GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists & Environmental Scientists

October 28, 2015 G-3837

Mr. William C. Summers
MI Treehouse, LLC
P.O. Box 261
Medina, Washington 98039

Subject: Response to September 3, 2015, Geotechnical Third Party Review Letter, Proposed Residence, 5637 East Mercer Way, Mercer Island, Washington.

Reference: Geotechnical Third Party Review, 5637 E. Mercer Way, Mercer Island, Washington (Perrone Consulting Project #15124). Perrone Consulting, Inc., P.S., September 3, 2015.

Dear Mr. Summers:

Per your request, GEO Group Northwest, Inc. has prepared this letter which presents our responses to comments in the above-referenced geotechnical third party review letter by Perrone Consulting, Inc., regarding the proposed residence to be constructed at 5637 East Mercer Way in Mercer Island, Washington.

Additional Subsurface Exploration

On October 2, 2015, a representative from our firm supervised the drilling of an exploratory soil boring, B-3, on the steep slope area in the southern portion of the site. The location of the borings is illustrated in Plate 1 – Site Plan. The boring was completed to a depth of approximately 31.5 feet below ground surface by using a manually-portable drilling rig equipped with hollow-stem augers.

Soils encountered in the boring consisted of loose fine-grained sand to a depth of approximately 16 feet, underlain with medium dense fine-grained sand, silty sand, and sandy silt to a depth of approximately 26 feet. Soils from 26 feet to the bottom of the boring consisted of medium dense to dense silt. No groundwater was encountered during drilling, but moist silty sand soils were present immediately above the silt at a depth of approximately 26 feet. A copy of the boring log (plus the logs for previous borings B-1 and B-2) is provided in Attachment 1.

Site Plan and Subsurface Profile

A site plan showing the locations of the soil borings previously completed on the site (B-1 and B-2) and the additional soil boring recently completed on the site (B-3) is provided in Plate 1 – Site Plan. Also, a subsurface profile through the site (the location of which is indicated on the site plan) is provided in Plate 2 – Subsurface Profile A-A'.

Slope Stability Analysis

Description of Analysis Method

The computer program XSTABL (Version 5.2) was used to analyze the stability of the existing fill slope along the west side of the project site. This program uses two-dimensional limit equilibrium analysis to analyze the stability of layered slopes using either the Janbu or modified Bishop method. We used the modified Bishop method of slices to analyze the stability of the slope at the project site.

The modified Bishop method is based upon plastic limit equilibrium conditions, which means that strain considerations are not considered in the analysis. Therefore, the magnitude of movement cannot be quantified using this method. In this method, the soil strength parameters are independent of the soil stress-strain behavior, and the soil shear strength is based upon Mohr-Coulomb criteria. The analysis is performed by dividing the soil mass into vertical slices to accommodate changes in soil properties throughout the slope.

The XSTABL program computes the factor of safety (FS) a slope has against movement along a surface within the soil mass (referred to as the critical surface). The FS value is a dimensionless ratio defined as the value of the resisting forces mobilized from the soil mass divided by the driving forces for movement of the soil mass. An FS value of 1.0 represents a situation where both forces are equivalent, and slope failure may be imminent. An FS value slightly above 1.0 indicates a slope with minimal stability, and increasing higher values indicate greater relative degrees of stability.

Slope Profile and Soil Parameters

Stability analyses were performed for the site profile A-A' enclosed with this letter. The subsurface soil conditions illustrated in the profiles are based on the soil conditions logged for the borings drilled on site and our interpretation of the extent of those conditions into other portions of the profile. The interpreted soil conditions at locations other than at the boring locations are inferred based on our professional experience and judgment; the actual conditions may vary from those represented in the profile.

The soils logged from the borings were categorized into discrete soil units for purposes of performing the stability analyses. The analysis parameters for each of the soil units were obtained from published correlations with standard penetration test (SPT) data, soil grain-size properties, and other attributes (apparent cohesion due to root action; glacial over-consolidation), and also were selected or adjusted based on our experience with past stability analyses involving similar soil types. Descriptions and analysis parameters for the units are summarized below in Table 1.

Table 1 - Soil Unit Descriptions and Parameters

Unit	Soil Description	In-Situ Unit Weight (pcf)	Saturated Unit Weight (pcf)	Internal Cohesion (psf)	Friction Angle (deg)
1	Loose fine SAND (Advance Glacial Outwash)	107.5	140	50*	30
2	Medium dense, stratified Fine SILTY SAND (lower Advance Glacial Outwash)	117.5	140	50*	34
3	Medium dense to dense SILT (Glacio-lacustrine deposits)	120	140	250	35

Note: * - Apparent cohesion associated with moisture adhesion and rooting in soils.

Slope Failure Model

The slope failure mode selected for the analyses was a conventional modified Bishop circular surface model. Based on the subsurface conditions associated with the slope profile, it is our opinion that this is the most appropriate failure model to analyze for the slope.

Analysis Scenario

The slope stability analyses were performed for the existing slope condition and for a potential temporary condition during construction that involves excavation to construct the proposed residence. The final, post-construction condition is anticipated to have the grade configuration essentially similar to the initial condition.

Analysis Results

The stability analysis calculations indicate that the slope profile has an FS value of 1.26 for stability in its existing configuration for the static case, and an FS value of 0.94 for the seismic case. The most critical failure surfaces for the existing slope condition consist of arc-shaped failures that involve the loose sand soils. These failures surfaces are generally similar for the static and seismic cases. The most critical failure surfaces identified in the analyses are illustrated in the analysis plots provided in Attachment 2.

Evaluation of Results

Based upon the results from the subsurface investigation and slope stability analysis that we have completed, it is our opinion that the steep slope in proximity to the proposed residence location is relatively stable in its current condition. However, based on the observed conditions, it also is our opinion that the slope is susceptible to shallow raveling or sloughing, particularly if it is disturbed by earthwork or significant clearing. With regard to larger-scale movement, we concluded that the slope has a low potential for failure in its existing condition over the short term. However, there is the potential for failure of the loose sandy soils in the slope over the long term, particularly during high-intensity seismic events or if exceptionally high groundwater levels develop in the sandy soils up the slope.

Catchment Wall

Protection of the residence from slope failure of the types identified from the slope stability analysis results can be provided by constructing an engineered catchment/retaining wall at or near the base of the steep slope south and southwest of the proposed residence location. We recommend that the wall have a minimum height of 6 feet above final grade as measured on its upslope side. We also recommend that the wall be supported using a system of small-diameter pipe piles to provide vertical support and inclined helical anchors embedded into the soils below the slope to provide lateral support.

Drainage of potential water accumulation behind the wall should be managed by installing a 4"-diameter rigid perforated Schedule 80 PVC drain pipe along the back of the wall, surrounding the pipe with at least 6" of clean crushed or drain rock, and surrounding the rock with a layer of durable non-woven geotextile filter fabric. The drain line should be sloped to direct flow to an appropriate discharge point or tightline.

Down-drag Effects on Pipe Piles

In our opinion, liquefaction and settlement of the loose sandy soils poses minimal potential to exert down-drag forces on the steel pipe piles proposed for the project. Down-drag forces typically are generated in scenarios where competent cohesive soils undergo settlement due to decrease of support from underlying soft or loose soils. The soil conditions at the project site are similar these types of scenarios: The competent silt soils present below the loose saturated sandy soils are not susceptible to downward movement, and the loose sandy soils lack sufficient cohesion to generate drag forces on the piles.

Closing

Please feel welcome to contact us if you have any questions.

Sincerely,

GEO GROUP NORTHWEST, INC.

Keith Johnson
Project Geologist

KEITH A. JOHNSON

William Chang, P.E.
Principal

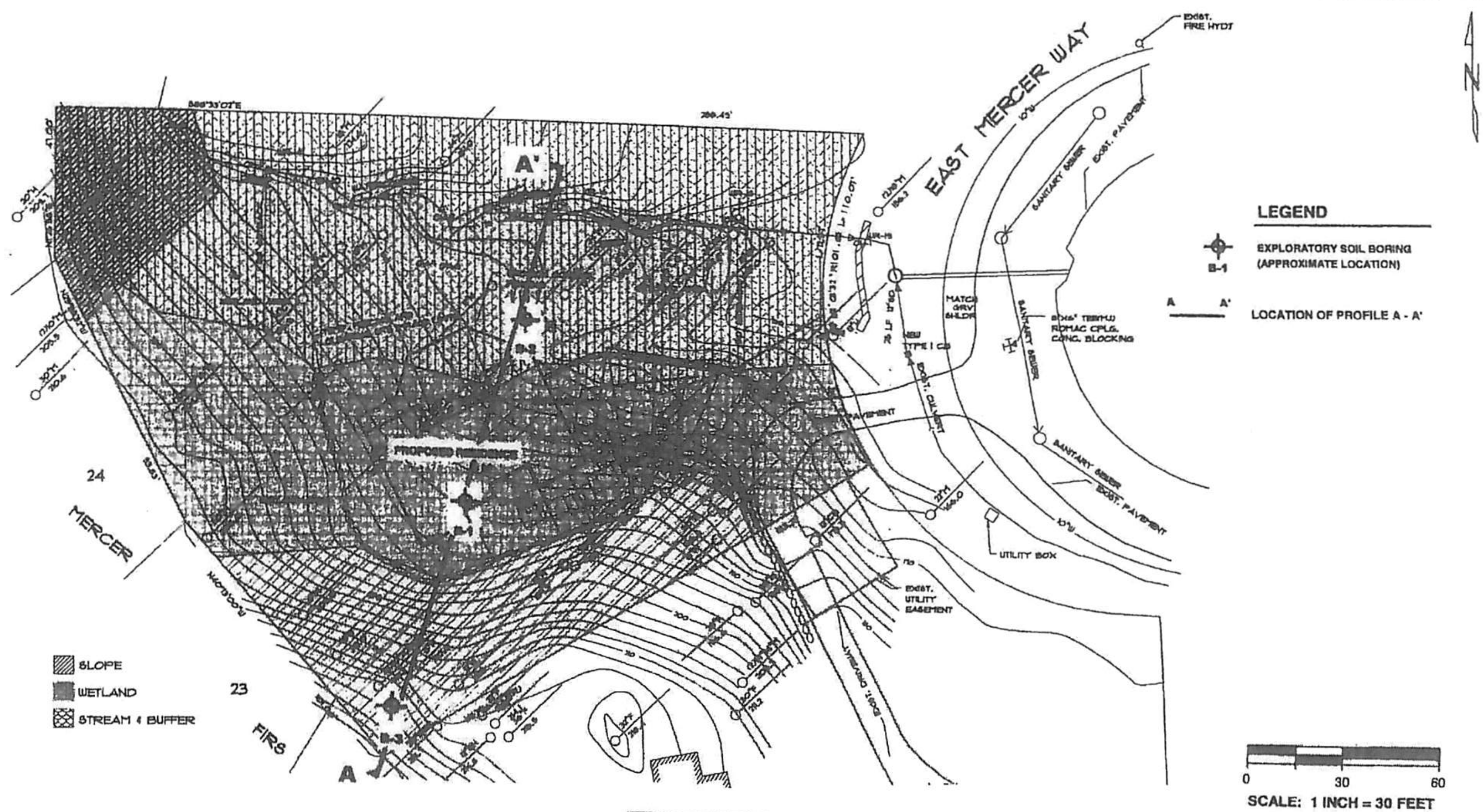
Enclosures:

Plate 1 – Site Plan
Plate 2 – Subsurface Profile A-A'
Attachment 1 – Boring Logs
Attachment 2 – Slope Stability Analysis Results

PLATES

G-3837

GEO Group Northwest, Inc.



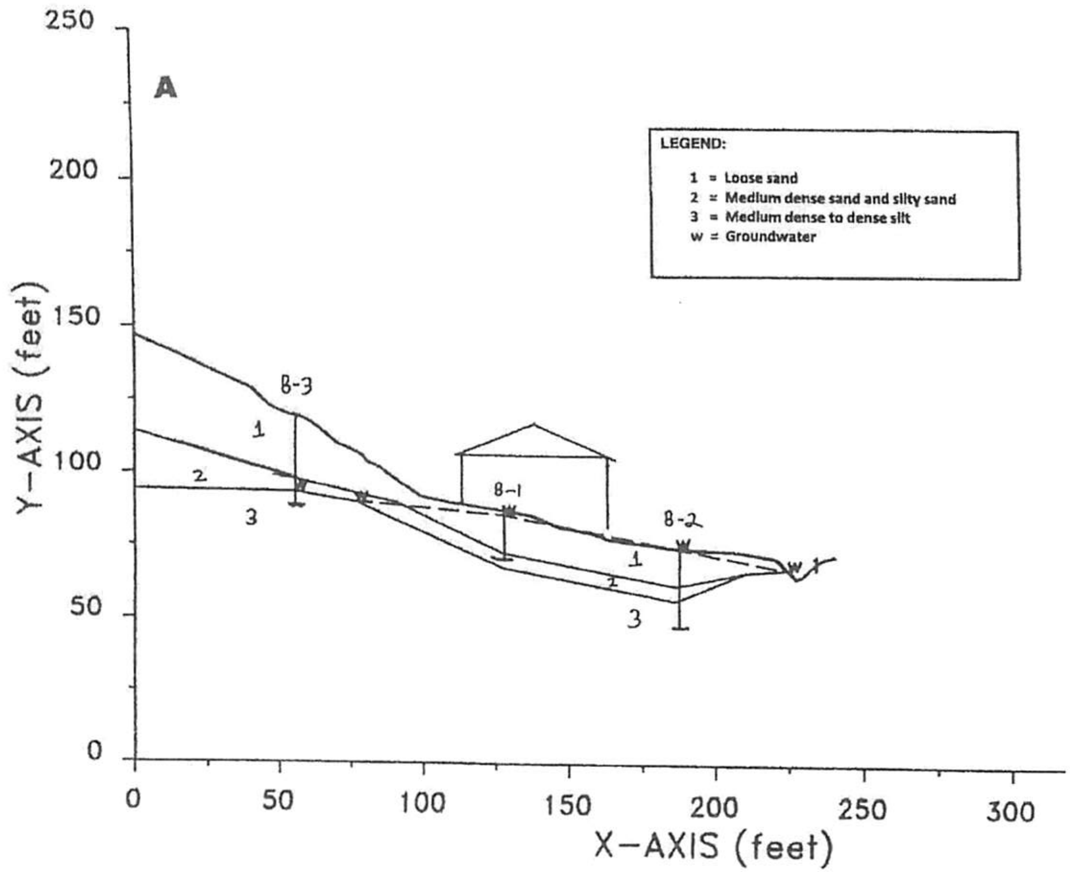
Source: Master Site Plan by Healy-Jorgensen Architects, dated 3/2/15.

Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

SITE PLAN

PROPOSED RESIDENCE
5637 E. MERCER WAY
MERCER ISLAND, WASHINGTON

SCALE	1" = 30'	DRAWN BY	KJ	CHECKED BY	WC	DATE	10/28/2015	PROJECT NO.	G-3827	PLATE	1



NOTE: Y-axis elevations shown above are 100 feet less than actual elevations, for illustration purposes.

GEO Group Northwest, Inc. Geotechnical Engineers, Geologists, & Environmental Scientists				SUBSURFACE PROFILE A - A' PROPOSED RESIDENCE 5637 E. MERCER WAY MERCER ISLAND, WASHINGTON		
SCALE 1" = 40'	DRAWN BY KJ	CHECKED BY WC		DATE 10/28/2015	PROJECT NO. G-3837	PLATE 2

ATTACHMENT 1

G-3837

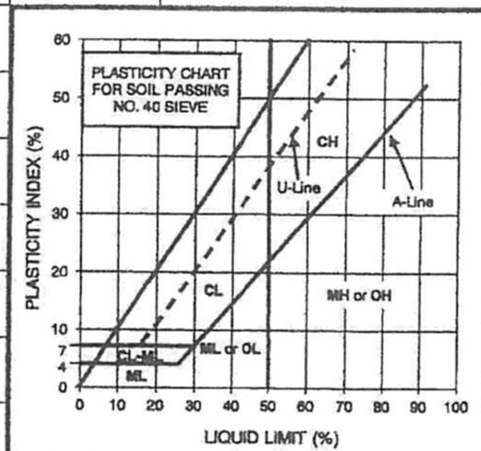
BORING LOGS

GEO Group Northwest, Inc.

SOIL CLASSIFICATION & PENETRATION TEST DATA EXPLANATION

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS	GRAVELS (More Than Half Coarse Fraction Is Larger Than No. 4 Sieve)	CLEAN GRAVELS (little or no fines)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	CONTENT OF FINES BELOW 5%	Cu = (D60 / D10) greater than 4 Cc = $(D30)^2$ / (D10 * D60) between 1 and 3
			GP	POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES LITTLE OR NO FINES		CLEAN GRAVELS NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (with some fines)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	GM: ATTERBERG LIMITS BELOW "A" LINE. or P.I. LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		GC: ATTERBERG LIMITS ABOVE "A" LINE. or P.I. MORE THAN 7
More Than Half by Weight Larger Than No. 200 Sieve	SANDS (More Than Half Coarse Fraction is Smaller Than No. 4 Sieve)	CLEAN SANDS (little or no fines)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	CONTENT OF FINES BELOW 5%	Cu = (D60 / D10) greater than 6 Cc = $(D30)^2$ / (D10 * D60) between 1 and 3
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES		CLEAN SANDS NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (with some fines)	SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE with P.I. LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE with P.I. MORE THAN 7
FINE-GRAINED SOILS	SILTS (Below A-Line on Plasticity Chart, Negligible Organics)	Liquid Limit < 50%	ML	INORGANIC SILTS, ROCK FLOUR, SANDY SILTS OF SLIGHT PLASTICITY		
		Liquid Limit > 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOIL		
	CLAYS (Above A-Line on Plasticity Chart, Negligible Organics)	Liquid Limit < 50%	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, CLEAN CLAYS		
		Liquid Limit > 50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
Less Than Half by Weight Larger Than No. 200 Sieve	ORGANIC SILTS & CLAYS (Below A-Line on Plasticity Chart)	Liquid Limit < 50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		Liquid Limit > 50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS		



SOIL PARTICLE SIZE

FRACTION	U.S. STANDARD SIEVE			
	Passing		Retained	
	Sieve	Size (mm)	Sieve	Size (mm)
SILT / CLAY	#200	0.075		
SAND				
FINE	#40	0.425	#200	0.075
MEDIUM	#10	2.00	#40	0.425
COARSE	#4	4.75	#10	2.00
GRAVEL				
FINE	0.75"	19	#4	4.75
COARSE	3"	76	0.75"	19
COBBLES	76 mm to 203 mm			
BOULDERS	> 203 mm			
ROCK FRAGMENTS	> 76 mm			
ROCK	>0.76 cubic meter in volume			

GENERAL GUIDANCE FOR ENGINEERING PROPERTIES OF SOILS, BASED ON STANDARD PENETRATION TEST (SPT) DATA

SANDY SOILS				SILTY & CLAYEY SOILS		
Blow Counts N	Relative Density, %	Friction Angle ϕ, degrees	Description	Blow Counts N	Unconfined Strength q_u, tsf	Description
0 - 4	0 - 15		Very Loose	< 2	< 0.25	Very soft
4 - 10	15 - 35	26 - 30	Loose	2 - 4	0.25 - 0.50	Soft
10 - 30	35 - 65	28 - 35	Medium Dense	4 - 8	0.50 - 1.00	Medium Stiff
30 - 50	65 - 85	35 - 42	Dense	8 - 15	1.00 - 2.00	Stiff
> 50	85 - 100	38 - 46	Very Dense	15 - 30	2.00 - 4.00	Very Stiff
				> 30	> 4.00	Hard

GEO Group Northwest, Inc.
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13240 NE 20th Street, Suite 10 Bellevue, WA 98005
Phone (425) 649-8757 Fax (425) 649-8758

PLATE A1

BORING NO. B-1

Logged By: KJ Date Drilled: 8/10/1999 Surface Elev. 187 feet +/-

Depth ft.		USCS Code	Description	Sample Type	Sample No.	Blow Count per 6-inches	Water Content %	Other Tests & Comments
		OL	Organic topsoil, very soft, wet, black.	I	S1	1,1,1 (N=2)	44.4	
		SM	SILTY SAND, very loose, wet, fine grained sand, 20-25% fines, trace black organics, occasional gray lenses, brown.	I	S2	1/12",1 (N=1)	27.0	
5		SP-SM	SAND, loose, wet, 10% fines, fine grained, mottled gray and brown.	I	S3	1,2,3 (N=5)	28.0	
		SP-SM	As above, medium dense, 5-10% fines.	I	S4	5,6,6 (N=12)	29.2	
10		SP-SM	As above, 2.5 feet of sand heave into hole.	I	S5	5,6,9 (N=15)	27.9	
15		SM	SILTY SAND, medium dense to dense, moist to wet, 20% fines, very fine to fine grained sand, brownish gray.	I	S6	9,15, 16,28 (N=31*)	25.8	* = Blow counts may be affected by sand heave.
20			Bottom of boring: 17 feet. Drilling Method: Hollow-stem auger 0 to 17 feet. Sampling Method: 2-inch-O.D. standard penetration sampler driven using a 140 lb. hammer with a 30-inch drop. Groundwater encountered near ground surface during drilling. Boring backfilled with bentonite chips.					
25								
30								
35								
40								

LEGEND: I 2" O.D. Split-Spoon Sampler; II 3" O.D. Shelby-Tube Sampler; III 3" O.D. California Sampler

GROUNDWATER OBSERVATION WELL: seal; measured water level; well tip (screen)

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BORING LOG

PROPOSED RESIDENCE
5637 E. MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO. G-3837 DATE 3/11/2015 PLATE A2

BORING NO. B-2

Logged By: KJ   Date Drilled: 8/10/1999   Surface Elev. 176 feet +/-

Depth ft.	USCS Code	Description	Sample Type	Sample No.	Blow Count per 6-inches	Water Content %	Other Tests & Comments
	OL	Very soft, moist, black, organic topsoil and red decomposed wood, poor sample recovery.			1/18" (N=0)		Poor recovery.
	SP-SM	SAND, loose, wet, fine to medium grained, 10-15% fines, rust-colored oxide staining, some black organics, brown.		S1	1,2,2 (N=4)	34.6	
5	SP-SM	As above, loose.		S2	4,3,5 (N=8)	23.6	
	SP-SM	As above, medium dense, trace coarse sand.		S3	4,7,9 (N=16)	21.4	
10	SP	As above, loose, 5% fines, fine grained, grayish brown.		S4	4,4,4 (N=8)	27.4	
15	SM	SILTY SAND, loose, wet, fine to medium grained sand, 20-25% fines, trace small wood chips, rare coarse sand, trace reddish oxide staining, dark gray.		S5	3,2,3 (N=5)	23.8	
20	ML	SILT, stiff, damp to moist, trace fine sand, contains wet sand lenses, dark gray.		S6	5,11,12 (N=23)	30.6	
25	ML	As above, occasionally laminated (some brown laminae and organics, some wet sand lenses.		S7	5,9,10 (N=19)	28.1	
30		Bottom of boring: 27 feet. Drilling Method: Hollow-stem auger 0 to 27 feet. Sampling Method: 2-inch O.D. standard penetration sampler driven using a 140 lb. hammer with a 30-inch drop. Groundwater encountered near ground surface during drilling. Boring backfilled with bentonite chips.					
35							
40							

LEGEND:
- 2" O.D. Split-Spoon Samples
- 3" O.D. Shelby-Tube Sampler
- 3" O.D. California Sampler

GROUNDWATER OBSERVATION WELL:
- seal
- measured water level
- well tip (screen)

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BORING LOG

PROPOSED RESIDENCE
5637 E. MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO. G-3837 | DATE 3/11/2015 | PLATE A3

BORING NO. B - 3

Logged By: KJ Date Drilled: 10/2/2015 Surface Elev. 215 ' ±
Drilled By: CN Drilling

Depth ft.	Elevation	USCS Code	Description	Sample Loc.	Sample No.	SPT Blow Counts	Water Content %	Other Tests/ Comments
0			Ivy, ferns, forest duff at surface, very loose, dry	SPT		1,1,2 (N=3)		
		SP	SAND, brown, loose, dry to damp, predominantly fine grained, 5% fines, trace organics (NATIVE SOIL).	SPT		2,2,2 (N=4)	3.8	
5		SP	SAND, brown, loose, damp, predominantly fine grained, no fines, no organics, occasional oxidized laminae.	SPT		2,3,4 (N=7)	4.6	
		SP	As above, light grayish brown, no oxidized laminae.	SPT		3,3,4 (N=7)	5.1	
10		SP	As above, trace oxidized staining.	SPT		3,3,5 (N=8)	7.0	
		SP	As above, loose to medium dense.	SPT		3,4,6 (N=10)	5.0	
15		SP	SAND, light brown-gray, damp, loose to medium dense, very fine to fine grained, no oxidation staining.	SPT		3,4,6 (N=10)	6.1	
		SP	As above, damp to moist, medium dense.	SPT		5,7,10 (N=17)	7.3	
20		SP/SM	Light grayish brown SAND and SILTY SAND, interbedded, moist, medium dense, sand is very fine and fine grained and grades to silty layers, SM layers are in lower part of sample.	SPT		6,8,9 (N=17)	8.2	
25								

LEGEND: 2" O.D. SPT Sampler; 3" O.D. California Sampler
▽ Water Level noted during drilling
▼ Water Level measured at later time, as noted

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

BORING LOG

PROPOSED RESIDENCE
5637 E. MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO. G-3837 DATE ____ PLATE ____

BORING NO. B - 3

Logged By: KJ
Drilled By: CN Drilling
Date Drilled: 10/2/2015
Surface Elev. 215 ' ±

Depth ft.	Elevation	USCS Code	Description	Sample Loc.	Sample No.	SPT Blow Counts	Water Content %	Other Tests/ Comments
		SP/SM/ ML	SAND and SILTY SAND, gray-brown; and SANDY SILT and SILT, gray to olive brown; moist, medium dense, sand is fine grained, silty units have very fine to fine sand. Silt is in bottom of sample, bottom of silty sand is very moist.	I		7,12,15 (N=27)	24.3	
30		ML	SILT, dark gray, damp, medium dense to dense, trace very fine sand, massive.	I		9,13,17 (N=30)	24.2	
35			Depth of boring: 31.5 feet. Drilling Method: Hollow-stem auger. Sampling Method: 2-inch-O.D. standard penetration sampler driven using a 140 lb. hammer with a 30-inch drop (cathead). Groundwater not encountered during drilling.					
40								
45								
50								

LEGEND: 2" O.D. SPT Sampler; 3" O.D. California Sampler

▽ Water Level noted during drilling
▼ Water Level measured at later time, as noted

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BORING LOG

PROPOSED RESIDENCE
5637 E. MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO. G-3837 DATE _____ PLATE _____

ATTACHMENT 2

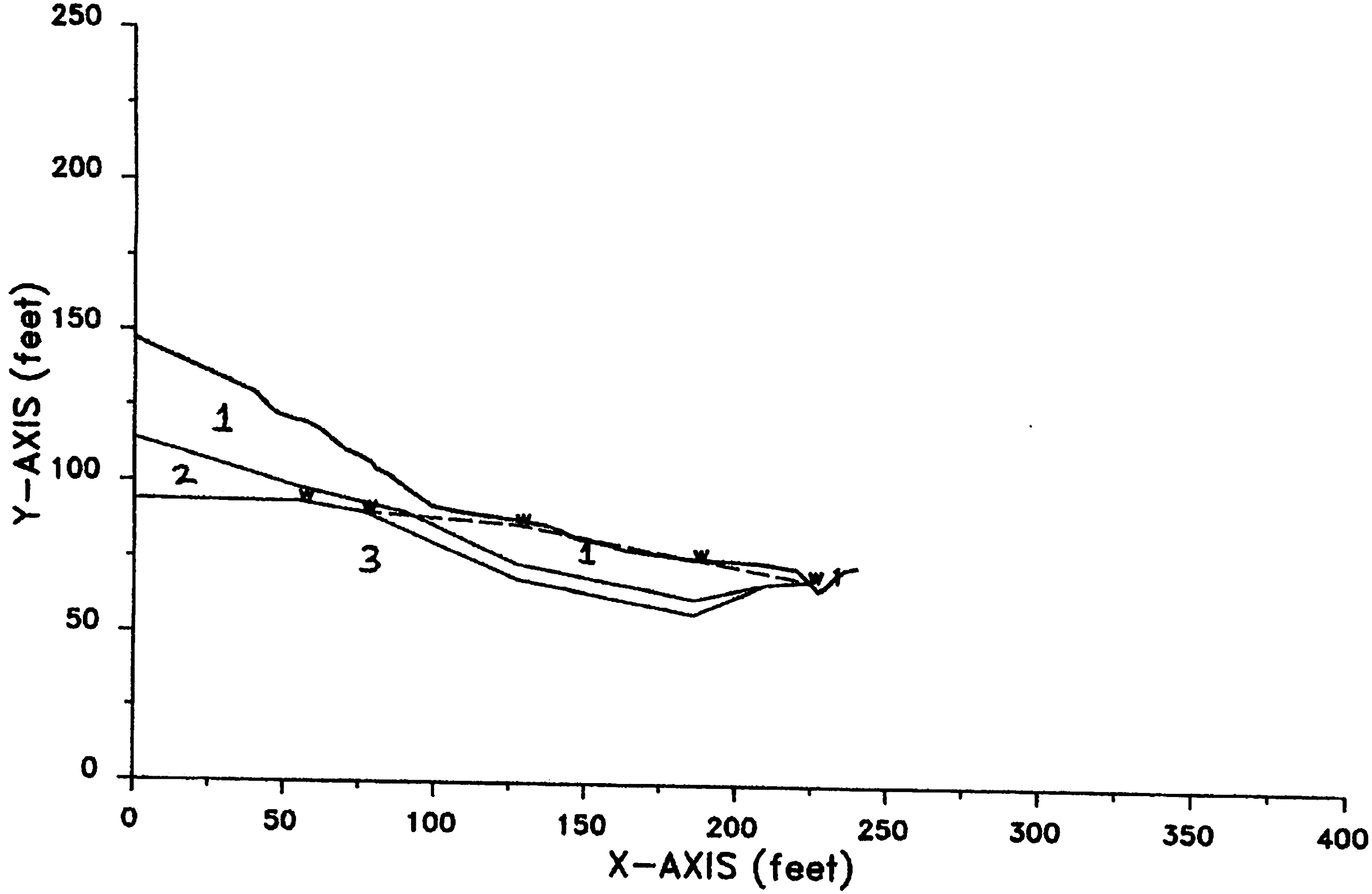
G-3837

SLOPE STABILITY ANALYSIS RESULTS

GEO Group Northwest, Inc.

G3837A 10-27-** 13:07

5637 E MERCER WY



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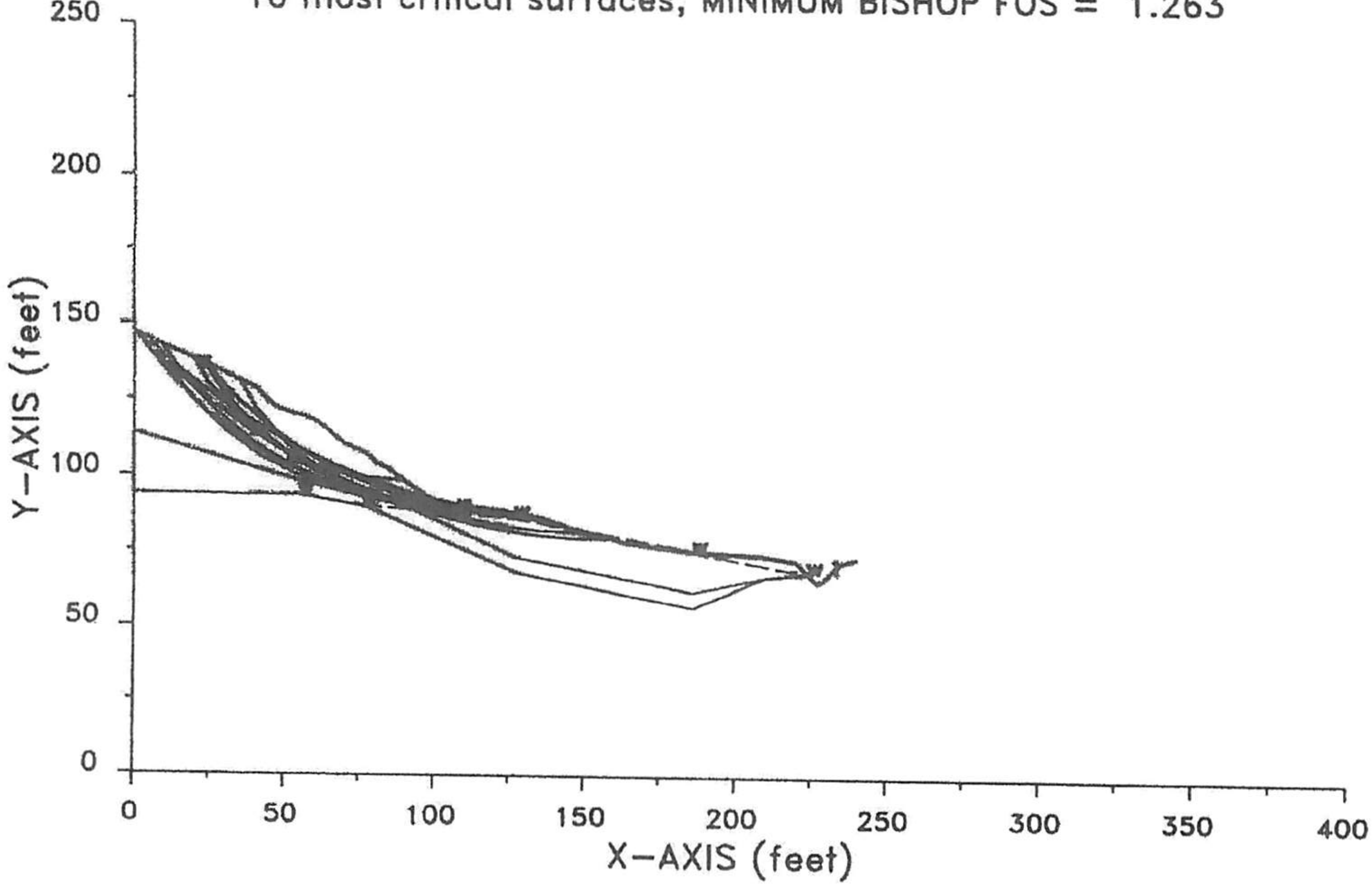
5637 E MERCER WY

10 most critical surfaces, MINIMUM BISHOP FOS = 1.263



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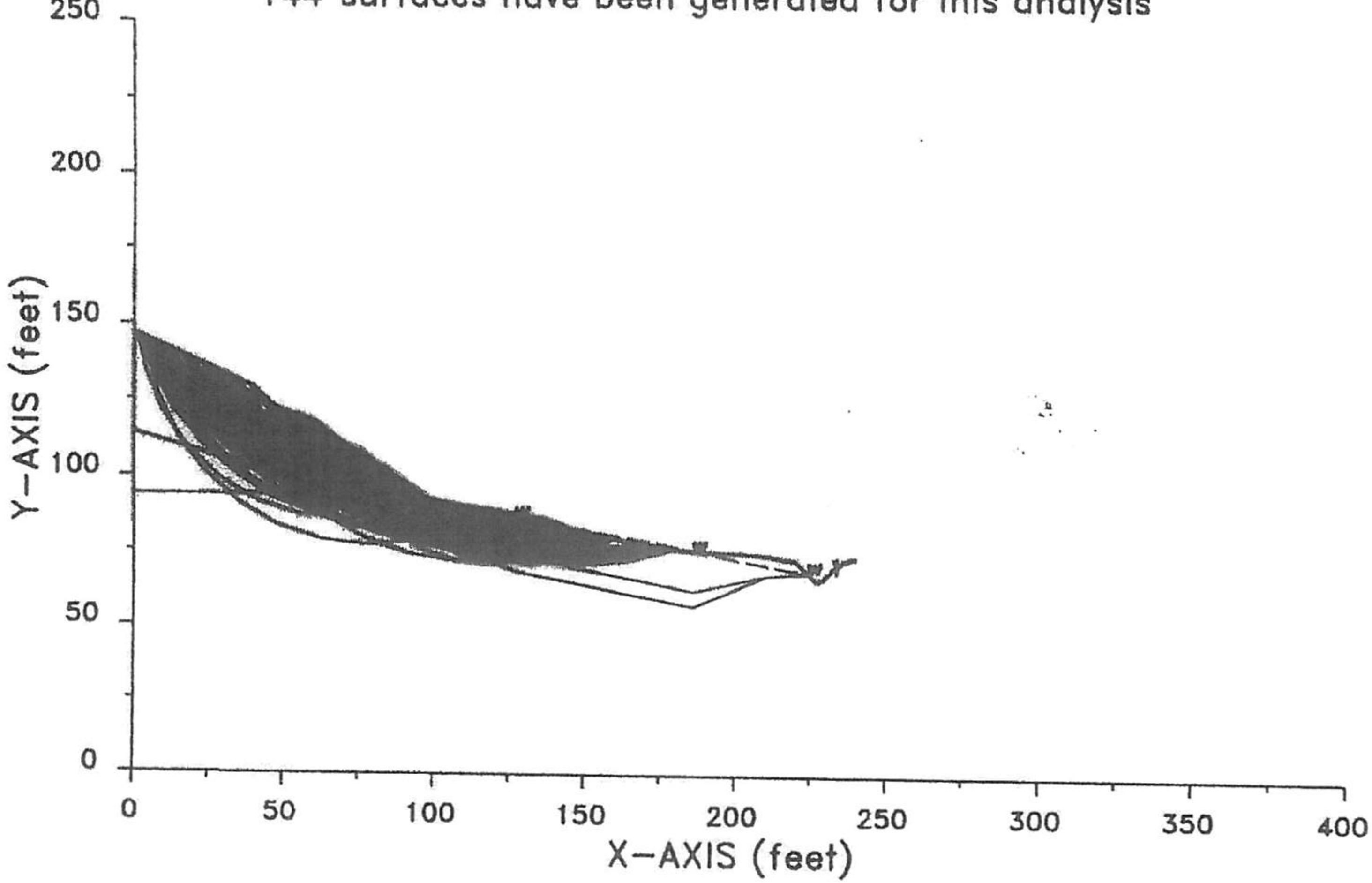
5637 E MERCER WY
144 surfaces have been generated for this analysis



XSTABL File: G3837A 10-27-** 13:07

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****************************************
*          X S T A B L           *
*                              *
*     Slope Stability Analysis      *
*           using the             *
*        Method of Slices          *
*                              *
*     Copyright (C) 1992 Ä 96      *
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*                              *
* Ver. 5.200           96 Ä 1295  *
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Problem Description : 5637 E MERCER WY

SEGMENT BOUNDARY COORDINATES

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38 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	147.0	40.0	129.0	1
2	40.0	129.0	45.0	124.0	1
3	45.0	124.0	48.0	122.0	1
4	48.0	122.0	53.5	120.0	1
5	53.5	120.0	55.0	120.0	1
6	55.0	120.0	60.0	118.0	1
7	60.0	118.0	63.0	116.0	1
8	63.0	116.0	68.0	112.0	1
9	68.0	112.0	70.5	110.0	1
10	70.5	110.0	75.5	108.0	1
11	75.5	108.0	79.0	106.0	1
12	79.0	106.0	80.5	104.0	1

13	80.5	104.0	85.0	102.0	1
14	85.0	102.0	87.5	100.0	1
15	87.5	100.0	93.0	96.0	1
16	93.0	96.0	96.0	94.0	1
17	96.0	94.0	99.0	92.0	1
18	99.0	92.0	109.0	90.0	1
19	109.0	90.0	124.0	88.0	1
20	124.0	88.0	127.0	87.5	1
21	127.0	87.5	136.0	86.0	1
22	136.0	86.0	142.0	84.0	1
23	142.0	84.0	146.0	82.0	1
24	146.0	82.0	157.5	80.0	1
25	157.5	80.0	163.0	78.0	1
26	163.0	78.0	178.0	76.0	1
27	178.0	76.0	186.0	75.0	1
28	186.0	75.0	207.5	74.0	1
29	207.5	74.0	220.0	72.0	1
30	220.0	72.0	222.0	70.0	1
31	222.0	70.0	224.0	68.0	1
32	224.0	68.0	226.0	66.0	3
33	226.0	66.0	227.0	65.0	3
34	227.0	65.0	229.0	66.0	3
35	229.0	66.0	231.0	68.0	3
36	231.0	68.0	233.0	70.0	3
37	233.0	70.0	236.0	72.0	3
38	236.0	72.0	240.0	73.0	3

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	114.0	55.0	98.0	2
2	55.0	98.0	90.0	90.0	2
3	90.0	90.0	127.0	73.0	2
4	127.0	73.0	186.0	62.0	2
5	186.0	62.0	210.0	67.0	2
6	210.0	67.0	224.0	68.0	3
7	.0	94.0	55.0	93.5	3
8	55.0	93.5	76.0	90.0	3
9	76.0	90.0	127.0	68.0	3
10	127.0	68.0	186.0	57.0	3
11	186.0	57.0	210.0	67.0	3

ISOTROPIC Soil Parameters

----

3 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	107.5	140.0	50.0	30.00	.000	.0	1
2	117.5	140.0	50.0	34.00	.000	.0	1
3	120.0	140.0	250.0	35.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 5 coordinate points

****

PHREATIC SURFACE,

****

Point No.	x-water (ft)	y-water (ft)
1	55.00	93.50
2	76.00	90.00
3	127.00	86.00
4	186.00	75.00
5	224.00	68.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

144 trial surfaces will be generated and analyzed.

12 Surfaces initiate from each of 12 points equally spaced along the ground surface between x = 70.0 ft
and x = 180.0 ft

Each surface terminates between x = .0 ft
and x = 90.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 70.0 ft

15.0 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 := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	110.00	89.87
2	95.01	90.40

3	80.28	93.24
4	66.17	98.32
5	53.01	105.53
6	41.13	114.68
7	30.81	125.56
8	23.23	136.55

**** Simplified BISHOP FOS = 1.263 ****

The following is a summary of the TEN most critical surfaces

Problem Description : 5637 E MERCER WY

	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.	1.263	105.90	186.48	96.70	110.00	23.23	5.035E+06
2.	1.278	105.23	203.65	113.88	110.00	8.86	8.247E+06
3.	1.288	113.00	225.91	137.55	120.00	.75	1.142E+07
4.	1.305	129.18	224.74	137.75	130.00	23.59	5.648E+06
5.	1.324	93.99	191.90	100.28	100.00	6.05	8.236E+06
6.	1.331	158.67	312.70	228.80	140.00	1.97	1.157E+07
7.	1.338	86.95	175.05	76.93	90.00	19.87	3.455E+06
8.	1.346	151.13	288.09	206.79	150.00	.13	1.693E+07
9.	1.353	107.68	170.49	82.87	120.00	34.95	3.834E+06
10.	1.363	157.29	292.40	213.33	160.00	2.29	1.708E+07

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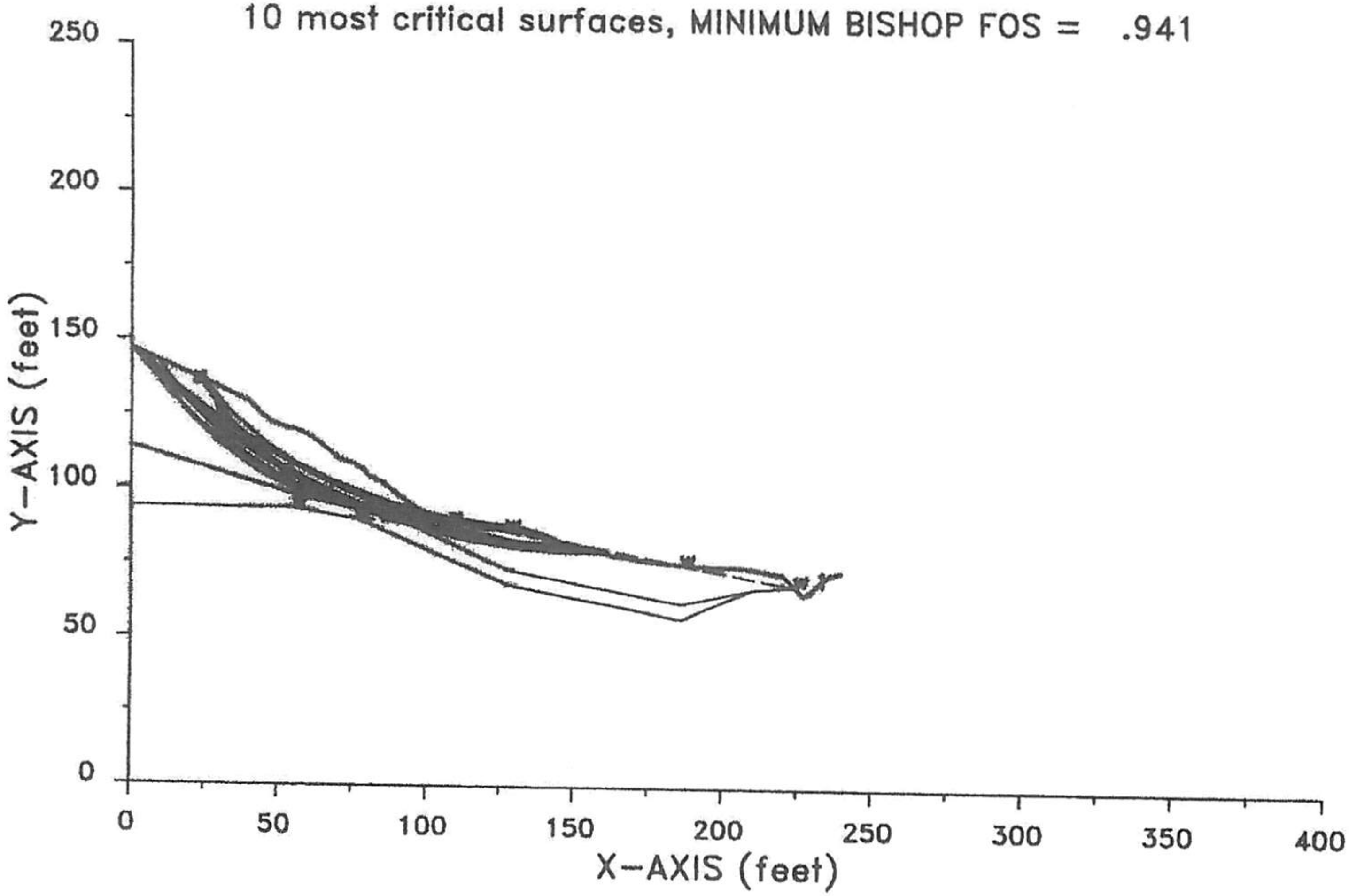
5637 E MERCER WY
10 most critical surfaces, MINIMUM BISHOP FOS = .941



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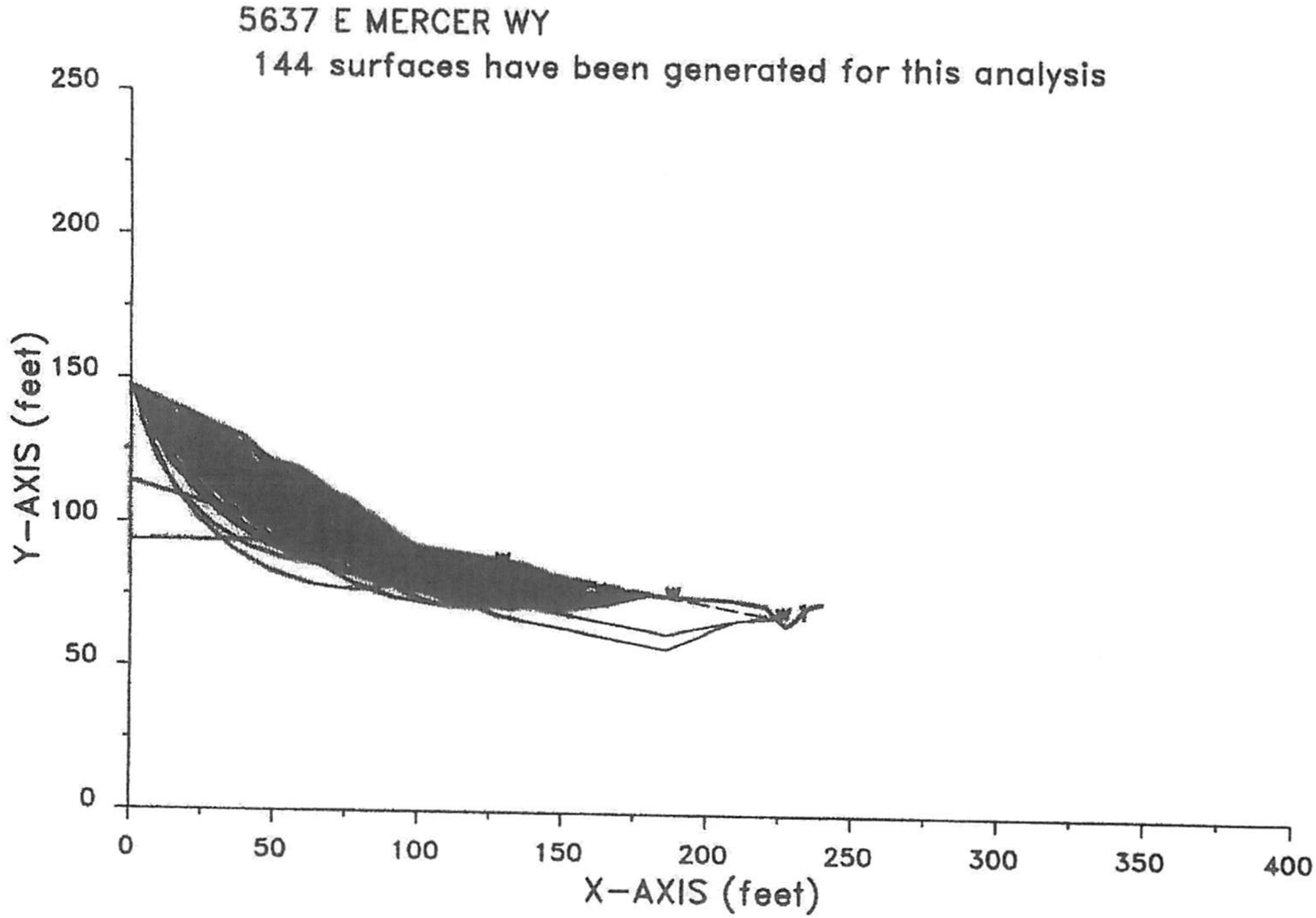

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Problem Description : 5637 E MERCER WY

SEGMENT BOUNDARY COORDINATES

38 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	147.0	40.0	129.0	1
2	40.0	129.0	45.0	124.0	1
3	45.0	124.0	48.0	122.0	1
4	48.0	122.0	53.5	120.0	1
5	53.5	120.0	55.0	120.0	1
6	55.0	120.0	60.0	118.0	1
7	60.0	118.0	63.0	116.0	1
8	63.0	116.0	68.0	112.0	1
9	68.0	112.0	70.5	110.0	1
10	70.5	110.0	75.5	108.0	1
11	75.5	108.0	79.0	106.0	1
12	79.0	106.0	80.5	104.0	1

13	80.5	104.0	85.0	102.0	1
14	85.0	102.0	87.5	100.0	1
15	87.5	100.0	93.0	96.0	1
16	93.0	96.0	96.0	94.0	1
17	96.0	94.0	99.0	92.0	1
18	99.0	92.0	109.0	90.0	1
19	109.0	90.0	124.0	88.0	1
20	124.0	88.0	127.0	87.5	1
21	127.0	87.5	136.0	86.0	1
22	136.0	86.0	142.0	84.0	1
23	142.0	84.0	146.0	82.0	1
24	146.0	82.0	157.5	80.0	1
25	157.5	80.0	163.0	78.0	1
26	163.0	78.0	178.0	76.0	1
27	178.0	76.0	186.0	75.0	1
28	186.0	75.0	207.5	74.0	1
29	207.5	74.0	220.0	72.0	1
30	220.0	72.0	222.0	70.0	1
31	222.0	70.0	224.0	68.0	1
32	224.0	68.0	226.0	66.0	3
33	226.0	66.0	227.0	65.0	3
34	227.0	65.0	229.0	66.0	3
35	229.0	66.0	231.0	68.0	3
36	231.0	68.0	233.0	70.0	3
37	233.0	70.0	236.0	72.0	3
38	236.0	72.0	240.0	73.0	3

11 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	114.0	55.0	98.0	2
2	55.0	98.0	90.0	90.0	2
3	90.0	90.0	127.0	73.0	2
4	127.0	73.0	186.0	62.0	2
5	186.0	62.0	210.0	67.0	2
6	210.0	67.0	224.0	68.0	3
7	.0	94.0	55.0	93.5	3
8	55.0	93.5	76.0	90.0	3
9	76.0	90.0	127.0	68.0	3
10	127.0	68.0	186.0	57.0	3
11	186.0	57.0	210.0	67.0	3

ISOTROPIC Soil Parameters
----

3 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	107.5	140.0	50.0	30.00	.000	.0	1
2	117.5	140.0	50.0	34.00	.000	.0	1
3	120.0	140.0	250.0	35.00	.000	.0	0

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 5 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	55.00	93.50
2	76.00	90.00
3	127.00	86.00
4	186.00	75.00
5	224.00	68.00

A horizontal earthquake loading coefficient
of .150 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

144 trial surfaces will be generated and analyzed.

12 Surfaces initiate from each of 12 points equally spaced along the ground surface between x = 70.0 ft
and x = 180.0 ft

Each surface terminates between x = .0 ft
and x = 90.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 70.0 ft

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ANGULAR RESTRICTIONS

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Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	110.00	89.87
2	95.01	90.40
3	80.28	93.24
4	66.17	98.32
5	53.01	105.53
6	41.13	114.68
7	30.81	125.56
8	23.23	136.55

**** Simplified BISHOP FOS = .941 ****

The following is a summary of the TEN most critical surfaces

Problem Description : 5637 E MERCER WY

	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.	.941	105.90	186.48	96.70	110.00	23.23	4.717E+06
2.	.947	105.23	203.65	113.88	110.00	8.86	7.732E+06
3.	.949	113.00	225.91	137.55	120.00	.75	1.071E+07
4.	.964	157.29	292.40	213.33	160.00	2.29	1.598E+07
5.	.965	151.13	288.09	206.79	150.00	.13	1.501E+07
6.	.966	129.18	224.74	137.75	130.00	23.59	5.296E+06
7.	.973	152.82	283.99	205.03	160.00	.55	1.733E+07
8.	.976	158.67	312.70	228.80	140.00	1.97	1.085E+07
9.	.983	93.99	191.90	100.28	100.00	6.05	7.747E+06
10.	.986	173.37	333.11	254.37	160.00	.14	1.534E+07

* * * END OF FILE * * *