SAUL EWING ARNSTEIN & LEHR LLP

Cynthia A. Giordano
Phone: (202) 295-6612
Fax: (202) 295-6712
Cynthia.Giordano@saul.com
www.saul.com

June 13, 2022

Via Email to dcoz@dc.gov
Frederick L. Hill, Chairman
Board of Zoning Adjustment
441 4th St NW, Suite 210S
Washington, D.C. 20001

RE: BZA Application No. 20636 - 4509 Foxhall Crescent, NW (Square 1397, Lot 960)

Dear Chairman Hill and Members of the BZA:

Enclosed please find a copy of a slope stability study prepared for the Project civil engineer in support of the Project site plan.

Thank you for your consideration.

Sincerely,

Cynthia A. Giordano

Attachment

CERTIFICATE OF SERVICE

I certify that on June 13, 2022, an electronic copy of this submission was served to the following:

1. **D.C. Office of Planning**
   Matthew Jesick, AICP, Development Review Specialist
   via email: matthew.jesick@dc.gov

2. **District Department of Transportation**
   Mr. Jonathan Rogers, DDOT
   Mr. Aaron Zimmerman, DDOT
   via email: jonathan.rogers2@dc.gov
   aaron.zimmerman@dc.gov

3. **Neighborhood Commission 3D**
   via Email: 3D@anc.dc.gov

4. **Advisory Neighborhood Commissioner SMD Chuck Elkins**
   via Email: 3D01@anc.dc.gov

5. **Jody Westby, Party in Support**
   via Email: westby@globalcyberrisk.com

6. **Andrea Ferster**
   via Email: aferster@railstotrails.org

Cynthia A. Giordano
Saul Ewing Arnstein & Lehr, LLP

June 12, 2022

Penguin, LLC
P. O. Box 370 McLean, VA 22101
Attn. Tamara Sarkisian

Reference: **Global Slope Stability Analyses Report for the Proposed Development at 4509 Foxhall Cres NW, Washington, DC 20007**

Pursuant to your request and our agreement, GIT has performed the authorized slope stability analysis to address the global slope stability concerns at the property. Global stability analyses have been performed for critical areas at two (2) locations (Slopes A & B) at the western and northern portions of the property as shown in the sketch (attached).

The slope stability analyses have been performed using the GEOSTASE software. For planned conditions at the locations (Slopes A & B), the factors of safety are greater than the minimum recommended factor of safety (FOS) of 1.5.

The Geostase Slope Stability Analysis outputs for both slopes A & B are attached to this letter.

Should you have any questions regarding the content of this report, please do not hesitate to call us at (240) 505-8154.

Respectfully,

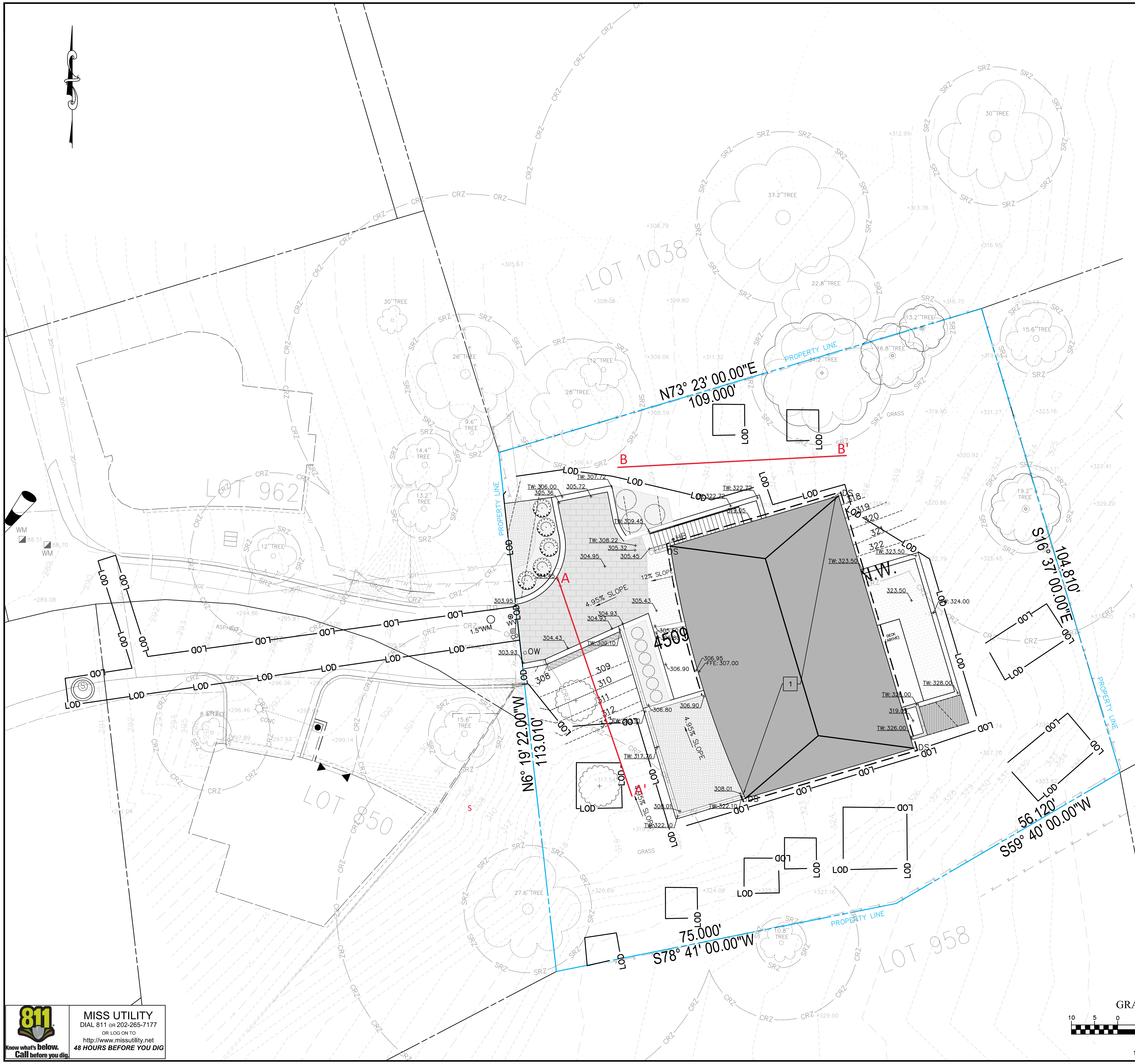
GIT CORPORATION

Sentayehu B. Akalu, PE.
Principal Engineer

Petros Woldemariam, P.E.
Project Engineer

Attachments:

- Sketch with Slopes A & B
- Boring Locations, Boring Logs and laboratory Data
- Geostase Slope Stability Analysis outputs



SITE PLAN LEGEND

	BUILDING
	PAVED AREA/CONCRETE WALK
	LANDSCAPED AREA
	PAVERS
	PERMEABLE PAVEMENT
	LIMITS OF GROUND COVER
	WOODEN UPPER DECK
	PERENNIALS PLANTER BOX
	FENCE
	EXISTING TREE
	NEW TREES ≥ 40' CANOPY [B4]
	NEW TREES < 40' CANOPY [B3]
	SHRUB & PLANTS ≥ 2" HEIGHT [B2]
HB	HOSE BIB
DS	DOWNSPOUT
OW	OBSERVATION WELL
CO	CLEANOUT
WM	WATER METER
WV	CURB STOP
CO	SANITARY CLEANOUT
	SANITARY MANHOLE
	PROPERTY LINE

SITE PLAN KEYNOTES

1 LIMITS OF PROPOSED BUILDING

Slopes A & B

SITE PLAN NOTES

1. ALL EXISTING FEATURES ARE NOT NECESSARILY DEPICTED ON THIS PLAN. SEE EXISTING CONDITIONS SHEETS.
2. WORK IN PUBLIC SPACE SHALL BE IN ACCORDANCE WITH DDOT STANDARDS AND AN ASSOCIATED PUBLIC SPACE PERMIT.
3. REPLACEMENT OF PAVEMENT IN-KIND, SUCH AS FOR SUBSURFACE UTILITY INSTALLATION, IS NOT GRAPHICALLY DEPICTED ON THIS PLAN. BID PRICING SHALL INCLUDE IN-KIND REPLACEMENT OF PAVEMENT BASED ON EXTENT OF THE PROPOSED WORK.

GRAPHIC SCALE

10 5 0 5 10 20 30

(IN FEET)
1 inch = 10 feet

5/13/2022
THESE PLANS ARE ISSUED FOR AGENCY REVIEW. ALL APPLICABLE AGENCY PERMIT APPROVALS MUST BE OBTAINED PRIOR TO CONSTRUCTION. FINAL APPROVED "FOR CONSTRUCTION" PLANS WILL BE ISSUED UPON COMPLETION OF THE REVIEW AND APPROVAL PROCESS BY ALL DISTRICT AGENCIES.

SERA ENGINEERED, LLC

SEAL

DISTRICT OF COLUMBIA
GALATES SERA
PE908893
5/13/2022
CIVIL
PROFESSIONAL ENGINEER

REVISIONS

No.	Date	Drawing Issue	By

DATE: MAY 13, 2022

DRAWN BY: AC/DW CHECKED BY: GS

S.E. JOB NUMBER: 121–126

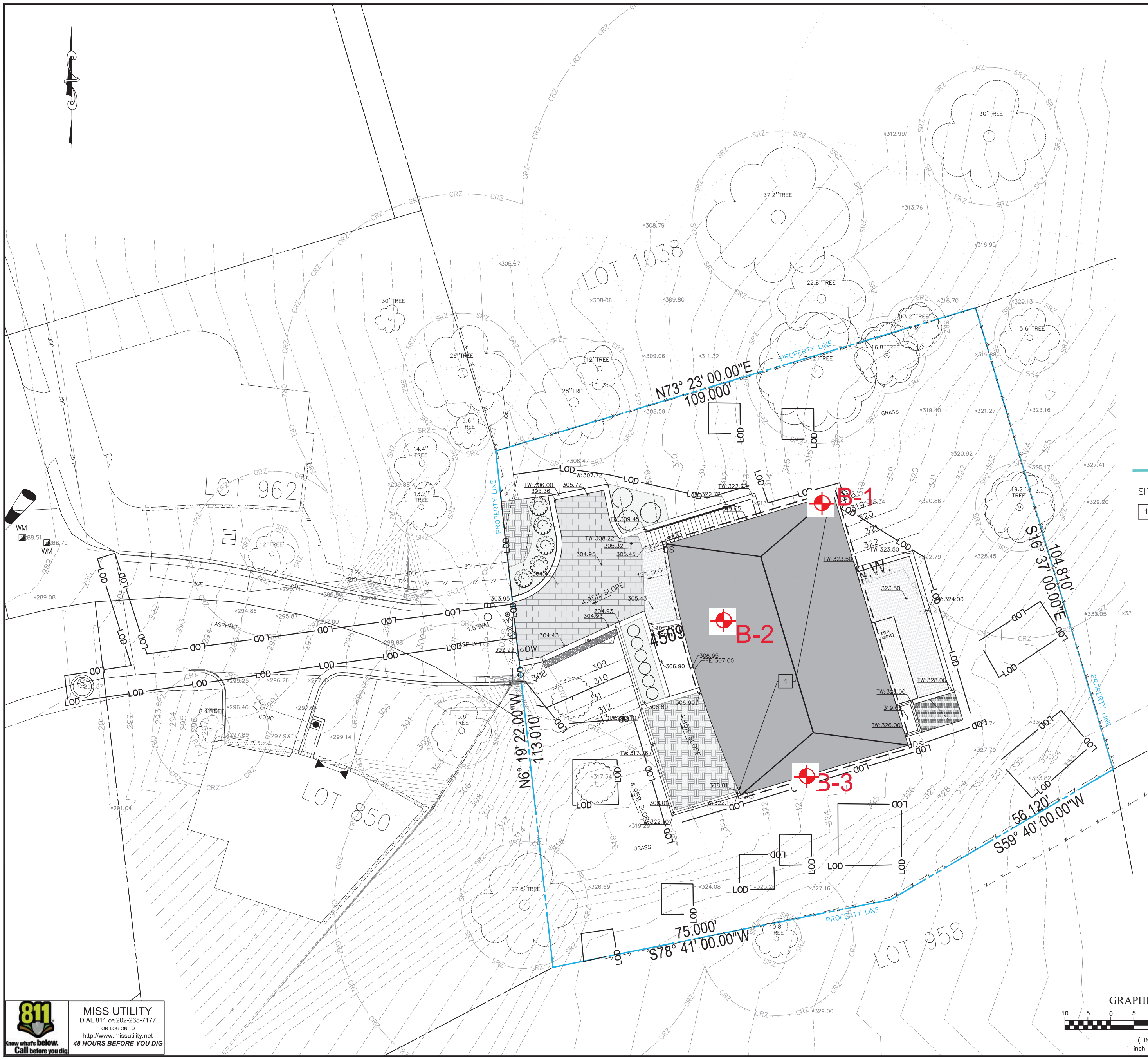
PROJECT ADDRESS:
4509 FOXHALL CRES NW
WASHINGTON DC, 20007

PHASE:
PERMIT DOCUMENTS

SHEET NO.:
CIV200

SHEET TITLE:
SITE PLAN

SHEET SCALE.:
AS SHOWN



SITE PLAN LEGEND

- BUILDING
- PAVED AREA/CONCRETE WALK
- LANDSCAPED AREA
- PAVERS
- PERMEABLE PAVEMENT
- LIMITS OF GROUND COVER
- WOODEN UPPER DECK
- PERENNIALS PLANTER BOX
- FENCE
- EXISTING TREE
- NEW TREES ≥ 40' CANOPY [B4]
- NEW TREES < 40' CANOPY [B3]
- SHRUB & PLANTS ≥ 2" HEIGHT [B2]
- HB HOSE BIB
- DS DOWNSPOUT
- OW OBSERVATION WELL
- CO CLEANOUT
- WM WATER METER
- WV CURB STOP
- CO SANITARY CLEANOUT
- SANITARY MANHOLE
- PROPERTY LINE

SITE PLAN KEYNOTES

1 LIMITS OF PROPOSED BUILDING

SITE PLAN NOTES

1. ALL EXISTING FEATURES ARE NOT NECESSARILY DEPICTED ON THIS PLAN. SEE EXISTING CONDITIONS SHEETS.
2. WORK IN PUBLIC SPACE SHALL BE IN ACCORDANCE WITH DDOT STANDARDS AND AN ASSOCIATED PUBLIC SPACE PERMIT.
3. REPLACEMENT OF PAVEMENT IN–KIND, SUCH AS FOR SUBSURFACE UTILITY INSTALLATION, IS NOT GRAPHICALLY DEPICTED ON THIS PLAN. BID PRICING SHALL INCLUDE IN–KIND REPLACEMENT OF PAVEMENT BASED ON EXTENT OF THE PROPOSED WORK.

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10 5 0 5 10 20 30

(IN FEET)
1 inch = 10 feet

5/13/2022
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SERA ENGINEERED, LLC

SEAL

DISTRICT OF COLUMBIA
GALATES SERA
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5/13/2022
CIVIL
PROFESSIONAL ENGINEER

REVISIONS

No.	Date	Drawing Issue	By

DATE: MAY 13, 2022
DRAWN BY: AC/DW CHECKED BY: GS
S.E. JOB NUMBER: 121-126

PROJECT ADDRESS:
4509 FOXHALL CRES NW
WASHINGTON DC, 20007

PHASE:
PERMIT DOCUMENTS

SHEET NO.:
CIV200

SHEET TITLE:
SITE PLAN

SHEET SCALE.:
AS SHOWN

GIT Corporation
14674-F Southlawn Ln
Rockville, MD 20850

BORING NUMBER B-1

CLIENT Penguin , LLC
PROJECT NAME 4509 Foxhall Cres NW
PROJECT NUMBER G22-097
PROJECT LOCATION 4509 Foxhall Cres NW, Washington, DC 20007
DATE STARTED 6/8/22 **COMPLETED** 6/8/22
GROUND ELEVATION _____ **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR GIT Corporation
GROUND WATER LEVELS:
DRILLING METHOD Hand Auger
AT TIME OF DRILLING --- None
LOGGED BY SA **CHECKED BY** PF
AT END OF DRILLING --- None
BORING LOCATION See Plan
24hrs AFTER DRILLING --- None

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0						FILL: brown sandy silt, gravel, organic material, moist
2.5						
	AU S-1	11-12-13 (12)	MC = 16%			SILTY SAND, (SM) (A-1-b) light yellowish brown, fine to medium grained, moist, medium dense
5.0	AU S-2	11-11-13 (12)	MC = 16% LL = NP PL = NP Fines = 33%			
7.5	AU S-3	10-12-14 (12)	MC = 16%	SM		
10.0						
12.5	AU S-4	12-13-13 (13)	MC = 15%			
15.0						

3.0

15.0

Bottom of borehole at 15.0 feet.

GIT Corporation
14674-F Southlawn Ln
Rockville, MD 20850

BORING NUMBER B-2

CLIENT Penguin , LLC
PROJECT NAME 4509 Foxhall Cres NW
PROJECT NUMBER G22-097
PROJECT LOCATION 4509 Foxhall Cres NW, Washington, DC 20007
DATE STARTED 6/8/22 **COMPLETED** 6/8/22
GROUND ELEVATION _____ **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR GIT Corporation
GROUND WATER LEVELS:
DRILLING METHOD Hand Auger
AT TIME OF DRILLING --- None
LOGGED BY SA **CHECKED BY** PF
AT END OF DRILLING --- None
BORING LOCATION See Plan
24hrs AFTER DRILLING --- None

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0						FILL: brown sandy silt, gravel, organic material, moist
2.5						
	AU S-1	11-13-14 (13)	MC = 17%			SILTY SAND, (SM) (A-1-b) light yellowish brown, fine to medium grained, moist, medium dense
5.0	AU S-2	12-11-13 (12)	MC = 18%			
7.5	AU S-3	12-13-13 (13)	MC = 16%	SM		
10.0						
12.5	AU S-4	13-12-14 (13)	MC = 16%			
15.0						15.0

Bottom of borehole at 15.0 feet.

GIT Corporation
14674-F Southlawn Ln
Rockville, MD 20850

BORING NUMBER B-3

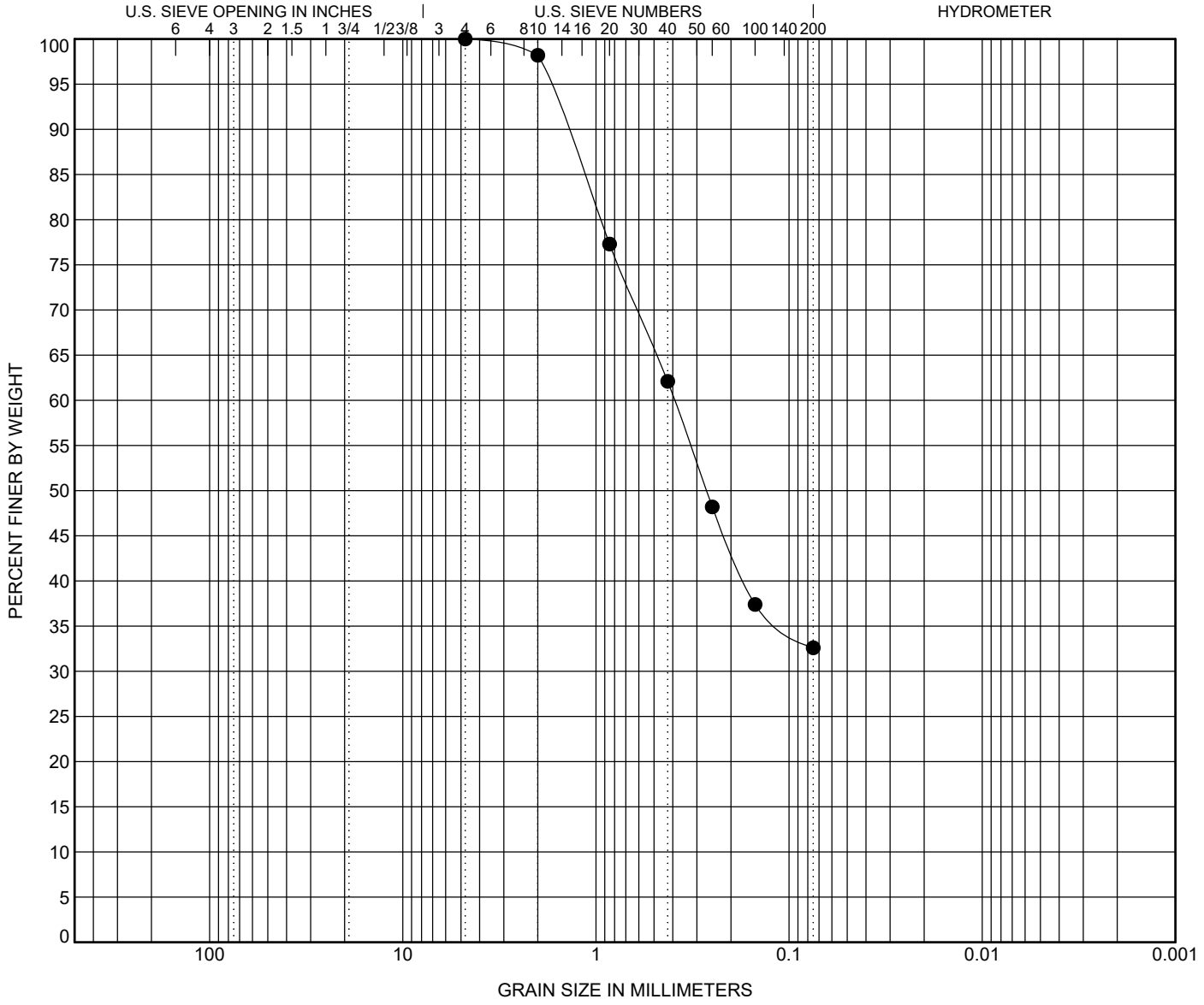
CLIENT Penguin , LLC
PROJECT NAME 4509 Foxhall Cres NW
PROJECT NUMBER G22-097
PROJECT LOCATION 4509 Foxhall Cres NW, Washington, DC 20007
DATE STARTED 6/8/22 **COMPLETED** 6/8/22
GROUND ELEVATION _____ **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR GIT Corporation
GROUND WATER LEVELS:
DRILLING METHOD Hand Auger
AT TIME OF DRILLING --- None
LOGGED BY SA **CHECKED BY** PF
AT END OF DRILLING --- None
BORING LOCATION See Plan
24hrs AFTER DRILLING --- None

DEPTH (ft)	SAMPLE TYPE NUMBER	DCP BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0						FILL: brown sandy silt, gravel, organic material, moist
2.5						
	AU S-1	12-11-12 (12)	MC = 16%			SILTY SAND, (SM) (A-1-b) light yellowish brown, fine to medium grained, moist, medium dense
5.0	AU S-2	10-12-14 (12)	MC = 16%			
7.5	AU S-3	11-13-12 (12)	MC = 15%	SM		
10.0						
12.5	AU S-4	13-12-14 (13)	MC = 15%			
15.0						Bottom of borehole at 15.0 feet.

GIT Corporation
14674-F Southlawn Ln
Rockville, MD 20850

GRAIN SIZE DISTRIBUTION
ASTM D422

CLIENT Penguin , LLC
PROJECT NAME 4509 Foxhall Cres NW
PROJECT NUMBER G22-097
PROJECT LOCATION 4509 Foxhall Cres NW, Washington, DC 20007



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

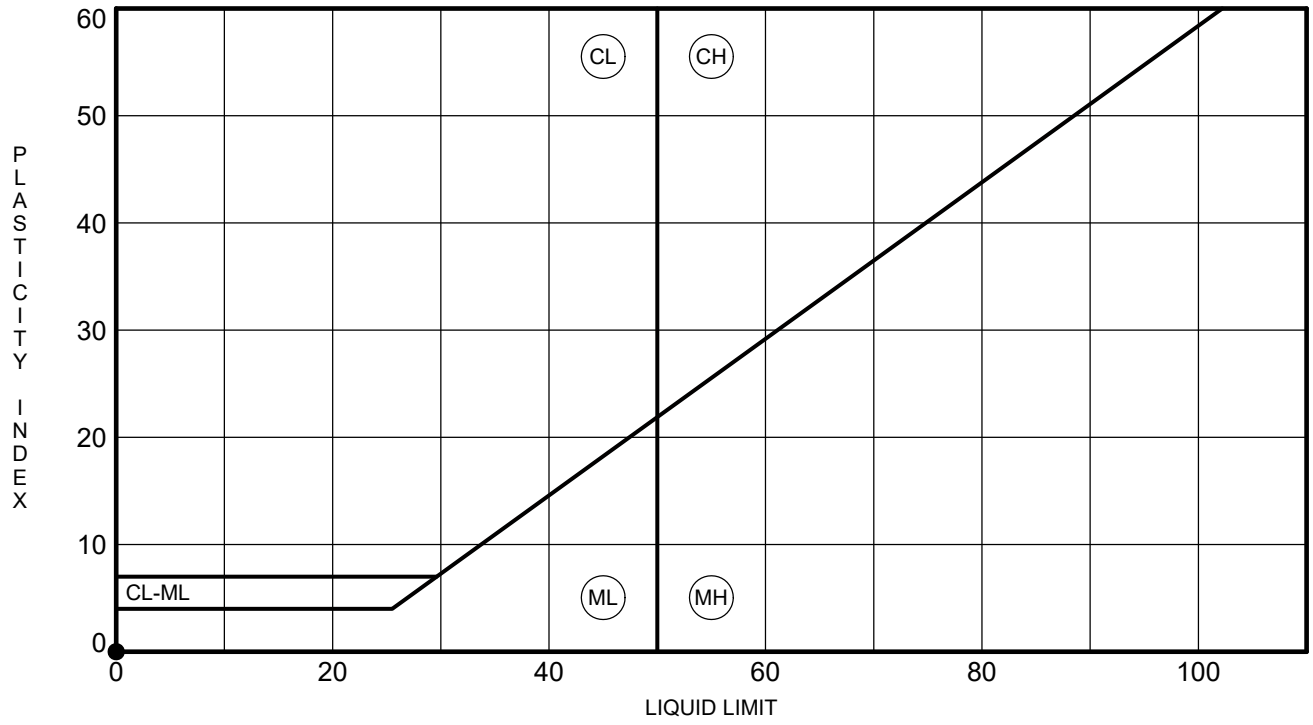
	SAMPLE No.	DEPTH(ft)	Classification	LL	PL	PI	Cc	Cu
●	**B-1**	**6.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		

	SAMPLE No.	DEPTH(ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**6.0**	**4.75**	**0.392**			**0.0**	**67.4**	**32.6**	

GIT Corporation
14674-F Southlawn Ln
Rockville, MD 20850

ATTERBERG LIMITS' RESULTS
ASTM D4318 - 10e1

CLIENT Penguin , LLC
PROJECT NAME 4509 Foxhall Cres NW
PROJECT NUMBER G22-097
PROJECT LOCATION 4509 Foxhall Cres NW, Washington, DC 20007

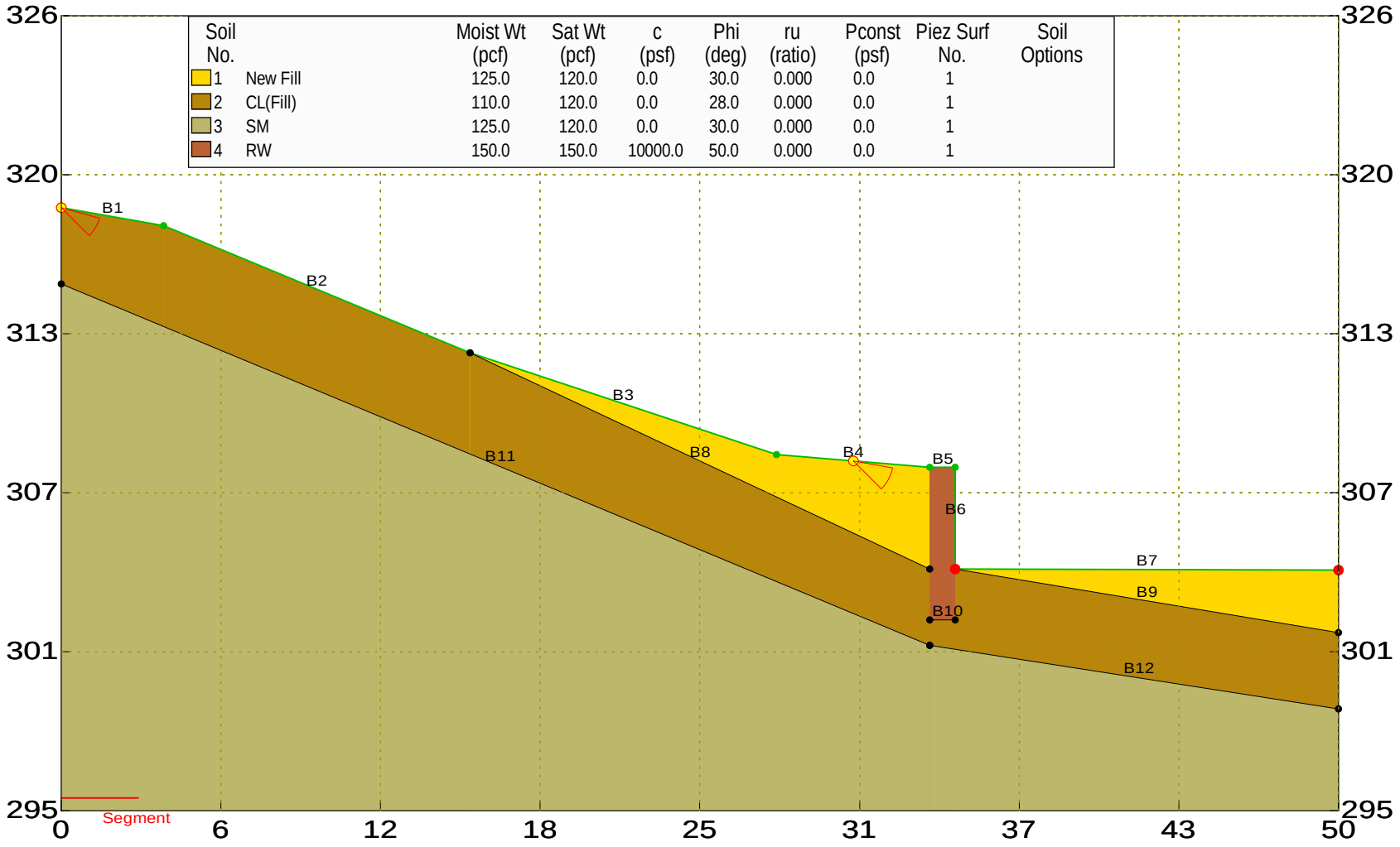


	SAMPLE No.	DEPTH(ft)	LL	PL	PI	Fines	Classification
●	**B-1**	**6.0**	**NP**	**NP**	**NP**	**33**	**SILTY SAND(SM)**

4509 Foxhall Cres NW
Slope A

GIT

\A 6-10-22.gsd



GEOSTASE PROFILE PREVIEW

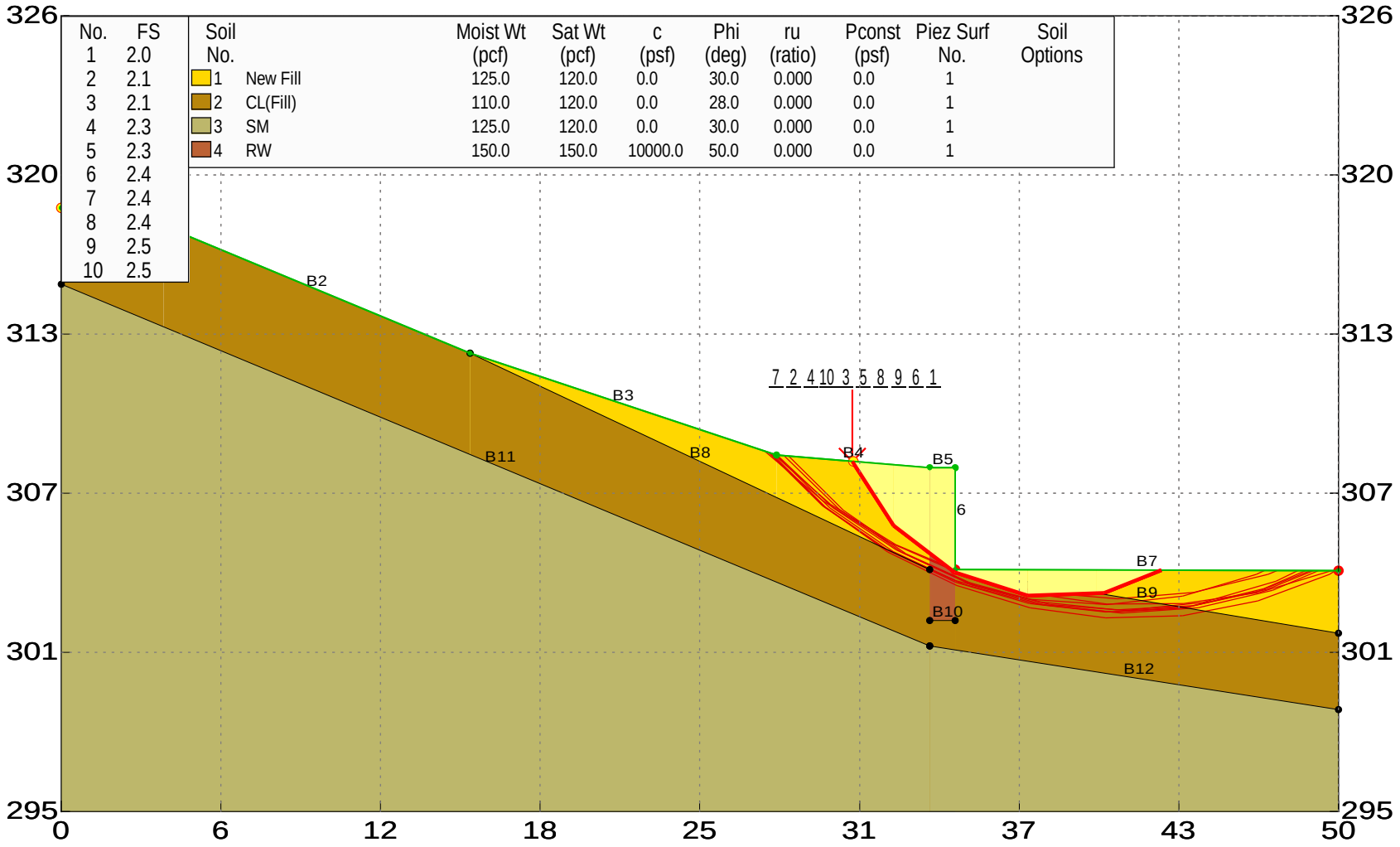
Spencer Method

GEOSTASE Slope Stability Analysis

4509 Foxhall Cres NW
Slope A

GIT

\A 6-10-22.gsd



GEOSTASE FS =2.0

Spencer Method

GEOSTASE Slope Stability Analysis

*** GEOSTASE(R) ***

** Current Version 4.30.30-Double Precision, January 2019 **

****

SLOPE STABILITY ANALYSIS SOFTWARE

Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.

****

Analysis Date: 6/ 11/ 2022
Analysis Time:
Analysis By: GIT
Input File Name: C:\Users\pfw\Documents\GIT Sintayehu\Slope Stability Analyses_4509 Foxhall Cres NW\Geostase\A 6-10-22.gsd
Output File Name: C:\Users\pfw\Documents\GIT Sintayehu\Slope Stability Analyses_4509 Foxhall Cres NW\Geostase\A 6-10-22.OUT
Unit System: English

PROJECT: 4509 Foxhall Cres NW

DESCRIPTION: Slope A

BOUNDARY DATA

7 Surface Boundaries
12 Total Boundaries

Boundary No.	X - 1 (ft)	Y - 1 (ft)	X - 2 (ft)	Y - 2 (ft)	Soil Type Below Bnd
1	0.000	318.700	4.000	318.000	2
2	4.000	318.000	16.000	313.000	2
3	16.000	313.000	28.000	309.000	1
4	28.000	309.000	34.000	308.500	1
5	34.000	308.500	35.000	308.500	4
6	35.000	308.500	35.000	304.500	1
7	35.000	304.500	50.000	304.450	1
8	16.000	313.000	34.000	304.500	2
9	35.000	304.500	50.000	302.000	2
10	34.000	302.500	35.000	302.500	2
11	0.000	315.700	34.000	301.500	3
12	34.000	301.500	50.000	299.000	3

User Specified X-Origin = 0.000(ft)

User Specified Y-Origin = 295.000(ft)

MOHR-COULOMB SOIL PARAMETERS

4 Type(s) of Soil Defined

Soil Number and Description	Moist Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Constant (psf)	Water Surface Option	Water Pressure Ratio(ru)
1 New Fill	125.0	120.0	0.00	30.00	0.000	1	0.0
2 CL(Fill)	110.0	120.0	0.00	28.00	0.000	1	0.0
3 SM	125.0	120.0	0.00	30.00	0.000	1	0.0

```
  4 RW                        150.0    150.0   10000.00    50.00    0.000
0.0      1       0


          TRIAL FAILURE SURFACE DATA

          Circular Trial Failure Surfaces Have Been Generated Using A
Random Procedure.

            1000 Trial Surfaces Have Been Generated.

            1000 Surfaces Generated at Increments of 0.3724(in) Equally
Spaced Within the Start Range

          Along The Specified Surface Between  X =   0.00(ft)
                                           and  X =  31.00(ft)

          Each Surface Enters within a Range Between   X =  35.00(ft)
                                                   and   X =  50.00(ft)

          Unless XCLUDE Lines Were Specified, The Minimum Elevation
          To Which A Surface Extends Is  Y =     295.00(ft)


          Specified Maximum Radius = 5000.000(ft)

          3.000(ft) Line Segments Were Used For Each Trial Failure
Surface.


          The Spencer Method Was Selected for FS Analysis.

          Selected fx function = Constant (1.0)

          SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
          Initial estimate of FS =  1.500
          FS tolerance =  0.000001000
          Initial estimate of theta(deg) = 15.00
          Theta tolerance(radians) =  0.0001000
          Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
          Theta convergence Step Factor = 5000.00
          Maximum number of iterations = 50
          Allowable negative side force = -1000.0(lbs)
          Maximum force imbalance  = 100.000000(lbs)
          Maximum moment imbalance = 100.000000 (ft/lbs)

          Selected Lambda Coefficient =  1.00

          Specified Tension Crack Water Depth Factor =   0.000

          Total Number of Trial Surfaces Attempted = 1000

          WARNING! The Factor of Safety Calculation for one or More Trial
Surfaces
```

Did Not Converge in 50 Iterations.

Number of Trial Surfaces with Non-Converged FS = 343

Number of Trial Surfaces With Valid FS = 657

Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted = 34.3 %

Statistical Data On All Valid FS Values:
FS Max = 19.028 FS Min = 1.984 FS Ave = 6.996
Standard Deviation = 2.803 Coefficient of Variation = 40.06 %

Critical Surface is Sequence Number 655 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 39.043934(ft) ; Y = 312.170395(ft); and Radius = 8.768493(ft)

Circular Trial Failure Surface Generated With 6 Coordinate Points

Point No.	X-Coord. (ft)	Y-Coord. (ft)
1	30.969	308.753
2	32.594	306.231
3	34.973	304.404
4	37.830	303.486
5	40.828	303.585
6	43.071	304.473

Iter. No.	Theta (deg) (fx=1.0)	FS (Moment)	FS (Force)	Lambda	Delta FS
1	-15.0000	2.347836	1.882462	-0.268	0.4653747E+00
2	-19.9500	2.011050	1.967802	-0.363	0.4324835E-01
3	-20.4561	1.994797	1.977236	-0.373	0.1756152E-01

```
              4       -20.8019    1.984726   1.983769    -0.380
0.9568274E-03
              5       -20.8217    1.984172   1.984147    -0.380
0.2509277E-04
              6       -20.8222    1.984157   1.984157    -0.380
0.2224775E-06


          Factor Of Safety For The Preceding Specified Surface =  1.984
          Theta (fx = 1.0) = -20.82 Deg    Lambda =  -0.380


          The Spencer Method Has Been Selected For FS Analysis.

          Selected fx function = Constant (1.0)

          SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
          Initial estimate of FS =  1.500
          FS tolerance =  0.000001000
          Initial estimate of theta(deg) = 15.00
          Theta tolerance(radians) =  0.0001000
          Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
          Theta convergence Step Factor = 5000.00
          Maximum number of iterations = 50
          Maximum force imbalance = 100.000000(lbs)
          Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


          Selected Lambda Coefficient =  1.00

          Tension Crack Water Force =        0.00(lbs)

          Specified Tension Crack Water Depth Factor =  0.000

          Depth of Tension Crack (zo) at Side of First Slice =
0.000(ft)

          Depth of Water in Tension Crack =   0.000(ft)

          Theoretical Tension Crack Depth =   0.000(ft)

          NOTE: In Table 1 following, when a tension crack with water is
present on the
          first slice (right facing slope) or on the last slice (left
facing slope), the
          "side force" in the tension crack is set equal to the water
pressure resultant.


                  *** Table 1 - Line of Thrust(if applicable) and Slice
Force Data ***

          Slice      X         Y              Side Force     fx    Force
Angle  Vert. Shear
```

No.	Coord.	Coord.	h/H	(lbs)		
(Deg)	Force(lbs)					
1	30.97	308.75	0.000	0.00	1.000	
0.00	0.0					
2	32.59	307.49	0.528	169.32	1.000	-
20.82	-60.2					
3	34.00	306.16	0.301	352.33	1.000	-
20.82	-125.2					
4	34.97	304.51	0.026	-5055.55	1.000	-
20.82	1797.1					
5	35.00	304.50	0.961	-5205.36	1.000	-
20.82	1850.4					
6	37.83	303.42	0.000-	-5195.97	1.000	-
20.82	1847.0					
7	40.54	302.40	0.000-	-5310.92	1.000	-
20.82	1887.9					
8	40.83	302.30	0.000-	-5323.69	1.000	-
20.82	1892.4					

NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below
the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that
the line of thrust is at or above the upper boundary of the sliding mass.

Table 2 - Geometry Data on the 8 Slices

Slice	Width	Height	X-Cntr	Y-Cntr-Base	Y-Cntr-Top	Alpha	Beta	Base Length
No.	(ft)	(ft)	(ft)	(ft)	(ft)	(deg)	(deg)	(ft)
1	1.62	1.19	31.78	307.49	308.68	-57.21	-	
4.76	3.00							
2	1.41	2.87	33.30	305.69	308.56	-37.51	-	
4.76	1.77							
3	0.97	3.72	34.49	304.78	308.50	-37.51		
0.00	1.23							
4	0.03	4.10	34.99	304.40	308.50	-17.81		
0.00	0.03							
5	2.83	0.55	36.41	303.94	304.50	-17.81	-	
0.19	2.97							
6	2.71	0.95	39.19	303.53	304.49	1.89	-	
0.19	2.72							
7	0.28	0.90	40.69	303.58	304.48	1.89	-	
0.19	0.28							
8	2.24	0.45	41.95	304.03	304.48	21.59	-	
0.19	2.41							

Table 2A - Coordinates of Slice Points Defining the Slip Surface

Point No.	X-Pt (ft)	Y-Pt (ft)
1	30.968969	308.752586
2	32.593691	306.230627
3	34.000000	305.151161
4	34.973451	304.403951
5	35.000000	304.395423
6	37.829684	303.486383
7	40.544234	303.575961
8	40.828052	303.585327
9	43.071469	304.473095

Table 3 - Force and Pore Pressure Data On The 8 Slices (Excluding Reinforcement)

Slice No.	Weight (lbs)	Ubeta Force Top (lbs)	Ubeta Stress Top (psf)	Ualpha Force Bot (lbs)	Pore Pressure (psf)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Distributed Load (lbs)
1	242.3	0.0	0.0	0.0	0.0	0.0	0.0	0.00
2	504.1	0.0	0.0	0.0	0.0	0.0	0.0	0.00
3	543.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00
4	16.3	0.0	0.0	0.0	0.0	0.0	0.0	0.00
5	182.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00
6	313.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
7	31.9	0.0	0.0	0.0	0.0	0.0	0.0	0.00
8	125.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00

TOTAL WEIGHT OF SLIDING MASS = 1959.13(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 1959.13(lbs)

TOTAL AREA OF SLIDING MASS = 15.12(ft2)

TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 8 SLICES

Slice No.	Soil Type	Cohesion (psf)	Phi(Deg)	Options
1	1	0.00	30.00	
2	1	0.00	30.00	
3	4	10000.00	50.00	
4	4	10000.00	50.00	
5	2	0.00	28.00	
6	2	0.00	28.00	
7	1	0.00	30.00	
8	1	0.00	30.00	

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified Soil Options (if any).

TABLE 5 - Total Base Stress Data on the 8 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Total Normal Stress (psf)	Total Vert. Stress (psf)	Total Normal/Vert. Stress Ratio
1	-57.21	31.78	3.00	77.23	149.16	0.518
2	-37.51	33.30	1.77	255.20	358.46	0.712
3	-37.51	34.49	1.23	-914.04	558.37	-1.637
4	-17.81	34.99	0.03	839.87	615.05	1.366
5	-17.81	36.41	2.97	58.25	64.45	0.904
6	1.89	39.19	2.72	131.51	115.29	1.141
7	1.89	40.69	0.28	129.79	112.55	1.153
8	21.59	41.95	2.41	89.71	55.95	1.603

TABLE 5A - Total Base Force Data on the 8 Slices

Slice No.	Alpha (deg)	X-Coord. Slice Cntr	Base Leng.	Total Normal Force	Total Vert. Force	Total Normal/Vert.

*		(ft)	(ft)	(lbs)	(lbs)	Force Ratio
1	-57.21	31.78	3.00	231.69	242.34	0.956
2	-37.51	33.30	1.77	452.44	504.11	0.897
3	-37.51	34.49	1.23	-1121.68	543.54	-2.064
4	-17.81	34.99	0.03	23.42	16.33	1.434
5	-17.81	36.41	2.97	173.14	182.37	0.949
6	1.89	39.19	2.72	357.18	312.97	1.141
7	1.89	40.69	0.28	36.86	31.94	1.154
8	21.59	41.95	2.41	216.45	125.53	1.724

TABLE 6 - Effective and Base Shear Stress Data on the 8 Slices

Slice No.	Alpha (deg)	X-Coord. Slice Cntr * (ft)	Base Leng. (ft)	Effective Normal Stress (psf)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	-57.21	31.78	3.00	77.23	44.59	22.47
2	-37.51	33.30	1.77	255.20	147.34	74.26
3	-37.51	34.49	1.23	0.00	0.00	0.00
4	-17.81	34.99	0.03	839.87	11000.92	5544.38
5	-17.81	36.41	2.97	58.25	30.97	15.61
6	1.89	39.19	2.72	131.51	69.93	35.24
7	1.89	40.69	0.28	129.79	74.93	37.77
8	21.59	41.95	2.41	89.71	51.80	26.10

TABLE 6A - Effective and Base Shear Force Data on the 8 Slices

Slice	Alpha	X-Coord.	Base	Effective	Available	Mobilized

No.	(deg)	Slice Cntr (ft)	Leng. (ft)	Normal Force (lbs)	Shear Force (lbs)	Shear Force * (lbs)
1	-57.21	31.78	3.00	231.69	133.77	67.42
2	-37.51	33.30	1.77	452.44	261.21	131.65
3	-37.51	34.49	1.23	0.00	0.00	0.00
4	-17.81	34.99	0.03	23.42	306.76	154.61
5	-17.81	36.41	2.97	173.14	92.06	46.40
6	1.89	39.19	2.72	357.18	189.92	95.72
7	1.89	40.69	0.28	36.86	21.28	10.72
8	21.59	41.95	2.41	216.45	124.97	62.98

Average Effective Normal Stress = 25.6366(psf)
Average Available Shear Strength = 78.4009(psf)
Total Length of Failure Surface = 14.4127(ft)

SUM OF MOMENTS = -0.110480E-02 (ft/lbs);Imbalance (Fraction of Total Weight) = -0.5639238E-06
SUM OF FORCES = 0.152028E-08 (lbs);Imbalance (Fraction of Total Weight) = 0.7759946E-12

Sum of Available Shear Forces = 1129.97(lbs)

Sum of Mobilized Shear Forces = 569.49(lbs)

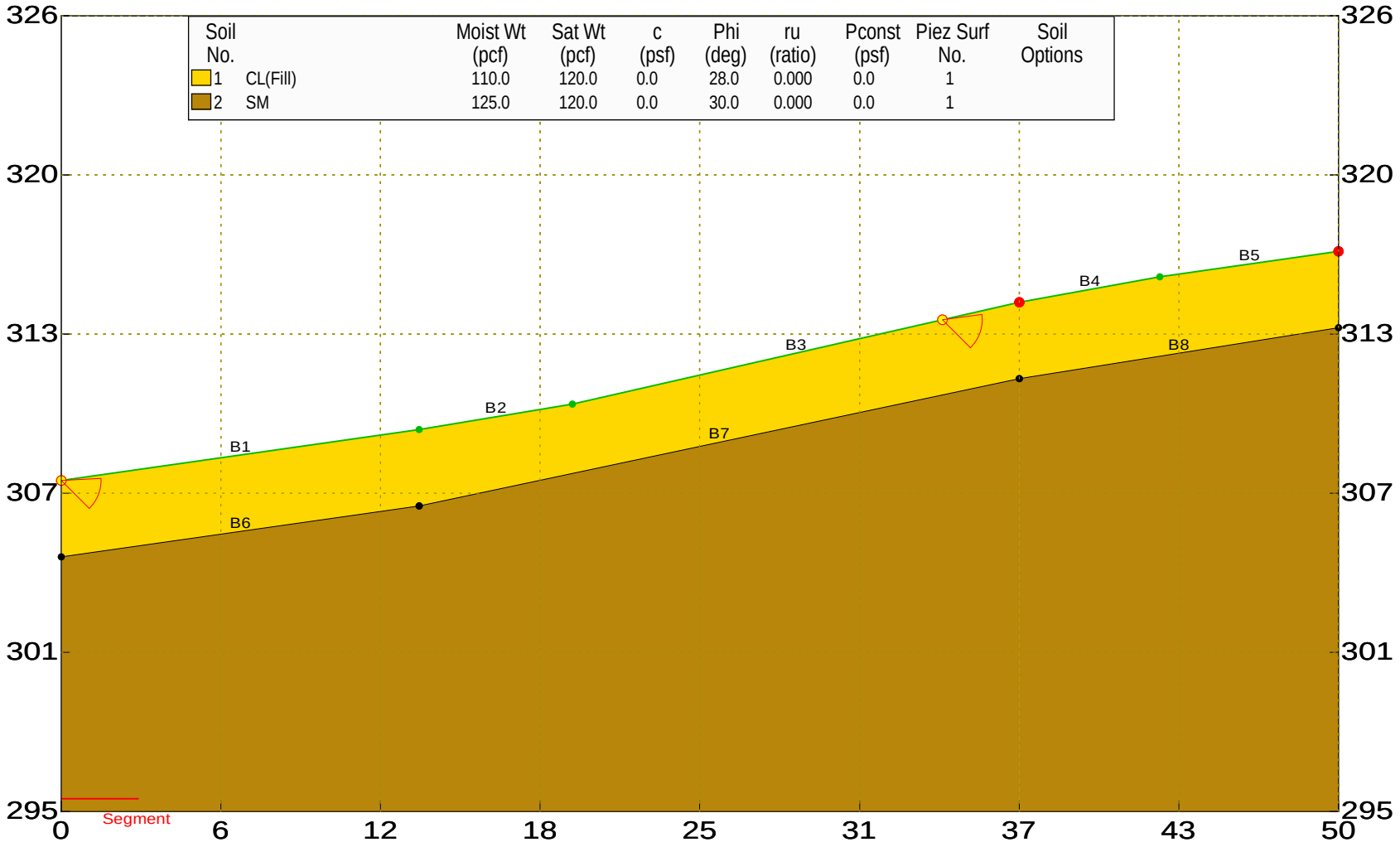
FS Balance Check: FS = 1.984157

**** END OF GEOSTASE OUTPUT ****

4509 Foxhall Cres NW
Slope B

GIT

\B 6-10-22.gsd



GEOSTASE PROFILE PREVIEW

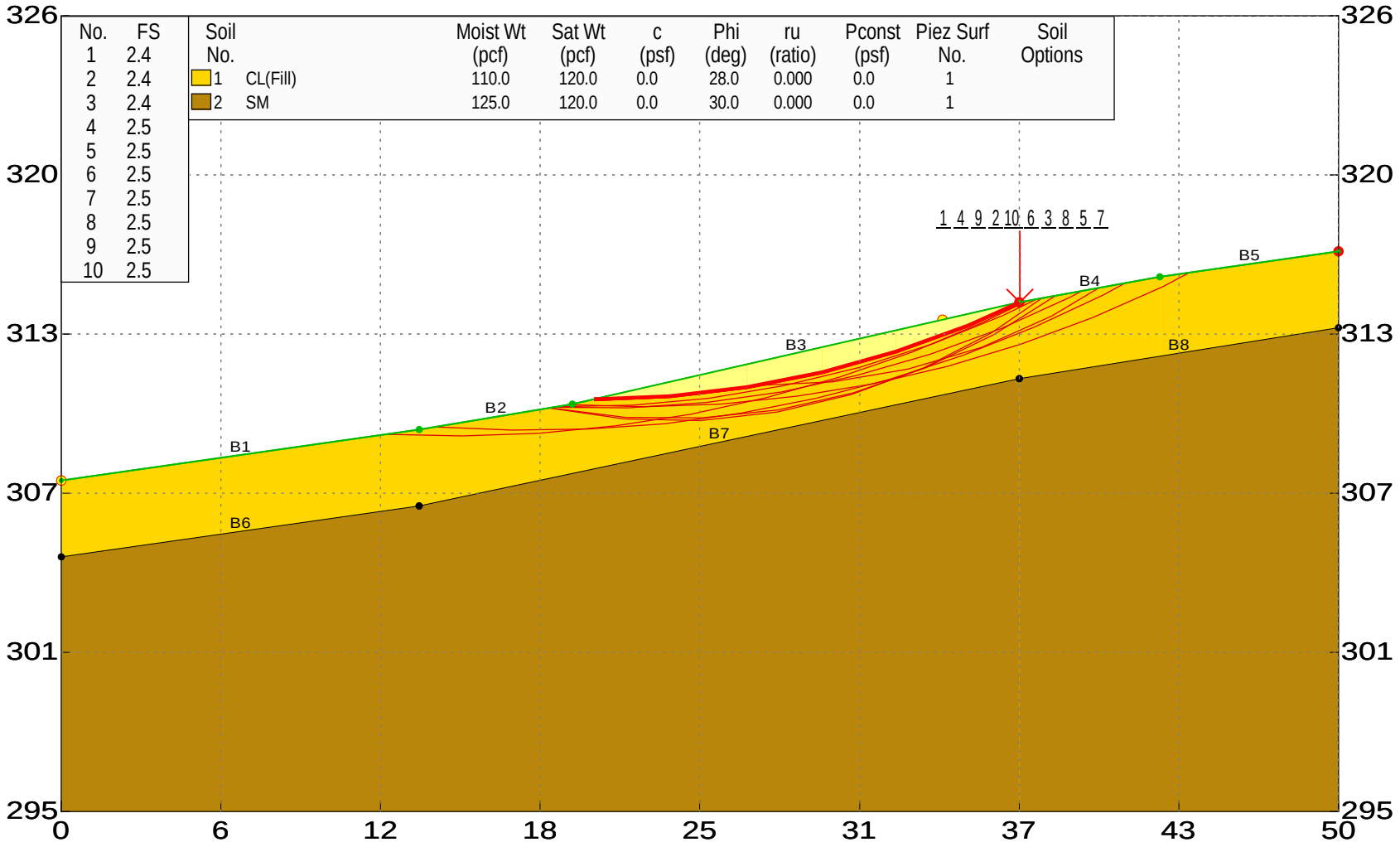
Spencer Method

GEOSTASE Slope Stability Analysis

4509 Foxhall Cres NW
Slope B

GIT

\B 6-10-22.gsd



GEOSTASE FS =2.4

Spencer Method

GEOSTASE
Slope Stability Analysis

*** GEOSTASE(R) ***

** Current Version 4.30.30-Double Precision, January 2019 **

****
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
****

Analysis Date:
Analysis Time:
Analysis By: GIT
Input File Name: C:\Users\pfw\Documents\GIT Sintayehu\Slope Stability Analyses_4509 Foxhall Cres NW\Geostase\B 6-10-22.gsd
Output File Name: C:\Users\pfw\Documents\GIT Sintayehu\Slope Stability Analyses_4509 Foxhall Cres NW\Geostase\B 6-10-22.OUT
Unit System: English

PROJECT: 4509 Foxhall Cres NW

DESCRIPTION: Slope B

BOUNDARY DATA

5 Surface Boundaries
8 Total Boundaries

Boundary No.	X - 1 (ft)	Y - 1 (ft)	X - 2 (ft)	Y - 2 (ft)	Soil Type Below Bnd
1	0.000	308.000	14.000	310.000	1
2	14.000	310.000	20.000	311.000	1
3	20.000	311.000	37.500	315.000	1
4	37.500	315.000	43.000	316.000	1
5	43.000	316.000	50.000	317.000	1
6	0.000	305.000	14.000	307.000	2
7	14.000	307.000	37.500	312.000	2
8	37.500	312.000	50.000	314.000	2

User Specified X-Origin = 0.000(ft)

User Specified Y-Origin = 295.000(ft)

MOHR-COULOMB SOIL PARAMETERS

2 Type(s) of Soil Defined

Soil Number and Description	Moist Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Ratio(ru)	Water Pressure (psf)	Water and Constant Surface Option No.
1 CL(Fill)	110.0	120.0	0.00	28.00	0.000	0.0	1 0
2 SM	125.0	120.0	0.00	30.00	0.000	0.0	1 0

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

1000 Trial Surfaces Have Been Generated.

1000 Surfaces Generated at Increments of 0.4144(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 0.00(ft)
and X = 34.50(ft)

Each Surface Enters within a Range Between X = 37.50(ft)
and X = 50.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = 295.00(ft)

Specified Maximum Radius = 5000.000(ft)

3.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Spencer Method Was Selected for FS Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
Initial estimate of FS = 1.500
FS tolerance = 0.000001000
Initial estimate of theta(deg) = 15.00
Theta tolerance(radians) = 0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) = 45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Allowable negative side force = -1000.0(lbs)
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance = 100.000000 (ft/lbs)

Selected Lambda Coefficient = 1.00

Specified Tension Crack Water Depth Factor = 0.000

Total Number of Trial Surfaces Attempted = 1000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 50 Iterations.

Number of Trial Surfaces with Non-Converged FS = 87

Number of Trial Surfaces With Valid FS = 913

Percentage of Trial Surfaces With Non-Converged and/or
Non-Valid FS Solutions of the Total Attempted = 8.7 %

Statistical Data On All Valid FS Values:
FS Max = 6.197 FS Min = 2.377 FS Ave = 3.827
Standard Deviation = 0.694 Coefficient of Variation = 18.13 %

Critical Surface is Sequence Number 562 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 20.784412(ft) ; Y = 350.137798(ft); and Radius = 38.941559(ft)

Circular Trial Failure Surface Generated With 7 Coordinate Points

Point No.	X-Coord. (ft)	Y-Coord. (ft)
1	20.859	311.196
2	23.856	311.318
3	26.836	311.669
4	29.779	312.249
5	32.669	313.054
6	35.489	314.079
7	37.533	315.006

Iter. No.	Theta (deg) (fx=1.0)	FS (Moment)	FS (Force)	Lambda	Delta FS
1	15.0000	2.002880	2.381870	0.268	0.3789904E+00
2	19.9500	6.952612	2.392793	0.363	0.4559818E+01
3	15.3798	1.894159	2.382685	0.275	0.4885261E+00
4	15.8229	1.731905	2.383640	0.283	0.6517355E+00
5	14.0538	2.198003	2.379855	0.250	0.1818518E+00
6	13.3696	2.296720	2.378410	0.238	0.8168925E-01
7	12.8119	2.360463	2.377239	0.227	0.1677560E-01
8	12.6679	2.375027	2.376938	0.225	0.1910659E-02

```
              9        12.6494    2.376846   2.376899     0.224
0.5310126E-04
             10        12.6489    2.376897   2.376898     0.224
0.5417040E-06


          Factor Of Safety For The Preceding Specified Surface =  2.377
          Theta (fx = 1.0) =  12.65 Deg    Lambda =   0.224


          The Spencer Method Has Been Selected For FS Analysis.

          Selected fx function = Constant (1.0)

          SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
          Initial estimate of FS =  1.500
          FS tolerance =  0.000001000
          Initial estimate of theta(deg) = 15.00
          Theta tolerance(radians) =  0.0001000
          Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
          Theta convergence Step Factor = 5000.00
          Maximum number of iterations = 50
          Maximum force imbalance = 100.000000(lbs)
          Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


          Selected Lambda Coefficient =  1.00

          Tension Crack Water Force =        0.00(lbs)

          Specified Tension Crack Water Depth Factor =  0.000

          Depth of Tension Crack (zo) at Side of Last Slice =   0.000(ft)

          Depth of Water in Tension Crack =   0.000(ft)

          Theoretical Tension Crack Depth =   0.000(ft)

          NOTE: In Table 1 following, when a tension crack with water is
present on the
          first slice (right facing slope) or on the last slice (left
facing slope), the
          "side force" in the tension crack is set equal to the water
pressure resultant.


                  *** Table 1 - Line of Thrust(if applicable) and Slice
Force Data ***

          Slice      X         Y               Side Force     fx    Force
Angle  Vert. Shear
           No.     Coord.    Coord.    h/H        (lbs)
(Deg)      Force(lbs)
```

1	23.86	311.59	0.489	18.04	1.000	12.65	3.9
2	26.84	312.01	0.378	43.82	1.000	12.65	9.6
3	29.78	312.61	0.365	51.82	1.000	12.65	11.3
4	32.67	313.37	0.380	36.64	1.000	12.65	8.0
5	35.49	314.31	0.500	10.62	1.000	12.65	2.3
6	37.50	315.00	1.000+	0.00	1.000	12.65	0.0
7	37.53	315.01	0.000	0.00	1.000	12.65	0.0

NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or below the lower boundary of the sliding mass. A value of 1.000+ for h/H indicates that the line of thrust is at or above the upper boundary of the sliding mass.

Table 2 - Geometry Data on the 7 Slices

Slice No.	Width (ft)	Height (ft)	X-Cntr (ft)	Y-Cntr-Base (ft)	Y-Cntr-Top (ft)	Alpha (deg)	Beta (deg)	Base Length (ft)
1	3.00	0.28	22.36	311.26	311.54	2.32	12.88	3.00
2	2.98	0.73	25.35	311.49	312.22	6.73	12.88	3.00
3	2.94	0.94	28.31	311.96	312.90	11.15	12.88	3.00
4	2.89	0.91	31.22	312.65	313.57	15.56	12.88	3.00
5	2.82	0.65	34.08	313.57	314.22	19.98	12.88	3.00
6	2.01	0.24	36.49	314.54	314.77	24.39	12.88	2.21
7	0.03	0.00	37.52	315.00	315.00	24.39	10.30	0.04

Table 2A - Coordinates of Slice Points Defining the Slip Surface

Point No.	X-Pt (ft)	Y-Pt (ft)
1	20.858859	311.196311

2	23.856406	311.317599
3	26.835721	311.669283
4	29.779122	312.249275
5	32.669140	313.054133
6	35.488623	314.079080
7	37.500000	314.991161
8	37.532539	315.005916

Table 3 - Force and Pore Pressure Data On The 7 Slices (Excluding Reinforcement)

Slice No.	Weight (lbs)	Ubeta Force Top (lbs)	Ubeta Stress Top (psf)	Ualpha Force Bot (lbs)	Pore Pressure (psf)	Earthquake Force Hor (lbs)	Ver (lbs)	Distributed Load (lbs)
1	93.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
2	238.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00
3	304.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00
4	290.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00
5	202.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
6	52.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00

TOTAL WEIGHT OF SLIDING MASS = 1180.47(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 1180.47(lbs)

TOTAL AREA OF SLIDING MASS = 10.73(ft2)

TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 7 SLICES

Slice No.	Soil Type	Cohesion (psf)	Phi(Deg)	Options
1	1	0.00	28.00	
2	1	0.00	28.00	
3	1	0.00	28.00	
4	1	0.00	28.00	
5	1	0.00	28.00	
6	1	0.00	28.00	
7	1	0.00	28.00	

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified Soil Options (if any).

TABLE 5 - Total Base Stress Data on the 7 Slices

Slice No.	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Total Normal Stress (psf)	Total Vert. Stress (psf)	Total Normal/Vert. * Stress Ratio
1	2.32	22.36	3.00	32.04	31.01	1.033
2	6.73	25.35	3.00	79.92	80.14	0.997
3	11.15	28.31	3.00	99.56	103.35	0.963
4	15.56	31.22	3.00	93.54	100.52	0.931
5	19.98	34.08	3.00	64.40	71.66	0.899
6	24.39	36.49	2.21	22.42	25.85	0.867
7	24.39	37.52	0.04	0.42	0.49	0.867

TABLE 5A - Total Base Force Data on the 7 Slices

Slice No.	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Total Normal Force (lbs)	Total Vert. Force (lbs)	Total Normal/Vert. * Force Ratio
1	2.32	22.36	3.00	96.12	92.96	1.034
2	6.73	25.35	3.00	239.76	238.75	1.004
3	11.15	28.31	3.00	298.68	304.21	0.982
4	15.56	31.22	3.00	280.62	290.50	0.966
5	19.98	34.08	3.00	193.20	202.03	0.956

6	24.39	36.49	2.21	49.52	52.00	0.952
7	24.39	37.52	0.04	0.02	0.02	0.952

TABLE 6 - Effective and Base Shear Stress Data on the 7 Slices

Slice No.	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Stress (psf)	Available Shear Strength (psf)	Mobilized Shear Stress * (psf)
1	2.32	22.36	3.00	32.04	17.04	7.17
2	6.73	25.35	3.00	79.92	42.50	17.88
3	11.15	28.31	3.00	99.56	52.94	22.27
4	15.56	31.22	3.00	93.54	49.74	20.93
5	19.98	34.08	3.00	64.40	34.24	14.41
6	24.39	36.49	2.21	22.42	11.92	5.02
7	24.39	37.52	0.04	0.42	0.22	0.09

TABLE 6A - Effective and Base Shear Force Data on the 7 Slices

Slice No.	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Effective Normal Force (lbs)	Available Shear Force (lbs)	Mobilized Shear Force * (lbs)
1	2.32	22.36	3.00	96.12	51.11	21.50
2	6.73	25.35	3.00	239.76	127.49	53.64
3	11.15	28.31	3.00	298.68	158.81	66.81
4	15.56	31.22	3.00	280.62	149.21	62.78
5	19.98	34.08	3.00	193.20	102.72	43.22
6	24.39	36.49	2.21	49.52	26.33	11.08

```
   7      24.39      37.52       0.04            0.02            0.01
0.00

     Average Effective Normal Stress = 67.1478(psf)
     Average Available Shear Strength = 35.7031(psf)
     Total Length of Failure Surface = 17.2442(ft)


     SUM OF MOMENTS =  -0.223591E-05 (ft/lbs);Imbalance (Fraction of
Total Weight) =  -0.1894086E-08
     SUM OF FORCES = -.450080E-07 (lbs);Imbalance (Fraction of Total
Weight) =   -0.3812728E-10

     Sum of Available Shear Forces =     615.67(lbs)

     Sum of Mobilized Shear Forces =     259.02(lbs)

     FS Balance Check: FS =  2.376898

                         **** END OF GEOSTASE OUTPUT ****
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