SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS
TCEQ PERMIT NO. MSW–1663C

SECTION 305.62(j)(2)
LIMITED SCOPE MAJOR PERMIT AMENDMENT

ALTERNATIVE LINER DESIGN
SECTORS 17D THROUGH 29

Prepared for

Southwest Landfill TX, LP

June 2024
Revised October 2024

Revised January 2025

STATE OF TEXAS
KYLE D. GOULD
106018
LICENSED
PROFESSIONAL ENGINEER

Prepared by

01/30/2025

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

Project No. 0120-094-11-140

January 30, 2025

Michael Smith
Project Manager
MC-124
Texas Commission on Environmental Quality
12100 Park 35 Circle
Austin, Texas 78753

Re: Response to Notice of Deficiency Letter – Limited Scope Major Permit Amendment Application
Southwest Landfill
Randall County, Texas
MSW Permit No.: 1663C
Tracking No. 29885599

Dear Mr. Smith:

On behalf of Southwest Landfill TX, LP, please find enclosed one original and three copies of the replacement pages for the referenced Limited Scope Major Permit Amendment application. The attached replacement pages were developed to incorporate comments included in your letter dated November 8, 2024.

The response letter contains each comment identified by the TCEQ (in bold) and a response to each.

1. Part III, Appendix IIIB.

   a. **Throughout. Identify which constituents in tables are provided at half the reporting level because they were non-detects during laboratory testing.**

Response:

a. Table 2-2 in Appendix IIIB has been revised to specify which constituents are reported at half the reporting limits because they were non-detect during laboratory testing.

   The footnote 2 in Tables 4-1, 5-1, and 6-3 reference Table 2-2. Footnote 3 for Table 2-2 was updated to provide clarification of how the site specific leachate quality was selected.

b. Tables 2-2, 4-1, 5-1, and 6-3. Correct the page footers to reflect the first revision, October 2024. Additionally, reflect the revision date in response to this NOD if necessary.

Response:

b. The revision numbers for Tables 2-2, 4-1, 5-1, and 6-3 were revised to "Rev 1." The dates for Tables 2-2 and 6-3 were updated to reflect the second NOD revision date. Tables 4-1 and 5-1 were revised to reflect the October 2024 date.

c. Table 6-3. Correct the calculated Cp based on the site-specific concentration of arsenic in leachate provided during the first revision.

Response:

c. Table 6-3 was revised to reflect the correct Cp value of 2.3E-06 mg/L.

d. Table 6-4. Revise the initial contaminant concentrations and subsequent calculations to reflect TCEQ's historical guidance, TWC (1993). Explain which and how initial concentrations were selected for contaminants without TCEQ's historical guidance (1993).

Response:

d. The C_o values were updated in Table 6-4 to reflect the leachate quality information historically used for POC demonstrations in Texas as presented in Table 2-2. The subsequent calculations in Table 6-4 were revised to reflect the updated C_o values. Contaminants without any historical guidance were not calculated, which is consistent with recent POC demonstrations submitted to TCEQ.

   After reviewing the 2018 POC demonstration, it was found that the MCL concentrations were inadvertently used as the initial concentrations (C_o) instead of the historical guidance concentrations in Tables 4-2 and 5-2. The subsequent calculations in these Tables were also revised.

2. Part III, Appendix IIIB, Section 6.

   a. Identify the range of groundwater gradients observed in Stratum II and associated dilution attenuation factors for the proposed Subtitle D alternative liner design (ALD) based on groundwater contour maps that cover the entire 1663C facility.

Response:

a. A new section has been added to Appendix IIIB-D named "Additional Demonstrations" to evaluate the scenarios requested. In this section, a demonstration was performed to evaluate the DAF at minimum and maximum groundwater gradients, which shows that the demonstration is in compliance with the POC requirements specified in Title 30 TAC §330.331(a)(1).

b. Identify the range of hydraulic conductivities observed in Stratum II and associated dilution attenuation factors for the proposed Subtitle D ALD based on groundwater contour maps that cover the entire 1663C facility.

Response:

b. A new section has been added to Appendix IIIB-D named "Additional Demonstrations" to evaluate the scenarios requested. In this section, a demonstration was performed to evaluate the DAF at the minimum and maximum observed hydraulic conductivities in Stratum II. The results of this demonstration show that the demonstration is in compliance with the POC requirements specified in Title 30 TAC §330.331(a)(1).

c. Perform side gradient modeling for the proposed Subtitle D ALD because it was described on the figures for the proposed GCL overliner ALD and contributed to the GCL overliner ALD justification and approval. The presence of a groundwater gradient in one direction does not preclude contaminant diffusion in a transverse direction.

Response:

c. MW-21 was projected onto Section A to evaluate transverse contaminant diffusion in the alternative liner areas. Case I through IV in Appendix IIIB-D (Figures 3 through 6) have been updated to include the calculated DAF of MW-21. Additionally, the additional demonstrations presented in Appendix IIIB-D also calculated the DAF for MW-21. The results of this demonstration show that the demonstration is in compliance with the POC requirements specified in Title 30 TAC §330.331(a)(1).

Additionally, the $1.0x10^7$ DAF contour callout was updated to correct an inconsistency on Figures 4 and 6.

3. Part III, Appendix IIIB, Section 6.2. Perform non-HELP leachate infiltration rate calculations and identify the associated dilution attenuation factors for the proposed Subtitle D ALD because they were described in Appendix IIIB, Section 5.2 and Appendix

IIIB-C for the GCL overliner ALD and contributed to the GCL overliner ALD justification and approval. These calculations are described in TCEQ's historical guidance documents TWC (1993) and TNRCC (1998).

Response:

A new section has been added to Appendix IIIB-D named "Additional Demonstrations" to evaluate the scenarios requested. In this section, a demonstration was performed to evaluate the DAF, assuming that the alternative liner leachate collection system does not function as designed and allows a buildup of 12 inches of head on the alternative liner and overliner systems. The results of this demonstration show that the demonstration is in compliance with the POC requirements specified in Title 30 TAC §330.331.

4. Part III, Appendix IIIE, Geotechnical Report, Section 5.5.1.

   a. Revise the Rankine-Block analyses to consider sliding parallel to the current liner and proposed alternative liner. Include the factor of safety against sliding within the compacted clay liner or protective cover based on their peak undrained shear strength (1,000 psf cohesion and zero degrees of friction angle) and total stresses.

Response:

a. Numerous changes have been made to Appendix IIIE to address the comment, including adding stability analyses incorporating the total stress values referenced in the comment into interim, final cover, and overliner analyses. Note that the interim slope analysis also required (in order to meet the minimum factor of safety of 1.3 for total stress), reducing the maximum interim slope length from 590 feet to 575 feet in Appendix IIIE. We also have reduced the required minimum factor of safety for total stress in the interim condition from 1.5 (for long term stress conditions) to 1.3 (for short term stress conditions), consistent with other stability analyses and demonstrations prepared by WCG for multiple landfills in Texas. Components included in this response include Appendix IIIE text revisions (including Tables 5-3 and 5-4 as referenced in comment 4.b below) and Appendix IIIE-A revisions (which include revised input and output data tables, revised stability section figures, and updated XSTABL computer stability models incorporating the referenced total stress values). Overall, the included revisions demonstrate that the landfill is stable when total stress conditions are imposed on the translational block analyses.

b. Tables 5-3 and 5-4. Clarify which factors of safety were computed using peak or residual strengths and total or effective stresses.

Response:

b. Tables 5-3 and 5-4 have been updated with the new factors of safety derived in response to comment 4.a above, as well as providing clarification regarding the various stress conditions used in the analyses presented in the tables.

5. Part III, Appendix IIIE, Geotechnical Report, p IIIE-A-4-11. Provide a clean copy that include the revisions presented on the marked-up copy.

Response:

c. For clarity the previous redline strikeout version and a clean version of page IIIE-A-4-11 has been included in this response.

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

Sincerely,

Brian Danko
Environmental Manager

Attachment: Limited Scope Major Permit Amendment Replacement Pages
(1 original and 3 copies)

cc: TCEQ Region 1
Kyle Gould, P.E., Weaver Consultants Group, LLC

October 4, 2024

Michael Smith
Project Manager
MC-124
Texas Commission on Environmental Quality
12100 Park 35 Circle
Austin, Texas 78753

Re: Response to Notice of Deficiency Letter – Limited Scope Major Permit Amendment Application
Southwest Landfill
Randall County, Texas
MSW Permit No.: 1663C
Tracking No. 29885599

Dear Mr. Smith:

On behalf of Southwest Landfill TX, LP, please find enclosed one original and three copies of the replacement pages for the referenced Limited Scope Major Permit Amendment application. The attached replacement pages were developed to incorporate comments included in your letter dated September 6, 2024.

The response letter contains each comment identified by the TCEQ (in bold) and a response to each.

1. **Part I/II, Section 2.1.4, bullet 3. Clarify that the protective cover is above both the geomembrane and the leachate collection system.**

Response:

The third bullet on page I/II-2-9 was revised to clarify the order of the Subtitle-D liner system.

2. **Part III, Appendix IIIB, Section 6. Demonstrate that site leachate contaminant concentrations and groundwater gradients have not increased since the overliner point-of-compliance demonstration was submitted in 2018. Explain why no side gradient monitor wells were modelled along the area to receive the Subtitle D alternate liner design.**

Response:

A review of the semi-annual groundwater monitoring report groundwater elevation maps provided by Hydrex Environmental from June 2020 through June 2024 was performed to assess changes in groundwater gradients. No increases in groundwater gradient were observed since the overliner point of compliance was developed in 2018; therefore, no changes were made to the point of compliance demonstration. Groundwater elevation maps prior to the February 20, 2020 approval of the major permit application MSW-1663C were ignored as the maps did not include data from the northern portion of the site. Additionally, historical site leachate contaminant concentrations provided by the site were analyzed for any increases since the original point of compliance demonstration was performed. Arsenic and Chromium values were found to have minor increases and were incorporated into Table 2-1. Tables 4-1, 5-1, and 6-3 were updated to reflect the minor increases in arsenic and chromium and updated C_p valves. The total concentration at the point of compliance is still below the required MCL.

No side gradient monitoring wells were modeled along the Subtitle-D alternative liner areas as the groundwater flows in a northern direction downgradient of the monitoring wells along the side of the disposal footprint. An analysis of the June 2020 through June 2024 groundwater elevation maps shows the direction of groundwater flow remains consistent over time.

3. Part III, Appendix IIIB, Section 6.2. Explain why percolation rates based on leakage through geomembrane defects were not applied to the Subtitle D and alternate bottom liner areas during time periods when final cover systems were not in place on those areas.

Response:

As shown on Figure 1 and Figure 2 in Appendix IIIB-D, a percolation rate of 0.0001 mm/yr was applied to the Subtitle-D alternative liner areas through the active life of the site. The percolation rate through the alternative liner areas was estimated by the HELP model and summarized on page IIIB-D-11. Note 3 on the HELP model summary page indicates the highest percolation rate from the interim conditions was used as the input into MODFLOW.

4. Part III, Appendix IIIB, Section 6.4, Table 6.2. Ensure the dilution attenuation factor for Case III matches the dilution attenuation factor shown on Appendix IIIB-D, Figure 5.

Response:

Table 6.2 in Appendix IIIB, Section 6.4 was revised to reflect the correct DAF value for Case III, which is correctly shown in Figure 5 in Appendix IIIB-D.

5. Part III, Appendix IIIB-D, Figure 3. Remove the leftmost 10E-9 contour from the expanded detail.

Response:

Figure 3 in Appendix IIIB-D was revised to add the DAF contours and label to the top section and revised the bottom section label to show a DAF at $1x10^7$.

6. Part III, Appendix IIID, Liner Quality Control Plan. Section 2.2. Clarify that any geosynthetic clay liner for the alternate liner design in Sectors 17D through 29 would replace a compacted clay liner and not a geomembrane.

Response:

Appendix IIID section 2.2 was revised to clarify a GCL can only replace the 2-foot-thick compacted clay liner portion of the liner.

7. Part III, Appendix IIIE-A, p IIIE-A-1. Demonstrate that geosynthetic clay liner and compacted clay liner share similar strength parameters or provide the appropriate stability analyses incorporating parameters for geosynthetic clay liner.

Response:

Review of the infinite stability analyses output table included in Appendix IIIE-A-4 confirms that, for the LSMPA, infinite slope stability analyses were run for both the internal strength of clay liner as well as the internal strength of the reinforced geosynthetic clay liner (GCL). As demonstrated in the table, the strength parameters for the GCL internal strength are greater than the values assumed for the clay liner soils (as derived from the 2018 permit amendment application), and therefore reasonably could be expected to have higher factors of safety when analyzed and as confirmed in the table. As analyses of both the clay liner soils and GCL are included in Appendix IIIE-A-4, the referenced text edits originally included on sheet IIIE-A-1 of the LSMPA have been stricken as irrelevant to the analyses.

8. Part III, Appendix IIIE-B, p IIIE-B-3. Explain how settlement, heave, and strain analyses for geosynthetic clay liner as an over liner are appropriate for a geosynthetic clay liner as a bottom liner or provide the appropriate settlement, heave, and strain analyses for geosynthetic clay liner as a bottom liner.

Response:

The material-specific conclusions presented in the original settlement analyses (Appendix IIIE-B, Sheet IIIE-B-1-30) have been revised to incorporate the allowable settlement-related strain for GCL. As shown on Sheet IIIE-B-1-30, the allowable level of strain for GCL's exceeds the calculated strain for the liner system as presented in the 2018 analyses.

9. Part III, Appendix IIIE, Geotechnical Report, p IIIE-A-4-2. Clarify that the composite liner system will have either a compacted clay liner or a geosynthetic clay liner but not both. Provide protective cover between the leachate collection layer and the select waste.

Response:

The Detail on Sheet IIIE-A-4-2 in Appendix IIIE was revised to show the liner and leachate collection system components correctly, including showing the protective cover between the leachate collection layer (geocomposite) and the select waste. A note has been added to clarify that a geosynthetic clay liner (GCL) may be used in lieu of a compacted clay liner for the MSW sectors only.

10. Part III, Appendix IIIE, Geotechnical Report, p IIIE-A-4-11. Provide results for compacted clay liner against subgrade and geosynthetic clay liner against subgrade on the 3H:1V maximum slope.

Response:

The infinite stability analysis has been revised to incorporate the compacted clay liner/subgrade and GCL/subgrade interfaces on the 3H:1V slope.

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

Sincerely,

Brian Danko

Brian Danko
Environmental Manager

Attachment: Limited Scope Major Permit Amendment Replacement Pages
(1 original and 3 copies)

cc: TCEQ Region 1
Kyle Gould, P.E., Weaver Consultants Group, LLC

REPUBLIC SERVICES

Sustainability in Action

May 31, 2024

Ms. Megan Henson
Executive Director
MC-124
Texas Commission on Environmental Quality
12100 Park 35 Circle
Austin, Texas 78753

Re: Section 305.62(j)(2) Limited Scope Major Permit Amendment Application
Alternative Liner Design – Sectors 17D through 29
Southwest Landfill – Permit No. MSW-1663C
Randall County, Texas

Dear Ms. Henson:

The purpose of this limited scope major permit amendment is to authorize an alternative liner design at the Southwest Landfill. The alternative liner design consists of replacing the 24-inch thick compacted clay liner in the Subtitle D composite liner system with a geosynthetic clay liner (GCL). No changes will be made to the top of liner grades.

It is requested that this permit amendment application be processed per Title 30 TAC §305.62(j)(2)(C). A detailed justification is included in the permit amendment narrative.

One original and three copies are provided for your use and distribution. Copies of this submittal have been sent to the TCEQ Region 1 office and placed in the Site Operating Record for this facility.

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

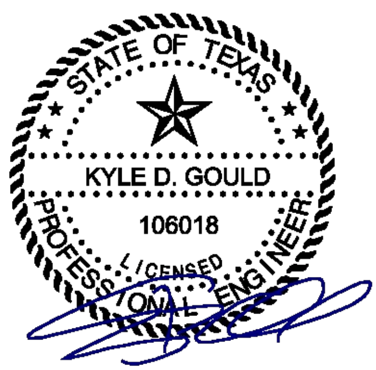
Sincerely,

Brian Danko
Environmental Manager

Attachment: Limited Scope Major Permit Amendment (1 original and 3 copies)

cc: TCEQ Region 1
Kyle Gould, P.E., Weaver Consultants Group, LLC

CONTENTS



06/13/2024

LIMITED SCOPE MAJOR PERMIT AMENDMENT NARRATIVE

1.0 Introduction

The purpose of this Section 305.62(j)(2) Limited Scope Major Permit Amendment (LSMPA) is to provide an alternative liner design for the MSW area at the Southwest Landfill located in Randall County (MSW-1663C).

The following sections detail the proposed alternative liner design, a replacement page summary, and the justification for processing this LSMPA application under Title 30 §305.62(j)(2)(C).

2.0 Alternative Liner Design

The proposed alternative liner design consists of replacing the 24-inch-thick compacted clay infiltration layer of the MSW Subtitle D composite liner system with a geosynthetic clay liner (GCL). The location of the proposed alternative liner is shown on Figure 1 which includes Sectors 17D through 29. The currently approved and proposed alternative liner systems for the MSW area are shown on Figure 2. Note that the alternative liner will not be constructed for Class 1 waste.

Details for the alternative liner system have been incorporated into Appendix IIIA-A – Liner, Overliner, and Final Cover System Details. The Overliner Equivalency and Point of Compliance Demonstration (Appendix IIIB) has been updated to incorporate the proposed GCL alternative liner. Liner slope stability calculations are presented in Appendix IIIE – Geotechnical Report.

3.0 Alternative Liner Point of Compliance Demonstration

The Point of Compliance (POC) demonstration included in Appendix IIIB has been updated to include an alternative liner POC which demonstrates that the proposed alternative liner system design option for the MSW area will meet the POC requirements set forth in Title 30 TAC §330.331(a)(1). The alternative liner POC demonstration is included in Appendix IIIB-D.

The currently approved POC demonstration consisted of a north and south case (Case I and II) and two additional scenarios that modified these cases. Refer to

Section 5 – Additional POC Demonstration for a discussion of these scenarios. An alternative liner POC demonstration was added to the currently approved POC demonstration which further modifies the four cases to test the alternative liner system design. Specifically, the percolation rate through the alternative liner system was assigned to the MSW areas. Additional Hydrologic Evaluation of Landfill Performance (HELP) models for the alternative liner system were added to Appendix IIIB-D.

Additional MODFLOW simulations were added to Appendix IIIB-D for the alternative liner system design option. The percolation rates obtained from the HELP model were input into MODFLOW to represent percolation from the alternative liner system. The MODFLOW results are illustrated on Figures 3 through 6 in Appendix IIIB-D.

Based on the model simulation results, it is concluded that the alternative liner system design option included in this permit modification meets the requirements of Title 30 TAC §330.331(a)(1).

4.0 Updated Geotechnical Analyses

A review was performed of the previous geotechnical analyses presented in Appendix IIIE and the analyses was updated to incorporate the proposed alternative liner design that includes a geosynthetic clay liner. The geosynthetic clay liner interfaces were determined to not represent the critical interfaces for the designs.

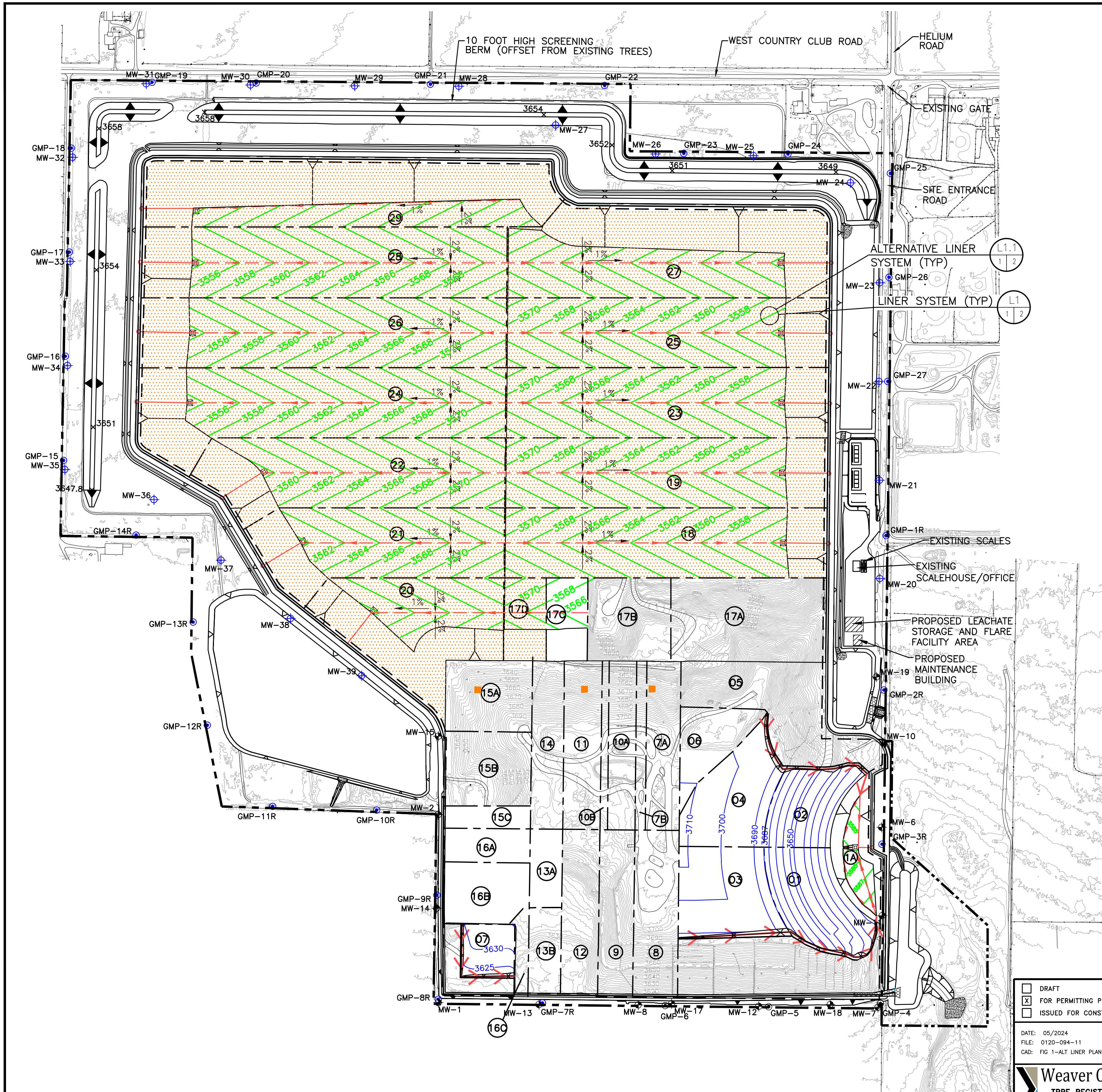
The previous translational analyses (for both interim and final conditions) had been performed using an average or typical interface value for the various geosynthetics incorporated into the bottom liner designs. The translational (block) failure analyses was updated for this amendment to incorporate the worst case liner geosynthetic liner interfaces for both interim and final conditions. The revised analyses demonstrate all analyzed conditions meet or exceed the minimum requirements for factor of safety.

5.0 Section 305.62(j)(2) Replacement Pages

Consistent with Title 30 TAC §305.62(j)(2), applicable revised portions within the current permit that are affected by the changes in this amendment are included in Attachment 1 (redline/strikeout version) and Attachment 2 (clean version). The table included in Attachment 1 contains the list of replacement pages.

6.0 Limited Scope Permit Amendment Justification

It is requested that this limited scope permit amendment be processed per Title 30 TAC §305.62(j)(2)(C). §305.62(j)(2)(C) specifically allows an alternative liner design to be submitted under §305.62(j)(2). This submittal is not a full application required by §305.62(j)(1), because the proposed changes do not (1) increase the maximum permitted elevation of the landfill, (2) laterally expand the permitted waste footprint, (3) increase the volumetric waste capacity of the landfill, or (4) upgrade the landfill to meet the requirements of 40 CFR 258. Section 305.62(j)(2) allows for submitting only the applicable revised portions of the permit where appropriate changes are being proposed. The applicable revisions have been completed for the appropriate portions of the TCEQ Permit No. MSW-1663C Permit Amendment and are listed in the introduction section of Attachment 1.



LEGEND

PERMIT BOUNDARY

LIMIT OF WASTE

DRAINAGE EASEMENT

N 3648000 STATE PLANE COORDINATE

35°00'30" GEODETIC COORDINATE

3660 EXISTING CONTOUR

EASEMENT

SECTOR BOUNDARY

7A SECTOR DESIGNATION

3560 EXCAVATION CONTOUR

3690 TOP OF OVERLINER CONTOUR

LEACHATE COLLECTION PIPE

LEACHATE COLLECTION SUMP

VERTICAL LEACHATE SUMP

LEACHATE CLEANOUT RISER

LEACHATE COLLECTION PIPE

MW-2 EXISTING GROUNDWATER MONITOR WELL

MW-24 PROPOSED GROUNDWATER MONITOR WELL

GMP-4 EXISTING LANDFILL GAS MONITOR PROBE

GMP-26 PROPOSED LANDFILL GAS MONITOR PROBE

GCL ALTERNATIVE LINER AREA

N

0 300 600

SCALE IN FEET

NOTE:

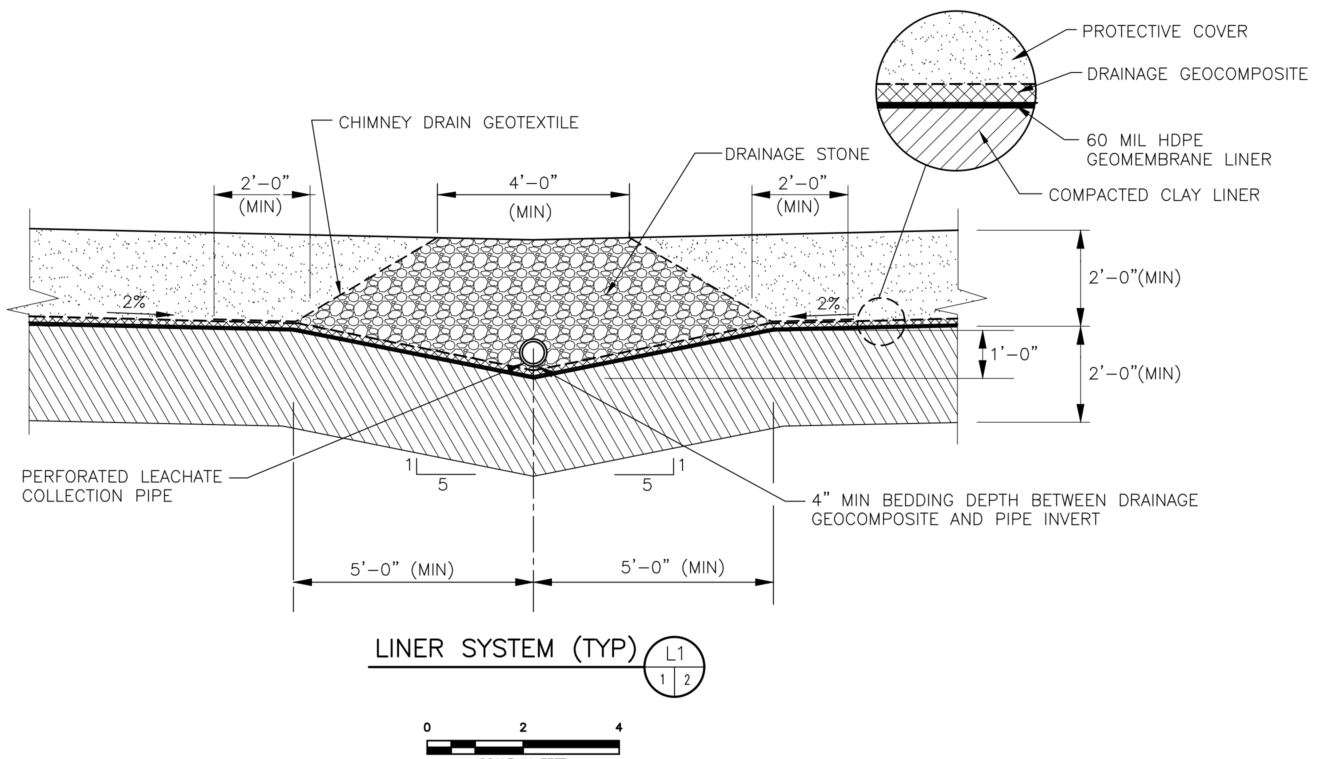
1. CONTOURS AND ELEVATIONS PROVIDED BY FIRMATEK, LLC. FROM AERIAL PHOTOGRAPHY FLOWN 11-13-2023. THE GRID SYSTEM (STATE PLANE COORDINATE SYSTEM) IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH ZONE NAD 83.
2. PERMIT BOUNDARY WAS PREPARED BY WEAVER CONSULTANTS GROUP IN NOVEMBER 2017.

STATE OF TEXAS
KYLE D. GOULD
106018
LICENSED
PROFESSIONAL ENGINEER

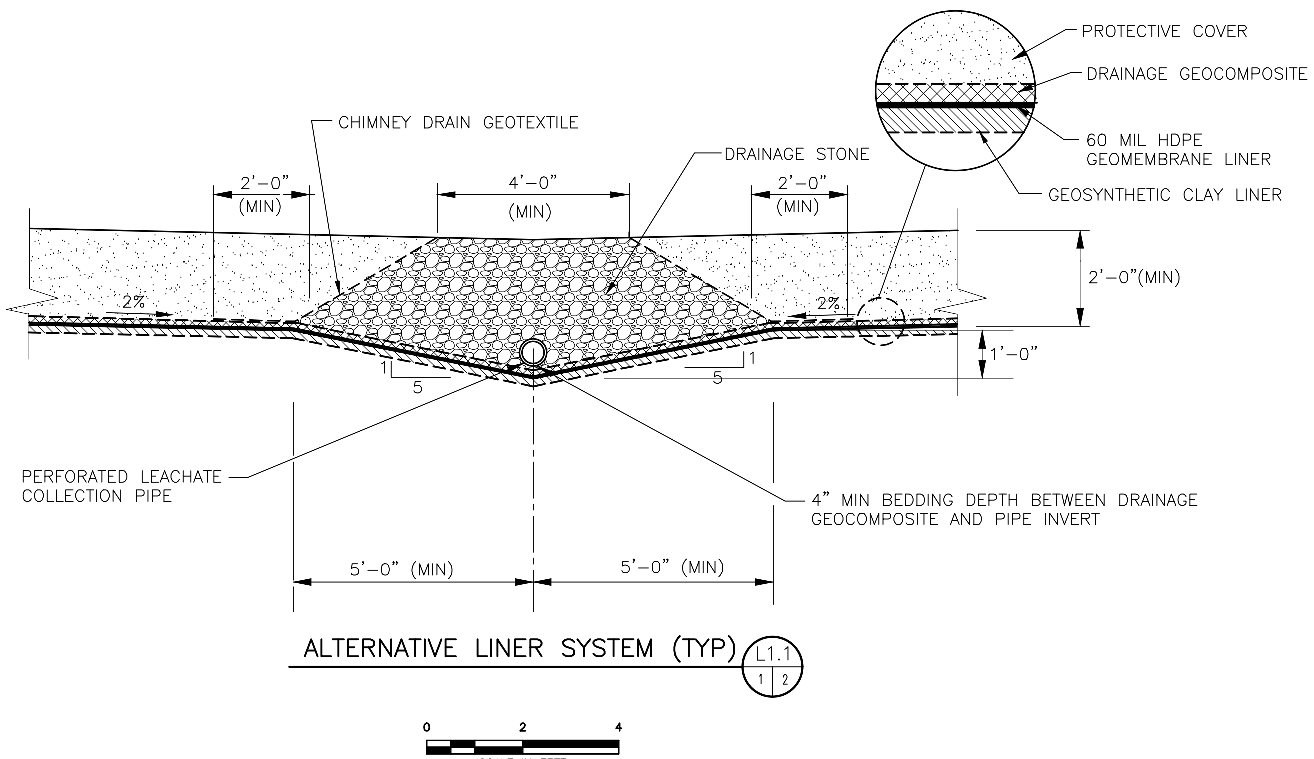
06/13/2024

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR SOUTHWEST LANDFILL TX, LP	MAJOR PERMIT AMENDMENT ALTERNATIVE LINER PLAN SOUTHWEST LANDFILL RANDALL COUNTY, TEXAS		
DATE: 05/2024 FILE: 0120-094-11 CAD: FIG 1-ALT LINER PLAN.dwg	DRAWN BY: RAA DESIGN BY: BPY REVIEWED BY: KDG	REVISIONS NO. / DATE / DESCRIPTION		
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM	FIGURE 1	

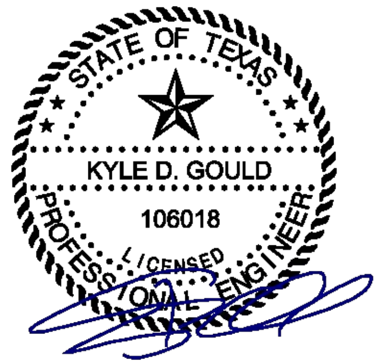
O:\0120\94\SMPA 2024\PART III\IIIA\A\FIG 1-ALTERNATIVE LINER PLAN.dwg, byoung, 1:2



LINER SYSTEM (TYP)



ALTERNATIVE LINER SYSTEM (TYP)



06/13/2024

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR SOUTHWEST LANDFILL TX, LP	MAJOR PERMIT AMENDMENT LINER SYSTEM COMPARISON
DATE: 05/2024 FILE: 0120-094-11 CAD: FIG 2-LINER SYSTEM DETAILS.dwg DRAWN BY: RAA DESIGN BY: BPY REVIEWED BY: KDG	REVISIONS NO. / DATE / DESCRIPTION	SOUTHWEST LANDFILL RANDALL COUNTY, TEXAS
Weaver Consultants Group TBPE REGISTRATION NO. F-3727		WWW.WCGRP.COM — FIGURE 2

O:\0120\094\LSMPA 2024\PART III\IIIA\A\FIG 2- LINER SYSTEM DETAILS.dwg, byoung, 1:2

ATTACHMENT 1

SECTION 305.62(J)(2) LIMITED SCOPE MAJOR PERMIT AMENDMENT REPLACEMENT PAGES (REDLINE/STRIKEOUT VERSION)

INTRODUCTION

Consistent with Title 30 Texas Administrative Code (TAC) §305.62(j)(2), the following replacement pages have been developed to replace applicable portions of the current permit to which changes are being proposed. The following table summarizes the proposed replacement pages.

Section 305.62(j)(2) Limited Scope Major Permit Amendment Replacement Pages

Replacement Section/Page Number	Explanation
TCEQ Part I Form and Core Data Form	Complete replacement.
Parts I/II – General Application Requirements and Cover Page	Updated for revision date.
Parts I/II – General Application Requirements, Pages I/II-2-8 and I/II-2-9	Updated text for alternative liner.
Parts I/II, Section 5 – Landowner and Mineral Rights List and Map	Updated property owners list and map.
Part III – Site Development Plan, Site Development Plan Narrative, Cover Page	Updated for revision date.
Part III, Site Development Plan Narrative, Page III-12	Updated text for alternative liner.
Part III, Appendix IIIA – Landfill Unit Design Information, Cover Page	Updated for revision date.
Part III, Appendix IIIA, Table of Contents	Updated for new drawings.
Part III, Appendix IIIA, Pages IIIA-2 and IIIA-3	Updated text for alternative liner.
Part III, Appendix IIIA-A – Liner and Final Cover System Details, Cover Page, and Table of Contents	Update for new drawings.
Part III, Appendix IIIA-A, Drawing A.1	Drawing updated for alternative liner area.
Part III, Appendix IIIA-A, Drawings A.6, A.6A, A.7, A.8, A.17	Added/updated for alternative liner system.
Part III, Appendix IIIB – Overliner Point of Compliance Demonstration Cover Page	Updated for revision date.
Part III, Appendix IIIB – Table of Contents and Page IIIB-2.	Pages revised to incorporate the alternative liner POC demonstration.
Part III, Appendix IIIB, Appendix IIID-B – Section 6	Added section to present the results of the alternative liner POC demonstration.
Part III, Appendix IIIB, Appendix IIIB-D – Alternative Liner POC Demonstration	New appendix added for alternative liner POC demonstration.

Section 305.62(j)(2) Limited Major Permit Amendment Replacement Pages (Continued)

Replacement Section/Page Number	Explanation
Part III, Appendix IIID – Liner Quality Control Plan, Cover Page	Updated for revision date.
Part III, Appendix IIID – Table of Contents and Pages IIID-6, 8, 26, 27, 41, and 59	Pages revised to incorporate geosynthetic clay liner component of the alternative liner.
Part III, Appendix IIIE – Geotechnical Report, Cover Page	Updated for revision date.
Part III, Appendix IIIE – Table of Contents, Pages IIIE-6, 10, 11, 19, 22, and 27	Revised to incorporate geotechnical analysis of the GCL alternative liner.
Part III, Appendix IIIE, Appendix IIIE-A, Cover Page and Table of Contents	Provided Engineer seal and signature.
Part III, Appendix IIIE, Appendix IIIE-A, Page IIIE-A-1	Text revised to incorporate GCL.
Page III, Appendix IIIE, Appendix IIIE-A-2, Cover Page	Provided Engineer seal and signature.
Part III, Appendix IIIE, Appendix IIIE – Pages IIIE-A-1-1, 2, 4, 5, 6	Text edited to reflect additional interim slope stability analyses performed for LSMPA.
Part III, Appendix IIIE, Appendix IIIE – Page IIIE-A-2-7	Stability modeling cover sheet provided Engineer seal and cover.
Part III, Appendix IIIE, Appendix IIIE-A-2-20 to 39	Replaced XStabl modeling output files for revised modeling.
Part III, Appendix IIIE, Appendix IIIE-A-3, Cover Page	Provided Engineer seal and signature.
Part III, Appendix IIIE, Appendix IIIE-A-3, Pages IIIE-A-3-1, 2, 5, 6, 7, 8, ,14, 15	Text edited to reflect additional interim slope stability analyses performed.
Part III, Appendix IIIE, Appendix IIIE-A-3, Pages IIIE-A-3-27 through 44, IIIE-A-3-55 through 70, IIIE-A-3-81 through 107, IIIE-A-3-118 through 133	Replaced XStabl modeling output files for revised modeling.
Part III, Appendix IIIE, Appendix IIIE-A-4, Cover Page	Provided Engineer seal and signature.
Part III, Appendix IIIE, Appendix IIIE-A-4, Pages IIIE-A-4-2 and 11	Revised calculations to incorporate GCL bottom liner alternative.

Texas Commission on Environmental Quality

Part I Application Form for New Permit, Permit Amendment, or Registration for a Municipal Solid Waste Facility

Instructions for completing this Part I Application Form are provided in TCEQ 00650-instr[1]. Include a Core Data Form (TCEQ 10400)[2] with the application for the facility owner, and Core Data Forms for the operator and property owner if different from the facility owner. If you have questions, contact the Municipal Solid Waste (MSW) Permits Section by email to [redacted] or by phone at 512-239-2335. Rules cited on this form are in Title 30 Texas Administrative Code (30 TAC) and may be viewed online at www.tceq.texas.gov/goto/view-30tac.

Application Tracking Information

Facility Regulated Entity Name[3]: Southwest Landfill

Site Operator (Permittee or Registrant Name)[4]: Southwest Landfill TX, LP

MSW Authorization Number: 1663C

Initial Submission Date: 5/31/2024

Revision Date: ______________

Application Data

1. Submission Type	
☒ Initial Submission	☐ Notice of Deficiency (NOD) Response

2. Authorization Type	
☒ Permit	☐ Registration

3. Application Type	
☐ New Permit	
☐ Permit Major Amendment	☒ Permit Limited Scope Major Amendment
☐ New Registration	

[1] www.tceq.texas.gov/downloads/permitting/waste-permits/msw/forms/00650-instr.pdf
[2] www.tceq.texas.gov/goto/coredata
[3] Facility Regulated Entity Name must match the Regulated Entity Name indicated on the TCEQ Core Data Form.
[4] Site Operator is defined in 30 TAC 330.3(148) as the holder of, or the applicant for, an authorization (or license) for a municipal solid waste facility.

4. Application Fee

Amount

☐ \$2,050—New Landfill Permits, and Landfill Permit Major Amendments Described in 30 TAC 305.62(j)(1)

☒ \$150—Other Permits, Permit Amendments, Limited Scope Major Amendments, and all Registrations

Payment Method

☒ Online through ePay portal [redacted]

Enter ePay Trace Number: [redacted]

☐ Check (send to TCEQ Finan

Payor Name: ______________________________ Check Number: __________

5. Application URL

For applications other than those for arid exempt (AE) landfills, provide the URL address of a publicly accessible internet website where the application and all revisions to the application will be posted.

http://www.ftwweaverboos.com

6. Party Responsible for Publishing Notice

Indicate who will be responsible for publishing notice:

☐ Applicant ☐ Agent in Service ☒ Consultant

Contact Name: Kyle Gould

Title: Senior Engineer

Email Address [redacted]

7. Alternative Language Notice

Use the Alternative Language Checklist on Public Notice Verification Form TCEQ-20244-Waste-NORI, TCEQ-20244-Waste-NAPD, or TCEQ-20244-Waste-NAORPM available at www.tceq.texas.gov/permitting/waste_permits/msw_permits/msw_notice.html to determine if an alternative language notice is required.

Is an alternative language notice required for this application?

☐ Yes ☒ No

Indicate the alternative language: ______________________

8. Public Place for Copy of Application

Name of the Public Place: Canyon Public Library

Physical Address: 1501 3rd Avenue

City: Canyon County: Randall State: TX Zip Code: 79015

Phone Number: (806) 655-5015

9. Consolidated Permit Processing

Is this submittal part of a consolidated permit processing request, in accordance with 30 TAC Chapter 33?

☐ Yes ☒ No

If "Yes", indicate the other TCEQ program authorizations requested:

10. Confidential Documents

Does the application contain confidential documents?

☐ Yes ☒ No

If "Yes", reference the confidential documents in the application, but submit the confidential documents as an attachment in a separate binder marked "CONFIDENTIAL."

11. Permits and Construction Approvals

Mark the following table to indicate status of other permits or approvals.

Table 1. Permits and Construction Approvals.

Permit or Approval	Received	Pending	Not Applicable
Hazardous Waste Management Program under Texas Solid Waste Disposal Act			X
Underground Injection Control Program under Texas Injection Well Act			X
National Pollutant Discharge Elimination System Program under Clean Water Act; Waste Discharge Program under Texas Water Code, Chapter 26	X		
Prevention of Significant Deterioration Program under Federal Clean Air Act (FCAA); Nonattainment Program under the FCAA			X
National Emission Standards for Hazardous Air Pollutants Preconstruction Approval under the FCAA			X
Ocean Dumping Permits under Marine Protection Research and Sanctuaries Act			X
Dredge or Fill Permits under Clean Water Act	X		
Licenses under the Texas Radiation Control Act			
Other (describe): TCEQ Air Quality Permit or Registration Petroleum Storage Tank Registration Under Ground Inspection Control Permit	X		
Other (describe):			

12. General Information About the Facility

Facility Regulated Entity Name: Southwest Landfill

Contact Name: Brian Danko Title: Environmental Manager

MSW Authorization Number (if existing): 1663C

Regulated Entity Reference Number: **RN** 102064151

Physical or Street Address (if available): 20700 E. Helium Road

City: Canyon County: Randall State: TX Zip Code: 79015

Phone Number: 806-655-4776

Latitude (decimal degrees, six decimal places): 35° 00' 17.7"

Longitude (decimal degrees, six decimal places): 101° 57' 19"

Elevation (above mean sea level): 3617.02 feet (benchmark elevation for landfills)

Description of facility location with respect to known or easily identifiable landmarks:

The landfill is located approximately 1 mile northwest of the City of Canyon in Randall County. The site entrance is located approximately 1 mile west of the intersection of FM 2590 and West Country Club Road (also known as Buffalo Stadium Road).

Access routes from the nearest United States or state highway to the facility:

The site is accessed via State Hwy 6 and FM 2590. Both of these roads intersect West Country Club Road (also known as Buffalo Stadium Road). From these two intersections, vehicles will travel west on West Country Club Road. The site entrance road is located approximately 1 mile west of the intersection of FM 2590 and West Country Club Road.

Coastal Management Program

Is the facility within the Coastal Management Program boundary?

☐ Yes ☒ No

13. Facility Types

Facility types are described in 30 TAC 330.5(a).

Indicate facility type (select all that apply):

☒ Type I ☐ Type IV ☐ Type V

☐ Type IAE ☐ Type IVAE ☐ Type VI

14. Activities Conducted at the Facility

☒ Storage ☒ Processing ☒ Disposal

PAGE REVISION DATE: ________________

15. Facility Waste Management Units

Check the box for each type of waste management unit proposed.

- ☒ Landfill Unit(s)
- ☐ Incinerator(s)
- ☒ Class 1 Landfill Unit(s)
- ☒ Process Tank(s)
- ☒ Storage Tank(s)
- ☐ Tipping Floor
- ☒ Storage Area
- ☐ Other (specify):
- ☐ Container(s)
- ☒ Roll-off Boxes
- ☐ Surface Impoundment
- ☐ Autoclave(s)
- ☐ Refrigeration Unit(s)
- ☐ Mobile Processing Unit(s)
- ☐ Compost Pile(s) or Vessel(s)

16. Description of Proposed Facility or Changes to Existing Facility

Provide a brief description of the proposed activities if application is for a new facility, or the proposed changes to an existing facility or permit conditions if the application is for an amendment.

The purpose of this Limited Scope Major Permit Amendment is to authorize an alternative liner at the Southwest Landfill.

17. Facility Contact Information

Site Operator (Permittee or Registrant)

Name: Southwest Landfill TX, LP

Customer Reference Number: **CN**601436355

Contact Name: Brian Danko Title: Environmental Manager

Mailing Address: 4709 Pine Street

City: Abilene County: Taylor State: TX Zip Code: 79601

Phone Number: 325-267-9931

Email Address: [redacted]

Operator (if different from *Site Operator*)

Name: Same as "Site Operator" (Permittee/Registrant)

Customer Reference Number: **CN**__________

Contact Name: ____________________ Title: ____________________

Mailing Address: ____________________

City: ____________________ County: ____________________ State: ____ Zip Code: _____

Phone Number: ____________________

Email Address: ____________________

Consultant (if applicable)

Firm Name: Weaver Consultants Group

Consultant Name: Kyle D. Gould

Texas Board of Professional Engineers Firm Registration Number: F-3727

Contact Name: Kyle D. Gould Title: Senior Engineer

Mailing Address: 6420 Southwest Boulevard, Suite 206

City: Fort Worth County: Tarrant State: TX Zip Code: 76109

Phone Number: 817-735-9770

Email Address: [redacted]

Agent in Service (required for out-of-state applicants)

Name: N/A

Mailing Address: ____________________

City: ____________________ County: ____________________ State: TX Zip Code: _____

Phone Number: ____________________

Email Address: ____________________

18. Facility Supervisor License

Indicate the level of Municipal Solid Waste Facility Supervisor license, as defined in 30 TAC Chapter 30, Occupational Licenses and Registrations, Subchapter F that the individual who supervises or manages the operations will obtain prior to commencing operations.

☒ Class A Supervisor License ☐ Class B Supervisor License

19. Facility Ownership

Facility Owner

Does the Site Operator (Permittee or Registrant) own all the facility units and all the facility property?

☒ Yes ☐ No

If "No", provide the following information for the other owner, and include a Core Data Form for the other owner. Attach supplemental sheet if more than one other owner.

Other Owner Name: ______________________________

What is Owned: ☐ Facility Units ☐ Property

☐ Other (describe): ______________________________

Mailing Address: ______________________________

City: ______________ County: ______________ State: ____ Zip Code: _____

Phone Number: ______________

Email Address: ______________________________

20. Other Government Entities Information

Texas Department of Transportation

District: 4

District Engineer's Name: Blair Johnson

Mailing Address: 5715 Canyon Dr.

City: Amarillo County: Randall State: TX Zip Code: 79110

Phone Number: 806-655-3861

Email Address: [redacted]

Local Government Authority Responsible for Road Maintenance (if applicable)

Government or Agency Name: Randall County Road and Bride Dept.

Contact Person's Name: Tim Sorrells

Mailing Address: 301 W. Hwy 60

City: Canyon County: Randall State: TX Zip Code: 79015

Phone Number: 806-655-3861

Email Address: [redacted]

City Mayor Information

City Mayor's Name: Gary Hinders
Mailing Address: 301 16th St.
City: Canyon County: Randall State: TX Zip Code: 79015
Phone Number: 806-655-5000
Email Address: [redacted]

City Health Authority

Authority Name: Amarillo Public Health Department
Contact Person's Name: Anthony Spanel, R.S/REHS, D.R. S.E.
Contact Person's Title: Environmental Health Director
Mailing Address: 808 South Buchanan St.
City: Amarillo County: Potter State: TX Zip Code: 79105
Phone Number: 806-378-9473
Email Address: [redacted]

County Judge Information

County Judge's Name: Christy Dyer
Mailing Address: 501 16th Street, Suite 303
City: Canyon County: Randall State: TX Zip Code: 79015
Phone Number: 806-468-5500
Email Address: [redacted]

County Health Authority

Agency Name: Amarillo Public Health Department
Contact Person's Name: Anthony Spanel, R.S/REHS, D.R. S.E.
Contact Person's Title: Environmental Health Director
Mailing Address: 808 South Buchanan St.
City: Amarillo County: Potter State: TX Zip Code: 79105
Phone Number: 806-378-9473
Email Address: [redacted]

State Representative Information

House District Number: 86
State Representative's Name: John T. Smithee
District Office Mailing Address: 320 S. Polk, 1st Floor
City: Amarillo County: Randall State: TX Zip Code: 79101
Phone Number: 806-372-3327
Email Address: [redacted]

State Senator Information

District Number: 31

State Senator's Name: Kevin Sparks

District Office Mailing Address: Historic Federal Building

City: Amarillo County: Randall State: TX Zip Code: 79101

Phone Number: 806-374-8994

Email Address: [redacted]

Council of Governments (COG)

COG Name: Panhandle Regional Planning Commission

COG Representative's Name: Mike Peters

COG Representative's Title: Executive Director/General Manager

Mailing Address: P.O. Box 9257

City: Amarillo County: Randall State: TX Zip Code: 79105

Phone Number: 806-372-3381

Email Address: [redacted]

River Basin Authority

Authority Name: Red River Authority

Contact Person's Name: Fabian A. Heaney

Watershed Sub-Basin Name: Palo Duro

Mailing Address: P.O. Box 240

City: Wichita Falls County: Wichita State: TX Zip Code: 76307

Phone Number: 940-723-8697

Email Address: [redacted]

Local Drainage or Flood Management Authority

Authority Name: Randall County Road and Bridge Department

Contact Person's Name: Tim Sorrells

Mailing Address: 310 West Highway 60

City: Canyon County: Randall State: TX Zip Code: 79015

Phone Number: 806-655-3861

Email Address: [redacted]

U.S. Army Corps of Engineers District

Indicate the U.S. Army Corps of Engineers district in which the facility is located:

- ☐ Albuquerque, NM
- ☐ Galveston, TX
- ☐ Fort Worth, TX
- ☒ Tulsa, OK

Local Government Jurisdiction

Within City Limits of: N/A

Within Extraterritorial Jurisdiction of: City of Canyon

Is the facility located in an area in which the governing body of the municipality or county has prohibited the storage, processing, or disposal of municipal or industrial solid waste?

☐ Yes ☒ No

If "Yes", provide a copy of the ordinance as an attachment.

PAGE REVISION DATE: 01/2025

Applicant Signature Page

Site Operator (Permittee or Registrant Name) or Authorized Signatory

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 gather and evaluate 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 submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Brian Danko Title: Environmental Manager

Email Address: [redacted]

Signature: Br Danko Date: 1/30/2025

Authorization by Facility Owner for Operator to Submit Application

To be completed by the facility owner if the application is submitted by an operator who is not the facility owner.

I am the owner of the facility that is the subject of this application, and authorize the operator, ______________________ to submit this application pursuant to 30 TAC 305.43(c).

Name: ______________________ Title: ______________________

Email Address: ______________________

Signature: ______________________ Date: ____________

Notary

SUBSCRIBED AND SWORN to before me by the said Brian Danko

On this 30th day of January, 2025

My commission expires on the 11th day of August, 2026

Stacy M. Wilson

Notary Public in and for

Tarrant (notary's jurisdiction, including county and state)

Note: Application Must Bear Signature & Seal of Notary Public

NOTARY PUBLIC STATE OF TEXAS
STACY M. WILSON
Notary Public, State of Texas
Comm. Expires 08-11-2026
Notary ID 133903285

Property Owner Affidavit

Property Owner Affidavit for Landfill Facility

I acknowledge in accordance with 30 TAC 330.59(d)(2) that the State of Texas may hold me either jointly or severally responsible for the operation, maintenance, and closure and post-closure care of the facility. For a facility where waste will remain after closure, I acknowledge that I have a responsibility to file with the county deed records an affidavit to the public advising that the land will be used for a solid waste facility prior to the time that the facility actually begins operating as a municipal solid waste landfill facility, and to file a final recording upon completion of disposal operations and closure of the landfill units according to 30 TAC 330.19 (relating to Deed Recordation). I further acknowledge that the facility owner or operator and the State of Texas shall have access to the property during the active life and post-closure care period for the purpose of inspection and maintenance.

Name: Brian Danko

Email Address: [redacted]

Signature: Brian Danko Date: 10/04/2024

Property Owner Affidavit for Processing Facility

I acknowledge in accordance with 30 TAC 330.59(d)(2) that the State of Texas may hold me either jointly or severally responsible for the operation, maintenance, and closure of the facility. I further acknowledge that the facility owner or operator and the State of Texas shall have access to the property during the active life and post-closure care period for the purpose of inspection and maintenance.

Name: ____________________

Email Address: ____________________

Signature: ____________________ Date: __________

Notary

SUBSCRIBED AND SWORN to before me by the said Brian Danko

On this 4th day of October, 2024

My commission expires on the 11th day of August, 2026

Stacy M. Wilson

Notary Public in and for

Tarrant (notary's jurisdiction, including county and state)

Note: Application Must Bear Signature & Seal of Notary Public

STACY M. WILSON
Notary Public, State of Texas
Comm. Expires 08-11-2026
Notary ID 133903285

Part I Attachments

Refer to instruction document TCEQ 00650-instr[5] for professional engineer seal requirements.

Attachments Table 1. Required attachments.

Required Attachments	Attachment Number
Supplementary Technical Report [30 TAC 305.45(a)(8)]	
Property Legal Description [30 TAC 330.59(d)(1)]	
Property Metes and Bounds Description [30 TAC 330.59(d)(1)]	
Facility Legal Description [30 TAC 330.59(d)(1)]	
Facility Metes and Bounds Description [30 TAC 330.59(d)(1)]	
Metes and Bounds Drawings [30 TAC 330.59(d)(1)]	
On-Site Easements Drawing [30 TAC 330.61(c)(10)]	
Land Ownership Map [30 TAC 330.59(c)(3)]	
Landowners List [30 TAC 330.59(c)(3)]	Attachment 1
Mailing Labels (in electronic file, in Avery 5160 format; see instructions) [30 TAC 281.5(7)]	Attachment 1
General Location Maps [30 TAC 330.59(c)(2)]	Attachment 3
Texas Department of Transportation (TxDOT) County Map [30 TAC 330.59(c)(2)]	
General Topographic Maps [30 TAC 330.61(e)]	
Verification of Legal Status / Legal Authority (certificate of incorporation) [30 TAC 281.5 and 330.59(e)]	
Evidence of Competency [30 TAC 330.59(f)]	
Signatory Authority Documentation [30 TAC 305.44 and 330.59(g)]	
TCEQ Core Data Form(s) TCEQ-10400[6] [30 TAC 281.5(7)]	

[5] www.tceq.texas.gov/downloads/permitting/waste-permits/msw/forms/00650-instr.pdf
[6] www.tceq.texas.gov/permitting/central_registry/guidance.html

Attachments Table 2. Additional attachments as applicable.

Additional Attachments (select all that apply and add others as needed)	Attachment Number
☐ Plain Language Summary Form TCEQ-20947[7] [30 TAC 39.405(k)]	
☐ Public Involvement Plan Form TCEQ-20960[8]	
☐ Fee Payment Receipt	
☐ Confidential Documents	
☐ Waste Storage, Processing and Disposal Ordinances [Texas Health and Safety Code, Section 363.112[9]]	
☐ Final Plat Record of Property Description [30 TAC 330.59(d)(1)(B)]	
Other (describe):	
Other (describe):	
Other (describe):	

[7] www.tceq.texas.gov/downloads/permitting/waste-permits/msw/forms/20947-instr.pdf
[8] www.tceq.texas.gov/downloads/agency/decisions/hearings/environmental-equity/pip-form-tceq-20960.pdf www.tceq.texas.gov/downloads/agency/decisions/hearings/environmental-equity/instructions-for-pip-form-tceq-20960.pdf
[9] statutes.capitol.texas.gov/Docs/HS/htm/HS.363.htm#363.112

TCEQ Use Only

TCEQ Core Data Form

For detailed instructions on completing this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission *(If other is checked please describe in space provided.)*

☐ New Permit, Registration or Authorization (*Core Data Form should be submitted with the program application.)*

☐ Renewal *(Core Data Form should be submitted with the renewal form)*

☒ Other **Limited Scope Major Permit Amendment**

2. Customer Reference Number *(if issued)*	Follow this link to search for CN or RN numbers in Central Registry**	**3. Regulated Entity Reference Number** *(if issued)*
CN 601436355		**RN 102064151**

SECTION II: Customer Information

4. General Customer Information	**5. Effective Date for Customer Information Updates** (mm/dd/yyyy)	7/9/2024

☐ New Customer ☒ Update to Customer Information ☐ Change in Regulated Entity Ownership
☐ Change in Legal Name (Verifiable with the Texas Secretary of State or Texas Comptroller of Public Accounts)

The Customer Name submitted here may be updated automatically based on what is current and active with the Texas Secretary of State (SOS) or Texas Comptroller of Public Accounts (CPA).

6. Customer Legal Name *(If an individual, print last name first: eg: Doe, John)*	*If new Customer, enter previous Customer below:*
Southwest Landfill TX, LP	

7. TX SOS/CPA Filing Number	**8. TX State Tax ID** (11 digits)	**9. Federal Tax ID** (9 digits)	**10. DUNS Number** *(if applicable)*
0800036030	12600151778	260015177	112886903

11. Type of Customer: ☐ Corporation ☐ Individual Partnership: ☐ General ☒ Limited

Government: ☐ City ☐ County ☐ Federal ☐ Local ☐ State ☐ Other ☐ Sole Proprietorship ☐ Other:

12. Number of Employees

☐ 0-20 ☒ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 and higher

13. Independently Owned and Operated?

☐ **Yes** ☒ **No**

14. Customer Role (Proposed or Actual) – *as it relates to the Regulated Entity listed on this form. Please check one of the following*

☐ Owner ☐ Operator ☒ Owner & Operator ☐ Other:
☐ Occupational Licensee ☐ Responsible Party ☐ VCP/BSA Applicant

15. Mailing Address:	4831 SE 25th Ave						
	City	Amarillo	**State**	TX	**ZIP**	79103	**ZIP + 4** 6413

16. Country Mailing Information *(if outside USA)*	**17. E-Mail Address** *(if applicable)*

18. Telephone Number	**19. Extension or Code**	**20. Fax Number** *(if applicable)*

(806) 655-4776		( ) -

SECTION III: Regulated Entity Information

21. General Regulated Entity Information *(If 'New Regulated Entity" is selected, a new permit application is also required.)*

☐ New Regulated Entity ☐ Update to Regulated Entity Name ☒ Update to Regulated Entity Information

The Regulated Entity Name submitted may be updated, in order to meet TCEQ Core Data Standards (removal of organizational endings such as Inc, LP, or LLC).

22. Regulated Entity Name *(Enter name of the site where the regulated action is taking place.)*

Southwest Landfill

23. Street Address of the Regulated Entity: ***(No PO Boxes)***	20700 E. Helium Road						
	City	Canyon	**State**	TX	**ZIP**	79015	**ZIP + 4**
24. County	Randall						

If no Street Address is provided, fields 25-28 are required.

25. Description to Physical Location:	

26. Nearest City	**State**	**Nearest ZIP Code**

Latitude/Longitude are required and may be added/updated to meet TCEQ Core Data Standards. (Geocoding of the Physical Address may be used to supply coordinates where none have been provided or to gain accuracy).

27. Latitude (N) In Decimal:	35.0042°		**28. Longitude (W) In Decimal:**	101.9597°	
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
35	00	15	101	57	35

29. Primary SIC Code (4 digits)	**30. Secondary SIC Code** (4 digits)	**31. Primary NAICS Code** (5 or 6 digits)	**32. Secondary NAICS Code** (5 or 6 digits)
4953			

33. What is the Primary Business of this entity? *(Do not repeat the SIC or NAICS description.)*

Municipal Solid Waste Landfill

34. Mailing Address:	**20700 E. Helium Road**						
	City	**Canyon**	**State**	**TX**	**ZIP**	**79015**	**ZIP + 4**
35. E-Mail Address:							

36. Telephone Number	**37. Extension or Code**	**38. Fax Number** *(if applicable)*
(806) 655-4776		( ) -

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be affected by the updates submitted on this form. See the Core Data Form instructions for additional guidance.

☐ Dam Safety	☐ Districts	☐ Edwards Aquifer	☐ Emissions Inventory Air	☐ Industrial Hazardous Waste
☒ Municipal Solid Waste	☐ New Source Review Air	☐ OSSF	☒ Petroleum Storage Tank	☐ PWS
1663C			57512	
☐ Sludge	☐ Storm Water	☒ Title V Air	☐ Tires	☐ Used Oil
		1475		
☐ Voluntary Cleanup	☐ Wastewater	☐ Wastewater Agriculture	☐ Water Rights	☐ Other:

SECTION IV: Preparer Information

40. Name:	Kyle D. Gould	**41. Title:**	Senior Engineer

42. Telephone Number	**43. Ext./Code**	**44. Fax Number**	**45. E-Mail Address**
(817) 735-9770		(817) 735-9775	[redacted]

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:	Southwest Landfill TX, LP	**Job Title:**	Environmental Manager
Name *(In Print):*	Brian Danko	**Phone:**	(325) 267- **9931**
Signature:	Brian Danko	**Date:**	July 9, 2024

Texas Commission on Environmental Quality

Plain Language Summary of Municipal Solid Waste Permit or Permit Amendment Application

Applicants are required by public notice rules in Title 30 Texas Administrative Code, Chapter 39, Section 39.405(k)[1] to provide this summary of an application.

A. Purpose of the Proposed Facility

Dispose of municipal solid waste for Randall County and surrounding communities.

B. Information About the Applicant

Name: Southwest Landfill TX, LP

Applicant Type: Type I

Facility Name: Southwest Landfill

Permit Application Number: 1663C

Customer Number (CN): 601436355

Regulated Entity Reference Number (RN): 102064151

C. Location of the Proposed Facility

Facility Address (or description of site location if no address):

20700 Helium Road, Canyon, Tx 79015

Link to Map of Facility Location (TCEQ Location Mapper[2]): https://arcg.is/1ySjma

D. Information about Facility Operation

What types of waste would be received?

Municipal solid waste, household waste, yard waste, commercial waste, industrial waste (nonhazardous), construction-demolition waste, and some special wastes.

What geographical area would the wastes come from?

Service areas consists of Randall County and surrounding communities.

[1] www.tceq.texas.gov/goto/view-30tac
[2] www.tceq.texas.gov/gis/hb-610-viewer

What days and hours would the facility operate?

Hours of operation and waste acceptance may vary within a 24-hour period depending on incoming volumes of waste.

At what rate would wastes be accepted?

The average daily projected waste inflow is 1,253 tons/day.

How would wastes be managed?

The majority of all wastes accepted at this facility will be disposed of at the working face. Other wastes will be processed at the liquid waste bulking facility before being disposed of at the working face.

E. Pollution Control Methods

What methods would the facility use for containing wastes and odors, and monitoring for releases?

- Accidental fires will be controlled.
- 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.
- Ponded water at the site will be prevented.
- The Gas Collection and Control System (GCCS) will be expanded and operated in accordance with all applicable requirements.
- The landfill haul roads and access roads will be maintained in a reasonable dust-free condition by periodic spraying from a water truck.

What methods would the facility use or require for preventing litter or spills, and for cleanup of litter and spills?

Policing of litter and fugitive debris at the facility entrance area will be performed as part of a scheduled routine. Any litter scattered throughout the site, including along fences and access roads, and at the gate will be collected at least daily on the days the facility is in operation. Any spills will be contained, analyzed as appropriate, and properly handled.

Texas Commission on Environmental Quality

Public Involvement Plan Form for Permit and Registration Applications

The Public Involvement Plan is intended to provide applicants and the agency with information about how public outreach will be accomplished for certain types of applications in certain geographical areas of the state. It is intended to apply to new activities; major changes at existing plants, facilities, and processes; and to activities which are likely to have significant interest from the public. This preliminary screening is designed to identify applications that will benefit from an initial assessment of the need for enhanced public outreach.

All applicable sections of this form should be completed and submitted with the permit or registration application. For instructions on how to complete this form, see TCEQ-20960-inst.

Section 1. Preliminary Screening

☐ New Permit or Registration Application
☒ New Activity – modification, registration, amendment, facility, etc. (see instructions)

If neither of the above boxes are checked, completion of the form is not required and does not need to be submitted.

Section 2. Secondary Screening

☒ Requires public notice,

☐ Considered to have significant public interest, **and**

☒ Located within any of the following geographical locations:

- Austin
- Dallas
- Fort Worth
- Houston
- San Antonio
- West Texas
- Texas Panhandle
- Along the Texas/Mexico Border
- Other geographical locations should be decided on a case-by-case basis

**If all the above boxes are not checked, a Public Involvement Plan is not necessary.
Stop after Section 2 and submit the form.**

☐ Public Involvement Plan not applicable to this application. Provide **brief** explanation.

Section 3. Application Information

Type of Application (check all that apply):

Air ☐ Initial ☐ Federal ☐ Amendment ☐ Standard Permit ☐ Title V

Waste ☒ Municipal Solid Waste ☐ Industrial and Hazardous Waste ☐ Scrap Tire
☐ Radioactive Material Licensing ☐ Underground Injection Control

Water Quality

☐ Texas Pollutant Discharge Elimination System (TPDES)

☐ Texas Land Application Permit (TLAP)

☐ State Only Concentrated Animal Feeding Operation (CAFO)

☐ Water Treatment Plant Residuals Disposal Permit

☐ Class B Biosolids Land Application Permit

☐ Domestic Septage Land Application Registration

Water Rights New Permit

☐ New Appropriation of Water

☐ New or existing reservoir

Amendment to an Existing Water Right

☐ Add a New Appropriation of Water

☐ Add a New or Existing Reservoir

☐ Major Amendment that could affect other water rights or the environment

Section 4. Plain Language Summary

Provide a brief description of planned activities.

Dispose of municipal solid waste for Randall County and surrounding communities.

Section 5. Community and Demographic Information

Community information can be found using EPA's EJ Screen, U.S. Census Bureau information, or generally available demographic tools.

Information gathered in this section can assist with the determination of whether alternative language notice is necessary. Please provide the following information.

The landfill is located within the ETJ of the City of Canyon.

(City)

Randall County

(County)

(Census Tract)

Please indicate which of these three is the level used for gathering the following information.

☐ City ☒ County ☐ Census Tract

(a) Percent of people over 25 years of age who at least graduated from high school

According to the U.S. Census Bureau, the percentage of people over 25 years of age who at least graduated from high school in Randall County, Texas was 93.9% from 2018 to 2022.

(b) Per capita income for population near the specified location

According to the U.S. Census Bureau, the per capita income for the population in Randall County, Texas was $40,047 from 2018 to 2022.

(c) Percent of minority population and percent of population by race within the specified location

According to the U.S. Census Bureau, White: 71%, Hispanic or Latino: 20%, Black or African American: 3%, American Indian and Alaska Native: 0%, Asian: 2%, Native Hawaiian and other Pacific Islander: 0%, Two or more races: 3%

(d) Percent of Linguistically Isolated Households by language within the specified location

Limited English Households: 1%. Spanish: 54%, Other Indo-European: 11%, Asian-Pacific Island: 31%, Other languages: 5%

(e) Languages commonly spoken in area by percentage

English: 89%, Spanish: 8%, Other Indo-European: 1%

(f) Community and/or Stakeholder Groups

City of Canyon and surrounding communities

(g) Historic public interest or involvement

None at this site.

Section 6. Planned Public Outreach Activities

(a) Is this application subject to the public participation requirements of Title 30 Texas Administrative Code (30 TAC) Chapter 39?

☒ Yes ☐ No

(b) If yes, do you intend at this time to provide public outreach other than what is required by rule?

☐ Yes ☒ No

If Yes, please describe.

If you answered "yes" that this application is subject to 30 TAC Chapter 39, answering the remaining questions in Section 6 is not required.

(c) Will you provide notice of this application in alternative languages?

☐ Yes ☒ No

Please refer to Section 5. If more than 5% of the population potentially affected by your application is Limited English Proficient, then you are required to provide notice in the alternative language.

If yes, how will you provide notice in alternative languages?

☐ Publish in alternative language newspaper

☐ Posted on Commissioner's Integrated Database Website

☐ Mailed by TCEQ's Office of the Chief Clerk

☐ Other (specify)

(d) Is there an opportunity for some type of public meeting, including after notice?

☒ Yes ☐ No

(e) If a public meeting is held, will a translator be provided if requested?

☒ Yes ☐ No

(f) Hard copies of the application will be available at the following (check all that apply):

☐ TCEQ Regional Office ☐ TCEQ Central Office

☑ Public Place (specify) Canyon Public Library 1501 3rd Avenue, Canyon, Tx 79015

Section 7. Voluntary Submittal

For applicants voluntarily providing this Public Involvement Plan, who are not subject to formal public participation requirements.

Will you provide notice of this application, including notice in alternative languages?

☐ Yes ☐ No

What types of notice will be provided?

☐ Publish in alternative language newspaper

☐ Posted on Commissioner's Integrated Database Website

☐ Mailed by TCEQ's Office of the Chief Clerk

☐ Other (specify)

ATTACHMENT 2

SECTION 305.62(J)(2) LIMITED SCOPE MAJOR PERMIT AMENDMENT REPLACEMENT PAGES (CLEAN VERSION)

THIS ATTACHMENT INCLUDES ONLY CLEAN VERSIONS OF THE PAGES WITH REDLINE/STRIKEOUT INCLUDED IN ATTACHMENT 1.

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1663C

LIMITED SCOPE MAJOR PERMIT AMENDMENT APPLICATION

PARTS I/II
GENERAL APPLICATION REQUIREMENTS

Prepared for:

Southwest Landfill TX, LP

TCEQ Approved February 20, 2020
Revised June 2024
Revised July 2024

Revised October 2024

STATE OF TEXAS
KYLE D. GOULD
106018
LICENSED
PROFESSIONAL ENGINEER

Prepared by:

10/04/2024

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0120-094-11-140

This document intended for permitting purposes only.

2.1.3 Solid Waste Containment System

The design objective of the containment system [final cover, Subtitle D liner, pre-Subtitle D liner (overliner), and leachate management systems] is to isolate the solid waste and remove leachate (defined as a liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste) that may collect on the liner system. Two composite Subtitle D liner systems are proposed for the landfill (compacted clay, 60-mil geomembrane liner, and drainage geocomposite or geosynthetic clay liner, 60-mil geomembrane liner and drainage geocomposite). The overliner system that will be constructed over the pre-subtitle D waste disposal area and the expansion disposal area will consist of a geosynthetic clay liner (GCL), a 40-mil LLDPE geomembrane liner, and a drainage geocomposite layer. A generalized detail of the containment system for the Southwest Landfill is shown in Figure 2.1. Design information and the required QA/QC construction procedures for the individual components of the containment system are presented in Part III of this application.

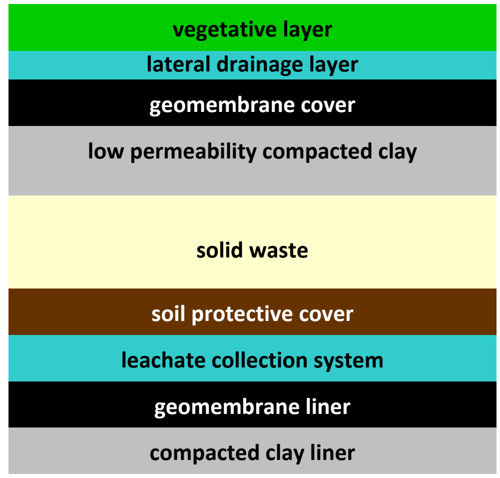


Figure 2.1. The composite liner and cover systems will be designed to meet or exceed all state and federal regulations.

2.1.4 Site Development Plan

The site development plan (SDP) is included in Part III of this application. This plan sets forth the overall design and operating characteristics of the landfill. Drawings showing the proposed landfill configuration during site development are presented in Parts I/II, Appendix I/IIA – Facility Layout Maps. A summary of the landfill configuration is provided below (refer to Figures I/II-2.6 and I/II-2.7 for additional information).

- The proposed permit boundary will include an area of 472.9 acres. The permit boundary for the existing site is listed in the existing permit (TCEQ Permit No. MSW-1663B) as 124.3 acres. Both permit boundaries are shown on Figure I/II-2.6. The legal description for the proposed permit boundary is included in Section 13 of Parts I/II.
- A summary of the capacity (volume of waste and cover soils) of the site is listed below:
  - Remaining capacity of existing site (TCEQ Permit No. MSW-1663B) = 2.6 million cubic yards (as of November 19, 2016).
  - Increase due to major permit amendment application = 52.185 million cubic yards.

- Remaining capacity of the site with the proposed expansion (TCEQ Permit No. MSW-1663C) = 54.784 million cubic yards (as of November 19, 2016). Of the total volume available for solid waste and daily cover, approximately 35.6 million cubic yards is available for Class 1 waste. Non-Class 1 waste may also be disposed of in this area. In addition, the Class 1 area may not be fully developed; therefore, to provide for a conservative analysis, the Class 1 area 4-foot-thick barrier soil and Option 2 containment dike or Option 2A soil cover system volumes are included in the remaining airspace estimate.

- The maximum elevation of the final cover will be 3,765 ft-msl, and the maximum waste elevation will be 3,760.5 ft-msl.
- The minimum elevation of the proposed landfill liner system excavation will be 3,547 ft-msl (i.e., bottom of liner system in deepest sump). This elevation represents the bottom of the liner system. As discussed in Part III, Appendix IIIA, there will be an 0.8-foot-thick recompacted clay separation zone below the 3-foot-thick compacted clay liner as part of subgrade preparation. Refer to Appendix IIID-LQCP for more information.
- A Subtitle D composite liner (2-foot-thick compacted clay liner or a GCL overlain by a 60-mil HDPE geomembrane liner for non-Class 1 areas, and 3-foot-thick compacted clay liner overlain by a 60-mil HDPE geomembrane liner in Class 1 areas) and leachate collection system will be constructed according to Title 30 TAC §330.331(a)(2) and §330.333. Details for the liner and LCS are provided in Part III, Appendix IIIA-A – Liner, Overliner, and Final Cover System Details.
- The Class 1 non-hazardous industrial solid waste area will be lined with a composite liner system consisting of a 60-mil HDPE FML overlying a 3-foot-thick compacted clay soil liner with a hydraulic conductivity of no more than $1x10^{-7}$ cm/sec. The three Class 1 waste area disposal options are shown on Drawing A.9 in Part III, Appendix IIIA-A and discussed in Part III, Appendix IIIA, Section 6.0. The Class 1 waste liner system, leachate collection system, barrier soil layer, and chimney drain system will be constructed according to Title 30 TAC §330.331(a)(2), §330.333, and §330.331(e), as detailed in Appendix IIIA and subject to the requirements of the LQCP (refer to Appendix IIID). The working faces for the Class 1 waste area and the MSW area will each have runon and runoff controls as outlined in Appendix IIIC.
- This application does include a vertical expansion over the pre-Subtitle portion of the landfill. A containment system design for this area is provided to meet the point of compliance (POC) requirements listed in Title 30 TAC §330.331(a)(1). The design includes a composite liner system and a site development sequence that will include construction of the overliner and final cover system in the pre-Subtitle D area before a significant portion of the lateral expansion area is developed. This will eliminate the potential for stormwater percolation into the pre-Subtitle D waste disposal area. The

5 PROPERTY OWNERS LIST AND MAP

This section addresses §330.59(c) and §305.45(a)(6)(D).

The following list and figure provide the names, mailing addresses, and locations of the "Adjacent and Potentially Affected Landowners" within ¼ mile of the Southwest Landfill. The numbers on the landowner list correspond to the numbers listed on Figure I/II-5.1. The list is based on records of the Potter-Randall County Appraisal District as of June 2024. Refer to Figure I/II-5.1, Property Owners Map, for location of the properties. Easement holders and mineral interest owners in accordance with Title 30 TAC §330.59(c)(3) are also listed in Table 5-1.

TABLE 5-1
PROPERTY OWNERS LIST

1. SOUTHWEST LANDFILL TX LP
   C/O REPUBLIC SERVICES PROPERTY TAX
   PO BOX 29246
   PHOENIX AZ 85038-9246

2. CITY OF CANYON
   301 16TH ST
   CANYON TX 79015-2828

3. ATTEBURY ELEVATORS LLC
   7830 HILLSIDE RD
   SUITE 300
   AMARILLO TX 79119-7875

4. PISTOCCO FAMILY PARTNERSHIP LTD
   PO BOX 51178
   AMARILLO TX 79159-1178

5. MARK HUGHES
   PO BOX 1041
   CANYON TX 79015-1041

6. ALLEN FAMILY TRUST
   20050 ARROWHEAD RD
   CANYON TX 79015-5840

7. CANYON COUNTRY CLUB
   19501 CHAPARRAL RD
   CANYON TX 79015-5862

8. RANDY TOOLEY
   19525 CHAPARRAL RD
   CANYON TX 79015-5862

9. RAY BRADLEY
   19850 ARROWHEAD RD
   CANYON TX 79015-5841

10. BILLY POPE
    19421 ROBIN ST
    CANYON TX 79015-5850

11. DARRELL E FRANKLIN
    19431 ROBIN ST
    CANYON TX 79015-5850

12. SUZANNE CARLETON RATCLIFF
    19441 ROBIN ST
    CANYON TX 79015-5850

13. RICHARD N STAFFORD
    19401 MOCKINGBIRD RD
    CANYON TX 79015-5849

14. DARRELL E FRANKLIN
    19431 ROBIN ST
    CANYON TX 79015-5850

15. STEVE BRYAN MALCOM
    11000 CCC LOOP
    CANYON TX 79015-5619

16. MARK A MUEHLING
    10801 CCC LOOP
    CANYON TX 79015-5837

17. JOHN P WIRCK
    8300 ADDISON DR
    AMARILLO TX 79119-7457

18. BO DEAN SIMON
    PO BOX 61
    LOMA CO 81524-0061

19. CARLA SUE RITTENBERRY
    PO BOX 248
    CANYON TX 79015-0248

20. HARRY H THWEATT
    11011 CCC LOOP
    CANYON TX 79015-5852

TABLE 5-1
PROPERTY OWNERS LIST (CONTINUED)

21. NO RECORD AVAILABLE

22. JARED LEE
11441 CCC LOOP
CANYON TX 79015-5851

23. SCOTT A ANKENEY
11350 CCC LOOP
CANYON TX 79015-1646

24. DON MASON
11500 CCC LOOP
CANYON TX 79015-1647

25. BRANDON CONRAD
11901 W COUNTRY CLUB RD
CANYON TX 79015-5835

26. NEAL E HINDERS
11691 W COUNTRY CLUB RD
CANYON TX 79015-5845

27. TEXAS 5G LTD
PO BOX 7366
AMARILLO TX 79114-7366

28. DAVID WINTERS
11400 W COUNTRY CLUB RD
CANYON TX 79015-5834

29. JAMES L MCCLURE
2000 JULIAN BLVD
AMARILLO TX 79102-1405

30. TRISTA LYNN MILLS
19001 HELIUM RD
CANYON TX 79015-5832

31. KENNETH E SMART
PO BOX 267
CANYON TX 79015-0267

32. JAMES S WOODARD
9900 W COUNTRY CLUB RD
CANYON TX 79015-5831

33. PALLA FAMILY TRUST
902 COLONIAL PKWY
CLOVIS NM 88101-3006

34. JOHN E HAMM
4 WILLIAM LN
CANYON TX 79015-6497

35. NO RECORD AVAILABLE

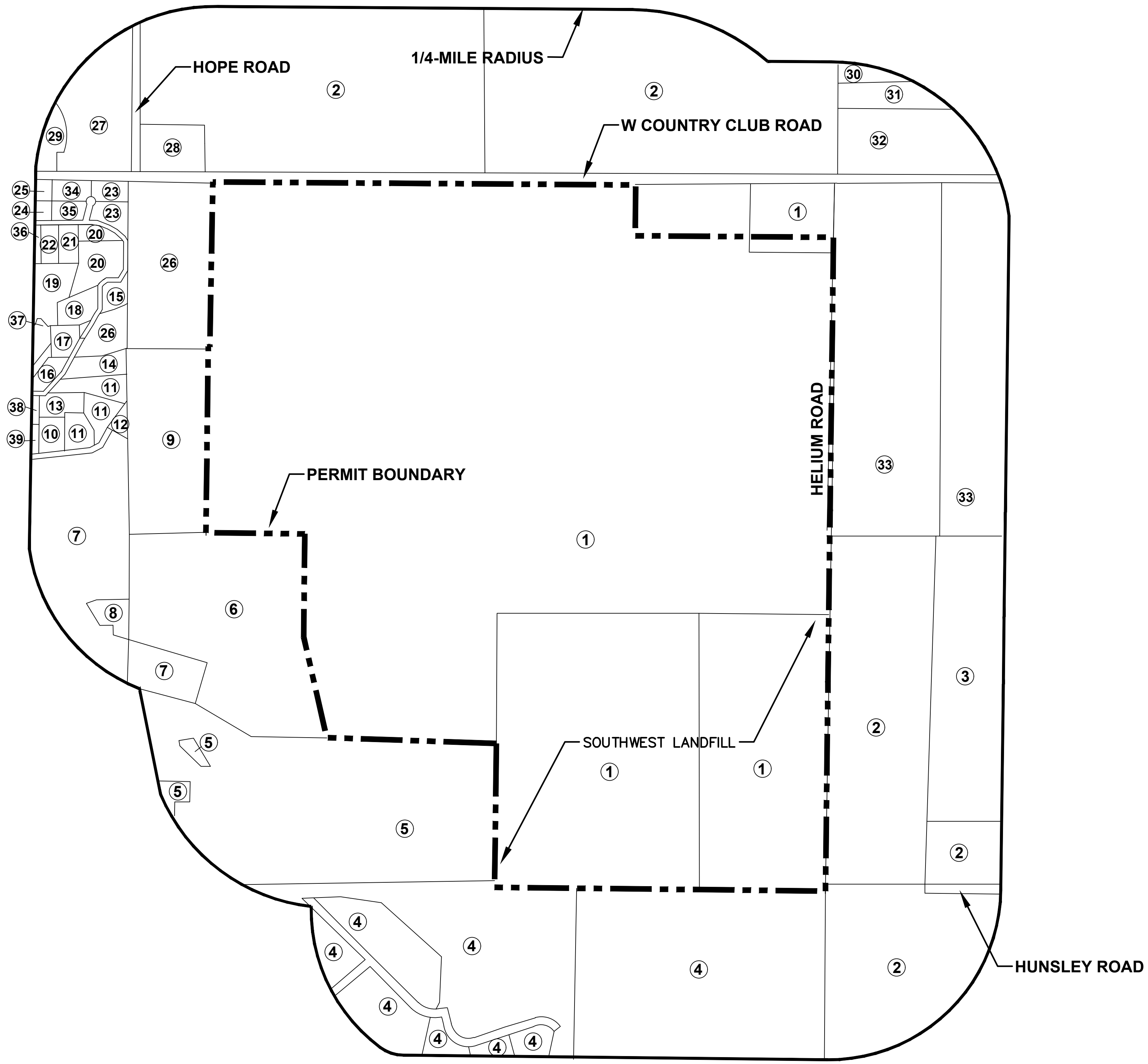
36. LANDON GHEER
19127 CLUB RIM DR
CANYON TX 79015-5871

37. MICHAEL D BELLAH
19621 QUAIL TR
CANYON TX 79015-5875

TABLE 5-1
PROPERTY OWNERS LIST (CONTINUED)

38. THOMAS A SAMES
    PO BOX 1156
    CANYON TX 79015-1156

39. MARC D IRWIN
    STEPHANIE LANE IRWIN
    19420 MOCKINGBIRD RD
    CANYON TX 79015-5848



N

0 500 1000
SCALE IN FEET

LEGEND

PERMIT BOUNDARY

ADJACENT LANDOWNERS DIVISION

NOTES:

1. ① REFERS TO LAND OWNERS LISTED ON LANDOWNERS LIST. LANDOWNER INFORMATION OBTAINED FROM POTTER–RANDALL APPRAISAL DISTRICT.
2. THIS LINE REPRESENTS A 1/4 MILE DISTANCE FROM THE OF THE PERMIT BOUNDARY.

STATE OF TEXAS
KYLE D. GOULD
106018
LICENSED
PROFESSIONAL ENGINEER

07/09/2024

☐ DRAFT
☒ FOR PERMITTING PURPOSES ONLY
☐ ISSUED FOR CONSTRUCTION

DATE: 11/2017
FILE: 0120–094–11
CAD: 5.1–PROPERTY OWNERS.DWG

DRAWN BY: JDW
DESIGN BY: CCH
REVIEWED BY: JAE

Weaver Consultants Group
TBPE REGISTRATION NO. F–3727

PREPARED FOR
SOUTHWEST LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION
1	06/2024	PERMIT MODIFICATION
2	07/2024	PERMIT MODIFICATION

MAJOR PERMIT AMENDMENT
PROPERTY OWNERS MAP

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS

WWW.WCGRP.COM

FIGURE I/II–5.1

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1663C

LIMITED SCOPE MAJOR PERMIT AMENDMENT APPLICATION

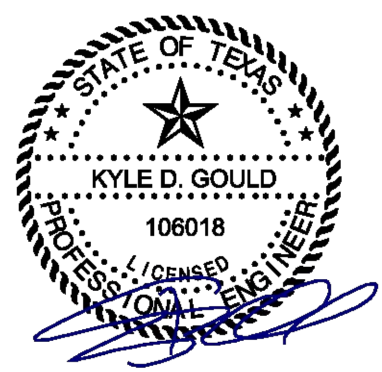
PART III – SITE DEVELOPMENT PLAN
SITE DEVELOPMENT PLAN NARRATIVE

Prepared for

Southwest Landfill TX, LP

TCEQ Approved February 20, 2020

Revised June 2024



06/13/2024

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. 0120-094-11-140

This document is intended for permitting purposes only.

The landfill drawings depicting existing site conditions, excavation, final fill height, sector fill layout, sector sections, sequence of development plans, site contour maps, and landfill completion plan are included in Parts I/II, Appendix I/IIA – Facility Layout Maps.

The excavation side slopes will be no steeper than 3 horizontal to 1 vertical (3H:1V), the aerial fill side slopes will be approximately 4H:1V, and the aerial fill top slope will be approximately 5 percent. Final cover placement will generally follow the sequence of development as shown in Parts I/II, Drawings I/IIA.4 through I/IIA.7, and will be ongoing as the site is developed. Sectors will be closed according to the closure plan provided in Part III, Appendix IIIJ – Closure Plan.

4.3 Liner and Final Cover System Design (§330.63(d)(4)(C))

4.3.1 Liner System for the Undeveloped Portion of the Solid Waste Disposal Area

The proposed composite liner systems are designed to meet the requirements of Title 30 TAC §330.331(a)(1), §330.331(a)(2), and §330.331(e). The composite liner system options that will be constructed within the undeveloped sectors are described below.

Table III-1
Liner System Components

Standard Subtitle D Composite Liner System (MSW Area)	Alternative Subtitle D Liner System (MSW Area)	Subtitle D Class 1 Composite Liner System (Class 1 Areas)
24-inch-thick Soil Protective Cover	24-inch-thick Soil Protective Cover	24-inch-thick Soil Protective Cover
Drainage Geocomposite Leachate Collection System Layer	Drainage Geocomposite Leachate Collection System Layer	Drainage Geocomposite Leachate Collection System Layer
60-mil HDPE Geomembrane	60-mil HDPE Geomembrane	60-mil HDPE Geomembrane
2-foot-thick Compacted Clay Liner (CCL)	Geosynthetic Clay Liner (GCL)	3-foot-thick CCL

A summary of the liner system design for proposed liner areas and existing constructed areas and the liner system details are included in Part III, Appendix IIIA – Landfill Unit Design Information. Information regarding liner materials and construction quality assurance are included in Part III, Appendix IIID – Liner Quality Control Plan. The elevation of the deepest excavation is 3,547 ft-msl, which occurs in Sectors 17 through 29.

4.3.2 Overliner System for the Pre-Subtitle D Area

The proposed overliner system for the pre-Subtitle D area of the landfill is designed consistent with Title 30 TAC §330.331(a)(1). The proposed system is designed to convey leachate generated over the existing pre-Subtitle D area to leachate collection

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1663C

LIMITED SCOPE MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIA
LANDFILL UNIT DESIGN INFORMATION

Prepared for

Southwest Landfill TX, LP

TCEQ Approved February 20, 2020

Revised June 2024

STATE OF TEXAS
KYLE D. GOULD
106018
LICENSED
PROFESSIONAL ENGINEER

Prepared by

06/13/2024

Weaver Consultants Group, LLC
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6420 Southwest Boulevard, Suite 206
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817-735-9770

WCG Project No. 0120-094-11-140

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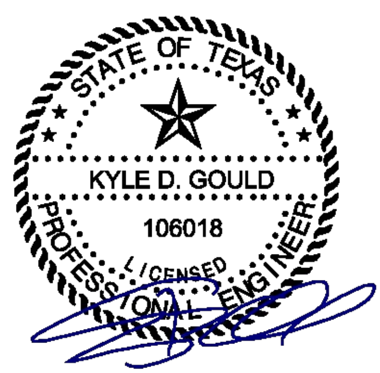
CONTENTS



06/13/2024

2 PROPOSED LINER SYSTEMS FOR THE SUBTITLE D AREAS

The proposed composite liner systems are designed to meet the requirements of Title 30 TAC §330.331(a)(1), §330.331(a)(2), and §330.331(e). The composite liner system options that will be constructed within the undeveloped sectors are described below.

Table IIIA-1
Liner System Components

Standard Subtitle D Composite Liner System (MSW Only Area)	Alternative Subtitle D Liner System (MSW Only Area)	Subtitle D Composite Liner System (Class 1 Areas)
24-inch-thick Soil Protective Cover	24-inch-thick Soil Protective Cover	24-inch-thick Soil Protective Cover
Drainage Geocomposite Leachate Collection System Layer	Drainage Geocomposite Leachate Collection System Layer	Drainage Geocomposite Leachate Collection System Layer
60-mil HDPE Geomembrane	60-mil HDPE Geomembrane	60-mil HDPE Geomembrane
2-foot-thick Compacted Clay Liner (CCL)	Geosynthetic Clay Liner (GCL)	3-foot-thick CCL (See Note 1)

1. There will 0.8 feet of recompacted separation clay placed below the 3-foot-thick CCL as part of subgrade preparation. Refer to IIID-LQCP for more information.

Drawing A.1 (Appendix IIIA-A) details the excavation plan for the undeveloped areas at the Southwest Landfill. The areas designated for Class 1 waste disposal are also shown on Drawings A.3 and A.4 in Appendix IIIA-A (refer to Section 6.0 for more information). As shown on Drawing A.1, the elevation of deepest excavation is 3,547 ft-msl, which corresponds to a minimum elevation of waste placement of 3,555 ft-msl.

As shown on Typical Sections A through F (Figures B.6 through B.11 in Appendix IIIA-B) and on Drawing A.1 in Appendix IIIA-A, the existing permitted waste disposal area will be expanded with this major permit amendment application. The existing limits of waste will be expanded in the northern and southeastern portions of the site. The existing limits of waste will be expanded by approximately 232.7 acres.

The proposed liner system, as shown on Drawings A.6 through A.8 in Appendix IIIA-A, is designed with a leachate collection system. The design of the leachate collection system components, including the drainage geocomposite leachate collection layer, leachate collection piping, chimney drains, sumps, and pumps, are provided in Appendix IIIC – Leachate and Contaminated Water Management Plan. Material specifications, construction, and testing requirements for the leachate collection system are provided in Appendix IIID – LQCP. The alternative liner demonstration is provided in Appendix IIIB – Overliner Point of Compliance Demonstration.

A geotechnical report including a stability demonstration for the liner system is provided in Appendix IIIE – Geotechnical Report. A summary of the liner design information that is included in the Geotechnical Report is provided below.

- **Excavation Stability.** The stability of the proposed excavation slopes was evaluated at the most critical sections (i.e., where the 3H:1V sideslopes are the longest). The excavation slopes were analyzed using undrained strength parameters (total stress) as well as drained strength parameters (effective stress). The slope stability analysis resulted in an acceptable factor of safety for each analyzed condition. All factors of safety generated were greater than the minimum recommended factor of safety of 1.3 for short-term and 1.5 for long-term conditions.
- **Liner System Stability.** In addition to the generalized slope stability summarized above, the interfaces of the components of the liner systems were evaluated using infinite slope stability analysis. All the calculated factor of safety values for interface slope stability are acceptable. The GCL alternative liner has the same strength properties as the overliner system and liner system, and therefore the infinite slope stability analysis is representative of both the subtitle D clay liner and the GCL alternative liner.
- **Liner System Settlement and Strain Analysis.** The liner system was evaluated for settlement and strain due to loading of liner soil, waste, and cover soils. The maximum strain on the liner system caused by the estimated differential settlement is within the acceptable range for each liner system component. The analysis is representative of both the subtitle D clay liner and GCL alternative liner.

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1663C

LIMITED SCOPE MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIA-A
LINER, OVERLINER, AND FINAL COVER
SYSTEM DETAILS

Prepared for

Southwest Landfill TX, LP

TCEQ Approved February 20, 2020

Revised June 2024

STATE OF TEXAS
KYLE D. GOULD
106018
LICENSED
PROFESSIONAL ENGINEER

06/13/2024

Prepared by

Weaver Consultants Group, LLC
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6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0120-094-11-140

This document is intended for permitting purposes only.

CONTENTS

STATE OF TEXAS
KYLE D. GOULD
106018
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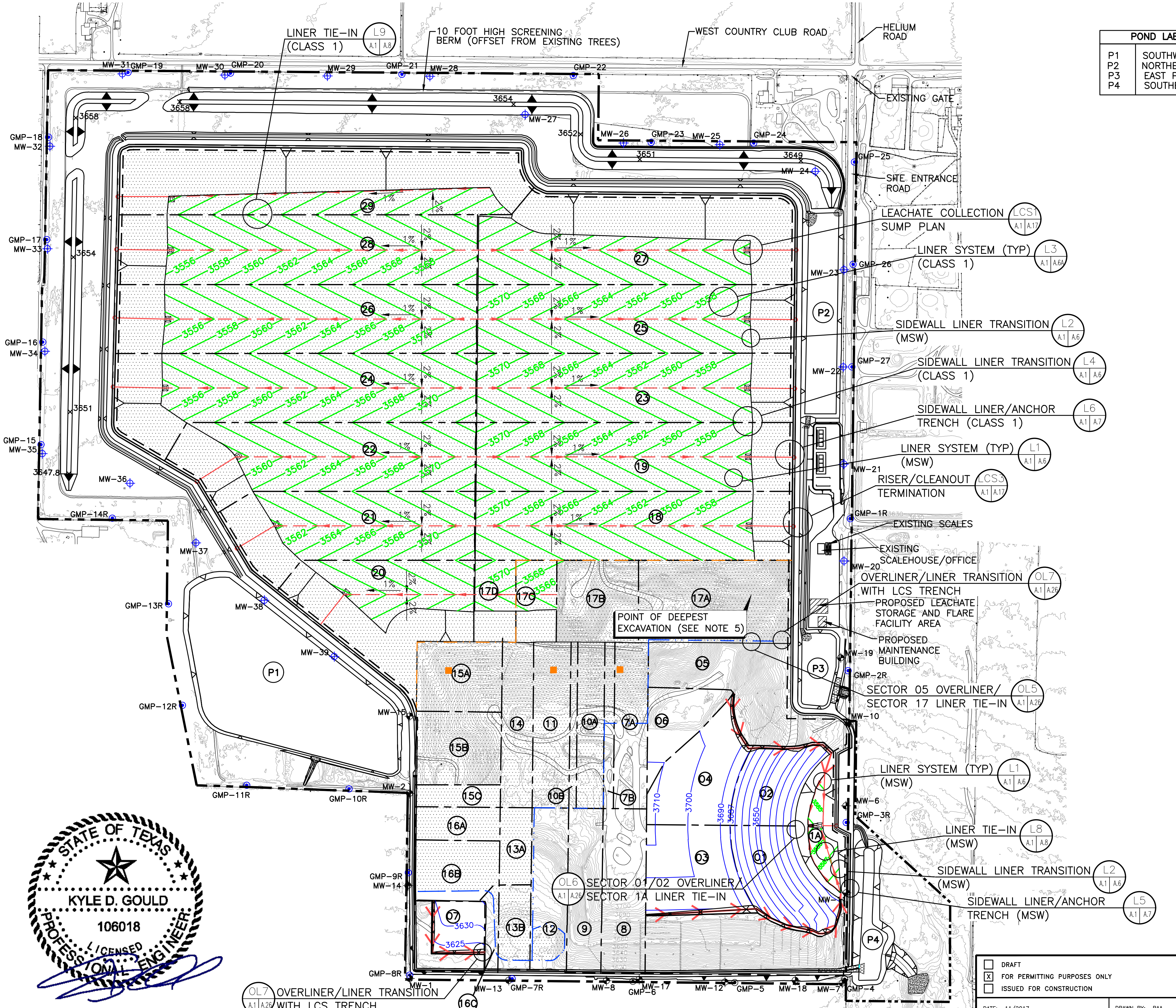
PROFESSIONAL ENGINEER

06/13/2024



STATE OF TEXAS
KYLE D. GOULD
106018
LICENSED
PROFESSIONAL ENGINEER

06/13/2024

POND LABELS	
P1	SOUTHWEST POND
P2	NORTHEAST POND
P3	EAST POND
P4	SOUTHEAST POND

LEGEND

- PERMIT BOUNDARY
- LIMIT OF WASTE
- DRAINAGE EASEMENT
- N 3648000 STATE PLANE COORDINATE
- 35°00'30" GEODETIC COORDINATE
- 3660 EXISTING CONTOUR
- EASEMENT
- SECTOR BOUNDARY
- 7A SECTOR DESIGNATION
- 3560 EXCAVATION CONTOUR
- 3690 TOP OF OVERLINER CONTOUR
- LEACHATE COLLECTION PIPE
- LEACHATE COLLECTION SUMP
- VERTICAL LEACHATE SUMP
- LEACHATE CLEANOUT RISER
- LEACHATE COLLECTION PIPE
- CLASS 1 NON-HAZARDOUS INDUSTRIAL SOLID WASTE DISPOSAL AREA (SEE NOTE 7)
- LIMIT OF CLASS 1 WASTE
- LIMIT OF ALTERNATIVE LINER (SEE NOTE 9)
- MW-2 EXISTING GROUNDWATER MONITOR WELL
- MW-24 PROPOSED GROUNDWATER MONITOR WELL
- GMP-4 EXISTING LANDFILL GAS MONITOR PROBE
- GMP-26 PROPOSED LANDFILL GAS MONITOR PROBE
- P1 STORMWATER DETENTION POND

N

0 300 600
SCALE IN FEET

NOTE:

1. CONTOURS AND ELEVATIONS PROVIDED BY FIRMATEK, LLC. FROM AERIAL PHOTOGRAPHY FLOWN 11-13-2023. THE GRID SYSTEM (STATE PLANE COORDINATE SYSTEM) IS TIED TO THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH ZONE NAD 83.
2. PROPOSED PERMIT BOUNDARY WAS PREPARED BY WEAVER CONSULTANTS GROUP IN NOVEMBER 2017.
3. SEE APPENDIX IIIC FOR STORAGE TANK INFORMATION.
4. THE ELEVATION OF DEEPEST EXCAVATION AT LCS SUMPS IS 3547 FT-MSL. THE MINIMUM ELEVATION OF WASTE PLACEMENT IS 3555 FT-MSL.
5. SUBTITLE D AREA LCS PIPES SLOPE WITH A MINIMUM OF 1% TO SUMPS. LCS LATERAL DRAINAGE SLOPE IS A MINIMUM OF 1% ALONG THE FLOW PATH. OVERLINER LCS SLOPES ARE SHOWN ON DRAWING A.2.
6. SEQUENCE OF SITE DEVELOPMENT IS PROVIDED IN PARTS I/II, APPENDIX I/IIA.
7. CLASS 1 NON HAZARDOUS INDUSTRIAL WASTE (NOT CLASSIFIED AS SUCH DUE TO ASBESTOS CONTENT) WILL BE DEVELOPED ONLY IN SECTORS 7, 10, 11, AND 12 THROUGH 29.
8. EXCAVATION CONTOURS FOR THE EXISTING CONSTRUCTED AREA ARE SHOWN ON FIGURE I/II-3.3 IN PARTS I/II.
9. A STANDARD OR ALTERNATIVE SUBTITLE D LINER SYSTEM MAY BE INSTALLED IN SECTORS 17D THROUGH 29. IF AN ALTERNATIVE SUBTITLE D LINER IS INSTALLED, THAT AREA WILL ONLY RECEIVE MSW WASTE.

SHEET IIIA-A.1

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DATE: 11/2017
FILE: 0120-094-11
CAD: A.1-EXCAVATION.dwg

DRAWN BY: RAA
DESIGN BY: BPY
REVIEWED BY: KDG

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MAJOR PERMIT AMENDMENT EXCAVATION PLAN

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DRAWING A.1

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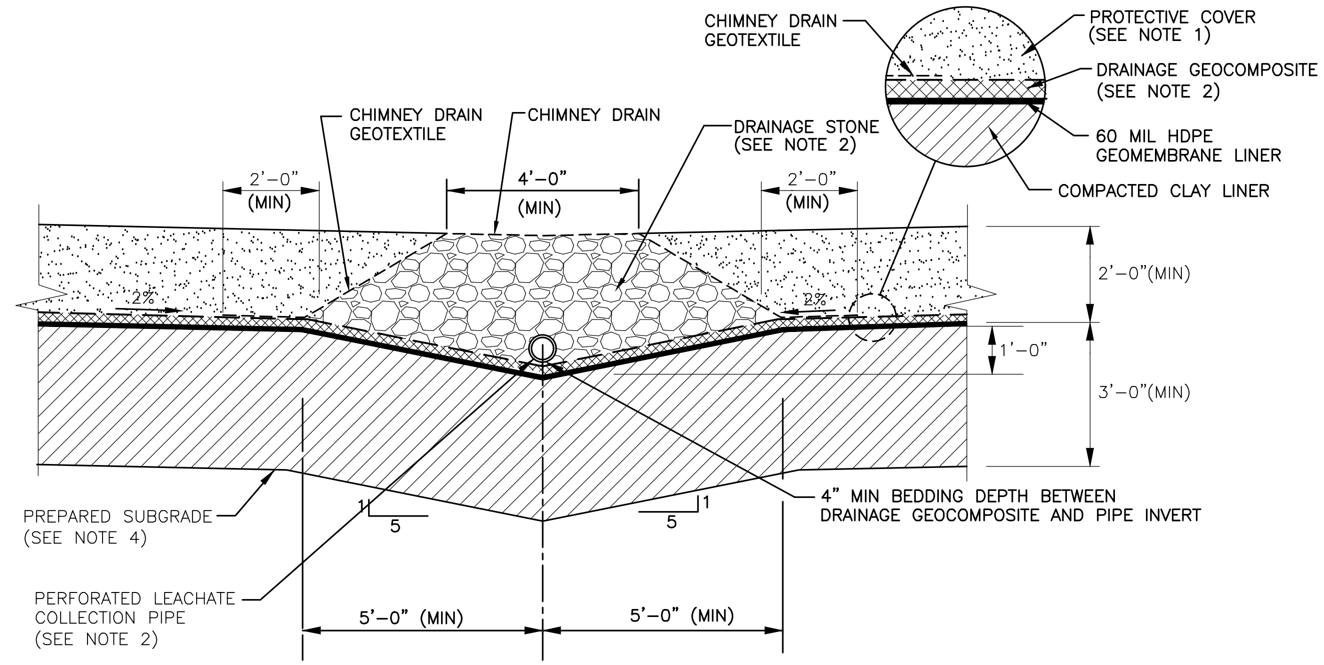
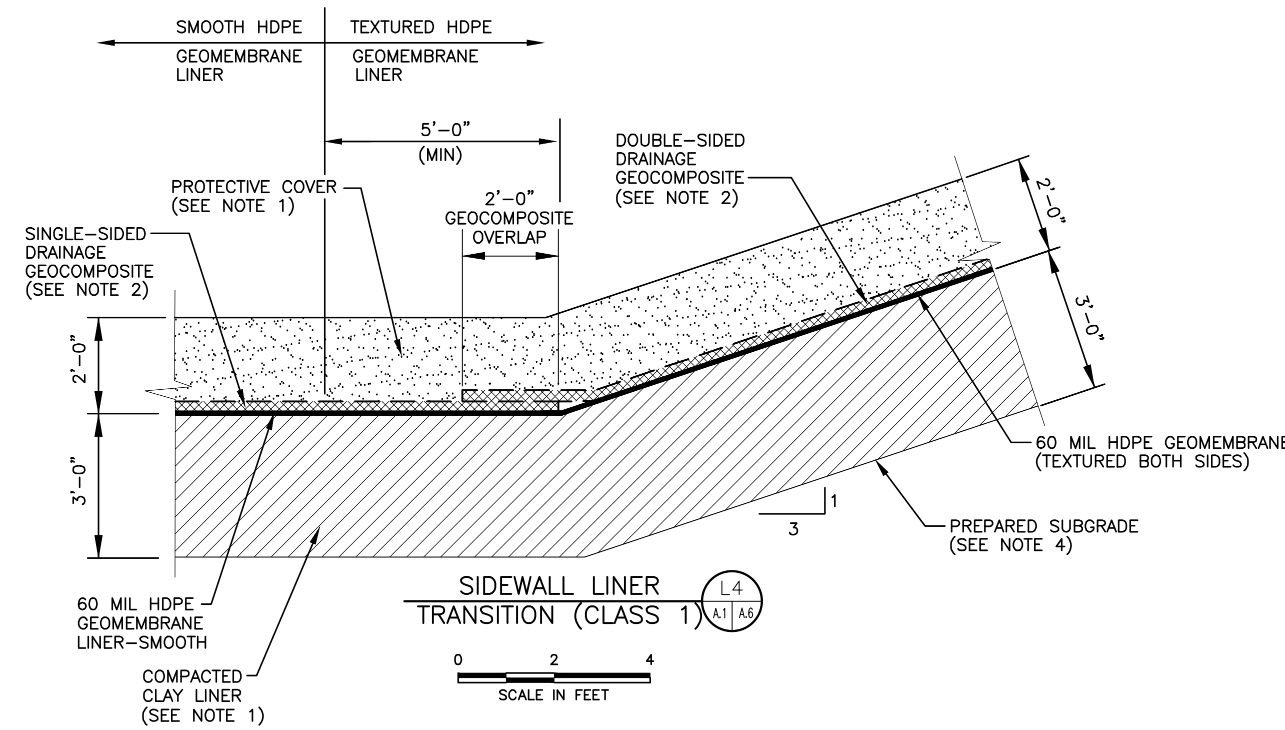


LINER SYSTEM (TYP)
(CLASS 1)
L3 A.1 A.6

0 2 4
SCALE IN FEET



SIDEWALL LINER
TRANSITION (CLASS 1)
L4 A.1 A.6

0 2 4
SCALE IN FEET

NOTES:

1. SUBGRADE PREPARATION, CONSTRUCTION OF THE COMPACTED CLAY LINER, GEOMEMBRANE LINER, AND PLACEMENT OF PROTECTIVE COVER WILL BE IN ACCORDANCE WITH THE LQCP.
2. DESIGN INFORMATION FOR THE LEACHATE COLLECTION SYSTEM (LCS) COMPONENTS ARE INCLUDED IN APPENDIX IIIC–LEACHATE AND CONTAMINATED WATER MANAGEMENT PLAN. SPECIFICATIONS FOR LCS COMPONENTS ARE INCLUDED IN APPENDIX IIID–LQCP. DRAINAGE GEOCOMPOSITE FOR UNDEVELOPED LINER AREAS CONSISTS OF A 250–MIL GEONET WITH 6 OZ/SY GEOTEXTILE HEAT BONDED ON THE TOP SIDE FOR THE BOTTOM LINER AND HEAT BONDED GEOTEXTILE (6 OZ/SY) ON BOTH SIDES FOR GEOCOMPOSITE ON 3H:1V SIDESLOPES.
3. DEPENDING ON THE SLOPE, SMOOTH OR TEXTURED HDPE GEOMEMBRANE WILL BE USED, REFER TO SECTION 3 OF APPENDIX IIID–LQCP.
4. FOR SUBGRADE PREPARATION IN CLASS 1 AREAS REFER TO APPENDIX IIID, SECTION 2.3.1.1.

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SHEET IIIA–A.6A

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DRAWN BY: JDW
DESIGN BY: MDM
REVIEWED BY: JAE

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MAJOR PERMIT AMENDMENT
LINER SYSTEM DETAILS

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RANDALL COUNTY, TEXAS

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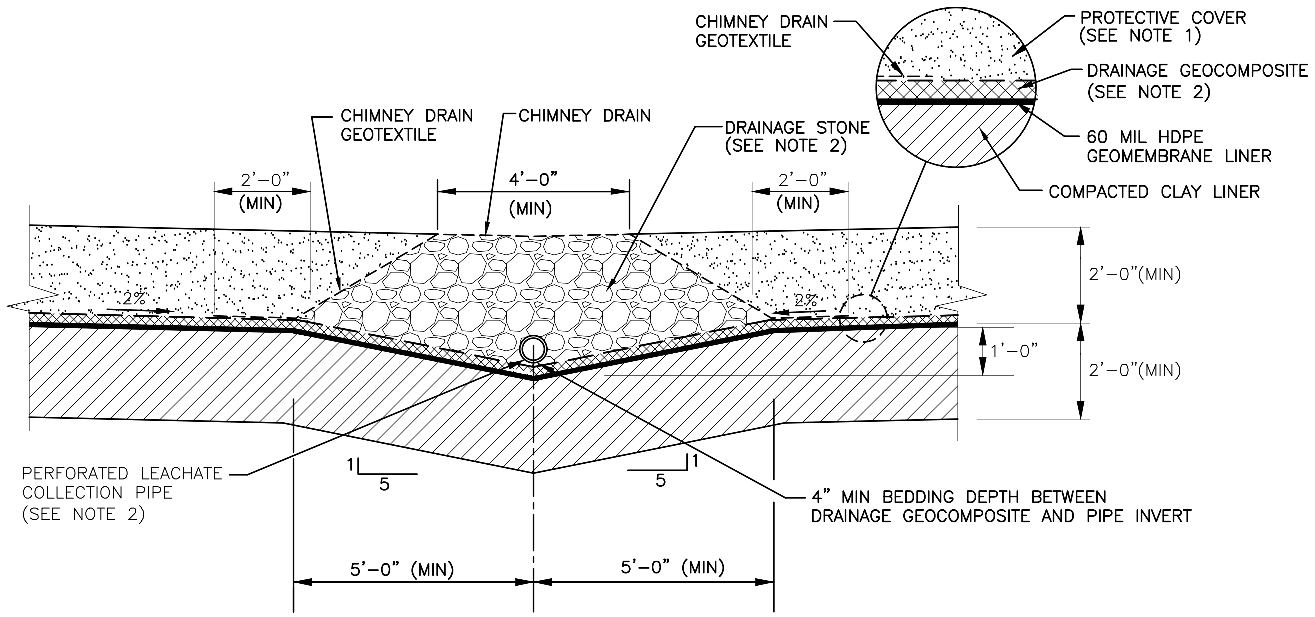
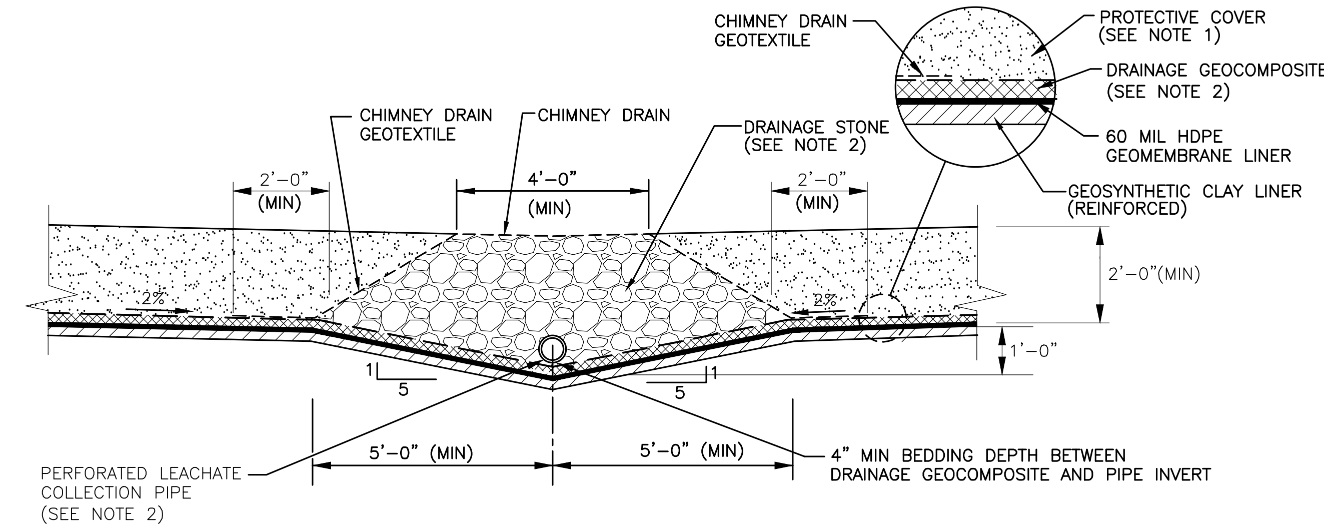
DRAWING A.6A



COMPACTED CLAY LINER OPTION

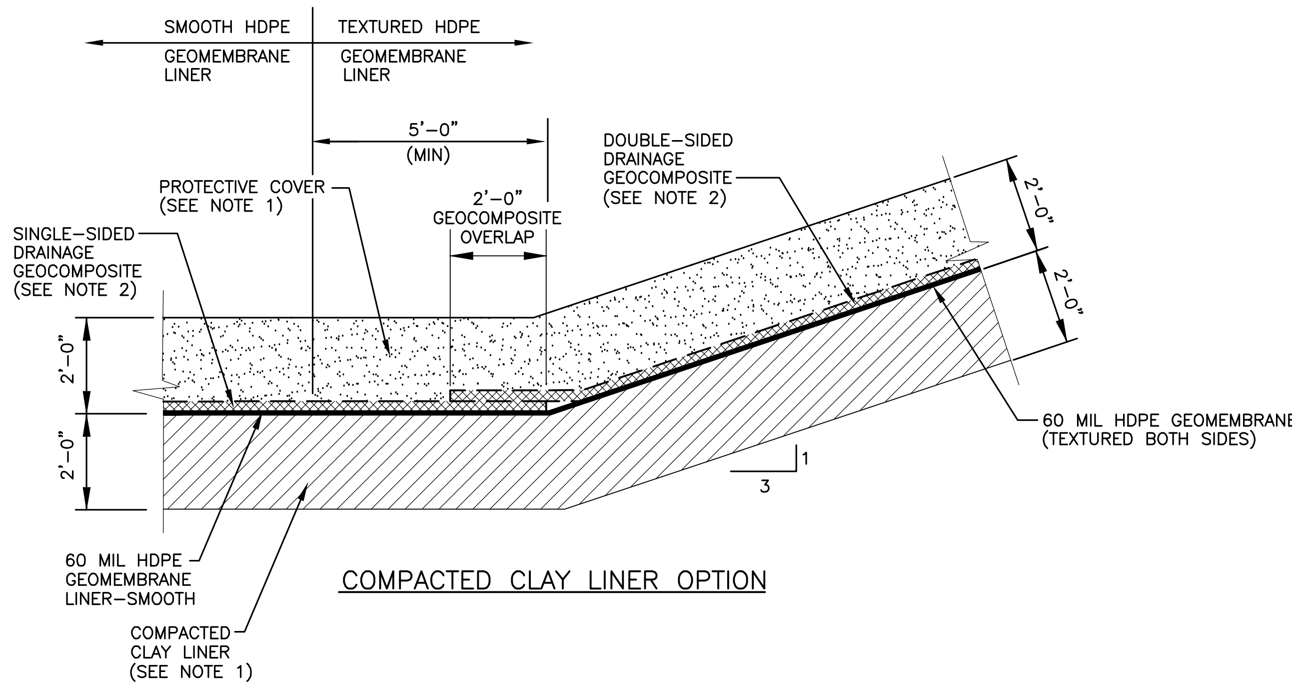


GCL OPTION

LINER SYSTEM (TYP) (MSW)

L1 A.1 A.6

0 2 4
SCALE IN FEET



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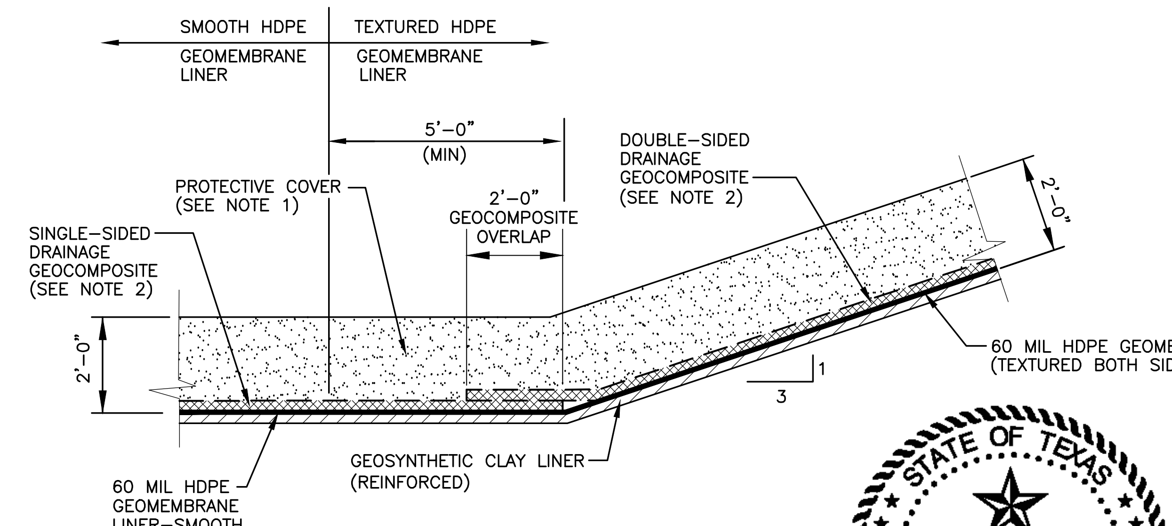

GCL OPTION

SIDEWALL LINER TRANSITION (MSW)

L2 A.1 A.6

0 2 4
SCALE IN FEET

STATE OF TEXAS
KYLE D. GOULD
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LICENSED
PROFESSIONAL ENGINEER

06/13/2024

NOTES:

1. SUBGRADE PREPARATION, CONSTRUCTION OF THE COMPACTED CLAY LINER, GEOSYNTHETIC CLAY LINER, GEOMEMBRANE LINER, AND PLACEMENT OF PROTECTIVE COVER WILL BE IN ACCORDANCE WITH THE LQCP.
2. DESIGN INFORMATION FOR THE LEACHATE COLLECTION SYSTEM (LCS) COMPONENTS ARE INCLUDED IN APPENDIX IIIC–LEACHATE AND CONTAMINATED WATER MANAGEMENT PLAN. SPECIFICATIONS FOR LCS COMPONENTS ARE INCLUDED IN APPENDIX IIID–LQCP. DRAINAGE GEOCOMPOSITE FOR UNDEVELOPED LINER AREAS CONSISTS OF A 250–MIL GEONET WITH 6 OZ/SY GEOTEXTILE HEAT BONDED ON THE TOP SIDE FOR THE BOTTOM LINER AND HEAT BONDED GEOTEXTILE (6 OZ/SY) ON BOTH SIDES FOR GEOCOMPOSITE ON 3H:1V SIDESLOPES.
3. DEPENDING ON THE SLOPE, SMOOTH OR TEXTURED HDPE GEOMEMBRANE WILL BE USED, REFER TO SECTION 3 OF APPENDIX IIID–LQCP.

SHEET IIIA–A.6

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DRAWN BY: JDW
DESIGN BY: MDM
REVIEWED BY: JAE

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MAJOR PERMIT AMENDMENT
LINER SYSTEM DETAILS

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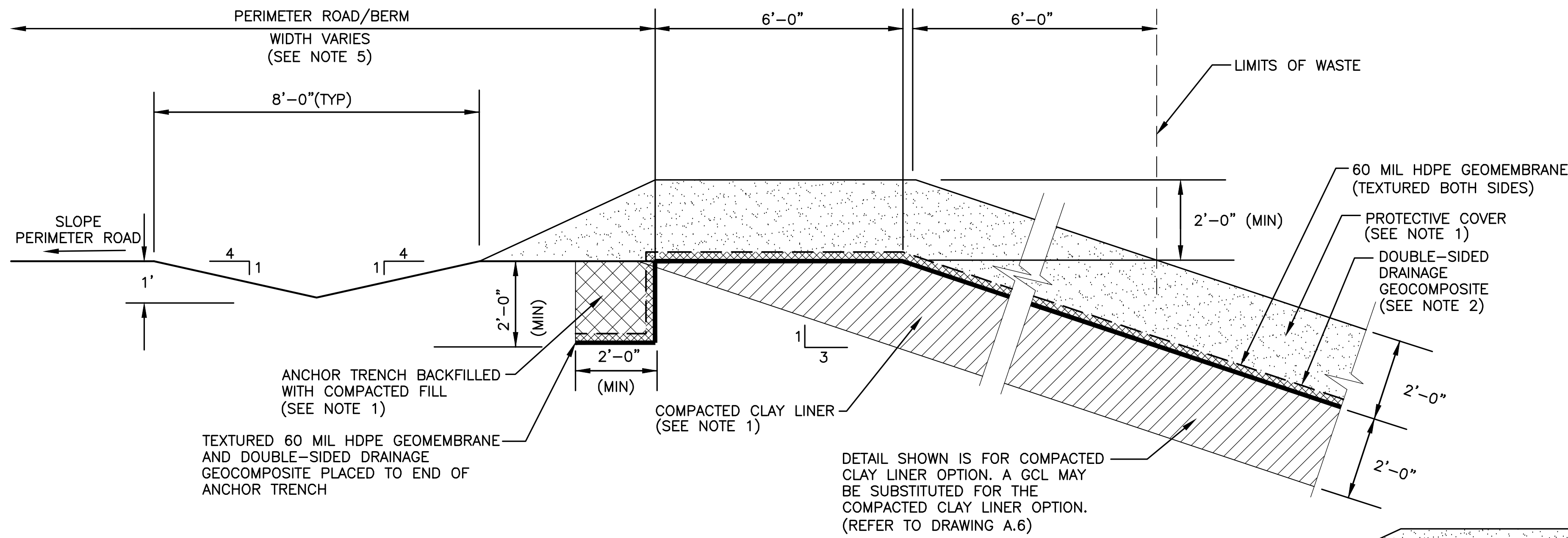
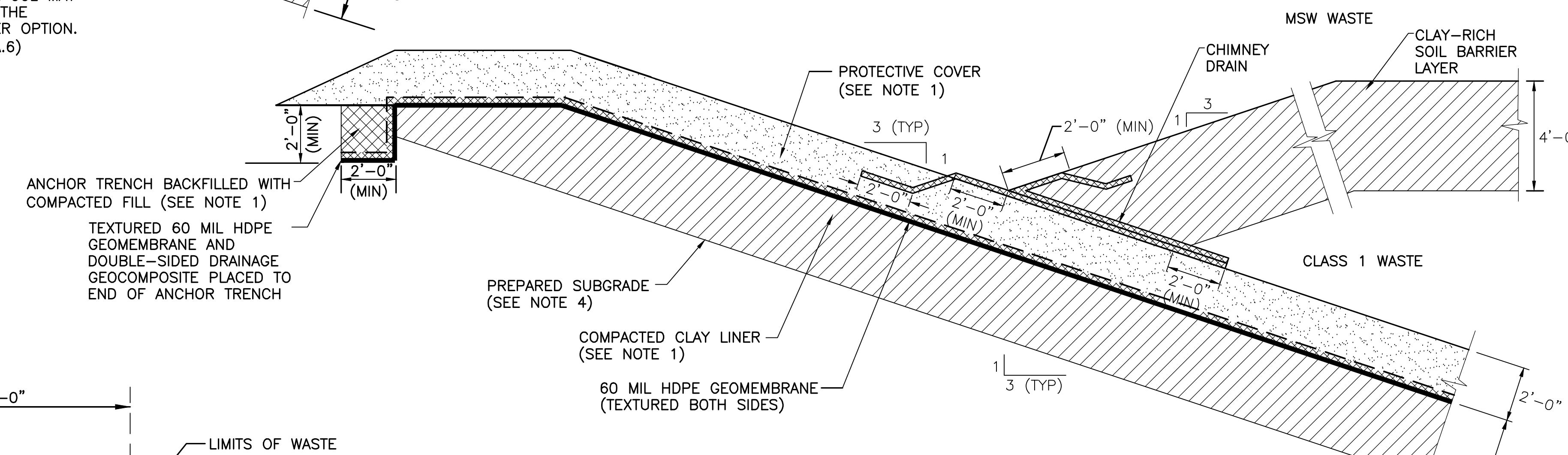
DRAWING A.6

O:\0120\94\LSMPA 2024\PART III\IIIA\A\CLEAN\A.6-LINER SYSTEM DETAILS.dwg, byoung, 1:2



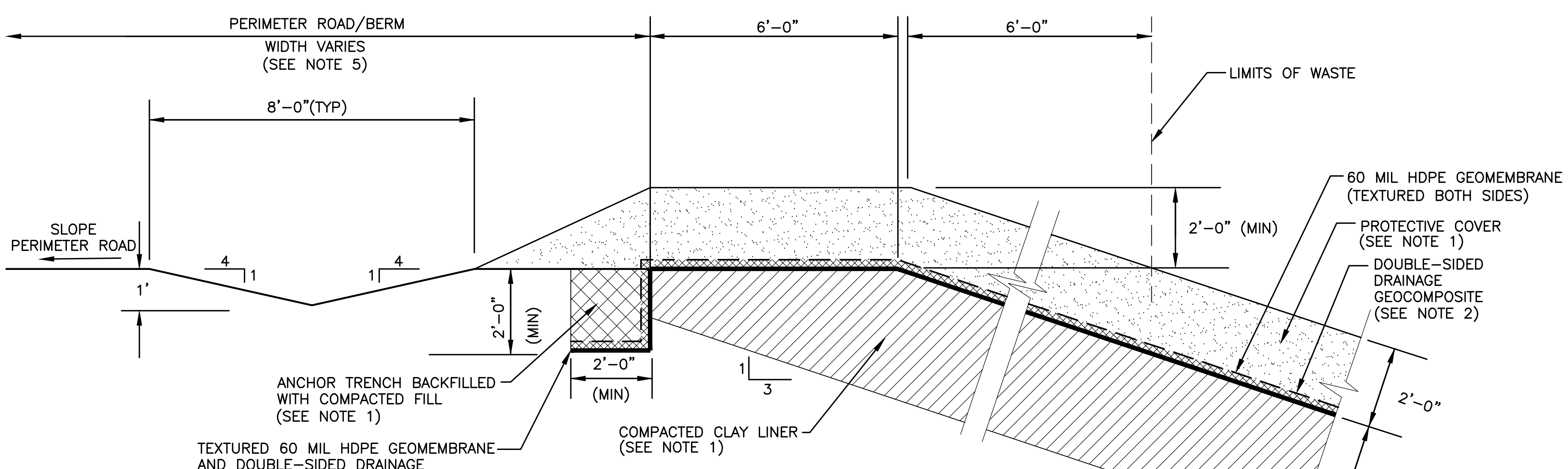
SIDEWALL LINER/ANCHOR TRENCH (MSW) L5 A.7 A.1,A.23

0 2 4 SCALE IN FEET



SIDEWALL LINER/CHIMNEY DRAIN (BELOW-GRADE CLASS 1 DISPOSAL OPTION) L7 A.3 A.7

0 3 6 SCALE IN FEET



SIDEWALL LINER/ANCHOR TRENCH (CLASS 1) L6 A.7 A.1,A.23

0 2 4 SCALE IN FEET

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PROFESSIONAL ENGINEER
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NOTES:

1. SUBGRADE PREPARATION, CONSTRUCTION OF THE COMPACTED CLAY LINER, GEOSYNTHETIC CLAY LINER, GEOMEMBRANE LINER, AND PLACEMENT OF PROTECTIVE COVER WILL BE IN ACCORDANCE WITH THE LQCP.
2. DESIGN INFORMATION FOR THE LEACHATE COLLECTION SYSTEM (LCS) COMPONENTS ARE INCLUDED IN APPENDIX IIIC-LEACHATE AND CONTAMINATED WATER MANAGEMENT PLAN. SPECIFICATIONS FOR LCS COMPONENTS ARE INCLUDED IN APPENDIX IIID-LQCP. DRAINAGE GEOCOMPOSITE FOR UNDEVELOPED LINER AREAS CONSISTS OF A 250-MIL GEONET WITH 6 OZ/SY GEOTEXTILE HEAT BONDED ON THE TOP SIDE FOR THE BOTTOM LINER AND HEAT BONDED GEOTEXTILE (6 OZ/SY) ON BOTH SIDES FOR GEOCOMPOSITE ON 3H:1V SIDESLOPES.
3. DEPENDING ON THE SLOPE, SMOOTH OR TEXTURED HDPE GEOMEMBRANE WILL BE USED, REFER TO SECTION 3 OF APPENDIX IIID-LQCP.
4. FOR SUBGRADE PREPARATION IN CLASS 1 AREAS REFER TO APPENDIX IIID, SECTION 2.3.1.1.
5. THE PERMITTED WIDTH OF THE PERIMETER ROAD AROUND THE EXISTING LANDFILL IS 15 FEET. THE PROPOSED WIDTH OF THE PERIMETER ROAD AROUND THE EXPANSION AREA IS 30 FEET.

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CAD: A.7 LINER DETAILS.dwg

DRAWN BY: JDW
DESIGN BY: MDM
REVIEWED BY: JAE

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LINER SYSTEM DETAILS

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SHEET IIIA-A.7

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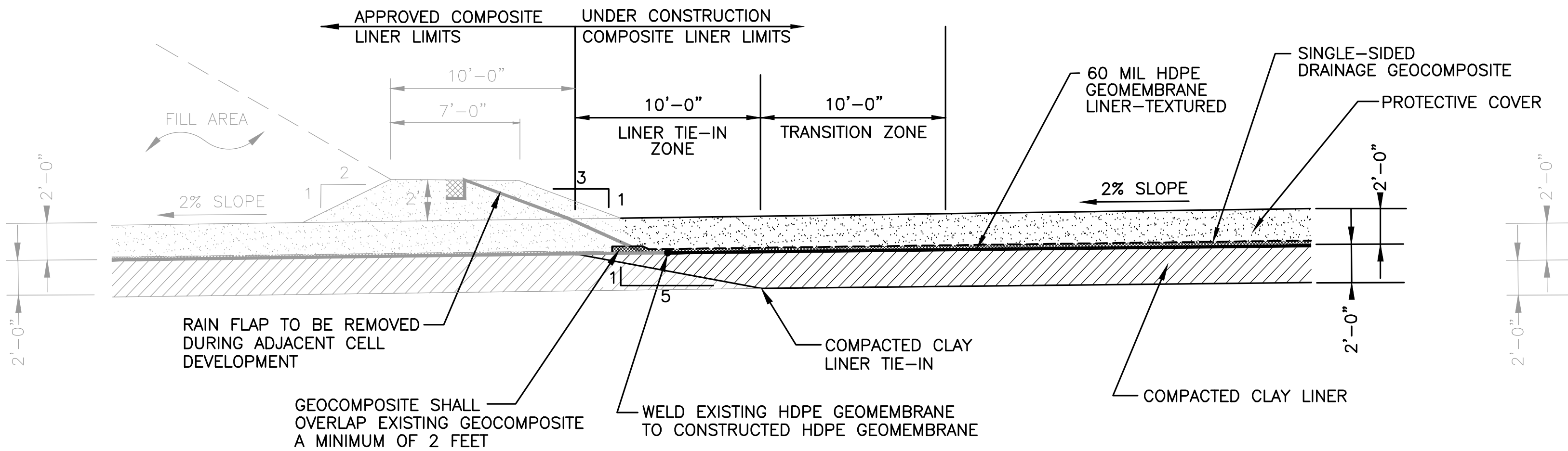
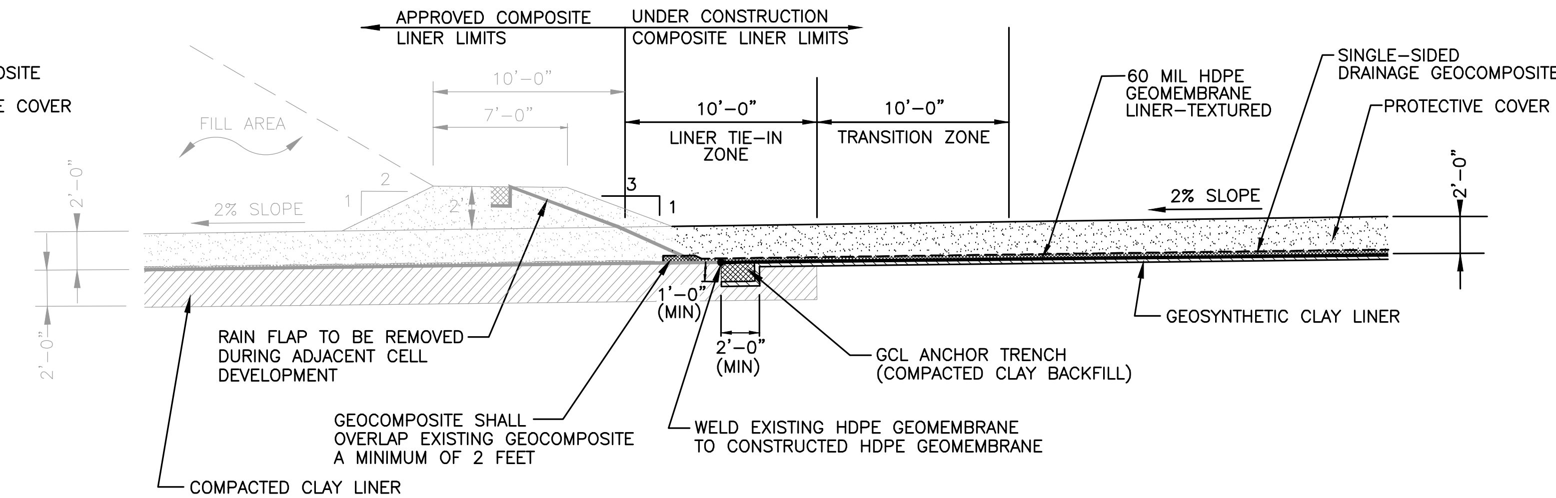
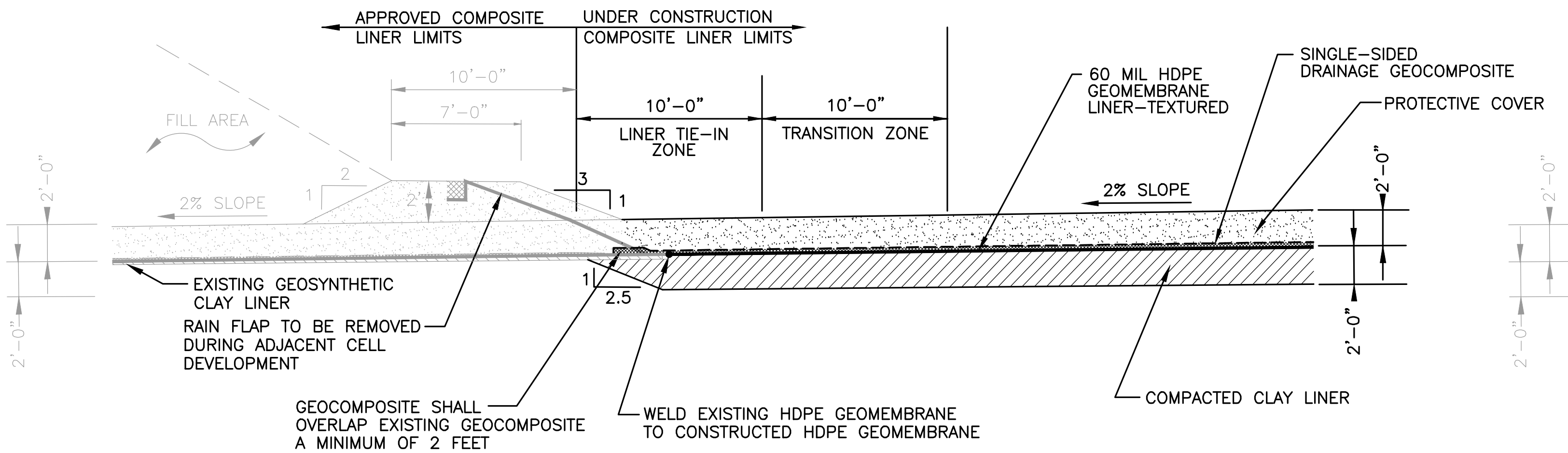


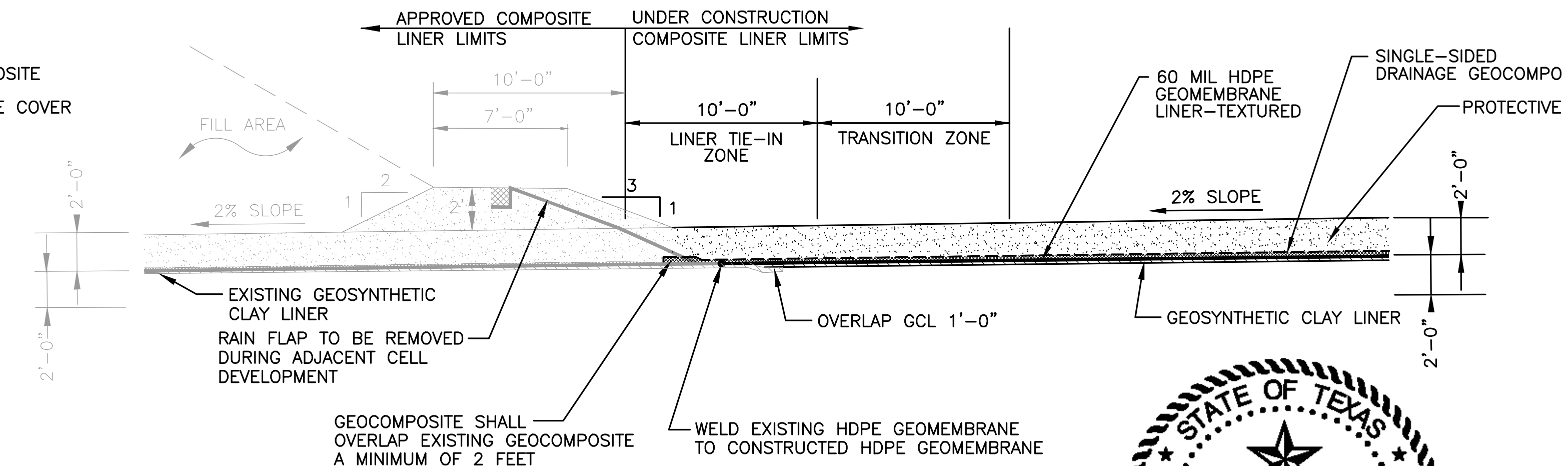
COMPACTED CLAY LINER/COMPACTED CLAY LINER TIE–IN



COMPACTED CLAY LINER/GCL LINER TIE–IN



GCL LINER/COMPACTED CLAY LINER TIE–IN



GCL LINER/GCL LINER TIE–IN

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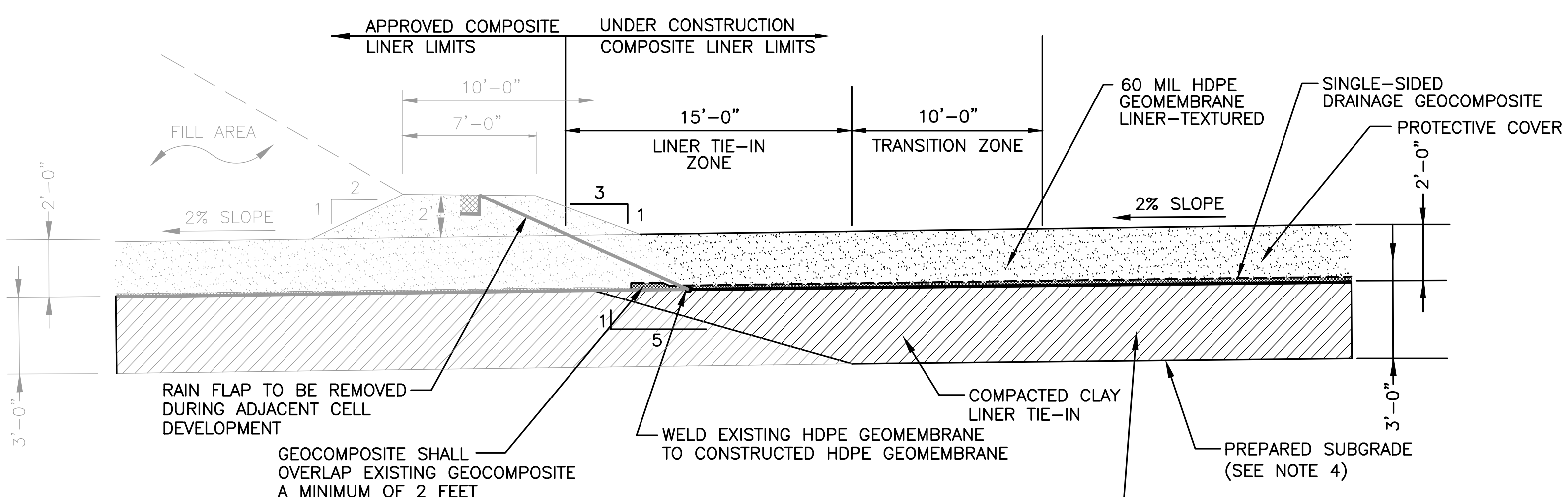
LINER TIE–IN (MSW) L8 A.1 A.8
(SEE NOTE 5)

0 5 10
SCALE IN FEET



LINER TIE–IN L9 A.1 A.8
(CLASS 1)

0 5 10
SCALE IN FEET

NOTES:

1. SUBGRADE PREPARATION, CONSTRUCTION OF THE COMPACTED CLAY LINER, GEOSYNTHETIC CLAY LINER, GEOMEMBRANE LINER, AND PLACEMENT OF PROTECTIVE COVER WILL BE IN ACCORDANCE WITH THE LQCP.
2. DESIGN INFORMATION FOR THE LEACHATE COLLECTION SYSTEM (LCS) COMPONENTS ARE INCLUDED IN APPENDIX IIIC–LEACHATE AND CONTAMINATED WATER MANAGEMENT PLAN. SPECIFICATIONS FOR LCS COMPONENTS ARE INCLUDED IN APPENDIX IIID–LQCP. DRAINAGE GEOCOMPOSITE FOR UNDEVELOPED LINER AREAS CONSISTS OF A 250–MIL GEONET WITH 6 OZ/SY GEOTEXTILE HEAT BONDED ON THE TOP SIDE FOR THE BOTTOM LINER AND HEAT BONDED GEOTEXTILE (6 OZ/SY) ON BOTH SIDES FOR GEOCOMPOSITE ON 3H:1V SIDESLOPES.
3. DEPENDING ON THE SLOPE, SMOOTH OR TEXTURED HDPE GEOMEMBRANE WILL BE USED, REFER TO SECTION 3 OF APPENDIX IIID–LQCP.
4. FOR SUBGRADE PREPARATION IN CLASS 1 AREAS REFER TO APPENDIX IIID, SECTION 2.3.1.1.
5. THE MSW ALTERNATIVE LINER TIE–INS SHOWN MAY ALSO BE CONSTRUCTED WITH A 3–FOOT COMPACTED CLAY LINER.

SHEET IIIA–A.8

☐ DRAFT ☒ FOR PERMITTING PURPOSES ONLY ☐ ISSUED FOR CONSTRUCTION	PREPARED FOR SOUTHWEST LANDFILL TX, LP	MAJOR PERMIT AMENDMENT LINER SYSTEM DETAILS
DATE: 11/2017 FILE: 0120–094–11 CAD: A.8 LINER DETAILS.dwg	DRAWN BY: JDW DESIGN BY: MDM REVIEWED BY: JAE	SOUTHWEST LANDFILL RANDALL COUNTY, TEXAS
Weaver Consultants Group TBPE REGISTRATION NO. F–3727		WWW.WCGRP.COM — DRAWING A.8

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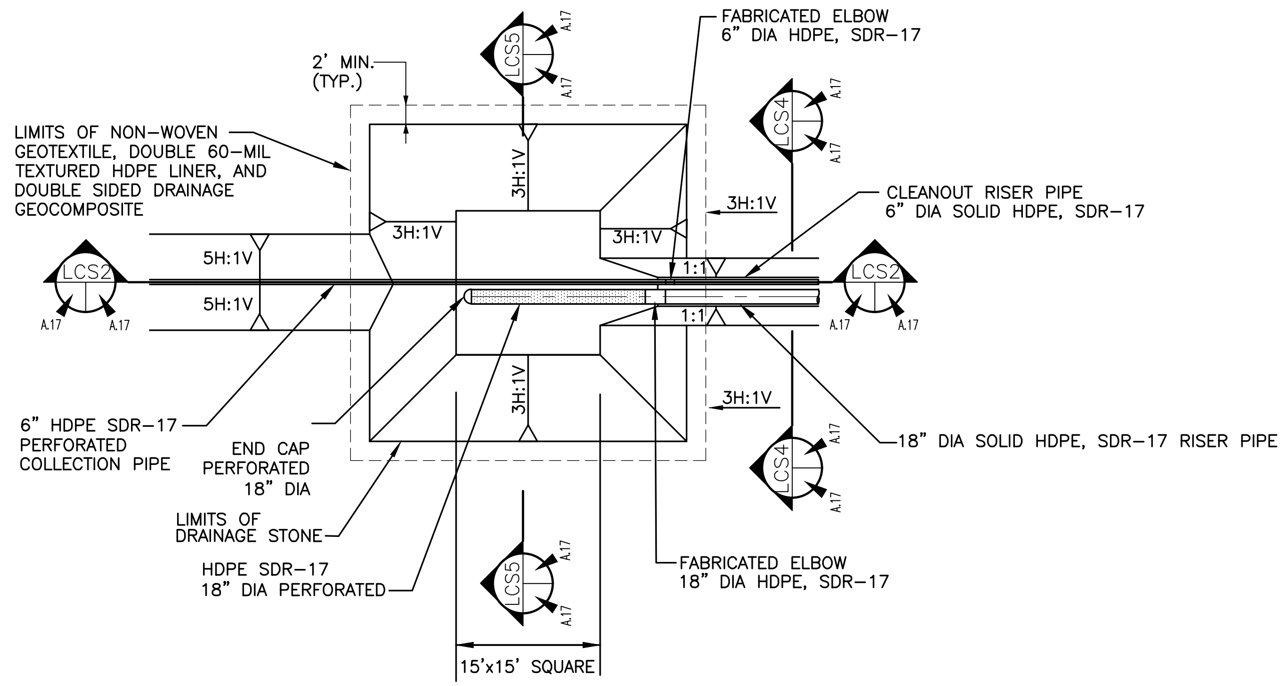
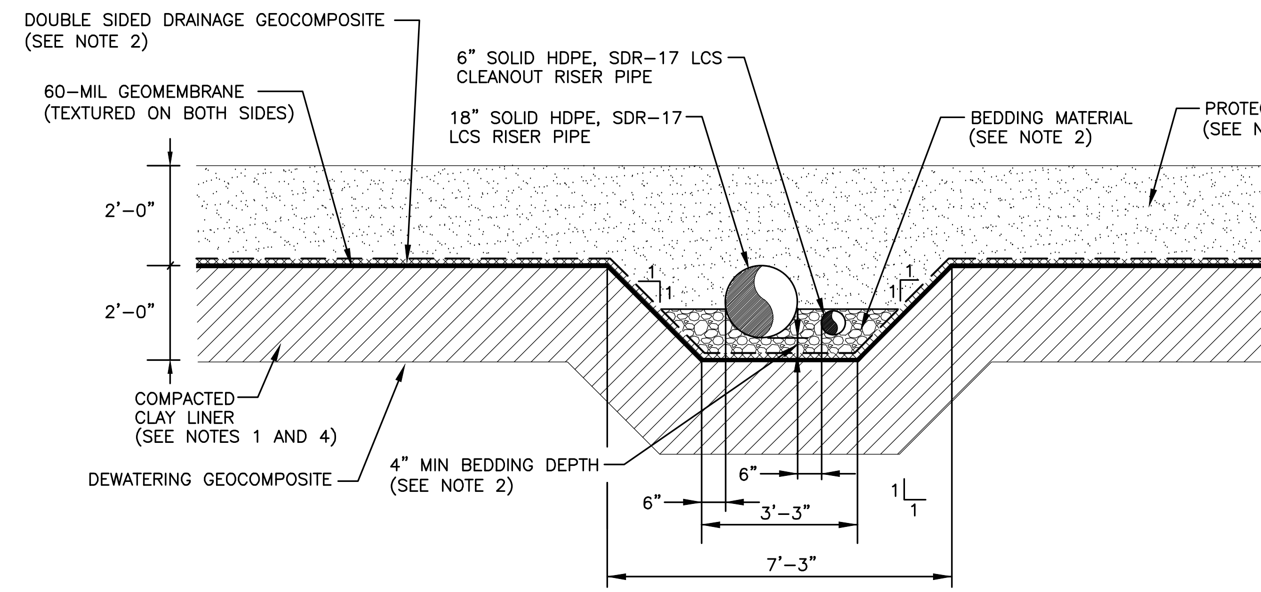


LEACHATE COLLECTION SUMP PLAN (LCS1 A.1 A.17)

NTS



LEACHATE RISER PIPES (LCS4 A.17 A.17)

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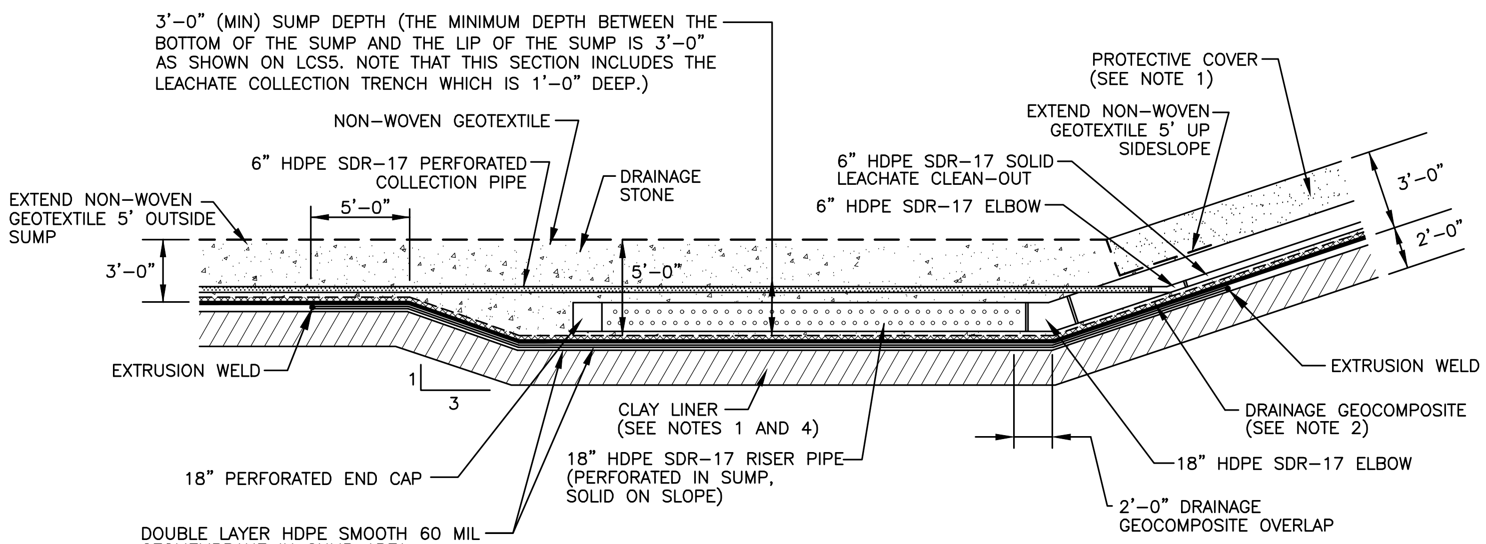

TYPICAL LEACHATE SUMP SECTION (LCS2 A.17 A.17)

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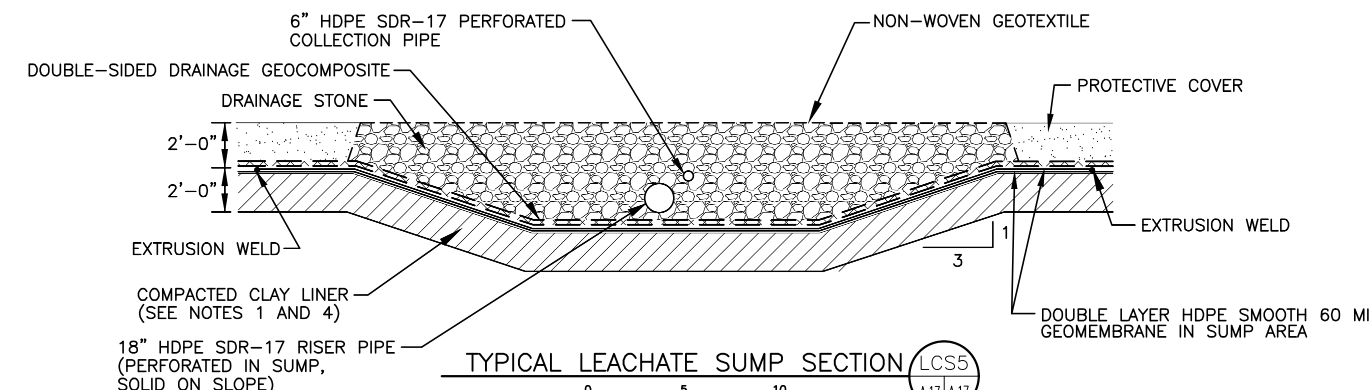

TYPICAL LEACHATE SUMP SECTION (LCS5 A.17 A.17)

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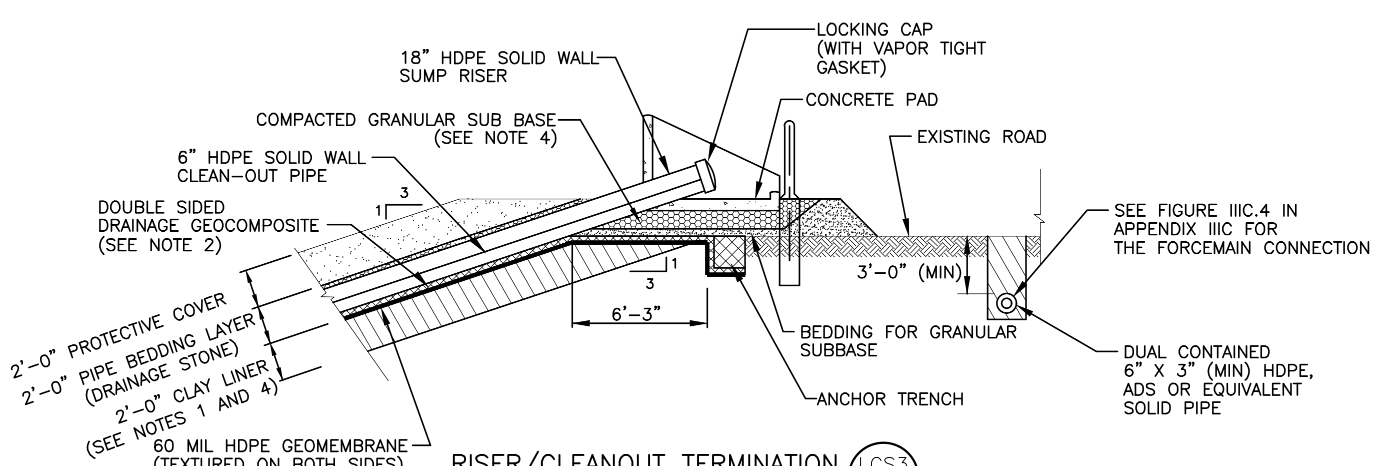

RISER/CLEANOUT TERMINATION (LCS3 A.1 A.17)

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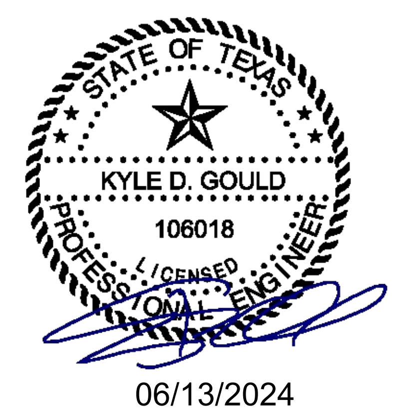

NOTES:

1. SUBGRADE PREPARATION, CONSTRUCTION OF THE COMPACTED CLAY LINER, GEOMEMBRANE LINER, AND PLACEMENT OF PROTECTIVE COVER WILL BE IN ACCORDANCE WITH APPENDIX IIID-LQCP.
2. DESIGN INFORMATION FOR THE LEACHATE COLLECTION SYSTEM (LCS) COMPONENTS ARE INCLUDED IN APPENDIX IIIC-LEACHATE AND CONTAMINATED WATER MANAGEMENT PLAN. SPECIFICATIONS FOR LCS COMPONENTS ARE INCLUDED IN APPENDIX IIID-LQCP. DRAINAGE GEOCOMPOSITE FOR UNDEVELOPED LINER AREAS CONSISTS OF A 250-MIL GEONET WITH 6 OZ/SY GEOTEXTILE HEAT BONDED ON THE TOP SIDE FOR THE BOTTOM LINER AND HEAT BONDED GEOTEXTILE (6 OZ/SY) ON BOTH SIDES FOR GEOCOMPOSITE ON 3H:1V SIDESLOPES.
3. THE SUMP PLAN IS A TYPICAL PLAN FOR UNDEVELOPED SUBTITLE D SECTORS. SECTORS 1A AND 17 WILL HAVE ADDITIONAL COLLECTION PIPES ENTERING THE SUMPS AS SHOWN ON DRAWING A.1.
4. DETAILS SHOWN ARE FOR THE BOTTOM LINER LCS. DETAILS ARE SHOWN WITH 2-FOOT-THICK COMPACTED CLAY LINER. A GCL MAY ALSO BE INSTALLED IN MSW AREAS. A 3-FOOT-THICK COMPACTED CLAY IS USED FOR THE CLASS 1 LINER AREAS.

SHEET IIIA-A.17

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DESIGN BY: MDM
REVIEWED BY: JAE

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MAJOR PERMIT AMENDMENT LEACHATE COLLECTION SYSTEM DETAILS

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SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1663C

LIMITED SCOPE MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIIB
OVERLINER POINT OF COMPLIANCE DEMONSTRATION

Prepared for

Southwest Landfill TX, LP

TCEQ Approved February 20, 2020

Revised January 2025

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER

01/30/2025

Weaver Consultants Group, LLC
TBPE Registration No. F-3727
6420 Southwest Boulevard, Suite 206
Fort Worth, Texas 76109
817-735-9770

WCG Project No. 0120-094-11-140

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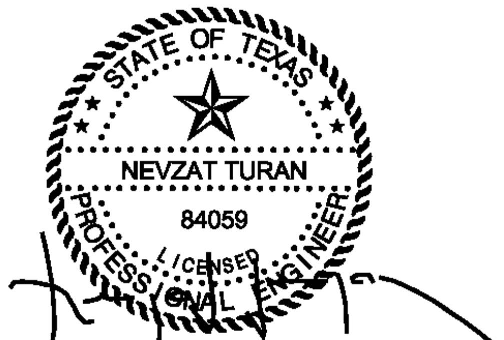
CONTENTS (Continued)



06/13/2024

STATE OF TEXAS
NEVZAT TURAN
84059
LICENSED
PROFESSIONAL ENGINEER
06/13/2024

TABLES

The waste containment system design is shown on Figure 1-3. As shown on Figure 1-3, the overliner system will consist of a reinforced GCL and a 40-mil LLDPE geomembrane (textured on both sides) overlain by a geocomposite leachate collection layer. The leachate collection layer placed above the geomembrane will consist of a 250-mil-thick HDPE geonet with 6 oz/sy non-woven geotextile heat-bonded to both sides. A 24-inch-thick protective cover layer will be placed above the leachate collection layer.

Details for the overliner system are provided in Appendix IIIA-A – Liner, Overliner, and Final Cover System Details. Design of the overliner leachate collection is presented in Appendix IIIC – Leachate and Contaminated Water Management Plan. Stability of the overliner system is analyzed in Appendix IIIE-A. Overliner settlement analysis is provided in Appendix IIIE-B-3.

In addition, an alternative liner is proposed for Sectors 17D through 29, which comprise of approximately 207.7 acres of the disposal footprint. The proposed alternative liner system will consist of a 60-mil HDPE geomembrane placed over a geosynthetic clay liner (GCL) overlain by geocomposite leachate collection layer. Alternative Liner Point of compliance Demonstration is provided in Appendix IIIB-D.

1.3 POC Demonstration Overview

The purpose of the POC demonstration is to show that the proposed containment system design for the pre-Subtitle D area will meet the POC requirements set forth in §330.331(a)(1). This is achieved by demonstrating that the predicted concentration of a wide range of leachate chemical constituents does not exceed allowable values at the POC.

The POC demonstration will show that the site, which is located in an arid area, generates minimal quantities of leachate. The POC will also show that once the overliner is installed, leachate infiltration into the waste below the overliner will be eliminated. Once the Subtitle D final cover is in place, leachate generation rates will decrease in the entire pre-Subtitle D area.

The MCL's listed in §330.331(a)(1) and the current groundwater constituent levels are listed in Table 1-1. Also included in Table 1-1 are the maximum historical site groundwater chemical constituent levels. As shown in the table, current constituent levels at the site are below the MCLs set forth in §330.331(a)(1).

If the proposed "design" (i.e., separatory overliner system shown on Figure 1-3), will eliminate leachate generation into the waste below the overliner, then current groundwater conditions at the site will be unaffected and will remain below the constituent parameters listed in Table 1 of §330.331(a)(1).

As discussed in Section 1.2, the amount of waste to be placed above the overliner leachate collection system is minimal and the projected settlement will have minimal impact on the leachate collection system. This is illustrated on Figure 1-4, which shows the overliner grades before and after waste is placed above. The small amount of waste also translates to minimal impact to the overliner leachate collection system (i.e., grades and slopes remain consistent and the geocomposite will experience only

Table 2-2
Chemical Constituent Concentrations in Leachate

Constituent	MCL Listed in §330.331(a)(1) (mg/l)	Site Specific Leachate Quality[1, 3] (mg/l)	Leachate Quality Information Historically Used for POC Demonstrations in Texas (mg/l)	DAF Range (from Site Specific Data to Historically Used Data)[4]
Arsenic	0.05	0.0855	5.0	<1 to 100
Barium	1.0	7.450	100.0	7.45 to 100
Benzene[2]	0.005	0.0025	0.814	<1 to 163
Cadmium[2]	0.01	0.0001	1.0	<1 to 100
Carbon tetrachloride[2]	0.005	0.0025	0.5	<1 to 100
Chromium (hexavalent)	0.05	0.0126	5.0	<1 to 100
2,4-Dichlorophenoxy acetic acid[2]	0.1	0.0005	10.0	<1 to 100
1,4-Dichlorobenzene[2]	0.075	0.0025	7.5	<1 to 100
1,2-Dichloroethane[2]	0.005	0.0025	0.5	<1 to 100
1,1-Dichloroethylene[2]	0.007	0.0025	0.7	<1 to 100
Endrin[2]	0.0002	0.00005	0.05	<1 to 250
Fluoride	4	0.94		<1
Lindane[2]	0.004	0.000025	0.4	<1 to 100
Lead[2]	0.05	0.0025	5.0	<1 to 100
Mercury[2]	0.002	0.0001	0.2	<1 to 100
Methoxychlor[2]	0.1	0.00025		<1
Nitrate[2]	10	0.00005		<1
Selenium[2]	0.01	0.0005	1.0	<1 to 100
Silver[2]	0.05	0.00025	5.0	<1 to 100
Toxaphene[2]	0.005	0.0005	0.5	<1 to 100
1,1,1-Trichloroethane[2]	0.2	0.0025		<1
Trichloroethylene	0.005	0.0025	1.3	<1 to 260
2,4,5-Trichlorophenoxy acetic acid[2]	0.01	0.0005	1.0	1 to 100
Vinyl Chloride[2]	0.002	0.001	0.2	<1 to 100

1 Leachate concentrations obtained from historical leachate samples provided by the site.
2 For constituents not detected at reporting limits, one-half of the reporting limit is listed.
3 The constituents represent the highest values reported from laboratory testing from a leachate sample in June 2017 from the shared sump in Sectors 7 and 10 and annual historical leachate sampling for constituents tested.
4 This column illustrates the range of DAFs needed for each constituent.

Table 4-1
Summary of Constituent Levels at the POC
(Using Site Specific Leachate Data)

Constituent	C_{BG}, Background Concentration[1] (mg/l)	C_P (mg/l) (Constituent Concentration at the POC due to Estimated Leachate Percolation)	=	C_O[2]	/	DAF[3] (mg/l)	$C_{BG} + C_P = C_T$ at POC (mg/l)	MCL (mg/l) Listed in §330.331(a)(1)	C_T at POC < MCL
Arsenic	0.0056	6.81E-06	=	0.0855	/	12,552	0.0056	0.05	Yes
Barium	0.07	1.16E-04	=	7.450	/	12,552	0.07	1.0	Yes
Benzene	0.0005	1.99E-07	=	0.0025	/	12,552	0.0005	0.005	Yes
Cadmium	0.001	7.97E-09	=	0.0001	/	12,552	0.001	0.01	Yes
Carbon tetrachloride	0.0025	1.99E-07	=	0.0025	/	12,552	0.0025	0.005	Yes
Chromium (hexavalent)	0.010	1.0E-06	=	0.0126	/	12,552	0.01	0.05	Yes
2,4-Dichlorophenoxy acetic acid	0.09	3.98E-08	=	0.0005	/	12,552	0.09	0.1	Yes
1,4-Dichlorobenzene	0.001	1.99E-07	=	0.0025	/	12,552	0.001	0.075	Yes
1,2-Dichloroethane	0.0005	1.99E-07	=	0.0025	/	12,552	0.0005	0.005	Yes
1,1-Dichloroethylene	0.0014	1.99E-07	=	0.0025	/	12,552	0.0014	0.007	Yes
Endrin	0.00005	3.98E-09	=	0.00005	/	12,552	0.0001	0.0002	Yes
Fluoride	3.85	7.49E-05	=	0.94	/	12,552	3.85	4	Yes
Lindane	0.0005	1.99E-09	=	0.000025	/	12,552	0.0005	0.004	Yes
Lead	0.0075	1.99E-07	=	0.0025	/	12,552	0.0075	0.05	Yes
Mercury	0.0001	7.97E-09	=	0.0001	/	12,552	0.0001	0.002	Yes
Methoxychlor	0.00025	1.99E-08	=	0.00025	/	12,552	0.0003	0.1	Yes
Nitrate	3.6	3.98E-09	=	0.00005	/	12,552	3.6	10	Yes
Selenium	0.005	3.98E-08	=	0.0005	/	12,552	0.005	0.01	Yes
Silver	0.005	1.99E-08	=	0.00025	/	12,552	0.005	0.05	Yes
Toxaphene	0.0005	3.98E-08	=	0.0005	/	12,552	0.0005	0.005	Yes
1,1,1-Trichloroethane	0.0005	1.99E-07	=	0.0025	/	12,552	0.0005	0.2	Yes
Trichloroethylene	0.0025	1.99E-07	=	0.0025	/	12,552	0.0025	0.005	Yes
2,4,5-Trichlorophenoxy acetic acid	0.0005	3.98E-08	=	0.0005	/	12,552	0.0005	0.01	Yes
Vinyl Chloride	0.001	7.97E-08	=	0.001	/	12,552	0.001	0.002	Yes

1 Background concentrations have been obtained from Table 1-1.

2 Leachate concentrations (C_0, Site Specific Concentrations) represent levels obtained from the leachate sample analysis results provided in Table 2-2.

3 DAF value for Case II presented on Figure 3-7.

Table 4-2
Summary of Constituent Levels at the POC
(Using Historical Guidance Information)

Constituent	C_{BG}, Background Concentration [1] (mg/l)	C_P (mg/l) (Constituent Concentration at the POC)	=	C_O[2] / DAF[3] (mg/l)		$C_{BG} + C_P = C_T$[2] at POC (mg/l)	MCL (mg/l) Listed in §330.331(a)(1)	C_T at POC < MCL
Arsenic	0.0056	4.0E-04	=	5.0	/12,552	0.006	0.05	Yes
Barium	0.07	8.0E-03	=	100.0	/12,552	0.078	1.0	Yes
Benzene	0.0005	6.5E-05	=	0.814	/12,552	0.001	0.005	Yes
Cadmium	0.001	8.0E-05	=	1.0	/12,552	0.001	0.01	Yes
Carbon tetrachloride	0.0025	4.0E-05	=	0.5	/12,552	0.003	0.005	Yes
Chromium (hexavalent)	0.010	4.0E-04	=	5.0	/12,552	0.010	0.05	Yes
2,4-Dichlorophenoxy acetic acid	0.09	8.0E-04	=	10.0	/12,552	0.091	0.1	Yes
1,4-Dichlorobenzene	0.001	6.0E-04	=	7.5	/12,552	0.002	0.075	Yes
1,2-Dichloroethane	0.0005	4.0E-05	=	0.5	/12,552	0.001	0.005	Yes
1-1-Dichloroethylene	0.0014	5.6E-05	=	0.7	/12,552	0.001	0.007	Yes
Endrin	0.00005	4.0E-06	=	0.05	/12,552	0.000	0.0002	Yes
Fluoride	3.85	--	=	--	/12,552	--	4	--
Lindane	0.0005	3.2E-05	=	0.4	/12,552	0.001	0.004	Yes
Lead	0.0075	4.0E-04	=	5.0	/12,552	0.008	0.05	Yes
Mercury	0.0001	1.6E-05	=	0.2	/12,552	0.000	0.002	Yes
Methoxychlor[4]	0.00025	--	=	--	/12,552	--	0.1	--
Nitrate[4]	3.6	--	=	--	/12,552	--	10	--
Selenium	0.005	8.0E-05	=	1.0	/12,552	0.005	0.01	Yes
Silver	0.005	4.0E-04	=	5.0	/12,552	0.005	0.05	Yes
Toxaphene	0.0005	4.0E-05	=	0.5	/12,552	0.001	0.005	Yes
1,1,1-Trichloroethane[4]	0.0005	--	=	--	/12,552	--	0.2	--
Trichloroethylene	0.0025	1.0E-04	=	1.3	/12,552	0.003	0.005	Yes
2,4,5-Trichlorophenoxy acetic acid	0.0005	8.0E-05	=	1.0	/12,552	0.001	0.01	Yes
Vinyl Chloride	0.001	1.6E-05	=	0.2	/12,552	0.001	0.002	Yes

1 Background concentrations have been obtained from Table 1-1.
2 C_P represents chemical concentrations estimated by the fate and transport model or the POC. Initial concentrations, C_O, has been reproduced from historical standard information utilized by TCEQ as discussed in Section 1.3. Total concentration for each constituent at the POC is the sum of C_P and the background concentration, C_{BG}.
3 DAF value for Case II presented on Figure 3-7.

Table 5-1
Summary of Constituent Levels at the POC
(Using Site Specific Leachate Data)

Constituent	C_{BG}, Background Concentration[1] (mg/l)	C_P (mg/l) (Constituent Concentration at the POC due to Estimated Leachate Percolation)	=	C_O[2] / DAF[3] (mg/l)	$C_{BG} + C_P = C_T$ at POC (mg/l)	MCL (mg/l) Listed in §330.331(a)(1)	C_T at POC < MCL
Arsenic	0.0056	8.81E-06	=	0.0855 / 9,702	0.0056	0.05	Yes
Barium	0.07	7.68E-04	=	7.450 / 9,702	0.07	1.0	Yes
Benzene	0.0005	2.58E-07	=	0.0025 / 9,702	0.0005	0.005	Yes
Cadmium	0.001	1.03E-08	=	0.0001 / 9,702	0.001	0.01	Yes
Carbon tetrachloride	0.0025	2.58E-07	=	0.0025 / 9,702	0.0025	0.005	Yes
Chromium (hexavalent)	0.010	1.30E-06	=	0.0126 / 9,702	0.01	0.05	Yes
2,4-Dichlorophenoxy acetic acid	0.09	5.15E-08	=	0.0005 / 9,702	0.09	0.1	Yes
1,4-Dichlorobenzene	0.001	2.58E-07	=	0.0025 / 9,702	0.001	0.075	Yes
1,2-Dichloroethane	0.0005	2.58E-07	=	0.0025 / 9,702	0.0005	0.005	Yes
1,1-Dichloroethylene	0.0014	2.58E-07	=	0.0025 / 9,702	0.0014	0.007	Yes
Endrin	0.00005	5.15E-09	=	0.00005 / 9,702	0.0001	0.0002	Yes
Fluoride	3.85	9.69E-05	=	0.94 / 9,702	3.85	4	Yes
Lindane	0.0005	2.58E-09	=	0.000025 / 9,702	0.0005	0.004	Yes
Lead	0.0075	2.58E-07	=	0.0025 / 9,702	0.0075	0.05	Yes
Mercury	0.0001	1.03E-08	=	0.0001 / 9,702	0.0001	0.002	Yes
Methoxychlor	0.00025	2.58E-08	=	0.00025 / 9,702	0.0003	0.1	Yes
Nitrate	3.6	5.15E-09	=	0.00005 / 9,702	3.6	10	Yes
Selenium	0.005	5.15E-08	=	0.0005 / 9,702	0.005	0.01	Yes
Silver	0.005	2.58E-08	=	0.00025 / 9,702	0.005	0.05	Yes
Toxaphene	0.0005	5.15E-08	=	0.0005 / 9,702	0.0005	0.005	Yes
1,1,1-Trichloroethane	0.0005	2.58E-07	=	0.0025 / 9,702	0.0005	0.2	Yes
Trichloroethylene	0.0025	2.58E-07	=	0.0025 / 9,702	0.0025	0.005	Yes
2,4,5-Trichlorophenoxy acetic acid	0.0005	5.15E-08	=	0.0005 / 9,702	0.0005	0.01	Yes
Vinyl Chloride	0.001	1.03E-07	=	0.001 / 9,702	0.001	0.002	Yes

1 Background concentrations have been obtained from Table 1-1.
2 Leachate concentrations (C_0, Site Specific Concentrations) represent levels obtained from the leachate sample analysis results provided in Table 2-2.
3 DAF value for Case II presented on Figure 3 in Appendix IIIB-C.

Table 5-2
Summary of Constituent Levels at the POC
(Using Historical Guidance Information)

Constituent	C_{BG}, Background Concentration[1] (mg/l)	C_P (mg/l) (Constituent Concentration at the POC)	=	C_O[2] (mg/l)	/ DAF[3]	$C_{BG} + C_P = C_T$[2] at POC (mg/l)	MCL (mg/l) Listed in §330.331(a)(1)	C_T at POC < MCL
Arsenic	0.0056	5.2E-04	=	5.0	/ 9,702	0.006	0.05	Yes
Barium	0.07	1.0E-02	=	100.0	/ 9,702	0.080	1.0	Yes
Benzene	0.0005	8.4E-05	=	0.814	/ 9,702	0.001	0.005	Yes
Cadmium	0.001	1.0E-04	=	1.0	/ 9,702	0.001	0.01	Yes
Carbon tetrachloride	0.0025	5.2E-05	=	0.5	/ 9,702	0.003	0.005	Yes
Chromium (hexavalent)	0.010	5.2E-04	=	5.0	/ 9,702	0.011	0.05	Yes
2,4-Dichlorophenoxy acetic acid	0.09	1.0E-03	=	10.0	/ 9,702	0.091	0.1	Yes
1,4-Dichlorobenzene	0.001	7.7E-04	=	7.5	/ 9,702	0.002	0.075	Yes
1,2-Dichloroethane	0.0005	5.2E-05	=	0.5	/ 9,702	0.001	0.005	Yes
1-1-Dichloroethylene	0.0014	7.2E-05	=	0.7	/ 9,702	0.001	0.007	Yes
Endrin	0.00005	5.2E-06	=	0.05	/ 9,702	0.000	0.0002	Yes
Fluoride	3.85	--	=	--	/ 9,702	--	4	--
Lindane	0.0005	4.1E-05	=	0.4	/ 9,702	0.001	0.004	Yes
Lead	0.0075	5.2E-04	=	5.0	/ 9,702	0.008	0.05	Yes
Mercury	0.0001	2.1E-05	=	0.2	/ 9,702	0.000	0.002	Yes
Methoxychlor[4]	0.00025	--	=	--	/ 9,702	--	0.1	--
Nitrate[4]	3.6	--	=	--	/ 9,702	--	10	--
Selenium	0.005	1.0E-04	=	1.0	/ 9,702	0.005	0.01	Yes
Silver	0.005	5.2E-04	=	5.0	/ 9,702	0.006	0.05	Yes
Toxaphene	0.0005	5.2E-05	=	0.5	/ 9,702	0.001	0.005	Yes
1,1,1-Trichloroethane[4]	0.0005	--	=	--	/ 9,702	--	0.2	--
Trichloroethylene	0.0025	1.3E-04	=	1.3	/ 9,702	0.003	0.005	Yes
2,4,5-Trichlorophenoxy acetic acid	0.0005	1.0E-04	=	1.0	/ 9,702	0.001	0.01	Yes
Vinyl Chloride	0.001	2.1E-05	=	0.2	/ 9,702	0.001	0.002	Yes

[1] Background concentrations have been obtained from Table 1-1.

[2] C_P represents chemical concentrations estimated by the fate and transport model or the POC. Initial concentrations, C_O, has been reproduced from historical standard information utilized by TCEQ as discussed in Section 1.3. Total concentration for each constituent at the POC is the sum of C_P and the background concentration, C_{BG}.

[3] DAF value for Case II presented on Figure 3 in Appendix IIIB-C.

6 ALTERNATIVE LINER POC DEMONSTRATION

6.1 Purpose

The purpose of this section is to demonstrate that the proposed alternative liner for the undeveloped, Subtitle D portion of the landfill will meet the alternative liner demonstration requirements specified in Title 30 Texas Administrative Code (TAC) §330.331(a)(1). This is achieved by demonstrating that the predicted concentrations of leachate chemical constituents do not exceed maximum contaminant levels (as listed in Table 1 in §330.331(a)(1)) in the uppermost aquifer at the point of compliance (POC). The concentration of various constituents at the POC is determined as detailed in the following sections.

Figures 1 and 2 located in Appendix IIIB-D provide the sequence of events for this POC demonstration. The following lists two scenarios that modify the POC demonstration discussed in Section 3 to include the propose alternative liner and show the waste containment system's ability to meet the design criteria listed in §330.331(a)(1).

- Case I w/ alternative liner (Section 3.5.1). In this case, the only change to the model involves updating the percolation rate for the undeveloped Subtitle-D areas to reflect the modeled leakage through the proposed alternative liner. Refer to the HELP summary sheet on page IIIB-D-11 in Appendix IIIB-D.
- Case II w/ alternative liner (Section 3.5.2). This case also changes the model to update the percolation rate for the undeveloped Subtitle-D areas to reflect the modeled leakage through the alternative liner.

The following lists two conditional scenarios that modify the POC demonstration discussed in Section 5 to include the propose alternative liner.

- Case III w/ alternative liner. This case modifies Case I discussed in Section 5 (Figure 2 in Appendix IIIB-C) to model the percolation through the proposed alternative liner.
- Case IV w/ alternative liner. This case modifies Case II discussed in Section 5 (Figure 3 in Appendix IIIB-C) to model the percolation through the proposed alternative liner.

6.2 Proposed Alternative Liner Design

The proposed alternative liner system for future sectors will consist of a 60-mil HDPE geomembrane placed over a geosynthetic clay liner (GCL). A geocomposite leachate collection layer will be placed above the geomembrane and will be covered with a 2-foot-thick layer of protective cover soil.

Details for the alternative liner system are provided in Appendix IIIA-A – Liner, Overliner, and Final Cover System Details. Liner slope stability calculations are presented in Appendix IIIE – Geotechnical Report.

6.3 Landfill Configuration Analyzed

A HELP model simulation was performed to obtain an assumed current leachate percolation rate through the bottom of the proposed alternative liner area.

Six HELP Model simulations were performed to obtain percolation rates through the alternative liner system. Table 6-1 summarizes the landfill configurations modeled using HELP. Results for the HELP Model simulations for the alternative liner area are presented in Appendix IIIB-D.

Table 6-1
Landfill Configurations Modeled in HELP

Area	Description
Alternative Liner Area	Case 1: Active landfill with 10 feet of waste above the alternative liner modeled for 1 year. Case 2: Interim landfill with 50 feet of waste above the alternative liner modeled for 10 years. Case 3: Interim landfill with 100 feet of waste above the alternative liner modeled for 15 years. Case 4: Interim landfill with 150 feet of waste above the alternative liner modeled for 10 years. Case 5: Interim landfill with 190 feet of waste above the alternative liner modeled for 5 years. Case 6: Closed landfill with 190 feet of waste above the alternative liner modeled for 30 years.

6.4 Summary of Results

The results of the MODFLOW model are summarized in Table 6-2 and graphically shown on Figures 3 through 6 in Appendix IIIB-D.

Table 6-2
Summary of MODFLOW Simulation Results

Case	Calculated DAF[1]	Minimum Required DAF	Design Compliant with §330.331(a)(1)
Case I	84,641	260	Yes
Case II	12,653	260	Yes
Case III	16,931	260	Yes
Case IV	3,656	260	Yes

[1] For each case, the lowest calculated DAF is shown in Table 6-2.

Tables 6-3 and 6-4 have been developed to further illustrate how the DAF is used to determine the constituent level at the POC. The DAF value used corresponds to Case IV. As summarized on Tables 6-3 and 6-4, the concentration at the POC (combined total of background concentration and constituent concentration at the POC) is less than the MCL listed in §330.331(a)(1).

Therefore, the demonstration in this section further supports the fact that the site design is in compliance with the POC requirements specified in Title 30 TAC §330.331.

Table 6-3
Summary of Constituent Levels at the POC
(Using Site Specific Leachate Data)

Constituent	C_{BG}, Background Concentration[1] (mg/l)	C_P (mg/l) (Constituent Concentration at the POC due to Estimated Leachate Percolation)	=	C_O[2] / DAF[3] (mg/l)	$C_{BG} + C_P = C_T$ at POC (mg/l)	MCL (mg/l) Listed in §330.331(a)(1)	C_T at POC < MCL
Arsenic	0.0056	2.3E-05	=	0.0855 / 3,656	0.0056	0.05	Yes
Barium	0.07	2.0E-03	=	7.450 / 3,656	0.07	1.0	Yes
Benzene	0.0005	6.8E-07	=	0.0025 / 3,656	0.0005	0.005	Yes
Cadmium	0.001	2.7E-08	=	0.0001 / 3,656	0.001	0.01	Yes
Carbon tetrachloride	0.0025	6.8E-07	=	0.0025 / 3,656	0.0025	0.005	Yes
Chromium (hexavalent)	0.010	3.4E-06	=	0.0126 / 3,656	0.01	0.05	Yes
2,4-Dichlorophenoxy acetic acid	0.09	1.4E-07	=	0.0005 / 3,656	0.09	0.1	Yes
1,4-Dichlorobenzene	0.001	6.8E-07	=	0.0025 / 3,656	0.001	0.075	Yes
1,2-Dichloroethane	0.0005	6.8E-07	=	0.0025 / 3,656	0.0005	0.005	Yes
1,1-Dichloroethylene	0.0014	6.8E-07	=	0.0025 / 3,656	0.0014	0.007	Yes
Endrin	0.00005	1.4E-08	=	0.00005 / 3,656	0.0001	0.0002	Yes
Fluoride	3.85	2.6E-04	=	0.94 / 3,656	3.85	4	Yes
Lindane	0.0005	6.8E-09	=	0.000025 / 3,656	0.0005	0.004	Yes
Lead	0.0075	6.8E-07	=	0.0025 / 3,656	0.0075	0.05	Yes
Mercury	0.0001	2.7E-08	=	0.0001 / 3,656	0.0001	0.002	Yes
Methoxychlor	0.00025	6.8E-08	=	0.00025 / 3,656	0.0003	0.1	Yes
Nitrate	3.6	1.4E-08	=	0.00005 / 3,656	3.6	10	Yes
Selenium	0.005	1.4E-07	=	0.0005 / 3,656	0.005	0.01	Yes
Silver	0.005	6.8E-08	=	0.00025 / 3,656	0.005	0.05	Yes
Toxaphene	0.0005	1.4E-07	=	0.0005 / 3,656	0.0005	0.005	Yes
1,1,1-Trichloroethane	0.0005	6.8E-07	=	0.0025 / 3,656	0.0005	0.2	Yes
Trichloroethylene	0.0025	6.8E-07	=	0.0025 / 3,656	0.0025	0.005	Yes
2,4,5-Trichlorophenoxy acetic acid	0.0005	1.4E-07	=	0.0005 / 3,656	0.0005	0.01	Yes
Vinyl Chloride	0.001	2.7E-07	=	0.001 / 3,656	0.001	0.002	Yes

1 Background concentrations have been obtained from Table 1-1.
2 Leachate concentrations (C_O, Site Specific Concentrations) represent levels obtained from the leachate sample analysis results provided in Table 2-2.
3 DAF value for Case II presented on Figure 6 in Appendix IIIB-D.

Table 6-4
Summary of Constituent Levels at the POC
(Using Historical Guidance Information)

Constituent	C_{BG}, Background Concentration[1] (mg/l)	C_P (mg/l) (Constituent Concentration at the POC)	=	C_O^2 (mg/l)	/	DAF^3	$C_{BG} + C_P = C_T^2$ at POC (mg/l)	MCL (mg/l) Listed in §330.331(a)(1)	C_T at POC < MCL
Arsenic	0.0056	1.4E-03	=	5.0	/	3,656	0.007	0.05	Yes
Barium	0.07	2.7E-02	=	100.0	/	3,656	0.097	1.0	Yes
Benzene	0.0005	2.2E-04	=	0.814	/	3,656	0.001	0.005	Yes
Cadmium	0.001	2.7E-04	=	1.0	/	3,656	0.001	0.01	Yes
Carbon tetrachloride	0.0025	1.4E-04	=	0.5	/	3,656	0.003	0.005	Yes
Chromium (hexavalent)	0.010	1.4E-03	=	5.0	/	3,656	0.011	0.05	Yes
2,4-Dichlorophenoxy acetic acid	0.09	2.7E-03	=	10.0	/	3,656	0.093	0.1	Yes
1,4-Dichlorobenzene	0.001	2.1E-03	=	7.5	/	3,656	0.003	0.075	Yes
1,2-Dichloroethane	0.0005	1.4E-04	=	0.5	/	3,656	0.001	0.005	Yes
1-1-Dichloroethylene	0.0014	1.9E-04	=	0.7	/	3,656	0.002	0.007	Yes
Endrin	0.00005	1.4E-05	=	0.1	/	3,656	0.000	0.0002	Yes
Fluoride	3.85	--	=	--	/	3,656	--	4	--
Lindane	0.0005	1.1E-04	=	0.4	/	3,656	0.001	0.004	Yes
Lead	0.0075	1.4E-03	=	5.0	/	3,656	0.009	0.05	Yes
Mercury	0.0001	5.5E-05	=	0.2	/	3,656	0.000	0.002	Yes
Methoxychlor[4]	0.00025	--	=	--	/	3,656	--	0.1	--
Nitrate[4]	3.6	--	=	--	/	3,656	--	10	--
Selenium	0.005	2.7E-04	=	1.0	/	3,656	0.005	0.01	Yes
Silver	0.005	1.4E-03	=	5.0	/	3,656	0.006	0.05	Yes
Toxaphene	0.0005	1.4E-04	=	0.5	/	3,656	0.001	0.005	Yes
1,1,1-Trichloroethane[4]	0.0005	--	=	--	/	3,656	--	0.2	--
Trichloroethylene	0.0025	3.6E-04	=	1.3	/	3,656	0.003	0.005	Yes
2,4,5-Trichlorophenoxy acetic acid	0.0005	2.7E-04	=	1.0	/	3,656	0.001	0.01	Yes
Vinyl Chloride	0.001	5.5E-05	=	0.2	/	3,656	0.001	0.002	Yes

1 Background concentrations have been obtained from Table 1-1.

2 C_P represents chemical concentrations estimated by the fate and transport model or the POC. Initial concentrations, C_O, has been reproduced from historical standard information utilized by TCEQ as discussed in Section 1.3. Total concentration for each constituent at the POC is the sum of C_P and the background concentration, C_{BG}.

3 DAF value for Case II presented on Figure 6 in Appendix IIIB-D.

APPENDIX IIIB-D

ALTERNATIVE LINER POINT OF COMPLIANCE DEMONSTRATION

Includes pages IIIB-D-1 through IIIB-D-64

STATE OF TEXAS
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CONTENTS

STATE OF TEXAS
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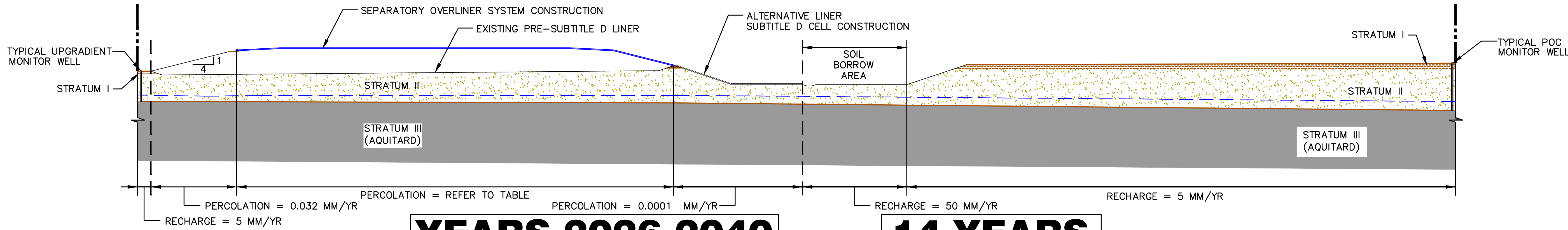
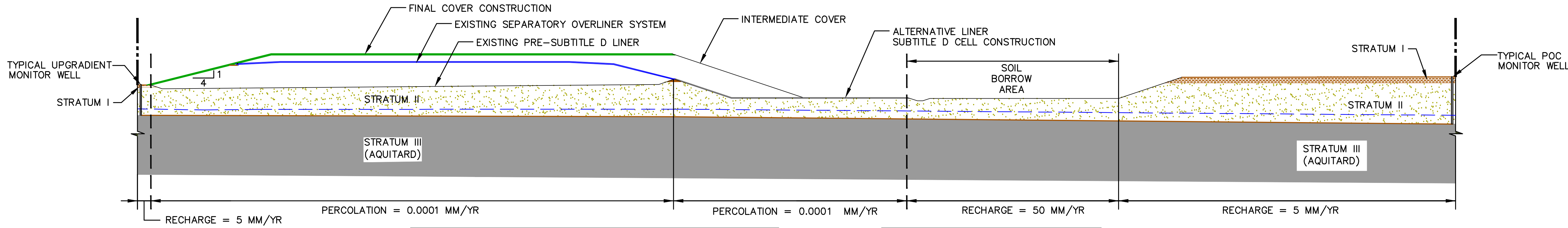
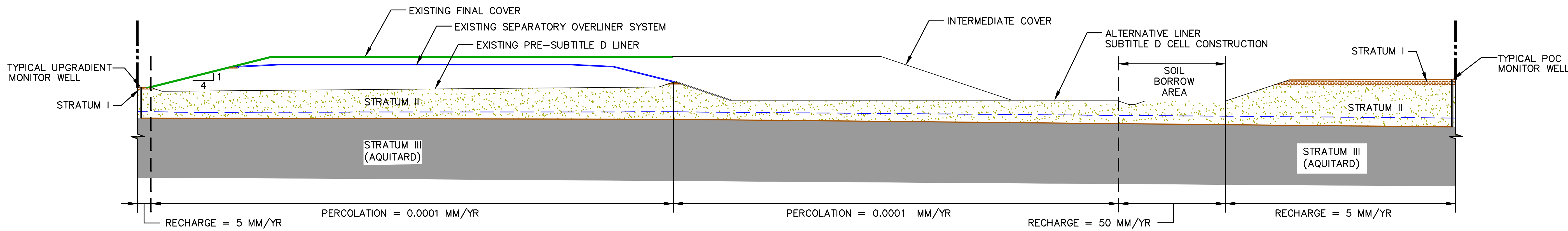
FIGURES



YEARS 2026-2040 **14 YEARS**



YEARS 2040-2055 **15 YEARS**



YEARS 2055-2080 **25 YEARS**

PERCOLATION RATES		
	CASE I & II	CASE III & IV
YEARS 1–7	0.032 MM/YR	0.066 MM/YR
YEAR 8	0.008 MM/YR	0.066 MM/YR
YEARS 9–13	0.0032 MM/YR	0.066 MM/YR
YEAR 14	0.0016 MM/YR	0.066 MM/YR

LEGEND

PERMIT BOUNDARY

LIMIT OF WASTE

STATE OF TEXAS
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TYPICAL SECTION

0 200 400
SCALE IN FEET

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DATE: 05/2024
FILE: 0120-094-11
CAD: FIG 3-5A-TYP SECTION.dwg

DRAWN BY: JDW
DESIGN BY: BPY
REVIEWED BY: KDG

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PREPARED FOR
SOUTHWEST LANDFILL TX, LP

REVISIONS		
NO.	DATE	DESCRIPTION

MAJOR PERMIT AMENDMENT
TYPICAL SECTION
SEQUENCE OF EVENTS

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS

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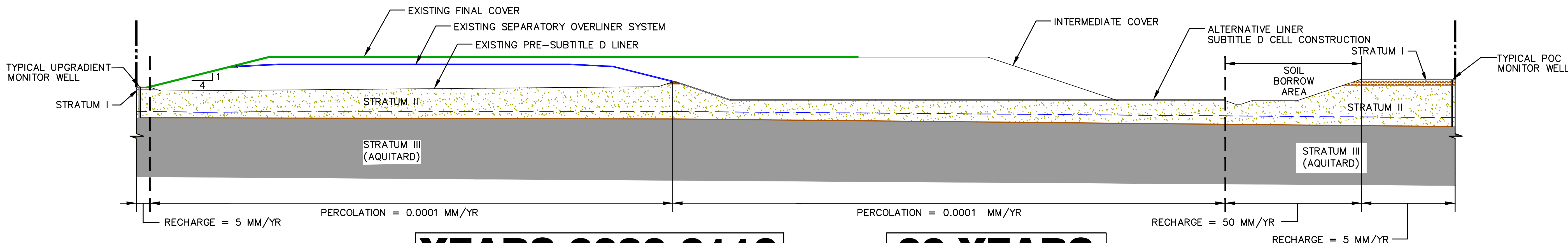
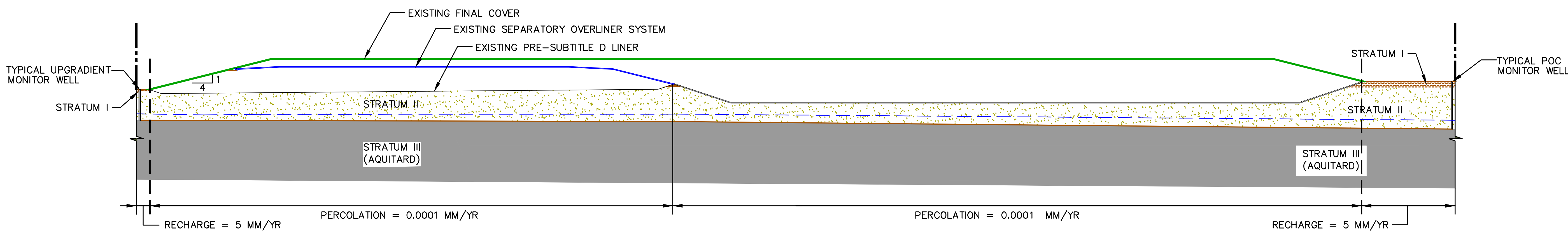
FIGURE 1

SHEET IIIB-D-2

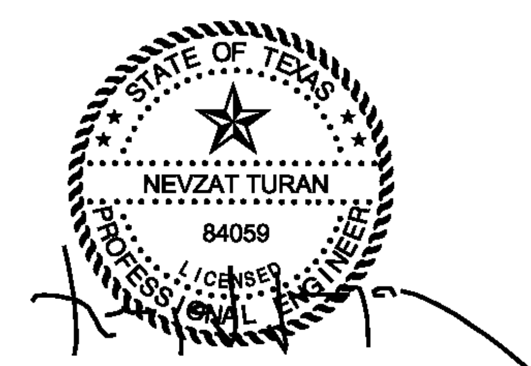
O:\0120\094\LSMPA 2024\PART III\IIIB\FIG 1-5A-5B-SECTION SEQ.dwg, byoung, 1:2



YEARS 2080-2110 **30 YEARS**



YEARS 2110-2140 **30 YEARS**

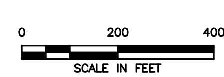


06/13/2024

LEGEND

PERMIT BOUNDARY
LIMIT OF WASTE

TYPICAL SECTION



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TYPICAL SECTION
SEQUENCE OF EVENTS

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS

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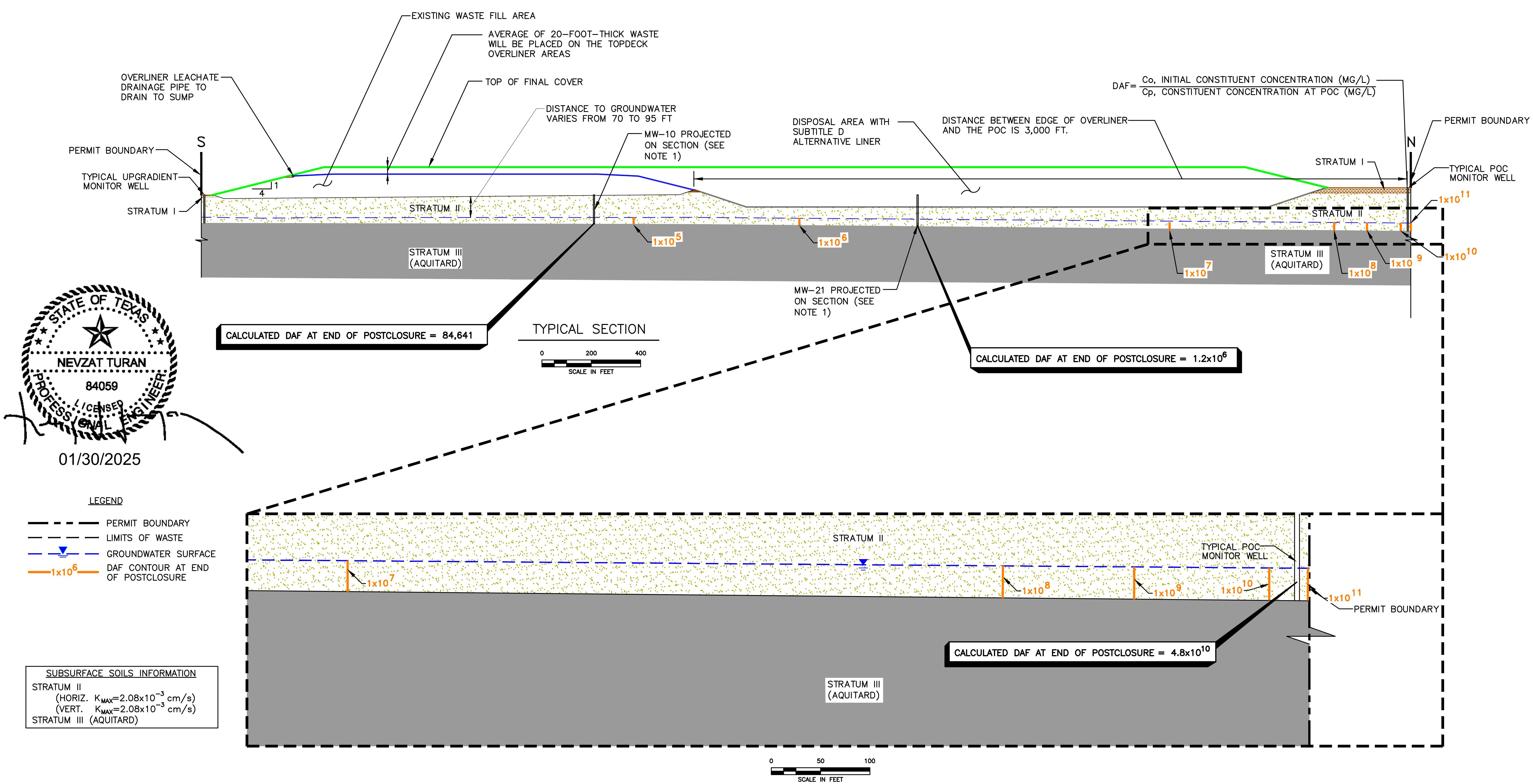
FIGURE 2

SHEET IIIB-D-3

O:\0120\94\LSMPA 2024\PART III\IIIB\FIG 1-5A-5B-SECTION SEQ.dwg, byoung, 1:2



LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- GROUNDWATER SURFACE
- $1x10^6$ DAF CONTOUR AT END OF POSTCLOSURE

SUBSURFACE SOILS INFORMATION

STRATUM II
(HORIZ. $K_{MAX}=2.08x10^{-3}$ cm/s)
(VERT. $K_{MAX}=2.08x10^{-3}$ cm/s)
STRATUM III (AQUITARD)

NOTE

1. MW-10 AND MW-21 ARE SIDE GRADIENT MONITOR WELLS. THIS TWO-DIMENSIONAL MODELING SECTION HAS BEEN DEVELOPED FOR THE HIGHEST GROUNDWATER GRADIENT. MODEL DEMONSTRATION FOR MW-10 AND MW-21 AT THE PROJECTED LOCATION IS CONSERVATIVE AS THE TWO-DIMENSIONAL MODELING SECTION REPRESENTS A HIGHER GROUNDWATER GRADIENT AS OPPOSED TO THE GRADIENT OF GROUNDWATER BETWEEN THE OVERLINER AREA AND THE ACTUAL LOCATION OF MW-10 AND MW-21.

SHEET IIIB-D-4

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MAJOR PERMIT AMENDMENT
CASE I – NORTH

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS

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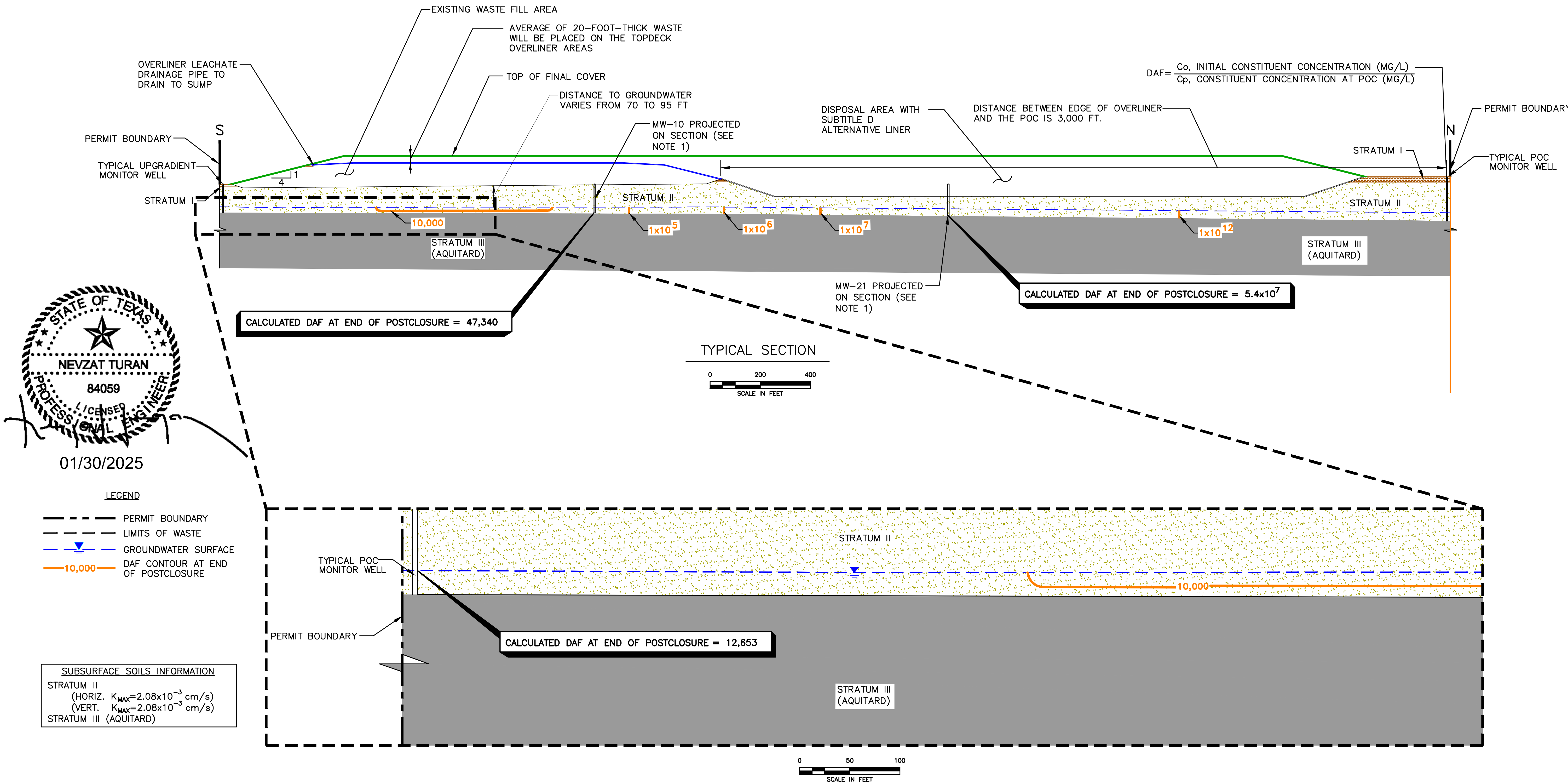
FIGURE 3



SUBSURFACE SOILS INFORMATION

STRATUM II
(HORIZ. $K_{MAX}=2.08\times10^{-3}$ cm/s)
(VERT. $K_{MAX}=2.08\times10^{-3}$ cm/s)
STRATUM III (AQUITARD)

NOTE

1. MW-10 AND MW-21 ARE SIDE GRADIENT MONITOR WELLS. THIS TWO-DIMENSIONAL MODELING SECTION HAS BEEN DEVELOPED FOR THE HIGHEST GROUNDWATER GRADIENT. MODEL DEMONSTRATION FOR MW-10 AND MW-21 AT THE PROJECTED LOCATION IS CONSERVATIVE AS THE TWO-DIMENSIONAL MODELING SECTION REPRESENTS A HIGHER GROUNDWATER GRADIENT AS OPPOSED TO THE GRADIENT OF GROUNDWATER BETWEEN THE OVERLINER AREA AND THE ACTUAL LOCATION OF MW-10 AND MW-21.

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DATE: 05/2024
FILE: 0120-094-11
CAD: FIG 3-7-TYP SECTION.dwg

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MAJOR PERMIT AMENDMENT CASE II

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS

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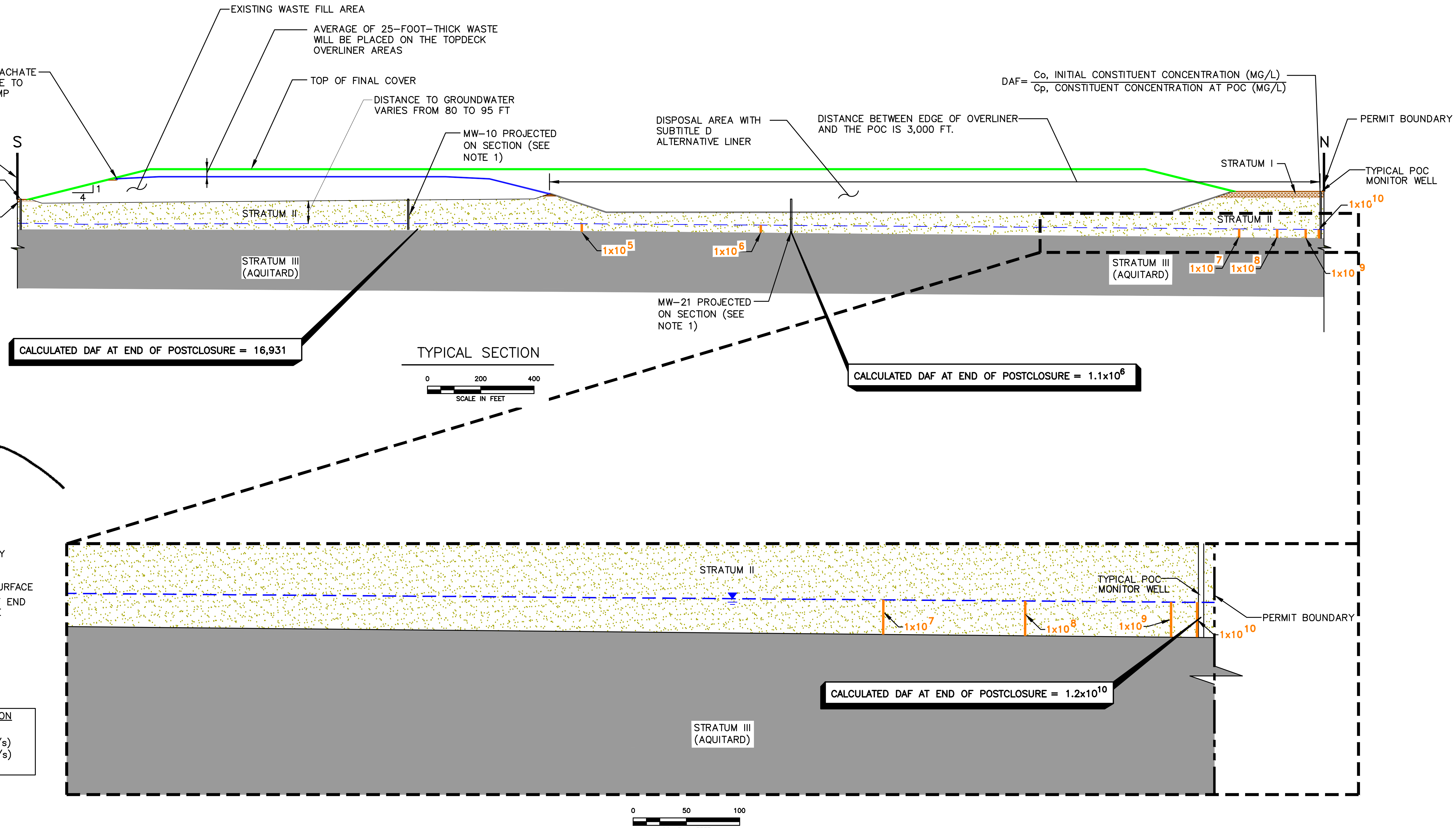
FIGURE 4



STATE OF TEXAS
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LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- GROUNDWATER SURFACE
- $1x10^6$ DAF CONTOUR AT END OF POSTCLOSURE

SUBSURFACE SOILS INFORMATION
STRATUM II
(HORIZ. $K_{MAX}=2.08x10^{-3}$ cm/s)
(VERT. $K_{MAX}=2.08x10^{-3}$ cm/s)
STRATUM III (AQUITARD)

NOTE

1. MW-10 AND MW-21 ARE SIDE GRADIENT MONITOR WELLS. THIS TWO-DIMENSIONAL MODELING SECTION HAS BEEN DEVELOPED FOR THE HIGHEST GROUNDWATER GRADIENT. MODEL DEMONSTRATION FOR MW-10 AND MW-21 AT THE PROJECTED LOCATION IS CONSERVATIVE AS THE TWO-DIMENSIONAL MODELING SECTION REPRESENTS A HIGHER GROUNDWATER GRADIENT AS OPPOSED TO THE GRADIENT OF GROUNDWATER BETWEEN THE OVERLINER AREA AND THE ACTUAL LOCATION OF MW-10 AND MW-21.

- [ ] DRAFT
- [x] FOR PERMITTING PURPOSES ONLY
- [ ] ISSUED FOR CONSTRUCTION

DATE: 05/2024
FILE: 0120-094-11
CAD: FIG 5-TYP SECTION.dwg

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MAJOR PERMIT AMENDMENT
CASE III

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS

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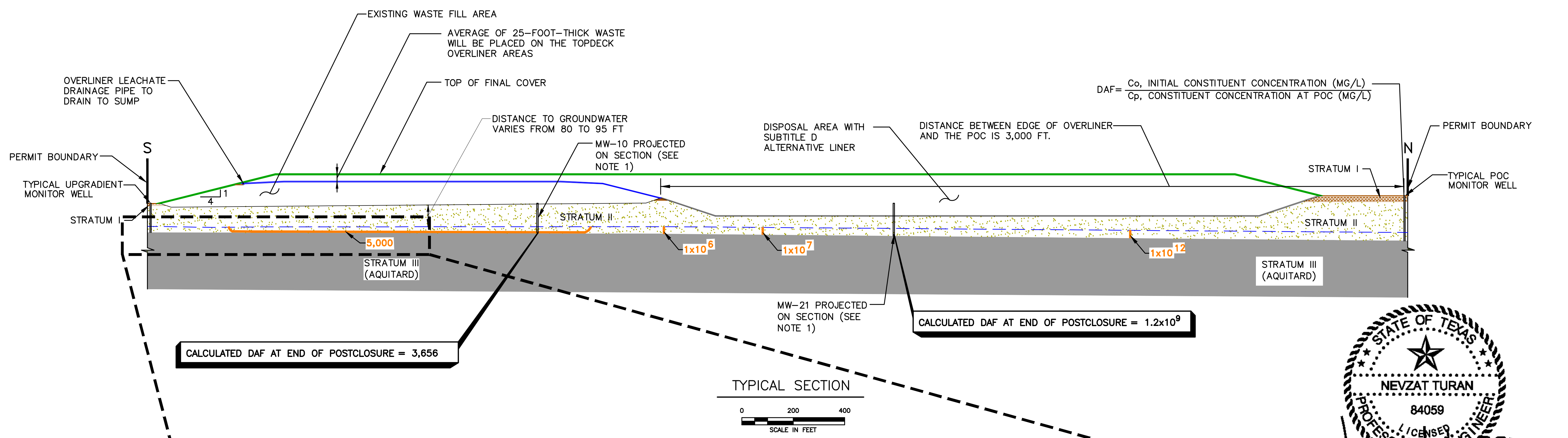
FIGURE 5

SHEET IIIB-D-6



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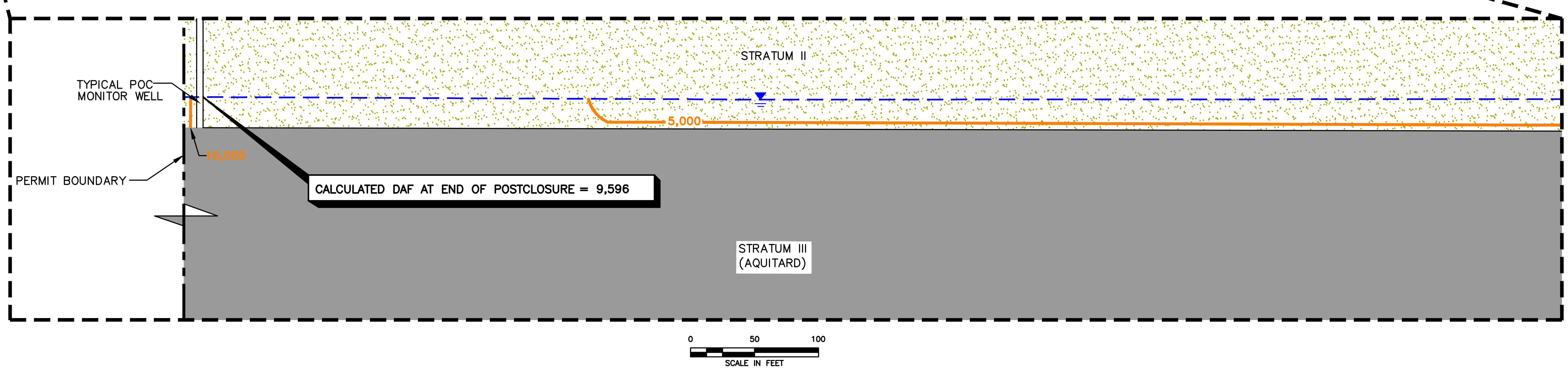
01/30/2025

LEGEND

- PERMIT BOUNDARY
- LIMITS OF WASTE
- GROUNDWATER SURFACE
- 10,000 DAF CONTOUR AT END OF POSTCLOSURE



SUBSURFACE SOILS INFORMATION

STRATUM II
(HORIZ. K_{MAX}=2.08x10^{-3} cm/s)
(VERT. K_{MAX}=2.08x10^{-3} cm/s)
STRATUM III (AQUITARD)

NOTE

1. MW-10 AND MW-21 ARE SIDE GRADIENT MONITOR WELLS. THIS TWO-DIMENSIONAL MODELING SECTION HAS BEEN DEVELOPED FOR THE HIGHEST GROUNDWATER GRADIENT. MODEL DEMONSTRATION FOR MW-10 AND MW-21 AT THE PROJECTED LOCATION IS CONSERVATIVE AS THE TWO-DIMENSIONAL MODELING SECTION REPRESENTS A HIGHER GROUNDWATER GRADIENT AS OPPOSED TO THE GRADIENT OF GROUNDWATER BETWEEN THE OVERLINER AREA AND THE ACTUAL LOCATION OF MW-10 AND MW-21.

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FILE: 0120-094-11
CAD: FIG 6-TYP SECTION.dwg

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MAJOR PERMIT AMENDMENT
CASE IV

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS

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FIGURE 6

SHEET IIIB-D-7

O:\0120\94\LSMPA 2024\PART III\IIIB\CLEAN\FIG 6-TYPICAL SECTION.dwg, byoung, 1:2

HELP MODEL ANALYSIS

HELP MODEL ANALYSIS

The following HELP model simulations were run to obtain percolation rates through the alternative liner area.

Table 1
Landfill Configurations

Area	Description
Alternative Liner	Case 1: Active landfill with 10 feet of waste above the alternative liner modeled for 1 year. Case 2: Interim landfill with 50 feet of waste above the alternative liner modeled for 10 years. Case 3: Interim landfill with 100 feet of waste above the alternative liner modeled for 15 years. Case 4: Interim landfill with 150 feet of waste above the alternative liner modeled for 10 years. Case 5: Interim landfill with 190 feet of waste above the alternative liner modeled for 5 years. Case 6: Closed landfill with 190 feet of waste above the alternative liner modeled for 30 years.

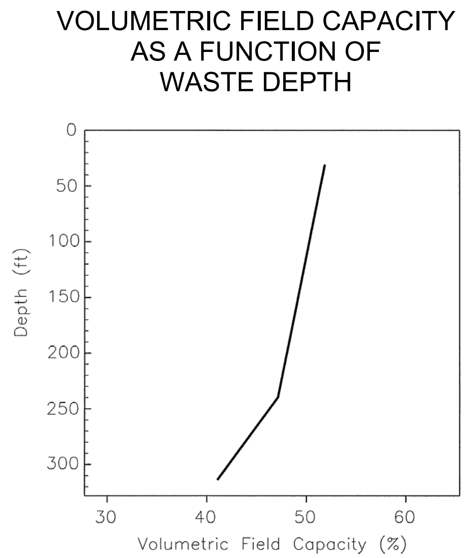
The evaporative zone depth and leaf area index were chosen to be 10 inches and 2.0, respectively, for the interim cases; and 18 inches and 4.5, respectively, for the closed cases. The Soil Conservation Service (SCS) runoff curve numbers were calculated by HELP based on soil data and expected ground cover, surface slope, and slope length. The HELP Model output results can be found starting on page IIIB-A-9.

CLIMATE DATA INPUT

Precipitation data was synthetically generated by the HELP Model using normal mean monthly precipitation data from NOAA for the Canyon, Texas weather station for the years 1981 through 2020. The average annual precipitation over the modeled 30-year period was 17.78 inches. Temperature and solar radiation data were also synthetically generated by the HELP Model using program defaults for Amarillo, Texas.

FIELD CAPACITY AND MOISTURE CONTENT

The porosity values for each layer other than the waste were provided by HELP. The field capacity and porosity values for the waste layer were obtained from "Retention of Free Liquids in Landfills Undergoing Vertical Expansion" (Zornberg, Jorge G., et al., 1999) and varies based on average waste column thickness, as shown in the following graph.



The initial moisture content for all layers except waste was set to field capacity. The initial moisture content for the waste was selected to be 35.0 percent to artificially inflate the leachate generation provided in the model to force percolation through the liner systems.

LANDFILL PROFILE INFORMATION

Refer to Appendix IIIB-A for information on the various landfill layers that are included in this demonstration are discussed below.

Alternative Liner System

The proposed alternative liner system for future sectors will consist of a 60-mil HDPE geomembrane placed over a geosynthetic clay liner (GCL).

HELP OUTPUT

The HELP summaries and output files are presented starting on page IIIB-D-11.

SOUTHWEST LANDFILL
0120-94-11-91
HELP VERSION 3.07 SUMMARY SHEET
SUBTITLE-D ALTERNATIVE LINER (MSW)

		ACTIVE (10 FT WASTE)	INTERIM (50 FT WASTE)	INTERIM (100 FT WASTE)	INTERIM (150 FT WASTE)	INTERIM (190 FT WASTE)	CLOSED (190 FT WASTE)
GENERAL	Case No.	1	2	3	4	5	6
INFORMATION	No. of Years	1	10	15	10	5	30
	Ground Cover	BARE	FAIR	FAIR	FAIR	FAIR	GOOD
	SCS Runoff Curve No.	94.6	87.1	87.1	87.1	87.1	79.9
	Model Area (acre)	1	1	1	1	1	1
	Runoff Area (%)	0	70	80	80	90	100
	Maximum Leaf Area Index	0.0	2.0	2.0	2.0	2.0	4.5
	Evaporative Zone Depth (inch)	10	10	10	10	10	18
TOPSOIL	Thickness (in)						24
LAYER	Porosity (vol/vol)						0.3980
(Texture = 10)	Field Capacity (vol/vol)						0.2440
	Wilting Point (vol/vol)						0.1360
	Init. Moisture Content (vol/vol)						0.2440
	Hyd. Conductivity (cm/s)						1.2E-04
FLEXIBLE	Thickness (in)						0.04
MEMBRANE	Hyd. Conductivity (cm/s)						4.0E-13
LINER	Pinhole Density (holes/acre)						1
(Texture = 36)	Install. Defects (holes/acre)						4
	Placement Quality						GOOD
INFILTRATION	Thickness (in)						18
LAYER	Porosity (vol/vol)						0.4270
(Texture = 0)	Field Capacity (vol/vol)						0.4180
	Wilting Point (vol/vol)						0.3670
	Init. Moisture Content (vol/vol)						0.4270
	Hyd. Conductivity (cm/s)						1.0E-05
INTERMEDIATE	Thickness (in)		12	12	12	12	12
COVER	Porosity (vol/vol)		0.4640	0.4640	0.4640	0.4640	0.4640
(Texture = 11)	Field Capacity (vol/vol)		0.3100	0.3100	0.3100	0.3100	0.3100
	Wilting Point (vol/vol)		0.1870	0.1870	0.1870	0.1870	0.1870
	Init. Moisture Content (vol/vol)		0.3100	0.3100	0.3100	0.3100	0.3100
	Hyd. Conductivity (cm/s)		6.4E-05	6.4E-05	6.4E-05	6.4E-05	6.4E-05
WASTE TOP[2]	Thickness (in)	120	600	1200	1500	1500	1500
(Texture = 0)	Porosity (vol/vol)	0.6649	0.6483	0.6277	0.6174	0.6174	0.6174
	Field Capacity (vol/vol)	0.5262	0.5215	0.5156	0.5127	0.5127	0.5127
	Wilting Point (vol/vol)	0.0770	0.0770	0.0770	0.0770	0.0770	0.0770
	Init. Moisture Content (vol/vol)	0.2500	0.2500	0.3500	0.3500	0.3500	0.3500
	Hyd. Conductivity (cm/s)	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03
WASTE BOTTOM[2]	Thickness (in)				300	780	780
(Texture = 0)	Porosity (vol/vol)				0.5554	0.5389	0.5389
	Field Capacity (vol/vol)				0.4951	0.4904	0.4904
	Wilting Point (vol/vol)				0.0770	0.0770	0.0770
	Init. Moisture Content (vol/vol)				0.3500	0.3500	0.3500
	Hyd. Conductivity (cm/s)				1.0E-04	1.0E-04	1.0E-04
PROTECTIVE	Thickness (in)	24	24	24	24	24	24
COVER	Porosity (vol/vol)	0.3980	0.3980	0.3980	0.3980	0.3980	0.3980
(Texture = 10)	Field Capacity (vol/vol)	0.2440	0.2440	0.2440	0.2440	0.2440	0.2440
	Wilting Point (vol/vol)	0.1360	0.1360	0.1360	0.1360	0.1360	0.1360
	Init. Moisture Content (vol/vol)	0.2440	0.2440	0.2440	0.2440	0.2440	0.2440
	Hyd. Conductivity (cm/s)	1.2E-04	1.2E-04	1.2E-04	1.2E-04	1.2E-04	1.2E-04
LEACHATE	Thickness (in)	0.248	0.234	0.211	0.187	0.175	0.174
COLLECTION	Porosity (vol/vol)	0.8500	0.8500	0.8500	0.8500	0.8500	0.8500
LAYER	Field Capacity (vol/vol)	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
(Texture = 0)	Wilting Point (vol/vol)	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
	Init. Moisture Content (vol/vol)	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
	Hyd. Conductivity (cm/s)	58.95	34.49	21.44	13.60	9.73	8.23
	Slope (%)	2.0	2.0	2.0	2.0	2.0	2.0
	Slope Length (ft)	215	215	215	215	215	215
FLEXIBLE	Thickness (in)	0.06	0.06	0.06	0.06	0.06	0.06
MEMBRANE	Hyd. Conductivity (cm/s)	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13	2.0E-13
LINER	Pinhole Density (holes/acre)	1	1	1	1	1	1
(Texture = 35)	Install. Defects (holes/acre)	4	4	4	4	4	4
	Placement Quality	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
GEOSYNTHETIC	Thickness (in)	0.25	0.25	0.25	0.25	0.25	0.25
CLAY LINER	Porosity (vol/vol)	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
(Texture = 0)	Field Capacity (vol/vol)	0.7470	0.7470	0.7470	0.7470	0.7470	0.7470
	Wilting Point (vol/vol)	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000
	Init. Moisture Content (vol/vol)	0.7500	0.7500	0.7500	0.7500	0.7500	0.7500
	Hyd. Conductivity (cm/s)	5.0E-09	5.0E-09	5.0E-09	5.0E-09	5.0E-09	5.0E-09
PRECIPITATION	Average Annual (in)	23.57	18.71	17.87	18.71	19.03	17.78
RUNOFF	Average Annual (in)	0.00	0.51	0.56	0.54	0.39	0.21
EVAPOTRANSPIRATION	Average Annual (in)	21.99	16.68	15.98	16.59	17.88	17.42
LATERAL	Average Annual (cf/year)	0.0	0.0	10,032.6	11,176.2	15,367.6	10,321.2
DRAINAGE COLLECTED	Peak Daily (cf/day)	0.00	0.00	42.13	53.53	68.18	81.55
PERCOLATION	Average Annual (cf/yr)	0.000	0.000	0.010	0.010	0.011	0.010
THROUGH GCL	Average Annual[3] (mm/yr)	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001

[1] Drainage collected includes actual leachate pumped by the leachate pumps (i.e., the total of the collected and recirculated leachate).

[2] The field capacity and porosity values for the waste layer were obtained from: Zornberg, Jorge G. et. al, *Retention of Free Liquids in Landfills Undergoing Vertical Expansion.* Journal of Geotechnical and Geoenvironmental Engineering, July 1999, pp. 583-594.

[3] The highest percolation rate from the interim conditions was used as the input into MODFLOW.

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\SW\ALT\AC\DATA4.D4
TEMPERATURE DATA FILE:      C:\SW\ALT\AC\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\SW\ALT\AC\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\SW\ALT\AC\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\SW\ALT\AC\DATA10.D10
OUTPUT DATA FILE:           C:\SW\ALT\AC\OUTPUT1.OUT


TIME:  33:22     DATE:   2/24/2024


******************************************************************************

     TITLE:  SOUTHWEST LANDFILL - ALT LINER (ACTIVE 10')

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =    120.00   INCHES
```

```
POROSITY                     =      0.6649 VOL/VOL
FIELD CAPACITY               =      0.5262 VOL/VOL
WILTING POINT                =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2500 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC



                        LAYER  2
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  10
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.3980 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC



                        LAYER  3
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.25   INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   58.9500008000     CM/SEC
SLOPE                        =      2.00   PERCENT
DRAINAGE LENGTH              =    215.0    FEET



                        LAYER  4
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
```

```
   INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
   FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
   FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  5
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
   THICKNESS                   =      0.25   INCHES
   POROSITY                    =      0.7500 VOL/VOL
   FIELD CAPACITY              =      0.7470 VOL/VOL
   WILTING POINT               =      0.4000 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #11 WITH BARE
          GROUND CONDITIONS, A SURFACE SLOPE OF  2.% AND
          A SLOPE LENGTH OF  200. FEET.

SCS RUNOFF CURVE NUMBER            =     94.60
FRACTION OF AREA ALLOWING RUNOFF   =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     10.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      2.500  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      6.649  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.770  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =     36.046  INCHES
TOTAL INITIAL WATER                =     36.046  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR


           EVAPOTRANSPIRATION AND WEATHER DATA
           -----------------------------------
```

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
AMARILLO TEXAS

STATION LATITUDE	=	35.23 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	95
END OF GROWING SEASON (JULIAN DATE)	=	303
EVAPORATIVE ZONE DEPTH	=	10.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	13.70 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	55.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	52.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	57.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	57.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.59	0.40	1.06	0.99	2.25	2.68
2.26	3.03	1.90	1.98	0.68	0.63

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
37.40	40.40	48.80	57.10	67.00	76.30
79.70	78.30	70.70	59.30	46.90	37.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS
AND STATION LATITUDE = 35.23 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 11 THROUGH 11

		JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION							
	TOTALS	0.27	0.00	2.06	0.49	3.36	1.41
		3.39	3.47	2.62	3.09	1.84	1.57
	STD. DEVIATIONS	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00
RUNOFF							
	TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
		0.000	0.000	0.000	0.000	0.000	0.000
	STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
		0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION							
	TOTALS	0.639	0.378	0.346	1.533	3.171	1.246
		3.871	2.897	0.824	4.398	0.676	2.013
	STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
		0.000	0.000	0.000	0.000	0.000	0.000
LATERAL DRAINAGE COLLECTED FROM LAYER 3							
	TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5							
	TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 11 THROUGH 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	23.57 (0.000)	85559.1	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	21.991 (0.0000)	79828.87	93.303
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.00000 (0.00000)	0.001	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000 (0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 4	0.000 (0.000)		
CHANGE IN WATER STORAGE	1.579 (0.0000)	5730.26	6.697

****

****

PEAK DAILY VALUES FOR YEARS 11 THROUGH 11

	(INCHES)	(CU. FT.)
PRECIPITATION	1.53	5553.900

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.00000	0.00086
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00000
AVERAGE HEAD ON TOP OF LAYER 4	0.000	
MAXIMUM HEAD ON TOP OF LAYER 4	0.006	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.72	2616.3181

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3549

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0770

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 11

LAYER	(INCHES)	(VOL/VOL)
1	30.9882	0.2582
2	5.8560	0.2440
3	0.0025	0.0100
4	0.0000	0.0000

```
           5            0.1875          0.7500

       SNOW WATER       0.590

*******************************************************************************
*******************************************************************************
```

```
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******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\SW\ALT\I50\DATA4.D4
TEMPERATURE DATA FILE:      C:\SW\ALT\I50\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\SW\ALT\I50\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\SW\ALT\I50\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\SW\ALT\I50\DATA10.D10
OUTPUT DATA FILE:           C:\SW\ALT\I50\OUTPUT1.OUT


TIME:  33:23     DATE:   2/24/2024


******************************************************************************

     TITLE:  SOUTHWEST LANDFILL - ALT LINER (INTERIM 50')

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  11
           THICKNESS                  =     12.00   INCHES
```

```
  POROSITY                    =      0.4640 VOL/VOL
  FIELD CAPACITY              =      0.3100 VOL/VOL
  WILTING POINT               =      0.1870 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.3100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.639999998000E-04 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =    600.00   INCHES
  POROSITY                    =      0.6483 VOL/VOL
  FIELD CAPACITY              =      0.5215 VOL/VOL
  WILTING POINT               =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.2500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                          LAYER  3
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  10
  THICKNESS                   =     24.00   INCHES
  POROSITY                    =      0.3980 VOL/VOL
  FIELD CAPACITY              =      0.2440 VOL/VOL
  WILTING POINT               =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC


                          LAYER  4
                          --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =      0.23   INCHES
  POROSITY                    =      0.8500 VOL/VOL
  FIELD CAPACITY              =      0.0100 VOL/VOL
  WILTING POINT               =      0.0050 VOL/VOL
```

```
  INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =   34.4900017000     CM/SEC
  SLOPE                       =      2.00   PERCENT
  DRAINAGE LENGTH             =    215.0    FEET


                        LAYER  5
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
  THICKNESS                   =      0.06   INCHES
  POROSITY                    =      0.0000 VOL/VOL
  FIELD CAPACITY              =      0.0000 VOL/VOL
  WILTING POINT               =      0.0000 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
  FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
  FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  6
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =      0.25   INCHES
  POROSITY                    =      0.7500 VOL/VOL
  FIELD CAPACITY              =      0.7470 VOL/VOL
  WILTING POINT               =      0.4000 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #11 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
         AND A SLOPE LENGTH OF  200. FEET.
```

SCS RUNOFF CURVE NUMBER	=	87.10	
FRACTION OF AREA ALLOWING RUNOFF	=	70.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	10.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.100	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.640	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.870	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	159.766	INCHES
TOTAL INITIAL WATER	=	159.766	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
AMARILLO TEXAS

STATION LATITUDE	=	35.23 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	95
END OF GROWING SEASON (JULIAN DATE)	=	303
EVAPORATIVE ZONE DEPTH	=	10.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	13.70 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	55.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	52.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	57.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	57.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.59	0.40	1.06	0.99	2.25	2.68
2.26	3.03	1.90	1.98	0.68	0.63

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
37.40	40.40	48.80	57.10	67.00	76.30
79.70	78.30	70.70	59.30	46.90	37.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS
AND STATION LATITUDE = 35.23 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 21 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.63	0.36	1.17	0.71	1.47	3.39
	2.32	2.61	1.31	3.01	1.09	0.66
STD. DEVIATIONS	0.61	0.29	0.62	0.50	0.88	1.42
	0.95	1.50	1.21	2.22	0.91	0.60
RUNOFF						
TOTALS	0.000	0.000	0.006	0.000	0.010	0.200
	0.004	0.064	0.019	0.178	0.023	0.003
STD. DEVIATIONS	0.000	0.000	0.012	0.000	0.016	0.277
	0.007	0.093	0.055	0.295	0.047	0.010
EVAPOTRANSPIRATION						
TOTALS	0.648	0.438	0.716	0.853	1.702	2.877
	2.409	2.220	1.548	1.393	1.314	0.561
STD. DEVIATIONS	0.521	0.222	0.653	0.588	0.970	1.279
	0.873	1.251	1.098	0.741	0.698	0.378

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 21 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.71 (2.731)	67928.2	100.00
RUNOFF	0.506 (0.3454)	1838.02	2.706
EVAPOTRANSPIRATION	16.680 (2.2549)	60546.84	89.134
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00000 (0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000 (0.00000)	0.000	0.00000

```
 AVERAGE HEAD ON TOP              0.000 (    0.000)
   OF LAYER  5

 CHANGE IN WATER STORAGE          1.527   (  1.6276)       5543.34      8.161

******************************************************************************




******************************************************************************

               PEAK DAILY VALUES FOR YEARS   21 THROUGH   30
   ------------------------------------------------------------------------
                                                  (INCHES)      (CU. FT.)
                                                 ----------   -------------
      PRECIPITATION                                3.08         11180.399

      RUNOFF                                       0.893         3241.0125

      DRAINAGE COLLECTED FROM LAYER  4             0.00000          0.00086

      PERCOLATION/LEAKAGE THROUGH LAYER  6         0.000000         0.00000

      AVERAGE HEAD ON TOP OF LAYER  5              0.000

      MAXIMUM HEAD ON TOP OF LAYER  5              0.008

      LOCATION OF MAXIMUM HEAD IN LAYER  4
            (DISTANCE FROM DRAIN)                  0.0 FEET

      SNOW WATER                                   0.92          3352.7432


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.4196

      MINIMUM VEG. SOIL WATER (VOL/VOL)                    0.1870


       ***  Maximum heads are computed using McEnroe's equations.  ***

            Reference:  Maximum Saturated Depth over Landfill Liner
                        by Bruce M. McEnroe, University of Kansas
                        ASCE Journal of Environmental Engineering
                        Vol. 119, No. 2, March 1993, pp. 262-270.


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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	2.8688	0.2391
2	166.1220	0.2769
3	5.8560	0.2440
4	0.0023	0.0100
5	0.0000	0.0000
6	0.1875	0.7500
SNOW WATER	0.000	

****
****

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\SW\ALT\I100\DATA4.D4
TEMPERATURE DATA FILE:      C:\SW\ALT\I100\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\SW\ALT\I100\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\SW\ALT\I100\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\SW\ALT\I100\DATA10.D10
OUTPUT DATA FILE:           C:\SW\ALT\I100\OUTPUT1.OUT


TIME:  33:31     DATE:   2/24/2024


******************************************************************************

     TITLE:  SOUTHWEST LANDFILL - ALT LINER (INTERIM 100')

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER  11
          THICKNESS                  =     12.00   INCHES
```

```
  POROSITY                    =      0.4640 VOL/VOL
  FIELD CAPACITY              =      0.3100 VOL/VOL
  WILTING POINT               =      0.1870 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.3100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.639999998000E-04 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =   1200.00   INCHES
  POROSITY                    =      0.6277 VOL/VOL
  FIELD CAPACITY              =      0.5156 VOL/VOL
  WILTING POINT               =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.3500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                          LAYER  3
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  10
  THICKNESS                   =     24.00   INCHES
  POROSITY                    =      0.3980 VOL/VOL
  FIELD CAPACITY              =      0.2440 VOL/VOL
  WILTING POINT               =      0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC


                          LAYER  4
                          --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =      0.21   INCHES
  POROSITY                    =      0.8500 VOL/VOL
  FIELD CAPACITY              =      0.0100 VOL/VOL
  WILTING POINT               =      0.0050 VOL/VOL
```

```
INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   21.4400005000     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    215.0    FEET


                        LAYER  5
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  6
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.7500 VOL/VOL
FIELD CAPACITY              =      0.7470 VOL/VOL
WILTING POINT               =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC


        GENERAL DESIGN AND EVAPORATIVE ZONE DATA
        ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #11 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
         AND A SLOPE LENGTH OF  200. FEET.
```

SCS RUNOFF CURVE NUMBER	=	87.10	
FRACTION OF AREA ALLOWING RUNOFF	=	80.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	10.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.100	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.640	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.870	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	429.766	INCHES
TOTAL INITIAL WATER	=	429.766	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
AMARILLO TEXAS

STATION LATITUDE	=	35.23	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	95	
END OF GROWING SEASON (JULIAN DATE)	=	303	
EVAPORATIVE ZONE DEPTH	=	10.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	13.70	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	55.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	52.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	57.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	57.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.59	0.40	1.06	0.99	2.25	2.68
2.26	3.03	1.90	1.98	0.68	0.63

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
37.40	40.40	48.80	57.10	67.00	76.30
79.70	78.30	70.70	59.30	46.90	37.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS
AND STATION LATITUDE = 35.23 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 16 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.60	0.28	1.12	0.73	1.57	3.25
	2.10	2.84	1.17	2.60	1.06	0.56
STD. DEVIATIONS	0.61	0.27	0.57	0.51	0.93	1.54
	1.08	1.45	1.07	2.11	0.93	0.54
RUNOFF						
TOTALS	0.000	0.000	0.005	0.011	0.013	0.199
	0.006	0.087	0.023	0.193	0.021	0.002
STD. DEVIATIONS	0.000	0.000	0.012	0.041	0.023	0.297
	0.010	0.106	0.057	0.338	0.046	0.009
EVAPOTRANSPIRATION						
TOTALS	0.558	0.389	0.579	0.843	1.819	2.828
	2.229	2.455	1.347	1.153	1.198	0.583
STD. DEVIATIONS	0.402	0.229	0.555	0.497	0.899	1.211
	1.080	1.150	0.953	0.752	0.676	0.382

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.2261	0.2175	0.2340	0.2284	0.2351	0.2277
	0.2363	0.2344	0.2265	0.2344	0.2271	0.2362
STD. DEVIATIONS	0.0416	0.0139	0.0149	0.0177	0.0149	0.0183
	0.0156	0.0144	0.0146	0.0147	0.0158	0.0157

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0006	0.0007	0.0007	0.0007	0.0007	0.0007
	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
STD. DEVIATIONS	0.0001	0.0000	0.0000	0.0001	0.0000	0.0001
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 16 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	17.87 (3.266)	64877.8	100.00
RUNOFF	0.560 (0.3989)	2032.30	3.133
EVAPOTRANSPIRATION	15.980 (2.6250)	58006.08	89.408
LATERAL DRAINAGE COLLECTED FROM LAYER 4	2.76379 (0.16174)	10032.558	15.46378
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000 (0.00000)	0.010	0.00001

```
 AVERAGE HEAD ON TOP              0.001 (    0.000)
   OF LAYER  5

 CHANGE IN WATER STORAGE        -1.431   (  1.4242)      -5193.18     -8.005

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                PEAK DAILY VALUES FOR YEARS   16 THROUGH   30
   ------------------------------------------------------------------------
                                                   (INCHES)      (CU. FT.)
                                                  ----------   -------------
      PRECIPITATION                                  3.08         11180.399

      RUNOFF                                         0.998         3623.1907

      DRAINAGE COLLECTED FROM LAYER  4               0.01161         42.13332

      PERCOLATION/LEAKAGE THROUGH LAYER  6           0.000000         0.00003

      AVERAGE HEAD ON TOP OF LAYER  5                0.001

      MAXIMUM HEAD ON TOP OF LAYER  5                0.005

      LOCATION OF MAXIMUM HEAD IN LAYER  4
            (DISTANCE FROM DRAIN)                    0.0 FEET

      SNOW WATER                                     0.92          3352.7432


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                      0.3991

      MINIMUM VEG. SOIL WATER (VOL/VOL)                      0.1870


       ***  Maximum heads are computed using McEnroe's equations.  ***

            Reference:  Maximum Saturated Depth over Landfill Liner
                        by Bruce M. McEnroe, University of Kansas
                        ASCE Journal of Environmental Engineering
                        Vol. 119, No. 2, March 1993, pp. 262-270.


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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	2.8894	0.2408
2	399.1465	0.3326
3	6.0803	0.2533
4	0.0025	0.0119
5	0.0000	0.0000
6	0.1875	0.7500
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
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PRECIPITATION DATA FILE:    C:\SW\ALT\I150\DATA4.D4
TEMPERATURE DATA FILE:      C:\SW\ALT\I150\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\SW\ALT\I150\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\SW\ALT\I150\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\SW\ALT\I150\DATA10.D10
OUTPUT DATA FILE:           C:\SW\ALT\I150\OUTPUT1.OUT


TIME:  33:32     DATE:   2/24/2024


******************************************************************************

     TITLE:  SOUTHWEST LANDFILL - ALT LINER (INTERIM 150')

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                    LAYER  1
                                    --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  11
           THICKNESS                  =     12.00   INCHES
```

```
  POROSITY                     =      0.4640 VOL/VOL
  FIELD CAPACITY               =      0.3100 VOL/VOL
  WILTING POINT                =      0.1870 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.3100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =  0.639999998000E-04 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.



                          LAYER  2
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                    =   1500.00   INCHES
  POROSITY                     =      0.6174 VOL/VOL
  FIELD CAPACITY               =      0.5127 VOL/VOL
  WILTING POINT                =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.3500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC



                          LAYER  3
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                    =    300.00   INCHES
  POROSITY                     =      0.5554 VOL/VOL
  FIELD CAPACITY               =      0.4951 VOL/VOL
  WILTING POINT                =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT   =      0.3500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-04 CM/SEC



                          LAYER  4
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  10
  THICKNESS                    =     24.00   INCHES
  POROSITY                     =      0.3980 VOL/VOL
  FIELD CAPACITY               =      0.2440 VOL/VOL
  WILTING POINT                =      0.1360 VOL/VOL
```

```
INITIAL SOIL WATER CONTENT  =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC


                        LAYER  5
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.19   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   13.6000004000     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    215.0    FEET


                        LAYER  6
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  7
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.7500 VOL/VOL
FIELD CAPACITY              =      0.7470 VOL/VOL
WILTING POINT               =      0.4000 VOL/VOL
```

```
INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

```
NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #11 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
         AND A SLOPE LENGTH OF  200. FEET.

SCS RUNOFF CURVE NUMBER             =     87.10
FRACTION OF AREA ALLOWING RUNOFF    =     80.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =     10.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      3.100  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.640  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.870  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =    639.765  INCHES
TOTAL INITIAL WATER                 =    639.765  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

```
NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         AMARILLO              TEXAS

     STATION LATITUDE                         =  35.23 DEGREES
     MAXIMUM LEAF AREA INDEX                  =   2.00
     START OF GROWING SEASON (JULIAN DATE)    =     95
     END OF GROWING SEASON (JULIAN DATE)      =    303
     EVAPORATIVE ZONE DEPTH                   =  10.0  INCHES
     AVERAGE ANNUAL WIND SPEED                =  13.70 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  55.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  52.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  57.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  57.00 %

NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
```

COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.59	0.40	1.06	0.99	2.25	2.68
2.26	3.03	1.90	1.98	0.68	0.63

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
37.40	40.40	48.80	57.10	67.00	76.30
79.70	78.30	70.70	59.30	46.90	37.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS
AND STATION LATITUDE = 35.23 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 21 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.63	0.36	1.17	0.71	1.47	3.39
	2.32	2.61	1.31	3.01	1.09	0.66
STD. DEVIATIONS	0.61	0.29	0.62	0.50	0.88	1.42
	0.95	1.50	1.21	2.22	0.91	0.60
RUNOFF						
TOTALS	0.000	0.000	0.007	0.000	0.010	0.218

```
                        0.004    0.073    0.021    0.182    0.023    0.003

  STD. DEVIATIONS       0.000    0.000    0.014    0.001    0.018    0.318
                        0.007    0.106    0.061    0.320    0.046    0.011

EVAPOTRANSPIRATION
------------------
  TOTALS                0.640    0.436    0.714    0.875    1.681    2.829
                        2.406    2.224    1.547    1.383    1.300    0.557

  STD. DEVIATIONS       0.512    0.220    0.645    0.567    0.945    1.262
                        0.864    1.256    1.089    0.734    0.683    0.377

LATERAL DRAINAGE COLLECTED FROM LAYER  5
----------------------------------------
  TOTALS                0.2445   0.2389   0.2683   0.2577   0.2663   0.2573
                        0.2626   0.2628   0.2544   0.2585   0.2500   0.2575

  STD. DEVIATIONS       0.0487   0.0295   0.0403   0.0389   0.0395   0.0382
                        0.0342   0.0318   0.0284   0.0307   0.0275   0.0257

PERCOLATION/LEAKAGE THROUGH LAYER  7
------------------------------------
  TOTALS                0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS       0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER  6
-------------------------------------
  AVERAGES              0.0011   0.0012   0.0012   0.0012   0.0012   0.0012
                        0.0012   0.0012   0.0012   0.0012   0.0012   0.0012

  STD. DEVIATIONS       0.0002   0.0001   0.0002   0.0002   0.0002   0.0002
                        0.0002   0.0001   0.0001   0.0001   0.0001   0.0001

*******************************************************************************


*******************************************************************************

    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS   21 THROUGH   30
```

	INCHES	CU. FEET	PERCENT
PRECIPITATION	18.71 (2.731)	67928.2	100.00
RUNOFF	0.541 (0.3909)	1965.47	2.893
EVAPOTRANSPIRATION	16.593 (2.2638)	60232.40	88.671
LATERAL DRAINAGE COLLECTED FROM LAYER 5	3.07885 (0.33543)	11176.231	16.45301
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000 (0.00000)	0.010	0.00001
AVERAGE HEAD ON TOP OF LAYER 6	0.001 (0.000)		
CHANGE IN WATER STORAGE	-1.500 (1.5878)	-5445.91	-8.017

****

****

PEAK DAILY VALUES FOR YEARS 21 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	3.08	11180.399
RUNOFF	1.016	3687.0229
DRAINAGE COLLECTED FROM LAYER 5	0.01475	53.52757
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.002	
MAXIMUM HEAD ON TOP OF LAYER 6	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	174.5 FEET	
SNOW WATER	0.92	3352.7432

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3911

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1870

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

****

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	2.8912	0.2409
2	520.5213	0.3470
3	95.0026	0.3167
4	6.1576	0.2566
5	0.0024	0.0131
6	0.0000	0.0000
7	0.1875	0.7500
SNOW WATER	0.000	

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******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\SW\ALT\I190\DATA4.D4
TEMPERATURE DATA FILE:       C:\SW\ALT\I190\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\SW\ALT\I190\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\SW\ALT\I190\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\SW\ALT\I190\DATA10.D10
OUTPUT DATA FILE:            C:\SW\ALT\I190\OUTPUT1.OUT


TIME:  33:37     DATE:   2/24/2024


******************************************************************************

     TITLE:  SOUTHWEST LANDFILL - ALT LINER (INTERIM 190')

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER  11
           THICKNESS                  =     12.00   INCHES
```

```
  POROSITY                       =      0.4640 VOL/VOL
  FIELD CAPACITY                 =      0.3100 VOL/VOL
  WILTING POINT                  =      0.1870 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.3100 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.639999998000E-04 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

           TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER   0
  THICKNESS                      =   1500.00   INCHES
  POROSITY                       =      0.6174 VOL/VOL
  FIELD CAPACITY                 =      0.5127 VOL/VOL
  WILTING POINT                  =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.3500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                          LAYER  3
                          --------

           TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER   0
  THICKNESS                      =    780.00   INCHES
  POROSITY                       =      0.5389 VOL/VOL
  FIELD CAPACITY                 =      0.4904 VOL/VOL
  WILTING POINT                  =      0.0770 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.3500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-04 CM/SEC


                          LAYER  4
                          --------

           TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER  10
  THICKNESS                      =     24.00   INCHES
  POROSITY                       =      0.3980 VOL/VOL
  FIELD CAPACITY                 =      0.2440 VOL/VOL
  WILTING POINT                  =      0.1360 VOL/VOL
```

```
INITIAL SOIL WATER CONTENT  =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC


                        LAYER  5
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.17   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   9.72999954000     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    215.0    FEET


                        LAYER  6
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  7
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.7500 VOL/VOL
FIELD CAPACITY              =      0.7470 VOL/VOL
WILTING POINT               =      0.4000 VOL/VOL
```

```
INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

```
NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #11 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  2.%
         AND A SLOPE LENGTH OF  200. FEET.

SCS RUNOFF CURVE NUMBER             =     87.10
FRACTION OF AREA ALLOWING RUNOFF    =     90.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =     10.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      3.100  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.640  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.870  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =    807.765  INCHES
TOTAL INITIAL WATER                 =    807.765  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

```
NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         AMARILLO             TEXAS

     STATION LATITUDE                        =  35.23 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   2.00
     START OF GROWING SEASON (JULIAN DATE)   =     95
     END OF GROWING SEASON (JULIAN DATE)     =    303
     EVAPORATIVE ZONE DEPTH                  =  10.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =  13.70 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  55.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  52.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  57.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  57.00 %


NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
```

COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.59	0.40	1.06	0.99	2.25	2.68
2.26	3.03	1.90	1.98	0.68	0.63

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
37.40	40.40	48.80	57.10	67.00	76.30
79.70	78.30	70.70	59.30	46.90	37.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS
AND STATION LATITUDE = 35.23 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 26 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.57	0.22	1.52	0.67	1.70	3.96
	2.05	3.13	1.57	2.22	0.68	0.73
STD. DEVIATIONS	0.36	0.13	0.53	0.57	0.98	0.87
	0.66	1.54	1.59	1.32	0.80	0.56
RUNOFF						
TOTALS	0.000	0.000	0.015	0.000	0.011	0.118

```
                         0.001    0.118    0.044    0.081    0.000    0.000

  STD. DEVIATIONS        0.000    0.000    0.021    0.000    0.024    0.129
                         0.001    0.154    0.093    0.124    0.000    0.000

EVAPOTRANSPIRATION
------------------
  TOTALS                 0.564    0.364    1.088    0.982    1.585    3.778
                         2.306    2.616    1.770    1.120    1.128    0.580

  STD. DEVIATIONS        0.381    0.103    0.734    0.547    1.106    0.700
                         0.861    1.255    1.447    0.830    0.725    0.375

LATERAL DRAINAGE COLLECTED FROM LAYER  5
----------------------------------------
  TOTALS                 0.3177   0.3408   0.3759   0.3571   0.3676   0.3572
                         0.3607   0.3585   0.3439   0.3548   0.3453   0.3540

  STD. DEVIATIONS        0.1034   0.0390   0.0465   0.0452   0.0452   0.0442
                         0.0434   0.0522   0.0382   0.0451   0.0445   0.0462

PERCOLATION/LEAKAGE THROUGH LAYER  7
------------------------------------
  TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER  6
-------------------------------------
  AVERAGES               0.0020   0.0024   0.0024   0.0023   0.0023   0.0023
                         0.0023   0.0023   0.0022   0.0022   0.0022   0.0022

  STD. DEVIATIONS        0.0007   0.0003   0.0003   0.0003   0.0003   0.0003
                         0.0003   0.0003   0.0002   0.0003   0.0003   0.0003

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS   26 THROUGH   30
```

	INCHES		CU. FEET	PERCENT
PRECIPITATION	19.03	(2.690)	69078.9	100.00
RUNOFF	0.388	(0.3370)	1407.30	2.037
EVAPOTRANSPIRATION	17.880	(2.1806)	64904.96	93.958
LATERAL DRAINAGE COLLECTED FROM LAYER 5	4.23351	(0.45542)	15367.648	22.24651
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00000	(0.00000)	0.011	0.00002
AVERAGE HEAD ON TOP OF LAYER 6	0.002	(0.000)		
CHANGE IN WATER STORAGE	-3.471	(1.4594)	-12601.00	-18.241

****

****

PEAK DAILY VALUES FOR YEARS 26 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	2.26	8203.800
RUNOFF	0.379	1374.4877
DRAINAGE COLLECTED FROM LAYER 5	0.01878	68.18404
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000000	0.00003
AVERAGE HEAD ON TOP OF LAYER 6	0.004	
MAXIMUM HEAD ON TOP OF LAYER 6	0.005	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	73.7 FEET	
SNOW WATER	0.66	2396.9431

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3749

```
MINIMUM VEG. SOIL WATER (VOL/VOL)                 0.1870


 ***  Maximum heads are computed using McEnroe's equations.  ***

      Reference:  Maximum Saturated Depth over Landfill Liner
                  by Bruce M. McEnroe, University of Kansas
                  ASCE Journal of Environmental Engineering
                  Vol. 119, No. 2, March 1993, pp. 262-270.

******************************************************************************




******************************************************************************

                   FINAL WATER STORAGE AT END OF YEAR   30
        ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1            2.8920         0.2410

                      2          529.6387         0.3531

                      3          251.4410         0.3224

                      4            6.2463         0.2603

                      5            0.0029         0.0164

                      6            0.0000         0.0000

                      7            0.1875         0.7500

                   SNOW WATER      0.000

******************************************************************************
******************************************************************************
```

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\SW\ALT\CL\DATA4.D4
TEMPERATURE DATA FILE:      C:\SW\ALT\CL\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\SW\ALT\CL\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\SW\ALT\CL\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\SW\ALT\CL\DATA10.D10
OUTPUT DATA FILE:           C:\SW\ALT\CL\OUTPUT1.OUT


TIME:  33:49     DATE:   2/24/2024


******************************************************************************

     TITLE:  SOUTHWEST LANDFILL - ALT LINER (CLOSED 190')

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  10
           THICKNESS                  =     24.00   INCHES
```

```
  POROSITY                   =     0.3980 VOL/VOL
  FIELD CAPACITY             =     0.2440 VOL/VOL
  WILTING POINT              =     0.1360 VOL/VOL
  INITIAL SOIL WATER CONTENT =     0.2440 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.119999997000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
        FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.




                        LAYER  2
                        --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  36
  THICKNESS                  =     0.04   INCHES
  POROSITY                   =     0.0000 VOL/VOL
  FIELD CAPACITY             =     0.0000 VOL/VOL
  WILTING POINT              =     0.0000 VOL/VOL
  INITIAL SOIL WATER CONTENT =     0.0000 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.399999993000E-12 CM/SEC
  FML PINHOLE DENSITY        =     1.00   HOLES/ACRE
  FML INSTALLATION DEFECTS   =     4.00   HOLES/ACRE
  FML PLACEMENT QUALITY      =  3 - GOOD




                        LAYER  3
                        --------

                TYPE 3 - BARRIER SOIL LINER
                MATERIAL TEXTURE NUMBER   0
  THICKNESS                  =    18.00   INCHES
  POROSITY                   =     0.4270 VOL/VOL
  FIELD CAPACITY             =     0.4180 VOL/VOL
  WILTING POINT              =     0.3670 VOL/VOL
  INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.999999975000E-05 CM/SEC




                        LAYER  4
                        --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  11
  THICKNESS                  =    12.00   INCHES
```

```
POROSITY                    =      0.4640 VOL/VOL
FIELD CAPACITY              =      0.3100 VOL/VOL
WILTING POINT               =      0.1870 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.639999998000E-04 CM/SEC


                        LAYER  5
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =   1500.00   INCHES
POROSITY                    =      0.6174 VOL/VOL
FIELD CAPACITY              =      0.5127 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                        LAYER  6
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =    780.00   INCHES
POROSITY                    =      0.5389 VOL/VOL
FIELD CAPACITY              =      0.4904 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-04 CM/SEC


                        LAYER  7
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  10
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.3980 VOL/VOL
FIELD CAPACITY              =      0.2440 VOL/VOL
WILTING POINT               =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2440 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC
```

```
                    LAYER  8
                    --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.17   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   8.22999954000     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    215.0    FEET


                    LAYER  9
                    --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      4.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                    LAYER 10
                    --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.7500 VOL/VOL
FIELD CAPACITY              =      0.7470 VOL/VOL
WILTING POINT               =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 700. FEET.

SCS RUNOFF CURVE NUMBER	=	79.90	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.392	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.164	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.448	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	821.307	INCHES
TOTAL INITIAL WATER	=	821.307	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM AMARILLO TEXAS

STATION LATITUDE	=	35.23	DEGREES
MAXIMUM LEAF AREA INDEX	=	4.50	
START OF GROWING SEASON (JULIAN DATE)	=	95	
END OF GROWING SEASON (JULIAN DATE)	=	303	
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	13.70	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	55.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	52.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	57.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	57.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.59	0.40	1.06	0.99	2.25	2.68
2.26	3.03	1.90	1.98	0.68	0.63

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
37.40	40.40	48.80	57.10	67.00	76.30
79.70	78.30	70.70	59.30	46.90	37.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR AMARILLO TEXAS
AND STATION LATITUDE = 35.23 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.57	0.30	1.10	0.85	2.06	2.60
	2.07	2.78	1.63	2.17	0.90	0.74
STD. DEVIATIONS	0.47	0.28	0.67	0.68	1.47	1.40
	1.01	1.51	1.32	1.87	0.77	0.74
RUNOFF						
TOTALS	0.000	0.000	0.000	0.001	0.005	0.033
	0.000	0.010	0.012	0.083	0.059	0.004

STD. DEVIATIONS	0.000	0.000	0.000	0.003	0.022	0.102
	0.000	0.027	0.035	0.359	0.324	0.022

EVAPOTRANSPIRATION

TOTALS	0.716	0.419	0.657	1.235	2.376	2.686
	2.140	2.530	1.622	1.104	1.082	0.849
STD. DEVIATIONS	0.441	0.211	0.523	0.725	1.254	1.173
	1.020	1.298	1.236	0.765	0.656	0.412

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0125	0.0110	0.0121	0.0117	0.0114	0.0107
	0.0110	0.0109	0.0105	0.0127	0.0146	0.0140
STD. DEVIATIONS	0.0050	0.0040	0.0041	0.0036	0.0025	0.0016
	0.0016	0.0015	0.0015	0.0049	0.0073	0.0054

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	0.2355	0.2230	0.2453	0.2372	0.2426	0.2355
	0.2413	0.2408	0.2327	0.2418	0.2301	0.2376
STD. DEVIATIONS	0.0604	0.0605	0.0668	0.0674	0.0689	0.0628
	0.0632	0.0661	0.0615	0.0649	0.0582	0.0592

PERCOLATION/LEAKAGE THROUGH LAYER 10

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	5.8672	5.6445	5.6342	5.6329	5.2922	5.0893
	5.0674	5.0273	5.0016	5.9389	7.1536	6.5613
STD. DEVIATIONS	2.4993	2.1771	2.0581	1.8594	1.2534	0.8086
	0.7891	0.7606	0.7722	2.4534	3.7970	2.7310

DAILY AVERAGE HEAD ON TOP OF LAYER 9

```
  -------------------------------------
    AVERAGES              0.0018   0.0018   0.0018   0.0018   0.0018   0.0018
                          0.0018   0.0018   0.0018   0.0018   0.0018   0.0018

    STD. DEVIATIONS       0.0004   0.0005   0.0005   0.0005   0.0005   0.0005
                          0.0005   0.0005   0.0005   0.0005   0.0004   0.0004

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                      INCHES            CU. FEET      PERCENT
                                -------------------  -------------  ---------
 PRECIPITATION                   17.78    (   3.187)     64535.4     100.00

 RUNOFF                           0.206   (  0.6741)       749.23      1.161

 EVAPOTRANSPIRATION              17.417   (  3.0932)     63222.33     97.965

 PERCOLATION/LEAKAGE THROUGH      0.14319 (  0.02894)      519.783     0.80542
   LAYER  3

 AVERAGE HEAD ON TOP              5.659 (    1.229)
   OF LAYER  2

 LATERAL DRAINAGE COLLECTED       2.84331 (  0.73702)    10321.226   15.99313
   FROM LAYER  8

 PERCOLATION/LEAKAGE THROUGH      0.00000 (  0.00000)        0.010     0.00002
   LAYER 10

 AVERAGE HEAD ON TOP              0.002 (    0.000)
   OF LAYER  9

 CHANGE IN WATER STORAGE         -2.688   (  1.3932)     -9757.45    -15.120

*******************************************************************************


******************************************************************************

                PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
   -----------------------------------------------------------------------
                                                   (INCHES)     (CU. FT.)
```

```
                                               ----------   -------------
    PRECIPITATION                                3.08         11180.399

    RUNOFF                                       1.325         4809.8979

    PERCOLATION/LEAKAGE THROUGH LAYER  3         0.001560         5.66442

    AVERAGE HEAD ON TOP OF LAYER  2             23.893

    DRAINAGE COLLECTED FROM LAYER  8             0.02246         81.54538

    PERCOLATION/LEAKAGE THROUGH LAYER 10         0.000000         0.00003

    AVERAGE HEAD ON TOP OF LAYER  9              0.005

    MAXIMUM HEAD ON TOP OF LAYER  9              0.012

    LOCATION OF MAXIMUM HEAD IN LAYER  8
          (DISTANCE FROM DRAIN)                  0.0 FEET

    SNOW WATER                                   1.36          4937.9434


    MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.3980

    MINIMUM VEG. SOIL WATER (VOL/VOL)                    0.1360

     ***  Maximum heads are computed using McEnroe's equations.  ***

          Reference:  Maximum Saturated Depth over Landfill Liner
                      by Bruce M. McEnroe, University of Kansas
                      ASCE Journal of Environmental Engineering
                      Vol. 119, No. 2, March 1993, pp. 262-270.

******************************************************************************



******************************************************************************

                    FINAL WATER STORAGE AT END OF YEAR   30
    ----------------------------------------------------------------------
                     LAYER        (INCHES)       (VOL/VOL)
                     -----        --------       ---------
                       1            6.2197         0.2592
```

2	0.0000	0.0000
3	7.6860	0.4270
4	3.7200	0.3100
5	489.9949	0.3267
6	226.8083	0.2908
7	6.0483	0.2520
8	0.0024	0.0140
9	0.0000	0.0000
10	0.1875	0.7500
SNOW WATER	0.000	

****
****

ADDITIONAL DEMONSTRATIONS

ADDITIONAL DEMONSTRATIONS

The purpose of modeling the following additional demonstrations is to evaluate the alternative liner POC demonstrations shown in Figures 3 through 6 under various conditions, that includes varying groundwater gradients, minimum and maximum observed hydraulic conductivities, and assuming that the alternative liner leachate collection system does not function as designed allowing a buildup of 12 inches of head on the liner system.

Groundwater Gradients Demonstration

The groundwater elevation maps from the semi-annual groundwater reports, provided by Hydrex Environmental from June 2020 through June 2024, were analyzed to assess changes in groundwater gradients over time. The groundwater gradients vary from 0.0053 ft/ft to 0.0056 ft/ft along Section A, which is shown on Figure 3-2 in Appendix IIIB. The Case III model presented on Figure 5 in Appendix IIIB-D was chosen for this evaluation as the demonstration represents the lowest DAF under expected groundwater flow conditions (i.e., groundwater flow toward north). Case III was run with a gradient of 0.0058 which represents the maximum gradient observed. An additional run with a gradient of 0.0052 was run to represent the minimum gradient. The results are presented in Table 1 below which show the design is complainant with §330.311(a)(1).

Table 1
Groundwater Gradients Demonstration Results

Case	Groundwater Gradient (ft/ft)	Calculated DAF[1]	Minimum Required DAF	Design Compliant with §330.331(a)(1)
Case III	0.0058	16,031	260	Yes
	0.0052	12,704	260	Yes

[1] For each model, the groundwater well with the lowest calculated DAF is shown in the table.

Additionally, the Case IV model presented on Figure 6 in Appendix IIID artificially reverses the groundwater flow to the south using a conservative gradient of 0.0029. This condition results in a DAF of 3,656 which is presented on Figure 6 in Appendix IIIB-D.

Hydraulic Conductivity Demonstration

The minimum and maximum observed hydraulic conductivities in Stratum II were analyzed to assess the impacts of hydraulic conductivity on the modeled concentrations. As shown in Tables 4-3 and 4-4 in Appendix IIIG, the maximum hydraulic conductivity is 2.08×10^{-3} cm/s while the minimum is 2.45×10^{-5} cm/s within Stratum II. Case III, presented in Figure 5 in Appendix IIIB-D, was chosen for this evaluation. The results are presented in Table 2 below which show the design is complainant with §330.311(a)(1).

Table 2
Minimum and Maximum observed Hydraulic conductivity Demonstration Results

Case	Hydraulic Conductivity (cm/sec)	Calculated DAF[1]	Minimum Required DAF	Design Compliant with §330.331(a)(1)
Case III	2.08×10^{-3}	16,031	260	Yes
	2.45×10^{-5}	20,666	260	Yes

[1] For each model, the groundwater well with the lowest calculated DAF is shown in the table.

Non-functioning Leachate Collection System Demonstration

This demonstration modifies Case IV in Appendix IIIB-D to assume that the alternative liner leachate collection system does not function as designed and allows a buildup of 12 inches of head on the alternative liner and overliner systems, which will increase the percolation rate in these areas. The assumed leakage through the overliner calculations on Page IIIB-C-1 was applied to the alternative liner areas. The calculation assumes 12 inches of head on the liner and 4 defects per acre for a resulting percolation of 0.066 mm/yr. The results are presented in Table 3 below which show the design is complainant with §330.311(a)(1).

Table 3
Non-functioning Leachate Collection System Demonstration Results

Case	Percolation[2] (mm/yr)	Calculated DAF[1]	Minimum Required DAF	Design Compliant with §330.331(a)(1)
Case IV	0.066	1,466	260	Yes

1 For each model, the groundwater well with the lowest calculated DAF is shown in the table.
2 The percolation is applied to both overliner and alternative liner areas.

Summary

Therefore, the demonstration supports the fact that the site design is in compliance with the POC requirements specified in Title 30 TAC §330.331.

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1663C

LIMITED SCOPE MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN
APPENDIX IIID
LINER QUALITY CONTROL PLAN

Prepared for

Southwest Landfill TX, LP

TCEQ Approved February 20, 2020
Revised June 2024

Revised October 2024

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Project No. 0120-094-11-140

This document is intended for permitting purposes only.

2 CONSTRUCTION QUALITY ASSURANCE EARTHWORK AND DRAINAGE AGGREGATES

2.1 Introduction

This section of the LQCP addresses the construction of the soil and drainage components of the liner system and the overliner system and outlines the LQCP program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements, and treatment of problems.

The scope of earthwork and related construction quality assurance includes the following elements:

- Subgrade preparation
- Soil liner stockpile
- Soil liner placement
- General fill
- Drainage aggregates
- Anchor trench backfill
- Excavation dewatering

2.2 Composite Liner

The landfill is designed to include a Subtitle D composite liner for the undeveloped sectors. Class 1 waste sectors will be constructed with a 3-foot-thick compacted clay liner overlain by a 60-mil-thick high density polyethylene (HDPE) flexible membrane liner (FML). The Class 1 sectors will also require additional subgrade preparation as discussed in Section 2.3.1. MSW sectors will be constructed with a 2-foot-thick compacted clay liner overlain by a 60-mil-thick HDPE FML. A GCL may be used in lieu of the 2-foot-thick compact 60-mil High Density Polyethylene (HDPE) in Sectors 17D through 29.

In addition, the landfill design also includes an overliner system for the pre-Subtitle D area. The overliner is placed on a 12-inch soil subgrade and consists of a GCL overlain by a 40-mil linear low-density polyethylene (LLDPE) FML which is textured on both sides.

These liner systems are detailed in Appendix IIIA – Landfill Unit Design Information. A structural stability analysis for the liner systems, including calculations for anchor trench runout lengths, stress on the liner components, and an infinite slope stability analysis, is included in Appendix IIIE – Geotechnical Report.

2.3 Earthwork Construction

The following paragraphs describe general construction procedures to be used for various earthwork components within the landfill. The earthwork construction specifications will be developed based on the material and construction procedures outlined in this section of the LQCP for each specific liner construction. The earthwork construction specifications will include details for compaction of soils, cross sections showing typical slopes, widths, and thicknesses for compacted lifts.

2.3.1 Subgrade

Subgrade refers to a surface which is exposed after stripping topsoil or excavating to establish the grade directly beneath the composite liner. The prepared subgrade must conform to the Excavation Plan included in Appendix IIIA – Landfill Unit Design Information.

Prior to beginning liner construction, the subgrade area will be stripped to a depth sufficient to remove all loose surface soils or soft zones within the exposed excavation. The liner subgrade area will be proof rolled with heavy, rubber tired construction equipment to detect unstable areas. Unstable areas will be undercut to firm material and refilled with suitable compacted general fill. Soil used for backfill will meet the same material requirements as the soil liner and will be installed in accordance with the soil liner installation procedures. The fill will be free of organic matter, foreign objects, and other deleterious matter, compacted sufficiently to provide a firm base for composite liner placement. The subgrade will also be scarified a minimum of 2 inches prior to placement of the first lift of clay liner. The subgrade preparation specifications for each liner construction event will be developed in accordance with this section. Construction project specifications and construction plans will be developed for each cell construction event in accordance with this LQCP consistent with the Excavation Plan (Drawing A.1) included in Appendix IIIA – Landfill Design Unit Information and the sector design as contained in the approved Site Development Plan.

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

The POR will approve the prepared subgrade prior to the placement of the underdrain, soil liner, or structural fill. Approval will be based on a review of test information, if applicable, and CQA monitoring of the subgrade preparation. Additionally, during the subgrade acceptance, the POR will verify that the underlying material is consistent with the geotechnical design assumptions included in Appendix IIIE.

Surveying will be performed to verify that the finished subgrade is to the lines and grades specified in design with a vertical tolerance of -0.2 feet to +0.0 feet to ensure that the clay liner will achieve the required minimum thickness.

2.3.1.1 Class 1 Liner Subgrade Preparation

For the site to meet the requirements of Title 30 TAC §335.584(b)(2), which requires a minimum of 10 feet of material with a hydraulic conductivity towards the aquifer not greater than 1×10^{-7} cm/s, a reconstructed separation layer will be used to provide equivalent or greater environmental protection. Per the equivalency calculations in Appendix IIIA-C, the separation layer will consist of a minimum 0.8 feet of recompacted clay with a hydraulic conductivity of no greater than 5×10^{-8} cm/s directly beneath the containment system.

The Class 1 area will be excavated a minimum of 0.8 feet below the permitted excavation grade, and the area will be reconstructed with soils which provide a hydraulic conductivity not greater than 5.0×10^{-8} cm/s.

The separation layer material, below the liner subgrade, will be placed in 6-inch loose lifts and compacted to 95 percent of the maximum dry density at a moisture content between optimum moisture content and up to 5 percent above optimum as determined by the Standard Proctor Compaction Test (ASTM D 698). This material will exhibit a hydraulic conductivity of 5×10^{-8} cm/s or less.

Testing of the separation layer soil shall be performed at the same frequency for soil liners as indicated in Table 2-2. A licensed land surveyor shall be retained to verify thickness of the reconstructed separation layer by surveying methods, prior to subsequent soil liner construction. The separation layer thickness will be determined on a grid not exceeding 5,000 ft^2 with a minimum of two grid points required for verification of an area. Documentation of any Class 1 separation layer construction will be included in the SLER.

2.3.2 Soil Liner

The soil liner will consist of a minimum 2-foot-thick (or 3-foot-thick for Class 1 area) compacted clay liner (measured perpendicular to the subgrade surface) that will extend along the floor and side slopes of the landfill. The soil liner will be constructed in continuous, single, compacted lifts (6 inches thick) parallel to the floor and sideslope subgrades. A GCL may be used in lieu of the 2-foot-thick compacted clay liner which is described in Section 4. Details depicting the liner system are included in Appendix IIIA – Landfill Unit Design Information.

The density of the geomembrane must be greater than 0.94 g/cc; the carbon black content must be between 2 percent and 3 percent; and recycled or reclaimed material must not be used in the manufacturing process.

The design engineer may require additional test procedures, and will inform the third party laboratory in writing. The POR must review all test results and report any nonconformance to the design engineer prior to product installation. In addition to the conformance thickness tests shown above, field thickness measurements must be taken at maximum 5-foot intervals along the leading edge of each geomembrane panel. For smooth geomembranes, no single measurement will be less than 10 percent below the required nominal thickness for the panel to be accepted (i.e., for 60-mil geomembrane a minimum thickness of 54 mils is required) and the average must be at least 60 mils. Refer to Table 3-2 for a complete listing of the material requirements for both smooth and textured geomembranes that will be used for the composite Subtitle D bottom liner.

Sampling Procedure. Samples will be taken across the entire roll width. Unless otherwise specified, samples will be approximately 15 inches long by the roll width. The CQA monitor must mark the machine direction and the manufacturer's roll identification number on the sample. The CQA monitor must also assign a conformance test number to the sample and mark the sample with that number.

3.3.3 Geomembrane Installation

Surface Preparation. Prior to any geomembrane installation, the installed soil liner surface will be inspected by the CQA and geosynthetics contractor. The POR or CQA monitor must observe the following:

- All lines and grades for the soil liner or GCL have been verified by the surveyor and accepted by the contractor for geosynthetic installation. The POR or his representative, the owner, and geomembrane installer will certify and accept in writing the finished final lift of the soil liner or GCL surface.
- The soil liner has been prepared in accordance with the earthwork construction plans and specifications as outlined in Section 2.
- The GCL has been prepared in accordance with the construction plans and specifications as outlined in Section 4.
- The soil liner surface is free of surface irregularities and protrusions. The soil liner will be rolled and compacted to ensure a clean surface.
- The soil liner or GCL surface does not contain stones or other objects that could damage the geomembrane and underlying soil liner or GCL. The surface of the soil liner or GCL will be smooth and free of foreign and organic material, sharp objects, exposed soil or aggregate particles greater than 3/8 inches (or less if recommended by the geosynthetic manufacturer), or other deleterious material.
- The anchor trench dimensions have been checked, and the trenches are free of sharp objects and stones.

- There are no excessively soft areas in the soil liner that could result in geomembrane damage.
- The geomembrane will not be placed over soil or GCL liner during inclement weather such as rain or high winds.
- The soil liner is not saturated, and no standing water is present above the soil liner.
- The soil liner has not desiccated (e.g., areas with desiccation cracks).
- All construction stakes and hubs have been removed and the resultant holes have been backfilled. There are no rocks, debris, or any other objects on the soil liner surface.
- The geosynthetics contractor has certified in writing that the soil liner or GCL surface on which the geomembrane will be installed is acceptable.

Panel Placement. Prior to the installation of the geomembrane, the contractor must submit drawings showing the panel layout, indicating panel identification number, both fabricated (if applicable) and field seams, as well as details not conforming to the drawings.

The CQA monitor must maintain an up-to-date panel layout drawing showing panel numbers that are keyed to roll numbers on the placement log. The panel layout drawing will also include seam numbers and destructive test locations.

During panel placement, the POR or CQA monitor must:

- Observe that geomembrane is placed in direct and uniform contact with the underlying compacted clay soil liner or GCL.
- Record roll numbers, panel numbers, and dimensions on the panel or seam logs. Measure and record thickness of leading edge of each panel at 5-foot maximum intervals. No single thickness measurement can be less than 10 percent below the required nominal thickness.
- Observe the sheet surface as it is deployed and record all panel defects and repair of the defects (panel rejected, patch installed, extradite placed over the defect, etc.) on the repair sheet. All repairs must be made in accordance with the specifications as outlined in Section 3.3.5 and located on a repair drawing.
- Observe that support equipment is not allowed on the geomembrane during handling (see Section 3.7 also).
- Observe that the surface beneath the geomembrane has not deteriorated since previous acceptance.
- Observe that there are no angular stones, construction debris, or other items beneath the geomembrane that could cause damage to the geomembrane.

- When placing the geomembrane on the composite liner or overliner GCL, construction placement equipment should not be permitted to ride directly on the GCL. The geomembrane will be moved by hand or by using small pneumatic-tire lifting units. Other techniques, such as use of block and tackles, have also been used.
- All-terrain vehicles (ATVs) or equipment with smooth, oversized tires of maximum ground contact pressure of 28 to 41 kPa (4-6 lb/in.^{2}) can be used; however, the following restrictions will be imposed:
  - The vehicle can be operated on the previously placed GCL only when deploying materials.
  - There should be no sudden stops or starts.
  - There should be no spinning of tires or sliding at any time.
  - Vehicle tires must be smooth and clean of mud, dirt, and debris that could potentially puncture or damage the underlying GCL.
  - All entering and exiting on the GCL should be done at 90-degree angles to the material.
  - There should be no excessive turning while driving on the GCL. Movement should be primarily forward and backward while deploying, and turning should be minimized to the greatest extent possible.
  - There should be no driving over wrinkles in geosynthetics.
  - There should be no more than one person riding on vehicle.
  - Vehicles should not be used on slopes.
- The underlying GCL should have all folds, wrinkles, and other undulations removed before placement of the overlying geomembrane.
- The anchor trench dimensions have been checked, and the trenches are free of sharp objects and stones.
- The geomembrane will not be placed during inclement weather such as rain or high winds.
- The geosynthetics contractor has certified in writing that the surface on which the geomembrane will be installed is acceptable.

Consistent with Section 4.3.1, the POR will verify that only panels that can be covered on the same day with geomembrane will be deployed.

Panel Placement. Prior to the installation of the geomembrane, the contractor must submit drawings showing the panel layout, indicating panel identification number, both fabricated (if applicable) and field seams, as well as details not conforming to the drawings. The POR must review field conditions and approve revised panel layout plan if the field conditions vary from the original plan layout.

4 CONSTRUCTION QUALITY ASSURANCE FOR GEOSYNTHETIC CLAY LINER

4.1 Introduction

GCL will be used in the overliner Sectors O1 through O7 (reinforced GCL only). A GCL may be used in lieu of a 2-foot-thick compacted clay liner in Sectors 17D through 29. A geotechnical analysis of the liner and overliner systems with a GCL including slope stability analyses ~~is~~ are included in Appendix IIIE Geotechnical Report. Table 4-1 – Required Testing and Properties for GCL Materials includes the tests, testing methods, and frequencies. The GCL used in the liner systems will meet the material properties listed in Table 4-1.

4.2 Material Requirements

1. A reinforced GCL which consists of bentonite encapsulated between two geotextiles, one nonwoven and one woven, which are needle punched together will be used. The GCL materials and its components will be tested in accordance with Table 4-1 by the supplier/GCL manufacturer and a third party independent laboratory and will have the required values listed in Table 4-1. A certificate of analysis for each GCL panel will be submitted as part of the quality control documentation. The GCL permeability will be certified by the manufacturer and will be tested by an independent laboratory at frequencies included in Table 4-1 (the terms "hydraulic conductivity" and "permeability" are used interchangeably). The manufacturer will provide recommended seaming procedures and supporting test (flow box or other suitable device). The manufacturer will provide documentation showing the GCL seams are no more permeable than the GCL itself at a confining pressure anticipated in the field. The minimum shear strength of hydrated GCL (reinforced) will meet the requirements set forth in the geotechnical analysis provided in Appendix IIIE. The nonwoven side of the GCL will be in contact with the geomembrane. Table 4-1 includes further details for the GCL material.
2. The GCL will be shipped in rolls, which are wrapped individually in relatively impermeable and opaque protective covers. GCL rolls will be offloaded with equipment that will not damage the GCL rolls. The rolls may be stacked only as allowed by manufacturer's recommendations. The GCL rolls must be stored above ground (i.e., wooden pallets) and covered with a waterproof tarpaulin.

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS
TCEQ PERMIT NO. MSW-1663C

LIMITED SCOPE MAJOR PERMIT AMENDMENT APPLICATION

PART III – SITE DEVELOPMENT PLAN

APPENDIX IIIE

Prepared for

Southwest Landfill TX, LP

TCEQ Approved February 20, 2020

Revised February 202

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WCG Project No. 0120-094-11-140

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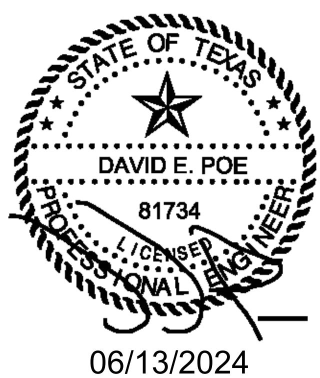
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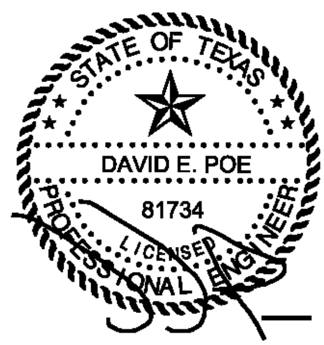

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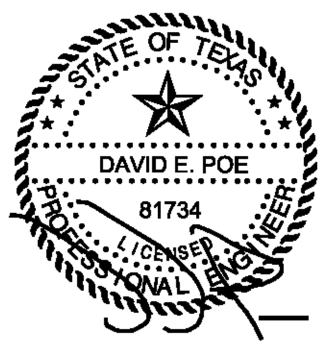
TABLES



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3.2.3 Stratum III

Stratum III is comprised of a low permeability silty, clayey shale with occasional grayish-blue siltstone laminae. The Stratum III sediments penetrated were weathered, dense, hard to stiff, plastic, and had a dusty reddish-brown to red color. Stratum III is continuous beneath the proposed permit boundary and is the lower confining unit (aquiclude) for the overlying Stratum II uppermost aquifer interval. The top of this formation is at least 74 feet below the proposed elevation and deepest excavation (3,547 ft-msl) of the landfill. Hydraulic conductivity test results from three Stratum III samples indicate the average vertical conductivity of 5.9×10^{-8} cm/s.

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/s or less for the soil liner portion of the composite liner 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 and the Alternative Geosynthetic Clay Liner (GCL) 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 IIIJ-A – 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.

"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 POR, tested to verify that it meets the requirements outlined in Section 4.3, and surveyed to verify grades.

4.3 Liner Construction

The bottom and sides of the landfill excavation will consist of 2-foot-thick compacted soil liner or Alternative GCL Liner (MSW areas) and 3-foot-thick (Class 1 waste areas) compacted soil liner. The clay liner will have a maximum hydraulic conductivity of $1x10^{-7}$ 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 soils used for liner 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 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 indicate that some soils which will achieve a coefficient of permeability of less than $1x10^{-7}$ cm/s exist at the site (refer to Appendix IIIE-C). 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 D 698) 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.

4.3.1 Geosynthetic Clay Liner Construction

The Alternative GCL Liner System consists of a prepared subgrade overlain with a GCL with a coefficient of permeability less than or equal to $5x10^{-9}$ cm/sec, 60-mil-thick HDPE geomembrane, drainage composite, and a 24-inch-thick protective cover soil layer. The GCL is an option in the unconstructed Subtitle D area of the facility and for the overliner system described in Section 4.9 of this Appendix.

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

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 condition for short-term (excavation and construction) and long-term (after construction) safety. The slope stability analyses are provided in Appendix IIIE-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 IIIE-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 interim and final cover configurations subjected to effective (rotational failure) and peak (translational or block failure) conditions. A factor of safety of 1.3 is acceptable for total stress conditions that will be in place for a short period of time such that pore pressures cannot fully dissipate and including both interim and final conditions. A factor of safety of 1.1 is acceptable for analyses performed incorporating residual stress.

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 IIIE-A (refer to Appendix IIIE-A-1 for the excavation slope stability analysis, Appendix IIIE-A-2 for the interim condition slope stability analysis, and Appendix IIIE-A-3 for the final landfill slopes stability analysis, including overliner stability analysis).

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 4 horizontal to 1 vertical (4H: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 4H: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 IIIE-A. Additionally, the configurations analyzed are graphically illustrated in Appendix IIIE-A. The interim condition was analyzed considering a 3H:1V slope with a horizontal length of approximately 575 feet. If the horizontal length of actual interim slopes longer than 575 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 Drawings A.1 and A.5 in Appendix IIIA-A – Liner, Overliner, and Final Cover System Details). 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 (Figure IIIG-D-14) 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 (Continued)
Summary of Material Weight and Strength Parameters Used in the Slope Stability Analysis

Strength Parameters — Solid Waste

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)
288	23	59	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.	

Comments: See comments listed under Solid Waste above.

Strength Parameters — Liner System

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	0	22
Effective Stress	100	16				
Total Stress	1,000	0				
Liner System (Typical)			120	3H:1V Sideslope	100	16
Effective Stress	100	16				
Total Stress	1,000	0				
Liner System (Translational Block Analysis)				Peak Stress		
				Floor Grades	188	11
				3H:1V Sideslope	200	15
				Residual Stress		
				Floor Grades	188	9
				3H:1V Sideslope	80	10
				Total Stress		
				Floor Grades	1000	0
				3H:1V Sideslope	1000	0

Comments:

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:IV 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.

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/ft^2) and the lowest reported friction angle value is 19 degrees. Therefore, selected values of 100 lb/ft^2 for cohesion and 16 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 IIIE-A-1 and IIIE-A-3.

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 IIIE-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). As noted in Appendix IIID, Table 6-1, the strength parameters listed are for the interfaces with the lowest strength parameters to provide for a conservative design.

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 IIIE-A-1, IIIE-A-2, and IIIE-A-3 for more information – i.e., the loading conditions reflect different landfill configurations). XSTABL 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.

[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 5-3
Summary of Slope Stability Analysis for Intermediate Cover Slopes

Slope Designation	Method of Analysis	Minimum Factor of Safety Generated[1, 2]		Factor of Safety Acceptable	
		Peak / Effective Stress	Residual / Total Stress	Peak / Effective	Residual / Total
		1.5	1.1/1.3		
Interim Fill Slope A-1	Bishop-Circular	1.60 (effect)	1.56 (total)	YES	YES
Interim Fill Slope A-2	Rankine-Block	1.53 (peak)	1.44 (residual)	YES	YES
Interim Fill Slope A-2	Rankine-Block	--	1.30 (total)	YES	YES

1 Factor of Safety for temporary slopes is 1.5.
2 Block analysis performed for peak and residual stresses.
3 Recommended Minimum Factor of Safety for stability analysis using peak stress is 1.5 and residual stress is 1.1.
4 Interim slope stability analyses were developed for the 2025 LSMPA to incorporate a revised maximum horizontal length of slope of 575 feet at a 3H:1V maximum outer slope.

Computer-generated slope stability analysis output is included in Appendix IIIE-A. As shown in Table 5-2, the minimum calculated factor of safety for excavation, liner, and interim slopes is 1.56, which is an acceptable factor of safety recommended for short-term slope stability. Long-term landfill slope stability has been estimated for the closed (final cover and overliner) condition. The minimum calculated factor of safety for the closed condition is 1.61, which is higher than the recommended 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 (i.e., Rankine Block) 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 IIIE-A-4. As demonstrated in Appendix IIIE-A-4, the liner and cover systems are structurally stable using the strength parameters, 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.

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	
		Total / Effective Stress	Residual / Total Stress	Peak / Effective	Residual / Total
Final Cover Slope A-1	Bishop-Circular	2.43 (effect)	2.38 (total)	YES	YES
Final Cover Slope A-2	Rankine-Block[3]	2.23 (peak)	2.09 (residual)	YES	YES
Final Cover Slope A-2	Rankine-Block[3]	--	2.05 (total)	YES	YES
Final Cover Slope B-1	Bishop-Circular	2.26 (effect)	2.27 (total)	YES	YES
Final Cover Slope B-2	Rankine-Block	2.67 (peak)	2.55 (residual)	YES	YES
Final Cover Slope B-2	Rankine-Block	--	2.81 (total)	YES	YES
Final Cover Slope C-1	Bishop-Circular	2.62 (effect)	2.69 (total)	YES	YES
Final Cover Slope C-2	Rankine-Block	4.05 (peak)	3.96 (residual)	YES	YES
Final Cover Slope C-2	Rankine-Block	--	3.86 (total)	YES	YES
Final Cover Slope D-1	Bishop-Circular	2.62 (effect)	2.71 (total)	YES	YES
Final Cover Slope D-2	Rankine-Block	3.1 (peak)	2.71 (residual)	YES	YES
Final Cover Slope D-2	Rankine-Block	--	2.79 (total)	YES	YES
Overliner Slope A-1	Bishop-Circular	2.61 (effect)	2.71 (total)	YES	YES
Overliner Slope A-2	Rankine-Block	2.17 (peak)	1.72 (residual)	YES	YES
Overliner Slope A-2	Rankine-Block	--	2.39 (total)	YES	YES
Overliner Slope B-1	Bishop-Circular	2.35 (effect)	2.35 (total)	YES	YES
Overliner Slope B-2	Rankine-Block	3.27 (peak)	3.06 (residual)	YES	YES
Overliner Slope B-2	Rankine-Block	--	3.49 (total)	YES	YES
Overliner Slope C-1	Bishop-Circular	2.55 (effect)	2.56 (total)	YES	YES
Overliner Slope C-2	Rankine-Block	2.05(residual)	1.61 (residual)	YES	YES
Overliner Slope C-2	Rankine-Block	--	2.26 (total)	YES	YES
Overliner Slope D-1	Rankine-Block	6.19 (residual)	4.41 (residual)	YES	YES
Overliner Slope D-1	Rankine-Block	--	15.5 (total)	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 1.1.
3 Rankine Block analysis uses interface strength values where applicable.

7 CONCLUSIONS AND RECOMMENDATIONS

This geotechnical analysis has been developed using (1) various geotechnical data obtained from testing performed on the soil samples recovered at the site; (2) general soil stratigraphy of the project area; and (3) known geotechnical characteristics of solid waste, geosynthetic materials commonly used for landfill development, and 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) will be geotechnically stable and will function as designed. The following summarizes various findings of the geotechnical analysis.

- All 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 IIIE-A).
- Stability of the liner (both clay liner and alternative GCL liner), overliner, and final cover system components is acceptable as designed (see Appendix IIIE-A).
- Foundation heave during excavation is expected to be negligible and is within the strain limits of the liner system (refer to Appendix IIIE-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).
- Foundation settlement after filling is expected to be negligible and within the strain limits of the liner system (refer to Appendix IIIE-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).
- 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 IIIE-B).

APPENDIX IIIE-A

SLOPE STABILITY ANALYSIS

Includes page IIIE-A-1

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01/30/2025

CONTENTS

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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 constructed liner systems (soil liner and GCL) and interim and closed conditions were evaluated by using the XSTABL 5.2 computer program. The Simplified Bishop method was used for circular failure surfaces, and the Simplified Janbu method using Rankine Block was used for the translational slope stability analysis. Infinite slope stability has also been analyzed for the soil liner and final cover system. Soil profiles analyzed for each configuration for the slope stability analysis are provided in the sub-appendices, along with XSTABL computer output files as applicable. The stability analysis for the site is provided in the following four appendices.

- Appendix IIIE-A-1 includes the slope stability analysis for the excavated landfill condition.
- Appendix IIIE-A-2 includes the slope stability analysis for the interim overliner landfill condition.
- Appendix IIIE-A-3 includes the slope stability analysis for the closed landfill condition (including analysis of the overliner system).
- Appendix IIIE-A-4 includes the infinite slope stability evaluation for the liner, overliner, and final cover systems.

APPENDIX IIIE-A-2

INTERIM LANDFILL CONFIGURATION STABILITY ANALYSIS

Includes pages IIIE-A-2-1 through IIIE-A-2-49

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Required: Evaluate the slope stability of the landfill interim slopes for the undeveloped area.

Given: Typical interim slope section locations are illustrated on Sheet IIIE-A-2-3.

Method:

A. Evaluate the stability of the proposed interim fill slopes

1. Determine the most critical excavation slopes in the proposed design.
2. Generalize a soil profile for the critical section using available boring logs. Use the highest measured groundwater in upper silt lenses of Stratum II.
3. Select material properties using average unit weights and strength parameters. (Laboratory testing summaries for the site soils are provided in Appendix IIIE-C).
4. Perform stability analyses.
    a. Analyze the worst-case interim fill slope using XSTABL 5.208, Simplified Bishop method of circular failure surfaces, and Rankine's method of block failure surfaces. Use undrained and drained strength parameters to model the end of construction conditions.

References:

1. XSTABL 5.208 (computer program for slope stability analyses), Interactive Software Designs, Inc.
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. Koerner, George R. and Narejo, Dhani, Geosynthetics Research Institute (GRI), *Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic to Soil Interfaces* , GRI Report #30, June 14, 2005.

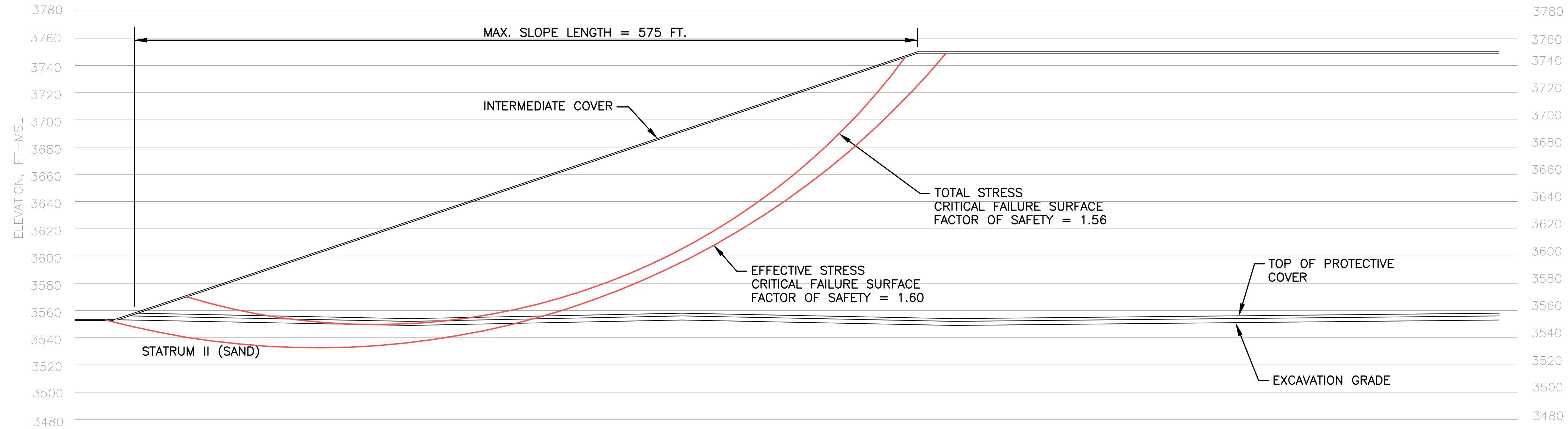
Solution: A. Slope stability analyses of the proposed interim slopes

1. The locations of the most critical sections selected for the stability analysis for the proposed slopes are shown on Sheet IIIE-A-2-3. Sections analyzed are shown with the most critical failure surfaces on Sheet IIIE-A-2-4.
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 IIIE-A-2-5 and IIIE-A-2-6. 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 finer than #200 sieve, Standard Proctor, and strength testing , e.g. unconfined compression) and engineering judgment from previous experience with similar materials. Laboratory testing results for the site soils are included in Appendix IIIE-C.

   Liner system interface strength values were derived from the GRI Report #30 (Ref. 5), dated June 14, 2005, specifically regarding interface shear strength values incorporated into the translational block failure analyses.
4. The output from the slope stability analyses on the interim fill slopes are provided on Sheets IIIE-A-2-8 through IIIE-A-2-37. A summary of the output can be seen on Sheet IIIE-A-2-6.

Conclusion: Based on the above slope stability analyses, the proposed interim slopes have adequate factors of safety to be considered stable.

INTERIM SECTION A–1



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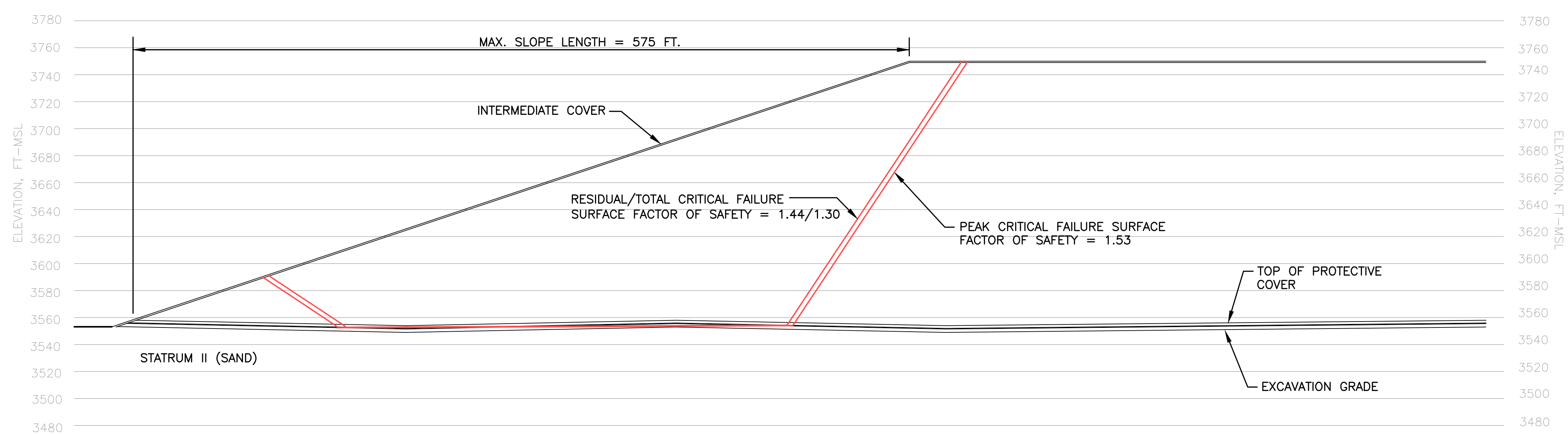
INTERIM SECTION A–2



SECTION A–2 TRANSLATIONAL (A; IIIE–A–2–3, IIIE–A–2–4)

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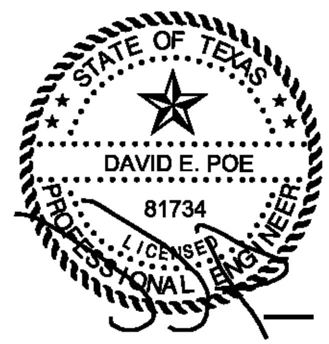

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☐ DRAFT
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FILE: 0120–094–11
CAD: IIIA–E–A–2–4 SECTIONS.dwg

DRAWN BY: JDW
DESIGN BY: CCH
REVIEWED BY: DEP

Weaver Consultants Group
TBPE REGISTRATION NO. F–3727

PREPARED FOR
SOUTHWEST LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION
1	05/2024	LSMPA

MAJOR PERMIT AMENDMENT
SLOPE STABILITY
INTERIM COVER SECTION A–A

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS

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SHEET IIIE–A–2–4

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Derivation of Slope Stability Parameters:

Laboratory testing data are provided in Appendix IIIE-C. The following includes material strength properties based on the laboratory testing results from each subsurface unit.

Material	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)
Stratum I (Clay)	122.5	--
Stratum I (Caliche)	121.9	--
Stratum II (Sand)	122.5	127.0
Stratum III (Shale)	138.4	139.0

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

Stratum I (Clay and Caliche)

A triaxial shear tests was performed on Stratum I samples which resulted in cohesion and friction angle values listed in the table below. The values in the table will be used for both Clay and Caliche. Moist unit weight and saturated unit weight values are calculated from the dry unit weight, the moisture content, and the void ratio obtained from the triaxial shear test. These unit weight values conservatively compare to the average obtained from all laboratory testing performed on the material.

	Total Stress		Effective Stress	
	Cohesion (lb/ft^2)	Friction Angle	Cohesion (lb/ft^2)	Friction Angle
Triaxial Shear Test G-5	100	26.0	100	27.1

Stratum II (Sand)

Triaxial shear tests and direct shear tests were performed on the Stratum II (sand) samples which resulted in cohesion and friction angle values listed in the table below. Stratum II is modeled using a cohesion of 1,200 psf and a friction angle of 26.7° conservatively. Moist unit weight values are calculated from each pair of moisture content and dry unit weight obtained from all laboratory testing performed on the material. These moist unit weight values were then averaged and this value is used in the slope stability analysis.

	Cohesion (lb/ft^2)	Friction Angle	Cohesion (lb/ft^2)	Friction Angle
Triaxial Shear Test G-3	1620 (total)	40.9 (total)	3020 (effective)	35.0 (effective)
Direct Shear Test WB-121	900 (residual)	26.9 (residual)	1200 (peak)	26.7 (peak)

Stratum III (Shale)

The slope stability analysis indicates no failure surface through this stratum as the top of this stratum is located a minimum of 74 feet below the elevation of the deepest excavation. The laboratory testing for shear strength is reported on page IIIE-18.

Material	Effective Stress		Total Stress	
	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)
Stratum I (Clay)	100	26	100	27.1
Stratum I (Caliche)	100	26	100	27.1
Stratum II (Sand)	1,200	26.7	1,200	26.7
Stratum III (Shale)	500	33	5,000	0

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 factor of safety values.

Material	Moist Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Clay Liner(1)	120	100	16
Protective Cover	120	100	16

1. A cohesion of 100 psf and internal friction angle of 16 degrees (effective stress) and a cohesion of 1,000 psf and internal friction angle of 0 degrees (total stress) is used for the clay liner for simplified Bishop Method of the slope stability analysis.
2. For translational (block) stability analysis, the strength parameters of the weakest interface were used to model the liner. The values used for the interim slope stability analysis are highlighted in the table below titled "Minimum Required Interface Strength Values". Note that both total and residual stress analyses were performed for the translational analyses.

Solid waste data used in this analysis are listed below.

Soil Description	Moist Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Solid Waste	59	288	23

This 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 of a few of the studies completed is listed below.

Reference	Data Type	Results
Pagotto & Rimoldi (1987)	Back-calculation from plate bearing tests	$\phi = 22,^o$ c = 605 psf (29 kPa)
Landva & Clark (1990)	Laboratory direct shear tests on MSW	$\phi = 24,^o$ c = 460 psf (22 kPa) to $\phi = 39,^o$ c = 400 psf (19 kPa)
Richardson & Reynolds (1991)	Large direct shear tests performed in-situ	$\phi = 18^o$ to $43,^o$ c = 210 psf (10 kPa)

To provide for a conservative analysis, a cohesion of 288 psf and a friction angle of 23° were selected.

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

Factor of Safety Summary for Slope Stability

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 A-1	Bishop-Circular	1.56	1.60	1.5	1.3	YES	YES

Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Peak	Residual/Total	Peak	Residual/ Total	Peak	Residual/ Total
Interm A-2	Rankine-Block	1.53	1.44 (Residual) 1.30 (Total)	1.5	1.1/1.3	YES	YES

Minimum Required Interface Strength Parameters

Landfill Component	Interface	Peak		Residual	
		Adhesion (psf)	Friction Angle (degrees)	Adhesion (psf)	Friction Angle (degrees)
Liner	Protective Cover/Geocomposite	100	18	80	14
Liner (Note 1, 3)	***Geonet/Smooth Geomembrane***	***188***	***11***	***188***	***9***
Liner (Note 3)	Geonet/Textured Geomembrane	0	13	0	10
Liner	Geocomposite/Textured Geomembrane	100	21	80	10
Liner	Smooth Geomembrane/Clay Liner	100	13	80	8
Liner (Note 2)	***Textured Geomembrane/Clay Liner***	***200***	***15***	***80***	***10***
Liner	Clay Internal	100	16	100	12
Liner	Smooth Geomembrane/Geosynthetic Clay Liner	100	16	80	10
Liner	Textured Geomembrane/Geosynthetic Clay Liner	100	18	80	10
Liner	Geosynthetic Clay Liner Internal	100	24	380	11
Liner/Protective Cover (Note 4)	***Clay Internal/Protective Cover (Total Stress)***	***--***	***--***	***1000 (Total Only)***	***0 (Total Only)***

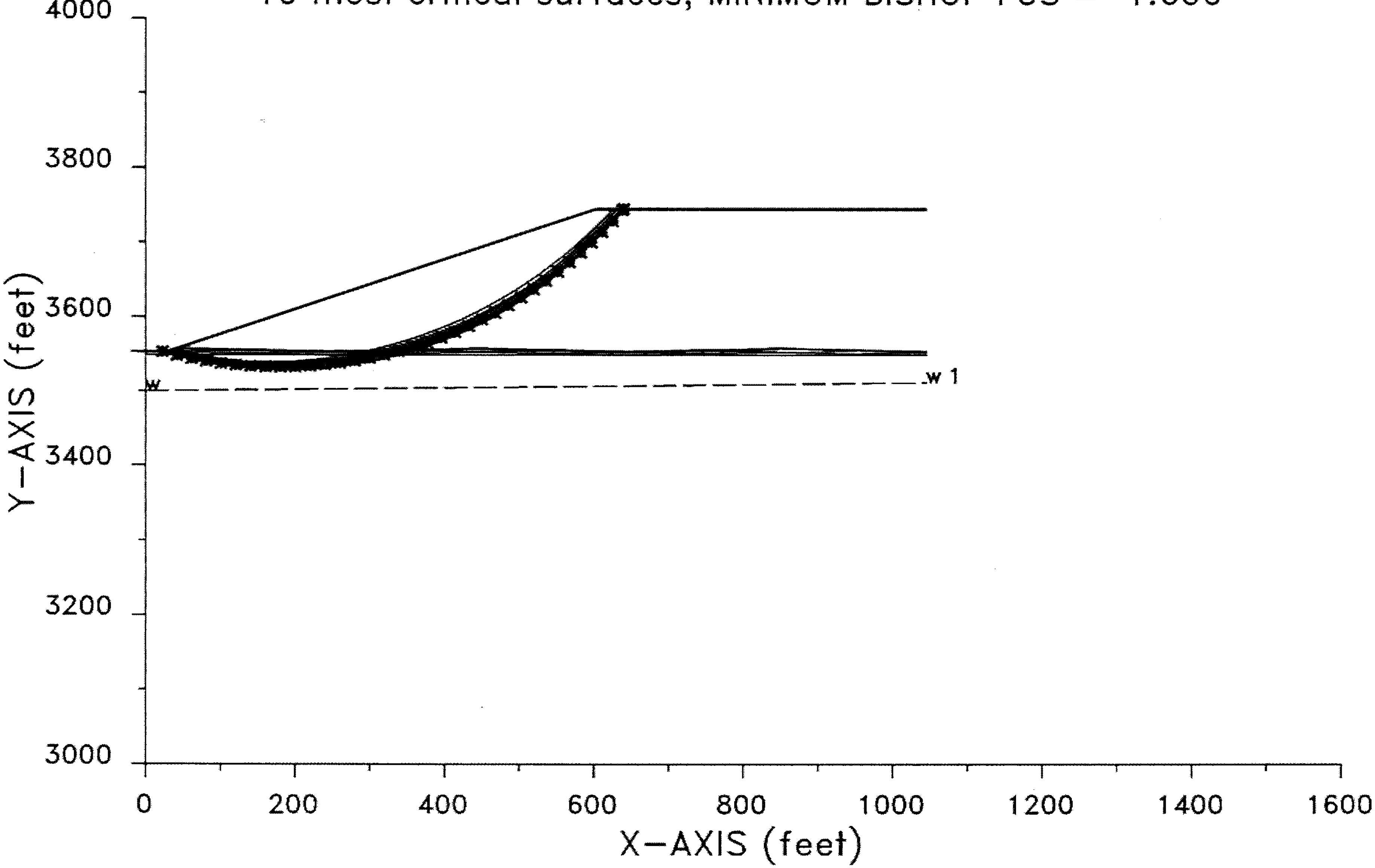
1. Interface parameters used for translational block analysis of cell floor.
2. Interface parameters used for translational block analysis of cell sideslope (3H:1V typical).
3. Interface parameters derived from GRI Report #30 (Ref. 5).
4. Total stress values assumed for both rotational and translational analysis of interim conditions. Effective, peak and residual stresses also analyzed.

SLOPE STABILITY XSTABL OUTPUT FILES

INT-A1E4 1-27-25 9:10

SWLF LSMPA INTERIM A1E4 EFFECT NOD2

10 most critical surfaces, MINIMUM BISHOP FOS = 1.606



XSTABL File: INT-A1E4   1-27-25   9:10

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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*****************************************
```

Problem Description : SWLF LSMPA INTERIM A1E4 EFFECT NOD2

SEGMENT BOUNDARY COORDINATES

3 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3553.3	27.8	3553.1	1
2	27.8	3553.1	602.8	3745.0	2
3	602.8	3745.0	1045.6	3745.0	2

21 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	27.8	3553.1	30.9	3553.1	1
2	30.9	3553.1	39.7	3556.0	4
3	39.7	3556.0	45.6	3558.0	3
4	45.6	3558.0	603.0	3744.0	5
5	603.0	3744.0	1045.6	3744.0	5
6	45.6	3558.0	245.6	3554.0	3
7	245.6	3554.0	445.6	3558.0	3

8	445.6	3558.0	645.6	3554.0	3
9	645.6	3554.0	845.6	3558.0	3
10	845.6	3558.0	1045.6	3554.0	3
11	39.7	3556.0	245.6	3552.0	4
12	245.6	3552.0	445.6	3556.0	4
13	445.6	3556.0	645.6	3552.0	4
14	645.6	3552.0	845.6	3556.0	4
15	845.6	3558.0	1045.6	3552.0	4
16	30.9	3553.1	245.6	3549.1	1
17	245.6	3549.1	445.6	3553.1	1
18	445.6	3553.1	645.6	3549.1	1
19	645.6	3549.1	845.6	3553.1	1
20	845.6	3553.1	1045.6	3549.1	1
21	.0	3549.0	1045.6	3549.0	2

ISOTROPIC Soil Parameters
----

5 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	122.5	127.0	1200.0	26.70	.000	.0	1
2	116.0	120.0	100.0	16.00	.000	.0	0
3	120.0	125.0	100.0	16.00	.000	.0	0
4	120.0	125.0	100.0	16.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3500.00
2	1045.60	3511.60

```
A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.


  100 trial surfaces will be generated and analyzed.


  10 Surfaces initiate from each of  10 points equally spaced
along the ground surface between  x =     20.0 ft
                             and  x =     40.0 ft


Each surface terminates between   x =    620.0 ft
                            and   x =    640.0 ft


Unless further limitations were imposed, the minimum elevation
at which a surface extends is  y =       .0 ft


* * * * *  DEFAULT SEGMENT LENGTH SELECTED BY XSTABL  * * * * *

   20.0 ft line segments define each trial failure surface.


---------------------
ANGULAR RESTRICTIONS
---------------------

  The first segment of each failure surface will be inclined
  within the angular range defined by :

          Lower angular limit :=   -45.0 degrees
          Upper angular limit :=    -5.0 degrees



Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *
```

The most critical circular failure surface
is specified by 36 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	22.22	3553.14
2	41.62	3548.28
3	61.17	3544.07
4	80.85	3540.50
5	100.64	3537.58
6	120.51	3535.32
7	140.45	3533.72
8	160.42	3532.77
9	180.42	3532.48
10	200.42	3532.86
11	220.39	3533.89
12	240.32	3535.58
13	260.18	3537.93
14	279.96	3540.93
15	299.62	3544.58
16	319.15	3548.88
17	338.53	3553.82
18	357.74	3559.40
19	376.75	3565.61
20	395.55	3572.44
21	414.11	3579.89
22	432.41	3587.94
23	450.44	3596.60
24	468.18	3605.85
25	485.60	3615.67
26	502.68	3626.07
27	519.42	3637.02
28	535.78	3648.52
29	551.76	3660.56
30	567.32	3673.11
31	582.47	3686.17
32	597.18	3699.72
33	611.43	3713.76
34	625.21	3728.25
35	638.51	3743.19
36	640.01	3745.00

**** Simplified BISHOP FOS = 1.606 ****

The following is a summary of the TEN most critical surfaces

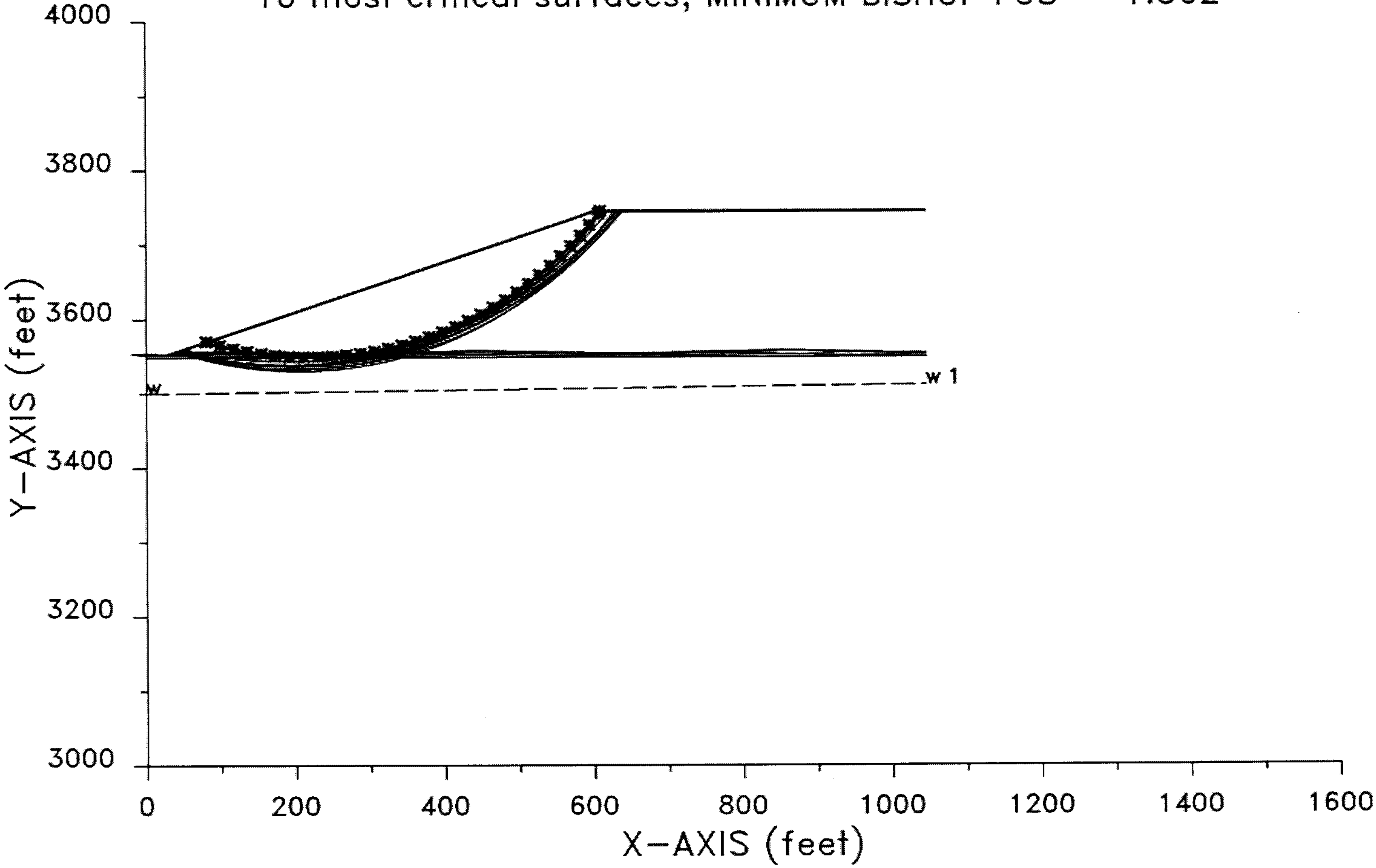
Problem Description : SWLF LSMPA INTERIM A1E4 EFFECT NOD2

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.606	179.15	4138.74	606.26	22.22	640.01	7.213E+08
2.	1.607	173.62	4120.47	587.74	20.00	625.82	6.664E+08
3.	1.607	170.34	4159.63	623.80	24.44	636.27	7.056E+08
4.	1.607	180.17	4111.68	580.44	22.22	630.02	6.797E+08
5.	1.610	158.67	4171.98	632.80	26.67	625.73	6.621E+08
6.	1.610	189.09	4124.46	589.13	35.56	639.58	6.852E+08
7.	1.610	184.55	4110.81	580.81	22.22	635.65	7.029E+08
8.	1.612	170.56	4155.96	617.70	31.11	631.76	6.730E+08
9.	1.612	187.92	4128.90	591.83	37.78	638.21	6.737E+08
10.	1.612	186.89	4110.01	581.32	20.00	639.25	7.215E+08

* * * END OF FILE * * *

INT-A1T4 1-27-25 9:14

SWLF LSMPA INTERIM A1T4 TOTAL NOD2
10 most critical surfaces, MINIMUM BISHOP FOS = 1.562



XSTABL File: INT-A1T4   1-27-25   9:14

```
******************************************
*              X S T A B L               *
*                                        *
*        Slope Stability Analysis        *
*               using the                *
*            Method of Slices            *
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*  Ver. 5.209                96 - 2083   *
******************************************
```

Problem Description : SWLF LSMPA INTERIM A1T4 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

3 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3553.3	27.8	3553.1	1
2	27.8	3553.1	602.8	3745.0	2
3	602.8	3745.0	1045.6	3745.0	2

21 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	27.8	3553.1	30.9	3553.1	1
2	30.9	3553.1	39.7	3556.0	4
3	39.7	3556.0	45.6	3558.0	3
4	45.6	3558.0	603.0	3744.0	5
5	603.0	3744.0	1045.6	3744.0	5
6	45.6	3558.0	245.6	3554.0	3
7	245.6	3554.0	445.6	3558.0	3

8	445.6	3558.0	645.6	3554.0	3
9	645.6	3554.0	845.6	3558.0	3
10	845.6	3558.0	1045.6	3554.0	3
11	39.7	3556.0	245.6	3552.0	4
12	245.6	3552.0	445.6	3556.0	4
13	445.6	3556.0	645.6	3552.0	4
14	645.6	3552.0	845.6	3556.0	4
15	845.6	3558.0	1045.6	3552.0	4
16	30.9	3553.1	245.6	3549.1	1
17	245.6	3549.1	445.6	3553.1	1
18	445.6	3553.1	645.6	3549.1	1
19	645.6	3549.1	845.6	3553.1	1
20	845.6	3553.1	1045.6	3549.1	1
21	.0	3549.0	1045.6	3549.0	2

ISOTROPIC Soil Parameters
----

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	122.5	127.0	1200.0	26.70	.000	.0	1
2	116.0	120.0	100.0	16.00	.000	.0	0
3	120.0	125.0	100.0	16.00	.000	.0	0
4	120.0	125.0	1000.0	.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3500.00
2	1045.60	3511.60

```
A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.


  100 trial surfaces will be generated and analyzed.


  10 Surfaces initiate from each of  10 points equally spaced
along the ground surface between  x =     40.0 ft
                             and  x =     80.0 ft


Each surface terminates between   x =    600.0 ft
                            and   x =    640.0 ft


Unless further limitations were imposed, the minimum elevation
at which a surface extends is  y =       .0 ft


* * * * *  DEFAULT SEGMENT LENGTH SELECTED BY XSTABL  * * * * *

   19.0 ft line segments define each trial failure surface.


---------------------
ANGULAR RESTRICTIONS
---------------------

  The first segment of each failure surface will be inclined
  within the angular range defined by :

          Lower angular limit :=   -45.0 degrees
          Upper angular limit :=    -5.0 degrees


************************************************************************
    --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
************************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
```

****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *

The most critical circular failure surface
is specified by 33 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	80.00	3570.52
2	98.29	3565.39
3	116.78	3560.98
4	135.42	3557.30
5	154.18	3554.35
6	173.06	3552.14
7	192.00	3550.66
8	210.98	3549.93
9	229.98	3549.94
10	248.97	3550.70
11	267.91	3552.20
12	286.78	3554.44
13	305.54	3557.41
14	324.18	3561.12
15	342.65	3565.55
16	360.94	3570.70
17	379.01	3576.57
18	396.84	3583.14
19	414.40	3590.40
20	431.66	3598.34
21	448.60	3606.95
22	465.18	3616.22
23	481.40	3626.12
24	497.21	3636.66
25	512.59	3647.81
26	527.53	3659.55
27	542.00	3671.86
28	555.98	3684.74
29	569.44	3698.15
30	582.36	3712.07

31	594.73	3726.49
32	606.53	3741.39
33	609.17	3745.00

**** Simplified BISHOP FOS = 1.562 ****

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA INTERIM A1T4 TOTAL NOD2

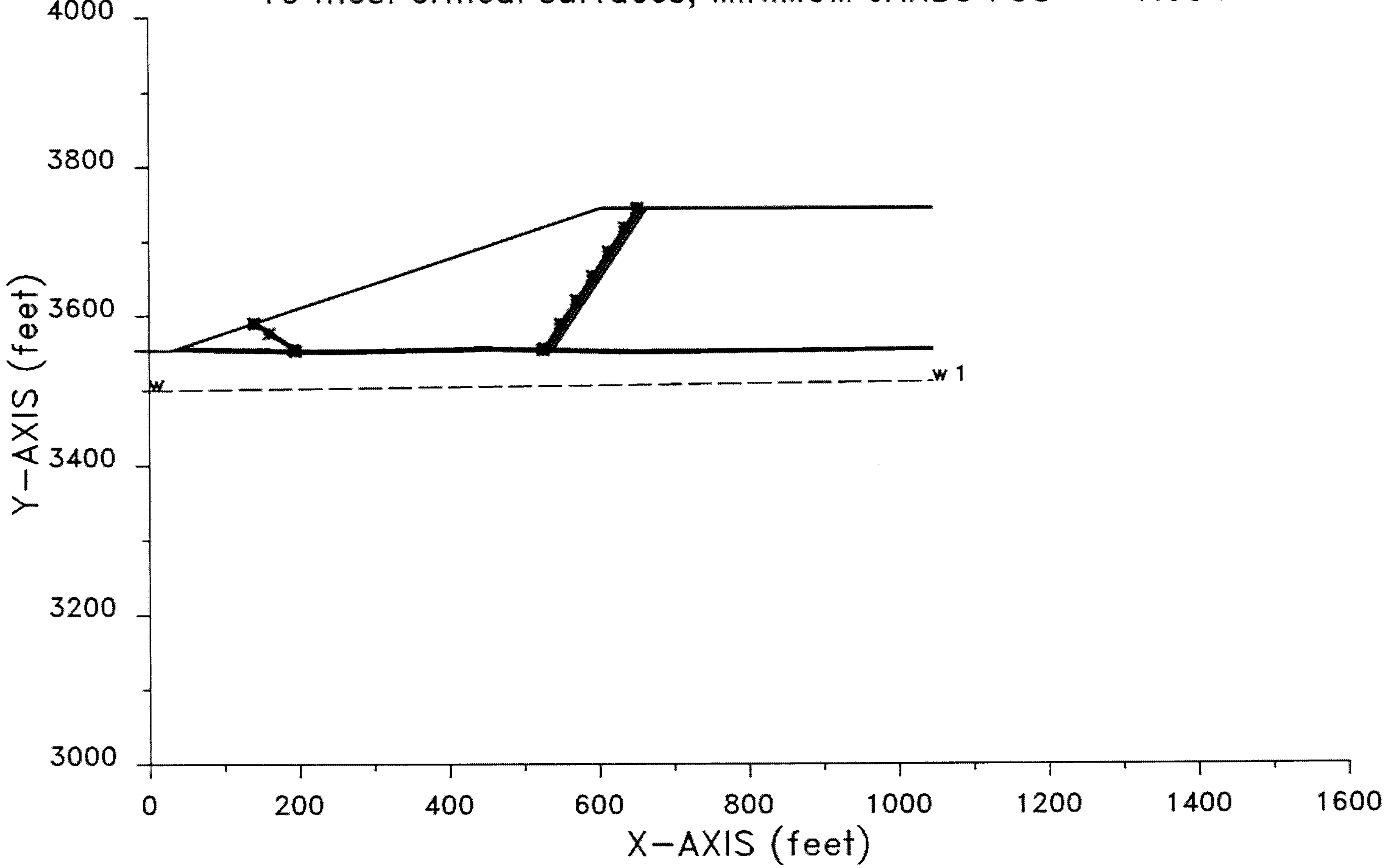
	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.562	220.15	4035.20	485.35	80.00	609.17	4.326E+08
2.	1.592	215.90	4103.50	552.58	75.56	636.31	5.443E+08
3.	1.606	198.89	4089.32	552.68	44.44	631.07	6.198E+08
4.	1.609	195.19	4121.61	582.79	44.44	639.95	6.567E+08
5.	1.609	192.75	4082.62	544.55	44.44	620.02	5.800E+08
6.	1.611	200.56	4093.37	559.72	40.00	638.58	6.632E+08
7.	1.613	183.30	4085.71	547.62	40.00	611.90	5.645E+08
8.	1.616	197.00	4045.96	513.38	40.00	612.95	5.672E+08
9.	1.616	205.58	4052.51	522.28	40.00	627.68	6.217E+08
10.	1.619	187.51	4136.41	592.71	48.89	632.52	6.215E+08

* * * END OF FILE * * *

INT-A2P4   1-27-25   9:12

SWLF LSMPA INTERIM A2P4 PEAK NOD2

10 most critical surfaces, MINIMUM JANBU FOS =   1.534



XSTABL File: INT-A2P4   1-27-25   9:12

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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*  Ver. 5.209                96 - 2083  *
*****************************************
```

Problem Description : SWLF LSMPA INTERIM A2P4 PEAK NOD2

SEGMENT BOUNDARY COORDINATES

3 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3553.3	27.8	3553.1	1
2	27.8	3553.1	602.8	3745.0	2
3	602.8	3745.0	1045.6	3745.0	2

22 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	27.8	3553.1	30.9	3553.1	1
2	30.9	3553.1	38.5	3555.6	4
3	38.5	3555.6	39.9	3556.1	6
4	39.9	3556.1	45.6	3558.0	3
5	45.6	3558.0	603.0	3744.0	5
6	603.0	3744.0	1045.6	3744.0	5
7	45.6	3558.0	245.6	3554.0	3

8	245.6	3554.0	445.6	3558.0	3
9	445.6	3558.0	645.6	3554.0	3
10	645.6	3554.0	1045.6	3556.1	3
11	39.9	3556.1	245.6	3552.0	6
12	245.6	3552.0	445.6	3556.0	6
13	445.6	3556.0	645.6	3552.0	6
14	645.6	3552.0	1045.6	3556.0	6
15	38.5	3555.6	245.6	3551.5	4
16	245.6	3551.5	445.5	3555.5	4
17	445.5	3555.5	645.5	3551.5	4
18	645.5	3551.5	1045.6	3555.5	4
19	30.9	3553.1	245.5	3549.0	1
20	245.5	3549.0	445.4	3553.0	1
21	445.4	3553.0	645.4	3549.0	1
22	645.4	3549.0	1045.6	3553.0	1

ISOTROPIC Soil Parameters
----

6 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	122.5	127.0	1200.0	26.70	.000	.0	1
2	116.0	120.0	100.0	16.00	.000	.0	0
3	120.0	125.0	100.0	16.00	.000	.0	0
4	120.0	125.0	188.0	11.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0
6	120.0	125.0	188.0	11.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)

1	.00	3500.00
2	1045.60	3511.60

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 39.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	195.0	3552.8	215.0	3552.4	.5
2	525.0	3554.1	545.0	3553.8	.5

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	139.33	3590.32

2	140.29	3589.60
3	159.94	3576.59
4	192.46	3555.06
5	195.19	3553.00
6	195.67	3552.61
7	525.18	3553.94
8	525.56	3554.40
9	527.05	3556.37
10	548.57	3588.89
11	570.10	3621.41
12	591.62	3653.94
13	613.15	3686.46
14	634.67	3718.98
15	651.23	3744.00
16	651.99	3745.00

** Corrected JANBU FOS = 1.534 ** (Fo factor = 1.084)

Failure surface No. 2 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	139.14	3590.26
2	140.11	3589.54
3	159.66	3576.59
4	192.18	3555.07
5	194.91	3553.01
6	195.43	3552.58
7	531.98	3554.10
8	532.12	3554.27
9	533.60	3556.24
10	555.13	3588.76
11	576.65	3621.28
12	598.18	3653.80
13	619.70	3686.33
14	641.23	3718.85
15	657.88	3744.00
16	658.63	3745.00

** Corrected JANBU FOS = 1.538 ** (Fo factor = 1.084)

Failure surface No. 3 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	140.94	3590.86

2	141.90	3590.13
3	162.44	3576.54
4	194.96	3555.01
5	197.69	3552.96
6	198.15	3552.58
7	527.55	3554.09
8	527.77	3554.36
9	529.25	3556.33
10	550.78	3588.85
11	572.30	3621.37
12	593.83	3653.89
13	615.35	3686.41
14	636.88	3718.93
15	653.47	3744.00
16	654.22	3745.00

** Corrected JANBU FOS = 1.539 ** (Fo factor = 1.084)

Failure surface No. 4 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	139.02	3590.22
2	139.99	3589.50
3	159.47	3576.60
4	191.99	3555.07
5	194.72	3553.01
6	195.07	3552.73
7	531.99	3553.85
8	532.33	3554.27
9	533.82	3556.24
10	555.34	3588.76
11	576.87	3621.28
12	598.39	3653.80
13	619.92	3686.32
14	641.44	3718.84
15	658.10	3744.00
16	658.85	3745.00

** Corrected JANBU FOS = 1.540 ** (Fo factor = 1.084)

Failure surface No. 5 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	141.77	3591.14

2	142.73	3590.41
3	163.73	3576.51
4	196.25	3554.99
5	198.98	3552.93
6	199.41	3552.57
7	528.78	3553.98
8	529.07	3554.33
9	530.55	3556.30
10	552.08	3588.82
11	573.60	3621.34
12	595.13	3653.87
13	616.66	3686.39
14	638.18	3718.91
15	654.79	3744.00
16	655.54	3745.00

** Corrected JANBU FOS = 1.541 ** (Fo factor = 1.084)

Failure surface No. 6 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	142.54	3591.39
2	143.50	3590.67
3	164.92	3576.49
4	197.44	3554.96
5	200.17	3552.91
6	200.72	3552.45
7	536.86	3553.77
8	537.19	3554.17
9	538.67	3556.14
10	560.20	3588.66
11	581.73	3621.18
12	603.25	3653.70
13	624.78	3686.22
14	646.30	3718.75
15	663.02	3744.00
16	663.77	3745.00

** Corrected JANBU FOS = 1.542 ** (Fo factor = 1.084)

Failure surface No. 7 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	143.25	3591.63

2	144.21	3590.91
3	166.03	3576.47
4	198.55	3554.94
5	201.28	3552.88
6	201.79	3552.47
7	527.63	3554.30
8	527.68	3554.36
9	529.17	3556.33
10	550.69	3588.85
11	572.22	3621.37
12	593.74	3653.89
13	615.27	3686.41
14	636.79	3718.94
15	653.38	3744.00
16	654.14	3745.00

** Corrected JANBU FOS = 1.543 ** (Fo factor = 1.084)

Failure surface No. 8 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	143.42	3591.69
2	144.38	3590.96
3	166.28	3576.46
4	198.81	3554.94
5	201.54	3552.88
6	201.98	3552.51
7	527.94	3554.18
8	528.08	3554.35
9	529.56	3556.32
10	551.09	3588.84
11	572.62	3621.36
12	594.14	3653.89
13	615.67	3686.41
14	637.19	3718.93
15	653.79	3744.00
16	654.54	3745.00

** Corrected JANBU FOS = 1.543 ** (Fo factor = 1.084)

Failure surface No. 9 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	141.29	3590.98

2	142.25	3590.25
3	162.99	3576.53
4	195.51	3555.00
5	198.24	3552.94
6	198.64	3552.62
7	533.30	3553.96
8	533.53	3554.24
9	535.01	3556.21
10	556.54	3588.73
11	578.06	3621.25
12	599.59	3653.78
13	621.11	3686.30
14	642.64	3718.82
15	659.31	3744.00
16	660.06	3745.00

** Corrected JANBU FOS = 1.544 ** (Fo factor = 1.084)

Failure surface No.10 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	142.93	3591.52
2	143.89	3590.80
3	165.53	3576.48
4	198.05	3554.95
5	200.78	3552.89
6	201.31	3552.46
7	538.75	3553.68
8	539.12	3554.13
9	540.60	3556.10
10	562.13	3588.62
11	583.66	3621.14
12	605.18	3653.66
13	626.71	3686.19
14	648.23	3718.71
15	664.97	3744.00
16	665.73	3745.00

** Corrected JANBU FOS = 1.544 ** (Fo factor = 1.084)

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA INTERIM A2P4 PEAK NOD2

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	1.534	1.084	139.33	651.99	9.994E+05
2.	1.538	1.084	139.14	658.63	1.019E+06
3.	1.539	1.084	140.94	654.22	1.006E+06
4.	1.540	1.084	139.02	658.85	1.022E+06
5.	1.541	1.084	141.77	655.54	1.009E+06
6.	1.542	1.084	142.54	663.77	1.029E+06
7.	1.543	1.084	143.25	654.14	1.003E+06
8.	1.543	1.084	143.42	654.54	1.005E+06
9.	1.544	1.084	141.29	660.06	1.024E+06
10.	1.544	1.084	142.93	665.73	1.035E+06

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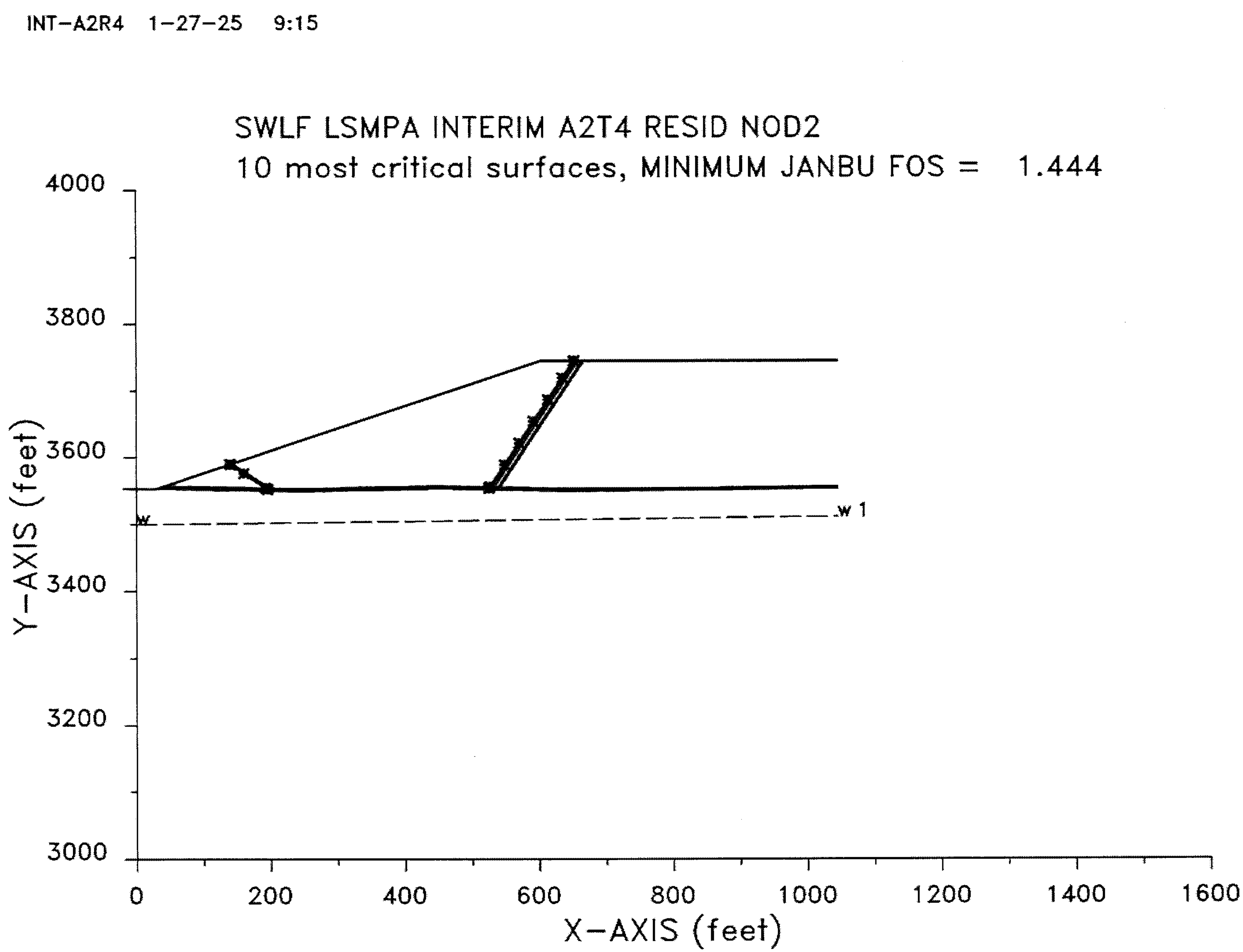
INT-A2R4 1-27-25 9:15
SWLF LSMPA INTERIM A2T4 RESID NOD2
10 most critical surfaces, MINIMUM JANBU FOS = 1.444
4000
3800
3600
3400
3200
3000
Y-AXIS (feet)
0
200
400
600
800
1000
1200
1400
1600
X-AXIS (feet)
w
w 1

XSTABL File: INT-A2R4   1-27-25   9:15

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*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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```

Problem Description : SWLF LSMPA INTERIM A2T4 RESID NOD2

SEGMENT BOUNDARY COORDINATES
----

3 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3553.3	27.8	3553.1	1
2	27.8	3553.1	602.8	3745.0	2
3	602.8	3745.0	1045.6	3745.0	2

22 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	27.8	3553.1	30.9	3553.1	1
2	30.9	3553.1	38.5	3555.6	4
3	38.5	3555.6	39.9	3556.1	6
4	39.9	3556.1	45.6	3558.0	3
5	45.6	3558.0	603.0	3744.0	5
6	603.0	3744.0	1045.6	3744.0	5
7	45.6	3558.0	245.6	3554.0	3

8	245.6	3554.0	445.6	3558.0	3
9	445.6	3558.0	645.6	3554.0	3
10	645.6	3554.0	1045.6	3556.1	3
11	39.9	3556.1	245.6	3552.0	6
12	245.6	3552.0	445.6	3556.0	6
13	445.6	3556.0	645.6	3552.0	6
14	645.6	3552.0	1045.6	3556.0	6
15	38.5	3555.6	245.6	3551.5	4
16	245.6	3551.5	445.5	3555.5	4
17	445.5	3555.5	645.5	3551.5	4
18	645.5	3551.5	1045.6	3555.5	4
19	30.9	3553.1	245.5	3549.0	1
20	245.5	3549.0	445.4	3553.0	1
21	445.4	3553.0	645.4	3549.0	1
22	645.4	3549.0	1045.6	3553.0	1

ISOTROPIC Soil Parameters
----

6 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	122.5	127.0	1200.0	26.70	.000	.0	1
2	116.0	120.0	100.0	16.00	.000	.0	0
3	120.0	125.0	100.0	16.00	.000	.0	0
4	120.0	125.0	188.0	9.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0
6	120.0	125.0	188.0	9.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water =   62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)

1	.00	3500.00
2	1045.60	3511.60

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 39.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	195.0	3552.8	215.0	3552.4	.5
2	525.0	3554.1	545.0	3553.8	.5

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	139.34	3590.32

2	140.30	3589.60
3	159.96	3576.59
4	192.48	3555.06
5	195.21	3553.00
6	195.67	3552.61
7	525.18	3553.94
8	525.57	3554.40
9	527.06	3556.37
10	548.58	3588.89
11	570.11	3621.41
12	591.64	3653.94
13	613.16	3686.46
14	634.69	3718.98
15	651.25	3744.00
16	652.00	3745.00

** Corrected JANBU FOS = 1.444 ** (Fo factor = 1.084)

Failure surface No. 2 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	142.55	3591.40
2	143.51	3590.67
3	164.94	3576.49
4	197.46	3554.96
5	200.19	3552.91
6	200.72	3552.45
7	536.86	3553.77
8	537.20	3554.17
9	538.69	3556.14
10	560.21	3588.66
11	581.74	3621.18
12	603.26	3653.70
13	624.79	3686.22
14	646.31	3718.75
15	663.03	3744.00
16	663.78	3745.00

** Corrected JANBU FOS = 1.445 ** (Fo factor = 1.084)

Failure surface No. 3 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	142.94	3591.53

2	143.90	3590.80
3	165.55	3576.48
4	198.07	3554.95
5	200.80	3552.89
6	201.31	3552.46
7	538.75	3553.68
8	539.13	3554.13
9	540.62	3556.10
10	562.14	3588.62
11	583.67	3621.14
12	605.19	3653.66
13	626.72	3686.19
14	648.25	3718.71
15	664.99	3744.00
16	665.74	3745.00

** Corrected JANBU FOS = 1.446 ** (Fo factor = 1.084)

Failure surface No. 4 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	139.16	3590.26
2	140.12	3589.54
3	159.68	3576.59
4	192.20	3555.07
5	194.93	3553.01
6	195.43	3552.58
7	531.98	3554.10
8	532.12	3554.27
9	533.61	3556.24
10	555.13	3588.76
11	576.66	3621.28
12	598.18	3653.80
13	619.71	3686.33
14	641.24	3718.85
15	657.88	3744.00
16	658.64	3745.00

** Corrected JANBU FOS = 1.446 ** (Fo factor = 1.084)

Failure surface No. 5 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	143.01	3591.55

2	143.97	3590.83
3	165.65	3576.47
4	198.18	3554.95
5	200.91	3552.89
6	201.43	3552.44
7	540.76	3553.85
8	540.97	3554.09
9	542.45	3556.06
10	563.98	3588.58
11	585.51	3621.11
12	607.03	3653.63
13	628.56	3686.15
14	650.08	3718.67
15	666.85	3744.00
16	667.60	3745.00

** Corrected JANBU FOS = 1.448 ** (Fo factor = 1.084)

Failure surface No. 6 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	140.95	3590.86
2	141.91	3590.14
3	162.45	3576.54
4	194.97	3555.01
5	197.70	3552.95
6	198.15	3552.58
7	527.55	3554.09
8	527.77	3554.36
9	529.26	3556.33
10	550.78	3588.85
11	572.31	3621.37
12	593.83	3653.89
13	615.36	3686.41
14	636.89	3718.93
15	653.48	3744.00
16	654.23	3745.00

** Corrected JANBU FOS = 1.449 ** (Fo factor = 1.084)

Failure surface No. 7 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	141.78	3591.14

2	142.74	3590.41
3	163.74	3576.51
4	196.26	3554.99
5	198.99	3552.93
6	199.41	3552.57
7	528.78	3553.98
8	529.08	3554.33
9	530.56	3556.30
10	552.09	3588.82
11	573.62	3621.34
12	595.14	3653.87
13	616.67	3686.39
14	638.19	3718.91
15	654.80	3744.00
16	655.55	3745.00

** Corrected JANBU FOS = 1.449 ** (Fo factor = 1.084)

Failure surface No. 8 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	141.63	3591.09
2	142.59	3590.36
3	163.51	3576.52
4	196.03	3554.99
5	198.76	3552.93
6	199.20	3552.56
7	540.79	3553.75
8	541.08	3554.09
9	542.56	3556.06
10	564.09	3588.58
11	585.61	3621.10
12	607.14	3653.63
13	628.66	3686.15
14	650.19	3718.67
15	666.96	3744.00
16	667.71	3745.00

** Corrected JANBU FOS = 1.450 ** (Fo factor = 1.084)

Failure surface No. 9 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	139.03	3590.22

2	139.99	3589.50
3	159.48	3576.60
4	192.01	3555.07
5	194.74	3553.01
6	195.07	3552.73
7	531.99	3553.85
8	532.34	3554.27
9	533.83	3556.24
10	555.35	3588.76
11	576.88	3621.28
12	598.41	3653.80
13	619.93	3686.32
14	641.46	3718.84
15	658.11	3744.00
16	658.86	3745.00

** Corrected JANBU FOS = 1.450 ** (Fo factor = 1.084)

Failure surface No.10 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	139.97	3590.53
2	140.93	3589.81
3	160.94	3576.57
4	193.46	3555.04
5	196.19	3552.98
6	196.65	3552.59
7	539.65	3554.01
8	539.74	3554.12
9	541.23	3556.09
10	562.75	3588.61
11	584.28	3621.13
12	605.80	3653.65
13	627.33	3686.17
14	648.85	3718.69
15	665.60	3744.00
16	666.36	3745.00

** Corrected JANBU FOS = 1.451 ** (Fo factor = 1.084)

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA INTERIM A2T4 RESID NOD2

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	1.444	1.084	139.34	652.00	9.268E+05
2.	1.445	1.084	142.55	663.78	9.492E+05
3.	1.446	1.084	142.94	665.74	9.538E+05
4.	1.446	1.084	139.16	658.64	9.442E+05
5.	1.448	1.084	143.01	667.60	9.589E+05
6.	1.449	1.084	140.95	654.23	9.329E+05
7.	1.449	1.084	141.78	655.55	9.350E+05
8.	1.450	1.084	141.63	667.71	9.632E+05
9.	1.450	1.084	139.03	658.86	9.484E+05
10.	1.451	1.084	139.97	666.36	9.630E+05

* * * END OF FILE * * *

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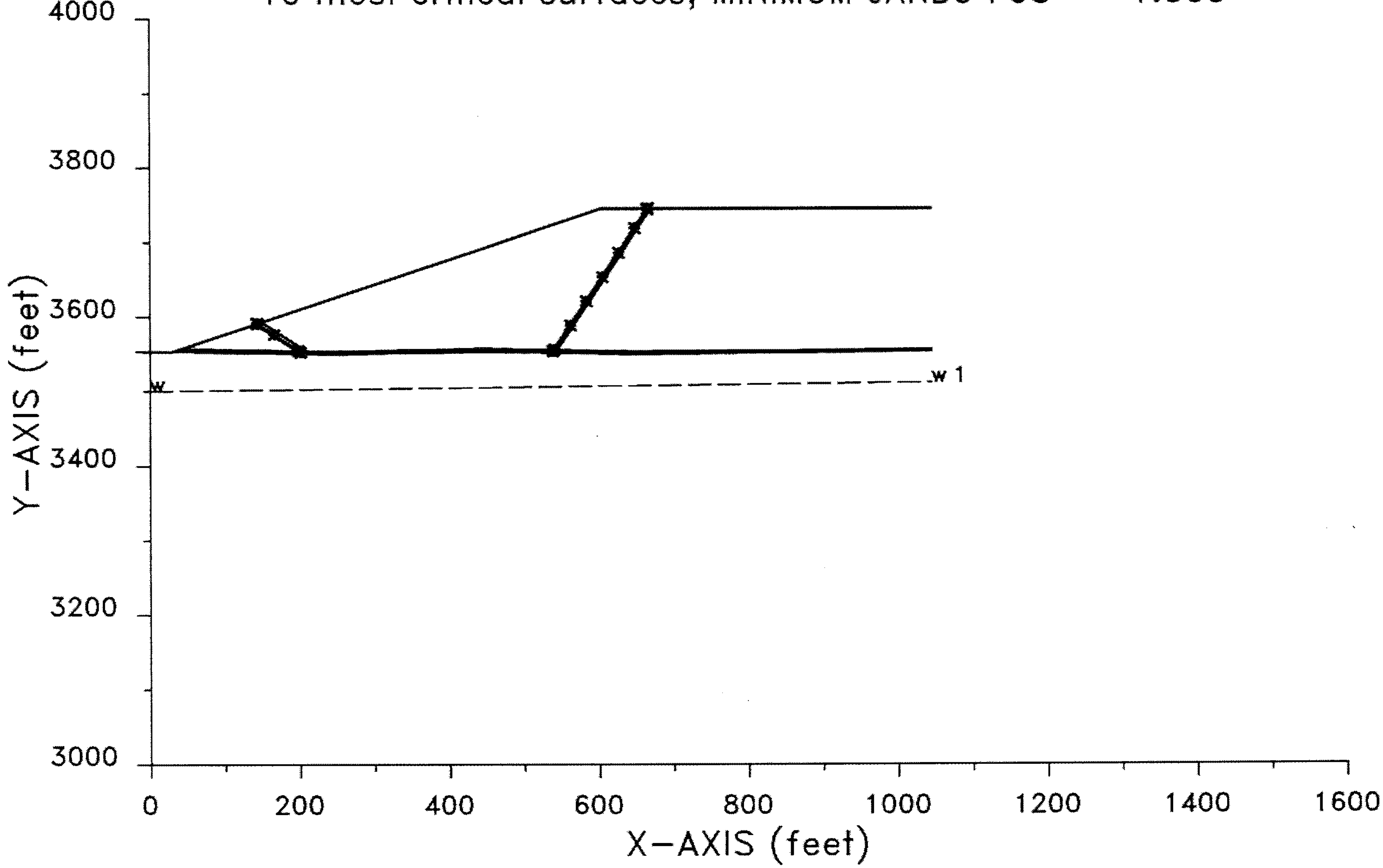
SWLF LSMPA INTERIM A2T4 TOTAL NOD2

10 most critical surfaces, MINIMUM JANBU FOS = 1.305



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*              X S T A B L              *
*                                       *
*       Slope Stability Analysis        *
*               using the               *
*            Method of Slices           *
*                                       *
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```

Problem Description : SWLF LSMPA INTERIM A2T4 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

3 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3553.3	27.8	3553.1	1
2	27.8	3553.1	602.8	3745.0	2
3	602.8	3745.0	1045.6	3745.0	2

22 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	27.8	3553.1	30.9	3553.1	1
2	30.9	3553.1	38.5	3555.6	4
3	38.5	3555.6	39.9	3556.1	6
4	39.9	3556.1	45.6	3558.0	3
5	45.6	3558.0	603.0	3744.0	5
6	603.0	3744.0	1045.6	3744.0	5
7	45.6	3558.0	245.6	3554.0	3

8	245.6	3554.0	445.6	3558.0	3
9	445.6	3558.0	645.6	3554.0	3
10	645.6	3554.0	1045.6	3556.1	3
11	39.9	3556.1	245.6	3552.0	6
12	245.6	3552.0	445.6	3556.0	6
13	445.6	3556.0	645.6	3552.0	6
14	645.6	3552.0	1045.6	3556.0	6
15	38.5	3555.6	245.6	3551.5	4
16	245.6	3551.5	445.5	3555.5	4
17	445.5	3555.5	645.5	3551.5	4
18	645.5	3551.5	1045.6	3555.5	4
19	30.9	3553.1	245.5	3549.0	1
20	245.5	3549.0	445.4	3553.0	1
21	445.4	3553.0	645.4	3549.0	1
22	645.4	3549.0	1045.6	3553.0	1

ISOTROPIC Soil Parameters
----

6 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	122.5	127.0	1200.0	26.70	.000	.0	1
2	116.0	120.0	100.0	16.00	.000	.0	0
3	120.0	125.0	100.0	16.00	.000	.0	0
4	120.0	125.0	1000.0	.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0
6	120.0	125.0	1000.0	.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)

1	.00	3500.00
2	1045.60	3511.60

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 39.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	195.0	3552.8	215.0	3552.4	.5
2	525.0	3554.1	545.0	3553.8	.5

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	142.99	3591.54

2	143.95	3590.82
3	165.62	3576.47
4	198.15	3554.95
5	200.88	3552.89
6	201.31	3552.46
7	538.75	3553.68
8	539.20	3554.13
9	540.68	3556.10
10	562.21	3588.62
11	583.73	3621.14
12	605.26	3653.66
13	626.78	3686.18
14	648.31	3718.71
15	665.05	3744.00
16	665.81	3745.00

** Corrected JANBU FOS = 1.305 ** (Fo factor = 1.084)

Failure surface No. 2 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	142.60	3591.41
2	143.56	3590.69
3	165.02	3576.49
4	197.54	3554.96
5	200.27	3552.90
6	200.72	3552.45
7	536.86	3553.77
8	537.26	3554.17
9	538.74	3556.14
10	560.27	3588.66
11	581.79	3621.18
12	603.32	3653.70
13	624.85	3686.22
14	646.37	3718.74
15	663.09	3744.00
16	663.84	3745.00

** Corrected JANBU FOS = 1.306 ** (Fo factor = 1.084)

Failure surface No. 3 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	148.74	3593.46

2	149.71	3592.74
3	174.55	3576.30
4	207.07	3554.77
5	209.80	3552.71
6	210.24	3552.27
7	542.57	3553.65
8	542.97	3554.05
9	544.45	3556.02
10	565.98	3588.54
11	587.50	3621.07
12	609.03	3653.59
13	630.55	3686.11
14	652.08	3718.63
15	668.87	3744.00
16	669.63	3745.00

** Corrected JANBU FOS = 1.306 ** (Fo factor = 1.084)

Failure surface No. 4 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	143.06	3591.57
2	144.02	3590.84
3	165.73	3576.47
4	198.25	3554.95
5	200.98	3552.89
6	201.43	3552.44
7	540.76	3553.85
8	541.00	3554.09
9	542.49	3556.06
10	564.02	3588.58
11	585.54	3621.11
12	607.07	3653.63
13	628.59	3686.15
14	650.12	3718.67
15	666.88	3744.00
16	667.64	3745.00

** Corrected JANBU FOS = 1.307 ** (Fo factor = 1.084)

Failure surface No. 5 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	149.52	3593.72

2	150.48	3593.00
3	175.75	3576.27
4	208.27	3554.75
5	211.00	3552.69
6	211.46	3552.23
7	542.38	3553.88
8	542.55	3554.06
9	544.04	3556.03
10	565.56	3588.55
11	587.09	3621.07
12	608.62	3653.60
13	630.14	3686.12
14	651.67	3718.64
15	668.45	3744.00
16	669.21	3745.00

** Corrected JANBU FOS = 1.308 ** (Fo factor = 1.084)

Failure surface No. 6 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	141.67	3591.10
2	142.63	3590.38
3	163.57	3576.52
4	196.09	3554.99
5	198.82	3552.93
6	199.20	3552.56
7	540.79	3553.75
8	541.13	3554.09
9	542.61	3556.06
10	564.14	3588.58
11	585.66	3621.10
12	607.19	3653.62
13	628.71	3686.15
14	650.24	3718.67
15	667.01	3744.00
16	667.76	3745.00

** Corrected JANBU FOS = 1.308 ** (Fo factor = 1.084)

Failure surface No. 7 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	148.58	3593.41

2	149.54	3592.68
3	174.29	3576.30
4	206.81	3554.78
5	209.54	3552.72
6	209.97	3552.29
7	543.00	3553.79
8	543.25	3554.05
9	544.74	3556.02
10	566.26	3588.54
11	587.79	3621.06
12	609.32	3653.58
13	630.84	3686.10
14	652.37	3718.62
15	669.16	3744.00
16	669.92	3745.00

** Corrected JANBU FOS = 1.308 ** (Fo factor = 1.084)

Failure surface No. 8 specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	150.25	3593.97
2	151.21	3593.24
3	176.88	3576.25
4	209.40	3554.72
5	212.13	3552.67
6	212.59	3552.20
7	544.07	3554.03
8	545.55	3556.00
9	567.08	3588.52
10	588.60	3621.04
11	610.13	3653.57
12	631.65	3686.09
13	653.18	3718.61
14	669.98	3744.00
15	670.74	3745.00

** Corrected JANBU FOS = 1.310 ** (Fo factor = 1.084)

Failure surface No. 9 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	140.01	3590.55
2	140.97	3589.83

3	161.00	3576.57
4	193.53	3555.04
5	196.26	3552.98
6	196.65	3552.59
7	539.65	3554.01
8	539.76	3554.12
9	541.24	3556.09
10	562.77	3588.61
11	584.29	3621.13
12	605.82	3653.65
13	627.34	3686.17
14	648.87	3718.69
15	665.62	3744.00
16	666.37	3745.00

** Corrected JANBU FOS = 1.312 ** (Fo factor = 1.084)

Failure surface No.10 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	149.60	3593.75
2	150.56	3593.02
3	175.87	3576.27
4	208.39	3554.74
5	211.12	3552.69
6	211.44	3552.37
7	542.06	3553.63
8	542.50	3554.06
9	543.98	3556.03
10	565.51	3588.55
11	587.04	3621.08
12	608.56	3653.60
13	630.09	3686.12
14	651.61	3718.64
15	668.40	3744.00
16	669.15	3745.00

** Corrected JANBU FOS = 1.313 ** (Fo factor = 1.084)

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA INTERIM A2T4 TOTAL NOD2

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	1.305	1.084	142.99	665.81	8.383E+05
2.	1.306	1.084	142.60	663.84	8.359E+05
3.	1.306	1.084	148.74	669.63	8.362E+05
4.	1.307	1.084	143.06	667.64	8.423E+05
5.	1.308	1.084	149.52	669.21	8.355E+05
6.	1.308	1.084	141.67	667.76	8.462E+05
7.	1.308	1.084	148.58	669.92	8.386E+05
8.	1.310	1.084	150.25	670.74	8.378E+05
9.	1.312	1.084	140.01	666.37	8.486E+05
10.	1.313	1.084	149.60	669.15	8.392E+05

* * * END OF FILE * * *

APPENDIX IIIE-A-3

OVERLINER AND FINAL LANDFILL CONFIGURATION STABILITY ANALYSIS

Includes pages IIIE-A-3-1 through IIIE-A-3-306

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APPENDIX IIIE-A-3
FINAL CONFIGURATION AND OVERLINER SLOPE STABILITY ANALYSIS

Required: Evaluate the slope stability of the proposed landfill final and overliner slopes.

Given: The slope stability analyses section locations are provided on Sheets IIIE-A-3-3 and 4.

Method:

A. Evaluate the stability of the proposed overliner and final cover slopes.
1. Determine the most critical final fill height slopes in the proposed design.
2. Select a soil profile for each critical section using available boring logs near the sections. Use the highest measured groundwater in upper silt lenses of Stratum II.
3. Select material properties using average unit weights and strength parameters. (Laboratory testing summaries for the site soils are provided in Appendix IIIE-C).
4. Perform stability analyses.
   a. Analyze the final fill slopes using XSTABL 5.208, Simplified Bishop method of cir failure surfaces, and Rankine's method of block failure surfaces. Use undrained and drained strength parameters to model the final proposed conditions.

References:

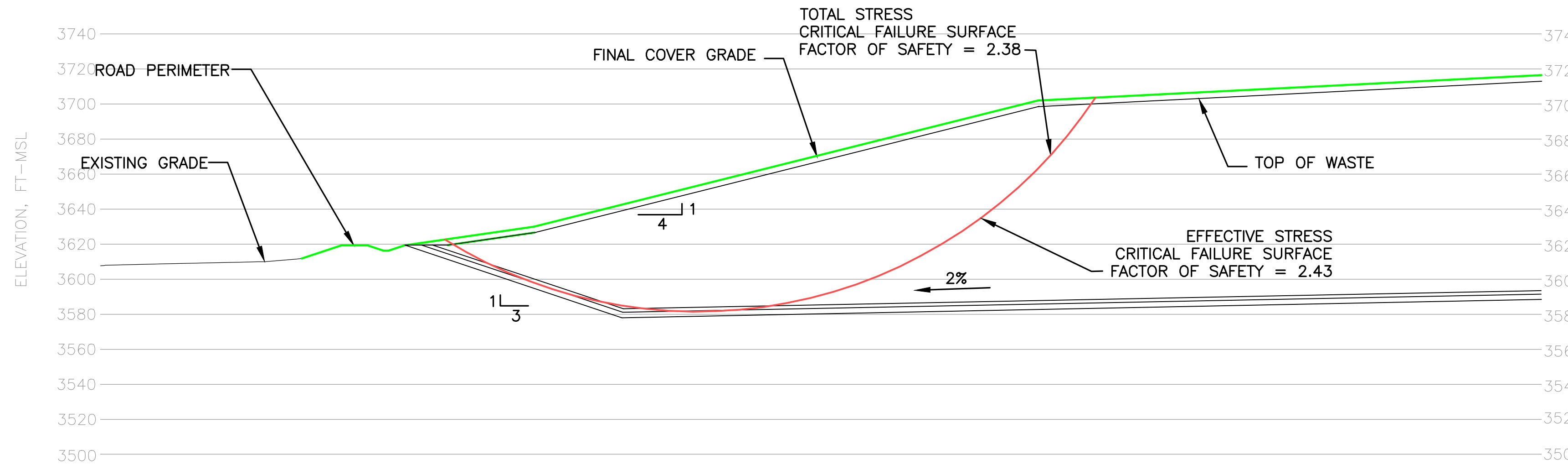
1. Bowles, Joseph E., *Foundation Analyses and Design* , 4th Ed., Mc-Graw-Hill, 1988.
2. Duncan, J.M. and Buchignani, A.L., *An Engineering Manual for Slope Stability Studies* , Department of Civil Engineering-University of California-Berkeley, 1975.
3. Koerner, Robert M., *Designing with Geosynthetics* , 5th Ed., Prentice-Hall, Inc., 2005.
4. XSTABL 5.208 (computer program for slope stability analyses), Interactive Software.
5. Koerner, George R. and Narejo, Dhani, Geosynthetics Research Institute (GRI), *Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic to Soil Interfaces* , GRI Report #30, June 14, 2005.

Solution: A. Slope stability analyses of the proposed final slopes

1. The locations of the most critical sections selected for the stability analysis for the proposed slopes are shown on Sheets IIIE-A-3-3 and IIIE-A-3-4. Sections analyzed are shown with the most critical failure surfaces on Sheets IIIE-A-3-5 through 12.
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 IIIE-A-3-13 through IIIE-A-3-14. 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 finer than #200 sieve, Standard Proctor, and strength testing) and engineering judgment from previous experience with similar materials. Laboratory testing results for the site soils are included in Appendix IIIE-C.

   Liner system interface strength values were derived from the GRI Report #30 (Ref. 5), dated June 14, 2005, specifically regarding interface shear strength values incorporated into the translational block failure analyses.
4. The output from the slope stability analyses on the final cover and overliner slopes are provided on Sheets IIIE-A-3-17 through IIIE-A-3-221. A summary of the output can be seen on Sheet IIIE-A-3-15.

FINAL COVER SECTION A–1

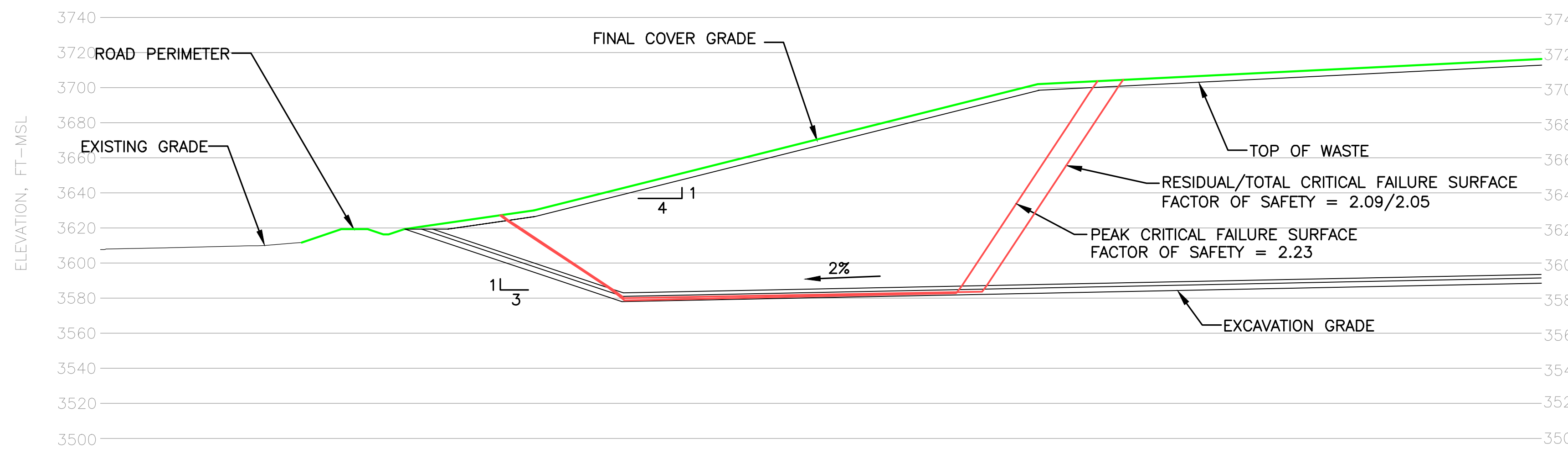


SECTION A–1 ROTATIONAL

0 50 100 SCALE IN FEET

A IIIE–A–3–3 IIIE–A–3–5

FINAL COVER SECTION A–2



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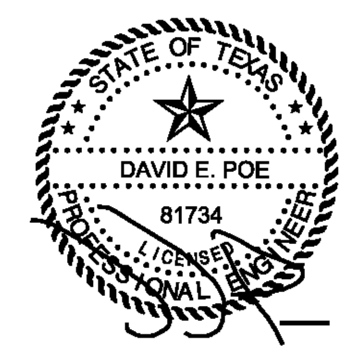
A IIIE–A–3–3 IIIE–A–3–5



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SHEET IIIE–A–3–5

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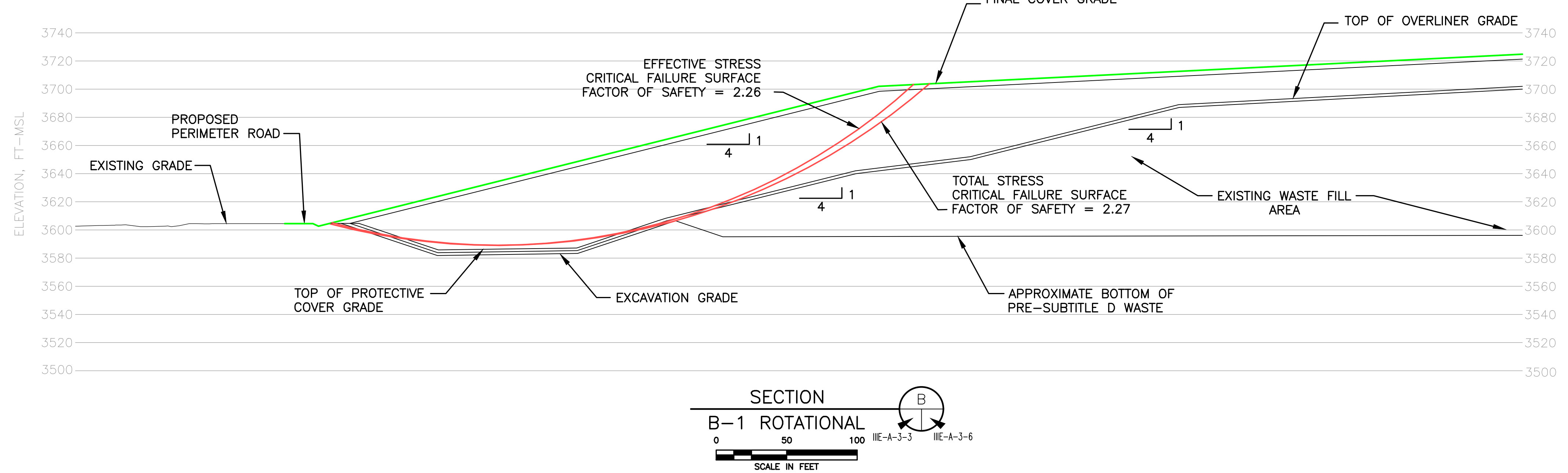
FINAL COVER SECTION B-1



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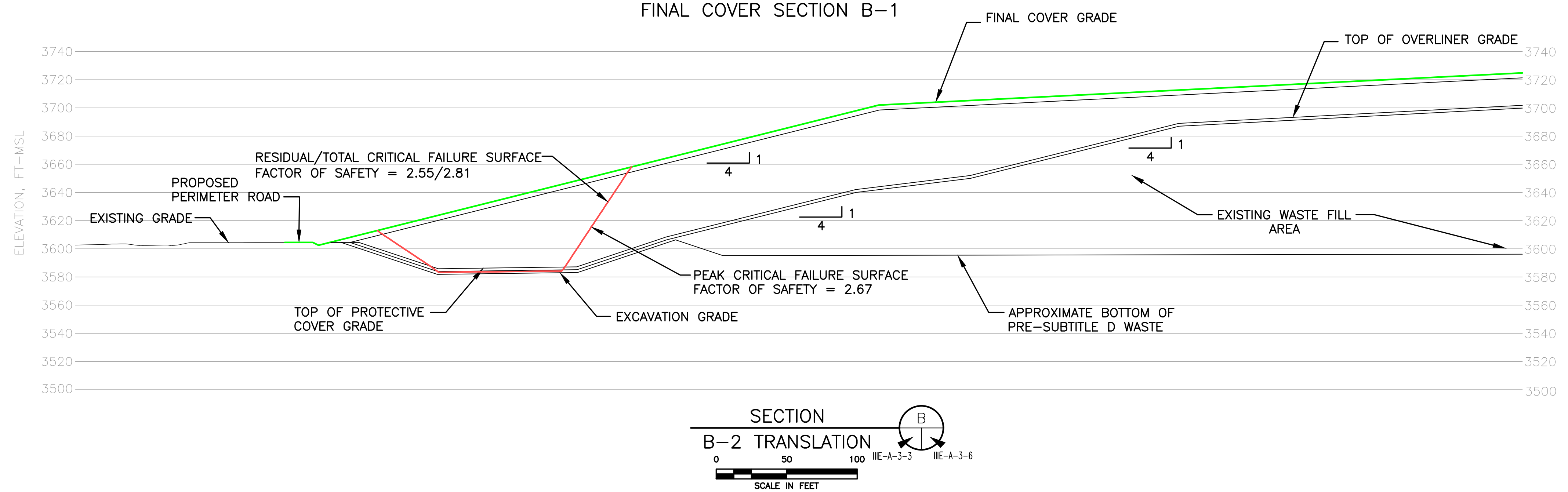

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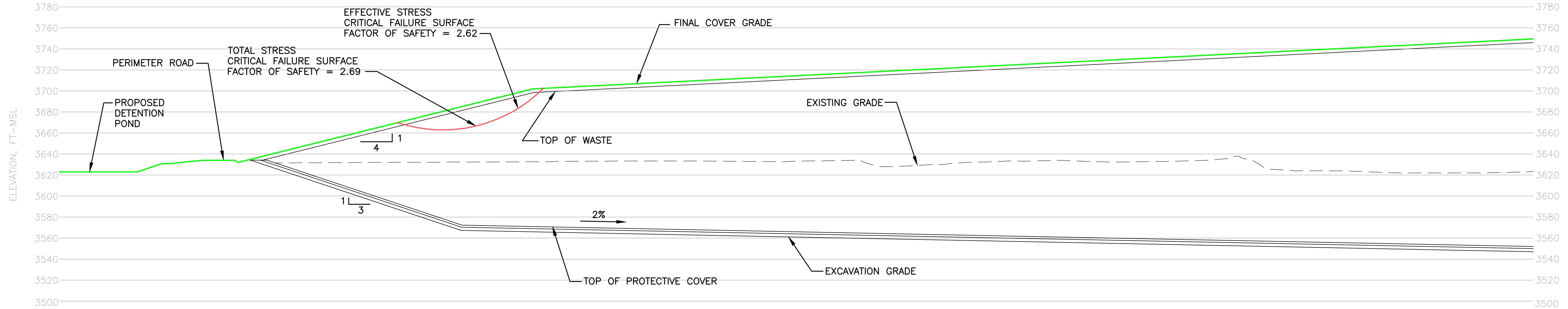
SHEET IIIE-A-3-6

FINAL COVER SECTION C–1



SECTION C–1 ROTATIONAL

IIIE–A–3–3 IIIE–A–3–7

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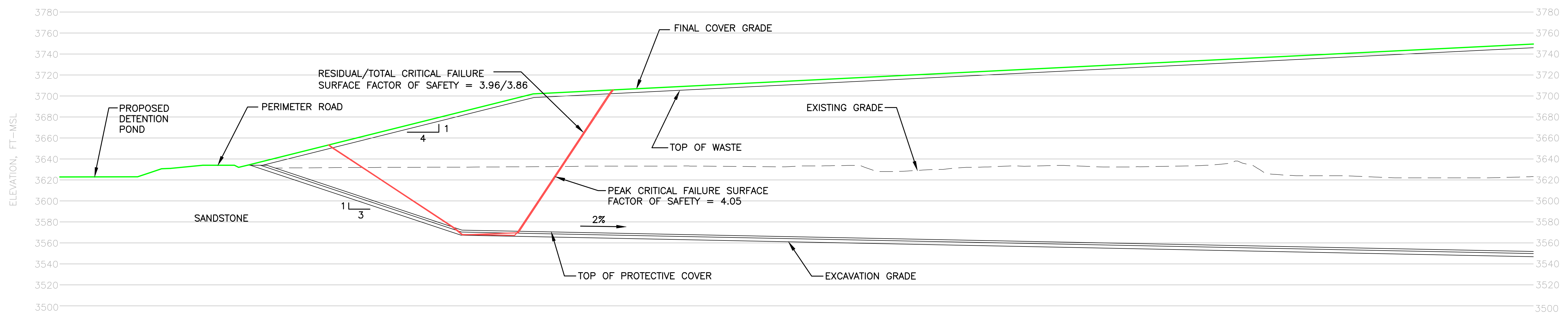
FINAL COVER SECTION C–2



SECTION C–2 TRANSLATIONAL

IIIE–A–3–3 IIIE–A–3–7

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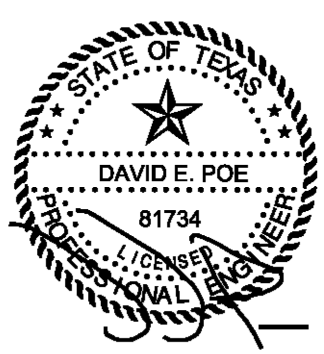

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SHEET IIIE–A–3–7

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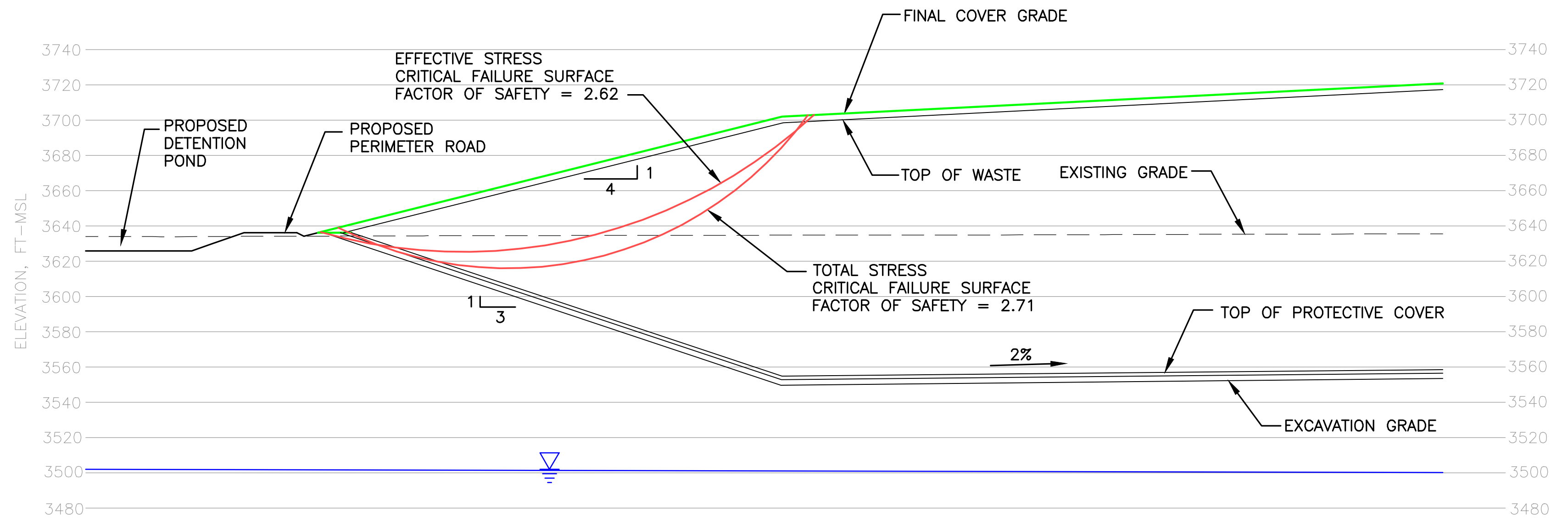
FINAL COVER SECTION D-1



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D
IIIE-A-3-3 IIIE-A-3-8
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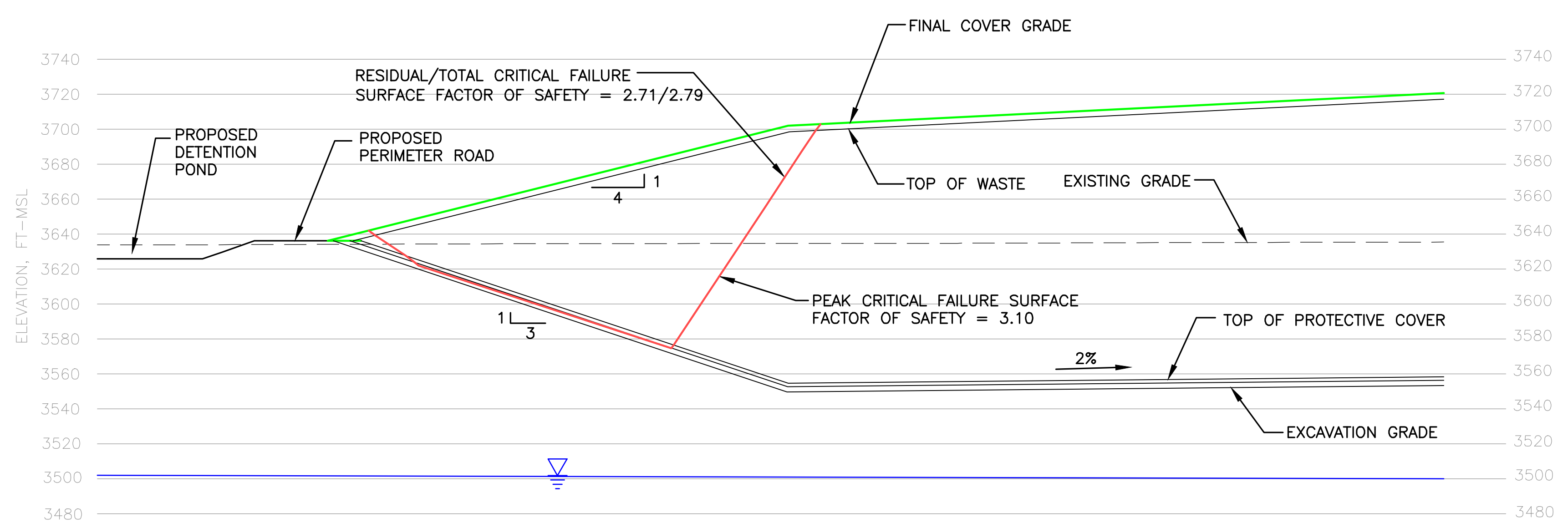
SCALE IN FEET

FINAL COVER SECTION D-2



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D-2 TRANSLATIONAL
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IIIE-A-3-3 IIIE-A-3-8
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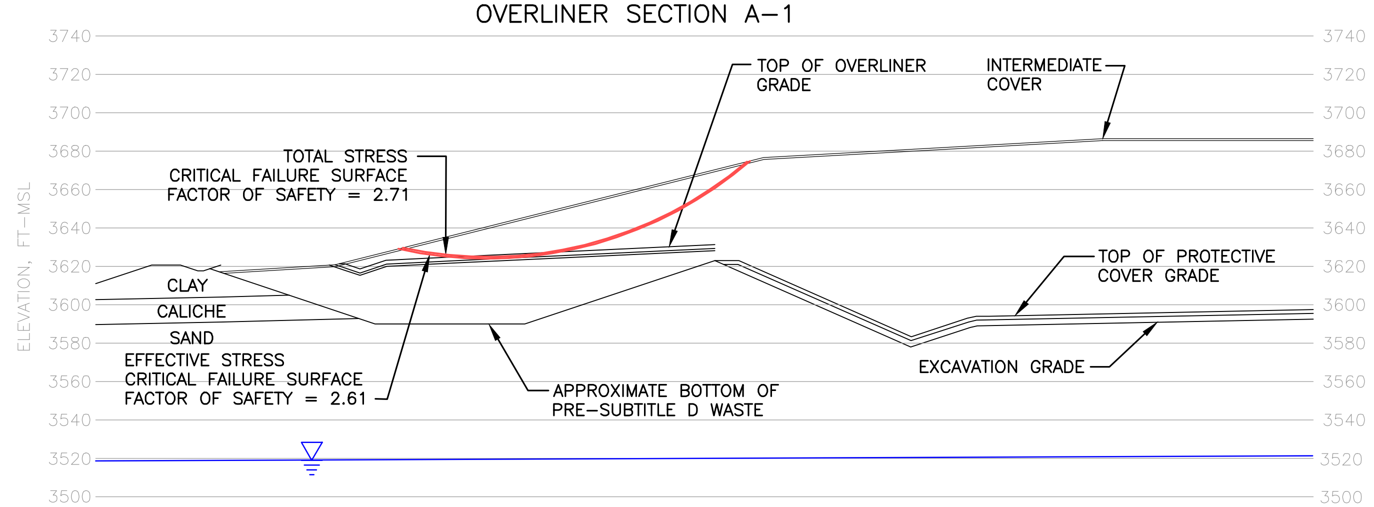
SHEET IIIE-A-3-8

OVERLINER SECTION A–1



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A–1 ROTATIONAL
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IIIE–A–3–4 IIIE–A–3–9

0 50 100
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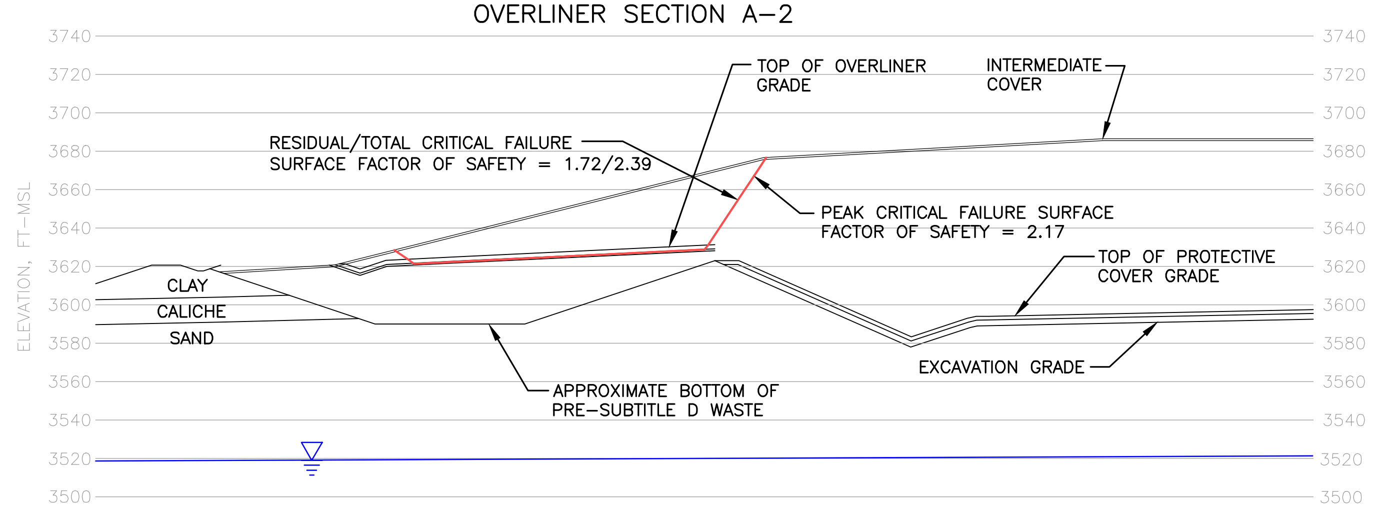
OVERLINER SECTION A–2



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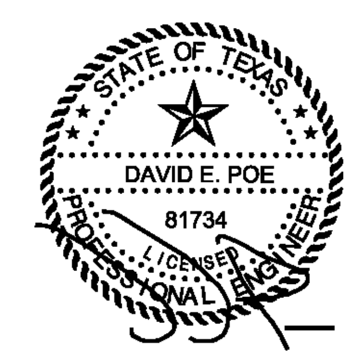

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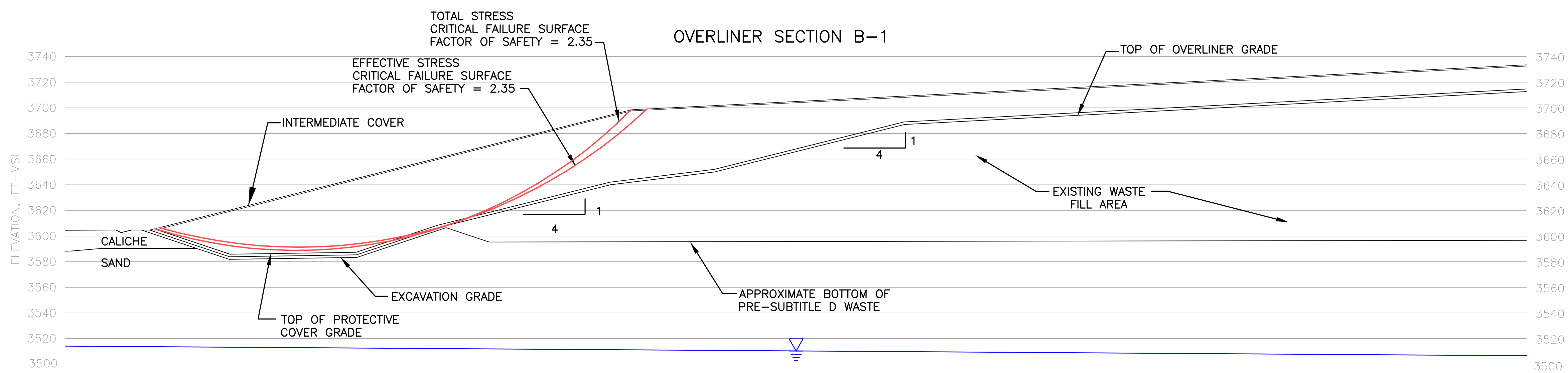

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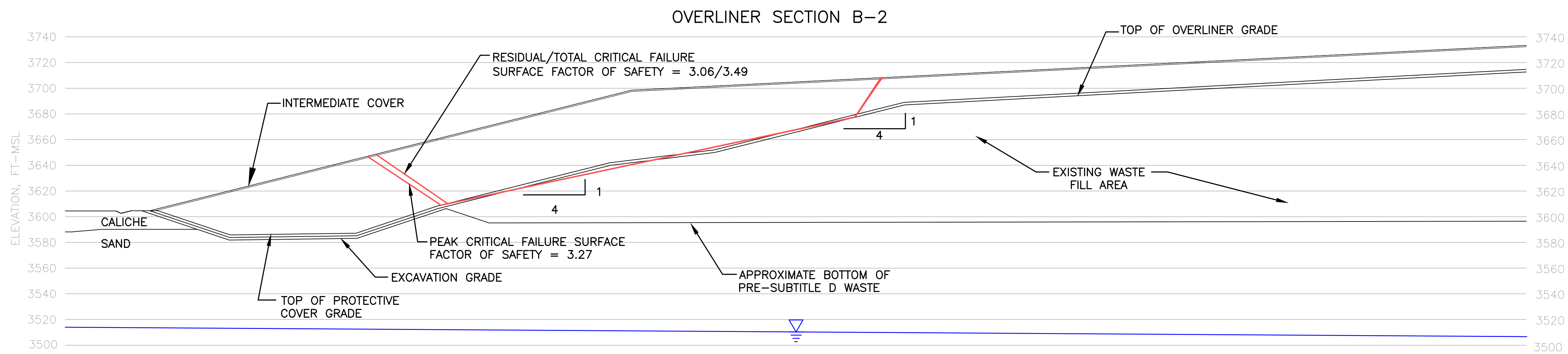

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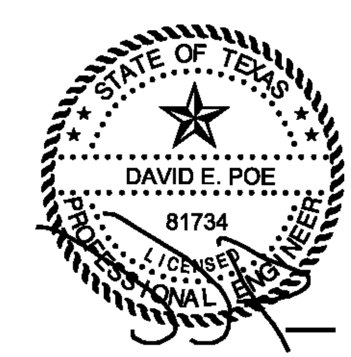

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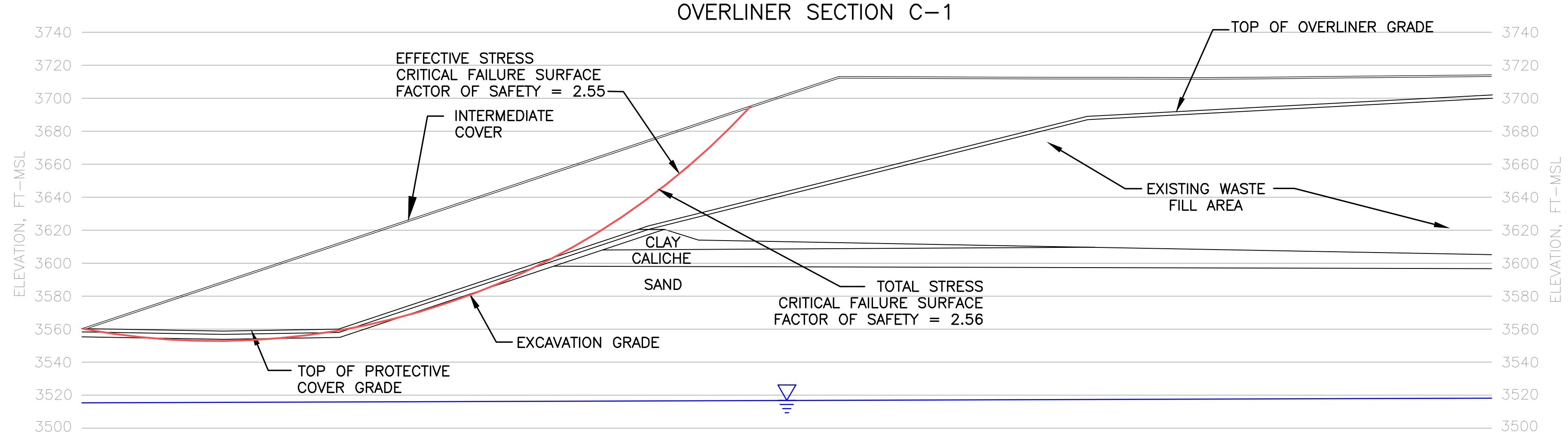
OVERLINER SECTION C–1



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C–1 ROTATIONAL
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IIIE–A–3–4 IIIE–A–3–11

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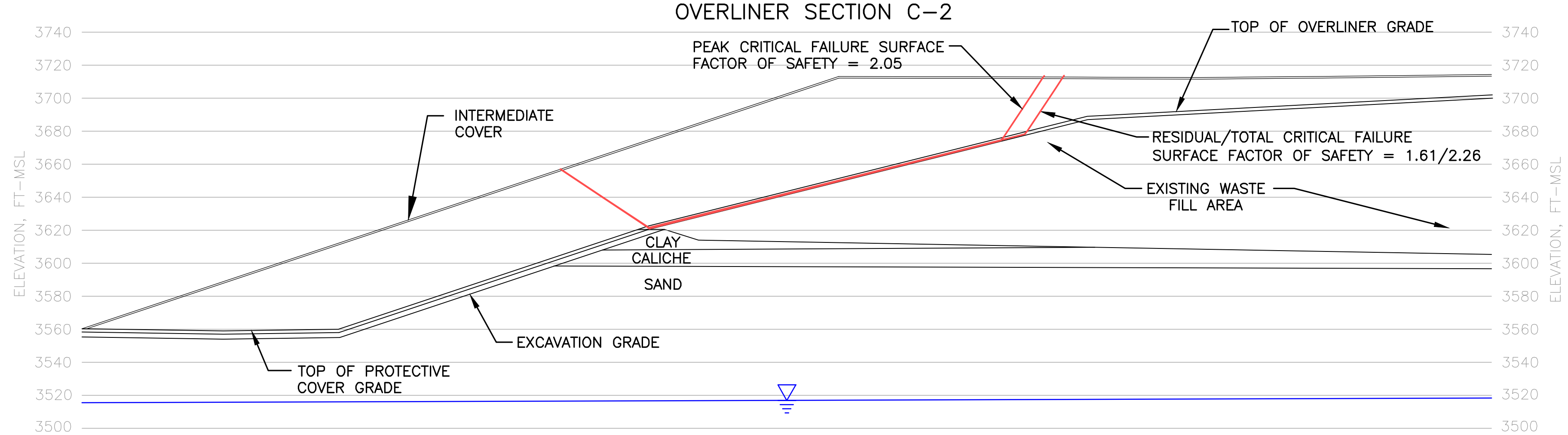
OVERLINER SECTION C–2



SECTION
C–1 TRANSLATIONAL
C
IIIE–A–3–4 IIIE–A–3–11

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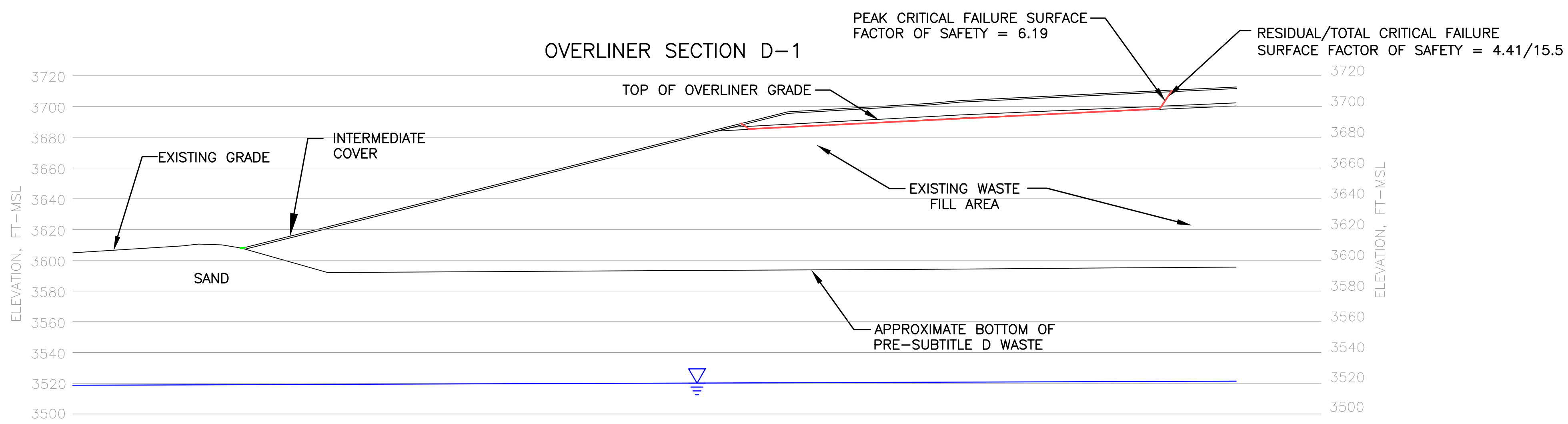

SECTION
D-1 TRANSITIONAL

D
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REVIEWED BY: DEP

Weaver Consultants Group
TBPE REGISTRATION NO. F-3727

PREPARED FOR
SOUTHWEST LANDFILL TX, LP

REVISIONS

NO.	DATE	DESCRIPTION
1	02/2025	LSMPA

MAJOR PERMIT AMENDMENT
SLOPE STABILITY
OVERLINER SECTIONS

SOUTHWEST LANDFILL
RANDALL COUNTY, TEXAS

WWW.WCGRP.COM

SHEET IIIE-A-3-12

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Derivation of Slope Stability Parameters:

Laboratory testing data are provided in Appendix IIIE-C. The following includes material strength properties based on the laboratory testing results from each subsurface unit.

Material	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)
Stratum I (Clay)	122.5	--
Stratum I (Caliche)	121.9	--
Stratum II (Sand)	122.5	127.0
Stratum III (Shale)	138.4	139.0

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

Stratum I (Clay and Caliche)

A triaxial shear test was performed on Stratum I samples which resulted in cohesion and friction angle values listed in the table below. The values in the table will be used for both Clay and Caliche. Moist unit weight and saturated unit weight values are calculated from the dry unit weight, the moisture content, and the void ratio obtained from the triaxial shear test. These unit weight values conservatively compare to the average obtained from all laboratory testing performed on the material.

	Total Stress		Effective Stress	
	Cohesion (lb/ft^2)	Friction Angle	Cohesion (lb/ft^2)	Friction Angle
Triaxial Shear Test G-5	100	26.0	100	27.1

Stratum II (Sand)

A triaxial shear tests and direct shear tests were performed on the Stratum II (sand) samples which resulted in cohesion and friction angle values listed in the table below. Stratum II is modeled using a cohesion of 1,200 psf and a friction angle of 26.7° conservatively. Moist unit weight values are calculated from each pair of moisture content and dry unit weight obtained from all laboratory testing performed on the material. These moist unit weight values were then averaged and this value is used in the slope stability analysis.

	Cohesion (lb/ft^2)	Friction Angle	Cohesion (lb/ft^2)	Friction Angle
Triaxial Shear Test G-3	1620 (total)	40.9 (total)	3020 (effective)	35.0 (effective)
Direct Shear Test WB-121	900 (residual)	26.9 (residual)	1200 (peak)	26.7 (peak)

Shale

The slope stability analysis indicate no failure surface through this stratum as the top of this stratum is located minimum of 74 feet below the elevation of the deepest excavation. The laboratory testing for shear strength is reported on page IIIE-18.

Material	Effective Stress		Total Stress	
	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)
Stratum I (Clay)	100	26	100	27.1
Stratum I (Caliche)	100	26	100	27.1
Stratum II (Sand)	1,200	26.7	1,200	26.7
Stratum III (Shale)	500	33	5,000	0

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 factor of safety values.

Material	Moist Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Final Cover System	116	100	16
Clay Liner[(1)]	120	100	16
Protective Cover	120	100	16
Overliner Protective Cover[(2)]	120	100	16

1. A cohesion of 100 psf and internal friction angle of 16 degrees (effective stress) and a cohesion of 1,000 psf and internal friction angle of 0 degrees (total stress) is used for the clay liner for simplified Bishop Method of the slope stability analysis.

2. For translational (block) stability analysis, the strength parameters of the weakest interface were used to model the liner. The values used for the final slope stability analysis are highlighted in the table below titled "Minimum Required Interface Strength Values". Note that both total and residual stress analyses were performed for the translational analyses.

3. A cohesion of 100 psf and internal friction angle of 16 degrees is used for the overliner for Simplified Bishop method of the slope stability analysis. For global translational stability analysis, the strength parameters of the weakest interface were used to model the overliner. For peak values, an adhesion of 100 psf and an interface friction angle of 18 degrees (textured geomembrane/GCL) is used in the Rankine Block 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 8 degrees (smooth geomembrane/GCL) is used.

Soil Description	Moist Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Solid Waste	59	288	23

This 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 1400 psf. Many of the lower values are directly contradicted by observations of actual stable landfill slopes. A summary of a few of the studies completed is listed below.

Reference	Data Type	Results
Pagotto & Rimoldi (1987)	Back-calculation from plate bearing tests	$\phi = 22,^{o}$ c = 605 psf (29 kPa)
Landva & Clark (1990)	Laboratory direct shear tests on MSW	$\phi = 24,^{o}$ c = 460 psf (22 kPa) to $\phi = 39,^{o}$ c = 400 psf (19 kPa)
Richardson & Reynolds (1991)	Large direct shear tests performed in-situ	$\phi = 18^{o}$ to $43,^{o}$ c = 210 psf (10 kPa)

To provide for a conservative analysis, a cohesion of 288 psf and a friction angle of 23° were selected.

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

Factor of Safety Summary for Long-Term Slope Stability

Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Effective Stress	Total Stress	Effective Stress	Total Stress	Effective Stress	Total Stress
Final Cover A-1	Bishop-Circular	2.43	2.38	1.5	1.3	YES	YES
Final Cover B-1	Bishop-Circular	2.26	2.27	1.5	1.3	YES	YES
Final Cover C-1	Bishop-Circular	2.62	2.69	1.5	1.3	YES	YES
Final Cover D-1	Bishop-Circular	2.62	2.71	1.5	1.3	YES	YES
Overliner A-1	Bishop-Circular	2.61	2.71	1.5	1.3	YES	YES
Overliner B-1	Bishop-Circular	2.35	2.35	1.5	1.3	YES	YES
Overliner C-1	Bishop-Circular	2.55	2.56	1.5	1.3	YES	YES

Description		Minimum Factor of Safety Generated		Recommended Minimum Factor of Safety		Acceptable Factor of Safety	
Slope Designation	Method of Analysis	Peak	Residual/ Total	Peak	Residual/ Total	Peak	Residual
Final Cover A-2	Rankine-Block	2.23	2.09/2.05	1.5	1.1 / 1.3	YES	YES
Final Cover B-2	Rankine-Block	2.67	2.55/2.81	1.5	1.1 / 1.3	YES	YES
Final Cover C-2	Rankine-Block	4.05	3.96/3.86	1.5	1.1 / 1.3	YES	YES
Final Cover D-3	Rankine-Block	3.10	2.71/2.79	1.5	1.1 / 1.3	YES	YES
Overliner A-2	Rankine-Block	2.17	1.72/2.39	1.5	1.1 / 1.3	YES	YES
Overliner B-2	Rankine-Block	3.27	3.06/3.49	1.5	1.1 / 1.3	YES	YES
Overliner C-2	Rankine-Block	2.05	1.61/2.26	1.5	1.1 / 1.3	YES	YES
Overliner D-1	Rankine-Block	6.19	4.41/15.5	1.5	1.1 / 1.3	YES	YES

Minimum Required Interface Strength Parameters

Landfill Component	Interface	Peak		Residual	
		Adhesion (psf)	Friction Angle (degrees)	Adhesion (psf)	Friction Angle (degrees)
Liner/Overliner/FC Systems	Protective Cover/Geocomposite	100	18	80	14
Liner/FC Systems (Notes 1, 3)	***Geonet/Smooth Geomembrane***	***188***	***11***	***188***	***9***
Liner/FC Systems (Note 3)	Geonet/Textured Geomembrane	0	13	0	10
Liner/Overliner/FC Systems	Geocomposite/Textured Geomembrane	100	21	80	10
Liner/FC Systems	Smooth Geomembrane/Clay Liner	100	13	80	8
Liner/FC Systems (Note 2)	***Textured Geomembrane/Clay Liner***	***200***	***15***	***80***	***10***
Liner/Overliner Systems	Textured Geomembrane/Geosynthetic Clay Liner	100	18	80	10
Liner/Protective Cover (Note 4)	***Clay Internal/Protective Cover (Total Stress)***	***--***	***--***	***1000 (Total Only)***	***0 (Total Only)***

1. Interface parameters used for translational block analysis of cell floor.
2. Interface parameters used for translational block analysis of cell sideslope (3H:1V typical).
3. Interface parameters derived from GRI Report #30 (Ref. 5).
4. Total stress values assumed for both rotational and translational anlaysis of final cover conditions. Effective, peak and residual stresses also analyzed.

SLOPE STABILITY XSTABL OUTPUT FILES

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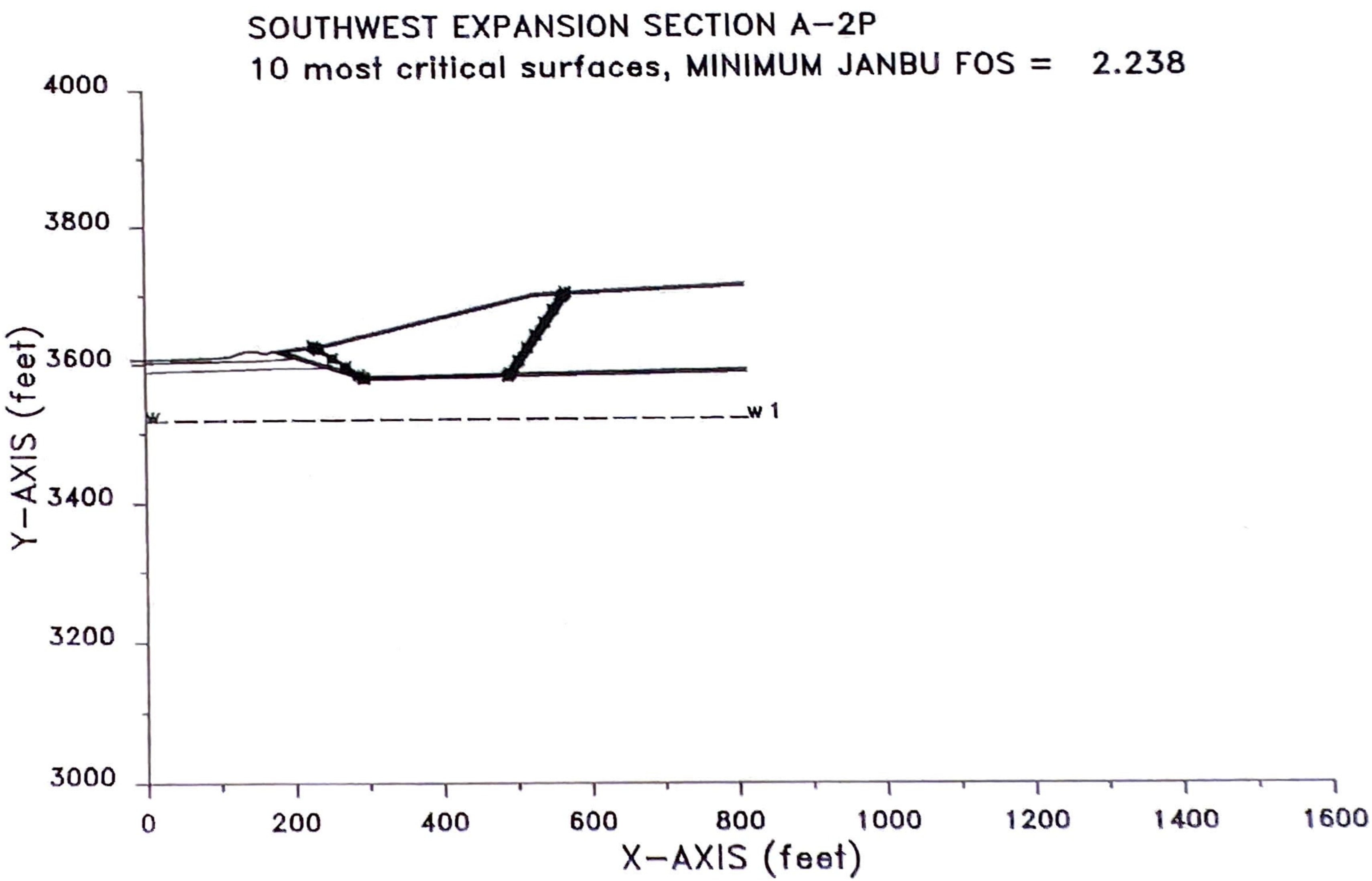

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*                 X S T A B L               *
*                                           *
*         Slope Stability Analysis          *
*                using the                  *
*            Method of Slices               *
*                                           *
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Problem Description : SOUTHWEST EXPANSION SECTION A-2P

SEGMENT BOUNDARY COORDINATES

11 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3607.6	93.9	3610.0	1
2	93.9	3610.0	114.9	3611.7	1
3	114.9	3611.7	137.6	3619.3	1
4	137.6	3619.3	152.6	3619.3	1
5	152.6	3619.3	161.6	3616.3	1
6	161.6	3616.3	164.6	3616.3	1
7	164.6	3616.3	173.6	3619.3	1
8	173.6	3619.3	173.9	3619.4	1
9	173.9	3619.4	247.6	3630.0	5
10	247.6	3630.0	535.6	3702.0	5
11	535.6	3702.0	823.4	3716.4	5

18 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	173.9	3619.4	183.4	3619.4	8

2	183.4	3619.4	189.7	3619.4	7
3	189.7	3619.4	198.4	3619.4	6
4	198.4	3619.4	248.3	3626.5	6
5	248.3	3626.5	536.1	3698.5	6
6	536.1	3698.5	823.4	3712.9	6
7	189.7	3619.4	298.7	3583.0	7
8	298.7	3583.0	823.3	3593.5	7
9	183.4	3619.4	298.4	3581.0	8
10	298.4	3581.0	823.4	3591.5	9
11	173.6	3619.3	204.4	3609.2	1
12	204.4	3609.2	248.4	3594.5	2
13	248.4	3594.5	298.0	3578.0	3
14	298.0	3578.0	823.4	3588.5	3
15	.0	3602.3	160.0	3606.0	2
16	160.0	3606.0	204.4	3609.2	2
17	.0	3589.3	181.6	3594.5	3
18	181.6	3594.5	248.4	3594.5	3

ISOTROPIC Soil Parameters
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9 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	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	122.5	127.0	1200.0	26.70	.000	.0	0
5	116.0	120.0	100.0	16.00	.000	.0	0
6	59.0	59.0	288.0	23.00	.000	.0	0
7	120.0	125.0	100.0	16.00	.000	.0	0
8	120.0	125.0	200.0	15.00	.000	.0	0
9	120.0	125.0	188.0	11.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

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PHREATIC SURFACE,

****

Point No.	x-water (ft)	y-water (ft)
1	.00	3518.60
2	823.40	3522.00

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 22.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	298.8	3580.5	318.8	3580.9	5.0
2	488.8	3584.3	508.7	3584.7	5.0

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	228.85	3627.30
2	232.84	3624.30
3	236.67	3621.76
4	255.02	3609.62
5	273.36	3597.48
6	291.71	3585.33
7	296.71	3581.56
8	298.87	3579.78
9	495.76	3583.04
10	497.36	3584.98
11	498.89	3587.01
12	511.03	3605.35
13	523.17	3623.70
14	535.31	3642.04
15	547.46	3660.39
16	559.60	3678.73
17	571.74	3697.08
18	573.94	3700.40
19	576.70	3704.06

** Corrected JANBU FOS = 2.238 ** (Fo factor = 1.085)

Failure surface No. 2 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	228.40	3627.24
2	232.38	3624.24
3	235.55	3622.14
4	253.90	3609.99
5	272.25	3597.85
6	290.59	3585.71
7	295.60	3581.94
8	299.47	3578.74
9	488.98	3582.77
10	490.69	3584.85
11	492.22	3586.87
12	504.36	3605.22
13	516.51	3623.56
14	528.65	3641.91
15	540.79	3660.26
16	552.93	3678.60
17	565.08	3696.95
18	567.13	3700.06

19	569.89	3703.72

** Corrected JANBU FOS = 2.239 ** (Fo factor = 1.086)

Failure surface No. 3 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	229.16	3627.35
2	233.15	3624.34
3	237.43	3621.51
4	255.78	3609.37
5	274.12	3597.22
6	292.47	3585.08
7	297.47	3581.31
8	299.09	3579.98
9	503.71	3583.67
10	504.92	3585.13
11	506.44	3587.16
12	518.59	3605.50
13	530.73	3623.85
14	542.87	3642.19
15	555.01	3660.54
16	567.16	3678.89
17	579.30	3697.23
18	581.65	3700.78
19	584.41	3704.44

** Corrected JANBU FOS = 2.240 ** (Fo factor = 1.085)

Failure surface No. 4 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	230.34	3627.52
2	234.33	3624.51
3	240.33	3620.54
4	258.67	3608.40
5	277.02	3596.26
6	295.36	3584.11
7	299.47	3581.02
8	301.95	3578.98
9	491.33	3584.65
10	491.51	3584.86
11	493.04	3586.89
12	505.18	3605.24
13	517.32	3623.58
14	529.47	3641.93
15	541.61	3660.27
16	553.75	3678.62

17	565.89	3696.96
18	567.97	3700.10
19	570.73	3703.76

** Corrected JANBU FOS = 2.246 ** (Fo factor = 1.085)

Failure surface No. 5 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	230.31	3627.51
2	234.30	3624.51
3	240.26	3620.56
4	258.61	3608.42
5	276.95	3596.28
6	295.30	3584.14
7	299.43	3581.02
8	299.63	3580.86
9	501.23	3582.61
10	503.28	3585.10
11	504.80	3587.13
12	516.95	3605.47
13	529.09	3623.82
14	541.23	3642.16
15	553.37	3660.51
16	565.52	3678.85
17	577.66	3697.20
18	579.98	3700.70
19	582.73	3704.36

** Corrected JANBU FOS = 2.251 ** (Fo factor = 1.085)

Failure surface No. 6 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.16	3627.64
2	235.15	3624.63
3	242.33	3619.87
4	260.68	3607.73
5	279.02	3595.59
6	297.37	3583.44
7	300.56	3581.04
8	302.44	3579.49
9	497.06	3584.36
10	497.57	3584.98
11	499.10	3587.01
12	511.24	3605.36
13	523.39	3623.70
14	535.53	3642.05

15	547.67	3660.39
16	559.81	3678.74
17	571.96	3697.08
18	574.16	3700.41
19	576.91	3704.07

** Corrected JANBU FOS = 2.253 ** (Fo factor = 1.085)

Failure surface No. 7 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.12	3627.63
2	235.11	3624.62
3	242.23	3619.91
4	260.58	3607.76
5	278.92	3595.62
6	297.27	3583.48
7	300.50	3581.04
8	303.00	3578.98
9	504.51	3583.50
10	505.87	3585.15
11	507.40	3587.18
12	519.54	3605.52
13	531.69	3623.87
14	543.83	3642.21
15	555.97	3660.56
16	568.11	3678.90
17	580.26	3697.25
18	582.63	3700.83
19	585.38	3704.49

** Corrected JANBU FOS = 2.257 ** (Fo factor = 1.085)

Failure surface No. 8 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.45	3627.68
2	235.44	3624.67
3	243.04	3619.63
4	261.39	3607.49
5	279.73	3595.35
6	298.08	3583.21
7	300.94	3581.05
8	303.21	3579.18
9	492.56	3583.73
10	493.53	3584.90
11	495.06	3586.93
12	507.20	3605.28

13	519.34	3623.62
14	531.49	3641.97
15	543.63	3660.31
16	555.77	3678.66
17	567.91	3697.00
18	570.03	3700.20
19	572.79	3703.86

** Corrected JANBU FOS = 2.258 ** (Fo factor = 1.086)

Failure surface No. 9 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.62	3627.70
2	235.61	3624.69
3	243.46	3619.49
4	261.81	3607.35
5	280.15	3595.21
6	298.50	3583.07
7	301.17	3581.06
8	304.52	3578.29
9	500.60	3583.00
10	502.31	3585.08
11	503.84	3587.11
12	515.98	3605.45
13	528.12	3623.80
14	540.27	3642.14
15	552.41	3660.49
16	564.55	3678.83
17	576.69	3697.18
18	578.99	3700.65
19	581.75	3704.31

** Corrected JANBU FOS = 2.261 ** (Fo factor = 1.085)

Failure surface No.10 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	232.23	3627.79
2	236.22	3624.78
3	244.29	3619.44
4	262.64	3607.30
5	280.98	3595.16
6	299.33	3583.01
7	301.91	3581.07
8	305.23	3578.33
9	504.48	3584.46
10	505.04	3585.13

11	506.57	3587.16
12	518.71	3605.51
13	530.85	3623.85
14	543.00	3642.20
15	555.14	3660.54
16	567.28	3678.89
17	579.42	3697.23
18	581.78	3700.79
19	584.53	3704.45

** Corrected JANBU FOS = 2.262 ** (Fo factor = 1.085)

The following is a summary of the TEN most critical surfaces

Problem Description : SOUTHWEST EXPANSION SECTION A-2P

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.238	1.085	228.85	576.70	5.442E+05
2.	2.239	1.086	228.40	569.89	5.348E+05
3.	2.240	1.085	229.16	584.41	5.562E+05
4.	2.246	1.085	230.34	570.73	5.313E+05
5.	2.251	1.085	230.31	582.73	5.546E+05
6.	2.253	1.085	231.16	576.91	5.432E+05
7.	2.257	1.085	231.12	585.38	5.629E+05
8.	2.258	1.086	231.45	572.79	5.383E+05
9.	2.261	1.085	231.62	581.75	5.599E+05
10.	2.262	1.085	232.23	584.53	5.607E+05

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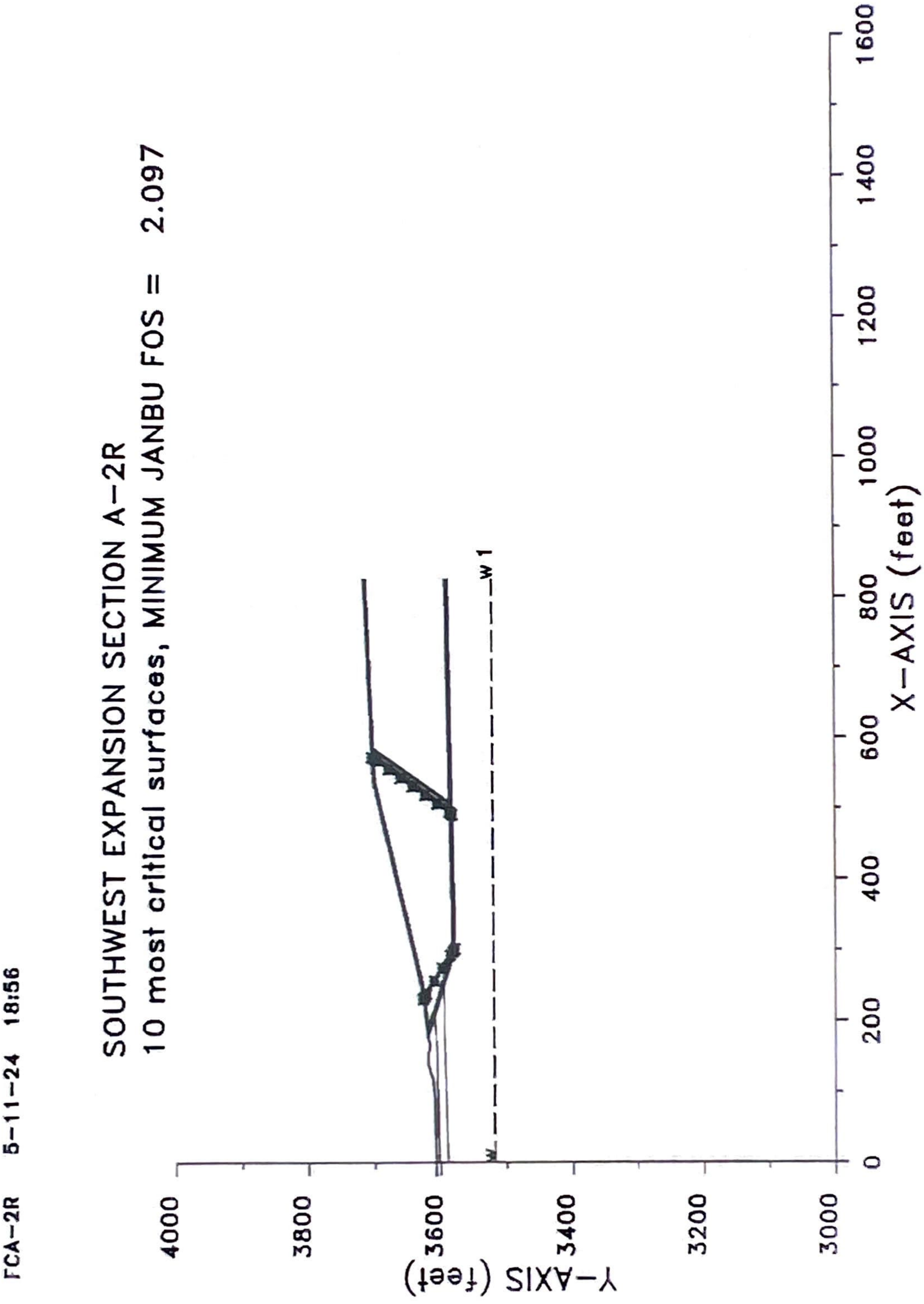
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SOUTHWEST EXPANSION SECTION A-2R
10 most critical surfaces, MINIMUM JANBU FOS = 2.097
Y-AXIS (feet)
4000
3800
3600
3400
3200
3000
X-AXIS (feet)
0
200
400
600
800
1000
1200
1400
1600
W1

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*                                        *
*        Slope Stability Analysis        *
*               using the                *
*            Method of Slices            *
*                                        *
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* Ver. 5.209                 96 - 2083   *
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Problem Description : SOUTHWEST EXPANSION SECTION A-2R

SEGMENT BOUNDARY COORDINATES

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11 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3607.6	93.9	3610.0	1
2	93.9	3610.0	114.9	3611.7	1
3	114.9	3611.7	137.6	3619.3	1
4	137.6	3619.3	152.6	3619.3	1
5	152.6	3619.3	161.6	3616.3	1
6	161.6	3616.3	164.6	3616.3	1
7	164.6	3616.3	173.6	3619.3	1
8	173.6	3619.3	173.9	3619.4	1
9	173.9	3619.4	247.6	3630.0	5
10	247.6	3630.0	535.6	3702.0	5
11	535.6	3702.0	823.4	3716.4	5

18 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	173.9	3619.4	183.4	3619.4	8

2	183.4	3619.4	189.7	3619.4	7
3	189.7	3619.4	198.4	3619.4	6
4	198.4	3619.4	248.3	3626.5	6
5	248.3	3626.5	536.1	3698.5	6
6	536.1	3698.5	823.4	3712.9	6
7	189.7	3619.4	298.7	3583.0	7
8	298.7	3583.0	823.3	3593.5	7
9	183.4	3619.4	298.4	3581.0	8
10	298.4	3581.0	823.4	3591.5	9
11	173.6	3619.3	204.4	3609.2	1
12	204.4	3609.2	248.4	3594.5	2
13	248.4	3594.5	298.0	3578.0	3
14	298.0	3578.0	823.4	3588.5	3
15	.0	3602.3	160.0	3606.0	2
16	160.0	3606.0	204.4	3609.2	2
17	.0	3589.3	181.6	3594.5	3
18	181.6	3594.5	248.4	3594.5	3

ISOTROPIC Soil Parameters

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9 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	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	122.5	127.0	1200.0	26.70	.000	.0	0
5	116.0	120.0	100.0	16.00	.000	.0	0
6	59.0	59.0	288.0	23.00	.000	.0	0
7	120.0	125.0	100.0	16.00	.000	.0	0
8	120.0	125.0	80.0	10.00	.000	.0	0
9	120.0	125.0	188.0	9.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3518.60
2	823.40	3522.00

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 22.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	298.8	3580.5	318.8	3580.9	5.0
2	488.8	3584.3	508.7	3584.7	5.0

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	228.49	3627.25
2	232.47	3624.25
3	235.78	3622.06
4	254.12	3609.92
5	272.47	3597.78
6	290.81	3585.63
7	295.82	3581.86
8	299.47	3578.74
9	488.98	3582.77
10	490.75	3584.85
11	492.28	3586.87
12	504.43	3605.22
13	516.57	3623.57
14	528.71	3641.91
15	540.85	3660.26
16	553.00	3678.60
17	565.14	3696.95
18	567.20	3700.06
19	569.96	3703.72

** Corrected JANBU FOS = 2.097 ** (Fo factor = 1.086)

Failure surface No. 2 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	228.90	3627.31
2	232.89	3624.31
3	236.80	3621.72
4	255.14	3609.58
5	273.49	3597.44
6	291.83	3585.29
7	296.84	3581.52
8	298.87	3579.78
9	495.76	3583.04
10	497.42	3584.98
11	498.95	3587.01
12	511.09	3605.35
13	523.23	3623.70
14	535.37	3642.04
15	547.52	3660.39
16	559.66	3678.74
17	571.80	3697.08
18	574.00	3700.40

19	576.76	3704.06

** Corrected JANBU FOS = 2.098 ** (Fo factor = 1.085)

Failure surface No. 3 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	229.20	3627.35
2	233.19	3624.35
3	237.52	3621.48
4	255.87	3609.34
5	274.22	3597.19
6	292.56	3585.05
7	297.57	3581.28
8	299.09	3579.98
9	503.71	3583.67
10	504.96	3585.13
11	506.49	3587.16
12	518.63	3605.50
13	530.77	3623.85
14	542.92	3642.20
15	555.06	3660.54
16	567.20	3678.89
17	579.34	3697.23
18	581.70	3700.79
19	584.45	3704.44

** Corrected JANBU FOS = 2.099 ** (Fo factor = 1.085)

Failure surface No. 4 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	230.32	3627.51
2	234.31	3624.51
3	240.27	3620.56
4	258.62	3608.42
5	276.97	3596.27
6	295.31	3584.13
7	299.44	3581.02
8	299.63	3580.86
9	501.23	3582.61
10	503.35	3585.10
11	504.88	3587.13
12	517.02	3605.47
13	529.16	3623.82
14	541.31	3642.16
15	553.45	3660.51
16	565.59	3678.85

17	577.73	3697.20
18	580.05	3700.70
19	582.81	3704.36

** Corrected JANBU FOS = 2.113 ** (Fo factor = 1.085)

Failure surface No. 5 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	230.40	3627.53
2	234.39	3624.52
3	240.48	3620.49
4	258.83	3608.35
5	277.17	3596.21
6	295.52	3584.06
7	299.55	3581.02
8	301.95	3578.98
9	491.33	3584.65
10	491.52	3584.86
11	493.05	3586.89
12	505.19	3605.24
13	517.33	3623.58
14	529.47	3641.93
15	541.62	3660.27
16	553.76	3678.62
17	565.90	3696.96
18	567.98	3700.10
19	570.73	3703.76

** Corrected JANBU FOS = 2.115 ** (Fo factor = 1.085)

Failure surface No. 6 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.18	3627.64
2	235.17	3624.63
3	242.39	3619.85
4	260.73	3607.71
5	279.08	3595.57
6	297.43	3583.43
7	300.59	3581.04
8	303.00	3578.98
9	504.51	3583.50
10	505.92	3585.15
11	507.45	3587.18
12	519.59	3605.52
13	531.74	3623.87
14	543.88	3642.21

15	556.02	3660.56
16	568.16	3678.91
17	580.31	3697.25
18	582.68	3700.83
19	585.44	3704.49

** Corrected JANBU FOS = 2.117 ** (Fo factor = 1.085)

Failure surface No. 7 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.20	3627.64
2	235.19	3624.64
3	242.45	3619.83
4	260.80	3607.69
5	279.14	3595.55
6	297.49	3583.40
7	300.62	3581.04
8	302.44	3579.49
9	497.06	3584.36
10	497.59	3584.98
11	499.12	3587.01
12	511.26	3605.36
13	523.41	3623.70
14	535.55	3642.05
15	547.69	3660.39
16	559.83	3678.74
17	571.98	3697.08
18	574.18	3700.41
19	576.93	3704.07

** Corrected JANBU FOS = 2.119 ** (Fo factor = 1.085)

Failure surface No. 8 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.70	3627.71
2	235.69	3624.71
3	243.67	3619.43
4	262.01	3607.29
5	280.36	3595.14
6	298.70	3583.00
7	301.28	3581.06
8	304.52	3578.29
9	500.60	3583.00
10	502.37	3585.08
11	503.90	3587.11
12	516.04	3605.45

13	528.19	3623.80
14	540.33	3642.14
15	552.47	3660.49
16	564.61	3678.83
17	576.76	3697.18
18	579.06	3700.65
19	581.81	3704.31

** Corrected JANBU FOS = 2.122 ** (Fo factor = 1.085)

Failure surface No. 9 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	232.33	3627.80
2	236.32	3624.80
3	244.41	3619.44
4	262.75	3607.30
5	281.10	3595.16
6	299.44	3583.01
7	302.02	3581.07
8	305.23	3578.33
9	504.48	3584.46
10	505.06	3585.13
11	506.59	3587.16
12	518.73	3605.51
13	530.87	3623.85
14	543.02	3642.20
15	555.16	3660.54
16	567.30	3678.89
17	579.44	3697.23
18	581.80	3700.79
19	584.56	3704.45

** Corrected JANBU FOS = 2.124 ** (Fo factor = 1.085)

Failure surface No.10 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.50	3627.69
2	235.50	3624.68
3	243.19	3619.59
4	261.53	3607.44
5	279.88	3595.30
6	298.22	3583.16
7	301.02	3581.05
8	303.21	3579.18
9	492.56	3583.73
10	493.57	3584.90

11	495.09	3586.93
12	507.24	3605.28
13	519.38	3623.62
14	531.52	3641.97
15	543.66	3660.31
16	555.81	3678.66
17	567.95	3697.00
18	570.07	3700.20
19	572.83	3703.86

** Corrected JANBU FOS = 2.125 ** (Fo factor = 1.086)

The following is a summary of the TEN most critical surfaces

Problem Description : SOUTHWEST EXPANSION SECTION A-2R

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.097	1.086	228.49	569.96	4.926E+05
2.	2.098	1.085	228.90	576.76	5.017E+05
3.	2.099	1.085	229.20	584.45	5.127E+05
4.	2.113	1.085	230.32	582.81	5.122E+05
5.	2.115	1.085	230.40	570.73	4.921E+05
6.	2.117	1.085	231.18	585.44	5.195E+05
7.	2.119	1.085	231.20	576.93	5.027E+05
8.	2.122	1.085	231.70	581.81	5.171E+05
9.	2.124	1.085	232.33	584.56	5.179E+05
10.	2.125	1.086	231.50	572.83	4.985E+05

* * * END OF FILE * * *

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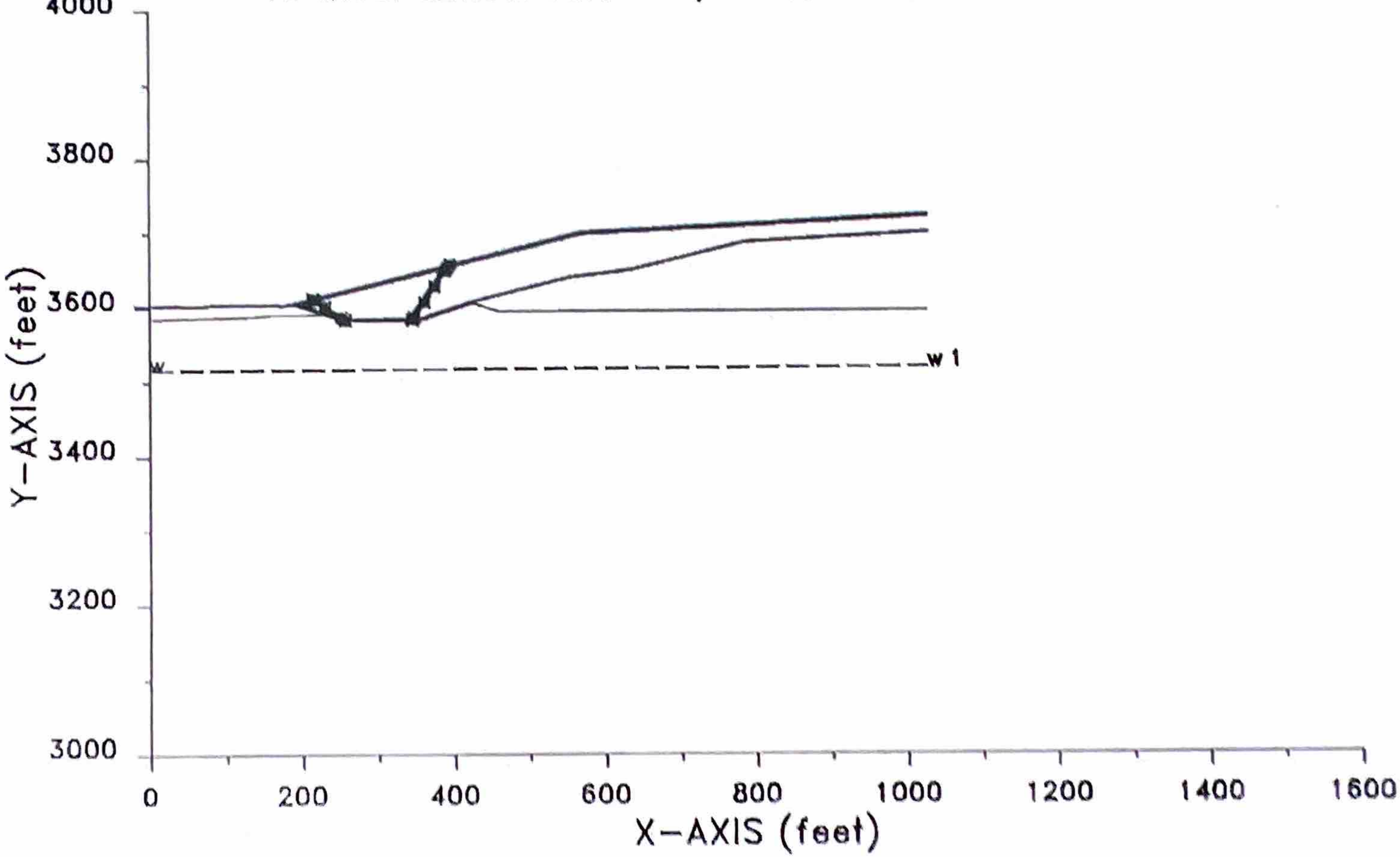
SOUTHWEST EXPANSION - SECTION B-2P
10 most critical surfaces, MINIMUM JANBU FOS = 2.670



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Problem Description : SOUTHWEST EXPANSION - SECTION B-2P

SEGMENT BOUNDARY COORDINATES

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9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3602.7	35.7	3603.6	1
2	35.7	3603.6	45.0	3602.4	1
3	45.0	3602.4	68.0	3602.2	1
4	68.0	3602.2	80.8	3604.4	1
5	80.8	3604.4	168.4	3604.5	1
6	168.4	3604.5	172.4	3602.6	1
7	172.4	3602.6	180.4	3604.6	1
8	180.4	3604.6	570.0	3702.0	4
9	570.0	3702.0	1026.7	3724.8	4

32 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	180.4	3604.6	188.4	3604.6	1
2	188.4	3604.6	194.8	3604.6	7
3	194.8	3604.6	194.9	3604.6	6

4	194.9	3604.6	570.5	3698.5	5
5	570.5	3698.5	1026.7	3721.3	5
6	194.9	3604.6	201.1	3604.6	6
7	201.1	3604.6	257.5	3585.8	6
8	257.5	3585.8	355.6	3587.2	6
9	355.6	3587.2	413.2	3606.4	6
10	413.2	3606.4	419.0	3608.3	9
11	419.0	3608.3	553.6	3642.0	9
12	553.6	3642.0	634.8	3652.0	9
13	634.8	3652.0	782.8	3689.0	9
14	782.8	3689.0	1026.7	3701.9	9
15	413.2	3606.4	419.5	3606.4	6
16	194.9	3604.6	257.2	3583.8	7
17	257.2	3583.8	356.0	3585.2	8
18	356.0	3585.2	419.5	3606.4	7
19	419.5	3606.4	553.9	3640.0	5
20	553.9	3640.0	635.1	3650.0	5
21	635.1	3650.0	783.1	3687.0	5
22	783.1	3687.0	1026.7	3699.9	5
23	419.5	3606.4	425.8	3606.4	7
24	188.4	3604.6	231.7	3590.2	1
25	231.7	3590.2	256.9	3581.8	2
26	256.9	3581.8	356.3	3583.2	2
27	356.3	3583.2	425.8	3606.4	2
28	425.8	3606.4	459.4	3595.2	2
29	459.4	3595.2	1026.7	3596.2	2
30	.0	3585.1	133.8	3588.2	2
31	133.8	3588.2	157.3	3590.2	2
32	157.3	3590.2	231.7	3590.2	2

ISOTROPIC Soil Parameters
----

9 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	121.9	121.9	100.0	26.00	.000	.0	0
2	122.5	127.0	1200.0	26.70	.000	.0	1
3	122.5	127.0	1200.0	26.70	.000	.0	0
4	116.0	120.0	100.0	16.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0

6	120.0	125.0	100.0	16.00	.000	.0	0
7	120.0	125.0	200.0	15.00	.000	.0	0
8	120.0	125.0	188.0	11.00	.000	.0	0
9	120.0	125.0	100.0	18.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3516.00
2	1026.70	3520.00

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 25.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)

1	257.5	3583.8	267.5	3584.0	4.0
2	337.5	3584.6	347.5	3585.1	4.0

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED JANBU METHOD   * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.16	3613.04
2	217.77	3610.32
3	231.25	3601.40
4	252.10	3587.60
5	257.09	3583.84
6	257.64	3583.38
7	344.99	3584.23
8	345.67	3585.05
9	347.20	3587.08
10	361.00	3607.93
11	374.80	3628.77
12	388.59	3649.62
13	391.29	3653.70
14	394.66	3658.16

** Corrected JANBU FOS = 2.670 ** (Fo factor = 1.088)

Failure surface No. 2 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.78	3613.20
2	218.39	3610.47
3	232.96	3600.83
4	253.81	3587.03
5	258.08	3583.81
6	259.60	3582.56
7	345.39	3584.10
8	346.19	3585.06
9	347.71	3587.09
10	361.51	3607.93
11	375.31	3628.78

12	389.11	3649.63
13	391.90	3653.85
14	395.27	3658.32

** Corrected JANBU FOS = 2.680 ** (Fo factor = 1.088)

Failure surface No. 3 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.08	3613.27
2	218.69	3610.55
3	233.80	3600.55
4	254.65	3586.75
5	258.54	3583.82
6	260.72	3582.02
7	345.38	3584.87
8	345.53	3585.05
9	347.06	3587.08
10	360.86	3607.93
11	374.66	3628.77
12	388.46	3649.62
13	391.13	3653.66
14	394.49	3658.12

** Corrected JANBU FOS = 2.691 ** (Fo factor = 1.088)

Failure surface No. 4 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.14	3613.28
2	218.75	3610.56
3	233.95	3600.50
4	254.80	3586.70
5	258.62	3583.82
6	260.65	3582.14
7	344.37	3583.22
8	345.88	3585.06
9	347.41	3587.08
10	361.21	3607.93
11	375.01	3628.78
12	388.81	3649.62
13	391.54	3653.76
14	394.91	3658.23

** Corrected JANBU FOS = 2.696 ** (Fo factor = 1.089)

Failure surface No. 5 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.83	3613.21
2	218.44	3610.49
3	233.11	3600.78
4	253.96	3586.98
5	258.16	3583.81
6	260.36	3582.00
7	343.43	3583.67
8	344.56	3585.04
9	346.08	3587.06
10	359.88	3607.91
11	373.68	3628.76
12	387.48	3649.61
13	389.97	3653.37
14	393.34	3657.83

** Corrected JANBU FOS = 2.700 ** (Fo factor = 1.089)

Failure surface No. 6 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	213.98	3613.00
2	217.59	3610.27
3	230.75	3601.57
4	251.60	3587.77
5	256.60	3584.00
6	257.54	3583.23
7	341.00	3583.65
8	342.11	3585.00
9	343.64	3587.03
10	357.43	3607.88
11	371.23	3628.72
12	385.03	3649.57
13	387.06	3652.64
14	390.43	3657.11

** Corrected JANBU FOS = 2.705 ** (Fo factor = 1.089)

Failure surface No. 7 specified by 13 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.90	3613.23
2	218.52	3610.50
3	233.31	3600.71
4	254.15	3586.92

5	257.92	3584.08
6	343.75	3583.36
7	345.13	3585.05
8	346.66	3587.07
9	360.46	3607.92
10	374.26	3628.77
11	388.05	3649.61
12	390.65	3653.54
13	394.02	3658.00

** Corrected JANBU FOS = 2.718 ** (Fo factor = 1.089)

Failure surface No. 8 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.92	3613.23
2	218.53	3610.51
3	233.36	3600.70
4	254.20	3586.90
5	258.30	3583.82
6	259.32	3582.97
7	341.65	3584.72
8	341.88	3585.00
9	343.41	3587.03
10	357.20	3607.87
11	371.00	3628.72
12	384.80	3649.57
13	386.79	3652.57
14	390.16	3657.04

** Corrected JANBU FOS = 2.725 ** (Fo factor = 1.088)

Failure surface No. 9 specified by 13 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.67	3613.42
2	219.28	3610.70
3	235.44	3600.00
4	256.29	3586.20
5	259.30	3583.94
6	343.72	3583.07
7	345.35	3585.05
8	346.88	3587.08
9	360.68	3607.92
10	374.47	3628.77
11	388.27	3649.62
12	390.91	3653.60
13	394.28	3658.07

** Corrected JANBU FOS = 2.725 ** (Fo factor = 1.089)

Failure surface No.10 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	213.55	3612.89
2	217.16	3610.17
3	229.55	3601.97
4	250.40	3588.17
5	255.39	3584.40
6	257.84	3582.39
7	337.59	3583.38
8	338.89	3584.96
9	340.42	3586.98
10	354.22	3607.83
11	368.02	3628.68
12	381.81	3649.52
13	383.24	3651.69
14	386.61	3656.15

** Corrected JANBU FOS = 2.735 ** (Fo factor = 1.089)

The following is a summary of the TEN most critical surfaces

Problem Description : SOUTHWEST EXPANSION - SECTION B-2P

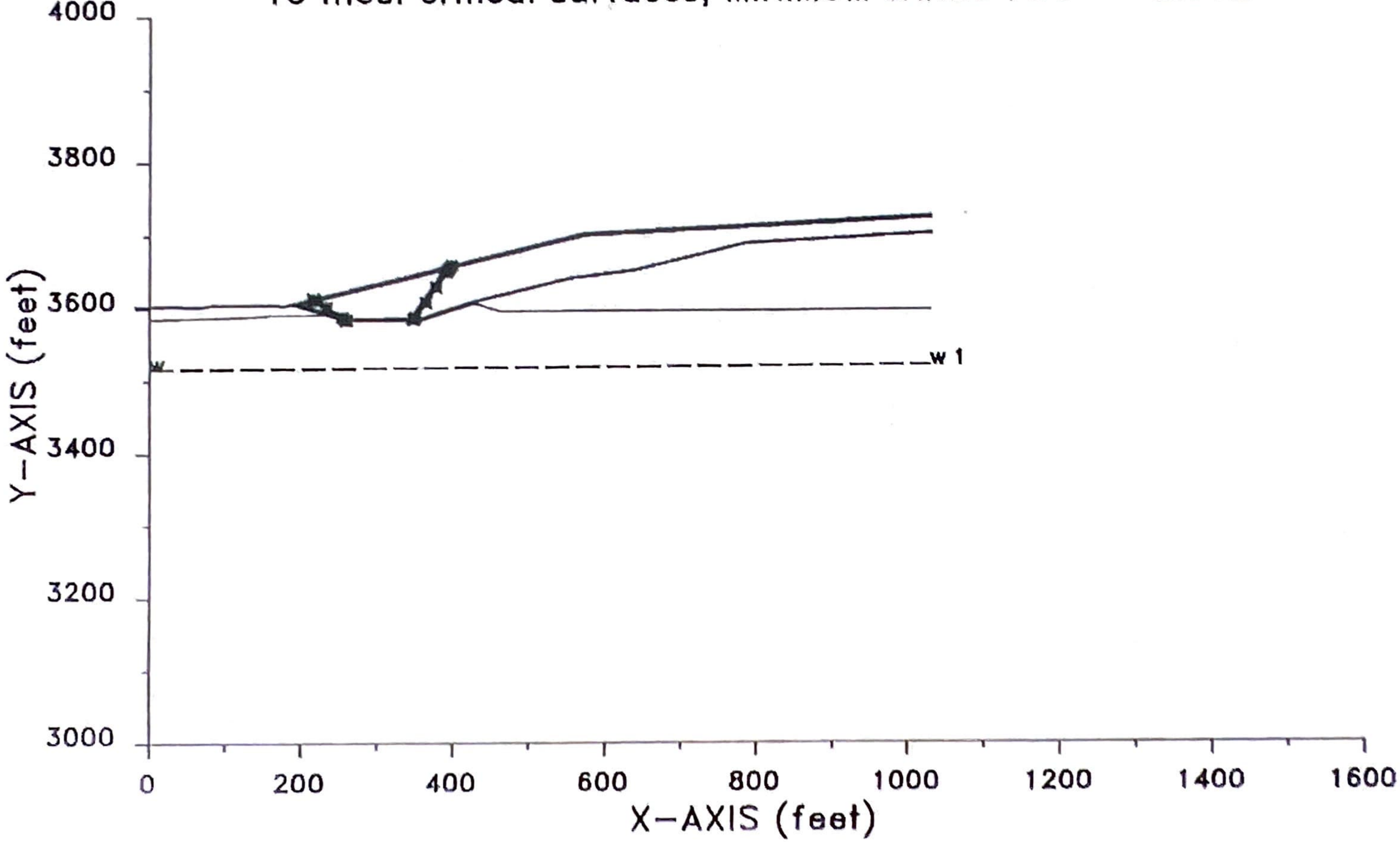
	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.670	1.088	214.16	394.66	1.985E+05
2.	2.680	1.088	214.78	395.27	2.009E+05
3.	2.691	1.088	215.08	394.49	1.999E+05
4.	2.696	1.089	215.14	394.91	2.025E+05
5.	2.700	1.089	214.83	393.34	1.999E+05
6.	2.705	1.089	213.98	390.43	1.943E+05
7.	2.718	1.089	214.90	394.02	2.006E+05

1.934E+05	8.	2.725	1.088	214.92	390.16
2.008E+05	9.	2.725	1.089	215.67	394.28
1.911E+05	10.	2.735	1.089	213.55	386.61

* * * END OF FILE * * *

FCB-2R 5-11-24 21:50

SOUTHWEST EXPANSION - SECTION B-2R
10 most critical surfaces, MINIMUM JANBU FOS = 2.552



XSTABL File: FCB-2R   5-11-24   21:50

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******************************************
*              X S T A B L               *
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*               using the                *
*           Method of Slices             *
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```

Problem Description : SOUTHWEST EXPANSION - SECTION B-2R

SEGMENT BOUNDARY COORDINATES

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3602.7	35.7	3603.6	1
2	35.7	3603.6	45.0	3602.4	1
3	45.0	3602.4	68.0	3602.2	1
4	68.0	3602.2	80.8	3604.4	1
5	80.8	3604.4	168.4	3604.5	1
6	168.4	3604.5	172.4	3602.6	1
7	172.4	3602.6	180.4	3604.6	1
8	180.4	3604.6	570.0	3702.0	4
9	570.0	3702.0	1026.7	3724.8	4

32 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	180.4	3604.6	188.4	3604.6	1
2	188.4	3604.6	194.8	3604.6	7
3	194.8	3604.6	194.9	3604.6	6

4	194.9	3604.6	570.5	3698.5	5
5	570.5	3698.5	1026.7	3721.3	5
6	194.9	3604.6	201.1	3604.6	6
7	201.1	3604.6	257.5	3585.8	6
8	257.5	3585.8	355.6	3587.2	6
9	355.6	3587.2	413.2	3606.4	6
10	413.2	3606.4	419.0	3608.3	9
11	419.0	3608.3	553.6	3642.0	9
12	553.6	3642.0	634.8	3652.0	9
13	634.8	3652.0	782.8	3689.0	9
14	782.8	3689.0	1026.7	3701.9	9
15	413.2	3606.4	419.5	3606.4	6
16	194.9	3604.6	257.2	3583.8	7
17	257.2	3583.8	356.0	3585.2	8
18	356.0	3585.2	419.5	3606.4	7
19	419.5	3606.4	553.9	3640.0	5
20	553.9	3640.0	635.1	3650.0	5
21	635.1	3650.0	783.1	3687.0	5
22	783.1	3687.0	1026.7	3699.9	5
23	419.5	3606.4	425.8	3606.4	7
24	188.4	3604.6	231.7	3590.2	1
25	231.7	3590.2	256.9	3581.8	2
26	256.9	3581.8	356.3	3583.2	2
27	356.3	3583.2	425.8	3606.4	2
28	425.8	3606.4	459.4	3595.2	2
29	459.4	3595.2	1026.7	3596.2	2
30	.0	3585.1	133.8	3588.2	2
31	133.8	3588.2	157.3	3590.2	2
32	157.3	3590.2	231.7	3590.2	2

ISOTROPIC Soil Parameters
----

9 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	121.9	121.9	100.0	26.00	.000	.0	0
2	122.5	127.0	1200.0	26.70	.000	.0	1
3	122.5	127.0	1200.0	26.70	.000	.0	0
4	116.0	120.0	100.0	16.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0

6	120.0	125.0	100.0	16.00	.000	.0	0
7	120.0	125.0	80.0	10.00	.000	.0	0
8	120.0	125.0	188.0	9.00	.000	.0	0
9	120.0	125.0	80.0	10.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3516.00
2	1026.70	3520.00

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 25.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)

1	257.5	3583.8	267.5	3584.0	4.0
2	337.5	3584.6	347.5	3585.1	4.0

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.17	3613.04
2	217.79	3610.32
3	231.28	3601.39
4	252.13	3587.59
5	257.12	3583.83
6	257.64	3583.38
7	344.99	3584.23
8	345.70	3585.05
9	347.22	3587.08
10	361.02	3607.93
11	374.82	3628.77
12	388.62	3649.62
13	391.32	3653.71
14	394.69	3658.17

** Corrected JANBU FOS = 2.552 ** (Fo factor = 1.088)

Failure surface No. 2 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.81	3613.20
2	218.43	3610.48
3	233.06	3600.80
4	253.91	3587.00
5	258.13	3583.81
6	259.60	3582.56
7	345.39	3584.10
8	346.22	3585.06
9	347.74	3587.09
10	361.54	3607.94
11	375.34	3628.78

12	389.14	3649.63
13	391.94	3653.86
14	395.30	3658.33

** Corrected JANBU FOS = 2.562 ** (Fo factor = 1.088)

Failure surface No. 3 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.13	3613.28
2	218.74	3610.56
3	233.94	3600.50
4	254.79	3586.70
5	258.61	3583.82
6	260.72	3582.02
7	345.38	3584.87
8	345.54	3585.05
9	347.07	3587.08
10	360.86	3607.93
11	374.66	3628.77
12	388.46	3649.62
13	391.13	3653.66
14	394.50	3658.13

** Corrected JANBU FOS = 2.575 ** (Fo factor = 1.088)

Failure surface No. 4 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.18	3613.30
2	218.79	3610.57
3	234.08	3600.46
4	254.93	3586.66
5	258.69	3583.82
6	260.65	3582.14
7	344.37	3583.22
8	345.94	3585.06
9	347.47	3587.08
10	361.26	3607.93
11	375.06	3628.78
12	388.86	3649.63
13	391.61	3653.78
14	394.98	3658.24

** Corrected JANBU FOS = 2.576 ** (Fo factor = 1.089)

Failure surface No. 5 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.88	3613.22
2	218.49	3610.50
3	233.25	3600.73
4	254.09	3586.94
5	258.24	3583.81
6	260.36	3582.00
7	343.43	3583.67
8	344.60	3585.04
9	346.13	3587.06
10	359.92	3607.91
11	373.72	3628.76
12	387.52	3649.61
13	390.02	3653.38
14	393.38	3657.85

** Corrected JANBU FOS = 2.580 ** (Fo factor = 1.089)

Failure surface No. 6 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.00	3613.00
2	217.61	3610.28
3	230.81	3601.55
4	251.65	3587.75
5	256.65	3583.98
6	257.54	3583.23
7	341.00	3583.65
8	342.15	3585.00
9	343.68	3587.03
10	357.48	3607.88
11	371.27	3628.72
12	385.07	3649.57
13	387.11	3652.65
14	390.48	3657.12

** Corrected JANBU FOS = 2.584 ** (Fo factor = 1.089)

Failure surface No. 7 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	213.60	3612.90
2	217.21	3610.18
3	229.69	3601.92
4	250.54	3588.12

5	255.53	3584.36
6	257.84	3582.39
7	337.59	3583.38
8	338.94	3584.96
9	340.47	3586.98
10	354.26	3607.83
11	368.06	3628.68
12	381.86	3649.53
13	383.30	3651.70
14	386.67	3656.17

** Corrected JANBU FOS = 2.604 ** (Fo factor = 1.089)

Failure surface No. 8 specified by 13 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.67	3613.42
2	219.28	3610.70
3	235.44	3600.00
4	256.29	3586.20
5	259.30	3583.94
6	343.72	3583.07
7	345.41	3585.05
8	346.94	3587.08
9	360.74	3607.92
10	374.53	3628.77
11	388.33	3649.62
12	390.98	3653.62
13	394.35	3658.09

** Corrected JANBU FOS = 2.611 ** (Fo factor = 1.089)

Failure surface No. 9 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.94	3613.24
2	218.56	3610.51
3	233.42	3600.68
4	254.27	3586.88
5	258.33	3583.82
6	259.32	3582.97
7	341.65	3584.72
8	341.89	3585.00
9	343.41	3587.03
10	357.21	3607.87
11	371.01	3628.72
12	384.81	3649.57
13	386.80	3652.58

14	390.17	3657.04

** Corrected JANBU FOS = 2.611 ** (Fo factor = 1.088)

Failure surface No.10 specified by 13 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.90	3613.23
2	218.52	3610.50
3	233.31	3600.71
4	254.15	3586.92
5	257.92	3584.08
6	343.75	3583.36
7	345.18	3585.05
8	346.71	3587.07
9	360.51	3607.92
10	374.31	3628.77
11	388.10	3649.61
12	390.71	3653.55
13	394.08	3658.02

** Corrected JANBU FOS = 2.613 ** (Fo factor = 1.089)

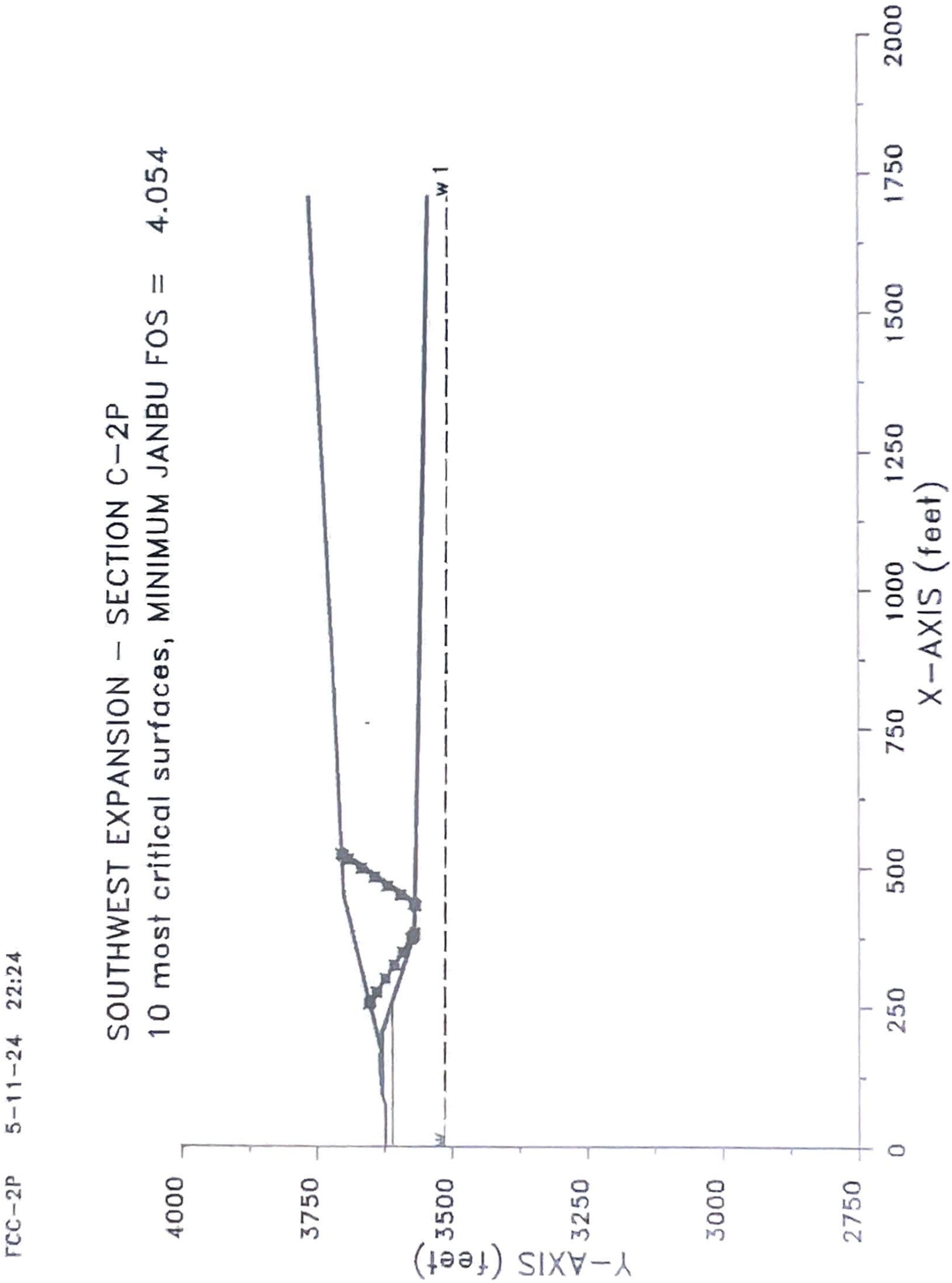
The following is a summary of the TEN most critical surfaces

Problem Description : SOUTHWEST EXPANSION - SECTION B-2R

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.552	1.088	214.17	394.69	1.873E+05
2.	2.562	1.088	214.81	395.30	1.896E+05
3.	2.575	1.088	215.13	394.50	1.887E+05
4.	2.576	1.089	215.18	394.98	1.910E+05
5.	2.580	1.089	214.88	393.38	1.886E+05
6.	2.584	1.089	214.00	390.48	1.832E+05
7.	2.604	1.089	213.60	386.67	1.796E+05

	8.	2.611	1.089	215.67	394.35
1.902E+05					
	9.	2.611	1.088	214.94	390.17
1.829E+05					
	10.	2.613	1.089	214.90	394.08
1.908E+05					

* * * END OF FILE * * *


FCC-2P 5-11-24 22:24
SOUTHWEST EXPANSION - SECTION C-2P
10 most critical surfaces, MINIMUM JANBU FOS = 4.054
Y-AXIS (feet)
4000
3750
3500
3250
3000
2750
X-AXIS (feet)
0
250
500
750
1000
1250
1500
1750
2000
W1

XSTABL File: FCC-2P   5-11-24   22:24

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******************************************
*              X S T A B L               *
*                                        *
*        Slope Stability Analysis        *
*               using the                *
*            Method of Slices            *
*                                        *
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```

Problem Description : SOUTHWEST EXPANSION - SECTION C-2P

SEGMENT BOUNDARY COORDINATES

----

11 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3622.9	73.9	3623.0	2
2	73.9	3623.0	74.8	3623.3	2
3	74.8	3623.3	88.3	3627.8	2
4	88.3	3627.8	96.8	3630.7	1
5	96.8	3630.7	105.2	3631.0	1
6	105.2	3631.0	136.0	3634.0	1
7	136.0	3634.0	166.0	3634.0	1
8	166.0	3634.0	170.0	3632.0	1
9	170.0	3632.0	178.4	3634.1	1
10	178.4	3634.1	450.0	3702.0	4
11	450.0	3702.0	1710.0	3765.0	4

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	178.3	3634.1	181.0	3634.1	1

2	181.0	3634.1	190.5	3634.1	7
3	190.5	3634.1	192.9	3634.1	6
4	192.9	3634.1	450.5	3698.5	5
5	450.5	3698.5	1710.0	3761.5	5
6	192.7	3634.1	196.9	3634.1	6
7	196.9	3634.1	382.2	3572.3	6
8	382.2	3572.3	1710.0	3545.7	6
9	190.5	3634.1	381.9	3570.3	7
10	381.9	3570.3	1710.0	3543.7	8
11	181.0	3634.1	199.8	3627.8	1
12	199.8	3627.8	253.3	3610.0	2
13	253.3	3610.0	381.4	3567.3	3
14	381.4	3567.3	1710.0	3540.7	3
15	88.3	3627.8	199.8	3627.8	2
16	.0	3610.0	253.3	3610.0	3

ISOTROPIC Soil Parameters
----

8 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	116.0	120.0	100.0	16.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0
6	120.0	125.0	100.0	16.00	.000	.0	0
7	120.0	125.0	200.0	15.00	.000	.0	0
8	120.0	125.0	188.0	11.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3514.00
2	1710.00	3506.60

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 29.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	382.2	3569.8	392.2	3569.6	5.0
2	432.2	3568.8	442.2	3568.6	5.0

****
** Factor of safety calculation for surface # 2 **
** failed to converge within FIFTY iterations **
** **
** The last calculated value of the FOS was 4.3652 **
** This will be ignored for final summary of results **
****

The trial failure surface in question is defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.95	3655.74
2	268.56	3653.02
3	269.85	3652.16
4	294.04	3636.15
5	318.22	3620.15
6	342.40	3604.14
7	366.58	3588.13
8	390.77	3572.13
9	391.64	3571.47
10	441.60	3568.04
11	442.47	3569.09
12	443.96	3571.06
13	459.96	3595.25
14	475.97	3619.43
15	491.97	3643.61
16	507.98	3667.79
17	523.99	3691.98
18	530.97	3702.53
19	533.73	3706.19

```
***************************************************************
**     Factor of safety calculation for surface #    18      **
**     failed to converge within FIFTY iterations            **
**                                                           **
**    The last calculated value of the FOS was   4.1952      **
**    This will be ignored for final summary of results      **
***************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.63	3655.66
2	268.24	3652.94
3	269.40	3652.17
4	293.58	3636.16
5	317.77	3620.16
6	341.95	3604.15
7	366.13	3588.14
8	390.31	3572.14
9	391.40	3571.32
10	432.32	3566.32
11	434.73	3569.24
12	436.22	3571.22
13	452.22	3595.40
14	468.23	3619.58
15	484.24	3643.77
16	500.24	3667.95

17	516.25	3692.13
18	522.86	3702.12
19	525.62	3705.78

```
***************************************************************
**      Factor of safety calculation for surface #    23     **
**      failed to converge within FIFTY iterations           **
**                                                           **
**    The last calculated value of the FOS was   4.2559      **
**    This will be ignored for final summary of results      **
***************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.31	3655.58
2	267.93	3652.86
3	268.95	3652.18
4	293.14	3636.17
5	317.32	3620.16
6	341.50	3604.16
7	365.68	3588.15
8	389.87	3572.15
9	390.22	3571.88
10	432.90	3568.29
11	433.70	3569.26
12	435.19	3571.24
13	451.19	3595.42
14	467.20	3619.60
15	483.21	3643.79
16	499.21	3667.97
17	515.22	3692.15
18	521.78	3702.07
19	524.54	3705.73

```
***************************************************************
**      Factor of safety calculation for surface #    32     **
**      failed to converge within FIFTY iterations           **
**                                                           **
**    The last calculated value of the FOS was   4.3826      **
**    This will be ignored for final summary of results      **
***************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	265.21	3655.80
2	268.82	3653.08
3	270.22	3652.15
4	294.41	3636.15
5	318.59	3620.14
6	342.77	3604.13
7	366.95	3588.13
8	391.14	3572.12
9	391.75	3571.66
10	435.60	3568.63
11	436.08	3569.21
12	437.57	3571.19
13	453.58	3595.37
14	469.58	3619.56
15	485.59	3643.74
16	501.59	3667.92
17	517.60	3692.10
18	524.28	3702.19
19	527.04	3705.85

```
**********************************************************
**     Factor of safety calculation for surface #    67  **
**     failed to converge within FIFTY iterations        **
**                                                       **
**    The last calculated value of the FOS was   4.1642  **
**    This will be ignored for final summary of results  **
**********************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	265.84	3655.96
2	269.45	3653.24
3	271.12	3652.13
4	295.30	3636.13
5	319.48	3620.12
6	343.67	3604.12
7	367.85	3588.11
8	392.03	3572.10
9	392.15	3572.02
10	440.54	3568.38
11	441.14	3569.11
12	442.63	3571.09
13	458.63	3595.27
14	474.64	3619.45
15	490.65	3643.64
16	506.65	3667.82
17	522.66	3692.00
18	529.58	3702.46
19	532.34	3706.12

```
****************************************************************
**     Factor of safety calculation for surface #    69       **
**     failed to converge within FIFTY iterations             **
**                                                            **
**    The last calculated value of the FOS was   4.0423       **
**    This will be ignored for final summary of results       **
****************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.50	3655.62
2	268.11	3652.90
3	269.21	3652.17
4	293.39	3636.17
5	317.58	3620.16
6	341.76	3604.15
7	365.94	3588.15
8	390.13	3572.14
9	391.64	3571.00
10	432.51	3567.65
11	433.83	3569.26
12	435.32	3571.24
13	451.33	3595.42
14	467.34	3619.60
15	483.34	3643.78
16	499.35	3667.97
17	515.35	3692.15
18	521.92	3702.07
19	524.68	3705.73

```
****************************************************************
**     Factor of safety calculation for surface #    85       **
**     failed to converge within FIFTY iterations             **
**                                                            **
**    The last calculated value of the FOS was   4.0327       **
**    This will be ignored for final summary of results       **
****************************************************************
```

The trial failure surface in question is
defined by the following 20 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	263.31	3655.33
2	266.92	3652.61
3	267.53	3652.21

4	291.71	3636.20
5	315.89	3620.19
6	340.08	3604.19
7	364.26	3588.18
8	388.44	3572.18
9	391.18	3570.11
10	391.55	3569.81
11	432.27	3567.50
12	433.72	3569.26
13	435.21	3571.24
14	451.22	3595.42
15	467.22	3619.60
16	483.23	3643.79
17	499.24	3667.97
18	515.24	3692.15
19	521.80	3702.07
20	524.56	3705.73

```
****************************************************************
**      Factor of safety calculation for surface #     86      **
**      failed to converge within FIFTY iterations             **
**                                                             **
**    The last calculated value of the FOS was      4.1656     **
**    This will be ignored for final summary of results        **
****************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.71	3655.68
2	268.33	3652.96
3	269.52	3652.17
4	293.71	3636.16
5	317.89	3620.15
6	342.07	3604.15
7	366.25	3588.14
8	390.44	3572.14
9	391.94	3571.00
10	432.79	3566.53
11	435.02	3569.24
12	436.51	3571.21
13	452.51	3595.39
14	468.52	3619.58
15	484.53	3643.76
16	500.53	3667.94
17	516.54	3692.13
18	523.16	3702.13
19	525.92	3705.80

```
*************************************************************
**     Factor of safety calculation for surface #    92     **
**     failed to converge within FIFTY iterations           **
**                                                          **
**    The last calculated value of the FOS was   4.1527     **
**    This will be ignored for final summary of results     **
*************************************************************
```

The trial failure surface in question is
defined by the following 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	265.73	3655.93
2	269.34	3653.21
3	270.96	3652.14
4	295.14	3636.13
5	319.32	3620.12
6	343.51	3604.12
7	367.69	3588.11
8	391.87	3572.11
9	391.96	3572.04
10	433.59	3569.61
11	434.82	3571.25
12	450.83	3595.43
13	466.83	3619.61
14	482.84	3643.79
15	498.85	3667.98
16	514.85	3692.16
17	521.40	3702.05
18	524.16	3705.71

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED JANBU METHOD   * * * * *

The 10 most critical of all the failure surfaces examined
are displayed below - the most critical first

Failure surface No. 1 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	255.72	3653.43
2	259.33	3650.71
3	276.60	3639.28
4	300.78	3623.28
5	324.96	3607.27

6	349.14	3591.27
7	373.33	3575.26
8	378.33	3571.49
9	382.54	3568.02
10	432.29	3567.27
11	433.93	3569.26
12	435.42	3571.23
13	451.43	3595.42
14	467.43	3619.60
15	483.44	3643.78
16	499.45	3667.96
17	515.45	3692.15
18	522.03	3702.08
19	524.78	3705.74

** Corrected JANBU FOS = 4.054 ** (Fo factor = 1.085)

Failure surface No. 2 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	255.44	3653.36
2	259.05	3650.64
3	275.80	3639.55
4	299.98	3623.54
5	324.16	3607.54
6	348.35	3591.53
7	372.53	3575.53
8	377.53	3571.76
9	382.41	3567.73
10	435.69	3569.78
11	436.77	3571.21
12	452.77	3595.39
13	468.78	3619.57
14	484.78	3643.75
15	500.79	3667.94
16	516.80	3692.12
17	523.43	3702.15
18	526.19	3705.81

** Corrected JANBU FOS = 4.060 ** (Fo factor = 1.086)

Failure surface No. 3 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.32	3653.58
2	259.93	3650.86
3	278.25	3638.73
4	302.43	3622.73

5	326.62	3606.72
6	350.80	3590.71
7	374.98	3574.71
8	379.98	3570.94
9	382.24	3569.08
10	435.70	3567.33
11	437.23	3569.19
12	438.72	3571.17
13	454.73	3595.35
14	470.73	3619.53
15	486.74	3643.72
16	502.75	3667.90
17	518.75	3692.08
18	525.48	3702.25
19	528.24	3705.91

** Corrected JANBU FOS = 4.067 ** (Fo factor = 1.086)

Failure surface No. 4 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.59	3653.65
2	260.20	3650.93
3	279.00	3638.48
4	303.19	3622.47
5	327.37	3606.47
6	351.55	3590.46
7	375.73	3574.46
8	380.73	3570.69
9	383.77	3568.18
10	433.47	3569.07
11	433.63	3569.26
12	435.12	3571.24
13	451.13	3595.42
14	467.13	3619.60
15	483.14	3643.79
16	499.15	3667.97
17	515.15	3692.15
18	521.71	3702.06
19	524.47	3705.72

** Corrected JANBU FOS = 4.069 ** (Fo factor = 1.086)

Failure surface No. 5 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.52	3653.63
2	260.13	3650.91

3	278.82	3638.54
4	303.00	3622.54
5	327.18	3606.53
6	351.37	3590.52
7	375.55	3574.52
8	380.55	3570.75
9	382.34	3569.27
10	439.69	3567.72
11	440.85	3569.12
12	442.34	3571.10
13	458.34	3595.28
14	474.35	3619.46
15	490.35	3643.64
16	506.36	3667.83
17	522.37	3692.01
18	529.27	3702.44
19	532.03	3706.10

** Corrected JANBU FOS = 4.073 ** (Fo factor = 1.086)

Failure surface No. 6 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	257.11	3653.78
2	260.72	3651.06
3	280.45	3638.00
4	304.63	3621.99
5	328.82	3605.99
6	353.00	3589.98
7	377.18	3573.97
8	382.06	3570.30
9	384.02	3568.68
10	436.35	3568.61
11	436.84	3569.20
12	438.33	3571.18
13	454.33	3595.36
14	470.34	3619.54
15	486.34	3643.72
16	502.35	3667.91
17	518.36	3692.09
18	525.07	3702.23
19	527.83	3705.89

** Corrected JANBU FOS = 4.085 ** (Fo factor = 1.086)

Failure surface No. 7 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	256.00	3653.50
2	259.61	3650.78
3	277.37	3639.03
4	301.55	3623.02
5	325.73	3607.01
6	349.92	3591.01
7	374.10	3575.00
8	379.10	3571.23
9	383.03	3568.00
10	439.52	3569.92
11	440.43	3571.13
12	456.44	3595.32
13	472.45	3619.50
14	488.45	3643.68
15	504.46	3667.86
16	520.47	3692.05
17	527.28	3702.34
18	530.04	3706.00

** Corrected JANBU FOS = 4.087 ** (Fo factor = 1.087)

Failure surface No. 8 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.89	3653.72
2	260.50	3651.00
3	279.83	3638.20
4	304.01	3622.20
5	328.20	3606.19
6	352.38	3590.19
7	376.56	3574.18
8	381.56	3570.41
9	384.30	3568.16
10	440.09	3567.52
11	441.40	3569.11
12	442.89	3571.08
13	458.90	3595.27
14	474.90	3619.45
15	490.91	3643.63
16	506.92	3667.81
17	522.92	3692.00
18	529.85	3702.47
19	532.61	3706.13

** Corrected JANBU FOS = 4.088 ** (Fo factor = 1.086)

Failure surface No. 9 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	256.81	3653.70
2	260.42	3650.98
3	279.61	3638.28
4	303.80	3622.27
5	327.98	3606.27
6	352.16	3590.26
7	376.34	3574.25
8	381.34	3570.49
9	385.06	3567.42
10	438.13	3567.15
11	439.77	3569.14
12	441.26	3571.12
13	457.27	3595.30
14	473.27	3619.48
15	489.28	3643.66
16	505.29	3667.85
17	521.29	3692.03
18	528.15	3702.38
19	530.90	3706.05

** Corrected JANBU FOS = 4.088 ** (Fo factor = 1.086)

Failure surface No.10 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	257.10	3653.77
2	260.71	3651.05
3	280.41	3638.01
4	304.60	3622.00
5	328.78	3606.00
6	352.96	3589.99
7	377.14	3573.99
8	382.04	3570.30
9	384.41	3568.35
10	434.09	3568.11
11	435.02	3569.24
12	436.51	3571.21
13	452.51	3595.39
14	468.52	3619.58
15	484.52	3643.76
16	500.53	3667.94
17	516.54	3692.13
18	523.16	3702.13
19	525.92	3705.80

** Corrected JANBU FOS = 4.088 ** (Fo factor = 1.086)

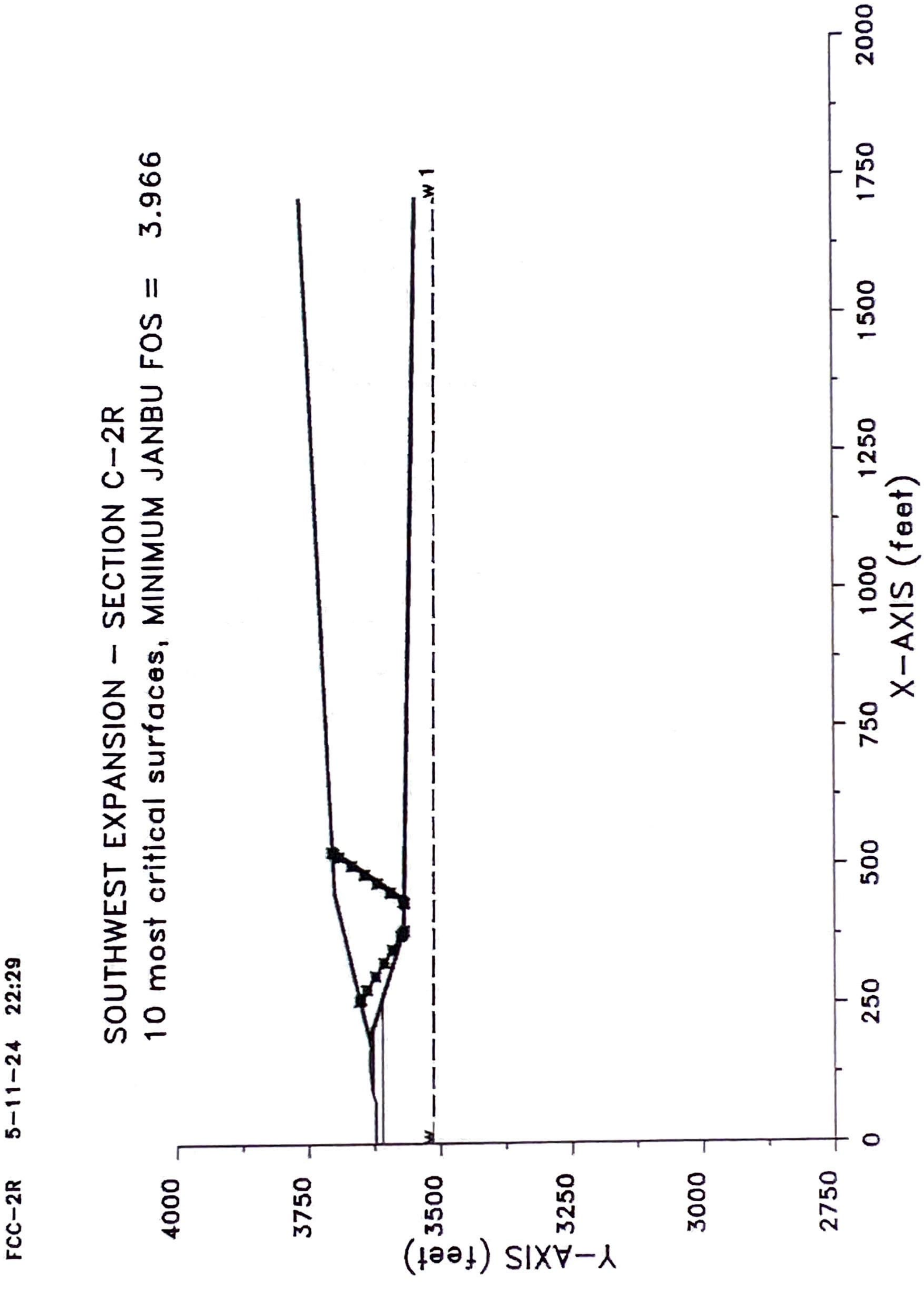
```
**********************************************************************
          **
**
          **  Out of the    100 surfaces generated and analyzed by
XSTABL,  **
          **         9 surfaces were found to have MISLEADING FOS values.
**
          **
**
**********************************************************************
```

The following is a summary of the TEN most critical surfaces

Problem Description : SOUTHWEST EXPANSION - SECTION C-2P

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	4.054	1.085	255.72	524.78	6.553E+05
2.	4.060	1.086	255.44	526.19	6.608E+05
3.	4.067	1.086	256.32	528.24	6.611E+05
4.	4.069	1.086	256.59	524.47	6.522E+05
5.	4.073	1.086	256.52	532.03	6.679E+05
6.	4.085	1.086	257.11	527.83	6.592E+05
7.	4.087	1.087	256.00	530.04	6.710E+05
8.	4.088	1.086	256.89	532.61	6.709E+05
9.	4.088	1.086	256.81	530.90	6.689E+05
10.	4.088	1.086	257.10	525.92	6.565E+05

* * * END OF FILE * * *


FCC-2R 5-11-24 22:29
SOUTHWEST EXPANSION - SECTION C-2R
10 most critical surfaces, MINIMUM JANBU FOS = 3.966
W1
W1
Y-AXIS (feet)
4000
3750
3500
3250
3000
2750
X-AXIS (feet)
0
250
500
750
1000
1250
1500
1750
2000

XSTABL File: FCC-2R 5-11-24 22:29

```
*******************************************
*              X S T A B L                *
*                                         *
*       Slope Stability Analysis          *
*              using the                  *
*           Method of Slices              *
*                                         *
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* Ver. 5.209                 96 - 2083    *
*******************************************
```

Problem Description : SOUTHWEST EXPANSION - SECTION C-2R

SEGMENT BOUNDARY COORDINATES

----

11 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3622.9	73.9	3623.0	2
2	73.9	3623.0	74.8	3623.3	2
3	74.8	3623.3	88.3	3627.8	2
4	88.3	3627.8	96.8	3630.7	1
5	96.8	3630.7	105.2	3631.0	1
6	105.2	3631.0	136.0	3634.0	1
7	136.0	3634.0	166.0	3634.0	1
8	166.0	3634.0	170.0	3632.0	1
9	170.0	3632.0	178.4	3634.1	1
10	178.4	3634.1	450.0	3702.0	4
11	450.0	3702.0	1710.0	3765.0	4

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	178.3	3634.1	181.0	3634.1	1

2	181.0	3634.1	190.5	3634.1	7
3	190.5	3634.1	192.9	3634.1	6
4	192.9	3634.1	450.5	3698.5	5
5	450.5	3698.5	1710.0	3761.5	5
6	192.7	3634.1	196.9	3634.1	6
7	196.9	3634.1	382.2	3572.3	6
8	382.2	3572.3	1710.0	3545.7	6
9	190.5	3634.1	381.9	3570.3	7
10	381.9	3570.3	1710.0	3543.7	8
11	181.0	3634.1	199.8	3627.8	1
12	199.8	3627.8	253.3	3610.0	2
13	253.3	3610.0	381.4	3567.3	3
14	381.4	3567.3	1710.0	3540.7	3
15	88.3	3627.8	199.8	3627.8	2
16	.0	3610.0	253.3	3610.0	3

ISOTROPIC Soil Parameters
----

8 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	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	116.0	120.0	100.0	16.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0
6	120.0	125.0	100.0	16.00	.000	.0	0
7	120.0	125.0	80.0	10.00	.000	.0	0
8	120.0	125.0	188.0	9.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

```
**********************************
        PHREATIC SURFACE,
**********************************
```

Point No.	x-water (ft)	y-water (ft)
1	.00	3514.00
2	1710.00	3506.60

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 29.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	382.2	3569.8	392.2	3569.6	5.0
2	432.2	3568.8	442.2	3568.6	5.0

```
*************************************************************
**     Factor of safety calculation for surface #   18      **
**     failed to converge within FIFTY iterations           **
**                                                          **
**   The last calculated value of the FOS was  4.1716       **
**   This will be ignored for final summary of results      **
*************************************************************
```

The trial failure surface in question is defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.63	3655.66
2	268.24	3652.94
3	269.40	3652.17
4	293.58	3636.16
5	317.77	3620.16
6	341.95	3604.15
7	366.13	3588.14
8	390.31	3572.14
9	391.40	3571.32
10	432.32	3566.32
11	434.81	3569.24
12	436.30	3571.22
13	452.31	3595.40
14	468.32	3619.58
15	484.32	3643.76
16	500.33	3667.95
17	516.33	3692.13
18	522.95	3702.12
19	525.71	3705.79

```
*****************************************************************
**      Factor of safety calculation for surface #    23      **
**      failed to converge within FIFTY iterations             **
**                                                             **
**    The last calculated value of the FOS was   4.2869       **
**    This will be ignored for final summary of results       **
*****************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.31	3655.58
2	267.93	3652.86
3	268.95	3652.18
4	293.14	3636.17
5	317.32	3620.16
6	341.50	3604.16
7	365.68	3588.15
8	389.87	3572.15
9	390.22	3571.88
10	432.90	3568.29
11	433.73	3569.26
12	435.22	3571.24
13	451.22	3595.42
14	467.23	3619.60
15	483.24	3643.79
16	499.24	3667.97

17	515.25	3692.15
18	521.81	3702.07
19	524.57	3705.73

```
**************************************************************
**     Factor of safety calculation for surface #    32     **
**     failed to converge within FIFTY iterations           **
**                                                          **
**    The last calculated value of the FOS was   4.4333     **
**    This will be ignored for final summary of results     **
**************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	265.21	3655.80
2	268.82	3653.08
3	270.22	3652.15
4	294.41	3636.15
5	318.59	3620.14
6	342.77	3604.13
7	366.95	3588.13
8	391.14	3572.12
9	391.75	3571.66
10	435.60	3568.63
11	436.10	3569.21
12	437.59	3571.19
13	453.59	3595.37
14	469.60	3619.56
15	485.61	3643.74
16	501.61	3667.92
17	517.62	3692.10
18	524.29	3702.19
19	527.05	3705.85

```
**************************************************************
**     Factor of safety calculation for surface #    67     **
**     failed to converge within FIFTY iterations           **
**                                                          **
**    The last calculated value of the FOS was   4.1283     **
**    This will be ignored for final summary of results     **
**************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	265.84	3655.96
2	269.45	3653.24
3	271.12	3652.13
4	295.30	3636.13
5	319.48	3620.12
6	343.67	3604.12
7	367.85	3588.11
8	392.03	3572.10
9	392.15	3572.02
10	440.54	3568.38
11	441.16	3569.11
12	442.65	3571.09
13	458.66	3595.27
14	474.66	3619.45
15	490.67	3643.64
16	506.67	3667.82
17	522.68	3692.00
18	529.60	3702.46
19	532.36	3706.12

```
***************************************************************
**     Factor of safety calculation for surface #    69      **
**     failed to converge within FIFTY iterations            **
**                                                           **
**    The last calculated value of the FOS was   3.9714      **
**    This will be ignored for final summary of results      **
***************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.50	3655.62
2	268.11	3652.90
3	269.21	3652.17
4	293.39	3636.17
5	317.58	3620.16
6	341.76	3604.15
7	365.94	3588.15
8	390.13	3572.14
9	391.64	3571.00
10	432.51	3567.65
11	433.88	3569.26
12	435.37	3571.23
13	451.38	3595.42
14	467.38	3619.60
15	483.39	3643.78
16	499.39	3667.97
17	515.40	3692.15
18	521.97	3702.07
19	524.73	3705.74

```
***************************************************************
**     Factor of safety calculation for surface #    85      **
**     failed to converge within FIFTY iterations            **
**                                                           **
**    The last calculated value of the FOS was    3.9789     **
**    This will be ignored for final summary of results      **
***************************************************************
```

The trial failure surface in question is
defined by the following 20 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	263.32	3655.33
2	266.93	3652.61
3	267.54	3652.21
4	291.72	3636.20
5	315.91	3620.19
6	340.09	3604.19
7	364.27	3588.18
8	388.46	3572.17
9	391.19	3570.11
10	391.55	3569.81
11	432.27	3567.50
12	433.77	3569.26
13	435.26	3571.24
14	451.27	3595.42
15	467.27	3619.60
16	483.28	3643.78
17	499.29	3667.97
18	515.29	3692.15
19	521.86	3702.07
20	524.62	3705.73

```
***************************************************************
**     Factor of safety calculation for surface #    86      **
**     failed to converge within FIFTY iterations            **
**                                                           **
**    The last calculated value of the FOS was    4.1301     **
**    This will be ignored for final summary of results      **
***************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.71	3655.68
2	268.33	3652.96

3	269.52	3652.17
4	293.71	3636.16
5	317.89	3620.15
6	342.07	3604.15
7	366.25	3588.14
8	390.44	3572.14
9	391.94	3571.00
10	432.79	3566.53
11	435.10	3569.23
12	436.59	3571.21
13	452.59	3595.39
14	468.60	3619.58
15	484.61	3643.76
16	500.61	3667.94
17	516.62	3692.12
18	523.25	3702.14
19	526.01	3705.80

```
*************************************************************
**     Factor of safety calculation for surface #    92     **
**     failed to converge within FIFTY iterations           **
**                                                          **
**    The last calculated value of the FOS was   4.1527     **
**    This will be ignored for final summary of results     **
*************************************************************
```

The trial failure surface in question is
defined by the following 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	265.73	3655.93
2	269.34	3653.21
3	270.96	3652.14
4	295.14	3636.13
5	319.32	3620.12
6	343.51	3604.12
7	367.69	3588.11
8	391.87	3572.11
9	391.96	3572.04
10	433.59	3569.61
11	434.82	3571.25
12	450.83	3595.43
13	466.83	3619.61
14	482.84	3643.79
15	498.85	3667.98
16	514.85	3692.16
17	521.40	3702.05
18	524.16	3705.71

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED JANBU METHOD   * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	255.81	3653.45
2	259.42	3650.73
3	276.84	3639.20
4	301.02	3623.20
5	325.20	3607.19
6	349.38	3591.19
7	373.57	3575.18
8	378.57	3571.41
9	382.54	3568.02
10	432.29	3567.27
11	433.99	3569.26
12	435.48	3571.23
13	451.49	3595.42
14	467.49	3619.60
15	483.50	3643.78
16	499.50	3667.96
17	515.51	3692.15
18	522.09	3702.08
19	524.85	3705.74

** Corrected JANBU FOS = 3.966 ** (Fo factor = 1.085)

Failure surface No. 2 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	255.54	3653.38
2	259.15	3650.66
3	276.08	3639.46
4	300.26	3623.45
5	324.44	3607.44
6	348.63	3591.44
7	372.81	3575.43
8	377.81	3571.66
9	382.41	3567.73
10	435.69	3569.78
11	436.77	3571.21
12	452.77	3595.39

13	468.78	3619.57
14	484.78	3643.75
15	500.79	3667.94
16	516.80	3692.12
17	523.43	3702.15
18	526.19	3705.81

** Corrected JANBU FOS = 3.982 ** (Fo factor = 1.086)

Failure surface No. 3 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.37	3653.59
2	259.98	3650.87
3	278.38	3638.69
4	302.56	3622.68
5	326.75	3606.68
6	350.93	3590.67
7	375.11	3574.66
8	380.11	3570.90
9	382.24	3569.08
10	435.70	3567.33
11	437.29	3569.19
12	438.78	3571.17
13	454.78	3595.35
14	470.79	3619.53
15	486.80	3643.71
16	502.80	3667.90
17	518.81	3692.08
18	525.54	3702.25
19	528.30	3705.92

** Corrected JANBU FOS = 3.984 ** (Fo factor = 1.086)

Failure surface No. 4 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.56	3653.64
2	260.17	3650.92
3	278.92	3638.51
4	303.10	3622.50
5	327.29	3606.50
6	351.47	3590.49
7	375.65	3574.48
8	380.65	3570.72
9	382.34	3569.27
10	439.69	3567.72
11	440.89	3569.12

12	442.38	3571.09
13	458.38	3595.28
14	474.39	3619.46
15	490.40	3643.64
16	506.40	3667.82
17	522.41	3692.01
18	529.31	3702.44
19	532.07	3706.10

** Corrected JANBU FOS = 3.990 ** (Fo factor = 1.086)

Failure surface No. 5 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.65	3653.66
2	260.26	3650.94
3	279.18	3638.42
4	303.36	3622.42
5	327.54	3606.41
6	351.73	3590.40
7	375.91	3574.40
8	380.91	3570.63
9	383.77	3568.18
10	433.47	3569.07
11	433.64	3569.26
12	435.13	3571.24
13	451.13	3595.42
14	467.14	3619.60
15	483.15	3643.79
16	499.15	3667.97
17	515.16	3692.15
18	521.72	3702.06
19	524.48	3705.72

** Corrected JANBU FOS = 3.998 ** (Fo factor = 1.086)

Failure surface No. 6 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.89	3653.72
2	260.50	3651.00
3	279.82	3638.21
4	304.01	3622.20
5	328.19	3606.19
6	352.37	3590.19
7	376.56	3574.18
8	381.56	3570.41
9	385.06	3567.42

10	438.13	3567.15
11	439.83	3569.14
12	441.32	3571.12
13	457.33	3595.30
14	473.33	3619.48
15	489.34	3643.66
16	505.34	3667.85
17	521.35	3692.03
18	528.21	3702.39
19	530.97	3706.05

** Corrected JANBU FOS = 4.009 ** (Fo factor = 1.086)

Failure surface No. 7 specified by 20 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.94	3653.74
2	260.56	3651.01
3	279.99	3638.15
4	304.17	3622.15
5	328.35	3606.14
6	352.53	3590.14
7	376.72	3574.13
8	381.72	3570.36
9	381.79	3570.30
10	384.30	3568.16
11	440.09	3567.52
12	441.45	3569.11
13	442.94	3571.08
14	458.94	3595.27
15	474.95	3619.45
16	490.96	3643.63
17	506.96	3667.81
18	522.97	3692.00
19	529.90	3702.47
20	532.66	3706.13

** Corrected JANBU FOS = 4.009 ** (Fo factor = 1.086)

Failure surface No. 8 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	257.11	3653.78
2	260.73	3651.06
3	280.46	3637.99
4	304.64	3621.99
5	328.83	3605.98
6	353.01	3589.98

7	377.19	3573.97
8	382.07	3570.30
9	385.42	3567.44
10	440.08	3568.48
11	440.63	3569.12
12	442.12	3571.10
13	458.12	3595.28
14	474.13	3619.46
15	490.14	3643.65
16	506.14	3667.83
17	522.15	3692.01
18	529.04	3702.43
19	531.80	3706.09

** Corrected JANBU FOS = 4.015 ** (Fo factor = 1.086)

Failure surface No. 9 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	257.15	3653.79
2	260.77	3651.07
3	280.57	3637.96
4	304.75	3621.95
5	328.94	3605.95
6	353.12	3589.94
7	377.30	3573.93
8	382.13	3570.30
9	384.02	3568.68
10	436.35	3568.61
11	436.85	3569.20
12	438.34	3571.18
13	454.35	3595.36
14	470.36	3619.54
15	486.36	3643.72
16	502.37	3667.91
17	518.37	3692.09
18	525.09	3702.23
19	527.85	3705.89

** Corrected JANBU FOS = 4.016 ** (Fo factor = 1.086)

Failure surface No.10 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.08	3653.52
2	259.69	3650.80
3	277.59	3638.95
4	301.78	3622.95

5	325.96	3606.94
6	350.14	3590.93
7	374.32	3574.93
8	379.32	3571.16
9	383.03	3568.00
10	439.52	3569.92
11	440.43	3571.13
12	456.44	3595.32
13	472.45	3619.50
14	488.45	3643.68
15	504.46	3667.86
16	520.47	3692.05
17	527.28	3702.34
18	530.04	3706.00

** Corrected JANBU FOS = 4.019 ** (Fo factor = 1.087)

****
**
**
** Out of the 100 surfaces generated and analyzed by
XSTABL, **
** 8 surfaces were found to have MISLEADING FOS values.
**
**
**

****

The following is a summary of the TEN most critical surfaces

Problem Description : SOUTHWEST EXPANSION - SECTION C-2R

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	3.966	1.085	255.81	524.85	6.365E+05
2.	3.982	1.086	255.54	526.19	6.438E+05
3.	3.984	1.086	256.37	528.30	6.432E+05
4.	3.990	1.086	256.56	532.07	6.497E+05

5.	3.998	1.086	256.65	524.48	6.364E+05
6.	4.009	1.086	256.89	530.97	6.514E+05
7.	4.009	1.086	256.94	532.66	6.533E+05
8.	4.015	1.086	257.11	531.80	6.519E+05
9.	4.016	1.086	257.15	527.85	6.437E+05
10.	4.019	1.087	256.08	530.04	6.560E+05

* * * END OF FILE * * *

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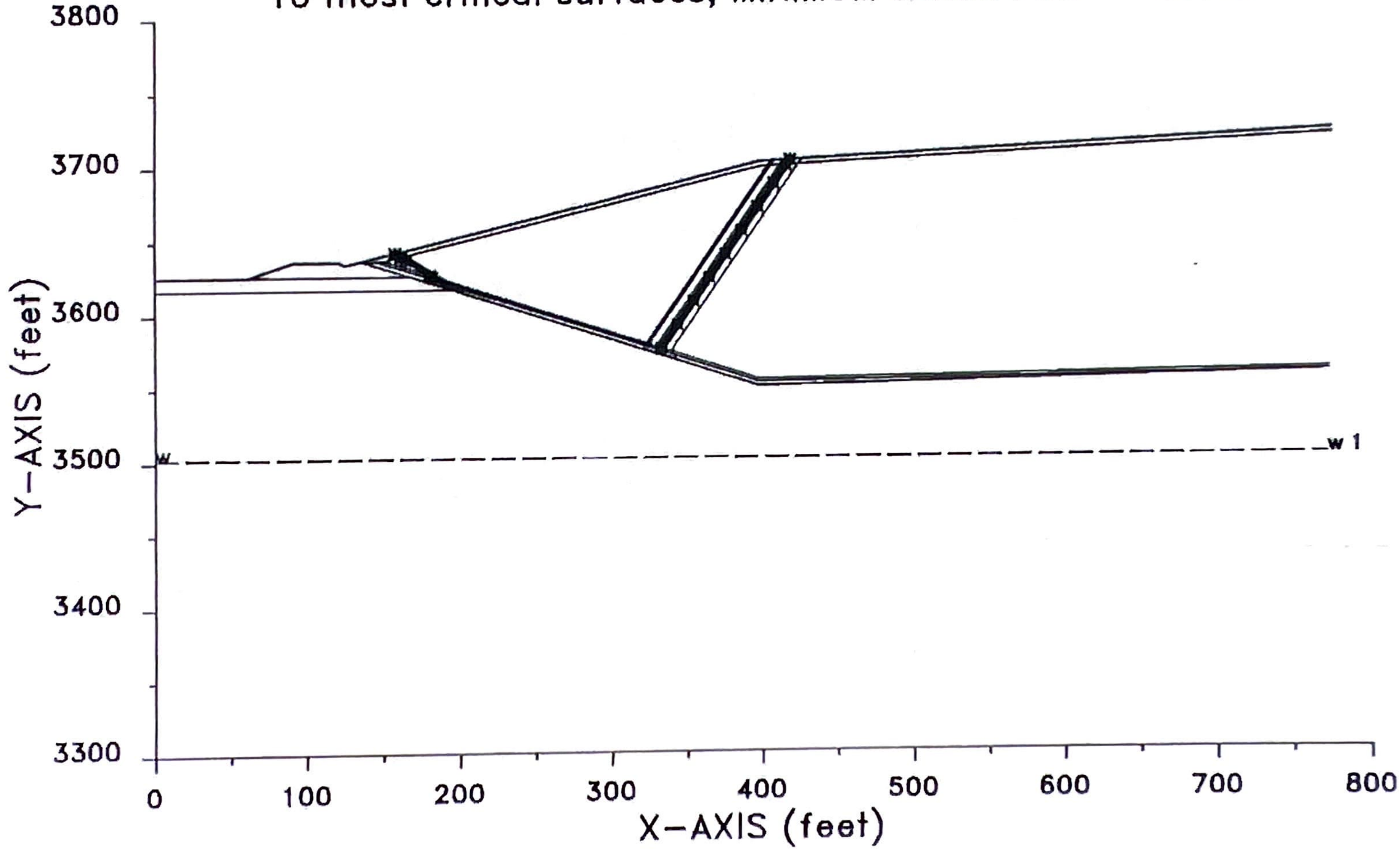
SOUTHWEST EXPANSION - SECTION D-2P
10 most critical surfaces, MINIMUM JANBU FOS = 3.102



XSTABL File: FCD-2P   5-10-24   15:38

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******************************************
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*              using the                 *
*           Method of Slices             *
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******************************************
```

Problem Description : SOUTHWEST EXPANSION - SECTION D-2P

SEGMENT BOUNDARY COORDINATES
----

8 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3625.9	60.2	3625.9	2
2	60.2	3625.9	60.3	3625.9	2
3	60.3	3625.9	89.9	3636.2	1
4	89.9	3636.2	119.9	3636.2	1
5	119.9	3636.2	123.9	3634.2	1
6	123.9	3634.2	132.0	3636.2	1
7	132.0	3636.2	395.2	3702.0	5
8	395.2	3702.0	770.1	3720.7	5

18 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	131.9	3636.2	135.1	3636.2	1
2	135.1	3636.2	144.6	3636.2	8
3	144.6	3636.2	146.5	3636.2	7
4	146.5	3636.2	395.7	3698.5	6

5	395.7	3698.5	770.1	3717.2	6
6	146.3	3636.2	150.9	3636.2	7
7	150.9	3636.2	395.2	3554.7	7
8	395.2	3554.7	770.1	3558.5	7
9	144.6	3636.2	394.9	3552.7	8
10	394.9	3552.7	770.1	3556.5	9
11	135.1	3636.2	165.9	3625.9	1
12	165.9	3625.9	192.9	3616.9	2
13	192.9	3616.9	363.7	3560.1	3
14	363.7	3560.1	393.7	3550.1	4
15	393.7	3550.1	394.4	3549.7	3
16	394.4	3549.7	770.1	3556.5	3
17	60.3	3625.9	165.9	3625.9	2
18	.0	3616.9	192.9	3616.9	3

ISOTROPIC Soil Parameters

----

9 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	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	122.5	127.0	1200.0	26.70	.000	.0	0
5	116.0	120.0	100.0	16.00	.000	.0	0
6	59.0	59.0	288.0	23.00	.000	.0	0
7	120.0	125.0	100.0	16.00	.000	.0	0
8	120.0	125.0	200.0	15.00	.000	.0	0
9	120.0	125.0	188.0	11.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3502.00
2	770.10	3500.10

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 19.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	180.0	3624.4	200.0	3617.7	5.0
2	320.0	3577.7	340.0	3571.0	5.0

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	156.15	3642.24
2	159.76	3639.51
3	163.01	3637.36
4	178.86	3626.87
5	180.22	3625.84
6	330.29	3575.32
7	330.92	3576.15
8	341.40	3591.99
9	351.89	3607.83
10	362.38	3623.68
11	372.86	3639.52
12	383.35	3655.36
13	393.84	3671.21
14	404.32	3687.05
15	412.45	3699.34
16	415.21	3703.00

** Corrected JANBU FOS = 3.102 ** (Fo factor = 1.088)

Failure surface No. 2 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	158.07	3642.72
2	161.68	3640.00
3	168.36	3635.58
4	184.20	3625.09
5	184.45	3624.91
6	322.11	3578.21
7	322.63	3578.91
8	333.12	3594.75
9	343.61	3610.60
10	354.09	3626.44
11	364.58	3642.28
12	375.07	3658.13
13	385.55	3673.97
14	396.04	3689.82
15	402.00	3698.81
16	404.76	3702.48

** Corrected JANBU FOS = 3.102 ** (Fo factor = 1.088)

Failure surface No. 3 specified by 17 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	155.26	3642.01
2	158.87	3639.29
3	160.54	3638.18
4	176.39	3627.70
5	181.39	3623.93
6	181.85	3623.58
7	332.66	3575.21
8	332.87	3575.49
9	343.36	3591.34
10	353.84	3607.18
11	364.33	3623.03
12	374.82	3638.87
13	385.30	3654.71
14	395.79	3670.56
15	406.28	3686.40
16	414.92	3699.46
17	417.68	3703.12

** Corrected JANBU FOS = 3.115 ** (Fo factor = 1.088)

Failure surface No. 4 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	158.48	3642.82
2	162.09	3640.10
3	169.49	3635.20
4	185.33	3624.71
5	187.17	3623.33
6	329.64	3575.67
7	330.18	3576.39
8	340.67	3592.23
9	351.15	3608.08
10	361.64	3623.92
11	372.13	3639.77
12	382.62	3655.61
13	393.10	3671.45
14	403.59	3687.30
15	411.53	3699.29
16	414.29	3702.95

** Corrected JANBU FOS = 3.123 ** (Fo factor = 1.088)

Failure surface No. 5 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	158.03	3642.71
2	161.64	3639.99

3	168.25	3635.61
4	184.09	3625.13
5	187.98	3622.20
6	330.82	3575.62
7	331.16	3576.06
8	341.65	3591.91
9	352.13	3607.75
10	362.62	3623.60
11	373.11	3639.44
12	383.59	3655.28
13	394.08	3671.13
14	404.57	3686.97
15	412.76	3699.35
16	415.52	3703.01

** Corrected JANBU FOS = 3.125 ** (Fo factor = 1.088)

Failure surface No. 6 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	159.94	3643.18
2	163.55	3640.46
3	173.54	3633.85
4	189.38	3623.36
5	191.35	3621.88
6	328.38	3576.35
7	328.77	3576.86
8	339.25	3592.71
9	349.74	3608.55
10	360.23	3624.39
11	370.71	3640.24
12	381.20	3656.08
13	391.69	3671.93
14	402.17	3687.77
15	409.74	3699.20
16	412.50	3702.86

** Corrected JANBU FOS = 3.130 ** (Fo factor = 1.088)

Failure surface No. 7 specified by 17 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	156.00	3642.20
2	159.61	3639.48
3	162.62	3637.49
4	178.46	3627.01
5	183.46	3623.24
6	185.97	3621.31

7	321.45	3579.25
8	321.48	3579.29
9	331.97	3595.14
10	342.46	3610.98
11	352.95	3626.82
12	363.43	3642.67
13	373.92	3658.51
14	384.41	3674.35
15	394.89	3690.20
16	400.55	3698.74
17	403.31	3702.40

** Corrected JANBU FOS = 3.132 ** (Fo factor = 1.088)

Failure surface No. 8 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	156.81	3642.40
2	160.42	3639.68
3	164.86	3636.74
4	180.71	3626.26
5	185.52	3622.63
6	336.81	3573.67
7	337.12	3574.08
8	347.60	3589.92
9	358.09	3605.76
10	368.58	3621.61
11	379.06	3637.45
12	389.55	3653.30
13	400.04	3669.14
14	410.53	3684.98
15	420.28	3699.73
16	423.04	3703.39

** Corrected JANBU FOS = 3.136 ** (Fo factor = 1.088)

Failure surface No. 9 specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	158.05	3642.71
2	161.67	3639.99
3	168.10	3635.73
4	183.95	3625.24
5	326.20	3575.94
6	327.27	3577.36
7	337.76	3593.21
8	348.24	3609.05
9	358.73	3624.89

10	369.22	3640.74
11	379.70	3656.58
12	390.19	3672.42
13	400.68	3688.27
14	407.85	3699.11
15	410.61	3702.77

** Corrected JANBU FOS = 3.145 ** (Fo factor = 1.088)

Failure surface No.10 specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	160.28	3643.27
2	163.89	3640.55
3	174.50	3633.53
4	190.34	3623.04
5	194.04	3620.26
6	321.03	3579.47
7	331.52	3595.31
8	342.00	3611.16
9	352.49	3627.00
10	362.98	3642.85
11	373.46	3658.69
12	383.95	3674.53
13	394.44	3690.38
14	399.95	3698.71
15	402.71	3702.37

** Corrected JANBU FOS = 3.145 ** (Fo factor = 1.088)

The following is a summary of the TEN most critical surfaces

Problem Description : SOUTHWEST EXPANSION - SECTION D-2P

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	3.102	1.088	156.15	415.21	4.547E+05
2.	3.102	1.088	158.07	404.76	4.208E+05
3.	3.115	1.088	155.26	417.68	4.653E+05

4.	3.123	1.088	158.48	414.29	4.532E+05
5.	3.125	1.088	158.03	415.52	4.578E+05
6.	3.130	1.088	159.94	412.50	4.475E+05
7.	3.132	1.088	156.00	403.31	4.226E+05
8.	3.136	1.088	156.81	423.04	4.825E+05
9.	3.145	1.088	158.05	410.61	4.451E+05
10.	3.145	1.088	160.28	402.71	4.189E+05

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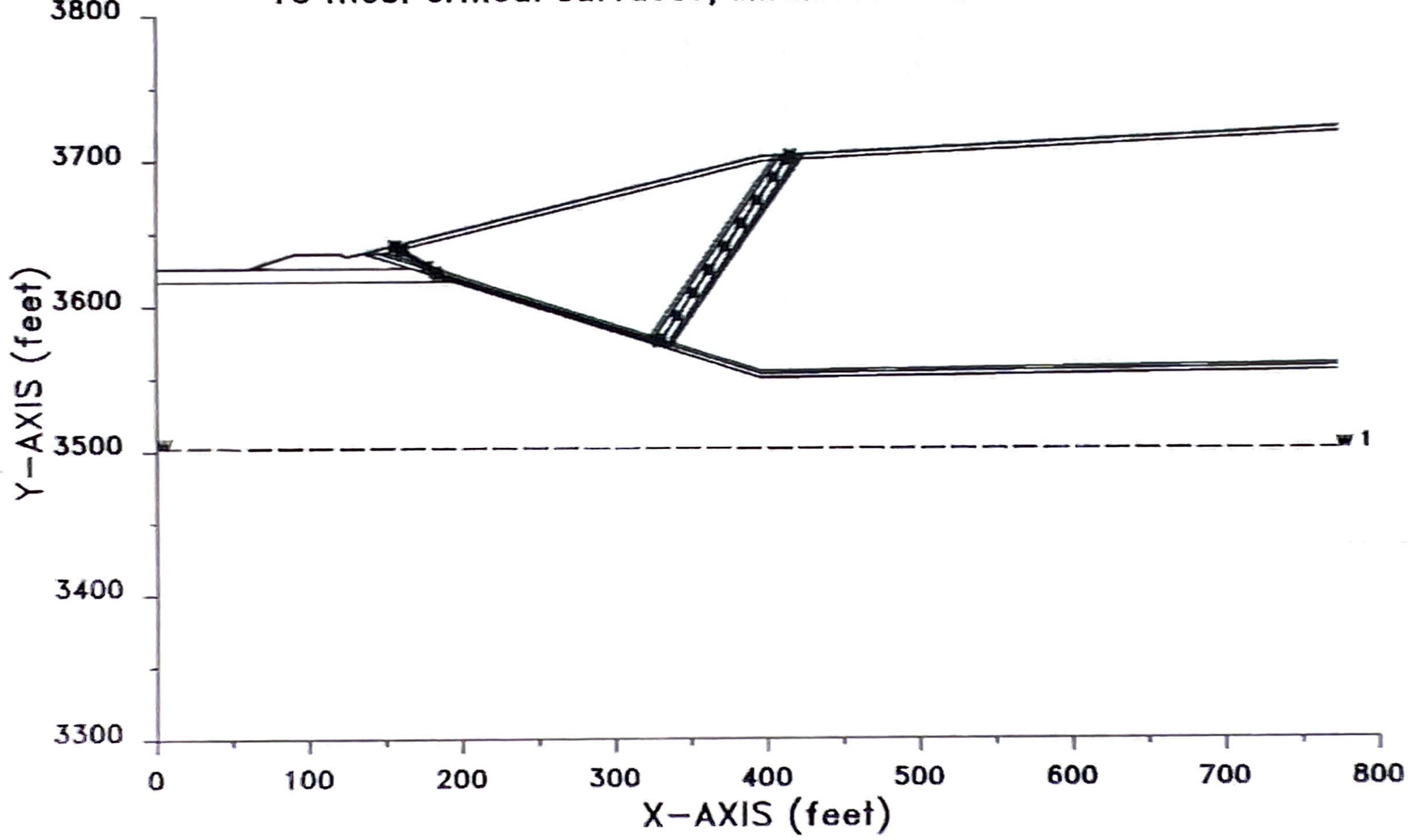
SOUTHWEST EXPANSION - SECTION D-2R
10 most critical surfaces, MINIMUM JANBU FOS = 2.711



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*              X S T A B L               *
*                                        *
*       Slope Stability Analysis         *
*              using the                 *
*           Method of Slices             *
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Problem Description : SOUTHWEST EXPANSION - SECTION D-2R

SEGMENT BOUNDARY COORDINATES
----

8 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3625.9	60.2	3625.9	2
2	60.2	3625.9	60.3	3625.9	2
3	60.3	3625.9	89.9	3636.2	1
4	89.9	3636.2	119.9	3636.2	1
5	119.9	3636.2	123.9	3634.2	1
6	123.9	3634.2	132.0	3636.2	1
7	132.0	3636.2	395.2	3702.0	5
8	395.2	3702.0	770.1	3720.7	5

18 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	131.9	3636.2	135.1	3636.2	1
2	135.1	3636.2	144.6	3636.2	8
3	144.6	3636.2	146.5	3636.2	7
4	146.5	3636.2	395.7	3698.5	6

5	395.7	3698.5	770.1	3717.2	6
6	146.3	3636.2	150.9	3636.2	7
7	150.9	3636.2	395.2	3554.7	7
8	395.2	3554.7	770.1	3558.5	7
9	144.6	3636.2	394.9	3552.7	8
10	394.9	3552.7	770.1	3556.5	9
11	135.1	3636.2	165.9	3625.9	1
12	165.9	3625.9	192.9	3616.9	2
13	192.9	3616.9	363.7	3560.1	3
14	363.7	3560.1	393.7	3550.1	4
15	393.7	3550.1	394.4	3549.7	3
16	394.4	3549.7	770.1	3553.5	3
17	60.3	3625.9	165.9	3625.9	2
18	.0	3616.9	192.9	3616.9	3

ISOTROPIC Soil Parameters

---

9 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	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	122.5	127.0	1200.0	26.70	.000	.0	0
5	116.0	120.0	100.0	16.00	.000	.0	0
6	59.0	59.0	288.0	23.00	.000	.0	0
7	120.0	125.0	100.0	16.00	.000	.0	0
8	120.0	125.0	80.0	10.00	.000	.0	0
9	120.0	125.0	188.0	9.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3502.00
2	770.10	3500.10

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 19.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	180.0	3624.4	200.0	3617.7	5.0
2	320.0	3577.7	340.0	3571.0	5.0

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.30	3642.02
2	158.91	3639.30
3	160.66	3638.15
4	176.50	3627.66
5	181.51	3623.89
6	183.64	3622.10
7	328.30	3574.81
8	328.37	3574.89
9	329.63	3576.57
10	340.12	3592.42
11	350.61	3608.26
12	361.09	3624.10
13	371.58	3639.95
14	382.07	3655.79
15	392.55	3671.64
16	403.04	3687.48
17	410.84	3699.26
18	413.60	3702.92

** Corrected JANBU FOS = 2.711 ** (Fo factor = 1.088)

Failure surface No. 2 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	154.49	3641.82
2	158.10	3639.10
3	158.42	3638.89
4	174.26	3628.41
5	179.26	3624.64
6	180.29	3623.78
7	334.98	3571.75
8	335.60	3572.48
9	336.87	3574.16
10	347.35	3590.00
11	357.84	3605.85
12	368.33	3621.69
13	378.81	3637.54
14	389.30	3653.38
15	399.79	3669.22
16	410.27	3685.07
17	419.97	3699.71
18	422.72	3703.37

** Corrected JANBU FOS = 2.723 ** (Fo factor = 1.088)

Failure surface No. 3 specified by 17 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	154.28	3641.77
2	157.89	3639.05
3	173.67	3628.60
4	178.67	3624.83
5	180.07	3623.66
6	326.99	3573.95
7	327.91	3575.05
8	329.18	3576.73
9	339.66	3592.57
10	350.15	3608.41
11	360.64	3624.26
12	371.12	3640.10
13	381.61	3655.94
14	392.10	3671.79
15	402.58	3687.63
16	410.26	3699.23
17	413.02	3702.89

** Corrected JANBU FOS = 2.724 ** (Fo factor = 1.088)

Failure surface No. 4 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.34	3642.04
2	158.96	3639.31
3	160.78	3638.10
4	176.63	3627.62
5	181.63	3623.85
6	184.41	3621.51
7	323.78	3575.78
8	324.20	3576.29
9	325.46	3577.96
10	335.95	3593.81
11	346.44	3609.65
12	356.93	3625.50
13	367.41	3641.34
14	377.90	3657.18
15	388.39	3673.03
16	398.87	3688.87
17	405.57	3698.99
18	408.33	3702.66

** Corrected JANBU FOS = 2.730 ** (Fo factor = 1.088)

Failure surface No. 5 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	157.60	3642.60
2	161.21	3639.88
3	167.06	3636.01
4	182.90	3625.52
5	187.90	3621.75
6	188.44	3621.30
7	323.33	3576.51
8	323.37	3576.56
9	324.63	3578.24
10	335.12	3594.09
11	345.61	3609.93
12	356.09	3625.77
13	366.58	3641.62
14	377.07	3657.46
15	387.55	3673.30
16	398.04	3689.15
17	404.52	3698.94
18	407.28	3702.60

** Corrected JANBU FOS = 2.731 ** (Fo factor = 1.088)

Failure surface No. 6 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.43	3642.06
2	159.05	3639.34
3	161.04	3638.02
4	176.88	3627.53
5	181.88	3623.76
6	186.43	3619.95
7	335.76	3572.26
8	335.87	3572.39
9	337.14	3574.07
10	347.62	3589.91
11	358.11	3605.76
12	368.60	3621.60
13	379.08	3637.45
14	389.57	3653.29
15	400.06	3669.13
16	410.54	3684.98
17	420.31	3699.73
18	423.07	3703.39

** Corrected JANBU FOS = 2.742 ** (Fo factor = 1.088)

Failure surface No. 7 specified by 17 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	153.74	3641.64
2	157.35	3638.91
3	172.18	3629.10
4	177.18	3625.33
5	180.67	3622.40
6	320.18	3576.11
7	321.18	3577.29
8	322.44	3578.97
9	332.93	3594.82
10	343.42	3610.66
11	353.90	3626.50
12	364.39	3642.35
13	374.88	3658.19
14	385.37	3674.03
15	395.85	3689.88
16	401.76	3698.80
17	404.52	3702.46

** Corrected JANBU FOS = 2.742 ** (Fo factor = 1.088)

Failure surface No. 8 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.13	3641.98
2	158.74	3639.26
3	160.19	3638.30
4	176.03	3627.82
5	181.04	3624.04
6	184.20	3621.39
7	335.79	3571.29
8	336.53	3572.17
9	337.79	3573.85
10	348.28	3589.70
11	358.77	3605.54
12	369.25	3621.38
13	379.74	3637.23
14	390.23	3653.07
15	400.71	3668.91
16	411.20	3684.76
17	421.14	3699.77
18	423.90	3703.43

** Corrected JANBU FOS = 2.752 ** (Fo factor = 1.088)

Failure surface No. 9 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	157.04	3642.46
2	160.65	3639.74
3	165.50	3636.53
4	181.34	3626.04
5	186.35	3622.27
6	187.91	3620.96
7	333.02	3571.97
8	333.92	3573.04
9	335.19	3574.72
10	345.67	3590.56
11	356.16	3606.41
12	366.65	3622.25
13	377.13	3638.10
14	387.62	3653.94
15	398.11	3669.78
16	408.59	3685.63
17	417.85	3699.61
18	420.60	3703.27

** Corrected JANBU FOS = 2.764 ** (Fo factor = 1.088)

Failure surface No.10 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.16	3641.99
2	158.78	3639.27
3	160.28	3638.27
4	176.13	3627.78
5	181.13	3624.01
6	185.72	3620.16
7	331.86	3572.19
8	332.87	3573.39
9	334.13	3575.07
10	344.62	3590.92
11	355.11	3606.76
12	365.59	3622.60
13	376.08	3638.45
14	386.57	3654.29
15	397.05	3670.14
16	407.54	3685.98
17	416.52	3699.54
18	419.28	3703.20

** Corrected JANBU FOS = 2.766 ** (Fo factor = 1.088)

The following is a summary of the TEN most critical surfaces

Problem Description : SOUTHWEST EXPANSION - SECTION D-2R

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.711	1.088	155.30	413.60	3.727E+05
2.	2.723	1.088	154.49	422.72	3.963E+05
3.	2.724	1.088	154.28	413.02	3.728E+05
4.	2.730	1.088	155.34	408.33	3.615E+05
5.	2.731	1.088	157.60	407.28	3.584E+05
6.	2.742	1.088	155.43	423.07	3.995E+05
7.	2.742	1.088	153.74	404.52	3.529E+05
8.	2.752	1.088	155.13	423.90	4.026E+05
9.	2.764	1.088	157.04	420.60	3.957E+05
10.	2.766	1.088	155.16	419.28	3.931E+05

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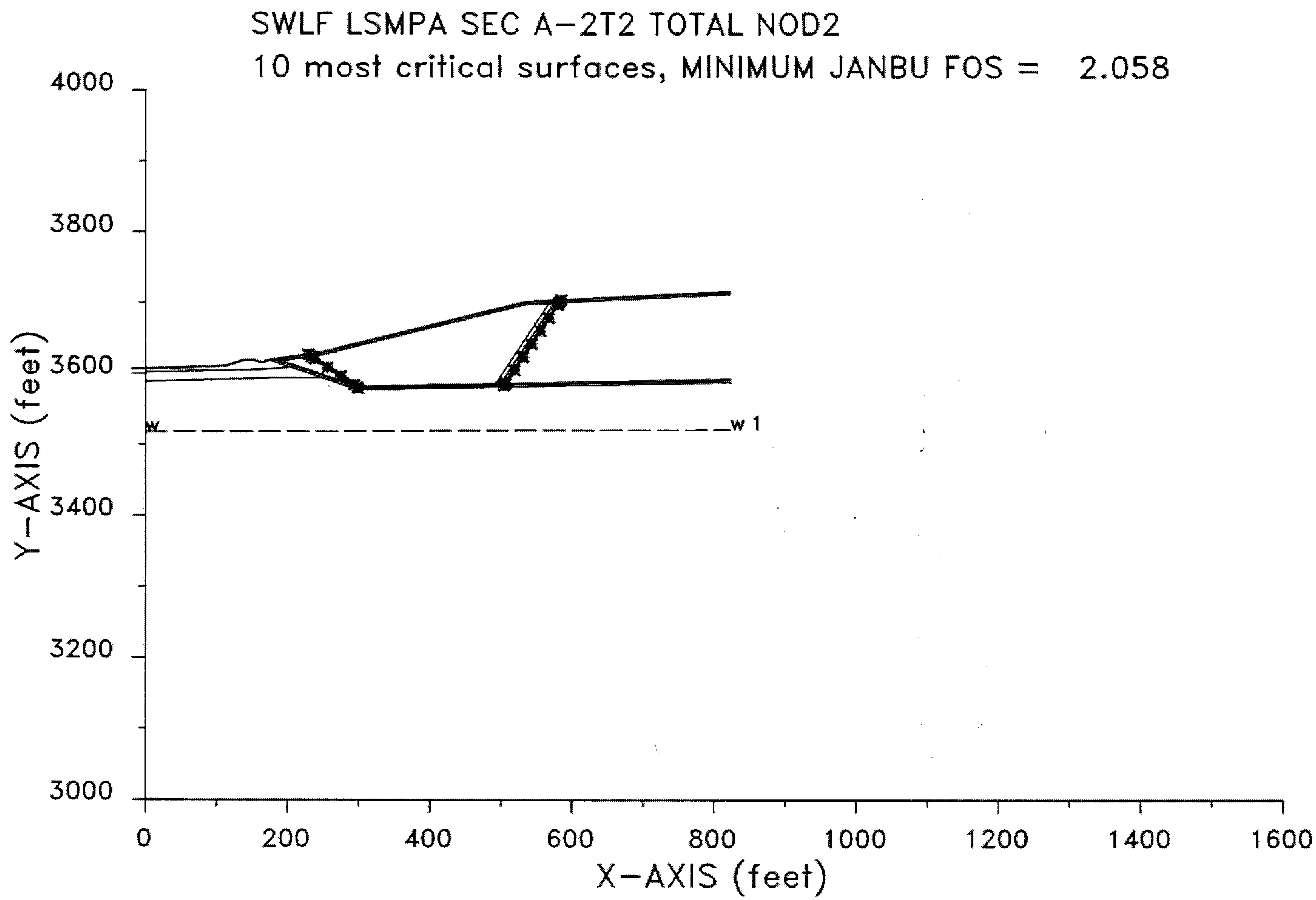
ADDITIONAL TRANSITIONAL (BLOCK) STABILITY ANALYSES INCORPORATING TOTAL STRESS PARAMETERS

FCA-2T2 1-26-25 11:32



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 *                                        *
 *       Slope Stability Analysis         *
 *              using the                 *
 *           Method of Slices             *
 *                                        *
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Problem Description : SWLF LSMPA SEC A-2T2 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

11 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3607.6	93.9	3610.0	1
2	93.9	3610.0	114.9	3611.7	1
3	114.9	3611.7	137.6	3619.3	1
4	137.6	3619.3	152.6	3619.3	1
5	152.6	3619.3	161.6	3616.3	1
6	161.6	3616.3	164.6	3616.3	1
7	164.6	3616.3	173.6	3619.3	1
8	173.6	3619.3	173.9	3619.4	1
9	173.9	3619.4	247.6	3630.0	5
10	247.6	3630.0	535.6	3702.0	5
11	535.6	3702.0	823.4	3716.4	5

18 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment

1	173.9	3619.4	183.4	3619.4	8
2	183.4	3619.4	189.7	3619.4	7
3	189.7	3619.4	198.4	3619.4	6
4	198.4	3619.4	248.3	3626.5	6
5	248.3	3626.5	536.1	3698.5	6
6	536.1	3698.5	823.4	3712.9	6
7	189.7	3619.4	298.7	3583.0	7
8	298.7	3583.0	823.3	3593.5	7
9	183.4	3619.4	298.4	3581.0	8
10	298.4	3581.0	823.4	3591.5	9
11	173.6	3619.3	204.4	3609.2	1
12	204.4	3609.2	248.4	3594.5	2
13	248.4	3594.5	298.0	3578.0	3
14	298.0	3578.0	823.4	3588.5	3
15	.0	3602.3	160.0	3606.0	2
16	160.0	3606.0	204.4	3609.2	2
17	.0	3589.3	181.6	3594.5	3
18	181.6	3594.5	248.4	3594.5	3

ISOTROPIC Soil Parameters

----

9 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	122.5	122.5	100.0	27.10	.000	.0	0
2	121.9	121.9	100.0	27.10	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	122.5	127.0	1200.0	26.70	.000	.0	0
5	116.0	120.0	100.0	16.00	.000	.0	0
6	59.0	59.0	288.0	23.00	.000	.0	0
7	120.0	125.0	100.0	16.00	.000	.0	0
8	120.0	125.0	1000.0	.00	.000	.0	0
9	120.0	125.0	1000.0	.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

```
*********************************
        PHREATIC SURFACE,
*********************************
```

Point No.	x-water (ft)	y-water (ft)
1	.00	3518.60
2	823.40	3522.00

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is   22.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	298.8	3580.5	318.8	3580.9	5.0
2	488.8	3584.3	508.7	3584.7	5.0

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED JANBU METHOD   * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	229.33	3627.37
2	233.32	3624.37
3	237.86	3621.37
4	256.20	3609.22
5	274.55	3597.08
6	292.89	3584.94
7	297.90	3581.17
8	299.09	3579.98
9	503.71	3583.67
10	505.18	3585.14
11	506.71	3587.16
12	518.85	3605.51
13	530.99	3623.85
14	543.13	3642.20
15	555.28	3660.55
16	567.42	3678.89
17	579.56	3697.24
18	581.92	3700.80
19	584.68	3704.46

** Corrected JANBU FOS = 2.058 ** (Fo factor = 1.085)

Failure surface No. 2 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	229.08	3627.34
2	233.07	3624.33
3	237.24	3621.57
4	255.59	3609.43
5	273.93	3597.29
6	292.28	3585.14
7	297.28	3581.37
8	298.87	3579.78
9	495.76	3583.04
10	497.71	3584.99
11	499.23	3587.01
12	511.38	3605.36
13	523.52	3623.70
14	535.66	3642.05
15	547.81	3660.40
16	559.95	3678.74

17	572.09	3697.09
18	574.29	3700.41
19	577.05	3704.07

** Corrected JANBU FOS = 2.059 ** (Fo factor = 1.085)

Failure surface No. 3 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	228.81	3627.30
2	232.80	3624.29
3	236.58	3621.79
4	254.92	3609.65
5	273.27	3597.51
6	291.61	3585.37
7	296.62	3581.59
8	299.47	3578.74
9	488.98	3582.77
10	491.06	3584.85
11	492.59	3586.88
12	504.73	3605.23
13	516.88	3623.57
14	529.02	3641.92
15	541.16	3660.26
16	553.30	3678.61
17	565.45	3696.95
18	567.51	3700.07
19	570.27	3703.73

** Corrected JANBU FOS = 2.059 ** (Fo factor = 1.086)

Failure surface No. 4 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	232.74	3627.86
2	236.73	3624.85
3	244.89	3619.45
4	263.24	3607.31
5	281.58	3595.17
6	299.93	3583.02
7	302.50	3581.08
8	305.11	3578.48
9	502.48	3582.43
10	505.19	3585.14

11	506.72	3587.16
12	518.86	3605.51
13	531.00	3623.85
14	543.15	3642.20
15	555.29	3660.55
16	567.43	3678.89
17	579.57	3697.24
18	581.93	3700.80
19	584.69	3704.46

** Corrected JANBU FOS = 2.065 ** (Fo factor = 1.085)

Failure surface No. 5 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	232.09	3627.77
2	236.09	3624.76
3	244.13	3619.44
4	262.48	3607.29
5	280.82	3595.15
6	299.17	3583.01
7	301.75	3581.07
8	304.52	3578.29
9	500.60	3583.00
10	502.68	3585.09
11	504.21	3587.11
12	516.35	3605.46
13	528.50	3623.80
14	540.64	3642.15
15	552.78	3660.50
16	564.92	3678.84
17	577.07	3697.19
18	579.37	3700.67
19	582.13	3704.33

** Corrected JANBU FOS = 2.067 ** (Fo factor = 1.085)

Failure surface No. 6 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.44	3627.68
2	235.43	3624.67
3	243.03	3619.64
4	261.37	3607.50

5	279.72	3595.36
6	298.06	3583.21
7	300.93	3581.05
8	303.00	3578.98
9	504.51	3583.50
10	506.17	3585.16
11	507.70	3587.18
12	519.84	3605.53
13	531.98	3623.87
14	544.12	3642.22
15	556.27	3660.56
16	568.41	3678.91
17	580.55	3697.26
18	582.93	3700.85
19	585.69	3704.51

** Corrected JANBU FOS = 2.067 ** (Fo factor = 1.085)

Failure surface No. 7 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	230.34	3627.52
2	234.33	3624.51
3	240.32	3620.54
4	258.67	3608.40
5	277.02	3596.26
6	295.36	3584.11
7	299.47	3581.02
8	299.63	3580.86
9	501.23	3582.61
10	503.72	3585.11
11	505.25	3587.13
12	517.39	3605.48
13	529.53	3623.82
14	541.68	3642.17
15	553.82	3660.52
16	565.96	3678.86
17	578.10	3697.21
18	580.43	3700.72
19	583.19	3704.38

** Corrected JANBU FOS = 2.067 ** (Fo factor = 1.085)

Failure surface No. 8 specified by 19 coordinate points

Point x-surf y-surf

No.	(ft)	(ft)
1	232.72	3627.86
2	236.71	3624.85
3	244.87	3619.45
4	263.21	3607.31
5	281.56	3595.17
6	299.90	3583.02
7	302.48	3581.08
8	305.23	3578.33
9	504.48	3584.46
10	505.16	3585.14
11	506.69	3587.16
12	518.83	3605.51
13	530.97	3623.85
14	543.12	3642.20
15	555.26	3660.54
16	567.40	3678.89
17	579.55	3697.24
18	581.90	3700.80
19	584.66	3704.45

** Corrected JANBU FOS = 2.076 ** (Fo factor = 1.085)

Failure surface No. 9 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	232.33	3627.80
2	236.32	3624.80
3	244.40	3619.44
4	262.75	3607.30
5	281.10	3595.16
6	299.44	3583.01
7	302.02	3581.07
8	302.39	3580.70
9	501.18	3582.25
10	504.04	3585.11
11	505.57	3587.14
12	517.71	3605.49
13	529.86	3623.83
14	542.00	3642.18
15	554.14	3660.52
16	566.28	3678.87
17	578.43	3697.21
18	580.76	3700.74
19	583.52	3704.40

** Corrected JANBU FOS = 2.078 ** (Fo factor = 1.085)

Failure surface No.10 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	231.40	3627.67
2	235.39	3624.66
3	242.93	3619.67
4	261.28	3607.53
5	279.62	3595.39
6	297.97	3583.24
7	300.88	3581.05
8	302.44	3579.49
9	497.06	3584.36
10	497.69	3584.99
11	499.21	3587.01
12	511.36	3605.36
13	523.50	3623.70
14	535.64	3642.05
15	547.78	3660.40
16	559.93	3678.74
17	572.07	3697.09
18	574.27	3700.41
19	577.03	3704.07

** Corrected JANBU FOS = 2.086 ** (Fo factor = 1.085)

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA SEC A-2T2 TOTAL NOD2

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.058	1.085	229.33	584.68	5.002E+05
2.	2.059	1.085	229.08	577.05	4.903E+05
3.	2.059	1.086	228.81	570.27	4.814E+05
4.	2.065	1.085	232.74	584.69	5.029E+05
5.	2.067	1.085	232.09	582.13	4.998E+05
6.	2.067	1.085	231.44	585.69	5.038E+05
7.	2.067	1.085	230.34	583.19	4.993E+05
8.	2.076	1.085	232.72	584.66	5.023E+05

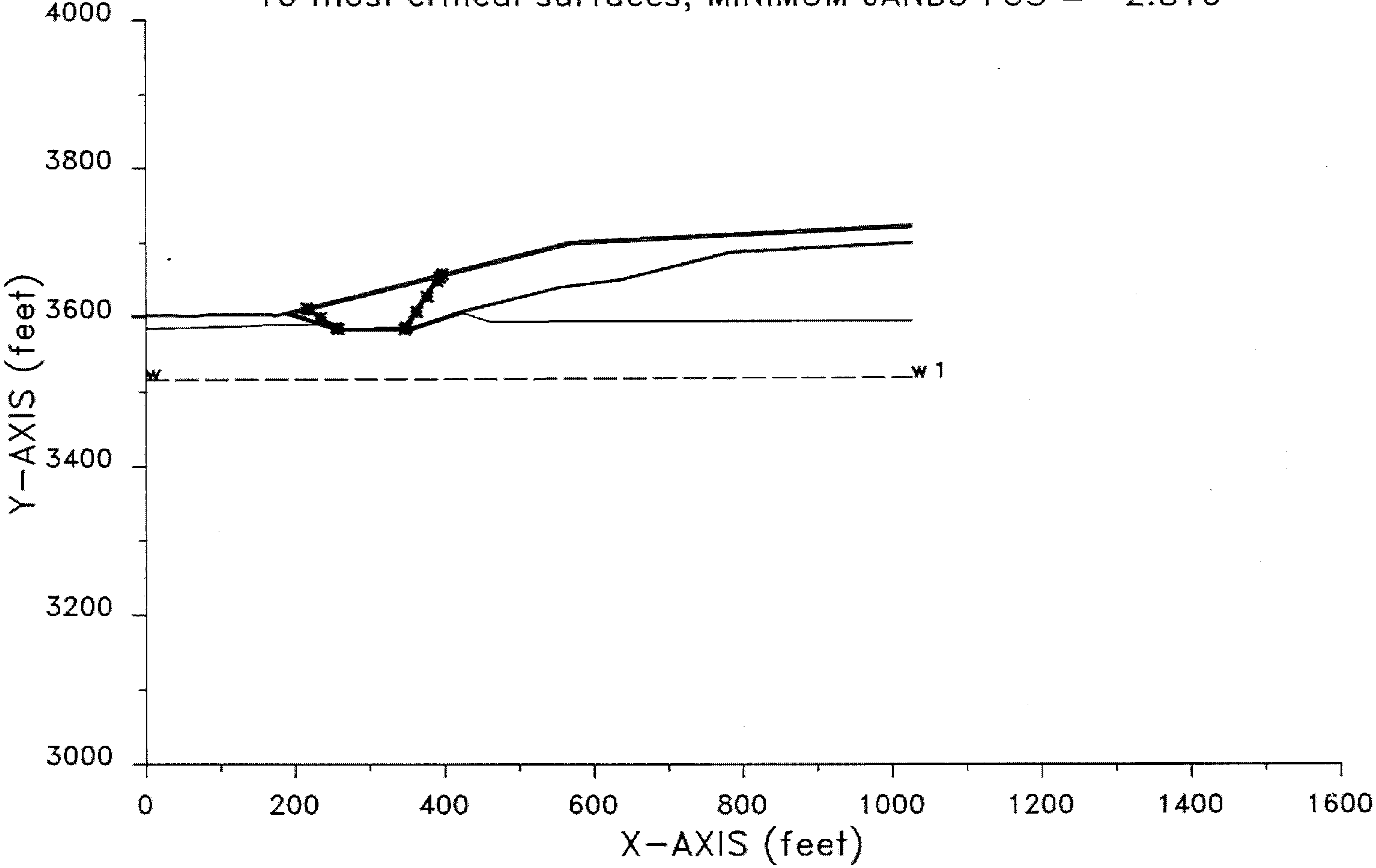
9.	2.078	1.085	232.33	583.52	5.009E+05
10.	2.086	1.085	231.40	577.03	4.923E+05

* * * END OF FILE * * *

FCB-2T2 1-26-25 11:41

SWLF LSMPA SEC B-2T2 TOTAL NOD2

10 most critical surfaces, MINIMUM JANBU FOS = 2.816



XSTABL File: FCB-2T2   1-26-25   11:41

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****************************************
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*              using the               *
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```

Problem Description : SWLF LSMPA SEC B-2T2 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3602.7	35.7	3603.6	1
2	35.7	3603.6	45.0	3602.4	1
3	45.0	3602.4	68.0	3602.2	1
4	68.0	3602.2	80.8	3604.4	1
5	80.8	3604.4	168.4	3604.5	1
6	168.4	3604.5	172.4	3602.6	1
7	172.4	3602.6	180.4	3604.6	1
8	180.4	3604.6	570.0	3702.0	4
9	570.0	3702.0	1026.7	3724.8	4

32 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	180.4	3604.6	188.4	3604.6	1

2	188.4	3604.6	194.8	3604.6	7
3	194.8	3604.6	194.9	3604.6	6
4	194.9	3604.6	570.5	3698.5	5
5	570.5	3698.5	1026.7	3721.3	5
6	194.9	3604.6	201.1	3604.6	6
7	201.1	3604.6	257.5	3585.8	6
8	257.5	3585.8	355.6	3587.2	6
9	355.6	3587.2	413.2	3606.4	6
10	413.2	3606.4	419.0	3608.3	9
11	419.0	3608.3	553.6	3642.0	9
12	553.6	3642.0	634.8	3652.0	9
13	634.8	3652.0	782.8	3689.0	9
14	782.8	3689.0	1026.7	3701.9	9
15	413.2	3606.4	419.5	3606.4	6
16	194.9	3604.6	257.2	3583.8	7
17	257.2	3583.8	356.0	3585.2	8
18	356.0	3585.2	419.5	3606.4	7
19	419.5	3606.4	553.9	3640.0	5
20	553.9	3640.0	635.1	3650.0	5
21	635.1	3650.0	783.1	3687.0	5
22	783.1	3687.0	1026.7	3699.9	5
23	419.5	3606.4	425.8	3606.4	7
24	188.4	3604.6	231.7	3590.2	1
25	231.7	3590.2	256.9	3581.8	2
26	256.9	3581.8	356.3	3583.2	2
27	356.3	3583.2	425.8	3606.4	2
28	425.8	3606.4	459.4	3595.2	2
29	459.4	3595.2	1026.7	3596.2	2
30	.0	3585.1	133.8	3588.2	2
31	133.8	3588.2	157.3	3590.2	2
32	157.3	3590.2	231.7	3590.2	2

ISOTROPIC Soil Parameters
----

9 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	121.9	121.9	100.0	26.00	.000	.0	0
2	122.5	127.0	1200.0	26.70	.000	.0	1
3	122.5	127.0	1200.0	26.70	.000	.0	0
4	116.0	120.0	100.0	16.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0
6	120.0	125.0	100.0	16.00	.000	.0	0
7	120.0	125.0	1000.0	.00	.000	.0	0

8	120.0	125.0	1000.0	.00	.000	.0	0
9	120.0	125.0	1000.0	.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3516.00
2	1026.70	3520.00

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 25.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	257.5	3583.8	267.5	3584.0	4.0

2	337.5	3584.6	347.5	3585.1	4.0

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED JANBU METHOD   * * * * *

The 10 most critical of all the failure surfaces examined
are displayed below - the most critical first

Failure surface No. 1 specified by 13 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.32	3613.33
2	218.93	3610.61
3	234.45	3600.33
4	255.30	3586.53
5	257.85	3584.61
6	347.00	3584.49
7	347.59	3585.08
8	349.12	3587.11
9	362.91	3607.95
10	376.71	3628.80
11	390.51	3649.65
12	393.57	3654.27
13	396.93	3658.73

** Corrected JANBU FOS = 2.816 ** (Fo factor = 1.088)

Failure surface No. 2 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.22	3613.05
2	217.83	3610.33
3	231.40	3601.35
4	252.25	3587.55
5	257.23	3583.80
6	257.64	3583.38
7	344.99	3584.23
8	345.82	3585.06
9	347.35	3587.08
10	361.14	3607.93

11	374.94	3628.78
12	388.74	3649.62
13	391.47	3653.74
14	394.83	3658.21

** Corrected JANBU FOS = 2.818 ** (Fo factor = 1.088)

Failure surface No. 3 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.95	3613.24
2	218.57	3610.52
3	233.45	3600.67
4	254.29	3586.87
5	258.34	3583.82
6	259.60	3582.56
7	345.39	3584.10
8	346.36	3585.06
9	347.89	3587.09
10	361.68	3607.94
11	375.48	3628.78
12	389.28	3649.63
13	392.11	3653.90
14	395.47	3658.37

** Corrected JANBU FOS = 2.819 ** (Fo factor = 1.088)

Failure surface No. 4 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.37	3613.34
2	218.98	3610.62
3	234.60	3600.28
4	255.44	3586.49
5	258.97	3583.83
6	260.65	3582.14
7	344.37	3583.22
8	346.21	3585.06
9	347.74	3587.09
10	361.54	3607.93
11	375.33	3628.78
12	389.13	3649.63
13	391.93	3653.86
14	395.30	3658.32

** Corrected JANBU FOS = 2.821 ** (Fo factor = 1.089)

Failure surface No. 5 specified by 13 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.90	3613.23
2	218.52	3610.50
3	233.31	3600.71
4	254.15	3586.92
5	257.92	3584.08
6	343.75	3583.36
7	345.43	3585.05
8	346.96	3587.08
9	360.76	3607.92
10	374.56	3628.77
11	388.35	3649.62
12	391.01	3653.63
13	394.37	3658.09

** Corrected JANBU FOS = 2.823 ** (Fo factor = 1.089)

Failure surface No. 6 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.08	3613.27
2	218.70	3610.55
3	233.81	3600.55
4	254.65	3586.75
5	258.54	3583.82
6	260.36	3582.00
7	343.43	3583.67
8	344.80	3585.04
9	346.33	3587.07
10	360.13	3607.91
11	373.92	3628.76
12	387.72	3649.61
13	390.26	3653.44
14	393.62	3657.91

** Corrected JANBU FOS = 2.833 ** (Fo factor = 1.089)

Failure surface No. 7 specified by 13 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	217.12	3613.78
2	220.73	3611.06
3	238.02	3599.62
4	258.86	3585.82
5	260.05	3584.93
6	346.19	3583.53
7	347.75	3585.08
8	349.27	3587.11
9	363.07	3607.96
10	376.87	3628.80
11	390.67	3649.65
12	393.76	3654.31
13	397.12	3658.78

** Corrected JANBU FOS = 2.838 ** (Fo factor = 1.089)

Failure surface No. 8 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.33	3613.33
2	218.94	3610.61
3	234.49	3600.32
4	255.34	3586.52
5	258.92	3583.82
6	260.72	3582.02
7	345.38	3584.87
8	345.57	3585.05
9	347.09	3587.08
10	360.89	3607.93
11	374.69	3628.77
12	388.49	3649.62
13	391.17	3653.67
14	394.53	3658.13

** Corrected JANBU FOS = 2.838 ** (Fo factor = 1.088)

Failure surface No. 9 specified by 13 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	215.67	3613.42

2	219.28	3610.70
3	235.44	3600.00
4	256.29	3586.20
5	259.30	3583.94
6	343.72	3583.07
7	345.70	3585.05
8	347.23	3587.08
9	361.03	3607.93
10	374.83	3628.77
11	388.63	3649.62
12	391.33	3653.71
13	394.70	3658.17

** Corrected JANBU FOS = 2.841 ** (Fo factor = 1.089)

Failure surface No.10 specified by 14 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.07	3613.02
2	217.68	3610.30
3	231.00	3601.48
4	251.85	3587.68
5	256.84	3583.92
6	257.54	3583.23
7	341.00	3583.65
8	342.35	3585.01
9	343.88	3587.03
10	357.68	3607.88
11	371.47	3628.73
12	385.27	3649.57
13	387.35	3652.71
14	390.72	3657.18

** Corrected JANBU FOS = 2.849 ** (Fo factor = 1.089)

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA SEC B-2T2 TOTAL NOD2

Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)

1.	2.816	1.088	215.32	396.93	2.137E+05
2.	2.818	1.088	214.22	394.83	2.132E+05
3.	2.819	1.088	214.95	395.47	2.145E+05
4.	2.821	1.089	215.37	395.30	2.149E+05
5.	2.823	1.089	214.90	394.37	2.116E+05
6.	2.833	1.089	215.08	393.62	2.127E+05
7.	2.838	1.089	217.12	397.12	2.135E+05
8.	2.838	1.088	215.33	394.53	2.134E+05
9.	2.841	1.089	215.67	394.70	2.132E+05
10.	2.849	1.089	214.07	390.72	2.083E+05

* * * END OF FILE * * *

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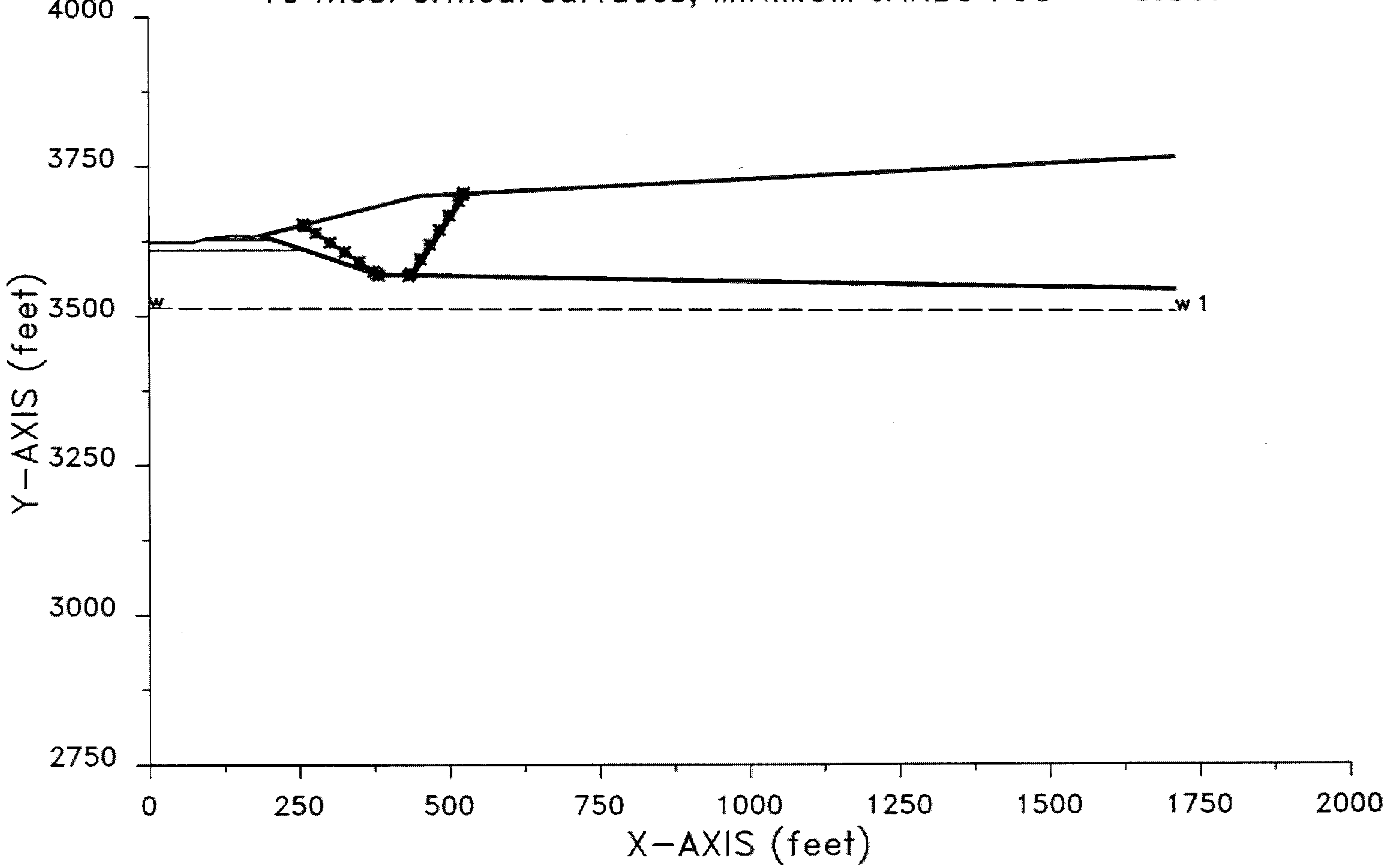
SWLF LSMPA SEC C-2T2 TOTAL NOD2

10 most critical surfaces, MINIMUM JANBU FOS = 3.867



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```
****************************************
*              X S T A B L             *
*                                      *
*       Slope Stability Analysis       *
*              using the               *
*           Method of Slices           *
*                                      *
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* Ver. 5.209               96 - 2083   *
****************************************
```

Problem Description : SWLF LSMPA SEC C-2T2 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

11 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3622.9	73.9	3623.0	2
2	73.9	3623.0	74.8	3623.3	2
3	74.8	3623.3	88.3	3627.8	2
4	88.3	3627.8	96.8	3630.7	1
5	96.8	3630.7	105.2	3631.0	1
6	105.2	3631.0	136.0	3634.0	1
7	136.0	3634.0	166.0	3634.0	1
8	166.0	3634.0	170.0	3632.0	1
9	170.0	3632.0	178.4	3634.1	1
10	178.4	3634.1	450.0	3702.0	4
11	450.0	3702.0	1710.0	3765.0	4

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment

1	178.3	3634.1	181.0	3634.1	1
2	181.0	3634.1	190.5	3634.1	7
3	190.5	3634.1	192.9	3634.1	6
4	192.9	3634.1	450.5	3698.5	5
5	450.5	3698.5	1710.0	3761.5	5
6	192.7	3634.1	196.9	3634.1	6
7	196.9	3634.1	382.2	3572.3	6
8	382.2	3572.3	1710.0	3545.7	6
9	190.5	3634.1	381.9	3570.3	7
10	381.9	3570.3	1710.0	3543.7	8
11	181.0	3634.1	199.8	3627.8	1
12	199.8	3627.8	253.3	3610.0	2
13	253.3	3610.0	381.4	3567.3	3
14	381.4	3567.3	1710.0	3540.7	3
15	88.3	3627.8	199.8	3627.8	2
16	.0	3610.0	253.3	3610.0	3

ISOTROPIC Soil Parameters
----

8 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	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	116.0	120.0	100.0	16.00	.000	.0	0
5	59.0	59.0	288.0	23.00	.000	.0	0
6	120.0	125.0	100.0	16.00	.000	.0	0
7	120.0	125.0	1000.0	.00	.000	.0	0
8	120.0	125.0	1000.0	.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3514.00
2	1710.00	3506.60

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 29.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	382.2	3569.8	392.2	3569.6	5.0
2	432.2	3568.8	442.2	3568.6	5.0

```
*************************************************************
**     Factor of safety calculation for surface #    18     **
**     failed to converge within FIFTY iterations           **
**                                                          **
**    The last calculated value of the FOS was   4.1247     **
**    This will be ignored for final summary of results     **
*************************************************************
```

The trial failure surface in question is defined by the following 19 coordinate points

Point x-surf y-surf

No.	(ft)	(ft)
1	264.63	3655.66
2	268.24	3652.94
3	269.40	3652.17
4	293.58	3636.16
5	317.77	3620.16
6	341.95	3604.15
7	366.13	3588.14
8	390.31	3572.14
9	391.40	3571.32
10	432.32	3566.32
11	435.23	3569.23
12	436.72	3571.21
13	452.73	3595.39
14	468.73	3619.57
15	484.74	3643.76
16	500.74	3667.94
17	516.75	3692.12
18	523.39	3702.15
19	526.15	3705.81

```
***********************************************************
**     Factor of safety calculation for surface #    23    **
**     failed to converge within FIFTY iterations          **
**                                                         **
**    The last calculated value of the FOS was   4.3289    **
**    This will be ignored for final summary of results    **
***********************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.31	3655.58
2	267.93	3652.86
3	268.95	3652.18
4	293.14	3636.17
5	317.32	3620.16
6	341.50	3604.16
7	365.68	3588.15
8	389.87	3572.15
9	390.22	3571.88
10	432.90	3568.29
11	433.87	3569.26
12	435.36	3571.24
13	451.36	3595.42

14	467.37	3619.60
15	483.37	3643.78
16	499.38	3667.97
17	515.39	3692.15
18	521.96	3702.07
19	524.72	3705.74

```
***********************************************************
**     Factor of safety calculation for surface #    32    **
**     failed to converge within FIFTY iterations          **
**                                                         **
**    The last calculated value of the FOS was   4.5109    **
**    This will be ignored for final summary of results    **
***********************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	265.21	3655.80
2	268.82	3653.08
3	270.22	3652.15
4	294.41	3636.15
5	318.59	3620.14
6	342.77	3604.13
7	366.95	3588.13
8	391.14	3572.12
9	391.75	3571.66
10	435.60	3568.63
11	436.18	3569.21
12	437.67	3571.19
13	453.68	3595.37
14	469.68	3619.55
15	485.69	3643.74
16	501.70	3667.92
17	517.70	3692.10
18	524.38	3702.20
19	527.14	3705.86

```
***********************************************************
**     Factor of safety calculation for surface #    67    **
**     failed to converge within FIFTY iterations          **
**                                                         **
**    The last calculated value of the FOS was   4.0711    **
**    This will be ignored for final summary of results    **
***********************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	265.84	3655.96
2	269.45	3653.24
3	271.12	3652.13
4	295.30	3636.13
5	319.48	3620.12
6	343.67	3604.12
7	367.85	3588.11
8	392.03	3572.10
9	392.15	3572.02
10	440.54	3568.38
11	441.26	3569.11
12	442.75	3571.09
13	458.76	3595.27
14	474.77	3619.45
15	490.77	3643.63
16	506.78	3667.82
17	522.78	3692.00
18	529.71	3702.46
19	532.47	3706.12

```
***************************************************************
**     Factor of safety calculation for surface #    69     **
**     failed to converge within FIFTY iterations           **
**                                                          **
**    The last calculated value of the FOS was   3.8621     **
**    This will be ignored for final summary of results     **
***************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.50	3655.62
2	268.11	3652.90
3	269.21	3652.17
4	293.39	3636.17
5	317.58	3620.16
6	341.76	3604.15
7	365.94	3588.15
8	390.13	3572.14

9	391.64	3571.00
10	432.51	3567.65
11	434.11	3569.25
12	435.60	3571.23
13	451.61	3595.41
14	467.61	3619.60
15	483.62	3643.78
16	499.63	3667.96
17	515.63	3692.14
18	522.21	3702.09
19	524.97	3705.75

```
************************************************************
**     Factor of safety calculation for surface #    85    **
**     failed to converge within FIFTY iterations          **
**                                                         **
**    The last calculated value of the FOS was   3.9094    **
**    This will be ignored for final summary of results    **
************************************************************
```

The trial failure surface in question is
defined by the following 20 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	263.36	3655.34
2	266.97	3652.62
3	267.59	3652.20
4	291.78	3636.20
5	315.96	3620.19
6	340.14	3604.19
7	364.33	3588.18
8	388.51	3572.17
9	391.24	3570.11
10	391.55	3569.81
11	432.27	3567.50
12	434.03	3569.26
13	435.51	3571.23
14	451.52	3595.41
15	467.53	3619.60
16	483.53	3643.78
17	499.54	3667.96
18	515.55	3692.15
19	522.12	3702.08
20	524.88	3705.74

****

```
**     Factor of safety calculation for surface #    86     **
**     failed to converge within FIFTY iterations           **
**                                                          **
**    The last calculated value of the FOS was   4.0808     **
**    This will be ignored for final summary of results     **
**************************************************************
```

The trial failure surface in question is
defined by the following 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	264.71	3655.68
2	268.33	3652.96
3	269.52	3652.17
4	293.71	3636.16
5	317.89	3620.15
6	342.07	3604.15
7	366.25	3588.14
8	390.44	3572.14
9	391.94	3571.00
10	432.79	3566.53
11	435.49	3569.23
12	436.97	3571.20
13	452.98	3595.39
14	468.99	3619.57
15	484.99	3643.75
16	501.00	3667.93
17	517.01	3692.12
18	523.65	3702.16
19	526.41	3705.82

```
**************************************************************
**     Factor of safety calculation for surface #    92     **
**     failed to converge within FIFTY iterations           **
**                                                          **
**    The last calculated value of the FOS was   4.1527     **
**    This will be ignored for final summary of results     **
**************************************************************
```

The trial failure surface in question is
defined by the following 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	265.73	3655.93
2	269.34	3653.21

3	270.96	3652.14
4	295.14	3636.13
5	319.32	3620.12
6	343.51	3604.12
7	367.69	3588.11
8	391.87	3572.11
9	391.96	3572.04
10	433.59	3569.61
11	434.82	3571.25
12	450.83	3595.43
13	466.83	3619.61
14	482.84	3643.79
15	498.85	3667.98
16	514.85	3692.16
17	521.40	3702.05
18	524.16	3705.71

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED JANBU METHOD   * * * * *

The 10 most critical of all the failure surfaces examined
are displayed below - the most critical first

Failure surface No. 1 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.12	3653.53
2	259.73	3650.81
3	277.70	3638.91
4	301.89	3622.91
5	326.07	3606.90
6	350.25	3590.90
7	374.44	3574.89
8	379.44	3571.12
9	382.54	3568.02
10	432.29	3567.27
11	434.28	3569.25
12	435.76	3571.23
13	451.77	3595.41
14	467.78	3619.59
15	483.78	3643.77
16	499.79	3667.96
17	515.80	3692.14

18	522.38	3702.10
19	525.14	3705.76

** Corrected JANBU FOS = 3.867 ** (Fo factor = 1.085)

Failure surface No. 2 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.53	3653.63
2	260.15	3650.91
3	278.85	3638.53
4	303.03	3622.53
5	327.21	3606.52
6	351.39	3590.52
7	375.58	3574.51
8	380.58	3570.74
9	382.24	3569.08
10	435.70	3567.33
11	437.55	3569.19
12	439.04	3571.16
13	455.05	3595.34
14	471.06	3619.53
15	487.06	3643.71
16	503.07	3667.89
17	519.07	3692.07
18	525.82	3702.27
19	528.58	3705.93

** Corrected JANBU FOS = 3.879 ** (Fo factor = 1.086)

Failure surface No. 3 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.69	3653.67
2	260.31	3650.95
3	279.29	3638.39
4	303.47	3622.38
5	327.66	3606.37
6	351.84	3590.37
7	376.02	3574.36
8	381.02	3570.59
9	382.34	3569.27
10	439.69	3567.72
11	441.09	3569.11

12	442.58	3571.09
13	458.58	3595.27
14	474.59	3619.46
15	490.60	3643.64
16	506.60	3667.82
17	522.61	3692.00
18	529.52	3702.45
19	532.28	3706.11

** Corrected JANBU FOS = 3.880 ** (Fo factor = 1.086)

Failure surface No. 4 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	257.17	3653.79
2	260.79	3651.07
3	280.63	3637.94
4	304.81	3621.93
5	328.99	3605.93
6	353.17	3589.92
7	377.36	3573.92
8	382.16	3570.29
9	384.30	3568.16
10	440.09	3567.52
11	441.67	3569.10
12	443.16	3571.08
13	459.17	3595.26
14	475.18	3619.44
15	491.18	3643.63
16	507.19	3667.81
17	523.19	3691.99
18	530.14	3702.48
19	532.90	3706.14

** Corrected JANBU FOS = 3.899 ** (Fo factor = 1.086)

Failure surface No. 5 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	257.19	3653.80
2	260.80	3651.08
3	280.67	3637.92
4	304.85	3621.92
5	329.04	3605.91

6	353.22	3589.91
7	377.40	3573.90
8	382.19	3570.29
9	385.06	3567.42
10	438.13	3567.15
11	440.12	3569.13
12	441.60	3571.11
13	457.61	3595.29
14	473.62	3619.48
15	489.62	3643.66
16	505.63	3667.84
17	521.64	3692.02
18	528.51	3702.40
19	531.26	3706.06

** Corrected JANBU FOS = 3.901 ** (Fo factor = 1.086)

Failure surface No. 6 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	257.49	3653.87
2	261.10	3651.15
3	281.49	3637.65
4	305.67	3621.64
5	329.86	3605.64
6	354.04	3589.63
7	378.22	3573.63
8	382.66	3570.28
9	385.35	3567.59
10	439.07	3566.51
11	441.66	3569.10
12	443.15	3571.08
13	459.16	3595.26
14	475.16	3619.44
15	491.17	3643.63
16	507.18	3667.81
17	523.18	3691.99
18	530.13	3702.48
19	532.89	3706.14

** Corrected JANBU FOS = 3.908 ** (Fo factor = 1.086)

Failure surface No. 7 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	257.36	3653.84
2	260.97	3651.12
3	281.15	3637.77
4	305.33	3621.76
5	329.51	3605.75
6	353.69	3589.75
7	377.88	3573.74
8	382.46	3570.29
9	382.62	3570.13
10	438.45	3566.74
11	440.83	3569.12
12	442.31	3571.10
13	458.32	3595.28
14	474.33	3619.46
15	490.33	3643.64
16	506.34	3667.83
17	522.35	3692.01
18	529.25	3702.44
19	532.01	3706.10

** Corrected JANBU FOS = 3.909 ** (Fo factor = 1.086)

Failure surface No. 8 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	255.90	3653.47
2	259.51	3650.75
3	277.09	3639.12
4	301.27	3623.11
5	325.45	3607.11
6	349.63	3591.10
7	373.82	3575.10
8	378.82	3571.33
9	382.41	3567.73
10	435.69	3569.78
11	436.77	3571.21
12	452.77	3595.39
13	468.78	3619.57
14	484.78	3643.75
15	500.79	3667.94
16	516.80	3692.12
17	523.43	3702.15
18	526.19	3705.81

** Corrected JANBU FOS = 3.910 ** (Fo factor = 1.086)

Failure surface No. 9 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	256.88	3653.72
2	260.49	3651.00
3	279.80	3638.21
4	303.99	3622.21
5	328.17	3606.20
6	352.35	3590.20
7	376.54	3574.19
8	381.54	3570.42
9	383.77	3568.18
10	433.47	3569.07
11	433.67	3569.26
12	435.15	3571.24
13	451.16	3595.42
14	467.17	3619.60
15	483.17	3643.79
16	499.18	3667.97
17	515.19	3692.15
18	521.75	3702.06
19	524.51	3705.73

** Corrected JANBU FOS = 3.910 ** (Fo factor = 1.086)

Failure surface No.10 specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	257.43	3653.86
2	261.04	3651.14
3	281.33	3637.70
4	305.52	3621.70
5	329.70	3605.69
6	353.88	3589.69
7	378.06	3573.68
8	382.57	3570.29
9	385.42	3567.44
10	440.08	3568.48
11	440.72	3569.12
12	442.21	3571.10
13	458.21	3595.28
14	474.22	3619.46
15	490.23	3643.65
16	506.23	3667.83

17	522.24	3692.01
18	529.14	3702.43
19	531.90	3706.09

** Corrected JANBU FOS = 3.912 ** (Fo factor = 1.086)

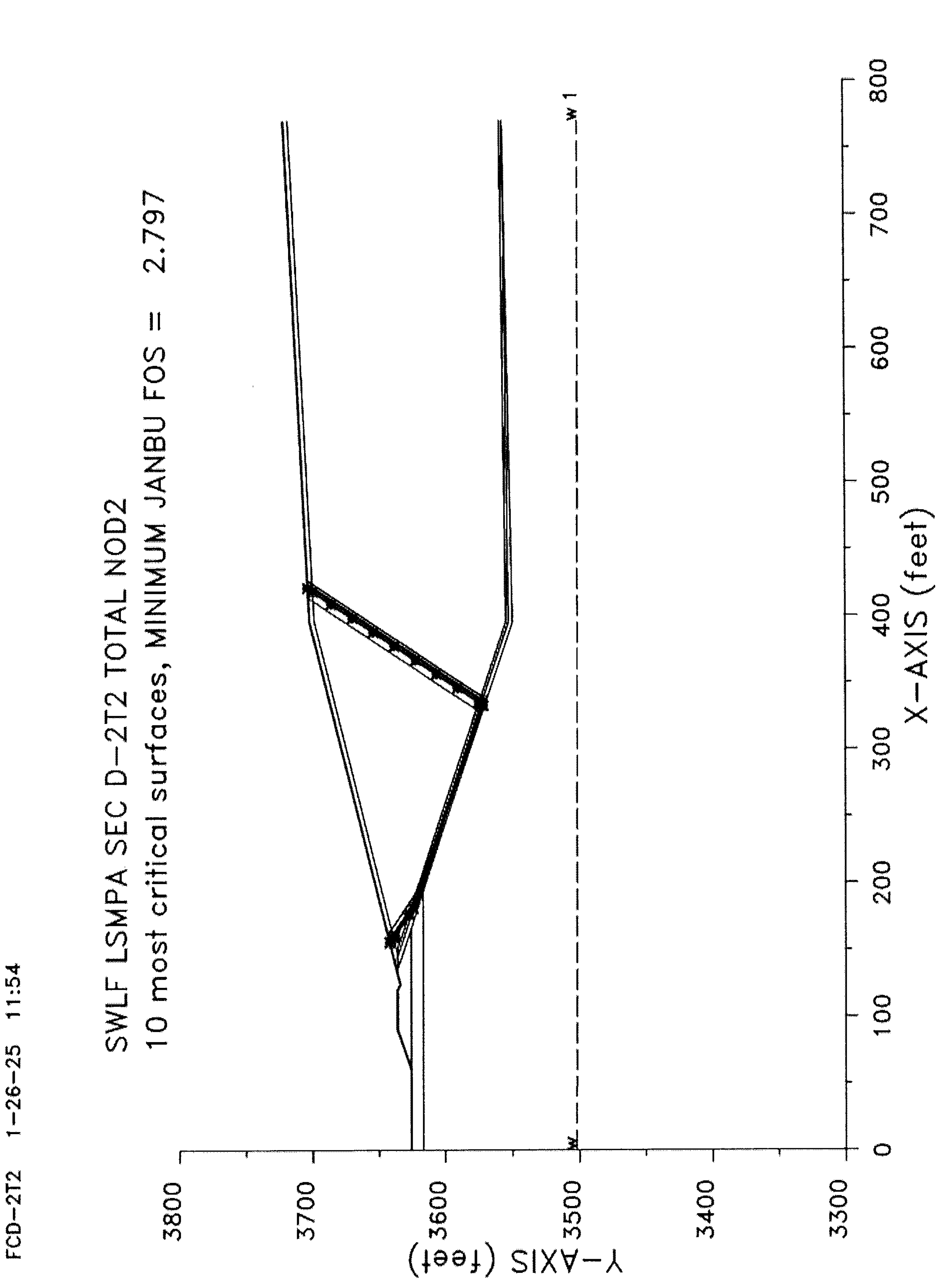
```
*******************************************************************
**                                                              **
**  Out of the    100 surfaces generated and analyzed by XSTABL, **
**        8 surfaces were found to have MISLEADING FOS values.   **
**                                                              **
*******************************************************************
```

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA SEC C-2T2 TOTAL NOD2

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	3.867	1.085	256.12	525.14	6.139E+05
2.	3.879	1.086	256.53	528.58	6.197E+05
3.	3.880	1.086	256.69	532.28	6.249E+05
4.	3.899	1.086	257.17	532.90	6.280E+05
5.	3.901	1.086	257.19	531.26	6.264E+05
6.	3.908	1.086	257.49	532.89	6.294E+05
7.	3.909	1.086	257.36	532.01	6.270E+05
8.	3.910	1.086	255.90	526.19	6.256E+05
9.	3.910	1.086	256.88	524.51	6.156E+05
10.	3.912	1.086	257.43	531.90	6.273E+05

* * * END OF FILE * * *


FCD-2T2 1-26-25 11:54
SWLF LSMPA SEC D-2T2 TOTAL NOD2
10 most critical surfaces, MINIMUM JANBU FOS = 2.797
Y-AXIS (feet)
X-AXIS (feet)
3800
3700
3600
3500
3400
3300
0
100
200
300
400
500
600
700
800
W
W 1

XSTABL File: FCD-2T2   1-26-25   11:54

```
****************************************
*              X S T A B L             *
*                                      *
*        Slope Stability Analysis      *
*               using the              *
*            Method of Slices          *
*                                      *
*        Copyright (C) 1992 - 2013     *
*   Interactive Software Designs, Inc. *
*       Moscow, ID 83843, U.S.A.       *
*                                      *
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*                                      *
* Ver. 5.209               96 - 2083   *
****************************************
```

Problem Description : SWLF LSMPA SEC D-2T2 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

8 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3625.9	60.2	3625.9	2
2	60.2	3625.9	60.3	3625.9	2
3	60.3	3625.9	89.9	3636.2	1
4	89.9	3636.2	119.9	3636.2	1
5	119.9	3636.2	123.9	3634.2	1
6	123.9	3634.2	132.0	3636.2	1
7	132.0	3636.2	395.2	3702.0	5
8	395.2	3702.0	770.1	3720.7	5

18 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	131.9	3636.2	135.1	3636.2	1
2	135.1	3636.2	144.6	3636.2	8

3	144.6	3636.2	146.5	3636.2	7
4	146.5	3636.2	395.7	3698.5	6
5	395.7	3698.5	770.1	3717.2	6
6	146.3	3636.2	150.9	3636.2	7
7	150.9	3636.2	395.2	3554.7	7
8	395.2	3554.7	770.1	3558.5	7
9	144.6	3636.2	394.9	3552.7	8
10	394.9	3552.7	770.1	3556.5	9
11	135.1	3636.2	165.9	3625.9	1
12	165.9	3625.9	192.9	3616.9	2
13	192.9	3616.9	363.7	3560.1	3
14	363.7	3560.1	393.7	3550.1	4
15	393.7	3550.1	394.4	3549.7	3
16	394.4	3549.7	770.1	3556.5	3
17	60.3	3625.9	165.9	3625.9	2
18	.0	3616.9	192.9	3616.9	3

ISOTROPIC Soil Parameters
----

9 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	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	122.5	127.0	1200.0	26.70	.000	.0	0
5	116.0	120.0	100.0	16.00	.000	.0	0
6	59.0	59.0	288.0	23.00	.000	.0	0
7	120.0	125.0	100.0	16.00	.000	.0	0
8	120.0	125.0	1000.0	.00	.000	.0	0
9	120.0	125.0	1000.0	.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3502.00
2	770.10	3500.10

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 19.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	180.0	3624.4	200.0	3617.7	5.0
2	320.0	3577.7	340.0	3571.0	5.0

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 17 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.35	3642.04
2	158.97	3639.32
3	160.81	3638.09
4	176.66	3627.61
5	180.83	3624.46
6	332.49	3571.58
7	333.95	3573.03
8	335.21	3574.71
9	345.70	3590.56
10	356.18	3606.40
11	366.67	3622.24
12	377.16	3638.09
13	387.64	3653.93
14	398.13	3669.78
15	408.62	3685.62
16	417.88	3699.61
17	420.64	3703.27

** Corrected JANBU FOS = 2.797 ** (Fo factor = 1.088)

Failure surface No. 2 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	154.58	3641.84
2	158.19	3639.12
3	158.66	3638.81
4	174.51	3628.32
5	179.51	3624.55
6	180.29	3623.78
7	334.98	3571.75
8	335.69	3572.45
9	336.95	3574.13
10	347.44	3589.98
11	357.93	3605.82
12	368.41	3621.66
13	378.90	3637.51
14	389.39	3653.35
15	399.87	3669.19
16	410.36	3685.04
17	420.08	3699.72
18	422.84	3703.38

** Corrected JANBU FOS = 2.822 ** (Fo factor = 1.088)

Failure surface No. 3 specified by 17 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	156.16	3642.24
2	159.77	3639.52
3	163.05	3637.35
4	178.90	3626.86
5	183.59	3623.32
6	332.44	3571.23
7	334.17	3572.96
8	335.43	3574.64
9	345.92	3590.48
10	356.41	3606.33
11	366.89	3622.17
12	377.38	3638.01
13	387.87	3653.86
14	398.35	3669.70
15	408.84	3685.54
16	418.16	3699.62
17	420.92	3703.28

** Corrected JANBU FOS = 2.824 ** (Fo factor = 1.088)

Failure surface No. 4 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	157.75	3642.64
2	161.36	3639.91
3	167.46	3635.88
4	183.30	3625.39
5	185.09	3624.04
6	337.38	3569.99
7	338.80	3571.41
8	340.07	3573.09
9	350.56	3588.94
10	361.04	3604.78
11	371.53	3620.62
12	382.02	3636.47
13	392.50	3652.31
14	402.99	3668.15
15	413.48	3684.00
16	423.96	3699.84
17	424.01	3699.91
18	426.77	3703.57

** Corrected JANBU FOS = 2.826 ** (Fo factor = 1.088)

Failure surface No. 5 specified by 17 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	161.43	3643.56
2	165.04	3640.83
3	177.68	3632.47
4	193.53	3621.98
5	198.52	3618.22
6	336.70	3572.04
7	336.76	3572.10
8	338.02	3573.78
9	348.51	3589.62
10	358.99	3605.46
11	369.48	3621.31
12	379.97	3637.15
13	390.45	3652.99
14	400.94	3668.84
15	411.43	3684.68
16	421.42	3699.78
17	424.18	3703.45

** Corrected JANBU FOS = 2.829 ** (Fo factor = 1.088)

Failure surface No. 6 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.48	3642.07
2	159.10	3639.35
3	161.17	3637.97
4	177.02	3627.49
5	182.02	3623.72
6	183.64	3622.10
7	328.30	3574.81
8	328.38	3574.89
9	329.64	3576.57
10	340.13	3592.41
11	350.62	3608.26
12	361.10	3624.10
13	371.59	3639.94
14	382.08	3655.79
15	392.56	3671.63

16	403.05	3687.48
17	410.85	3699.26
18	413.61	3702.92

** Corrected JANBU FOS = 2.830 ** (Fo factor = 1.088)

Failure surface No. 7 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.83	3642.16
2	159.44	3639.44
3	162.14	3637.65
4	177.98	3627.17
5	182.98	3623.40
6	186.43	3619.95
7	335.76	3572.26
8	335.89	3572.39
9	337.15	3574.07
10	347.64	3589.91
11	358.13	3605.75
12	368.61	3621.60
13	379.10	3637.44
14	389.59	3653.28
15	400.07	3669.13
16	410.56	3684.97
17	420.33	3699.73
18	423.09	3703.39

** Corrected JANBU FOS = 2.831 ** (Fo factor = 1.088)

Failure surface No. 8 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.40	3642.05
2	159.02	3639.33
3	160.95	3638.05
4	176.80	3627.56
5	181.80	3623.79
6	184.20	3621.39
7	335.79	3571.29
8	336.63	3572.14
9	337.90	3573.82
10	348.39	3589.66
11	358.87	3605.50

12	369.36	3621.35
13	379.85	3637.19
14	390.33	3653.03
15	400.82	3668.88
16	411.31	3684.72
17	421.27	3699.78
18	424.03	3703.44

** Corrected JANBU FOS = 2.835 ** (Fo factor = 1.088)

Failure surface No. 9 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	157.18	3642.49
2	160.79	3639.77
3	165.88	3636.41
4	181.72	3625.92
5	186.72	3622.15
6	187.91	3620.96
7	333.02	3571.97
8	334.05	3573.00
9	335.32	3574.68
10	345.80	3590.52
11	356.29	3606.37
12	366.78	3622.21
13	377.26	3638.05
14	387.75	3653.90
15	398.24	3669.74
16	408.72	3685.58
17	418.01	3699.61
18	420.77	3703.28

** Corrected JANBU FOS = 2.837 ** (Fo factor = 1.088)

Failure surface No.10 specified by 18 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	161.28	3643.52
2	164.89	3640.80
3	177.28	3632.60
4	193.12	3622.11
5	198.10	3618.36
6	338.24	3570.90
7	338.77	3571.43

8	340.03	3573.10
9	350.52	3588.95
10	361.01	3604.79
11	371.49	3620.64
12	381.98	3636.48
13	392.47	3652.32
14	402.95	3668.17
15	413.44	3684.01
16	423.93	3699.85
17	423.97	3699.91
18	426.72	3703.57

** Corrected JANBU FOS = 2.840 ** (Fo factor = 1.088)

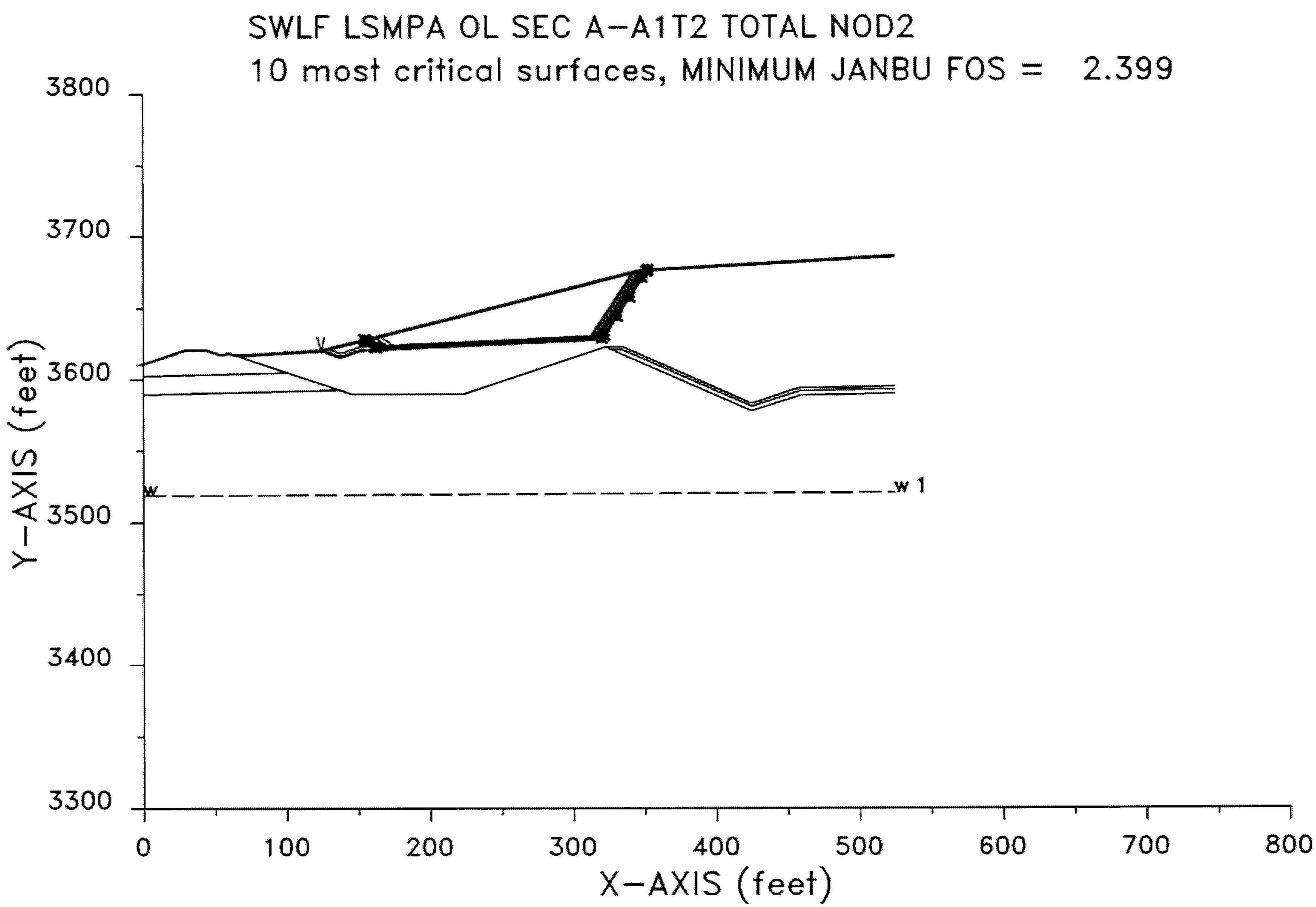
The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA SEC D-2T2 TOTAL NOD2

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.797	1.088	155.35	420.64	4.044E+05
2.	2.822	1.088	154.58	422.84	4.157E+05
3.	2.824	1.088	156.16	420.92	4.087E+05
4.	2.826	1.088	157.75	426.77	4.227E+05
5.	2.829	1.088	161.43	424.18	4.141E+05
6.	2.830	1.088	155.48	413.61	3.941E+05
7.	2.831	1.088	155.83	423.09	4.156E+05
8.	2.835	1.088	155.40	424.03	4.184E+05
9.	2.837	1.088	157.18	420.77	4.101E+05
10.	2.840	1.088	161.28	426.72	4.214E+05

* * * END OF FILE * * *

OL-A1T2 1-26-25 13:29



XSTABL File: OL-A1T2   1-26-25   13:29

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*        Copyright (C) 1992 - 2013      *
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*                                       *
*  Ver. 5.209                96 - 2083  *
*****************************************
```

Problem Description : SWLF LSMPA OL SEC A-A1T2 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

11 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3611.0	29.1	3620.7	1
2	29.1	3620.7	44.1	3620.7	1
3	44.1	3620.7	53.1	3617.7	1
4	53.1	3617.7	56.1	3617.7	1
5	56.1	3617.7	59.3	3618.8	1
6	59.3	3618.8	64.1	3617.1	1
7	64.1	3617.1	121.7	3620.6	4
8	121.7	3620.6	124.6	3620.8	8
9	124.6	3620.8	126.5	3621.3	5
10	126.5	3621.3	347.7	3676.6	4
11	347.7	3676.6	524.5	3686.5	4

42 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment

1	126.5	3621.3	129.7	3621.3	5
2	129.7	3621.3	130.3	3621.2	5
3	124.6	3620.8	126.4	3630.2	8
4	121.7	3630.2	124.2	3619.8	9
5	66.7	3616.3	124.2	3619.8	9
6	124.2	3619.8	124.8	3619.8	8
7	124.8	3619.8	126.4	3620.2	8
8	126.4	3620.2	130.3	3621.2	5
9	130.3	3621.2	347.9	3675.6	9
10	347.9	3675.6	524.5	3685.5	9
11	130.3	3621.2	137.7	3618.7	5
12	137.7	3618.7	151.1	3623.1	5
13	151.1	3623.1	188.2	3625.0	5
14	188.2	3625.0	322.5	3631.3	5
15	126.4	3620.2	137.7	3616.5	8
16	137.7	3616.5	151.5	3621.1	8
17	151.5	3621.1	188.3	3622.9	8
18	188.3	3622.9	322.5	3629.2	8
19	124.2	3619.8	137.7	3615.3	9
20	137.7	3615.3	151.7	3620.0	9
21	151.7	3620.0	188.3	3621.8	9
22	188.3	3621.8	322.5	3628.1	9
23	66.7	3616.3	100.8	3604.9	1
24	100.8	3604.9	137.0	3592.8	2
25	137.0	3592.8	145.5	3590.0	3
26	145.5	3590.0	223.5	3590.0	3
27	223.5	3590.0	322.5	3623.0	3
28	322.5	3623.0	334.9	3623.0	5
29	334.9	3623.0	424.8	3583.3	5
30	424.8	3583.3	454.0	3592.9	5
31	454.0	3592.9	458.6	3594.0	5
32	458.6	3594.0	524.5	3595.2	5
33	322.5	3623.0	327.0	3621.0	3
34	327.0	3621.0	334.5	3621.0	6
35	334.5	3621.0	424.7	3581.2	6
36	424.7	3581.2	458.8	3592.0	7
37	458.8	3592.0	524.5	3593.3	7
38	327.0	3621.0	424.5	3578.0	3
39	424.5	3578.0	459.2	3589.0	3
40	459.2	3589.0	524.5	3590.3	3
41	.0	3602.6	100.8	3604.9	2
42	.0	3589.6	137.0	3592.8	3

ISOTROPIC Soil Parameters
----

9 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	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	116.0	120.0	100.0	16.00	.000	.0	0
5	120.0	125.0	100.0	16.00	.000	.0	0
6	120.0	125.0	1000.0	.00	.000	.0	0
7	120.0	125.0	1000.0	.00	.000	.0	0
8	120.0	125.0	1000.0	.00	.000	.0	0
9	59.0	59.0	288.0	23.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3518.70
2	524.50	3520.80

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 16.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	161.6	3622.1	181.6	3623.1	3.2
2	301.4	3628.7	321.4	3629.7	3.2

****

-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)

****

Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.

****

USER SELECTED option for unrestricted values of strength

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	154.33	3628.26
2	155.38	3627.47
3	161.19	3623.62
4	162.31	3622.78
5	320.40	3629.18
6	321.98	3631.28

7	330.81	3644.62
8	339.64	3657.96
9	348.47	3671.30
10	351.45	3675.80
11	352.24	3676.85

** Corrected JANBU FOS = 2.399 ** (Fo factor = 1.070)

Failure surface No. 2 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	156.22	3628.73
2	157.26	3627.94
3	163.61	3623.74
4	163.65	3623.71
5	318.78	3630.21
6	319.50	3631.16
7	328.33	3644.50
8	337.16	3657.84
9	345.99	3671.19
10	348.95	3675.66
11	349.74	3676.71

** Corrected JANBU FOS = 2.409 ** (Fo factor = 1.070)

Failure surface No. 3 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	157.51	3629.05
2	158.56	3628.26
3	165.26	3623.83
4	167.12	3622.43
5	318.21	3630.56
6	318.63	3631.12
7	327.46	3644.46
8	336.29	3657.80
9	345.12	3671.15
10	348.08	3675.61
11	348.87	3676.67

** Corrected JANBU FOS = 2.410 ** (Fo factor = 1.070)

Failure surface No. 4 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	154.47	3628.29
2	155.51	3627.50
3	161.37	3623.63
4	163.45	3622.06
5	314.06	3630.45
6	314.41	3630.92
7	323.24	3644.26
8	332.07	3657.60
9	340.90	3670.95
10	343.20	3674.43
11	344.18	3675.72

** Corrected JANBU FOS = 2.414 ** (Fo factor = 1.069)

Failure surface No. 5 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	158.15	3629.21
2	159.20	3628.42
3	166.08	3623.87
4	167.25	3622.99
5	317.26	3629.48
6	318.49	3631.11
7	327.33	3644.45
8	336.16	3657.80
9	344.99	3671.14
10	347.94	3675.60
11	348.74	3676.66

** Corrected JANBU FOS = 2.426 ** (Fo factor = 1.071)

Failure surface No. 6 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	155.94	3628.66
2	156.98	3627.87
3	163.25	3623.72
4	164.38	3622.87
5	312.66	3630.77
6	312.71	3630.84

7	321.54	3644.18
8	330.37	3657.53
9	339.20	3670.87
10	341.23	3673.93
11	342.21	3675.23

** Corrected JANBU FOS = 2.427 ** (Fo factor = 1.069)

Failure surface No. 7 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	154.27	3628.24
2	155.32	3627.45
3	161.12	3623.61
4	161.82	3623.08
5	311.69	3629.90
6	312.39	3630.83
7	321.22	3644.17
8	330.05	3657.51
9	338.88	3670.85
10	340.86	3673.84
11	341.84	3675.13

** Corrected JANBU FOS = 2.431 ** (Fo factor = 1.070)

Failure surface No. 8 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	157.87	3629.14
2	158.91	3628.35
3	165.72	3623.85
4	165.76	3623.82
5	315.59	3629.91
6	316.42	3631.01
7	325.25	3644.36
8	334.08	3657.70
9	342.91	3671.04
10	345.54	3675.01
11	346.52	3676.30

** Corrected JANBU FOS = 2.432 ** (Fo factor = 1.070)

Failure surface No. 9 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	164.89	3630.90
2	165.94	3630.11
3	174.70	3624.31
4	175.50	3623.71
5	320.59	3630.58
6	321.08	3631.23
7	329.91	3644.58
8	338.74	3657.92
9	347.58	3671.26
10	350.55	3675.75
11	351.34	3676.80

** Corrected JANBU FOS = 2.435 ** (Fo factor = 1.071)

Failure surface No.10 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	161.39	3630.02
2	162.44	3629.23
3	170.23	3624.08
4	172.25	3622.55
5	315.86	3629.47
6	317.05	3631.04
7	325.88	3644.39
8	334.71	3657.73
9	343.54	3671.07
10	346.27	3675.19
11	347.24	3676.49

** Corrected JANBU FOS = 2.445 ** (Fo factor = 1.072)

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA OL SEC A-A1T2 TOTAL NOD2

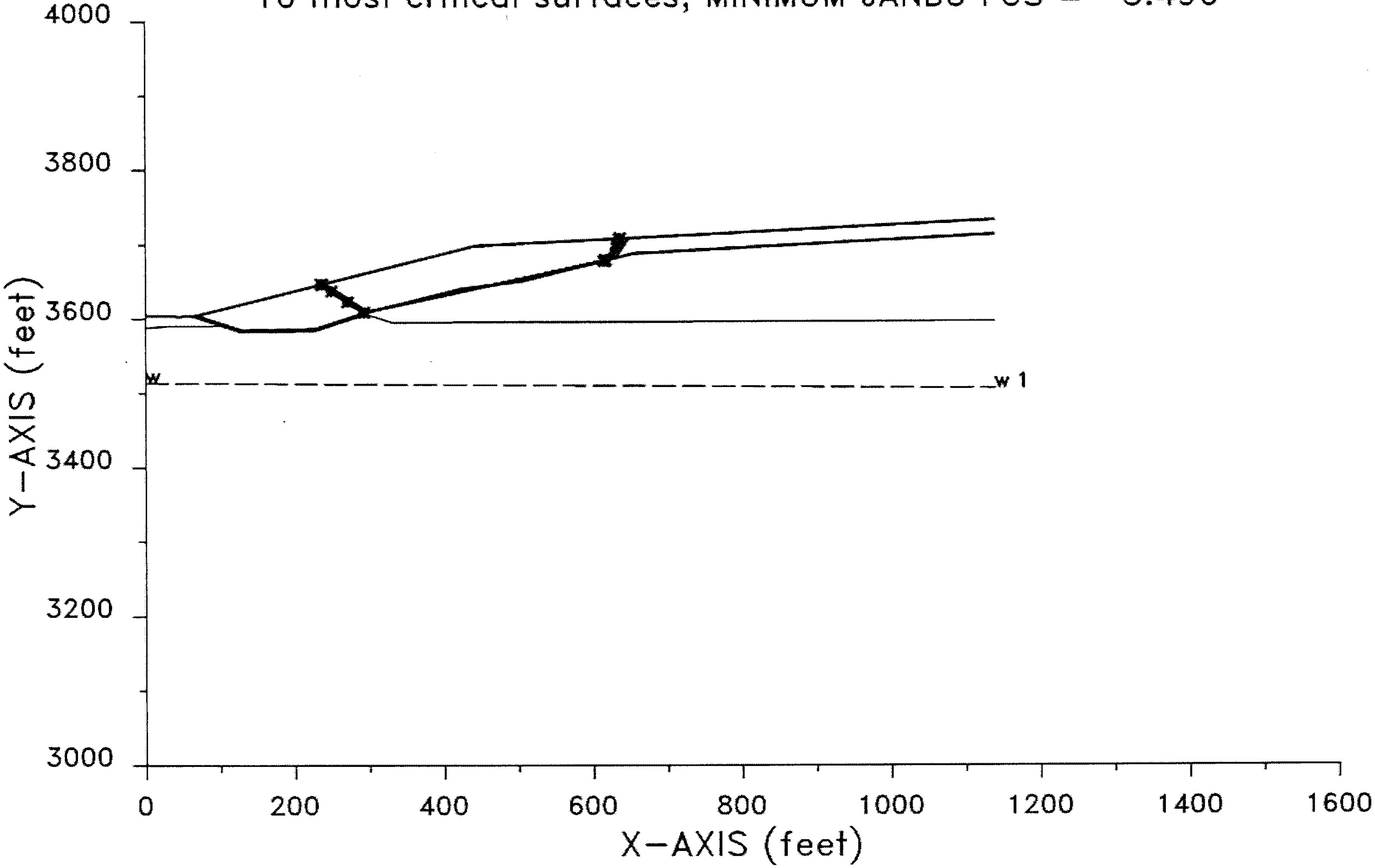
Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)

1.	2.399	1.070	154.33	352.24	1.264E+05
2.	2.409	1.070	156.22	349.74	1.180E+05
3.	2.410	1.070	157.51	348.87	1.197E+05
4.	2.414	1.069	154.47	344.18	1.160E+05
5.	2.426	1.071	158.15	348.74	1.210E+05
6.	2.427	1.069	155.94	342.21	1.109E+05
7.	2.431	1.070	154.27	341.84	1.123E+05
8.	2.432	1.070	157.87	346.52	1.151E+05
9.	2.435	1.071	164.89	351.34	1.190E+05
10.	2.445	1.072	161.39	347.24	1.205E+05

* * * END OF FILE * * *

OL-B1T2   1-26-25   13:33

SWLF LSMPA OL SEC B-B1T2 TOTAL NOD2
10 most critical surfaces, MINIMUM JANBU FOS =   3.496



XSTABL File: OL-B1T2   1-26-25   13:33

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*****************************************
*              X S T A B L              *
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*               using the               *
*            Method of Slices           *
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Problem Description : SWLF LSMPA OL SEC B-B1T2 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

8 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3604.5	39.4	3604.5	1
2	39.4	3604.5	43.4	3602.6	1
3	43.4	3602.6	51.4	3604.6	1
4	51.4	3604.6	59.4	3604.6	1
5	59.4	3604.6	65.7	3604.6	6
6	65.7	3604.6	65.8	3604.6	5
7	65.8	3604.6	441.6	3698.5	9
8	441.6	3698.5	1138.7	3733.4	9

27 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	65.8	3604.6	70.0	3604.6	5
2	70.0	3604.6	441.6	3697.5	4

3	441.6	3697.5	1138.7	3732.4	4
4	70.0	3604.6	72.1	3604.6	5
5	72.1	3604.6	128.5	3585.8	5
6	128.5	3585.8	226.6	3587.2	5
7	226.6	3587.2	284.2	3606.4	5
8	284.2	3606.4	289.9	3608.3	8
9	289.9	3608.3	424.5	3642.0	8
10	424.5	3642.0	505.7	3652.0	8
11	505.7	3652.0	653.8	3689.0	8
12	653.8	3689.0	1138.6	3714.7	8
13	65.7	3604.6	128.2	3583.8	6
14	128.2	3583.8	226.9	3585.2	7
15	226.9	3585.2	290.5	3606.4	6
16	290.5	3606.4	424.9	3640.0	4
17	424.9	3640.0	506.1	3650.0	4
18	506.1	3650.0	654.1	3687.0	4
19	654.1	3687.0	1138.7	3712.7	4
20	59.4	3604.6	102.7	3590.2	1
21	102.7	3590.2	127.9	3581.8	2
22	127.9	3581.8	227.3	3583.2	2
23	227.3	3583.2	296.8	3606.4	2
24	296.8	3606.4	330.3	3595.2	2
25	330.3	3595.2	1138.7	3596.6	2
26	.0	3588.1	28.3	3590.2	2
27	28.3	3590.2	102.7	3590.2	2

ISOTROPIC Soil Parameters
----

9 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	121.9	121.9	100.0	26.00	.000	.0	0
2	122.5	127.0	1200.0	26.70	.000	.0	1
3	122.5	127.0	1200.0	26.70	.000	.0	0
4	59.0	59.0	288.0	23.00	.000	.0	0
5	120.0	125.0	100.0	16.00	.000	.0	0
6	120.0	125.0	1000.0	.00	.000	.0	0
7	120.0	125.0	1000.0	.00	.000	.0	0
8	120.0	125.0	1000.0	.00	.000	.0	0
9	116.0	120.0	100.0	16.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	3514.00
2	1139.10	3506.60

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 26.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	290.2	3607.3	309.6	3612.2	2.0
2	615.0	3678.3	634.4	3683.1	2.0

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED JANBU METHOD   * * * * *

The 10 most critical of all the failure surfaces examined
are displayed below - the most critical first

Failure surface No. 1 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	235.61	3647.03
2	236.63	3646.26
3	249.50	3637.74
4	271.18	3623.39
5	292.86	3609.04
6	292.95	3608.94
7	615.05	3677.57
8	617.38	3679.90
9	631.73	3701.58
10	635.45	3707.21
11	636.24	3708.24

** Corrected JANBU FOS =   3.496 **   (Fo factor = 1.048)

Failure surface No. 2 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	240.62	3648.28
2	241.64	3647.51
3	254.50	3639.00
4	276.19	3624.64
5	297.87	3610.29
6	297.91	3610.25
7	615.34	3677.43
8	617.95	3680.04
9	632.31	3701.73
10	635.95	3707.23
11	636.73	3708.27

** Corrected JANBU FOS =   3.526 **   (Fo factor = 1.048)

Failure surface No. 3 specified by 11 coordinate points

Point   x-surf   y-surf

No.	(ft)	(ft)
1	237.05	3647.39
2	238.07	3646.62
3	250.94	3638.10
4	272.62	3623.75
5	294.30	3609.40
6	294.51	3609.19
7	617.04	3679.29
8	617.74	3679.99
9	632.09	3701.67
10	635.77	3707.22
11	636.55	3708.26

** Corrected JANBU FOS = 3.529 ** (Fo factor = 1.048)

Failure surface No. 4 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	234.83	3646.84
2	235.86	3646.06
3	248.72	3637.55
4	270.40	3623.20
5	292.09	3608.85
6	292.19	3608.74
7	631.86	3682.87
8	632.72	3683.73
9	647.07	3705.42
10	648.70	3707.87
11	649.48	3708.91

** Corrected JANBU FOS = 3.531 ** (Fo factor = 1.047)

Failure surface No. 5 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	232.79	3646.32
2	233.81	3645.55
3	246.68	3637.04
4	268.36	3622.69
5	290.04	3608.34
6	290.42	3607.96
7	624.98	3681.20
8	625.79	3682.00

9	640.14	3703.68
10	642.71	3707.57
11	643.49	3708.61

** Corrected JANBU FOS = 3.532 ** (Fo factor = 1.047)

Failure surface No. 6 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	236.62	3647.28
2	237.64	3646.51
3	250.51	3637.99
4	272.19	3623.64
5	293.87	3609.29
6	294.03	3609.13
7	621.01	3679.91
8	622.21	3681.11
9	636.56	3702.79
10	639.62	3707.41
11	640.40	3708.45

** Corrected JANBU FOS = 3.533 ** (Fo factor = 1.048)

Failure surface No. 7 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	236.88	3647.35
2	237.91	3646.58
3	250.77	3638.06
4	272.45	3623.71
5	294.14	3609.36
6	294.23	3609.26
7	628.76	3682.02
8	629.73	3682.99
9	644.08	3704.67
10	646.11	3707.74
11	646.90	3708.78

** Corrected JANBU FOS = 3.542 ** (Fo factor = 1.047)

Failure surface No. 8 specified by 11 coordinate points

Point	x-surf	y-surf

No.	(ft)	(ft)
1	235.11	3646.90
2	236.13	3646.13
3	249.00	3637.62
4	270.68	3623.27
5	292.36	3608.92
6	292.90	3608.38
7	625.92	3681.95
8	626.04	3682.06
9	640.39	3703.75
10	642.93	3707.58
11	643.71	3708.62

** Corrected JANBU FOS = 3.556 ** (Fo factor = 1.048)

Failure surface No. 9 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	241.37	3648.47
2	242.39	3647.70
3	255.26	3639.18
4	276.94	3624.83
5	298.62	3610.48
6	298.78	3610.32
7	623.57	3681.20
8	623.91	3681.53
9	638.26	3703.21
10	641.09	3707.49
11	641.87	3708.53

** Corrected JANBU FOS = 3.561 ** (Fo factor = 1.048)

Failure surface No.10 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	241.46	3648.49
2	242.48	3647.72
3	255.35	3639.21
4	277.03	3624.86
5	298.71	3610.51
6	299.03	3610.18
7	616.17	3677.71
8	618.69	3680.23

9	633.04	3701.91
10	636.58	3707.26
11	637.37	3708.30

** Corrected JANBU FOS = 3.562 ** (Fo factor = 1.049)

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA OL SEC B-B1T2 TOTAL NOD2

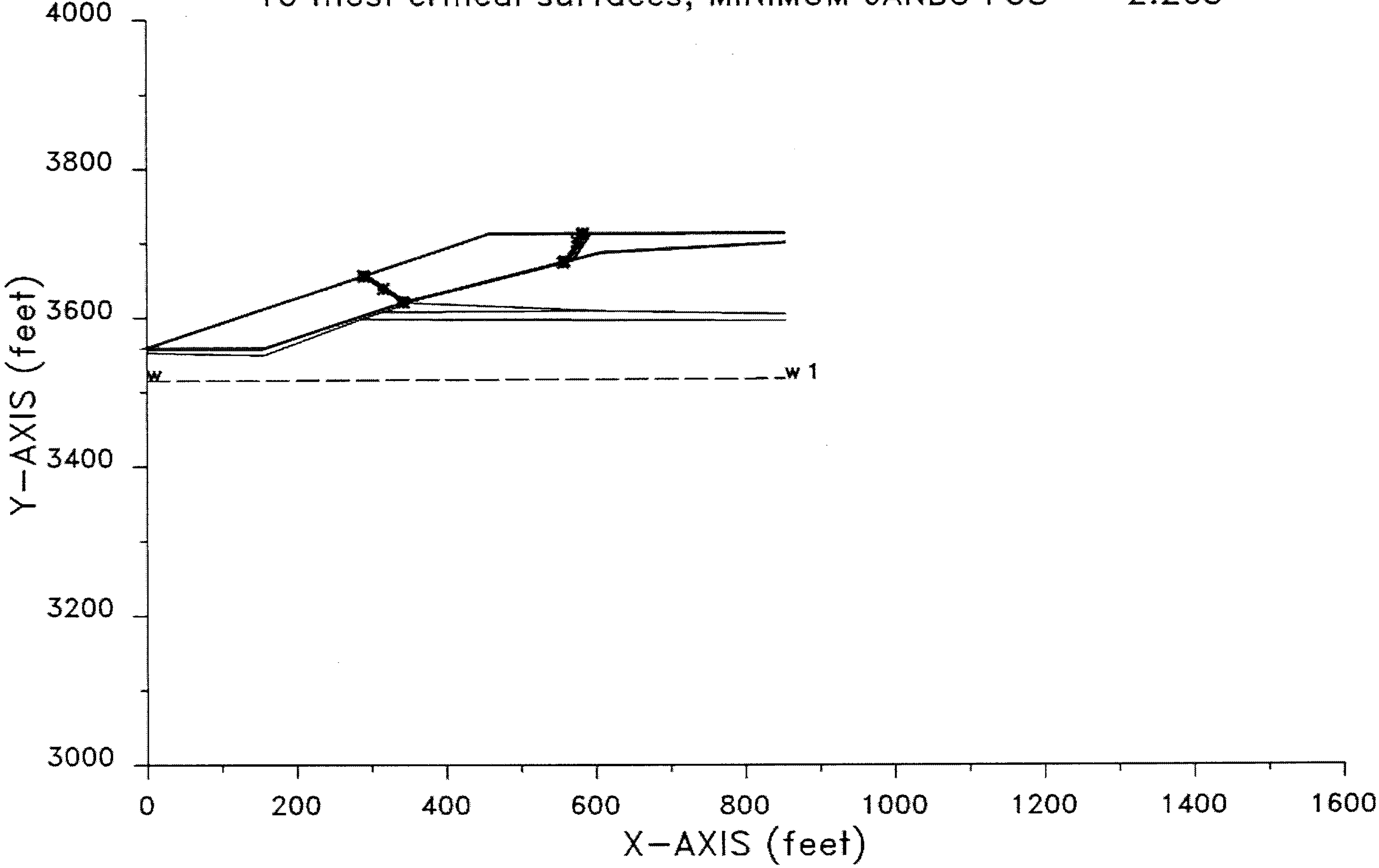
	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	3.496	1.048	235.61	636.24	5.416E+05
2.	3.526	1.048	240.62	636.73	5.326E+05
3.	3.529	1.048	237.05	636.55	5.381E+05
4.	3.531	1.047	234.83	649.48	5.491E+05
5.	3.532	1.047	232.79	643.49	5.556E+05
6.	3.533	1.048	236.62	640.40	5.425E+05
7.	3.542	1.047	236.88	646.90	5.442E+05
8.	3.556	1.048	235.11	643.71	5.523E+05
9.	3.561	1.048	241.37	641.87	5.309E+05
10.	3.562	1.049	241.46	637.37	5.380E+05

* * * END OF FILE * * *

OL-C1T2   1-26-25   13:35

SWLF LSMPA OL SEC C-C1T2 TOTAL NOD2

10 most critical surfaces, MINIMUM JANBU FOS =   2.263



XSTABL File: OL-C1T2   1-26-25   13:35

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
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Problem Description : SWLF LSMPA OL SEC C-C1T2 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

2 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3560.3	458.7	3713.2	9
2	458.7	3713.2	853.9	3714.2	9

20 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3560.3	3.0	3560.3	5
2	3.0	3560.3	458.4	3712.1	4
3	458.4	3712.1	853.9	3713.2	4
4	3.0	3560.3	155.3	3560.0	5
5	155.3	3560.0	336.9	3620.0	8
6	336.9	3620.0	342.8	3622.4	8
7	342.8	3622.4	609.0	3689.0	8
8	609.0	3689.0	854.4	3702.0	8

9	.0	3558.3	155.7	3558.0	7
10	155.7	3558.0	343.3	3620.5	6
11	343.3	3620.5	609.3	3687.0	4
12	609.3	3687.0	853.9	3700.0	4
13	.0	3553.3	156.2	3550.0	3
14	156.2	3550.0	285.8	3598.2	3
15	285.8	3598.2	315.2	3608.0	2
16	315.2	3608.0	352.7	3620.5	1
17	352.7	3620.5	613.6	3609.6	1
18	613.6	3609.6	853.9	3605.3	2
19	315.2	3608.0	613.6	3609.6	2
20	285.8	3598.2	854.0	3596.7	3

ISOTROPIC Soil Parameters
----

9 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	122.5	122.5	100.0	26.00	.000	.0	0
2	121.9	121.9	100.0	26.00	.000	.0	0
3	122.5	127.0	1200.0	26.70	.000	.0	1
4	59.0	59.0	288.0	23.00	.000	.0	0
5	120.0	125.0	100.0	16.00	.000	.0	0
6	120.0	125.0	1000.0	.00	.000	.0	0
7	120.0	125.0	1000.0	.00	.000	.0	0
8	120.0	125.0	1000.0	.00	.000	.0	0
9	116.0	120.0	100.0	16.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)

1	.00	3515.40
2	853.90	3518.20

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 31.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	343.0	3621.5	362.4	3626.3	2.0
2	556.4	3674.8	575.9	3679.7	2.0

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	290.01	3656.97

2	290.93	3656.28
3	316.53	3639.34
4	342.38	3622.23
5	343.65	3620.95
6	556.58	3674.23
7	558.78	3676.44
8	575.89	3702.29
9	582.62	3712.45
10	583.42	3713.52

** Corrected JANBU FOS = 2.263 ** (Fo factor = 1.060)

Failure surface No. 2 specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	289.78	3656.89
2	290.70	3656.20
3	316.31	3639.25
4	342.16	3622.14
5	343.07	3621.23
6	563.22	3675.95
7	565.34	3678.08
8	582.45	3703.93
9	588.10	3712.46
10	588.91	3713.53

** Corrected JANBU FOS = 2.295 ** (Fo factor = 1.059)

Failure surface No. 3 specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	289.70	3656.87
2	290.62	3656.17
3	316.23	3639.22
4	342.08	3622.11
5	343.42	3620.78
6	563.20	3676.93
7	564.02	3677.75
8	581.13	3703.60
9	587.00	3712.46
10	587.80	3713.53

** Corrected JANBU FOS = 2.297 ** (Fo factor = 1.059)

Failure surface No. 4 specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	292.28	3657.73
2	293.20	3657.03
3	318.93	3640.00
4	344.78	3622.89
5	346.05	3621.62
6	558.88	3675.54
7	560.11	3676.77
8	577.22	3702.62
9	583.73	3712.45
10	584.53	3713.52

** Corrected JANBU FOS = 2.309 ** (Fo factor = 1.060)

Failure surface No. 5 specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	293.46	3658.12
2	294.38	3657.43
3	320.21	3640.33
4	346.06	3623.22
5	347.28	3622.00
6	560.08	3675.47
7	561.81	3677.19
8	578.92	3703.04
9	585.15	3712.45
10	585.96	3713.52

** Corrected JANBU FOS = 2.318 ** (Fo factor = 1.060)

Failure surface No. 6 specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	290.04	3656.98
2	290.96	3656.29
3	316.55	3639.35
4	342.40	3622.24
5	343.28	3621.36
6	571.01	3678.10

7	572.87	3679.96
8	589.98	3705.81
9	594.40	3712.48
10	595.20	3713.55

** Corrected JANBU FOS = 2.327 ** (Fo factor = 1.058)

Failure surface No. 7 specified by 11 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	294.35	3658.42
2	295.27	3657.72
3	295.33	3657.68
4	321.18	3640.57
5	347.03	3623.46
6	348.55	3621.94
7	567.96	3677.09
8	570.15	3679.28
9	587.26	3705.13
10	592.12	3712.47
11	592.93	3713.54

** Corrected JANBU FOS = 2.328 ** (Fo factor = 1.059)

Failure surface No. 8 specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	290.79	3657.23
2	291.71	3656.54
3	317.30	3639.60
4	343.15	3622.49
5	343.81	3621.84
6	568.58	3677.09
7	570.98	3679.49
8	588.09	3705.34
9	592.81	3712.47
10	593.62	3713.54

** Corrected JANBU FOS = 2.330 ** (Fo factor = 1.058)

Failure surface No. 9 specified by 10 coordinate points

Point x-surf y-surf

No.	(ft)	(ft)
1	292.86	3657.92
2	293.78	3657.23
3	319.57	3640.16
4	345.42	3623.05
5	346.53	3621.94
6	564.49	3676.79
7	565.92	3678.22
8	583.03	3704.07
9	588.59	3712.46
10	589.39	3713.53

** Corrected JANBU FOS = 2.334 ** (Fo factor = 1.059)

Failure surface No.10 specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	290.90	3657.27
2	291.82	3656.57
3	317.42	3639.63
4	343.27	3622.52
5	344.60	3621.18
6	570.68	3678.90
7	571.37	3679.59
8	588.48	3705.44
9	593.14	3712.47
10	593.94	3713.54

** Corrected JANBU FOS = 2.336 ** (Fo factor = 1.058)

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA OL SEC C-C1T2 TOTAL NOD2

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	2.263	1.060	290.01	583.42	3.205E+05
2.	2.295	1.059	289.78	588.91	3.253E+05
3.	2.297	1.059	289.70	587.80	3.244E+05
4.	2.309	1.060	292.28	584.53	3.190E+05

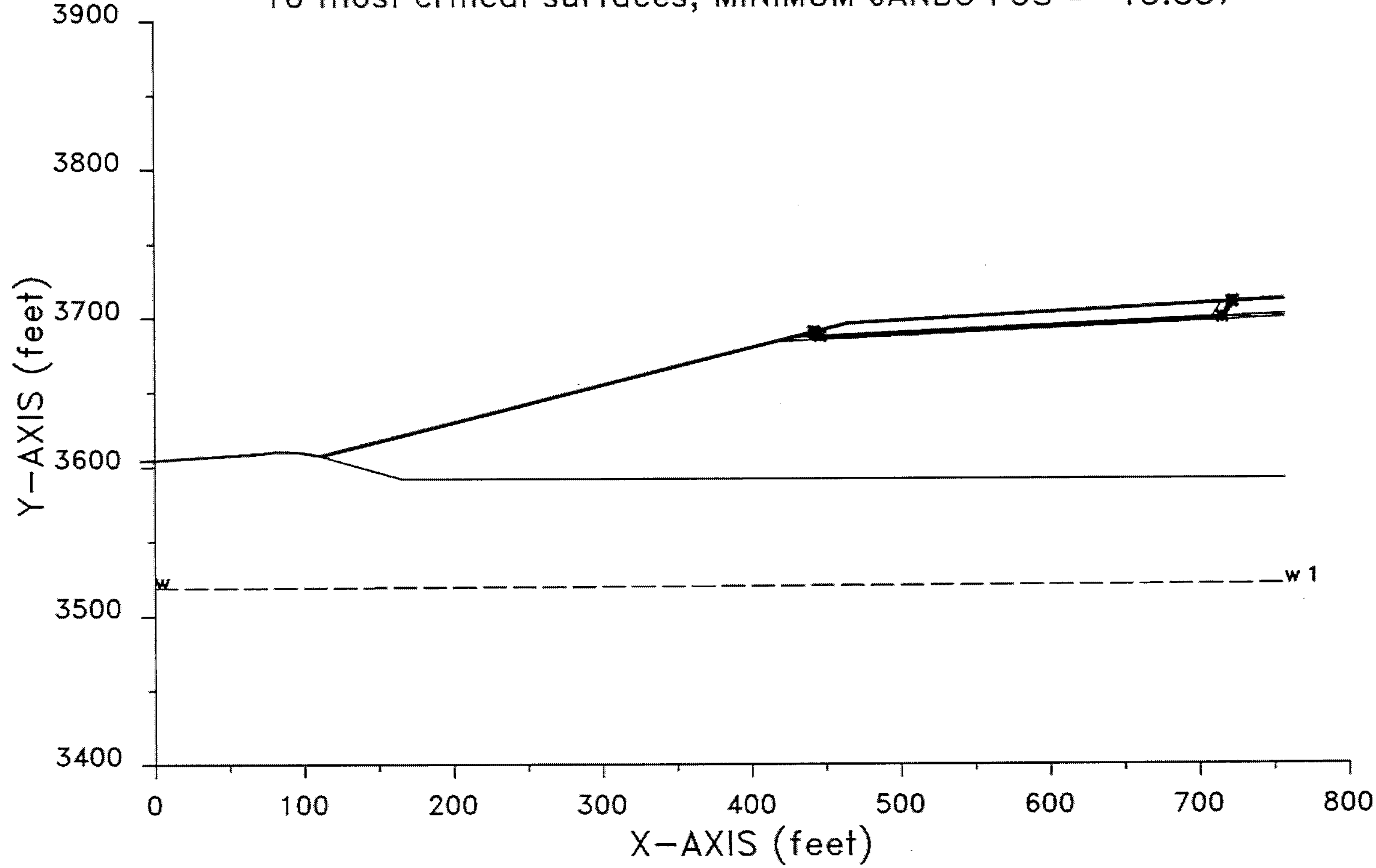
5.	2.318	1.060	293.46	585.96	3.192E+05
6.	2.327	1.058	290.04	595.20	3.306E+05
7.	2.328	1.059	294.35	592.93	3.250E+05
8.	2.330	1.058	290.79	593.62	3.283E+05
9.	2.334	1.059	292.86	589.39	3.227E+05
10.	2.336	1.058	290.90	593.94	3.286E+05

* * * END OF FILE * * *

OL-D1T2 1-26-25 13:36

SWLF LSMPA OL SEC D-D1T2 TOTAL NOD2

10 most critical surfaces, MINIMUM JANBU FOS = 15.557



XSTABL File: OL-D1T2   1-26-25   13:36

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*        Copyright (C) 1992 - 2013      *
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*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.209              96 - 2083    *
*****************************************
```

Problem Description : SWLF LSMPA OL SEC D-D1T2 TOTAL NOD2

SEGMENT BOUNDARY COORDINATES
----

7 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	3604.7	71.6	3609.2	1
2	71.6	3609.2	81.9	3610.5	1
3	81.9	3610.5	97.0	3610.0	1
4	97.0	3610.0	109.3	3607.9	1
5	109.3	3607.9	111.3	3608.0	5
6	111.3	3608.0	465.3	3696.5	5
7	465.3	3696.5	757.0	3712.7	5

9 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	109.3	3607.9	112.4	3607.2	1
2	112.4	3607.2	419.2	3683.9	3
3	419.2	3683.9	429.4	3686.5	4

4	429.4	3686.5	465.8	3695.6	3
5	465.8	3695.6	757.5	3711.7	3
6	429.4	3686.5	757.5	3702.2	4
7	419.2	3683.9	757.2	3700.2	3
8	109.3	3607.9	165.8	3592.0	1
9	165.8	3592.0	757.2	3592.0	1

ISOTROPIC Soil Parameters

----

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Constant (psf)	Water Surface No.
1	122.5	127.0	1200.0	26.70	.000	.0	1
2	122.5	127.0	1200.0	26.70	.000	.0	0
3	59.0	59.0	288.0	23.00	.000	.0	0
4	120.0	125.0	1000.0	.00	.000	.0	0
5	116.0	120.0	100.0	16.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****

PHREATIC SURFACE,

****

Point No.	x-water (ft)	y-water (ft)
1	.00	3518.60
2	757.20	3521.30

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces
are generated according to the Rankine theory.

100 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of
sliding block is 22.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	439.5	3686.0	449.4	3686.6	2.0
2	707.2	3699.1	717.2	3699.5	2.0

```
***********************************************************
**      Factor of safety calculation for surface #     1    **
**      failed to converge within FIFTY iterations          **
**                                                          **
**    The last calculated value of the FOS was  21.8099     **
**    This will be ignored for final summary of results     **
***********************************************************
```

The trial failure surface in question is
defined by the following 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	435.62	3689.08
2	436.64	3688.31
3	438.71	3686.95
4	440.32	3685.34
5	714.52	3699.90
6	714.78	3700.16
7	721.09	3709.69
8	721.89	3710.75

```
***********************************************************
**      Factor of safety calculation for surface #     2    **
```

2	439.78	3689.10
3	442.74	3687.14
4	443.45	3686.43
5	712.61	3699.94
6	712.73	3700.06
7	719.04	3709.58
8	719.83	3710.64

```
*************************************************************
**     Factor of safety calculation for surface #   100     **
**     failed to converge within FIFTY iterations           **
**                                                          **
**    The last calculated value of the FOS was  24.6188     **
**    This will be ignored for final summary of results     **
*************************************************************
```

The trial failure surface in question is
defined by the following 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	442.13	3690.71
2	443.15	3689.94
3	447.07	3687.35
4	447.43	3686.99
5	714.54	3699.69
6	715.02	3700.17
7	721.33	3709.70
8	722.13	3710.76

Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED JANBU METHOD   * * * * *

The 10 most critical of all the failure surfaces examined
are displayed below - the most critical first

Failure surface No. 1 specified by 7 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	441.79	3690.62
2	442.82	3689.85

3	446.51	3687.41
4	715.76	3700.20
5	715.77	3700.20
6	722.09	3709.75
7	722.88	3710.81

** Corrected JANBU FOS = 15.557 ** (Fo factor = 1.017)

Failure surface No. 2 specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	437.33	3689.51
2	438.35	3688.74
3	440.90	3687.05
4	442.62	3685.33
5	714.07	3698.52
6	715.76	3700.20
7	722.08	3709.74
8	722.88	3710.80

** Corrected JANBU FOS = 20.443 ** (Fo factor = 1.019)

Failure surface No. 3 specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	437.05	3689.44
2	438.07	3688.67
3	440.54	3687.03
4	442.33	3685.24
5	713.13	3698.72
6	714.55	3700.14
7	720.86	3709.68
8	721.66	3710.74

** Corrected JANBU FOS = 20.596 ** (Fo factor = 1.019)

Failure surface No. 4 specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	435.24	3688.99
2	436.27	3688.22

3	438.22	3686.92
4	439.83	3685.31
5	707.29	3698.49
6	708.66	3699.86
7	714.94	3709.35
8	715.74	3710.41

** Corrected JANBU FOS = 20.802 ** (Fo factor = 1.019)

Failure surface No. 5 specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	440.79	3690.37
2	441.81	3689.60
3	445.35	3687.26
4	447.04	3685.57
5	715.98	3698.72
6	717.55	3700.29
7	723.88	3709.84
8	724.68	3710.91

** Corrected JANBU FOS = 20.895 ** (Fo factor = 1.019)

Failure surface No. 6 specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	435.62	3689.08
2	436.64	3688.31
3	438.71	3686.95
4	440.32	3685.34
5	714.52	3699.90
6	714.78	3700.16
7	721.09	3709.69
8	721.89	3710.75

** Corrected JANBU FOS = 500.000 ** (Fo factor = 1.017)

Failure surface No. 7 specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	443.42	3691.03

2	444.45	3690.26
3	448.73	3687.43
4	448.85	3687.31
5	716.60	3699.25
6	717.65	3700.29
7	723.97	3709.85
8	724.77	3710.91

** Corrected JANBU FOS = 500.000 ** (Fo factor = 1.019)

Failure surface No. 8 specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	437.68	3689.60
2	438.71	3688.83
3	441.36	3687.07
4	442.23	3686.20
5	715.60	3700.08
6	715.73	3700.20
7	722.05	3709.74
8	722.84	3710.80

** Corrected JANBU FOS = 500.000 ** (Fo factor = 1.017)

Failure surface No. 9 specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	441.72	3690.60
2	442.74	3689.83
3	446.54	3687.32
4	447.97	3685.88
5	715.98	3700.12
6	716.07	3700.22
7	722.39	3709.76
8	723.19	3710.82

** Corrected JANBU FOS = 500.000 ** (Fo factor = 1.017)

Failure surface No.10 specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	441.45	3690.54
2	442.47	3689.77
3	446.20	3687.30
4	447.37	3686.13
5	715.50	3699.52
6	716.20	3700.22
7	722.52	3709.77
8	723.32	3710.83

** Corrected JANBU FOS = 500.000 ** (Fo factor = 1.018)

```
*******************************************************************
**                                                               **
**  Out of the    100 surfaces generated and analyzed by XSTABL, **
**       95 surfaces were found to have MISLEADING FOS values.   **
**                                                               **
*******************************************************************
```

The following is a summary of the TEN most critical surfaces

Problem Description : SWLF LSMPA OL SEC D-D1T2 TOTAL NOD2

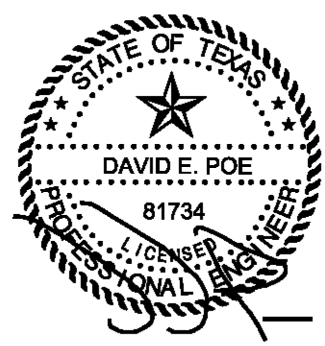
	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	15.557	1.017	441.79	722.88	1.590E+05
2.	20.443	1.019	437.33	722.88	2.831E+05
3.	20.596	1.019	437.05	721.66	2.821E+05
4.	20.802	1.019	435.24	715.74	2.782E+05
5.	20.895	1.019	440.79	724.68	2.808E+05
6.	500.000	1.017	435.62	721.89	2.835E+05
7.	500.000	1.019	443.42	724.77	2.770E+05
8.	500.000	1.017	437.68	722.84	2.817E+05
9.	500.000	1.017	441.72	723.19	2.777E+05
10.	500.000	1.018	441.45	723.32	2.782E+05

* * * END OF FILE * * *

APPENDIX IIIE-A-4

INFINITE SLOPE STABILITY ANALYSIS

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

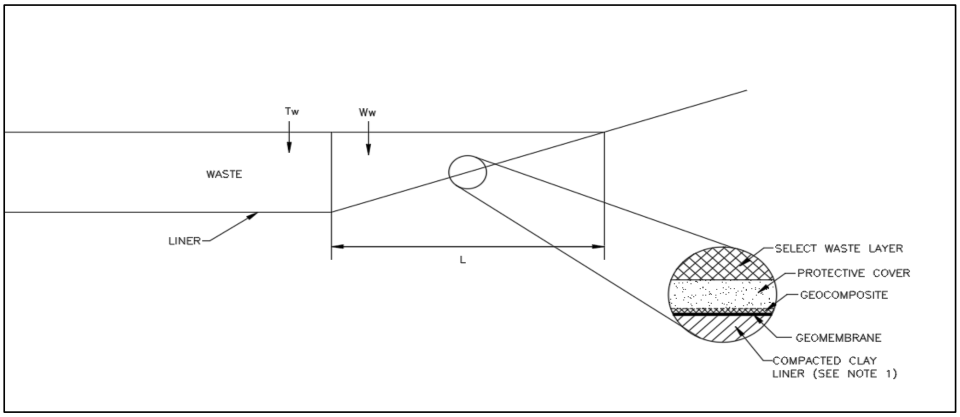


01/30/2025

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 compacted (MSW) or 3-foot-thick (Class 1) compacted clay liner (CCL). A geosynthetic clay liner (GCL) may be used in lieu of a compacted clay liner for the MSW sectors only.

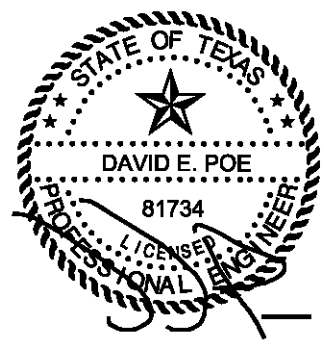
1. Verify that the tensile stress in liner system is less than yield stress for the liner system.



Note 1: A geosynthetic clay liner may be used in lieu of a compacted clay liner for the MSW sectors only.

APPENDIX IIIE-B

SETTLEMENT AND HEAVE ANALYSIS



10/04/2024

Calculated Strain Between Evaluation Points

Evalution Point		Initial Elevation (ft-msl)		Post-Settlement Elevation (ft-msl)		Plan View Distance (ft)	L_o (ft)	L_f (ft)	Strain (%)
A	B	A	B	A	B				
3	1	3588.9	3581.0	3588.4	3580.2	390.6	390.7107	390.7158	0.0013
3	2	3588.9	3583.2	3588.4	3582.1	271.4	271.4501	271.4630	0.0047
4	5	3596.0	3581.7	3594.2	3580.5	756.4	756.5153	756.5032	-0.0016
6	7	3596.0	3582.9	3594.3	3581.9	747.3	747.4246	747.4134	-0.0015
9	8	3581.0	3593.0	3579.2	3591.4	572.6	572.6957	572.6999	0.0007
11	10	3581.0	3594.8	3579.0	3592.9	697.3	697.3958	697.3991	0.0005
12	13	3567.0	3552.0	3565.2	3550.2	1527.8	1527.9038	1527.9034	0.0000
14	15	3568.0	3562.0	3566.0	3560.1	624.5	624.5088	624.5078	-0.0002
16	17	3567.0	3552.0	3564.9	3550.1	1512.0	1512.0343	1512.0324	-0.0001
18	19	3568.1	3558.0	3566.1	3556.0	1021.9	1021.9397	1021.9404	0.0001
20	21	3567.0	3552.0	3564.6	3550.0	1496.7	1496.7947	1496.7913	-0.0002
22	23	3568.1	3556.0	3565.8	3554.0	1247.5	1247.5091	1247.5065	-0.0002
24	25	3566.9	3552.0	3564.6	3550.0	1494.8	1494.8344	1494.8312	-0.0002
26	27	3568.2	3552.0	3565.9	3549.7	1679.4	1679.4681	1679.4677	0.0000
28	29	3567.7	3552.0	3565.5	3550.0	1488.8	1488.9023	1488.9004	-0.0001
30	31	3568.3	3552.0	3566.1	3549.7	1667.2	1667.3192	1667.3209	0.0001
32	33	3567.6	3552.0	3565.6	3550.0	1484.9	1484.9616	1484.9613	0.0000
34	35	3568.3	3552.0	3566.2	3549.6	1656.3	1656.4203	1656.4238	0.0002

Conclusion:

Strain is acceptable.

- The allowable tensile strain for an HDPE geomembrane is 25 percent (Reference 1, page 94).
- 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 allowable tensile strain for geosynthetic clay liner (GCL) is 10 percent (ranges from 10-22 percent, Koerner et.al., 1996).
- The maximum calculated tensile strain (0.0047%) is below the allowable tensile strain for the components of the liner system; therefore, the system will be stable.

SOUTHWEST LANDFILL
0120-094-11-107-11
APPENDIX IIIE-A-4
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
Liner System (3H:1V Maximum Slope)																		
Composite Liner																		
Protective Cover/Geocomposite	100	80	18	14	2	120	18.43	0	0.00	3.0	1.0	3.3	2.35	1.85	1.5	1.0	YES	YES
Geocomposite/Textured Geomembrane	100	80	21	10	2	120	18.43	0	0.00	3.0	1.0	3.3	2.53	1.63	1.5	1.0	YES	YES
Textured Geomembrane/Clay Liner	200	80	15	10	2	120	18.43	0	0.00	3.0	1.0	3.3	3.55	1.63	1.5	1.0	YES	YES
Clay Liner/Subgrade (Note 1)	200	100	18	12	2	120	18.43	0	0.00	3.0	1.0	3.3	3.72	2.01	1.5	1.0	YES	YES
Clay Liner Internal	100	-	16	-	2	120	18.43	0	0.00	3.0	1.0	3.3	2.24	-	1.5	-	YES	-
Textured Geomembrane / Geosynthetic Clay Liner	100	0	18	0	2	120	18.43	0	0.00	3.0	1.0	3.3	2.35	-	1.5	-	YES	-
Geosynthetic Clay Liner Internal	100	-	24	-	2	120	18.43	0	0.00	3.0	1.0	3.3	2.71	-	1.5	-	YES	-
Geosynthetic Clay Liner/Subgrade	100	80	25	12	2	120	18.43	0	0.00	3.0	1.0	3.3	2.77	1.74	1.5	1.0	YES	YES
Overliner System (25 Percent Maximum Slope)																		
Protective Cover/Geocomposite	100	80	18	14	2	120	11.31	0	0.00	5.0	1.0	5.3	3.83	3.01	1.5	1.0	YES	YES
Geocomposite/Textured Geomembrane	100	80	21	10	2	120	11.31	0	0.00	5.0	1.0	5.3	4.13	2.65	1.5	1.0	YES	YES
Textured Geomembrane/ Geosynthetic Clay Liner	100	80	18	10	2	120	11.31	0	0.00	5.0	1.0	5.3	3.83	2.65	1.5	1.0	YES	YES
Geosynthetic Clay Liner Internal	100	-	24	-	2	120	11.31	0	0.00	5.0	1.0	5.3	4.43	-	1.5	-	YES	-
Geosynthetic Clay Liner/Subgrade	100	100	25	12	2	120	11.31	0	0.00	5.0	1.0	5.3	4.54	3.27	1.5	1.0	YES	YES

Notes

1. Clay liner to subgrade interface assumes that clay is founded on granular or sandy soils. In the event clay liner is founded on predominantly clayey soil, the interface for infinite slope stability analysis would be represented by the "Clay Liner Internal" analysis above.

ATTACHMENT 3

MAILING LABELS
(ON CD IN ORIGINAL COPY ONLY)