APPENDIX I

BORING LOGS

GENERAL NOTES

SAMPLE INDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted (ASTM D 487)

SOIL PROPERTY SYMBOLS

N:	Standard "N" penetration; Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split spoon sampler (ASTM D 1586)
c:	Cohesive strength, KSF (ASTM D 2166)
DUW:	Dry Unit Weight, PCF
Qp:	Penetrometer value, an estimate of the unconfined compressive stregth, TSF
MC:	Moisture content, based on dry weight of soil, % (ASTM D 2216)
LL:	Liquid limit, % - Atterberg Limits Test (ASTM D 4318)
PI:	Plasticity Index, % - Atterberg Limits Test (ASTM D 4318)

DRILLING AND SAMPLING SYMBOLS

H.S.A.	Hollow Stem Auger Drilling
S.F.A.	Solid Flight Auger Drilling
M.R.	Mud-Rotary Drilling
H.A.	Hand Auger Drilling

SPT: Split Spoon Sampler: 1-3/8" I.D., 2" O.D., except where noted (ASTM D 1586)

ST: Shelby Tube Sampler: 3" O.D., except where noted (ASTM D 1587)

CP: Hand Cone Penetrometer - Blows per 1-3/4 inches (ASTM STP 399) - correlated to the Standard Penetration Test

Ground water level encountered during drilling of borehole

Ground water level encountered upon completion of drilling

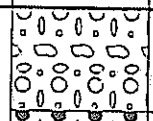
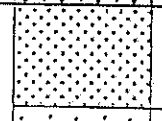
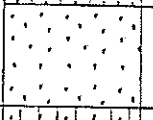
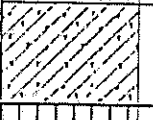
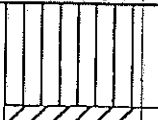
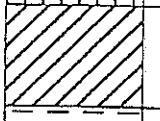
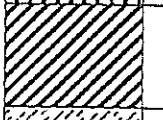
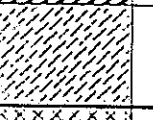
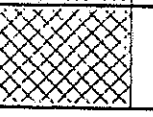
RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

Term (Non-Cohesive Soils)	Standard Penetration Resistance, Blows/ft.	Term (Cohesive Soils)	Standard Penetration Resistance, Blows/ft.
Very Loose	0 - 4	Very Soft	0 - 2
Loose	5 - 9	Soft	3 - 4
Medium Dense	10 - 29	Firm	5 - 8
Dense	30 - 49	Stiff	9 - 15
Very Dense	50 +	Very Stiff	16 - 30
		Hard	30 +

PARTICLE SIZE

Boulders	8 in. +	Coarse Sand	0.6 mm - 5 mm	Silt	0.005 mm - 0.074 mm
Cobbles	3 in. - 8 in.	Medium Sand	0.2 mm - 0.6 mm	Clay	< 0.005 mm
Gravel	5 mm - 3 in.	Fine Sand	0.074 mm - 0.2 mm		

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT LESS THAN 50			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS — LIQUID LIMIT GREATER THAN 50			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
MISCELLANEOUS FILL SOILS					FILL SOILS, CONTAINING VARYING AMOUNTS OF DEBRIS, NON-ENGINEERED FILL

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension			**Boring No.:** B-1
Location: Shelby County, Tennessee			**Elev:** 258 ±
Date: 5/1/03	**Water level while drilling:** ▽ Dry	**Water level at completion:** ▽ Dry	
Boring Method: Hand Auger	**Boring Cave In:** Open	**Driller:** E. Morris	

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		Soft to Firm Brown Silty CLAY (CL), A-7-6	4		29				trace sand and roots
5			5		28				
			5		27	46	24		
10			4		26				
		Boring Terminated at 10.5 Feet.							

PSI502 35079.GPJ 11/18/03

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension			**Boring No.:** B-2
Location: Shelby County, Tennessee			**Elev:** 246 ±
Date: 5/1/03	**Water level while drilling:** ▽ 10'	**Water level at completion:** ▽ 10'	
Boring Method: Hand Auger	**Boring Cave In:** Open	**Driller:** E. Morris	

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		Firm Brown SILT (ML), A-4	6		25	NP	NP		
5		Firm to Soft Brown to Gray Silty CLAY (CL), A-6	5		30				
			4		30				
10			4		28				
		Boring Terminated at 10.5 Feet.							

PSI502 35079.GPJ 11/18/03

PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension			Boring No.: B-3
Location: Shelby County, Tennessee			Elev: 239 ±
Date: 4/14/03	Water level while drilling: ▽ Dry	Water level at completion: ▽ Dry	
Boring Method: HSA	Boring Cave In: Open	Driller: Jeff	

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		Soft Brown and Light Gray Clayey SILT (ML), A-4	4		24				
			6		27				
		Firm to Stiff Light Gray to Brown Silty CLAY (CL), A-6							
5			6		24	35	12		
			10		26				
10			7		30				trace sand, wet
		Boring Terminated at 10.5 Feet.							

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PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension		Boring No.: B-4
Location: Shelby County, Tennessee		Elev: 240 ±
Date: 4/14/03	Water level while drilling: ▽ 1'	Water level at completion: ▽ Dry
Boring Method: HSA	Boring Cave In: 9'	Driller: Jeff

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		Soft to Firm Brown Silty CLAY (CL), A-6	3		25				
			3		28	40	17		
5			7		28				
			6		32				
10			7		28				trace sand
		Boring Terminated at 10.5 Feet.							

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PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension			**Boring No.:** B-5
Location: Shelby County, Tennessee			**Elev:** 238 ±
Date: 4/14/03	**Water level while drilling:** ▽ 9'	**Water level at completion:** ▽ 9'	
Boring Method: HSA	**Boring Cave In:** Open	**Driller:** Jeff	

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		Soft Brown Clayey SILT (ML), A-4	4		28				
		Soft to Stiff Brown Silty CLAY (CL), A-6	3		26	38	14		
5			6		27				
			7		28				
10			10		29				
		Boring Terminated at 10.5 Feet.							

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension			Boring No.: B-6
Location: Shelby County, Tennessee			Elev: 238 ±
Date: 4/14/03	Water level while drilling: ▽ 15'	Water level at completion: ▽ Dry	
Boring Method: HSA	Boring Cave In: 3'	Driller: E. Morris	

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
5		Firm Brown Silty CLAY (CL), A-6	5		26			1.5	
			7		27			2.0	
			6		29				
10		Firm to Stiff Brown and Light Gray Clayey SILT (ML), A-4			32	33	8	3.2	Dry Density = 90.9 pcf Vane Shear = 0.84 ksf Cohesion = 0.85 ksf
			6		29			3.0	(UC)
15			7		30			1.0	
20			6		28				
					25	27	4	1.8	Dry Density = 101 pcf Vane Shear = 1.25 ksf Cohesion = 1.15 ksf
25			7		24			1.5	(UC)
30		Stiff to Hard Light Gray Silty CLAY (CL), A-6	9		21			2.0	
35			42		30			1.5	
40		Dense Brown SAND (SP), A-1	46		16				
		Boring Terminated at 40.5 Feet.							

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PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension — **Boring No.:** B-7

Location: Shelby County, Tennessee — **Elev:** 237 ±

Date: 4/14/03 — **Water level while drilling:** ▽ 15' — **Water level at completion:** ▽ NA

Boring Method: HSA to 35'/MR to 60' — **Boring Cave In:** NA — **Driller:** E. Morris

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		Firm Brown Clayey SILT (ML), A-4	6		23			1.0	
		Firm Brown Silty CLAY (CL), A-6	6		26			1.5	
5			8		27			1.0	
		Firm to Stiff Brown Clayey SILT (ML), A-4			28	35	8	2.0	Dry Density = 94.6 pcf Vane Shear = 0.94 ksf c=0.3, phi=18 c'=0, phi'=31
10			5		32				
					29	35	5	2.5	Dry Density = 96.1 pcf Vane Shear = 1.0 ksf Cohesion = 1.5 ksf (UU)
15			5		29			2.0	
		Soft to Firm Brown to Light Gray Silty CLAY (CL), A-6	7		25			1.0	
					24			2.5	Vane Shear = 0.84 ksf
25			4		30	34	14		
30			5		29			1.0	
35		Reddish Brown to Brown SAND (SP) A-2-4	+		27				clay seams
40		A-3	+		23				

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PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension | **Boring No.:** B-7

Location: Shelby County, Tennessee | **Elev:** 237 ±

Date: 4/14/03 | **Water level while drilling:** ▽ 15' | **Water level at completion:** ▽ NA

Boring Method: HSA to 35'/MR to 60' | **Boring Cave In:** NA | **Driller:** E. Morris

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
45		Medium Dense to Dense Brown SAND (SP) A-2-4	36		20				clay seams
50		A-3	18		21				
55		A-1-a	38		11				with gravel
60		Stiff Dark Brown CLAY (CH), A-7	13		34			1.5	
		Boring Terminated at 60.5 Feet.							

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PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension — **Boring No.:** B-8

Location: Shelby County, Tennessee — **Elev:** 235 ±

Date: 5/8/03 — **Water level while drilling:** ▽ NE — **Water level at completion:** ▽ NA

Boring Method: HSA/MR — **Boring Cave In:** NA — **Driller:** R. Strunk

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		2" Topsoil							
		Firm Brown Clayey SILT (ML), A-4	6		23			1.0	
		Stiff Black CLAY (CH), A-7	10		28			1.75	
5		Firm Gray Lean CLAY (CL), A-6	8		25			0.75	
		Firm to Very Stiff Brown and Light Gray Clayey SILT (ML), A-6			27	37	12		Dry Density = 96.7 pcf Vane Shear = 0.71 ksf Cohesion = 0.70 ksf
10			7		29			1.75	(UC)
15			7		28			2.0	
		A-4			28	34	10	3.0	Dry Density = 97.6 pcf Vane Shear = 0.75 ksf Cohesion = 2.1 ksf (UU)
20		Firm Gray Silty CLAY (CL), A-6	7		31				
25			6		25			0.25	some sand
30		Medium Dense Brown SAND (SP), A-3	18		22				
35			28		20				
40			28		23				

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RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension			**Boring No.:** B-8
Location: Shelby County, Tennessee			**Elev:** 235 ±
Date: 5/8/03	**Water level while drilling:** ▽ NE	**Water level at completion:** ▽ NA	
Boring Method: HSA/MR	**Boring Cave In:** NA	**Driller:** R. Strunk	

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		2" Topsoil							
45		Medium Dense to Very Dense Brown to Gray SAND (SP) A-3	22		24				
50		A-1-b	49		15				trace gravel
55		A-1-b	74		13				trace gravel
60		A-3	48		26				trace organics
		Boring Terminated at 60.5 Feet.							

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension | **Boring No.:** B-9

Location: Shelby County, Tennessee | **Elev:** 237 ±

Date: 5/8/03 | **Water level while drilling:** ▽ 15' | **Water level at completion:** ▽ Dry

Boring Method: HSA | **Boring Cave In:** 13' | **Driller:** E. Morris

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		2-1/2" Topsoil							
		Firm Brown and Light Gray Silty CLAY (CL), A-6	7		28			1.0	trace roots
			6		26				trace roots
5			7		28				
			8		28			1.0	
10		Firm to Stiff Brown to Reddish Brown Clayey SILT (ML), A-4	5		31	29	3		wet
15			5		29				wet
20			9		25				
25		Firm Light Gray and Reddish Brown Silty CLAY (CL), with trace sand, A-6	7		22			1.0	
30		Loose Gray and Reddish Brown Silty SAND (SM), A-2-4	9		20				
35		Medium Dense Brown SAND (SP), A-2-4	14		21				clay lense
40			21		20				
		Boring Terminated at 40.5 Feet.							

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PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension | **Boring No.:** B-10

Location: Shelby County, Tennessee | **Elev:** 235 ±

Date: 5/8/03 | **Water level while drilling:** ▽ 7' | **Water level at completion:** ▽ NA

Boring Method: HSA to 20'/MR to 40' | **Boring Cave In:** 13' | **Driller:** E. Morris

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		3" Topsoil							
		Soft to Firm Brown Silty CLAY (CL), A-6	5		28				trace roots
			7		26			1.5	
5					26	36	15	0.8	Dry Density = 95.3 pcf Vane Shear = 0.42 ksf Cohesion = 0.73 ksf (UC)
			4		31	36	12		
10			5		30				wet
		Firm to Stiff Brown to Light Gray Clayey SILT (ML), A-4	6		29			2.0	
15					31	32	8		Dry Density = 95.9 pcf Vane Shear = 0.46 ksf Cohesion = 1.0 ksf (UU)
20			9		26			2.0	
		Firm Light Gray Silty CLAY (CL), A-6	6		31			1.0	
25									
30			6		22				trace sand
		Dense to Medium Dense Brown SAND (SP), A-3	41		21				
35									
40			24		21				
		Boring Terminated at 40.5 Feet.							

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PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension			Boring No.: B-11
Location: Shelby County, Tennessee			Elev: 235 ±
Date: 5/8/03	Water level while drilling: ▽ 14'	Water level at completion: ▽ NA	
Boring Method: HSA to 20'/MR to 40'	Boring Cave In: NA	Driller: R. Strunk	

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		2" Topsoil							
		Soft to Firm Brown Silty CLAY (CL), A-6	4		29			0.75	trace roots
			8		27			0.75	
5			8		26	37	14	1.25	
			6		27			1.0	
10		Firm Brown and Light Gray Clayey SILT (ML), A-4	7		29	32	4	2.75	
			8		27			2.0	
20			7		28			1.5	
25		Firm Light Gray Silty CLAY (CL), with trace sand, A-6	6		22			2.25	
30		Medium Dense Brown Silty SAND (SM), A-2-4	14		19				
35		Medium Dense Brown SAND (SP), A-1-b	15		20				
40			20		22				
		Boring Terminated at 40.5 Feet.							

PSIS02 35079.GPJ 11/18/03

PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension			**Boring No.:** B-12
Location: Shelby County, Tennessee			**Elev:** 241 ±
Date: 5/1/03	**Water level while drilling:** ▽ Dry	**Water level at completion:** ▽ Dry	
Boring Method: Hand Auger	**Boring Cave In:** Open	**Driller:** E. Morris	

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		3" Topsoil							
		Stiff to Soft Brown Clayey SILT (ML), A-4	9		21				
5			6		24				
			4		23	32	7		
10			4		25				
		Boring Terminated at 10.5 Feet.							

PSI502 35079.GPJ 11/18/03

PSI

RECORD OF SUBSURFACE EXPLORATION

PSI File No.: 502-35079

Project: Fite Road Extension			**Boring No.:** B-13
Location: Shelby County, Tennessee			**Elev:** 243 ±
Date: 5/1/03	**Water level while drilling:** ▽ Dry	**Water level at completion:** ▽ Dry	
Boring Method: Hand Auger	**Boring Cave In:** Open	**Driller:** E. Morris	

Depth (feet)	Sampler	DESCRIPTION OF MATERIALS	N (bpf)	N VALUE (bpf) ▲ PL %MC LL 10 20 30 40 50 60 70 80 90	MC %	LL	PI	Qp tsf	Comments
		2" Topsoil							
		Firm to Soft Brown Clayey SILT (ML), A-4	7		22				
5			5		23	29	4		
			5		26				
10			4		26				
		Boring Terminated at 10.5 Feet.							

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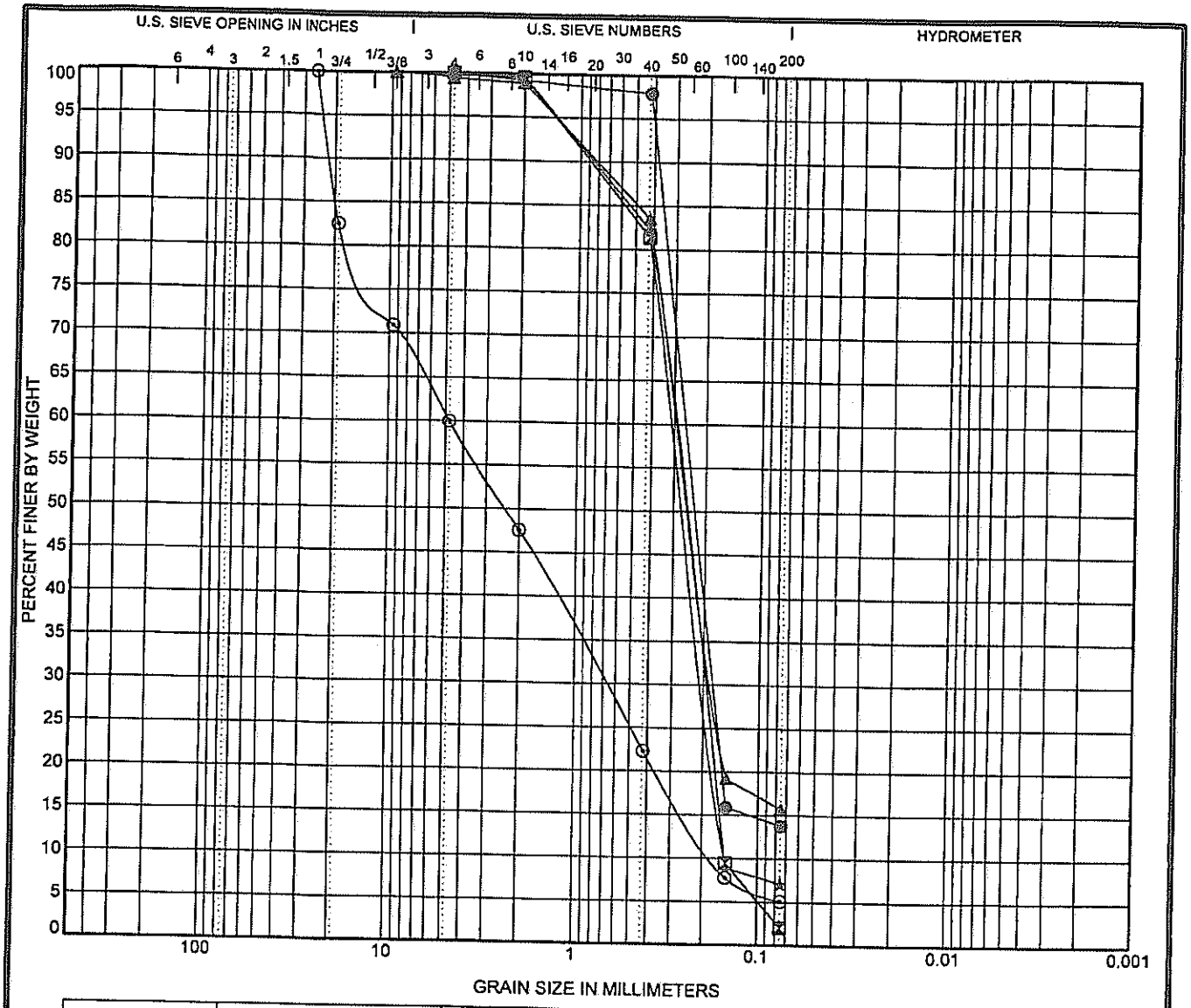
APPENDIX II

GRADATION CURVES, ATTERBERG LIMITS, AND pH



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

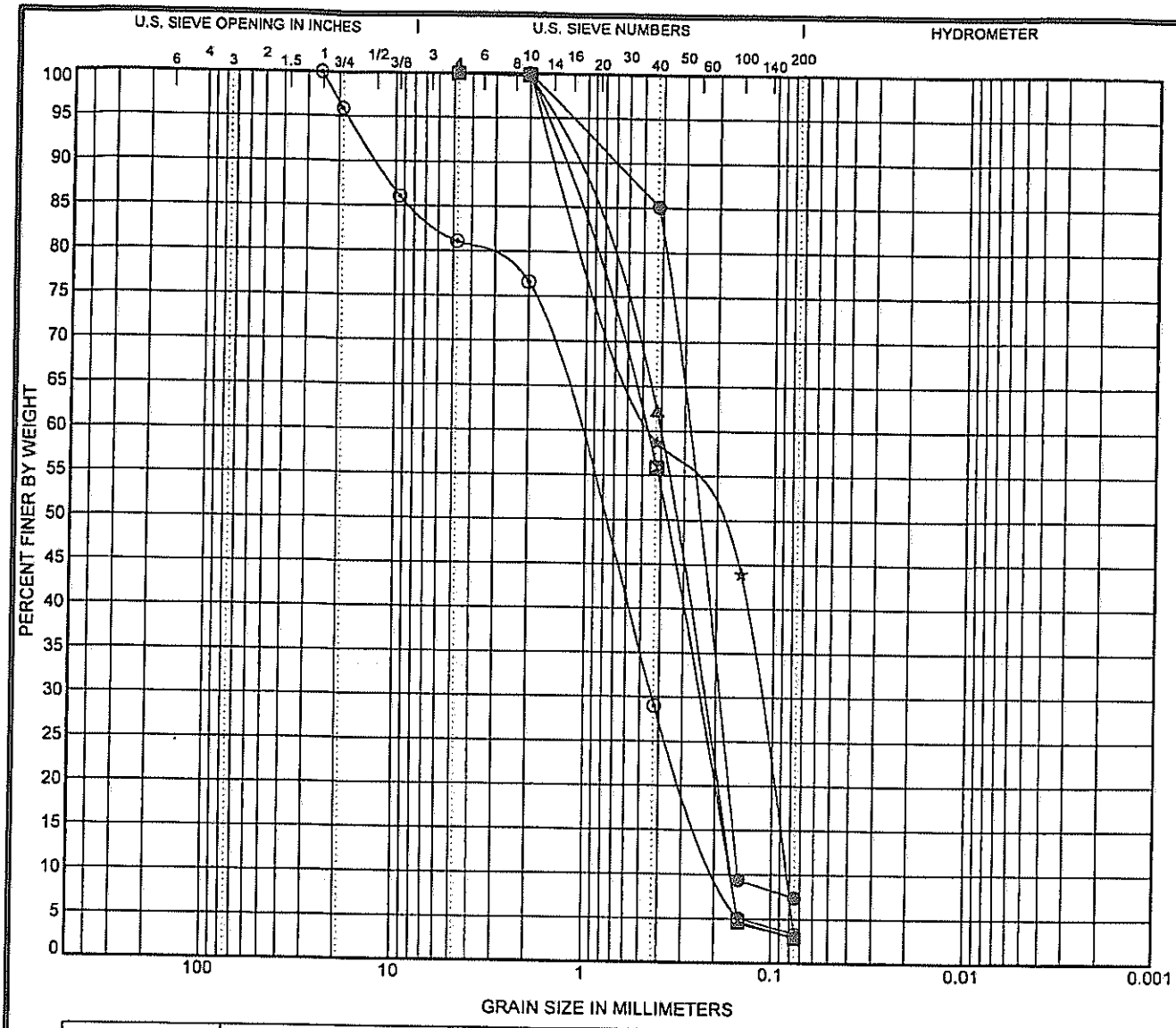
Specimen Identification			Classification	LL	PL	PI	Cc	Cu
◉	B-7	34.5						
⊠	B-7	39.5					0.87	2.06
▲	B-7	44.5						
★	B-7	49.5					0.87	2.03
⊙	B-7	54.5					0.55	27.30

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
◉	B-7	34.5	4.76	0.26	0.178		0.0	86.2	13.8	
⊠	B-7	39.5	4.76	0.309	0.2	0.15	0.0	98.0	2.0	
▲	B-7	44.5	9.5	0.288	0.177		0.6	83.7	15.7	
★	B-7	49.5	9.5	0.307	0.201	0.151	0.3	92.6	7.1	
⊙	B-7	54.5	25.4	4.76	0.675	0.174	40.0	54.9	5.1	

psi

GRAIN SIZE DISTRIBUTION

Client:
Project: Fite Road Extension
Location:
Number: 502-35079



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

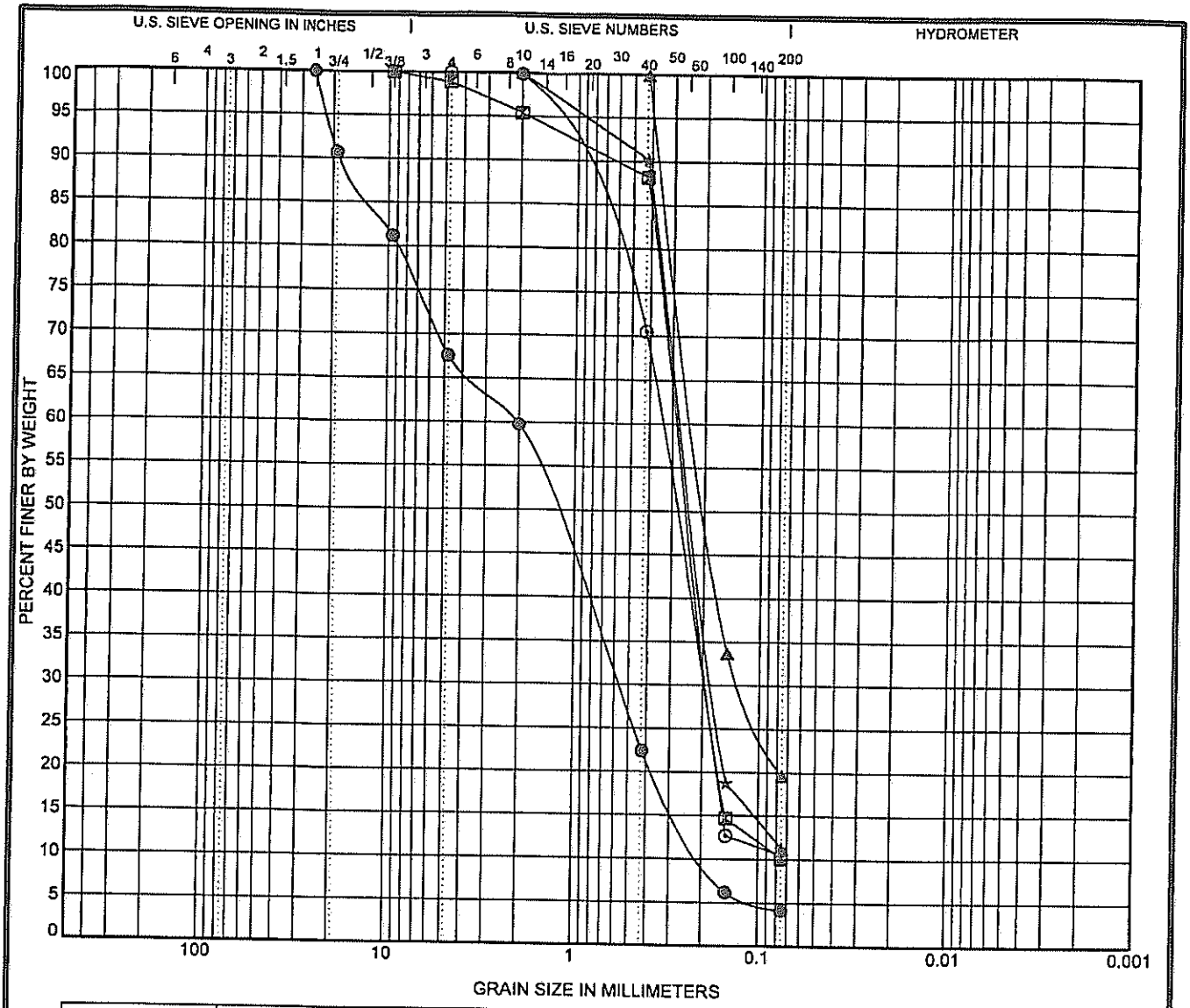
Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	B-8	29.5					0.87	1.98
⊠	B-8	34.5					0.77	2.93
▲	B-8	39.5					0.84	2.45
★	B-8	44.5					0.37	5.25
⊙	B-8	49.5					0.88	6.30

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-8	29.5	2	0.298	0.198	0.15	0.0	92.6	7.4	
⊠	B-8	34.5	4.76	0.486	0.248	0.166	0.0	97.2	2.8	
▲	B-8	39.5	4.76	0.403	0.235	0.164	0.0	97.1	2.9	
★	B-8	44.5	2	0.441	0.118	0.084	0.0	96.8	3.2	
⊙	B-8	49.5	25.4	1.161	0.434	0.184	18.9	77.8	3.3	

psi

GRAIN SIZE DISTRIBUTION

Client:
Project: Fite Road Extension
Location:
Number: 502-35079



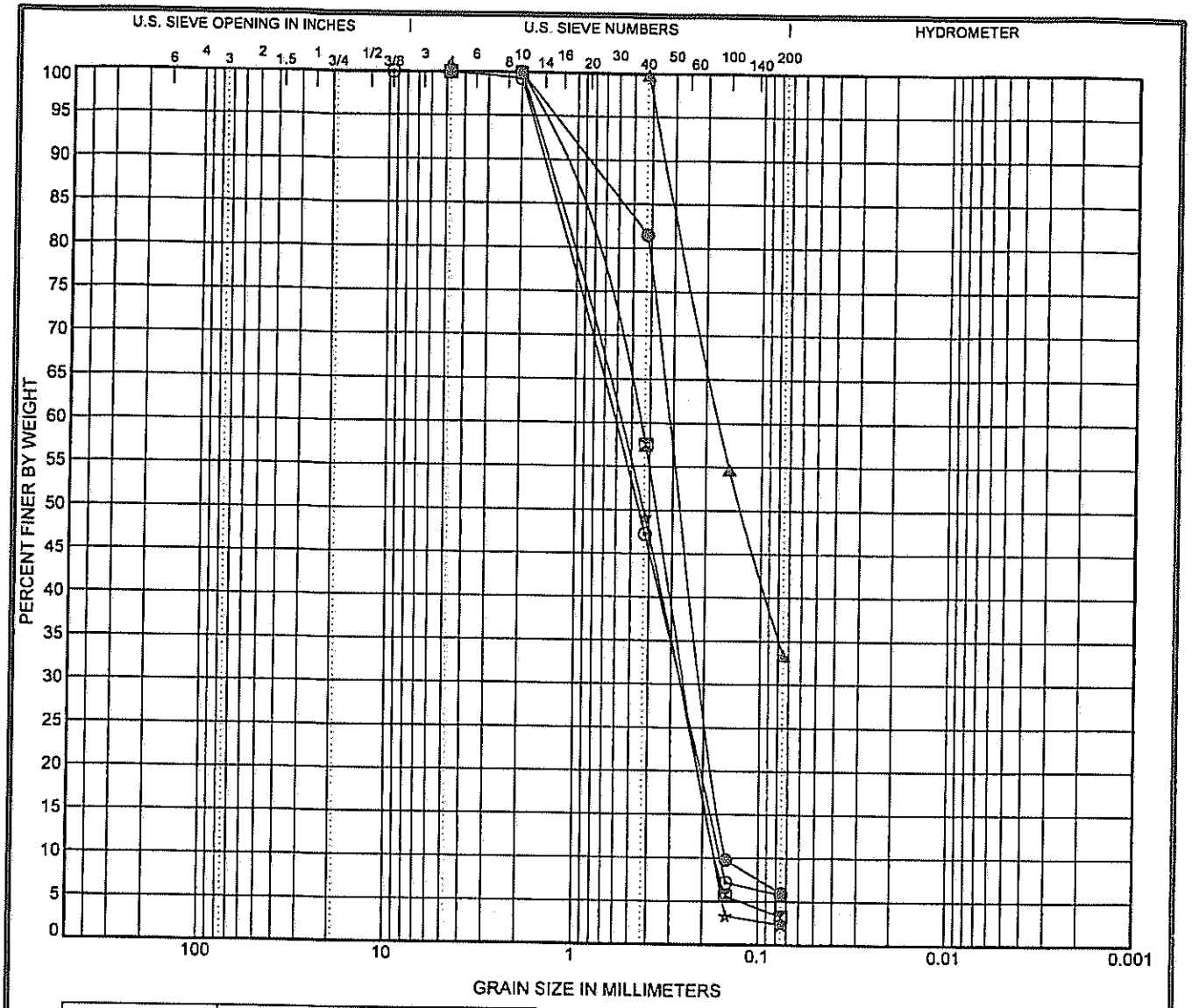
COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-8	54.5					0.86	10.76
⊠	B-8	59.5					1.64	3.82
▲	B-9	29.5						
★	B-9	34.5					1.70	4.07
⊙	B-9	39.5					1.85	5.42

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-8	54.5	25.4	2.045	0.577	0.19	32.4	63.5	4.1	
⊠	B-8	59.5	9.5	0.282	0.185		1.1	88.8	10.1	
▲	B-9	29.5	2	0.225	0.124		0.0	80.4	19.6	
★	B-9	34.5	2	0.271	0.175		0.0	88.7	11.3	
⊙	B-9	39.5	4.76	0.348	0.203		0.0	89.5	10.5	

GRAIN SIZE DISTRIBUTION

Client:
Project: Fite Road Extension
Location:
Number: 502-35079



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

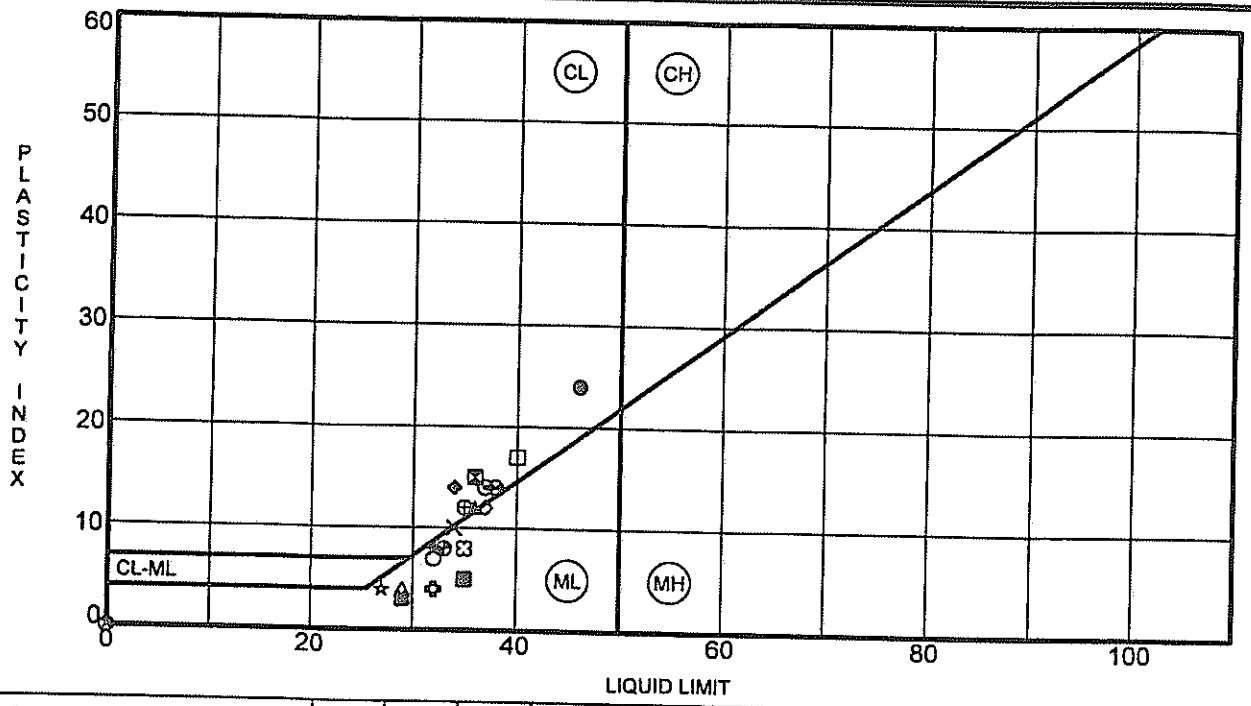
	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-10	34.5					0.87	2.06
⊠	B-10	39.5					0.79	2.84
▲	B-11	29.5						
★	B-11	34.5					0.73	3.38
⊙	B-11	39.5					0.73	3.84

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-10	34.5	2	0.308	0.2	0.149	0.0	94.0	6.0	
⊠	B-10	39.5	4.76	0.46	0.242	0.162	0.0	96.8	3.2	
▲	B-11	29.5	2	0.168			0.0	66.6	33.4	
★	B-11	34.5	2	0.585	0.272	0.173	0.0	97.7	2.3	
⊙	B-11	39.5	9.5	0.615	0.269	0.16	0.1	94.1	5.8	

psi

GRAIN SIZE DISTRIBUTION

Client:
Project: Fite Road Extension
Location:
Number: 502-35079



Specimen Identification			LL	PL	PI	Fines	Classification
◉	B-1	7.0	46	22	24		
⊠	B-10	4.5	36	21	15		
▲	B-10	7.0	36	24	12		
★	B-10	17.5	32	24	8		
⊙	B-11	4.5	37	23	14		
✿	B-11	9.5	32	28	4		
○	B-12	7.0	32	25	7		
△	B-13	4.0	29	25	4		
⊗	B-2	2.0	NP	NP	NP		
⊕	B-3	4.5	35	23	12		
□	B-4	2.5	40	23	17		
⊛	B-5	2.5	38	24	14		
⊕	B-6	6.5	33	25	8		
☆	B-6	21.5	27	23	4		
⊠	B-7	6.5	35	27	8		
▩	B-7	11.5	35	30	5		
◆	B-7	24.5	34	20	14		
◇	B-8	6.5	37	25	12		
×	B-8	16.5	34	24	10		
▩	B-9	9.5	29	26	3		

ATTERBERG LIMITS' RESULTS

Client:
Project: Fite Road Extension
Location:
Number: 502-35079

PSI Information To Build On
Engineering • Consulting • Testing

Soil pH - AASHTO T-289-91

Project: Fite Road Extension
502-35079

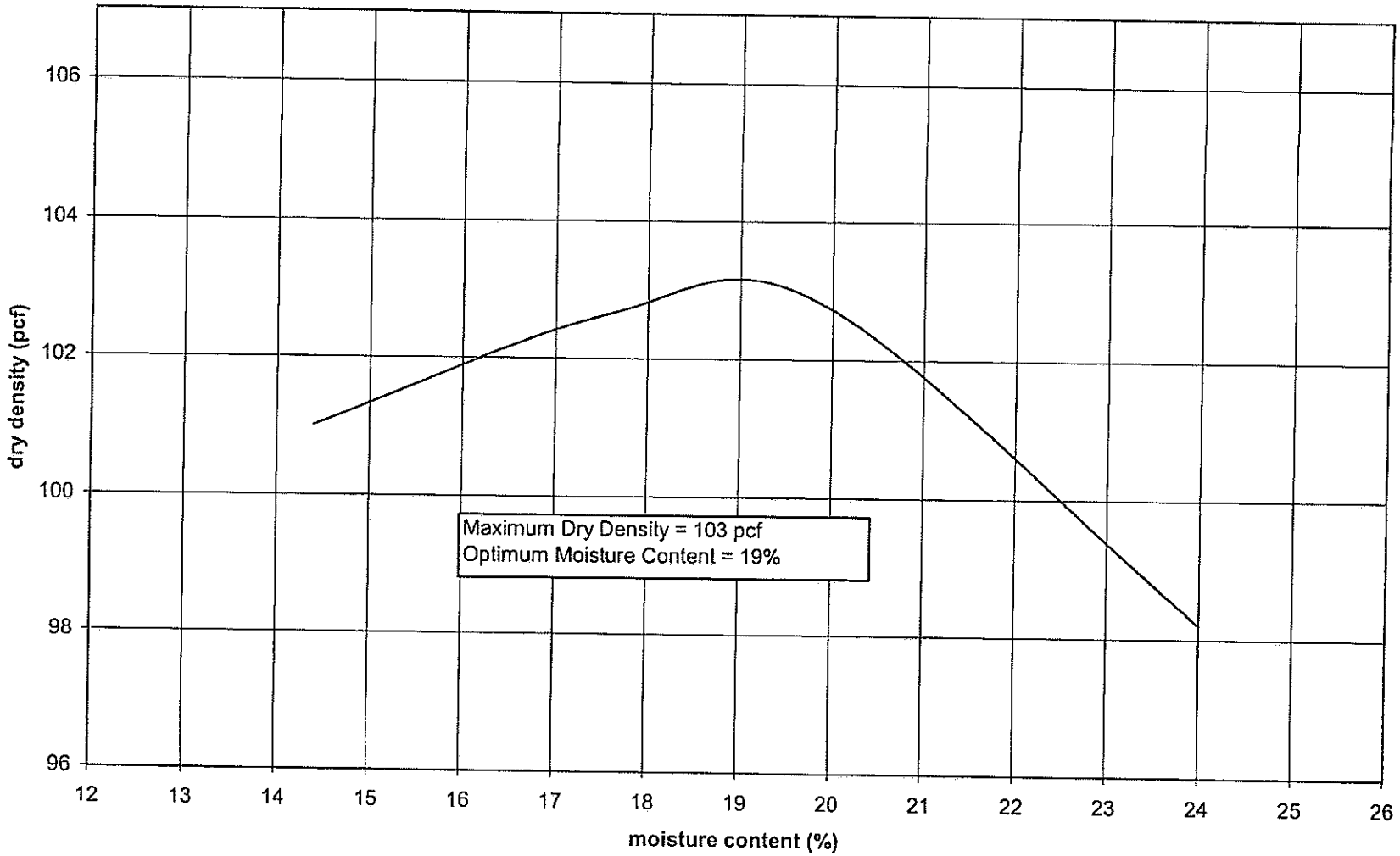
Sample	Boring	Depth (ft)	Soil Classification	pH
1	B-8	4	A-6, lean clay (CL)	7.2
2	B-8	20	A-6, silty clay (CL)	7.8
3	B-9	4	A-6, silty clay (CL)	4.7
4	B-10	2	A-6, silty clay (CL)	5.9
5	B-11	0	A-6, silty clay (CL)	4.3
6	B-11	4	A-6, silty clay (CL)	6.5
7	B-11	7	A-6, silty clay (CL)	6.9
8	B-11	15	A-4, clayey silt (ML)	7.7
9	B-11	20	A-4, clayey silt (ML)	7.5
10	B-11	25	A-6, silty clay (CL)	6.8

APPENDIX III

MAXIMUM DRY DENSITY (STANDARD PROCTOR)

CALORIFINA BEARING RATIO TEST RESULTS

Fite Road Extension- B-3 Top 5 feet
standard Proctor AASHTO T 99-95 Method A



REPORT OF LABORATORY CALIFORNIA BEARING RATIO (CBR) TEST

Project: Fite Road Extension

Location: Memphis, Tennessee

Sample Source: Boring B-3, Top 5 feet

Job Number: 502-35079 Date: November, 2003

Sample Classification

Liquid Limit: 35 Plasticity Index: 12

Soil Description: Brown Silty Clay (CL)

Compaction Data

Compaction Method: Standard Proctor, AASHTO T 99-95 Method A

Maximum Dry Density: 103 pcf

Optimum Moisture: 19.5 percent

CBR (AASHTO T 193-93) Specimen Data and Test Results

Dry Density as Remolded: 97.3 pcf

Remolded Moisture: 21.2 %

Percent Compaction: 94.5 %

Percent Swell: 1.0 % after 96 hour soak

CBR at 0.1 Inch Penetration: 1.2

CBR at 0.2 Inch Penetration: 1.1

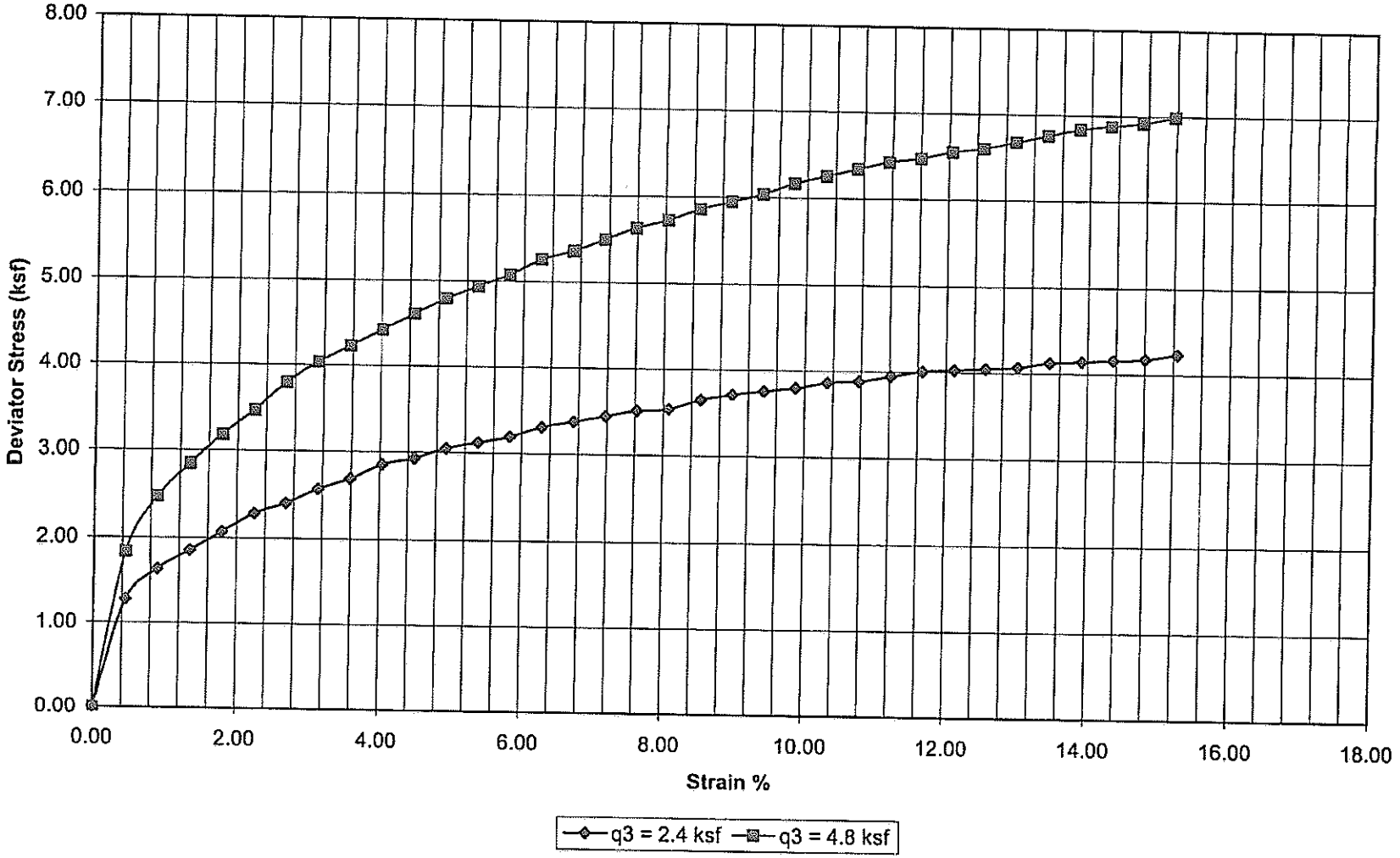
Moisture of Top Inch: 25.3 %

Average Moisture: 23.2 %

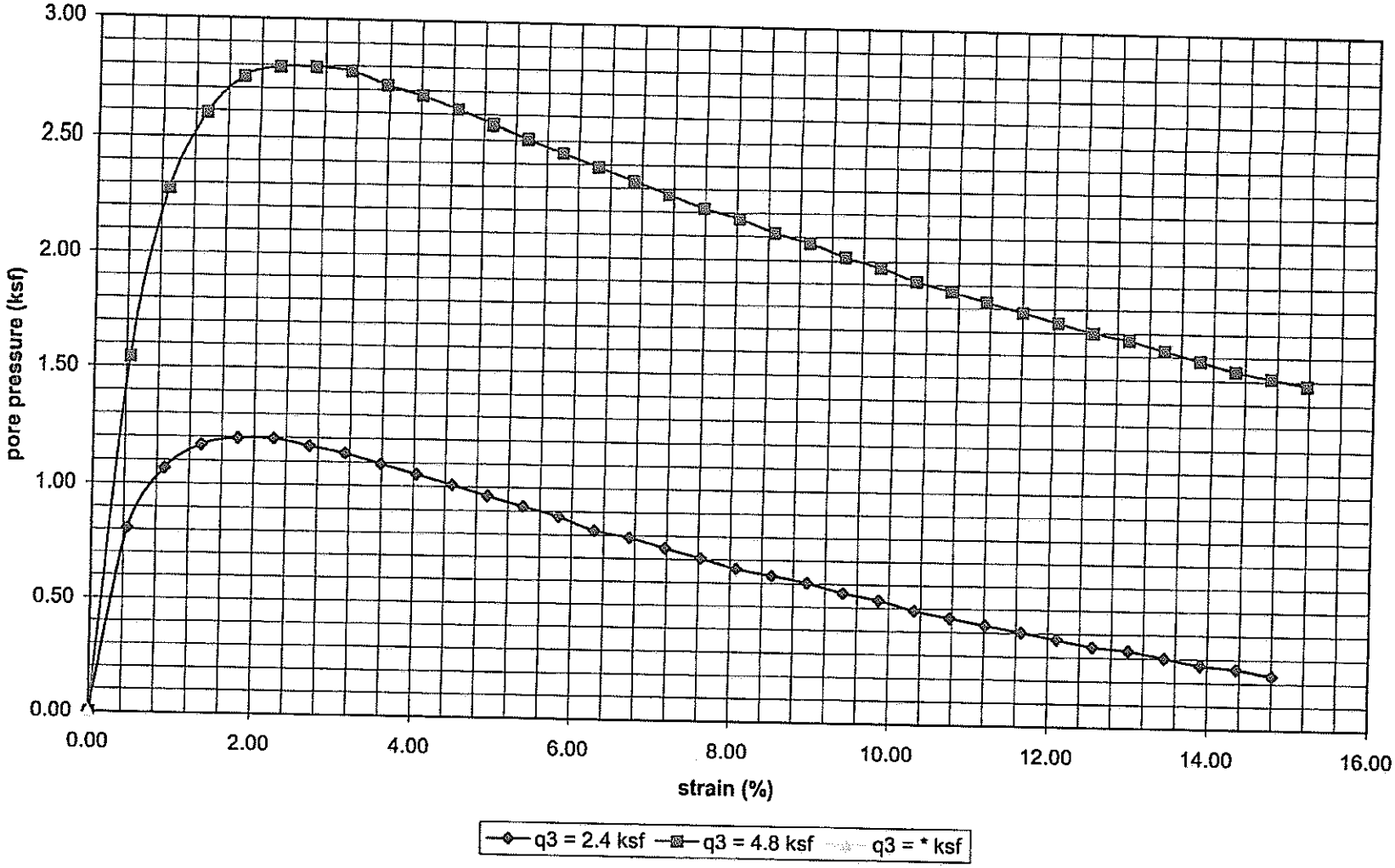
APPENDIX IV

TRIAXIAL TEST FAILURE ENVELOPES

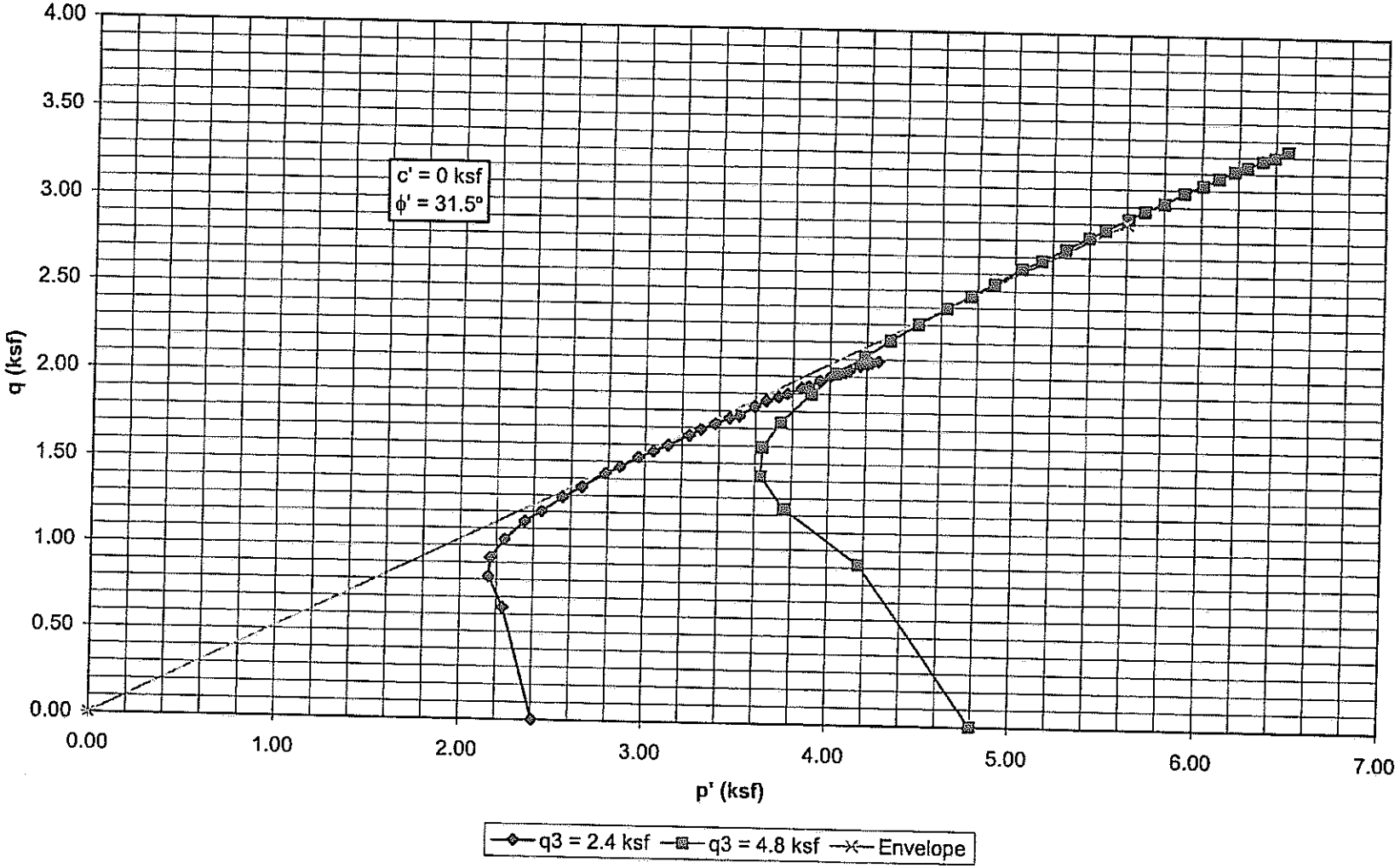
Triaxial R test B7 6'-8'
ASTM D-4767



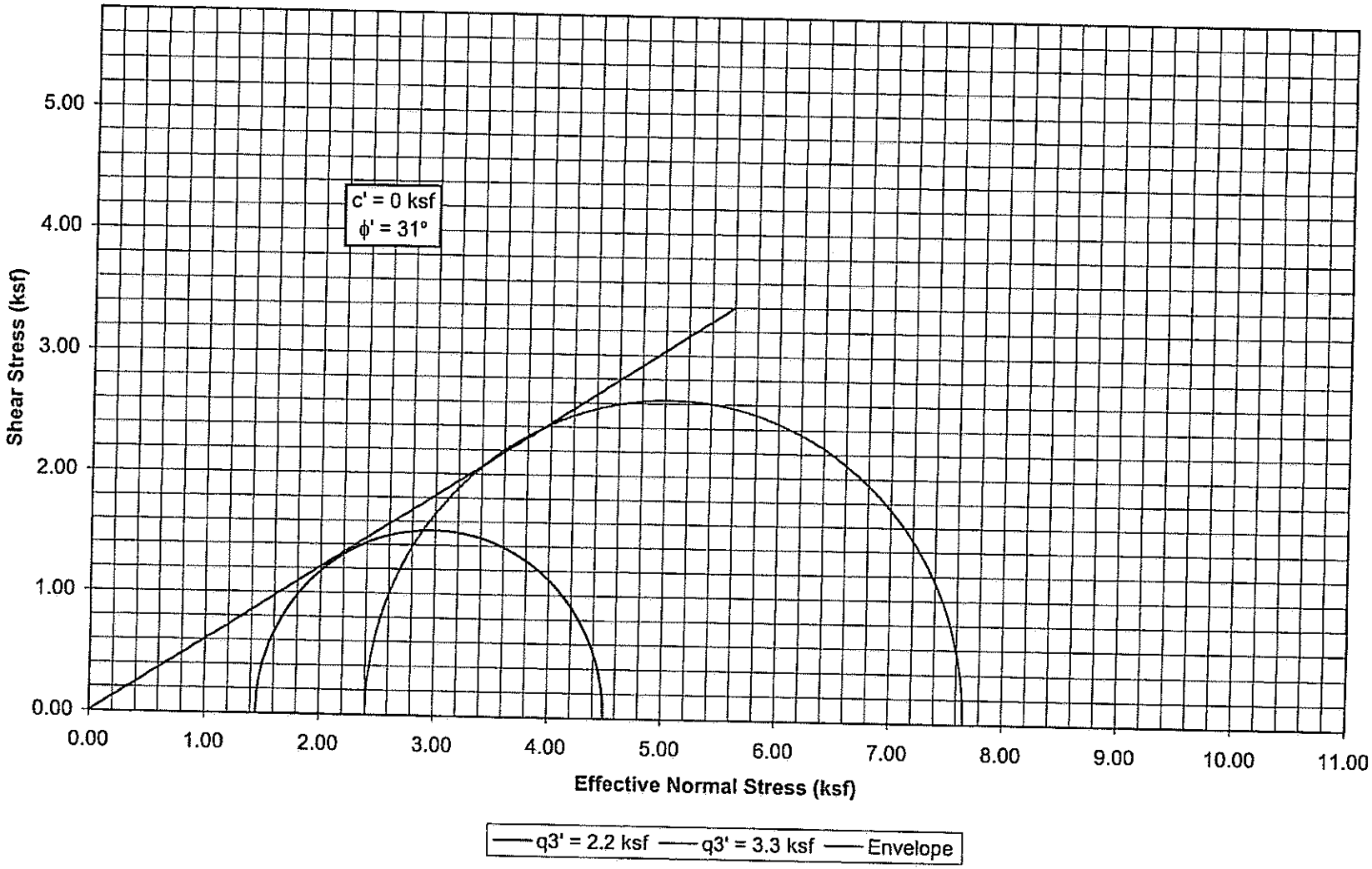
Triaxial R Test B-7 6'-8'
ASTM D-4767



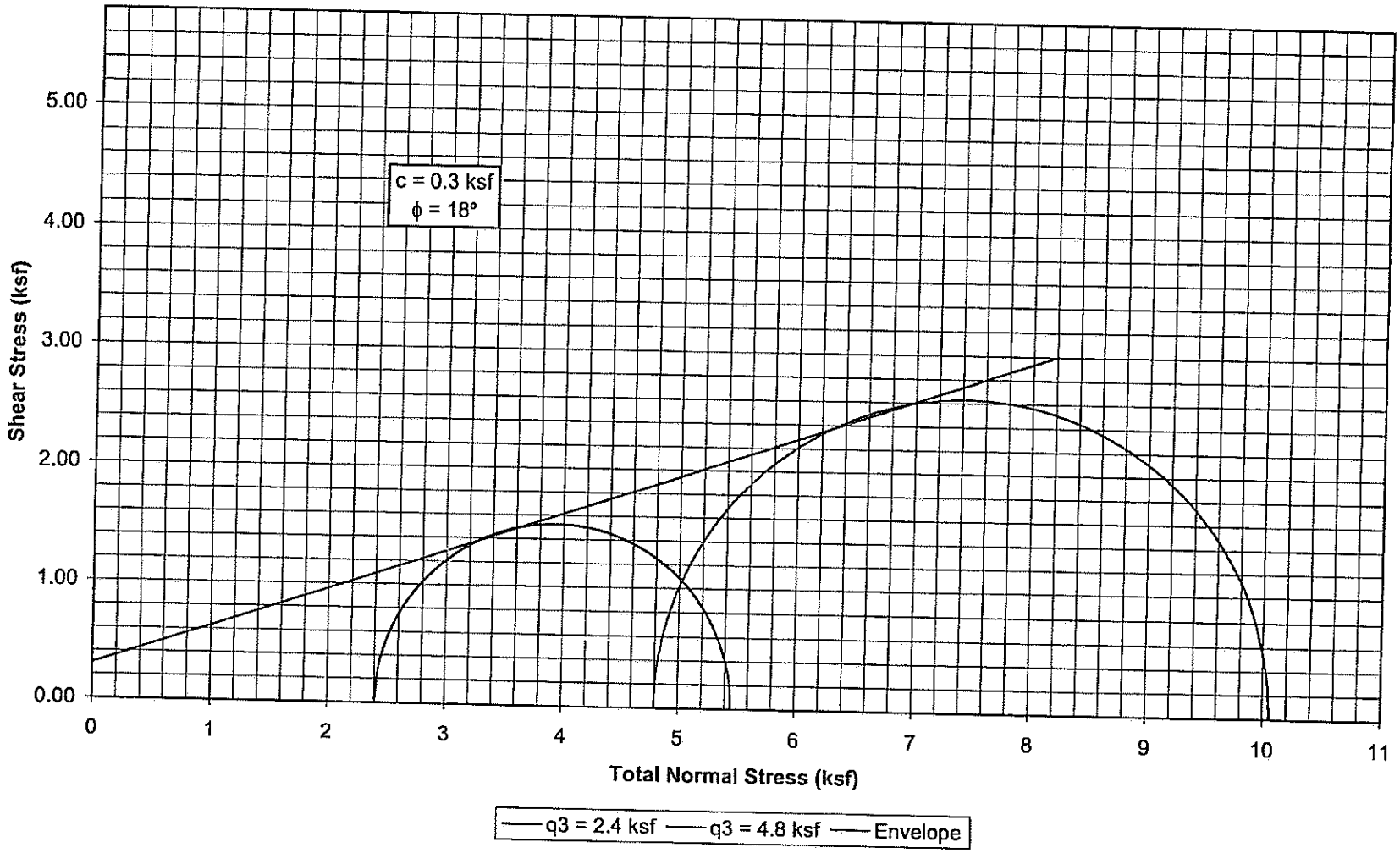
P-Q Curve B7 6'-8'
ASTM D-4767



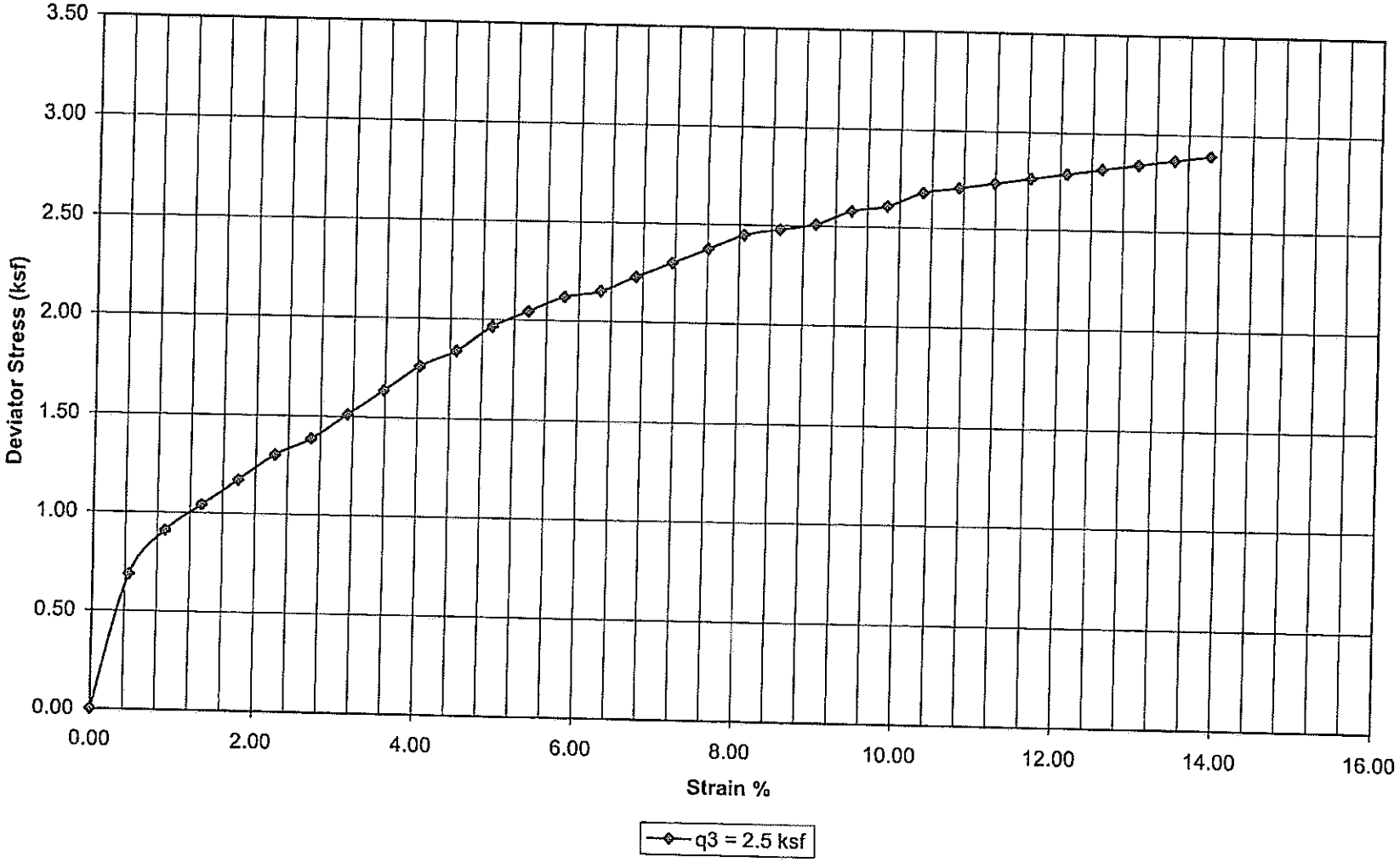
Triaxial R Test B7 6'-8'
(Effective Stress) ASTM D-4767



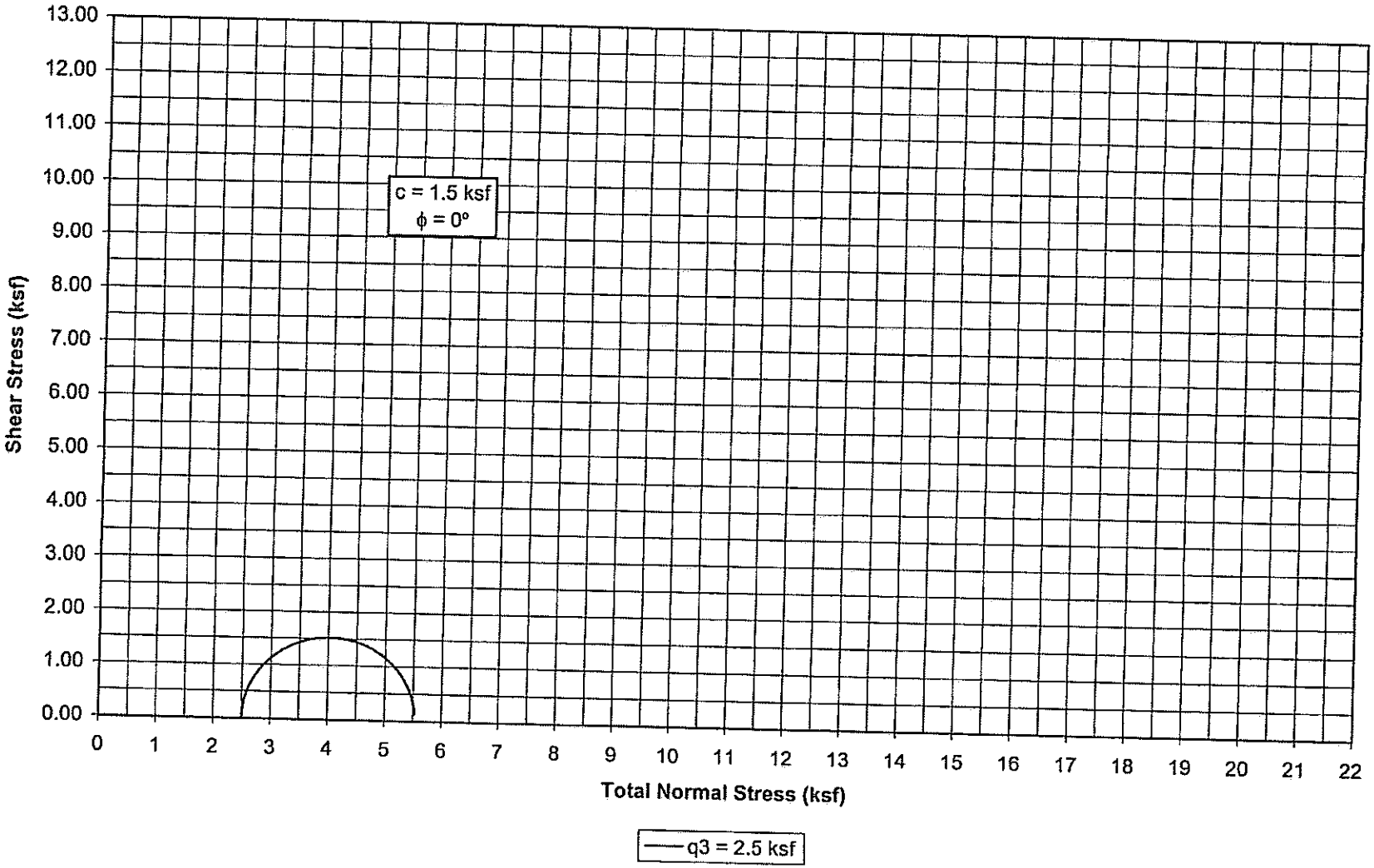
Triaxial R Test B7 6'-8'
(Total Stress) ASTM D-4767



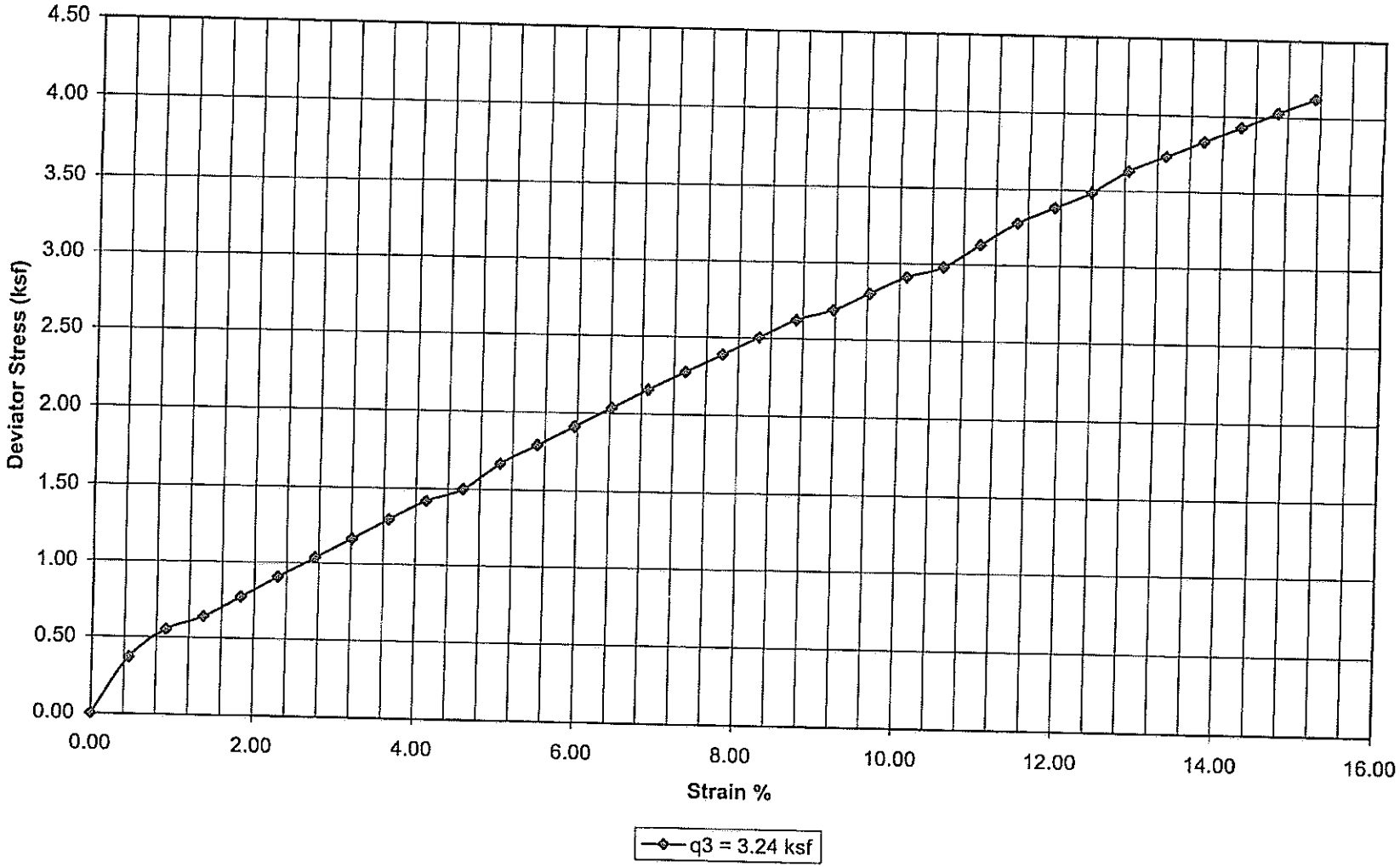
Triaxial Q Test B7 11'-13'
ASTM D-2850



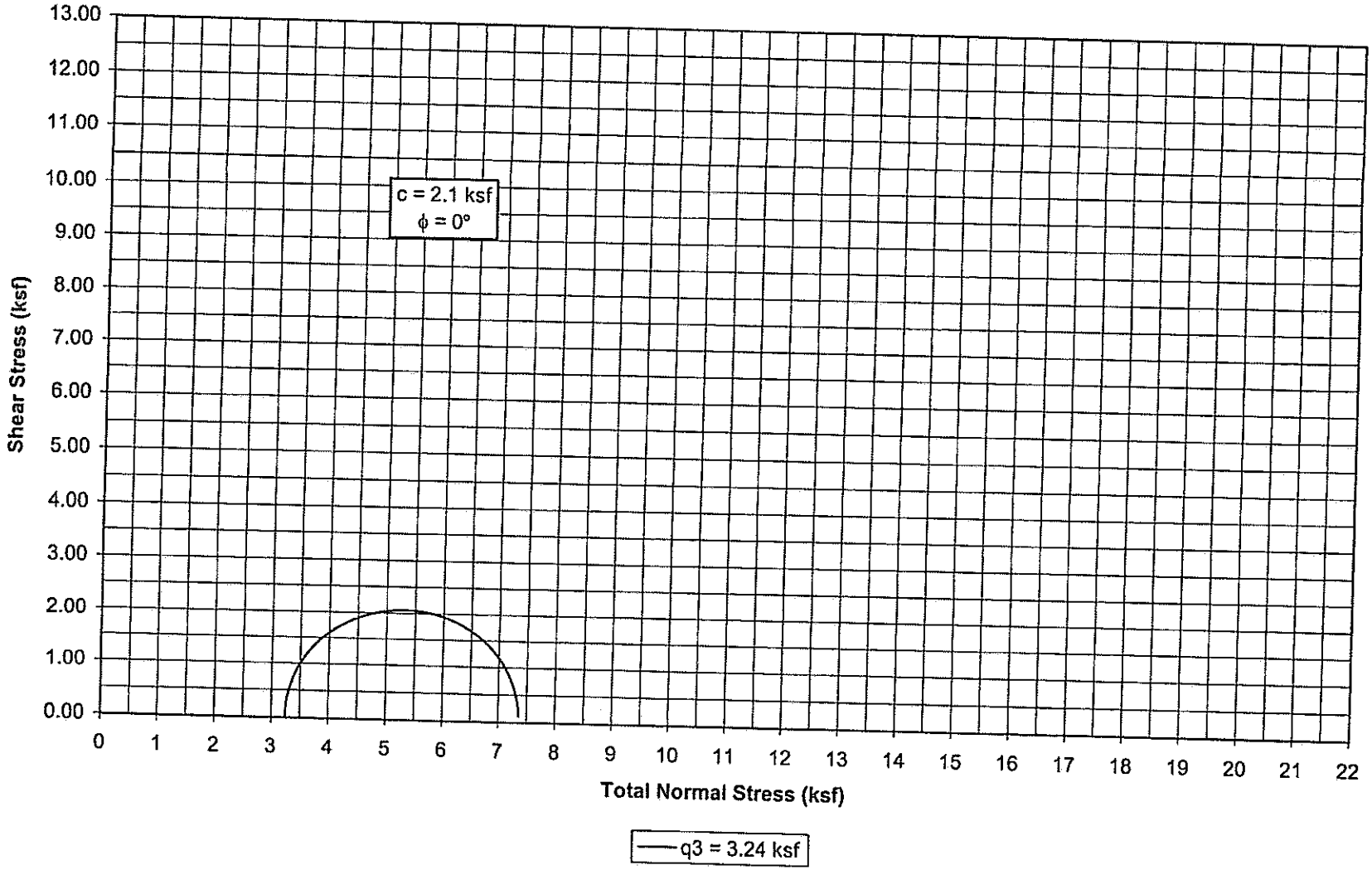
Triaxial Q Test B7 11'-13'
ASTM D-2850



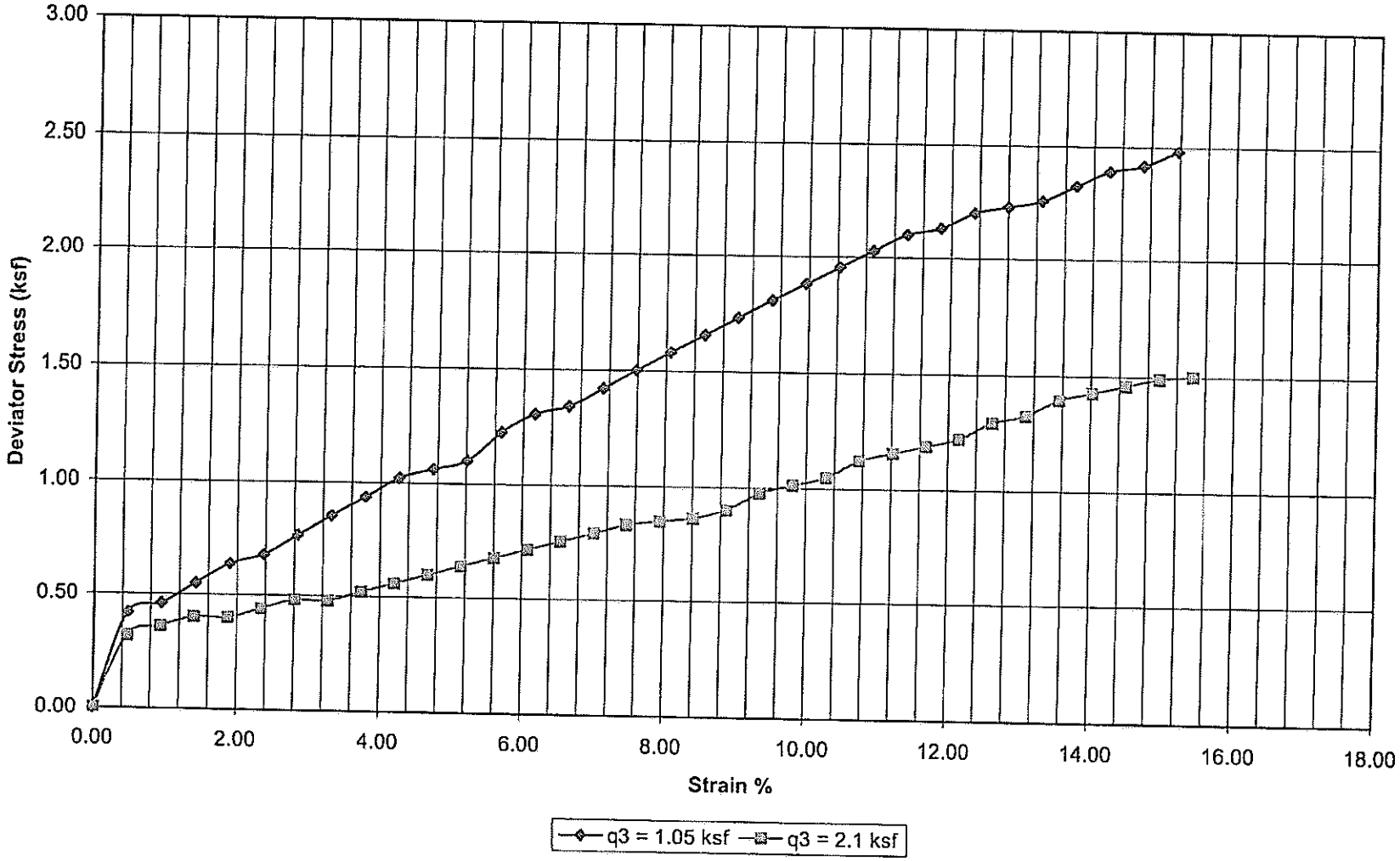
Triaxial Q Test B8 16'-18'
ASTM D-2850



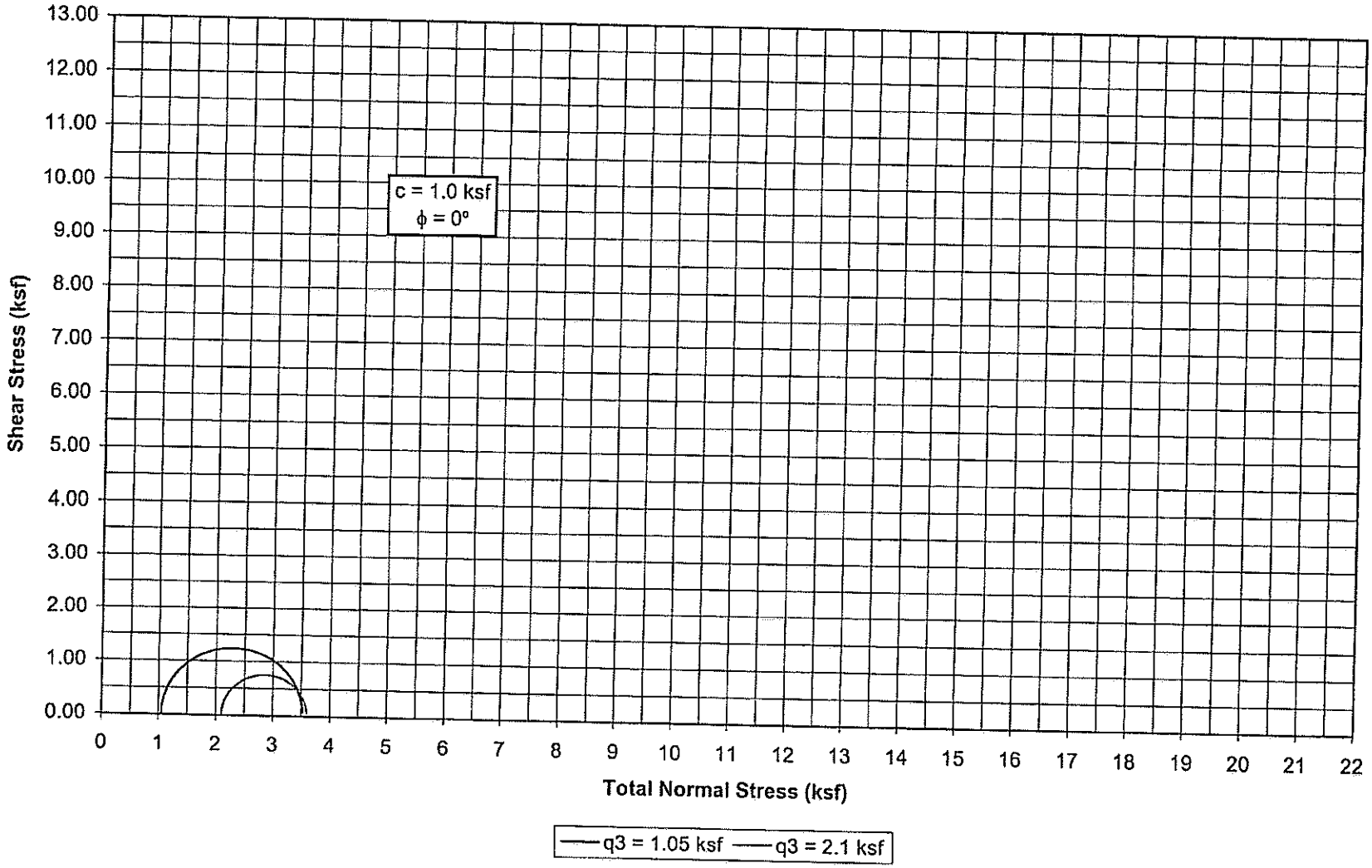
Triaxial Q Test B8 16'-18'
ASTM D-2850



Triaxial Q Test B10 16'-18'
ASTM D-2850



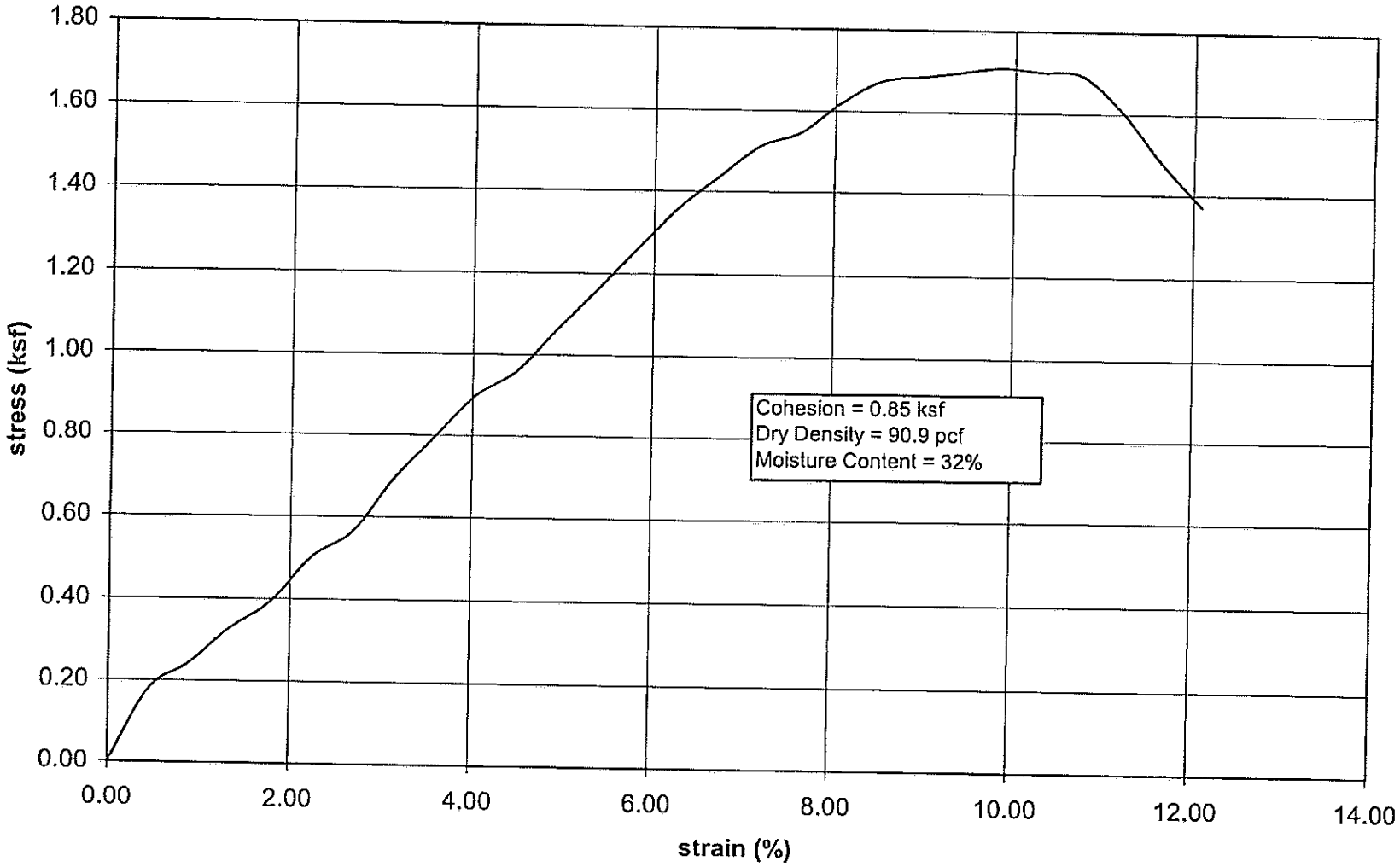
Triaxial Q Test B10 16'-18'
ASTM D-2850



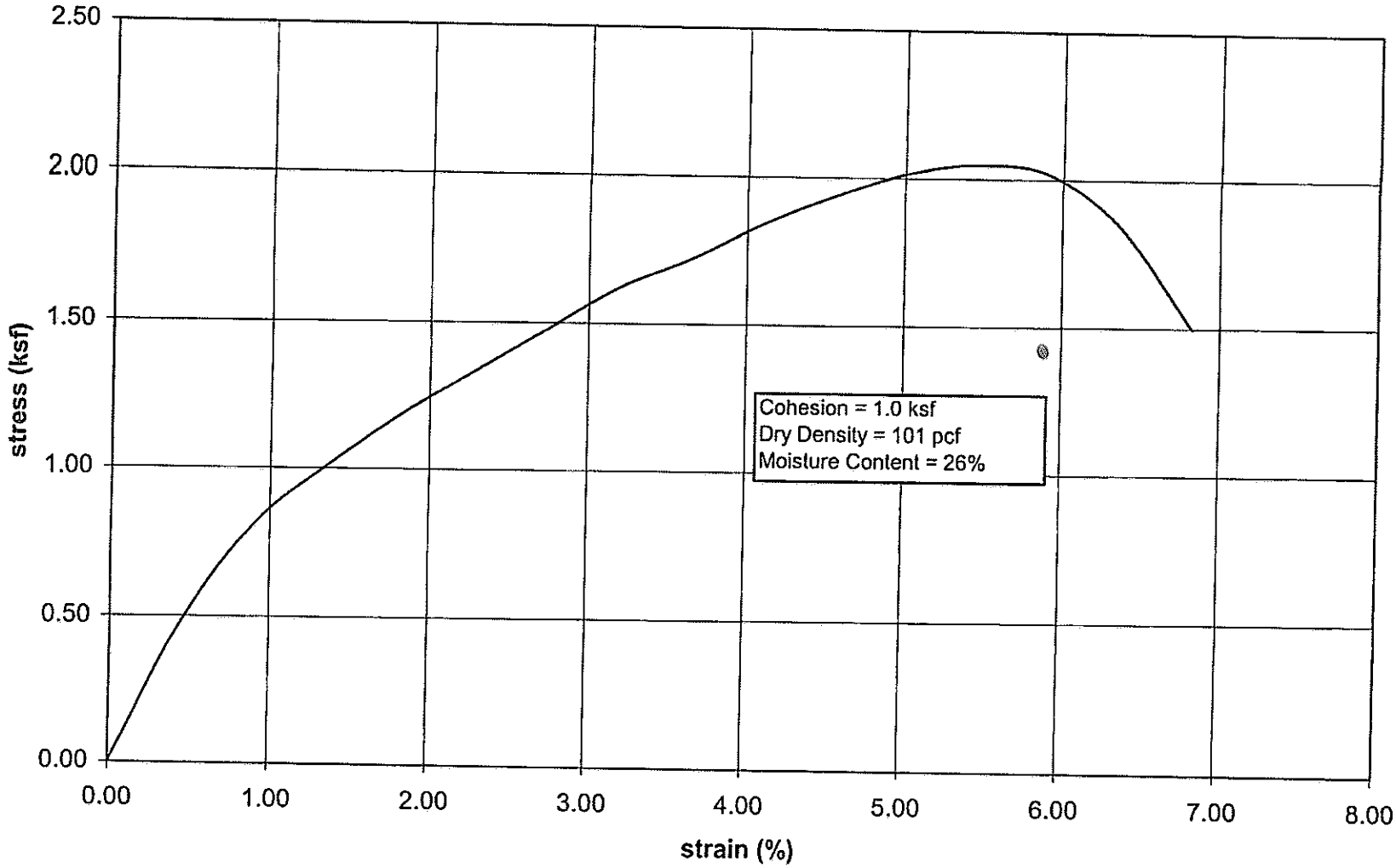
APPENDIX V

UNCONFINED COMPRESSION TEST RESULTS

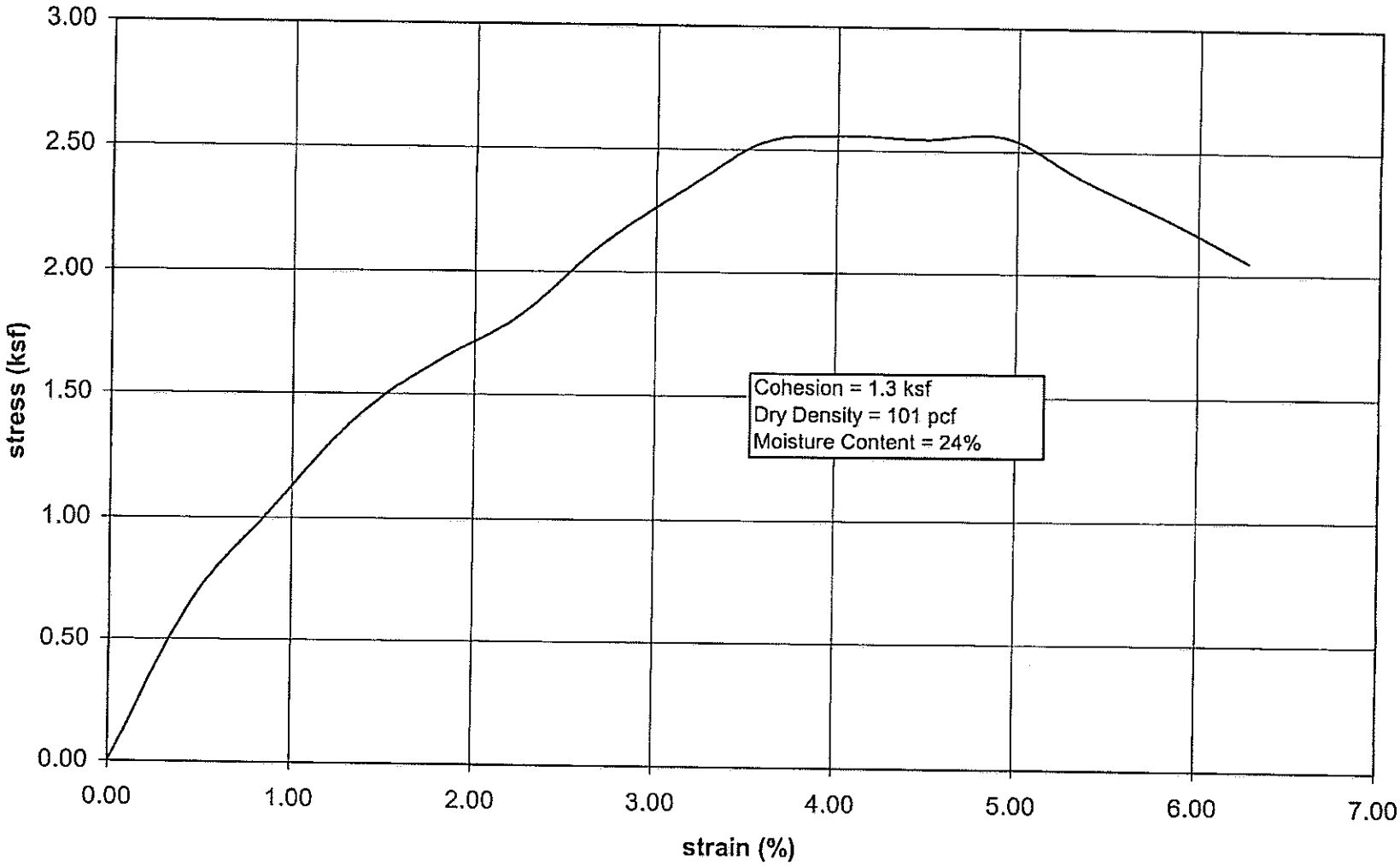
UC - B-6 @ 6'-8'


1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
stress (ksf)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
strain (%)
Cohesion = 0.85 ksf
Dry Density = 90.9 pcf
Moisture Content = 32%

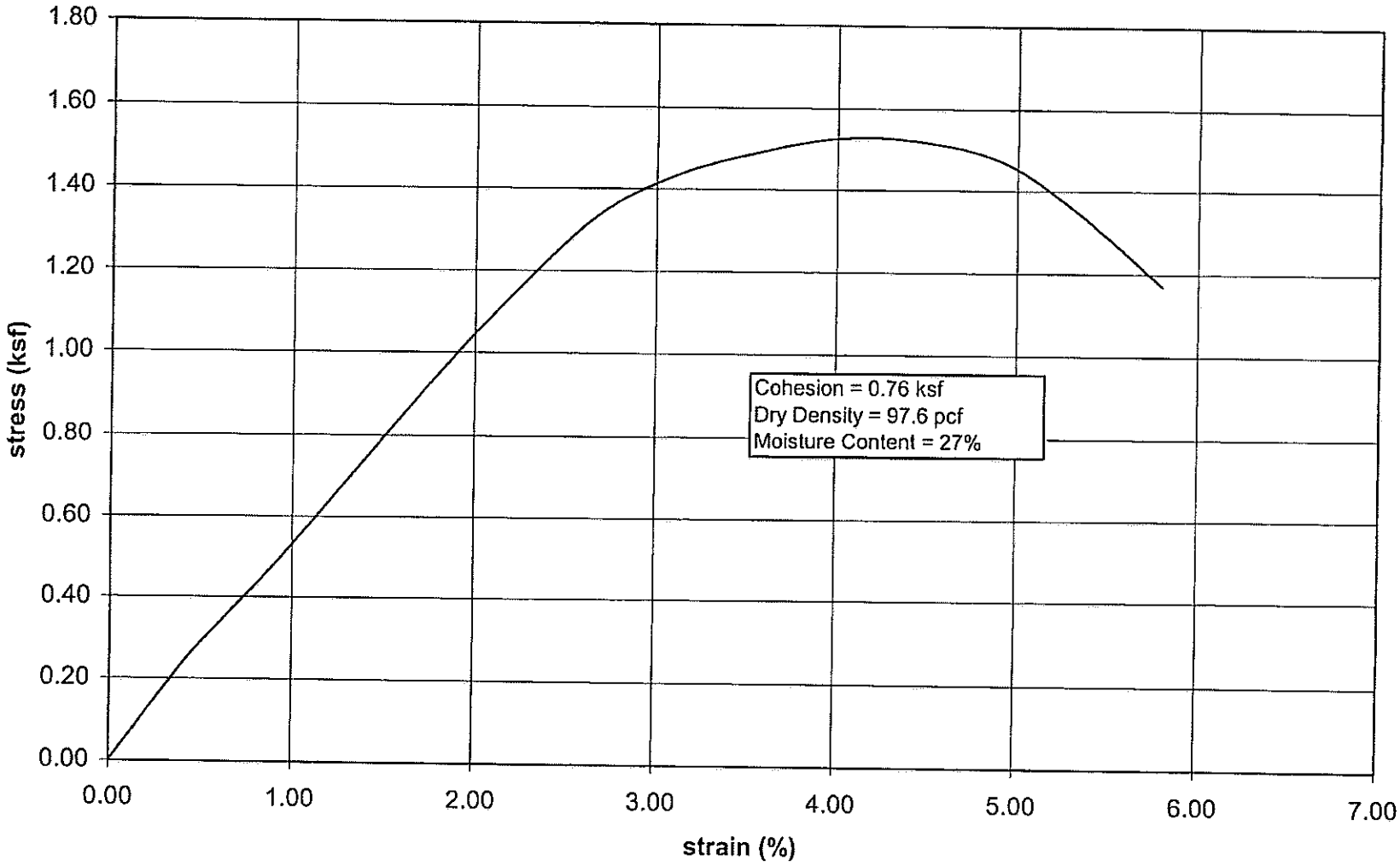
UC - B-6 @ 21'-23' Sample A



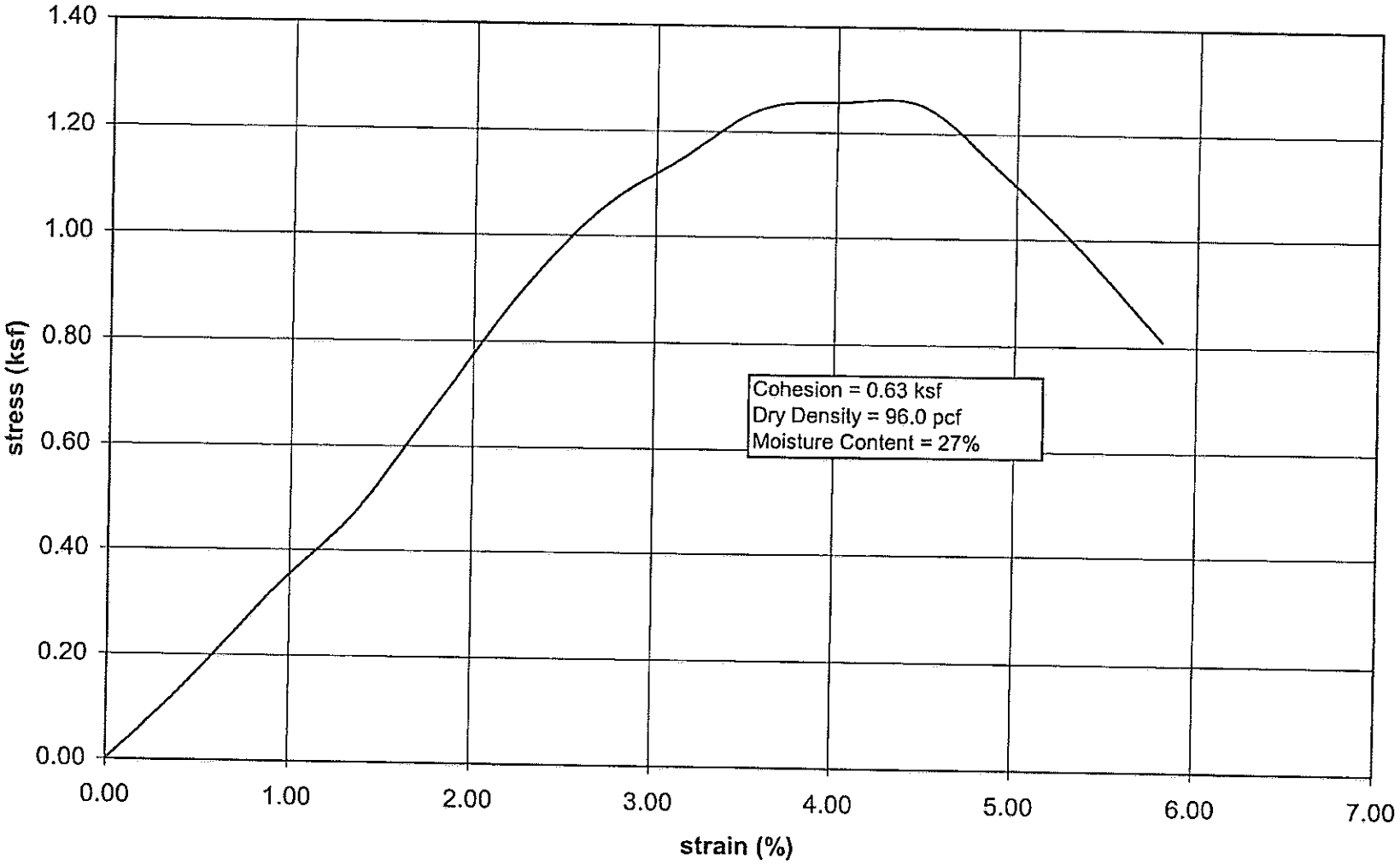
UC - B-6 @ 21'-23' Sample B



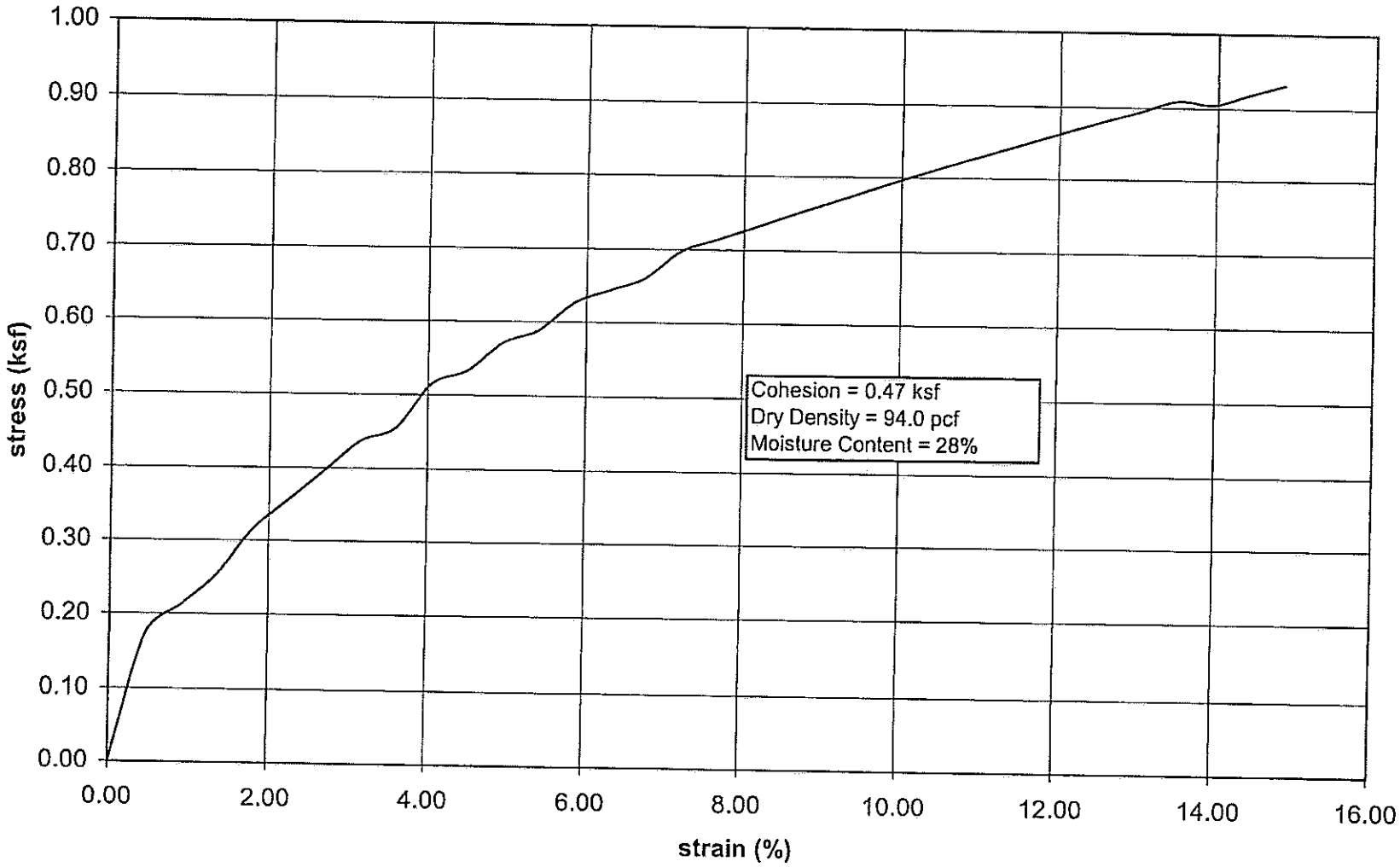
UC - B-8 @ 6'-8' Sample A



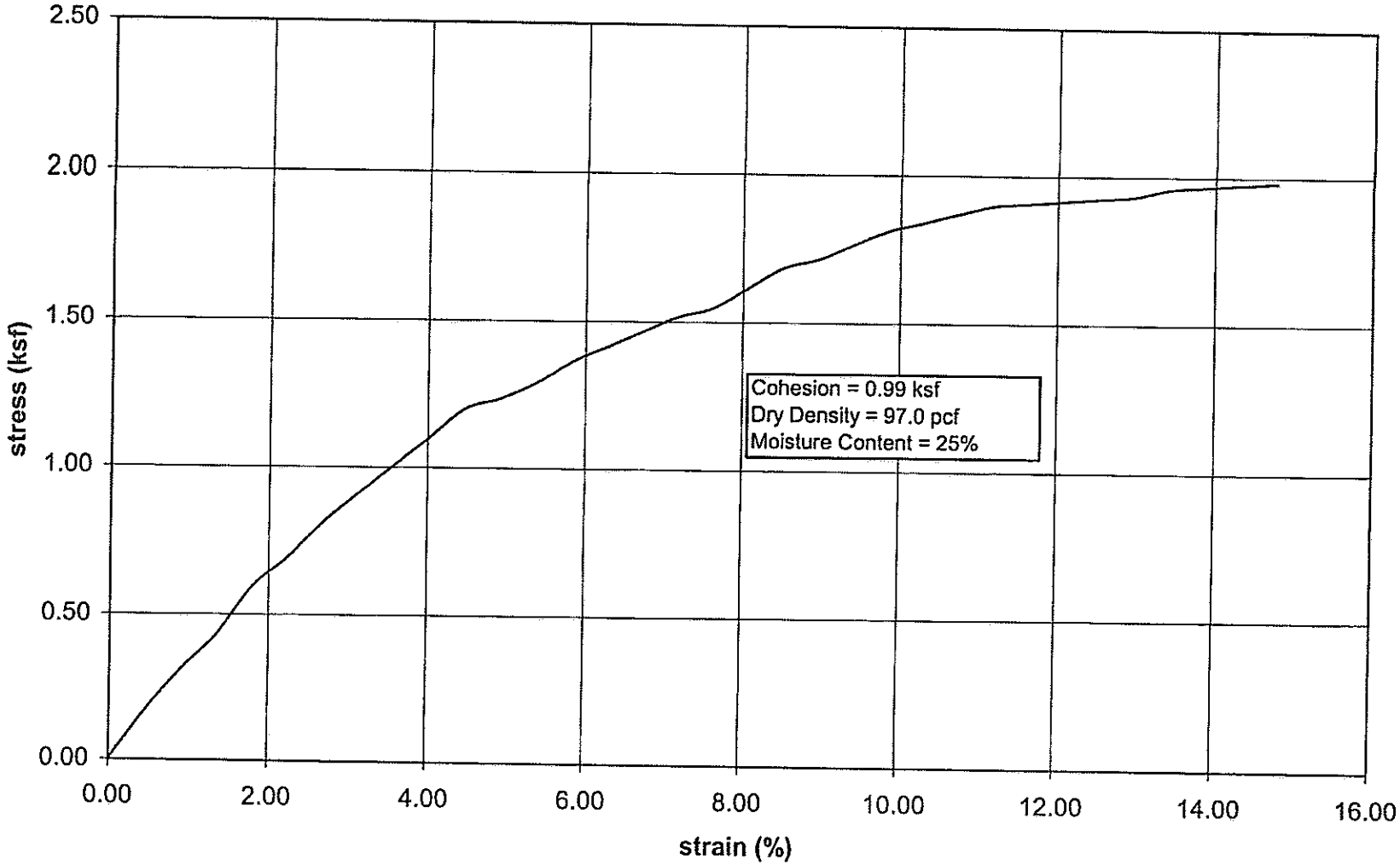
UC - B-8 @ 6'-8' Sample B



UC - B-10 @ 4'-6' Sample A



UC - B-10 @ 4'-6' Sample B

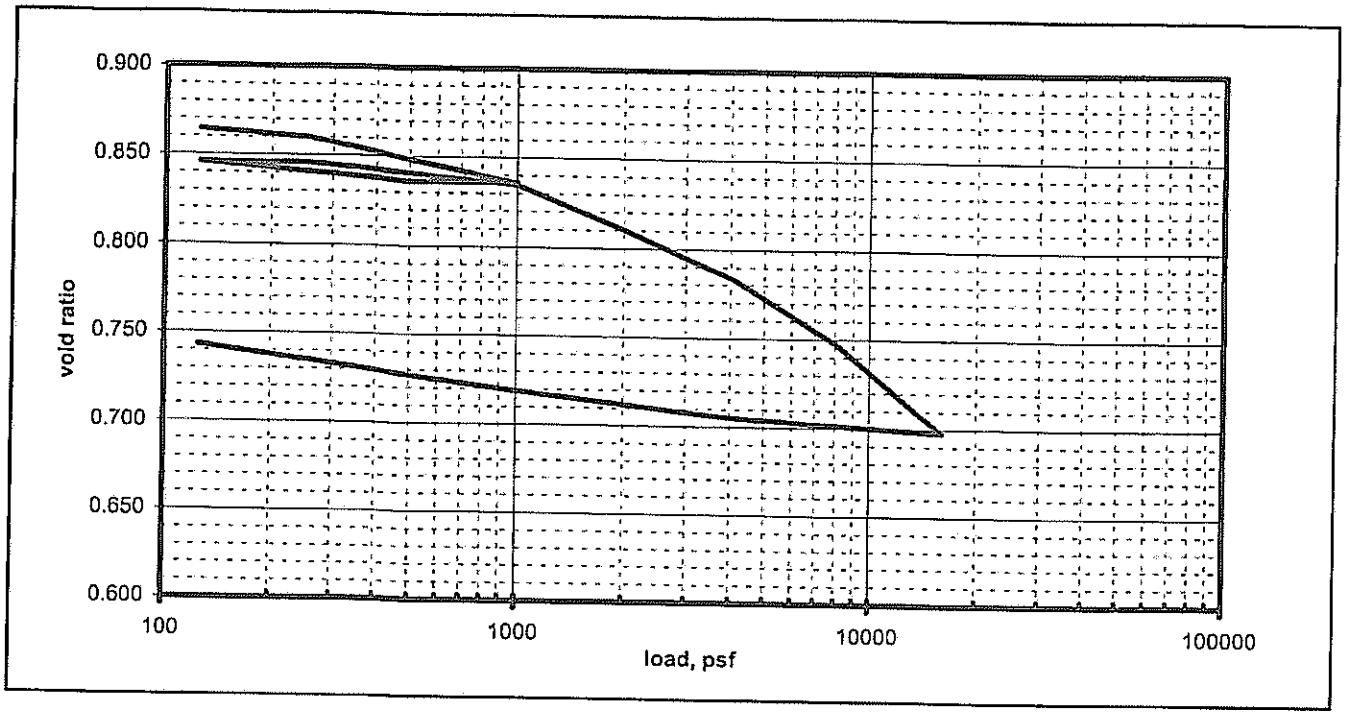


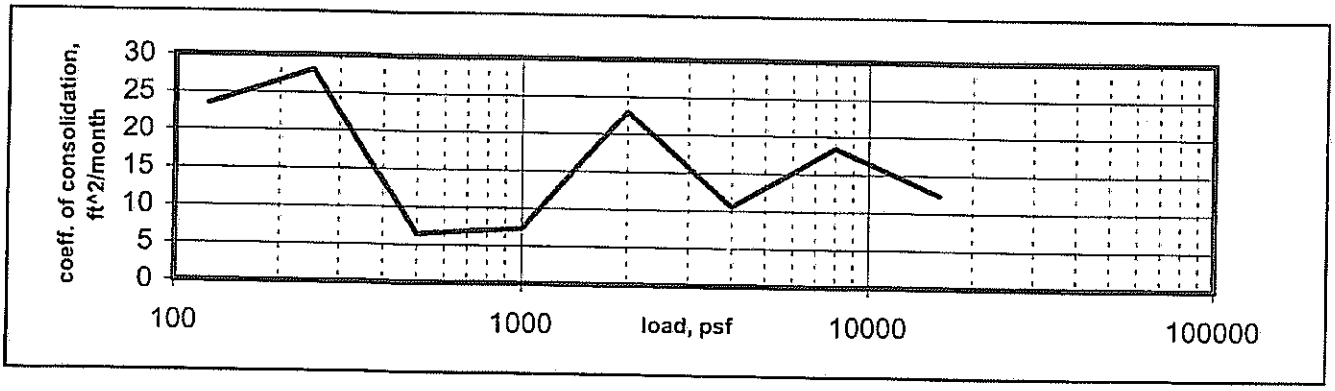
APPENDIX VI

CONSOLIDATION TEST RESULTS

PSI Information To Build On
Engineering • Consulting • Testing

MEMPHIS GEOTECHNICAL DEPARTMENT





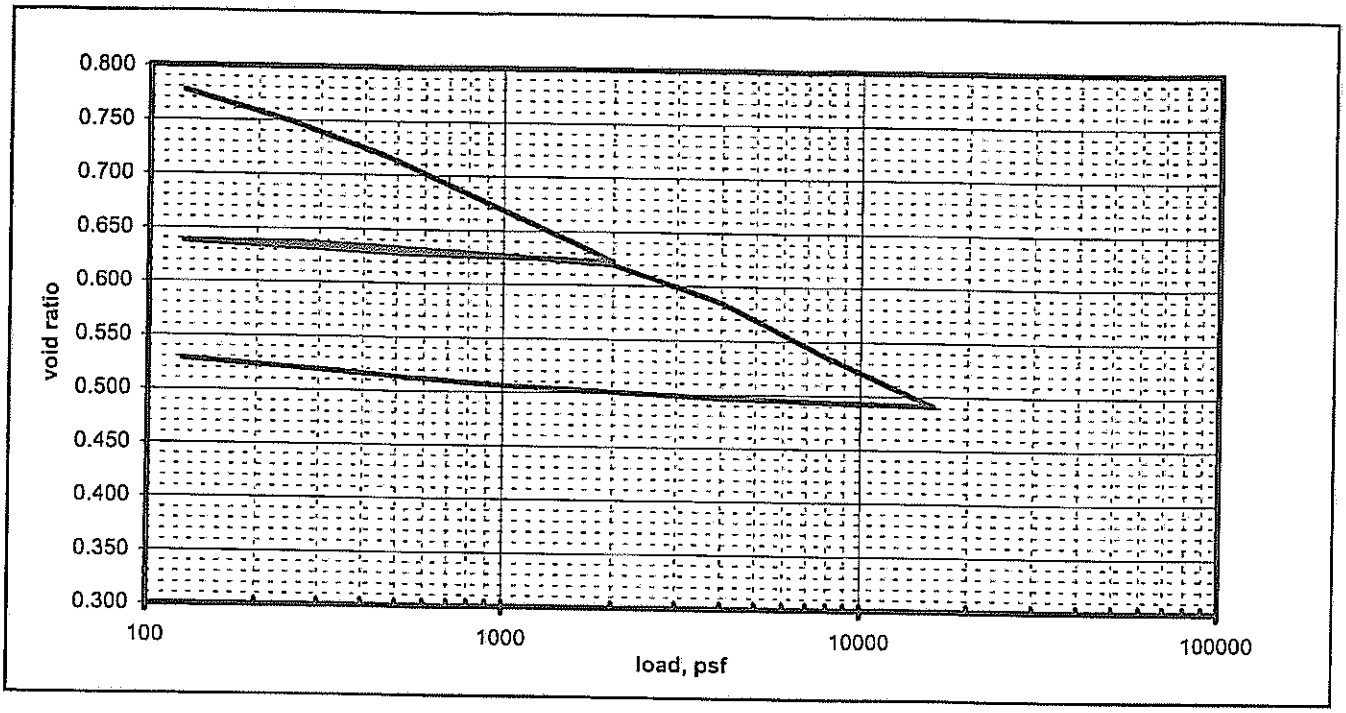
CONSOLIDATION TEST RESULTS

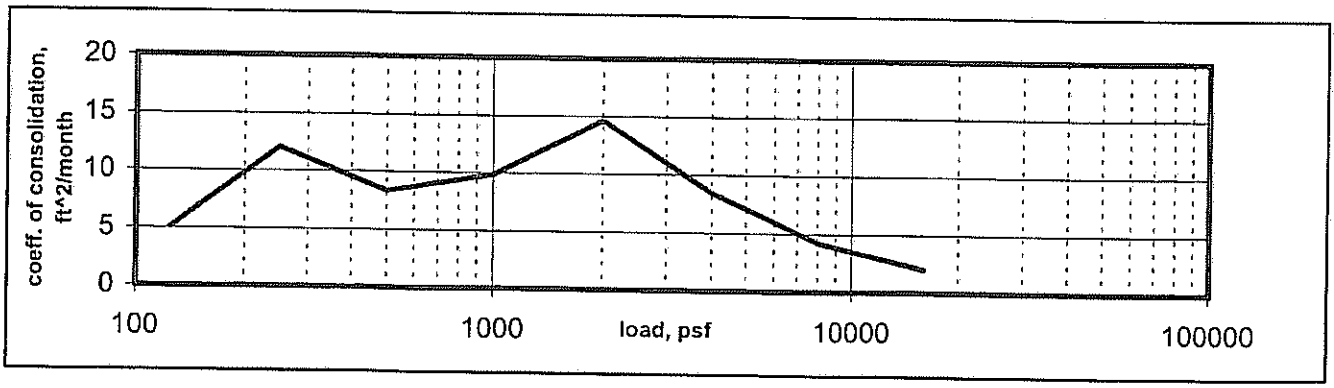
			before test	
Sample I.D.:	B-6 6'-8'			
Sample Classification:	Brown Clayey Silt (ML)	Moisture, %:	29.4	
Liquid Limit:	33	Void Ratio:	0.870	
Plasticity Index:	8	Saturation, %:	91.1	
Dry Density:	90.1 pcf	Specific Gravity:		2.7

PROJECT: Fite Road Ext.	FILE NO: 502-35079
	DATE: 6/26/03

PSI Information To Build On
Engineering • Consulting • Testing

MEMPHIS GEOTECHNICAL DEPARTMENT





CONSOLIDATION TEST RESULTS

			before test	
Sample I.D.:	B-8 16'-18'			
Sample Classification:	Brown Clayey Silt (ML)	Moisture, %:	31.3	
Liquid Limit:	34	Void Ratio:	0.848	
Plasticity Index:	10	Saturation, %:	99.7	
Dry Density:	91.2 pcf	Specific Gravity:		2.7

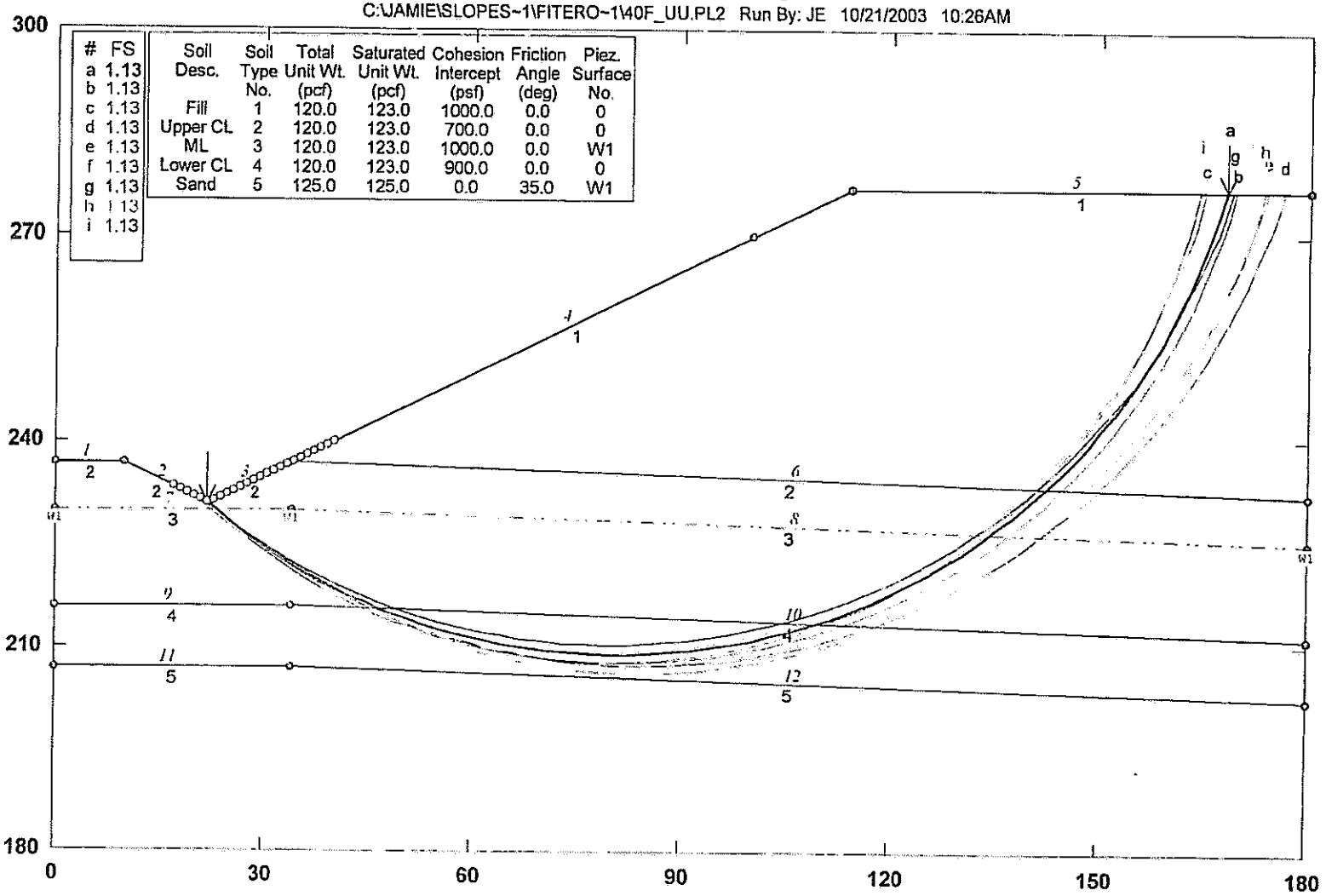
PROJECT:	FILE NO:
Fite Road Ext	502-35079
	DATE: 6/30/03

APPENDIX VII

SLOPE STABILITY ANALYSES RESULTS

Fite Road Extension - 40-foot Fill DepthStage I - After Construction - UU

C:\JAMIE\SLOPES~1\FITERO~1\40F_UU.PL2 Run By: JE 10/21/2003 10:26AM



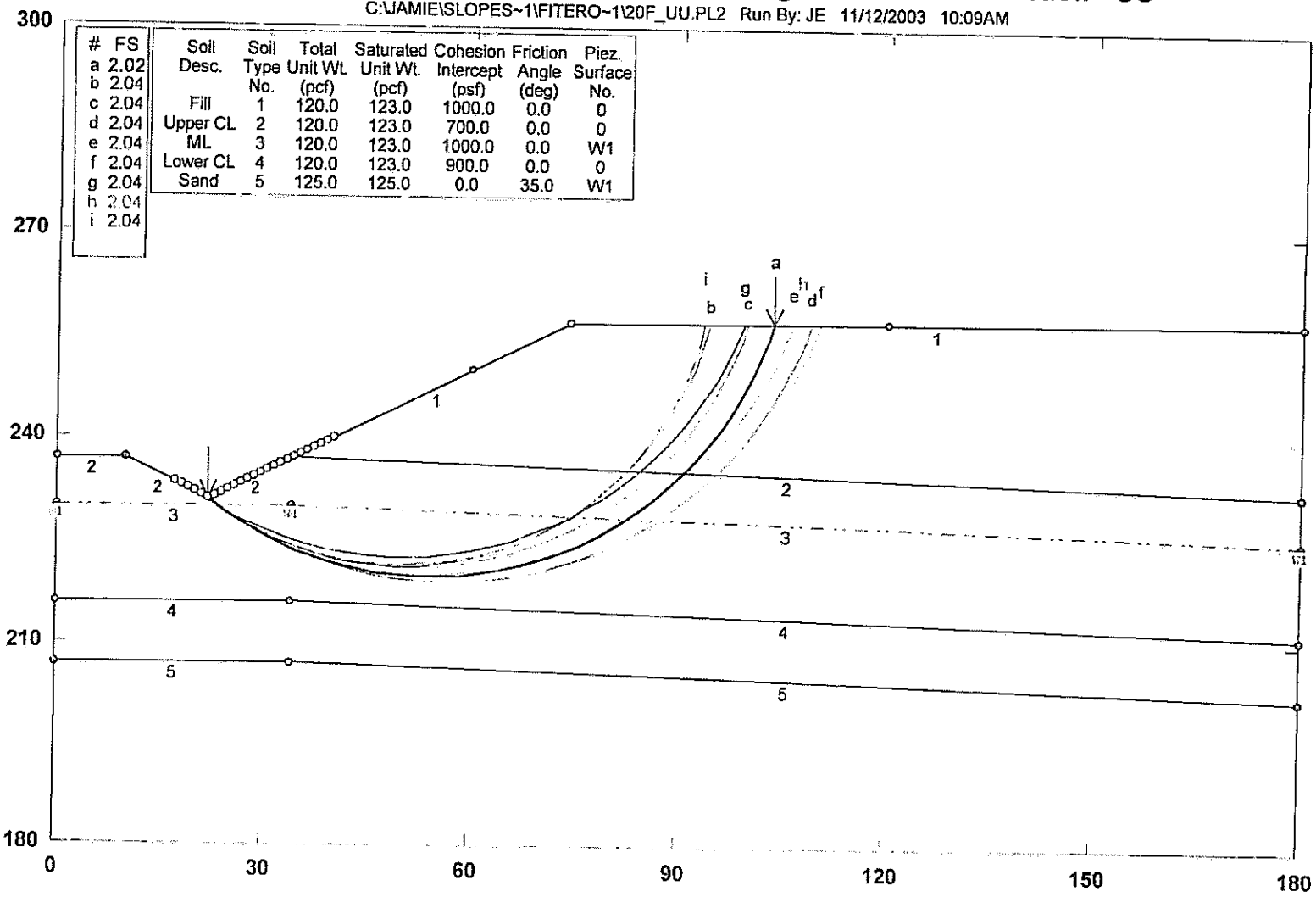
GSTABL7 FSmin=1.13

Safety Factors Are Calculated By The Modified Bishop Method

STED

Fite Road Extension - 20-foot Fill DepthStage I - After Construction - UU

C:\JAMIE\SLOPES~1\FITERO~1\20F_UU.PL2 Run By: JE 11/12/2003 10:09AM



GSTABL7 FSmin=2.02

Safety Factors Are Calculated By The Modified Bishop Method

STED

Fite Road Extension - 30-foot Fill DepthStage I - After Construction - UU

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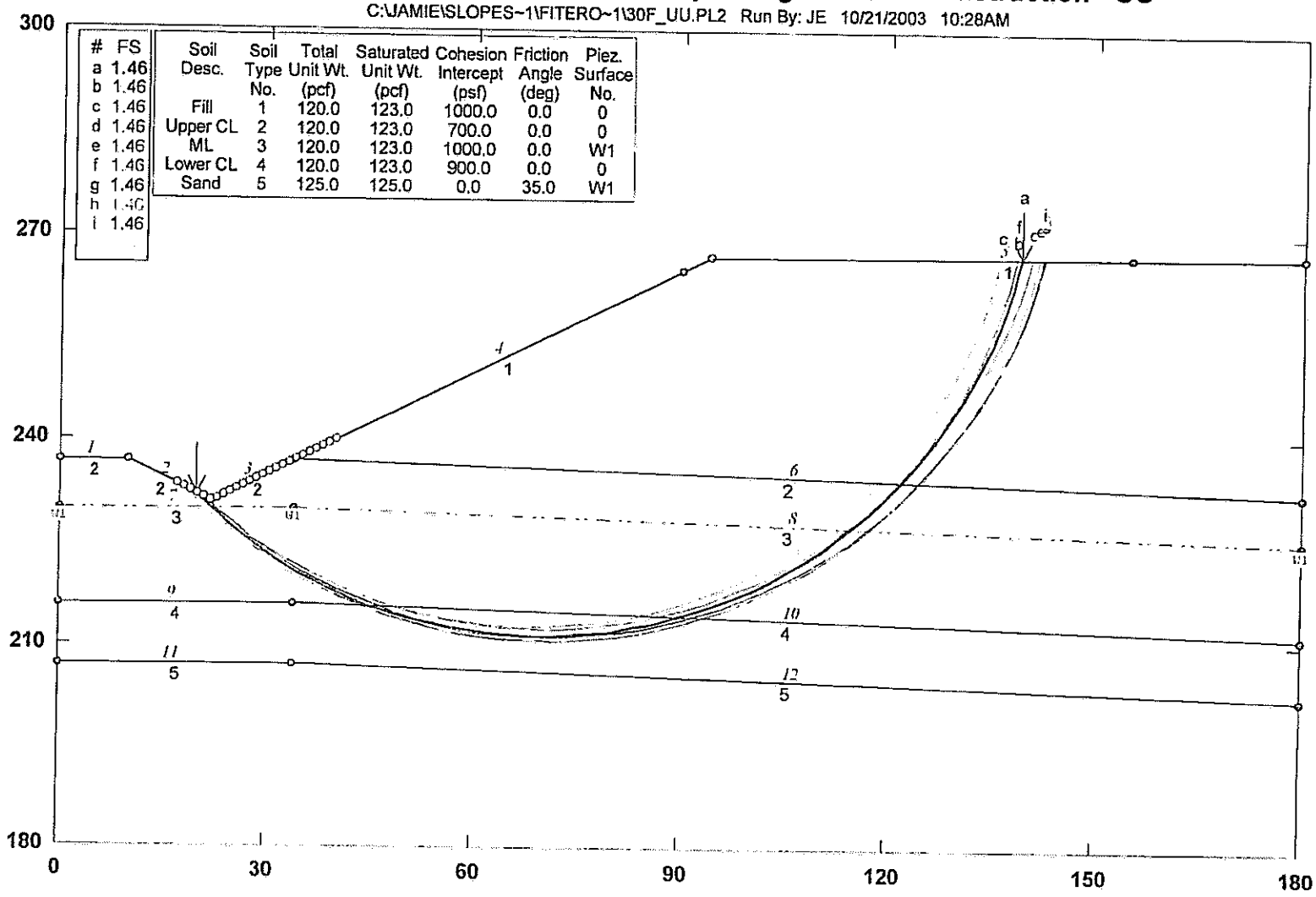


#	FS
a	1.46
b	1.46
c	1.46
d	1.46
e	1.46
f	1.46
g	1.46
h	1.46
i	1.46

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	120.0	123.0	1000.0	0.0	0
Upper CL	2	120.0	123.0	700.0	0.0	0
ML	3	120.0	123.0	1000.0	0.0	W1
Lower CL	4	120.0	123.0	900.0	0.0	0
Sand	5	125.0	125.0	0.0	35.0	W1

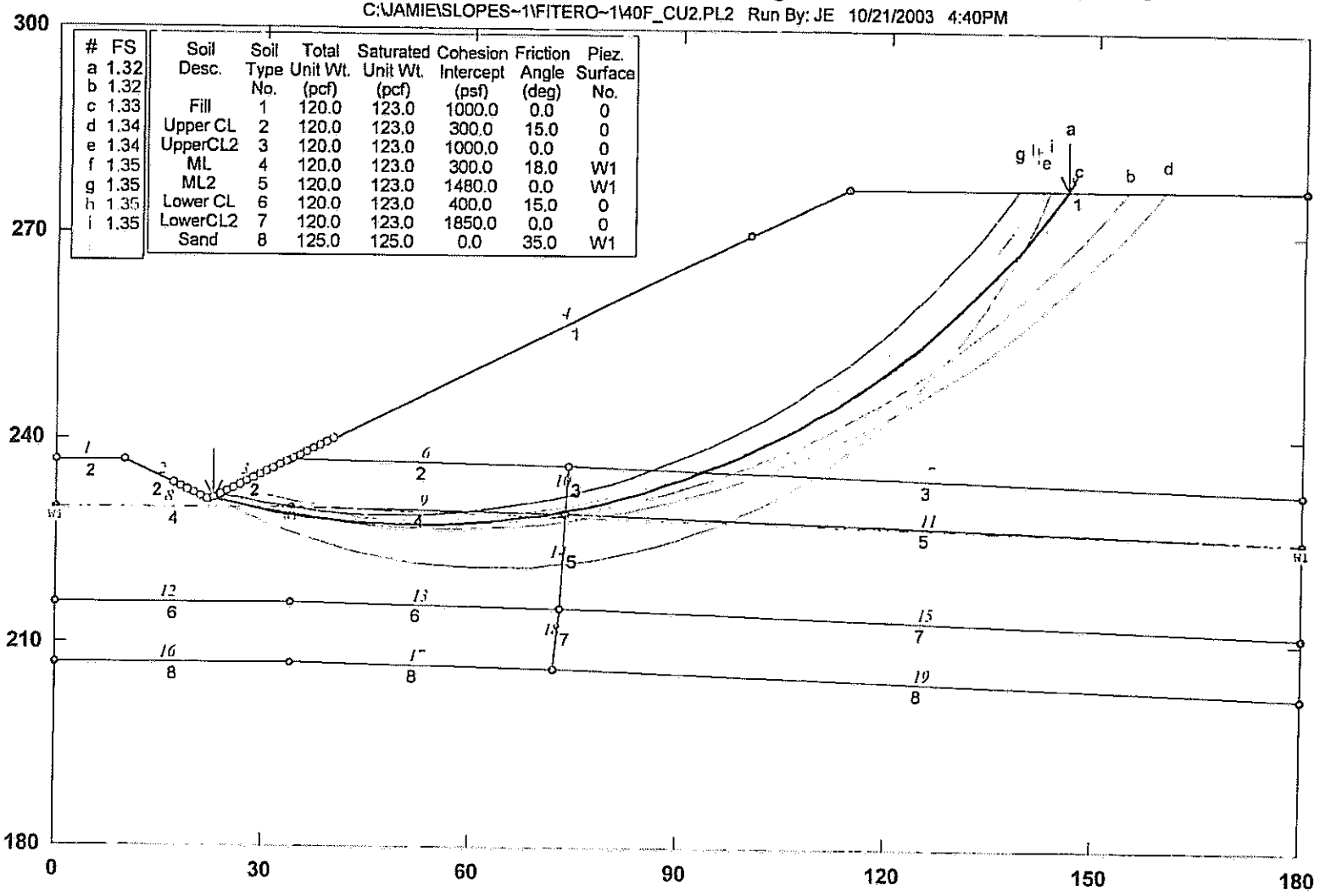
GSTABL7 FSmin=1.46

Safety Factors Are Calculated By The Modified Bishop Method

STED

Fite Road Extension - 40-foot Fill DepthStage 2 - After Construction - CU

C:\JAMIE\SLOPES~1\FITERO~1\40F_CU2.PL2 Run By: JE 10/21/2003 4:40PM



#	FS
a	1.32
b	1.32
c	1.33
d	1.34
e	1.34
f	1.35
g	1.35
h	1.35
i	1.35

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	120.0	123.0	1000.0	0.0	0
Upper CL	2	120.0	123.0	300.0	15.0	0
UpperCL2	3	120.0	123.0	1000.0	0.0	0
ML	4	120.0	123.0	300.0	18.0	W1
ML2	5	120.0	123.0	1480.0	0.0	W1
Lower CL	6	120.0	123.0	400.0	15.0	0
LowerCL2	7	120.0	123.0	1850.0	0.0	0
Sand	8	125.0	125.0	0.0	35.0	W1

GSTABL7 FSmin=1.32

Safety Factors Are Calculated By The Modified Bishop Method

STED

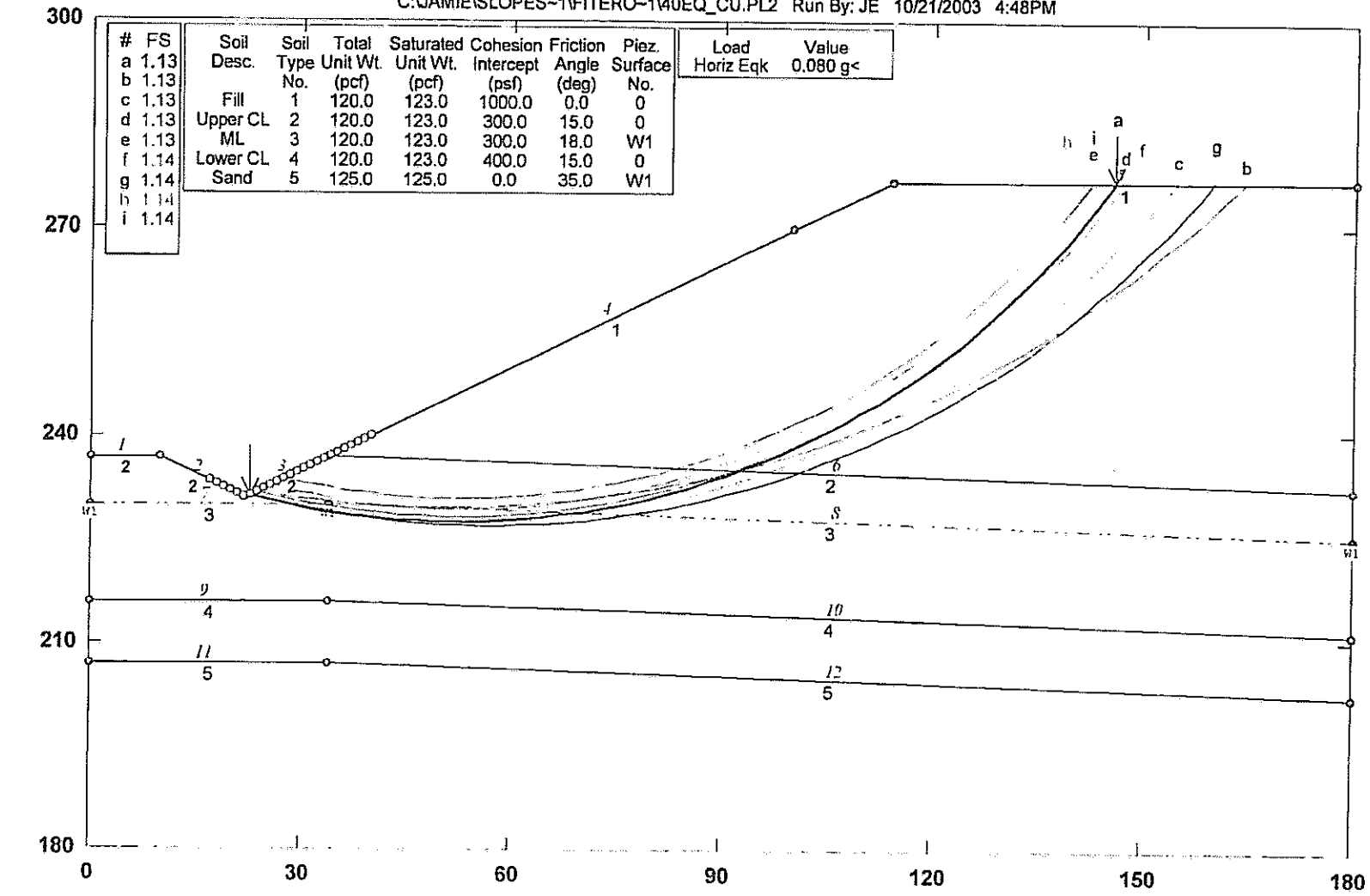
Fite Road Extension - 40-foot Fill Depth- Earthquake (0.075g) - CU

C:\JAMIE\SLOPES~1\FITERO~1\40EQ_CU.PL2 Run By: JE 10/21/2003 4:48PM

#	FS
a	1.13
b	1.13
c	1.13
d	1.13
e	1.13
f	1.14
g	1.14
h	1.14
i	1.14

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	120.0	123.0	1000.0	0.0	0
Upper CL	2	120.0	123.0	300.0	15.0	0
ML	3	120.0	123.0	300.0	18.0	W1
Lower CL	4	120.0	123.0	400.0	15.0	0
Sand	5	125.0	125.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.080 g<



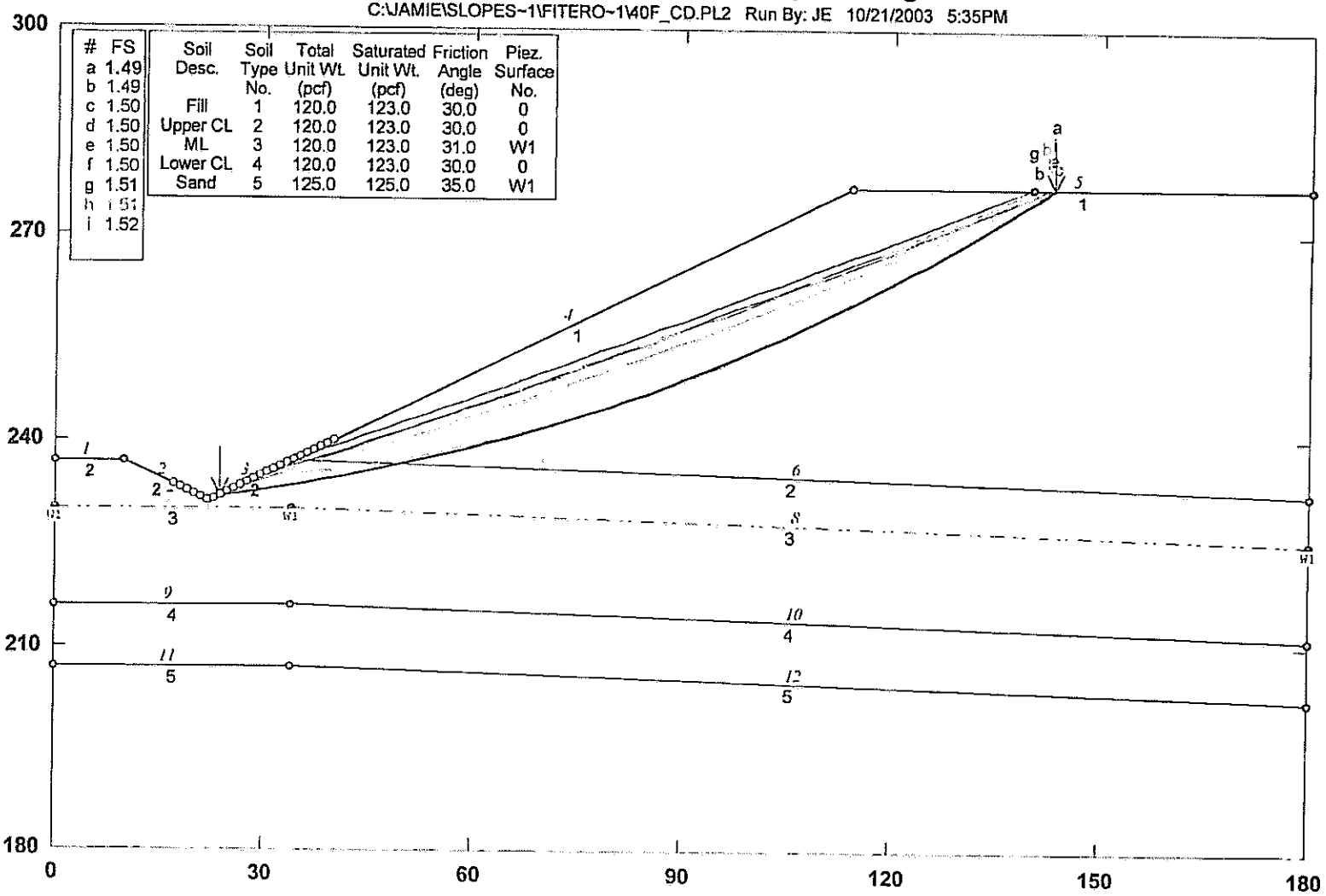
GSTABL7 FSmin=1.13

Safety Factors Are Calculated By The Modified Bishop Method

STED

Fite Road Extension - 40-foot Fill Depth- Long Term - CD

C:\JAMIE\SLOPES~1\FITERO~1\40F_CD.PL2 Run By: JE 10/21/2003 5:35PM



GSTABL7 FSmin=1.49

Safety Factors Are Calculated By The Modified Bishop Method

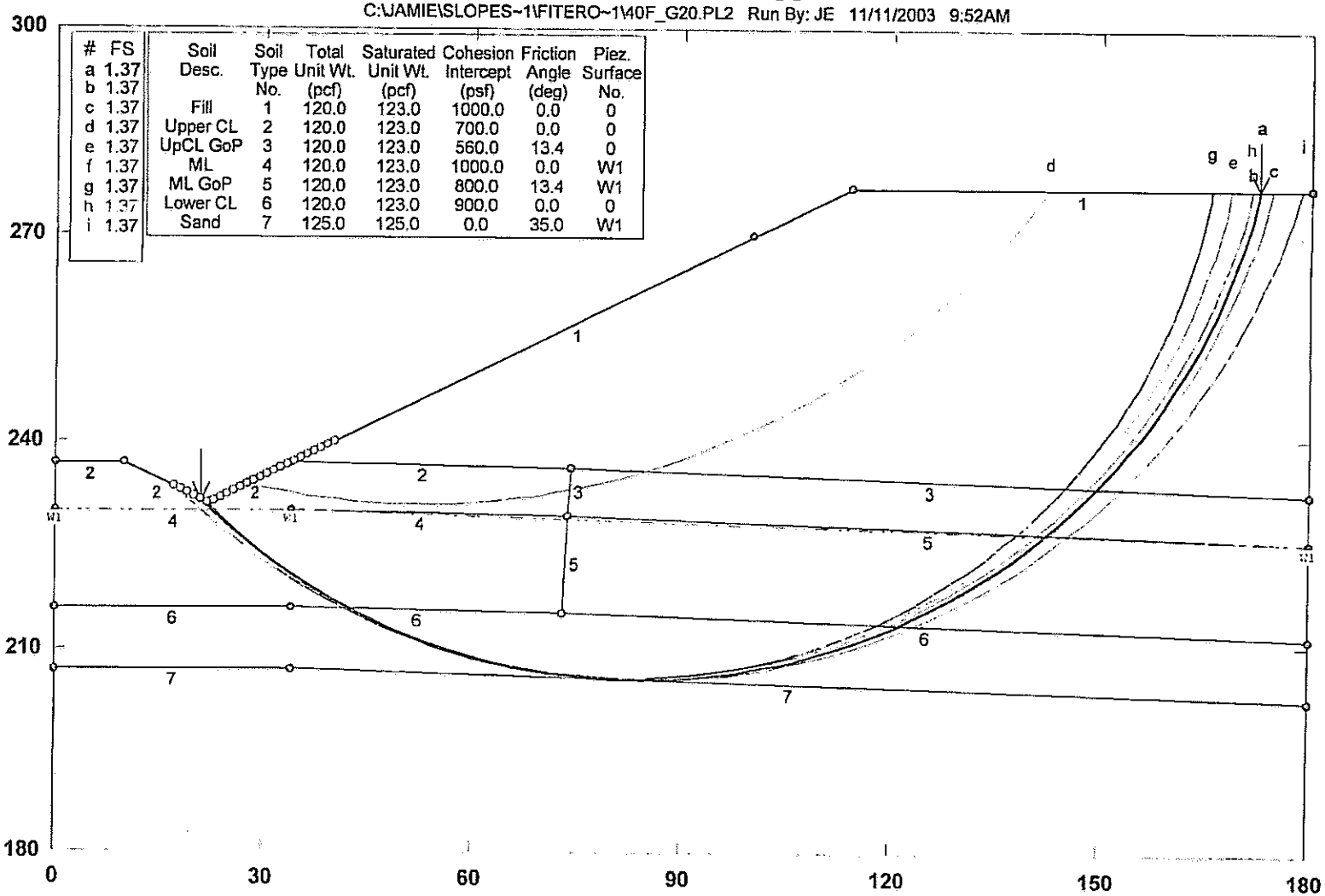
STED

Fite Road Extension - 40-foot Fill Depth-20' Agg Pier- After Construction - UU

C:\JAMIE\SLOPES~1\FITERO~1\40F_G20.PL2 Run By: JE 11/11/2003 9:52AM

#	FS
a	1.37
b	1.37
c	1.37
d	1.37
e	1.37
f	1.37
g	1.37
h	1.37
i	1.37

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	120.0	123.0	1000.0	0.0	0
Upper CL	2	120.0	123.0	700.0	0.0	0
UpCL GoP	3	120.0	123.0	560.0	13.4	0
ML	4	120.0	123.0	1000.0	0.0	W1
ML GoP	5	120.0	123.0	800.0	13.4	W1
Lower CL	6	120.0	123.0	900.0	0.0	0
Sand	7	125.0	125.0	0.0	35.0	W1



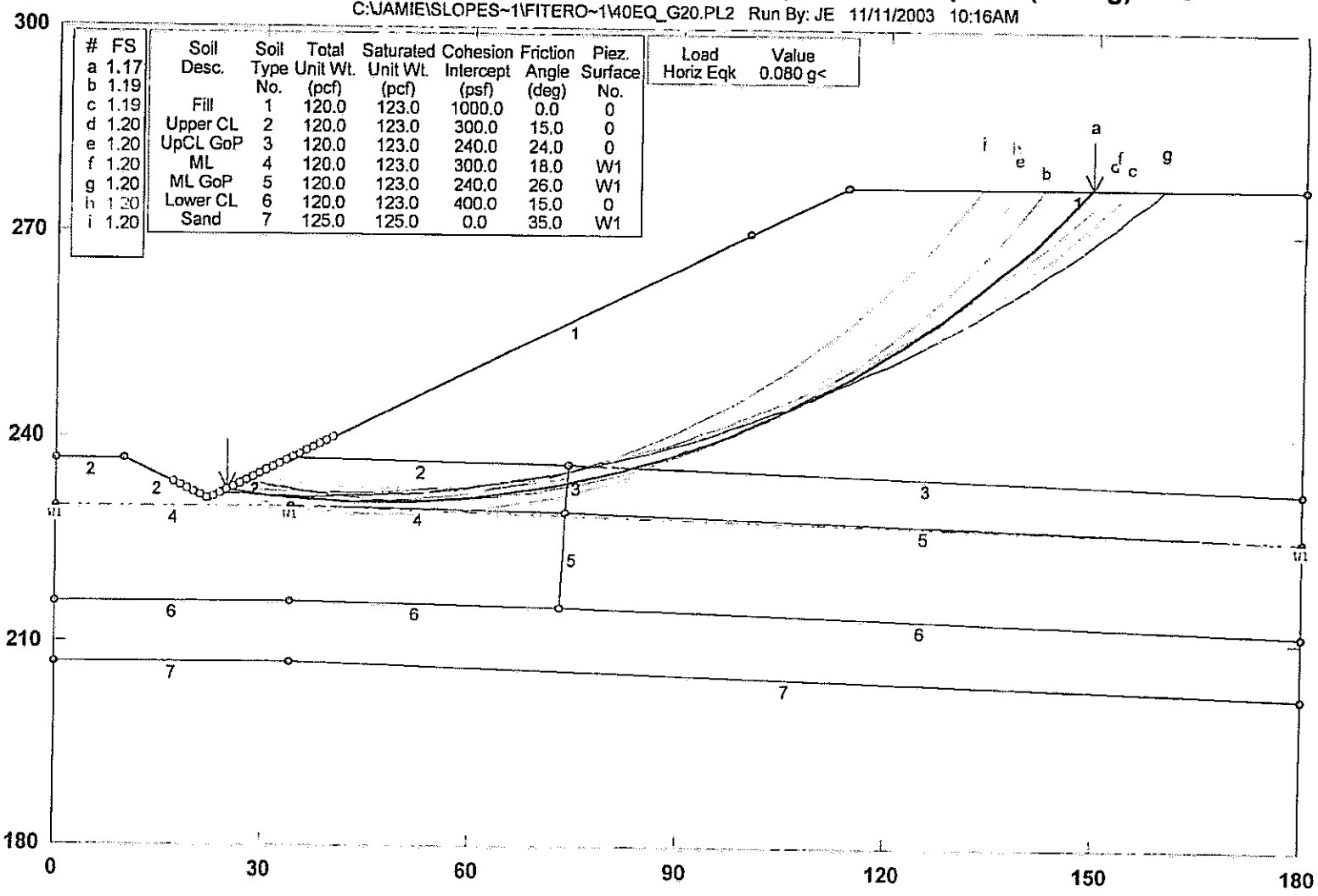
GSTABL7 FSmin=1.37

Safety Factors Are Calculated By The Modified Bishop Method

STED

Fite Road Extension - 40-foot Fill Depth-20' Agg Pier- Earthquake (0.075g) - CU

C:\JAMIE\SLOPES~1\FITERO~1\40EQ_G20.PL2 Run By: JE 11/11/2003 10:16AM



#	FS
a	1.17
b	1.19
c	1.19
d	1.20
e	1.20
f	1.20
g	1.20
h	1.20
i	1.20

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	120.0	123.0	1000.0	0.0	0
Upper CL	2	120.0	123.0	300.0	15.0	0
UpCL GoP	3	120.0	123.0	240.0	24.0	0
ML	4	120.0	123.0	300.0	18.0	W1
ML GoP	5	120.0	123.0	240.0	26.0	W1
Lower CL	6	120.0	123.0	400.0	15.0	0
Sand	7	125.0	125.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.080 g<

GSTABL7 FSmin=1.17

Safety Factors Are Calculated By The Modified Bishop Method

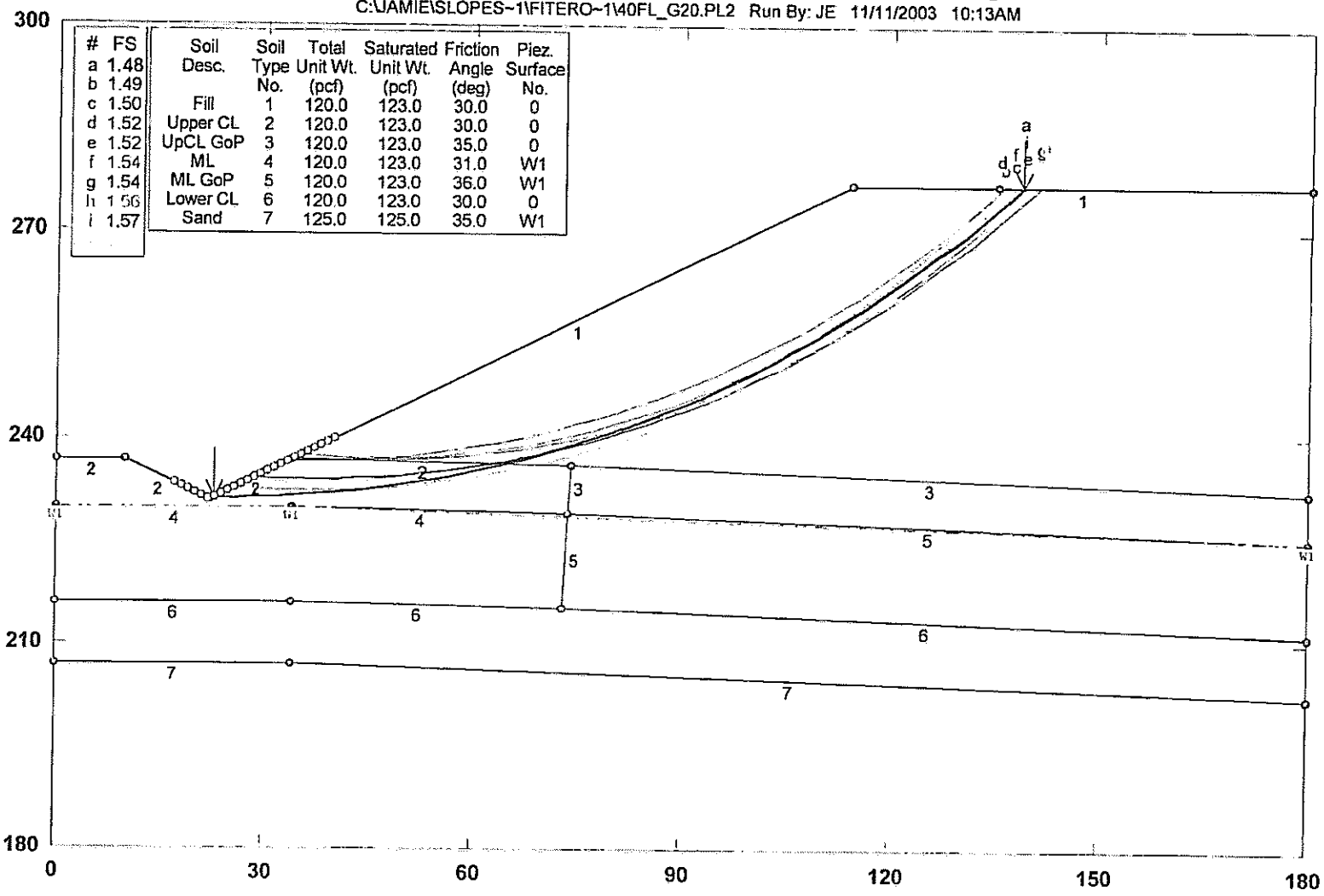
STED

Fite Road Extension - 40-foot Fill Depth-20' Agg Pier- Long Term - CD

C:\JAMIE\SLOPES~1\FITERO~1\40FL_G20.PL2 Run By: JE 11/11/2003 10:13AM

#	FS
a	1.48
b	1.49
c	1.50
d	1.52
e	1.52
f	1.54
g	1.54
h	1.56
i	1.57

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	120.0	123.0	30.0	0
Upper CL	2	120.0	123.0	30.0	0
UpCL GoP	3	120.0	123.0	35.0	0
ML	4	120.0	123.0	31.0	W1
ML GoP	5	120.0	123.0	36.0	W1
Lower CL	6	120.0	123.0	30.0	0
Sand	7	125.0	125.0	35.0	W1



GSTABL7 FSmin=1.48

Safety Factors Are Calculated By The Modified Bishop Method

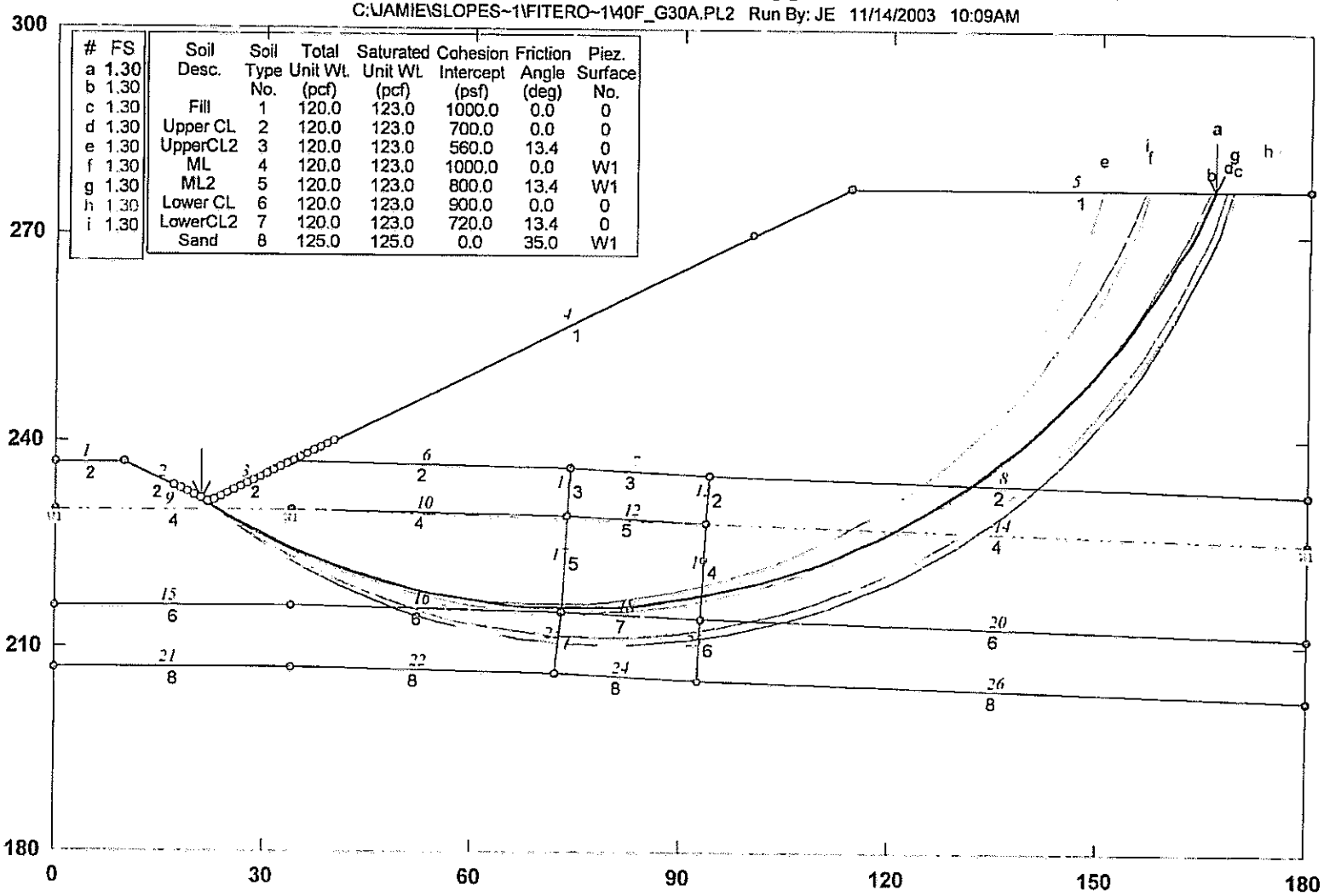
STED

Fite Road Extension - 40-foot Fill Depth-30' Agg Pier - After Construction - UU

C:\JAMIE\SLOPES~1\FITERO~1\40F_G30A.PL2 Run By: JE 11/14/2003 10:09AM

#	FS
a	1.30
b	1.30
c	1.30
d	1.30
e	1.30
f	1.30
g	1.30
h	1.30
i	1.30

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	120.0	123.0	1000.0	0.0	0
Upper CL	2	120.0	123.0	700.0	0.0	0
UpperCL2	3	120.0	123.0	560.0	13.4	0
ML	4	120.0	123.0	1000.0	0.0	W1
ML2	5	120.0	123.0	800.0	13.4	W1
Lower CL	6	120.0	123.0	900.0	0.0	0
LowerCL2	7	120.0	123.0	720.0	13.4	0
Sand	8	125.0	125.0	0.0	35.0	W1



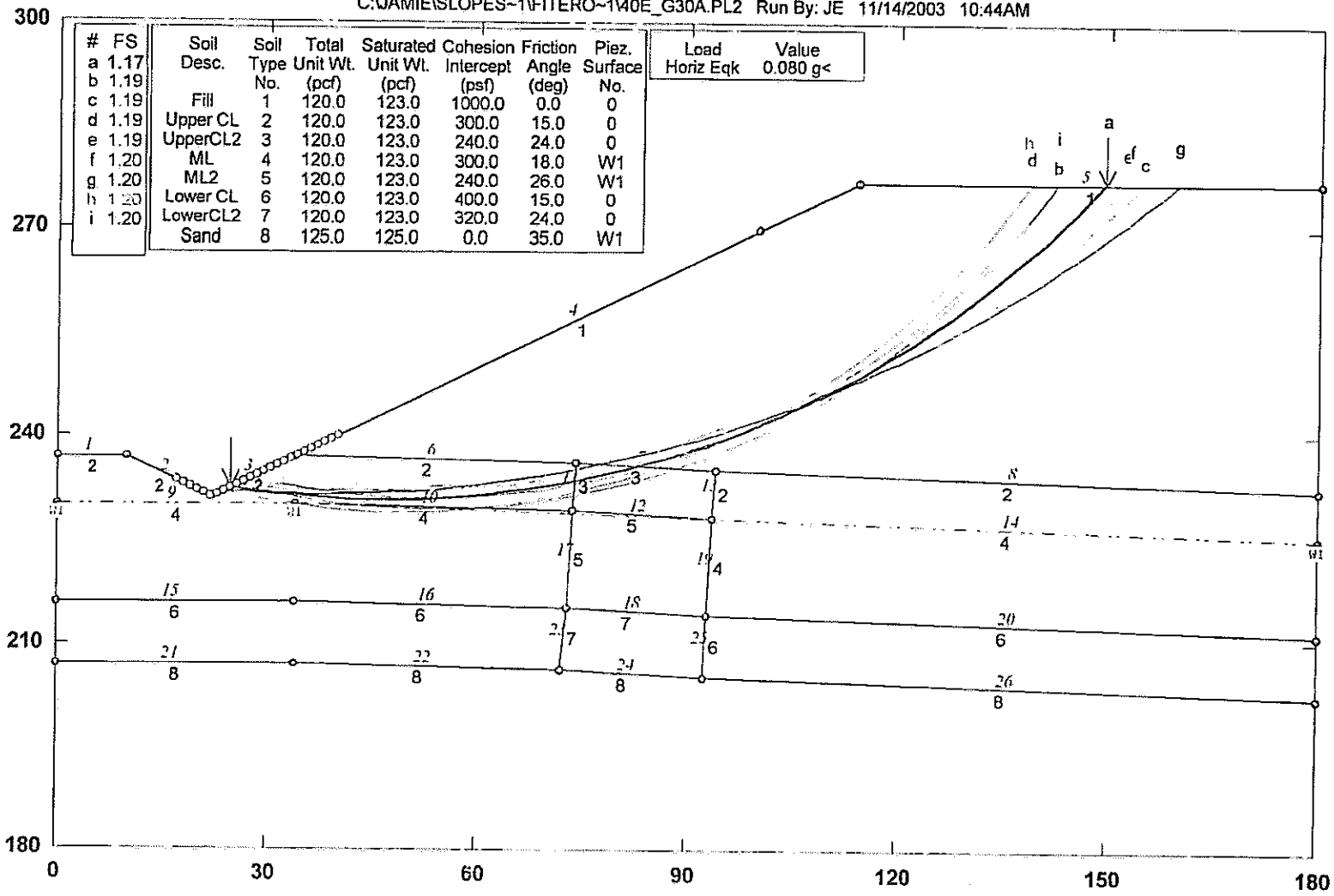
GSTABL7 FSmin=1.30

Safety Factors Are Calculated By The Modified Bishop Method

STED

Fite Road Extension - 40-foot Fill Depth-30' Agg Pier - Earthquake (0.075g) - CU

C:\JAMIE\SLOPES~1\FITERO~1\40E_G30A.PL2 Run By: JE 11/14/2003 10:44AM



GSTABL7 FSmin=1.17

Safety Factors Are Calculated By The Modified Bishop Method

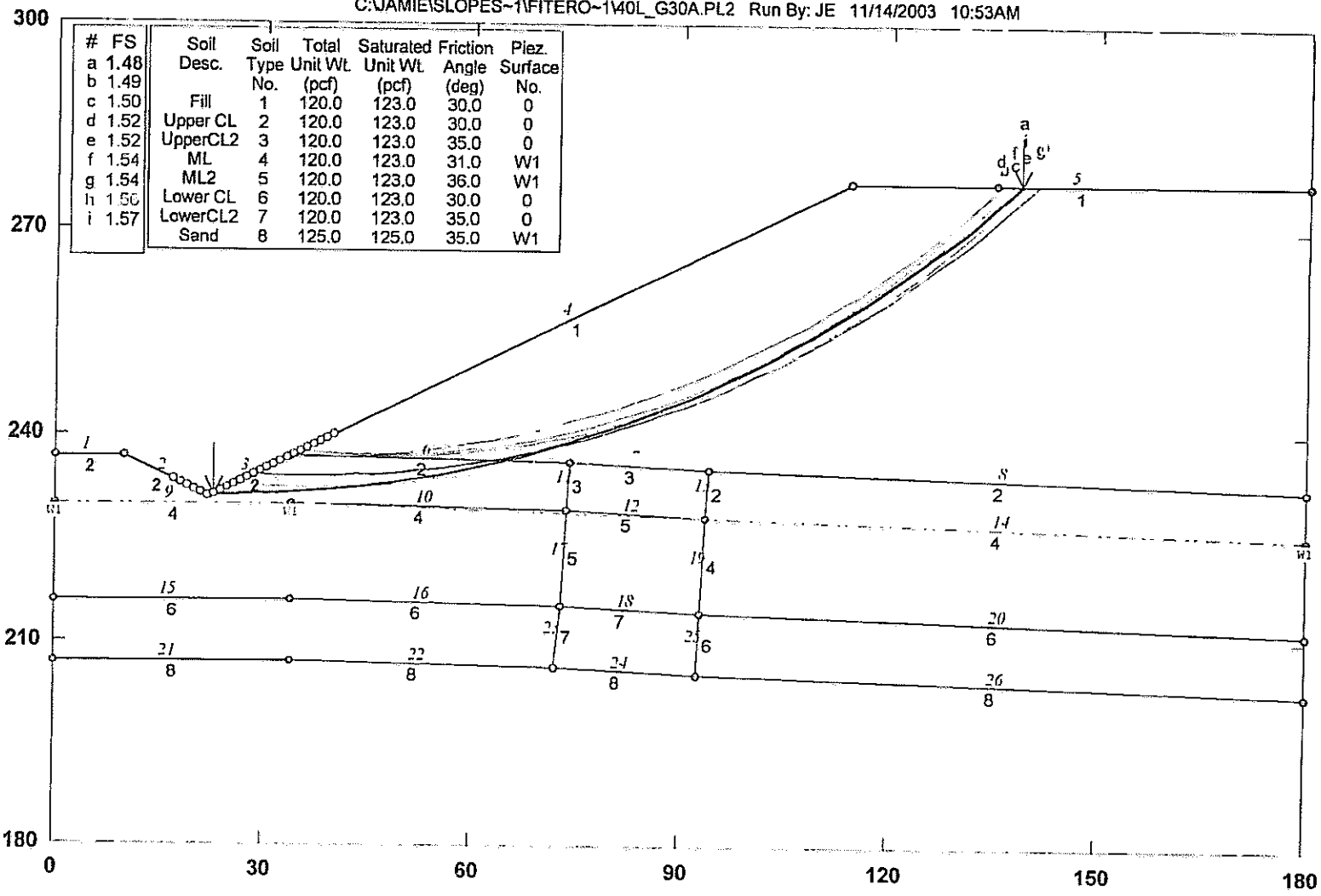
STED

Fite Road Extension - 40-foot Fill Depth-30' Agg Pier - Long Term - CD

C:\JAMIE\SLOPES~1\FITERO~1\40L_G30A.PL2 Run By: JE 11/14/2003 10:53AM

#	FS
a	1.48
b	1.49
c	1.50
d	1.52
e	1.52
f	1.54
g	1.54
h	1.56
i	1.57

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt (pcf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	120.0	123.0	30.0	0
Upper CL	2	120.0	123.0	30.0	0
UpperCL2	3	120.0	123.0	35.0	0
ML	4	120.0	123.0	31.0	W1
ML2	5	120.0	123.0	36.0	W1
Lower CL	6	120.0	123.0	30.0	0
LowerCL2	7	120.0	123.0	35.0	0
Sand	8	125.0	125.0	35.0	W1



GSTABL7 FSmin=1.48

Safety Factors Are Calculated By The Modified Bishop Method

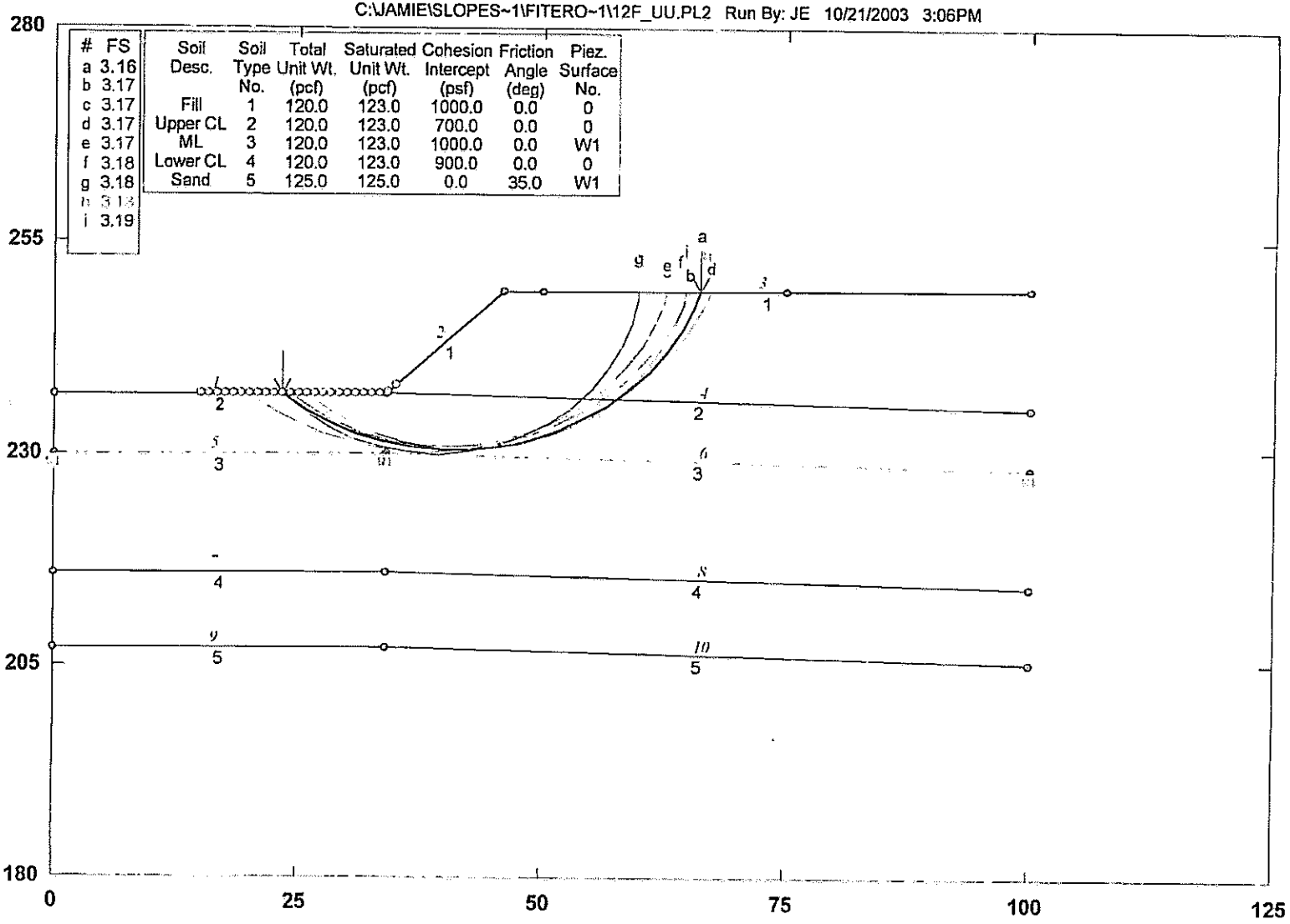
STED

Fite Road Extension - 12-foot Fill Depth-1:1 slope - After Construction - UU

C:\JAMIE\SLOPES~1\FITERO~1\12F_UU.PL2 Run By: JE 10/21/2003 3:06PM

#	FS
a	3.16
b	3.17
c	3.17
d	3.17
e	3.17
f	3.18
g	3.18
h	3.13
i	3.19

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	120.0	123.0	1000.0	0.0	0
Upper CL	2	120.0	123.0	700.0	0.0	0
ML	3	120.0	123.0	1000.0	0.0	W1
Lower CL	4	120.0	123.0	900.0	0.0	0
Sand	5	125.0	125.0	0.0	35.0	W1



GSTABL7 FSmin=3.16

Safety Factors Are Calculated By The Modified Bishop Method

STED

APPENDIX VIII

PILE FOUNDATION CAPACITY DIAGRAMS

Pile Capacity Diagram
PSI File No.: 502-35079

PSI Information To Build On
Engineering • Consulting • Testing

Project: Fite Road Extension			Boring No.: B-7
Location: Memphis, Tennessee			Elevation: +/-237'
Date: 8/29/03		Water level while drilling: 15'	
Boring Method: HSA to 35' - MR to 60'			Driller: E. Morris
Depth (ft)			
	N = 6	f_s = 0.260	q_b = 7
	N = 6	f_s = 0.300	q_b = 3
5-	N = 8	f_s = 0.400	q_b = 4
10-	N = 5	f_s = 0.220	q_b = 5
15-	N = 5	f_s = 0.220	q_b = 5
20-	N = 7	f_s = 0.350	q_b = 3
25-	N = 4	f_s = 0.200	q_b = 0
30-	N = 5	f_s = 0.250	q_b = 2
35-	N = 14	f_s = 0.260	q_b = 30
40-	N = 25	f_s = 0.480	q_b = 54
45-	N = 36	f_s = 0.580	q_b = 65
50-	N = 18	f_s = 0.340	q_b = 39
55-	N = 38	f_s = 0.580	q_b = 65
60-	N = 13	f_s = 0.620	q_b = 6

Pile Capacity Diagram
PSI File No.: 502-35079

PSI Information To Build On
Engineering • Consulting • Testing

Project: Fite Road Extension			Boring No.: B-8
Location: Memphis, Tennessee			Elevation: +/-237'
Date: 8/29/03		Water level while drilling: NE	
Boring Method: HSA to 15' - MR to 60'			Driller: R. Strunk
Depth (ft)			
	N = 6	f_s = 0.260	q_b = 7
	N = 10	f_s = 0.500	q_b = 5
5-	N = 8	f_s = 0.400	q_b = 4
10-	N = 7	f_s = 0.300	q_b = 8
15-	N = 7	f_s = 0.300	q_b = 8
20-	N = 7	f_s = 0.350	q_b = 3
25-	N = 6	f_s = 0.300	q_b = 3
30-	N = 18	f_s = 0.340	q_b = 39
35-	N = 28	f_s = 0.540	q_b = 61
40-	N = 28	f_s = 0.540	q_b = 61
45-	N = 22	f_s = 0.420	q_b = 48
50-	N = 49	f_s = 0.580	q_b = 65
55-	N = 74	f_s = 0.580	q_b = 65
60-	N = 48	f_s = 0.580	q_b = 65

APPENDIX IX

LIQUEFACTION ANALYSES

Liquefaction Analysis
PSI File No.: 502-35079

PSI Information To Build On
Engineering • Consulting • Testing

Project: Fite Road Extension					Boring No.: Avg. Profile
Location: Memphis, Tennessee					Elevation: --
Boring Method: HSA/MR				Water level while drilling: 10	
Magnitude (M_w): 6.5		PGA: 0.15 g		Assumed water level: 10	
Simplified Procedure - SPT Analysis (1996 NCEER Modification)					Hammer: Safety/CH
Depth (ft)		N_f	$(N_1)_{60cs}$	CSR	CRR	Factor of Safety
	0.5	7	7	NA	NA	NA
	5	7	7	NA	NA	NA
(CL/ML)	10	7	7	NA	NA	NA
	15	7	7	NA	NA	NA
	20	7	7	NA	NA	NA
	25	7	7	NA	NA	NA
	30	14	15	0.138	0.2481	1.8
	35	25	27	0.137	0.4891	3.6
(SP)	40	27	28	0.134	0.5245	3.9
	45	29	29	0.131	0.5695	4.4
	50	33	32	0.126	1.5227	12.1
	55	56	52	0.121	1.5227	12.6
	60	48	43	0.116	1.5227	13.1
	70					
	80					

Liquefaction Analysis
PSI File No.: 502-35079

PSI Information To Build On
Engineering • Consulting • Testing

Project: Flte Road Extension						Boring No.: Avg. Profile
Location: Memphis, Tennessee						Elevation: --
Boring Method: HSA/MR				Water level while drilling: 10		
Magnitude (M_w): 6.5		PGA: 0.15 g		Assumed water level: 10		
Simplified Procedure - SPT Analysis (1996 NCEER Modification)						Hammer: Safety/CH
Depth (ft)		N_f	$(N_1)_{60cs}$	CSR	CRR	Factor of Safety
	0.5	7	7	NA	NA	NA
	5	7	7	NA	NA	NA
(CL/ML)	10	7	7	NA	NA	NA
	15	7	7	NA	NA	NA
	20	7	7	NA	NA	NA
	25	7	7	NA	NA	NA
	30	14	15	0.069	0.2481	3.6
	35	25	27	0.066	0.4891	7.4
(SP)	40	27	28	0.066	0.5245	7.9
	45	29	29	0.066	0.5695	8.6
	50	33	32	0.066	1.5227	23.0
	55	56	52	0.066	1.5227	23.1
	60	48	43	0.066	1.5227	23.2
	70					
	80					

Note: Analysis includes 40-foot fill height.

Liquefaction Analysis
PSI File No.: 502-35079

Information To Build On
Engineering • Consulting • Testing

Project: Fite Road Extension					Boring No.: B-9
Location: Memphis, Tennessee					Elevation: --
Boring Method: HSA/MR@45'				Water level while drilling: 10	
Magnitude (M_w): 6.5		PGA: 0.15 g		Assumed water level: 10	
Simplified Procedure - SPT Analysis (1996 NCEER Modification)					Hammer: Safety/CH
Depth (ft)		N_f	$(N_1)_{60cs}$	CSR	CRR	Factor of Safety
	0.5	7	7	NA	NA	NA
	5	7	7	NA	NA	NA
(CL)	10	5	5	NA	NA	NA
	15	5	5	NA	NA	NA
	20	9	9	NA	NA	NA
	25	7	7	NA	NA	NA
(SM)	30	9	14	0.138	0.2319	1.7
	35	14	17	0.137	0.2757	2.0
(SP)	40	21	24	0.134	0.3983	3.0

Liquefaction Analysis
PSI File No.: 502-35079

PSI Information To Build On
Engineering • Consulting • Testing

Project: Fite Road Extension					Boring No.: B-9
Location: Memphis, Tennessee					Elevation: --
Boring Method: HSA/MR@45'			Water level while drilling: 10		
Magnitude (M_w): 6.5	PGA: 0.15 g		Assumed water level: 10		
Simplified Procedure - SPT Analysis (1996 NCEER Modification)					Hammer: Safety/CH

	Depth (ft)	N_f	$(N_1)_{60cs}$	CSR	CRR	Factor of Safety
	0.5	7	7	NA	NA	NA
	5	7	7	NA	NA	NA
(CL)	10	5	5	NA	NA	NA
	15	5	5	NA	NA	NA
	20	9	9	NA	NA	NA
	25	7	7	NA	NA	NA
(SM)	30	9	14	0.069	0.2319	3.4
	35	14	17	0.066	0.2757	4.2
(SP)	40	21	24	0.066	0.3983	6.0

Note: Analysis includes 40-foot fill height.

GEOTECHNOLOGY INC
FROM THE GROUND UP

February 15, 2012 J019679.01

Mr. John Pankey, P.E.
Fisher & Arnold
9180 Crestwyn Hills Drive
Memphis, Tennessee 38125

Re: Addendum #1
Project No. : STP-M-7900(29)
Geotechnical Engineering Section No.: N/A
County: Shelby Region: IV
Fite Road Retaining Walls No. 1 and 2 – Additional Fill Placement Recommendations

Dear Mr. Pankey:

Per our discussion during the meeting of February 14, 2012, presented is this addendum are additional recommendations regarding fill placement, and retaining wall design and construction for the referenced project. Refer to the geotechnical reports (previously issued) for information regarding the project in general, as well as specific recommendations for mitigation of settlement, liquefaction and protecting against global stability failure.

Preparation of Fill Areas

In areas where filling will be required to bring the site to grade, the following procedures are recommended.

(a) Remove all organic matter, foreign material and debris.

(b) Compact the top 6 inches of cleared subgrade to a minimum of 95% of the maximum dry density as determined by the standard Proctor compaction test (ASTM D 698). If the subgrade is granular material, compact the top 6 inches to a minimum of 70% relative density as determined by the relative density test ASTM D 4253 and D 4254.

(c) If the cleared subgrade is excessively wet, it should be stabilized so that construction traffic can operate without damaging/disturbing the subgrade. This can be accomplished by placing a layer of biaxial geogrid and covering it with a minimum of 12 inches of crushed stone.

Suitable Fill Materials

Fill material should consist of natural soils that have a maximum liquid limit of 45 and a plasticity index of not more than 20. It should be free from organic matter, debris, or other

deleterious materials. In general, the material should have an upper particle size diameter of 2 inches.

Fill and Backfill Placement

Fill or backfill should be placed in lifts of uniform thickness and compacted. The compacted lift thickness, however, should generally not exceed 6 inches. Each lift should be compacted to a minimum of 95% of the maximum dry density as determined by the standard Proctor test. Moisture content should be controlled to within ± 2% of optimum. If granular fill is used, compact each lift to a minimum of 70% of relative density as determined by ASTM D 4253 and D 4254.

The rate of fill placement should be slow enough to allow for increase of strength and stiffness of the native (in place) soil through consolidation process (reducing moisture content and void ratio), which is typically known as staged placement of the fill material. The increase in soil stiffness and strength is related to the rate of excess porewater pressure dissipation and the associated settlement due to fill placement. The suggested rate of placement is 1 to 2 feet per week. However, that rate should be adjusted based on monitoring of the settlement and dissipation of pore pressure. Settlement monitoring can be performed using settlement plates or other appropriate surveying methods. Dissipation of excess pore pressure can be monitored by installation of vibrating wire (VW) piezometers.

Prior to fill placement, global stability analyses should be performed to simulate the stages of fill placement and the consequent gain in soil strength. The rate of fill placement should not result in a safety factor against slope failure that is below acceptable levels. These analyses should incorporate the type of fill material type, strength parameters and side slope configuration.

If a pile-supported retaining wall system is to be utilized, it is recommended that the piles be driven after the fill is completely placed and the fill-induced settlement is practically complete. If the piles are to be driven before fill placement or before completion of the fill-induced settlement, then the edge (toe) of the fill should be maintained a minimum distance from the nearest pile (1/2 of the pile length), otherwise, downdrag effects and settlement should be considered when calculating the pile capacities.

Subgrade Protection

The subgrade soils are very silty and therefore easily disturbed, especially in saturated conditions. For this reason, it is recommended that proper drainage of the construction areas be maintained to protect the prepared subgrade from the detrimental effects of weather conditions during construction. Finished subgrades and excavations should be kept free of standing water at all times, and equipment traffic prohibited.

We are pleased to be of service. Please contact us if you have any questions or if we may be of further service.

Very truly yours,

GEOTECHNOLOGY, INC.

Ashraf Elsayed, Ph.D., P.E.
Branch Manager – Memphis Branch

ASE/JKH/JAB

Copies submitted: (1) WORD copy
(1) PDF copy

SUBSURFACE EXPLORATION REPORT
FITE ROAD RETAINING WALL #1
MEMPHIS, TENNESSEE

Prepared for:

FISHER & ARNOLD
Memphis, Tennessee

Prepared by:

GEOTECHNOLOGY, INC.
Memphis, Tennessee

Geotechnology Report No. J019679.01

February 11, 2012

GEOTECHNOLOGY INC
FROM THE GROUND UP

February 11, 2012

J019679.01

Mr. John Pankey, P.E.
Fisher & Arnold
9180 Crestwyn Hills Drive
Memphis, Tennessee 38125

Re: Project No. : STP-M-7900(29)
Geotechnical Engineering Section No. : N/A
County : Shelby Region : IV Date Drilled : 1/12
Roadway Description : Retaining Wall- Fite Road
Structure : Retaining Structure No. 1 from Station 77+72.19 to Station 80+80.00

Dear Mr. Pankey:

Presented herein are findings from our exploration of the subsurface conditions at the subject location. The services documented in this report were provided in accordance with the terms, conditions and scope of services described in the Geotechnology, Inc. September 28, 2011 proposal.

SCOPE OF SERVICES

The recommendations given in this report are intended for the design of the proposed retaining wall at the above referenced location. These recommendations are professional opinions based on a subsurface exploration conducted at the location of the planned retaining wall. The exploration included drilling of test borings in the general area of the retaining wall. Enclosed are the boring logs and laboratory test results. The report complies with the current geotechnical requirements set forth in the Tennessee Department of Transportation (TDOT) Earth Retaining Structures Manual.

INTENT AND DESCRIPTION OF THE STRUCTURE

The purpose of Wall No. 1 is to retain the proposed fill from Station 77+72.19 to Station 80+80.00. The structure is necessary due to the proposed relocation of Fite Road. The retaining wall alignment will be between 100 feet left and 150 feet to the right of the centerline. The wall height will vary from approximately 8 feet to 23 feet.

SOIL PROFILE

Two borings (R-1 and R-2) were drilled to depths ranging from approximately 30 to 40 feet to define the subsurface conditions along the proposed retaining wall alignment (See wall plan). The station and offset at the location of each boring are shown on each boring log.

Layers of soft to stiff, silty clay (CL), clayey silt (ML) and clay (CL) were encountered in the upper 28 to 38 feet. At Boring R-2, these materials were underlain by medium dense silty sand (SM) to the depth of termination (40 feet). Groundwater was encountered in the borings at depths of 13 and 18, respectively. It is noted that due to the proximity of the wall to an existing stream, fluctuations in water elevations can be expected.

ENGINEERING ANALYSIS

LIQUEFACTION ANALYSIS

The potential for liquefaction and dynamic settlement along the wall alignment was evaluated. Both field and laboratory data were used to perform the analysis. The field measurements include SPT "N" values, which were obtained typically at 5-foot depth intervals in each boring, and the depth of the water table. The laboratory data include USCS soil classification, soil unit weight, and percent fines of soil samples obtained from various strata. An earthquake magnitude (M_w) of 7.5 (probability of exceedance of 7% in 75 years, or 1,000-year return interval) was considered in accordance with the latest requirements for seismic design of highway bridges[1]. A corresponding peak ground acceleration of 0.523g, as determined by published information from the USGS[2], was used in the analysis. Subsurface conditions (as characterized by the field and laboratory data) and earthquake characteristics were used to determine the factors of safety against liquefaction in each soil layer, as well as the associated dynamic settlement during the design seismic event. Based on the analysis, no potentially liquefiable soils are present in the analyzed boring. However, potentially liquefiable soils were found while evaluating the conditions for Wall # 2. Therefore this hazard should be further evaluated while conducting the wall design.

GLOBAL STABILITY

A preliminary analysis was performed to evaluate the global stability of the wall. The preliminary analysis was based on the subsurface conditions as encountered in the borings, the wall height as previously stated in this report, and standard assumptions regarding the wall

[1] American Association of State Highway and Transportation Officials LRFD Bridge Design Specifications, 4th Edition, 2007

[2] Earthquake Hazards Program Ground Motion Parameter Calculator- United States Geological Survey

dimensions. The preliminary analysis indicated inadequate safety factors for both non-seismic and seismic conditions. Therefore, global stability of the wall should be thoroughly evaluated once the wall design is complete, and the wall type and configurations are determined.

SETTLEMENT DUE TO FILL PLACEMENT

Fill material will be placed to construct the embankment. The maximum depth of the controlled fill placement will vary, but will approach 40 feet in some areas. Soft to medium stiff soils with relatively low shear strengths were encountered to depths ranging from 28 to 30 feet. The weight of the fill will induce settlement, mainly due to the compression of the soft, silty soils. The estimated fill-induced settlement is approximately 12 inches near the planned wall location. Refer to subsequent sections for settlement mitigation recommendations.

RECOMMENDATIONS

RECOMMENDED WALL TYPES

The different types of earth retaining structures listed below are considered suitable for the site:

- Gravity Wall
- Cast-in-Place Reinforced Concrete Wall
- MSE Wall
- Gabion Wall
- Cast-in-Place Concrete Cantilever Gravity Wall
- Sheet Pile Wall

EXCAVATION AND BACKFILL

Temporary construction slopes should have a maximum allowable slope of 1V:1H. The contractor shall ensure that these temporary back slopes are not and do not become unstable. If a slope is unstable, becomes unstable, or is unacceptable for other reasons, then temporary shoring shall be used. All walls must follow the design guidelines established in the TDOT Earth Retaining Structures Manual (available version at the time of letting).

The 1V:1H temporary construction slope should be backfilled with select backfill as specified later in this report. Refer to the Select Backfill Material table presented in the subsequent section for engineering properties. The engineer shall approve potential backfill materials before use. The backfill should extend vertically to the full height of the wall.

The backfill is to be placed in accordance with TDOT's *Standard Specifications for Road and Bridge Construction* (March 1, 2006). Prior to fill placement, the foundation soil and areas receiving fill shall be observed by the engineer. Any soft zones or unsuitable materials shall be removed and the resulting excavation backfilled with approved fill materials.

RECOMMENDED SOIL PARAMETERS

Recommended soil parameters to be used in the design are provided in the following table.

SELECT BACKFILL						
Material	Undrained Condition (Short Term)			Drained Condition (Long Term)		
	$\phi(^\circ)$	Cohesion (psf)	Density (pcf)	$\phi(^\circ)$	Cohesion (psf)	Density (pcf)
Coarse-grained (select) Backfill	34	0	-	34	0	-
Fine-grained Backfill	0	1000	120	28	0	120

The sliding coefficient values shall be as follows:

Fine-grained material:	0.35
Select granular material:	0.50

The select fill shall conform to the specifications outlined in Item 4.5 of Section F, Chapter 3 of the TDOT Earth Retaining Structures Manual (available version at the time of letting). It should also be reasonably free (maximum of 0.1%) from organic and otherwise deleterious materials. To utilize the angle of internal friction (ϕ) of the select backfill, the backfill must extend behind the wall for a minimum zone formed by a 1V:1H slope behind the back edge of footing or reinforced zone. The unit weight of the select backfill is to be determined by the contractor/wall designer depending upon the actual backfill material used.

FACTORS OF SAFETY

The following safety factors should be incorporated the wall design.

Mode of Failure	Minimum Safety Factors	
	Non-Seismic Condition	Seismic Condition
Sliding	1.5	1.2
Overturning	2.0	1.5
Bearing Capacity	2.5 For MSE Walls	1.9
	3.0 For All Other Types	2.3

BEARING CAPACITY RECOMMENDATIONS

The maximum allowable bearing pressure is as follows:

Length of Wall = 1200 psf
(based on ultimate bearing pressure of 3700 psf and a Factor of Safety of 3.0)

It is recommended that the geotechnical engineer be present to observe the excavation of the footings for the retaining structures. If the observed bearing conditions are not sufficient to support the wall, soil improvement will be necessary.

SETTLEMENT MITIGATION

A relatively large magnitude of settlement is expected. This can be mitigated by either staging the fill placement or by using soil reinforcement. Staging the fill consists of placing the fill at a controlled rate to allow the in situ soils to gain strength and stiffness. Settlement should be monitored using settlement plates or other appropriate means. Construction of the roadway can only commence after the settlement due to fill placement is complete.

Soil improvement by other means, such as stone columns or rammed aggregate piers, can be utilized to mitigate settlement. Such systems are proprietary and are typically provided on a design/build basis.

BEARING CAPACITY IMPROVEMENT

The allowable bearing capacity can be increased by means of soil reinforcement techniques, such as stone columns or rammed aggregate piers. Such systems can increase bearing capacity to 4000 or 4500 psf.

MITIGATION OF GLOBAL STABILITY

The preliminary analysis indicated insufficient factors of safety against global stability failure. Mitigation can be accomplished by utilizing a soil reinforcement technique, using a sheet pile wall system or by placing the fill at a controlled rate (staged construction) to increase the strength of the foundation soils. If this approach is utilized, additional global stability analyses should be performed to evaluate the stability at each stage.

SPECIFIC DESIGN REQUIREMENTS

The wall shall have a drainage gutter at the top designed to carry surface runoff to either or both ends of the walls. Actual details are to be provided in the contractor's wall design plans. If a concrete cantilever wall is used, the wall designer must provide for a drainage layer behind the wall stem with adequate drainage provided via weep holes.

SPECIAL NOTE REGARDING RETAINING WALL

Unless specifically stated otherwise in the contract plans, the bidding for, the design of and the construction of retaining walls shown in the plans shall be governed by the TDOT Earth Retaining Structures Manual (available version at the time of letting). This manual is available on the TDOT web site under the Information for Contractors link. The TDOT manual shall be considered as one of those documents which the bidder/contractor has examined and made himself familiar with as described in Section 102.04 – Examination of the Site, the Work, the Plans, and the Specifications in the TDOT Standard Specifications for Road and Bridge Construction.

We are pleased to be of service. Please contact us if you have any questions or if we may be of further service.

Very truly yours,

GEOTECHNOLOGY, INC.

Ashraf Elsayed, Ph.D., P.E.
Branch Manager – Memphis Branch

ASE/JKR

Copies submitted: (3) Hard copies
(1) PDF copy

Surface Elevation: 233.87 | Completion Date: 1/9/12
Datum MSL | Station 80+56.69 | Offset: -137.81

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Soft to medium stiff, mottled brown and gray, silty CLAY- CL trace roots		1-2-3	SS1
5			2-3-3	SS2
	brown-orange and gray		91	ST3
10			2-2-2	SS4
	Medium stiff, brown and gray, clayey SILT (ML)		93	ST5
	Medium stiff, mottled brown and gray, silty CLAY - CL		2-2-3	SS6
15				
	Medium stiff, gray CLAY- CL		2-2-4	SS7
20				
25			2-2-3	SS8
	Medium dense, gray, silty SAND- SM		7-9-11	SS9
30				
35			7-12-18	SS10
40	Boring terminated at 40 feet.		8-8-12	SS11
45				
50				
55				
60				

SHEAR STRENGTH, tsf
Δ - UU/2 ○ - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
(ASTM D 1586)
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 13 FEET ▽

DRILLING DATA

__ AUGER 3 1/4" HOLLOW STEM
WASHBORING FROM 20 FEET
MH DRILLER JKH LOGGER
D50 DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: JKH	Checked by:	App'vd. by:
Date: 1/10/12	Date:	Date:

GEOTECHNOLOGY INC
FROM THE GROUND UP

Fite Road Retaining Wall
Fisher & Arnold

LOG OF BORING: R-1

Project No. J019679.01

LOG OF BORING 2002 WL J019679.01.GPJ GTINC 053301.GPJ 2/6/12

Surface Elevation: 235.31
Datum MSL
Completion Date: 1/9/12
Station 78+57.36
Offset: -109.39

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
0	Soft to medium stiff, brown, silty CLAY- CL		2-2-2	SS1
			2-2-2	SS2
5	light brown and gray		2-2-3	SS3
			2-2-3	SS4
10				
	orange-brown and gray		2-2-2	SS5
15				
	Soft to stiff, gray CLAY- CL ▽		2-2-3	SS6
20				
			2-2-2	SS7
25				
			3-4-6	SS8
30	Boring terminated at 30 feet.			
35				
40				
45				
50				
55				
60				

SHEAR STRENGTH, tsf
Δ - UU/2 O - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
(ASTM D 1586)
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 18 FEET ▽

DRILLING DATA

__ AUGER 3 1/4" HOLLOW STEM
WASHBORING FROM __ FEET
MH DRILLER JKH LOGGER
D50 DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: JKH	Checked by:	App'vd. by:
Date: 1/10/12	Date:	Date:

GEOTECHNOLOGY INC
FROM THE GROUND UP

Fite Road Retaining Wall
Fisher & Arnold

LOG OF BORING: R-2

Project No. J019679.01

LOG OF BORING 2002 WL J019679.01.GPJ GTINC.0638301.GPJ 2/6/12

BORING LOG: TERMS AND SYMBOLS

GENERAL NOTES

1. *Information on each boring log is a compilation of subsurface conditions based on soil or rock classifications obtained from the field as well as from laboratory testing of samples. The strata lines on the logs may be approximate or the transition between the strata may be gradual rather than distinct. Water level measurements refer only to those ob - served at the times and places indicated, and may vary with time, geologic condition or construction activity.*
2. *Relative composition and Unified Soil Classification designations are based on visual estimates and are approximate only. If laboratory tests were performed to classify the soil, the unified designation is show in parenthesis.*
3. *Value given in Unit Dry Weight/SPT Column is either a unit dry weight in pounds per cubic foot, if adjacent to a ST sample designation, or blows per 6-inch increment if adjacent to a SS sample designation.*

ABBREVIATIONS

UU/2 *Shear Strength from Unconsolidated – Undrained Triaxial Test (ASTM D2850)*
QU/2 *Shear Strength from Unconfined Compression Test (ASTM D2166)*
SV *Shear Strength from Field Vane (ASTM D2573)*
PL *Plastic Limit (ASTM D4318)*
LL *Liquid Limit (ASTM D4318)*

LEGEND

CS	Continuous Sampler
GB	Grab Sample Taken From Auger Cuttings Or Wash Water Return
NX 100 42	NX Rock Core with Percent Recovery/R.Q.D. Given In Adjacent Column
PST	Three Inch Diameter Piston Tube Sample
SS	Split Spoon Sample (Standard Penetration Test)
ST	Three Inch Diameter Shelby Tube Sample
•	Sample Not Recovered
SV	Field Vane Test

SPLIT – BARREL SAMPLER DRIVING RECORD

Blow Per Foot (N-Value)	Description
25	25 blows drove sampler 12 inches after initial 6 inches of seating.
75/10"	75 blows drove sampler 10 inches after initial 6 inches of seating.
50/S3"	50 blows drove sampler 3 inches during initial 6 inch seating interval.

NOTES: 1. *To avoid damage to sampling tools, driving is limited to 50 blows during any six inch interval.*
2. *N-Value (Blow Count) is the standard penetration resistance based on the total number of blows, using a 140-lb hammer with 30-inch free fall, required to drive a split spoon the last two of three, 6-inch drive increments. (Example: 4/7/9, N = 7 + 9 = 16). Values are shown as a summation on grid plot and may be shown as 4/7/9 in Unit Dry Weight – SPT column.*

RELATIVE COMPOSITION

Trace.....0-10 %
With/Some.....11-35 %
Soil modifier such..... > 35 %
As silty, clayey, sandy, etc.

DENSITY OF GRANULAR SOILS

Descriptive Term:	*N—Value*
Very Loose	*0 - 4*
Loose	*5 - 10*
Medium Dense	*11 - 30*
Dense	*31 - 50*
Very Dense	*> 50*

STRENGTH OF COHESIVE SOILS

Consistency	Undrained Shear Strength Tons Per Sq. Ft.	Field Test	Approximate N-Value Range
Very Soft	*less than 0.12*	*Thumb will penetrate soil more than 1"*	*0 - 1*
Soft	*13 to 0.25*	*Thumb will penetrate soil about 1"*	*2 - 4*
Medium Stiff	*0.26 to 0.50*	*Thumb will penetrate soil about ¼"*	*5 – 8*
Stiff	*0.51 to 1.00*	*Thumb hardly indents soil*	*9 – 15*
Very Stiff	*1.01 to 2.00*	*Thumb will not indent soil, but readily indented with thumbnail*	*16 – 30*
Hard	*greater than 2.00*	*Thumbnail will not indent soil*	*> 30*

SOIL GRAIN SIZE

U.S. STANDARD SIEVE

12"	3"	¾"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
300	76.2	19.1	4.76	2.00	0.42	0.074	0.002	

SOIL GRAIN SIZE IN MILLIMETERS

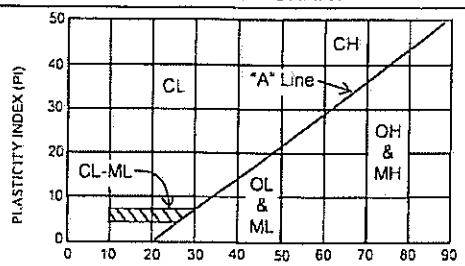
SOIL STRUCTURE

Calcareous *– Having appreciable quantities of carbonate.*
Fissured *– Containing shrinkage or relief cracks, often filled with sand or silt; usually more or less vertical.*
Slickensided *– Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along those planes.*
Layer *– Inclusion greater than 3 inches thick.*
Seam *– Inclusion 1/8 inch to 3 inches thick extending through the sample*
Parting *– Inclusion less than 1/8 inch thick.*
Pocket *– Inclusion of material of different texture that is smaller than the diameter of the sample.*
Interlayered *– Soil samples composed of alternating layers of different soil types.*
Intermixed *– Soil samples composed of pockets of different soil types and a layered or laminated structure is not evident.*
Laminated *– Soil sample composed of alternating partings or seams of different soil type.*

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOL	DESCRIPTION
Coarse-Grained Soils (More than 50% Larger than No 200 Sieve Size)	Gravel and Gravelly Soils	Clean Gravels Little or no Fines	GW	Well-Graded Gravel, Gravel-Sand Mixture
			GP	Poorly –Graded Gravel Gravel-Sand Mixture
		Gravels with Appreciable Fines	GM	Silty Gravel, Gravel-Sand-Silt Mixture
			GC	Clayey-Gravel, Gravel-Sand-Clay Mixture
	Sand and Sandy Soils	Clean Sands Little or no Fines	SW	Well-Graded Sand, Gravelly Sand
			SP	Poorly Graded Sand, Gravelly Sand
		Sands with Appreciable Fines	SM	Silty Sand, Sand-Silt Mixture
			SC	Clayey Sand, Sand-Clay Mixture
Fine-Grained Soils (More than 50% is Smaller than No 200 Sieve Size)	Silts and Clays	Liquid Limit Less Than 50	ML	Silt, Clayey Silt, Silty or Clayey Very Fine Sand, Slight Plasticity
			CL	Clay, Sandy Clay, Silty Clay, Low to Medium Plasticity
			OL	Organic Silts, or Silty Clays of Low Plasticity
	Silts and Clays	Liquid Limit More Than 50	MH	Silt, Fine Sandy or Silt Soil with High Plasticity
			CH	Clay, High Plasticity
			OH	Organic Clay of Medium to High Plasticity
	Highly Organic Soils		PT	Peat, Humus, Swamp Soil

PLASTICITY CHART



RELATIVE PLASTICITY

Nonplastic	Cannot Roll Into Ball
Trace Plasticity	Barely Roll Into Ball
Medium Plastic	Can be Rolled Into Ball
Highly Plastic	No Rupture by Kneading

VISUAL DESCRIPTION CRITERIA*

TABLE 1: CRITERIA FOR DESCRIBING ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

TABLE 2: CRITERIA FOR DESCRIBING PARTICLE SHAPE

Description	Criteria
Flat	Particles with width/thickness X3
Elongated	Particles with length/width X3
Flat and Elongated	Particles meet criteria for both flat and elongated

TABLE 3: CRITERIA FOR DESCRIBING MOISTURE CONDITION

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below the water table

TABLE 4: CRITERIA FOR DESCRIBING REACTION WITH HCL

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming rapidly

TABLE 6: CRITERIA FOR DESCRIBING CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

TABLE 8: CRITERIA FOR DESCRIBING DRY STRENGTH

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and a hard surface

TABLE 9: CRITERIA FOR DESCRIBING DILATANCY

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

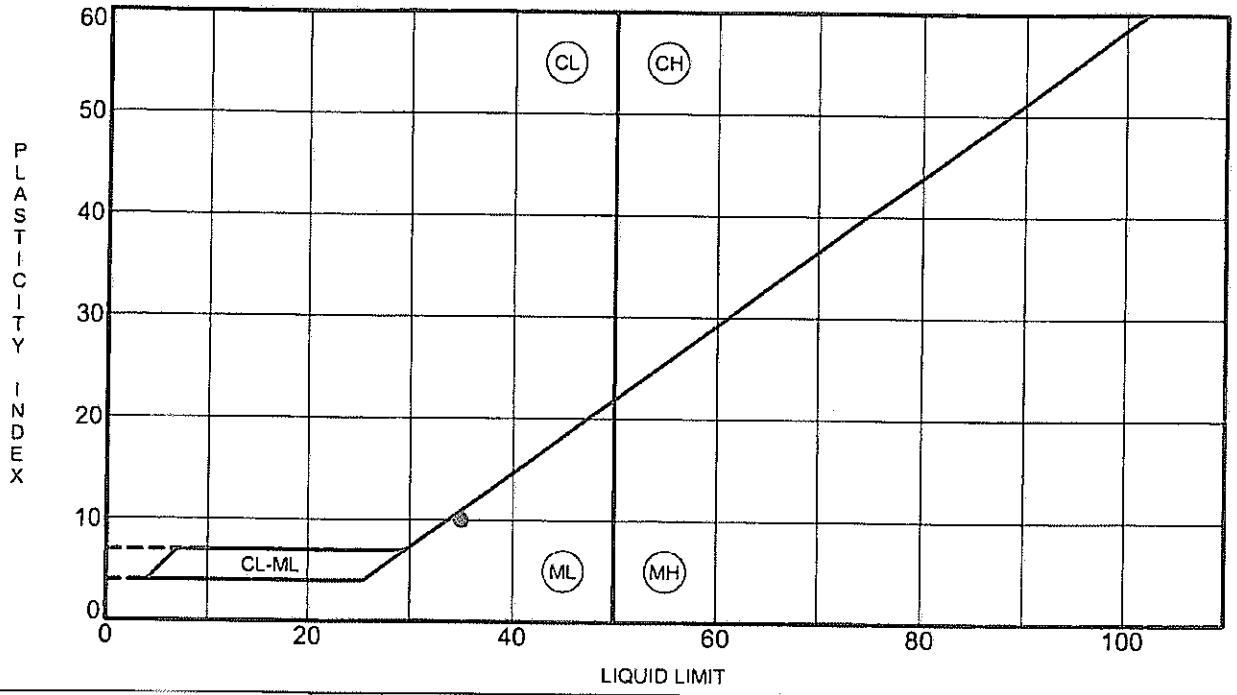
TABLE 10: CRITERIA FOR DESCRIBING TOUGHNESS

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

TABLE 12: IDENTIFICATION OF INORGANIC FINE-GRAINED SOILS FROM MANUAL TESTS

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	none	High

NOTES: 1. Tables adapted from ASTM D2488 "Description and identification of Soils" (Visual-Manual Procedure)
2. Tables 5, 7 and 11 incorporated into other information on this plate.



Specimen Identification		LL	PL	PI	Fines	Classification
R-1	10.0	35	25	10		SILT (ML)

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ATTERBERG LIMITS RESULTS

Fite Road Retaining Wall
Flsher & Arnold
J019679.01

US ATTERBERG LIMITS J019679.01.GPJ GINT STD US LAB.GDT 2/10/12

GEOTECHNOLOGY INC
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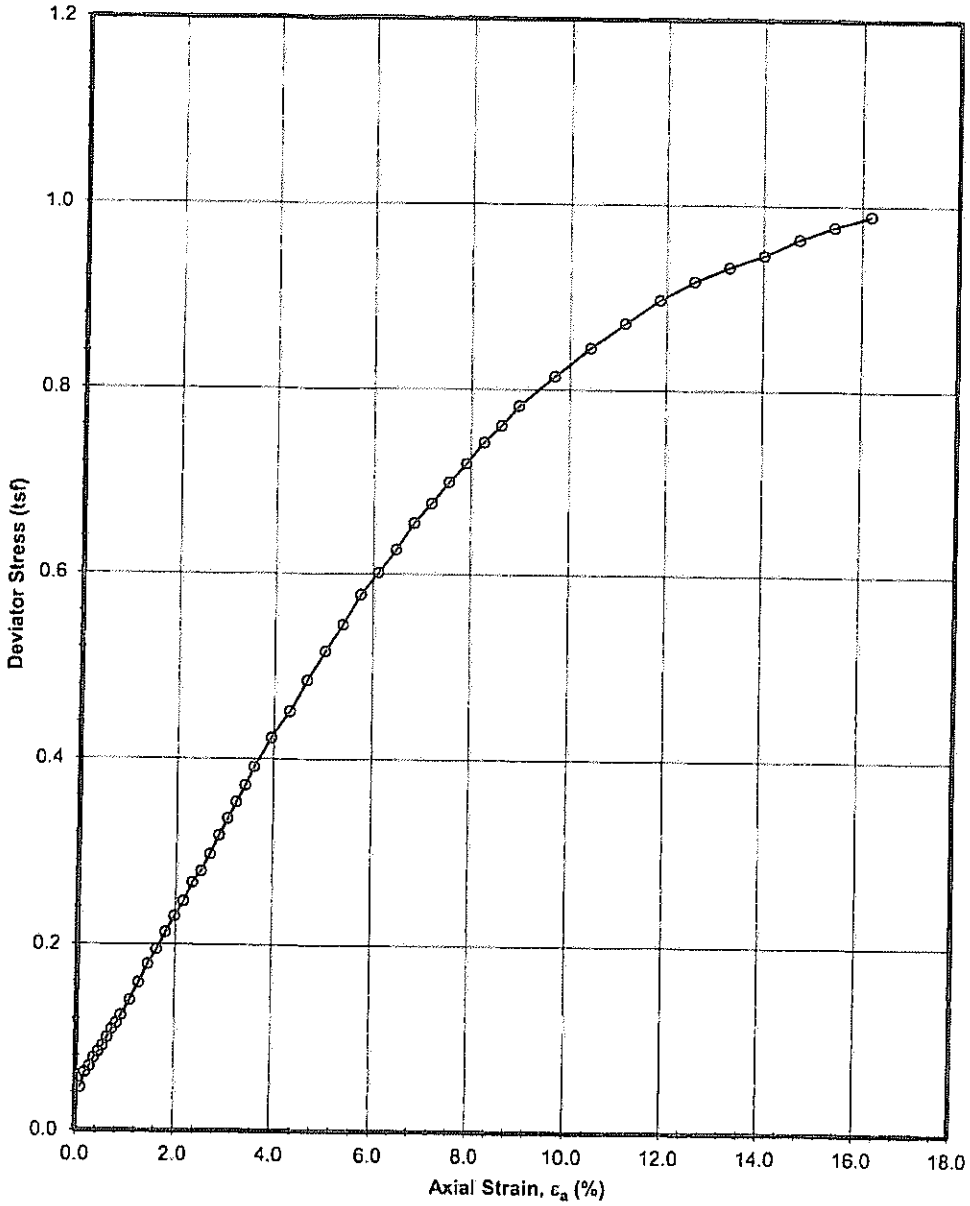

UNCONSOLIDATED-UNDRAINED COMPRESSION TEST

ASTM D 2850
Project No.: J019679.01
Boring: R-1
Sample: ST-5 - Depth: 10 ft.

SUBSURFACE EXPLORATION REPORT
FITE ROAD RETAINING WALL #2
MEMPHIS, TENNESSEE

Prepared for:

FISHER & ARNOLD
Memphis, Tennessee

Prepared by:

GEOTECHNOLOGY, INC.
Memphis, Tennessee

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Geotechnical Engineering Section No. : N/A
County : Shelby Region : IV Date Drilled : 1/12
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INTENT AND DESCRIPTION OF THE STRUCTURE

The purpose of Wall No. 2 is to retain the proposed fill from Station 77+73.15 to Station 87+85 (Wall Station 10+00 to 20+09.44). The structure is necessary due to the proposed relocation of Fite Road. The retaining wall alignment will be between 34 and 146 feet to the right of the centerline. The wall height will vary from approximately 7 feet to 35 feet.

SOIL PROFILE

Five borings (R-3 through R-7) were drilled to depths ranging from approximately 30 to 60 feet to define the subsurface conditions along the proposed retaining wall alignment (See wall plan). The station and offset at the location of each boring are shown on each boring log.

Layers of soft to stiff, silty clay (CL), clayey silt (ML), clay (CL), fat clay (CH), and sandy silt (ML) were encountered in the upper 28 to 38 feet of each boring. These materials were underlain by loose to medium dense silty sand (SM) to the depth of termination (60 feet). Groundwater was encountered in Borings R-3 and R-7 at depths of 30 and 34. It is noted that due to the proximity of the wall to an existing stream, fluctuations in water elevations can be expected.

ENGINEERING ANALYSIS

LIQUEFACTION ANALYSIS

The potential for liquefaction and dynamic settlement along the wall alignment was evaluated. Both field and laboratory data were used to perform the analysis. The field measurements include SPT "N" values, which were obtained typically at 5-foot depth intervals in each boring, and the depth of the water table. The laboratory data include USCS soil classification, soil unit weight, and percent fines of soil samples obtained from various strata. An earthquake magnitude (M_w) of 7.5 (probability of exceedance of 7% in 75 years, or 1,000-year return interval) was considered in accordance with the latest requirements for seismic design of highway bridges[1]. A corresponding peak ground acceleration of 0.523g, as determined by published information from the USGS[2], was used in the analysis. Subsurface conditions (as characterized by the field and laboratory data) and earthquake characteristics were used to determine the factors of safety against liquefaction in each soil layer, as well as the associated dynamic settlement during the design seismic event. Based on the analysis, potentially liquefiable soils are present at depths of 38 to 43 feet. The estimated dynamic settlement is approximately 1 inch. Please note that the estimated settlements are independent of the settlement resulting from sustained structural loads.

GLOBAL STABILITY

A preliminary analysis was performed to evaluate the global stability of the wall. The preliminary analysis was based on the subsurface conditions as encountered in the borings, the wall height as previously stated in this report, and standard assumptions regarding the wall

[1] American Association of State Highway and Transportation Officials LRFD Bridge Design Specifications, 4th Edition, 2007
[2] Earthquake Hazards Program Ground Motion Parameter Calculator- United States Geological Survey

dimensions. The preliminary analysis indicated inadequate safety factors for both non-seismic and seismic conditions. Therefore, global stability of the wall should be thoroughly evaluated once the wall design is complete, and the wall type and configurations are determined.

SETTLEMENT DUE TO FILL PLACEMENT

Fill material will be placed to construct the embankment. The maximum depth of the controlled fill placement will vary, but will approach 40 feet in some areas. Soft to medium stiff soils with relatively low shear strengths were encountered to depths ranging from 28 to 30 feet. The weight of the fill will induce settlement, mainly due to the compression of the soft, silty soils. The estimated fill-induced settlement is approximately 12 inches near the planned wall location. Refer to subsequent sections for settlement mitigation recommendations.

RECOMMENDATIONS

RECOMMENDED WALL TYPES

The different types of earth retaining structures listed below are considered suitable for the site:

- Gravity Wall
- Cast-in-Place Reinforced Concrete Wall
- MSE Wall
- Gabion Wall
- Cast-in-Place Concrete Cantilever Gravity Wall
- Sheet Pile Wall

EXCAVATION AND BACKFILL

Temporary construction slopes should have a maximum allowable slope of 1V:1H. The contractor shall ensure that these temporary back slopes are not and do not become unstable. If a slope is unstable, becomes unstable, or is unacceptable for other reasons, then temporary shoring shall be used. All walls must follow the design guidelines established in the TDOT Earth Retaining Structures Manual (available version at the time of letting).

The 1V:1H temporary construction slope should be backfilled with select backfill as specified later in this report. Refer to the Select Backfill Material table presented in the subsequent section for engineering properties. The engineer shall approve potential backfill materials before use. The backfill should extend vertically to the full height of the wall.

The backfill is to be placed in accordance with TDOT's *Standard Specifications for Road and Bridge Construction* (March 1, 2006). Prior to fill placement, the foundation soil and areas receiving fill shall be observed by the engineer. Any soft zones or unsuitable materials shall be removed and the resulting excavation backfilled with approved fill materials.

RECOMMENDED SOIL PARAMETERS

Recommended soil parameters to be used in the design are provided in the following table.

SELECT BACKFILL						
Material	Undrained Condition (Short Term)			Drained Condition (Long Term)		
	ϕ(°)	Cohesion (psf)	Density (pcf)	ϕ(°)	Cohesion (psf)	Density (pcf)
Coarse-grained (select) Backfill	34	0	-	34	0	-
Fine-grained Backfill	0	1000	120	28	0	120

The sliding coefficient values shall be as follows:

Fine-grained material:	0.35
Select granular material:	0.50

The select fill shall conform to the specifications outlined in Item 4.5 of Section F, Chapter 3 of the TDOT Earth Retaining Structures Manual (available version at the time of letting). It should also be reasonably free (maximum of 0.1%) from organic and otherwise deleterious materials. To utilize the angle of internal friction (ϕ) of the select backfill, the backfill must extend behind the wall for a minimum zone formed by a 1V:1H slope behind the back edge of footing or reinforced zone. The unit weight of the select backfill is to be determined by the contractor/wall designer depending upon the actual backfill material used.

FACTORS OF SAFETY

The following safety factors should be incorporated the wall design.

Mode of Failure	Minimum Safety Factors	
	Non-Seismic Condition	Seismic Condition
Sliding	1.5	1.2
Overturning	2.0	1.5
Bearing Capacity	2.5 For MSE Walls	1.9
	3.0 For All Other Types	2.3

BEARING CAPACITY RECOMMENDATIONS

The maximum allowable bearing pressure is as follows:

Length of Wall = 1300 psf
(based on ultimate bearing pressure of 4000 psf and a Factor of Safety of 3.0)

It is recommended that the geotechnical engineer be present to observe the excavation of the footings for the retaining structures. If the observed bearing conditions are not sufficient to support the wall, soil improvement will be necessary.

SETTLEMENT MITIGATION

A relatively large magnitude of settlement is expected. This can be mitigated by either staging the fill placement or by using soil reinforcement. Staging the fill consists of placing the fill at a controlled rate to allow the in situ soils to gain strength and stiffness. Settlement should be monitored using settlement plates or other appropriate means. Construction of the roadway can only commence after the settlement due to fill placement is complete.

Soil improvement by other means, such as stone columns or rammed aggregate piers, can be utilized to mitigate settlement. Such systems are proprietary and are typically provided on a design/build basis.

BEARING CAPACITY IMPROVEMENT

The allowable bearing capacity can be increased by means of soil reinforcement techniques, such as stone columns or rammed aggregate piers. Such systems can increase bearing capacity to 4000 or 4500 psf.

LIQUEFACTION MITIGATION

Additional liquefaction analysis should be performed based on the actual fill placement and the final wall configurations. Liquefaction hazard mitigation can be achieved by several ground improvement methods such as densification and reinforcement techniques (compaction grouting, stone columns, vibration methods, or compaction piles), grouting and mixing techniques (such as permeation grouting, jet grouting, or soil mixing), or drainage techniques (not recommended). Placement of fill as planned can also mitigate liquefaction. Mitigation can also be accomplished by driving large displacement piles (precast concrete piles or pipe piles driven closed-ended). If liquefaction hazard mitigation is to be considered, Geotechnology should be contacted for further recommendations.

MITIGATION OF GLOBAL STABILITY

The preliminary analysis indicated insufficient factors of safety against global stability failure. Mitigation can be accomplished by utilizing a soil reinforcement technique, using a sheet pile wall system or by placing the fill at a controlled rate (staged construction) to increase the strength of the foundation soils. If this approach is utilized, additional global stability analyses should be performed to evaluate the stability at each stage.

SPECIFIC DESIGN REQUIREMENTS

The wall shall have a drainage gutter at the top designed to carry surface runoff to either or both ends of the walls. Actual details are to be provided in the contractor's wall design plans. If a concrete cantilever wall is used, the wall designer must provide for a drainage layer behind the wall stem with adequate drainage provided via weep holes.

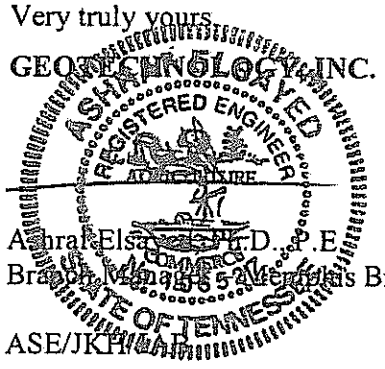
SPECIAL NOTE REGARDING RETAINING WALL

Unless specifically stated otherwise in the contract plans, the bidding for, the design of and the construction of retaining walls shown in the plans shall be governed by the TDOT Earth Retaining Structures Manual (available version at the time of letting). This manual is available on the TDOT web site under the Information for Contractors link. The TDOT manual shall be considered as one of those documents which the bidder/contractor has examined and made himself familiar with as described in Section 102.04 – Examination of the Site, the Work, the Plans, and the Specifications in the TDOT Standard Specifications for Road and Bridge Construction.

We are pleased to be of service. Please contact us if you have any questions or if we may be of further service.

Very truly yours,

GEOTECHNOLOGY, INC.



Ashraf Elsayed, Ph.D., P.E.
Branch Manager – Memphis Branch

ASE/JKH/dar

Copies submitted: (3) Hard copies
(1) PDF copy

Surface Elevation: 232.44
Datum MSL
Completion Date: 1/9/12
Station 78+19.79
Offset: 109.69

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium stiff, brown and gray CLAY (CL)		3-4-4	SS1
5			100	ST2
	Medium stiff, mottled brown and gray, silty CLAY - CL		2-3-4	SS3
10			95	ST4
15			2-3-4	SS5
	Soft to medium stiff, orange-brown CLAY- CL		2-2-3	SS6
20				
	gray		2-2-2	SS7
25				
	Medium dense to dense, gray, SAND with SILT (SP-SM) ▽		3-6-5	SS8
30				
35	Boring terminated at 35 feet.		8-14-20	SS9
40				
45				
50				
55				
60				

SHEAR STRENGTH, tsf
Δ - UU/2 O - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
(ASTM D 1586)
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 30 FEET ▽

DRILLING DATA

___ AUGER 3 1/4" HOLLOW STEM
WASHBORING FROM 30 FEET
MH DRILLER JKH LOGGER
D50 DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: JKH	Checked by:	App'vd. by:
Date: 1/10/12	Date:	Date:

GEOTECHNOLOGY INC
FROM THE GROUND UP

Fite Road Retaining Wall
Fisher & Arnold

LOG OF BORING: R-3

Project No. J019679.01

LOG OF BORING 2002 WL J019679.01.GPJ GTINC 0638301.GPJ 2/8/12

Surface Elevation: 235.18
Datum MSL
Completion Date: 1/11/12
Station 80+11.68
Offset: 110.87

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	SHEAR STRENGTH, tsf (Δ - UU/2, O - QU/2, □ - SV; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) Δ N-VALUE (BLOWS PER FOOT) / WATER CONTENT, % (PL, LL; 10, 20, 30, 40, 50)
	Soft to medium stiff, brown, silty CLAY- CL				
			1-1-1	SS1	
5			1-2-2	SS2	
	brown and gray		2-3-3	SS3	
	brown		2-3-3	SS4	
10					
			2-1-2	SS5	
15					
	brown and gray		3-2-4	SS6	
20					
	Soft, gray CLAY- CL		2-2-2	SS7	
25					
	Medium dense, orange-gray, silty SAND- SM		8-9-16	SS8	
30	Boring terminated at 30 feet.				
35					
40					
45					
50					
55					
60					

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 1/4" HOLLOW STEM
WASHBORING FROM 5 FEET
MH DRILLER JKH LOGGER
D50 DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: JKH	Checked by:	App'vd. by:
Date: 1/12/12	Date:	Date:

GEOTECHNOLOGY INC
FROM THE GROUND UP

Fite Road Retaining Wall
Fisher & Arnold

LOG OF BORING: R-4

Project No. J019679.01

LOG OF BORING 2002 WL J019679.01.GPJ GTINC 0638301.GPJ 2/6/12

Surface Elevation: 234.09
Datum MSL
Completion Date: 1/10/12
Station 82+33.65 Northing: 0
Offset: 51.75 Easting: 5

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
0	Soft to medium stiff, brown and gray, silty CLAY (CL)		2-1-1	SS1
			93	ST2
5			2-3-4	ST3
			1-2-2	SS4
10				
			2-3-3	SS5
15				
	Medium stiff, gray CLAY (CL)		2-2-3	SS6
20			96	ST7
			1-2-2	SS8
25				
			2-3-3	SS9
30				
	Stiff, gray sandy SILT- ML		6-4-10	SS10
35				
	Medium dense to dense, orange-gray to gray, SILTY SAND (SM)		14-12-13	SS11
40				
			7-8-9	SS12
45				
			16-24-26	SS13
50	Boring terminated at 50 feet.			
55				
60				

SHEAR STRENGTH, tsf
Δ - UU/2 O - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
(ASTM D 1586)
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 1/4" HOLLOW STEM
WASHBORING FROM 5 FEET
MH DRILLER JKH LOGGER
D50 DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: JKH	Checked by:	App'vd. by:
Date: 1/12/12	Date:	Date:

GEOTECHNOLOGY INC
FROM THE GROUND UP

Fite Road Retaining Wall
Fisher & Arnold

LOG OF BORING: R-5

Project No. J019679.01

LOG OF BORING 2002 WL J019679.01.GPJ GTINC.0638301.GPJ 2/7/12

Surface Elevation: 234.09
Datum MSL
Completion Date: 1/10/12
Station 82+33.65
Offset: 51.75

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Soft to medium stiff, brown and gray, silty CLAY (CL)		2-1-1	SS1
5			93	ST2
			2-3-4	ST3
10			1-2-2	SS4
			2-3-3	SS5
15				
	Medium stiff, gray CLAY (CL)		2-2-3	SS6
20			96	ST7
			1-2-2	SS8
25				
			2-3-3	SS9
30				
	Stiff, gray sandy SILT- ML		6-4-10	SS10
35				
	Medium dense to dense, orange-gray to gray, SILTY SAND (SM)		14-12-13	SS11
40				
			7-8-9	SS12
45				
			16-24-26	SS13
50	Boring terminated at 50 feet.			
55				
60				

SHEAR STRENGTH, tsf
Δ - UU/2 O - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
(ASTM D 1586)
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 1/4" HOLLOW STEM
WASHBORING FROM 5 FEET
MH DRILLER JKH LOGGER
D50 DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: JKH	Checked by:	App'vd. by:
Date: 1/12/12	Date:	Date:

GEOTECHNOLOGY INC
FROM THE GROUND UP

Fite Road Retaining Wall
Fisher & Arnold

LOG OF BORING: R-5

Project No. J019679.01

LOG OF BORING 2002 WL J019679.01.GPJ GTINC 0638301.GPJ 2/6/12

Surface Elevation: 235.27
Datum MSL
Completion Date: 1/11/12
Station 84+99.78
Offset: 47.59

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	ASPHALT to 13 inches			
	BASE MATERIAL TO 2 feet		11-9-6	SS1
	Stiff, brown and gray, silty CLAY- CL		2-6-7	SS2
5				
	Stiff, black-brown, FAT CLAY (CH)		3-3-6	SS3
	gray and black		3-4-5	SS4
10				
	Soft to stiff, brown-gray, silty CLAY (CL)		2-2-4	SS5
15			92	ST6
			2-2-2	SS7
20				
			99	ST8
25				
30	Loose, gray, silty SAND- SM		2-2-5	SS9
	Medium dense to dense, orange and tan SAND with SILT- SP-SM		11-16-23	SS10
35				
	gray and tan		14-13-15	SS11
40				
			9-10-13	SS12
45				
	gray		15-18-29	SS13
50				
55				
			11-18-24	SS14
60	Boring terminated at 60 feet.			

SHEAR STRENGTH, tsf
Δ - UU/2 O - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
(ASTM D 1586)
N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %
PL 10 20 30 40 50 LL

63 >>

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

___ AUGER 3 1/4" HOLLOW STEM
WASHBORING FROM 5 FEET
MH DRILLER JKH LOGGER
D50 DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: JKH	Checked by:	App'vd. by:
Date: 1/12/12	Date:	Date:

GEOTECHNOLOGY INC
FROM THE GROUND UP

Fite Road Retaining Wall
Fisher & Arnold

LOG OF BORING: R-6

Project No. J019679.01

LOG OF BORING 2002 WL J019679.01.GPJ GTINC.0638301.GPJ 2/6/12

Surface Elevation: 235.30
Datum MSL
Completion Date: 1/10/12
Station: 86+75.53
Offset: 34.58

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	ASPHALT to 1 foot			
	FILL: Gray clayey SILT with gravel- ML		20-17-10	SS1
	apparent chemical odor			
5	apparent chemical odor		8-4-2	SS2
	Soft to medium stiff, gray-brown, silty CLAY (CL)		91	ST3
10			2-3-4	SS4
	orange-gray			
15			2-1-2	SS5
20			3-3-3	SS6
	Soft to medium stiff, gray CLAY- CL			
25			2-2-2	SS7
30			3-3-3	SS8
35	Loose, gray, silty SAND- SM ▽		1-4-5	SS9
	Boring terminated at 35 feet.			
40				
45				
50				
55				
60				

SHEAR STRENGTH, tsf
Δ - UU/2 O - QU/2 □ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
(ASTM D 1586)
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %
PL 10 20 30 40 50 LL

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

ENCOUNTERED AT 34 FEET ▽

DRILLING DATA

__ AUGER 3 1/4" HOLLOW STEM
WASHBORING FROM __ FEET
MH DRILLER JKH LOGGER
D50 DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: JKH	Checked by:	App'vd. by:
Date: 1/12/12	Date:	Date:

GEOTECHNOLOGY INC
FROM THE GROUND UP

Fite Road Retaining Wall
Fisher & Arnold

LOG OF BORING: R-7

Project No. J019679.01

LOG OF BORING 2002 WL J019679.01.GPJ GTINC 0638301.GPJ 2/6/12

BORING LOG: TERMS AND SYMBOLS

GENERAL NOTES

1. *Information on each boring log is a compilation of subsurface conditions based on soil or rock classifications obtained from the field as well as from laboratory testing of samples. The strata lines on the logs may be approximate or the transition between the strata may be gradual rather than distinct. Water level measurements refer only to those ob - served at the times and places indicated, and may vary with time, geologic condition or construction activity.*
2. *Relative composition and Unified Soil Classification designations are based on visual estimates and are approximate only. If laboratory tests were performed to classify the soil, the unified designation is show in parenthesis.*
3. *Value given in Unit Dry Weight/SPT Column is either a unit dry weight in pounds per cubic foot, if adjacent to a ST sample designation, or blows per 6-inch increment if adjacent to a SS sample designation.*

ABBREVIATIONS

UU/2	*Shear Strength from Unconsolidated – Undrained Triaxial Test (ASTM D2850)*
QU/2	*Shear Strength from Unconfined Compression Test (ASTM D2166)*
SV	*Shear Strength from Field Vane (ASTM D2573)*
PL	*Plastic Limit (ASTM D4318)*
LL	*Liquid Limit (ASTM D4318)*

LEGEND

CS	Continuous Sampler
GB	Grab Sample Taken From Auger Cuttings Or Wash Water Return
NX 100/42	NX Rock Core with Percent Recovery/R.Q.D. Given In Adjacent Column
PST	Three Inch Diameter Piston Tube Sample
SS	Split Spoon Sample (Standard Penetration Test)
ST	Three Inch Diameter Shelby Tube Sample
*	Sample Not Recovered
SV	Field Vane Test

SPLIT – BARREL SAMPLER DRIVING RECORD

Blow Per Foot (N-Value)	*Description*
25	*25 blows drove sampler 12 inches after initial 6 inches of seating.*
75/10"	*75 blows drove sampler 10 inches after initial 6 inches of seating.*
50/3"	*50 blows drove sampler 3 inches during initial 6 inch seating interval.*

NOTES: 1. To avoid damage to sampling tools, driving is limited to 50 blows during any six inch interval.
2. N-Value (Blow Count) is the standard penetration resistance based on the total number of blows, using a 140-lb hammer with 30-inch free fall, required to drive a split spoon the last two of three, 6-inch drive increments. (Example: 4/7/9, N = 7 + 9 = 16). Values are shown as a summation on grid plot and may be shown as 4/7/9 in Unit Dry Weight – SPT column.

RELATIVE COMPOSITION

Trace	*0-10 %*
With/Some	*11-35 %*
Soil modifier such	*> 35 %*
As silty, clayey, sandy, etc.	

DENSITY OF GRANULAR SOILS

Descriptive Term:	*N—Value*
Very Loose	*0 - 4*
Loose	*5 - 10*
Medium Dense	*11 - 30*
Dense	*31 - 50*
Very Dense	*> 50*

STRENGTH OF COHESIVE SOILS

Consistency	Undrained Shear Strength Tons Per Sq. Ft.	Field Test	Approximate N-Value Range
Very Soft	*less than 0.12*	*Thumb will penetrate soil more than 1"*	*0 - 1*
Soft	*13 to 0.25*	*Thumb will penetrate soil about 1"*	*2 - 4*
Medium Stiff	*0.26 to 0.50*	*Thumb will penetrate soil about ¼"*	*5 – 8*
Stiff	*0.51 to 1.00*	*Thumb hardly indents soil*	*9 – 15*
Very Stiff	*1.01 to 2.00*	*Thumb will not indent soil, but readily indented with thumbnail*	*16 – 30*
Hard	*greater than 2.00*	*Thumbnail will not indent soil*	*> 30*

SOIL GRAIN SIZE

U.S. STANDARD SIEVE

12"	3"	¾"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
300	76.2	19.1	4.76	2.00	0.42	0.074	0.002	

SOIL GRAIN SIZE IN MILLIMETERS

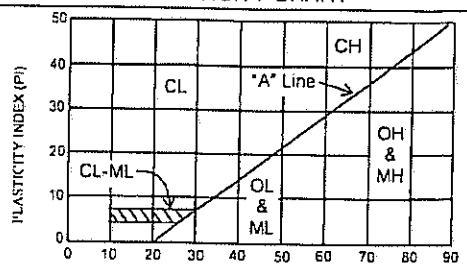
SOIL STRUCTURE

Calcareous *– Having appreciable quantities of carbonate.*
Fissured *– Containing shrinkage or relief cracks, often filled with sand or silt; usually more or less vertical.*
Slickensided *– Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along those planes.*
Layer *-- Inclusion greater than 3 inches thick.*
Seam *– Inclusion 1/8 inch to 3 inches thick extending through the sample*
Parting *– Inclusion less than 1/8 inch thick.*
Pocket *– Inclusion of material of different texture that is smaller than the diameter of the sample.*
Interlayered *– Soil samples composed of alternating layers of different soil types.*
Intermixed *– Soil samples composed of pockets of different soil types and a layered or laminated structure is not evident.*
Laminated *– Soil sample composed of alternating partings or seams of different soil type.*

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOL	DESCRIPTION
Coarse-Grained Soils (More than 50% Larger than No 200 Sieve Size)	Gravel and Gravelly Soils	Clean Gravels Little or no Fines	GW	Well-Graded Gravel, Gravel-Sand Mixture
			GP	Poorly –Graded Gravel, Gravel-Sand Mixture
		Gravels with Appreciable Fines	GM	Silty Gravel, Gravel-Sand-Silt Mixture
			GC	Clayey-Gravel, Gravel-Sand-Clay Mixture
	Sand and Sandy Soils	Clean Sands Little or no Fines	SW	Well-Graded Sand, Gravelly Sand
			SP	Poorly Graded Sand, Gravelly Sand
		Sands with Appreciable Fines	SM	Silty Sand, Sand-Silt Mixture
			SC	Clayey Sand, Sand-Clay Mixture
Fine-Grained Soils (More than 50% Smaller than No 200 Sieve Size)	Silts and Clays	Liquid Limit Less Than 50	ML	Silt, Clayey Silt, Silty or Clayey Very Fine Sand, Slight Plasticity
			CL	Clay, Sandy Clay, Silty Clay, Low to Medium Plasticity
			OL	Organic Silts, or Silty Clays of Low Plasticity
	Silts and Clays	Liquid Limit More Than 50	MH	Silt, Fine Sandy or Silt Soil with High Plasticity
			CH	Clay, High Plasticity
			OH	Organic Clay of Medium to High Plasticity
	Highly Organic Soils		PT	Peat, Humus, Swamp Soil

PLASTICITY CHART



RELATIVE PLASTICITY

Nonplastic	Cannot Roll Into Ball
Trace Plasticity	Barely Roll Into Ball
Medium Plastic	Can be Rolled Into Ball
Highly Plastic	No Rupture by Kneading

VISUAL DESCRIPTION CRITERIA*

TABLE 1: CRITERIA FOR DESCRIBING ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

TABLE 2: CRITERIA FOR DESCRIBING PARTICLE SHAPE

Description	Criteria
Flat	Particles with width/thickness X3
Elongated	Particles with length/width X3
Flat and Elongated	Particles meet criteria for both flat and elongated

TABLE 3: CRITERIA FOR DESCRIBING MOISTURE CONDITION

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below the water table

TABLE 4: CRITERIA FOR DESCRIBING REACTION WITH HCL

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming rapidly

TABLE 6: CRITERIA FOR DESCRIBING CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

TABLE 8: CRITERIA FOR DESCRIBING DRY STRENGTH

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and a hard surface

TABLE 9: CRITERIA FOR DESCRIBING DILATANCY

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

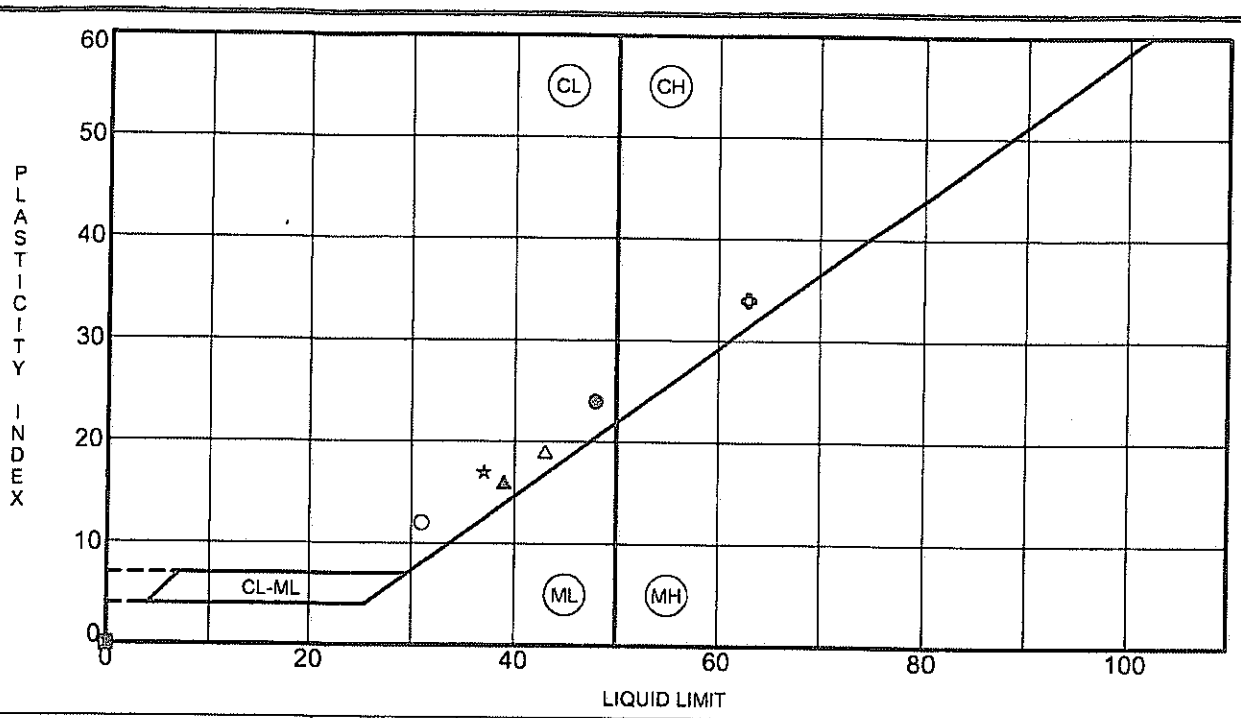
TABLE 10: CRITERIA FOR DESCRIBING TOUGHNESS

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

TABLE 12: IDENTIFICATION OF INORGANIC FINE-GRAINED SOILS FROM MANUAL TESTS

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	none	High

NOTES: 1. Tables adapted from ASTM D2488 "Description and identification of Soils" (Visual-Manual Procedure)
2. Tables 5, 7 and 11 incorporated into other information on this plate.



	Specimen Identification		LL	PL	PI	Fines	Classification
◎	R-3	3.0	48	24	24		LEAN CLAY (CL)
⊠	R-3	28.5	NP	NP	NP	11	POORLY GRADED SAND with SILT (SP-SM)
△	R-5	3.0	39	23	16		LEAN CLAY (CL)
☆	R-5	20.0	37	20	17		LEAN CLAY (CL)
⊙	R-5	43.5	NP	NP	NP	34	SILTY SAND (SM)
✥	R-6	6.0	63	29	34		FAT CLAY (CH)
○	R-6	23.0	31	19	12		LEAN CLAY (CL)
△	R-7	5.0	43	24	19		LEAN CLAY (CL)

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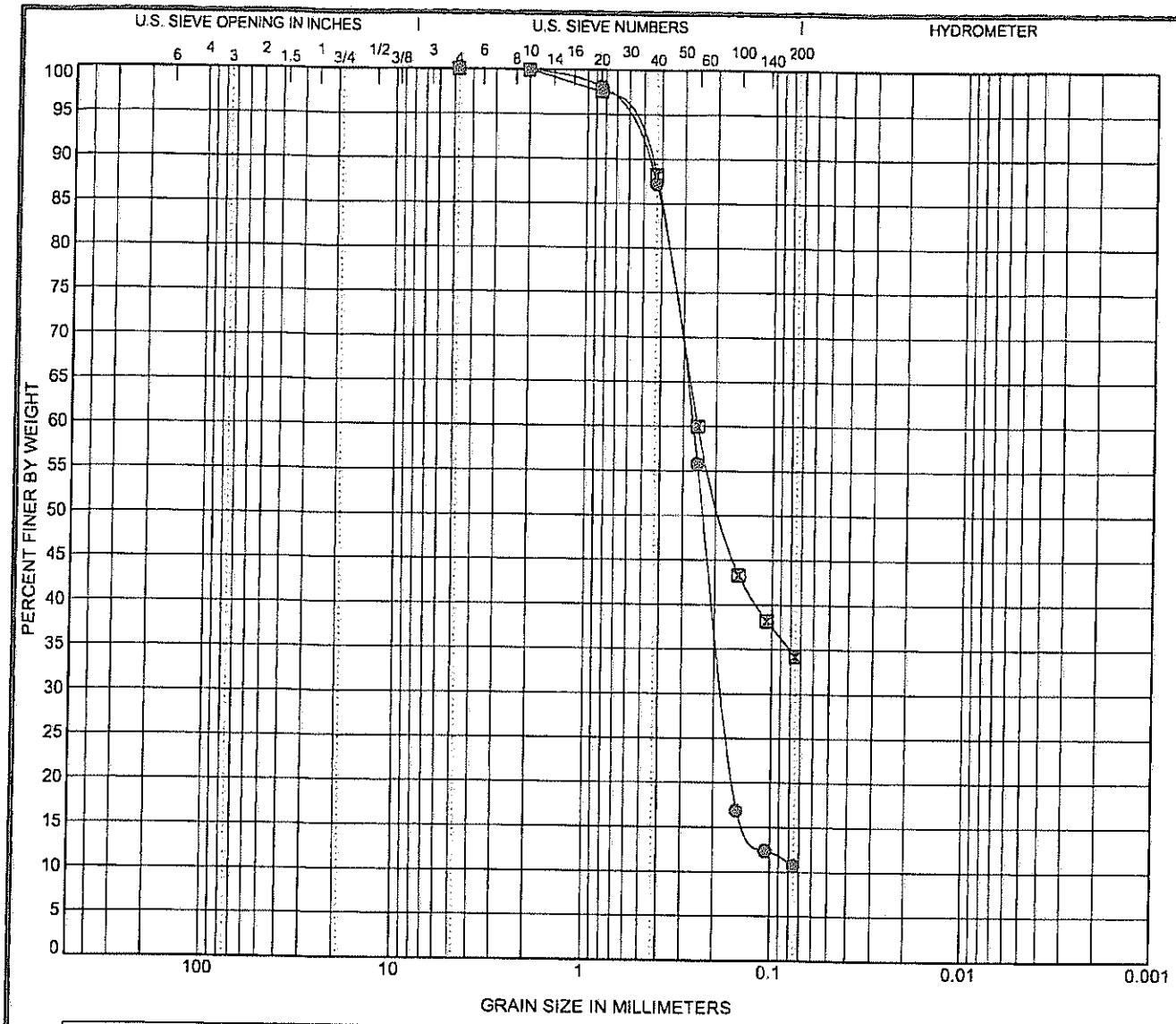
ATTERBERG LIMITS RESULTS

Fite Road Retaining Wall
Fisher & Arnold
J019679.01

US ATTERBERG LIMITS J019679.01.GPJ GINT STD US LAB.GDT 2/10/12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
◎ R-3	28.5	POORLY GRADED SAND with SILT (SP-SM)	NP	NP	NP	1.82	4.13
☒ R-5	43.5	SILTY SAND (SM)	NP	NP	NP		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
◎ R-3	28.5	4.75	0.268	0.178		0.0	89.3	10.7	
☒ R-5	43.5	4.75	0.25			0.0	65.8	34.2	

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GRAIN SIZE DISTRIBUTION

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US GRAIN SIZE J019679.01.GPJ US LAB.GDT 2/6/12

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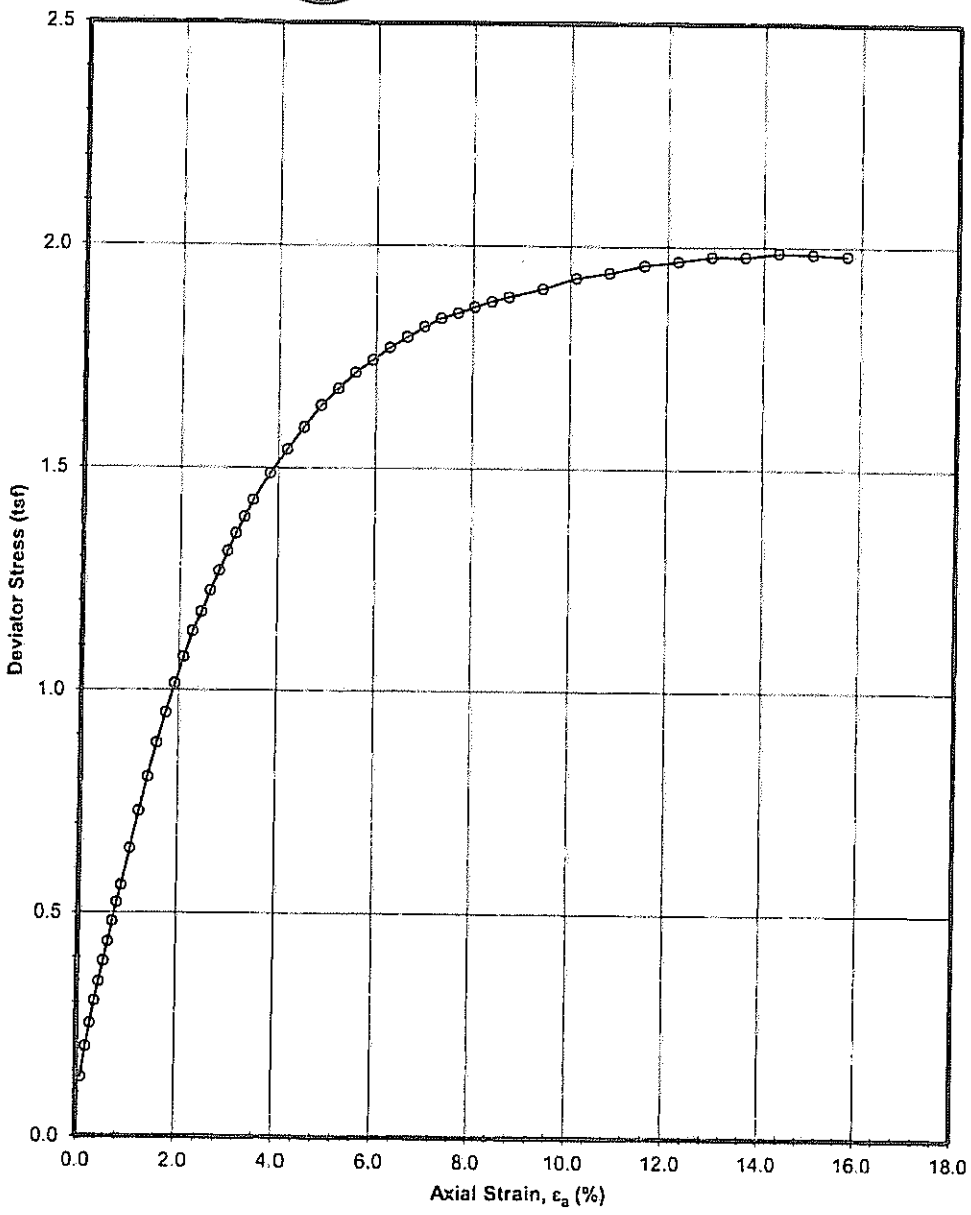

UNCONSOLIDATED-UNDRAINED COMPRESSION TEST
ASTM D 2850
Project No.: J019679.01
Boring: R-3
Sample: ST-1 - Depth: 3 ft.

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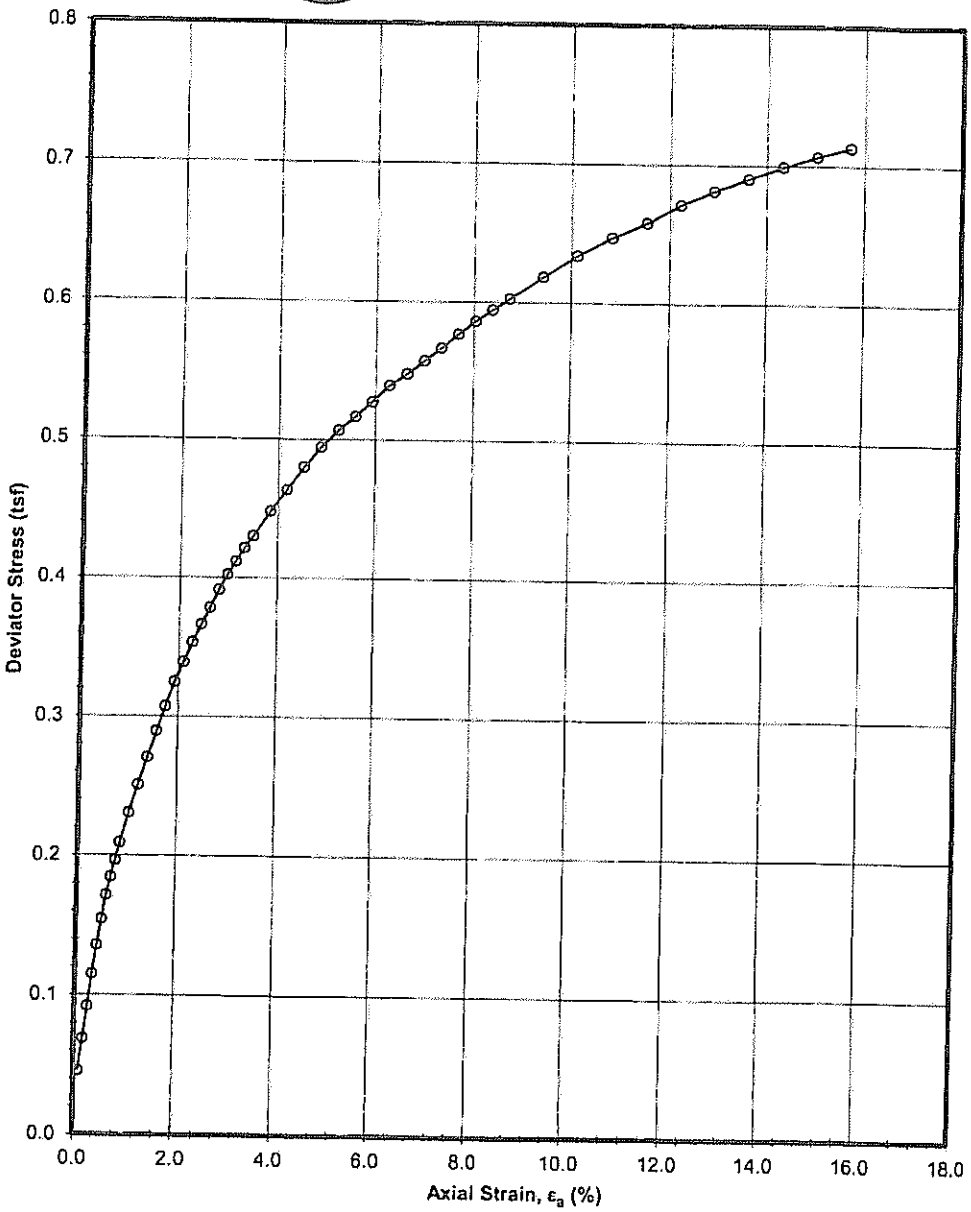
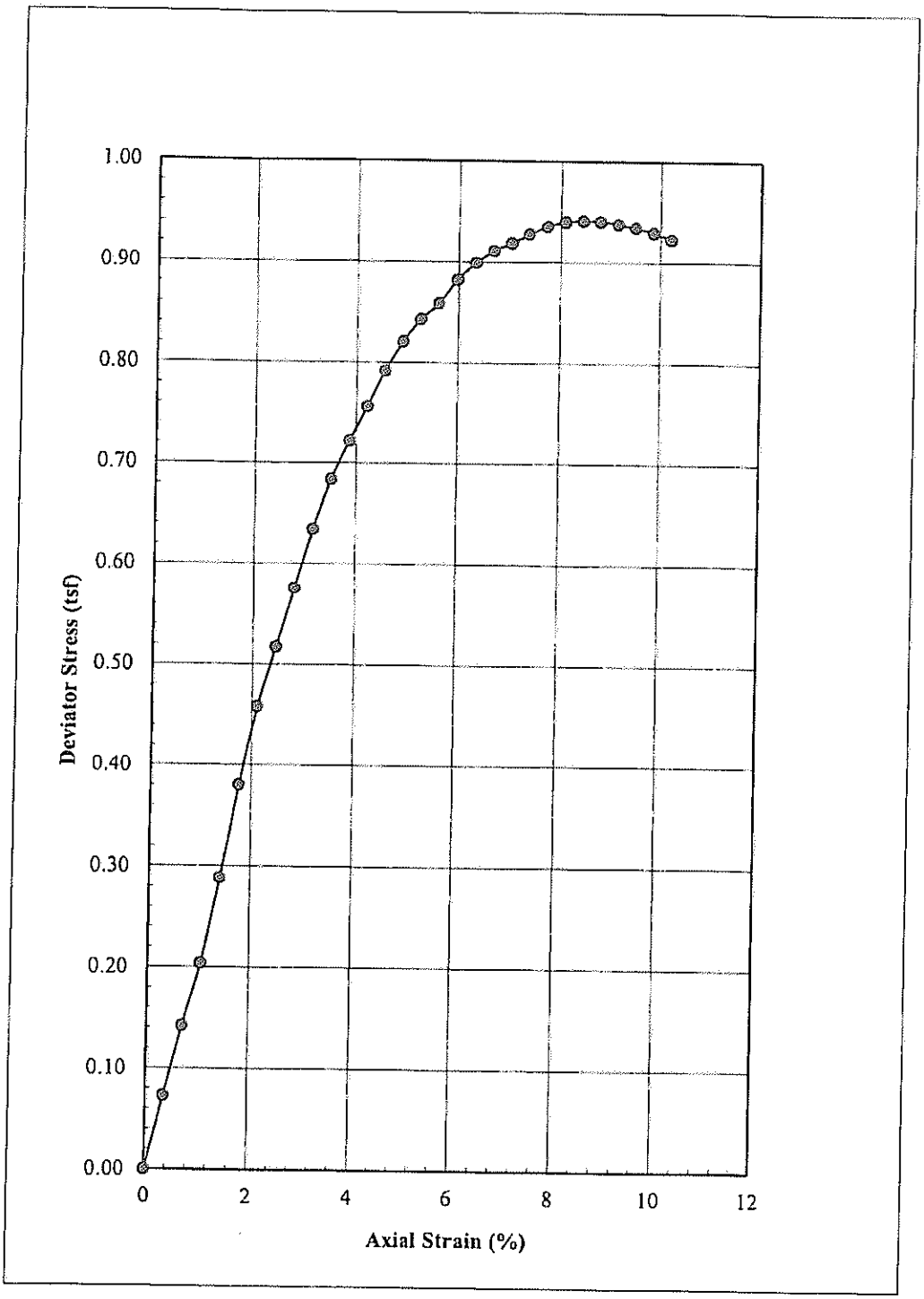
FROM THE GROUND UP



UNCONSOLIDATED-UNDRAINED COMPRESSION TEST

ASTM D 2850
Project No.: J019679.01
Boring: R-5
Sample: ST-2 - Depth: 20 ft.

GEOTECHNOLOGY INC
FROM THE GROUND UP



UNCONFINED COMPRESSION TEST

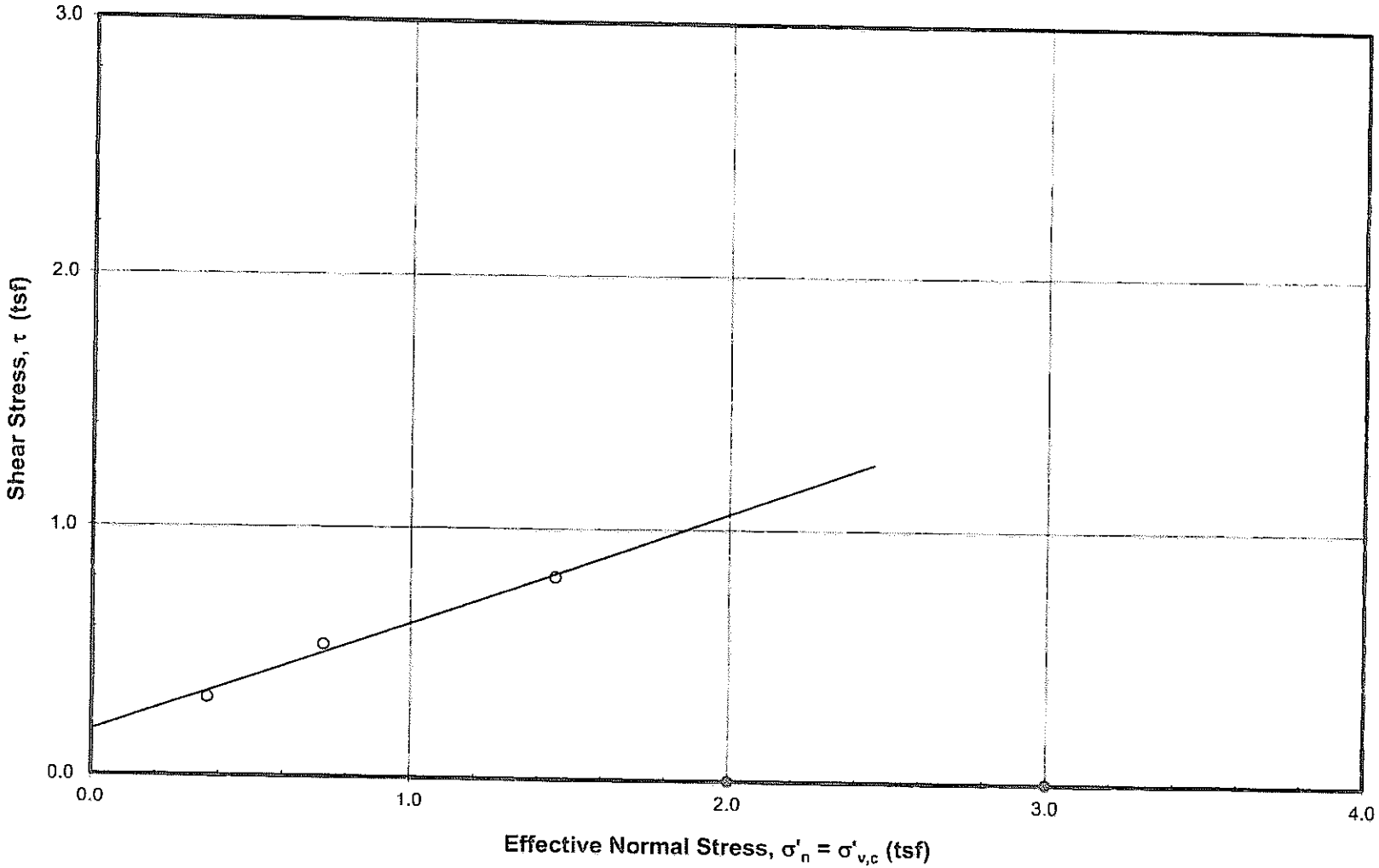
ASTM D 2166

Project No.: J019679.01

Boring: R-6

Sample: ST-8 - Depth: 23 ft.

GEOTECHNOLOGY INC
FROM THE GROUND UP



DRAINED DIRECT SHEAR TEST
ASTM D 3080
Boring: R-7

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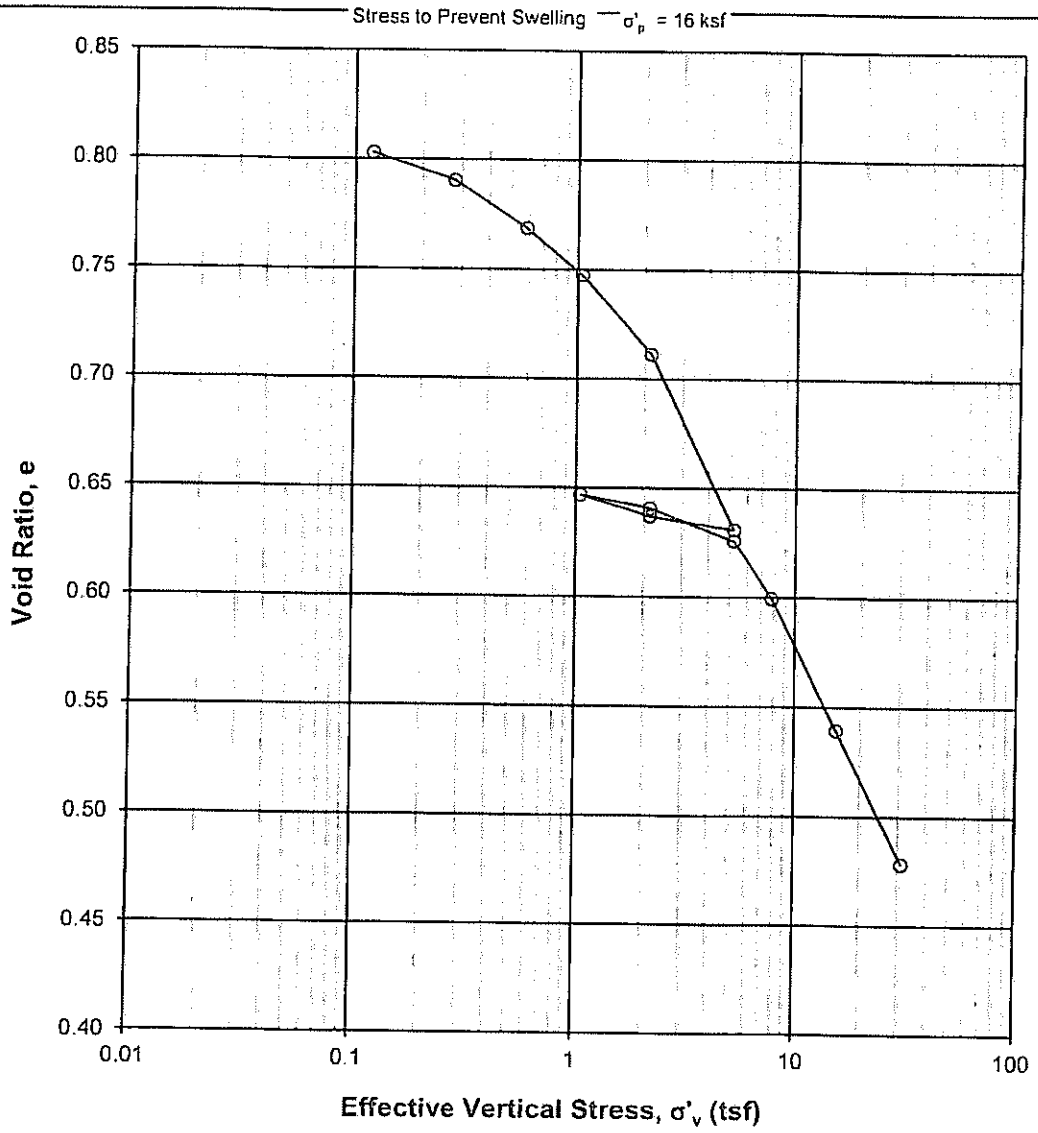
Liquid Limit= 37 Plastic Limit= 20 Plastic Index = 17 USCS: CL

Compression Index, C_c = 0.25 Void Ratio, e_o = 0.8

Recompression Index, C_r = 0.05 Preconsolidation Pressure = 1.3 tsf



1-D CONSOLIDATION TEST: INCREMENTAL

ASTM D 2435

Project No.: J019679.01

Boring: R-5

Sample: ST-2 - Depth: 20-22