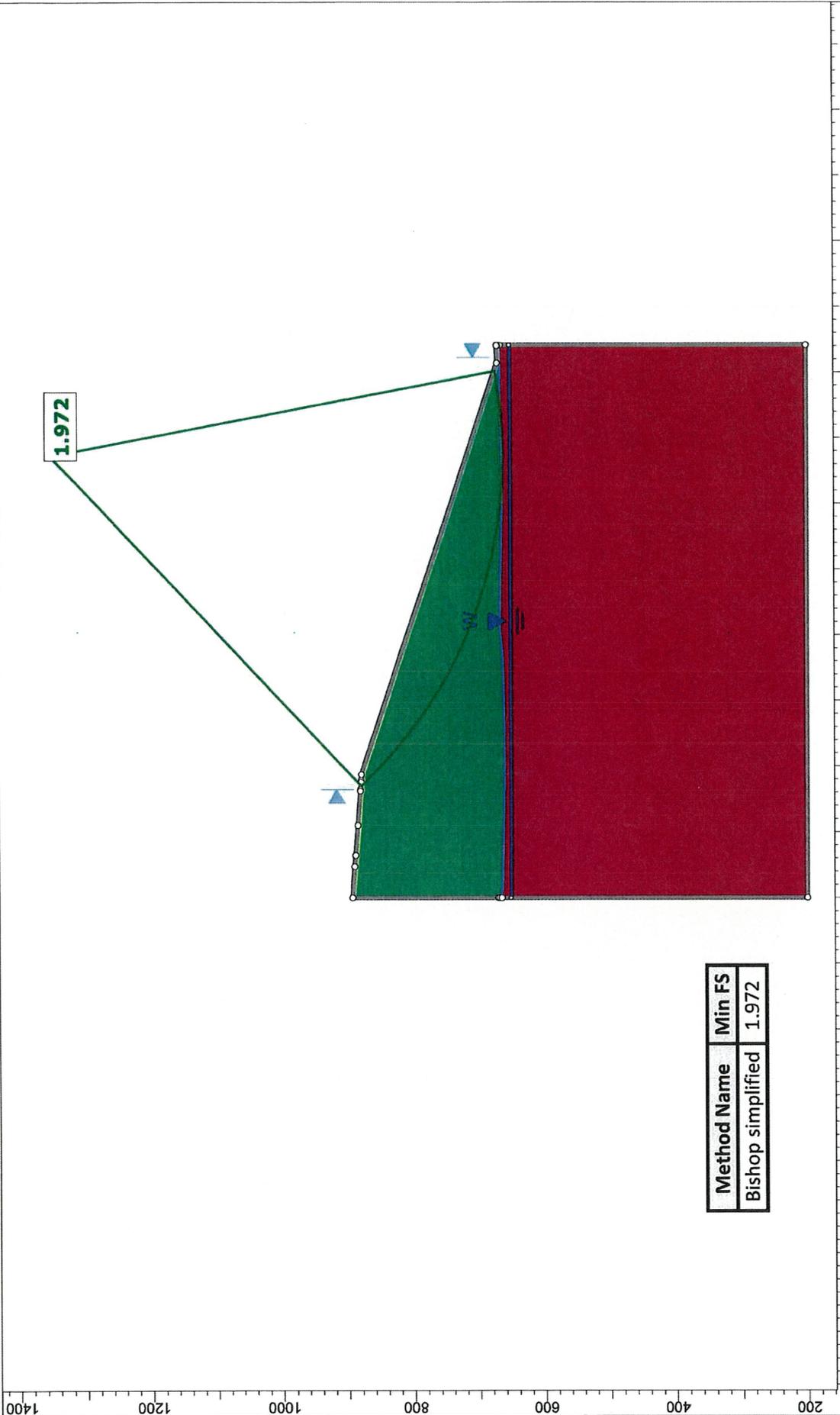
Shear Normal Functions

Name: User Defined 1		
	Effective Normal (psf)	Shear (psf)
0		500
208		500
417		500
625		500
626		406.53
834		541.61
1040		675.38
1250		811.76
2500		1623.52
25000		16235.2

Global Minimums

Method: bishop simplified

	FS	1.972160
Center:		673.009, 1353.255
Radius:		690.745
Left Slip Surface Endpoint:		169.234, 880.667
Right Slip Surface Endpoint:		801.626, 674.589
Resisting Moment:		1.02603e+09 lb-ft
Driving Moment:		5.20256e+08 lb-ft
Total Slice Area:		39761.6 ft ²
Surface Horizontal Width:		632.392 ft
Surface Average Height:		62.875 ft



TURKEY CREEK LANDFILL	
ENGINEERING	TOTAL STRESS - CIRCULAR
PREP BY: MB	WEAVER CONSULTANTS GROUP
CHKD BY: DEP	Section_B_Total_Stress.slm
Date	File Name
2/18/2022	Section_B_Total_Stress.slm



Slide Analysis Information

Section_B_Total_Stress

Project Summary

File Name:	Section_B_Total_Stress.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:01.98s
Project Title:	SECTION B - EFFECTIVE STRESS-CIRCULAR
Date Created:	8/26/2021, 1:18:02 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check $m\alpha < 0.2$:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

BOUNDING SHALE

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

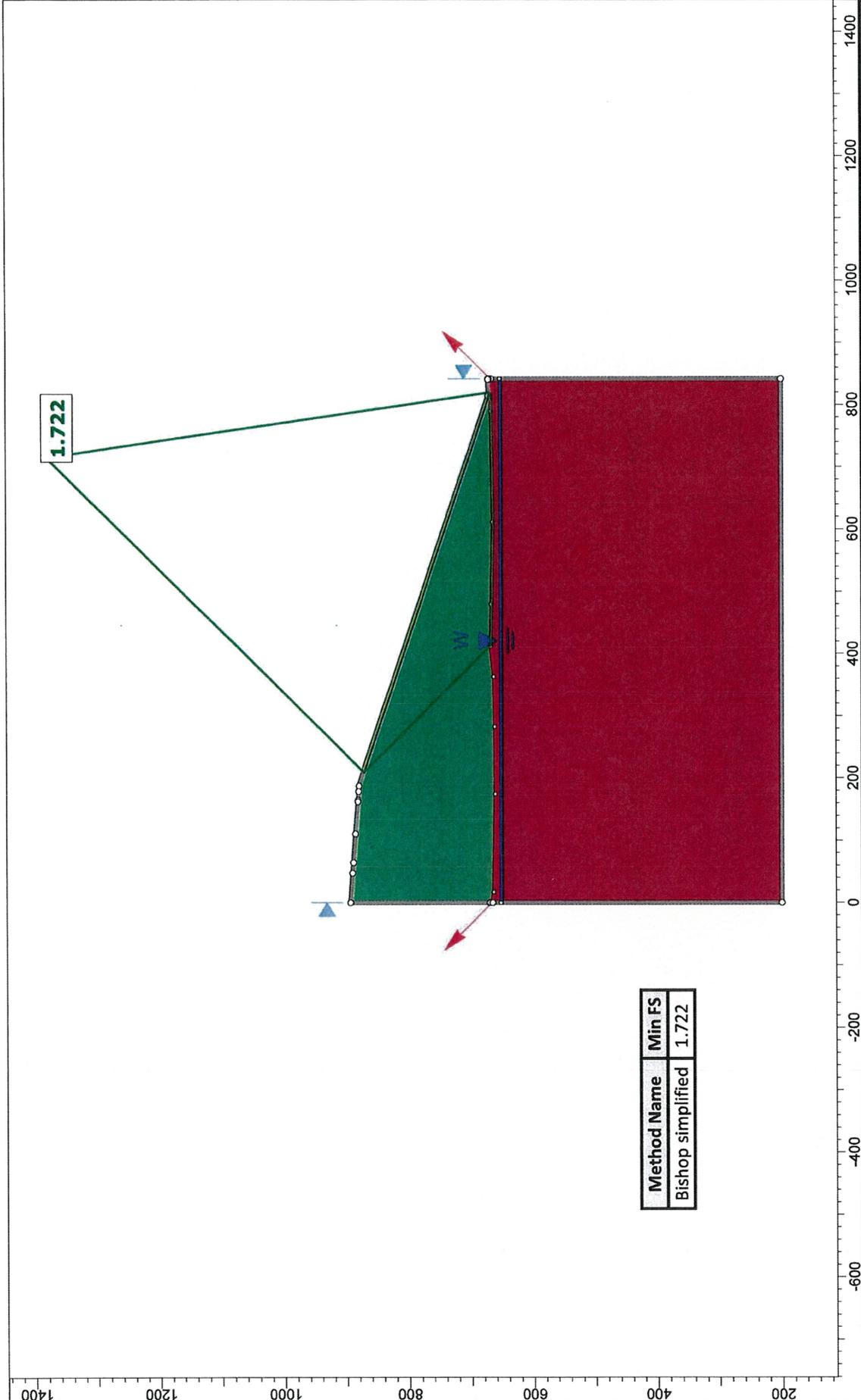
Shear Normal Functions

Name: User Defined 1		
	Effective Normal (psf)	Shear (psf)
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208		500
417		500
625		500
626		406.53
834		541.61
1040		675.38
1250		811.76
2500		1623.52
25000		16235.2

Global Minimums

Method: bishop simplified

	FS	1.972160
Center:		673.009, 1353.255
Radius:		690.745
Left Slip Surface Endpoint:		169.234, 880.667
Right Slip Surface Endpoint:		801.626, 674.589
Resisting Moment:		1.02603e+09 lb-ft
Driving Moment:		5.20256e+08 lb-ft
Total Slice Area:		39761.6 ft ²
Surface Horizontal Width:		632.392 ft
Surface Average Height:		62.875 ft



Method Name	Min FS
Bishop simplified	1.722

TURKEY CREEK LANDFILL	
Project	PEAK STRESS - BLOCK
Group	ENGINEERING
Drawn By	PREP BY: MB
Date	2/18/2022
Company	WEAVER CONSULTANTS GROUP
File Name	Section_B_Peak_Block.slmd



SLIDEINTERPRET 9.018

Slide Analysis Information

Section_B_Peak_Block

Project Summary

File Name:	Section_B_Peak_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.432s
Project Title:	SECTION B - PEAK STRESS - BLOCK SEARCH
Date Created:	8/26/2021, 1:18:02 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

BOUNDING SHALE

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

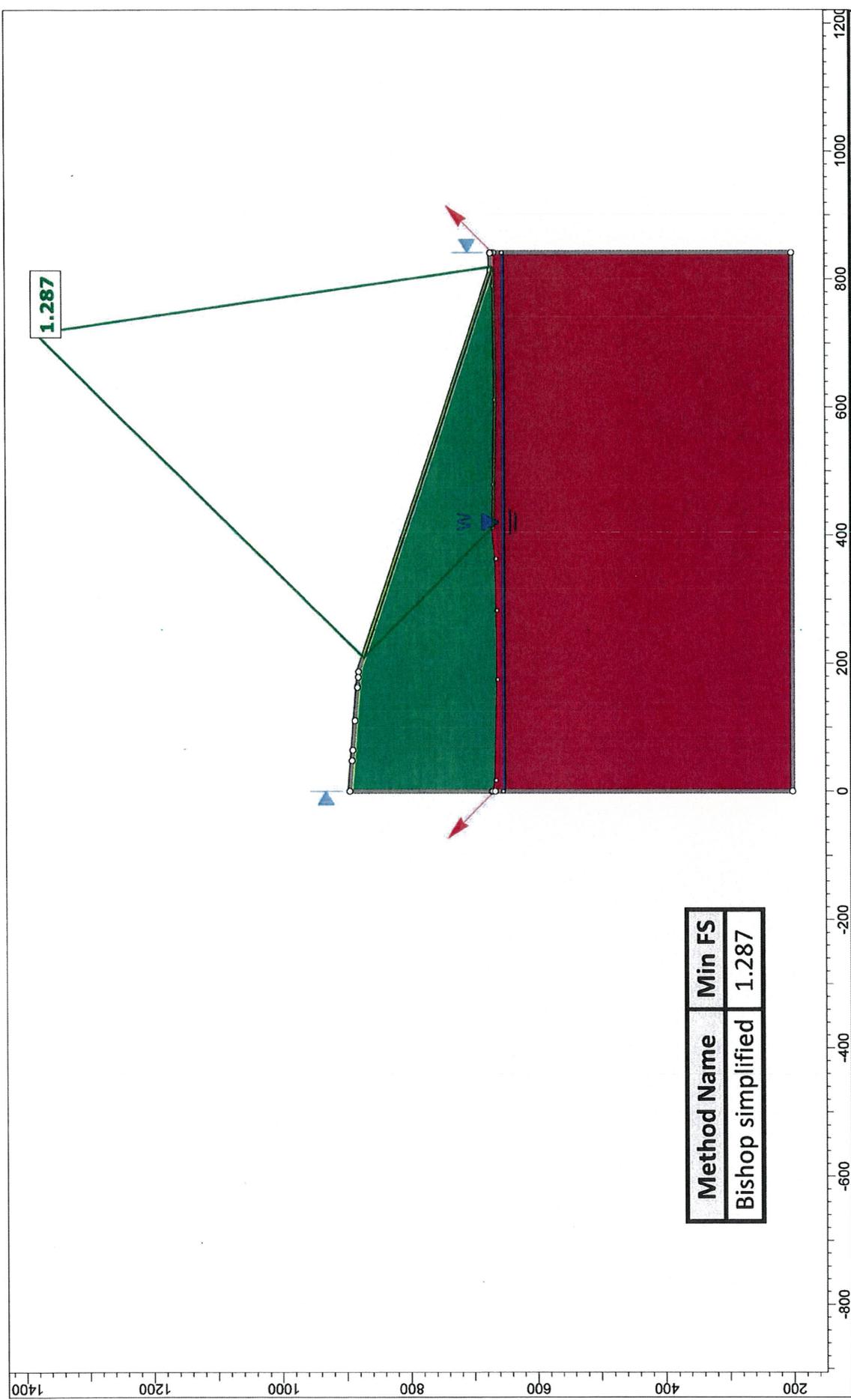
Shear Normal Functions

Name: User Defined 1		
	Effective Normal (psf)	Shear (psf)
0		500
208		500
417		500
625		500
626		406.53
834		541.61
1040		675.38
1250		811.76
2500		1623.52
25000		16235.2

Global Minimums

Method: bishop simplified

	FS	1.721500
Axis Location:		715.738, 1381.956
Left Slip Surface Endpoint:		208.710, 872.228
Right Slip Surface Endpoint:		819.303, 670.496
Resisting Moment:		9.14861e+08 lb-ft
Driving Moment:		5.31433e+08 lb-ft
Total Slice Area:		42627.8 ft ²
Surface Horizontal Width:		610.593 ft
Surface Average Height:		69.8137 ft



Method Name	Min FS
Bishop simplified	1.287



SLIDINTERPRET 9.018

TURKEY CREEK LANDFILL

Project		RESIDUAL STRESS - BLOCK	
Group	ENGINEERING	Scenario	RESIDUAL STRESS - BLOCK
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	2/18/2022	File Name	Section_B_RESIDUAL_Block.slm

Slide Analysis Information

Section_B_RESIDUAL_Block

Project Summary

File Name:	Section_B_RESIDUAL_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.431s
Project Title:	SECTION B - PEAK STRESS - BLOCK SEARCH
Date Created:	8/26/2021, 1:18:02 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check $m\alpha < 0.2$:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	10
Water Surface	None
Ru Value	0

BOUNDING SHALE

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: User Defined 1		
	Effective Normal (psf)	Shear (psf)
0		500
208		500
417		500
625		500
626		406.53
834		541.61
1040		675.38
1250		811.76
2500		1623.52
25000		16235.2

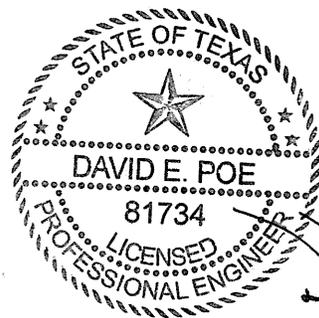
Global Minimums

Method: bishop simplified

	FS	1.287010
Axis Location:		715.738, 1381.956
Left Slip Surface Endpoint:		208.710, 872.228
Right Slip Surface Endpoint:		819.303, 670.496
Resisting Moment:		6.65149e+08 lb-ft
Driving Moment:		5.16818e+08 lb-ft
Total Slice Area:		42627.8 ft ²
Surface Horizontal Width:		610.593 ft
Surface Average Height:		69.8137 ft

APPENDIX IIIM-A-3
FINAL COVER AND OVERLINER CONFIGURATION
STABILITY ANALYSIS

Includes pages IIIM-A-3-1 through IIIM-A-3-84



DA

02-22-2022

FINAL CONFIGURATION AND OVERLINER SLOPE STABILITY ANALYSES

Required: Evaluate the slope stability of the proposed final cover configuration (closed) and overliner slopes.

Given: The slope stability analyses section locations are provided on Sheet IIIM-A-3-6. The section dimensions and analysis results are shown on Sheets IIIM-A-3-7 through IIIM-A-3-9.

Method:

A. Evaluate the stability of the proposed final cover slopes and overliner.

1. Determine the most critical final fill height slopes in the proposed design.
2. Generalize a soil profile for each critical section using available boring logs and sections.
3. Select material properties using average unit weights and strength parameters developed during field and laboratory investigations (laboratory testing summaries for site soils are provided in Appendix IIIG and summarized in Appendix IIIM, Table 3-1). Field results are shown on boring logs included in Appendix IIIG.
4. Perform stability analyses.
 - a. Analyze the excavation slopes using SLIDE2, Simplified Bishop method for circular failure surfaces and Simplified Janbu method with Rankine Blocks for translational failure surfaces. Use both total and effective stress strength parameters to model final configuration and overliner slope conditions for short and long term slope stability. Assumed peak and residual strength values were used to analyze both peak and large deformation failures at the geosynthetic interfaces.

References:

1. Bowles, Joseph E., *Foundation Analyses and Design*, 4th Ed., Mc-Graw-Hill, 1988.
2. Duncan, J.M. and Buchignani, A.L., *An Engineering Manual for Slope Stability Studies*, Department of Civil Engineering-University of California-Berkeley, 1975.
3. Koerner, Robert M., *Designing with Geosynthetics*, 5th Ed., Prentice-Hall, Inc., 2005.
4. SLIDE2 Modeler (v.9.018) (slope stability analyses computer program), RocScience, Inc., 2021.
5. Geosynthetic Research Institute (Koerner et.al.), *Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces*, GRI Report #30, 2005.

FINAL CONFIGURATION AND OVERLINER SLOPE STABILITY ANALYSES

Solution:

- A. Slope stability analyses of the final configuration and overliner slopes
1. The locations of the critical sections selected for the stability analysis are shown on Figures IIIM-A-3-6. Sections analyzed are shown with the most critical failure surfaces on Sheets IIIM-A-3-7 through IIIM-A-3-9.
 2. The soil profile used for each analysis was based on boring log data from previous site investigations from the undeveloped area of the site and the geologic cross sections (see Appendix IIIG - Geology Report).
 3. A summary table of the assumed material weight and strength properties is provided on pages IIIM-A-3-3 through IIIM-A-3-5. The material weight and strength parameter determination for each material type was based on previous laboratory testing results (Atterburg limits, natural moisture contents, unit weight, percent passing #200 sieve, standard Proctor, and strength testing), field strength testing (pocket penetrometer and standard penetration testing (SPT)), and engineering judgment from previous experience with similar materials. Laboratory testing results for the site soils are included in Appendix IIIM-C.
 4. The output from the slope stability analyses on the final cover and overliner slopes are provided on Sheets IIIM-A-3-7 through IIIM-A-3-9. The output for the critical failure surface of each section is included, while only graphics of the failure surfaces are included. A summary of analysis output is provided on Sheet IIIM-A-3-5.

FINAL CONFIGURATION AND OVERLINER SLOPE STABILITY ANALYSIS

Derivation of Slope Stability Parameters

Laboratory testing data are provided in Appendix IIIM-C, and field testing results are provided on logs included in Appendix IIIG. The following includes material strength properties based on the laboratory testing results and field test results for each subsurface unit.

Material/Unit	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)
Stratum I (Upper Sand)	125.9	129.7
Stratum II (Bounding Shale and Lower Sand)	133.0	135.0

The strength parameters used for analysis of the in-situ soils were selected based on the following:

Stratum I (Upper Sand) Input Parameters

Soil Penetration Tests (SPT) and hand penetrometer testing was performed on Stratum I during previous subsurface investigations. The cohesion and friction angle values listed in the table below are conservative strength representations for dense sand stratum, and were calculated from review of previous pocket penetrometer readings. Moist unit weight and saturated unit weight values are calculated from the dry unit weight, the moisture content, and the void ratio calculated assuming a specific gravity of 2.65 for sands. These unit weight values conservatively compare to the mean value obtained from previous field and laboratory testing performed on the material. The strength values below are considered conservative for sands and clayey sands.

	Total Stress		Effective Stress	
	Cohesion (lb/ft ²)	Friction Angle (phi)	Cohesion (lb/ft ²)	Friction Angle (phi)
Stratum I (Upper Sand)	2500	0.0	1000	39.1

Stratum II (Bounding Shale and Lower Sand) Input Parameters

Unconfined compression tests and hand penetrometer tests previously were performed on Stratum II, which is comprised of the shale unit underlying Stratum I (Upper Sand) interbedded with sand lenses (Lower Sand). The Lower Sand is discontinuous and lenticular bodies of predominately sand and sandstone in a shale matrix. The Lower Sand is difficult to differentiate during investigations. For the stability analyses, the Bounding Shale and Lower Sand were considered as one stratum, and distinguishing the sand lenses within the shale for stability analyses was deemed unnecessary due to the difficulty in defining the separate units, and the generally hard nature of both the shale and the Lower Sand. The cohesion and friction angle values in the below table are conservative representations of hard shale units. Moist unit weight and saturated unit weight values are calculated from the dry unit weight, the moisture content, and the void ratio calculated assuming a specific gravity of 2.65 for shales. These moist unit weight values were then averaged and this value is used in the slope stability analysis.

	Total Stress		Effective Stress	
	Cohesion (lb/ft ²)	Friction Angle (phi)	Cohesion (lb/ft ²)	Friction Angle (phi)
Stratum II (Bounding Shale and Lower Sand)	4100	0.0	1000	38.6

FINAL CONFIGURATION AND OVERLINER SLOPE STABILITY ANALYSIS

Solid Waste Input Parameters

Soil Description	Overburden Pressure (psf)	Moist Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Solid Waste	< 30 kPa	65	500	0
	> 30 kPa	65	0	33

The above information was derived from several references. Reference 3 provides a summary of several studies that have been completed to develop the shear strength parameters for MSW (refer to Chapter 6.7 in Ref. 3). MSW shear strength parameters reported in technical literature references vary widely, with friction angles as low as 10° and as high as 53°, and cohesion values varying from 0 psf to 1,400 psf. Many of the lower values are directly contradicted by observations of actual stable landfill slopes. A summary list of a few of the studies completed is provided below.

Reference	Data Type	Results
Pagotto & Rimoldi (1987)	Back-calculation from plate bearing tests	$\phi = 22^\circ$ $c = 605 \text{ psf (29 kPa)}$
Landva & Clark (1990)	Laboratory direct shear tests on MSW	$\phi = 24^\circ, c = 460 \text{ psf (22 kPa)}$ to $\phi = 39^\circ, c = 400 \text{ psf (19 kPa)}$
Richardson & Reynolds (1991)	Large direct shear tests performed in-situ	$\phi = 18^\circ \text{ to } 43^\circ$ $c = 210 \text{ psf (10 kPa)}$
Kavazanjian, Bonaparte, et.al. (1995)	Back-calculation from multiple authors and sites	Normal Stress < 30 kPa: $\phi = 0^\circ$ and $c = 500 \text{ psf}$ Normal Stress > 30 kPa: $\phi = 33^\circ$ and $c = 0 \text{ psf}$

The results presented by Kavazanjian et.al. above were utilized in the analysis as representative of MSW.

The moist unit weight is estimated at the midpoint of the average depth to represent the average unit weight of waste/cover soil within the landfill, generally consistent with what is used in the site life calculations in Appendix IIIM.

Liner and Protective Cover Input Parameters

Slope stability strength parameters for constructed soil materials were selected as follows based on engineering judgment. Prior to construction,

Material	Moist Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Clay Liner - Total Stress, Bishops ⁽¹⁾	120	100	18
Clay Liner - Effective Stress, Bishops ⁽¹⁾	120	100	18
Liner System - Peak Stress - Rankine ⁽²⁾ (Section D-D only)	120	100	13
Liner System - Residual Stress - Rankine ⁽²⁾ (Section D-D only)	120	80	8
Liner System - Peak Stress - Rankine ⁽²⁾ (Section C-C and E-E only)	120	100	18
Liner System - Residual Stress - Rankine ⁽²⁾ (Section C-C and E-E only)	120	80	10
Protective Cover (Bishops and Rankine) (modeled as liner system)	120	--	--

1. A cohesion of 100 psf and internal friction angle of 18 degrees (effective and total stress) is used for the clay liner for Simplified Bishop method of the slope stability analysis, and assumes pore pressure are dissipated within the liner system components.

2. For global translational stability analysis (Janbu/Rankine Block) of the final configuration, the strength parameters of the weakest interface were used to model the clay liner, as presented in the below table of Minimum Interface Strength Parameters. Values represented in table are representative of GCL/liner interfaces, with Section D-D incorporating smooth geomembrane, and Sections C-C and E-E incorporating textured geomembrane.

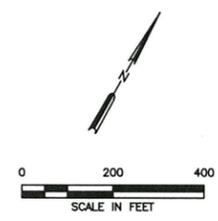
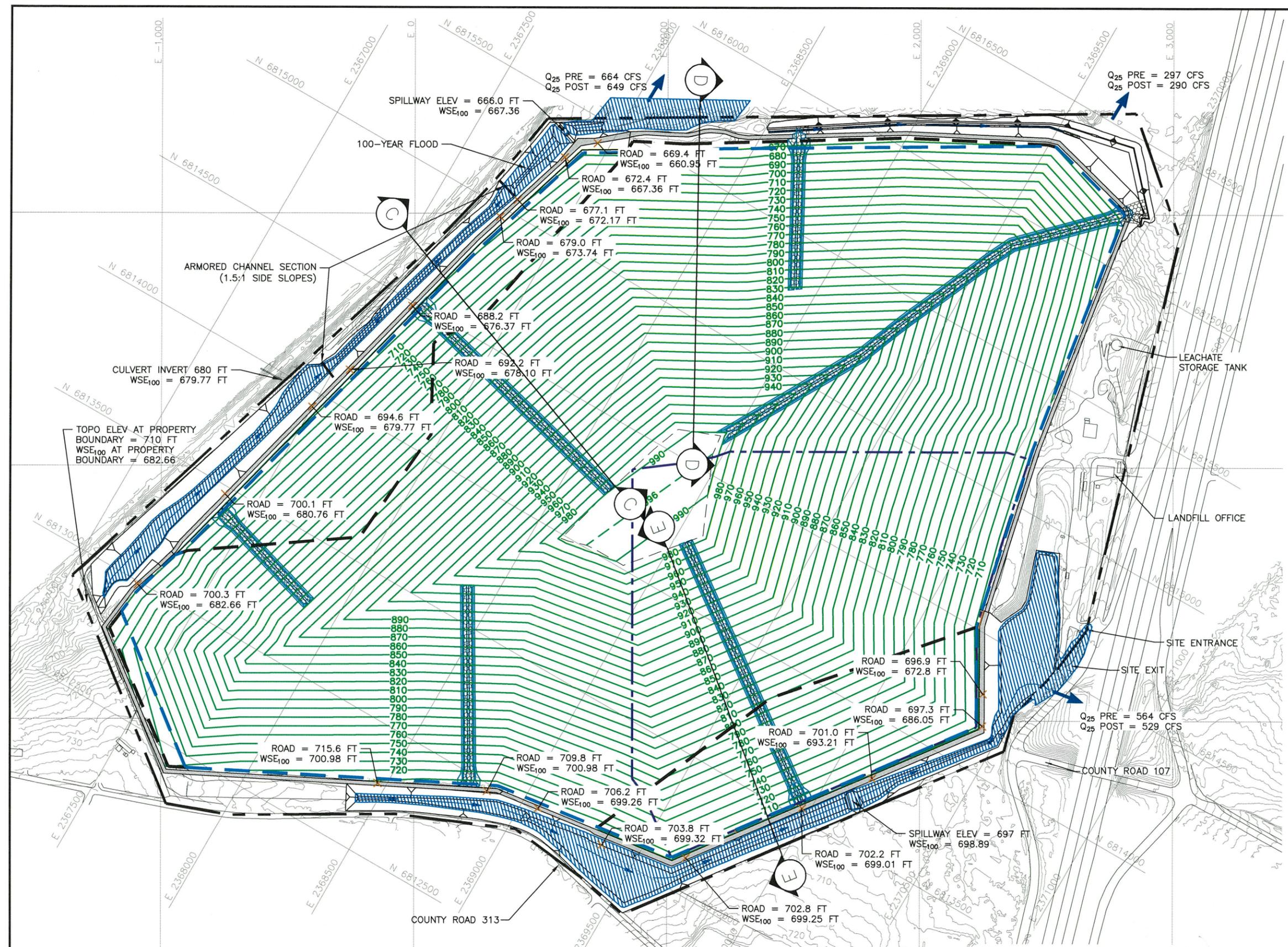
FINAL CONFIGURATION AND OVERLINER SLOPE STABILITY ANALYSIS

Factor of Safety Summary for Overliner and Final Cover Slope Stability Analysis

Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Total	Effective	Total	Effective	Total	Effective
		Overliner C-1	Bishop-Circular	1.52	1.88	1.3	1.5
Final Cover D-1	Bishop-Circular	1.51	2.03	1.3	1.5	YES	YES
Final Cover E-1	Bishop-Circular	1.77	2.57	1.3	1.5	YES	YES

Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Peak	Residual	Peak	Residual	Peak	Residual
		Overliner C-2	Janbu/Rankine Block	1.55	1.06	1.5	1.0
Final Cover D-2	Janbu/Rankine Block	1.56	1.25	1.5	1.0	YES	YES
Final Cover E-2	Janbu/Rankine Block	2.12	1.53	1.5	1.0	YES	YES

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LEGEND

	PERMIT BOUNDARY
	EXPANSION LIMIT OF WASTE
	HISTORICAL LIMIT OF WASTE
	STATE PLANE GRID
	EXISTING CONTOUR
	PROPOSED FINAL COVER CONTOUR
	DRAINAGE LETDOWN
	100-YEAR FLOODPLAIN (SEE NOTE 2)
	DISCHARGE POINT (SEE NOTE 2)

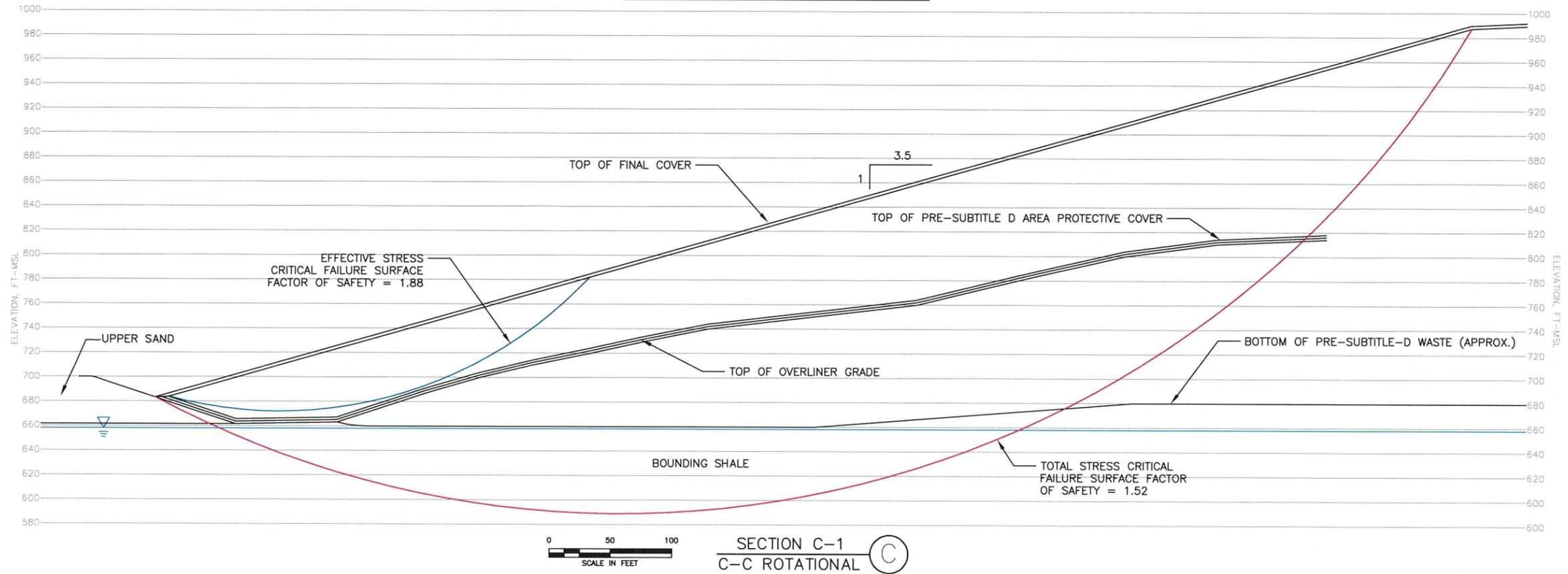
- NOTE:**
- EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS FROM AERIAL PHOTOGRAPHY FLOWN ON 01-08-2021. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.
 - FLOODPLAIN ELEVATION AND FLOW RATE BASED IN HYDRAULIC AND HYDROLOGIC MODELS PREPARED BY WEAVER CONSULTANTS GROUP IN FEBRUARY 2021. THESE MODELS ARE TIED TO THIS SPECIFIC FINAL COVER LAYOUT AND PERIMETER STRUCTURE LAYOUT. REFER TO THE TEXT IN THE MEMORANDUM REGARDING THE PRELIMINARY DRAINAGE ANALYSIS AND FEMA FLOODPLAIN COORDINATION.



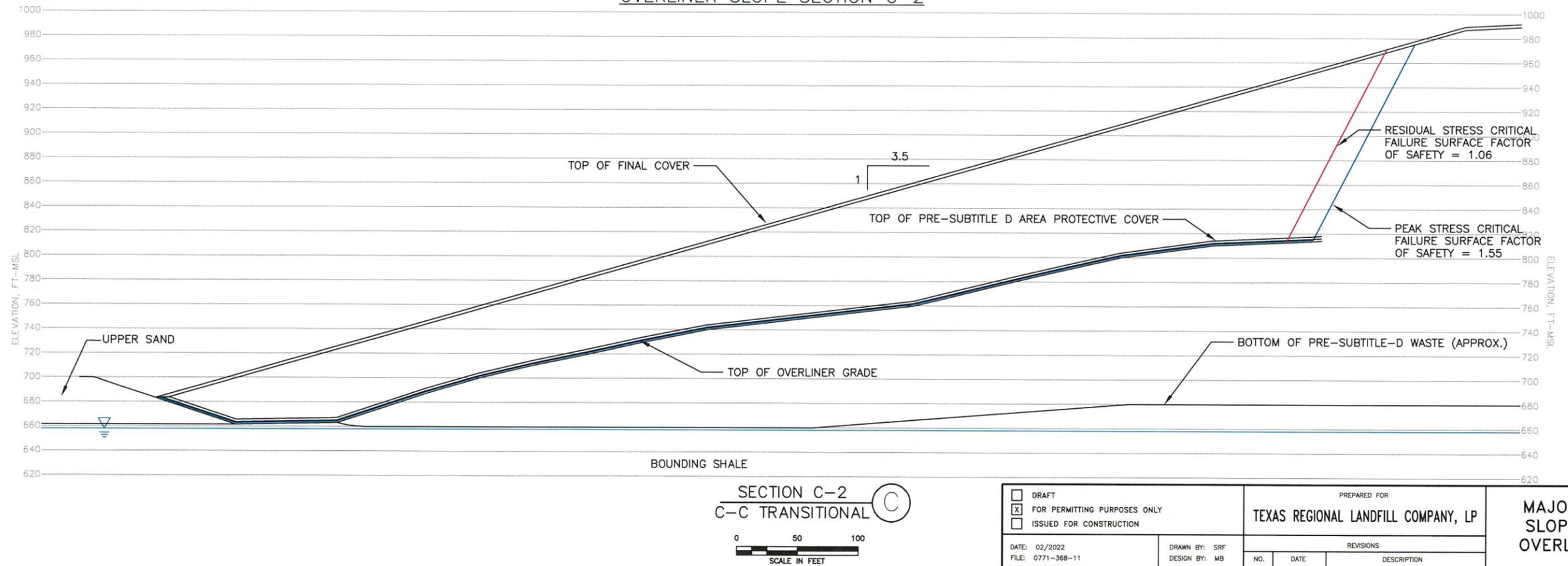
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02-22-2022

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	DATE: 02/2022 FILE: 0771-368-11 CAD: SHEET IIM-A-3-6.DWG	DRAWN BY: SRF DESIGN BY: MB REVIEWED BY: DEP	TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS						
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NO.	DATE	DESCRIPTION							

OVERLINER SLOPE SECTION C-1



OVERLINER SLOPE SECTION C-2



02-22-2022

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<input type="checkbox"/> ISSUED FOR CONSTRUCTION														
DATE: 02/2022	DRAWN BY: SRF	<table border="1"> <thead> <tr> <th colspan="3">REVISIONS</th> </tr> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	REVISIONS			NO.	DATE	DESCRIPTION						
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FILE: 0771-368-11	DESIGN BY: MB													
CAD: SHEET IIM-A-3-7.DWG	REVIEWED BY: DEP													

**MAJOR PERMIT AMENDMENT
 SLOPE STABILITY ANALYSIS
 OVERLINER SLOPE SECTIONS**

TURKEY CREEK LANDFILL
 JOHNSON COUNTY, TEXAS

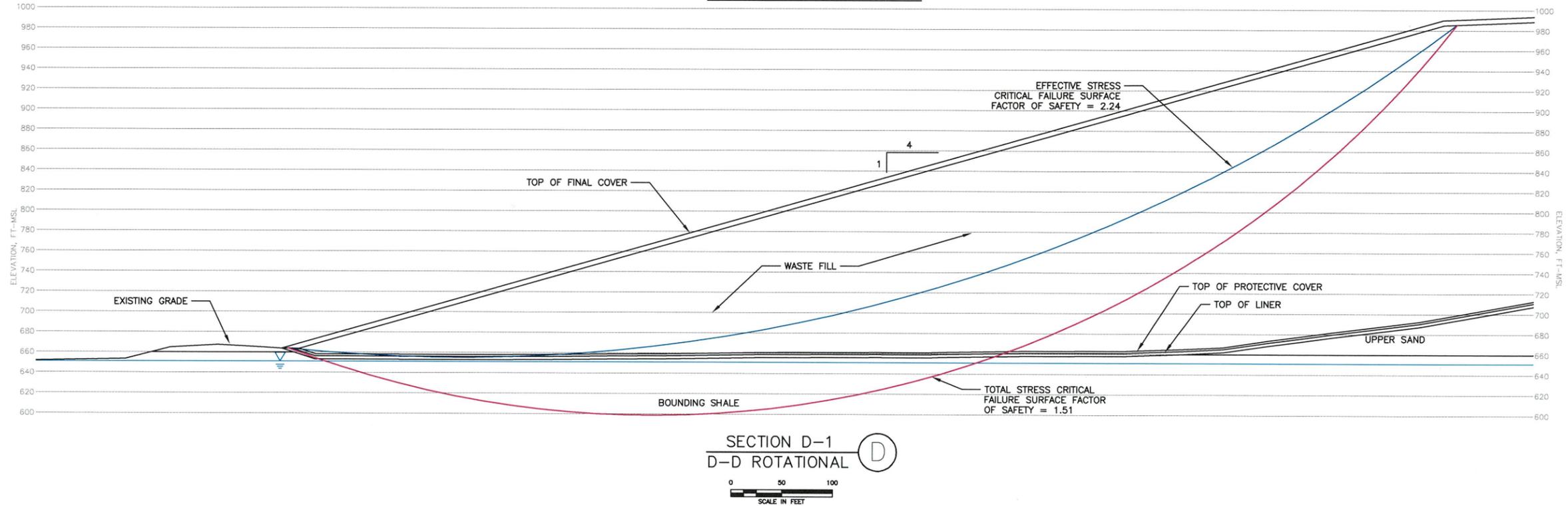
WWW.WCGRP.COM SHEET IIM-A-3-7

Weaver Consultants Group
 TBPE REGISTRATION NO. F-3727

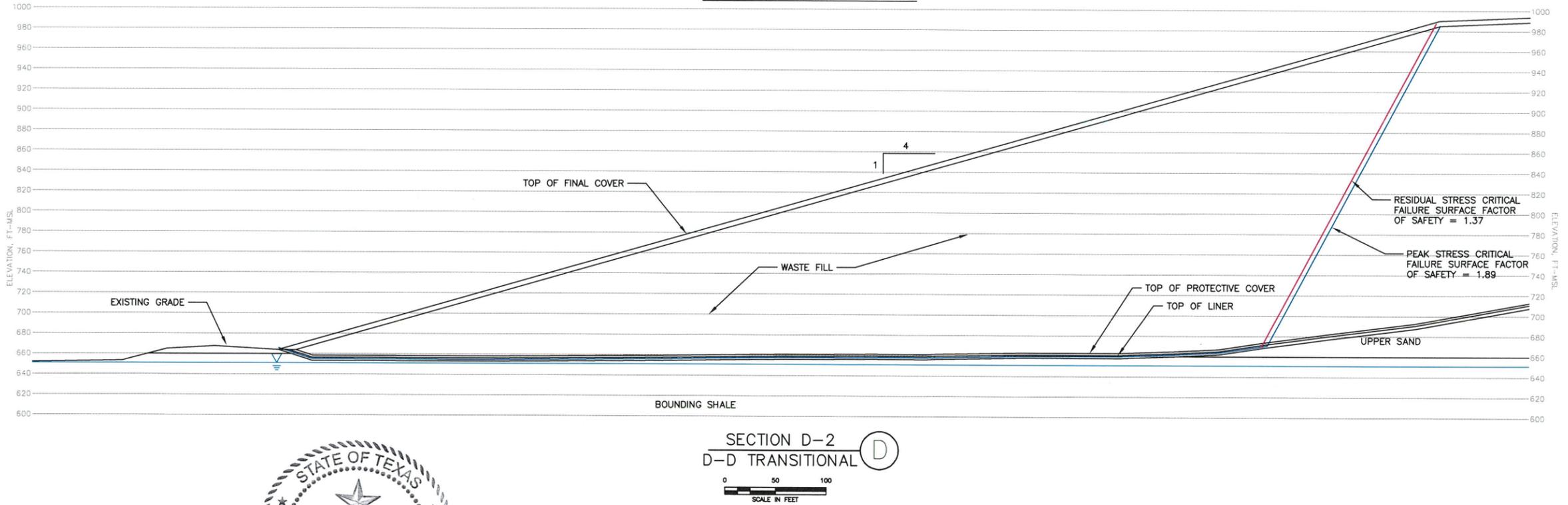
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FINAL COVER SECTION D-1



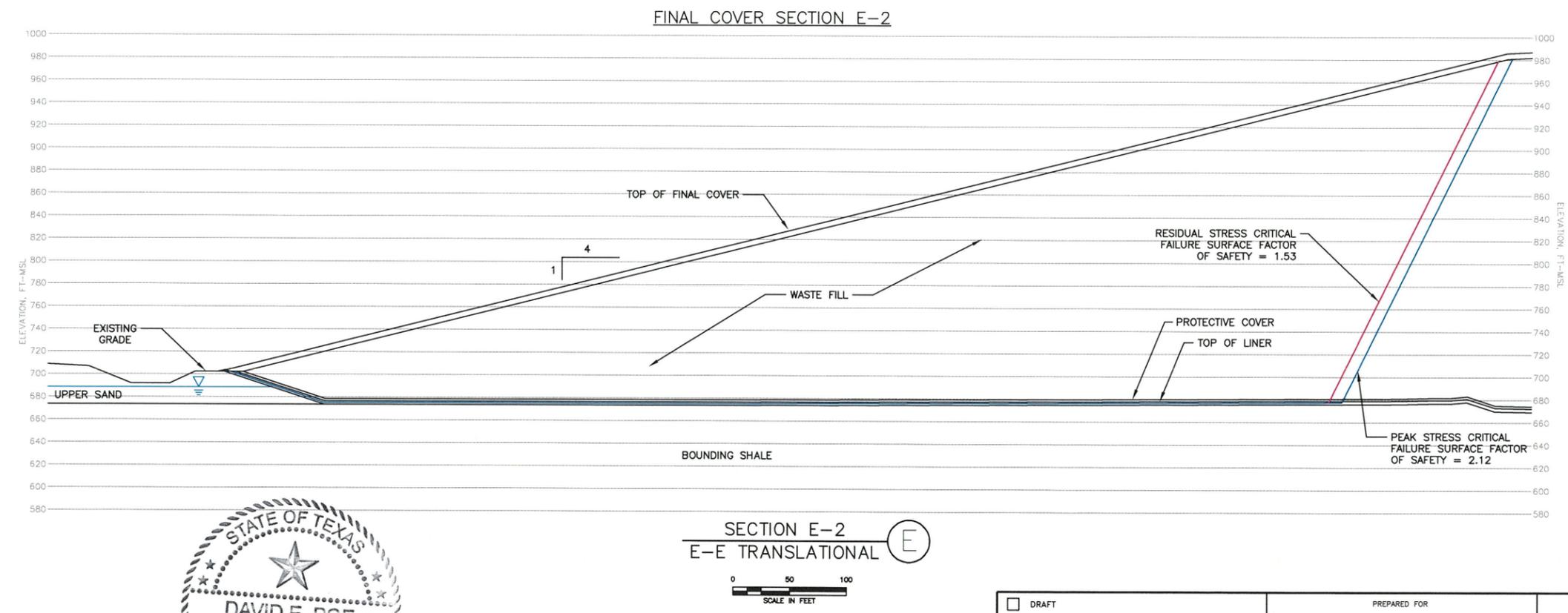
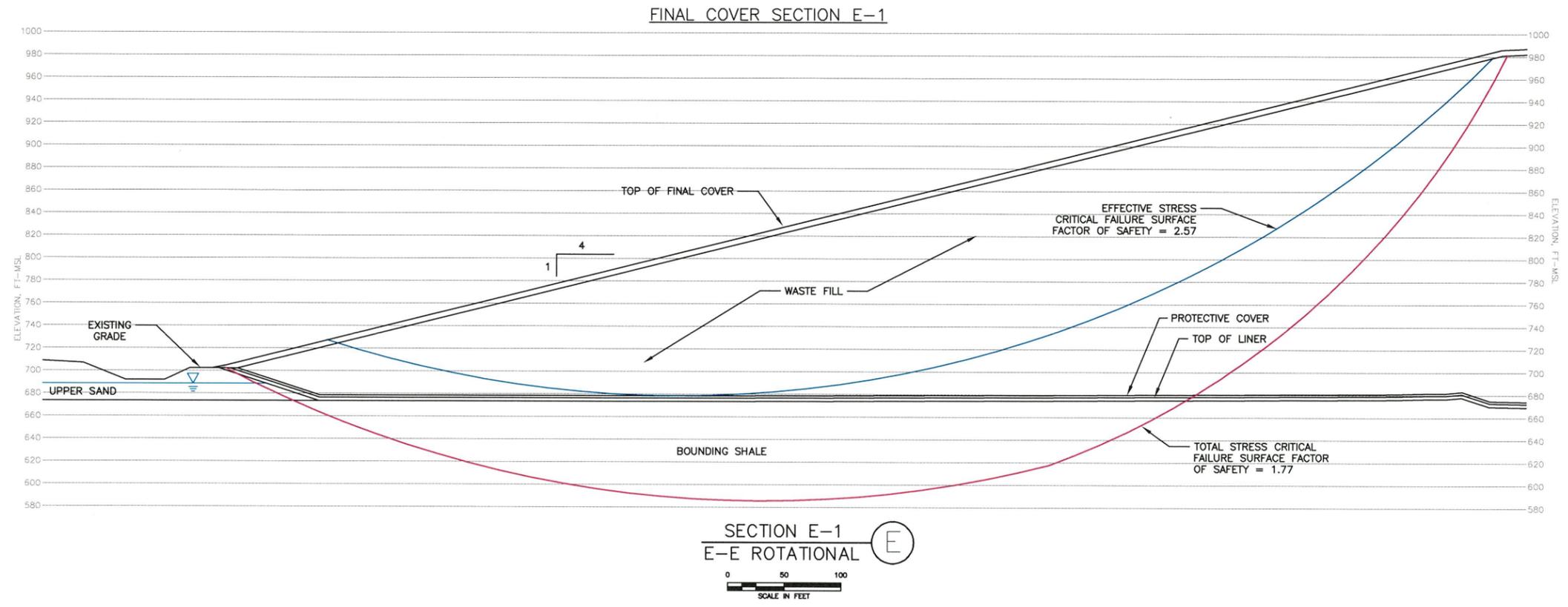
FINAL COVER SECTION D-2



JR
02-22-2022

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DATE: 02/2022	DRAWN BY: SRF	<table border="1"> <thead> <tr> <th colspan="3">REVISIONS</th> </tr> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	REVISIONS			NO.	DATE	DESCRIPTION						
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FILE: 0771-368-11	DESIGN BY: MB													
CAD: SHEET IIM-A-3-8.DWG	REVIEWED BY: DEP													
Weaver Consultants Group TBPE REGISTRATION NO. F-3727														

MAJOR PERMIT AMENDMENT
SLOPE STABILITY ANALYSIS
FINAL COVER SECTIONS
TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS



JJP
02-22-2022

<input type="checkbox"/> DRAFT <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR TEXAS REGIONAL LANDFILL COMPANY, LP										
	REVISIONS										
DATE: 02/2022 FILE: 0771-368-11 CAD: SHEET IIM-A-3-9.DWG	DRAWN BY: SRF DESIGN BY: MB REVIEWED BY: DEP	<table border="1"> <thead> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	NO.	DATE	DESCRIPTION						
NO.	DATE	DESCRIPTION									
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		MAJOR PERMIT AMENDMENT SLOPE STABILITY ANALYSIS FINAL COVER SECTIONS TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS									

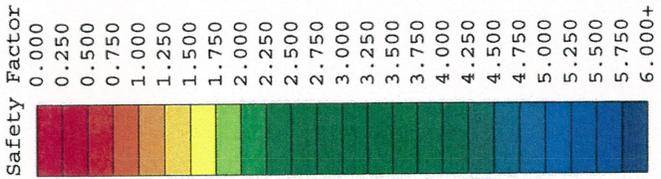
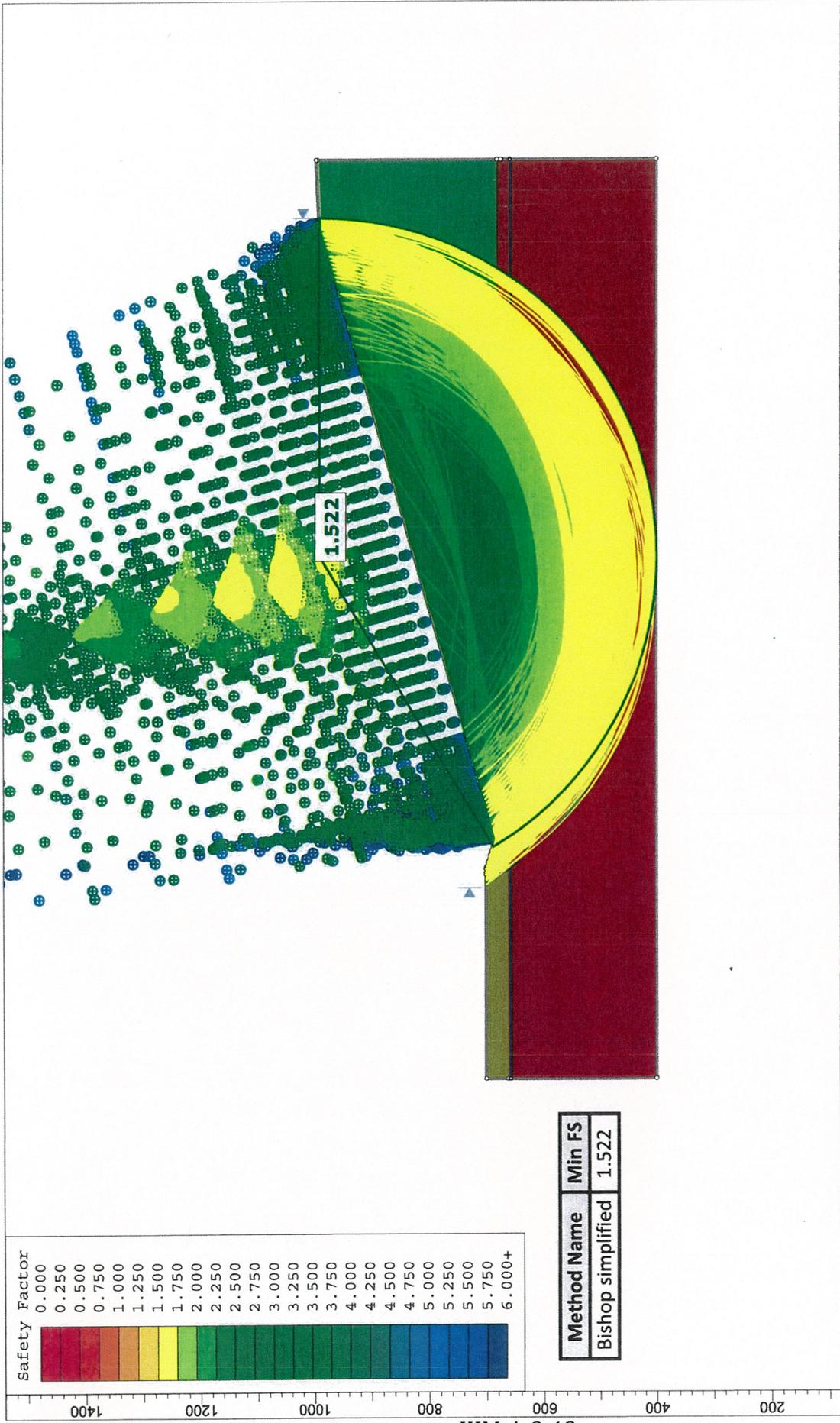
MAJOR PERMIT AMENDMENT SLOPE STABILITY ANALYSIS FINAL COVER SECTIONS TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS	WWW.WCGRP.COM	SHEET IIM-A-3-9
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**TURKEY CREEK LANDFILL
MAJOR PERMIT AMENDMENT APPLICATION
SLOPE STABILITY ANALYSIS**

**APPENDIX IIIM-A-3
SLIDE2 COMPUTER MODEL OUTPUT FILES
FINAL COVER AND OVERLINER CONFIGURATIONS**

**OVERLINER CONFIGURATION
SECTION C-C**



Method Name	Min FS
Bishop simplified	1.522

IIIM-A-3-12

Project	
TURKEY CREEK LANDFILL	
Group	ENGINEERING
Scenario	TOTAL STRESS - CIRCULAR
Drawn By	PREP BY: MB CHKD BY: DEP
Company	WEAVER CONSULTANTS GROUP
Date	1/18/2022
File Name	Section_C_Total_Stress.slm



SLIDEINTERPRET 9.0.18

Slide Analysis Information

Section_C_Total_Stress

Project Summary

File Name:	Section_C_Total_Stress.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:01.10s
Project Title:	SECTION C-EFFECTIVE STRESS
Date Created:	8/26/2021, 2:54:58 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
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Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

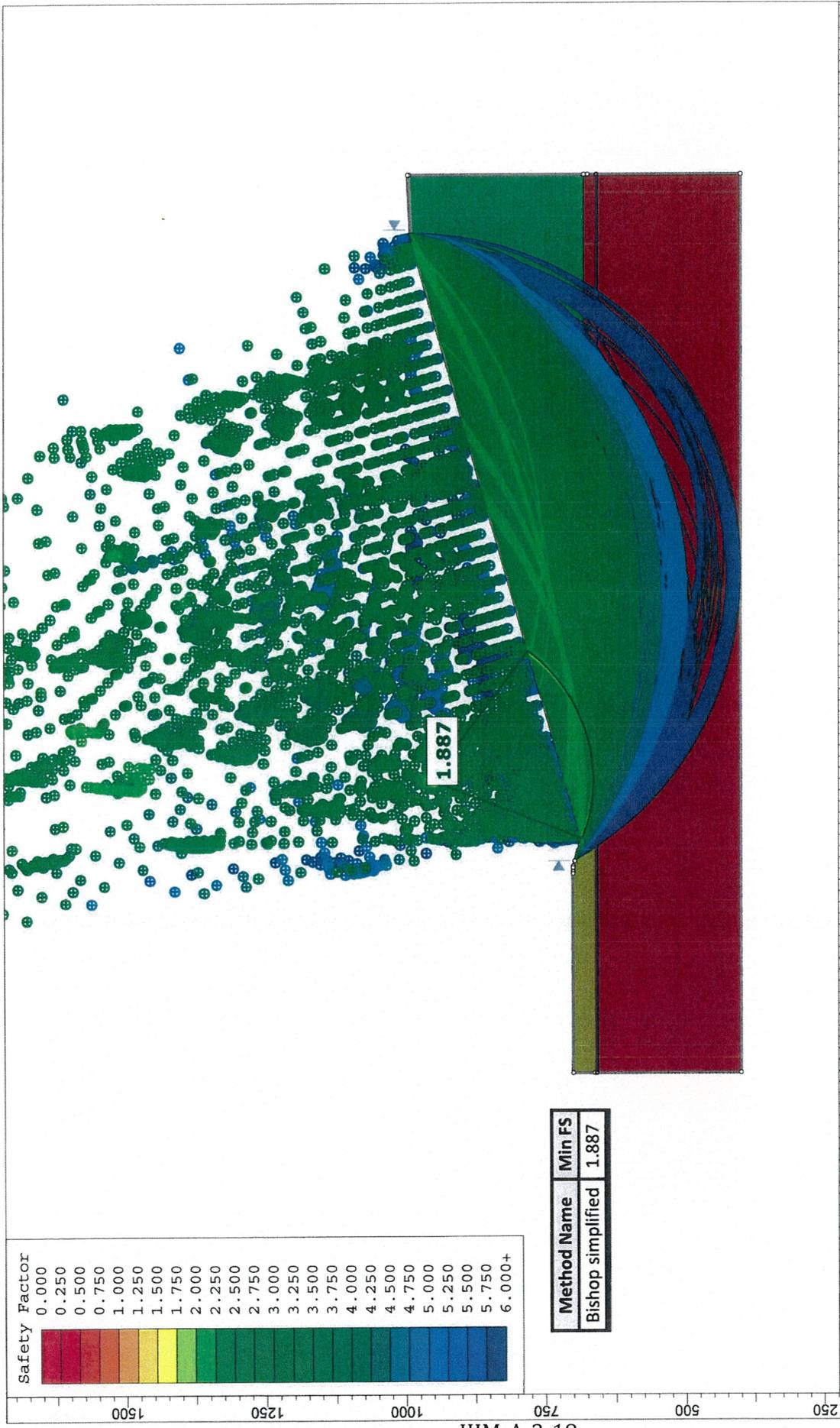
Shear Normal Functions

Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

Global Minimums

Method: bishop simplified

	FS	1.521580
Center:		927.928, 990.233
Radius:		590.219
Left Slip Surface Endpoint:		421.117, 687.742
Right Slip Surface Endpoint:		1518.147, 990.233
Resisting Moment:		3.45247e+09 lb-ft
Driving Moment:		2.26901e+09 lb-ft
Total Slice Area:		360204 ft ²
Surface Horizontal Width:		1097.03 ft
Surface Average Height:		328.345 ft



TURKEY CREEK LANDFILL	
Group	ENGINEERING
Scenario	EFFECTIVE STRESS - CIRCULAR
Drawn By	PREP BY: MB CHKD BY: DEP
Company	WEAVER CONSULTANTS GROUP
Date	1/18/2022
File Name	Section_C_Effective_Stress.slmtd



SLIDEINTERPRET 9.0.18

Slide Analysis Information

Section_C_Effective_Stress

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
-------	---

Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

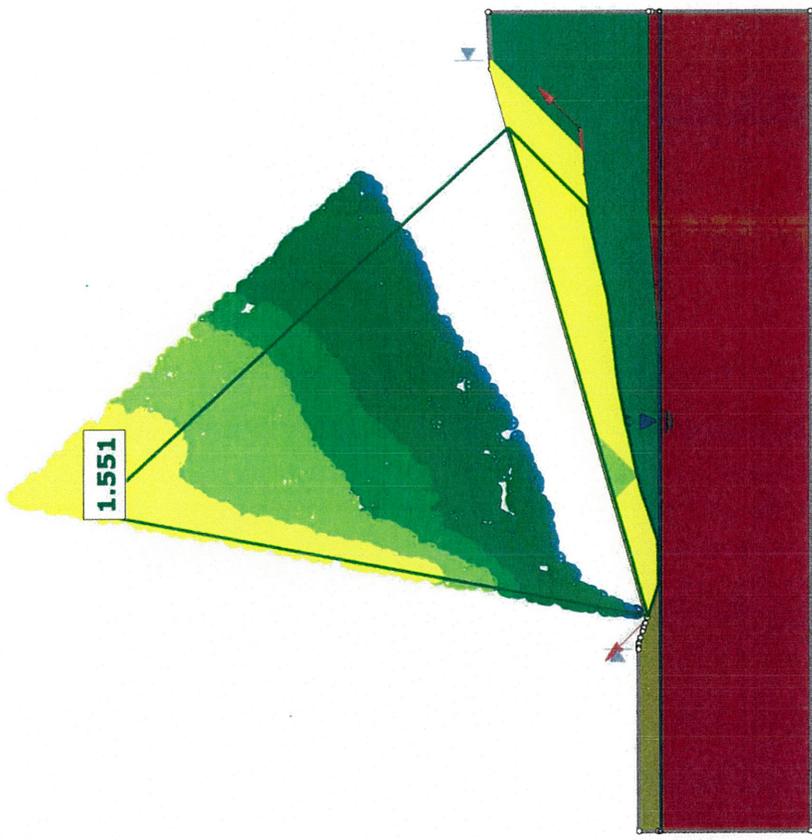
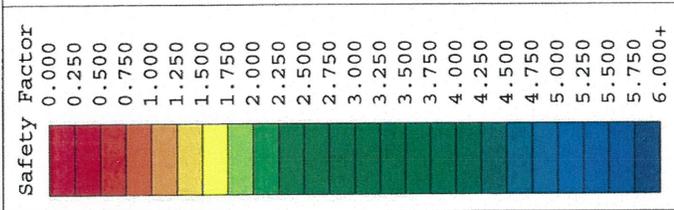
Shear Normal Functions

Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

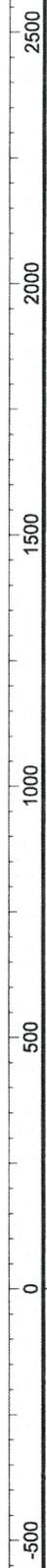
Global Minimums

Method: bishop simplified

	FS	1.887500
Center:		539.359, 953.550
Radius:		289.511
Left Slip Surface Endpoint:		435.125, 683.455
Right Slip Surface Endpoint:		770.468, 779.181
Resisting Moment:		1.25358e+08 lb-ft
Driving Moment:		6.64145e+07 lb-ft
Total Slice Area:		13870.8 ft ²
Surface Horizontal Width:		335.343 ft
Surface Average Height:		41.3628 ft



Method Name	Min FS
Bishop simplified	1.551



SLIDEINTERPRET 9.0.18

TURKEY CREEK LANDFILL

Project	PEAK STRESS - BLOCK SEARCH
Group	ENGINEERING
Drawn By	PREP BY: MB
Date	1/18/2022
Scenario	PEAK STRESS - BLOCK SEARCH
Company	WEAVER CONSULTANTS GROUP
File Name	Section_C_Peak_Block.slmd

Slide Analysis Information

Section_C_Peak_Block

Project Summary

File Name:	Section_C_Peak_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.533s
Project Title:	SECTION C-PEAK STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 2:54:58 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
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Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

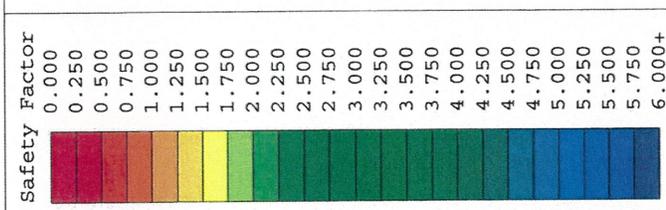
Shear Normal Functions

Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

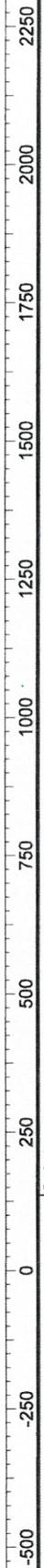
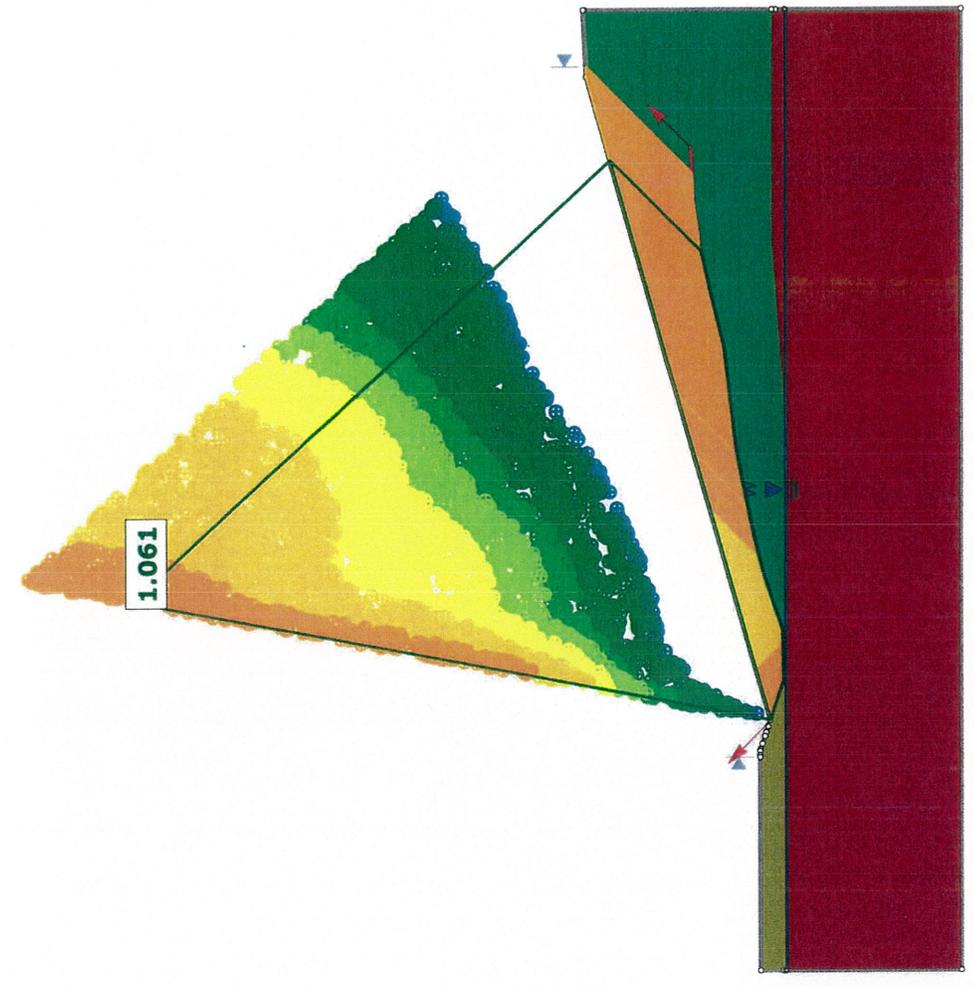
Global Minimums

Method: bishop simplified

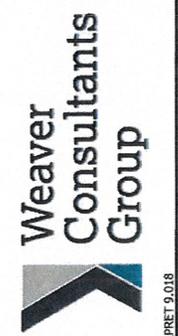
	FS	1.551380
Axis Location:		642.871, 1775.776
Left Slip Surface Endpoint:		437.943, 684.259
Right Slip Surface Endpoint:		1393.128, 956.923
Resisting Moment:		1.89977e+09 lb-ft
Driving Moment:		1.22457e+09 lb-ft
Total Slice Area:		66326.6 ft2
Surface Horizontal Width:		955.185 ft
Surface Average Height:		69.4386 ft



Method Name	Min FS
Bishop simplified	1.061



IIIM-A-3-30



SLIDENTERPRET_9.018

TURKEY CREEK LANDFILL

Project	TURKEY CREEK LANDFILL		
Group	ENGINEERING	Scenario	RESIDUAL STRESS - BLOCK SEARCH
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	1/18/2022	File Name	Section_C_Residual_Block.simd

Slide Analysis Information

Section_C_Residual_Block

Project Summary

File Name:	Section_C_Residual_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.485s
Project Title:	SECTION C-RESIDUAL STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 2:54:58 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	12
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	10
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	10
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
-------	---

Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

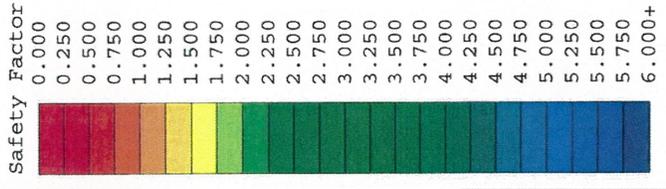
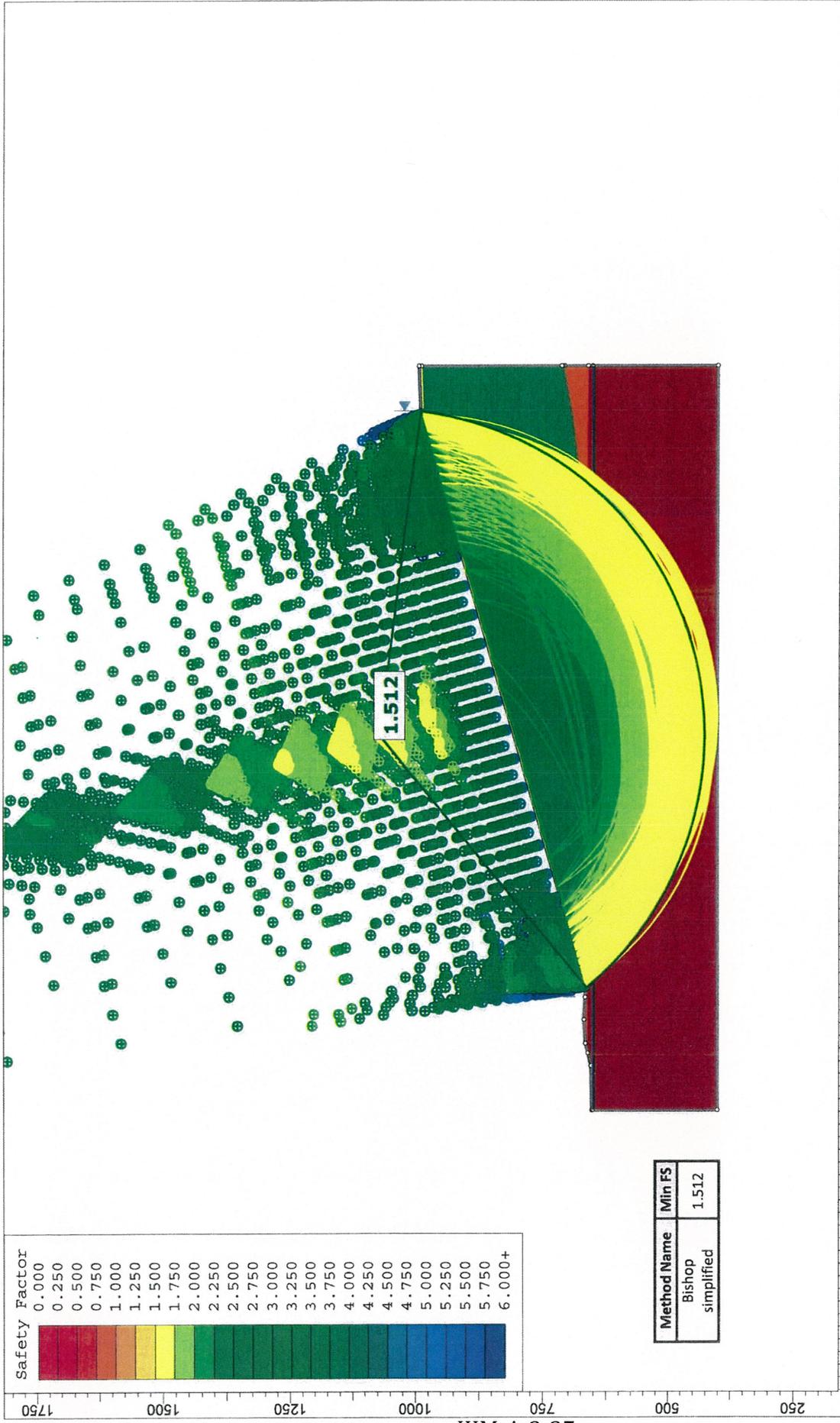
Global Minimums

Method: bishop simplified

	FS	1.061010
Axis Location:		635.134, 1750.701
Left Slip Surface Endpoint:		434.742, 683.345
Right Slip Surface Endpoint:		1368.783, 949.974
Resisting Moment:		1.20873e+09 lb-ft
Driving Moment:		1.13923e+09 lb-ft
Total Slice Area:		63682.7 ft ²
Surface Horizontal Width:		934.041 ft
Surface Average Height:		68.1798 ft

**FINAL COVER CONFIGURATION
SECTION D-D**

IIIM-A-3-36



Method Name	Min FS
Bishop simplified	1.512

IIIM-A-3-37

		Project	
		TURKEY CREEK LANDFILL	
Group	ENGINEERING	Scenario	TOTAL STRESS - CIRCULAR
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	1/25/2022	File Name	Section_D_Total_Stress.slm

SLIDEINTERPRET 9.018

Slide Analysis Information

Section_D_Total_Stress

Project Summary

File Name:	Section_D_Total_Stress.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:01.97s
Project Title:	SECTION D-TOTAL STRESS-CIRCULAR
Date Created:	8/26/2021, 3:53:34 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	13
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	13
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
-------	---

Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4200
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

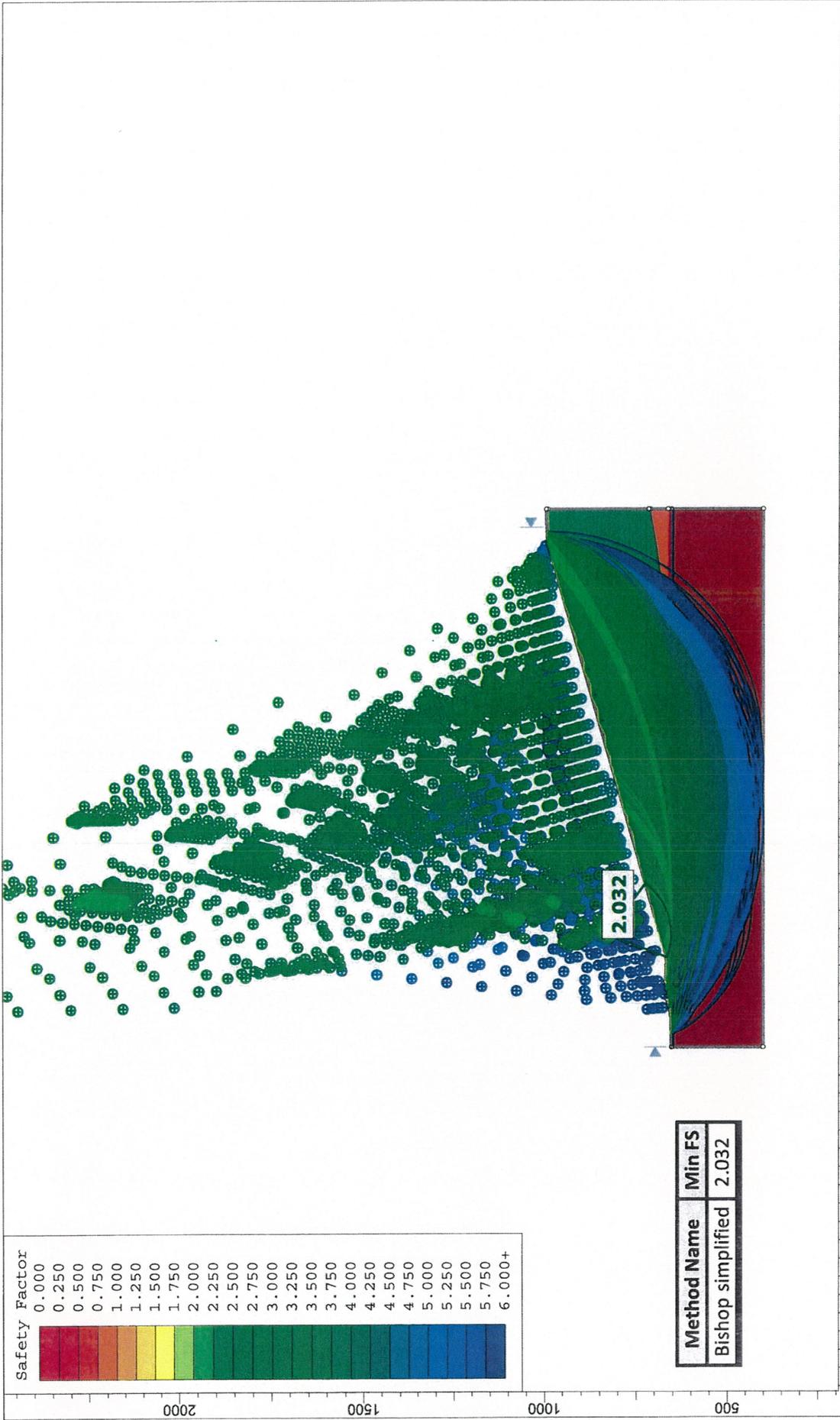
Shear Normal Functions

Name: User Defined 2	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

Global Minimums

Method: bishop simplified

	FS	1.511950
Center:		869.872, 1073.565
Radius:		646.659
Left Slip Surface Endpoint:		369.455, 663.992
Right Slip Surface Endpoint:		1511.138, 990.219
Resisting Moment:		3.8741e+09 lb-ft
Driving Moment:		2.56232e+09 lb-ft
Total Slice Area:		333831 ft2
Surface Horizontal Width:		1141.68 ft
Surface Average Height:		292.402 ft



IIIM-A-3-43

TURKEY CREEK LANDFILL	
Project	Scenario
Group	ENGINEERING
Drawn By	PREP BY: MB
Date	1/25/2022
Company	EFFECTIVE STRESS - CIRCULAR
File Name	WEAVER CONSULTANTS GROUP
	Section_D_Effective_Stress.slm



SLIDEINTERPRET 9.0.18

Slide Analysis Information

Section_D_Effective_Stress

Project Summary

File Name:	Section_D_Effective_Stress.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.988s
Project Title:	SECTION D-EFFECTIVE STRESS-CIRCULAR
Date Created:	8/26/2021, 3:53:34 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	13
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	13
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
-------	---

Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

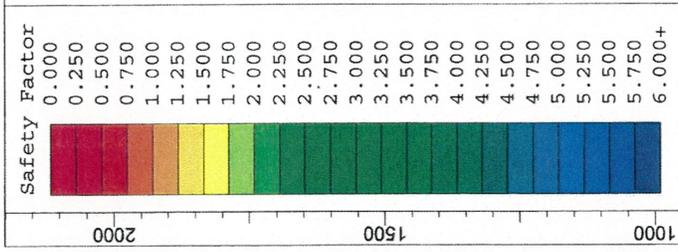
Shear Normal Functions

Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

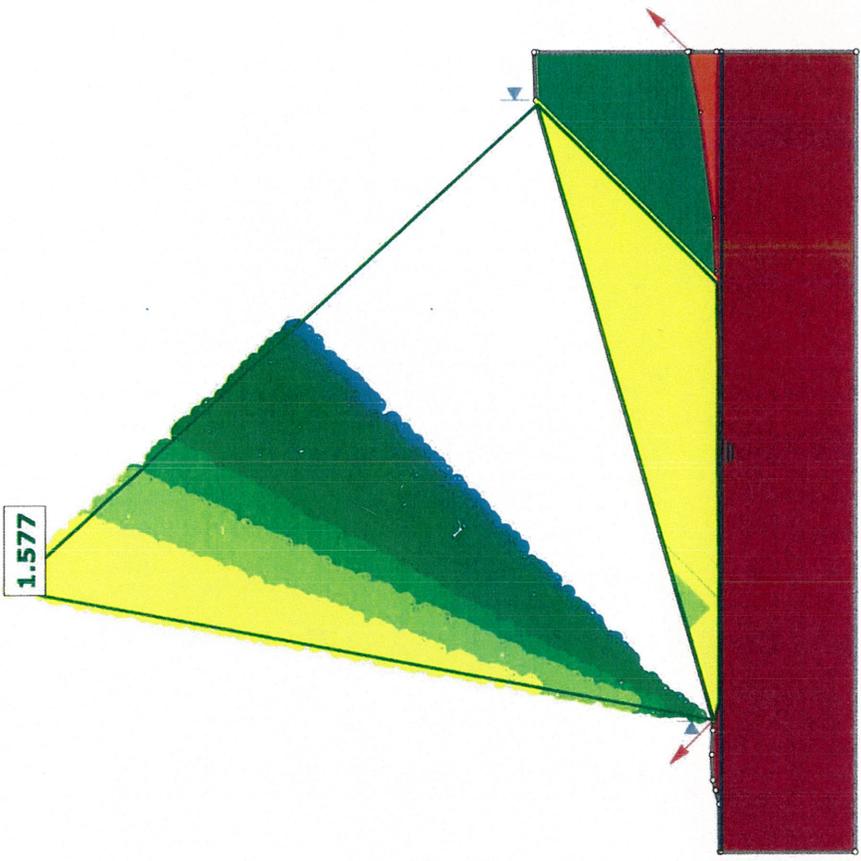
Global Minimums

Method: bishop simplified

	FS	2.032080
Center:		436.247, 829.117
Radius:		175.886
Left Slip Surface Endpoint:		372.987, 665.001
Right Slip Surface Endpoint:		576.667, 723.201
Resisting Moment:		3.26499e+07 lb-ft
Driving Moment:		1.60672e+07 lb-ft
Total Slice Area:		5116.68 ft2
Surface Horizontal Width:		203.68 ft
Surface Average Height:		25.1212 ft



1.577



Method Name	Min FS
Bishop simplified	1.577



Project

TURKEY CREEK LANDFILL

Group	ENGINEERING
Drawn By	PREP BY: MB CHKD BY: DEP
Date	1/25/2022

Scenario	PEAK STRESS - BLOCK
Company	WEAVER CONSULTANTS GROUP
File Name	Section_D_Peak_Block.simd



SLIDEINTERPRET 9.018

Slide Analysis Information

Section_D_Peak_Block

Project Summary

File Name:	Section_D_Peak_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.476s
Project Title:	SECTION D-PEAK STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 3:53:34 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	13
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	13
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
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Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

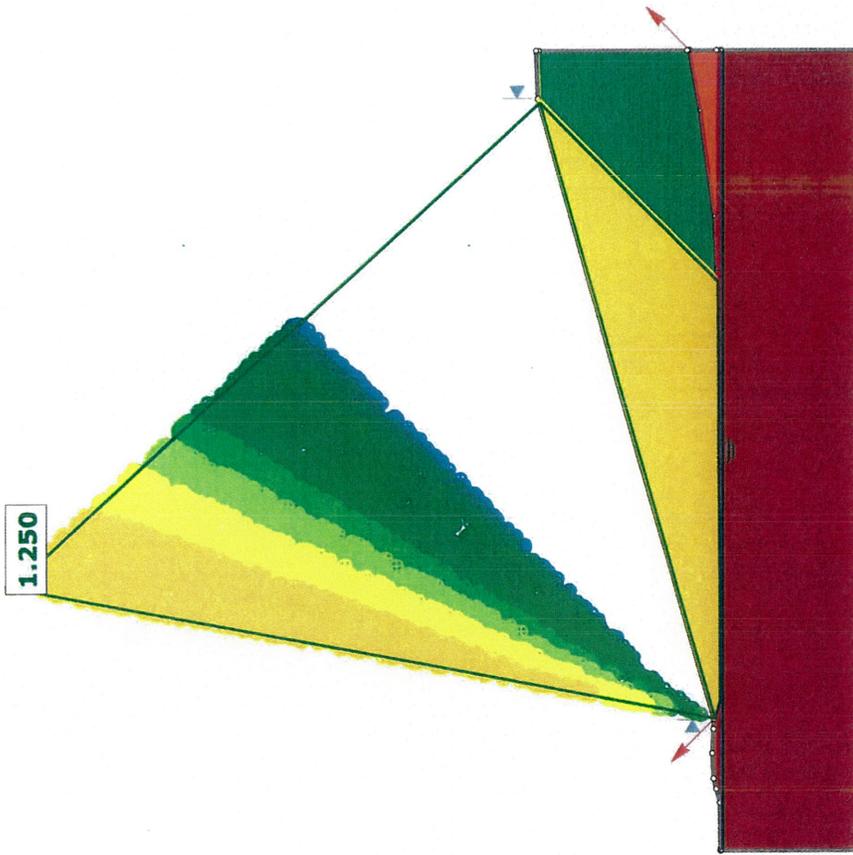
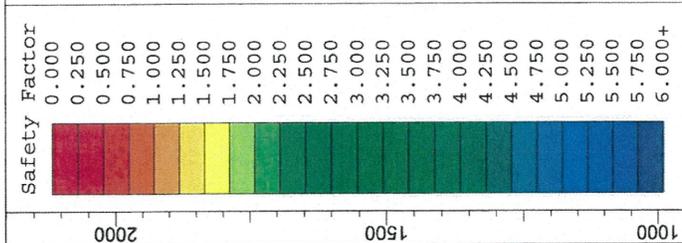
Shear Normal Functions

Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

Global Minimums

Method: bishop simplified

	FS	1.576590
Axis Location:		613.535, 1959.596
Left Slip Surface Endpoint:		370.711, 664.351
Right Slip Surface Endpoint:		1504.037, 988.190
Resisting Moment:		4.3441e+09 lb-ft
Driving Moment:		2.75539e+09 lb-ft
Total Slice Area:		137310 ft2
Surface Horizontal Width:		1133.33 ft
Surface Average Height:		121.157 ft



Method Name	Min FS
Bishop simplified	1.250

IIIM-A-3-55

TURKEY CREEK LANDFILL	
Project	TURKEY CREEK LANDFILL
Group	ENGINEERING
Scenario	RESIDUAL STRESS - BLOCK
Drawn By	PREP BY: MB CHKD BY: DEP
Company	WEAVER CONSULTANTS GROUP
Date	1/25/2022
File Name	Section_D_Residual_Block.slm



SLIDEINTERPRET 9.018

Slide Analysis Information

Section_D_Residual_Block

Project Summary

File Name:	Section_D_Residual_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.401s
Project Title:	SECTION D-RESIDUAL STRESS STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 3:53:34 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	12
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	8
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	8
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
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Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

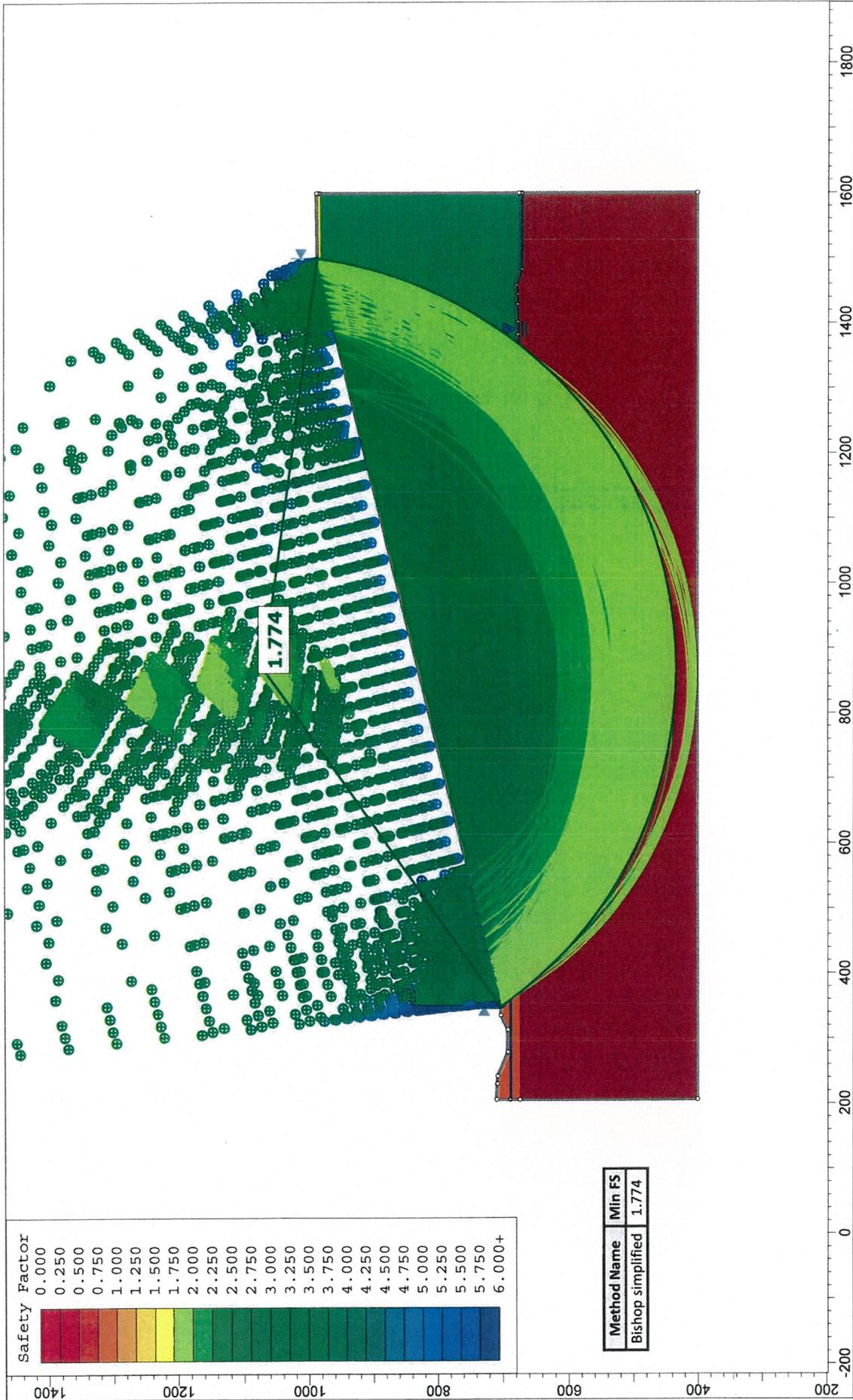
Name: User Defined 1		
	Effective Normal (psf)	Shear (psf)
0		500
208		500
417		500
625		500
626		406.53
834		541.61
1040		675.38
1250		811.76
2500		1623.52
25000		16235.2

Global Minimums

Method: bishop simplified

	FS	1.249840
Axis Location:		613.535, 1959.596
Left Slip Surface Endpoint:		370.711, 664.351
Right Slip Surface Endpoint:		1504.037, 988.190
Resisting Moment:		3.36318e+09 lb-ft
Driving Moment:		2.69089e+09 lb-ft
Total Slice Area:		137310 ft ²
Surface Horizontal Width:		1133.33 ft
Surface Average Height:		121.157 ft

**FINAL COVER CONFIGURATION
SECTION E-E**



Weaver Consultants Group		TURKEY CREEK LANDFILL	
Group	ENGINEERING	Scenario	TOTAL STRESS - CIRCULAR
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	1/19/2022	File Name	Section_E_Total_Stress.slmtd

Slide Analysis Information

Section_E_Total_Stress

Project Summary

File Name:	Section_E_Total_Stress.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:01.148s
Project Title:	SECTION E-TOTAL STRESS-CIRCULAR
Date Created:	8/26/2021, 4:24:28 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
-------	---

Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

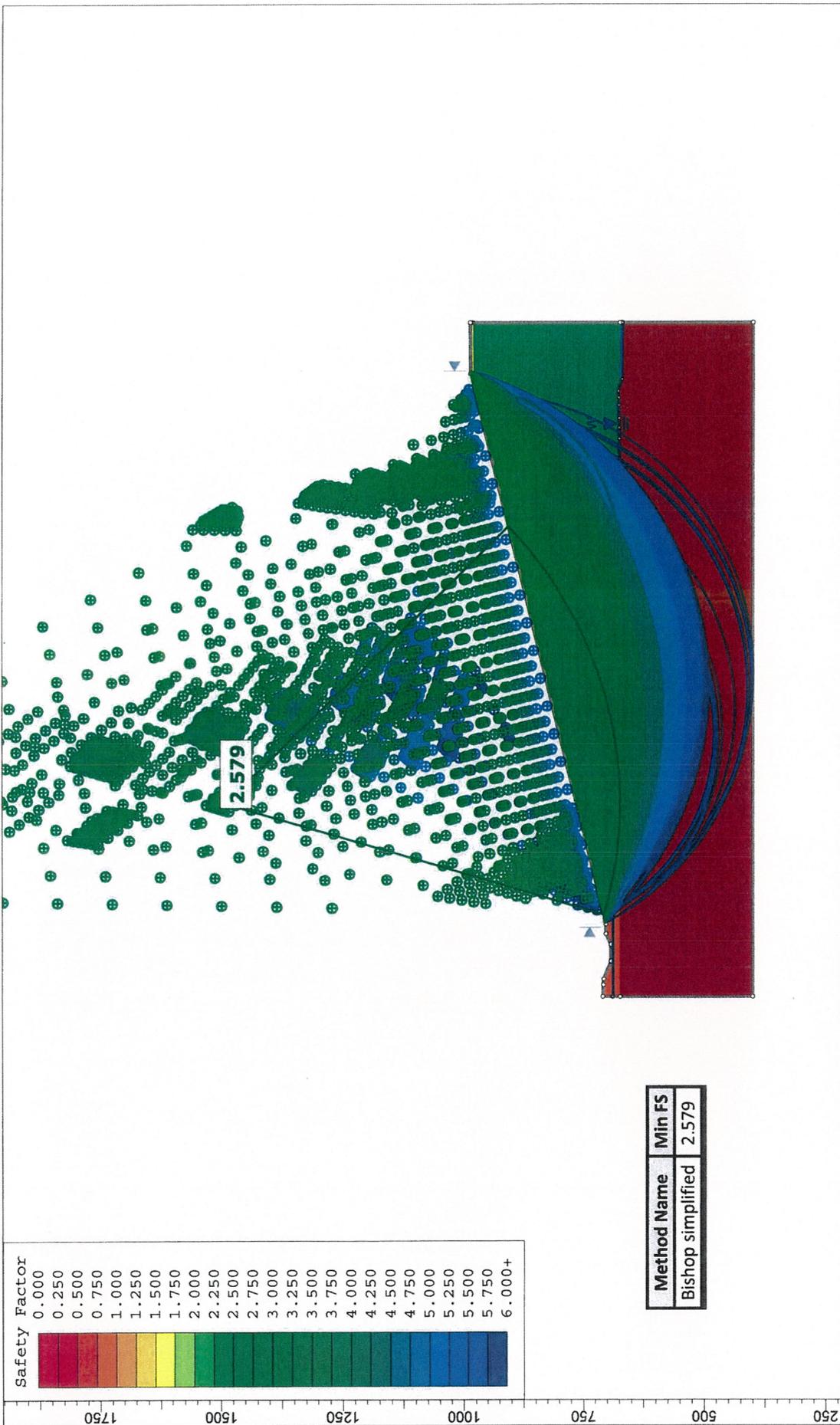
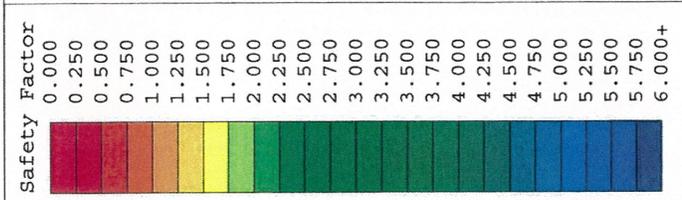
Shear Normal Functions

Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

Global Minimums

Method: bishop simplified

	FS	1.774490
Center:		868.973, 1070.500
Radius:		636.790
Left Slip Surface Endpoint:		349.360, 702.393
Right Slip Surface Endpoint:		1500.147, 986.115
Resisting Moment:		3.84373e+09 lb-ft
Driving Moment:		2.16611e+09 lb-ft
Total Slice Area:		346135 ft ²
Surface Horizontal Width:		1150.79 ft
Surface Average Height:		300.781 ft



Method Name	Min FS
Bishop simplified	2.579

IIIM-A-3-68

		TURKEY CREEK LANDFILL	
		Project	
Group	ENGINEERING	Scenario	EFFECTIVE STRESS - CIRCULAR
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	1/19/2022	File Name	Section_E_Effective_Stress.slmd

Slide Analysis Information

Section_E_Effective_Stress

Project Summary

File Name:	Section_E_Effective_Stress.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:01.211s
Project Title:	SECTION E-EFFECTIVE STRESS-CIRCULAR
Date Created:	8/26/2021, 4:24:28 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	Water Table
Hu Value	1

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

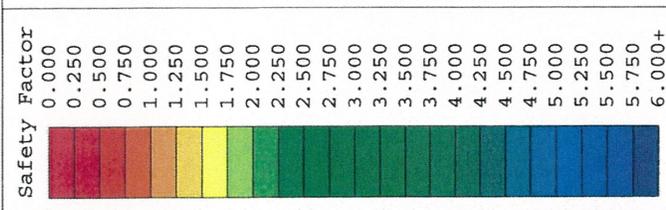
BOUNDING_SHALE

Color	
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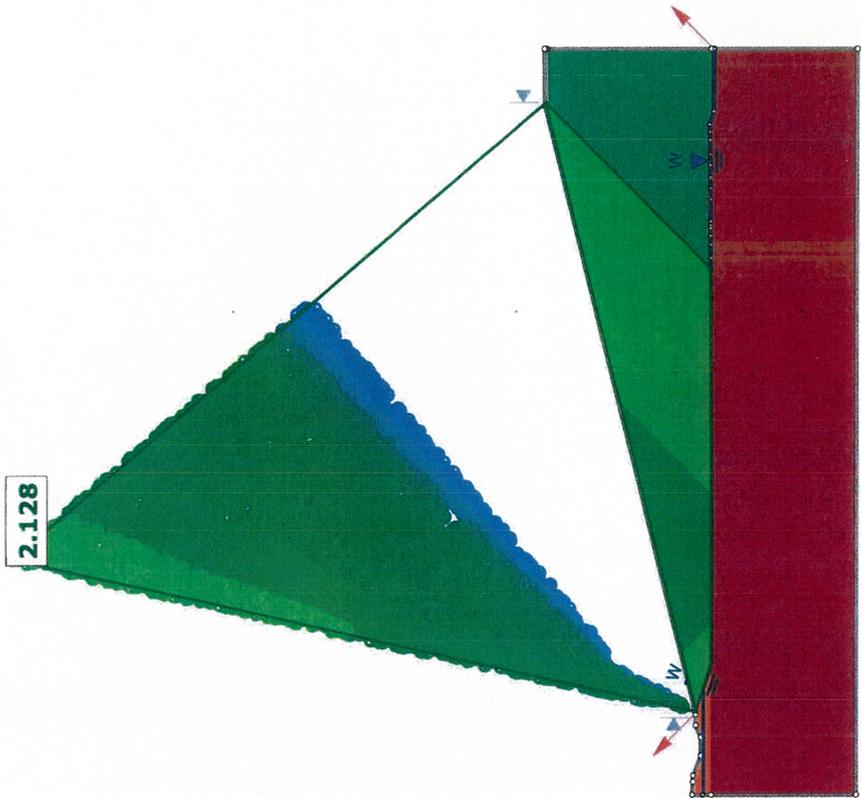
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2



2.128



Method Name	Min FS
Bishop simplified	2.128



IIIM-A-3-73



SLIDEINTERPRET 9.018

Project		TURKEY CREEK LANDFILL	
Group	ENGINEERING	Scenario	PEAK STRESS - BLOCK
Drawn By	PREP BY: MB CHKD BY: DEP	Company	WEAVER CONSULTANTS GROUP
Date	1/19/2022	File Name	Section_E_PEAK_BLOCK.sfmt

Slide Analysis Information

Section_E_PEAK_BLOCK

Project Summary

File Name:	Section_E_PEAK_BLOCK.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.461s
Project Title:	SECTION E-PEAK STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 4:24:28 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	18
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
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Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

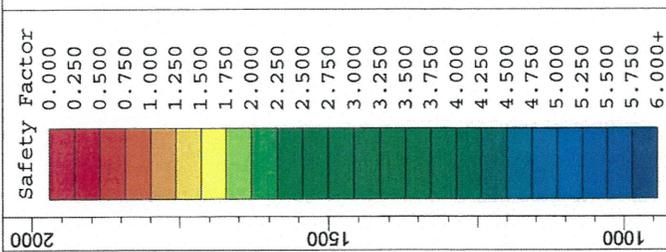
Shear Normal Functions

Name: User Defined 1		
	Effective Normal (psf)	Shear (psf)
0		500
208		500
417		500
625		500
626		406.53
834		541.61
1040		675.38
1250		811.76
2500		1623.52
25000		16235.2

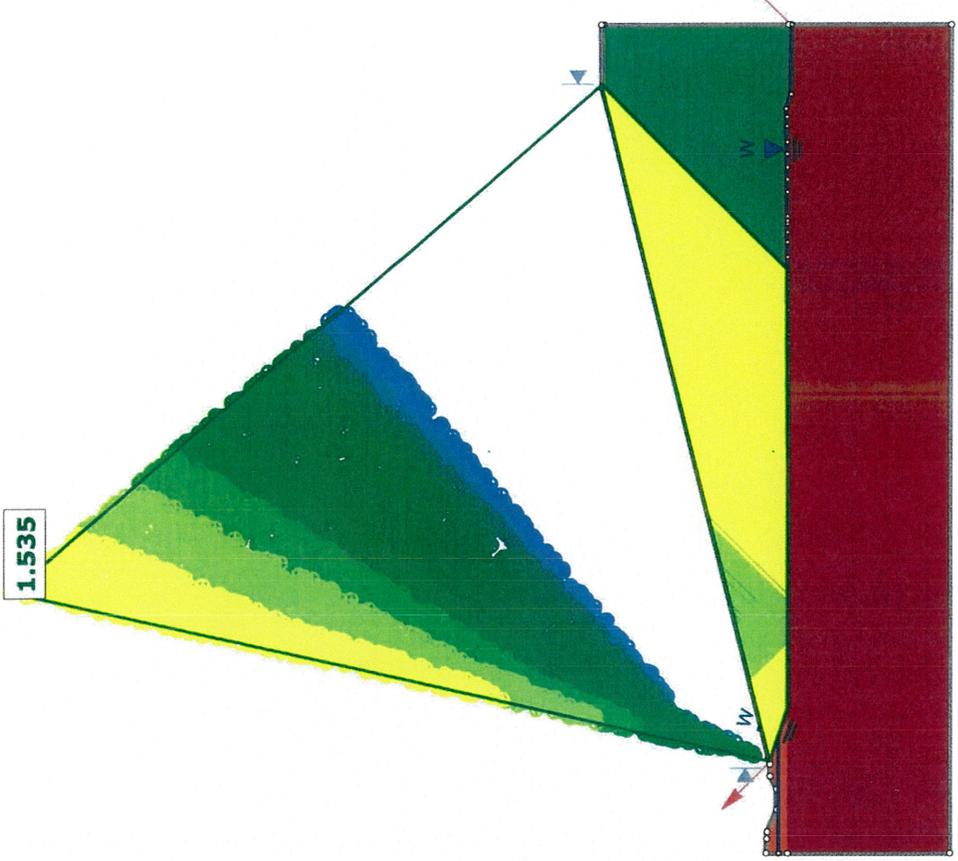
Global Minimums

Method: bishop simplified

	FS	2.127510
Axis Location:		647.505, 1982.715
Left Slip Surface Endpoint:		361.157, 703.494
Right Slip Surface Endpoint:		1499.072, 986.104
Resisting Moment:		5.46522e+09 lb-ft
Driving Moment:		2.56883e+09 lb-ft
Total Slice Area:		143710 ft ²
Surface Horizontal Width:		1137.92 ft
Surface Average Height:		126.293 ft



1.535



Method Name	Min FS
Bishop simplified	1.535



IIIM-A-3-79



SLIDEINTERPRET_9.018

TURKEY CREEK LANDFILL

Project	TURKEY CREEK LANDFILL		
Group	ENGINEERING	Scenario	RESIDUAL STRESS - BLOCK
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	1/19/2022	File Name	Section_E_Residual_Block.slmd

Slide Analysis Information

Section_E_Residual_Block

Project Summary

File Name:	Section_E_Residual_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.453s
Project Title:	SECTION E-RESIDUAL STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 4:24:28 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	12
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	Water Table
Hu Value	1

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	10
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	10
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
-------	---

Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: User Defined 1		
	Effective Normal (psf)	Shear (psf)
0		500
208		500
417		500
625		500
626		406.53
834		541.61
1040		675.38
1250		811.76
2500		1623.52
25000		16235.2

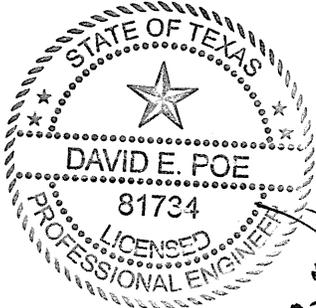
Global Minimums

Method: bishop simplified

	FS	1.534680
Axis Location:		647.505, 1982.715
Left Slip Surface Endpoint:		361.157, 703.494
Right Slip Surface Endpoint:		1499.072, 986.104
Resisting Moment:		3.81686e+09 lb-ft
Driving Moment:		2.48707e+09 lb-ft
Total Slice Area:		143710 ft ²
Surface Horizontal Width:		1137.92 ft
Surface Average Height:		126.293 ft

APPENDIX IIIM-A-4
INFINITE SLOPE STABILITY ANALYSIS

Includes pages IIIM-A-4-1 through IIIM-A-4-13



DEP
02-22-2022

STABILITY ANALYSIS OF THE LINER/OVERLINER/FINAL COVER SYSTEMS

Required: Evaluate the stability of the liner/overliner/final cover system components.

- Procedure:**
- A. Liner System Stability - Anchor Trench Design
 - 1. Verify that the tensile stress in the liner system will be less than the yield stress by using Koerner's method for determination of shear stress in liner systems considering cohesion/adhesion forces.
 - 2. Provide liner anchor trench design considering pullout of the geomembrane.
 - B. Infinite Slope Stability Analysis
 - 1. Use Duncan and Buchignani's method for infinite stability analyses to evaluate the internal stability of the liner, overliner, and final cover systems using peak and residual shear strength values.

Contents:

- Verification that the tensile stress in the liner system will be less than yield stress is provided on Sheets IIIM-A-4-2 through IIIM-A-4-6.
- Anchor trench design is provided on Sheets IIIM-A-4-7 through IIIM-A-4-8.
- Infinite stability analysis to evaluate the internal stability of the liner/overliner/final cover systems is presented on Sheets IIIM-A-4-9 through IIIM-A-4-13.

- References:**
- 1. Koerner, Robert M., *Designing with Geosynthetics*, 3rd Edition, Prentice-Hall Inc., 1994.
 - 2. Duncan, J.M. and Buchignani, A. L., *An Engineering Manual for Slope Stability Studies*, Department of Civil Engineering - University of California-Berkeley, 1975.
 - 3. USACE, *Slope Stability*, Engineering and Design Manual, EM 1110-2-1902, October 31, 2003.
 - 4. Koerner, Robert M., *Analysis and Design of Veneer Cover Soils*, 1998 Sixth International Conference of Geosynthetics.
 - 5. Koerner, George R. and Narejo, Dhani, *Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces*, GRI Report #30, June 14, 2005.
 - 6. Gilbert, Robert B., *Peak Versus Residual Strength for Waste Containment Systems*,
 - 7. Proceedings of the 15th GRI Conference, December 13, 2001.
 - 8. NAVFAC Design Manual 7.01, September 1986.
 - 9. CETCO Bentomat Direct Shear Testing Summary.

LINER SYSTEM STABILITY - ANCHOR TRENCH DESIGN

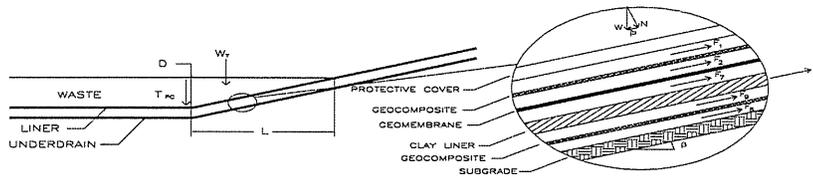
A. Liner System Stability - Anchor Trench Design

Note:

The liner system includes a 2-foot-thick protective cover, drainage geocomposite, geomembrane, and a 2-foot-thick (MSW areas) or 3-foot-thick (Class 1 areas) compacted clay liner (CCL).

1. Verify that tensile stress in liner system is less than yield stress for the liner system.

CCL OPTION (All Areas)



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APPENDIX IIIM-A-4
LINER SYSTEM STABILITY - ANCHOR TRENCH DESIGN

Definition of terms/variables:

W_E = Weight of equipment, lb/ft

Assume a Caterpillar D8T WH Track-Type Tractor

Operational Weight = 85,150 lb

Number of Tracks = 2

Track Width = 1.84 ft

W_W = Weight of solid waste, lb/ft

W_{PC} = Weight of protective cover, lb/ft

W_T = Combined weight of equipment, solid waste, and protective cover, lb/ft

T_{PC} = Friction force on edge of protective cover, lb/ft

W = Net force of equipment, waste, and protective cover on liner system, lb/ft

N = Normal force on liner system, lb/ft

P = Shearing force on liner system, lb/ft

β = Slope angle, deg

F_n = Resisting force, lb/ft, calculated using the equation:

$$(N * \tan(\Delta_n)) + (C_{an} * L / \cos(\beta))$$

F_1 = Resistance of protective cover/geocomposite interface, lb/ft

F_2 = Resistance of geocomposite/textured geomembrane interface, lb/ft

F_3 = Resistance of textured geomembrane/geosynthetic clay liner interface, lb/ft

F_4 = Resistance of internal geosynthetic clay liner, lb/ft

F_5 = Resistance of geosynthetic clay liner/geocomposite interface, lb/ft

F_6 = Resistance of geocomposite/subgrade interface, lb/ft

F_7 = Resistance of textured geomembrane/clay liner interface, lb/ft

F_8 = Resistance of internal clay liner, lb/ft

F_9 = Resistance of clay liner/geocomposite interface, lb/ft

Δ_n = Interface friction angle of interface "n", deg

C_{an} = Adhesion of interface "n", psf

ϕ_n = Internal friction angle of material "n", deg

C_n = Cohesion of material "n", psf

γ_{was} = Unit weight of solid waste (including daily cover), pcf

D_{was} = Individual lift height, ft

ϕ_{was} = Internal friction angle of waste, deg

γ_{pc} = Unit weight of protective cover, pcf

D_{pc} = Thickness of protective cover, ft

ϕ_{pc} = Internal friction angle of protective cover, deg

L = Horizontal length of lift, ft

TURKEY CREEK LANDFILL
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APPENDIX IIIM-A-4
LINER SYSTEM STABILITY - ANCHOR TRENCH DESIGN

Parameters:

$\beta_{\text{sideslope}} = 18.43$ deg	$\Delta_7 = 18$ deg
$\Delta_1 = 18$ deg	$C_{a7} = 100$ psf
$C_{a1} = 100$ psf	$\phi_8 = 18$ deg
$\Delta_2 = 21$ deg	$C_8 = 100$ psf
$C_{a2} = 100$ psf	$\Delta_9 = 18$ deg
$\Delta_3 = 18$ deg	$C_{a9} = 200$ psf
$C_{a3} = 100$ psf	$\gamma_{\text{was}} = 59$ pcf
$\phi_4 = 24$ deg	$D_{\text{was}} = 10$ ft
$C_4 = 100$ psf	$\phi_{\text{was}} = 21$ deg
$\Delta_5 = 18$ deg	$\gamma_{\text{pc}} = 120$ pcf
$C_{a5} = 100$ psf	$D_{\text{pc}} = 1$ ft
$\Delta_6 = 18$ deg	$\phi_{\text{pc}} = 16$ deg
$C_{a6} = 200$ psf	$L = 30$ ft

Note:

Interface friction strength values are selected conservatively from laboratory testing of similar material/interfaces. Prior to construction, laboratory tests will be performed to verify the assumed values for interface adhesion (or cohesion) and friction angle using project-specific soil and synthetic materials. The interface friction testing will be performed for the specific conditions analyzed. If test results differ from the assumed values, this analysis will be updated for acceptable factor of safety values using the procedure presented in the following sections.

Weight of Equipment

$$W_E = \frac{\text{Operational Weight}}{\text{Number of Tracks} \times \text{Width of Track}}$$

$$W_E = 23,139 \text{ lb/ft}$$

Weight of Solid Waste

$$W_W = \frac{D_{\text{was}} \times L \times \gamma_{\text{was}}}{2} \quad W_W = 8,850 \text{ lb/ft}$$

Weight of Protective Cover

$$W_{\text{PC}} = D_{\text{pc}} \times \gamma_{\text{pc}} \times \frac{L}{\cos(\beta_{\text{sideslope}})} \quad W_{\text{PC}} = 3,795 \text{ lb/ft}$$

Combined Weight of Equipment, Solid Waste, and Protective Cover,

$$W_T = W_E + W_W + W_{\text{PC}} \quad W_T = 35,783 \text{ lb/ft}$$

Friction Force on Edge of Protective Cover

$$T_{\text{PC}} = k_o \times \sigma_v \times \tan \phi_{\text{pc}} \times D_{\text{pc}}$$

where: $k_o = 1 - \sin \phi_{\text{pc}}$

$$\sigma_v = \frac{D_{\text{pc}} \times \gamma_{\text{pc}}}{2} \quad T_{\text{PC}} = 12 \text{ lb/ft}$$

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APPENDIX IIIM-A-4
LINER SYSTEM STABILITY - ANCHOR TRENCH DESIGN

Net Force of Equipment, Waste, and Protective Cover on Liner System

$$\begin{aligned} W &= W_T - T_{PC} & W &= 35,771 \text{ lb/ft} \\ N &= W \cos(\beta) & N &= 33,936 \text{ lb/ft} \\ P_{\text{sideslope}} &= W \sin(\beta) & P_{\text{sideslope}} &= 11,309 \text{ lb/ft} \end{aligned}$$

Compacted Clay Liner Option:

$$\text{Resistance of Protective Cover/Geocomposite Interface} = F_1 = 14,189 \text{ lb/ft}$$

$P_{\text{sideslope}} < F_1$ Therefore, protective cover soil is stable on the geocomposite and a driving force equal to P is transferred to the next interface.

$$\text{Resistance of Geocomposite/Geomembrane Interface} = F_2 = 16,189 \text{ lb/ft}$$

$P_{\text{sideslope}} < F_2$ Therefore, geocomposite is stable on the geomembrane and a driving force equal to P is transferred to the next interface.

$$\text{Resistance of Geomembrane/Clay Liner Interface} = F_7 = 14,189 \text{ lb/ft}$$

$P_{\text{sideslope}} < F_7$ Therefore, the geomembrane is stable on the clay liner and a driving force equal to P is transferred to the next interface.

$$\text{Resistance of Internal Clay Liner} = F_8 = 14,189 \text{ lb/ft}$$

$P_{\text{sideslope}} < F_8$ Therefore, the clay liner internally is stable and a driving force equal to P is transferred to the next interface.

$$\text{Resistance of Clay Liner/Geocomposite Interface} = F_9 = 17,351 \text{ lb/ft}$$

$P_{\text{sideslope}} < F_9$ Therefore, the clay liner is stable on the geocomposite and a driving force equal to P is transferred to the next interface.

$$\text{Resistance of Geocomposite/Subgrade Interface} = F_6 = 17,351 \text{ lb/ft}$$

$P_{\text{sideslope}} < F_6$ Therefore, the geocomposite is stable on the subgrade and a driving force equal to P is transferred to the next interface.

$$\text{The Actual Tensile Force on liner system } (T_{\text{act}}) = 0 \text{ lb/ft}$$

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APPENDIX IIIM-A-4
LINER SYSTEM STABILITY - ANCHOR TRENCH DESIGN

Geosynthetic Clay Liner Option:

Resistance of Protective Cover/Geocomposite Interface = $F_1 = 14,189$ lb/ft

$P_{\text{sideslope}} < F_1$ Therefore, protective cover soil is stable on the geocomposite and a driving force equal to P is transferred to the next interface.

Resistance of Geocomposite/Geomembrane Interface = $F_2 = 16,189$ lb/ft

$P_{\text{sideslope}} < F_2$ Therefore, geocomposite is stable on the geomembrane and a driving force equal to P is transferred to the next interface.

Resistance of Geomembrane/Geosynthetic Clay Liner Interface = $F_3 = 14,189$ lb/ft

$P_{\text{sideslope}} < F_3$ Therefore, geomembrane is stable on the geosynthetic clay liner and a driving force equal to P is transferred to the next interface.

Resistance of Internal Geosynthetic Clay Liner = $F_4 = 18,272$ lb/ft

$P_{\text{sideslope}} < F_4$ Therefore, the geosynthetic clay liner internally is stable and a driving force equal to P is transferred to the next interface.

Resistance of Geosynthetic Clay Liner/Geocomposite Interface = $F_5 = 14,189$ lb/ft

$P_{\text{sideslope}} < F_5$ Therefore, the geosynthetic clay liner is stable on the geocomposite and a driving force equal to P is transferred to the next interface.

Resistance of Geocomposite/Subgrade Interface = $F_6 = 17,351$ lb/ft

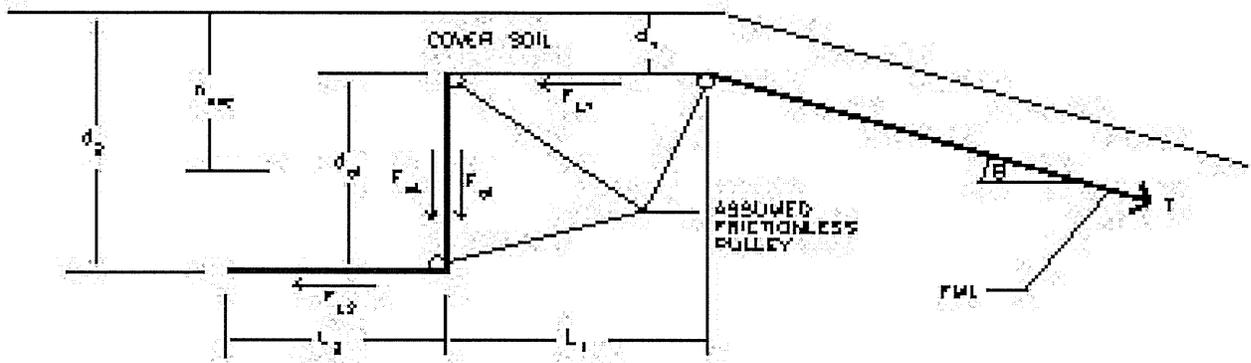
$P_{\text{sideslope}} < F_6$ Therefore, the geocomposite is stable on the subgrade and a driving force equal to P is transferred to the next interface.

The Actual Tensile Force on Liner System (T_{act}) = 0 lb/ft

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APPENDIX IIIM-A-4
LINER SYSTEM STABILITY - ANCHOR TRENCH DESIGN

2. Provide liner anchor trench design considering pullout of the geomembrane.

Force Diagram for Liner System



$$F_{L1} = (q_1 \tan\Delta)(L_1)$$

q_1 = Surcharge pressure = $d_1 \times \gamma_{soil}$
 d_1 = Depth of soil, ft
 γ_{soil} = Unit weight of soil, pcf
 Δ = Interface friction angle, degrees
 L_1 = Length of runout, ft

$$F_{L2} = (q_2 \tan\Delta)(L_2)$$

q_2 = Surcharge pressure = $d_2 \times \gamma_{soil}$
 d_2 = Depth of soil, ft
 γ_{soil} = Unit weight of soil, pcf
 Δ = Interface friction angle, degrees
 L_2 = Length of runout, ft

$$F_{at} = (V \tan\Delta)(d_{at})$$

V = Average horizontal stress = $K_o \times y$
 K_o = $1 - \sin(r)$
 r = Internal friction angle of soil, degrees
 y = $\gamma_{soil} \times h_{ave}$
 γ_{soil} = Unit weight of soil, pcf
 h_{ave} = Average depth of trench, ft
 Δ = Interface friction angle, degrees
 d_{at} = Depth of trench, ft

Parameters:

γ_{soil} = 120 pcf
 Δ = 15 deg
 r = 16 deg

d_1 = 2.0 ft
 L_1 = 6.0 ft
 d_2 = 4.0 ft
 L_2 = 2.0 ft
 d_{at} = 2.0 ft
 h_{ave} = 3.0 ft

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APPENDIX IIIM-A-4
LINER SYSTEM STABILITY - ANCHOR TRENCH DESIGN

Calculations:

$$F_{L1} = 385.8 \text{ lb / ft}$$

$$F_{L2} = 257.2 \text{ lb / ft}$$

$$F_{at} = 139.7 \text{ lb / ft}$$

$$T = 782.8 \text{ lb / ft}$$

Compare force required for pullout (T) with the actual tensile force in the geomembrane from Part 1:

$$T = 783 \text{ lb / ft}$$

$$T > T_{act}$$

$$T_{act} = 0 \text{ lb / ft}$$

Therefore, the runout lengths are sufficient to prevent pullout.

INFINITE SLOPE STABILITY ANALYSIS FOR LINER/OVERLINER/FINAL COVER SYSTEMS

B. Infinite Slope Stability Analysis

Interface friction strength values are selected conservatively from laboratory testing of similar material/interfaces. Prior to construction, laboratory tests will be performed to verify the assumed values for interface adhesion (or cohesion) and friction angle using project-specific soil and synthetic materials. The interface friction testing will be performed for the specific conditions analyzed. If test results differ from the assumed values, this analysis will be updated for acceptable factor of safety values using the procedure presented in the following sections.

The liner, overliner, and final cover systems are described below.

LINER SYSTEM

The liner system includes a 2-foot-thick protective cover, drainage geocomposite, geomembrane, and a 2-foot-thick (MSW areas) or 3-foot-thick (Class 1 areas) compacted clay liner (CCL).

OVERLINER SYSTEM

The overliner system includes a 2-foot-thick protective cover, drainage geocomposite, geomembrane, and prepared subgrade.

FINAL COVER SYSTEM

The final cover system includes a 1-foot-thick erosion layer, drainage geocomposite, geomembrane, and an 18-inch-thick clay infiltration layer (4-foot-thick infiltration layer for Class 1 areas).

Additionally, the in-place pre-Subtitle D final cover is analyzed. This final cover consists of a 6-inch-thick erosion layer and 18-inch-thick clay infiltration layer.

1. Use Duncan and Buchignani's method for infinite stability analyses to evaluate the internal stability of the liner, overliner, and final cover systems using peak and residual shear strength values.

The factor of safety is calculated using the following equation:

$$F.S. = A \frac{\tan \Delta}{\tan \beta} + B \frac{C_a}{\gamma H}$$

where:

- Δ = Interface friction angle, deg
- C_a = Adhesion, psf
- β = Slope angle, deg
- A = Parameter A from chart on page IIIM-A-4-13
- B = Parameter B from chart on page IIIM-A-4-13
- γ = Unit weight of soil, pcf
- H = Thickness of material above interface, ft

INFINITE SLOPE STABILITY ANALYSIS FOR LINER/OVERLINER/FINAL COVER SYSTEMS

An example using the protective cover/geocomposite interface of the liner system is provided below.

A. Define the shear strength parameters (peak shear strength parameters will be used for this example).

$$\begin{aligned} \Delta &= 18 \text{ deg} \\ C_a &= 100 \text{ psf} \end{aligned}$$

B. Calculate the pore pressure, r_u , using the following equation:

$$r_u = (T \times \gamma_w \times \cos^2 \beta) / (H \times \gamma)$$

where: H = Thickness of material above interface, ft
 γ_w = Unit weight of water, pcf
 β = Slope angle, deg
T = Maximum head above interface, ft
 γ = Unit weight of soil, pcf

$$\begin{aligned} H &= 2 \text{ ft} \\ \gamma_w &= 62.4 \text{ pcf} \\ \beta &= 18.43 \text{ deg (3H:1V)} \\ T &= 0 \text{ ft} \\ \gamma &= 120 \text{ pcf} \\ r_u &= 0.00 \end{aligned}$$

Since T=0, there is no pore pressure build-up in the protective cover. If the soil material is assumed to be saturated, use a unit weight of 125 pcf for soil.

C. Calculate the slope ratio, b.

$$b = \cot \beta = 3.0$$

D. Using r_u and b, determine Parameters A and B from the charts on page IIIE-A-4-13.

$$\begin{aligned} A &= 1.0 \\ B &= 3.3 \end{aligned}$$

E. Calculate the factor of safety and compare against the minimum recommended factor of safety.

F.S. = 2.35	>	F.S. _{min} = 1.5
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INFINITE SLOPE STABILITY ANALYSIS SUMMARY

Component/Interface	Cohesion/Adhesion (psf)		Friction Angle (deg)		H (ft)	γ (pcf)	β (deg)	T (ft)	r_u	b	A	B	Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
	Peak	Residual	Peak	Residual									Peak	Residual	Peak	Residual	Peak	Residual
Liner System (3H:1V Maximum Slope)																		
<i>Composite Liner</i>																		
Protective Cover/Geocomposite	100	80	18	14	2	120	15.95	0	0.00	3.5	1.0	3.3	2.51	1.97	1.5	1.0	YES	YES
Geocomposite/Textured Geomembrane	100	80	21	10	2	120	15.95	0	0.00	3.5	1.0	3.3	2.72	1.72	1.5	1.0	YES	YES
Textured Geomembrane/Clay Liner	200	80	15	10	2	120	15.95	0	0.00	3.5	1.0	3.3	3.69	1.72	1.5	1.0	YES	YES
Clay Liner Internal	100	-	16	-	2	120	15.95	0	0.00	3.5	1.0	3.3	2.38	-	1.5	-	YES	-
Overliner System (4H:1V Maximum Slope)																		
Protective Cover/Geocomposite	100	80	18	14	2	120	14.04	0	0.00	4.0	1.0	5.3	3.51	2.76	1.5	1.0	YES	YES
Geocomposite/Textured Geomembrane	100	80	21	10	2	120	14.04	0	0.00	4.0	1.0	5.3	3.74	2.47	1.5	1.0	YES	YES
Textured Geomembrane/ Prepared Subgrade	200	80	15	10	2	120	14.04	0	0.00	4.0	1.0	5.3	5.49	2.47	1.5	1.0	YES	YES

INFINITE SLOPE STABILITY ANALYSIS SUMMARY

Component/Interface	Strength Parameters				H (ft)	γ (pcf)	β (deg)	T (ft)	r_u	b	A	B	Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety			
	Cohesion/Adhesion (psf)		Friction Angle (deg)										Peak	Residual	Peak	Residual	Peak	Residual	Peak	Residual
	Peak	Residual	Peak	Residual																
Final Cover System (3.5H:1V Maximum Sideslope)																				
<i>Composite Final Cover (Saturated Erosion Layer)</i>																				
Erosion Layer/Geocomposite	100	80	18	14	2	120	15.95	2	0.48	3.5	0.45	3.75	2.07	1.64	1.5	1.0	YES	YES		
Geocomposite/Textured Geomembrane	100	80	21	10	2	120	15.95	2	0.48	3.5	0.45	3.75	2.17	1.53	1.5	1.0	YES	YES		
Textured Geomembrane/Clay Infiltration Layer	200	80	15	10	2	116	15.95	0	0.00	3.5	1.0	3.75	4.17	1.91	1.5	1.0	YES	YES		
Clay Infiltration Layer Internal	100	-	16	-	2	116	15.95	0	0.00	3.5	1.0	3.75	2.62	-	1.5	-	YES	-		
Final Cover System (6% Maximum Top Slope)																				
<i>Composite Final Cover (Saturated Erosion Layer)</i>																				
Erosion Layer/Geocomposite	100	80	18	14	1	120	3.43	2	1.04	16.7	0.48	6.3	7.85	6.19	1.5	1.0	YES	YES		
Geonet/Smooth Geomembrane	100	80	13	8	1	120	3.43	2	1.04	16.7	0.48	6.3	7.10	5.32	1.5	1.0	YES	YES		
Smooth Geomembrane/Clay Infiltration Layer	100	80	13	8	1	116	3.43	0	0.00	16.7	1.0	6.3	9.28	6.69	1.5	1.0	YES	YES		
Clay Infiltration Layer Internal	100	-	16	-	1	116	3.43	0	0.00	16.7	1.0	6.3	10.21	-	1.5	-	YES	-		

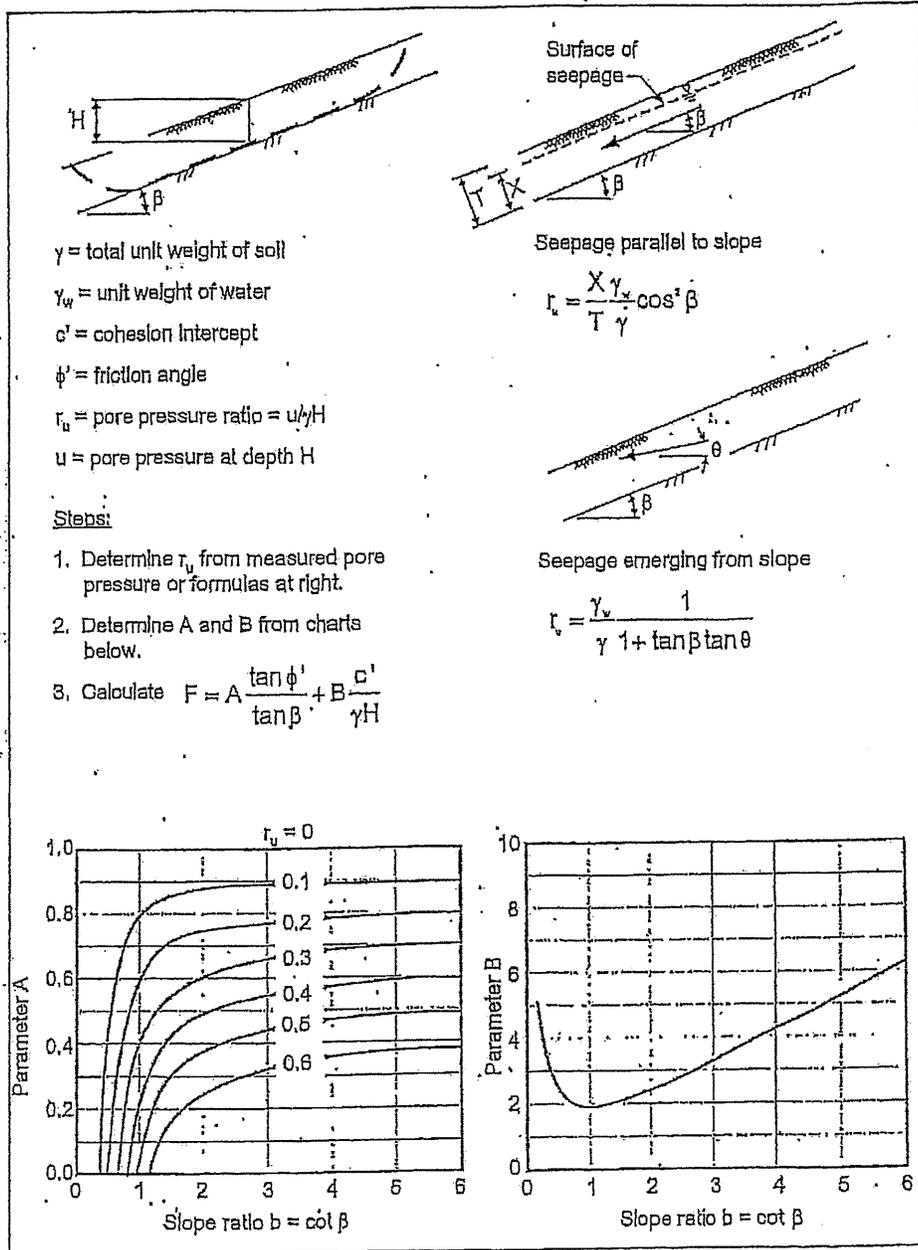
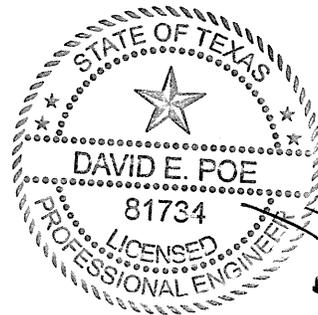


Figure E-7. Slope stability charts for infinite slopes (after Duncan, Buchanan, and DeWet 1987)

APPENDIX IIIM-A-5

**INTERFACE SHEAR STRENGTH CONFORMANCE
TESTING REQUIREMENTS**

Includes pages IIIM-A-5-1 through IIIM-A-5-30



DAE
02-22-2022

INTERFACE SHEAR STRENGTH CONFORMANCE TESTING

Prior to each construction event, interface shear strength conformance testing will be required for the specific soils and geosynthetic products to be incorporated into the project. The required conformance testing requirements have been established for the project based on stability analyses performed for the expansion, as presented in Appendix IIIM-A. The assumed worst-case stability analysis (Section C-C) was selected at the condition to utilize in developing the conformance testing limits for the overliner and Section E-E for the bottom liner, and the stability analyses was iterated to find the minimum factors of safety (FS=1.5 for total stress and FS=1.0 for residual stress conditions). The results of these analyses are presented on Sheets IIIM-A-5-7 through IIIM-A-5-30. Individual graphs for overliner and bottom liner are presented on Sheets IIIM-A-5-3 through IIIM-A-5-6.

The global stability analysis results represent the minimum interface shear strength required during future conformance testing. These values also are applicable to the internal shear strength of the clay liner and geosynthetic clay liner (GCL) if incorporated into the analysis and future liner designs.

The following values were developed to represent the minimum shear strength at the material interfaces required during conformance testing.

Table IIIM-A-5-1
Minimum Shear Strength Values for Future Interface Shear Strength
Conformance Testing

Liner System	Peak Shear Strength Parameters		Residual Shear Strength Parameters		Average Waste Unit Weight (lb/cf)
	Cohesion/Adhesion (psf)	Friction Angle (degrees)	Cohesion/Adhesion (psf)	Friction Angle (degrees)	
Overliner	100	17.4	80	9.7	65
Bottom Liner	100	10	80	4	65

A graph of the shear strength envelopes represented by the above values (for both Peak and Residual Stress Conditions) are presented on Sheets IIIM-A-5-3 through IIIM-A-5-6. Future laboratory conformance test results will be required to plot within the shaded zone

A graph of the shear strength envelopes represented by the above values (for both Peak and Residual Stress Conditions) are presented on Sheets IIIM-A-5-3 through IIIM-A-5-6. Future laboratory conformance test results will be required to plot within the shaded zone on the graph, with test-specific shear strength values calculated assuming a waste density of 65 lb/cf (consistent with the values used for the graph) and strength parameters developed within the laboratory.

The above values may be used for stack testing of multiple geosynthetic and clay liner layers or testing of individual interfaces. A stack test (i.e., multiple geosynthetic or soil layers tested concurrently) meeting the above strength requirements demonstrates conformance of the individual materials used in the stack. Internal shear strength testing of GCL, clay liner, and protective cover will be performed as stand-alone tests, although interfaces with other materials may be performed as a stack test.

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 0771-368-11-123
 APPENDIX IIIM-A-5
 INTERFACE SHEAR STRENGTH CONFORMANCE TESTING REQUIREMENTS
 PEAK STRESS PARAMETERS
 OVERLINER ONLY

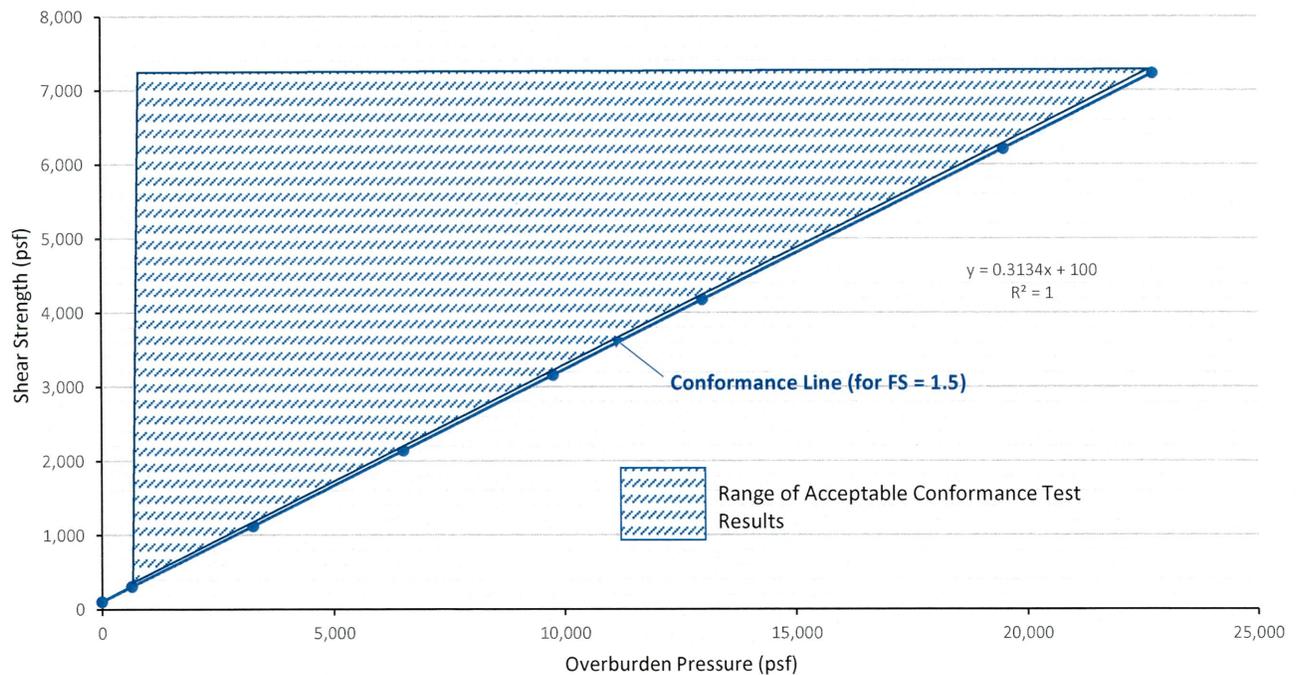
Minimum Allowable Peak Shear Strength Parameters¹

Friction Angle (ϕ , degrees)	17.4
Cohesion (c, psf)	100
Unit Weight of Overburden Waste (γ_{waste} , pcf)	65

Peak Shear Strength Calculations²

Fill height (H, ft)	Overburden Pressure (psf)	Peak Shear Strength ³ (psf)
0	0	100
10	650	304
50	3,250	1,118
100	6,500	2,137
150	9,750	3,155
200	13,000	4,174
300	19,500	6,211
350	22,750	7,229

Interface Shear Strength VS. Overburden Pressure
 Peak Stress Condition (Overliner Only)



Notes

1. Values shown are minimums developed from global stability analysis, and were used to develop the conformance graph shown
2. Shear strength values calculated based on an overburden stress of 65 pounds per cubic foot.
3. Shear Strength = Cohesion (c) + (H) x (γ_{waste})($\tan\phi$)
4. Laboratory interface shear strength test results plotting below the conformance line for overburden stresses below 650 psf (representing 10 feet of overburden fill) are not considering failing.

TURKEY CREEK LANDFILL
 0771-368-11-123
 APPENDIX IIIM-A-5
 INTERFACE SHEAR STRENGTH CONFORMANCE TESTING REQUIREMENTS
 RESIDUAL STRESS PARAMETERS
 OVERLINER ONLY

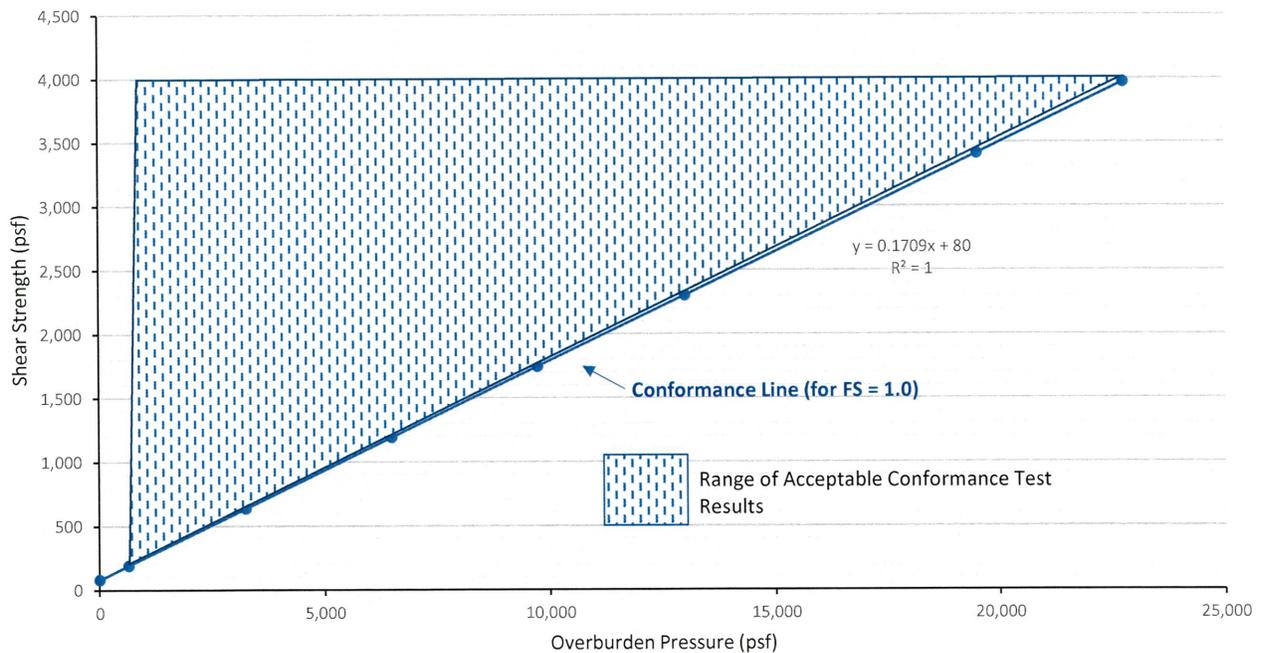
Minimum Allowable Residual Shear Strength Parameters¹

Friction Angle (ϕ , degrees)	9.7
Cohesion (c, psf)	80
Unit Weight of Overburden Waste (γ_{waste} , pcf)	65

Residual Shear Strength Calculations²

Fill height (H, ft)	Overburden Pressure (psf)	Residual Shear Strength ³ (psf)
0	0	80
10	650	191
50	3,250	636
100	6,500	1,191
150	9,750	1,747
200	13,000	2,302
300	19,500	3,413
350	22,750	3,969

Interface Shear Strength VS. Overburden Pressure
 Residual Stress Condition (Overliner Only)



Notes

1. Values shown are minimums developed from global stability analysis, and were used to develop the conformance graph shown
2. Shear strength values calculated based on an overburden stress of 65 pounds per cubic foot.
3. Shear Strength = Cohesion (c) + (H) x (γ_{waste}) (tan ϕ)
4. Laboratory interface shear strength test results plotting below the conformance line for overburden stresses below 650 psf (representing 10 feet of overburden fill) are not considering failing.

TURKEY CREEK LANDFILL
 0771-368-11-123
 APPENDIX IIIM-A-5
 INTERFACE SHEAR STRENGTH CONFORMANCE TESTING REQUIREMENTS
 PEAK STRESS PARAMETERS
 BOTTOM LINER ONLY

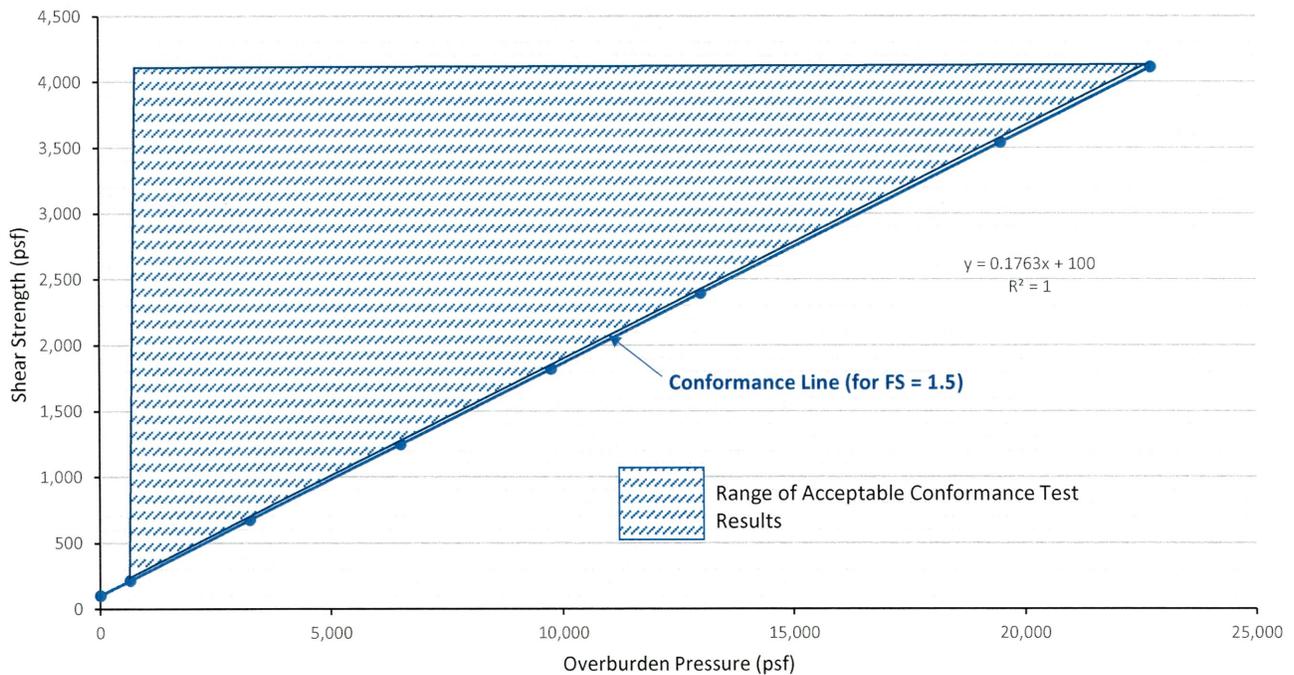
Minimum Allowable Peak Shear Strength Parameters¹

Friction Angle (ϕ , degrees)	10
Cohesion (c, psf)	100
Unit Weight of Overburden Waste (γ_{waste} , pcf)	65

Peak Shear Strength Calculations²

Fill height (H, ft)	Overburden Pressure (psf)	Peak Shear Strength ³ (psf)
0	0	100
10	650	215
50	3,250	673
100	6,500	1,246
150	9,750	1,819
200	13,000	2,392
300	19,500	3,538
350	22,750	4,111

Interface Shear Strength VS. Overburden Pressure
 Peak Stress Condition (Bottom Liner Only)



Notes

1. Values shown are minimums developed from global stability analysis, and were used to develop the conformance graph shown
2. Shear strength values calculated based on an overburden stress of 65 pounds per cubic foot.
3. Shear Strength = Cohesion (c) + (H) x (γ_{waste})($\tan\phi$)
4. Laboratory interface shear strength test results plotting below the conformance line for overburden stresses below 650 psf (representing 10 feet of overburden fill) are not considering failing.

TURKEY CREEK LANDFILL
 0771-368-11-123
 APPENDIX IIIM-A-5
 INTERFACE SHEAR STRENGTH CONFORMANCE TESTING REQUIREMENTS
 RESIDUAL STRESS PARAMETERS
 BOTTOM LINER ONLY

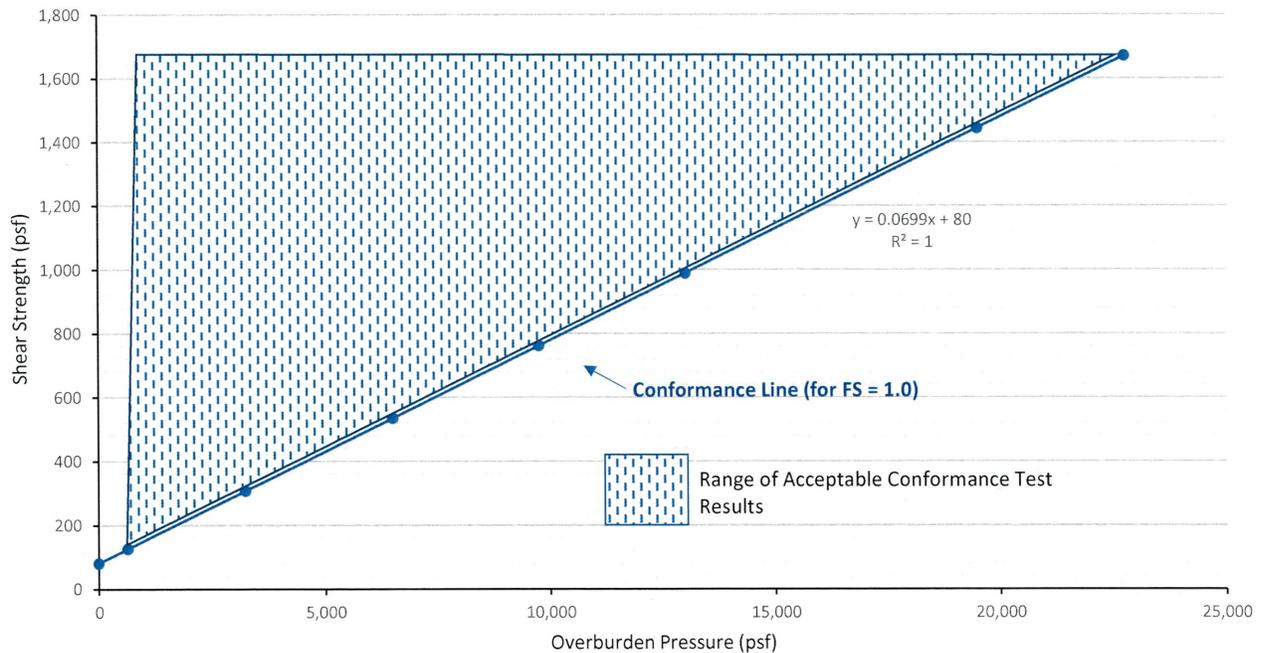
Minimum Allowable Residual Shear Strength Parameters¹

Friction Angle (ϕ , degrees)	4
Cohesion (c, psf)	80
Unit Weight of Overburden Waste (γ_{waste} , pcf)	65

Residual Shear Strength Calculations²

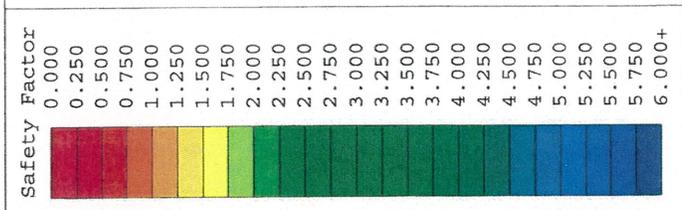
Fill height (H, ft)	Overburden Pressure (psf)	Residual Shear Strength ³ (psf)
0	0	80
10	650	125
50	3,250	307
100	6,500	535
150	9,750	762
200	13,000	989
300	19,500	1,444
350	22,750	1,671

Interface Shear Strength VS. Overburden Pressure
 Residual Stress Condition (Bottom Liner Only)



Notes

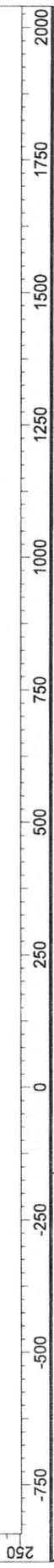
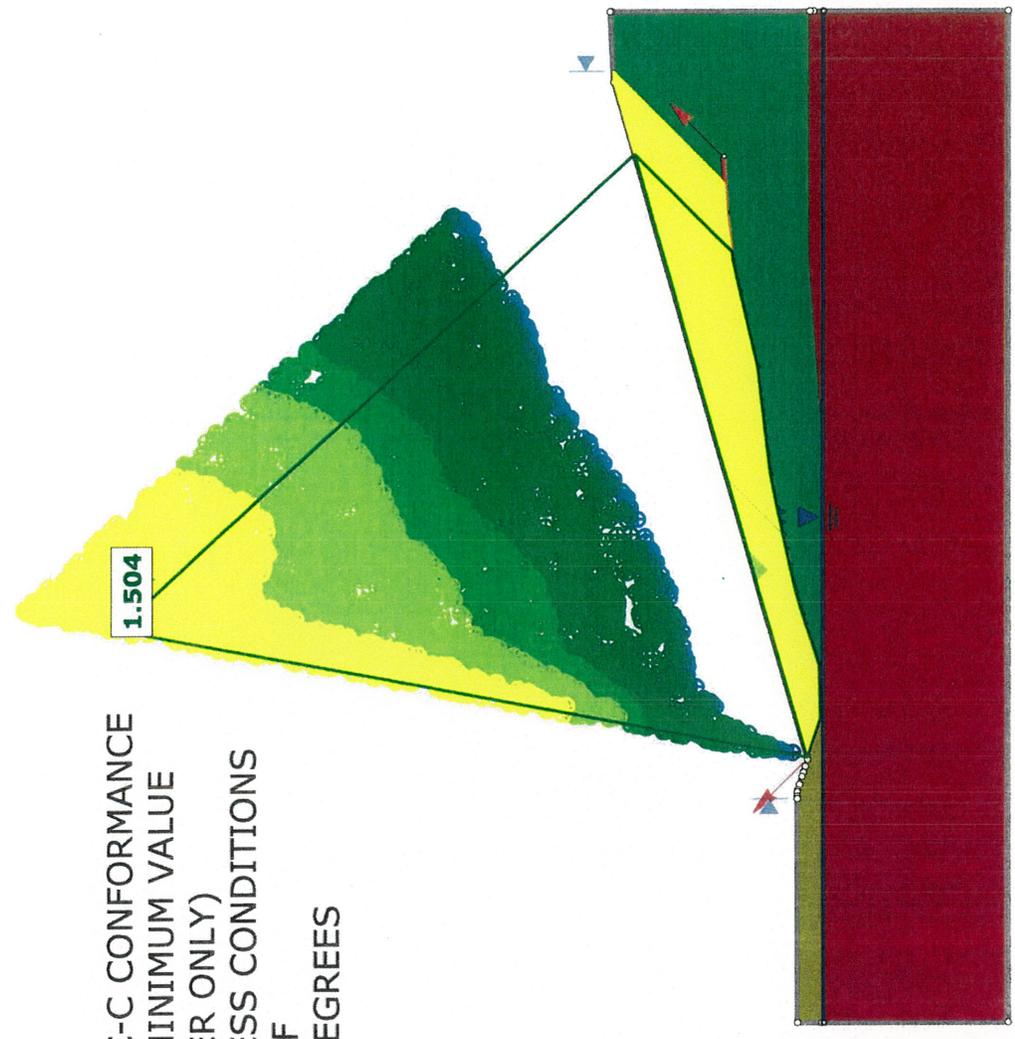
1. Values shown are minimums developed from global stability analysis, and were used to develop the conformance graph shown
2. Shear strength values calculated based on an overburden stress of 65 pounds per cubic foot.
3. Shear Strength = Cohesion (c) + (H) x (γ_{waste})($\tan\phi$)
4. Laboratory interface shear strength test results plotting below the conformance line for overburden stresses below 650 psf (representing 10 feet of overburden fill) are not considering failing.



SECTION C-C CONFORMANCE
 TESTING MINIMUM VALUE
 (OVERLINER ONLY)
 PEAK STRESS CONDITIONS
 C= 100 PSF
 $\phi = 17.4$ DEGREES

1.504

Method Name	Min FS
Bishop simplified	1.504



IIIM-A-5-7

Weaver Consultants Group

SLIDEPRESENT 9.018

TURKEY CREEK LANDFILL

Project	TURKEY CREEK LANDFILL		
Group	ENGINEERING	Scenario	PEAK STRESS - BLOCK
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	CHKD BY: DEP	File Name	Section_C_Peak_Block.sldm
	1/19/2022		

Slide Analysis Information

Section_C_Peak_Block

Project Summary

File Name:	Section_C_Peak_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.699s
Project Title:	SECTION C-PEAK STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 2:54:58 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	17.4
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	17.4
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
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Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

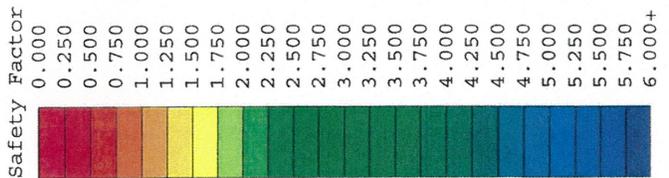
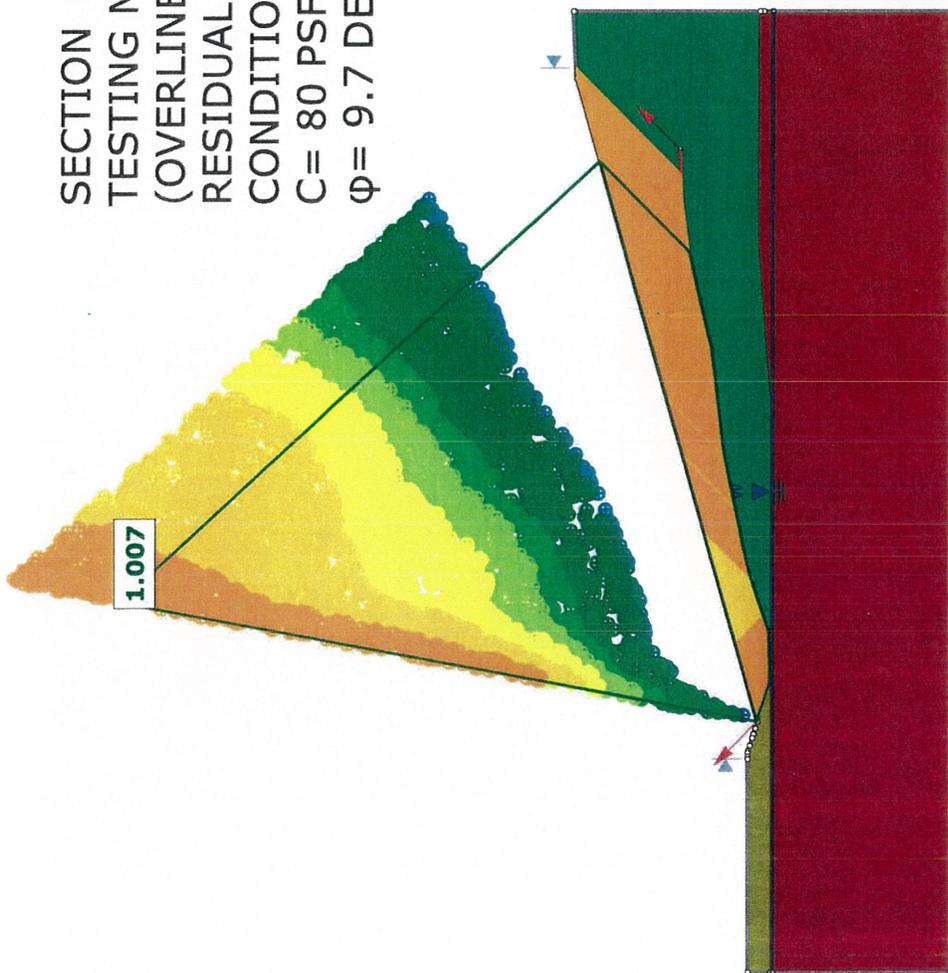
Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

Global Minimums

Method: bishop simplified

	FS	1.504280
Axis Location:		642.871, 1775.776
Left Slip Surface Endpoint:		437.943, 684.259
Right Slip Surface Endpoint:		1393.128, 956.923
Resisting Moment:		1.84052e+09 lb-ft
Driving Moment:		1.22352e+09 lb-ft
Total Slice Area:		66326.6 ft ²
Surface Horizontal Width:		955.185 ft
Surface Average Height:		69.4386 ft

SECTION C-C CONFORMANCE
 TESTING MINIMUM VALUE
 (OVERLINER ONLY)
 RESIDUAL STRESS
 CONDITIONS
 C = 80 PSF
 $\phi = 9.7$ DEGREES



Method Name	Min FS
Bishop simplified	1.007

IIIM-A-5-13

		TURKEY CREEK LANDFILL	
Project	2500	Scenario	RESIDUAL STRESS - BLOCK
Group	ENGINEERING	Company	WEAVER CONSULTANTS GROUP
Drawn By	PREP BY: MB	File Name	Section_C_Residual_Block.sifmd
Date	1/19/2022	CHKD BY: DEP	

Slide Analysis Information

Section_C_Residual_Block

Project Summary

File Name:	Section_C_Residual_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.709s
Project Title:	SECTION C-RESIDUAL STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 2:54:58 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft ³]	116
Saturated Unit Weight [lbs/ft ³]	120
Cohesion [psf]	100
Friction Angle [deg]	12
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft ³]	65
Saturated Unit Weight [lbs/ft ³]	65
Water Surface	None
Ru Value	0

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft ³]	120
Saturated Unit Weight [lbs/ft ³]	124
Cohesion [psf]	80
Friction Angle [deg]	9.7
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft ³]	120
Saturated Unit Weight [lbs/ft ³]	124
Cohesion [psf]	80
Friction Angle [deg]	9.7
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft ³]	125.9
Saturated Unit Weight [lbs/ft ³]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
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Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

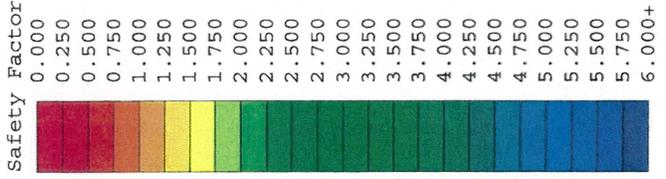
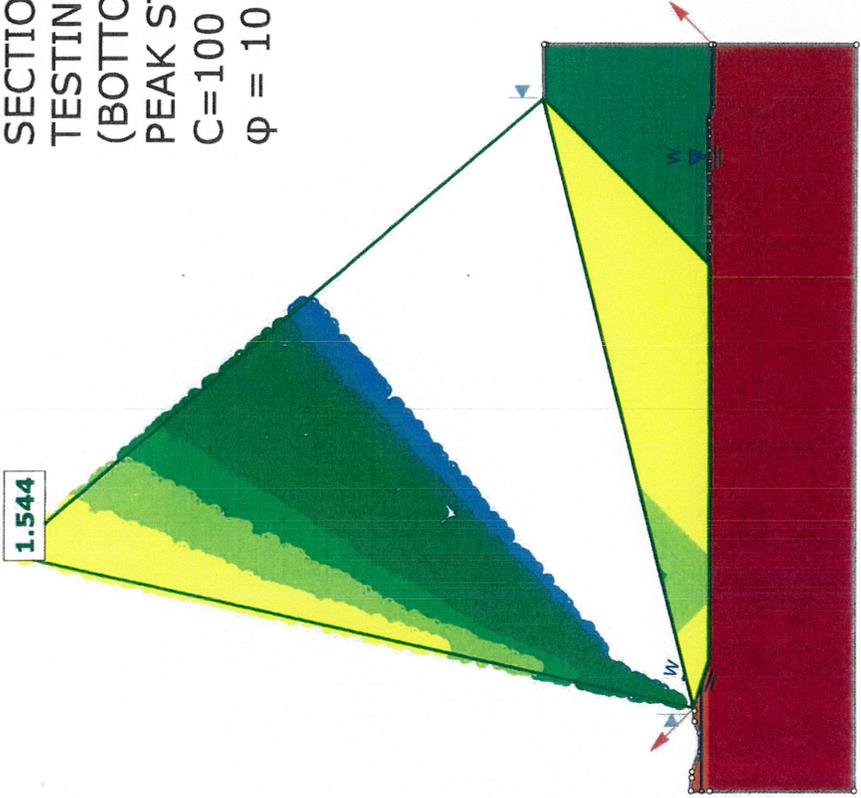
Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

Global Minimums

Method: bishop simplified

	FS	1.007150
Axis Location:		635.134, 1750.701
Left Slip Surface Endpoint:		434.742, 683.345
Right Slip Surface Endpoint:		1368.783, 949.974
Resisting Moment:		1.1454e+09 lb-ft
Driving Moment:		1.13728e+09 lb-ft
Total Slice Area:		63682.7 ft ²
Surface Horizontal Width:		934.041 ft
Surface Average Height:		68.1798 ft

SECTION E-E CONFORMANCE
 TESTING MINIMUM VALUE
 (BOTTOM LINER ONLY)
 PEAK STRESS CONDITIONS
 C=100
 $\phi = 10$ DEGREES



Method Name	Min FS
Bishop simplified	1.544

IIIM-A-5-19

		Project	
		TURKEY CREEK LANDFILL	
Group	ENGINEERING	Scenario	PEAK STRESS - BLOCK
Drawn By	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Date	1/25/2022	File Name	Section_E_PEAK_BLOCK.slmd
		CHKD BY: DEP	

Slide Analysis Information

Section_E_PEAK_BLOCK

Project Summary

File Name:	Section_E_PEAK_BLOCK.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.450s
Project Title:	SECTION E-PEAK STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 4:24:28 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	0
Friction Angle [deg]	16
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	2500
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	10
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	100
Friction Angle [deg]	10
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
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Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	4100
Friction Angle [deg]	0
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

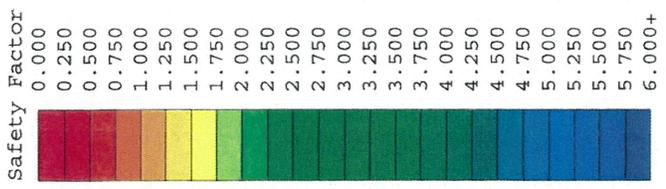
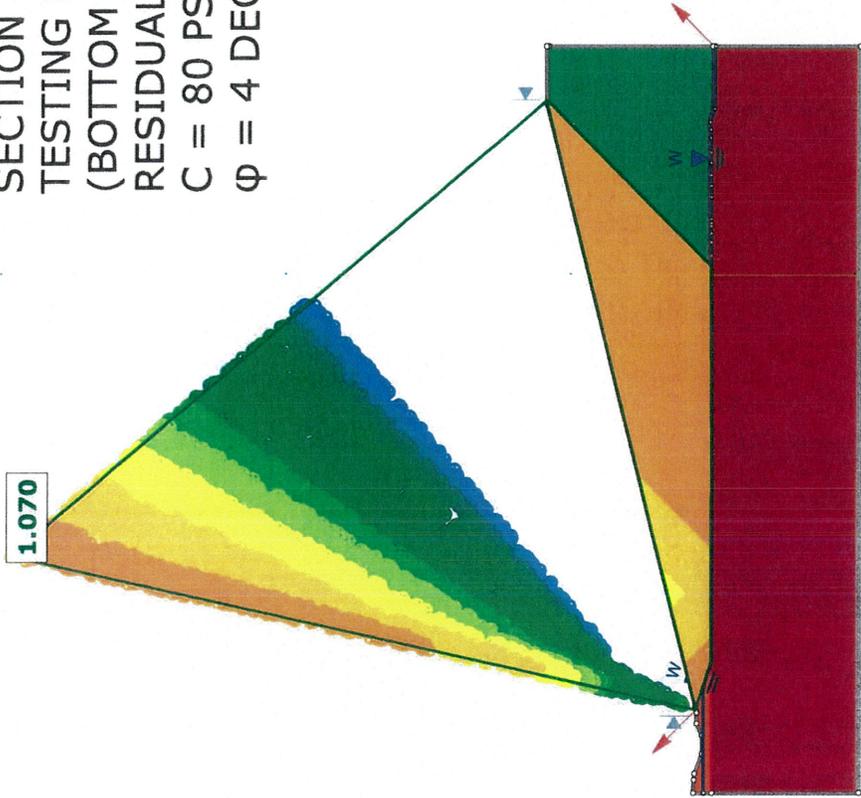
Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

Global Minimums

Method: bishop simplified

	FS	1.543500
Axis Location:		647.505, 1982.715
Left Slip Surface Endpoint:		361.157, 703.494
Right Slip Surface Endpoint:		1499.072, 986.104
Resisting Moment:		3.84131e+09 lb-ft
Driving Moment:		2.4887e+09 lb-ft
Total Slice Area:		143710 ft ²
Surface Horizontal Width:		1137.92 ft
Surface Average Height:		126.293 ft

SECTION E-E CONFORMANCE
 TESTING MINIMUM VALUE
 (BOTTOM LINER ONLY)
 RESIDUAL STRESS CONDITIONS
 $C = 80 \text{ PSF}$
 $\phi = 4 \text{ DEGREES}$



Method Name	Min FS
Bishop simplified	1.070

IIIM-A-5-25

		TURKEY CREEK LANDFILL	
Project	ENGINEERING	Scenario	RESIDUAL STRESS - BLOCK
Group	PREP BY: MB	Company	WEAVER CONSULTANTS GROUP
Drawn By	CHKD BY: DEP	File Name	Section_E_Residual_Block.sldm
Date	1/25/2022		

Slide Analysis Information

Section_E_Residual_Block

Project Summary

File Name:	Section_E_Residual_Block.slmd
Slide Modeler Version:	9.018
Compute Time:	00h:00m:00.428s
Project Title:	SECTION E-RESIDUAL STRESS-BLOCK SEARCH
Date Created:	8/26/2021, 4:24:28 PM

Analysis Options

Slices Type:	Vertical
	Analysis Methods Used
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check $m\alpha < 0.2$:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Materials

FC

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	116
Saturated Unit Weight [lbs/ft3]	120
Cohesion [psf]	100
Friction Angle [deg]	12
Water Surface	None
Ru Value	0

WASTE

Color	
Strength Type	Shear Normal function
Unsaturated Unit Weight [lbs/ft3]	65
Saturated Unit Weight [lbs/ft3]	65
Water Surface	None
Ru Value	0

UPPER_SAND

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125.9
Saturated Unit Weight [lbs/ft3]	129.7
Cohesion [psf]	1000
Friction Angle [deg]	39.1
Water Surface	Water Table
Hu Value	1

PC (MODELED AS LINER)

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	4
Water Surface	None
Ru Value	0

LINER

Color	
Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	120
Saturated Unit Weight [lbs/ft3]	124
Cohesion [psf]	80
Friction Angle [deg]	4
Water Surface	None
Ru Value	0

BOUNDING_SHALE

Color	
-------	---

Strength Type	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	133
Saturated Unit Weight [lbs/ft3]	135
Cohesion [psf]	1000
Friction Angle [deg]	38.6
Water Surface	Water Table
Hu Value	1

Shear Normal Functions

Name: User Defined 1	
Effective Normal (psf)	Shear (psf)
0	500
208	500
417	500
625	500
626	406.53
834	541.61
1040	675.38
1250	811.76
2500	1623.52
25000	16235.2

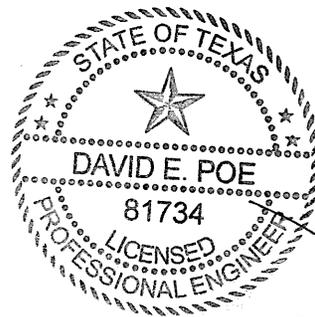
Global Minimums

Method: bishop simplified

	FS	1.070420
Axis Location:		647.505, 1982.715
Left Slip Surface Endpoint:		361.157, 703.494
Right Slip Surface Endpoint:		1499.072, 986.104
Resisting Moment:		2.55146e+09 lb-ft
Driving Moment:		2.38361e+09 lb-ft
Total Slice Area:		143710 ft ²
Surface Horizontal Width:		1137.92 ft
Surface Average Height:		126.293 ft

APPENDIX IIIM-B

SETTLEMENT AND HEAVE ANALYSIS



DEP
01-22-2022

CONTENTS

INTRODUCTION	IIIM-B-1
APPENDIX IIIM-B-1 Foundation/Bottom Liner Settlement and Heave Analysis	
APPENDIX IIIM-B-2 Final Cover System Settlement Analysis	
APPENDIX IIIM-B-3 Overliner System Settlement Analysis	
APPENDIX IIIM-B-4 Foundation Heave Analysis	



02-22-2022

INTRODUCTION

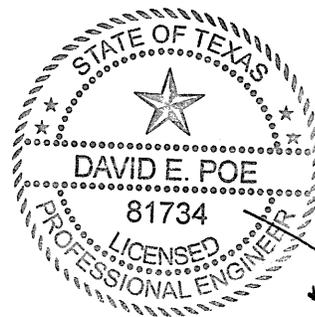
This appendix includes the settlement, strain, and heave analyses for the foundation soils and the settlement and strain analyses for the overliner system and final cover systems. The following three appendices are developed for the foundation soils, overliner, and final cover, respectively.

- Appendix IIIM-B-1 includes the settlement, heave, and strain analyses for the foundation soils.
- Appendix IIIM-B-2 includes the settlement and strain analyses for the final cover system.
- Appendix IIIM-B-3 includes the settlement and strain analyses for the overliner system.
- Appendix IIIM-B-4 includes the heave analysis for the foundation.

APPENDIX IIIM-B-1

FOUNDATION/BOTTOM LINER SETTLEMENT ANALYSIS

Includes pages IIIM-B-1-1 through IIIM-B-1-30



DA
02-22-2022

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIM-B-1
BOTTOM LINER SYSTEM
SETTLEMENT AND STRAIN

Required: Determine the post-settlement slope of the bottom liner system and verify that the strain induced on the bottom liner system due to settlement is within acceptable limits.

- Method:**
- A. Estimate settlement of subsurface below the bottom liner system. Settlement calculated by consolidation theory using SETTLE3. The program uses the Boussinesq method to approximate 2 dimensional consolidation of the foundation strata.
1. Waste filling and liner and final cover installation will result in loading of the foundation soils causing consolidation and potential differential settlement. The magnitude of consolidation and settlement will be a function of the net stress increase and properties of the foundation soils. Net stress increase is assumed to result from loading of the foundation soils during landfilling.
 2. Modeling was performed using SETTLE3, RocScience, Inc. Procedures are described below. Primary settlement (only) was analyzed. Secondary settlement within the shale formation is assumed negligible.
 - 2a. The subgrade conditions were developed from the available boring logs, normalized to the excavation grades proposed for the landfill. Normalization refers to inputting boring information from the proposed excavation grade downward, based on recorded elevations shown on the logs. The borehole locations used to establish the subgrade conditions are shown on Sheet IIIM-B-1-8. For the analysis vertical loads were applied for for the final cover at the locations shown on Sheet IIIM-B-1-9.
 - 2b. Load polygons were developed for input into SETTLE3, for the loading conditions proposed for the landfill. Vertical loads were estimated for each polygon vertex (at the locations shown on Sheet IIIM-B-1-9), and this information inputted into SETTLE3. The load polygons are shown on Sheet IIIM-B-1-10. Loads at the polygon vertices were estimated based on waste fill height and an assumed unit weight of waste (varies based on total waste depth).
 - 2c. The SETTLE3 program calculated total settlement based on Boussinesq equation. The model output files are included in Appendix IIIM-B-1-A. The settlement isopach created by SETTLE3 is presented on Sheet IIIM-B-1-11.
 3. Utilizing the settlement values calculated by SETTLE3, post-settlement slopes and strains are calculated, as presented on Sheets IIIM-B-1-5 through IIIM-B-1-7. An example of the calculation method is presented on Sheets IIIM-B-1-3 and IIIM-B-1-4.

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIM-B-1
BOTTOM LINER SYSTEM
SETTLEMENT AND STRAIN

Description of Contents:

Sheet IIIM-B-1-1 presents the method used for the settlement analyses.
Sheets IIIM-B-1-3 and IIIM-B-1-4 present the method of analysis for post-settlement slopes and strain between designated Evaluation Points.

Sheet IIIM-B-1-8 presents the borehole locations used to develop the subsurface profile for the SETTLE3 model.

Sheet IIIM-B-1-9 presents the final cover load locations incorporated into the SETTLE3 model.

Sheet IIIM-B-1-10 presents the SETTLE3 load polygons incorporated into model.

Sheet IIIM-B-1-11 presents the SETTLE3 settlement isopach.

Sheet IIIM-B-1-12 presents the Evaluation Points and Evaluation Lines used in analysis of the strain and post-settlement slopes for the bottom liner.

Tables 1A and 1B present the settlement results at the Evaluation Points and distances between the Evaluation Points.

Table 2 presents slope and strain summary results from the analysis.

References:

1. Sowers, George F., Settlement of Solid Waste, *Proceedings of the Eighth International Conference on Soil Mechanics and Foundations Engineering, 1973*.
2. Quian, Xuede, R.M. Koerner, D. H. Gray, Geotechnical Aspects of Landfill Design and Construction, Prentice-Hall, Inc., New Jersey, 2002.
3. Koerner, Robert M., Designing with Geosynthetics, Third Edition. Prentice-Hall, New Jersey, 1994.
4. Acar, Yalcin B. & Daniel, David E., *Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics*, Volume 2, American Society of Civil Engineers, 1995.
5. Zornberg, Jorge G., et al., Retention of Free Liquids in Landfills Undergoing Vertical Expansion, *Journal of Geotechnical and Geoenvironmental Engineering*, July 1999.
6. Fassett, Jeffrey B., et al., Geotechnical Properties of Municipal Solid Wastes and Their Use in Landfill Design, Waste Tech, 1994.
7. SETTLE3, Version 5.009 Copyright © 2008-2021 Rocscience Inc.
8. Beggs, Ian D. et al, Assessment of Maximum Allowable Strains in Polyethylene and Polypropylene Geomembranes, Geo-Frontiers Congress, Austin, TX, 2005.

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIM-B-1
BOTTOM LINER SYSTEM
SETTLEMENT AND STRAIN

Solution: **A) Estimate settlement of bottom liner system.**

The SETTLE3 model was used to determine waste loading-induced settlement in the bottom liner system. The vertices and polygons developed for the modeling are shown on Sheet IIIM-B-1-9. The analysis was performed for the final contours (at build-out) of the landfill.

Post-settlement slopes were calculated between the points shown on Sheet IIIM-B-1-12. The pre- and post-settlement elevations were determined from AutoCAD surfaces for the design condition and the post-settlement conditions from the SETTLE3 model. The post-settlement condition was generated as output from SETTLE3, which was used to develop the post-settlement surface (isopach) shown on Sheet IIIM-B-1-11. The pre and post-settlement point elevations are presented in Table 1A and 1B, and the strain and slope calculations are presented in Table 2.

B) Verify that strain induced on the bottom liner system components due to settlement is within acceptable limits.

Determine the post-settlement slope of the bottom liner and verify the strain induced on the geocomposite due to settlement is within acceptable limits.

Note that negative values indicate the components are in compression.

$$\text{Strain} = \frac{L_f - L_o}{L_o} \times 100 \quad (\text{Reference 2, Page 472})$$

L_f = Final distance between evaluation points after total settlement (ft)

L_o = Initial distance between evaluation points before total settlement (ft)

An example calculation of the estimated strain is shown below for Evaluation Points BL17 and BL18. The estimated strain for all evaluation points is shown in Table 2.

Evaluation Point BL17 to Evaluation Point BL18:

Initial Distance:

Evaluation Point BL17 Elev. =	740.0 ft-msl
Evaluation Point BL18 Elev. =	684.0 ft-msl
Plan View Distance =	156.0 ft
L_o =	165.8 ft

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIM-B-1
BOTTOM LINER SYSTEM
SETTLEMENT AND STRAIN

Total Settlement:	
Total Settlement Point BL17=	0.38 ft
Total Settlement Point BL18=	1.66 ft
Final Distance (after settlement):	
Evaluation Point BL17 Elev. =	739.6 ft-msl
Evaluation Point BL18 Elev. =	682.3 ft-msl
Plan View Distance=	156.0 ft
L _r =	166.2 ft
Strain=	0.262%

Conclusions:

- Compacted clay liner component of bottom liner has the smallest allowable tensile strain value which is 0.5 percent (Reference 2, page 469).
- The allowable tensile strain for geosynthetic clay liner is 10 percent (ranges from 10 to 22 percent, Koerner et.al., 1996).
- The allowable tensile strain for an HDPE geomembrane is 6 to 8 percent (Reference 8).
- The allowable tensile strain for a drainage geocomposite (if used) is more than 20 percent for the geotextile (reference 3, page 112) and 200 percent for the geonet (reference 3, page 400).
- The maximum calculated strain (0.262%) represents tensile strain and is acceptable, therefore the system will be stable. The maximum compressive strain is -0.027%.

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIM-B-1
BOTTOM LINER SYSTEM SETTLEMENT SUMMARY

TABLE 1A. BOTTOM LINER SYSTEM - SETTLEMENT SUMMARY

Evaluation Point ¹	Initial Top of Excavation (Bottom of Liner System) Elevation (ft-msl)	Post-Settlement Top of Excavation (Bottom of Liner System) Elevation (ft-msl)	Total Bottom Liner Settlement (ft)
BL1	675.00	669.19	5.81
BL2	670.10	666.82	3.28
BL3	662.96	656.90	6.06
BL4	653.10	651.48	1.62
BL5	664.37	659.63	4.74
BL6	657.38	655.79	1.59
BL7	672.82	670.64	2.18
BL8	665.52	663.84	1.68
BL9	676.00	669.93	6.07
BL10	668.00	666.49	1.51
BL11	681.99	678.07	3.92
BL12	676.00	674.35	1.65
BL13	702.40	696.31	6.09
BL14	706.31	700.46	5.85
BL15	662.00	657.87	4.13
BL16	652.00	651.75	0.25
BL17	739.96	739.57	0.38
BL18	684.00	682.34	1.66
BL19	661.19	660.31	0.88
BL20	664.80	661.78	3.02
BL21	669.60	667.32	2.28
BL22	702.59	700.18	2.42
BL23	682.00	680.36	1.64
BL24	685.87	682.43	3.44
BL25	666.21	664.09	2.12
BL26	660.87	656.71	4.16
BL27	655.98	652.43	3.55
BL28	668.00	665.32	2.68
BL29	662.00	660.37	1.63
BL30	667.00	661.11	5.89
BL31	663.00	657.04	5.96
BL32	676.00	670.00	6.00
BL33	680.00	673.71	6.29
BL34	706.31	700.47	5.84
BL35	690.23	684.99	5.24

¹ Refer to Sheet IIIM-B-1-11 for Evaluation Point locations BL1 thru BL35.

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIM-B-1
BOTTOM LINER SYSTEM SETTLEMENT SUMMARY

TABLE 1B. DISTANCES BETWEEN SETTLEMENT EVALUATION POINTS

Evaluation Points ¹		Distance (ft)
From	To	
BL1	BL2	684.6
BL3	BL4	1,121.9
BL5	BL6	874.0
BL7	BL8	162.8
BL9	BL10	1,038.3
BL11	BL12	825.9
BL13	BL3	239.4
BL14	BL25	786.6
BL15	BL16	1,150.6
BL17	BL18	156.0
BL19	BL20	228.1
BL21	BL22	140.4
BL23	BL24	504.7
BL26	BL27	185.8
BL28	BL29	240
BL30	BL31	185.7
BL32	BL33	187.08
BL34	BL35	186.74

¹ Refer to Sheet IIIM-B-1-11 for Evaluation Points BL1 through BL35.

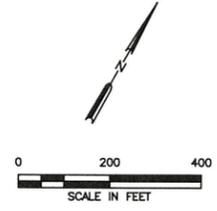
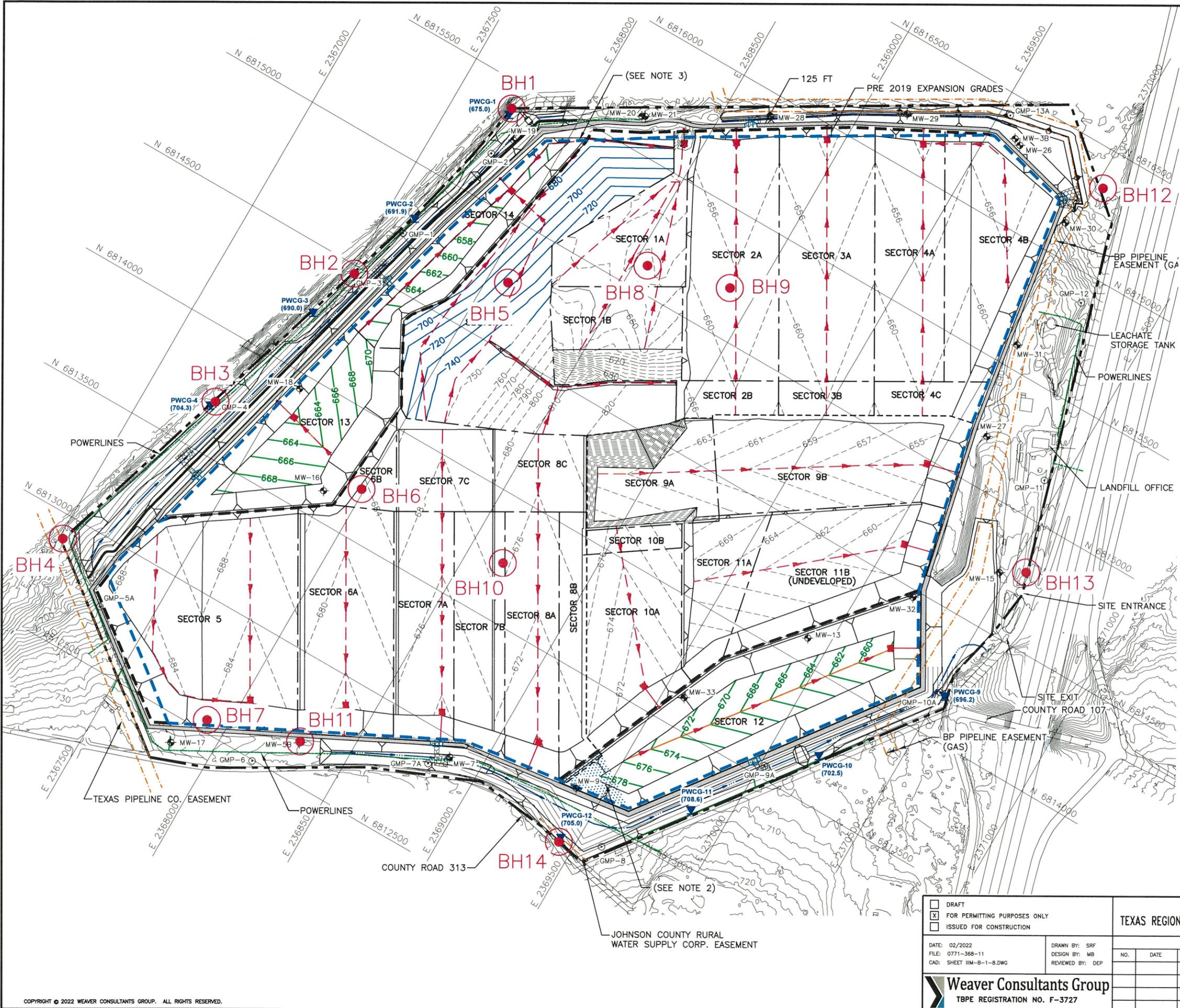
BOTTOM LINER SYSTEM SLOPE AND STRAIN AND SUMMARY

TABLE 2. BOTTOM LINER SYSTEM - SLOPE AND STRAIN SUMMARY

Evaluation Point ¹	Initial Top of Bottom Liner Elevation (ft-msl)		Post-Settlement Top of Bottom Liner Elevation (ft-msl)		Plan View Distance (ft)	L _o (ft)	L _r (ft)	Initial Slope (ft/ft)	Post-Settlement Slope (ft/ft)	Tensile Strain (%)
	A	B	A	B						
BL1	675.0	670.1	669.2	666.8	684.6	684.7	684.6	0.007	0.003	-0.002
BL3	663.0	653.1	656.9	651.5	1121.9	1121.9	1121.9	0.009	0.005	-0.003
BL5	664.4	657.4	659.6	655.8	874.0	874.1	874.0	0.008	0.004	-0.002
BL7	670.0	666.0	670.6	663.8	162.8	162.8	162.9	0.025	0.042	0.057
BL9	676.0	668.0	669.9	666.5	1038.3	1038.3	1038.3	0.008	0.003	-0.002
BL11	682.0	676.0	678.1	674.4	825.9	825.9	825.9	0.007	0.005	-0.002
BL13	702.4	663.0	696.3	656.9	239.4	242.6	242.6	0.165	0.165	-0.002
BL14	706.3	666.2	700.5	664.1	786.6	787.7	787.5	0.051	0.046	-0.023
BL15	662.0	652.0	657.9	651.8	1150.6	1150.6	1150.6	0.009	0.005	-0.002
BL17	740.0	684.0	739.6	682.3	156.040	165.8	166.2	0.359	0.367	0.262
BL19	661.2	664.8	660.3	661.8	228.1	228.1	228.1	-0.016	-0.006	-0.010
BL21	669.6	702.6	667.3	700.2	140.4	144.2	144.2	-0.235	-0.234	-0.022
BL23	682.0	685.9	680.4	682.4	504.7	504.7	504.7	-0.008	-0.004	-0.002
BL26	660.0	656.0	656.7	652.4	185.8	185.8	185.8	0.022	0.023	0.003
BL28	668	662	665	660	240.0	240.1	240.1	0.025	0.021	-0.010
BL30	667	663	661	657	185.7	185.7	185.7	0.022	0.022	0.001
BL32	676	680	670	674	187.1	187.1	187.1	-0.021	-0.020	-0.003
BL34	706	690	700	685	186.7	187.4	187.4	0.086	0.083	-0.027

¹ Refer to Sheet IIIM-B-1-11 for Evaluation Point locations. The "A" and "B" points represent the upgradient and downgradient endpoints, respectively.

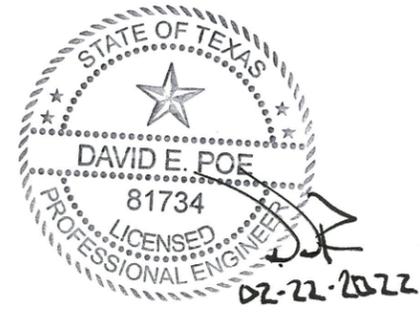
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 - HISTORICAL LIMIT OF WASTE
 - STATE PLANE GRID
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 - 664 EXISTING EXCAVATION/OVERLINER CONTOUR
 - 664 PROPOSED EXCAVATION CONTOUR
 - LEACHATE COLLECTION PIPE
 - LEACHATE COLLECTION SUMP
 - CLASS 1 LIMIT
 - 700 EXPANSION OVERLINER CONTOUR
 - BELOW GRADE CLASS I AREA
 - EASEMENT
 - POWERLINE LOCATION
 - EXCAVATION SIDESLOPE 3H:1V OTHERWISE INDICATED
 - EXISTING GROUNDWATER MONITORING WELL
 - EXISTING GAS MONITORING PROBE
 - PROPOSED 2021 EXPANSION BORING WITH PIEZOMETER INSTALLATION
 - BOREHOLE LOCATION

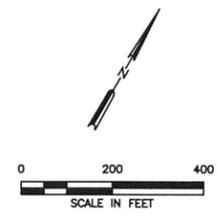
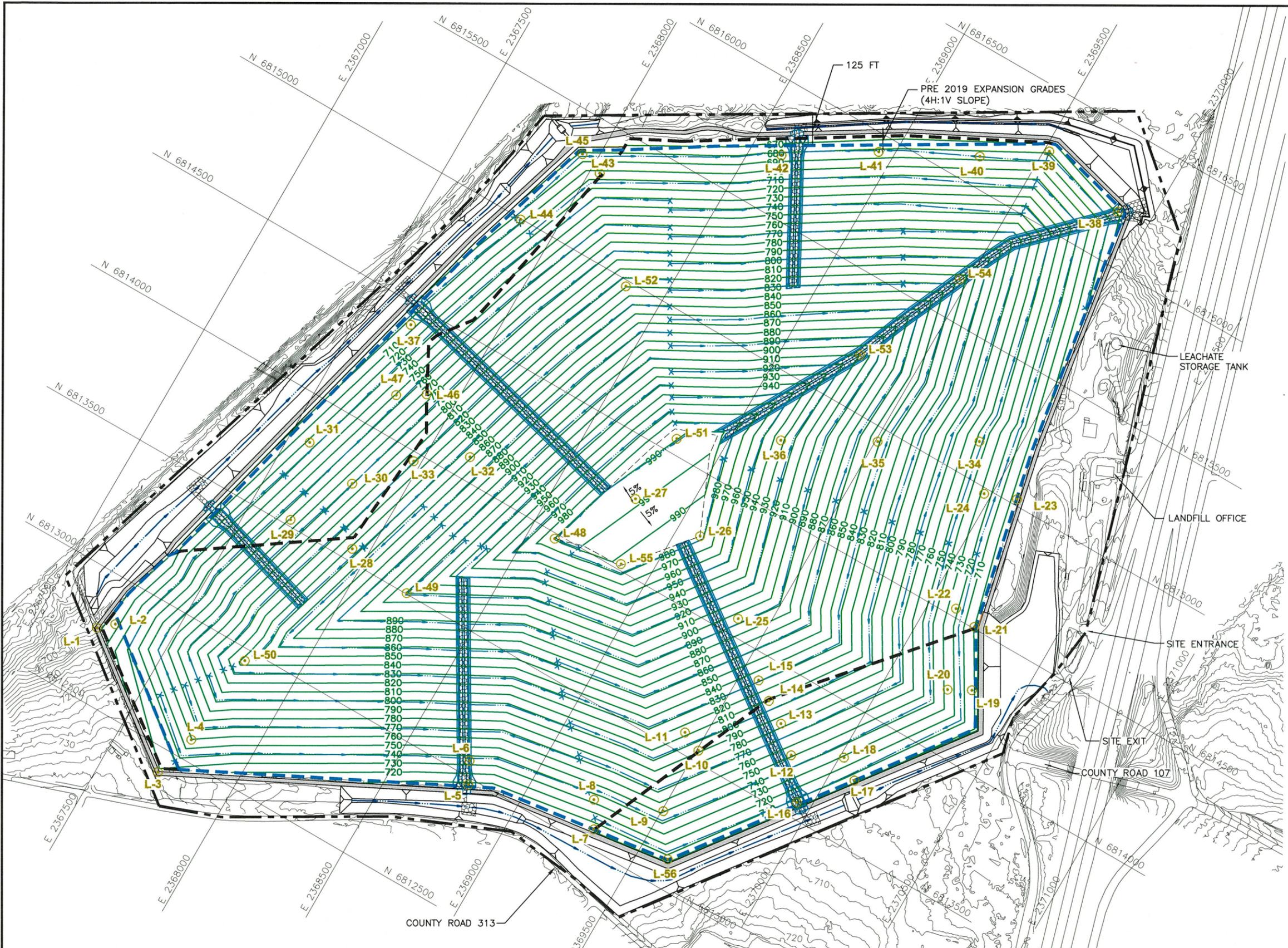
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	730 PROPOSED FINAL COVER CONTOUR
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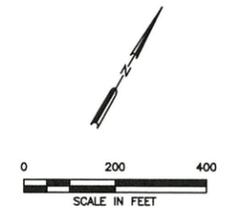
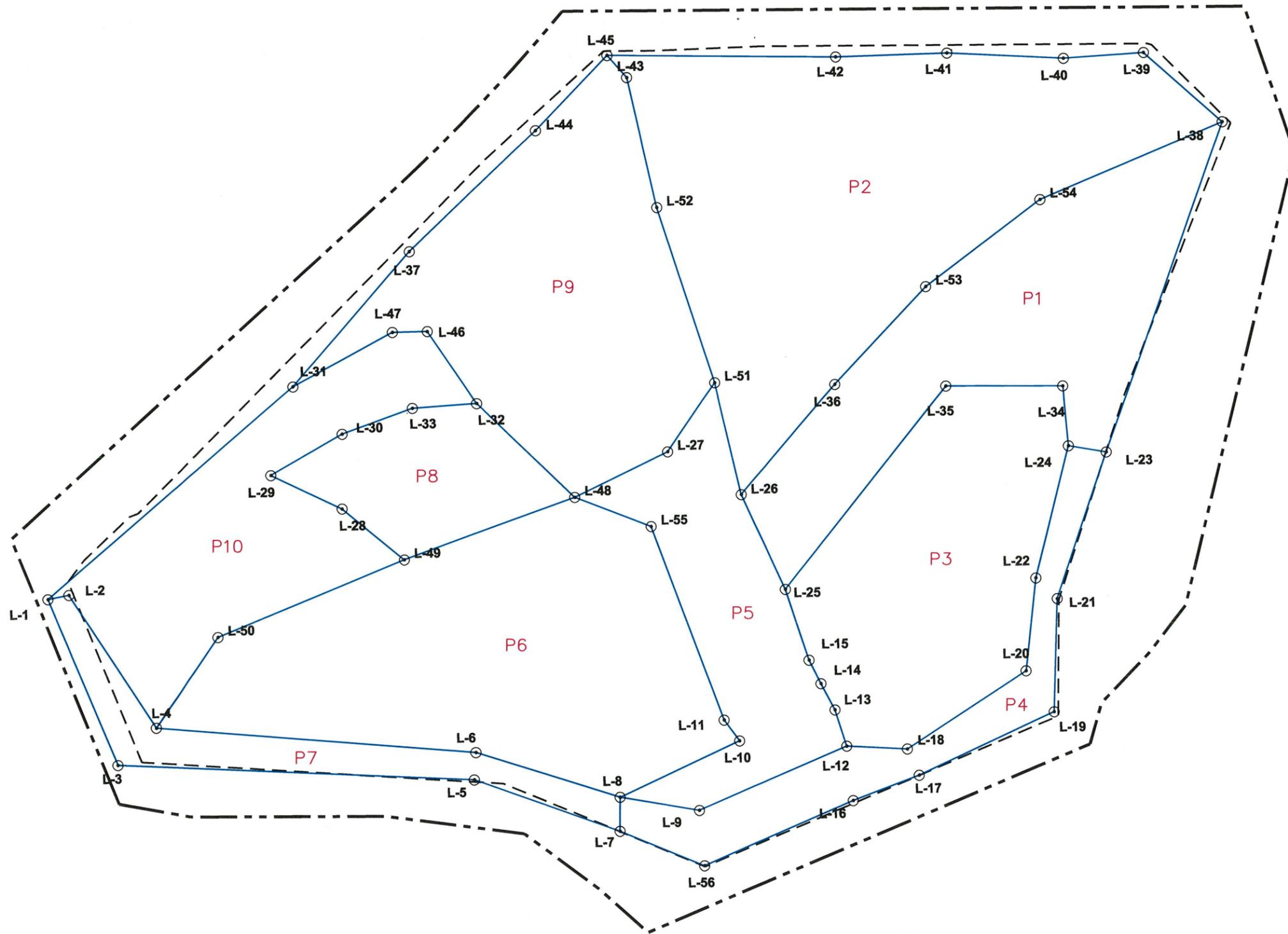
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 - THE EXPANSION LIMIT OF WASTE IS LOCATED A MINIMUM OF 125 FT FROM THE PERMIT BOUNDARY. NO WASTE IS PROPOSED TO BE PLACED OR RELOCATED BETWEEN THE HISTORICAL LIMIT OF WASTE AND THE EXPANSION LIMIT OF WASTE.



02-22-2022

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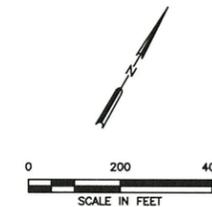
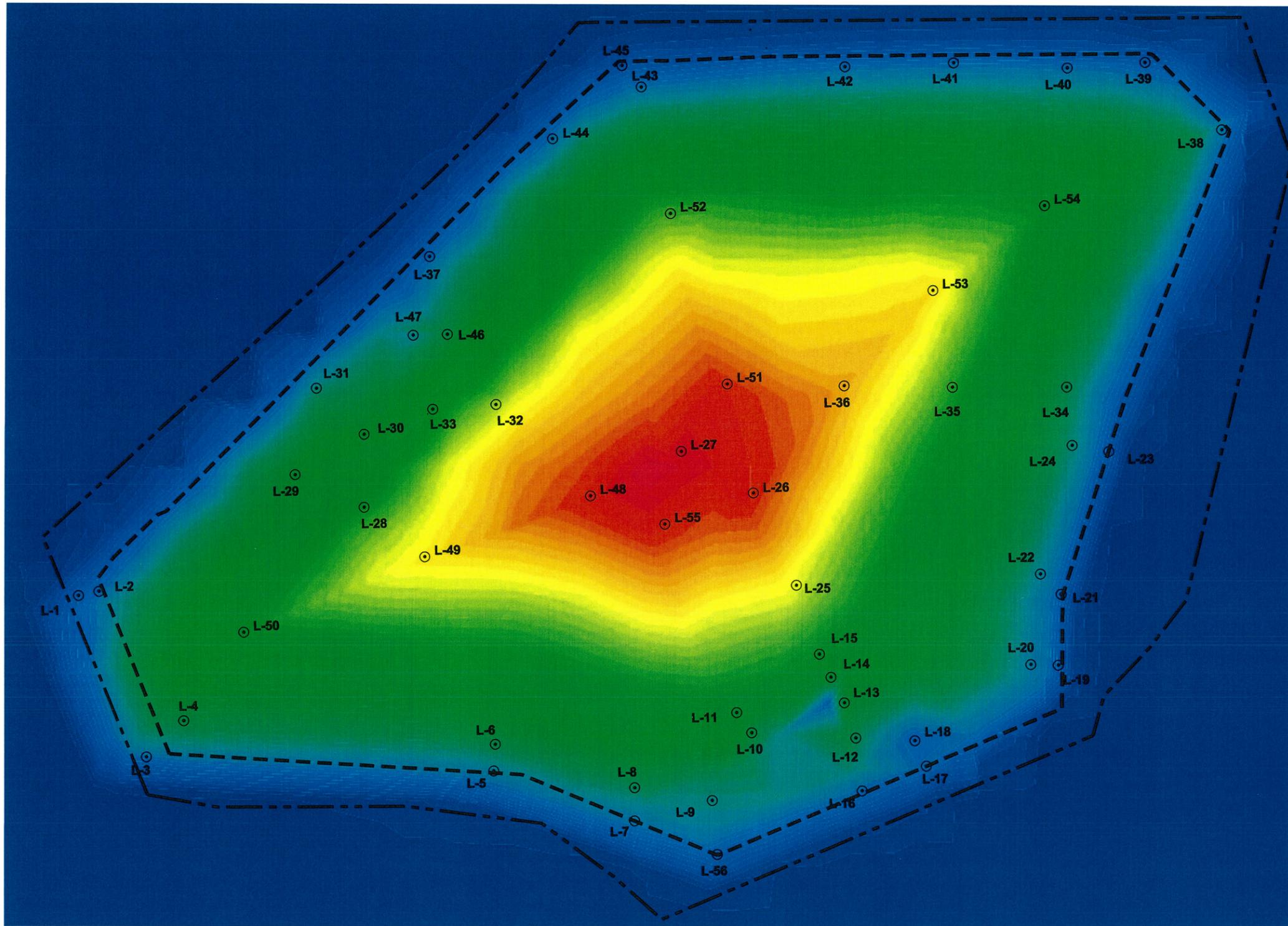
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NOTES:
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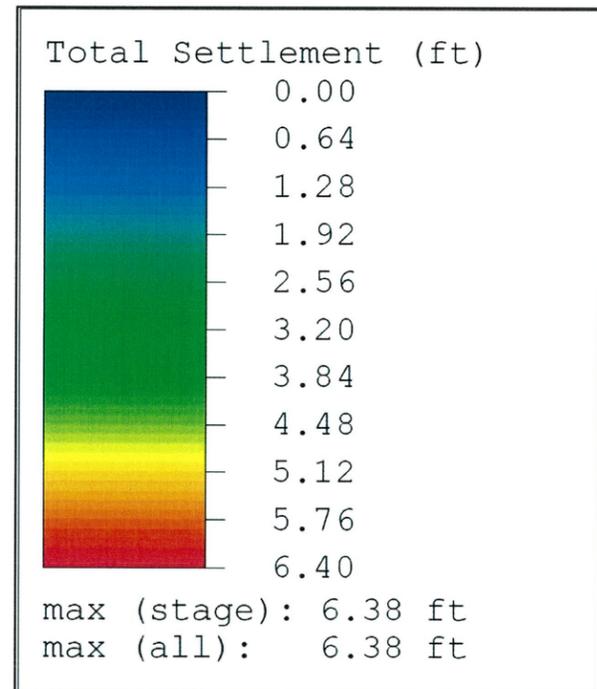


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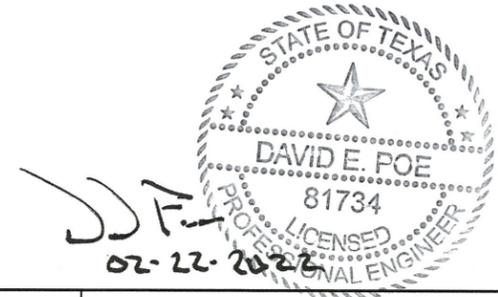
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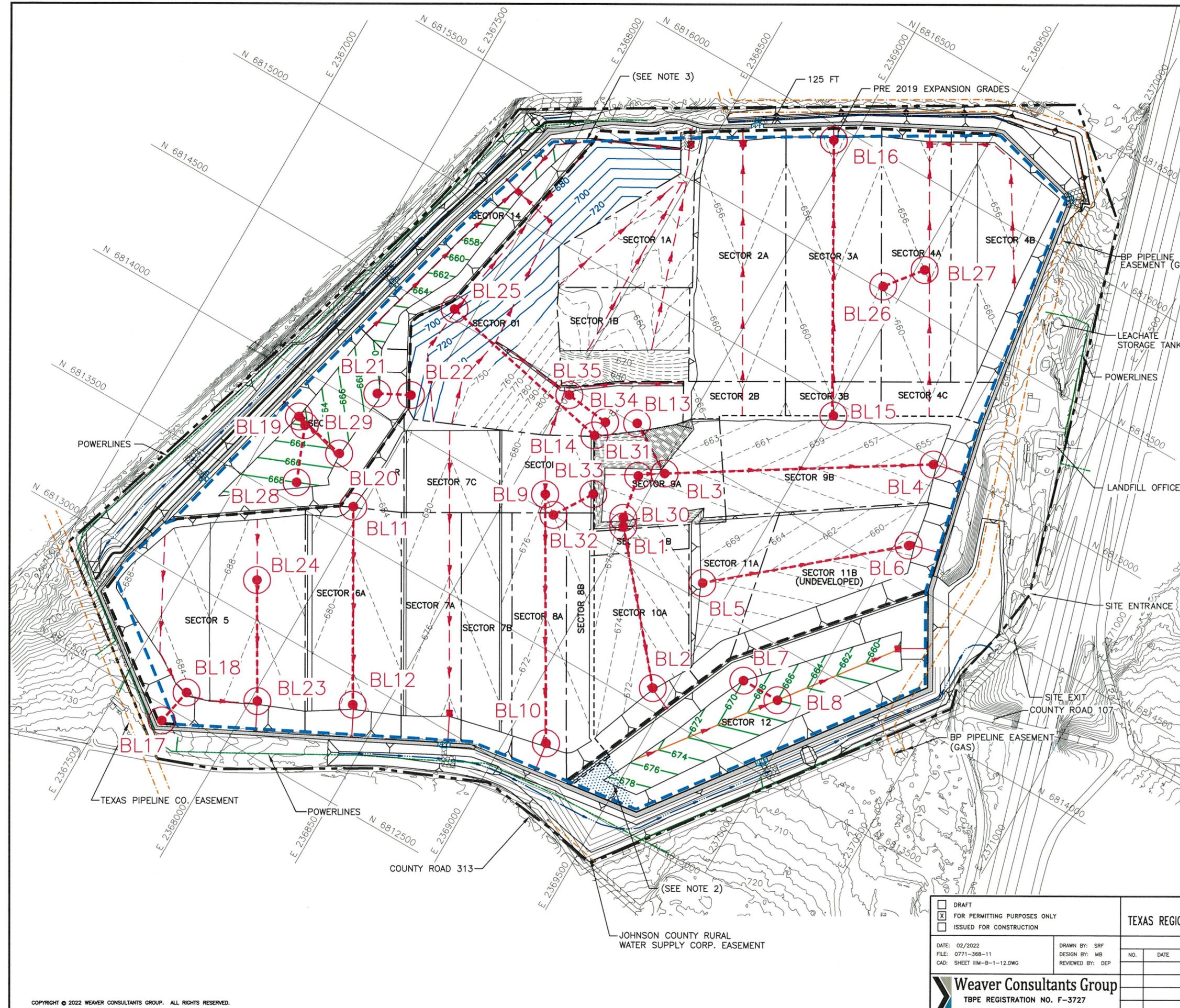
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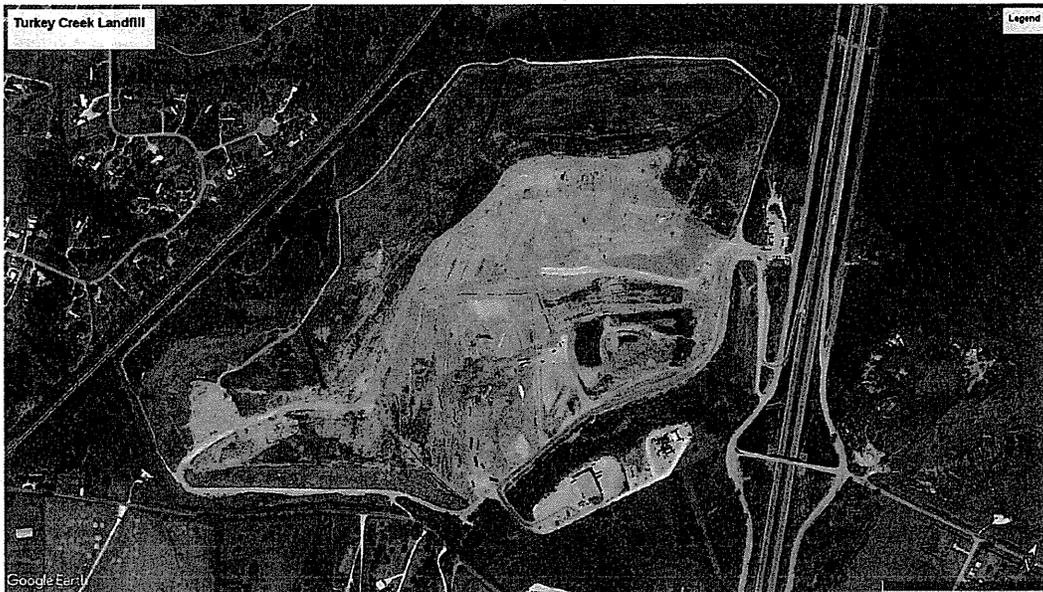


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Turkey_Creek_Settlement
Report Creation Date: 2021/10/07, 15:19:53

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Settle3 Analysis Information

Turkey_Creek_Settlement

Project Settings

Document Name	Turkey_Creek_Settlement.s3z
Project Title	Turkey_Creek_Settlement
Date Created	7/16/2021, 10:08:58 AM
Stress Computation Method	Boussinesq
Minimum settlement ratio for subgrade modulus	0.9
Use average properties to calculate layered stresses	
Improve consolidation accuracy	
Ignore negative effective stresses in settlement calculations	

Stage Settings

	Stage #	Name
1	Stage 1	

Results

Time taken to compute: 0 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [ft]	0	6.37528
Total Consolidation Settlement [ft]	0	5.04206
Virgin Consolidation Settlement [ft]	0	4.44366
Recompression Consolidation Settlement [ft]	0	0.800487
Immediate Settlement [ft]	0	1.78061
Loading Stress ZZ [ksf]	-0.000260966	27.0312
Loading Stress XX [ksf]	-6.55503	25.1484
Loading Stress YY [ksf]	-8.4792	28.0864
Total Stress ZZ [ksf]	-0.000260966	38.926
Total Stress XX [ksf]	-6.55503	38.0912
Total Stress YY [ksf]	-5.08074	41.0413
Modulus of Subgrade Reaction (Total) [ksf/ft]	-0.000666967	5.47224
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	-0.359135	326.397
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	-0.000666967	6.135
Total Strain	-0.000306648	0.157946
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.0087936	38.9211
Over-consolidation Ratio	1	12483.4
Void Ratio	0	0.418435
Hydroconsolidation Settlement [ft]	0	0
Undrained Shear Strength	-8.16087e-07	1.77572

Loads

1. Fill Load: "Fill Load 2"

Label	Fill Load 2
Load Type	Flexible
Area of Load	1.47259e+06 ft2
Elevation	670 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
2778.18	1005.4	4.29197
2508.45	1241.18	1.20042
2236.6	1220.95	1.78118
1838.98	1237.42	1.57985
1458.13	1222.75	1.58943
677.51	1225.61	1.2432
745.32	1149.86	1.5078
849.42	706.26	13.6878
1049.5	108.53	25.4436
1141.71	-273.47	26.1954
1458.29	103.68	21.9072
1768.44	438.9	20.538
2158.38	737.68	13.4316

2. Fill Load: "Fill Load 1"

Label	Fill Load 1
Load Type	Flexible
Area of Load	829716 ft2
Elevation	670 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
2158.38	737.68	13.4316
1768.44	438.9	20.538
1458.29	103.68	21.9072
1141.71	-273.47	26.1954
1292.24	-596.87	18.9
1838.16	99.61	14.2758
2237.69	101.3	5.355
2257.54	-102.93	4.6578
2386.11	-123.81	0
2778.18	1005.4	4.2924

3. Fill Load: "Fill Load 3"

Label	Fill Load 3
Load Type	Flexible
Area of Load	790507 ft2
Elevation	670 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
1709.42	-1139.79	3.7086
2115.56	-871.62	4.2588
2148.11	-554.67	3.7548
2257.54	-102.93	4.6578
2237.69	101.3	5.355
1838.16	99.61	14.2758
1292.24	-596.87	18.9
1373.19	-838.06	12.9906
1413.89	-918.32	0
1461.62	-1007.65	8.4042
1502	-1131.02	5.5272

4. Fill Load: "Fill Load 4"

Label	Fill Load 4
Load Type	Flexible
Area of Load	291403 ft2
Elevation	670 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
1018.19	-1539.87	0.3864
1524.92	-1315.88	0.567
1750.28	-1228.59	0.3318
2211.53	-873.87	0.7014
2220.44	-625.276	0.2604
2386.11	-123.81	0
2257.54	-102.931	4.6578
2148.11	-554.671	3.7548
2115.56	-871.621	4.2588
1709.42	-1139.79	3.7086
1502	-1131.02	5.5272
1000.07	-1351.21	4.8006
728.489	-1307.63	3.8766
728.379	-1423.55	0

5. Fill Load: "Fill Load 5"

Label	Fill Load 5
Load Type	Flexible
Area of Load	489526 ft2
Elevation	670 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
1000.07	-1351.21	4.8006
1502	-1131.02	5.5272
1461.62	-1007.65	8.4042
1413.89	-918.319	0
1373.19	-838.058	12.9906
1292.24	-596.871	18.9
1141.71	-273.47	26.1954
1049.5	108.53	25.4436
889.265	-128.241	27.0312
571.487	-284.911	25.6746
832.917	-383.691	25.4562
1084.48	-1043.29	11.1762
1137.49	-1114.07	5.9346
728.489	-1307.63	3.8766

6. Fill Load: "Fill Load 6"

Label	Fill Load 6
Load Type	Flexible
Area of Load	1.1712e+06 ft2
Elevation	670 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-852.331	-1077.19	4.8132
238.159	-1156.9	3.7464
728.489	-1307.63	3.8766
1137.49	-1114.07	5.9346
1084.48	-1043.29	11.1762
832.917	-383.691	25.4562
571.487	-284.911	25.6746
-9.1007	-500.271	19.4712
-643.857	-766.884	12.6252

7. Fill Load: "Fill Load 7"

Label	Fill Load 7
Load Type	Flexible
Area of Load	253540 ft2
Elevation	670 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1221.79	-639.07	0
-982.51	-1204.28	0
232.73	-1250.05	0.1806
728.38	-1423.55	0
728.49	-1307.63	3.8766
238.16	-1156.9	3.7464
-852.33	-1077.19	4.8132
-1150.46	-624.3	0.6384

8. Fill Load: "Fill Load 8"

Label	Fill Load 8
Load Type	Flexible
Area of Load	304794 ft2
Elevation	670 ft
Installation Stage	Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
237.91	34.51	14.2716
17.49	17.49	8.841
-222.97	-71.43	9.4752
-465.06	-213.56	7.2618
-222.33	-327.31	12.7344
-9.1	-500.27	19.4712
571.49	-284.91	25.6746

9. Fill Load: "Fill Load 9"

Label	Fill Load 9
Load Type	Flexible
Area of Load	965529 ft2
Elevation	670 ft
Installation Stage	Stage 1

Coordinates and Load

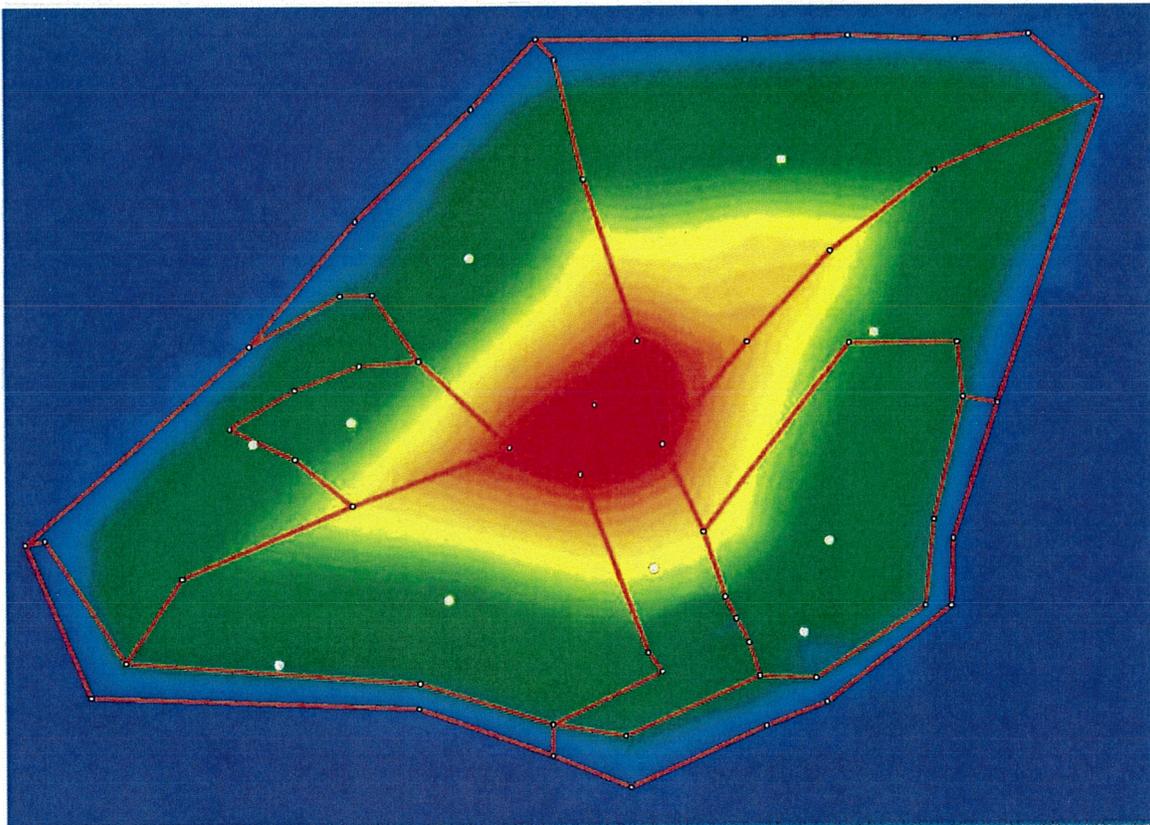
X [ft]	Y [ft]	Load Magnitude [ksf]
571.487	-284.911	25.6746
889.265	-128.241	27.0312
1049.5	108.528	25.4436
849.423	706.255	13.6878
745.319	1149.86	1.5078
677.508	1225.61	1.2432
434.8	967.475	2.3058
5.0438	552.784	2.0664
-391.01	89.8211	3.7044
-51.8508	276.709	5.3298
67.5798	280.011	4.0866
237.909	34.5093	14.2716

10. Fill Load: "Fill Load 10"

Label	Fill Load 10
Load Type	Flexible
Area of Load	668485 ft2
Elevation	670 ft
Installation Stage	Stage 1

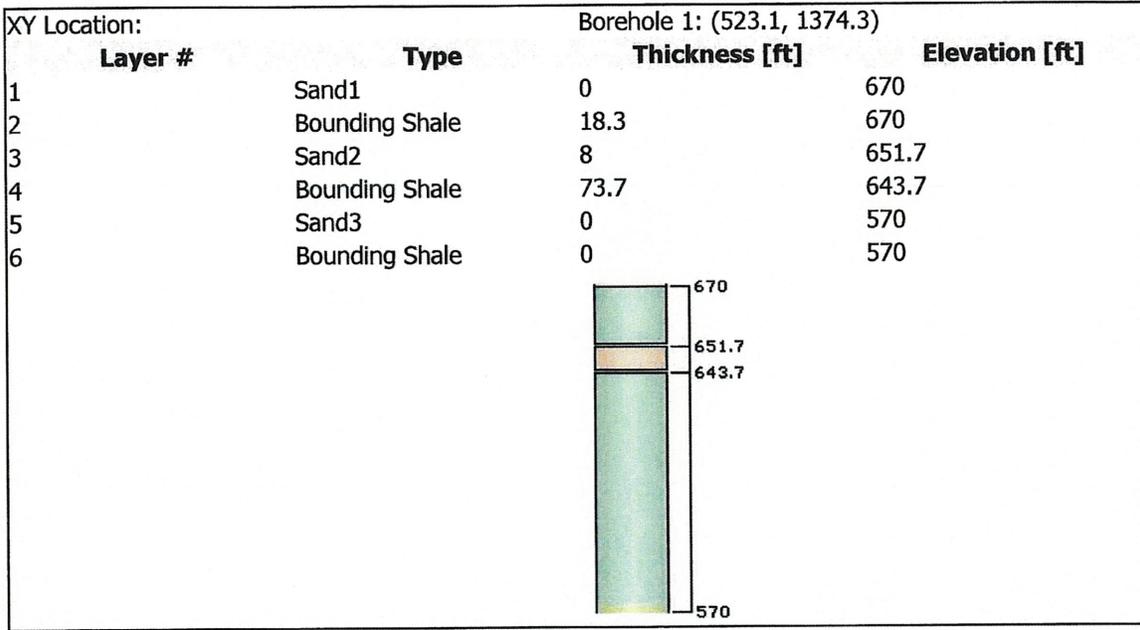
Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1221.79	-639.07	0
-1150.46	-624.3	0.6384
-852.33	-1077.19	4.8132
-643.86	-766.88	12.6252
-9.1	-500.27	19.4712
-222.33	-327.31	12.7344
-465.06	-213.56	7.2618
-222.97	-71.43	9.4752
17.49	17.49	8.841
237.91	34.51	14.2716
67.58	280.01	4.0866
-51.85	276.71	5.3298
-391.01	89.82	3.7044

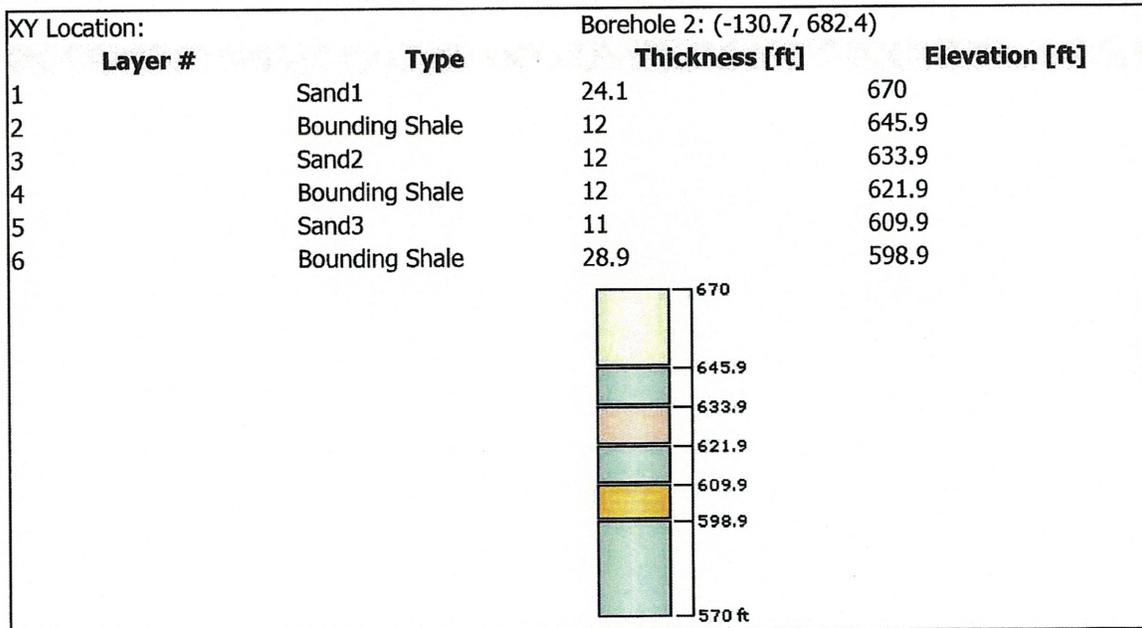


Soil Layers

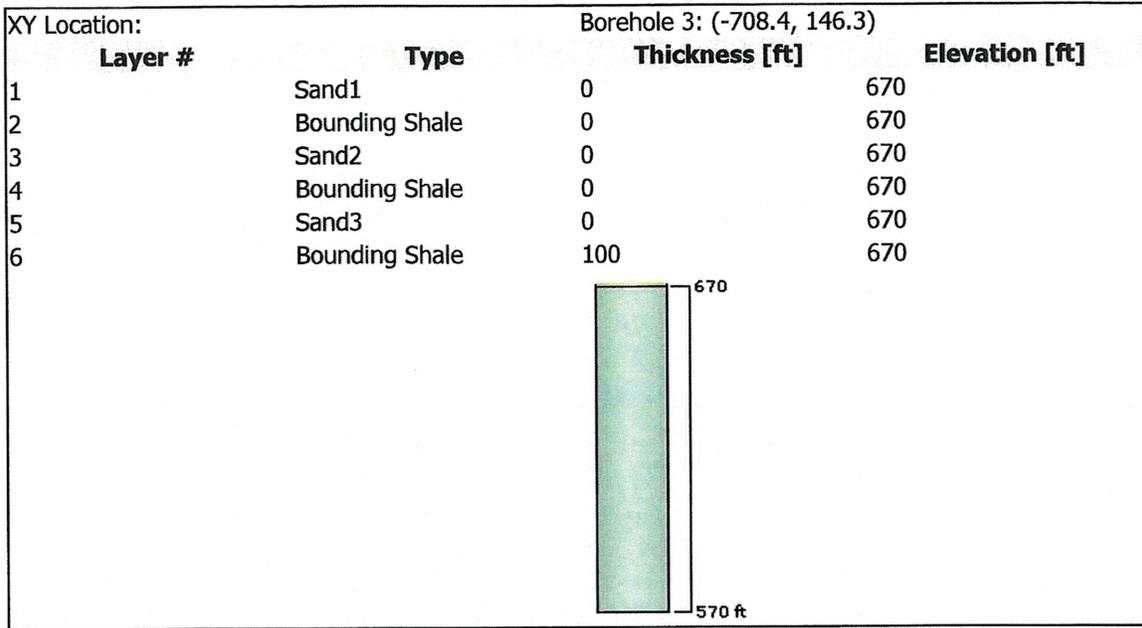
Borehole 1



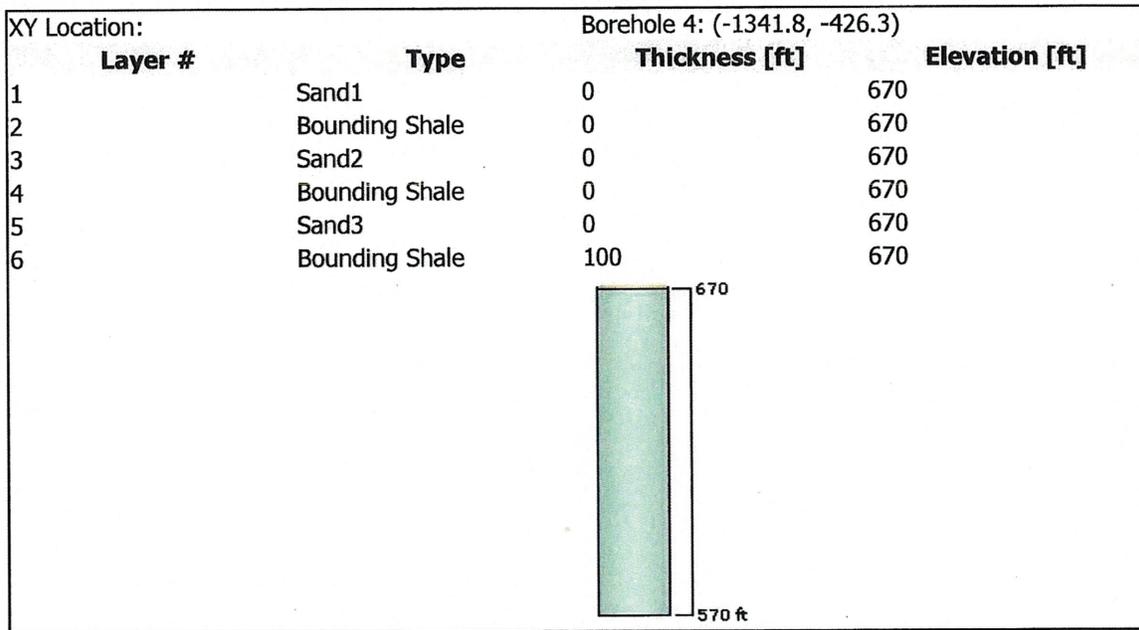
Borehole 2



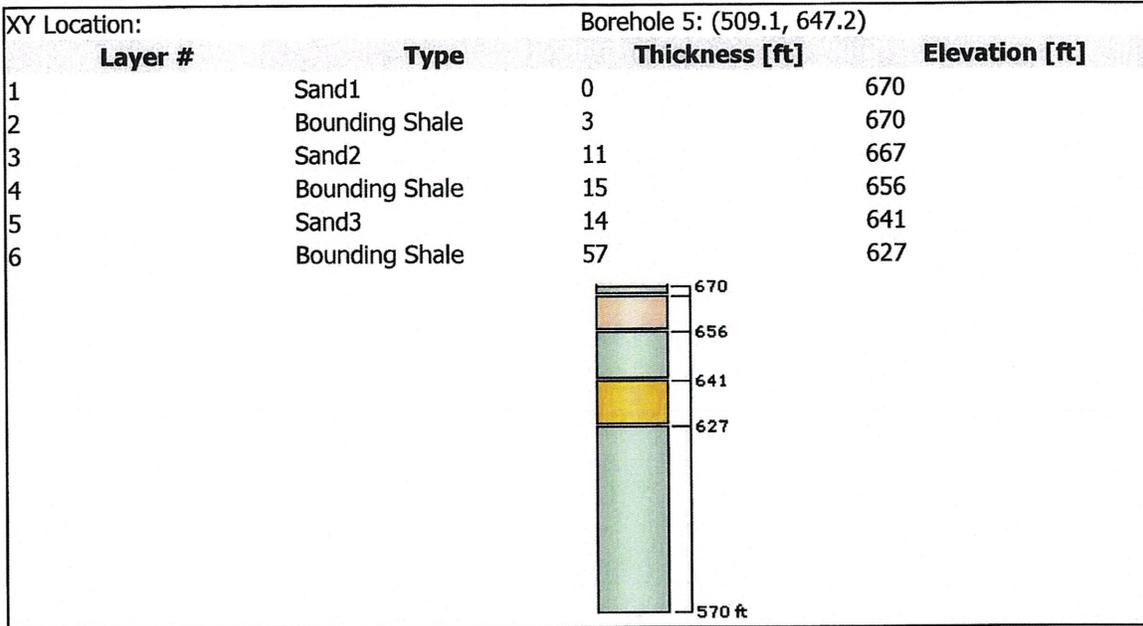
Borehole 3



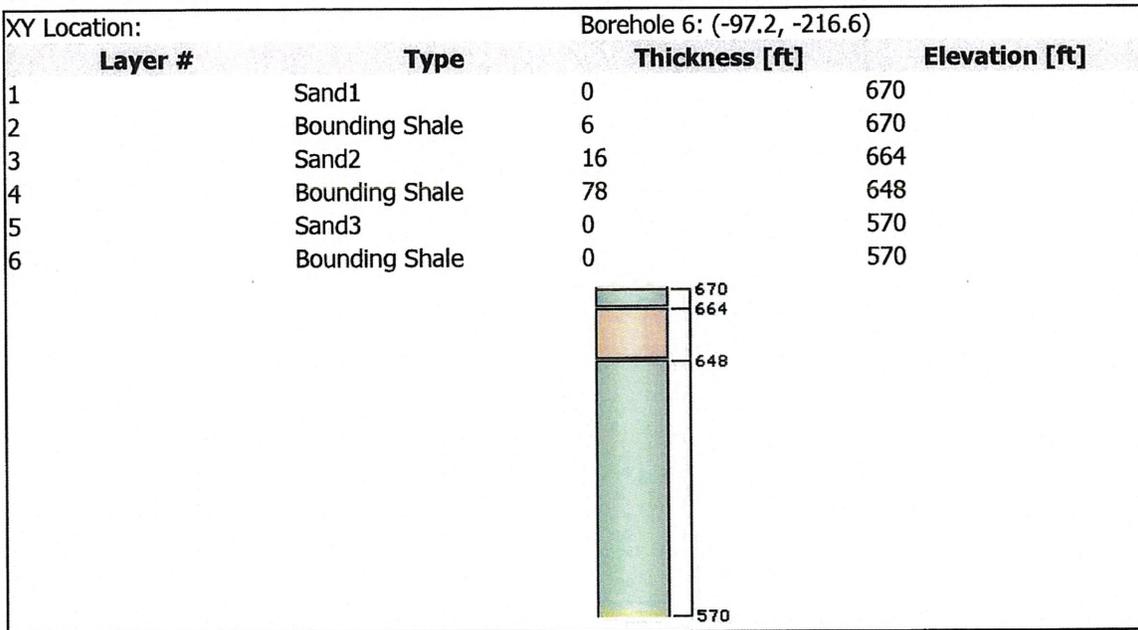
Borehole 4



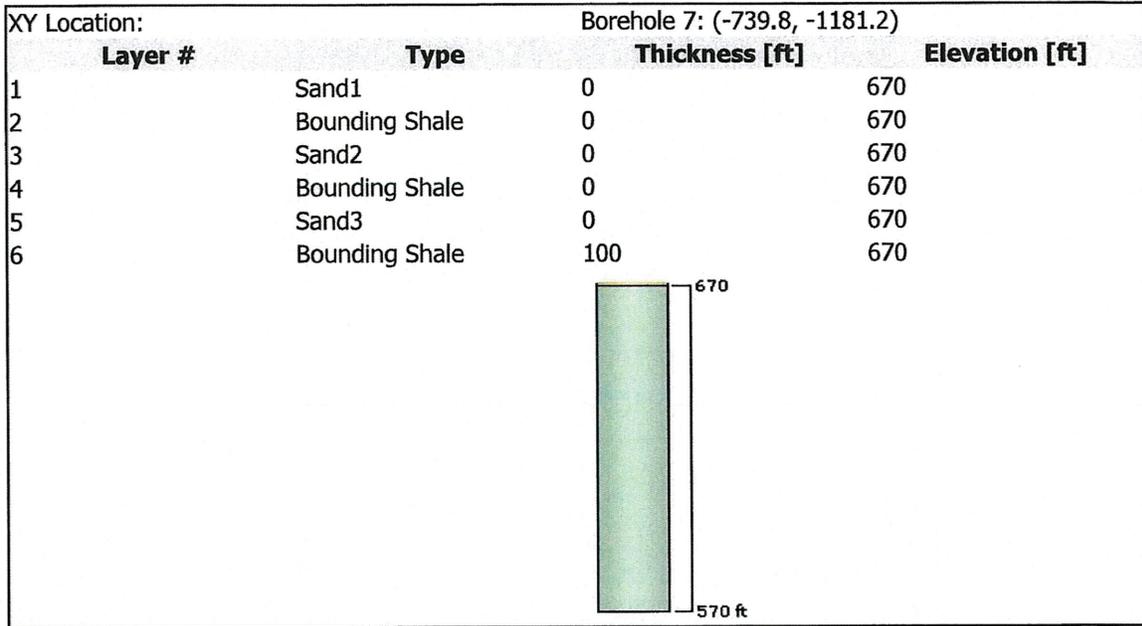
Borehole 5



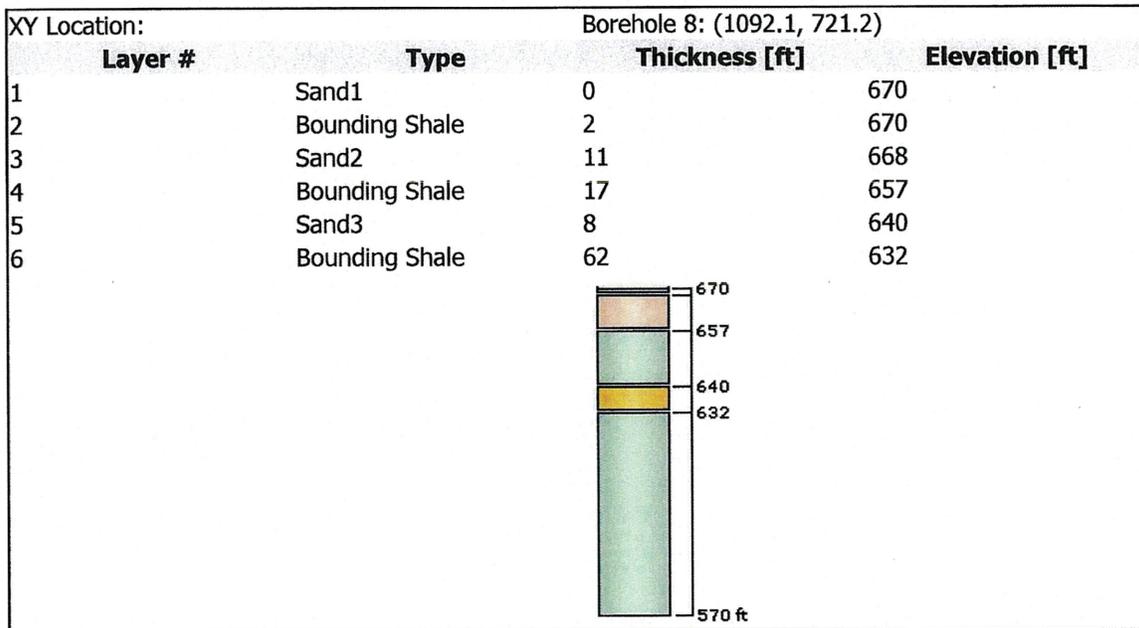
Borehole 6



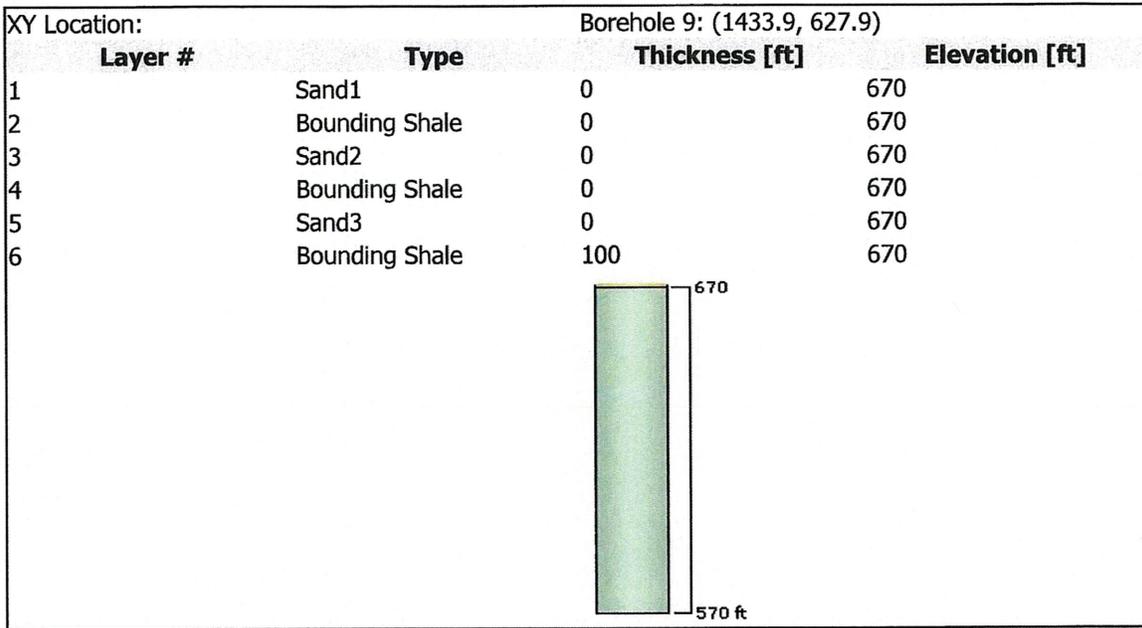
Borehole 7



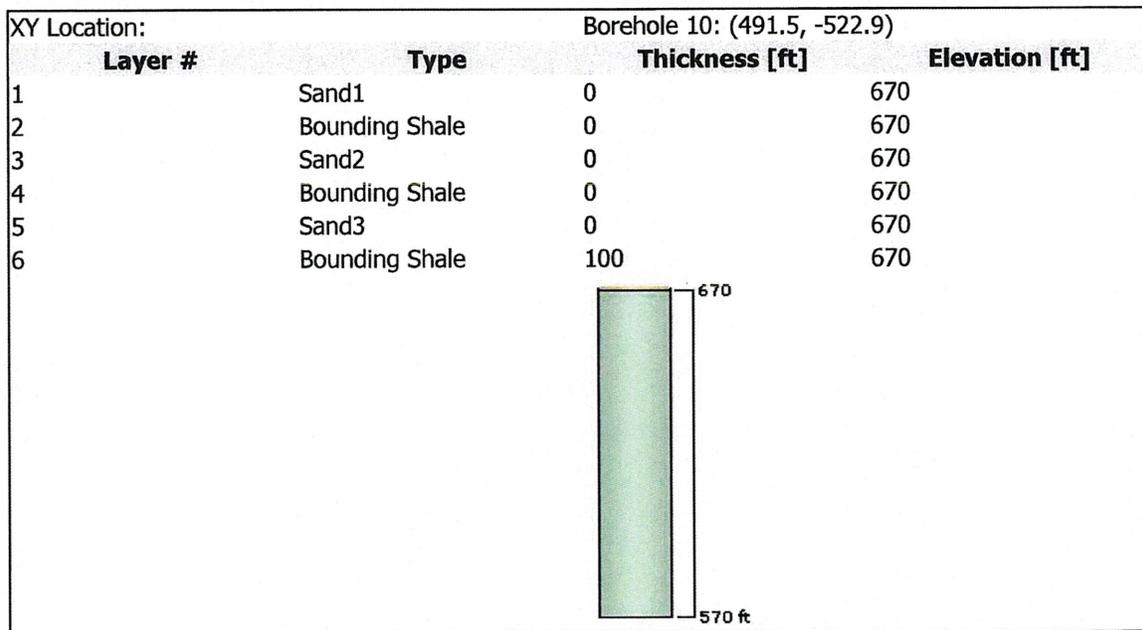
Borehole 8



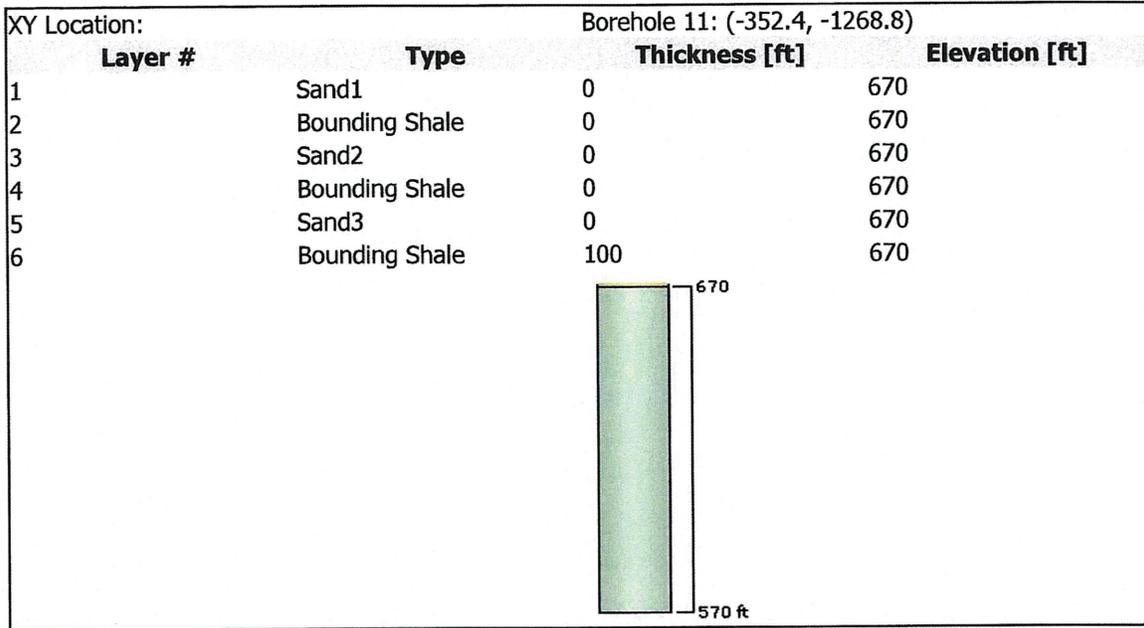
Borehole 9



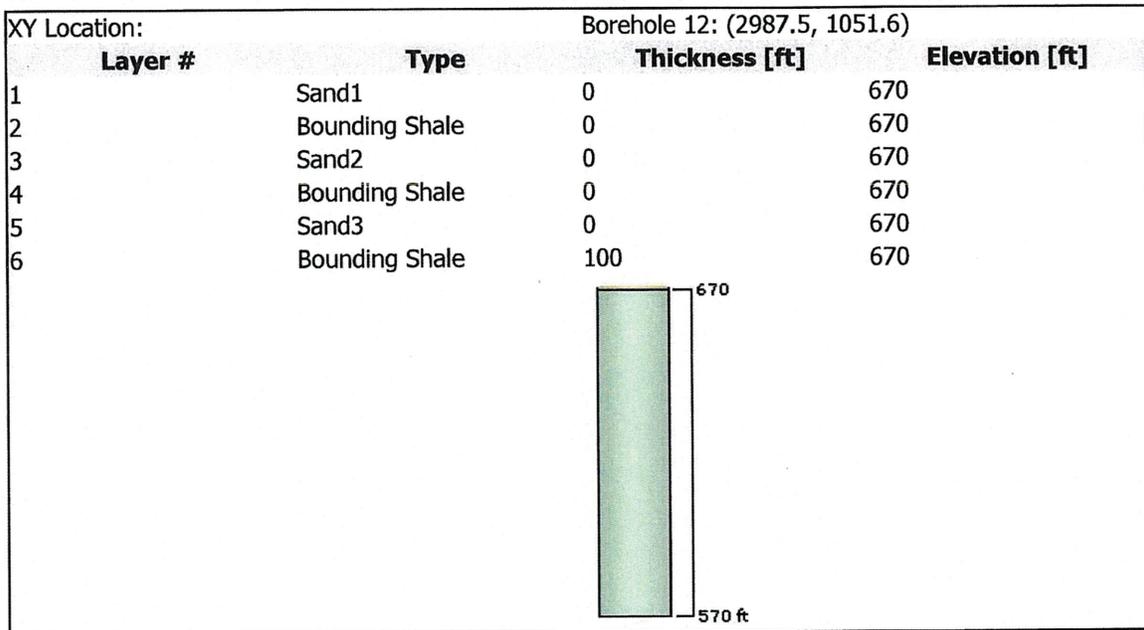
Borehole 10



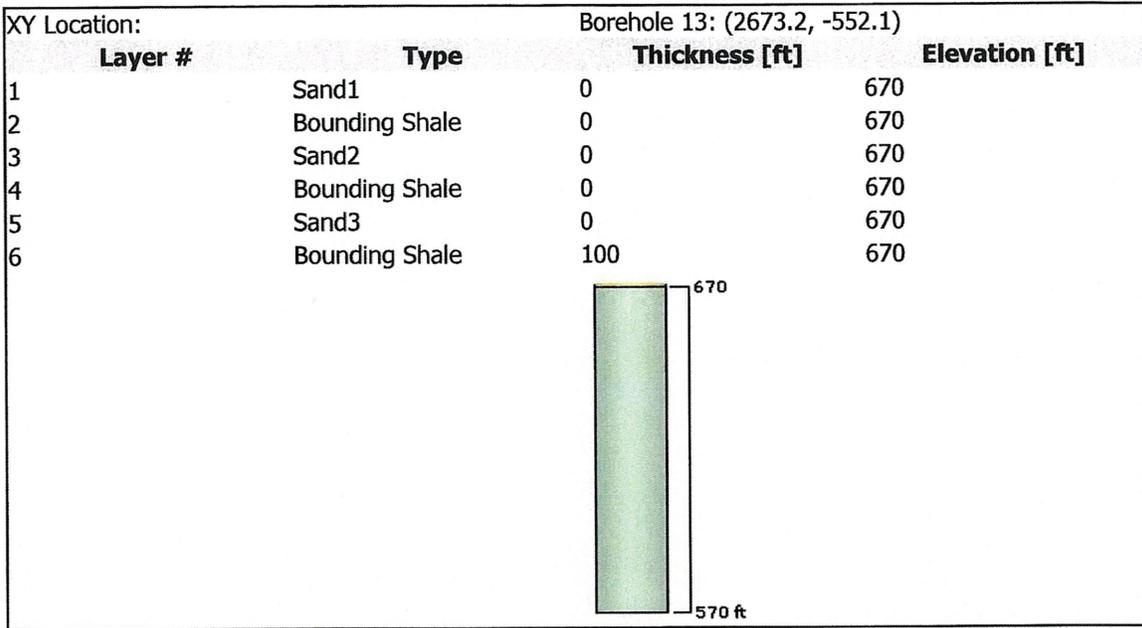
Borehole 11



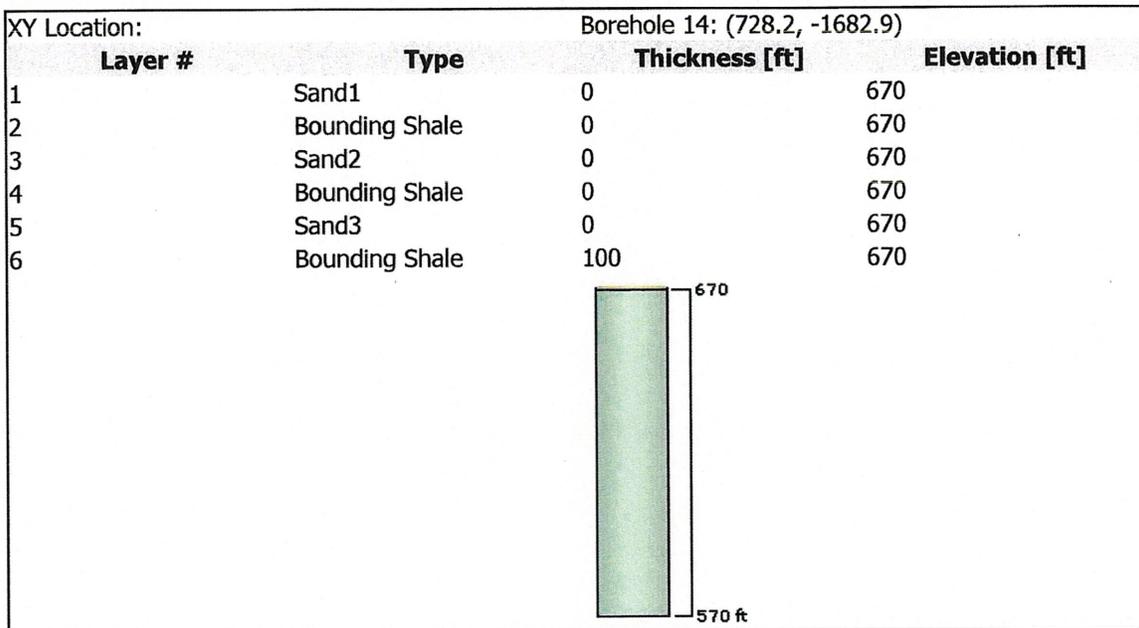
Borehole 12



Borehole 13



Borehole 14

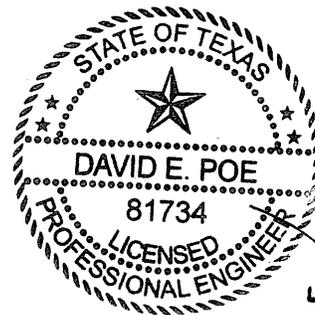


Soil Properties

Property	Sand1	Bounding Shale	Sand2	Sand3
Color				
Unit Weight [kips/ft3]	0.115	0.131	0.115	0.115
K0	1	1	1	1
Immediate Settlement	Enabled	Disabled	Enabled	Enabled
Es [ksf]	208.9	-	208.9	208.9
Esur [ksf]	300	-	300	300
Primary Consolidation	Disabled	Enabled	Disabled	Disabled
Material Type		Non-Linear		
Cc	-	0.114	-	-
Cr	-	0.05	-	-
e0	-	0.418	-	-
Pc [ksf]	-	6.9	-	-
Undrained Su A [kips/ft2]	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8

APPENDIX IIIM-B-2
FINAL COVER SETTLEMENT ANALYSIS

Includes pages IIIM-B-2-1 through IIIM-B-2-12



02-22-2022

Required: Determine the post-settlement slope of the final cover system and verify that the strain induced on the final cover due to settlement is within acceptable limits.

Method:

- A. Estimate primary settlement of waste below the final cover system.
- B. Estimate secondary settlement of waste below the final cover system.
- C. Estimate total settlement of waste below the final cover system.
- D. Verify that strain induced on the final cover due to settlement is within acceptable limits.

Description of Contents:

- Sheet IIIM-B-2-12 provides the final cover analysis points and evaluation lines supporting the strain calculations.
- Table 1 presents the final cover settlement point parameters and analysis results.
- Table 2 presents the final cover strain calculations along the evaluation lines.

References:

1. Sowers, George F., Settlement of Solid Waste, *Proceedings of the Eighth International Conference on Soil Mechanics and Foundations Engineering*, 1973.
2. Quian, Xuede, R.M. Koerner, D. H. Gray, Geotechnical Aspects of Landfill Design and Construction, Prentice-Hall, Inc., New Jersey, 2002.
3. Koerner, Robert M., Designing with Geosynthetics, Third Edition. Prentice-Hall, New Jersey, 1994.
4. Acar, Yalcin B. & Daniel, David E., *Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics*, Volume 2, American Society of Civil Engineers, 1995.
5. Zornberg, Jorge G., et al., *Retention of Free Liquids in Landfills Undergoing Vertical Expansion*, *Journal of Geotechnical and Geoenvironmental Engineering*, July 1999.
6. Fassett, Jeffrey B., et al., Geotechnical Properties of Municipal Solid Wastes and Their Use in Landfill Design, Waste Tech, 1994.
7. SETTLE3, V. 5.009 (Settlement Program), 2021, Rockscience Inc.
8. Beggs, Ian D. et al, Assessment of Maximum Allowable Strains in Polyethylene and Polypropylene Geomembranes, Geo-Frontiers Congress, Austin, TX, 2005.

Solution:

A) Estimate primary settlement of waste below the final cover system.

MSW will undergo primary consolidation due to its own weight, final cover, equipment, etc. Primary consolidation occurs quickly, generally within the first month after loading. Therefore, the weight of the final cover system is the only remaining factor that contributes to primary consolidation. In addition, by the time the construction of the final cover is complete, settlement of the waste due to the weight of the final cover will be complete.

Primary settlement is calculated using the following equation:

$$S_p = \frac{H_o C_c}{1 + e_o} \log \left(\frac{\sigma'_o + \Delta\sigma}{\sigma'_o} \right)$$

S_p = primary settlement, ft

H_o = waste thickness below the final cover system, ft

C_c = compression index

e_o = void ratio of the waste layer below final cover before settlement
(i.e., before final cover placement)

$\Delta\sigma$ = change in loading/increase in overburden pressure, psf

σ'_o = overburden pressure acting at mid-height of refuse below the
final cover, psf

For this site assume: $C_c = 0.35 \times e_o$ (Ref. 1, p. 210)

The compression index is a function of the void ratio. The compression index can range from $C_c = 0.15e_o$ to $C_c = 0.55e_o$ for fills that are low and high in organic content, respectively. An average compression index value was chosen because it is consistent with the types of waste accepted in the past. It is also representative of the minimal amount of settlement the site has experienced.

The average void ratio of waste below the final cover is estimated by determining the void ratio at the midpoint of the waste column below the final cover system. The void ratio is calculated for each settlement evaluation point using the following equation.

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where: $e_o = 1.86 - 0.00102 \sigma'_o$ (Ref. 5, p. 590)
 $\sigma'_o =$ overburden pressure in kPa

$$\sigma'_o = 0.5 \gamma_{msw} H_o$$

$$\Delta\sigma = \gamma_{cov} T_c$$

γ_{msw} = unit weight of waste below the final cover system, pcf

γ_{cov} = unit weight of cover, pcf

T_c = thickness of final cover system, ft

Parameters:

$$\gamma_{cov} = 116 \text{ pcf}$$

$$T_c = 2.5 \text{ feet}$$

γ_{msw} = varies (see note below)

Note: γ_{msw} is selected based on the midpoint of the waste thicknesses below the final cover system using the Unit Weight Profile for Waste/Daily Cover within an MSW Landfill chart from Ref. 4.

The settlement points analyzed are shown on Figure IIIM-B-2-12. An example calculation of the estimated primary settlement is shown below for Evaluation Points FC1 and FC2. The estimated primary settlement for all evaluation points is shown in Table 1.

At Evaluation Point FC1:

Top of Final Cover Elevation (ft-msl)= 981

Bottom of Waste Elevation (ft-msl)= 680.5

$$H_o = 298.0 \text{ ft}$$

$$\gamma_{msw} = 79 \text{ pcf}$$

$$\sigma'_o = 0.5 \gamma_{msw} H_o$$

$$\sigma'_o = 11771.0 \text{ psf}$$

$$\sigma'_o = 563.6 \text{ kPa}$$

$$e_o = 1.86 - 0.00102 \sigma'_o$$

$$e_o = 1.29$$

$$C_c = 0.35 e_o$$

$$C_c = 0.45$$

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$$\Delta\sigma = 290.0 \text{ psf}$$

$$S_p = \frac{298.0 \times 0.44}{1 + 0.62 \times 2.26} \log \left(\frac{11771.0 + 290.0}{11771.0} \right)$$

At Evaluation Point FC2:

Top of Final Cover Elevation (ft-msl)= 708.9

Bottom of Waste Elevation (ft-msl)= 695.7

$$H_o = 10.7 \text{ ft}$$

$$\gamma_{msw} = 43 \text{ pcf}$$

$$\sigma'_o = 0.5 \gamma_{msw} H_o$$

$$\sigma'_o = 230.0 \text{ psf}$$

$$\sigma'_o = 11.0 \text{ kPa}$$

$$e_o = 1.86 - 0.00102 \sigma'_o$$

$$e_o = 1.85$$

$$C_c = 0.35 e_o$$

$$C_c = 0.65$$

$$\Delta\sigma = 290.0 \text{ psf}$$

$$S_p = \frac{10.7 \times 0.65}{1 + 1.85} \log \left(\frac{230.0 + 290.0}{230.0} \right)$$

$$S_p = 0.86 \text{ ft}$$

B) Estimate secondary settlement of waste below the final cover system.

Secondary consolidation continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physico-chemical reaction, and bio-chemical decay. The settlement-log time relationship is similar to secondary compression of soils and can be expressed by:

$$S_c = \frac{H'_o \alpha}{1 + e'_o} \log (t_2/t_1) \quad (\text{Ref. 2, p. 451})$$

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Parameters:

S_c = secondary settlement, ft

α = secondary compression index

e'_o = void ratio of the waste layer below the final cover after primary settlement has occurred due to the final cover

H'_o = waste thickness below the final cover system after settlement, ft

t_1 = starting time of secondary settlement in years

t_2 = time at which settlement is determined in years

For this site assume: $\alpha = 0.06 \times e'_o$ (Ref. 1, p. 210)

As reported by Sowers (Ref. 1), the secondary compression index is used to estimate waste decomposition. The secondary compression index ranges from $\alpha = 0.03e'_o$ to $\alpha = 0.09e'_o$ for conditions that are unfavorable and favorable to decay, respectively. An average secondary compression index value was chosen because it is consistent with the types of waste accepted in the past. It is also representative of the minimal amount of settlement the site has experienced.

The void ratio of the waste below the final cover at closure is a function of the overburden pressure caused by placement of the final cover system. The void ratio is calculated for each settlement evaluation point using the following equation.

$$e'_o = 1.86 - 0.00102 \sigma''_o \quad (\text{Ref. 5, p. 590})$$

where: σ''_o = overburden pressure in kPa

$$\sigma''_o = 0.5 \gamma'_{\text{msw}} H'_o$$

γ'_{msw} = unit weight of waste below the final cover after primary settlement has occurred, pcf

For this site, the void ratio after primary settlement for the waste/cover soils below the final cover system varies between 1.5 to 1.9. Therefore, the secondary compression index will range between 0.09 to 0.11. Most literature sources report the secondary compression index in terms of the "modified secondary compression index" (Refs. 2, 6). The modified secondary compression index is defined by the following.

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$$C'_\alpha = \frac{\alpha}{1 + e'_o}$$

The secondary compression index calculated for this site translates to a modified secondary compression index of 0.03 to 0.04 (for a void ratio of 1.5 to 1.9). These values are consistent with reported values for the modified secondary compression index which vary from 0.03 to 0.1 (Refs. 2, 6).

Time frame used for this analysis:

$$t_1 = 1 \text{ years}$$
$$t_2 = 30.0 \text{ years (postclosure period)}$$

An example calculation of the estimated secondary settlement using the above secondary settlement period is shown below for Evaluation Points FC1 and FC2. The estimated secondary settlement for all evaluation points is shown in Table 1.

At Evaluation Point FC1:

$$H'_o = H_o - S_p$$
$$H'_o = 297.4 \text{ ft}$$

$$\sigma''_o = 0.5 \gamma'_{msw} H'_o$$
$$\gamma'_{msw} = 79 \text{ pcf}$$
$$\sigma''_o = 11746.5 \text{ psf}$$
$$\sigma''_o = 562.4 \text{ kPa}$$

$$e'_o = 1.86 - 0.00102 \sigma''_o$$
$$e'_o = 1.29$$

$$\alpha = 0.06 e'_o$$
$$\alpha = 0.08$$

$$S_c = \frac{H'_o \alpha}{1 + e'_o} \log(t_2/t_1)$$

$$S_c = \frac{297.4 \times 0.08}{1 + 1.29} \log(30/1)$$

$$S_c = 14.83 \text{ ft}$$

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At Evaluation Point FC2:

$$H'_o = H_o - S_p$$

$$H'_o = 9.8 \quad \text{ft}$$

$$\sigma''_o = 0.5 \gamma'_{msw} H'_o$$

$$\gamma'_{msw} = 43 \quad \text{pcf}$$

$$\sigma''_o = 211.5 \quad \text{psf}$$

$$\sigma''_o = 10.1 \quad \text{kPa}$$

$$e'_o = 1.86 - 0.00102 \sigma''_o$$

$$e'_o = 1.85$$

$$\alpha = 0.06 e'_o$$

$$\alpha = 0.11$$

$$S_c = \frac{H'_o \alpha}{1 + e'_o} \log (t_2/t_1)$$

$$S_c = \frac{9.8 \times 0.09}{1+1.57} \log (30/1)$$

$$S_c = 0.57 \quad \text{ft}$$

C) Estimate total settlement of waste below the final cover system.

Total settlement is the combination of primary and secondary settlement. An example calculation of the estimated total settlement is shown below for Evaluation Points FC1 and FC2. The estimated total settlement for all Evaluation Points is shown in Table 1.

At Evaluation Point FC1:			
Thickness of waste column, ft =	298.0	Primary Settlement =	0.62 ft
		Secondary Settlement =	14.83 ft
		Total Settlement =	15.45 ft
At Evaluation Point FC2:			
Thickness of waste column, ft =	10.7	Primary Settlement =	0.86 ft
		Secondary Settlement =	0.57 ft
		Total Settlement =	1.43 ft

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D) Verify that strain induced on the final cover due to settlement is within acceptable limits.

Determine the post-settlement slope of the final cover system and verify the strain induced on the final cover due to settlement is within acceptable limits.

Note that negative values indicate the components are in compression.

$$\text{Strain} = \frac{L_f - L_o}{L_o} \times 100 \quad (\text{Reference 2, Page 472})$$

L_f = Final distance between evaluation points after total settlement (ft)

L_o = Initial distance between evaluation points before total settlement (ft)

An example calculation of the estimated strain is shown below for Evaluation Points FC1 and FC2. The estimated strain for all evaluation points is shown in Table 2.

Evaluation Point FC1 to Evaluation Point FC2:

Initial Distance:

Evaluation Point FC1 Elev. =	980.99 ft-msl
Evaluation Point FC2 Elev. =	708.90 ft-msl
Plan View Distance=	1088.35 ft
L_o =	1121.8 ft

Total Settlement:

Total Settlement Point FC1=	15.45 ft
Total Settlement Point FC2=	1.43 ft

Final Distance (after settlement):

Evaluation Point FC1 Elev. =	965.5 ft-msl
Evaluation Point FC2 Elev. =	707.5 ft-msl
Plan View Distance=	1088.4 ft
L_f =	1118.5 ft

Strain= -0.296%

Conclusions:

Strain is acceptable.

- Compacted clay component of final cover has the smallest average allowable tensile strain value which is 0.5 percent (Reference 2, Page 469).
- The allowable tensile strain for an LDPE and LLDPE geomembrane is 8 to 12 percent (Reference 8).
- The allowable tensile strain for a drainage geocomposite is more than 20 percent for the geotextile (reference 3, page 112) and 200 percent for the geonet (reference 3, page 400).
- The maximum calculated strain (-0.319%) represents compression versus tensile strain and is acceptable, therefore the system will be stable. No tensile strain was observed in the analysis results.

TABLE 1. FINAL COVER EVALUATION - SETTLEMENT SUMMARY²

Evaluation Point ¹	Primary Settlement Calculations										Secondary Settlement Calculations							
	Initial Top of Final Cover Elevation (ft-msl)	Initial Top of Waste Elevation (ft-msl)	Bottom of Waste Elevation (ft-msl)	H _o (ft)	γ _{msw} (pcf)	σ' _o (psf)	Δσ (psf)	e _o	C _c	S _p (ft)	H _o (ft)	γ _{msw} (pcf)	σ'' _o (psf)	e' _o	α	S _c (ft)	Total Settlement (ft)	Post-Settlement Top of Final Cover Elevation (ft-msl)
1	981.0	978.5	680.5	298.0	79	11771.0	290.0	1.29	0.45	0.62	297.4	79	11746.5	1.29	0.08	14.83	15.45	965.5
2	708.9	706.4	695.7	10.70	43	230.0	290.0	1.85	0.65	0.86	9.8	43	211.5	1.85	0.11	0.57	1.43	707.5
3	996.0	993.5	678.5	315.0	80	12598.6	290.0	1.24	0.44	0.60	314.4	80	12574.4	1.25	0.07	15.46	16.06	979.9
4	984.0	981.5	668.6	313.0	80	12518.1	290.0	1.25	0.44	0.60	312.3	80	12493.9	1.25	0.07	15.38	15.98	968.1
5	990.1	987.6	675.4	312.3	80	12490.2	290.0	1.25	0.44	0.61	311.6	80	12466.0	1.25	0.08	15.35	15.96	974.2
6	854.6	852.1	663.7	188.4	69	6499.3	290.0	1.54	0.54	0.76	187.6	69	6473.2	1.54	0.09	10.09	10.85	843.8
7	670.0	667.5	665.2	2.3	42	48.3	290.0	1.86	0.65	0.44	1.9	42	39.0	1.86	0.11	0.11	0.55	669.5
8	989.7	987.2	680.9	306.3	79	12097.4	290.0	1.27	0.44	0.62	305.6	79	12073.0	1.27	0.08	15.16	15.77	973.9
9	869.3	866.8	691.2	175.7	68	5972.2	290.0	1.57	0.55	0.77	174.9	67	5838.5	1.57	0.09	9.48	10.25	859.1
10	730.1	727.6	718.1	9.5	43	203.7	290.0	1.85	0.65	0.83	8.6	43	185.9	1.85	0.11	0.50	1.33	728.7
11	990.0	987.5	707.3	280.3	78	10929.9	290.0	1.33	0.46	0.64	279.6	78	10905.1	1.33	0.08	14.13	14.77	975.3
12	691.9	689.4	677.6	11.7	43	232.1	290.0	1.85	0.65	0.89	10.8	43	233.0	1.85	0.11	0.62	1.51	690.4

¹ Refer to Sheet IIM-B-2-12 and 13 for Evaluation Point locations (FC1 thru FC12).

² Settlement calculations in above table rounded to one significant figure.

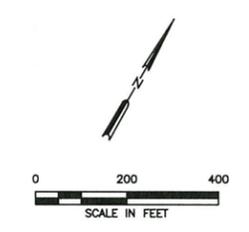
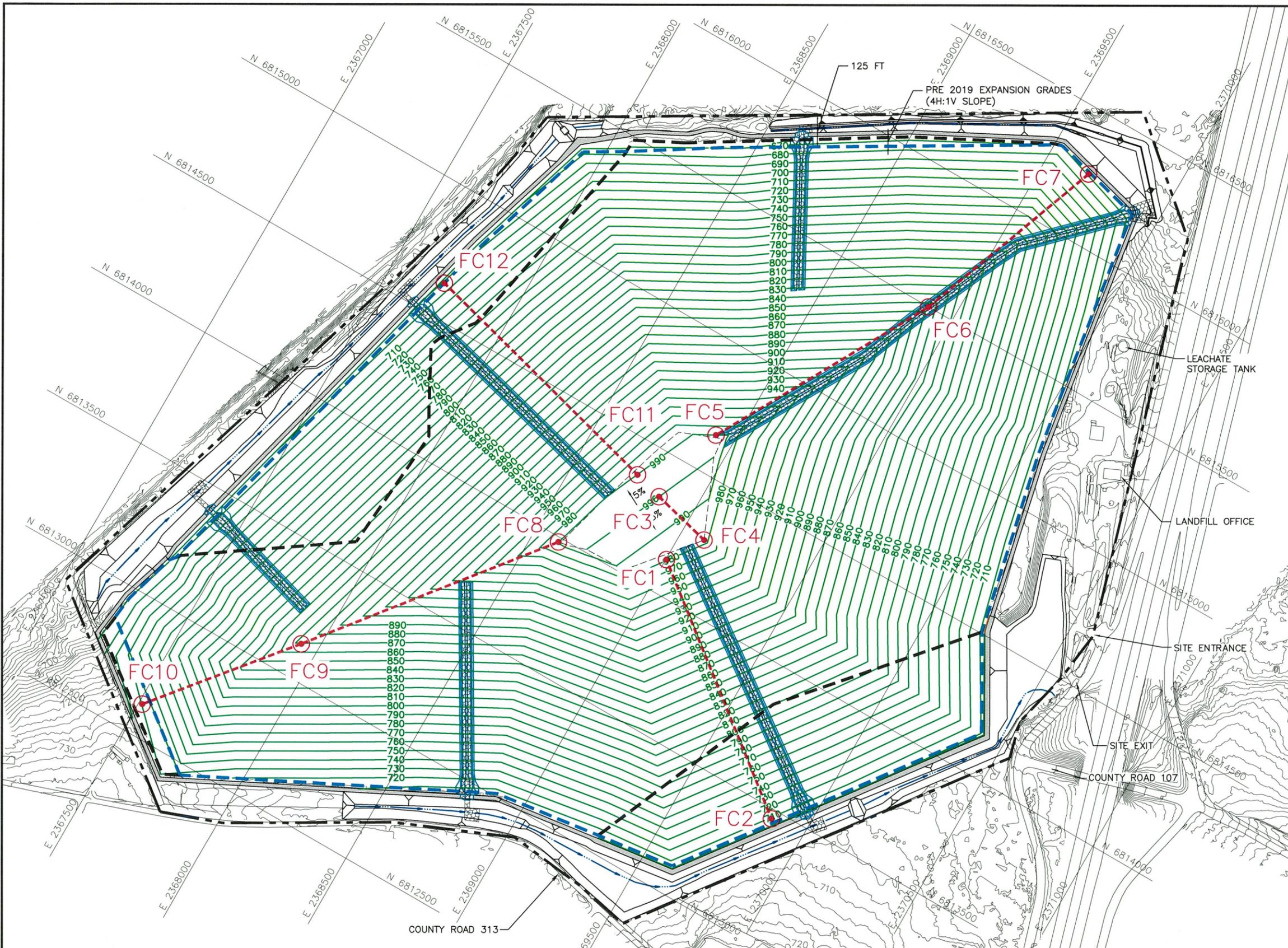
APPENDIX IIIM-B-2
FINAL COVER STRAIN SUMMARY

TABLE 2. FINAL COVER EVALUATION - STRAIN SUMMARY

Evaluation Point ¹	Initial Top of Final Cover Elevation (ft-msl)		Post-Settlement Top of Final Cover Elevation (ft-msl)		Plan View Distance (ft)	L _o (ft)	L _r (ft)	Initial Slope (ft/ft)	Post-Settlement Slope (ft/ft)	Strain (%)
	A	B	A	B						
1	981.0	708.9	965.5	707.5	1088.4	1121.8	1118.5	0.250	0.237	-0.296
3	996.0	984.0	979.9	968.1	243.0	243.3	243.3	0.049	0.049	-0.002
5	990.1	854.6	974.2	843.8	968.9	978.3	977.6	0.140	0.135	-0.071
6	854.6	670.0	843.8	669.5	811.1	831.9	829.6	0.228	0.215	-0.267
8	989.7	869.3	973.9	859.1	1079.7	1086.3	1085.7	0.111	0.106	-0.055
9	869.3	730.1	859.1	728.7	662.4	676.8	675.1	0.210	0.197	-0.263
11	990.0	691.9	975.3	690.4	1061.3	1102.4	1098.9	0.281	0.268	-0.319

¹ Refer to Sheet IIIM-B-2-12 and 13 for Evaluation Point locations. The "A" and "B" points represent the upgradient and downgradient endpoints, respectively.

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LEGEND

	PERMIT BOUNDARY
	EXPANSION LIMIT OF WASTE (SEE NOTE 3)
	HISTORICAL LIMIT OF WASTE
	N 6816000 STATE PLANE GRID
	730 EXISTING CONTOUR
	730 PROPOSED FINAL COVER CONTOUR
	DRAINAGE LETDOWN
	FC2 FINAL COVER EVALUATION POINT
	FINAL COVER EVALUATION LINE

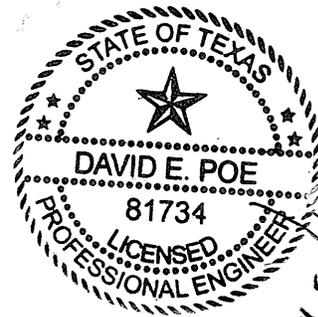
- NOTES:**
- EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS FROM AERIAL PHOTOGRAPHY FLOWN ON 01-08-2021. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.
 - THE EXPANSION LIMIT OF WASTE IS LOCATED A MINIMUM OF 125 FT FROM THE PERMIT BOUNDARY. NO WASTE IS PROPOSED TO BE PLACED OR RELOCATED BETWEEN THE HISTORICAL LIMIT OF WASTE AND THE EXPANSION LIMIT OF WASTE.

DAVID E. POE
 81734
 LICENSED PROFESSIONAL ENGINEER
 JR
 02-22-2022

<input type="checkbox"/> DRAFT <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR TEXAS REGIONAL LANDFILL COMPANY, LP	MAJOR PERMIT AMENDMENT SETTLE3 SETTLEMENT ANALYSIS FINAL COVER SETTLEMENT AND STRAIN TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS												
DATE: 02/2022 FILE: 0771-368-11 CAD: SHEET IIM-B-2-12.DWG	DRAWN BY: SRF DESIGN BY: MB REVIEWED BY: DEP	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3">REVISIONS</th> </tr> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	REVISIONS			NO.	DATE	DESCRIPTION						
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Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM SHEET IIM-B-2-12												

APPENDIX IIIM-B-3
OVERLINER SETTLEMENT ANALYSIS

Includes pages IIIM-B-3-1 through IIIM-B-3-13



DEP
02-21-2022

TURKEY CREEK LANDFILL
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APPENDIX IIIM-B-3
OVERLINER SETTLEMENT AND STRAIN

Required: Determine the after settlement slope of the overliner system and verify that the strain induced on the overliner system components due to settlement is within acceptable limits. Calculation of the after settlement slope is also used to support the geocomposite drainage design included in Appendix IIC.

Method:

- A. Estimate primary settlement of waste below the overliner system.
- B. Estimate secondary settlement of waste below the overliner system.
- C. Estimate total settlement of waste below the overliner system.
- D. Verify that strain induced on the overliner system components due to settlement is within acceptable limits.
- E. Estimate the after settlement slope of the overliner systems.

Description of Contents:

- Sheet IIIM-B-3-12 shows the Overliner Plan, Evaluation Points, and Total Settlement.
- Sheet IIIM-B-3-13 shows the overliner settlement evaluation points.
- Sheets IIIM-B-3-2 through IIIM-B-3-9 detail the procedure for the settlement calculations.
- Table 1 provides a summary of the settlement calculations for the overliner.
- Table 2 provides a summary of the overliner strain calculations.

References:

1. Sowers, George F., *Settlement of Solid Waste*, Proceedings of the Eighth International Conference on Soil Mechanics and Foundations Engineering, 1973.
2. Qian, Xuede, R.M. Koerner, D. H. Gray, Geotechnical Aspects of Landfill Design and Construction, Prentice-Hall, Inc., New Jersey, 2002.
3. Koerner, Robert M., Designing with Geosynthetics, Fifth Edition. Prentice-Hall, New Jersey, 2005.
4. Acar, Yalcin B. & Daniel, David E., *Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics*, Volume 2, American Society of Civil Engineers, 1995.
5. Zornberg, Jorge G., et al., *Retention of Free Liquids in Landfills Undergoing Vertical Expansion*, Journal of Geotechnical and Geoenvironmental Engineering, July 1999.
6. Fassett, Jeffrey B., et al., Geotechnical Properties of Municipal Solid Wastes and Their Use in Landfill Design, Waste Tech, 1994.
7. Beggs, Ian D. et al, Assessment of Maximum Allowable Strains in Polyethylene and Polypropylene Geomembranes, Geo-Frontiers Congress, Austin, TX, 2005.

Solution:

A) Estimate primary settlement of waste below the overliner system.

MSW below the overliner system will undergo primary consolidation due to its own weight, the weight of MSW placed in the pre-Subtitle D area above the overliner system, the overliner and final cover, equipment, etc. Primary consolidation occurs quickly, generally within the first month after loading. Therefore, the weight of the MSW placed above the overliner system, the overliner system, and the final cover system are the main factors that contribute to primary consolidation.

Primary settlement is calculated using the following equation:

$$S_p = \frac{H_o C_c}{1 + e_o} \log \left(\frac{\sigma'_o + \Delta \sigma}{\sigma'_o} \right)$$

- S_p = primary settlement, ft
- H_o = waste thickness below the overliner system, ft
- C_c = compression index
- e_o = average void ratio of the waste layer below overliner before settlement (i.e., before waste/cover soils are placed above the overliner)
- $\Delta \sigma$ = change in loading/increase in overburden pressure, psf
- σ'_o = overburden pressure acting at mid-height of refuse below the overliner, psf

For this site assume: $C_c = 0.38 \times e_o$ (Ref. 1, p. 210)

The compression index is a function of the void ratio. The compression index can range from $C_c = 0.15e_o$ to $C_c = 0.55e_o$ for fills that are low and high in organic content, respectively. A value of 0.35 was chosen because it is consistent with the types of waste accepted in the past. Therefore, an average value was chosen.

The average void ratio of waste below the overliner is estimated by determining the void ratio at the midpoint of the waste column below the overliner. The void ratio is calculated for each settlement evaluation point using the following equation.

$$e_o = 1.86 - 0.00102 \sigma'_o \quad (\text{Ref. 5, p. 590})$$

where: σ'_o = overburden pressure in kPa

- $\sigma'_o = 0.5 \gamma_{mswb} H_o$
- $\Delta \sigma = \gamma_{cov} T_c + \gamma_{mswa} T_{waste} + \gamma_{cov} T_p + \gamma_{cov} T_s$
- γ_{mswb} = unit weight of waste below the overliner system, pcf
- γ_{mswa} = unit weight of waste above the overliner system, pcf
- γ_{cov} = unit weight of cover (for final cover, overliner protective cover, overliner subgrade), pcf
- T_{waste} = waste thickness between the final cover system and the overliner system, ft
- T_c = thickness of final cover system, ft
- T_p = thickness of overliner protective cover, ft
- T_s = thickness of soil subgrade for overliner, ft

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APPENDIX IIIM-B-3
OVERLINER SETTLEMENT AND STRAIN

Parameters:

$$\begin{aligned} \gamma_{cov} &= 120 && \text{pcf} \\ T_c &= 2.5 && \text{ft} \\ T_p &= 2.0 && \text{ft} \\ T_s &= 1.0 && \text{ft} \\ \gamma_{mswb} &= \text{varies (see note below)} \\ \gamma_{mswa} &= \text{varies (see note below)} \end{aligned}$$

Note: γ_{mswb} and γ_{mswa} are selected based on the midpoint of the waste thicknesses lying below and above the overliner system, respectively, using the Unit Weight Profile for Waste/Daily Cover within an MSW Landfill chart from Ref. 4.

The settlement points analyzed are shown on Sheet IIIM-B-3-11. An example calculation of the estimated primary settlement is shown below for Evaluation Points 12 and 24 for the overliner. The estimated settlement for all evaluation points is also shown on Sheet IIIM-B-3-11.

At Evaluation Point 12:

$$\begin{aligned} \text{Top of Waste Elev. (ft-msl)} &= 804.4 \\ \text{Top of Overliner Protective Cover Elev. (ft-msl)} &= 736.8 \\ \text{Top of Waste Below Overliner Elev. (ft-msl)} &= 733.8 \\ \text{Bottom of Waste Elev. (ft-msl)} &= 660.0 \end{aligned}$$

$$\begin{aligned} H_o &= \text{Top of Waste Below Overliner Elev.} - \text{Bottom of Waste Elev.} \\ &= 73.8 && \text{ft} \\ \gamma_{mswb} &= 52.7 && \text{pcf} \end{aligned}$$

$$\begin{aligned} T_{waste} &= \text{Top of Waste Elev.} - \text{Top of Overliner Protective Cover Elev.} \\ &= 67.6 && \text{ft} \\ \gamma_{mswa} &= 51.8 && \text{pcf} \end{aligned}$$

$$\begin{aligned} \sigma'_o &= 0.5 \gamma_{mswb} H_o \\ \sigma'_o &= 1944.6 && \text{psf} \\ \sigma'_o &= 93.1 && \text{kPa} \end{aligned}$$

$$\begin{aligned} e_o &= 1.86 - 0.00102 \sigma'_o \\ e_o &= 1.77 \end{aligned}$$

$$\begin{aligned} C_c &= 0.25 e_o \\ C_c &= 0.67 \end{aligned}$$

$$\Delta\sigma = 4162.9 \quad \text{psf}$$

$$S_p = \frac{73.8 \times 0.67}{1 + 1.77} \quad \log \quad \frac{1944.6 + 4162.9}{1944.6}$$

$$S_p = 8.9 \quad \text{ft}$$

At Evaluation Point 24:

Top of Waste Elev. (ft-msl) = 749.3
Top of Overliner Protective Cover Elev. (ft-msl) = 692.9
Top of Waste Below Overliner Elev. (ft-msl) = 689.9
Bottom of Waste Elev. (ft-msl) = 660.0

$$H_o = \text{Top of Waste Below Overliner Elev.} - \text{Bottom of Waste Elev.}$$

$$= 29.9 \quad \text{ft}$$

$$\gamma_{mswb} = 45.7 \quad \text{pcf}$$

$$T_{\text{waste}} = \text{Top of Waste Elev.} - \text{Top of Overliner Protective Cover Elev.}$$

$$= 56.3 \quad \text{ft}$$

$$\gamma_{mswa} = 49.9 \quad \text{pcf}$$

$$\sigma'_o = 0.5 \gamma_{mswb} H_o$$

$$\sigma'_o = 683.6 \quad \text{psf}$$

$$\sigma'_o = 32.7 \quad \text{kPa}$$

$$e_o = 1.86 - 0.00102 \sigma'_o$$

$$e_o = 1.83$$

$$C_c = 0.25 e_o$$

$$C_c = 0.69$$

$$\Delta\sigma = 3470.6 \quad \text{psf}$$

$$S_p = \frac{29.9 \times 0.69}{1 + 1.83} \log \frac{683.6 + 3470.6}{683.6}$$

$$S_p = 5.8 \quad \text{ft}$$

B) Estimate secondary settlement of waste below the overliner system.

Secondary consolidation continues at substantial rates for periods of time well beyond primary settlement. It is a combination of mechanical secondary compression, physico-chemical reaction, and bio-chemical decay. Secondary settlement is calculated using the following expression:

$$S_c = \frac{H'_o \alpha}{1 + e'_o} \log (t_2/t_1) \quad (\text{Ref. 2, p. 451})$$

Parameters:

S_c = secondary settlement, ft
 α = secondary compression index
 e'_o = average void ratio of waste layer below the overliner after primary settlement has occurred
 H'_o = waste thickness between the overliner system and the bottom of waste after primary settlement, ft
 t_1 = starting time of secondary settlement in years
 t_2 = time at which settlement is determined in years

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For this site assume: $\alpha = 0.06 \times e'_o$ (Ref. 1, p. 210)

As reported by Sowers (Ref. 1), the secondary compression index is used to estimate waste decomposition. The secondary compression index ranges from $\alpha = 0.03e'_o$ to $\alpha = 0.09e'_o$ for conditions that are unfavorable and favorable to decay, respectively. An average secondary compression index value was chosen because it is consistent with the types of waste accepted in the past. It is also representative of the minimal amount of settlement the site has experienced in the pre-Subtitle D area.

The void ratio below the overliner at closure is a function of the overburden pressure caused by waste/cover soil, and the final cover system located above the overliner. The void ratio is calculated for each settlement evaluation point using the following equation.

$$e'_o = 1.86 - 0.00102 \sigma''_o \quad (\text{Ref. 5, p. 590})$$

where: σ''_o = overburden pressure in kPa

$$\sigma''_o = 0.5 \gamma'_{\text{mswb}} H'_o$$

γ'_{mswb} = unit weight of waste below the overliner after primary settlement has occurred, pcf

For this site, the void ratio after primary settlement for the waste/cover soils below the overliner varies between 1.7 to 1.9. Therefore, the secondary compression index will range between 0.10 to 0.11. Most literature sources report the secondary compression index in terms of the "modified secondary compression index" (Refs. 2, 6). The modified secondary compression index is defined by the following.

$$C'_\alpha = \frac{\alpha}{1 + e'_o}$$

The secondary compression index calculated for this site translates to a modified secondary compression index of 0.04 (for a void ratio of 1.8 to 1.9). These values are consistent with reported values for the modified secondary compression index which vary from 0.03 to 0.1 (Refs. 2, 6).

Time frame used for this analysis:

$$t_1 = 25 \text{ years (see note below)}$$
$$t_2 = 69 \text{ years (see note below)}$$

The initial time t_1 represents the assumed length of time (25 years) in which waste will have been in place and experiencing secondary settlement before overliner construction begins. The site life calculated in Appendix IIIN is approximately 14 years. The time at which settlement is calculated conservatively assumes the site life of 14 years plus a postclosure period of 30 years.

An example calculation of the estimated secondary settlement using the above secondary settlement period is shown below for Evaluation Points 12 and 24, as presented in Table 1.

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At Evaluation Point 12:

$$\begin{aligned} H'_o &= H_o - S_p \\ H'_o &= 64.9 \quad \text{ft} \end{aligned}$$

$$\begin{aligned} \sigma''_o &= 0.5 \gamma'_{\text{mswb}} H'_o \\ \gamma'_{\text{mswb}} &= 70.9 \quad \text{pcf} \\ \sigma''_o &= 2299.0 \quad \text{psf} \\ \sigma''_o &= 110.1 \quad \text{kPa} \end{aligned}$$

$$\begin{aligned} e'_o &= 1.86 - 0.00102 \sigma''_o \\ e'_o &= 1.75 \end{aligned}$$

$$\begin{aligned} \alpha &= 0.06 e'_o \\ \alpha &= 0.10 \end{aligned}$$

$$S_c = \frac{H'_o \alpha}{1 + e'_o} \log(t_2/t_1)$$

$$S_c = \frac{64.9 \times 0.1}{1 + 1.75} \log(69/25)$$

$$S_c = 1.1 \quad \text{ft}$$

At Evaluation Point 24:

$$\begin{aligned} H'_o &= H_o - S_p \\ H'_o &= 24.2 \quad \text{ft} \end{aligned}$$

$$\begin{aligned} \sigma''_o &= 0.5 \gamma'_{\text{mswb}} H'_o \\ \gamma'_{\text{mswb}} &= 61.6 \quad \text{pcf} \\ \sigma''_o &= 744.4 \quad \text{psf} \\ \sigma''_o &= 35.6 \quad \text{kPa} \end{aligned}$$

$$\begin{aligned} e'_o &= 1.86 - 0.00102 \sigma''_o \\ e'_o &= 1.82 \end{aligned}$$

$$\begin{aligned} \alpha &= 0.06 e'_o \\ \alpha &= 0.11 \end{aligned}$$

$$S_c = \frac{H'_o \alpha}{1 + e'_o} \log(t_2/t_1)$$

$$S_c = \frac{24.2 \times 0.11}{1 + 1.82} \log(25/69)$$

$$S_c = 0.4 \quad \text{ft}$$

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C) Estimate total settlement of waste below the overliner system.

Total settlement is the combination of primary, and secondary settlement. An example calculation of the estimated total settlement is shown below for Evaluation Points 12 and 24. The estimated total settlement for all evaluation points is shown on Figure --- (overliner).

At Evaluation Point 12: Thickness of waste column below overliner, ft = 73.8	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Primary Settlement =</td> <td style="width: 20%;">8.9</td> <td style="width: 20%;">ft</td> </tr> <tr> <td>Secondary Settlement =</td> <td>1.1</td> <td>ft</td> </tr> <tr style="border-top: 1px solid black;"> <td>Total Settlement =</td> <td>10.0</td> <td>ft</td> </tr> </table>	Primary Settlement =	8.9	ft	Secondary Settlement =	1.1	ft	Total Settlement =	10.0	ft
Primary Settlement =	8.9	ft								
Secondary Settlement =	1.1	ft								
Total Settlement =	10.0	ft								
At Evaluation Point 24: Thickness of waste column below overliner, ft = 29.9	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Primary Settlement =</td> <td style="width: 20%;">5.8</td> <td style="width: 20%;">ft</td> </tr> <tr> <td>Secondary Settlement =</td> <td>0.4</td> <td>ft</td> </tr> <tr style="border-top: 1px solid black;"> <td>Total Settlement =</td> <td>6.2</td> <td>ft</td> </tr> </table>	Primary Settlement =	5.8	ft	Secondary Settlement =	0.4	ft	Total Settlement =	6.2	ft
Primary Settlement =	5.8	ft								
Secondary Settlement =	0.4	ft								
Total Settlement =	6.2	ft								

D) Verify that strain induced on the overliner system components due to settlement is within acceptable limits.

Determine the after settlement slope of the overliner system and verify the strain induced on the overliner system components due to settlement is within acceptable limits.

$$\text{Strain} = \frac{L_f - L_o}{L_o} \times 100 \quad (\text{Ref. 2, p. 472})$$

L_f = Final distance between evaluation points after total settlement (ft)

L_o = Initial distance between evaluation points before total settlement (ft)

An example calculation of the estimated strain is shown below for Evaluation Points 12 and 24 for the overliner.

Initial Distance:

Evaluation Point 12 Elev. =	734.8 ft-msl
Evaluation Point 24 Elev. =	690.9 ft-msl
Plan View Distance =	193.0 ft
L_o =	197.92 ft

Final Distance (after settlement):

Evaluation Point 12 Elev. =	724.8 ft-msl
Evaluation Point 24 Elev. =	684.7 ft-msl
Plan View Distance =	193.0 ft
L_f =	197.11 ft

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$$\text{Strain} = \frac{197.22 - 197.92}{197.22} \times 100$$

$$\text{Strain} = -0.410 \quad \%$$

As shown on Table 2, the estimated strain between select points ranges from -0.41% to -0.028%. The estimated strain values are acceptable and the system will be stable. Note that the calculated negative strain values indicate the component is in compression and not tensile strain. Allowable strain values for the overliner geosynthetic components are shown below Table 2.

E) Estimate the after settlement slope of the overliner.

Determine the after settlement slope of the overliner system.

An example calculation of the estimated after settlement slope is shown below for Evaluation Points 12 and 14 for the overliner. Evaluation points are shown on Figure ---.

Prior to Settlement:

Evaluation Point 14 Elev. =	690.9 ft-msl
Evaluation Point 12 Elev. =	734.8 ft-msl
Plan View Distance =	193.0 ft
Initial Slope =	-22.7 %

After Settlement:

Evaluation Point 14 Elev. =	684.7 ft-msl
Evaluation Point 12 Elev. =	724.8 ft-msl
Plan View Distance =	193.0 ft
After settlement Slope =	-20.76 %

Post-settlement slope calculations are provided for select evaluations points.

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIM-B-3
OVERLINER SETTLEMENT AND STRAIN

TABLE 1. OVERLINER EVALUATION - SETTLEMENT CALCULATIONS SUMMARY

Evaluation Point	Top of Waste Elevation (ft-msl)	Initial Top of Overliner Elevation (ft-msl)	Initial Top of Waste Below Overliner Elevation (ft-msl)	Bottom of Waste Elevation (ft-msl)	PRIMARY SETTLEMENT CALCULATIONS									SECONDARY SETTLEMENT CALCULATIONS						Total Settlement (ft)	Post-Settlement Top of Overliner Elevation (ft-msl)	Post-Settlement Top of Waste Below Overliner Elevation (ft-msl)
					H _o (ft)	T _{waste} (ft)	γ _{m_{swb}} (pcf)	γ _{m_{swa}} (pcf)	σ' _o (psf)	Δσ (psf)	e _o	C _c	S _p (ft)	H' _o (ft)	γ' _{m_{swb}} (pcf)	σ'' _o (psf)	e' _o	α	S _c (ft)			
1	991.9	826.5	825.5	685.7	139.8	163.4	62.2	65.9	4346.4	11427.9	1.65	0.63	18.5	121.3	81.5	4941.1	1.62	0.10	2.0	20.5	806.0	805.0
2	971.1	825.3	824.3	672.1	152.2	143.7	64.0	62.8	4874.1	9689.4	1.62	0.62	17.0	135.2	81.3	5493.8	1.59	0.10	2.2	19.2	806.1	805.1
3	986.0	821.9	820.9	689.2	131.7	162.2	61.1	65.6	4020.6	11296.8	1.66	0.63	18.2	113.5	81.4	4620.4	1.63	0.10	1.9	20.0	801.9	800.9
4	965.1	820.1	819.1	677.2	141.9	143.0	62.5	62.8	4432.8	9645.2	1.64	0.62	16.8	125.1	81.1	5074.6	1.61	0.10	2.0	18.9	801.2	800.2
5	949.8	814.7	813.7	671.1	142.6	133.1	62.5	61.4	4454.0	8829.8	1.64	0.62	16.0	126.6	81.0	5126.9	1.61	0.10	2.1	18.0	796.6	795.6
6	928.4	811.2	810.2	694.8	115.4	115.2	58.9	58.9	3396.9	7440.0	1.69	0.64	13.9	101.5	80.1	4069.2	1.66	0.10	1.7	15.6	795.6	794.6
7	930.0	810.5	809.5	666.1	143.4	117.5	62.8	59.1	4502.7	7612.0	1.64	0.62	14.5	128.8	80.7	5200.3	1.61	0.10	2.1	16.6	793.8	792.8
8	909.4	804.1	803.1	691.0	112.1	103.3	58.3	57.1	3268.2	6565.5	1.70	0.65	12.8	99.3	79.4	3942.2	1.67	0.10	1.6	14.5	789.6	788.6
9	844.6	762.7	761.7	669.3	92.4	79.9	55.4	53.6	2557.5	4943.6	1.74	0.66	10.4	82.0	75.3	3084.5	1.71	0.10	1.4	11.8	750.9	749.9
10	911.5	800.7	799.7	665.8	133.9	108.9	61.4	57.7	4107.4	6941.8	1.66	0.63	13.6	120.2	80.3	4826.4	1.62	0.10	2.0	15.6	785.1	784.1
11	869.1	772.7	771.7	660.0	111.7	94.4	58.3	55.7	3256.5	5912.5	1.70	0.65	12.0	99.7	78.5	3912.4	1.67	0.10	1.6	13.7	759.1	758.1
12	804.4	734.8	733.8	660.0	73.8	67.6	52.7	51.8	1944.6	4162.9	1.77	0.67	8.9	64.9	70.9	2299.0	1.75	0.10	1.1	10.0	724.8	723.8
13	871.2	767.7	766.7	660.0	106.7	101.5	57.4	56.9	3063.5	6427.8	1.71	0.65	12.6	94.2	79.1	3722.8	1.68	0.10	1.6	14.1	753.6	752.6
14	841.9	753.1	752.1	660.0	92.1	86.8	55.4	54.5	2549.3	5387.8	1.74	0.66	10.9	81.1	76.3	3093.5	1.71	0.10	1.4	12.3	740.8	739.8
15	872.5	762.6	761.6	669.7	91.9	107.9	55.4	57.7	2544.2	6888.9	1.74	0.66	12.6	79.3	79.0	3130.4	1.71	0.10	1.3	13.9	748.7	747.7
16	835.9	750.2	749.2	660.0	89.2	83.7	55.1	54.2	2455.2	5196.5	1.74	0.66	10.6	78.5	75.6	2968.4	1.72	0.10	1.3	11.9	738.2	737.2
17	833.2	741.4	740.4	671.6	68.8	89.8	51.8	55.1	1782.8	5603.4	1.77	0.67	10.3	58.5	74.9	2191.3	1.75	0.11	1.0	11.3	730.1	729.1
18	816.2	740.8	739.8	660.0	79.8	73.4	53.6	52.7	2137.7	4529.9	1.76	0.67	9.5	70.2	73.0	2563.5	1.73	0.10	1.2	10.7	730.1	729.1
19	778.2	714.4	713.4	689.6	23.8	61.8	44.9	50.9	534.0	3808.1	1.83	0.70	5.3	18.5	62.5	576.4	1.83	0.11	0.3	5.6	708.8	707.8
20	776.6	720.5	719.5	660.0	59.5	54.1	50.6	49.5	1506.6	3338.5	1.79	0.68	7.4	52.2	65.3	1702.9	1.78	0.11	0.9	8.2	712.3	711.3
21	782.4	720.1	719.1	660.0	59.1	60.3	50.6	50.6	1496.1	3713.4	1.79	0.68	7.8	51.3	67.0	1719.4	1.78	0.11	0.9	8.7	711.4	710.4
22	737.1	690.4	689.4	678.8	10.5	44.7	43.2	47.7	227.9	2789.9	1.85	0.70	2.9	7.6	56.0	213.5	1.85	0.11	0.1	3.0	687.3	686.3
23	748.2	691.5	690.5	677.1	13.4	54.7	43.7	49.5	292.5	3367.2	1.85	0.70	3.6	9.8	59.4	290.3	1.85	0.11	0.2	3.8	687.7	686.7
24	749.3	690.9	689.9	660.0	29.9	56.3	45.7	49.9	683.6	3470.6	1.83	0.69	5.8	24.2	61.6	744.4	1.82	0.11	0.4	6.2	684.7	683.7
25	731.0	683.7	682.7	664.4	18.3	45.3	44.2	48.0	403.3	2836.9	1.84	0.70	4.1	14.2	57.1	405.4	1.84	0.11	0.2	4.3	679.4	678.4
26	701.5	680.3	679.3	664.6	14.7	19.2	43.7	44.4	322.2	1514.1	1.84	0.70	2.7	12.0	48.8	292.7	1.85	0.11	0.2	3.0	677.3	676.3
27	680.8	679.9	678.9	661.2	17.8	0.0	44.2	42.0	392.4	660.0	1.84	0.70	1.9	15.9	44.0	349.2	1.84	0.11	0.3	2.1	677.8	676.8
28	680.7	680.0	679.0	660.0	19.0	0.0	44.4	42.0	422.9	660.0	1.84	0.70	1.9	17.1	44.2	378.2	1.84	0.11	0.3	2.2	677.8	676.8
29	705.7	700.7	699.7	660.0	39.7	3.0	46.9	42.4	931.6	788.1	1.81	0.69	2.6	37.1	47.7	884.6	1.82	0.11	0.6	3.2	697.5	696.5
30	738.0	729.5	728.5	658.6	69.9	6.5	52.1	42.7	1821.0	939.1	1.77	0.67	3.1	66.8	53.6	1790.6	1.77	0.11	1.1	4.2	725.3	724.3
31	755.3	729.5	728.5	660.0	68.5	23.9	51.8	44.9	1773.4	1731.7	1.77	0.67	4.9	63.5	58.3	1851.8	1.77	0.11	1.1	6.0	723.5	722.5
32	789.1	729.2	728.2	662.7	65.5	57.8	51.5	50.3	1687.5	3566.4	1.78	0.68	7.9	57.7	67.3	1941.0	1.77	0.11	1.0	8.8	720.4	719.4
33	771.8	710.4	709.4	660.0	49.4	59.4	48.8	50.6	1205.4	3665.2	1.80	0.68	7.3	42.1	65.3	1374.5	1.79	0.11	0.7	8.0	702.4	701.4
34	764.7	710.0	709.0	660.0	49.0	52.7	48.8	49.1	1195.5	3248.9	1.80	0.68	6.8	42.2	63.4	1338.2	1.79	0.11	0.7	7.5	702.5	701.5
35	738.3	700.4	699.4	660.0	39.4	35.9	46.9	46.4	924.8	2326.0	1.81	0.69	5.3	34.1	57.4	980.1	1.81	0.11	0.6	5.9	694.6	693.6
36	706.8	700.5	699.5	660.0	39.5	4.3	46.9	42.4	926.9	841.3	1.81	0.69	2.7	36.8	48.0	883.6	1.82	0.11	0.6	3.3	697.2	696.2
37	974.2	820.0	819.0	695.5	123.5	152.2	60.0	64.0	3706.0	10408.0	1.68	0.64	17.1	106.4	81.1	4319.0	1.65	0.10	1.8	18.8	801.2	800.2
38	921.4	810.0	809.0	694.5	114.5	109.4	58.6	58.0	3354.9	7007.3	1.70	0.64	13.4	101.1	79.9	4038.6	1.66	0.10	1.7	15.1	794.9	793.9

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIM-B-3
OVERLINER SETTLEMENT AND STRAIN

TABLE 1. OVERLINER EVALUATION - SLOPE SUMMARY

Evaluation Point ¹		Initial Top of Overliner Elevation (ft-msl)		Post-Settlement Top of Overliner Elevation (ft-msl)		Plan View Distance (ft)	Initial Slope (%)	Post-Settlement Slope (%)
A	B	A	B	A	B			
2	6	825.3	811.2	806.1	795.6	400.8	-3.5	-2.62
8	14	804.1	753.1	789.6	740.8	243.4	-21.0	-20.06
12	24	734.8	690.9	724.8	684.7	193.0	-22.7	-20.76
31	26	729.5	680.3	723.5	677.3	222.8	-22.1	-20.70
37	38	820.0	810.0	801.2	794.9	186.8	-5.4	-3.35

¹ Refer to Sheet IIIM-B-3-12 for slope Evaluation Point locations.

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIM-B-3
OVERLINER SETTLEMENT AND STRAIN

TABLE 2. OVERLINER EVALUATION - STRAIN SUMMARY

Evaluation Point ¹		Initial Top of Overliner Elevation (ft-msl)		Post-Settlement Top of Overliner Elevation (ft-msl)		Plan View Distance (ft)	L ₀ (ft)	L _r (ft)	Strain (%)
A	B	A	B	A	B				
2	6	825.3	811.2	806.1	795.6	400.8	401.05	400.94	-0.028
8	14	804.1	753.1	789.6	740.8	243.4	248.69	248.25	-0.176
12	24	734.8	690.9	724.8	684.7	193.0	197.92	197.11	-0.410
31	26	729.5	680.3	723.5	677.3	222.8	228.16	227.52	-0.279
37	38	820.0	810.0	801.2	794.9	186.8	187.02	186.85	-0.088

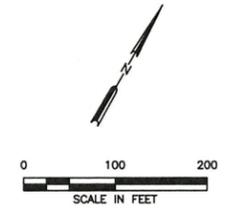
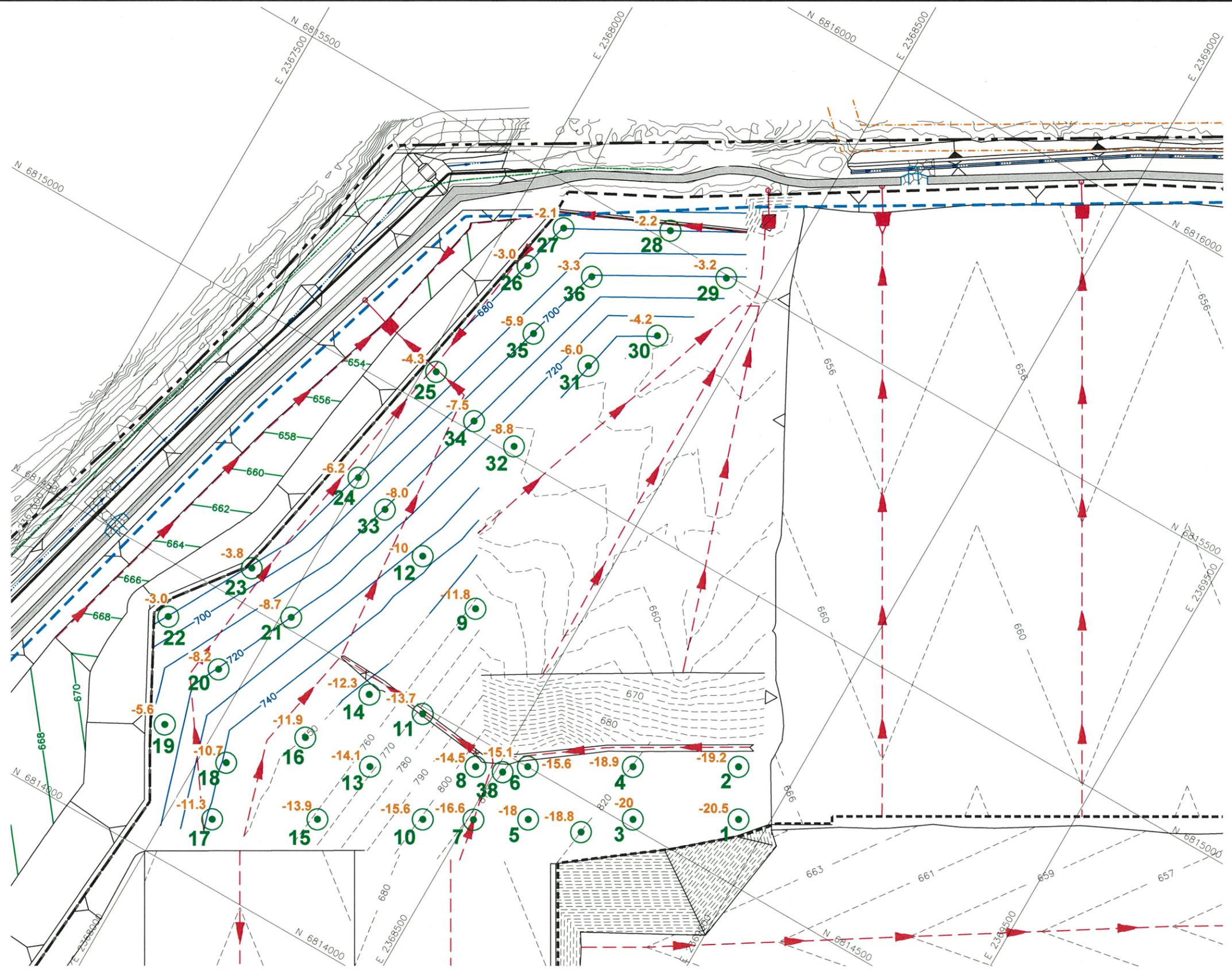
¹ Refer to Sheet IIIM-B-3-12 for evaluation point and strain analysis line locations.

Conclusion:

Strain is acceptable.

- The allowable tensile strain for an LDPE and LLDPE geomembrane is 8 to 12 percent (Reference 7).
- The allowable tensile strain for a drainage geocomposite is more than 20 percent for the geotextile (reference 2, page 112) and 200 percent for the geonet (reference 2, page 400).
The allowable tensile strain for compacted clay liner is 0.5 percent (Reference 1, page 469).
- The maximum calculated strain (-0.410% compression strain) is below the allowable tensile strain for the components of the liner system; therefore, the system will be stable. Note that negative values represent compression strain not tensile strain.

O:\0771\368\EXPANSION 2021\PART III\IIM\FIGURE IIM-B-3-12.dwg, rarrington, 1:2



LEGEND

- PERMIT BOUNDARY
- EXPANSION LIMIT OF WASTE
- HISTORICAL LIMIT OF WASTE
- STATE PLANE GRID
- 730 EXISTING CONTOUR
- 664 EXISTING EXCAVATION/OVERLINER CONTOUR
- 664 PROPOSED EXCAVATION CONTOUR
- LEACHATE COLLECTION PIPE
- LEACHATE COLLECTION SUMP
- 700 EXPANSION OVERLINER CONTOUR
- BELOW GRADE CLASS I AREA
- EASEMENT
- POWERLINE LOCATION
- EXCAVATION SIDESLOPE
3H:1V OTHERWISE INDICATED
- 20.5 TOTAL SETTLEMENT AT EVALUATION POINT
- SETTLEMENT EVALUATION POINT

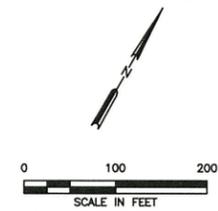
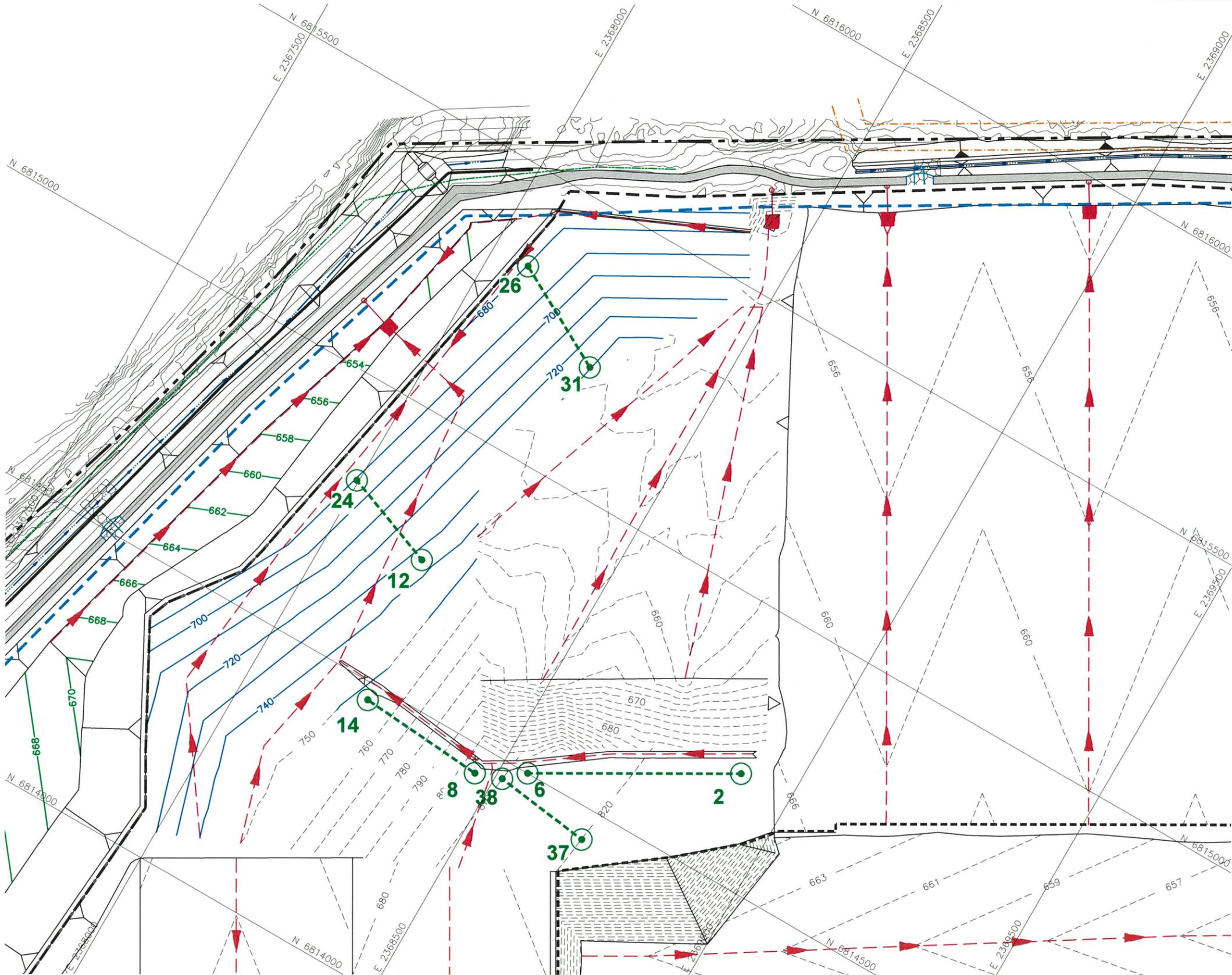
NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS FROM AERIAL PHOTOGRAPHY FLOWN ON 01-08-2021. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.



DEP
62.22.2022

<input type="checkbox"/> DRAFT <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR TEXAS REGIONAL LANDFILL COMPANY, LP	MAJOR PERMIT AMENDMENT OVERLINER SETTLEMENT ANALYSIS EVALUATION POINTS/TOTAL SETTLEMENT TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS															
DATE: 02/2022 FILE: 0771-368-11 CAD: SHEET IIM-B-3-12.DWG	DRAWN BY: RAA DESIGN BY: DEP REVIEWED BY: DEP	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3">REVISIONS</th> </tr> <tr> <th style="width: 10%;">NO.</th> <th style="width: 10%;">DATE</th> <th style="width: 80%;">DESCRIPTION</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	REVISIONS			NO.	DATE	DESCRIPTION									
REVISIONS																	
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Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM SHEET IIM-B-3-12															



- LEGEND**
- PERMIT BOUNDARY
 - EXPANSION LIMIT OF WASTE
 - HISTORICAL LIMIT OF WASTE
 - STATE PLANE GRID
 - 730 EXISTING CONTOUR
 - 664 EXISTING EXCAVATION/OVERLINER CONTOUR
 - 664 PROPOSED EXCAVATION CONTOUR
 - LEACHATE COLLECTION PIPE
 - LEACHATE COLLECTION SUMP
 - 700 EXPANSION OVERLINER CONTOUR
 - BELOW GRADE CLASS I AREA
 - EASEMENT
 - POWERLINE LOCATION
 - EXCAVATION SIDESLOPE 3H:1V OTHERWISE INDICATED
 - SETTLEMENT EVALUATION POINT
 - STRAIN EVALUATION LINE

NOTES:
 1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS FROM AERIAL PHOTOGRAPHY FLOWN ON 01-08-2021. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.



DEP
 02-22-2022

<input type="checkbox"/> DRAFT <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR TEXAS REGIONAL LANDFILL COMPANY, LP		MAJOR PERMIT AMENDMENT TOTAL SETTLEMENT AT EVALUATION POINTS													
	DATE: 02/2022 FILE: 0771-368-11 CAD: SHEET IIM-B-3-13.DWG		DRAWN BY: RAA DESIGN BY: DEP REVIEWED BY: DEP													
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		REVISIONS		TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS												
		<table border="1"> <thead> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>		NO.	DATE	DESCRIPTION										WWW.WCGRP.COM SHEET IIM-B-3-13
NO.	DATE	DESCRIPTION														

O:\0771\368\EXPANSION 2021\PART III\IIM\FIGURE IIM-B-3-13.dwg, rarrington, 1:2

APPENDIX IIIM-B-4
FOUNDATION HEAVE ANALYSIS

Includes pages IIIM-B-4-1 through IIIM-B-4-4



DA
02-22-2022

TURKEY CREEK LANDFILL
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APPENDIX IIIM-B-4
FOUNDATION HEAVE

Required: Estimate the potential heave of the bottom of excavation resulting from the removal of overburden soils during liner construction.

Method: Heave will be analyzed for the proposed excavation in Sector 12 (East Expansion Area).

- References:**
1. Terzaghi, Karl and Peck, Ralph, Soil Mechanics in Engineering Principle, Third Edition, John Wiley and Sons, Inc, New York, 1996.
 2. Das, Braja M., Principles of Geotechnical Engineering, Fourth Edition, PWS, Boston, 1998.
 3. Day, Robert W., Geotechnical Engineer's Portable Handbook, McGraw-Hill, New York, 2000.
 4. Dunn, I.S., Anderson, L.R., and Kiefer, F.W., Fundamentals of Geotechnical Analysis, 1st Edition, 1980.
 5. Coduto, Donald P., Geotechnical Engineering Principles and Practices, 1999.
 6. Acar, Yalcin B. & Daniel, David E., Geoenvironment 2000 Characterization, Containment, Remediation, and Performance in Environmental Geotechnics, Volume 2, American Society of Civil Engineers, 1995.

Foundation Heave Calculations

Estimate the potential heave of the excavation bottom in Sector 12.

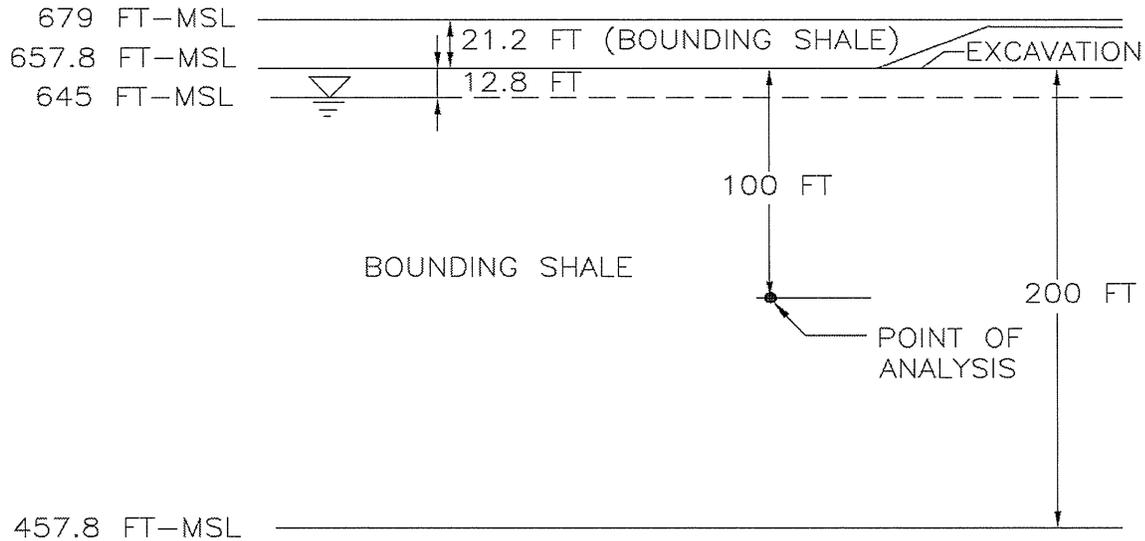
Note: Evaluation location for the heave analysis is the shown as on Figure IIIM-B-4-4 (Heave Analysis Point 1)

Method: Excavation for liner construction will result in reduced overburden pressure on Bounding Shale which may result in heave.

- A. Select critical location for heave. The critical location is established as the location that has the estimated highest overburden pressure relief resulting from landfill excavation prior to liner installation. For this analysis it was assumed this point is in Sector 12 (East Expansion Area).
- B. Use unit weight values for the excavated soils and consolidation parameter values derived from available field and laboratory results presented in Appendix IIIM-C.
- C. Stratum elevations, thicknesses, and water table are shown on the below diagram.

Solution:

Diagram for Heave Analysis in Sector 12 (East Expansion Area)



Definition of Terms/Variables:

- e_o = initial void ratio
- γ_d = Dry Unit Weight (pcf)
- γ_{moist} = Moist Unit Weight (pcf)
- γ_{sat} = Saturated Unit Weight (pcf)
- γ_w = Unit Weight of Water (pcf)
- γ_{waste} = Unit Weight of Waste (pcf)
- γ_I = Assumed Unit Weight Stratum I (pcf)
- γ_{II} = Assumed Unit Weight Stratum II (pcf)
- P_o = Initial Average Effective Overburden Pressure (psf)
- P_c = Preconsolidation Pressure (psf) (pressure in excess of overburden pressure, assumed zero)
- ΔP = Change in Vertical Pressure (psf)
- D = depth of excavation
- D_I = Overburden depth of Loess (ft)
- D_{II} = Overburden depth of Stratum II (ft)
- H_i = thickness of soil layer (Stratum II thickness analyzed for heave)
- C_r = Recompression index (rebound portion of consolidation curve during unloading)
- C_c = Compression Index

TURKEY CREEK LANDFILL
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APPENDIX IIIM-B-4
FOUNDATION HEAVE

Based on the laboratory test results included in Appendix IIIM-C, the material properties of the soil overburden material to be excavated during liner construction are shown in following table:

	e_o	γ_d (pcf)	γ_m (pcf)	γ_{sat} (pcf)	C_c	C_r
Stratum I (Sand)		122.7	128	131	na ¹	na ¹
Stratum II (Bounding Shal)	0.418	120.4	122.5	135	0.114	0.05

¹Consolidation parameters are not needed for Stratum I as this analysis assumes stratum will be removed entirely from the landfill floor during excavations.

The following parameters were used for Stratum II heave calculations:

$$\begin{aligned}
 H_i &= 200 \text{ ft} \\
 e_o &= 0.418 \\
 C_r &= 0.0500 \\
 P_c &= 6,900 \text{ psf (From lab testing, not used).}
 \end{aligned}$$

Estimate Potential Maximum Heave of the Excavation Bottom

The change in loading is due to the excavation of overburden soils.
There is no sand layer in sector 12 and unloading is due to shale layer therefore:

$$\begin{aligned}
 \Delta P &= D_I * \gamma_{I, \text{moist}} + D_{II} * \gamma_{II, \text{moist}} \\
 D_I &= 0 \text{ ft} \\
 D_{II} &= 21.2 \text{ ft} \\
 \Delta P &= 2,597 \text{ psf}
 \end{aligned}$$

Using the standard consolidation theory:

$$S = C_r H_i \log ((P_o - \Delta P) / P_o) \quad (\text{at midpoint of Stratum II})$$

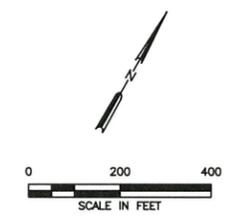
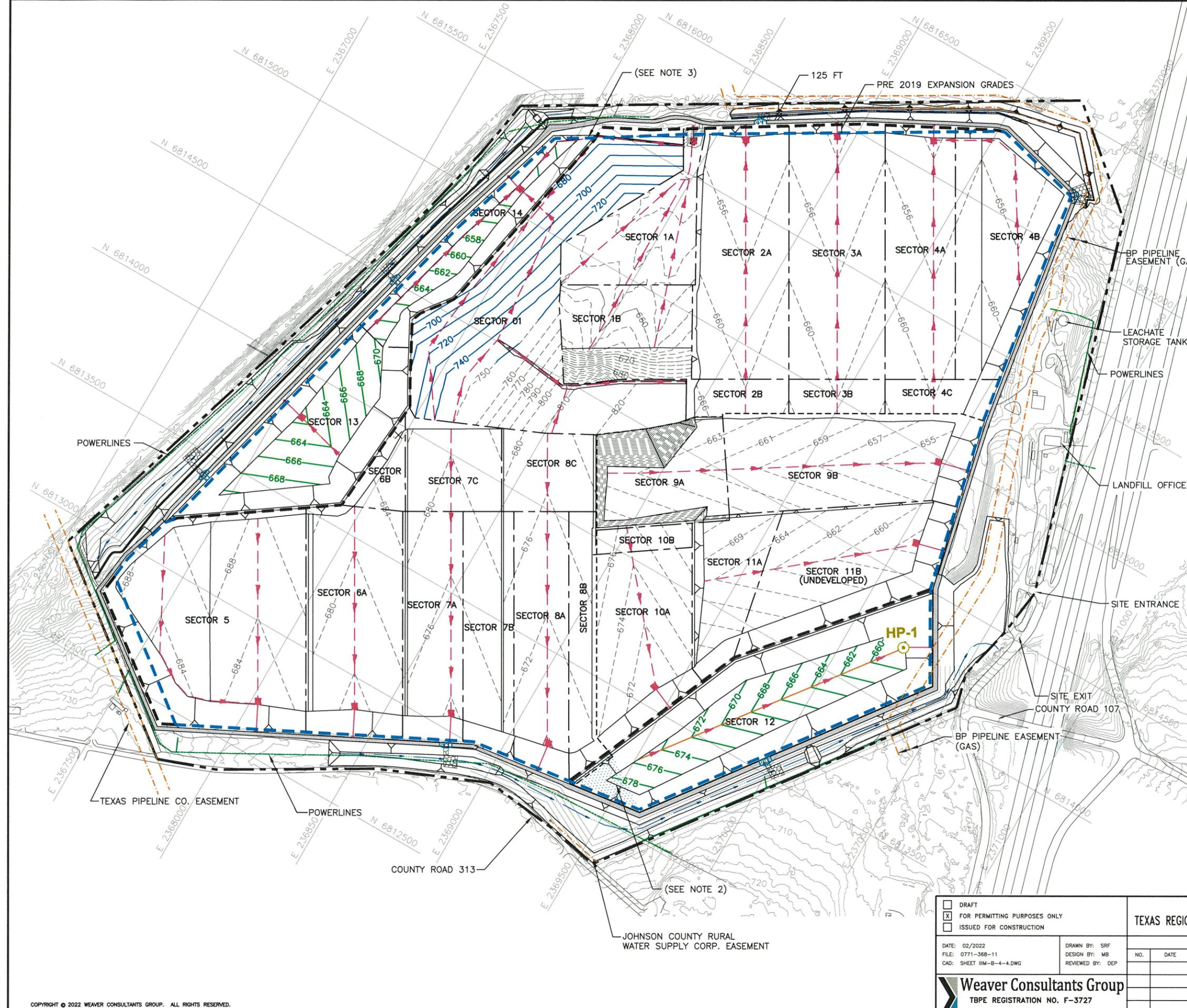
$$P_o = ((H_i/2 - 12.8) * (\gamma_{II(sat)} - \gamma_{(w)})) + 12.8' * \gamma_{II(\text{moist})} + \Delta P$$

$$\begin{aligned}
 P_o &= 10,495.72 \text{ psf} \\
 S &= -1.23 \text{ ft}
 \end{aligned}$$

Projected Heave¹ =	-1.23	ft	or	-14.8	inches
--------------------------------------	--------------	-----------	-----------	--------------	---------------

¹ Negative value represents heave or uplift of excavated foundation. Note that heave will be recovered during settlement of sector. As the settlement analysis conservatively does not incorporate actual preconsolidation stresses on formation, the actual heave and settlement will be less than calculated.

O:\0771\3668\EXPANSION 2021\PART III\IIM-SHEET IIM-B-4-4.dwg, Farrington, 1:2



LEGEND

	PERMIT BOUNDARY
	EXPANSION LIMIT OF WASTE (SEE NOTE 3)
	HISTORICAL LIMIT OF WASTE
	STATE PLANE GRID
	EXISTING CONTOUR
	EXISTING EXCAVATION/OVERLINER CONTOUR
	PROPOSED EXCAVATION CONTOUR
	LEACHATE COLLECTION PIPE
	LEACHATE COLLECTION SUMP
	CLASS 1 LIMIT (SEE NOTE 5)
	EXPANSION OVERLINER CONTOUR
	BELOW GRADE CLASS I AREA
	EASEMENT
	POWERLINE LOCATION
	EXCAVATION SIDESLOPE 3H:1V OTHERWISE INDICATED
	HEAVE ANALYSIS POINT

NOTES:

1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY DALLAS AERIAL SURVEYS FROM AERIAL PHOTOGRAPHY FLOWN ON 01-08-2021. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.

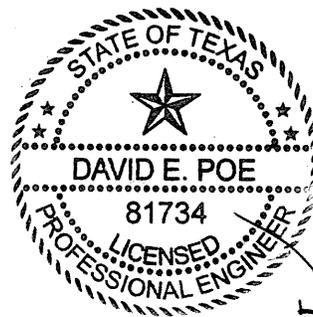


DP
02-22-2022

<input type="checkbox"/> DRAFT <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR TEXAS REGIONAL LANDFILL COMPANY, LP	PERMIT AMENDMENT APPLICATION SETTLEMENT ANALYSIS FOUNDATION HEAVE TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS								
	DATE: 02/2022 FILE: 0771-368-11 CAD: SHEET IIM-B-4-4.DWG		REVISIONS <table border="1"> <thead> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	NO.	DATE	DESCRIPTION				
NO.	DATE	DESCRIPTION								
Weaver Consultants Group TBPE REGISTRATION NO. F-3727	DRAWN BY: SRF DESIGN BY: MB REVIEWED BY: DEP	WWW.WCGRP.COM SHEET IIM-B-4-4								

APPENDIX IIIM-C
LABORATORY TEST RESULTS

Includes pages IIIM-C-1 through IIIM-C-106



DJR
02-22-2022

LABORATORY TESTING

Introduction

Various investigations have been conducted at the Turkey Creek Landfill facility to characterize the subsurface conditions at the site. Based on the previous investigations, the site-specific near-surface soils have been divided into three distinct stratigraphic strata. The properties of these strata are summarized in Table 3-1. As shown, stratigraphy includes the Upper Sands (Stratum I), Bounding Shale (Stratum II), and the Lower Sands (Stratum III). For analysis contained in this appendix, Stratum III is assumed interbedded in Stratum II Bounding Shale, and was analyzed as a single stratum or formation. Copies of the lithologic and geophysical logs for these borings are presented in Appendix IIIG.

Geotechnical Data Summary

A summary of field and laboratory testing is presented in Section 3 of this appendix, Table 3-1. Laboratory data from soil samples was evaluated to determine the properties of three major strata underlying the landfill site. These strata are described in Section 3 of this appendix, with further description provided in Appendix IIIG – Geology Report of this application.

A majority of the geotechnical test results (field and laboratory) available for the landfill is summarized on the logs presented in Appendix IIIG-B. Additionally, this appendix includes the following previous geotechnical evaluations for the facility, which include discussion of parameter selection and test results:

- 2021 Geotechnical Field and Laboratory Studies by WCG.
- Attachment 11b, Geotechnical Investigations Proposed Site for Johnson County Sanitary Landfill, Inc., Johnson County, Texas. Baker-Shiflett, Inc. December 1981
- Attachment 11c, Geotechnical Study, Supplement No. 1, Johnson County Sanitary Landfill, Johnson County, Texas. Baker-Shiflett, Inc. June 1986

Information obtained from the above reports, as well as logs prepared during subsequent investigations at the site, are summarized in Table 3-1 of Appendix IIIM.

**GEOTECHNICAL FIELD AND LABORATORY STUDIES
WEAVER CONSULTANTS GROUP, 2021**

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Percent Passing #40	Unconfined Compressive Strength (tsf)
PWCG-01	25.0	43	18	25	4.76	92	CL	16.3	109.2		2.87
PWCG-01	27.5	46	19	27	9.53	96	CL	17.1	113.3		1.75
PWCG-09	50.0	38	17	21	4.76	98	CL	12.0	130.9		3.80
PWCG-09	52.5	39	17	22	2.38	98	CL	12.7	129.7		8.11
PWCG-10	80.0	56	20	36	4.76	99	CH	15.5			
WCG-06	38.0	55	20	35	2.38	100	CH	20.7			
WCG-07	36.0	66	21	45	4.76	100	CH	16.5			
WCG-07	40.0	65	21	44	4.76	99	CH	16.7			
WCG-08	26.0	33	17	16	4.76	52	CL	15.6			
WCG-08	40.0	43	18	25	4.76	91	CL	16.1			

US LAB SUMMARY TURKEY CREEK LANDFILL EXPANSION.GPJ 9/28/21

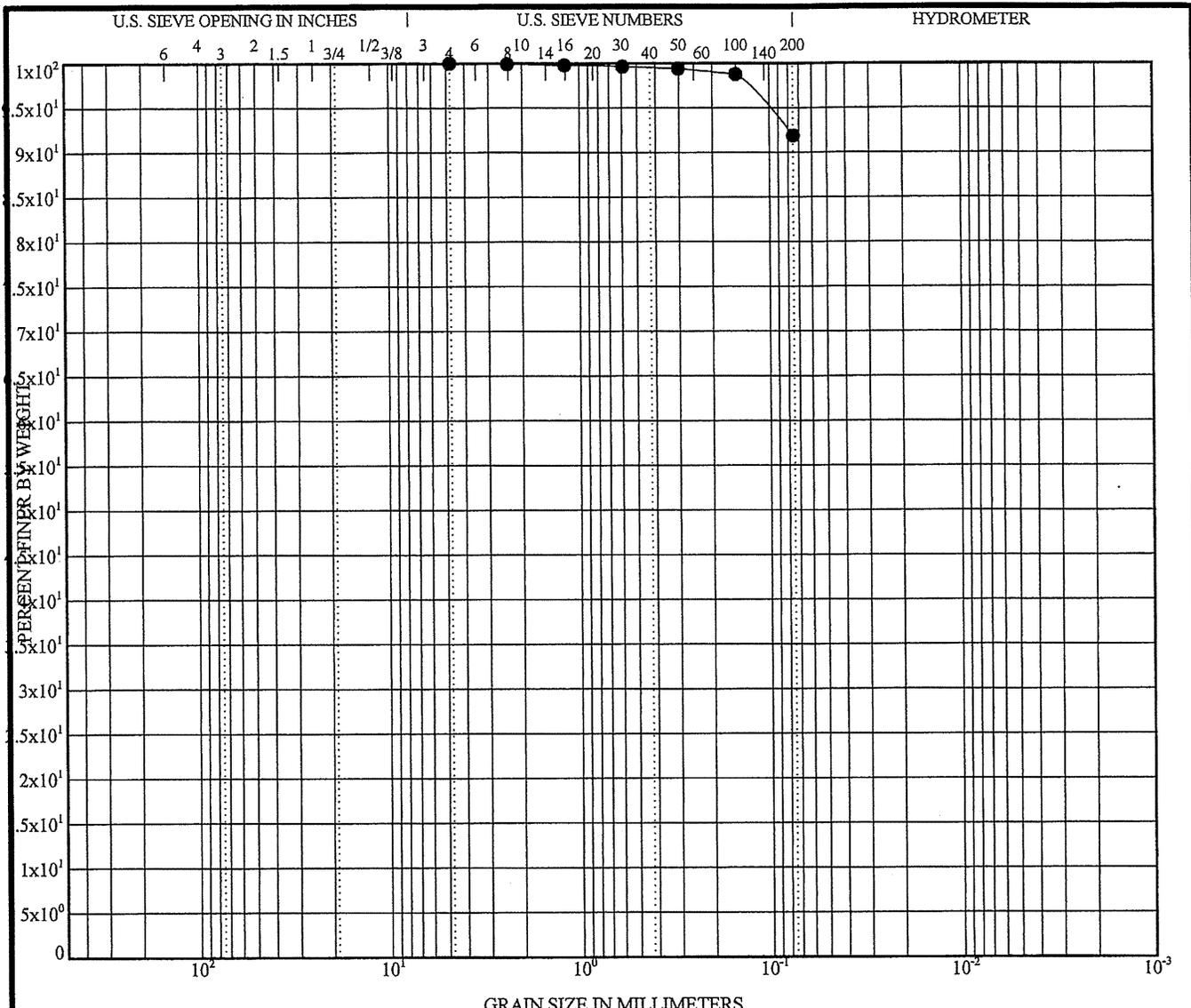
Summary of Laboratory Results

Project: Turkey Creek Landfill Expansion

Telephone:
Fax:

IIIM-C-3

Number: 0771-368-11-123



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● PWCG-01 25.0	LEAN CLAY(CL)	43	18	25		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● PWCG-01 25.0	4.76				0.0	8.1	91.9	

GRAIN SIZE DISTRIBUTION

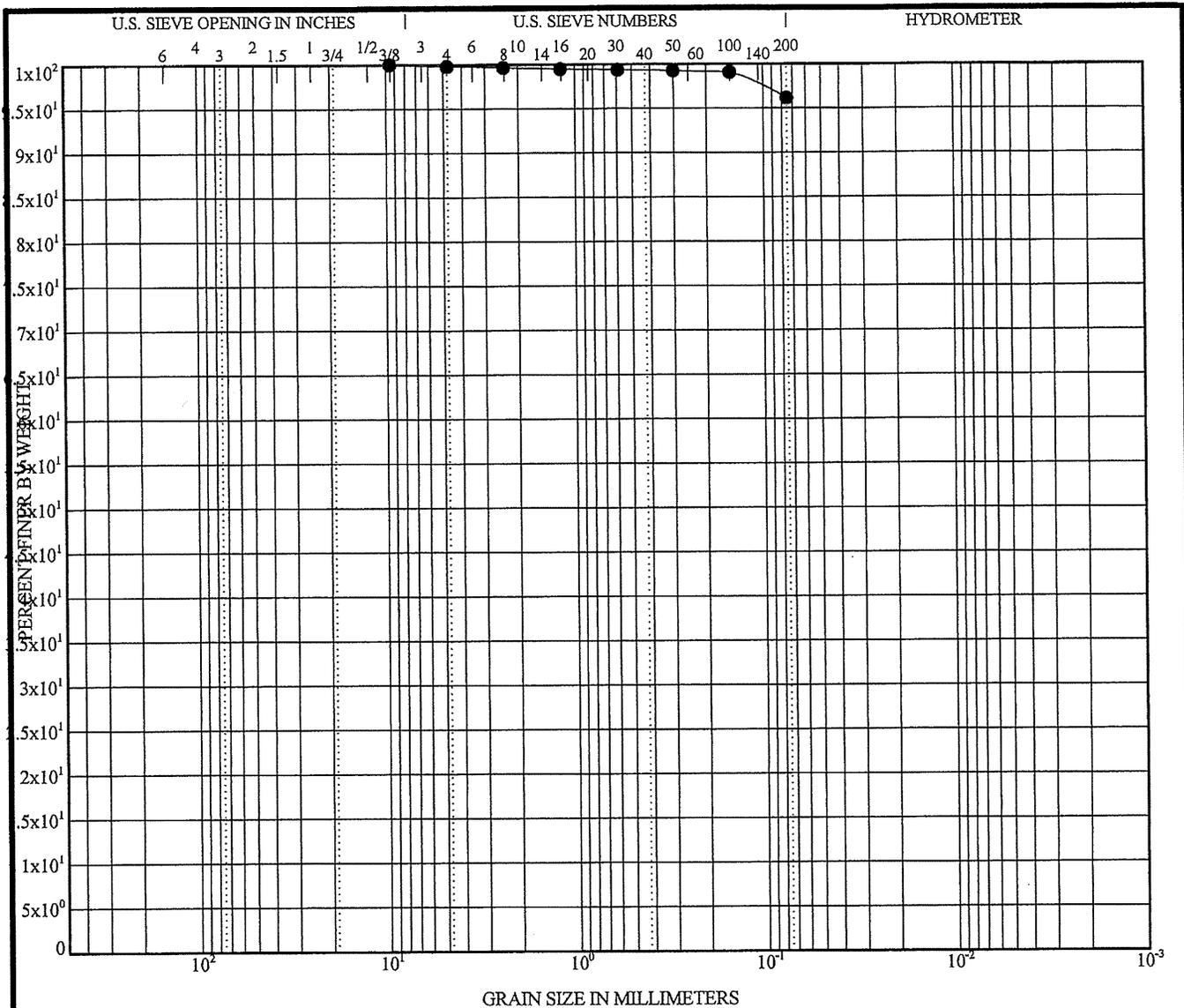
Project: Turkey Creek Landfill Expansion

Telephone:
Fax:

IIIM-C-4

Number: 0771-368-11-123

US GRAIN SIZE TURKEY CREEK LANDFILL EXPANSION.GPJ 9/28/71



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● PWCG-01 27.5	LEAN CLAY (CL)	46	19	27		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● PWCG-01 27.5	9.53				0.2	3.6	96.2	

GRAIN SIZE DISTRIBUTION

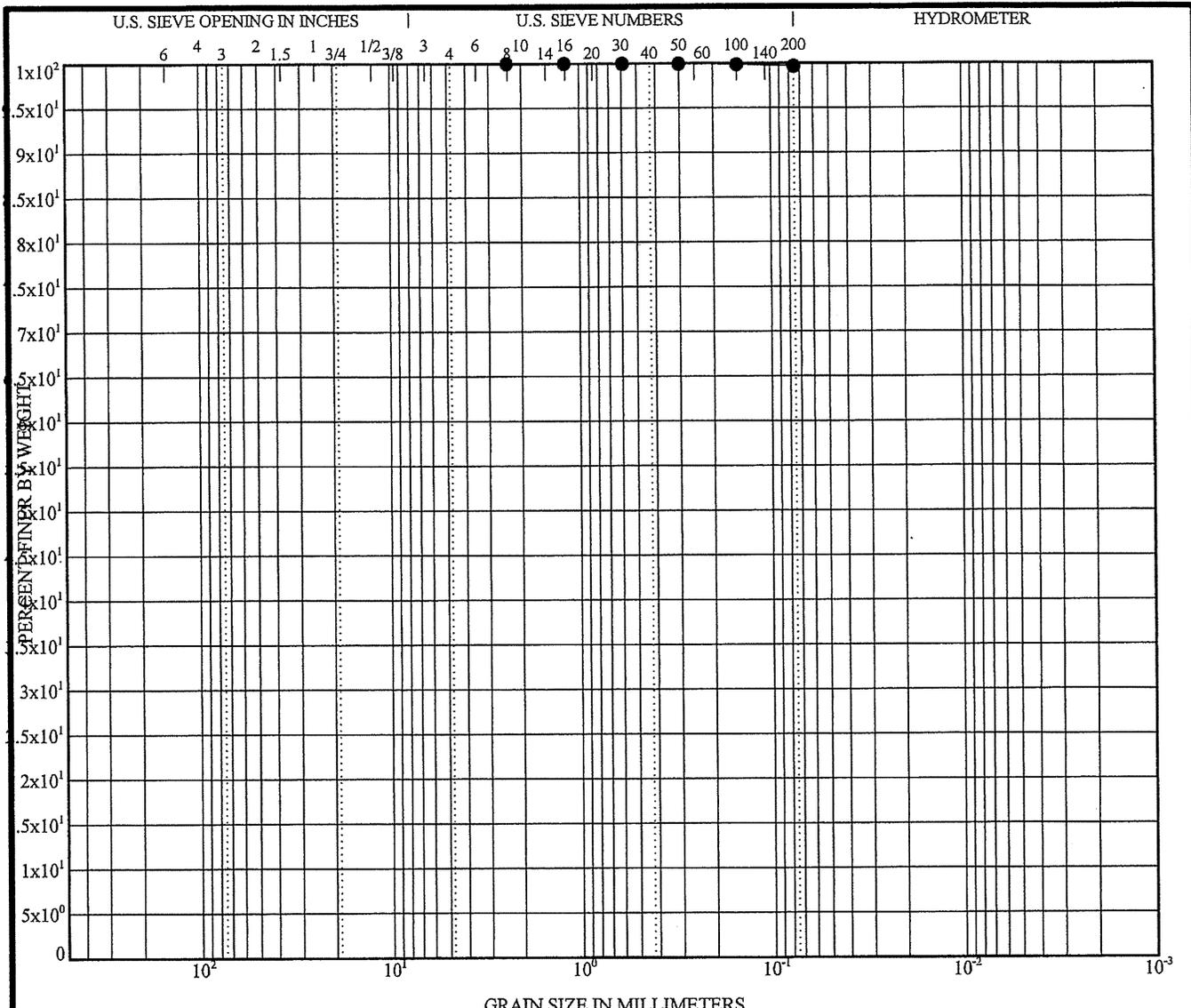
Project: Turkey Creek Landfill Expansion

Telephone:
Fax:

IIIM-C-5

Number: 0771-368-11-123

US GRAIN SIZE TURKEY CREEK LANDFILL EXPANSION.GPJ 9/28/21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● WCG-06 38.0	FAT CLAY(CH)	55	20	35		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● WCG-06 38.0	2.38				0.0	0.3	99.7	

GRAIN SIZE DISTRIBUTION

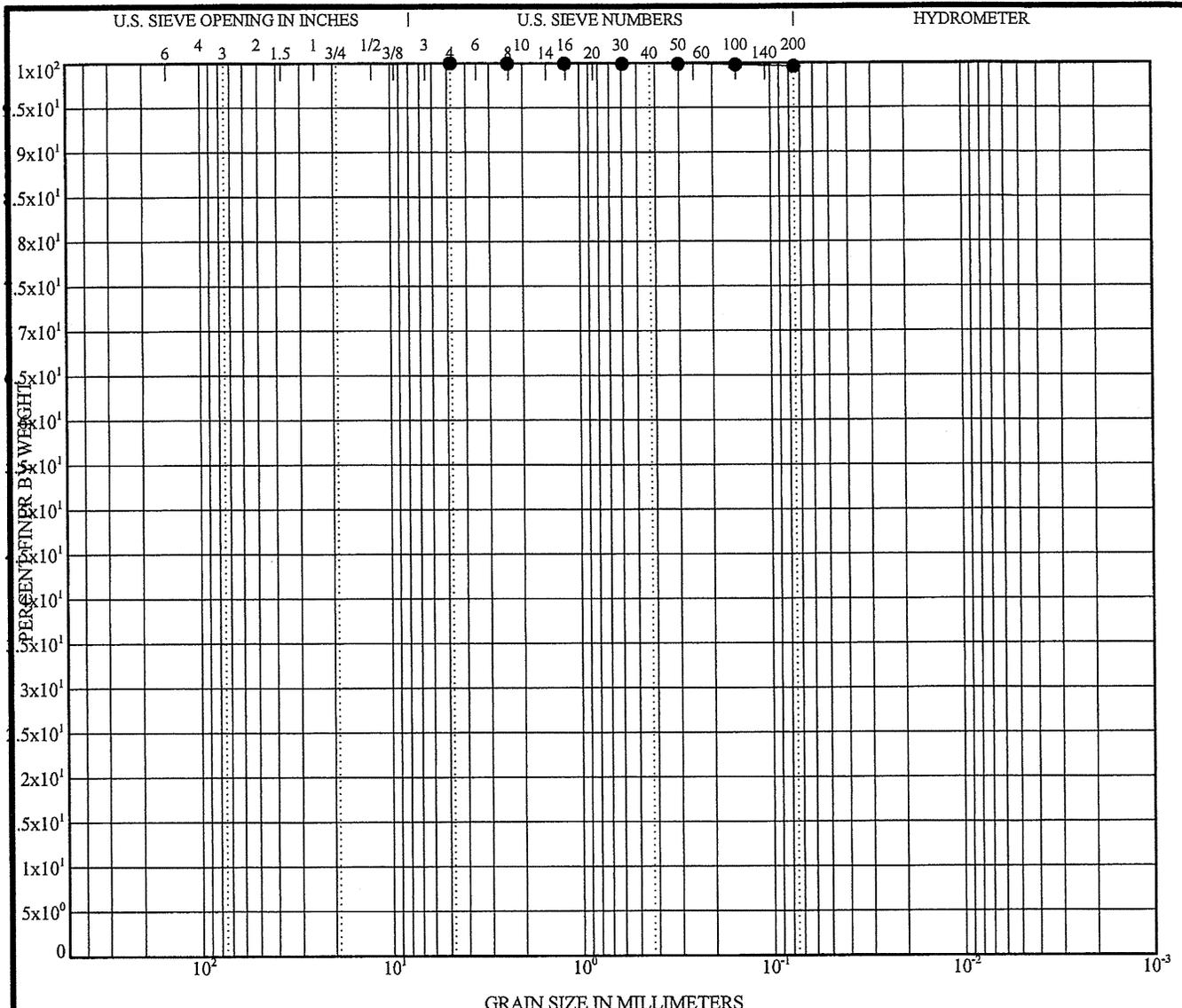
Project: Turkey Creek Landfill Expansion

Telephone:
Fax:

IIIM-C-6

Number: 0771-368-11-123

US GRAIN SIZE TURKEY CREEK LANDFILL EXPANSION.GPJ 9/28/21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● WCG-07 36.0	FAT CLAY(CH)	66	21	45		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● WCG-07 36.0	4.76				0.0	0.4	99.6	

GRAIN SIZE DISTRIBUTION

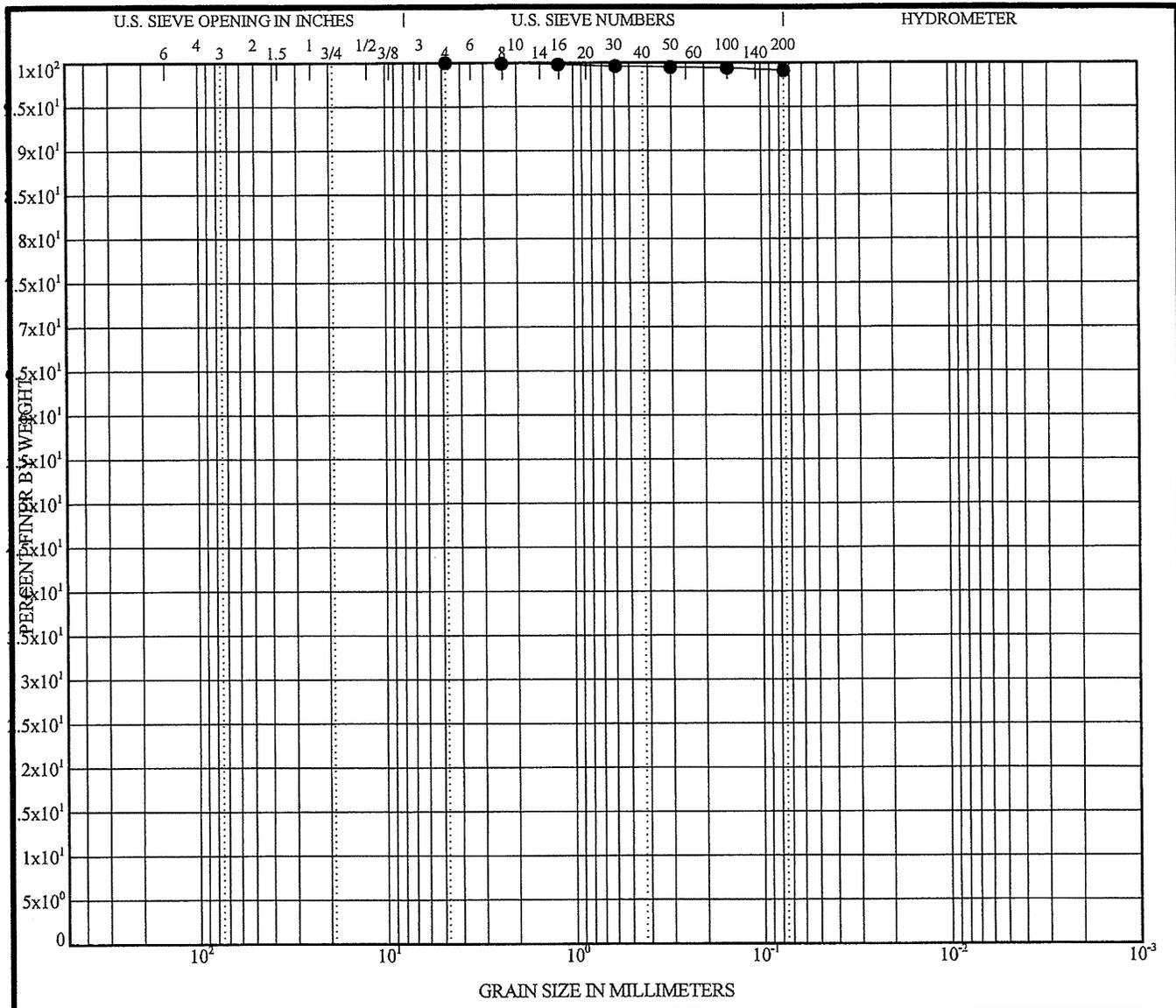
Project: Turkey Creek Landfill Expansion

Telephone:
Fax:

IIIM-C-7

Number: 0771-368-11-123

U.S. GRAIN SIZE TURKEY CREEK LANDFILL EXPANSION.GPJ 9/28/21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● WCG-07 40.0	FAT CLAY(CH)	65	21	44		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● WCG-07 40.0	4.76				0.0	0.9	99.1	

GRAIN SIZE DISTRIBUTION

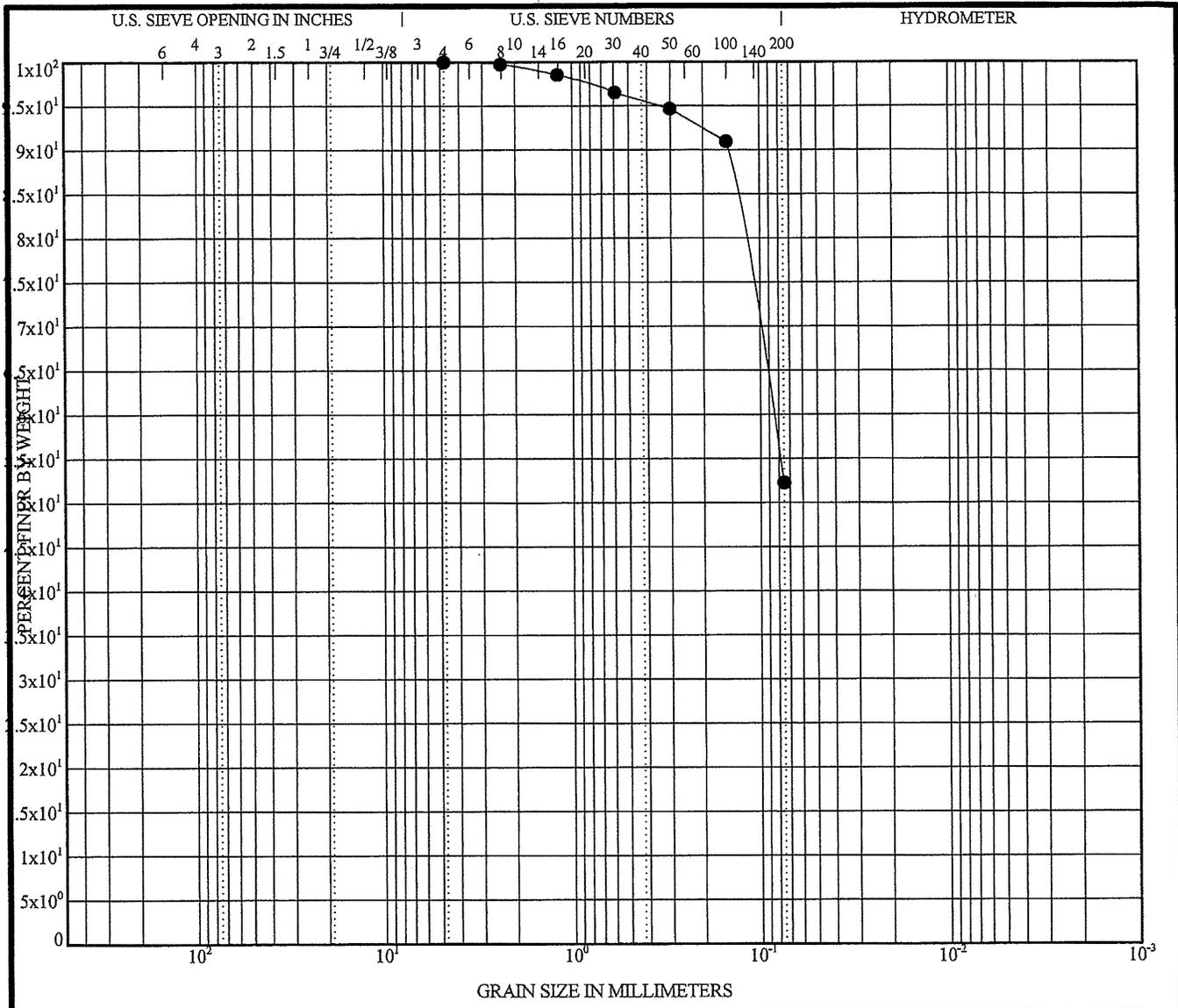
Project: Turkey Creek Landfill Expansion

Telephone:
Fax:

IIIM-C-8

Number: 0771-368-11-123

US GRAIN SIZE TURKEY CREEK LANDFILL EXPANSION.GPI 9/28/21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● WCG-08 26.0	SANDY LEAN CLAY (CL)	33	17	16		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● WCG-08 26.0	4.76	0.086			0.0	47.7	52.3	

GRAIN SIZE DISTRIBUTION

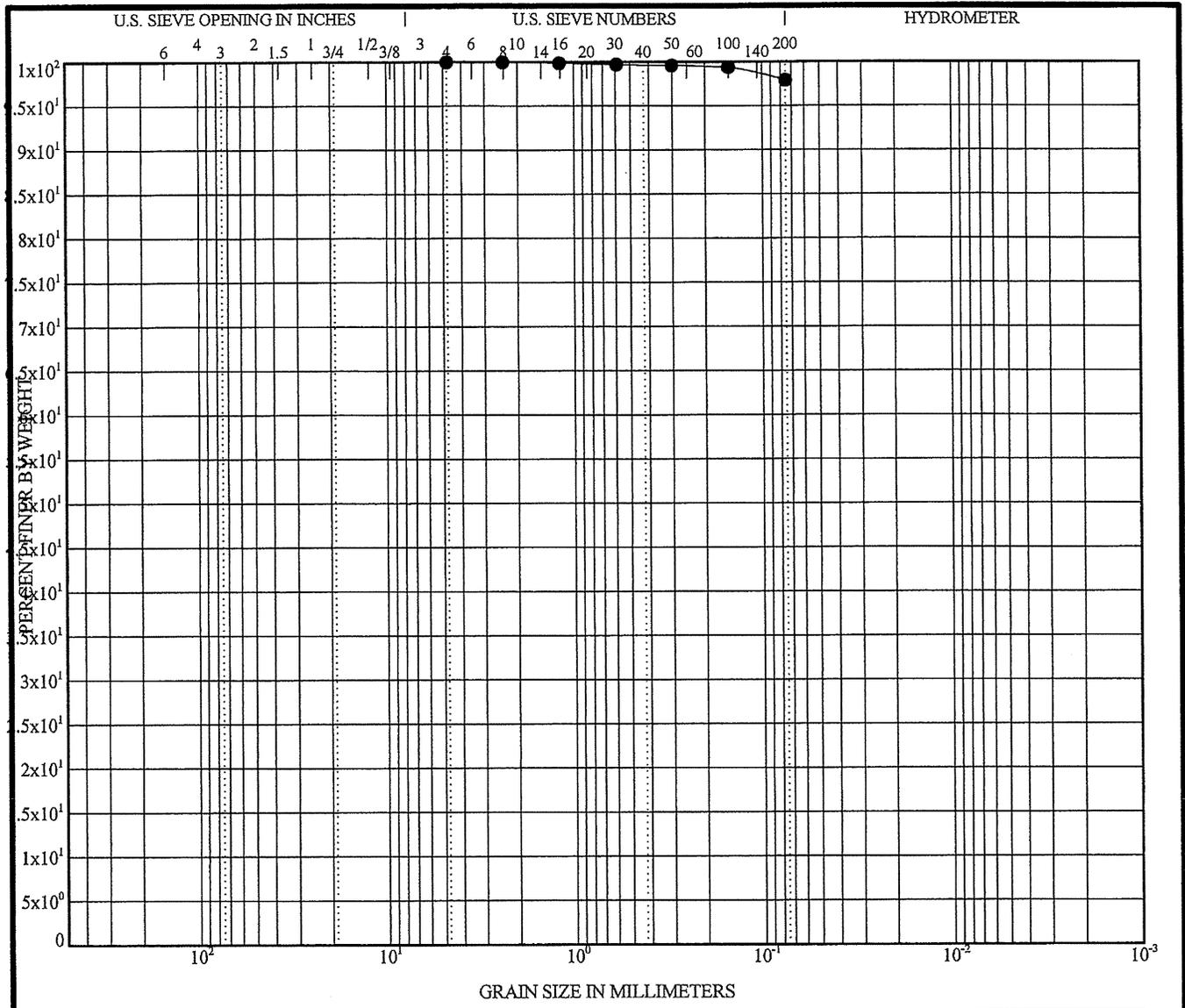
Project: Turkey Creek Landfill Expansion

Telephone:
Fax:

IIIM-C-9

Number: 0771-368-11-123

US GRAIN SIZE TURKEY CREEK LANDFILL EXPANSION.GPJ 9/28/21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification					LL	PL	PI	Cc	Cu
● PWCG-09 50.0	LEAN CLAY (CL)					38	17	21		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● PWCG-09 50.0	4.76				0.0	2.1	97.9	

GRAIN SIZE DISTRIBUTION

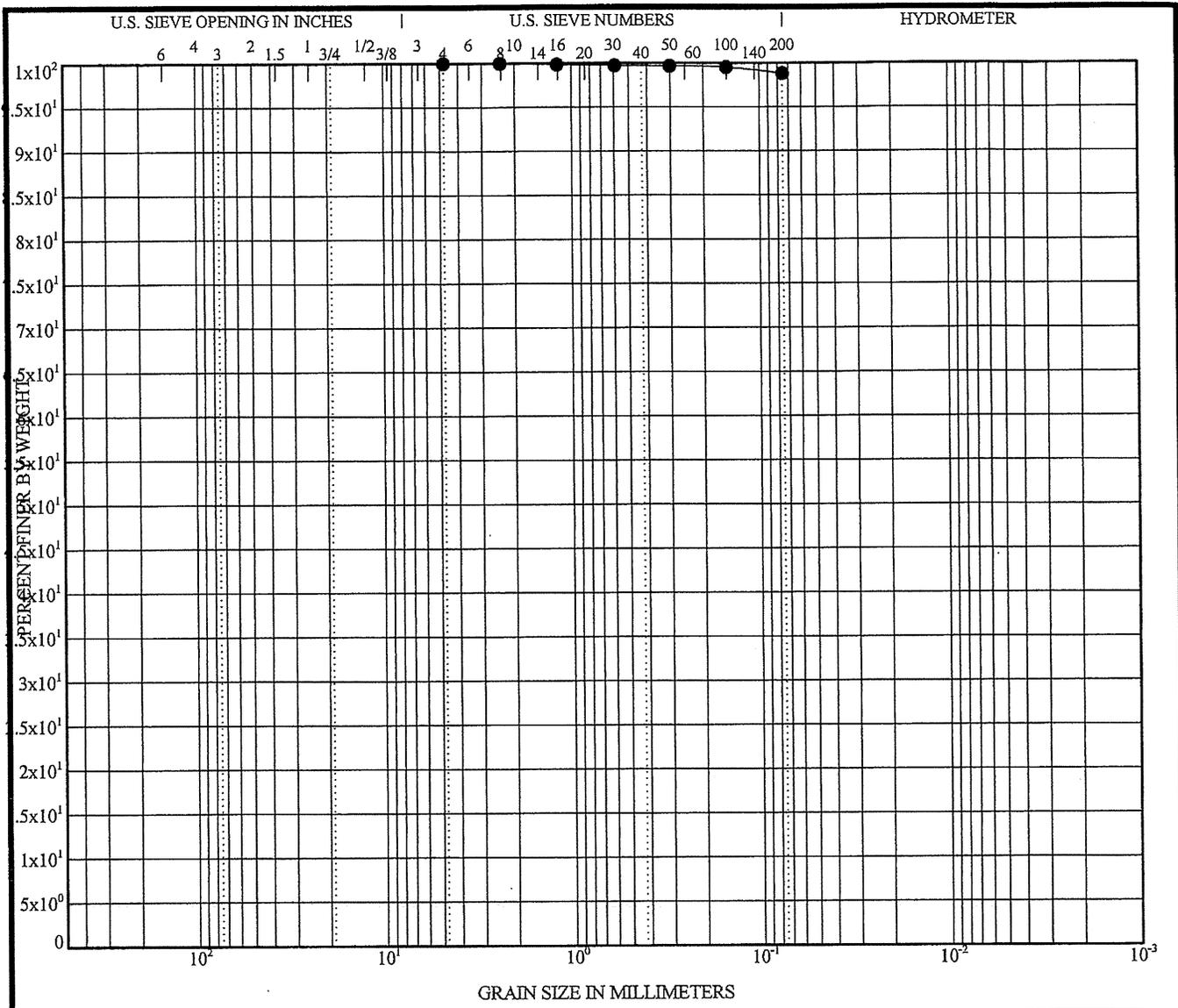
Project: Turkey Creek Landfill Expansion

Telephone:
Fax:

IIIM-C-11

Number: 0771-368-11-123

US GRAIN SIZE TURKEY CREEK LANDFILL EXPANSION.GPJ 9/28/21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● PWCG-10 80.0	FAT CLAY(CH)	56	20	36		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● PWCG-10 80.0	4.76				0.0	1.2	98.8	

GRAIN SIZE DISTRIBUTION

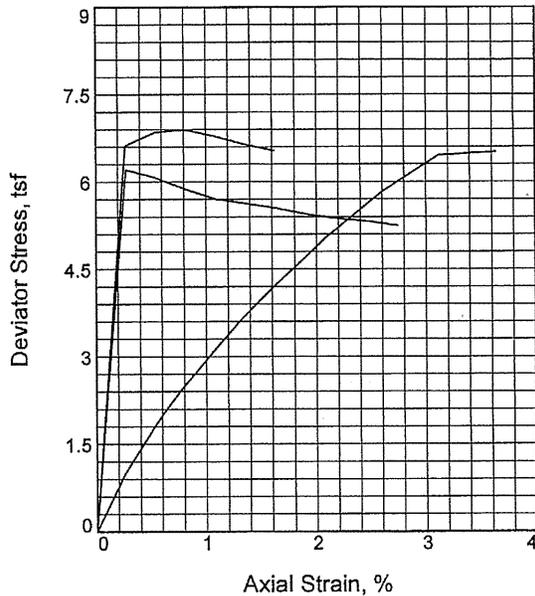
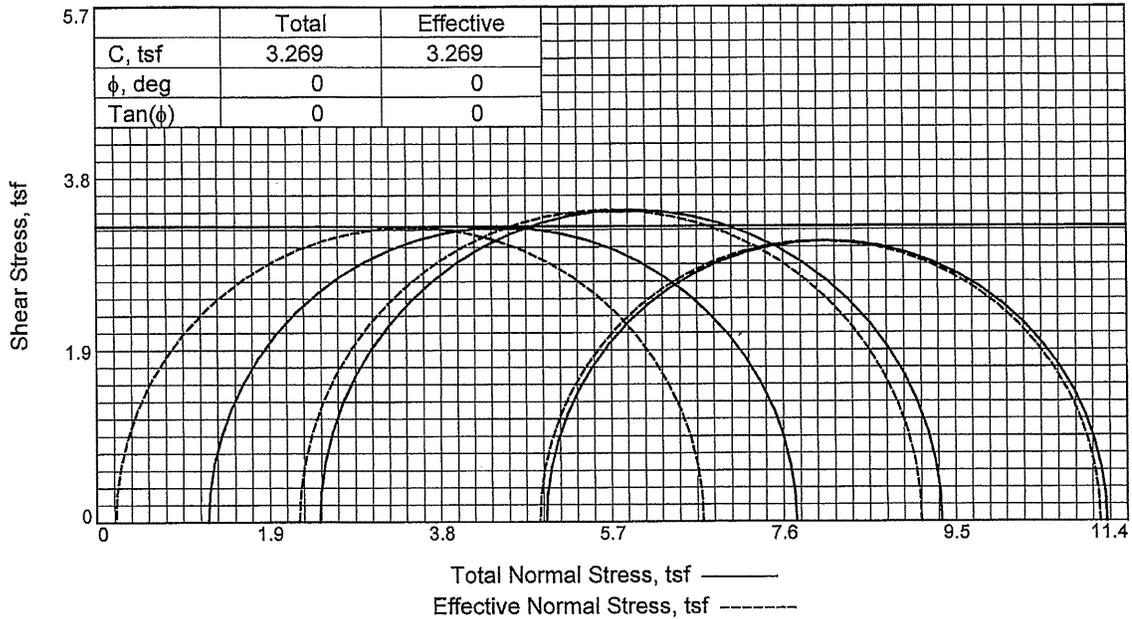
Project: Turkey Creek Landfill Expansion

Telephone:
Fax:

IIIM-C-13

Number: 0771-368-11-123

US GRAIN SIZE TURKEY CREEK LANDFILL EXPANSION.GPI 9/28/21



Sample No.		1	2	3
Initial	Water Content, %	16.0	16.0	16.0
	Dry Density, pcf	113.3	113.3	113.3
	Saturation, %	92.4	92.4	92.4
	Void Ratio	0.4602	0.4602	0.4602
	Diameter, in.	2.00	2.00	2.00
	Height, in.	3.85	3.85	3.85
At Test	Water Content, %	17.4	17.4	17.4
	Dry Density, pcf	113.3	113.3	113.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.4602	0.4602	0.4602
	Diameter, in.	2.00	2.04	2.05
	Height, in.	3.85	3.71	3.65
Strain rate, in./min.				
Back Pressure, psi		10.00	10.00	10.00
Cell Pressure, psi		27.00	44.00	79.00
Fail. Stress, tsf		6.5	6.9	6.2
Total Pore Pr., tsf		1.7	0.9	0.8
Ult. Stress, tsf				
Total Pore Pr., tsf				
$\bar{\sigma}_1$ Failure, tsf		6.7	9.1	11.1
$\bar{\sigma}_3$ Failure, tsf		0.2	2.2	4.9

Type of Test:

CU with Pore Pressures

Sample Type: Core

Description: Sandy shale, gray

LL= 43

PL= 18

PI= 25

Assumed Specific Gravity= 2.65

Remarks:

Figure _____

Client:

Project: Turkey Creel Landfill Expansion

Location: PWCG-1

Depth: 25.0'-27.5'

Proj. No.: 0771-368-11-123

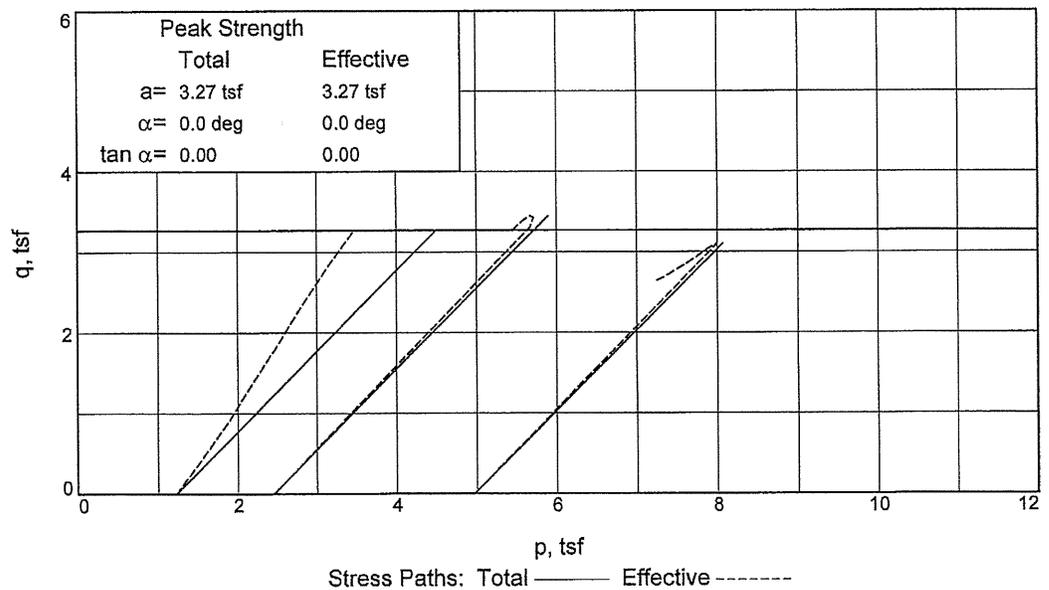
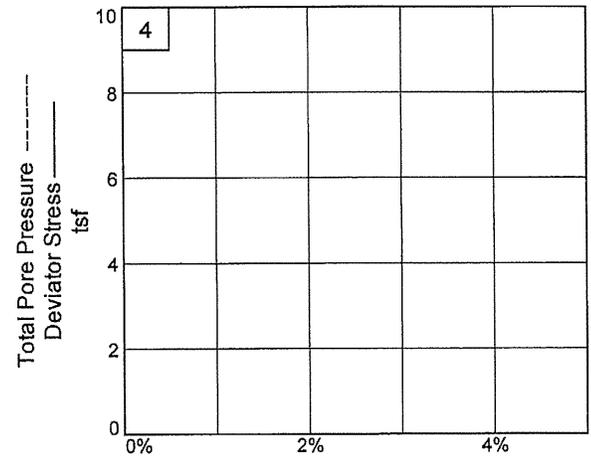
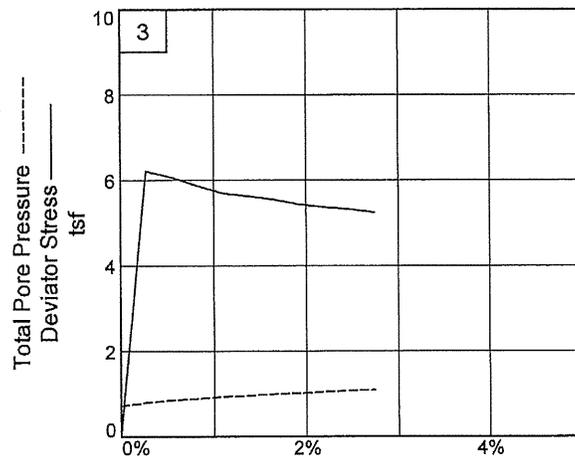
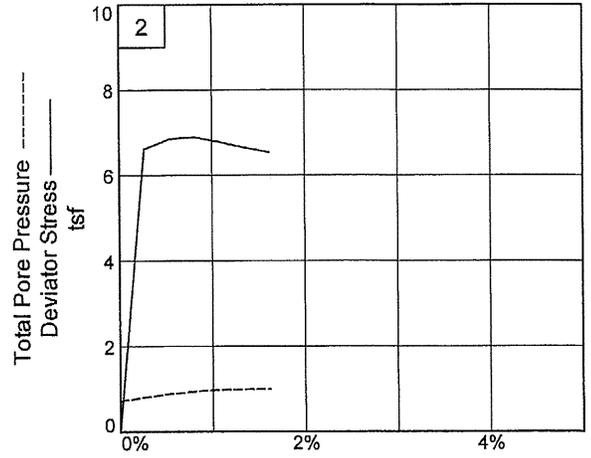
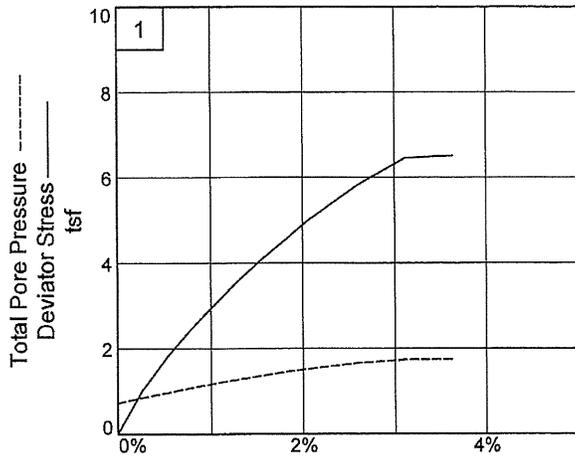
Date Sampled: 2021

TRIAXIAL SHEAR TEST REPORT

M L Testing, LLC

Bluff Dale, TX

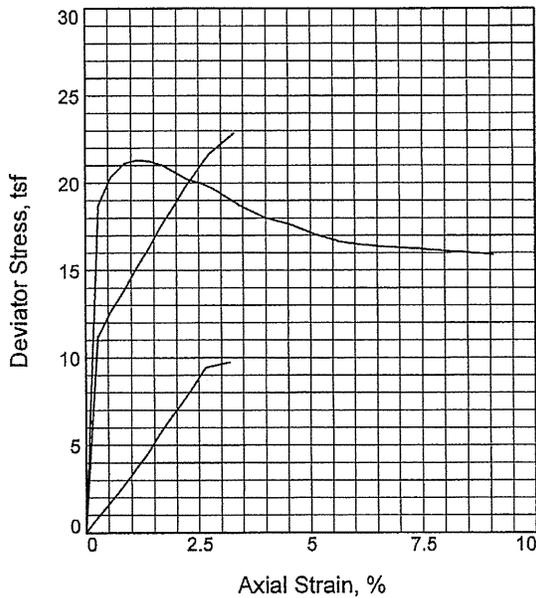
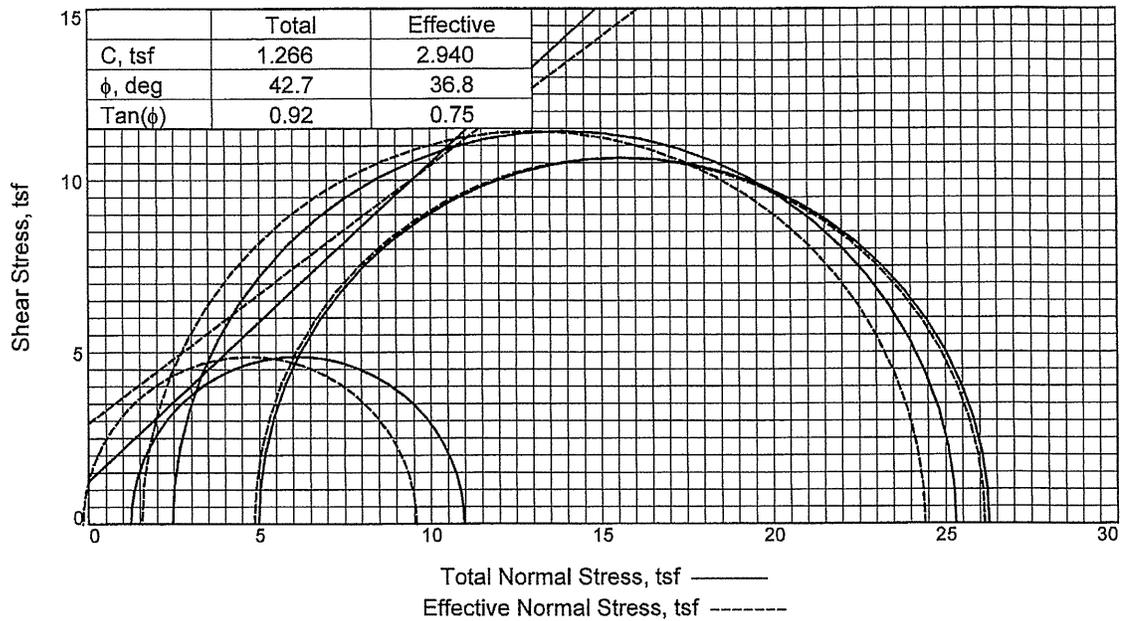
IIIM-C-14



Client:
Project: Turkey Creel Landfill Expansion
Location: PWCG-1 **Depth:** 25.0'-27.5'
Project No.: 0771-368-11-123

Figure _____

ML Testing, LLC



Sample No.		1	2	3
Initial	Water Content, %	11.7	11.7	11.7
	Dry Density, pcf	126.2	126.2	126.2
	Saturation, %	99.5	99.5	99.5
	Void Ratio	0.3111	0.3111	0.3111
	Diameter, in.	2.00	2.00	2.00
	Height, in.	3.77	3.77	3.77
At Test	Water Content, %	11.7	11.7	11.7
	Dry Density, pcf	126.2	126.2	126.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.3111	0.3111	0.3111
	Diameter, in.	2.00	2.03	2.07
	Height, in.	3.77	3.65	3.53
Strain rate, in./min.				
Back Pressure, psi		10.00	10.00	10.00
Cell Pressure, psi		27.00	44.00	79.00
Fail. Stress, tsf		9.7	22.9	21.3
Total Pore Pr., tsf		2.1	1.6	0.8
Ult. Stress, tsf				
Total Pore Pr., tsf				
$\bar{\sigma}_1$	Failure, tsf	9.6	24.4	26.1
$\bar{\sigma}_3$	Failure, tsf	-0.2	1.5	4.8

Type of Test:
CU with Pore Pressures

Sample Type: Core

Description: Sandy shale, gray

LL= 38 PL= 17 PI= 21

Assumed Specific Gravity= 2.65

Remarks:

Client:

Project: Turkey Creel Landfill Expansion

Location: PWCG-9

Depth: 50.0'-52.0'

Proj. No.: 0771-368-11-123

Date Sampled: 2021

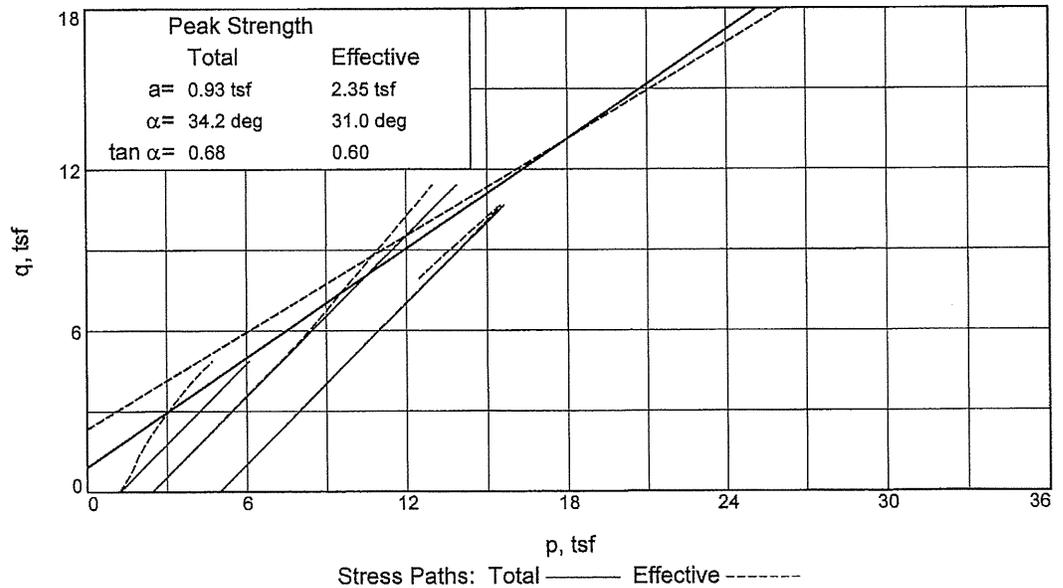
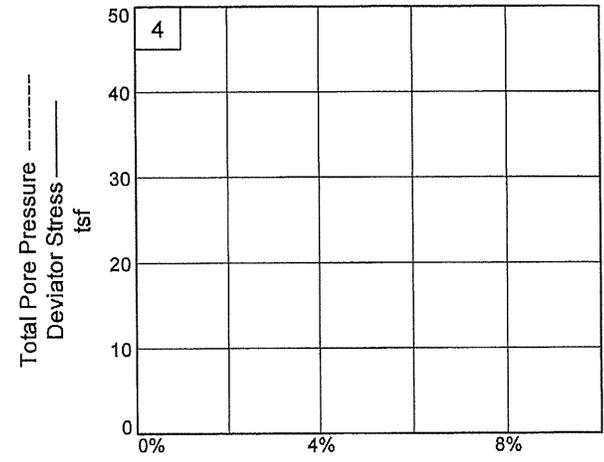
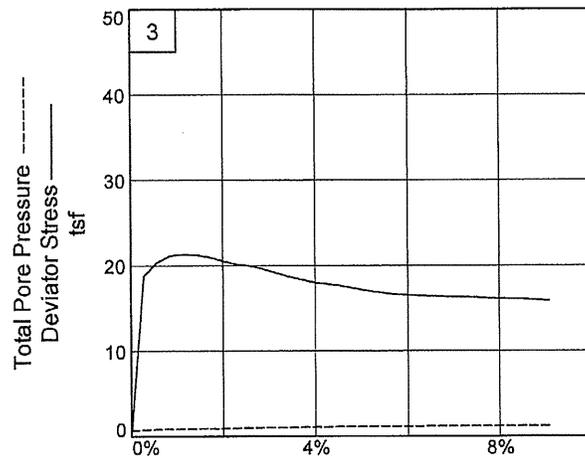
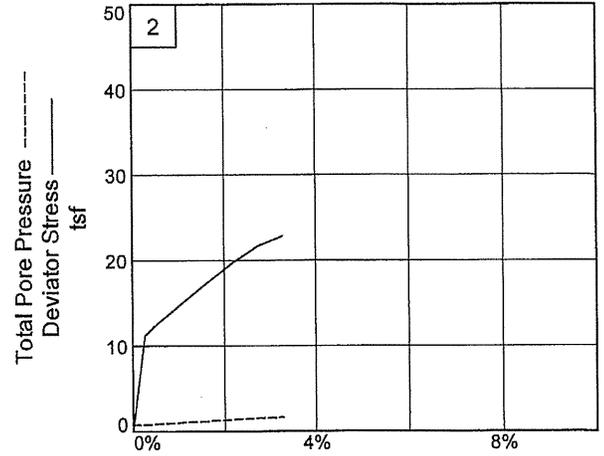
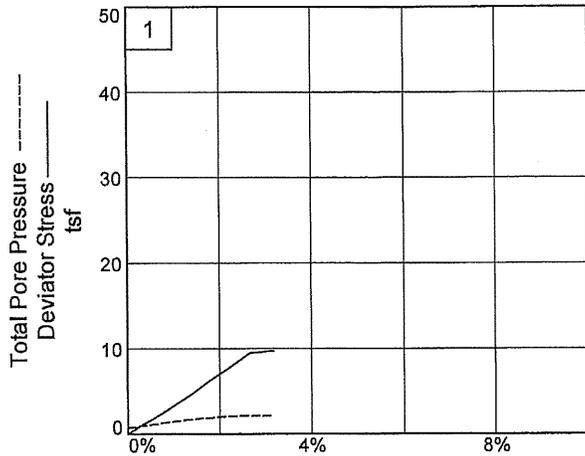
TRIAXIAL SHEAR TEST REPORT

M L Testing, LLC

Bluff Dale, TX

Figure _____

IIM-C-16

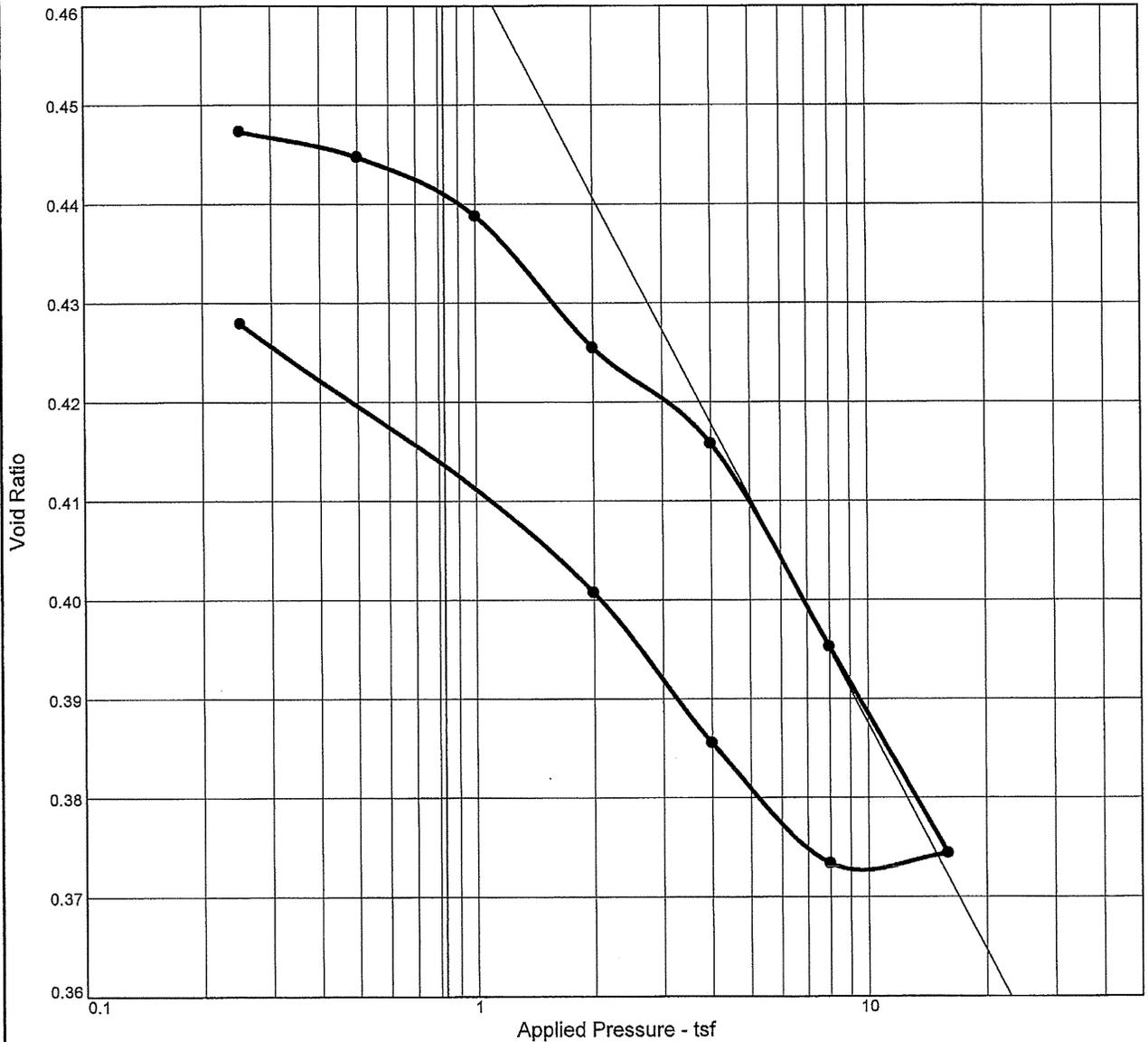


Client:
Project: Turkey Creel Landfill Expansion
Location: PWCG-9 **Depth:** 50.0'-52.0'
Project No.: 0771-368-11-123

Figure _____

M L Testing, LLC

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	Initial Void Ratio
Saturation	Moisture							
88.1 %	14.8 %	114.4	46	27	2.65	0	2.3	0.447

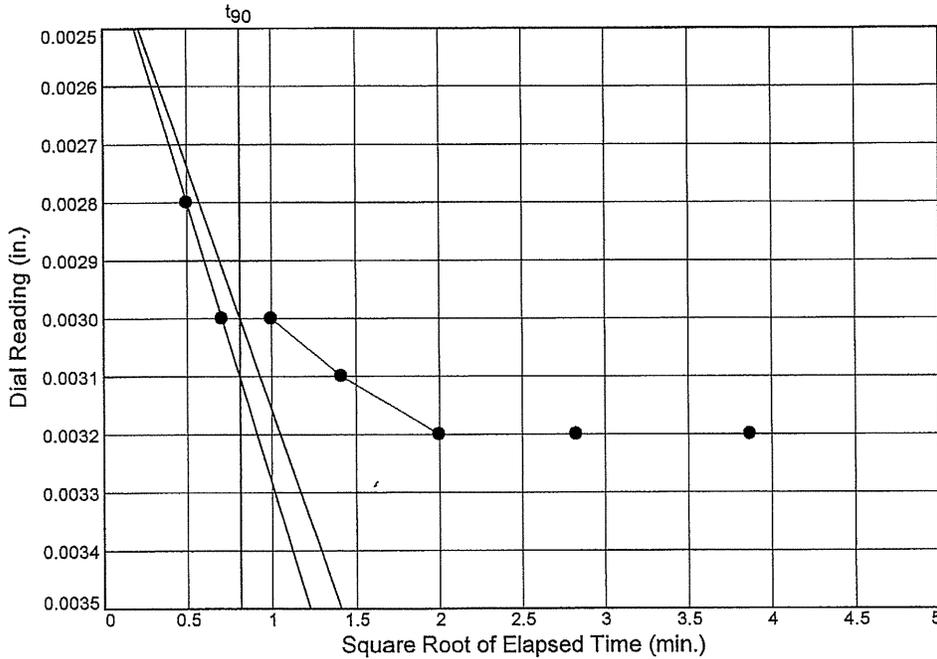
MATERIAL DESCRIPTION	USCS	AASHTO
Sandy shale, gray		

Project No. 0771-368- Client: Project: Turkey Creek Landfill Expansion Location: PWCG-1 Depth: 27.5'-30.0' <div style="text-align: center;">M L Testing, LLC</div> <div style="text-align: center;">Bluff Dale, TX</div>	Remarks: <div style="text-align: right;">Figure</div>
--	---

Dial Reading vs. Time

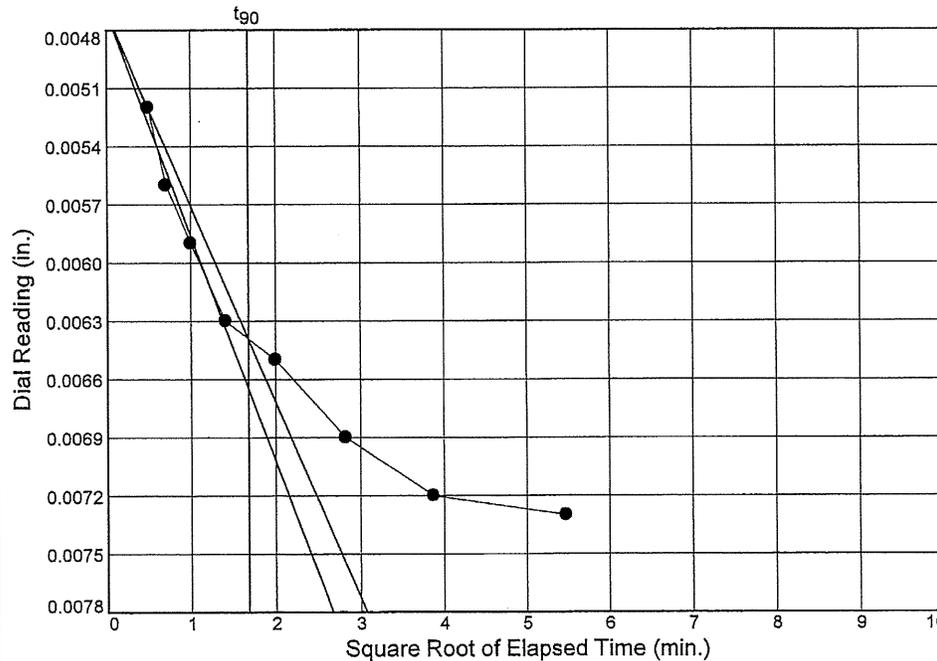
Project No.: 0771-368-11-123
 Project: Turkey Creek Landfill Expansion

Location: PWCG-1 Depth: 27.5'-30.0'



Load No.= 2
 Load= 0.50 tsf
 $D_0 = 0.0023$
 $D_{90} = 0.0030$
 $D_{100} = 0.0031$
 $T_{90} = 0.66 \text{ min.}$

$C_v @ T_{90}$
 3.205 ft.²/day



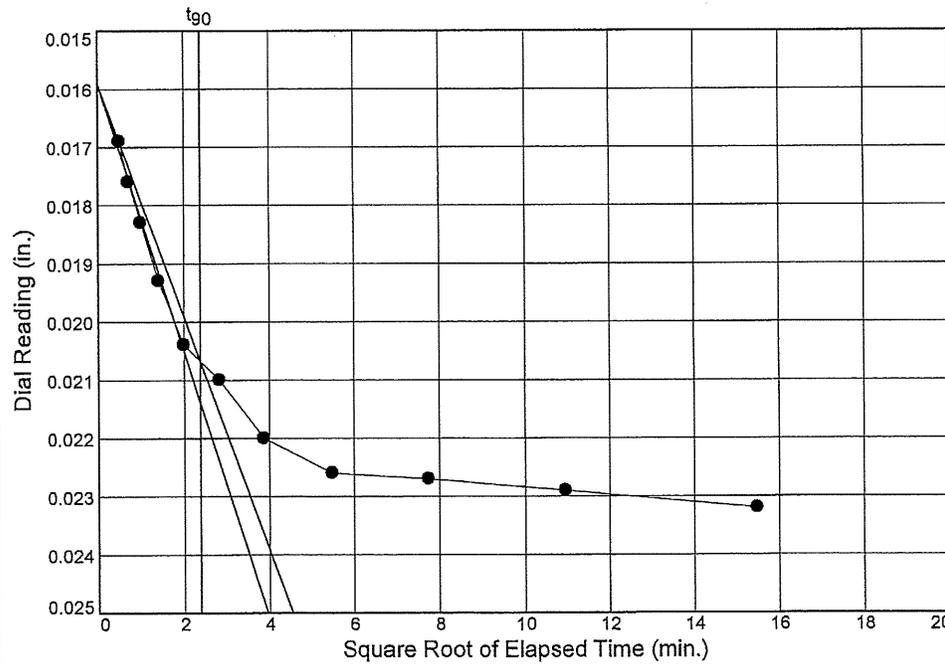
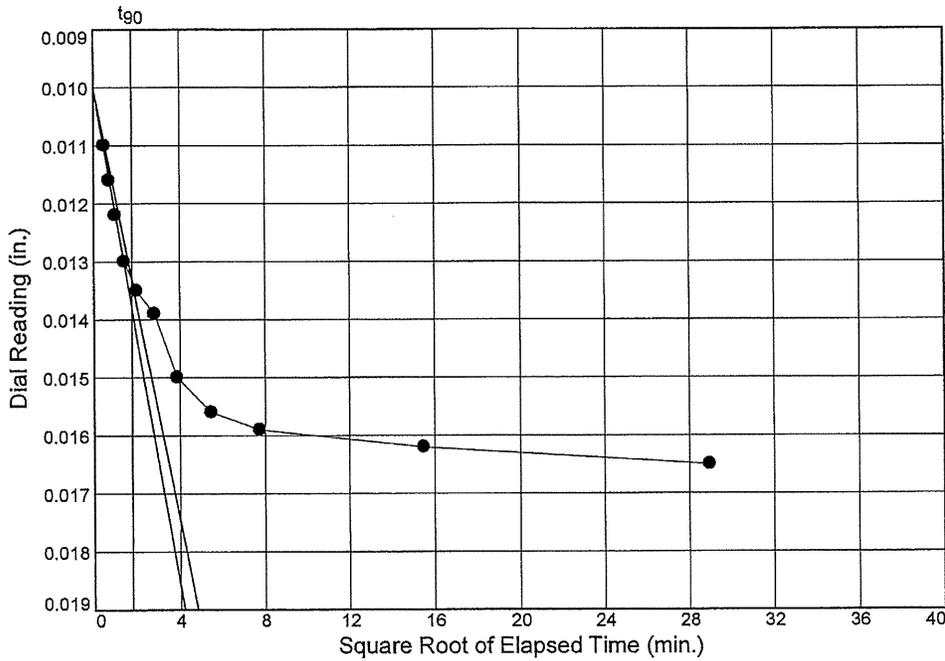
Load No.= 3
 Load= 1.00 tsf
 $D_0 = 0.0047$
 $D_{90} = 0.0064$
 $D_{100} = 0.0066$
 $T_{90} = 2.81 \text{ min.}$

$C_v @ T_{90}$
 0.749 ft.²/day

Dial Reading vs. Time

Project No.: 0771-368-11-123
 Project: Turkey Creek Landfill Expansion

Location: PWCG-1 Depth: 27.5'-30.0'



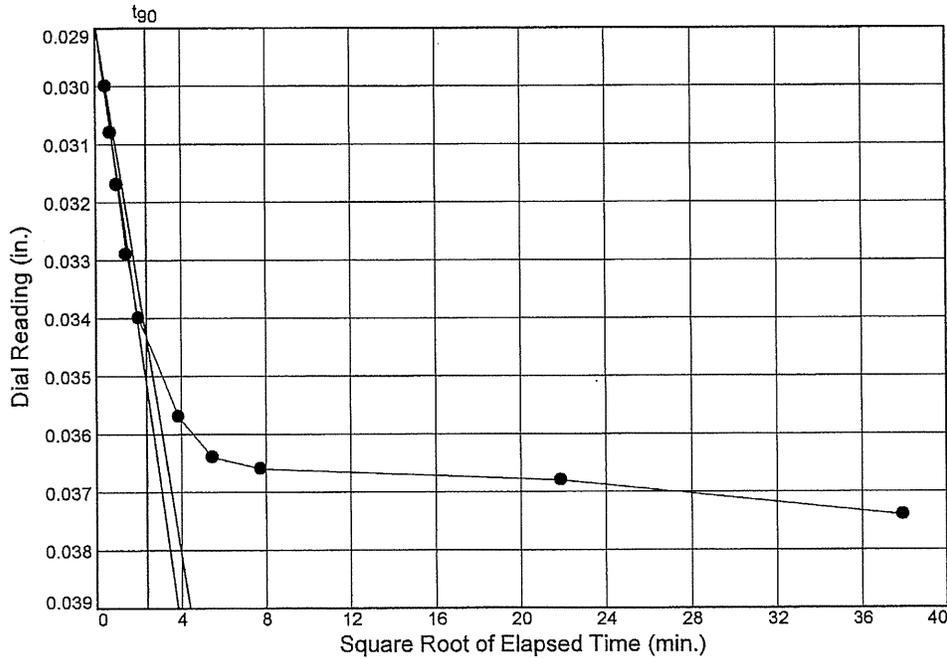
M L Testing, LLC

Figure

Dial Reading vs. Time

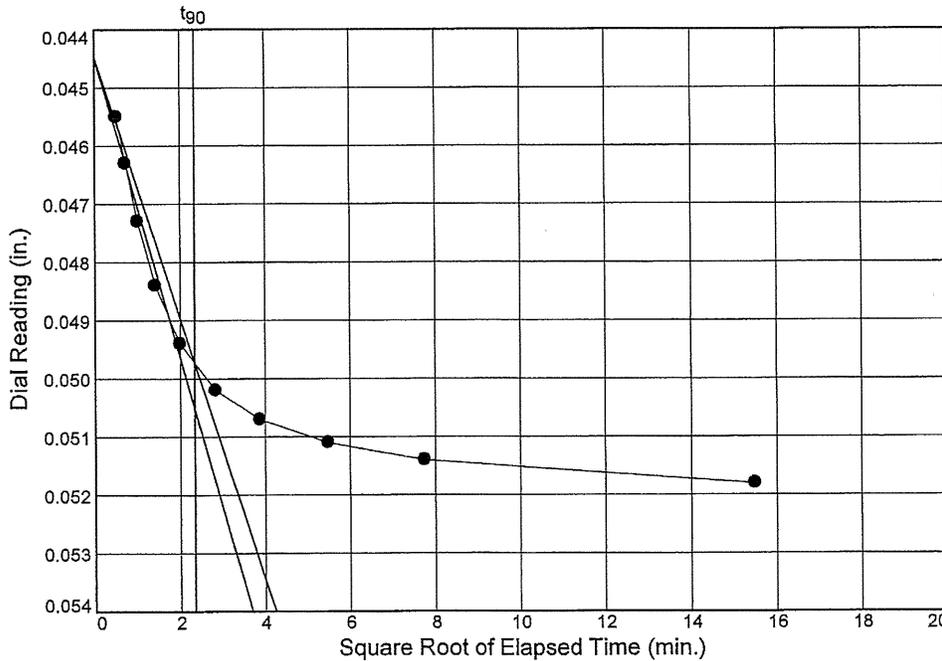
Project No.: 0771-368-11-123
 Project: Turkey Creek Landfill Expansion

Location: PWCG-1 Depth: 27.5'-30.0'



Load No.= 6
 Load= 8.00 tsf
 $D_0 = 0.0289$
 $D_{90} = 0.0343$
 $D_{100} = 0.0349$
 $T_{90} = 5.51 \text{ min.}$

$C_v @ T_{90}$
 0.363 ft.²/day



Load No.= 7
 Load= 16.00 tsf
 $D_0 = 0.0445$
 $D_{90} = 0.0497$
 $D_{100} = 0.0503$
 $T_{90} = 5.45 \text{ min.}$

$C_v @ T_{90}$
 0.356 ft.²/day

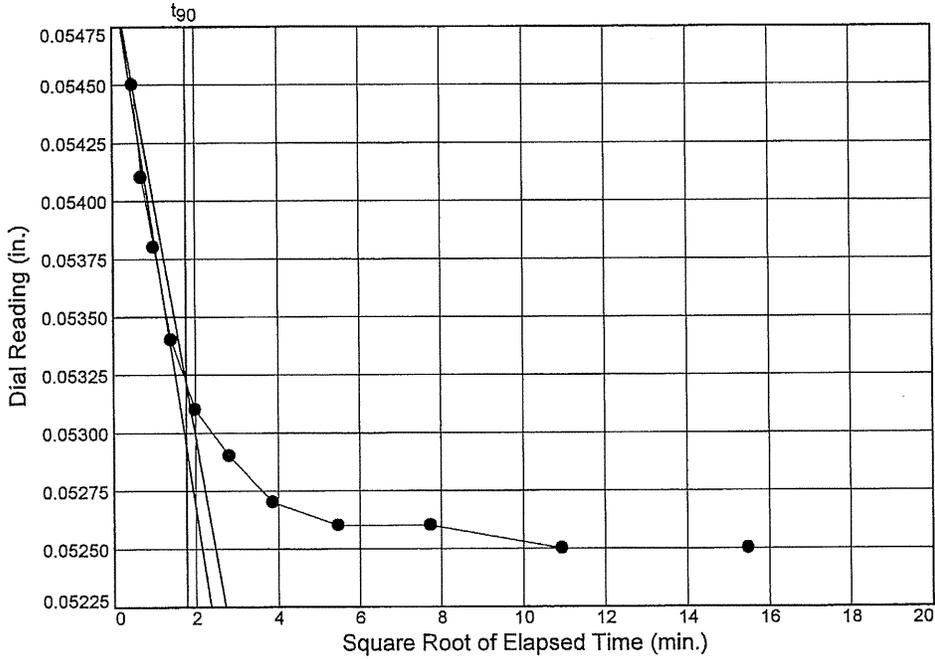
M L Testing, LLC

Figure

Dial Reading vs. Time

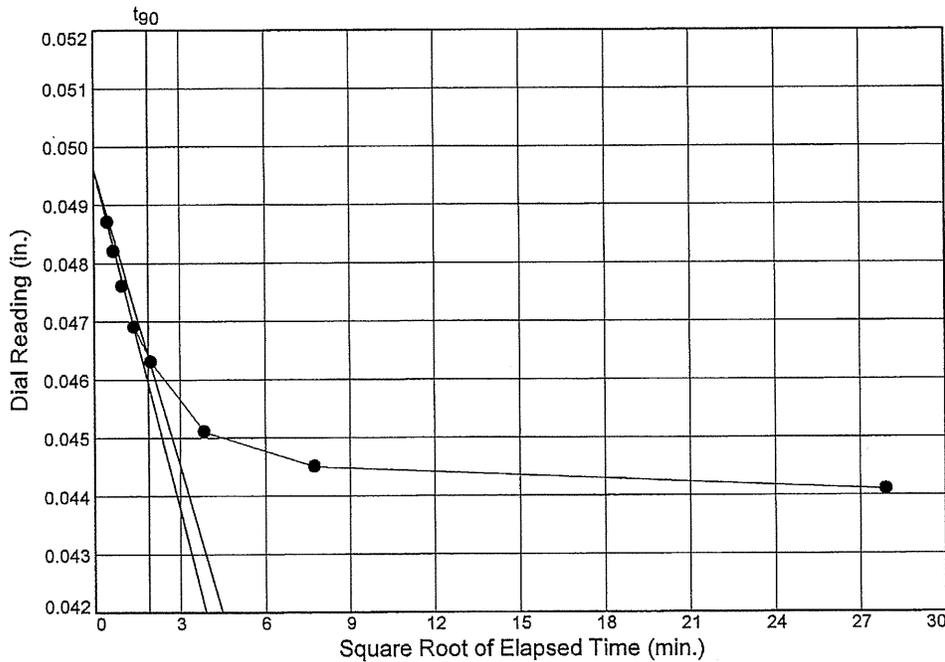
Project No.: 0771-368-11-123
 Project: Turkey Creek Landfill Expansion

Location: PWCG-1 Depth: 27.5'-30.0'



Load No.= 8
 Load= 8.00 tsf
 $D_0 = 0.0550$
 $D_{90} = 0.0532$
 $D_{100} = 0.0530$
 $T_{90} = 3.11 \text{ min.}$

$C_v @ T_{90}$
 0.614 ft.²/day



Load No.= 9
 Load= 4.00 tsf
 $D_0 = 0.0496$
 $D_{90} = 0.0464$
 $D_{100} = 0.0461$
 $T_{90} = 3.54 \text{ min.}$

$C_v @ T_{90}$
 0.544 ft.²/day

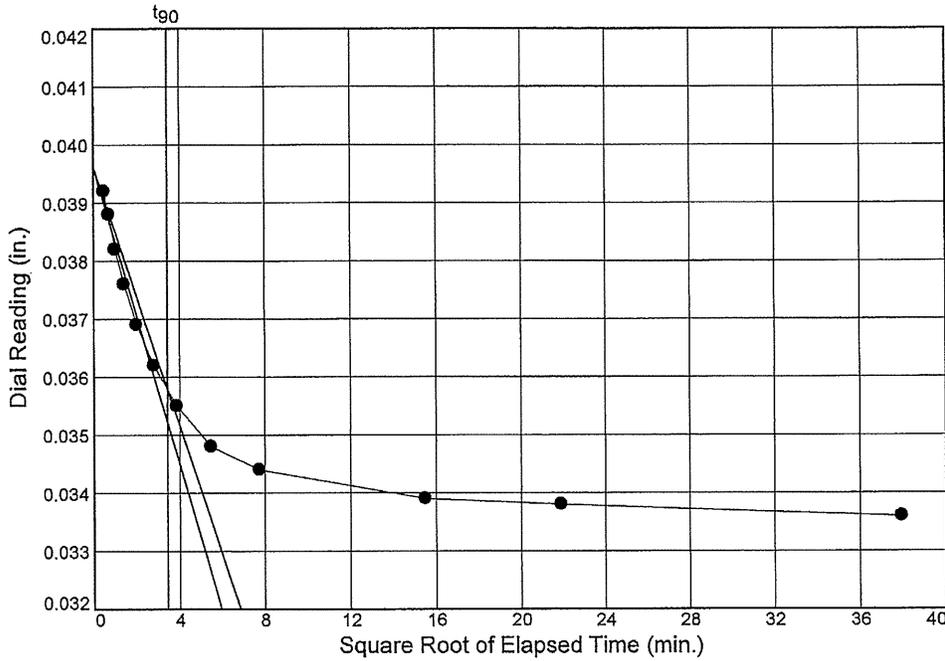
Figure

M L Testing, LLC

Dial Reading vs. Time

Project No.: 0771-368-11-123
Project: Turkey Creek Landfill Expansion

Location: PWCG-1 Depth: 27.5'-30.0'



Load No.= 10

Load= 2.00 tsf

$D_0 = 0.0396$

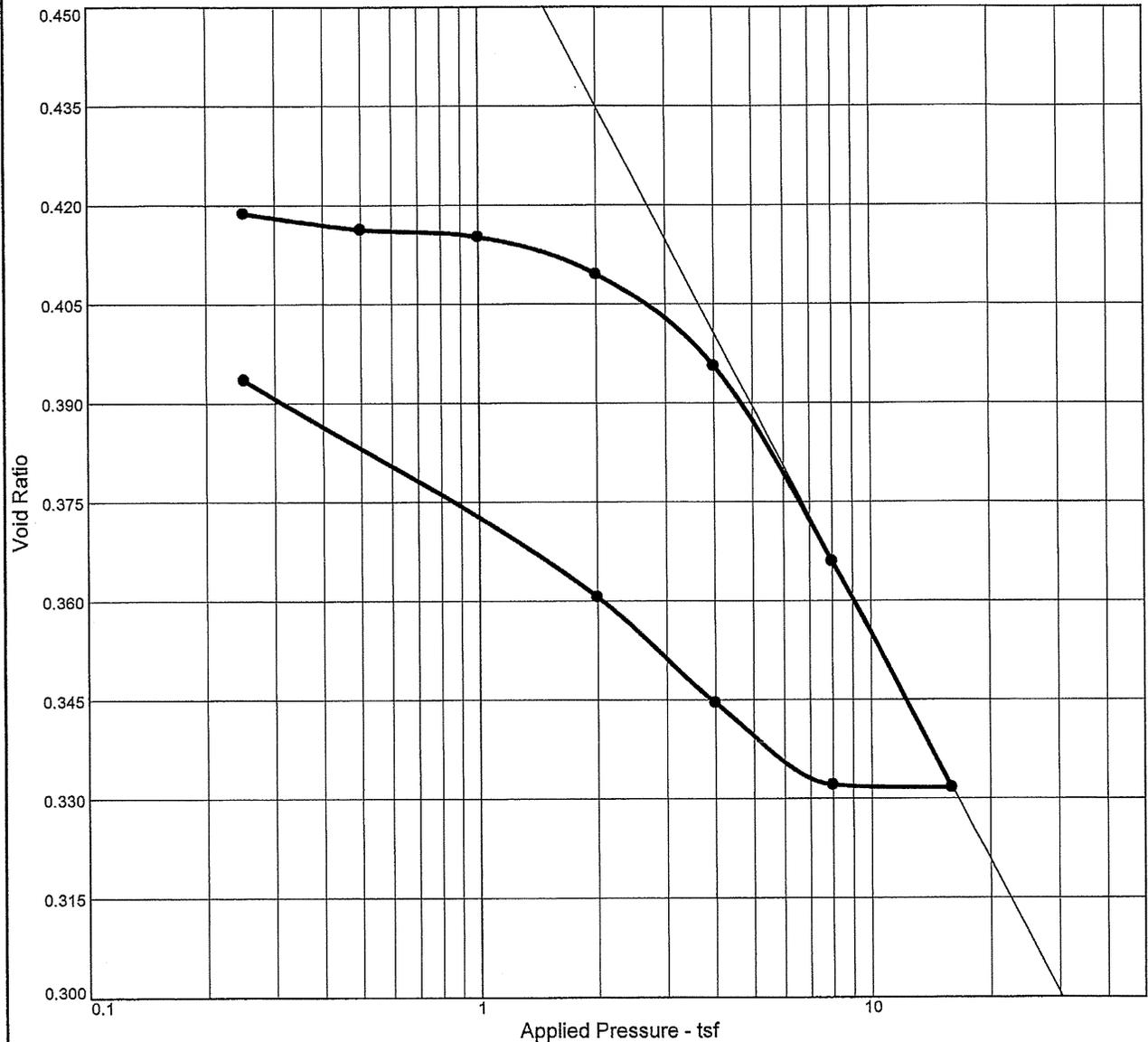
$D_{90} = 0.0358$

$D_{100} = 0.0354$

$T_{90} = 11.77$ min.

$C_v @ T_{90}$
0.167 ft.²/day

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	Initial Void Ratio
Saturation	Moisture							
79.7 %	12.6 %	116.7	39	22	2.65	0	3.1	0.418

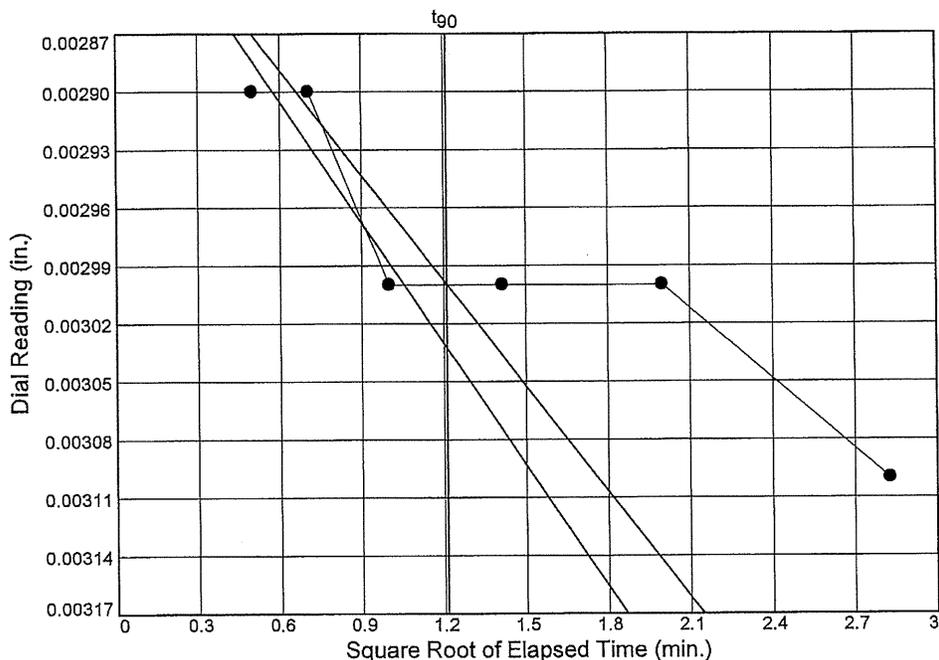
MATERIAL DESCRIPTION	USCS	AASHTO
Sandy shale, gray & brown		

<p>Project No. 0771-368- Client:</p> <p>Project: Turkey Creek Landfill Expansion</p> <p>Location: PWCG-9 Depth: 52.5'-55.0'</p> <p style="text-align: center;">M L Testing, LLC</p> <p style="text-align: center;">Bluff Dale, TX</p>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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Dial Reading vs. Time

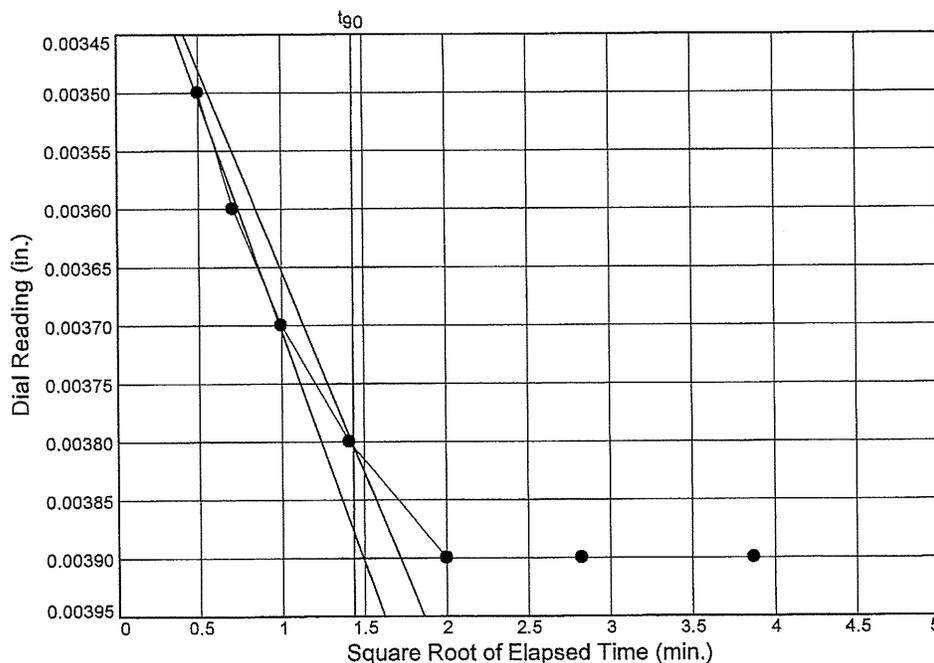
Project No.: 0771-368-11-123
 Project: Turkey Creek Landfill Expansion

Location: PWCG-9 Depth: 52.5'-55.0'



Load No.= 2
 Load= 0.50 tsf
 $D_0 = 0.0028$
 $D_{90} = 0.0030$
 $D_{100} = 0.0030$
 $T_{90} = 1.46 \text{ min.}$

$C_v @ T_{90}$
 1.448 ft.²/day



Load No.= 3
 Load= 1.00 tsf
 $D_0 = 0.0033$
 $D_{90} = 0.0038$
 $D_{100} = 0.0039$
 $T_{90} = 2.06 \text{ min.}$

$C_v @ T_{90}$
 1.025 ft.²/day

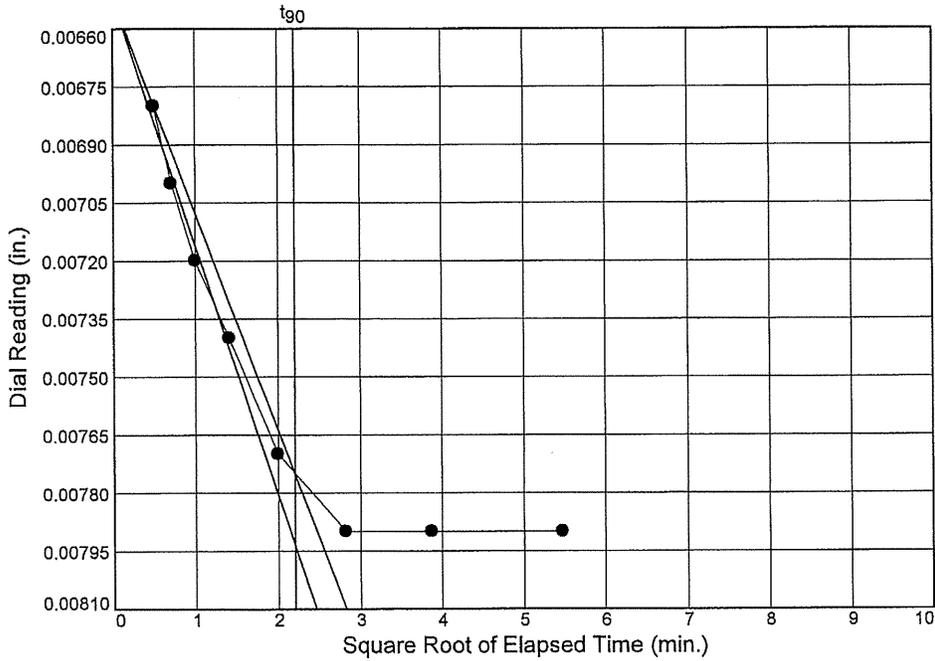
M L Testing, LLC

Figure

Dial Reading vs. Time

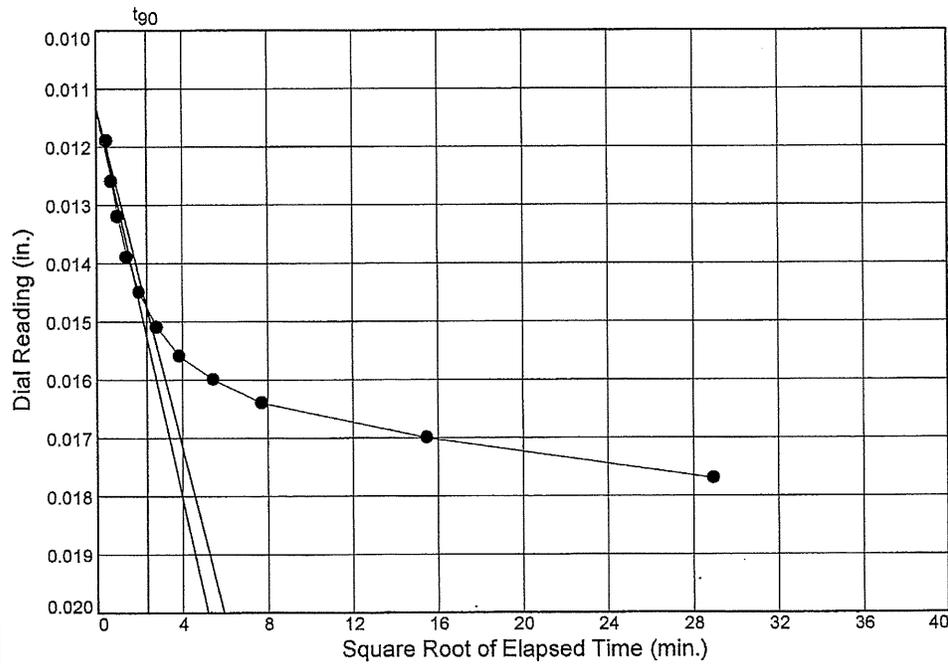
Project No.: 0771-368-11-123
 Project: Turkey Creek Landfill Expansion

Location: PWCG-9 Depth: 52.5'-55.0'



Load No.= 4
 Load= 2.00 tsf
 $D_0 = 0.0065$
 $D_{90} = 0.0077$
 $D_{100} = 0.0079$
 $T_{90} = 4.85 \text{ min.}$

$C_v @ T_{90}$
 0.434 ft.²/day



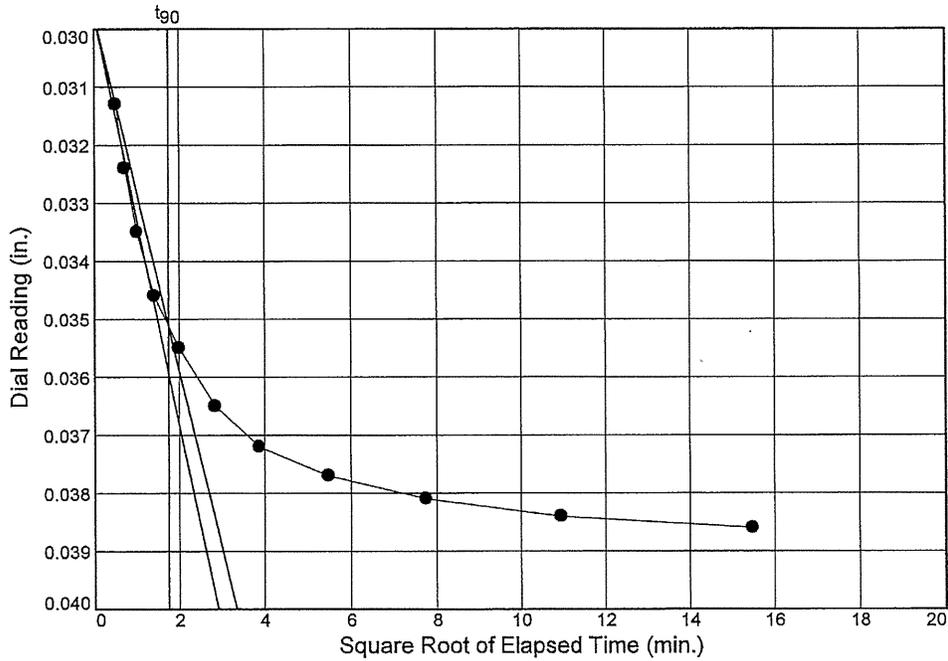
Load No.= 5
 Load= 4.00 tsf
 $D_0 = 0.0113$
 $D_{90} = 0.0147$
 $D_{100} = 0.0151$
 $T_{90} = 5.45 \text{ min.}$

$C_v @ T_{90}$
 0.380 ft.²/day

Dial Reading vs. Time

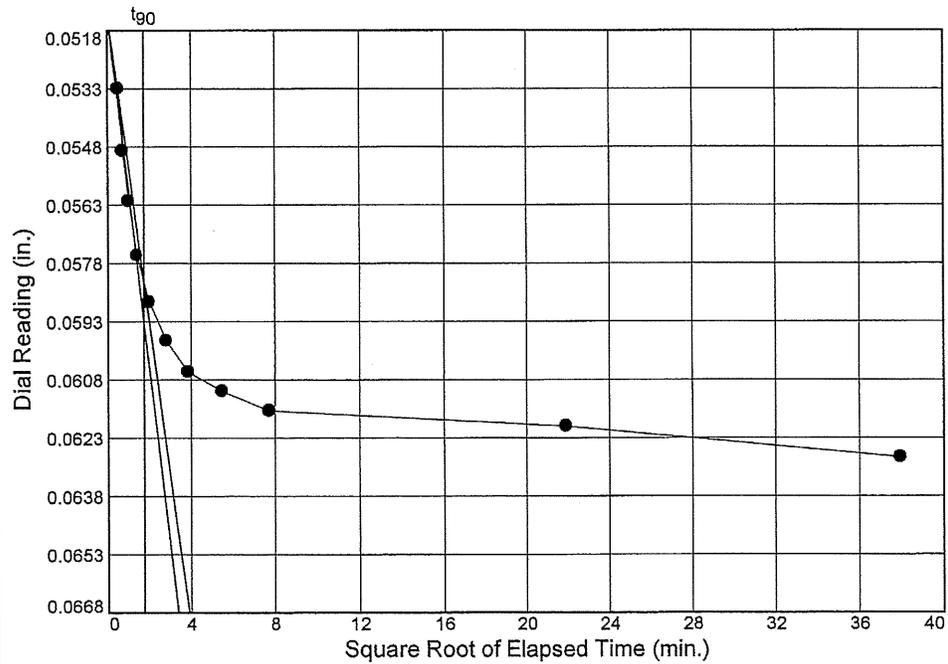
Project No.: 0771-368-11-123
 Project: Turkey Creek Landfill Expansion

Location: PWCG-9 Depth: 52.5'-55.0'



Load No.= 6
 Load= 8.00 tsf
 $D_0 = 0.0297$
 $D_{90} = 0.0351$
 $D_{100} = 0.0357$
 $T_{90} = 3.02 \text{ min.}$

$C_v @ T_{90}$
 0.665 ft.²/day



Load No.= 7
 Load= 16.00 tsf
 $D_0 = 0.0514$
 $D_{90} = 0.0583$
 $D_{100} = 0.0590$
 $T_{90} = 3.03 \text{ min.}$

$C_v @ T_{90}$
 0.632 ft.²/day

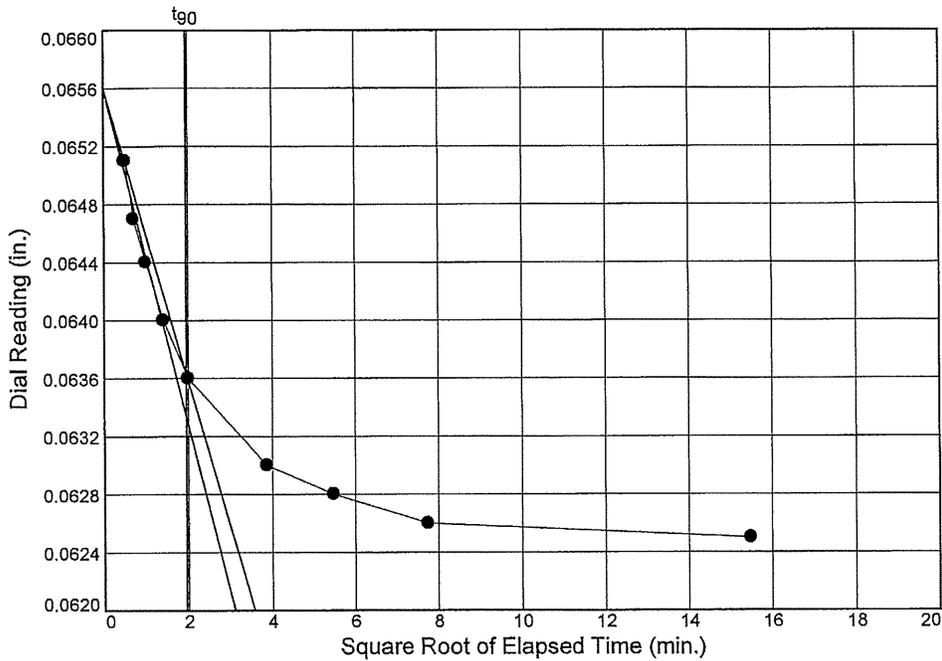
M L Testing, LLC

Figure

Dial Reading vs. Time

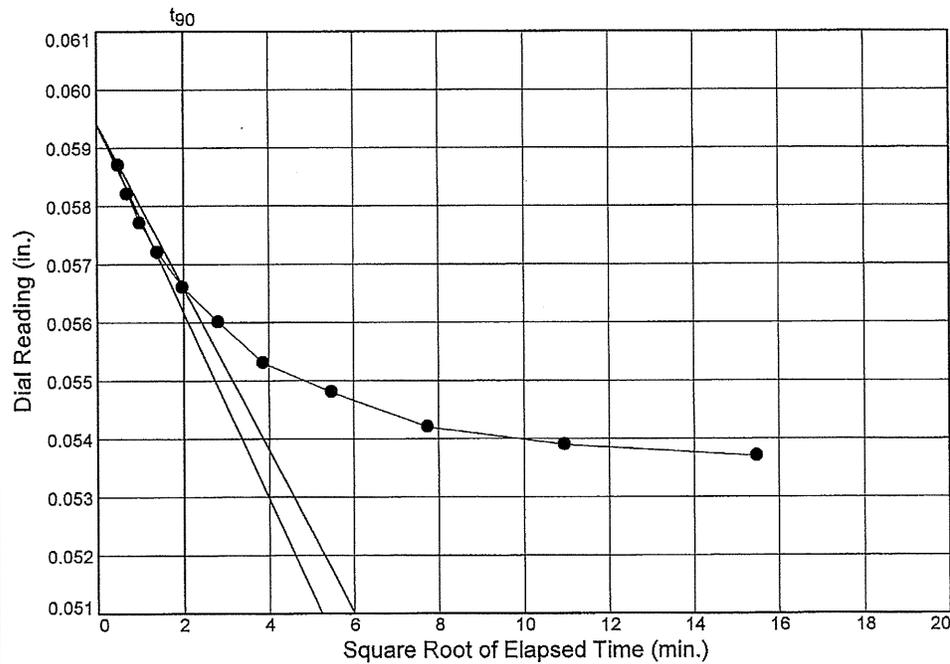
Project No.: 0771-368-11-123
 Project: Turkey Creek Landfill Expansion

Location: PWCG-9 Depth: 52.5'-55.0'



Load No.= 8
 Load= 8.00 tsf
 $D_0 = 0.0656$
 $D_{90} = 0.0636$
 $D_{100} = 0.0634$
 $T_{90} = 3.80 \text{ min.}$

$C_v @ T_{90}$
 0.492 ft.²/day



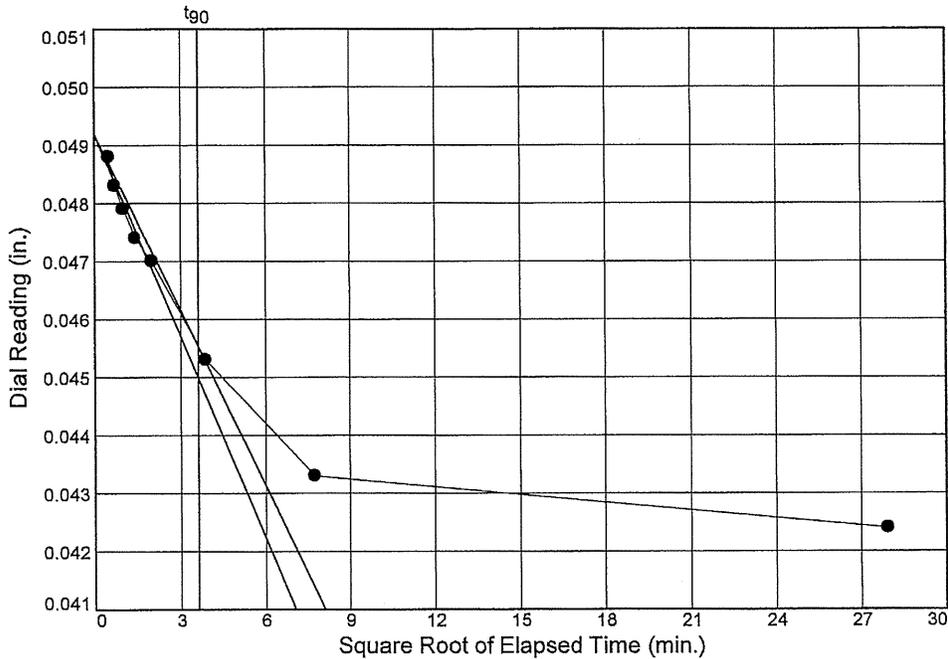
Load No.= 9
 Load= 4.00 tsf
 $D_0 = 0.0594$
 $D_{90} = 0.0566$
 $D_{100} = 0.0563$
 $T_{90} = 4.05 \text{ min.}$

$C_v @ T_{90}$
 0.467 ft.²/day

Dial Reading vs. Time

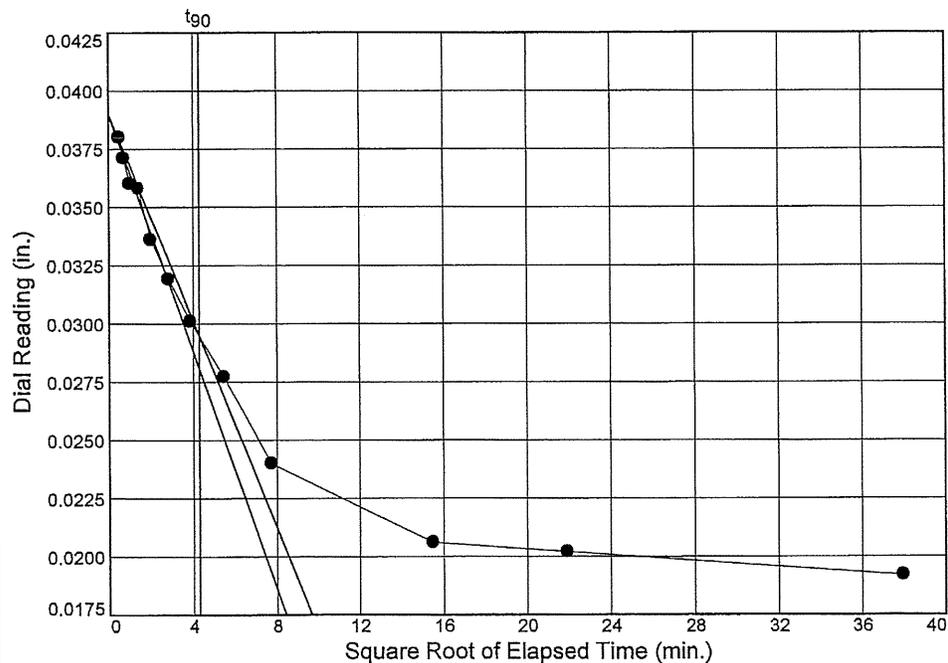
Project No.: 0771-368-11-123
 Project: Turkey Creek Landfill Expansion

Location: PWCG-9 Depth: 52.5'-55.0'



Load No.= 10
 Load= 2.00 tsf
 $D_0 = 0.0492$
 $D_{90} = 0.0455$
 $D_{100} = 0.0451$
 $T_{90} = 12.99 \text{ min.}$

$C_v @ T_{90}$
 0.148 ft.²/day



Load No.= 11
 Load= 0.25 tsf
 $D_0 = 0.0390$
 $D_{90} = 0.0295$
 $D_{100} = 0.0284$
 $T_{90} = 18.34 \text{ min.}$

$C_v @ T_{90}$
 0.109 ft.²/day

CLIENT:

REPORT DATE: 9/26/2021

PROJECT NO.: 0771-368-11-123

PROJECT: Turkey Creek Landfill Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER, CONSTANT VOLUME - FLEXIBLE WALL PERMEAMETER

LOCATION: _____
 MATERIAL: Shale, gray clayey
 BORING/SAMPLE: WCG-6
 PROCTOR #: _____
 SAMPLE ORIENTATION: Vertical
 Remold _____

LAB START DATE: 9/24/2021
 LAB RPT. DATE: 9/26/2021
 TECHNICIAN: MLT
 DEPTH/LIFT: 38.0'-40.0'
 PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 1.95 in
 c. Sample Volume
 ($\pi b^2 / 4 * a$): 6.13 cu in

b. Avg. Diameter of Specimen: 2.00 in
 d. Wet Unit Weight:
 [(e * 3.8095) / c]: 143.1 pcf

INITIAL CONDITIONS

FINAL CONDITIONS

e. Wet Weight Soil: 230.1 gms
 f. Wet Weight Soil + Tare: 321.5 gms
 g. Dry Weight Soil + Tare: 284.9 gms
 h. Tare Weight: 91.4 gms
 i. Moisture Content
 [(f-g)/(g-h)]*100: 18.9 %
 j. Unit Dry Weight
 [d/(1+(i/100))]: 120.3 pcf

k. Wet Weight Soil + Tare: 326.6 gms
 l. Dry Weight Soil + Tare: 284.9 gms
 m. Tare Weight: 91.4 gms
 n. Moisture Content
 [(k-l)/(l-m)]*100: 21.6 %

Specific Gravity of Mercury, d_{Hg} : 13.55
 Specific Gravity of Water, d_w : 1.00

Equilibrium Head, R_{eq} : 2.0 cm
 Maximum Pipet Head, R_p : 13.37 cm
 Maximum Gradient, i: 30.0 cm/cm

B COEFFICIENT DETERMINATION						PRESSURE, psi			
	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow ha, in	Outflow ha, out
		10							
		10							
		10							
26-Sep	50	10	45	54.5	0.95	1	50	45	45
	Time	Cumul. Time, s	Head Reading H, cm	Total Head Loss Dz_p , cm	Temp C	Rt	k @ 20C cm/sec		
9/26/2021	15:06		13.30						
9/26/2021	15:20	840	12.60	0.70	20	1.000	4.4E-08		
9/26/2021	15:30	1440	12.40	0.90	20	1.000	3.4E-08		
9/26/2021	15:41	2100	12.20	1.10	20	1.000	2.8E-08		
9/26/2021	15:55	2940	12.10	1.20	20	1.000	2.2E-08		
9/26/2021	16:10	3840	12.00	1.30	20	1.000	1.9E-08		

Test Method ASTM D 5084-90

Pipet Area = 0.031416 sq cm
 Annulus Area = 0.767120 sq cm

CLIENT:

REPORT DATE: 9/26/2021

PROJECT NO.: 0771-368-11-123

PROJECT: Turkey Creek Landfill Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER, CONSTANT VOLUME - FLEXIBLE WALL PERMEAMETER

LOCATION: _____
 MATERIAL: Shale, gray
 BORING/SAMPLE: WCG-7
 PROCTOR #: _____
 SAMPLE ORIENTATION: Vertical
 Remold _____

LAB START DATE: 9/24/2021
 LAB RPT. DATE: 9/26/2021
 TECHNICIAN: MLT
 DEPTH/LIFT: 40.0'-42.0'
 PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 1.65 in
 c. Sample Volume
 ($\pi b^2 / 4 * a$): 5.18 cu in

b. Avg. Diameter of Specimen: 2.00 in
 d. Wet Unit Weight:
 $[(e * 3.8095) / c]$: 137.8 pcf

INITIAL CONDITIONS

FINAL CONDITIONS

e. Wet Weight Soil: 187.5 gms
 f. Wet Weight Soil + Tare: 282.1 gms
 g. Dry Weight Soil + Tare: 255.8 gms
 h. Tare Weight: 94.6 gms
 i. Moisture Content
 $[(f-g)/(g-h)]*100$: 16.3 %
 j. Unit Dry Weight
 $[d/(1+(i/100))]$: 118.5 pcf

k. Wet Weight Soil + Tare: 286.0 gms
 l. Dry Weight Soil + Tare: 255.8 gms
 m. Tare Weight: 94.6 gms
 n. Moisture Content
 $[(k-l)/(l-m)]*100$: 18.7 %

Specific Gravity of Mercury, d_{Hg} : 13.55
 Specific Gravity of Water, d_w : 1.00

Equilibrium Head, R_{eq} : 2.0 cm
 Maximum Pipet Head, R_p : 11.62 cm
 Maximum Gradient, i : 30.0 cm/cm

B COEFFICIENT DETERMINATION						PRESSURE, psi			
	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow ha, in	Outflow ha, out
26-Sep	50	10 10 10 10	45	54.5	0.95	1	50	45	45
	Time	Cumul. Time, s	Head Reading H, cm	Total Head Loss Dz_p , cm	Temp C	Rt	k @ 20C cm/sec		
9/26/2021	16:15		11.60						
9/26/2021	16:22	420	11.20	0.40	20	1.000	5.0E-08		
9/26/2021	16:30	900	11.00	0.60	20	1.000	3.6E-08		
9/26/2021	16:43	1680	10.90	0.70	20	1.000	2.2E-08		
9/26/2021	16:55	2400	10.80	0.80	20	1.000	1.8E-08		
9/26/2021	17:08	3180	10.80	0.80	20	1.000	1.4E-08		

Test Method ASTM D 5084-90

Pipet Area = 0.031416 sq cm
 Annulus Area = 0.767120 sq cm

CLIENT:

REPORT DATE: 9/26/2021

PROJECT NO.: 0771-368-11-123

PROJECT: Turkey Creek Landfill Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER, CONSTANT VOLUME - FLEXIBLE WALL PERMEAMETER

LOCATION:
 MATERIAL: Clayey sand, brown w/sandy shale
 BORING/SAMPLE: WCG-8
 PROCTOR #:
 SAMPLE ORIENTATION: Vertical
 Remold _____

LAB START DATE: 9/24/2021
 LAB RPT. DATE: 9/26/2021
 TECHNICIAN: MLT
 DEPTH/LIFT: 26.0'-28.0'
 PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 2.35 in
 c. Sample Volume
 ($\pi b^2 / 4 * a$): 7.38 cu in

b. Avg. Diameter of Specimen: 2.00 in
 d. Wet Unit Weight:
 $[(e * 3.8095) / c]$: 131.3 pcf

INITIAL CONDITIONS

FINAL CONDITIONS

e. Wet Weight Soil: 254.4 gms
 f. Wet Weight Soil + Tare: 344.1 gms
 g. Dry Weight Soil + Tare: 308.3 gms
 h. Tare Weight: 89.7 gms
 i. Moisture Content
 $[(f-g)/(g-h)]*100$: 16.4 %
 j. Unit Dry Weight
 $[d/(1+(i/100))]$: 112.8 pcf

k. Wet Weight Soil + Tare: 350.1 gms
 l. Dry Weight Soil + Tare: 308.3 gms
 m. Tare Weight: 89.7 gms
 n. Moisture Content
 $[(k-l)/(l-m)]*100$: 19.1 %

Specific Gravity of Mercury, d_{Hg} : 13.55
 Specific Gravity of Water, d_w : 1.00

Equilibrium Head, R_{eq} : 2.0 cm
 Maximum Pipet Head, R_p : 15.71 cm
 Maximum Gradient, i : 30.0 cm/cm

B COEFFICIENT DETERMINATION						PRESSURE, psi			
	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow ha, in	Outflow ha, out
		10							
		10							
		10							
26-Sep	50	10	45	54.7	0.97	1	50	45	45
	Time	Cumul. Time, s	Head Reading H, cm	Total Head Loss Dz _p , cm	Temp C	Rt	k @ 20C cm/sec		
9/26/2021	17:15		15.70						
9/26/2021	17:28	780	14.30	1.40	20	1.000	9.8E-08		
9/26/2021	17:36	1260	13.60	2.10	20	1.000	9.3E-08		
9/26/2021	17:45	1800	12.90	2.80	20	1.000	9.0E-08		
9/26/2021	17:57	2520	11.90	3.80	20	1.000	9.1E-08		
9/26/2021	18:05	3000	11.30	4.40	20	1.000	9.1E-08		

Test Method ASTM D 5084-90

Pipet Area = 0.031416 sq cm
 Annulus Area = 0.767120 sq cm

CLIENT:

REPORT DATE: 9/26/2021

PROJECT NO.: 0771-368-11-123

PROJECT: Turkey Creek Landfill Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER, CONSTANT VOLUME - FLEXIBLE WALL PERMEAMETER

LOCATION:
MATERIAL: Shale, gray
BORING/SAMPLE: WCG-8
PROCTOR #:
SAMPLE ORIENTATION: Vertical Remold

LAB START DATE: 9/24/2021
LAB RPT. DATE: 9/26/2021
TECHNICIAN: MLT
DEPTH/LIFT: 40.0'-42.0'
PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 1.8 in
c. Sample Volume (pi b^2 / 4 * a): 5.65 cu in

b. Avg. Diameter of Specimen: 2.00 in
d. Wet Unit Weight: [(e * 3.8095) / c]: 133.1 pcf

INITIAL CONDITIONS

FINAL CONDITIONS

e. Wet Weight Soil: 197.6 gms
f. Wet Weight Soil + Tare: 289.9 gms
g. Dry Weight Soil + Tare: 260.5 gms
h. Tare Weight: 92.3 gms
i. Moisture Content [(f-g)/(g-h)]*100: 17.5 %
j. Unit Dry Weight [d/(1+(i/100))]: 113.3 pcf

k. Wet Weight Soil + Tare: 293.8 gms
l. Dry Weight Soil + Tare: 260.5 gms
m. Tare Weight: 92.3 gms
n. Moisture Content [(k-l)/(l-m)]*100: 19.8 %

Specific Gravity of Mercury, dHg: 13.55
Specific Gravity of Water, dW: 1.00

Equilibrium Head, Req: 2.0 cm
Maximum Pipet Head, Rp: 12.50 cm
Maximum Gradient, i: 30.0 cm/cm

Table with columns: B COEFFICIENT DETERMINATION (P3, Delta Pressure, Back Pressure, Pore Pressure, B Coeff.) and PRESSURE, psi (Trial, P3 cp, Inflow ha, In, Outflow ha, Out). Includes a data table with Time, Cumul. Time, Head Reading, Total Head Loss, Temp, Rt, and k @ 20C.

Test Method ASTM D 5084-90

Pipet Area = 0.031416 sq cm
Annulus Area = 0.767120 sq cm

CLIENT:

REPORT DATE: 9/26/2021

PROJECT NO.: 0771-368-11-123

PROJECT: Turkey Creek Landfill Expansion

HYDRAULIC CONDUCTIVITY WORKSHEET

FALLING HEAD, RISING TAILWATER, CONSTANT VOLUME - FLEXIBLE WALL PERMEAMETER

LOCATION: _____
 MATERIAL: Clay shaley, brown & gray sandy
 BORING/SAMPLE: WCG-10
 PROCTOR #: _____
 SAMPLE ORIENTATION: Vertical
 Remold _____

LAB START DATE: 9/24/2021
 LAB RPT. DATE: 9/26/2021
 TECHNICIAN: MLT
 DEPTH/LIFT: 80.0'-82.0'
 PERM FLUID USED: De-aired Tap Water

a. Length of Specimen, L: 1.8 in
 c. Sample Volume
 ($\pi b^2 / 4 * a$): 5.65 cu in

b. Avg. Diameter of Specimen: 2.00 in
 d. Wet Unit Weight:
 $[(e * 3.8095) / c]$: 107.7 pcf

INITIAL CONDITIONS

FINAL CONDITIONS

e. Wet Weight Soil: 159.9 gms
 f. Wet Weight Soil + Tare: 255.4 gms
 g. Dry Weight Soil + Tare: 234.5 gms
 h. Tare Weight: 95.5 gms
 i. Moisture Content
 $[(f-g)/(g-h)]*100$: 15.0 %
 j. Unit Dry Weight
 $[d/(1+(i/100))]$: 93.6 pcf

k. Wet Weight Soil + Tare: 260.7 gms
 l. Dry Weight Soil + Tare: 234.5 gms
 m. Tare Weight: 95.5 gms
 n. Moisture Content
 $[(k-l)/(l-m)]*100$: 18.8 %

Specific Gravity of Mercury, d_{Hg} : 13.55
 Specific Gravity of Water, d_w : 1.00

Equilibrium Head, R_{eq} : 2.0 cm
 Maximum Pipet Head, R_p : 12.50 cm
 Maximum Gradient, i : 30.0 cm/cm

B COEFFICIENT DETERMINATION						PRESSURE, psi			
	P3	Delta Pressure	Back Pressure, bp	Pore Pressure	B Coeff.	Trial	P3 cp	Inflow he, in	Outflow ha, out
		10							
		10							
		10							
26-Sep	50	10	45	54.6	0.96	1	50	45	45
	Time	Cumul. Time, s	Head Reading H, cm	Total Head Loss Dz_p , cm	Temp C	Rt	k @ 20C cm/sec		
9/26/2021	19:07		12.40						
9/26/2021	19:18	660	12.00	0.40	20	1.000	3.2E-08		
9/26/2021	19:29	1320	11.80	0.60	20	1.000	2.4E-08		
9/26/2021	19:38	1860	11.70	0.70	20	1.000	2.0E-08		
9/26/2021	19:49	2520	11.70	0.70	20	1.000	1.5E-08		
9/26/2021	19:59	3120	11.70	0.70	20	1.000	1.2E-08		

Test Method ASTM D 5084-90

Pipet Area = 0.031416 sq cm
 Annulus Area = 0.767120 sq cm

**ATTACHMENT 11b, GEOTECHNICAL INVESTIGATIONS,
PROPOSED SITE FOR JOHNSON COUNTY SANITARY
LANDFILL, INC., JOHNSON COUNTY, TEXAS,
BAKER-SHIFLETT, INC., DECEMBER 1981**

ATTACHMENT 11b

GEOTECHNICAL INVESTIGATION
PROPOSED SITE FOR
JOHNSON COUNTY SANITARY LANDFILL, INC.
JOHNSON COUNTY, TEXAS

* * *

Report To
JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

* * *

BY
BAKER-SHIFLETT, INC.
Consulting Geotechnical Engineers
Fort Worth, Texas

December, 1981

December 3, 1981
Report No. 81114

Johnson County Sanitary Landfill, Inc.
c/o Mr. R. J. Robinson, P.E.
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Geotechnical Investigation
Proposed Site for
Johnson County Sanitary Landfill, Inc.
Alvarado, Texas

Gentlemen:

Attached is our report of the geotechnical investigation at the proposed site for a sanitary landfill in Johnson County, Texas. This investigation has been performed in general accordance with our proposal dated November 9, 1981, and as authorized on November 13, 1981 by Mr. Byron P. Rayburne, Sr. of Johnson County Sanitary Landfill, Inc.

A single boring was made and a piezometer set on October 28, 1981 which served as a preliminary investigation. These results, together with analytical results, engineering recommendations, and other information gained during the extent of this investigation have been included within this report. We trust that this information will aid in the development of an economical and safe landfill.

If we may be of additional service, it will indeed be a pleasure.

Respectfully submitted,

BAKER-SHIFLETT, INC.

Michael M. Shiflett, P.E.

MMS/pn

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INTRODUCTION

The proposed landfill site for Johnson County Sanitary Landfill, Inc. is located south of Alvarado, Texas, on Interstate Highway 35W. The site has been formerly occupied by Rayburne Sand, Inc., which excavated sand from the property. The proposed site is bordered on the north by Turkey Creek, on the east by I.H. 35W, on the south by an unnamed tributary to Turkey Creek and privately owned land and on the west by the M.K. & T. Railroad.

The limits of the proposed fill area do not extend beyond the sand pit areas and include approximately 50 acres of the 92 acre tract. The proposed fill area will be out of the floodplain of Turkey Creek. Ground elevation decreases rapidly from the edge of the proposed fill area (north and west sides) to Turkey Creek and the railroad. Vegetation was cleared from the site during sand excavation.

The site is crossed by an underground gas pipeline as shown on Plate I. The soils have not been excavated at this pipeline, resulting in a large earthen levee (divider) crossing the site in a northwesterly direction. This earthen embankment will remain in place resulting in a site consisting of at least an east and west area.

FIELD INVESTIGATIONS

Subsurface conditions at the site were explored by fifteen sample borings. This number of borings was determined as appropriate after one boring (B-6) had been made as a preliminary investigation and

discussed in a meeting with the Texas Department of Health in Austin on November 4, 1981. The locations of the borings are as shown on Plate 1. The Logs of Borings are attached as Plates 2 through 16.

Soils encountered in each boring are shown on the Logs of Borings. The terms and classifications used on the logs are according to the Unified Soil Classification System. The consistency of each undisturbed sample was determined in the field utilizing a hand penetrometer. Texas Highway Department cone penetrometer tests were also utilized to help define in-situ conditions of the harder subsurface strata.

Groundwater observations and bailing procedures are shown on the logs. Additionally, five piezometers were set to permit subsequent groundwater monitoring. Piezometers were set in B-1, B-6, B-9, B-10 and B-13. A summary of elevations for top and bottom of the piezometers is shown on Plate 17. Subsequent groundwater observations for the piezometers, and also for borings which were bailed are shown in graph form, also on Plate 17.

Field infiltration tests were performed in B-9, B-10 and B-13, with results shown on the individual logs and summarized on Plate 21. Although these infiltration tests should only be considered as approximates, the resulting permeability rates do offer guidelines concerning in-situ permeabilities.

LABORATORY INVESTIGATIONS

The physical characteristics of the materials encountered at the site were determined by visual classifications, Atterberg Limits, minus 200-mesh sieve tests, grain-size analysis, unconfined compression tests, and unit dry weight and moisture content tests. The results of these investigations are presented in the Appendix on Plates 18, 19 and 20.

The permeability of the shaly clay, weathered shale, and the gray shale were defined by pressure head permeability tests. In this test, a representative sample of undisturbed soil is trimmed to a desired size, placed into a pressure chamber, submerged, and a pressure (compressed air) applied to provide a constant head. Water is permitted to permeate through the specimen for a length of time, depending upon an equalization of the flow rate. The less permeable the sample, the greater the pressure head required. The results of the laboratory permeability tests are presented at the respective sample depths on the logs of borings and are also summarized on Plate 21.

GENERALIZED SOIL AND GROUNDWATER CONDITIONS

General

Since the site is an abandoned sand pit, the natural overburden soils within the proposed fill area have, for the largest extent, been removed. Most of the existing ground surface within the proposed fill

area is very near the stratum of weathered shale.

This site is within the Woodbine Formation. The general dip of the formation is to the southeast, and this was found to be the localized case for the investigated site, as shown by Plate 22. It appears as though Turkey Creek on the north may have cut through the overlying soils, leaving the hill to the south, and the resulting relatively shallow shale stratum.

Stratification

Specific types and depths of subsurface strata encountered at the fifteen boring locations are shown on the Logs of Borings. In general, the materials encountered within the proposed fill area consist of:

1 to 9 1/2 feet of tan to reddish brown sands, clayey sands, and sandstone;

1 to 16 feet of shaly clay and weathered shales; and, gray sandy shale down to at least the bottoms of the borings.

Lignite and gypsum pockets or seams were observed within the weathered shale and gray shale.

Boring No. 8 was drilled along the southern property boundary on a road which leads from natural grade down into the excavated area. Therefore, the clayey sand, sand, and sandstone encountered in B-8 are the strata which form the sides of the excavated pit. As can be seen, even though B-8 is somewhat higher than the bottom of the pit at this location, B-9, B-12 and B-13 on the opposite side and within the

excavated area, are at higher ground elevations, further indications of the local dip. Borings 14 and 15 were made just north of the proposed fill area in unexcavated areas in order to investigate subsurface strata and groundwater. Generalized soil profiles for sections across the site are shown on Plates 23 and 24.

Groundwater

Previous excavations into the weathered shale stratum have encountered groundwater perched at the surface of the shale. These areas have formed "water holes" across the pit area where excavations have penetrated to sufficient depths. During field investigations, piezometers were set in order to monitor subsurface water conditions. At completion of the drilling operations and all 5 piezometers in place, the piezometers were pumped to virtually dry (with the exception of P-13, which was not pumped) and allowed to stabilize with the groundwater. Borings B-4, B-5, B-8 and B-11 were bailed at the completion of drilling operations. The holes have remained open permitting groundwater observations at these locations, in addition to the piezometers.

Groundwater was encountered at very shallow depths in B-4 and B-6, approximately one foot below the ground surface (see water notes on boring logs):

Field investigations were made during a period following heavy areal rainfalls. The "water holes" were full and plentiful. Subsequent monitoring of water levels also have lead to visual observations

of these "water holes." By November 27, there had not been any more rainfall, and the surface water at the site was diminishing in observable magnitudes. This fact, along with the groundwater observations as shown on Plate 17 in graph form, indicate that the groundwater is at least, somewhat seasonal. Whether the moisture will dissipate entirely during prolonged periods of very little rainfall is not known at this time.

The groundwater is at the surface of the shaly clays and weathered shale. The sand layers within the shaly clay and the sand seams within the weathered shale were observed within the undisturbed samples to be dry. Although these sand layers and seams serve as passageways for subsurface moisture, moisture was not observed within the layers or seams for the samples recovered.

It appears as though subsurface moisture is traveling along the surface of the impermeable zone to lower elevations. The recharge area influencing the proposed site probably includes the higher elevations to the south and slightly west of the site. Groundwater is not entering the site from the north, although the subsurface dip creates a subsurface flow tendency toward the southeast (B-1). In most probability, the impermeable surface includes irregular areas and discontinuous depressions. It is often difficult, if not impossible, to trace a particular bed for any distance within the Woodbine formation.

ANALYSIS OF RESULTS AND RECOMMENDATIONS

Preliminary plans for a landfill at this site have included excavations below the existing abandoned pit floor. Excavations will extend through the weathered shale and into the gray sandy shale, possibly as deep as 15 feet, if practical. The laboratory permeability tests summarized on Plate 21, were performed on various shale conditions. The weathered shale varies from very shaly to very sandy. The attempt through the laboratory testing program has been to determine permeability rates for the varying shale conditions.

Permeability rates (k) for the shaly clay with sand layers indicated a marginally acceptable rate of 2.0×10^{-7} centimeters per second (cm/sec), dependent upon the sand. Weathered shale, with sand seams, yield a k value of 4.5×10^{-9} cm/sec. Permeability rates for the gray sandy shale will vary with the condition of the shale; i.e. where the shale is sandier, or fractured, the permeability rate increases. For firm gray shale with very little sand, the shale is practically impervious with regards to landfill requirements. The permeability rates in B-8 and B-12 where the shale was jointed and sandy, indicate marginally acceptable permeability rates. Horizontal permeability tests (direction of flow in direction of fissility or bedding) indicated k values of 5.9×10^{-6} cm/sec for a very sandy and jointed sample, (vertical 5.6×10^{-8}) and as low as 3.8×10^{-8} cm/sec for a sample of firm gray shale with very little sand.

The field infiltration tests indicate somewhat larger values for k , which is generally the case. Although these infiltration tests should be considered as rough approximates, they do indicate ranges of expected permeabilities.

It may be concluded that the shales at the site will be desirable materials with regards to permeability requirements. As the shales are excavated, it will be necessary to utilize at least a portion of the shale to line the perimeter of the sand pit area, and the embankment at the pipeline. This liner should be keyed into the shale at least 3 feet, in order to provide a desirable moisture barrier. The shale should be placed along the side slopes so as to provide a minimum dimension of 3 feet through the liner. The liner should be compacted to at least 92 percent of ASTM-D 698 with a minimum moisture content of -2 percentage points of optimum. Cover should be provided over the side wall liner to protect the material from desiccation, as shown on Plate 25.

The floor of the cell or trench area will be located within the gray sandy shale. For areas which will be founded within shale which includes sandy portions of the material, the surface of the shale should be scarified and recompact. Once the sand seams or pockets have been remolded through mixing and compacting, the shale will be relatively impervious, providing a desirable cell or trench bottom. It may also be necessary in areas where sandy shale forms the side-walls, to provide a recompact layer, similar to the shallower liner. This recompact along the shale sidewalls would require a sloped

sidewall for compaction equipment. It will be necessary to observe the excavation as it proceeds in order to determine areas which will require compaction.

Based upon groundwater information available at this time, it appears as though it may be possible to dewater the site through use of open trenches conveying the shallow subsurface water to lower elevations. It may also be desirable to initiate a dewatering program during a dry climatic period, and place the southern sidewall liner to route the subsurface moisture around the site. More sophisticated methods of forming the moisture barrier along the southern property boundary are available (slurry walls, sheet piling, then material compaction, etc.), but are not considered necessary methods at this time. If further work at the site indicates these methods will be required, recommendations will be made.

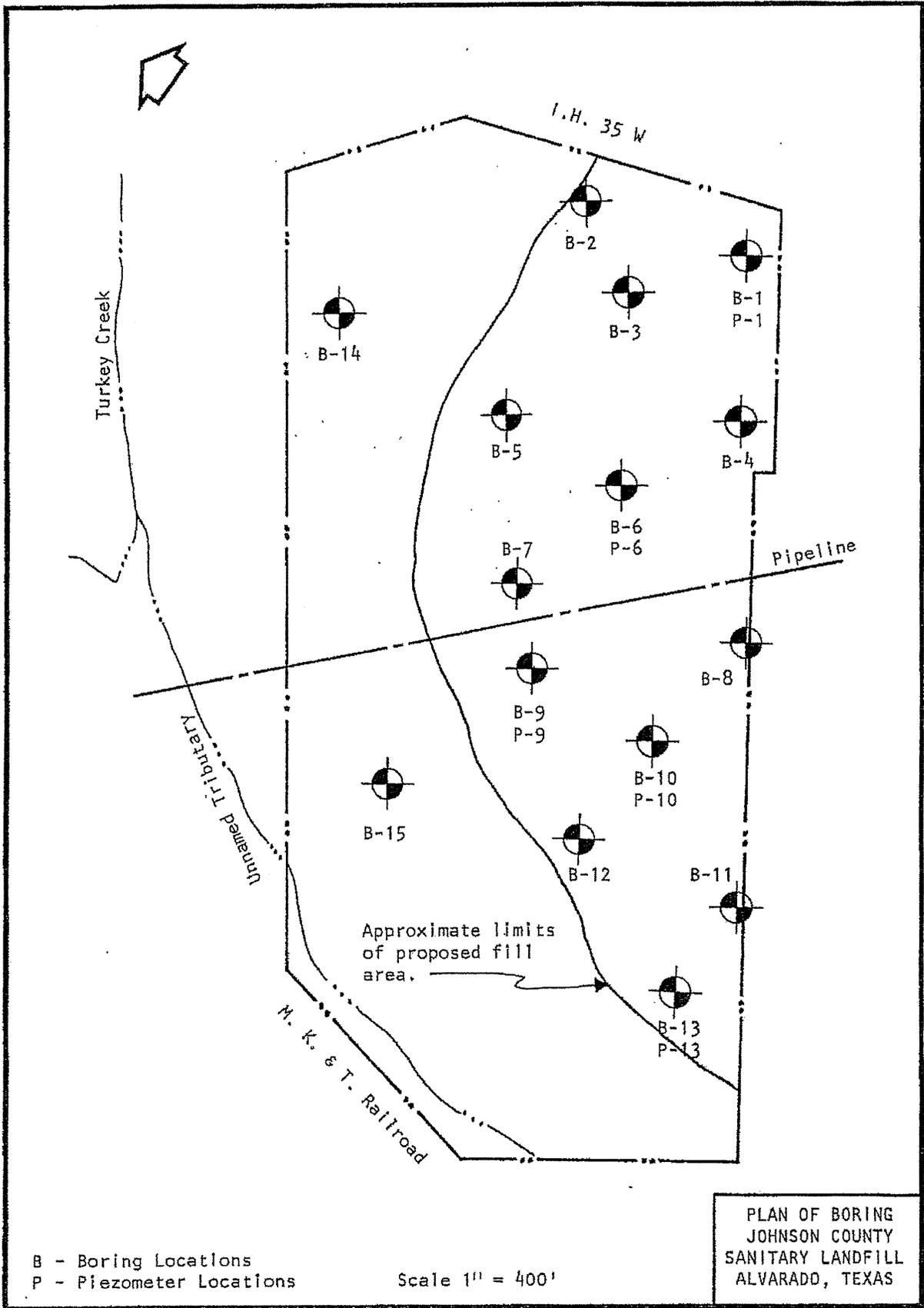
In conclusion, it is believed that a sanitary landfill can be developed at this site meeting the requirements of the Texas Health Department. Some special provisions should be incorporated into the construction and operating procedures in order to assure a desirable fill area with regards to permeabilities and groundwater protection.

1. Provide a sidewall liner at the existing sand pit. The liner may be constructed of the shale materials and should be keyed into the underlying shale.
2. Scarify and roll the shale walls and bottom of pit with excavating and compaction equipment. Utilize sufficient moisture during compaction to permit bonding of soil particles. The reworking of the sandy shale walls and bottoms will reduce the permeability characteristics of the materials to minimum values.

3. The sanitary landfill should include lining the side slope of the pipeline embankment which crosses the site.
4. It is recommended that two or three observation wells be constructed for periodic monitoring of the influence of the sanitary landfill on the shallow groundwater in the area. Wells placed before construction begins, would allow for checks of groundwater quality before, during and after construction for comparison and monitoring purposes.
5. Provide surface drainage for removal of areal runoff.
6. Observations of the cell walls during construction by the geotechnical engineer will be helpful to determine shale side walls which will not require recompacting (i.e. areas which include shales containing only small amounts of sand as at B-1).
7. Provide for periodic inspections of the landfill operation by the geotechnical engineer to confirm that provisions discussed within this report are being maintained during the life of the pit.

* * *

Report No. 81114



LOG OF BORING NO. 1

JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

DATE: 11-19-81

PROJECT NO: 81114

TYPE: Core

LOCATION: See Plan of Boring

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 684.2			
5				4.5+	Reddish brown sand, poorly cemented, -firmer w/depth -occasional clay seams and iron stone (SP)			674.7
10				2.5	Gray weathered shale w/tan & gray sand seams (CH)			668.4
15				4.5+	Gray sandy shale -hard siltstone seams at 27' & 28'			649.2
20								
25								
30								
35					Total depth = 35'			
40					15 - 16.5' k (horizontal) = 3.8×10^{-8} cm/sec			
45								
50								

LOG OF BORING NO. 2
 JOHNSON COUNTY SANITARY LANDFILL, INC.
 Alvarado, Texas

DATE: 11-16-81
 TYPE: Core

PROJECT NO: 81114
 LOCATION: See Plan of Boring

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 679.3			
				3.0	Brown sand w/scattered iron ore gravels (SP)			676.8
5				4.5	Gray shaly clay w/tan & gray sand layers			
					-iron stone @ 7' (CH)			672.3
10				4.5	Gray weathered shale w/tan & gray sand seams			
					-scattered gypsum pockets			
15				4.5				
					(CH)			660.3
20				4.5+	Gray sandy shale			
					-hard siltstone seam @ 23'			
25					Total depth = 25'			654.3
30								
					4.5' - 5.5' $k = 2.7 \times 10^{-7}$ cm/sec			
35								
40								
45								
50								

LOG OF BORING NO. 3

JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

DATE: 11-20-81

PROJECT NO: 81114

TYPE: Core

LOCATION: See Plan of Boring

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 680.8			
				4.5	Random fill - brown sand, sandstone, gravel (moist)			678.8
					Reddish brown & gray clayey sand, moist (SC)			676.8
5				4.0	Gray shaly clay w/tan & gray sand layers			
				3.5				
				3.0				
10				3.0	-scattered iron ore gravels			
					(CH)			667.8
15				3.5	Gray weathered shale w/tan & gray sand seams			
					-lignite pocket (CH)			660.8
20					Gray sandy shale			
					-hard siltstone seams @ 24', 24 3/4', 31, & 32			
25						5.0	5.0	
30						5.0	4.5	
35								645.8
					Total depth = 35'			
40								
45								
50								

LOG OF BORING NO. 4

JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

DATE: 11-20-81

PROJECT NO: 81114

TYPE: Core

LOCATION: See Plan of Boring

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 684.8			
					Reddish brown sand (SP)			
					Reddish brown sandstone			
5					-clay seams @ 6'			678.3
					Gray weathered shale w/sand seams (CH)			677.3
10			3"		Gray sandy shale			
15								
20					-hard siltstone 1/2' thick @ 24'			
25								
30					-siltstone seams @ 26 3/4'; 28', 31', & 33 3/4'			
35								
40					Total depth = 40'			644.8
45					Hole bailed upon completion. Groundwater entered hole faster than could be bailed. Water rose to 1-foot depth in 2 minutes.			
50								

LOG OF BORING NO. 5

JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

DATE: 11-19 & 20-81
TYPE: Core

PROJECT NO: 81114
LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 697.0			
					Brown & tan sand (SP)			
					Tan sandstone			
5				3.0	Gray shaly clay w/tan & gray sand layers -1/2' sandstone @ 3' & 5' (CH)			691.5
				4.5+	Gray weathered shale w/tan & gray sand seams (CH)			688.5
10				3.5	Gray sandy shale			
					-siltstone seams @ 13' & 22'			
15				4.5+				
20								
25								
30								667.0
					Total depth = 30'			
35					At completion, hole bailed to 22' hole open to 29'			
40					9 - 10.5' k (vertical) = 5.6×10^{-8} cm/sec k (horizontal) = 5.9×10^{-6} cm/sec			
45								
50								

LOG OF BORING NO. 6
 JOHNSON COUNTY SANITARY LANDFILL, INC.
 Alvarado, Texas

DATE: 10-28-81
 TYPE: Core

PROJECT NO: 81114
 LOCATION: See Plan of Boring

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 687.5			
					Brown sand w/iron ore gravels (SP)			683.5
5				3.5	Gray weathered shale w/tan and gray sand seams (CH)			679.5
10				4.5+	Gray sandy shale			
15					-hard layer 14.5' - 15'			
					Total depth = 18'			669.5
20					NOTE: Groundwater encountered at 3.0 feet. After 10 minutes, water at 1.0 foot, hole open to 2.0 feet.			
25								
30								
35								
40								
45								
50								

LOG OF BORING NO. 7
JOHNSON COUNTY SANITARY LANDFILL, INC.

DATE: 11-19-81
 TYPE: Core

PROJECT NO: 81114
 LOCATION: See Plan of Boring

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 698.2			
					Reddish brown sand (SP)			696.7
				1.0	Gray weathered shale w/tan & gray sand seams			
				2.0				
5				2.0		(CH)		
			4"		Gray sandy shale			
					-siltstone seams at 11 1/2', 21', 22', 28', 31', 33', & 36 1/2'			
10								
15								
20								
25								
30								
35								
40								658.2
					Total depth = 40'			
45								
50								

LOG OF BORING NO. 8

JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

DATE: 11-18-81

PROJECT NO: 81114

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSP	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 702.7			
				2.5	Reddish brown, tan & gray clayey sand			
				4.5				
				4.5+	(SC)			698.2
5					Reddish brown & tan sand, wet -poorly cemented lenses (SP)			695.2
10					Reddish brown sandstone -clay seams 12' - 13'			
15			7"					685.2
20				4.5+	Gray weathered shale w/sand seams: (CH)			682.7
					Gray sandy shale			
25				4.5+	-siltstone seam at 24'			
					-gray sandstone 27 1/2' - 32'			
30								
35								667.7
					Total depth = 35'			
					Hole bailed to 27' upon completion, open to 33 1/2'			
					20' - 21' $k = 7.3 \times 10^{-7}$ cm/sec			
40								
45								
50								

LOG OF BORING NO. 9
JOHNSON COUNTY SANITARY LANDFILL, INC
 Alvarado, Texas

DATE: 11-17-81
 TYPE: Core

PROJECT NO: 81114
 LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 702.5			
					Reddish brown sand - iron ore & clay seams 2' - 3' (SP)			699.5
5				4.5+	Gray weathered shale w/tan & gray sand seams - sandstone 4' - 5' (CH)			695.9
10				4.5+	Gray sandy shale - siltstone seams @ 8 3/4' & 18'			
15								
20								
				1"				678.5
25					Total depth = 24'			
30					Field infiltration test 8 1/2' to 24' k = 2 X 10 ⁻⁵ cm/sec			
35					5' - 5.75' k = 4.5 X 10 ⁻⁹ cm/sec			
40								
45								
50								

LOG OF BORING NO. 10
 JOHNSON COUNTY SANITARY LANDFILL, INC.
 Alvarado, Texas

DATE: 11-18-81

PROJECT NO: 81114

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 692.9			
					Tan sand, well cemented below 6'			691.4
				2.5	Gray weathered shale w/sand seams (CH)			689.9
5				4.5	Gray sandy shale			
10				4.5+	-shells @ 10'			
15				4.5+	-siltstone seams from 10' to 15'			
20					-gray sandstone 18' - 19 3/4'			
25					-siltstone seams @ 26', 27 3/4', 28 1/4', 31 1/4', 34', 38' & 39'			
30								
35								
40								652.9
45					Total depth = 40'			
					Field infiltration test 5' to 15' k = 2.5 X 10 ⁻⁶ cm/sec			
					4' - 5' k = 5.3 X 10 ⁻⁸ cm/sec			
50								

LOG OF BORING NO. 11
JOHNSON COUNTY SANITARY LANDFILL, INC.
 Alvarado, Texas

DATE: 11-16 & 20-81
 TYPE: Core

PROJECT NO: 81114
 LOCATION: See Plan of Boring

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 707.4			
				4.5	Reddish brown sandstone			705.4
5					Gray weathered shale w/tan & gray sand seams (CH)			701.9
10				3 1/2"	Gray sandy shale -siltstone seams @ 11', 12', 19' & 24'			
15								
20								
25								682.4
					Total depth = 25'			
30					Upon completion, hole bailed to 10.5', open to 25'			
35								
40								
45								
50								

LOG OF BORING NO. 12

JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

DATE: 11-18-81

PROJECT NO: 81114

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 706.8			
					Reddish brown sand & sandstone (SP)			707.3
					Reddish brown sand w/gray clay layers (SP)			703.8
				3.0	Gray shaly clay w/tan & gray clay layers (CH)			702.3
5				4.5+	Gray weathered shale w/sand seams (CH)			700.8
				4.5				
10				3.5	Gray sandy shale -intermittent siltstone seams from 11' to 40'			
15				4.5+				
20					-sandstone 19' - 21'			
25								
30								
35								
40					Total depth = 40'			666.8
45					15' - 15.5' $k = 2 \times 10^{-7}$ cm/sec			
50								

LOG OF BORING NO. 13
JOHNSON COUNTY SANITARY LANDFILL, INC.
 Alvarado, Texas

DATE: 11-18-81

PROJECT NO: 81114

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 714.2			
			1"		Reddish brown sand, poorly cemented (SP)			712.7
				4.5+	Reddish brown sandstone, hard			
				4.5+	Reddish brown sandstone (poorly cemented)			710.7
5				4.5+	Gray shaly clay w/tan & gray sand layers			
				4.5+	(CH)			706.2
10				4.5+	Gray weathered shale w/tan & gray sand seams			
				4.5+	(CH)			701.2
15				4.5+	Gray sandy shale			
20					-intermittent siltstone seams to 35'			
25					-gypsum & lignite pockets			
30								
35					Total depth = 35'			679.2
40					Field infiltration test 5' to 35' k = 6.4 X 10 ⁻⁶ cm/sec.			
45								
50								

LOG OF BORING NO. 14

JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

DATE: 11-20-81

PROJECT NO: 81114

TYPE: Core

LOCATION: See Plan of Boring

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL: 669.1			
5				1.5 2.0 3.5 3.5	Gray sandy shaly clay w/gypsum pockets and sand seams -shallier w/depth (CH)			663.1
10				3.0 3.5 4.5 4.5+	Tan & gray weathered shale -gypsum pockets (CH) Gray sandy shale, water stains			659.1 657.6
15					Total depth = 11.5' Dry at completion			
20								
25								
30								
35								
40								
45								
50								

LOG OF BORING NO. 15
JOHNSON COUNTY SANITARY LANDFILL, INC.
 Alvarado, Texas

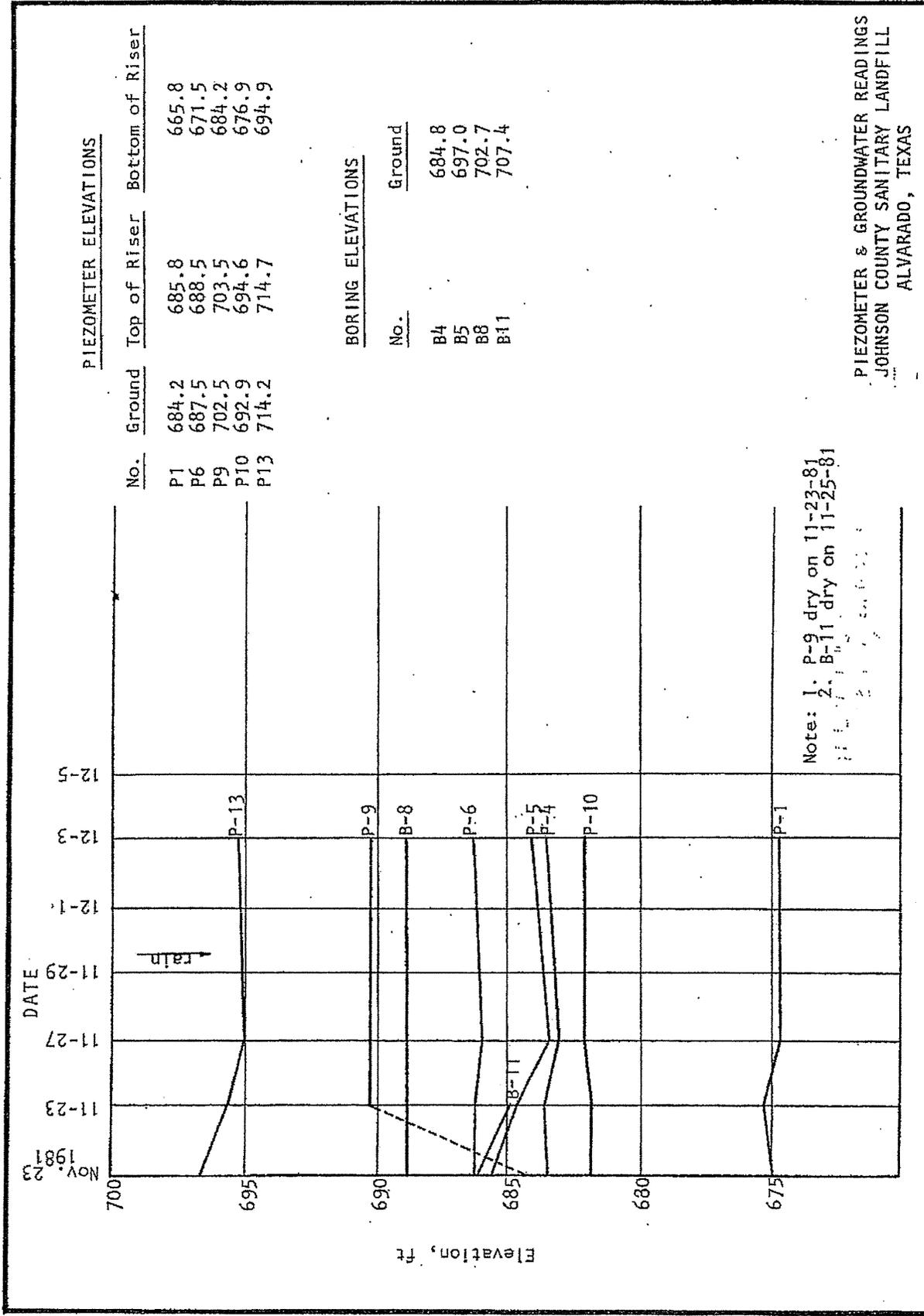
DATE: 11-20-81

PROJECT NO: 81114

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FT	HAND PEN. TSF	MATERIAL DESCRIPTION	CORE		ELEVATION, FT	
						DRILLED	RECOVERED		
					SURFACE EL: 678.0				
				4.5	Reddish brown & gray sandy clay w/ironstone & sandstone seams				
				4.5+					
				4.5+		(CL)			673.5
5				4.5+		Tan & gray poorly cemented sandstone			
				4.5+	Gray shaly clay w/sand seams			670.5	
				4.5+		(CH)			
					Total depth = 7.5'				
10					Dry at completion				
15									
20									
25									
30									
35									
40									
45									
50									



SUMMARY OF SOIL CLASSIFICATION TESTS

JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

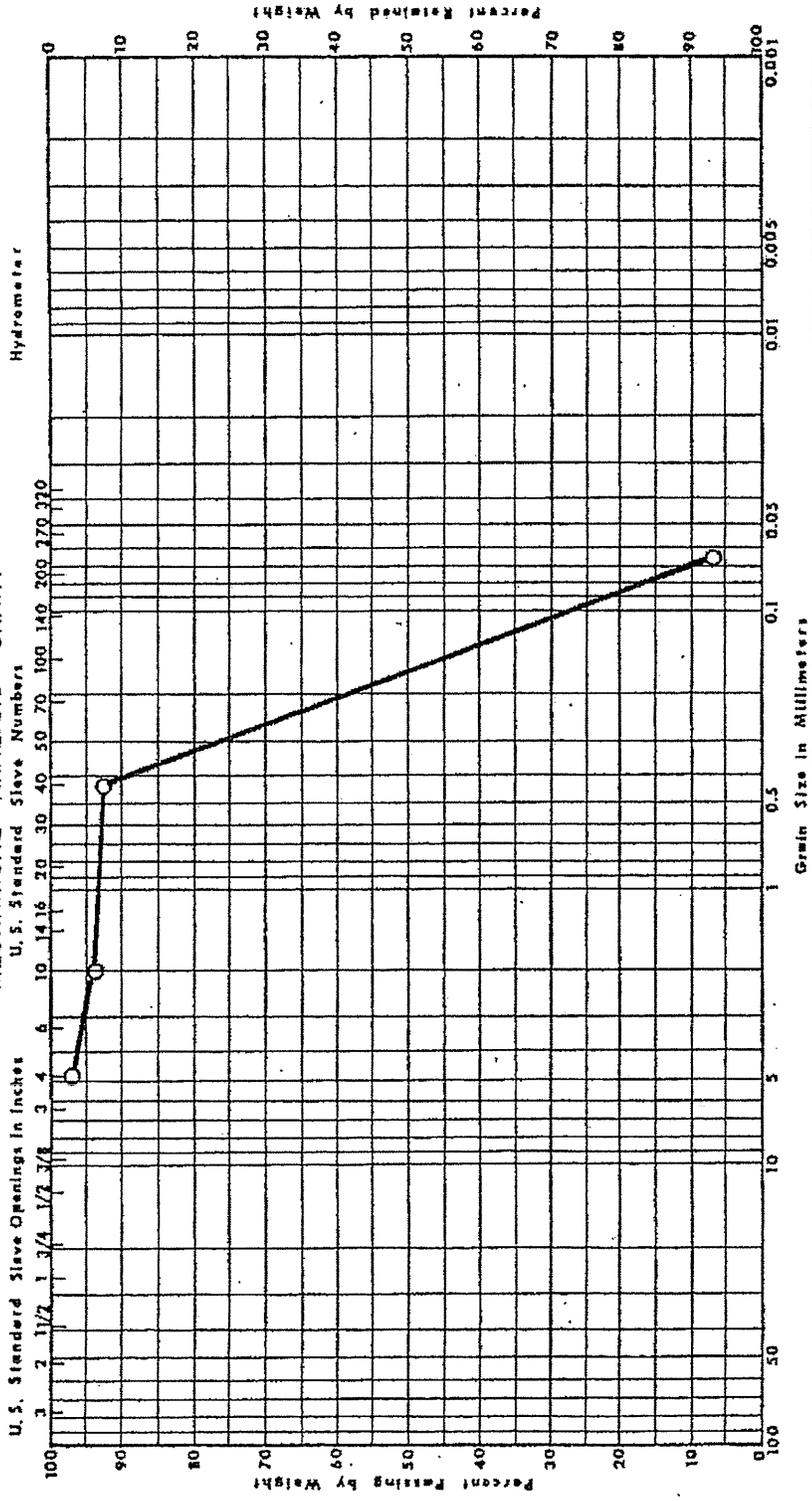
<u>Boring No.</u>	<u>Depth, ft.</u>	<u>Liquid Limit %</u>	<u>Plastic Limit %</u>	<u>Plasticity Index</u>	<u>Minus 200 %</u>	<u>Description</u>
B-1	10.0 - 11.0	42	18	24	82	Gray weathered shale
B-3	5.5 - 7.0	-	-	-	99	Gray shaly clay
B-3	8.5 - 10.0	59	20	39	-	Gray shaly clay
B-4	4.5 - 5.5	51	13	38	-	Reddish brown sandstone
B-5	1.5 - 2.5	30	11	19	71	Gray shaly clay
B-5	15.0 - 15.5	57	20	37	-	Gray sandy shale
B-6	9.0 - 10.0	50	20	30	63	Gray sandy shale
B-7	4.0 - 5.5	50	13	37	-	Gray weathered shale
B-8	1.5 - 3.0	-	-	-	42	Reddish brown, tan & gray clayey sand
B-9	0.0 - 1.5	-	-	-	10	Reddish brown sand
B-10	3.0 - 4.0	51	15	36	89	Gray weathered shale
B-10	24.5 - 25.0	-	-	-	77	Gray sandy shale
B-11	2.0 - 3.0	38	15	23	61	Gray weathered shale
B-12	5.0 - 5.5	31	14	17	74	Gray weathered shale
B-12	15.0 - 15.5	59	22	37	-	Gray sandy shale
B-12	34.0 - 35.0	-	-	-	84	Gray sandy shale
B-13	10.0 - 10.5	48	12	36	82	Gray weathered shale

SUMMARY OF UNIT DRY WEIGHTS, MOISTURE
CONTENTS, AND UNCONFINED COMPRESSION TESTS

JOHNSON COUNTY SANITARY LANDFILL, INC.
Alvarado, Texas

Boring No.	Depth, ft.	Unit Dry Weight, pcf	M.C. %	Q _u tsf	Description
B-1	10.0 - 11.0	-	24	-	Gray weathered shale
B-1	15.0 - 16.5	108	20	4.59	Gray sandy shale
B-3	1.5 - 2.5	116	18	-	Reddish brown & gray clayey sand
B-3	5.5 - 7.5	-	16	-	Gray shaly clay
B-3	15.0 - 16.5	103	24	1.19	Gray weathered shale
B-3	26.5 - 27.5	124	16	-	Gray sandy shale
B-3	27.5 - 28.5	121	17	-	Gray sandy shale
B-3	32.5 - 33.0	120	15	-	Gray sandy shale
B-3	33.0 - 34.0	123	15	-	Gray sandy shale
B-4	6.5 - 8.0	99	23	0.99	Gray weathered shale
B-5	1.5 - 2.5	-	28	-	Tan sandstone
B-5	5.5 - 6.5	109	20	-	Gray weathered shale
B-5	9.0 - 10.5	-	25	-	Gray sandy shale
B-9	8.0 - 9.0	116	15	1.54	Gray sandy shale
B-10	15.0 - 15.5	123	15	-	Gray sandy shale
B-11	2.0 - 3.0	-	18	-	Gray weathered shale
B-11	6.0 - 7.0	106	23	0.83	Gray sandy shale
B-12	5.0 - 5.5	-	20	-	Gray sandy shale
B-12	10.0 - 11.0	-	-	2.28	Gray sandy shale
B-13	10.0 - 11.0	114	18	2.19	Gray sandy shale
B-13	15.0 - 16.0	116	21	5.39	Gray sandy shale

MECHANICAL ANALYSIS CHART



GRAVEL		SAND			SILT or CLAY	
		Coarse	Medium	Fine		

Unified Soil Classification System - Corps of Engineers, U.S. Army

JOHNSON COUNTY
SANITARY LANDFILL
ALVARADO, TEXAS

MECHANIC ANALYSIS
B-9 0.01 - 1.5'
Reddish Brown Sand

JOHNSON COUNTY SANITARY LANDFILL, INC.

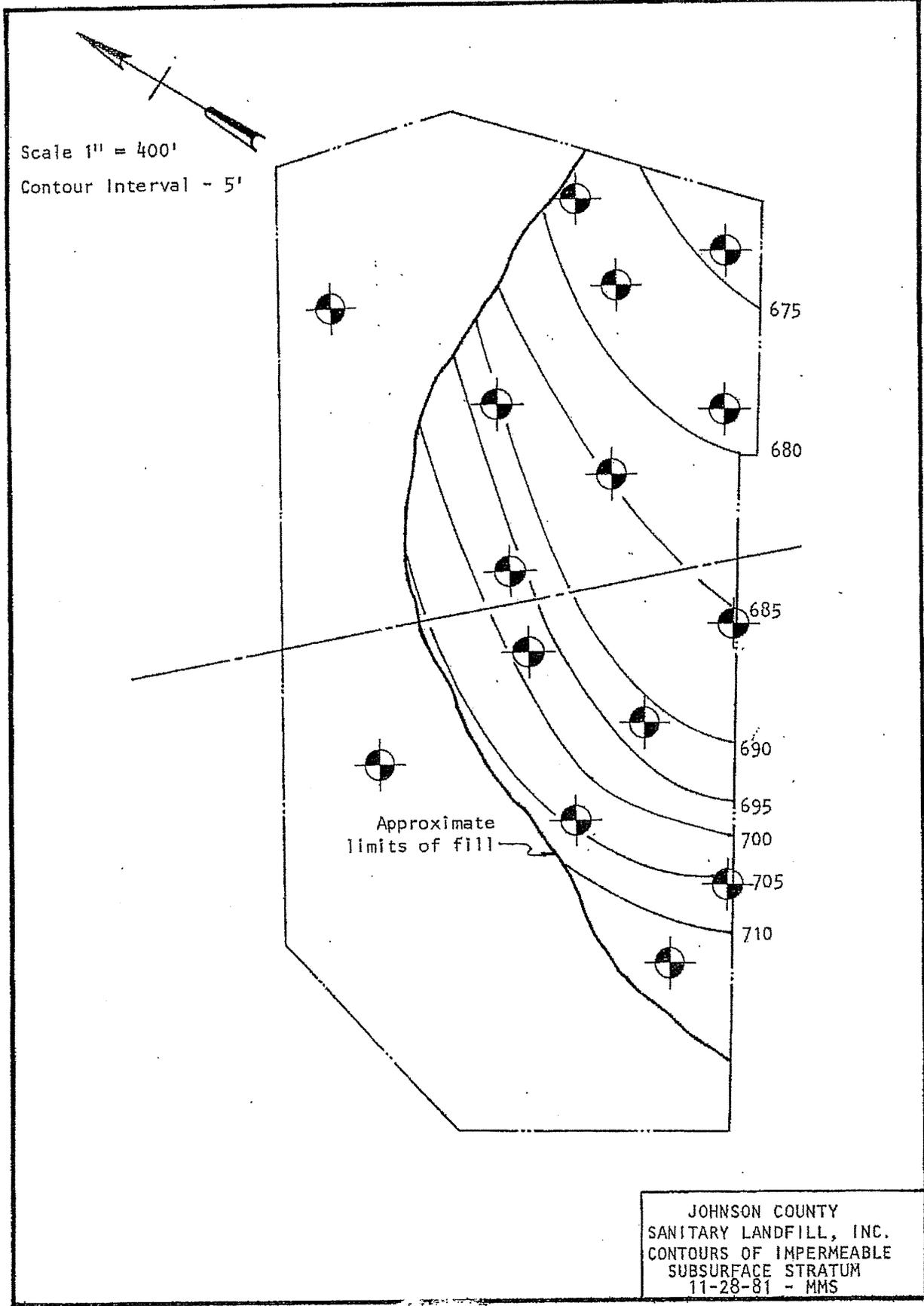
SUMMARY OF PERMEABILITY DETERMINATIONS

LABORATORY TEST RESULTS

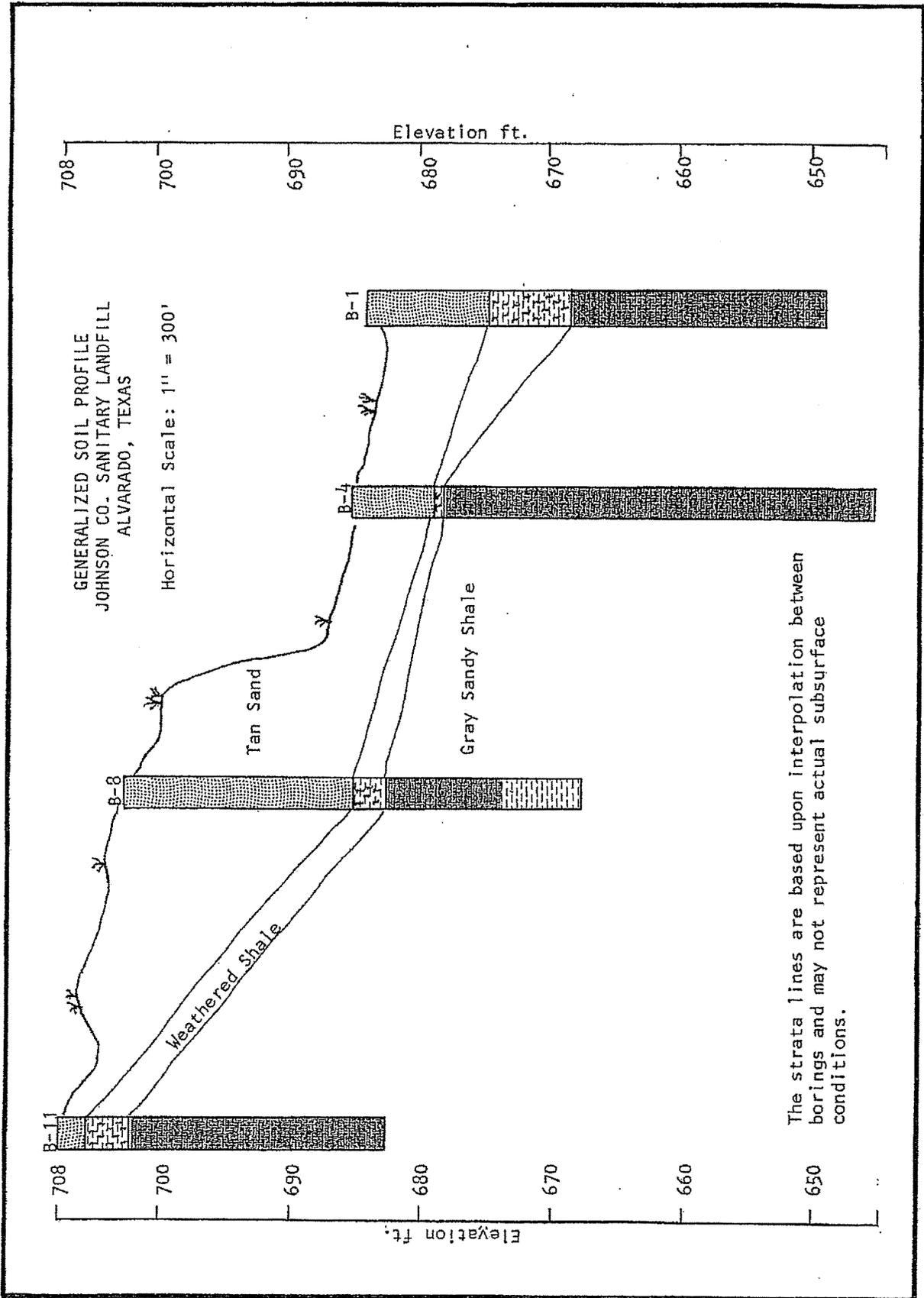
<u>Boring No.</u>	<u>Depth, ft.</u>	<u>"K" (cm/sec)</u>	<u>Description</u>
B-1	15.0 - 16.5	3.8×10^{-8} Horiz.	Gray shale - firm
B-2	4.5 - 5.5	2×10^{-7}	Gray shaly clay w/tan & gray layers
B-5	9.0 - 10.5	5.6×10^{-8} Vert.	Gray sandy shale - very sandy & fractured
B-5	9.0 - 10.5	5.9×10^{-6} Horiz.	Gray sandy shale - very sandy & fractured
B-8	20.0 - 21.0	7.3×10^{-7}	Gray sandy shale
B-9	5.0 - 5.75	4.5×10^{-9}	Gray weathered shale w/tan & gray sand seams
B-10	4.0 - 5.0	5.3×10^{-8}	Gray sandy shale
B-12	15.0 - 15.5	2×10^{-7}	Gray shale - jointed & fractured

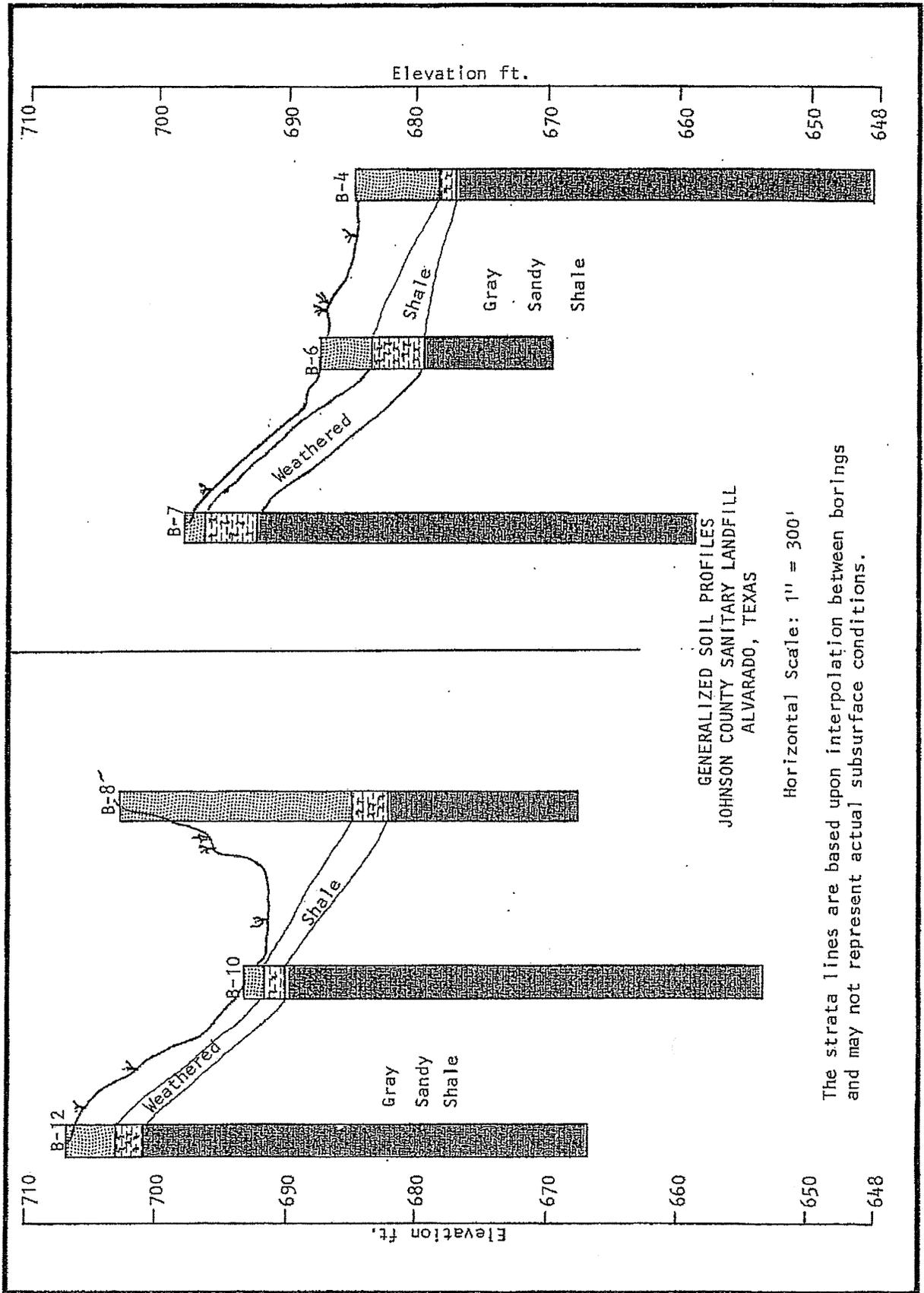
FIELD INFILTRATION RATES

<u>Boring No.</u>	<u>Interval tests (ft)</u>	<u>"k" cm/sec</u>
B-9	8 1/2 to 24	2×10^{-5}
B-10	5 to 15	2.5×10^{-6}
B-13	5 to 35	6.4×10^{-6}

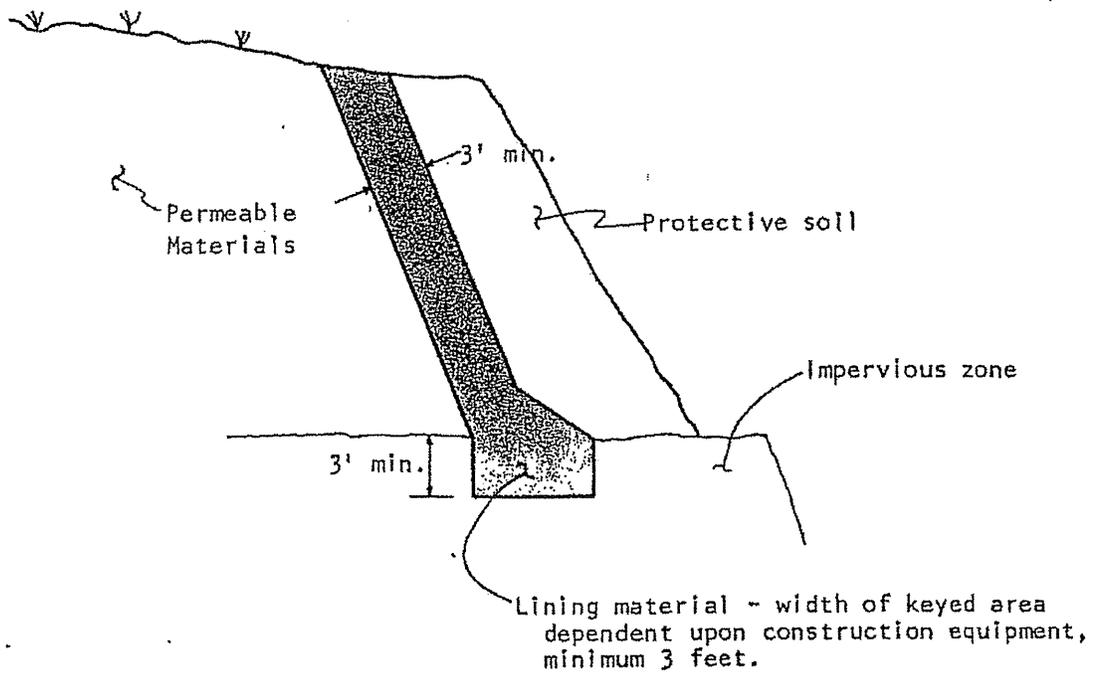


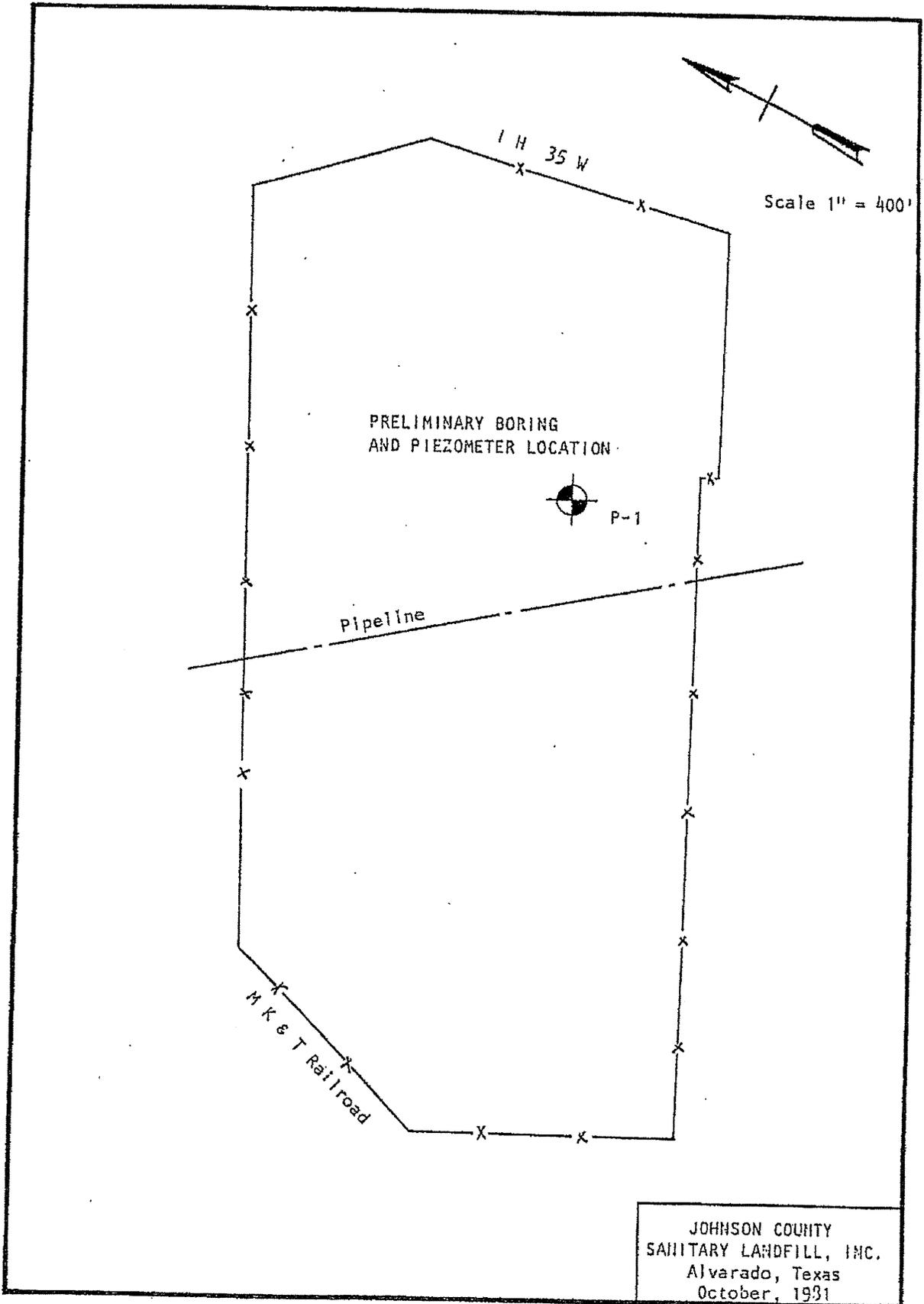
JOHNSON COUNTY
 SANITARY LANDFILL, INC.
 CONTOURS OF IMPERMEABLE
 SUBSURFACE STRATUM
 11-28-81 - MMS





TYPICAL SECTION FOR SIDEWALL LINER
JOHNSON COUNTY SANITARY LANDFILL
ALVARADO, TEXAS





JOHNSON COUNTY
SANITARY LANDFILL, INC.
Alvarado, Texas
October, 1981

PRELIMINARY WATER INFORMATION
JOHNSON COUNTY SANITARY LANDFILL, INC.

<u>Location</u>	<u>Ground Elevation</u>	<u>Bottom of Hole Elevation</u>
P-1	681.9	665.9 (bottom of piezometer)
Office	679.4	665.4

WATER SURFACE ELEVATION

<u>Date</u>	<u>Location</u>	
	<u>P-1</u>	<u>Office</u>
10-29-81	680.9	671.4
10-31-81	681.1	671.7
11-02-81	681.1	671.7

**ATTACHMENT 11C, GEOTECHNICAL STUDY,
SUPPLEMENT NO. 1, JOHNSON COUNTY
SANITARY LANDFILL, JOHNSON COUNTY, TEXAS,
BAKER-SHIFLETT, INC., JUNE 1986**

ATTACHMENT 11c

GEO TECHNICAL STUDY
SUPPLEMENT NO. 1
JOHNSON COUNTY SANITARY LANDFILL
JOHNSON COUNTY, TEXAS

* * *

Report To

JOHNSON COUNTY SANITARY LANDFILL
Alvarado, Texas

* * *

BY

BAKER-SHIFLETT, INC.
Consulting Geotechnical Engineers
Fort Worth, Texas

June, 1986

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1.0 INTRODUCTION

Johnson County Sanitary Landfill is a permitted Type I landfill located on the west side of Interstate Highway 35W, south of Alvarado, Texas. A geotechnical investigation was performed at the site and reported in Baker-Shiflett Report No. 81114, dated December 3, 1981 as a portion of the original permit application to Texas Department of Health. Since the permit approval, and operation of the site as a landfill, the site and permit have been transferred to the current owners. The current owners have therefore decided to change the Site Development Plan in order to make use of the entire 91-acre tract, rather than only 50 acres as planned in the original Site Development Plan.

The purpose of this supplementary information to the geotechnical study has been to explore subsurface conditions along the northern edge of the 91-acre tract and to provide geotechnical data necessary for development of this area.

2.0 ADDITIONAL GEOTECHNICAL TESTING

Fifteen core borings were drilled during the initial permitting process in 1981. During negotiations to change ownership, four additional borings, labeled S-1 through S-4, were drilled for additional subsurface information, these being drilled during June,

1984. Borings 16 through 21 were drilled in February and May, 1986 to obtain subsurface information within portions of the 91-acre tract not previously core drilled.

As described in the original report, the ground elevation is relatively high within the southern part of the tract, but decreases rapidly at a "bluff" area and slopes downward toward Turkey Creek to the north. It was this lower northern area where Borings 16 through 21 have been drilled. Additionally, temporary piezometers have been placed into Borings 16, 17 and 21 to enable groundwater measurements to continue. Boring 20 was backfilled with clay and bentonite upon completion. Borings 18 and 19 were not backfilled but have since caved and filled in.

The locations of all borings completed on this site are provided on Plate 1. The Logs of Borings S-1 through S-4 and B-16 through B-21 are shown on Plates 2 through 15.

Laboratory testing was performed on recovered soil samples in order to accurately classify the soils encountered. The results of these tests are provided on Plates 16 and 17.

3.0 GENERALIZED SOIL AND GROUNDWATER CONDITIONS

3.1 Stratigraphy

The site lies within the Woodbine Geologic Formation. The materials encountered in the additional borings are similar to the previous borings, with the exception of a sand layer or pocket near the

elevation of the creek, and layers or boulders of sandstone at lower elevations. The sand layer was observed near the following elevations in the borings:

<u>Boring</u>	<u>Elevation of Sand Layer</u>
16	653.3
17	658.5
18	653.5
19	659.5
20	655.5
21	647.0

The presence and relationship of the sand layer is also depicted on the attached Generalized Subsurface Profiles (Plates 18 through 23). As noted, the sand layer occurs in the vicinity of the creek, and lies at elevations which are lower than the southern part of the site. Original Borings 1, 2, 3, 4, 7, and 10 were drilled to sufficient depths to encounter this sand layer, if it were continuous at similar elevations across the 91 acres. However, the borings indicate the sand pocket or layer occurs only near the creek, and is therefore, probably an alluvial deposit.

3.2 Groundwater

The groundwater observations during drilling and the subsequent groundwater measurements indicate water does occur within the mentioned sand layer, and normally lies below Elevation 650. Due to the proximity of the creek, the perched water condition is most likely associated with the creek channel. A summary of the groundwater measurements made on the three existing temporary piezometers is provided on Plate 24.

Groundwater measurements will continue to be taken in the coming months.

4.0 RECOMMENDATIONS

4.1 Previous Site Operations

The initial geotechnical study documented a groundwater source which entered the site from the southwest and traveled down gradient along the shale surface. This is thoroughly discussed in the original report. Site operations have been successful to date in constructing the southern sidewall liner and keying the liner into the shale bottom. This sidewall liner, once in place, has prevented the groundwater seepage along the surface of the shale from entering the site, and has forced the moisture further downhill to the east. This liner construction and sequence should continue.

The liner construction, which is actually a mixing and recompaction of 3 feet of sandy shale, should also continue. Plate 17 depicts laboratory test results showing a proctor curve and permeability rate for a sample of the sandy shale remolded to 95 percent of Standard Proctor density, at optimum moisture content.

4.2 Additional Considerations

For the portion of the site which will be developed along the lower creek area, the bottom of the landfill excavation may encounter the sand layer. It will be necessary to line the sandy area, if uncovered, with no less than 3 feet of suitable clay soil or shale,

similar to the liner construction occurring during the previous site operation.

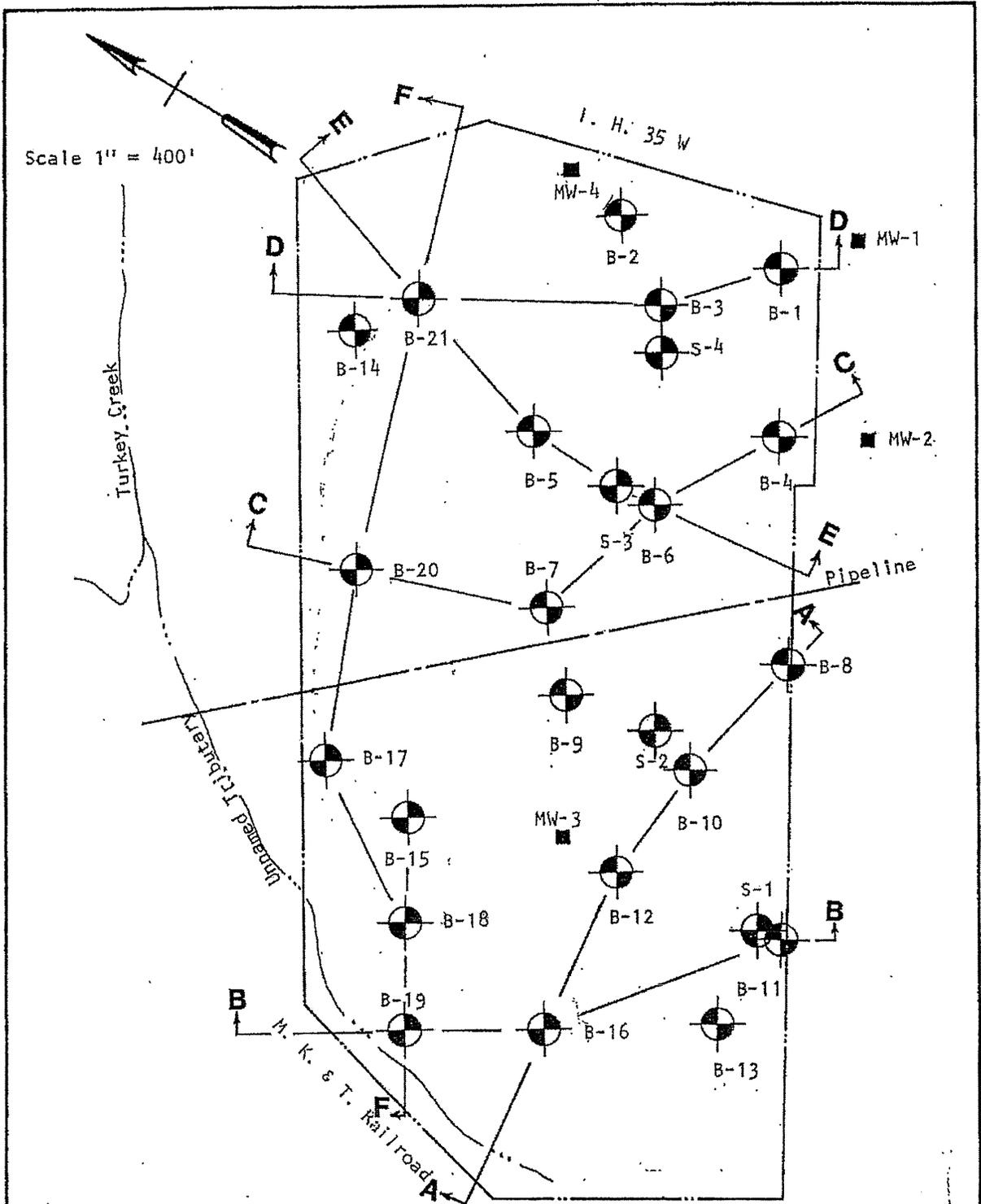
Additionally, sufficient depth of soil must be provided over the groundwater to offset hydrostatic pressures exerted on the liner. This amounts to one foot of soil for each two feet of hydrostatic pressure. It is understood that approximately elevation 652 may be used as the landfill bottom along the northern end of the site. Based upon the groundwater measurements made within the borings and piezometers, a landfill floor elevation of 652 will be above the groundwater. These groundwater measurements have been made during a wet climatic period, and should be indicative of wet-weather conditions. If groundwater is encountered during site excavation, it may be advantageous to elevate the floor of the landfill above the water, before the 3-foot liner is constructed.

5.0 SUMMARY

The previous sidewall and bottom liner procedure using the gray sandy shale has performed well in eliminating groundwater seepage across the shale surface and producing a dry landfill area. The mixed and compacted sandy shale results in a low permeability liner. This lining operation should continue into the additional acreage to the north. As the creek channel is approached, the sand layer may be uncovered. The sand, if exposed, should be lined with three feet of compacted sandy shale or other suitable clay similar to the current liner operation.

At the planned elevation of 652 of the landfill bottom near the creek channel, it is not anticipated that groundwater will be encountered. If, however, groundwater is uncovered, either the landfill bottom can be raised, or one foot of liner for each two feet of hydrostatic pressure provided.

* * *



Note:
 B-1 thru B-15 drilled for initial geotechnical study. See Attachment No. 11a for Logs of these fifteen (15) borings.

BAKER-SHIFLETT, INC.	
PLAN OF BORINGS JOHNSON COUNTY LANDFILL JOHNSON COUNTY, TEXAS	
Scale: 1"=400'	Date: June 1986

LOG OF BORING NO S-1
JOHNSON COUNTY LANDFILL
ALVARADO, TEXAS

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL 700±			
5					SHALE, gray, occasional sand seams, scattered siltstone seam			
10					-siltstone seam @ 9', 11', 20' and 24'	5.0'	5.0'	
15						9.0'	2.0'	
20						4.0'	4.0'	
25								675.0'
30					SAND AND SHALE, gray, shaly sand, w/shale seams & layers, some cemented sand layers	10.0'	2.0'	
35						7.5'	2.0'	
40								
45						8.5'	6.5'	
								650.0'
COMPLETION DEPTH:				50'	DATE: 6-13-84			

LOG OF BORING NO S-2-1
 JOHNSON COUNTY LANDFILL
 ALVARADO, TEXAS

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT.
						DRILLED	RECOVERED	
					SURFACE EL. 697±			696.5
					SAND, brown, fine			693.5
5					SAND, brown to tan, cemented			692.5
					WEATHERED SHALE, tan & gray			
10					SHALE, gray			
					-sandy shale below 8'			
15								
					-siltstone seam @ 16½', 18', 20', 27½', & 30'			
20								
25								
30								
35								660.0
40					SHALE, dark gray			
45						10.0'	10.0'	
					SANDSTONE, gray & tan, fossiliferous			648.0
COMPLETION DEPTH:				Cont'd		DATE:		6-13-84

LOG OF BORING NO S-2-2
 JOHNSON COUNTY LANDFILL
 ALVARADO, TEXAS

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL. 697±			
55					SHALE, gray, sandy w/siltstone seams	10'0"	10.0'	642.0'
60					SAND AND SHALE, gray, shaly sand w/shale seams & layers, siltstone seams			
65					-cemented sand seam @ 64', 64½', & 69'	10.0'	10.0'	
70								627.0'
75								
80								
85								
90								
95								
COMPLETION DEPTH:				70'	DATE: 6-13-84			

LOG OF BORING NO S-3-1
 JOHNSON COUNTY LANDFILL
 ALVARADO, TEXAS

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL. 690±			689.5
					SAND, brown, fine			686.5
5					SAND, brown to tan, cemented			683.0
					WEATHERED SHALE, tan & gray sand seams			
10					SHALE, gray, sandy			
15					-less sand 16½' - 19'			
20					-hard siltstone layer @ 21 - 21½'			
25					-siltstone @ 23½', 24½', 29' & 30½'			
30								658.0
					SHALE, dark gray, scattered sand seam			
35								651.0
40					SHALE, gray, sandy seams & layers -siltstone seams @ 41', 42', & 46'			
45						10.0'	10.0'	
					SAND & SHALE, gray, shaly sand w/shale seams & layers; some cemented sand zones,			641.0
COMPLETION DEPTH:					Cont'd	DATE: 6-13-84		

LOG OF BORING NO S-3-2
 JOHNSON COUNTY LANDFILL
 ALVARADO, TEXAS

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL. 690±			
55					-laminated below 55'	10.0'	9.5'	
60								
65					-sandstone layer @ 63'	10.0'	9.0'	
70					-siltstone seam @ 69'			620.0'
75								
80								
85								
90								
95								
COMPLETION DEPTH:				70'				
						DATE: 6-13-84		

LOG OF BORING NO S-4-1
JOHNSON COUNTY LANDFILL
ALVARADO, TEXAS

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL 681+			
					SAND, brown, fine			677.5
5					WEATHERED SHALE, tan & gray, sandy			674.0
10					SHALE, gray, sandy			
15								
20					-siltstone seam @ 17' & 25'			
25					-lighter gray color 26½' to 38'			
30								
35					-siltstone @ 34'			
40					-soft sandstone layers @ 42', 42½', 43½', 45', 46', 48', 49½', 51½' & 56'	10.0'	10.0'	
45					-lighter gray 45' - 50'			
								631.0

COMPLETION DEPTH:

Cont'd

DATE: 6-13-84

LOG OF BORING NO S-4-2
 JOHNSON COUNTY LANDFILL
 ALVARADO, TEXAS

TYPE: Core

LOCATION: See Plan of Borings

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL 681±			
55					SANDSTONE, light gray, shale seams	10.0'	10.0'	624.5
60					SHALE, gray, sandy			
65					-siltstone seams 64' & 66'	10.0'	9.0'	
70								611.0
75								
80								
85								
90								
95								
COMPLETION DEPTH:				70'	DATE: 6-13-84			

LOG OF BORING NO 8-16
 JOHNSON COUNTY LANDFILL
 JOHNSON COUNTY, TEXAS

TYPE: Core

LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL. 672±			
5			2.0 4.5 4.5 4.5+		CLAY, tan, brown & gray to tan & gray, stiff to hard, shaly, w/ironstone gravel, sandy seams & sand partings (CH)			666.4
10			4.5+ 4.5+ 4.5+ 4.5+	50 2 ¹¹	CLAY, shaly, gray, very stiff to hard, fissured, w/gypsum, ironstone gravel, & sand partings (CH) SANDSTONE, tan, w/broken ironstone, poorly cemented			663.0 661.5
15			4.0		CLAY, shaly, gray, very stiff, w/tan & gray sand laminations (CH-CL)			653.3
20				50 3 ¹¹	SAND, tan, very dense, fine grained, poorly graded, w/clay seams			
25				50 4 ¹¹				
30				50 2 ¹¹	(SP) SHALE, dark gray, w/thin tan & gray sand & sandstone laminations, w/occasional lignitic seams & limestone stringers	5.0	4.5	643.0
35								
40						10.0	9.2	
45					SANDSTONE, poorly cemented, tannish gray, w/thin shale laminations			627.5
					NOTE: Upon completion, piezometer set. See text for readings.	5.0	4.5	622.0
COMPLETION DEPTH: 50'				DATE: 2-24-86				

LOG OF BORING NO B-17
 JOHNSON COUNTY LANDFILL
 JOHNSON COUNTY, TEXAS

TYPE: Core

LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL. 665±			
			4.5+	38	SANDY CLAY, tan, very stiff to hard, w/iron ore nodules (CL)			664.0
			4.5+		SAND, tan, dense, w/clay seams (SC-CL)			659.5
5				44	CLAY, gray, hard, w/sand seams & iron stains (CH)			658.5
				50 5 1/2"	SAND, tan, very dense, w/clay & sandstone seams			
10				50 5 1/2"				
				50 5 1/2"				
15				50 5 1/2"				
				50 2 1/2"				
20				50 5 1/2"	- gravelly seam below 23 1/2' (SP)			640.8
25				50 5 1/2"	SHALE, sandy, gray	5.0'	5.0'	636.5
30					SHALE, sandy, gray, w/thin tan & gray sand & sandstone laminations			
35						10.0'	10.0'	
40								
45					NOTE: Upon completion, piezometer set. See text for readings.	10.0'	10.0'	
								615.0

COMPLETION DEPTH: 50'

DATE: 2-25-86

LOG OF BORING NO B-18
 JOHNSON COUNTY LANDFILL
 JOHNSON COUNTY, TEXAS

Page 1 of 2

TYPE: Core

LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL. 666±			
3.0					SANDY CLAY, tan to reddish tan, tan, & gray, stiff to hard, w/iron ore nodules (CL)			661.5
4.0								
4.5+					CLAYEY SAND, tan, medium dense to very dense, w/gray clay seams & iron ore nodules (SC)			657.0
4.5+								
5				35	SANDY CLAY, reddish tan & tan, very stiff to hard, w/iron ore nodules (CL)			653.5
10			4.5					
15				11	CLAYEY SAND, tannish brown, medium dense, w/clay seams & scattered gravel, wet (SC)			647.3
20				25	CLAY, w/sand, tan & gray, stiff, w/iron ore nodules (CL)			646.0
25			4.5		SHALE AND SAND, gray, interbedded laminations			642.0
25			4.0		SHALE, gray, w/thin tan sand & sandstone laminations			638.5
30					SANDSTONE, tan, w/thin gray shale laminations	5.0	4.0	632.0
35					SHALE, sandy, gray, w/thin tan & gray sand & sandstone laminations	10.0	10.0	
40								
45						10.0	9.5	

- continued on next page -

LOG OF BORING NO B-18
 JOHNSON COUNTY LANDFILL
 JOHNSON COUNTY, TEXAS

Page 2 of 2

TYPE: Core

LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT	
						DRILLED	RECOVERED		
					SURFACE EL.				
					SHALE, sandy, gray, w/ thin tan & gray sand & sandstone laminations			614.0	
55					SANDSTONE, gray, w/ thin gray shale laminations	10.0	9.0	608.0	
60					SAND, gray, medium grained, poorly graded (SP)			606.0	
65					NOTE: Water encountered @ 16 1/2' (El. 650) during the drilling process.				
70									
75									
80									
85									
90									
95									

COMPLETION DEPTH: 60'

DATE: 2-25-86

LOG OF BORING NO B-19
JOHNSON COUNTY LANDFILL
JOHNSON COUNTY, TEXAS

TYPE: Core

LOCATION:

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL. 669±			
				5	CLAYEY SILT, brown, firm			668.0
			4.5+		CLAY, reddish tan, tan, & gray, very stiff to hard, w/iron ore nodules			
			4.5+		(CH)			664.4
5			4.5		CLAY AND SAND, tan & gray, interbedded laminations			
			4.0		(CL-SC)			659.5
10			2.5	60	SAND, tan, very dense, fine grained, poorly graded, w/clay seams			
				50	(SP)			652.0
15				5"	SANDSTONE, tan, sand seams			649.5
20					SHALE, sandy, gray, w/thin tan & gray sand & sandstone laminations	5.0'	3.8'	
25						5.0'	5.0'	
30					NOTE: Sampled dry to 11', and water not encountered. Water used during coring of shale; bailed to 31' upon completion. After 1 hour, water @ 19' (El. 650).			
35						10.0'	8.0'	
40					SAND, tan, w/thin gray shale laminations			629.0
45					(SP-SC)	10.0'	10.0'	623.5
					SHALE, sandy, gray, w/thin tan & gray sand & sandstone laminations.			619.0

COMPLETION DEPTH: 50'

DATE: 2-26-86

LOG OF BORING NO B-20
JOHNSON COUNTY LANDFILL
JOHNSON COUNTY, TEXAS

TYPE: Core

LOCATION: See Plate I

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL 667±			
			4.5+		SANDY CLAY, brown, hard, w/gray clay seams & tan sand pockets & seams & iron stains (SW)			665.5
			4.5+		SAND, reddish brown, dense, w/iron stains & gray clay seams (SW-SC)			662.5
5			4.5+		SANDY CLAY, gray, hard, w/reddish-brown iron stains & nodules, w/sand pockets (CL)			659.5
			4.5		CLAY, olive-brown & gray, hard, w/iron stains, calcareous nodules & crystal seams (CH)			656.5
10			4.5+		CLAY, gray, hard, w/yellow & brown sand seams (CH)			655.5
					SAND, light tan & yellow & brown, dense, w/gray clay seams			
15								
20								
25								
					(SW-SC)			638.0
30					SHALE, gray, moderately hard, w/silty sand seams & occasional fossils	5.0'	4.8'	
35								
40					SHALE, gray, hard	10.0'	10.0'	627.0
					SANDSTONE, light gray, hard, w/gray shale & sand seams & calcareous seams			623.0
45								
					NOTE: Water not encountered during continuous sampling above the 14-foot depth. Upon completion, bailed to 33', open to 48'. After 5 hours, water at 26', open to 47'.	5.0'	5.0'	617.0
COMPLETION DEPTH: 50'					DATE: 5/13/86			

LOG OF BORING NO B-21
JOHNSON COUNTY LANDFILL
JOHNSON COUNTY, TEXAS

TYPE: Core

LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	HAND PEN. TSF	BLOWS PER FT	MATERIAL DESCRIPTION	CORE		ELEVATION, FT
						DRILLED	RECOVERED	
					SURFACE EL. 669±			
			4.5		SAND, brown, dense, w/clay seams & iron stains (SP)			667.5
			2.5		SANDY CLAY, gray to grayish tan, stiff, w/tan sand seams, iron stains, gypsum seams (CL)			665.0
5			2.5		CLAY, gray & brown, stiff to hard, w/reddish iron stains, tan & brown sand seams, calcareous deposits			
			4.0					
			2.5					
			4.5+					
10			4.5		(CH)			657.0
			4.5+		CLAY, dark gray, stiff, w/yellow & brown sand seams (CH)			653.0
15					SHALE, dark gray, weathered, w/tan sandstone seams			651.0
					SHALE, light gray, severely weathered, w/sand pockets & seams			647.0
20					SILTY SAND, light gray, interbedded w/calcareous nodules & fragments			645.0
					SAND, light gray, dense, lightly cemented	10.0'	3.5'	640.0
25					SHALE, gray, hard, w/silty sand seams & iron stains			
30								
35								
						10.0'	6.0'	
40					SHALE, gray, sandy, hard, w/fossils			
45								
						10.0'	9.4'	622.0
					NOTE: Upon completion, piezometer set. See text for readings.			619.0

COMPLETION DEPTH: 50'

DATE: 5/13/86

SUMMARY OF LABORATORY TESTS

Johnson County Landfill
 Johnson County, Texas
 Report No. 861681

<u>Boring No.</u>	<u>Sample Depth, ft.</u>	<u>Liquid Limit</u>	<u>Plastic Limit</u>	<u>Plasticity Index</u>	<u>Minus 200</u>
B-16	1.5 - 3.0	55	22	33	93
B-16	6.0 - 7.0	57	23	34	98
B-16	13.5 - 15.0	45	18	27	84
B-16	37.4 - 38.0	47	21	26	97
B-17	1.5 - 3.0	29	13	16	68
B-17	5.0 - 6.5	-	-	-	97
B-17	25.2 - 26.2	26	13	13	63
B-18	3.0 - 4.5	34	13	21	58
B-18	7.0 - 8.5	-	-	-	53
B-18	13.5 - 15.0	-	-	-	27
B-18	20.0 - 21.5	35	17	18	82
B-18	37.3 - 38.0	45	19	26	99
B-19	3.5 - 5.0	58	20	38	89
B-19	8.0 - 9.5	-	-	-	92
B-19	26.3 - 26.8	38	18	20	99
B-20	1.5 - 3.0	20	17	3	42
B-20	7.5 - 9.0	52	21	31	88
B-20	12.5 - 14.0	-	-	-	32
B-20	18.5 - 19.5	-	-	-	52
B-20	30.0 - 31.0	45	19	26	98
B-21	4.5 - 6.0	56	21	35	94
B-21	7.5 - 9.0	58	22	36	-
B-21	13.5 - 15.0	52	20	32	-
B-21	47.0 - 47.5	33	14	19	-

MOISTURE-DENSITY RELATIONSHIP

PROJECT: Johnson County Sanitary LF

REPORT DATE: June 1986

LOCATION: Johnson County, Texas

REPORT NO: 861681

TEST METHOD: ASTM D 698

LIQUID LIMIT: 42

RAMMER TYPE: 5.5 lb.

PLASTIC LIMIT: 17

SAMPLE DATE: April 19, 1986

PLASTICITY INDEX: 25

SAMPLE PREPARATION: Air dried

(-) 200 MESH SIEVE: 64%

SAMPLED BY: RH

CLASSIFICATION: CL

SAMPLE LOCATION: Combination of materials
between Borings 12 & 16

DESCRIPTION: Sandy shale, gray, w/gypsum

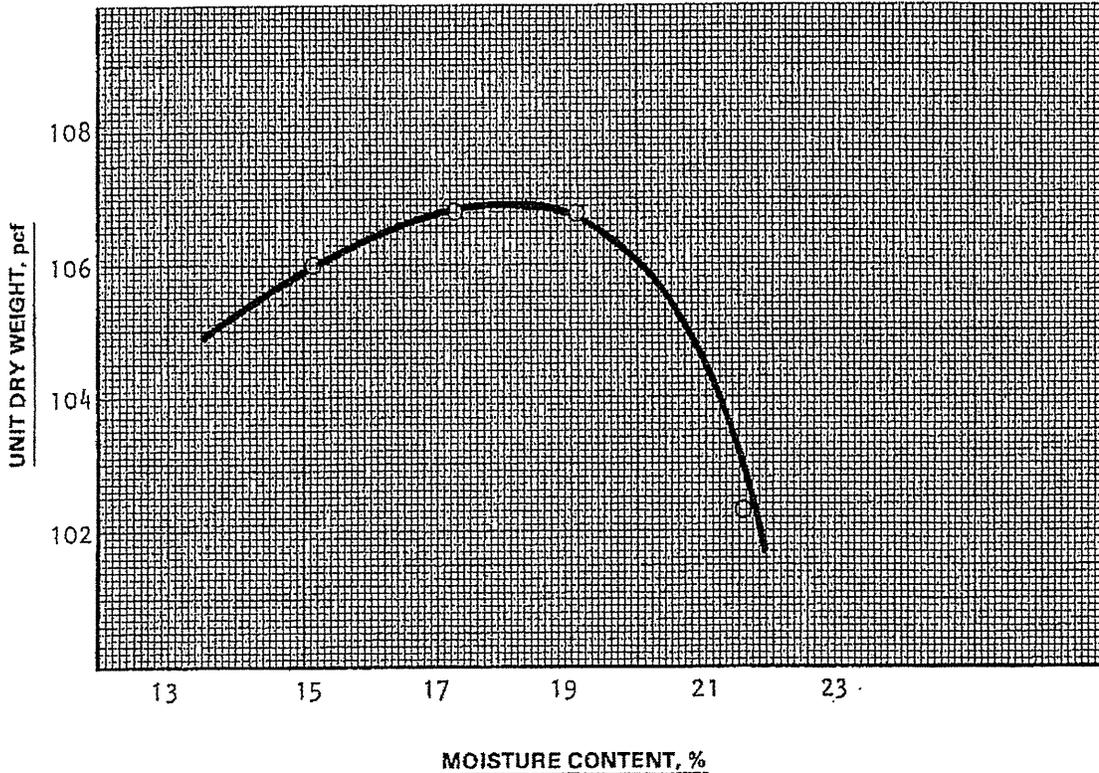
$K = 6.5 \times 10^{-9}$ cm/sec

remold: 95% MDD at OM

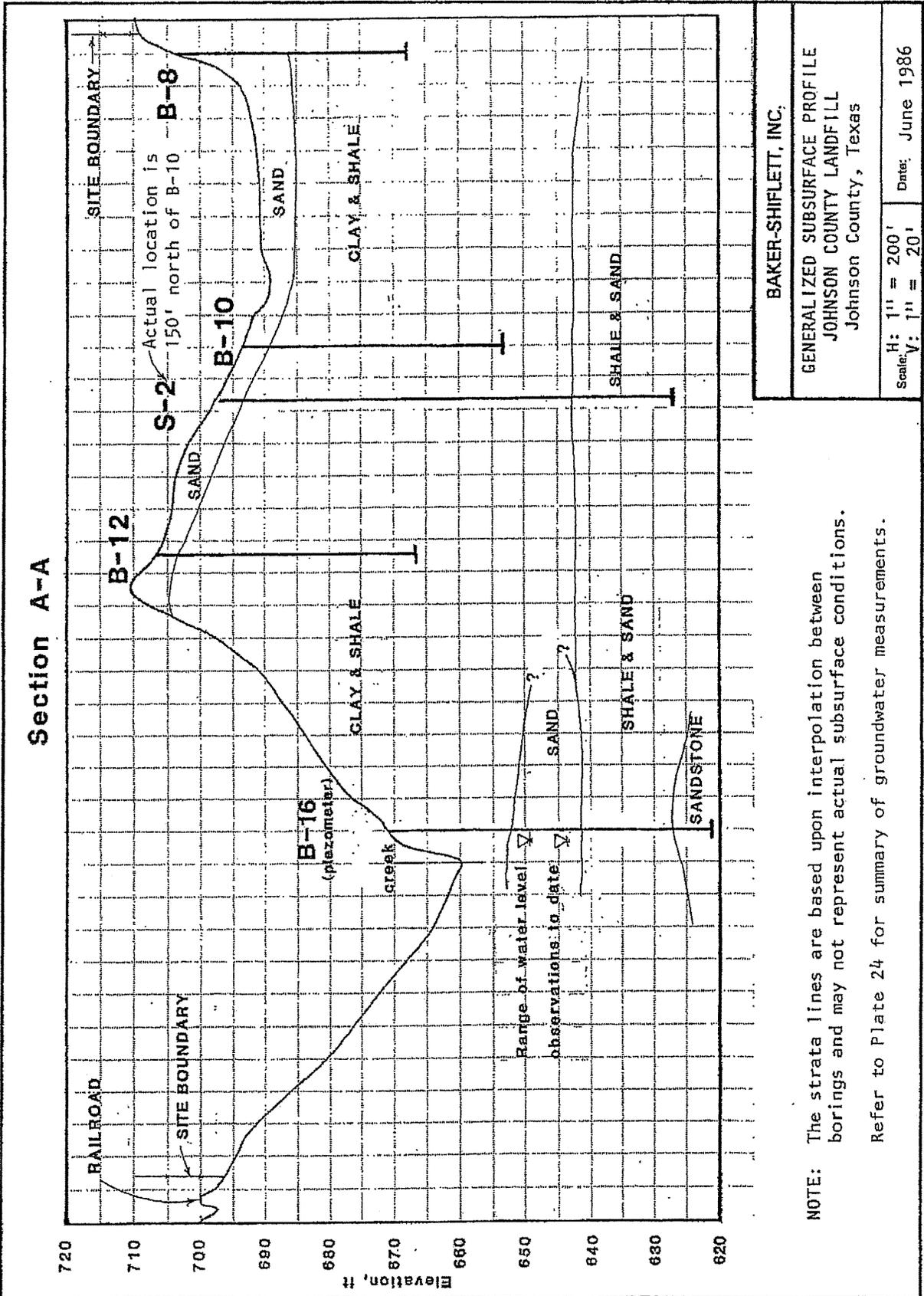
PROCTOR CURVE

MAXIMUM DRY DENSITY: 106.9

OPTIMUM MOISTURE CONTENT, %: 18.2



OUR LETTERS AND REPORTS ARE FOR THE EXCLUSIVE USE OF THE CLIENT TO WHOM THEY ARE ADDRESSED, AND APPLY ONLY TO THE SAMPLES TESTED.
TEST RESULTS ARE NOT NECESSARILY INDICATIVE OF THE QUALITY OF APPARENTLY IDENTICAL OR SIMILAR SAMPLES.



BAKER-SHIFLETT, INC.

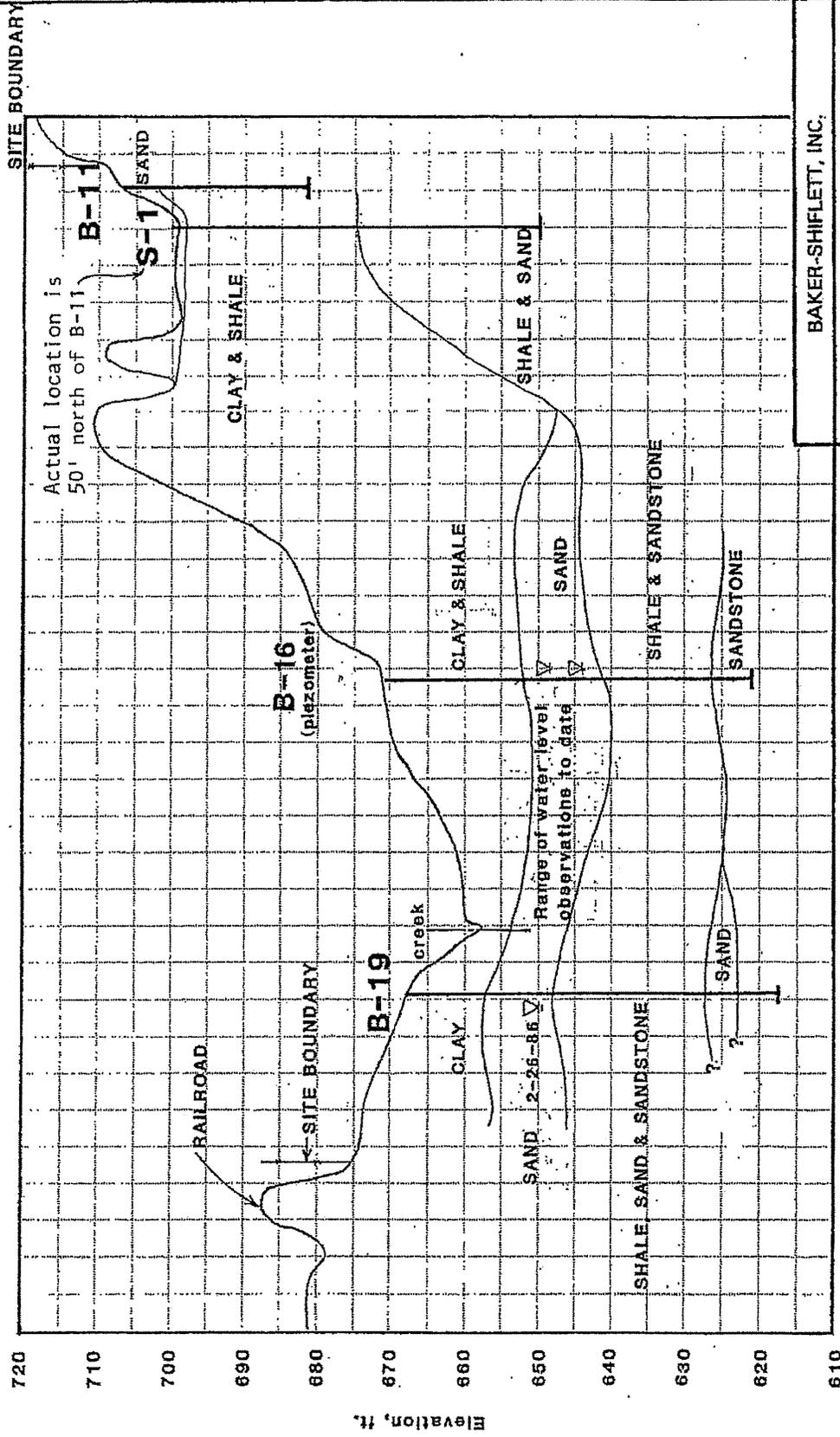
GENERALIZED SUBSURFACE PROFILE
JOHNSON COUNTY LANDFILL
Johnson County, Texas

H: 1" = 200'
Scale: V: 1" = 20'

Date: June 1986

NOTE: The strata lines are based upon interpolation between borings and may not represent actual subsurface conditions. Refer to Plate 24 for summary of groundwater measurements.

Section B-B



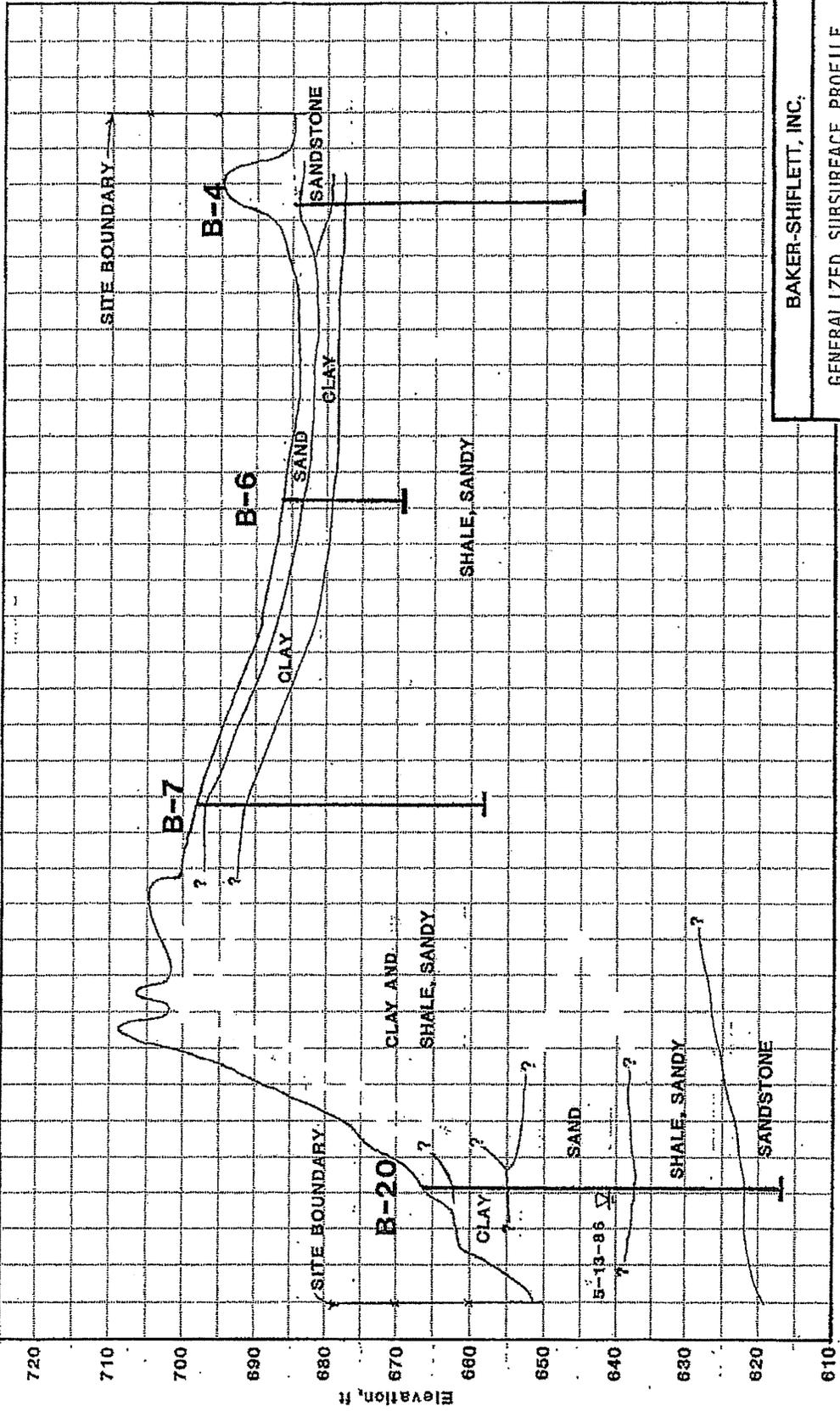
BAKER-SHIFLETT, INC.

GENERALIZED SUBSURFACE PROFILE
JOHNSON COUNTY LANDFILL
Johnson County, Texas

H: 1" = 200'
Scale: V: 1" = 20' Date: June 1986

NOTE: The strata lines are based upon interpolation between borings and may not represent actual subsurface conditions. Refer to Plate 24 for summary of groundwater measurements.

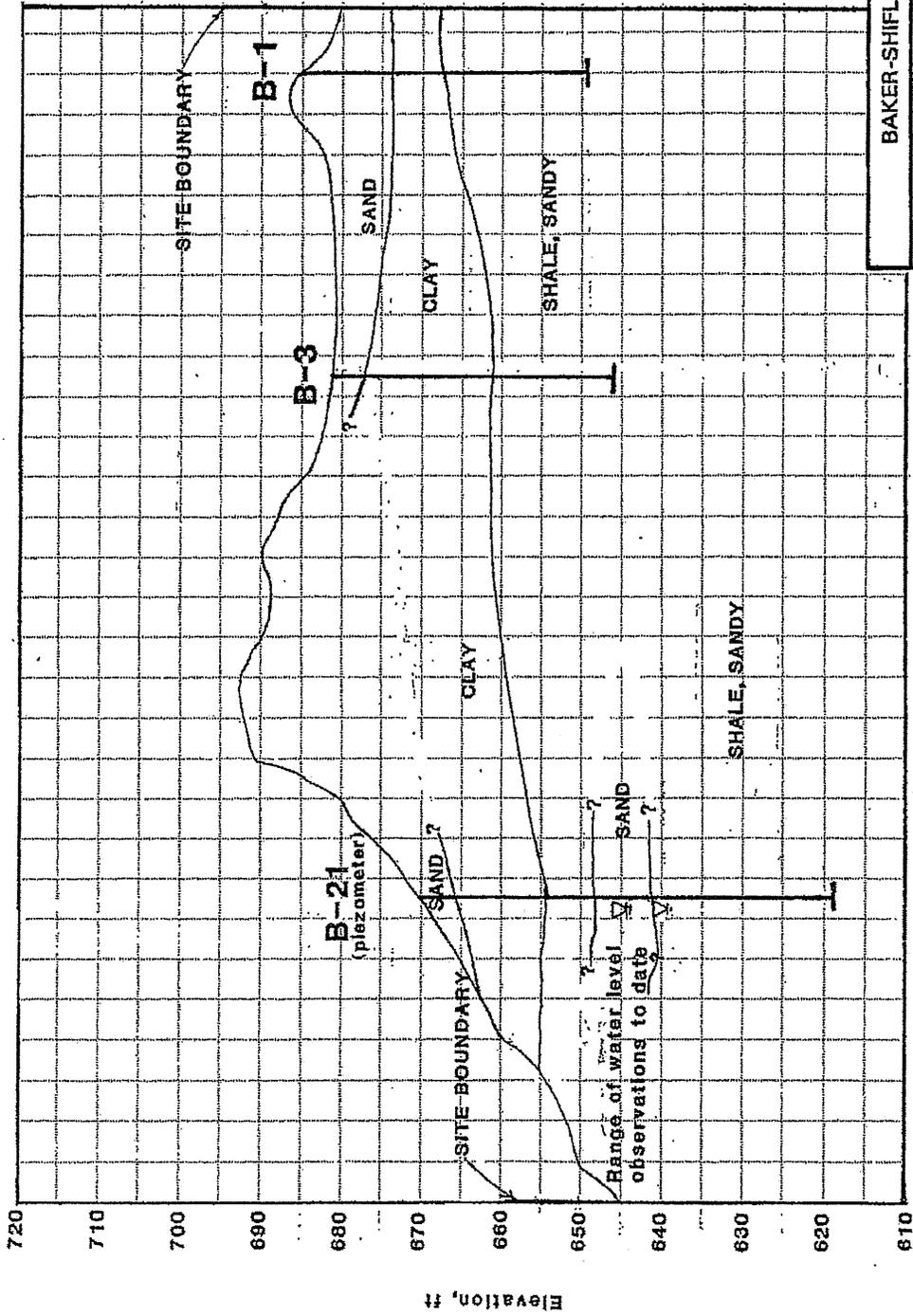
Section C-C



NOTE: The strata lines are based upon interpolation between borings and may not represent actual subsurface conditions.

BAKER-SHIFLETT, INC.
 GENERALIZED SUBSURFACE PROFILE
 JOHNSON COUNTY LANDFILL
 Johnson County, Texas
 H: 1" = 200'
 Scale: V: 1" = 20' Date: June 1986

Section D-D



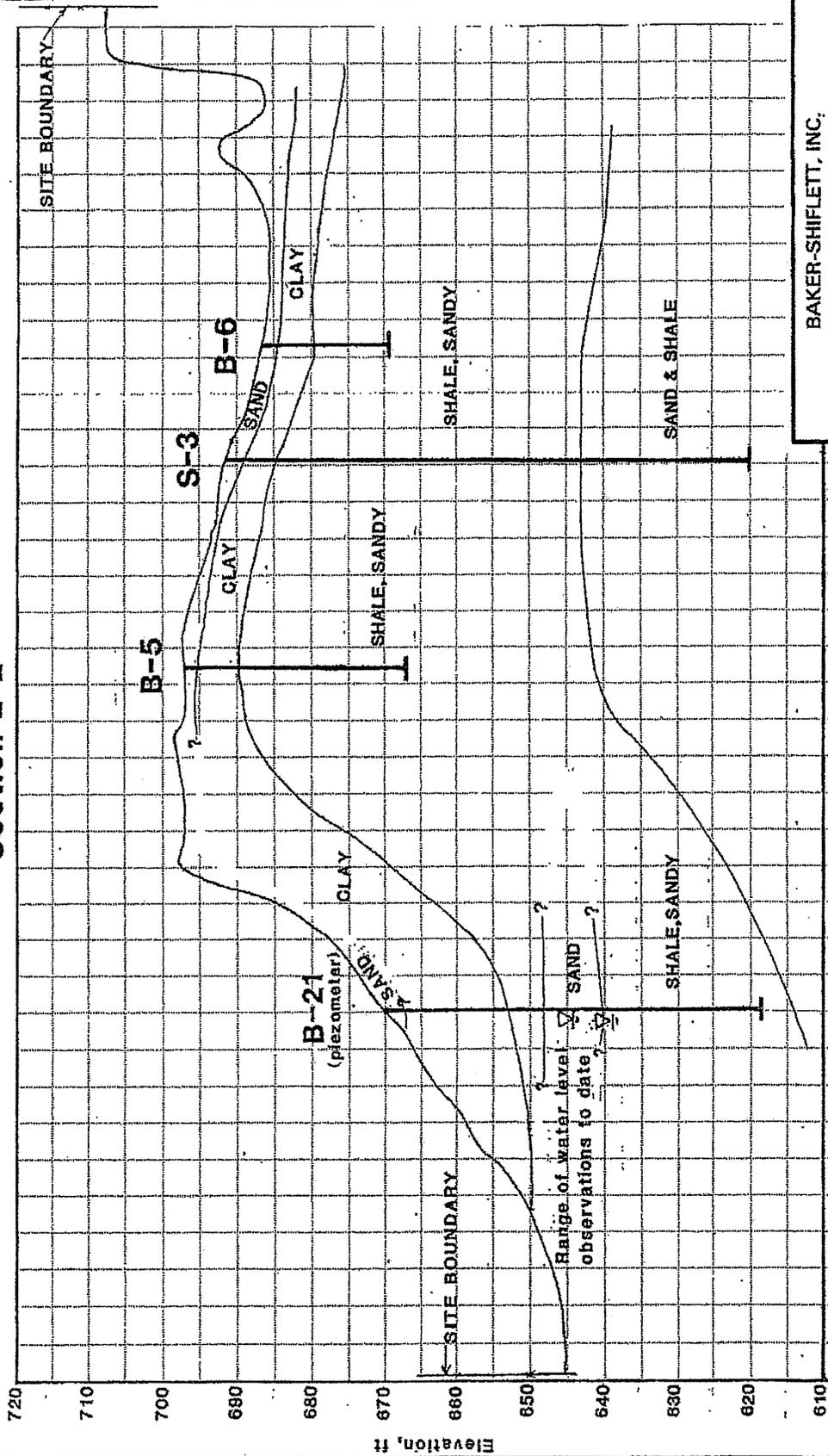
BAKER-SHIFLETT, INC.

GENERALIZED SUBSURFACE PROFILE
 JOHNSON COUNTY LANDFILL
 Johnson County, Texas

Scale: H: 1" = 20'
 V: 1" = 20' Date: June 1986

NOTE: The strata lines are based upon interpolation between borings and may not represent actual subsurface conditions. Refer to Plate 24 for summary of groundwater measurements.

Section E-E



BAKER-SHIFLETT, INC.

GENERALIZED SUBSURFACE PROFILE
 JOHNSON COUNTY LANDFILL
 Johnson County, Texas

H: 1" = 200'
 Scale: V: 1" = 20' Date: June 1986

NOTE: The strata lines are based upon interpolation between borings and may not represent actual subsurface conditions. Refer to Plate 24 for summary of groundwater measurements.

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417D**

MAJOR PERMIT AMENDMENT APPLICATION

**PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIIN
SITE LIFE CALCULATIONS**

Prepared for
Texas Regional Landfill Company, LP
February 2022



Prepared by:

Weaver Consultants Group, LLC
TPBE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, TX 76109
817-735-9770

WCG Project No. 0771-368-11-123

This document is intended for permitting purposes only.

CONTENTS

1	SITE LIFE	IIIN-1
1.1	Solid Waste Generation	IIIN-1
1.2	Population Equivalent	IIIN-2
1.3	Landfill Capacity	IIIN-2
1.4	Site Life Calculations	IIIN-2



1 SITE LIFE

1.1 Solid Waste Generation

The following estimate has been developed to provide an assessment of the solid waste generation rate for the Turkey Creek Landfill. It is important to note that the estimates included in both sections are based on numerous assumptions and may vary as market conditions change.

Over the last few years the waste inflow rate at Turkey Creek Landfill has varied from 1,694 tons per day to 2,366 tons per day as listed below.

Fiscal Year	Actual Waste Inflow ¹	Typical Daily Waste Inflow Rate Based on a 286-Day Operating Schedule
2014	484,321 tons per year	1,694 tons per day
2015	528,945 tons per year	1,850 tons per day
2016	537,956 tons per year	1,881 tons per day
2017	601,693 tons per year	2,104 tons per day
2018	557,783 tons per year	1,950 tons per day
2019	589,717 tons per year	2,062 tons per day
2020	663,541 tons per year	2,320 tons per day
2021	676,662 tons per year	2,366 tons per day

¹ Information obtained from the TCEQ MSW Annual Reports filed by the Turkey Creek Landfill.

Turkey Creek Landfill estimates that the waste inflow will increase to 1,000,000 tons per year (3,497 tons per day based on a 286-day operating schedule) in 2022. This increase is due to the proposed closure of the Weatherford Landfill and accepting additional waste from Dallas. After 2022, the waste inflow rate is assumed to increase consistent with the projected growth rate for the facility's general service area which for this analysis is assumed to be Dallas, Johnson, Kaufman, Denton, Tarrant, Ellis, Hill, Wise, Erath, Hood, Palo Pinto and Parker counties, through 2035.

Using this methodology, the expected maximum annual waste acceptance rate is 1,221,321 tons per year (4,270 tons per day based on a 286-day operating schedule). The above projections are based on current market conditions and may vary as market conditions change. Over the life of the facility, the expected average daily

volume of incoming waste is projected to be approximately 3,877 tons per day (1,108,822 tons per year based on a 286-day operating schedule).

Site life calculations based on the Turkey Creek Landfill projections are shown on pages IIN-3 and IIN-4.

1.2 Population Equivalent

Using the average waste inflow rate of 1,108,822 tons per year discussed in Section 1.1 (an average daily volume of 3,877 tons per day based on a 286-day operating schedule) and assuming 5 pounds of waste is generated per capita per day, the population equivalent is:

$$\frac{(1,108,822 \text{ tons per year}) \times (2,000 \text{ pounds/ton})}{(5 \text{ pounds/person/day}) \times (365 \text{ days/year})} = 1,215,147 \text{ persons}$$

1.3 Landfill Capacity

The estimated total capacity of waste (defined as waste and daily cover) ever on site over the active life of the facility is approximately 37.7 million cubic yards. The total volume available for solid waste and daily cover after January 8, 2021 (date of topographic information) is estimated to be 20,950,000 cubic yards. This airspace estimate includes the remaining available volume in the existing permitted area. The current volume of waste (defined as waste and daily cover) in-place as of January 8, 2021, is approximately 16.75 million cubic yards.

1.4 Site Life Calculations

The site life calculations are presented on pages IIN-3 and IIN-4. In summary, the site life is projected to be approximately 12.9 years, which would result in the site's closure during the year 2033.

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIN
SITE LIFE CALCULATIONS

Required: Determine approximate site life (years) for the site based on Turkey Creek Landfill's waste inflow projections. The site will typically operate 286 days per year. The waste inflow rate is expected to increase by an additional 170 tons/day in 2022 due to the closure of Weatherford Landfill in December 2021 and additional waste from Dallas.

Solution: Determine available landfill tonnage and initial annual waste inflow rate:

Remaining airspace (includes existing permitted site and expansion) ¹ =	20,950,000	cy	(as of January 8, 2021)
Percent daily cover =	15	%	
In-place density of waste/cover soils ² =	1,728	lb/cy	

¹ This remaining volume includes the capacity in the Class 1 waste area. Volume calculations were performed using the currently permitted/proposed bottom of waste (developed by WCG) and the proposed top of waste.

² The in-place density of waste was developed as an average density calculated in three previous years of internal budgeting documents. These budgeting documents compare year-over-year topography with the tonnage placed in the active area to determine density of waste placed.

Estimate the total remaining airspace (tons).

-Estimate density of waste only

$$(\gamma_{\text{soil}})(15\% \text{ of } 20,950,000 \text{ cy}) + (\gamma_{\text{waste}})(85\% \text{ of } 20,950,000 \text{ cy}) = (\gamma_{\text{soil/waste}})(20,950,000 \text{ cy})$$

$$(2,430 \text{ lb/cy})(3,142,500 \text{ cy}) + (\gamma_{\text{waste}})(17,807,500 \text{ cy}) = (1,728 \text{ lb/cy})(20,950,000 \text{ cy})$$

$$\gamma_{\text{waste}} = 1,604 \text{ lb/cy}$$

$$\text{Remaining available airspace} = (85\% \text{ of } 20,950,000 \text{ cy}) * (1,604 \text{ lb/cy} * 1/2000 \text{ tons/lb})$$

$$\text{Remaining available airspace} = 14,282,663 \text{ tons}$$

Total remaining capacity (includes existing permitted site and expansion) = 14,282,663 tons

Initial waste stream estimate =	3,143 tons/day
Days of operation per year =	286 days

Initial waste inflow rate = 899,000 tons/year

Assumed growth rates (based on population growth rates):

Growth rate (years 2021-2030)=	15.52%	or annualized growth rate of:	1.55%
Growth rate (years 2031-2040)=	13.22%	or annualized growth rate of:	1.32%
Growth rate (years 2041-2050)=	12.08%	or annualized growth rate of:	1.21%
Growth rate (years 2051-2060)=	11.38%	or annualized growth rate of:	1.14%
Growth rate (years 2061-2070)=	10.69%	or annualized growth rate of:	1.07%

The growth rate estimates were obtained from the Texas Water Development Board (County Population Projections for 2020-2070 from the 2021 Regional Water Plan). The initial waste stream estimate is based on site projections.

TURKEY CREEK LANDFILL
0771-368-11-123
APPENDIX IIIN
SITE LIFE CALCULATIONS

The following table calculates the waste stream growth (assuming the growth rates described above) and the projected cumulative airspace consumed.

Year	Waste Inflow (tons/year)	Tonnage Consumed (tons)
2021	899,000	879,296
2022	1,000,000	1,879,296
2023	1,054,133	2,933,429
2024	1,070,496	4,003,925
2025	1,087,113	5,091,038
2026	1,103,988	6,195,026
2027	1,121,125	7,316,152
2028	1,138,529	8,454,680
2029	1,156,202	9,610,882
2030	1,174,149	10,785,032
2031	1,189,667	11,974,699
2032	1,205,390	13,180,089
2033	1,102,573	14,282,663

8-Jan 357 days

330 days

Available tonnage is consumed during year	2033
Site life is projected to be approximately	12.9 years

Initial inflow =	3,143	tons/day
------------------	-------	----------

Summary of waste tonnage information:

$$\text{Maximum inflow} = \frac{\text{Tonnage accepted during final year of operation (1,221,321 tons/year)}^1}{286 \text{ days of operation per year}}$$

¹ 1,221,321 tons/year represents the calculated total waste inflow rate for the final year of 2033, the year in which the maximum waste inflow occurs.

Projected maximum waste inflow rate:

Maximum inflow =	4,270 tons/day
------------------	----------------

$$\text{Average inflow} = \frac{\text{Maximum waste accepted}}{\text{Site life}}$$

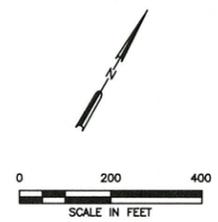
Projected average waste inflow rate:

$$\frac{14,282,663 \text{ tons}}{12.9 \text{ years} * 286 \text{ days/year}}$$

Average inflow =	3,877 tons/day
------------------	----------------

The above listed site life calculations are based on current market conditions and may vary based on waste stream, soil cover, actual tonnage received, or changing market conditions.

REMAINING CAPACITY - 20,950,000 CY
AS OF JANUARY 8, 2021

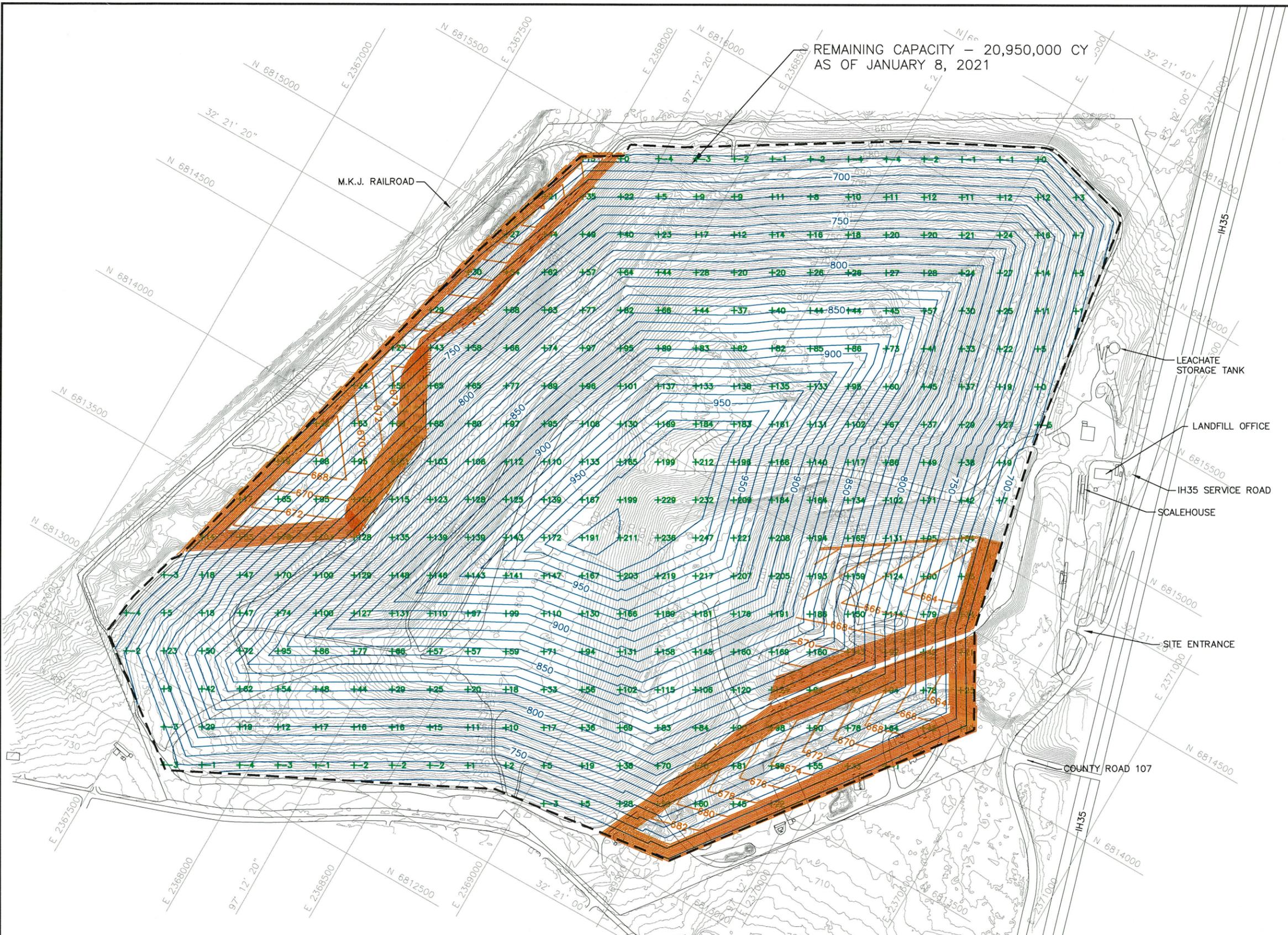


LEGEND

	PROPERTY BOUNDARY
	LIMITS OF WASTE
	STATE PLANE COORDINATE
	GEODETIC COORDINATE
	EXISTING CONTOUR
	INTERMEDIATE CONTOUR
	FUTURE BOTTOM OF WASTE CONTOUR
	DEPTH OF REMAINING FILL

NOTES:

- EXISTING CONTOURS AND ELEVATIONS PROVIDED BY COOPER AERIAL SURVEYS CO. FROM AERIAL PHOTOGRAPHY FLOWN 01-08-2021. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NAD 83, NORTH CENTRAL ZONE.



DRAFT
 FOR PERMITTING PURPOSES ONLY
 ISSUED FOR CONSTRUCTION

DATE: 02/2022
 FILE: 0771-368-11
 CAD: I11N-5 REMAINING.DWG

DRAWN BY: RAA
 DESIGN BY: JBP
 REVIEWED BY: NT

Weaver Consultants Group
 TBPE REGISTRATION NO. F-3727

PREPARED FOR
TEXAS REGIONAL LANDFILL COMPANY, LP

REVISIONS		
NO.	DATE	DESCRIPTION

**MAJOR PERMIT AMENDMENT
REMAINING CAPACITY**

TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS

WWW.WCGRP.COM **FIGURE I11N-5**

O:\0771\368\EXPANSION 2021\PART I11N\I11N-5 Airspace Remaining.dwg, rarrington, 1:2

APPENDIX III O

**APPROVED CLASS 1 WASTE FILL
PERMIT MODIFICATION**

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417B**

PERMIT MODIFICATION

**SITE DEVELOPMENT PLAN PART III
ATTACHMENT 1**

Prepared for

IESI TX Landfill, LP

October 1995

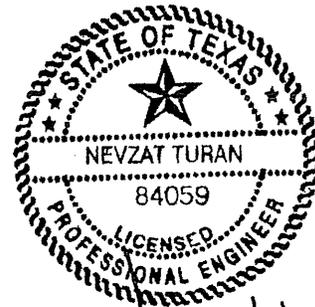
Revised April 1997

Revised March 2000

Revised November 2012

Revised February 2016

Revised March 2017



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03/23/2017

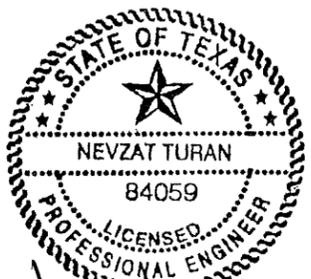
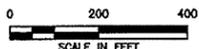
Revision Prepared by

Weaver Consultants Group, LLC
TPBE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9770

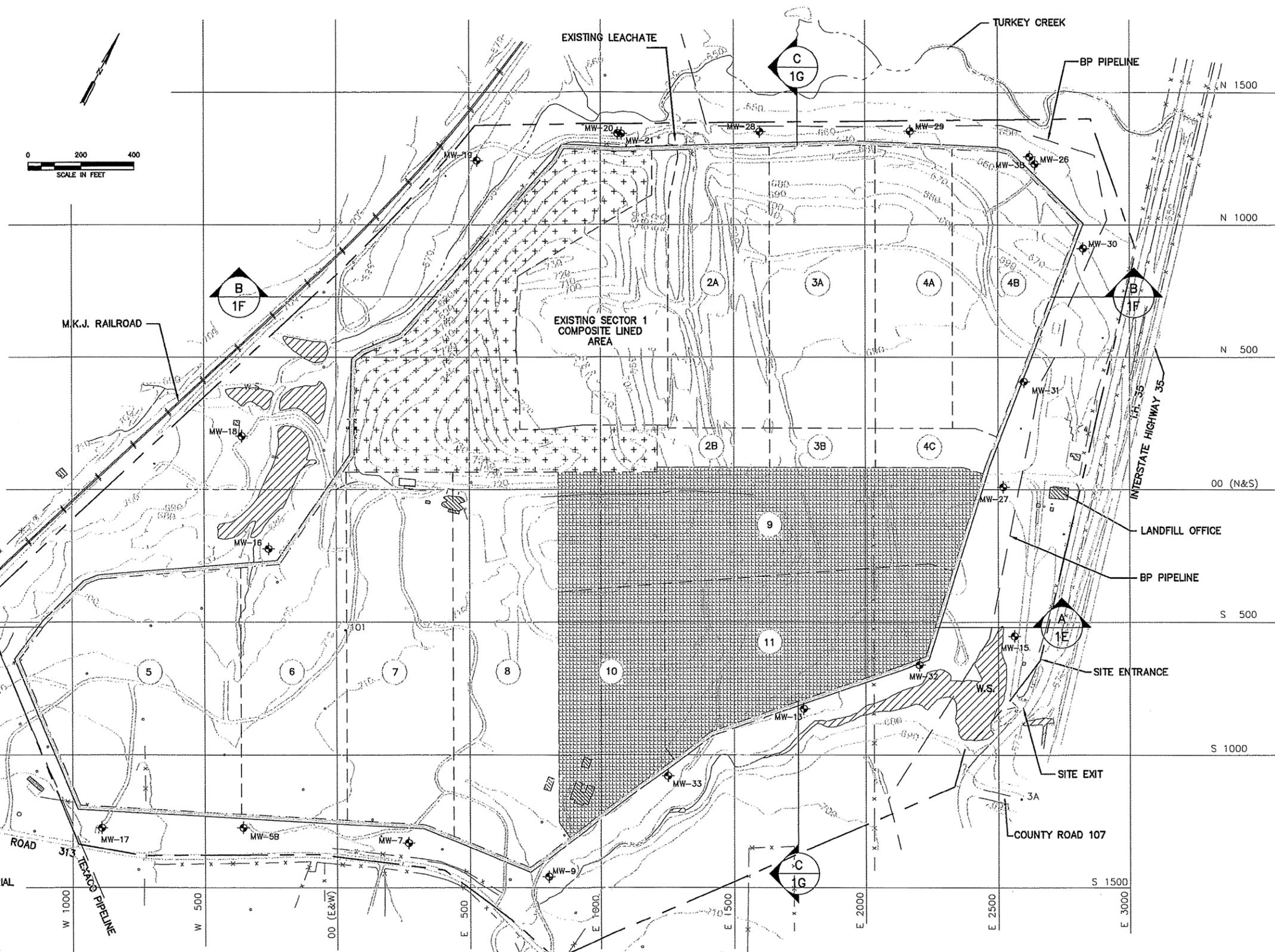
Project No. 0771-368-11-83

LEGEND

- PERMIT BOUNDARY
- ⊕ PRE-SUBTITLE "D" AREA
- - - EXISTING CONTOUR
- 9 SECTOR DESIGNATIONS
- ▬ PERIMETER ROAD
- - - SECTOR LIMITS
- ⊕ MW-18 GROUNDWATER MONITOR WELL
- ▨ SECTORS DESIGNATED FOR CLASS 1 NON-HAZARDOUS INDUSTRIAL WASTE DISPOSAL (NOTE 3)



03/23/2017



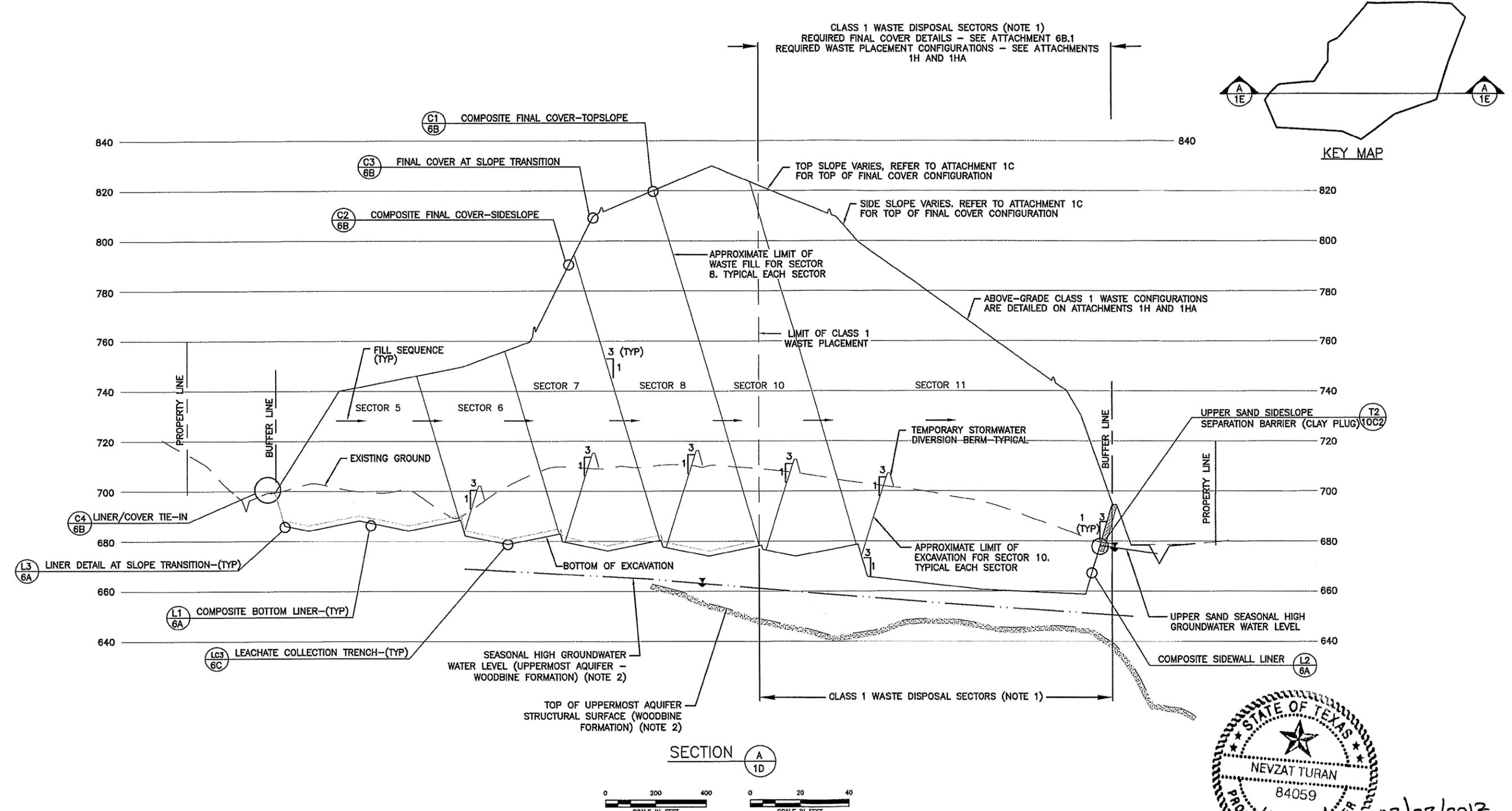
NOTES:

1. EXISTING CONTOURS DEVELOPED BY METROPOLITAN AERIAL SURVEYORS, 12/96.
2. RELOCATED ARCO PIPELINE LOCATION PROVIDED BY METROPOLITAN AERIAL SURVEY.
3. CLASS 1 NON-HAZARDOUS INDUSTRIAL WASTE MAY BE PLACED IN THE DESIGNATED SECTORS, PROVIDED THAT THE REQUIRED CLASS 1 WASTE LINER SYSTEM IS USED (SEE ATTACHMENT 6A AND 6A.1) AND ALL OTHER CLASS 1 WASTE OPERATING REQUIREMENTS ARE MET (SEE PART IV SITE OPERATING PLAN). SEE ATTACHMENTS 1H AND 1HA FOR CLASS 1 WASTE CONFIGURATION DETAILS.

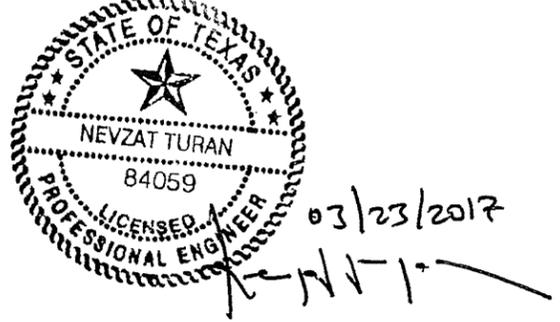
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Weaver Consultants Group TBPE REGISTRATION NO. F-3727		REVISIONS		WWW.WCGRP.COM										
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NO.	DATE	DESCRIPTION												
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2	03/2017	SEE LIST OF REVISIONS												

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P:\Solid waste\IESI\Turkey Creek\Perimeter Dike Mod\1E-Sector Cross Section.dwg, cmichael, 1:2

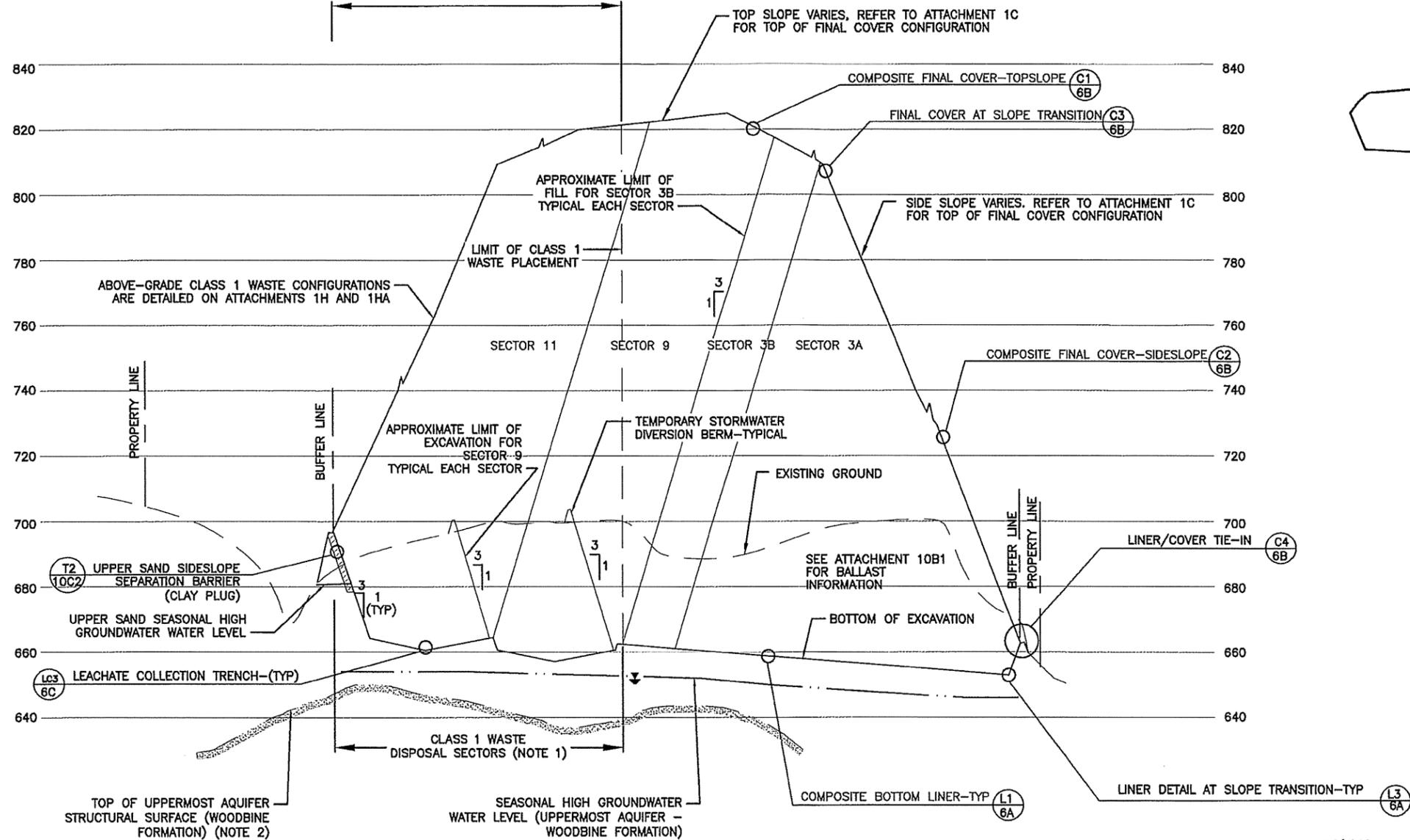


- NOTES:
- CLASS 1 NON-HAZARDOUS INDUSTRIAL WASTE MAY BE PLACED IN SECTORS 9 THROUGH 11, PROVIDED THAT THE REQUIRED CLASS 1 WASTE LINER SYSTEM IS USED (SEE ATTACHMENT 6A AND 6A.1) AND ALL OTHER CLASS 1 WASTE OPERATING REQUIREMENTS ARE MET (SEE PART IV SITE OPERATING PLAN). SEE ATTACHMENTS 1H AND 1HA FOR CLASS 1 WASTE CONFIGURATION DETAILS.
 - SEASONAL HIGH GROUNDWATER LEVEL TAKEN FROM CONTOURS PRESENTED ON ATTACHMENT 1B, AND REPRESENTS THE SEASONAL HIGH POTENTIOMETRIC GROUNDWATER LEVEL IN THE UPPERMOST AQUIFER (WOODBINE FORMATION). THE TOP OF THE UPPERMOST AQUIFER FORMATION CONTAINING THIS GROUNDWATER IS TAKEN FROM THE TOP OF AQUIFER STRUCTURAL MAP ON FIGURE 11e.5 OF ATTACHMENT 11.



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4	08/2012	ADD GROUNDWATER TABLE AND REV. EXCAVATION GRADES																					
5	03/2017	SEE LIST OF REVISIONS																					

CLASS 1 WASTE DISPOSAL SECTORS (NOTE 1)
 REQUIRED FINAL COVER DETAILS - SEE ATTACHMENT 6B.1
 REQUIRED WASTE PLACEMENT CONFIGURATIONS - SEE ATTACHMENTS 1H AND 1HA

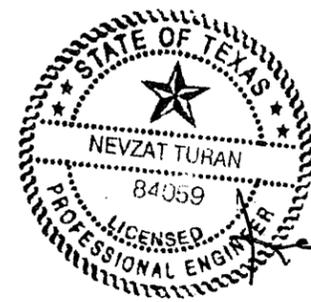


SECTION C 1D



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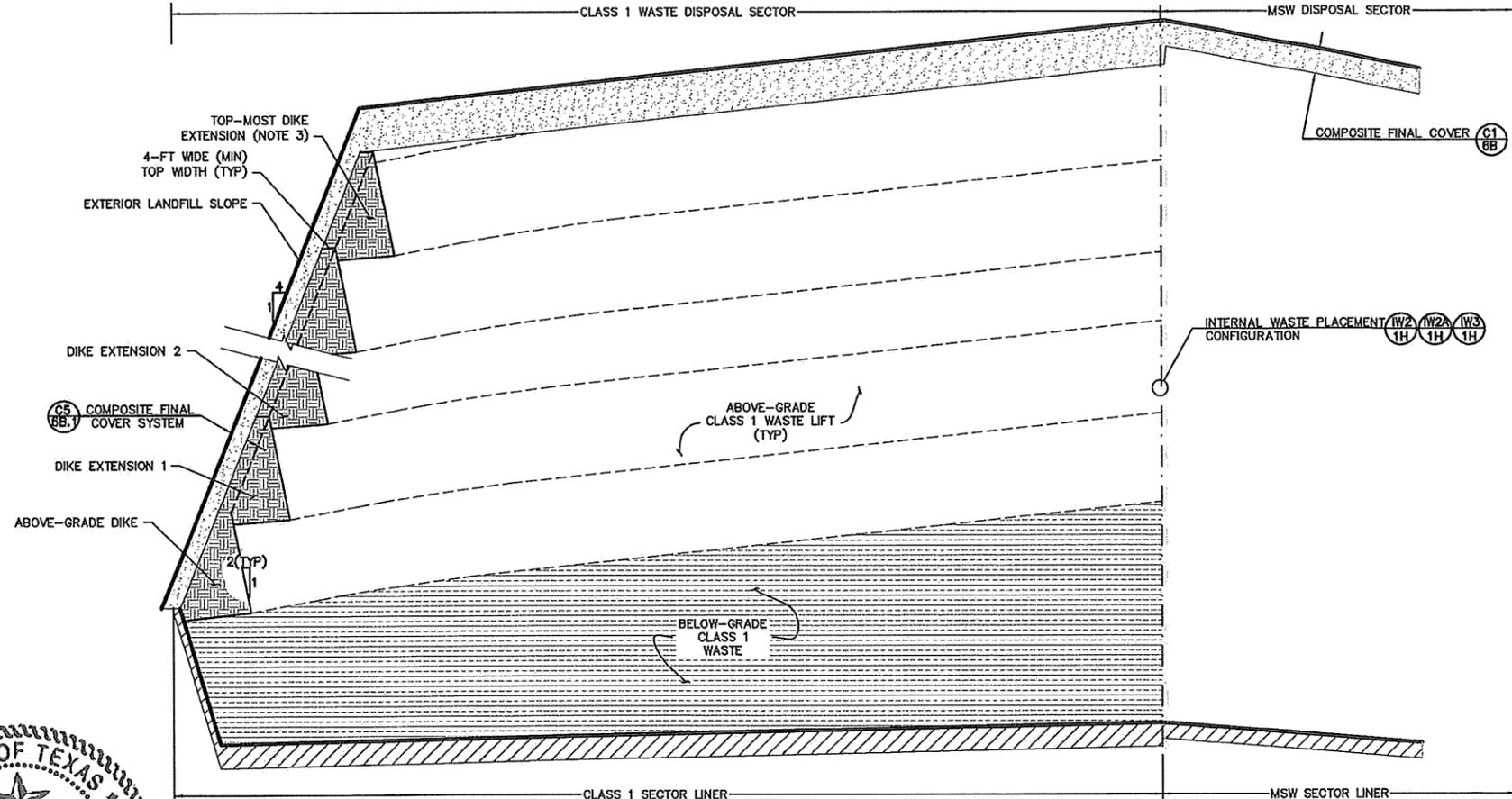
- CLASS 1 NON-HAZARDOUS INDUSTRIAL WASTE MAY BE PLACED IN SECTORS 9 THROUGH 11, PROVIDED THAT THE REQUIRED CLASS 1 WASTE LINER SYSTEM IS USED (SEE ATTACHMENT 6A AND 6A.1) AND ALL OTHER CLASS 1 WASTE OPERATING REQUIREMENTS ARE MET (SEE PART IV SITE OPERATING PLAN). SEE ATTACHMENTS 1H AND 1HA FOR CLASS 1 WASTE CONFIGURATION DETAILS.
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03/23/2017
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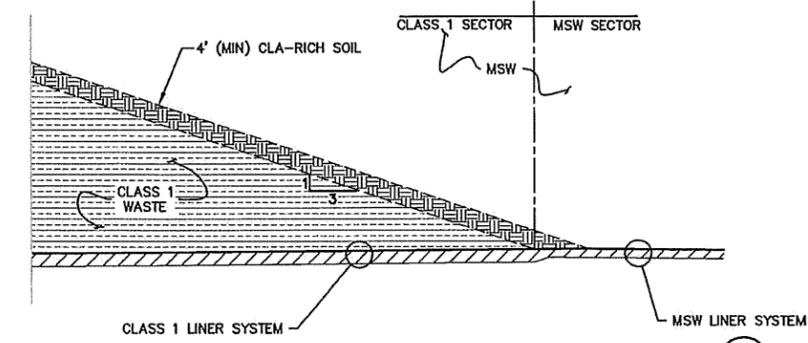
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Weaver Consultants Group TBPE REGISTRATION NO. F-3727		<table border="1"> <thead> <tr> <th colspan="3">REVISIONS</th> </tr> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>04/1995</td> <td>NAME CHANGE</td> </tr> <tr> <td>2</td> <td>07/1995</td> <td>CALL OUT CHANGE</td> </tr> <tr> <td>3</td> <td>10/1995</td> <td>CALL OUT CHANGE</td> </tr> <tr> <td>4</td> <td>08/2012</td> <td>ADD GROUNDWATER TABLE AND REV. EXCAVATION GRADES</td> </tr> <tr> <td>5</td> <td>03/2017</td> <td>SEE LIST OF REVISIONS</td> </tr> </tbody> </table>		REVISIONS			NO.	DATE	DESCRIPTION	1	04/1995	NAME CHANGE	2	07/1995	CALL OUT CHANGE	3	10/1995	CALL OUT CHANGE	4	08/2012	ADD GROUNDWATER TABLE AND REV. EXCAVATION GRADES	5	03/2017	SEE LIST OF REVISIONS	WWW.WCGRP.COM ATTACHMENT 1G	
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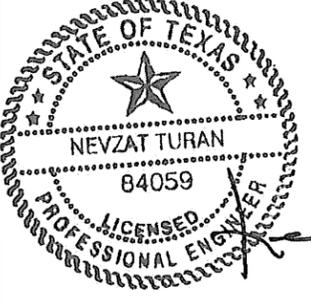


CLASS 1 WASTE CONFIGURATION AND ABOVE-GRADE PLACEMENT DETAIL (IW1) GENERALIZED CROSS SECTION (1H) SCALE: N.T.S.

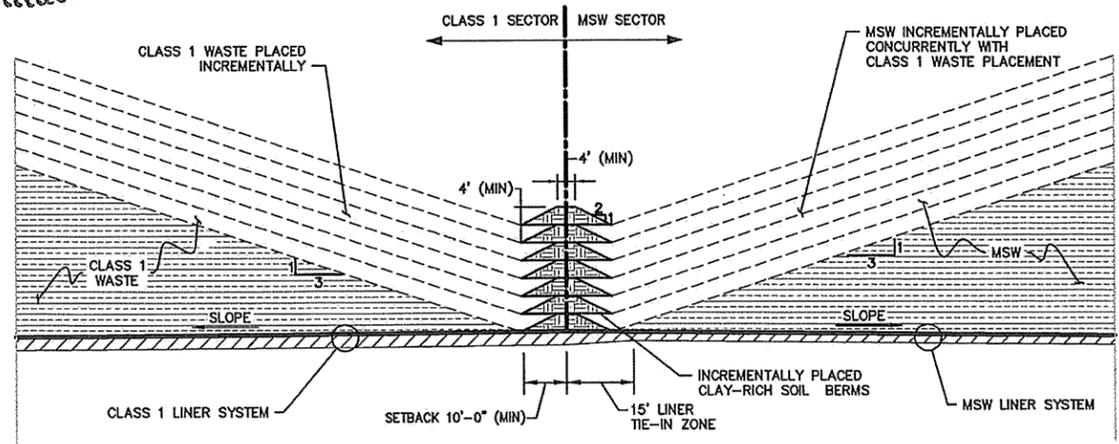
- NOTES:
- DETAIL IW1 ON THIS ATTACHMENT SHOWS A GENERALIZED CROSS SECTION OF A CLASS 1 WASTE DISPOSAL SECTOR, INCLUDING THE CONFIGURATION OF ABOVE-GRADE CLASS 1 WASTE PLACEMENT. ADDITIONAL REQUIREMENTS OF ABOVE-GRADE CLASS 1 WASTE PLACEMENT ARE AS FOLLOWS:
 - ABOVE-GRADE CLASS 1 WASTE PLACEMENT WILL INCORPORATE INCREMENTALLY-CONSTRUCTED EARTHEN DIKES (AND DIKE EXTENSIONS) ON EXTERIOR LANDFILL SLOPES AS CLASS 1 WASTE PLACEMENT PROGRESSES ABOVE-GRADE. MAXIMUM DIKE HEIGHT IS 12 FT. MINIMUM TOP WIDTH IS 4 FT.
 - THE OVERALL PURPOSE OF THE DIKES IS TO LATERALLY-CONTAIN THE CLASS 1 WASTE. ACCORDINGLY, THE DIKES ARE DESIGNED AND WILL BE CONSTRUCTED TO BE PHYSICALLY STABLE AGAINST SLOPE FAILURE AND AGAINST HYDROSTATIC AND HYDRODYNAMIC FORCES DURING STORM EVENTS OR FLOODS; PREVENT THE WASHOUT, RELEASE, OR EXPOSURE OF WASTE; PREVENT STORM WATER FROM REACHING THE WASTE; MINIMIZE THE RELEASE OF LEACHATE; AND MINIMIZE LONG-TERM MAINTENANCE.
 - DIKES SHALL BE CONSTRUCTED, MONITORED, AND DOCUMENTED IN ACCORDANCE WITH THE QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES SET FORTH IN APPENDIX 12E OF ATTACHMENT 12/13 OF THE SITE DEVELOPMENT PLAN.
 - FOR EACH LIFT OF CLASS 1 WASTE, THE WASTE PLACED AGAINST A DIKE/DIKE EXTENSION SHALL BE NO HIGHER THAN 3-FT BELOW THE CREST OF THAT DIKE.
 - UPON COMPLETION OF EACH DIKE, A THIRD-PARTY INDEPENDENT PROFESSIONAL ENGINEER LICENSED TO PRACTICE IN TEXAS WILL CERTIFY THE INSTALLED DIKE PRIOR TO PLACEMENT OF WASTE, AS DESCRIBED IN APPENDIX 12E OF ATTACHMENT 12/13 OF THE SITE DEVELOPMENT PLAN.
 - DETAILS IW2, IW2A, AND IW3 ON THIS ATTACHMENT SHOW THREE POSSIBLE CLASS 1 WASTE CONFIGURATIONS AT THE BOUNDARY BETWEEN A CLASS 1 WASTE DISPOSAL SECTOR AND A MSW DISPOSAL SECTOR.
 - THE ABOVE-GRADE CLASS 1 WASTE FILLING SEQUENCE STARTING WHEN WASTE IS JUST BELOW GRADE, WILL BE AS FOLLOWS:
 - CONSTRUCT AND CERTIFY THE FIRST ABOVE-GRADE DIKE.
 - PLACE THE FIRST LIFT OF ABOVE-GRADE CLASS 1 WASTE ADJACENT TO THE DIKE, KEEPING THE WASTE THAT IS DIRECTLY AGAINST THE DIKE AT AN ELEVATION 3-FT BELOW THE DIKE CREST (I.E. A 3-FT SEPARATION DISTANCE).
 - WHEN THAT LIFT IS COMPLETE, CONSTRUCT AND CERTIFY THE NEXT DIKE EXTENSION. AS PART OF THE DIKE EXTENSION, THE 3-FT SEPARATION DISTANCE NEXT TO THE DIKE LEFT FROM THE PREVIOUS LIFT WILL BE FILLED WITH SOIL.
 - PLACE THE NEXT LIFT OF ABOVE-GRADE CLASS 1 WASTE.
 - REPEAT THESE STEPS AS FILLING PROGRESSES.
 - AT THE TOP MOST DIKE EXTENSION, THE 3-FT SEPARATION DISTANCE NEXT TO THE DIKE WILL BE FILLED WITH SOIL FILL, AND THEN THE FINAL COVER SYSTEM WILL BE INSTALLED.
 - THE INTERCELL RIDGE (HIGHEST POINT OF THE LEACHATE COLLECTION LAYER OR TOP OF LINER) IN BOTH SECTORS CANNOT BE LOCATED WITHIN AREA THAT IS DESIGNED TO RECEIVE CLASS 1 WASTE. CLASS 1 WASTE SHALL BE PLACED NO CLOSER THAN 25 FEET TO THE SECTOR RIDGE OR THE CLASS 1 SIDE EDGE OF TIE-IN, WHICHEVER PROVIDES LONGER SETBACK (FOR OPTION SHOWN BY IW2A ONLY).
 - SEE ATTACHMENT 1HA FOR AN ADDITIONAL ABOVE-GRADE CLASS 1 FILL CONFIGURATION (ABOVE GRADE CLASS 1 FILL WITH SOIL COVER LAYER).



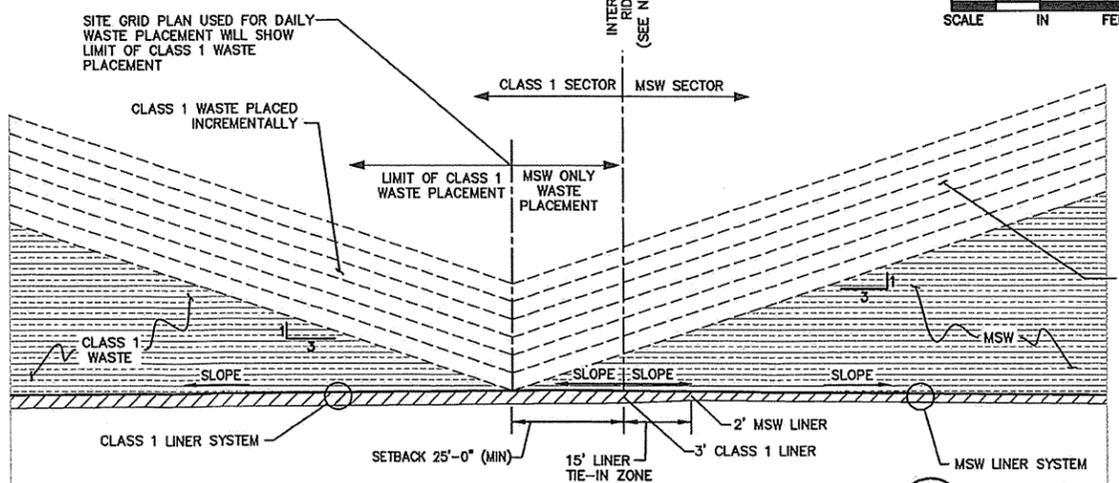
CLASS 1 WASTE SECTOR - MSW SECTOR INTERNAL WASTE PLACEMENT CONFIGURATION (IW3) GENERALIZED CROSS SECTION, SLOPED SOIL SEPARATION LAYER (1H)



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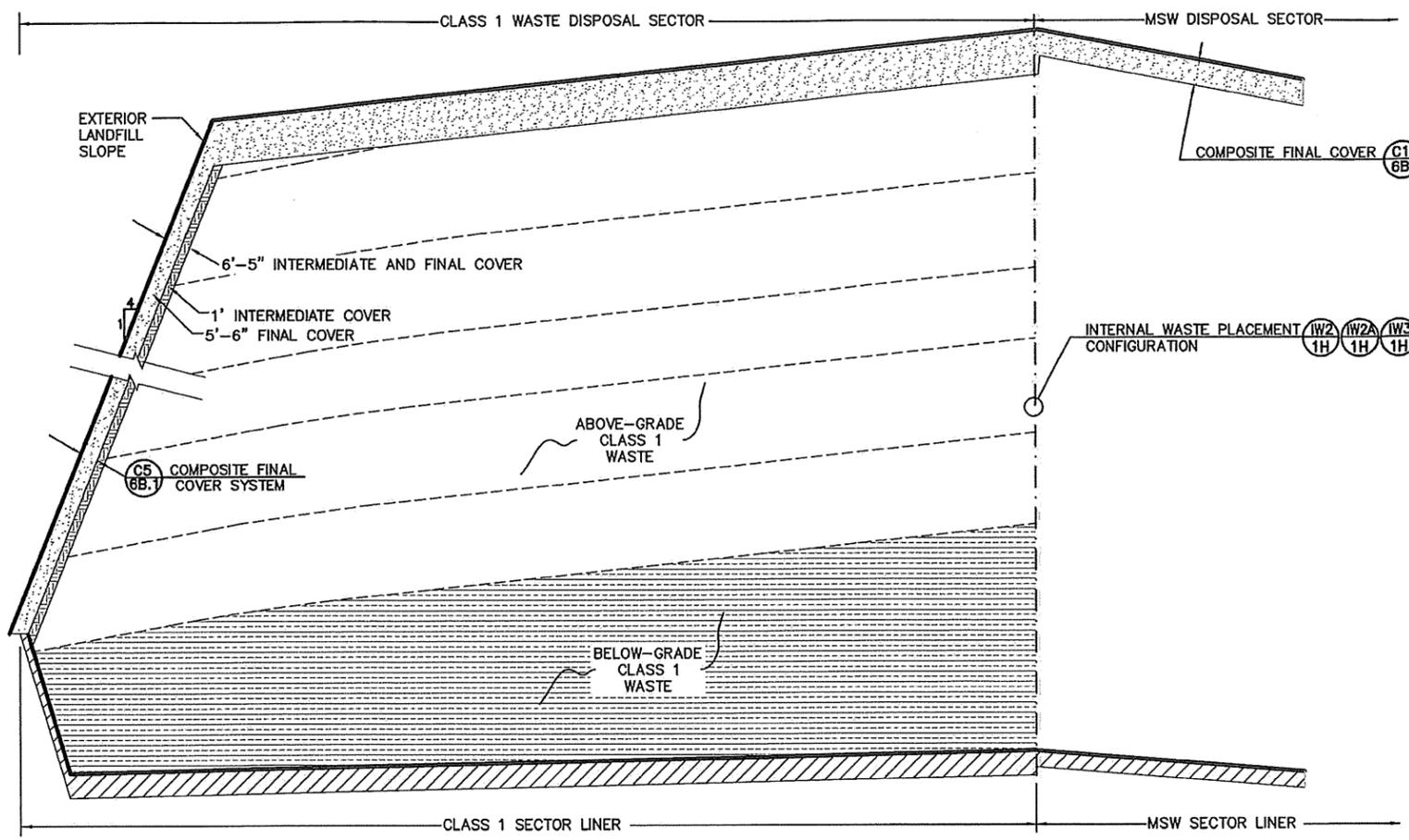


CLASS 1 WASTE SECTOR - MSW SECTOR INTERNAL WASTE PLACEMENT CONFIGURATION (IW2) GENERALIZED CROSS SECTION, VERTICAL SOIL SEPARATION LAYER (1H)

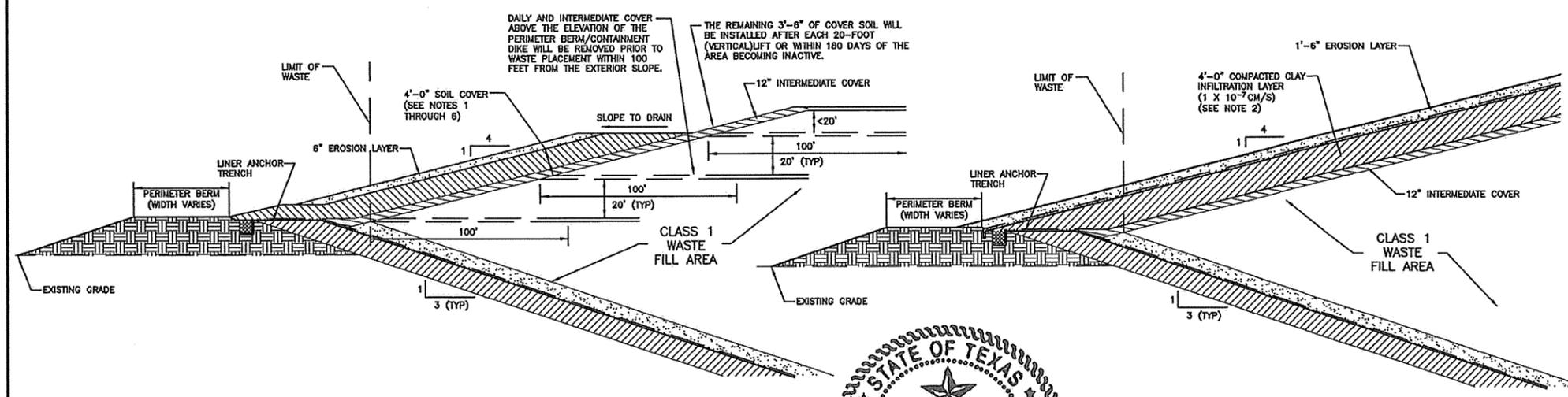


CLASS 1 WASTE SECTOR - MSW SECTOR INTERNAL WASTE PLACEMENT CONFIGURATION (IW2A) GENERALIZED CROSS SECTION, SETBACK OPTION (1H)

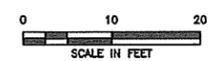
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2	12-2016	SEE LIST OF REVISIONS												
Weaver Consultants Group TBPE REGISTRATION NO. F-3727				TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS WWW.WCGRP.COM ATTACHMENT 1H										



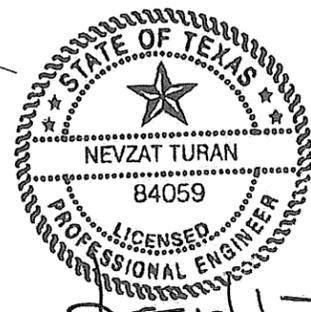
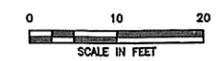
CLASS 1 WASTE CONFIGURATION WITH SOIL COVER LAYER AND ABOVE-GRADE PLACEMENT DETAIL (IW1A)
GENERALIZED CROSS SECTION 1HA
SCALE: N.T.S.



TYPICAL ABOVE GRADE CLASS 1 WASTE AREA DURING SITE OPERATIONS



TYPICAL ABOVE GRADE CLASS 1 WASTE AREA WITH FINAL COVER



04/13/2017
III0-6

NOTES:

- DETAIL IW1A ON THIS ATTACHMENT SHOWS A GENERALIZED CROSS SECTION OF A CLASS 1 WASTE DISPOSAL SECTOR, INCLUDING THE CONFIGURATION OF ABOVE-GRADE CLASS 1 WASTE PLACEMENT WITH 4.5-FOOT-THICK SOIL COVER LAYER.
- THE ADDITIONAL ABOVE-GRADE CLASS 1 WASTE PLACEMENT WITH 4.5-FOOT-THICK SOIL COVER LAYER ALLOWS CLASS 1 WASTE TO BE FILLED ABOVE THE INITIAL PERIMETER BERM/CONTAINMENT DIKE OR ABOVE PREVIOUSLY CONSTRUCTED SIDESLOPE CONTAINMENT DIKES. FOR THIS OPTION, A 4.5-FOOT-THICK SOIL COVER LAYER WILL BE PLACED ON THE EXTERIOR SIDESLOPES, EXTENDING FROM THE TOP OF THE PERIMETER BERM/CONTAINMENT DIKE TO THE MAXIMUM CLASS 1 FILL ELEVATION. THE SOIL COVER LAYER WILL ALSO BE PLACED ON THE TOPSLOPE OF CLASS 1 DISPOSAL AREAS WHEN FILLED TO FINAL GRADE. THE FINAL COVER WILL BE CONSTRUCTED BY STRIPPING THE UPPER 3.5- FEET FROM THE SOIL COVER LAYER (SEE NOTE 4), AND CONSTRUCTING A FINAL COVER IN COMPLIANCE WITH 30 TAC §335.590(24)(E) AND INCLUDE A 4-FOOT-THICK COMPACTED CLAY-RICH INFILTRATION LAYER (REFER TO SECTION 3.1 OF ATTACHMENT 12 AND 13). THE FINAL COVER SYSTEM WILL BE CONSTRUCTED IN ACCORDANCE WITH ALL LABORATORY AND FIELD TESTING REQUIREMENTS SET FORTH IN APPENDIX 12E OF ATTACHMENT 12/13 OF THE SITE DEVELOPMENT PLAN.
- DURING CONSTRUCTION OF FINAL COVER, THE 3.5-FEET STRIPPED FROM THE SOIL COVER LAYER MAY BE USED TO CONSTRUCT FINAL COVER IF IT MEETS ALL REQUIRED FIELD AND LABORATORY TESTING IN ACCORDANCE WITH THE FINAL CLOSURE PLAN.
- IN ACCORDANCE WITH 30 TAC §335.590(24)(F)(i), THE 4.5-FOOT-THICK SOIL COVER LAYER IS DESIGNED TO:
 - PREVENT WASHOUT, RELEASE, OR EXPOSURE OF WASTE;
 - BE PHYSICALLY STABLE;
 - PREVENT WASHOUT FROM HYDROSTATIC AND HYDRODYNAMIC FORCES FROM STORMS AND FLOODS;
 - PREVENT STORM WATER RUN-ON FROM REACHING THE WASTE;
 - MINIMIZE THE RELEASE OF LEACHATE; AND
 - MINIMIZE LONG TERM MAINTENANCE.
- THE 4.5-FOOT-THICK SOIL COVER LAYER:
 - WILL BE CONSTRUCTED ALONG THE EXTERIOR SIDESLOPES AS PART OF SITE OPERATIONS FROM CLAY-RICH SOILS;
 - WILL BE PLACED IN 12-INCH THICK LOOSE LIFTS AND COMPACTED BY TRACKED EQUIPMENT OR OTHER COMPACTION EQUIPMENT;
 - WILL BE LOCATED OVER THE LINED AREA AT THE PERIMETER OF THE WASTE FOOTPRINT;
 - WILL BE MEASURED FOR THICKNESS BY SURVEY OR SETTLEMENT PLATES; AND
 - WILL BE CERTIFIED BY A TEXAS LICENSED PROFESSIONAL ENGINEER AFTER CONSTRUCTION.
- AS SHOWN IN ATTACHMENT 1HA, THE 4.5-FOOT-THICK SOIL COVER LAYER WILL BE PLACED CONCURRENT WITH CLASS 1 WASTE PLACEMENT, WITH SLOPES COVERED IN 20-FOOT (VERTICAL) INCREMENTS.
- THE FOLLOWING OUTLINES ABOVE-GRADE CLASS 1 WASTE PLACEMENT WITH 4.5-FOOT-THICK OUTER SLOPE (BOTH SIDESLOPE AND TOP DECK) SOIL COVER LAYER CONSTRUCTION AND CERTIFICATION REQUIREMENTS.
 - THE PLACEMENT OF WASTE FILL WILL OCCUR CONSISTENT WITH THE APPLICABLE REQUIREMENTS OF THE SOP.
 - AREAS OF CLASS 1 WASTE THAT WILL UTILIZE THE 4.5-FOOT-THICK SOIL COVER ON THE OUTER SIDESLOPES WILL HAVE THE DAILY AND INTERMEDIATE COVER SOIL ABOVE THE ELEVATION OF THE PERIMETER BERM/CONTAINMENT DIKE REMOVED PRIOR TO WASTE PLACEMENT WITHIN 100 FEET OF THE EXTERIOR SIDESLOPE, TO PROMOTE DOWNWARD MIGRATION OF LEACHATE INTO THE LEACHATE COLLECTION SYSTEM. REMOVAL OF THE DAILY AND INTERMEDIATE COVER WILL BE DOCUMENTED IN THE COVER APPLICATION LOG AND MAINTAINED IN THE SITE OPERATING RECORD.
 - THE SOIL COVER LAYER WILL BE CONSTRUCTED OF CLAY-RICH SOILS UNDER THE DIRECTION OF THE LANDFILL MANAGER OR HIS DESIGNEE. THE CLAY-RICH SOILS WILL TYPICALLY HAVE A LIQUID LIMIT GREATER THAN 30 AND A PLASTICITY INDEX GREATER THAN 15. THE SOIL COVER LAYER MATERIAL WILL BE FREE OF DEBRIS, VEGETATIVE MATERIALS, FOREIGN OBJECTS, AND ORGANICS. SOILS PLACED AS SOIL COVER LAYER DO NOT REQUIRE LABORATORY OR FIELD TESTING.
 - CLASS 1 WASTE ON THE EXTERIOR SLOPE WILL BE IMMEDIATELY COVERED WITH A MINIMUM OF 12-INCHES OF SOIL COVER AND COMPACTED BY TRACKED EQUIPMENT OR OTHER COMPACTION EQUIPMENT. THE REMAINING THICKNESS OF THE 4.5-FOOT-THICK SOIL COVER LAYER WILL BE INSTALLED AFTER THE 20-FOOT (VERTICAL) LIFT OF WASTE IS PLACED OR WITHIN 180 DAYS OF THE AREA BECOMING INACTIVE.
 - THE 4-FOOT-THICK PORTION OF THE SOIL COVER LAYER WILL BE PLACED IN 12-INCH THICK LOOSE LIFTS AND COMPACTED BY TRACKED EQUIPMENT OR OTHER COMPACTION EQUIPMENT. FIELD OR LABORATORY TESTING OF THE SOIL COVER LAYER IS NOT REQUIRED.
 - A 6-INCH EROSION LAYER WILL BE PLACED OVER THE 4-FOOT-THICK PORTION OF THE SOIL COVER LAYER AND WILL BE MAINTAINED IN ACCORDANCE WITH THE APPROVED TCEQ EROSION CONTROL PLAN. THE EROSION LAYER WILL BE SEEDED AFTER INSTALLATION.
 - THE LANDFILL MANAGER OR HIS DESIGNEE WILL DOCUMENT THE LOCATION OF THE 4.5-FOOT-THICK SOIL COVER LAYER. THE INSTALLED THICKNESS WILL BE VERIFIED BY USE OF SETTLEMENT PLATES OR BY SURVEYING. THE LANDFILL MANAGER OR HIS DESIGNEE WILL DOCUMENT THE 4.5-FOOT-THICK SOIL COVER LAYER, INDICATING THAT HE (OR HIS DESIGNEE) HAS VERIFIED THE THICKNESS AND CONDITION (I.E., EROSION) IN THE COVER APPLICATION LOG. IN ADDITION, AFTER CONSTRUCTION OF EACH SOIL COVER AREA, A TEXAS LICENSED PROFESSIONAL ENGINEER WILL EVALUATE THE CONSTRUCTED AREA AND PREPARE A CERTIFICATION REPORT IN ACCORDANCE WITH THE GUIDELINES OF 30 TAC §335.590(24)(F)(vi). THIS CERTIFICATION REPORT WILL BE INCLUDED AS PART OF THE SITE OPERATING RECORD AND WILL VERIFY THAT THE 4-FOOT-THICK CLAY COVER AND 6-INCH-THICK EROSION LAYER WERE PLACED CONSISTENT WITH THE REQUIREMENTS LISTED ON THIS ATTACHMENT.
 - FOR CLASS 1 WASTE FILL AREAS UTILIZING THE 4.5-FOOT-THICK SOIL COVER, THE LOG SHOWS THE SOIL COVER AREA, REPORTS THE DATE THE SOIL COVER WAS APPLIED, REPORTS THE THICKNESS OF THE SOIL COVER, AND REFERENCES THE SOIL COVER CERTIFICATION REPORT. THE COVER APPLICATION LOG WILL ALSO DOCUMENT REMOVAL OF THE DAILY AND INTERMEDIATE COVER SOILS IN CLASS 1 (SOIL COVER CONFIGURATION) FILL AREAS WITHIN 100 FEET OF THE OUTER SIDESLOPE PRIOR TO PLACEMENT OF ADDITIONAL WASTE. THE LOG WILL SPECIFY THE AREA OF DAILY OR INTERMEDIATE COVER SOIL REMOVAL (BY USE OF THE GRID SYSTEM), AND THE ESTIMATED THICKNESS OF SOIL REMOVED. EACH ENTRY OF COVER SOIL REMOVAL WILL BE CERTIFIED BY THE SIGNATURE OF THE LANDFILL MANAGER (OR HIS DESIGNEE) THAT THE REMOVAL WAS ACCOMPLISHED AS STATED IN THE LOG.
 - CERTIFICATION RECORDS FOR ABOVE-GRADE CLASS 1 FILL WITH SOIL COVER LAYER CONSTRUCTION WILL BE PLACED INTO THE SITE OPERATING RECORD.

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DATE: 03/2017 FILE: 0771-356-11 QAD: 119A-SOIL COVER LAYER DETAILS.DWG		REVISIONS	
DATE: 03/2017 FILE: 0771-356-11 QAD: 119A-SOIL COVER LAYER DETAILS.DWG		NO. 1 DATE 03-2017 DESCRIPTION SEE LIST OF REVISIONS	TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS WWW.WCGRP.COM
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		ATTACHMENT 1HA	

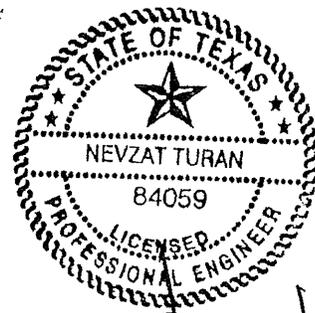
F:\Solid waste\ESI\Tur-key Dike Mod\119A-SOIL COVER LAYER DETAILS.dwg cmichael, 1:2

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417B**

SUBTITLE D UPGRADE

**SITE DEVELOPMENT PLAN PART III
CLOSURE/POSCLOSURE PLAN
ATTACHMENT 12 AND 13**

Prepared for
IESI TX Landfill, LP
TCEQ Approved January 31, 1996
Revised November 2004
Revised June 2012
Revised March 2017



Handwritten signature and date:
03/23/2017

Revision Prepared by
Weaver Consultants Group, LLC
TPBE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9770

Project No. 0771-368-11-83

CONTENTS (Continued)

APPENDIX 12A
Erosion Layer Evaluation

APPENDIX 12B
Solid Waste Settlement

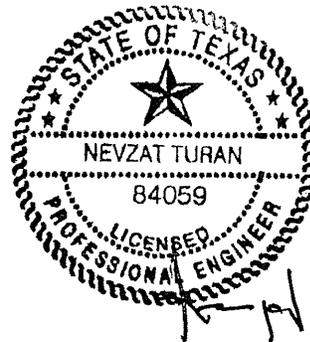
EACH APPENDIX IS INDIVIDUALLY SIGNED AND
SEALED BY THE RESPONSIBLE PROFESSIONAL
ENGINEER (P.E.)

APPENDIX 12C
Alternate Final Cover Erosion Control Structure Design

APPENDIX 12D
Cost Estimate for Closure and Postclosure Care

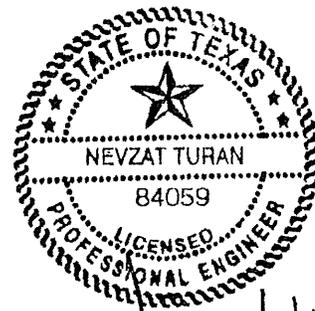
APPENDIX 12E
Above-Grade Dike Stability Analysis

APPENDIX 12F
Above-Grade Soil Cover Stability Analysis



03/23/2017

APPENDIX 12F
ABOVE GRADE SOIL COVER STABILITY ANALYSIS



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03/23/2017

TURKEY CREEK LANDFILL
0771-368-11-99-01
ABOVE GRADE CLASS 1 SOIL COVER STABILITY ANALYSIS

Purpose: The purpose of this analysis is to demonstrate that the above-grade Class 1 fill with soil cover layer configurations for waste disposal are stable against slope failure, with a minimum factor of safety of 1.5.

Method: The above-grade Class 1 waste stability analysis has been completed using XSTABL 5.206, a computer program developed to model general slope stability. This program is widely accepted for slope stability analysis at landfill sites and has been used in permit applications submitted to TCEQ for over 15 years (refer to Section 3.2 of Attachment 6D for additional information). Circular failure surfaces using Spencer's method have been generated to analyze the slopes for the configurations given below. Note that this section was selected to provide worse case scenario (e.g. steepest and longest slope).

- Slope completely developed with 4.5-foot soil cover: 4H:1V sideslope with 4.5-foot soil cover extending to elevation 808 ft-msl.
- Slope completely developed with 6.5-foot final cover: 4H:1V sideslope with 6.5-foot final cover extending to elevation 810 ft-msl.

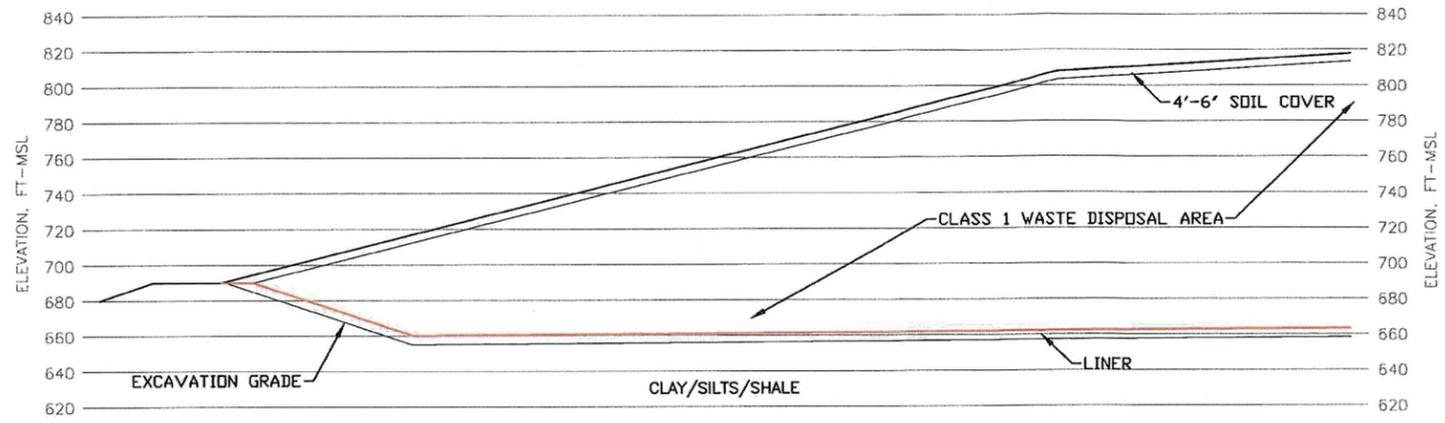
The above-grade Class 1 fill with soil cover waste configuration is shown on Figure 1-1. XSTABL output is presented in Attachment 1 of this Appendix.

Procedure:

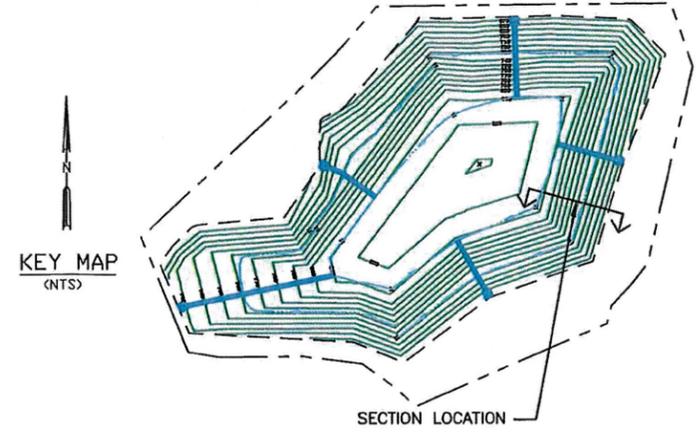
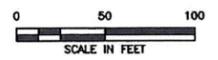
1. Input interim and final conditions for above-grade Class 1 fill with soil cover and final conditions.
2. Select strength parameters.
3. Perform analysis to calculate factor of safety.

References:

1. Duncan, J. Michael and Stephen G. Wright., *Soil Strength and Slope Stability*, John Wiley & Sons, Inc., Hoboken, NJ, 2005.
2. Terzaghi, Karl, Peck, Ralph B., and Mesri, Gholamreza, *Soil Mechanics in Engineering Practice, Third Ed.*, John Wiley & Sons, Inc. New York, NY, 1996.
3. Day, Robert W., *Geotechnical Engineer's Portable Handbook*, McGraw-Hill Companies, Inc., New York, NY, 2000.
4. Abramson, Lee W., Lee, Thomas S., Sharma, Sunil, Boyce, Glenn M., *Slope Stability and Stabilization Methods, 2nd Ed.*, John Wiley & Sons, Inc., New York, NY, 2001.
5. XSTABL 5.206 (computer program for slope stability analyses), Interactive Software Designs, Inc.
6. Kavazanjian Jr. E., Matasovic, N., Bonaparte, R., and Schmertmann, G. (1995), "Evaluation of MSW Properties for Seismic Analysis," Proceedings, Geoenvironmental 2000, Vol II. New Orleans, L.A. February, pp. 1126-1141

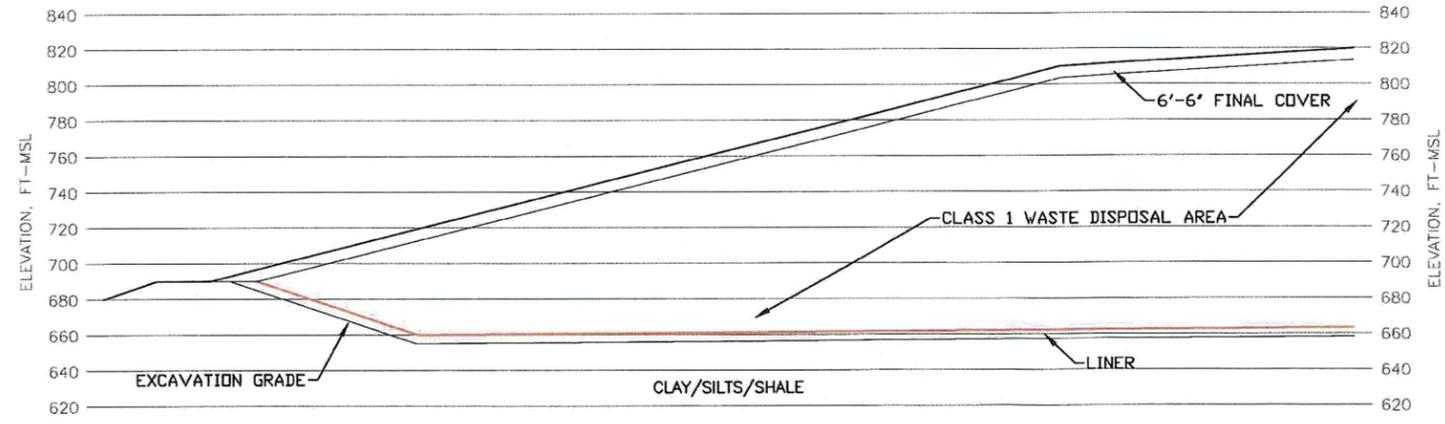


SLOPE COMPLETELY DEVELOPED WITH 4.5-FOOT SOIL COVER



NOTES:

1. THE SLOPE STABILITY XSTABL PROGRAM OUTPUT FILES ARE PROVIDED IN ATTACHMENT 1 OF APPENDIX 12F. THE FACTOR OF SAFETY VALUES SHOWN ARE PROVIDED IN THE OUTPUT FOR EACH PROGRAM RUN ON THE REFERENCED PAGES.
2. FINAL COVER CONTOURS SHOWN ARE REPRODUCED FROM AN ADDITIONAL LETDOWN OPTION PERMIT MODIFICATION BY WEAVER BOOS CONSULTANTS, DATED 12-07-2004.
3. THE SELECTED SECTION LOCATION SHOWN IS THE LONGEST AND STEEPEST SLOPE ASSOCIATED WITH THE CLASS 1 AREA.



SLOPE COMPLETELY DEVELOPED WITH 6.5-FOOT FINAL COVER



03/23/2017

<input type="checkbox"/> 90% SUBMITTAL <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR	ABOVE-GRADE CLASS 1 WASTE WITH SOIL COVER SLOPE STABILITY SECTION TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS
	IESI TX LANDFILL LP	
DATE: 03/2017 FILE: 0771-368-11 CAD: APPENDIX 12F-FIG. 1-1.dwg	DRAWN BY: CAM DESIGN BY: CAM REVIEWED BY: NT	REVISIONS NO. DATE DESCRIPTION
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM

1. Input Interim and Final Condition Option 2A Soil Cover and Option 2A Final Cover Configurations

Sections showing the above-grade Class 1 fill with soil cover option are shown on Figure 1-1. As illustrated, the configurations show multiple scenarios that include placement of the 4.5-foot-thick soil cover and the 6.5-foot-thick final cover.

As shown on Figures 1-1 and 1-2, the following three conditions were analyzed for the Option 2A scenario:

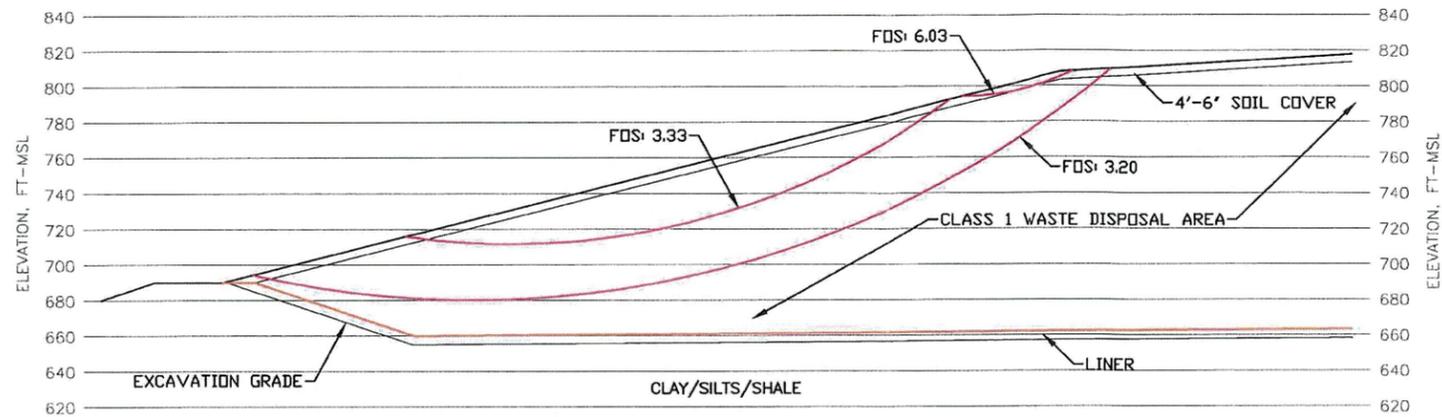
- Condition 1 - Slope completely developed with soil cover (4.5-foot-thick).
- Condition 2 - Slope completely developed with final cover (6.5-foot-thick).

2. Select Strength Parameters

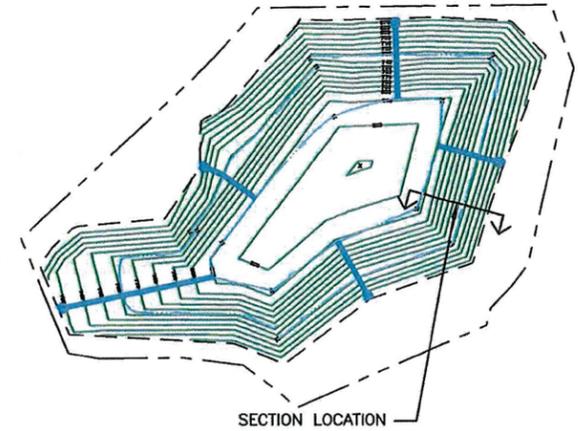
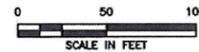
The slope stability analyses have been developed for effective stress conditions. The selected strength parameters for the soil cover and other materials are described below.

EFFECTIVE STRESS SOIL PROPERTIES

Unit	Unit Weight		Cohesion Intercept (psf)	Internal Friction Angle (deg)	Comments
	Moist (pcf)	Saturated (pcf)			
Soil Cover Layer	115	120	100	16	Refer to page 6D-1-3 for more information.
Waste	64	64	(See Comment)	(See Comment)	These values match the values used in the slope stability analysis included in Appendix 12E. Values for solid waste are provided in Appendix 12E-Attachment 1.
Liner	115	120	0	30	
Clays, Silts, and Shales	125	125	750	35	Added to establish slope stability model space. Obtained from Turkey Creek Landfill (Subtitle D Upgrade) Permit Modification, prepared by Emcon in 1995.

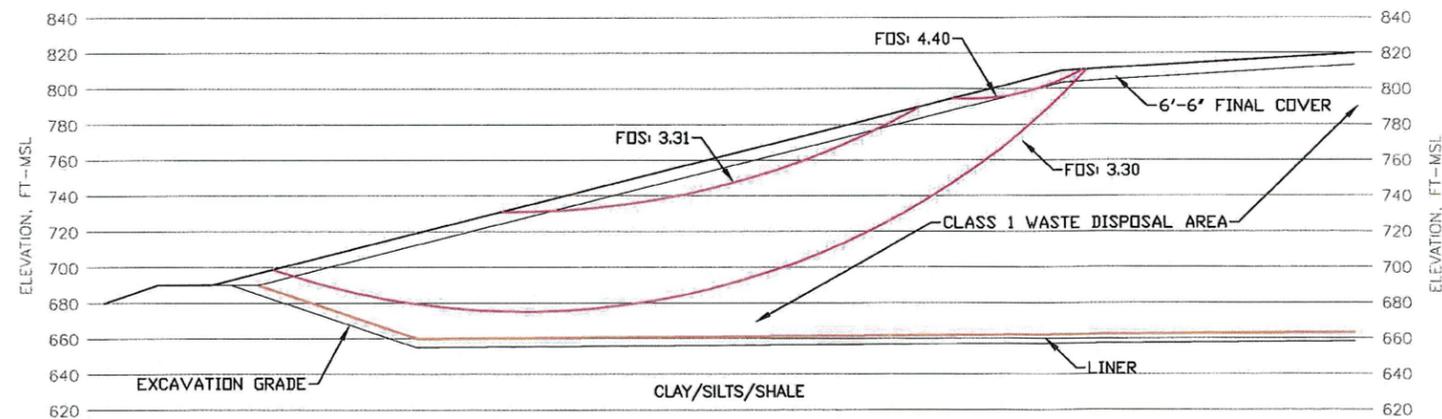


SLOPE COMPLETELY DEVELOPED WITH 4.5-FOOT SOIL COVER

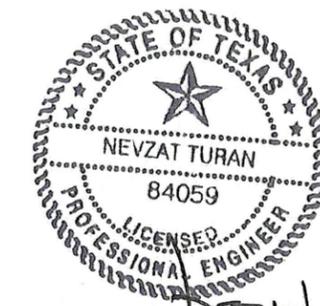
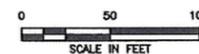


NOTES:

1. THE SLOPE STABILITY XSTABL PROGRAM OUTPUT FILES ARE PROVIDED IN ATTACHMENT 1 OF APPENDIX 12F. THE FACTOR OF SAFETY VALUES SHOWN ARE PROVIDED IN THE OUTPUT FOR EACH PROGRAM RUN ON THE REFERENCED PAGES.
2. FINAL COVER CONTOURS SHOWN ARE REPRODUCED FROM AN ADDITIONAL LETDOWN OPTION PERMIT MODIFICATION BY WEAVER BOOS CONSULTANTS, DATED 12-07-2004.
3. THE SELECTED SECTION LOCATION SHOWN IS THE LONGEST AND STEEPEST SLOPE ASSOCIATED WITH THE CLASS 1 AREA.



SLOPE COMPLETELY DEVELOPED WITH 6.5-FOOT FINAL COVER



03/23/2017
[Signature]

<input type="checkbox"/> 90% SUBMITTAL <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR	ABOVE-GRADE CLASS 1 WASTE WITH SOIL COVER SLOPE STABILITY SECTION AND RESULTS SUMMARY TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS
	IESI TX LANDFILL LP	
DATE: 03/2017 FILE: 0771-368-11 CAD: APPENDIX 12F-FIG. 3-1.dwg	DRAWN BY: CAM DESIGN BY: CAU REVIEWED BY: HT	REVISIONS NO. DATE DESCRIPTION
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		
WWW.WCGRP.COM		FIGURE 3-1

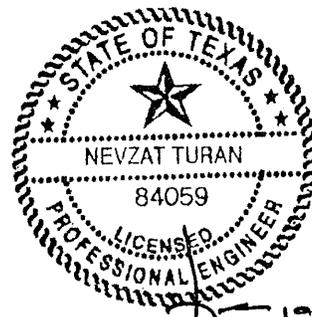
3. Perform Analysis and Calculate Factors of Safety

The calculated factors of safety are shown below and summarized on Figures 3-1. As noted, all the calculated factors of safety, using conservatively selected strength parameters, are above 1.5. Additionally, the results below demonstrate that a variety of assumed unit weight values for the waste all result in acceptable factors of safety. Therefore, the proposed design meets §335.590(24)(F)(i)(II) which requires the containment dike to "be physically stable against slope failure, with a minimum safety factor of 1.5."

**Table 3-1
Stability Analysis Results**

Slope Designation	Method of Analysis	Minimum Factor of Safety Generated	Recommended Minimum Factor of Safety	Acceptable Factor of Safety	Analysis Page No.
Class 1 Fill with Soil Cover Layer					
Slope Completely Developed, 4.5-foot Soil Cover, Top of Slope	Spencer	6.03	1.5	YES	12F-1-1
Slope Completely Developed, 4.5-foot Soil Cover, Middle of Slope	Spencer	3.33	1.5	YES	12F-1-6
Closed - Slope Completely Developed, 4.5-foot Soil Cover, Entire Slope	Spencer	3.20	1.5	YES	12F-1-13
Class 1 Fill with Final Cover System					
Slope Completely Developed, 6.5-foot Final Cover, Top of Slope	Spencer	4.40	1.5	YES	12F-1-22
Slope Completely Developed, 6.5-foot Final Cover, Middle of Slope	Spencer	3.31	1.5	YES	12F-1-27
Slope Completely Developed, 6.5-foot Final Cover, Entire Slope	Spencer	3.30	1.5	YES	12F-1-34

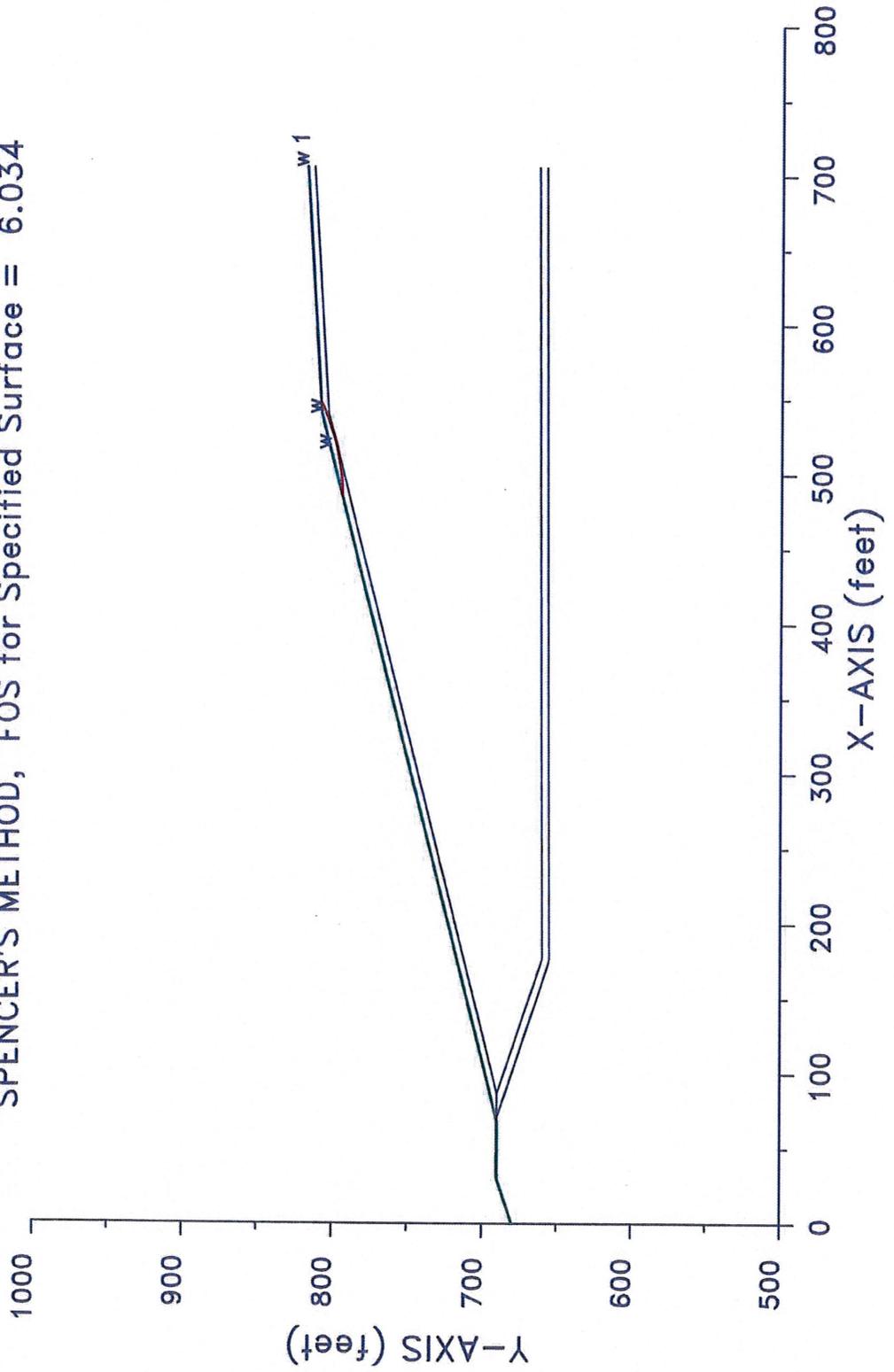
APPENDIX 12F
ATTACHMENT 1
XSTABL OUTPUT FILES



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Turkey Creek Inter. Soil Cover 1
SPENCER'S METHOD, FOS for Specified Surface = 6.034



```

*****
*                               *
*           X S T A B L         *
*                               *
*       Slope Stability Analysis *
*           using the           *
*           Method of Slices    *
*                               *
*       Copyright (C) 1992 - 2008 *
*       Interactive Software Designs, Inc. *
*           Moscow, ID 83843, U.S.A. *
*                               *
*           All Rights Reserved   *
*                               *
*       Ver. 5.208                96 - 2046 *
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```

Problem Description : Turkey Creek Inter. Soil Cover 1

 SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	680.0	30.0	690.0	4
2	30.0	690.0	68.3	690.0	4
3	68.3	690.0	540.2	808.0	1
4	540.2	808.0	705.3	817.9	1

8 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	68.3	690.0	71.0	690.0	4
2	71.0	690.0	86.8	690.0	3
3	86.8	690.0	540.9	803.6	2
4	540.9	803.6	705.3	813.4	2
5	86.8	690.0	176.8	660.0	3
6	176.8	660.0	705.3	663.4	3
7	71.0	690.0	176.0	655.0	4
8	176.0	655.0	705.3	658.4	4

 ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight (pcf)	Moist Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Water Constant (psf)	Surface No.
1	115.0	120.0	500.0	.00	.000	.0	1
2	64.0	64.0	.0	.00	.000	.0	0
3	115.0	130.0	.0	30.00	.000	.0	0
4	125.0	125.0	750.0	35.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 2

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	.0	501.0
2	501.0	501.0
3	6265.0	4281.0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 3 coordinate points

PHREATIC SURFACE,

Point No.	x-water (ft)	y-water (ft)
1	516.50	802.10
2	540.20	808.00
3	705.30	817.90

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface is CIRCULAR, with a radius of 138.24 feet

Center at x = 487.20 ; y = 932.60 ; Seg. Length = 10.00 feet

The CIRCULAR failure surface was estimated by the following 8 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	485.70	794.37
2	495.70	794.63
3	505.65	795.60
4	515.50	797.29
5	525.21	799.69
6	534.72	802.79
7	543.98	806.56
8	547.81	808.46

SELECTED METHOD OF ANALYSIS: Spencer (1973)

SUMMARY OF INDIVIDUAL SLICE INFORMATION

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
-------	-------------	-------------	-------------	------------	-------	------	-------------

1	490.70	794.50	1.12	10.00	1.45	14.04	1291.
2	500.67	795.11	3.00	9.95	5.60	14.04	3437.
3	510.58	796.45	4.15	9.86	9.74	14.04	4699.
4	516.00	797.42	4.53	1.00	13.89	14.04	519.
5	520.86	798.62	4.55	8.71	13.89	14.04	4754.
6	529.97	801.24	4.20	9.51	18.03	14.04	4793.
7	537.46	803.91	3.41	5.48	22.18	14.04	2242.
8	542.09	805.79	2.32	3.78	22.18	3.43	1053.
9	545.89	807.51	.83	3.82	26.33	3.43	382.

Nonlinear M-C Iteration Number - 1

 ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	9.8329	6.0337	6.0521
3	9.8290	6.0337	6.0337

 ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	9.8290	6.0337	6.0337

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	140.8	500.0	.00	0.	0.	0.	.00
2	345.7	500.0	.00	0.	0.	0.	.00
3	463.1	500.0	.00	0.	0.	0.	.00
4	494.1	500.0	.00	0.	0.	0.	.00
5	250.2	500.0	.00	2409.	12.	0.	.00
6	218.4	500.0	.00	2475.	7.	0.	.00
7	163.7	500.0	.00	1186.	1.	0.	.00
8	97.6	500.0	.00	589.	0.	0.	.00
9	15.7	500.0	.00	221.	0.	0.	.00

 SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	490.70	140.8	129.2	.0	82.9
2	500.67	345.7	345.4	.0	82.9
3	510.58	463.1	476.8	.0	82.9
4	516.00	494.1	521.4	.0	82.9
5	520.86	518.7	547.0	268.4	82.9
6	529.97	465.9	504.7	247.5	82.9
7	537.46	364.2	409.3	200.5	82.9
8	542.09	241.9	278.4	144.3	82.9
9	545.89	67.4	99.8	51.7	82.9

 SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice	Right	Force	Interslice	Force	Boundary	Height
-------	-------	-------	------------	-------	----------	--------

#	x-coord (ft)	Angle (degrees)	Force (lb)	Height (ft)	Height (ft)	Ratio
1	495.70	9.83	805.	.74	2.25	.329
2	505.65	9.83	1299.	1.06	3.76	.283
3	515.50	9.83	1333.	1.05	4.53	.232
4	516.50	9.83	1293.	1.01	4.53	.222
5	525.21	9.83	895.	.68	4.56	.150
6	534.72	9.83	233.	-.85	3.84	-.222
7	540.20	9.83	-132.	1.99	2.98	.667
8	543.98	9.83	-192.	.61	1.66	.370
9	547.81	.00	0.	.09	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 460.99 (psf)
Pore Water Pressure = 107.05 (psf)
Shear Stress = 82.87 (psf)

Total Length of failure surface = 64.27 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 6.034

Total shear strength available
along specified failure surface = 321.33E+02 lb

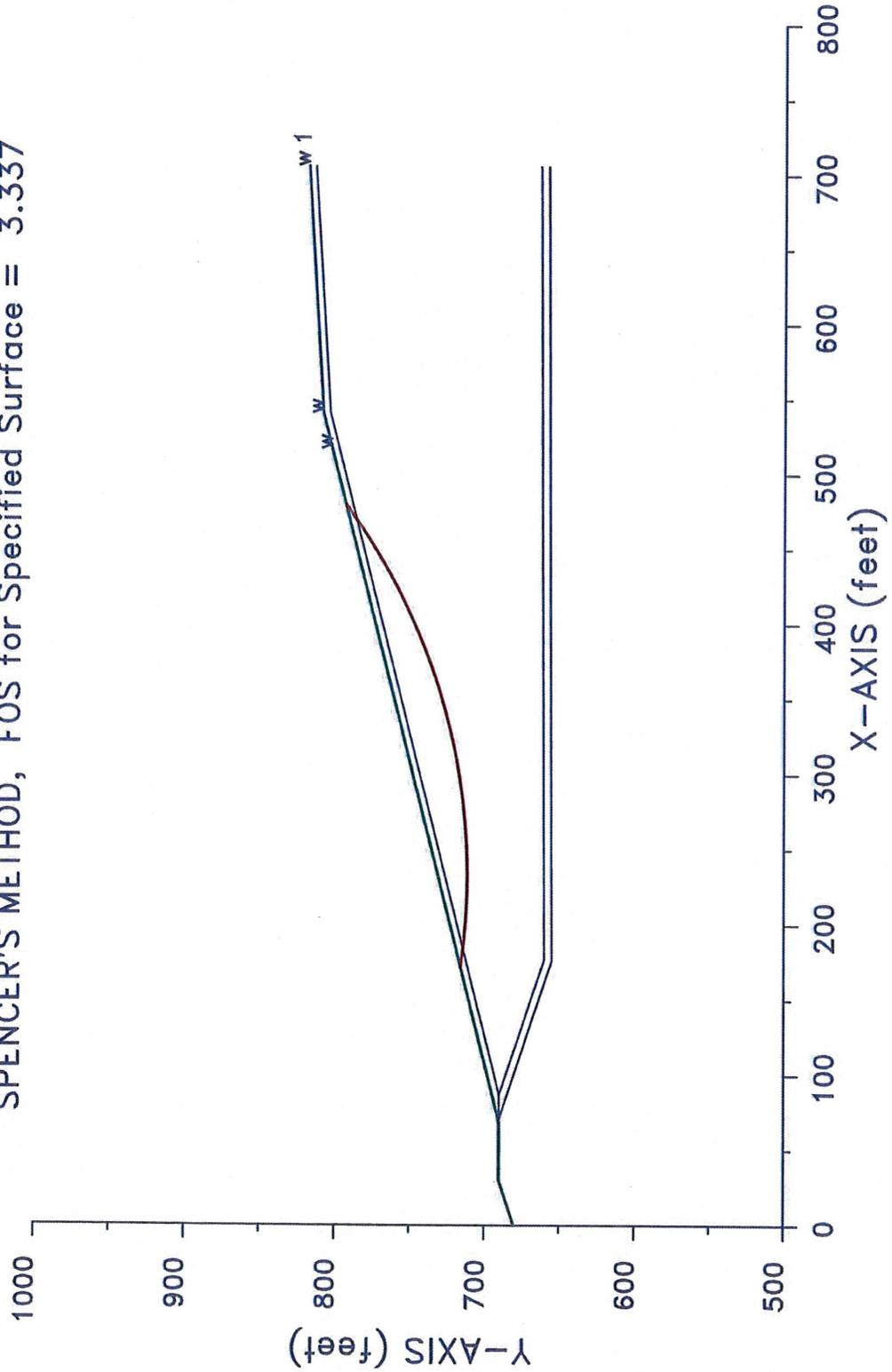
For the specified surface, the analysis computed the following:

Negative (tensile) Normal Effective Force = 0 slices
Negative (tensile) Interslice Force = 2 slices
Unreasonable Location of Interslice Force = 1 slices

In view of these errors, the computed FOS may be UNREASONABLE!

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Turkey Creek Inter. Soil Cover 2
SPENCER'S METHOD, FOS for Specified Surface = 3.337



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*                               *
*           X S T A B L         *
*                               *
*       Slope Stability Analysis *
*       using the               *
*       Method of Slices        *
*                               *
*       Copyright (C) 1992 - 2008 *
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*       Moscow, ID 83843, U.S.A. *
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*                               *
*       Ver. 5.208              96 - 2046 *
*****

```

Problem Description : Turkey Creek Inter. Soil Cover 2

SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	680.0	30.0	690.0	4
2	30.0	690.0	68.3	690.0	4
3	68.3	690.0	540.2	808.0	1
4	540.2	808.0	705.3	817.9	1

8 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	68.3	690.0	71.0	690.0	4
2	71.0	690.0	86.8	690.0	3
3	86.8	690.0	540.9	803.6	2
4	540.9	803.6	705.3	813.4	2
5	86.8	690.0	176.8	660.0	3
6	176.8	660.0	705.3	663.4	3
7	71.0	690.0	176.0	655.0	4
8	176.0	655.0	705.3	658.4	4

ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pressure Constant (psf)	Water Surface No.
1	115.0	120.0	500.0	.00	.000	.0	1
2	64.0	64.0	.0	.00	.000	.0	0
3	115.0	130.0	.0	30.00	.000	.0	0
4	125.0	125.0	750.0	35.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 2

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	.0	501.0
2	501.0	501.0
3	6265.0	4281.0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 3 coordinate points

PHREATIC SURFACE,

Point No.	x-water (ft)	y-water (ft)
1	516.50	802.10
2	540.20	808.00
3	705.30	817.90

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface is CIRCULAR, with a radius of 416.86 feet

Center at x = 232.10 ; y = 1128.40 ; Seg. Length = 10.00 feet

The CIRCULAR failure surface was estimated by the following 34 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	171.90	715.91
2	181.81	714.58
3	191.75	713.49
4	201.71	712.64
5	211.69	712.04
6	221.69	711.67
7	231.69	711.54
8	241.69	711.65
9	251.68	712.00
10	261.66	712.59
11	271.63	713.41
12	281.57	714.48
13	291.49	715.79
14	301.37	717.33
15	311.21	719.11
16	321.00	721.13
17	330.74	723.38
18	340.43	725.86
19	350.06	728.57
20	359.61	731.52
21	369.10	734.69
22	378.50	738.09
23	387.82	741.71
24	397.05	745.56

25	406.19	749.63
26	415.22	753.91
27	424.15	758.41
28	432.97	763.12
29	441.68	768.05
30	450.26	773.18
31	458.72	778.51
32	467.05	784.05
33	475.24	789.79
34	479.29	792.77

 SELECTED METHOD OF ANALYSIS: Spencer (1973)

 SUMMARY OF INDIVIDUAL SLICE INFORMATION

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	176.85	715.24	1.90	9.91	-7.62	14.04	2167.
2	182.94	714.46	4.21	2.26	-6.24	14.04	1094.
3	187.91	713.91	6.00	7.68	-6.24	14.04	4755.
4	196.73	713.07	9.05	9.96	-4.87	14.04	8113.
5	206.70	712.34	12.27	9.98	-3.49	14.04	10185.
6	216.69	711.85	15.26	9.99	-2.12	14.04	12107.
7	226.69	711.60	18.00	10.00	-.74	14.04	13873.
8	236.69	711.59	20.51	10.00	.63	14.04	15479.
9	246.68	711.82	22.78	9.99	2.00	14.04	16922.
10	256.67	712.29	24.81	9.98	3.38	14.04	18198.
11	266.65	713.00	26.60	9.97	4.75	14.04	19305.
12	276.60	713.95	28.14	9.94	6.13	14.04	20240.
13	286.53	715.13	29.43	9.91	7.50	14.04	21004.
14	296.43	716.56	30.48	9.88	8.88	14.04	21596.
15	306.29	718.22	31.29	9.84	10.25	14.04	22014.
16	316.10	720.12	31.85	9.79	11.63	14.04	22261.
17	325.87	722.25	32.16	9.74	13.00	14.04	22338.
18	335.59	724.62	32.22	9.69	14.38	14.04	22246.
19	345.24	727.22	32.04	9.62	15.75	14.04	21989.
20	354.83	730.04	31.60	9.56	17.12	14.04	21570.
21	364.35	733.10	30.93	9.48	18.50	14.04	20992.
22	373.80	736.39	30.00	9.40	19.87	14.04	20261.
23	383.16	739.90	28.83	9.32	21.25	14.04	19380.
24	392.44	743.64	27.41	9.23	22.62	14.04	18357.
25	401.62	747.59	25.75	9.14	24.00	14.04	17197.
26	410.71	751.77	23.85	9.04	25.37	14.04	15907.
27	419.69	756.16	21.70	8.93	26.75	14.04	14494.
28	428.56	760.77	19.32	8.82	28.12	14.04	12967.
29	437.32	765.59	16.69	8.70	29.49	14.04	11333.
30	445.97	770.61	13.82	8.58	30.87	14.04	9601.
31	454.49	775.85	10.72	8.46	32.24	14.04	7781.
32	462.88	781.28	7.38	8.33	33.62	14.04	5882.
33	468.24	784.89	5.12	2.39	34.99	14.04	1340.
34	472.33	787.75	3.28	5.81	34.99	14.04	2188.
35	477.26	791.28	.99	4.05	36.37	14.04	459.

Nonlinear M-C Iteration Number - 1

 ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	12.7151	3.3339	3.3454
3	12.7363	3.3341	3.3339

Nonlinear M-C Iteration Number - 2

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	12.7176	3.3371	3.3372

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	12.7176	3.3371	3.3372

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	281.0	500.0	.00	0.	0.	0.	.00
2	547.7	500.0	.00	0.	0.	0.	.00
3	699.7	172.4	33.26	0.	0.	0.	.00
4	902.8	172.4	33.26	0.	0.	0.	.00
5	1113.3	172.4	33.26	0.	0.	0.	.00
6	1303.2	172.4	33.26	0.	0.	0.	.00
7	1473.2	172.4	33.26	0.	0.	0.	.00
8	1623.6	172.4	33.26	0.	0.	0.	.00
9	1755.0	172.4	33.26	0.	0.	0.	.00
10	1867.8	172.4	33.26	0.	0.	0.	.00
11	1962.6	172.4	33.26	0.	0.	0.	.00
12	2039.8	172.4	33.26	0.	0.	0.	.00
13	2099.8	172.4	33.26	0.	0.	0.	.00
14	2143.0	172.4	33.26	0.	0.	0.	.00
15	2170.0	172.4	33.26	0.	0.	0.	.00
16	2181.1	172.4	33.26	0.	0.	0.	.00
17	2176.7	172.4	33.26	0.	0.	0.	.00
18	2157.2	172.4	33.26	0.	0.	0.	.00
19	2123.2	172.4	33.26	0.	0.	0.	.00
20	2074.9	172.4	33.26	0.	0.	0.	.00
21	2012.9	172.4	33.26	0.	0.	0.	.00
22	1937.6	172.4	33.26	0.	0.	0.	.00
23	1849.4	172.4	33.26	0.	0.	0.	.00
24	1748.7	172.4	33.26	0.	0.	0.	.00
25	1636.1	172.4	33.26	0.	0.	0.	.00
26	1512.0	172.4	33.26	0.	0.	0.	.00
27	1376.8	172.4	33.26	0.	0.	0.	.00
28	1231.1	172.4	33.26	0.	0.	0.	.00
29	1075.3	172.4	33.26	0.	0.	0.	.00
30	910.0	172.4	33.26	0.	0.	0.	.00
31	735.7	172.4	33.26	0.	0.	0.	.00
32	553.0	172.4	33.26	0.	0.	0.	.00
33	423.3	501.0	.00	0.	0.	0.	.00
34	264.1	500.0	.00	0.	0.	0.	.00
35	31.6	500.0	.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord	Normal Stress	Vertical Stress	Pore Water Pressure	Shear Stress
---------	--------------	---------------	-----------------	---------------------	--------------

	(ft)	(psf)	(psf)	(psf)	(psf)
1	176.85	281.0	218.7	.0	149.8
2	182.94	547.7	484.0	.0	149.8
3	187.91	699.7	619.0	.0	189.2
4	196.73	902.8	814.2	.0	229.1
5	206.70	1113.3	1020.4	.0	270.5
6	216.69	1303.2	1211.5	.0	307.8
7	226.69	1473.2	1387.4	.0	341.2
8	236.69	1623.6	1548.0	.0	370.7
9	246.68	1755.0	1693.2	.0	396.6
10	256.67	1867.8	1822.9	.0	418.7
11	266.65	1962.6	1937.1	.0	437.4
12	276.60	2039.8	2035.7	.0	452.5
13	286.53	2099.8	2118.6	.0	464.3
14	296.43	2143.0	2185.7	.0	472.8
15	306.29	2170.0	2237.1	.0	478.1
16	316.10	2181.1	2272.8	.0	480.3
17	325.87	2176.7	2292.6	.0	479.4
18	335.59	2157.2	2296.6	.0	475.6
19	345.24	2123.2	2284.7	.0	468.9
20	354.83	2074.9	2257.1	.0	459.4
21	364.35	2012.9	2213.6	.0	447.3
22	373.80	1937.6	2154.4	.0	432.5
23	383.16	1849.4	2079.4	.0	415.1
24	392.44	1748.7	1988.7	.0	395.3
25	401.62	1636.1	1882.4	.0	373.2
26	410.71	1512.0	1760.5	.0	348.8
27	419.69	1376.8	1623.1	.0	322.2
28	428.56	1231.1	1470.2	.0	293.6
29	437.32	1075.3	1302.0	.0	263.0
30	445.97	910.0	1118.6	.0	230.5
31	454.49	735.7	920.0	.0	196.3
32	462.88	553.0	706.3	.0	160.3
33	468.24	423.3	561.4	.0	150.1
34	472.33	264.1	376.8	.0	149.8
35	477.26	31.6	113.3	.0	149.8

 SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	181.81	12.72	1904.	1.78	3.80	.468
2	184.07	12.72	2390.	2.10	4.62	.455
3	191.75	12.72	4482.	3.09	7.38	.419
4	201.71	12.72	7607.	4.28	10.72	.400
5	211.69	12.72	11070.	5.36	13.82	.388
6	221.69	12.72	14717.	6.33	16.69	.379
7	231.69	12.72	18410.	7.21	19.32	.373
8	241.69	12.72	22027.	7.99	21.71	.368
9	251.68	12.72	25461.	8.69	23.86	.364
10	261.66	12.72	28617.	9.31	25.77	.361
11	271.63	12.72	31418.	9.83	27.43	.358
12	281.57	12.72	33798.	10.28	28.85	.356
13	291.49	12.72	35707.	10.63	30.02	.354
14	301.37	12.72	37106.	10.91	30.95	.352
15	311.21	12.72	37970.	11.09	31.63	.351
16	321.00	12.72	38286.	11.20	32.06	.349
17	330.74	12.72	38055.	11.21	32.25	.348
18	340.43	12.72	37288.	11.15	32.19	.346
19	350.06	12.72	36007.	10.99	31.88	.345
20	359.61	12.72	34245.	10.75	31.33	.343
21	369.10	12.72	32045.	10.42	30.53	.341
22	378.50	12.72	29462.	10.00	29.48	.339
23	387.82	12.72	26558.	9.49	28.18	.337
24	397.05	12.72	23403.	8.88	26.65	.333

25	406.19	12.72	20077.	8.18	24.86	.329
26	415.22	12.72	16666.	7.38	22.84	.323
27	424.15	12.72	13265.	6.47	20.57	.315
28	432.97	12.72	9971.	5.44	18.06	.301
29	441.68	12.72	6890.	4.25	15.32	.278
30	450.26	12.72	4132.	2.83	12.33	.230
31	458.72	12.72	1810.	.84	9.11	.092
32	467.05	12.72	40.	-46.29	5.66	-8.182
33	469.43	12.72	-318.	5.37	4.58	1.172
34	475.24	12.72	-526.	1.03	1.97	.525
35	479.29	.00	0.	1.90	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 1508.12 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 351.87 (psf)

Total Length of failure surface = 325.03 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 3.337

Total shear strength available
along specified failure surface = 381.66E+03 lb

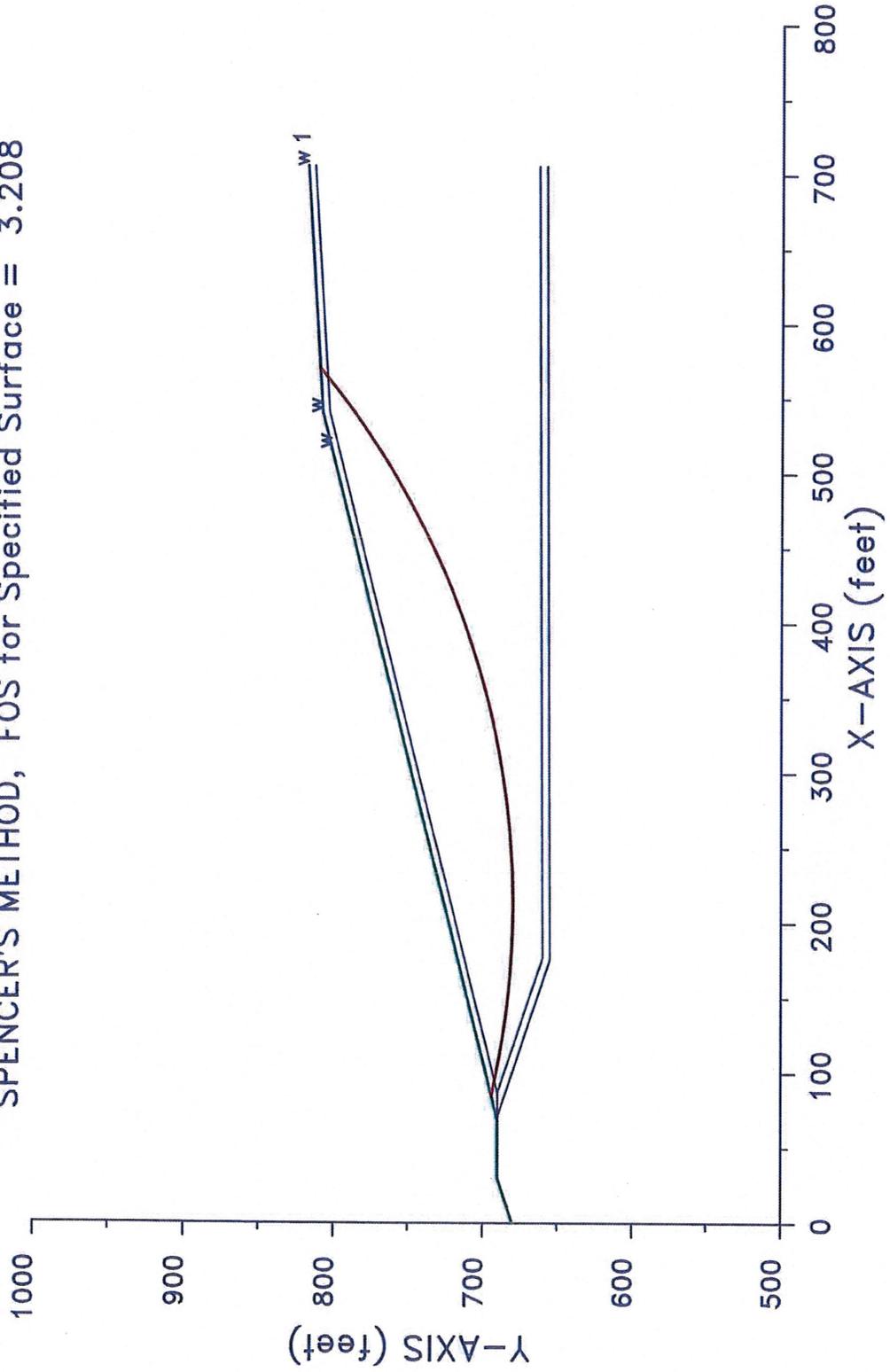
For the specified surface, the analysis computed the following:

Negative (tensile) Normal Effective Force = 0 slices
Negative (tensile) Interslice Force = 2 slices
Unreasonable Location of Interslice Force = 2 slices

In view of these errors, the computed FOS may be UNREASONABLE!

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Turkey Creek Inter. Soil Cover 3
SPENCER'S METHOD, FOS for Specified Surface = 3.208



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*****
*           X S T A B L           *
*           *                     *
*           Slope Stability Analysis *
*           using the               *
*           Method of Slices        *
*           *                     *
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Problem Description : Turkey Creek Inter. Soil Cover 3

 SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	680.0	30.0	690.0	4
2	30.0	690.0	68.3	690.0	4
3	68.3	690.0	540.2	808.0	1
4	540.2	808.0	705.3	817.9	1

8 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	68.3	690.0	71.0	690.0	4
2	71.0	690.0	86.8	690.0	3
3	86.8	690.0	540.9	803.6	2
4	540.9	803.6	705.3	813.4	2
5	86.8	690.0	176.8	660.0	3
6	176.8	660.0	705.3	663.4	3
7	71.0	690.0	176.0	655.0	4
8	176.0	655.0	705.3	658.4	4

 ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	115.0	120.0	500.0	.00	.000	.0	1
2	64.0	64.0	.0	.00	.000	.0	0
3	115.0	130.0	.0	30.00	.000	.0	0
4	125.0	125.0	750.0	35.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 2

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	.0	501.0
2	501.0	501.0
3	6265.0	4281.0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 3 coordinate points

PHREATIC SURFACE,

Point No.	x-water (ft)	y-water (ft)
1	516.50	802.10
2	540.20	808.00
3	705.30	817.90

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface is CIRCULAR, with a radius of 562.23 feet

Center at x = 210.80 ; y = 1242.30 ; Seg. Length = 10.00 feet

The CIRCULAR failure surface was estimated by the following 53 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	85.30	694.25
2	95.06	692.11
3	104.87	690.13
4	114.70	688.34
5	124.57	686.72
6	134.47	685.27
7	144.39	684.00
8	154.33	682.91
9	164.28	681.99
10	174.26	681.25
11	184.24	680.69
12	194.23	680.31
13	204.23	680.10
14	214.23	680.08
15	224.23	680.23
16	234.22	680.55
17	244.21	681.06
18	254.19	681.74
19	264.15	682.60
20	274.10	683.64
21	284.02	684.85
22	293.93	686.24
23	303.80	687.81
24	313.65	689.55

25	323.46	691.47
26	333.24	693.56
27	342.98	695.82
28	352.68	698.26
29	362.34	700.87
30	371.94	703.65
31	381.50	706.60
32	391.00	709.72
33	400.44	713.01
34	409.82	716.47
35	419.14	720.09
36	428.40	723.88
37	437.59	727.83
38	446.70	731.95
39	455.74	736.22
40	464.70	740.66
41	473.58	745.26
42	482.38	750.01
43	491.09	754.92
44	499.72	759.98
45	508.25	765.19
46	516.69	770.56
47	525.03	776.07
48	533.27	781.74
49	541.41	787.54
50	549.45	793.50
51	557.38	799.59
52	565.20	805.82
53	569.99	809.79

 SELECTED METHOD OF ANALYSIS: Spencer (1973)

 SUMMARY OF INDIVIDUAL SLICE INFORMATION

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	90.18	693.18	2.29	9.76	-12.39	14.04	2574.
2	95.11	692.10	4.61	.09	-11.37	14.04	46.
3	100.01	691.11	6.82	9.72	-11.37	14.04	6531.
4	109.79	689.24	11.14	9.84	-10.35	14.04	9331.
5	119.64	687.53	15.31	9.87	-9.33	14.04	11995.
6	129.52	685.99	19.31	9.89	-8.31	14.04	14563.
7	139.43	684.64	23.15	9.92	-7.29	14.04	17033.
8	149.36	683.46	26.81	9.94	-6.27	14.04	19399.
9	159.30	682.45	30.31	9.96	-5.26	14.04	21659.
10	169.27	681.62	33.62	9.97	-4.24	14.04	23809.
11	179.25	680.97	36.77	9.98	-3.22	14.04	25846.
12	189.24	680.50	39.74	9.99	-2.20	14.04	27766.
13	199.23	680.21	42.53	10.00	-1.18	14.04	29568.
14	209.23	680.09	45.15	10.00	-.16	14.04	31249.
15	219.23	680.15	47.59	10.00	.86	14.04	32806.
16	229.23	680.39	49.85	9.99	1.88	14.04	34237.
17	239.22	680.81	51.93	9.99	2.90	14.04	35542.
18	249.20	681.40	53.83	9.98	3.92	14.04	36718.
19	259.17	682.17	55.56	9.96	4.94	14.04	37764.
20	269.12	683.12	57.10	9.95	5.95	14.04	38680.
21	279.06	684.25	58.45	9.93	6.97	14.04	39465.
22	288.97	685.55	59.63	9.90	7.99	14.04	40118.
23	298.86	687.03	60.63	9.88	9.01	14.04	40640.
24	308.73	688.68	61.44	9.85	10.03	14.04	41030.
25	318.56	690.51	62.07	9.81	11.05	14.04	41289.

26	328.35	692.51	62.51	9.78	12.07	14.04	41417.
27	338.11	694.69	62.78	9.74	13.09	14.04	41417.
28	347.83	697.04	62.85	9.70	14.11	14.04	41287.
29	357.51	699.57	62.75	9.65	15.13	14.04	41032.
30	367.14	702.26	62.46	9.61	16.15	14.04	40651.
31	376.72	705.13	61.99	9.55	17.16	14.04	40147.
32	386.25	708.16	61.34	9.50	18.18	14.04	39522.
33	395.72	711.37	60.50	9.44	19.20	14.04	38779.
34	405.13	714.74	59.48	9.38	20.22	14.04	37920.
35	414.48	718.28	58.28	9.32	21.24	14.04	36949.
36	423.77	721.99	56.90	9.25	22.26	14.04	35868.
37	432.99	725.86	55.34	9.19	23.28	14.04	34681.
38	442.14	729.89	53.59	9.11	24.30	14.04	33391.
39	451.22	734.09	51.66	9.04	25.32	14.04	32003.
40	460.22	738.44	49.56	8.96	26.34	14.04	30521.
41	469.14	742.96	47.27	8.88	27.36	14.04	28948.
42	477.98	747.63	44.81	8.80	28.37	14.04	27290.
43	486.74	752.46	42.17	8.71	29.39	14.04	25550.
44	495.41	757.45	39.35	8.62	30.41	14.04	23734.
45	503.98	762.59	36.36	8.53	31.43	14.04	21848.
46	512.38	767.82	33.23	8.25	32.45	14.04	19469.
47	516.59	770.50	31.60	.19	32.45	14.04	431.
48	520.86	773.32	29.85	8.34	33.47	14.04	18073.
49	529.15	778.90	26.33	8.24	34.49	14.04	16003.
50	536.74	784.21	22.93	6.93	35.51	14.04	11939.
51	540.55	786.93	21.09	.70	35.51	3.43	1122.
52	541.16	787.36	20.70	.51	35.51	3.43	808.
53	545.43	790.52	17.79	8.04	36.53	3.43	11151.
54	553.41	796.54	12.25	7.93	37.55	3.43	8190.
55	560.76	802.29	6.95	6.77	38.57	3.43	4694.
56	564.67	805.40	4.06	1.05	38.57	3.43	513.
57	567.59	807.81	1.84	4.79	39.58	3.43	1056.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	12.6439	3.2081	3.2174
3	12.6535	3.2082	3.2081

Nonlinear M-C Iteration Number - 2

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	12.6535	3.2084	3.2081

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	12.6535	3.2084	3.2081

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	350.2	500.0	.00	0.	0.	0.	.00
2	624.1	500.0	.00	0.	0.	0.	.00

3	800.8	172.4	33.26	0.	0.	0.	.00
4	1108.1	172.4	33.26	0.	0.	0.	.00
5	1399.3	172.4	33.26	0.	0.	0.	.00
6	1673.4	172.4	33.26	0.	0.	0.	.00
7	1930.7	172.4	33.26	0.	0.	0.	.00
8	2171.7	172.4	33.26	0.	0.	0.	.00
9	2396.6	172.4	33.26	0.	0.	0.	.00
10	2605.8	172.4	33.26	0.	0.	0.	.00
11	2799.7	172.4	33.26	0.	0.	0.	.00
12	2978.5	172.4	33.26	0.	0.	0.	.00
13	3142.5	172.4	33.26	0.	0.	0.	.00
14	3292.1	172.4	33.26	0.	0.	0.	.00
15	3427.4	172.4	33.26	0.	0.	0.	.00
16	3548.8	172.4	33.26	0.	0.	0.	.00
17	3656.5	172.4	33.26	0.	0.	0.	.00
18	3750.8	172.4	33.26	0.	0.	0.	.00
19	3831.8	172.4	33.26	0.	0.	0.	.00
20	3900.0	172.4	33.26	0.	0.	0.	.00
21	3955.4	172.4	33.26	0.	0.	0.	.00
22	3998.4	172.4	33.26	0.	0.	0.	.00
23	4029.1	172.4	33.26	0.	0.	0.	.00
24	4047.9	172.4	33.26	0.	0.	0.	.00
25	4054.9	172.4	33.26	0.	0.	0.	.00
26	4050.3	172.4	33.26	0.	0.	0.	.00
27	4034.5	172.4	33.26	0.	0.	0.	.00
28	4007.6	172.4	33.26	0.	0.	0.	.00
29	3969.9	172.4	33.26	0.	0.	0.	.00
30	3921.5	172.4	33.26	0.	0.	0.	.00
31	3862.8	172.4	33.26	0.	0.	0.	.00
32	3794.0	172.4	33.26	0.	0.	0.	.00
33	3715.2	172.4	33.26	0.	0.	0.	.00
34	3626.8	172.4	33.26	0.	0.	0.	.00
35	3529.0	172.4	33.26	0.	0.	0.	.00
36	3422.0	172.4	33.26	0.	0.	0.	.00
37	3306.0	172.4	33.26	0.	0.	0.	.00
38	3181.4	172.4	33.26	0.	0.	0.	.00
39	3048.4	172.4	33.26	0.	0.	0.	.00
40	2907.2	172.4	33.26	0.	0.	0.	.00
41	2758.1	172.4	33.26	0.	0.	0.	.00
42	2601.3	172.4	33.26	0.	0.	0.	.00
43	2437.3	172.4	33.26	0.	0.	0.	.00
44	2266.1	172.4	33.26	0.	0.	0.	.00
45	2088.2	172.4	33.26	0.	0.	0.	.00
46	1905.6	172.4	33.26	0.	0.	0.	.00
47	1840.7	172.4	33.26	0.	0.	0.	.00
48	1732.7	172.4	33.26	0.	11.	0.	.00
49	1535.5	172.4	33.26	0.	7.	0.	.00
50	1347.1	172.4	33.26	0.	2.	0.	.00
51	1250.8	172.4	33.26	0.	0.	0.	.00
52	1227.7	172.4	33.26	0.	0.	0.	.00
53	1069.3	172.4	33.26	0.	0.	0.	.00
54	781.8	172.4	33.26	0.	0.	0.	.00
55	511.4	172.4	33.26	0.	0.	0.	.00
56	85.2	500.0	.00	340.	0.	0.	.00
57	-7.4	500.0	.00	710.	0.	0.	.00

 SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	90.18	350.2	263.7	.0	155.8
2	95.11	624.1	529.6	.0	155.8
3	100.01	800.8	672.1	.0	217.4
4	109.79	1108.1	948.6	.0	280.2
5	119.64	1399.3	1215.6	.0	339.8
6	129.52	1673.4	1471.8	.0	395.8

7	139.43	1930.7	1717.2	.0	448.4
8	149.36	2171.7	1951.6	.0	497.6
9	159.30	2396.6	2175.1	.0	543.6
10	169.27	2605.8	2387.4	.0	586.4
11	179.25	2799.7	2588.7	.0	626.0
12	189.24	2978.5	2778.7	.0	662.6
13	199.23	3142.5	2957.4	.0	696.1
14	209.23	3292.1	3124.9	.0	726.6
15	219.23	3427.4	3280.9	.0	754.3
16	229.23	3548.8	3425.6	.0	779.1
17	239.22	3656.5	3558.7	.0	801.1
18	249.20	3750.8	3680.4	.0	820.4
19	259.17	3831.8	3790.5	.0	837.0
20	269.12	3900.0	3889.0	.0	850.9
21	279.06	3955.4	3975.9	.0	862.2
22	288.97	3998.4	4051.2	.0	871.0
23	298.86	4029.1	4114.8	.0	877.3
24	308.73	4047.9	4166.7	.0	881.1
25	318.56	4054.9	4206.9	.0	882.6
26	328.35	4050.3	4235.4	.0	881.6
27	338.11	4034.5	4252.1	.0	878.4
28	347.83	4007.6	4257.1	.0	872.9
29	357.51	3969.9	4250.4	.0	865.2
30	367.14	3921.5	4232.0	.0	855.3
31	376.72	3862.8	4201.8	.0	843.3
32	386.25	3794.0	4160.0	.0	829.2
33	395.72	3715.2	4106.4	.0	813.1
34	405.13	3626.8	4041.1	.0	795.1
35	414.48	3529.0	3964.2	.0	775.1
36	423.77	3422.0	3875.6	.0	753.2
37	432.99	3306.0	3775.4	.0	729.5
38	442.14	3181.4	3663.7	.0	704.0
39	451.22	3048.4	3540.4	.0	676.8
40	460.22	2907.2	3405.6	.0	648.0
41	469.14	2758.1	3259.3	.0	617.5
42	477.98	2601.3	3101.6	.0	585.5
43	486.74	2437.3	2932.5	.0	551.9
44	495.41	2266.1	2752.1	.0	516.9
45	503.98	2088.2	2560.5	.0	480.6
46	512.38	1905.6	2360.0	.0	443.3
47	516.59	1840.7	2280.3	.0	430.0
48	520.86	1732.7	2167.9	.0	407.9
49	529.15	1535.5	1942.3	.0	367.6
50	536.74	1347.1	1723.8	.0	329.1
51	540.55	1250.8	1602.4	.0	309.4
52	541.16	1227.7	1573.3	.0	304.7
53	545.43	1069.3	1387.6	.0	272.3
54	553.41	781.8	1032.9	.0	213.6
55	560.76	511.4	693.6	.0	158.3
56	564.67	337.8	487.5	252.6	155.8
57	567.59	106.8	220.5	114.2	155.8

 SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	95.06	12.65	2329.	2.17	4.59	.473
2	95.15	12.65	2354.	2.18	4.63	.472
3	104.87	12.65	6123.	3.70	9.01	.411
4	114.70	12.65	10989.	5.18	13.27	.391
5	124.57	12.65	16751.	6.58	17.35	.379
6	134.47	12.65	23244.	7.90	21.27	.371
7	144.39	12.65	30314.	9.15	25.02	.365
8	154.33	12.65	37816.	10.33	28.60	.361
9	164.28	12.65	45614.	11.45	32.01	.358
10	174.26	12.65	53580.	12.50	35.24	.355

11	184.24	12.65	61596.	13.50	38.30	.352
12	194.23	12.65	69552.	14.43	41.18	.350
13	204.23	12.65	77348.	15.31	43.89	.349
14	214.23	12.65	84889.	16.12	46.41	.347
15	224.23	12.65	92092.	16.87	48.77	.346
16	234.22	12.65	98881.	17.57	50.94	.345
17	244.21	12.65	105187.	18.20	52.93	.344
18	254.19	12.65	110950.	18.77	54.74	.343
19	264.15	12.65	116117.	19.28	56.37	.342
20	274.10	12.65	120644.	19.74	57.82	.341
21	284.02	12.65	124494.	20.13	59.09	.341
22	293.93	12.65	127636.	20.45	60.17	.340
23	303.80	12.65	130048.	20.72	61.08	.339
24	313.65	12.65	131715.	20.93	61.80	.339
25	323.46	12.65	132627.	21.07	62.34	.338
26	333.24	12.65	132783.	21.15	62.69	.337
27	342.98	12.65	132189.	21.17	62.86	.337
28	352.68	12.65	130854.	21.13	62.85	.336
29	362.34	12.65	128797.	21.02	62.65	.335
30	371.94	12.65	126040.	20.85	62.27	.335
31	381.50	12.65	122615.	20.62	61.71	.334
32	391.00	12.65	118555.	20.32	60.97	.333
33	400.44	12.65	113901.	19.96	60.04	.332
34	409.82	12.65	108699.	19.53	58.93	.331
35	419.14	12.65	102999.	19.04	57.64	.330
36	428.40	12.65	96858.	18.49	56.16	.329
37	437.59	12.65	90335.	17.86	54.51	.328
38	446.70	12.65	83495.	17.18	52.67	.326
39	455.74	12.65	76405.	16.42	50.66	.324
40	464.70	12.65	69138.	15.59	48.46	.322
41	473.58	12.65	61770.	14.70	46.09	.319
42	482.38	12.65	54379.	13.73	43.53	.315
43	491.09	12.65	47048.	12.69	40.81	.311
44	499.72	12.65	39860.	11.57	37.90	.305
45	508.25	12.65	32902.	10.37	34.82	.298
46	516.50	12.65	26404.	9.11	31.64	.288
47	516.69	12.65	26261.	9.08	31.56	.288
48	525.03	12.65	19958.	7.74	28.13	.275
49	533.27	12.65	14153.	6.32	24.53	.258
50	540.20	12.65	9666.	5.08	21.32	.238
51	540.90	12.65	9248.	4.96	20.86	.238
52	541.41	12.65	8948.	4.87	20.53	.237
53	549.45	12.65	4668.	3.28	15.06	.218
54	557.38	12.65	1520.	1.26	9.44	.133
55	564.14	12.65	-210.	3.06	4.45	.688
56	565.20	12.65	-333.	1.44	3.67	.392
57	569.99	.00	-1.	1.34	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 2797.11 (psf)
Pore Water Pressure = 2.03 (psf)
Shear Stress = 626.70 (psf)

Total Length of failure surface = 516.21 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 3.208

Total shear strength available
along specified failure surface = 103.80E+04 lb

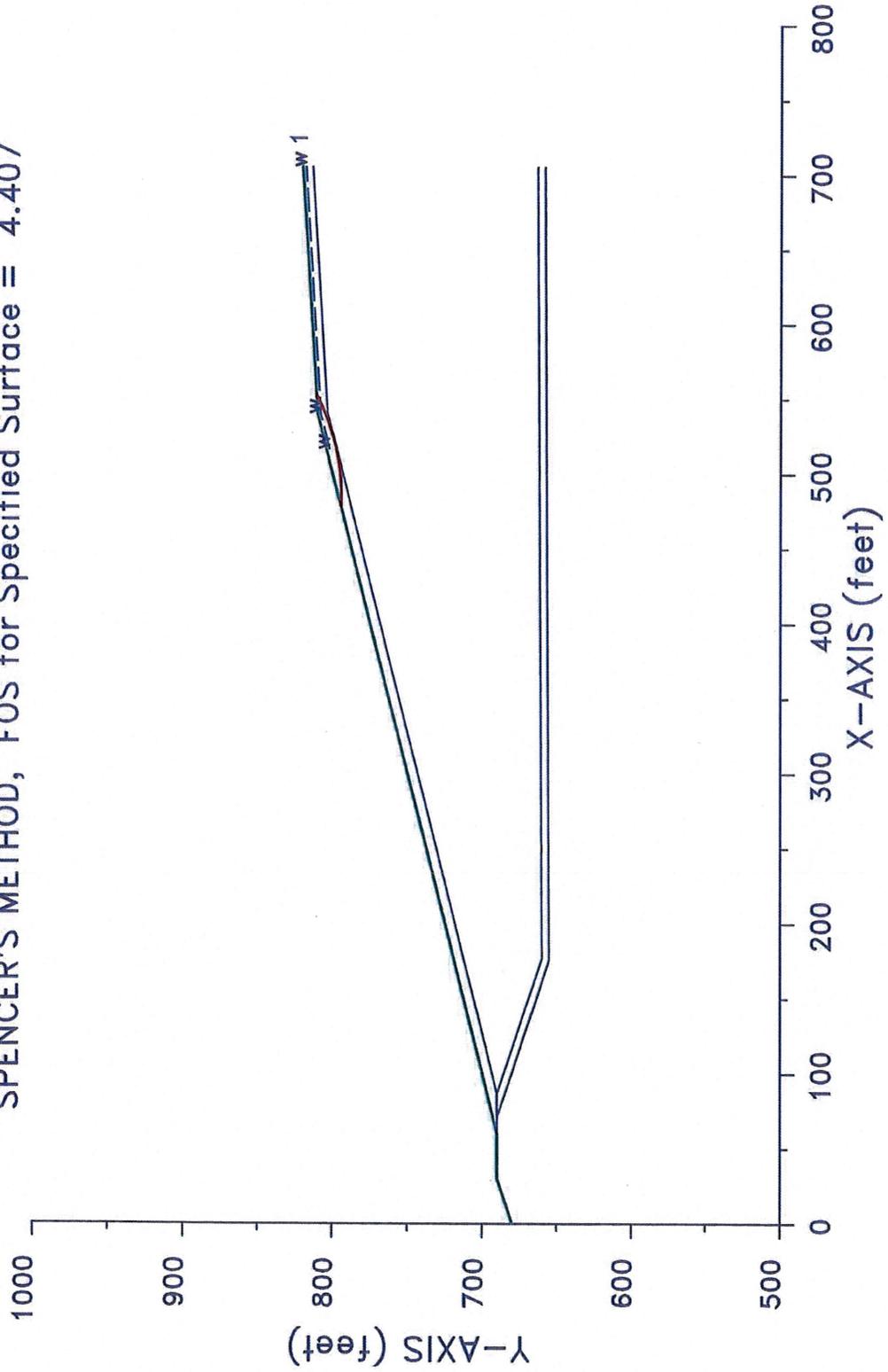
For the specified surface, the analysis computed the following:

Negative (tensile) Normal Effective Force = 0 slices
Negative (tensile) Interslice Force = 2 slices
Unreasonable Location of Interslice Force = 0 slices

In view of these errors, the computed FOS may be UNREASONABLE!

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Turkey Creek Final Cover 1
SPENCER'S METHOD, FOS for Specified Surface = 4.407



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*           X S T A B L           *
*           *                       *
*           Slope Stability Analysis *
*           using the               *
*           Method of Slices        *
*           *                       *
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Problem Description : Turkey Creek Final Cover 1

SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	680.0	30.0	690.0	4
2	30.0	690.0	60.0	690.0	4
3	60.0	690.0	539.9	810.0	1
4	539.9	810.0	705.3	819.9	1

8 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	690.0	71.0	690.0	4
2	71.0	690.0	86.8	690.0	3
3	86.8	690.0	540.9	803.5	2
4	540.9	803.5	705.3	813.4	2
5	86.8	690.0	176.8	660.0	3
6	176.8	660.0	705.3	663.4	3
7	71.0	690.0	176.0	655.0	4
8	176.0	655.0	705.3	658.4	4

ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	115.0	120.0	500.0	.00	.000	.0	1
2	64.0	64.0	.0	.00	.000	.0	0
3	115.0	130.0	.0	30.00	.000	.0	0
4	125.0	125.0	750.0	35.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 2

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	.0	501.0
2	501.0	501.0
3	6265.0	4281.0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 3 coordinate points

PHREATIC SURFACE,

Point No.	x-water (ft)	y-water (ft)
1	516.50	802.10
2	540.20	808.00
3	705.30	817.90

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface is CIRCULAR, with a radius of 138.23 feet

Center at x = 487.20 ; y = 932.60 ; Seg. Length = 10.00 feet

The CIRCULAR failure surface was estimated by the following 9 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	478.50	794.65
2	488.50	794.38
3	498.48	794.83
4	508.42	796.01
5	518.24	797.90
6	527.89	800.50
7	537.34	803.79
8	546.52	807.75
9	552.27	810.74

SELECTED METHOD OF ANALYSIS: Spencer (1973)

SUMMARY OF INDIVIDUAL SLICE INFORMATION

Slice x-base y-base height width alpha beta weight

	(ft)	(ft)	(ft)	(ft)			(lb)
1	483.50	794.51	1.38	10.00	-1.54	14.04	1590.
2	493.49	794.61	3.79	9.99	2.61	14.04	4352.
3	503.45	795.42	5.46	9.93	6.76	14.04	6239.
4	512.46	796.79	6.35	8.08	10.90	14.04	5903.
5	517.37	797.73	6.63	1.74	10.90	14.04	1363.
6	523.06	799.20	6.59	9.66	15.05	14.04	7538.
7	532.61	802.14	6.04	9.44	19.19	14.04	6743.
8	538.62	804.34	5.34	2.56	23.34	14.04	1616.
9	540.05	804.96	5.05	.30	23.34	3.43	179.
10	543.36	806.38	3.82	6.32	23.34	3.43	2834.
11	547.20	808.10	2.33	1.37	27.49	3.43	370.
12	550.08	809.60	1.01	4.38	27.49	3.43	508.

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	8.9958	4.4070	4.4276
3	8.9850	4.4070	4.4070

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	180.9	500.0	.00	0.	0.	0.	.00
2	445.3	500.0	.00	0.	0.	0.	.00
3	621.1	500.0	.00	0.	0.	0.	.00
4	704.8	500.0	.00	0.	0.	0.	.00
5	489.3	500.0	.00	476.	0.	0.	.00
6	470.2	500.0	.00	2664.	0.	0.	.00
7	423.1	500.0	.00	2333.	0.	0.	.00
8	369.2	500.0	.00	536.	0.	0.	.00
9	352.3	500.0	.00	58.	0.	0.	.00
10	278.7	500.0	.00	772.	0.	0.	.00
11	191.8	500.0	.00	30.	0.	0.	.00
12	69.2	500.0	.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	483.50	180.9	159.1	.0	113.5
2	493.49	445.3	435.7	.0	113.5
3	503.45	621.1	628.3	.0	113.5
4	512.46	704.8	730.1	.0	113.5
5	517.37	758.5	785.5	269.2	113.5
6	523.06	736.7	780.5	266.4	113.5
7	532.61	656.3	714.0	233.3	113.5
8	538.62	561.2	630.5	192.0	113.5
9	540.05	528.9	596.1	176.6	113.5
10	543.36	390.9	448.6	112.2	113.5
11	547.20	211.4	269.9	19.6	113.5
12	550.08	69.2	116.0	.0	113.5

SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord	Force Angle	Interslice Force	Force Height	Boundary Height	Height Ratio
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	(ft)	(degrees)	(lb)	(ft)	(ft)	
1	488.50	8.98	1197.	.92	2.77	.334
2	498.48	8.98	2139.	1.39	4.81	.290
3	508.42	8.98	2540.	1.54	6.12	.251
4	516.50	8.98	2358.	1.37	6.58	.208
5	518.24	8.98	2301.	1.34	6.68	.200
6	527.89	8.98	1474.	.72	6.50	.111
7	537.34	8.98	374.	-1.59	5.57	-.285
8	539.90	8.98	40.	-18.58	5.11	-3.638
9	540.20	8.98	5.	-150.77	5.00	-30.175
10	546.52	8.98	-348.	1.28	2.65	.482
11	547.89	8.98	-344.	.79	2.02	.393
12	552.27	.00	0.	-.28	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 595.06 (psf)
Pore Water Pressure = 89.81 (psf)
Shear Stress = 113.46 (psf)

Total Length of failure surface = 76.48 feet

For the single specified surface and the assumed angle of the interslice forces, the SPENCER'S (1973) procedure gives a

FACTOR OF SAFETY = 4.407

Total shear strength available
along specified failure surface = 382.42E+02 lb

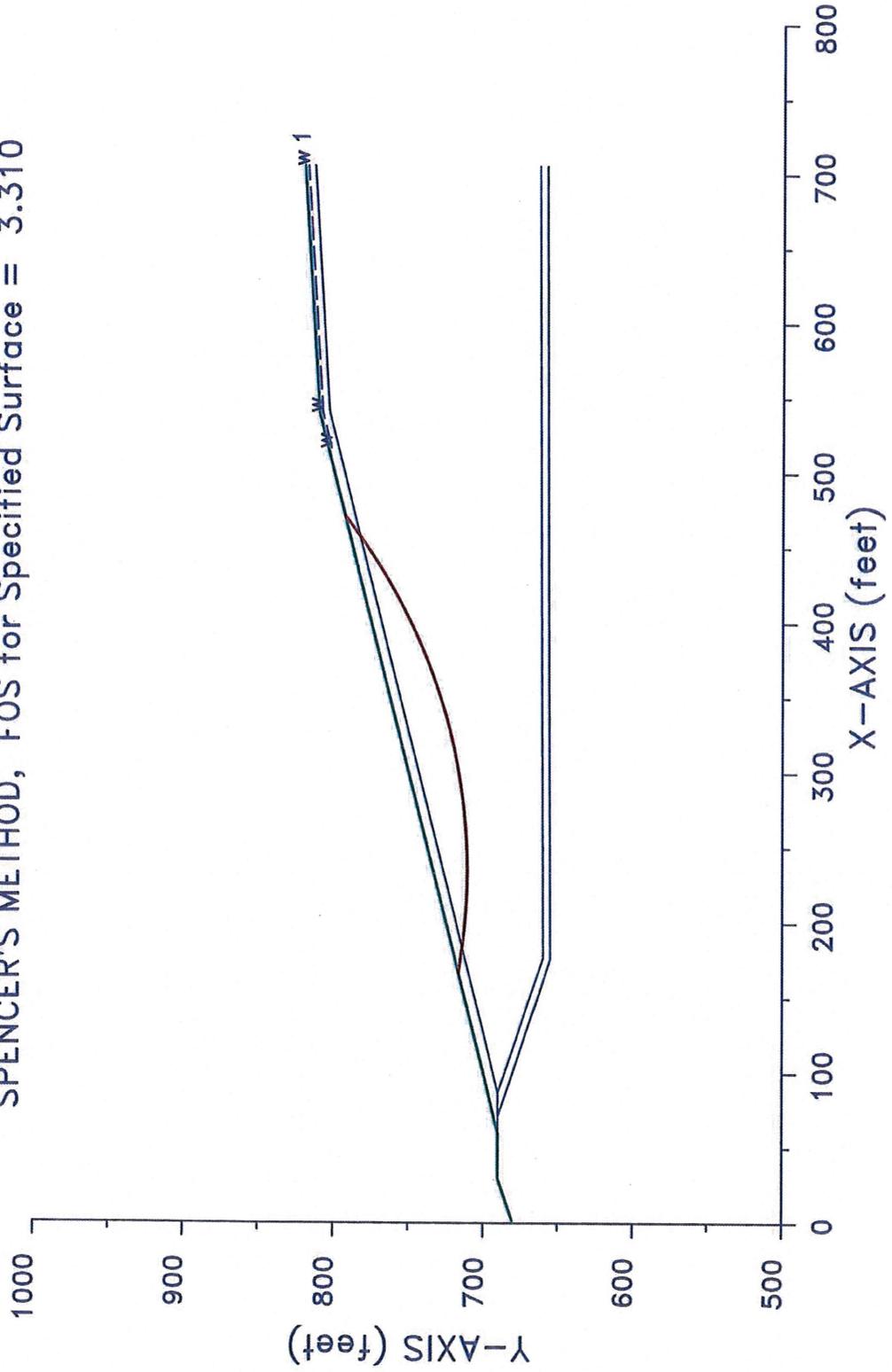
For the specified surface, the analysis computed the following:

Negative (tensile) Normal Effective Force = 0 slices
Negative (tensile) Interslice Force = 2 slices
Unreasonable Location of Interslice Force = 3 slices

In view of these errors, the computed FOS may be UNREASONABLE!

TCL-F2 3-13-17 18:37

Turkey Creek Final Cover 2
SPENCER'S METHOD, FOS for Specified Surface = 3.310



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*****
*           X S T A B L           *
*                               *
*      Slope Stability Analysis   *
*      using the                 *
*      Method of Slices         *
*                               *
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Problem Description : Turkey Creek Final Cover 2

 SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	680.0	30.0	690.0	4
2	30.0	690.0	60.0	690.0	4
3	60.0	690.0	539.9	810.0	1
4	539.9	810.0	705.3	819.9	1

8 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	690.0	71.0	690.0	4
2	71.0	690.0	86.8	690.0	3
3	86.8	690.0	540.9	803.5	2
4	540.9	803.5	705.3	813.4	2
5	86.8	690.0	176.8	660.0	3
6	176.8	660.0	705.3	663.4	3
7	71.0	690.0	176.0	655.0	4
8	176.0	655.0	705.3	658.4	4

 ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight (pcf)	Moist Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	115.0	120.0	500.0	.00	.000	.0	1
2	64.0	64.0	.0	.00	.000	.0	0
3	115.0	130.0	.0	30.00	.000	.0	0
4	125.0	125.0	750.0	35.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 2

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	.0	501.0
2	501.0	501.0
3	6265.0	4281.0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 3 coordinate points

PHREATIC SURFACE,

Point No.	x-water (ft)	y-water (ft)
1	516.50	802.10
2	540.20	808.00
3	705.30	817.90

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface is CIRCULAR, with a radius of 385.07 feet

Center at x = 233.70 ; y = 1096.00 ; Seg. Length = 10.00 feet

The CIRCULAR failure surface was estimated by the following 34 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	167.00	716.76
2	176.87	715.15
3	186.78	713.80
4	196.72	712.71
5	206.68	711.88
6	216.67	711.31
7	226.66	711.00
8	236.66	710.95
9	246.66	711.15
10	256.65	711.62
11	266.62	712.34
12	276.57	713.33
13	286.50	714.57
14	296.38	716.07
15	306.23	717.83
16	316.02	719.84
17	325.76	722.10
18	335.44	724.62
19	345.05	727.39
20	354.59	730.40
21	364.04	733.66
22	373.40	737.17
23	382.67	740.92
24	391.84	744.91

25	400.91	749.13
26	409.86	753.59
27	418.69	758.28
28	427.40	763.20
29	435.97	768.34
30	444.41	773.70
31	452.71	779.28
32	460.86	785.08
33	468.86	791.08
34	470.99	792.77

 SELECTED METHOD OF ANALYSIS: Spencer (1973)

 SUMMARY OF INDIVIDUAL SLICE INFORMATION

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	171.93	715.95	2.04	9.87	-9.23	14.04	2310.
2	180.29	714.69	5.39	6.84	-7.74	14.04	4241.
3	185.24	714.01	7.30	3.07	-7.74	14.04	2485.
4	191.75	713.26	9.68	9.94	-6.26	14.04	9564.
5	201.70	712.30	13.13	9.97	-4.77	14.04	11788.
6	211.67	711.60	16.33	9.98	-3.28	14.04	13852.
7	221.66	711.16	19.27	10.00	-1.79	14.04	15749.
8	231.66	710.97	21.95	10.00	-.30	14.04	17474.
9	241.66	711.05	24.37	10.00	1.18	14.04	19022.
10	251.65	711.39	26.54	9.99	2.67	14.04	20388.
11	261.63	711.98	28.44	9.97	4.16	14.04	21570.
12	271.60	712.84	30.07	9.95	5.65	14.04	22565.
13	281.53	713.95	31.45	9.92	7.14	14.04	23371.
14	291.44	715.32	32.55	9.89	8.62	14.04	23987.
15	301.30	716.95	33.39	9.84	10.11	14.04	24414.
16	311.12	718.83	33.96	9.80	11.60	14.04	24652.
17	320.89	720.97	34.27	9.74	13.09	14.04	24702.
18	330.60	723.36	34.30	9.68	14.58	14.04	24569.
19	340.25	726.00	34.07	9.61	16.06	14.04	24253.
20	349.82	728.89	33.58	9.53	17.55	14.04	23760.
21	359.31	732.03	32.81	9.45	19.04	14.04	23095.
22	368.72	735.42	31.78	9.36	20.53	14.04	22262.
23	378.04	739.05	30.48	9.27	22.02	14.04	21268.
24	387.26	742.91	28.92	9.17	23.50	14.04	20121.
25	396.38	747.02	27.09	9.06	24.99	14.04	18828.
26	405.38	751.36	25.00	8.95	26.48	14.04	17397.
27	414.27	755.94	22.65	8.83	27.97	14.04	15838.
28	423.04	760.74	20.04	8.71	29.46	14.04	14159.
29	431.69	765.77	17.17	8.58	30.94	14.04	12373.
30	440.19	771.02	14.05	8.44	32.43	14.04	10488.
31	448.56	776.49	10.67	8.30	33.92	14.04	8517.
32	455.07	780.96	7.83	4.72	35.41	14.04	3983.
33	459.15	783.86	5.95	3.44	35.41	14.04	2350.
34	464.86	788.08	3.16	8.00	36.90	14.04	2903.
35	469.92	791.93	.58	2.13	38.38	14.04	141.

Nonlinear M-C Iteration Number - 1

 ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	12.7718	3.3093	3.3218
3	12.7941	3.3095	3.3093

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	12.7941	3.3095	3.3093

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	304.2	500.0	.00	0.	0.	0.	.00
2	696.4	500.0	.00	0.	0.	0.	.00
3	923.7	172.4	33.26	0.	0.	0.	.00
4	1078.5	172.4	33.26	0.	0.	0.	.00
5	1304.0	172.4	33.26	0.	0.	0.	.00
6	1506.8	172.4	33.26	0.	0.	0.	.00
7	1687.6	172.4	33.26	0.	0.	0.	.00
8	1846.8	172.4	33.26	0.	0.	0.	.00
9	1985.2	172.4	33.26	0.	0.	0.	.00
10	2103.4	172.4	33.26	0.	0.	0.	.00
11	2201.7	172.4	33.26	0.	0.	0.	.00
12	2280.9	172.4	33.26	0.	0.	0.	.00
13	2341.3	172.4	33.26	0.	0.	0.	.00
14	2383.6	172.4	33.26	0.	0.	0.	.00
15	2408.2	172.4	33.26	0.	0.	0.	.00
16	2415.5	172.4	33.26	0.	0.	0.	.00
17	2406.2	172.4	33.26	0.	0.	0.	.00
18	2380.7	172.4	33.26	0.	0.	0.	.00
19	2339.5	172.4	33.26	0.	0.	0.	.00
20	2283.0	172.4	33.26	0.	0.	0.	.00
21	2211.9	172.4	33.26	0.	0.	0.	.00
22	2126.5	172.4	33.26	0.	0.	0.	.00
23	2027.5	172.4	33.26	0.	0.	0.	.00
24	1915.3	172.4	33.26	0.	0.	0.	.00
25	1790.5	172.4	33.26	0.	0.	0.	.00
26	1653.6	172.4	33.26	0.	0.	0.	.00
27	1505.2	172.4	33.26	0.	0.	0.	.00
28	1345.9	172.4	33.26	0.	0.	0.	.00
29	1176.2	172.4	33.26	0.	0.	0.	.00
30	996.9	172.4	33.26	0.	0.	0.	.00
31	808.4	172.4	33.26	0.	0.	0.	.00
32	651.8	172.4	33.26	0.	0.	0.	.00
33	526.2	500.0	.00	0.	0.	0.	.00
34	242.5	500.0	.00	0.	0.	0.	.00
35	-16.1	500.0	.00	0.	0.	0.	.00

SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	171.93	304.2	234.1	.0	151.1
2	180.29	696.4	620.0	.0	151.1
3	185.24	923.7	809.8	.0	235.1
4	191.75	1078.5	962.1	.0	265.8
5	201.70	1304.0	1182.9	.0	310.5
6	211.67	1506.8	1387.5	.0	350.7
7	221.66	1687.6	1575.7	.0	386.5
8	231.66	1846.8	1747.5	.0	418.1
9	241.66	1985.2	1902.6	.0	445.5

10	251.65	2103.4	2041.1	.0	468.9
11	261.63	2201.7	2162.7	.0	488.4
12	271.60	2280.9	2267.5	.0	504.1
13	281.53	2341.3	2355.3	.0	516.1
14	291.44	2383.6	2426.1	.0	524.4
15	301.30	2408.2	2479.9	.0	529.3
16	311.12	2415.5	2516.6	.0	530.8
17	320.89	2406.2	2536.1	.0	528.9
18	330.60	2380.7	2538.6	.0	523.9
19	340.25	2339.5	2523.9	.0	515.7
20	349.82	2283.0	2492.0	.0	504.5
21	359.31	2211.9	2443.1	.0	490.4
22	368.72	2126.5	2377.1	.0	473.5
23	378.04	2027.5	2294.1	.0	453.9
24	387.26	1915.3	2194.2	.0	431.6
25	396.38	1790.5	2077.3	.0	406.9
26	405.38	1653.6	1943.6	.0	379.8
27	414.27	1505.2	1793.2	.0	350.4
28	423.04	1345.9	1626.1	.0	318.8
29	431.69	1176.2	1442.6	.0	285.2
30	440.19	996.9	1242.6	.0	249.6
31	448.56	808.4	1026.4	.0	212.3
32	455.07	651.8	844.8	.0	181.3
33	459.15	526.2	684.2	.0	151.1
34	464.86	242.5	363.0	.0	151.1
35	469.92	-16.1	66.4	.0	151.1

 SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	176.87	12.79	2029.	1.92	4.07	.472
2	183.71	12.79	3753.	2.95	6.71	.440
3	186.78	12.79	4888.	3.25	7.90	.412
4	196.72	12.79	8803.	4.41	11.47	.384
5	206.68	12.79	13087.	5.55	14.79	.375
6	216.67	12.79	17561.	6.62	17.86	.370
7	226.66	12.79	22064.	7.58	20.67	.367
8	236.66	12.79	26451.	8.46	23.23	.364
9	246.66	12.79	30598.	9.24	25.52	.362
10	256.65	12.79	34395.	9.92	27.55	.360
11	266.62	12.79	37752.	10.51	29.32	.358
12	276.57	12.79	40594.	11.00	30.83	.357
13	286.50	12.79	42862.	11.40	32.06	.356
14	296.38	12.79	44514.	11.71	33.04	.355
15	306.23	12.79	45521.	11.93	33.74	.353
16	316.02	12.79	45872.	12.05	34.18	.353
17	325.76	12.79	45567.	12.08	34.35	.352
18	335.44	12.79	44621.	12.01	34.26	.351
19	345.05	12.79	43065.	11.85	33.89	.350
20	354.59	12.79	40937.	11.59	33.26	.349
21	364.04	12.79	38291.	11.24	32.36	.347
22	373.40	12.79	35191.	10.79	31.20	.346
23	382.67	12.79	31712.	10.24	29.77	.344
24	391.84	12.79	27938.	9.59	28.07	.341
25	400.91	12.79	23962.	8.83	26.11	.338
26	409.86	12.79	19887.	7.96	23.89	.333
27	418.69	12.79	15821.	6.98	21.41	.326
28	427.40	12.79	11881.	5.87	18.67	.314
29	435.97	12.79	8187.	4.60	15.67	.294
30	444.41	12.79	4865.	3.12	12.42	.251
31	452.71	12.79	2046.	1.18	8.91	.132
32	457.43	12.79	681.	-1.03	6.74	-.153
33	460.86	12.79	-104.	11.38	5.16	2.207
34	468.86	12.79	-358.	.60	1.15	.521
35	470.99	.00	0.	-1.54	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 1686.29 (psf)
Pore Water Pressure = .00 (psf)
Shear Stress = 388.99 (psf)

Total Length of failure surface = 322.71 feet

For the single specified surface and the assumed angle
of the interslice forces, the SPENCER'S (1973)
procedure gives a

FACTOR OF SAFETY = 3.310

Total shear strength available
along specified failure surface = 415.44E+03 lb

For the specified surface, the analysis computed the following:

Negative (tensile) Normal Effective Force = 0 slices
Negative (tensile) Interslice Force = 2 slices
Unreasonable Location of Interslice Force = 2 slices

In view of these errors, the computed FOS may be UNREASONABLE!

```

*****
*           X S T A B L           *
*           Slope Stability Analysis *
*           using the               *
*           Method of Slices        *
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*****
    
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Problem Description : Turkey Creek Final Cover 3

 SEGMENT BOUNDARY COORDINATES

4 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	680.0	30.0	690.0	4
2	30.0	690.0	60.0	690.0	4
3	60.0	690.0	539.9	810.0	1
4	539.9	810.0	705.3	819.9	1

8 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	60.0	690.0	71.0	690.0	4
2	71.0	690.0	86.8	690.0	3
3	86.8	690.0	540.9	803.5	2
4	540.9	803.5	705.3	813.4	2
5	86.8	690.0	176.8	660.0	3
6	176.8	660.0	705.3	663.4	3
7	71.0	690.0	176.0	655.0	4
8	176.0	655.0	705.3	658.4	4

 ISOTROPIC Soil Parameters

4 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pressure Constant (psf)	Water Surface No.
1	115.0	120.0	500.0	.00	.000	.0	1
2	64.0	64.0	.0	.00	.000	.0	0
3	115.0	130.0	.0	30.00	.000	.0	0
4	125.0	125.0	750.0	35.00	.000	.0	0

NON-LINEAR MOHR-COULOMB envelope has been specified for 1 soil(s)

Soil Unit # 2

Point No.	Normal Stress (psf)	Shear Stress (psf)
1	.0	501.0
2	501.0	501.0
3	6265.0	4281.0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 3 coordinate points

PHREATIC SURFACE,

Point No.	x-water (ft)	y-water (ft)
1	516.50	802.10
2	540.20	808.00
3	705.30	817.90

A SINGLE FAILURE SURFACE HAS BEEN SPECIFIED FOR ANALYSIS

Trial failure surface is CIRCULAR, with a radius of 439.68 feet

Center at x = 237.10 ; y = 1114.90 ; Seg. Length = 10.00 feet

The CIRCULAR failure surface was estimated by the following 51 coordinate points :

Point No.	x-surf (ft)	y-surf (ft)
1	95.10	698.78
2	104.60	695.66
3	114.17	692.75
4	123.80	690.06
5	133.49	687.60
6	143.23	685.35
7	153.03	683.33
8	162.86	681.53
9	172.74	679.95
10	182.65	678.60
11	192.58	677.47
12	202.54	676.58
13	212.52	675.90
14	222.51	675.46
15	232.51	675.24
16	242.51	675.25
17	252.50	675.49
18	262.49	675.95
19	272.47	676.64
20	282.43	677.56
21	292.36	678.70
22	302.27	680.07
23	312.14	681.67
24	321.97	683.48

25	331.76	685.53
26	341.50	687.79
27	351.19	690.28
28	360.82	692.98
29	370.38	695.90
30	379.87	699.04
31	389.30	702.40
32	398.64	705.96
33	407.90	709.74
34	417.07	713.73
35	426.14	717.93
36	435.12	722.33
37	444.00	726.94
38	452.77	731.74
39	461.43	736.75
40	469.97	741.95
41	478.39	747.34
42	486.69	752.92
43	494.85	758.69
44	502.89	764.64
45	510.78	770.78
46	518.54	777.09
47	526.15	783.58
48	533.61	790.24
49	540.92	797.07
50	548.07	804.06
51	554.74	810.89

 SELECTED METHOD OF ANALYSIS: Spencer (1973)

 SUMMARY OF INDIVIDUAL SLICE INFORMATION

Slice	x-base (ft)	y-base (ft)	height (ft)	width (ft)	alpha	beta	weight (lb)
1	99.85	697.22	2.75	9.50	-18.19	14.04	3001.
2	105.69	695.32	6.10	2.18	-16.89	14.04	1530.
3	110.47	693.87	8.75	7.39	-16.89	14.04	6661.
4	118.98	691.41	13.34	9.63	-15.58	14.04	11518.
5	128.64	688.83	18.33	9.69	-14.28	14.04	14685.
6	138.36	686.47	23.12	9.74	-12.98	14.04	17752.
7	148.13	684.34	27.70	9.79	-11.68	14.04	20710.
8	157.95	682.43	32.06	9.84	-10.37	14.04	23551.
9	167.80	680.74	36.22	9.88	-9.07	14.04	26268.
10	177.69	679.28	40.15	9.91	-7.77	14.04	28854.
11	187.62	678.04	43.87	9.94	-6.46	14.04	31302.
12	197.56	677.03	47.37	9.96	-5.16	14.04	33606.
13	207.53	676.24	50.65	9.98	-3.86	14.04	35760.
14	217.52	675.68	53.71	9.99	-2.55	14.04	37760.
15	227.51	675.35	56.54	10.00	-1.25	14.04	39600.
16	237.51	675.24	59.14	10.00	.05	14.04	41277.
17	247.51	675.37	61.52	10.00	1.36	14.04	42787.
18	257.50	675.72	63.67	9.99	2.66	14.04	44127.
19	267.48	676.29	65.59	9.98	3.96	14.04	45294.
20	277.45	677.10	67.27	9.96	5.27	14.04	46287.
21	287.40	678.13	68.73	9.93	6.57	14.04	47105.
22	297.32	679.39	69.95	9.91	7.87	14.04	47746.
23	307.20	680.87	70.94	9.87	9.18	14.04	48210.
24	317.06	682.58	71.70	9.83	10.48	14.04	48497.
25	326.87	684.51	72.23	9.79	11.78	14.04	48609.
26	336.63	686.66	72.51	9.74	13.08	14.04	48546.
27	346.35	689.03	72.57	9.69	14.39	14.04	48311.

28	356.00	691.63	72.39	9.63	15.69	14.04	47907.
29	365.60	694.44	71.97	9.56	16.99	14.04	47335.
30	375.13	697.47	71.33	9.49	18.30	14.04	46601.
31	384.58	700.72	70.44	9.42	19.60	14.04	45707.
32	393.97	704.18	69.33	9.34	20.90	14.04	44658.
33	403.27	707.85	67.98	9.26	22.21	14.04	43460.
34	412.48	711.74	66.40	9.17	23.51	14.04	42119.
35	421.60	715.83	64.59	9.08	24.81	14.04	40639.
36	430.63	720.13	62.55	8.98	26.12	14.04	39029.
37	439.56	724.63	60.28	8.88	27.42	14.04	37294.
38	448.38	729.34	57.78	8.77	28.72	14.04	35442.
39	457.10	734.24	55.05	8.66	30.03	14.04	33481.
40	465.70	739.35	52.10	8.54	31.33	14.04	31419.
41	474.18	744.64	48.92	8.42	32.63	14.04	29265.
42	482.54	750.13	45.53	8.30	33.93	14.04	27028.
43	490.77	755.80	41.91	8.17	35.24	14.04	24717.
44	498.87	761.67	38.07	8.03	36.54	14.04	22341.
45	506.84	767.71	34.02	7.90	37.84	14.04	19911.
46	513.64	773.11	30.33	5.72	39.15	14.04	13061.
47	517.52	776.26	28.14	2.04	39.15	14.04	4423.
48	522.34	780.34	25.27	7.61	40.45	14.04	15106.
49	529.88	786.91	20.58	7.46	41.75	14.04	12571.
50	536.75	793.18	16.04	6.29	43.06	14.04	8768.
51	540.05	796.26	13.75	.30	43.06	3.43	374.
52	540.55	796.72	13.31	.70	43.06	3.43	849.
53	540.91	797.06	13.00	.02	43.06	3.43	19.
54	544.42	800.49	9.78	7.01	44.36	3.43	6891.
55	548.00	803.99	6.49	.14	44.36	3.43	106.
56	550.36	806.40	4.22	4.58	45.66	3.43	2276.
57	553.69	809.82	1.01	2.09	45.66	3.43	243.

Nonlinear M-C Iteration Number - 1

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
2	12.4909	3.2991	3.3231
3	12.5145	3.2996	3.2991

ITERATIONS FOR SPENCER'S METHOD

Iter #	Theta	FOS_force	FOS_moment
1	12.5145	3.2996	3.2991

SLICE INFORMATION ... continued :

Slice	Sigma (psf)	c-value (psf)	phi	U-base (lb)	U-top (lb)	P-top (lb)	Delta
1	430.9	500.0	.00	0.	0.	0.	.00
2	837.5	500.0	.00	0.	0.	0.	.00
3	1122.1	172.4	33.26	0.	0.	0.	.00
4	1457.2	172.4	33.26	0.	0.	0.	.00
5	1814.6	172.4	33.26	0.	0.	0.	.00
6	2148.5	172.4	33.26	0.	0.	0.	.00
7	2459.4	172.4	33.26	0.	0.	0.	.00
8	2748.2	172.4	33.26	0.	0.	0.	.00
9	3015.5	172.4	33.26	0.	0.	0.	.00
10	3261.9	172.4	33.26	0.	0.	0.	.00
11	3487.8	172.4	33.26	0.	0.	0.	.00
12	3693.8	172.4	33.26	0.	0.	0.	.00
13	3880.5	172.4	33.26	0.	0.	0.	.00
14	4048.2	172.4	33.26	0.	0.	0.	.00
15	4197.4	172.4	33.26	0.	0.	0.	.00

16	4328.5	172.4	33.26	0.	0.	0.	.00
17	4442.0	172.4	33.26	0.	0.	0.	.00
18	4538.1	172.4	33.26	0.	0.	0.	.00
19	4617.4	172.4	33.26	0.	0.	0.	.00
20	4680.1	172.4	33.26	0.	0.	0.	.00
21	4726.7	172.4	33.26	0.	0.	0.	.00
22	4757.5	172.4	33.26	0.	0.	0.	.00
23	4772.8	172.4	33.26	0.	0.	0.	.00
24	4773.1	172.4	33.26	0.	0.	0.	.00
25	4758.6	172.4	33.26	0.	0.	0.	.00
26	4729.7	172.4	33.26	0.	0.	0.	.00
27	4686.7	172.4	33.26	0.	0.	0.	.00
28	4630.1	172.4	33.26	0.	0.	0.	.00
29	4560.1	172.4	33.26	0.	0.	0.	.00
30	4477.2	172.4	33.26	0.	0.	0.	.00
31	4381.7	172.4	33.26	0.	0.	0.	.00
32	4273.9	172.4	33.26	0.	0.	0.	.00
33	4154.3	172.4	33.26	0.	0.	0.	.00
34	4023.2	172.4	33.26	0.	0.	0.	.00
35	3881.0	172.4	33.26	0.	0.	0.	.00
36	3728.2	172.4	33.26	0.	0.	0.	.00
37	3565.0	172.4	33.26	0.	0.	0.	.00
38	3392.0	172.4	33.26	0.	0.	0.	.00
39	3209.6	172.4	33.26	0.	0.	0.	.00
40	3018.2	172.4	33.26	0.	0.	0.	.00
41	2818.3	172.4	33.26	0.	0.	0.	.00
42	2610.4	172.4	33.26	0.	0.	0.	.00
43	2394.8	172.4	33.26	0.	0.	0.	.00
44	2172.2	172.4	33.26	0.	0.	0.	.00
45	1943.0	172.4	33.26	0.	0.	0.	.00
46	1736.2	172.4	33.26	0.	0.	0.	.00
47	1646.5	172.4	33.26	0.	0.	0.	.00
48	1485.0	172.4	33.26	0.	0.	0.	.00
49	1239.3	172.4	33.26	0.	0.	0.	.00
50	1005.7	172.4	33.26	0.	0.	0.	.00
51	896.3	172.4	33.26	0.	0.	0.	.00
52	871.7	172.4	33.26	0.	0.	0.	.00
53	854.0	172.4	33.26	0.	0.	0.	.00
54	689.9	172.4	33.26	0.	0.	0.	.00
55	259.5	500.0	.00	54.	0.	0.	.00
56	168.6	500.0	.00	899.	0.	0.	.00
57	-4.3	500.0	.00	0.	0.	0.	.00

 SPENCER'S (1973) - TOTAL Stresses at center of slice base

Slice #	Base x-coord (ft)	Normal Stress (psf)	Vertical Stress (psf)	Pore Water Pressure (psf)	Shear Stress (psf)
1	99.85	430.9	316.0	.0	151.5
2	105.69	837.5	701.4	.0	151.5
3	110.47	1122.1	901.8	.0	275.3
4	118.98	1457.2	1195.8	.0	341.9
5	128.64	1814.6	1515.3	.0	412.9
6	138.36	2148.5	1821.7	.0	479.3
7	148.13	2459.4	2114.7	.0	541.1
8	157.95	2748.2	2394.2	.0	598.5
9	167.80	3015.5	2660.0	.0	651.6
10	177.69	3261.9	2912.1	.0	700.6
11	187.62	3487.8	3150.2	.0	745.5
12	197.56	3693.8	3374.2	.0	786.4
13	207.53	3880.5	3584.1	.0	823.5
14	217.52	4048.2	3779.7	.0	856.8
15	227.51	4197.4	3960.9	.0	886.5
16	237.51	4328.5	4127.7	.0	912.6
17	247.51	4442.0	4279.9	.0	935.1
18	257.50	4538.1	4417.4	.0	954.2
19	267.48	4617.4	4540.3	.0	970.0

20	277.45	4680.1	4648.4	.0	982.4
21	287.40	4726.7	4741.6	.0	991.7
22	297.32	4757.5	4820.0	.0	997.8
23	307.20	4772.8	4883.4	.0	1000.9
24	317.06	4773.1	4932.0	.0	1000.9
25	326.87	4758.6	4965.5	.0	998.0
26	336.63	4729.7	4984.0	.0	992.3
27	346.35	4686.7	4987.6	.0	983.8
28	356.00	4630.1	4976.1	.0	972.5
29	365.60	4560.1	4949.6	.0	958.6
30	375.13	4477.2	4908.2	.0	942.1
31	384.58	4381.7	4851.8	.0	923.1
32	393.97	4273.9	4780.5	.0	901.7
33	403.27	4154.3	4694.2	.0	877.9
34	412.48	4023.2	4593.1	.0	851.9
35	421.60	3881.0	4477.3	.0	823.6
36	430.63	3728.2	4346.6	.0	793.2
37	439.56	3565.0	4201.3	.0	760.8
38	448.38	3392.0	4041.5	.0	726.4
39	457.10	3209.6	3867.1	.0	690.2
40	465.70	3018.2	3678.2	.0	652.1
41	474.18	2818.3	3475.1	.0	612.4
42	482.54	2610.4	3257.7	.0	571.1
43	490.77	2394.8	3026.2	.0	528.2
44	498.87	2172.2	2780.7	.0	484.0
45	506.84	1943.0	2521.4	.0	438.4
46	513.64	1736.2	2285.2	.0	397.3
47	517.52	1646.5	2168.7	.0	379.5
48	522.34	1485.0	1985.2	.0	347.4
49	529.88	1239.3	1685.0	.0	298.6
50	536.75	1005.7	1393.9	.0	252.1
51	540.05	896.3	1246.3	.0	230.4
52	540.55	871.7	1213.1	.0	225.5
53	540.91	854.0	1189.3	.0	222.0
54	544.42	689.9	982.8	.0	189.4
55	548.00	537.9	769.2	278.4	151.5
56	550.36	305.8	496.7	137.2	151.5
57	553.69	-4.3	116.0	.0	151.5

 SPENCER'S (1973) - Magnitude & Location of Interslice Forces

Slice #	Right x-coord (ft)	Force Angle (degrees)	Interslice Force (lb)	Force Height (ft)	Boundary Height (ft)	Height Ratio
1	104.60	12.51	2852.	2.62	5.50	.476
2	106.78	12.51	3758.	2.99	6.70	.447
3	114.17	12.51	8419.	4.15	10.79	.384
4	123.80	12.51	15803.	5.91	15.89	.372
5	133.49	12.51	24487.	7.62	20.78	.367
6	143.23	12.51	34213.	9.24	25.46	.363
7	153.03	12.51	44739.	10.77	29.93	.360
8	162.86	12.51	55838.	12.22	34.19	.357
9	172.74	12.51	67298.	13.59	38.24	.355
10	182.65	12.51	78923.	14.88	42.07	.354
11	192.58	12.51	90532.	16.10	45.68	.352
12	202.54	12.51	101957.	17.23	49.07	.351
13	212.52	12.51	113047.	18.29	52.23	.350
14	222.51	12.51	123662.	19.27	55.18	.349
15	232.51	12.51	133679.	20.18	57.90	.349
16	242.51	12.51	142985.	21.01	60.39	.348
17	252.50	12.51	151484.	21.76	62.65	.347
18	262.49	12.51	159092.	22.43	64.68	.347
19	272.47	12.51	165735.	23.03	66.49	.346
20	282.43	12.51	171356.	23.55	68.06	.346
21	292.36	12.51	175909.	23.99	69.40	.346
22	302.27	12.51	179360.	24.36	70.51	.345
23	312.14	12.51	181685.	24.64	71.38	.345

24	321.97	12.51	182875.	24.85	72.02	.345
25	331.76	12.51	182931.	24.98	72.43	.345
26	341.50	12.51	181863.	25.02	72.60	.345
27	351.19	12.51	179695.	24.99	72.54	.345
28	360.82	12.51	176459.	24.88	72.24	.344
29	370.38	12.51	172197.	24.69	71.71	.344
30	379.87	12.51	166962.	24.42	70.94	.344
31	389.30	12.51	160814.	24.07	69.94	.344
32	398.64	12.51	153822.	23.64	68.71	.344
33	407.90	12.51	146065.	23.13	67.25	.344
34	417.07	12.51	137628.	22.54	65.55	.344
35	426.14	12.51	128603.	21.87	63.63	.344
36	435.12	12.51	119088.	21.11	61.47	.344
37	444.00	12.51	109190.	20.28	59.08	.343
38	452.77	12.51	99018.	19.36	56.47	.343
39	461.43	12.51	88687.	18.36	53.63	.342
40	469.97	12.51	78319.	17.27	50.57	.341
41	478.39	12.51	68034.	16.09	47.28	.340
42	486.69	12.51	57961.	14.83	43.77	.339
43	494.85	12.51	48227.	13.47	40.05	.336
44	502.89	12.51	38962.	12.01	36.10	.333
45	510.78	12.51	30297.	10.44	31.94	.327
46	516.50	12.51	24349.	9.19	28.72	.320
47	518.54	12.51	22342.	8.76	27.57	.318
48	526.15	12.51	15180.	6.96	22.98	.303
49	533.61	12.51	9009.	5.02	18.19	.276
50	539.90	12.51	4578.	3.23	13.88	.232
51	540.20	12.51	4392.	3.14	13.62	.231
52	540.90	12.51	3969.	2.95	13.01	.227
53	540.92	12.51	3960.	2.95	12.99	.227
54	547.93	12.51	474.	-.15	6.56	-.023
55	548.07	12.51	421.	-.28	6.43	-.043
56	552.65	12.51	-336.	.84	2.02	.415
57	554.74	.00	-2.	-.48	.00	.000

AVERAGE VALUES ALONG FAILURE SURFACE

Total Normal Stress = 3266.00 (psf)
Pore Water Pressure = 1.91 (psf)
Shear Stress = 702.08 (psf)

Total Length of failure surface = 499.55 feet

For the single specified surface and the assumed angle
of the interslice forces, the SPENCER'S (1973)
procedure gives a

FACTOR OF SAFETY = 3.300

Total shear strength available
along specified failure surface = 115.72E+04 lb

For the specified surface, the analysis computed the following:

Negative (tensile) Normal Effective Force = 0 slices
Negative (tensile) Interslice Force = 1 slices
Unreasonable Location of Interslice Force = 2 slices

In view of these errors, the computed FOS may be UNREASONABLE!

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417B**

SITE OPERATING PLAN

Prepared for

IESI TX Landfill, LP

TCEQ Approved April 28, 2006

Revised January 2007

Revised July 2007

Revised May 2010

Revised August 2012

Revised March 2017

Revision Prepared by

Weaver Consultants Group, LLC

TPBE Registration No. F-3727

6420 Southwest Blvd., Suite 206

Fort Worth, Texas 76109

817-735-9770

Project No. 0771-368-11-83

4.24 Site Inspection and Maintenance List

Item	Task	Frequency	Inspector	Inspection Documentation
Fence/Gates	Inspect perimeter fence and gates for damage. Make repairs if necessary.	Weekly	Landfill Manager or Designee	Document inspection in the Site Operating Record
Windblown Waste	Police working face area, wind fences, access roads, entrance areas, and perimeter fence for loose trash. Clean up as necessary.	Daily as specified in Section 4.5.	Landfill Manager or Designee	Document inspection in the Site Operating Record
Waste Spilled on Route to the Site	Police the entrance areas and all roads at least 2 miles from the site entrances for loose trash. Clean up as necessary.	Daily as specified in Section 4.8.	Landfill Manager or Designee	Document inspection in the Site Operating Record
Landfill Markers	Inspect all landfill markers for damage, color-coding, and general location. Correct or replace damaged markers within 15 days of location.	Monthly	Landfill Manager or Designee	Document inspection in the Site Operating Record
Site Access Road	Inspect site access road for damage from vehicle traffic, erosion, or excessive mud accumulation. Maintain as needed with crushed rock or stone. Grading equipment will be used at least once per week to control or remove mud accumulations on roads as well as minimize depressions, ruts.	Daily - more often during wet weather or extended dry weather periods.	Landfill Manager or Designee	Document inspection and repairs in the Site Operating Record
Daily Cover	Inspect for proper placement, thickness, and compaction. Correct problems as needed. Verify that vectors are not an issue.	Daily at the active face and all daily cover areas will be inspected.	Landfill Manager or Designee	Document inspection in the Site Operating Record
Intermediate Cover/Class 1 Soil Cover Layer	Inspect for proper placement, thickness, erosion, compaction and for presence of waste or other contamination. Correct problems as needed.	Weekly and within 72-hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record
Final Cover	Inspect for proper placement, thickness, compaction, slope, settlement and erosion. Maintenance will be ongoing throughout postclosure care period. Correct problems as needed.	Weekly and within 72-hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record
Leachate	Measure depth of leachate in sump, as required.	Weekly	Landfill Manager or Designee	Document in the Site Operating Record
Leachate Storage Tanks	Measure leachate levels in storage tank and volume of leachate removed from the site.	Daily	Landfill Manager or Designee	Document in the Site Operating Record
Site Signs	Inspect all site signs for damage, general location, and accuracy of posted information.	Weekly	Landfill Manager or Designee	Document in the Site Operating Record
Ponded Water	Inspect site for unauthorized ponded water areas as described in Section 4.19. Correct problems as needed.	Weekly and within 72-hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record
Odor	Inspect the perimeter of the site to access the performance of site operations to control odor.	Daily	Landfill Manager or Designee	Document in the Site Operating Record
Perimeter Channels/Ponds	Inspect perimeter channels and detention ponds to verify that they are functioning as designed (e.g., excess sediment removed, outlet structures intact, erosion control measures intact).	Weekly and within 72-hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record
Class 1 Waste - Unloading Areas	Inspect Class 1 waste unloading areas for spills.	Daily	Landfill Manager or Designee	Document in the Site Operating Record ¹
Class 1 Waste - Above-Grade Dikes	Inspect above-grade dikes to verify that they are present where required and functioning as designed. Check for erosion, deformation, or other deterioration/damage. Take remedial actions to repair the problem immediately if a hazard is imminent or has already occurred.	Weekly and within 72-hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record ¹

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417D**

MAJOR PERMIT AMENDMENT APPLICATION

PART IV – SITE OPERATING PLAN

Prepared for
Texas Regional Landfill Company, LP
February 2022



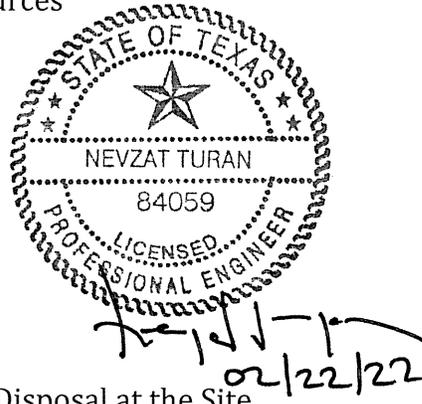
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WCG Project No. 0771-368-11-123

This document intended for permitting purposes only.

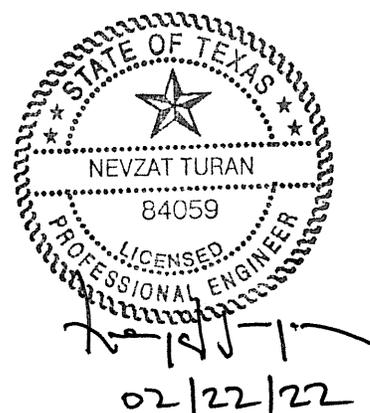
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LIST OF ACRONYMS

ADC – Alternative Daily Cover

ADCOP – Alternative Daily Cover Operating Plan

BER – Ballast Evaluation Report

CFR – Code of Federal Regulations

DOT – Department of Transportation

EPA – U.S. Environmental Protection Agency

FWS – U.S. Fish and Wildlife Service

GCCS – Gas Collection and Control System

GLER – Geomembrane Liner Evaluation Report

LCS – leachate collection system

LFG – landfill gas

LQCP – Liner Quality Control Plan

MSDS – Material Safety Data Sheets

msl – mean sea level

MSW – municipal solid waste

NRACM – nonregulated asbestos-containing material

OSHA – Occupational Health and Safety Administration

PCBs – polychlorinated biphenyls

RACM – regulated asbestos-containing material

RCRA – Resource Conservation Recovery Act

LIST OF ACRONYMS (CONTINUED)

SDP – Site Development Plan

SLER – Soils and Liner Evaluation Report

SPCC – Spill Prevention Control and Countermeasure

SOP – Site Operating Plan

SWP3 – Stormwater Pollution Prevention Plan

TAC – Texas Administrative Code

TCEQ – Texas Commission on Environmental Quality

TxDOT – Texas Department of Transportation

WWTP – wastewater treatment plant

1 INTRODUCTION

This Site Operating Plan (SOP) has been prepared for the Turkey Creek Landfill consistent with Title 30 Texas Administrative Code (TAC) §330.65. The purpose of this SOP is to provide guidance to site management and operating personnel to meet the general and site-specific requirements of Title 30 TAC §330. This document also provides a guide for site management to maintain the facility in compliance with the engineering design and applicable regulatory requirements of the TCEQ. The plan may also serve as a reference source and assist in personnel training. This SOP and the permit will be kept onsite throughout the facility's active life.

Wherever the term “executive director” or “TCEQ” is used in this SOP, these terms refer to the executive director of the TCEQ or the designated representative of the TCEQ. References to information in the permit or permit application for this facility refer to the most current version of those documents, including any amendments, modifications, or revisions as approved.

If any questions arise regarding this SOP, Turkey Creek Landfill personnel should consult with:

1. Texas Commission on Environmental Quality
Municipal Solid Waste Section
Austin, Texas
Telephone: (512) 239-2334
2. Texas Commission on Environmental Quality, Region 4
Fort Worth, Texas
Telephone: (817) 588-5800
3. Texas General Land Office
Spill and Release Reporting
State (SERC): 1-800-832-8224
Federal (NRC): 1-800-424-8802

2 PERSONNEL AND TRAINING

2.1 Personnel

This section lists and describes the management and site personnel involved with the operation of the Turkey Creek Landfill. The Turkey Creek Management Team and Site Personnel are also listed on the organizational chart shown on Figure 2.1. In addition, a summary table noting the various site personnel, qualifications and expected training is provided in Table 2-1.

2.1.1 Turkey Creek Landfill Management Team

The Turkey Creek Landfill will be staffed with and supported by qualified individuals experienced with solid waste disposal operations and earthmoving construction projects. Figure 2.1 – Organization Chart illustrates the personnel organization for the landfill. Refer to Table 2-1 for a summary of job descriptions, minimum qualifications, and expected training for landfill personnel.

2.1.2 Landfill Manager/Site Manager

The Landfill Manager also known as Site Manager (individual having managerial oversight of the facility) is responsible for daily operations, administers the facility's SDP and SOP, serves as the Emergency Coordinator, and is designated as the contact person for regulatory compliance matters. This person is responsible for assuring that adequate personnel and equipment are available to provide facility operation in accordance with this SOP, the SDP, TCEQ regulations, and other applicable local, state or federal regulations. The Landfill Manager will also assure implementation of the requirements listed in the site's SWP3 and SPCC plans. The Landfill Manager will maintain an adequate level of competency, training and experience to fulfill these duties. The Landfill Manager will designate an individual(s) to fulfill his duties during periods when the Landfill Manager is absent. Such designee(s) will have the qualifications necessary to manage landfill operations; however, the designated individual(s) are not required to possess a Class A license. Wherever this SOP provides that responsibility or authority is assigned to the Landfill Manager, this responsibility or authority may be automatically transferred to the individual(s) so designated by the Landfill Manager when the Landfill Manager is not present. The delegated individual(s) will receive training and be familiar with the applicable contents of this SOP.

**Table 2-1
Site Personnel and Training Summary**

Position	Minimum Qualifications	Job Description	Expected Training Topics													
			Site Orientation	Site Operations	Endangered Species	Prohibited Waste Identification	Safety	Fire Prevention	Load Inspection	SPPC	Emergency Response	Landfill License	Litter Control	Random Inspections	SWPPP	
Landfill Manager/Site Manager	The Landfill Manager will have a minimum of high school diploma or equivalent, experience in earthmoving operations, and experience in municipal solid waste disposal operations, and have a Class A License	Refer to Section 2.1.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Scale Operators	The minimum qualifications for the Scale House Staff are being able to fulfill the duties described in Section 2.1.3 as well as a high school diploma or equivalent and the completion of on-the-job training (refer to Section 2.1.3 for more information).	Refer to Section 2.1.3	X			X	X	X	X	X					X	
Equipment Operators	The minimum qualifications for the Equipment Operators are being able to fulfill the duties described in Section 2.1.4 as well as a minimum of 6 months of experience or the completion of on-the-job training.	Refer to Section 2.1.4	X			X	X	X	X	X				X	X	X
Spotters and Laborers ¹	The minimum qualifications for the Spotters and Laborers are being able to fulfill the duties described in Section 2.1.5 as well as the completion of on-the-job training.	Refer to Section 2.1.5	X			X	X	X	X	X				X	X	X

¹Laborers that are only hired to collect windblown waste will only be required to receive training for the following items: Site Orientation, Safety, and Litter Control.

The designated individual(s) will have a minimum of 6 months of landfill operation experience or 6 months of on-the-job training. All onsite employees are under the direct or indirect supervision of the Landfill Manager or his designee.

The Landfill Manager at a minimum will have a high school diploma or equivalent, experience in earthmoving operations, and experience in solid waste disposal operations. The Landfill Manager is required to have and maintain a Class A License as a municipal solid waste operator consistent with the requirements of Title 30 TAC §§30.201, 30.207, 30.210, and 30.212. The Landfill Manager must be familiar with the specific operating procedures set forth in this plan and will participate in training with other employees. The Landfill Manager or his designee is also responsible for routine site inspections as described herein.

The Landfill Manager's responsibilities include the following:

- Directing site personnel in the performance of tasks necessary for daily site operations.
- Identifying any additional equipment or personnel necessary for normal operations in the event of equipment breakdowns, changes in waste volumes accepted, or other circumstances.
- Performing inspections and completing inspection forms and checklists. The Landfill Manager may delegate this responsibility to other staff.
- Monitoring and evaluating the performance of employees with respect to assigned duties and compliance with regulatory requirements.
- Anticipating changes to the operating practices necessary due to changes in the weather, disposal location, or other conditions affecting site operations.
- Ensuring that inspections and monitoring (e.g., leachate collection system, GCCS, perimeter LFG monitoring, and groundwater monitoring) are completed on schedule and in accordance with all requirements.
- Monitoring and directing the abatement of any nuisance conditions, such as litter, odor, dust, and mud tracking.

2.1.3 Scale Operators

The primary job of the Scale Operators, stationed near the site entrance, is to maintain complete and accurate records of vehicles and solid waste entering the facility. The Scale Operator will visually check for unauthorized wastes, weigh vehicles, collect waste disposal fees, and direct vehicles to the working face. The Scale Operator reports to the Landfill Manager. Specifically, Scale Operators are required to: (1) monitor the incoming vehicles for type of waste and exclude prohibited waste; (2) inspect waste loads to confirm that they are authorized for disposal; (3) review manifests and other shipping documents; (4) record incoming waste loads; (5) review and confirm special waste documents; and (6) accept

tipping fees. Scale Operators should direct visitors to their destination within the facility.

Scale Operators will receive training with respect to special waste evaluation and acceptance. Any questions regarding acceptance of special waste are to be addressed to the Landfill Manager or the Special Waste Department.

The minimum qualifications for the Scale Operators are being able to fulfill the duties described in this section. In addition, a high school diploma, GED certificate or equivalent academic training is required. Scale Operators will also complete on-the-job training administered by the Landfill Manager or other qualified personnel.

2.1.4 Equipment Operators

The Equipment Operators report to the Landfill Manager. Equipment Operators are responsible for the safe operation of the equipment. As the personnel most closely involved with the actual landfill operation, these employees are responsible for being alert for potentially dangerous conditions, or careless and improper actions on the part of nonemployees and other persons while on the premises. Equipment Operators monitor and direct unloading vehicles and can also be responsible for maintenance, construction, litter abatement, and general site cleanup. Equipment Operators are also responsible for identifying prohibited wastes as discussed in Section 4.2. Equipment Operators may also be required to assist in bird control activities under the supervision of the Landfill Manager or his designee. The Equipment Operators will intervene as necessary to prevent accidents. Equipment Operators will also report any operational problems to the Landfill Manager.

Equipment Operators will have a minimum of 6 months of equipment operation experience or completion of on-the-job training administered by a supervisor. Equipment Operators that are hired on the basis of previous heavy equipment experience may be assigned to operate specific types of equipment without additional training. Upon their employment, all Equipment Operators without experience in the equipment assigned will receive on-the-job training and oversight from an experienced operator until the new operator becomes proficient on the particular piece(s) of equipment to which he has been assigned, or until he is reassigned to a different piece of equipment for which his previous training or experience is adequate.

All Equipment Operators are required to wear safety equipment, as appropriate, for their work assignments.

The minimum qualifications for the Equipment Operators are being able to fulfill the duties described in this section. Equipment Operators will also complete on-the-job training administered by the Landfill Manager or other qualified personnel.

2.1.5 Spotters and Laborers

Spotters and Laborers will be assigned to collect litter, direct waste vehicles at the working face, and perform other tasks as needed. Spotters and Laborers are also responsible for identifying prohibited wastes as discussed in Section 4.2. Spotters and Laborers will either be Turkey Creek Landfill employees or contract employees or a combination of both. Laborers may also be required to assist in bird control activities under the supervision of the Landfill Manager or his designee.

Spotters and Laborers will be required to wear safety equipment, as appropriate for their work. Contract employee oversight will be by a Turkey Creek Landfill employee. Spotters and Laborers report to the Landfill Manager or his designee.

The minimum qualifications for the Spotters and Laborers are being able to fulfill the duties described in this section. Spotters and Laborers will also complete on-the-job training administered by the Landfill Manager or other qualified personnel.

2.1.6 Other Site Personnel

Other Site Personnel may be employed from time to time in categories such as maintenance, construction, litter abatement, and general site cleanup. Other Site Personnel will report to the Landfill Manager or his designee. Other Site Personnel may be permanent or part-time.

2.1.7 Other Corporate Resources

Texas Regional Landfill Company, LP possesses additional solid waste management and operational resources, including consulting and management resources which are available to site personnel, as needed. The Landfill Manager can contact appropriate personnel to provide additional assistance at any time.

Corporate and Region Staff serve as the Special Waste Coordinator/Analyst and will provide review and approval of pre-authorized requests for special wastes received at the site and may also provide oversight for special waste acceptance by the Scale Operators and assist with other site regulatory matters, as requested by Landfill Manager or his designee.

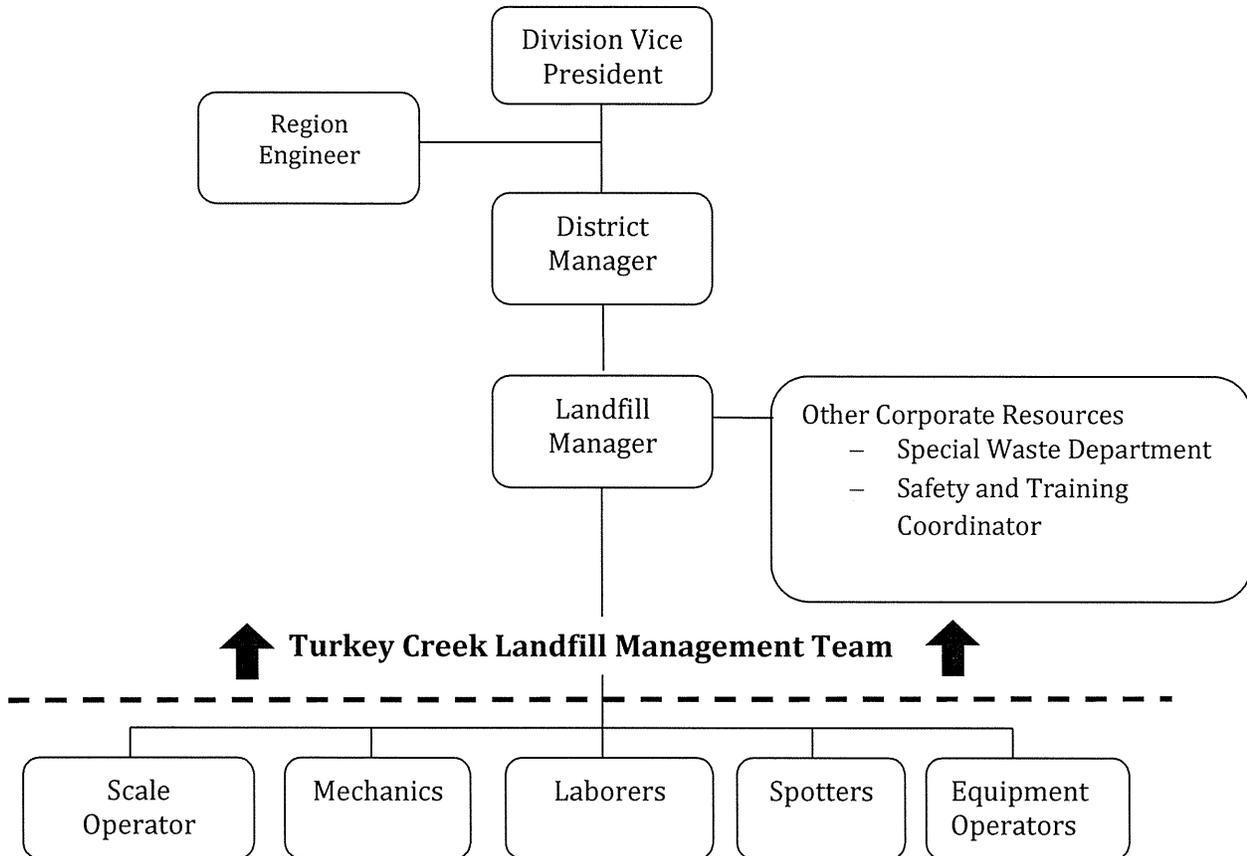
The Regional Engineer supports the Landfill Manager and is responsible for environmental compliance, engineering, and construction issues as well as verifying that the site is developed consistent with the SDP (minimum qualifications – degree from an accredited university).

2.2 Training

The Landfill Manager and the Turkey Creek Landfill management team will train the Equipment Operators, Scale Operators, Laborers, and Spotters in the contents of this SOP, as described in Table 2.1. Site personnel will receive training in the applicable sections of this SOP within 6 months after the date of their employment or assignment to the facility (or to a new position at the facility) and must take part in an annual review of the initial SOP training.

Records of training procedures, dates, topics covered, and personnel attending will be placed in the Site Operating Record. Records will include a written description of the type and amount of both introductory and continuing training that is provided to each employee. Personnel may also receive training at TCEQ-sponsored or other appropriate training courses, as deemed appropriate by the Landfill Manager.

**Figure 2.1
Turkey Creek Landfill
Organization Chart**



3 EQUIPMENT

Sufficient quantity and quality of equipment will be provided onsite at the Turkey Creek Landfill to conduct site operations in accordance with the volume of waste accepted at the facility, design requirements, and permit conditions.

The equipment listed in Table 3-1 will be available for use at the facility. Equipment requirements may vary in accordance with the method of landfill operations or the waste acceptance rate at any given time. Additional equipment will be provided by Turkey Creek Landfill as required for increasing volumes of incoming solid waste. Other similar types of equipment by other manufacturers may be substituted on an as-needed basis, at the discretion of the Landfill Manager. Backup equipment will be made available to Turkey Creek Landfill on an as needed basis from other area Texas Regional Landfill Company, LP landfills or other sources.

Compactors will be used for spreading and compacting the refuse. Excavation equipment will be used for various purposes at the Turkey Creek Landfill, including excavating of the cover material used in the site operations and in firefighting support. The dozer is mainly used to spread waste at the active face, spread cover material, and assist with waste compaction. The motorgrader will be used for activities such as road maintenance, ditch construction, surface water control, and final grading of the completed fill areas. The water truck(s) will be used for dust control and moisture conditioning of soil materials, as necessary, and will be utilized, if necessary, in the event of a fire at the facility. The water truck(s) will be equipped with appropriate equipment to facilitate firefighting. The heavy equipment and scale house will be equipped with fire extinguishers. In addition to the above, miscellaneous pickups, vans, and other light utility vehicles as well as instruments and safety and training equipment may be on-site as necessary to assist with site operations. Other miscellaneous equipment will be required for the maintenance of the machinery and other duties. This equipment will be kept onsite and may include all tools necessary to service and repair equipment.

For information relating to methane monitoring at the Turkey Creek Landfill, see the Landfill Gas Management Plan (Appendix III I). For information relating to leachate monitoring, and the control of contaminated water, see the Leachate and Contaminated Water Management Plan (Appendix III C).

**Table 3-1
Equipment Dedicated to the Turkey Creek Landfill**

Equipment	Minimum Number of Equipment Needed for Each Range of Waste Volume ¹ – Landfill Disposal Operations					Typical Size ¹	Function
	0 1,500 Tons/Day	1,500 3,000 Tons/Day	3,000 6,000 Tons/Day	6,000 10,000 Tons/Day	10,000 15,000 Tons/Day		
Compactor(s)	1	1	1	2	2	70,000 lbs	Trash compaction
Dozer(s)	1	1	1	2	2	150 hp or 35,000 lbs	Movement and placement of refuse and soil. May also be used to assist with waste compaction.
Articulated Dump Truck or Scrapers	1	1	2	3	3	30 tons or 40 cy	Hauling of soil and fire fighting support
Excavator ³	1	1	1	1	1	adequate size for equipment being loaded	Excavation of soil, fire fighting support
Loader	0	0	0	0	0	4 cy bucket capacity	Loading solidifying agents to liquid waste basins
Motorgrader	1	1	1	1	1	50 hp	Maintenance of interior roads
Pickup Truck(s)	1	1	1	1	1	¼ ton	Personnel use for litter control, maintenance
Water Truck(s)	1	1	1	1	1	2,000 gallons (minimum)	Dust control, compaction of earth fills, fire fighting support. The number of water trucks may be less as long as a total capacity is provided.
Pumps with Hose	1	1	1	1	1	2" to 6" diameter pump	Pumping of stormwater
Street Broom	1	1	1	1	1	5 ft broom	Cleaning of site roads
Light Plant ²	1	1	1	1	1	2 – 250 watt fixtures	Adequate lighting at active face

¹ Number, types, and equipment manufacturers will vary based on operational needs.

² Only needed if site operates during low or no natural light conditions.

³ A scraper may be utilized in lieu of off-road truck and excavator.

4 OPERATIONAL PROCEDURES

4.1 Access Control

Public access to the waste fill area is controlled by the entrance facility, which houses the Scale Operators, located in the southeast portion of the facility. The site entrance facilities are staffed during hours of operation. The Scale Operators control access and monitor all vehicles entering and exiting the site.

4.1.1 Site Security

Site security measures are designed to prevent unauthorized persons from entering the site, to protect the facility and its equipment from possible damage caused by trespassers, and to prevent disruption of facility operations caused by unauthorized site entry.

Unauthorized access to the site is minimized by controlling access with perimeter fencing, gated entrance, gated construction entrance, natural barriers (e.g., M.K.T. Railroad, Turkey Creek and its tributaries, and heavily-wooded vegetation), and a closed circuit television system that monitors the entrance and exit. The perimeter fence and gate will be inspected as indicated in Section 4.24. Repairs and maintenance will be performed as necessary. Refer to Section 4.24 of this SOP for site inspection and maintenance schedule.

In the event of a breach of the access controls (i.e., a portion of a fence is impacted in a way that it no longer prevents access to the site), the TCEQ Regional Office will be notified within 24 hours of detection of the breach. The breached area will be temporarily repaired within 24 hours of detection and will be permanently repaired by the time specified to the TCEQ Regional Office when it was reported in the initial breach report. In this case, the TCEQ Regional Office will also be notified when the permanent repair is completed. If a permanent repair can be made within 8 hours of detection, no notification to the TCEQ Regional Office is required. Temporary repairs may consist of a barbed wire fence, a 3-foot-high earthen berm, equipment, a security guard posted in the area of the breach or other barriers.

Entry to the active portion of the site will be restricted to designated personnel, approved waste haulers, and properly identified persons whose entry is authorized by Turkey Creek Landfill management. Visitors will be allowed on the active area

only when accompanied by a site representative (note that third party contractors and vendors completing construction or monitoring activities will not be considered visitors for the purpose of access control).

4.1.2 Traffic Control

Access to the landfill is currently provided by the south bound access road of Interstate Highway 35 W. All waste hauling vehicles must enter the site through the entrance facility located at the southeast corner of the site.

Solid waste transportation vehicles will be directed to appropriate unloading areas by signs located along the landfill access road. These vehicles will deposit their loads and depart the site. No private or commercial solid waste vehicles will be allowed access to any areas other than the active portion of the landfill. Site personnel will provide traffic directions as necessary to facilitate safe movement of vehicles.

Within the site, signs will be placed along the landfill access road, beginning at the gated entrance, at a frequency adequate for users to be able to understand where unloading areas are located and which roads are to be used for ingress and egress. Roads not being used for access to unloading areas will be blocked or otherwise marked for no entry.

4.2 Unloading Wastes

4.2.1 Unloading Areas

The Turkey Creek Landfill accepts general municipal solid wastes as well as brush, rubbish, construction/demolition waste, and certain special wastes outlined in Section 4.20 of this SOP (refer to Parts I/II, Section 2.1.1 – Waste Acceptance Plan for a complete description of waste accepted for disposal at the facility). Wastes are disposed of or processed at the following unloading areas at the Turkey Creek Landfill.

- MSW Unloading Area or Working Face. The vast majority of all wastes accepted at this facility, including MSW and Class 2 and Class 3 non-hazardous industrial wastes, are disposed of at this working face. The working face includes areas where waste is being deposited for disposal but has not been covered with daily or intermediate cover.
- Class 1 Non-hazardous Industrial Waste Unloading Area or Class 1 Working Face. This separate working face will accept Class 1 non-hazardous industrial waste and be located within a Class 1 Waste disposal sector. The Class 1 working face includes areas where waste has been deposited for

disposal but has not been covered with soil. Class 1 non-hazardous waste and MSW or Class 2/3 industrial waste may be co-mingled into this separate active working face provided that the co-mingled waste is kept within a Class 1 waste disposal sector.

- Citizens Convenience Center. This unloading area is used by the general public (i.e., small-vehicle landfill customers) to dispose of their waste in an area separate from the working face. This improves site safety by reducing traffic at the working face. Waste material is off-loaded from the small vehicles to roll-off containers. Landfill personnel then haul the roll-off containers periodically to the working face for disposal.
- Wood Waste Processing Area. Wood waste is periodically stockpiled on-site in a designated area prior to being processed (i.e., ground to wood chips).
- RACM Unloading and Disposal Area. The RACM unloading and disposal area will be designated by the Landfill Manager as noted in Section 4.20.5.
- Liquid Waste Solidification Area. Information associated with liquid waste solidification operations, including the location of the liquid waste solidification area, the types of liquid wastes (e.g., MSW; Class 1 & 2 non-hazardous industrial wastes), and the solidifying agents, is included in Appendix IVE of this SOP.

4.2.2 Waste Excluded from Disposal at the Site

The following wastes are specifically excluded from disposal at the site:

- Regulated hazardous wastes (refer to Section 6 of this SOP for more information).
- Liquid wastes that do not pass the paint filter test, except as allowed under Section 4.20.1 of this SOP.
- Articles, equipment and clothing containing or contaminated with PCBs (refer to Section 6 for more information).
- Grease trap wastes, except as allowed under Section 4.20.1 of this SOP.
- Waste prohibited by the TCEQ (refer to Section 4.2.5 of this SOP and see Title 30 TAC §330.15(e) for more information).

4.2.3 Waste Unloading Procedures

Scale Operators, Equipment Operators, Laborers, and Spotters will monitor the incoming waste. Scale Operators control site access and monitor incoming vehicles for unauthorized or prohibited wastes by: (1) receiving manifests and other shipping documents; (2) recording incoming waste loads; (3) completing a visual inspection of the vehicle (including a video camera inspection of the top of the vehicle's contents); and/or (4) interviewing the driver, as necessary. Any

non-conforming issues will be reported to the Landfill Manager. If the non-conforming issues involve Special or non-hazardous Industrial Wastes, the Landfill Manager or his designee will review Sections 4.20 and 6.2 of the SOP to verify that all requirements for acceptance of Special and non-hazardous Industrial Wastes have been met before the material is accepted for disposal. The procedures for handling prohibited waste that is not discovered until after it is unloaded are discussed in Section 6.2.

Equipment Operators, Spotters, Laborers, or other field personnel will be present at the working face at all times to monitor incoming loads of waste. These personnel will be familiar with the rules and regulations governing the various types of waste that can or cannot be accepted into this facility and will be trained to identify prohibited wastes before being assigned to this task (refer to Section 2.2 for training procedures). The Spotters and Equipment Operators have the authority and responsibility to reject unauthorized loads, have unauthorized material removed by the transporter, and have the unauthorized material removed by on-site personnel or otherwise properly managed by the facility.

Solid waste unloading will be controlled to prevent disposal in locations other than those specified by site management. For example, random load inspections will be conducted as outlined in Section 6.2 of this SOP. Any allowable waste deposited in an unauthorized area will be immediately removed and disposed of properly at the current working face. The Spotters and Equipment Operators or other appropriate site personnel will actively investigate any approved waste haul vehicles that do not dispose of their waste in an authorized area. In the event that an authorized load of waste has been deposited in an unauthorized area, site personnel will notify the Landfill Manager and the waste load will be promptly relocated to the authorized unloading area.

4.2.4 Maximum Size of the Unloading Area

As discussed previously, the following unloading areas exist at the Turkey Creek Landfill.

- MSW Unloading Area or Working Face
- Class 1 Waste Unloading area or Class 1 Working Face
- Citizens Convenience Center
- Wood Waste Processing Area
- RACM Unloading and Disposal Area
- Liquid Waste Solidification Area (Fixed or Portable/Moveable Areas)

The maximum size of the Citizens Convenience Center area is 100 feet by 200 feet and the maximum size of the Wood Waste processing area is 400 feet by 400 feet. The MSW unloading and working face area is discussed below. The RACM

unloading and disposal area is discussed in Section 4.20.5. The maximum size of the liquid solidification fixed facility is approximately 3.5 acres. The maximum size of the liquid solidification moveable/portable area is approximately 2 acres.

Control(s) will also be used to confine MSW and Class 1 working faces to as small an area as practical consistent with the rate of incoming waste and safe and efficient working face operations. The maximum size of the working face will be limited to the area listed in the following table for a range of waste accepted at the facility.

Maximum Working Face Size¹

Incoming Waste ² Accepted	Maximum Working Face Size ^{2,3}
0 - 1,500 Tons/Day	150 feet by 175 feet (or 26,250 sf) ⁵
1,500 - 3,000 Tons/Day	250 feet by 325 feet (or 81,250 sf) ⁵
3,000 - 6,000 Tons/Day	375 feet by 450 feet (or 168,750 sf) ⁵
6,000 - 10,000 Tons/Day	525 feet by 600 feet (or 315,000 sf) ⁵

- ¹ Typically only one working face will be utilized for MSW operations, and one working face for Class 1 waste operations. These may be combined into one working face that co-mingles MSW and Class 1 waste, provided that disposal is within a Class 1 waste sector. However, a second MSW working face and a second Class 1 waste working face may be used in some situations (i.e., during a time when the active face is transitioned to a new cell). Additionally, a separate working face for asbestos disposal may be used. The maximum number of MSW and Class 1 working faces to be used at the same time (apart from asbestos disposal) is two each. The working face sizes referenced above are individually applicable to each authorized working face.
- ² The working face maximum size listed above is based on the maximum area needed to spread and compact waste in uniform lifts. The working face does not include areas used to move waste from an MSW Tipper to the working face.
- ³ During the placement of the first lift of MSW in a newly constructed cell, the maximum working face size listed above does not apply provided that odors, vectors, and windblown litter are controlled consistent with standard operating conditions.
- ⁴ The maximum working face size listed above does not apply to areas that have less than a 6-foot thick waste column left before the final permitted grades are achieved provided that odors, vectors, and windblown waste are controlled consistent with standard operating conditions.
- ⁵ The width and length shown above is for guidance purposes only. The maximum working face size will be governed by the area listed above.

The working face includes areas where waste has been deposited for disposal but has not been covered with daily or intermediate cover. The working face includes areas that are covered with Alternative Daily Cover and the area where waste collection vehicles deposit waste onto the working face. As discussed in Appendix IIC (Leachate and Contaminated Water Management Plan), the working face area will not allow contaminated water to discharge and prevents stormwater run-on.

4.2.5 Prohibited Waste

Prohibited or unauthorized waste that is not discovered until after it is unloaded will be immediately returned to the vehicle that delivered the waste. That party will be responsible for the proper disposal of this rejected waste at a permitted facility. In the event the unauthorized waste is not discovered until after the vehicle that delivered it is gone, the waste will be segregated and controlled to the extent possible. The unauthorized waste will be covered with soil or ADC and no additional filling will occur over that area until the unauthorized waste is removed

and properly disposed of. Survey stakes or similar markings will be placed around the perimeter of the area that contains the unauthorized waste so that it is clear where the unauthorized waste is located. Alternatively, the unauthorized waste may be segregated by placing the unauthorized waste in a roll-off or similar container.

An effort will first be made to identify the entity that deposited the prohibited waste and have them return to the site and properly dispose of the waste. In the event that identification is not possible, Turkey Creek Landfill will notify the TCEQ within 24 hours to seek guidance on how properly to dispose of the waste as soon as practical. A record of each unauthorized material removal event will be maintained in the Site Operating Record.

Signs with directional arrows and/or portable traffic barricades will be installed as necessary to help restrict traffic to designated unloading areas. Signs will be placed along the access route to direct traffic to the current unloading areas. In addition, rules for waste disposal and prohibited waste will be prominently displayed on signs at the site entrance. Refer to Section 6 of this SOP for additional waste handling procedures.

Tires will only be accepted for disposal if they are split, quartered, or shredded.

4.3 Hours of Operation

The facility is permitted to be open for waste acceptance and other facility operations, including the transportation of materials onsite/offsite and the operation of heavy equipment, 24 hours per day, 7 days a week. The site may be closed on certain holidays. Actual hours of operation may vary depending on incoming volumes of waste and other waste management considerations. Waste acceptance hours will be posted on the entrance sign.

The preceding hours of operation are reasonably necessary to enable Texas Regional Landfill Company, LP to safely and efficiently meet future solid waste management needs in the North Central Texas region. The region has been experiencing rapid growth and additional waste streams will be diverted to the Turkey Creek Landfill as other regional disposal facilities approach their current capacities. The option to operate the site and accept waste at the site 24 hours per day, seven days per week will ensure that the site has the ability to provide solid waste disposal services for the surrounding area. The landfill serves a variety of areas that have long haul distances to the landfill and urban areas that have specific waste collection requirements (e.g., early morning collection so as to minimize area traffic impacts). An extended-hour operation will ensure that these areas have access to the landfill.

4.4 Site Signs

A sign will be displayed at the entrance to the site. This sign will be readable from the site entrance, will measure at least 4 feet by 4 feet, and have lettering of at least 3 inches in height that state the name of the site, type of site, hours and days of waste acceptance, the TCEQ permit number, and local emergency fire department phone number. The sign displayed at the site entrance will also list an emergency 24-hour contact phone number(s) that reach an individual with the authority to obligate the facility at all times that the facility is closed. The Landfill Manager will be responsible for the accuracy of the information posted on the site sign. An additional sign will be posted containing a description of prohibited wastes.

Within the site, signs will be placed along the landfill access road, beginning at the gated entrance, at a frequency adequate for users to be able to understand where disposal areas are located and which roads are to be used. Roads not being used for access to the disposal area will be blocked or otherwise marked for no entry.

4.5 Control of Windblown Wastes and Litter

Windblown wastes will be controlled at the Turkey Creek Landfill by the following methods.

- The Scale Operator will visually inspect each waste transportation vehicle entering the site to verify that the load is adequately covered or contained. A sign will be posted at the entrance indicating that improperly covered or contained vehicles shall be covered and/or are subject to a surcharge.
- Daily cover (e.g., soil or ADC) will be applied at least once every 24 hours to assist with the control of windblown waste.
- Portable litter control fencing may be used for the confinement of windblown material in the areas adjacent to the working face area. Such fencing may be located along the downwind length of the working face area. The fencing may be constructed of screens attached to portable frames or other appropriate anchor methods. The fencing may typically be 8 feet in height and located as close as practical to the working face area to control windblown waste and litter.
- Temporary fencing may be installed on the downwind side of the working face. The purpose of temporary fencing is to catch windblown waste that escapes the portable fencing discussed above. The temporary fence will either consist of additional portable fence modules described above or stationary fences made of various materials including, but not limited to, t-posts and netting to minimize windblown litter. The Landfill Manager or his designee will determine the appropriate fence location and actual length.

Additional fences may be used as necessary for effective litter control based on the actual filling location, filling direction, wind direction, and wind speed. Any litter control fencing which is determined to be ineffective will promptly be repaired or replaced.

Tall perimeter fencing may be used for the control of windblown waste and litter. Tall perimeter fencing may be installed between any waste filling area and the permit boundary. The tall perimeter fence will typically be 8 to 15 feet in height. The actual length and height of the perimeter fencing used will be determined by the Landfill Manager or his designee, based on the need for this additional litter control measure, filling location, average wind direction, average wind speed, height of fill above natural ground surface, and proximity of working face to the permit boundary.

- As part of the overall site maintenance program, facility personnel will collect windblown waste materials that have accumulated throughout the site, on fences and gates, and onsite access roads a minimum of once a day that the site is in operation. Such waste will be taken to and disposed of at the working face. The collection of windblown waste will be an ongoing activity at the site each day the site is in operation.

The solidification of liquid wastes will occur in basins recessed in the ground. Therefore, windblown waste in these areas is not expected to be an issue. If it is determined that windblown waste is created in these areas, then a combination of the methods noted above will be used to control windblown waste.

- In addition, portable fencing and/or temporary fencing will be used in the Citizens Convenience Center and/or wood waste processing areas to control stored material, if needed.

4.6 Easements and Buffer Zones

4.6.1 Easements

Texas Pipeline Company, Sinclair Pipeline Company, United Electrical Cooperative Services, Inc., and Johnson County Water Supply Corp. all have easements within the permit boundary shown in Drawing I/II-A.1. No solid waste unloading, storage, disposal, or processing operations will occur within any easement at the Turkey Creek Landfill. Also, no waste disposal is allowed within 25 feet of the centerline of any utility line or pipeline easement unless otherwise authorized by the executive director. Easements are or will be marked as specified in Section 4.7 of this SOP.

4.6.2 Buffer Zones

No solid waste unloading, storage, disposal, or processing operations will occur within any buffer zone at the Turkey Creek Landfill. As shown in the Site Development Plan, the buffer zones vary around the perimeter of the site. Consistent with the current Site Development Plan, the buffer zones vary around the site but in no case are they less than 50 feet between the permit boundary and existing waste (the limit of waste permitted as part of MSW Permit No. 1417C) and 125 feet from the newly permitted limit of waste (refer to Parts I/II, Appendix I/IIC – Location Restrictions Demonstration for more information). The buffer zones around the site will provide for the safe passage of firefighting or other emergency vehicles. All buffer zones will be clearly marked as specified in Section 4.7 of this SOP.

4.7 Landfill Markers and Benchmark

Landfill markers will be installed to clearly mark significant features as described in Title 30 TAC §330.143(b). The markers will be steel, plastic, or wooden posts (or other TCEQ approved material) and will extend at least 6 feet above the ground surface. The markers will not be obscured by vegetation and will be placed in sufficient numbers to clearly show the required boundaries. Markers will be installed with an offset where markers otherwise would not be visible. Markers that are removed or destroyed will be replaced within 15 days of their removal or destruction. Landfill markers will be inspected to ensure they are installed and maintained in accordance with the requirements of this SOP and will be maintained and repaired as necessary. Refer to Section 4.24 of this SOP for site inspection and maintenance schedule. Inspection results and repairs will be documented in the Site Operating Record. Markers will be repainted as needed to retain visibility. Guidelines for type, placement, and color-coding of markers are outlined in the following table.

The required landfill markers are:

Landfill Markers

Marker	Color
Site Boundary	Black
Buffer Zone	Yellow
Easements and Right-of-Way	Green
Grid System	White
SLER/GLER	Red
Floodplain	Blue

The site boundary markers will be placed at each corner of the site and along each boundary line at intervals no greater than 300 feet apart. The buffer zone markers will be placed along each buffer zone boundary at all corners and between corners at intervals of 300 feet.

The easement and right-of-way markers will be placed along the centerline of an easement and along the boundary of right-of-way at each corner within the site and at the intersection of the site boundary. The easement and right-of-way markers will also be placed at intervals no greater than 300 feet along the centerline of the area. The current site coordinate based grid system will be used as shown on the Site Layout Plans. The grid system markers will be spaced no greater than 100 feet apart measured along perpendicular lines. Intermediate markers will be installed in the case where markers cannot be seen from opposite boundaries. The grid system markers will be maintained during the active life of the site. The SLER/GLER markers will be placed so that all areas for which a SLER/GLER has been submitted and approved the TCEQ are readily determinable. Such markers are to provide site workers immediate knowledge of the extent of approved disposal areas. These markers will be located so that they are not destroyed during operations until operations extend into the next SLER/GLER. The location of these markers will be tied into the landfill grid system. SLER/GLER markers will not be placed inside the evaluated areas.

A permanent benchmark has been established at the site in an area that is readily accessible and will not be used for disposal. The benchmark elevation has been surveyed from a known United States Coast and Geodetic Survey Benchmark. The benchmark is a bronze survey marker stamped with elevation and survey date and set in concrete.

4.8 Control of Waste Spilled on Route to the Site

The Landfill Manager or his designee will take steps to encourage that vehicles hauling waste to the working face or other unloading areas arrive on-site with a tarpaulin, net, or other means to properly secure the load (as discussed in Section 4.5). These steps are necessary to prevent the escape of any part of the load by blowing or spilling. A sign will be posted at the entrance indicating that improperly covered or contained vehicles shall be covered and/or are subject to a surcharge.

The Landfill Manager will be responsible for the cleanup of waste materials spilled along and within the right-of-way of all public access roads serving the site for a distance of two miles in either direction from the entrance to the site. For days that the landfill is open, cleanup for the spilled solid waste materials will be performed as described in Table 2-24. Laborers performing litter and spilled solid waste materials collection will be required to wear appropriate safety equipment. A log will be maintained to document the date and time the roads are checked.

The Landfill Manager will consult with TxDOT officials concerning cleanup of state highways and right-of-ways consistent with Title 30 TAC §330.145. The TxDOT District Office will be contacted to discuss the procedures for litter cleanup on, and within, right-of-ways along state highways in the vicinity of the site. If TxDOT will not allow access to their right-of-ways for litter cleanup, this documentation will be maintained in the Site Operating Record.

4.9 Disposal of Large Items

Large, heavy, or bulky items may be disposed of at the working face. Items that can be classified as large, heavy, or bulky can include, but are not limited to, white goods (household appliances), air conditioner units, metal tanks, large metal pieces, and automobiles. Refrigerators, freezers, air conditioning units, or other items containing chlorinated fluorocarbon (CFC) refrigerant will be handled in accordance with 40 CFR §82.156(f), as amended. Items containing CFC's will not be accepted unless the CFC contained in the item has been captured and sent to an approved CFC disposal site or recycling facility and the generator or transporter provides written certification that the CFC has been evacuated from the unit. Items such as electrical equipment, which contains PCBs, will be excluded from waste fill. Procedures for detecting and excluding PCBs are provided in Section 6.

Large items will be reduced in size at the working face to the extent practical. Care will be taken during disposal of large items to ensure that: (1) large items are excluded from the initial 5 feet of waste placed over the liner system; (2) large items are placed so that they do not interfere with continued waste filling; and (3) that other, smaller municipal solid waste is placed and compacted around them.

4.10 Air Quality and Odor Management Plan

The site will comply with all the applicable air quality rules and regulations. The site will be required to operate in accordance with the New Source Performance Standards (NSPS) for MSW landfills.

Steps will be taken to limit the impact of the facility's operation on air quality. Among the measures to be employed are the following:

- Accidental fires will be controlled as outlined in Section 7 of this SOP.
- Open burning of waste will not be permitted at this facility.
- Incoming waste will be promptly compacted into the working face area. Daily cover will be placed consistent with the procedures specified in Section 4.18.2 of this SOP.

- Ponded water at the site will be controlled as detailed in Section 4.19 of this SOP.
- The GCCS will be expanded and operated in accordance with all applicable requirements.

The site management team (e.g., Landfill Manager) will verify that Turkey Creek Landfill does not violate any applicable air quality and/or LFG requirements (refer to the Landfill Gas Management Plan for more information). The Landfill Manager is responsible for verifying and documenting compliance with the site's operating permit and any other applicable regulations. Current permits will be maintained in the Site Operating Record. The site management team will maintain the required probe monitoring data and GCCS records as described in the Landfill Gas Management Plan.

Odors will be controlled at the site and will be reduced if they occur, in accordance with this Odor Management Plan. Sources of landfill odor can vary considerably and may include the wastes being delivered to the landfill, the open working face, surface emissions from the covered portion of the landfill, or the leachate collection system. Certain wastes received at a landfill are a source of odor upon receipt, such as sludge and dead animals, and certain materials handled at the liquid waste solidification area (e.g., grease and grit trap wastes – refer to Appendix IVE of this SOP for more information) are a source of odor. Other wastes have the potential for becoming a source of odor by their biodegradable characteristics, generating gases as they advance through the decomposition process. Leachate may also be a source of odor if not properly handled or disposed of in a timely manner.

Among the measures that may be employed to reduce potential odors are the following.

- Minimize the size of the working face.
- Increase the thickness of daily cover applied to sources of odor.
- Prevent ponded water, consistent with the procedures outlined in Section 4.19 of this SOP.
- Place daily and intermediate cover to the specified thickness over the fill area. The Landfill Manager or his designee will visually inspect daily and intermediate cover areas to confirm that no trash is exposed and no significant erosion of cover material has occurred.
- Assess the effectiveness of the LFG extraction system and make all necessary repairs to the system or expand the system, as needed, to control odors.
- Identify any waste stream that requires special attention to control odor. If the Scale Operator notes a load with significant odors, they will notify the working face personnel. The load will be promptly covered with soil or solid waste when it arrives at the working face.

- Evaluate the possible use of aqueous or non-aqueous chemical deodorizers when other controls do not reduce or eliminate significant odors leaving the permit boundary. The deployment of aqueous or non-aqueous chemical deodorizers will be documented in the site operating record.
- The solidification operation will be evaluated for odors. Preventative measures (Such as adding bulking agents to the mixing basins prior to placement of liquid waste) and control measures such as use of deodorizers will be installed.

4.11 Disease Vector Control

Turkey Creek Landfill personnel will control on-site populations of disease vectors. Vectors include rodents, excessive bird populations, flies, mosquitoes, and other insects or animals capable of transmitting diseases to humans. The primary means of control will be to prevent, inhibit, or deter vectors from coming into contact with deposited waste through proper waste compaction and daily cover application. Waste deposited at a working face area will be promptly compacted in accordance with Section 4.17. Daily cover and/or ADC will be applied at the end of each operating day in accordance with Section 4.18.2. A schedule of inspections is provided in Section 4.24 (refer to daily cover item). Routine inspection and housekeeping of the liquid waste solidification area will additionally control vectors.

If site inspections identify the need for additional vector controls, the site will implement a control program by contracting with a licensed commercial pesticide applicator, or other qualified pest control specialist to perform the following services:

1. Develop a pest management program for the vectors identified.
2. Implement the additional vector management practices.
3. Assist in the development of vector specific awareness training materials for site personnel.
4. Assist the site in distributing these training materials and providing any necessary training activities on vector awareness and control for site personnel.

The site may use pyrotechnic devices, or an alternative bird abatement program, to control birds at the working face area.

4.12 Maintenance of Site Access

The Turkey Creek Landfill has an existing paved entrance road from the Interstate Highway 35 West (IH-35W) service road as shown in the Site Development Plan. In addition, the landfill access roads are constructed with a crushed-stone surface or similar material surface to provide for all weather access from the unloading areas to public access roads. The paved entrance road and crushed-stone internal roads provide mud control for the waste hauling vehicles prior to exiting the site and returning to public access roads (i.e., mud on vehicles will “spin-off” on the access roads within the landfill before the vehicle returns to the public access road). During wet weather conditions, the Landfill Manager or his designee will routinely inspect the site and implement measures to further minimize mud tracking onto public access roads, as necessary. Such measures may include the installation of a temporary or permanent wheel wash.

The landfill access roads will be maintained in a reasonable dust-free condition by periodic spraying from a water truck. During dry weather conditions, the Landfill Manager or his designee will routinely inspect the site and establish a frequency, if necessary, to spray the landfill access roads with uncontaminated water to prevent nuisance conditions from developing.

Litter and other debris along the landfill access roads will be removed consistent with the schedule and requirements listed in Section 4.24 of this SOP (Site Inspection and Maintenance List). Tracked mud and assorted debris at the access to the facility on the public roadway will be removed once per day on days when mud and associated debris are being tracked onto public roadways, consistent with the schedule and requirements listed in Section 4.24 of this SOP (Site Inspection and Maintenance List). Grading equipment will be used to control or remove mud accumulations on roads as well as minimize depressions, ruts, and potholes. All on-site and other access roadways will be maintained on a regular basis consistent with the schedule and requirements listed in Section 4.24 of this SOP (Site Inspections and Maintenance List).

4.13 Salvaging and Scavenging

For purposes of this SOP, salvaging is the removal of waste materials from the working face or waste hauling vehicles at the entrance for reuse or recycling. Salvaging will be prohibited at all times. Scavenging is the uncontrolled and unauthorized removal of materials at any point in the solid waste management system, including but not limited to, the removal of waste deposited at the working face or active disposal area. Scavenging will be prohibited at all times. Various site personnel (e.g., Equipment Operators and Spotters) will guard against salvaging and scavenging activities.

4.14 Endangered Species

As part of the current Site Development Plan, the U.S. Fish and Wildlife Service (FWS) was contacted regarding possible impact to endangered species at the site. FWS information indicated that Johnson County, Texas is within the migration route of three endangered birds, the bald eagle, the whooping crane, and the black-capped vireo; as well as one threatened bird, the piping plover. The FWS held the opinion that the facility would not likely impact these species. The letter of correspondence with the FWS is included in the currently approved Site Development Plan. No endangered or threatened species have been documented at the site nor has a critical habitat for such species been identified at the site. The facility or its operation will not result in the destruction or adverse modification of the critical habitat of endangered or threatened species or cause or contribute to the taking of endangered or threatened species. If endangered or threatened species are encountered during site operations work will be ceased in the immediate area and Texas Parks and Wildlife Department and U.S. Fish and Wildlife will be notified.

4.15 Control of Landfill Gas

The control and monitoring of landfill gas for the proposed Turkey Creek Landfill will be in accordance with the Landfill Gas Management Plan included in Appendix III I. The Landfill Gas Management Plan was developed in accordance with Title 30 TAC §330.371 and provides for required reports and other submittals to be included in the Site Operating Record and submitted to the executive director (refer to Section 4.10 for additional information).

4.16 Treatment of Oil, Gas, and Water Wells

There is one active water well currently within the site boundary. The active well is used as a non-potable source for the employee sanitation facilities and is not a drinking water source. As described in Title 30 TAC 330.16(a), water wells used for supply at the facility may remain in use as long as it is located outside of the footprint, it is not impacted by landfill operations, and it can be demonstrated the well design and installation prevent cross-contamination from the waste management unit from the water well to the well production zone. The monitoring well is located in the upper perched aquifer, and is not connected to the lower drinking water formation(s). Additional information regarding the water well geology is presented in Appendix G of this application.

Any additional wells encountered will be plugged in accordance with all applicable rules and regulations of the TCEQ, the Railroad Commission of Texas, or other applicable State agencies.

If an abandoned oil, gas, or water well is identified during facility development, Turkey Creek Landfill will provide written notification to the TCEQ's executive director of its location within 30 days after discovery. If any wells are encountered, they will be exposed, the casing cut to a minimum of 2 feet below the excavation, and the well capped and plugged in accordance with all applicable rules and regulations of the TCEQ, the Railroad Commission of Texas, or other applicable state agency.

Texas Regional Landfill Company, LP will provide written notification to the executive director of the location of any existing or abandoned water wells within the facility upon discovery during site development. Within 30 days of such a discovery, Turkey Creek Landfill will provide written notification and certification to the executive director of the TCEQ that all such wells have been capped, plugged, and closed in accordance with all applicable rules and regulations of the TCEQ or other applicable state agency.

For crude oil or natural gas wells, or other wells associated with mineral recovery that are under the jurisdiction of the Railroad Commission of Texas, within 30 days after the plugging of any such well, Texas Regional Landfill Company, LP will provide the executive director of the TCEQ with written certification that all such wells have been properly capped, plugged, and closed in accordance with all applicable rules and regulations of the Railroad Commission of Texas or other applicable state agency.

A copy of the well plugging report to be submitted to the appropriate state agency will also be submitted to the executive director of the TCEQ within 30 days after the well has been plugged.

In the event that an abandoned well causes a change to the liner installation plan, a permit modification will be submitted to the executive director in accordance with Title 30 TAC §330.161(d).

4.17 Compaction of Solid Waste

Compaction of incoming waste facilitates efficient use of available space, minimizes settlement and consolidation, and promotes proper application of daily, intermediate, and final cover. Landfill compactor(s) or similar equipment will be used to compact waste at the Turkey Creek Landfill. Unless otherwise documented in the Site Operating Record, the Landfill Manager will instruct the Equipment Operators to spread waste in lifts that are approximately 10 feet thick. Lifts may vary in thickness depending on the operational filling sequence. The compactor will typically make two-passes to compact the waste. A pass is defined as one direction of travel. The number of passes required may be increased depending upon the nature of the waste that is being compacted.

4.18 Soil Management, Placement, and Compaction of Daily, Intermediate, and Final Cover

4.18.1 Soil Management

The earthen material that will be used for daily cover, intermediate cover, final cover, and other uses will be obtained from onsite and offsite soil borrow sources.

The earthen material will consist of soil that has not previously come in contact with waste and will be of sufficient volume to meet the fire protection requirements specified in Section 7.7. As this earthen material is used, it will be replenished and/or located as soon as practical but will at all times be maintained to meet the fire protection requirements specified in Section 7.7. Both the volume of earthen material required to be maintained within 1,000 feet of each working face and the volume of the earthen material to cover each working face with at least a 1 day application of 6 inches of daily cover will be documented on the Cover Application Log (refer to Section 4.18.5 and Section 7.7.4 for an example earthen material calculation).

4.18.2 Daily Cover

Daily cover of waste is used to control disease vectors, windblown waste, odors, fires, and scavenging and to promote runoff from the fill area. At least once every 24 hours, the exposed solid waste fill area(s) will be covered by (1) at least 6 inches of soil cover material that has not been previously mixed with garbage, rubbish, or other solid waste, or (2) an approved Alternate Daily Cover (ADC) material. An ADC Operating Plan (ADCOP) is included in Appendix IVB of this SOP. The plan addresses the following items.

- Description and thickness of the alternative cover material
- Effect of ADC on vectors, fires, odors, and windblown litter
- Application and operational methods to be utilized at the site when using the ADC
- Chemical composition of the material and the MSDS(s) for the ADC

ADC is used to cover waste in areas that will be filled again within a 24-hour period.

The remaining portion of this section details the procedures to be used if soil daily cover is utilized. To ensure that the soil daily cover soil will be adequate (i.e., minimize vectors, prevent contaminated stormwater runoff, prevent odors, etc.) the following procedures will be followed:

- The daily cover will be spread and compacted to minimize infiltration of stormwater, graded to drain, and will not have any waste visibly protruding through it.
- The Landfill Manager or his designee will document, on a daily basis, the daily cover placement area and indicate that he has visually verified the thickness and condition in the Cover Application Log (discussed further in Section 4.18.5 of this SOP).

All areas that have received waste but will be inactive for longer than 180 days will receive an additional 6 inches of earthen material not previously mixed with garbage, rubbish or other solid waste, which will be placed over the daily cover for a total of not less than 12 inches of cover. This 12-inch-thick layer of cover soil will be classified as “intermediate cover” as described in Section 4.18.3 of this SOP. If the area becomes active again, the cover soil may be stripped off for use as daily cover in other areas.

4.18.3 Intermediate Cover

All areas that receive waste and are covered with 6 inches of daily cover but will be inactive for longer than 180 days will be covered with an additional 6 inches of compacted cover material, for a total cover thickness of at least 12 inches. The intermediate cover will be graded and maintained to prevent ponding. In addition, the top 6 inches of earthen material used for intermediate cover will be suitable for sustaining native plant growth and will be seeded following the placement of intermediate cover soils. Seeding will occur during a standard growing season when it is feasible to establish vegetation. The establishment of vegetation is desirable to reduce erosion and aid in sediment control.

The sequence of intermediate cover placement with respect to waste placement is included in detail in the Site Layout Plans. The Landfill Manager or his designee will inspect intermediate cover consistent with the schedule and requirements listed in Section 4.24 of this SOP (Site Inspection and Maintenance List). This includes the inspection of intermediate cover following significant rainfall events as described in Section 4.24. Erosion gullies or washed-out areas will be repaired within 5 days of detection by restoring the cover material, grading, compacting, and seeding, if necessary, unless the TCEQ Regional Office approves otherwise, based on the extent of the damage requiring more time to repair, or the repairs are delayed because of weather conditions.

4.18.4 Final Cover

Final cover placement will occur as disposal areas of the site are filled to their design top-of-waste grades as described in Appendix III-J. Final cover placement over individual areas will be in accordance with the Final Closure Plan and will permit ongoing landfilling operations to continue until the time of final closure. Surface water will be managed throughout the active life of the site to minimize

infiltration into the filled areas and to minimize contact with solid waste. Erosion of final or intermediate cover will be repaired within 5 days after the initial inspection by restoring the cover material, grading, compacting, and seeding unless the TCEQ Regional Office approves otherwise, based on the extent of the damage requiring more time to repair, or the repairs are delayed because of weather conditions. The date of detection of erosion and date of completion of repairs, including reasons for any delays, must be documented in the Cover Application Log (refer to Section 4.18.5). Such periodic inspections and restorations are required during the entire operational life and for the postclosure maintenance period. Refer to Section 4.24 of this SOP for a Site Inspection and Maintenance List.

The final cover system, including the erosion control structures (drainage swales and chutes) will be maintained during and after construction. During the active life of the site, the Landfill Manager or his designee will inspect the final cover system consistent with the schedule and requirements listed in Section 4.24 of this SOP (Site Inspection and Maintenance List). This includes the inspection of final cover following significant rainfall events as described in Section 4.24.

Postclosure care inspection procedures are outlined in the Postclosure Care Plan (Appendix IIIK).

4.18.5 Temporary Waiver

The executive director may grant a temporary waiver from the daily cover, ADC, and intermediate cover requirements if the operator demonstrates that there are extreme seasonal climatic conditions that make meeting such requirements impractical.

4.18.6 Cover Application Log

Throughout the landfill operation, a Cover Application Log will be maintained by the Landfill Manager or his designee and be readily available for inspection in accordance with Title 30 §330.165(h). For intermediate cover and daily cover, the log will specify the date cover (no exposed waste) was accomplished, the area covered (by use of the grid system), how it was placed, when it was completed, and the last area covered. For final cover, the log will show the final cover area, specify the area covered, the date cover was applied, the thickness applied that date, and reference the final cover certification report for each area. The signature of the Landfill Manager or his designee will certify that the work was accomplished as stated in the log. Repairs will be documented in the log. The date of detection of erosion, or other repair issues, the date of completion of repair (including reasons for any delays) will be included to document the repair.

4.19 Prevention of Pondered Water

Site grading and maintenance will minimize the ponding of water over areas containing waste. Should ponding occur, the water will be removed as soon as practicable from areas not designated as stormwater collection areas in the Site Development Plan. Records of ponded water corrective activities will be kept in the Site Operating Record. The depressions will be filled and regraded as quickly as possible, but no later than 7 days from the end of the rainfall event (i.e., the “occurrence” for purposes of 30 TAC §330.167). If the ponded water has come into contact with waste, leachate, or contaminated soils, it will be treated as contaminated water and handled in accordance with the Leachate and Contaminated Water Management Plan (Appendix IIIC).

The site will be inspected to verify that no unauthorized ponded water areas exist consistent with the schedule and requirements listed in Section 4.24 of this SOP (Site Inspections and Maintenance List). Ponded water in areas not over waste, such as in excavations, and detention ponds, is not prohibited so long as ponding in other areas does not cause or contribute to nuisance conditions. In addition, excavations will be pumped out as necessary to maintain the area as accessible to earth-moving equipment. Detention ponds will be maintained to perform as designed. Water contained in basins or excavations may be used for dust control.

4.20 Disposal of Special Wastes

Special wastes, as defined in Title 30 TAC §330.3, will be accepted at the facility in accordance with Title 30 TAC §330.171, §330.173 and the Special Waste Acceptance Plan (SWAP) presented in Appendix IVC of this SOP. The SWAP outlines the acceptance criteria and the review and approval process that will be used to accept special waste for disposal at the Turkey Creek Landfill.

Special wastes authorized for acceptance by Title 30 TAC §330.171(c)-(d) and §330.173(c) and (i)-(j) (e.g., materials discussed in Sections 4.20.1-4.20.7, below) may be accepted at the facility without any further waste-specific or site-specific approvals from the executive director. They will be managed at the facility in accordance with the methods set forth below.

As specified in Title 30 TAC §330.171(b)(2) a generator may request approval to dispose of other, non-enumerated special wastes directly from the Turkey Creek Landfill, which has an approved SWAP under Title 30 TAC §330.61(b) that authorizes the acceptance of such wastes on site-specific basis. The SWAP addresses the requirements for such site-specific authorizations to accept special wastes meeting the facility’s waste acceptance criteria. Unless otherwise approved by the executive director, only those non-enumerated special wastes that meet the

waste acceptance criteria of the SWAP will be disposed of at the Turkey Creek Landfill.

When special wastes are to be disposed of at the Turkey Creek Landfill, a complete generator profile will be required prior to acceptance of the special wastes as set forth in the SWAP. This profile includes:

- A written declaration by the generator that the waste stream is non-hazardous waste. In addition, the generator will also note if the waste stream is a Class 1 non-hazardous waste.
- An estimate of the anticipated quantity, rate, and frequency of disposal for each special waste.

The above-listed information will be maintained in the Site Operating Record.

A waste discrepancy form or similar documentation will be placed in the Site Operating Record when one or more of the following occurs:

- A special waste arrives without a waste manifest or required shipping document.
- A special waste arrives and the waste material does not match the description on the waste manifest or other shipping document.
- A special waste arrives and the waste differs from the approved waste based upon QA/QC review or other monitoring.
- The volume of the waste is not consistent with the information on the shipping documents.

The Scale Operators, Landfill Manager, corporate and/or region staff will attempt to resolve any waste discrepancies. If the discrepancy can be resolved, the waste may be accepted and the discrepancy form will be filed to document the resolution of the discrepancy in the Site Operating Record. If the discrepancy cannot be resolved, the waste shipment will be rejected and a discrepancy form prepared and filed for the rejected waste shipment.

4.20.1 Sludges

Sludges, grease trap waste, grit trap waste or liquid waste from municipal sources will be accepted and disposed if the material has been treated or processed, and has passed the paint filter test and is certified to contain no free liquid, as prescribed in Title 30 TAC §330.171(b)(7).

4.20.2 Dead Animals

The Turkey Creek Landfill may receive and dispose of dead animals or slaughterhouse wastes. Dead animals and slaughterhouse wastes will be buried at

the working face and covered with a minimum of 3 feet of other solid waste or a minimum of 2 feet of soil immediately upon receipt. Additional waste or soil will be added over the dead animals if objectionable odors are created by the dead animals or slaughterhouse wastes.

4.20.3 Empty Containers

Empty containers, which have been used for pesticides, herbicides, fungicides, or rodenticides will be accepted and disposed of in accordance with Title 30 TAC §330.171(b)(7) and as outlined below.

1. These containers may be disposed of at the landfill working face provided that:
 - (i) the containers are triple-rinsed prior to receipt at the site; and
 - (ii) the containers are rendered unusable prior to or upon receipt at the site.
2. Empty containers accepted at the site will be covered by the end of the same working day they are received.
3. Those containers for which triple-rinsing is not feasible or practical (e.g., paper bags, cardboard containers) may be disposed of as CESQG waste (if they are municipal hazardous wastes), Class 1 waste, Class 2 waste, or Class 3 waste as determined by the classification process detailed in Section 3 of the SWAP and disposed of per the applicable protocol for that class of waste.

4.20.4 Nonregulated Asbestos-Containing Materials

Non-regulated asbestos-containing materials (non-RACM) may be accepted for disposal provided the wastes are placed on the active working face and covered in accordance with Section 4.18 of this SOP. Under no circumstances will any material containing non-RACM be placed on any surface or roadway which is subject to vehicular traffic or disposed of by any other means by which the material could be crumbled into a friable state.

4.20.5 Regulated Asbestos-Containing Material (RACM)

RACM may be accepted at the facility in accordance with Title 30 TAC §330.171(c)(3). RACM disposal locations will be identified by surveying and marked on a current site drawing at the site. Each load of RACM that arrives on-site will be documented. This documentation will include the volume of material, and the location and depth of its disposal. Disposal of RACM may occur at any location within the constructed landfill footprint. Approval of this SOP satisfies the written notification requirements specified in Title 30 TAC §330.171(c)(3). The RACM disposal area will not be larger than 50 feet by 50 feet.

Delivery of RACM will be coordinated by the Landfill Manager or his designee so that the waste will arrive during times that it can be properly managed by site personnel.

RACM will be accepted at the site only if it is contained in tightly closed containers or bags, or wrapped as necessary with 6-mil-thick polyethylene.

RACM will be placed in landfill cells such that it will not be exposed as a result of erosion or weathering. At a minimum, the RACM will be placed such that it is, at closure of the landfill unit, at least 20 feet away from exterior final sideslopes, and at least 10 feet below the final surface grade of the unit. During unloading and placement of RACM in the waste fill, care will be exercised to prevent breaking open the bags or containers. One foot of soil cover or 3 feet of asbestos-free municipal solid waste will be placed over the RACM immediately after it is placed in the landfill.

RACM that has been designated as Class 1 industrial solid waste, will be disposed of in accordance with Title 30 TAC §330.173 and in accordance with this section of the Site Operating Plan.

Shipments of Class 1 RACM must be accompanied by a waste manifest document. The waste manifest is to be completed by the generator and transporter, and will accompany the driver of each waste load. The facility will then verify pre-authorization for disposal and complete the destination section of each manifest and return one copy of the completed manifest to the driver. One copy of the completed waste manifest will also be returned to the waste generator within 30 days after receipt of the waste. Manifests are prepared in triplicate and the remaining copy will be filed in the Site Operating Record.

The Scale Operators, Landfill Manager, corporate and/or region staff, will attempt to resolve any waste discrepancies. If the discrepancy can be resolved, the waste may be accepted and the discrepancy form will be filed to document the resolution of the discrepancy. If the discrepancy cannot be resolved, the waste shipment will be rejected and documented.

Shipments of Class 1 RACM are subject to the random waste inspections for identifying unauthorized wastes as described in Section 6.2. The Landfill Manager or his designee will contact the transporter and/or generator and notify them of the identification of any unauthorized waste. The transporter and/or generator will be required to take all necessary steps to determine the origin and to assure that in the future such wastes are either not collected or are taken to a facility approved to accept such waste.

All information and documents pertaining to Class 1 RACM profiled for disposal and delivered to the landfill for disposal including, but not limited to, all records

concerning measurements and analyses performed at the site, will be retained in the Site Operating Record.

Additionally, the TCEQ Monthly Waste Receipt Summary will be prepared by the Landfill Manager or his designee and submitted to the TCEQ. This report will be submitted consistent with TCEQ requirements. Reports will be on forms provided by the TCEQ and submitted to the Registration and Reporting Section.

A Quarterly Municipal Solid Waste Fee Report will be submitted to the TCEQ on a form provided by the TCEQ. In addition to a statement of the amount of Class 1 RACM received for processing or disposal, the report will contain other information requested on the form. The required quarterly report will be submitted to the TCEQ within the timeframe required by the TCEQ.

In the event that bags or containers that contain RACM rupture, they will be immediately contained by spraying the area with water to prevent the spread of RACM. Also, earthen dikes, berms or by other appropriate measures will be constructed to contain the spill. The Landfill Manager or his designee will be promptly notified of the spill and will coordinate the collection and disposal of the spilled RACM. The spilled RACM will be picked up mechanically or by employees wearing proper protective equipment and re-packaged for disposal.

Upon closure of the facility, a notation indicating that the site accepted RACM will be placed in the real property records of Johnson County. This notation will indicate where the RACM was disposed of on the property by showing its location on a site diagram. A copy of this documentation will be provided to the TCEQ.

4.20.6 Class 2 and Class 3 Non-Hazardous Industrial Waste

Class 2 and Class 3 non-hazardous industrial solid wastes will be accepted for disposal at the facility in accordance with the SWAP presented in Appendix IVC of this SOP and the acceptance of such wastes will not interfere with the operation of the Turkey Creek Landfill.

4.20.7 Class 1 Non-Hazardous Industrial Waste

4.20.7.1 Class 1 Non-Hazardous Waste Disposal Locations and Quantity

Class 1 non-hazardous industrial waste, other than asbestos-containing waste, will be placed only in designated waste disposal sectors that meet the requirements of Title 30 TAC §330.331(e) (relating to Design Criteria for MSW Landfills that Accept Class 1 Waste). Industrial Solid Waste that is defined as a Class 1 only because of its asbestos content will be accepted and handled in accordance with the procedures listed in Section 4.20.5. The site will not accept Class 1 industrial solid waste in an amount in excess of 20 percent of the total amount of waste (not including Class 1 waste) accepted during the current or previous year (measured on a consistently

applied weight or volume basis, unless a variance is authorized by the executive director).

4.20.7.2 Class 1 Waste Liner Design, Waste Placement, and Cover

Waste placement, daily cover placement, and intermediate cover placement for Class 1 waste will be accomplished consistent with the procedures for other wastes that are accepted at the landfill (refer to Section 4.18 of this SOP). The design of Class 1 waste areas is consistent with the requirements of Title 30 TAC §330.331(e), and is included in Part III, Appendix IIIC – Leachate and Contaminated Water Management Plan.

Each truck will stop at the scale house where directions to the appropriate working face will be provided. The Scale Attendant will direct waste haulers to follow the signs as they enter the facility. Access roadways will be clearly marked with portable signs directing Class 1 haulers to the Class 1 working face, and MSW haulers to the MSW working face. Spotters (or Equipment Operators) will verify waste cargo with haulers before unloading.

4.20.7.3 Manifesting of Class 1 Wastes

Shipments of Class 1 wastes must be accompanied by a waste manifest document. The waste manifest is to be completed by the generator and transporter and will accompany each waste load. Turkey Creek Landfill will verify pre-authorization for disposal and complete the destination section of each manifest and return one copy of the completed manifest to the driver. One copy of the completed waste manifest will also be returned to the waste generator within 30 days after receipt of the waste. Manifests are prepared in triplicate, and the remaining copy will be filed and maintained in the Site Operating Record for a period of not less than 3 years.

The Scale Operator, Landfill Manager or his designee, or the Special Waste Department will attempt to resolve any Class 1 waste discrepancies. If the discrepancy can be resolved, the waste may be accepted. If the discrepancy cannot be resolved, the waste shipment will be rejected and documented.

4.20.7.4 Random Inspection of Class 1 Waste Shipments

Shipments of Class 1 wastes are subject to the random waste inspections for identifying unauthorized wastes as described in Section 6.2 of this SOP. The Landfill Manager or his designee will notify the transporter and/or generator of the identification of any unauthorized waste. The transporter and/or generator will be required to take all necessary steps to determine the origin and to assure that in the future such wastes are either not collected or are taken to a facility approved to accept such waste. The TCEQ may also be contacted to provide the name and contact information of the transporter/generator and to report measures taken to resolve the arrival of unauthorized waste (i.e., returned for disposal at an approved

facility). Instances of unauthorized waste presented by a transporter or generator may result in Turkey Creek Landfill refusing to accept waste from that transporter or generator.

4.20.7.5 Additional Class 1 Waste Verifications

The Class 1 waste delivered to the Turkey Creek Landfill for disposal will receive a visual inspection to observe the contents and nature of waste. Additional waste verifications may be performed, as determined by the Landfill Manager or his designee, or the Special Waste Department, and may include pH testing, water reactivity testing, and ignitability testing. Class 1 wastes, except excluded loads, are subject to random screening, as well as spot checking and testing as described in Section 6.2 of this SOP.

4.20.7.6 Class 1 Waste Recordkeeping and Reporting

All information and documents pertaining to Class 1 waste profiled for disposal and delivered to the landfill for disposal in the Class 1 cell including, but not limited to, all records concerning measurements and analyses performed at the site will be retained at the site in accordance with the provisions in Section 9 of this SOP, unless otherwise indicated.

Additionally, the TCEQ Monthly Waste Receipt Summary Report will be prepared by the Landfill Manager or his designee and submitted to the TCEQ. This report will be submitted consistent with TCEQ requirements. Reports will be on forms provided by the TCEQ.

A Quarterly Municipal Solid Waste Fee Report will be submitted to the TCEQ on a form provided by the TCEQ. In addition to a statement of the amount of Class 1 waste received for processing or disposal, the report will contain other information requested on the form. The required quarterly report will be submitted to the TCEQ within the time frame required by the TCEQ.

4.20.7.7 Class 1 Waste-Related Inspection Requirements

Section 4.24 of this SOP presents a Site Inspection and Maintenance List with inspection items and frequencies that will be followed at the facility, including certain items which specifically pertain to Class 1 waste operations.

4.20.7.8 Class 1 Waste Contingency Plan

Introduction

This Class 1 waste contingency plan has been developed to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of Class 1 waste or constituents of such waste to air, soil, or surface water. The provisions of the plan must be carried out immediately

whenever there is a fire, explosion, or release of waste or constituents of such waste that could threaten human health or the environment.

A copy of this Class 1 waste contingency plan and all revisions to the plan must be maintained at the facility and submitted to the local providers that may be called upon to provide emergency services (as identified subsequently in this plan).

This Class 1 waste contingency plan must be reviewed and updated, if necessary, whenever: (1) the facility permit affecting Class 1 waste operations is revised; (2) the plan fails in an emergency; (3) the facility changes in its Class 1 waste design, construction, operation, maintenance, or other circumstances in a way that materially increases the potential for fires, explosions, or releases of Class 1 waste or constituents of such waste, or changes the response necessary in an emergency; or (4) the list of emergency equipment materially changes.

Emergency Contacts

The Landfill Manager or his designee will maintain a list of names, addresses, and phone numbers (office and home) of persons qualified to act as Emergency Coordinator (as discussed subsequently in this plan), and this list must be kept up-to-date and at the facility. Where more than one person is listed as the Emergency Coordinator, one must be named as primary Emergency Coordinator and others must be listed in the order in which they will assume responsibility as alternates.

The facility is within the coverage area of the following emergency services providers:

- City of Alvarado Police and Fire Department
- Texas Health Resources Burleson (Hospital)
- Texas Department of Public Safety (Emergency Spill Response)

Emergency Equipment

Class 1 waste related emergencies at the facility could potentially involve spills or fires. Accordingly, the emergency equipment related to Class 1 waste and its location on-site is listed below.

Item	Location	Capabilities
Class A/B/C Fire Extinguishers	One per piece of heavy equipment involved in Class 1 waste operations (e.g., excavator, bulldozer).	Extinguish small combustion fires.
Site Two-Way Telecommunication Radios or Cellular Phones	One per site personnel assigned to Class 1 waste operations, including Landfill Manager or his designee.	Maintain contact among site personnel; inform personnel or emergency situations.

This list of emergency equipment must be kept up to date.

Evacuation Plan

In the event the facility needs to be evacuated, the following actions will be taken:

- The Emergency Coordinator (discussed subsequently in this contingency plan) will designate emergency response team leaders, who will notify all personnel at the facility to evacuate the site immediately.
- The scale house located in the southeastern portion of the site near the main entrance/exit will be the primary evacuation rally point for facility personnel to gather during the evacuation. The evacuation routes to reach this rally point are via the main site haul roads and perimeter roads.
- Emergency response team leaders will take a head count of facility personnel once they arrive at the designated rally point, and will each report back to the Emergency Coordinator of whether their personnel are accounted for.

Emergency Coordinator

The Landfill Manager or his designee will serve as the primary Emergency Coordinator, so that there is an Emergency Coordinator either on the facility premises or on call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility for coordinating all emergency response measures. The Emergency Coordinator will be thoroughly familiar with this Class 1 Waste Contingency Plan, operations and activities at the facility, the location of records within the facility, and the facility layout. In addition, this person has the authority to commit the resources needed to carry out this Class 1 Waste Contingency Plan.

Emergency Procedures

Whenever there is an imminent or actual emergency situation such as a release, fire, or explosion that could threaten human health or the environment, the Emergency Coordinator will immediately:

- Notify appropriate facility personnel in person or by phone (two-way site telecommunications).
- Assess the situation by identifying the character, exact source, amount, and areal extent of any released materials. The Emergency Coordinator may do this by observation or review of facility records or manifests, and, if necessary, by chemical analysis. This assessment will consider possible hazards to human health or the environment that may result from the release, fire, or explosion. This assessment must consider both direct and indirect effects of the release, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any

surface run-off from water or chemical agents used to control fire and heat-induced explosions).

- If help is needed, notify appropriate state or local agencies with designated response roles. If the Emergency Coordinator determines that the facility has had a release, fire, or explosion that could threaten human health or the environment outside the facility, the following applies:
 - If the Emergency Coordinator's assessment indicates that evacuation of local areas may be advisable, the Emergency Coordinator will immediately notify appropriate local authorities, and must be available to help appropriate officials decide whether local areas should be evacuated. This includes an immediate notification of the National Response Center (using their 24-hour toll free number 1-800-424-8802). The report must include:
 - name and telephone number of person making report
 - name and address of facility
 - time and type of incident (e.g., release, fire)
 - name and quantity of material(s) involved, to the extent known
 - the extent of injuries, if any
 - the possible hazards to human health, or the environment, outside the facility
- During an emergency, the Emergency Coordinator will take reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other waste at the facility. These measures must include, where applicable, stopping operations, collecting and containing released waste, and removing or isolating containers. Further details are presented in the bullets that follow.
- Should any accidental spill of Class 1 wastes occur at the facility, it will be immediately contained by earthen dikes, berms or by other appropriate measures. The Landfill Manager or his designee will be promptly notified of the spill and will coordinate the collection and disposal of the spilled material. The spilled wastes will be picked up mechanically or by employees wearing proper protective equipment and managed according to procedures for handling the special waste.
- For larger spills, or where there is potential for the waste to impact waters of the state, the Emergency Coordinator will assess the situation and determine the appropriate means to contain and collect the material. If spilled material threatens to impact storm water discharge from the site, the Landfill Manager or his designee will use booms or diversionary dikes, or excavate holes or pits as needed to contain the spilled material. Equipment typically available for spill response includes excavators, backhoes, dozers, pumps,

and haul trucks. In the event of a spill that cannot be picked up using hand-held tools, this equipment will be used as needed to contain and collect spilled material. For larger spills of liquid wastes that cannot be adequately cleaned up with on-site equipment, a qualified emergency cleanup contractor or vacuum truck company will be contacted to assist with cleaning up the spill. Once the liquids are removed, a visual inspection of the spill area will be made, and soils observed to be potentially impacted will be over-excavated and disposed with the collected material as described below.

- Should an incident occur where hazardous wastes, radioactive waste, or other prohibited wastes are suspected or discovered, the waste will not be authorized for disposal but instead will be isolated until the material can be adequately identified to determine the proper disposition/remediation of the material and the appropriate handling procedures. During this identification process, the generator's representative will be contacted to determine the identity of the material, and the planned disposition/ remediation of the material. The proper disposition/remediation of the prohibited waste will be specific to the waste and will be implemented.
- Immediately after an emergency incident, the Emergency Coordinator will provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility. The owner or operator will classify all recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility in accordance with TCEQ rules.
- The Emergency Coordinator will ensure that in the affected area(s) of the facility:
 - no waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed; and
 - emergency equipment listed in this Contingency Plan is cleaned and fit for its intended use before operations are resumed.

4.21 Prevention of Discharge of Contaminated Water

The Landfill Manager will implement necessary steps to control and prevent the discharge of contaminated water from the facility. No discharge of contaminated water will occur without obtaining specific written authorization from the TCEQ prior to the discharge. All water contacting waste or contaminated soils will be treated as contaminated water. Runon and runoff for the 25-year, 24-hour storm event will be controlled following the procedures set forth in the Groundwater and Surface Water Protection Plan and the Leachate and Contaminated Water Management Plan. The landfill will be operated consistent with Title 30 TAC

§330.15(h) regarding discharge of solid wastes or pollutants into waters of the United States.

4.22 Leachate and Contaminated Water Management Plan

Leachate and contaminated water will be controlled at the Turkey Creek Landfill as specified in the Leachate and Contaminated Water Management Plan. Consistent with Title 30 TAC §330.177, recirculation of leachate or gas condensate will only occur over the areas underlain by a Subtitle D liner system (i.e., composite liner system with a leachate collection system). Leachate will be recirculated from a water truck or other comparable equipment using a spray bar or hose to distribute leachate back to the working face (i.e., within the active waste fill area that is contained by the containment berm).

The following performance standards will govern the application rate of leachate recirculation.

- The rate of leachate recirculation will not exceed the moisture holding capacity of the landfill. For example, the application rate will be applied so that no seeps or ponding is observed in the vicinity of the recirculation area. In addition, leachate recirculation over a specific phase will cease if the leachate flow rate to a sump approaches the capacity of the pump within the sump. If this occurs, recirculation activities will move to another phase.
- Leachate recirculation will not occur immediately before, during, or immediately after rainfall events, or during freezing temperatures that could affect the holding-capacity of the waste.
- Leachate recirculation will not occur during high wind events.

The leachate generated from the landfill will be recirculated to the landfill working face, and excess quantities of leachate will be directed to the leachate storage facilities where it will be transported to the liquid waste bulking facility using a tanker truck or other compatible equipment, a properly permitted privately-owned off-site facility, or a POTW for treatment using third party trucks. Per Title 30 TAC §330.991(a)(7) leachate recirculation will not exceed 100,000 gallons per day.

4.23 Waste-for-Ballast Verification

In the areas of the landfill excavation which have been identified to extend below the groundwater table, the liner system itself and the waste placed above the liner system will provide ballast (weight) to protect the liner system from uplift forces due to inward and upward seepage forces of the groundwater. Soil or compacted

waste may be used as ballast. The areas of landfill excavation requiring ballast are identified in the Site Layout Plans.

As discussed in the Liner Quality Control Plan (LQCP), the Construction Quality Assurance Professional of Record (POR) will verify that short-term and long-term uplift of the liner system has been controlled by the ballast. The verification will be documented in the Ballast Evaluation Report (BER) which will be submitted to the TCEQ for approval. As discussed in the LQCP, the BER will contain the signature and seal of the POR performing the evaluation and the signature of the site operator.

4.23.1 First Lift Considerations

As specified in Section 4.9 of this SOP, appropriate personnel will be on-site full time during the placement of the first 5 feet of waste over the liner system to verify that this lower 5 feet of waste does not contain large bulky items which could damage the liner system or which cannot be compacted to the required density.

4.23.2 Documentation

The calculations for the height of waste required to ballast the liner system will be submitted with the SLER/GLER for TCEQ approval. Once the compacted waste ballast is in place, the "Waste-For-Ballast Placement Record" and the engineer's survey elevations of the top of the waste documentation will be provided in the BER. As discussed in the currently permitted SLQCP, the BER will contain the documentation substantiating that the appropriate depth of ballast has been placed over the liner system. The BER will contain the signature and seal of the POR performing the evaluation and the signature of the Landfill Manager.

4.24 Site Inspection and Maintenance List

Item ¹	Part IV Section	Task	Frequency	Inspector	Inspection Documentation
Fence/Gates	IV – 4.1.1	Inspect perimeter fence and gates for damage. Make repairs if necessary.	Weekly	Landfill Manager or Designee	Document inspection in the Site Operating Record
Windblown Waste	IV – 4.5	Police working face area, wind fences, access roads, entrance areas, and perimeter fence for loose trash. Clean up as necessary.	Daily as specified in Section 4.5.	Landfill Manager or Designee	Document inspection in the Site Operating Record
Waste Spilled on Route to the Site	IV – 4.8	Police the entrance areas and all roads at least 2 miles from the site entrances for loose trash. Clean up as necessary.	Daily as specified in Section 4.8.	Landfill Manager or Designee	Document inspection in the Site Operating Record
Landfill Markers	IV – 4.7	Inspect all landfill markers for damage, color-coding, and general location. Correct or replace damaged markers within 15 days of discovery.	Monthly	Landfill Manager or Designee	Document inspection in the Site Operating Record
Site Access Road	IV-4.12	Inspect site access road for damage from vehicle traffic, erosion, or excessive mud accumulation. Maintain as needed with crushed rock or stone. Grading equipment will be used at least once per week to control or remove mud accumulations on roads as well as minimize depressions, ruts, and notholes.	Daily – more often during wet weather or extended dry weather periods.	Landfill Manager or Designee	Document inspection and repairs in the Site Operating Record
Daily Cover	IV – 4.18.2	Inspect for proper placement, thickness, and compaction. Correct problems as needed. Verify that vectors are not an issue.	Daily at the active face and all daily cover areas will be inspected.	Landfill Manager or Designee	Document inspection in the Site Operating Record
Intermediate Cover/Class 1 Soil Cover Layer	IV – 4.18.3	Inspect for proper placement, thickness, erosion, compaction, and for presence of waste or other contamination. Correct problems as needed.	Monthly and within 72 hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record
Final Cover	IV – 4.18.4	Inspect for proper placement, thickness, compaction, slope, settlement and erosion. Maintenance will be ongoing throughout postclosure care period. Correct problems as needed.	Weekly and within 72 hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record
Site Signs	IV – 4.4	Inspect all site signs for damage, general location, and accuracy of posted information.	Weekly	Landfill Manager or Designee	Document in the Site Operating Record
Ponded Water	IV – 4.19	Inspect site for unauthorized ponded water areas as described in Section 4.19. Correct problems as needed.	Weekly and within 72 hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record
Odor	IV – 4.10	Inspect the perimeter of the site to assess the performance of site operations to control odor.	Daily	Landfill Manager or Designee	Document in the Site Operating Record
Perimeter Channels/Ponds	IV – 4.19	Inspect perimeter channels and detention ponds to verify that they are functioning as designed (e.g., excess sediment removed, outlet structures intact, erosion control measures intact).	Weekly and within 72 hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record
Class 1 Waste – Unloading Areas	IV – 4.20.7	Inspect Class 1 waste unloading areas for spills.	Daily	Landfill Manager or Designee	Document in the Site Operating Record
Class 1 Waste – Above-Grade Dikes	IV – 4.20.7	Inspect above-grade dikes to verify that they are present where required and functioning as designed. Check for erosion, deformation, or other deterioration/damage. Take remedial actions to repair the problem immediately if a hazard is imminent or has already occurred.	Weekly and within 72 hours of a rainfall event of 0.5 inches or more.	Landfill Manager or Designee	Document in the Site Operating Record
Random Load Inspections	IV – 6.4	Perform and document random load inspections as described in Section 6.4	Weekly	Landfill Manager or Designee	Document in the Site Operating Record

¹ All inspections listed above shall be maintained in the Site Operating Record.

4.25 Visual Screening of Daily Operations

Existing vegetation in the buffer zones will be maintained, as practicable, to provide visual screening of disposal operations from public view. The facility will continue to operate the landfill in a manner that will provide the maximum practicable screening within the requirements of the design.

5 SEQUENCE OF DEVELOPMENT

5.1 Overall Sector Development

The Turkey Creek Landfill has been divided into sectors for disposal operations. Excavation and fill operation began in Sector 1, which is located as shown on the Sector Plan (Figure I/IIA.2, Parts I/II, Appendix I/IIA). Each sector will be developed by constructing adjoining lined areas which may range in size. The size of the lined area will be based on the waste inflow and the economics of liner construction. The side slopes of the excavation will generally be 3H:IV. The excavated material will be stockpiled near the excavation for future use in the construction of liner and also for use as daily and intermediate cover and/or removed from the site. The stockpiles will be placed to avoid conflicts with drainage plans.

After a portion of the sector is excavated, construction of bottom and sidewall liners will be completed in accordance with the Soil and Liner Quality Control Plan. Waste will not be placed in this sector until the liner system has been certified and approved by the TCEQ for waste disposal. Diversion berms will be constructed as needed to keep run-on and run-off away from the working face.

5.2 Individual Sector Development

As the fill reaches the existing ground elevation, fill will be placed vertically up to the final contour elevations as shown on the Final Contour Plan. Areas will be covered with an intermediate cover, until the final cover system is in place. Such a sequence of filling operation will be followed until all the sectors have been closed.

6 DETECTION AND PREVENTION OF DISPOSAL OF PROHIBITED WASTES

6.1 General

Turkey Creek Landfill will implement a program to exclude prohibited wastes as described in Title 30 TAC §330.15(e), including but not limited to, regulated hazardous and PCB wastes as defined in 40 CFR Parts 261 and 761, respectively. The program will include training site personnel to know in detail what the prohibited wastes are, how to perform random inspections, how to control site access, and what procedures are required in the event of identification of prohibited wastes. The detection and exclusion program at the Turkey Creek Landfill will include at least the following steps:

- Random inspections of incoming loads
- Records of all inspections
- Training for facility personnel to recognize prohibited waste
- Notification to TCEQ of any incident involving the disposal of regulated hazardous or PCB wastes at the landfill
- Provisions for remediation of the incident

6.2 Load Inspection Procedure

As noted in Section 4.2, Scale Operators, Equipment Operators, Spotters, and Laborers will monitor the incoming waste. Should any indication of prohibited waste be detected, the Landfill Manager or his designee will conduct a thorough evaluation of the load. The driver will be directed to a load inspection area located at or near the working face where the load will be discharged from the vehicle. The inspector will break up the waste pile and inspect the material for any prohibited waste.

Inspections at or near the working face will be conducted away from: (1) turn-around areas; and (2) normal travel routes. Spreading of the waste for inspection may be accomplished by using mechanized equipment or hand

implements. Inspectors will observe the waste materials as the waste discharged from the truck is spread and separated. The waste will be sufficiently spread to determine its character and composition. Inspectors will wear appropriate personal protective equipment during the inspection which includes, at a minimum, the following:

- Gloves
- Work boots
- Clothing which minimizes contact with waste
- High visibility clothing
- Hardhat

Additional personal protective equipment will be used if regulated hazardous waste or PCB waste is identified. In the event that regulated hazardous waste or PCB waste is identified during an inspection, waste inspection activities will cease until inspection personnel obtain sufficient protective equipment, if needed. This additional equipment may include:

- Respirator with appropriate cartridge filters (i.e., organic vapor or particulate)
- Tyvek suit or coveralls
- Eye protection

6.3 Managing Prohibited Wastes

Unknown wastes undergoing inspection by Turkey Creek Landfill personnel must be properly segregated and protected against the elements, secured against unauthorized removal, and isolated from other waste and activities.

Known prohibited wastes detected during an inspection will be returned immediately to the transporter and generator. If the transporter is not available, the waste will be safely stored until provisions for removal can be arranged.

If regulated hazardous waste or PCB wastes are detected, the TCEQ will be notified. As soon as is practical, the transporter will be required to remove the regulated hazardous waste or PCB waste from the site. Prior to removal, the transporter must obtain an EPA identification number, package the waste in accordance with TxDOT regulations, and properly manifest the waste designating a permitted facility to treat, store, or dispose of the hazardous waste.

Any prohibited waste that is discovered at the working face after it is unloaded will be promptly returned to the vehicle that delivered the waste. That party will be responsible for the proper disposal of this rejected waste at a permitted facility. In the event the unauthorized waste is not discovered until after the vehicle that delivered it is gone, the waste will be segregated and controlled to the extent possible (e.g., the unauthorized waste will be covered with soil and/or ADC and no additional filling will occur over the unauthorized waste pending final resolution). Survey stakes or similar markings will be placed around the perimeter of the area that contains the unauthorized waste so that it is clear where the unauthorized waste is located. Alternately, the unauthorized waste may be segregated by placing the unauthorized waste in a roll-off or similar container.

An effort will first be made to identify the entity that delivered the prohibited waste and have them return to the site to remove and properly dispose of the waste. In the event that identification is not possible, Turkey Creek Landfill will notify the TCEQ within 24 hours and seek guidance on how to properly manage the waste.

6.4 Random Inspection Procedures

In addition to inspecting suspicious loads, random inspections will be undertaken. Random inspections will be supervised by the Landfill Manager or his designee. Staff conducting random inspections will receive training on the random inspection procedures in this plan and instruction on the recognition of regulated hazardous waste, PCB waste, and other prohibited wastes. Random inspections will be conducted at or near the working face to facilitate disposal of authorized waste after random inspections have been completed.

Except as provided herein, all waste loads will be subject to random inspections consistent with the schedule and requirements listed in Section 4.24 of this SOP (Site Inspection and Maintenance List). The Landfill Manager will determine the procedure for the random selection of the waste hauling vehicles that will be inspected. The following criteria will be utilized in the development of the selection procedure:

- The random selection procedure will objectively select waste hauling vehicles for inspection.
- The random selection procedure will ensure that waste hauling vehicles are selected at varying times of day.
- The random selection procedure will apply to all waste hauling vehicles that transport waste to the site, except those excluded below.

If inclement weather or other conditions preclude the random inspection from being performed on the scheduled day, the delayed random inspection will be performed at the same scheduled time on the next full day that the site is operating.

The loads which are excluded from random inspections are listed below:

- Waste from transfer stations (meeting the criteria stated below)
- Asbestos wastes
- Loads for which other steps have been taken to ensure that regulated hazardous wastes or PCB wastes are excluded

The Turkey Creek Landfill may accept waste from transfer stations. Wastes received from transfer stations will not be screened at the landfill if the transfer station is permitted or registered by the TCEQ and random screening procedures are conducted at the transfer station. Vehicles hauling waste from transfer stations are expected to meet all applicable TCEQ inspection requirements, including random inspections of waste received at the transfer station.

6.5 Recordkeeping

The Landfill Manager is required to maintain and include in the Site Operating Record the following:

- Random load inspection reports
- Reports on quantities and disposal of authorized waste
- Records of regulated hazardous or PCB waste notifications sent to TCEQ
- Personnel training records

Random load inspection reports, recorded on standardized forms, will be completed for each inspected load. The reports should include at a minimum, the date and time of inspection, the name of the hauling company, the size of the load, any indicators of prohibited waste, and results of the inspection. A copy of an example load inspection report form is included in Appendix IVA of this SOP. The actual form that will be used at the time of inspection may vary from the sample provided in Appendix IVA.

The TCEQ will be notified within 24 hours whenever regulated hazardous or PCB waste is detected. Records of the notification will be kept in the Site Operating Record and will include the date and time of notification, the individual contacted, and the information reported.

6.6 Training

Individuals responsible for inspecting incoming loads will receive training in the provisions and procedures of this section (refer to Section 2.2 for additional information). Training will be conducted by site employees or contract personnel experienced in waste inspection and detection requirements. Training will be scheduled and attendance will be recorded. The training outline will incorporate the requirements and procedures of this section. Training will include state and federal laws and regulations for managing prohibited waste. The training will at a minimum include the following topics:

- Safety requirements during inspection procedures
- Wastes prohibited from disposal at the site
- Methods of identifying prohibited wastes
- Various labels used for waste identification
- Safety procedures if prohibited wastes are encountered
- Procedures for managing prohibited wastes encountered

Documentation of training will be placed in the Site Operating Record.

7 FIRE PROTECTION PLAN

7.1 Fire Protection Standards

7.1.1 Posted Information

The following fire protection information will be posted at the main entrance to the site.

1. Emergency contact phone number(s) for site personnel
2. "No Smoking" signs

7.1.2 Fire Safety Rules

The following fire safety rules may be posted in the employee area.

1. Do not attempt to fight fire alone.
2. Be familiar with the use and limitations of fire-fighting equipment.
3. Alert other facility personnel in the area.
4. Assess extent of fire and likelihood that the fire will spread.
5. Contact the local fire department at 911, as necessary.
6. Attempt to contain or extinguish the fire until the fire department arrives if the fire can be safely fought with onsite fire-fighting equipment.

7.1.3 Burning Waste Loads (Hot Loads)

Steps will be taken to identify incoming "hot loads" prior to their being unloaded for disposal at the working face. The Scale Operators, Equipment Operators, Spotters, and Laborers must be alert for signs of hot loads, such as smoke, steam, or heat being released from incoming waste loads.

Fire-fighting methods include smothering with soil, separating burning material from other waste, or spraying with water from the water truck. A small fire may be controlled with a hand-held extinguisher.

In the event of a fire within a vehicle, the vehicle will be brought to a safe stop away from any fuel storage area or exposed waste, if possible. The vehicle should be driven away from active areas and the load ejected in a hot load area, which is any space, preferably at least 50 feet away from a road, with either no waste deposited or waste with at least 6 inches of soil cover. A water truck, bulldozer, or other equipment will be used to extinguish the burning waste load. The waste will be covered with an adequate amount of soil to ensure it is extinguished. The load will be inspected by the Landfill Manager or his designee before disposal. During inspection, if the soil is removed thereby allowing oxygen to contact the waste, the load will be observed for hot spots or flare-ups. No smoldering or smoking waste will be placed in the working face area for permanent burial until all hot spots or flare-ups have been extinguished.

If it is not possible to move a burning vehicle away from fuel storage or exposed waste, the local fire department will be called at 911, as necessary. While awaiting the arrival of the local fire department, all reasonable measures should be employed to extinguish the fire and prevent it from spreading beyond the vehicle.

7.2 Preventive Procedures

Fuel spills will be controlled immediately. Soil contaminated with spilled fuel will be excavated and, if authorized, disposed of at the active face. Contaminated soils may be excavated using a shovel for small areas or with heavy equipment as appropriate. Onsite brush and vegetation will be controlled through mowing to reduce the possibility of brush fires from spreading to the landfill or off-site.

Proper compaction and earth cover will be used to minimize the potential for accidental fires. The compaction of the waste as it is disposed, and the subsequent covering with daily soil cover or ADC, will reduce the potential for fires by reducing voids within the waste and the amount of oxygen available for combustion. The daily cover serves as a physical, non-combustible barrier to a fire.

In addition, equipment that is used at the working face may be periodically cleaned through the use of high pressure water or steam cleaners. The high pressure water or steam cleaning will remove combustible waste and caked material which can cause equipment overheating and increase fire potential. The amount of water used to clean the equipment will be minimized.

7.3 Vehicle or Equipment Fire

If equipment or other site vehicles experience a fire, the operator will attempt to bring the vehicle or equipment to a safe stop, away from fuel supplies, uncovered

solid waste, and other vehicles. The operator will attempt to shut off the engine and engage the brake. Lowering of any implements should be attempted as a means to prevent subsequent movement of the vehicle.

7.4 Structure Fire

The local fire department will be called at 911 for all structure fires. No site personnel will enter a structure on fire.

7.5 Working Face(s) Fire Protection Plan

7.5.1 Working Face Fire Protection Requirements

Title 30 TAC §330.129 sets forth the following two methods for fire protection:

- Maintain a source of earthen material large enough to cover the working face with 6 inches of earth material within a 1-hour period, or
- An alternate method that is approved by the executive director of the TCEQ.

The plan set forth in this section provides an alternate method that utilizes both water and earthen material (as well as fire extinguishers for small fires) to provide fire protection for each working face.

7.5.2 Working Face Fire Fighting Plan

When a fire is detected within material at the working face, the spotter (or Equipment Operator) will first redirect incoming loads away from the affected area. Working face fires will be extinguished by one of the following techniques.

- If the area of burning waste is small, it will be extinguished using a fire extinguisher located on the equipment at the working face. After the fire is extinguished, the affected portion of the working face will remain closed while the area is inspected to verify the fire is completely extinguished. Inspection of the fire area will be conducted by the Landfill Manager or his designee.
- The burning waste material will be smothered with soil from a nearby stockpile or removed from the working face (i.e., “cut out” with a dozer or similar equipment) and relocated to an area where it can be covered with 6 inches of soil. The affected portion of the working face will remain closed while the area is inspected to verify the fire is completely extinguished.

Inspection of the fire area will be conducted by the Landfill Manager or his designee.

- A water source may also be used to help extinguish the burning waste. The burning waste material within the working face will be sprayed with water from a water truck or water tank stationed in a readily accessible location near the working face. The burned (or burning) waste material will then be removed from the working face (cut out) and relocated to an area where it can be covered with 6 inches of soil. The working face area which contained the burning waste will remain closed while the area is inspected to verify the fire is completely extinguished. Inspection of the fire area will be conducted by the Landfill Manager or his designee.
- The working face area from which burned (or burning) waste material was removed will be covered with 6 inches of soil after the Landfill Manager or his designee has verified the fire is completely extinguished.

In each case listed above, after the Landfill Manager or his designee confirms that the fire has been extinguished, then waste filling operations in that area may resume.

7.5.3 Water Trucks or Storage Tank Requirements

A water source (either a water truck or storage tank) equipped with a water cannon will be maintained in a readily accessible location to assist with the fighting of any potential working face fire. The water truck or storage tank may be used in support of other landfill activities (e.g., dust suppression, compaction of earth fills).

The on-site stormwater detention ponds may also be used as a source of water for fire control. A minimum of 2,000 gallons of water will be available for firefighting purposes. Depending on the size, configuration, and location of the active working faces, additional water sources may be provided as determined by the Landfill Manager. Also, during periods of freezing temperatures, measures will be taken to ensure that the tank(s) remain operational.

7.5.4 Soil Stockpile Requirements

A soil stockpile will be maintained within 1,000 feet of each working face. The stockpile will be available to (1) smother burning waste material at the working face or (2) place soil over burning waste material that has been cut out of the working face. The stockpile will be sized to cover at least 25 percent of the size of each working face. In addition, enough earthen material (i.e., soil stockpiles and soil within borrow areas) will be maintained on-site to cover the entire working face within 24 hours. The earthen material requirements are listed in the following table.

Size of Working Face	Earthen Material Volume Requirements		
Area of Working Face in Square Feet	Volume of Earthen Material Required to Cover the Working Face Area with 6 Inches of Soil	Volume of Earthen Material Required to Cover the Working Face Area with 6 Inches of Soil	Volume of Earthen Material Required to be Maintained Within 1,000 feet of the Working Face
26,250 ft ²	13,125 ft ³ *	486 yd ³	122 yd ³
81,250 ft ²	40,625 ft ³ *	1,505 yd ³	377 yd ³
168,750 ft ²	84,375 ft ³ *	3,125 yd ³	782 yd ³
315,000 ft ²	157,500 ft ³ *	5,834 yd ³	1,459 yd ³

* 26,250 ft² x 0.5 ft (0.5 foot thickness is obtained by using a 6-inch thickness of cover for a 1-day period over the working face).

Along with the list of equipment, calculations that show how the specified equipment can cover 25 percent of the working face in 1 hour will also be maintained in the Site Operating Record. The calculations will consider the following.

- Capacities of loading and unloading equipment
- Transportation route to the stockpile and working face
- Time needed to spread available soil on the working face (note that the top 6 inches of areas adjacent to the working face that have 12 inches of intermediate cover may be used as a soil source)

An example calculation is listed below.

Largest stockpile to be located within 1,000 feet for 25% coverage (refer to the table in Section 7.7.4).

$$\text{Volume of Cover} = V_c = 1,458 \text{ cy}$$

Assume:

$$\text{Truck Capacity} = TR_c = 20 \text{ cy}$$

$$\text{Number of Trucks} = N_{TR} = 3$$

$$\text{Average Truck Velocity} = v_A = 12 \text{ mph} = 1,056 \text{ fpm}$$

$$\text{Time to Cover Working Face} = t = 60 \text{ min}$$

Total Number of Loads (L):

$$L = V_c / TR_c = 1,458 \text{ cy} / 20 \text{ cy} = 73 \text{ loads}$$

Number of Feet Traveled for Truck (D_{TR}) in t:

$$D_{TR} = v_A \times t = 1,056 \text{ fpm} \times 60 \text{ min} = 63,360 \text{ ft}$$

Distance of Stockpile from Working Face (D_s):

$$D_s = (D_{TR} / (L / N_{TR})) = 63,360 \text{ ft} / (73 \text{ loads} / 3 \text{ trucks}) = 2,604 \text{ ft (round trip)}$$
$$D_s = 2,604 \text{ ft} / 2 = 1,302 \text{ ft}$$

Therefore, in this case a 1,458 cy stockpile could be maintained within 1,302 feet of the working face. However, a minimum distance of 1,000 feet is specified.

A readily accessible water source and a soil stockpile within 1,000 feet will facilitate a quick response to any fires at the working face. Any working face fire will be controlled quickly so that it will not spread. Because of the quick response provided by this plan, working face fires are projected to encompass no more than 10 to 15 percent of the working face. Therefore, by maintaining a soil stockpile within 1,000 feet of the working face, which is large enough to cover 25% of the working face, enough soil will be available to cover the area of burning waste, including a significant contingency.

7.6 Convenience Center or Wood Waste Processing Area Fire

If a fire occurs in the Convenience Center or Wood Waste Processing area, field personnel will first redirect incoming loads away from the affected area. Fire-fighting methods include smothering with soil, separating burning material from other waste, or spraying with water from the water truck. A small fire may be controlled with a hand-held extinguisher. Upon extinguishing the fire, the portion of the Convenience Center or Wood Waste Processing area affected by the fire will remain closed while the area is inspected to verify the fire is completely extinguished. Inspection of the fire area will be conducted by the Landfill Manager or his designee.

7.7 RACM Area Fire

A soil stockpile of at least 50 cubic yards will be maintained within 100 feet of the RACM disposal area. This stockpile will cover the 50-foot by 50-foot maximum disposal area size with 6 inches of soil in the event of a fire in this area. The area may also be sprayed with water from a water truck.

7.8 Liquid Waste Solidification Area Fire

The fire protection procedure for the liquid waste solidification area is described in Appendix IVE of this SOP.

7.9 Contacting Fire Department and TCEQ

If firefighting assistance is needed from the local fire department, the Landfill Manager or his designee will call 911, or the local fire department, and report the fire. The Landfill Manager will also notify Scale Operators, who will direct the fire department personnel to the scene of the fire.

If a fire occurs that is not extinguished within 10 minutes of detection, the TCEQ's Regional Office will be contacted immediately by telephone, but not later than four hours, and in writing within 14 days with a description of the fire and the resulting response.

8 HEALTH AND SAFETY

8.1 General Site Safety

To promote site safety, (i) facility personnel will be properly trained, use well-maintained equipment, and perform standard work procedures in accordance with OSHA guidelines; (ii) access to active areas of the facility will be limited to authorized personnel only; and (iii) planned emergency response procedures will be followed in the event of an emergency.

A record of training will be maintained in the Site Operating Record to confirm that each employee has received the proper training (refer to Section 2.2 of this SOP for additional information).

Well-maintained equipment is vital to the safe conduct of daily landfilling operations. Therefore, all site equipment will be maintained in proper working order and all safety guards, backup alarms, and engine kill switches will be operational. Equipment Operators will perform an equipment check at the beginning of each workday. Fire extinguishers will be routinely inspected (refer to Section 7 of this SOP for additional information).

Access to the site will be limited to authorized personnel as described in Section 4.1 of this SOP. Access is controlled by a combination of signs and physical barriers. Site personnel are responsible to be alert for the entrance of unauthorized personnel or the entrance of authorized personnel into prohibited areas.

In the event of an emergency, site personnel will assess the situation, notify the Landfill Manager or his designee, and take appropriate actions such as rendering aid, calling for assistance, or closing access to the emergency scene. Emergency numbers will be posted.

These include:

Ambulance 911

Fire 911

Sheriff/Police 911

8.2 Preparedness and Prevention Measures

Preparedness and prevention measures have been developed to minimize both frequency and severity of accidents and emergency situations threatening human health. Preparedness and prevention measures depend largely on the attentiveness and state of readiness of facility personnel. Preparedness and prevention measures have been developed for one general category and two specific areas of the site: the Scale House and the landfill access road. These preparedness and prevention measures are detailed in the following sections.

8.2.1 General

General preparedness and prevention measures that will be followed at the Turkey Creek Landfill are:

- Access controls will provide for the safety of non-landfill personnel.
- Routine preventive maintenance of equipment will be provided.
- A management representative will perform site inspections as noted in Section 4.24.
- Appropriate personnel safety equipment will be kept onsite and maintained in good repair.
- Adequate turning areas for hauling vehicles will be provided.
- Salvaging and scavenging will not be allowed.
- Waste unloading will be restricted to designated areas only.
- Site personnel will be alert for possible hazardous or other unauthorized wastes.
- Non-approved wastes will be controlled or contained and removed as necessary.

8.2.2 Scale House

Preventive measures that will be implemented at the scale house include the following:

- Visually screen all incoming loads for unauthorized wastes.
- Monitor incoming wastes to ensure that all wastes loads are adequately covered, or otherwise secured or contained.
- Visually observe incoming vehicles for evidence of improper operation, faulty equipment, or other conditions that could be hazardous to personnel or other persons on site.

- Maintain access to appropriate emergency equipment and first-aid materials.

8.2.3 Landfill Access Road

Preventive measures that will be implemented for the landfill access road include:

- Display directional and other precautionary signs on-site.
- Provide road passage for two-way traffic.
- Maintain roadway free from obstructions.
- Enforce requirements for safe operation of vehicles onsite.

9 RECORDKEEPING REQUIREMENTS

The Landfill Manager will maintain a copy of the current permit (including any permit modifications); the approved SDP, SOP, Groundwater Sampling and Analysis Plan, Final Closure Plan, Postclosure Care Plan, Landfill Gas Management Plan, and Leachate and Contaminated Water Management Plan; and any other TCEQ required plans or documents onsite (or an alternate location approved by the executive director) at all times during the active life of the facility. The landfill will maintain the Site Operating Record in an organized format which allows the information to be easily located and retrieved. Additionally, all information contained in the Site Operating Record will be furnished upon request to the executive director and will be made available for inspection by the executive director. As required by the TCEQ, the Site Operating Record will be maintained at the site.

The Landfill Manager is responsible for recording and retaining in the Site Operating Record the information listed below:

- All location restriction demonstrations
- Inspection logs and records, training procedures, and notification procedures relating to excluding the receipt of prohibited waste
- Inspection records and training procedures relating to fire prevention and site safety
- All inspection documentation noted on Table 4.24 – Site Inspection and Maintenance List
- Fire Occurrence Notices
- Personnel training records and operator licenses. Training records (including operator licenses) for current personnel will be kept until closure and training records on former employees will be kept for at least three years from the date the employee last worked at the facility. Records may accompany personnel transferred within the company.
- Landfill Gas Management Plan
- Cover Application Logs
- Results from gas monitoring events and any remediation plans relating to explosive and other gases

- Unit design documentation for the placement of leachate or gas condensate in the landfill
- Remediation plans for explosive and other gases, if applicable
- All inspection logs and reports and all demonstrations, certifications, findings, monitoring, testing, and analytical data relating to groundwater monitoring and corrective action
- Closure plans and monitoring, testing, or analytical data relating to closure requirements
- Postclosure care plans and monitoring, testing, or analytical data relating to postclosure requirements
- Cost estimates and financial assurance documentation relating to financial assurance for closure and postclosure care
- Copies of all correspondence and responses relating to the operation of the facility, modifications to the permit, approvals, and other matters pertaining to technical assistance
- Any and all documents, manifests, scale tickets, generator waste profile sheets, etc., involving special waste
- RACM Acceptance Records
- Class 1 non-hazardous industrial waste profile and acceptance records
- A record of each unauthorized material removal event
- Annual waste acceptance rate documentation including Quarterly and Annual Solid Waste Summary Reports
- A record of alternate operations hours
- Access control breach and repair notices
- Other documents as specified by the approved permit or by the executive director of the TCEQ

The Landfill Manager will retain all information contained within the Site Operating Record and all plans required for the facility for the life of the facility including the postclosure care period. The above listed items will be incorporated into the Site Operating Record within seven working days of the completion of the item/record or receipts of the analytical data. Physical space limitations may warrant the offsite storage of non-electronic (paper) records older than five years at a nearby records storage facility or corporate office.

In addition to the above, the permittee will provide written notice in the form of a Soils and Liner Evaluation Report (SLER), Geomembrane Liner Evaluation Report (GLER), and/or Geosynthetic Clay Liner Evaluation Report (GCLER) detailing the

final construction and lining of a new disposal cell. The reports will be submitted to the TCEQ for review 14 days prior to the placement of any waste in the new cell. If verbal or written response from the TCEQ is not provided by the end of the 14th day following TCEQ receipt of the report(s), placement of solid waste may begin. All SLER, GLER, and GCLER approvals will be maintained in the Site Operating Record.

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417D**

MAJOR PERMIT AMENDMENT APPLICATION

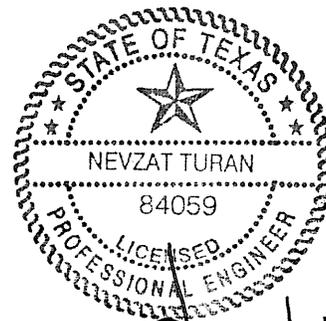
**PART IV – SITE OPERATING PLAN
APPENDIX IVA
EXAMPLE LOAD INSPECTION REPORT**

(For information purposes only; actual forms may vary)

Prepared by

Texas Regional Landfill Company, LP

February 2022



Prepared by

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9770

[Handwritten Signature]
02/22/22

WCG Project No. 0771-368-11-123

Random Load #

TURKEY CREEK LANDFILL RANDOM LOAD INSPECTION

LOAD INSPECTION REPORT

LOAD INSPECTION DESCRIPTION					
Date of Inspection:		Time of Inspection:		Ticket Number:	
Name of Inspector:					
Name of Hauling Company:					
Driver's Name:					
Vehicle Identification:				Load Size:	
SOURCE IDENTIFICATION					
LOW RISK SOURCES		MEDIUM RISK SOURCES		HIGH RISK SOURCES	
<input type="checkbox"/> Residential		<input type="checkbox"/> Dry Cleaners		<input type="checkbox"/> Large Manufacturing	
<input type="checkbox"/> Office Buildings		<input type="checkbox"/> Auto Body Repair		<input type="checkbox"/> Doctor's Office	
<input type="checkbox"/> Schools		<input type="checkbox"/> Small Manufacturing		<input type="checkbox"/> Hospital	
<input type="checkbox"/> Farms		<input type="checkbox"/> Nursing Homes		<input type="checkbox"/> Paint Manufacturers	
<input type="checkbox"/> Apartments		<input type="checkbox"/> Other		<input type="checkbox"/> Print Shops	
<input type="checkbox"/> Restaurants				<input type="checkbox"/> Waste Brokers	
<input type="checkbox"/> Department Stores				<input type="checkbox"/> POTW's	
<input type="checkbox"/> Other				<input type="checkbox"/> Other	
LOAD CONTENTS					
Household Wastes	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Transformers/Capacitors	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Wood, Sawdust	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Labeled Hazardous Waste	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Metal	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Batteries	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Paper, Cardboard	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Oil	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Yard Waste, Brush, Stumps	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Medical	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Containers > 5 gallons	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Radioactive	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Bulk Liquids	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Soil	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Powders, Dusts	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Asphalt, Concrete, Rock	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Roofing Material	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Food Waste	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Tires	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Other	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Does Waste Match the Waste Hauler's Description?				Yes <input type="checkbox"/>	No <input type="checkbox"/>
Unusual Odors?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Unusual Colors?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Heat, Excessive Smoke?	Yes <input type="checkbox"/>	No <input type="checkbox"/>			
ACTION TAKEN					
Signature of Inspector:			Signature of Driver:		

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417D**

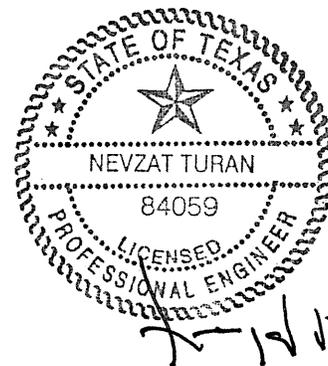
MAJOR PERMIT AMENDMENT APPLICATION

**PART IV – SITE OPERATING PLAN
APPENDIX IVB
ALTERNATIVE DAILY COVER OPERATING PLAN INFORMATION**

Prepared for

Texas Regional Landfill Company, LP

February 2022



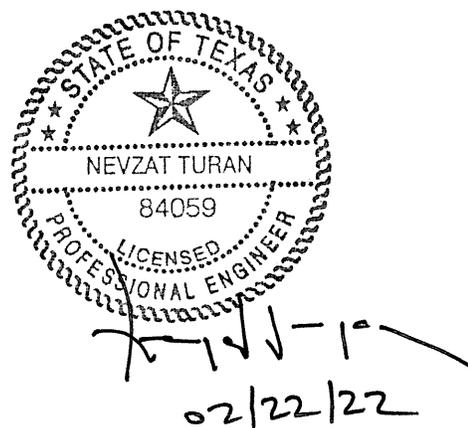
Prepared by

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0771-368-11-123

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ADC SUMMARY

The site is currently approved to use the following types of ADC.

- Biocover. This material was approved on November 6, 2002. The approval letter and Alternative Daily Cover Operating Plan (ADCOP) is provided on pages B-2 through B-12 of this SOP.
- Petroleum Contaminated Soils and Tire Shredding Process Waste. These materials were approved on September 17, 1996. The approval letter and ADCOP for these materials are presented on page B-13 through B-22 of this SOP. Also included in this ADCOP is a ConCover paper mulch material. This material has been replaced with Biocover and subsequently approved (refer to first bullet).
- Posi-Shell. The Posi-Shell spray-type ADCOP is provided on pages B-23 through B-53.
- Synthetic Tarps. Synthetic tarps were approved by TCEQ as an ADC material on June 13, 2018. The DCOP is provided on pages B-54 through B-64.

Consistent with Title 30 TAC §330.165(d), a temporary authorization will be submitted for any additional future ADC materials. Consistent with Title 30 TAC §330.165(d)(2), after a temporary authorization to use a new ADC material is approved, a status report for the new ADC materials will be submitted on a two-month basis to the TCEQ describing the effectiveness of the alternative materials, any problems that may have occurred, and corrective actions required as a result of such problems. The trial period will be for two 180-day periods with an extension request to be submitted near the end of the first 180-day period. If no unresolved problems occur within the trial period, a permit modification consistent with Title 30 TAC §305.70(k)(1) will be submitted to the TCEQ to obtain permanent approval of the ADC material.

Robert J. Huston, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Kathleen Hartnett White, *Commissioner*
- Margaret Hoffman, *Executive Director*



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 6, 2002

Mr. Larry Bressman, Landfill Manager
Turkey Creek Landfill
9100 S Interstate 35W
Alvarado, Texas 76009

Re: Municipal Solid Waste-Johnson County
Turkey Creek Landfill-Permit No. MSW 1417B
4th Alternate Daily Cover (ADC) Quarterly Report
Mail Log No. 03-210

Dear Mr. Bressman:

We have reviewed your letter dated September 30, 2002, received in this office on October 3, 2002. The letter is a 4th quarter status report, regarding the effectiveness of using BioCover as an alternate daily cover, and a request to use BioCover on a permanent basis. No problems have been reported for the use of BioCover since it was placed into use on September 24, 2001, at the referenced site.

The authorization from TCEQ to use BioCover was issued to the referenced site on August 23, 2001, under Title 30 of the Texas Administrative Code (TAC), Chapter 305, Section (§) 305.70(i), regarding Municipal Solid Waste Class I Modifications, which was in existence, and 30 TAC §330.133(c)(2), regarding the use of alternate daily cover. We have determined that based on the provisions of the August 23, 2001 approved authorization, and no problems reported by Turkey Creek Landfill personnel, during the use of BioCover, status reports are no longer required and BioCover may be used on a permanent basis. Please be reminded that should the use of this material become ineffective, this authorization may be revoked.

If you have any questions concerning this letter, or if we may be of assistance to you regarding municipal solid waste, please contact Mr. Mario A. Perez, Sr., at MC-124 of the letterhead address; telephone number (512) 239-6681.

Sincerely,

A handwritten signature in cursive script that reads "Ada Lichaa".

Ada Lichaa, Team Leader
Municipal Solid Waste Permits
Waste Permits Division

AL/map

cc: Mr. Matt Henry, 901 E College Street, Lewisville, TX 75067

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION



MODIFICATION TO
MUNICIPAL SOLID WASTE PERMIT № MSW-1417B
Turkey Creek Landfill

Municipal Solid Waste Permit No. MSW-1417B is hereby modified as follows:

Description of Change:

The addition of Bio-Cover as an alternate daily cover in accordance with the provisions found in Title 30 of the Texas Administrative Code, Section 330.133(c).

Permit Section Revised:

Site Operating Plan: Site Layout Plan
Appendix C, Par IV, SOP-Alternate Daily Cover Operating Plan
Section 4.18.2, Daily Cover, Page 14

This modification is a part of Permit No. MSW-1417B and should be attached thereto.

APPROVED, ISSUED, AND EFFECTIVE in accordance with 30 Texas Administrative Code Section 305.70(i).

ISSUED DATE:

AUG 23 2001.

A handwritten signature in black ink, appearing to read "Jeffrey A. Swartz".

For the Commission

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TNRCC PERMIT NO. 1417B**

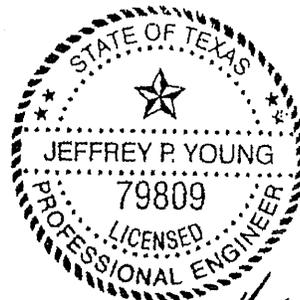
**CLASS I PERMIT MODIFICATION
BIOCOVER ALTERNATE DAILY COVER OPERATING
PLAN**

Prepared for:

Turkey Creek Landfill TX, LP

June 2001

Revised August 2001



Prepared by:

Weaver Boos & Gordon, LLC—Southwest
6420 Southwest Blvd. Suite 206
Fort Worth, Texas 76109
817/735-9770
Project 0120-72-11

Jeffrey P. Young
8-7-01

CONTENTS

PERMIT MODIFICATION NARRATIVE

APPENDIX A

BioCover Information

APPENDIX B

Applicant Certification

1 PERMIT MODIFICATION NARRATIVE

The purpose of this permit modification is to provide Turkey Creek Landfill the option to use BioCover as an additional alternate daily cover (ADC) material. The TNRCC has approved the use of several ADC materials at the Turkey Creek Landfill. Consistent with 30 TAC §330.133(c) of the TNRCC municipal solid waste regulations and the currently approved Alternate Daily Cover Operating Plan (ADCOP), material and operational issues for the BioCover ADC material are discussed below.

- General Material Description - BioCover is produced by Profile Products LLC. BioCover consists of wood fiber, corrugated fiber, and hydro-colloid based tackifier. BioCover is mixed with water and a guar gum tackifier and applied with a hydromulch machine. BioCover mixtures will form a crust-like barrier after application. The hardened product is similar to Refiber, Posishell or Concover (other TNRCC approved ADC materials). BioCover is a reformulation of Refiber. Additional information on the BioCover product is included in Appendix A.
- Chemical Characteristics - Characteristics of BioCover are also included in Appendix A. BioCover is not reactive, ignitable, or corrosive.
- Operational Methods - Site personnel will verify that the waste fill area has been covered with the minimum required thickness at the completion of each working day. BioCover will be applied to the working face using a FINN T90 (900 gallon capacity) or similar equipment following the procedure listed below.
 1. The operator will become familiar with the MSDS sheet on the product to be used before operating the hydroseed machine for ADC.
 2. The operator will not operate the hydroseed machine until he has been trained by qualified personnel.
 3. The operator will mix the spray ADC according to the manufacturer's recommendation. Then, using the hydroseed machine, the operator will apply the ADC from at least two different directions to achieve an overall thickness of approximately 0.25 inches over the exposed waste at the working face.

- Effectiveness – BioCover applied as an ADC will prevent vectors, odors, and windblown litter and waste from occurring in the area of use. This ADC will cover and hold down litter and waste, seal off odors and prevent vector propagation.
- ADC Verification and Inspection Procedures - At the end of each working day, site personnel will inspect the working face to verify the minimum thickness of ADC has been placed over the exposed wastes. Site personnel will also routinely assess the effectiveness of the ADC in controlling vectors, fires, odors, and windblown waste. In the event that the BioCover ADC does not control vectors, fires, odors, or windblown waste, then the BioCover ADC application process will be re-evaluated to verify that this ADC material adequately covers the working face and serves its intended purpose. Any required changes to the ADC operational procedures will be documented in the Site Operating Record. The location of each BioCover daily cover area will be maintained on the daily cover log, which will be kept in the site operating record.

Consistent with 30 TAC §330.133(c)(3), ADC will not be used to cover exposed waste if the landfill is to be closed for a period of greater than 24 hours (unless otherwise approved by the TNRCC).

~~Consistent with §330.133 (c)(2), status reports will be submitted on a quarterly basis to TNRCC describing the effectiveness of the ADC material, any problems that may have occurred and corrective actions required as a result of such problems. If no problems occur within four consecutive quarters of use, status reports will no longer be required.~~

Please process this permit modification per §305.70(g)(16). The use of the BioCover material is consistent with other materials used at the site and does not substantially alter the current permit conditions or reduce the capacity of the facility to protect human health and the environment. The attached applicant certification (included in Appendix B) is prepared consistent with §305.70 (a) and §305.44.

APPENDIX A
BIOCOVER INFORMATION

MATERIAL SAFETY DATA SHEET

BIOCOVER™ DAILY LANDFILL COVER

PAGE 2

HAZARDOUS DECOMPOSITION OR BY-PRODUCTS

NONE

HAZARDOUS
POLYMERIZATION

MAY OCCUR?
"WILL NOT OCCUR"

CONDITIONS TO AVOID
"WILL NOT OCCUR"

NONE

HEALTH HAZARDS DATA

ROUTE OF ENTRY: INHALATION? X SKIN? X INGESTION? X

HEALTH HAZARD: AVOID INHALATION OF ANY DUST, AVOID SKIN CONTACT, PROTECT EYES, AVOID INGESTION AND PROLONGED EXPOSURE.

OBSERVE FOR DEVELOPMENT OF ALLERGENIC REACTIONS AND CALL A PHYSICIAN

CARCINOGENICITY: NPT? IARC MONOGRAPHS? OSHA REGULATED?
 "NO" "NO" "NO"

SYMPTOMS OF EXPOSURE IRRITATES SKIN, EYE IRRITATION; BURNING, TEARING, SWELLING.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

ALLERGIES, DERMATITIS

EMERGENCY FIRST AID PROCEDURES: USE WATER TO CLEANSE AREA, EYES FLUSH WITH WATER, CONTACT PHYSICIAN IF ALLERGIC REACTIONS OCCUR WITHIN 0-2 HOURS.

PRECAUTIONS FOR SAFE HANDLING AND USE

GOGGLES FOR EYES, GLOVES FOR HANDS, WEAR CLOTHING TO PREVENT SKIN CONTACT

STEPS TO BE TAKEN IN CASE OF SPILL

SPRINKLE SPILLAGE COMPOUND TO MINIMIZE DUST AND SWEEP UP SPILLED DEBRIS, ABSORB AND SWEEP UP / COLLECT; AVOID INHALATION AND / OR INGESTION OF ANY DUST.

WASTE DISPOSAL METHOD NO SPECIAL DISPOSAL METHOD STANDARD LANDFILL
DISPOSAL ACCORDING TO LOCAL, STATE AND FEDERAL ENVIRONMENTAL REQUIREMENTS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

"NO SPECIAL REQUIREMENTS EXCEPT FOR CONTAINER DAMAGE".

1-1-01

APPENDIX B
APPLICANT CERTIFICATION

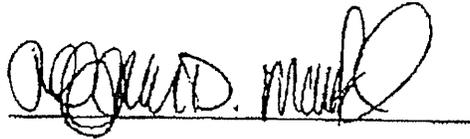
**CLASS I PERMIT MODIFICATION
APPLICANT CERTIFICATION
AND
NOTICE OF APPOINTMENT**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

This will also advise you that I have duly appointed Weaver Boos & Gordon, LLC-Southwest, as consulting and design engineers for the purpose of preparing and submitting this Class I Permit Modification.

Authorized Representative: Jeffrey D. Mayfield, P.E.
Title: General Manager

Signature:


Jeffrey D. Mayfield

Date:

June 4, 2001

Barry R. McBee, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
John M. Baker, *Commissioner*
Dan Pearson, *Executive Director*



TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

September 17, 1996

Mr. Kevin Carel
Director of Environmental Management
Laidlaw Waste Systems, Inc.
9001 Airport Freeway, Suite 500
North Richland Hills, TX 76180

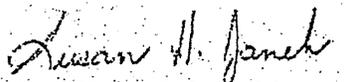
Subject: Municipal Solid Waste - Johnson County
Laidlaw/Turkey Creek - Permit No. MSW-1417B
9100 S IH-35W, Alvarado

Dear Mr. Carel:

This is in response to a letter, dated July 29, 1996, from Mr. Kim A. Mote, General Manager, submitting additional information for two requested modifications to the Site Development Plan (SDP) of the subject permit. The requested modifications are for the use of two alternate daily cover (ADC) materials, petroleum contaminated and waste from a tire shredding operation. A revised Alternate Daily Cover Operating Plan (ADCOP) was submitted that included these materials. The information has been reviewed and was found to be acceptable. The modifications for use of the petroleum contaminated soil and the waste from a tire shredding operation as ADC and the revised ADCOP are hereby approved as a Class I Modification to the SDP of Permit No. MSW-1417B in accordance with 30 Texas Administrative Code (TAC) Sections (§§) 305.70(i) and 330.133(c).

If you have any questions concerning this letter or if we may be of any assistance to you regarding municipal solid waste, you may contact Mr. Michael D. Graeber, P.E., at MC-124, P.O. Box 13087, Austin, Texas 78711; telephone number (512) 239-6671.

Sincerely,


Susan H. Janek, P.E., Manager
Permits Section
Municipal Solid Waste Division

SHJ/MDG/ff

cc: TNRCC Region 4
Laidlaw/Turkey Creek Landfill General Manager

Class I Permit Modification

Alternate Daily Cover Operating Plan

for

Turkey Creek Landfill (Johnson County) - Permit #1417-B

Prepared by

LAIDLAW WASTE SYSTEMS, INC.

Dated

July 1996

ADCOP

Table of Contents

Section

- I. Introduction
- II. Description and Thickness of Alternative Materials
- III. Effect of ADC on Vectors, Fires, Odors, and Windblown Litter
- IV. Operational Methods
- V. Chemical Characteristics
- VI. Other Pertinent Information Regarding Use of ADC

ADCOP

I. Introduction

The purpose of this Class I modification is to obtain approval for each of the alternate daily cover materials listed within this operating plan (Paper Mulch Material was previously approved). Section 330.133 (c) of the Texas Natural Resource Conservation Commission (TNRCC) municipal solid waste regulations require an alternate daily cover operation plan (ADCOP) for sites utilizing an alternate daily cover (ADC). The regulations require the ADCOP to discuss the following:

1. Description and thickness of the alternative cover material.
2. Effect of the ADC on vectors, fires, odors, and windblown litter.
3. Methods of operation used at the site for the ADC.
4. Chemical composition of the material and the MSDS(s) for the ADC (if applicable).
5. Any other pertinent characteristic, feature, or other factors related to the use of the ADC.

II. Description and Thickness of Alternate Materials

The following types of ADC materials may be used at this site:

A. Petroleum Contaminated Soil (PCS): The TNRCC has an official "Soils Policy" that allows acceptance of certain PCS at this facility. PCS material that have concentrations that comply with this soils policy or are authorized by TNRCC for disposal through a site specific process for Turkey Creek Landfill may be applied as ADC. The PCS will be applied in a minimum 6" thickness. Clean soil may be combined with the PCS if necessary.

B. Paper Mulch Material: ConCover® spray-applied daily cover from NewWaste Concepts or Second Nature® from Central Fiber Corporation have been previously approved by Class I Permit Modification and the site's Subtitle D upgrade modification.

C. Tire Shredding Process Waste: Turkey Creek currently receives a limited quantity of a tire shredding process waste. The process waste consists of fines (primarily dirt and very small rubber chips) and small pieces of steel wire from tire cords and belts washed out during the processing of tires into the chip product. The product is very stable on slopes and performs similar to dirt when worked with heavy equipment. The shredding waste will be applied in minimum 6" thickness. Via a letter from Laidlaw Waste Systems dated July 6, 1996, the TNRCC was notified that Laidlaw would be conducting a test of this material for ADC (see Appendix A).

III. Effect of ADC on Vectors, Fires, Odors, and Windblown Litter

Each of the above listed ADC materials have been used successfully to minimize odors, litter, and vectors. This facility and other facilities utilizing the above ADC materials have not reported any problems with fires, odors, vectors or windblown debris as a result of using the materials.

ADCOP

IV. Operational Methods

A. Petroleum Contaminated Soil (PCS): PCS material will be stockpiled near the working face and spread over the working face with a bulldozer or similar equipment to a minimum 6" thickness. Additionally, clean soil may be added as necessary to ensure the appropriate thickness is applied.

B. Paper Mulch Material: These material will be used in accordance with procedures outlined in the site's approved Subtitle D Upgrade operating plan.

C. Tire Shredding Process Waste: The Tire Shredding Process Waste will be stockpiled near the working face and spread over the working face with a bulldozer or similar equipment to a minimum 6" thickness. Additionally, clean soil may be added as necessary to ensure the appropriate thickness is applied.

V. Chemical Characteristics

A. Petroleum Contaminated Soil (PCS): PCS used for ADC will meet the TNRCC soils policy.

B. Paper Mulch Material: Previously approved

C. Tire Shredding Process Waste: Analytical results for the last laboratory analysis are attached in Appendix A.

The materials listed above are not a characteristic or listed hazardous material.

VI. Other Pertinent Information Regarding Use of ADC

There are no other pertinent characteristics, feature, or other factors related to the use of the above ADC materials.

ADCOP

APPENDIX A

Tire Shredding Process Waste



LIDLAW WASTE SYSTEMS, INC.

July 6, 1996

Mr. Michael Graeber, P.E.,
MC 124, Municipal Solid Waste Division, Permits Section
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, Texas 78711-3087.

Subject: Class I Permit Modification Request - Tire Shredding Process Waste Use as
Alternate Daily Cover - Turkey Creek Landfill (Johnson County) Laidlaw Waste
Systems, Inc. Permit #1417-B

Per our telephone discussion on July 3, 1996, Laidlaw Waste Systems is planning to conduct a test using tire shredder process waste as alternate daily cover at Turkey Creek Landfill. The process waste consists of fines (primarily dirt and very small rubber chips) and small pieces of steel wire from tire cords and belts washed out during the shredding of tires into the chip product. The material is very stable and performs similar to dirt when worked with heavy equipment. There may be some safety concerns as the wire has potential to puncture pneumatic tires if trucks are driven on the waste and with soles of shoes if people walk on the waste. Laidlaw believes these issues can be overcome with operational controls. This is why we desire to run the test. Laidlaw will prepare an Alternate Daily Cover Operating Plan (ADCOP) prescribe procedures to be followed for the application of this waste as ADC.

Notification is also provided that a copy of this letter is being placed in the operating record of this landfill as required by 30 TAC §330.113 (b). Should you require any additional information, you may contact me at (817) 783-5124.

Sincerely,

Kim A. Mote
General Manager

cc: Texas Natural Resource Conservation Commission, Region 4
Environmental Manager, Laidlaw Waste Systems, Inc. US Office

9100 South I-35 West, Alvarado, TX 76009 (817) 783-5124



306 West Broadway Avenue
 Fort Worth, Texas 76104
 817/335-1186
 Metro/654-0442

Mailing Address:
 P.O. Box 3270
 Fort Worth, Texas 76113

Attention: Leo G Templer
 Reported to: Safe Tire Disposal of Texas
 P.O. Box 460
 Midlothian, TX 76065

Date of Report: 06/21/95

Lab ID.: 2316 06/14/95 1

Identification: WIRE

Date Collected: 06/14/95
 Time Collected: 11:55
 Collected by: CST

Results

Quality Control

Lead, TCLP
 EPA 6010A
 ICP-Atomic Emission Spectro-
 metric Method; Test Methods
 For Evaluating Solid Waste,
 SW-846, Vol IA, Ed 3, 11/86.

0.054 mg/L
 06/16/95
 17:00
 DMM

Blank: 0.0127
 Standard Expected: 0.100
 Standard Result: 0.104
 Duplicates: 0.552
 0.540
 Spike%: 98

Selenium, TCLP
 EPA 6010A
 ICP-Atomic Emission Spectro-
 metric Method; Test Methods
 For Evaluating Solid Waste,
 SW-846, Vol IA, Ed 3, 11/86.

0.67 mg/L
 06/16/95
 17:00
 DMM

Blank: 0.00406
 Standard Expected: 0.100
 Standard Result: 0.102
 Duplicates: 1.25
 1.27
 Spike%: 118

Distribution of Report:
 Safe Tire Disposal of Texas
 Fax Number

(for inquiries contact Mona Dillard)

TALEM, INC.

Per: Tyler Tull
 V. P. Environmental Services



306 West Broadway Avenue
 Fort Worth, Texas 76104
 817/335-1186
 Metro/654-0443

Mailing Address:
 P.O. Box 3270
 Fort Worth, Texas 76113

Attention: Leo G Templer
 Reported to: Safe Tire Disposal of Texas
 P.O. Box 460
 Midlothian, TX 76065

Date of Report: 06/21/95

Lab ID.: 2316 06/14/95 1

Identification: WIRE

Date Collected: 06/14/95
 Time Collected: 11:55
 Collected by: CST

Results

Quality Control

Silver, TCLP
 EPA 6010A
 ICP-Atomic Emission Spectro-
 metric Method; Test Methods
 For Evaluating Solid Waste,
 SW-846, Vol IA, Ed 3, 11/86.

0.056 mg/L
 06/15/95
 16:55
 SPS

Blank: 0.00283
 Standard Expected: 0.0500
 Standard Result: 0.0523
 Duplicates: 0.107
 0.108
 Spike%: 104

Arsenic, TCLP
 EPA 6010A
 ICP-Atomic Emission Spectro-
 metric Method; Test Methods
 For Evaluating Solid Waste,
 SW-846, Vol IA, Ed 3, 11/86.

0.41 mg/L
 06/16/95
 17:00
 DMM

Blank: -0.0156
 Standard Expected: 0.100
 Standard Result: 0.104
 Duplicates: 0.985
 0.964
 Spike%: 112

Barium, TCLP
 EPA 6010A
 ICP-Atomic Emission Spectro-
 metric Method; Test Methods
 For Evaluating Solid Waste,
 SW-846, Vol IA, Ed 3, 11/86.

0.040 mg/L
 06/06/95
 17:00
 DMM

Blank: 0.00278
 Standard Expected: 0.0500
 Standard Result: 0.0525
 Duplicates: 0.605
 0.605
 Spike%: 113

Distribution of Report:
 Safe Tire Disposal of Texas
 Fax Number

(for inquiries contact Mona Dillard)

TALEM, INC.

Per: Tyler Tull
 V. P. Environmental Services



306 West Broadway Avenue
 Fort Worth, Texas 76104
 817/335-1186
 Metro/654-0443

Mailing Address:
 P.O. Box 3270
 Fort Worth, Texas 76113

Attention: Leo G. Templer
 Reported to: Safe Tire Disposal of Texas
 P.O. Box 460
 Midlothian, TX 76065

Date of Report: 06/21/95

Lab ID.: 2316 06/14/95 1

Identification: WIRE

Date Collected: 06/14/95
 Time Collected: 11:55
 Collected by: CST

Results

Quality Control

Cadmium, TCLP
 EPA 6010A
 ICP-Atomic Emission Spectro-
 metric Method; Test Methods
 For Evaluating Solid Waste,
 SW-846, Vol IA, Ed 3, 11/86

<0.010 mg/L
 06/16/95
 17:00
 DMM

Blank: 0.00207
 Standard Expected: 0.100
 Standard Result: 0.104
 Duplicates: 0.528
 0.535
 Spike%: 106

Chromium, TCLP
 EPA 6010A
 ICP-Atomic Emission Spectro-
 metric Method; Test Methods
 For Evaluating Solid Waste,
 SW-846, Vol IA, Ed 3, 11/86

0.24 mg/L
 06/16/95
 17:00
 DMM

Blank: -0.0026
 Standard Expected: 0.100
 Standard Result: 0.0957
 Duplicates: 0.724
 0.724
 Spike%: 97

Mercury, TCLP
 EPA 7470
 AA, Hg in Liquid Waste (MCV
 Technique); Test Methods For
 Eval Solid Waste, SW-846, Vol
 IA, Ed 3, 11/86

<0.0040 mg/L
 06/19/95
 17:20
 JXS

Blank: 0.0010
 Standard Expected: N/A
 Standard Result: N/A
 Duplicates: N/A
 N/A
 Spike%: N/A

Distribution of Report:
 Safe Tire Disposal of Texas
 Fax Number

(for inquiries contact Mona Dillard)

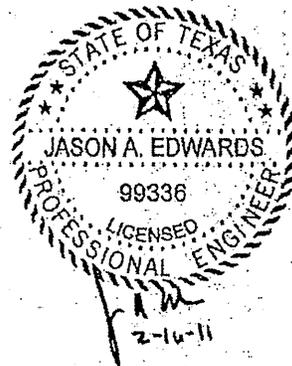
TALEM, INC.

By: Tyler Tull
 V. P. Environmental Services

TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417B

ALTERNATE DAILY COVER OPERATING PLAN
FOR
POSI-SHELL ALTERNATIVE DAILY COVER

Prepared for
IESI TX Landfill LP
February 2011



Prepared by
Weaver Boos Consultants, LLC—Southwest
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9770
WBC Project No. 0771-368-11-25-01

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APPENDIX A Posi-Shell Information

1 INTRODUCTION

This Alternative Daily Cover Operating Plan (ADCOP) has been prepared for the Turkey Creek Landfill consistent with §330.165(d). The purpose of this ADCOP is to address the following issues associated with spray-type Alternative Daily Cover (ADC) materials:

- Description and thickness of the proposed ADC material;
- Chemical composition of the material and the Material Safety Data Sheets (MSDS) for the spray-type ADC;
- Operation methods to be utilized at the site when using spray-type ADC;
- Effect of spray-type ADC material on vectors, fires, odors, and windblown waste.

As specified in the Site Operating Plan (SOP), ADC may be used to cover exposed waste except when the landfill is to be closed for a period greater than 24 hours (unless otherwise approved by the TCEQ). However, if the area in which ADC has been used is not filled over with waste within 24 hours, the area will be covered with a minimum of six inches of daily cover soil.

2 MATERIAL CHARACTERISTICS

2.1 Description of Posi-Shell

Posi-Shell is manufactured by Landfill Service Corporation. Posi-Shell consists of polyester fibers which are mixed with a binder and applied with a hydromulch machine. This ADC spray material will form a crust-like barrier after application. The hardened product is similar to other TCEQ approved ADC materials. Additional information for Posi-Shell is included in Appendix A.

2.2 Chemical Characteristics

The MSDS for Posi-Shell is included in Appendix A. Posi-Shell is not reactive, ignitable, or corrosive under the expected conditions (e.g., high temperature, intense sunlight).

3 OPERATIONAL METHODS

3.1 Spray-Type ADC Materials

Spray-type ADC materials will be applied to the working face using a FINN T90 (900-gallon capacity) or similar equipment following the procedure listed below.

1. The operator will become familiar with this ADCOP and Posi-Shell. Specifically the mixing ratio and application rate for the spray-type ADC material. This ADCOP includes information on Posi-Shell in Appendix A as well as the MSDS for this product; however, manufacturer's instructions included with the ADC material itself should be followed as well.
2. The operator will not operate the hydromulch machine until he has been trained by qualified personnel. Site personnel that are responsible for the application of ADC materials will receive training in the operation of the equipment, mixing procedures, and application methods.
3. The operator will mix the spray ADC according to the manufacturer's recommendation. Then, using the hydromulch machine, the operator will apply the ADC from at least two different directions to achieve an overall thickness of approximately 0.25 inches over the exposed waste at the working face.

4 SPRAY-TYPE ADC MATERIAL PERFORMANCE AND INSPECTION PROCEDURES

4.1 ADC Performance

The spray-type ADC material included in this plan will control vectors, fires, odors, and windblown litter and waste. This type of ADC forms a crust-like barrier over the waste and this crust-like surface serves as a barrier. The spray-type ADC will control vectors and windblown waste by creating a physical barrier between the atmosphere and waste (e.g., the cohesive nature of the ADC material will prevent windblown waste and the crust-like barrier of Posi-Shell has been proven to prevent vectors). The cohesive nature of the spray-type ADC also minimizes the airflow between the working face and the atmosphere, which minimizes the fire hazard and odor potential.

4.2 Verification and Inspection Procedures

At the end of each working day, landfill personnel will inspect the working face to confirm that the minimum thickness of an approved ADC has been placed over the working face in accordance with this ADCOP. Landfill personnel will routinely assess the effectiveness of Posi-Shell in controlling vectors, fires, odors, and windblown litter and waste. Daily application of ADC will be documented and maintained in the Site Operating Record.

In the event that the ADC does not control vectors, fires, odors, or windblown litter and waste, then the ADC application process will be re-evaluated to ensure that Posi-Shell adequately covers the working face and serves its intended purpose. Any required changes to the ADC operational procedures will be documented in the Site Operating Record.

APPENDIX A

POSI-SHELL INFORMATION

- Posi-Shell Synthetic Cover Advanced Formulation MSDS Sheet
- Posi-Pak Type P-100 Fibers MSDS Sheet
- PSM-200 Setting Agent MSDS Sheet
- Portland Cement MSDS Sheet
- Extreme RainShield MSDS Sheet



MATERIAL SAFETY DATA SHEET

MATERIAL: POSI-SHELL® SYNTHETIC COVER ADVANCED FORMULATION
DATE OF PREPARATION: APRIL 2009
OSHA 29CFR 1910.1200

SECTION I - IDENTITY

Distributor's Name and Address: Landfill Service Corporation
2183 Pennsylvania Avenue
Apalachin, NY 13732

Emergency Telephone: (807) 825-3050

Chemical Name and Synonyms: Aqueous alkaline slurry

Generic Name: N/A

Trade Name: Post-Shell® Synthetic Cover Advanced Formulation

SECTION II - HAZARDOUS INGREDIENTS

N/A

SECTION III - PHYSICAL DATA

Boiling Point (°F) (Aqueous Portion):	212
Vapor Pressure (mm. Hg):	N/A
Vapor Density (Air=1):	N/A
Solubility in Water:	N/A
Percent Volatile by Volume (%):	N/A
Specific Gravity (H ₂ O=1):	1.21
Evaporation Rate:	N/A
Appearance and Odor:	Brown viscous liquid slurry with a smell similar to wet Portland cement and liquid clay.

SECTION IV - CHEMICAL DATA

Chemical family: N/A

Formula: The major constituents are water, Portland cement, and PSM-200 Setting Agent, a blend of sodium montmorillonite clay with adhesives. The slurry also contains P.E.T. fibers, water (or landfill leachate), and optional iron oxide coloring agent.

Hazardous mixtures of other liquids, solids, or gases: N/A

SECTION V - FIRE AND EXPLOSION HAZARD DATA

Non-explosive, Non-flammable

SECTION VI - HEALTH HAZARD DATA

Threshold Limit Value: N/A

Effects of Overexposure:

Acute: Can dry skin and cause alkali burns. May cause eye and skin irritation to those with sensitive skin.

Chronic: Non-observed, if properly handled. If cured material is pulverized and dispersed, fugitive dust can cause inflammation of the lining tissue of the interior of the nose and inflammation of the cornea. Hypersensitive individuals may develop an allergic dermatitis.

Emergency and First Aid Procedures: Irrigate eyes with water. Wash exposed skin areas with soap and water.

SECTION VII - REACTIVITY DATA

Stability: Product is stable.

Hazardous Polymerization: Will not occur.

Incompatibility: None known.

Hazardous Decomposition Products: None known.

SECTION VIII - SPILL PROCEDURES

Steps to be Taken if Material is Released or Spilled: Handle as normal non-hazardous solid waste.

SECTION IX - EXPOSURES OF CONCERN

N/A

SECTION X - HANDLING AND USE PRECAUTIONS

Waste Disposal Methods: Material can be disposed of as common waste in approved landfill.

SECTION XI - INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements: Local exhaust may be used.

Respiratory Protection: A dust mask is recommended during mixing procedures.

Eye Protection: Use of tight-fitting goggles is recommended.

Skin Protection: Avoid skin contact with wet slurry. Wear rubber or plastic gloves.

Other Protective Clothing or Equipment: Use barrier creams; wear coveralls; shower with soap and water.

SECTION XII - SPECIAL PRECAUTIONS

No special precautions need to be taken in handling and storing.

SECTION XIII - DISPOSAL AND SHIPPING INFORMATION

Shipping Name:	N/A (Not Regulated)
Hazardous Substance:	N/A
Hazard Class:	N/A
Caution Labeling:	N/A

*N/A = Not Applicable. **ND = Not Determined

All information presented herein is believed to be accurate; however, it is the user's responsibility to determine in advance of need that the information is current and suitable for their circumstances. No warranty or guarantee, expressed or implied, is made by Landfill Service Corporation as to this information or as to the safety, toxicity, or effect of the use of this product.



Landfill Service
CORPORATION

MATERIAL SAFETY DATA SHEET

MATERIAL: OSHA 29CFR 1910.1200
POSI-PAK® TYPE P-100 FIBERS DATE OF PREPARATION: AUGUST 2009

SECTION I - IDENTITY

Distributor's Name and Address: Landfill Service Corporation
2183 Pennsylvania Avenue
Apalachin, NY 13732

Emergency Telephone: (607) 625-3050

Chemical Name and Synonyms:

Generic Name: Polyester Staple

Trade Name: Posi-Pak® Type P-100 Fibers

SECTION II - HAZARDOUS INGREDIENTS

Ingredient: Polyethylene terephthalate polymer and one or more surface finishes (organic lubricants).

CAS No.: 25038-59-9

Hazard: No known physical or health hazards associated with this product.

Note: Polyester Staple is a family of fiber products having similar hazard and physical property characteristics. The polymer immobilizes the constituents of the polymer system (delusterants, catalyst residues, etc.) which, therefore, present no likelihood of exposure under normal conditions of processing and handling.

SECTION III - PHYSICAL DATA

Melting Point: Approx. 500° F (260° C)

SECTION IV - CHEMICAL DATA

Polyethylene terephthalate is chemically stable and resistant to attack by oils, solvents, weak acids, and weak alkalis.

SECTION V - FIRE AND EXPLOSION HAZARD DATA

Polyester Staple will burn if exposed to flame. Decomposition products generated from molten polymer may be subject to autoignition. Combustion products will be comprised of carbon, hydrogen, and oxygen. The exact composition will depend on the conditions of combustion.

SECTION VI - HEALTH HAZARD DATA

This product has not been fully evaluated for toxicological properties. Preliminary evaluation of chemical components used in the finish and toxicological testing of the polymer have given no indication that health problems would occur in normal handling and use.

Similar products have given no indication that health problems would occur in normal handling and use.

SECTION VII - REACTIVITY DATA

N/A

SECTION VIII - SPILL PROCEDURES

N/A

SECTION IX - EXPOSURES OF CONCERN

Inhalation of finish mist above the recommended 3 mg/m³ 8-hour TWA would be an exposure of concern.

SECTION X - HANDLING AND USE PRECAUTIONS

Personal hygiene measures, such as washing hands and face immediately after working with the fibers and before eating, smoking, or using lavatory facilities, are recommended.

SECTION XI - INDUSTRIAL HYGIENE CONTROL MEASURES

Adequate ventilation is recommended to maintain finish mist levels below 3 mg/m³ 8-hour TWA and minimize exposure.

Fire fighters should protect themselves from decomposition and combustion products that may include carbon monoxide and other toxic gases.

SECTION XII - SPECIAL PRECAUTIONS

N/A

SECTION XIII - DISPOSAL AND SHIPPING INFORMATION

These products are not classified as hazardous wastes under the Resource Conservation and Recovery Act, and unless prohibited by state or local regulation, can be disposed of in a municipal landfill or incinerated. Any finish oils contained in plant wastewater should be biodegradable in conventional biological wastewater treatment systems.

These fibers are not classified by the Department of Transportation as a hazardous material.

**N/A = Not Applicable. **N/D = Not Determined*

All information presented herein is believed to be accurate; however, it is the user's responsibility to determine in advance of need that the information is current and suitable for their circumstances.

No warranty or guarantee, expressed or implied, is made by Landfill Service Corporation as to this information or as to the safety, toxicity, or effect of the use of this product.



MATERIAL SAFETY DATA SHEET

MATERIAL:
PSM-200 SETTING AGENT™

OSHA 29CFR 1910.1200

DATE OF PREPARATION: AUGUST 2009

SECTION I - IDENTITY

Distributor's Name and Address:

Landfill Service Corporation
2183 Pennsylvania Avenue
Apalachin, NY 13732

Emergency Telephone:

(607) 625-3050

Chemical Name and Synonyms:

Sodium Montmorillonite Clay with
Additives

Generic Name:

(SMC) (CAS No. 1318-93-0)
SMC with proprietary additives
(CAS No. 1318-93-0)

Trade Name:

Posi-Shell® PSM 200 Setting Agent

SECTION II - HAZARDOUS INGREDIENTS

Ingredient:

Crystalline Silica (SiO₂) as Quartz

CAS No.:

14808-60-7

Hazard:

Low concentrations of crystalline silica in the form of quartz may be present in airborne SMC dust. See Section VI for discussion of health hazard.

Note:

Although the typical quartz content of western SMC is in the range of 2 to 6% most of the quartz particles are larger than the 10µ respirable threshold size. The actual respirable quartz concentration in airborne SMC dust will depend upon SMC source, fineness of product, moisture content of product, local humidity and wind condition at point of use and other use specific factors.

SECTION III - PHYSICAL DATA

Boiling Point (°F):

N/A

Vapor Pressure (mm. Hg):

N/A

Vapor Density (Air=1):	N/A
Solubility in Water:	Insoluble, forms colloidal suspension
Density (at 20° C):	65 lbs/cu ft as product
Specific Gravity (H2O=1):	2.45-2.55
Melting Point:	Approx. 1450° C
Evaporation Rate (Butyl Acetate=1):	N/A
pH:	8-10 (5% aqueous suspension)

SECTION IV - CHEMICAL DATA

PSM-200 is a blend of sodium montmorillonite clay and proprietary adhesive ingredients.

SECTION V - FIRE AND EXPLOSION HAZARD DATA

Flash Point:	N/A
Special Fire Fighting Procedures:	N/A
Unusual Fire and Explosion Hazards:	None. Product will not support combustion.
Extinguishing Media:	None for product. Any media can be used for the packaging. Product becomes slippery when wet.
Flammable Limits:	LEL: N/A UEL: N/A

SECTION VI - HEALTH HAZARD DATA

Routes of Exposure and Effects:

Skin:	Possible drying resulting in dermatitis.
Eyes:	Mechanical irritant.
Inhalation:	<i>Acute</i> (short term) exposure to dust levels exceeding the PEL may cause irritation of respiratory tract resulting in a dry cough. <i>Chronic</i> (long term) exposure to airborne SMC dust containing respirable size ($\approx 10\mu$) quartz particles, where respirable quartz particle levels are higher than TLVs, may lead to development of silicosis or other respiratory problems. Persistent dry cough and labored breathing upon exertion may be symptomatic.
Ingestion:	No adverse effects.

Permissible Exposure Limits:
(for air contaminants)

OSHA PEL ACGIH TLV
(8 HR. TWA)

SMC as "Particulates not otherwise regulated" (formerly nuisance dust)

Total dust	15mg/m ³	N/D
Respirable dust	5mg/m ³	N/D
Crystalline Quartz (respirable)	0.1mg/m ³	0.1mg/m ³

Carcinogenicity:

SMC is not listed by ACGIH, IARC, NTP, or OSHA. IARC, 1997, concludes that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica from occupational sources (IARC Class 1), that carcinogenicity was not detected in all industrial circumstances studied and that carcinogenicity may depend on characteristics of the crystalline silica or on external factors affecting its biological activity. NTP classifies respirable crystalline silica as "known to be a human carcinogen" (NTP 9th Report on Carcinogens - 2000). ACGIH classifies crystalline silica quartz as a suspected human carcinogen (A2).

Acute Oral LD50:	N/D
Acute Dermal LD50:	N/D
Aquatic Toxicology LC50:	N/D

Emergency and First Aid Procedures:

Skin:	Wash with soap and water until clean.
Eyes:	Flush with water until irritation ceases.
Inhalation:	Move to area free from dust. If symptoms of irritation persist, contact physician. Inhalation may aggravate existing respiratory illness.

SECTION VI - REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	None
Incompatibility:	None
Hazardous Decomposition Products:	None

SECTION VIII - SPILL PROCEDURES

Steps to be Taken if Material is Released or Spilled:	Avoid breathing dust; wear respirator approved for silica bearing dust. Vacuum up to avoid generating airborne dust. Avoid using water. Product slippery when wetted.
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SECTION IX - EXPOSURES OF CONCERN

N/A

SECTION X - HANDLING AND USE PRECAUTIONS

Waste Disposal Methods:

Product should be disposed of in accordance with applicable local, state, and federal regulations.

Handling and Storage Precautions:

Use NIOSH/MSHA respirators approved for silica bearing dust when free silica containing airborne SMC dust levels exceed PEL/TLVs. Clean up spills promptly to avoid making dust. Storage area floors may become slippery if wetted.

SECTION XI - INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements:

Mechanical, general room ventilation. Use local ventilation to maintain PELs/TLVs.

Respirator:

Use respirators approved by NIOSH/MSHA for silica bearing dust.

Eye Protection:

Generally not necessary. Personal preference.

Gloves:

Generally not necessary. Personal preference.

Other Protective Clothing or Equipment: None.

SECTION XII - SPECIAL PRECAUTIONS

Avoid prolonged inhalation of airborne dust.

SECTION XIII - DISPOSAL AND SHIPPING INFORMATION

Shipping Name:

N/A (Not Regulated)

Hazardous Substance:

N/A

Hazard Class:

N/A

Caution Labeling:

N/A

***N/A = Not Applicable. **ND = Not Determined**

All information presented herein is believed to be accurate; however, it is the user's responsibility to determine in advance of need that the information is current and suitable for their circumstances.

No warranty or guarantee, expressed or implied, is made by Landfill Service Corporation as to this information or as to the safety, toxicity, or effect of the use of this product.



MATERIAL SAFETY DATA SHEET

MATERIAL: OSHA 29CFR 1910.1200
 PORTLAND CEMENT DATE OF PREPARATION: MARCH 2006

SECTION I - IDENTITY

Distributor's Name and Address: Landfill Service Corporation
 2183 Pennsylvania Avenue
 Apalachin, NY 13732

Emergency Telephone: (607) 625-3050

Chemical Name and Synonyms: Portland Cement

Generic Name: Also known as hydraulic cement

Trade Name: Portland Cement Type I, IA, II, III, V

SECTION II - HAZARDOUS INGREDIENTS

Component (percentage)	CAS No.	OSHA PEL (8-hour TWA)	ACGIH TLV-TWA (2002)
Tri-calcium silicate (20-70)	12168-85-3	see Nuisance Dust PEL	see Nuisance Dust TLV
Di-calcium silicate (10-80)	10034-77-2	see Nuisance Dust PEL	see Nuisance Dust TLV
Tetra-calcium-alumino-ferrite (5-15)	12088-35-8	see Nuisance Dust PEL	see Nuisance Dust TLV
Calcium sulfate (2-10)	N/D	see Nuisance Dust PEL	see Nuisance Dust TLV
Tri-calcium Aluminate (1-15)	12042-78-3	see Nuisance Dust PEL	see Nuisance Dust TLV
Magnesium oxide (0-4)	1309-48-4	see Nuisance Dust PEL	see Nuisance Dust TLV
Nuisance Dusts	N/D	15 mg/m ³ (total dust) 5 mg/m ³ (respirable dust)	10 mg/m ³ (total dust) 3 mg/m ³ (respirable dust)
Crystalline Silica (Quartz)* (0-1)	14808-80-7	10mg/m ³ /percent silica + 2 (respirable dust) 30 mg total dust/m ³ /percent silica + 2 (total dust)	0.10 mg/m ³
Hexavalent Chromium (measured as chromic acid and chromates)	18540-29-9	(100 mg/m ³)	N/D

**Trace Constituents:* Portland cement has a variable composition depending upon the cementitious products produced in the cement kiln. Small amounts of naturally occurring, but potentially harmful, chemical compounds might be detected during chemical analysis. These trace compounds might include free crystalline silica, potassium, and sodium compounds; heavy metals, including cadmium, chromium, nickel, and lead; and organic compounds. Other trace constituents may include calcium oxide (also known as free lime or quick lime).

SECTION III - PHYSICAL DATA

Boiling Point (°F) (Aqueous Portion):	N/A
Vapor Pressure (mm. Hg):	N/A
Vapor Density (Air=1):	N/A
Solubility in Water:	Slight (0.1-1.0%)
pH (in water):	12-13
Specific Gravity (H ₂ O=1):	2.9-3.15
Evaporation Rate:	N/A
Appearance and Odor:	Gray or white powder, no distinct odor

SECTION IV - CHEMICAL DATA

N/A

SECTION V - FIRE AND EXPLOSION HAZARD DATA

Portland cement is non-combustible and not explosive.
Special firefighting procedures are not applicable. (Although Portland cement poses no fire-related hazards, a self-contained breathing apparatus is recommended to limit exposure to combustion products when fighting any fire.)

SECTION VI - HEALTH HAZARD DATA

Threshold Limit Value: N/A

Effects of Overexposure:

Acute:

Wet cement on unprotected skin, whether direct or through saturated clothing, can cause severe, third-degree caustic burns.

NOTE: Portland cement burns skin with little warning; discomfort or pain cannot be relied upon to alert a person to a hazardous skin exposure. The severity of the burn may not be detected until several hours after the damage begins.

Dry Portland cement can produce mild irritation to severe burns of the eye; it can irritate the upper respiratory system.

Chronic:

Dry Portland cement can cause inflammation of the lining of the nose and the cornea. Repeated exposure to Portland cement may result in drying of the skin and may lead to thickening, cracking, or fissuring, of the skin. Hypersensitive individuals may develop an allergic dermatitis (possibly due to trace amounts of hexavalent chromium at less than 0.005%). This reaction may appear in several forms including a mild rash to severe skin ulcers. Persons already sensitized may react to their first contact with the product. Other persons may experience this effect after years of exposure to Portland cement products.

While Portland cement typically has less than 0.2% crystalline silica, other additives to Portland cement and those components (e.g. aggregates) added to produce Portland cement concrete may significantly increase the amount of crystalline silica that is present. Exposure to respirable crystalline silica without the use of a respirator can cause silicosis and may aggravate other lung conditions.

Signs and Symptoms of Exposure:

Burning sensation around moist tissue areas (i.e., eyes, nose, upper respiratory system); painful burning on exposed skin that can develop with little warning. *Exposure of sufficient duration to wet Portland cement can cause serious, potentially irreversible tissue (skin or eye) destruction in the form of chemical (caustic) burns, including third-degree burns.* The same kind of destruction can occur if wet or moist areas of the body are exposed for sufficient duration to dry Portland cement.

Do not allow wet Portland cement to get inside boots, shoes, or gloves, and do not allow wet, saturated clothing to remain against the skin.

Emergency and First Aid Procedures:

- Irrigate eyes immediately and repeatedly with large amount of clean water for at least 15 minutes and get prompt medical attention.
- Wash exposed skin areas with pH-neutral soap and clean water.
- Apply sterile dressings; seek medical treatment in all cases of prolonged exposure to wet Portland cement, Portland cement mixtures, liquids from fresh Portland cement products, or prolonged wet skin exposure to dry Portland cement.
- If ingested, consult a physician immediately.
- Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately.
- In the event of inhalation, remove to fresh air.
- Seek medical attention if coughing and other symptoms do not subside.
- Inhalation of gross amounts of Portland cement requires immediate medical attention.

SECTION VII - REACTIVITY DATA

Stability:

Product is stable. Keep dry until used.

Hazardous Polymerization:

Will not occur.

Incompatibility:

Aluminum powder and other alkali and alkaline earth elements will react in wet mortar or concrete, liberating hydrogen gas. Portland cement is highly alkaline and will react with acids to produce a violent, heat-generating reaction. Toxic gases or vapors may be given off, depending on the acid involved.

Hazardous Decomposition Products:

None known.

SECTION VIII - SPILL PROCEDURES

Steps to be Taken if Material is Released or Spilled:

Use dry cleanup methods that do not disperse the dust into the air. Avoid breathing the dust. Emergency procedures are not required.

SECTION IX - EXPOSURES OF CONCERN

Medical Conditions Generally Aggravated by Exposure:

Pre-existing skin conditions may be worsened. Silicosis may aggravate other chronic pulmonary conditions and may increase the risk of pulmonary tuberculosis infection.

Chemical Listed as Carcinogenic or Potential Carcinogen:

Portland cements are not considered carcinogenic. However, the International Agency for Research on Cancer (IARC) has determined, primarily through animal studies, that silica is a known human carcinogen. The National Toxicology Program (NTP) has characterized respirable quartz silica as reasonably anticipated to be a carcinogen. OSHA does not regulate silica as a carcinogen.

SECTION X - HANDLING AND USE PRECAUTIONS

Portland cement should only be used by knowledgeable persons. While the information provided in the material safety data sheet is believed to provide a useful summary of the hazards of Portland cement, as it is commonly used, the sheet cannot anticipate and provide all of the information that might be needed in every situation. Inexperienced product users should obtain proper training before using this product.

A key to using the product safely requires the user to recognize that Portland cement chemically reacts with water, and that some of the intermediate products of this reaction (that is, those present while a Portland cement product is "setting") pose a more severe hazard than does Portland cement itself. These hazards include potential injuries to eyes and skin.

The data furnished in this sheet do not address hazards that may be posed by other materials mixed with Portland cement to produce Portland cement products. Users should review other relevant material safety data sheets before working with this Portland cement or with Portland cement products, including, for example, Portland cement concrete.

SECTION XI - INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation Requirements:

Local exhaust can be used to control airborne dust levels.

Respiratory Protection:

Avoid actions that cause dust to become airborne. Use local or general ventilation to control exposures below applicable exposure limits.

Use NIOSH/MSHA-approved (under 30 CFR 11) or NIOSH-approved (under 42 CFR 84) respirators in poorly ventilated areas, or if an applicable exposure limit is exceeded, or when dust causes discomfort or irritation. *(Advisory: Respirators and filters purchased after July 10, 1998, must be certified under 42 CFR 84.)*

Eye Protection:

When engaged in activities where Portland cement dust or wet Portland cement or concrete could contact the eye, wear goggles or safety glasses with side shields. In extremely dusty environments and unpredictable environments, wear unvented or indirectly vented goggles to avoid eye irritation or injury. Contact lenses should not be worn when working with Portland cement or wet Portland cement products.

Skin Protection:

Prevention is essential to avoiding potentially severe skin injury. Avoid contact with unhardened (wet) Portland cement products. If contact occurs, promptly wash affected area with soap and water.

Do Not Allow Wet Portland Cement to Get Inside Boots, Shoes, or Gloves; and Do Not Allow Wet, Saturated Clothing to Remain Against the Skin.

Do not rely on barrier creams. Barrier creams should not be used in place of gloves. Use impervious, abrasion- and alkali-resistant gloves, boots, and protective clothing to protect the skin from prolonged contact with wet Portland cement in plastic concrete, mortar, or slurries.

SECTION XII - SPECIAL PRECAUTIONS

Work/Hygienic Practices:

- Periodically wash areas contacted by dry Portland cement, or by wet Portland cement, or concrete fluids with a pH neutral soap and clean, uncontaminated water.
- Wash again at the end of the work.
- If irritation occurs, immediately wash the affected area and seek treatment.
- If clothing becomes saturated with wet Portland cement or concrete, it should be removed and replaced with clean, dry clothing.
- Follow listed precautions as appropriate, during repair or maintenance work on contaminated equipment.

SECTION XIII - DISPOSAL AND SHIPPING INFORMATION

Shipping Name:

Portland cement is not hazardous under US Dept. of Transportation (DOT) regulations.

Hazardous Substance:

N/A

Hazard Class:

N/A

Caution Labeling:

N/A

Identification Number:

N/A

Disposal Method:

Small amounts of material can be returned to the container for later use if it is not contaminated. Dispose of waste material in accordance with Federal, State, and Local requirements. Portland cement is not a hazardous waste as defined by the Resource Conservation and Recovery Act (40 CFR 261).

SECTION XIV - OTHER REGULATORY INFORMATION

Status under USDOL-OSHA Hazard Communication Standard (29 CFR 1910.1200):

Portland cement is considered a "hazardous chemical" under this regulation and should be a part of any Hazard Communication Program.

Status under CERCLA / Superfund (40 CFR 117 and 302):

Not listed.

Status under SARA (Title III, Sections 311 and 312):

Portland cement qualifies as a "hazardous substance" with delayed health effects.

Status under SARA (Title III, Section 313):

This product may contain constituents listed under SARA (Title III, Section 313,) but not in amounts requiring supplier notification under 40 CFR Part 372 Subpart C.

Status under TSCA (as of May 1997):

Portland cement and some of the substances in Portland cement are on the TSCA inventory list.

Status under the Federal Hazardous Substances Act:

Portland cement is a "hazardous substance" subject to statutes promulgated under the subject act.

Status under California Proposition 65:

Portland cement contains chemicals (trace metals) including silica and hexavalent chromium, known to the State of California to cause cancer, birth defects or other reproductive harm. California law requires the manufacturer to give the above warning in the absence of definitive testing to prove that the defined risks do not exist.

Status under the Canadian Environmental Protection Act:

Not listed.

Workplace Hazardous Material Information System (Canada):

Portland cement is considered to be a hazardous material under the Hazardous Product Act as defined by the Controlled Products Regulations (Class E - Corrosive Material), and is therefore, subject to the labeling and MSDS requirements of the Workplace Hazardous Materials Information System (WHMIS).

**N/A = Not Applicable. **N/D = Not Determined*

All information presented herein is believed to be accurate; however, it is the user's responsibility to determine in advance of need that the information is current and suitable for their circumstances.

No warranty or guarantee, expressed or implied, is made by Landfill Service Corporation as to this information or as to the safety, toxicity, or effect of the use of this product.



Landfill Service
CORPORATION

MATERIAL SAFETY DATA SHEET

Date of Preparation: October 20, 2009

1. Product: Extreme RainShield™
2. Chemical Name: HYDROXYPROPYL METHYLCELLULOSE
Manufacturer: BioPolymer Industries
2001 North 170th East Ave.
Tulsa, OK 74116
Phone: (918) 437-1880
Fax: (918) 437-1123
Product Code: BPI 0152
Effective Date: 04/14/08

In case of emergency: (918) 625-1101 (BioPolymer Industries)

3. COMPOSITION / INFORMATION ON INGREDIENTS

Hydroxypropyl methylcellulose	CAS# 009004-65-3	85-99%
Water	CAS# 007732-18-5	1-10%
Sodium Chloride	CAS# 007647-14-5	0.5-5%

4. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

White to off-white, free-flowing powder. No odor. Dust explosion hazard.

POTENTIAL HEALTH EFFECTS (See Section 11 for toxicological data.)

EYE: Essentially nonirritating to skin. A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts.

SKIN: Essentially nonirritating to skin. A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts.

INGESTION: Single dose oral toxicity is considered to be low. No hazards anticipated from swallowing small amounts incidental to normal handling operations.

INHALATION: Single exposure to dust is not likely to be hazardous.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Repeated ingestion of similar cellulose by humans has not resulted in known significant adverse effects.

MATERIAL SAFETY DATA SHEET

Page: 2

CANCER INFORMATION: Similar celluloseics did not cause cancer in long-term animal studies.

TERATOLOGY (BIRTH DEFECTS): Birth defects are unlikely. Exposures having no adverse effects on the mother should have no effect on the fetus.

REPRODUCTIVE EFFECTS: In animal studies, a similar celluloseic has been shown not to interfere with reproduction.

5. FIRST AID

EYE: Flush eyes with plenty of water, mechanical effects only.

SKIN: Wash off in flowing water or shower.

INGESTION: No adverse effects anticipated by this route of exposure incidental to proper industrial handling.

INHALATION: No adverse effects anticipated by this route of exposure.

6. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT: Not applicable.

METHOD USED: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABILITY LIMITS

LFL: Not determined

UFL: Not determined

HAZARDOUS COMBUSTION PRODUCTS: During a fire, smoke may contain the original material in addition to unidentified toxic and / or irritating compounds. Hazardous combustion products may include and are not limited to carbon monoxide, carbon dioxide.

OTHER FLAMMABILITY INFORMATION: Mechanical handling can cause formation of dusts. To reduce the potential for dust explosion, do not permit dust to accumulate. Material can be ignited by static discharge. Electrically ground all equipment. Do not permit dust to accumulate. Dust

layers can be ignited by spontaneous combustion or other ignition sources. When suspended in air dust can pose an explosion hazard.

EXTINGUISHING MEDIA: Water, carbon dioxide and dry chemical.

FIRE FIGHTING INSTRUCTIONS: Keep people away. Isolate fire area and deny unnecessary entry. Soak thoroughly with water to cool and prevent re-ignition. Cool surroundings with water to localize fire zone. Hand held carbon dioxide or dry chemical hazard may result from forceful application of fire extinguishing agents.

PROTECTIVE EQUIPMENT FOR FIRE FIGHTERS: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, pants, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.

7. ACCIDENTAL RELEASE MEASURES (See Section 15 for Regulatory Information)

PROTECT PEOPLE: Material becomes slippery when wet.

PROTECT THE ENVIRONMENT: Contain spilled material to prevent contamination of soil, surface water or ground water.

CLEANUP: Spills should be cleaned up immediately using care to minimize generation of airborne dust.

8. HANDLING AND STORAGE

HANDLING: Good housekeeping and controlling of dusts are necessary for safe handling of product. No smoking, open flames or sources of ignition in handling and storage area.

STORAGE: Store in a dry place. Store below 90 F (32 C).

9. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide general and / or local exhaust ventilation to control airborne levels below the exposure guidelines.

PERSONAL PROTECTIVE EQUIPMENT

EYE / FACE PROTECTION: Use safety glasses. If there is a potential for exposure to particles, which could cause mechanical injury to the eye, wear chemical goggles.

SKIN PROTECTION: No precautions other than clean body-covering clothing should be needed.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. In dusty atmospheres, use an approved dust respirator.

EXPOSURE GUIDELINES: Hydroxopropyl methyl cellulose: IHG is 10 mg/m³.

10. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE / PHYSICAL STATE: White to off-white free-flowing powder.

ODOR: Not available.

VAPOR PRESSURE: Not applicable.

VAPOR DENSITY: Not applicable.

BOILING POINT: Not applicable.

SOLUBILITY IN WATER / MISCIBILITY: Not applicable.

SPECIFIC GRAVITY / OR DENSITY: Not applicable.

11. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable under recommended storage conditions. See Storage, Section 7.

CONDITIONS TO AVOID: product can decompose at elevated temperatures.

HAZARDOUS DECOMPOSITION PRODUCTS: Hazardous decomposition products depend upon temperature, air supply and the presence of other materials.

HAZARDOUS POLYMERIZATION: Will not occur.

INCOMPATIBILITY WITH OTHER MATERIALS: Avoid contact with oxidizing materials. Avoid contact with strong acids, strong bases.

12. TOXICOLOGICAL INFORMATION (See Section 3 for Potential Health Effects. For detailed toxicological data, write or call the address or non-emergency number shown in Section 1)

INGESTION: The oral LD50 for rats is >10,000 mg/kg.

MUTAGENICITY: For methylcellulose, a similar cellulose: in vitro mutagenicity studies were negative; animal mutagenicity studies were negative.

13. ECOLOGICAL INFORMATION (For detailed Ecological data, write or call the address or non-emergency number shown in Section 1)

ENVIRONMENTAL FATE

MOVEMENT & PARTITIONING: No bioconcentration is expected because of the relatively high molecular weight (MW greater than 1000).

DEGRADATION & PERSISTENCE: Based on information for methocellulose. Biodegradation may occur under aerobic conditions (in the presence of oxygen). The half-life in activated sludge is less than 20 days.

ECOTOXICITY: Not expected to be acutely toxic.

14. DISPOSAL CONSIDERATIONS (See Section 15 for Regulatory Information)

DISPOSAL: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal methods must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. BIOPOLYMER INDUSTRIES HAS NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED

CONDITION AS DESCRIBED IN MSDS SECTION 2 (Composition / Information On Ingredients).

FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: recycler, reclaimer, incinerator, or landfill.

15. TRANSPORT INFORMATION

DEPARTMENT OF TRANSPORTATION (D.O.T.) : This product is not regulated by D.O.T. when shipped domestically by land.

CANADIAN TDG INFORMATION:

For TDG regulatory information, if required, consult transportation regulations, product shipping papers.

16. REGULATORY INFORMATION (Not meant to be all-inclusive—selected regulations represented)

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied is given. Regulatory requirements are subject to change and may differ

NOTICE CONT.

from one location to another, it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See other sections for health and safety information.

U.S. REGULATIONS

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

A fire hazard

(Due to dust explosion potential)

MATERIAL SAFETY DATA SHEET

PAGE: 7

TOXIC SUBSTANCES CONTROL ACT (TSCA):

All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: This product is not known to contain any substances subject to the disclosure requirements of
New Jersey
Pennsylvania

OSHA HAZARD COMMUNICATION STANDARD:

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

CANADIAN REGULATIONS

WHMIS INFORMATION: The Canadian Workplace Hazardous Materials Information System (WHMIS) Classification for this product is:

This product is not a "Controlled Product" under WHMIS.

CANADIAN TDG INFORMATION: For guidance, the Transportation of Dangerous Goods Classification for this product is:

Not regulated.

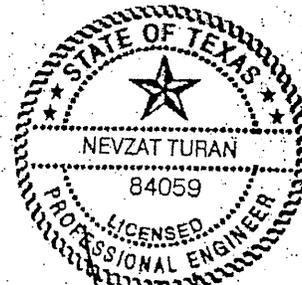
17. OTHER INFORMATION

MSDS STATUS: Revised to 16 Section format.

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417B**

**ALTERNATIVE DAILY COVER OPERATING PLAN
FOR
SYNTHETIC TARP TYPE
ALTERNATIVE DAILY COVER**

Prepared for
IESI TX Landfill LP
March 2018



J. Turan
03/29/2018

Prepared by

Weaver Consultants Group, LLC
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Fort Worth, Texas 76109
817-735-9770

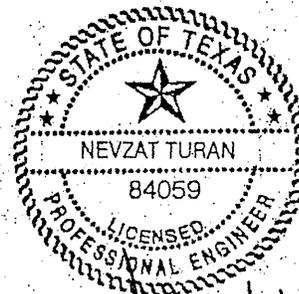
WCG Project No. 0771-368-11-108

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APPENDIX A

Synthetic Tarp Alternative Daily Cover Material



[Handwritten signature]
02-15-2018

1 INTRODUCTION

This Alternative Daily Cover Operating Plan (ADCOP) has been prepared for the Turkey Creek Landfill consistent with Title 30 Texas Administrative Code (30 TAC) Section (§)330.165(d). The purpose of this ADCOP is to address the following issues associated with Alternative Daily Cover (ADC) materials:

- Description of the proposed ADC materials;
- Chemical composition of the material for the ADC materials;
- Operation methods to be utilized at the site when using ADC;
- Effect of the ADC material on vectors, fires, odors, and windblown waste.

ADC will be used to cover exposed waste that will be filled again within a 24-hour period. However, if the area in which ADC has been used is not filled over with waste within 24 hours, the area will be covered with a minimum of six inches of daily cover soil.

2 SYNTHETIC TARP ALTERNATIVE DAILY COVER

2.1 Material Characteristics

2.1.1 Description of ADC Material

Information regarding synthetic tarps to be used as ADC material is presented in Appendix A. The tarp is manufactured in panels of various sizes. The thickness of the tarp material is approximately 30 mils, as indicated in Appendix A. The material is reported to have a 495-pound grab tensile strength. The polypropylene fabric ADC material is reinforced with 15,000-pound nylon webbing and stitched with high-stress bonded polyester thread. Specifications for the synthetic tarps proposed to be used as ADC are included in Appendix A.

2.1.2 Chemical Characteristics

Typical chemical characteristics of the synthetic tarps are included in Appendix A. The synthetic tarps are not reactive, ignitable, or corrosive under the expected conditions (i.e., high temperature, intense sunlight).

2.2 Synthetic Tarp ADC Operational Methods

Using standard landfill equipment and site personnel, the tarp(s) will be placed over the waste and weighted (to secure the sides and ends with materials such as chains, cables, soil, rock, or other heavy items). The tarps will be removed within 24 hours of their application and prior to waste placement. Tarps may be used in combination with soil or other approved ADC material to provide complete coverage of the working face. The tarp ADC will be extended to ensure complete coverage at the working face. If needed, upslope tarps may lap over down slope tarps in a shingle-type fashion to minimize stormwater infiltration into the underlying waste.

2.3 ADC Material Performance and Inspection Procedures

2.3.1 ADC Performance

The synthetic tarp ADC material specified in this plan serves as a physical barrier over waste. The synthetic tarp ADC will control vectors, windblown waste, and odor, and will minimize fire hazards by creating a physical barrier between the atmosphere and waste. The tarps are not flammable, are sufficiently heavy, and will be properly anchored to remain positioned over waste when in use.

2.3.2 Verification and Inspection Procedures

At the end of each working day, landfill personnel will inspect the working face to confirm that the synthetic tarp ADC has been placed over the working face in accordance with this ADCOP. The end of day inspection demonstrating that the synthetic tarp ADC has been placed in accordance with this ADCOP will be documented filling out the date, landfill foreman, supervisor, and "Additional Comments" sections of the Tarp ADC performance evaluation form included in Appendix A. The remaining portions of the form will be completed prior to removal of the tarp ADC on the following day by filling out the rest of the items in the form; thus, a tarp ADC performance evaluation form will be completed for each day of use. This form will be kept in the Site Operating Record and will be submitted to TCEQ as part of bimonthly status reports. Landfill personnel will routinely assess the effectiveness of each ADC in controlling vectors, fires, odors, and windblown litter and waste. Landfill personnel will use the performance evaluations form in Appendix A or a similar form to document the effectiveness of the ADC. Daily application of ADC will be documented and maintained in the Site Operating Record.

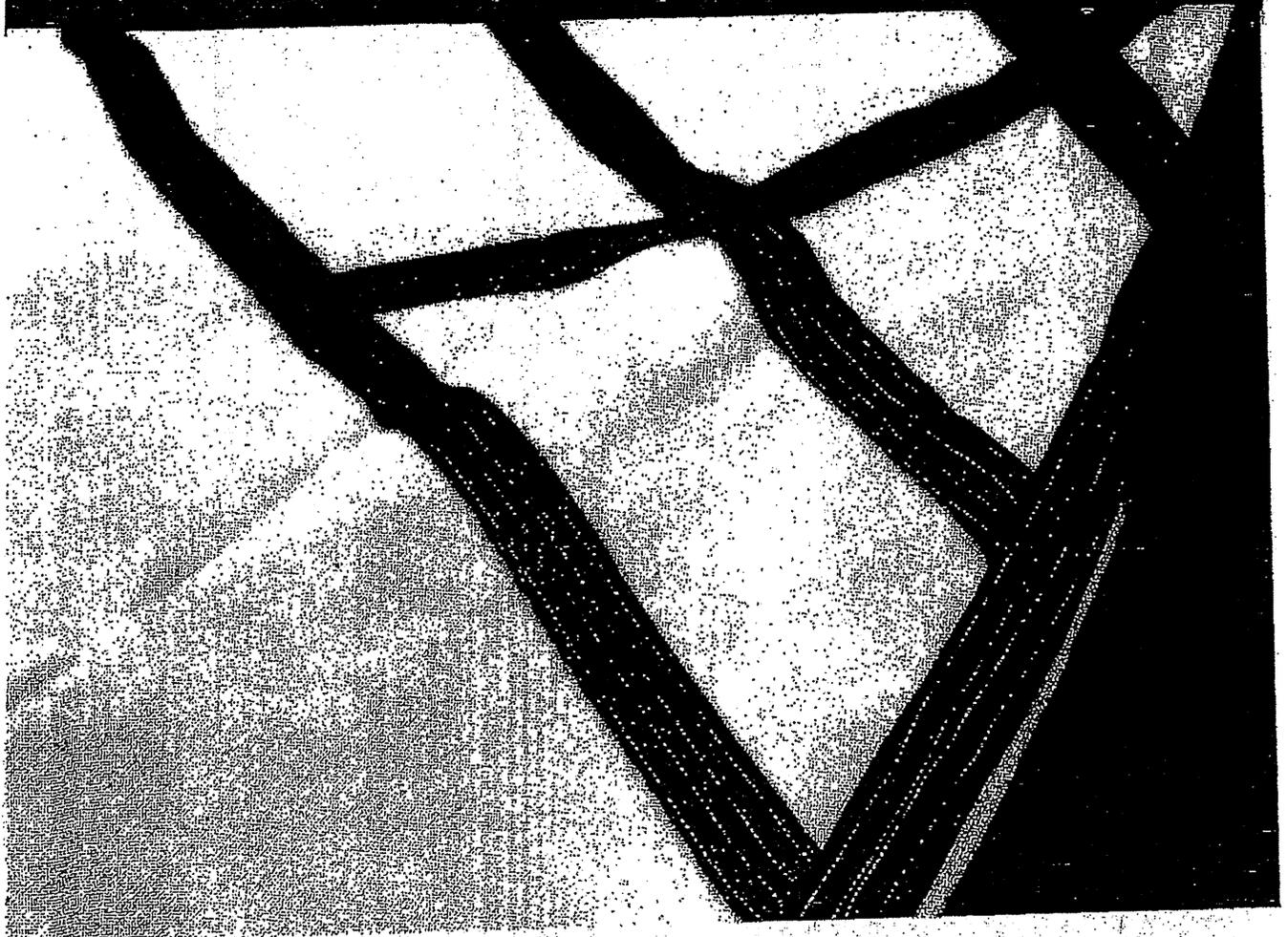
In the event the proposed ADC material does not control vectors, fires, odors, or windblown litter and waste, the subject ADC application process will be re-evaluated to ensure that the ADC material adequately covers the working face and serves its intended purpose. Any required changes to the ADC operational procedures will be documented in the Site Operating Record.

APPENDIX A
SYNTHETIC TARP ALTERNATIVE DAILY COVER MATERIAL

**TURKEY CREEK LANDFILL
TARP ALTERNATIVE DAILY COVER
PERFORMANCE EVALUATION**

DATE	Weather Conditions					General Description	
LANDFILL FOREMAN	Wind Direction:						
	Wind Speed:						
LANDFILL SUPERVISOR	Temperature:						
	Precipitation:						
Please rank the performance of the alternative daily cover based upon the following attributes: Circle the numeric value that best describes the alternative daily cover performance compared to soil cover.							
Vector Ability to resist vectors.	Excellent	1	2	3	4	Poor 5	Comments:
Odor control Odor from alternative daily cover area.	None	1	2	3	4	5	Strong Comments:
Litter Control Ability to control blowing litter.	Excellent	1	2	3	4	Poor 5	Comments:
Erosion Control Ability to control erosion.	Excellent	1	2	3	4	Poor 5	Comments:
Orderliness of Operation Overall appearance of working face/slopes/erosion control surface.	Excellent	1	2	3	4	Poor 5	Comments:
Fire Control	Please describe any fire event that may have occurred and the impact of the alternative daily cover and equipment, if any. _____ _____ _____						
Additional Comments:							

We've earned our good **REPUTATION**



AmCon originally developed and continues to improve its alternate daily cover through testing and feedback from landfill users. AmCon covers have been in use at hundreds of sites throughout the United States since 1988. AmCon strives to meet the needs of clients with timely service and product support. Repeat customers are a testament to AmCon's proven track record of superior products and services. The Environmental Protection Agency has approved the cover for all states.

References available

STOCK SIZES

150' X 150' • 150' X 100'
100' X 100' • 100' X 50'
50' X 50'

**WE MAKE REPLACEMENT
TARPS FOR MACHINES**



116 AMCON DRIVE • SOMERSET, KY 42501-4154

800 866-0369 • 606 679-7929 • 606 678-6580 FAX

Our covers are built for **STRENGTH**

AmCon daily covers are designed to stand up to rigorous landfill conditions. Polypropylene fabric is reinforced with **15,000 LB. NYLON** webbing, quadruple stitched with high-stress bonded polyester thread (the strongest thread available). The reinforced corners will withstand the stress of heavy machinery pulling while the cover is light enough to be handled manually.

FABRIC PHYSICAL PROPERTIES

Weight: 9.0

Color: White

AOS: 60

UV Resistance:

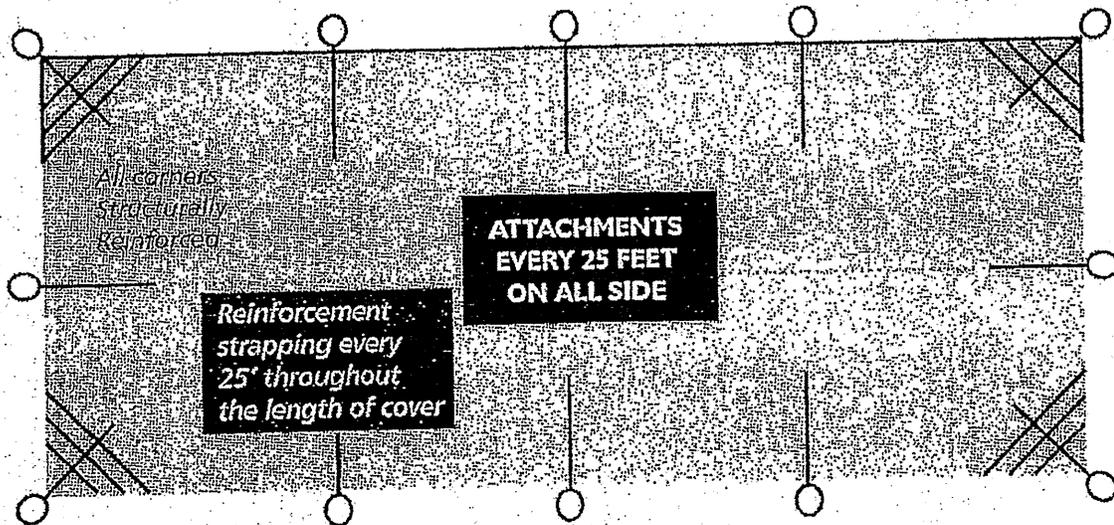
Tensile: 495/530

85% (500hrs)

Puncture: 240

Permittivity: 0.050

FULLY SEAMED PULL EDGES ON TWO SIDES



116 AMCON DRIVE • SOMERSET, KY 42501-4154

800 866-0369 • 606 679-7929 • 606 678-6580 FAX



Style 884

Product Data Sheet

July 2013

A woven geotextile fabric, produced from polypropylene slit-film tapes, which will meet or exceed the following MARV's. This fabric is produced for use as an Alternative Daily Landfill Cover. It is also frequently used in Stabilization applications.

Property	Test Method	English Units			SI Units		
		MARV			MARV		
		MD	CD		MD	CD	
Grab Tensile Strength	ASTM D-4632	495	530	lbs	2203	2359	N
Grab Tensile Elongation	ASTM D-4832	25	20	%	25	20	%
Wide Width Tensile Ultimate	ASTM D-4595	290	340	lbs/in	51	60	kN/m
Wide Width Elongation	ASTM D-4595	25	20	%	25	20	%
Trapezoid Tear	ASTM D-4533	165	195	lbs	734	868	N
Puncture	ASTM D-4833	225		lbs	1001		N
Permittivity	ASTM D-4491	0.050		sec ¹	0.050		sec ¹
Thickness, - Typical Value	ASTM D-5199	31		mils	0.79		mm
A.O.S.	ASTM D-4751	35		U.S. Sieve	0.500		mm
UV Resistance (1200 hrs)	ASTM D-4355	70		%	70		%
Flammability (Typical value based on third party testing)	ASTM E-84	"Class A"			"Class A"		



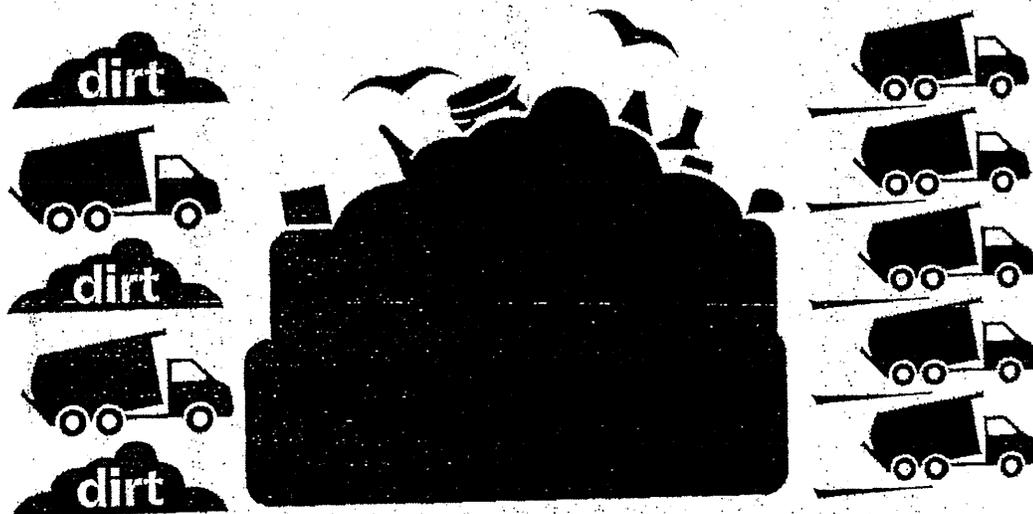
Produced in Belton, South Carolina, U.S.A.

The foregoing is believed to be an accurate representation of information compiled from inside and/or outside sources; however, because test values, statistical data and other information presented may be based solely on results of unverified tests made on random samples, information presented may relate only to tested samples and because the conditions in which such information may be used are beyond the control of Belton Industries, Inc., Belton does not guarantee either the accuracy or reliability of the information or the suggestions and recommendations contained herein. Belton assumes no responsibility for the use of information presented herein and hereby disclaims all liabilities which may arise in connection with the use of information herein presented. All specifications, properties, values, statistical data and applications listed herein are provided as information only without charge or obligation to the recipient or user, and in no way either makes or creates any warranty with respect to any product or modifies, amends or enlarges any warranty made with respect to any product. Final determination of the suitability, reliability and accuracy of the information and suggested use is solely the responsibility of the user.

PO Box 127 • 1205 Hamby Road • Belton, South Carolina 29627
 Phone 864.338.5711 / 800.845.8753 • Fax 864.338.5594 / 800.851.5049 • www.BeltonIndustries.com

Why Use Amcon DAILY COVERS?

An alternate daily cover saves valuable air space by eliminating the need for a dirt layer between daily loads. AmCon covers are very easy to use - saving time, energy & money. AmCon uses the highest quality fabric and a unique design to make a tough, long lasting daily cover.



- Extends the life of the landfill by saving valuable air space.
- Constructed for maximum strength to ensure long life.
- Provides a cost-efficient alternative to other daily covers with a minimized expense required to maintain, store and move.
- Extends tipping hours, increasing daily revenues.
- EPA-approved for all states.
- Improves site - minimizes blowing paper/litter.
- Minimizes rodent burrowing, birds, and lessens animal activity
- Minimizes fly, mosquito and insect emergence
- Provides a low-permeable fabric to facilitate water runoff and minimize erosion.
- Controls movement of atmospheric oxygen and noxious odors.
- Flame-resistant
- Custom sizes and specifications are available.
- Lighter duty covers are available upon request.



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**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417D**

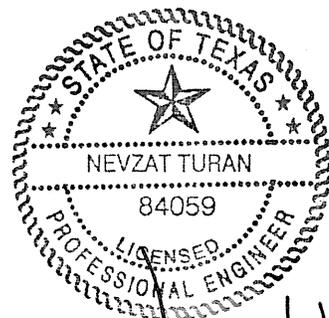
MAJOR PERMIT AMENDMENT APPLICATION

**PART IV – SITE OPERATING PLAN
APPENDIX IVC
SPECIAL WASTE ACCEPTANCE PLAN**

Prepared for

Texas Regional Landfill Company, LP

February 2022



Prepared by

Nevzat Turan
02/22/22

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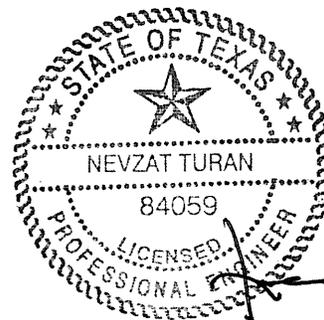
WCG Project No. 0771-368-11-123

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Special Waste Profile (SWP) Sheet

APPENDIX IVC-B
Non Hazardous Waste Manifests



02/22/22

1 INTRODUCTION

1.1 Objectives of Special Waste Acceptance Plan

This Special Waste Acceptance Plan (SWAP) outlines the acceptance criteria and the review and approval process that will be used to accept certain "special waste" as defined by the Texas Commission on Environmental Quality (TCEQ) for disposal at the Turkey Creek Landfill (MSW Permit No. 1417C). The Turkey Creek Landfill is owned and operated by Texas Regional Landfill Company, LP. This SWAP defines the procedures to be followed in determining whether the landfill may accept a waste for disposal, and it outlines the procedures for identifying and preventing the disposal of unacceptable wastes which are delivered to the facility.

The objectives of the SWAP are as follows.

- Verify that the waste is not a regulated hazardous waste.
- Verify that the waste meets permit criteria for acceptance at the landfill.
- Verify that the waste meets facility criteria for acceptance at the landfill.
- Establish the necessary conditions to ensure the safe and environmentally sound management (handling, storage, processing and disposal) of the waste.

1.2 Special Wastes Regulations

The TCEQ's solid waste regulations define a special waste as a "solid waste or combination of solid wastes that because of its quantity, concentration, physical or chemical characteristics, or biological properties requires handling and disposal to protect the human health or the environment" (refer to Title 30 TAC §330.3(148)). Although the regulations identify specific waste streams as special wastes, the rules also include the above catch-all provision. This broad definition of special waste covers many wastes that are routinely disposed at Municipal Solid Waste Landfill Facilities (MSWLFs).

The TCEQ rules specifically provide that the receipt of certain types of special waste does not require waste-specific or site-specific written approval of the Executive Director if handled in accordance with the noted provisions for each waste (e.g., Title 30 TAC §330.171(c) and (d) and §330.173(e) and (i) – (j) of the rules). By way

of example, the receipt of properly treated medical waste, dead animals or slaughterhouse wastes, certain asbestos-containing material that is properly managed, empty containers that are properly rinsed, municipal hazardous waste from small quantity generators that are conditionally exempt, sludge, grease/grit trap waste and liquid wastes from municipal sources that are properly processed, and used oil filters from household generators that are properly crushed or otherwise processed to remove all free-flowing used oil do not require waste-specific and/or site-specific written approval from the TCEQ's Executive Director prior to acceptance and disposal as noted in the regulations. Similarly, soils contaminated by petroleum products, crude oils, or other chemicals may be accepted and disposed of, subject to limitations set forth in Title 30 TAC §330.171 (relating to Disposal of Wastes), and certain industrial solid wastes, such as Class 1 asbestos-containing material and Class 2 or Class 3 industrial solid wastes that do not interfere with facility operations, may be accepted and disposed of without a waste-specific and/or site-specific written approval from the Executive Director, subject to limitations set forth in Title 30 TAC §330.173 (relating to Disposal of Industrial Wastes).

The special wastes enumerated in Title 30 TAC §330.171(c) and (d) and §330.173(c) and (i) – (j) (generally referenced above) will be accepted for disposal at the Turkey Creek Landfill by operation of rule, without the necessity for any waste-specific or site-specific approvals. They will be managed at the facility in accordance with the methods set forth in those rules and any applicable requirements set forth in the Site Operating Plan (SOP), as further detailed in Section 6 of this SWAP.

Title 30 TAC §330.171(b)(1) provides that approvals for any other (non-enumerated) wastes must be waste-specific and/or site-specific in nature (i.e., not authorized by operation of rule); however, Title 30 TAC §330.171(b)(2) allows a generator to request approval to dispose of special waste directly from a landfill operator who has an approved Special Waste Acceptance Plan under Title 30 TAC §330.61(b) that authorizes the acceptance of such waste on a site-specific basis. This SWAP addresses requirements of the TCEQ rules allowing site-specific authorization to accept special waste meeting the facility's waste acceptance criteria set forth in Section 3 – Evaluation Guidelines of this SWAP. Unless otherwise approved by the Executive Director, only those non-enumerated special wastes that meet the waste acceptance criteria of this SWAP will be disposed of at the Turkey Creek Landfill in accordance with the disposal requirements set forth in the SOP and further detailed in Section 6 of this SWAP.

2 DEFINITIONS

Listed below are definitions of some common terms used in this SWAP. Terms not defined below carry the common industry definition. Note that if any of the definitions listed below conflict with a definition listed in State or Federal regulations applicable to the landfill, the regulatory definition will govern.

Conditionally Exempt Small Quantity Generator

A generator who generates 100 kg (220 pounds) or less of hazardous waste in a calendar month and whose waste is excluded from full regulation under 30 TAC §335.78 (relating to Requirements for Hazardous Waste Generated by Conditionally Exempt Small Quantity Generators).

Commercial Solid Waste

All types of solid waste generated by stores, offices, restaurants, warehouses, and other non-manufacturing activities, excluding residential and industrial wastes.

Household Waste

Any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households (including single and multiple-family residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas).

Industrial Solid Waste

Industrial solid waste includes nonhazardous solid waste generated by manufacturing or industrial processes. Such waste may include, but is not limited to, waste resulting from the following manufacturing or industrial processes: electric power generation; agricultural fertilizer/chemicals; food and related products/by products; organic or inorganic chemicals; iron and steel manufacturing; leather and leather products; nonferrous metals manufacturing/foundries; plastics and resins manufacturing; pulp and paper industry; rubber and miscellaneous plastic products; stone, glass, clay, and concrete products; textile manufacturing; and transportation equipment. This term does not include: (i) solid or dissolved materials in domestic sewage, irrigation return flows or industrial discharges subject to regulation by permit under Texas Water Code, Chapter 26; or (ii) nonhazardous waste materials that result from activities associated with the exploration, development, or

production of oil or gas or geothermal resources regulated by the Railroad Commission of Texas under Section 91.101, Natural Resources Code.

Class 1 Industrial Solid Waste:

An industrial solid waste is a Class 1 waste if:

- it contains specific constituents which equal or exceed the levels listed in Title 30 TAC §335.521(a)(1) (relating to Appendix I, Table 1) as determined by the methods outlined in Title 30 TAC §335.505(1) (relating to Class 1 Waste Determination);
- it is Class 1 ignitable as determined by the methods outlined in §335.505(2) (relating to Class 1 Waste Determination);
- it is Class 1 corrosive as determined by the methods outlined in §335.505(3) (relating to Class 1 Waste Determination);
- it contains total recoverable cyanides equal to or greater than 20 parts per million;
- there is an absence of analytical data and/or documented process knowledge (as described in §335.511 (relating to Use of Process Knowledge)) which proves a waste is Class 2 or Class 3;
- it is identified as a Class 1 waste in §335.508 (relating to Classification of Specific Industrial Solid Wastes); or
- it is not a hazardous waste pursuant to §335.504 (relating to Hazardous Waste Determination) and a generator chooses to classify the waste as Class 1 waste.

Class 2 Industrial Solid Waste:

An industrial solid waste is a Class 2 waste if:

- it is not a hazardous waste pursuant to Title 30 TAC §335.504 (relating to Hazardous Waste Determination);
- it is not a Class 1 waste pursuant to Title 30 §335.505 (relating to Class 1 Waste Determination); and
- it is not a Class 3 waste because:
 - it cannot qualify as a Class 3 waste pursuant to Title 30 TAC §335.507 (relating to Class 3 Waste Determination); or
 - a generator chooses not to classify the waste as a Class 3 waste.

Any waste designated as a Class 2 waste under Title 30 TAC §335.508 (relating to Classification of Specific industrial Solid Wastes) is a Class 2 waste.

Class 3 Industrial Solid Waste:

An industrial solid waste is a Class 3 waste if:

- it is not a hazardous waste pursuant to Title 30 TAC §335.504 of this title (relating to Hazardous Waste Determination);
- it does not meet any of the Class 1 waste criteria set forth in Title 30 TAC §335.505 of this title (relating to Class 1 Waste Determination);
- it is inert; and
- it is essentially insoluble.

Class 3 wastes include, but are not limited to, materials such as rock, brick, glass, dirt, and certain plastics and rubber which are not readily decomposable.

Leachate

A liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste.

Municipal Solid Waste Landfill Facility (MSWLF) Unit

A discrete area of land or an excavation that receives household waste and that is not a land application unit, surface impoundment, injection well, or waste pile under 40 CFR §257.2. A MSWLF unit also may receive other types of RCRA Subtitle D wastes, such as commercial solid waste, non-hazardous sludge, conditionally-exempt, small-quantity generator waste, and industrial solid waste. A MSWLF unit may be a new unit, an existing unit, or a lateral expansion of a unit.

Pollution Control Waste

Any solid waste generated as a direct or indirect result from the removal of contaminants from the air, water, or land which may pose a present or potential threat to human health or the environment or with inherent properties which make the disposal of such waste in a landfill difficult to manage by normal means.

RCRA

Resource Conservation and Recovery Act of 1976, as amended, 42 U.S.C. §§ 6901 *et seq.*

Sludge

Any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility, exclusive of the treated effluent from a wastewater treatment plant.

Solid Waste

Any garbage, or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, municipal, commercial, mining, and agricultural operations, and from community activities. This term does not include (i) solid or dissolved materials in domestic sewage, irrigation return flows or industrial discharges subject to regulation by permit under Texas Water Code, Chapter 26, or (ii) nonhazardous waste materials that result from activities associated with the exploration, development, or production of oil or gas or geothermal resources regulated by the Railroad Commission of Texas under Section 91.101, Natural Resources Code.

Special Waste

Any solid waste or combination of solid wastes that because of its quantity, concentration, physical or chemical characteristics or biological properties requires handling and disposal to protect human health or the environment. If improperly handled, transported, stored, processed, disposed of or otherwise managed, special waste may pose a present or potential danger to human health or the environment.

Special wastes are:

- hazardous waste from conditionally exempt small quantity generators;
- Class 1 industrial solid waste;
- untreated medical waste;
- municipal wastewater treatment plant sludges, other types of domestic sewage treatment plant sludges, and water-supply treatment plant sludges;
- septic tank pumpings;
- grease and grit trap wastes;
- wastes from commercial or industrial wastewater treatment plants; air pollution control facilities; and tanks, drums, or containers used for shipping or storing any material that has been listed as a hazardous constituent in 40 CFR Part 261, Appendix VIII, but has not been listed as a commercial chemical product in 40 CFR §261.33(e) or
- slaughterhouse wastes;
- dead animals;
- drugs, contaminated foods, or contaminated beverages, other than those contained in normal household waste;
- pesticide (insecticide, herbicide, fungicide, or rodenticide) containers;
- discarded materials containing asbestos;

- incinerator ash;
- soil contaminated by petroleum products, crude oils, or chemicals in concentrations of greater than 1,500 milligrams per kilogram total petroleum hydrocarbons, or contaminated by constituents of concern that exceed the concentrations listed in Table 1 of 30 TAC §335.521(a)(1) (relating to Waste Classification; Appendices);
- used oil;
- waste from oil, gas, and geothermal activities subject to regulation by the Railroad Commission of Texas when those wastes are to be processed, treated, or disposed of at a MSWLF Unit;
- waste generated out-of-state as defined below;
- lead acid storage batteries; and
- used-oil filters from internal combustion engines.

SWP Sheet

Special Waste Profile (SWP) Sheet or other facility-approved waste profile documentation containing equivalent information.

Special Waste Coordinator/Analyst

Facility personnel authorized to review and approve SWP Sheets. This person is typically located in the corporate office and is trained in waste acceptance procedures and regulations.

TCEQ

Texas Commission on Environmental Quality

USEPA

United States Environmental Protection Agency

Wastes Generated Out-of-State

All solid waste generated outside the boundaries of the State of Texas and transported into Texas for processing, storage, or disposal at a MSWLF Unit that contains (i) any industrial solid waste; (ii) any waste associated with oil, gas or geothermal exploration, production, or development activities; or (iii) any special waste as defined above.

Waste Stream

A separate and distinct waste type generated from a particular process at a generating location.

3 EVALUATION GUIDELINES

The waste evaluation guidelines, pre-receipt and recordkeeping requirements, and recertification frequency obligations of Sections 3 – 5 of this SWAP are not applicable to the acceptance of municipal solid waste or any materials authorized for disposal by operation of rule under Title 30 TAC §§330.171 and 330.173. These guidelines will be applied to wastes for which waste-specific or site-specific written approval is required under Title 30 TAC §330.171(b).

Before accepting any such waste for disposal at the facility, Turkey Creek Landfill will verify the waste generator has the following: (1) TCEQ waste code (for industrial wastes); (2) TCEQ registration number (for industrial waste); (3) TCEQ authorization (if applicable); and (4) facility-approved SWP Sheet (including any appropriate analytical data). Appendix IVC-A contains a standard SWP Sheet. Alternative forms of documentation containing information equivalent to the SWP Sheet found in Appendix IVC-A can be used. References to the information used to classify the waste based on analytical testing and/or process knowledge (e.g., MSDS, manufacturers' literature, or other documentation generated in conjunction with a particular process, etc.) will be included on the SWP Sheet as applicable (see Section 3.2 for more information). Each waste must be evaluated by a Special Waste Coordinator/Analyst to ensure that it is acceptable for disposal at this facility. The following guidelines are provided to assist in reviewing SWP Sheets.

3.1 Hazardous Waste and Industrial Solid Waste Determinations

In accordance with USEPA and TCEQ regulations, a waste is considered hazardous if it is listed as mixed with, or derived from, a listed hazardous waste or it exhibits any characteristic of a hazardous waste as further detailed in the following subsections. The generator should determine if the material is hazardous using the following method:

- Determine if the material is excluded from being a solid waste or hazardous waste per Title 30 TAC §335.1 (relating to Definitions) or 40 CFR Part 261, Subpart A, as amended through January 2, 2008 (73 FR 57);
- If the material is a solid waste, determine if the waste is listed as, or mixed with, or derived from a listed hazardous waste identified in 40 CFR Part 261, Subpart D, as amended through June 4, 2008 (73 FR 31756); and

- If the material is a solid waste, determine whether the waste exhibits any characteristics of a hazardous waste as identified in 40 CFR Part 261, Subpart C, as amended through July 14, 2006 (71 FR 40254).

If the material is determined to be a nonhazardous industrial solid waste, the generator should then classify the waste as Class 1, Class 2, or Class 3 waste as defined in Section 2 of this SWAP.

3.1.1 Listed Wastes

Listed wastes are solid wastes listed, by name, as hazardous by the USEPA. Listed wastes are categorized by the USEPA in the following categories:

- 40 CFR §261.31 lists more than 25 hazardous wastes resulting from non-specific sources (i.e., common manufacturing and industrial activities). These wastes include spent solvents, sludges, and similar materials. It is important to closely evaluate dried paints, paint strippings, and spray paint booth wastes for the potential to fall under this category. If a waste falls under this category it is considered an F-listed waste.
- 40 CFR §261.32 lists more than 100 hazardous wastes resulting from specific sources (i.e., specific waste generating industries). These wastes include various types of sludges, still bottoms, spent catalysts, and other materials from specific industrial operations. If a waste falls under this category it is considered a K-listed waste.
- 40 CFR §261.33(e) lists over 400 chemical products defined as acute hazardous wastes. If a waste falls under this category it is considered a P-listed waste.
- 40 CFR §261.33(f) lists more than 900 chemical products that are classified as toxic hazardous wastes. If a waste falls under this category it is considered a U-listed waste.

Listed wastes identified above and those wastes that may be included as listed wastes in the future by the USEPA and TCEQ will not be accepted for disposal at the Turkey Creek Landfill.

3.1.2 Characteristic Wastes

Wastes can be designated as hazardous based upon certain characteristics of the respective waste. A waste may be hazardous based on any one or more of the following characteristics: toxicity, ignitability, corrosivity, or reactivity. A general summary for determining if a waste exhibits one or more of the four characteristics is described below:

- Ignitability (40 CFR §261.21): In general, any liquid waste having a flash point less than 60° Celsius (140° F) is considered ignitable. A non-liquid

waste is also considered hazardous for ignitability when under standard temperature and pressure is capable of causing a fire through friction, absorption of moisture, or spontaneous chemical change, and which will vigorously and persistently burn when ignited. Also included are ignitable compressed gases and certain substances that readily yield oxygen and stimulate the combustion of organic matter (oxidizers). These are classified as D001 wastes.

- Corrosivity (40 CFR §261.22): In general, any aqueous waste that exhibits a pH of less than or equal to 2.0 or greater than or equal to 12.5 is considered corrosive. Liquids that corrode steel at rates exceeding 1/4 inch per year at 55° Celsius (130° F) are also characteristic hazardous wastes. The literal reading of the regulations state that these values are for liquid wastes. These are classified as D002 wastes.
- Reactivity (40 CFR §261.23): Any waste that is normally unstable and readily undergoes violent change without detonating, reacts violently with water, or forms potentially explosive mixtures or generates toxic fumes in sufficient quantities when mixed with water is considered reactive. This category also addresses wastes which contain sulfide and cyanide. These are classified as D003 wastes.
- Toxicity (40 CFR §261.24): Toxicity testing was developed to simulate the leaching of contaminants from a landfill. The current procedure involves the extraction of contaminants using the Toxicity Characteristic Leaching Procedure (TCLP). The extraction is analyzed for up to 40 different constituents. These are classified as D004 – D043 wastes.

Characteristic wastes identified above, and those wastes that may be included as characteristic listed wastes in the future by the USEPA and TCEQ, will not be accepted for disposal at the Turkey Creek Landfill.

3.2 Analytical Requirements and Process Knowledge

The analytical data and/or process knowledge used to conduct the hazardous waste and industrial solid waste determinations referenced in Section 3.1 of this SWAP will be included with or referenced on a completed SWP Sheet as applicable. The Special Waste Coordinator/Analyst will have a thorough understanding of the regulations referenced above and any applicable sampling and testing requirements referenced on the SWP Sheet (see Appendix IVC-A).

Analytical Requirements – Any analytical data submitted to the Turkey Creek Landfill for use in the waste evaluation process shall meet the following criteria:

- Analytical data must be less than 18 months old (unless the generator demonstrates there has been no material change in the process generating the waste stream).
- The analytical report must be a final copy, legible, complete in all material respects, and signed.
- The analytical data must "correlate" with information contained in the SWP Sheet.
- The results must have the units of measure identified. (c) The detection limits should be included for results that are "non-detect."
- The analytical methods employed must accompany the analytical data, and
- Analytical sampling, analysis, and interpretations must be in material conformance with currently applicable State and Federal regulatory requirements.

Process Knowledge Requirements – Process knowledge may be used to demonstrate that a waste stream is not a prohibited hazardous or industrial solid waste. The following are examples of information that may be used to support a process knowledge determination:

- Review of MSDS sheets and manufacturers' literature.
- Historical analysis of representative samples from the waste stream.
- Review of constituents present in the waste stream and their physical properties.
- Consideration of potential contaminants, by-products or decomposition products.
- Review of the waste generating process to ensure that hazardous characteristics are not imparted on the waste stream.

3.3 Waste Acceptance Criteria

The Special Waste Coordinator/Analyst will utilize the waste-specific chemical and characteristic information submitted by the generator on the SWP Sheet and any accompanying analytical test results to determine the acceptability of a waste for disposal at the Turkey Creek Landfill. The objective is to confirm that the generator's waste stream is not a prohibited hazardous or industrial solid waste and is acceptable for disposal at the Turkey Creek Landfill in accordance with the regulations referenced above. The Special Waste Coordinator/Analyst will be responsible for maintaining and utilizing current regulatory guidelines and constituent limits for evaluation of wastes. The Special Waste Coordinator/Analyst also will be responsible for knowing and applying any applicable future changes to State and Federal disposal regulations, review and acceptance procedures.

Waste review procedures will include the following:

- The SWP Sheet will be reviewed for completeness.
 - The SWP Sheet must be legibly filled out with addresses, contact names, phone numbers, and signatures.
 - The "Waste Stream Information" must include sufficient information to provide the Special Waste Coordinator/Analyst a clear understanding of the waste type, origin, shipping method, and anticipated volume and frequency of disposal. This information will be used by the Special Waste Coordinator/Analyst to compare the waste with the appropriate State and Federal regulations. If the description is not explicit, additional information will be requested of the generator.
 - The "Physical Characteristics of Waste" must include information on the chemical and physical properties of the waste sufficient to allow the Special Waste Coordinator/Analyst to confirm the generator's waste characterization and correlate the waste properties to the appropriate State and Federal regulations. It is important that all portions of this section of the SWP Sheet be completed by the generator of the waste, and that the generator executes the certification statement in the subsequent section on the SWP Sheet.
- Site Specific Evaluation – The Special Waste Coordinator/Analyst will confirm that each site-specific approval to accept and dispose of waste at the Turkey Creek Landfill complies with the following: (1) applicable TCEQ regulations governing the acceptance and disposal of wastes; (2) TCEQ Permit No. 1417C for the Turkey Creek Landfill; and (3) any TCEQ orders or other official directives concerning the acceptance and disposal of special waste at the facility.
- Request for Additional Information – The Special Waste Coordinator/Analyst may request additional information from the generator before rendering a decision. This may include additional analytical data, process descriptions, MSDS, or other applicable information. After review of the SWP Sheet is completed, the Special Waste Coordinator/Analyst will complete the appropriate section of the SWP Sheet, and copies of the approval will be provided to the generator.
- Executive Director Approval – The facility may receive additional types of waste pursuant to waste-specific and/or site-specific approvals issued by the Executive Director in response to requests by generators under Title 30 TAC §330.171(b)(2) or as otherwise authorized by the Executive Director pursuant to §§330.171 or 330.173.
- Liquid wastes classified as Class 1 will be directed to the Class 1 solidification basin(s) for solidification prior to being disposed in the Class 1 disposal area.

3.3.1 Class 1 Waste Evaluation and Acceptance Procedures

To ensure that the waste acceptance criteria of this plan is satisfied, all Class 1 waste intended for management and disposal at the Turkey Creek Landfill will be evaluated and approved by Turkey Creek Landfill staff as meeting all permit conditions, state/local regulations, and SWAP requirements.

The following forms and/or documentation are required to be submitted to Turkey Creek Landfill under the SWAP.

- All in-state industrial waste generators will be required to provide documentation that their waste has been classified as a nonhazardous Class 1 waste by TCEQ or self-classified as a nonhazardous Class 1 waste according to TCEQ regulations.
- All industrial wastes generated outside the borders of Texas and classified as Class 1 waste (other than maquiladora waste) must receive written authorization for disposal from the TCEQ. Copies of the authorization must be submitted to the Turkey Creek Landfill prior to waste acceptance.

When Class 1 non-hazardous industrial wastes are to be disposed of at the Turkey Creek Landfill, a complete waste profile will be required prior to acceptance of the waste.

Analytical data indicating compliance with this plan will be required as part of the generator profile as determined by the Special Waste Department. Any analytical data submitted to Turkey Creek Landfill for use in the waste evaluation process will meet the following criteria:

- Analytical data must be less than 18 months old (unless the generator determines that has been no material change in the process generating the waste stream).
- The analytical report must be a final copy, legible, complete in all material respects, and signed.
- The analytical data must “correlate” with information requested on the generator profile sheet.
- The results must have the units of measure identified.
- The detection limits should be included for results that are “non-detect.”
- The reference of methods employed must accompany the analytical data.
- Analytical sampling, analysis, and interpretations must be in conformance with currently applicable state and federal regulatory requirements.

Additional information may be required to be submitted to assist Turkey Creek Landfill in evaluating an industrial waste for disposal. Such information may

include analytical data, Material Safety Data Sheets (MSDS), additional waste composition data, pertinent letters or memos, or any other applicable waste shipment forms by the generator. Such information may be requested by Turkey Creek Landfill as determined by the Landfill Manager, his designee, or representatives of the Special Waste Department and will be included in the Site Operating Record.

The generator waste profile will be re-evaluated at a minimum of once every 3 years after the original approval date to verify consistency with the original approved waste profile. Turkey Creek Landfill may require the generator to complete a new waste profile as part of this re-evaluation process. The re-evaluated waste profile information will be maintained in the Site Operating Record.

4 PRE-RECEIPT AND RECORDKEEPING

The landfill operator must receive an approved SWP Sheet from the Special Waste Coordinator/Analyst prior to acceptance of the special waste for disposal. The landfill must keep a copy of the approved SWP Sheet on file in the Site Operating Record for the life of the site including the post-closure care period.

Landfill personnel will visually compare the material presented for disposal to the approved SWP Sheet to confirm that the physical characteristics (i.e., color, odor, and appearance) of the material match those detailed on the SWP Sheet. In the event that the physical characteristics of the waste are determined to differ from the approved waste stream, the Special Waste Coordinator/Analyst will be notified. The generator will be contacted and an attempt made to resolve the differences and the resolution will be documented on the SWP Sheet. If the differences in the waste load cannot be resolved at that time, the waste load will be rejected. The generator will be notified of the reasons for rejecting the load. Additional process and chemical analyses may be required to further characterize the waste.

A complete Non-Hazardous Manifest (if applicable) or Non-Hazardous Sludge Manifest (if applicable) will accompany each load of special waste delivered to the facility. Alternative versions of these manifests may be used where the forms are in accordance with applicable regulations.

5 RECERTIFICATION FREQUENCY

Generators of waste are under a continuing duty to notify the facility of any known or suspected material change in a waste stream previously approved for disposal. Generators of special waste approved for disposal are required to recertify each waste stream, at a minimum, once every three (3) years after the original SWP Sheet approval date. This requirement is intended to verify that the waste stream has not significantly changed since the generator's initial characterization. This requirement does not apply to wastes that are accepted for disposal on a one-time basis (i.e., spill clean-ups) or to generators who no longer expect to use the facility.

The facility may require a generator to recertify its waste stream more frequently than every three (3) years. This is recommended for waste streams that are variable due to process variations or if changes in the manufacturing process have occurred.

6 DISPOSAL AND SPILL PROCEDURES

6.1 Disposal

The landfill personnel will exercise appropriate care and safeguards when disposing of wastes. Only onsite personnel who have received waste training will be utilized for disposal of special wastes. In general, special wastes will be handled and disposed of at the site in a similar manner as municipal solid waste. The special waste will be off-loaded from transport trucks and disposed of at the appropriate unloading area/working face identified in Section 4.2.1 of the SOP based on how the waste is classified (e.g., MSW working face, Class 1 working face, RACM disposal area). The special waste will then be placed and spread using standard landfill equipment listed in Section 3 of the SOP. Specific handling/disposal procedures for certain wastes (e.g., dead animals, certain empty containers) will be in accordance with the TCEQ regulations governing their proper disposal and as described further in Section 4.20 of the SOP. The U.S. Drug Enforcement Agency will be contacted for specific destruction and disposal requirements of controlled substances (e.g., nonhazardous drugs, prescription medication) approved for acceptance and disposal.

6.2 Spill Procedures

In the event that there is a spill during the delivery and/or on-site management of the waste, the landfill personnel will first attempt to abate and contain the release at the source. Then the landfill personnel will recover or clean up the spilled material. Any cover soils (e.g., intermediate cover) that have come in contact with the waste will be collected and disposed of at the active working face. The affected area will then be re-covered consistent with the requirements of the Site Operating Plan (SOP). A notation of the incident will be made in the facility's Site Operating Record by landfill personnel.

7 WASTE DISCREPANCIES AND REJECTED LOADS

Documentation for approved wastes that arrive at the landfill for disposal will be reviewed by facility personnel. Any discrepancies (i.e., incomplete documentation, questionable waste characteristics) will be resolved prior to acceptance of the waste. In the event the discrepancies cannot be resolved, the waste load will be rejected. Discrepancies which will cause a load to be rejected include but are not limited to:

- An approval SWP Sheet is not on file at the landfill.
- A waste arrives without a required manifest.
- A waste arrives, and the waste does not match the description on the waste manifest.
- A waste arrives, and the information on the manifest is not sufficiently complete, is incorrect, or does not match the information provided on the SWP Sheet such that a correlation between the waste being shipped and the approved SWP Sheet cannot be made.
- A waste arrives and the SWP is expired or outdated.

In the event that the description or physical characteristics of a waste being presented for disposal at the landfill is determined to differ from that of an approved waste stream, the vehicle will be stopped, the waste will not be offloaded, and the generator/customer will be required to provide additional process knowledge and/or chemical analysis data to adequately identify the waste as required by this SWAP. If this additional information resolves the discrepancy(ies), the SWP Sheet will be annotated as such and the resolved load accepted. The request for additional information may not always result in resolving the issues, and in the event the discrepancy(ies) cannot be resolved, the waste load will be rejected.

Regulated hazardous waste, PCBs, radioactive, or other prohibited wastes are not authorized for disposal at the landfill facility. If such wastes are suspected or discovered, they will be isolated until the material can be adequately characterized. Appropriate handling procedures will be used to manage the material.

If the suspect material is determined to be a regulated hazardous waste or contain regulated levels of PCBs, radioactive, or other prohibited materials, the TCEQ will be notified of the incident and the planned disposition/remediation of the material. The proper disposition/remediation of the prohibited waste will be specific to the waste and will be implemented upon TCEQ concurrence and approval.

8 PERSONNEL TRAINING

Appropriate facility personnel will receive initial training on waste identification, screening, and management procedures. Refresher training will be provided to appropriate personnel on a regular basis. The training will be conducted by either in-house staff or outside specialists familiar with proper waste management procedures and the requirements of this SWAP. Documentation of the training will be placed in the facility's Site Operating Record and personnel files.

APPENDIX IVC-A
SPECIAL WASTE PROFILE (SWP) SHEET



SPECIAL WASTE PROFILE (SWP) SHEET

WASTE CHARACTERIZATION DATA (WCD)

This form is to be utilized to describe "Special Waste" offered to IESI for management, transportation, and/or disposal. "Special Wastes" are defined as any solid, liquid, semi-solid, or gaseous material and associated containers generated as a direct or indirect result of a manufacturing process or from the removal of contaminant(s) from the air, water or land.

These materials include but are not limited to:

- ~ State regulated wastes.
- ~ Asbestos wastes from manufacturing or chemical processing facilities.
- ~ Industrial process wastes.
- ~ Pollution control wastes.
- ~ Infectious wastes (untreated).
- ~ Outdated products, and
- ~ Incinerator wastes.

Wastes not included in this definition are:

- ~ General household wastes
- ~ Uncontaminated packaging material and uncontaminated construction or demolition debris from a building or structure that is not involved with any manufacturing or chemical process.
- ~ Landscape wastes.
- ~ Domestic sewage (Wastewater Treatment Plant (WWTP) sludge is included as a Special Waste®), and
- ~ Uncontaminated food or grain wastes.

In accordance with US EPA rules under 40 CFR Part 262 and equivalent state, provincial, and local rules, generators must determine whether their waste is a hazardous waste. In order to manage your waste, IESI requires certain information about your waste to confirm your determination that it is not a hazardous waste and that it can be managed in a safe, environmentally sound, and lawful manner. This information will serve to protect you, the waste generator, as well as IESI. NOTE: This form is not to be used for hazardous waste or PCBs regulated by a federal or applicable state, provincial, or local authority.

GENERAL INSTRUCTIONS

1. The IESI individual requesting approval is to complete the Waste Approval Request/Sign-Off portion.
2. A representative of the generator must provide all information required for completion of the Waste Characterization Data (WCD) portion of the form. Please be thorough in your answers. The entire form must be completed, answers must be legibly printed in ink or typewritten, and the completed form must be signed and dated. Check "N/A" where the data requested are not applicable. Unless waived by the District Vice President, please attach any additional relevant information such as MSDS or analytical data that will help to describe the waste and expedite its review. Use this form only one time since this form has a unique WCD number assigned to it.
3. Send the completed and signed form to your IESI Sales Office. If you have any questions concerning the completion of this form, please contact your IESI Sales Representative.

1. GENERATOR INFORMATION

- a) Generator's Name - Name of the company generating the waste.
- b) Generating Facility's Complete Address - Physical address including the street, city and state of the generating facility. Do not use P.O. Box numbers.
- c) Generator's Representative - The name of the generator's employee or authorized representative completing the form and their telephone and fax numbers.
- d) Emergency Information Contact - Provide the name and phone number of the individual(s) representing the generator who may be contacted regarding emergencies (e.g. spills) or for any additional information in case of an employee exposure.
- e) If the generating facility is regulated by a state, provincial, or local regulatory agency as a generator of a "Hazardous Waste", a "Special Waste", a "Pollution Control Waste", or an "Industrial Process Waste", note the facility registration number, if one has been assigned.
- f) Indicate current hazardous waste generator status.
- g) Billing Information - If the company to be billed is different than the generator, supply the customer's name, mailing address, individual to be contacted, and his/her telephone and fax numbers.

2. PERSONAL PROTECTION EQUIPMENT

In accordance with OSHA Hazard Communication requirements (29 CFR 1910.1200) and Canadian WHMIS requirements, provide any special handling information, personal protective equipment recommendations, and other relevant information that will prevent injury or illness resulting from the management of the waste.

3. GENERAL WASTE STREAM INFORMATION

- a) Name/Description of the Waste - Describe the waste and the source from where it is generated. For example, sludge from a biological treatment system clarifier, tank bottoms from diesel fuel storage tank, solidified epoxy paint from spray booth, etc. Please be as thorough as possible. Indicate whether or not the waste is a "Industrial Waste" generated by an "Industrial Generator" and if so list the TCEQ Waste Code number for the waste as determined by the generator under 30 TAC 335, Subchapter R.
- b) Process Generating the Waste - Describe the complete process, not just the source of the waste. For example, municipal wastewater treatment plant, crude oil refining operation, furniture manufacturing, repair of a storage tank containing number 6 fuel oil, etc. Please be as thorough as possible.
- c) Indicate properties of waste by checking all boxes that apply.

PHYSICAL STATE - Check the appropriate boxes that best describe the physical state of the waste at ambient conditions. If the waste is bi-layered, describe the type of physical states that make up the combination: e.g., SEMI-SOLID and LIQUID.

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REACTIVITY - If the waste exhibits any of the following reactive properties, mark the appropriate box(es),

- **Water Reactive** - Reacts violently, forms potentially explosive mixtures, or generates toxic gases or vapors when exposed to water.
- **Acid or Alkaline Reactive** - Releases heat, toxic gases or vapors when exposed to an acid (pH < 2) up to an alkaline (pH > 12) environment.
- **Oxidizer** - Reacts with organic matter to cause fires or smoldering.
- **Autopolymerizable** - Hardens or solidifies without assistance, usually with a release of heat.
- **Pyrophoric** - Ignites in air.
- **Explosive** - Burns suddenly with violent results.
- **Thermally Sensitive** - The hazardous or toxic properties may change with the application of heat.
- **Shock Sensitive** - Detonates or explodes if jolted or dropped.
- **None of the above** - The waste exhibits none of the reactive properties defined above.

FLASH POINT - If the waste is solid or powder, note "N/A". Otherwise, check the temperature range at which the waste exhibits a flash point. Do not check more than two (2) consecutive boxes.

pH - If the waste is aqueous, note its pH range. If the waste is solid, note non-applicable (N/A). No more than two (2) consecutive boxes may be checked.

ODOR - Describe any obvious odor, for example, sweet, acidic, solvent. Describe the intensity of the odor (none, mild, strong). Note that you should not purposefully smell the waste, but any incidental odor noticed upon management of the waste is to be described.

COLOR - Describe the color of the waste, or if non-homogeneous, the colors associated with the waste.

ESTIMATED VOLUME - The quantity and frequency of generation of the waste described is to be noted. Also, note the manner in which the waste is to be transported for disposal.

d) Indicate source of information for waste stream characterization.

e) Indicate that an evaluation has been conducted and a determination made that the waste is: 1.) not a D001-D043 hazardous waste, or 2.) has been excluded from regulation as a hazardous waste. If excluded, please provide the regulatory citation.

f) Indicate that an evaluation has been conducted and determination made that the waste is: 1.) not an F,K,P or U hazardous waste, or 2.) has been excluded from regulation as a hazardous waste. If excluded, please provide the regulatory citation.

g) (i) Indicate if the waste was previously a restricted hazardous waste which has been treated to render the waste non-hazardous. Note: if yes, additional information regarding the waste codes of the waste being treated, the underlying hazardous constituents, and the method of treatment must be provided.

(ii) If the answer to 3. g)(i) is yes, indicate whether the waste residue meets all applicable 40 CFR 268 land disposal treatment standards.

h) Indicate if the waste material is regulated by an applicable state, provincial, or local regulatory agency as a "Hazardous Waste". If so, enter the Waste Identification Number, if one has been assigned. Materials designated as hazardous waste by the USEPA are not to be described on this form.

i) Indicate if the waste material is regulated by the State of Texas as a Class I Waste Material due to its concentration, or physical or chemical characteristics as being toxic, corrosive, flammable, a strong sensitizer or irritant, a generator of sudden pressure by decomposition, heat, or other means, or may pose a substantial present or potential danger to human health or the environment when improperly processed, stored, transported, or disposed of or otherwise managed as defined in 336.505.

4. WASTE COMPOSITION

Describe the components of the waste. Use common or generic terms describing the constituent concentrations in percentages (%) or parts per million (ppm). Do not use abbreviations, Trade Names, or vague descriptions, such as, oil or sludge.

- ~ **Organic Solvents** - Aromatic and aliphatic hydrocarbon solvents such as alcohols, ketones, esters, ethers, benzene, mineral spirits, lacquer thinner, amines or chlorinated hydrocarbons.
- ~ **OSHA Substances** - The compounds identified by federal health and safety authorities (i.e. OSHA in the U.S., Labour Canada in Canada) as having occupational exposure limits.
- ~ **Radioactive Materials** - Naturally occurring or byproduct materials that emit radiation above background.
- ~ **Virgin Oils** - Unused oils, for example, crude oil, fuel oil, diesel oil, mineral or edible oils.
- ~ **Used Oils** - For example, motor oils, lubricating oils, or cutting oils.
- ~ **Etiological/Infectious Agents** - A substance which causes disease or abnormal conditions in humans.
- ~ **PCBs** - Polychlorinated biphenyls not regulated by TSCA, 40 CFR 761. If checked, complete the IESI PCB Questionnaire, and attach.
- ~ **Free Cyanides; Free Sulfides; Free Ammonia** - Hydrogen cyanide, hydrogen sulfide or ammonia gas liberated when the waste is subjected to an environment with a pH of 2 to 12.5
- ~ **None of the above** - The waste contains none of the above.

5. TRANSPORTATION INFORMATION

If the waste is a USDOT Hazardous Material, the Proper USDOT Shipping Name, Hazardous Class, UN or NA Number, Packaging Group (PG), and CERCLA Reportable Quantity must be noted for manifesting and placarding purposes (see 49 CFR 172.101).

6. GENERATOR'S WARRANTY AND INDEMNITY

An authorized representative of the generator must sign the warranty and indemnity. The WCD will not be processed and the waste will not be approved for IESI management without completion of this and all other sections.

WCD Revision 01/11



WCD NO.: TX _____
Expires: _____

WASTE APPROVAL REQUEST/SIGN-OFF

IESI to complete this section.

IESI Initial Contact: _____
Location: _____
Tel: () _____ Fax: () _____
Date: _____

Action Requested: New Waste Approval
 Up-Date Approval - Previous Number: _____
Disposal Site(s) Requested: _____
Management Method Requested: Landfill Hauling
 Solidification Bioremediation Other _____

Authorizing Manager's Signature: _____ Title: _____ Date: _____

1. GENERATOR INFORMATION

a) Generator's Name: _____
b) Generating Facility's Address: _____
City: _____ State: _____ Zip: _____
c) Generator's Representative: _____
Title: _____
Tel: () _____ Fax: () _____
d) Emergency Information Contact: _____
Title: _____
Tel: () _____ Fax: () _____

e) TCEQ Registration / Generator No.: _____
f) Hazardous Waste Generator Status: LQG SQG
 CESQG N/A
Billing Information
g) Customer's Name: _____
h) Customer's Mailing Address: _____
City: _____ State: _____ Zip: _____
i) Billing Contact: _____
Tel: () _____ Fax: () _____

2. PERSONAL PROTECTION EQUIPMENT

a) Recommended personal protection equipment:
Respiratory Protection: None Cartridge _____ type Dust/Asbestos Supplied Air
Skin Protection: Work uniform/leather gloves Tyvek™ suit Encapsulated suit Gloves _____ material
Eye Protection: Safety Glasses Goggles
 Other (See attached Material Safety Data Sheets (MSDS))
Additional Comments: _____

3. GENERAL WASTE STREAM INFORMATION

a) Name / Description of the Waste: _____
Is Waste an Industrial Waste? Yes No If yes, list TCEQ Waste Code No.: _____
b) Detailed Description of Process Generating the Waste (include Process Schematic as Necessary): _____
c) Waste Properties at 72° F:
Physical State: Solid Semi-Solid Powder Free Liquid Combination (Describe): _____
Reactivity: Water Reactive Acid Reactive Alkaline Reactive Oxidizer Autopolymerizable
 Pyrophoric Explosive Thermally Sensitive Shock Sensitive None of the Above
Flash Point, °F: <72 73 - 100 101 - 139 (D001) 140 - 200 >201 N/A-Solid (passes paint filter test)
pH: <2 (D002) 2.1 - 5.0 5.1 - 9.0 9.1 - 12.4 >12.5 (D002) N/A-Solid (passes paint filter test)
Odor: None Mild Strong (Describe): _____
Color(s) (Describe): _____
Estimated volume: _____ Cubic yards Tons Gallons Cubic meters Tonnes (metric) Other
Per: Year Month Week Day One time Other _____
d) Waste stream characterization is based on the following:
 Laboratory analysis, (Copy attached): Yes No Name of Lab. / Date of Report: _____
 Generator's process knowledge MSDS (Copy attached): Yes No Date of MSDS: _____
 Other documentation, (Describe and attach as necessary): _____

WCD Revision 01/11



3. GENERAL WASTE STREAM INFORMATION (Cont.)

- e) Is this waste a characteristically hazardous waste per 40 CFR 261.21-24? Yes No Excluded - Citation _____
- f) Is this waste an F, K, P, U listed hazardous waste as per 40 CFR 261.32-33? Yes No Excluded - Citation _____
- g)(i) Is this waste a treatment residue of a waste which was previously a characteristically hazardous waste or a treated hazardous debris residue? Yes [answer g)(ii)] No [skip g)(ii)] If yes, describe the waste, applicable code(s) and the process generating the waste prior to treatment: _____
- g)(ii) If yes, does the waste meet all applicable land disposal restriction treatment standards found under 40 CFR 268, and applicable state, local and provincial regulations? Yes No
- h) Is this a "Hazardous Waste" as defined by state, provincial, or local regulations? Yes No If yes, enter the waste identification number if one has been assigned: _____
- i) Is this waste a "Class 1" waste as defined by TCEQ Chapter 335 - Industrial Solid Waste and Municipal Hazardous Waste Regulations, Section 335.505? Yes No

4. WASTE COMPOSITION

Please provide a breakdown of the waste stream based upon generator knowledge of the waste and the process(es) generating the waste stream.

Does this waste contain any of the following:

Components/Contaminants	Range (%) / ppm
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

- Organic Solvents
- OSHA Hazardous Substances
- Radioactive Materials
- Virgin Oils
- Used Oils
- Etiological / Infectious Agents
- PCBs (if checked, complete and attach PCB questionnaire)
- Free Sulfides
- Free Cyanides
- Free Ammonia
- None of the Above

If any of the above are marked, they must also be included in waste breakdown at left.

5. TRANSPORTATION INFORMATION

If the waste is a DOT Hazardous Material, complete the following:

Proper USDOT Shipping Name: _____
 USDOT Hazard Class: _____ UN or NA Number: _____ PG: _____ CERCLA: _____

6. GENERATOR'S WARRANTY AND INDEMNITY

Generator warrants and agrees that: (1) all of the information above and provided pursuant hereto is true, correct and complete, and all known or suspected hazards have been disclosed, (2) all analytical results submitted are accurate and representative of the waste (pursuant to SW846), (3) the waste is not a hazardous waste as defined, characterized or regulated by the USEPA or applicable state, provincial or other authority, and does not contain PCBs regulated by TSCA (40 CFR 761) that are prohibited for disposal in a landfill regulated by 40 CFR 257 or 258, or any provincial or other authority, (4) the waste is not a Class I waste as defined and characterized by the Texas Commission on Environmental Quality (§335.505), (5) Generator shall immediately give written notice to IESI of a new or newly discovered material property, characteristic or condition pertaining to the waste not provided herein. Generator shall indemnify IESI and its affiliates against all claims, actions, penalties, liabilities and expenses (including legal expenses) resulting from breach of or misrepresentation under the foregoing warranty and agreement. All warranties and indemnifications herein shall survive any termination of services by IESI or related agreements.

GENERATOR'S AUTHORIZED SIGNATORY:

The undersigned individual warrants that he/she is authorized to sign this document on behalf of the Generator

PRINT NAME: _____ SIGNATURE: _____
 TITLE: _____ COMPANY: _____ DATE: _____
 TELEPHONE: _____ FAX: _____

Waste Profile Name:

Status

Status:

Generator Company

Company:

Address:

City:

Postal code:

Phone:

State/Province:

County:

Generator Site

Site:

Address:

City:

Postal code:

Phone:

State/Province:

County:

Waste Origin

Address:

City:

State/Province:

Postal code:

Landfill

Landfill:

Address:

City:

State/Province:

Postal code:

Phone:

Billing Company

Company:

Address:

City:

Postal code:

Phone:

State/Province:

County:

Billing Site

Site:

Address:

City:

Postal code:

Phone:

State/Province:

County:

Broker/Consultant Company

Company:

Address:

City:

Postal code:

Phone:

State/Province:

County:

Broker/Consultant Site

Site:
Address:
City:
Postal code:
Phone:
State/Province:
County:

Transporter Company

Company:
Address:
City:
Postal code:
Phone:
State/Province:
County:

Transporter Site

Site:
Address:
City:
Postal code:
Phone:
State/Province:
County:

Non Hazardous Determination

EPA Hazardous Waste:
Process Knowledge:
Process Knowledge Details:
Safety Data Sheet:
Certified Analytical:
Is this a representative sample in accordance with 40 CFR 261?
What type of sample is this?:
Sample ID?:
Exempt Waste:
Exempt Waste Item:
Reference to Exemption:
NonHazardous Waste:
NonHazardous Waste Type:
State hazardous material:
Waste Delisted:
Contain PCB:
Is this waste subject to 40 CFR 761?
Is this a remediation project under 40 CFR 761.61(a)?
Has this waste been imported into the USA?
Contain Asbestos:
Asbestos Type:
Produced from benzene transfer or benzene waste operations:
Are you a TSDF:
Does this waste contain Benzene?
What is the flow weighted average concentration? (PPMW)
Facilities total annual benzene quantity:
Is this waste generated from a remediation project?
Benzene concentration in PPWM.
Does the waste contain more than 10% moisture?
Has the material been treated to remove 99% of benzene or to achieve less than 10 PPMW?
Is the waste exempt under 40 CFR 61.342?
Provide Exemption

Is the waste subject to the requirements of 40 CFR 61 Subpart FF?
 Waste contain NORM or TENORM radioactive material:
 Isotopes:
 Waste contain regulated, untreated or infectious medical waste:
 Waste subject to RCRA Organic Air Emissions Standards:
 Waste from a CERCLA site:
 Please submit the Record of Decision:
 Waste produced from a site remediation project:
 Does the waste contain less than 500 PPMW VOHAPS?
 DOT Hazardous:

Waste Description

Waste Description:
 Waste Type:
 Industrial waste:
 How was waste generated:
 Why is this material being disposed?
 Waste been contaminated:
 Contamination Description:
 Waste Constituent:
 Color:
 Physical State:
 pH:
 Odor:
 Material Reactive:
 Flash Point:

Shipping Description

Event Frequency:
 Anticipated Number of Loads:
 Estimated Annual Quantity:
 Unit of Measure:
 Shipping Frequency:
 Quantity Per Shipment:
 Container Type:
 Container Size:

Signature

I hereby certify that all information contained herein is true and correct, and the material described is properly identified, classified, packaged, labeled, and prepared as indicated. I certify that this waste is either (i) not hazardous or dangerous as defined by the U.S. EPA, or the state or province of origin; or (ii) hazardous, special or industrial waste (including friable asbestos) that meets the classification of Class II waste. I certify that this waste does not contain any regulated radioactive materials and does not contain PCB's regulated by TSCA or any other regulatory authority. I certify that all known and suspected hazards have been disclosed. I certify that all samples used for this analysis are representative of the materials described herein. I understand that all wastes may undergo inspection upon arrival at the designated facility and may be refused if the delivered material does not conform to the description herein. Notification will be provided immediately if there is a change in the composition of, or process generating this waste stream, prior to offering the waste for shipment or management.

Print Name:
 Certification Signature:
 Title:
 Company Name:
 Date:

APPENDIX IVC-B
NON HAZARDOUS WASTE MANIFESTS



WASTE CONNECTIONS
Connect with the Future

NON - HAZARDOUS MANIFEST

No. TC 22-51492

TICKET # _____

TONS _____

GALLONS _____

GENERATOR

Generator _____ EPA _____

Address _____ I.D.# _____

Shipping Location(s) _____

Address _____

Phone _____ Phone _____

Description of Waste Materials	State Industrial Waste Code #	WC Profile Number	Total Quantity	Unit of Measure	Container Type

I hereby certify that the above describe material are not hazardous wastes as defined by 40 CFR, Part 261 or any applicable state law or regulation, have been fully and accurately described, classified and packaged, and are in proper condition for transportation according to applicable law and regulations.

Generator Authorized Agent Name (Print) _____ Generator Signature _____ Delivery Date _____

TRANSPORTER

Transporter Name _____ Driver Name (Print) _____

Truck Number _____

Address _____ Truck Type _____

I hereby acknowledge receipt of the above-described materials for transport from the generator shipping location listed above.

I hereby acknowledge receipt of the above-described materials were received from the generator shipping location and were transported without incident to the destination listed below.

Driver Signature _____ Shipment Date _____ Driver Signature _____ Shipment Date _____

DESTINATION

Entity Name Texas Regional Landfill Company, LP Facility Type MSW Type 1 Landfill

Site Location Turkey Creek Landfill State Permit # 1417-C

Address 9100 South I-35W Phone Number 817-790-0311

Alvarado, Texas 76009

Disposal Location: North _____ East _____ Level _____

I hereby acknowledge receipt of the above-described materials.

Name of Authorized Agent (Print) _____ Signature _____ Receipt Date _____

White - Original

Canary - Disposer Retain

Pink - Transporter Retain

Goldenrod - Generator Retain

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417D**

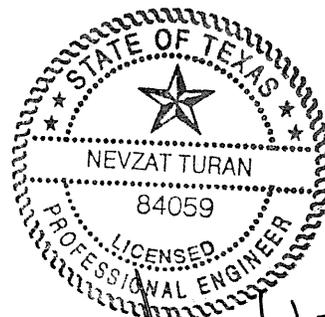
MAJOR PERMIT AMENDMENT APPLICATION

**PART IV – SITE OPERATING PLAN
APPENDIX IVD
WASTE-FOR-BALLAST PLACEMENT RECORD
(Forms may be updated for
future TCEQ revisions.)**

Prepared for

Texas Regional Landfill Company, LP

February 2022



Prepared by

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0771-368-11-123



**Texas Commission on Environmental Quality
Municipal Solid Waste Landfill
Ballast Evaluation Report**

******Read These Instructions Before Completing This Form******

This form is to be completed by a knowledgeable independent third party professional engineer experienced in geotechnical engineering. The engineer must have experience with groundwater level assessment and the analysis, design, and construction of liners placed below the seasonal high groundwater level.

The purpose of the ballast evaluation report is to verify that the liner did not undergo uplift during construction, filling, or operation of the landfill and to document that the ballast meets the Texas Commission on Environmental Quality's (TCEQ) regulatory requirements.

This report is to be supplemented with the groundwater and dewatering data, ballast documentation, and uplift stability calculations as detailed in the Liner Quality Control Plan (LQCP) of the permit Site Development Plan (SDP) and shall be the basis of documentation that the liner did not undergo uplift.

Attach additional sheets as needed, and on each sheet identify the appropriate part and paragraph number for each reference.

(Submit This Report to the TCEQ in Duplicate)



**Texas Commission on Environmental Quality
Municipal Solid Waste Landfill
Ballast Evaluation Report**

Part A: Facility Identification

Permittee: _____

Permit No.: _____ Operational Classification Type: _____

County: _____

Part B: General Information

1. Describe liner system cross-section in bottom, sidewalls, leachate collection trenches, and sumps.

2. Does the SDP require an active or passive dewatering system for this liner system?

3. Which cell, area, or sector does the BER represent? _____

4. Date of the current LQCP that was used to develop this BER? _____

a. Was this plan followed? _____

b. If not followed, why not? _____

5. Dates the certifying engineer and the technician visited the site (other than previously reported in SLER/GLER). _____

Part C: Groundwater and Ballast Data

1. Attach to this report a map(s) of the area under evaluation showing the site grid system and elevation contours of seasonal high groundwater level, liner system, and top of ballast. Also include actual groundwater elevation contours if lower than seasonal high groundwater levels

due to dewatering or other causes if these lower groundwater levels are being used to demonstrate uplift stability during construction or during waste-as-ballast placement.

2. Attach instrumentation data (from piezometers, pneumatic pore pressure cells, etc.) taken during liner construction and since the end of construction or last BER.
3. Attach surveyed elevations of top of ballast. Was all surveying performed under the supervision of a registered surveyor? _____
4. Attach any test or other documentation of unit weights of soil materials used as ballast.
5. If waste was used as ballast, submit Waste-as-Ballast Placement Record (attached) with authorized signature of facility operator or permittee. Does the record indicate that the waste ballast is in accordance with the LQCP? _____

If not, provide explanation. _____

Does the record indicate that a minimum 40,000-pound wheeled compactor was used throughout the period covered by this BER? _____. If not, indicate the following:

Time period covered? _____

Approximate volume of airspace consumed during period? _____

Tons of waste from landfill gate records during period? _____

Approximate percentage of daily/intermediate cover? _____

Unit weight of waste (attach calculations)? _____

(Note: Ballast calculations must not use unit weight of waste greater than 1,200 lbs/yd³).

Part D: Calculations of Uplift Stability

1. Provide calculated factors of safety against uplift for all critical locations in the area covered by this BER (see attached table). The factors of safety must be checked at critical points in the liner system (i.e. at bottom of geomembrane, bottom of compacted clay, etc.). The factors of safety must cover stability using the appropriate piezometric heads after completion of waste-as-ballast placement. Include sample uplift stability calculation(s).
2. Do the analyses conducted in D.1 indicate adequate factors of safety against uplift (1.2 if only soil is used as ballast and 1.5 if waste is used as ballast from the seasonal high groundwater level)?



**Texas Commission on Environmental Quality
Municipal Solid Waste Facility
Waste-As-Ballast Placement Record**

This form is to be completed by the landfill manager or designated representative for all landfilled areas utilizing waste as ballast. One form will be developed for each area (or combination of areas) described by approved liner evaluation reports. This form is to be submitted with the Ballast Evaluation Report (BER) for the evaluated area and may be referenced by the Professional of Record (POR) in order to verify that the placement of ballast is in compliance with the Soils and Liner Quality Control Plan (SLQCP). The site operator must prepare and sign supporting documentation on a daily basis verifying the area of waste placement, the waste material in the first 5 feet of waste was free of brush and large bulky items, daily operation of the pressure relief/dewatering system, and a wheeled trash compactor having a minimum weight of 40,000 pounds was used.

1. General Information

Area documented by this record (provide site grid coordinates of each corner)

Soils and Liner Evaluation Report and Geomembrane Liner Evaluation Report document date(s) and approval date(s) for this area

Date of initial waste placement _____

Date of completion of first 5 feet of waste in place over entire area _____

Total required waste-as-ballast thickness for this area (Note: Calculations for determining the required thickness of waste as ballast are included with the SLQCP/BER for this area.)

Date when minimum required thickness of waste was achieved _____

2. Waste Equipment Used

What type of compaction equipment was used? _____

Did the compactor have a minimum gross weight of 40,000 pounds? _____

Was this compactor used throughout the entire period covered by this record? _____

If a minimum 40,000 pound wheeled trash compactor was not used throughout the period covered by this record, attach documentation of initial and final survey data (if not previously provided as part of the BER) of the ballasted area and measurements of truck

weights at the scale house for the time period covered by the BER for use in determining in-place waste density. Is this documentation complete and accurate? _____

3. First Waste Lift Considerations

Describe type(s) of waste placed in first 5 feet of waste over the top of the liner protective cover _____

Does the first 5 feet of waste contain any brush or large bulky waste items which would damage the underlying liner system or which cannot be compacted to the required density?

4. Waste Compaction Methods

Approximate loose waste layer thickness prior to compaction _____

Minimum number of compactor passes for each waste layer _____

Maximum slope of compacted waste layers _____

5. Pressure Relief/Dewatering System

Was the pressure relief/dewatering system (if required) operated continuously during the period covered by this record? _____

Is the pressure relief/dewatering system presently in operation? _____

Signature of Permittee or Operator

The waste overlying the area described in this record has been placed and compacted as described in this record and in accordance with the Soils and Liner Quality Control Plan and Site Operating Plan

(signature)

(typed or printed name)

(title)

(date signed)

(phone number)

(fax number)

(company or business name)

(address, city, state, zip code)

Note: This completed form must be submitted with the BER and placed in the Operating Record and be available for review.

**TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1417D**

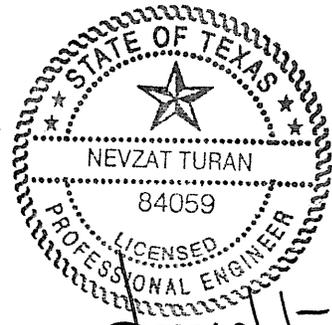
MAJOR PERMIT AMENDMENT APPLICATION

**PART IV – SITE OPERATING PLAN
APPENDIX IVE
LIQUID WASTE SOLIDIFICATION PLAN**

Prepared for

Texas Regional Landfill Company, LP

February 2022



Prepared by

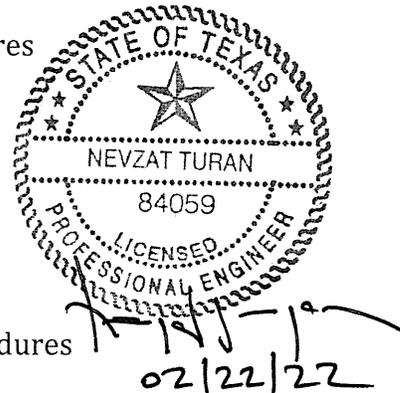
Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Blvd., Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0771-368-11-123

This document intended for permitting purposes only.

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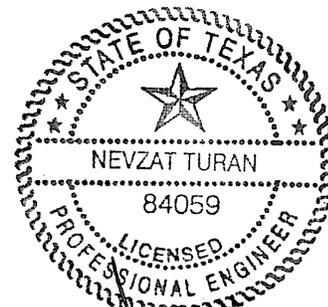
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APPENDIX IVE-1

Liquid Waste Solidification Area Drawings

APPENDIX IVE-2

Evaluation of Adequacy of Liner Separation Distance



[Handwritten Signature]
02/22/22

1 INTRODUCTION

1.1 Terms of Reference

Turkey Creek Landfill is a Type I landfill owned and operated by Texas Regional Landfill Company, LP. This Liquid Waste Solidification Plan (LWSP) provides general instructions for site management and personnel to conduct liquid waste solidification operations in a manner consistent with the design of the facility, and with the Texas Commission on Environmental Quality's (TCEQ) rules to protect human health and the environment. This LWSP has been developed in accordance with the requirements of 30 TAC Chapter 330 Subchapter E of the TCEQ Municipal Solid Waste Management Regulations (MSWMR) "Operational Standards for Solid Waste Storage and Processing Units."

The specific operational procedures outlined in this LWSP have been identified to aid in the solidification operations and in the implementation of this Plan. The LWSP for the facility will be maintained at the site as part of the Site Operating Record in an easily accessible location to allow the site operating personnel to review the LWSP as needed. The Landfill Manager has overall responsibility for the implementation of this LWSP. Wherever this LWSP describes procedures or tasks without naming a specific individual or position responsible for those tasks, the Landfill Manager shall have primary responsibility for those tasks. Where a specific position is responsible for a particular task, that responsibility is described. Otherwise, the Landfill Manager may assign any qualified personnel to accomplish the requirements of this LWSP.

References to the terms "Executive Director" or "TCEQ" used in this LWSP shall include the designated representatives of the Executive Director and TCEQ. References to information in the permit or "permit application" for this facility shall refer to the most current version of these documents, including any amendments, modifications, or revisions as approved.

1.2 Solidification Area Location and Information

1.2.1 Overview

Solidification of liquid wastes will occur on-site at: (1) a "portable/moveable" liquid waste solidification area containing up to three basins and located within the permitted landfill footprint (at the facility's option, located either on existing waste over lined landfill areas, or in future landfill footprint areas that are not yet developed); and/or (2) at a "fixed facility" liquid waste solidification area containing up to four basins. The permitted layout and cross sectional views of the solidification area and features are reproduced in Appendix IVE-1. The existing solidification facility is shown on Figure I/II-3.1 – Existing Site Plan. The facility will need to be relocated as needed to permit the development of the landfill footprint. Prior to relocating the facility, a permit modification will be submitted to TCEQ.

In general, the liquid waste solidification areas will consist of a bulking agent storage area and a solidification area comprised of the mixing basins. The basins will be constructed of concrete, metal, or fiberglass.

The portable/moveable liquid waste solidification area will be located within the limits of the permitted landfill footprint. To further minimize any potential for odor related nuisance conditions, a minimum separation distance of 550 feet will be maintained from the portable/moveable mixing basins to the nearest existing off-site residence located adjacent to the southwest portion of the site.

The estimated maximum weights and load distributions of fully-loaded solidification basins are as follows:

- **Portable/Moveable Facility:** Maximum basin dimensions of 22-foot-long x 8-foot-wide x 8-foot-deep; 1 foot minimum freeboard; estimated maximum percentage of liquid (remainder being solidifying agent) is 75%; estimated maximum unit weight of a sludgy-liquid is 80 lb/ft³ (for reference, water is 62.4 lb/ft³ and soil is typically 100 to 110 lb/ft³); estimated maximum unit weight of a solidifying agent (fly ash is the most dense) is 130 lb/ft³. Resulting fully-loaded weight of the basin contents is 57 tons. Resulting distributed load over the bottom of the basin is 4.5 psi.
- **Fixed Facility:** Maximum basin dimensions of 60-foot-long x 20-foot-wide x 12-foot deep; 1 foot minimum freeboard; estimated maximum percentage of liquid (remainder being solidifying agent) is 75%; estimated maximum unit weight of a sludgy-liquid 80 lb/ft³ (for reference, water is 62.4 lb/ft³ and soil is typically 100 to 110 lb/ft³); estimated maximum unit weight of a solidifying agent (fly ash is the most dense) 130 lb/ft³. Resulting fully-loaded weight of the basin contents is 610 tons. Resulting distributed load over the bottom of the basin is 7.1 psi.

As shown on the figures in Appendix IVE-1 of this plan, when/if the portable/moveable facility is located on waste (i.e., over lined landfill areas), a minimum 10-foot separation distance will be maintained between the basins (and operating equipment/vehicles) and the top of landfill liner. An evaluation of the adequacy of this minimum liner separation distance is provided in Appendix IVE-2.

1.2.2 Secondary Containment System Design

As further protection, the solidification basins for both the fixed facility and portable/moveable facility will be underlain by a secondary containment system composed of a composite liner system. The components, specifications, and quality control/quality assurance (QA/QC) requirements for the secondary containment system are addressed on the figures in Appendix IVE-1.

1.2.3 Fixed Facility Leak Detection System

The fixed facility operations will allow for possible temporary storage of liquid waste in the basins as it is awaiting solidification (as discussed in Section 5.1 of this plan). Accordingly, the fixed facility will have a leak detection system located above the secondary containment composite liner. In summary, a drainage layer above the secondary containment liner will collect and convey potential leakage from the basins to a sump at the low point of the contained area. There, a standpipe (riser pipe) with perforations at the bottom will be used as an access point to monitor for the presence of liquid. Liquid levels in the leak detection sump will be measured on a weekly basis. Accumulated liquid will be withdrawn using a pump inserted into the sump through the riser pipe to maintain a hydraulic head of less than 1 foot on the secondary containment liner. It should be recognized that accumulated liquid in the leak detection layer is not necessarily due to basin leakage, as it could also be from clean sources such as consolidation and drainage of water within the pore space of soils surrounding the basins. The trends of accumulated leak detection system liquid quantities over time along with analytical data or inspection of basins for defects, holes, or damage, may be used to identify potential sources of the liquid. Notwithstanding, the leak detection liquid will be managed in accordance with Section 4 of this plan.

2 PERSONNEL AND TRAINING

Site personnel and training requirements are discussed in Sections 2.1 and 2.2, respectively, of the Site Operating Plan (SOP). When needed, the Landfill Manager will assign Equipment Operators, Mechanics, and other personnel to the liquid waste solidification area, to conduct operations in accordance with this plan.

3 WASTE ACCEPTANCE AND ANALYSIS

3.1 Properties and Characteristics of Waste

Only liquid waste streams authorized by the facility permit for disposal (once solidified) and meeting applicable acceptance criteria will be accepted for solidification (unless otherwise authorized by rule, permit, order, or other approval of the TCEQ). The liquid wastes that are special wastes will be subject to the acceptance procedures and criteria described in Appendix IVC (Special Waste Acceptance Plan (SWAP)) of the SOP. Subject to the foregoing, liquid waste streams that may be accepted for solidification are:

- those specified in Title 30 TAC §§ 330.11(d) and 330.171(c)(7), including sludge, grease trap waste, grit trap waste, septage, or liquid wastes from municipal sources; and
- non-hazardous industrial wastes including Class 1 and 2 liquid wastes, non-hazardous Texas Railroad Commission-regulated oil and gas wastes¹, wastes that are not classified as bulk liquids but do not pass the paint filter test, and other non-hazardous bulk liquids.

¹ These may include drilling muds, fluids and cuttings; well completion, treatment and stimulation fluids; fractionation and produced sands; packing fluids; workover fluids; blowdown materials; rig wash; rinsate from tanks, trucks and drums (primary field operations and haulers); water treatment backwash solids; pigging wastes from gathering lines (primary field operations); contaminated soils (primary field operations); and other wastes generated from a material or process uniquely associated with the exploration, development or production of crude oil or natural gas, and authorized for management at a MSW landfill pursuant to applicable Railroad Commission of Texas and TCEQ memoranda of understanding and regulations.

As described in the SWAP, the liquid wastes will be pre-characterized by the generator to verify that the waste is non-hazardous. Liquid waste that is not pre-characterized or does not have the proper manifest(s), will not be accepted at the facility until such pre-characterization is approved and/or a proper manifest is completed. Regulated hazardous wastes that require authorization under Title 30 TAC Chapter 335 will not be accepted at the site.

Analyses for wastes, including sludges, will be conducted in accordance with Section 3.2 of the SWAP. Records of each analysis will be maintained at the facility for a minimum of three years. Sampling and analysis done by the generator will be done according to EPA-approved methods.

3.2 Volume and Rate of Transfer

Over time the facility estimates it may receive approximately 11,000,000 gallons of liquid waste per year. This is equivalent to approximately 39,000 gallons per day based on the typical 286 working-day year. This quantity is based on market projections, and is not intended as a limiting value; the actual daily and annual quantity of liquid waste may be more or significantly less than this estimated quantity. The solidification basins and their maximum dimensions are shown in Appendix IVE-1, and the general layout of the solidification area was developed consistent with these quantity expectations.

3.3 Waste Processing Operations

The solidification of liquid wastes will be accomplished by mixing and processing the liquid with a solidifying agent(s). In general, liquid waste trucks will discharge their waste directly into the solidification basins. It is noted that the portable/moveable facility may be equipped with "frac tanks" as shown on Drawings 1 and 2 of Appendix IVE-1, to temporarily store liquid waste; and if so, the liquid waste trucks would discharge their waste into the frac tanks and it would then be subsequently transferred to the basins for solidification. Mixing will be accomplished using a backhoe or other appropriate machinery to combine the solidifying agent(s) with the liquid waste.

After mixing, each batch of solidified material will be tested for free liquids in accordance with Method 9095 (Paint Filter Liquids Test), as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Method" (EPA Publication Number SW-846), as amended. Upon verification that the solidified material passes the paint filter test, the mixture will be removed from the basin and transported to the landfill working face for disposal. In the event the solidified liquid does not pass the paint filter test, additional solidifying agent(s) will be added and mixed until the desired solidification is achieved.

At least once per month, each basin will be inspected for holes or other signs of damage, and if found, the basin will not be used until repairs are made. The inspection will be made by emptying each basin and visually inspecting the side walls and floor.

3.4 Solidification Agents

Acceptable solidification agents include fly ash, lime, kiln dust, sawdust, foundry dust, uncontaminated soils, mechanical shredder fluff, shredded paper, wood chips, crushed cement/wood fiber wallboard, or other nonhazardous materials with

similar properties. Also, contaminated soils and other suitable special and industrial wastes allowed for receipt by the facility's SWAP (Appendix IVC of the SOP) may be used as the solidifying agent. Solidification agents will be stored in close proximity to the liquid waste solidification basins as shown on Drawings 1 and 3 in Appendix IVE-1 of this plan, with the exception of solidification agents that are classified as contaminated soil or special/industrial wastes. Solidification agents that are classified as contaminated soil or special/industrial waste, if used, will be directly added to the basins as part of the solidification process. Other waste materials used as solidification agents will be subject to the storage requirements presented in Section 5.1 of this plan. The following is a brief description of selected solidification agents that are commonly used. Additional agents may be used, provided they may otherwise be accepted for disposal and their physical properties aid in the solidification process.

Crushed Cement/Wood Fiber Wallboard

Crushed cement/wood fiber wallboard is a fibrous cement board used in construction (i.e., siding, shingles, etc.). When crushed, it is very effective in solidifying many types of liquid waste.

Lime

Lime is a grayish-white powder, often called quicklime. It is obtained by heating (calcining) limestone and releasing carbon dioxide from the calcium carbonate. Lime has been used in similar processes for many years and is very effective in solidifying many types of liquid waste.

Fly Ash

Fly ash is the particulate matter collected in air pollution control equipment used for cleaning flue gas from burning pulverized coal. Fly ash has been widely used and is very effective in solidifying many types of liquid waste.

Kiln Dust

Kiln dust is the particulate matter collected in air pollution control equipment used for cleaning exhaust gases from kilns in the manufacture of cement. It is very effective in solidifying many types of liquid waste.

Foundry Dust

Foundry dust is the particulate matter collected in air pollution control equipment used for cleaning exhaust gases from the casting of metals in a foundry. It is very effective in solidifying many types of liquid waste. Foundry dust mixing ratios vary greatly depending on the foundry process.

Sawdust

Woodworking machines produce large quantities of sawdust. The particulate matter that is removed from the air exhaust systems for these machines can be used to solidify many types of liquid waste.

Wood Chips

Wood chips are produced through the grinding and chipping of wood material such as trees, stumps, and clean wood products. It has been effective in solidifying liquids.

Mechanical Shredder Fluff

Mechanical shredder fluff (MSF) consists of the residual light fraction of shredder residue and may contain fibrous textiles, polyurethane foams, plastics, rubber, and a wide variety of light metal content. The facility will require the MSF generator to submit waste profile information in accordance with Section 3.2 of the SWAP. Only MSF that has been classified by the generator as being non-hazardous may be accepted as a solidification agent for the solidification area.

3.5 Waste Disposal

As discussed earlier, the solidified material will be tested for free liquids in accordance with the paint filter test. After passing the paint filter test, the solidified waste will be disposed of at the working face of the landfill.

4 CONTAMINATED WATER MANAGEMENT

The facility will take the steps necessary to control and prevent the discharge of contaminated water from the liquid waste solidification area. Liquids associated with the solidification process will be managed and disposed of in a manner that will not cause surface water or groundwater pollution. Water coming in contact with waste will be treated as contaminated water. Runon and runoff for the 25-year, 24-hour storm event will be controlled following the procedures set forth in the approved SDP. In general, surface water will be directed away from the mixing basins by site grading. Furthermore, the liquid waste solidification area will be operated in accordance with Title 30 TAC §330.15(h) regarding discharge of solid wastes or pollutants into waters of the United States.

For the moveable/portable facility, as shown in Appendix IVE-1, the area will be surrounded by earthen berms. Also, Drawing 1 shows that the portable/moveable facility may use frac tanks for storage of liquid awaiting solidification. Up to two frac tanks, each with a nominal 21,000-gallon capacity, may be used. As shown on Drawing 1, the frac-tanks will have their own contained area with helms and a secondary containment liner. The lined secondary containment area around the frac tanks shall provide at least 10% greater containment capacity than the combined capacities of the frac tanks, while also providing a 1-foot minimum freeboard below the top of the lined containment berms.

For the fixed facility, the solidification of liquid waste will take place under the cover of the liquid waste solidification building. Therefore, little if any mixing of precipitation water with the liquid waste will occur. The concrete floor within the building will be sloped to drain into the mixing basins. Furthermore, for the fixed facility, the ground surface at the truck unloading area adjacent to the basin will have curbs/road humps to serve as storm water containment and runon/run off diversion, and the surface within this contained area will be graded to drain stormwater runoff towards the basins, where this runoff will typically be solidified along with the contents of the basin.

Storm-water runoff that has come in contact with waste and wash water must be either solidified along with the waste contents of the basin or handled as contaminated water in accordance with the provisions of the facility Leachate and Contaminated Water Management Plan (Part III, Appendix IIIC).

In addition, as previously described in Section 1.2 of this plan, the solidification basins will be underlain by a secondary containment system. Also, the fixed facility will allow for possible temporary storage of liquid waste in the basins as it is awaiting solidification (as discussed in Section 5.1 of this plan). Accordingly, the fixed facility will have a leak detection system located above the secondary containment composite liner. Liquid withdrawn from the leak detection system will also be either solidified as liquid waste, or handled as contaminated water in accordance with the provisions of the facility Leachate and Contaminated Water Management Plan (Part III, Appendix IIIC).

5 STORAGE REQUIREMENTS

5.1 Waste Storage

The facility will not accumulate waste in quantities that cannot be solidified within such time as will preclude the creation of odors, insect breeding, or harborage of other vectors, and as set forth below. Care shall be taken such that the storing of waste does not constitute a fire, safety, or health hazard or provide food or harborage for animals and vectors. Regarding liquid waste storage, the following requirements shall apply:

- Portable/Moveable Facility: Liquid waste will not be stored in the portable/moveable liquid waste basins. Liquid waste in these basins will be solidified and emptied from the basins on the same day it is received. The basins will be constructed of concrete, metal or fiberglass. The portable/moveable facility may use frac tanks (fully-enclosed, sealed metal liquid storage tanks located above ground and commonly used in industrial settings to hold liquids) for storage of liquid awaiting solidification. Up to 6 frac tanks, each with a nominal 21,000-gallon capacity, may be used. The frac-tanks will have their own secondary containment liner as protection against spills or leaks from the above-ground frac tanks. The maximum time liquid waste material will be stored in a frac tank at the portable/moveable facility will not exceed 72 hours.
- Fixed Facility: The maximum time liquid waste material will be stored in the basins at the fixed facility liquid waste solidification area will not exceed 72 hours. If such accumulations occur, additional liquid waste materials will not be received until the conditions are abated.

5.2 Approved Containers

Liquid waste entering the facility is typically transported in vacuum trucks, tanker trucks, and sealed containers. These trucks are designed to prevent spillage or leakage during storage, handling, or transport. For the portable/moveable facility the liquid waste may be temporarily stored in frac tanks, which are sealed containers specifically designed to hold liquids without spillage or leakage. The solidification basins themselves will be recessed below grade, and may consist of: (1) concrete basins; (2) metallic-lined basins such as steel boxes or roll-off

containers; or (3) fiberglass basins. The solidification basins will be equipped with lids or tarps that will cover the basins when it holds liquid waste prior to solidification and during down time. The solidification basins will be maintained in a manner so that they do not constitute a nuisance and to retard the harborage, feeding, and propagation of vectors.

6 RECORDKEEPING AND REPORTING REQUIREMENTS

The Site Operating Record will be kept on site to document key operating and construction items as required by the TCEQ, will be made available to the Executive Director upon request, and will be accessible for inspection during normal operating hours. A complete list of documents that need to be included in the Site Operating Record is provided in Section 9 of the SOP. In addition to the information listed in Section 9 of the SOP, the following information will also be maintained in the Site Operating Record specific to the liquid solidification process.

Records to be Maintained in the Site Operating Record ¹	Frequency
As-built construction drawings for the Liquid Waste Solidification Area	As needed
Additional analytical testing performed at the facility to verify compliance with this plan.	As needed

¹ In addition to the information provided in Section 9 of the SOP.

7 FIRE PREVENTION PROCEDURES

7.1 Fire Prevention Procedures

With regard to the liquid waste solidification operations, the following steps will be taken regularly by designated site personnel to prevent fires. These steps apply to both the fixed facility and the portable/moveable facility. Please see Section 7 of the SOP for additional fire prevention procedures at the facility.

- No unauthorized burning of liquid or solidified waste will be permitted at this site.
- Equipment used at the liquid waste solidification area will be routinely cleaned using water or steam cleaners to reduce possible fire hazard. The water or steam cleaning will remove any combustible waste or caked material which can cause equipment overheating and increase fire potential. As previously noted, wash water will be directed to the solidification basins and solidified or managed as contaminated water in accordance with the Leachate and Contaminated Water Management Plan (Appendix IIIC).
- Fuels will be stored and dispensed only in authorized areas. Efforts will be made to contain and control fuel spills immediately upon discovery.
- Smoking is allowed only in designated areas. Smoking is specifically prohibited at fuel storage and dispensing areas.
- "No Smoking" signs will be posted at appropriate locations.
- The emergency telephone contact numbers for the Turkey Creek Landfill will be posted at the front gate.
- The solidification area will be equipped with fire extinguishers of a type, size, location, and number as recommended by the local fire department. Each fire extinguisher will be fully-charged and ready for use at all times. Each extinguisher will be inspected on an annual basis and recharged as necessary. These inspections will be performed by a qualified service company, and all extinguishers will display a current inspection tag. Inspection and recharging will be performed following each use. At a minimum, each building and applicable equipment will have fire extinguishers.

7.2 General Rules for Fires

The following rules will be implemented in the event of a fire at the liquid waste solidification area. Section 7 of the SOP describes additional fire safety rules.

- Contact the local Fire Department by calling 911.
- Notify the Landfill Manager and alert other facility personnel.
- Assess the extent of the fire and potential for the fire to spread.
- If safe, attempt to contain or extinguish the fire until the local fire department arrives.
- Assist the local fire department as appropriate.
- Do not attempt to fight the fire alone.
- Do not attempt to fight the fire without adequate personal protective equipment.
- Be familiar with the use and limitations of firefighting equipment available onsite.
- Firefighting methods include spraying the burning material with water from the hose. If detected soon enough, a small fire may be fought with a hand-held fire extinguisher.
- Notify TCEQ's Regional Office in accordance with the timeframe specified in Section 7.10 of the SOP.

7.3 Specific Fire-Fighting Procedures

The following procedures will be followed in the event of a fire.

- If a fire occurs on solidification area equipment or a vehicle, the operator will attempt to bring the unit to a stop away from fuel areas, exposed waste material and other equipment or vehicles. If possible, the operator will shut off the engine and set the brake. Fire suppression may be achieved by fire suppression equipment installed on some equipment or by trained personnel that will attempt to extinguish the fire using fire extinguishers or water. If the fire cannot be extinguished using the above methods, the local fire department will be contacted immediately at 911. Facility personnel will use reasonable measures to contain the fire until the fire department arrives
- If a fire is on the solidification area ground surface/floor, the burning area should be (1) extinguished with a fire extinguisher; (2) sprayed with water from the water truck; or (3) smothered with soil.

7.4 Fire Protection Training

Key facility personnel, (not including personnel with administrative duties only) will receive annual training in fire protection and fire fighting as described in Section 7 - Fire Protection Plan of the SOP.

8 OPERATIONAL PROCEDURES

8.1 Access Control

8.1.1 Security

Security at the solidification area will be accomplished in accordance with Section 4.1.1 of the SOP. The site is accessed through an entry gate at the main entrance. With the exception of customers, the facility restricts entry to the landfill to designated personnel only (e.g., facility personnel, authorized waste disposal vehicles, TCEQ personnel, properly identified visitors, appropriate subcontractors, etc.). Visitors entering the site are directed to the landfill office location.

8.1.2 Traffic Control

Section 4.1.2 of the SOP describes general description of the traffic control procedures at the facility. Scale House Attendant(s) will direct waste transport drivers to the proper disposal area. Additionally, when appropriate, signs with directional arrows and/or barricades may be placed along site roads to direct traffic and control interior access. These vehicles will deposit their loads within the facility and depart the site. Roads not being used for access will be blocked or otherwise marked for no entry.

During normal operating hours, facility personnel will be on duty at the scale house and in the vicinity of landfill operations to control access and disposal operations. When the site is closed, the entry gate will be closed to prevent site access, and locked when no personnel are present on site.

8.2 Unloading of Waste

8.2.1 Waste Unloading Procedures

Section 4.2.3 of the SOP describes the general waste unloading procedures at the facility. As discussed in the SOP, incoming liquid waste transport vehicles will be directed to the liquid waste solidification area by the Scale House Attendant once the vehicle's incoming weight has been recorded. Personnel working at the liquid waste solidification area will inspect the load and direct the transport vehicle to the

proper solidification basin. The unloading of waste will be directed by personnel working at the liquid waste solidification area.

Prohibited waste will not be allowed to enter the site. All waste loads will be visually inspected and accompanied by a generator waste profile sheet or other appropriate documentation prior to being approved to unload. In the event prohibited wastes are identified in the load, the entire load may be turned away from the gate and not allowed entrance to the facility or may otherwise be processed in accordance with Section 7 of the SWAP.

Unloading of waste in unauthorized areas will be prohibited. Any waste which is identified as having been deposited in an unauthorized area will be immediately contained and moved to the appropriate unloading area.

8.2.2 Procedures for the Detection and Prevention of Hazardous and PCB Waste

Procedures for the detection and prevention of the disposal of regulated hazardous waste as defined in 40 CFR Part 261 and polychlorinated biphenyl (PCB) wastes as defined in 40 CFR Part 761 are provided in Section 7 of the SWAP.

Visual inspections of incoming liquid waste will be conducted at a location where containment is provided and/or potential spills of unauthorized waste would be minimized.

Vehicles containing suspicious loads will be inspected. Suspicious loads may include:

- Drums or containers with warning labels
- Loads which have a visible emission, smoke, strong chemical odor, or cause physical symptoms (e.g., irritation of eyes, nose, throat, skin, nausea, dizziness, or headache)

The inspector will not inspect any vehicle that appears to present possible physical danger. The Landfill Manager or his designee shall be contacted immediately if such a load enters the facility.

The inspections shall be conducted in a manner that allows the inspector to view all contents of the waste load. The inspector shall make an effort to view as much of the waste load as possible. In some cases, liquid waste loads may be unloaded into a solidification basin in order to visually inspect the contents of the load. The inspections will be conducted in an expeditious manner to minimize disruption to normal operations.

8.3 Spill Prevention and Control

The liquid waste solidification area has been designed to control and contain spills and contaminated water. Section 4 of this plan provides a more detailed description of the contaminated water management procedures. For incidental liquid waste spills, the spill will be contained and cleaned up using oil dry, absorbent pads, or other available materials at the direction of the Landfill Manager or his designee. For larger spills, the Landfill Manager or his designee will use mechanisms such as booms or diversionary dikes, or excavate holes or pits as needed to contain the spilled liquid. Once the liquids are removed to the solidification basin(s), a visual inspection of the spill area will be made, and soils observed to be potentially impacted will be over-excavated and brought to the appropriate disposal area.

8.4 Operating Hours

The liquid waste solidification area may operate during the operating hours of the facility (refer to Section 4.3 of the SOP).

8.5 Facility Sign

Facility signs will be placed in accordance with the facility's approved Site Operating Plan (refer to Section 4.4 of the SOP).

8.6 Control of Windblown Material and Litter

The liquid waste solidification area will be operated in such a way as to minimize windblown material, using the measures described below:

- Solidifying agents may be stored in either concrete bunkers, enclosed silos, under a roof structure, in woven super sacks, or on a prepared hard surface area. Solidifying agents will also be stored in close proximity to the liquid waste solidification basins as shown on Figures 1 and 3 provided in Exhibit A of this plan.
- The solidification basins will be recessed below grade, which will help protect the mixing operation from wind and resulting potential for windblown waste.

8.7 Materials Along the Route to the Facility

The control of waste along the route to the facility is described in Section 4.8 of the SOP.

8.8 Facility Access Roads

The facility has an existing paved entrance road from the Interstate Highway 35 West service road. The on-site access road to the liquid waste solidification area will be an all-weather surface that provides for all weather access. On wet weather days, rough gravel surfacing on the all-weather access road will help to reduce the amount of mud tracked from the disposal area by shaking and dislodging mud from vehicle tires and frame as they exit the disposal area. During dry weather, the facility will control dust from becoming a nuisance by watering site roads using the water truck and/or sweeping the roads.

8.9 Noise Pollution and Visual Screening

The solidification of liquid waste will be conducted inside the liquid waste solidification area. The portable/moveable facility will have earthen containment berms surrounding the area to help screen the operations and minimize adverse visual and noise impacts. The fixed facility will have an earthen stormwater diversion berm and the solidification activities will be performed within the building, both of which will screen the operations and minimize adverse visual and noise impacts.

8.10 Overloading and Breakdown

In the event that equipment of critical importance breaks down or is otherwise unavailable, equipment with equivalent performance that is performing a non-critical function may be temporarily reassigned to the critical function until the primary equipment is repaired. The site will limit the receiving of liquid wastes when a significant work stoppage occurs. Under such circumstances, incoming liquid waste shall be diverted. If the work stoppage is anticipated to last long enough to create objectionable odors, insect breeding, or harborage of vectors, steps shall be taken to remove the accumulated waste materials from the liquid waste solidification area to an approved permitted offsite disposal facility.

8.11 Sanitation

When in use, the solidification basins will be washed down on a weekly basis at the completion of processing. During times when the solidification area is operating on a continuous basis, the liquid waste solidification area will be washed down at least two times per week. Wash water will drain to the mixing basin and be solidified with the liquid waste material or removed from the mixing basins and managed in accordance with the Leachate and Contaminated Water Plan (Appendix IIIC).

8.12 Ventilation and Air Pollution Control

No significant air pollution emissions are expected to result from the operation of the solidification area. The liquid waste solidification operation is covered under the Turkey Creek Landfill facility's Standard Air Permit. Excessive dust and particulates associated with the solidification operations will be controlled by covering the solidification agents and also using water sprays, mist systems, or other similar methods. The portable/moveable facility will have natural ventilation to the atmosphere. The fixed facility will have a building which will be designed to provide ventilation sufficient to meet building code requirements addressing buildup of vehicle emissions inside the building.

The solidification area will be designed and operated to provide adequate ventilation for odor control and employee safety. The operator will prevent nuisance odors from leaving the boundary of the facility. If nuisance odors are found to be passing the facility boundary, the site will immediately take action to abate the nuisance, for example, by promptly solidifying and disposing of the odorous material.

8.13 Health and Safety

Training requirements of site personnel are discussed in Section 2.2 of the SOP. This includes training on health and safety topics.

8.14 Employee Sanitation Facilities

Potable water and sanitary facilities are provided for all employees and visitors within the landfill office and scale house. Additional facilities may be added to the waste solidification area for the convenience of site personnel and visitors.

9 SOLIDIFICATION AREA CLOSURE

9.1 Closure Activities

Upon closure of the solidification area, any remaining waste will be solidified and transported to the landfill for disposal. The solidification area will be washed down, and the wash waters shall be collected and disposed of in an authorized manner. All solidifying agents and equipment will be removed from the site.

The mixing basins will be removed, disassembled or crushed as necessary, and disposed of in the landfill. Any soil below the basins that is visually stained will be excavated and disposed of in the landfill. The excavated area will be backfilled with clean material. Alternatively, the fixed facility basins may be filled with clean, inert material to grade level and secured. If the building is to remain in place, the building will be secured.

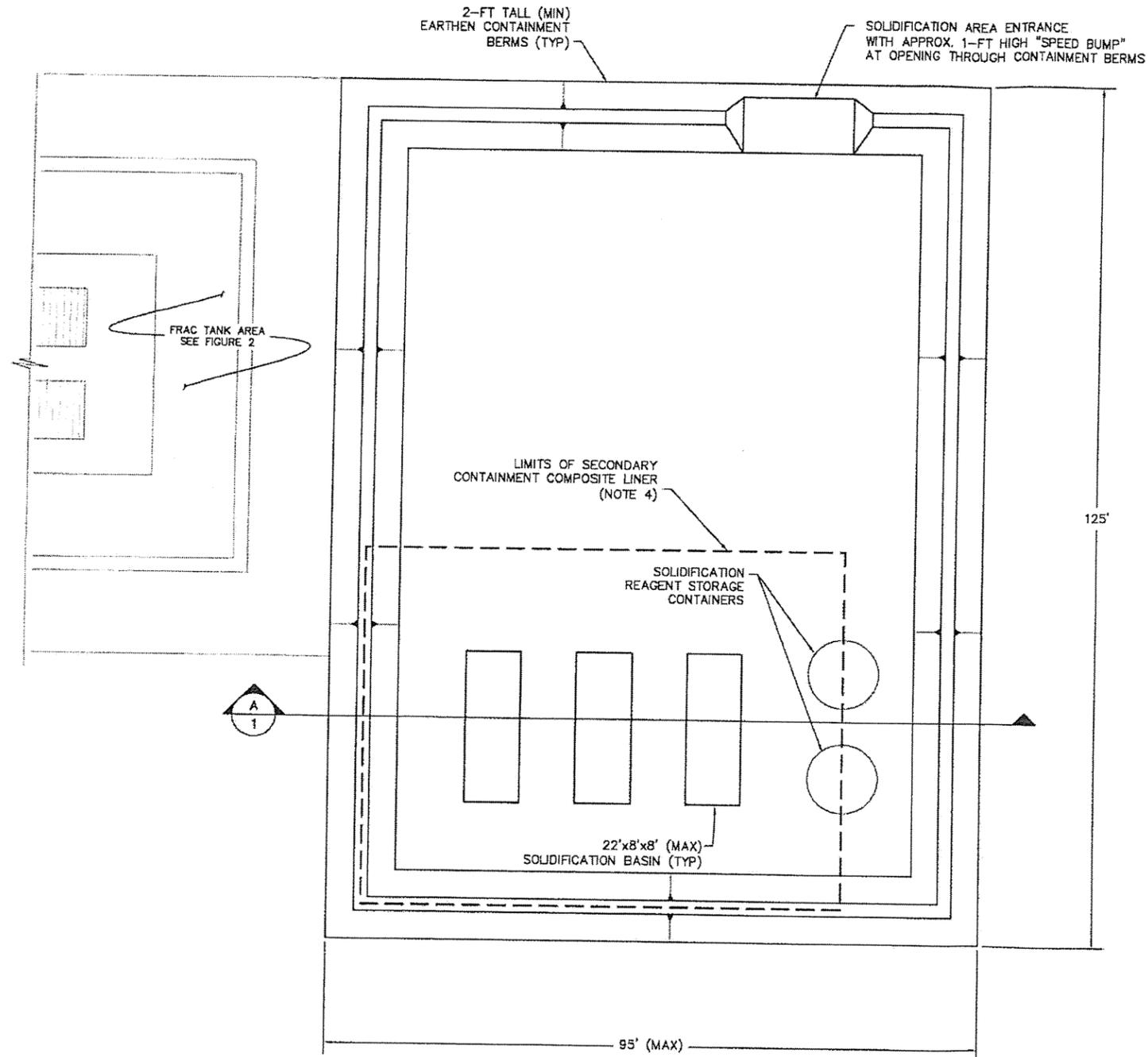
9.2 Closure Cost Estimate

A cost estimate to perform the closure activities has been prepared, and is provided in Appendix III.L of the Site Development Plan ("Closure and Postclosure Care Cost Estimate"). Specifically, the liquid waste solidification facility closure cost estimate is provided in Table 1A of Appendix III.L.

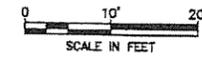
APPENDIX IVE-1

LIQUID WASTE SOLIDIFICATION AREA DRAWINGS

P:\CAD\Projects\Turkey Creek LF\Permit\MOD Solid Facility & Class 1 (TXL0201)\Dwg-Rev0\Facility-Portable.dwg



PLAN
PORTABLE / MOVEABLE LIQUID WASTE
SOLIDIFICATION AREA
SCALE: 1" = 20'



REV	DATE	DESCRIPTION	OWN BY	DES BY	CHK BY	APP BY
1	APR 2012		JLV	MZI	SMC	SMC

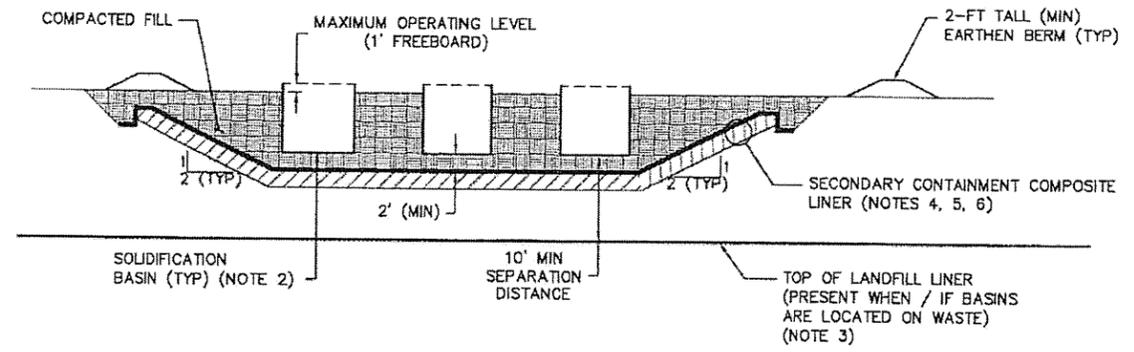
Geosyntec
consultants
GEOSYNTEC CONSULTANTS, INC.
TEXAS FIRM REGISTRATION NUMBER 1182
3600 BEE CAVES ROAD, SUITE 101
AUSTIN, TEXAS 78746
PHONE: 512.451.4003

IESI TX LANDFILL, LP

LIQUID WASTE SOLIDIFICATION
"PORTABLE / MOVEABLE FACILITY" AREA
LAYOUT PLAN
TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS

FIGURE
1

- NOTES:
1. PORTABLE / MOVEABLE LIQUID WASTE SOLIDIFICATION AREA SHALL BE LOCATED WITHIN THE LIMITS OF THE PERMITTED LANDFILL FOOTPRINT (EITHER ON WASTE OVER EXISTING LINED AREAS, OR ON FUTURE LANDFILL FOOTPRINT NOT YET CONSTRUCTED, AT THE FACILITY'S DISCRETION).
 2. SOLIDIFICATION BASINS FOR PORTABLE / MOVEABLE FACILITY SHALL BE METALLIC, CONCRETE, OR FIBERGLASS BOX-SHAPED CONTAINERS WITH SEALED WALLS AND BOTTOM AND AN OPEN TOP, AND RECESSED BELOW GRADE AS SHOWN.
 3. IF PORTABLE / MOVEABLE AREA IS LOCATED ON WASTE, THERE SHALL BE A 10-FT (MIN) SEPARATION DISTANCE FROM THE BASINS (AND ALL OPERATING EQUIPMENT AND VEHICLES) TO THE TOP OF LANDFILL LINER.
 4. SECONDARY CONTAINMENT COMPOSITE LINER SHALL BE COMPOSED OF A 60-MIL HDPE GEOMEMBRANE PLACED ON EITHER A 2-FT THICK RECOMPACTED SOIL LINER ($k \leq 1 \times 10^{-7}$ cm/s), OR ON A GEOSYNTHETIC CLAY LINER (GCL).
 5. THE GEOMEMBRANE AND RECOMPACTED SOIL LINER MATERIAL SPECIFICATIONS, CONSTRUCTION REQUIREMENTS, AND QUALITY ASSURANCE / QUALITY CONTROL (QA/QC) REQUIREMENTS SHALL BE IN ACCORDANCE WITH THE FACILITY SOIL AND LINER QUALITY CONTROL PLAN (SLOCP) PRESENTED IN THE SITE DEVELOPMENT PLAN.
 6. IF A GCL IS USED INSTEAD OF THE RECOMPACTED SOIL LINER, THE GCL MATERIAL, CONSTRUCTION, AND QA/QC REQUIREMENT SHALL BE AS SET FORTH IN EXHIBIT C OF THE LIQUID WASTE SOLIDIFICATION PLAN.



A
1 SECTION
PORTABLE / MOVEABLE LIQUID WASTE
SOLIDIFICATION AREA
SCALE: 1" = 20'

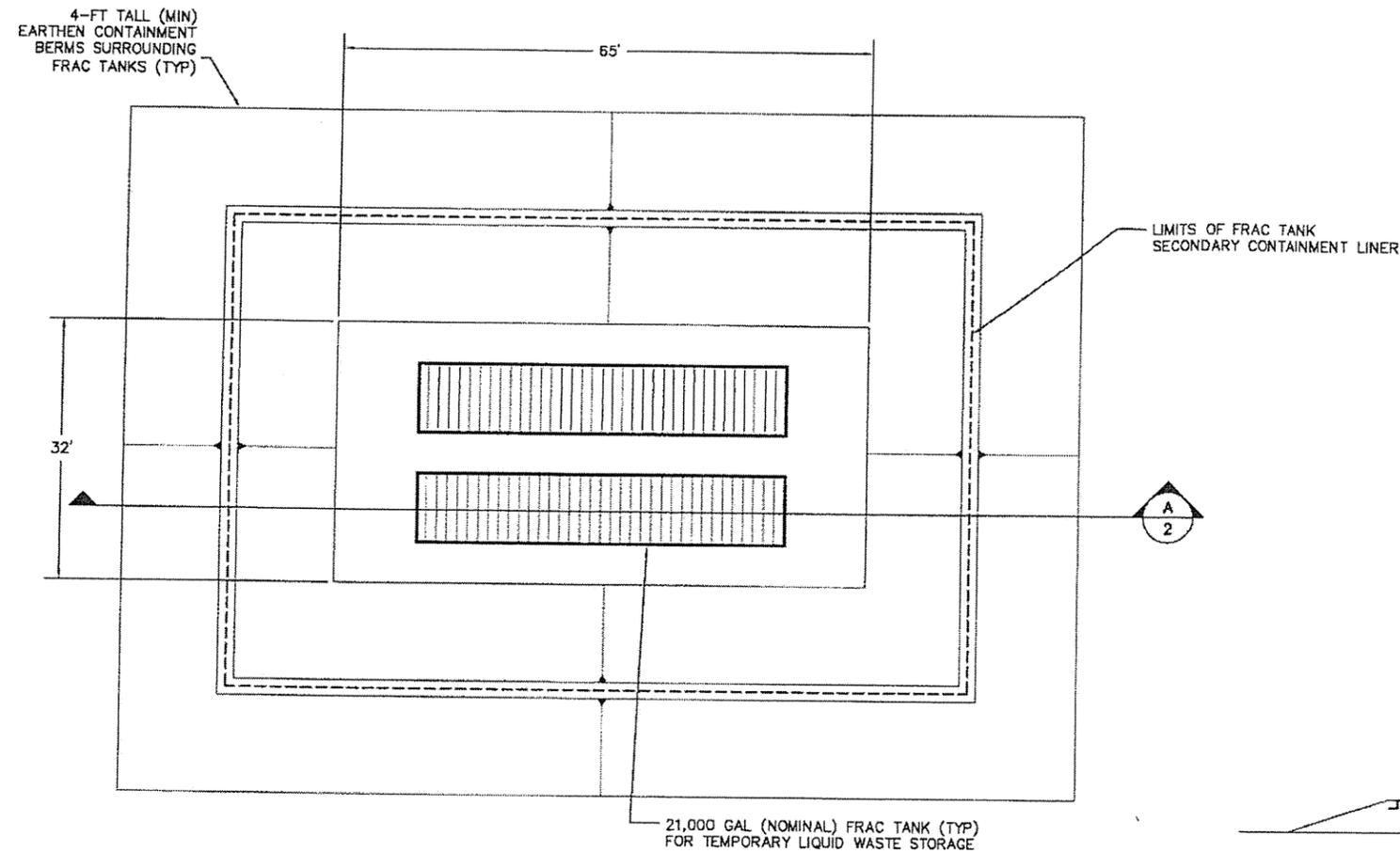
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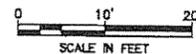
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PLAN
 PORTABLE / MOVEABLE LIQUID WASTE
 SOLIDIFICATION FRAC TANK AREA (NOTE 1)
 SCALE: 1" = 20'



REV	DATE	DESCRIPTION	OWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE	DWN BY	CHK BY	DES BY
MAY 2012	JLV	SMC	MZI

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LIQUID WASTE SOLIDIFICATION
 "PORTABLE / MOVEABLE FACILITY" AREA
 FRAC TANK LOCATION
 TURKEY CREEK LANDFILL
 JOHNSON COUNTY, TEXAS

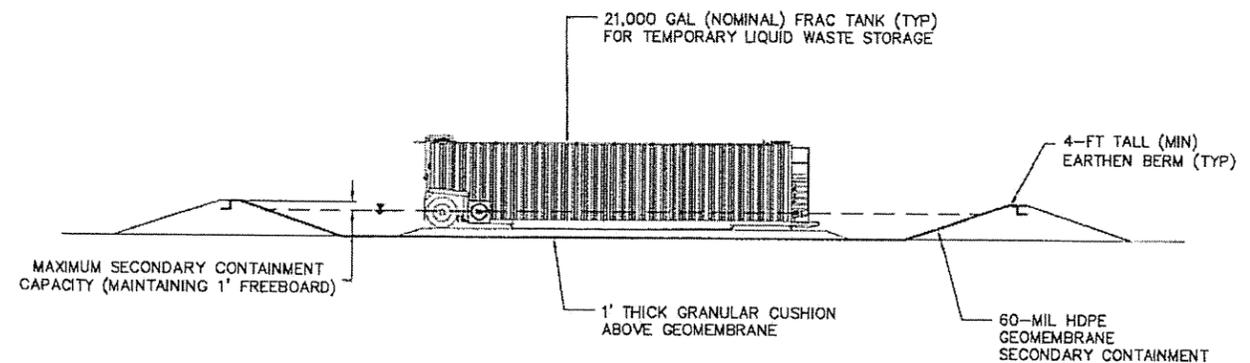
FIGURE
 2

NOTE:

1. SECONDARY CONTAINMENT LINER CONFIGURATION SHALL PROVIDE CONTAINMENT CAPACITY OF AT LEAST 110% OF THE HOLDING CAPACITY OF THE LIQUID STORAGE FRAC TANKS, WITH AT LEAST 1-FT OF FREEBOARD. AS DRAWN, CONTAINMENT CAPACITY IS CALCULATED AS FOLLOWS:

CONTAINMENT CAPACITY CALCULATION:

- WORST-CASE SPILL/RELEASE: CONSERVATIVELY ASSUME BOTH TANKS ARE FULL AND SIMULTANEOUSLY DEVELOP A LEAK AT THE BASE OF THEIR TANKS. 2 x 21,000 GALLONS = 42,000 GALLONS
- FOR ADDED MARGIN OF SAFETY, REQUIRED MINIMUM CONTAINMENT CAPACITY AT 110% CAPACITY OF TANKS = 46,200 GALLONS.
- CALCULATE ACTUAL CONTAINMENT CAPACITY BELOW THE FREEBOARD LEVEL:
 - Gross Capacity: $\frac{[(83' \times 50') + (65' \times 32')]}{2} \times 3' = 9345 \text{ ft}^3$
 - Minus Granular Cushion, 1-ft thick x 50-ft long x 26-ft wide = 1300 ft³
 - Net Containment Capacity = 9345 - 1300 = 8045 ft³ (i.e., 60,177 GALLONS)
- ACTUAL CONTAINMENT CAPACITY > MINIMUM REQUIRED (60,177 > 46,200) **CONFIRMED ACCEPTABLE.**
- ABOVE CALCULATION SHOWS THAT THERE IS EXCESS CONTAINMENT CAPACITY, AND THEREFORE THE ACTUAL LIQUID LEVEL FROM A WORST-CASE RELEASE WOULD RISE TO BELOW THE 1-FT FREEBOARD LEVEL (WHICH IS FAVORABLE AND INDICATES AN ADDED MARGIN OF SAFETY).
- CONFIRM THAT SPECIFIED 1-FT MINIMUM FREEBOARD IS ADEQUATE TO CONTAIN PRECIPITATION FROM 25-YR, 24-HR STORM WITHOUT OVERTOPPING BERM:
 - 25-YR, 24-HR STORM = 7.5 IN. (I.E., 0.625 FT) [Source - Rainfall Frequency Atlas of the United States, Technical Paper No. 40 (TP-40) for Johnson County, Texas]
 - FREEBOARD DEPTH > STORM DEPTH; and
 - 1-FT FREEBOARD CONTAINMENT VOLUME: 89' x 56' x 1' = 4984 ft³ (34,161 GALLONS) vs STORM VOLUME (625' x 89' x 56') = 23,300 GALLONS
 - FREEBOARD CONFIRMED ACCEPTABLE



SECTION
 FRAC TANK LIQUID WASTE STORAGE WITH
 SECONDARY CONTAINMENT (NOTE 1)
 SCALE: 1" = 20'

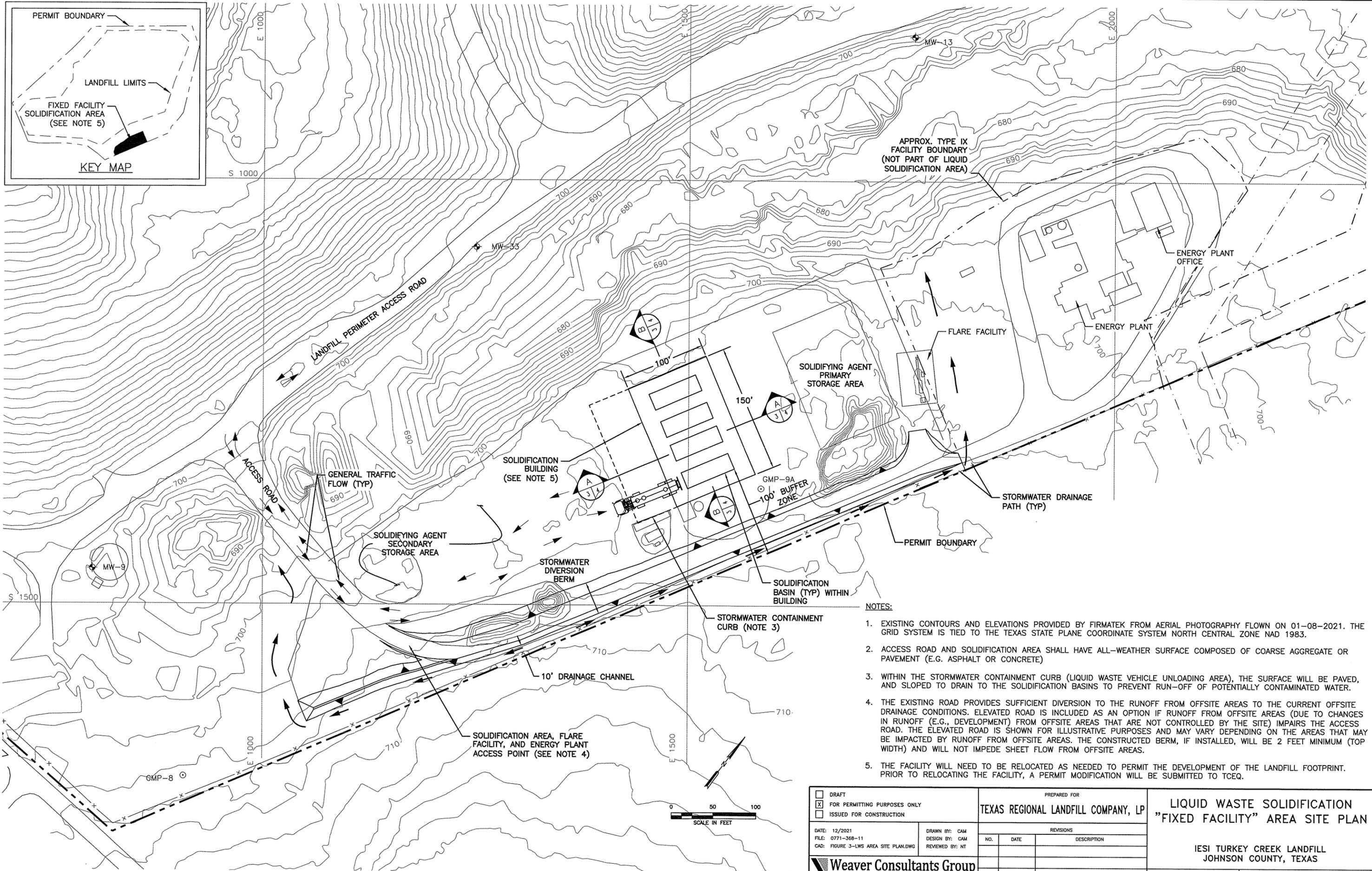
5/14/2012



Signature of Scott M. Graves

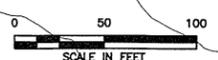
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0:\0771\366\EXPANSION 2021\PART IV\Figure 3 - LWS Area Site Plan.dwg, sford, 1:2

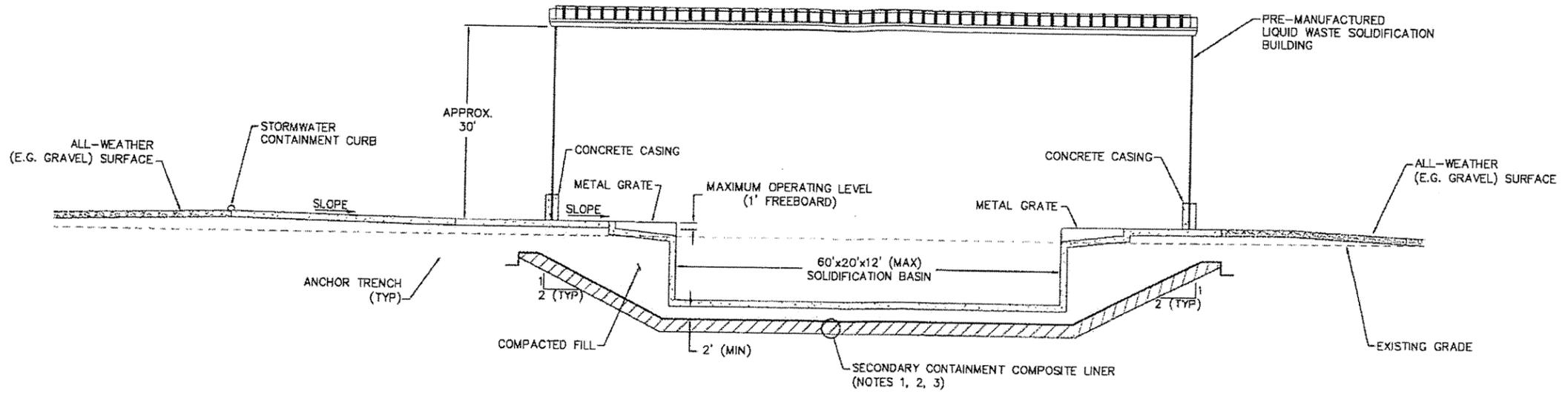


NOTES:

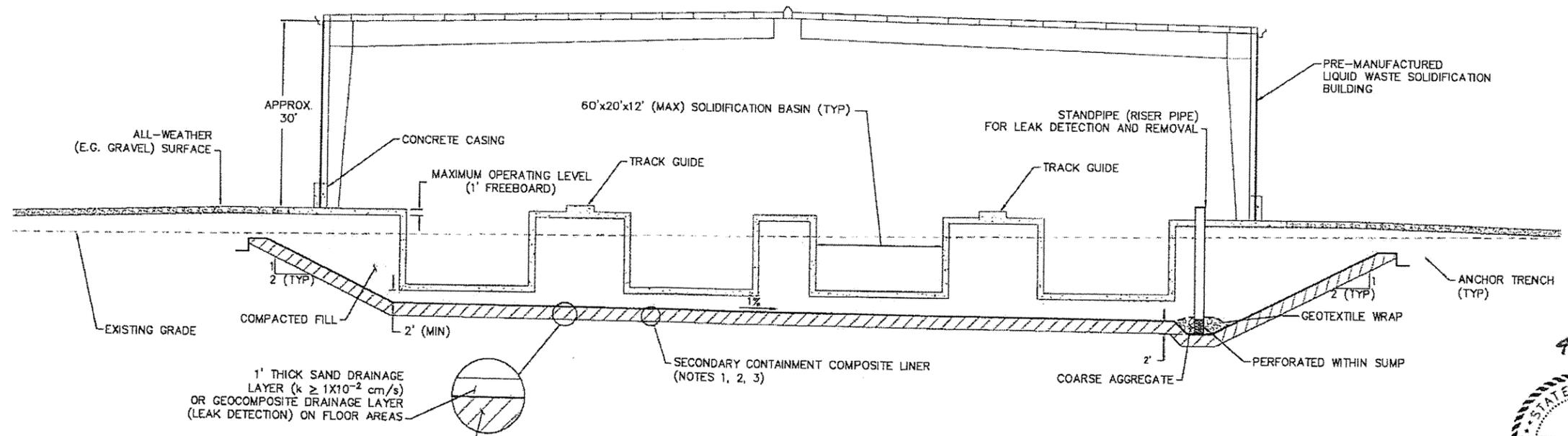
1. EXISTING CONTOURS AND ELEVATIONS PROVIDED BY FIRMAK FROM AERIAL PHOTOGRAPHY FLOWN ON 01-08-2021. THE GRID SYSTEM IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE NAD 1983.
2. ACCESS ROAD AND SOLIDIFICATION AREA SHALL HAVE ALL-WEATHER SURFACE COMPOSED OF COARSE AGGREGATE OR PAVEMENT (E.G. ASPHALT OR CONCRETE)
3. WITHIN THE STORMWATER CONTAINMENT CURB (LIQUID WASTE VEHICLE UNLOADING AREA), THE SURFACE WILL BE PAVED, AND SLOPED TO DRAIN TO THE SOLIDIFICATION BASINS TO PREVENT RUN-OFF OF POTENTIALLY CONTAMINATED WATER.
4. THE EXISTING ROAD PROVIDES SUFFICIENT DIVERSION TO THE RUNOFF FROM OFFSITE AREAS TO THE CURRENT OFFSITE DRAINAGE CONDITIONS. ELEVATED ROAD IS INCLUDED AS AN OPTION IF RUNOFF FROM OFFSITE AREAS (DUE TO CHANGES IN RUNOFF (E.G., DEVELOPMENT) FROM OFFSITE AREAS THAT ARE NOT CONTROLLED BY THE SITE) IMPAIRS THE ACCESS ROAD. THE ELEVATED ROAD IS SHOWN FOR ILLUSTRATIVE PURPOSES AND MAY VARY DEPENDING ON THE AREAS THAT MAY BE IMPACTED BY RUNOFF FROM OFFSITE AREAS. THE CONSTRUCTED BERM, IF INSTALLED, WILL BE 2 FEET MINIMUM (TOP WIDTH) AND WILL NOT IMPEDE SHEET FLOW FROM OFFSITE AREAS.
5. THE FACILITY WILL NEED TO BE RELOCATED AS NEEDED TO PERMIT THE DEVELOPMENT OF THE LANDFILL FOOTPRINT. PRIOR TO RELOCATING THE FACILITY, A PERMIT MODIFICATION WILL BE SUBMITTED TO TCEQ.



<input type="checkbox"/> DRAFT <input checked="" type="checkbox"/> FOR PERMITTING PURPOSES ONLY <input type="checkbox"/> ISSUED FOR CONSTRUCTION	PREPARED FOR TEXAS REGIONAL LANDFILL COMPANY, LP	LIQUID WASTE SOLIDIFICATION "FIXED FACILITY" AREA SITE PLAN
DATE: 12/2021 FILE: 0771-368-11 CAD: FIGURE 3-LWS AREA SITE PLAN.DWG	DRAWN BY: CAM DESIGN BY: CAM REVIEWED BY: NT	IESI TURKEY CREEK LANDFILL JOHNSON COUNTY, TEXAS
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM FIGURE 3



A SECTION A
SCALE: 1" = 20'



B SECTION B
SCALE: 1" = 20'

- NOTES:
1. SECONDARY CONTAINMENT COMPOSITE LINER SHALL BE COMPOSED OF A 60-MIL HDPE GEOMEMBRANE PLACED ON EITHER A 2-FT THICK RECOMPACTED SOIL LINER ($k \leq 1 \times 10^{-7}$ cm/s), OR ON A GEOSYNTHETIC CLAY LINER (GCL).
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 3. IF A GCL IS USED INSTEAD OF THE RECOMPACTED SOIL LINER, THE GCL MATERIAL, CONSTRUCTION, AND QA/QC REQUIREMENT SHALL BE AS SET FORTH IN EXHIBIT C OF THE LIQUID WASTE SOLIDIFICATION PLAN.

4/4/12

[Signature]

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER

FOR PERMIT PURPOSES ONLY

REV	DATE	DESCRIPTION	OWN BY	DES BY	CHK BY	APP BY

Geosyntec
consultants

GEOSYNTEC CONSULTANTS, INC.
TEXAS FIRM REGISTRATION NUMBER 1182
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IESI TX LANDFILL, LP

LIQUID WASTE SOLIDIFICATION
"FIXED FACILITY" AREA CROSS-SECTIONS

TURKEY CREEK LANDFILL
JOHNSON COUNTY, TEXAS

FIGURE
4

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APPENDIX IVE-2

EVALUATION OF ADEQUACY OF LINER SEPARATION DISTANCE

INTRODUCTION

The purpose of this write-up is to present an evaluation of the adequacy of the specified liner separation distance between the portable/moveable liquid waste solidification facility (when it is located on waste), and the underlying liner system. As shown on the figures presented in Appendix IVE-1 of the Liquid Waste Solidification Plan (LWSP), a minimum 10-foot separation distance is specified between the basins (and the operating equipment/vehicles) and the top of the liner system. Since the basins are recessed into waste, the operations equipment/vehicles will have a greater separation distance of approximately 17 feet from the top of the liner (see Drawing 1 in Appendix IVE-1).

Part of the rationale for selecting this minimum separation distance is to protect the liner system from potential stresses due to liquid waste facility features and equipment/vehicles. For comparison, other landfill-related activities that occur in close proximity to the liner include the following:

- Placement of 2-foot thick protective cover layer over the liner system geosynthetics during cell construction using bulldozers and off-road articulated dump trucks — 2 or 3-foot separation distance (depending on equipment type) from the geosynthetic component of the liner system.
- Placement of the 5-foot thick first lift of waste in a cell per Section 4.23.2 of the Site Operating Plan; involving bulldozers, waste compactor, and waste hauling vehicles (garbage trucks) — 7-foot separation distance from the geosynthetic component of the liner system.
- Placement of the second lift of waste in the cell, involving the same equipment as the first lift – approximately 17-foot separation distance from the geosynthetic component of the liner system based on typical 10-foot thick waste lifts.

Based on the above, it is apparent that the liquid waste solidification facility operations will be located with a similar or greater separation distance from the liner than other landfill operations, and thus are not expected to create new or more critical situations that would impart any greater stress on the liner system than for other previously-approved landfill operations. Nevertheless, this situation will be further evaluated in the remainder of this write-up.

METHODOLOGY

The methodology for this evaluation is as follows:

- Calculate the estimated ground pressure of the basins, equipment and vehicles;
- Based on the ground pressure, compare the separation distance to the allowable separation distance between equipment/vehicles and the liner system as set forth in the Liner Quality Control Plan (LQCP); and
- Compare the ground pressures to the estimated stress when the landfill is filled to capacity to evaluate which stress is larger (more critical).

Step 1. Ground Pressure

The estimated ground pressures for the main types of anticipated loads are as follows:

- Basin filled to capacity with solidified material — Ground pressure = 4.5 psi (see Section 1.2 of LWSP).
- Typical excavator anticipated for use during solidification, Caterpillar 330: Operating weight 74,360 lb; Ground contact area 10,200 in². Ground Pressure = 7.29 psi (i.e., 74,360 lb/10,200 in²). [Source: Caterpillar Performance Handbook, Edition 31, 2000].
- Typical bulldozer (periodic use such as to grade area to maintain drainage controls, etc.). Conservatively assume a non-low ground pressure dozer such as a Caterpillar D7R: operating weight 61,500 lb; ground contact area 4,996 in². Ground pressure = 12.3 psi. [Source: *ibid*].
- Typical off-road dump truck that will receive solidified material to transport to working face. Assume Caterpillar D400 series: Operating weight fully loaded = 149,830 lb; Tire load limit 25,350 lb; Ground pressure = 22 psi. (equates to contact area of 1152 in² per tire) [Source: *ibid*, using specified chart for 29.5R25 Tires at 51-psi inflation pressure].
- Typical tanker truck (highway-legal with gross weight of 80,000 lb): Maximum axle weight 18,000 lb, or 4,500 lb/tire. Contact area = 129 in². Typical tire inflation 35 psi (conservatively assume tire pressure = ground pressure).

It is important to recognize that the specified separation distance will attenuate (reduce) the live and dead loads from equipment and the basins based on the geotechnical principle of load distribution with depth [Lambe & Whitman (1969), Soil Mechanics, Wiley & Sons, p. 553]. In particular, from the ground pressures listed above, the largest pressure is for tires of vehicles that will be operating on the ground surface next to the basins and accordingly will have on the order of a minimum 17-foot separation distance (see Drawing 1 of Appendix IVE-1, since a 10-foot separation will be maintained between the bottom of the basins and the top of the liner). Therefore, the above ground pressures do not equal the pressure on the liner — the stress acting on the liner due to these operations will be substantially less. If the results of Steps 2 and 3 presented subsequently warrant calculating the load distribution and resulting stress on the liner, it will be performed. If Steps 2 and 3 allow the conclusion that the ground pressures associated with liquid solidification operations are not critical and the separation distance is adequate, it is not necessary to formally calculate the stress on the liner itself.

Step 2. Allowable Separation Distance Between Equipment and the Liner

Section 3.6 of the facility's permitted LQCP (in accordance with standard industry practice) requires that the following separation distance be maintained between equipment and the top of the geosynthetics of the liner system:

Equipment Ground Pressure (psi)	Minimum Separation Thickness (in.)
<5.0	12
5.1 — 8.0	18
8.1 — 16.0	24
>16.0	36

Comparison of the calculated ground pressures from Step 1 to the allowable separation distance in the above table reveals that the basin, excavator, and bulldozer have low enough pressures that they could be allowed within 2 feet of the liner system and not expected to overstress the liner, thereby showing that the 10-foot minimum specified separation is more than adequate. The comparison further shows that tire-vehicles which cause the largest ground pressure should maintain greater than a 3-foot separation - which the 10-foot minimum specified separation will accomplish.

Step 3. Maximum Future Stress on the Liner

The Turkey Creek Landfill will have a maximum waste height and final cover of approximately 282 feet (using drawings in Appendix IIIA-A of the Site Development

Plan, showing top elevation of 946 feet-msl and underlying liner elevation of 664 feet-msl). Over time waste consolidates and densifies under its own weight as more waste is placed above it, resulting in a typical in-place unit weight of waste of 70 lb/ft³.

The stress on the liner from this thickness of waste is $282 \text{ ft} \times 70 \text{ lb/ft}^3 = 19,740 \text{ lb/ft}^2$ (i.e., 137.1 psi).

In comparison, the 137.1 psi stress on the liner due to the full height of waste is substantially larger than the ground pressures on the order of 4.5 psi to 35 psi (which will attenuate to much smaller stresses on the liner due to the aforementioned load distribution principle) expected from liquid waste solidification basins/equipment operating above the liner.

CONCLUSIONS

For the reasons presented herein and summarized below, it is concluded that the specified 10-foot minimum separation distance between the liquid waste solidification features/equipment and the liner is adequate to handle the resulting pressures.

- The 10-foot minimum separation distance is larger than the 3-foot (36-in) separation distance specified in the LQCP for unrestricted ground pressure equipment operation.
- The 10-foot minimum separation distance is larger than the 5-foot separation that will occur during placement of the first lift of waste in a cell as specified in the SOP.
- Even without accounting for load distribution with depth (which will reduce the ground pressures to much smaller loads acting on the liner), the maximum future stress on the liner due to the weight of overlying waste is substantially larger than the loads due to the liquid waste solidification operations, indicating that other landfill conditions govern.