NOT FOR CONSTRUCTION

Geotechnical Engineering Evaluation
US Route 301 Southbound
Replacement Bridge over Four Hole Swamp
Orangeburg County, South Carolina

March 16, 2016

GSE Project No. 41503-0002-0001

Prepared for:
South Carolina Department of Transportation
Regional Production Group 3
Geotechnical Design Section
Columbia, South Carolina

Prepared by:
GeoStellar Engineering, LLC

March 16, 2016

South Carolina Department of Transportation
SCDOT Regional Production Group 3 Geotechnical Design Section
955 Park Street
Columbia, SC 29201

Attn: Ms. Sara Stone, P.E.
SCDOT Regional Production Group 3 Geotechnical Design Section

Re: **Geotechnical Engineering Evaluation**
US Route 301 Southbound
Replacement Bridge over Four Hole Swamp
Orangeburg County, South Carolina
GSE Project No. 41503-0002-0001

Dear Ms. Sara Stone:

GeoStellar Engineering, LLC (GSE) has completed a geotechnical engineering evaluation for the US 301 southbound replacement bridge over Four Hole Swamp. This work was prepared in general accordance with the Scope of Services and discussions between GeoStellar Engineering, LLC and SCDOT as indicated in the notice to proceed (NTP) dated June 19, 2015. This evaluation presents preliminary subsurface site characterization, bridge foundation recommendations, and bridge approach embankment stability evaluation that can be used for the design of the southbound bridge replacement structure over Four Hole Swamp. This evaluation has been prepared in general accordance with the South Carolina Department of Transportation (SCDOT) Geotechnical Design Manual (GDM; Version 1.1, 2010).

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this evaluation, or if we may be of further service, please contact us.

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Orangeburg County, South Carolina

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1 BACKGROUND

GeoStellar Engineering, LLC (GSE) has been retained by SCDOT to provide geotechnical engineering evaluations for this project by performing a review of the subsurface soil exploration, a liquefaction assessment, a review of the bridge interior bent foundations, and a review of embankment longitudinal slope stability. These evaluations were performed after our review of the following documents provided by SCDOT:

1. Preliminary Bridge plans dated January 26, 2015
2. Bridge foundation plan layout (existing and proposed) dated June 10, 2015
3. Bridge Load Data Sheet dated April 2, 2015.
4. Bridge Plan and Profile Layout dated June 10, 2015. Plan sheet indicates all subsurface investigation locations (ICA and PSI) and scour profiles.
5. Roadway cross-sections dated June 9, 2015.
6. ICA Revised Geotechnical Data Report dated October 17, 2014.
7. PSI Geotechnical Subsurface Data Report dated February 27, 2015.
8. SCDOT Preliminary Bridge Geotechnical Engineering Report dated October 15, 2014.

Discussions and meetings between GSE and SCDOT revealed that SCDOT has identified weak subsurface soil conditions (i.e. WOH or very low SPT blow counts) that are possibly susceptible to soil shear strength loss (SSL) under the Extreme Event I limit state within the subsurface alluvium soils and underlying the base of the Santee Formation within the Congaree Formation. The subsurface weak soils were first encountered by ICA in their initial geotechnical subsurface data report. An additional subsurface investigation was conducted by PSI to supplement the initial ICA geotechnical subsurface data report. SCDOT has concerns that the weak soils encountered within the Congaree Formation will have detrimental effects on the constructability and costs of the proposed drilled shaft foundations located at the internal bridge bents. SCDOT also has concerns that the weak alluvium soils may adversely affect the performance of the bridge approach embankments during the Extreme Event I limit state that may require ground improvement.

On April 13, 2015 SCDOT consulted with the William R. Doar III, Senior Geologist – Coastal Plain, of the South Carolina Geological Survey in order to gain a better understanding of the geology at the project site. Of special interest was the geology below the Santee Limestone Formation where weak soils had been encountered. The underlying formation was classified as the Congaree Formation in the subsurface geotechnical data reports. Mr. Doar has indicated that this formation may actually be the Warley Hill Formation. In follow up discussions by GSE with Mr. Doar it was concluded that these weak soil zones are most likely not the result of sinkhole found in karst terrain that is typically underlain by limestone and are more likely to be the result of scour holes cause by wave action that were filled with weak soils and then overlain by the Santee Limestone Formation.

2 GENERAL PROJECT INFORMATION

2.1 Project Description

This project consists of the replacement the US 301 southbound bridge over Four Hole Swamp in Orangeburg County, South Carolina. The bridge is located at approximately Latitude 33.457508° and Longitude 80.647784° on US 301 between Orangeburg and Santee. The bridge location is shown on the site location map in Figure 1.

2.2 Project Information and Site Details

The new bridge is a 294 feet long with a 264 feet long continuous flat slab bridge deck consisting of six 44 feet long spans between Bents 1 and 7 and one 30 foot flat slab between Bents 7 and 8. The bridge span arrangement is the same as the northbound bridge crossing Four Hole Swamp in order to maintain the same current bridge hydraulics at both structures. At this time only the southbound bridge is being replaced along the same alignment of the existing bridge. The roadway cross-sections indicate that the finished grade is being raised by approximately two feet above the existing bridge abutments embankments currently at about elevation 120 feet. There are no signs of bridge approach embankment settlement at the existing bridge abutments upon review of aerial photography. The existing bridges do not appear to have any approach slabs.

The bridge hydraulic information included in the plans indicates a 50 year H.W. elevation of 118.3 and a 100 year H.W. elevation of 119.0 feet. The bridge drawings also include bridge scour profiles for the 100 year scour and the 500 year scour as shown in Table 1.

Table 1. Bridge Scour Summary

Bridge Bent	Elevation (ft-msl)		
	Ground Surface	100-Year Scour	500-Year Scour
End Bent 1	119	119.0 (no scour)	119.0 (no scour)
2	114	99.0	99.0
3	114	87.5	82.7
4	114	96.6	94.4
5	114	96.0	93.8
6	114	84.4	81.4
7	114	103.0	103.0
End Bent 8	119	119.0 (no scour)	119.0 (no scour)

3 SUBSURFACE CONDITIONS

3.1 Local Site Conditions

The project site is located within the USDA MLRA Atlantic Coast Flatwoods region (153A) of the Coastal Plain Province of the Atlantic Plain. This area is relatively flat coastal plain that is crossed by many broad, shallow valleys that have widely meandering stream channels. The new bridge will cross over Four Hole Swamp that is a small blackwater river that is a tributary to the Edisto River. The surface soils at this site are within a flood plain with a natural ground surface elevation of approximately 110 ft-msl. The surface

soils are poorly drained and are from the USDA Mouzon Series and are classified as Mouzon fine sandy loam (Mo).

3.2 Area Geology

The project site is located in the Middle Coastal Plain Province between the South Carolina geologic features referred to as the Orangeburg Scarp (OS) and the Surry Scarp (SS). The approximate location of the project is shown on the Generalized Geological Map of South Carolina in Figure 2. The surface topography of this region is marked by abandoned shorelines that form marine terraces. The project site is located within the Marietta Unit (previously Okefenokee terrace) that is typically encountered between the Surry Scarp at elevation 90 feet and the Parlor Scarp 140 ft-msl. Based on the Generalized Geological Map, the surface geology consists of the Marietta Unit formation of Pleistocene epoch underlain by the Santee Limestone formation.

The soils underlying the Marietta Unit terrace were formed during the Eocene epoch. The general geology at the project site has been simplified into the following four major soil formations (in order encountered, from the surface downward):

1. *Marietta Unit (previously Okefenokee/Sunderland) Terrace Sediments* – The soils underlying the Marietta Unit terrace were formed during the Pleistocene epoch and are generally described as quartz sand to granules or pebbles, Quartz-pebble conglomerate, mixed Quartzose sand and clay, and minor clay.
2. *Santee Limestone* – This formation was formed during the middle of the Eocene epoch and is typically considered part of the Orangeburg Group. The formation consists of fossiliferous limestone with sand, marl, and shell beds. The top of the Santee Limestone in this area is typically located near surface underlying surficial terrace sediments.
3. *Warley Hill Formation* – This Warley Hill formation was formed within the middle Eocene epoch and is typically considered part of the Orangeburg Group. The formation consists of fine green to yellow glauconitic sand.
4. *Congaree Formation* – The Congaree formation was formed within the late Eocene epoch and is typically considered part of the Orangeburg Group. The formation consists of light gray to green shale alternating with thin bedded fine grained siltstone. Glauconitic sand and interstitial clay.

3.3 Soils Encountered and Groundwater

Geotechnical subsurface site investigations were performed by Infrastructure Corporation of America Engineering (ICA) and Professional Service Industries, Inc. (PSI) as shown in Table 2. ICA performed 16 soil test borings (STB), 4 hand augers (HA), 2 bulk samples (BS), and a multichannel analysis of surface waves (MASW) for the preliminary subsurface site investigation. PSI performed 7 STBs and 2 dilatometer test soundings (DMT).

Table 2. Geotechnical Subsurface Site Investigation Summary

Test ID	Test Type	Station (Project Alignment)	Offset	Test Depth (ft)	Water Table Depth (ft)	Ground Elev.[1] (ft-msl)	Water Table Elev. (ft-msl)	Description/Note
ICA Borings								
B-1	STB	5949+31	13'-L	102.5	7.7	119.9	112.2	End Bent
B-2	STB	5949+65	9'-R	111.5	---	108.8	---	Interior Bent
B-3	STB	5950+02	3'-R	101.5	3.3	108.8	105.5	Interior Bent
B-4	STB	5950+42	8'-R	101.5	---	107.9	---	Interior Bent
B-5	STB	5950+98	8'-L	101.3	---	105.5	---	Interior Bent
B-6	STB	5951+41	8'-R	35.2	---	107.8	---	Interior Bent
B-7	STB	5951+86	8'-L	41	---	105	---	Interior Bent
B-8	STB	5952+17	8'-R	101.4	10.4	120	109.6	End Bent
B-9	STB	5952+28	8'-L	101.5	12.6	120	107.4	End Bent
Bulk-1	BS	5949+31	13'-L	5	---	---	---	Taken at B-1
Bulk-2	BS	5952+17	8'-R	5	---	---	---	Taken at B-8
SA-1	MASW	5952+40	14'-R	---	---	---	---	
RW-1	STB	5947+73	20'-L	41.4	8.8	119.9	111.1	Roadway
RW-2	STB	5948+38	18'-R	41.5	8	119.1	111.1	Roadway
RW-3	STB	5948+83	13'-L	33.7	---	120.2	---	Roadway
RW-4	STB	5952+50	20'-R	25.1	---	119.5	---	Roadway
RW-5	STB	5952+70	10'-L	41.4	---	120.3	---	Roadway
RW-6	STB	5953+15	22'-R	20.9	---	119.2	---	Roadway
RW-7	STB	5953+66	20'-L	21.8	7.9	119.7	111.8	Roadway
HA-1	HA	5948+00	50'-R	10.5	0.2	112.9	112.7	
HA-2	HA	5949+00	60'-R	7.5	0.2	112.1	111.9	
HA-3	HA	5952+23	40'-R	10.5	0	110.7	110.7	
HA-4	HA	5952+54	42'-R	3.5	0	112.8	112.8	
PSI Borings								
B-1A	STB	5949+32	8.75'-R	120	6	119.9	113.9	Bridge Deck
B-3A	STB	5950+11	6.25'-L	120	---	120.3	---	Bridge Deck
B-5A	STB	5950+99	8.13'-R	120	---	120.3	---	Bridge Deck
B-6A	STB	5951+43	7.28'-L	120	---	120.3	---	Bridge Deck
B-7A	STB	5951+88	8.39'-R	120	---	120.3	---	Bridge Deck
RW-3A	STB	5948+81	7.49'-L	13	---	120.2	---	Roadway
RW-3B	STB	5948+83	7.41'-L	16	---	120.2	---	Roadway
DMT-1	DMT			15.1	9.5	122.4	112.9	
DMT-2	DMT			15.1	12.1	122.7	110.6	

[1] Elevations referenced to Mean Sea Level (MSL).

Groundwater measurements were obtained at least 24 hours after completion of drilling as summarized in Table 2. The ground water table elevations ranged from 105.5 ft-msl to 113.9 ft-msl. For evaluation purposes, a ground water table elevation of 110 ft-msl was used.

3.4 Laboratory Test Results

See Appendix A for index properties laboratory testing results. A summary of the laboratory soil shear strength testing results are provided in Table 3.

Table 3. Soil Shear Strength Laboratory Test Results

Company	Sample	Test Type	Location	Total		Effective	
				ϕ' (°)	c (psf)	ϕ' (°)	c (psf)
ICA	Bulk Sample 1	Direct Shear	B-1: 0-5ft depth	---	---	35.96	119.52
ICA	Bulk Sample 2	Direct Shear	B-8: 0-5ft depth	---	---	30.62	46.08
PSI	ST (UD)	Triaxial Shear CU w/PP	RW-3B[1]: 9-11 ft depth	23.8	76	28.9	324

[1] PSI Triaxial test was performed on sample from RW-3A, not from B-3A as indicated in laboratory test results (communication with SCDOT 1/20/2016).

3.5 Evaluation of Subsurface Soils

Laboratory index testing and visual soil classifications were used to evaluate the soil behavior of the subsurface soils encountered in all of the soil borings. The criteria in the 2010 SCDOT GDM Section 13.6 was used to determine soil behavior as either sand-like or clay-like.

The laboratory index testing from both subsurface investigations were used to plot the fines content (FC), plasticity index (PI), and natural moisture content (NMC) vs. elevation as shown in Figure 4. The general trend observed for each of the formation are shown in Table 4.

Table 4. Project Site Soil Behavior Trends

Formation	Approximate Elevation (ft-msl)		Soil Behavior	USCS Soil Type
	Bottom	Top		
Recent (Fill Embankment)	110	120	Sand-Like	SM, SW-SM, SP
			Clay-Like	SC
Marietta Unit	100	110	Sand-Like	SP, SM, ML, SM
			Clay-Like	SC, SC-SM, CL
Santee Limestone	30	100	Sand-Like	ML, SC (SC-SM)
			Clay-Like	ML, SM
Warley Hill	10	30	Sand-Like	SW-SM, SP-SM, SC-SM (SW)
			Clay-Like	MH, SM
Congaree	---	10	Sand-Like	SM, SW-SM
			Clay-Like	MH, CL (CH)

The trends observed in Table 4 were used to interpret subsurface soil behavior for soils that did not have any index testing performed. The interpretation of Sand-Like /Clay-Like for all soil samples is presented by plotting the fines content (FC), plasticity index (PI), and natural moisture content (NMC) vs. elevation as shown in Figure 5.

The interpreted results were then applied to all borings and used to develop a Subsurface Soil Profile of Sand-Like and Clay-Like soils shown in Figures 6 through 9.

The geotechnical subsurface profile and field and laboratory testing revealed in the Marietta Unit formation zones of weak clay-like soils (i.e. ML, SM, SC, SC-SM, CL). Weak clay-like soils subject to cyclic softening were predominantly encountered in ICA soil test borings (RW-1, RW-3, B-8, B-9, RW-5, RW-6, and RW-7) at or just below the water table. Isolated locations of sand-like soils subject to cyclic liquefaction were encountered in ICA soil test borings at RW-2 and at B-8 at or below the water table.

Since the groundwater table was found within 5 to 10 feet below the ground surface, SPT blow counts may reflect field exploration difficulties in preventing disturbance of these soils due to unbalanced hydraulic forces while drilling near the surface. The soil test boring B-8 boring log includes a note related to drilling method difficulties near the groundwater table, "Could not obtain sample at 15.0' due to bore backfilling w/wash rotary, switched to mud rotary drilling." PSI boring B-1A, B-3A, B-5A, B-6A, and B-7A showed weak soils only at the mudline, which is reasonable because these are within the channel of Four Hole Swamp subjected to scour.

It is our understanding that PSI borings were performed adjacent to ICA borings for confirmation purposes of soil classification and soil shear strength. In several instances there is significant contrast as presented below:

1. RW-3B (PSI) was taken to confirm the soil boring results obtained from RW-3 (ICA). RW-3 indicated SPT N_{60} = 1 bl/ft at 11.5 feet, at approximately the same depth RW-3B indicated SPT N_{60} = 3 – 5 bl/ft. PSI Triaxial test was performed on sample from RW-3A, not from B-3A as indicated in laboratory test results (communication with SCDOT 1/20/2016). PSI obtained an undisturbed soil sample at RW-3A and conducted a CU with Pore Pressure Triaxial test at the same depth and test results indicate: c=75psf, ϕ=23.8° and c'=325psf, ϕ'=28.9°, these results indicate that the ICA SPT N_{60} = 1bl/ft is significantly underestimating the shear strength of the clay-like soils in the Marietta Unit.

2. B-3A (PSI) was taken to confirm the soil boring results obtained from B-3 (ICA). B-3 indicated SPT N_{60} = WOH and B-3A indicated SPT N_{60} = WOH to 4 bl/ft within the Warley Hill formation from elevation 31 – 51 ft-msl. These SPT N_{60} generally are in the same range. The soil classification of these soils is significantly different, B-3A (PSI) classifies MH and SM clay-like soil and B-3 (ICA) classifies as a SW, sand-like soil. B-3 (ICA) relies on visual classification, whereas B-3A (PSI) included index testing. The significance of the soil classification is that B-3 (ICA) indicates potential for cyclic liquefaction of sand-like soil (soil shear strength loss) and seismic settlement and B-3A (PSI) indicates potential for cyclic softening of clay-like soils (no seismic settlement).

3. B-5A (PSI) was taken to confirm the soil boring results obtained from B-5 (ICA). B-5 indicated SPT N_{60} = WOH to 3 bl/ft and B-5A indicated SPT N_{60} = 46 – 50 bl/ft within the Warley Hill formation from elevation 32 – 42 ft-msl. These SPT N_{60} for B-5A (PSI) are significantly greater the B-5 (ICA). The soil classification of these soils is significantly different, B-5A (PSI) classifies ML clay-like soil and B-5 (ICA) classifies as a SW, sand like soil. The significance of the soil classification is that B-5 (ICA) indicates potential for cyclic liquefaction of sand like soil (soil shear strength loss) and seismic

settlement and B-5A (PSI) does not indicate potential for soil shear strength loss (SSL) or seismic settlement.

4. B-7A (PSI) was taken adjacent to B-7 (ICA) to evaluate the potential for weak soils within the Warley Hill formation since B-7 did not penetrate into the Wareley Hill Formation to evaluate the potential for weak soils. B-7A (PSI) indicated SPT N_{60} = 8 - 9 bl/ft from elevations 32 – 38 ft-msl. Borings B-8 (ICA) and B-9 (ICA) were taken approximately 30 feet east of B-7A (PSI) at Bent 8. Borings B-8 (ICA) indicates SPT $N_{60} \geq 50$ bl/ft and B-9 SPT N_{60} = 9 bl/ft from elevations 30 – 40 ft-msl. These SPT N_{60} for B-7A (PSI) are less than B-8 (ICA) and approximately the same as B-9 (ICA). The soil classification for borings B-7A (PSI), B-8 (ICA), and B-9 (ICA) is SP-SM, sand-like soils. The significance of the soil classification and SPT N_{60} is that B-7A (PSI) and B-9 (ICA) have the potential for cyclic liquefaction of sand like soil and seismic soil settlement. Boring B-8 (ICA) does not indicate potential for soil shear strength loss (SSL) or seismic settlement.

3.6 Subsurface Investigation Observations

Subsurface exploration observations are summarized below:

1. The weak soils in the Marietta Unit are typically clay-like soils and thus cannot be accurately modeled using SPT driving resistance. The weak clay-like soils should be modeled by using the laboratory shear strength test. The sand-like soils in the Marietta Unit that may have the potential for cyclic liquefaction were only encountered at isolated locations and may not be representative of the actual soil conditions.

2. Low blow count sand-like soils encountered at or below the water table in the upper 25 feet of borings B-8 and B-9 should not be considered representative since the low blow counts may reflect field exploration difficulties in preventing disturbance of these soils due to unbalanced hydraulic forces. The soil test boring B-8 boring log includes a note related to drilling method difficulties near the groundwater table, “Could not obtain sample at 15.0’ due to bore backfilling w/wash rotary, switched to mud rotary drilling.”

3. The soils encountered in the Warley Hill formation show distinct inconsistencies at Bent 3 (B-3/B-3A) and at Bent 5 (B-3/B-5A) with respect to soil classification and strength and this may indicate that the Warley Hill formation contains isolated pockets (not a uniform layer) of low strength soils that may be subject to cyclic liquefaction or cyclic softening.

4 SEISMIC EVALUATION

4.1 Seismic Response

The bridge design seismic parameters (i.e. PGA, S_{DS}, S_{D1}, etc.) shown in Table 5 were obtained from the SCDOT Preliminary Bridge Geotechnical Engineering Report dated October 15, 2014.

Table 5. Design ADRS Parameters

Design Earthquake	PGA (g)	S_{DS} (g)	S_{D1} (g)	M_w	R (km)	Site Class
FEE	0.20	0.39	0.18	7.36	64.1	D
SEE	0.43	0.87	0.49	7.37	63.3	D

4.2 Seismic Hazard

Soil Shear Strength Loss (SSL) and seismic settlements were evaluated using the procedures outlined by Idriss and Boulanger in the 2008 EERI Monograph MNO-12, "Soil Liquefaction During Earthquakes" and *Chapter 13 –* "*Geotechnical Seismic Hazards*" of the 2010 Geotechnical Design Manual (GDM). The results of the soil SSL analyses are summarized in *Section 4 – Soil Shear Strength Loss* of this report. The results of the soil SSL evaluation (screening and triggering) and seismic settlement are included in Table 6. The results of the seismic settlement analysis are summarized in Table 7.

4.2.1 Soil Shear Strength Loss

The potential for seismic soil shear strength loss (SSL) of the subsurface soils was evaluated by first screening the SPT soil borings to determine if the soils encountered are susceptible to soil shear strength loss (SSL). Soils identified as susceptible to soil SSL were then evaluated to determine if the seismic demand (SEE) was capable of triggering soil SSL. The soil SSL evaluation (screening and triggering) of borings RW-1, RW-2, RW-3, RW-4, RW-5, RW-6, RW-7, B-1, B-2, B-3, B-4, B-5, B-6, B-7, B-8, B-9, B-1A, B-3A, B-5A, B-6A, B-7A, and RW-3B are included in Appendix B and a summary of the SSL results is provided in Table 6.

A summary of the soil SSL triggering results with and without modification based on the observations in Section 3 – *Subsurface Soils Observations* is provided in Table 6.

Table 6. Soil Shear Strength Loss Triggering Summary

Boring No.	Geotech	SEE		SEE – Modified[1]	
		Thickness (feet)	Elevation (ft-msl) – SSL	Thickness (feet)	Elevation (ft-msl) – SSL
RW-1	ICA	2	110' to 112' (Cyclic Softening)	2	110' to 112' (Cyclic Softening)
RW-2	ICA	6	105' to 111' (Cyclic Liquefaction)	6	105' to 111' (Cyclic Liquefaction)
RW-3	ICA	5 4	105' to 110' (Cyclic Softening) 101' to 105' (Cyclic Liquefaction)	5 4	105' to 110' (Cyclic Softening) 101' to 105' (Cyclic Liquefaction)
RW-3B	PSI	1	104' to 105' (Cyclic Liquefaction)	1	104' to 105' (Cyclic Liquefaction)
B-1	ICA	0	NSL	0	NSL
B-1A	PSI	0	NSL	0	NSL
B-2	ICA	3 5	106' to 109' (Cyclic Liquefaction) 30' to 35' (Cyclic Liquefaction)	3 5	106' to 109' (Cyclic Liquefaction) 30' to 35' (Cyclic Liquefaction)
B-3	ICA	3 **20**	106' to 109' (Cyclic Liquefaction) **30' to 50' (Cyclic Liquefaction)**	3 **20**	106' to 109' (Cyclic Liquefaction) **30' to 50' (Cyclic Liquefaction)**
B-3A	PSI	2 4 8 2 2 2	102' to 104' (Cyclic Liquefaction) 46' to 50' (Cyclic Liquefaction) 38' to 46' (Cyclic Softening) 36' to 38' (Cyclic Liquefaction) 34' to 36' (Cyclic Softening) 30' to 32' (Cyclic Liquefaction)	2 4 8 2 2 2	102' to 104' (Cyclic Liquefaction) 46' to 50' (Cyclic Liquefaction) 38' to 46' (Cyclic Softening) 36' to 38' (Cyclic Liquefaction) 34' to 36' (Cyclic Softening) 30' to 32' (Cyclic Liquefaction)
B-4	ICA	4	98' to 102' (Cyclic Liquefaction)	4	98' to 102' (Cyclic Liquefaction)
B-5	ICA	4 1 **10**	102' to 106' (Cyclic Liquefaction) 98' to 99' (Cyclic Liquefaction) **32' to 42' (Cyclic Liquefaction)**	4 1 **10**	102' to 106' (Cyclic Liquefaction) 98' to 99' (Cyclic Liquefaction) **32' to 42' (Cyclic Liquefaction)**
B-5A	PSI	5	103' to 108' (Cyclic Liquefaction)	5	103' to 108' (Cyclic Liquefaction)
B-6	ICA	4 6	104' to 108' (Cyclic Liquefaction) 94' to 100' (Cyclic Liquefaction)	4 6	104' to 108' (Cyclic Liquefaction) 94' to 100' (Cyclic Liquefaction)
B-6A	PSI	7	102' to 109' (Cyclic Liquefaction)	7	102' to 109' (Cyclic Liquefaction)
B-7	ICA	6	99' to 105' (Cyclic Liquefaction)	6	99' to 105' (Cyclic Liquefaction)
B-7A	PSI	9 6	99' to 108' (Cyclic Liquefaction) 31' to 37' (Cyclic Liquefaction)	9 6	99' to 108' (Cyclic Liquefaction) 31' to 37' (Cyclic Liquefaction)
B-8	ICA	15	95' to 110' (Cyclic Liquefaction)	0	NSL
B-9	ICA	4 5 2	106' to 110' (Cyclic Liquefaction) 26' to 31' (Cyclic Liquefaction) 19' to 21' (Cyclic Liquefaction)	5 2	26' to 31' (Cyclic Liquefaction) 19' to 21' (Cyclic Liquefaction)
RW-4	ICA	5	105' to 110' (Cyclic Liquefaction)	5	105' to 110' (Cyclic Liquefaction)
RW-5	ICA	12	100' to 112' (Cyclic Liquefaction)	12	100' to 112' (Cyclic Liquefaction)
RW-6	ICA	6	105' to 111' (Cyclic Softening)	6	105' to 111' (Cyclic Softening)
RW-7	ICA	4	106' to 110' (Cyclic Softening)	4	106' to 110' (Cyclic Softening)

[1] Modified SSL results to reflect observations presented in *Section 3 – Subsurface Soils Observations*.

4.2.2 Seismic Settlement

The seismic settlement of soil susceptible to cyclic liquefaction was evaluated for borings RW-1, RW-2, RW-3, RW-4, RW-5, RW-6, RW-7, B-1, B-2, B-3, B-4, B-5, B-6, B-7, B-8, B-9, B-1A, B-3A, B-5A, B-6A, B-7A, and RW-3B. The total seismic settlement at the ground surface is summarized in Table 7 and in Appendix B.

Modified seismic settlements in Table 7 reflect the observations in Section 3 – *Subsurface Soils Observations* and reduction in ground surface damage according to Idriss and Boulanger 2008 Figure 107 (Ishihara 1985). A worst case boring B-3, with 20 feet of calculated seismic settlement, has approximately 50 feet of nonliquefied Santee Limestone Formation above the potentially liquefiable soils. According to Ishihara 1985, the case plots outside of the Liquefaction-induced ground damage curve for a max acceleration of 0.4g to 0.5g. Furthermore, as discussed in this report, the potentially liquefiable soils do not represent a continuous layer and rather appear as isolated pockets, further reducing the likelihood of ground surface distress resulting from soils below the Santee Limestone Formation.

Table 7. Seismic Settlement Summary

Boring	SEE Seismic Settlement (in)	SEE Seismic Settlement (in) - Modified
RW-1	0.00	0.00
RW-2	1.64	1.64
RW-3B	0.18	0.18
RW-3	2.02	2.02
B-1	0.00	0.00
B-1A	0.00	0.00
B-2	2.73	1.09
B-3	19.22	1.24
B-3A	4.54	0.68
B-4	1.93	1.93
B-5	11.73	2.45
B-5A	1.28	1.28
B-6	3.15	3.15
B-6A	2.59	2.59
B-7	2.91	2.91
B-7A	6.92	4.21
B-8	8.75[1]	0.00[1]
B-9	4.64	0.00
RW-4	0.58	0.58
RW-5	4.67	4.67
RW-6	1.62	1.62
RW-7	0.86	0.86

[1] Possible erroneous data. Soil test boring B-8 boring logs includes a note related to drilling method difficulties near the groundwater table, “Could not obtain sample at 15.0’ due to bore backfilling w/wash rotary, switched to mud rotary drilling.”

5 SOIL SHEAR STRENGTHS

5.1 Embankment

Because the bridge approach embankments have been constructed and will only be raised approximately 2 feet, the soil shear strength obtained from laboratory soil shear strength testing conducted on the bulk samples should be representative of the existing and future embankment fill. A summary of the embankment soil shear strength parameters is shown in Table 8.

Table 8. Embankment Soil Shear Strength

Location	Effective	
	ϕ' (deg)	c' (psf)
East Bridge Approach Embankment at Bent 1	36	120
West Bridge Approach Embankment at Bent 8	31	50

5.2 In-Situ Soil Shear Strength

Soil shear strengths were computed based the soil behavior classifications of clay-like and sand-like defined in *Section 3 – Evaluation of Subsurface Soils* of this report. Static short-term soil shear strengths were computed using the SPT soil borings, DMT testing, and laboratory shear strength testing for the evaluation of the Strength and Service limit states. The corrected SPT blow counts (*Section 3 – Evaluation of Subsurface Soils*) were used to obtain total soil shear strength parameters based on correlations included in the 2010 SCDOT GDM, Sections 7.10 and 7.11, respectively. For sand-like soils an internal angle of friction was assigned based on correlations for sands. For clay-like soils a cohesion value was assigned based on correlations for clays. The computed SPT soil shear strength parameters (internal angle of friction or cohesion) and DMT shear strength parameters were combined and evaluated to characterize the total and effective soil shear strengths parameters in general accordance with Tables 7-15 and 7-16 of the SCDOT GDM unless laboratory testing was available.

Seismic soil shear strengths were computed using SPT soil borings for the evaluation of the Extreme Event I limit state. Soils that are not susceptible to soil shear strength loss were assigned the static short-term soil shear strengths. Soils that are susceptible to SSL were assigned seismic soil shear strengths based on the type of SSL triggering identified in Table 6. A summary of static soil shear strengths used for pile capacity analysis is provided in Table 9. A summary of static and seismic soil shear strengths used for slope stability analysis is provided in Table 10.

Table 9. Typical Soil Shear Strength Summary for Deep Foundation Design

Description	USCS Soil Type	Soil Behavior	Elevation		No Weak Soil Zone - Static Shear Strength (Strength & Service LS)		Weak Soil Zone - Static Shear Strength (Strength & Service LS)	
			Bottom	Top	Effective ϕ' (deg)	Total $\tau = c$ (psf)	Effective ϕ' (deg)	Total $\tau = c$ (psf)
Recent Embank. Fill	SM, SW-SM, SP	Sand	101	110	---	---	---	---
Marietta Unit	SC, SC-SM, CL, ML, SM	Clay	97	101	---	Scour	---	Scour
	SP, SM	Sand	90	97	Scour	---	Scour	---
Santee Limestone	ML, SM (MH, SC)	Sand	53	90	36	---	36	---
Warley Hill	SM, SW-SM	Sand	30	53	36	---	24	---
Congaree	SM, SW-SM	Sand	---	30	36	---	36	---

Table 10. Typical Soil Shear Strength Summary for Slope Stability

Description	USCS Soil Type	Soil Behavior	Elevation		Static Shear Strength (Strength & Service LS)		SEE Seismic Shear Strength (Extreme Event I LS)	
			Bottom	Top	Effective ϕ' (degrees)	Total $\tau = c$ (psf)	Effective ϕ' (degrees)	Total $\tau = c$ (psf)
Recent Embank. Fill	SM, SW-SM, SP	Sand	120	122	34	50	34	50
	SM, SW-SM, SP	Sand	110	120	31	46	31	46
Marietta Unit	SP, SM	Sand	107	110	30	---	30	---
	SC, SC-SM, CL, ML, SM	Clay	102	107	24	75	---	520[1]
	SP, SM	Sand	100	102	30	---	30	---
Santee Limestone	ML, SM (MH, SC)	Silt	---	100	36	---	36	---

[1] Soil Shear Strength Loss (SSL).

Static long-term soil shear strengths only affect clay-like soils after all excess pore water pressure has dissipated. The static long-term soil shear strength of clay-like soils is typically modeled using drained effective shear strength parameters (i.e. internal friction angle, ϕ'). The effective shear strengths of normally consolidated clay soils were computed using the correlations included in SCDOT GDM Section

7.11.2. A summary of the types of clay-like soils encountered with their corresponding long-term drained soil shear strengths is provided in Table 11.

Table 11. Typical Long Term Clay-Like Soil Shear Strength Summary

Description	USCS Soil Type	Elevation		Plasticity Index, I_P		Static Short-Term Shear Strength (Strength & Service LS)		Static Long-Term Shear Strength (Strength & Service LS)	
		Bottom	Top	High I_P	Low I_P	Effective ϕ' (degrees)	Total $\tau = c$ (psf)	Effective ϕ' (degrees)	Total $\tau = c$ (psf)
Marietta Unit	SC, SC-SM, CL, ML, SM	100	110	20	2	24	75	29	324
Santee Limestone	ML, SM (MH, SC)	50	100	14	NP	36	---	32 – 36	---

6 BRIDGE FOUNDATION ALTERNATIVES

SCDOT has requested GSE to evaluate foundation alternatives based on our review and evaluation of the of the geotechnical subsurface investigations prepared by ICA and PSI. It is our understanding that the original bridge design approach was to use H-Pile foundations at the bridge abutments and drilled shaft foundations at the interior bent locations.

6.1 Subsurface Soil Conditions Summary

Weak soils were encountered in the Warley Hill formation, located at the base of the Santee Limestone formation. The effects of these weak soils should be taken into consideration when selecting the bridge foundations. These weak soils encountered in the Warley Hill formation are referred to in this report as a “weak soil zone”. A summary of the weak soils encountered at the bridge borings is presented in Table 12.

Table 12. Warley Hill Formation Soil Shear Strength Loss Triggering Summary

Boring No.	Bent No.	GSDR	SEE		SEE – Modified[1]	
			Thickness (feet)	Elevation (ft-msl) – SSL	Thickness (feet)	Elevation (ft-msl) – SSL
B-1 End Bent	1	ICA	0	NSL	0	NSL
B-1A	1	PSI	0	NSL	0	NSL
B-2	2	ICA	5	30' to 35' (Cyclic Liquefaction)	5	30' to 35' (Cyclic Liquefaction)
B-3	3	ICA	20	30' to 50' (Cyclic Liquefaction)	20	30' to 50' (Cyclic Liquefaction)
B-3A	3	PSI	4 8 2 2 2	46' to 50' (Cyclic Liquefaction) 38' to 46' (Cyclic Softening) 36' to 38' (Cyclic Liquefaction) 34' to 36' (Cyclic Softening) 30' to 32' (Cyclic Liquefaction)	4 8 2 2 2	46' to 50' (Cyclic Liquefaction) 38' to 46' (Cyclic Softening) 36' to 38' (Cyclic Liquefaction) 34' to 36' (Cyclic Softening) 30' to 32' (Cyclic Liquefaction)
B-4	4	ICA	0	NSL	0	NSL
B-5	5	ICA	10	32' to 42' (Cyclic Liquefaction)	10	32' to 42' (Cyclic Liquefaction)
B-5A	5	PSI	0	NSL	0	NSL
B-6	6	ICA	0	NSL	0	NSL
B-6A	6	PSI	0	NSL	0	NSL
B-7	7	ICA	0	NSL	0	NSL
B-7A	7	PSI	6	31' to 37' (Cyclic Liquefaction)	6	31' to 37' (Cyclic Liquefaction)
B-8	8	ICA	0	NSL	0	NSL
B-9 End Bent	9	ICA	5 2	26' to 31' (Cyclic Liquefaction) 19' to 21' (Cyclic Liquefaction)	5 2	26' to 31' (Cyclic Liquefaction) 19' to 21' (Cyclic Liquefaction)

[1] Modified SSL results to reflect observations presented in *Section 3 – Evaluation of Subsurface Soils*.

The subsurface conditions indicate that the Warley Hill formation weak soils subject to SSL will be encountered at Interior Bent 2 (5' of soil), Bent 3 (18'-20' of soil), Bent 5 (0 – 10' of soil), and Bent 7 (0 – 6' of soil). The weak soils encountered at the interior bents are relatively isolated at interior bents 2, 3, 5, and 7 and do not appear to delineate a consistent weak formation. Even though these soils may be subject to cyclic liquefaction, it is not anticipated that seismic settlement would translate into a uniformly settling of soils that would cause downdrag to a deep foundation. Conversely, because the weak soil zones are encountered at a depth of least 50 feet below the channel bottom, some risk does remain that additional areas may be subject to weak soil zones that may reduce the maximum allowable axial capacity of a deep foundation installed or of the bearing capacity of a shallow foundation. The following sections will provide the pros and cons associated with installing a drilled shaft, shallow spread footing, and driven pile foundation.

The extent and distribution of the weak soil zones is unknown. To further quantify the risk, at a minimum an expanded subsurface exploration would be required to locate the weak soil zones and define their extent. It is our understanding that because there is an existing foundation, time considerations, additional expense, and the risk remaining high that all weak soil zones cannot be quantified. Geophysical

testing was considered and discounted because of difficulties and unreliability in obtaining conclusive results for weak soils encountered 60 feet or more below the ground surface and having standing water within the area of interest.

6.2 Drilled Shafts

The selection of drilled shafts at the interior bents would be subject to challenges related to design and constructability. Drilled shafts are typically selected for interior bents in similar formations due to the requirement of large foundation capacity and relatively dense subsurface conditions typically encountered in the Santee Limestone and Congaree formations. Drilled shafts also provide large lateral resistance due to their size and stiffness that may be necessary when evaluating lateral loads where large scour depths are anticipated or when designing for Extreme Event I limit state. Drilled shaft construction is routinely performed by local contractors and SCDOT QA/QC procedures have been established and are routinely used.

The design and constructability of a drilled shaft becomes a challenge as a result of the weak soils encountered approximately 60 feet below the ground surface, within the Warley Hill formation. The challenge is even greater because the spatial distribution of the weak soils encountered is unpredictable. The drilled shaft construction approach significantly affects the design and consequently the cost of the foundation. The design and constructability concerns for a drilled shaft foundation are as follows:

1. For drill hole stability during construction of drilled shafts through the weak soils, the drilled shafts will require permanent casing to a depth of at least 85 feet below the dredge line (elevation 25 ft-msl). Total permanent casing to the order of 95 feet would be required at each drilled shaft.
2. The use of permanent casing to an elevation of 25 feet would require that the skin friction along the surface of the casing be ignored based on SCDOT standard practice. The drilled shafts will consequently get extremely long since the drilled shaft support length would begin at elevation 25 ft-msl.
3. Since the spatial distribution of the weak soils encountered is unknown, the design and construction approach would need to be applied to the entire bridge.

6.3 Shallow Foundations

Shallow spread footings are traditionally not used on bridge projects since this type of foundation typically requires subsurface soils with sufficient support within the depth of bearing influence that is in the range of 2 to 3 times the footing width. Shallow spread footings placed on rock or dense soil formations typically are feasible where there is low variability and where design conditions are not variable throughout the design life of the bridge such as in an overpass.

The design and constructability of a spread footing within a waterway and variable subsurface conditions becomes a challenge as a result of the scour requirements, weak soils encountered at elevation 50 ft-msl, foundation embedment requirements below the maximum scour elevation, and interference with existing structures. The challenge is even greater because the spatial distribution of the weak soils encountered is unpredictable. The constructability challenges will significantly affect the foundation costs. The design and constructability concerns for a shallow spread foundation at Bent 3 are presented below:

1. The scour at Bent 3 is approximately at an elevation of 82 feet which would require the bottom of the footing to be embedded to an approximate elevation of 72 ft-msl or installed at elevation 72 ft-msl with scour mitigation to protect the footing from being undermined. With water levels as high as an elevation of 119 feet, the Contractor would need to construct cofferdams to retain approximately 30 to 40 feet of soil within 37 to 47 feet of water.
2. There would be 22 to 32 feet of soil between the bottom of the spread footing and the top of the weak soils at elevation 50 ft-msl. This scenario would create a complex design in that the weak subsurface soils are encountered with in the depth of influence for the bearing support.
3. Since the spatial distribution of the weak soils encountered is unknown, the shallow spread foundation design would have a higher risk of failure or bad performance.
4. Construction time would need to be extended and seasonal changes may affect the construction changes.
5. Environmental permitting to construct cofferdams may be required.

6.4 Pipe Piles

The selection of pipe piles at the interior bents would be subject to challenges related to design and constructability. In order to replace the original design concept of drilled shaft foundations with driven piles, large pipe piles will need to be used in order to maintain high load capacity, foundation layout, and bridge hydraulics (i.e. scour). Steel pipe piles with thick walls can be driven through dense soils stratums. Steel pipe piles can be designed to resist large compressive driving stresses by specifying higher steel yield strengths, pipe sizes, and pipe wall thickness. Pipe piles can also be manufactured for different lengths and spliced in the field. Pipe piles are increasingly being used to support bridges and are routinely used in seismically active project sites in states such as Alaska and Montana. Recently, 30" and 72" diameters large pipe piles were chosen to be used for new bridges over Kentucky Lake and Lake Barkley.

The design and constructability of pipe piles becomes a challenge as a result of the weak soils encountered approximately 60 feet below the ground surface, within the Warley Hill formation. The challenge is even greater because the spatial distribution of the weak soils encountered is unpredictable. The pipe pile size, details, and specifications will significantly affect the design and consequently the cost of the foundation. The design and constructability concerns for a pipe pile foundation are as follows:

1. Special pipe pile structural connections are needed between the pipe pile and the pile cap. Several State DOTs such as Alaska and Montana are currently using specially designed connections. Alaska uses a special design to ensure that a plastic hinge occurs below the pile cap to avoid pile cap stresses that may damage the bridge during an earthquake.
2. Pipe piles typically need a concrete section constructed at the pile top to embed steel reinforcement and construct the connection to the pile cap. The minimum concrete section length should be designed and constructed inside the top of the pipe pile after the pipe pile has either been excavated to the minimum concrete section length or backfilled to the minimum concrete section length required. It is not common practice by other State DOTs or geotechnically necessary to auger out the soil plug to the pile tip and backfill with concrete. This practice may cause a loss in pile tip capacity by relieving the soil plug.
3. Large pipe piles are not a stock item and may need to be manufactured on a project-specific basis, therefore increasing cost and lead time. Because pipe piles are manufactured on a project-

specific basis, pile lengths, steel strength requirements, pipe thickness, and maximum number of splices can be specified in the plans.

4. Although it is preferable to splice piles when they are being manufactured, field splicing can be performed. The time required to accomplish this is based on the pipe pile size and thickness. Recent inquiries with the pipe pile manufacturers indicate that a 48-inch diameter pipe pile with 1.5" wall thickness could be field welded in 8 hours if only one welder is used and 4 hours if two welders are simultaneously being used with high quality welding equipment.
5. In order to avoid installation issues due to setup or delays, the Contractor should be required to drive full length piles. Splicing during pile installation should be avoided and limited to piles not achieving the required pile capacity after performing pile restrikes.
6. Guidance in the selection of pile driving equipment will need to be provided in the plans based on a driveability analysis. When driven piles need to penetrate through dense materials, the pile driving hammer will need to be monitored continuously during pile driving for hammer energy and rate of impact. The driving hammer will need to have reserve capacity to facilitate penetration through dense layers interbedded within moderate soils layers, mobilize pile capacity during pile restrikes, or in case the pipe pile becomes plugged. Typically a double-acting hydraulic hammer should be specified since the energy is adjustable by continuous variation of stroke and/or downward pressure resulting in a high efficiency of the energy transferred to the pile top. Typical hammer efficiencies of 95% are not uncommon. Higher speed double-acting hydraulic hammers are perceived to keep the pile in motion better by reducing inertia, skin friction and point resistance, thus facilitating the pile installation in dense granular soils.
7. Since the spatial distribution of the weak soils encountered is unknown, the design and construction approach would need to be applied to the entire bridge. It is recommended that a minimum pile length be specified that not only meets critical depth for lateral loads, Strength limit state axial loads, Extreme Event I limit state, and performance limits, but also achieves sufficient penetration to penetrate a minimum distance below the bottom of the deepest zone of weak soil.
8. Large pipe piles typically do not plug during continuous driving unless sufficient skin friction is developed inside the pile. It is also recognized that even if a static plug develops, the plugged pile tip bearing capacity may not be able to be verified using dynamic pile load testing. Static load testing has been shown to validate plugged pile tip bearing conditions. Consequently, to avoid costly static pile load testing, pipe piles should be designed as open-ended.
9. Dynamic testing should be conducted on index piles for pile capacity verification. An index pile should be located at each bent since there may be significant variability from bent to bent.

A limited literature research has been conducted with respect to the state-of-practice in the design of pipe piles.

7 BRIDGE FOUNDATION GEOTECHNICAL EVALUATION

Large pipe piles are recommended to support the bridge interior bent foundations.

7.1 Deep Foundation Type/Size and Foundation Loads

Discussions with SCDOT has indicated that a 48-inch pipe pile diameter would be the preferred foundation size based on their structural evaluation of the foundation sizes. SCDOT provided the axial compression and lateral pile loads for interior bents for the Strength and Service limit states as shown in Table 13. No load information was provided for the Extreme Event I limit state.

Table 13. SCDOT Foundation Loads[1]

Foundation Location			Strength Limit State			Service Limit State			Extreme Event I Limit State[2]
			Case 1FL ($P=P_{max}$)	Case 2FL ($V=V_{max}$)	Case 3FL ($M=M_{max}$)	Case 1SL ($P=P_{max}$)	Case 2SL ($V=V_{max}$)	Case 3SL ($M=M_{max}$)	
Interior Bent[3] with 3 48" dia. Columns	Longitudinal	Axial Compression (kips)	**-768.4**	-499.3	-768.4	-551.7	-356.7	-546	NA
		Lateral Load (kips)[4]	-20.07	21.46	-20.07	-11.47	-14.43	-13.62	NA
		Moment (kips)[4]	-254.1	198.7	-254.1	-145.2	-116.6	-147.7	NA
	Transverse	Axial Compression (kips)	-768.4	-345.4	-345.4	-551.7	-328.6	-328.6	NA
		Lateral Load (kips)[4]	-0.4159	-8.815	-8.815	2.592	-5.427	-5.427	NA
		Moment (kips)[4]	-16.1	-374.0	-374.0	71.79	-209.3	-209.3	NA
Interior Bent[3] with 5 48" dia. Columns	Longitudinal	Axial Compression (kips)	-371.3	-346.2	-371.3	-266.8	-253.4	-261.9	NA
		Lateral Load (kips)[4]	-11.69	13.03	-11.69	7.438	-8.743	-7.488	NA
		Moment (kips)[4]	-165.5	113.7	-165.5	64.97	-66.64	-100.7	NA
	Transverse	Axial Compression (kips)	-371.3	-217.9	-220.3	-266.8	-218.7	-222.6	NA
		Lateral Load (kips)[4]	-0.119	7.281	-4.115	-1.637	-2.107	2.994	NA
		Moment (kips)[4]	-5.11	208.4	-234.0	-70.73	-90.71	91.11	NA

[1] SCDOT provided axial compression loads and lateral loads on 8/26/2015.
[2] Not provided loads for Extreme Event Limit State.
[3] Only interior bents are considered in this evaluation.
[4] Lateral loads are applied at the top of the pile.

Pile top boundary conditions have been evaluated for both Fixed Head (Slope = 0) and Free Head (Moment = 0) conditions.

7.2 Strength Limit State Axial Compression Pile Capacity Analyses

Nominal (ultimate) axial compression pile capacities for the Strength limit state were computed using the computer software APILE 2014 (FHWA methodology). The ultimate pile capacity vs. depth for piles driven at Bent 3 have been plotted in Figure 12 and the results of the APILE analyses are included in Appendix C.

The determination of the Strength limit state required nominal pile capacity is shown in Table 14. The model used a 48-inch steel pipe pile with a wall thickness of 1.5 inches. Pipe wall thickness was determined from driveability analyses. Soil strength parameters were based on the soils recorded in STB B-3. The model included the 500-year scour by neglecting skin friction and toe bearing to a depth of 27 feet. Skin friction in the weak soil zone was neglected by modeling the soil with a friction angle of 0 degrees and an effective unit weight of 22 pcf (84.4pcf – 62.4 pcf). The unit skin friction was limited to 2 ksf for all soils. Nominal (Ultimate) pile capacities versus depth for Bent 3 are provided in Figure 12 with and without the weak soil zone.

The required pile driving resistance was determined using a model without scour, without any reduction in skin friction, and without the weak soil zone. A value was determined for both the plugged and unplugged pipe pile conditions. A resistance factor of 0.55 corresponds to Non-Redundant Strength Limit State Nominal Resistance Single Pile in Axial Compression with Dynamic Testing (PDA) and calibrated Wave Equation (SCDOT GDM Table 9-2). Two pile capacity evaluations were performed, one with the weak soil zone (Table 14) and one without the weak soil zone (Table 15).

Table 14. Strength Limit State Nominal Axial Compression Pile Capacity – weak soil zone encountered

Load Type	Strength Limit State
	Bent 3
Factored Axial Compression Load (kips)	768.4
Required Nominal Resistance (kips) Strength LS Resistance Factor φ = 0.55	**1398**
Estimated Pile Tip Penetration (feet)[1]	111
Estimated Pile Tip Elevation (ft-msl)	**-1**
Unplugged Required Pile Driving Resistance (kips)	**2851**
Plugged Required Pile Driving Resistance (kips)	**5728**

[1] Penetration referenced to ground elevation 110 ft-msl.

Table 15. Strength Limit State Nominal Axial Compression Pile Capacity – No weak soil zone encountered

Load Type	Strength Limit State
	Bent 3
Factored Axial Compression Load (kips)	768.4
Required Nominal Resistance (kips) Strength LS Resistance Factor φ = 0.55	**1398**
Estimated Pile Tip Penetration (feet)[1]	96
Estimated Pile Tip Elevation (ft-msl)	**14**
Unplugged Required Pile Driving Resistance (kips)	**2869**
Plugged Required Pile Driving Resistance (kips)	**5810**

[1] Penetration referenced to ground elevation 110 ft-msl.

Based on the subsurface investigation data, a minimum tip elevation of 10 ft-msl should be achieved to reach a sufficient depth below possible weak soils in the Warley Hill Formation and bear into the Congaree Formation.

7.3 Axial Pile Settlement

Axial compression loads on piles can produce vertical displacements as a result of pile-soil load transfer and elastic compression of the pile. The Strength limit state pile tip elevations (Table 14) were selected for Bent 3. The pipe pile was modeled with a 10-foot unsupported length above the ground surface. Pile top settlement for the service limit state is shown in Table 16.

Table 16. Service Limit State Pile Top Settlement

Pile Type	Settlement
	Bent 3
Service Axial Load (kips)[1]	552
Estimated Pile Tip Elevation (ft-msl)[2]	-1 / 14
Estimated Total Pile Length, TL (feet)[3]	121 / 108
Settlement Top of Pile (inches)	**< ⅛**

[1] Axial compression loads

7.4 Lateral Pile Response

The lateral response of the bridge pile foundations under combined axial and lateral loads has been evaluated for the Service limit state. The pile response was evaluated by performing soil-structure interaction analyses using the software program LPILE version 2013. The LPILE program solves a set of differential equations for a beam-column using a model of nonlinear lateral load-transfer p-y curves subjected to known boundary conditions. The structural section properties for the pipe pile are shown in Table 17. A friction angle of 24 degrees and an effective unit weight of 22 pcf (84.4pcf – 62.4 pcf) was selected for soil in the weak zone. The pipe pile was modeled with a 33-foot unsupported length above the scour depth for a scour elevation of 83 and with a 22-foot unsupported length above the scour depth for a scour elevation of 94, corresponding to a pile top at the bottom of the bent cap shown on the provided bridge plans.

Table 17. LPILE – Pile Input Properties

Pile Type	Area (in2)	Moment of Inertia (in^4)	Thickness of pile wall (inches)[1]	Modulus of Elasticity (ksi)
48” Steel Pipe Pile	219.13	59,287	1.5	29,000
[1] 1.5 inch thickness was used based on driveability analysis.				

The interior Bent 3 pile lateral response was evaluated with fixed head and free head conditions for the following soil and scour conditions:

- Weak Soil Zone Encountered, Scour Elevation at 83 feet (Scour at Bent 3)
- Weak Soil Zone Encountered, Scour Elevation at 94 feet (Scour at Bents 4 and 5)
- Weak Soil Zone Not Encountered, Scour Elevation at 83 feet (Scour at Bent 3)
- Weak Soil Zone Not Encountered, Scour Elevation at 94 feet (Scour at Bents 4 and 5)

The pile layout and spacing for the bridge bents are included in Figure 12. The interior Bent 3 LPILE results for a single pile are summarized in Table 18 through Table 25 for the Service limit state.

Weak Soil Zone Encountered, Scour elevation at 83 feet:

Table 18. LPILE – Interior Bent Service Limit State – Fixed Head

Load Case	LPILE Loading Type No.	Pile Head Deflection (in)	Axial Load (kip)	Maximum Shear Force[1] (kip)	Maximum Bending +Moment (in-kip)	Depth to Max Moment (ft)	Max Moment Elevation[2] (ft-msl)	Critical Depth (ft)	Critical Depth Elevation[2] (ft-msl)
1	5	0.12	552	11.38	1888.46	42	74	96	20
2	5	0.25	552	22.76	3776.92	42	74	96	20
3	5	0.50	552	44.93	7538.11	42	74	96	20
4	5	1.00	552	81.86	14044.02	43.5	72.5	96	20

[1] Pile top shear load
[2] The top of pile assumed to be at elevation 116 ft-msl. Critical depth elevation is the minimum pile tip elevation required to maintain lateral stability.

Table 19. LPILE – Interior Bent Service Limit State – Free Head

Load Case	LPILE Loading Type No.	Pile Head Deflection (in)	Axial Load (kip)	Maximum Shear Force[1] (kip)	Maximum Bending +Moment (in-kip)	Depth to Max Moment (ft)	Max Moment Elevation[2] (ft-msl)	Critical Depth (ft)	Critical Depth Elevation[2] (ft-msl)
1	4	0.12	552	2.85	1315.95	39	77	96	20
2	4	0.25	552	5.7	2631.91	39	77	96	20
3	4	0.50	552	11.41	5263.81	39	77	96	20
4	4	1.00	552	22.41	10459.62	39	77	96	20

[1] Pile top shear load
[2] The top of pile assumed to be at elevation 116 ft-msl. Critical depth elevation is the minimum pile tip elevation required to maintain lateral stability.

Weak Soil Zone Encountered, Scour elevation at 94 feet:

Table 20. LPILE – Interior Bent Service Limit State – Fixed Head

Load Case	LPILE Loading Type No.	Pile Head Deflection (in)	Axial Load (kip)	Maximum Shear Force[1] (kip)	Maximum Bending +Moment (in-kip)	Depth to Max Moment (ft)	Max Moment Elevation[2] (ft-msl)	Critical Depth (ft)	Critical Depth Elevation[2] (ft-msl)
1	5	0.12	552	25.05	2667.06	33	83	78	38
2	5	0.25	552	49.85	5335.04	33	83	78	38
3	5	0.50	552	91.62	10214.21	33	83	82.5	33.5
4	5	1.00	552	154.2	17552.57	36	80	91.5	24.5

[1] Pile top shear load
[2] The top of pile assumed to be at elevation 116 ft-msl. Critical depth elevation is the minimum pile tip elevation required to maintain lateral stability.

Table 21. LPILE – Interior Bent Service Limit State – Free Head

Load Case	LPILE Loading Type No.	Pile Head Deflection (in)	Axial Load (kip)	Maximum Shear Force[1] (kip)	Maximum Bending +Moment (in-kip)	Depth to Max Moment (ft)	Max Moment Elevation[2] (ft-msl)	Critical Depth (ft)	Critical Depth Elevation[2] (ft-msl)
1	4	0.12	552	6.62	2067.7	28.5	87.5	70.5	45.5
2	4	0.25	552	13.23	4135.39	28.5	87.5	70.5	45.5
3	4	0.50	552	26.17	8248.64	28.5	87.5	70.5	45.5
4	4	1.00	552	48.3	15747.12	28.5	87.5	72	44

[1] Pile top shear load
[2] The top of pile assumed to be at elevation 116 ft-msl. Critical depth elevation is the minimum pile tip elevation required to maintain lateral stability.

Weak Soil Zone not Encountered, Scour elevation at 83 feet:

Table 22. LPILE – Interior Bent Service Limit State – Fixed Head

Load Case	LPILE Loading Type No.	Pile Head Deflection (in)	Axial Load (kip)	Maximum Shear Force[1] (kip)	Maximum Bending +Moment (in-kip)	Depth to Max Moment (ft)	Max Moment Elevation[2] (ft-msl)	Critical Depth (ft)	Critical Depth Elevation[2] (ft-msl)
1	5	0.12	552	11.47	1921.01	42	74	84	32
2	5	0.25	552	22.94	3842.01	42	74	84	32
3	5	0.50	552	45.33	7670.94	42	74	84	32
4	5	1.00	552	82.82	14375.25	43.5	72.5	85.5	30.5

[1] Pile top shear load
[2] The top of pile assumed to be at elevation 116 ft-msl. Critical depth elevation is the minimum pile tip elevation required to maintain lateral stability.

Table 23. LPILE – Interior Bent Service Limit State – Free Head

Load Case	LPILE Loading Type No.	Pile Head Deflection (in)	Axial Load (kip)	Maximum Shear Force[1] (kip)	Maximum Bending +Moment (in-kip)	Depth to Max Moment (ft)	Max Moment Elevation[2] (ft-msl)	Critical Depth (ft)	Critical Depth Elevation[2] (ft-msl)
1	4	0.12	552	2.88	1329.2	39	77	81	35
2	4	0.25	552	5.76	2658.41	39	77	81	35
3	4	0.50	552	11.52	5316.81	39	77	81	35
4	4	1.00	552	22.65	10571.8	39	77	82.5	33.5

[1] Pile top shear load
[2] The top of pile assumed to be at elevation 116 ft-msl. Critical depth elevation is the minimum pile tip elevation required to maintain lateral stability.

Weak Soil Zone not Encountered, Scour elevation at 94 feet:

Table 24. LPILE – Interior Bent Service Limit State – Fixed Head

Load Case	LPILE Loading Type No.	Pile Head Deflection (in)	Axial Load (kip)	Maximum Shear Force[1] (kip)	Maximum Bending +Moment (in-kip)	Depth to Max Moment (ft)	Max Moment Elevation[2] (ft-msl)	Critical Depth (ft)	Critical Depth Elevation[2] (ft-msl)
1	5	0.12	552	25.05	2668.94	33	83	73.5	42.5
2	5	0.25	552	49.86	5338.82	33	83	73.5	42.5
3	5	0.50	552	91.68	10227.42	33	83	73.5	42.5
4	5	1.00	552	154.44	17617.62	36	80	76.5	39.5

[1] Pile top shear load
[2] The top of pile assumed to be at elevation 116 ft-msl. Critical depth elevation is the minimum pile tip elevation required to maintain lateral stability.

Table 25. LPILE – Interior Bent Service Limit State – Free Head

Load Case	LPILE Loading Type No.	Pile Head Deflection (in)	Axial Load (kip)	Maximum Shear Force[1] (kip)	Maximum Bending +Moment (in-kip)	Depth to Max Moment (ft)	Max Moment Elevation[2] (ft-msl)	Critical Depth (ft)	Critical Depth Elevation[2] (ft-msl)
1	4	0.12	552	6.62	2068.09	28.5	87.5	70.5	45.5
2	4	0.25	552	13.23	4136.17	28.5	87.5	70.5	45.5
3	4	0.50	552	26.17	8250.25	28.5	87.5	70.5	45.5
4	4	1.00	552	48.31	15752.52	28.5	87.5	70.5	45.5

[1] Pile top shear load
[2] The top of pile assumed to be at elevation 116 ft-msl. Critical depth elevation is the minimum pile tip elevation required to maintain lateral stability.

A summary of the range of Service limit state maximum lateral shear forces corresponding to displacements ranging from 1/8" to 1.0" is provided in Table 26.

Table 26. Interior Bent Summary: Range of Maximum Shear Forces for Displacements of 1/8" – 1"

Response Criteria	Service Limit State Range of Max Shear Forces @ Pile Top (kips)	
	Fixed Head	Free Head
Weak Soil Zone Encountered, Scour elevation at 83 feet	11.4 – 81.9	2.9 – 22.4
Weak Soil Zone Encountered, Scour elevation at 94 feet	25.1 – 154.2	6.6 – 48.3
Weak Soil Zone not Encountered, Scour elevation at 83 feet	11.5 – 82.8	2.9 – 22.7
Weak Soil Zone not Encountered, Scour elevation at 94 feet	25.1 – 154.4	6.6 – 48.3

Results of lateral pile analyses have been included in Appendix D.

7.5 Pile Driveability

A preliminary Wave Equation Analysis of Piles (WEAP) driveability analyses was conducted to evaluate potential hammer sizes that could be used to install the steel pipe piles. All pile driving hammers selected in the analysis were double-acting hydraulic hammers. The pipe pile wall thickness required to maintain pile compressive driving stresses within acceptable limits (Section 711.4.2 of the SCDOT 2007 Standard Specifications for Highway Construction) was 1.5 inches using 50 ksi steel.

A driveability analysis has been performed to evaluate pile installation stresses and pile driving equipment required to penetrate the Santee Limestone and underlying formations with and without plugging of the pipe pile. The evaluation was modeled with the weak soil zone, without the weak soil zone, and with 15% more skin and toe resistance. The evaluation conducted of the RBO Four Hole Swamp foundation used 48-inch steel pipe piles with 1.5-inch thick walls.

The WEAP analysis conducted is presented in Appendix E. A total pile length of 120 feet with 92% embedment was used for analysis. A variable frictional distribution and end bearing distribution was used in GRLWEAP based on the nominal pile resistances obtained from the APILE. The range of energy required for plugged and uplugged pipe piles was evaluated. Table 27 presents the soil input parameters used in the Wave Equation analyses.

Table 27. Driveability Analysis WEAP Input Parameters

Description	WEAP Parameter
Pile Type	48” Steel Pipe Pile with 1.5” walls
Skin Quake	0.10
Toe Quake	0.10
Skin Damping	0.05
Toe Damping	0.15
% Skin Friction	N/A
% End Bearing	N/A
Distribution Shape No.	Variable Resistance Distribution
Pile Penetration	110 ft
Hammer Rated Energy Range[1]	With Weak Soil Zone Unplugged: 56.7 kip-ft – 140.4 kip-ft Plugged: 94.0 kip-ft – 221.0 kip-ft Without Weak Zone Unplugged: 69.4 kip-ft – 172.8 kip-ft Plugged: 138.6 kip-ft – 342.9 kip-ft Reserve Capacity for hard layers Plugged: 187.9 kip-ft – 473.7 kip-ft

Notes:

[1] Hammer rated energy is based on GRLWEAP maximum rated energy database for hydraulic hammers.

The results of the WEAP pile driveability analyses indicate that a double-acting hydraulic pile driving hammer with a maximum rated energy of 340 to 475 ft-kip should be suitable for pile installation at interior bents. Larger hammers may be suitable but may require limiting the energy delivered.

For very hard or stiff soils (i.e. Santee Limestone) the inside of the pipe pile may need to be augered out in order to drive the pile. The inside of the pipe pile should not be augered out deeper than the bottom of the Santee Limestone Formation (elevation 30 ft-msl), and the final pile tip elevation must not be shallower than 20 feet below the augered depth.

8 BRIDGE APPROACH EMBANKMENT GEOTECHNICAL EVALUATION

The bridge approach embankments for US 301 Replacement Bridge over Four Hole Swamp have been evaluated for slope stability under the Service limit state and the Extreme Event I limit state. The bridge approach embankments evaluated in this report are within 150 feet from the bridge abutments in the longitudinal direction. Roadway embankments beyond 150 feet from the bridge abutments are not included in this report. The west and east bridge approach embankments will be raised approximately 2 feet in height.

8.1 Slope Stability

Global slope stability analyses for the Service and Extreme Event I limit state were conducted using Rocscience, Inc. slope stability software SLIDE 7.0. The global slope stability analyses were conducted in the longitudinal and transverse directions. The maximum bridge approach embankment height analyzed was 2 feet at Bents 1 and 8. Slope stability analyses assumed a groundwater table elevation of 110 ft-msl to account for seasonal variations to match the elevation of Four Hole Swamp.

The slope stability software uses soil shear strength parameters to estimate the slope stability margin of safety. The soil strength parameters selected for the slope stability analyses are based on Section 5 of this report. Circular failure surfaces have been modeled for the Service and Extreme Event I limit states to evaluate the global slope stability. The results of the slope stability analyses and the soil shear strengths used in the soil model are included in Appendix F.

8.1.1 Service Limit State Slope Stability (Static)

The Service limit state was used to evaluate the static slope stability in the longitudinal direction of bridge approach embankments. The Spencer method of analyzing slope stability was used to evaluate the Demand/Capacity ratio (D/C). The Service limit state analyses considered the short-term (during construction, total stress analysis) soil shear strengths for the east and west bridge approach embankments. For the short-term soil shear strength analyses only a live load surcharge (LS) was modeled with a uniform surcharge of 250 psf (Load Factor, γ = 1.0). For the long-term soil shear strength analyses, a uniform surcharge of 400 psf (Load Factor, γ = 1.0) was used to simulate the live load surcharge (LS) of 250 psf and a future dead load surcharge of 150 psf. A summary of the Service limit state (static) longitudinal global slope stability analyses and the governing Demand/Capacity ratios (D/C) and factor of safety, FS, (C/D) are provided in Table 28 and Table 29.

Table 28. Bent 1 Service Limit State Longitudinal Global Stability Summary

Slope Stability Location	Spencer Slope Stability Method Demand/Capacity, D/C (FS = C/D)[1]	Remarks
Short-Term Soil Shear Strengths Longitudinal Stability H_{Embk} = 2 feet End Bent 1 Station 5949+30	**0.621** **(1.611)**	Slope stability analysis shown in Appendix F. Slope stability D/C =0.621 (FS=1.611) meets the design criteria φ = 0.65 (FS=1.539)

[1] **Bold** values indicate governing Demand/Capacity ratio

Table 29. Bent 8 Service Limit State Longitudinal Global Stability Summary

Slope Stability Location	Spencer Slope Stability Method Demand/Capacity, D/C (FS = C/D)[1]	Remarks
Short-Term Soil Shear Strengths Longitudinal Stability H_{Embk} = 2 feet End Bent 8 Station 5952+24	**0.580** **(1.725)**	Slope stability analysis shown in Appendix F. Slope stability D/C = 0.580 (FS=1.725) meets the design criteria φ = 0.65 (FS=1.539)

[1] **Bold** values indicate governing Demand/Capacity ratio

8.1.2 Extreme Event I Limit State Slope Stability (Seismic)

The Extreme Event I limit state was used to evaluate the seismic slope stability in the longitudinal direction of the bridge approach embankments. The Spencer slope stability method was used to evaluate the Demand/Capacity ratio (D/C) and slope performance. The seismic soil shear strength properties were based on Section 5 of this report. Seismic loading was evaluated only for the Safety Evaluation Earthquake (SEE) in accordance with Section 4 of this report. For the Extreme Event I limit state a uniform surcharge of 275 psf (Load Factor, γ = 1.0) was used to simulate the live load surcharge (LS) of 125 psf (load factor, γ = 0.5) and a future dead load surcharge of 150 psf (load factor, γ = 1.0). The yield acceleration (C/D=FS=1.0) was computed when (D/C) SEE is greater 1.0 (FS < 1.0) to evaluate embankment performance based on displacements. Performance displacements were computed using Simplified Newmark Chart in accordance with GDM Section 13.16 (Equation 13-106). The results of the seismic slope stability analyses are provided in Appendix F.

A summary of the Extreme Event I limit state (seismic) global slope stability analyses Demand/Capacity ratios (D/C) and factor of safety, FS, (C/D) and estimated slope stability performance is provided in Table 30 and Table 31.

Table 30. End Bent 1 Extreme Event I Limit State Longitudinal Global Stability Summary

Slope Stability Location	Spencer Slope Stability Method Demand/Capacity, D/C (FS = C/D)		Yield Acceleration k_{yield} D/C=1.0 (FS = C/D)	Performance Displacements[2] (inches)
	Flow Failure	SEE[1] (k_h = 0.430g)		SEE
Circular Failure Surface H_{Embk} = 2 feet End Bent 1 Station 5949+30	0.646 (1.548)	**1.179** **(0.848)**	**0.360g**	**0.0**

[1] PGA_{SEE} = 0.43g
[2] Simplified Newmark Chart (GDM Section 13.16, Equation 13-106)

Table 31. End Bent 8 Extreme Event I Limit State Longitudinal Global Stability Summary

Slope Stability Location	Spencer Slope Stability Method Demand/Capacity, D/C (FS = C/D)		Yield Acceleration k_{yield} D/C=1.0 (FS = C/D)	Performance Displacements[2] (inches)
	Flow Failure	SEE[1] (k_h = 0.430g)		SEE
Circular Failure Surface H_{Embk} = 2 feet End Bent 8 Station 5952+24	0.571 (1.750)	**1.517** **(0.659)**	**0.199g**	**4.9**

[1] PGA_{SEE} = 0.43g
[2] Simplified Newmark Chart (GDM Section 13.16, Equation 13-106)

9 SCOPE OF WORK LIMITATIONS

The scope of work for this project was limited to specific analytical design consideration for this project. Additional design analyses and construction considerations will need to be addressed as the final design is completed. The following is a summary of design and construction considerations that will need to be addressed. This list is not all inclusive and attempts to provide some of the major design issues that need to be addressed.

Bridge Foundation

1. Analysis of end bent piles. The analysis of end bent piles has not been included since SCDOT did not include foundation loads or request that end bent piles be evaluated.
2. Pipe pile final pile length design based on governing limit state and site variability
3. Evaluation/design of deep foundation performance (i.e. settlement, lateral)
4. Bridge foundation plan notes

Embankment Foundation

1. Embankment final stability design/analyses for all limit states (Service limit state: short-term and long-term loading and Extreme Event I limit state) for the longitudinal and transverse directions
2. Evaluation/design of deep foundation performance (i.e. settlement, stability, etc.)
3. Embankment construction plan notes

10 GEOTECHNICAL ENGINEERING EVALUATION CONCLUSIONS

We have completed a preliminary geotechnical engineering evaluation for the US 301 southbound replacement bridge over Four Hole Swamp. The geotechnical engineering evaluation consisted of performing a review of the subsurface soil exploration, a soils shear strength loss (SSL) assessment, a review of the bridge interior bent foundations, and a review of embankment longitudinal slope stability. A summary of our conclusions is provided in the following sections.

10.1 Summary of Subsurface Exploration Evaluation and Soil Shear Strength Evaluation

A total of 23 soil test borings, 2 DMT profiles, and 6 shallow investigations (hand augers and bulk samples) were evaluated and combined with all laboratory test results to develop a site characterization consistent with the GDM (2010). Soils were categorized as either clay-like or sand-like based on the soil classification, fines content, and plasticity index. Soil shear strengths were evaluated for the static short-term and long-term loading conditions. The seismic soil shear strength loss (SSL) was also evaluated for the Safety Evaluation Earthquake (SEE) based on the potential for cyclic liquefaction of sand-like soils and cyclic softening of clay-like soils. A subsurface profile was developed for the project that identifies the soil stratigraphy based on clay-like and sand-like soils within geologic formations. Peak short-term soil shear strengths and soil shear strength losses have been annotated within the profile. Weak soil zones have been identified within the Warley Hill formation that underlies the Santee Limestone formation. A detailed evaluation has also been presented where there is a significant contrast between the two

subsurface investigations that have been conducted for this project. Subsurface exploration observations have also been presented to assist in the interpretation of the field and laboratory testing that was conducted for this project site.

10.2 Summary of Bridge Interior Bent Foundations

Three foundation alternatives were evaluated to determine feasibility based on evaluation of the subsurface investigations conducted at the bridge site. The original drilled shaft foundation was found to not be reasonable due to the permanent casing required through the weak soil zones encountered 60 feet below the ground at the interior bents and having to design drilled shaft capacity to start below the casing. The shallow foundation was also found not to be reasonable due to the construction requirements of using cofferdams that would be extremely difficult at bents 3 and 6 due to the deep scour at these locations and increased risk associated with placing a spread footing overlying weak soils that may be 22 to 32 feet below the bottom of the footing. The recommended bridge interior foundation that can reasonably be used to accommodate the existing soil conditions and provide reasonable performance is large diameter pipe piles with thick walls. Although large pipe piles (48-inch diameter, 1.5-inch wall thickness) are not commonly used on SCDOT projects, these foundations are currently being used by other State DOTs with increasing frequency and have performed well at project sites subject to seismic design.

Ultimate axial pile capacity results have been provided for the Bent 3 soil profile with and without the effects of encountering the weak soil zone. The results of lateral pile analyses have been included for soil profiles with and without the effects of encountering the weak soil zone. The lateral pile analyses have also considered the effects of scour occurring at Bent 3 (Scour elevation 83 feet) and at Bent 4/5 (Scour elevation 94 feet). A wave equation pile driveability evaluation has been performed to evaluate possible pile driving conditions that may occur such as encountering or not encountering the soil weak zone, effects of piles driving unplugged/plugged, and the possibility of encountering cemented zones within the Santee Limestone formation. Guidance has been provided for pile installation consideration with respect to pile driveability, pile driving equipment, and installation techniques to facilitate pile installation.

10.3 Summary of Longitudinal Slope Stability

Longitudinal slope stability analyses have been performed at each abutment for the Service limit state short-term loading condition and for the Extreme Event I limit state with seismic conditions based on the Safety Evaluation Earthquake (SEE). The resistance factor for the Service limit state for the short-term loading condition appears to meet or exceed the required resistance factor (Demand/Capacity). The Extreme Event I limit state slope stability analyses indicate that there will be no flow failure with resistance factors (Demand/Capacity) less than 1. The seismic slope stability indicates that the resistance factors Demand/Capacity) exceed the acceptable threshold of 1 requiring a Newmark displacement analysis. The displacement analysis indicates 6 inches of soil displacement along the failure circle at the bridge approach embankment adjacent to End Bent 1 and 2 inches of soil displacement along the failure circle at the bridge approach embankment adjacent to End Bent 8.

11 EVALUATION LIMITATIONS

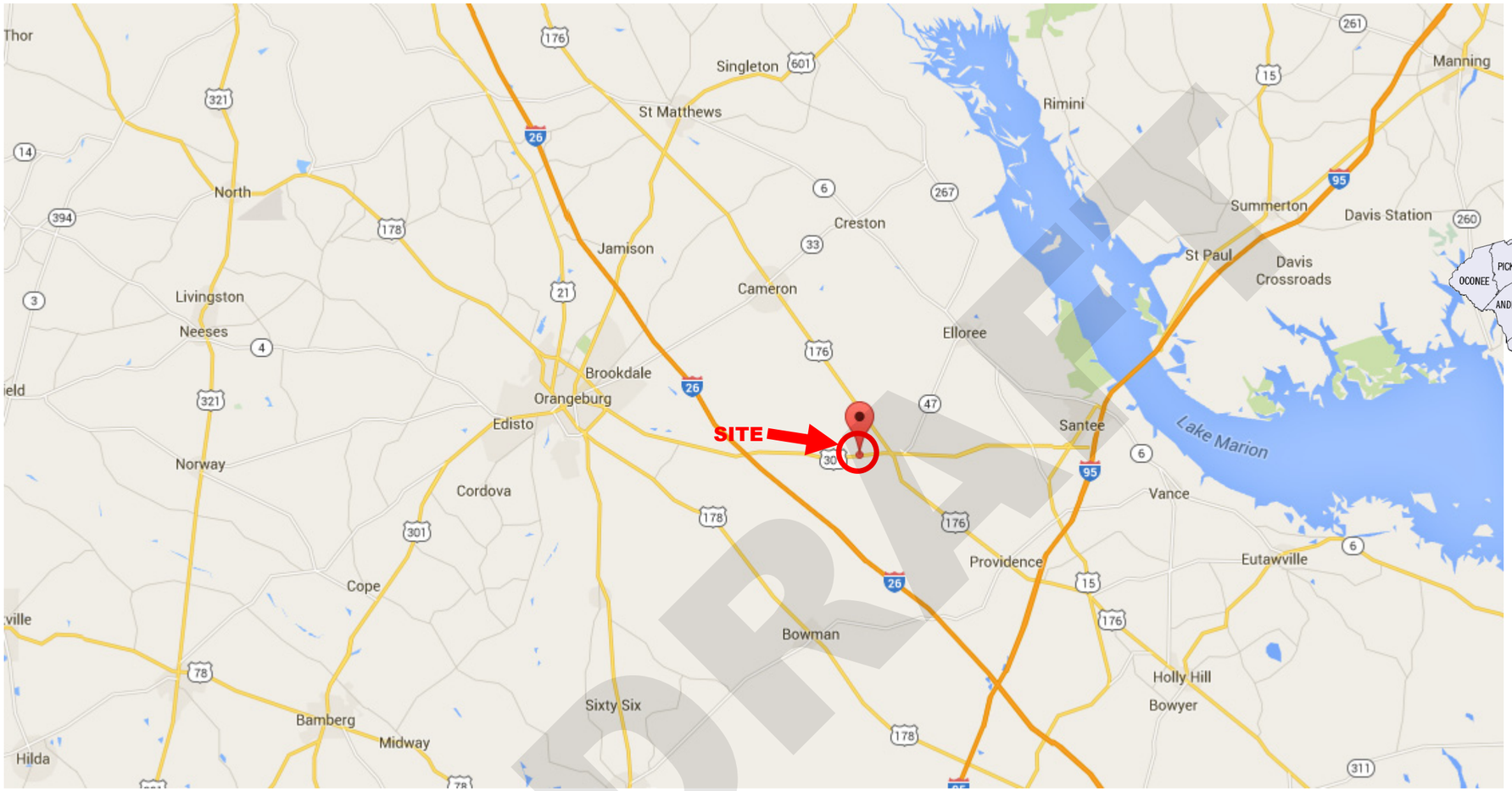
We have prepared this Geotechnical Engineering foundation evaluation for use by SCDOT for the RBO Four Hole Swamp project in Orangeburg County, South Carolina. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this evaluation was prepared. No warranties, either expressed or implied, are intended or made. The analyses and recommendations presented in this evaluation are based upon the geotechnical site exploration and laboratory testing provided by others, information provided by SCDOT, and other information discussed in this evaluation. In the event that changes in the nature, design, or location of the project as outlined in this evaluation are planned, the conclusions and recommendations contained in this evaluation shall not be considered valid unless GeoStellar Engineering, LLC reviews the changes and either verifies or modifies the conclusions of this evaluation in writing. This evaluation does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, GSE should be immediately notified so that further evaluation and supplemental recommendations can be provided.

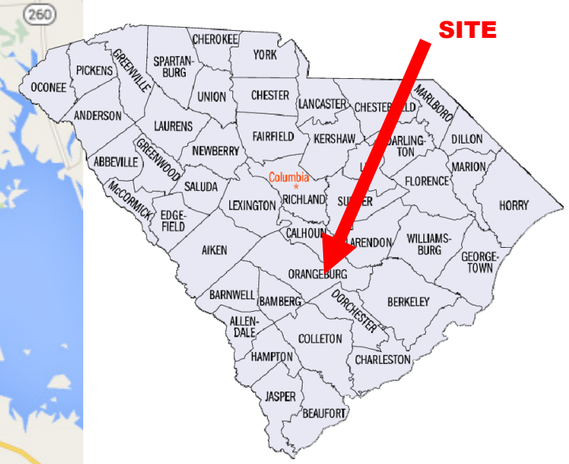
Any electronic form or hard copy of this document (email, text, table, and/or figure), if provided, and any attachments are only a copy of a master document. The master hard copy is stored by GeoStellar Engineering, LLC and will serve as the official document of record.

EVALUATION FIGURES

GeoStellar Engineering

LIST OF FIGURES





Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoStellar Engineering, LLC cannot guarantee the accuracy and content of reference files.

Reference Files:

Google Maps

GeoStellar Engineering

Site Location Plan

US 301 RBO Four Hole Swamp Orangeburg County, South Carolina

GeoStellar Engineering, LLC | Figure 1

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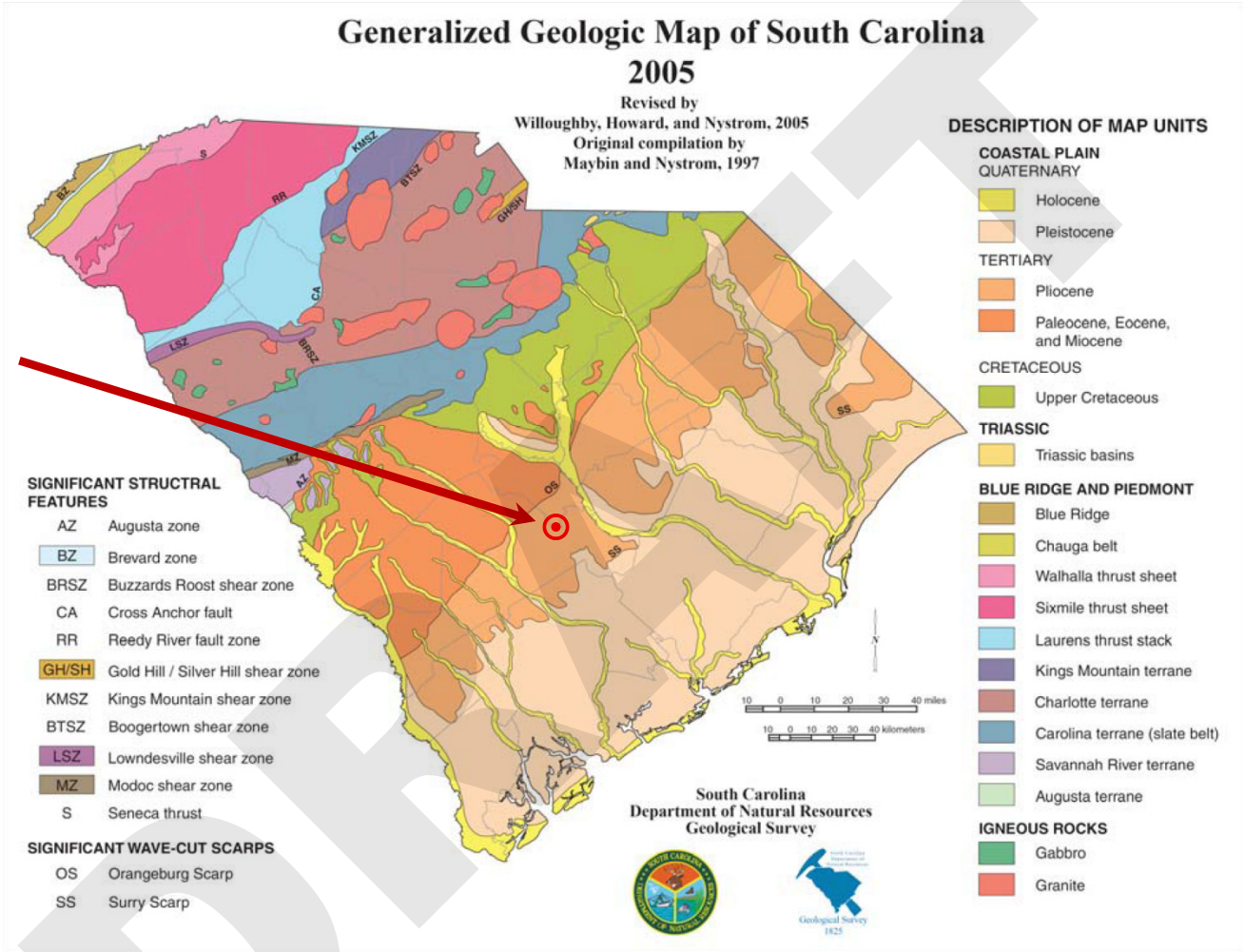
Approximate Project Location



Legend

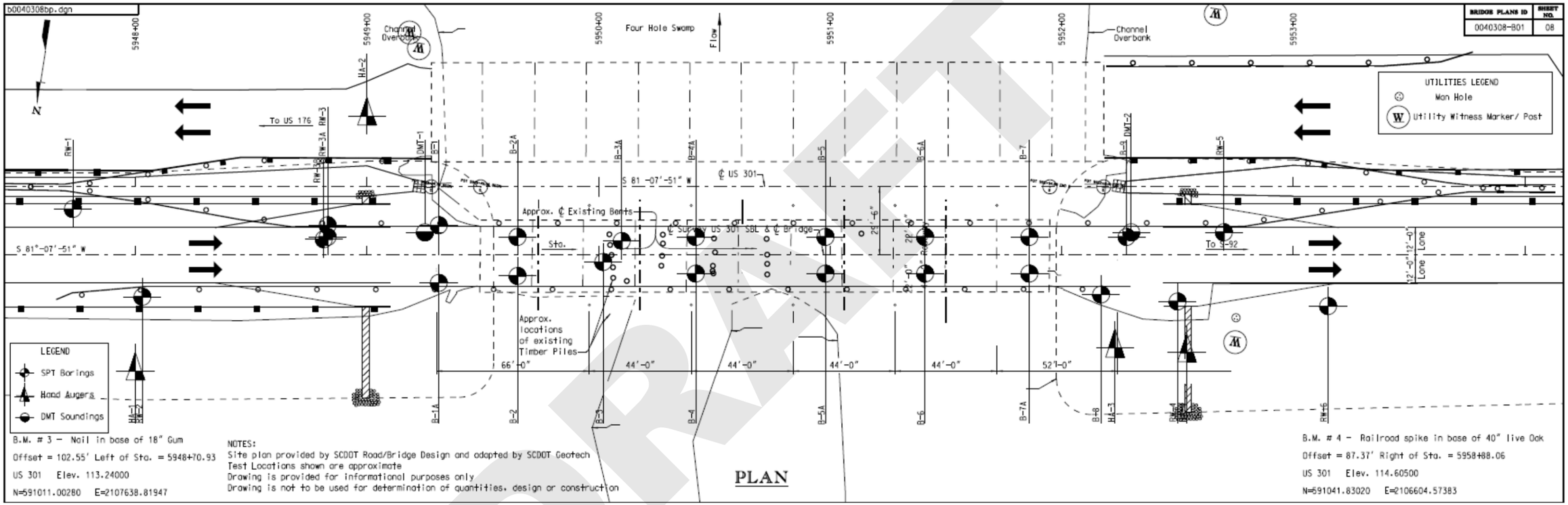
⊙ US 301 RBO Four Hole Swamp Approximate Project Location

Notes:

1. Generalized Geologic map of South Carolina (2005) obtained from SC Department of Natural Resources (SCDNR). This map is referenced in the SCDOT Geotechnical Design Manual, Section 11.2, Figure 11-2.

Generalized Geologic Map of South Carolina	
US 301 RBO Four Hole Swamp **Orangeburg County, South Carolina**	
GeoStellar Engineering, LLC	Figure 2

P:\41503-0002-0001\Geologic_Map.pptx



P:\41503-0002-0001\RBO Four Hole Swamp\Boring Location Plan.pptx

Notes:

1. Locations and scale are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoStellar Engineering, LLC cannot guarantee the accuracy and content of reference files.

Reference Files:

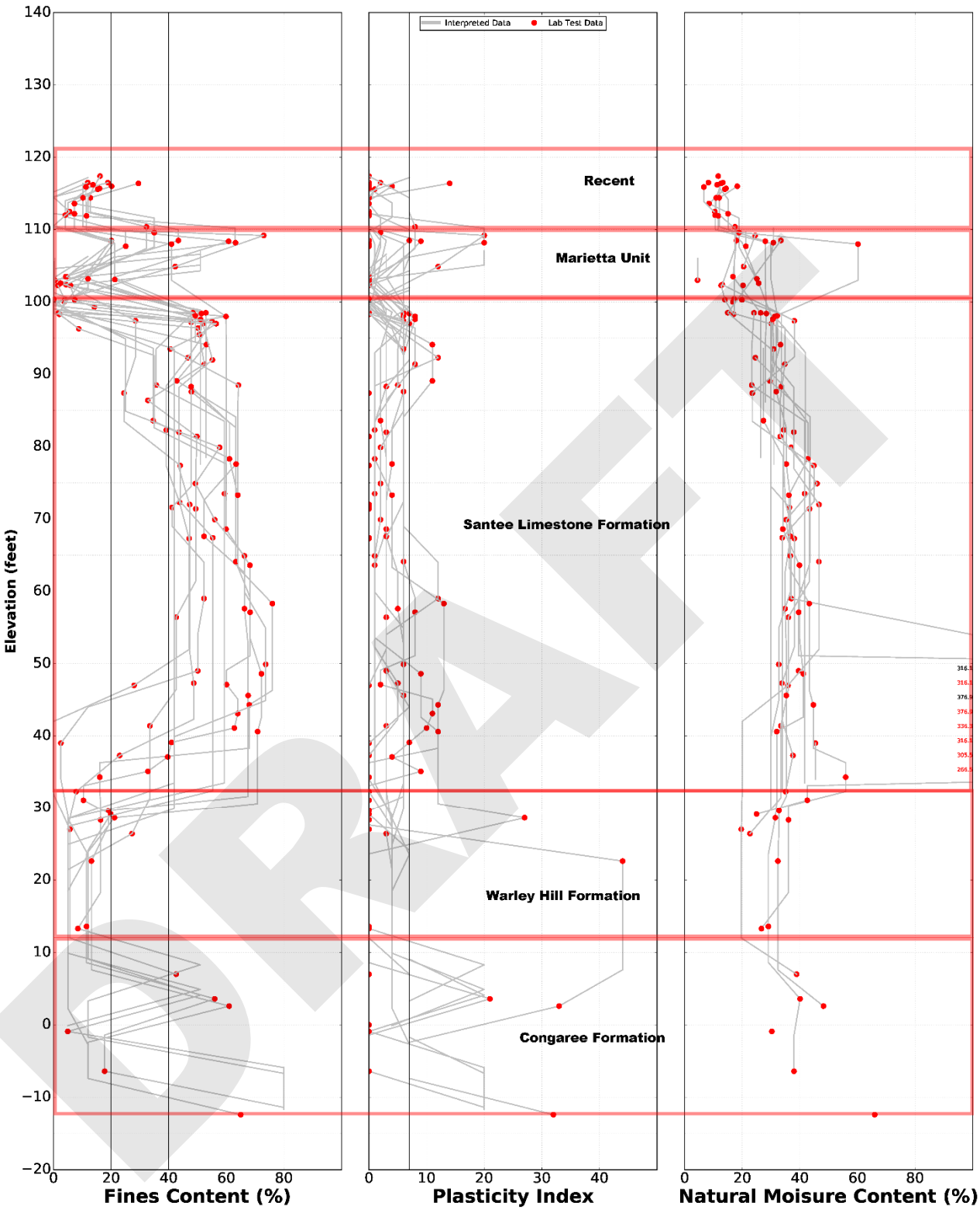
Drawing provided by SCDOT, print date 6/10/15 (b0040308bp.dgn)

GeoStellar Engineering

Boring Location Plan

US 301 RBO Four Hole Swamp
Orangeburg County, South Carolina

GeoStellar Engineering, LLC | **Figure 3**



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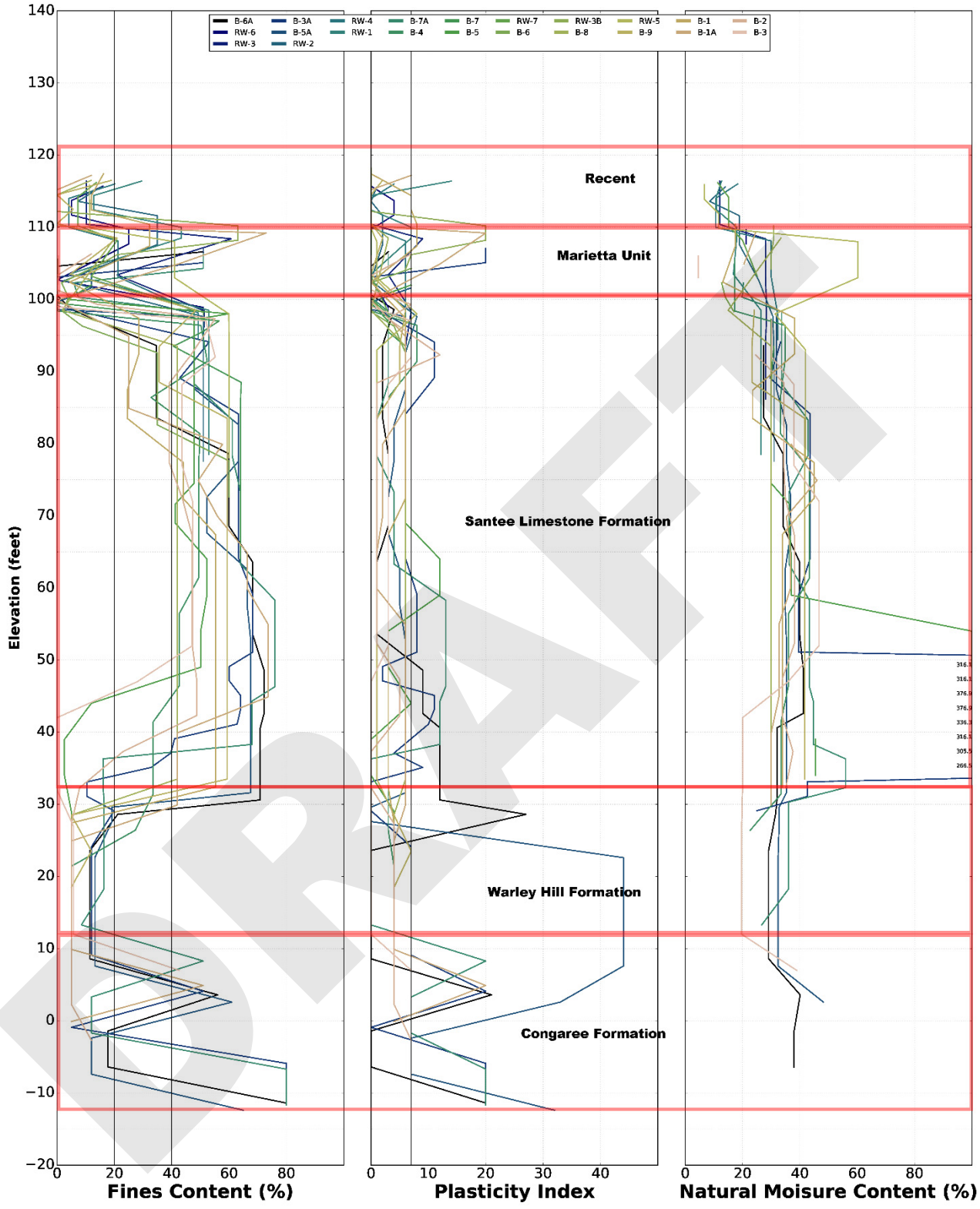
Index Properties – Laboratory Data

US 301 RBO Four Hole Swamp

Orangeburg County, South Carolina

GeoStellar Engineering, LLC

Figure 4



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Index Properties – Interpretation

US 301 RBO Four Hole Swamp

Orangeburg County, South Carolina

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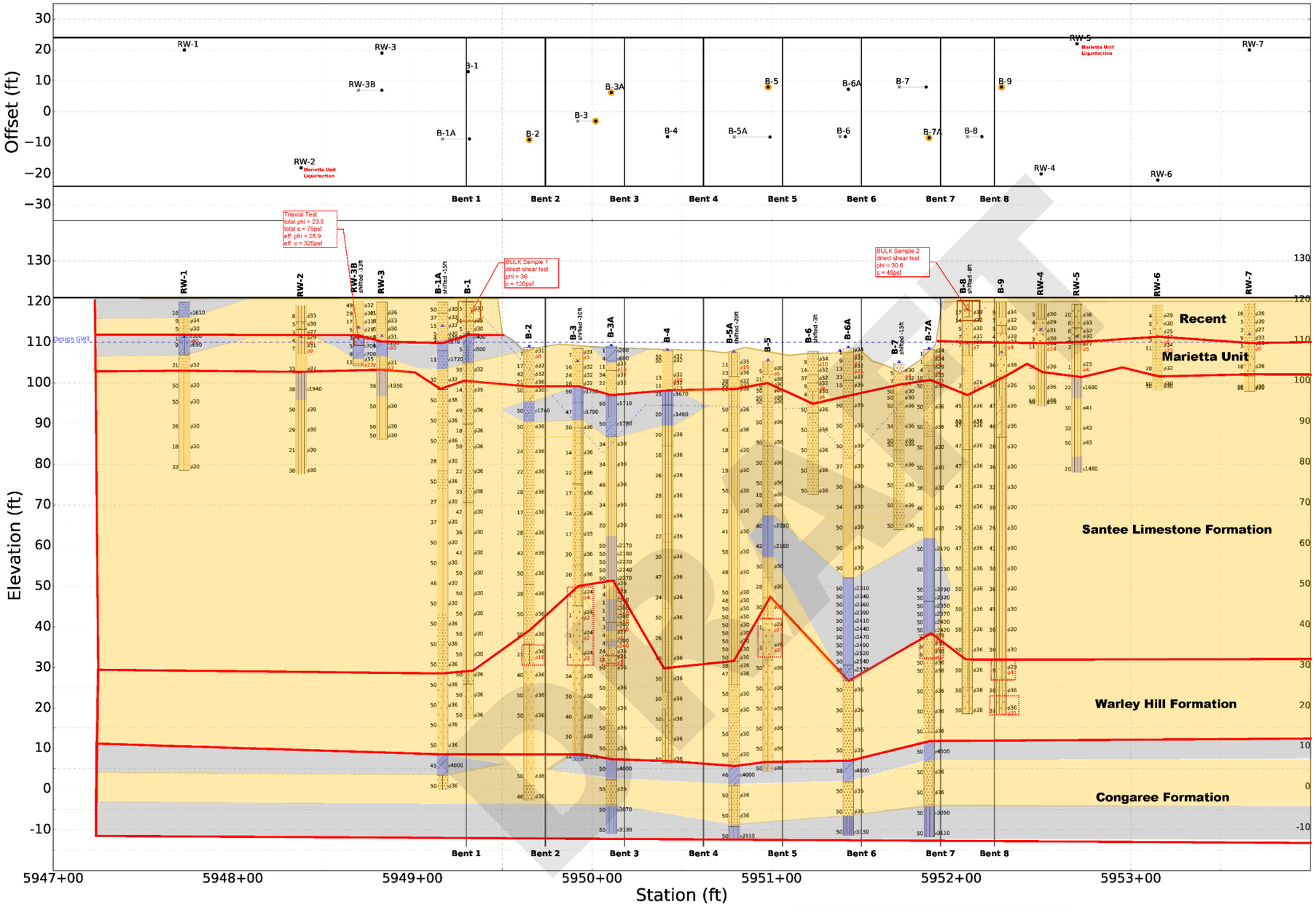
Figure 5



Boring ID

N_{60} Sand-like / Clay-like

Soil Strength:
Static (ϕ or c)
Seismic (ϕ or c)

Warley Hill Cyclic Liquefaction

shown — taken

(#') denotes boring station shifted for readability

P:\41503-0002-0001\RBO Four Hole Swamp\Subsurface Profile.pptx

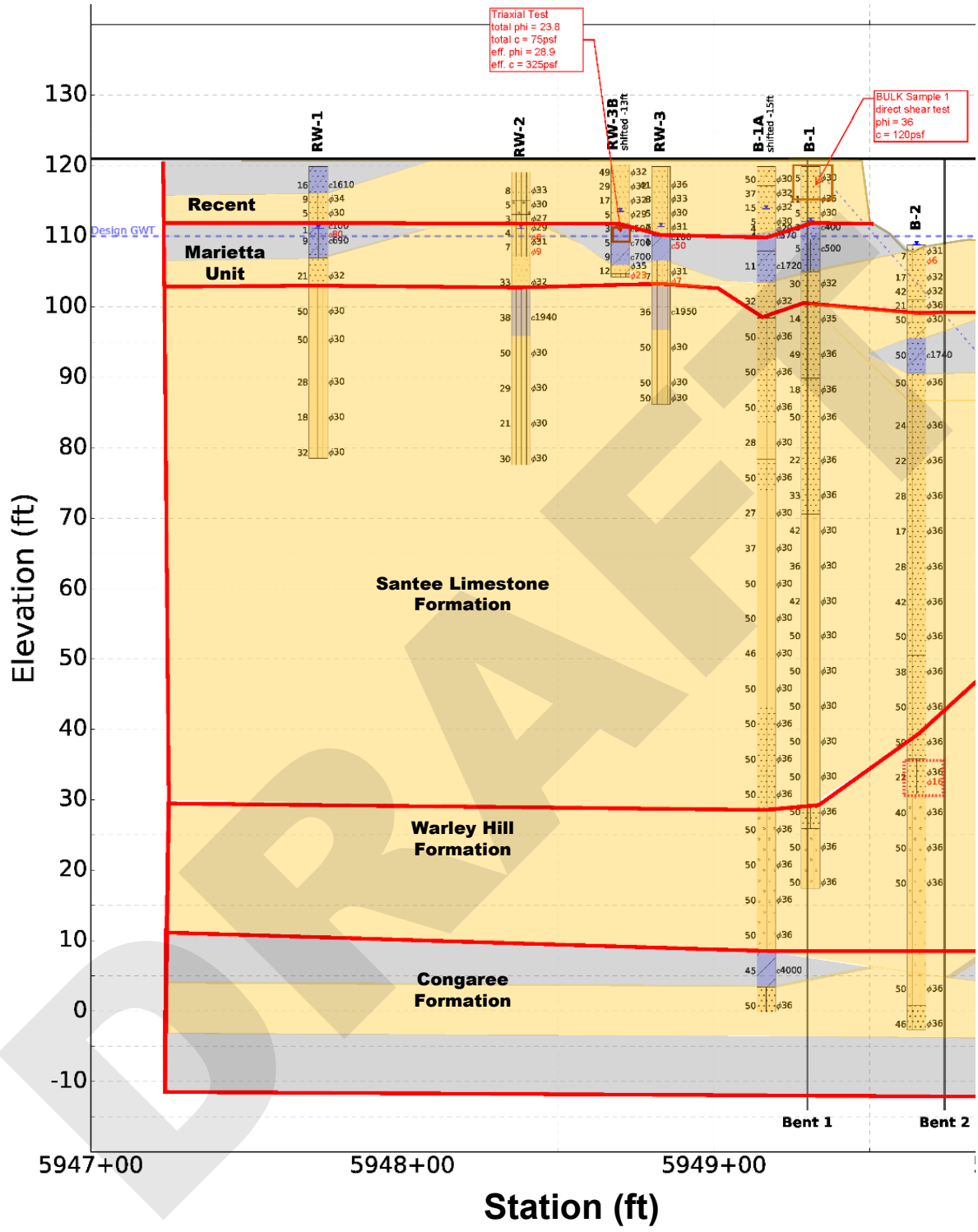
GeoStellar Engineering

Subsurface Profile

US 301 RBO Four Hole Swamp
Orangeburg County, South Carolina

GeoStellar Engineering, LLC

Figure 6



Boring ID

N_{60} Sand-like Clay-like **Soil Strength:** Static (ϕ or c) Seismic (ϕ or c)

Subsurface Profile (Bent 1)

US 301 RBO Four Hole Swamp

Orangeburg County, South Carolina

GeoStellar Engineering, LLC | Figure 7

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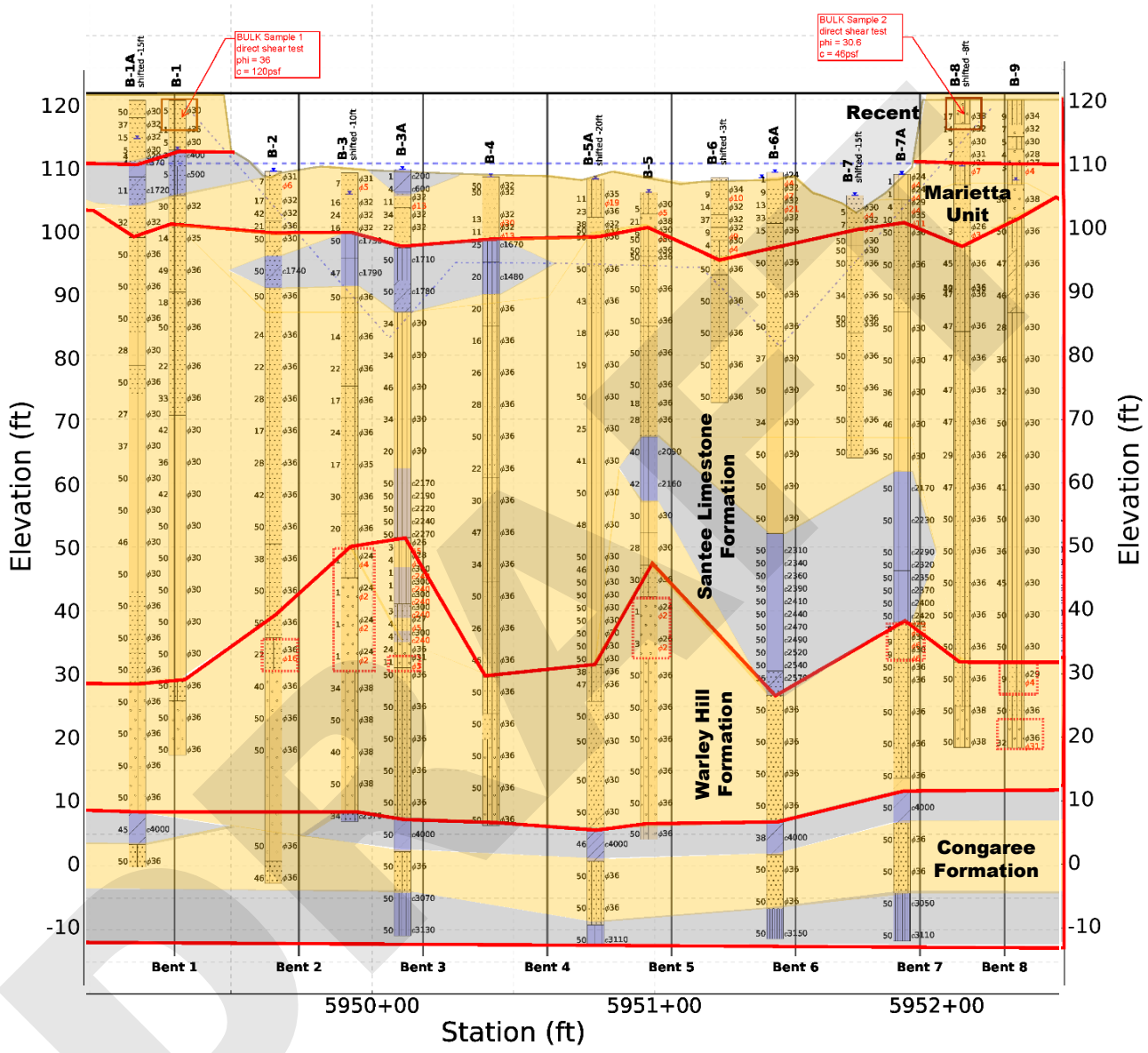

Boring ID

N_{60} Sand-like / Clay-like

Soil Strength:
Static (ϕ or c)
Seismic (ϕ or c)

Subsurface Profile (Bridge)

US 301 RBO Four Hole Swamp

Orangeburg County, South Carolina

GeoStellar Engineering, LLC

Figure 8

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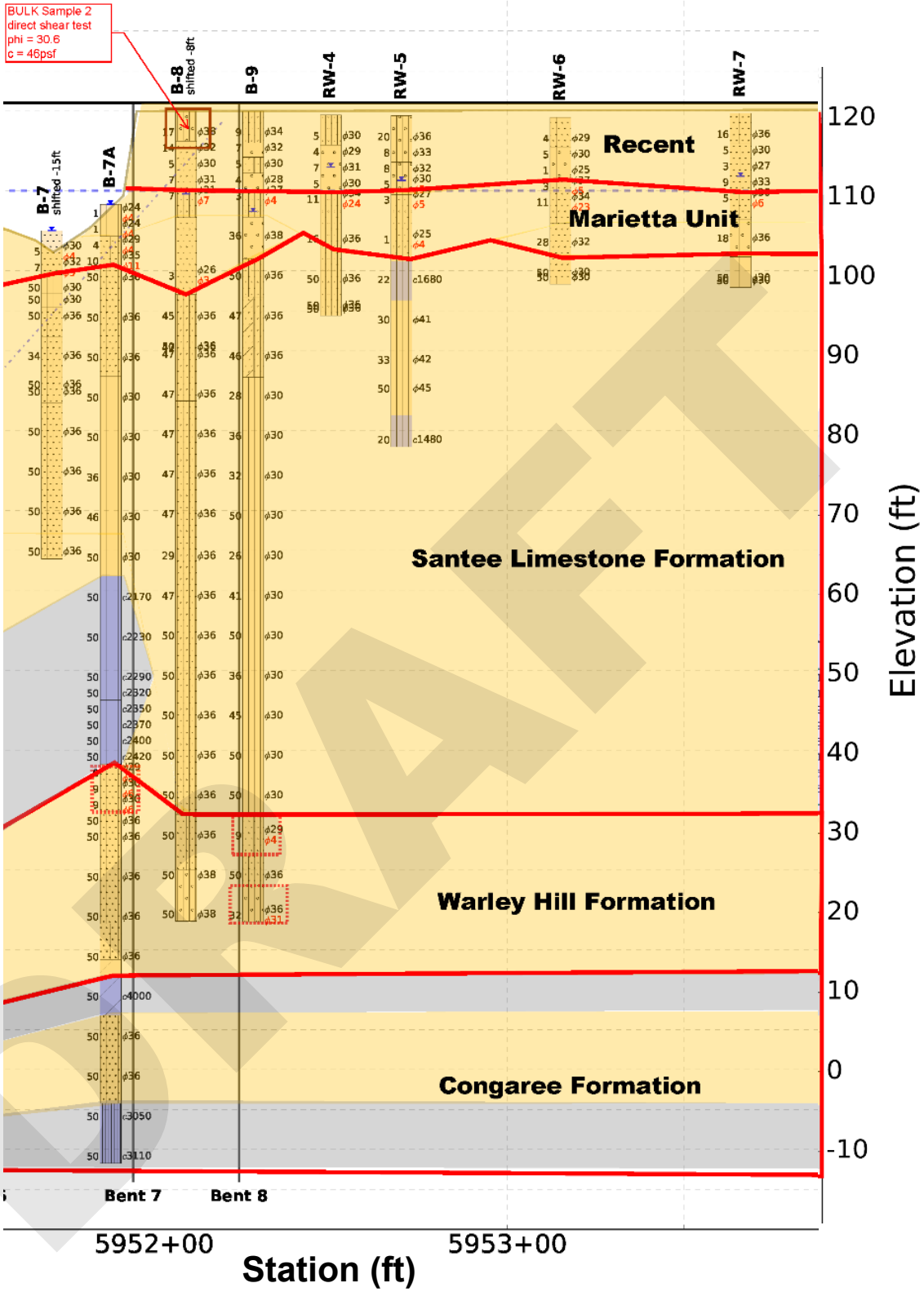

Boring ID

N_{60} Sand-like / Clay-like

Soil Strength:
Static (ϕ or c)
Seismic (ϕ or c)

Subsurface Profile (Bent 8)

US 301 RBO Four Hole Swamp

Orangeburg County, South Carolina

GeoStellar Engineering, LLC | Figure 9

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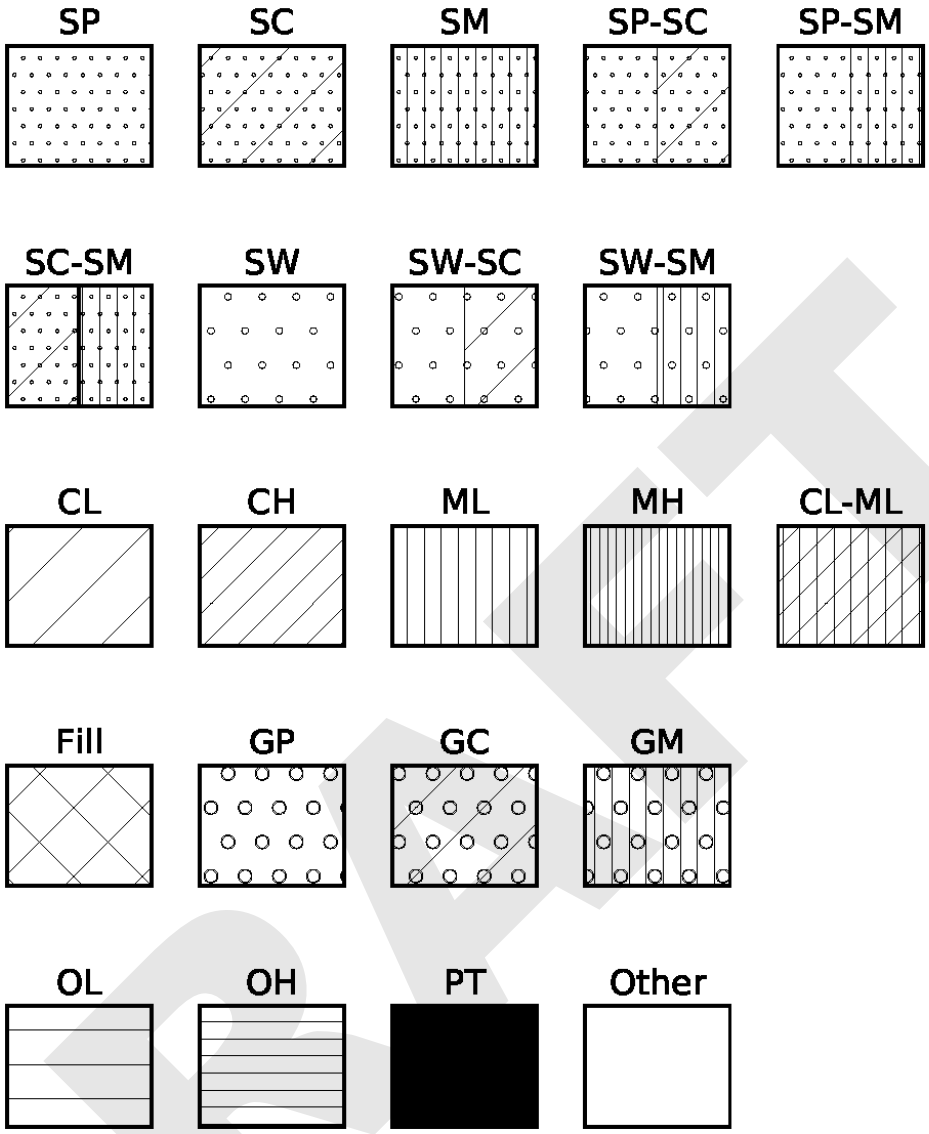


STB ID

N_{60} (blows/ft)

Sand-Like
Clay-Like

Soil Strength:
Static (ϕ or c)
Seismic (ϕ or c)

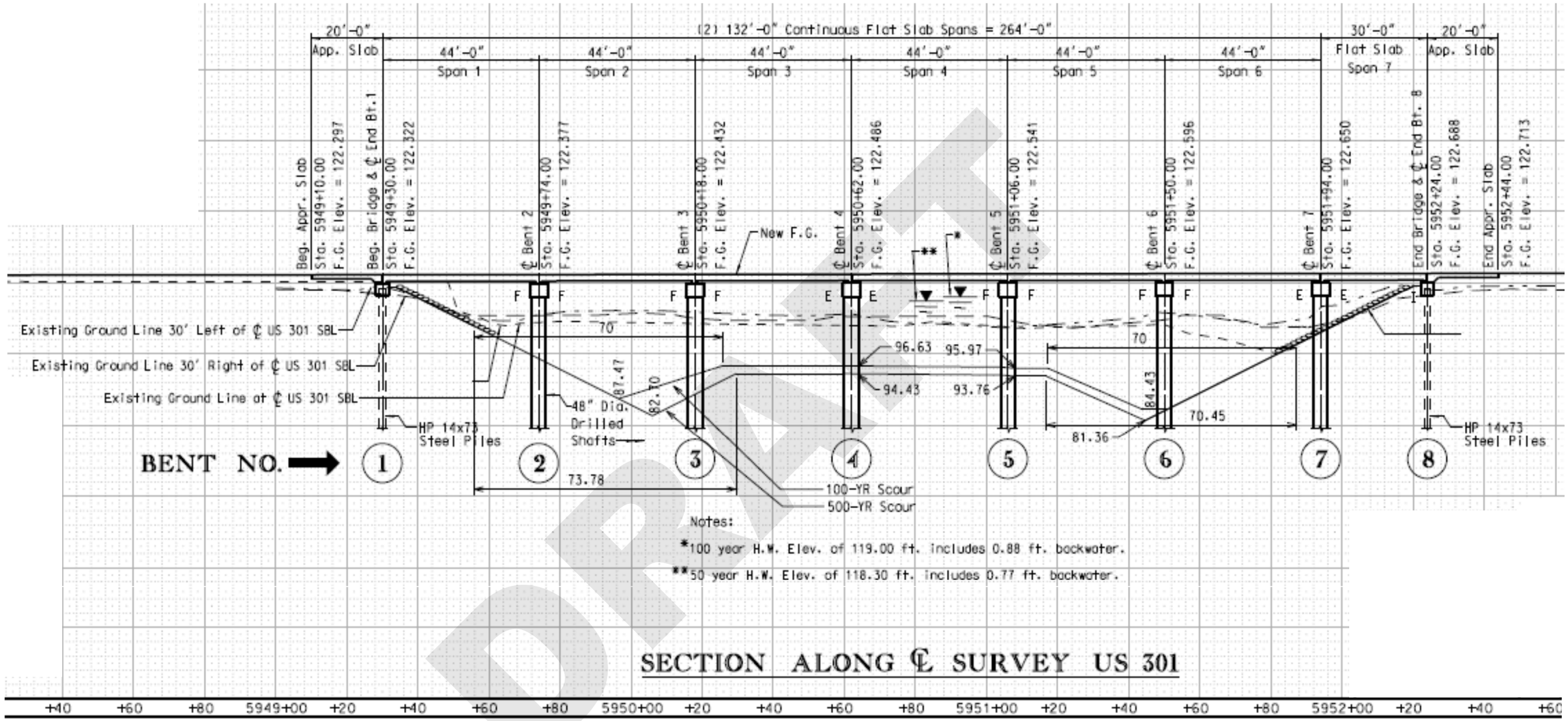
Graphic Log Legend

US 301 RBO Four Hole Swamp

Orangeburg County, South Carolina

GeoStellar Engineering, LLC | Figure 10

P:\41503-0002-0001\RBO Four Hole Swamp\Graphic Log Legend.pptx



Notes:

1. Locations and scale are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoStellar Engineering, LLC cannot guarantee the accuracy and content of reference files.

Reference Files:

Drawing provided by SCDOT, print date 6/10/15 (b0040308bp.dgn)

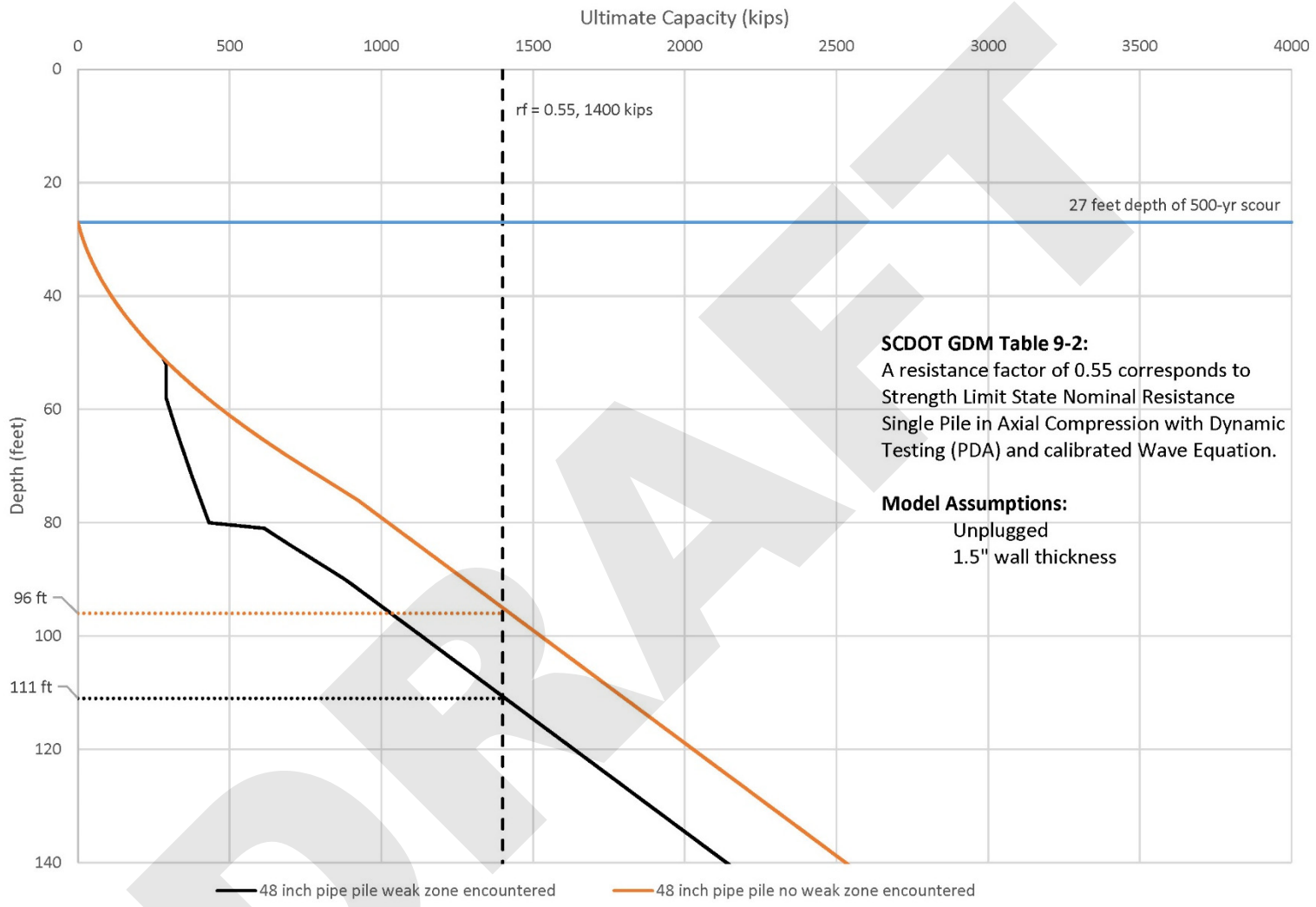
GeoStellar Engineering

Bridge Foundation Profile

US 301 RBO Four Hole Swamp
Orangeburg County, South Carolina

GeoStellar Engineering, LLC | Figure 11

P:\41503-0002-0001\RBO Four Hole Swamp\Foundation Layout.pptx



Notes:

1. Bent 3 – 48-Inch Diameter Pipe Pile Axial Nominal Pile Capacity Computations Using APILE 2014

Bent 3 – 48-Inch Pipe Pile Capacity (Open-Ended)

US 301 RBO Four Hole Swamp

Orangeburg County, South Carolina

GeoStellar Engineering, LLC | **Figure 12**

P:\41503-0002-0001\Axial Pipe Pile Compression Capacity.pptx

APPENDICES

GeoStellar Engineering

APPENDIX A

SUBSURFACE INVESTIGATION

GeoStellar Engineering

APPENDIX A
SUBSURFACE INVESTIGATION

Included in this appendix are the following Geotechnical Subsurface Data Reports:

- ICA Revised Geotechnical Data Report dated October 17, 2014.
- PSI Geotechnical Subsurface Data Report dated February 27, 2015.

ICA Revised Geotechnical Data Report

Revised Geotechnical Data Report

October 17, 2014

US 301 Bridge Replacement over Four Hole Swamp
Orangeburg County, South Carolina

Prepared For:

South Carolina Department of Transportation

submitted by

ICA Engineering

ICA Engineering

October 17, 2014

Sara M. Stone, P.E.
RPG-3 Geotechnical Design Team Leader
South Carolina Department of Transportation
955 Park Street
Columbia, SC 29201

RE: Revised Geotechnical Data Report
US 301 Bridge Replacement over Four Hole Swamp
Orangeburg County, South Carolina

Dear Ms. Stone,

We have completed the data report for the referenced project. ICA Engineering appreciates the opportunity to provide geotechnical services to the South Carolina Department of Transportation.

Sincerely,

ICA Engineering

Kenneth R. Bussey, Jr., P.E.
Project Engineer

Maegan L. Mansfield, EIT

NOT FOR CONSTRUCTION

Table of Contents

APPENDICES

ICA Engineering

1. Project Information

This report provides a characterization of subsurface conditions for the US 301 Bridge Replacement over Four Hole Swamp in Orangeburg County, South Carolina. The geotechnical data presented herein includes standard penetration testing, bulk samples, hand auger borings, core extraction, a Multichannel Analysis of Surface Waves (MASW) survey, and laboratory tests. The subsurface information provides correlation with regional geological stratigraphy and site specific strata conditions to aid the South Carolina Department of Transportation (SCDOT) in the design and construction of the proposed project. A site vicinity map is included in Section I of the Appendix.

2. Site Conditions

2.1 Regional Geology

The proposed US 301 over Four Hole Swamp bridge site is located within the perimeter limits of the USGS, Indian Camp Branch 7.5 minute X 7.5 minute, topographic quadrangle map. This location places the bridge site southeast of the Orangeburg Scarp and within the Middle Coastal Plain physiographic province as defined in South Carolina. Published mapping and report data suggest the proposed project site lies within an alluvial floodplain eroded thru undifferentiated Pliocene sediments and onto middle Eocene sediments. Alluvial sediments (Holocene) are reportedly composed of sands with limited silt/clay components and typically non-plastic. Underlying middle Eocene sediments interpreted as Santee Limestone and Congaree Formation are reportedly composed of calcareous and shelly silts and sands, interbedded glauconitic and micaceous sands, and silicified clays, respectively. Lower Eocene sediments assigned to the Fishburne Formation are interpreted within published reports to underlie the Congaree Formation.

2.2 Site Geology

Sixteen (16) standard penetration test (SPT)/sample preliminary borings and four (4) hand auger preliminary borings were advanced to investigate the proposed bridge footprint, associated retaining walls, and inaccessible areas immediately adjacent to the structures. Nine (9) borings, B-1 thru B-9, were advanced at the bridge site while seven (7) borings, RW-1 thru RW-7, were advanced near retaining wall alignments. Generally, each boring is interpreted to have intercepted some combination of roadway embankment materials, alluvium, Santee Limestone sediments, Congaree Formation sediments, and if deep enough, Fishburne Formation sediments.

Laboratory testing of recovered SPT, hand auger, bulk samples, and core samples suggested five distinct strata intervals within the advanced bridge borings. Borings B-1, B-4, B-8, B-9, RW-1 thru RW-7, and HA-3 intercepted very loose to very dense, silty to rarely clayey, fine to medium grain sand with the fine to medium fractions roughly equal or less frequently, predominately medium grain (well sorted) sand or predominately fine grain (well sorted) sand, and traces to small fractions of silt interpreted as roadway embankment. Recovered samples typically exhibited non-plastic characteristics, though low plasticity and rarely medium plasticity samples were documented. These embankment materials were encountered at the surface then penetrated to depths of 2.2 feet to 7.7 feet.

Recovered samples of very loose to medium dense with rare dense, poorly to well sorted, fine, medium and coarse grain sands with trace to small fractions (rarely equal fractions) of silt, clay, and/or gravel were interpreted within each advanced boring and interpreted as alluvium. Alluvial deposits are typically non-plastic, but occasionally exhibit low plasticity characteristics as well. Thin layers of finely sandy, non-plastic silt or finely sandy, low plasticity clay were occasionally intercepted within the alluvial deposits. Alluvial samples were encountered at the surface for borings B-2, B-3, B-5, B-6, B-7, HA-1, HA-2, and HA-4. In all other borings alluvial samples were underlying roadway embankment.

Interpreted alluvial deposits thickness ranged from 5.4 feet to 20.7 feet with base of deposits ranging from elevation 102.9 feet to elevation 92.6 feet above MSL. Borings HA-1 thru HA-4 were terminated within alluvial deposits.

Alluvial deposits are interpreted to directly overlie Santee Limestone sediments at the project site. Santee sediments typically were comprised of calcareous (strongly reactive), fine grain to occasionally medium grain sand with some to nearly half of the sample silt, and trace to small fractions of gravel within scattered samples or alternatively comprised of calcareous silt with significant fractions of fine grain sand. Rare samples comprised of fine to medium grain sand and clay were also recovered. Cementation of the Santee sediments varied from weak to strong thus resulting in SPT values equating to medium dense to very dense or very stiff to hard, with a rare loose layer immediately underlying alluvial deposits. Cementation was sufficient to support coring of intervals within the Santee sediments in borings B-5, B-6, B-7 and B-8. Recovered samples were described as very weak to weak, calcareous, fossiliferous, shelly, fine to medium grain sandstone or very weak to weak fossiliferous, shelly, very fine to fine grain calcarenite. Thin beds of medium strong sediments were noted and tested within the calcareous sandstone and noted within the calcarenite. Core recovery varied from 46 percent to 100 percent, with most runs greater than 70 percent. Core RQD varied from 0 percent to 64 percent, with most runs 40 percent or less. Selected core samples were subjected to unconfined compression testing with calcareous sandstone samples ranging from 261 psi to 4,688 psi and calcarenite samples ranging from 116 psi to 643 psi. Santee sediments are interpreted to be 49.3 feet to 74.2 feet in thickness with the Santee base ranging from elevation 50.1 feet to elevation 23.9 feet above MSL. Borings B-6, B-7, and RW1 thru RW-7, were terminated within Santee sediments.

Sediments interpreted as Congaree Formation underlie Santee sediments at the bridge site. Sediments exhibited non-plastic characteristics, very loose to very dense compaction, and were composed

of medium grain sand with smaller fractions of both fine and coarse grain sizes, contain traces of silt and gravel, were micaceous, glauconitic, and occasionally strongly cemented. Congaree sediments appear to be 35.0 feet to 41.3 feet thick at the subject bridge site. Borings B-1, B-4, B-5, B-8 and B-9 were terminated within Congaree Formation sediments.

Borings B-2 and B-3 penetrated Congaree sediments to encounter medium dense to dense, fine grain sand with equal fractions of silt, and small fractions of medium grain sand. Published documents suggest these sediments to be lower Eocene Fishburne Formation. This material was penetrated to depths of 108.0 feet and 100.0 feet in borings B-2 and B-3, respectively. These depths equate to elevations of 0.9 feet and 8.8 feet above MSL.

SPT refusal was encountered at different levels within fourteen (14) of the advanced borings. In each case, with the exception of two (2) instances, visual observation indicated strong cementation to be the factor linked to refusal. Santee sediments in particular exhibited widely varying cementation levels at variable elevations but not necessarily correlative from boring to boring. Congaree sediments also exhibited thin seams of moderate to strong cementation but not to the vertical extent of the Santee strata unit. Two (2) instances of SPT refusal at shallow depths were upon the apparent interception of existing bridge footings in borings B-4 and B-6.

3. Field Exploration Program

ICA Engineering, Inc. (ICA) advanced a total of sixteen (16) SPT borings. As previously stated, nine (9) SPT borings (B-1 through B-9) were drilled at the proposed bridge site and seven (7) SPT borings (RW-1 through RW-7) were drilled near the proposed retaining walls. Two (2) bulk samples (Bulk-1 and Bulk-2) were obtained in the bridge borings. Four (4) hand auger borings (HA-1 through HA-4) were also conducted. An MASW survey was also performed near the bridge site. Table 1 lists the subsurface testing conducted for the described investigation.

Table 1: Subsurface Testing Locations

Test Hole No.	Station	Offset (ft)	Soil Depth (ft)	Core Depth (ft)
B-1	5949+31	13’ LT	102.5	0
B-2	5949+65	9’ RT	111.5	0
B-3	5950+02	3’ RT	101.5	0
B-4	5950+42	8’ RT	101.5	0
B-5	5950+98	8’ LT	80.3	21
B-6	5951+41	8’ RT	15.2	20
B-7	5951+86	8’ LT	20	21
B-8	5952+17	8’ RT	80.5	20.9
B-9	5952+28	8’ LT	101.5	0
Bulk-1	5949+31	13’ LT	5	N/A
Bulk-2	5952+17	8’ RT	5	N/A
SA-1	5952+40	14’RT	92.6	N/A
RW-1	5947+73	20’ LT	41.4	N/A
RW-2	5948+38	18’ RT	41.5	N/A
RW-3	5948+83	13’ LT	33.7	N/A
RW-4	5952+50	20’ RT	25.1	N/A
RW-5	5952+70	10’ LT	41.4	N/A
RW-6	5953+15	22’ RT	20.9	N/A
RW-7	5953+66	20’ LT	21.8	N/A
HA-1	5948+00	50’ RT	10.5	N/A
HA-2	5949+00	60’ RT	7.5	N/A
HA-3	5952+23	40’ RT	10.5	N/A
HA-4	5952+54	42’ RT	3.5	N/A

The SPT borings were advanced by a CME-45C track-mounted drill rig using rotary wash and casing techniques. Two (2) bridge borings, B-5 and B-8, encountered casing refusal at 10.0 feet and 30.4 feet, respectively. Borings B-5 and B-8 returned to sampling at 31 feet and 51.3 feet, respectively, and did not encounter casing refusal thereafter. Borings B-6 and B-7 encountered casing refusal at depths ranging between 15.2 feet and 20 feet. The remaining bridge borings did not encounter casing refusal and all borings were terminated at depths ranging between 41 feet to 111.5 feet. Two (2) bulk samples were taken at depths of five (5) feet in borings B-1 and B-8.

The retaining wall borings were drilled to an approximate depth of 41 feet, except where SPT refusal occurred. SPT refusal occurred in borings RW-3, RW-4, RW-6, and RW-7, at depths ranging

between 20.9 feet to 30.7 feet. Hand auger borings were terminated at depths ranging from 3.5 feet to 10.5 feet. Terracon also performed one (1) MASW survey.

Recovered SPT samples along with the rock cores were delivered to ICA's laboratory for testing and analysis. Plan sheets depicting the locations of the borings are presented in Section II of the Appendix. Boring logs are presented in Section III and the results of the laboratory testing are presented in Section IV. The results of the MASW survey are depicted in Section V.

3.1 Standard Penetration Testing

SPT borings were terminated at depths ranging from 20 feet to 111.5 feet. Boring logs are presented in Section III of the Appendix. In all borings, except boring B-4, standard penetration tests were conducted at 2 foot intervals in the top 10 feet and at 5 feet intervals until achieving casing refusal or the boring termination depths. During drilling operations of boring B-4, the concrete bridge footing was penetrated at a depth range of 3.3 feet to 4.8 feet; thus a sample was not taken at the standard 4.0 foot interval. Normal SPT sampling procedures were conducted throughout the remainder of the boring. It should be noted that the N-values presented in the boring logs are the uncorrected, field N-values. Blow counts recorded at these intervals were produced from a standard penetration test hammer with an energy ratio of 79% for the CME-45C drill rig. The recent hammer report is included in Section VI of the Appendix.

3.2 MASW Survey

Multichannel analysis of surface waves (MASW) is a seismic method that uses the dispersive characteristics of Rayleigh-type surface waves to determine the variation of the shear wave velocity of layered systems with depth. Unlike spectral analysis of surface waves (SASW) which can get overwhelmed by noise and other artificial source waves, the MASW method can identify and reject non-fundamental Rayleigh waves and noise; thereby it can focus the data collection on the Rayleigh waves.

Refraction Microtremor (ReMi) and Microtremor Array Measurement (MAM) are two methods of passive source techniques to measure noise. In both, lower frequency surface waves arising from microtremors and/or noise, such as traffic, are recorded using linear or two dimensional arrays of geophones. Due to the shortcomings of techniques being performed along and the advantages offered through their combined use, Terracon used MAM in conjunction with MASW for the development of this survey.

The result of this one (1) survey was an average shear wave velocity in the top 100 feet of 1082.7 feet per second and the coefficient of variability (COV) is 0.44. Therefore, based on this one (1) result, we would recommend that the site would classify as Site Class D in accordance with Step 2 of Table 12-20 in the SCDOT Geotechnical Design Manual (GDM). The result of the MASW test is shown in Section IV of the Appendix. The location is also shown as SA-1 on the test location plans in Section II of the Appendix.

4. Laboratory Testing Program

Laboratory tests performed on representative samples were selected by SCDOT. Procedures included natural moisture content of soils, Atterberg limits, sieve analysis, AASHTO and ASTM soil classification, unconfined compression, and direct shear testing. Table 2 summarizes the testing performed and quantity of each test. Laboratory results are presented in Section IV of the Appendix.

Table 2: Laboratory Testing

Test Type	Quantity
Atterberg Limits	70
#200 wash	85
Hydrometer	14
Natural Moisture Content	69
Unconfined Compression (Rock)	17
Direct Shear	2

5. Limitations to Report

Discussion of geologic and geotechnical conditions observed in the field, observed from field sample recovery, observed in laboratory examination of samples and computed data analysis, which are all quantified in this data report, should be considered preliminary investigation and are subject to change upon the acquisition of additional data during the final investigation. No other warranty, express or implied, is made. The Geotechnical Engineer of Record for the project must review the data submitted in this report and develop their own interpretation of the testing results as they apply to design.

6. References

Colquhoun, D.J., et. al., 1987; Quaternary Geologic Map of the Savannah 4° X 6° Quadrangle, United States; USGS Miscellaneous Investigations Series, Map-I-1420 (NI-17).

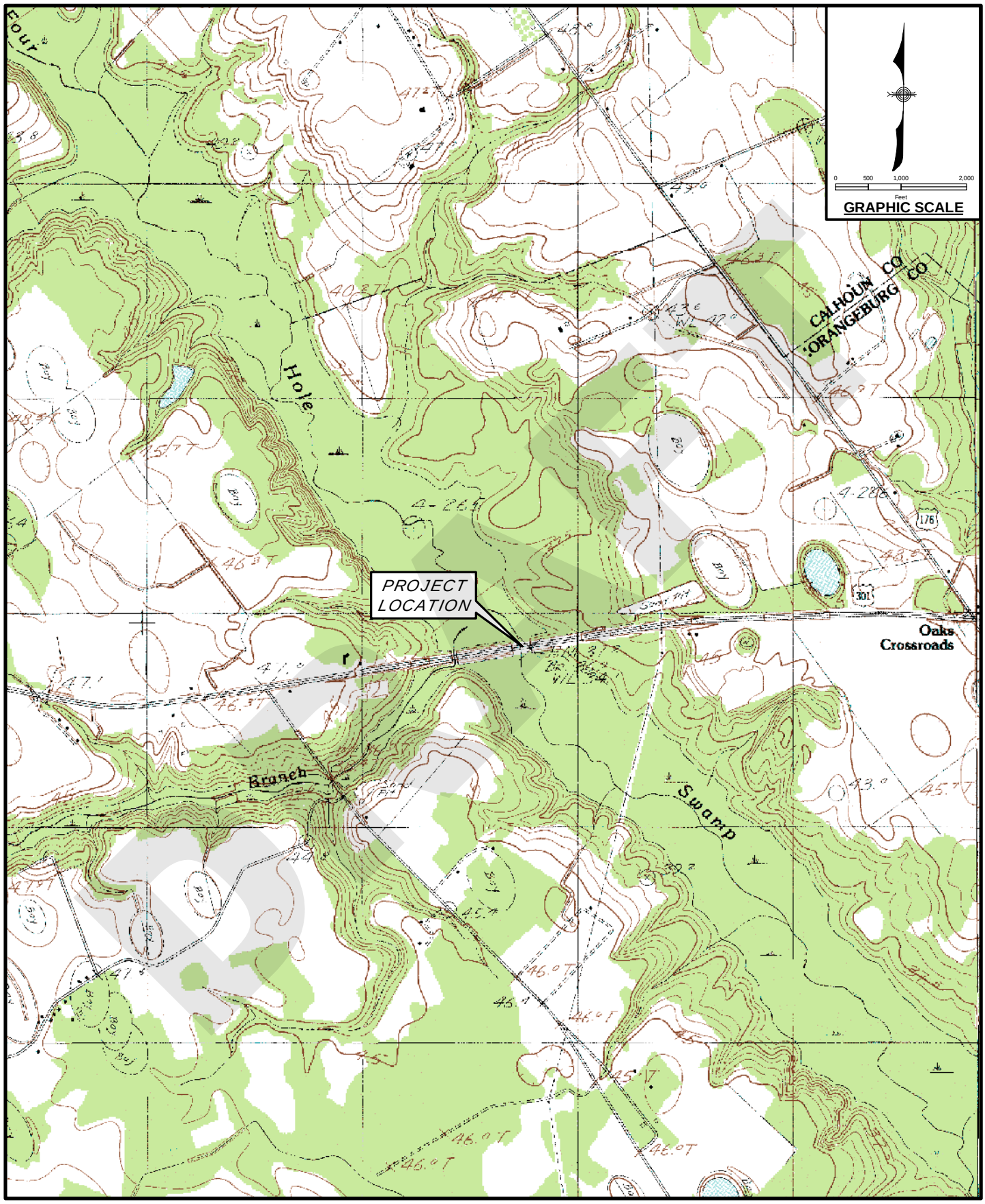
Force, L.A., 1978; Geological Studies of the Charleston, South Carolina, Area – Thickness of Overburden Map; USGS Miscellaneous Field Studies, Map MF-1021 B; 1 sheet.

Harris, W.B. and Zullo, V.A., 1991; Eocene and Oligocene Stratigraphy of the Outer Coastal Plain in Geology of the Carolinas – Chapter 14, J. Wright Horton,, Jr. and Victor A. Zullo eds.; University of Tennessee Press.

McCartan, L.A., Weems, R.E. and Lemon, E.M.Jr., 1988; Quaternary Stratigraphy in the Vicinity of Charleston, South Carolina and Its Relationship to Local Seismicity and Regional Tectonism; in USGS Professional Paper 1367, Studies Related to the Charleston, South Carolina Earthquake of 1886 – Neogene and Quaternary Lithostratigraphy and Biostratigraphy, pgs. 1, 3, 6 and 9.

Renken, R.A., 1996; Hydrogeology of the Southeastern Coastal Plain Aquifer System in Mississippi, Alabama, Georgia and South Carolina; USGS Professional Paper 1410-B; pgs. 46-47.

Appendix Section I
Site Vicinity Map


PROJECT LOCATION
Four Hole Swamp
Branch
Oaks Crossroads
CALHOUN CO
ORANGEBURG CO
GRAPHIC SCALE
0 500 1,000 2,000
Feet

Appendix Section II
Test Location Plans and Profiles

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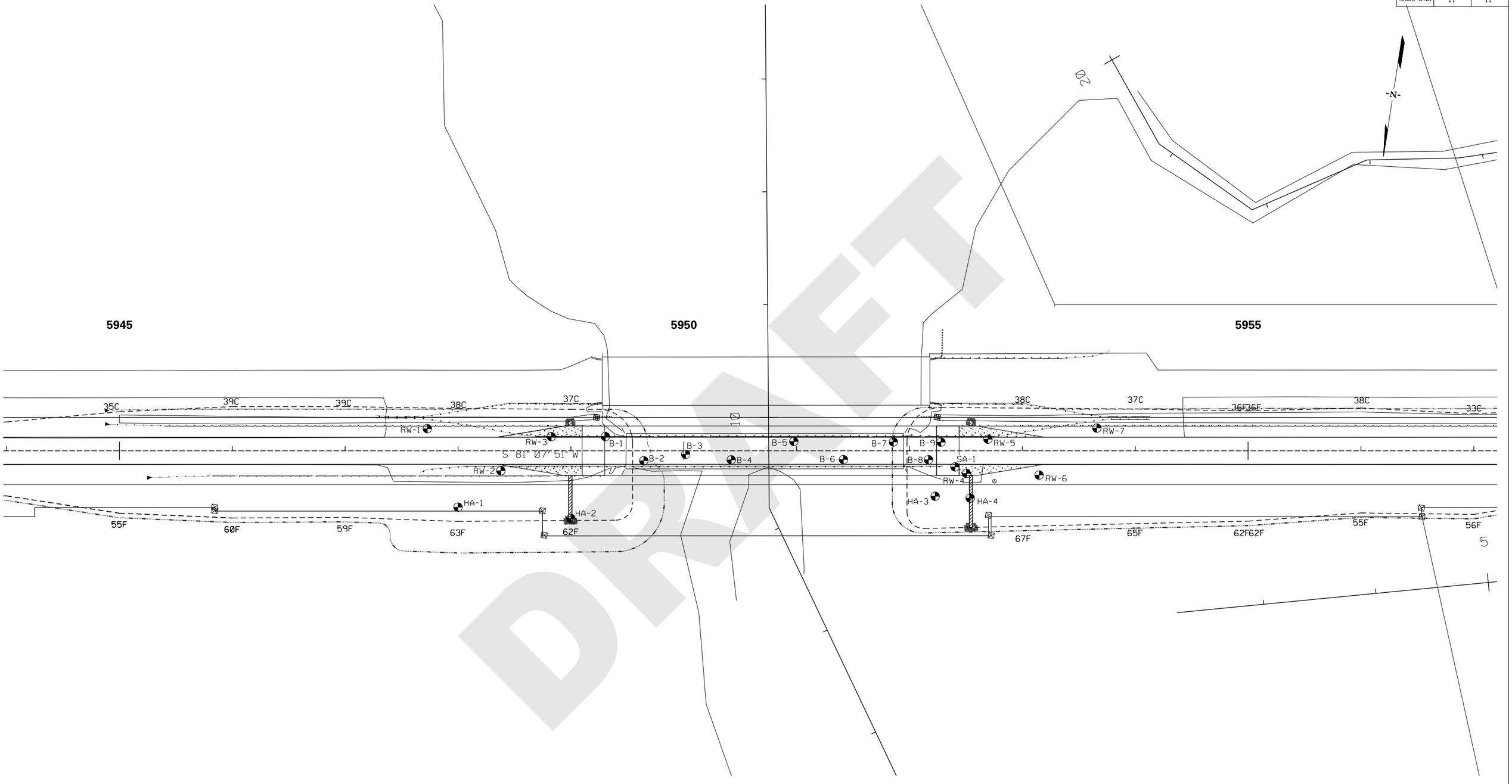

REV.			
REV.			
REV.			
REVIEWED			
QUAN.			
DR.	TAR		8-14
DES.	KRB		8-14
	BY	CHK.	DATE

SCDOT BRIDGE DESIGN COLUMBIA, S.C.

BRIDGE REPLACEMENT OVER FOUR HOLE SWAMP

FILE NO.	ROUTE	COUNTY	DRAWING NO.
38.040308	US 301	ORANGEBURG	A - 18

ICA Engineering

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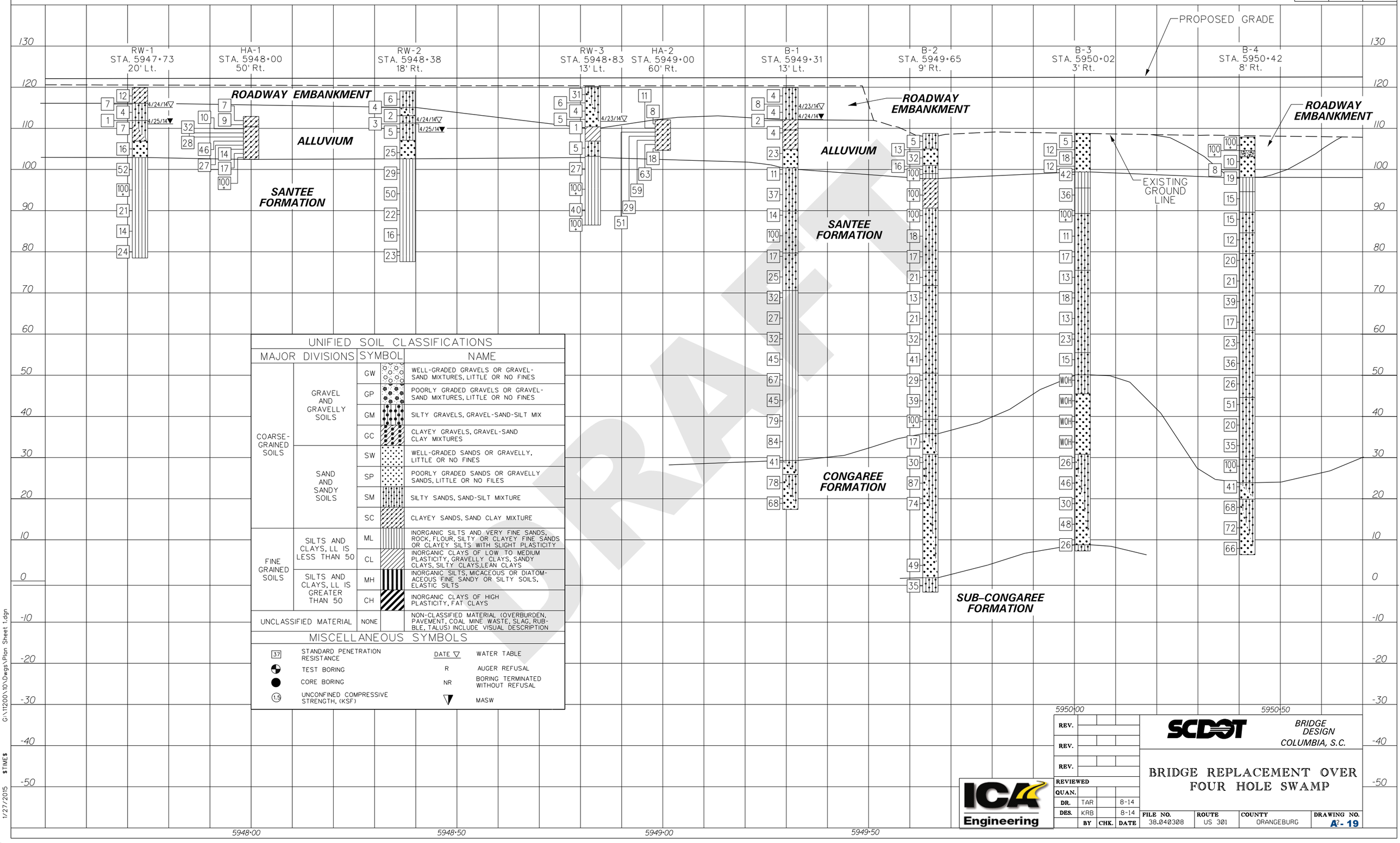

UNIFIED SOIL CLASSIFICATIONS

MAJOR DIVISIONS		SYMBOL	NAME
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIX
		GC	CLAYEY GRAVELS, GRAVEL-SAND CLAY MIXTURES
	SAND AND SANDY SOILS	SW	WELL-GRADED SANDS OR GRAVELLY, LITTLE OR NO FINES
		SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FILES
		SM	SILTY SANDS, SAND-SILT MIXTURE
		SC	CLAYEY SANDS, SAND CLAY MIXTURE
FINE GRAINED SOILS	SILTS AND CLAYS, LL IS 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
	SILTS AND CLAYS, LL IS GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
UNCLASSIFIED MATERIAL		NONE	NON-CLASSIFIED MATERIAL (OVERBURDEN, PAVEMENT, COAL MINE WASTE, SLAG, RUBBLE, TALUS) INCLUDE VISUAL DESCRIPTION

MISCELLANEOUS SYMBOLS

37	STANDARD PENETRATION RESISTANCE	DATE ▽	WATER TABLE
	TEST BORING	R	AUGER REFUSAL
	CORE BORING	NR	BORING TERMINATED WITHOUT REFUSAL
1.5	UNCONFINED COMPRESSIVE STRENGTH, (KSF)		MASW

REV.				
REV.				
REV.				
REVIEWED				
QUAN.				
DR.	TAR		8-14	
DES.	KRB		8-14	
	BY	CHK.	DATE	

SCDOT BRIDGE DESIGN COLUMBIA, S.C.

BRIDGE REPLACEMENT OVER FOUR HOLE SWAMP

FILE NO.	ROUTE	COUNTY	DRAWING NO.
38.040308	US 301	ORANGEBURG	A²- 19

ICA Engineering

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$TIME$
1/27/2015

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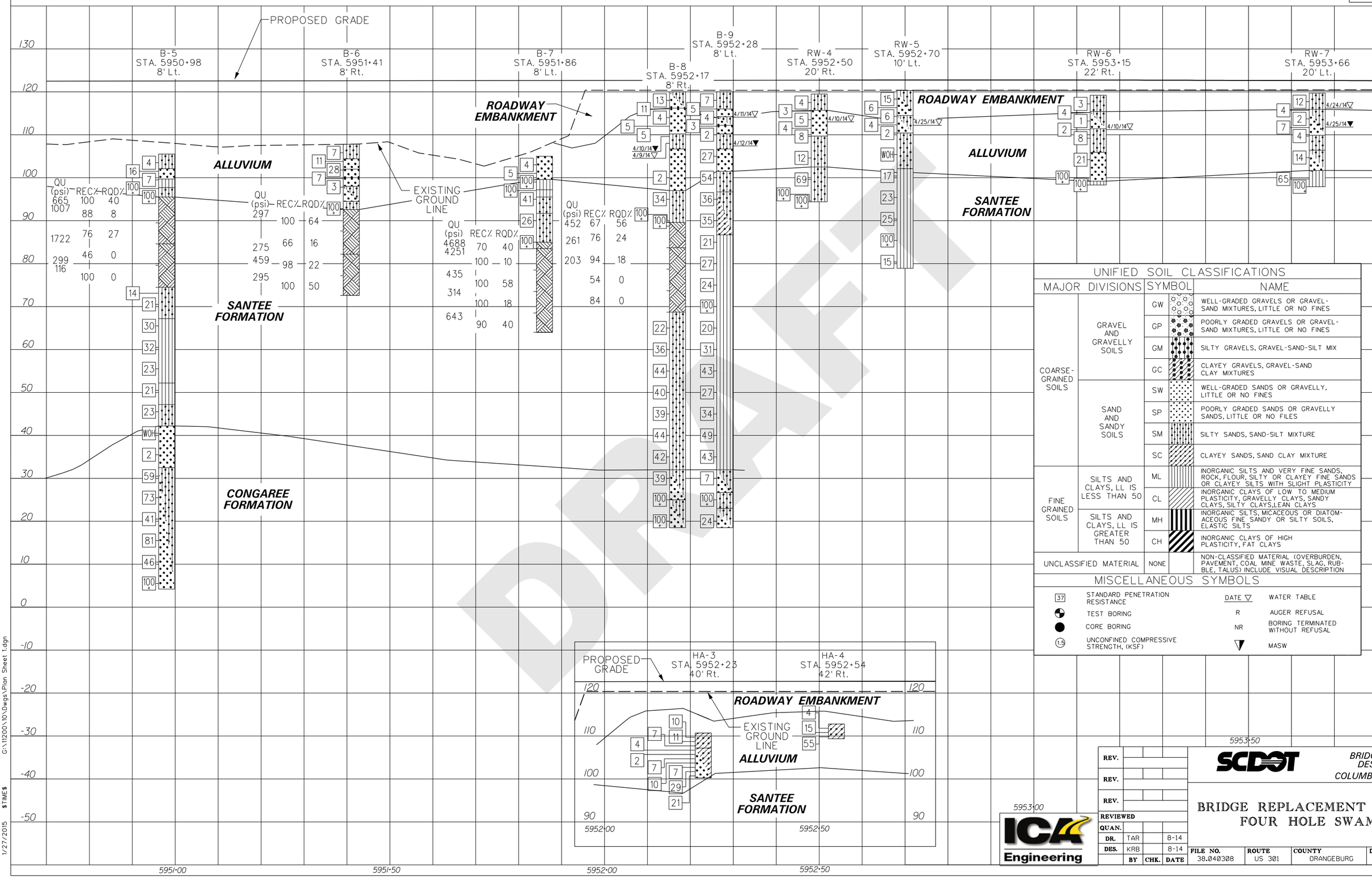


UNIFIED SOIL CLASSIFICATIONS

MAJOR DIVISIONS		SYMBOL	NAME
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIX
		GC	CLAYEY GRAVELS, GRAVEL-SAND CLAY MIXTURES
	SAND AND SANDY SOILS	SW	WELL-GRADED SANDS OR GRAVELLY, LITTLE OR NO FINES
		SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FILES
		SM	SILTY SANDS, SAND-SILT MIXTURE
		SC	CLAYEY SANDS, SAND CLAY MIXTURE
FINE GRAINED SOILS	SILTS AND CLAYS, LL IS 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
	SILTS AND CLAYS, LL IS GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
UNCLASSIFIED MATERIAL		NONE	NON-CLASSIFIED MATERIAL (OVERBURDEN, PAVEMENT, COAL MINE WASTE, SLAG, RUBBLE, TALUS) INCLUDE VISUAL DESCRIPTION

MISCELLANEOUS SYMBOLS

37	STANDARD PENETRATION RESISTANCE	DATE ▽	WATER TABLE
	TEST BORING	R	AUGER REFUSAL
	CORE BORING	NR	BORING TERMINATED WITHOUT REFUSAL
1.5	UNCONFINED COMPRESSIVE STRENGTH, (KSF)		MASW

5953+50

5953+00

ICA Engineering

REV.			
REV.			
REV.			
REVIEWED			
QUAN.			
DR.	TAR		8-14
DES.	KRB		8-14
	BY	CHK.	DATE

SCDOT BRIDGE DESIGN COLUMBIA, S.C.

BRIDGE REPLACEMENT OVER FOUR HOLE SWAMP

FILE NO.	ROUTE	COUNTY	DRAWING NO.
38.040308	US 301	ORANGEBURG	A - 20

Appendix Section III
Soil Test Boring Logs

Field Exploration Description

Overview

The testing locations were chosen by SCDOT using aerial photography and landmarks. Stations and offsets were estimated using aerial photography and existing drawings. The borings were surveyed by Carolina Surveying Services after drilling was complete. The locations shown in the Exploration and Location Plan should be considered accurate only to the degree implied by the means and methods used to define them.

A field log of each test was prepared by field personnel. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

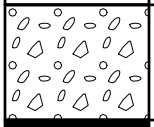
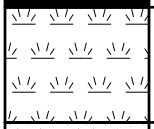
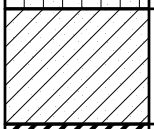
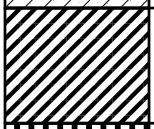
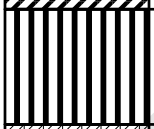
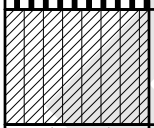
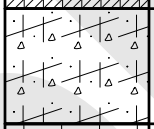
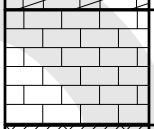
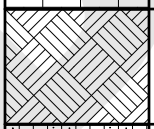
Soil Test Borings

All boring and sampling operations were conducted in accordance with the following procedures:

- SCDOT Geotechnical Design Manual 2010
- ASTM D5783, "Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration"
- ASTM D1586, "Test Method for Penetration Test and Split-Barrel Sampling of Soils"
- ASTM D4220, "Standard Practices for Preserving and Transporting Soil"

Unless noted otherwise, at 2 foot intervals within the upper 10 feet and 5 foot intervals thereafter, soil samples were obtained with a standard 1.4 inch I.D., 2 inch O.D., split-barrel sampler, also known as a standard split-spoon. The sampler is advanced into the soil a total of 18 inches by striking the drill rod using a 140-pound safety or automatic hammer falling 30 inches. The number of blows required to advance the sampler for each of three 6 inch increments is recorded. The sum of the number of blows for the second and third increments is called the "Standard Penetration Value", or N-value (Nmeas) (blows per foot). The N-value, when properly evaluated, is an index to the soil strength.

Soil Classification provides a general guide to the engineering properties of various soil types and enables the engineer to apply his experience to current situations. In our exploration, samples obtained during drilling operations are examined and visually classified by a geotechnical engineer using the procedures outlined in ASTM D2487 "Standard Classification of Soils for Engineering Purposes" (Unified Soil Classification system). Laboratory testing was also performed on select split-spoon samples to evaluate index properties for further classification. The soils are described according to color, texture, and relative density or consistency (based on standard penetration resistance). The designations shown on the logs are described on the following page.

SYMBOL	gINT CODE*	TYPICAL DESCRIPTION
	**SCCT**	*CONCRETE*
	**SCAT**	*ASPHALT*
	**SCTS**	*TOPSOIL/PEAT*
	**SCSAND**	*SAND*
	**SCSTSAND**	*SILTY SAND/SANDY SILT*
	**SCCLSAND**	*CLAYEY SAND/SANDY CLAY*
	**SCCLAY**	*CLAY*
	**SCSILT**	*SILT*
	**SCSTCLAY**	*SILTY CLAY/CLAYEY SILT*
	**SCSAP**	*SAPROLITE*
	**SCLS**	*LIMESTONE*
	**SCBR**	*GRANITE (BEDROCK)*
	**SCMARL**	*MARL*

**These codes are not the classification for the material. These are the Graphic codes to be used in the Lithology table.*

gINT SOIL/ROCK SYMBOL LEGEND

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-1	**Boring Location:**	5949+31	**Offset:**	13' Lt.	**Alignment:**	US 301
Elev.:	119.9 ft	**Latitude:**	33.45753	**Longitude:**	80.64727	**Date Started:**	4/22/14
Total Depth:	102.5 ft	**Soil Depth:**	102.5 ft	**Core Depth:**	ft	**Date Completed:**	4/23/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.2 ft	**24HR**	7.7 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	**Roadway Embankment:** Very loose to loose, dry to wet, orange, tan, black, brown & gray, sub-angular, non-reactive, f. to med. grain silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=11.7, %#200=16.2		2.0	SS-1	3	2	2	4
114.9	7.8			4.0	SS-2	3	4	4	8
				6.0	SS-3	3	2	2	4
				8.0	SS-4	1	1	1	2
109.9	10.3	**Alluvium:** Very loose, moist, tan, brown & gray, non-reactive, clayey SAND (SC/A-2-4). LL=25, PL=17, PI=8, NMC=17.5, %#200=32.3		11.0	SS-5	1	2	2	4
104.9	15.0	Very loose, moist, tan, brown & gray, non-reactive, silty, clayey SAND (SC-SM/A-4).		16.0	SS-6	10	11	12	23
99.9	19.5	Medium dense, wet, gray & white, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=13.1, %#200=4.4		21.0	SS-7	1	2	9	11
94.9		**Santee Formation:** Medium dense to dense, moist, green & gray, strongly reactive, silty SAND (SM/A-2-4). LL=37, PL=31, PI=6, NMC=38.1, %#200=28.5		26.0	SS-8	8	16	21	37
89.9	30.0			31.0	SS-9	8	4	10	14
84.9		Medium dense to very dense, moist to wet, green & gray, sub-angular, strongly reactive, strongly cemented, f. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=23.5, %#200=24.5		36.0	SS-10	16	50/0.4		50/0.4
79.9	40.2			41.0	SS-11	5	5	12	17
74.9		Medium dense, moist, green, gray & tan, strongly reactive, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=44.9, %#200=44.0		46.0	SS-12	6	9	16	25
	49.3								

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-1	**Boring Location:**	5949+31	**Offset:**	13' Lt.	**Alignment:**	US 301
Elev.:	119.9 ft	**Latitude:**	33.45753	**Longitude:**	80.64727	**Date Started:**	4/22/14
Total Depth:	102.5 ft	**Soil Depth:**	102.5 ft	**Core Depth:**	ft	**Date Completed:**	4/23/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.2 ft	**24HR**	7.7 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		Very stiff to hard, moist, green, gray & tan, strongly reactive, med. to strongly cemented, sandy SILT (ML/A-4). LL=NP, PL=NP, PI=NP, NMC=33.9, %#200=55.3		51.0	SS-13	8	9	23	32
64.9				56.0	SS-14	6	10	17	27
59.9				61.0	SS-15	10	14	18	32
54.9				66.0	SS-16	9	17	28	45
49.9				71.0	SS-17	9	21	46	67
44.9				76.0	SS-18	12	18	27	45
39.9				81.0	SS-19	17	31	48	79
34.9				86.0	SS-20	19	34	50	84
29.9	90.6	Congaree Formatiom: Dense, moist, dark green, black & gray, weakly reactive, poorly graded SAND with silt (SP-SM/A-1-b).		91.0	SS-21	8	19	22	41
24.9	94.0	Very dense, moist, gray, sub-angular, weakly reactive, well-graded SAND with silt (SW-SM/A-1-b).		96.0	SS-22	19	28	50	78

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-1	**Boring Location:**	5949+31	**Offset:**	13' Lt.	**Alignment:**	US 301
Elev.:	119.9 ft	**Latitude:**	33.45753	**Longitude:**	80.64727	**Date Started:**	4/22/14
Total Depth:	102.5 ft	**Soil Depth:**	102.5 ft	**Core Depth:**	ft	**Date Completed:**	4/23/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.2 ft	**24HR**	7.7 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
				101.0					
	102.5				SS-23	22	28	40	68
		No Casing Refusal & Boring Terminated @ 102.5' (Elev. 17.4).							
14.9		Bulk Sample #1 taken at 1' to 5' deep as per boring plan.							
9.9									
4.9									
-0.1									
-5.1									
-10.1									
-15.1									
-20.1									
-25.1									

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT BRIDGE OVER FOUR HOLE SWAMP.GPJ SC_DOT.GDT 9/19/14

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-2	**Boring Location:**	5949+65	**Offset:**	9' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45757	**Longitude:**	80.6474	**Date Started:**	4/3/2014
Total Depth:	111.5 ft	**Soil Depth:**	111.5 ft	**Core Depth:**	ft	**Date Completed:**	4/5/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Mudline							
		Alluvium: Loose, wet, gray, sub-angular, non-reactive, med. to cse. grain, silty SAND (SM/A-2-4).		2.0	SS-1	1	2	3	5
103.8	3.8	Medium dense to dense, wet, gray, sub-angular, non-reactive, med to cse. grain, poorly graded SAND (SP/A-1-b).		4.0	SS-2	3	6	7	13
				6.0	SS-3	10	17	15	32
	7.8	Medium dense, wet, gray, sub-angular, strongly reactive, med. to cse. grazin, silty SAND (SM/A-1-b).		8.0	SS-4	7	8	8	16
98.8	9.8			10.0	SS-5	6	13	50/0.3	63/0.8
	11.0	LL=NA, PL=NA, PI=NA, NMC=NA, %#200=14.2							
93.8		Hard, moist, green & gray, sub-angular, strongly reactive, f. to cse. grain, sandy SILT (ML/A-4).		15.0	SS-6	20	38	50/0.3	88/0.8
	18.2	LL=NA, PL=NA, PI=NA, NMC=NA, %#200=55.1							
88.8		Santee Formation: Very dense, moist, green and gray, sub-angular, strongly reactive, f. to cse. grain, clayey SAND (SC/A-6).		20.0	SS-7	50/0.4			50/0.4
83.8		LL=35, PL=23, PI=12, NMC=24.6, %#200=46.7		25.0	SS-8	6	7	11	18
78.8		Medium dense to very dense, moist, green, gray & tan, sub-angular, strongly reactive, strongly cemented in portions, f. to cse. grain, silty SAND (SM/A-4).		30.0	SS-9	4	6	11	17
	33.3	LL=31, PL=30, PI=1, NMC=34.4, %#200=39.2							
73.8		Medium dense, moist, gray & green, sub-angular, strongly reactive, f. grain, silty SAND (SM/A-4).		35.0	SS-10	6	8	13	21
	37.0	LL=NA, PL=NA, PI=NA, NMC=NA, %#200=43.8							
68.8		Medium dense to dense, moist, gray & green, sub-angular, strongly reactive, mod. cemented, f. grain, silty SAND (SM/A-4).		40.0	SS-11	3	4	9	13
63.8		LL=NP, PL=NP, PI=NP, NMC=38.1, %#200=47.1		45.0	SS-12	4	8	13	21
				50.0					

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

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LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-2	**Boring Location:**	5949+65	**Offset:**	9' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45757	**Longitude:**	80.6474	**Date Started:**	4/3/2014
Total Depth:	111.5 ft	**Soil Depth:**	111.5 ft	**Core Depth:**	ft	**Date Completed:**	4/5/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
53.8	58.3	Medium dense to dense, moist, gray & green, sub-angular, strongly reactive, mod. cemented, f. grain, silty SAND (SM/A-4). LL=40, PL=35, PI=5, NMC=33.8, %#200=48.7		55.0	SS-13	6	13	19	32
48.8				60.0	SS-14	10	18	23	41
43.8				65.0	SS-15	5	12	17	29
38.8	69.5	Very dense, dry, green & gray, sub-angular, strongly reactive, strongly cemented, f. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=37.6, %#200=23.0		70.0	SS-16	11	16	23	39
33.8	73.0	Congaree Formation: Medium dense, dark green, weakly reactive, sub-angular, f. to cse. grain, poorly graded SAND with silt (SP-SM/A-1-b). LL=NP, PL=NP, PI=NP, NMC=35.1, %#200=7.9		75.0	SS-17	34	43	50/0.3	93/0.8
28.8	78.0			80.0	SS-18	4	7	10	17
23.8		Medium dense to very dense, moist to wet, green & gray, sub-angular, non-reactive, f. to cse. grain, well-graded, SAND with silt (SW-SM/A-1-b).		85.0	SS-19	9	12	18	30
18.8				90.0	SS-20	20	39	48	87
13.8					SS-21	25	30	43	74

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-2	**Boring Location:**	5949+65	**Offset:**	9' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45757	**Longitude:**	80.6474	**Date Started:**	4/3/2014
Total Depth:	111.5 ft	**Soil Depth:**	111.5 ft	**Core Depth:**	ft	**Date Completed:**	4/5/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
3.8	108.0	Sub-Congaree Formation:		105.0	SS-24	13	23	26	49
-1.2	111.5	Dense, moist, dark gray, f. to med. grain, non-reactive, silty SAND (SM/A-5).		110.0	SS-25	15	17	18	35
		No Casing Refusal & Boring Terminated @ 111.5' (Elev. 8.5).							
-6.2		Bridge deck to mudline 11.2'. Drilling ended for the day at 95.0', casing left overnight and it sank 10 feet into sand. Had to flush casing and resume sampling at 105.0' resulting in no sample obtained from 95.0'-101.5'							
-11.2									
-16.2									
-21.2									
-26.2									
-31.2									
-36.2									

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-3	**Boring Location:**	5950+02	**Offset:**	3' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45751	**Longitude:**	80.64752	**Date Started:**	4/21/14
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/22/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 3.3 ft	**24HR**	3.3 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Mudline							
103.8		Alluvium: Loose to medium dense, wet, white & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP-A-1-b). LL=NP, PL=NP, PI=NP, NMC=4.5, %#200=0.5		2.0	SS-1	1	2	3	5
				4.0	SS-2	1	3	9	12
				6.0	SS-3	3	6	12	18
	9.4			8.0	SS-4	7	8	4	12
98.8		Santee Formation: Hard, moist, green, gray & tan, strongly reactive, f. to cse. grain, sandy SILT (ML/A-4). LL=36, PL=29, PI=7, NMC=30.2, %#200=51.9		10.0	SS-5	3	10	32	42
	13.3			15.0	SS-6	10	17	19	36
93.8		Hard, moist, green, gray & tan, strongly reactive, f. to cse. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=55.2		20.0	SS-7	50/0.3			50/0.3
	19.5								
88.8		Medium dense to very dense, moist to wet, green, gray & tan, strongly reactive, weakly to strongly cemented, f. grain, silty SAND (SM/A-4). LL=36, PL=33, PI=3, NMC=37.9, %#200=43.6		25.0	SS-8	3	4	7	11
83.8				30.0	SS-9	4	6	11	17
78.8									
	33.3			35.0	SS-10	6	6	7	13
73.8		Medium dense, dry to wet, green & gray, strongly reactive, weakly cemented, f. grain, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=46.7, %#200=47.3		40.0	SS-11	16	10	8	18
68.8									
63.8				45.0	SS-12	5	6	7	13
				50.0					

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-3	**Boring Location:**	5950+02	**Offset:**	3' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45751	**Longitude:**	80.64752	**Date Started:**	4/21/14
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/22/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 3.3 ft	**24HR**	3.3 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	53.3				SS-13	7	10	13	23
53.8		Medium dense, moist, green & gray, strongly reactive, weakly cemented, f. grain, silty SAND (SM/A-2-4).		55.0	SS-14	10	8	7	15
	58.7								
48.8		Congaree Formation: Very loose, wet, dark green, weakly reactive, f. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=35.9, %#200=28.0		60.0	SS-15	0	0	0	0
	63.3								
43.8		Very loose, moist, dark green & tan, non-reactive, well-graded SAND (SW/A-1-b).		65.0	SS-16	0	0	0	0
38.8				70.0	SS-17	0	0	0	0
33.8				75.0	SS-18	0	0	0	0
	78.0								
28.8		Medium dense to dense, wet, gray, green, black & tan, sub-angular, non-reactive, med. to cde. grain, well-graded SAND with silt (SW-SM/A-1-b). LL=NP, PL=NP, PI=NP, NMC=19.7, %#200=5.7		80.0	SS-19	4	11	15	26
23.8				85.0	SS-20	14	20	26	46
18.8				90.0	SS-21	11	14	16	30
13.8				95.0	SS-22	12	20	28	48
	100.0			100.0					

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-3	**Boring Location:**	5950+02	**Offset:**	3' Rt.	**Alignment:**	US 301
Elev.:	108.8 ft	**Latitude:**	33.45751	**Longitude:**	80.64752	**Date Started:**	4/21/14
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/22/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 3.3 ft	**24HR**	3.3 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	101.5	Sub-Congaree Formation:			SS-23	10	11	15	26	
3.8		Medium dense, moist, dark gray, non-reactive, mod. cemented, silty SAND (SM/A-5).								
		LL=44, PL=44, PI=NP, NMC=38.9, %#200=42.6								
		No Casing Refusal & Boring Terminated @ 101.5' (Elev. 18.8).								
-1.2		Bridge deck to mudline 11.5'								
-6.2										
-11.2										
-16.2										
-21.2										
-26.2										
-31.2										
-36.2										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-4	**Boring Location:**	5950+42	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	107.9 ft	**Latitude:**	33.45754	**Longitude:**	80.64764	**Date Started:**	4/5/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Mudline								
102.9		Roadway Embankment: Loose to very dense, wet, gray & white, sub-angular, weakly reactive, strongly cemented, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=17.2, %#200=0.1		2.0	SS-1	1	50/0.3		50/0.3	>>
				3.3	SS-2	50/0.0			50/0.0	>>
				3.3	NQ-1					REC%=??, RQD%=??
	9.8			6.0	SS-3	2	7	3	10	
97.9		Santee Formation: Very stiff, moist, gray & green, sub-angular, strongly reactive, sub-angular, f. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=50.2		8.0	SS-4	4	3	5	8	
	13.3			10.0	SS-5	7	8	11	19	
92.9				15.0	SS-6	4	6	9	15	
	18.3	Stiff, moist, gray & green, sub-angular, strongly reactive, f. grain, sandy SILT, (ML/A-4). LL=35, PL=27, PI=8, NMC=34.8, %#200=52.4								
87.9				20.0	SS-7	7	6	9	15	
	23.3	Medium dense, moist, gray & green, sub-angular, strongly reactive, f. grain, silty SAND with gravel (SM/A-2-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=32.8		25.0	SS-8	3	5	7	12	
82.9										
	28.3	Medium dense, moist, gray & green, sub-angular, strongly reactive, f. grain, silty SAND (SM/A-4). LL=27, PL=27, PI=NP, NMC=33.2, %#200=49.8		30.0	SS-9	6	9	11	20	
77.9										
72.9		Medium dense to dense, moist, tan & gray, sub-angular, strongly reactive, f. grain, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=43.4, %#200=49.4		35.0	SS-10	6	7	14	21	
67.9				40.0	SS-11	21	17	22	39	
62.9				45.0	SS-12	4	7	10	17	
	47.0	Medium dense to dense, moist, gray, tan & green, strongly reactive, f. to cse. grain, silty SAND (SM/A-4).		50.0						

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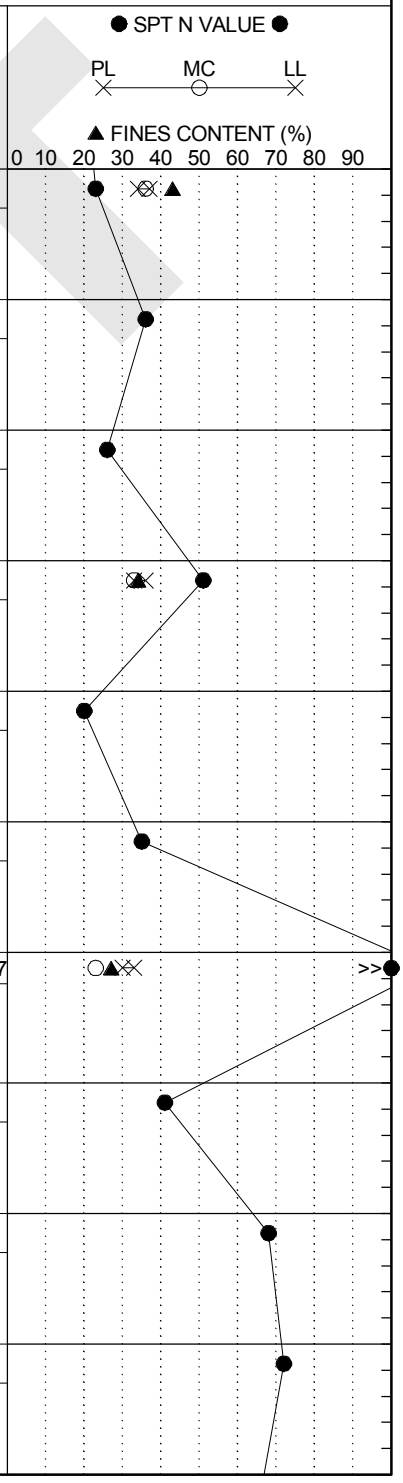
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-4	**Boring Location:**	5950+42	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	107.9 ft	**Latitude:**	33.45754	**Longitude:**	80.64764	**Date Started:**	4/5/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
52.9		LL=37, PL=34, PI=3, NMC=36.0, %#200=42.6		55.0	SS-13	8	10	13	23
47.9				60.0	SS-14	12	15	21	36
	63.3				SS-15	10	12	14	26
42.9		Medium dense to very dense, moist, gray, tan & green, strongly reactive, weakly cemented areas, f. grain, silty SAND (SM/A-2-4). LL=36, PL=33, PI=3, NMC=33.4, %#200=33.5		65.0	SS-16	16	18	33	51
37.9				70.0	SS-17	6	7	13	20
32.9				75.0	SS-18	14	16	19	35
	78.3								
27.9		Very dense, moist, gray, tan & green, weakly to strongly cemented, f. grain, silty SAND (SM/A-2-4). LL=33, PL=30, PI=3, NMC=22.7, %#200=27.3		80.0	SS-19	23	38	50/0.2	88/0.7
	84.0								
22.9		Congaree Formation: Dense, moist, dark green, gray & tan, sub-angular, strongly reactive, f. to med. grain, poorly graded SAND with silt (SP-SM/A-1-b).		85.0	SS-20	15	16	25	41
	88.0								
17.9		Very dense, wet, gray & green, sub-angular, non to weakly reactive, med. to cse. grain, well-graded SAND with silt (SW-SM/A-1-b).		90.0	SS-21	20	28	48	68
12.9				95.0	SS-22	17	32	40	72
				100.0					



LEGEND

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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-4	**Boring Location:**	5950+42	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	107.9 ft	**Latitude:**	33.45754	**Longitude:**	80.64764	**Date Started:**	4/5/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	101.5				SS-23	16	31	35	66	
		No Casing Refusal & Boring Terminated @ 101.5' (Elev. 18.7).								
2.9		Bridge deck to mudline 12.3'.								
-2.1										
-7.1										
-12.1										
-17.1										
-22.1										
-27.1										
-32.1										
-37.1										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-5	**Boring Location:**	5950+98	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	105.5 ft	**Latitude:**	33.45747	**Longitude:**	80.64781	**Date Started:**	4/12/2014
Total Depth:	101.3 ft	**Soil Depth:**	80.3 ft	**Core Depth:**	21 ft	**Date Completed:**	4/13/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Mudline								
		Alluvium: Very loose, wet, gray & tan, sub-angular, non-reactive, med. to cse. grain, silty SAND (SM/A-2-4).		2.0	SS-1	2	1	3	4	
100.5	3.4			4.0	SS-2	8	8	8	16	
	5.8	Medium dense, wet, gray & tan, sub-angular, non-reactive, med. to cse. grain, well-graded SAND (SW/A-1-b). LL=NP, PL=NP, PI=NP, NMC=16.8, %#200=3.8		6.0	SS-3	3	3	4	7	
	7.8			8.0	SS-4	10	50/0.3		50/0.3	>>
95.5	10.0			10.0	SS-5	50/0.0			50/0.0	>>
		Firm, moist, green, gray & tan, non-reactive, f. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=59.9		10.0	NQ-1					REC%=100, RQD%=40
				11.0	NQ-2					REC%=88, RQD%=8
90.5		Santee Formation: Very dense, moist, green & gray, strongly reactive, mod. to strongly cemented, f. grain, silty SAND (SM/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=47.8		16.0	NQ-3					REC%=76, RQD%=27
85.5	20.9			21.0	NQ-4					REC%=46, RQD%=0
80.5		Casing Refusal @ 10.0'. Begin coring in Calcareous Sandstone. Tan, lt. green, lt. gray, black-dk. brown, v.f. to scat. med. grain, thinly to thickly bedded, quartz-calcite-phosphate, mod. to highly weathered, v. weak to weak, friable in parts-seams low hardness, VC discontinuity spacing, seams calcarenite, fossiliferous (frags. & mega shells). med. strong 10.6'-11.0', 19.0'-20.0' & 20.5'-20.9'; 33+ 0° B, T-MW, No, Wa-lr, SR		26.0	NQ-5					REC%=100, RQD%=0
75.5	31.0			32.4	SS-6	4	4	10	14	
70.5		Calcarenite: Tan-gray, v.f. to f. grain, v. thinly to thinly bedded, calcite-quartz, mod. to highly weathered, v. weak to weak, friable, VC discontinuity spacing, pods of calcareous sandstone, fossiliferous (frags. & trc. mega shells). 1 90° J, T, No, Pl, Slk; 49+ 0° B, T-MW, No, Wa-lr, SR		35.0	SS-7	7	7	14	21	
65.5	38.3			40.0	SS-8	10	13	17	30	
60.5		End Coring @ 31.0'. Return to Casing and Sample. Medium dense, moist, green & gray, strongly reactive, f. grain, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=36.4,		45.0	SS-9	8	12	20	32	
				50.0						

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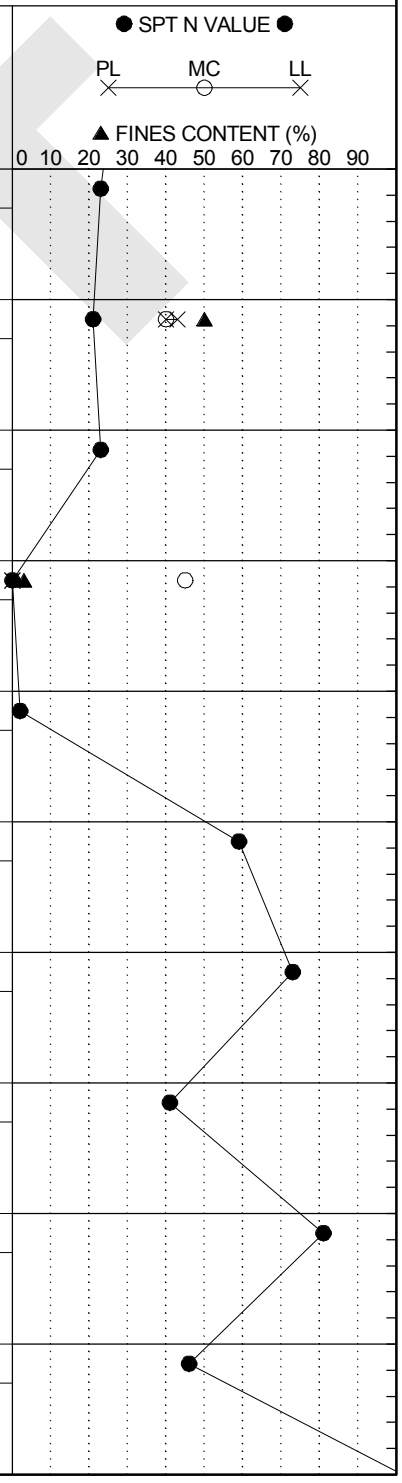
LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-5	**Boring Location:**	5950+98	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	105.5 ft	**Latitude:**	33.45747	**Longitude:**	80.64781	**Date Started:**	4/12/2014
Total Depth:	101.3 ft	**Soil Depth:**	80.3 ft	**Core Depth:**	21 ft	**Date Completed:**	4/13/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		%#200=41.2			SS-10	7	10	13	23
50.5	53.3	Very stiff to hard, moist, green & gray, strongly reactive, f. grain, sandy SILT (ML/A-7-5). LL=45, PL=33, PI=12, NMC=37.0, %#200=52.3		55.0	SS-11	5	10	11	21
45.5	58.3	Very stiff, moist, green & gray, strongly reactive, f. grain, sandy SILT (ML/A-5). LL=43, PL=40, PI=3, NMC=39.6, %#200=50.1		60.0	SS-12	9	11	12	23
40.5	63.3	Medium dense, wet, dark green & gray, strongly reactive, f. grain, silty SAND (SM/A-2-4).		65.0	SS-13	0	0	0	0
35.5		Congaree Formation: Very loose, wet, dark green, tan & black, non to weakly reactive, cse. grain, well-graded SAND (SW/A-1-b). LL=NP, PL=NP, PI=NP, NMC=45.4, %#200=2.6		70.0	SS-14	0	0	2	2
30.5	73.0	Dense to very dense, moist, gray, sub-angular, non-reactive, f. to med. grain, well-graded SAND with silt (SW-SM/A-1-b).		75.0	SS-15	13	24	35	59
25.5				80.0	SS-16	23	35	38	73
20.5				85.0	SS-17	10	18	23	41
15.5				90.0	SS-18	31	41	40	81
10.5				95.0	SS-19	7	13	33	46
				100.0					



LEGEND

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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-5	**Boring Location:**	5950+98	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	105.5 ft	**Latitude:**	33.45747	**Longitude:**	80.64781	**Date Started:**	4/12/2014
Total Depth:	101.3 ft	**Soil Depth:**	80.3 ft	**Core Depth:**	21 ft	**Date Completed:**	4/13/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

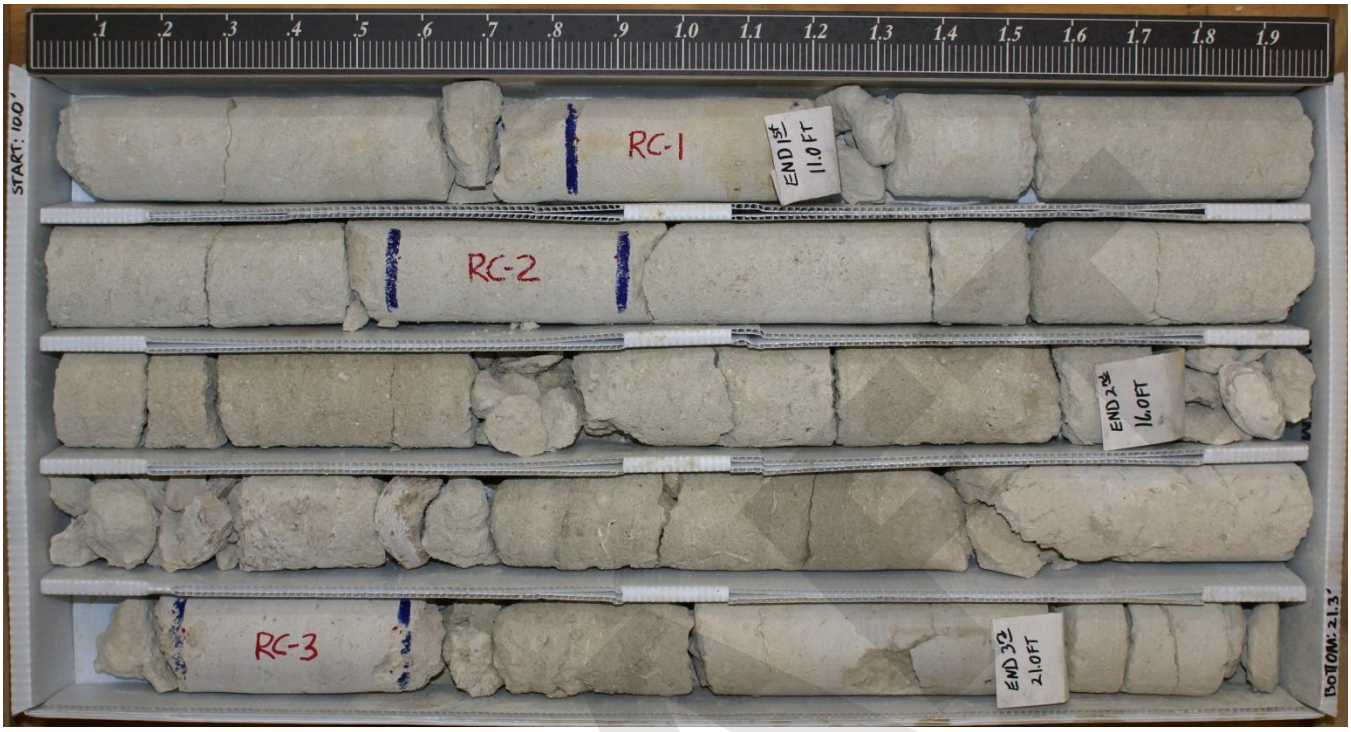
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	101.3				SS-20	15	42	50/0.3	92/0.8	>>
		No Casing Refusal & Boring Terminated @ 101.3' (Elev. 19.0).								
0.5		Bridge deck to mudline 14.8'.								
-4.5										
-9.5										
-14.5										
-19.5										
-24.5										
-29.5										
-34.5										
-39.5										

LEGEND

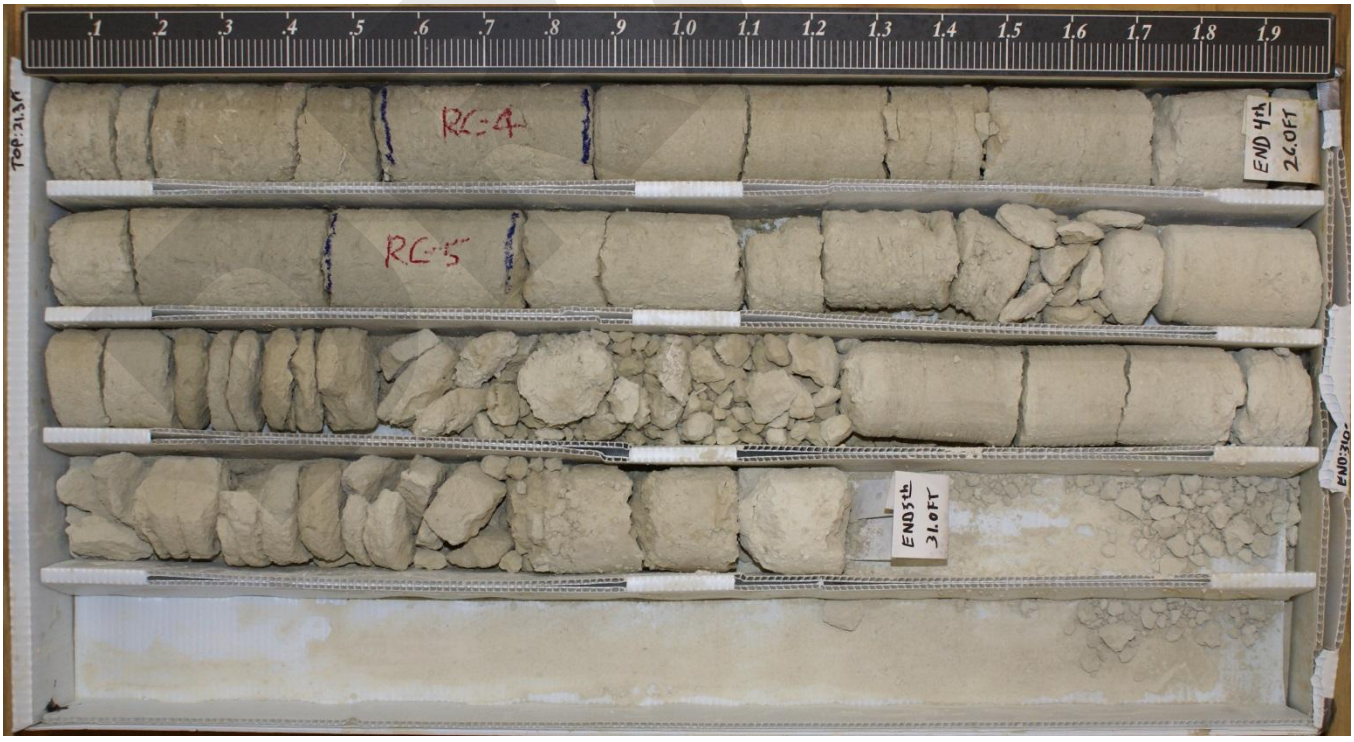
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp



B5 – Box 1 of 2



B5 – Box 2 of 2

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-6	**Boring Location:**	5951+41	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	107.8 ft	**Latitude:**	33.4575	**Longitude:**	80.64796	**Date Started:**	4/6/2014
Total Depth:	35.2 ft	**Soil Depth:**	15.2 ft	**Core Depth:**	20 ft	**Date Completed:**	4/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Mudline								
		Alluvium:								
	3.4	Loose, wet, brown, tan & gray, sub-angular, weakly reactive, med. to cse. grain, silty SAND (SM/A-2-4).		2.0	SS-1	3	4	3	7	
102.8	5.8	Medium dense, wet, brown, tan & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b).		4.0	SS-2	3	5	6	11	
	7.8	LL=NA, PL=NA, PI=NA, NMC=12.7, %#200=1.6		6.0	SS-3	8	11	17	28	
97.8	9.8			8.0	SS-4	0	3	4	7	
		Medium dense, wet, brown, tan & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b).		10.0	SS-5	1	1	2	3	
	13.3	LL=NP, PL=NP, PI=NP, NMC=14.0, %#200=4.0		15.0	SS-6	50/0.2			50/0.2	>>
92.8	15.2	Loose, wet, brown, tan & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b).		15.2	NQ-1					REC%=100, RQD%=64
87.8		LL=NP, PL=NP, PI=NP, NMC=17.0, %#200=2.1		20.2	NQ-2					REC%=66, RQD%=16
82.8	25.6	Very loose, wet, gray & brown, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND with silt (SP-SM/A-2-4).		25.2	NQ-3					REC%=98, RQD%=22
		LL=NA, PL=NA, PI=NA, NMC=NA, %#200=8.8		30.2	NQ-4					REC%=100, RQD%=50
77.8		Very dense, wet, gray & green, sub-angular, weakly reactive, med. to cse. grain, silty SAND (SM/A-4).								
		Casing Refusal @ 15.2'. Begin coring in Calcareous Sandstone. Santee Formation:								
72.8	35.2	Gray-tan, tan-lt. green, scat. black-dk. brown, f. to med. grain w/scat. cse. frags., thinly to thickly bedded, quartz-calcite-phosphate, mod. to highly weathered w/seams completely weathered, v. weak to weak, friable in parts-seams low hardness, VC discontinuity spacing, seams calcarenite, fossiliferous (frags. & mega shells), vugular texture.								
67.8		23 0°-10° B, T-MW, No, Pl-Wa, SR								
62.8		Calcarenite: Tan-gray, lt. green, v.f. to f. grain, thickly bedded, calcite-quartz, mod. weathered w/highly weathered seams, v. weak to weak, friable w/seams low hardness, VC discontinuity spacing, pods of calcareous								

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-6	**Boring Location:**	5951+41	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	107.8 ft	**Latitude:**	33.4575	**Longitude:**	80.64796	**Date Started:**	4/6/2014
Total Depth:	35.2 ft	**Soil Depth:**	15.2 ft	**Core Depth:**	20 ft	**Date Completed:**	4/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

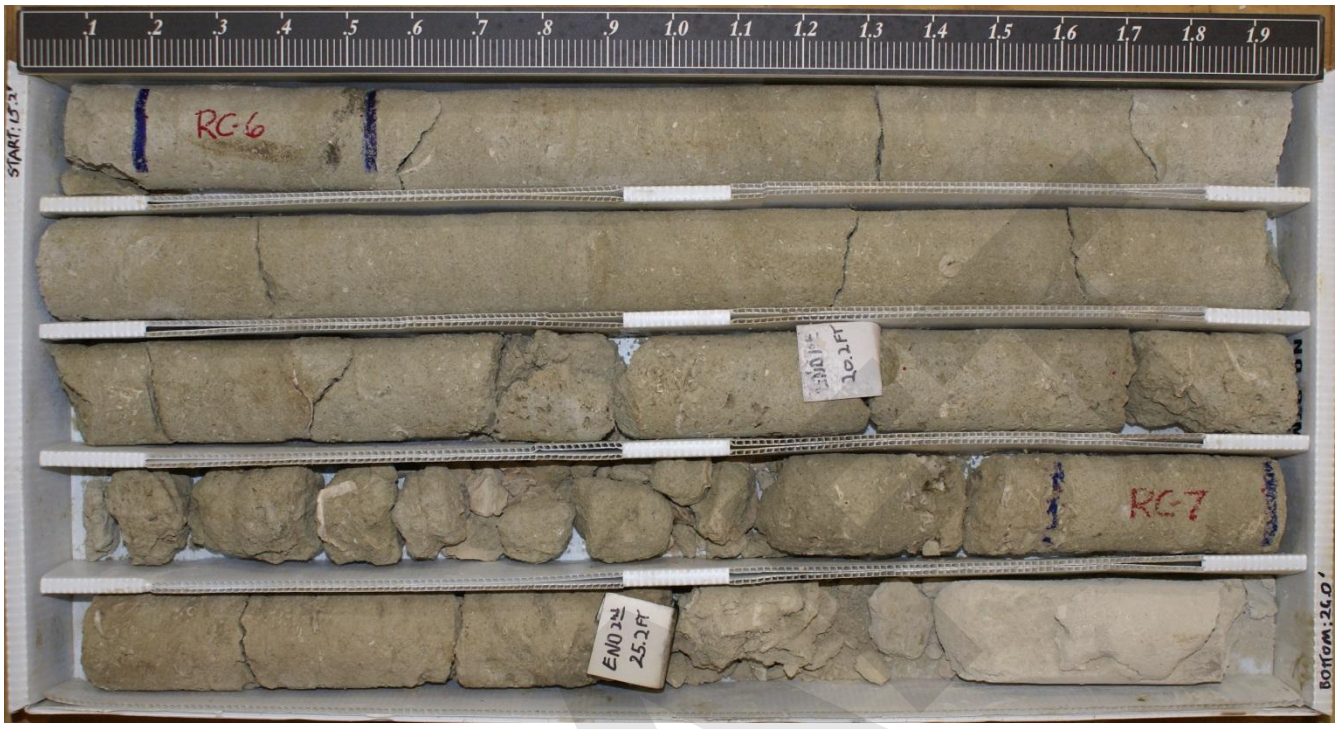
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
		sandstone, fossiliferous (frags. & trc. mega shells). med. strong 25.6'-26.5'; 27+ 0° B, T-MW, No, Pl-Ir, SR								
52.8		Boring Terminated @ 35.2' (Elev. 85.0).								
		Bridge deck to mudline 12.4'.								
47.8										
42.8										
37.8										
32.8										
27.8										
22.8										
17.8										
12.8										

LEGEND

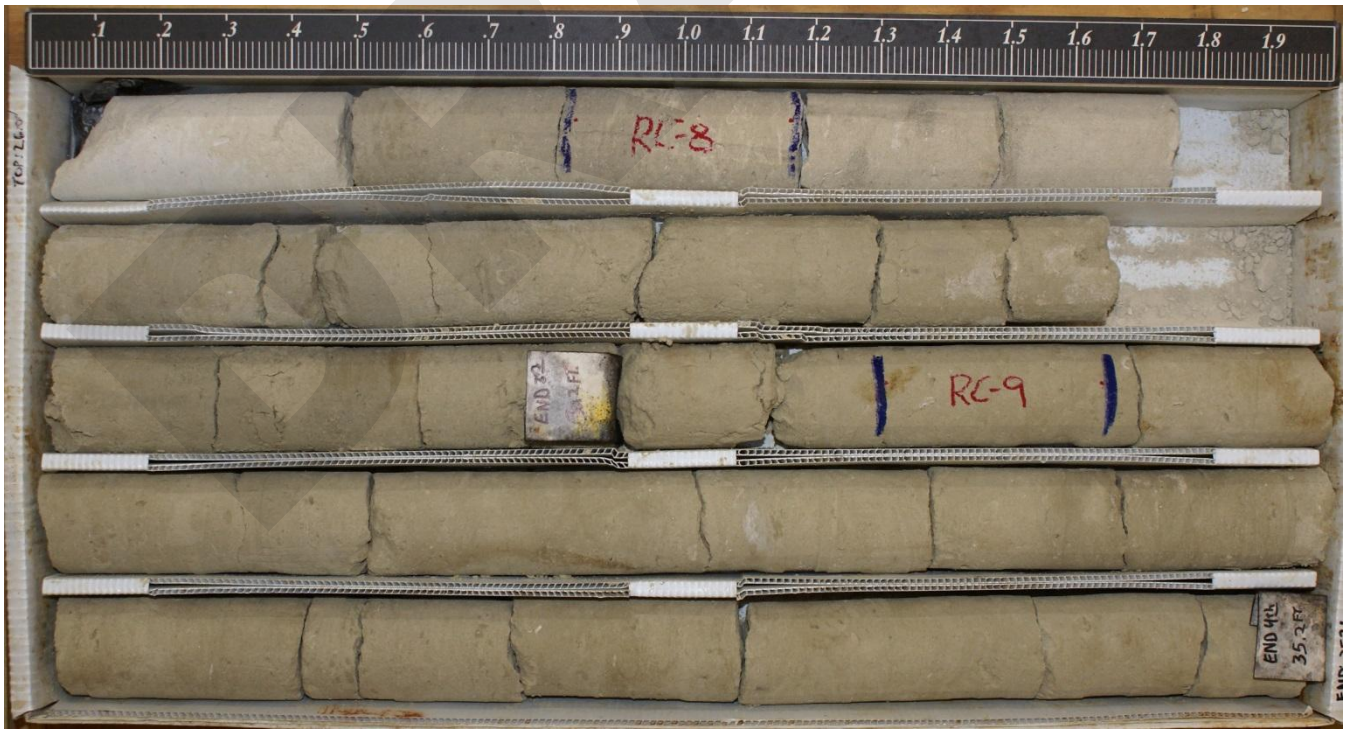
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp



B6 – Box 1 of 2



B6 – Box 2 of 2

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-7	**Boring Location:**	5951+86	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	105.0 ft	**Latitude:**	33.45744	**Longitude:**	80.6481	**Date Started:**	4/12/2014
Total Depth:	41 ft	**Soil Depth:**	20 ft	**Core Depth:**	21 ft	**Date Completed:**	4/12/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Mudline								
		Alluvium: Very loose to loose, wet, dark gray, gray & tan, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b).		2.0	SS-1	1	0	4	4	
100.0	5.4	Santee Formation: Hard, moist, green & gray, strongly reactive, mod. to strongly cemented, f. to med. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=56.5		4.0	SS-2	9	3	2	5	
	7.8			6.0	SS-3	8	50/0.3		50/0.3	>>
	9.5			8.0	SS-4	6	50/0.4		50/0.4	>>
95.0				10.0	SS-5	32	17	24	41	
	13.3	Hard, moist, green & gray, strongly reactive, mod. cemented areas, f. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=50.7		15.0	SS-6	22	13	13	26	
90.0										
	20.0	Dense, moist, green & gray, strongly reactive, mod. cemented areas, f. grain, silty SAND (SM/A-4). LL=31, PL=25, PI=6, NMC=30.9, %#200=40.6		20.0	SS-7	50/0.0			50/0.0	>>
85.0	21.5			20.0	NQ-1					REC%=70, RQD%=40
		Medium dense, moist, green & gray, strongly reactive, mod. cemented, f. grain, siilty SAND (SM/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=36.6		21.0	NQ-2					REC%=100, RQD%=10
80.0				26.0	NQ-3					REC%=100, RQD%=58
		Casing Refusal @ 20.0'. Begin coring in Calcareous Sandstone. Tan-gray, v.f. to scat. med. grain, thinly bedded, quartz-calcite-phosphate, mod. weathered w/ highly weathered seam, weak, mod. hardness w/low hardness seam, VC discontinuity spacing, fossiliferous (frags.). med. strong 20.0'-20.4' & 21.1'-21.5'; 2 0° B, N-MW, No, Pl, SR		31.0	NQ-4					REC%=100, RQD%=18
75.0				36.0	NQ-5					REC%=90, RQD%=40
70.0										
65.0	41.0	Calcarenite: Tan-lt. gray, scat. lt. olive green tint, v.f. to f. grain, thinly to thickly bedded, calcite-quartz, mod. to highly weathered, v. weak to weak, friable to low hardness, VC discontinuity spacing, fossiliferous (frags. & trc. mega shells). 45 0° B, VN-N, No, Pl-lr, SR; 1 25° J, VN, No, Pl, S; interpreted core loss 40.5'-41.0'								
60.0										

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-7	**Boring Location:**	5951+86	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	105.0 ft	**Latitude:**	33.45744	**Longitude:**	80.6481	**Date Started:**	4/12/2014
Total Depth:	41 ft	**Soil Depth:**	20 ft	**Core Depth:**	21 ft	**Date Completed:**	4/12/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

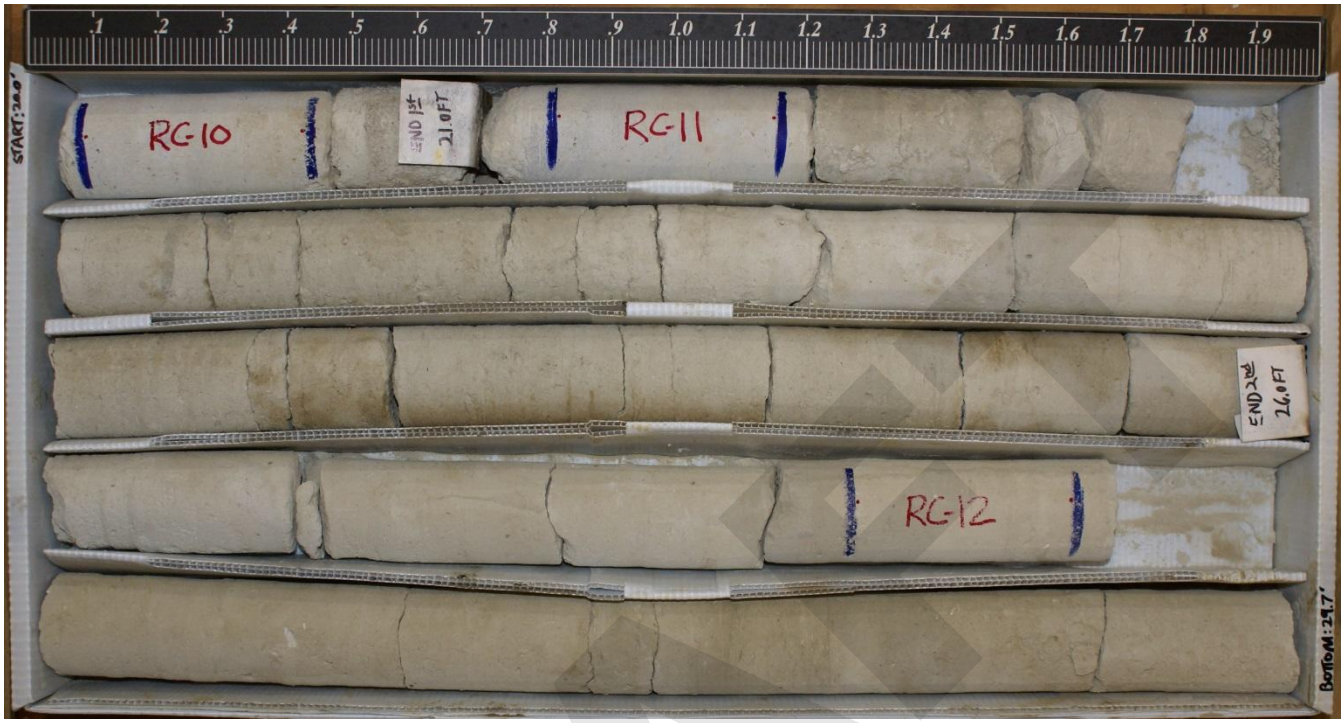
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
		Boring Terminated @ 41.0' (Elev. 79.1).								
		Bridge deck to mudline 15.1'.								
50.0										
45.0										
40.0										
35.0										
30.0										
25.0										
20.0										
15.0										
10.0										

LEGEND

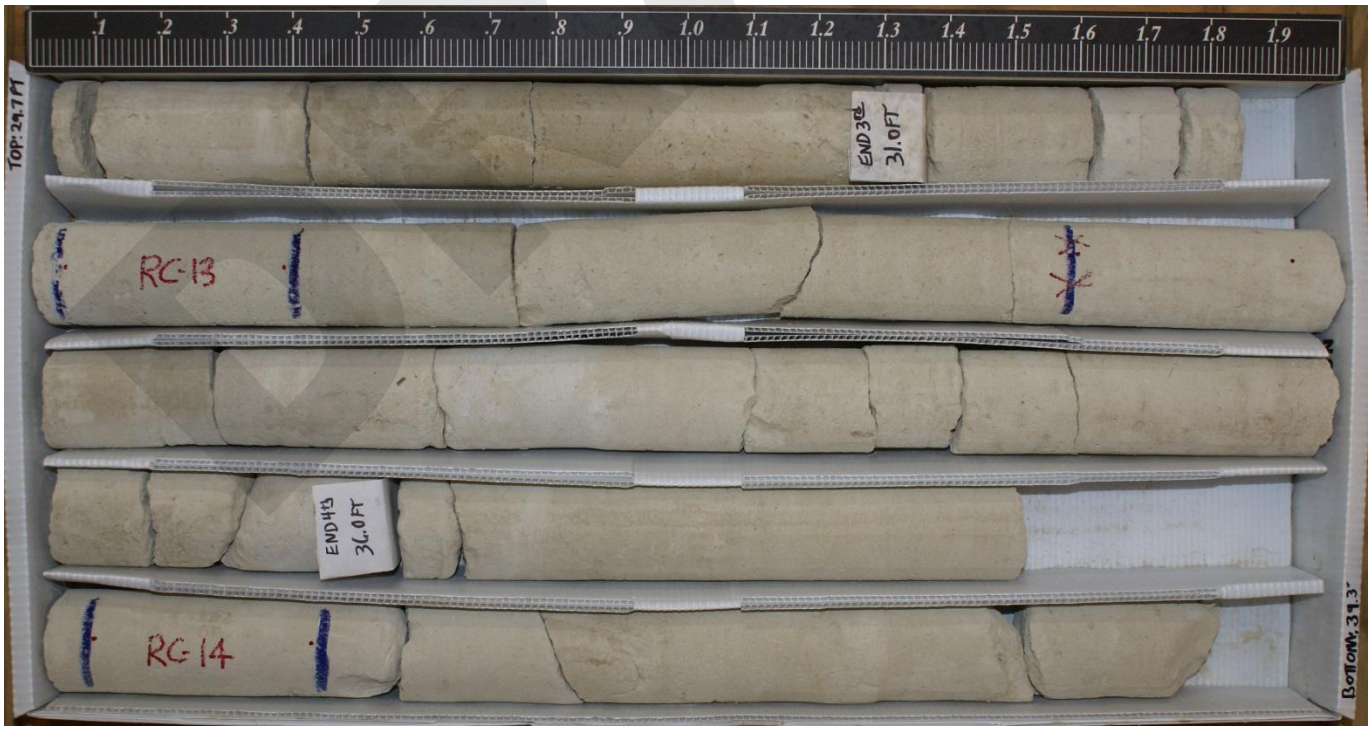
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp



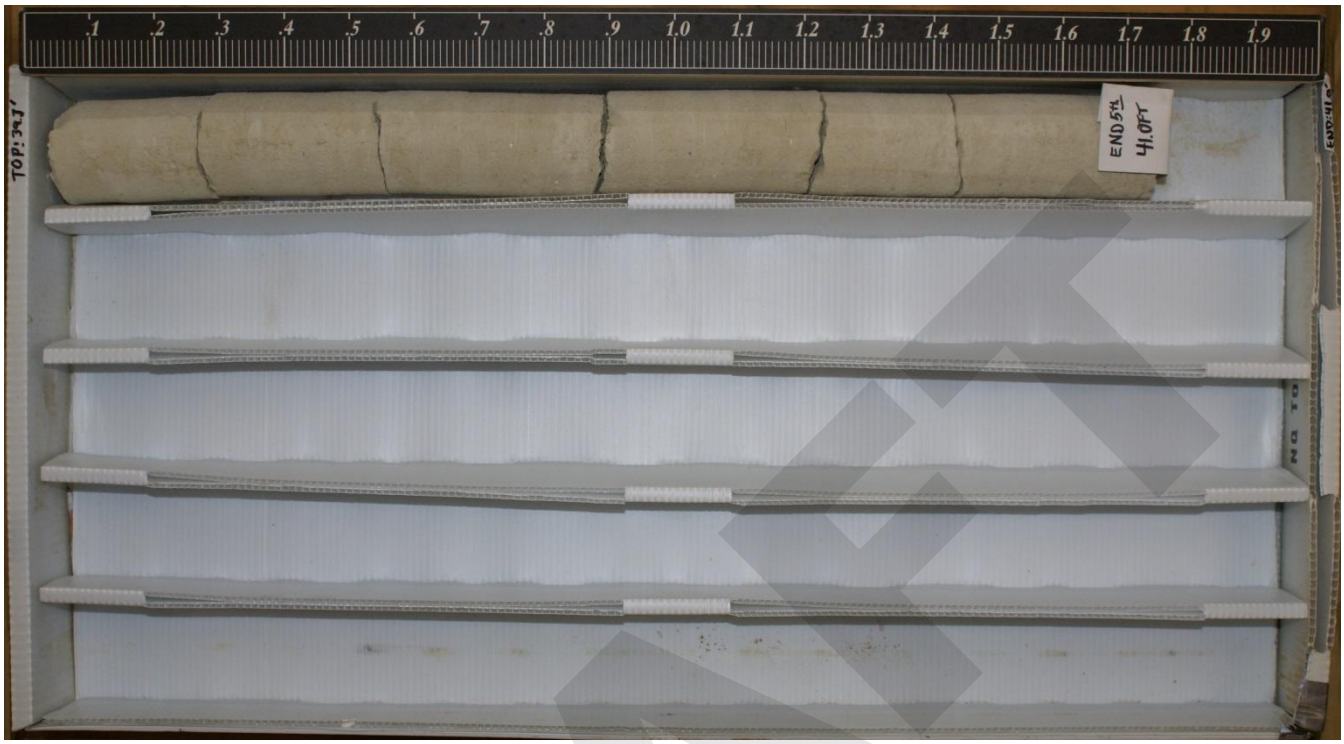
B7 – Box 1 of 3



B7 – Box 2 of 3

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp



B7 – Box 3 of 3

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-8	**Boring Location:**	5952+17	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45747	**Longitude:**	80.64821	**Date Started:**	4/8/2014
Total Depth:	101.4 ft	**Soil Depth:**	80.5 ft	**Core Depth:**	20.9 ft	**Date Completed:**	4/9/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 12 ft.	**24HR**	10.4 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / FINES CONTENT (%)
	0.0	Roadway Embankment: Medium dense, dry to moist, tan, brown & gray, sub-angular, non-reactive, f. to cse. grain, well-graded SAND with silt (SW-SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=8.3, %#200=11.9	2.0	SS-1	4	7	6	13	
115.0	3.8		4.0	SS-2	3	6	5	11	
			6.0	SS-3	1	2	2	4	
			8.0	SS-4	2	2	3	5	
110.0	9.8	Alluvium: Very loose to medium dense, dry to moist, tan, brown & gray, sub-angular, non to weakly reactive, f. to cse. grain, poorly graded SAND (SP/A-1-b).	10.0	SS-5	1	3	2	5	
	13.3	Loose, moist to wet, dark gray, sub-angular, non-reactive, f. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=33.4, %#200=20.1	15.0	SS-6					
105.0									
100.0		Very loose, moist to wet, dark gray, sub-angular, non-reactive, f. grain, poorly graded SAND (SP/A-1-b).	20.0	SS-7	1	1	1	2	
	23.0	LL=NP, PL=NP, PI=NP, NMC=15.0, %#200=1.8							
95.0		Santee Formation: Dense to very dense, moist, gray & green, sub-angular, strongly reactive, mod. to strongly cemented, f. to med. grain, silty SAND (SM/A-4).	25.0	SS-8	46	14	20	34	
90.0	30.4	Casing Refusal @ 30.4'. Begin coring in Calcareous Sandstone.	30.0	SS-9	50/0.3			50/0.3	
			30.3	SS-10	50/0.1			50/0.1	
			30.4	NQ-1					REC%=67, RQD%=56
			31.3	NQ-2					REC%=76, RQD%=24
85.0	36.3	Tan-lt. gray, lt. green-tan, trcs. black-dk. brown, f. to med. grain w/scat. cse. frags., thinly to thickly bedded, quartz-calcite-phosphate, mod. to highly weathered, v. weak to weak, friable in parts-seams mod. hardness, VC discontinuity spacing, seams calcarenite, fossiliferous (frags. & mega shells), vugular texture in parts. med. strong 30.4'-30.9' & 35.2'-36.3'; 21 0° B, T-MW, No, lr, SR	36.3	NQ-3					REC%=94, RQD%=18
80.0			41.3	NQ-4					REC%=54, RQD%=0
75.0		Calcarenite: Tan-gray, lt. olive green, v.f. to f. grain, thinly to thickly bedded, calcite-quartz, mod. to highly weathered, v. weak to weak, friable w/seams low hardness, VC discontinuity spacing, widely scat. pods	46.3	NQ-5					REC%=84, RQD%=0

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-8	**Boring Location:**	5952+17	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45747	**Longitude:**	80.64821	**Date Started:**	4/8/2014
Total Depth:	101.4 ft	**Soil Depth:**	80.5 ft	**Core Depth:**	20.9 ft	**Date Completed:**	4/9/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 12 ft.	**24HR**	10.4 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	51.3	of calcareous sandstone, fossiliferous (frags. & trc. mega shells). 116+ 0° B, T-MW, No, Pl-Ir, SR; med. strong 51.1'-51.3'							
65.0		End Coring @ 51.3'. Return to Casing and Sample. Medium dense to dense, moist, green & gray, strongly reactive, weakly cemented, f. grain, silty SAND (SM/A-4).		55.0	SS-11	7	8	14	22
60.0				60.0	SS-12	10	14	22	36
55.0				65.0	SS-13	11	16	28	44
50.0				70.0	SS-14	10	15	25	40
45.0				75.0	SS-15	12	17	22	39
40.0				80.0	SS-16	15	20	24	44
35.0				85.0	SS-17	14	18	24	42
30.0	88.0	Congaree Formation: Dense, wet, dark green & gray, sub-angular, weakly reactive, f. to cse. grain, poorly graded SAND with silt (SP-SM/A-1-b).		90.0	SS-18	12	20	19	39
25.0	95.0	Very dense, wet, dark gray, sub-angular, non-reactive, med. to cse. grain, well-graded SAND with silt (SW-SM/A-1-b).		95.0	SS-19	23	38	50/0.3	88/0.8
				100.0					

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90 >>

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-8	**Boring Location:**	5952+17	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45747	**Longitude:**	80.64821	**Date Started:**	4/8/2014
Total Depth:	101.4 ft	**Soil Depth:**	80.5 ft	**Core Depth:**	20.9 ft	**Date Completed:**	4/9/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 12 ft.	**24HR**	10.4 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	101.4				SS-20	25	31	50/0.4	81/0.9	>>
		No Casing Refusal & Boring Terminated @ 101.4' (Elev. 18.6).								
15.0		Could not obtain sample at 15.0' due to bore backfilling w/wash rotary, switched to mud rotary drilling. Bulk Sample #2 taken at 1' to 5' deep as per boring plan.								
10.0										
5.0										
0.0										
-5.0										
-10.0										
-15.0										
-20.0										
-25.0										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

CORE PHOTOGRAPHIC RECORD

Bridge Replacement over Four Hole Swamp

B8 – Box 1 of 2

B8 – Box 2 of 2

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-9	**Boring Location:**	5952+28	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45742	**Longitude:**	80.64824	**Date Started:**	4/11/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/11/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.9 ft.	**24HR**	12.6 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Embankment: Loose, wet, tan, red & gray, sub-angular, non-reactive, f. to cse. grain, silty SAND (SM/A-2-4).		2.0	SS-1	4	3	4	7
115.0	4.0	LL=20, PL=18, PI=2, NMC=13.3, %#200=18.9		4.0	SS-2	2	2	3	5
	5.8			6.0	SS-3	2	2	2	4
	7.8	Alluvium: Loose, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, well-graded SAND (SW/A-1-b).		8.0	SS-4	1	1	2	3
110.0	9.8			10.0	SS-5	0	0	2	2
	13.3	Very loose, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, poorly graded SAND with silt (SP-SM/A-3). LL=NP, PL=NP, PI=NP, NMC=10.5, %#200=5.6		15.0	SS-6	13	13	14	27
105.0	18.5	Very loose, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, well-graded SAND (SW/A-1-b).		20.0	SS-7	1	33	21	54
100.0	23.3	Very loose, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, silty SAND (SM/A-2-4).		25.0	SS-8	31	15	20	36
95.0		Medium dense, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, well-graded SAND (SW/A-1-b). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=4.6		30.0	SS-9	24	14	21	35
90.0		Santee Formation:							
	33.3	Very dense, moist, green & gray, strongly reactive, f. grain, silty SAND (SM/A-4). LL=34, PL=28, PI=6, NMC=24.1, %#200=48.4		35.0	SS-10	12	8	13	21
85.0		Dense, moist, green & gray, strongly reactive, f. grain, silty, clayey SAND (SC-SM/A-4). LL=26, PL=21, PI=5, NMC=23.3, %#200=35.7		40.0	SS-11	9	16	11	27
80.0									
75.0		Very stiff to hard, moist, green, gray & tan, strongly reactive, strongly cemented areas, f. to med. grain, sandy SILT (ML/A-5). LL=41, PL=40, PI=1, NMC=41.7, %#200=59.4		45.0	SS-12	7	10	14	24
				50.0					

SPT N VALUE ● PL × MC ○ LL × ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-9	**Boring Location:**	5952+28	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45742	**Longitude:**	80.64824	**Date Started:**	4/11/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/11/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.9 ft.	**24HR**	12.6 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
					SS-13	50/0.4			50/0.4
				55.0	SS-14	6	8	12	20
				60.0	SS-15	9	13	18	31
				65.0	SS-16	15	14	29	43
				70.0	SS-17	10	12	15	27
				75.0	SS-18	8	14	20	34
				80.0	SS-19	10	19	30	49
				85.0	SS-20	8	20	23	43
	88.0	Congaree Formation: Loose, wet, dark green & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND with silt (SP-SM/A-1-b).		90.0	SS-21	4	4	3	7
	93.3	Very dense, dry, gray, non-reactive, weakly to mod. cemented, f. grain, silty SAND (SM/A-4).		95.0	SS-22	22	35	50/0.4	85/0.9
	97.0	Medium dense, gray, sub-angular, non-reactive, med. to cse. grain, well-graded, SAND with silt (SW-SM/A-1-b).		100.0					

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-9	**Boring Location:**	5952+28	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	120.0 ft	**Latitude:**	33.45742	**Longitude:**	80.64824	**Date Started:**	4/11/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/11/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 5.9 ft.	**24HR**	12.6 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	101.5				SS-23	2	6	18	24	
		No Casing Refusal & Boring Terminated @ 101.5' (Elev. 18.5).								
15.0		No sample obtained at 35.0', drove rock fragment in front of spoon.								
10.0										
5.0										
0.0										
-5.0										
-10.0										
-15.0										
-20.0										
-25.0										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	HA-1	**Boring Location:**	5948+00	**Offset:**	50' Rt.	**Alignment:**	US 301
Elev.:	112.9 ft	**Latitude:**	33.45775	**Longitude:**	80.64687	**Date Started:**	4/4/2014
Total Depth:	10.5 ft	**Soil Depth:**	10.5 ft	**Core Depth:**	ft	**Date Completed:**	4/4/2014
Bore Hole Diameter (in):	NA	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	NA	**Drill Method:**	Hand Auger	**Hammer Type:**	NA	**Energy Ratio:**	
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 2 ft.	**24HR**	0.2 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%)
	0.0	▼ Gray & tan, moist to wet, f. to cse. grain, sandy clay.		1.0						DCP @ 1' = 1,3,4
	2.5	▽ Tan & gray, wet, sli. clayey, med. to cse. grain, sub-angular sand.		2.0						DCP @ 2' = 4,5,4
107.9				3.0						DCP @ 3' = 3,4,6
				4.0						DCP @ 4' = 13,16,16
				5.0						DCP @ 5' = 9,13,15
				6.0						DCP @ 6' = 20,21,25
				7.0						DCP @ 7' = 11,13,14
				8.0						DCP @ 8' = 6,7,7
				9.0						DCP @ 9' = 6,8,9
102.9	10.5	No Auger Refusal & Boring Terminated @ 10.5' (Elev. 102.4).		10.0						DCP @ 10' = 37,50/1"
97.9										
92.9										
87.9										
82.9										
77.9										
72.9										
67.9										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	HA-2	**Boring Location:**	5949+00	**Offset:**	60' Rt.	**Alignment:**	US 301
Elev.:	112.1 ft	**Latitude:**	33.45773	**Longitude:**	80.6472	**Date Started:**	4/4/2014
Total Depth:	7.5 ft	**Soil Depth:**	7.5 ft	**Core Depth:**	ft	**Date Completed:**	4/4/2014
Bore Hole Diameter (in):	NA	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	NA	**Drill Method:**	Hand Auger	**Hammer Type:**	NA	**Energy Ratio:**	
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 1.2 ft.	**24HR**	0.2 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%)
	0.0	Gray & tan, moist to wet, clayey, f. to cse. grain, sub-angular sand.		1.0 2.0 3.0 4.0 5.0 6.0 7.0						DCP @ 1' = 3,4,4 DCP @ 2' = 4,4,7 DCP @ 3' = 13,23,28 DCP @ 4' = 17,17,12 DCP @ 5' = 20,28,31 DCP @ 6' = 17,30,33 DCP @ 7' = 6,10,8
107.1	7.5	No Auger Refusal & Boring Terminated @ 7.5' (Elev. 104.6).								
102.1		Boring was caving in beyond 7.5'.								
97.1										
92.1										
87.1										
82.1										
77.1										
72.1										
67.1										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	HA-3	**Boring Location:**	5952+23	**Offset:**	40' Rt.	**Alignment:**	US 301
Elev.:	110.7 ft	**Latitude:**	33.45755	**Longitude:**	80.64824	**Date Started:**	4/4/2014
Total Depth:	10.5 ft	**Soil Depth:**	10.5 ft	**Core Depth:**	ft	**Date Completed:**	4/4/2014
Bore Hole Diameter (in):	NA	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	NA	**Drill Method:**	Hand Auger	**Hammer Type:**	NA	**Energy Ratio:**	
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 2.6 ft.	**24HR**	0 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%)
	0.0	Red & tan, moist, f. to med. grain, sub-angular sandy clay.		1.0						DCP @ 1' = 6,4,6
	3.5			2.0						DCP @ 2' = 4,5,6
105.7		Tan & gray, wet, clayey, f. to cse. grain, sub-angular sand.		3.0						DCP @ 3' = 3,3,4
				4.0						DCP @ 4' = 4,2,2
				5.0						DCP @ 5' = 3,1,1
				6.0						DCP @ 6' = 5,4,3
				7.0						DCP @ 7' = 3,5,5
				8.0						DCP @ 8' = 2,3,4
				9.0						DCP @ 9' = 5,12,17
100.7	10.5	No Auger Refusal & Boring Terminated @ 10.5' (Elev. 100.2).		10.0						DCP @ 10' = 5,9,12
95.7										
90.7										
85.7										
80.7										
75.7										
70.7										
65.7										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	HA-4	**Boring Location:**	5952+54	**Offset:**	42' Rt.	**Alignment:**	US 301
Elev.:	112.8 ft	**Latitude:**	33.45754	**Longitude:**	80.64834	**Date Started:**	4/4/2014
Total Depth:	3.5 ft	**Soil Depth:**	3.5 ft	**Core Depth:**	ft	**Date Completed:**	4/4/2014
Bore Hole Diameter (in):	NA	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	NA	**Drill Method:**	Hand Auger	**Hammer Type:**	NA	**Energy Ratio:**	
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 0.5 ft.	**24HR**	0 ft.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%)
	0.0	Gray, tan & brown, wet, silty, clayey, med. to cse. grain, sub-angular sand.		1.0 2.0 3.0						DCP @ 1' = 4,2,2 DCP @ 2' = 5,9,6 DCP @ 3' = 17,42,13
107.8	3.5	No Auger Refusal & Boring Terminated @ 3.5' (Elev. 109.3). Boring was caving in beyond 3.5'.								
102.8										
97.8										
92.8										
87.8										
82.8										
77.8										
72.8										
67.8										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	RW-1	**Boring Location:**	5947+73	**Offset:**	20' Lt.	**Alignment:**	US 301
Elev.:	119.9 ft	**Latitude:**	33.45758	**Longitude:**	80.64675	**Date Started:**	4/24/14
Total Depth:	41.4 ft	**Soil Depth:**	41.4 ft	**Core Depth:**	ft	**Date Completed:**	4/24/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 4.8 ft	**24HR**	8.8 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Embankment: Medium dense, moist, red, gray & tan, sub-angular, non-reactive, med. grain, clayey SAND (SC/A-2-6). LL=33, PL=19, PI=14, NMC=12.7, %#200=29.5	2.0					
114.9	3.8		4.0	SS-1	4	4	8	12
	8.0	Alluvium: Very loose to loose, wet, gray, tan & brown, sub-angular, non-reactive, f. to med. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=11.0, %#200=12.8	6.0	SS-2	3	4	3	7
			8.0	SS-3	2	3	1	4
109.9			9.9	SS-4	0	0	1	1
	13.0	Very loose to loose, wet, dark gray, non-reactive, silty, clayey SAND (SC-SM/A-4). LL=23, PL=16, PI=7, NMC=18.0, %#200=43.4		SS-5	1	3	4	7
104.9			14.9	SS-6	5	7	9	16
	17.0	Medium dense, wet, gray, sub-angular, non-reactive, f. to med. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=16.8, %#200=4.3	19.9	SS-7	36	22	30	52
99.9			24.9	SS-8	23	50/0.5		50/0.5
94.9		Santee Formation: Stiff to hard, moist to wet, gray & green, strongly reactive, med. to strongly cemented, f. to med. grain, sandy SILT (ML/A-4). LL=37, PL=31, PI=6, NMC=26.4, %#200=52.9	29.9	SS-9	13	11	10	21
89.9			34.9	SS-10	4	6	8	14
84.9			39.9	SS-11	8	11	13	24
79.9	41.4	No Casing Refusal & Boring Terminated @ 41.4' (Elev. 78.5).						
74.9								

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT BRIDGE OVER FOUR HOLE SWAMP.GPJ SC_DOT.GDT 9/19/14

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	RW-2	**Boring Location:**	5948+38	**Offset:**	18' Rt.	**Alignment:**	US 301
Elev.:	119.1 ft	**Latitude:**	33.45765	**Longitude:**	80.64698	**Date Started:**	4/24/14
Total Depth:	41.5 ft	**Soil Depth:**	41.5 ft	**Core Depth:**	ft	**Date Completed:**	4/24/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 7.7 ft	**24HR**	8.0 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Embankment: Loose, moist to wet, tan & red, sub-angular, non-reactive, f. to med. grain, silty SAND (SM/A-1-b). LL=18, PL=17, PI=1, NMC=14.0, %#200=15.4	2.0					
114.1	4.0		4.0	SS-1	3	4	2	6
	6.0		6.0	SS-2	1	2	2	4
	7.8	Alluvium: Very loose, wet, tan & brown, sub-angular, non-reactive, f. to med. grain, well-graded SAND with silt (SW-SM/A-1-b). LL=NP, PL=NP, PI=NP, NMC=8.5, %#200=7.3	8.0	SS-3	1	1	1	2
109.1	12.0		10.0	SS-4	0	2	1	3
				SS-5	0	0	5	5
104.1	16.5	Very loose, wet, tan & brown, non-reactive, f. to med. grain, silty SAND (SM/A-2-4).	15.0	SS-6	9	10	15	25
99.1		Very loose to loose, wet, tan & gray, non-reactive, f. to med. grain, silty SAND (SM/A-2-4). LL=21, PL=19, PI=2, NMC=18.9, %#200=35.0	20.0	SS-7	22	11	18	29
94.1		Medium dense, wet, gray, sub-angular, strongly reactive, med. grain, poorly graded SAND (SP/A-3). LL=NP, PL=NP, PI=NP, NMC=25.7, %#200=2.5	25.0	SS-8	6	14	36	50
89.1		Santee Formatin: Very stiff to hard, dry, gray & green, strongly reactive, f. grain, sandy SILT (ML/A-4). LL=39, PL=31, PI=8, NMC=30.6, %#200=51.1	30.0	SS-9	16	9	13	22
84.1			35.0	SS-10	9	8	8	16
79.1			40.0	SS-11	4	9	14	23
	41.5	No Casing Refusal & Boring Terminated @ 41.5' (Elev. 77.6).						
74.1								

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	RW-3	**Boring Location:**	5948+83	**Offset:**	13' Lt.	**Alignment:**	US 301
Elev.:	120.2 ft	**Latitude:**	33.45753	**Longitude:**	80.64711	**Date Started:**	4/23/14
Total Depth:	33.7 ft	**Soil Depth:**	33.7 ft	**Core Depth:**	ft	**Date Completed:**	4/23/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 8.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Embankment: Very loose to dense, moist, tan, brown, gray, green & black, sub-angular, non to strongly reactive, f. to cse. grain, poorly graded SAND with silt (SP-SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=12.0, %#200=10.3		2.0	SS-1	12	17	14	31
115.2				4.0	SS-2	3	3	3	6
				6.0	SS-3	1	2	2	4
				8.0	SS-4	3	3	2	5
	9.8			10.0	SS-5	0	0	1	1
110.2		Alluvium: Very soft, moist, gray & green, non-reactive, f. grain, sandy, lean CLAY (CL/A-4).							
	13.3	LL=25, PL=16, PI=9, NMC=28.0, %#200=60.8		15.0	SS-6	2	4	1	5
105.2									
	17.0	Loose, moist, gray & green, strongly reactive, f. grain, silty SAND (SM/A-1-b).							
		Santee Formation: Very stiff to hard, moist to wet, green & gray, sub-angular, strongly reactive, f. to cse. grain, sandy SILT (ML/A-4). LL=38, PL=31, PI=7, NMC=28.4, %#200=51.4		20.0	SS-7	8	12	15	27
100.2									
95.2				25.0	SS-8	12	24	50/0.3	74/0.8
90.2				30.0	SS-9	11	17	23	40
	33.7			33.7	SS-10	50/0.0			50/0.0
85.2		SPT Refusal & Boring Terminated @ 33.7' (Elev. 86.5).							
80.2									
75.2									

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	RW-4	**Boring Location:**	5952+50	**Offset:**	20' Rt.	**Alignment:**	US 301
Elev.:	119.5 ft	**Latitude:**	33.45749	**Longitude:**	80.64832	**Date Started:**	4/10/2014
Total Depth:	25.1 ft	**Soil Depth:**	25.1 ft	**Core Depth:**	ft	**Date Completed:**	4/10/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 6.5 ft.	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Embankment: Very loose, moist, tan, red & gray, sub-angular, non-reactive, f. to cse. grain, siilty SAND (SM/A-2-4). LL=20, PL=16, PI=4, NMC=18.3, %#200=20.2		2.0	SS-1	1	2	2	4
114.5	3.8			4.0	SS-2	1	2	1	3
				6.0	SS-3	1	1	4	5
				8.0	SS-4	2	2	2	4
109.5	9.8	Alluvium: Very loose to loose, wet, gray & tan, sub-angular, non-reactive, f. to cse. grain, well-graded SAND (SW/A-1-b). LL=NP, PL=NP, PI=NP, NMC=10.6, %#200=4.1		9.9	SS-5	1	3	5	8
104.5	17.0	Loose to medium dense, wet, gray, tan & dark gray, sub-angular, non to weakly reactive, med. to cse. grain, silty SAND (SM/A-2-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=21.3		14.9	SS-6	2	2	10	12
99.5				19.9	SS-7	12	37	32	69
94.5	25.1	Santee Formation: Very dense, moist, green & gray, strongly reactive, mod. to strongly cemented, f. grain, silty SAND (SM/A-4). LL=34, PL=28, PI=6, NMC=32.2, %#200=49.3		24.9	~~SS-8~~	~~50/0.2~~			~~50/0.2~~
				25.1	SS-9	50/0.0			50/0.0
89.5		SPT Refusal & Boring Terminated @ 25.1' (Elev. 94.4).							
84.5									
79.5									
74.5									

SPT N VALUE

PL MC LL

FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	RW-5	**Boring Location:**	5952+70	**Offset:**	10' Lt.	**Alignment:**	US 301
Elev.:	120.3 ft	**Latitude:**	33.45736	**Longitude:**	80.64836	**Date Started:**	4/25/14
Total Depth:	41.4 ft	**Soil Depth:**	41.4 ft	**Core Depth:**	ft	**Date Completed:**	4/25/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 8.1 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Embankment: Loose to medium dense, moist, gray, tan & black, sub-angular, non-reactive, f. to med. grain, well-graded SAND with silt (SW-SM/A-2-4).	2.0	SS-1	6	8	7	15
			4.0	SS-2	2	3	3	6
115.3	5.8	LL=NP, PL=NP, PI=NP, NMC=6.7, %#200=11.3	6.0	SS-3	3	3	3	6
			8.0	SS-4	2	1	3	4
110.3	9.9	Alluvium: Very loose to loose, wet, dark gray, brown, black & tan, sub-angular, non-reactive, f. to med. grain, well-graded SAND with silt (SW-SM/A-2-4).	9.9	SS-5	1	1	1	2
105.3		LL=NP, PL=NP, PI=NP, NMC=11.7, %#200=11.5	14.9	SS-6	0	0	0	0
	18.2	Very loose, wet, dark gray & brown, non-reactive, silty SAND (SM/A-4).						
100.3		LL=20, PL=20, PI=NP, NMC=60.2, %#200=41.0	19.9	SS-7	3	5	12	17
		Santee Formation: Stiff to hard, moist to wet, green & gray, strongly reactive, mod. to strongly cemented, f. grain, sandy SILT (ML/A-4).	24.9	DD-8	6	9	14	23
95.3		LL=38, PL=30, PI=8, NMC=31.3, %#200=59.9						
90.3			29.9	DD-9	4	9	16	25
85.3			34.9	SS-10	32	50/0.1		50/0.1
80.3			39.9	SS-11	5	6	9	15
	41.4	No Casing Refusal & Boring Terminated @ 41.4' (Elev. 78.9).						
75.3								

SPT N VALUE ● PL × MC ○ LL × ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT BRIDGE OVER FOUR HOLE SWAMP.GPJ SC_DOT.GDT 1/27/15

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	RW-6	**Boring Location:**	5953+15	**Offset:**	22' Rt.	**Alignment:**	US 301
Elev.:	119.2 ft	**Latitude:**	33.45746	**Longitude:**	80.64868	**Date Started:**	4/10/2014
Total Depth:	20.9 ft	**Soil Depth:**	20.9 ft	**Core Depth:**	ft	**Date Completed:**	4/10/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 8.0 ft.	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Embankment: Very loose, wet, dark gray & tan, sub-angular, non-reactive, med. to cse. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=14.4, %#200=16.0	2.0	SS-1	1	1	2	3
114.2	3.8		4.0	SS-2	1	2	2	4
	7.8	Alluvium: Very loose, wet, dark gray, tan, brown & gray, sub-angular, non-reactive, med. to cse. grain, well-graded SAND with silt (SW-SM/A-2-4).	6.0	SS-3	0	0	1	1
109.2			8.0	SS-4	1	1	1	2
	13.3	Very loose to loose, wet, dark gray & tan, sub-angular, non-reactive, med. to cse. grain, silty SAND (SM/A-2-4). LL=NP, PL=NP, PI=NP, NMC=21.3, %#200=25.1	10.0	SS-5	2	4	4	8
104.2			15.0	SS-6	7	13	18	21
	20.0	Medium dense, wet, dark gray & tan, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-3).	20.0					
99.2	20.9		20.9	SS-7	12	50/0.3		50/0.3
		Santee Formation: Hard, moist, green & gray, strongly reactive, mod. cemented, f. grain, sandy SILT (ML/A-4).		SS-8	50/0.0			50/0.0
94.2								
		SPT Refusal & Boring Terminated @ 20.9' (Elev. 98.3).						
89.2								
84.2								
79.2								
74.2								

SPT N VALUE

PL MC LL

FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT BRIDGE OVER FOUR HOLE SWAMP.GPJ SC_DOT.GDT 9/19/14

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	RW-7	**Boring Location:**	5953+66	**Offset:**	20' Lt.	**Alignment:**	US 301
Elev.:	119.7 ft	**Latitude:**	33.45733	**Longitude:**	80.64868	**Date Started:**	4/24/14
Total Depth:	21.8 ft	**Soil Depth:**	21.8 ft	**Core Depth:**	ft	**Date Completed:**	4/24/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** 3.5 ft	**24HR**	7.9 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway Embankment: Medium dense, moist, brown, dark gray & tan, non-reactive, f. to med. grain, silty SAND (SM/A-1-b).		2.0	SS-1	6	6	6	12
114.7	3.8	LL=NP, PL=NP, PI=NP, NMC=11.3, %#200=13.7		4.0	SS-2	2	2	2	4
		Alluvium:		6.0	SS-3	1	1	1	2
				8.0	SS-4	2	4	3	7
109.7	9.8	Very loose to loose, wet, brown, dark gray, tan & gray, sub-angular, non-reactive, f. to cse. grain, poorly graded SAND with silt (SP-SM/A-1-b).		10.0	SS-5	2	2	2	4
	13.3	LL=NP, PL=NP, PI=NP, NMC=15.1, %#200=7.3							
104.7				15.0	SS-6	4	6	8	14
	18.0	Very loose, wet, tan & gray, sub-angular, non-reactive, f. to cse. grain, silty SAND (SM/A-2-4).							
99.7		Medium dense, wet, tan & gray, sub-angular, non-reactive, f. to cse. grain, well-graded SAND with silt (SW-SM/A-2-4).		20.0	SS-7	0	15	50	65
	21.8	LL=NP, PL=NP, PI=NP, NMC=25.1, %#200=12.0		21.8	SS-8	50/0.0			50/0.0
94.7		Santee Formation: Hard, moist, gray & green, strongly reactive, f. to med. grain, sandy SILT (ML/A-4).							
89.7		SPT Refusal & Boring Terminated @ 21.8' (Elev. 97.9).							
84.7									
79.7									
74.7									

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT BRIDGE OVER FOUR HOLE SWAMP.GPJ SC_DOT.GDT 9/19/14

Appendix Section IV
Laboratory Testing

ICA Engineering

Project Name : Bridge Replacement over Four Hole Swamp

Location : Orangeburg County, South Carolina

Job Number : 11200-10

Soil Classifications Summary

				Grain Size Data					Hydrometer Test Data							Atterberg			Classification		Direct Shear		Rock Core
Soil No.	Boring No.	Sample No.	Depth (ft)	Natural Moisture (%)	%< #4 Sieve	%< #10 Sieve	%< #40 Sieve	%< #200 Sieve	%< #1 Hyd. Rd.	%< #2 Hyd. Rd.	%< #3 Hyd. Rd.	%< #4 Hyd. Rd.	%< #5 Hyd. Rd.	%< #6 Hyd. Rd.	%< #7 Hyd. Rd.	LL	PL	PI	ASTM	AASHTO	Phi Angle	Cohesion (psi)	Unconfined Compressive Stength (psi)
1	B-1	SS-1	2-3.5	11.7	99.7	97.7	60.1	16.2								NP	NP	NP	SM	A-2-4 (0)			
2	B-1	SS-4	8-9.5	17.5	99.6	97.8	79.3	32.3								25	17	8	SC	A-2-4 (0)			
3	B-1	SS-6	16-17.5	13.1	100	98.5	41.9	4.4								NP	NP	NP	SP	A-1-b (0)			
4	B-1	SS-7	21-22.5	38.1	100	99.4	80.9	28.5								37	31	6	SM	A-2-4 (0)			
5	B-1	SS-9	31-32.5	23.5	93.7	83.9	59.5	24.5								NP	NP	NP	SM	A-2-4 (0)			
6	B-1	SS-11	41-42.5	44.9	100	100	83.7	44								NP	NP	NP	SM	A-4 (0)			
7	B-1	SS-13	51-52.5	33.9	98.3	92.9	87.5	55.3								NP	NP	NP	ML	A-4 (0)			
8	B-2	SS-4	8-9.5	N/A	99	96.1	37.4	14.2	11.2	10.2	9.1	8.2	5.3	4.1	2.7	NA	NA	NA	SM	A-1-b (0)			
9	B-2	SS-5	10-11.3	N/A	100	100	95.2	55.1	46.3	42.4	38.2	33.2	29.2	17	8.6	NA	NA	NA	ML	A-4 (0)			
10	B-2	SS-6	15-16.5	24.6	100	100	76.7	46.7	41.8	40.7	32.8	28.8	23.9	15	7.1	35	23	12	SC	A-6 (3)			
11	B-2	SS-8	25-26.5	34.4	100	100	87.1	39.2								31	30	1	SM	A-4 (0)			
12	B-2	SS-10	35-36.5	N/A	100	99.9	82.4	43.8								NA	NA	NA	SM	A-4 (0)			
13	B-2	SS-11	40-41.5	38.1	100	99.2	87	47.1								NP	NP	NP	SM	A-4 (0)			
14	B-2	SS-15	60-61.5	33.8	100	99.6	81.9	48.7								40	35	5	SM	A-4 (1)			
15	B-2	SS-17	70-71.5	37.6	100	99.7	64.2	23								NP	NP	NP	SM	A-2-4 (0)			
16	B-2	SS-18	75-76.5	35.1	95.8	84.3	42	7.9								NP	NP	NP	SP-SM	A-1-b (0)			
17	B-3	SS-2	4-5.5	4.5	98.6	74.9	8	0.5								NP	NP	NP	SP	A-1-b (0)			
18	B-3	SS-5	10-11.5	30.2	99.5	97	85.2	51.9	44.9	40.1	38.1	32.2	27.5	15.6	8.3	36	29	7	ML	A-4 (2)			
19	B-3	SS-6	15-16.5	N/A	100	99.7	93.1	55.2	49.2	44.2	41.2	34.4	25.5	15.5	6	NA	NA	NA	ML	A-4 (0)			
20	B-3	SS-8	25-26.5	37.9	100	100	84.5	43.6								36	33	3	SM	A-4 (0)			
21	B-3	SS-10	35-36.5	46.7	100	99.4	82.5	47.3								NP	NP	NP	SM	A-4 (0)			
22	B-3	SS-15	60-61.5	35.9	99.8	93.5	63.7	28								NP	NP	NP	SM	A-2-4 (0)			
23	B-3	SS-19	80-81.5	19.7	100	95.5	17.1	5.7								NP	NP	NP	SW-SM	A-1-b (0)			
24	B-3	SS-23	100-101.5	38.9	100	97.7	82.9	42.6								NP	NP	NP	SM	A-5 (0)			
25	B-4	SS-3	6-7.5	17.2	92.3	83.5	7.2	0.1								NP	NP	NP	SP	A-1-b (0)			
26	B-4	SS-5	10.0-11.5	N/A	98.9	96.3	87.1	50.2	43.5	39.7	36	33.1	27.1	16.7	9.4	NA	NA	NA	ML	A-4(0)			
27	B-4	SS-6	15-16.5	34.8	100	100	92	52.4	45	41	37	32.9	28.8	17	9.2	35	27	8	ML	A-4 (2)			
28	B-4	SS-7	20-21.5	N/A	85	80	61.7	32.8	29.5	27.9	23.2	20.1	16	8.1	3	NA	NA	NA	SM	A-2-4 (0)			
29	B-4	SS-8	25-26.5	33.2	100	99.8	88	49.8								NP	NP	NP	SM	A-4 (0)			
30	B-4	SS-10	35-36.5	43.4	98.2	91.7	80	49.4								NP	NP	NP	SM	A-4 (0)			
31	B-4	SS-13	50-51.5	36.0	100	100	83.6	42.6								37	34	3	SM	A-4 (0)			
32	B-4	SS-16	65-66.5	33.4	100	99.3	82.6	33.5								36	33	3	SM	A-2-4 (0)			
33	B-4	SS-19	80-81.5	22.7	100	99.9	68.1	27.3								33	30	3	SM	A-2-4 (0)			
34	B-5	SS-2	4-5.5	16.8	96.9	85.4	29.2	3.8								NP	NP	NP	SW	A-1-b (0)			
35	B-5	SS-3	6-7.5	N/A	100	99.9	96.1	59.9	52.8	47.9	44.1	40.2	33.4	20.5	10.6	NA	NA	NA	ML	A-4 (0)			
36	B-5	SS-4	8-9.5	N/A	95.7	93.4	82.4	47.8	39.4	35.8	31.2	27.5	20	12.2	7	NA	NA	NA	SM	A-4 (0)			
37	B-5	SS-6	32.4-33.9	36.4	100	99.8	83.6	41.2								NP	NP	NP	SM	A-4 (0)			
38	B-5	SS-9	45-46.5	37.0	100	99.9	82.9	52.3								45	33	12	ML	A-7-5 (5)			
39	B-5	SS-11	55-56.5	39.6	100	100	84.1	50.1								43	40	3	ML	A-5 (1)			
40	B-5	SS-13	65-66.5	45.4	99.7	85.2	23.5	2.6								NP	NP	NP	SW	A-1-b (0)			
41	B-6	SS-2	4-5.5	12.7	100	88.2	11.9	1.6								NA	NA	NA	SP	A-1-b (0)			
42	B-6	SS-3	6-7.5	14.0	100	97.8	43.7	4								NP	NP	NP	SP	A-1-b (0)			
43	B-6	SS-4	8-9.5	17.0	96.7	92.2	37.7	2.1								NP	NP	NP	SP	A-1-b (0)			
44	B-6	SS-5	10-11.5	N/A	99.6	99.2	86.4	8.8	4.8	4.8	3.9	3.8	3.8	3.6	2.9	NA	NA	NA	SP-SM	A-2-4 (0)			
45	B-7	SS-3	6-7.5	N/A	100	99.9	93.1	56.5	46.8	44.9	39.9	35.1	27.3	17.7	8.8	NA	NA	NA	ML	A-4 (0)			
46	B-7	SS-4	8-9.5	N/A	100	100	93	50.7	42.2	40	36.8	34.6	28	17.2	9.9	NA	NA	NA	ML	A-4 (0)			
47	B-7	SS-5	10-11.5	30.9	99.8	97.5	86.9	40.6								31	25	6	SM	A-4 (0)			
48	B-7	SS-6	15-16.5	N/A	98	93	87.1	64.2	30.4	29.5	26.9	22.7	17.6	9.3	4.2	NA	NA	NA	SM	A-4 (0)			
49	B-8	SS-1	2-3.5	8.3	99.8	97.4	54.2	11.9								NP	NP	NP	SW-SM	A-2-4 (0)			
50	B-8	SS-5	10-11.5	33.4	100	98.9	90.2	20.1								NP	NP	NP	SM	A-2-4 (0)			
51	B-8	SS-7	20-21.5	15.0	100	95.2	16.9	1.8								NP	NP	NP	SP	A-1-b (0)			
52	B-9	SS-1	2-3.5	13.3	96.6	93.5	57.7	18.9								20	18	2	SM	A-2-4 (0)			
53	B-9	SS-3	6-7.5	10.5	100	98.1	51.9	5.6								NP	NP	NP	SP-SM	A-3 (0)			
54	B-9	SS-6	15-16.5	N/A	100	98.2	38.7	4.6								NA	NA	NA	SW	A-1-b (0)			
55	B-9	SS-7	20-21.5	24.1	94.6	88.7	78.8	48.4								34	28	6	SM	A-4 (1)			
56	B-9	SS-9	30-31.5	23.3	93.7	87.3	66.8	35.7								26	21	5	SC-SM	A-4 (0)			
57	B-9	SS-12	45-46.5	41.7	97.8	92.5	83.5	59.4								41	40	1	ML	A-5 (1)			
58	RW-1	SS-1	2-3.5	12.7	100	98.7	64.6	29.5								33	19	14	SC	A-2-6 (1)			
59	RW-1	SS-2	4-5.5	11.0	100	98.7	58.9	12.8								NP	NP	NP	SM	A-2-4 (0)			
60	RW-1	SS-5	9.9-11.4	18.0	99.2	98.3	84.4	43.4								23	16	7	SC-SM	A-4 (0)			
61	RW-1	SS-6	14.9-16.4	16.8	100	98.7	39.3	4.3								NP	NP	NP	SP	A-1-b (0)			
62	RW-1	SS-7	19.9-21.4	26.4	99.6	97.8	92	52.9								37	31	6	ML	A-4 (2)			
63	RW-2	SS-1	2-3.5	14.0	97.3	93.7	49.5	15.4								18	17	1	SM	A-1-b (0)			
64	RW-2	SS-2	4-5.5	8.5	98.8	97.2	38.7	7.3								NP	NP	NP	SW-SM	A-1-b (0)			
65	RW-2	SS-4	8-9.5	18.9	98	95.7	71.2	35								21	19	2	SM	A-2-4 (0)			

ICA Engineering

Project Name : Bridge Replacement over Four Hole Swamp

Location : Orangeburg County, South Carolina

Job Number : 11200-10

Soil Classifications Summary

				Grain Size Data					Hydrometer Test Data							Atterberg			Classification		Direct Shear		Rock Core
Soil No.	Boring No.	Sample No.	Depth (ft)	Natural Moisture (%)	%< #4 Sieve	%< #10 Sieve	%< #40 Sieve	%< #200 Sieve	%< #1 Hyd. Rd.	%< #2 Hyd. Rd.	%< #3 Hyd. Rd.	%< #4 Hyd. Rd.	%< #5 Hyd. Rd.	%< #6 Hyd. Rd.	%< #7 Hyd. Rd.	LL	PL	PI	ASTM	AASHTO	Phi Angle	Cohesion (psi)	Unconfined Compressive Stength (psi)
66	RW-2	SS-6	15-16.5	25.7	100	99.9	57.3	2.5								NP	NP	NP	SP	A-3 (0)			
67	RW-2	SS-7	20-21.5	30.6	99.2	96.8	89.9	51.1								39	31	8	ML	A-4 (2)			
68	RW-3	SS-2	4-5.5	12.0	100	99.3	58.2	10.3								NP	NP	NP	SP-SM	A-2-4 (0)			
69	RW-3	SS-5	10-11.5	28.0	99.6	99	95.8	60.8								25	16	9	CL	A-4 (3)			
70	RW-3	SS-7	20-21.5	28.4	99.6	97.1	91.6	51.4								38	31	7	ML	A-4 (2)			
71	RW-4	SS-1	2-3.5	18.3	97.3	94.9	64.8	20.2								20	16	4	SM	A-2-4 (0)			
72	RW-4	SS-3	6-7.5	10.6	100	95.9	17.2	4.1								NP	NP	NP	SW	A-1-b (0)			
73	RW-4	SS-6	14.9-16.4	N/A	100	96.7	73.2	21.3								NA	NA	NA	SM	A-2-4 (0)			
74	RW-4	SS-7	19.9-21.4	32.2	96.2	91	80.4	49.3								34	28	6	SM	A-4 (1)			
75	RW-5	SS-1	2-3.5	6.7	100	96.2	89	11.3								NP	NP	NP	SW-SM	A-2-4 (0)			
76	RW-5	SS-3	6-7.5	11.7	100	98	55.2	11.5								NP	NP	NP	SW-SM	A-2-4 (0)			
77	RW-5	SS-5	9.9-11.4	60.2	100	94.8	87.4	41								NP	NP	NP	SM	A-4 (0)			
78	RW-5	SS-7	19.9-21.4	31.3	100	99.5	94.8	59.9								38	30	8	ML	A-4 (4)			
79	RW-6	SS-1	2-3.5	14.4	96.8	95.2	61.8	16								NP	NP	NP	SM	A-2-4 (0)			
80	RW-6	SS-5	10-11.5	21.3	99.9	97.8	78.3	25.1								NP	NP	NP	SM	A-2-4 (0)			
81	RW-7	SS-1	2-3.5	11.3	92.5	88.4	45.6	13.7								NP	NP	NP	SM	A-1-b (0)			
82	RW-7	SS-3	6-7.5	15.1	96.1	90.7	43.1	7.3								NP	NP	NP	SP-SM	A-1-b (0)			
83	RW-7	SS-6	15-16.5	25.1	99.9	97.9	81.5	12								NP	NP	NP	SW-SM	A-2-4 (0)			
84	B-1	Bulk-1	0-5	N/A	99.3	95.3	45.1	15.5								NP	NP	NP	SM	A-1-b (0)	35.96	0.83	
85	B-8	Bulk-2	0-5	N/A	96.9	92.9	62.6	17								NP	NP	NP	SM	A-1-b (0)	30.62	0.32	
	RC-1	B-5	10.6-11																				665
	RC-2	B-5	12.3-12.6																				1007
	RC-3	B-5	19.5-19.9																				1722
	RC-4	B-5	24.6-24.9																				299
	RC-5	B-5	26.5-26.8																				116
	RC-6	B-6	15.3-15.7																				297
	RC-7	B-6	23.9-24.3																				275
	RC-8	B-6	26.7-27.1																				459
	RC-9	B-6	30.6-31.0																				295
	RC-10	B-7	20.0-20.4																				4688
	RC-11	B-7	21.1-21.5																				4251
	RC-12	B-7	27.3-27.6																				435
	RC-13	B-7	31.5-31.9																				314
	RC-14	B-7	37-37.4																				643
	RC-15	B-8	30.5-30.8																				452
	RC-16	B-8	34.5-34.9																				261
	RC-17	B-8	39-39.4																				203

ICA Engineering

Project Name : Bridge Replacement over Four Hole Swamp
Location : Orangeburg County, South Carolina
Job Number : 11200-10
Project Job No. : 11200-10

Moisture Data

(AASHTO T255-T265 / ASTM C566-D2216)

Soil No.	Boring No.	Station & Offset	Sample No.	Depth		Description of Soil	HCL	Natural Moisture Content (%)
1	B-1		SS-1	2.0	3.5	Orange, Tan & Black Silty Sand	N	11.7
1			SS-2	4.0	5.5	Orange, Tan & Black Silty Sand	N	
1			SS-3	6.0	7.5	Tan, Brown & Gray Silty Sand	N	
2			SS-4	8.0	9.5	Tan, Brown & Gray Clayey Sand	N	17.5
60			SS-5	11.0	12.5	Tan, Brown & Gray Silty, Clayey Sand	N	
3			SS-6	16.0	17.5	Gray & White Poorly Graded Sand	N	13.1
4			SS-7	21.0	22.5	Green & Gray Silty Sand	S	38.1
4			SS-8	26.0	27.5	Green & Gray Silty Sand	S	
5			SS-9	31.0	32.5	Green & Gray Silty Sand	S	23.5
5			SS-10	36.0	36.9	Green & Gray Silty Sand	S	
6			SS-11	41.0	42.5	Green, Gray & Tan Silty Sand	S	44.9
6			SS-12	46.0	47.5	Green, Gray & Tan Silty Sand	S	
7			SS-13	51.0	52.5	Green, Gray & Tan Sandy Silt	S	33.9
7			SS-14	56.0	57.5	Green, Gray & Tan Sandy Silt	S	
7			SS-15	61.0	62.5	Green, Gray & Tan Sandy Silt	S	
7			SS-16	66.0	67.5	Green, Gray & Tan Sandy Silt	S	
7			SS-17	71.0	72.5	Green, Gray & Tan Sandy Silt	S	
7			SS-18	76.0	77.5	Green, Gray & Tan Sandy Silt	S	
7			SS-19	81.0	82.5	Green, Gray & Tan Sandy Silt	S	
7			SS-20	86.0	87.5	Green, Gray & Tan Sandy Silt	S	
16			SS-21	91.0	92.5	Dark Green, Black & Gray Poorly Graded Sand with Silt	W	
23			SS-22	96.0	97.5	Gray Well-Graded Sand with Silt	W	
23			SS-23	101.0	102.5	Gray Well-Graded Sand with Silt	W	
84			Bulk-1	0.0	5.0	Orange, Tan & Black Silty Sand	N	
1	B-2		SS-1	2.0	3.5	Gray Silty Sand	N	
3			SS-2	4.0	5.5	Gray Poorly Graded Sand	N	
			SS-3	6.0	7.5	No Recovery		
8			SS-4	8.0	9.5	Gray Silty Sand	S	
9			SS-5	10.0	11.5	Green & Gray Sandy Silt	S	
10			SS-6	15.0	16.3	Green & Gray Clayey Sand	S	24.6
11			SS-7	20.0	20.4	Green, Gray & Tan Silty Sand	S	
11			SS-8	25.0	26.5	Gray & Green Silty Sand	S	34.4
11			SS-9	30.0	31.5	Gray & Green Silty Sand	S	
12			SS-10	35.0	36.5	Gray & Green Silty Sand	S	
13			SS-11	40.0	41.5	Gray & Green Silty Sand	S	38.1
13			SS-12	45.0	46.5	Gray & Green Silty Sand	S	
13			SS-13	50.0	51.5	Gray & Green Silty Sand	S	
13			SS-14	55.0	56.5	Gray & Green Silty Sand	S	
14			SS-15	60.0	61.5	Gray & Green Silty Sand	S	33.8
14			SS-16	65.0	66.5	Green & Gray Silty Sand	S	
15			SS-17	70.0	71.5	Green & Gray Silty Sand	S	37.6
16			SS-18	75.0	76.5	Dark Green Poorly Graded Sand with Silt	W	35.1
23			SS-19	80.0	81.5	Green & Gray Well-Graded Sand with Silt	N	
23			SS-20	85.0	86.5	Gray Well-Graded Sand with Silt	N	
23			SS-21	90.0	91.5	Gray Well-Graded Sand with Silt	N	
			SS-22	95.0	96.5	No Recovery		
			SS-23	100.0	101.5	No Recovery		
23			SS-24	105.0	106.5	Gray Well-Graded Sand with Silt	N	
24			SS-25	110.0	111.5	Dark Gray Silty Sand	N	
	B-3		SS-1	2.0	3.5	No Recovery		
17			SS-2	4.0	5.5	White & Gray Poorly Graded Sand	N	4.5
17			SS-3	6.0	7.5	White & Gray Poorly Graded Sand	N	
17			SS-4	8.0	9.5	White & Gray Poorly Graded Sand	N	
18			SS-5	10.0	11.5	Green, Gray & Tan Sandy Silt	S	30.2
19			SS-6	15.0	16.5	Green, Gray & Tan Sandy Silt	S	

Project Name : Bridge Replacement over Four Hole Swamp
Location : Orangeburg County, South Carolina
Job Number : 11200-10
Project Job No. : 11200-10

Moisture Data

(AASHTO T255-T265 / ASTM C566-D2216)

Soil No.	Boring No.	Station & Offset	Sample No.	Depth		Description of Soil	HCL	Natural Moisture Content (%)
20			SS-7	20.0	20.3	Green, Gray & Tan Silty Sand	S	
20			SS-8	25.0	26.5	Green & Gray Silty Sand	S	37.9
20			SS-9	30.0	31.5	Green & Gray Silty Sand	S	
21			SS-10	35.0	36.5	Green & Gray Silty Sand	S	46.7
21			SS-11	40.0	41.5	Green & Gray Silty Sand	S	
21			SS-12	45.0	46.5	Green & Gray Silty Sand	S	
21			SS-13	50.0	51.5	Green & Gray Silty Sand	S	
15			SS-14	55.0	56.5	Green & Gray Silty Sand	S	
22			SS-15	60.0	61.5	Dark Green Silty Sand	W	35.9
40			SS-16	65.0	66.5	Dark Green & Tan Well-Graded Sand	W	
40			SS-17	70.0	71.5	Dark Green & Tan Well-Graded Sand	N	
40			SS-18	75.0	76.5	Dark Green & Tan Well-Graded Sand	N	
23			SS-19	80.0	81.5	Gray, Green, Black & Tan Well-Graded Sand with Silt	N	19.7
23			SS-20	85.0	86.5	Gray Well-Graded Sand with Silt	N	
23			SS-21	90.0	91.5	Gray Well-Graded Sand with Silt	N	
23			SS-22	95.0	96.5	Gray Well-Graded Sand with Silt	N	
24			SS-23	100.0	101.5	Dark Gray Silty Sand	N	38.9
25	B-4		SS-1	2.0	2.8	Gray & White Poorly Graded Sand	W	
			SS-2	3.3	3.3	No Recovery		
25			SS-3	6.0	7.5	Gray Poorly Graded Sand	W	17.2
			SS-4	8.0	9.5	No Recovery		
26			SS-5	10.0	11.5	Gray & Green Sandy Silt	S	
27			SS-6	15.0	16.5	Gray & Green Sandy Silt	S	34.8
28			SS-7	20.0	21.5	Gray & Green Silty Sand with Gravel	S	
29			SS-8	25.0	26.5	Gray & Green Silty Sand	S	33.2
30			SS-9	30.0	31.5	Tan & Gray Silty Sand	S	
30			SS-10	35.0	36.5	Tan & Gray Silty Sand	S	43.4
30			SS-11	40.0	41.5	Tan & Gray Silty Sand	S	
30			SS-12	45.0	46.5	Tan & Gray Silty Sand	S	
31			SS-13	50.0	51.5	Gray, Tan & Green Silty Sand	S	36.0
31			SS-14	55.0	56.5	Gray, Tan & Green Silty Sand	S	
31			SS-15	60.0	61.5	Gray, Tan & Green Silty Sand	S	
32			SS-16	65.0	66.5	Gray, Tan & Green Silty Sand	S	33.4
32			SS-17	70.0	71.5	Gray, Tan & Green Silty Sand	S	
32			SS-18	75.0	76.5	Gray, Tan & Green Silty Sand	S	
33			SS-19	80.0	81.5	Gray, Tan & Green Silty Sand	S	22.7
16			SS-20	85.0	86.5	Dark Green, Gray & Tan Poorly Graded Sand with Silt	S	
23			SS-21	90.0	91.5	Gray & Green Well-Graded Sand with Silt	W	
23			SS-22	95.0	96.5	Gray & Green Well-Graded Sand with Silt	N	
23			SS-23	100.0	101.5	Gray & Green Well-Graded Sand with Silt	N	
1	B-5		SS-1	2.0	2.8	Gray & Tan Silty Sand	N	
34			SS-2	4.0	5.5	Gray & Tan Well-Graded Sand	N	16.8
35			SS-3	6.0	7.5	Green, Gray & Tan Sandy Silt	N	
36			SS-4	8.0	9.5	Green & Gray Silty Sand	S	
			SS-5	10.0	10.0	No Recovery		
37			SS-6	32.4	33.9	Green & Gray Silty Sand	S	36.4
37			SS-7	35.0	36.5	Green & Gray Silty Sand	S	
38			SS-8	40.0	41.5	Green & Gray Sandy Silt	S	
38			SS-9	45.0	46.5	Green & Gray Sandy Silt	S	37.0
38			SS-10	50.0	51.5	Green & Gray Sandy Silt	S	
39			SS-11	55.0	56.5	Green & Gray Sandy Silt	S	39.6
22			SS-12	60.0	61.5	Dark Green & Gray Silty Sand	S	
40			SS-13	65.0	66.5	Dark Green, Tan & Black Well-Graded Sand	W	45.4
40			SS-14	70.0	71.5	Dark Green, Tan & Black Well-Graded Sand	N	
23			SS-15	75.0	76.5	Gray Well-Graded Sand with Silt	N	
23			SS-16	80.0	81.5	Gray Well-Graded Sand with Silt	N	
23			SS-17	85.0	86.5	Gray Well-Graded Sand with Silt	N	
23			SS-18	90.0	91.5	Gray Well-Graded Sand with Silt	N	
23			SS-19	95.0	96.5	Gray Well-Graded Sand with Silt	N	
23			SS-20	100.0	101.3	Gray Well-Graded Sand with Silt	N	

Project Name : Bridge Replacement over Four Hole Swamp
Location : Orangeburg County, South Carolina
Job Number : 11200-10
Project Job No. : 11200-10

Moisture Data

(AASHTO T255-T265 / ASTM C566-D2216)

Soil No.	Boring No.	Station & Offset	Sample No.	Depth		Description of Soil	HCL	Natural Moisture Content (%)
1	B-6		SS-1	2.0	2.8	Brown, Tan & Gray Silty Sand	W	
41			SS-2	4.0	5.5	Brown, Tan & Gray Poorly Graded Sand	N	12.7
42			SS-3	6.0	7.5	Brown, Tan & Gray Poorly Graded Sand	N	14.0
43			SS-4	8.0	9.5	Brown, Tan & Gray Poorly Graded Sand	N	17.0
44			SS-5	10.0	11.5	Gray & Brown Poorly Graded Sand with Silt	N	
48			SS-6	15.0	15.2	Gray & Green Silty Sand	W	
42	B-7		SS-1	2.0	3.5	Dark Gray Poorly Graded Sand	N	
42			SS-2	4.0	5.5	Gray & Tan Poorly Graded Sand	N	
45			SS-3	6.0	7.5	Green & Gray Sandy Silt	S	
46			SS-4	8.0	9.5	Green & Gray Sandy Silt	S	
47			SS-5	10.0	11.5	Green & Gray Silty Sand	S	30.9
48			SS-6	15.0	16.5	Green & Gray Silty Sand	S	
49	B-8		SS-1	2.0	3.5	Tan, Brown & Gray Well-Graded Sand with Silt	N	8.3
42			SS-2	4.0	5.5	Tan, Brown & Gray Poorly Graded Sand	N	
42			SS-3	6.0	7.5	Tan, Brown & Gray Poorly Graded Sand	W	
42			SS-4	8.0	9.5	Tan, Brown & Gray Poorly Graded Sand	W	
50			SS-5	10.0	11.5	Dark Gray Silty Sand	N	33.4
			SS-6	15.0	15.0	No Recovery	N	
51			SS-7	20.0	21.5	Dark Gray Poorly Graded Sand	N	15.0
47			SS-8	25.0	26.5	Gray & Green Silty Sand	S	
47			SS-9	30.0	30.3	Gray & Green Silty Sand	S	
			SS-10	30.3	30.4	No Recovery	S	
48			SS-11	55.0	56.5	Green & Gray Silty Sand	S	
48			SS-12	60.0	61.5	Green & Gray Silty Sand	S	
48			SS-13	65.0	66.5	Green & Gray Silty Sand	S	
48			SS-14	70.0	71.5	Green & Gray Silty Sand	S	
48			SS-15	75.0	76.5	Green & Gray Silty Sand	S	
48			SS-16	80.0	81.5	Green & Gray Silty Sand	S	
48			SS-17	85.0	86.5	Green & Gray Silty Sand	S	
16			SS-18	90.0	91.5	Dark Green & Gray Poorly Graded Sand with Silt	W	
23			SS-19	95.0	96.3	Dark Gray Well-Graded Sand with Silt	N	
23			SS-20	100.0	101.4	Dark Gray Well-Graded Sand with Silt	N	
85			Bulk-2	0.0	5.0	Tan, Brown & Gray Silty Sand	N	
52	B-9		SS-1	2.0	3.5	Tan, Red & Gray Silty Sand	N	13.3
54			SS-2	4.0	5.5	Gray & Tan Well-Graded Sand	N	
53			SS-3	6.0	7.5	Gray & Tan Poorly Graded Sand with Silt	N	10.5
54			SS-4	8.0	9.5	Gray & Tan Well-Graded Sand	N	
50			SS-5	10.0	11.5	Gray & Tan Silty Sand	N	
54			SS-6	15.0	16.5	Gray & Tan Well-Graded Sand	N	
55			SS-7	20.0	21.5	Green & Gray Silty Sand	S	24.1
56			SS-8	25.0	26.5	Green & Gray Silty, Clayey Sand	S	
56			SS-9	30.0	31.5	Green & Gray Silty, Clayey Sand	S	23.3
			SS-10	35.0	36.5	No Recovery		
57			SS-11	40.0	41.5	Green & Gray Sandy Silt	S	
57			SS-12	45.0	46.5	Green & Gray Sandy Silt	S	41.7
57			SS-13	50.0	51.5	Green & Gray Sandy Silt	S	
57			SS-14	55.0	56.5	Green & Gray Sandy Silt	S	
57			SS-15	60.0	61.5	Green & Gray Sandy Silt	S	
57			SS-16	65.0	66.5	Green, Gray & Tan Sandy Silt	S	
57			SS-17	70.0	71.5	Green, Gray & Tan Sandy Silt	S	
57			SS-18	75.0	76.5	Green, Gray & Tan Sandy Silt	S	
57			SS-19	80.0	81.5	Green, Gray & Tan Sandy Silt	S	
57			SS-20	85.0	86.5	Green, Gray & Tan Sandy Silt	S	
16			SS-21	90.0	91.5	Dark Green & Gray Poorly Graded Sand with Silt	N	
48			SS-22	95.0	96.5	Gray Silty Sand	N	
23			SS-23	100.0	101.5	Gray Well-Graded Sand with Silt	N	
58	RW-1		SS-1	2.0	3.5	Red, Gray & Tan Clayey Sand	N	12.7

Project Name : Bridge Replacement over Four Hole Swamp
Location : Orangeburg County, South Carolina
Job Number : 11200-10
Project Job No. : 11200-10

Moisture Data

(AASHTO T255-T265 / ASTM C566-D2216)

Soil No.	Boring No.	Station & Offset	Sample No.	Depth		Description of Soil	HCL	Natural Moisture Content (%)
59			SS-2	4.0	5.5	Gray, Tan & Brown Silty Sand	N	11.0
59			SS-3	6.0	7.5	Gray, Tan & Brown Silty Sand	N	
60			SS-4	8.0	9.5	Dark Gray Silty, Clayey Sand	N	
60			SS-5	9.9	11.4	Dark Gray Silty, Clayey Sand	N	18.0
61			SS-6	14.9	16.4	Gray Poorly Graded Sand	N	16.8
62			SS-7	19.9	21.4	Gray & Green Sandy Silt	S	26.4
62			SS-8	24.9	25.9	Gray & Green Sandy Silt	S	
62			SS-9	29.9	31.4	Green & Gray Sandy Silt	S	
62			SS-10	34.9	36.4	Green & Gray Sandy Silt	S	
62			SS-11	39.9	41.4	Green & Gray Sandy Silt	S	
63	RW-2		SS-1	2.0	3.5	Tan & Red Silty Sand	N	14.0
64			SS-2	4.0	5.5	Tan & Brown Well-Graded Sand with Silt	N	8.5
52			SS-3	6.0	7.5	Tan & Brown Silty Sand	N	
65			SS-4	8.0	9.5	Tan & Gray Silty Sand	N	18.9
65			SS-5	10.0	11.5	Tan & Gray Silty Sand	N	
66			SS-6	15.0	16.5	Gray Poorly Graded Sand	S	25.7
67			SS-7	20.0	21.5	Gray & Green Sandy Silt	S	30.6
67			SS-8	25.0	26.5	Gray & Green Sandy Silt	S	
67			SS-9	30.0	31.5	Gray & Green Sandy Silt	S	
67			SS-10	35.0	36.5	Gray & Green Sandy Silt	S	
67			SS-11	40.0	41.5	Gray & Green Sandy Silt	S	
68	RW-3		SS-1	2.0	3.5	Tan, Brown & Gray Poorly Graded Sand with Silt	N	
68			SS-2	4.0	5.5	Tan, Brown & Gray Poorly Graded Sand with Silt	N	12.0
68			SS-3	6.0	7.5	Tan, Brown & Gray Poorly Graded Sand with Silt	N	
68			SS-4	8.0	9.5	Gray, Green & Black Poorly Graded Sand with Silt	S	
69			SS-5	10.0	11.5	Gray & Green Sandy Lean Clay	N	28.0
8			SS-6	15.0	16.5	Gray & Green Silty Sand	S	
70			SS-7	20.0	21.5	Green & Gray Sandy Silt	S	28.4
70			SS-8	25.0	26.3	Green & Gray Sandy Silt	S	
70			SS-9	30.0	31.5	Green & Gray Sandy Silt	S	
			SS-10	33.7	33.7	No Recovery		
71	RW-4		SS-1	2.0	3.5	Tan, Red & Gray Silty Sand	N	18.3
72			SS-2	4.0	5.5	Gray & Tan Well-Graded Sand	N	
72			SS-3	6.0	7.5	Gray & Tan Well-Graded Sand	N	10.6
72			SS-4	8.0	9.5	Gray & Tan Well-Graded Sand	N	
73			SS-5	9.9	11.4	Gray & Tan Silty Sand	W	
73			SS-6	14.9	16.4	Dark Gray & Tan Silty Sand	N	
74			SS-7	19.9	21.4	Green & Gray Silty Sand	S	32.2
74			SS-8	24.9	25.1	Green & Gray Silty Sand	S	
			SS-9	25.1	25.1	No Recovery		
75	RW-5		SS-1	2.0	3.5	Gray & Tan Well-Graded Sand with Silt	N	6.7
75			SS-2	4.0	5.5	Gray, Tan & Black Well-Graded Sand with Silt	N	
76			SS-3	6.0	7.5	Dark Gray, Brown, Black & Tan Well-Graded Sand with Silt	N	11.7
76			SS-4	8.0	9.5	Dark Gray, Brown, Black & Tan Well-Graded Sand with Silt	N	
77			SS-5	9.9	11.4	Dark Gray & Brown Silty Sand	N	60.2
77			SS-6	14.9	16.4	Dark Gray & Brown Silty Sand	N	
78			SS-7	19.9	21.4	Green & Gray Sandy Silt	S	31.3
78			SS-8	24.9	26.4	Green & Gray Sandy Silt	S	
78			SS-9	29.9	31.4	Green & Gray Sandy Silt	S	
78			SS-10	34.9	35.5	Green & Gray Sandy Silt	S	
78			SS-11	39.9	41.4	Green & Gray Sandy Silt	S	
79	RW-6		SS-1	2.0	3.5	Dark Gray & Tan Silty Sand	N	14.4
75			SS-2	4.0	5.5	Dark Gray & Tan Well-Graded Sand with Silt	N	
75			SS-3	6.0	7.5	Tan, Brown & Gray Well-Graded Sand with Silt	N	
80			SS-4	8.0	9.5	Dark Gray & Tan Silty Sand	N	
80			SS-5	10.0	11.5	Dark Gray & Tan Silty Sand	N	21.3
66			SS-6	15.0	16.5	Dark Gray & Tan Poorly Graded Sand	N	

Project Name : Bridge Replacement over Four Hole Swamp
Location : Orangeburg County, South Carolina
Job Number : 11200-10
Project Job No. : 11200-10

Moisture Data

(AASHTO T255-T265 / ASTM C566-D2216)

Soil No.	Boring No.	Station & Offset	Sample No.	Depth		Description of Soil	HCL	Natural Moisture Content (%)
78			SS-7	20.0	20.8	Green & Gray Sandy Silt	S	
			SS-8	20.9	20.9	No Recovery		
81	RW-7		SS-1	2.0	3.5	Brown, Dark Gray & Tan Silty Sand	N	11.3
82			SS-2	4.0	5.5	Brown, Dark Gray & Tan Poorly Graded Sand with Silt	N	
82			SS-3	6.0	7.5	Tan & Gray Poorly Graded Sand with Silt	N	15.1
82			SS-4	8.0	9.5	Tan & Gray Poorly Graded Sand with Silt	N	
80			SS-5	10.0	11.5	Tan & Gray Silty Sand	N	
83			SS-6	15.0	16.5	Tan & Gray Well-Graded Sand with Silt	N	25.1
78			SS-7	20.0	21.5	Gray & Green Sandy Silt	S	
			SS-8	21.8	21.8	No Recovery		

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Orange, Tan & Black Silty Sand

Sample No. : SS-1
Sample Loc. : Boring No. B-1
Sample Depth : 2.0' to 3.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.7
No.6		3.35	mm	
No.10		2	mm	97.7

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	60.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	16.2
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.2851 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 11.7
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.3
Coarse Sand (-No.10 + No.40) : 37.6
Fine Sand (-No.40 + No.200) : 43.9
Silt + Clay (-No.200) : 16.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.3
Coarse Sand (-No.4 + No.10) : 2.0
Medium Sand (-No.10 + No.40) : 37.6
Fine Sand (-No.40 + No.200) : 43.9
Silt + Clay (-No.200) : 16.2

Approved By : J.S.

Soil No. 1

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan, Brown & Gray Clayey Sand

Sample No. : SS-4
Sample Loc. : Boring No. B-1
Sample Depth : 8.0' to 9.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.6
No.6		3.35	mm	
No.10		2	mm	97.8
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	79.3
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	32.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1441 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 17.5
Liquid Limit (AASHTO T89) : 25
Plastic Limit (AASHTO T90) : 17
Plasticity Index : 8
Liquidity Index : 0.01
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SC

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.2
Coarse Sand (-No.10 + No.40) : 18.5
Fine Sand (-No.40 + No.200) : 47.0
Silt + Clay (-No.200) : 32.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.4
Coarse Sand (-No.4 + No.10) : 1.8
Medium Sand (-No.10 + No.40) : 18.5
Fine Sand (-No.40 + No.200) : 47.0
Silt + Clay (-No.200) : 32.3

Approved By : J.S.

Soil No. 2

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & White Poorly Graded Sand

Sample No. : SS-6
Sample Loc. : Boring No. B-1
Sample Depth : 16.0' to 17.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	98.5
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	41.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	4.4
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.5305 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 13.1
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 1.5
Coarse Sand (-No.10 + No.40) : 56.6
Fine Sand (-No.40 + No.200) : 37.5
Silt + Clay (-No.200) : 4.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 1.5
Medium Sand (-No.10 + No.40) : 56.6
Fine Sand (-No.40 + No.200) : 37.5
Silt + Clay (-No.200) : 4.4

Approved By : J.S.

Soil No. 3

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-7
Sample Loc. : Boring No. B-1
Sample Depth : 21.0' to 22.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.4
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	80.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	28.5
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1528 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 38.1
Liquid Limit (AASHTO T89) : 37
Plastic Limit (AASHTO T90) : 31
Plasticity Index : 6
Liquidity Index : 1.17
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.6
Coarse Sand (-No.10 + No.40) : 18.5
Fine Sand (-No.40 + No.200) : 52.4
Silt + Clay (-No.200) : 28.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.6
Medium Sand (-No.10 + No.40) : 18.5
Fine Sand (-No.40 + No.200) : 52.4
Silt + Clay (-No.200) : 28.5

Approved By : J.S.

Soil No. 4

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-9
Sample Loc. : Boring No. B-1
Sample Depth : 31.0' to 32.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	93.7
No.6		3.35	mm	
No.10		2	mm	83.9
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	59.5
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	24.5
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.2654 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 23.5
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 16.1
Coarse Sand (-No.10 + No.40) : 24.4
Fine Sand (-No.40 + No.200) : 35.0
Silt + Clay (-No.200) : 24.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 6.3
Coarse Sand (-No.4 + No.10) : 9.8
Medium Sand (-No.10 + No.40) : 24.4
Fine Sand (-No.40 + No.200) : 35.0
Silt + Clay (-No.200) : 24.5

Approved By : J.S.

Soil No. 5

ICA Engineering

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green, Gray & Tan Silty Sand

Sample No. : SS-11
Sample Loc. : Boring No. B-1
Sample Depth : 41.0' to 42.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	83.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	44.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0975 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 44.9
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 16.3
Fine Sand (-No.40 + No.200) : 39.7
Silt + Clay (-No.200) : 44.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 16.3
Fine Sand (-No.40 + No.200) : 39.7
Silt + Clay (-No.200) : 44.0

Approved By : J.S.

Soil No. 6

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green, Gray & Tan Sandy Silt

Sample No. : SS-13
Sample Loc. : Boring No. B-1
Sample Depth : 51.0' to 52.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	98.3
No.6		3.35	mm	
No.10		2	mm	92.9

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	87.5
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	55.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0398 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 33.9
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 7.1
Coarse Sand (-No.10 + No.40) : 5.4
Fine Sand (-No.40 + No.200) : 32.2
Silt + Clay (-No.200) : 55.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 1.7
Coarse Sand (-No.4 + No.10) : 5.4
Medium Sand (-No.10 + No.40) : 5.4
Fine Sand (-No.40 + No.200) : 32.2
Silt + Clay (-No.200) : 55.3

Approved By : J.S.

Soil No. 7

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray Silty Sand

Sample No. : SS-4
Sample Loc. : Boring No. B-2
Sample Depth : 8.0' to 9.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.0
No.6		3.35	mm	
No.10		2	mm	96.1

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	37.4
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	14.2
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0366	mm	11.2
Hyd. Rd.	# 2	0.0233	mm	10.2
Hyd. Rd.	# 3	0.0135	mm	9.1
Hyd. Rd.	# 4	0.0095	mm	8.2
Hyd. Rd.	# 5	0.0068	mm	5.3
Hyd. Rd.	# 6	0.0034	mm	4.1
Hyd. Rd.	# 7	0.0014	mm	2.7

D_{50} = 0.5926 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.655
AASHTO Classification: M145 : A-1-b (0) *
ASTM Classification: D2487 : SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 3.9
Coarse Sand (-No.10 + No.40) : 58.7
Fine Sand (-No.40 + No.200) : 23.2
Silt (-No.200 + 0.002mm) : 10.9
Clay (-0.002mm + 0.001mm) : 0.9
Colloids (-0.001mm) : 2.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 1.0
Coarse Sand (-No.4 + No.10) : 2.9
Medium Sand (-No.10 + No.40) : 58.7
Fine Sand (-No.40 + No.200) : 23.2
Silt (-No.200 + 0.005mm) : 9.4
Clay (-0.005mm + 0.001mm) : 2.4
Colloids (-0.001mm) : 2.4

Approved By : J.S.

Soil No. 8

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-5
Sample Loc. : Boring No. B-2
Sample Depth : 10.0' to 11.3'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	95.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	55.1
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0319	mm	46.3
Hyd. Rd.	# 2	0.0204	mm	42.4
Hyd. Rd.	# 3	0.0120	mm	38.2
Hyd. Rd.	# 4	0.0086	mm	33.2
Hyd. Rd.	# 5	0.0062	mm	29.2
Hyd. Rd.	# 6	0.0032	mm	17.0
Hyd. Rd.	# 7	0.0014	mm	8.6

D_{50} = 0.0457 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.758
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : ML *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 4.8
Fine Sand (-No.40 + No.200) : 40.1
Silt (-No.200 + 0.002mm) : 42.7
Clay (-0.002mm + 0.001mm) : 4.8
Colloids (-0.001mm) : 7.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 4.8
Fine Sand (-No.40 + No.200) : 40.1
Silt (-No.200 + 0.005mm) : 29.8
Clay (-0.005mm + 0.001mm) : 17.7
Colloids (-0.001mm) : 7.6

Approved By : J.S.

Soil No. 9

ICA Engineering

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Clayey Sand

Sample No. : SS-6
Sample Loc. : Boring No. B-2
Sample Depth : 15.0' to 16.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	76.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	46.7
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0330	mm	41.8
Hyd. Rd.	# 2	0.0210	mm	40.7
Hyd. Rd.	# 3	0.0124	mm	32.8
Hyd. Rd.	# 4	0.0089	mm	28.8
Hyd. Rd.	# 5	0.0064	mm	23.9
Hyd. Rd.	# 6	0.0032	mm	15.0
Hyd. Rd.	# 7	0.0014	mm	7.1

D_{50} = 0.0908 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 24.6
Liquid Limit (AASHTO T89) : 35
Plastic Limit (AASHTO T90) : 23
Plasticity Index : 12
Liquidity Index : 0.11
Activity : 1.13
Sp. Gr. (AASHTO T100) : 2.718
AASHTO Classification: M145 : A-6 (3)
ASTM Classification: D2487 : SC

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 23.3
Fine Sand (-No.40 + No.200) : 30.0
Silt (-No.200 + 0.002mm) : 36.0
Clay (-0.002mm + 0.001mm) : 4.4
Colloids (-0.001mm) : 6.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 23.3
Fine Sand (-No.40 + No.200) : 30.0
Silt (-No.200 + 0.005mm) : 26.0
Clay (-0.005mm + 0.001mm) : 14.5
Colloids (-0.001mm) : 6.3

Approved By : J.S.

Soil No. 10

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Silty Sand

Sample No. : SS-8
Sample Loc. : Boring No. B-2
Sample Depth : 25.0' to 26.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	87.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	39.2
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1109 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 34.4
Liquid Limit (AASHTO T89) : 31
Plastic Limit (AASHTO T90) : 30
Plasticity Index : 1
Liquidity Index : 4.80
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 12.9
Fine Sand (-No.40 + No.200) : 47.9
Silt + Clay (-No.200) : 39.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 12.9
Fine Sand (-No.40 + No.200) : 47.9
Silt + Clay (-No.200) : 39.2

Approved By : J.S.

Soil No. 11

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Silty Sand

Sample No. : SS-10
Sample Loc. : Boring No. B-2
Sample Depth : 35.0' to 36.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.9

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	82.4
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	43.8
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0991 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.1
Coarse Sand (-No.10 + No.40) : 17.5
Fine Sand (-No.40 + No.200) : 38.6
Silt + Clay (-No.200) : 43.8

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.1
Medium Sand (-No.10 + No.40) : 17.5
Fine Sand (-No.40 + No.200) : 38.6
Silt + Clay (-No.200) : 43.8

Approved By : J.S.

Soil No. 12

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Silty Sand

Sample No. : SS-11
Sample Loc. : Boring No. B-2
Sample Depth : 40.0' to 41.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.2

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	87.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	47.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0851 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 38.1
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.8
Coarse Sand (-No.10 + No.40) : 12.2
Fine Sand (-No.40 + No.200) : 39.9
Silt + Clay (-No.200) : 47.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.8
Medium Sand (-No.10 + No.40) : 12.2
Fine Sand (-No.40 + No.200) : 39.9
Silt + Clay (-No.200) : 47.1

Approved By : J.S.

Soil No. 13

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Silty Sand

Sample No. : SS-15
Sample Loc. : Boring No. B-2
Sample Depth : 60.0' to 61.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.6

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	81.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	48.7
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0803 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 33.8
Liquid Limit (AASHTO T89) : 40
Plastic Limit (AASHTO T90) : 35
Plasticity Index : 5
Liquidity Index : -0.27
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (1)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.4
Coarse Sand (-No.10 + No.40) : 17.7
Fine Sand (-No.40 + No.200) : 33.2
Silt + Clay (-No.200) : 48.7

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.4
Medium Sand (-No.10 + No.40) : 17.7
Fine Sand (-No.40 + No.200) : 33.2
Silt + Clay (-No.200) : 48.7

Approved By : J.S.

Soil No. 14

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-17
Sample Loc. : Boring No. B-2
Sample Depth : 70.0' to 71.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.7
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	64.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	23.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.2337 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 37.6
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.3
Coarse Sand (-No.10 + No.40) : 35.5
Fine Sand (-No.40 + No.200) : 41.2
Silt + Clay (-No.200) : 23.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.3
Medium Sand (-No.10 + No.40) : 35.5
Fine Sand (-No.40 + No.200) : 41.2
Silt + Clay (-No.200) : 23.0

Approved By : J.S.

Soil No. 15

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Green Poorly Graded Sand with Silt

Sample No. : SS-18
Sample Loc. : Boring No. B-2
Sample Depth : 75.0' to 76.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	99.6
1/4		6.3	mm	
No.4		4.75	mm	95.8
No.6		3.35	mm	
No.10		2	mm	84.3

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	42.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	7.9
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.5696 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 35.1
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 15.7
Coarse Sand (-No.10 + No.40) : 42.3
Fine Sand (-No.40 + No.200) : 34.1
Silt + Clay (-No.200) : 7.9

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 4.2
Coarse Sand (-No.4 + No.10) : 11.5
Medium Sand (-No.10 + No.40) : 42.3
Fine Sand (-No.40 + No.200) : 34.1
Silt + Clay (-No.200) : 7.9

Approved By : J.S.

Soil No. 16

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : White & Gray Poorly Graded Sand

Sample No. : SS-2
Sample Loc. : Boring No. B-3
Sample Depth : 4.0' to 5.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	98.6
No.6		3.35	mm	
No.10		2	mm	74.9
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	8.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	0.5
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 1.1238 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 4.5
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 25.1
Coarse Sand (-No.10 + No.40) : 66.9
Fine Sand (-No.40 + No.200) : 7.5
Silt + Clay (-No.200) : 0.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 1.4
Coarse Sand (-No.4 + No.10) : 23.7
Medium Sand (-No.10 + No.40) : 66.9
Fine Sand (-No.40 + No.200) : 7.5
Silt + Clay (-No.200) : 0.5

Approved By : J.S.

Soil No. 17

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green, Gray & Tan Sandy Silt

Sample No. : SS-5
Sample Loc. : Boring No. B-3
Sample Depth : 10.0' to 11.5'
Date Tested : 07/16/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.5
No.6		3.35	mm	
No.10		2	mm	97.0

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	85.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	51.9
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0320	mm	44.9
Hyd. Rd.	# 2	0.0206	mm	40.1
Hyd. Rd.	# 3	0.0120	mm	38.1
Hyd. Rd.	# 4	0.0087	mm	32.2
Hyd. Rd.	# 5	0.0062	mm	27.5
Hyd. Rd.	# 6	0.0032	mm	15.6
Hyd. Rd.	# 7	0.0014	mm	8.3

D_{50} = 0.0596 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 30.2
Liquid Limit (AASHTO T89) : 36
Plastic Limit (AASHTO T90) : 29
Plasticity Index : 7
Liquidity Index : 0.17
Activity : 0.60
Sp. Gr. (AASHTO T100) : 2.729
AASHTO Classification: M145 : A-4 (2)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 3.0
Coarse Sand (-No.10 + No.40) : 11.8
Fine Sand (-No.40 + No.200) : 33.3
Silt (-No.200 + 0.002mm) : 40.3
Clay (-0.002mm + 0.001mm) : 4.3
Colloids (-0.001mm) : 7.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.5
Coarse Sand (-No.4 + No.10) : 2.5
Medium Sand (-No.10 + No.40) : 11.8
Fine Sand (-No.40 + No.200) : 33.3
Silt (-No.200 + 0.005mm) : 28.3
Clay (-0.005mm + 0.001mm) : 16.3
Colloids (-0.001mm) : 7.3

Approved By : J.S.

Soil No. 18

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green, Gray & Tan Sandy Silt

Sample No. : SS-6
Sample Loc. : Boring No. B-3
Sample Depth : 15.0' to 16.5'
Date Tested : 07/17/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.7

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	93.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	55.2
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0323	mm	49.2
Hyd. Rd.	# 2	0.0208	mm	44.2
Hyd. Rd.	# 3	0.0121	mm	41.2
Hyd. Rd.	# 4	0.0088	mm	34.4
Hyd. Rd.	# 5	0.0064	mm	25.5
Hyd. Rd.	# 6	0.0032	mm	15.5
Hyd. Rd.	# 7	0.0014	mm	6.0

D_{50} = 0.0361 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.697
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : ML *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.3
Coarse Sand (-No.10 + No.40) : 6.6
Fine Sand (-No.40 + No.200) : 37.9
Silt (-No.200 + 0.002mm) : 45.1
Clay (-0.002mm + 0.001mm) : 4.9
Colloids (-0.001mm) : 5.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.3
Medium Sand (-No.10 + No.40) : 6.6
Fine Sand (-No.40 + No.200) : 37.9
Silt (-No.200 + 0.005mm) : 33.3
Clay (-0.005mm + 0.001mm) : 16.6
Colloids (-0.001mm) : 5.2

Approved By : J.S.

Soil No. 19

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-8
Sample Loc. : Boring No. B-3
Sample Depth : 25.0' to 26.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	84.5
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	43.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0984 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 37.9
Liquid Limit (AASHTO T89) : 36
Plastic Limit (AASHTO T90) : 33
Plasticity Index : 3
Liquidity Index : 1.67
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 15.5
Fine Sand (-No.40 + No.200) : 40.9
Silt + Clay (-No.200) : 43.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 15.5
Fine Sand (-No.40 + No.200) : 40.9
Silt + Clay (-No.200) : 43.6

Approved By : J.S.

Soil No. 20

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-10
Sample Loc. : Boring No. B-3
Sample Depth : 35.0' to 36.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.4

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	82.5
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	47.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0857 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 46.7
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.6
Coarse Sand (-No.10 + No.40) : 16.9
Fine Sand (-No.40 + No.200) : 35.2
Silt + Clay (-No.200) : 47.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.6
Medium Sand (-No.10 + No.40) : 16.9
Fine Sand (-No.40 + No.200) : 35.2
Silt + Clay (-No.200) : 47.3

Approved By : J.S.

Soil No. 21

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Green Silty Sand

Sample No. : SS-15
Sample Loc. : Boring No. B-3
Sample Depth : 60.0' to 61.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.8
No.6		3.35	mm	
No.10		2	mm	93.5

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	63.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	28.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.2184 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 35.9
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 6.5
Coarse Sand (-No.10 + No.40) : 29.8
Fine Sand (-No.40 + No.200) : 35.7
Silt + Clay (-No.200) : 28.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.2
Coarse Sand (-No.4 + No.10) : 6.3
Medium Sand (-No.10 + No.40) : 29.8
Fine Sand (-No.40 + No.200) : 35.7
Silt + Clay (-No.200) : 28.0

Approved By : J.S.

Soil No. 22

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray, Green, Black & Tan Well-Graded Sand with Silt

Sample No. : SS-19
Sample Loc. : Boring No. B-3
Sample Depth : 80.0' to 81.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	95.5

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	17.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	5.7
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.8141 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 19.7
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SW-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 4.5
Coarse Sand (-No.10 + No.40) : 78.4
Fine Sand (-No.40 + No.200) : 11.4
Silt + Clay (-No.200) : 5.7

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 4.5
Medium Sand (-No.10 + No.40) : 78.4
Fine Sand (-No.40 + No.200) : 11.4
Silt + Clay (-No.200) : 5.7

Approved By : J.S.

Soil No. 23

ICA Engineering

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Gray Silty Sand

Sample No. : SS-23
Sample Loc. : Boring No. B-3
Sample Depth : 100.0' to 101.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	97.7
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	82.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	42.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1031 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 38.9
Liquid Limit (AASHTO T89) : 44
Plastic Limit (AASHTO T90) : 44
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-5 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.3
Coarse Sand (-No.10 + No.40) : 14.8
Fine Sand (-No.40 + No.200) : 40.3
Silt + Clay (-No.200) : 42.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 2.3
Medium Sand (-No.10 + No.40) : 14.8
Fine Sand (-No.40 + No.200) : 40.3
Silt + Clay (-No.200) : 42.6

Approved By : J.S.

Soil No. 24

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray Poorly Graded Sand

Sample No. : SS-3
Sample Loc. : Boring No. B-4
Sample Depth : 6.0' to 7.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	93.4
1/4		6.3	mm	
No.4		4.75	mm	92.3
No.6		3.35	mm	
No.10		2	mm	83.5

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	7.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	0.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 1.0132 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 17.2
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 16.5
Coarse Sand (-No.10 + No.40) : 76.3
Fine Sand (-No.40 + No.200) : 7.1
Silt + Clay (-No.200) : 0.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 7.7
Coarse Sand (-No.4 + No.10) : 8.8
Medium Sand (-No.10 + No.40) : 76.3
Fine Sand (-No.40 + No.200) : 7.1
Silt + Clay (-No.200) : 0.1

Approved By : J.S.

Soil No. 25

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Sandy Silt

Sample No. : SS-5
Sample Loc. : Boring No. B-4
Sample Depth : 10.0' to 11.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	98.9
No.6		3.35	mm	
No.10		2	mm	96.3

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	87.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	50.2
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0324	mm	43.5
Hyd. Rd.	# 2	0.0208	mm	39.7
Hyd. Rd.	# 3	0.0121	mm	36.0
Hyd. Rd.	# 4	0.0087	mm	33.1
Hyd. Rd.	# 5	0.0063	mm	27.1
Hyd. Rd.	# 6	0.0032	mm	16.7
Hyd. Rd.	# 7	0.0014	mm	9.4

D_{50} = 0.0731 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.714
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : ML *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 3.7
Coarse Sand (-No.10 + No.40) : 9.2
Fine Sand (-No.40 + No.200) : 36.9
Silt (-No.200 + 0.002mm) : 37.5
Clay (-0.002mm + 0.001mm) : 4.4
Colloids (-0.001mm) : 8.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 1.1
Coarse Sand (-No.4 + No.10) : 2.6
Medium Sand (-No.10 + No.40) : 9.2
Fine Sand (-No.40 + No.200) : 36.9
Silt (-No.200 + 0.005mm) : 26.6
Clay (-0.005mm + 0.001mm) : 15.3
Colloids (-0.001mm) : 8.3

Approved By : J.S.

Soil No. 26

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Sandy Silt

Sample No. : SS-6
Sample Loc. : Boring No. B-4
Sample Depth : 15.0' to 16.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	92.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	52.4
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0326	mm	45.0
Hyd. Rd.	# 2	0.0209	mm	41.0
Hyd. Rd.	# 3	0.0122	mm	37.0
Hyd. Rd.	# 4	0.0088	mm	32.9
Hyd. Rd.	# 5	0.0063	mm	28.8
Hyd. Rd.	# 6	0.0032	mm	17.0
Hyd. Rd.	# 7	0.0014	mm	9.2

D_{50} = 0.0573 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 34.8
Liquid Limit (AASHTO T89) : 35
Plastic Limit (AASHTO T90) : 27
Plasticity Index : 8
Liquidity Index : 0.94
Activity : 0.63
Sp. Gr. (AASHTO T100) : 2.718
AASHTO Classification: M145 : A-4 (2)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 8.0
Fine Sand (-No.40 + No.200) : 39.6
Silt (-No.200 + 0.002mm) : 39.6
Clay (-0.002mm + 0.001mm) : 4.6
Colloids (-0.001mm) : 8.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 8.0
Fine Sand (-No.40 + No.200) : 39.6
Silt (-No.200 + 0.005mm) : 27.6
Clay (-0.005mm + 0.001mm) : 16.7
Colloids (-0.001mm) : 8.2

Approved By : J.S.

Soil No. 27

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Silty Sand with Gravel

Sample No. : SS-7
Sample Loc. : Boring No. B-4
Sample Depth : 20.0' to 21.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	100.0
3/4	in.	19	mm	97.4
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	90.2
1/4		6.3	mm	
No.4		4.75	mm	85.0
No.6		3.35	mm	
No.10		2	mm	80.0
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	61.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	32.8
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0335	mm	29.5
Hyd. Rd.	# 2	0.0213	mm	27.9
Hyd. Rd.	# 3	0.0125	mm	23.2
Hyd. Rd.	# 4	0.0090	mm	20.1
Hyd. Rd.	# 5	0.0064	mm	16.0
Hyd. Rd.	# 6	0.0033	mm	8.1
Hyd. Rd.	# 7	0.0014	mm	3.0

D_{50} = 0.2106 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.711
AASHTO Classification: M145 : A-2-4 (0) *
ASTM Classification: D2487 : SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 20.0
Coarse Sand (-No.10 + No.40) : 18.3
Fine Sand (-No.40 + No.200) : 28.9
Silt (-No.200 + 0.002mm) : 27.6
Clay (-0.002mm + 0.001mm) : 2.6
Colloids (-0.001mm) : 2.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 2.6
Fine Gravel (-3/4in. + No.4) : 12.4
Coarse Sand (-No.4 + No.10) : 5.0
Medium Sand (-No.10 + No.40) : 18.3
Fine Sand (-No.40 + No.200) : 28.9
Silt (-No.200 + 0.005mm) : 19.7
Clay (-0.005mm + 0.001mm) : 10.5
Colloids (-0.001mm) : 2.6

Approved By : J.S.

Soil No. 28

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Silty Sand

Sample No. : SS-8
Sample Loc. : Boring No. B-4
Sample Depth : 25.0' to 26.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.8
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	88.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	49.8
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0757 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 33.2
Liquid Limit (AASHTO T89) : 27
Plastic Limit (AASHTO T90) : 27
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.2
Coarse Sand (-No.10 + No.40) : 11.8
Fine Sand (-No.40 + No.200) : 38.2
Silt + Clay (-No.200) : 49.8

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.2
Medium Sand (-No.10 + No.40) : 11.8
Fine Sand (-No.40 + No.200) : 38.2
Silt + Clay (-No.200) : 49.8

Approved By : J.S.

Soil No. 29

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray Silty Sand

Sample No. : SS-10
Sample Loc. : Boring No. B-4
Sample Depth : 35.0' to 36.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	98.2
No.6		3.35	mm	
No.10		2	mm	91.7

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	80.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	49.4
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0776 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 43.4
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 8.3
Coarse Sand (-No.10 + No.40) : 11.7
Fine Sand (-No.40 + No.200) : 30.6
Silt + Clay (-No.200) : 49.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 1.8
Coarse Sand (-No.4 + No.10) : 6.5
Medium Sand (-No.10 + No.40) : 11.7
Fine Sand (-No.40 + No.200) : 30.6
Silt + Clay (-No.200) : 49.4

Approved By : J.S.

Soil No. 30

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray, Tan & Green Silty Sand

Sample No. : SS-13
Sample Loc. : Boring No. B-4
Sample Depth : 50.0' to 51.5'
Date Tested : 07/19/14
Date Reported : 07/23/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	83.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	42.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1026 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 36
Liquid Limit (AASHTO T89) : 37
Plastic Limit (AASHTO T90) : 34
Plasticity Index : 3
Liquidity Index : 0.76
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 16.4
Fine Sand (-No.40 + No.200) : 41.0
Silt + Clay (-No.200) : 42.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 16.4
Fine Sand (-No.40 + No.200) : 41.0
Silt + Clay (-No.200) : 42.6

Approved By : J.S.

Soil No. 31

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray, Tan & Green Silty Sand

Sample No. : SS-16
Sample Loc. : Boring No. B-4
Sample Depth : 65.0' to 66.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.3
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	82.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	33.5
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1343 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 33.4
Liquid Limit (AASHTO T89) : 36
Plastic Limit (AASHTO T90) : 33
Plasticity Index : 3
Liquidity Index : 0.17
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.7
Coarse Sand (-No.10 + No.40) : 16.7
Fine Sand (-No.40 + No.200) : 49.1
Silt + Clay (-No.200) : 33.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.7
Medium Sand (-No.10 + No.40) : 16.7
Fine Sand (-No.40 + No.200) : 49.1
Silt + Clay (-No.200) : 33.5

Approved By : J.S.

Soil No. 32

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray, Tan & Green Silty Sand

Sample No. : SS-19
Sample Loc. : Boring No. B-4
Sample Depth : 80.0' to 81.2'
Date Tested : 07/19/14
Date Reported : 07/23/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.9
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	68.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	27.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1969 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 22.7
Liquid Limit (AASHTO T89) : 33
Plastic Limit (AASHTO T90) : 30
Plasticity Index : 3
Liquidity Index : -2.43
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.1
Coarse Sand (-No.10 + No.40) : 31.8
Fine Sand (-No.40 + No.200) : 40.8
Silt + Clay (-No.200) : 27.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.1
Medium Sand (-No.10 + No.40) : 31.8
Fine Sand (-No.40 + No.200) : 40.8
Silt + Clay (-No.200) : 27.3

Approved By : J.S.

Soil No. 33

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Tan Well-Graded Sand

Sample No. : SS-2
Sample Loc. : Boring No. B-5
Sample Depth : 4.0' to 5.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	96.9
No.6		3.35	mm	
No.10		2	mm	85.4
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	29.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	3.8
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.7539 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 16.8
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SW

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 14.6
Coarse Sand (-No.10 + No.40) : 56.2
Fine Sand (-No.40 + No.200) : 25.4
Silt + Clay (-No.200) : 3.8

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 3.1
Coarse Sand (-No.4 + No.10) : 11.5
Medium Sand (-No.10 + No.40) : 56.2
Fine Sand (-No.40 + No.200) : 25.4
Silt + Clay (-No.200) : 3.8

Approved By : J.S.

Soil No. 34

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green, Gray & Tan Sandy Silt

Sample No. : SS-3
Sample Loc. : Boring No. B-5
Sample Depth : 6.0' to 7.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.9
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	96.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	59.9
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0316	mm	52.8
Hyd. Rd.	# 2	0.0204	mm	47.9
Hyd. Rd.	# 3	0.0119	mm	44.1
Hyd. Rd.	# 4	0.0085	mm	40.2
Hyd. Rd.	# 5	0.0062	mm	33.4
Hyd. Rd.	# 6	0.0031	mm	20.5
Hyd. Rd.	# 7	0.0014	mm	10.6

D_{50} = 0.0246 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.728
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : ML *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.1
Coarse Sand (-No.10 + No.40) : 3.8
Fine Sand (-No.40 + No.200) : 36.2
Silt (-No.200 + 0.002mm) : 44.7
Clay (-0.002mm + 0.001mm) : 5.8
Colloids (-0.001mm) : 9.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.1
Medium Sand (-No.10 + No.40) : 3.8
Fine Sand (-No.40 + No.200) : 36.2
Silt (-No.200 + 0.005mm) : 30.6
Clay (-0.005mm + 0.001mm) : 19.9
Colloids (-0.001mm) : 9.4

Approved By : J.S.

Soil No. 35

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-4
Sample Loc. : Boring No. B-5
Sample Depth : 8.0' to 9.5'
Date Tested : 07/16/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	97.9
1/4		6.3	mm	
No.4		4.75	mm	95.7
No.6		3.35	mm	
No.10		2	mm	93.4

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	82.4
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	47.8
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0327	mm	39.4
Hyd. Rd.	# 2	0.0210	mm	35.8
Hyd. Rd.	# 3	0.0123	mm	31.2
Hyd. Rd.	# 4	0.0088	mm	27.5
Hyd. Rd.	# 5	0.0064	mm	20.0
Hyd. Rd.	# 6	0.0032	mm	12.2
Hyd. Rd.	# 7	0.0014	mm	7.0

D_{50} = 0.0837 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.716
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 6.6
Coarse Sand (-No.10 + No.40) : 11.0
Fine Sand (-No.40 + No.200) : 34.6
Silt (-No.200 + 0.002mm) : 38.5
Clay (-0.002mm + 0.001mm) : 3.1
Colloids (-0.001mm) : 6.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 4.3
Coarse Sand (-No.4 + No.10) : 2.3
Medium Sand (-No.10 + No.40) : 11.0
Fine Sand (-No.40 + No.200) : 34.6
Silt (-No.200 + 0.005mm) : 30.6
Clay (-0.005mm + 0.001mm) : 11.0
Colloids (-0.001mm) : 6.2

Approved By : J.S.

Soil No. 36

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-6
Sample Loc. : Boring No. B-5
Sample Depth : 32.4' to 33.9'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.8
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	83.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	41.2
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1075 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 36.4
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.2
Coarse Sand (-No.10 + No.40) : 16.2
Fine Sand (-No.40 + No.200) : 42.4
Silt + Clay (-No.200) : 41.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.2
Medium Sand (-No.10 + No.40) : 16.2
Fine Sand (-No.40 + No.200) : 42.4
Silt + Clay (-No.200) : 41.2

Approved By : J.S.

Soil No. 37

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-9
Sample Loc. : Boring No. B-5
Sample Depth : 45.0' to 46.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.9
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	82.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	52.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0561 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 37
Liquid Limit (AASHTO T89) : 45
Plastic Limit (AASHTO T90) : 33
Plasticity Index : 12
Liquidity Index : 0.31
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-7-5 (5)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.1
Coarse Sand (-No.10 + No.40) : 17.0
Fine Sand (-No.40 + No.200) : 30.6
Silt + Clay (-No.200) : 52.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.1
Medium Sand (-No.10 + No.40) : 17.0
Fine Sand (-No.40 + No.200) : 30.6
Silt + Clay (-No.200) : 52.3

Approved By : J.S.

Soil No. 38

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-11
Sample Loc. : Boring No. B-5
Sample Depth : 55.0' to 56.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	84.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	50.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.074 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 39.6
Liquid Limit (AASHTO T89) : 43
Plastic Limit (AASHTO T90) : 40
Plasticity Index : 3
Liquidity Index : -0.19
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-5 (1)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 15.9
Fine Sand (-No.40 + No.200) : 34.0
Silt + Clay (-No.200) : 50.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 15.9
Fine Sand (-No.40 + No.200) : 34.0
Silt + Clay (-No.200) : 50.1

Approved By : J.S.

Soil No. 39

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Green, Tan & Black Well-Graded Sand

Sample No. : SS-13
Sample Loc. : Boring No. B-5
Sample Depth : 65.0' to 66.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.7
No.6		3.35	mm	
No.10		2	mm	85.2

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	23.5
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	2.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.8266 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 45.4
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SW

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 14.8
Coarse Sand (-No.10 + No.40) : 61.7
Fine Sand (-No.40 + No.200) : 20.9
Silt + Clay (-No.200) : 2.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.3
Coarse Sand (-No.4 + No.10) : 14.5
Medium Sand (-No.10 + No.40) : 61.7
Fine Sand (-No.40 + No.200) : 20.9
Silt + Clay (-No.200) : 2.6

Approved By : J.S.

Soil No. 40

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Brown, Tan & Gray Poorly Graded Sand

Sample No. : SS-2
Sample Loc. : Boring No. B-6
Sample Depth : 4.0' to 5.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	88.2
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	11.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	1.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.921 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 12.7
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 11.8
Coarse Sand (-No.10 + No.40) : 76.3
Fine Sand (-No.40 + No.200) : 10.3
Silt + Clay (-No.200) : 1.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 11.8
Medium Sand (-No.10 + No.40) : 76.3
Fine Sand (-No.40 + No.200) : 10.3
Silt + Clay (-No.200) : 1.6

Approved By : J.S.

Soil No. 41

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Brown, Tan & Gray Poorly Graded Sand

Sample No. : SS-3
Sample Loc. : Boring No. B-6
Sample Depth : 6.0' to 7.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	97.8

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	43.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	4.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.509 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 14
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.2
Coarse Sand (-No.10 + No.40) : 54.1
Fine Sand (-No.40 + No.200) : 39.7
Silt + Clay (-No.200) : 4.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 2.2
Medium Sand (-No.10 + No.40) : 54.1
Fine Sand (-No.40 + No.200) : 39.7
Silt + Clay (-No.200) : 4.0

Approved By : J.S.

Soil No. 42

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Brown, Tan & Gray Poorly Graded Sand

Sample No. : SS-4
Sample Loc. : Boring No. B-6
Sample Depth : 8.0' to 9.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	97.5
1/4		6.3	mm	
No.4		4.75	mm	96.7
No.6		3.35	mm	
No.10		2	mm	92.2

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	37.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	2.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.6028 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 17
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 7.8
Coarse Sand (-No.10 + No.40) : 54.5
Fine Sand (-No.40 + No.200) : 35.6
Silt + Clay (-No.200) : 2.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 3.3
Coarse Sand (-No.4 + No.10) : 4.5
Medium Sand (-No.10 + No.40) : 54.5
Fine Sand (-No.40 + No.200) : 35.6
Silt + Clay (-No.200) : 2.1

Approved By : J.S.

Soil No. 43

ICA Engineering

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Brown Poorly Graded Sand with Silt

Sample No. : SS-5
Sample Loc. : Boring No. B-6
Sample Depth : 10.0' to 11.5'
Date Tested : 07/17/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.6
No.6		3.35	mm	
No.10		2	mm	99.2

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	86.4
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	8.8
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0377	mm	4.8
Hyd. Rd.	# 2	0.0238	mm	4.8
Hyd. Rd.	# 3	0.0137	mm	3.9
Hyd. Rd.	# 4	0.0097	mm	3.8
Hyd. Rd.	# 5	0.0069	mm	3.8
Hyd. Rd.	# 6	0.0034	mm	3.6
Hyd. Rd.	# 7	0.0014	mm	2.9

D_{50} = 0.1884 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.672
AASHTO Classification: M145 : A-2-4 (0) *
ASTM Classification: D2487 : SP-SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.8
Coarse Sand (-No.10 + No.40) : 12.8
Fine Sand (-No.40 + No.200) : 77.6
Silt (-No.200 + 0.002mm) : 5.6
Clay (-0.002mm + 0.001mm) : 0.7
Colloids (-0.001mm) : 2.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.4
Coarse Sand (-No.4 + No.10) : 0.4
Medium Sand (-No.10 + No.40) : 12.8
Fine Sand (-No.40 + No.200) : 77.6
Silt (-No.200 + 0.005mm) : 5.1
Clay (-0.005mm + 0.001mm) : 1.2
Colloids (-0.001mm) : 2.5

Approved By : J.S.

Soil No. 44

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-3
Sample Loc. : Boring No. B-7
Sample Depth : 6.0' to 7.5'
Date Tested : 07/16/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.9

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	93.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	56.5
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0324	mm	46.8
Hyd. Rd.	# 2	0.0206	mm	44.9
Hyd. Rd.	# 3	0.0121	mm	39.9
Hyd. Rd.	# 4	0.0087	mm	35.1
Hyd. Rd.	# 5	0.0063	mm	27.3
Hyd. Rd.	# 6	0.0032	mm	17.7
Hyd. Rd.	# 7	0.0014	mm	8.8

D_{50} = 0.0427 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.713
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : ML *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.1
Coarse Sand (-No.10 + No.40) : 6.8
Fine Sand (-No.40 + No.200) : 36.6
Silt (-No.200 + 0.002mm) : 43.7
Clay (-0.002mm + 0.001mm) : 5.0
Colloids (-0.001mm) : 7.7

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.1
Medium Sand (-No.10 + No.40) : 6.8
Fine Sand (-No.40 + No.200) : 36.6
Silt (-No.200 + 0.005mm) : 32.5
Clay (-0.005mm + 0.001mm) : 16.3
Colloids (-0.001mm) : 7.7

Approved By : J.S.

Soil No. 45

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-4
Sample Loc. : Boring No. B-7
Sample Depth : 8.0' to 9.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	93.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	50.7
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0334	mm	42.2
Hyd. Rd.	# 2	0.0212	mm	40.0
Hyd. Rd.	# 3	0.0124	mm	36.8
Hyd. Rd.	# 4	0.0088	mm	34.6
Hyd. Rd.	# 5	0.0064	mm	28.0
Hyd. Rd.	# 6	0.0032	mm	17.2
Hyd. Rd.	# 7	0.0014	mm	9.9

D_{50} = 0.0702 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.715
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : ML *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 7.0
Fine Sand (-No.40 + No.200) : 42.3
Silt (-No.200 + 0.002mm) : 37.5
Clay (-0.002mm + 0.001mm) : 4.4
Colloids (-0.001mm) : 8.8

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 7.0
Fine Sand (-No.40 + No.200) : 42.3
Silt (-No.200 + 0.005mm) : 26.5
Clay (-0.005mm + 0.001mm) : 15.5
Colloids (-0.001mm) : 8.8

Approved By : J.S.

Soil No. 46

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-5
Sample Loc. : Boring No. B-7
Sample Depth : 10.0' to 11.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.8
No.6		3.35	mm	
No.10		2	mm	97.5

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	86.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	40.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1067 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 30.9
Liquid Limit (AASHTO T89) : 31
Plastic Limit (AASHTO T90) : 25
Plasticity Index : 6
Liquidity Index : 1.04
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.5
Coarse Sand (-No.10 + No.40) : 10.6
Fine Sand (-No.40 + No.200) : 46.3
Silt + Clay (-No.200) : 40.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.2
Coarse Sand (-No.4 + No.10) : 2.3
Medium Sand (-No.10 + No.40) : 10.6
Fine Sand (-No.40 + No.200) : 46.3
Silt + Clay (-No.200) : 40.6

Approved By : J.S.

Soil No. 47

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-6
Sample Loc. : Boring No. B-7
Sample Depth : 15.0' to 16.5'
Date Tested : 07/16/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	98.0
1/4		6.3	mm	
No.4		4.75	mm	93.0
No.6		3.35	mm	
No.10		2	mm	87.1

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	64.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	36.6
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0339	mm	30.4
Hyd. Rd.	# 2	0.0216	mm	29.5
Hyd. Rd.	# 3	0.0126	mm	26.9
Hyd. Rd.	# 4	0.0090	mm	22.7
Hyd. Rd.	# 5	0.0065	mm	17.6
Hyd. Rd.	# 6	0.0033	mm	9.3
Hyd. Rd.	# 7	0.0014	mm	4.2

D_{50} = 0.1741 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.714
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 12.9
Coarse Sand (-No.10 + No.40) : 22.9
Fine Sand (-No.40 + No.200) : 27.6
Silt (-No.200 + 0.002mm) : 30.2
Clay (-0.002mm + 0.001mm) : 2.7
Colloids (-0.001mm) : 3.7

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 7.0
Coarse Sand (-No.4 + No.10) : 5.9
Medium Sand (-No.10 + No.40) : 22.9
Fine Sand (-No.40 + No.200) : 27.6
Silt (-No.200 + 0.005mm) : 22.2
Clay (-0.005mm + 0.001mm) : 10.8
Colloids (-0.001mm) : 3.7

Approved By : J.S.

Soil No. 48

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan, Brown & Gray Well-Graded Sand with Silt

Sample No. : SS-1
Sample Loc. : Boring No. B-8
Sample Depth : 2.0' to 3.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.8
No.6		3.35	mm	
No.10		2	mm	97.4

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	54.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	11.9
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.3578 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 8.3
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SW-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.6
Coarse Sand (-No.10 + No.40) : 43.2
Fine Sand (-No.40 + No.200) : 42.3
Silt + Clay (-No.200) : 11.9

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.2
Coarse Sand (-No.4 + No.10) : 2.4
Medium Sand (-No.10 + No.40) : 43.2
Fine Sand (-No.40 + No.200) : 42.3
Silt + Clay (-No.200) : 11.9

Approved By : J.S.

Soil No. 49

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Gray Silty Sand

Sample No. : SS-5
Sample Loc. : Boring No. B-8
Sample Depth : 10.0' to 11.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	98.9

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	90.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	20.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1572 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 33.4
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 1.1
Coarse Sand (-No.10 + No.40) : 8.7
Fine Sand (-No.40 + No.200) : 70.1
Silt + Clay (-No.200) : 20.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 1.1
Medium Sand (-No.10 + No.40) : 8.7
Fine Sand (-No.40 + No.200) : 70.1
Silt + Clay (-No.200) : 20.1

Approved By : J.S.

Soil No. 50

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Gray Poorly Graded Sand

Sample No. : SS-7
Sample Loc. : Boring No. B-8
Sample Depth : 20.0' to 21.5'
Date Tested : 07/19/14
Date Reported : 07/23/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	95.2
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	16.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	1.8
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.818 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 15
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 4.8
Coarse Sand (-No.10 + No.40) : 78.3
Fine Sand (-No.40 + No.200) : 15.1
Silt + Clay (-No.200) : 1.8

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 4.8
Medium Sand (-No.10 + No.40) : 78.3
Fine Sand (-No.40 + No.200) : 15.1
Silt + Clay (-No.200) : 1.8

Approved By : J.S.

Soil No. 51

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan, Red & Gray Silty Sand

Sample No. : SS-1
Sample Loc. : Boring No. B-9
Sample Depth : 2.0' to 3.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	97.7
1/4		6.3	mm	
No.4		4.75	mm	96.6
No.6		3.35	mm	
No.10		2	mm	93.5
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	57.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	18.9
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.3012 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 13.3
Liquid Limit (AASHTO T89) : 20
Plastic Limit (AASHTO T90) : 18
Plasticity Index : 2
Liquidity Index : -2.28
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 6.5
Coarse Sand (-No.10 + No.40) : 35.8
Fine Sand (-No.40 + No.200) : 38.8
Silt + Clay (-No.200) : 18.9

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 3.4
Coarse Sand (-No.4 + No.10) : 3.1
Medium Sand (-No.10 + No.40) : 35.8
Fine Sand (-No.40 + No.200) : 38.8
Silt + Clay (-No.200) : 18.9

Approved By : J.S.

Soil No. 52

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Tan Poorly Graded Sand with Silt

Sample No. : SS-3
Sample Loc. : Boring No. B-9
Sample Depth : 6.0' to 7.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	98.1

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	51.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	5.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.3958 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 10.5
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-3 (0)
ASTM Classification: D2487 : SP-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 1.9
Coarse Sand (-No.10 + No.40) : 46.2
Fine Sand (-No.40 + No.200) : 46.3
Silt + Clay (-No.200) : 5.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 1.9
Medium Sand (-No.10 + No.40) : 46.2
Fine Sand (-No.40 + No.200) : 46.3
Silt + Clay (-No.200) : 5.6

Approved By : J.S.

Soil No. 53

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Tan Well-Graded Sand

Sample No. : SS-6
Sample Loc. : Boring No. B-9
Sample Depth : 15.0' to 16.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	98.2
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	38.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	4.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.5703 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SW

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 1.8
Coarse Sand (-No.10 + No.40) : 59.5
Fine Sand (-No.40 + No.200) : 34.1
Silt + Clay (-No.200) : 4.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 1.8
Medium Sand (-No.10 + No.40) : 59.5
Fine Sand (-No.40 + No.200) : 34.1
Silt + Clay (-No.200) : 4.6

Approved By : J.S.

Soil No. 54

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-7
Sample Loc. : Boring No. B-9
Sample Depth : 20.0' to 21.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	97.8
1/4		6.3	mm	
No.4		4.75	mm	94.6
No.6		3.35	mm	
No.10		2	mm	88.7

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	78.8
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	48.4
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0822 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 24.1
Liquid Limit (AASHTO T89) : 34
Plastic Limit (AASHTO T90) : 28
Plasticity Index : 6
Liquidity Index : -0.70
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (1)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 11.3
Coarse Sand (-No.10 + No.40) : 9.9
Fine Sand (-No.40 + No.200) : 30.4
Silt + Clay (-No.200) : 48.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 5.4
Coarse Sand (-No.4 + No.10) : 5.9
Medium Sand (-No.10 + No.40) : 9.9
Fine Sand (-No.40 + No.200) : 30.4
Silt + Clay (-No.200) : 48.4

Approved By : J.S.

Soil No. 55

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty, Clayey Sand

Sample No. : SS-9
Sample Loc. : Boring No. B-9
Sample Depth : 30.0' to 31.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	99.5
1/4		6.3	mm	
No.4		4.75	mm	93.7
No.6		3.35	mm	
No.10		2	mm	87.3

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	66.8
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	35.7
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1665 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 23.3
Liquid Limit (AASHTO T89) : 26
Plastic Limit (AASHTO T90) : 21
Plasticity Index : 5
Liquidity Index : 0.42
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SC-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 12.7
Coarse Sand (-No.10 + No.40) : 20.5
Fine Sand (-No.40 + No.200) : 31.1
Silt + Clay (-No.200) : 35.7

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 6.3
Coarse Sand (-No.4 + No.10) : 6.4
Medium Sand (-No.10 + No.40) : 20.5
Fine Sand (-No.40 + No.200) : 31.1
Silt + Clay (-No.200) : 35.7

Approved By : J.S.

Soil No. 56

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-12
Sample Loc. : Boring No. B-9
Sample Depth : 45.0' to 46.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	97.8
No.6		3.35	mm	
No.10		2	mm	92.5

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	83.5
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	59.4
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0263 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 41.7
Liquid Limit (AASHTO T89) : 41
Plastic Limit (AASHTO T90) : 40
Plasticity Index : 1
Liquidity Index : 1.70
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-5 (1)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 7.5
Coarse Sand (-No.10 + No.40) : 9.0
Fine Sand (-No.40 + No.200) : 24.1
Silt + Clay (-No.200) : 59.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 2.2
Coarse Sand (-No.4 + No.10) : 5.3
Medium Sand (-No.10 + No.40) : 9.0
Fine Sand (-No.40 + No.200) : 24.1
Silt + Clay (-No.200) : 59.4

Approved By : J.S.

Soil No. 57

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Red, Gray & Tan Clayey Sand

Sample No. : SS-1
Sample Loc. : Boring No. RW-1
Sample Depth : 2.0' to 3.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	98.7
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	64.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	29.5
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.2066 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 12.7
Liquid Limit (AASHTO T89) : 33
Plastic Limit (AASHTO T90) : 19
Plasticity Index : 14
Liquidity Index : -0.46
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-6 (1)
ASTM Classification: D2487 : SC

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 1.3
Coarse Sand (-No.10 + No.40) : 34.1
Fine Sand (-No.40 + No.200) : 35.1
Silt + Clay (-No.200) : 29.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 1.3
Medium Sand (-No.10 + No.40) : 34.1
Fine Sand (-No.40 + No.200) : 35.1
Silt + Clay (-No.200) : 29.5

Approved By : J.S.

Soil No. 58

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray, Tan & Brown Silty Sand

Sample No. : SS-2
Sample Loc. : Boring No. RW-1
Sample Depth : 4.0' to 5.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	98.7
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	58.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	12.8
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.3041 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 11
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 1.3
Coarse Sand (-No.10 + No.40) : 39.8
Fine Sand (-No.40 + No.200) : 46.1
Silt + Clay (-No.200) : 12.8

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 1.3
Medium Sand (-No.10 + No.40) : 39.8
Fine Sand (-No.40 + No.200) : 46.1
Silt + Clay (-No.200) : 12.8

Approved By : J.S.

Soil No. 59

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Gray Silty, Clayey Sand

Sample No. : SS-5
Sample Loc. : Boring No. RW-1
Sample Depth : 9.9' to 11.4'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.2
No.6		3.35	mm	
No.10		2	mm	98.3

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	84.4
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	43.4
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0992 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 18
Liquid Limit (AASHTO T89) : 23
Plastic Limit (AASHTO T90) : 16
Plasticity Index : 7
Liquidity Index : 0.35
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SC-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 1.7
Coarse Sand (-No.10 + No.40) : 13.9
Fine Sand (-No.40 + No.200) : 41.0
Silt + Clay (-No.200) : 43.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.8
Coarse Sand (-No.4 + No.10) : 0.9
Medium Sand (-No.10 + No.40) : 13.9
Fine Sand (-No.40 + No.200) : 41.0
Silt + Clay (-No.200) : 43.4

Approved By : J.S.

Soil No. 60

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray Poorly Graded Sand

Sample No. : SS-6
Sample Loc. : Boring No. RW-1
Sample Depth : 14.9' to 16.4'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	98.7
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	39.3
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	4.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.5618 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 16.8
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 1.3
Coarse Sand (-No.10 + No.40) : 59.4
Fine Sand (-No.40 + No.200) : 35.0
Silt + Clay (-No.200) : 4.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 1.3
Medium Sand (-No.10 + No.40) : 59.4
Fine Sand (-No.40 + No.200) : 35.0
Silt + Clay (-No.200) : 4.3

Approved By : J.S.

Soil No. 61

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Sandy Silt

Sample No. : SS-7
Sample Loc. : Boring No. RW-1
Sample Depth : 19.9' to 21.4'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.6
No.6		3.35	mm	
No.10		2	mm	97.8

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	92.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	52.9
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0522 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 26.4
Liquid Limit (AASHTO T89) : 37
Plastic Limit (AASHTO T90) : 31
Plasticity Index : 6
Liquidity Index : -0.72
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (2)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.2
Coarse Sand (-No.10 + No.40) : 5.8
Fine Sand (-No.40 + No.200) : 39.1
Silt + Clay (-No.200) : 52.9

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.4
Coarse Sand (-No.4 + No.10) : 1.8
Medium Sand (-No.10 + No.40) : 5.8
Fine Sand (-No.40 + No.200) : 39.1
Silt + Clay (-No.200) : 52.9

Approved By : J.S.

Soil No. 62

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan & Red Silty Sand

Sample No. : SS-1
Sample Loc. : Boring No. RW-2
Sample Depth : 2.0' to 3.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	97.7
1/4		6.3	mm	
No.4		4.75	mm	97.3
No.6		3.35	mm	
No.10		2	mm	93.7

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	49.5
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	15.4
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.4325 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 14
Liquid Limit (AASHTO T89) : 18
Plastic Limit (AASHTO T90) : 17
Plasticity Index : 1
Liquidity Index : -3.07
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 6.3
Coarse Sand (-No.10 + No.40) : 44.2
Fine Sand (-No.40 + No.200) : 34.1
Silt + Clay (-No.200) : 15.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 2.7
Coarse Sand (-No.4 + No.10) : 3.6
Medium Sand (-No.10 + No.40) : 44.2
Fine Sand (-No.40 + No.200) : 34.1
Silt + Clay (-No.200) : 15.4

Approved By : J.S.

Soil No. 63

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan & Brown Well-Graded Sand with Silt

Sample No. : SS-2
Sample Loc. : Boring No. RW-2
Sample Depth : 4.0' to 5.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	98.8
No.6		3.35	mm	
No.10		2	mm	97.2

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	38.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	7.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.5732 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 8.5
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SW-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.8
Coarse Sand (-No.10 + No.40) : 58.5
Fine Sand (-No.40 + No.200) : 31.4
Silt + Clay (-No.200) : 7.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 1.2
Coarse Sand (-No.4 + No.10) : 1.6
Medium Sand (-No.10 + No.40) : 58.5
Fine Sand (-No.40 + No.200) : 31.4
Silt + Clay (-No.200) : 7.3

Approved By : J.S.

Soil No. 64

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan & Gray Silty Sand

Sample No. : SS-4
Sample Loc. : Boring No. RW-2
Sample Depth : 8.0' to 9.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	98.0
No.6		3.35	mm	
No.10		2	mm	95.7
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	71.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	35.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1539 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 18.9
Liquid Limit (AASHTO T89) : 21
Plastic Limit (AASHTO T90) : 19
Plasticity Index : 2
Liquidity Index : 0.06
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 4.3
Coarse Sand (-No.10 + No.40) : 24.5
Fine Sand (-No.40 + No.200) : 36.2
Silt + Clay (-No.200) : 35.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 2.0
Coarse Sand (-No.4 + No.10) : 2.3
Medium Sand (-No.10 + No.40) : 24.5
Fine Sand (-No.40 + No.200) : 36.2
Silt + Clay (-No.200) : 35.0

Approved By : J.S.

Soil No. 65

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray Poorly Graded Sand

Sample No. : SS-6
Sample Loc. : Boring No. RW-2
Sample Depth : 15.0' to 16.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.9
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	57.3
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	2.5
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.3373 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 25.7
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-3 (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.1
Coarse Sand (-No.10 + No.40) : 42.6
Fine Sand (-No.40 + No.200) : 54.8
Silt + Clay (-No.200) : 2.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.1
Medium Sand (-No.10 + No.40) : 42.6
Fine Sand (-No.40 + No.200) : 54.8
Silt + Clay (-No.200) : 2.5

Approved By : J.S.

Soil No. 66

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Sandy Silt

Sample No. : SS-7
Sample Loc. : Boring No. RW-2
Sample Depth : 20.0' to 21.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	99.8
1/4		6.3	mm	
No.4		4.75	mm	99.2
No.6		3.35	mm	
No.10		2	mm	96.8

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	89.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	51.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.065 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 30.6
Liquid Limit (AASHTO T89) : 39
Plastic Limit (AASHTO T90) : 31
Plasticity Index : 8
Liquidity Index : -0.07
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (2)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 3.2
Coarse Sand (-No.10 + No.40) : 6.9
Fine Sand (-No.40 + No.200) : 38.8
Silt + Clay (-No.200) : 51.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.8
Coarse Sand (-No.4 + No.10) : 2.4
Medium Sand (-No.10 + No.40) : 6.9
Fine Sand (-No.40 + No.200) : 38.8
Silt + Clay (-No.200) : 51.1

Approved By : J.S.

Soil No. 67

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan, Brown & Gray Poorly Graded Sand with Silt

Sample No. : SS-2
Sample Loc. : Boring No. RW-3
Sample Depth : 4.0' to 5.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.3
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	58.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	10.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.3158 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 12
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SP-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.7
Coarse Sand (-No.10 + No.40) : 41.1
Fine Sand (-No.40 + No.200) : 47.9
Silt + Clay (-No.200) : 10.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.7
Medium Sand (-No.10 + No.40) : 41.1
Fine Sand (-No.40 + No.200) : 47.9
Silt + Clay (-No.200) : 10.3

Approved By : J.S.

Soil No. 68

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Sandy Lean Clay

Sample No. : SS-5
Sample Loc. : Boring No. RW-3
Sample Depth : 10.0' to 11.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.6
No.6		3.35	mm	
No.10		2	mm	99.0

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	95.8
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	60.8
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0231 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 28
Liquid Limit (AASHTO T89) : 25
Plastic Limit (AASHTO T90) : 16
Plasticity Index : 9
Liquidity Index : 1.31
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (3)
ASTM Classification: D2487 : CL

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 1.0
Coarse Sand (-No.10 + No.40) : 3.2
Fine Sand (-No.40 + No.200) : 35.0
Silt + Clay (-No.200) : 60.8

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.4
Coarse Sand (-No.4 + No.10) : 0.6
Medium Sand (-No.10 + No.40) : 3.2
Fine Sand (-No.40 + No.200) : 35.0
Silt + Clay (-No.200) : 60.8

Approved By : J.S.

Soil No. 69

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-7
Sample Loc. : Boring No. RW-3
Sample Depth : 20.0' to 21.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.6
No.6		3.35	mm	
No.10		2	mm	97.1

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	91.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	51.4
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0626 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 28.4
Liquid Limit (AASHTO T89) : 38
Plastic Limit (AASHTO T90) : 31
Plasticity Index : 7
Liquidity Index : -0.34
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (2)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.9
Coarse Sand (-No.10 + No.40) : 5.5
Fine Sand (-No.40 + No.200) : 40.2
Silt + Clay (-No.200) : 51.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.4
Coarse Sand (-No.4 + No.10) : 2.5
Medium Sand (-No.10 + No.40) : 5.5
Fine Sand (-No.40 + No.200) : 40.2
Silt + Clay (-No.200) : 51.4

Approved By : J.S.

Soil No. 70

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan, Red & Gray Silty Sand

Sample No. : SS-1
Sample Loc. : Boring No. RW-4
Sample Depth : 2.0' to 3.5'
Date Tested : 07/19/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	97.5
1/4		6.3	mm	
No.4		4.75	mm	97.3
No.6		3.35	mm	
No.10		2	mm	94.9

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	64.8
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	20.2
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.239 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 18.3
Liquid Limit (AASHTO T89) : 20
Plastic Limit (AASHTO T90) : 16
Plasticity Index : 4
Liquidity Index : 0.62
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 5.1
Coarse Sand (-No.10 + No.40) : 30.1
Fine Sand (-No.40 + No.200) : 44.6
Silt + Clay (-No.200) : 20.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 2.7
Coarse Sand (-No.4 + No.10) : 2.4
Medium Sand (-No.10 + No.40) : 30.1
Fine Sand (-No.40 + No.200) : 44.6
Silt + Clay (-No.200) : 20.2

Approved By : J.S.

Soil No. 71

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Tan Well-Graded Sand

Sample No. : SS-3
Sample Loc. : Boring No. RW-4
Sample Depth : 6.0' to 7.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	95.9
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	17.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	4.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.8105 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 10.6
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SW

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 4.1
Coarse Sand (-No.10 + No.40) : 78.7
Fine Sand (-No.40 + No.200) : 13.1
Silt + Clay (-No.200) : 4.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 4.1
Medium Sand (-No.10 + No.40) : 78.7
Fine Sand (-No.40 + No.200) : 13.1
Silt + Clay (-No.200) : 4.1

Approved By : J.S.

Soil No. 72

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Gray & Tan Silty Sand

Sample No. : SS-6
Sample Loc. : Boring No. RW-4
Sample Depth : 14.9' to 16.4'
Date Tested : 07/19/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	96.7
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	73.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	21.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1957 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0) *
ASTM Classification: D2487 : SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 3.3
Coarse Sand (-No.10 + No.40) : 23.5
Fine Sand (-No.40 + No.200) : 51.9
Silt + Clay (-No.200) : 21.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 3.3
Medium Sand (-No.10 + No.40) : 23.5
Fine Sand (-No.40 + No.200) : 51.9
Silt + Clay (-No.200) : 21.3

Approved By : J.S.

Soil No. 73

ICA Engineering

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-7
Sample Loc. : Boring No. RW-4
Sample Depth : 19.9' to 21.4'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	99.6
1/4		6.3	mm	
No.4		4.75	mm	96.2
No.6		3.35	mm	
No.10		2	mm	91.0

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	80.4
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	49.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.078 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 32.2
Liquid Limit (AASHTO T89) : 34
Plastic Limit (AASHTO T90) : 28
Plasticity Index : 6
Liquidity Index : 0.70
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (1)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 9.0
Coarse Sand (-No.10 + No.40) : 10.6
Fine Sand (-No.40 + No.200) : 31.1
Silt + Clay (-No.200) : 49.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 3.8
Coarse Sand (-No.4 + No.10) : 5.2
Medium Sand (-No.10 + No.40) : 10.6
Fine Sand (-No.40 + No.200) : 31.1
Silt + Clay (-No.200) : 49.3

Approved By : J.S.

Soil No. 74

SOIL CLASSIFICATION

Project Name	:	Bridge Replacement over Four Hole Swamp		
Project No.	:	11200-10	Sample No.	: SS-1
Project County	:	Orangeburg	Sample Loc.	: Boring No. RW-5
Project State	:	South Carolina	Sample Depth	: 2.0' to 3.5'
Laboratory No.	:	11200-10	Date Tested	: 07/19/14
Submitted By	:	ICA Engineering	Date Reported	: 07/24/14
Soil Type	:	Gray & Tan Well-Graded Sand with Silt		

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	96.2
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	89.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	11.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1779 mm

CBR	:	NA	Natural Moisture (%) (AASHTO T265)	: 6.7
Dry Dens.	:	NA	Liquid Limit (AASHTO T89)	: NP
Opt. Moist.	:	NA	Plastic Limit (AASHTO T90)	: NP
			Plasticity Index	: NP
AASHTO Composition of Total Sample: M145			Liquidity Index	: NA
Gravel (3in. + No.10)	:	3.8	Activity	: NA
Coarse Sand (-No.10 + No.40)	:	7.2	Sp. Gr. (AASHTO T100)	: NA
Fine Sand (-No.40 + No.200)	:	77.7	AASHTO Classification: M145	: A-2-4 (0)
Silt + Clay (-No.200)	:	11.3	ASTM Classification: D2487	: SW-SM

ASTM Composition of Total Sample: D2487

Coarse Gravel (3in. + 3/4in.)	:	0.0
Fine Gravel (-3/4in. + No.4)	:	0.0
Coarse Sand (-No.4 + No.10)	:	3.8
Medium Sand (-No.10 + No.40)	:	7.2
Fine Sand (-No.40 + No.200)	:	77.7
Silt + Clay (-No.200)	:	11.3

Approved By : J.S.

Soil No. 75

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Gray, Brown, Black & Tan Well-Graded Sand with Silt

Sample No. : SS-3
Sample Loc. : Boring No. RW-5
Sample Depth : 6.0' to 7.5'
Date Tested : 07/19/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	98.0

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	55.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	11.5
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.3457 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 11.7
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SW-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.0
Coarse Sand (-No.10 + No.40) : 42.8
Fine Sand (-No.40 + No.200) : 43.7
Silt + Clay (-No.200) : 11.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 2.0
Medium Sand (-No.10 + No.40) : 42.8
Fine Sand (-No.40 + No.200) : 43.7
Silt + Clay (-No.200) : 11.5

Approved By : J.S.

Soil No. 76

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Gray & Brown Silty Sand

Sample No. : SS-5
Sample Loc. : Boring No. RW-5
Sample Depth : 9.9' to 11.4'
Date Tested : 07/19/14
Date Reported : 07/24/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	94.8
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	87.4
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	41.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.105 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 60.2
Liquid Limit (AASHTO T89) : 20
Plastic Limit (AASHTO T90) : 20
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 5.2
Coarse Sand (-No.10 + No.40) : 7.4
Fine Sand (-No.40 + No.200) : 46.4
Silt + Clay (-No.200) : 41.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 5.2
Medium Sand (-No.10 + No.40) : 7.4
Fine Sand (-No.40 + No.200) : 46.4
Silt + Clay (-No.200) : 41.0

Approved By : J.S.

Soil No. 77

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-7
Sample Loc. : Boring No. RW-5
Sample Depth : 19.9' to 21.4'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.5

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	94.8
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	59.9
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0251 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 31.3
Liquid Limit (AASHTO T89) : 38
Plastic Limit (AASHTO T90) : 30
Plasticity Index : 8
Liquidity Index : 0.11
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (4)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.5
Coarse Sand (-No.10 + No.40) : 4.7
Fine Sand (-No.40 + No.200) : 34.9
Silt + Clay (-No.200) : 59.9

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.5
Medium Sand (-No.10 + No.40) : 4.7
Fine Sand (-No.40 + No.200) : 34.9
Silt + Clay (-No.200) : 59.9

Approved By : J.S.

Soil No. 78

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Gray & Tan Silty Sand

Sample No. : SS-1
Sample Loc. : Boring No. RW-6
Sample Depth : 2.0' to 3.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	97.6
1/4		6.3	mm	
No.4		4.75	mm	96.8
No.6		3.35	mm	
No.10		2	mm	95.2

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	61.8
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	16.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.2718 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 14.4
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 4.8
Coarse Sand (-No.10 + No.40) : 33.4
Fine Sand (-No.40 + No.200) : 45.8
Silt + Clay (-No.200) : 16.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 3.2
Coarse Sand (-No.4 + No.10) : 1.6
Medium Sand (-No.10 + No.40) : 33.4
Fine Sand (-No.40 + No.200) : 45.8
Silt + Clay (-No.200) : 16.0

Approved By : J.S.

Soil No. 79

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Gray & Tan Silty Sand

Sample No. : SS-5
Sample Loc. : Boring No. RW-6
Sample Depth : 10.0' to 11.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.9
No.6		3.35	mm	
No.10		2	mm	97.8

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	78.3
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	25.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1689 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 21.3
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.2
Coarse Sand (-No.10 + No.40) : 19.5
Fine Sand (-No.40 + No.200) : 53.2
Silt + Clay (-No.200) : 25.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.1
Coarse Sand (-No.4 + No.10) : 2.1
Medium Sand (-No.10 + No.40) : 19.5
Fine Sand (-No.40 + No.200) : 53.2
Silt + Clay (-No.200) : 25.1

Approved By : J.S.

Soil No. 80

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Brown, Dark Gray & Tan Silty Sand

Sample No. : SS-1
Sample Loc. : Boring No. RW-7
Sample Depth : 2.0' to 3.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	96.4
1/4		6.3	mm	
No.4		4.75	mm	92.5
No.6		3.35	mm	
No.10		2	mm	88.4

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	45.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	13.7
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.4984 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 11.3
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 11.6
Coarse Sand (-No.10 + No.40) : 42.8
Fine Sand (-No.40 + No.200) : 31.9
Silt + Clay (-No.200) : 13.7

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 7.5
Coarse Sand (-No.4 + No.10) : 4.1
Medium Sand (-No.10 + No.40) : 42.8
Fine Sand (-No.40 + No.200) : 31.9
Silt + Clay (-No.200) : 13.7

Approved By : J.S.

Soil No. 81

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan & Gray Poorly Graded Sand with Silt

Sample No. : SS-3
Sample Loc. : Boring No. RW-7
Sample Depth : 6.0' to 7.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	96.4
1/4		6.3	mm	
No.4		4.75	mm	96.1
No.6		3.35	mm	
No.10		2	mm	90.7
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	43.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	7.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.532 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 15.1
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 9.3
Coarse Sand (-No.10 + No.40) : 47.6
Fine Sand (-No.40 + No.200) : 35.8
Silt + Clay (-No.200) : 7.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 3.9
Coarse Sand (-No.4 + No.10) : 5.4
Medium Sand (-No.10 + No.40) : 47.6
Fine Sand (-No.40 + No.200) : 35.8
Silt + Clay (-No.200) : 7.3

Approved By : J.S.

Soil No. 82

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan & Gray Well-Graded Sand with Silt

Sample No. : SS-6
Sample Loc. : Boring No. RW-7
Sample Depth : 15.0' to 16.5'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.9
No.6		3.35	mm	
No.10		2	mm	97.9

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	81.5
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	12.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1936 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 25.1
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SW-SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.1
Coarse Sand (-No.10 + No.40) : 16.4
Fine Sand (-No.40 + No.200) : 69.5
Silt + Clay (-No.200) : 12.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.1
Coarse Sand (-No.4 + No.10) : 2.0
Medium Sand (-No.10 + No.40) : 16.4
Fine Sand (-No.40 + No.200) : 69.5
Silt + Clay (-No.200) : 12.0

Approved By : J.S.

Soil No. 83

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Orange, Tan & Black Silty Sand

Sample No. : Bulk-1
Sample Loc. : Boring No. B-1
Sample Depth : 0.0' to 5.0'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.3
No.6		3.35	mm	
No.10		2	mm	95.3

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	45.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	15.5
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.4944 mm

CBR (AASHTO: T-193) : NA
Dry Dens. (AASHTO: T-99; Method (C)) : 125.2 pcf
Opt. Moist. (AASHTO: T-99; Method (C)) : 9.3 %

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 4.7
Coarse Sand (-No.10 + No.40) : 50.2
Fine Sand (-No.40 + No.200) : 29.6
Silt + Clay (-No.200) : 15.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.7
Coarse Sand (-No.4 + No.10) : 4.0
Medium Sand (-No.10 + No.40) : 50.2
Fine Sand (-No.40 + No.200) : 29.6
Silt + Clay (-No.200) : 15.5

Approved By : J.S.

Soil No. 84

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Tan, Brown & Gray Silty Sand

Sample No. : Bulk-2
Sample Loc. : Boring No. B-8
Sample Depth : 0.0' to 5.0'
Date Tested : 07/14/14
Date Reported : 07/22/14

AASHTO T27 :

AASHTO T88

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	99.7
1/4		6.3	mm	
No.4		4.75	mm	96.6
No.6		3.35	mm	
No.10		2	mm	92.9

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	62.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	17.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.2632 mm

CBR (AASHTO: T-193) : NA
Dry Dens. (AASHTO: T-99; Method (C)) : 124.1 pcf
Opt. Moist. (AASHTO: T-99; Method (C)) : 8.5 %

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 7.1
Coarse Sand (-No.10 + No.40) : 30.3
Fine Sand (-No.40 + No.200) : 45.6
Silt + Clay (-No.200) : 17.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 3.4
Coarse Sand (-No.4 + No.10) : 3.7
Medium Sand (-No.10 + No.40) : 30.3
Fine Sand (-No.40 + No.200) : 45.6
Silt + Clay (-No.200) : 17.0

Approved By : J.S.

Soil No. 85

ICA Engineering

DIRECT SHEAR TEST
ASTM D 3080-72

PROJECT NAME : Bridge Replacement over Four Hole Swamp
PROJECT # : 11200-10
PROJECT COUNTY : Orangeburg
PROJECT STATE : South Carolina
LABORATORY # :
SUBMITTED BY : ICA Engineering Inc.

SAMPLE # : B-1
SAMPLE LOC. : Bulk 1
SAMPLE DEPTH : 0.0' to 5.0'
DATE TESTED : 7-23-14
DATE REPORTED : 7-23-14

SOIL TYPE : Silty Sand
TYPE OF SPECIMEN : Remolded

Specimen No.1		Specimen No.2		Specimen No.3	
INIT. HT. :	1.001 in	INIT. HT. :	1.001 in	INIT. HT. :	1.001 in
INIT. DIA. :	2.490 in	INIT. DIA. :	2.490 in	INIT. DIA. :	2.490 in
WET DEN. :	130.0 pcf	WET DEN. :	130.0 pcf	WET DEN. :	130.0 pcf
DRY DEN. :	118.9 pcf	DRY DEN. :	118.9 pcf	DRY DEN. :	118.9 pcf
MOISTURE :	9.4 %	MOIST. :	9.4 %	MOIST. :	9.4 %
VOID RATIO :	-1.000	VOID RATIO :	-1.000	VOID RATIO :	-1.000

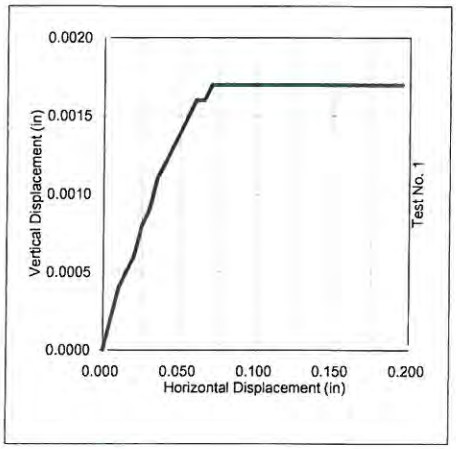
	Specimen No.1				Specimen No.2				Specimen No.3			
#	Horiz. Dsp. in.	Vert. Dsp. in.	Shear Force lbs.	Shear Stress psi	Horiz. Dsp. in.	Vert. Dsp. in.	Shear Force lbs.	Shear Stress psi	Horiz. Dsp. in.	Vert. Dsp. in.	Shear Force lbs.	Shear Stress psi
1	0.000	0.0000	0.00	0.00	0.000	0.0000	0.00	0.00	0.000	0.0000	0.000	0.00
2	0.005	0.0002	8.40	1.73	0.005	0.0000	16.28	3.34	0.005	0.0000	25.56	5.25
3	0.010	0.0004	9.00	1.85	0.010	0.0001	20.44	4.20	0.010	0.0000	29.40	6.04
4	0.015	0.0005	9.30	1.91	0.015	0.0002	23.96	4.92	0.015	0.0000	32.60	6.69
5	0.020	0.0006	9.60	1.97	0.020	0.0002	26.20	5.38	0.020	0.0000	35.48	7.29
6	0.025	0.0008	9.60	1.97	0.025	0.0003	28.12	5.77	0.025	0.0001	35.80	7.35
7	0.030	0.0009	9.60	1.97	0.030	0.0003	28.76	5.91	0.030	0.0001	36.12	7.42
8	0.035	0.0011	9.60	1.97	0.035	0.0004	29.08	5.97	0.035	0.0001	36.12	7.42
9	0.040	0.0012	9.30	1.91	0.040	0.0005	29.08	5.97	0.040	0.0002	37.08	7.61
10	0.045	0.0013	9.00	1.85	0.045	0.0006	30.04	6.17	0.045	0.0004	37.72	7.75
11	0.050	0.0014	8.70	1.79	0.050	0.0007	29.72	6.10	0.050	0.0005	38.68	7.94
12	0.055	0.0015	8.40	1.73	0.055	0.0008	29.08	5.97	0.055	0.0006	38.68	7.94
13	0.060	0.0016	8.40	1.73	0.060	0.0009	28.44	5.84	0.060	0.0006	39.00	8.01
14	0.065	0.0016	8.40	1.73	0.065	0.0010	28.12	5.77	0.065	0.0008	38.68	7.94
15	0.070	0.0017	8.40	1.73	0.070	0.0010	28.12	5.77	0.070	0.0008	39.00	8.01
16	0.075	0.0017	8.40	1.73	0.075	0.0011	27.80	5.71	0.075	0.0008	39.00	8.01
17	0.080	0.0017	8.40	1.73	0.080	0.0011	26.52	5.45	0.080	0.0008	39.96	8.21
18	0.085	0.0017	8.40	1.73	0.085	0.0011	26.20	5.38	0.085	0.0009	39.96	8.21
19	0.090	0.0017	8.40	1.73	0.090	0.0011	26.20	5.38	0.090	0.0009	39.96	8.21
20	0.095	0.0017	8.40	1.73	0.095	0.0011	26.20	5.38	0.095	0.0009	39.00	8.01
21	0.100	0.0017	8.40	1.73	0.100	0.0011	26.20	5.38	0.100	0.0009	38.68	7.94
22	0.105	0.0017	8.40	1.73	0.105	0.0011	26.20	5.38	0.105	0.0009	37.72	7.75
23	0.110	0.0017	8.40	1.73	0.110	0.0011	26.20	5.38	0.110	0.0009	36.76	7.55
24	0.115	0.0017	8.40	1.73	0.115	0.0011	26.20	5.38	0.115	0.0009	36.76	7.55
25	0.120	0.0017	8.40	1.73	0.120	0.0011	26.20	5.38	0.120	0.0009	36.76	7.55
26	0.125	0.0017	8.40	1.73	0.125	0.0011	26.20	5.38	0.125	0.0009	36.76	7.55
27	0.130	0.0017	8.40	1.73	0.130	0.0011	26.20	5.38	0.130	0.0009	36.76	7.55
28	0.135	0.0017	8.40	1.73	0.135	0.0011	26.20	5.38	0.135	0.0009	36.76	7.55
29	0.140	0.0017	8.40	1.73	0.140	0.0011	26.20	5.38	0.140	0.0009	36.76	7.55
30	0.145	0.0017	8.40	1.73	0.145	0.0011	26.20	5.38	0.145	0.0009	36.76	7.55
31	0.150	0.0017	8.40	1.73	0.150	0.0011	26.20	5.38	0.150	0.0009	36.76	7.55
32	0.155	0.0017	8.40	1.73	0.155	0.0011	26.20	5.38	0.155	0.0009	36.76	7.55
33	0.160	0.0017	8.40	1.73	0.160	0.0011	26.20	5.38	0.160	0.0009	36.76	7.55

ICA Engineering

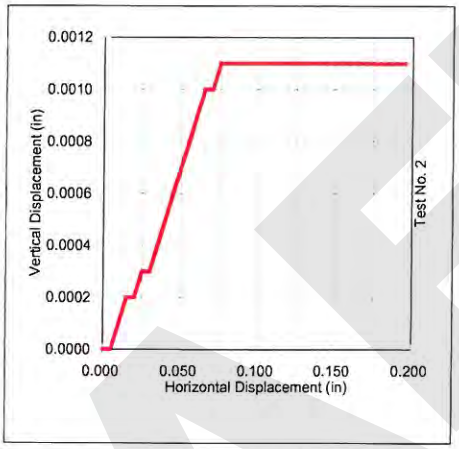
DIRECT SHEAR TEST
ASTM D 3080-72

PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT #	: 11200-10	SAMPLE #	: B-1
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: Bulk 1
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 0.0' to 5.0'
LABORATORY #	:	DATE TESTED	: 7-23-14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 7-23-14

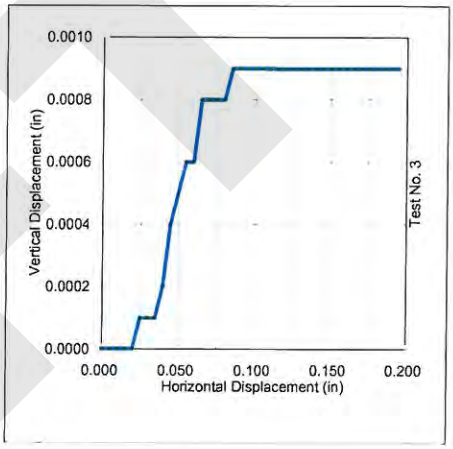
Specimen No.1

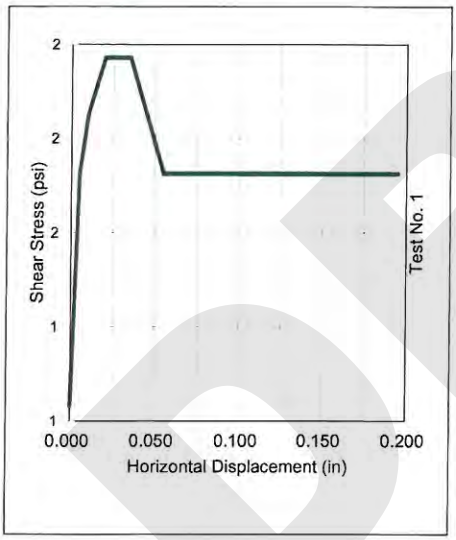


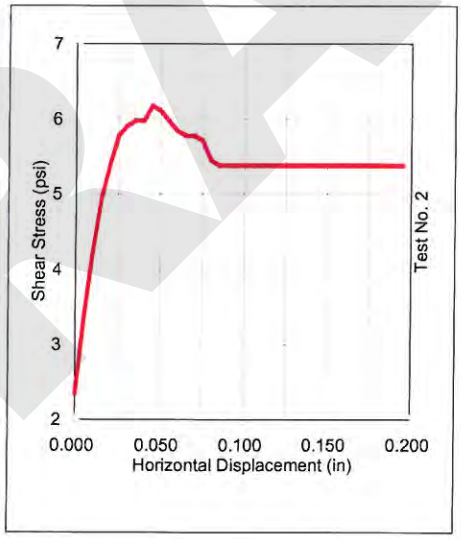
Specimen No.2

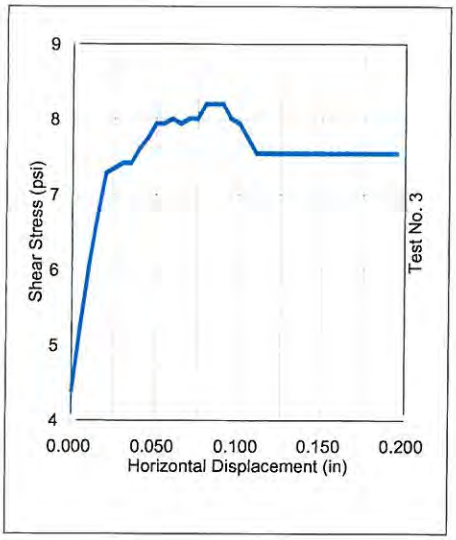


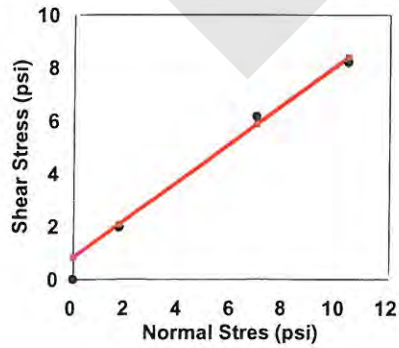
Specimen No.3











Summary of Results:

	Specimen No. 1	Specimen No. 2	Specimen No. 3
Normal Stress (psi)	1.74	6.94	10.41
Maximum Shear Stress (psi)	1.97	6.17	8.21

Phi Angle = 35.96°
Cohesion = 0.83 psi

Legend
- Specimen No. 1
- Specimen No. 2
- Specimen No. 3
- Tangent Line

APPROVED BY: Maggie Mansfield

ICA Engineering

DIRECT SHEAR TEST
ASTM D 3080-72

PROJECT NAME : Bridge Replacement over Four Hole Swamp
PROJECT # : 11200-01
PROJECT COUNTY : Orangeburg
PROJECT STATE : South Carolina
LABORATORY # : 100
SUBMITTED BY : ICA Engineering Inc.

SAMPLE # : B-8
SAMPLE LOC. : Bulk 1
SAMPLE DEPTH : 0.0' to 5.0'
DATE TESTED : 7-23-14
DATE REPORTED : 7-23-14

SOIL TYPE : Silty Sand
TYPE OF SPECIMEN : Remolded

Specimen No.1		Specimen No.2		Specimen No.3	
INIT. HT. :	1.001 in	INIT. HT. :	1.001 in	INIT. HT. :	1.001 in
INIT. DIA. :	2.490 in	INIT. DIA. :	2.490 in	INIT. DIA. :	2.490 in
WET DEN. :	128.0 pcf	WET DEN. :	128.0 pcf	WET DEN. :	128.0 pcf
DRY DEN. :	118.0 pcf	DRY DEN. :	118.0 pcf	DRY DEN. :	118.0 pcf
MOISTURE :	8.4 %	MOIST. :	8.4 %	MOIST. :	8.4 %
VOID RATIO :	-1.000	VOID RATIO :	-1.000	VOID RATIO :	-1.000

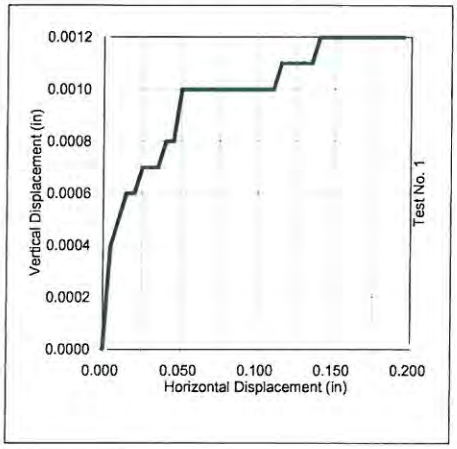
	Specimen No.1				Specimen No.2				Specimen No.3			
#	Horiz. Dsp. in.	Vert. Dsp. in.	Shear Force lbs.	Shear Stress psi	#	Horiz. Dsp. in.	Vert. Dsp. in.	Shear Force lbs.	Shear Stress psi	#	Horiz. Dsp. in.	Vert. Dsp. in.	Shear Force lbs.	Shear Stress psi
1	0.000	0.0000	0.00	0.00	1	0.000	0.0000	0.00	0.00	1	0.000	0.0000	0.000	0.00
2	0.005	0.0004	3.90	0.80	2	0.005	0.0000	13.80	2.83	2	0.005	0.0000	22.36	4.59
3	0.010	0.0005	4.50	0.92	3	0.010	0.0000	16.28	3.34	3	0.010	0.0000	27.16	5.58
4	0.015	0.0006	5.40	1.11	4	0.015	0.0000	17.88	3.67	4	0.015	0.0000	28.44	5.84
5	0.020	0.0006	5.70	1.17	5	0.020	0.0000	19.16	3.93	5	0.020	0.0000	29.72	6.10
6	0.025	0.0007	5.70	1.17	6	0.025	0.0000	19.80	4.07	6	0.025	0.0001	31.00	6.37
7	0.030	0.0007	5.70	1.17	7	0.030	0.0000	20.44	4.20	7	0.030	0.0001	31.32	6.43
8	0.035	0.0007	5.70	1.17	8	0.035	0.0000	20.44	4.20	8	0.035	0.0003	31.64	6.50
9	0.040	0.0008	5.70	1.17	9	0.040	0.0000	20.44	4.20	9	0.040	0.0003	31.00	6.37
10	0.045	0.0008	5.70	1.17	10	0.045	0.0000	20.44	4.20	10	0.045	0.0003	30.36	6.23
11	0.050	0.0010	6.00	1.23	11	0.050	0.0000	20.44	4.20	11	0.050	0.0003	30.68	6.30
12	0.055	0.0010	6.00	1.23	12	0.055	0.0000	19.48	4.00	12	0.055	0.0003	30.36	6.23
13	0.060	0.0010	6.00	1.23	13	0.060	0.0001	19.16	3.93	13	0.060	0.0003	29.72	6.10
14	0.065	0.0010	6.30	1.29	14	0.065	0.0001	19.16	3.93	14	0.065	0.0003	29.72	6.10
15	0.070	0.0010	6.30	1.29	15	0.070	0.0002	18.84	3.87	15	0.070	0.0003	29.40	6.04
16	0.075	0.0010	6.60	1.36	16	0.075	0.0002	18.52	3.80	16	0.075	0.0003	29.40	6.04
17	0.080	0.0010	6.60	1.36	17	0.080	0.0002	18.52	3.80	17	0.080	0.0003	29.40	6.04
18	0.085	0.0010	6.60	1.36	18	0.085	0.0002	18.52	3.80	18	0.085	0.0003	29.72	6.10
19	0.090	0.0010	6.60	1.36	19	0.090	0.0002	19.16	3.93	19	0.090	0.0003	29.72	6.10
20	0.095	0.0010	6.60	1.36	20	0.095	0.0003	18.84	3.87	20	0.095	0.0003	30.04	6.17
21	0.100	0.0010	6.60	1.36	21	0.100	0.0004	19.16	3.93	21	0.100	0.0003	30.04	6.17
22	0.105	0.0010	6.60	1.36	22	0.105	0.0004	19.16	3.93	22	0.105	0.0003	29.72	6.10
23	0.110	0.0010	6.60	1.36	23	0.110	0.0005	19.80	4.07	23	0.110	0.0003	29.72	6.10
24	0.115	0.0011	6.60	1.36	24	0.115	0.0005	20.44	4.20	24	0.115	0.0003	29.72	6.10
25	0.120	0.0011	6.60	1.36	25	0.120	0.0005	20.44	4.20	25	0.120	0.0003	29.72	6.10
26	0.125	0.0011	6.60	1.36	26	0.125	0.0006	20.44	4.20	26	0.125	0.0002	29.72	6.10
27	0.130	0.0011	6.30	1.29	27	0.130	0.0006	20.44	4.20	27	0.130	0.0002	29.72	6.10
28	0.135	0.0011	6.30	1.29	28	0.135	0.0006	20.76	4.26	28	0.135	0.0002	29.72	6.10
29	0.140	0.0012	6.30	1.29	29	0.140	0.0007	21.08	4.33	29	0.140	0.0002	29.72	6.10
30	0.145	0.0012	6.30	1.29	30	0.145	0.0007	21.08	4.33	30	0.145	0.0002	29.40	6.04
31	0.150	0.0012	6.30	1.29	31	0.150	0.0007	21.08	4.33	31	0.150	0.0001	29.40	6.04
32	0.155	0.0012	6.30	1.29	32	0.155	0.0007	21.08	4.33	32	0.155	0.0001	29.40	6.04
33	0.160	0.0012	6.30	1.29	33	0.160	0.0007	21.08	4.33	33	0.160	0.0001	29.40	6.04

ICA Engineering

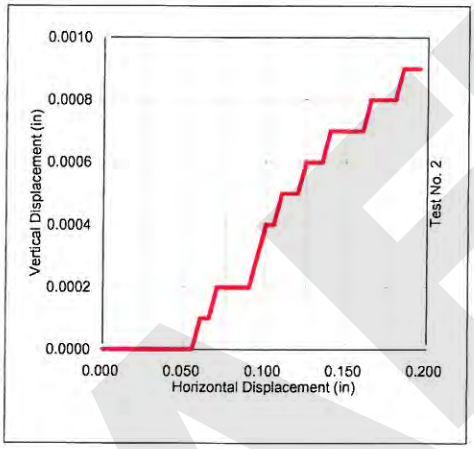
DIRECT SHEAR TEST
ASTM D 3080-72

PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT #	: 11200-01	SAMPLE #	: B-8
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: Bulk 1
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 0.0' to 5.0'
LABORATORY #	: 100	DATE TESTED	: 7-23-14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 7-23-14

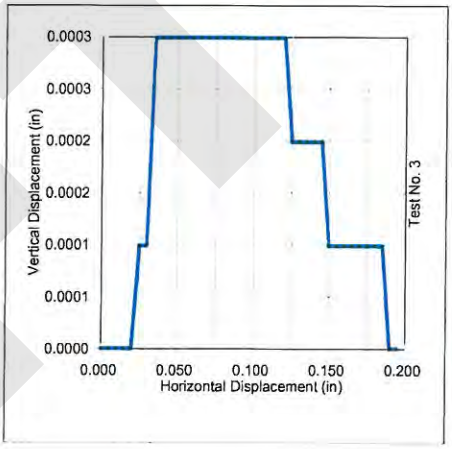
Specimen No.1

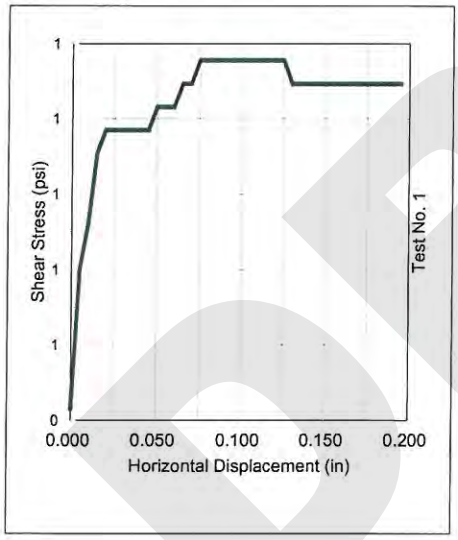


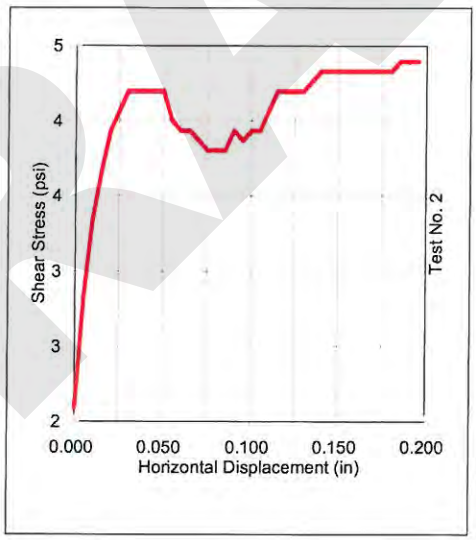
Specimen No.2

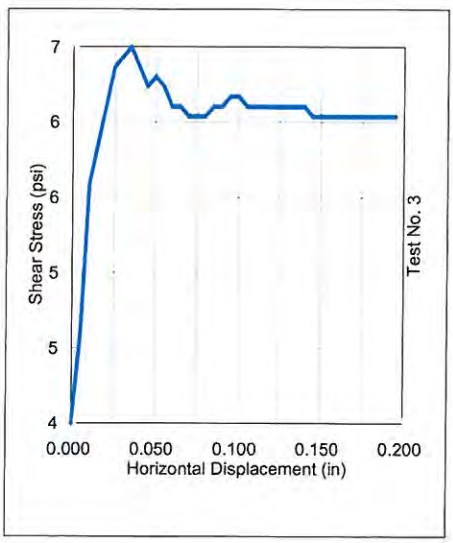


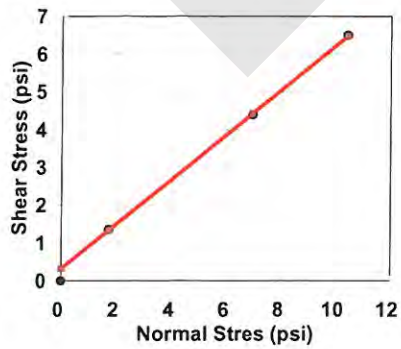
Specimen No.3











Summary of Results:

	Specimen No. 1	Specimen No. 2	Specimen No. 3
Normal Stress (psi)	1.74	6.94	10.41
Maximum Shear Stress (psi)	1.36	4.39	6.50

Phi Angle = 30.62°
Cohesion = 0.32 psi

Legend
- Specimen No. 1
- Specimen No. 2
- Specimen No. 3
- Tangent Line

APPROVED BY: Mayard Mansfield

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

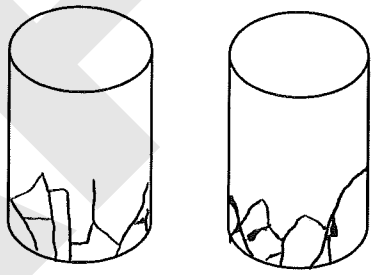
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-1
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-5
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 10.6' to 11.0'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to scat. med. grain fossiliferous, calcareous Sandstone, mod. wthd.

Diameter :	1.97 in	Area :	3.04 in^2
Height :	4.13 in	Volume :	0.00726 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	121.5	lbs/$ft.^3$
Maximum Stress :	665	psi
Elapsed Time :	3:56	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By : Jerry Sabo

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

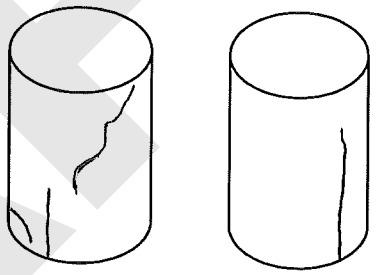
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-2
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-5
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 12.3' to 12.6'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to scat. med. grain fossiliferous, calcareous Sandstone, highly wthd.

Diameter :	1.98 in	Area :	3.08 in²
Height :	4.22 in	Volume :	0.00751 ft³

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	121.69	lbs/ft.³
Maximum Stress :	1007	psi
Elapsed Time :	5:05	min.
Rate of Loading :	20	lb/sec



Comments :

Approved By : Jeremy Sabo

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

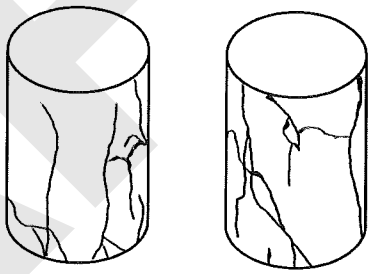
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-3
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-5
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 19.5' to 19.9'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to scat. med. grain fossiliferous, calcareous Sandstone, mod. wthd.

Diameter :	1.98 in	Area :	3.09 in^2
Height :	4.21 in	Volume :	0.00752 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	137.08	lbs/$ft.^3$
Maximum Stress :	1722	psi
Elapsed Time :	7:21	min.
Rate of Loading :	30	lb/sec



Comments :

Approved By : Jerry Sabo

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

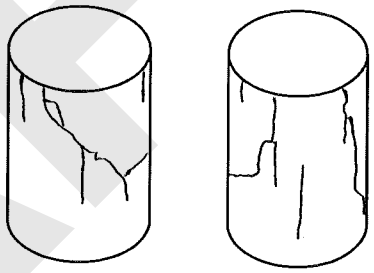
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-4
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-5
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 24.6' to 24.9'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to f. grain, fossiliferous Calcarenite, mod. to highly wthd.

Diameter :	1.95 in	Area :	2.99 in²
Height :	3.76 in	Volume :	0.00652 ft³

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	97.59	lbs/ft.³
Maximum Stress :	299	psi
Elapsed Time :	2:49	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By : Jeremy Sebo

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

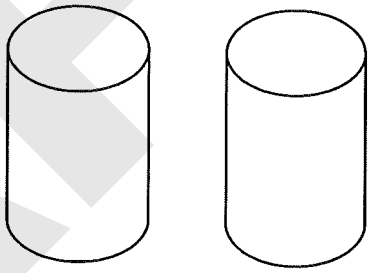
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-5
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-5
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 26.5' to 26.8'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to f. grain, fossiliferous Calcarenite, mod. to highly wthd.

Diameter :	1.95 in	Area :	2.97 in^2
Height :	3.40 in	Volume :	0.00584 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	95.02	lbs/ft.^{3}
Maximum Stress :	116	psi
Elapsed Time :	2:50	min.
Rate of Loading :	20	lb/sec



Comments : No fractures apparent at peak load.

Approved By :

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

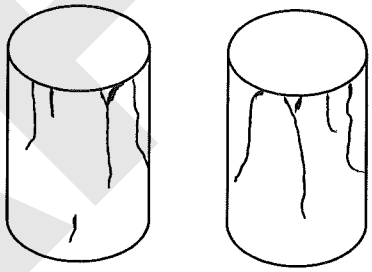
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-6
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-6
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 15.3' to 15.7'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : f. to med. grain w/ scat. cse. frags., fossiliferous, calcareous Sandstone, mod. to highly wthd.

Diameter :	1.99 in	Area :	3.10 in^2
Height :	4.22 in	Volume :	0.00756 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	120.13	lbs/$ft.^3$
Maximum Stress :	297	psi
Elapsed Time :	3:00	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By :

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

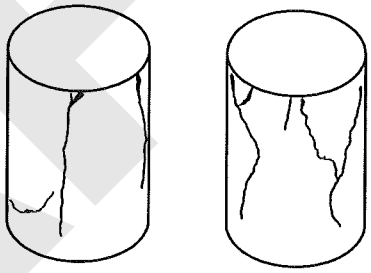
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-7
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-6
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 23.9' to 24.3'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : f. to med. grain w/ scat. cse. frags., fossiliferous, calcareous Sandstone, mod. to highly wthd.

Diameter :	1.92 in	Area :	2.91 in^2
Height :	4.10 in	Volume :	0.0069 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	99.35	lbs/$ft.^3$
Maximum Stress :	275	psi
Elapsed Time :	2:32	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By : Jeremy Sides

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

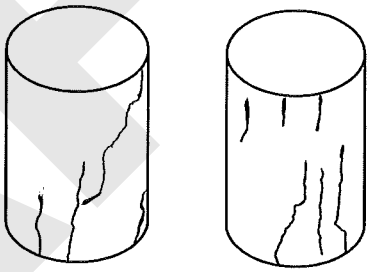
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-8
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-6
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 26.7' to 27.1'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to f. grain, fossiliferous Calcarenite, mod. wthd.

Diameter :	1.98 in	Area :	3.07 in^2
Height :	4.08 in	Volume :	0.00725 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	101.93	lbs/$ft.^3$
Maximum Stress :	459	psi
Elapsed Time :	3:02	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By :

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

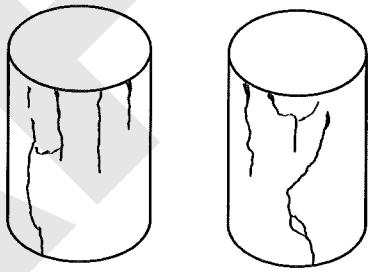
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-9
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-6
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 30.6' to 31.0'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to f. grain, fossiliferous Calcarenite, mod. wthd.

Diameter :	1.94 in	Area :	2.95 in²
Height :	4.19 in	Volume :	0.00715 ft³

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	98.09	lbs/ft.³
Maximum Stress :	295	psi
Elapsed Time :	1:30	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By :

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

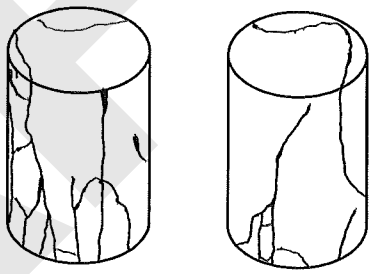
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-10
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-7
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 20.0' to 20.4'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to scat. med. grain, fossiliferous, calcareous Sandstone, mod. wthd.

Diameter :	1.98 in	Area :	3.07 in^2
Height :	4.30 in	Volume :	0.00765 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	145.77	lbs/ft.³
Maximum Stress :	4688	psi
Elapsed Time :	7:40	min.
Rate of Loading :	70	lb/sec



Comments :

Approved By :

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

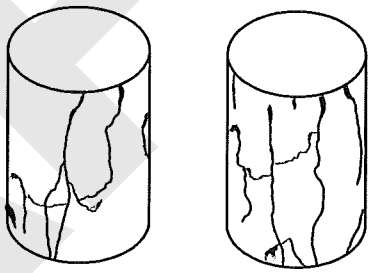
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-11
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-7
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 21.1' to 21.5'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to scat. med. grain, fossiliferous, calcareous Sandstone, mod. wthd.

Diameter :	1.98 in	Area :	3.09 in^2
Height :	4.24 in	Volume :	0.00759 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	147.82	lbs/$ft.^3$
Maximum Stress :	4251	psi
Elapsed Time :	3:52	min.
Rate of Loading :	70	lb/sec



Comments :

Approved By :

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

PROJECT NAME : Bridge Replacement over Four Hole Swamp

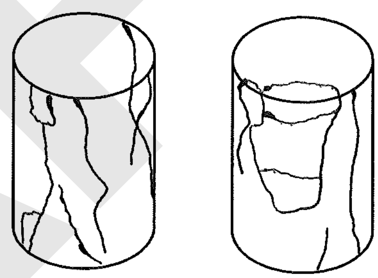
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-12
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-7
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 27.3' to 27.6'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to f. grain, fossiliferous Calcarenite, mod. to highly wthd.

Diameter :	1.97 in	Area :	3.06 in²
Height :	4.22 in	Volume :	0.00747 ft³

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	84.45	lbs/ft.³
Maximum Stress :	435	psi
Elapsed Time :	3:50	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By : [signature]

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

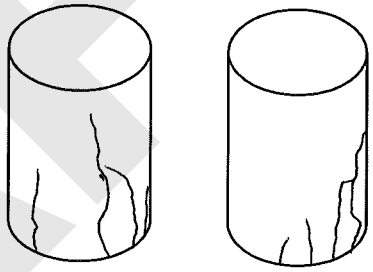
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-13
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-7
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 31.5' to 31.9'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to f. grain, fossiliferous Calcarenite, mod. to highly wthd.

Diameter :	1.97 in	Area :	3.05 in^2
Height :	4.20 in	Volume :	0.00742 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	83.78	lbs/$ft.^3$
Maximum Stress :	314	psi
Elapsed Time :	4:05	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By : Jeremy Sole

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

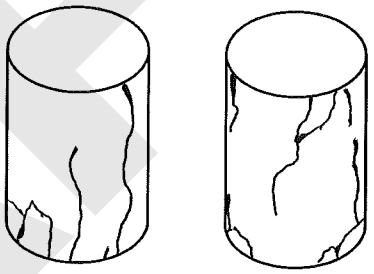
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-14
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-7
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 37.0' to 37.4'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to f. grain, fossiliferous Calcarenite, mod. to highly wthd.

Diameter :	1.98 in	Area :	3.08 in^2
Height :	4.26 in	Volume :	0.00759 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	89.01	lbs/$ft.^3$
Maximum Stress :	643	psi
Elapsed Time :	3:36	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By : Jeremy Sabo

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

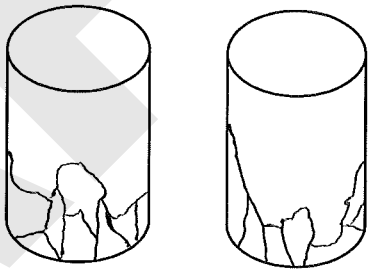
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-15
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-8
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 30.5' to 30.8'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : f. to med. grain w/ scat. cse. frags., fossiliferous, vugular texture in parts, calcareous Sandstone, mod. to highly wthd.

Diameter :	1.99 in	Area :	3.10 in^2
Height :	4.24 in	Volume :	0.0076 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	122.41	lbs/$ft.^3$
Maximum Stress :	452	psi
Elapsed Time :	4:39	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By : Jeremy Sides

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

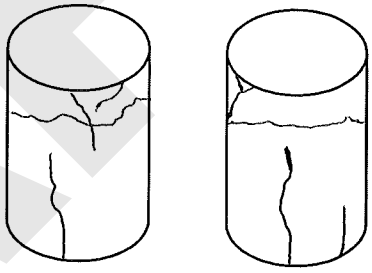
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-16
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-8
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 34.5' to 34.9'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : f. to med. grain w/ scat. cse. frags., fossiliferous, vugular texture in parts, calcareous Sandstone, mod. to highly wthd.

Diameter :	1.96 in	Area :	3.03 in^2
Height :	4.17 in	Volume :	0.0073 ft^3

RESULTS :

Moisture Air-Dry :	NA	
Air-Dry Density :	106.56	lbs/$ft.^3$
Maximum Stress :	261	psi
Elapsed Time :	3:12	min.
Rate of Loading :	10	lb/sec



Comments :

Approved By : Jeremy Sides

ICA Engineering

UNCONFINED COMPRESSION TEST (ROCK CORE)

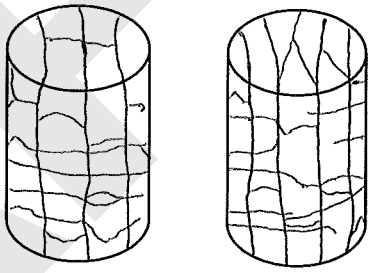
PROJECT NAME	: Bridge Replacement over Four Hole Swamp		
PROJECT NO.	: 11200-10	SAMPLE NO.	: RC-17
PROJECT COUNTY	: Orangeburg	SAMPLE LOC.	: B-8
PROJECT STATE	: South Carolina	SAMPLE DEPTH	: 39.0' to 39.4'
LABORATORY NO.	: 11200-10	DATE TESTED	: 07/22/14
SUBMITTED BY	: ICA Engineering Inc.	DATE REPORTED	: 07/24/14

ROCK DESCRIPTION : v.f. to f. grain, fossiliferous Calcarenite w/ pods, calcareous Sandstone, mod. to highly wthd.

Diameter :	1.97 in	Area :	3.05 in^2
Height :	4.18 in	Volume :	0.00738 ft^3

RESULTS :

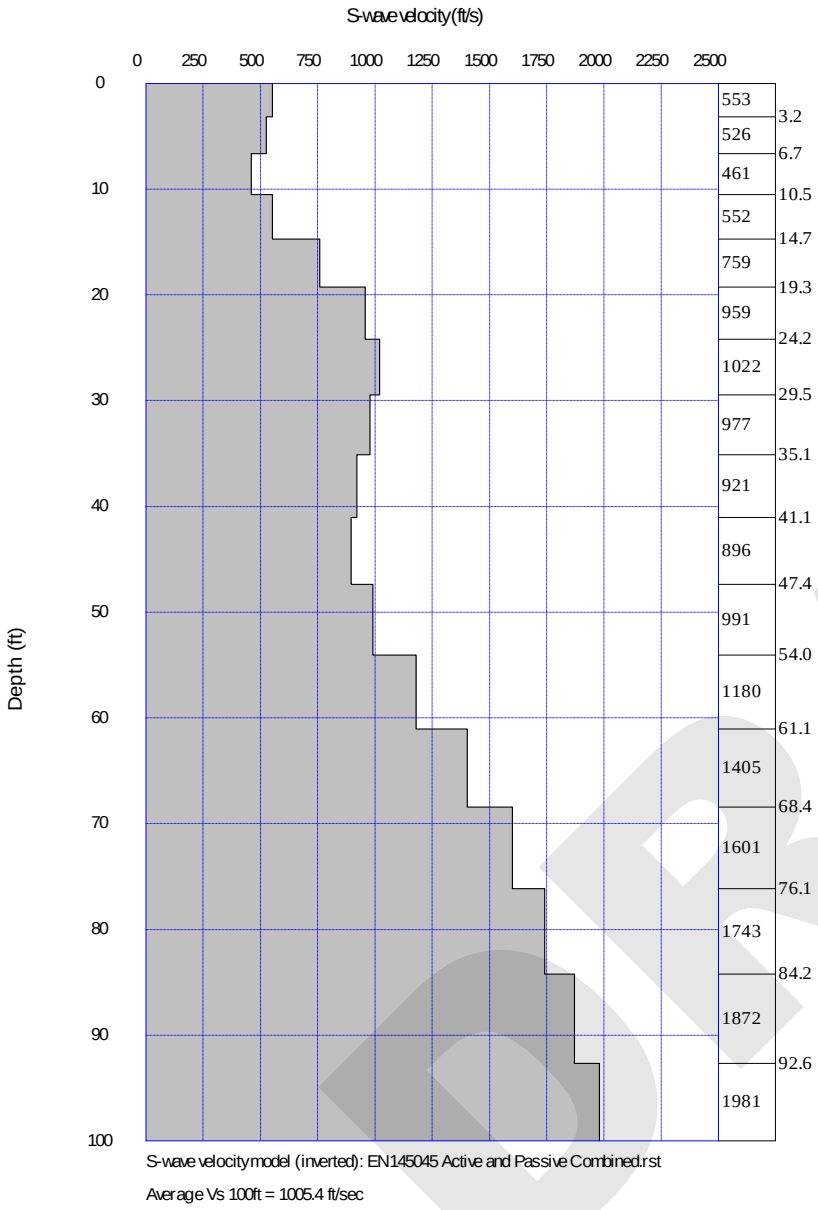
Moisture Air-Dry :	NA	
Air-Dry Density :	105.77	lbs/ft.^{3}
Maximum Stress :	203	psi
Elapsed Time :	2:30	min.
Rate of Loading :	10	lb/sec



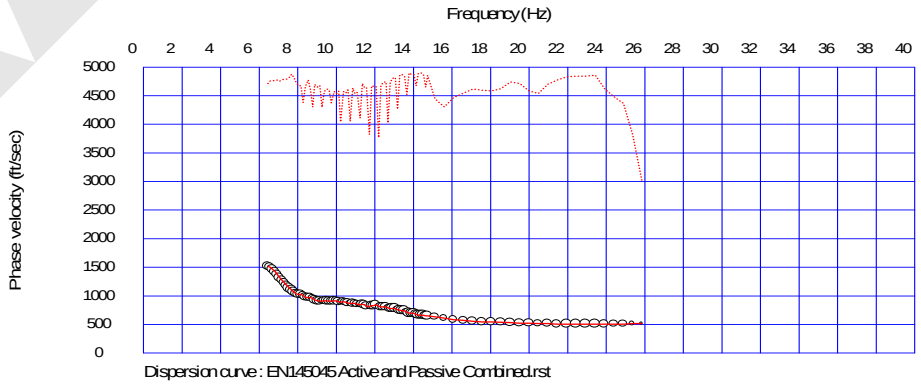
Comments :

Approved By : Jeremy Sabo

Appendix V
MASW Testing



Testing Results	
Depth(ft)	S-wave velocity(ft/s)
0.0	553.1
3.2	526.7
6.7	461.6
10.5	552.7
14.7	759.5
19.3	959.8
24.2	1022.2
29.5	977.8
35.1	921.2
41.1	896.1
47.4	991.6
54.0	1180.6
61.1	1405.0
68.4	1601.4
76.1	1743.3
84.2	1872.3
92.6	1981.6



Project Mgr:	BTS
Prepared by:	BTS
Checked by:	BTS
Approved by:	BTS

Project No.	EN145045
Scale:	NA
Date:	4/18/2014

Terracon
1450 FIFTH STREET WEST NORTH CHARLESTON, SC
PH: (843) 884-1234 Fax. (843) 884-9234

GEOPHYSICAL TESTING RESULTS
MASW SHEAR WAVE VELOCITY

XXXXX
Orangeburg County, South Carolina

TEST N0

X

Appendix VI
Hammer Energy Report

Applied Foundation Testing

North Carolina License No.: P-0294

August 22, 2013

Report of Standard Penetration Test (SPT) Energy Measurement Testing

B32 at Station 388+00, 110 Feet Left
Near Intersection of US 221 and Laurel Ridge Road South
CME Model 45C Rig with Auto Hammer
Rig Serial No.: 300404
Ashe County, North Carolina
AFT Project No.: 213060NC

Authored By:

Gerzan Nunez
Staff Geotechnical Engineer

Michael J. Simpson, P.E.
Geotechnical Engineer

Thomas G. Santee, P.E.
Chief Engineer
NC Registration No.: 029648
Certified PDA Signatory - Advanced

For: **Mr. Kenny Bussey, P.E.**
ICA Engineering, Inc.
kbussey@icaeng.com

Applied Foundation Testing

Specializing in **STAT***NAMIC*™ Load Testing,
Dynamic and Static Load Testing, Instrumentation
and Geotechnical Engineering

Report of SPT Energy Measurement Testing

In General Accordance to ASTM D 4633

General Information				
Date:	August 22, 2013			
AFT Project No.:	213060NC			
Project Description:	SPT Energy Measurement Testing of Drill Rig			
Client Name:	ICA Engineering, Inc.			
Client Address:	kbussey@icaeng.com			
Client Contact:	Mr. Kenny Bussey, P.E.			
Test Date:	August 21, 2013			
Test Equipment Manufacturer/Model:	Pile Dynamics, Inc. / Model PAX (strain and accelerometer calibrations attached in Appendix G)			
AFT Field Personnel:	Thomas G. Santee, P.E., Gerzan Nunez			
AFT Responsible Engineer:	Thomas G. Santee, P.E.			

Drill Rig Information				
Manufacturer	**Model**	**Serial Number**	**Operator**	**Type**
CME	45C	300404	Robbie	ATV (Track)

Hammer Information				
Type	**Model**	**Serial Number**		
Auto	CME	N/A		
Anvil Height (in.)	**Anvil Diameter (in.)**	**Drop Height (in.)**	**Ram Weight (lb.)**	**Ram Serial Number**
13	~2.5	30	140	N/A

Drilling Rod Information				
Type	**OD (in.)**	**ID (in.)**	**Cross Sectional Area (in^2)**	**Typical Length (ft.)**
AWJ	~1.75	~1.25	~1.18	5
Instrumented Rod Type	**OD (in.)**	**ID (in.)**	**Cross Sectional Area (in^2)**	**Length (ft.)**
AWJ	~1.75	~1.25	~1.18	2

Boring Information

ID	Location	Reference Elevation (ft.)	Impact to Instrumentation Length (ft.)	Boring Log Attached (Y or N)
B32 at Station 388+00, 110 Feet Left	Near US 221/Laurel Ridge Road South, Ashe County, NC	+3,075.13	2.1	N

Results

Energy Measurements

Representative plot of force and velocity for each data set attached [X]

Plots of average energy and all energy versus Rod Length attached [X]

Tabular and graphical data for each blow for each data set attached [X]

Data Set ID	Instru-mentation to Sampler Tip Length (ft.)(1)	Blows Recorded to Drive Sampler/N-value	Soil Sample Description	Average BPM for Increment	Average Maximum Energy (k-ft.)	Average Energy Transfer Ratio (percent)
1	33.6	14-20-17 / 37	Brown Sand	51.4	0.27	77.2
2	38.6	17-36-37 / 73	Brown Sand with Trace Quartz Fragments	51.5	0.28	79.9
3	43.6	8-14-14 / 28	Brown Sand with Mica, Some Silt	52.0	0.27	78.2
4	48.6	2-8-14 / 22	Brown Sand with Mica, Some Silt	49.8	0.28	79.6
5	53.6	18-18-16 / 34	Brown Sand with Mica, Some Silt	53.2	0.28	79.2

1. Penetration below grade is approximately 2.5 to 4.0 feet less than length shown for instrumentation to sampler tip for each increment.

Energy Measurement Interpretation

Five increments of data were gathered. The averages for energy (EFV) and the energy transfer ratio (ETR) for each increment are tabulated in the above table. In addition, the above table includes the N-value and soil sample description for each increment. Plots of average ETR versus rod length below instrumentation and ETR for each blow versus rod length below instrumentation are included in Appendix A. Additional information regarding each blow recorded for each increment can be found in Appendices B through F. A plot showing representative force and velocity traces, input parameters, gage information, and output quantities is also included in Appendices B through F for a representative blow for each increment. Please note in the attached plots in Appendices B through F the penetration is estimated and based on depth of the tip of the sampler below existing ground. Refer to the LE values in the tabulated date and plots for the actual rod length below gages.

The overall average EFV and ETR values (for all recorded blows for the last three increments only) are approximately 0.28 k-ft and 79.0 percent, respectively. The standard deviation for all data for only the last three increments for EFV and ETR are 0.01 k-ft or 1.51 percent, respectively. Increment 1 and 2 are not used in the overage average EFV and ETR because

the N-value is higher than 50 for Increment 2. The overall average EFV and ETR values for all five increments including Increments 1 and 2 are approximately 0.28 k-ft and 79.0 percent, respectively.

Limitations

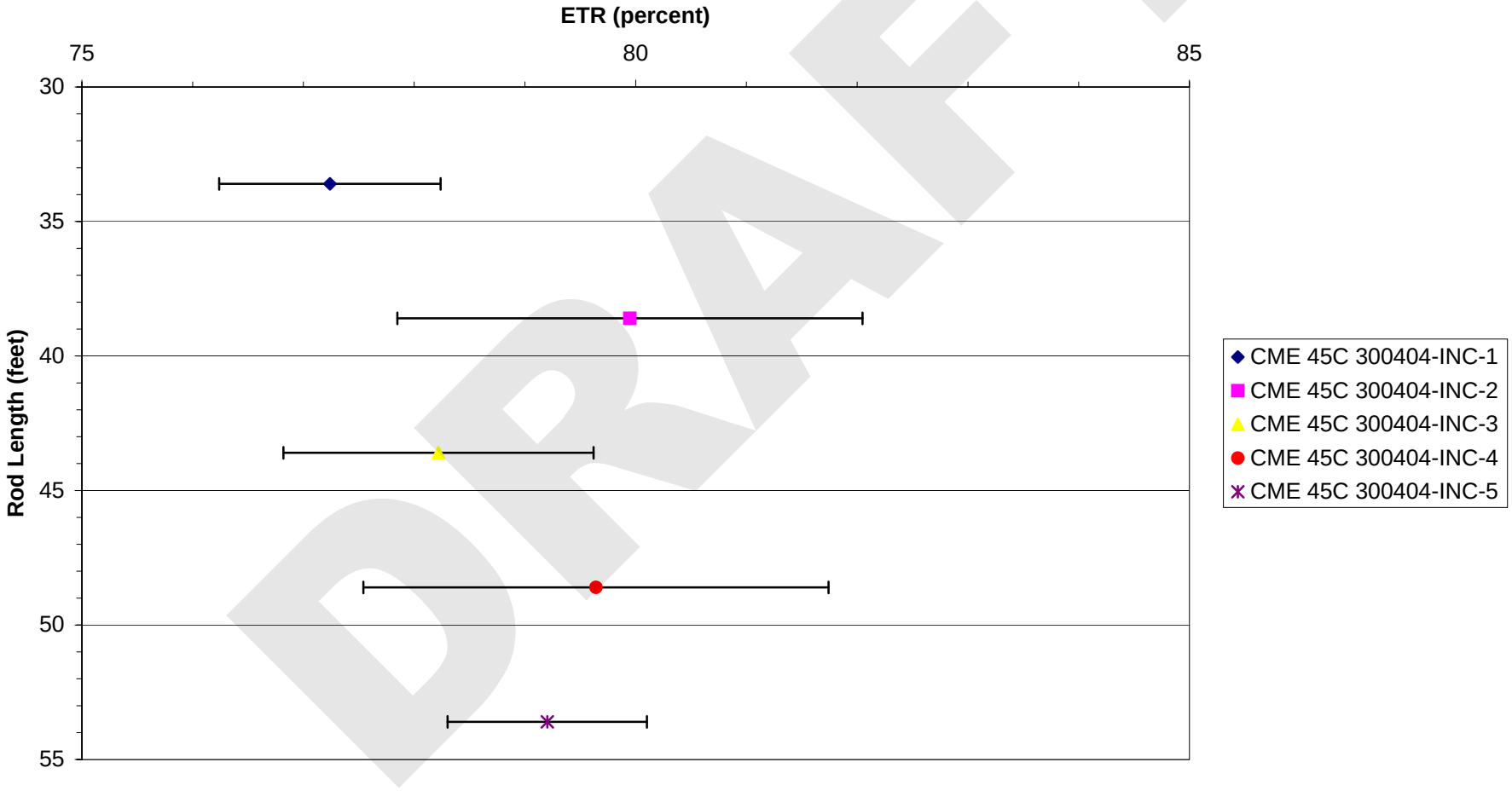
This report presents test measurements made by AFT. Interpretations were made based upon the measurements made by AFT with the latest techniques available and currently accepted standards of care recognized by Geotechnical Engineering professionals. AFT is an independent agency and is not the Geotechnical Engineer of Record. The Geotechnical Engineer of Record should ultimately make final recommendations for foundation design and construction.

Appendix A

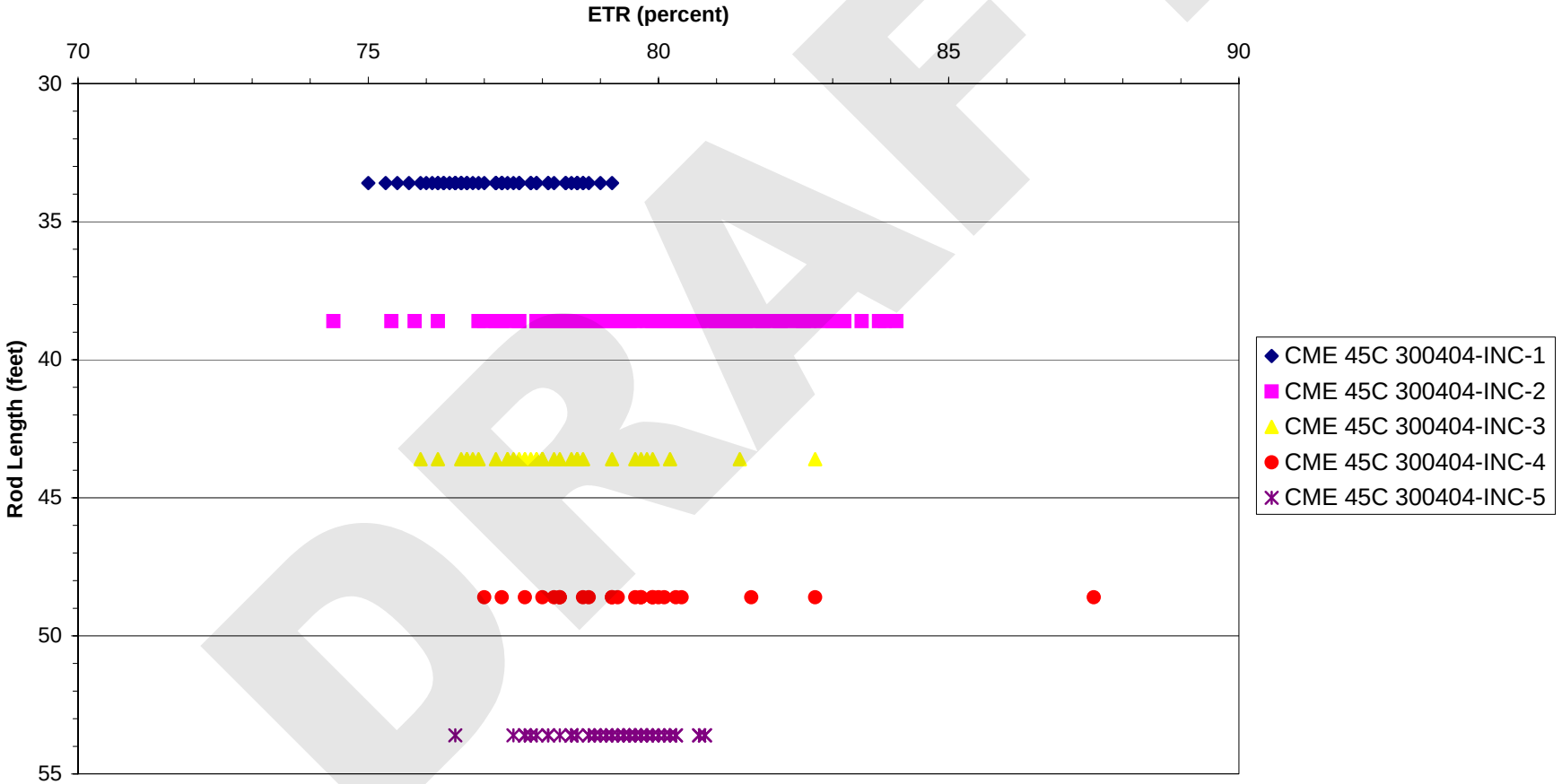
ETR and Average ETR versus Rod Length Plots

NCDOT
SPT Calibration
CME Rig, Model 45C
Serial No. 300404

Average ETR versus Rod Length with +- 1 Standard Deviation Shown
Rig Make and Model: CME 45C
Rig Serial # 300404
B32 at Station 388+00, 110 Feet Left
Near Intesection of US 221 and Laurel Ridge Road South, Ashe County, North Carolina



ETR versus Rod Length
Rig Make and Model: CME 45C
Rig Serial # 300404
B32 at Station 388+00, 110 Feet Left
Near Intesection of US 221 and Laurel Ridge Road South, Ashe County, North Carolina



Appendix B

Increment 1 PDIPLOT Data and Representative Blow Data

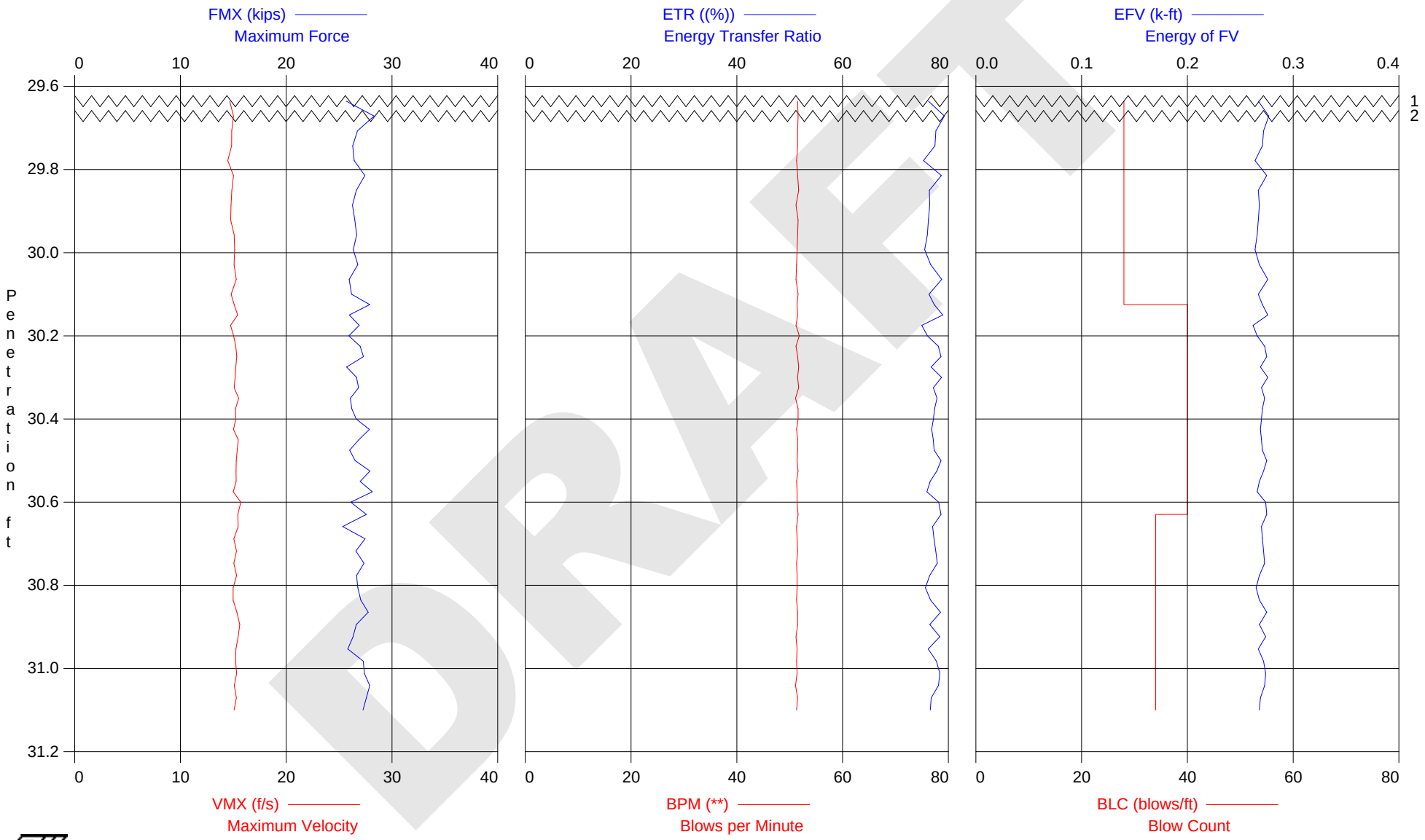
NCDOT
SPT Calibration
CME Rig, Model 45C
Serial No. 300404

Applied Foundation Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 22-Aug-2013

Test date: 21-Aug-2013

213060 NC - CME 45C 300404-INC-1



1 - Penetration is approximate distance below ground surface.

2 - Blows recorded were 14, 20, and 17 (N-Value = 37).

213060 NC - CME 45C 300404-INC-1
OP: AFT

AWJ ROD
Test date: 21-Aug-2013

AR: 1.18 in^2
LE: 33.60 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.60

FMX: Maximum Force
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute
VMX: Maximum Velocity

DMX: Maximum Displacement
DFN: Final Displacement
CSX: Max Measured Compr. Stress
FVP: Force/Velocity proportionality

BL#	depth	BLC	FMX	EFV	ETR	BPM	VMX	DMX	DFN	CSX	FVP
	ft	bl/ft	kips	k-ft	(%)	**	f/s	in	in	ksi	[]
1	29.64	28	26	0.27	76.3	51.5	14.7	0.52	0.47	21.8	0.8
2	29.67	28	28	0.28	79.2	51.6	15.0	0.51	0.46	24.0	0.9
3	29.71	28	27	0.27	77.6	51.5	14.8	0.47	0.43	22.7	0.9
4	29.74	28	26	0.27	77.5	51.5	14.8	0.48	0.46	22.3	0.8
5	29.78	28	26	0.26	75.3	51.3	14.5	0.46	0.46	22.4	0.8
6	29.81	28	27	0.28	78.7	51.5	15.0	0.48	0.46	23.3	0.9
7	29.85	28	27	0.27	76.4	51.7	14.9	0.46	0.46	22.6	0.9
8	29.89	28	26	0.27	76.5	51.2	14.8	0.45	0.45	22.3	0.8
9	29.92	28	26	0.27	76.2	51.6	14.8	0.45	0.45	22.4	0.8
10	29.96	28	27	0.27	76.0	51.5	15.1	0.45	0.45	22.6	0.8
11	29.99	28	26	0.26	75.5	51.4	15.1	0.44	0.44	22.3	0.8
12	30.03	28	27	0.27	76.7	51.3	15.1	0.45	0.45	22.7	0.8
13	30.06	28	26	0.28	78.8	51.2	15.3	0.46	0.46	22.0	0.8
14	30.10	28	26	0.27	76.3	51.6	14.8	0.45	0.45	22.2	0.8
15	30.13	40	28	0.27	77.3	51.4	15.1	0.40	0.33	23.6	0.8
16	30.15	40	26	0.28	79.0	51.5	15.4	0.42	0.34	22.0	0.8
17	30.18	40	27	0.26	75.0	51.2	14.7	0.40	0.32	22.8	0.8
18	30.20	40	26	0.27	76.1	51.8	15.0	0.39	0.32	22.0	0.8
19	30.23	40	27	0.27	78.1	51.2	15.2	0.41	0.34	22.9	0.8
20	30.25	40	27	0.28	78.6	51.5	15.3	0.39	0.32	23.1	0.8
21	30.28	40	26	0.27	76.7	51.7	15.2	0.40	0.32	21.8	0.8
22	30.30	40	27	0.28	78.7	51.5	15.2	0.42	0.33	22.6	0.8
23	30.33	40	27	0.27	77.2	51.7	15.1	0.41	0.32	22.7	0.8
24	30.35	40	26	0.27	77.9	51.1	15.5	0.41	0.33	22.1	0.8
25	30.38	40	26	0.27	77.4	51.6	15.2	0.41	0.34	22.2	0.8
26	30.40	40	27	0.27	77.2	51.6	15.2	0.40	0.32	22.6	0.8
27	30.43	40	28	0.27	76.9	51.3	15.0	0.40	0.32	23.6	0.8
28	30.45	40	27	0.27	77.2	51.5	15.5	0.41	0.33	22.8	0.8
29	30.48	40	26	0.27	77.3	51.5	15.4	0.41	0.33	22.0	0.8
30	30.50	40	27	0.28	78.6	51.4	15.3	0.40	0.33	22.5	0.8
31	30.53	40	28	0.27	77.8	51.6	15.3	0.41	0.32	23.7	0.9
32	30.55	40	27	0.27	76.6	51.3	15.3	0.39	0.32	22.9	0.8
33	30.58	40	28	0.27	75.9	51.4	15.0	0.38	0.33	23.9	0.9
34	30.60	40	26	0.27	78.2	51.4	15.7	0.40	0.33	22.1	0.8
35	30.63	34	28	0.28	78.6	51.6	15.4	0.40	0.38	23.4	0.8
36	30.66	34	25	0.27	77.0	51.3	15.5	0.39	0.38	21.5	0.8
37	30.69	34	27	0.27	77.3	51.4	15.0	0.41	0.37	23.3	0.8
38	30.72	34	27	0.27	77.6	51.5	15.3	0.41	0.38	22.5	0.8
39	30.75	34	27	0.27	77.9	51.3	15.0	0.39	0.38	23.2	0.8
40	30.78	34	27	0.27	76.5	51.4	15.3	0.40	0.38	22.6	0.8
41	30.81	34	27	0.27	75.7	51.4	15.0	0.39	0.37	22.7	0.8
42	30.84	34	27	0.27	76.6	51.3	15.0	0.41	0.37	22.9	0.9
43	30.86	34	28	0.28	78.5	51.5	15.3	0.41	0.37	23.5	0.9
44	30.89	34	27	0.27	76.5	51.5	15.6	0.39	0.37	22.6	0.8
45	30.92	34	26	0.27	78.4	51.2	15.5	0.42	0.38	22.3	0.8
46	30.95	34	26	0.27	76.2	51.4	15.3	0.40	0.38	21.9	0.8
47	30.98	34	27	0.27	77.8	51.3	15.2	0.40	0.38	23.1	0.8
48	31.01	34	27	0.27	78.4	51.4	15.3	0.39	0.38	23.2	0.8
49	31.04	34	28	0.27	78.1	51.1	15.1	0.41	0.37	23.6	0.8
50	31.07	34	28	0.27	76.8	51.5	15.3	0.39	0.37	23.4	0.9
51	31.10	34	27	0.27	76.6	51.3	15.1	0.39	0.37	23.1	0.9
		Average	27	0.27	77.2	51.4	15.1	0.42	0.38	22.7	0.8
		Std. Dev.	1	0.00	1.0	0.2	0.2	0.03	0.05	0.6	0.0
		Maximum	28	0.28	79.2	51.8	15.7	0.52	0.47	24.0	0.9
		@ Blow#	2	2	2	18	34	1	1	2	2

Total number of blows analyzed: 51

BL#	depth (ft)	Comments
1	29.64	Penetration is approximate distance below ground surface.
2	29.67	Blows recorded were 14, 20, and 17 (N-Value = 37).

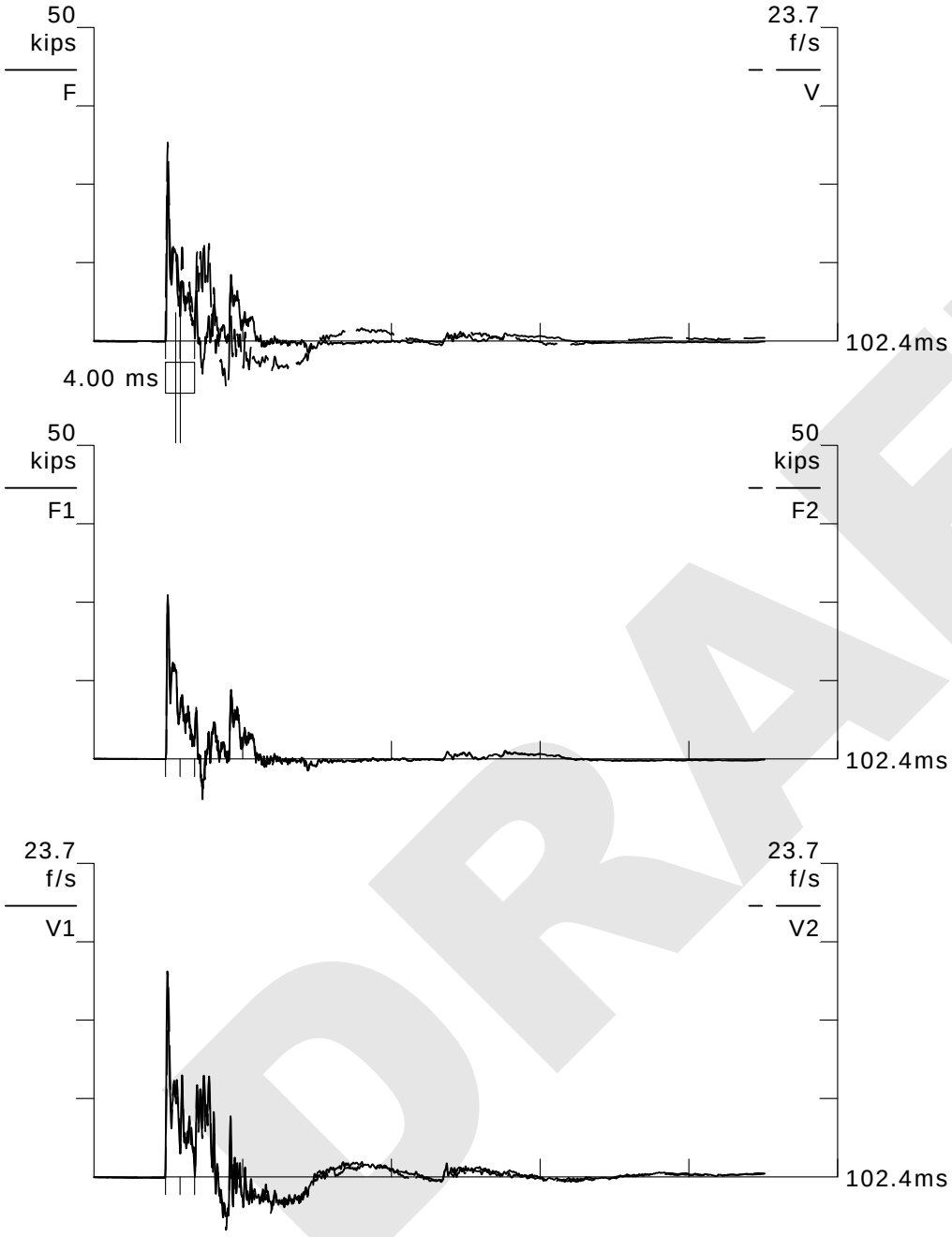
Time Summary

Drive 59 seconds 11:29:25 AM - 11:30:24 AM (8/21/2013) BN 1 - 51

Applied Foundation Testing, Inc.

213060 NC
PDA OP: AFT

PILE DRIVING ANALYZER ®
Version 2012.114
CME 45C 300404-INC-1
AWJ ROD



BN 18
8/21/2013 11:29:45 AM

FMX	26	kips
EFV	0.27	k-ft
ETR	76.1	(%)
BPM	51.8	bpm
VMX	15.0	f/s
DMX	0.39	in
DFN	0.32	in
CSX	22.0	ksi
FVP	0.8	[]
LE	33.60	ft
AR	1.18	in^2
EM	30000	ksi
SP	0.492	k/ft3
WS	16807.9	f/s
EA/C	2.1	ksec/ft
LP	30.20	ft

F34 A34

F3: [264-AWJ-1] 210.82 (1)
F4: [264-AWJ-2] 211.56 (1)
A3: [K3397] 275 mv/5000g's (1)
A4: [K3449] 395 mv/5000g's (1)

Appendix C

Increment 2 PDIPLOT Data and Representative Blow Data

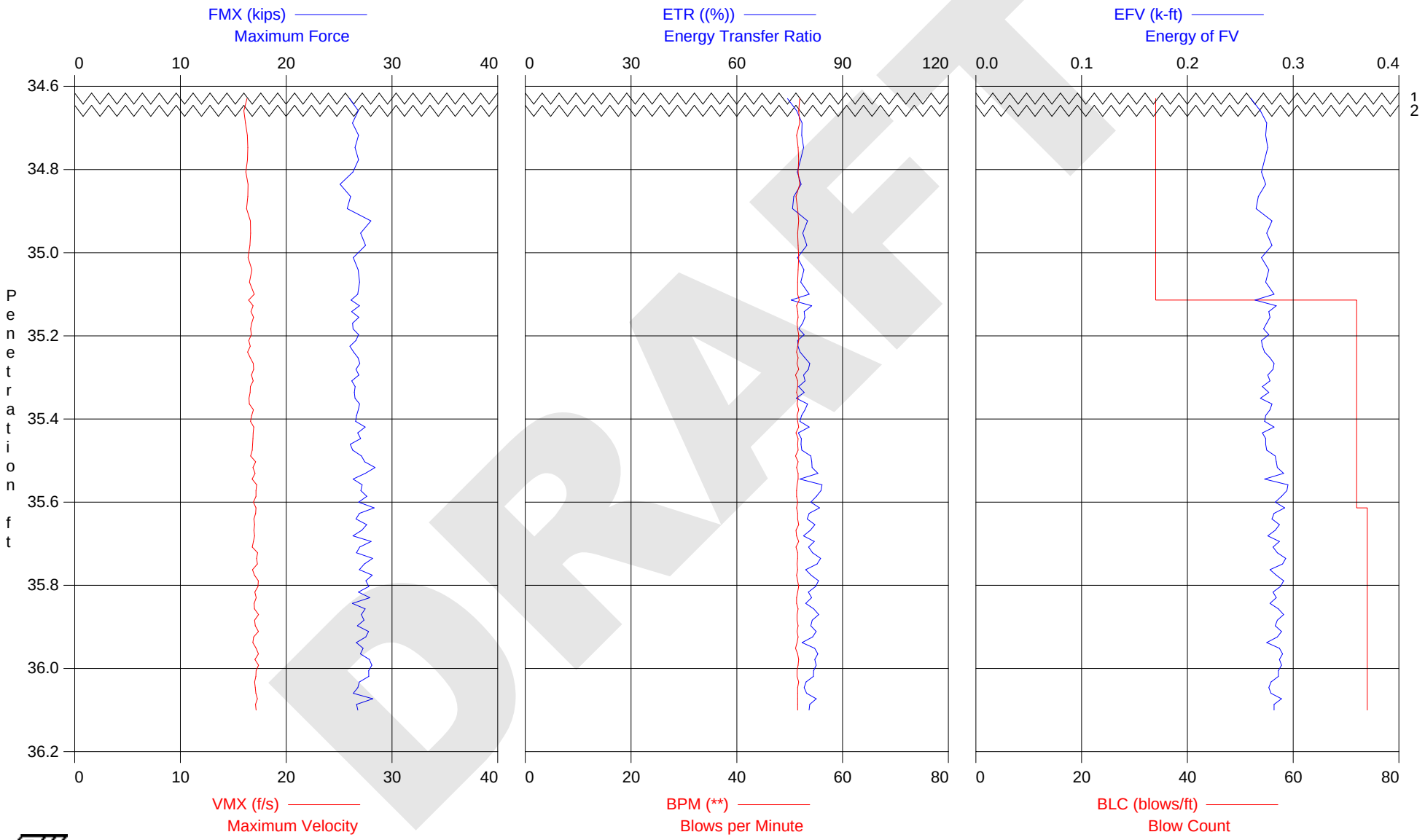
NCDOT
SPT Calibration
CME Rig, Model 45C
Serial No. 300404

Applied Foundation Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 22-Aug-2013

Test date: 21-Aug-2013

213060 NC - CME 45C 300404-INC-2



1 - Penetration is approximate distance below ground surface.

2 - Blows recorded were 17, 36, and 37 (N-Value = 73).

213060 NC - CME 45C 300404-INC-2
OP: AFT

AWJ ROD
Test date: 21-Aug-2013

AR: 1.18 in^2
LE: 38.60 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.60

FMX: Maximum Force
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute
VMX: Maximum Velocity

DMX: Maximum Displacement
DFN: Final Displacement
CSX: Max Measured Compr. Stress
FVP: Force/Velocity proportionality

BL#	depth	BLC	FMX	EFV	ETR	BPM	VMX	DMX	DFN	CSX	FVP
	ft	bl/ft	kips	k-ft	(%)	**	f/s	in	in	ksi	[]
1	34.63	34	26	0.26	74.4	51.9	16.3	0.44	0.37	22.0	0.8
2	34.66	34	27	0.27	77.0	51.7	16.0	0.44	0.35	22.7	0.8
3	34.69	34	26	0.28	78.5	51.9	16.1	0.44	0.35	22.3	0.8
4	34.72	34	27	0.27	78.4	51.3	16.3	0.43	0.36	22.7	0.8
5	34.75	34	27	0.28	79.0	51.6	16.4	0.42	0.34	22.5	0.8
6	34.78	34	27	0.27	78.1	51.7	16.3	0.41	0.35	22.7	0.8
7	34.81	34	26	0.27	77.2	51.6	16.2	0.41	0.35	22.3	0.7
8	34.84	34	25	0.27	78.3	51.9	16.4	0.42	0.36	21.3	0.7
9	34.86	34	26	0.27	76.2	51.2	16.4	0.40	0.35	22.1	0.8
10	34.89	34	26	0.27	75.8	51.5	16.2	0.41	0.36	21.8	0.8
11	34.92	34	28	0.28	80.1	51.7	16.6	0.42	0.35	23.7	0.8
12	34.95	34	27	0.28	78.7	51.5	16.6	0.40	0.33	22.9	0.8
13	34.98	34	28	0.28	79.9	51.6	16.6	0.41	0.34	23.3	0.8
14	35.01	34	26	0.27	77.2	51.7	16.4	0.40	0.34	22.3	0.8
15	35.04	34	27	0.28	79.0	51.6	16.8	0.40	0.34	22.7	0.8
16	35.07	34	27	0.27	78.2	51.5	16.5	0.39	0.34	22.8	0.8
17	35.10	34	27	0.28	80.5	51.5	17.0	0.40	0.36	22.7	0.8
18	35.11	72	26	0.26	75.4	51.8	16.4	0.37	0.17	22.1	0.7
19	35.13	72	27	0.28	81.3	51.3	16.9	0.40	0.17	22.8	0.8
20	35.14	72	26	0.28	79.1	51.5	16.7	0.39	0.17	22.2	0.7
21	35.16	72	27	0.28	79.3	51.6	16.9	0.38	0.16	22.8	0.8
22	35.17	72	26	0.28	78.7	51.4	16.7	0.40	0.18	22.3	0.7
23	35.18	72	26	0.27	77.6	51.5	16.6	0.39	0.17	22.3	0.8
24	35.20	72	27	0.28	79.1	51.7	16.7	0.37	0.17	22.8	0.8
25	35.21	72	27	0.27	77.3	51.7	16.5	0.37	0.18	22.5	0.8
26	35.23	72	26	0.27	77.3	51.5	16.6	0.37	0.16	22.1	0.7
27	35.24	72	26	0.27	78.0	51.3	16.4	0.37	0.18	22.3	0.8
28	35.25	72	27	0.28	79.3	51.6	16.6	0.37	0.16	22.7	0.8
29	35.27	72	27	0.28	80.7	51.4	16.9	0.38	0.16	22.8	0.7
30	35.28	72	27	0.28	80.3	51.7	16.9	0.37	0.15	22.5	0.7
31	35.29	72	27	0.28	78.9	51.1	16.7	0.36	0.16	22.8	0.8
32	35.31	72	26	0.28	79.4	51.5	16.9	0.37	0.17	22.2	0.7
33	35.32	72	27	0.27	77.6	51.5	16.6	0.36	0.16	22.5	0.8
34	35.34	72	26	0.28	79.1	51.3	16.6	0.37	0.16	22.4	0.8
35	35.35	72	27	0.27	76.9	51.6	16.5	0.35	0.15	22.5	0.8
36	35.36	72	27	0.28	80.1	51.4	16.5	0.36	0.15	22.8	0.8
37	35.38	72	27	0.28	79.3	51.7	16.9	0.37	0.15	22.7	0.7
38	35.39	72	27	0.27	78.4	51.4	16.7	0.35	0.15	22.6	0.7
39	35.41	72	27	0.27	77.9	51.5	16.6	0.34	0.16	22.5	0.7
40	35.42	72	27	0.28	80.5	51.7	16.9	0.35	0.17	23.3	0.8
41	35.43	72	27	0.27	77.5	51.2	16.9	0.35	0.15	22.7	0.8
42	35.45	72	27	0.27	78.3	51.6	16.9	0.34	0.17	22.9	0.8
43	35.46	72	26	0.27	78.2	51.5	16.8	0.36	0.16	22.1	0.7
44	35.48	72	26	0.28	78.4	51.6	16.8	0.34	0.17	22.3	0.7
45	35.49	72	27	0.28	81.0	51.1	16.6	0.34	0.16	23.0	0.8
46	35.50	72	27	0.28	81.3	51.6	17.1	0.34	0.16	23.2	0.7
47	35.52	72	28	0.29	81.3	51.3	16.9	0.35	0.17	24.1	0.7
48	35.53	72	27	0.29	83.0	51.6	17.0	0.34	0.17	23.3	0.7
49	35.54	72	26	0.27	77.9	51.6	16.8	0.33	0.16	22.3	0.7
50	35.56	72	27	0.30	84.2	51.4	17.2	0.36	0.17	23.0	0.8
51	35.57	72	27	0.29	83.9	51.3	17.1	0.35	0.18	22.9	0.7
52	35.59	72	28	0.29	82.6	51.3	17.1	0.35	0.17	23.4	0.8
53	35.60	72	27	0.28	81.0	51.5	16.9	0.33	0.17	22.8	0.7
54	35.61	74	28	0.29	83.5	51.3	17.1	0.34	0.16	24.0	0.7
55	35.63	74	27	0.28	80.5	51.5	17.1	0.35	0.17	22.8	0.8
56	35.64	74	27	0.28	80.0	51.5	17.0	0.34	0.17	22.5	0.7
57	35.65	74	28	0.29	82.1	51.7	17.0	0.34	0.17	23.4	0.8
58	35.67	74	27	0.28	80.9	51.2	16.9	0.35	0.17	23.0	0.8
59	35.68	74	26	0.28	78.9	51.3	17.0	0.32	0.16	22.3	0.7
60	35.69	74	28	0.29	82.0	51.7	16.9	0.34	0.17	23.8	0.8
61	35.71	74	27	0.28	80.4	51.2	16.8	0.33	0.16	22.8	0.8
62	35.72	74	27	0.29	81.5	51.5	17.3	0.33	0.17	22.6	0.7
63	35.74	74	28	0.29	83.8	51.5	17.2	0.36	0.17	23.9	0.8
64	35.75	74	27	0.29	82.8	51.4	17.3	0.36	0.16	23.2	0.8
65	35.76	74	27	0.28	79.5	51.5	16.8	0.33	0.17	22.8	0.7

213060 NC - CME 45C 300404-INC-2
OP: AFT
AWJ ROD
Test date: 21-Aug-2013

BL#	depth	BLC	FMX	EFV	ETR	BPM	VMX	DMX	DFN	CSX	FVP
	ft	bl/ft	kips	k-ft	(%)	**	f/s	in	in	ksi	[]
66	35.78	74	28	0.28	81.1	51.3	17.0	0.33	0.17	23.8	0.7
67	35.79	74	28	0.29	83.2	51.5	17.4	0.35	0.17	23.3	0.7
68	35.80	74	28	0.29	82.3	51.7	17.3	0.34	0.17	23.6	0.8
69	35.82	74	27	0.28	80.3	51.5	17.0	0.32	0.16	22.7	0.7
70	35.83	74	28	0.28	81.2	51.3	17.2	0.33	0.17	23.6	0.7
71	35.84	74	26	0.28	79.5	51.3	17.0	0.33	0.17	22.2	0.7
72	35.86	74	27	0.29	81.8	51.6	17.0	0.33	0.17	23.3	0.7
73	35.87	74	27	0.29	83.2	51.4	17.4	0.34	0.18	23.0	0.7
74	35.88	74	27	0.29	81.4	51.4	17.0	0.33	0.17	23.2	0.8
75	35.90	74	27	0.28	81.0	51.6	17.1	0.34	0.17	22.7	0.7
76	35.91	74	28	0.29	82.5	51.4	17.4	0.33	0.16	23.5	0.7
77	35.92	74	28	0.29	81.5	51.6	16.9	0.33	0.17	23.3	0.7
78	35.94	74	27	0.28	78.5	51.4	16.8	0.32	0.16	22.6	0.7
79	35.95	74	27	0.29	82.1	51.1	17.1	0.33	0.17	23.1	0.8
80	35.96	74	27	0.29	83.0	51.5	17.4	0.33	0.16	22.9	0.7
81	35.98	74	28	0.29	82.1	51.7	17.0	0.32	0.17	23.6	0.8
82	35.99	74	28	0.29	82.5	51.6	17.4	0.34	0.16	23.8	0.7
83	36.01	74	28	0.29	81.8	51.4	17.2	0.34	0.17	23.6	0.7
84	36.02	74	28	0.29	81.7	51.4	17.1	0.33	0.17	23.6	0.7
85	36.03	74	27	0.28	79.6	51.7	17.0	0.33	0.17	22.8	0.8
86	36.05	74	27	0.28	79.1	51.5	17.1	0.33	0.17	22.7	0.7
87	36.06	74	26	0.28	79.8	51.5	17.1	0.32	0.16	22.3	0.7
88	36.07	74	28	0.29	82.5	51.5	17.3	0.33	0.16	23.9	0.7
89	36.09	74	27	0.28	80.7	51.5	17.1	0.34	0.17	22.6	0.7
90	36.10	74	27	0.28	80.5	51.5	17.1	0.32	0.16	22.7	0.7
		Average	27	0.28	79.9	51.5	16.8	0.36	0.20	22.8	0.7
		Std. Dev.	1	0.01	2.1	0.2	0.3	0.03	0.07	0.5	0.0
		Maximum	28	0.30	84.2	51.9	17.4	0.44	0.37	24.1	0.8
		@ Blow#	47	50	50	1	82	1	1	47	2

Total number of blows analyzed: 90

BL#	depth (ft)	Comments
1	34.63	Penetration is approximate distance below ground surface.
2	34.66	Blows recorded were 17, 36, and 37 (N-Value = 73).

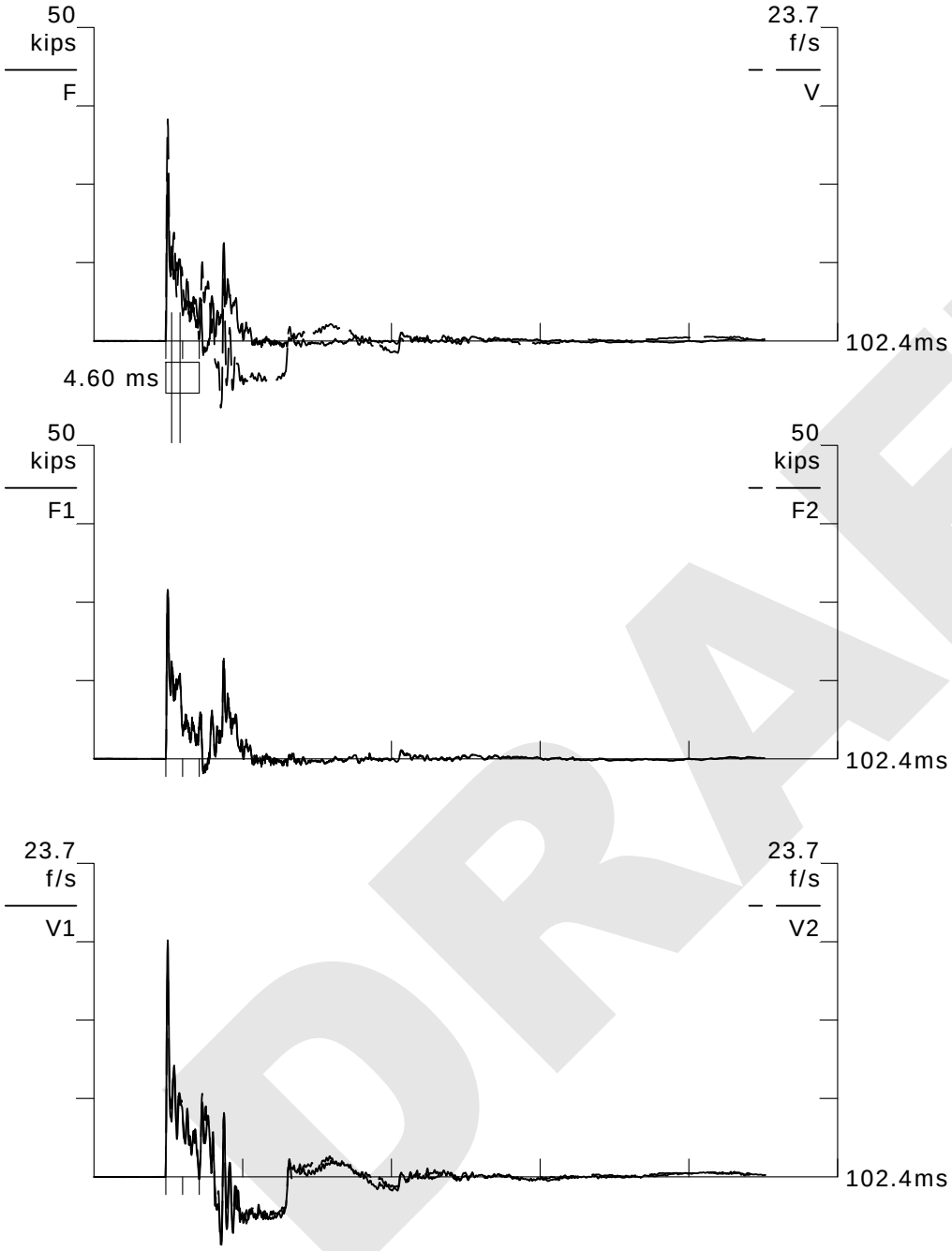
Time Summary

Drive	1 minute 43 seconds	11:44:20 AM - 11:46:03 AM (8/21/2013) BN 1 - 90

Applied Foundation Testing, Inc.

213060 NC
PDA OP: AFT

PILE DRIVING ANALYZER ®
Version 2012.114
CME 45C 300404-INC-2
AWJ ROD



BN 44
8/21/2013 11:45:09 AM

FMX	26	kips
EFV	0.27	k-ft
ETR	78.4	(%)
BPM	51.6	bpm
VMX	16.8	f/s
DMX	0.34	in
DFN	0.17	in
CSX	22.3	ksi
FVP	0.7	[]
LE	38.60	ft
AR	1.18	in^2
EM	30000	ksi
SP	0.492	k/ft3
WS	16807.9	f/s
EA/C	2.1	ksec/ft
LP	35.48	ft

F34 A34

F3: [264-AWJ-1] 210.82 (1)
F4: [264-AWJ-2] 211.56 (1)
A3: [K3397] 275 mv/5000g's (1)
A4: [K3449] 395 mv/5000g's (1)

Appendix D

Increment 3 PDIPLOT Data and Representative Blow Data

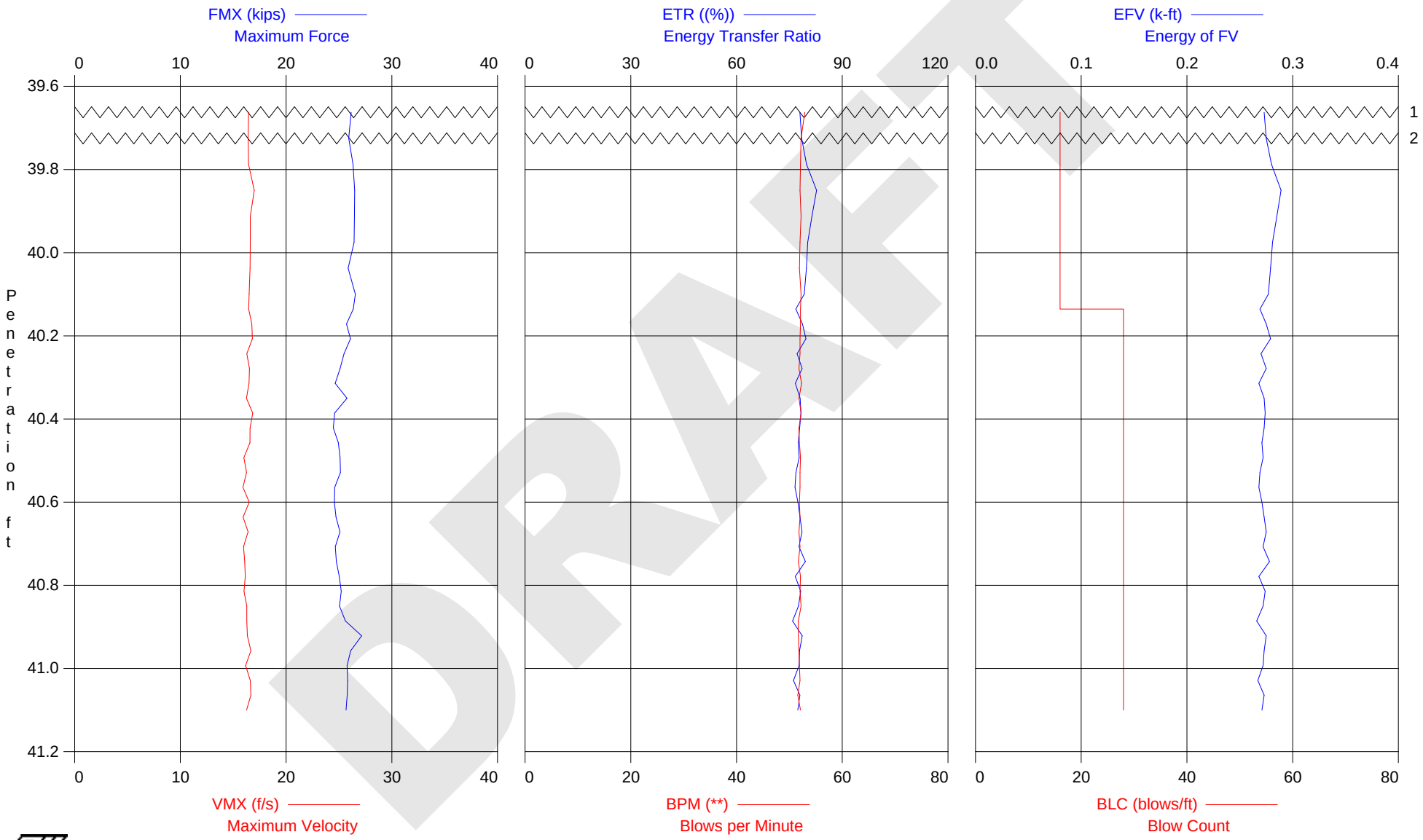
NCDOT
SPT Calibration
CME Rig, Model 45C
Serial No. 300404

Applied Foundation Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 22-Aug-2013

Test date: 21-Aug-2013

213060 NC - CME 45C 300404-INC-3



1 - Penetration is approximate distance below ground surface.

2 - Blows recorded were 8, 14, and 14 (N-Value = 28).

213060 NC - CME 45C 300404-INC-3
OP: AFT

AWJ ROD
Test date: 21-Aug-2013

AR: 1.18 in^2
LE: 43.60 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.60

FMX: Maximum Force
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute
VMX: Maximum Velocity

DMX: Maximum Displacement
DFN: Final Displacement
CSX: Max Measured Compr. Stress
FVP: Force/Velocity proportionality

BL#	depth	BLC	FMX	EFV	ETR	BPM	VMX	DMX	DFN	CSX	FVP
	ft	bl/ft	kips	k-ft	(%)	**	f/s	in	in	ksi	[]
1	39.66	16	26	0.27	78.0	52.9	16.4	0.76	0.76	22.2	0.8
2	39.73	16	26	0.28	78.5	52.2	16.4	0.77	0.77	22.0	0.7
3	39.79	16	26	0.28	79.9	52.1	16.5	0.78	0.78	22.3	0.7
4	39.85	16	26	0.29	82.7	52.0	17.0	0.78	0.78	22.4	0.7
5	39.91	16	26	0.29	81.4	52.2	16.6	0.77	0.77	22.4	0.7
6	39.98	16	26	0.28	80.2	52.0	16.6	0.77	0.77	22.4	0.7
7	40.04	16	26	0.28	79.8	51.9	16.6	0.77	0.77	21.9	0.7
8	40.10	16	27	0.28	79.2	52.2	16.5	0.78	0.78	22.5	0.7
9	40.14	28	26	0.27	76.8	52.1	16.5	0.53	0.45	22.3	0.7
10	40.17	28	26	0.28	78.7	52.1	16.8	0.52	0.47	21.8	0.7
11	40.21	28	26	0.28	79.7	52.0	16.8	0.55	0.46	22.1	0.7
12	40.24	28	25	0.27	77.2	52.0	16.3	0.52	0.46	21.6	0.7
13	40.28	28	25	0.28	78.6	51.8	16.5	0.55	0.47	21.3	0.7
14	40.31	28	25	0.27	76.7	52.3	16.5	0.54	0.46	20.9	0.7
15	40.35	28	26	0.27	78.0	51.8	16.3	0.53	0.46	21.8	0.7
16	40.39	28	25	0.27	78.3	52.2	16.9	0.54	0.46	20.8	0.7
17	40.42	28	24	0.27	77.9	51.8	16.6	0.54	0.46	20.7	0.7
18	40.46	28	25	0.27	77.5	51.9	16.6	0.54	0.45	21.1	0.7
19	40.49	28	25	0.27	77.8	52.1	16.0	0.53	0.46	21.3	0.7
20	40.53	28	25	0.27	76.9	52.0	16.3	0.53	0.46	21.3	0.7
21	40.56	28	25	0.27	76.6	52.0	15.9	0.54	0.47	20.8	0.7
22	40.60	28	25	0.27	77.4	51.9	16.5	0.53	0.47	20.8	0.7
23	40.64	28	25	0.27	78.0	52.0	15.9	0.53	0.46	20.9	0.7
24	40.67	28	25	0.28	78.6	51.8	16.4	0.53	0.47	21.3	0.7
25	40.71	28	25	0.27	77.7	52.0	16.0	0.52	0.46	20.9	0.7
26	40.74	28	25	0.28	79.6	51.7	16.1	0.52	0.46	21.0	0.7
27	40.78	28	25	0.27	76.7	52.1	16.1	0.49	0.46	21.2	0.7
28	40.81	28	25	0.27	78.2	52.0	16.0	0.52	0.45	21.4	0.7
29	40.85	28	25	0.27	77.6	52.2	16.3	0.52	0.47	21.2	0.7
30	40.89	28	26	0.27	75.9	51.7	16.3	0.48	0.45	21.7	0.7
31	40.92	28	27	0.28	78.6	51.7	16.3	0.48	0.45	23.0	0.8
32	40.96	28	26	0.27	77.9	51.8	16.7	0.50	0.46	22.1	0.7
33	40.99	28	26	0.27	77.7	51.9	16.2	0.51	0.46	21.8	0.7
34	41.03	28	26	0.27	76.2	52.0	16.6	0.45	0.44	21.9	0.7
35	41.06	28	26	0.27	78.0	51.6	16.7	0.47	0.46	21.8	0.7
36	41.10	28	26	0.27	77.4	52.1	16.3	0.48	0.46	21.8	0.8
	Average		26	0.27	78.2	52.0	16.4	0.57	0.53	21.6	0.7
	Std. Dev.		1	0.00	1.4	0.2	0.3	0.11	0.13	0.6	0.0
	Maximum		27	0.29	82.7	52.9	17.0	0.78	0.78	23.0	0.8
	@ Blow#		31	4	4	1	4	4	4	31	1

Total number of blows analyzed: 36

BL#	depth (ft)	Comments
1	39.66	Penetration is approximate distance below ground surface.
2	39.73	Blows recorded were 8, 14, and 14 (N-Value = 28).

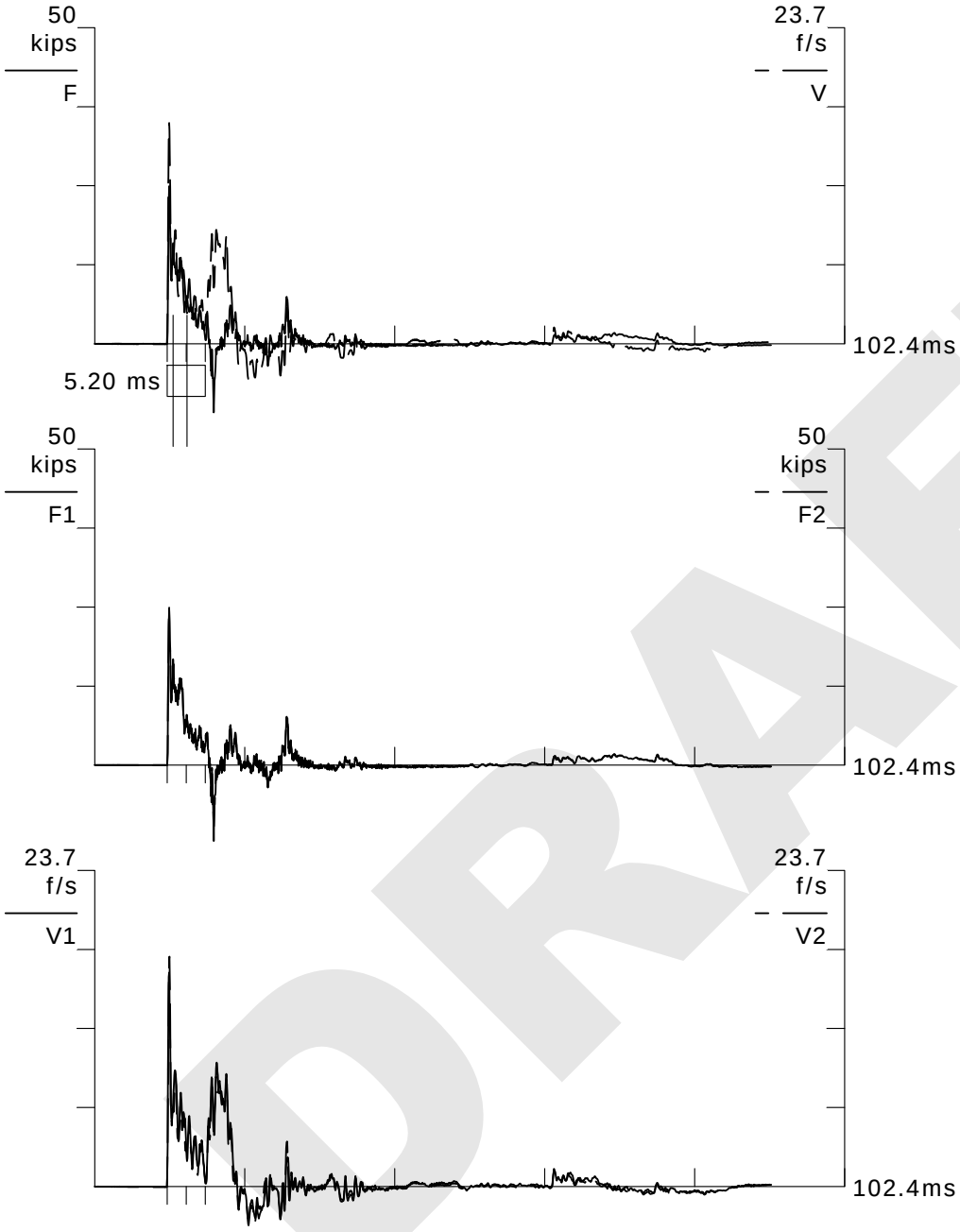
Time Summary

Drive 41 seconds 12:24:14 PM - 12:24:55 PM (8/21/2013) BN 1 - 36

Applied Foundation Testing, Inc.

213060 NC
PDA OP: AFT

PILE DRIVING ANALYZER ®
Version 2012.114
CME 45C 300404-INC-3
AWJ ROD



BN 18
8/21/2013 12:24:33 PM

FMX	25 kips
EFV	0.27 k-ft
ETR	77.5 (%)
BPM	51.9 bpm
VMX	16.6 f/s
DMX	0.54 in
DFN	0.45 in
CSX	21.1 ksi
FVP	0.7 []
LE	43.60 ft
AR	1.18 in^2
EM	30000 ksi
SP	0.492 k/ft3
WS	16807.9 f/s
EA/C	2.1 ksec/ft
LP	40.46 ft

F34 A34

F3: [264-AWJ-1] 210.82 (1)
F4: [264-AWJ-2] 211.56 (1)
A3: [K3397] 275 mv/5000g's (1)
A4: [K3449] 395 mv/5000g's (1)

Appendix E

Increment 4 PDIPLOT Data and Representative Blow Data

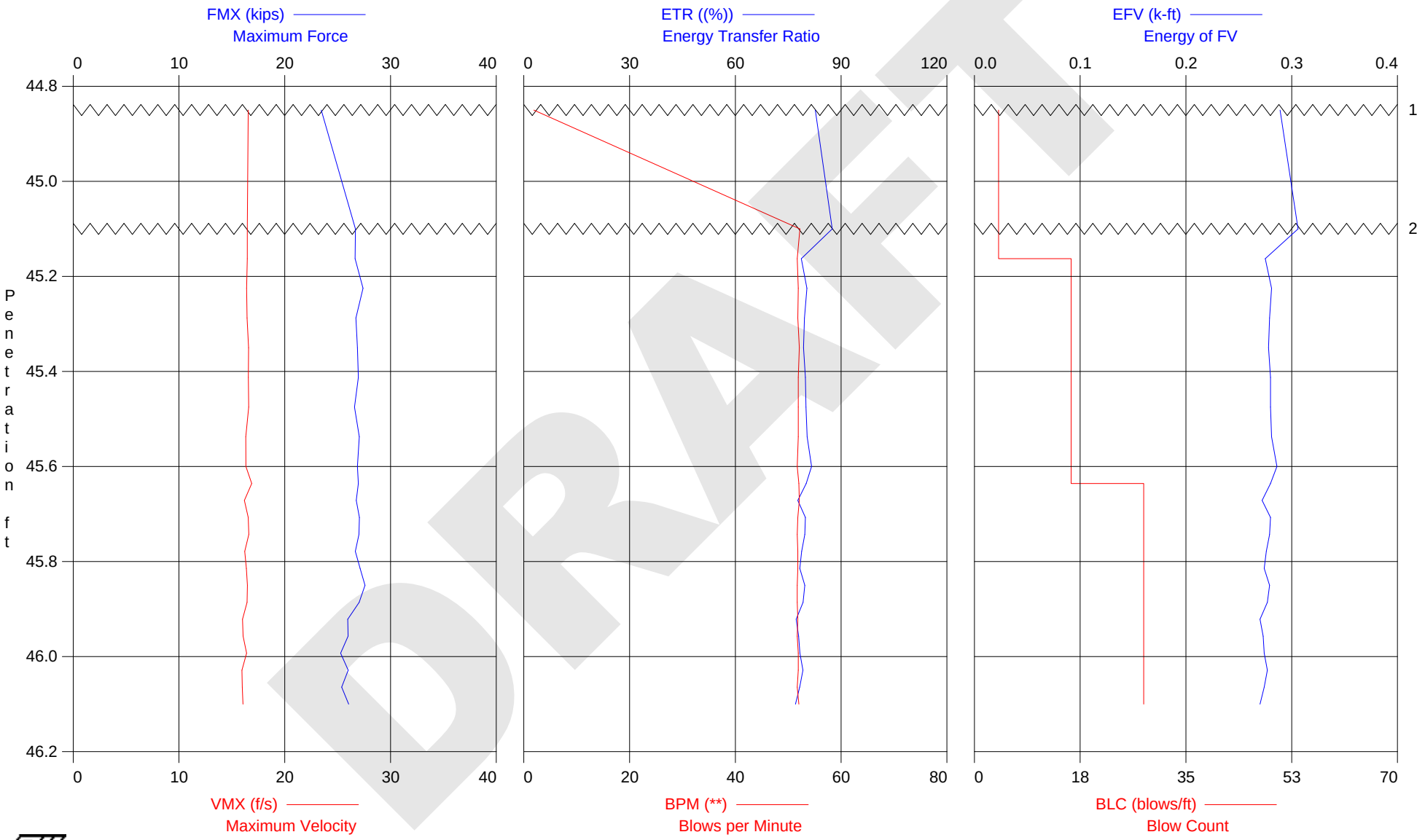
NCDOT
SPT Calibration
CME Rig, Model 45C
Serial No. 300404

Applied Foundation Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 22-Aug-2013

Test date: 21-Aug-2013

213060 NC - CME 45C 300404-INC-4



1 - Penetration is approximate distance below ground surface.

2 - Blows recorded were 2, 8, and 14 (N-Value = 22).

213060 NC - CME 45C 300404-INC-4
OP: AFT

AWJ ROD
Test date: 21-Aug-2013

AR: 1.18 in^2
LE: 48.60 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.60

FMX: Maximum Force
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute
VMX: Maximum Velocity

DMX: Maximum Displacement
DFN: Final Displacement
CSX: Max Measured Compr. Stress
FVP: Force/Velocity proportionality

BL#	depth	BLC	FMX	EFV	ETR	BPM	VMX	DMX	DFN	CSX	FVP
	ft	bl/ft	kips	k-ft	(%)	**	f/s	in	in	ksi	[]
1	44.85	4	23	0.29	82.7	1.9	16.5	3.01	3.01	19.9	0.7
2	45.10	4	27	0.31	87.5	52.2	16.5	3.06	3.06	22.6	0.8
3	45.16	16	27	0.28	78.7	51.7	16.5	0.86	0.80	22.6	0.8
4	45.23	16	27	0.28	80.3	51.9	16.4	0.87	0.83	23.2	0.8
5	45.29	16	27	0.28	79.6	51.8	16.4	0.85	0.82	22.6	0.8
6	45.35	16	27	0.28	79.3	52.1	16.6	0.88	0.85	22.8	0.8
7	45.41	16	27	0.28	79.9	51.9	16.6	0.86	0.83	22.8	0.8
8	45.48	16	27	0.28	80.1	51.9	16.6	0.84	0.82	22.5	0.8
9	45.54	16	27	0.28	80.4	51.9	16.3	0.84	0.82	22.9	0.8
10	45.60	16	27	0.29	81.6	51.7	16.3	0.80	0.79	22.8	0.8
11	45.64	28	27	0.28	80.1	52.0	16.9	0.58	0.46	22.8	0.8
12	45.67	28	27	0.27	77.7	52.1	16.2	0.56	0.47	22.7	0.8
13	45.71	28	27	0.28	79.9	51.8	16.5	0.57	0.47	22.9	0.8
14	45.74	28	27	0.28	79.7	51.7	16.6	0.57	0.47	22.9	0.8
15	45.78	28	27	0.28	78.8	51.8	16.2	0.56	0.49	22.6	0.8
16	45.81	28	27	0.27	78.3	51.8	16.4	0.53	0.48	23.0	0.8
17	45.85	28	28	0.28	79.7	51.7	16.5	0.57	0.49	23.4	0.8
18	45.89	28	27	0.28	79.2	51.7	16.4	0.54	0.47	22.9	0.8
19	45.92	28	26	0.27	77.3	51.8	16.0	0.53	0.44	22.0	0.8
20	45.96	28	26	0.27	78.0	51.7	16.1	0.54	0.46	22.0	0.8
21	45.99	28	25	0.27	78.3	51.9	16.4	0.52	0.46	21.4	0.7
22	46.03	28	26	0.28	79.2	51.9	16.0	0.53	0.45	22.0	0.8
23	46.06	28	25	0.27	78.2	51.7	16.0	0.51	0.45	21.5	0.8
24	46.10	28	26	0.27	77.0	52.0	16.1	0.48	0.46	22.1	0.8
		Average	27	0.28	79.6	49.8	16.4	0.85	0.80	22.5	0.8
		Std. Dev.	1	0.01	2.1	10.0	0.2	0.67	0.69	0.7	0.0
		Maximum	28	0.31	87.5	52.2	16.9	3.06	3.06	23.4	0.8
		@ Blow#	17	2	2	2	11	2	2	17	17

Total number of blows analyzed: 24

BL#	depth (ft)	Comments
1	44.85	Penetration is approximate distance below ground surface.
2	45.10	Blows recorded were 2, 8, and 14 (N-Value = 22).

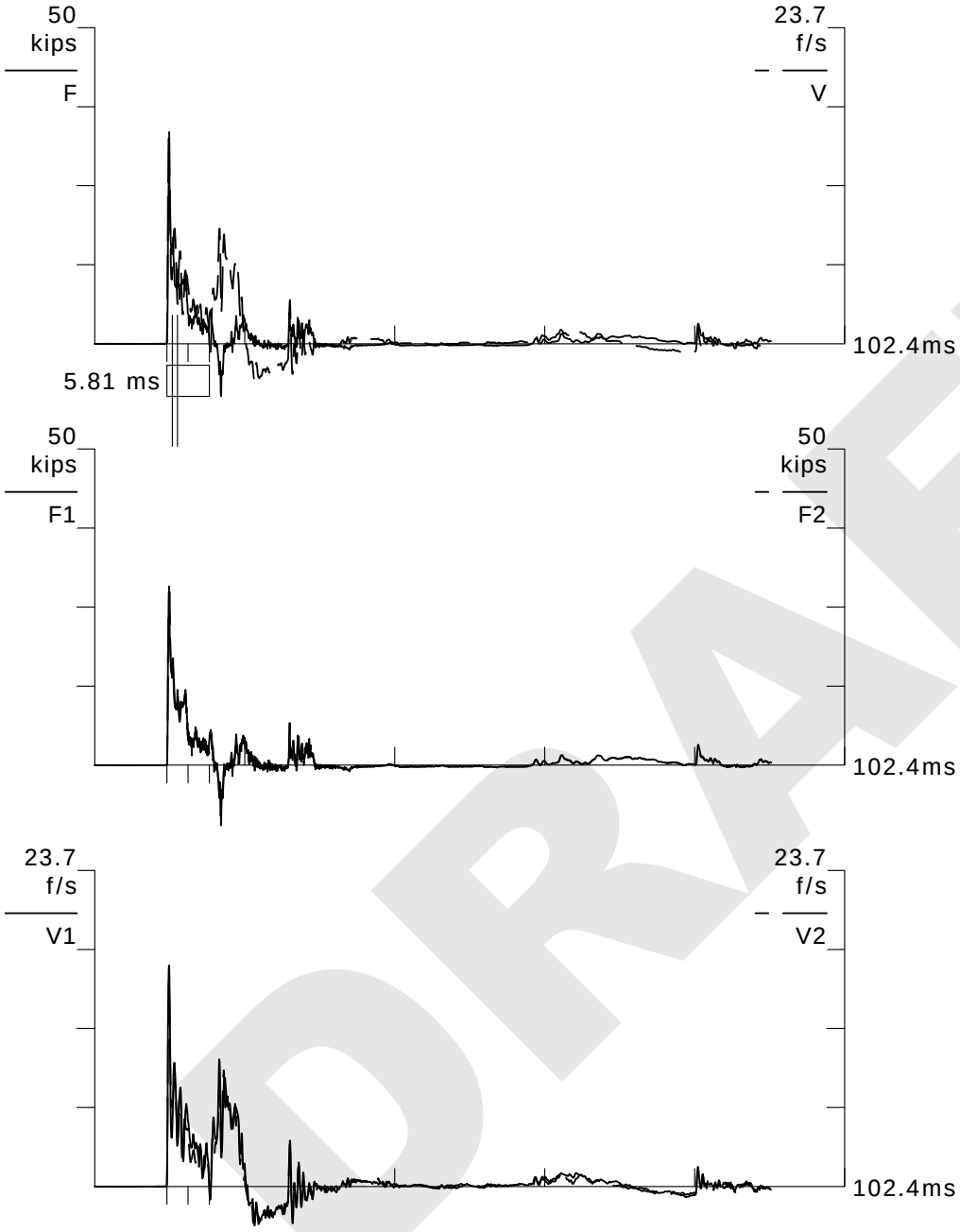
Time Summary

Drive 26 seconds 12:41:39 PM - 12:42:05 PM (8/21/2013) BN 1 - 24

Applied Foundation Testing, Inc.

213060 NC
PDA OP: AFT

PILE DRIVING ANALYZER ®
Version 2012.114
CME 45C 300404-INC-4
AWJ ROD



BN 15
8/21/2013 12:41:54 PM
FMX 27 kips
EFV 0.28 k-ft
ETR 78.8 (%)
BPM 51.8 bpm
VMX 16.2 f/s
DMX 0.56 in
DFN 0.49 in
CSX 22.6 ksi
FVP 0.8 []

LE 48.60 ft
AR 1.18 in^2
EM 30000 ksi
SP 0.492 k/ft3
WS 16807.9 f/s
EA/C 2.1 ksec/ft
LP 45.78 ft

F34 A34

F3: [264-AWJ-1] 210.82 (1)
F4: [264-AWJ-2] 211.56 (1)
A3: [K3397] 275 mv/5000g's (1)
A4: [K3449] 395 mv/5000g's (1)

Appendix F

Increment 5 PDIPLOT Data and Representative Blow Data

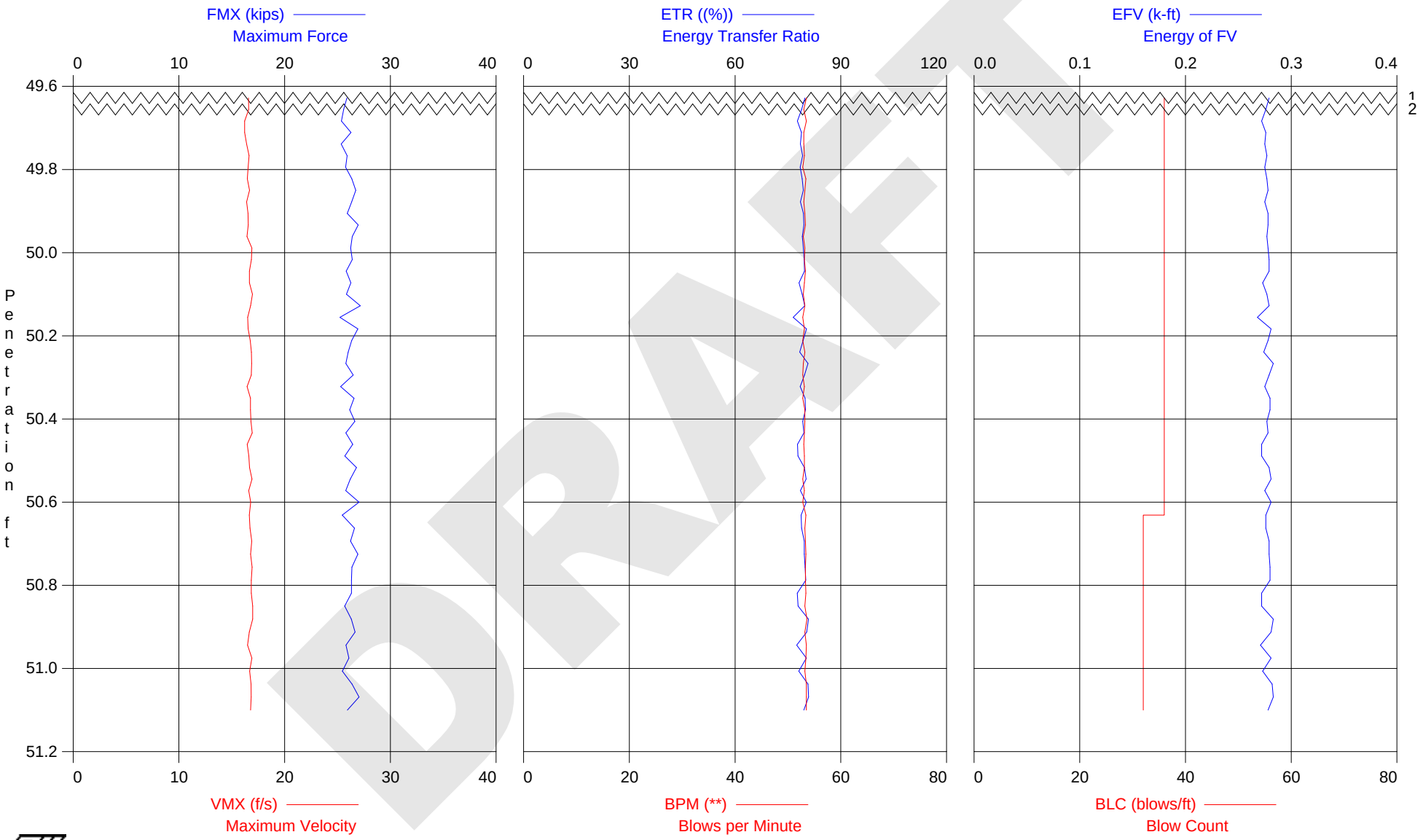
NCDOT
SPT Calibration
CME Rig, Model 45C
Serial No. 300404

Applied Foundation Testing, Inc. - Case Method & iCAP® Results

PDIPLOT Ver. 2012.2 - Printed: 22-Aug-2013

Test date: 21-Aug-2013

213060 NC - CME 45C 300404-INC-5



1 - Penetration is approximate distance below ground surface.

2 - Blows recorded were 18, 18, and 16 (N-Value = 34).

213060 NC - CME 45C 300404-INC-5
OP: AFT

AWJ ROD
Test date: 21-Aug-2013

AR: 1.18 in^2
LE: 53.60 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.60

FMX: Maximum Force
EFV: Energy of FV
ETR: Energy Transfer Ratio
BPM: Blows per Minute
VMX: Maximum Velocity

DMX: Maximum Displacement
DFN: Final Displacement
CSX: Max Measured Compr. Stress
FVP: Force/Velocity proportionality

BL#	depth	BLC	FMX	EFV	ETR	BPM	VMX	DMX	DFN	CSX	FVP
	ft	bl/ft	kips	k-ft	(%)	**	f/s	in	in	ksi	[]
1	49.63	36	26	0.28	79.8	53.5	16.6	0.60	0.36	21.9	0.7
2	49.66	36	26	0.28	78.9	53.0	16.6	0.52	0.33	21.7	0.7
3	49.68	36	25	0.27	77.7	53.5	16.2	0.51	0.35	21.5	0.7
4	49.71	36	26	0.28	78.8	53.0	16.2	0.49	0.35	22.3	0.7
5	49.74	36	25	0.28	78.5	53.0	16.4	0.49	0.36	21.5	0.7
6	49.77	36	26	0.28	79.2	53.1	16.6	0.49	0.33	22.0	0.7
7	49.79	36	26	0.28	78.5	52.8	16.5	0.46	0.34	21.8	0.7
8	49.82	36	26	0.28	79.0	53.4	16.5	0.46	0.34	22.3	0.7
9	49.85	36	27	0.28	79.4	53.2	16.7	0.48	0.31	22.6	0.8
10	49.88	36	26	0.28	78.6	53.0	16.4	0.45	0.37	22.3	0.7
11	49.91	36	26	0.28	79.4	53.2	16.5	0.45	0.34	22.0	0.7
12	49.93	36	27	0.28	79.6	53.3	16.6	0.48	0.36	22.8	0.8
13	49.96	36	26	0.28	79.1	52.9	16.4	0.45	0.33	22.4	0.8
14	49.99	36	26	0.28	79.4	53.2	16.9	0.45	0.34	22.2	0.7
15	50.02	36	26	0.28	79.6	53.1	16.9	0.44	0.34	22.4	0.7
16	50.04	36	26	0.28	79.7	53.3	16.7	0.45	0.34	21.9	0.7
17	50.07	36	26	0.27	78.1	53.1	16.7	0.43	0.34	22.3	0.7
18	50.10	36	26	0.28	79.1	52.9	17.0	0.45	0.34	21.9	0.7
19	50.13	36	27	0.28	79.8	53.2	16.8	0.45	0.36	23.0	0.8
20	50.16	36	25	0.27	76.5	52.8	16.5	0.44	0.34	21.4	0.7
21	50.18	36	27	0.28	80.3	53.1	16.5	0.48	0.36	22.8	0.8
22	50.21	36	26	0.28	79.3	52.8	16.7	0.45	0.34	22.3	0.7
23	50.24	36	26	0.27	78.3	53.2	16.9	0.45	0.34	22.0	0.7
24	50.27	36	26	0.28	80.7	52.9	16.9	0.47	0.35	21.9	0.7
25	50.29	36	26	0.28	79.7	52.8	16.8	0.46	0.35	22.4	0.7
26	50.32	36	25	0.28	78.5	53.1	16.5	0.45	0.34	21.4	0.7
27	50.35	36	27	0.28	79.9	52.8	16.8	0.46	0.34	22.5	0.8
28	50.38	36	26	0.28	80.0	53.2	16.8	0.46	0.34	22.2	0.7
29	50.41	36	27	0.28	79.2	53.2	16.8	0.46	0.34	22.6	0.7
30	50.43	36	26	0.28	79.5	53.1	16.9	0.47	0.34	21.9	0.7
31	50.46	36	26	0.27	77.7	53.0	16.5	0.45	0.34	22.4	0.8
32	50.49	36	26	0.27	77.8	53.1	16.6	0.45	0.34	21.8	0.7
33	50.52	36	27	0.28	79.7	53.1	16.7	0.47	0.34	22.7	0.8
34	50.54	36	26	0.28	80.2	52.8	16.9	0.48	0.34	22.2	0.7
35	50.57	36	26	0.28	78.5	53.1	16.6	0.48	0.36	21.9	0.7
36	50.60	36	27	0.28	80.2	52.8	16.8	0.48	0.35	22.9	0.8
37	50.63	32	25	0.28	78.8	53.4	16.7	0.48	0.39	21.6	0.7
38	50.66	32	27	0.28	78.9	53.2	16.7	0.48	0.38	22.6	0.8
39	50.69	32	26	0.28	79.6	53.3	16.9	0.52	0.40	22.2	0.7
40	50.73	32	27	0.28	79.6	53.4	16.8	0.48	0.39	22.8	0.8
41	50.76	32	26	0.28	79.9	53.3	16.9	0.49	0.39	22.3	0.7
42	50.79	32	26	0.28	80.1	53.3	16.9	0.50	0.40	22.3	0.7
43	50.82	32	26	0.27	77.7	53.4	16.8	0.46	0.39	22.3	0.7
44	50.85	32	26	0.27	77.9	53.2	17.0	0.50	0.39	21.8	0.7
45	50.88	32	26	0.28	80.8	53.6	17.0	0.52	0.38	22.3	0.7
46	50.91	32	27	0.28	80.3	53.2	16.7	0.51	0.38	22.6	0.8
47	50.94	32	26	0.27	77.5	53.5	16.5	0.48	0.38	21.9	0.7
48	50.98	32	26	0.28	80.2	53.4	16.9	0.52	0.39	22.1	0.7
49	51.01	32	25	0.27	78.1	53.2	16.7	0.48	0.38	21.6	0.7
50	51.04	32	26	0.28	80.7	53.5	16.8	0.51	0.39	22.4	0.7
51	51.07	32	27	0.28	80.8	53.5	16.8	0.53	0.39	22.9	0.8
52	51.10	32	26	0.28	79.5	53.5	16.8	0.51	0.38	22.0	0.7
		Average	26	0.28	79.2	53.2	16.7	0.48	0.36	22.2	0.7
		Std. Dev.	0	0.00	0.9	0.2	0.2	0.03	0.02	0.4	0.0
		Maximum	27	0.28	80.8	53.6	17.0	0.60	0.40	23.0	0.8
		@ Blow#	19	24	51	45	45	1	39	19	21

Total number of blows analyzed: 52

BL#	depth (ft)	Comments
1	49.63	Penetration is approximate distance below ground surface.
2	49.66	Blows recorded were 18, 18, and 16 (N-Value = 34).

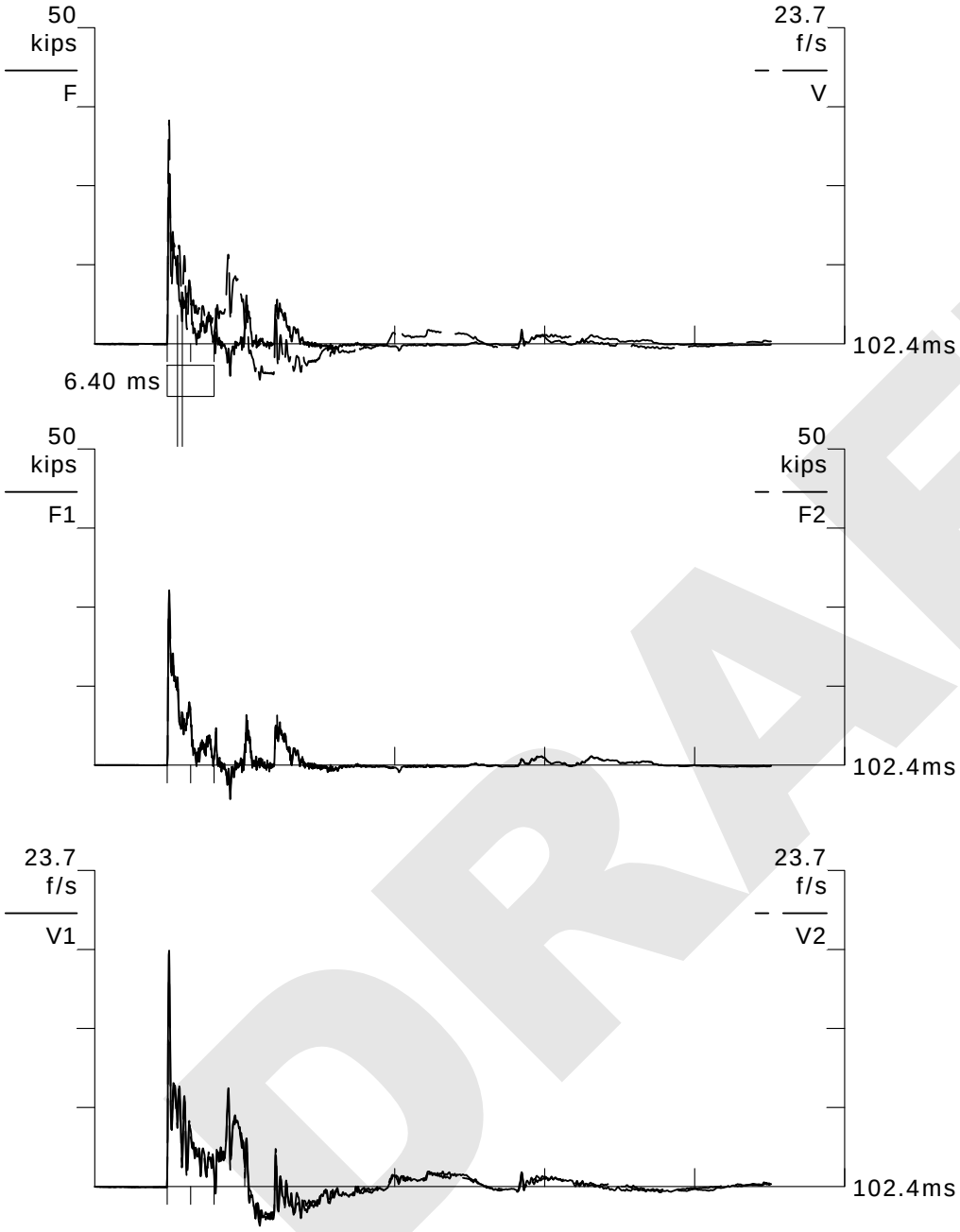
Time Summary

Drive 57 seconds 1:01:53 PM - 1:02:50 PM (8/21/2013) BN 1 - 52

Applied Foundation Testing, Inc.

213060 NC
PDA OP: AFT

PILE DRIVING ANALYZER ®
Version 2012.114
CME 45C 300404-INC-5
AWJ ROD



BN 40
8/21/2013 1:02:36 PM

FMX	27	kips
EFV	0.28	k-ft
ETR	79.6	(%)
BPM	53.4	bpm
VMX	16.8	f/s
DMX	0.48	in
DFN	0.39	in
CSX	22.8	ksi
FVP	0.8	[]
LE	53.60	ft
AR	1.18	in^2
EM	30000	ksi
SP	0.492	k/ft3
WS	16807.9	f/s
EA/C	2.1	ksec/ft
LP	50.73	ft

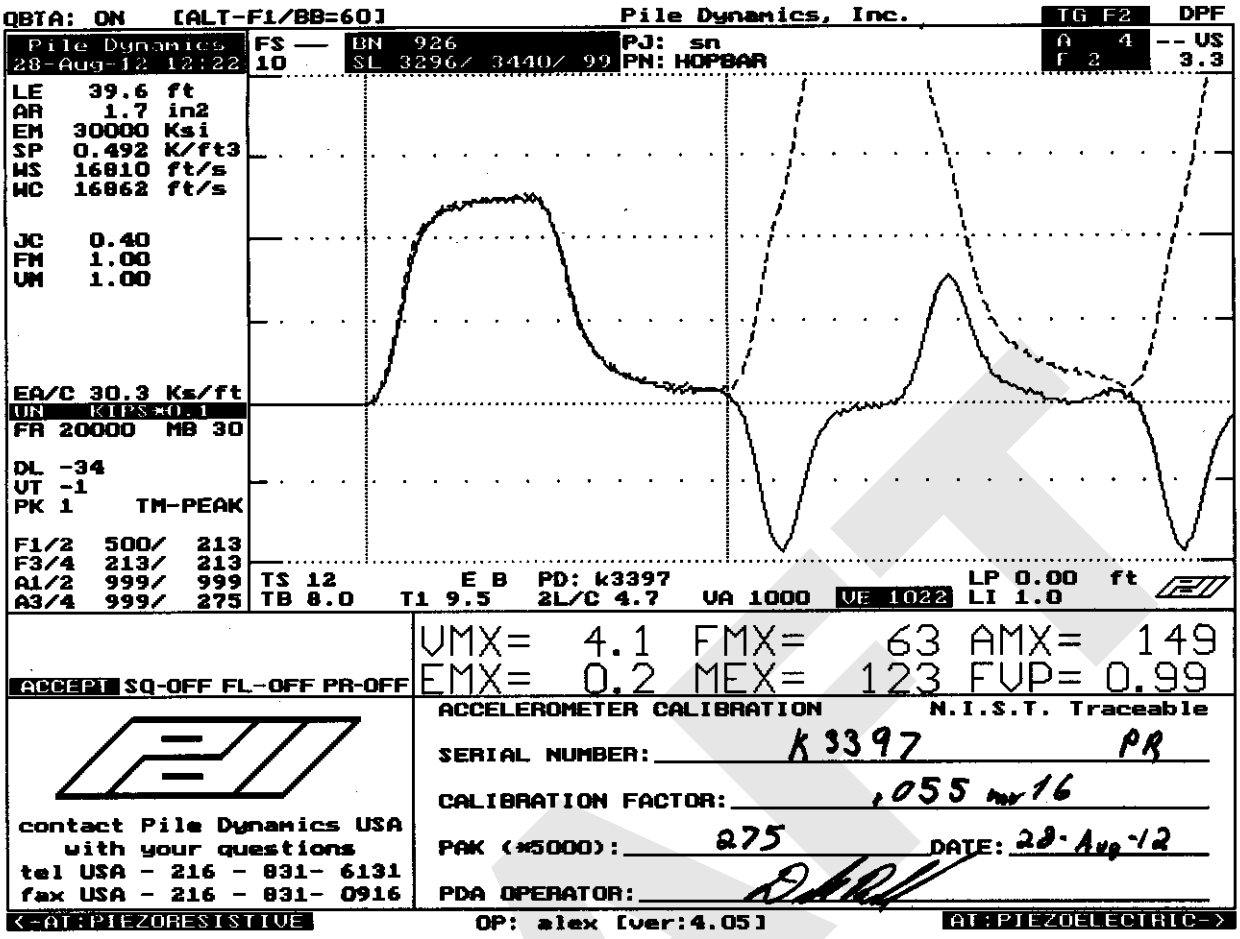
F34 A34

F3: [264-AWJ-1] 210.82 (1)
F4: [264-AWJ-2] 211.56 (1)
A3: [K3397] 275 mv/5000g's (1)
A4: [K3449] 395 mv/5000g's (1)

Appendix G

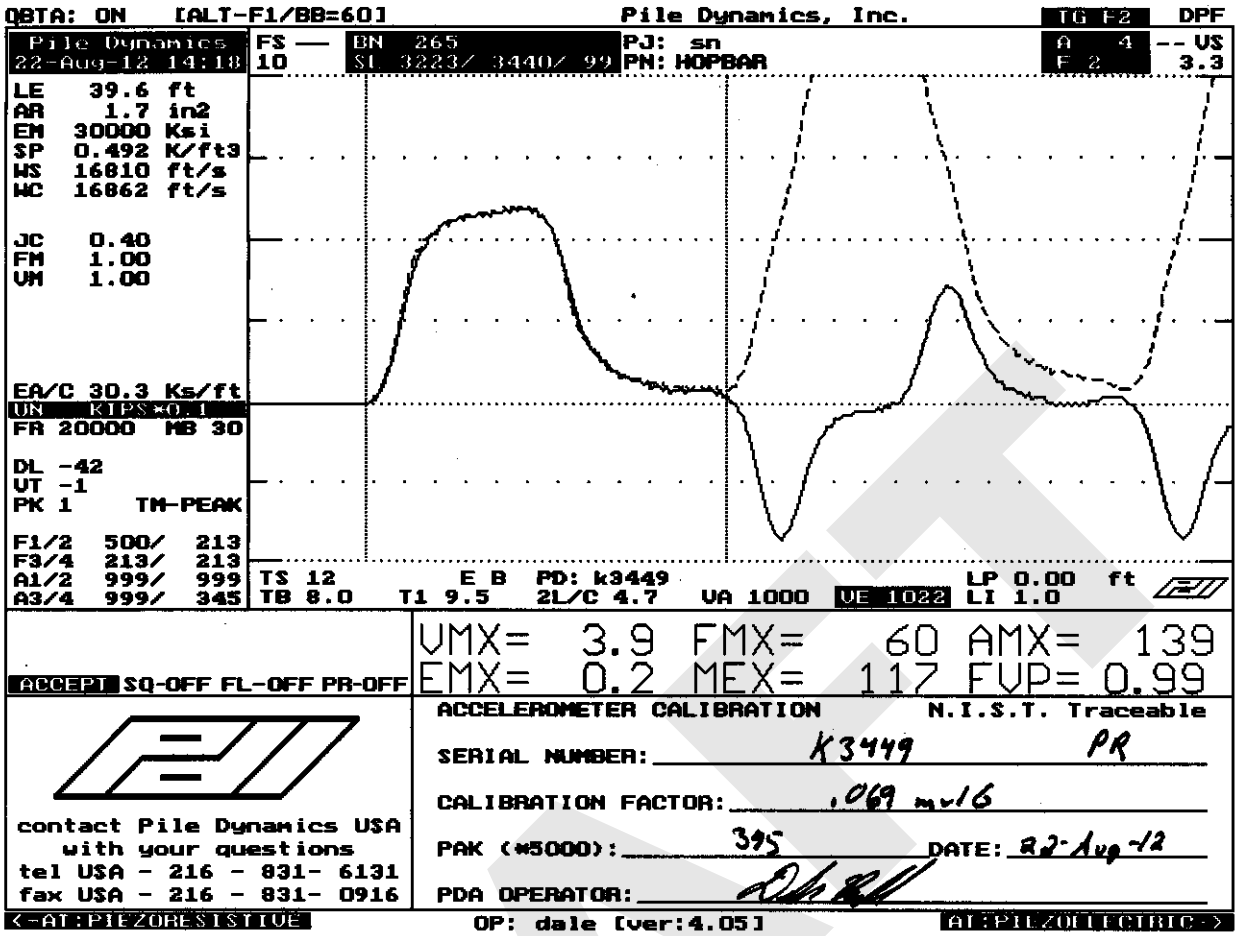
Gage Calibration Sheets

NCDOT
SPT Calibration
CME Rig, Model 45C
Serial No. 300404



Smart Sensor

Smart Chip Programmed By DB **on** 28-Aug-12 **CRC Value** 084F



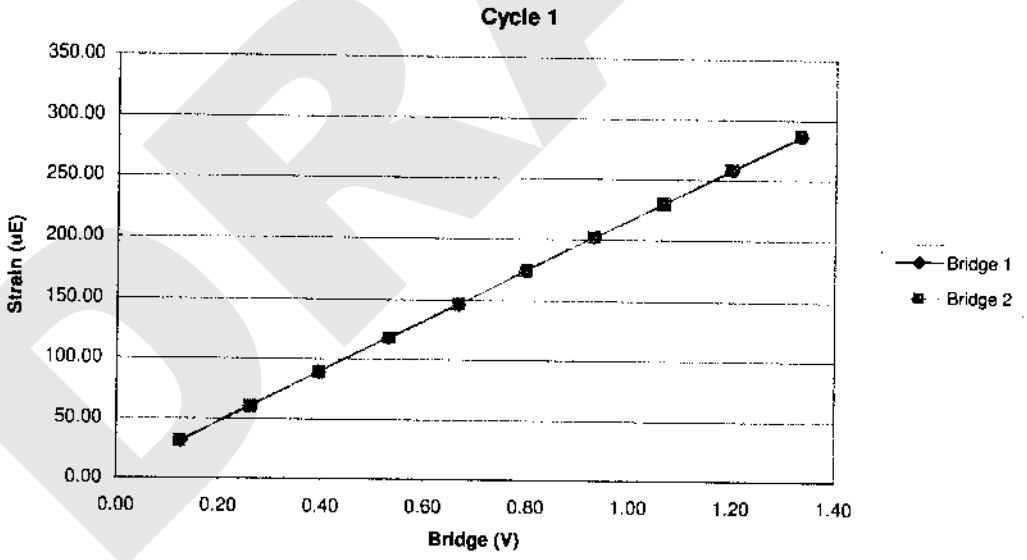
Smart Sensor

Smart Chip Programmed By DB **on** 23-Aug-12 **CRC Value** DE10

264AWJ		Cycle 1		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	955.37	31.71	0.13	0.12
3	1955.47	60.49	0.26	0.26
4	2950.34	88.80	0.39	0.40
5	3951.81	117.88	0.53	0.53
6	4973.09	146.56	0.67	0.67
7	5950.82	174.26	0.80	0.80
8	6948.25	202.20	0.93	0.93
9	7948.64	230.55	1.07	1.06
10	8952.87	258.70	1.20	1.20
11	9959.17	287.07	1.33	1.33

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7464.01**	**Force Calibration (lb/V)**	**7471.64**
Offset	0.71	Offset	-3.23
Correlation	0.999996	Correlation	0.999989
Strain Calibration (µE/V)	**211.52**	**Strain Calibration (µE/V)**	**211.74**
Offset	5.27	Offset	5.15
Correlation	0.999997	Correlation	0.999999

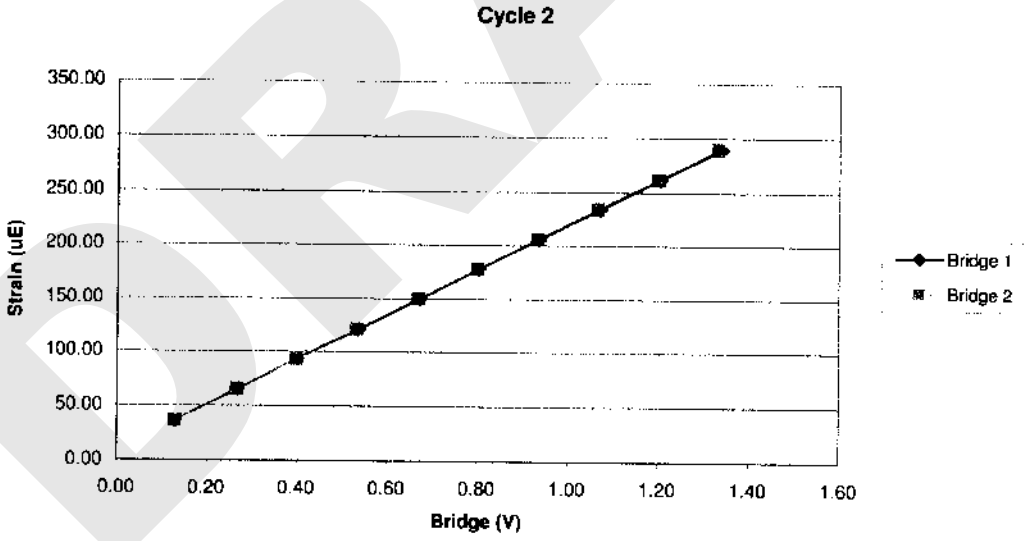
Force Strain Calibration	
EA (Klps)	**35287.57**
Offset	-185.09
Correlation	0.999990



264AWJ		Cycle 2		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	970.25	36.47	0.13	0.13
3	1976.45	65.35	0.27	0.27
4	2972.31	93.50	0.40	0.40
5	3971.42	121.77	0.54	0.53
6	4987.47	150.28	0.67	0.67
7	5975.44	178.01	0.80	0.80
8	6966.97	205.90	0.94	0.93
9	7971.89	234.13	1.07	1.07
10	8976.41	261.88	1.20	1.20
11	9970.79	289.79	1.34	1.33

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7465.70**	**Force Calibration (lb/V)**	**7501.87**
Offset	**-17.35**	Offset	**-23.39**
Correlation	**0.999994**	Correlation	**0.999996**
Strain Calibration (µE/V)	**209.93**	**Strain Calibration (µE/V)**	**210.95**
Offset	**9.30**	Offset	**9.13**
Correlation	**0.999996**	Correlation	**0.999998**

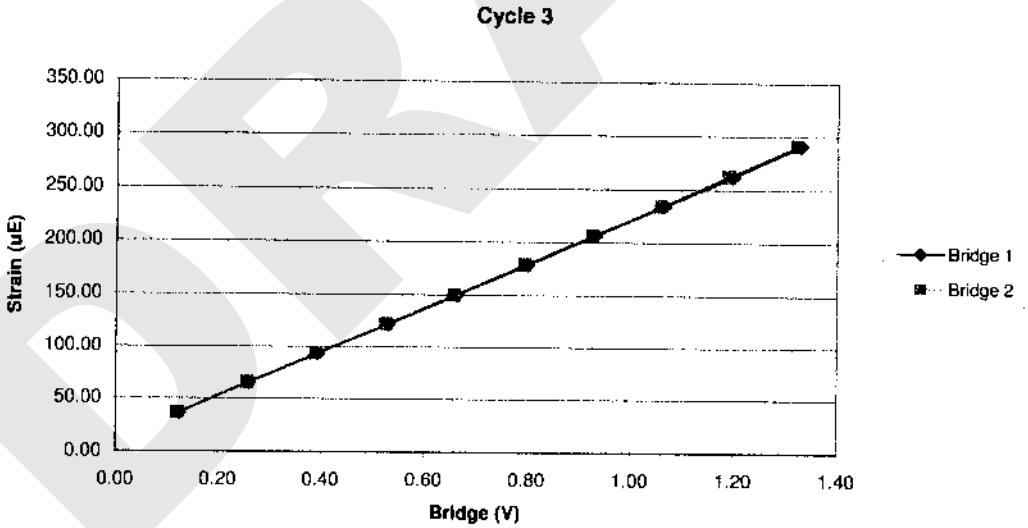
Force Strain Calibration	
EA (Klps)	**35562.82**
Offset	**-348.03**
Correlation	**0.999993**



264AWJ		Cycle 3		
Sample	**Force (lb)**	**Strain (µE)**	**Bridge 1 (V)**	**Bridge 2 (V)**
1	0.00	0.00	0.00	0.00
2	922.57	36.48	0.12	0.12
3	1939.71	65.41	0.26	0.26
4	2925.81	93.36	0.39	0.39
5	3932.90	122.14	0.53	0.53
6	4929.05	150.03	0.66	0.66
7	5944.91	178.73	0.80	0.79
8	6939.78	206.74	0.93	0.93
9	7933.67	234.97	1.06	1.06
10	8918.79	262.76	1.20	1.19
11	9919.08	291.13	1.33	1.32

Bridge 1		**Bridge 2**	
Force Calibration (lb/V)	**7460.83**	**Force Calibration (lb/V)**	**7495.57**
Offset	**-7.01**	Offset	**6.63**
Correlation	**0.999994**	Correlation	**0.999995**
Strain Calibration (µE/V)	**211.02**	**Strain Calibration (µE/V)**	**212.00**
Offset	**10.38**	Offset	**10.77**
Correlation	**0.999996**	Correlation	**0.999997**

Force Strain Calibration	
EA (Kips)	**35356.37**
Offset	**-374.08**
Correlation	**0.999999**



Bridge Excitation (V) 5
Shunt Resitor (ohm) 60.4k

Calibration Factors	264AWJ		
Bridge 1 (µE/V)	210.82	Bridge 2 (µE/V)	211.56
EA Factor (Kips)	35402.25	Area (in^2)	1.18

Calibrated by: _____
Calibrated Date: 1/18/2012

Pile Dynamics Inc
30725 Aurora Rd
Solon, OH 44139

Traceable to N.I.S.T.

2550 Irvin Cobb Drive
Paducah, KY 42003
Phone: 270.444.9691
Fax: 270.443.3943
www.icaeng.com

PSI Geotechnical Subsurface Data Report

GEOTECHNICAL SUBSURFACE DATA REPORT

FOR THE

PROPOSED BRIDGE REPLACEMENT
US 301 (FIVE CHOP ROAD) BRIDGE OVER
FOUR HOLE SWAMP
ORANGEBURG COUNTY, SOUTH CAROLINA

PREPARED FOR USE BY:

SCDOT
955 PARK STREET
COLUMBIA, SOUTH CAROLINA 29202

PREPARED BY

PROFESSIONAL SERVICE INDUSTRIES, INC.
534 SAINT ANDREWS ROAD
COLUMBIA, SOUTH CAROLINA 29210

PSI REPORT NO: 0451644

FEBRUARY 27, 2015

February 27, 2015

SCDOT
955 PARK STREET
COLUMBIA, SOUTH CAROLINA 29202

Attention: Sara Stone, PE

Renee Gardner, PE

SUBJECT: Geotechnical Subsurface Data Report
Proposed Bridge Replacement
US 301 (Five Chop Road) Bridge over Four Hole Swamp
Orangeburg County, South Carolina
PSI Report No. 0451644

Dear Ms. Sara Stone, PE and Ms. Renee Gardner, PE:

Professional Service Industries, Inc. (PSI) is pleased to submit this Geotechnical Subsurface Data Report for the proposed US 301 (Five Chop Road) Bridge Replacement Bridge over Four Hole Swamp in Orangeburg County, South Carolina. This report summarizes the work accomplished and provides our collected field and laboratory data for your design and construction purposes of the proposed replacement bridge structure.

PSI appreciates the opportunity to contribute our services for this project and looks forward to working with you during design and construction of this project, as appropriate. Please contact the undersigned directly if you have questions pertaining to this project.

Respectfully Submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Richard E. Finnen, Jr., P.E.
Principal Consultant

R. Thomas Cannarella, P.E.
Branch Manager

PROJECT DESCRIPTION AND SCOPE

This report presents the data of a subsurface exploration completed by Professional Service Industries, Inc. (PSI) for the proposed US 301 (Five Chop Road) Bridge Replacement over Four Hole Swamp, Orangeburg County, South Carolina. PSI understands that the existing bridge structure will be replaced with a new seven span bridge structure at the same general location. Based on the limited information provided, it is our understanding that previous geotechnical investigations/explorations have been completed by others. PSI has been provided with copies of three (3) soil test boring logs (B-3, B-5, RW-3) in which were performed by others for reference purposes only.

The objective of our work was to collect additional subsurface data at the bridge location to supplement the previous investigation and evaluations performed by others. More specifically, there were very loose SAND layers between 50 feet and 80 feet below ground surface that were observed in Soil Test Borings B-3 and B-5 (performed by others). In addition, there is a very soft lean CLAY layer between approximately 9 feet and 13 feet below ground surface that was observed in Soil Test Boring RW-3 (performed by others).

We explored the site by performing five (5) soil test borings (B-1A, B-3A, B-5A, B-6A, B-7A) to depths of as deep as approximately 120 feet below ground surface using mud rotary drilling techniques, two (2) soil test borings (RW-3A and RW-3B) up to approximately 16 feet below ground surface using hollow stem auger drilling techniques, and two (2) Dilatometer Test Soundings (DMT-1 and DMT-2) to approximately 15 feet below the ground surface. Soil Test Borings were performed using a truck-mounted CME-55 drill rig, except for RW-3A and RW-3B were performed using a truck-mounted CME-45D drill rig. The locations of the explorations are shown on the Boring Location Survey within the Appendix of this report.

All soil test boring locations were accessed by a truck mounted drill rig while one lane of US Route 301 was temporarily closed. PSI performed all field work between the dates of December 4, 2014 and January 29, 2015. Site and soil conditions have been documented in the photographs provided within the Appendix of this report. After the field work was completed, all soil test borings were surveyed by a Licensed Land Surveyor and shown on the attached Boring Location Survey within the Appendix of this Report providing locations and elevations.

Soil samples obtained during the field explorations were examined in our laboratory. The physical characteristics of the samples were noted and the field classifications were modified where necessary

in accordance with terminology presented the General Notes included in this appendix.

Representative samples were selected by SCDOT during the course of soil test boring log examination and requested for further laboratory testing. The laboratory program requested included determinations of Natural Moisture Content, Atterberg Limits, #200 Sieve Wash, Hydrometer Analysis, Organic Loss, Consolidation Test, Triaxial Compression Test, and Corrosion Series Tests. All Tests were performed in general accordance with the proper ASTM Standards and the SCDOT Geotechnical Design Manual.

Our services were conducted in general accordance with our work order number 40308 dated 11-14-2014 and the SCDOT Geotechnical Design Manual.

SITE DESCRIPTION

The bridge site is located where Route 301 crosses Four Hole Swamp (southbound) in Orangeburg County, South Carolina (approximate Latitude 38.4575, Longitude -80.6478), about 1.3 miles north of its intersection with Rt. 167, between mile marker 27.86 and 28.21. The existing bridge structure spans in an approximate east-west direction approximately 334 feet across Four Hole Swamp. The proposed bridge replacement is expected to be in the same general location and will consist of 7 spans and approximately 334 feet in length.

Elevation of the top of the existing roadway within the area of the subsurface explorations ranges between El 119.85 and El 120.26 feet, while the water level in Four Hole Swamp at the time of the drilling of the soil test borings was approximately El 110.15 feet. The mudline within Four Hole Swamp was also determined to have a range of approximately El 107.6 to El109.1 feet.

LIMITATIONS

This report has been prepared to aid the SCDOT design team in the design and construction of the US 301 (Five Chop Road) Bridge Replacement over Four Hole Swamp in Orangeburg County, South Carolina. The scope is limited to this specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the bridge structure and associated highway improvements. In the event that any changes in the design or location of the alignment or structure, as outlined in this report, are planned, we should be given the opportunity to review the changes and to modify or

reaffirm the conclusions and recommendations of this report in writing.

The field and laboratory data submitted in this report are based on the information obtained from the borings made at the locations indicated on the Boring Location Survey, and from other sources of information discussed in this report. In the performance of subsurface exploration, specific information is obtained at specific locations at specific times. However, it is acknowledged that variations in soil conditions may exist between boring locations. This report does not reflect any variations that may occur between these explorations. The nature and extent of variation may not become evident until construction. If, during construction, subsurface conditions different from those encountered in the explorations are observed or encountered, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.

APPENDIX A

BORING LOCATION SURVEY

SUBSURFACE DIAGRAM

SUBSURFACE FENCE DIAGRAM

FIELD EXPLORATION PROGRAM

SOIL TEST BORING LOGS

DILATOMETER TEST SOUNDING LOGS

LABORATORY TESTING PROGRAM

LAB DATA SUMMARY SHEETS

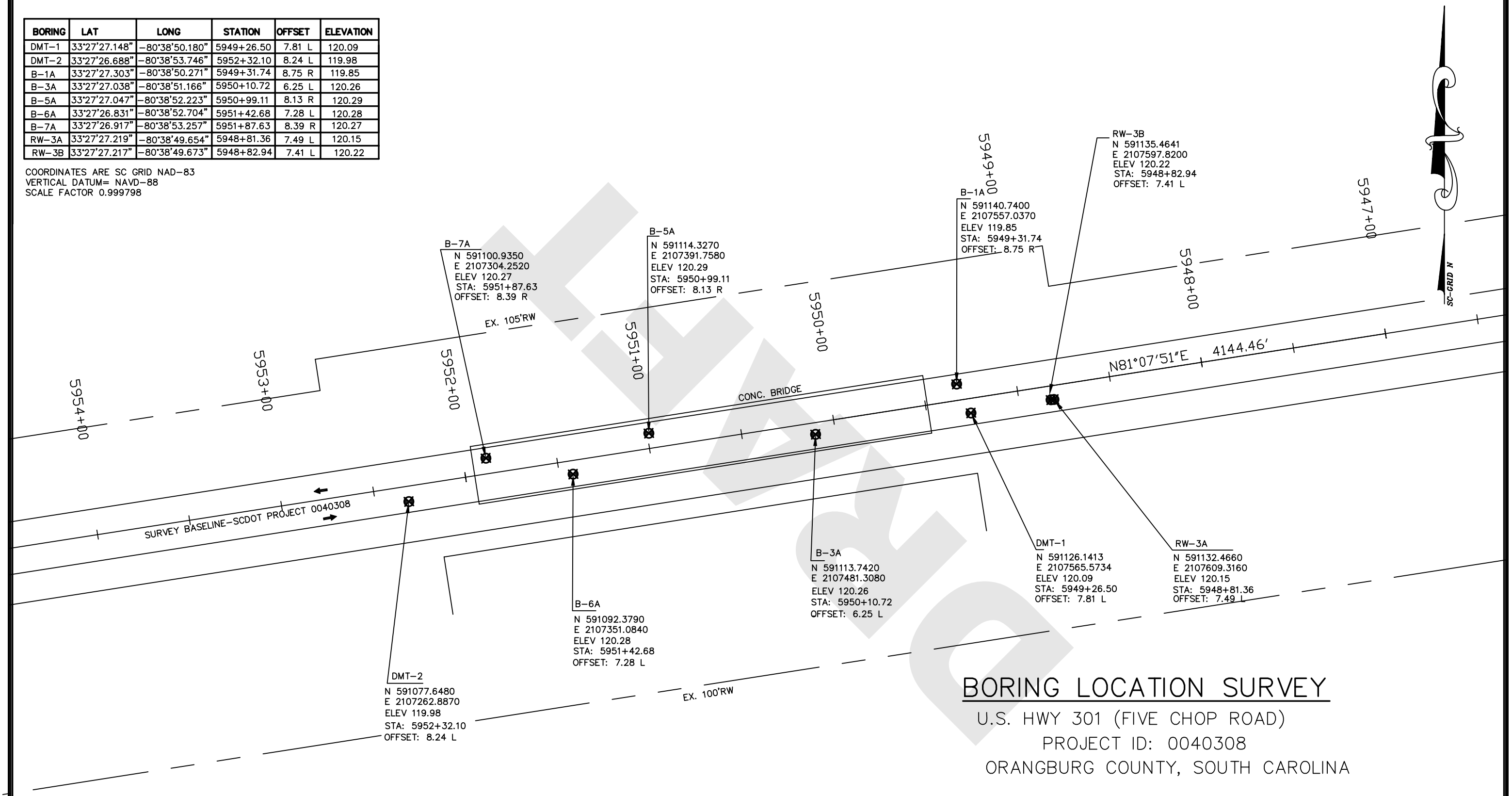
INDIVIDUAL LAB DATA SHEETS

GENERAL NOTES

SOIL CLASSIFICATION CHART

BORING	LAT	LONG	STATION	OFFSET	ELEVATION
DMT-1	33°27'27.148"	-80°38'50.180"	5949+26.50	7.81 L	120.09
DMT-2	33°27'26.688"	-80°38'53.746"	5952+32.10	8.24 L	119.98
B-1A	33°27'27.303"	-80°38'50.271"	5949+31.74	8.75 R	119.85
B-3A	33°27'27.038"	-80°38'51.166"	5950+10.72	6.25 L	120.26
B-5A	33°27'27.047"	-80°38'52.223"	5950+99.11	8.13 R	120.29
B-6A	33°27'26.831"	-80°38'52.704"	5951+42.68	7.28 L	120.28
B-7A	33°27'26.917"	-80°38'53.257"	5951+87.63	8.39 R	120.27
RW-3A	33°27'27.219"	-80°38'49.654"	5948+81.36	7.49 L	120.15
RW-3B	33°27'27.217"	-80°38'49.673"	5948+82.94	7.41 L	120.22

COORDINATES ARE SC GRID NAD-83
VERTICAL DATUM= NAVD-88
SCALE FACTOR 0.999798



BORING LOCATION SURVEY

U.S. HWY 301 (FIVE CHOP ROAD)

PROJECT ID: 0040308

ORANGBURG COUNTY, SOUTH CAROLINA

I HEREBY STATE THAT TO THE BEST OF MY PROFESSIONAL KNOWLEDGE, INFORMATION AND BELIEF, THE SURVEY SHOWN HEREON WAS MADE IN ACCORDANCE WITH THE REQUIREMENTS OF THE STANDARD OF PRACTICE MANUAL FOR SURVEYING IN SOUTH CAROLINA, AND MEETS OR EXCEEDS THE REQUIREMENTS FOR A CLASS " " SURVEY AS SPECIFIED THEREIN, ALSO THERE ARE NO ENCROACHMENTS, PROJECTIONS, OR SETBACKS AFFECTING THE PROPERTY OTHER THAN THOSE SHOWN.

PROPERTY NOT TO BE IN A FLOOD ZONE. UNLESS NOTED HEREON THIS MAP DOES NOT ADDRESS ENVIRONMENTAL CONCERNS OR SUBSURFACE INVESTIGATION.

FILE#

NESBITT SURVEYING CO., INC.
4340 ALLIGATOR ROAD
U.S. HIGHWAY 76 & ALLIGATOR ROAD
TIMMONSVILLE, S.C. 29161
PHONE (843) 346-3302
FAX (843)-346-5802
email davidn@nesbittsurveying.com

DAVID A. NESBITT RLS NO 7623

SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION
NESBITT SURVEYING CO., INC.
No. C01197

DATE:	DECEMBER 18, 2014
JOB NO:	14670
REVISED 2-5-15 TO SHOW	BORING RW3A & RW3B
ROUTE NO..	US 301
SCDOT #:	0040308

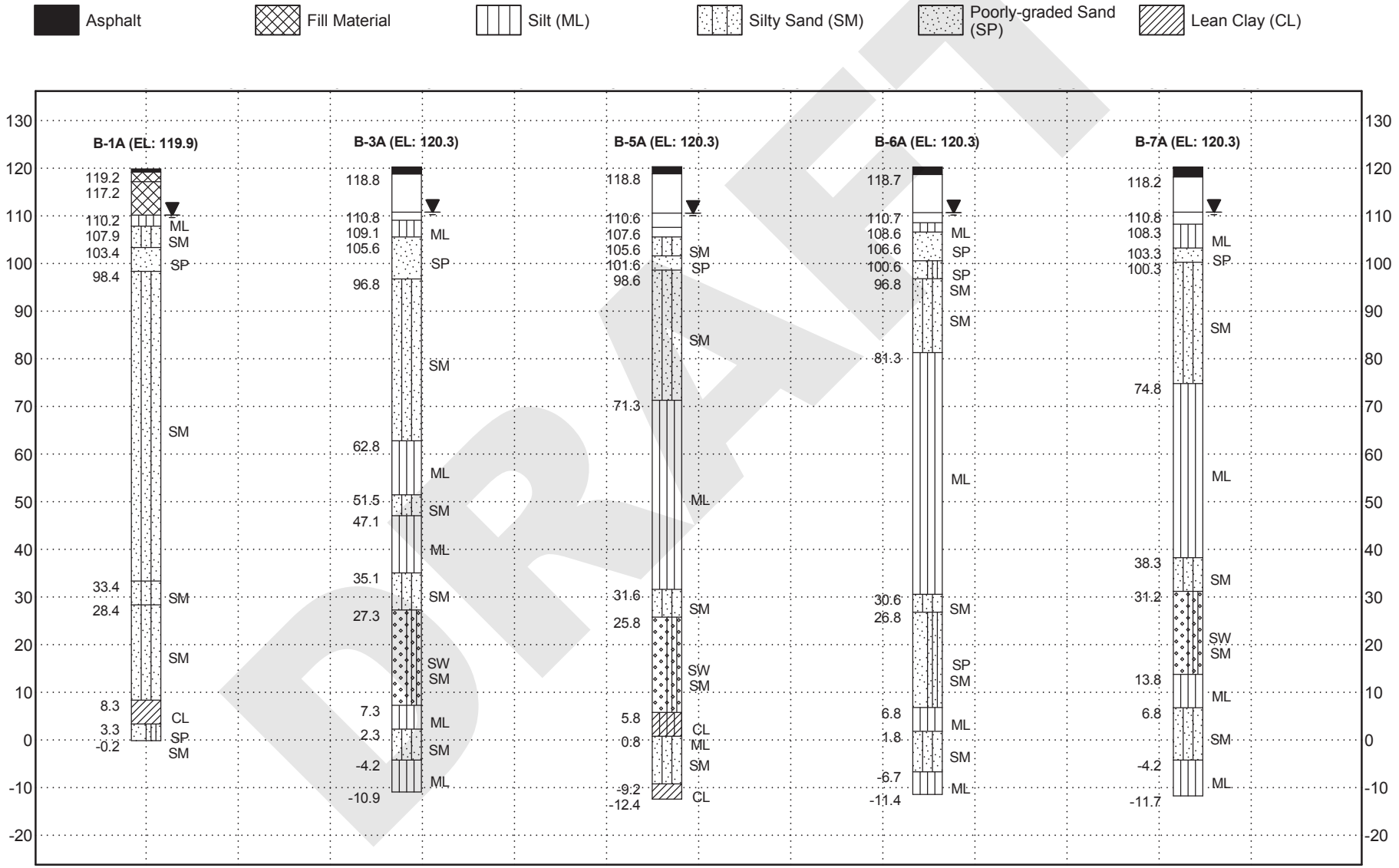
SCALE 1" =50 FT
0 25 50 100
GRAPHIC SCALE

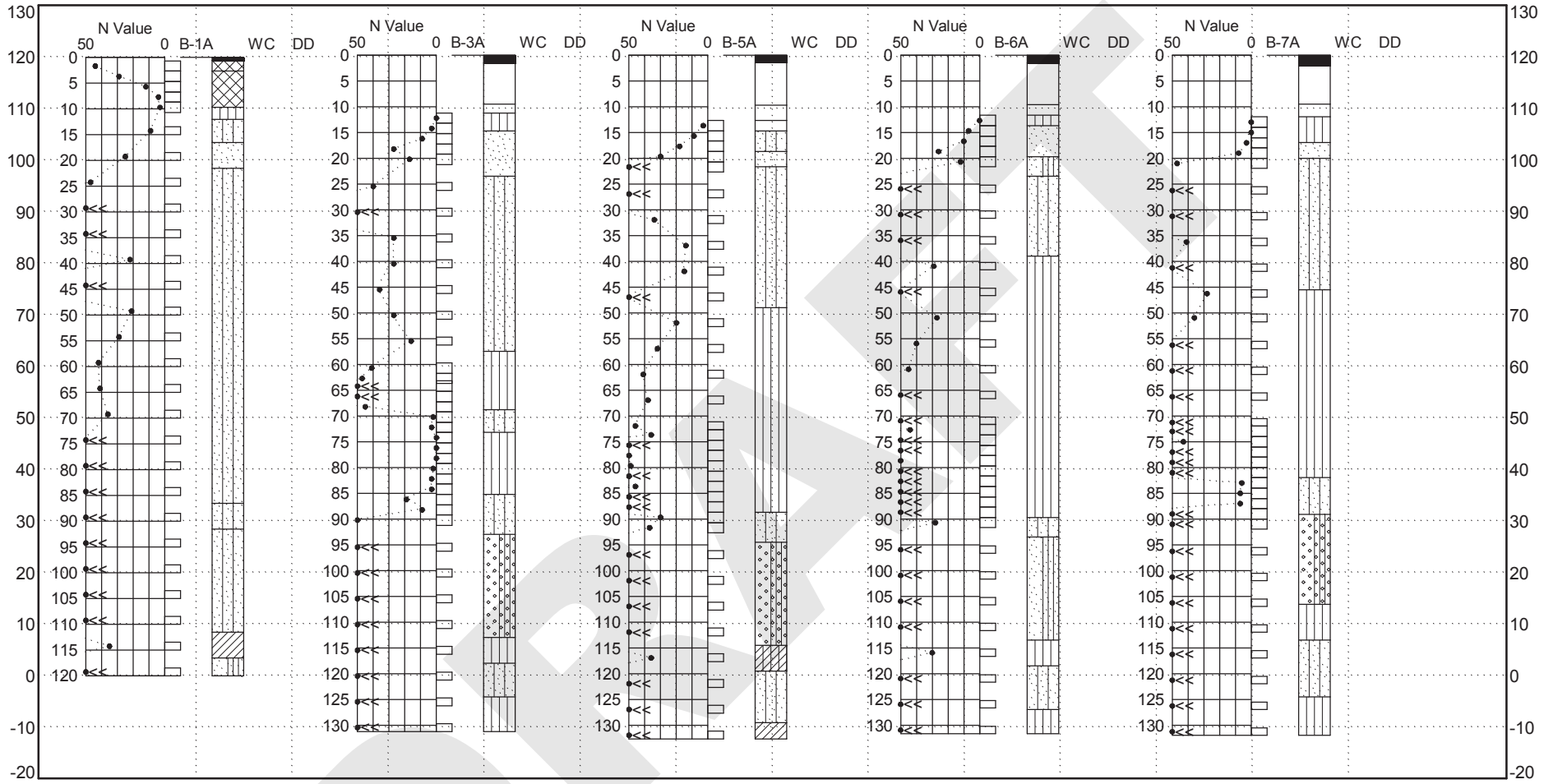
SUBSURFACE DIAGRAM

PROJECT NAME: Bridge Replacement Over Four Hole Swamp

PROJECT NUMBER: 0040308

PROJECT LOCATION: Orangeburg





SUBSURFACE FENCE DIAGRAM

Bridge Replacement Over Four Hole Swamp

Orangeburg

PROJECT #	DATE	PLATE
0040308	Jan 15	1

FIELD EXPLORATION PROGRAM

General

We explored the site by drilling five (5) soil test borings (B-1A, B-3A, B-5A, B-6A, B-7A) using mud rotary drilling techniques, two (2) soil test borings (RW-3A and RW-3B) using hollow stem auger drilling techniques and two (2) Dilatometer Test Soundings (DMT-1 and DMT-2) up to depths of approximately 120 feet, 16 feet, and 15 feet below the ground surface (bgs), respectively. Soil Test Borings were performed using a truck-mounted CME-55 drill rig, except for RW-3A and RW-3B were performed using a truck-mounted CME-45D drill rig. The locations of the explorations are shown on the Boring Location Survey within the Appendix of this report.

Drilling Sampling Procedures

Standard penetration tests were carried out while representative samples were being retrieved at selected depths in the borehole. Throughout the drilling operation, soil samples were obtained from the borings using a 3¼-inch (O.D.) split spoon sampler in general conformance with guidelines presented in ASTM D1586, Standard Test Method for Penetration Test and Split Barrel Sampling of Soils. The samplers were driven into the soil a distance of 18 – 24 inches or to refusal with a 140-pound hammer free falling a distance of 30 inches. The numbers of the blows required to drive the sampler in three 6-inch increments are provided in the boring logs. The sum of blows for the last two increments (or middle two increments for the 24 inch Split Barrel sampling that was performed during continuous sampling depths) was recorded as the standard penetration resistance, or N-value. When the sampler met practical refusal, the number of inches driven and the number of blows was recorded.

Soil samples were examined in the field and representative portions were stored in sealable plastic jars. The samples were transported to PSI's laboratory for further examination and testing.

Rock Coring

Rock coring was not necessary.

Field Classification

Soil samples were initially classified visually in the field. Consistency, color, relative moisture, degree of plasticity, peculiar odors and other distinguishing characteristics of the soil samples were noted. The terminology used in the soil and rock classifications and other modifiers are defined in the General Notes in this appendix.

Drilling Exploration Logs

Summary soil test boring logs follow in this appendix, and have been prepared in general accordance with SCDOT standards. The left-hand portion of the exploration log gives our description of the soil and rock encountered in the exploration, laboratory test results, and depth to groundwater, if encountered. The right-hand portion of the log shows SPT data, sample locations and depths, and a graphical representation of the laboratory results at the respective depths.

The soil stratifications shown on the boring logs represent the conditions only at actual exploration location. Variations may occur and should be expected. The stratifications represent the approximate boundary between subsurface materials; the actual transition may be gradual.

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-1A	**Boring Location:**	5949+31.74	**Offset:**	8.75 R	**Alignment:**	Proposed
Elev.:	119.9 ft	**Latitude:**	33.4575	**Longitude:**	-80.6472	**Date Started:**	12/4/2014
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0		0.7					
	0.7	Asphalt at 0 to 8 inches						
	2.7	FILL - Dense, moist, brown, red with gray, fine to medium grained, Clayey SAND (SC)	2.7	SS-1	16	17	27	44
			4.7	SS-2	15	15	14	29
114.9		FILL - Medium dense to very loose, moist, tan, fine to medium grained, poorly graded SAND (SP), slightly micaceous	6.7	SS-3	7	6	6	12
			8.7	SS-4	3	2	2	4
	9.7		10.7	SS-5	1	1	2	3
109.9		ALLUVIAL - Soft, wet, gray, Lean CLAY with sand (CL), slightly micaceous						
	12.0	SS-5: MC=24.5%, LL=34, PL=14, PI=20, FC=73%	13.5	SS-6	2	4	5	9
104.9		Loose, wet, gray, fine to medium grained Clayey SAND (SC), slightly micaceous						
	16.5	SS-6: MC=20.5%, LL=25, PL=13, PI=12, FC=42.3%	18.5	SS-7	7	16	9	25
99.9		COASTAL PLAIN DEPOSIT - Medium dense, wet, gray, medium grained, poorly graded SAND (SP), slightly micaceous						
	21.5	(low recovery)	23.5	SS-8	14	16	31	47
94.9		Dense to very dense, wet, green gray, fine to medium grained, Silty SAND (SM), slightly micaceous						
		(contains sand with strong cementation)	28.5	SS-9	50/5"			100
89.9		(contains trace shell fragments)						
			33.5	SS-10	7	50/4"		100
84.9	36.5							
		Very stiff, wet, green gray, Sandy SILT (ML), slightly micaceous	38.5	SS-11	7	9	13	22
79.9		(contains sand with strong cementation)						
		(conains trace shell fragments)						
	41.5	SS-11: MC=37%, LL=28, PL=26, PI=2, FC=57.7%	43.5	SS-12	11	14	50/5"	100
74.9								
	46.5	Very dense, wet, green gray, fine to coarse grained, Silty SAND (SM), slightly micaceous	48.5	SS-13	11	10	11	21
69.9		(contains sand with strong cementation)						
		(contains trace shell fragments)						

SPT N VALUE ● PL × MC ○ LL ×

▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-1A	**Boring Location:**	5949+31.74	**Offset:**	8.75 R	**Alignment:**	Proposed
Elev.:	119.9 ft	**Latitude:**	33.4575	**Longitude:**	-80.6472	**Date Started:**	12/4/2014
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		SS-12: MC=46%, LL=40, PL=38, PI=2, FC=49.3%		53.5					
64.9		Very stiff to hard, wet, green gray, Sandy SILT (ML), slightly micaceous			SS-14	7	13	16	29
		(contains lenses of sand with strong cementation)		58.5					
		(contains trace shell fragments)							
59.9		SS-13: MC=35.3%, LL=29, PL=27, PI=2, FC=56%			SS-15	10	18	24	42
		SS-14: MC=36.7%, LL=32, PL=31, PI=1, FC=66.3%		63.5					
54.9					SS-16	15	18	23	41
	66.5	Hard to very hard, wet, green gray, SILT with sand (ML), slightly micaceous		68.5					
		(contains sands with strong cementation)			SS-17	14	15	21	36
49.9		(contains trace shell fragments)							
		SS-17: MC=32.7%, LL=36, PL=30, PI=6, FC=73.7%		73.5					
					SS-18	19	22	29	51
44.9	76.5								
		Very dense, wet, green gray, fine to medium grained, Silty SAND (SM), slightly micaceous		78.5					
39.9		(contains sands with strong cementation)			SS-19	40	41	50	91
		(contains trace shell fragments)							
				83.5					
					SS-20	30	50/3"		100
34.9	86.5								
		Very dense, wet, dark green, fine to medium grained, Silty SAND (SM), slightly micaceous		88.5					
29.9					SS-21	17	32	50/5"	100
	91.5								
		Very dense, wet, gray, fine to coarse grained, well graded SAND with silt (SW-SM)		93.5					
24.9					SS-22	34	49	50/4"	100
				98.5					
19.9					SS-23	37	50/5.5"		100

SPT N VALUE

PL MC LL

FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-1A	**Boring Location:**	5949+31.74	**Offset:**	8.75 R	**Alignment:**	Proposed
Elev.:	119.9 ft	**Latitude:**	33.4575	**Longitude:**	-80.6472	**Date Started:**	12/4/2014
Total Depth:	120 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	6 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
14.9	111.5	Hard, wet, black, Sandy Lean CLAY (CL), micaceous		103.5	SS-24	29	45	50/5"	100
9.9				108.5	SS-25	37	37	48	85
4.9	116.5	Ver dense, wet, dark gray, fine to medium grained, poorly graded SAND with silt (SP-SM), micaceous		113.5	SS-26	12	17	18	35
-0.2	120.0	(contains cemented sands with strong cementation)		118.5	SS-27	30	32	50/5"	100
-5.2		Boring Terminated at 120 Feet Groundwater Encountered at 9.7 Feet at Time of Boring and 6 Feet 48 Hours After Boring							
-10.2									
-15.2									
-20.2									
-25.2									
-30.2									

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-3A	**Boring Location:**	5950+10.72	**Offset:**	6.25 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6475	**Date Started:**	12/8/2014
Total Depth:	131.2 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0								
	1.5	Asphalt at 0 to 3" / Sand-Stone Stabilized Subbase at 3" to 1' / Reinforced Concrete at 1' to 1.5'							
115.3		Air							
	9.5	▽							
110.3	11.2	Water		11.2	SS-1	WOR/24"			0
		ALLUVIAL - Very soft to soft, wet, dark gray, Lean CLAY with sand (CL)		13.2	SS-2	1	1	2	3
		(contains trace roots)		15.2	SS-3	4	4	5	9
105.3	14.7	Loose, wet, gray and white, medium to coarse grained, poorly graded SAND (SP)		17.2	SS-4	13	13	14	27
	17.2	COASTAL PLAIN DEPOSIT - Medium dense, wet, gray and white, medium to coarse grained, poorly graded SAND (SP)		19.2	SS-5	7	8	9	17
100.3									
	23.5	Hard, wet, green gray, Sandy SILT (ML), slightly micaceous		24.7	SS-6	7	18	22	40
95.3		(contains sand with strong cementation)							
		(contains shell fragments)							
	28.5	SS-6: MC=33.3%, LL=35, PL=24, PI=11, FC=53.1%		29.7	SS-7	11	14	50/2"	100
90.3									
	33.5	Very dense, wet, green gray, fine to medium grained, Clayey SAND (SC), slightly micaceous		34.7	SS-8	7	10	17	27
85.3		(contains sand with strong cementation)							
		(contains shell fragments)							
		SS-7: MC=29.6%, LL=29, PL=18, PI=11, FC=42.8%		39.7	SS-9	8	12	15	27
80.3									
		Very stiff to very hard, wet, green gray, Sandy SILT (ML), slightly micaceous		44.7	SS-10	10	17	19	36
75.3		(contains lenses of sand with strong cementation)							
		(contains shell fragments)							
		SS-12: MC=43.6%, LL=35, PL=29, PI=6, FC=63.3%		49.7	SS-11	10	12	15	27
70.3		SS-14: MC=39.6%, LL=41, PL=33, PI=8,							

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-3A	**Boring Location:**	5950+10.72	**Offset:**	6.25 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6475	**Date Started:**	12/8/2014
Total Depth:	131.2 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		FC=68.3%						
65.3			54.7	SS-12	6	6	10	16
			59.7					
60.3			61.2	SS-13	13	21	20	41
			63.2	SS-14	11	19	28	47
55.3			65.2	SS-15	15	24	32	56
			67.2	SS-16	15	19	50/5.5"	100
	68.8		69.2	SS-17	21	24	21	45
50.3		Very soft to soft, wet, dark green, Sandy Elastic SILT (MH), slightly micaceous	71.2	SS-18	1	1	1	2
		SS-19: MC=316.1%, LL=135, PL=133, PI=2, FC=60.1%	73.2	SS-19	4	2	1	3
		SS-21: MC=376.9%, LL=113, PL=102, PI=11, FC=64%	75.2	SS-20	WOR/24"			0
45.3		SS-22: MC=336.3%, LL=111, PL=101, PI=10, FC=62.8%	77.2	SS-21	WOR/18"	WOH		0
	79.2		79.2	SS-22	WOR	WOH/12"		0
40.3		Very soft to soft, wet, dark green, fine to medium grained, Silty SAND (SM), slightly micaceous	81.2	SS-23	WOR	WOH	2	2
		SS-23: MC=316.1%, LL=99, PL=92, PI=7, FC=41%	83.2	SS-24	WOH	1	2	3
	85.2	SS-24: MC=305.5%, LL=90, PL=86, PI=4, FC=39.7%	85.2	SS-25	WOH	2	1	3
35.3		SS-25: MC=266.5%, LL=75, PL=66, PI=9, FC=32.8%	87.2	SS-26	4	6	13	19
	89.2		89.2	SS-27	WOH	1	8	9
30.3		Medium dense to loose, wet, dark green, fine to coarse grained, well graded SAND with silt (SW-SM), slightly micaceous		SS-28	14	22	28	50
	93.0	SS-27: MC=42.6%, LL=NP, PL=NP, PI=NP, FC=10.4%	94.7					
25.3		SS-28: MC=25%, LL=NP, PL=NP, PI=NP, FC=19.9%		SS-29	25	50/3"		100
			99.7					
20.3		Dense, wet, dark green, fine to coarse grained, Silty SAND (SM), slightly micaceous		SS-30	23	28	28	56

SPT N VALUE ● PL × MC ○ LL ×
▲ FINES CONTENT (%)
0 10 20 30 40 50 60 70 80 90

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LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-3A	**Boring Location:**	5950+10.72	**Offset:**	6.25 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6475	**Date Started:**	12/8/2014
Total Depth:	131.2 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
15.3		Very dense, wet, gray, medium to coarse grained, well graded SAND with silt (SW-SM), slightly micaceous		104.7	SS-31	23	29	40	69
10.3				109.7	SS-32	34	50/5"		100
	113.0								
5.3		Very hard, wet, dark gray and black, Sandy Lean CLAY (CL), micaceous		114.7	SS-32	13	33	50/5"	100
	118.0								
0.3		Very dense, wet, dark gray, fine to medium grained, poorly graded SAND with silt (SP-SM), micaceous SS-34: MC=30.3%, LL=NP, PL=NP, PI=NP, FC=5%		119.7	SS-34	13	29	39	68
	124.5			124.7					
-4.7		Very hard, wet, black, Sandy Elastic SILT (MH), micaceous			SS-35	50/0"			100
-9.7				129.7	SS-36	42	50/4.5"		100
	131.2								
-14.7		Boring Terminated at 131.2' Groundwater Encountered at 9.5' at Time of Boring							
-19.7									
-24.7									
-29.7									

SPT N VALUE ● PL × MC ○ LL ×

▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-5A	**Boring Location:**	5950+99.11	**Offset:**	8.13 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/5/2014
Total Depth:	132.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0								
	1.5	Asphalt at 0 to 3 " / Stabilized Sand-Stone Subgrade at 3" to 11" / Concrete at 11" to 1.5'							
115.3		Air							
	9.7	▽ Water							
110.3	12.7	ALLUVIAL - Wood / Roots, no soil recovery in split spoon		12.7	SS-1	2	1	2	3
	14.7	Loose to medium dense, wet, gray, fine to coarse grained, Silty SAND (SM)		14.7	SS-2	4	5	4	9
105.3	18.7	contains trace roots		16.7	SS-3	5	6	12	18
		COASTAL PLAIN DEPOSITS - Medium dense to dense, wet, gray, medium to coarse grained, poorly graded SAND (SP)		18.7	SS-4	15	14	16	30
100.3	21.7	contains trace roots		20.7	SS-5	7	4	50/5"	100
95.3		Very dense to dense, wet, green gray, fine grained, Silty SAND (SM), slightly micaceous		26.2	SS-6	19	50/2.5"		100
90.3		(contains seams of cemented sands with strong cementation)		31.2	SS-7	13	12	22	34
		SS-7: MC=31.8%, LL=29, PL=23, PI=6, FC=47.9%							
85.3	34.2	(low recovery)		36.2	SS-8	8	7	7	14
		Very stiff to very hard, wet, green gray, Sandy SILT (ML), slightly micaceous							
80.3		(contains small amounts of moderate to highly cemented sands)		41.2	SS-9	8	7	8	15
		SS-9: MC=35.3%, LL=32, PL=28, PI=4, FC=63.4%							
75.3		SS-11: MC=36.8%, LL=28, PL=25, PI=3, FC=52.3%		46.2	SS-10	9	17	35	52
		SS-13: MC=34.9%, LL=35, PL=30, PI=5, FC=66.3%							
70.3		SS-16: MC=35.3%, LL=34, PL=28, PI=6,							

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-5A	**Boring Location:**	5950+99.11	**Offset:**	8.13 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/5/2014
Total Depth:	132.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		FC=67.6%		51.2	SS-11	8	9	11	20
65.3				56.2	SS-12	11	14	18	32
60.3				61.2	SS-13	14	15	26	41
55.3				66.2	SS-14	8	16	22	38
50.3				71.2	SS-15	15	18	28	46
				72.7	SS-16	13	17	19	36
45.3				74.7	SS-17	14	50/4.5"		100
				76.7	SS-18	15	22	28	50
				78.7	SS-19	18	23	26	49
40.3				80.7	SS-20	50/4"			100
				82.7	SS-21	15	20	23	46
				84.7	SS-22	26	41	43	84
35.3				86.7	SS-23	33	50/5"		100
	88.7	Dense, wet, dark green, fine to medium grained, Silty SAND (SM), slightly micaceous		88.7	SS-24	8	12	18	30
30.3		SS-24: MC=32.8%, LL=NP, PL=NP, PI=NP, FC=19.2%		90.7	SS-25	7	17	20	37
	94.5			92.7					
25.3		Very dense, wet, gray, fine to coarse grained, Clayey SAND (SC), micaceous		96.2	SS-26	26	43	50/4"	100
		SS-26: MC=32.4%, LL=61, PL=17, PI=44, FC=13.2%							
20.3				101.2					

SPT N VALUE

PL MC LL

FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-5A	**Boring Location:**	5950+99.11	**Offset:**	8.13 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/5/2014
Total Depth:	132.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/4/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.7 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
					SS-27	28	48	50/5"	100
15.3				106.2					
					SS-28	29	33	50/4.5"	100
10.3				111.2					
					SS-29	26	31	50/5"	100
	114.5								
5.3		Hard, wet, black, Sandy Fat CLAY (CH), micaceous SS-30: MC=48.2%, LL=53, PL=20, PI=33, FC=61%		116.2	SS-30	13	17	19	36
	119.5								
0.3		Very dense, wet, dark gray, fine to medium grained, Silty SAND (SM), micaceous (dense material from 123.7' - 125.7' caused slow drilling)		121.2	SS-31	21	50/4.5"		100
-4.7				126.2					
					SS-32	22	41	50/3"	100
	129.5								
-9.7		Very hard, wet, black, Sandy Elastic SILT (MH), slightly micaceous		131.2					
	132.7	SS-33: MC=66%, LL=85, PL=53, PI=32, FC=65%			SS-33	15	50/5.5"		100
-14.7		Boring Terminated at 132.7' Groundwater Encountered at 9.7' at Time of Boring							
-19.7									
-24.7									
-29.7									

SPT N VALUE ● PL × MC ○ LL × ▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-6A	**Boring Location:**	5951+42.68	**Offset:**	7.28 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/7/2014
Total Depth:	131.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/7/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.6 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0								
	1.6	Asphalt at 0 to 4" / Sand-Stone Stabilized Subgrade at 4" to 1.1' / Reinforced Concrete at 1.1' to 1.6'							
115.3		Air							
	9.6	▽ Water							
110.3	11.7	ALLUVIAL - Very soft, wet, brown, Sandy SILT (ML)		11.7	SS-1	WOH	WOH	3	0
	13.7	contains wood		13.7	SS-2	3	3	4	7
105.3		Loose to medium dense, wet, light gray and white, medium to coarse grained, poorly graded SAND (SP)		15.7	SS-3	3	4	6	10
				17.7	SS-4	10	14	12	26
	19.7	(dark gray and white color at 17.1')		19.7	SS-5	6	6	6	12
100.3		COASTAL PLAIN DEPOSIT - Medium dense, wet, dark gray, fine to medium grained, poorly graded SAND with silt (SP-SM)							
	23.5			25.2	SS-6	17	12	50/2"	100
95.3		Very dense, wet, green gray, fine grained, Silty SAND (SM), slightly micaceous							
		(contains sands with strong cementation)		30.2	SS-7	18	24	50/4"	100
		(contains shell fragments)							
90.3		SS-8: MC=27.4%, LL=24, PL=22, PI=2, FC=34.6%		35.2	SS-8	13	50/3"		100
85.3									
	39.0			40.2	SS-9	13	13	16	29
80.3		Very stiff to very hard, wet, green gray, Sandy SILT (ML), slightly micaceous							
		(contains lenses of cemented sands with moderate to strong cementation)		45.2	SS-10	12	17	35	52
		(contains small shell fragments)							
75.3		SS-11: MC=34.1%, LL=31, PL=28, PI=3, FC=59.9%							
		SS-12: MC=39.9%, LL=32, PL=31, PI=1, FC=68.2%		50.2					
70.3									

● SPT N VALUE ●

PL × MC ○ LL ×

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-6A	**Boring Location:**	5951+42.68	**Offset:**	7.28 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/7/2014
Total Depth:	131.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/7/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.6 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
					SS-11	10	13	14	27
65.3				55.2	SS-12	10	16	24	40
60.3				60.2	SS-13	12	17	28	45
55.3				65.2	SS-14	28	43	50/3"	100
	68.2	Hard to very hard, wet, green gray, SILT with sand (ML), slightly micaceous		70.2					
50.3		(contains lenses of cemented sands with moderate to strong cementation)		71.7	SS-15	14	32	50/5"	100
		(contains small shell fragments)		73.7	SS-16	15	19	25	44
45.3		SS-15: MC=41.2%, LL=38, PL=29, PI=9, FC=72.2%		75.7	SS-17	19	28	50/5.5"	100
		SS-19: MC=32%, LL=35, PL=23, PI=12, FC=70.9%		77.7	SS-18	23	24	35	59
				79.7	SS-19	18	22	28	50
40.3				81.7	SS-20	16	25	50/4"	100
				83.7	SS-21	26	33	50/5.5"	100
35.3				85.7	SS-22	19	28	32	60
				87.7	SS-23	27	50/5"		100
	89.7			89.7	SS-24	27	50/5.5"		100
30.3		Medium dense, wet, dark green, fine to medium grained, Clayey SAND (SC), slightly micaceous		91.7	SS-25	10	14	14	28
	93.5	SS-25: MC=31.5%, LL=49, PL=22, PI=27, FC=21.2%							
25.3		Very dense, wet, gray and black, fine to medium grained, poorly graded SAND with silt (SP-SM), micaceous		95.2	SS-26	45	50/4"		100
		(contains 2" - 5" black silt seams)		100.2					
20.3		SS-28: MC=29.1%, LL=NP, PL=NP, PI=NP,			SS-27	31	50/5.5"		100

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-6A	**Boring Location:**	5951+42.68	**Offset:**	7.28 L	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6478	**Date Started:**	12/7/2014
Total Depth:	131.7 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/7/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.6 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
15.3		FC=11.5%		105.2	SS-28	50/5.5"			100
10.3				110.2	SS-29	30	40	50/5"	100
	113.5								
5.3		Hard, wet, black, Sandy Lean CLAY (CL), micaceous SS-30, MC=40.1%, LL=40, PL=19, PI=21, FC=56%		115.2	SS-30	11	14	16	30
	118.5								
0.3		Very dense, wet, dark gray, fine to medium grained, Silty SAND (SM), micaceous SS-32: MC=38%, LL=NP, PL=NP, PI=NP, FC=17.8%		120.2	SS-31	37	40	50/4"	100
-4.7				125.2	SS-32	50/2"			100
	127.0								
-9.7		Very hard, wet, black, Sandy Elastic SILT (MH), micaceous		130.2	SS-33	16	23	50/5"	100
	131.7								
-14.7		Boring Terminated at 131.7' Groundwater Encountered at 9.6' at Time of Boring							
-19.7									
-24.7									
-29.7									

SPT N VALUE ● PL × MC ○ LL ×
▲ FINES CONTENT (%)
0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-7A	**Boring Location:**	5951+87.63	**Offset:**	8.39 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6481	**Date Started:**	12/6/2014
Total Depth:	132 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0								
	2.1	Asphalt at 0 to 5.5" / Sand-Stone Stabilized Subbase at 5.5" to 1.5' / Reinforced Concrete at 1.5' to 2.1'							
115.3		Air							
	9.5	▽							
110.3		Water							
	12.0	ALLUVIAL - Very soft, wet, brown, Sandy SILT (ML)		12.0					
		(contains trace roots)			SS-1	WOR/24"			0
105.3	16.0			14.0	SS-2	WOR/24"			0
		Very loose to loose, wet, gray, medium to coarse grained, poorly graded SAND with silt (SP-SM)		16.0	SS-3	WOR/WOH		3	3
	20.0	SS-3: MC=20.3%, LL=NP, PL=NP, PI=NP, FC=5.9%		18.0	SS-4	4	4	4	8
100.3		SS-4: MC=19.9%, LL=NP, PL=NP, PI=NP, FC=7.4%		20.0	SS-5	1	23	24	47
95.3		COASTAL PLAIN DEPOSIT - Dense to very dense, wet, green gray, fine grained, Silty SAND (SM), slightly micaceous		25.5	SS-6	32	31	50/4.5"	100
		(contains sands with strong cementation)							
		(contains trace shell fragments)							
90.3		SS-7: MC=33.6%, LL=25, PL=22, PI=3, FC=47.8%		30.5	SS-7	16	19	50/2"	100
	33.5								
85.3		Very stiff to hard, wet, green gray, Sandy SILT (ML), slightly micaceous		35.5	SS-8	15	16	25	41
		(contains cemented sands with moderate to high cementation)							
		SS-9: MC=42.8%, LL=36, PL=35, PI=1, FC=61.1%		40.5	SS-9	15	18	34	52
80.3		SS-10: MC=36.2%, LL=27, PL=23, PI=4, FC=64%							
75.3				45.5	SS-10	10	12	16	28
70.3				50.2					

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-7A	**Boring Location:**	5951+87.63	**Offset:**	8.39 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6481	**Date Started:**	12/6/2014
Total Depth:	132 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
					SS-11	9	15	21	36
65.3				55.5					
					SS-12	15	20	33	53
	58.5								
60.3		Very hard, wet, green gray, SILT with sand (ML), slightly micaceous (contains cemented sands with moderate to high cementation) SS-13: MC=43.3%, LL=44, PL=31, PI=13, FC=76%		60.5	SS-13	12	30	50/4"	100
55.3				65.5	SS-14	13	21	41	61
50.3				70.5					
				72.0	SS-15	16	21	50	71
					SS-16	16	25	47	72
	74.0			74.0					
45.3		Hard to very hard, wet, green gray, Sandy SILT (ML), slightly micaceous (contains cemented sands with moderate to high cementation) SS-17: MC=44.7%, LL=43, PL=31, PI=12, FC=68%		76.0	SS-17	12	14	29	43
				78.0	SS-18	17	33	50/5.5"	100
				80.0	SS-19	31	36	50/4.5"	100
40.3					SS-20	40	50/4"		100
	82.0			82.0					
		Loose, wet, dark green, fine grained, Silty SAND (SM), slightly micaceous SS-22: MC=55.9%, LL=NP, PL=NP, PI=NP, FC=16.1%		84.0	SS-21	2	4	2	6
35.3				86.0	SS-22	2	3	4	7
				88.0	SS-23	2	3	4	7
	89.1								
		Very dense, wet, gray, fine to coarse grained, Silty SAND (SM), micaceous SS-25: MC=36.1%, LL=NP, PL=NP, PI=NP, FC=16.4%		90.0	SS-24	13	38	50/4"	100
30.3					SS-25	22	30	37	67
				95.5					
25.3					SS-26	19	46	50/3"	100
				100.5					
20.3					SS-27	40	50/5.5"		100
	102.0								

SPT N VALUE
PL MC LL
FINES CONTENT (%)
0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	B. Livingston
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	B-7A	**Boring Location:**	5951+87.63	**Offset:**	8.39 R	**Alignment:**	Proposed
Elev.:	120.3 ft	**Latitude:**	33.4575	**Longitude:**	-80.6481	**Date Started:**	12/6/2014
Total Depth:	132 ft	**Soil Depth:**	120 ft	**Core Depth:**	ft	**Date Completed:**	12/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	Mud Rotary	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	76.4%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 9.5 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
15.3	106.5	Very dense, wet, black, fine to medium grained, poorly graded SAND with silt (SP-SM), micaceous SS-28: MC=26.7%, LL=NP, PL=NP, PI=NP, FC=8.5%		105.5	SS-28	19	33	50/3"	100
10.3	113.5	Very hard, wet, black, Sandy Lean CLAY (CL), micaceous		110.5	SS-29	15	50/5"		100
5.3		Very dense, wet, dark gray, fine to medium grained, Silty SAND (SM), micaceous		115.5	SS-30	15	40	50/4.5"	100
0.3	124.5			120.5	SS-31	15	42	50/5"	100
-4.7		Very hard, wet, black, Sandy Elastic SILT (MH), micaceous		125.5	SS-32	16	30	50/3"	100
-9.7	132.0			130.5	SS-33	50/5"			100
-14.7		Boring Terminated at 132' Groundwater Encountered at 9.5' at Time of Boring							
-19.7									
-24.7									
-29.7									

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	R. Cannarella
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	RW-3A	**Boring Location:**	5948+81.36	**Offset:**	7.49 L	**Alignment:**	Proposed
Elev.:	120.2 ft	**Latitude:**		**Longitude:**		**Date Started:**	01/29/2015
Total Depth:	13 ft	**Soil Depth:**	13 ft	**Core Depth:**	ft	**Date Completed:**	1/29/2015
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45D	**Drill Method:**	HSA	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	91.3%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB**		**24HR**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Auger Probe to 9'							
		(See Soil Test Boring Log RW-3B)							
115.2									
	9.0			9.0					
110.2		Very soft to soft, wet, gray-green, Sandy Lean CLAY (CL)			ST-1				
				11.0					
	12.5	ST-1: MC=30.8%, LL=35, PL=15, FC=63%, SG=2.630			ST-2				
	13.0			13.0					
105.2		Loose, wet, green-gray, fine grained, Clayey SAND (SC)							
		Boring Terminated at 13'							
100.2									
95.2									
90.2									
85.2									
80.2									
75.2									
70.2									

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

Shelby Tube ST-1 adv. from 9' to 11'

Shelby Tube ST-2 adv. from 11' to 13'

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38-40308.2	**Project No. (PIN):**	0040308	**County:**	Orangeburg	**Eng./Geo.:**	R. Cannarella
Site Description:	Bridge Replacement Over Four Hole Swamp					**Route:**	US301
Boring No.:	RW-3B	**Boring Location:**	5948+82.94	**Offset:**	7.41L	**Alignment:**	Proposed
Elev.:	120.2 ft	**Latitude:**		**Longitude:**		**Date Started:**	01/29/2015
Total Depth:	16 ft	**Soil Depth:**	16 ft	**Core Depth:**	ft	**Date Completed:**	1/29/2015
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME45D	**Drill Method:**	HSA	**Hammer Type:**	Safety Hammer	**Energy Ratio:**	91.3%
Core Size:		**Driller:**	Carolina Drilling	**Groundwater:**	**TOB** 6.7 ft	**24HR**	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0								
	0.7	Asphalt at 0 to 8 inches (no stone base)		0.5					
		FILL - Dense to very loose, moist, light brown, fine to medium grained, poorly graded SAND (SP)		2.0	SS-1	22	16	22	32
				4.0	SS-2	6	10	9	19
115.2		(tan, orange, dark brown color at 4 feet)		6.0	SS-3	3	5	6	11
		▽		8.0	SS-4	1	2	1	3
	8.9				SS-5	3	1	1	2
110.2		Very soft to soft, wet, gray-green, Sandy Lean CLAY (CL)		10.0	SS-6	1	1	2	3
	12.5	(trace organics in layer)		12.0	SS-7	1	3	3	6
		Loose, wet, green-gray, fine grained, Clayey SAND (SC)		14.0	SS-8	3	3	5	8
105.2	15.5			16.0					
	16.0	Loose, wet, light brown, fine to coarse grained, Silty SAND (SM)							
		Boring Terminated at 16'							
		Groundwater Encountered at 6.7' at Time of Boring							
100.2									
95.2									
90.2									
85.2									
80.2									
75.2									
70.2									

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
In-Situ Soil Testing, L.C.
JOB FILE: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC
SNDG.BY : R. Failmezger
ANAL.BY : Roger Failmezger, P.E.

SNDG. DATE: 12/9/14
ANAL. DATE: 12/9/14

ANALYSIS PARAMETERS: LO RANGE = 9.50 BARS ROD DIAM. = 3.6 CM BL.THICK. = 15.0 MM SU FACTOR = 1
SURF.ELEV. = 37.3 M LO GAGE 0 = 0.00 BARS FR.RED.DIA. = 4.4 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1
WATER DEPTH = 2.9 M HI GAGE 0 = 0.00 BARS LIN.ROD WT. = 6.5 KGF/M DELTA-A = 0.18 BARS OCR FACTOR = 1
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.5 DELTA-B = 0.63 BARS M FACTOR = 1
MAX SU ID = 0.6 SU OPTION = 0 MIN PHI ID = 1.2 OCR OPTION = 0 K0 FACTOR = 1
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	ELEV (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
0.60	36.70	7500	12.72	41.59		0.18	0.63	9.50	0.00	0.00	0.00	11.50	40.96		0.000	2.15	0.105
0.80	36.50	5000	9.85	29.12		0.18	0.63	9.50	0.00	0.00	0.00	9.11	28.49		0.000	2.15	0.147
1.00	36.30	2910	5.47	18.55		0.18	0.63	9.50	0.00	0.00	0.00	5.04	17.92		0.000	2.00	0.188
1.20	36.10	2490	4.50	15.29		0.18	0.63	9.50	0.00	0.00	0.00	4.18	14.66		0.000	2.00	0.227
1.40	35.90	2030	4.02	13.33		0.18	0.63	9.50	0.00	0.00	0.00	3.78	12.70		0.000	1.90	0.265
1.60	35.70	1530	2.69	10.64		0.18	0.63	9.50	0.00	0.00	0.00	2.51	10.01		0.000	1.90	0.303
1.80	35.50	1330	2.24	9.45		0.18	0.63	9.50	0.00	0.00	0.00	2.10	8.82		0.000	1.90	0.340
2.00	35.30	1260	2.40	8.90		0.18	0.63	9.50	0.00	0.00	0.00	2.30	8.27		0.000	1.90	0.377
2.20	35.10	970	1.55	7.43		0.18	0.63	9.50	0.00	0.00	0.00	1.48	6.80		0.000	1.80	0.414
2.40	34.90	740	1.02	5.43		0.18	0.63	9.50	0.00	0.00	0.00	1.02	4.80		0.000	1.80	0.449
2.60	34.70	760	1.36	7.27		0.18	0.63	9.50	0.00	0.00	0.00	1.29	6.64		0.000	1.80	0.484
2.80	34.50	340	1.54	2.89		0.18	0.63	9.50	0.00	0.00	0.00	1.69	2.26		0.000	1.60	0.518
3.00	34.30	340	2.26	5.05		0.18	0.63	9.50	0.00	0.00	0.00	2.34	4.42		0.010	1.70	0.540
3.20	34.10	480	2.91	6.52		0.18	0.63	9.50	0.00	0.00	0.00	2.95	5.89		0.029	1.70	0.554
3.40	33.90	650	3.09	6.75		0.18	0.63	9.50	0.00	0.00	0.00	3.13	6.12		0.049	1.80	0.569
3.60	33.70	1150	4.37	10.05		0.18	0.63	9.50	0.00	0.00	0.00	4.31	9.42		0.069	1.80	0.584
3.80	33.50	3330	2.88	16.75		0.18	0.63	9.50	0.00	0.00	0.00	2.41	16.12		0.088	1.90	0.601
4.00	33.30	5890	10.69	36.57		0.18	0.63	9.50	0.00	0.00	0.00	9.62	35.94		0.108	2.15	0.621
4.20	33.10	6280	14.39	41.59		0.18	0.63	9.50	0.00	0.00	0.00	13.25	40.96		0.128	2.15	0.644
4.40	32.90	5800	13.20	35.68		0.18	0.63	9.50	0.00	0.00	0.00	12.30	35.05		0.147	2.15	0.666
4.60	32.70	5640	12.41	35.61		0.18	0.63	9.50	0.00	0.00	0.00	11.47	34.98		0.167	2.15	0.689

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
In-Situ Soil Testing, L.C.
JOB FILE: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC
SNDG.BY : R. Failmezger
ANAL.BY : Roger Failmezger, P.E.

SNDG. NO. : DMT-1
Page 1b
FILE NO. :2014-68

SNDG. DATE: 12/9/14
ANAL. DATE: 12/9/14

ANALYSIS PARAMETERS: LO RANGE = 9.50 BARS ROD DIAM. = 3.6 CM BL.THICK. = 15.0 MM SU FACTOR = 1
SURF.ELEV. = 37.3 M LO GAGE 0 = 0.00 BARS FR.RED.DIA. = 4.4 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1
WATER DEPTH = 2.9 M HI GAGE 0 = 0.00 BARS LIN.ROD WT. = 6.5 KGF/M DELTA-A = 0.18 BARS OCR FACTOR = 1
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA / PHI = 0.5 DELTA-B = 0.63 BARS M FACTOR = 1
MAX SU ID = 0.6 SU OPTION = 0 MIN PHI ID = 1.2 OCR OPTION = 0 K0 FACTOR = 1
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	ELEV (M)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
0.60	36.70	109.50	2.56		1022	12.83		241.4	48.1	0.18	44.8	93.44	889.9	4872	SILTY SAND
0.80	36.50	61.87	2.13		673	7.32		155.1	45.5	0.25	42.3	49.87	338.8	2842	SILTY SAND
1.00	36.30	26.80	2.56		447	3.14		93.0	44.8	0.32	41.8	12.78	68.0	1535	SILTY SAND
1.20	36.10	18.40	2.51		364	2.16		80.9	44.2	0.39	41.5	7.52	33.1	1119	SILTY SAND
1.40	35.90	14.22	2.36		310	1.72		64.7	42.9	0.45	40.2	5.63	21.2	877	SILTY SAND
1.60	35.70	8.30	2.98		260	1.04		51.3	42.2	0.51	39.7	2.34	7.7	608	SILTY SAND
1.80	35.50	6.18	3.20		233	0.82		45.5	41.4	0.57	39.0	1.59	4.7	485	SILTY SAND
2.00	35.30	6.08	2.60		207	0.85		41.9	40.3	0.62	37.9	1.85	4.9	426	SILTY SAND
2.20	35.10	3.57	3.61		185	0.58		34.4	39.2	0.68	37.0	0.89	2.1	297	SAND
2.40	34.90	2.27	3.71		131	0.47		27.4	37.6	0.72	35.3	0.58	1.3	159	SAND
2.60	34.70	2.65	4.17		186	0.54		27.1	36.8	0.77	34.6	0.81	1.7	250	SAND
2.80	34.50	3.27	0.33		20	0.84	0.21					1.11	2.2	27	CLAY
3.00	34.30	4.32	0.89		72	1.04						1.79	3.3	119	CLAYEY SILT
3.20	34.10	5.27	1.01		102	1.21						2.51	4.5	190	SILT
3.40	33.90	5.41	0.97		104	1.23						2.69	4.7	196	SILT
3.60	33.70	7.25	1.21		177	1.14		30.1	34.8	0.92	32.9	4.84	8.3	387	SANDY SILT
3.80	33.50	3.86	5.91		476	0.33		128.6	45.4	1.03	44.1	0.57	0.9	796	SAND
4.00	33.30	15.31	2.77		913	1.82		194.0	43.7	1.05	42.3	14.65	23.6	2652	SILTY SAND
4.20	33.10	20.38	2.11		962	2.49		190.9	42.4	1.08	41.1	28.22	43.8	3052	SILTY SAND
4.40	32.90	18.23	1.87		790	2.24		176.8	42.2	1.11	40.9	23.68	35.5	2423	SILTY SAND
4.60	32.70	16.41	2.08		816	2.01		174.8	42.3	1.15	41.1	19.83	28.8	2422	SILTY SAND

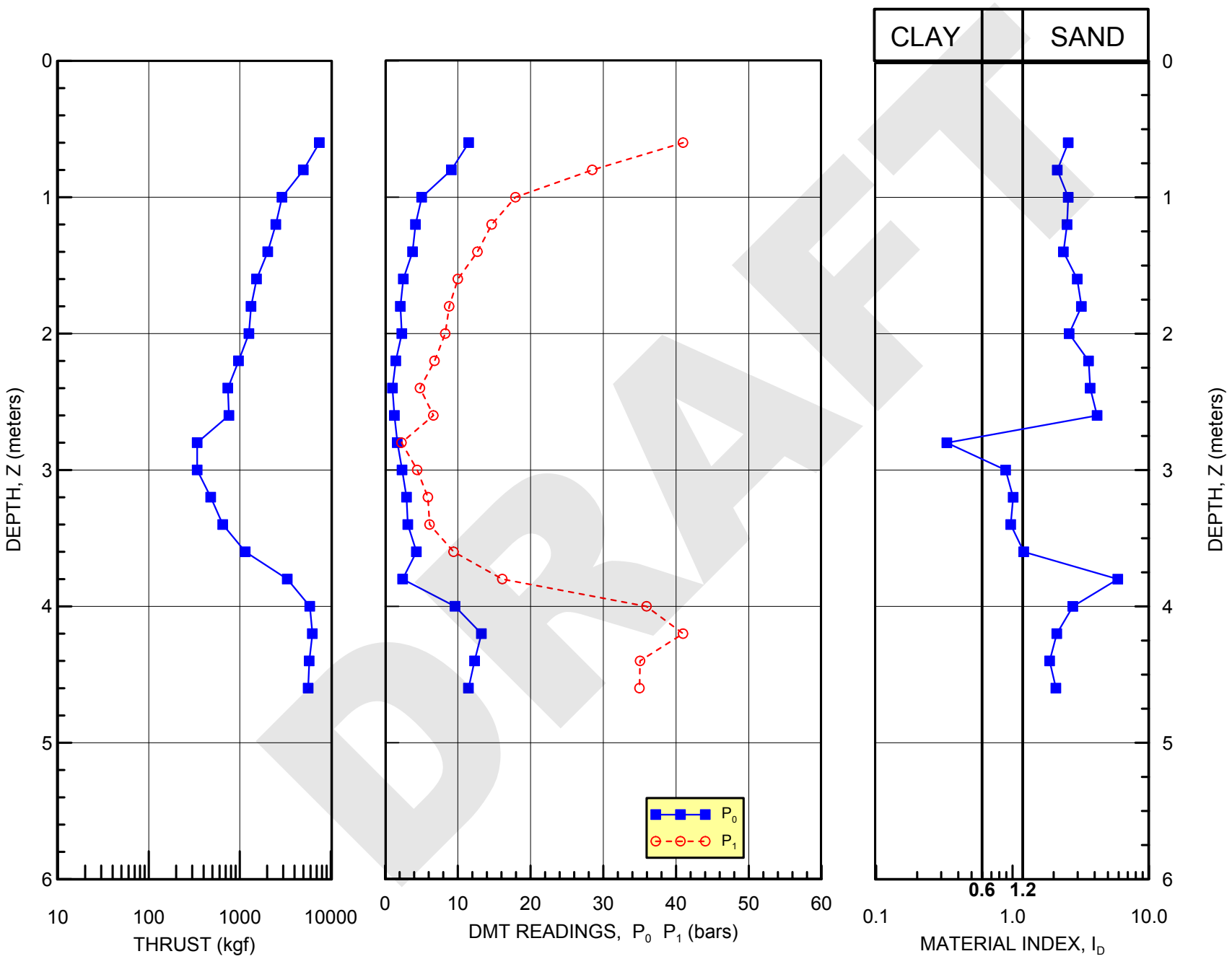
Ground Surface Elev.: ~37.3 m
Water Depth: ~2.9 m

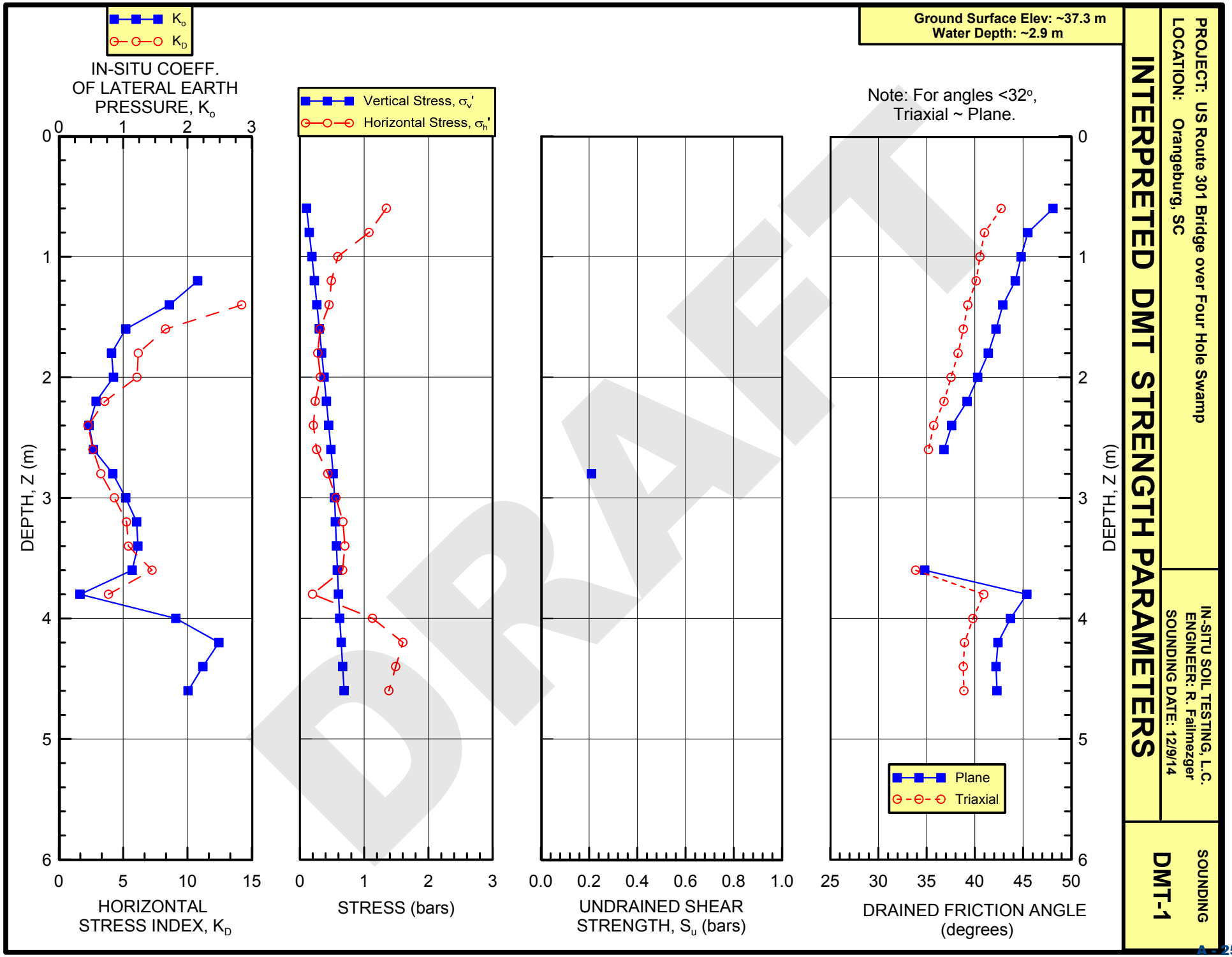
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

DILATOMETER RESULTS

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-1




Ground Surface Elev: ~37.3 m
Water Depth: ~2.9 m
INTERPRETED DMT STRENGTH PARAMETERS
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14
SOUNDING
DMT-1
Note: For angles <32°, Triaxial ~ Plane.
IN-SITU COEFF. OF LATERAL EARTH PRESSURE, K_o
K_o
K_D
HORIZONTAL STRESS INDEX, K_D
Vertical Stress, σ_v'
Horizontal Stress, σ_h'
STRESS (bars)
UNDRAINED SHEAR STRENGTH, S_u (bars)
Plane
Triaxial
DRAINED FRICTION ANGLE (degrees)
DEPTH, Z (m)
DRAFT

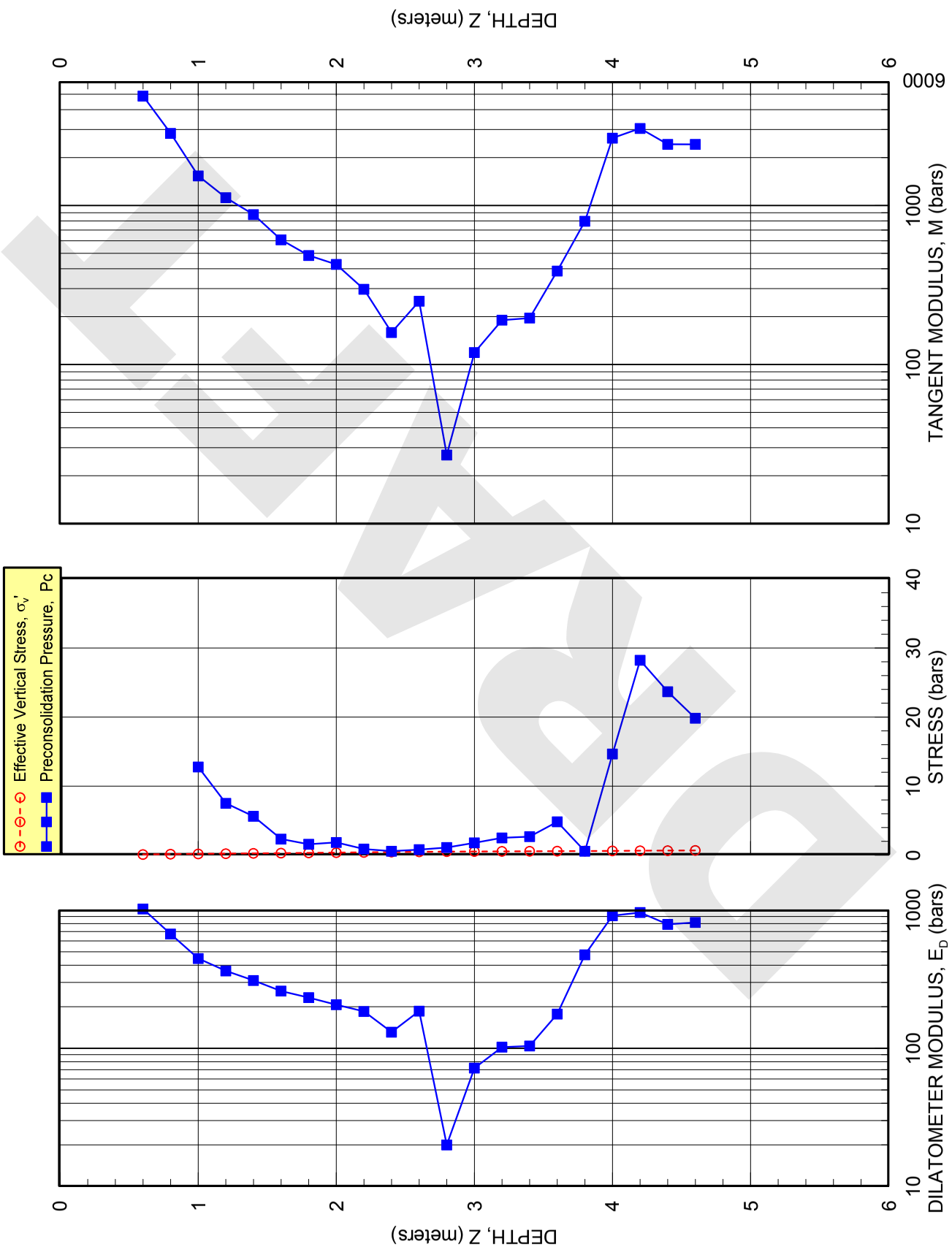
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-1

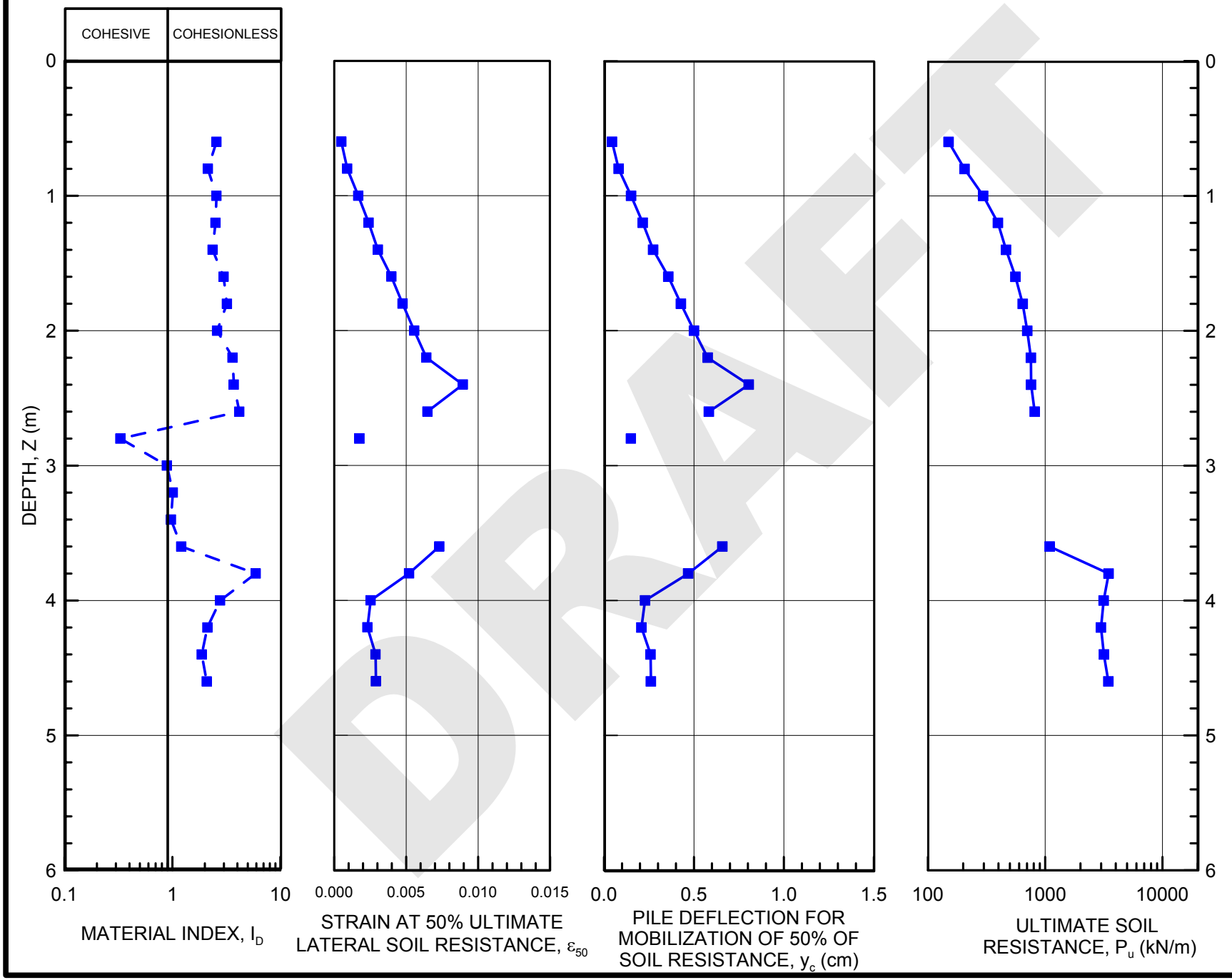
INTERPRETED DMT DEFORMATION PARAMETERS

Ground Surface Elev.: ~37.3 m
Water Depth: ~2.9 m



Pile Width/Diameter = 14 inches 36 cm

Ground Surface Elev: ~37.3 m
Water Depth: ~2.9 m



INTERPRETED P-y PARAMETERS FOR LATERAL LOAD ANALYSES

PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-1

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL) SNDG. NO. :DMT-2
In-Situ Soil Testing, L.C. Page 1a
JOB FILE: US Route 301 Bridge over Four Hole Swamp FILE NO. : 2014-68
LOCATION: Orangeburg, SC
SNDG.BY : R. Failmezger SNDG. DATE: 12/9/14
ANAL.BY : Roger Failmezger, P.E. ANAL. DATE: 12/9/14

ANALYSIS PARAMETERS: LO RANGE = 9.50 BARS ROD DIAM. = 3.6 CM BL.THICK. = 15.0 MM SU FACTOR = 1
SURF.ELEV. = 37.4 M LO GAGE 0 = 0.00 BARS FR.RED.DIA. = 4.4 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1
WATER DEPTH = 3.7 M HI GAGE 0 = 0.00 BARS LIN.ROD WT. = 6.5 KGF/M DELTA-A = 0.23 BARS OCR FACTOR = 1
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA/PHI = 0.5 DELTA-B = 0.36 BARS M FACTOR = 1
MAX SU ID = 0.6 SU OPTION = 0 MIN PHI ID = 1.2 OCR OPTION = 0 K0 FACTOR = 1
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	ELEV (M)	THRUST (KGF)	A (BAR)	B (BAR)	C (BAR)	DA (BAR)	DB (BAR)	ZMRNG (BAR)	ZMLO (BAR)	ZMHI (BAR)	ZMCAL (BAR)	P0 (BAR)	P1 (BAR)	P2 (BAR)	U0 (BAR)	GAMMA (T/M3)	SVP (BAR)
0.40	37.00	4540	6.15	25.29		0.23	0.36	9.50	0.00	0.00	0.00	5.45	24.93		0.000	2.00	0.070
0.60	36.80	4150	7.41	26.61		0.23	0.36	9.50	0.00	0.00	0.00	6.71	26.25		0.000	2.00	0.109
0.80	36.60	1980	5.06	12.41		0.23	0.36	9.50	0.00	0.00	0.00	4.95	12.05		0.000	1.80	0.147
1.00	36.40	1580	2.93	10.00		0.23	0.36	9.50	0.00	0.00	0.00	2.84	9.64		0.000	1.90	0.183
1.20	36.20	1720	3.22	12.15		0.23	0.36	9.50	0.00	0.00	0.00	3.03	11.79		0.000	1.90	0.220
1.40	36.00	1700	2.64	11.34		0.23	0.36	9.50	0.00	0.00	0.00	2.46	10.98		0.000	1.90	0.257
1.60	35.80	1450	2.56	10.41		0.23	0.36	9.50	0.00	0.00	0.00	2.43	10.05		0.000	1.90	0.295
1.80	35.60	970	2.20	8.02		0.23	0.36	9.50	0.00	0.00	0.00	2.17	7.66		0.000	1.90	0.332
2.00	35.40	640	1.36	5.27		0.23	0.36	9.50	0.00	0.00	0.00	1.42	4.91		0.000	1.80	0.368
2.20	35.20	530	0.85	4.50		0.23	0.36	9.50	0.00	0.00	0.00	0.93	4.14		0.000	1.70	0.403
2.40	35.00	520	0.71	4.77		0.23	0.36	9.50	0.00	0.00	0.00	0.77	4.41		0.000	1.70	0.436
2.70	34.70	660	1.67	6.62		0.23	0.36	9.50	0.00	0.00	0.00	1.68	6.26		0.000	1.80	0.488
2.80	34.60	700	1.35	6.49		0.23	0.36	9.50	0.00	0.00	0.00	1.35	6.13		0.000	1.80	0.505
3.00	34.40	460	1.52	2.85		0.23	0.36	9.50	0.00	0.00	0.00	1.71	2.49		0.000	1.60	0.539
3.20	34.20	200	0.88	1.73		0.23	0.36	9.50	0.00	0.00	0.00	1.10	1.37		0.000	1.50	0.569
3.40	34.00	180	0.81	1.57		0.23	0.36	9.50	0.00	0.00	0.00	1.03	1.21		0.000	1.50	0.598
3.70	33.70	1240	1.86	3.45		0.21	0.07	9.50	0.00	0.00	0.00	2.00	3.38		0.000	1.70	0.646
3.80	33.60	2200	6.36	14.79		0.21	0.07	9.50	0.00	0.00	0.00	6.16	14.72		0.010	1.95	0.654
4.00	33.40	5890	9.90	31.55		0.21	0.07	9.50	0.00	0.00	0.00	9.04	31.48		0.029	2.15	0.674
4.30	33.10	9270	19.98	50.38		0.21	0.07	9.50	0.00	0.00	0.00	18.68	50.31		0.059	2.10	0.707
4.40	33.00	9310	21.15	51.52		0.21	0.07	9.50	0.00	0.00	0.00	19.86	51.45		0.069	2.10	0.718
4.60	32.80	9300	23.41	52.41		0.21	0.07	9.50	0.00	0.00	0.00	22.18	52.34		0.088	2.10	0.740

DILATOMETER DATA LISTING & INTERPRETATION (BASED ON THE 1988 DILATOMETER MANUAL)
In-Situ Soil Testing, L.C.
JOB FILE: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC
SNDG.BY : R. Failmezger
ANAL.BY : Roger Failmezger, P.E.

SNDG. NO. : DMT-2
Page 1b
FILE NO. :2014-68

SNDG. DATE: 12/9/14
ANAL. DATE: 12/9/14

ANALYSIS PARAMETERS: LO RANGE = 9.50 BARS ROD DIAM. = 3.6 CM BL.THICK. = 15.0 MM SU FACTOR = 1
SURF.ELEV. = 37.4 M LO GAGE 0 = 0.00 BARS FR.RED.DIA. = 4.4 CM BL.WIDTH = 96.0 MM PHI FACTOR = 1
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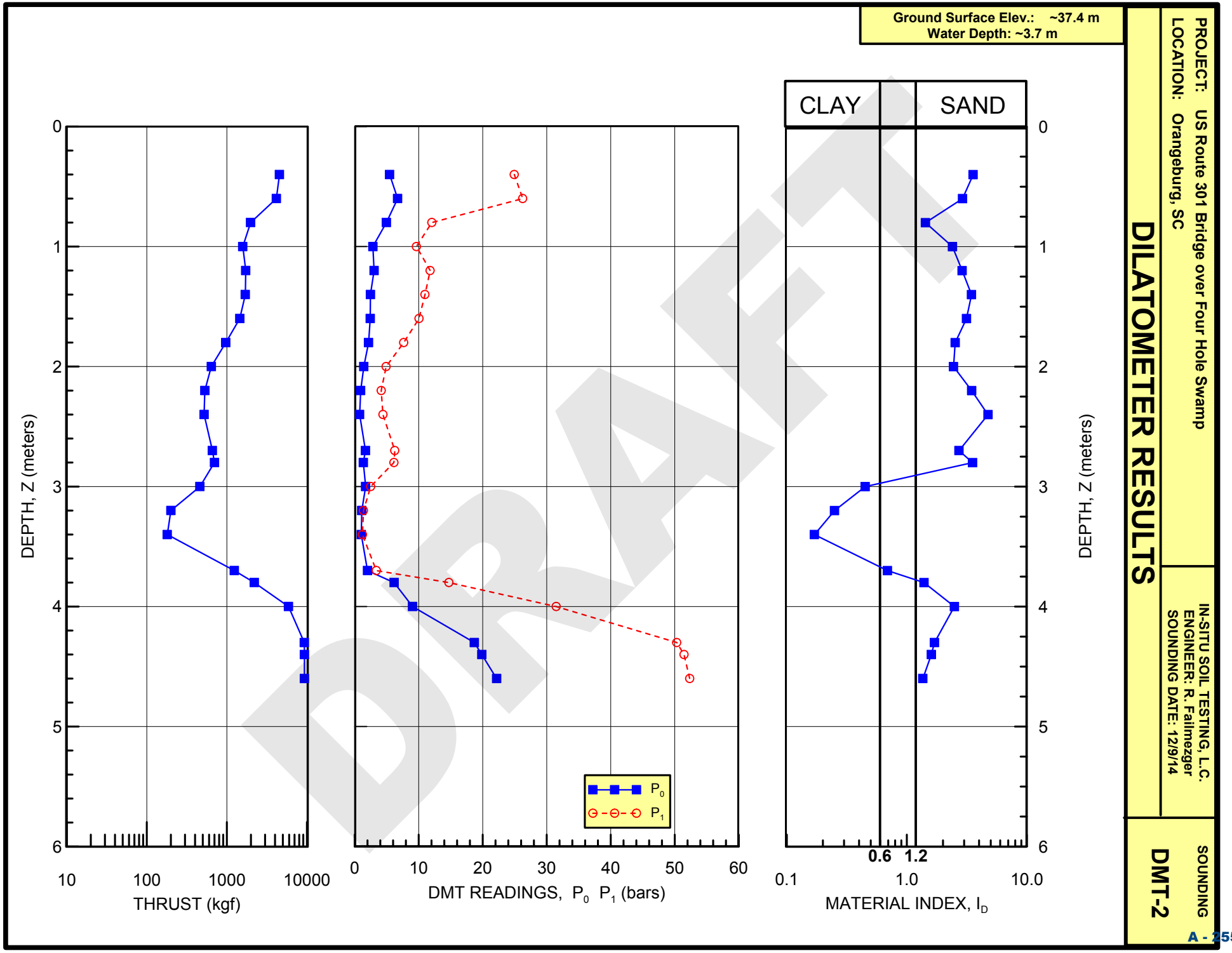
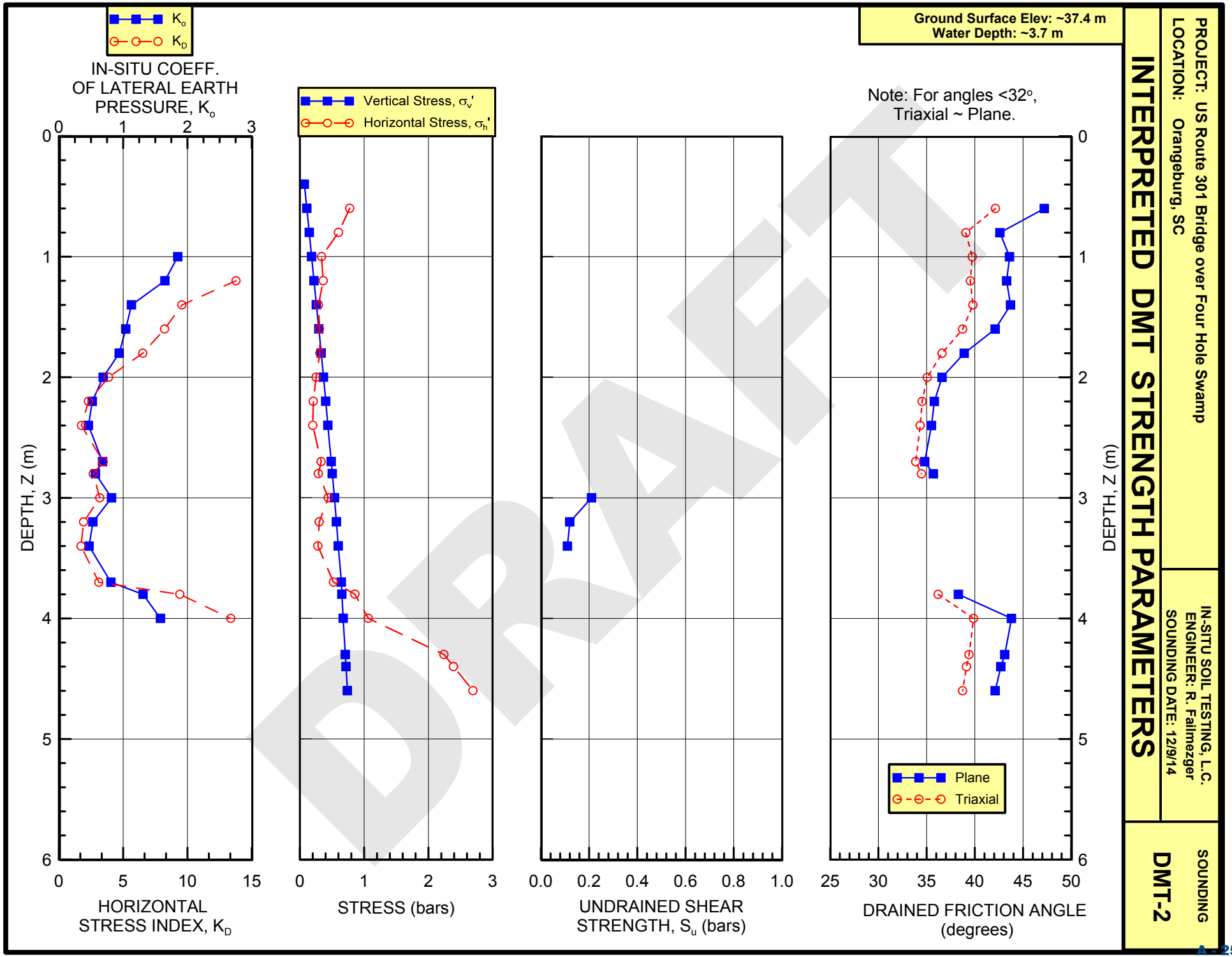
SP.GR.WATER = 1.000 CAL GAGE 0 = 0.00 BARS DELTA / PHI = 0.5 DELTA-B = 0.36 BARS M FACTOR = 1
MAX SU ID = 0.6 SU OPTION = 0 MIN PHI ID = 1.2 OCR OPTION = 0 K0 FACTOR = 1
UNIT CONVERSIONS: 1 BAR = 1.019 KGF/CM2 = 100 KPA = 1.044 TSF = 14.51 PSI 1 M = 3.2808 FT

Z (M)	ELEV (M)	KD	ID	UD	ED (BAR)	K0	SU (BAR)	QD (BAR)	PHI (DEG)	SIGFF (BAR)	PHIO (DEG)	PC (BAR)	OCR	M (BAR)	SOIL TYPE
0.40	37.00	77.89	3.57		676									3003	SAND
0.60	36.80	61.41	2.91		678	7.12		132.5	47.2	0.19	43.8	33.57	307.3	2860	SILTY SAND
0.80	36.60	33.79	1.43		246	4.09		55.4	42.6	0.25	39.0	17.24	117.6	900	SANDY SILT
1.00	36.40	15.51	2.40		236	1.85		50.7	43.6	0.31	40.4	4.45	24.4	688	SILTY SAND
1.20	36.20	13.78	2.89		304	1.65		55.7	43.3	0.37	40.4	4.30	19.5	852	SILTY SAND
1.40	36.00	9.57	3.46		295	1.13		58.2	43.7	0.44	41.0	2.39	9.3	728	SAND
1.60	35.80	8.23	3.14		265	1.04		48.4	42.1	0.49	39.5	2.26	7.7	617	SILTY SAND
1.80	35.60	6.53	2.53		191	0.94		30.6	38.9	0.54	36.3	1.97	5.9	403	SILTY SAND
2.00	35.40	3.87	2.45		121	0.69		21.1	36.6	0.59	33.9	1.05	2.8	198	SILTY SAND
2.20	35.20	2.30	3.47		111	0.52		19.2	35.8	0.64	33.2	0.60	1.5	136	SAND
2.40	35.00	1.76	4.75		126	0.46		19.6	35.5	0.69	33.1	0.49	1.1	125	SAND
2.70	34.70	3.45	2.72		159	0.68		21.3	34.8	0.77	32.4	1.28	2.6	247	SILTY SAND
2.80	34.60	2.68	3.53		166	0.57		24.5	35.7	0.80	33.6	0.91	1.8	225	SAND
3.00	34.40	3.18	0.45		27	0.82	0.21					1.11	2.1	36	SILTY CLAY
3.20	34.20	1.93	0.25		9	0.53	0.12					0.54	0.9	8	MUD
3.40	34.00	1.72	0.17		6	0.47	0.11					0.47	0.8	5	MUD
3.70	33.70	3.11	0.69		48	0.81						1.28	2.0	62	CLAYEY SILT
3.80	33.60	9.41	1.39		297	1.31		62.5	38.3	1.06	36.7	7.65	11.7	725	SANDY SILT
4.00	33.40	13.37	2.49		779	1.58		197.0	43.8	1.14	42.5	12.10	17.9	2160	SILTY SAND
4.30	33.10	26.33	1.70		1097	3.17		283.7	43.1	1.19	41.9	49.98	70.7	3749	SANDY SILT
4.40	33.00	27.55	1.60		1096	3.33		279.5	42.7	1.21	41.6	56.20	78.3	3793	SANDY SILT
4.60	32.80	29.87	1.36		1046	3.64		267.3	42.1	1.24	40.9	69.73	94.3	3700	SANDY SILT


Ground Surface Elev.: ~37.4 m
Water Depth: ~3.7 m
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC
DILATOMETER RESULTS
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14
SOUNDING
DMT-2
DRAFT
CLAY
SAND
DEPTH, Z (meters)
THRUST (kgf)
10
100
1000
10000
DMT READINGS, P0 P1 (bars)
0
10
20
30
40
50
60
P0
P1
MATERIAL INDEX, ID
0.1
1.0
10.0
0.6
1.2
0
1
2
3
4
5
6


Ground Surface Elev: ~37.4 m
Water Depth: ~3.7 m
INTERPRETED DMT STRENGTH PARAMETERS
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC
IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14
SOUNDING
DMT-2
Note: For angles <32°, Triaxial ~ Plane.
IN-SITU COEFF. OF LATERAL EARTH PRESSURE, Ko
Ko
KD
HORIZONTAL STRESS INDEX, KD
Vertical Stress, σv'
Horizontal Stress, σh'
STRESS (bars)
UNDRAINED SHEAR STRENGTH, Su (bars)
DRAINED FRICTION ANGLE (degrees)
Plane
Triaxial
DEPTH, Z (m)
DRAFT

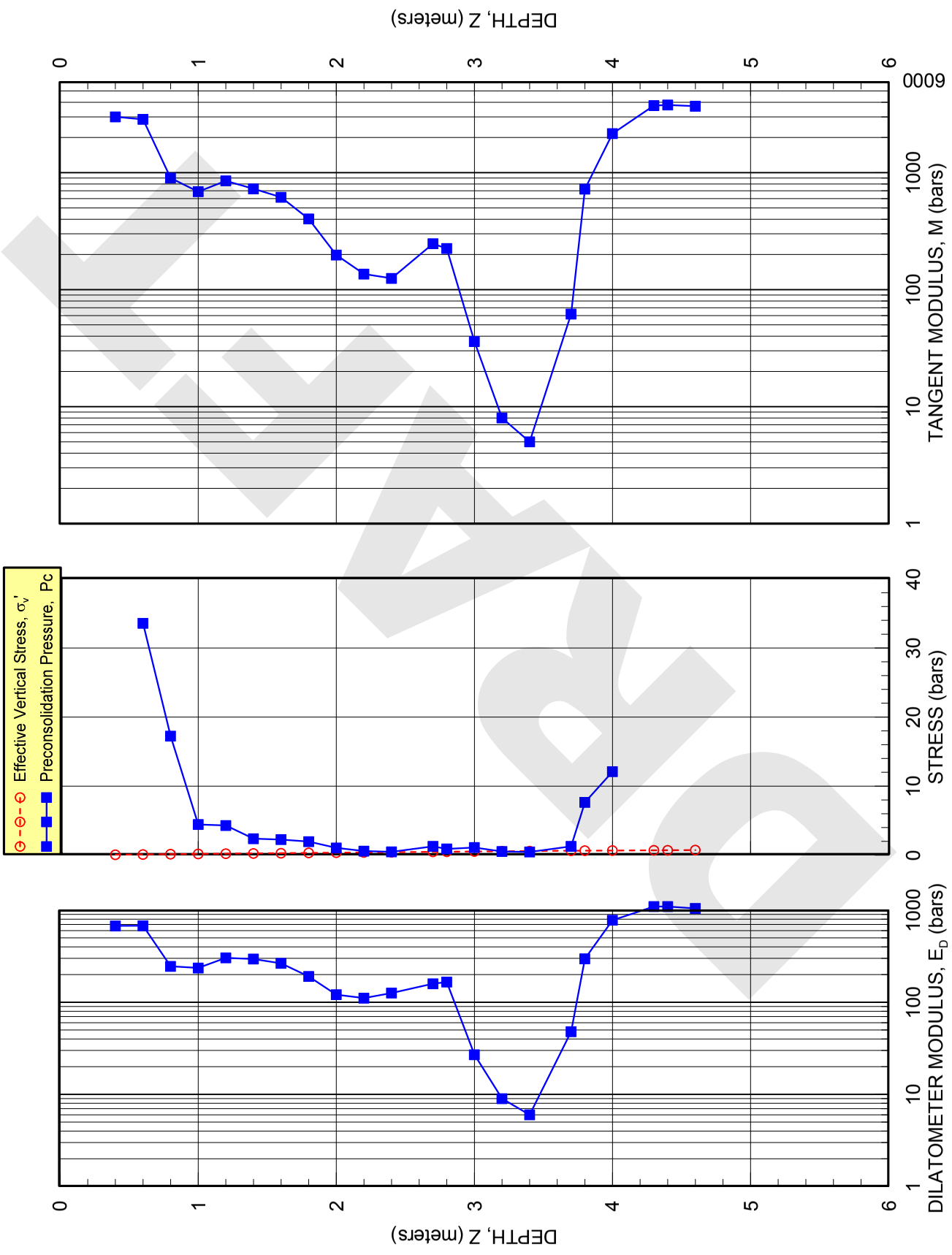
PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-2

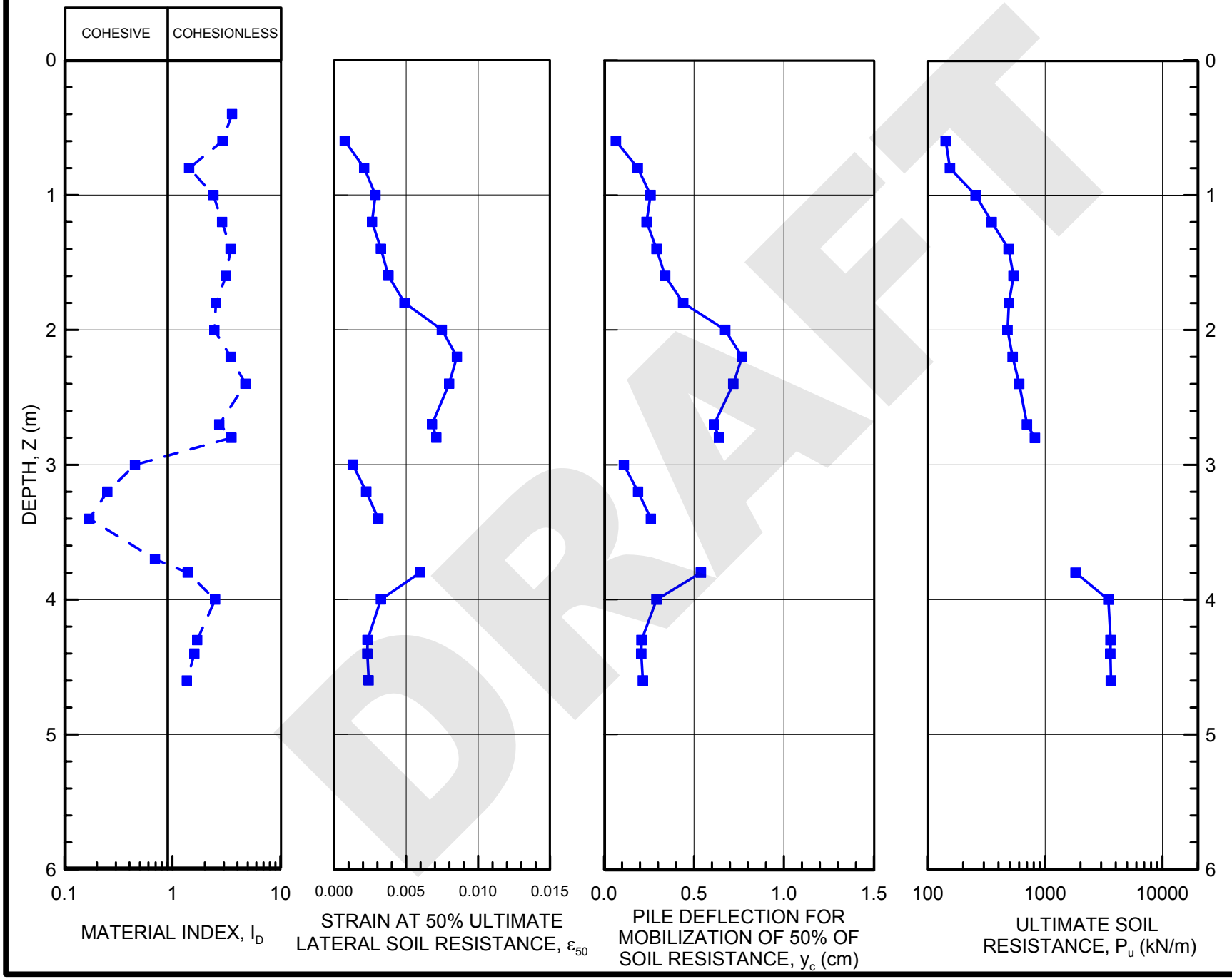
INTERPRETED DMT DEFORMATION PARAMETERS

Ground Surface Elev.: ~37.4 m
Water Depth: ~3.7 m



Pile Width/Diameter = 14 inches 36 cm

Ground Surface Elev: ~37.4 m
Water Depth: ~3.7 m



INTERPRETED P-y PARAMETERS FOR LATERAL LOAD ANALYSES

PROJECT: US Route 301 Bridge over Four Hole Swamp
LOCATION: Orangeburg, SC

IN-SITU SOIL TESTING, L.C.
ENGINEER: R. Failmezger
SOUNDING DATE: 12/9/14

SOUNDING
DMT-2

LABORATORY TESTING PROGRAM

General

Soil samples obtained during the field explorations were examined in our laboratory. The physical characteristics of the samples were noted and the field classifications were modified where necessary in accordance with terminology presented the General Notes included in this appendix.

Visual-Manual Classification

The soil samples were classified in general accordance with guidelines presented in ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Certain terminologies incorporating current local engineering practice, as provided in the Soil Classification Chart are included with or in lieu of ASTM terminology. The term which best described the major portion of the sample was used in determining the soil type (that is, gravel, sand, silt or clay).

Laboratory Testing

Representative samples were selected by SCDOT during the course of soil test boring log examination and requested for further testing. Undisturbed samples were extruded and selected for engineering property tests, as directed by SCDOT Engineers. The laboratory program requested included determinations of Natural Moisture Content, Atterberg Limits, #200 Sieve Wash, Hydrometer Analysis, Organic Loss, Consolidation Test, Triaxial Compression Test, and Corrosion Series Tests. All Tests were performed in general accordance with the proper ASTM Standards and the SCDOT Geotechnical Design Manual.

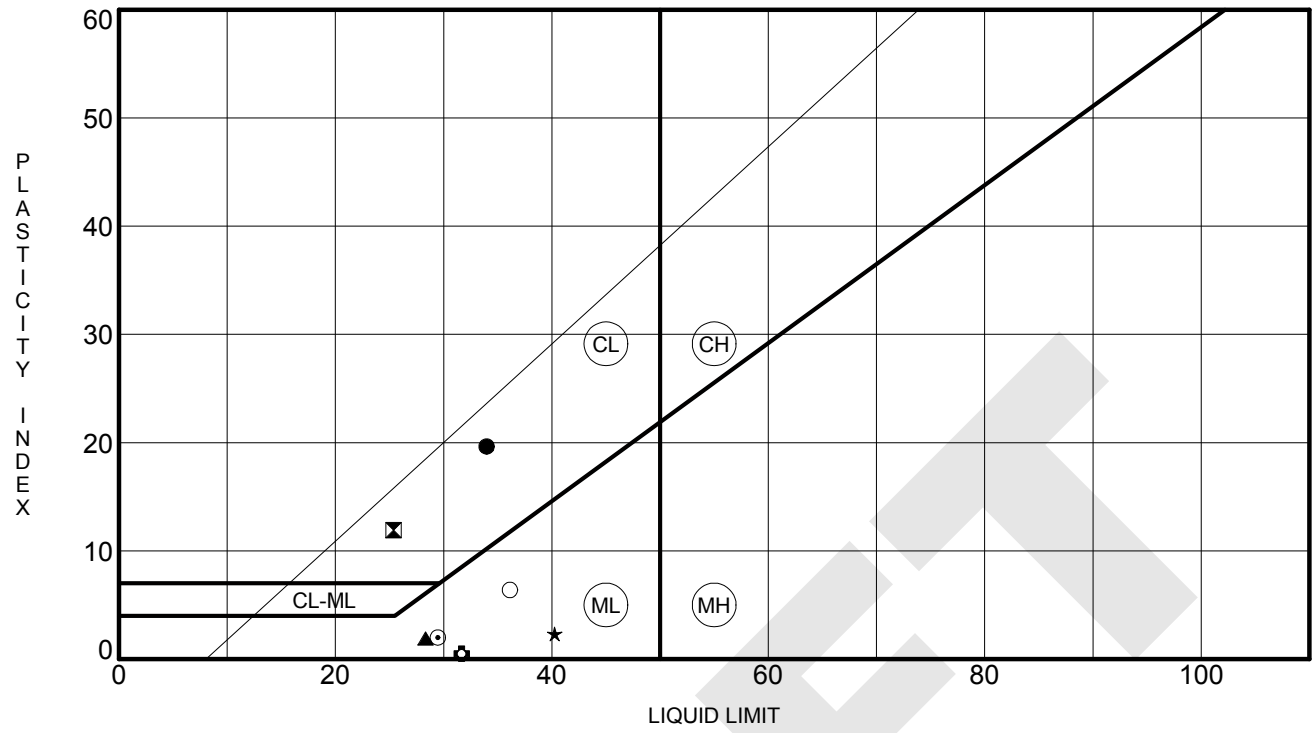
Moisture Content

SC File #38-40308.2

Bridge Replacement over Four Hole Swamp

Orangeburg County

Boring		Depth (ft.)	Moisture Content
B-1A	SS-5	8.7	24.5%
B-1A	SS-6	13.5	20.5%
B-1A	SS-11	38.5	37.0%
B-1A	SS-12	43.5	46.0%
B-1A	SS-13	48.5	35.3%
B-1A	SS-14	53.5	36.7%
B-1A	SS-17	68.5	32.7%
B-3A	SS-6	24.7	33.3%
B-3A	SS-7	31.2	29.6%
B-3A	SS-12	54.7	43.6%
B-3A	SS-14	61.7	39.6%
B-3A	SS-19	71.2	316.1%
B-3A	SS-21	75.2	376.9%
B-3A	SS-22	77.2	336.3%
B-3A	SS-23	79.2	316.1%
B-3A	SS-24	81.2	305.5%
B-3A	SS-25	83.2	266.5%
B-3A	SS-27	87.2	42.6%
B-3A	SS-28	89.2	25.0%
B-3A	SS-34	120.7	30.3%
B-5A	SS-7	31.2	31.8%
B-5A	SS-9	41.2	35.3%
B-5A	SS-11	51.2	36.8%
B-5A	SS-13	61.2	34.9%
B-5A	SS-16	72.7	35.3%
B-5A	SS-24	88.7	32.8%
B-5A	SS-26	96.2	32.4%
B-5A	SS-30	116.2	48.2%
B-5A	SS-33	132.7	66.0%
B-6A	SS-8	35.2	27.4%
B-6A	SS-11	50.2	34.1%
B-6A	SS-12	55.2	39.9%
B-6A	SS-15	70.2	41.2%
B-6A	SS-19	77.7	32.0%
B-6A	SS-25	89.7	31.5%
B-6A	SS-28	105.2	29.1%
B-6A	SS-30	115.2	40.1%
B-6A	SS-32	125.2	38.0%
B-7A	SS-3	16.0	20.3%
B-7A	SS-4	18.0	19.9%
B-7A	SS-7	30.5	33.6%
B-7A	SS-9	40.5	42.8%
B-7A	SS-10	45.5	36.2%
B-7A	SS-13	60.5	43.3%
B-7A	SS-17	74.0	44.7%
B-7A	SS-22	84.0	55.9%
B-7A	SS-25	90.0	36.1%
B-7A	SS-28	105.5	26.7%



	Boring		Depth (ft)	LL	PL	PI	Fines	Classification (*Visual)
●	B-1A	SS-5	9.7	34	14	20	73.0	Soft gray Lean CLAY with sand (CL)
⊠	B-1A	SS-6	13.5	25	13	12	42.3	Loose gray fine to medium grained Clayey SAND (SC)
▲	B-1A	SS-11	38.5	28	26	2	57.7	Very stiff green gray Sandy SILT (ML)
★	B-1A	SS-12	43.5	40	38	2	49.3	Very dense green gray fine to coarse grained Silty SAND (SM)
⊙	B-1A	SS-13	48.5	29	27	2	56.0	Very stiff to hard green gray Sandy SILT (ML)
✿	B-1A	SS-14	53.5	32	31	1	66.3	Very stiff to hard green gray Sandy SILT (ML)
○	B-1A	SS-17	68.5	36	30	6	73.7	Hard to very hard green gray SILT with sand (ML)

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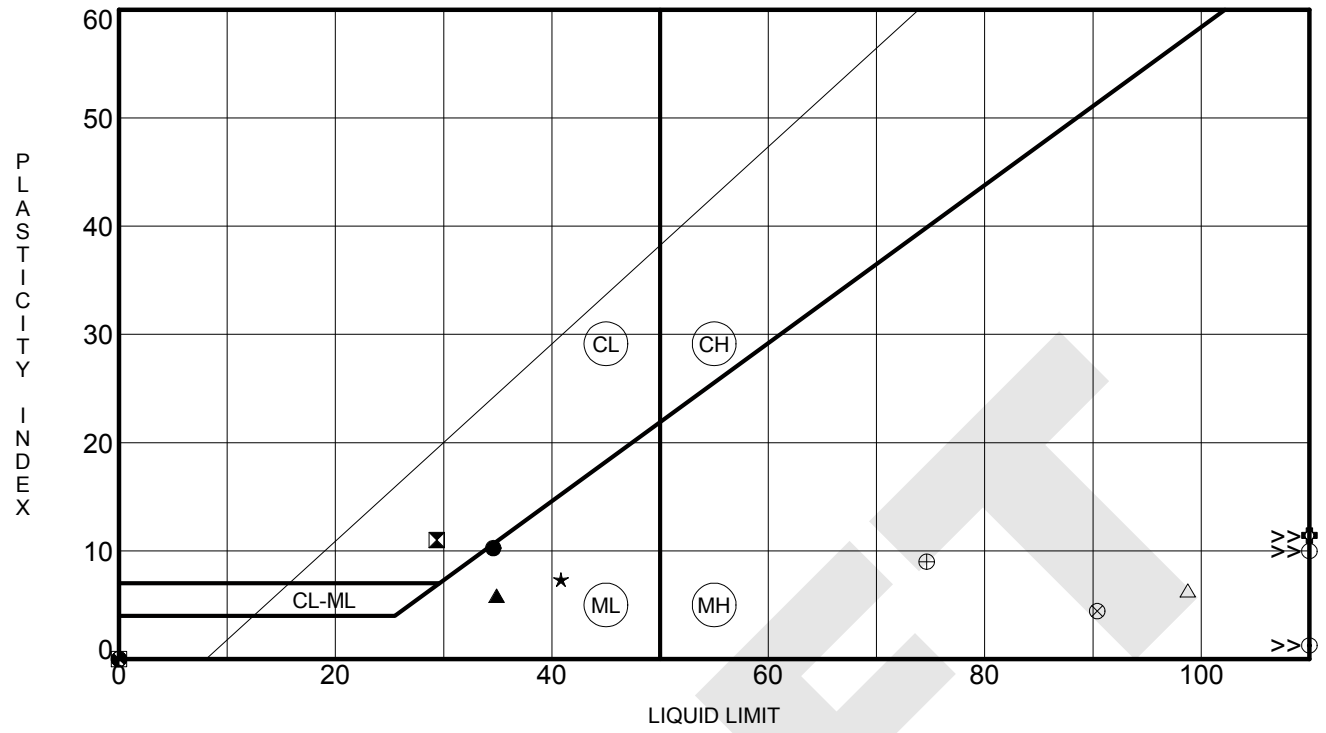
ATTERBERG LIMIT RESULTS

PSI Job No.: 0451644
Project: US301 Over Four Hole Swamp
Location: Orangeburg County, SC



	Boring		Depth (ft)	LL	PL	PI	Fines	Classification (*Visual)
●	B-3A	SS-6	24.7	35	24	11	53.1	Hard green gray Sandy SILT (ML)
⧓	B-3A	SS-7	29.7	29	18	11	42.8	Very dense green gray fine to medium grained Clayey SAND (SC)
▲	B-3A	SS-12	54.7	35	29	6	63.3	Very stiff to very hard green gray Sandy SILT (ML)
★	B-3A	SS-14	61.7	41	33	8	68.3	Very stiff to very hard green gray Sandy SILT (ML)
⊙	B-3A	SS-19	71.2	135	133	2	60.1	Very soft to soft dark green Sandy Elastic SILT (MH)
✿	B-3A	SS-21	75.2	113	102	11	64.0	Very soft to soft dark green Sandy Elastic SILT (MH)
○	B-3A	SS-22	77.2	111	101	10	62.8	Very soft to soft dark green Sandy Elastic SILT (MH)
△	B-3A	SS-23	79.2	99	92	7	41.0	Very soft to soft dark green fine to medium grained Silty SAND (SM)
⊗	B-3A	SS-24	81.2	90	86	4	39.7	Very soft to soft dark green fine to medium grained Silty SAND (SM)
⊕	B-3A	SS-25	83.2	75	66	9	32.8	Very soft to soft dark green fine to medium grained Silty SAND (SM)
□	B-3A	SS-27	87.2	NP	NP	NP	10.4	Med. dense-loose dk. green f-c well graded SAND w/silt (SW-SM)
⊛	B-3A	SS-28	89.2	NP	NP	NP	19.9	Dense dark green fine to coarse grained Silty SAND (SM)
◒	B-3A	SS-34	120.7	NP	NP	NP	5.0	Very dense dark gray f-m grained poorly graded SAND w/silt (SP-SM)

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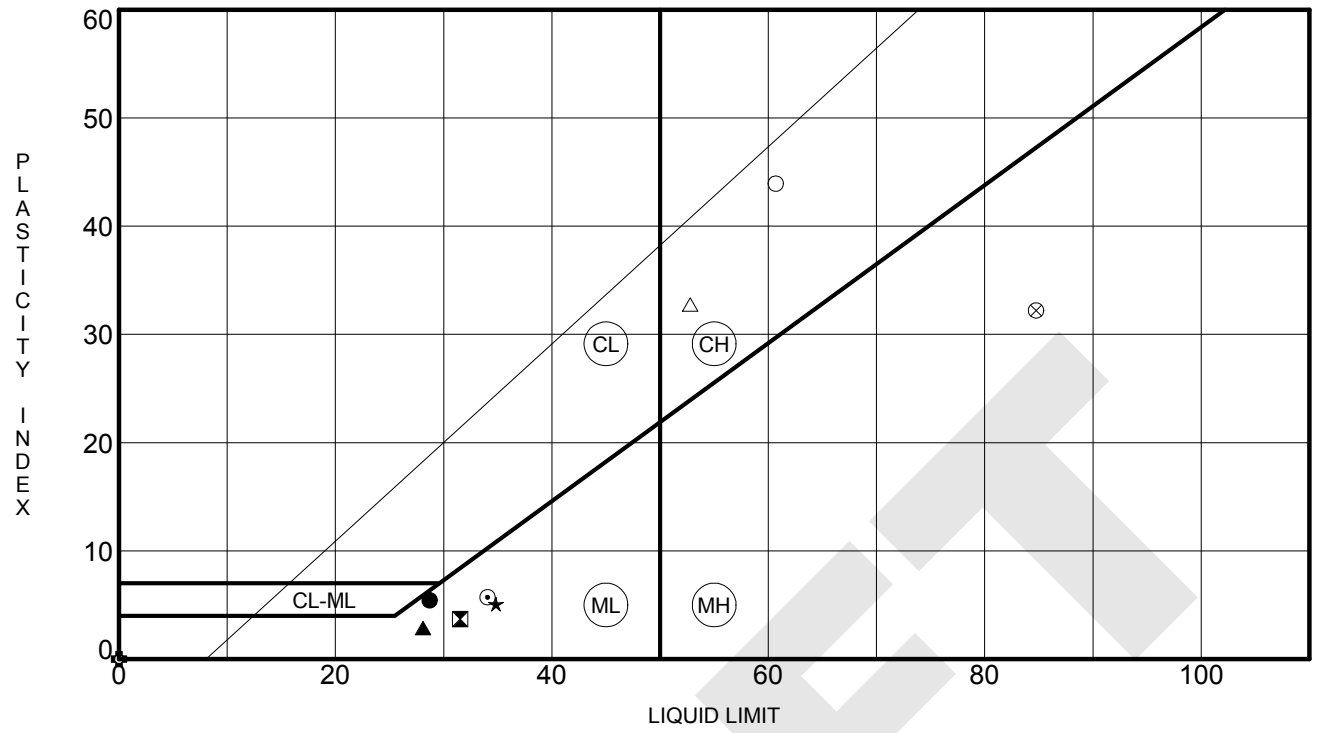
Project: US301 Over Four Hole Swamp
Location: Orangeburg County, SC



	Boring		Depth (ft)	LL	PL	PI	Fines	Classification (*Visual)
●	B-5A	SS-7	31.2	29	23	6	47.9	Very dense to dense green gray fine grained Silty SAND (SM)
⊠	B-5A	SS-9	41.2	32	28	4	63.4	Very stiff to very hard green gray Sandy SILT (ML)
▲	B-5A	SS-11	51.2	28	25	3	52.3	Very stiff to very hard green gray Sandy SILT (ML)
★	B-5A	SS-13	61.2	35	30	5	66.3	Very stiff to very hard green gray Sandy SILT (ML)
⊙	B-5A	SS-16	72.7	34	28	6	67.6	Very stiff to very hard green gray Sandy SILT (ML)
✿	B-5A	SS-24	88.7	NP	NP	NP	19.2	Dense dark green fine to medium grained Silty SAND (SM)
○	B-5A	SS-26	96.2	61	17	44	13.2	Very dense gray fine to coarse grained Clayey SAND (SC)
△	B-5A	SS-30	116.2	53	20	33	61.0	Hard black Sandy Fat CLAY (CH)
⊗	B-5A	SS-33	132.7	85	53	32	65.0	Very hard black Sandy Elastic SILT (MH)

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ATTERBERG LIMIT RESULTS

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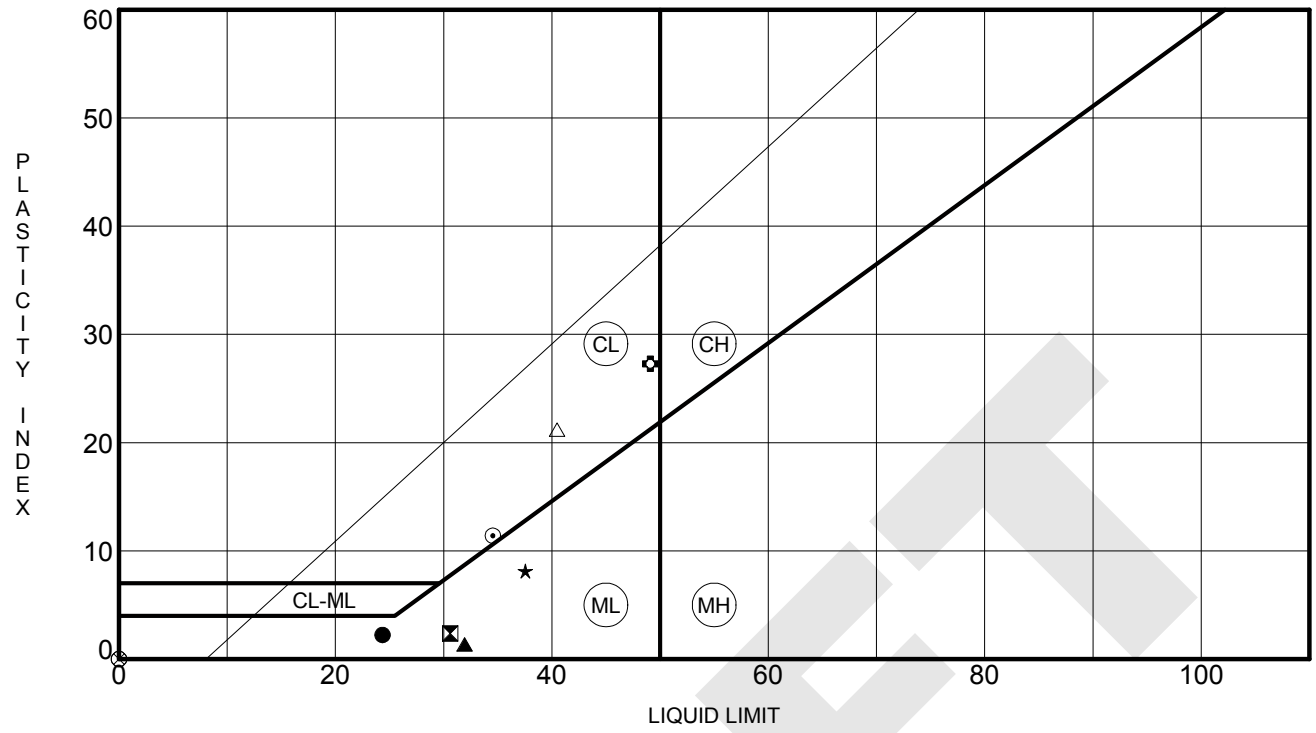
Project: US301 Over Four Hole Swamp
Location: Orangeburg County, SC



	Boring		Depth (ft)	LL	PL	PI	Fines	Classification (*Visual)
●	B-6A	SS-8	35.2	24	22	2	34.6	Very dense green gray fine grained Silty SAND (SM)
⊠	B-6A	SS-11	50.2	31	28	3	59.9	Very stiff to very hard green gray Sandy SILT (ML)
▲	B-6A	SS-12	55.2	32	31	1	68.2	Very stiff to very hard green gray Sandy SILT (ML)
★	B-6A	SS-15	70.2	38	29	9	72.2	Hard to very hard green gray SILT with sand (ML)
⊙	B-6A	SS-19	77.7	35	23	12	70.9	Hard to very hard green gray SILT with sand (ML)
✿	B-6A	SS-25	89.7	49	22	27	21.2	Medium dense dark green fine to medium grained Clayey SAND (SC)
○	B-6A	SS-28	105.2	NP	NP	NP	11.5	Very dense gray & black f-m poorly graded SAND w/silt (SP-SM)
△	B-6A	SS-30	115.2	40	19	21	56.0	Hard black Sandy Lean CLAY (CL)
⊗	B-6A	SS-32	125.2	NP	NP	NP	17.8	Very dense dark gray fine to medium grained Silty SAND (SM)

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ATTERBERG LIMIT RESULTS

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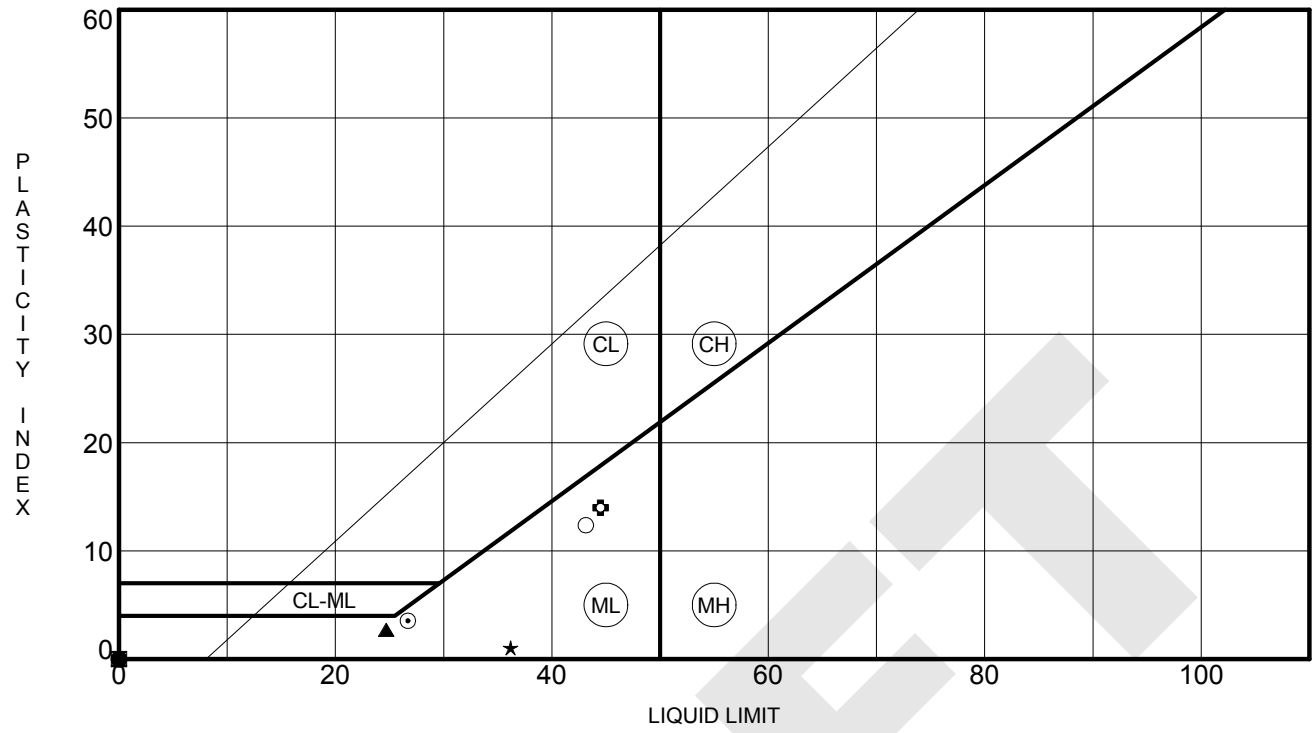
Project: US301 Over Four Hole Swamp
Location: Orangeburg County, SC



	Boring	Depth (ft)	LL	PL	PI	Fines	Classification (*Visual)
●	B-7A SS-3	16.0	NP	NP	NP	5.9	Very loose to loose gray m-c poorly graded SAND w/silt (SP-SM)
⊠	B-7A SS-4	18.0	NP	NP	NP	7.4	Very loose to loose gray m-c poorly graded SAND w/silt (SP-SM)
▲	B-7A SS-7	30.5	25	22	3	47.8	Dense to very dense green gray fine grained Silty SAND (SM)
★	B-7A SS-9	40.5	36	35	1	61.1	Very stiff to hard green gray Sandy SILT (ML)
⊙	B-7A SS-10	45.5	27	23	4	64.0	Very stiff to hard green gray Sandy SILT (ML)
✿	B-7A SS-13	60.5	44	31	13	76.0	Very hard green gray SILT with sand (ML)
○	B-7A SS-17	74.0	43	31	12	68.0	Hard to very hard green gray Sandy SILT (ML)
△	B-7A SS-22	84.0	NP	NP	NP	16.1	Loose dark green fine grained Silty SAND (SM)
⊗	B-7A SS-25	90.0	NP	NP	NP	16.4	Very dense gray fine to coarse grained Silty SAND (SM)
⊕	B-7A SS-28	105.5	NP	NP	NP	8.5	Very dense black f-m grained poorly graded SAND w/silt (SP-SM)

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ATTERBERG LIMIT RESULTS

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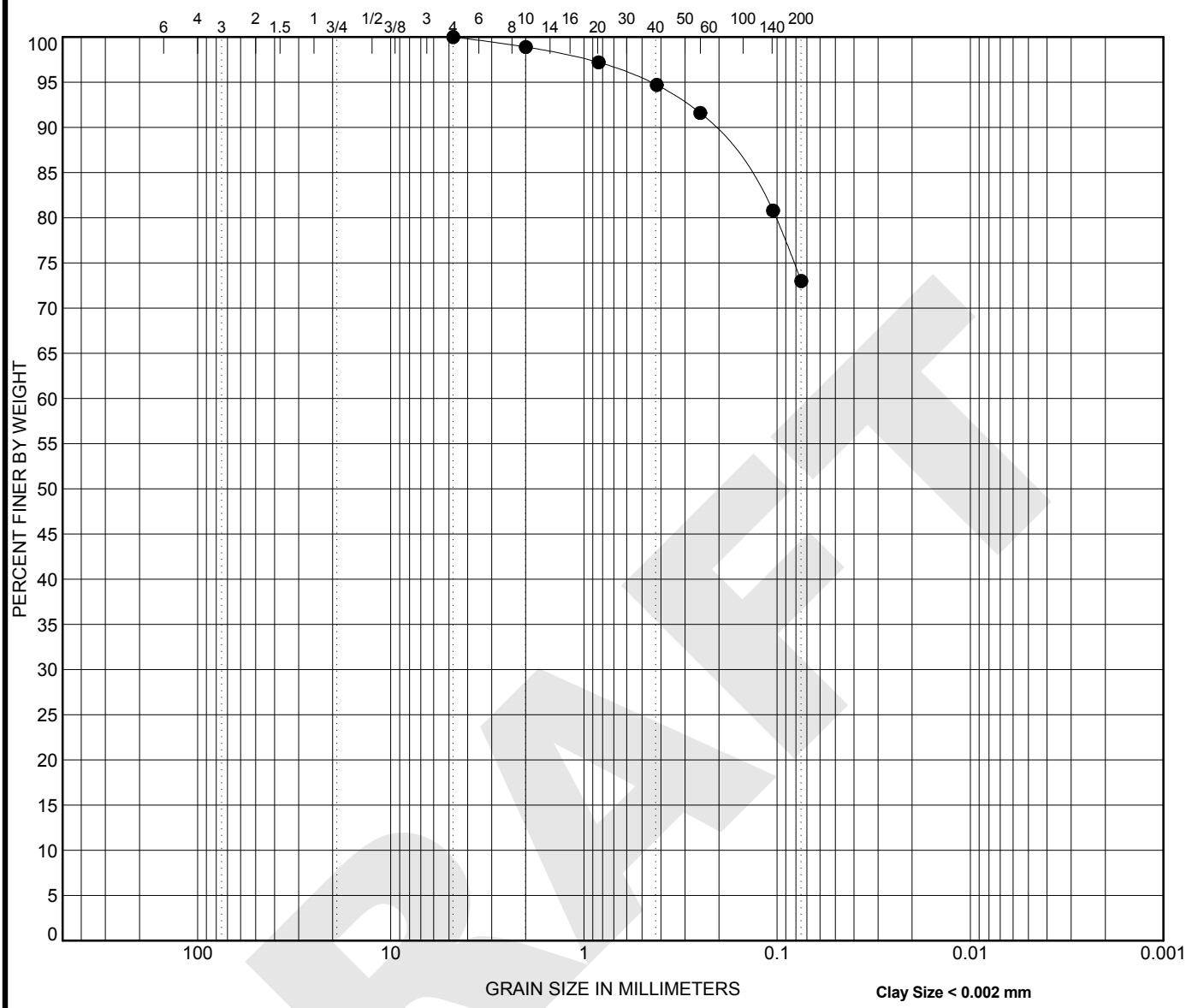

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-1A SS-5 9.7**	**Soft gray Lean CLAY with sand (CL)**	**34**	**14**	**20**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-1A SS-5 9.7**	**4.75**				**0.0**	**27.0**	**73.0**	

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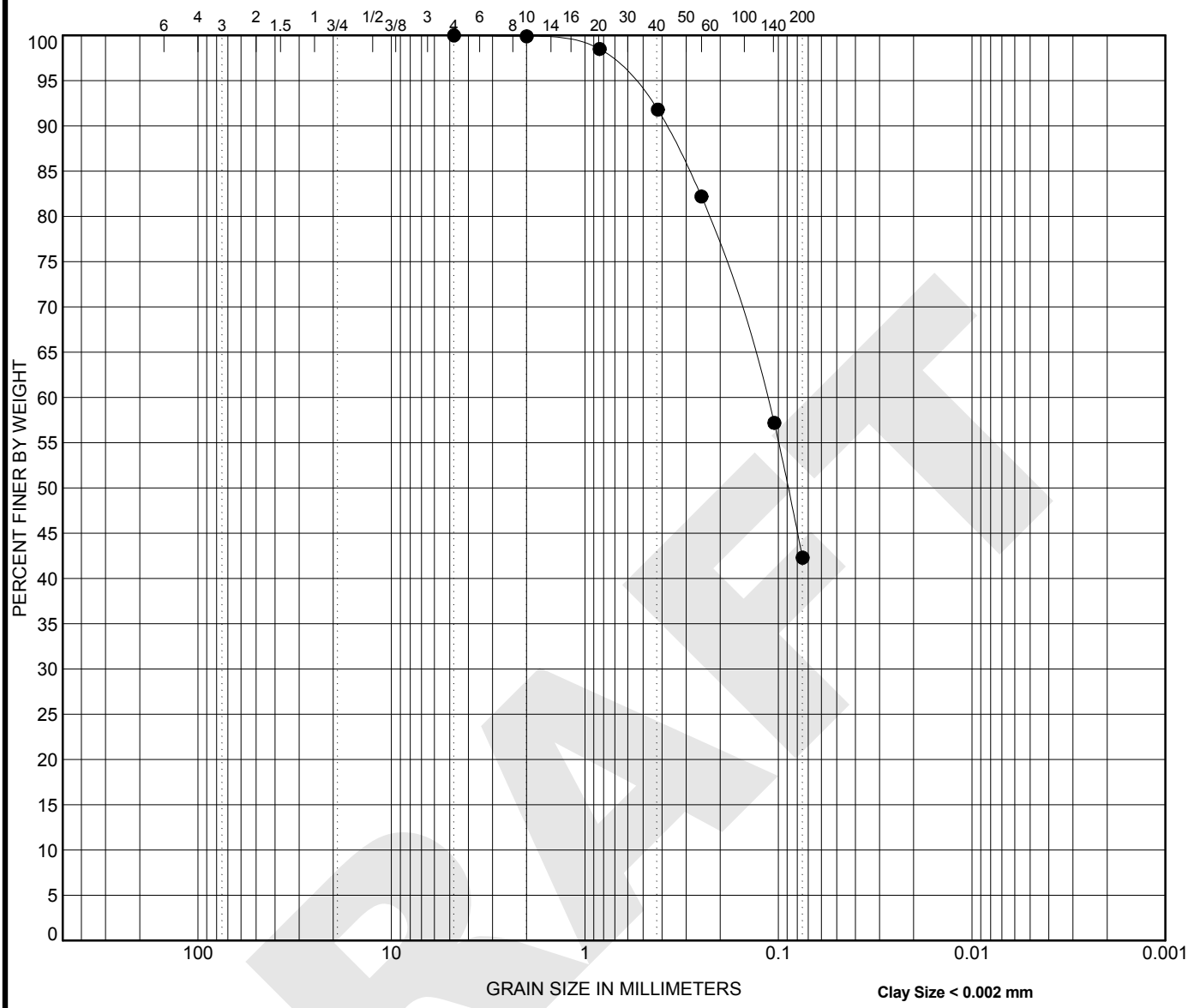
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-1A SS-6 13.5**	**Loose gray fine to medium grained Clayey SAND (SC)**	**25**	**13**	**12**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-1A SS-6 13.5**	**4.75**	**0.116**			**0.0**	**57.7**	**42.3**	

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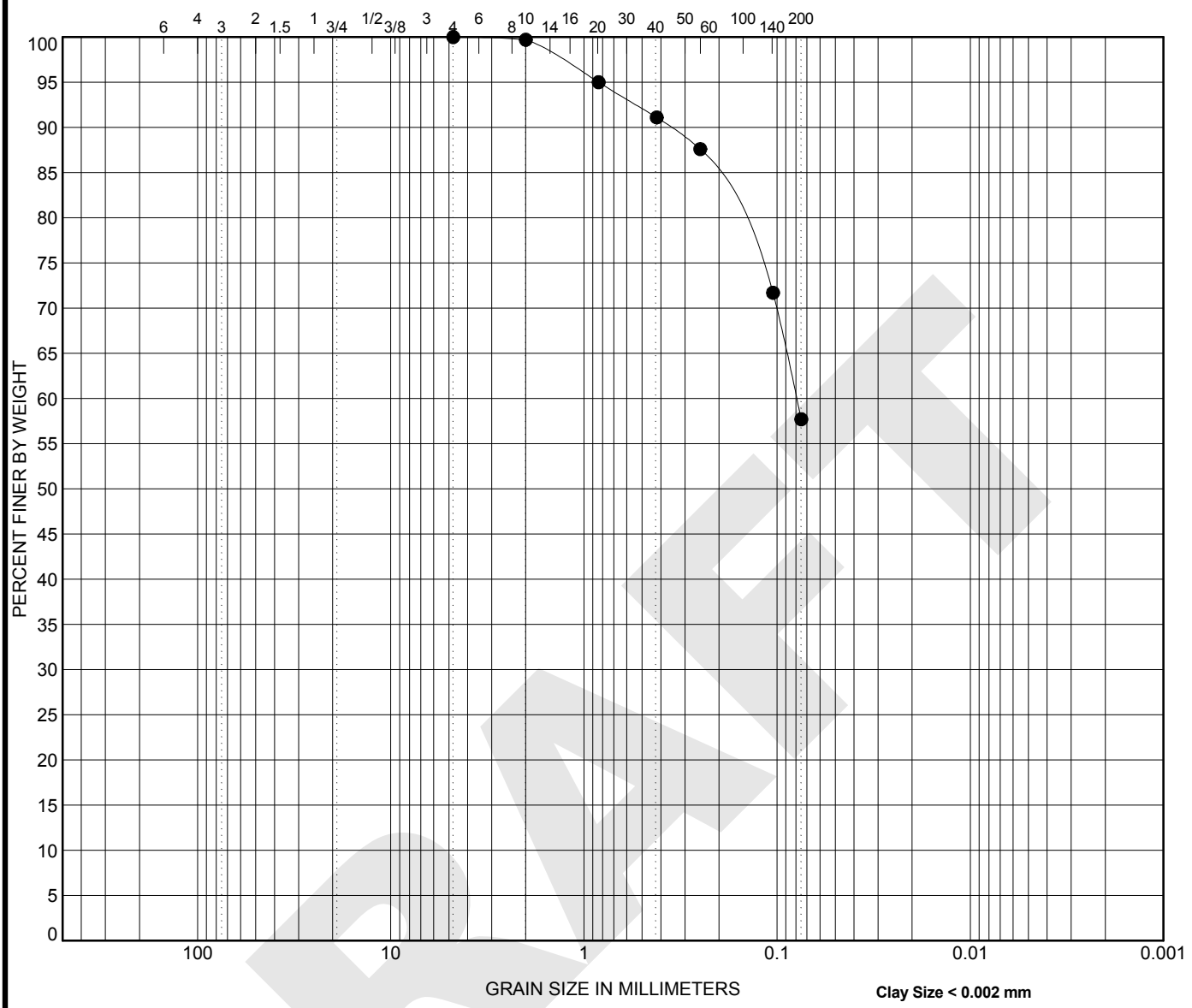
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● B-1A SS-11 38.5	Very stiff green gray Sandy SILT (ML)	28	26	2		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1A SS-11 38.5	4.75	0.079			0.0	42.3	57.7	

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GRAIN SIZE DISTRIBUTION

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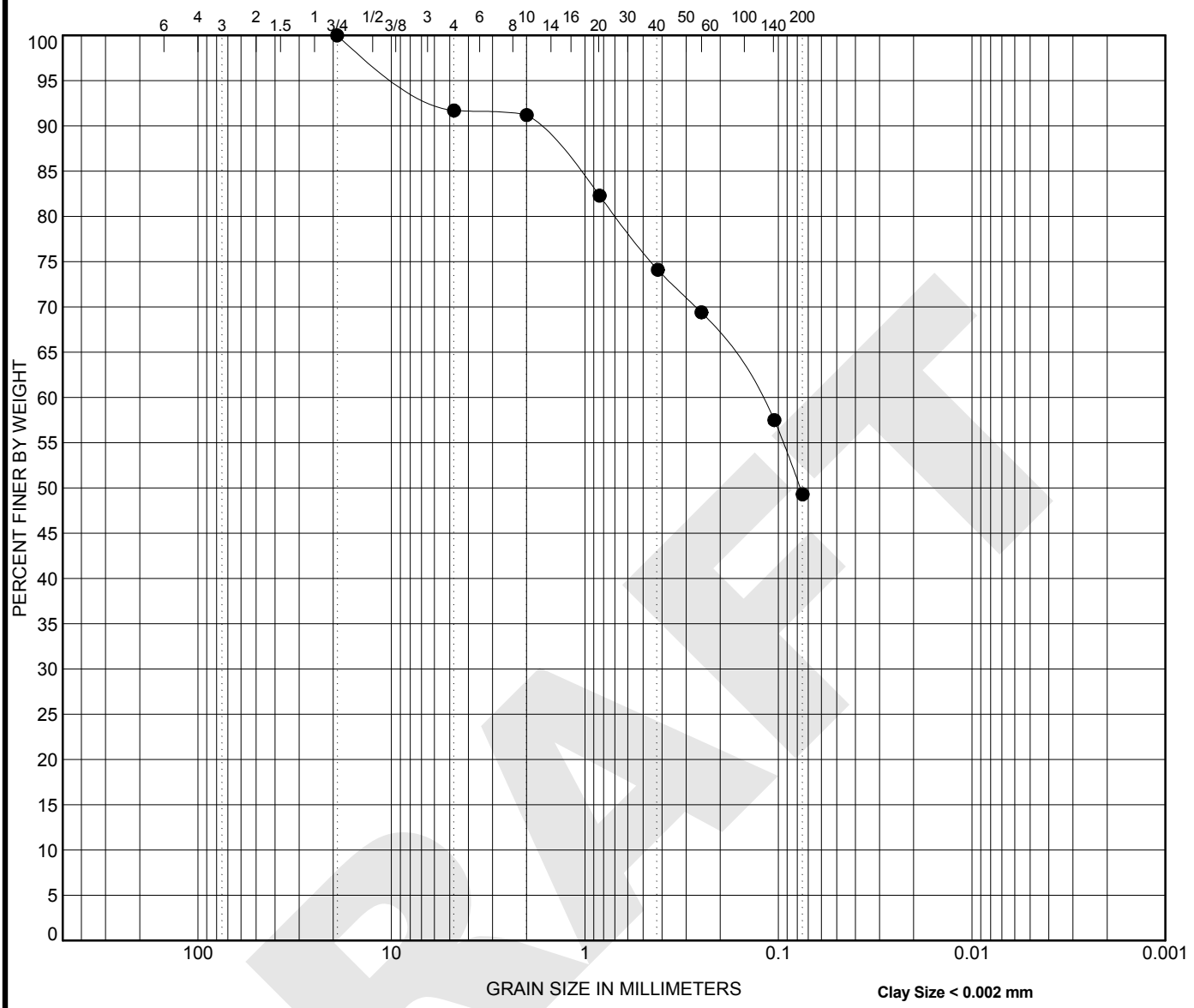
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-1A SS-12 43.5**	**Very dense green gray fine to coarse grained Silty SAND (SM)**	**40**	**38**	**2**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1A SS-12 43.5**	**19.1**	**0.126**			**8.3**	**42.4**	**49.3**	

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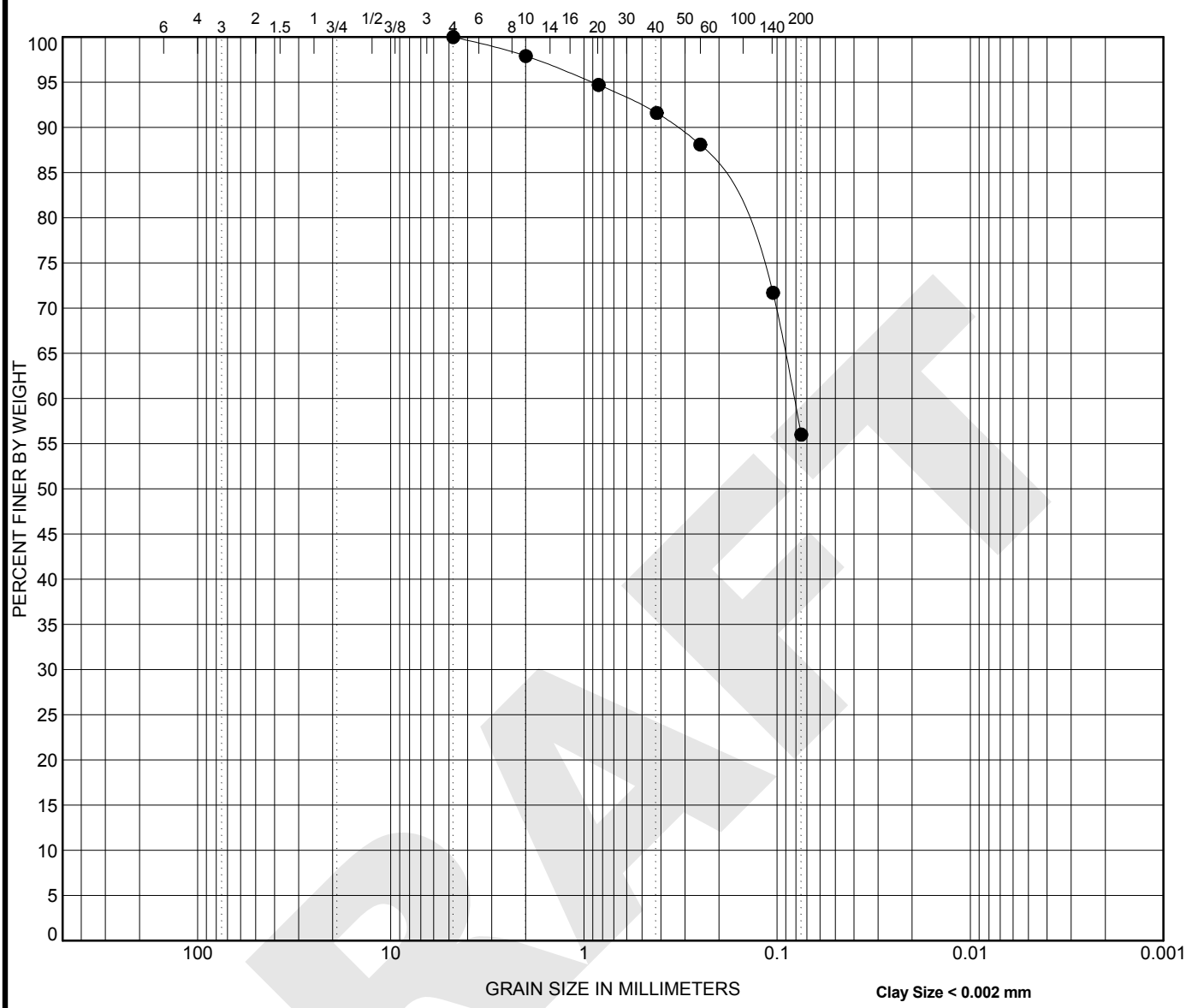
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-1A SS-13 48.5**	**Very stiff to hard green gray Sandy SILT (ML)**	**29**	**27**	**2**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-1A SS-13 48.5**	**4.75**	**0.082**			**0.0**	**44.0**	**56.0**	

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GRAIN SIZE DISTRIBUTION

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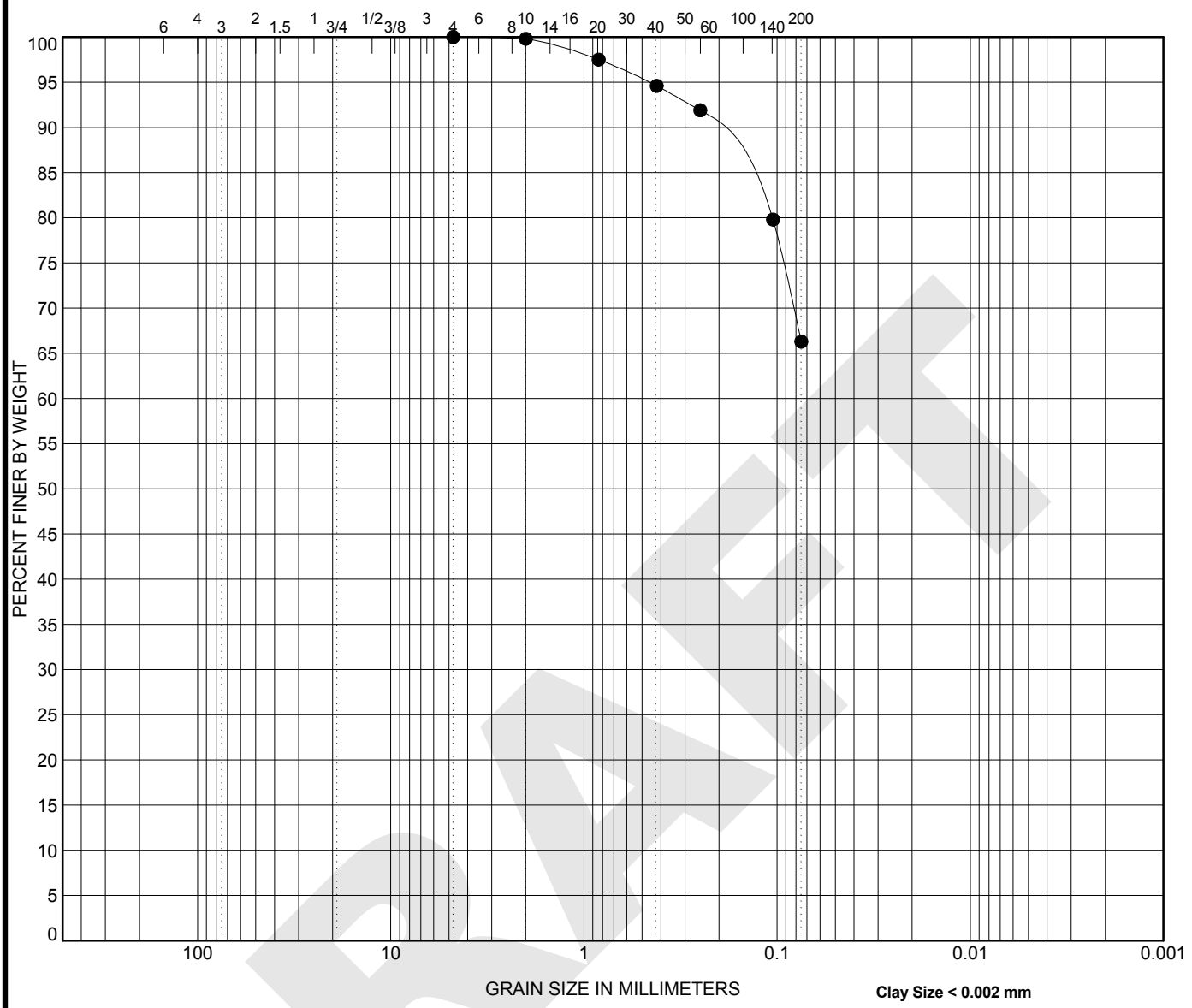
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

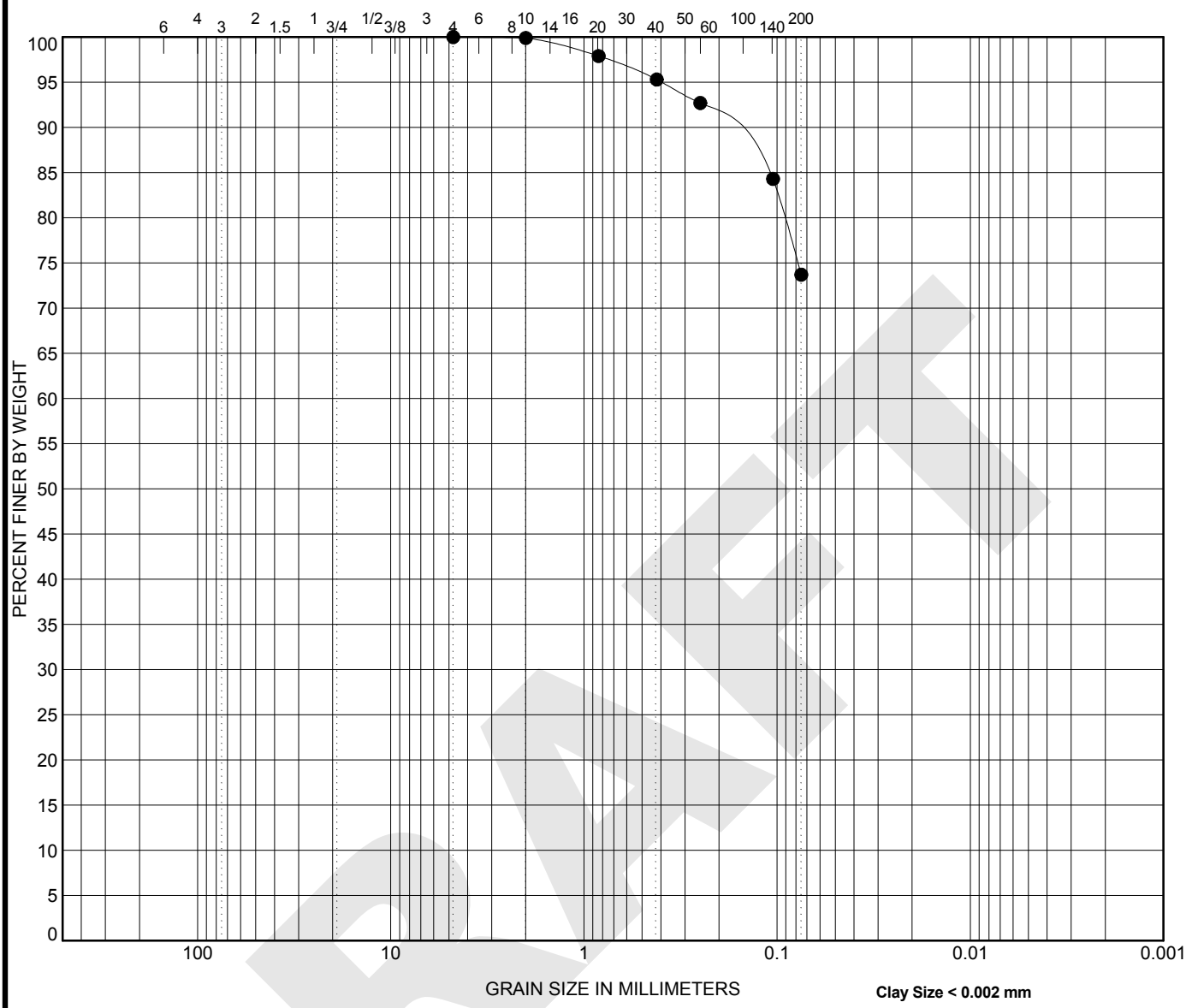
Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-1A SS-14 53.5**	**Very stiff to hard green gray Sandy SILT (ML)**	**32**	**31**	**1**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-1A SS-14 53.5**	**4.75**				**0.0**	**33.7**	**66.3**	

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210
Telephone: (803) 776-6050
Fax: (803) 772-2803

GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-1A SS-17 68.5**	**Hard to very hard green gray SILT with sand (ML)**	**36**	**30**	**6**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-1A SS-17 68.5**	**4.75**				**0.0**	**26.3**	**73.7**	

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GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC

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ENGINEERING
SOIL
TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	EB
Date	01/06/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1541-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bag
Sample ID	19241/B-1A SS-7	Depth/Elev.	18.5-20'
Location	-	Add. Info	-

ASTM G51/AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading	Reported pH
19241	B-1A SS-7	3.90	**3.9**

Standard buffer solutions used to standardize pH meter:

4.0 pH

7.0 pH

10.0 pH

pH Meter ID 375

REMARKS

TIMELY
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SOIL
TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	AV
Date	01/07/15
Checked By	LB

Client Pr. #	0451644	Lab. PR. #	1541-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bag
Sample ID	19241/B-1A SS-7	Depth/Elev.	18.5-20'
Location	-	Add. Info	-

ASTM G 57/G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	-
Calibrated Volume of Soil Box, ft^3	0.0027	Calibrated Soil Box Multiplier, cm	1.0
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	4.00	2.60	2.60						
Reading of Meter Range Multiplier	1000	1000	1000						
Measured Resistance, ohms	4000	2600	2600						
Calibrated Soil Box Multiplier, cm	1.0	1.0	1.0						
Measured Resistivity, ohms-cm	4000	2600	2600						

Reported Soil Minimum Resistivity, ohms-cm **2600**

Note: Material passed # 10 sieve used for testing

Oven ID #	12/13/14/15
Balance ID #	1/2/6
Soil Box ID #	112
Resistivity Meter ID #	111/396

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA

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Web: www.test-llc.com

Tested By	CRW
Date	01/13/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1505B-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19242/B-1A SS-9/SS-10	Depth/Elev.	28.5-35'
Location	-	Add. Info	-

Analytical Testing Results for
Water Soluble Sulfate Ion Content in Soil (Method AASHTO T290)

T.E.S.T. Sample ID	Client Sample ID	Sample Depth/Elevation, ft	Result, mg/kg-dry	Remarks
19242	see above	see above	**555**	

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Web: www.test-llc.com

Tested By	CRW
Date	01/13/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1505B-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19242/B-1A SS-9/SS-10	Depth/Elev.	28.5-35'
Location	-	Add. Info	-

Analytical Testing Results for
Water Soluble Chloride Ion Content in Soil (Method AASHTO T291)

T.E.S.T. Sample ID	Client Sample ID	Sample Depth/Elevation, ft	Result, mg/kg-dry	Remarks
19242	see above	see above	**5**	

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Fax: 770-923-8973
Web: www.test-llc.com

Tested By	EB
Date	01/06/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1541-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19242/B-1A SS-9/SS-10	Depth/Elev.	28.5-35'
Location	-	Add. Info	-

ASTM G51/AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading	Reported pH
19242	B-1A SS-9/SS-10	7.65	**7.7**

Standard buffer solutions used to standardize pH meter:

4.0 pH

7.0 pH

10.0 pH

pH Meter ID 375

REMARKS

TIMELY ENGINEERING SOIL TESTS, LLC
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Fax: 770-923-8973
Web: www.test-llc.com

Tested By	AV
Date	01/07/15
Checked By	LB

Client Pr. #	0451644	Lab. PR. #	1541-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19242/B-1A SS-9/SS-10	Depth/Elev.	28.5-35'
Location	-	Add. Info	-

ASTM G 57/G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	-
Calibrated Volume of Soil Box, ft^3	0.0027	Calibrated Soil Box Multiplier, cm	1.0
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	1.60	1.50	1.50						
Reading of Meter Range Multiplier	1000	1000	1000						
Measured Resistance, ohms	1600	1500	1500						
Calibrated Soil Box Multiplier, cm	1.0	1.0	1.0						
Measured Resistivity, ohms-cm	1600	1500	1500						

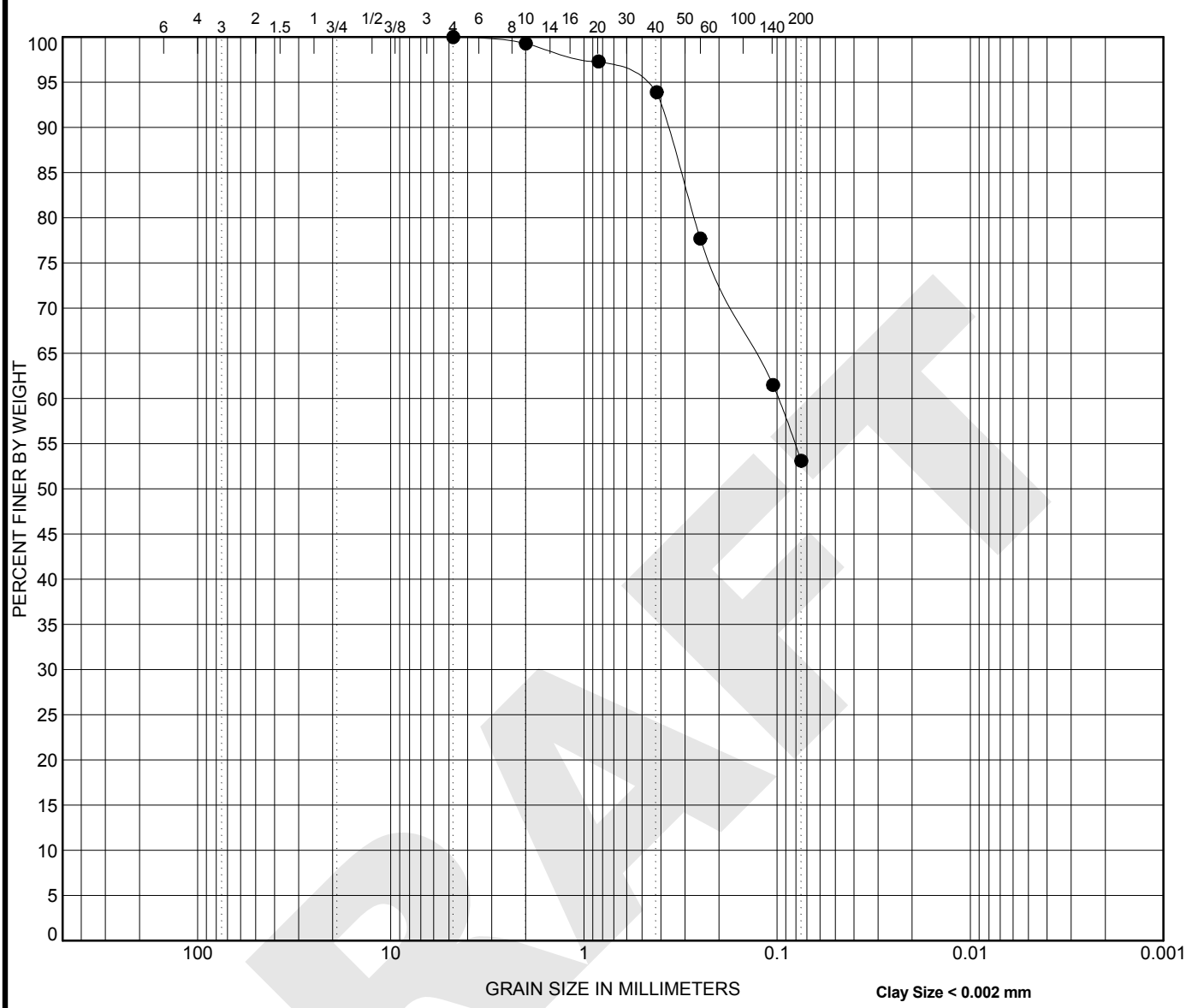
Reported Soil Minimum Resistivity, ohms-cm **1500**

Note: Material passed # 10 sieve used for testing

Oven ID #	12/13/14/15
Balance ID #	1/2/6
Soil Box ID #	112
Resistivity Meter ID #	111/396

Description: NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-3A SS-6 24.7**	**Hard green gray Sandy SILT (ML)**	**35**	**24**	**11**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-3A SS-6 24.7**	**4.75**	**0.099**			**0.0**	**46.9**	**53.1**	

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Telephone: (803) 776-6050
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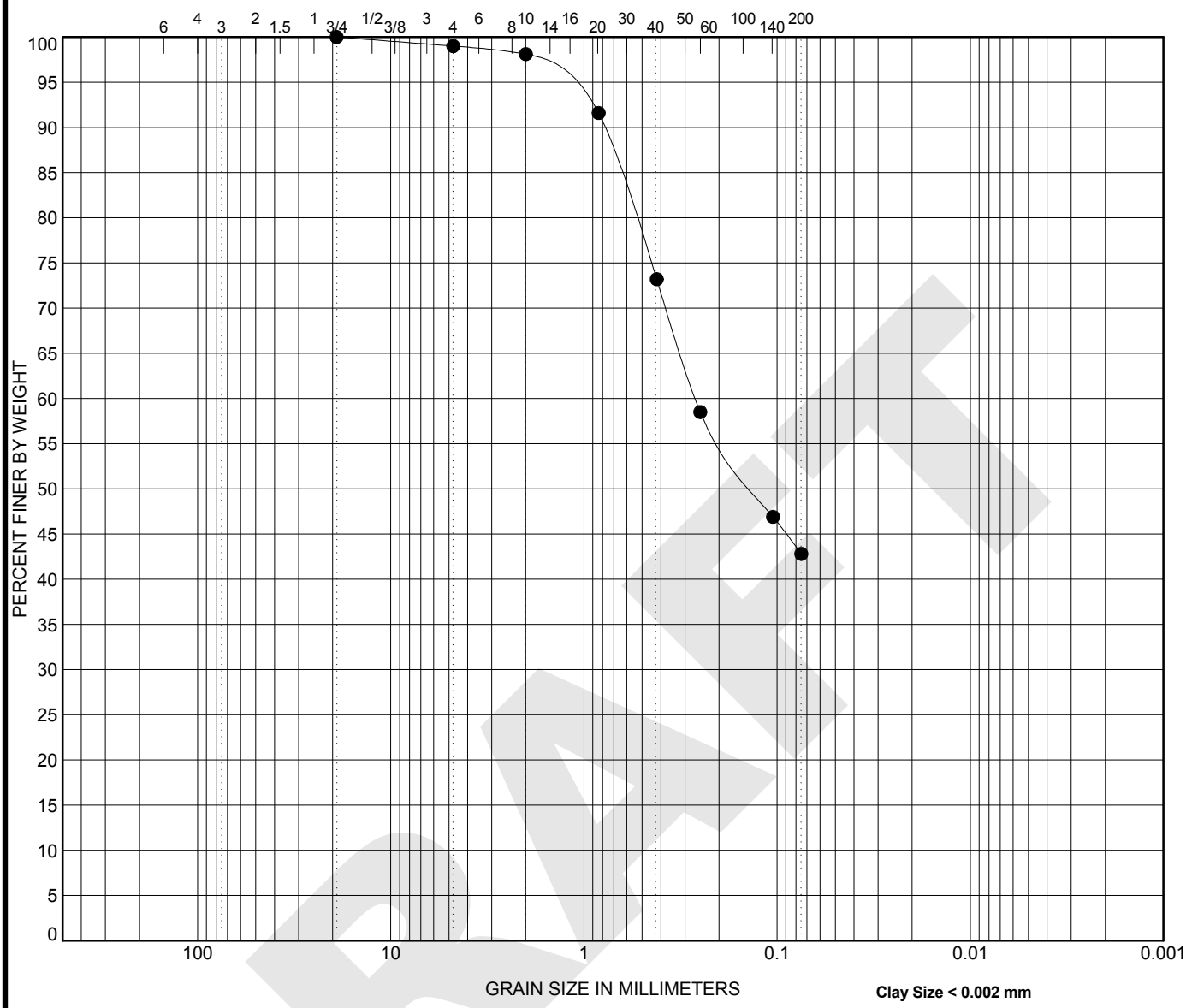
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-3A SS-7 29.7**	**Very dense green gray fine to medium grained Clayey SAND (SC)**	**29**	**18**	**11**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-3A SS-7 29.7**	**19.1**	**0.264**			**1.0**	**56.2**	**42.8**	

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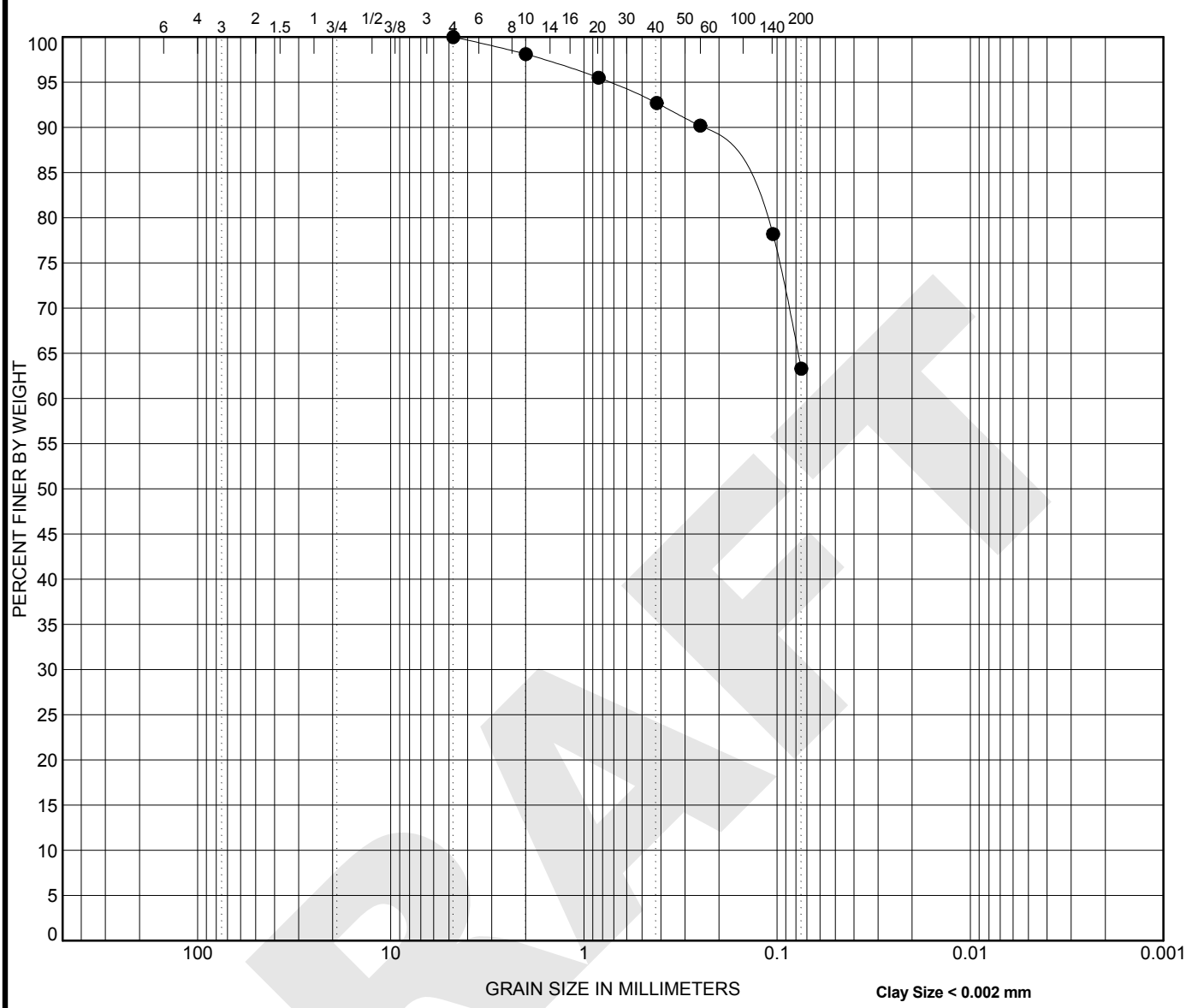
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-3A SS-12 54.7**	**Very stiff to very hard green gray Sandy SILT (ML)**	**35**	**29**	**6**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-3A SS-12 54.7**	**4.75**				**0.0**	**36.7**	**63.3**	

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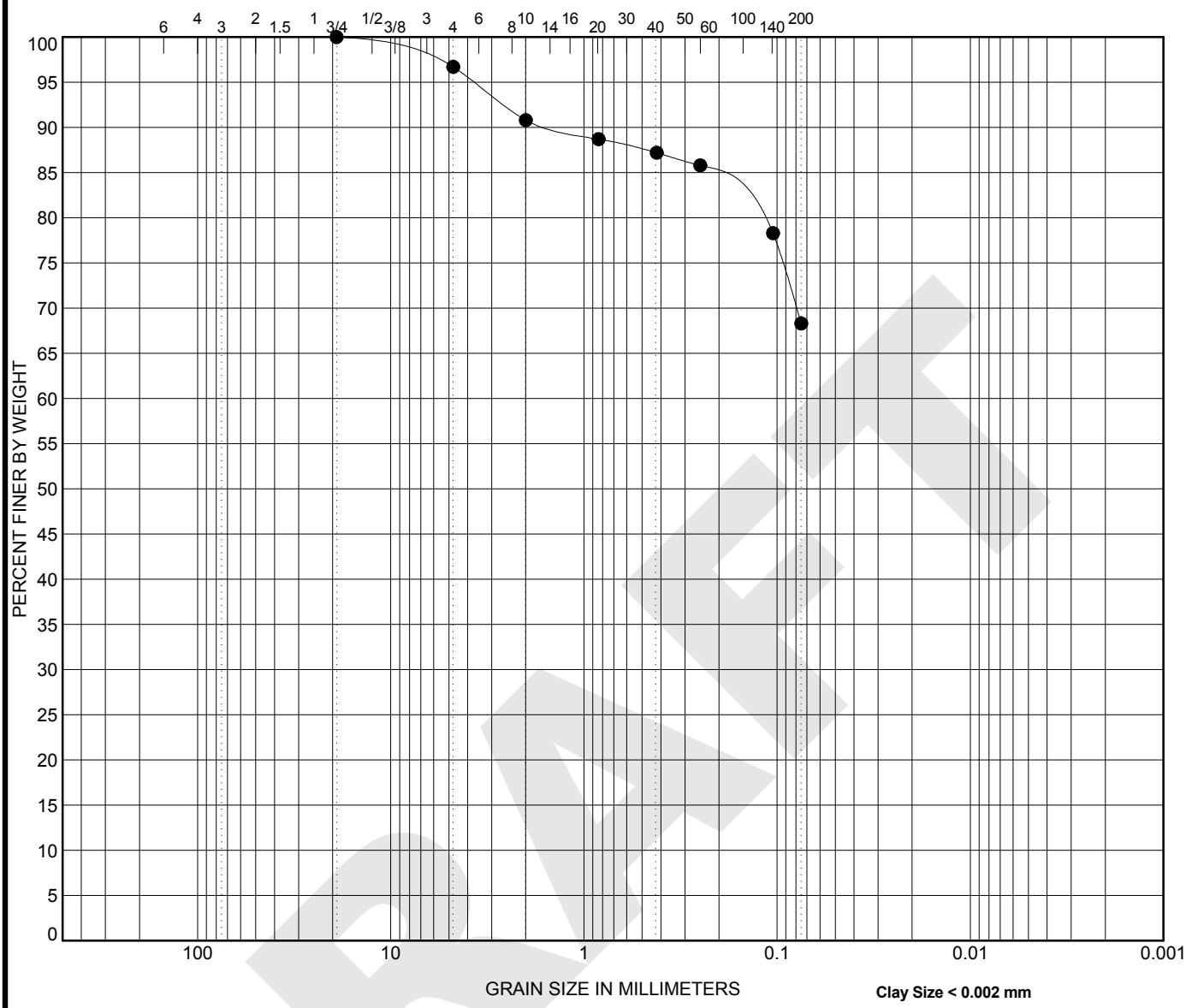
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-3A SS-14 61.7**	**Very stiff to very hard green gray Sandy SILT (ML)**	**41**	**33**	**8**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-3A SS-14 61.7**	**19.1**				**3.3**	**28.4**	**68.3**	

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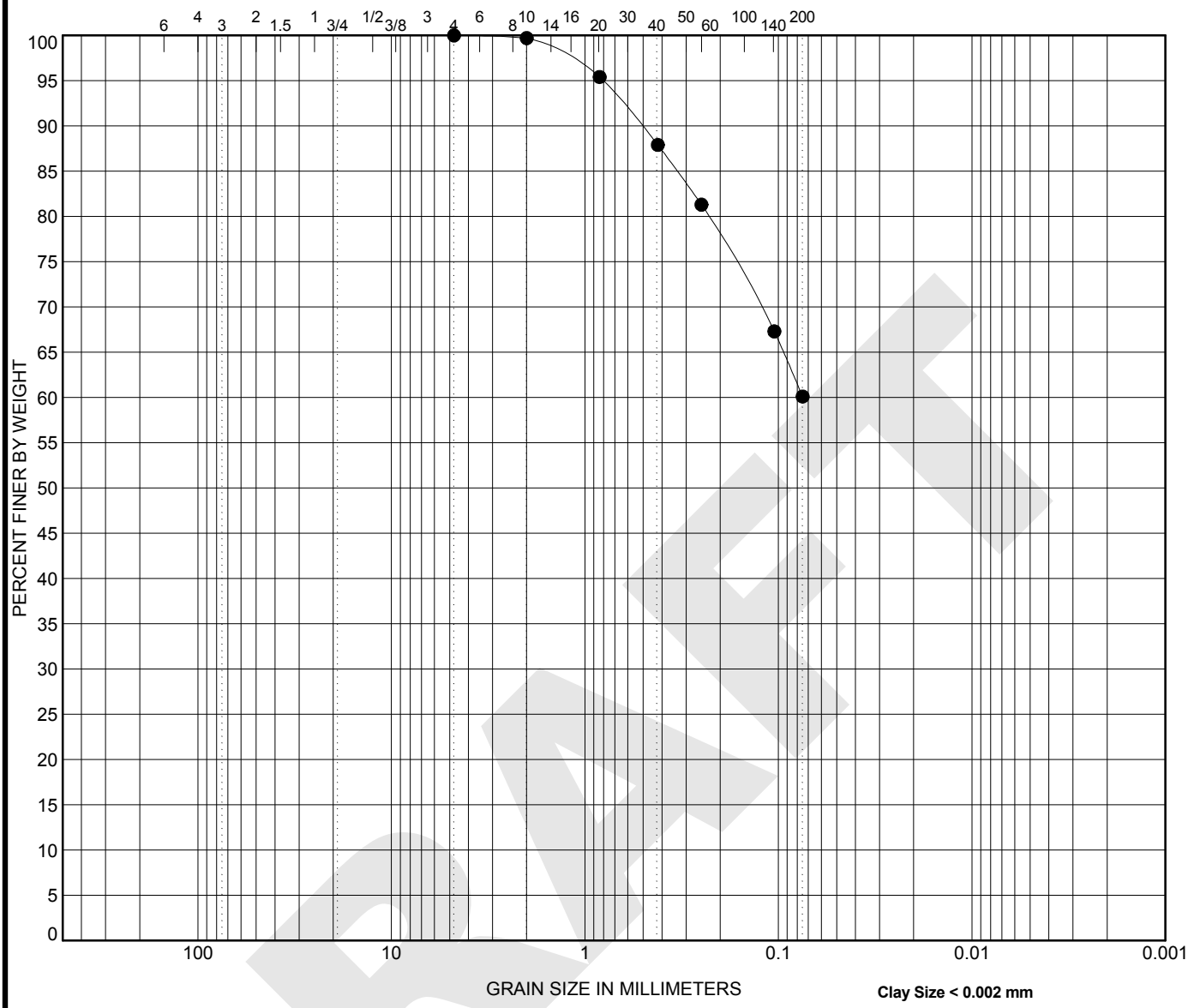
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● B-3A SS-19 71.2	Very soft to soft dark green Sandy Elastic SILT (MH)	135	133	2		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-3A SS-19 71.2	4.75				0.0	39.9	60.1	

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GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S1
Issue No: 2

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

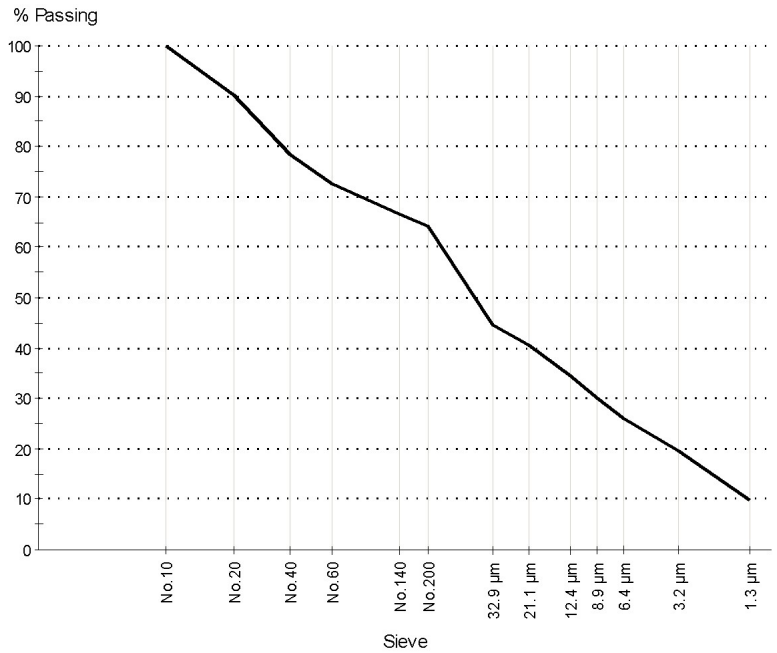
Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S1
Client Sample ID:	
Date Sampled:	12/08/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Dark Green Sandy Elastic SILT (MH)
Sampling Method:	(none)
General Location:	Boring # 3A SS-21
Location:	75.2' - 77.2'

Sample Description:

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.0%)	(0.0%)	(21.8%)	(13.9%)	(41.1%)	(23.2%)

Grading: ASTM D 422

Drying by: Oven
Date Tested: 12/29/2014

Sieve Size	% Passing	Limits
No.10 (2.0mm)	100	
No.20 (850µm)	90	
No.40 (425µm)	78	
No.60 (250µm)	72	
No.140 (106µm)	67	
No.200 (75µm)	64	
32.9 µm	44.7	
21.1 µm	40.6	
12.4 µm	34.4	
8.9 µm	30.0	
6.4 µm	25.9	
3.2 µm	19.7	
1.3 µm	9.7	

D85: 0.6320 D60: 0.0625 D50: 0.0411
D30: 0.0089 D15: 0.0021 D10: 0.0013
Cu: 46.83 Cc: 0.95

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Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S1
Issue No: 2

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

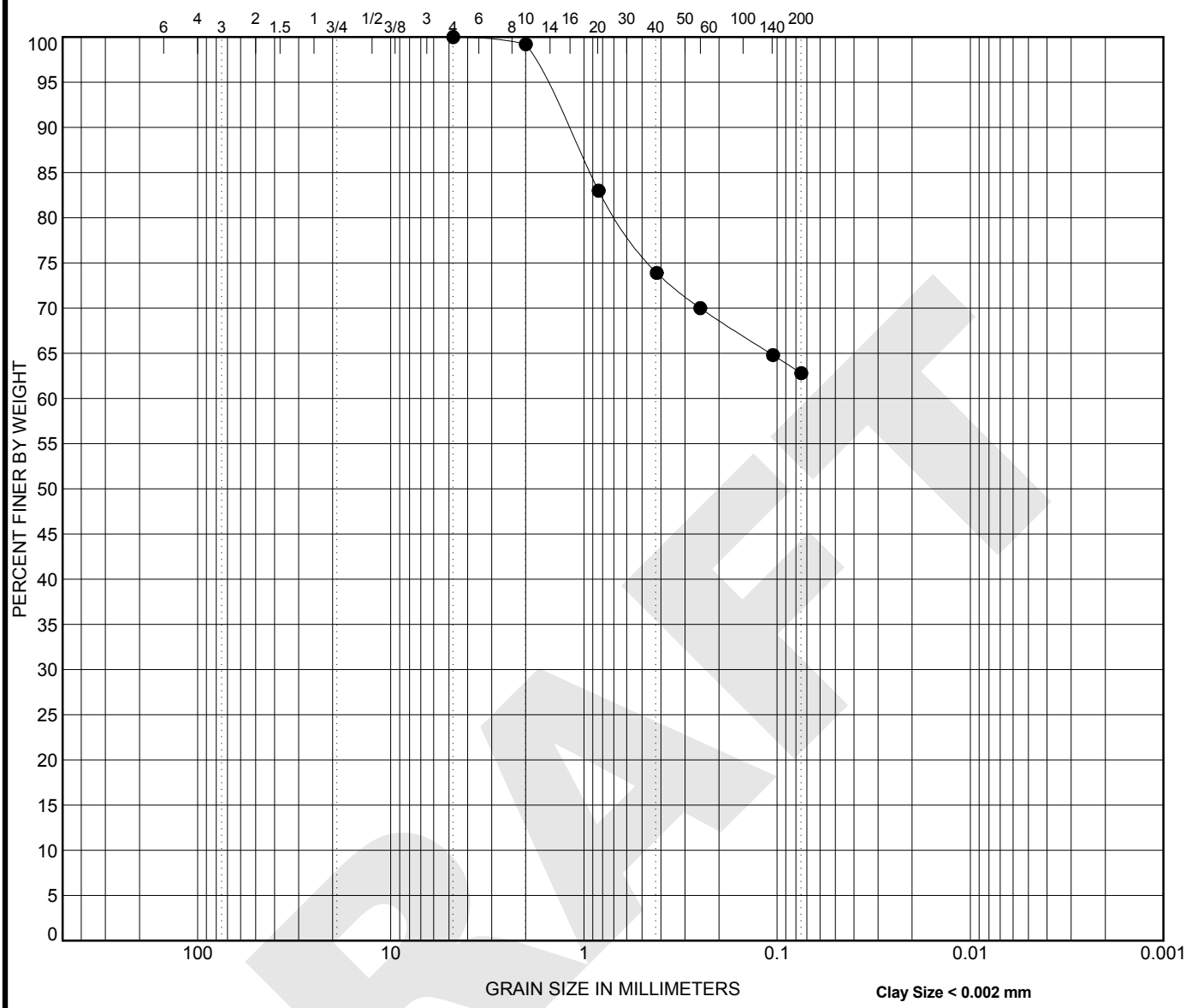
Sample ID:	0451644-1-S1
Client Sample ID:	
Date Sampled:	12/08/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Dark Green Sandy Elastic SILT (MH)
Sampling Method:	(none)
General Location:	Boring # 3A SS-21
Location:	75.2' - 77.2'

Other Test Results

Description	Method	Result	Limits
Group Symbol	ASTM D 2487		
Group Name			
Tested By		(unknown)	
Group Symbol (based on visual-manual procedures)	ASTM D 2488		
Group Name			
Tested By		(unknown)	
Dispersion device	ASTM D 422		
Dispersion time (min)			
Shape			
Hardness			
Tested By		Bennett Livingston	

Comments

N/A



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● B-3A SS-22 77.2	Very soft to soft dark green Sandy Elastic SILT (MH)	111	101	10		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-3A SS-22 77.2	4.75				0.0	37.2	62.8	

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GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S2
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

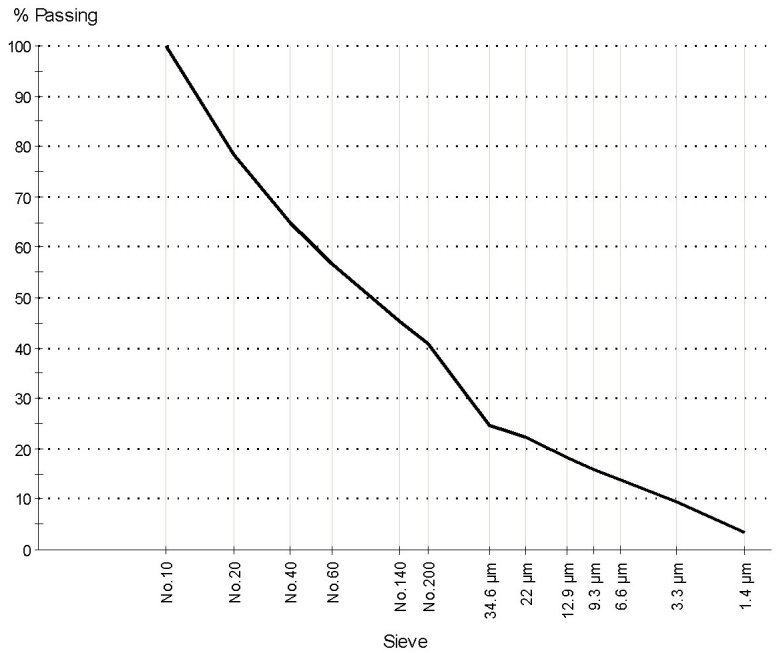
Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S2
Client Sample ID:	
Date Sampled:	12/08/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Dark Green Fine to Medium Grained Silty SAND (SM)
Sampling Method:	(none)
General Location:	Boring #3A SS-23
Location:	79.2' -81.2'

Sample Description:

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.0%)	(0.0%)	(35.2%)	(23.8%)	(29.4%)	(11.6%)

Grading: ASTM D 422

Date Tested:

Sieve Size	% Passing	Limits
No.10 (2.0mm)	100	
No.20 (850µm)	78	
No.40 (425µm)	65	
No.60 (250µm)	57	
No.140 (106µm)	45	
No.200 (75µm)	41	
34.6 µm	24.5	
22.0 µm	22.4	
12.9 µm	18.3	
9.3 µm	16.0	
6.6 µm	13.7	
3.3 µm	9.3	
1.4 µm	3.5	

D85: 1.1031 D60: 0.3086 D50: 0.1494
D30: 0.0448 D15: 0.0080 D10: 0.0037
Cu: 83.75 Cc: 1.76

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Material Test Report

Report No: MAT:0451644-1-S2
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

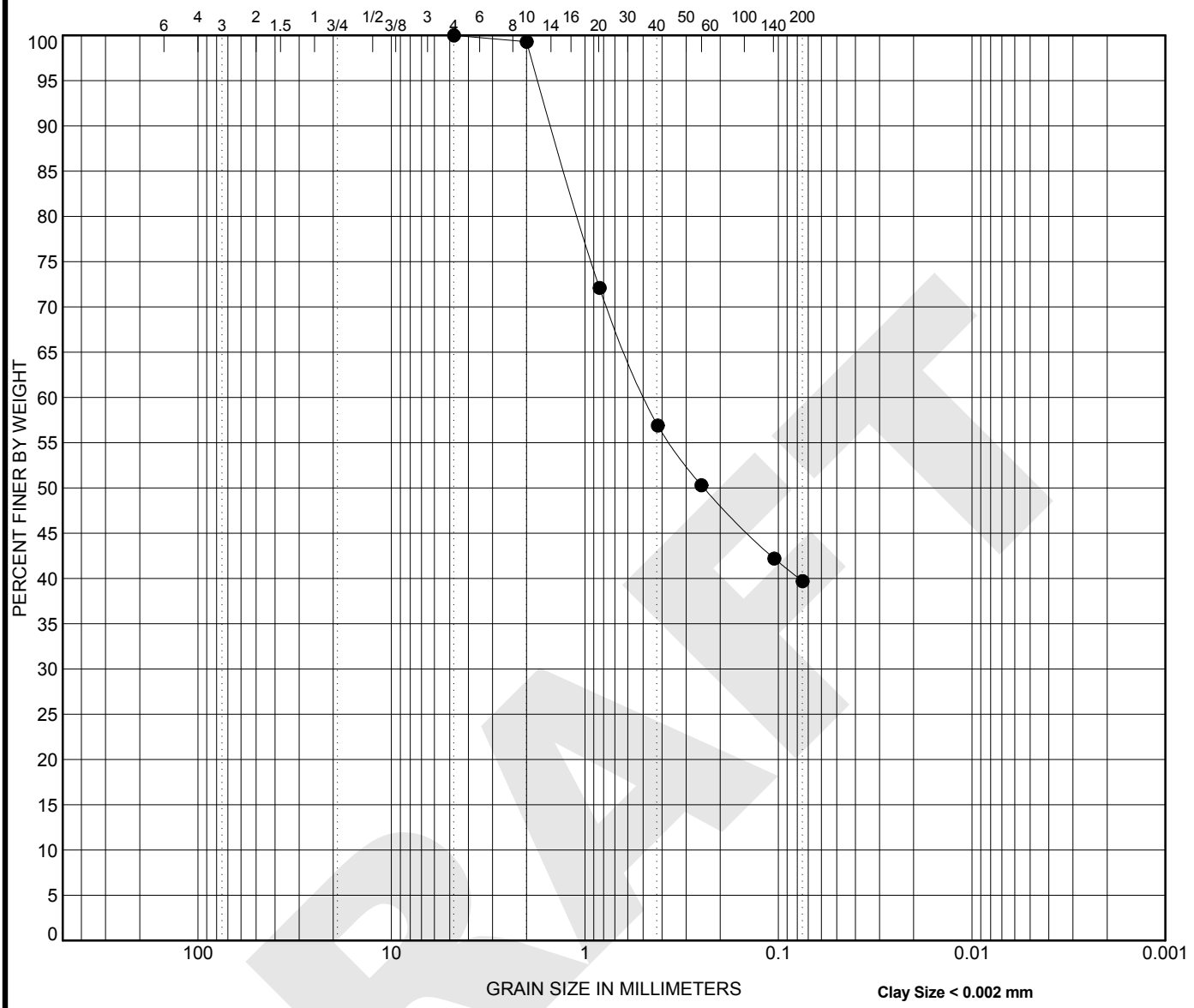
Sample ID:	0451644-1-S2
Client Sample ID:	
Date Sampled:	12/08/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Dark Green Fine to Medium Grained Silty SAND
Sampling Method:	(none)
General Location:	Boring #3A SS-23
Location:	79.2' -81.2'

Other Test Results

Description	Method	Result	Limits
Group Symbol	ASTM D 2487		
Group Name			
Tested By		(unknown)	
Group Symbol (based on visual-manual procedures)	ASTM D 2488		
Group Name			
Tested By		(unknown)	
Dispersion device	ASTM D 422		
Dispersion time (min)			
Shape			
Hardness			
Tested By		(unknown)	

Comments

N/A



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

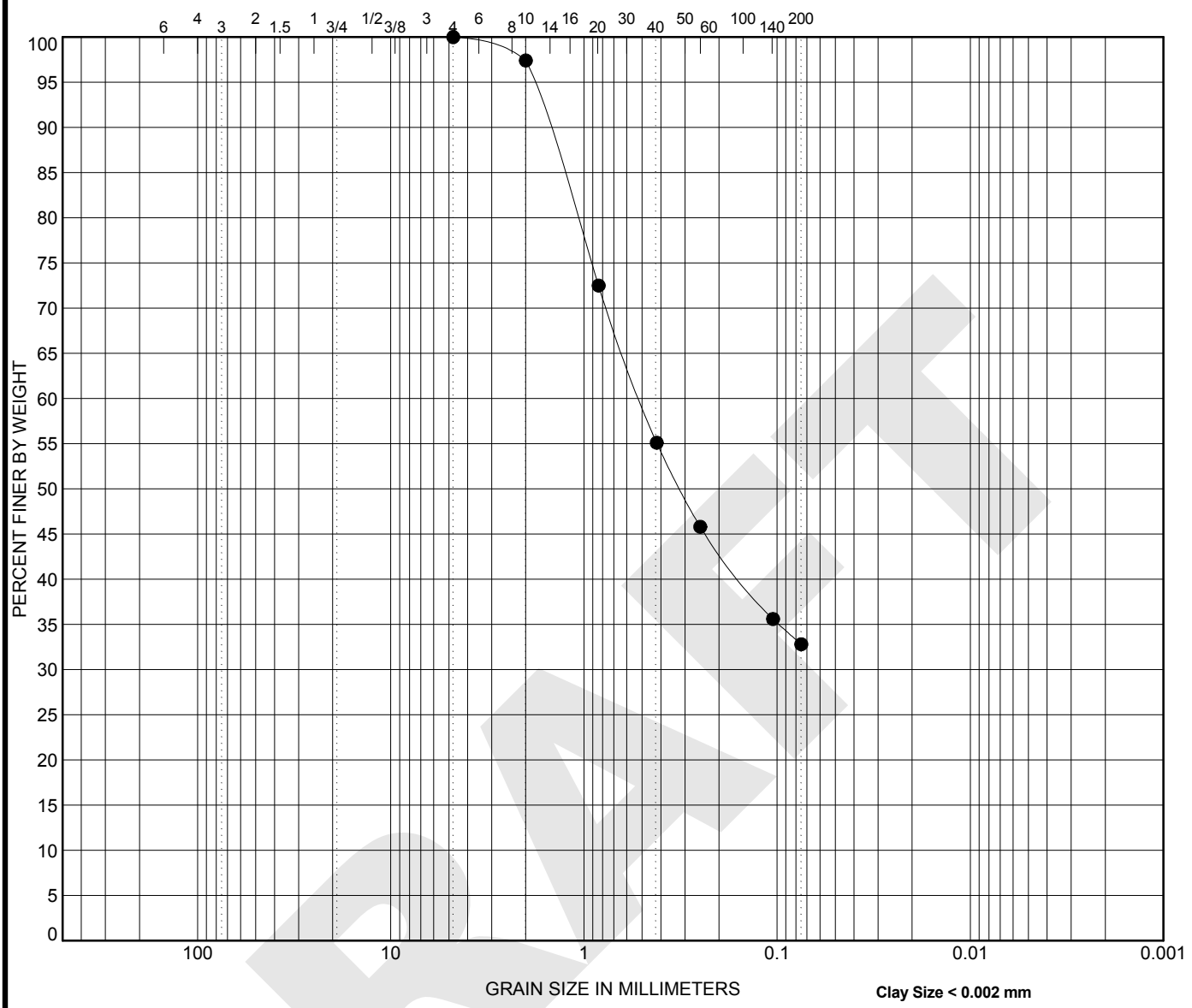
	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-3A SS-24 81.2**	**Very soft to soft dark green fine to medium grained Silty SAND (SM)**	**90**	**86**	**4**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-3A SS-24 81.2**	**4.75**	**0.484**			**0.0**	**60.3**	**39.7**	

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210
Telephone: (803) 776-6050
Fax: (803) 772-2803

GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-3A SS-25 83.2**	**Very soft to soft dark green fine to medium grained Silty SAND (SM)**	**75**	**66**	**9**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-3A SS-25 83.2**	**4.75**	**0.511**			**0.0**	**67.2**	**32.8**	

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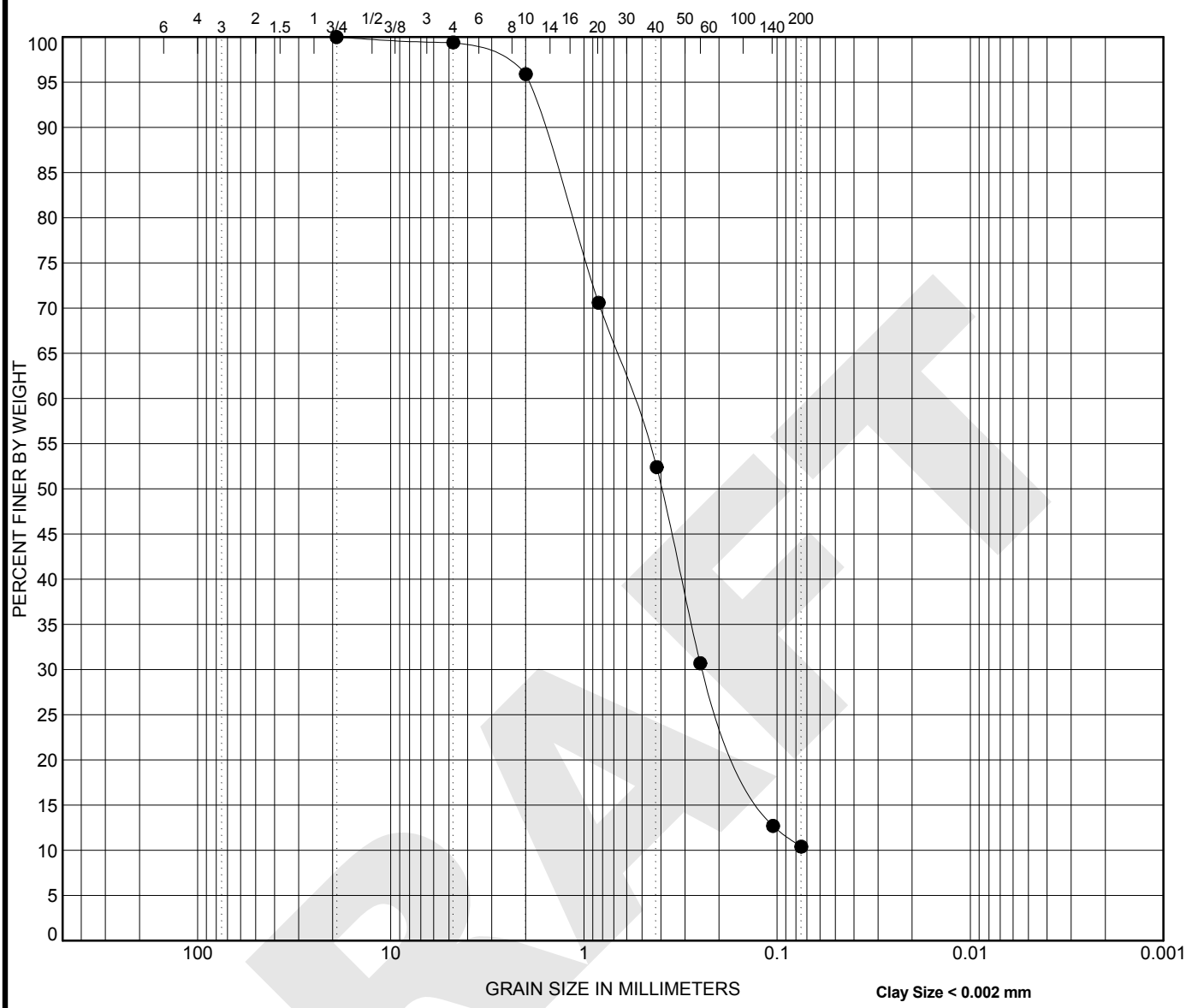
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-3A SS-27 87.2**	**Med. dense-loose dk. green f-c well graded SAND w/silt (SW-SM)**	**NP**	**NP**	**NP**	**1.47**	**7.93**

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-3A SS-27 87.2**	**19.1**	**0.561**	**0.242**		**0.6**	**89.0**	**10.4**	

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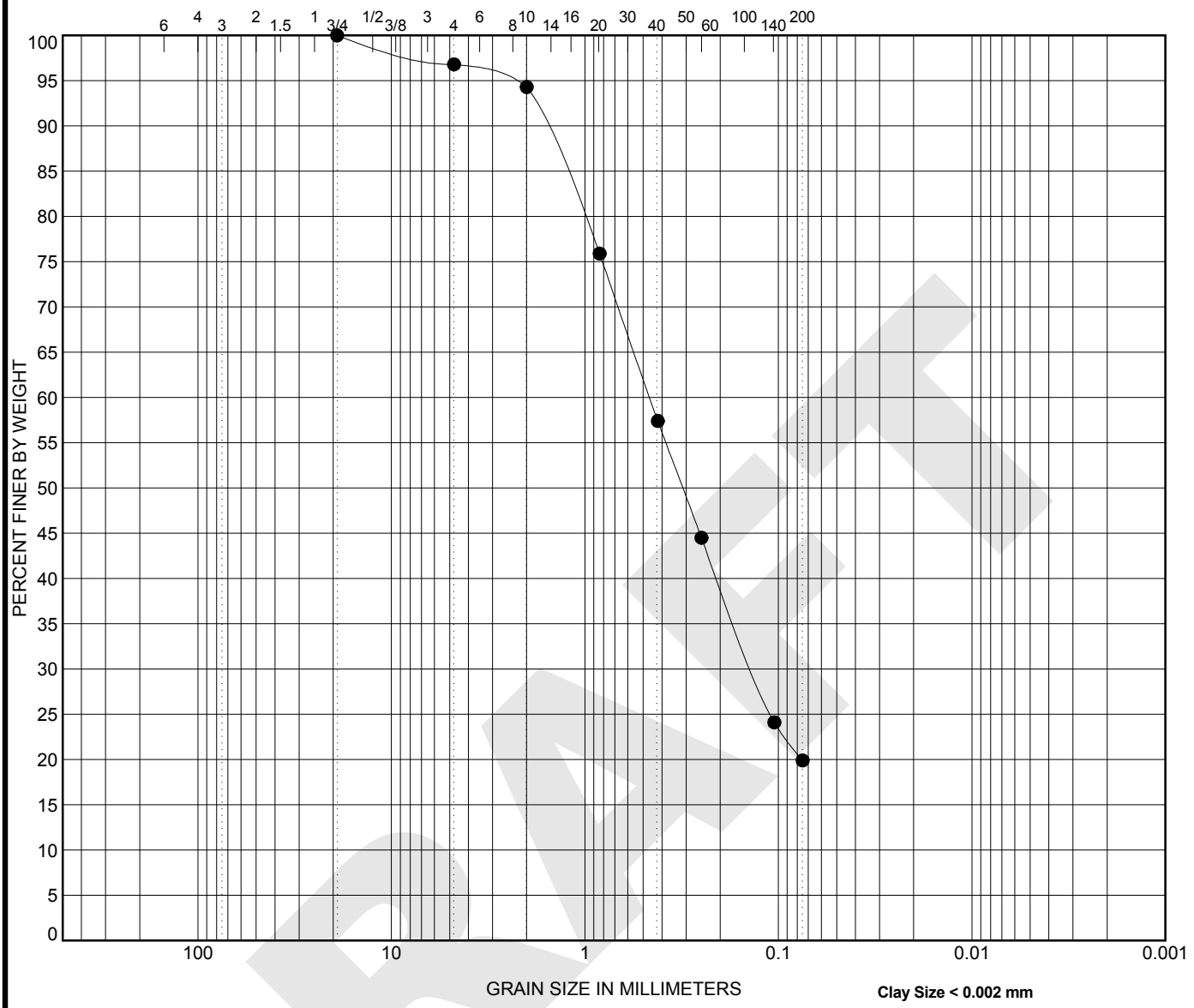
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-3A SS-28 89.2**	**Dense dark green fine to coarse grained Silty SAND (SM)**	**NP**	**NP**	**NP**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-3A SS-28 89.2**	**19.1**	**0.463**	**0.135**		**3.2**	**76.9**	**19.9**	

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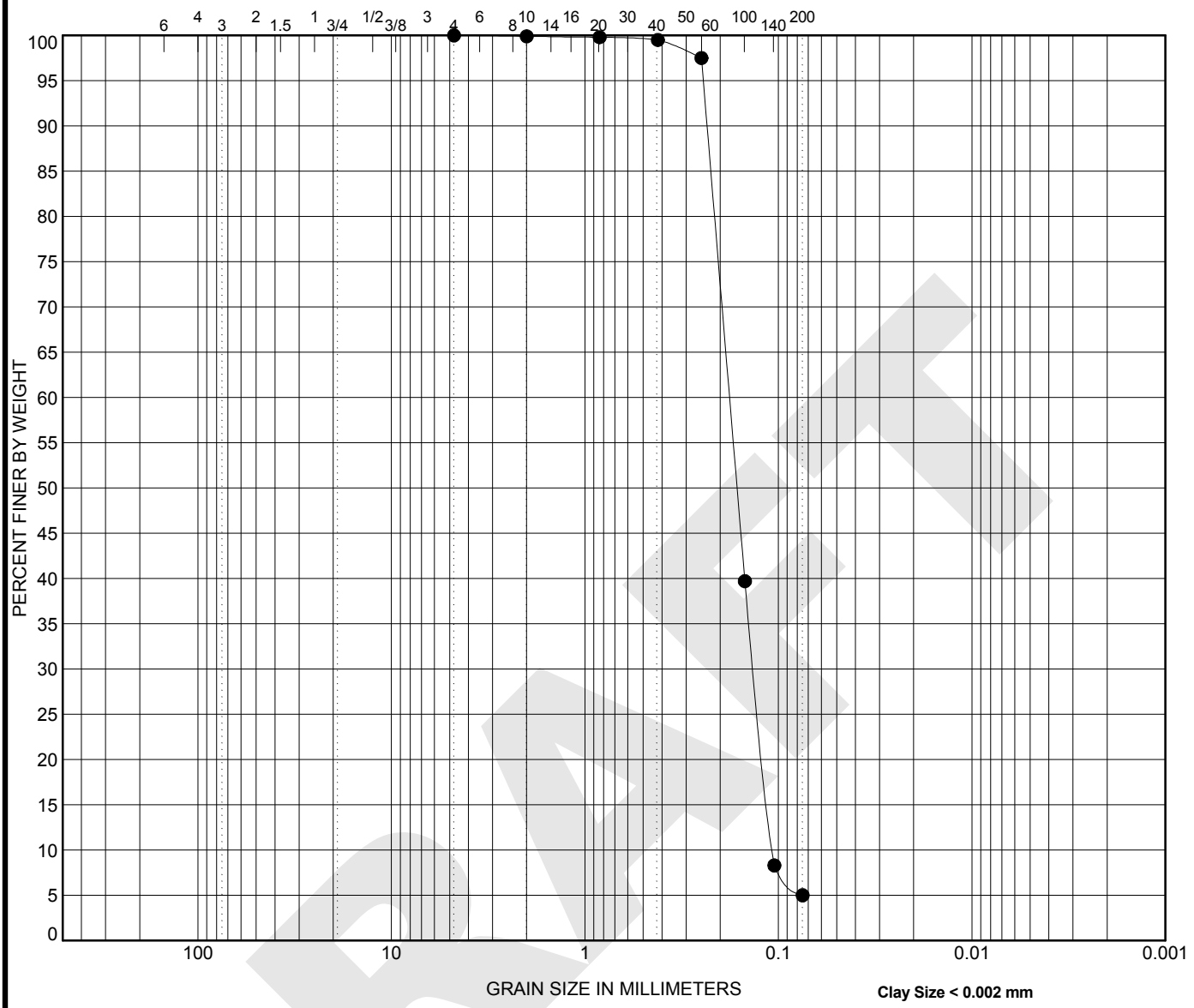
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-3A SS-34 120.7**	**Very dense dark gray f-m grained poorly graded SAND w/silt (SP-SM)**	**NP**	**NP**	**NP**	**0.94**	**1.67**

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-3A SS-34 120.7**	**4.75**	**0.179**	**0.134**	**0.107**	**0.0**	**95.0**	**5.0**	

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GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC

TIMELY
ENGINEERING
SOIL
TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	CRW
Date	01/13/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1505B-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19243/B-3A SS-3/SS-4	Depth/Elev.	15.2-19.2'
Location	-	Add. Info	-

Analytical Testing Results for
Water Soluble Sulfate Ion Content in Soil (Method AASHTO T290)

T.E.S.T. Sample ID	Client Sample ID	Sample Depth/Elevation, ft	Result, mg/kg-dry	Remarks
19243	see above	see above	**111**	

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Tested By	CRW
Date	01/13/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1505B-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19243/B-3A SS-3/SS-4	Depth/Elev.	15.2-19.2'
Location	-	Add. Info	-

Analytical Testing Results for
Water Soluble Chloride Ion Content in Soil (Method AASHTO T291)

T.E.S.T. Sample ID	Client Sample ID	Sample Depth/Elevation, ft	Result, mg/kg-dry	Remarks
19243	see above	see above	**2**	

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1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	EB
Date	01/06/15
Checked By	LB

Client Pr. #	0451644	Lab. PR. #	1541-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19243/B-3A SS-3/SS-4	Depth/Elev.	15.2-19.2'
Location	-	Add. Info	-

ASTM G51/AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading	Reported pH
19243	B-3A SS-3/SS-4	7.45	**7.5**

Standard buffer solutions used to standardize pH meter:

4.0 pH

7.0 pH

10.0 pH

pH Meter ID 375

REMARKS

TIMELY ENGINEERING SOIL TESTS, LLC
1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	AV
Date	01/07/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1541-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19243/B-3A SS-3/SS-4	Depth/Elev.	15.2-19.2'
Location	-	Add. Info	-

ASTM G 57/G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	-
Calibrated Volume of Soil Box, ft^3	0.0027	Calibrated Soil Box Multiplier, cm	1.0
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	10.60	7.60	7.60						
Reading of Meter Range Multiplier	1000	1000	1000						
Measured Resistance, ohms	10600	7600	7600						
Calibrated Soil Box Multiplier, cm	1.0	1.0	1.0						
Measured Resistivity, ohms-cm	10600	7600	7600						

Reported Soil Minimum Resistivity, ohms-cm **7600**

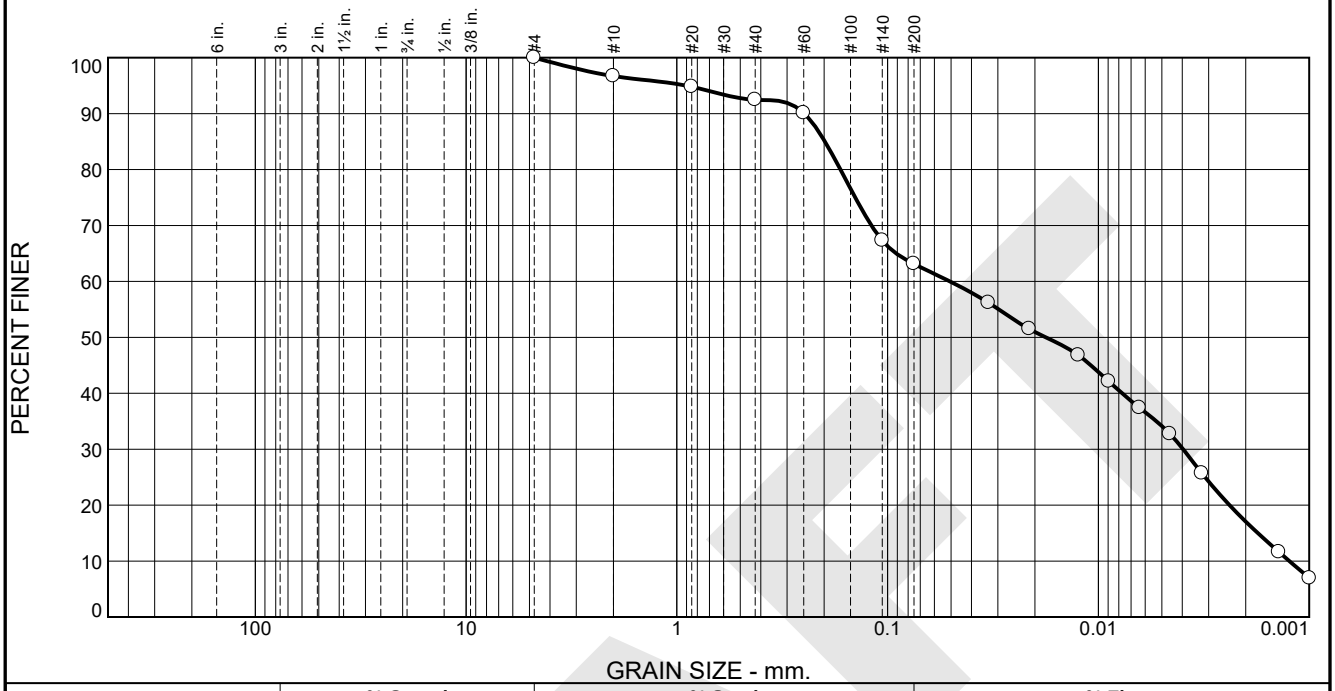
Note: Material passed # 10 sieve used for testing

Oven ID #	12/13/14/15
Balance ID #	1/2/6
Soil Box ID #	112
Resistivity Meter ID #	111/396

Description: NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	3.3	4.2	29.4	29.0	34.1

Test Results (D422 & D1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	96.7		
#20	94.8		
#40	92.5		
#60	90.1		
#140	67.3		
#200	63.1		
0.0332 mm.	56.2		
0.0213 mm.	51.5		
0.0125 mm.	46.8		
0.0089 mm.	42.1		
0.0064 mm.	37.4		
0.0046 mm.	32.7		
0.0032 mm.	25.7		
0.0014 mm.	11.6		
0.0010 mm.	6.9		

* (no specification provided)

Material Description

Grey Sandy Lean Clay

Atterberg Limits (ASTM D 4318)

PL= 15 **LL=** 35 **PI=** 20

Classification

USCS (D 2487)= CL **AASHTO (M 145)=** A-6(10)

Coefficients

D_{90}= 0.2483 D_{85}= 0.1983 D_{60}= 0.0507
D_{50}= 0.0178 D_{30}= 0.0040 D_{15}= 0.0018
D_{10}= 0.0012 C_u= 40.85 C_c= 0.25

Remarks

Natural Moisture Content: 30.8

Date Received: 2/5/15 **Date Tested:** 2/9/15

Tested By: Steven Putnam

Checked By: Tom Cannarella

Title: Branch Manager

Source of Sample: Boring B-3A **Depth:** 9.00' - 11.00' **Date Sampled:**

Sample Number: ST-1

Professional Service Industries, Inc.
5021 W. W.T. Harris Blvd.
Charlotte, NC

Client: SCDOT

Project: Orangburg County
US 301 Five Chop Road

Project No: **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

2/18/2015

Client: SCDOT
Project: Orangburg County
US 301 Five Chop Road
Over Four Hole Swamp
Project ID 0040308
Location: Boring B-3A
Depth: 9.00' - 11.00'
Sample Number: ST-1
Material Description: Grey Sandy Lean Clay
Date Received: 2/5/15 **PL:** 15 **LL:** 35 **PI:** 20
USCS Classification: CL
AASHTO Classification: A-6(10)
Grain Size Test Method: D422
#200 Wash Method: D1140
Testing Remarks: Natural Moisture Content: 30.8
Tested By: Steven Putnam
Test Date: 2/9/15
Checked By: Tom Cannarella
Title: Branch Manager

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 15.27
Tare Wt. = 0.00
Minus #200 from wash = 63.1%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
41.34	0.00	0.00	#4	0.00	100.0
			#10	1.36	96.7
			#20	2.15	94.8
			#40	3.12	92.5
			#60	4.09	90.1
			#140	13.51	67.3
			#200	15.24	63.1

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 96.7
Weight of hydrometer sample =54.17
Hygroscopic moisture correction:
Moist weight and tare = 141.95
Dry weight and tare = 129.21
Tare weight = 87.78
Hygroscopic moisture = 30.8%
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -6
Meniscus correction only = -2.0
Specific gravity of solids = 2.630
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Hydrometer Test Data (continued)

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	20.0	30.0	24.0	0.0137	28.0	11.7	0.0332	56.2
5.00	20.0	28.0	22.0	0.0137	26.0	12.0	0.0213	51.5
15.00	20.0	26.0	20.0	0.0137	24.0	12.4	0.0125	46.8
30.00	20.0	24.0	18.0	0.0137	22.0	12.7	0.0089	42.1
60.00	20.0	22.0	16.0	0.0137	20.0	13.0	0.0064	37.4
120.00	20.0	20.0	14.0	0.0137	18.0	13.3	0.0046	32.7
250.00	20.0	17.0	11.0	0.0137	15.0	13.8	0.0032	25.7
1440.00	20.0	11.0	5.0	0.0137	9.0	14.8	0.0014	11.6
2880.00	20.0	9.0	3.0	0.0137	7.0	15.1	0.0010	6.9

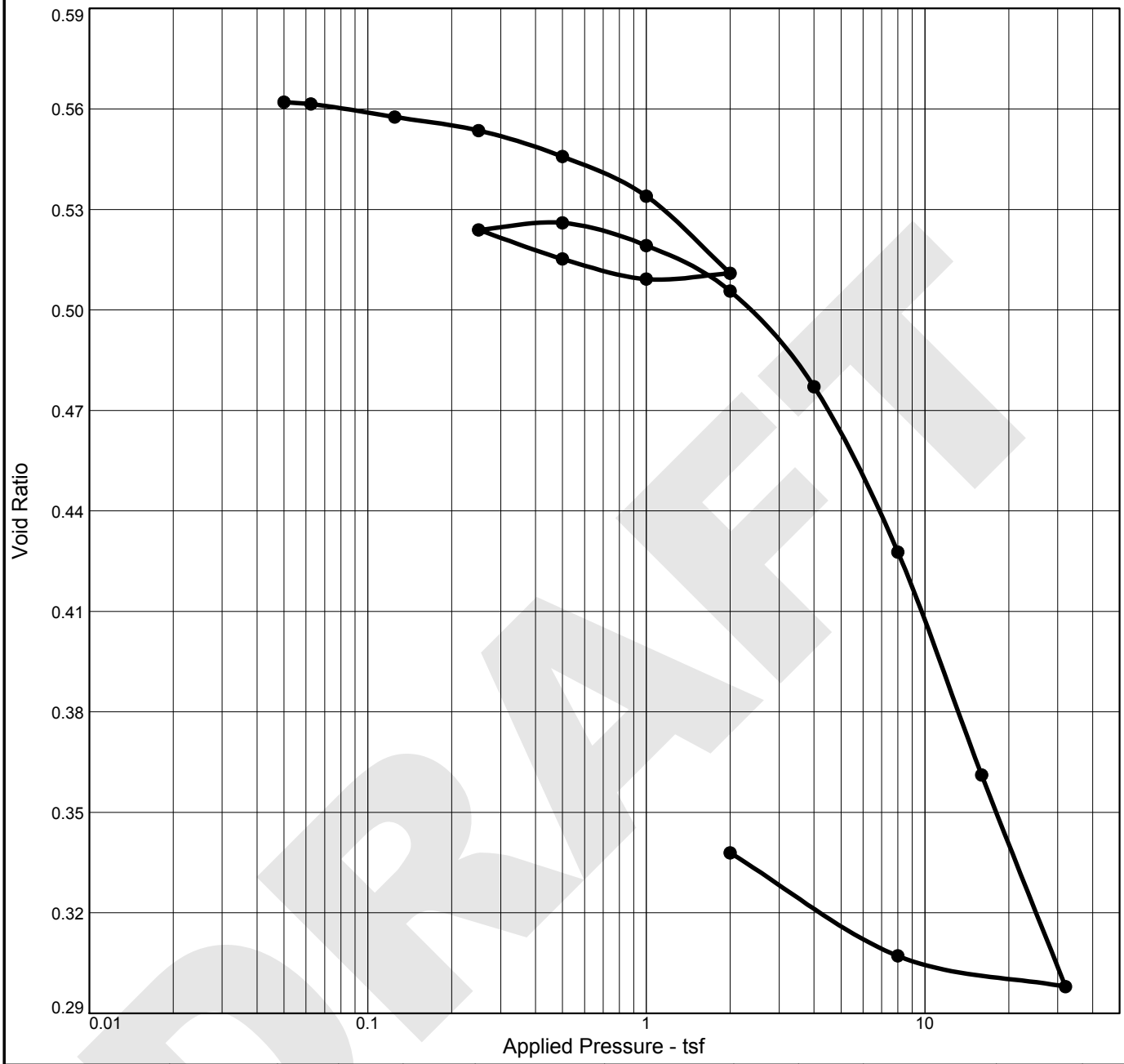
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	3.3	4.2	29.4	36.9	29.0	34.1	63.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0012	0.0018	0.0024	0.0040	0.0178	0.0507	0.1674	0.1983	0.2483	0.9031

Fineness Modulus	C_u	C_c
0.45	40.85	0.25

CONSOLIDATION TEST REPORT



Natural Sat.	Natural Moist.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
90.7 %	19.3 %	105.3	35	20	2.630	.05	3.22	0.23	0.04			0.560

MATERIAL DESCRIPTION	USCS	AASHTO
Grey Sandy Lean Clay	CL	A-6(10)

Project No. **Client:** SCDOT

Project: Orangburg County
US 301 Five Chop Road

Source: Boring B-3A **Depth:** 9.00' - 11.00' **Sample No.:** ST-1

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Charlotte, NC

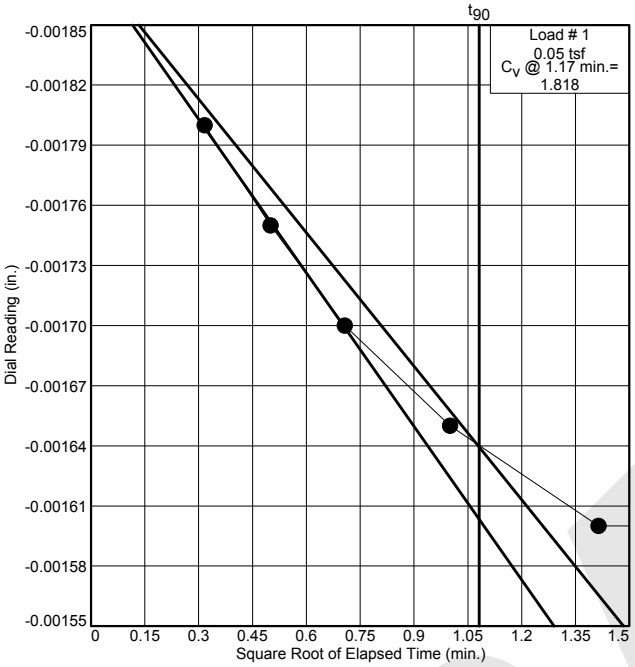
Remarks:
Date Tested: 2/9/15
Percent Finer: 63.1%

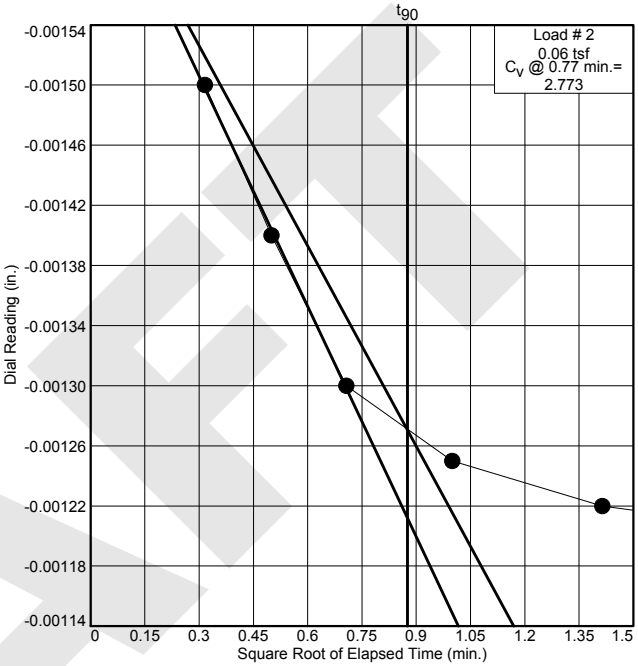
Figure 01

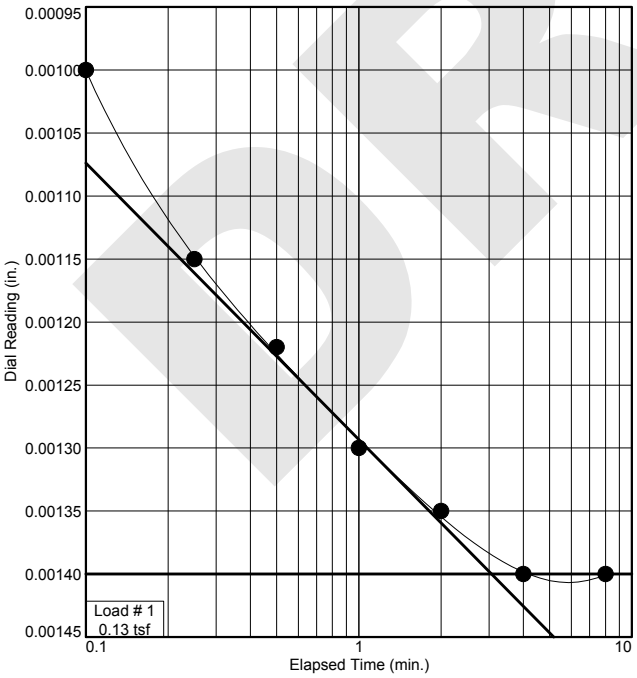
Checked By: Tom Cannarelle

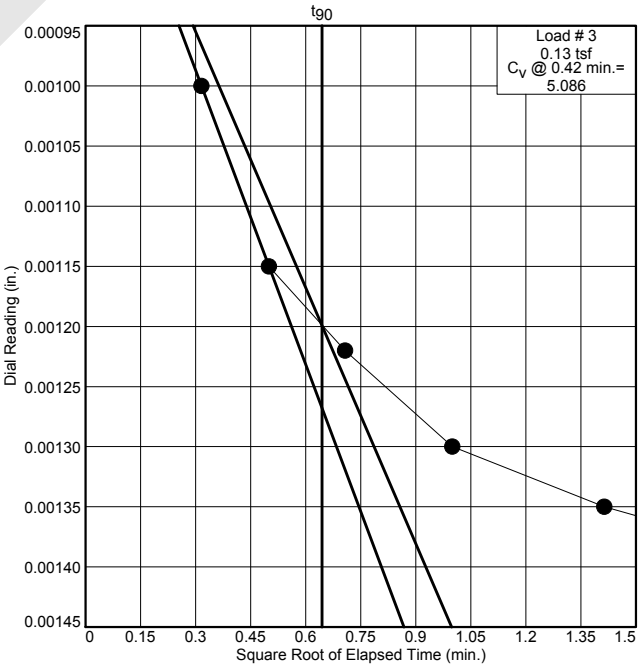
Dial Reading vs. Time

Project No.:
Project: Orangburg County
US 301 Five Chop Road
Source of Sample: Boring B-3A Depth: 9.00' - 11.00' Sample Number: ST-1









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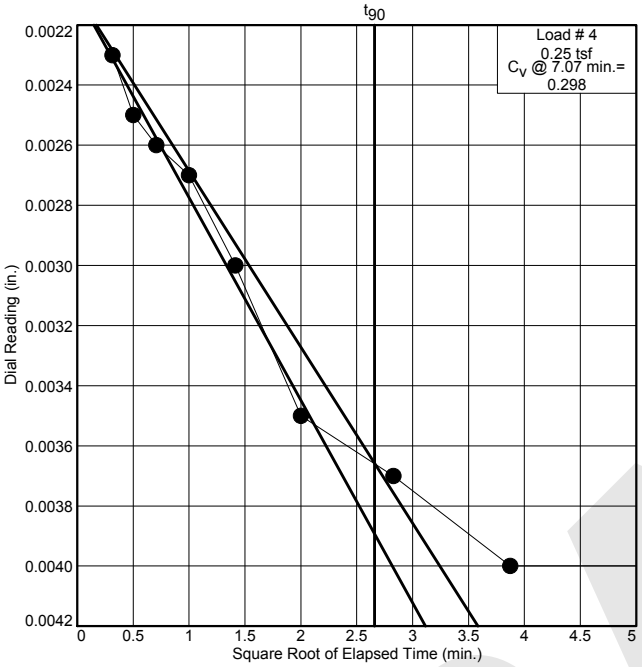
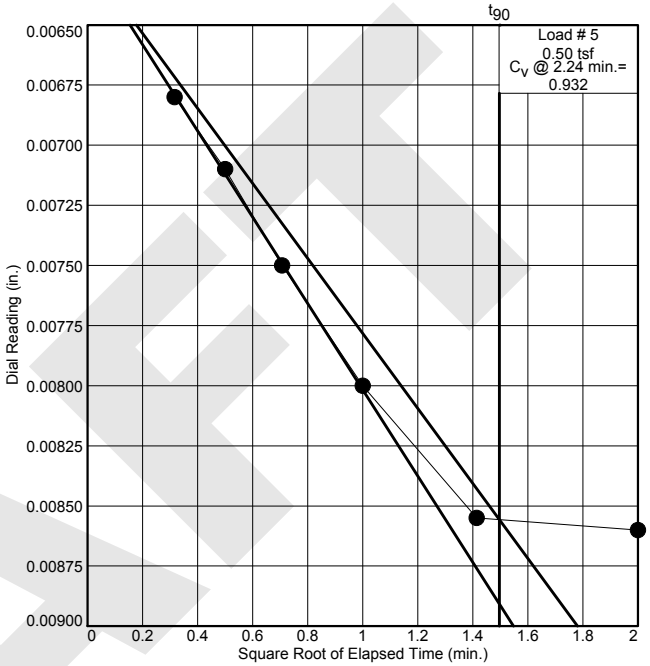
Charlotte, NC

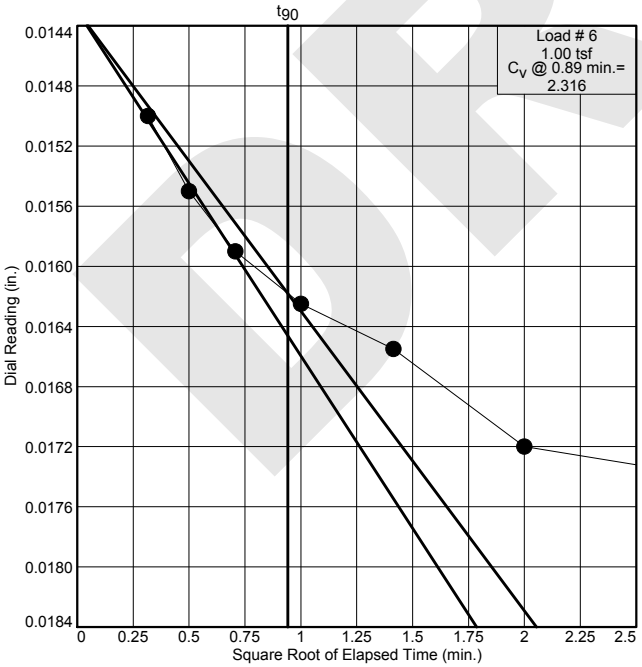
Figure 2

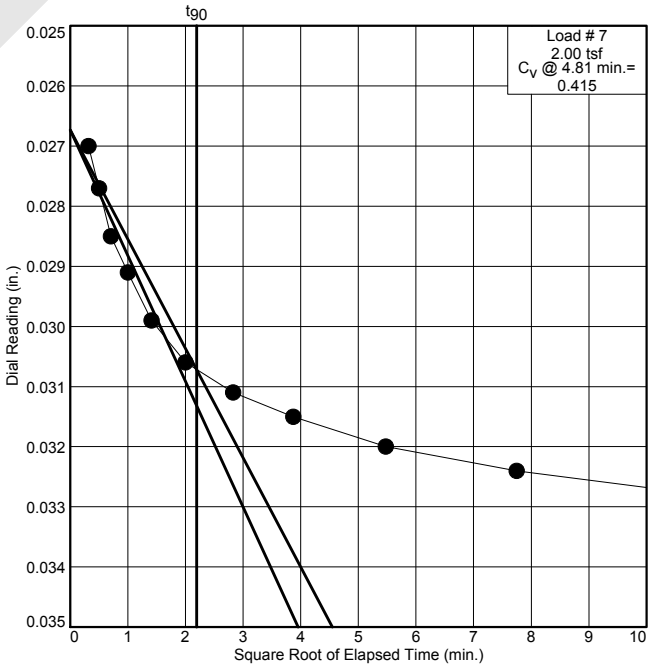
Dial Reading vs. Time

Project No.:
Project: Orangburg County
US 301 Five Chop Road
Source of Sample: Boring B-3A Depth: 9.00' - 11.00' Sample Number: ST-1









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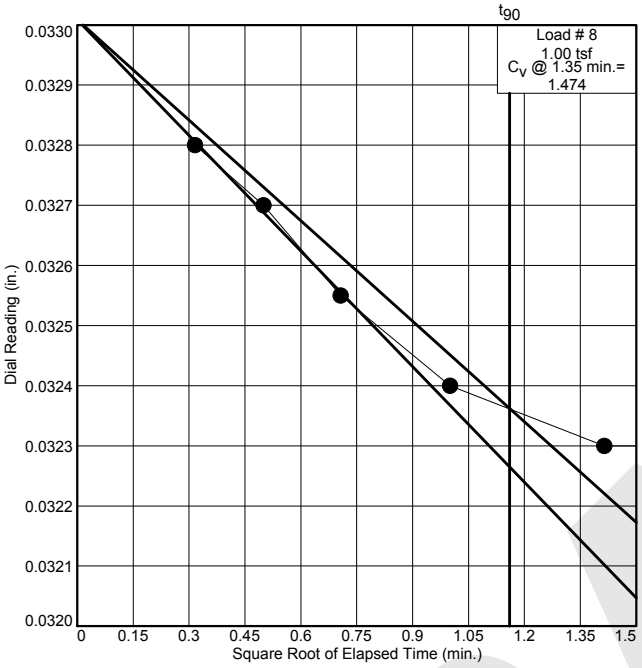
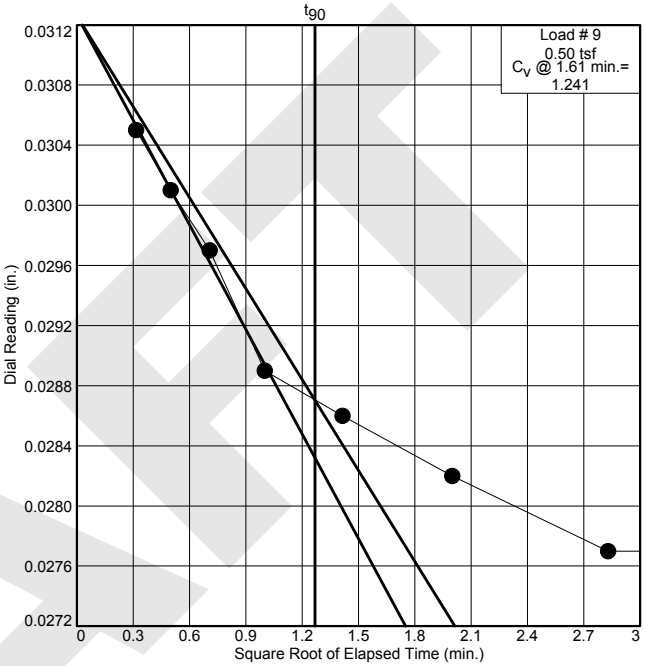
Charlotte, NC

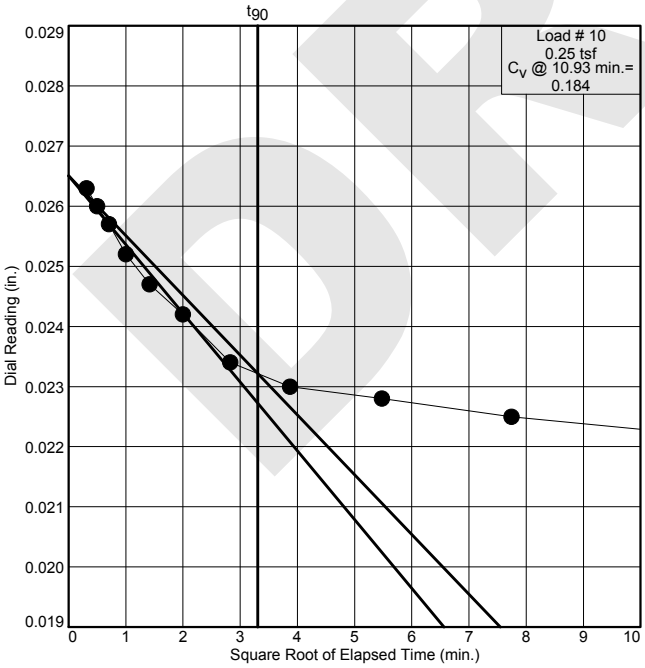
Figure 3

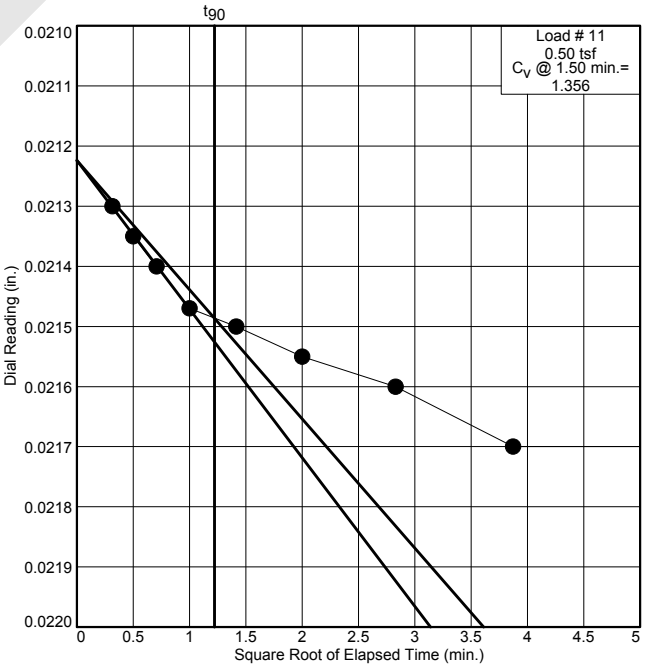
Dial Reading vs. Time

Project No.:
Project: Orangburg County
US 301 Five Chop Road
Source of Sample: Boring B-3A Depth: 9.00' - 11.00' Sample Number: ST-1









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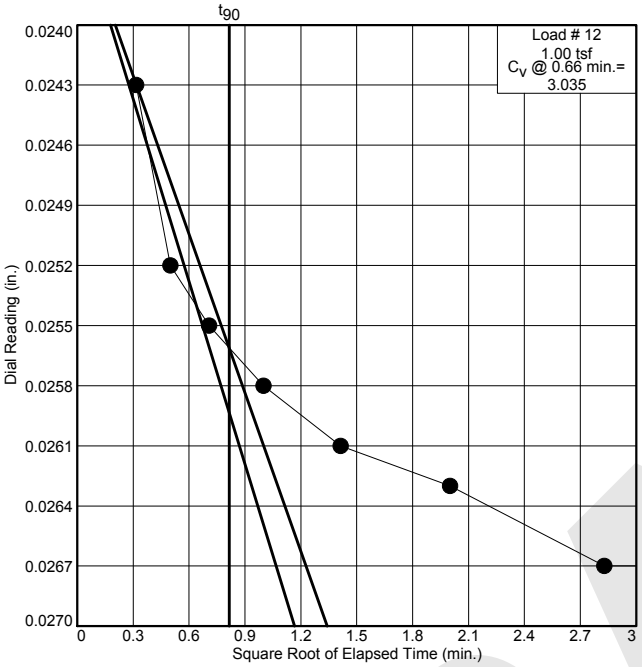
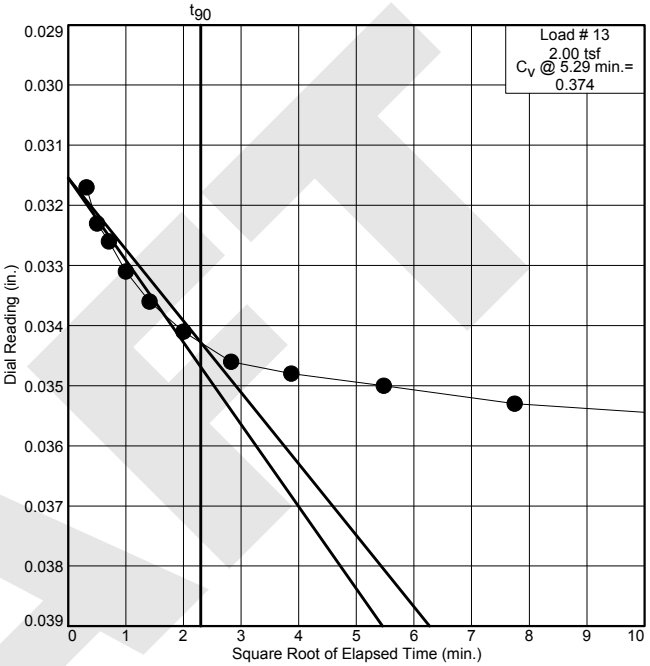
Charlotte, NC

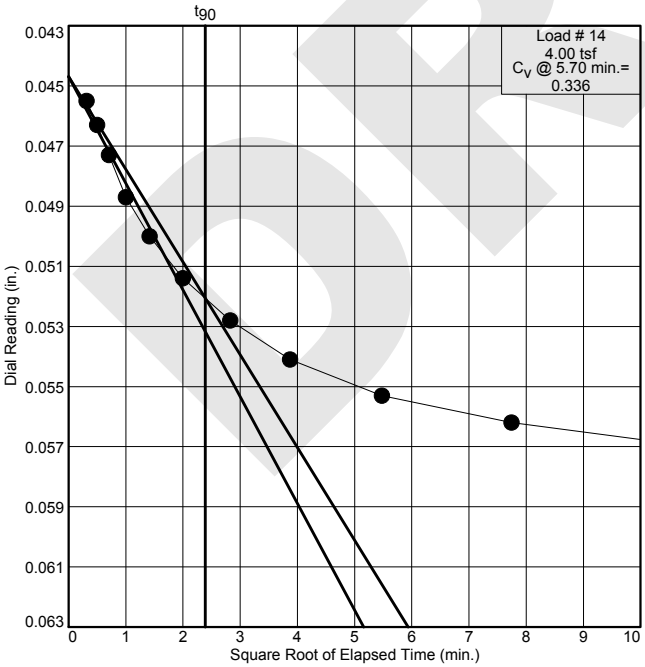
Figure 4

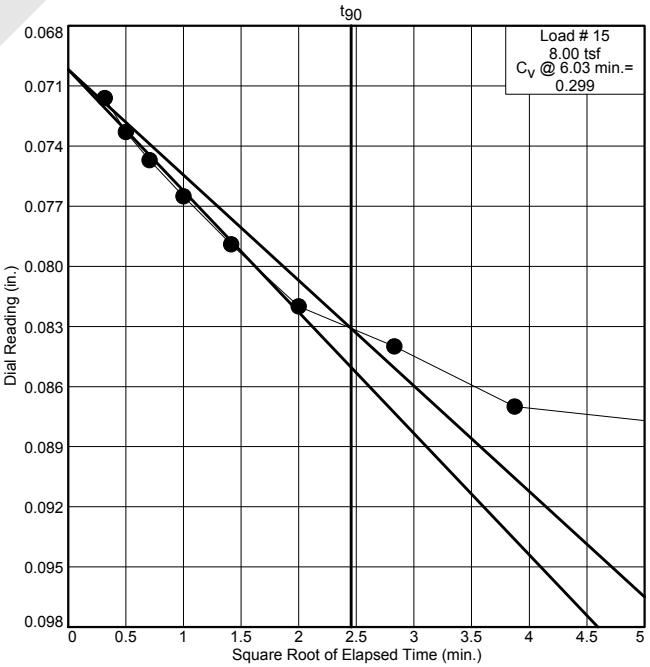
Dial Reading vs. Time

Project No.:
Project: Orangburg County
US 301 Five Chop Road
Source of Sample: Boring B-3A Depth: 9.00' - 11.00' Sample Number: ST-1









Professional Service Industries, Inc.
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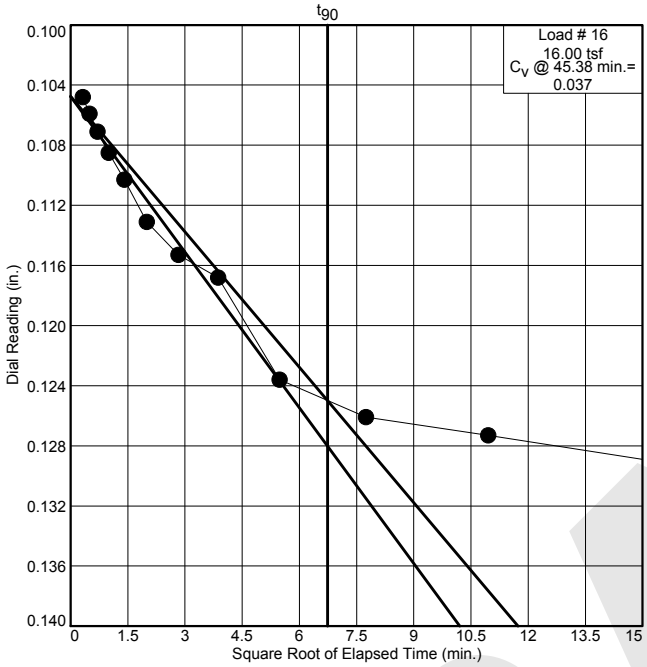
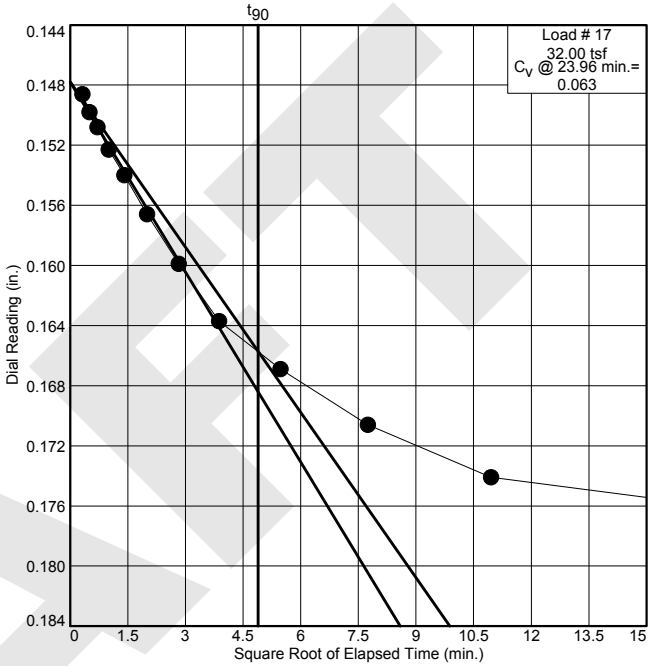
Charlotte, NC

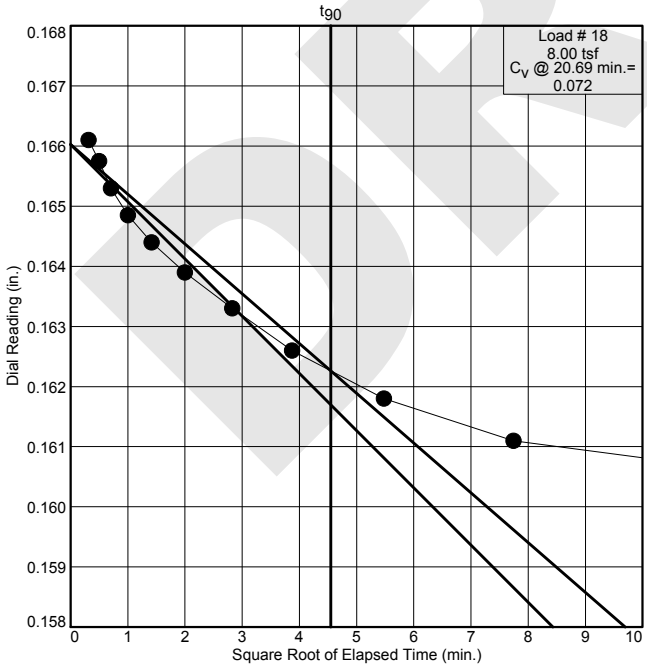
Figure 5

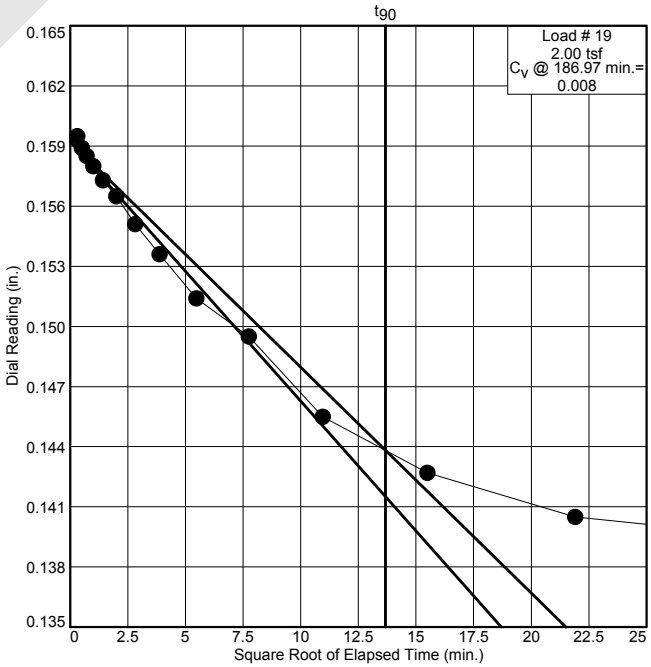
Dial Reading vs. Time

Project No.:
Project: Orangburg County
US 301 Five Chop Road
Source of Sample: Boring B-3A Depth: 9.00' - 11.00' Sample Number: ST-1









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Charlotte, NC

Figure 6

CONSOLIDATION TEST DATA

2/18/2015

Client: SCDOT
Project: Orangburg County
US 301 Five Chop Road
Over Four Hole Swamp
Project ID 0040308
Location: Boring B-3A
Depth: 9.00' - 11.00'
Sample Number: ST-1
Material Description: Grey Sandy Lean Clay
Liquid Limit: 35
Plasticity Index: 20
USCS: CL
AASHTO: A-6(10)
Figure No.: 01
Testing Remarks: Date Tested: 2/9/15
Percent Finer: 63.1%
Tested by: Steven Putnam
Checked by: Tom Cannarelle

Test Specimen Data

NATURAL MOISTURE
Wet w+t = 210.48 g.
Dry w+t = 190.90 g.
Tare Wt. = 89.43 g.
Moisture = 19.3 %

VOID RATIO
Spec. Gr. = 2.630
Est. Ht. Solids = 0.641 in.
Init. V.R. = 0.560
Init. Sat. = 90.7 %

AFTER TEST
Wet w+t = 244.42 g.
Dry w+t = 221.56 g.
Tare Wt. = 88.13 g.
Moisture = 17.1 %

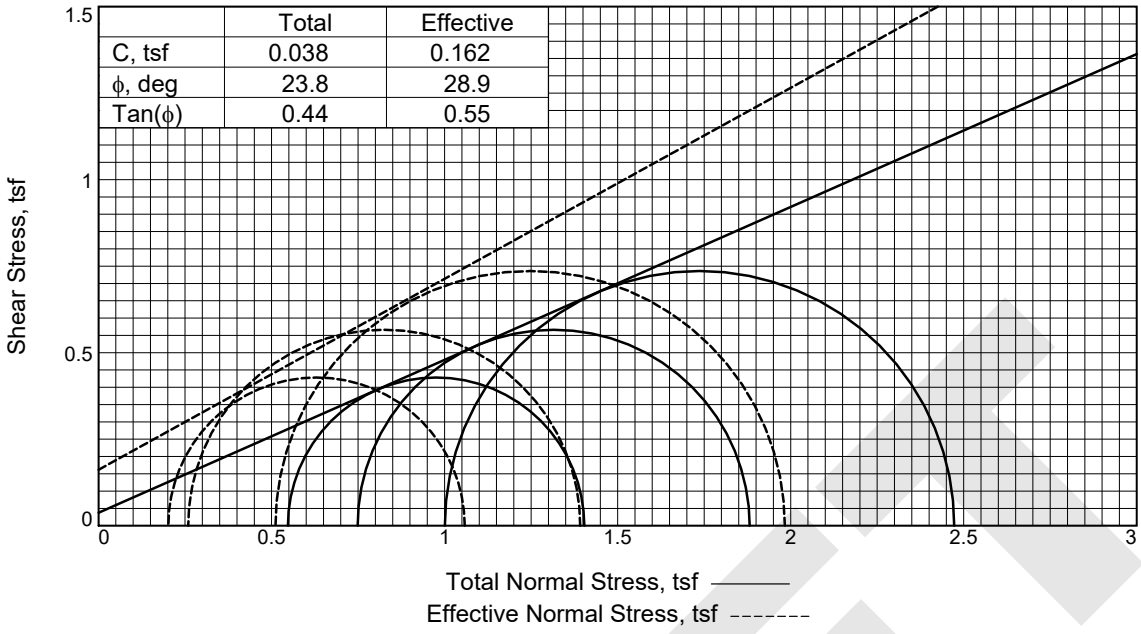
UNIT WEIGHT
Height = 1.000 in.
Diameter = 2.500 in.
Weight = 161.83 g.
Dry Dens. = 105.3 pcf

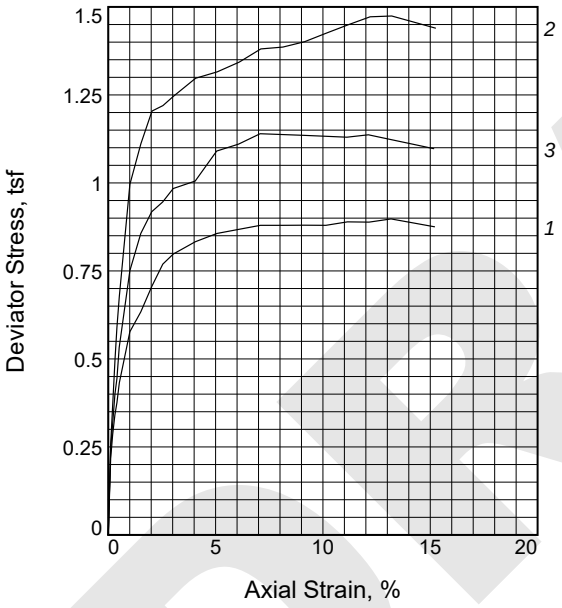
TEST START
Height = 1.000 in.
Diameter = 2.500 in.

Dry Wt. = 133.43 g.

End-Of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	Deformation (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Strain
start	0.00000		0.00000			0.560	
0.05	0.00030	0.00190	-0.00161*	1.818		0.562	0.2 Swell
0.06	0.00070	0.00190	-0.00123*	2.773		0.561	0.1 Swell
0.13	0.00140	0.00000	0.00125*	5.086		0.558	0.1 Comprs.
0.25	0.00420	0.00020	0.00383*	0.298		0.554	0.4 Comprs.
0.50	0.00920	0.00040	0.00882*	0.932		0.546	0.9 Comprs.
1.00	0.01840	0.00070	0.01639*	2.316		0.534	1.6 Comprs.
2.00	0.03440	0.00100	0.03116*	0.415		0.511	3.1 Comprs.
1.00	0.03360	0.00130	0.03229*	1.474		0.509	3.2 Comprs.
0.50	0.02900	0.00130	0.02842*	1.241		0.515	2.8 Comprs.
0.25	0.02280	0.00130	0.02285*	0.184		0.524	2.3 Comprs.
0.50	0.02360	0.00190	0.02152*	1.356		0.526	2.2 Comprs.
1.00	0.02860	0.00190	0.02585*	3.035		0.519	2.6 Comprs.
2.00	0.03730	0.00130	0.03459*	0.374		0.506	3.5 Comprs.
4.00	0.06070	0.00120	0.05287*	0.336		0.477	5.3 Comprs.
8.00	0.09600	0.00150	0.08453*	0.299		0.428	8.5 Comprs.





Sample No.		1	2	3
Initial	Water Content, %	30.8	19.5	25.5
	Dry Density, pcf	91.3	109.7	97.1
	Saturation, %	101.4	103.5	97.1
	Void Ratio	0.7976	0.4961	0.6906
	Diameter, in.	2.80	2.81	2.80
	Height, in.	5.54	4.55	5.56
At Test	Water Content, %	30.8	20.1	28.4
	Dry Density, pcf	90.7	107.3	93.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8109	0.5296	0.7480
	Diameter, in.	2.83	2.86	2.87
	Height, in.	5.47	4.47	5.49
Strain rate, in./min.		0.02	0.02	0.02
Eff. Cell Pressure, psi		7.60	13.90	10.40
Fail. Stress, tsf		0.86	1.47	1.13
Total Pore Pr., tsf		1.43	1.57	1.57
Strain, %		5.1	12.2	10.1
Ult. Stress, tsf		0.86	1.47	1.13
Total Pore Pr., tsf		1.43	1.57	1.57
Strain, %		5.1	12.2	10.1
$\bar{\sigma}_1$ Failure, tsf		1.06	1.98	1.39
$\bar{\sigma}_3$ Failure, tsf		0.20	0.51	0.26

Type of Test:
CU with Pore Pressures
Sample Type: Undisturbed Shelby Tube
Description: Grey Sandy Lean Clay

LL= 35 **PL=** 15 **PI=** 20
Specific Gravity= 2.630
Remarks: Date Tested: 2/6/15 Percent Finer: 63.2

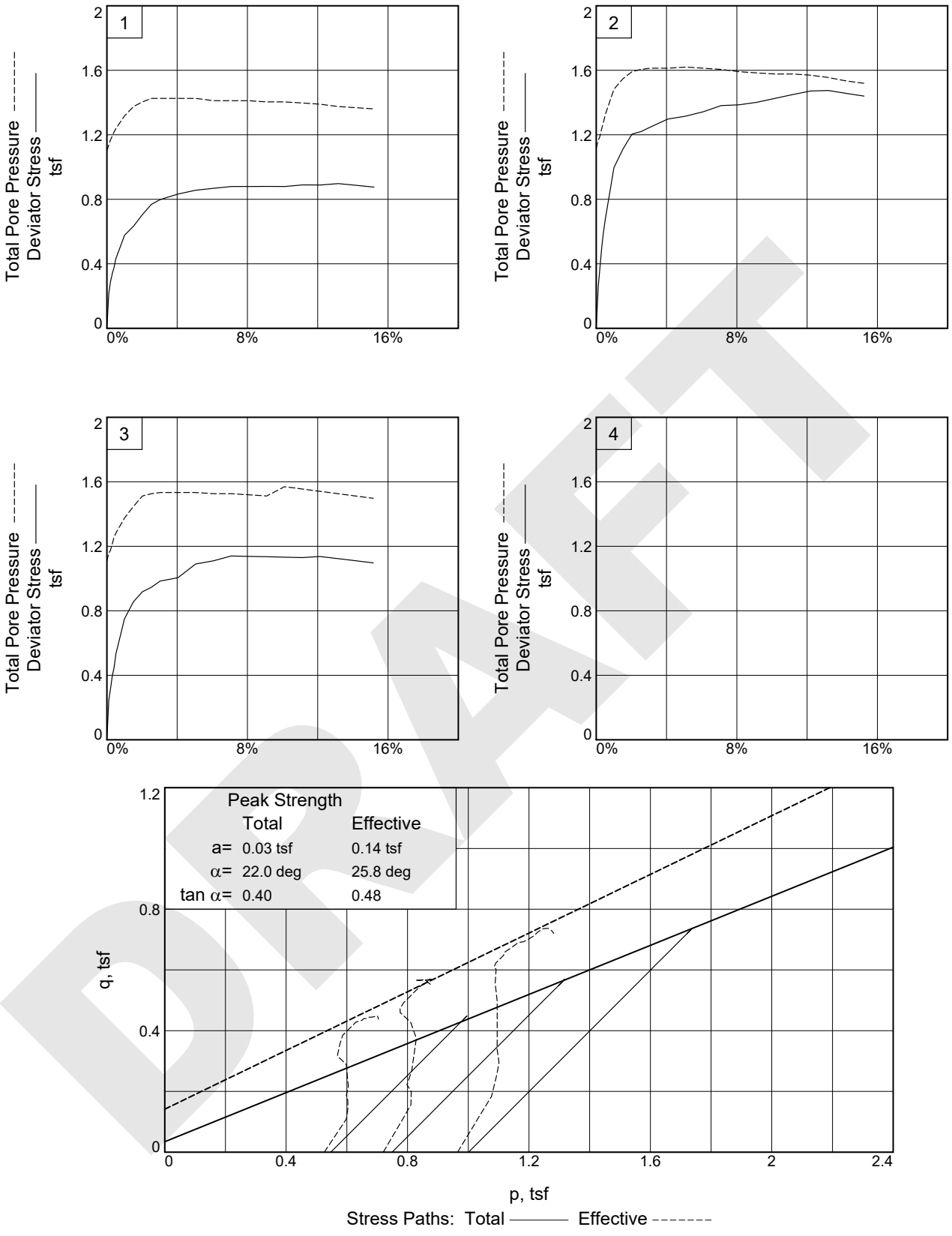
Figure 01

Client: SCDOT

Project: Orangburg County
US 301 Five Chop Road
Source of Sample: Boring B-3A **Depth:** 9.00' - 11.00'
Sample Number: ST-1
Proj. No.: **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Professional Service Industries, Inc.
5021 W. W.T. Harris Blvd.

Tested By: Steven Putnam **Checked By:** Tom Cannarella



Client: SCDOT
Project: Orangburg County
Source of Sample: Boring B-3A **Depth:** 9.00' - 11.00' **Sample Number:** ST-1
Project No.: **Figure** 02

Professional Service Industries, Inc.

Tested By: Steven Putnam **Checked By:** Tom Cannarella

TRIAXIAL COMPRESSION TEST 2/18/2015

CU with Pore Pressures 8:27 AM

Date:
Client: SCDOT
Project: Orangburg County
US 301 Five Chop Road
Over Four Hole Swamp
Project ID 0040308
Project No.:
Location: Boring B-3A
Depth: 9.00' - 11.00' **Sample Number:** ST-1
Description: Grey Sandy Lean Clay
Remarks: Date Tested: 2/6/15 Percent Finer: 63.2
Type of Sample: Undisturbed Shelby Tube
Specific Gravity=2.630 **LL=**35 **PL=**15 **PI=**20
Test Method: ASTM D 4767 Method B w/ saturation est.

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	141.950			1158.280
Moisture content: Dry soil+tare, gms.	129.210			906.390
Moisture content: Tare, gms.	87.780			89.480
Moisture, %	30.8		30.8	30.8
Moist specimen weight, gms.	1072.6			
Diameter, in.	2.80		2.83	
Area, in.²	6.17		6.30	
Height, in.	5.54		5.47	
Net decrease in height, in.		0.03	0.04	
Net decrease in water volume, cc.			6.00	
Wet density, pcf	119.4		118.6	
Dry density, pcf	91.3		90.7	
Void ratio	0.7976		0.8109	
Saturation, %	101.4		100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 22.60 psi (1.627 tsf)
Consolidation back pressure = 15.00 psi (1.080 tsf)
Consolidation effective confining stress = 0.547 tsf
Strain rate, in./min. = 0.02
Fail. Stress = 0.856 tsf **at reading no.** 12
Ult. Stress = 0.856 tsf **at reading no.** 12

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	0.000	0.0	0.0	0.000	0.526	0.526	1.00	15.30	0.526	0.000
1	0.0060	19.000	19.0	0.1	0.217	0.490	0.707	1.44	15.80	0.598	0.108
2	0.0110	25.000	25.0	0.2	0.285	0.461	0.746	1.62	16.20	0.603	0.143
3	0.0170	30.000	30.0	0.3	0.342	0.432	0.774	1.79	16.60	0.603	0.171
4	0.0220	33.000	33.0	0.4	0.376	0.410	0.786	1.92	16.90	0.598	0.188
5	0.0280	38.000	38.0	0.5	0.432	0.389	0.821	2.11	17.20	0.605	0.216
6	0.0550	51.000	51.0	1.0	0.577	0.310	0.887	2.86	18.30	0.598	0.289
7	0.0830	60.000	60.0	1.5	0.634	0.252	0.886	3.51	19.10	0.569	0.317
8	0.1110	68.000	68.0	2.0	0.706	0.223	0.930	4.16	19.50	0.576	0.353
9	0.1390	74.000	74.0	2.5	0.769	0.202	0.971	4.82	19.80	0.586	0.385
10	0.1660	77.000	77.0	3.0	0.798	0.202	1.000	4.96	19.80	0.601	0.399
11	0.2220	81.000	81.0	4.1	0.833	0.202	1.035	5.13	19.80	0.618	0.417
12	0.2770	84.000	84.0	5.1	0.856	0.202	1.058	5.25	19.80	0.630	0.428
13	0.3330	86.000	86.0	6.1	0.868	0.216	1.084	5.02	19.60	0.650	0.434
14	0.3880	88.000	88.0	7.1	0.879	0.216	1.095	5.07	19.60	0.656	0.440
15	0.4440	89.000	89.0	8.1	0.880	0.216	1.096	5.07	19.60	0.656	0.440
16	0.4990	90.000	90.0	9.1	0.880	0.223	1.103	4.94	19.50	0.663	0.440
17	0.5550	91.000	91.0	10.1	0.880	0.223	1.103	4.94	19.50	0.663	0.440
18	0.6100	93.000	93.0	11.1	0.889	0.230	1.120	4.86	19.40	0.675	0.445
19	0.6650	94.000	94.0	12.1	0.889	0.238	1.126	4.74	19.30	0.682	0.444
20	0.7210	96.000	96.0	13.2	0.898	0.252	1.150	4.56	19.10	0.701	0.449
21	0.7760	96.000	96.0	14.2	0.887	0.259	1.146	4.42	19.00	0.703	0.443
22	0.8320	96.000	96.0	15.2	0.875	0.266	1.142	4.29	18.90	0.704	0.438

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	140.180			1057.070
Moisture content: Dry soil+tare, gms.	131.910			894.600
Moisture content: Tare, gms.	89.540			87.780
Moisture, %	19.5		20.1	20.1
Moist specimen weight, gms.	970.9			
Diameter, in.	2.81		2.86	
Area, in.²	6.20		6.44	
Height, in.	4.55		4.47	
Net decrease in height, in.		0.03	0.05	
Net decrease in water volume, cc.			9.90	
Wet density, pcf	131.2		129.0	
Dry density, pcf	109.7		107.3	
Void ratio	0.4961		0.5296	
Saturation, %	103.5		100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 28.90 psi (2.081 tsf)
Consolidation back pressure = 15.00 psi (1.080 tsf)
Consolidation effective confining stress = 1.001 tsf
Strain rate, in./min. = 0.02
Fail. Stress = 1.472 tsf **at reading no.** 19
Ult. Stress = 1.472 tsf **at reading no.** 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	0.000	0.0	0.0	0.000	0.965	0.965	1.00	15.50	0.965	0.000
1	0.0050	23.000	23.0	0.1	0.257	0.914	1.171	1.28	16.20	1.043	0.128
2	0.0090	33.000	33.0	0.2	0.368	0.893	1.261	1.41	16.50	1.077	0.184
3	0.0140	45.000	45.0	0.3	0.501	0.842	1.344	1.60	17.20	1.093	0.251
4	0.0180	53.000	53.0	0.4	0.590	0.806	1.396	1.73	17.70	1.101	0.295
5	0.0230	61.000	61.0	0.5	0.678	0.756	1.434	1.90	18.40	1.095	0.339
6	0.0450	90.000	90.0	1.0	0.996	0.598	1.593	2.67	20.60	1.095	0.498
7	0.0680	101.000	101.0	1.5	1.112	0.533	1.644	3.09	21.50	1.089	0.556
8	0.0910	110.000	110.0	2.0	1.204	0.490	1.694	3.46	22.10	1.092	0.602
9	0.1140	112.000	112.0	2.5	1.220	0.475	1.695	3.57	22.30	1.085	0.610
10	0.1360	115.000	115.0	3.0	1.246	0.468	1.714	3.66	22.40	1.091	0.623
11	0.1820	121.000	121.0	4.1	1.297	0.468	1.765	3.77	22.40	1.117	0.649
12	0.2270	124.000	124.0	5.1	1.316	0.461	1.776	3.85	22.50	1.119	0.658
13	0.2730	128.000	128.0	6.1	1.343	0.468	1.811	3.87	22.40	1.140	0.672
14	0.3180	133.000	133.0	7.1	1.381	0.475	1.856	3.91	22.30	1.166	0.690
15	0.3640	135.000	135.0	8.1	1.386	0.490	1.876	3.83	22.10	1.183	0.693
16	0.4090	138.000	138.0	9.1	1.401	0.497	1.898	3.82	22.00	1.197	0.701
17	0.4550	142.000	142.0	10.2	1.426	0.504	1.930	3.83	21.90	1.217	0.713
18	0.5000	146.000	146.0	11.2	1.449	0.504	1.953	3.88	21.90	1.229	0.725
19	0.5460	150.000	150.0	12.2	1.472	0.511	1.983	3.88	21.80	1.247	0.736
20	0.5910	152.000	152.0	13.2	1.474	0.526	2.000	3.81	21.60	1.263	0.737

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
21	0.6370	152.000	152.0	14.2	1.457	0.547	2.004	3.66	21.30	1.276	0.728
22	0.6820	152.000	152.0	15.2	1.440	0.562	2.001	3.56	21.10	1.282	0.720

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	140.250			1183.750
Moisture content: Dry soil+tare, gms.	129.760			941.260
Moisture content: Tare, gms.	88.620			88.630
Moisture, %	25.5		28.4	28.4
Moist specimen weight, gms.	1096.3			
Diameter, in.	2.80		2.87	
Area, in.²	6.17		6.46	
Height, in.	5.56		5.49	
Net decrease in height, in.		0.02	0.05	
Net decrease in water volume, cc.			8.10	
Wet density, pcf	121.9		120.6	
Dry density, pcf	97.1		93.9	
Void ratio	0.6906		0.7480	
Saturation, %	97.1		100.0	

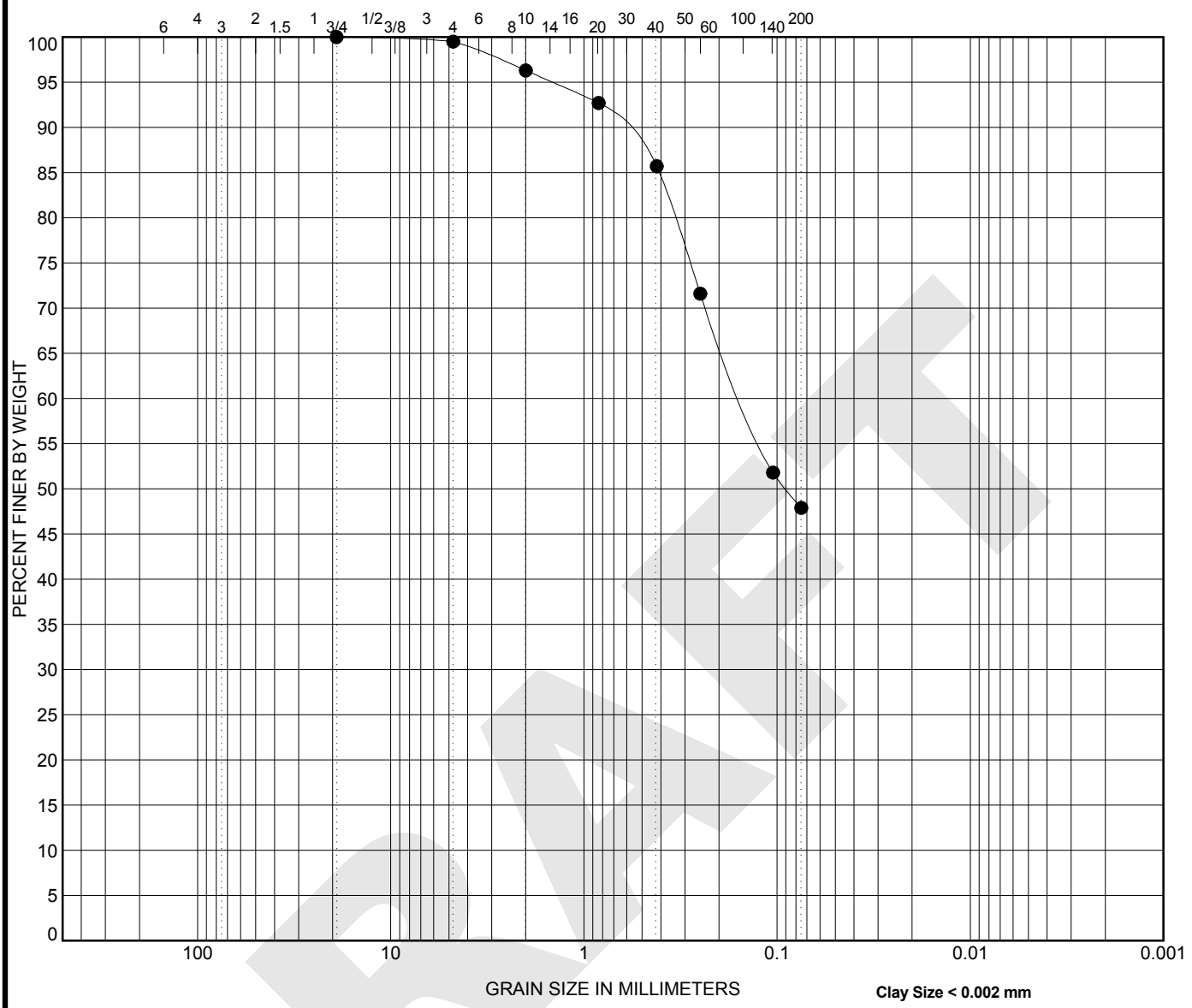
Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Consolidation cell pressure = 25.40 psi (1.829 tsf)
Consolidation back pressure = 15.00 psi (1.080 tsf)
Consolidation effective confining stress = 0.749 tsf
Strain rate, in./min. = 0.02
Fail. Stress = 1.133 tsf **at reading no.** 17
Ult. Stress = 1.133 tsf **at reading no.** 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
0	0.0000	0.000	0.0	0.0	0.000	0.720	0.720	1.00	15.40	0.720	0.000
1	0.0060	22.000	22.0	0.1	0.245	0.670	0.915	1.37	16.10	0.792	0.123
2	0.0110	28.000	28.0	0.2	0.312	0.655	0.967	1.48	16.30	0.811	0.156
3	0.0170	36.000	36.0	0.3	0.400	0.612	1.012	1.65	16.90	0.812	0.200
4	0.0220	40.000	40.0	0.4	0.444	0.576	1.020	1.77	17.40	0.798	0.222
5	0.0280	48.000	48.0	0.5	0.533	0.547	1.080	1.97	17.80	0.813	0.266
6	0.0550	68.000	68.0	1.0	0.751	0.454	1.204	2.65	19.10	0.829	0.375
7	0.0830	78.000	78.0	1.5	0.857	0.382	1.238	3.24	20.10	0.810	0.428
8	0.1110	89.000	89.0	2.0	0.918	0.317	1.235	3.90	21.00	0.776	0.459
9	0.1390	92.000	92.0	2.5	0.946	0.302	1.248	4.13	21.20	0.775	0.473
10	0.1660	96.000	96.0	3.0	0.984	0.295	1.279	4.33	21.30	0.787	0.492
11	0.2220	99.000	99.0	4.0	1.005	0.295	1.301	4.41	21.30	0.798	0.503
12	0.2770	103.000	103.0	5.0	1.091	0.295	1.386	4.69	21.30	0.840	0.545
13	0.3330	106.000	106.0	6.1	1.110	0.302	1.413	4.67	21.20	0.858	0.555
14	0.3880	110.000	110.0	7.1	1.140	0.302	1.442	4.77	21.20	0.872	0.570

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. psi	P tsf	Q tsf
15	0.4440	111.000	111.0	8.1	1.138	0.310	1.447	4.67	21.10	0.878	0.569
16	0.4990	112.000	112.0	9.1	1.135	0.317	1.452	4.58	21.00	0.884	0.568
17	0.5550	113.000	113.0	10.1	1.133	0.259	1.392	5.37	21.80	0.826	0.566
18	0.6100	114.000	114.0	11.1	1.130	0.274	1.403	5.13	21.60	0.839	0.565
19	0.6650	116.000	116.0	12.1	1.137	0.288	1.425	4.95	21.40	0.856	0.568
20	0.7210	116.000	116.0	13.1	1.124	0.302	1.426	4.72	21.20	0.864	0.562
21	0.7760	116.000	116.0	14.1	1.111	0.317	1.427	4.51	21.00	0.872	0.555
22	0.8320	116.000	116.0	15.2	1.097	0.331	1.429	4.31	20.80	0.880	0.549



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-5A SS-7 31.2**	**Very dense to dense green gray fine grained Silty SAND (SM)**	**29**	**23**	**6**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-5A SS-7 31.2**	**19.1**	**0.15**			**0.5**	**51.6**	**47.9**	

Professional Service Industries, Inc.
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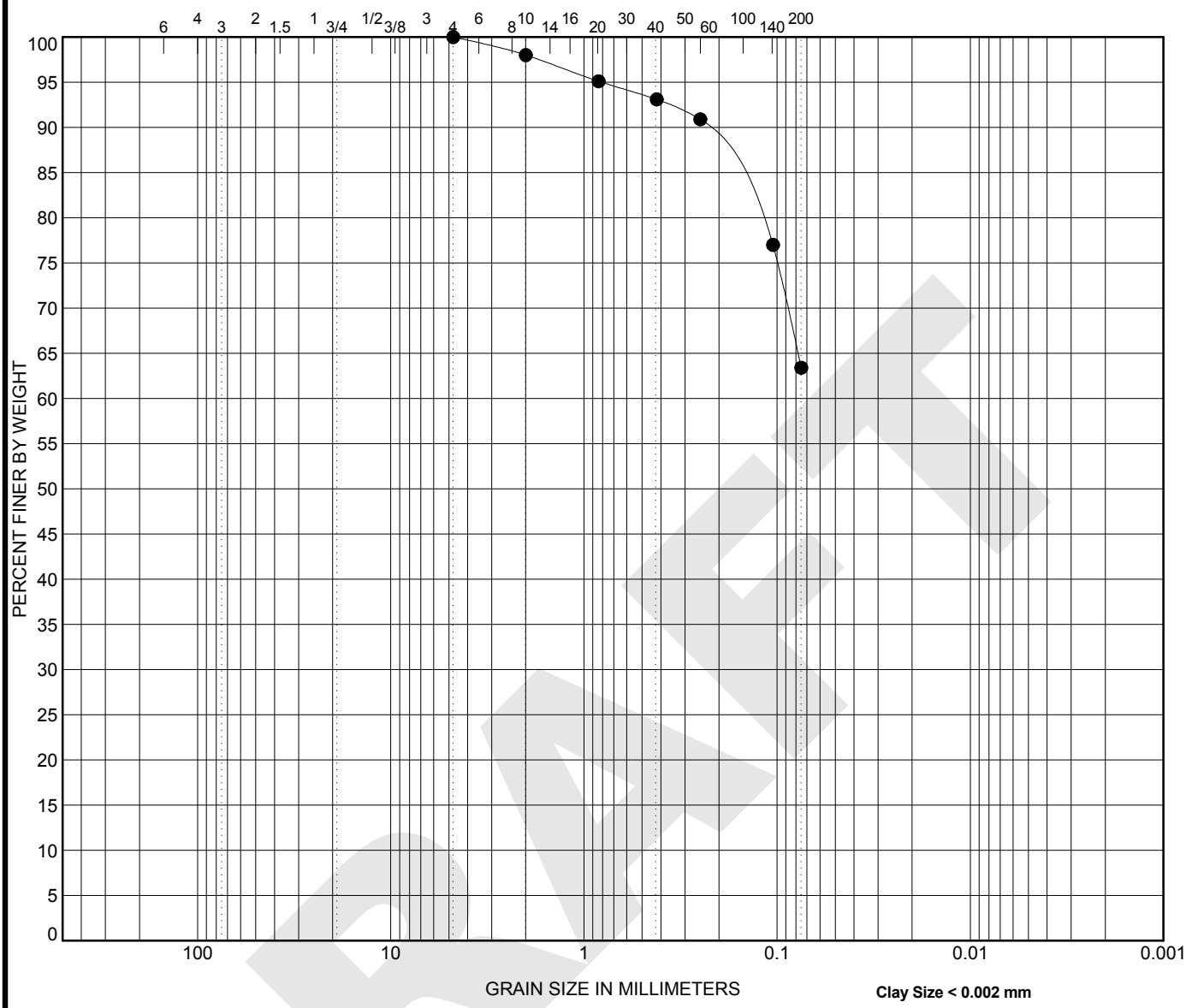
Columbia, SC 29210
Telephone: (803) 776-6050
Fax: (803) 772-2803

GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-5A SS-9 41.2**	**Very stiff to very hard green gray Sandy SILT (ML)**	**32**	**28**	**4**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-5A SS-9 41.2**	**4.75**				**0.0**	**36.6**	**63.4**	

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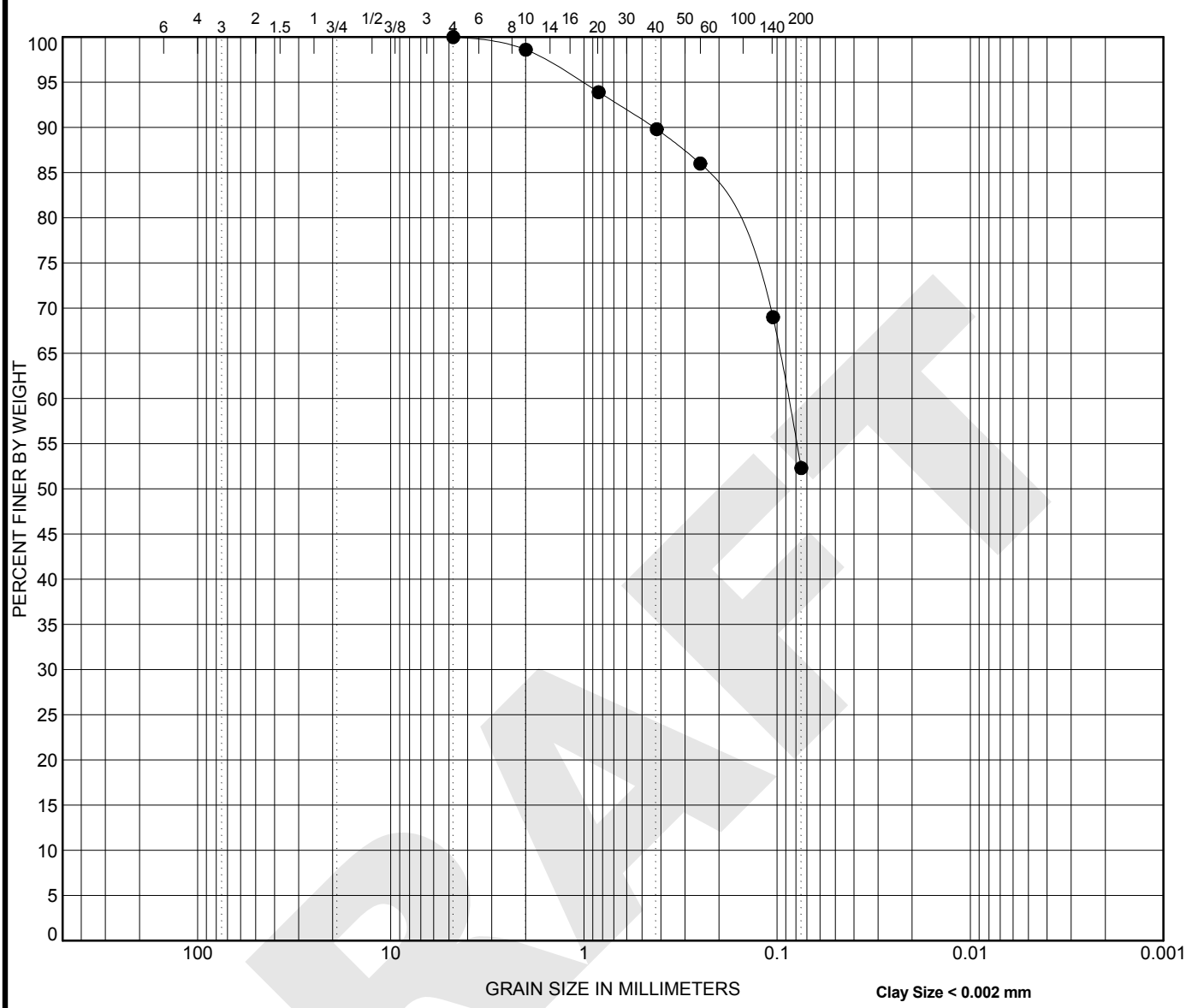
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-5A SS-11 51.2**	**Very stiff to very hard green gray Sandy SILT (ML)**	**28**	**25**	**3**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-5A SS-11 51.2**	**4.75**	**0.088**			**0.0**	**47.7**	**52.3**	

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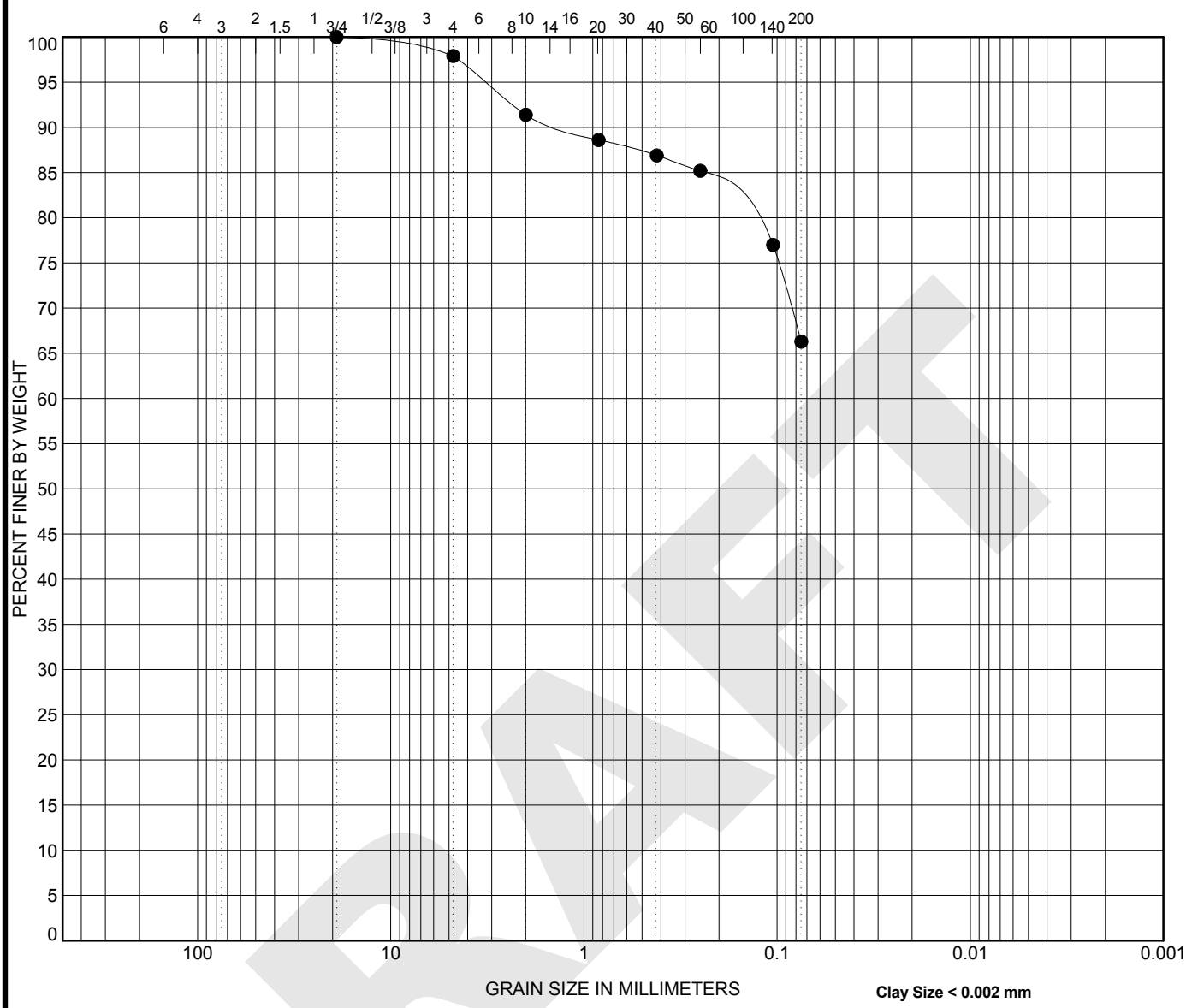
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-5A SS-13 61.2**	**Very stiff to very hard green gray Sandy SILT (ML)**	**35**	**30**	**5**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-5A SS-13 61.2**	**19.1**				**2.1**	**31.6**	**66.3**	

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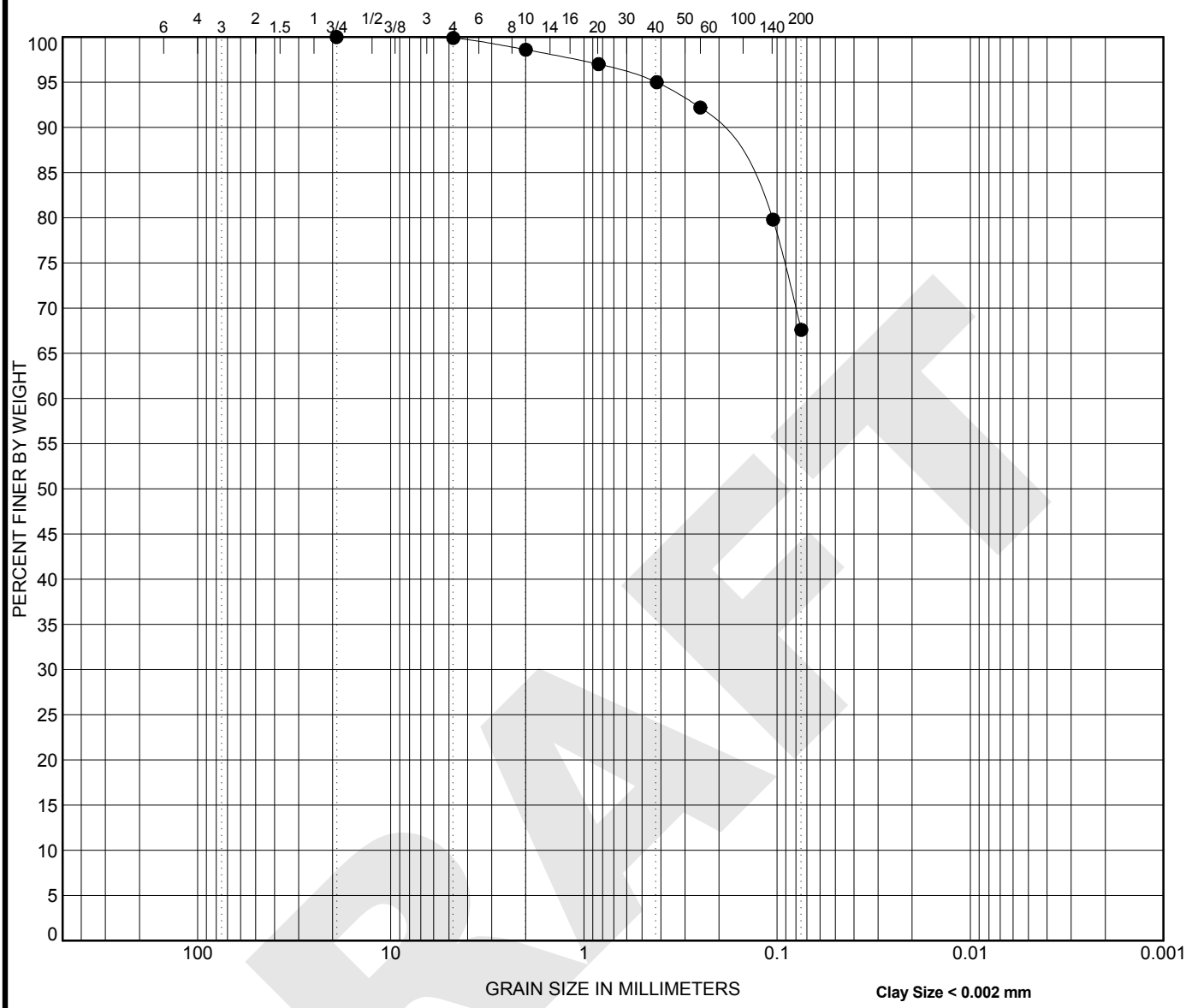
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-5A SS-16 72.7**	**Very stiff to very hard green gray Sandy SILT (ML)**	**34**	**28**	**6**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-5A SS-16 72.7**	**19.1**				**0.1**	**32.3**	**67.6**	

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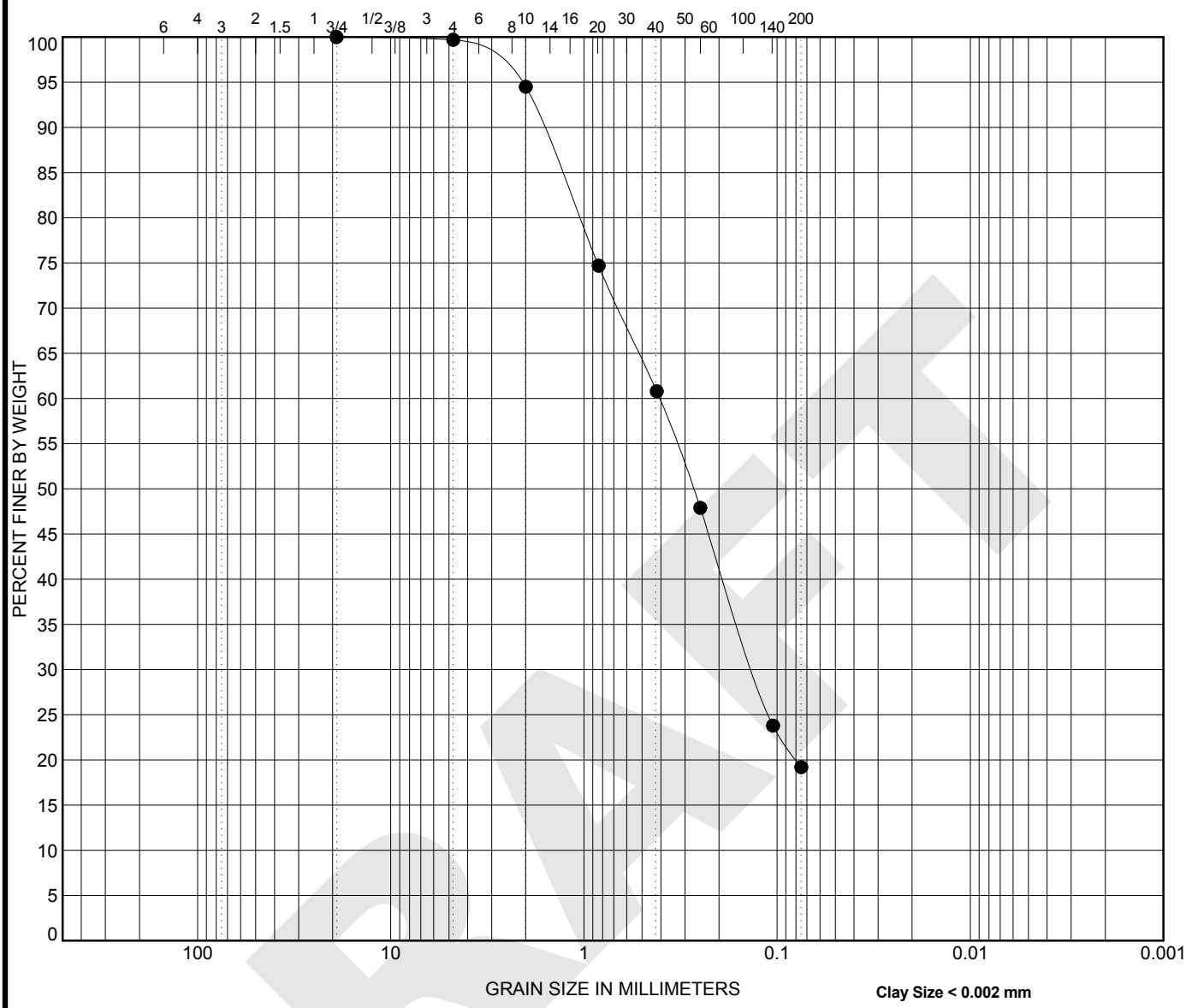
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-5A SS-24 88.7**	**Dense dark green fine to medium grained Silty SAND (SM)**	**NP**	**NP**	**NP**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-5A SS-24 88.7**	**19.1**	**0.407**	**0.131**		**0.3**	**80.5**	**19.2**	

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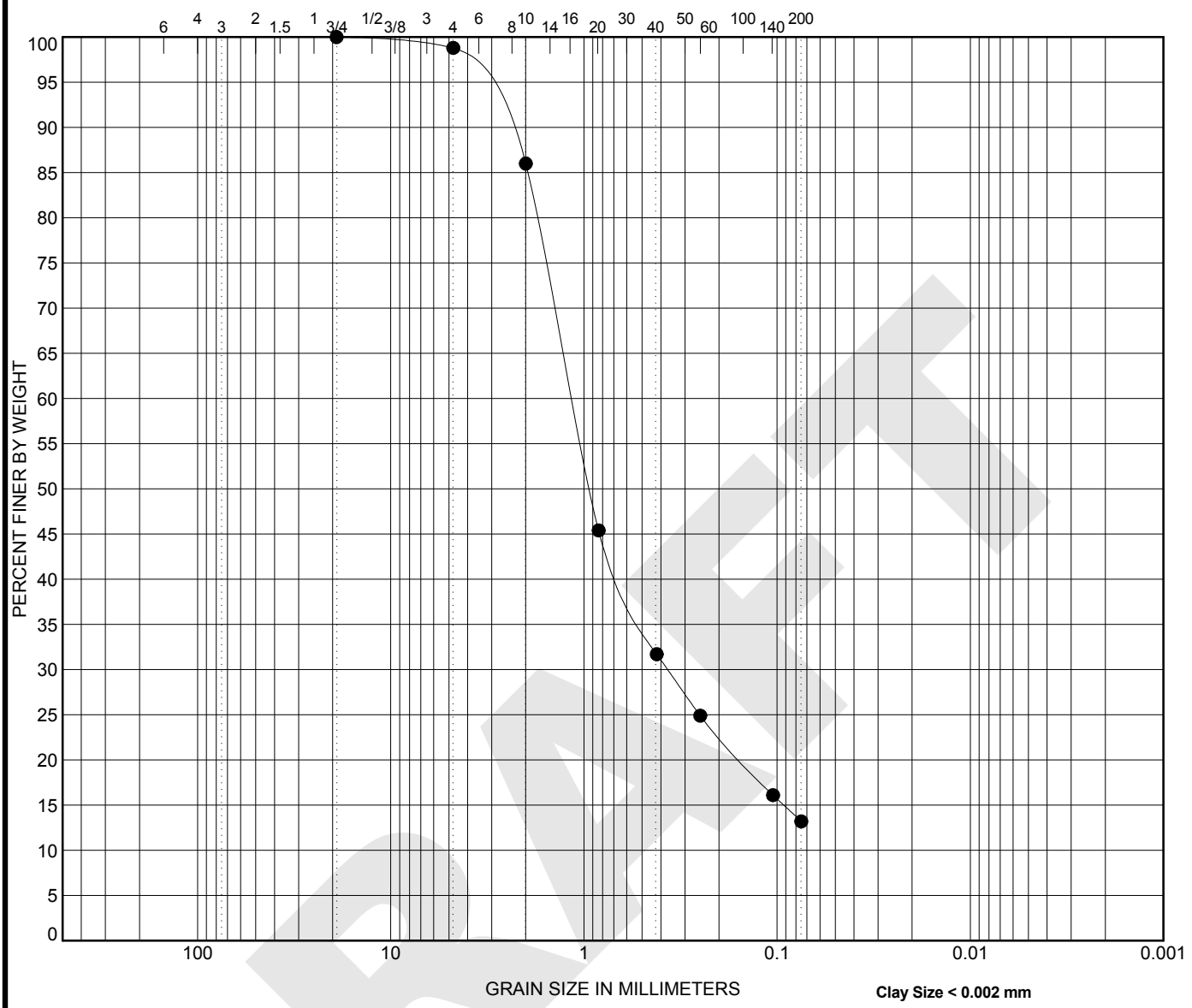
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-5A SS-26 96.2**	**Very dense gray fine to coarse grained Clayey SAND (SC)**	**61**	**17**	**44**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-5A SS-26 96.2**	**19.1**	**1.148**	**0.369**		**1.2**	**85.6**	**13.2**	

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GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S3
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

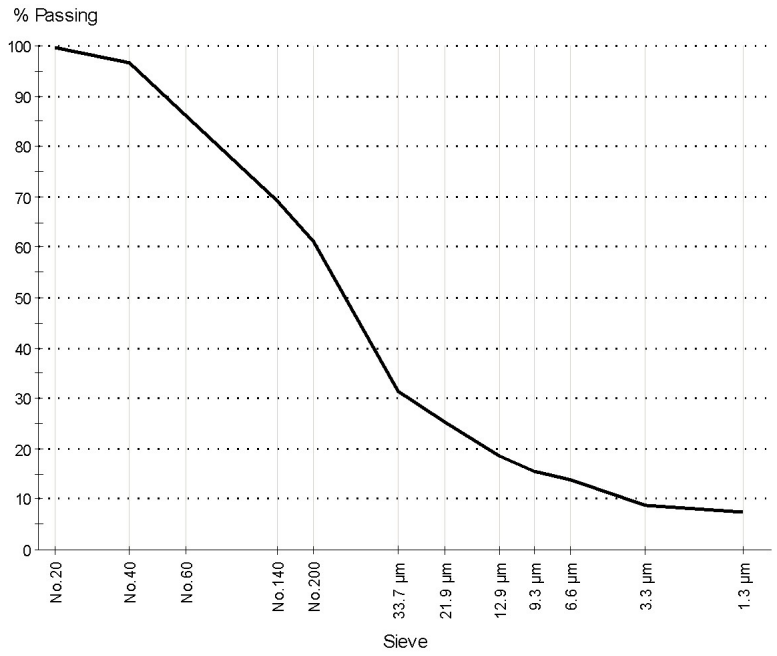
Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S3
Client Sample ID:	
Date Sampled:	12/05/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Black Sandy Fat CLAY (CH)
Sampling Method:	(none)
General Location:	Boring #5A SS-30
Location:	116.2' - 117.7'

Sample Description:

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.0%)	(0.0%)	(3.5%)	(35.4%)	(49.7%)	(11.4%)

Grading: ASTM D 422

Drying by: Oven
Date Tested:

Sieve Size	% Passing	Limits
No.20 (850µm)	99	
No.40 (425µm)	97	
No.60 (250µm)	86	
No.140 (106µm)	69	
No.200 (75µm)	61	
33.7 µm	31.5	
21.9 µm	25.2	
12.9 µm	18.7	
9.3 µm	15.4	
6.6 µm	13.8	
3.3 µm	8.9	
1.3 µm	7.6	

D85: 0.2359 D60: 0.0728 D50: 0.0556
D30: 0.0304 D15: 0.0085 D10: 0.0039
Cu: 18.88 Cc: 3.30

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S3
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S3
Client Sample ID:	
Date Sampled:	12/05/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Black Sandy Fat CLAY (CH)
Sampling Method:	(none)
General Location:	Boring #5A SS-30
Location:	116.2' - 117.7'

Other Test Results

Description	Method	Result	Limits
Group Symbol	ASTM D 2487		
Group Name			
Tested By		(unknown)	
Group Symbol (based on visual-manual procedures)	ASTM D 2488		
Group Name			
Tested By		(unknown)	
Dispersion device	ASTM D 422		
Dispersion time (min)			
Shape			
Hardness			
Tested By		(unknown)	

Comments

N/A

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S4
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

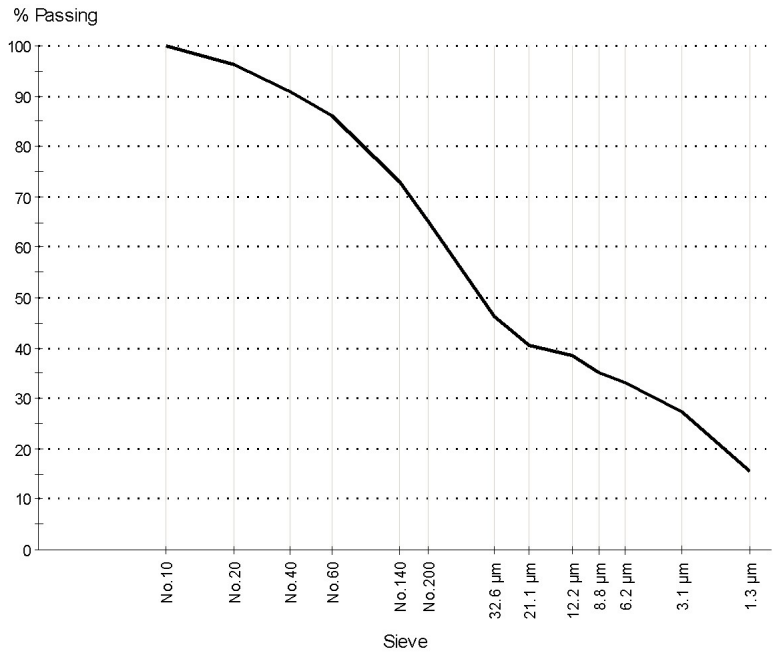
Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S4
Client Sample ID:	
Date Sampled:	12/05/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Black Sandy Elastic SILT (MH)
Sampling Method:	(none)
General Location:	Boring #5A SS-33
Location:	131.2' - 132.7'

Sample Description:

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.0%)	(0.0%)	(9.2%)	(25.8%)	(34.1%)	(31.0%)

Grading: ASTM D 422

Drying by: Oven
Date Tested:

Sieve Size	% Passing	Limits
No.10 (2.0mm)	100	
No.20 (850µm)	96	
No.40 (425µm)	91	
No.60 (250µm)	86	
No.140 (106µm)	73	
No.200 (75µm)	65	
32.6 µm	46.4	
21.1 µm	40.7	
12.2 µm	38.6	
8.8 µm	35.0	
6.2 µm	33.2	
3.1 µm	27.5	
1.3 µm	15.7	

D85: 0.2320 D60: 0.0599 D50: 0.0383
D30: 0.0042 D15: N/A D10: N/A

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Columbia, SC 29210

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Material Test Report

Report No: MAT:0451644-1-S4
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S4
Client Sample ID:	
Date Sampled:	12/05/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Black Sandy Elastic SILT (MH)
Sampling Method:	(none)
General Location:	Boring #5A SS-33
Location:	131.2' - 132.7'

Other Test Results

Description	Method	Result	Limits
Group Symbol	ASTM D 2487		
Group Name			
Tested By		(unknown)	
Group Symbol (based on visual-manual procedures)	ASTM D 2488		
Group Name			
Tested By		(unknown)	
Dispersion device	ASTM D 422		
Dispersion time (min)			
Shape			
Hardness			
Tested By		(unknown)	

Comments

N/A

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SOIL
TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	CRW
Date	01/13/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1505B-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19244/B-5A SS-8/SS-9/SS-10	Depth/Elev.	36.2-47.7'
Location	-	Add. Info	-

Analytical Testing Results for
Water Soluble Sulfate Ion Content in Soil (Method AASHTO T290)

T.E.S.T. Sample ID	Client Sample ID	Sample Depth/Elevation, ft	Result, mg/kg-dry	Remarks
19244	see above	see above	**396**	

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Web: www.test-llc.com

Tested By	CRW
Date	01/13/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1505B-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19244/B-5A SS-8/SS-9/SS-10	Depth/Elev.	36.2-47.7'
Location	-	Add. Info	-

Analytical Testing Results for
Water Soluble Chloride Ion Content in Soil (Method AASHTO T291)

T.E.S.T. Sample ID	Client Sample ID	Sample Depth/Elevation, ft	Result, mg/kg-dry	Remarks
19244	see above	see above	**4**	

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Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	EB
Date	01/06/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1541-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19244/B-5A SS-8/SS-9/SS-10	Depth/Elev.	36.2-47.7'
Location	-	Add. Info	-

ASTM G51/AASHTO T289

Standard Test Method for Determining pH of Soil for Use in Corrosion Testing

SAMPLE PREPARATION

Air dried Material passing #10 sieve was used for testing.

TEST DATA

T.E.S.T. Sample ID	Client Sample ID	pH meter Reading	Reported pH
19244	B-5A SS-8/SS-9/SS-10	7.60	**7.6**

Standard buffer solutions used to standardize pH meter:

4.0 pH

7.0 pH

10.0 pH

pH Meter ID 375

REMARKS

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SOIL
TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	AV
Date	01/07/15
Checked By	

Client Pr. #	0451644	Lab. PR. #	1541-01-1
Pr. Name	SCDOT US 301 Five Chop Rd - Orangeburg	S. Type	Bulk
Sample ID	19244/B-5A SS-8/SS-9/SS-10	Depth/Elev.	36.2-47.7'
Location	-	Add. Info	-

ASTM G 57/G187/AASHTO T 288

Standard Test Method for Determining Minimum Laboratory Soil Resistivity

Determination of Resistivity at as-received moisture content

As-received Moisture Content	
Mass of Wet Sample & Tare, g	
Mass of Dry Sample & Tare, g	
Mass of Tare, g	
Moisture Content, %	NA

Remarks

TEST DATA

Mass of Soil Box, g	-	Meter Dial Reading, ohms	-
Mass of Soil Box + Soil, g	-	Reading of Meter Range Multiplier	-
Mass of Soil, g	-	Measured Resistance, ohms	-
Calibrated Volume of Soil Box, ft^3	0.0027	Calibrated Soil Box Multiplier, cm	1.0
Wet Density of as-placed Soil, pcf	-		
Dry Density of as-placed Soil, pcf	-	**Reported Soil Resistivity, ohms-cm**	**NA**

Determination of Minimum Soil Resistivity

TEST DATA

	Trials at Various Moisture Content								
TRIAL #	1	2	3	4	5	6	7	8	9
Meter Dial Reading, ohms	3.00	2.00	1.80	1.80					
Reading of Meter Range Multiplier	1000	1000	1000	1000					
Measured Resistance, ohms	3000	2000	1800	1800					
Calibrated Soil Box Multiplier, cm	1.0	1.0	1.0	1.0					
Measured Resistivity, ohms-cm	3000	2000	1800	1800					

Reported Soil Minimum Resistivity, ohms-cm **1800**

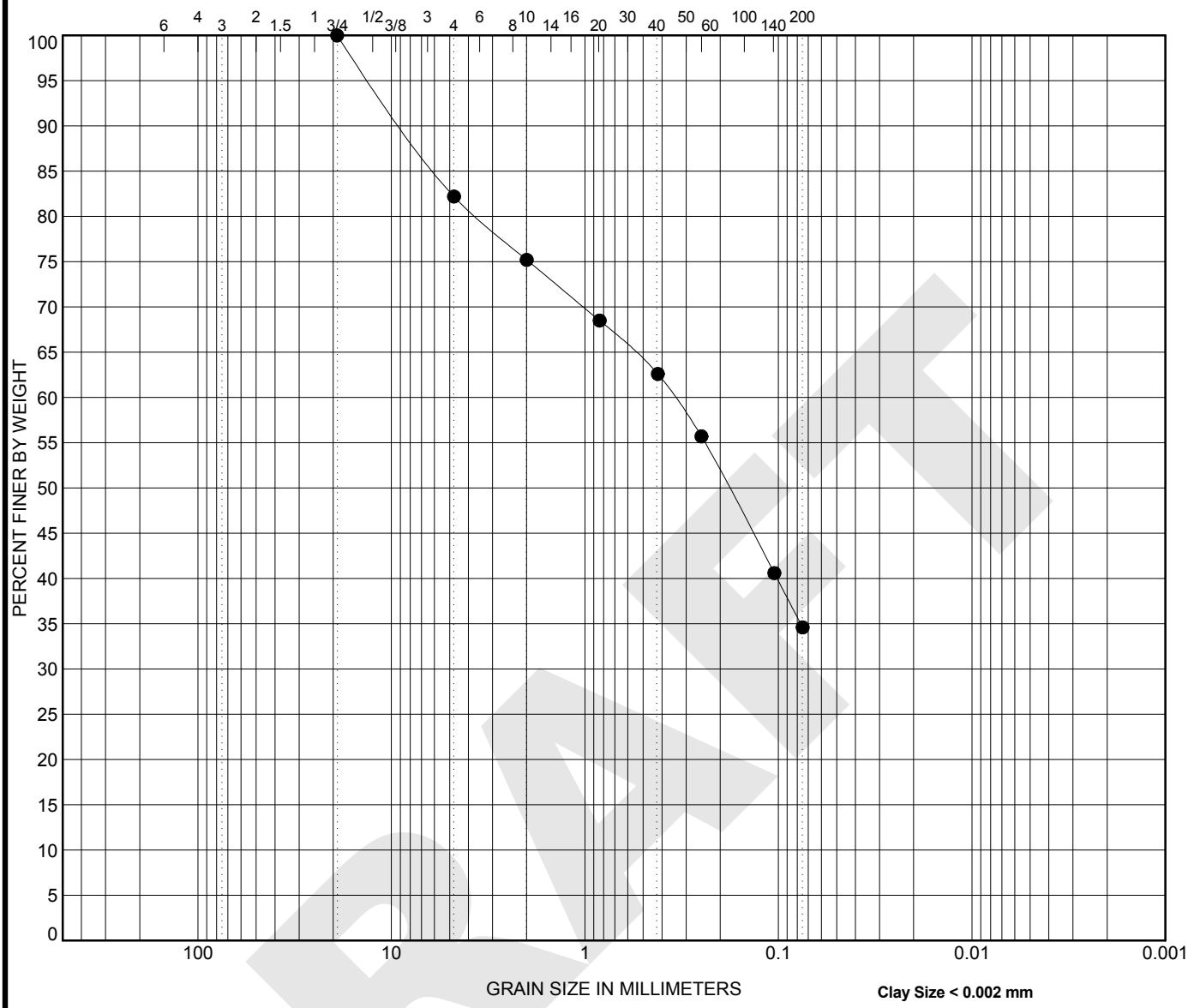
Note: Material passed # 10 sieve used for testing

Oven ID #	12/13/14/15
Balance ID #	1/2/6
Soil Box ID #	112
Resistivity Meter ID #	111/396

Description

NA

USCS (D2487; D2488)	NA
AASHTO (M145)	NA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● B-6A SS-8 35.2	Very dense green gray fine grained Silty SAND (SM)	24	22	2		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-6A SS-8 35.2	19.1	0.345			17.8	47.6	34.6	

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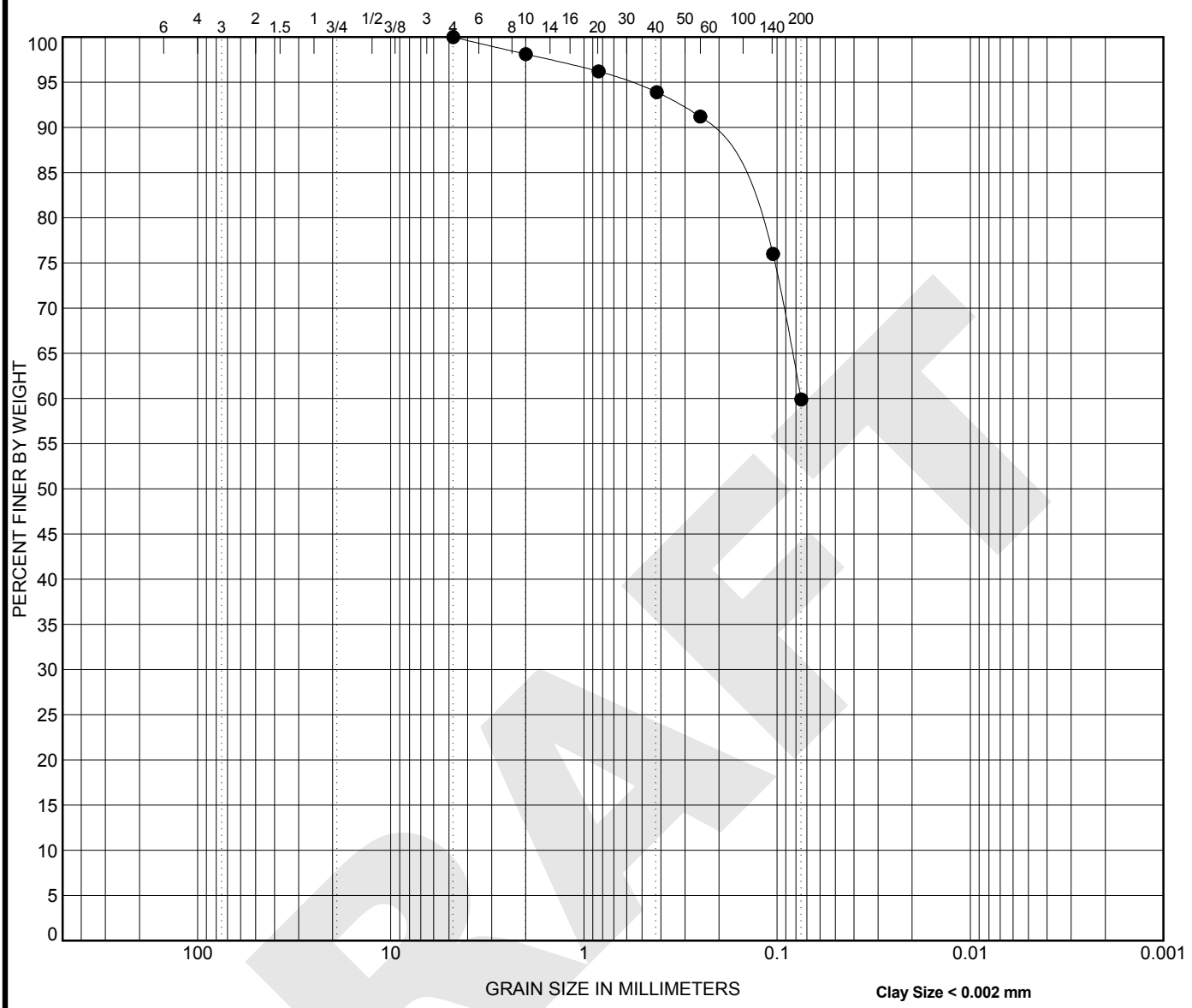
Fax: (803) 772-2803

GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-6A SS-11 50.2**	**Very stiff to very hard green gray Sandy SILT (ML)**	**31**	**28**	**3**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-6A SS-11 50.2**	**4.75**	**0.075**			**0.0**	**40.1**	**59.9**	

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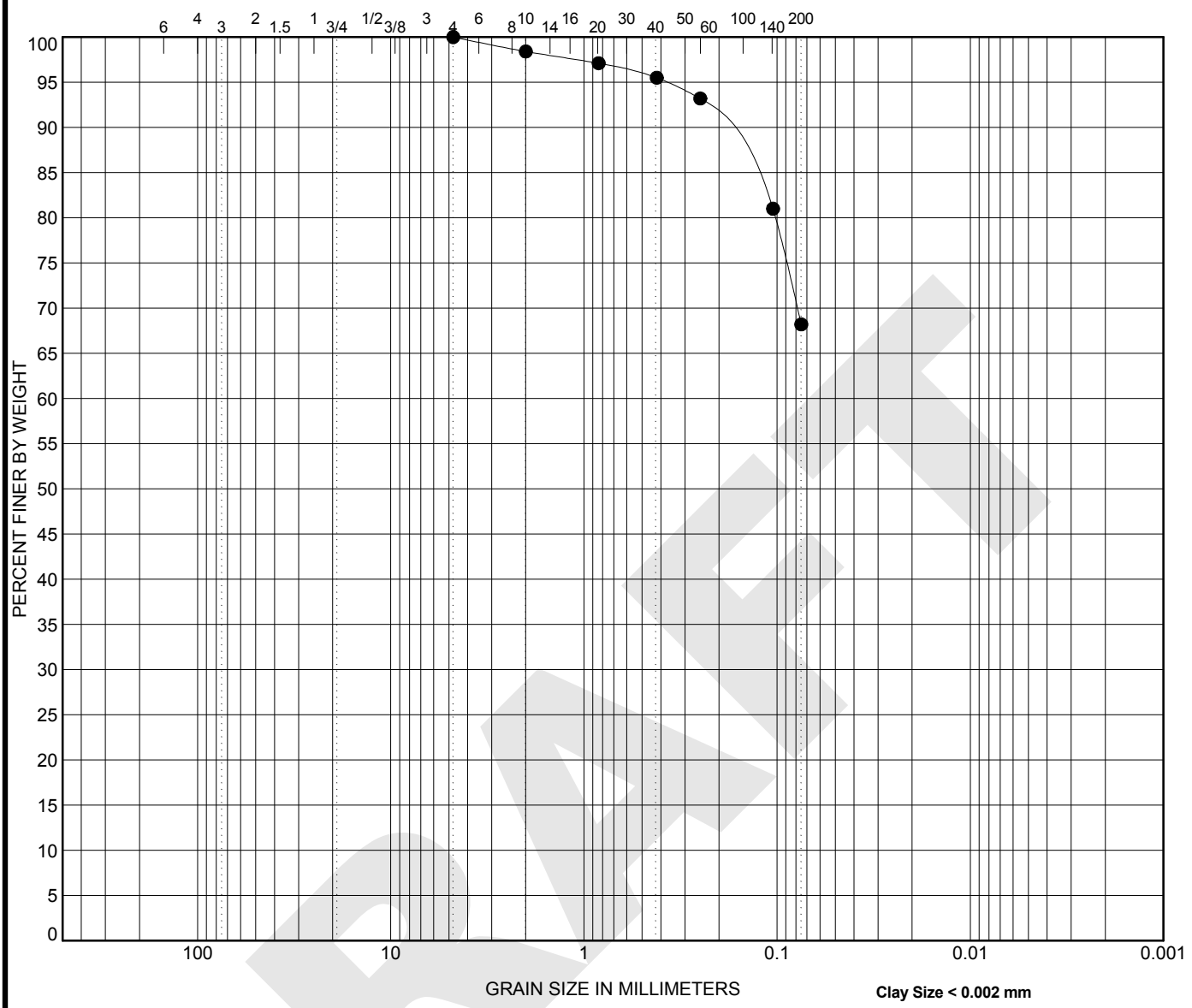
Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

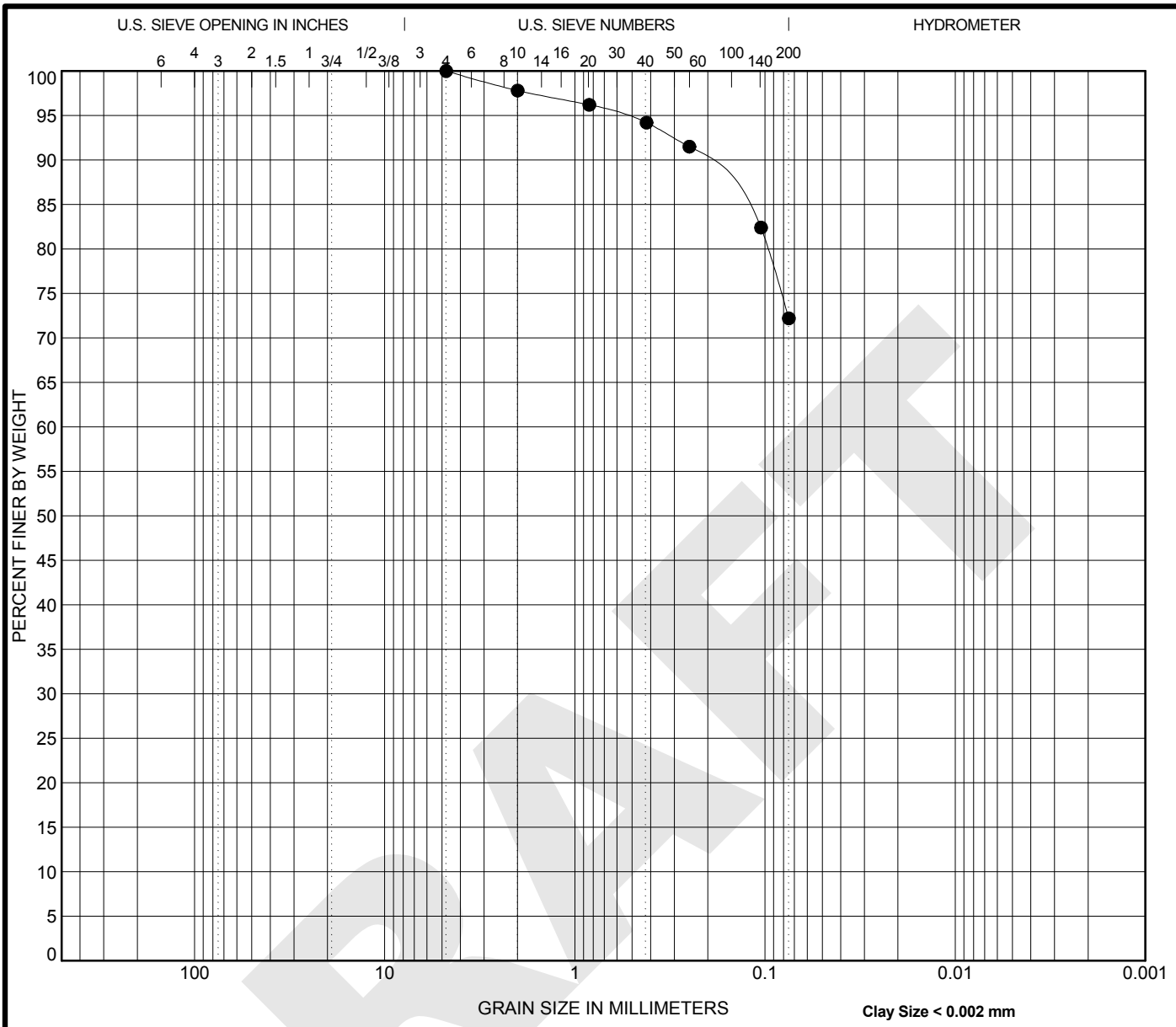
	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-6A SS-12 55.2**	**Very stiff to very hard green gray Sandy SILT (ML)**	**32**	**31**	**1**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-6A SS-12 55.2**	**4.75**				**0.0**	**31.8**	**68.2**	

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210
Telephone: (803) 776-6050
Fax: (803) 772-2803

GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-6A SS-15 70.2**	**Hard to very hard green gray SILT with sand (ML)**	**38**	**29**	**9**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-6A SS-15 70.2**	**4.75**				**0.0**	**27.8**	**72.2**	

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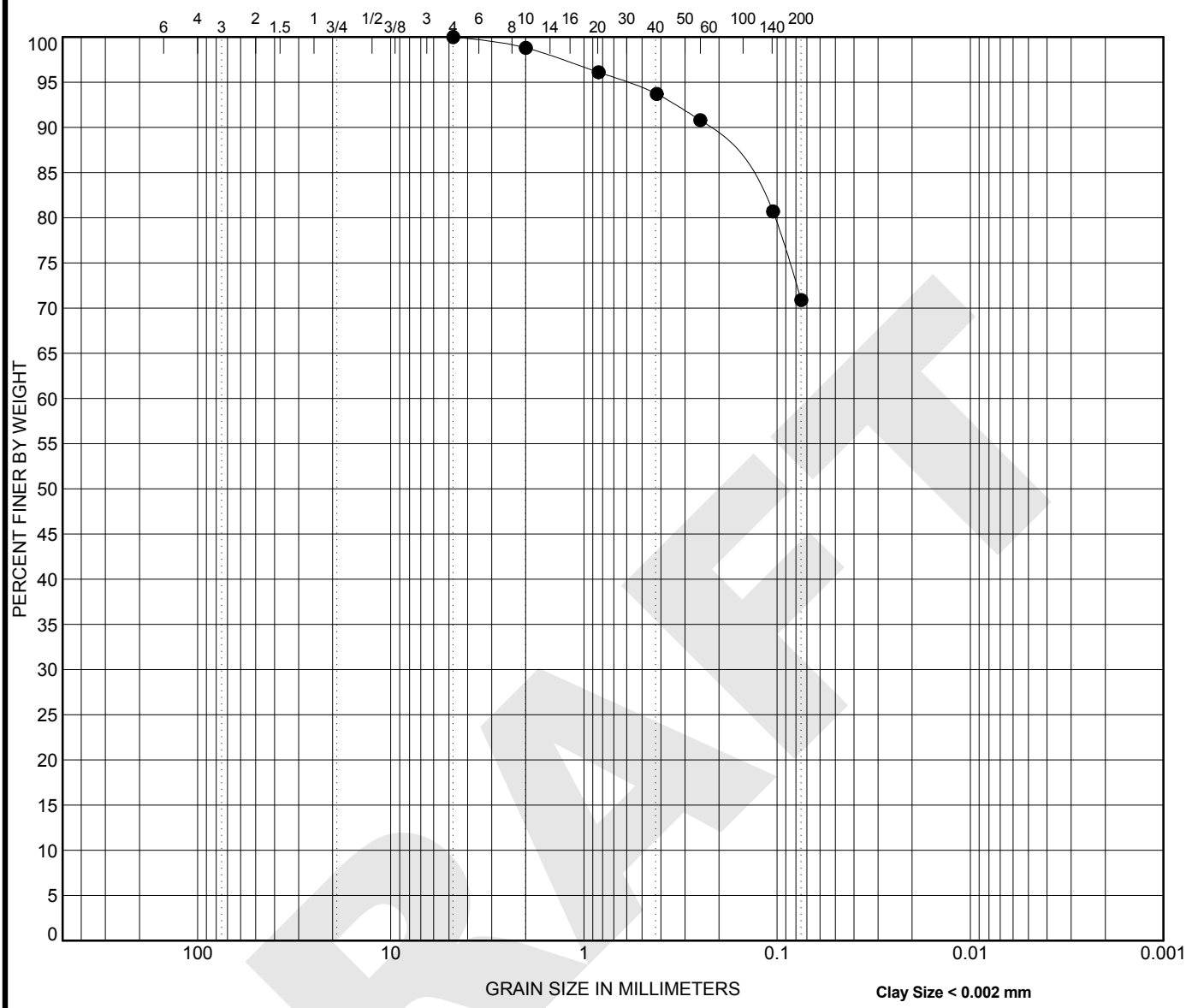
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-6A SS-19 77.7**	**Hard to very hard green gray SILT with sand (ML)**	**35**	**23**	**12**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-6A SS-19 77.7**	**4.75**				**0.0**	**29.1**	**70.9**	

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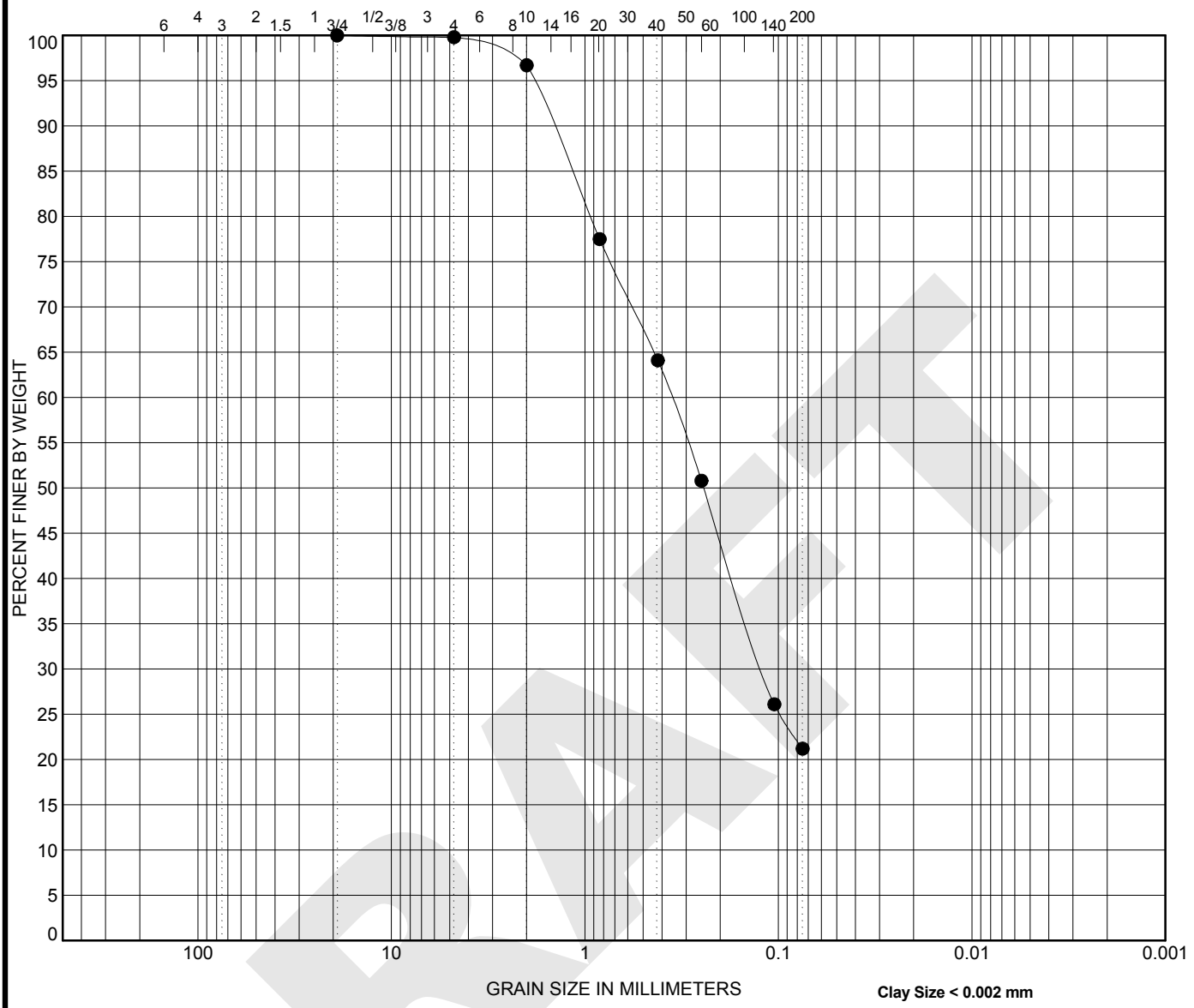
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-6A SS-25 89.7**	**Medium dense dark green fine to medium grained Clayey SAND (SC)**	**49**	**22**	**27**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-6A SS-25 89.7**	**19.1**	**0.358**	**0.12**		**0.2**	**78.6**	**21.2**	

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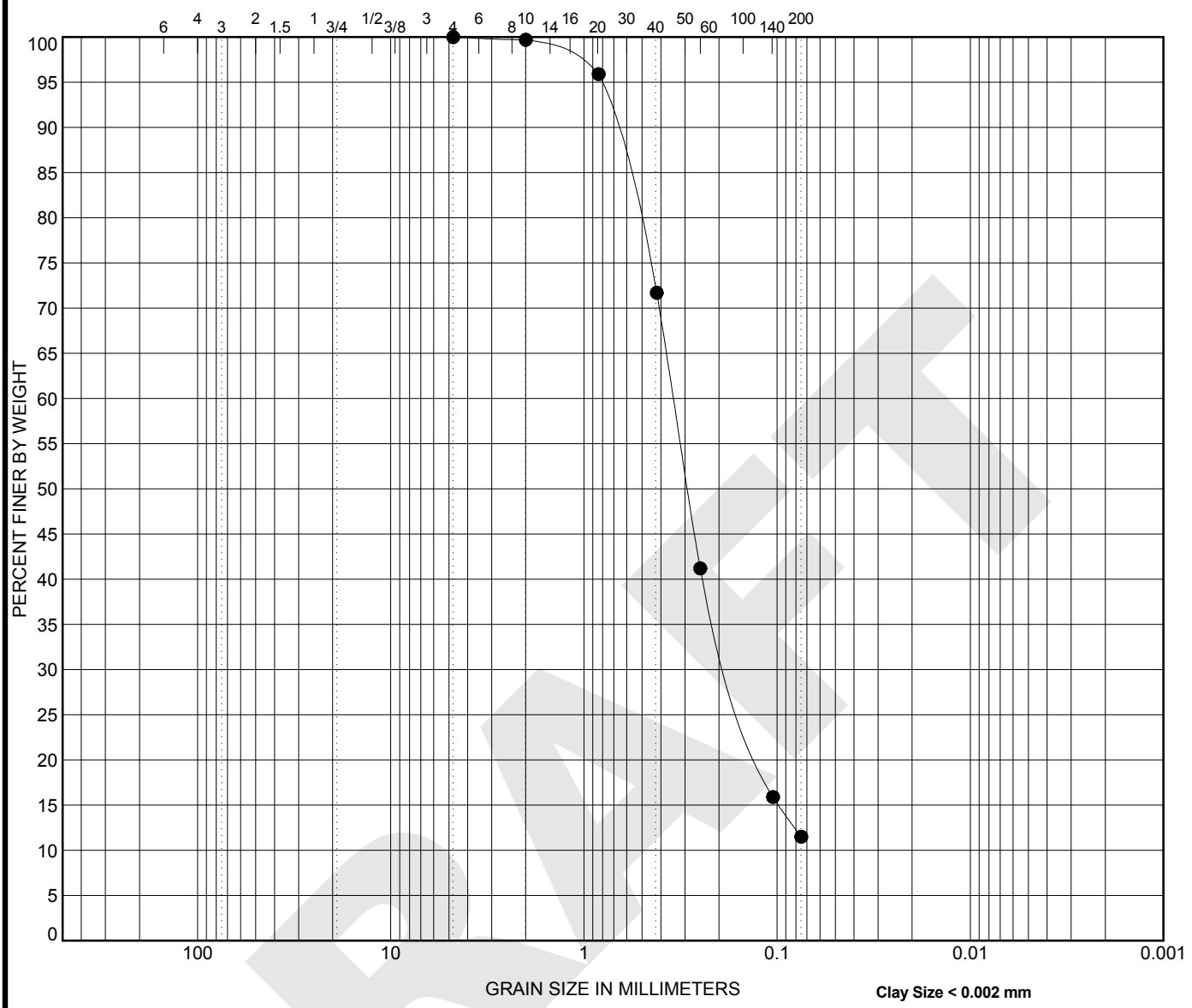
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-6A SS-28 105.2**	**Very dense gray & black f-m poorly graded SAND w/silt (SP-SM)**	**NP**	**NP**	**NP**	**1.26**	**5.15**

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-6A SS-28 105.2**	**4.75**	**0.344**	**0.17**		**0.0**	**88.5**	**11.5**	

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GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S5
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

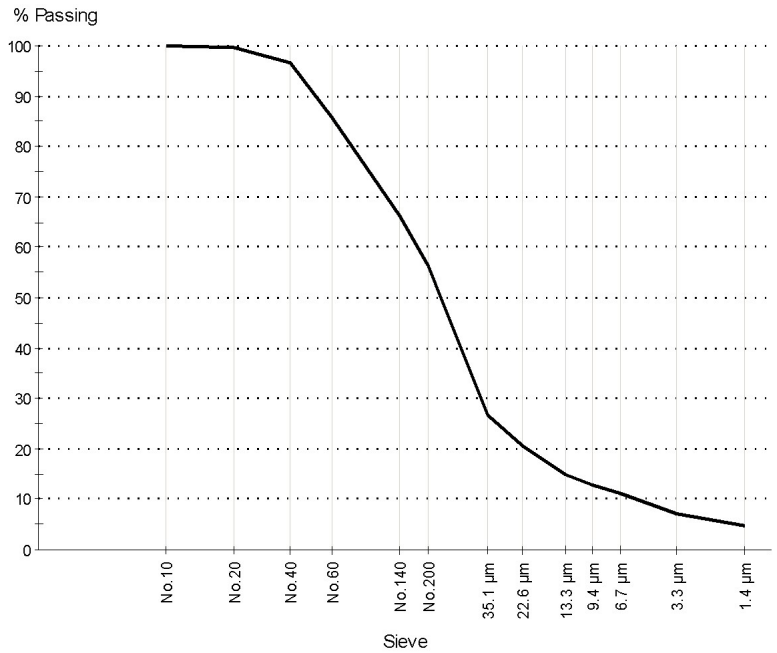
Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S5
Client Sample ID:	
Date Sampled:	12/07/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Black Sandy Lean CLAY (CL)
Sampling Method:	(none)
General Location:	Boring #6A SS-30
Location:	115.2' - 116.7'

Sample Description:

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.0%)	(0.0%)	(3.3%)	(40.3%)	(47.4%)	(9.0%)

Grading: ASTM D 422

Drying by: Oven
Date Tested:

Sieve Size	% Passing	Limits
No.10 (2.0mm)	100	
No.20 (850µm)	100	
No.40 (425µm)	97	
No.60 (250µm)	86	
No.140 (106µm)	66	
No.200 (75µm)	56	
35.1 µm	26.7	
22.6 µm	20.7	
13.3 µm	14.8	
9.4 µm	12.8	
6.7 µm	11.0	
3.3 µm	7.0	
1.4 µm	4.6	

D85: 0.2412 D60: 0.0852 D50: 0.0637
D30: 0.0382 D15: 0.0135 D10: 0.0056
Cu: 15.17 Cc: 3.05

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Material Test Report

Report No: MAT:0451644-1-S5
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

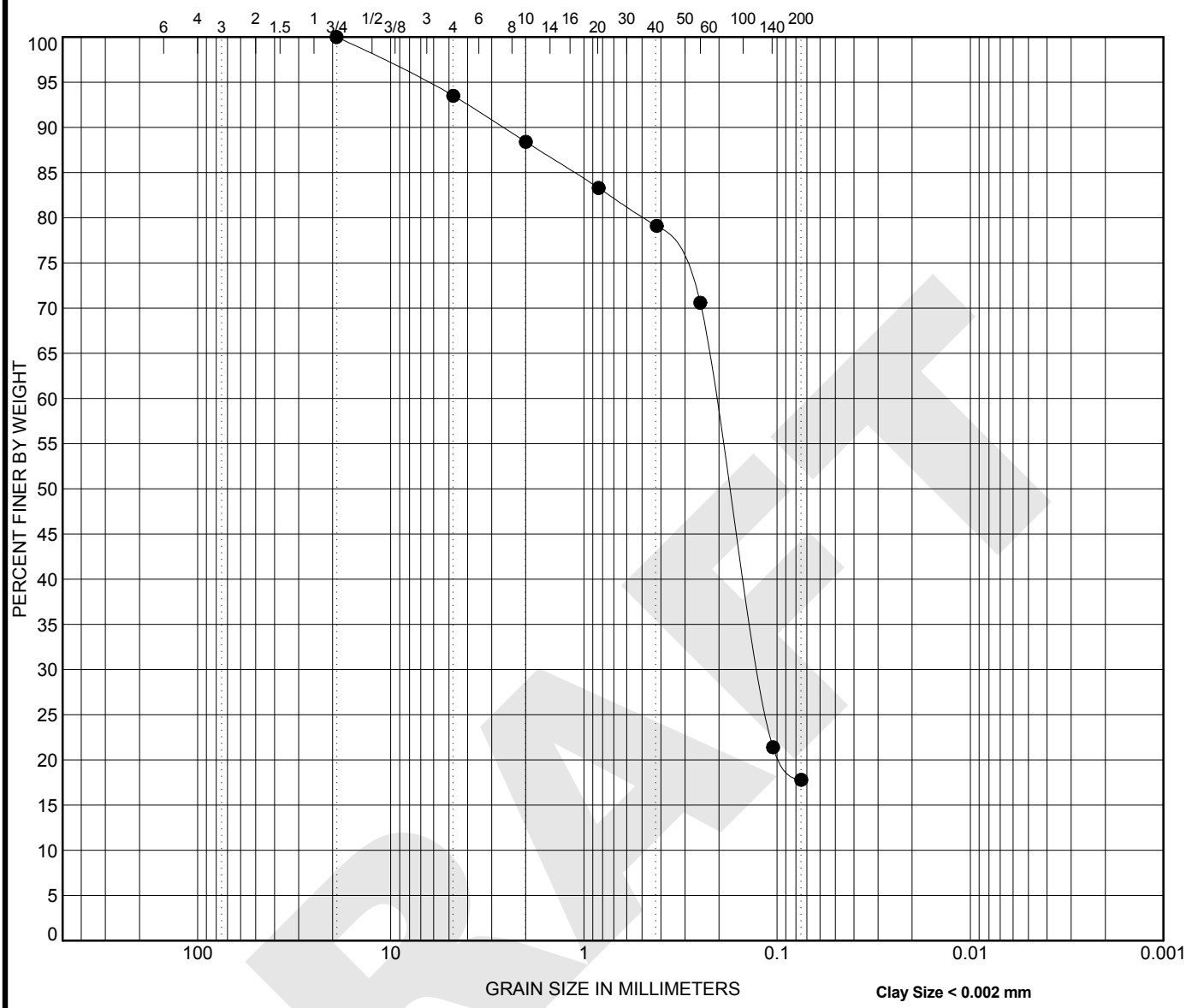
Sample ID:	0451644-1-S5
Client Sample ID:	
Date Sampled:	12/07/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Black Sandy Lean CLAY (CL)
Sampling Method:	(none)
General Location:	Boring #6A SS-30
Location:	115.2' - 116.7'

Other Test Results

Description	Method	Result	Limits
Group Symbol	ASTM D 2487		
Group Name			
Tested By		(unknown)	
Group Symbol (based on visual-manual procedures)	ASTM D 2488		
Group Name			
Tested By		(unknown)	
Dispersion device	ASTM D 422		
Dispersion time (min)			
Shape			
Hardness			
Tested By		(unknown)	

Comments

N/A



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-6A SS-32 125.2**	**Very dense dark gray fine to medium grained Silty SAND (SM)**	**NP**	**NP**	**NP**		

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-6A SS-32 125.2**	**19.1**	**0.207**	**0.122**		**6.5**	**75.7**	**17.8**	

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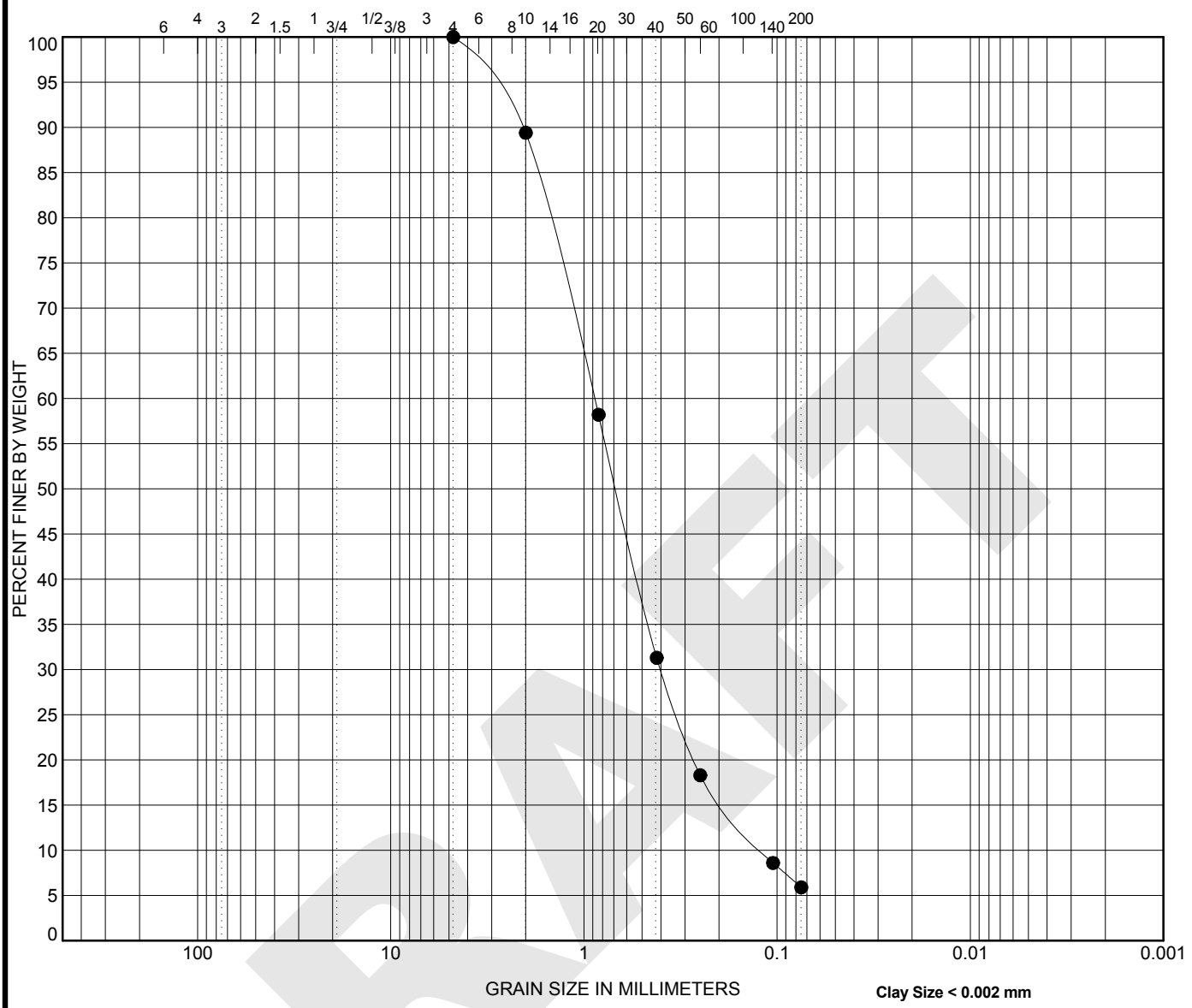
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-7A SS-3 16.0**	**Very loose to loose gray m-c poorly graded SAND w/silt (SP-SM)**	**NP**	**NP**	**NP**	**1.51**	**7.42**

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-7A SS-3 16.0**	**4.75**	**0.883**	**0.399**	**0.119**	**0.0**	**94.1**	**5.9**	

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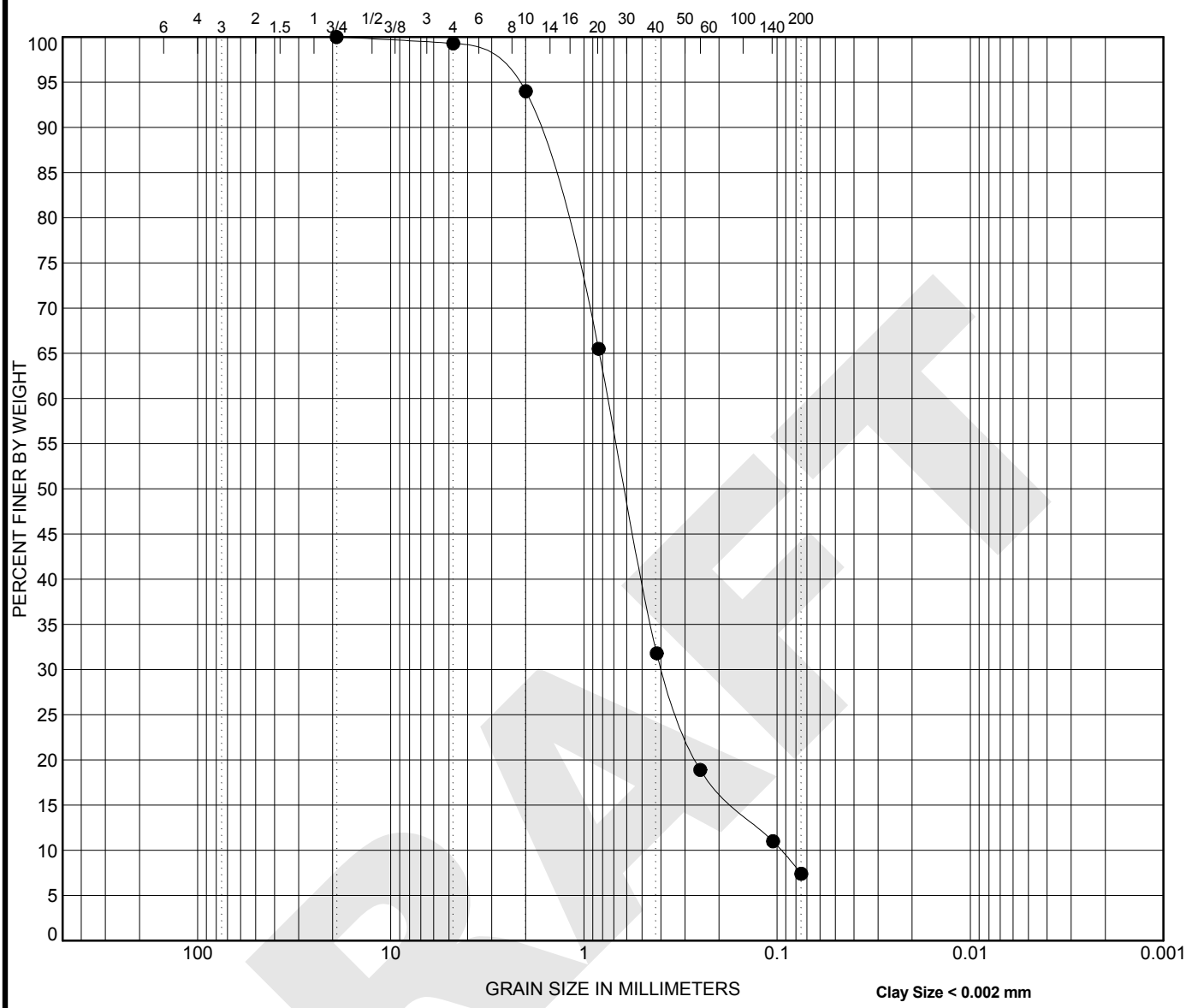
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-7A SS-4 18.0**	**Very loose to loose gray m-c poorly graded SAND w/silt (SP-SM)**	**NP**	**NP**	**NP**	**2.13**	**7.84**

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-7A SS-4 18.0**	**19.1**	**0.75**	**0.391**	**0.096**	**0.7**	**91.9**	**7.4**	

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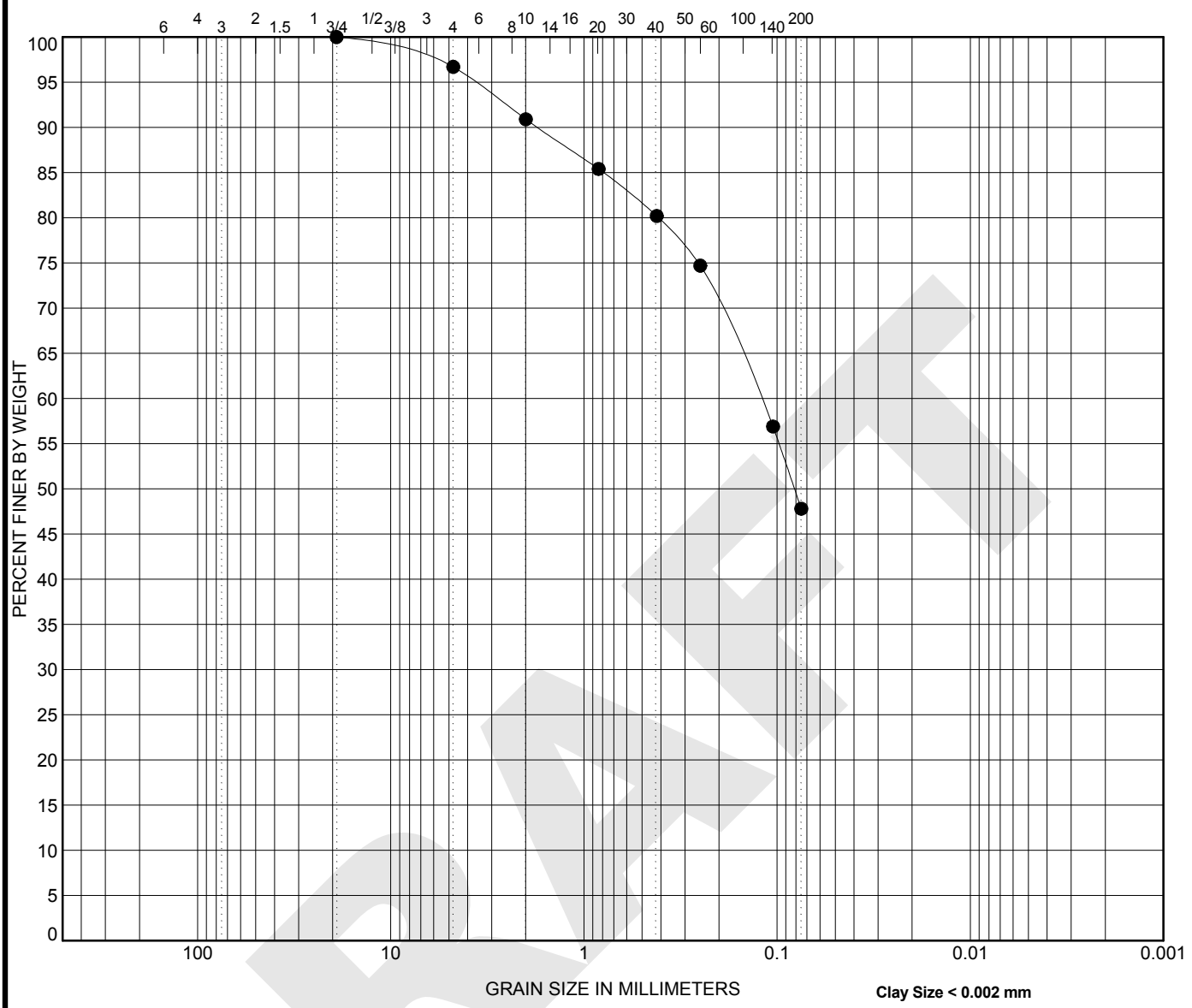
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● B-7A SS-7 30.5	Dense to very dense green gray fine grained Silty SAND (SM)	25	22	3		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-7A SS-7 30.5	19.1	0.122			3.3	48.9	47.8	

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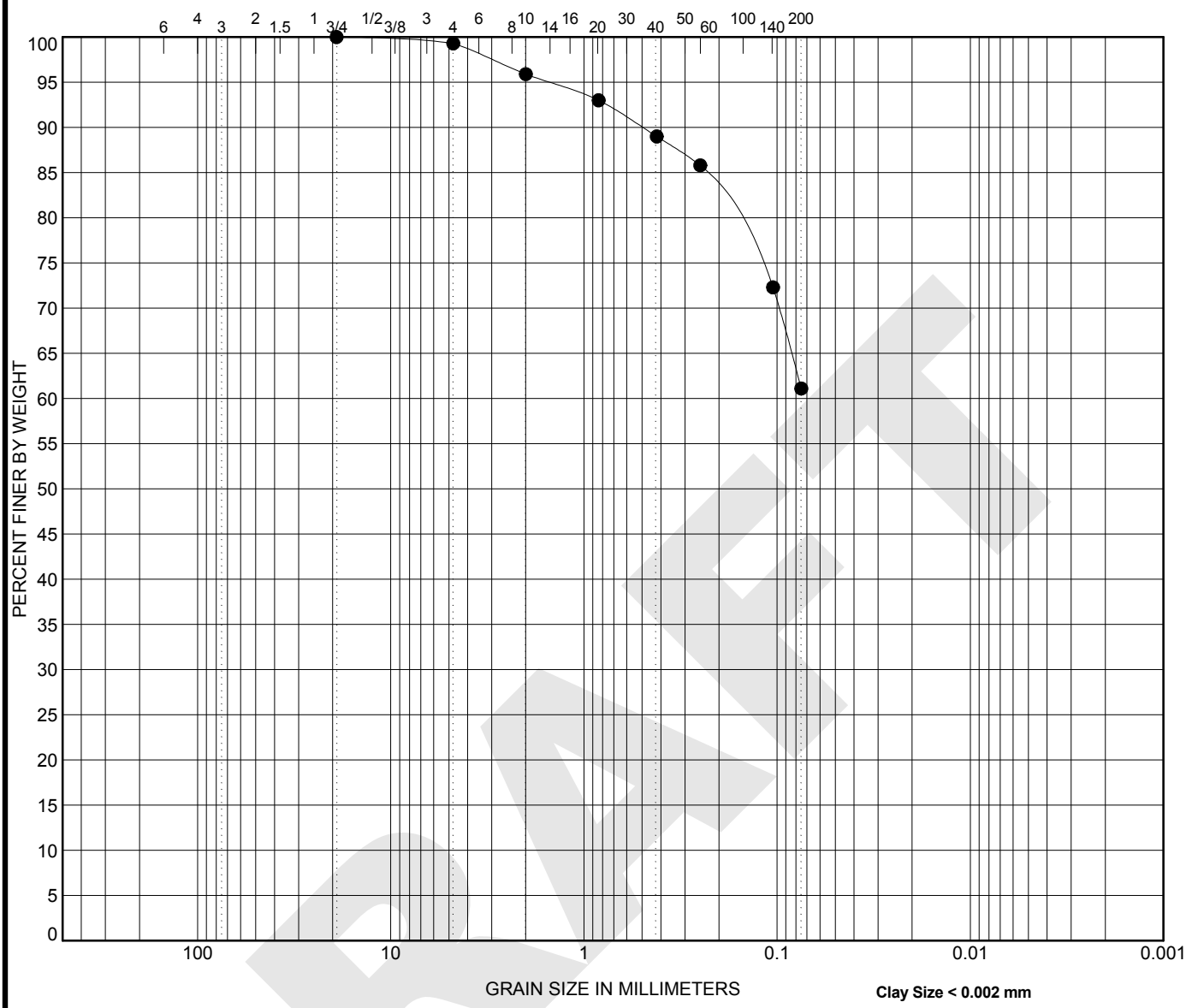
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● B-7A SS-9 40.5	Very stiff to hard green gray Sandy SILT (ML)	36	35	1		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-7A SS-9 40.5	19.1				0.7	38.2	61.1	

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GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S6
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

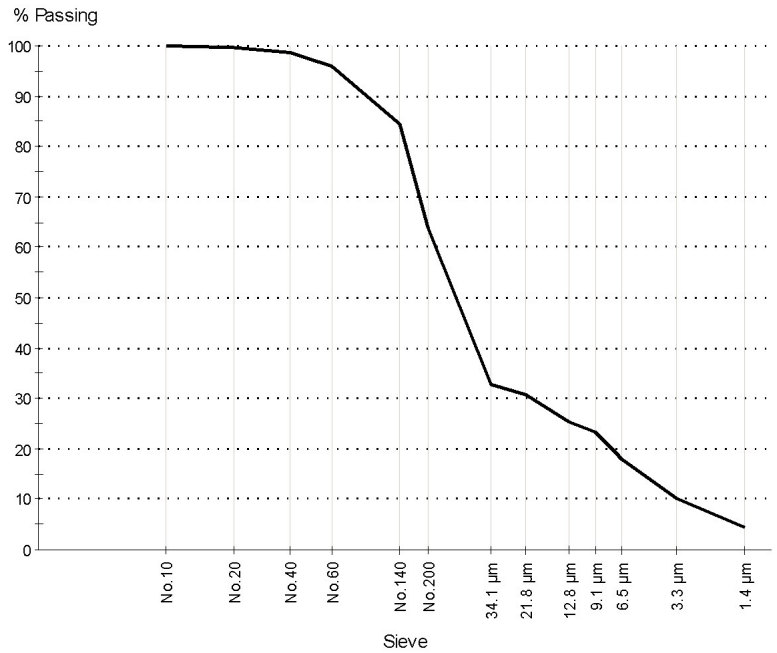
Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S6
Client Sample ID:	
Date Sampled:	12/06/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Green Gray Sandy SILT (ML)
Sampling Method:	(none)
General Location:	Boring #7A SS-10
Location:	45.5' - 47'

Sample Description:

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.0%)	(0.0%)	(1.4%)	(34.7%)	(49.6%)	(14.3%)

Grading: ASTM D 422

Date Tested:

Sieve Size	% Passing	Limits
No.10 (2.0mm)	100	
No.20 (850µm)	100	
No.40 (425µm)	99	
No.60 (250µm)	96	
No.140 (106µm)	84	
No.200 (75µm)	64	
34.1 µm	32.7	
21.8 µm	30.8	
12.8 µm	25.2	
9.1 µm	23.4	
6.5 µm	17.8	
3.3 µm	10.3	
1.4 µm	4.5	

D85: 0.1112 D60: 0.0681 D50: 0.0528
D30: 0.0202 D15: 0.0050 D10: 0.0032
Cu: 21.56 Cc: 1.90

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Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S6
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S6
Client Sample ID:	
Date Sampled:	12/06/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Green Gray Sandy SILT (ML)
Sampling Method:	(none)
General Location:	Boring #7A SS-10
Location:	45.5' - 47'

Other Test Results

Description	Method	Result	Limits
Group Symbol	ASTM D 2487		
Group Name			
Tested By		(unknown)	
Group Symbol (based on visual-manual procedures)	ASTM D 2488		
Group Name			
Tested By		(unknown)	
Dispersion device	ASTM D 422		
Dispersion time (min)			
Shape			
Hardness			
Tested By		(unknown)	

Comments

N/A

Professional Service Industries, Inc.
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Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S7
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

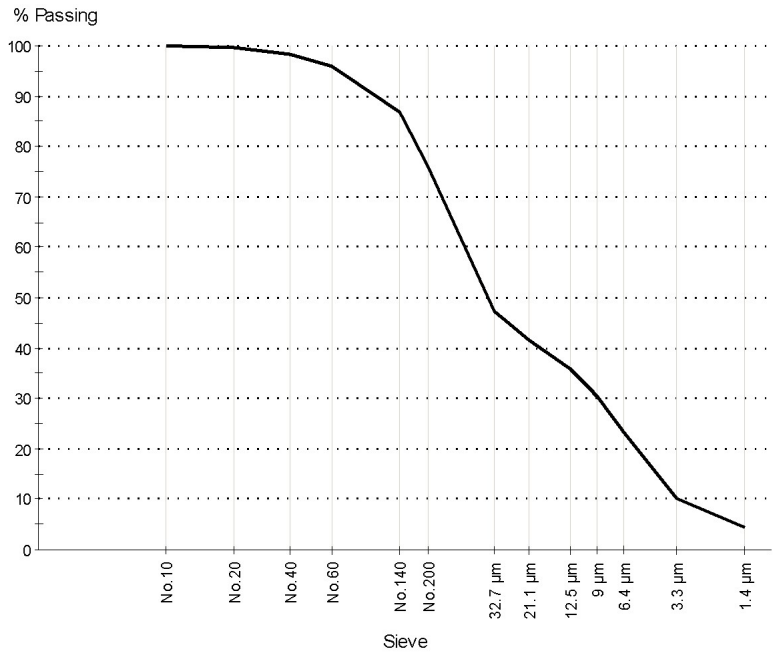
Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S7
Client Sample ID:	
Date Sampled:	12/06/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Green Gray SILT with Sand (ML)
Sampling Method:	(none)
General Location:	Boring #7A SS-13
Location:	60.5' - 62'

Sample Description:

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.0%)	(0.0%)	(1.9%)	(22.0%)	(58.8%)	(17.4%)

Grading: ASTM D 422

Drying by: Oven
Date Tested:

Sieve Size	% Passing	Limits
No.10 (2.0mm)	100	
No.20 (850µm)	100	
No.40 (425µm)	98	
No.60 (250µm)	96	
No.140 (106µm)	87	
No.200 (75µm)	76	
32.7 µm	47.4	
21.1 µm	41.7	
12.5 µm	35.9	
9.0 µm	30.5	
6.4 µm	23.2	
3.3 µm	10.3	
1.4 µm	4.5	

D85: 0.0995 D60: 0.0471 D50: 0.0353
D30: 0.0088 D15: 0.0042 D10: 0.0032
Cu: 14.91 Cc: 0.52

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S7
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/23/2015

Sample Details

Sample ID:	0451644-1-S7
Client Sample ID:	
Date Sampled:	12/06/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Green Gray SILT with Sand (ML)
Sampling Method:	(none)
General Location:	Boring #7A SS-13
Location:	60.5' - 62'

Other Test Results

Description	Method	Result	Limits
Group Symbol	ASTM D 2487		
Group Name			
Tested By		(unknown)	
Group Symbol (based on visual-manual procedures)	ASTM D 2488		
Group Name			
Tested By		(unknown)	
Dispersion device	ASTM D 422		
Dispersion time (min)			
Shape			
Hardness			
Tested By		(unknown)	

Comments

N/A

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S8
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

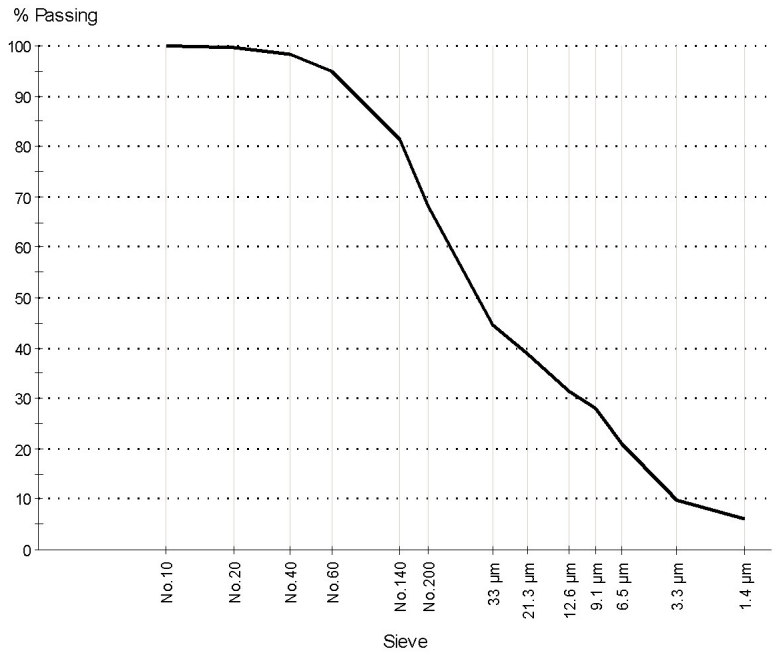
Project: SC FILE #38-40308.2
ORANGEBURG, SC

Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/16/2015

Sample Details

Sample ID:	0451644-1-S8
Client Sample ID:	
Date Sampled:	12/06/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Green Gray Sandy SILT (ML)
Sampling Method:	(none)
General Location:	Boring #7A
Location:	74' - 76'

Particle Size Distribution



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
(0.0%)	(0.0%)	(0.0%)	(0.0%)	(1.8%)	(29.9%)	(52.6%)	(15.7%)

Sample Description:

Grading: ASTM D 422

Drying by: Oven
Date Tested:

Sieve Size	% Passing	Limits
No.10 (2.0mm)	100	
No.20 (850µm)	100	
No.40 (425µm)	98	
No.60 (250µm)	95	
No.140 (106µm)	81	
No.200 (75µm)	68	
33.0 µm	44.5	
21.3 µm	39.0	
12.6 µm	31.5	
9.1 µm	28.0	
6.5 µm	20.9	
3.3 µm	9.9	
1.4 µm	6.2	

D85: 0.1339 D60: 0.0563 D50: 0.0399
D30: 0.0110 D15: 0.0045 D10: 0.0033
Cu: 16.96 Cc: 0.64

Professional Service Industries, Inc.
534 St. Andrews Road, Suite C
Columbia, SC 29210

Phone: (803) 776-6050
Fax: (803) 772-2803

Material Test Report

Report No: MAT:0451644-1-S8
Issue No: 1

Client: SC DEPARTMENT OF TRANSPORATION
POST OFFICE BOX 191
COLUMBIA, SC 29202

CC:

Project: SC FILE #38-40308.2
ORANGEBURG, SC

Approved Signatory: Tom Cannarella, P.E. (Branch Manager)
Date of Issue: 1/16/2015

Sample Details

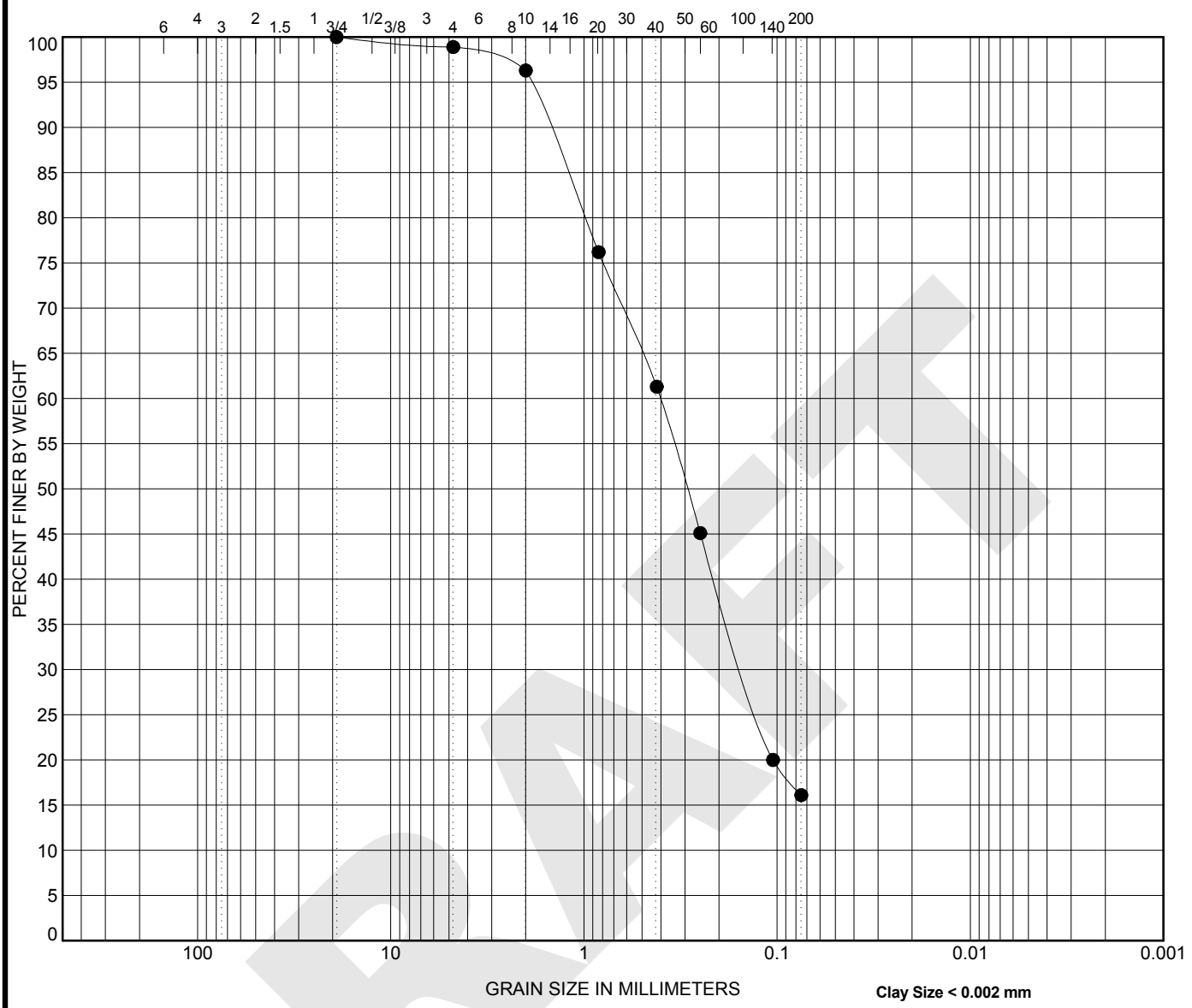
Sample ID:	0451644-1-S8
Client Sample ID:	
Date Sampled:	12/06/14
Sampled By:	Bennett Livingston
Specification:	D422/T88 Part. Size Analysis (Set #1)
Supplier:	
Source:	
Material:	Green Gray Sandy SILT (ML)
Sampling Method:	(none)
General Location:	Boring #7A
Location:	74' - 76'

Other Test Results

Description	Method	Result	Limits
Group Symbol	ASTM D 2487		
Group Name			
Tested By		(unknown)	
Group Symbol (based on visual-manual procedures)	ASTM D 2488		
Group Name			
Tested By		(unknown)	
Dispersion device	ASTM D 422		
Dispersion time (min)			
Shape			
Hardness			
Tested By		(unknown)	

Comments

N/A



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-7A SS-22 84.0**	**Loose dark green fine grained Silty SAND (SM)**	**NP**	**NP**	**NP**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-7A SS-22 84.0**	**19.1**	**0.403**	**0.148**		**1.1**	**82.8**	**16.1**	

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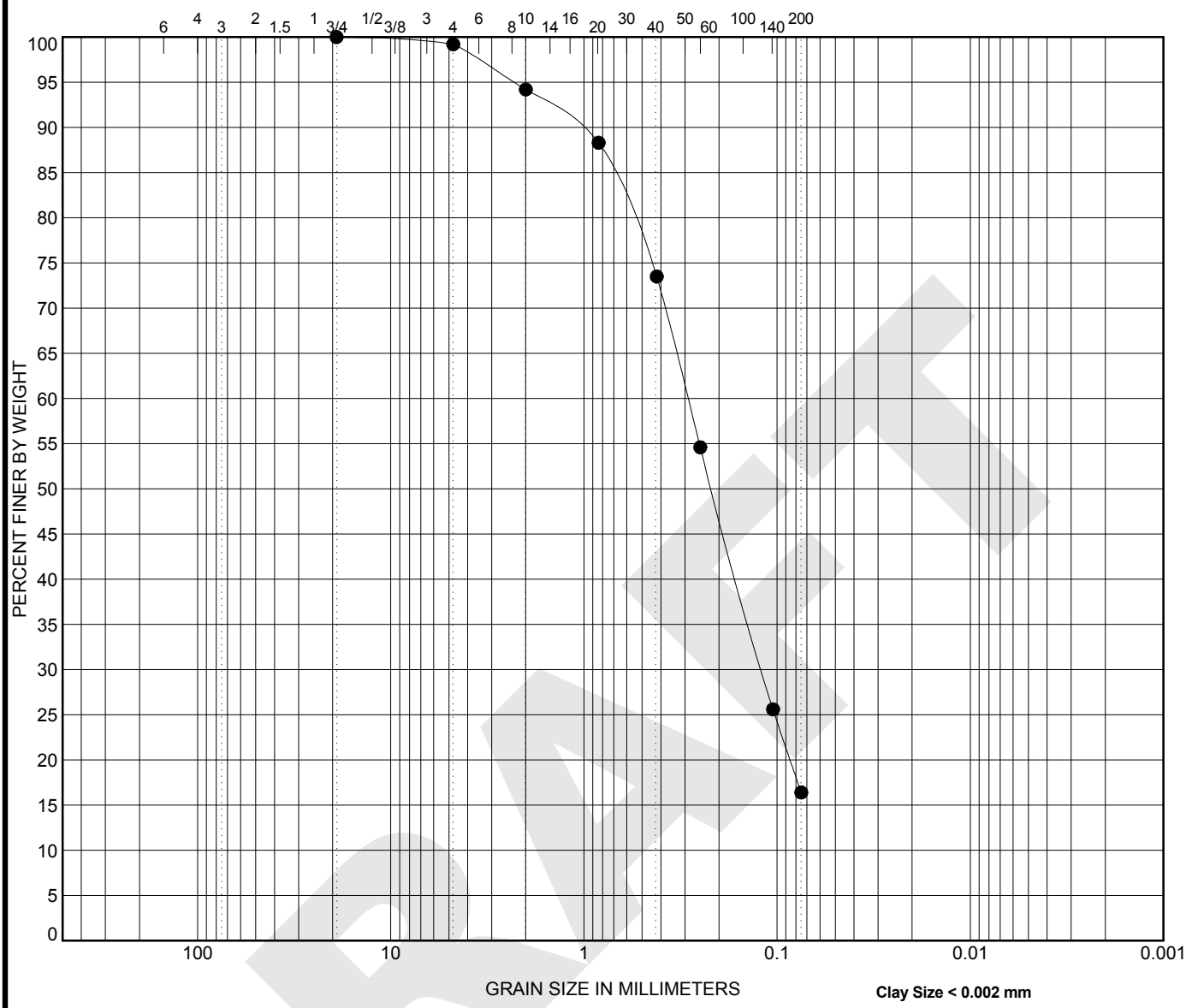
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-7A SS-25 90.0**	**Very dense gray fine to coarse grained Silty SAND (SM)**	**NP**	**NP**	**NP**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-7A SS-25 90.0**	**19.1**	**0.29**	**0.12**		**0.8**	**82.8**	**16.4**	

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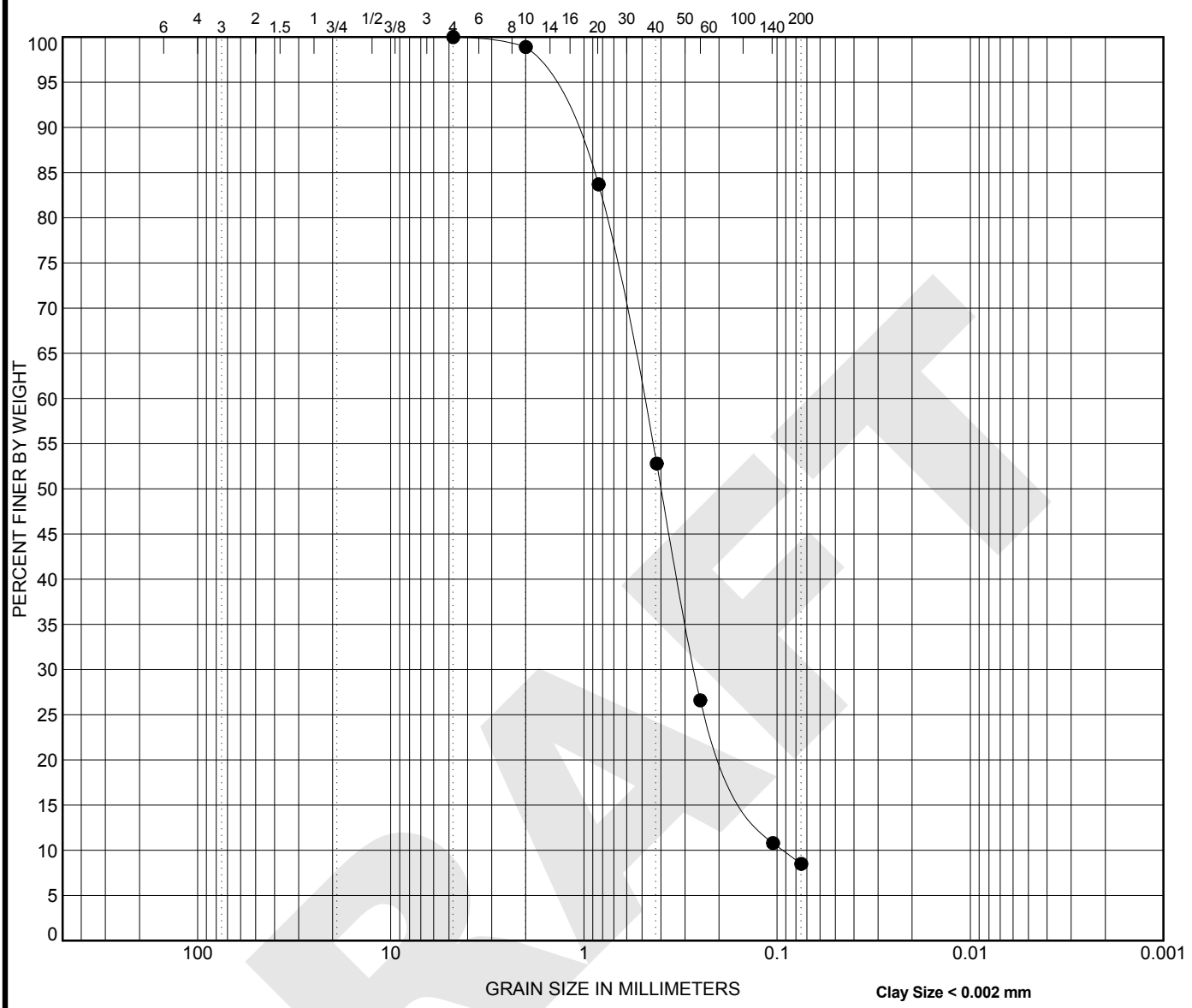
GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-7A SS-28 105.5**	**Very dense black f-m grained poorly graded SAND w/silt (SP-SM)**	**NP**	**NP**	**NP**	**1.55**	**5.28**

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-7A SS-28 105.5**	**4.75**	**0.494**	**0.267**	**0.093**	**0.0**	**91.5**	**8.5**	

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GRAIN SIZE DISTRIBUTION

Project: US301 Over Four Hole Swamp
PSI Job No.: 0451644
Location: Orangeburg County, SC

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
RC: Rock Core
TC: Texas Cone
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

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.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,⧩ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

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

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

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 water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

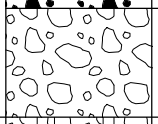
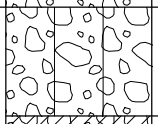
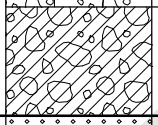
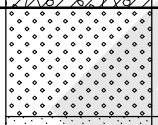
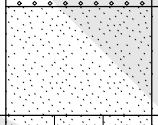
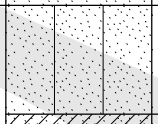
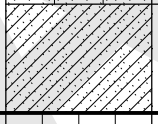
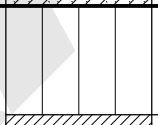
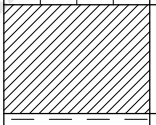
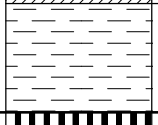
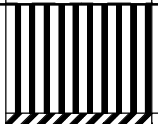
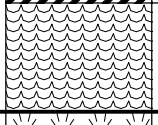
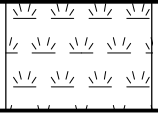
Slightly Weathered: Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.

Weathered: Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.

Highly Weathered: Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	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
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

APPENDIX B

APPROXIMATE PHOTO LOCATION PLAN

GENERAL PHOTOGRAPHS

PHOTOGRAPHS OF CONTINUOUS SAMPLING DEPTHS FOR B-3A, B-5A, B-6A, B-7A

Project Name:	SCDOT US 301 Orangburg	Base Drawing obtained from Boring Location Plan Provided by Client.	Approximate Scale 0 88 feet
Project Location:	US 301 Bridge over Four Hole Swamp, Orangeburg SC		
Client:	SCDOT	**Figure 1** **Approximate Photo Location Plan**	psi Information To Build On Engineering • Consulting • Testing 534 Saint Andrews Road, Suite C, Columbia, SC 29210
Project No.: 0451644	**Date:** December 2014		

Photo #1

Photo #2

Photo #3

Photo #4

Photo #5

Photo #6

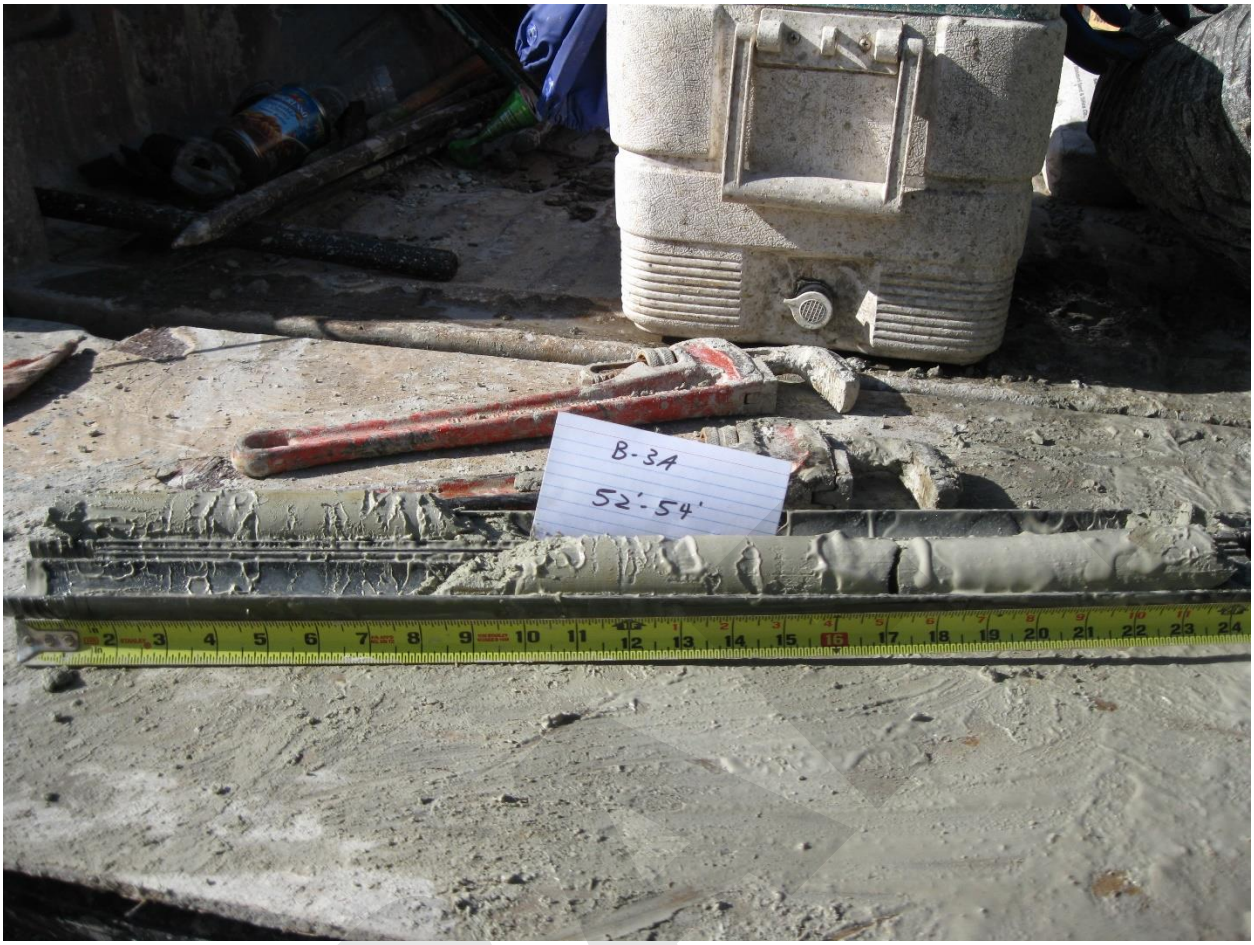
Photo #7

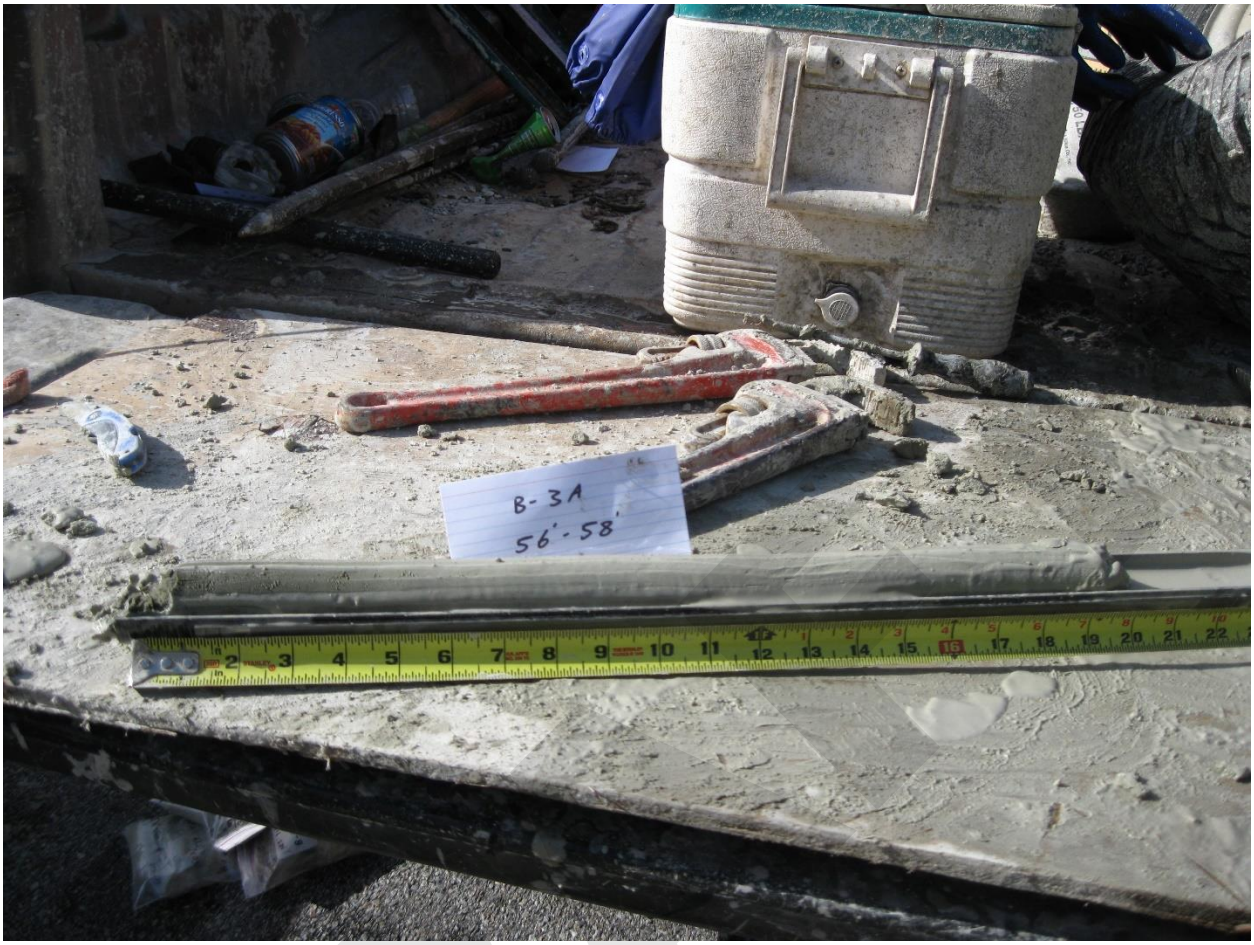
Photo #8

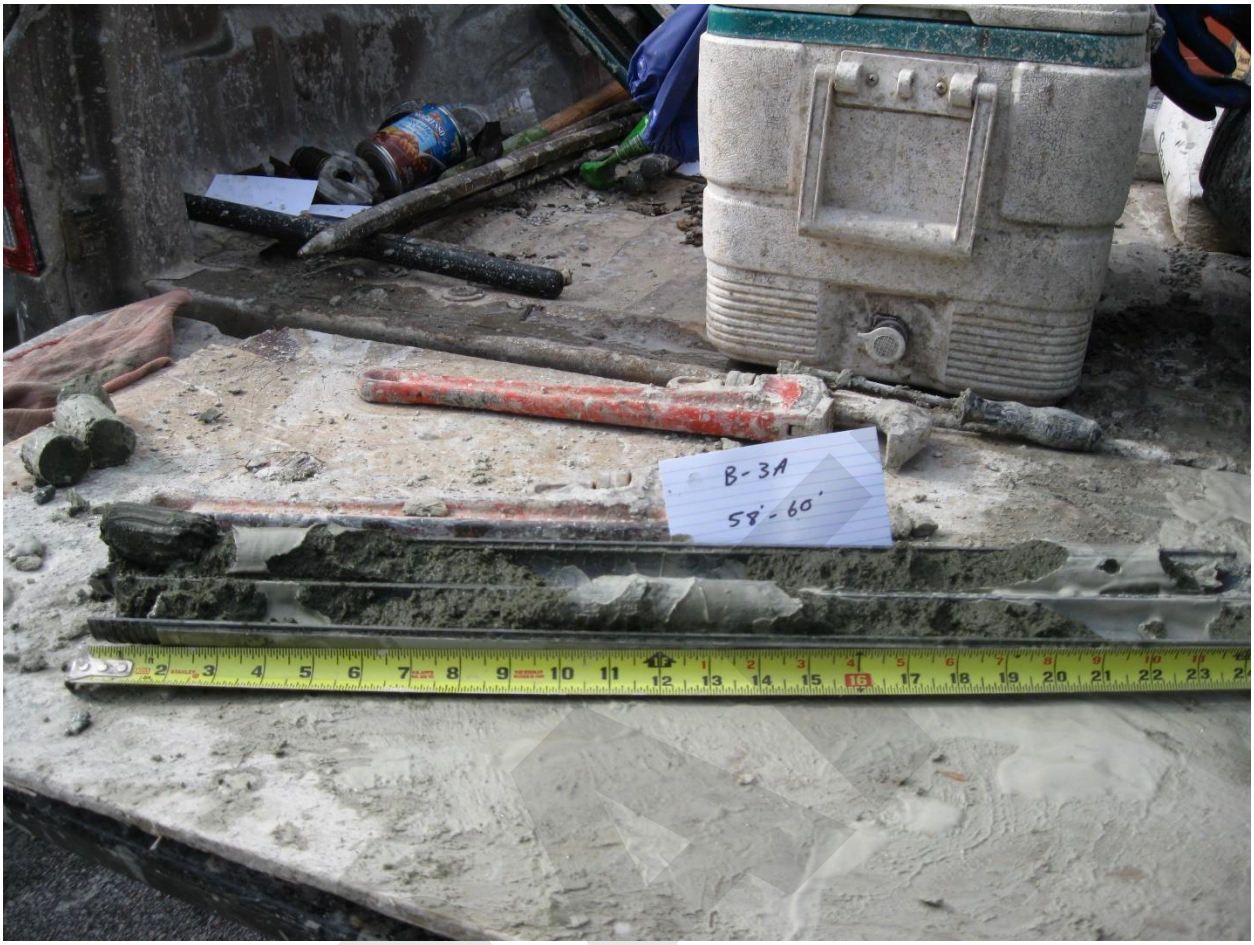
Photo #9

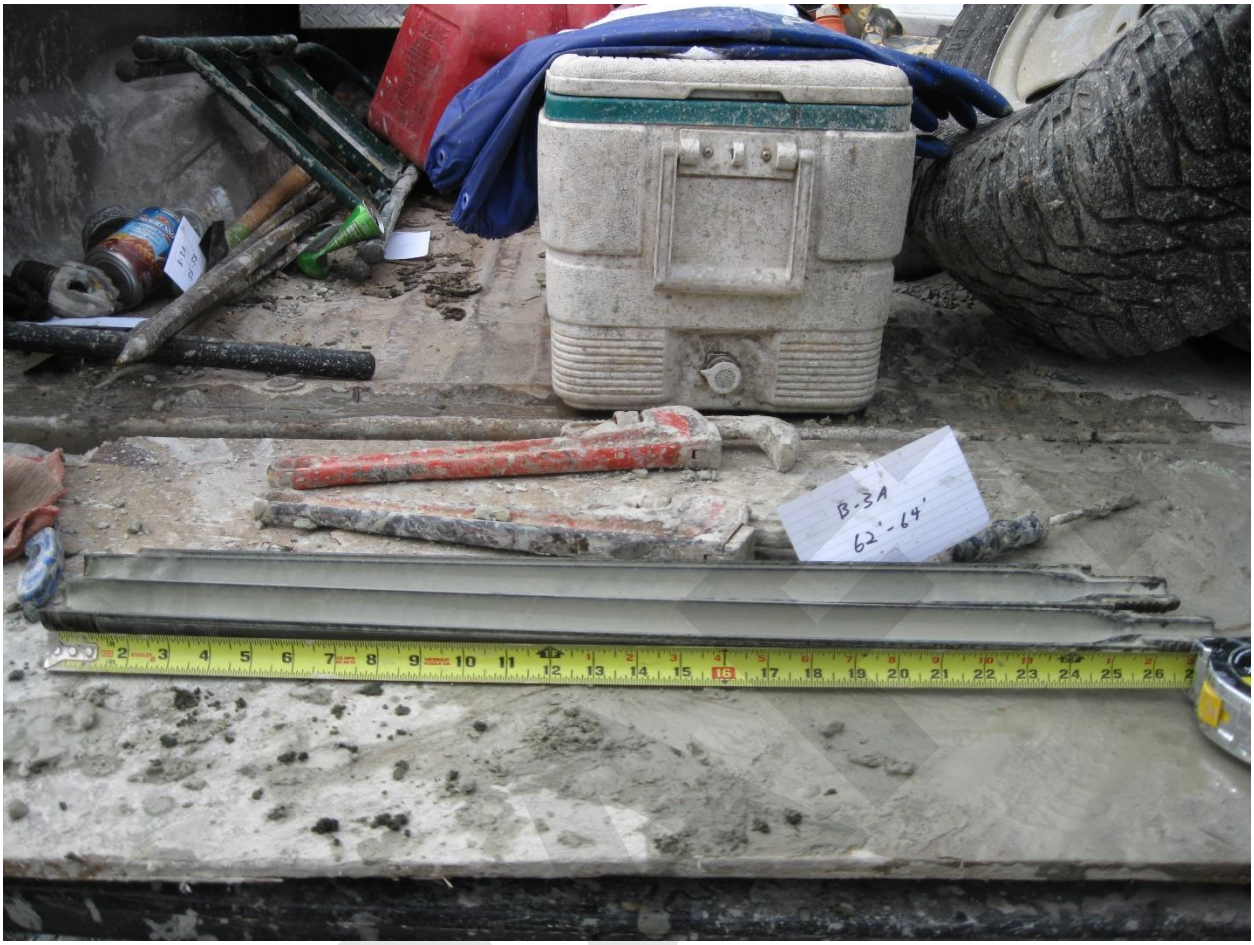
Photo #10

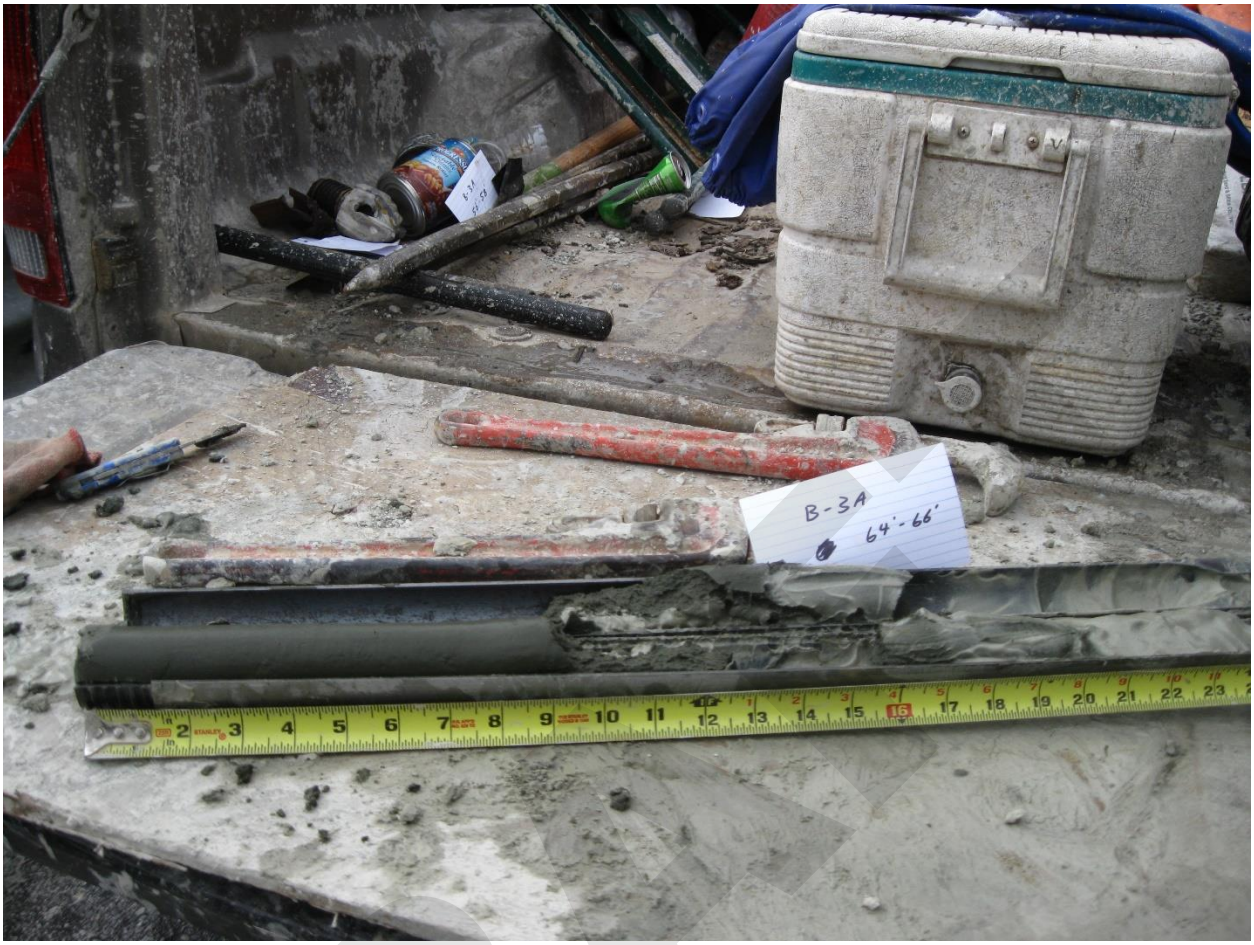
Boring 3A

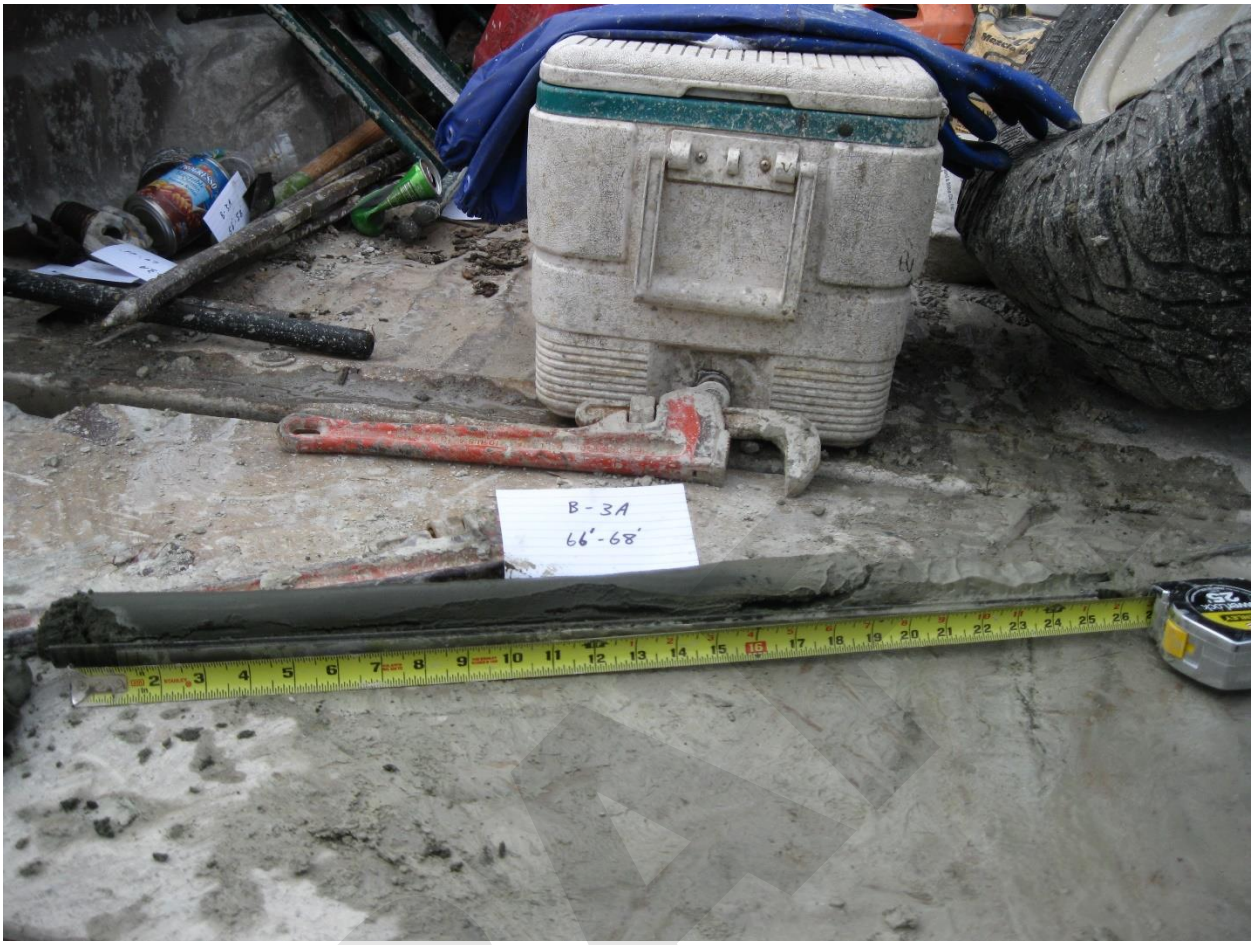


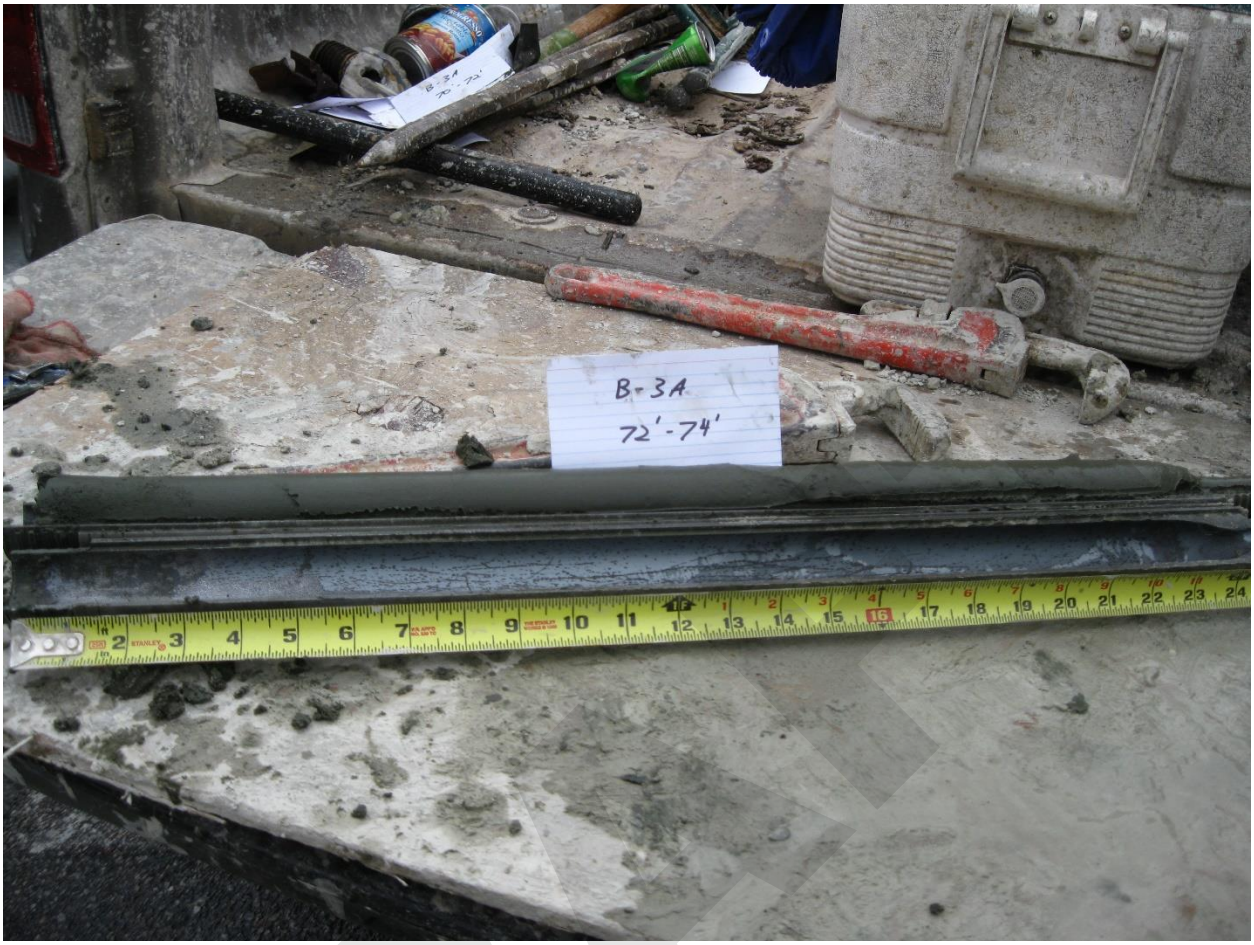




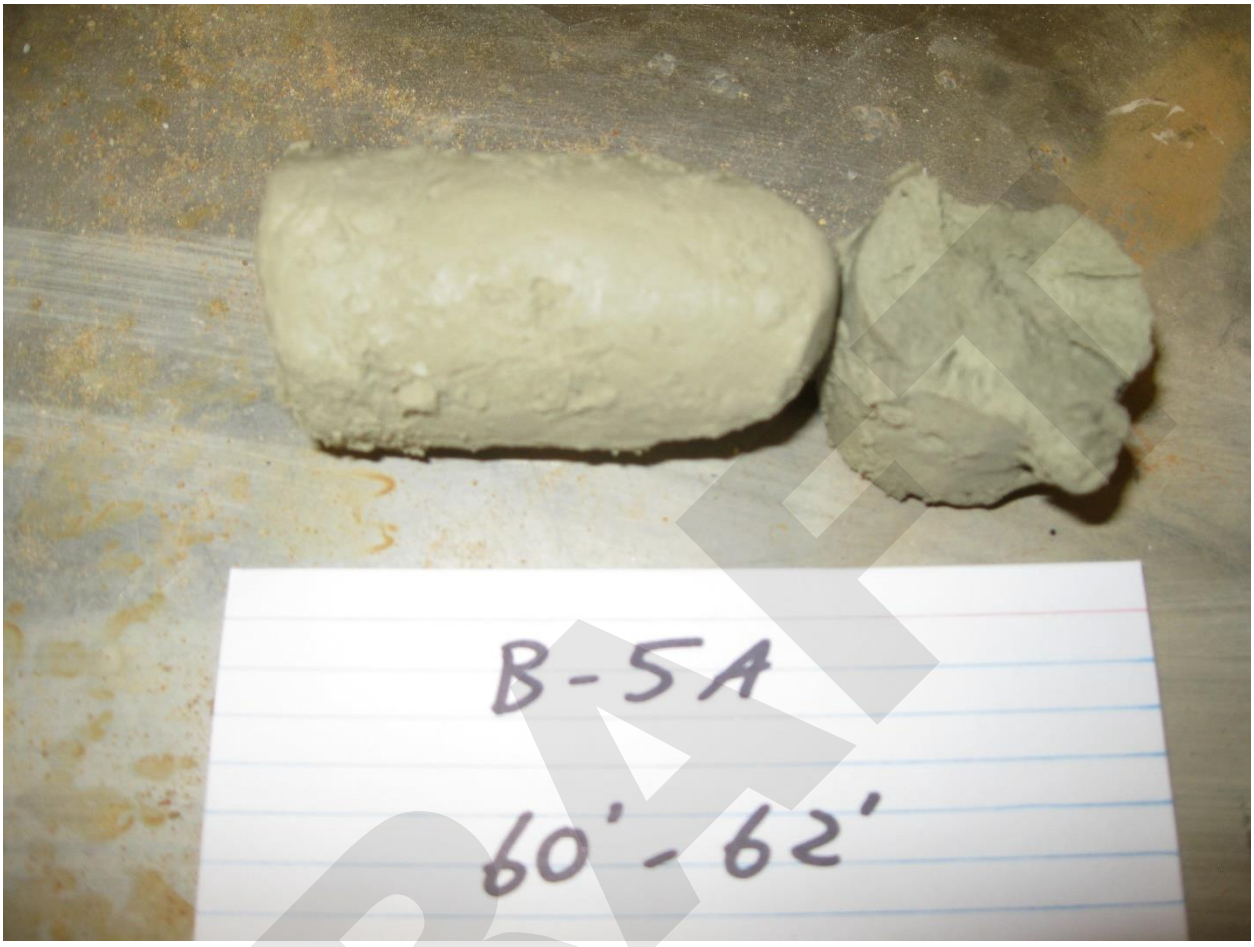


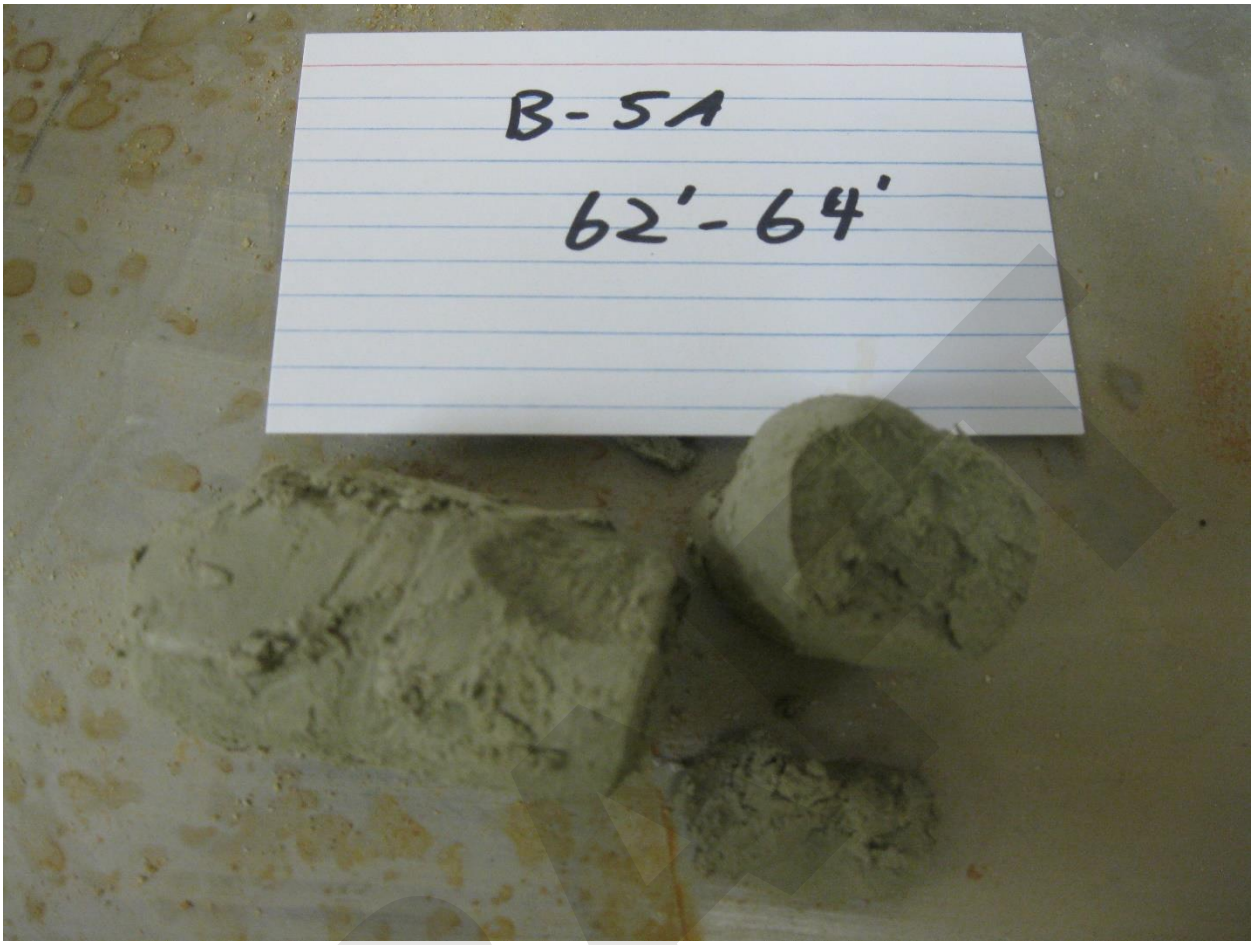


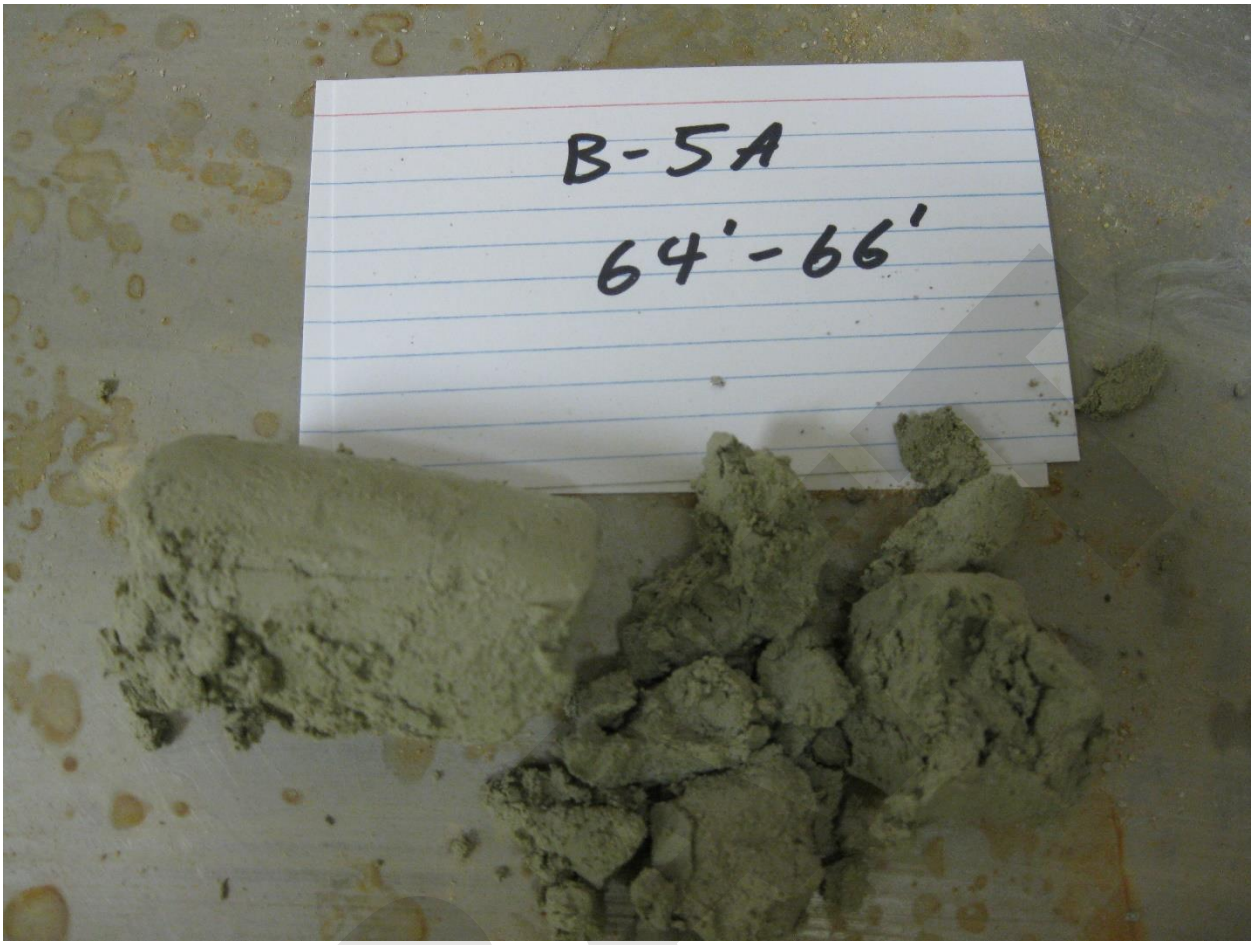


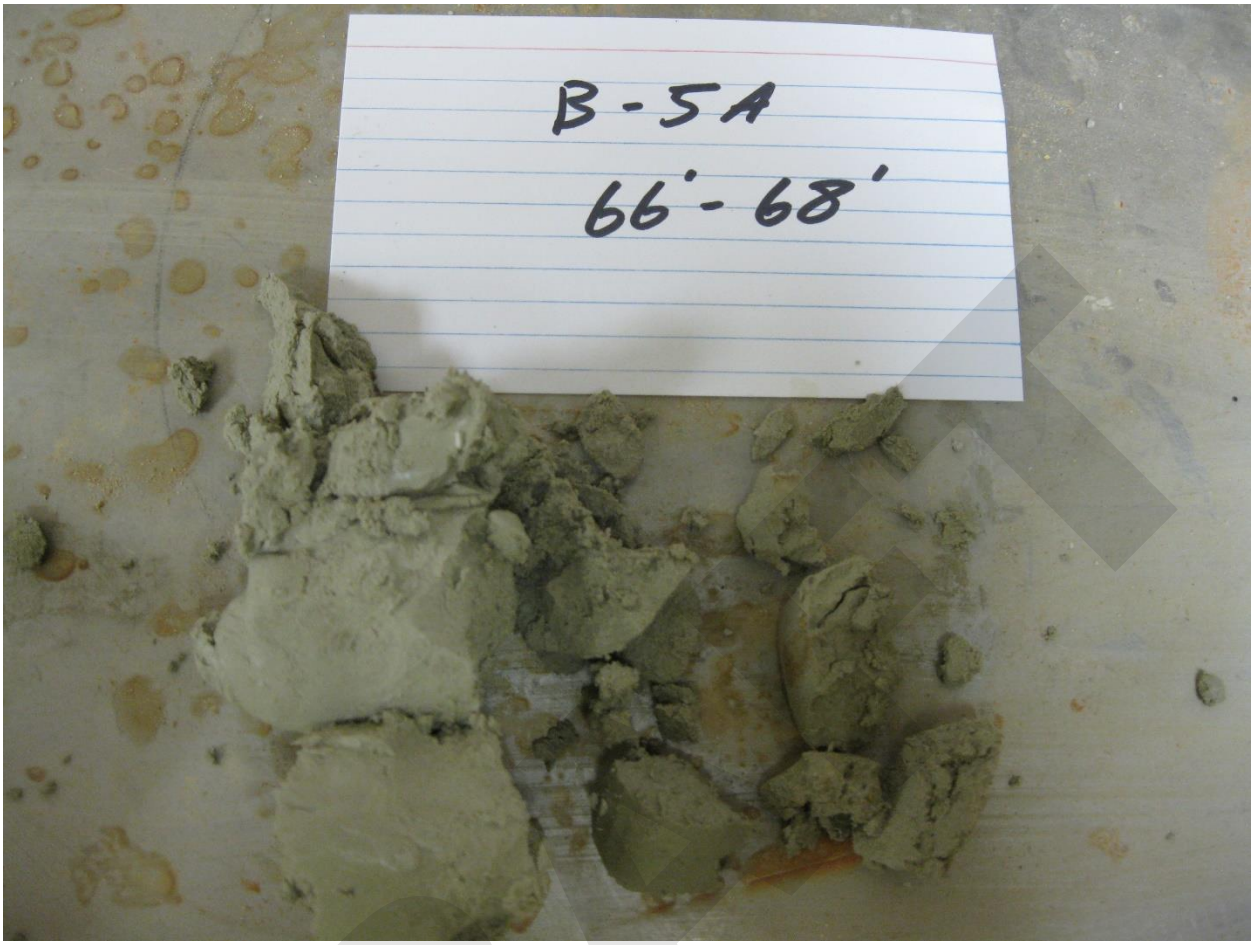


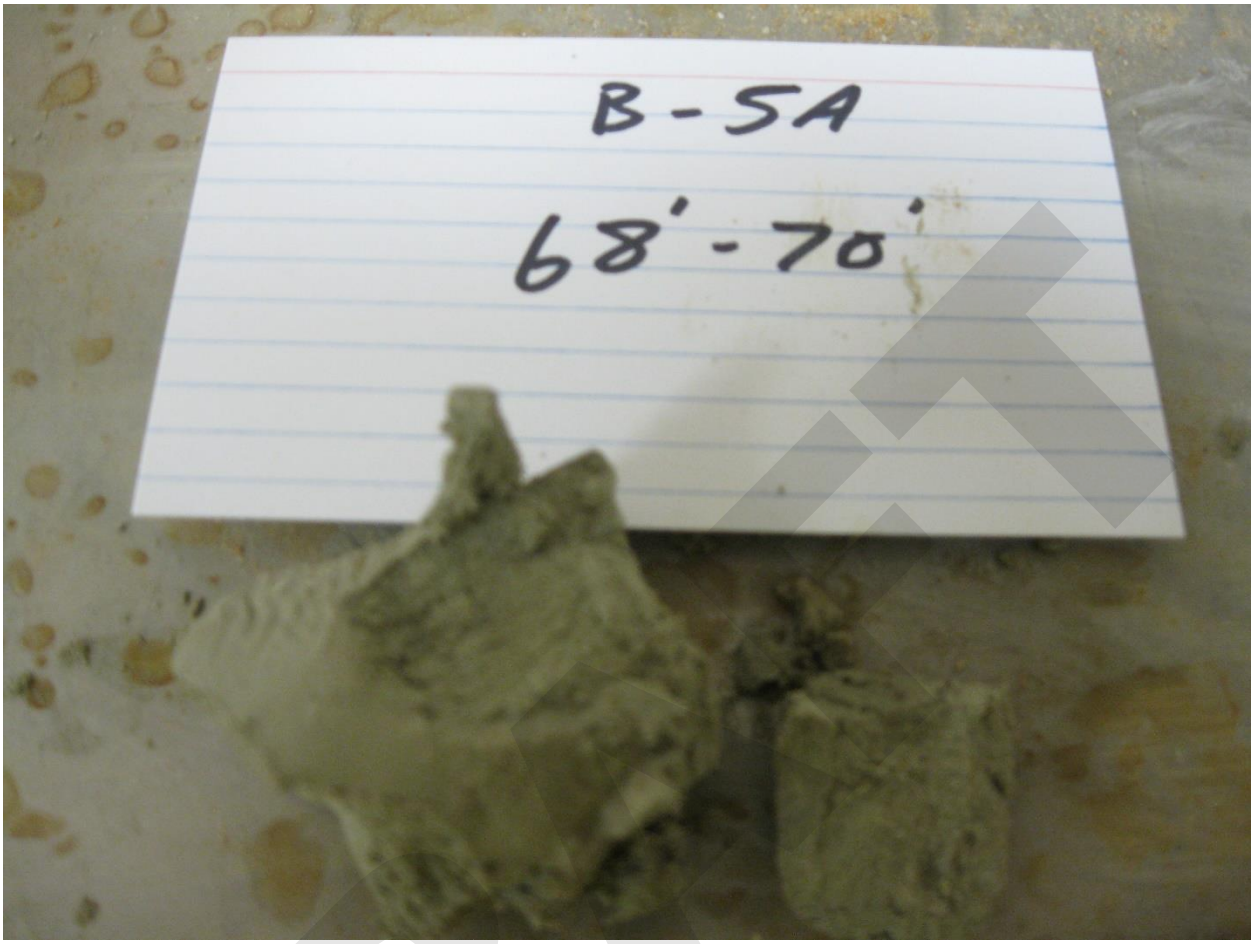
Boring 5A

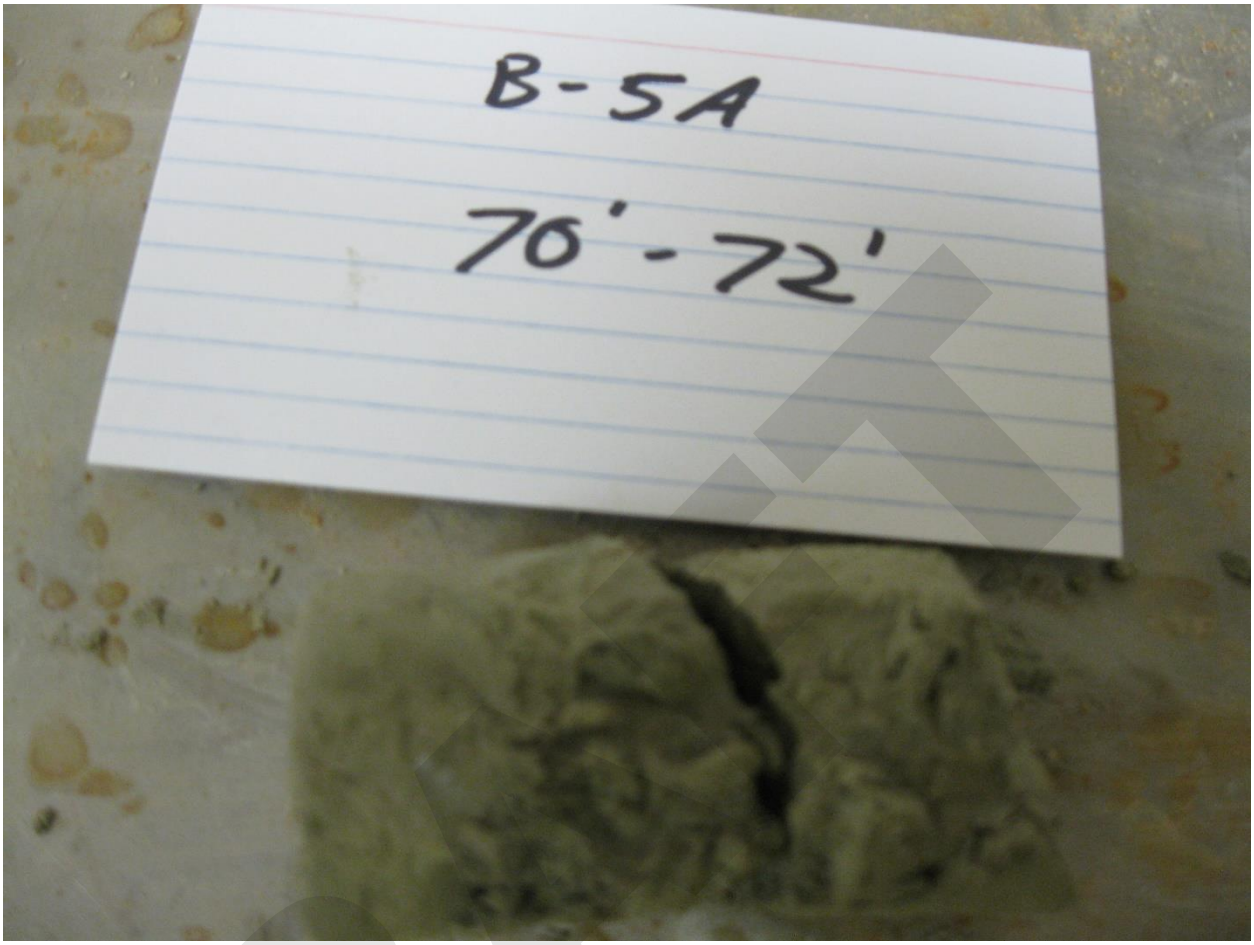


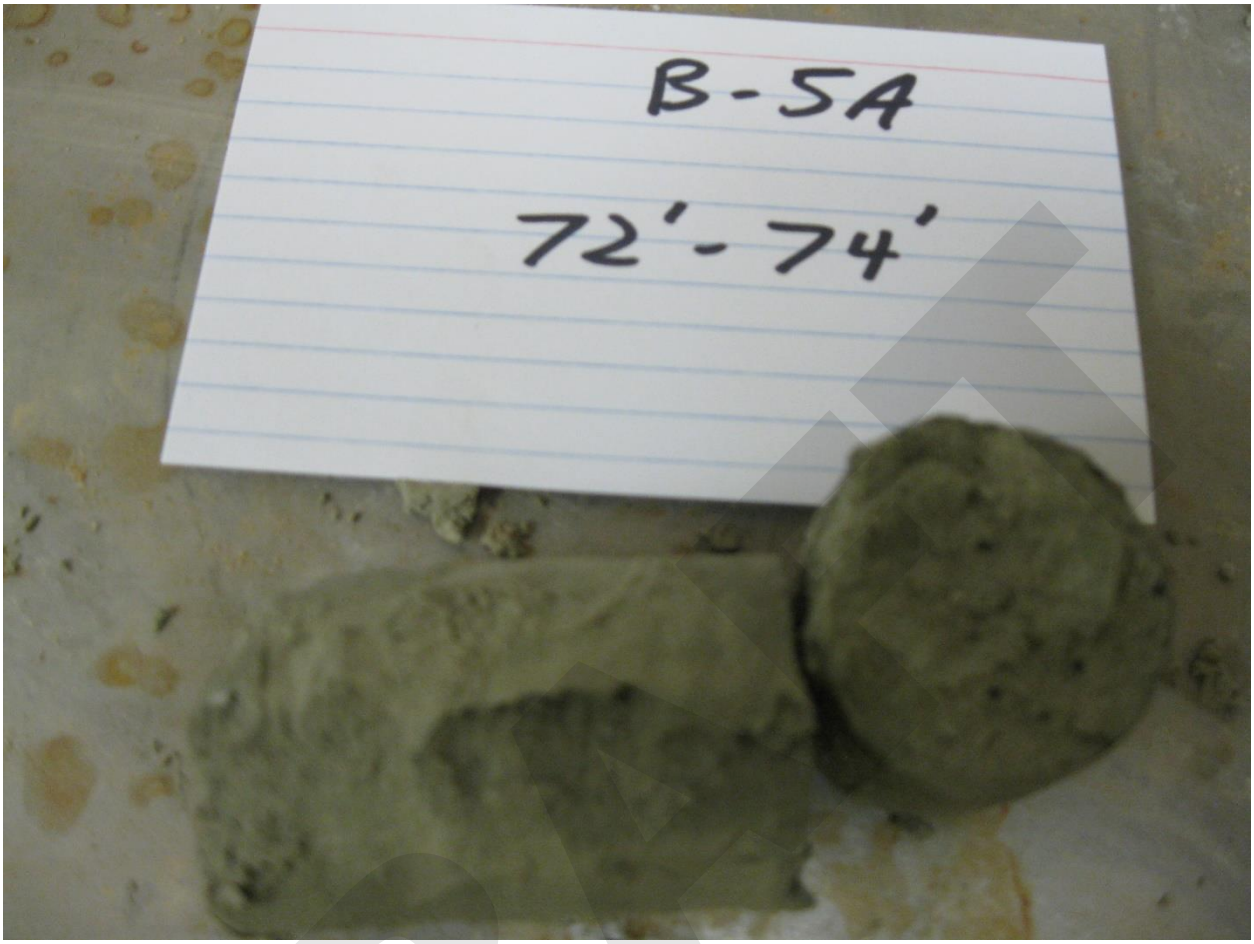


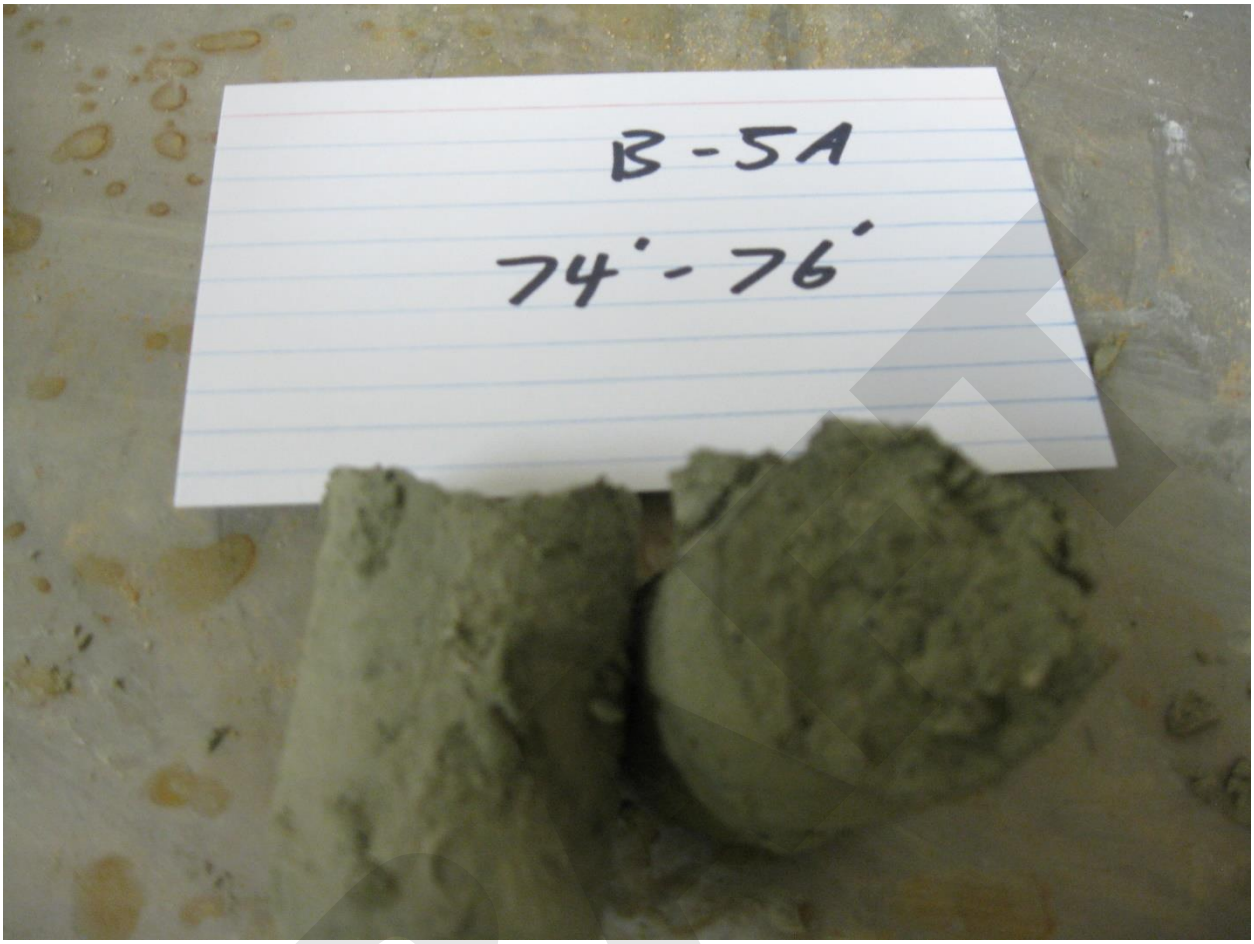




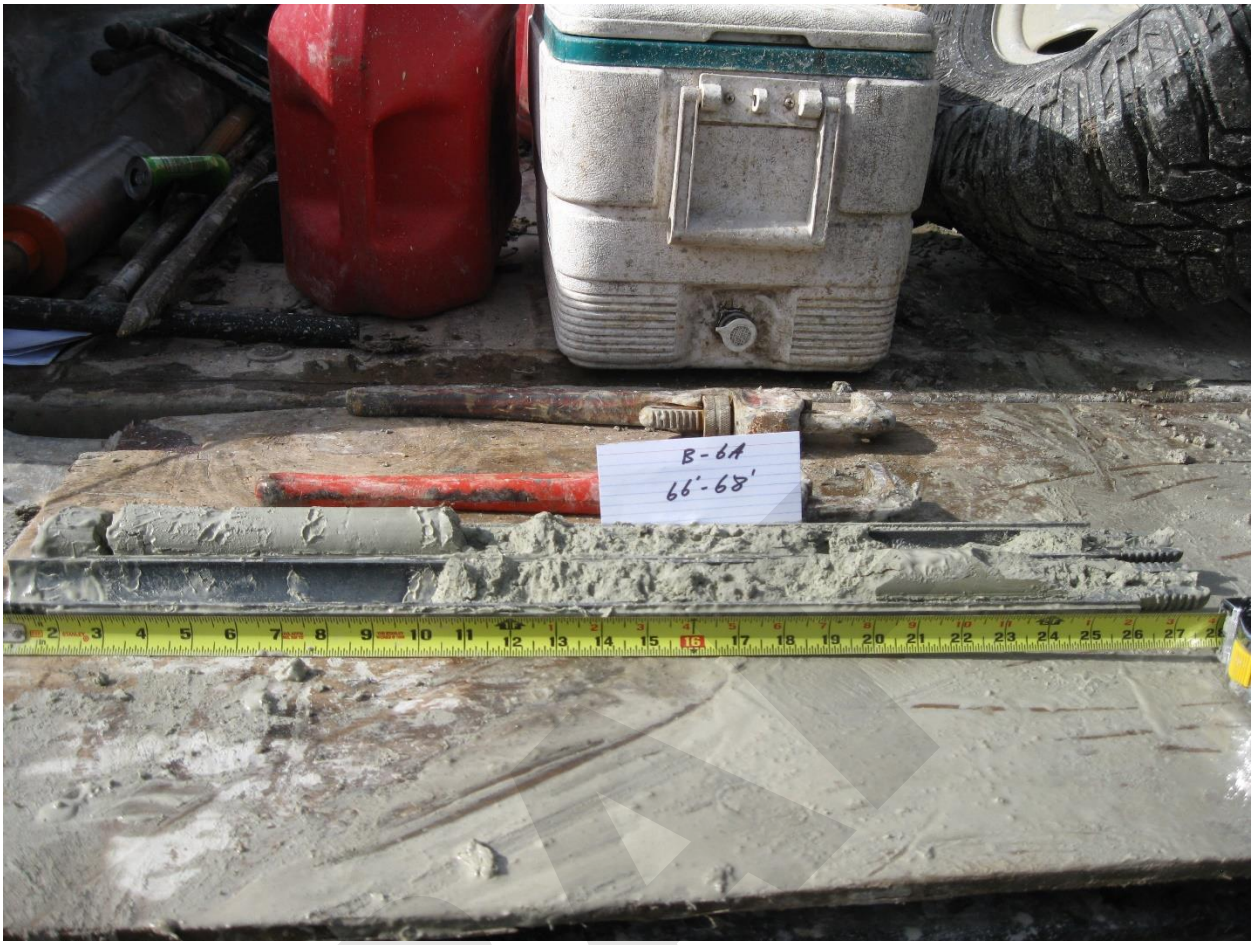








Boring 6A



Boring 7A

APPENDIX B

SPT CORRECTIONS, SOIL SHEAR STRENGTH, AND SEISMIC HAZARD EVALUATION

GeoStellar Engineering

APPENDIX B
SPT CORRECTIONS, SOIL SHEAR STRENGTH, AND SEISMIC HAZARD EVALUATION

Details of SPT sampling depths, penetration results, soil classification, and hammer energy ratio are presented in Appendix A. The SPT testing results were first corrected and then correlated to static soil shear strengths. Seismic soil shear strengths were evaluated by first screening for soils susceptible to soil shear strength loss (SSL) and then evaluating if soil SSL could be triggered by the SEE design events. If soil SSL was not triggered by the SEE design event, it was assumed that the FEE design event would also not trigger soil SSL. Seismic soil shear strengths were determined based on correlations with SPT results after evaluating if the soils are subject to cyclic softening, full cyclic liquefaction, or limited cyclic liquefaction.

SPT CORRECTIONS

The SPT penetration field results, N_{Meas}, were corrected for energy losses in order to obtain N_{60} and N^*_{60}. The energy corrected N^*_{60} blow counts were then normalized to a reference overburden pressure of 1 tsf (1 atm) to obtain a normalized $N^*_{1,60}$. The SPT N_{60} and $N^*_{1,60}$ were used to evaluate the static soil shear strengths. The energy corrections and overburden corrections used are in accordance with the 2010 SCDOT GDM, Section 7.8.1.1 and Section 13.11.1. The SPT $N^*_{1,60}$ values were also corrected for fines content to equivalent clean sand SPT $N^*_{1,60,cs}$ blow counts that were used to evaluate soil shear strength loss (SSL). The fines content correction used was in accordance with the 2010 SCDOT GDM, Table 13-7.

STATIC SOIL SHEAR STRENGTH

The SPT N_{60} blow counts were used to obtain total soil shear strength (cohesion, c) for cohesive soils and SPT $N^*_{1,60}$ was used to obtain effective shear strength (internal friction angle, ϕ') for cohesionless soils based on correlations obtained from the 2010 SCDOT GDM, Sections 7.10 for and 7.11. Effective (drained) soil shear strengths of clay-like soils typically used in long-term drained analyses were computed, and recommended effective soil shear strength parameters for clay-like soils are included in the main report.

An internal angle of friction was assigned for sand-like soils (typically: FC $\leq$ 20% or PI < 7) and a cohesion was assigned and for clay-like soils (typically: FC > 20% and PI $\geq$ 7) by using the appropriate SCDOT correlations. The computed shear strength parameters (internal angle of friction or cohesion) were further evaluated and limited to the maximum allowable total and effective soil shear strength in accordance with 2010 SCDOT GDM, Tables 7-15 and 7-16, respectively, unless laboratory shear strength data was available. The majority of the SPT blow counts, $N^*_{1,60}$, for cohesionless soils substantially exceeded a corrected blow count of 16.6 blows/foot which corresponds to an effective internal angle of friction, ϕ', of 36 degrees and consequently may be a lower bound value that has been limited to the maximum allowable internal angle of friction (typically 36 degrees). The corrected SPT blow counts, N_{60}, $N^*_{1,60}$, $N^*_{1,60,CS}$, and soil shear strength correlations for SPT soil borings are included in this appendix.

SEISMIC SOIL SHEAR STRENGTH

Seismic soil shear strength parameters of the subsurface soils were evaluated by first screening the SPT soil borings to determine if the soils encountered are susceptible to soil shear strength loss (SSL). Soils identified as susceptible to soil SSL were then evaluated to determine if the seismic demand (SEE) was capable of triggering soil SSL.

Soil borings were screened for soil SSL susceptibility based on classification of the soils as either No Strength Loss (NSL) or Possible Strength Loss (PSL). PSL soils were further classified as either Sand-Like, NS Clay-Like soils, or HS Clay-Like soils. The soil SSL screening for Sand-Like, NS Clay-Like soils, and HS Clay-Like soils was based on fines content corrected SPT blow counts, $N^*_{1,60,CS}$, Fines Content (FC), Plasticity Index (PI), USCS soil classification, and depth to ground water table in accordance with the GDM Subsection 13.6.

Sand-Like, NS Clay-Like soils, and HS Clay-Like soils were then evaluated to determine if the seismic demand (SEE) would trigger soil SSL. Soil SSL triggering was evaluated using seismic design parameters from Section 4 and the SSL triggering method for level ground sites in accordance with GDM Subsection 13.7. Sand-like soils were assigned liquefaction resistance age correction factors (K_{DR}) based on the Shear Wave Velocity Evaluation. Sand-Like soils that indicate triggering of soil SSL will undergo full or limited cyclic liquefaction and NS/HS Clay-Like soils that indicate triggering of soil SSL will undergo cyclic softening. The SSL screening, triggering, and seismic soil shear strengths for the borings listed below are provided in this appendix.

SEISMIC HAZARD EVALUATION

Seismic settlements were evaluated using the procedures outlined by Idriss and Boulanger in the 2008 EERI Monograph MNO-12, "Soil Liquefaction during Earthquakes." The results of the seismic settlement evaluation are included in this appendix.

Included in this appendix are analyses for the following borings:

- RW-1
- RW-2
- RW-3
- RW-3B
- B-1
- B-1A
- B-2
- B-3
- B-3A
- B-4
- B-5
- B-5A
- B-6
- B-6A
- B-7
- B-7A
- B-8
- B-9
- RW-4
- RW-5
- RW-6
- RW-7

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	**0.490**	**0.180**	g
k_{max} = **PGA =**	**0.430**	**0.200**	g
β = S_{D1}/PGA =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	**7.37**	**7.36**	
R =	**63.5**	**64.2**	km
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec
Z_{HR} =	**494.5**	**494.5**	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \le \beta \le 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20ft$ $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-1	No. of Soil Layers =	10	each	Hammer Type =	Automatic
Boring Station =	5949+31.00	No. of Split Spoon Samples =	23	each	Energy Ratio =	79
Boring Offset =	13 ft LT	Total Profile Thickness =	103	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	119.9	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	7.7	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	112.2	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.9														
1	2.5	117.4	4.0	1.32	1.00	0.75	1.00	287.5	1.70	16.2	3.6	5.3	6.7	10.3	1	SM
2	5.5	114.4	8.0	1.32	1.00	0.78	1.00	632.5	1.70	12.0	2.1	10.5	13.9	16.0	1	SM
3	7.5	112.4	4.0	1.32	1.00	0.82	1.00	862.5	1.52	12.0	2.1	5.3	6.5	8.6	1	SM
4	9.5	110.4	2.0	1.32	1.00	0.85	1.00	980.2	1.43	32.3	5.4	2.6	3.2	8.6	2	SC
5	12.5	107.4	4.0	1.32	1.00	0.89	1.00	1,138.0	1.33	32.3	5.4	5.3	6.2	11.7	3	SC-SM
6	17.5	102.4	23.0	1.32	1.00	0.93	1.00	1,413.5	1.19	4.4	0.0	30.3	33.7	33.7	4	SP
7	22.5	97.4	11.0	1.32	1.00	0.96	1.00	1,686.5	1.09	28.5	5.3	14.5	15.2	20.5	5	SM
8	27.5	92.4	37.0	1.32	1.00	0.98	1.00	1,949.5	1.01	28.5	5.3	48.7	48.2	46.0	5	SM
9	32.5	87.4	14.0	1.32	1.00	0.99	1.00	2,212.5	0.95	24.5	5.0	18.4	17.3	22.3	6	SM
10	36.4	83.5	50.0	1.32	1.00	1.00	1.00	2,417.6	0.91	24.5	5.0	50.0	50.0	46.0	6	SM
11	42.5	77.4	17.0	1.32	1.00	1.00	1.00	2,738.5	0.85	44.0	5.5	22.4	19.1	24.6	7	SM
12	47.5	72.4	25.0	1.32	1.00	1.00	1.00	3,001.5	0.82	44.0	5.5	32.9	26.9	32.4	7	SM
13	52.5	67.4	32.0	1.32	1.00	1.00	1.00	3,248.5	1.00	55.3	5.5	42.1	42.1	46.0	8	ML
14	57.5	62.4	27.0	1.32	1.00	1.00	1.00	3,486.5	1.00	55.3	5.5	35.6	35.6	41.1	8	ML
15	62.5	57.4	32.0	1.32	1.00	1.00	1.00	3,724.5	1.00	55.3	5.5	42.1	42.1	46.0	8	ML
16	67.5	52.4	45.0	1.32	1.00	1.00	1.00	3,962.5	1.00	55.3	5.5	50.0	50.0	46.0	8	ML
17	72.5	47.4	50.0	1.32	1.00	1.00	1.00	4,200.5	1.00	55.3	5.5	50.0	50.0	46.0	8	ML
18	77.5	42.4	45.0	1.32	1.00	1.00	1.00	4,438.5	1.00	55.3	5.5	50.0	50.0	46.0	8	ML
19	82.5	37.4	50.0	1.32	1.00	1.00	1.00	4,676.5	1.00	55.3	5.5	50.0	50.0	46.0	8	ML
20	87.5	32.4	50.0	1.32	1.00	1.00	1.00	4,914.5	1.00	55.3	5.5	50.0	50.0	46.0	8	ML
21	92.5	27.4	41.0	1.32	1.00	1.00	1.00	5,171.5	0.62	5.0	0.0	50.0	33.6	33.6	9	SP-SM
22	97.5	22.4	50.0	1.32	1.00	1.00	1.00	5,459.5	0.61	5.0	0.0	50.0	39.8	39.8	10	SW-SM
23	102.5	17.4	50.0	1.32	1.00	1.00	1.00	5,747.5	0.59	5.0	0.0	50.0	38.8	38.8	10	SW-SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-1	**No. of Soil Layers =**	10	each
Boring Station =	5949+31.00	**No. of Split Spoon Samples =**	23	each
Boring Offset =	13 ft LT	**Total Profile Thickness =**	103	feet
Ground Elevation at Boring (ft msl) =	119.9			
Water Table Depth (Dw) (ft) =	7.7			
Water Table Elevation (msl ft) =	112.2			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	119.9														
1	2.5	117.4	4.0	10.3	1	SM	115.0	Recent	Recent	Fill	1.00	16.2	11.7	NP	NP	NP
2	5.5	114.4	8.0	16.0	1	SM	115.0	Recent	Recent	Fill	1.00	12.0		15	8	7
3	7.5	112.4	4.0	8.6	1	SM	115.0	Recent	Recent	Fill	1.00	12.0		15	8	7
4	9.5	110.4	2.0	8.6	2	SC	115.0	Quaternary	Holocene	Alluvium	1.20	32.3	17.5	25	17	8
5	12.5	107.4	4.0	11.7	3	SC-SM	115.0	Quaternary	Holocene	Alluvium	1.20	32.3	17.5	25	17	8
6	17.5	102.4	23.0	33.7	4	SP	120.0	Quaternary	Holocene	Alluvium	1.20	4.4	13.1	NP	NP	NP
7	22.5	97.4	11.0	20.5	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	28.5	38.1	37	31	6
8	27.5	92.4	37.0	46.0	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	28.5	38.1	37	31	6
9	32.5	87.4	14.0	22.3	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	24.5	23.5	37	31	6
10	36.4	83.5	50.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	24.5	23.5	37	31	6
11	42.5	77.4	17.0	24.6	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	44.0	44.9	37	31	6
12	47.5	72.4	25.0	32.4	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	44.0	44.9	37	31	6
13	52.5	67.4	32.0	46.0	8	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	55.3	33.9	30	27	3
14	57.5	62.4	27.0	41.1	8	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	55.3	33.9	30	27	3
15	62.5	57.4	32.0	46.0	8	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	55.3	33.9	30	27	3
16	67.5	52.4	45.0	46.0	8	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	55.3	33.9	30	27	3
17	72.5	47.4	50.0	46.0	8	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	55.3	33.9	30	27	3
18	77.5	42.4	45.0	46.0	8	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	55.3	33.9	30	27	3
19	82.5	37.4	50.0	46.0	8	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	55.3	33.9	30	27	3
20	87.5	32.4	50.0	46.0	8	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	55.3	33.9	30	27	3
21	92.5	27.4	41.0	33.6	9	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
22	97.5	22.4	50.0	39.8	10	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
23	102.5	17.4	50.0	38.8	10	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-1	Design EQ =	SEE	SSL Water Table Depth (ft) =	9.9
Boring Station =	594931	Site Class =	D	SSL Water Table Elev. (msl ft) =	110.0
Boring Offset =	13 ft LT	PGA (g) =	0.43		
Ground Elevation at Boring (ft msl) =	119.9	M_W =	7.4		
Water Table Depth (Dw) (ft) =	7.7	R (km) =	0		
Water Table Elevation (msl ft) =	112.2	D_{a5-95} (sec) =	30.15		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	119.9														
1	2.5	117.4	10.3	SM	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
2	5.5	114.4	16.0	SM	NSL-S	Sand-Like			No Liquefaction		35.0			0.00		0.00
3	7.5	112.4	8.6	SM	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
4	9.5	110.4	8.6	SC	PSL	NS Clay-Like	0.80	0.90	No Strength Loss			400.0		0.00		0.00
5	12.5	107.4	11.7	SC-SM	PSL	NS Clay-Like	0.84	0.90	No Strength Loss			500.0		0.00		0.00
6	17.5	102.4	33.7	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
7	22.5	97.4	20.5	SM	NSL-S	Sand-Like			No Liquefaction		35.0			0.00		0.00
8	27.5	92.4	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
9	32.5	87.4	22.3	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
10	36.4	83.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
11	42.5	77.4	24.6	SM	SSL	Sand-Like	0.69	0.75	No Liquefaction	0.19	36.0			0.00		0.00
12	47.5	72.4	32.4	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
13	52.5	67.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
14	57.5	62.4	41.1	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
15	62.5	57.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
16	67.5	52.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
17	72.5	47.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
18	77.5	42.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
19	82.5	37.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
20	87.5	32.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
21	92.5	27.4	33.6	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
22	97.5	22.4	39.8	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
23	102.5	17.4	38.8	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
													0.00		0.00	
													LDI Total (feet)		S Total (inches)	

[D]Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-1	Design EQ =	SEE	No. of Soil Layers =	10 each
Boring Station =	5949+31.00	Site Class =	D	No. of Split Spoon Samples =	23 each
Boring Offset =	13 ft LT	PGA (g) =	0.43	Total Profile Thickness =	103 feet
Ground Elevation at Boring (ft msl) =	119.9	M_W =	7.37		
Water Table Depth (Dw) (ft) =	7.7	R (km) =	0		
Water Table Elevation (msl ft) =	112.2	$D_{a5\text{-}95}$ (sec) =	30.15		

																		Total Soil Shear Strengths						Effective Soil Shear Strengths			
																		Short Term Loading				Cyclic Loading		Long Term Loading			
																		Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																		ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	119.9	0.0																								
1	2.5	117.4	287.5	4.0	5.3	6.7	10.3	1	SM	Sand-Like	No Liquefaction		16.2	NP	NP				30		30		30		30			
2	5.5	114.4	632.5	8.0	10.5	13.9	16.0	1	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				35		35		35		35			
3	7.5	112.4	862.5	4.0	5.3	6.5	8.6	1	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				30		30		30		30			
4	9.5	110.4	980.18	2.0	2.6	3.2	8.6	2	SC	NS Clay-Like	No Strength Loss		32.3	8.0	25.0					198		400		400			29	
5	12.5	107.4	1137.98	4.0	5.3	6.2	11.7	3	SC-SM	NS Clay-Like	No Strength Loss		32.3	8.0	25.0					395		500		500			29	
6	17.5	102.4	1413.48	23.0	30.3	33.7	33.7	4	SP	Sand-Like	No Liquefaction		4.4	NP	NP				43		32		32		32			
7	22.5	97.4	1686.48	11.0	14.5	15.2	20.5	5	SM	Sand-Like	No Liquefaction		28.5	6.0	37.0				35		35		35		35			
8	27.5	92.4	1949.48	37.0	48.7	48.2	46.0	5	SM	Sand-Like	No Liquefaction		28.5	6.0	37.0				45		36		36		36			
9	32.5	87.4	2212.48	14.0	18.4	17.3	22.3	6	SM	Sand-Like	No Liquefaction		24.5	6.0	37.0				36		36		36		36			
10	36.4	83.5	2417.62	50.0	50.0	50.0	46.0	6	SM	Sand-Like	No Liquefaction		24.5	6.0	37.0				45		36		36		36			
11	42.5	77.4	2738.48	17.0	22.4	19.1	24.6	7	SM	Sand-Like	No Liquefaction	69.8	44.0	6.0	37.0				37		36		36		36			
12	47.5	72.4	3001.48	25.0	32.9	26.9	32.4	7	SM	Sand-Like	No Liquefaction		44.0	6.0	37.0				40		36		36		36			
13	52.5	67.4	3248.48	32.0	42.1	42.1	46.0	8	ML	Sand-Like	No Liquefaction		55.3	3.0	30.0				45		30		30		30			
14	57.5	62.4	3486.48	27.0	35.6	35.6	41.1	8	ML	Sand-Like	No Liquefaction		55.3	3.0	30.0				43		30		30		30			
15	62.5	57.4	3724.48	32.0	42.1	42.1	46.0	8	ML	Sand-Like	No Liquefaction		55.3	3.0	30.0				45		30		30		30			
16	67.5	52.4	3962.48	45.0	50.0	50.0	46.0	8	ML	Sand-Like	No Liquefaction		55.3	3.0	30.0				45		30		30		30			
17	72.5	47.4	4200.48	50.0	50.0	50.0	46.0	8	ML	Sand-Like	No Liquefaction		55.3	3.0	30.0				45		30		30		30			
18	77.5	42.4	4438.48	45.0	50.0	50.0	46.0	8	ML	Sand-Like	No Liquefaction		55.3	3.0	30.0				45		30		30		30			
19	82.5	37.4	4676.48	50.0	50.0	50.0	46.0	8	ML	Sand-Like	No Liquefaction		55.3	3.0	30.0				45		30		30		30			
20	87.5	32.4	4914.48	50.0	50.0	50.0	46.0	8	ML	Sand-Like	No Liquefaction		55.3	3.0	30.0				45		30		30		30			
21	92.5	27.4	5171.48	41.0	50.0	33.6	33.6	9	SP-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				43		36		36		36			
22	97.5	22.4	5459.48	50.0	50.0	39.8	39.8	10	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				45		36		36		36			
23	102.5	17.4	5747.48	50.0	50.0	38.8	38.8	10	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				44		36		36		36			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	**0.490**	**0.180**	g
k_{max} = **PGA =**	**0.430**	**0.200**	g
β = S_{D1}/PGA =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	**7.37**	**7.36**	
R =	**63.5**	**64.2**	km
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec
Z_{HR} =	**494.5**	**494.5**	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \le \beta \le 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20ft$ $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-1A	No. of Soil Layers =	15	each	Hammer Type =	Safety
Boring Station =	5949+31.75	No. of Split Spoon Samples =	28	each	Energy Ratio =	76
Boring Offset =	8.75 ft RT	Total Profile Thickness =	120	feet	Energy Correction (C_E) =	1.27
Ground Elevation at Boring (ft msl) =	119.9	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	6	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	113.9	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.9														
1	2.7	117.2	44.0	1.27	1.00	0.75	1.00	310.5	1.70	12.0	2.1	50.0	50.0	46.0	1	SC
2	4.7	115.2	29.0	1.27	1.00	0.76	1.00	550.5	1.70	0.0	0.0	36.9	47.6	46.0	2	SP
3	6.7	113.2	12.0	1.27	1.00	0.80	1.00	746.8	1.64	0.0	0.0	15.3	20.0	20.0	2	SP
4	8.7	111.2	4.0	1.27	1.00	0.84	1.00	862.0	1.52	0.0	0.0	5.1	6.5	6.5	2	SP
5	9.7	110.2	3.0	1.27	1.00	0.85	1.00	919.6	1.47	0.0	0.0	3.8	4.8	4.8	2	SP
6	10.7	109.2	3.0	1.27	1.00	0.87	1.00	967.2	1.00	73.0	5.5	3.8	3.3	8.8	3	CL
7	15	104.9	9.0	1.27	1.00	0.91	1.00	1,186.9	1.30	42.3	5.5	11.5	13.6	19.1	4	SC
8	20	99.9	25.0	1.27	1.00	0.95	1.00	1,467.4	1.17	0.0	0.0	31.8	35.3	35.3	5	SP
9	25	94.9	47.0	1.27	1.00	0.97	1.00	1,737.9	1.07	25.0	5.1	50.0	50.0	46.0	6	SM
10	30	89.9	50.0	1.27	1.00	0.98	1.00	2,000.9	1.00	25.0	5.1	50.0	50.0	46.0	6	SM
11	35	84.9	50.0	1.27	1.00	1.00	1.00	2,263.9	0.94	25.0	5.1	50.0	50.0	46.0	6	SM
12	40	79.9	22.0	1.27	1.00	1.00	1.00	2,509.4	1.00	57.7	5.5	28.0	28.0	33.5	7	ML
13	45	74.9	50.0	1.27	1.00	1.00	1.00	2,764.9	0.85	49.3	5.5	50.0	50.0	46.0	8	SM
14	50	69.9	21.0	1.27	1.00	1.00	1.00	3,010.4	1.00	56.0	5.5	26.7	26.7	32.2	9	ML
15	55	64.9	29.0	1.27	1.00	1.00	1.00	3,248.4	1.00	66.3	5.5	36.9	36.9	42.4	9	ML
16	60	59.9	42.0	1.27	1.00	1.00	1.00	3,486.4	1.00	66.3	5.5	50.0	50.0	46.0	9	ML
17	65	54.9	41.0	1.27	1.00	1.00	1.00	3,724.4	1.00	73.7	5.5	50.0	50.0	46.0	9	ML
18	70	49.9	36.0	1.27	1.00	1.00	1.00	3,962.4	1.00	73.7	5.5	45.8	45.8	46.0	10	ML
19	75	44.9	50.0	1.27	1.00	1.00	1.00	4,200.4	1.00	73.7	5.5	50.0	50.0	46.0	10	ML
20	80	39.9	50.0	1.27	1.00	1.00	1.00	4,455.9	0.67	42.0	5.5	50.0	42.7	46.0	11	SM
21	85	34.9	50.0	1.27	1.00	1.00	1.00	4,718.9	0.65	42.0	5.5	50.0	41.4	46.0	11	SM
22	90	29.9	50.0	1.27	1.00	1.00	1.00	4,981.9	0.63	42.0	5.5	50.0	40.3	45.8	12	SM
23	95	24.9	50.0	1.27	1.00	1.00	1.00	5,262.4	0.62	5.0	0.0	50.0	39.2	39.3	13	SW-SM
24	100	19.9	50.0	1.27	1.00	1.00	1.00	5,550.4	0.60	5.0	0.0	50.0	38.2	38.2	13	SW-SM
25	105	14.9	50.0	1.27	1.00	1.00	1.00	5,838.4	0.59	5.0	0.0	50.0	37.3	37.3	13	SW-SM
26	110	9.9	50.0	1.27	1.00	1.00	1.00	6,126.4	0.57	5.0	0.0	50.0	36.4	36.4	13	SW-SM
27	115	4.9	35.0	1.27	1.00	1.00	1.00	6,379.4	1.00	51.0	5.5	44.6	44.6	46.0	14	CL
28	120	-0.1	50.0	1.27	1.00	1.00	1.00	6,652.4	0.55	5.0	0.0	50.0	34.9	34.9	15	SP-SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-1A	**No. of Soil Layers =**	15	each
Boring Station =	5949+31.75	**No. of Split Spoon Samples =**	28	each
Boring Offset =	8.75 ft RT	**Total Profile Thickness =**	120	feet
Ground Elevation at Boring (ft msl) =	119.9			
Water Table Depth (Dw) (ft) =	6			
Water Table Elevation (msl ft) =	113.9			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	119.9														
1	2.7	117.2	44.0	46.0	1	SC	115.0	Recent	Recent	Fill	1.00	12.0		15	8	7
2	4.7	115.2	29.0	46.0	2	SP	120.0	Recent	Recent	Fill	1.00	0.0		NP	NP	NP
3	6.7	113.2	12.0	20.0	2	SP	120.0	Recent	Recent	Fill	1.00	0.0		NP	NP	NP
4	8.7	111.2	4.0	6.5	2	SP	120.0	Recent	Recent	Fill	1.00	0.0		NP	NP	NP
5	9.7	110.2	3.0	4.8	2	SP	120.0	Recent	Recent	Fill	1.00	0.0		NP	NP	NP
6	10.7	109.2	3.0	8.8	3	CL	110.0	Quaternary	Holocene	Alluvium	1.20	73.0	24.5	34	14	20
7	15	104.9	9.0	19.1	4	SC	115.0	Quaternary	Holocene	Alluvium	1.20	42.3	20.5	25	13	12
8	20	99.9	25.0	35.3	5	SP	120.0	Paleogene	Eocene	Santee Limestone	2.10	0.0		NP	NP	NP
9	25	94.9	47.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	25.0		36	30	6
10	30	89.9	50.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	25.0		36	30	6
11	35	84.9	50.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	25.0		36	30	6
12	40	79.9	22.0	33.5	7	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	57.7	37	28	26	2
13	45	74.9	50.0	46.0	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	49.3	46	40	38	2
14	50	69.9	21.0	32.2	9	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	56.0	35.3	29	27	2
15	55	64.9	29.0	42.4	9	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	66.3	36.7	32	31	1
16	60	59.9	42.0	46.0	9	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	66.3	36.7	32	31	1
17	65	54.9	41.0	46.0	9	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	73.7	32.7	36	30	6
18	70	49.9	36.0	46.0	10	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	73.7	32.7	36	30	6
19	75	44.9	50.0	46.0	10	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	73.7	32.7	36	30	6
20	80	39.9	50.0	46.0	11	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
21	85	34.9	50.0	46.0	11	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
22	90	29.9	50.0	45.8	12	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
23	95	24.9	50.0	39.3	13	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
24	100	19.9	50.0	38.2	13	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
25	105	14.9	50.0	37.3	13	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
26	110	9.9	50.0	36.4	13	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
27	115	4.9	35.0	46.0	14	CL	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	51.0		30	10	20
28	120	-0.1	50.0	34.9	15	SP-SM	120.0	Paleogene	Eocene	Subcongaree Formation	2.10	5.0		10	6	4

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-1A	Design EQ =	SEE	SSL Water Table Depth (ft) =	9.9
Boring Station =	594931.75	Site Class =	D	SSL Water Table Elev. (msl ft) =	110.0
Boring Offset =	8.75 ft RT	PGA (g) =	0.43		
Ground Elevation at Boring (ft msl) =	119.9	M_W =	7.4		
Water Table Depth (Dw) (ft) =	6	R (km) =	0		
Water Table Elevation (msl ft) =	113.9	D_{a5-95} (sec) =	30.15		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	119.9														
1	2.7	117.2	46.0	SC	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
2	4.7	115.2	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
3	6.7	113.2	20.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
4	8.7	111.2	6.5	SP	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
5	9.7	110.2	4.8	SP	NSL-S	Sand-Like			No Liquefaction		29.0			0.00		0.00
6	10.7	109.2	8.8	CL	PSL	NS Clay-Like	0.58	0.90	No Strength Loss			570.0		0.00		0.00
7	15.0	104.9	19.1	SC	PSL	NS Clay-Like	0.27	0.90	No Strength Loss			1720.0		0.00		0.00
8	20.0	99.9	35.3	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
9	25.0	94.9	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
10	30.0	89.9	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
11	35.0	84.9	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
12	40.0	79.9	33.5	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
13	45.0	74.9	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
14	50.0	69.9	32.2	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
15	55.0	64.9	42.4	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
16	60.0	59.9	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
17	65.0	54.9	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
18	70.0	49.9	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
19	75.0	44.9	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
20	80.0	39.9	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
21	85.0	34.9	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
22	90.0	29.9	45.8	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
23	95.0	24.9	39.3	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
24	100.0	19.9	38.2	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
25	105.0	14.9	37.3	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
26	110.0	9.9	36.4	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
27	115.0	4.9	46.0	CL	NSL-C				No Strength Loss			4000.0		0.00		0.00
28	120.0	-0.1	34.9	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
													0.00		0.00	
													LDI Total (feet)		S Total (inches)	

[D]Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-1A	Design EQ =	SEE	No. of Soil Layers =	15 each
Boring Station =	5949+31.75	Site Class =	D	No. of Split Spoon Samples =	28 each
Boring Offset =	8.75 ft RT	PGA (g) =	0.43	Total Profile Thickness =	120 feet
Ground Elevation at Boring (ft msl) =	119.9	M_W =	7.37		
Water Table Depth (Dw) (ft) =	6	R (km) =	0		
Water Table Elevation (msl ft) =	113.9	$D_{a5\text{-}95}$ (sec) =	30.15		

																		Total Soil Shear Strengths						Effective Soil Shear Strengths			
																		Short Term Loading				Cyclic Loading		Long Term Loading			
																		Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																		ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	119.9	0.0																								
1	2.7	117.2	310.5	44.0	50.0	50.0	46.0	1	SC	Sand-Like	No Liquefaction		12.0	7.0	15.0				45		30		30		30			
2	4.7	115.2	550.5	29.0	36.9	47.6	46.0	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP				45		32		32		32			
3	6.7	113.2	746.82	12.0	15.3	20.0	20.0	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP				38		32		32		32			
4	8.7	111.2	862.02	4.0	5.1	6.5	6.5	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP				30		30		30		30			
5	9.7	110.2	919.62	3.0	3.8	4.8	4.8	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP				29		29		29		29			
6	10.7	109.2	967.22	3.0	3.8	3.3	8.8	3	CL	NS Clay-Like	No Strength Loss		73.0	20.0	34.0					573		570		570		2	26	57
7	15	104.9	1186.9	9.0	11.5	13.6	19.1	4	SC	NS Clay-Like	No Strength Loss		42.3	12.0	25.0					1719		1720		1720			27	
8	20	99.9	1467.4	25.0	31.8	35.3	35.3	5	SP	Sand-Like	No Liquefaction		0.0	NP	NP				43		32		32		32			
9	25	94.9	1737.9	47.0	50.0	50.0	46.0	6	SM	Sand-Like	No Liquefaction		25.0	6.0	36.0				45		36		36		36			
10	30	89.9	2000.9	50.0	50.0	50.0	46.0	6	SM	Sand-Like	No Liquefaction		25.0	6.0	36.0				45		36		36		36			
11	35	84.9	2263.9	50.0	50.0	50.0	46.0	6	SM	Sand-Like	No Liquefaction		25.0	6.0	36.0				45		36		36		36			
12	40	79.9	2509.4	22.0	28.0	28.0	33.5	7	ML	Sand-Like	No Liquefaction		57.7	2.0	28.0				41		30		30		30			
13	45	74.9	2764.9	50.0	50.0	50.0	46.0	8	SM	Sand-Like	No Liquefaction		49.3	2.0	40.0				45		36		36		36			
14	50	69.9	3010.4	21.0	26.7	26.7	32.2	9	ML	Sand-Like	No Liquefaction		56.0	2.0	29.0				40		30		30		30			
15	55	64.9	3248.4	29.0	36.9	36.9	42.4	9	ML	Sand-Like	No Liquefaction		66.3	1.0	32.0				44		30		30		30			
16	60	59.9	3486.4	42.0	50.0	50.0	46.0	9	ML	Sand-Like	No Liquefaction		66.3	1.0	32.0				45		30		30		30			
17	65	54.9	3724.4	41.0	50.0	50.0	46.0	9	ML	Sand-Like	No Liquefaction		73.7	6.0	36.0				45		30		30		30			
18	70	49.9	3962.4	36.0	45.8	45.8	46.0	10	ML	Sand-Like	No Liquefaction		73.7	6.0	36.0				45		30		30		30			
19	75	44.9	4200.4	50.0	50.0	50.0	46.0	10	ML	Sand-Like	No Liquefaction		73.7	6.0	36.0				45		30		30		30			
20	80	39.9	4455.9	50.0	50.0	42.7	46.0	11	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0				45		36		36		36			
21	85	34.9	4718.9	50.0	50.0	41.4	46.0	11	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0				45		36		36		36			
22	90	29.9	4981.9	50.0	50.0	40.3	45.8	12	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0				45		36		36		36			
23	95	24.9	5262.4	50.0	50.0	39.2	39.3	13	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				45		36		36		36			
24	100	19.9	5550.4	50.0	50.0	38.2	38.2	13	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				44		36		36		36			
25	105	14.9	5838.4	50.0	50.0	37.3	37.3	13	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				44		36		36		36			
26	110	9.9	6126.4	50.0	50.0	36.4	36.4	13	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				44		36		36		36			
27	115	4.9	6379.4	35.0	44.6	44.6	46.0	14	CL		No Strength Loss		51.0	20.0	30.0					6685		4000		4000		2	26	400
28	120	-0.1	6652.4	50.0	50.0	34.9	34.9	15	SP-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				43		36		36		36			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	**0.490**	**0.180**	g
k_{max} = **PGA =**	**0.430**	**0.200**	g
β = S_{D1}/PGA =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	**7.37**	**7.36**	
R =	**63.5**	**64.2**	km
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec
Z_{HR} =	**494.5**	**494.5**	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \le \beta \le 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20ft$ $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-2	No. of Soil Layers =	13	each	Hammer Type = Automatic
Boring Station =	5949+65.00	No. of Split Spoon Samples =	23	each	Energy Ratio = 79
Boring Offset =	9 ft RT	Total Profile Thickness =	112	feet	Energy Correction (C_E) = 1.32
Ground Elevation at Boring (ft msl) =	108.8	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	0	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	108.8	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	108.8														
1	2.5	106.3	5.0	1.32	1.00	0.75	1.00	131.5	1.70	12.0	2.1	6.6	8.4	10.5	1	SM
2	5.5	103.3	13.0	1.32	1.00	0.78	1.00	297.8	1.70	0.0	0.0	17.1	22.6	22.6	2	SP
3	7.5	101.3	32.0	1.32	1.00	0.82	1.00	413.0	1.70	0.0	0.0	42.1	50.0	46.0	2	SP
4	9.5	99.3	16.0	1.32	1.00	0.85	1.00	519.7	1.70	14.2	3.0	21.1	30.4	33.4	3	SM
5	11.5	97.3	50.0	1.32	1.00	0.88	1.00	616.4	1.00	55.1	5.5	50.0	50.0	46.0	4	ML
6	16.5	92.3	50.0	1.32	1.00	0.93	1.00	881.9	1.51	46.7	5.5	50.0	50.0	46.0	5	SC
7	20.4	88.4	50.0	1.32	1.00	0.95	1.00	1,087.0	1.36	39.2	5.5	50.0	50.0	46.0	6	SM
8	26.5	82.3	18.0	1.32	1.00	0.98	1.00	1,407.9	1.19	39.2	5.5	23.7	27.5	33.0	6	SM
9	31.5	77.3	17.0	1.32	1.00	0.99	1.00	1,670.9	1.09	39.2	5.5	22.4	24.1	29.6	6	SM
10	36.5	72.3	21.0	1.32	1.00	1.00	1.00	1,933.9	1.02	43.8	5.5	27.7	28.1	33.6	7	SM
11	41.5	67.3	13.0	1.32	1.00	1.00	1.00	2,196.9	0.95	47.1	5.5	17.1	16.3	21.8	8	SM
12	46.5	62.3	21.0	1.32	1.00	1.00	1.00	2,459.9	0.90	47.1	5.5	27.7	24.9	30.4	8	SM
13	51.5	57.3	32.0	1.32	1.00	1.00	1.00	2,722.9	0.86	47.1	5.5	42.1	36.1	41.6	8	SM
14	56.5	52.3	41.0	1.32	1.00	1.00	1.00	2,985.9	0.82	47.1	5.5	50.0	44.2	46.0	8	SM
15	61.5	47.3	29.0	1.32	1.00	1.00	1.00	3,248.9	0.78	48.7	5.5	38.2	30.0	35.5	9	SM
16	66.5	42.3	39.0	1.32	1.00	1.00	1.00	3,511.9	0.75	48.7	5.5	50.0	38.8	44.3	9	SM
17	71.5	37.3	50.0	1.32	1.00	1.00	1.00	3,774.9	0.73	23.0	4.9	50.0	47.9	46.0	10	SM
18	76.5	32.3	17.0	1.32	1.00	1.00	1.00	4,055.4	0.70	7.9	0.3	22.4	15.7	16.1	11	SP-SM
19	81.5	27.3	30.0	1.32	1.00	1.00	1.00	4,343.4	0.68	5.0	0.0	39.5	26.8	26.8	12	SW-SM
20	86.5	22.3	50.0	1.32	1.00	1.00	1.00	4,631.4	0.66	5.0	0.0	50.0	43.3	43.3	12	SW-SM
21	91.5	17.3	50.0	1.32	1.00	1.00	1.00	4,919.4	0.64	5.0	0.0	50.0	42.0	42.0	12	SW-SM
22	106.5	2.3	49.0	1.32	1.00	1.00	1.00	5,783.4	0.59	5.0	0.0	50.0	37.9	37.9	12	SW-SM
23	111.5	-2.7	35.0	1.32	1.00	1.00	1.00	6,053.9	0.57	12.0	2.1	46.1	26.5	28.6	13	SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**B-2**	**No. of Soil Layers =**	**13**	**each**
Boring Station =	**5949+65.00**	**No. of Split Spoon Samples =**	**23**	**each**
Boring Offset =	**9 ft RT**	**Total Profile Thickness =**	**112**	**feet**
Ground Elevation at Boring (ft msl) =	**108.8**			
Water Table Depth (Dw) (ft) =	**0**			
Water Table Elevation (msl ft) =	**108.8**			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	108.8														
1	2.5	106.3	5.0	10.5	1	SM	115.0	Quaternary	Holocene	Alluvium	1.20	12.0		15	8	7
2	5.5	103.3	13.0	22.6	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
3	7.5	101.3	32.0	46.0	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
4	9.5	99.3	16.0	33.4	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	14.2		15	8	7
5	11.5	97.3	50.0	46.0	4	ML	110.0	Quaternary	Holocene	Alluvium	1.20	55.1		30	27	3
6	16.5	92.3	50.0	46.0	5	SC	115.0	Paleogene	Eocene	Santee Limestone	2.10	46.7	24.6	35	23	12
7	20.4	88.4	50.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	39.2	34.4	31	30	1
8	26.5	82.3	18.0	33.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	39.2	34.4	31	30	1
9	31.5	77.3	17.0	29.6	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	39.2	34.4	31	30	1
10	36.5	72.3	21.0	33.6	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	43.8	35	31	30	1
11	41.5	67.3	13.0	21.8	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.1	38.1	31	30	1
12	46.5	62.3	21.0	30.4	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.1	38.1	31	30	1
13	51.5	57.3	32.0	41.6	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.1	38.1	31	30	1
14	56.5	52.3	41.0	46.0	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.1	38.1	31	30	1
15	61.5	47.3	29.0	35.5	9	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	48.7	33.8	40	35	5
16	66.5	42.3	39.0	44.3	9	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	48.7	33.8	40	35	5
17	71.5	37.3	50.0	46.0	10	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	23.0	37.6	NP	NP	NP
18	76.5	32.3	17.0	16.1	11	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	7.9	35.1	NP	NP	NP
19	81.5	27.3	30.0	26.8	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
20	86.5	22.3	50.0	43.3	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
21	91.5	17.3	50.0	42.0	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
22	106.5	2.3	49.0	37.9	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
23	111.5	-2.7	35.0	28.6	13	SM	115.0	Paleogene	Eocene	Subcongaree Formation	2.10	12.0		15	8	7

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**B-2**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**0.0**
Boring Station =	**594965**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**9 ft RT**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**108.8**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**0**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**108.8**	**D_{a5-95} (sec) =**	**30.15**		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	108.8														
1	2.5	106.3	10.5	SM	SSL	Sand-Like	3.69	0.90	Full Liquefaction	0.70 - 1.00	6.0		1.12	1.91	1.09	2.73
2	5.5	103.3	22.6	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.78		1.64
3	7.5	101.3	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.78		1.64
4	9.5	99.3	33.4	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
5	11.5	97.3	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.78		1.64
6	16.5	92.3	46.0	SC	PSL	NS Clay-Like	0.33	0.90	No Strength Loss			1740.0		0.78		1.64
7	20.4	88.4	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
8	26.5	82.3	33.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
9	31.5	77.3	29.6	SM	SSL	Sand-Like	0.52	0.75	No Liquefaction	0.19	36.0			0.78		1.64
10	36.5	72.3	33.6	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
11	41.5	67.3	21.8	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
12	46.5	62.3	30.4	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
13	51.5	57.3	41.6	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
14	56.5	52.3	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
15	61.5	47.3	35.5	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
16	66.5	42.3	44.3	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
17	71.5	37.3	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.78		1.64
18	76.5	32.3	16.1	SP-SM	SSL	Sand-Like	1.27	0.90	Full Liquefaction	0.70 - 1.00	16.0		0.78	0.78	1.64	1.64
19	81.5	27.3	26.8	SW-SM	SSL	Sand-Like	0.64	0.75	No Liquefaction	0.19	36.0			0.00		0.00
20	86.5	22.3	43.3	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
21	91.5	17.3	42.0	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
22	106.5	2.3	37.9	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
23	111.5	-2.7	28.6	SM	SSL	Sand-Like	0.50	0.75	No Liquefaction	0.19	36.0			0.00		0.00

1.91	**2.73**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-2	Design EQ =	SEE	No. of Soil Layers =	13 each
Boring Station =	5949+65.00	Site Class =	D	No. of Split Spoon Samples =	23 each
Boring Offset =	9 ft RT	PGA (g) =	0.43	Total Profile Thickness =	112 feet
Ground Elevation at Boring (ft msl) =	108.8	M_W =	7.37		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	108.8	$D_{a5\text{-}95}$ (sec) =	30.15		

																		Total Soil Shear Strengths						Effective Soil Shear Strengths			
																		Short Term Loading				Cyclic Loading		Long Term Loading			
																		Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																		ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	108.8	0.0																								
1	2.5	106.3	131.5	5.0	6.6	8.4	10.5	1	SM	Sand-Like	Full Liquefaction	37.8	12.0	7.0	15.0			31		31		6		31			
2	5.5	103.3	297.8	13.0	17.1	22.6	22.6	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP			39		32		32		32			
3	7.5	101.3	413	32.0	42.1	50.0	46.0	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP			45		32		32		32			
4	9.5	99.3	519.7	16.0	21.1	30.4	33.4	3	SM	Sand-Like	No Liquefaction		14.2	7.0	15.0			42		36		36		36			
5	11.5	97.3	616.4	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		55.1	3.0	30.0			45		30		30		30			
6	16.5	92.3	881.9	50.0	50.0	50.0	46.0	5	SC	NS Clay-Like	No Strength Loss		46.7	12.0	35.0				7500		1740		1740			27	
7	20.4	88.4	1087.04	50.0	50.0	50.0	46.0	6	SM	Sand-Like	No Liquefaction		39.2	1.0	31.0			45		36		36		36			
8	26.5	82.3	1407.9	18.0	23.7	27.5	33.0	6	SM	Sand-Like	No Liquefaction		39.2	1.0	31.0			41		36		36		36			
9	31.5	77.3	1670.9	17.0	22.4	24.1	29.6	6	SM	Sand-Like	No Liquefaction	69.8	39.2	1.0	31.0			39		36		36		36			
10	36.5	72.3	1933.9	21.0	27.7	28.1	33.6	7	SM	Sand-Like	No Liquefaction		43.8	1.0	31.0			41		36		36		36			
11	41.5	67.3	2196.9	13.0	17.1	16.3	21.8	8	SM	Sand-Like	No Liquefaction		47.1	1.0	31.0			36		36		36		36			
12	46.5	62.3	2459.9	21.0	27.7	24.9	30.4	8	SM	Sand-Like	No Liquefaction		47.1	1.0	31.0			40		36		36		36			
13	51.5	57.3	2722.9	32.0	42.1	36.1	41.6	8	SM	Sand-Like	No Liquefaction		47.1	1.0	31.0			44		36		36		36			
14	56.5	52.3	2985.9	41.0	50.0	44.2	46.0	8	SM	Sand-Like	No Liquefaction		47.1	1.0	31.0			45		36		36		36			
15	61.5	47.3	3248.9	29.0	38.2	30.0	35.5	9	SM	Sand-Like	No Liquefaction		48.7	5.0	40.0			41		36		36		36			
16	66.5	42.3	3511.9	39.0	50.0	38.8	44.3	9	SM	Sand-Like	No Liquefaction		48.7	5.0	40.0			44		36		36		36			
17	71.5	37.3	3774.9	50.0	50.0	47.9	46.0	10	SM	Sand-Like	No Liquefaction		23.0	NP	NP			45		36		36		36			
18	76.5	32.3	4055.4	17.0	22.4	15.7	16.1	11	SP-SM	Sand-Like	Full Liquefaction	69.8	7.9	NP	NP			36		36		16		36			
19	81.5	27.3	4343.4	30.0	39.5	26.8	26.8	12	SW-SM	Sand-Like	No Liquefaction	92.7	5.0	4.0	10.0			40		36		36		36			
20	86.5	22.3	4631.4	50.0	50.0	43.3	43.3	12	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0			45		36		36		36			
21	91.5	17.3	4919.4	50.0	50.0	42.0	42.0	12	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0			45		36		36		36			
22	106.5	2.3	5783.4	49.0	50.0	37.9	37.9	12	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0			44		36		36		36			
23	111.5	-2.7	6053.9	35.0	46.1	26.5	28.6	13	SM	Sand-Like	No Liquefaction	100.1	12.0	7.0	15.0			40		36		36		36			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake; M_w & R = Deaggregation Analysis
R =	**63.5**	**64.2**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity; $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0
$D_{a5\text{-}95}$	30.15	30.09	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-3	No. of Soil Layers =	10	each	Hammer Type =	Automatic
Boring Station =	5950+02.00	No. of Split Spoon Samples =	23	each	Energy Ratio =	79
Boring Offset =	3 ft RT	Total Profile Thickness =	102	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	108.5	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	3.3	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	105.2	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	108.5														
1	2.5	106.0	5.0	1.32	1.00	0.75	1.00	300.0	1.70	0.5	0.0	6.6	8.4	8.4	1	SP
2	5.5	103.0	12.0	1.32	1.00	0.78	1.00	522.7	1.70	0.5	0.0	15.8	20.9	20.9	1	SP
3	7.5	101.0	18.0	1.32	1.00	0.82	1.00	637.9	1.70	0.0	0.0	23.7	32.9	32.9	1	SP
4	9.5	99.0	12.0	1.32	1.00	0.85	1.00	753.1	1.63	0.0	0.0	15.8	21.9	21.9	1	SP
5	11.5	97.0	42.0	1.32	1.00	0.88	1.00	848.3	1.00	51.9	5.5	50.0	48.5	46.0	2	ML
6	16.5	92.0	36.0	1.32	1.00	0.93	1.00	1,086.3	1.00	55.2	5.5	47.4	44.0	46.0	3	ML
7	20.3	88.2	50.0	1.32	1.00	0.95	1.00	1,271.2	1.25	43.6	5.5	50.0	50.0	46.0	4	SM
8	26.5	82.0	11.0	1.32	1.00	0.98	1.00	1,597.3	1.12	43.6	5.5	14.5	15.8	21.3	4	SM
9	31.5	77.0	17.0	1.32	1.00	0.99	1.00	1,860.3	1.04	43.6	5.5	22.4	22.9	28.4	4	SM
10	36.5	72.0	13.0	1.32	1.00	1.00	1.00	2,123.3	0.97	47.3	5.5	17.1	16.6	22.1	5	SM
11	41.5	67.0	18.0	1.32	1.00	1.00	1.00	2,386.3	0.92	47.3	5.5	23.7	21.7	27.2	5	SM
12	46.5	62.0	13.0	1.32	1.00	1.00	1.00	2,649.3	0.87	47.3	5.5	17.1	14.9	20.4	5	SM
13	51.5	57.0	23.0	1.32	1.00	1.00	1.00	2,912.3	0.83	47.3	5.5	30.3	25.1	30.6	5	SM
14	56.5	52.0	15.0	1.32	1.00	1.00	1.00	3,175.3	0.79	47.3	5.5	19.8	15.7	21.2	6	SM
15	61.5	47.0	1.0	1.32	1.00	1.00	1.00	3,438.3	0.76	28.0	5.3	1.3	1.0	6.3	7	SM
16	66.5	42.0	1.0	1.32	1.00	1.00	1.00	3,717.3	0.73	0.0	0.0	1.3	1.0	1.0	8	SW
17	71.5	37.0	1.0	1.32	1.00	1.00	1.00	4,005.3	0.71	0.0	0.0	1.3	0.9	0.9	8	SW
18	76.5	32.0	1.0	1.32	1.00	1.00	1.00	4,293.3	0.68	0.0	0.0	1.3	0.9	0.9	8	SW
19	81.5	27.0	26.0	1.32	1.00	1.00	1.00	4,581.3	0.66	5.7	0.0	34.2	22.6	22.6	9	SW-SM
20	86.5	22.0	46.0	1.32	1.00	1.00	1.00	4,869.3	0.64	5.7	0.0	50.0	38.8	38.8	9	SW-SM
21	91.5	17.0	30.0	1.32	1.00	1.00	1.00	5,157.3	0.62	5.7	0.0	39.5	24.6	24.6	9	SW-SM
22	96.5	12.0	48.0	1.32	1.00	1.00	1.00	5,445.3	0.61	5.7	0.0	50.0	38.3	38.3	9	SW-SM
23	101.5	7.0	26.0	1.32	1.00	1.00	1.00	5,725.8	0.59	42.6	5.5	34.2	20.2	25.7	10	SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-3	**No. of Soil Layers =**	10 each
Boring Station =	5950+02.00	**No. of Split Spoon Samples =**	23 each
Boring Offset =	3 ft RT	**Total Profile Thickness =**	102 feet
Ground Elevation at Boring (ft msl) =	108.5		
Water Table Depth (Dw) (ft) =	3.3		
Water Table Elevation (msl ft) =	105.2		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	108.5														
1	2.5	106.0	5.0	8.4	1	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.5	4.5	NP	NP	NP
2	5.5	103.0	12.0	20.9	1	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.5	4.5	NP	NP	NP
3	7.5	101.0	18.0	32.9	1	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
4	9.5	99.0	12.0	21.9	1	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
5	11.5	97.0	42.0	46.0	2	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.9	30.2	36	29	7
6	16.5	92.0	36.0	46.0	3	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	55.2	30.2	36	29	7
7	20.3	88.2	50.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	43.6	37.9	36	33	3
8	26.5	82.0	11.0	21.3	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	43.6	37.9	36	33	3
9	31.5	77.0	17.0	28.4	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	43.6	37.9	36	33	3
10	36.5	72.0	13.0	22.1	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.3	46.7	36	33	3
11	41.5	67.0	18.0	27.2	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.3	46.7	36	33	3
12	46.5	62.0	13.0	20.4	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.3	46.7	36	33	3
13	51.5	57.0	23.0	30.6	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.3	46.7	36	33	3
14	56.5	52.0	15.0	21.2	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.3	46.7	36	33	3
15	61.5	47.0	1.0	6.3	7	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	28.0	35.9	NP	NP	NP
16	66.5	42.0	1.0	1.0	8	SW	120.0	Paleogene	Eocene	Congaree Formation	2.10	0.0	20	NP	NP	NP
17	71.5	37.0	1.0	0.9	8	SW	120.0	Paleogene	Eocene	Congaree Formation	2.10	0.0	20	NP	NP	NP
18	76.5	32.0	1.0	0.9	8	SW	120.0	Paleogene	Eocene	Congaree Formation	2.10	0.0	20	NP	NP	NP
19	81.5	27.0	26.0	22.6	9	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.7	19.7	NP	NP	NP
20	86.5	22.0	46.0	38.8	9	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.7	19.7	NP	NP	NP
21	91.5	17.0	30.0	24.6	9	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.7	19.7	NP	NP	NP
22	96.5	12.0	48.0	38.3	9	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.7	19.7	NP	NP	NP
23	101.5	7.0	26.0	25.7	10	SM	115.0	Paleogene	Eocene	Subcongaree Formation	2.10	42.6	38.9	15	8	7

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**		

Designer: **G. Burnworth - GSE**
Date: **3/9/2016**

Boring Number =	**B-3**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**0.0**
Boring Station =	**595002**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**3 ft RT**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**108.5**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**3.3**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**105.2**	**D_{a5-95} (sec) =**	**30.15**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	108.5														
1	2.5	106.0	8.4	SP	SSL	Sand-Like	3.98	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.25	11.25	1.24	19.22
2	5.5	103.0	20.9	SP	NSL-S	Sand-Like			No Liquefaction		32.0			10.00		17.99
3	7.5	101.0	32.9	SP	NSL-S	Sand-Like			No Liquefaction		32.0			10.00		17.99
4	9.5	99.0	21.9	SP	NSL-S	Sand-Like			No Liquefaction		32.0			10.00		17.99
5	11.5	97.0	46.0	ML	PSL	NS Clay-Like	0.32	0.90	No Strength Loss			1730.0		10.00		17.99
6	16.5	92.0	46.0	ML	PSL	NS Clay-Like	0.40	0.90	No Strength Loss			1790.0		10.00		17.99
7	20.3	88.2	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			10.00		17.99
8	26.5	82.0	21.3	SM	NSL-S	Sand-Like			No Liquefaction		36.0			10.00		17.99
9	31.5	77.0	28.4	SM	SSL	Sand-Like	0.61	0.75	No Liquefaction	0.19	36.0			10.00		17.99
10	36.5	72.0	22.1	SM	NSL-S	Sand-Like			No Liquefaction		36.0			10.00		17.99
11	41.5	67.0	27.2	SM	SSL	Sand-Like	0.68	0.75	No Liquefaction	0.19	36.0			10.00		17.99
12	46.5	62.0	20.4	SM	NSL-S	Sand-Like			No Liquefaction		35.0			10.00		17.99
13	51.5	57.0	30.6	SM	NSL-S	Sand-Like			No Liquefaction		36.0			10.00		17.99
14	56.5	52.0	21.2	SM	NSL-S	Sand-Like			No Liquefaction		36.0			10.00		17.99
15	61.5	47.0	6.3	SM	SSL	Sand-Like	2.32	0.90	Full Liquefaction	0.70 - 1.00	4.0		2.50	10.00	2.86	17.99
16	66.5	42.0	1.0	SW	SSL	Sand-Like	3.25	0.90	Full Liquefaction	0.70 - 1.00	2.0		2.50	7.50	5.01	15.13
17	71.5	37.0	0.9	SW	SSL	Sand-Like	3.17	0.90	Full Liquefaction	0.70 - 1.00	2.0		2.50	5.00	5.04	10.12
18	76.5	32.0	0.9	SW	SSL	Sand-Like	3.10	0.90	Full Liquefaction	0.70 - 1.00	2.0		2.50	2.50	5.07	5.07
19	81.5	27.0	22.6	SW-SM	NSL-S	Sand-Like			No Liquefaction		38.0			0.00		0.00
20	86.5	22.0	38.8	SW-SM	NSL-S	Sand-Like			No Liquefaction		38.0			0.00		0.00
21	91.5	17.0	24.6	SW-SM	SSL	Sand-Like	0.74	0.75	No Liquefaction	0.19	38.0			0.00		0.00
22	96.5	12.0	38.3	SW-SM	NSL-S	Sand-Like			No Liquefaction		38.0			0.00		0.00
23	101.5	7.0	25.7	SM	NSL-C				No Strength Loss			2570.0		0.00		0.00
													11.25		**19.22**	
													LDI Total (feet)		**S Total (inches)**	

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-3	Design EQ =	SEE	No. of Soil Layers =	10 each
Boring Station =	5950+02.00	Site Class =	D	No. of Split Spoon Samples =	23 each
Boring Offset =	3 ft RT	PGA (g) =	0.43	Total Profile Thickness =	102 feet
Ground Elevation at Boring (ft msl) =	108.5	M_W =	7.37		
Water Table Depth (Dw) (ft) =	3.3	R (km) =	0		
Water Table Elevation (msl ft) =	105.2	$D_{a5\text{-}95}$ (sec) =	30.15		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	
	0	108.5	0.0																							
1	2.5	106.0	300	5.0	6.6	8.4	8.4	1	SP	Sand-Like	Full Liquefaction	37.8	0.5	NP	NP				31		31		5		31			
2	5.5	103.0	522.72	12.0	15.8	20.9	20.9	1	SP	Sand-Like	No Liquefaction		0.5	NP	NP				38		32		32		32			
3	7.5	101.0	637.92	18.0	23.7	32.9	32.9	1	SP	Sand-Like	No Liquefaction		0.0	NP	NP				43		32		32		32			
4	9.5	99.0	753.12	12.0	15.8	21.9	21.9	1	SP	Sand-Like	No Liquefaction		0.0	NP	NP				38		32		32		32			
5	11.5	97.0	848.32	42.0	50.0	48.5	46.0	2	ML	NS Clay-Like	No Strength Loss		51.9	7.0	36.0					3750		1730		1730		30		
6	16.5	92.0	1086.32	36.0	47.4	44.0	46.0	3	ML	NS Clay-Like	No Strength Loss		55.2	7.0	36.0					3555		1790		1790		30		
7	20.3	88.2	1271.2	50.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		43.6	3.0	36.0				45		36		36		36			
8	26.5	82.0	1597.32	11.0	14.5	15.8	21.3	4	SM	Sand-Like	No Liquefaction		43.6	3.0	36.0				36		36		36		36			
9	31.5	77.0	1860.32	17.0	22.4	22.9	28.4	4	SM	Sand-Like	No Liquefaction	69.8	43.6	3.0	36.0				39		36		36		36			
10	36.5	72.0	2123.32	13.0	17.1	16.6	22.1	5	SM	Sand-Like	No Liquefaction		47.3	3.0	36.0				36		36		36		36			
11	41.5	67.0	2386.32	18.0	23.7	21.7	27.2	5	SM	Sand-Like	No Liquefaction	71.8	47.3	3.0	36.0				38		36		36		36			
12	46.5	62.0	2649.32	13.0	17.1	14.9	20.4	5	SM	Sand-Like	No Liquefaction		47.3	3.0	36.0				35		35		35		35			
13	51.5	57.0	2912.32	23.0	30.3	25.1	30.6	5	SM	Sand-Like	No Liquefaction		47.3	3.0	36.0				40		36		36		36			
14	56.5	52.0	3175.32	15.0	19.8	15.7	21.2	6	SM	Sand-Like	No Liquefaction		47.3	3.0	36.0				36		36		36		36			
15	61.5	47.0	3438.32	1.0	1.3	1.0	6.3	7	SM	Sand-Like	Full Liquefaction	16.9	28.0	NP	NP				24		24		4		24			
16	66.5	42.0	3717.32	1.0	1.3	1.0	1.0	8	SW	Sand-Like	Full Liquefaction	16.9	0.0	NP	NP				24		24		2		24			
17	71.5	37.0	4005.32	1.0	1.3	0.9	0.9	8	SW	Sand-Like	Full Liquefaction	16.9	0.0	NP	NP				24		24		2		24			
18	76.5	32.0	4293.32	1.0	1.3	0.9	0.9	8	SW	Sand-Like	Full Liquefaction	16.9	0.0	NP	NP				24		24		2		24			
19	81.5	27.0	4581.32	26.0	34.2	22.6	22.6	9	SW-SM	Sand-Like	No Liquefaction		5.7	NP	NP				39		38		38		38			
20	86.5	22.0	4869.32	46.0	50.0	38.8	38.8	9	SW-SM	Sand-Like	No Liquefaction		5.7	NP	NP				44		38		38		38			
21	91.5	17.0	5157.32	30.0	39.5	24.6	24.6	9	SW-SM	Sand-Like	No Liquefaction	92.7	5.7	NP	NP				39		38		38		38			
22	96.5	12.0	5445.32	48.0	50.0	38.3	38.3	9	SW-SM	Sand-Like	No Liquefaction		5.7	NP	NP				44		38		38		38			
23	101.5	7.0	5725.82	26.0	34.2	20.2	25.7	10	SM		No Strength Loss		42.6	7.0	15.0					2568		2570		2570		30		

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	**0.490**	**0.180**	g
k_{max} = **PGA =**	**0.430**	**0.200**	g
β = S_{D1}/PGA =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	**7.37**	**7.36**	
R =	**63.5**	**64.2**	km
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec
Z_{HR} =	**494.5**	**494.5**	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \le \beta \le 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20ft$ $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-3A	No. of Soil Layers =	14	each	Hammer Type = Safety
Boring Station =	5950+10.72	No. of Split Spoon Samples =	36	each	Energy Ratio = 76
Boring Offset =	6.25 LT	Total Profile Thickness =	120	feet	Energy Correction (C_E) = 1.27
Ground Elevation at Boring (ft msl) =	109.1	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	0	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	109.1	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	109.1														
1	2	107.1	1.0	1.27	1.00	0.75	1.00	95.2	1.00	51.0	5.5	1.3	1.0	6.5	1	CL
2	4	105.1	3.0	1.27	1.00	0.75	1.00	190.4	1.00	51.0	5.5	3.8	2.9	8.4	1	CL
3	6	103.1	9.0	1.27	1.00	0.79	1.00	310.6	1.70	0.0	0.0	11.5	15.3	15.3	2	SP
4	8	101.1	27.0	1.27	1.00	0.83	1.00	425.8	1.70	0.0	0.0	34.4	48.2	46.0	3	SP
5	10	99.1	17.0	1.27	1.00	0.86	1.00	541.0	1.70	0.0	0.0	21.6	31.5	31.5	3	SP
6	15	94.1	40.0	1.27	1.00	0.91	1.00	802.0	1.00	53.1	5.5	50.0	46.6	46.0	4	ML
7	20	89.1	50.0	1.27	1.00	0.95	1.00	1,053.5	1.38	42.8	5.5	50.0	50.0	46.0	5	SC
8	25	84.1	27.0	1.27	1.00	0.97	1.00	1,303.0	1.00	63.3	5.5	34.4	33.4	38.9	6	ML
9	30	79.1	27.0	1.27	1.00	0.98	1.00	1,541.0	1.00	63.3	5.5	34.4	33.8	39.3	6	ML
10	35	74.1	36.0	1.27	1.00	1.00	1.00	1,779.0	1.00	63.3	5.5	45.8	45.8	46.0	6	ML
11	40	69.1	27.0	1.27	1.00	1.00	1.00	2,017.0	1.00	63.3	5.5	34.4	34.4	39.9	6	ML
12	45	64.1	16.0	1.27	1.00	1.00	1.00	2,255.0	1.00	63.3	5.5	20.4	20.4	25.9	6	ML
13	50	59.1	41.0	1.27	1.00	1.00	1.00	2,493.0	1.00	68.3	5.5	50.0	50.0	46.0	6	ML
14	52	57.1	47.0	1.27	1.00	1.00	1.00	2,588.2	1.00	68.3	5.5	50.0	50.0	46.0	6	ML
15	54	55.1	50.0	1.27	1.00	1.00	1.00	2,683.4	1.00	68.3	5.5	50.0	50.0	46.0	6	ML
16	56	53.1	50.0	1.27	1.00	1.00	1.00	2,778.6	1.00	68.3	5.5	50.0	50.0	46.0	6	ML
17	58	51.1	45.0	1.27	1.00	1.00	1.00	2,873.8	1.00	68.3	5.5	50.0	50.0	46.0	6	ML
18	60	49.1	2.0	1.27	1.00	1.00	1.00	2,969.0	1.00	60.1	5.5	2.5	2.5	8.0	7	MH
19	62	47.1	3.0	1.27	1.00	1.00	1.00	3,064.2	1.00	60.1	5.5	3.8	3.8	9.3	7	MH
20	64	45.1	1.0	1.27	1.00	1.00	1.00	3,159.4	1.00	64.0	5.5	1.3	1.3	6.8	7	MH
21	66	43.1	1.0	1.27	1.00	1.00	1.00	3,254.6	1.00	64.0	5.5	1.3	1.3	6.8	7	MH
22	68	41.1	1.0	1.27	1.00	1.00	1.00	3,349.8	1.00	62.8	5.5	1.3	1.3	6.8	7	MH
23	70	39.1	2.0	1.27	1.00	1.00	1.00	3,455.0	0.76	41.0	5.5	2.5	1.9	7.4	8	SM
24	72	37.1	3.0	1.27	1.00	1.00	1.00	3,560.2	0.75	39.7	5.5	3.8	2.9	8.4	8	SM
25	74	35.1	3.0	1.27	1.00	1.00	1.00	3,665.4	0.74	32.8	5.5	3.8	2.8	8.3	8	SM
26	76	33.1	19.0	1.27	1.00	1.00	1.00	3,780.6	0.73	10.4	1.3	24.2	17.6	18.9	9	SW-SM
27	78	31.1	9.0	1.27	1.00	1.00	1.00	3,895.8	0.72	10.4	1.3	11.5	8.2	9.5	9	SW-SM
28	80	29.1	50.0	1.27	1.00	1.00	1.00	4,001.0	0.71	19.9	4.5	50.0	45.0	46.0	10	SM
29	85	24.1	50.0	1.27	1.00	1.00	1.00	4,264.0	0.68	12.0	2.1	50.0	43.6	45.7	11	SM
30	90	19.1	50.0	1.27	1.00	1.00	1.00	4,527.0	0.66	12.0	2.1	50.0	42.3	44.4	11	SM
31	95	14.1	50.0	1.27	1.00	1.00	1.00	4,790.0	0.65	12.0	2.1	50.0	41.1	43.2	11	SM
32	100	9.1	50.0	1.27	1.00	1.00	1.00	5,053.0	0.63	12.0	2.1	50.0	40.1	42.1	11	SM
33	105	4.1	50.0	1.27	1.00	1.00	1.00	5,300.0	1.00	51.0	5.5	50.0	50.0	46.0	12	CL
34	110	-0.9	50.0	1.27	1.00	1.00	1.00	5,570.0	0.60	5.0	0.0	50.0	38.2	38.2	13	SP-SM
35	115	-5.9	50.0	1.27	1.00	1.00	1.00	5,841.0	1.00	80.0	5.5	50.0	50.0	46.0	14	MH
36	120	-10.9	50.0	1.27	1.00	1.00	1.00	6,079.0	1.00	80.0	5.5	50.0	50.0	46.0	14	MH

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-3A	**No. of Soil Layers =**	14	each
Boring Station =	5950+10.72	**No. of Split Spoon Samples =**	36	each
Boring Offset =	6.25 LT	**Total Profile Thickness =**	120	feet
Ground Elevation at Boring (ft msl) =	109.1			
Water Table Depth (Dw) (ft) =	0			
Water Table Elevation (msl ft) =	109.1			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	109.1														
1	2	107.1	1.0	6.5	1	CL	110.0	Quaternary	Holocene	Alluvium	1.20	51.0		30	10	20
2	4	105.1	3.0	8.4	1	CL	110.0	Quaternary	Holocene	Alluvium	1.20	51.0		30	10	20
3	6	103.1	9.0	15.3	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
4	8	101.1	27.0	46.0	3	SP	120.0	Quaternary	Holocene	Alluvium	1.00	0.0		NP	NP	NP
5	10	99.1	17.0	31.5	3	SP	120.0	Quaternary	Holocene	Alluvium	1.00	0.0		NP	NP	NP
6	15	94.1	40.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	53.1	33.3	35	24	11
7	20	89.1	50.0	46.0	5	SC	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.8	29.6	29	18	11
8	25	84.1	27.0	38.9	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	63.3	43.6	35	29	6
9	30	79.1	27.0	39.3	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	63.3	43.6	35	29	6
10	35	74.1	36.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	63.3	43.6	35	29	6
11	40	69.1	27.0	39.9	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	63.3	43.6	35	29	6
12	45	64.1	16.0	25.9	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	63.3	43.6	35	29	6
13	50	59.1	41.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.3	39.6	41	33	8
14	52	57.1	47.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.3	39.6	41	33	8
15	54	55.1	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.3	39.6	41	33	8
16	56	53.1	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.3	39.6	41	33	8
17	58	51.1	45.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.3	39.6	41	33	8
18	60	49.1	2.0	8.0	7	MH	110.0	Paleogene	Eocene	Congaree Formation	1.00	60.1	316.1	135	133	2
19	62	47.1	3.0	9.3	7	MH	110.0	Paleogene	Eocene	Congaree Formation	1.00	60.1	316.1	135	133	2
20	64	45.1	1.0	6.8	7	MH	110.0	Paleogene	Eocene	Congaree Formation	1.00	64.0	376.9	113	102	11
21	66	43.1	1.0	6.8	7	MH	110.0	Paleogene	Eocene	Congaree Formation	1.00	64.0	376.9	113	102	11
22	68	41.1	1.0	6.8	7	MH	110.0	Paleogene	Eocene	Congaree Formation	1.00	62.8	336.3	111	101	10
23	70	39.1	2.0	7.4	8	SM	115.0	Paleogene	Eocene	Congaree Formation	1.00	41.0	316.1	99	92	7
24	72	37.1	3.0	8.4	8	SM	115.0	Paleogene	Eocene	Congaree Formation	1.00	39.7	305.5	90	86	4
25	74	35.1	3.0	8.3	8	SM	115.0	Paleogene	Eocene	Congaree Formation	1.00	32.8	266.5	75	66	9
26	76	33.1	19.0	18.9	9	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	10.4	42.6	NP	NP	NP
27	78	31.1	9.0	9.5	9	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	10.4	42.6	NP	NP	NP
28	80	29.1	50.0	46.0	10	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	19.9	25	NP	NP	NP
29	85	24.1	50.0	45.7	11	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	12.0		15	8	7
30	90	19.1	50.0	44.4	11	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	12.0		15	8	7
31	95	14.1	50.0	43.2	11	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	12.0		15	8	7
32	100	9.1	50.0	42.1	11	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	12.0		15	8	7
33	105	4.1	50.0	46.0	12	CL	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	51.0		30	10	20
34	110	-0.9	50.0	38.2	13	SP-SM	120.0	Paleogene	Eocene	Subcongaree Formation	2.10	5.0	30.3	NP	NP	NP
35	115	-5.9	50.0	46.0	14	MH	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	80.0		75	55	20
36	120	-10.9	50.0	46.0	14	MH	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	80.0		75	55	20

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-3A	Design EQ =	SEE	SSL Water Table Depth (ft) =	0.0
Boring Station =	595010.72	Site Class =	D	SSL Water Table Elev. (msl ft) =	110.0
Boring Offset =	6.25 LT	PGA (g) =	0.43		
Ground Elevation at Boring (ft msl) =	109.1	M_W =	7.4		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	109.1	D_{a5-95} (sec) =	30.15		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	109.1														
1	2.0	107.1	6.5	CL	PSL	NS Clay-Like	0.35	0.90	No Strength Loss			200.0		4.53		4.54
2	4.0	105.1	8.4	CL	PSL	NS Clay-Like	0.23	0.90	No Strength Loss			600.0		4.53		4.54
3	6.0	103.1	15.3	SP	SSL	Sand-Like	2.81	0.90	Full Liquefaction	0.70 - 1.00	13.0		0.53	4.53	0.68	4.54
4	8.0	101.1	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			4.00		3.86
5	10.0	99.1	31.5	SP	NSL-S	Sand-Like			No Liquefaction		32.0			4.00		3.86
6	15.0	94.1	46.0	ML	PSL	NS Clay-Like	0.31	0.90	No Strength Loss			1710.0		4.00		3.86
7	20.0	89.1	46.0	SC	PSL	NS Clay-Like	0.39	0.90	No Strength Loss			1780.0		4.00		3.86
8	25.0	84.1	38.9	ML	NSL-S	Sand-Like			No Liquefaction		30.0			4.00		3.86
9	30.0	79.1	39.3	ML	NSL-S	Sand-Like			No Liquefaction		30.0			4.00		3.86
10	35.0	74.1	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			4.00		3.86
11	40.0	69.1	39.9	ML	NSL-S	Sand-Like			No Liquefaction		30.0			4.00		3.86
12	45.0	64.1	25.9	ML	NSL-S	Sand-Like			No Liquefaction		30.0			4.00		3.86
13	50.0	59.1	46.0	ML	PSL	NS Clay-Like	0.77	0.90	No Strength Loss			2170.0		4.00		3.86
14	52.0	57.1	46.0	ML	PSL	NS Clay-Like	0.80	0.90	No Strength Loss			2190.0		4.00		3.86
15	54.0	55.1	46.0	ML	PSL	NS Clay-Like	0.82	0.90	No Strength Loss			2220.0		4.00		3.86
16	56.0	53.1	46.0	ML	PSL	NS Clay-Like	0.84	0.90	No Strength Loss			2240.0		4.00		3.86
17	58.0	51.1	46.0	ML	PSL	NS Clay-Like	0.85	0.90	No Strength Loss			2270.0		4.00		3.86
18	60.0	49.1	8.0	MH	SSL	Sand-Like	4.53	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.00	4.00	1.01	3.86
19	62.0	47.1	9.3	MH	SSL	Sand-Like	4.16	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.00	3.00	0.93	2.85
20	64.0	45.1	6.8	MH	PSL	NS Clay-Like	6.31	0.90	Strength Loss			240.0		2.00		1.91
21	66.0	43.1	6.8	MH	PSL	NS Clay-Like	6.44	0.90	Strength Loss			240.0		2.00		1.91
22	68.0	41.1	6.8	MH	PSL	NS Clay-Like	6.57	0.90	Strength Loss			240.0		2.00		1.91
23	70.0	39.1	7.4	SM	PSL	NS Clay-Like	6.71	0.90	Strength Loss			240.0		2.00		1.91
24	72.0	37.1	8.4	SM	SSL	Sand-Like	4.20	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.00	2.00	0.99	1.91
25	74.0	35.1	8.3	SM	PSL	NS Clay-Like	6.99	0.90	Strength Loss			240.0		1.00		0.92
26	76.0	33.1	18.9	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			1.00		0.92
27	78.0	31.1	9.5	SW-SM	SSL	Sand-Like	1.83	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.00	1.00	0.92	0.92
28	80.0	29.1	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
29	85.0	24.1	45.7	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
30	90.0	19.1	44.4	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
31	95.0	14.1	43.2	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
32	100.0	9.1	42.1	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
33	105.0	4.1	46.0	CL	PSL	NS Clay-Like	0.88	0.90	No Strength Loss			4000.0		0.00		0.00
34	110.0	-0.9	38.2	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
35	115.0	-5.9	46.0	MH	NSL-C				No Strength Loss			3070.0		0.00		0.00
36	120.0	-10.9	46.0	MH	NSL-C				No Strength Loss			3130.0		0.00		0.00
													4.53		4.54	
													LDI Total (feet)		S Total (inches)	

[D]Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-3A	Design EQ =	SEE	No. of Soil Layers =	14 each
Boring Station =	5950+10.72	Site Class =	D	No. of Split Spoon Samples =	36 each
Boring Offset =	6.25 LT	PGA (g) =	0.43	Total Profile Thickness =	120 feet
Ground Elevation at Boring (ft msl) =	109.1	M_W =	7.37		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	109.1	$D_{a5\text{-}95}$ (sec) =	30.15		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																			Short Term Loading				Cyclic Loading		Long Term Loading			
																			Correlated Static		Static		Seismic		Static			
																			Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																			ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	109.1	0.0																									
1	2	107.1	95.2	1.0	1.3	1.0	6.5	1	CL	NS Clay-Like	No Strength Loss		51.0	20.0	30.0					191		200		200		5	26	20
2	4	105.1	190.4	3.0	3.8	2.9	8.4	1	CL	NS Clay-Like	No Strength Loss		51.0	20.0	30.0					573		600		600		7	26	60
3	6	103.1	310.6	9.0	11.5	15.3	15.3	2	SP	Sand-Like	Full Liquefaction	49.9	0.0	NP	NP				35		32		13		32			
4	8	101.1	425.8	27.0	34.4	48.2	46.0	3	SP	Sand-Like	No Liquefaction		0.0	NP	NP				45		32		32		32			
5	10	99.1	541	17.0	21.6	31.5	31.5	3	SP	Sand-Like	No Liquefaction		0.0	NP	NP				42		32		32		32			
6	15	94.1	802	40.0	50.0	46.6	46.0	4	ML	NS Clay-Like	No Strength Loss		53.1	11.0	35.0					7500		1710		1710			28	
7	20	89.1	1053.5	50.0	50.0	50.0	46.0	5	SC	NS Clay-Like	No Strength Loss		42.8	11.0	29.0					7500		1780		1780			28	
8	25	84.1	1303	27.0	34.4	33.4	38.9	6	ML	Sand-Like	No Liquefaction		63.3	6.0	35.0				43		30		30		30			
9	30	79.1	1541	27.0	34.4	33.8	39.3	6	ML	Sand-Like	No Liquefaction		63.3	6.0	35.0				43		30		30		30			
10	35	74.1	1779	36.0	45.8	45.8	46.0	6	ML	Sand-Like	No Liquefaction		63.3	6.0	35.0				45		30		30		30			
11	40	69.1	2017	27.0	34.4	34.4	39.9	6	ML	Sand-Like	No Liquefaction		63.3	6.0	35.0				43		30		30		30			
12	45	64.1	2255	16.0	20.4	20.4	25.9	6	ML	Sand-Like	No Liquefaction		63.3	6.0	35.0				38		30		30		30			
13	50	59.1	2493	41.0	50.0	50.0	46.0	6	ML	NS Clay-Like	No Strength Loss		68.3	8.0	41.0					3750		2170		2170			29	
14	52	57.1	2588.2	47.0	50.0	50.0	46.0	6	ML	NS Clay-Like	No Strength Loss		68.3	8.0	41.0					3750		2190		2190			29	
15	54	55.1	2683.4	50.0	50.0	50.0	46.0	6	ML	NS Clay-Like	No Strength Loss		68.3	8.0	41.0					3750		2220		2220			29	
16	56	53.1	2778.6	50.0	50.0	50.0	46.0	6	ML	NS Clay-Like	No Strength Loss		68.3	8.0	41.0					3750		2240		2240			29	
17	58	51.1	2873.8	45.0	50.0	50.0	46.0	6	ML	NS Clay-Like	No Strength Loss		68.3	8.0	41.0					3750		2270		2270			29	
18	60	49.1	2969	2.0	2.5	2.5	8.0	7	MH	Sand-Like	Full Liquefaction	23.5	60.1	2.0	135.0				26		26		5		26	#VALUE!		######
19	62	47.1	3064.2	3.0	3.8	3.8	9.3	7	MH	Sand-Like	Full Liquefaction	28.8	60.1	2.0	135.0				28		28		5		28	#VALUE!		######
20	64	45.1	3159.4	1.0	1.3	1.3	6.8	7	MH	NS Clay-Like	Strength Loss		64.0	11.0	113.0					191		300		240		0	28	
21	66	43.1	3254.6	1.0	1.3	1.3	6.8	7	MH	NS Clay-Like	Strength Loss		64.0	11.0	113.0	0.004	83.4	1.8		191		300		240		0	28	
22	68	41.1	3349.8	1.0	1.3	1.3	6.8	7	MH	NS Clay-Like	Strength Loss		62.8	10.0	111.0					**96**		300		240		0	28	
23	70	39.1	3455	2.0	2.5	1.9	7.4	8	SM	NS Clay-Like	Strength Loss		41.0	7.0	99.0	0.004	83.4	1.8		191		300		240			30	
24	72	37.1	3560.2	3.0	3.8	2.9	8.4	8	SM	Sand-Like	Full Liquefaction	28.8	39.7	4.0	90.0				27		27		5		27			
25	74	35.1	3665.4	3.0	3.8	2.8	8.3	8	SM	NS Clay-Like	Strength Loss		32.8	9.0	75.0					287		300		240			29	
26	76	33.1	3780.6	19.0	24.2	17.6	18.9	9	SW-SM	Sand-Like	No Liquefaction		10.4	NP	NP				36		36		36		36			
27	78	31.1	3895.8	9.0	11.5	8.2	9.5	9	SW-SM	Sand-Like	Full Liquefaction	49.9	10.4	NP	NP				31		31		5		31			
28	80	29.1	4001	50.0	50.0	45.0	46.0	10	SM	Sand-Like	No Liquefaction		19.9	NP	NP				45		36		36		36			
29	85	24.1	4264	50.0	50.0	43.6	45.7	11	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				45		36		36		36			
30	90	19.1	4527	50.0	50.0	42.3	44.4	11	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				45		36		36		36			
31	95	14.1	4790	50.0	50.0	41.1	43.2	11	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				45		36		36		36			
32	100	9.1	5053	50.0	50.0	40.1	42.1	11	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				45		36		36		36			
33	105	4.1	5300	50.0	50.0	50.0	46.0	12	CL	NS Clay-Like	No Strength Loss		51.0	20.0	30.0					7500		4000		4000		2	26	400
34	110	-0.9	5570	50.0	50.0	38.2	38.2	13	SP-SM	Sand-Like	No Liquefaction		5.0	NP	NP	0.107	1.7	0.9	44		36		36		36			
35	115	-5.9	5841	50.0	50.0	50.0	46.0	14	MH		No Strength Loss		80.0	20.0	75.0					7500		3070		3070		1	26	307
36	120	-10.9	6079	50.0	50.0	50.0	46.0	14	MH		No Strength Loss		80.0	20.0	75.0					7500		3130		3130		1	26	313

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	**0.490**	**0.180**	g
k_{max} = **PGA =**	**0.430**	**0.200**	g
β = S_{D1}/PGA =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	**7.37**	**7.36**	
R =	**63.5**	**64.2**	km
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec
Z_{HR} =	**494.5**	**494.5**	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \le \beta \le 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20ft$ $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-4	No. of Soil Layers =	11	each	Hammer Type = Automatic
Boring Station =	5950+42.00	No. of Split Spoon Samples =	23	each	Energy Ratio = 79
Boring Offset =	8 ft RT	Total Profile Thickness =	102	feet	Energy Correction (C_E) = 1.32
Ground Elevation at Boring (ft msl) =	107.9	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	0	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	107.9	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	107.9														
1	2.3	105.6	50.0	1.32	1.00	0.75	1.00	132.5	1.70	0.1	0.0	50.0	50.0	46.0	1	SP
2	3.3	104.6	50.0	1.32	1.00	0.75	1.00	190.1	1.70	0.1	0.0	50.0	50.0	46.0	1	SP
3	7.5	100.4	10.0	1.32	1.00	0.82	1.00	432.0	1.70	0.1	0.0	13.2	18.3	18.3	1	SP
4	9.5	98.4	8.0	1.32	1.00	0.85	1.00	547.2	1.70	0.1	0.0	10.5	15.2	15.2	1	SP
5	11.5	96.4	19.0	1.32	1.00	0.88	1.00	645.4	1.00	50.2	5.5	25.0	22.0	27.5	2	ML
6	16.5	91.4	15.0	1.32	1.00	0.93	1.00	883.4	1.00	52.4	5.5	19.8	18.3	23.8	3	ML
7	21.5	86.4	15.0	1.32	1.00	0.96	1.00	1,137.4	1.33	32.8	5.5	19.8	25.1	30.5	4	SM
8	26.5	81.4	12.0	1.32	1.00	0.98	1.00	1,400.4	1.20	49.8	5.5	15.8	18.4	23.9	5	SM
9	31.5	76.4	20.0	1.32	1.00	0.99	1.00	1,663.4	1.10	49.4	5.5	26.3	28.5	34.0	6	SM
10	36.5	71.4	21.0	1.32	1.00	1.00	1.00	1,926.4	1.02	49.4	5.5	27.7	28.2	33.7	6	SM
11	41.5	66.4	39.0	1.32	1.00	1.00	1.00	2,189.4	0.96	49.4	5.5	50.0	49.1	46.0	6	SM
12	46.5	61.4	17.0	1.32	1.00	1.00	1.00	2,452.4	0.90	49.4	5.5	22.4	20.2	25.7	6	SM
13	51.5	56.4	23.0	1.32	1.00	1.00	1.00	2,715.4	0.86	42.6	5.5	30.3	26.0	31.5	7	SM
14	56.5	51.4	36.0	1.32	1.00	1.00	1.00	2,978.4	0.82	42.6	5.5	47.4	38.8	44.3	7	SM
15	61.5	46.4	26.0	1.32	1.00	1.00	1.00	3,241.4	0.79	42.6	5.5	34.2	26.9	32.4	7	SM
16	66.5	41.4	50.0	1.32	1.00	1.00	1.00	3,504.4	0.76	33.5	5.5	50.0	49.7	46.0	8	SM
17	71.5	36.4	20.0	1.32	1.00	1.00	1.00	3,767.4	0.73	33.5	5.5	26.3	19.2	24.7	8	SM
18	76.5	31.4	35.0	1.32	1.00	1.00	1.00	4,030.4	0.70	33.5	5.5	46.1	32.5	37.9	8	SM
19	81.5	26.4	50.0	1.32	1.00	1.00	1.00	4,293.4	0.68	27.3	5.2	50.0	44.9	46.0	9	SM
20	86.5	21.4	41.0	1.32	1.00	1.00	1.00	4,568.9	0.66	5.0	0.0	50.0	35.7	35.7	10	SP-SM
21	91.5	16.4	50.0	1.32	1.00	1.00	1.00	4,856.9	0.64	5.0	0.0	50.0	42.2	42.2	11	SW-SM
22	96.5	11.4	50.0	1.32	1.00	1.00	1.00	5,144.9	0.62	5.0	0.0	50.0	41.0	41.0	11	SW-SM
23	101.5	6.4	50.0	1.32	1.00	1.00	1.00	5,432.9	0.61	5.0	0.0	50.0	39.9	39.9	11	SW-SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-4	**No. of Soil Layers =**	11	each
Boring Station =	5950+42.00	**No. of Split Spoon Samples =**	23	each
Boring Offset =	8 ft RT	**Total Profile Thickness =**	102	feet
Ground Elevation at Boring (ft msl) =	107.9			
Water Table Depth (Dw) (ft) =	0			
Water Table Elevation (msl ft) =	107.9			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	107.9														
1	2.3	105.6	50.0	46.0	1	SP	120.0	Recent	Recent	Roadway Embankment	1.00	0.1	17.2	NP	NP	NP
2	3.3	104.6	50.0	46.0	1	SP	120.0	Recent	Recent	Roadway Embankment	1.00	0.1	17.2	NP	NP	NP
3	7.5	100.4	10.0	18.3	1	SP	120.0	Recent	Recent	Roadway Embankment	1.00	0.1	17.2	NP	NP	NP
4	9.5	98.4	8.0	15.2	1	SP	120.0	Recent	Recent	Roadway Embankment	1.00	0.1	17.2	NP	NP	NP
5	11.5	96.4	19.0	27.5	2	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	50.2	34.8	35	27	8
6	16.5	91.4	15.0	23.8	3	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	52.4	34.8	35	27	8
7	21.5	86.4	15.0	30.5	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	32.8	33.2	37	34	3
8	26.5	81.4	12.0	23.9	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	49.8	33.2	37	34	3
9	31.5	76.4	20.0	34.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	49.4	43.4	37	34	3
10	36.5	71.4	21.0	33.7	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	49.4	43.4	37	34	3
11	41.5	66.4	39.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	49.4	43.4	37	34	3
12	46.5	61.4	17.0	25.7	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	49.4	43.4	37	34	3
13	51.5	56.4	23.0	31.5	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.6	36	37	34	3
14	56.5	51.4	36.0	44.3	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.6	36	37	34	3
15	61.5	46.4	26.0	32.4	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.6	36	37	34	3
16	66.5	41.4	50.0	46.0	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	33.5	33.4	36	33	3
17	71.5	36.4	20.0	24.7	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	33.5	33.4	36	33	3
18	76.5	31.4	35.0	37.9	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	33.5	33.4	36	33	3
19	81.5	26.4	50.0	46.0	9	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	27.3	22.7	33	30	3
20	86.5	21.4	41.0	35.7	10	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
21	91.5	16.4	50.0	42.2	11	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
22	96.5	11.4	50.0	41.0	11	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
23	101.5	6.4	50.0	39.9	11	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**B-4**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**0.0**
Boring Station =	**595042**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**8 ft RT**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**107.9**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**0**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**107.9**	**D_{a5-95} (sec) =**	**30.15**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\Sigma \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**ΣS_i (inches)**
	0.0	107.9														
1	2.3	105.6	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			1.35		1.93
2	3.3	104.6	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			1.35		1.93
3	7.5	100.4	18.3	SP	SSL	Sand-Like	2.71	0.90	Full Liquefaction	0.70 - 1.00	30.0		0.81	1.35	1.25	1.93
4	9.5	98.4	15.2	SP	SSL	Sand-Like	3.18	0.90	Full Liquefaction	0.70 - 1.00	13.0		0.54	0.54	0.68	0.68
5	11.5	96.4	27.5	ML	PSL	NS Clay-Like	0.25	0.90	No Strength Loss			1670.0		0.00		0.00
6	16.5	91.4	23.8	ML	PSL	NS Clay-Like	0.39	0.90	No Strength Loss			1480.0		0.00		0.00
7	21.5	86.4	30.5	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
8	26.5	81.4	23.9	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
9	31.5	76.4	34.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
10	36.5	71.4	33.7	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
11	41.5	66.4	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
12	46.5	61.4	25.7	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
13	51.5	56.4	31.5	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
14	56.5	51.4	44.3	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
15	61.5	46.4	32.4	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
16	66.5	41.4	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
17	71.5	36.4	24.7	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
18	76.5	31.4	37.9	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
19	81.5	26.4	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
20	86.5	21.4	35.7	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
21	91.5	16.4	42.2	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
22	96.5	11.4	41.0	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
23	101.5	6.4	39.9	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00

1.35	**1.93**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-4	Design EQ =	SEE	No. of Soil Layers =	11 each
Boring Station =	5950+42.00	Site Class =	D	No. of Split Spoon Samples =	23 each
Boring Offset =	8 ft RT	PGA (g) =	0.43	Total Profile Thickness =	102 feet
Ground Elevation at Boring (ft msl) =	107.9	M_W =	7.37		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	107.9	$D_{a5\text{-}95}$ (sec) =	30.15		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	
																	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	107.9	0.0																							
1	2.3	105.6	132.48	50.0	50.0	50.0	46.0	1	SP	Sand-Like	No Liquefaction		0.1	NP	NP				45		32		32		32			
2	3.3	104.6	190.08	50.0	50.0	50.0	46.0	1	SP	Sand-Like	No Liquefaction		0.1	NP	NP				45		32		32		32			
3	7.5	100.4	432	10.0	13.2	18.3	18.3	1	SP	Sand-Like	Full Liquefaction	53.5	0.1	NP	NP				37		32		30		32			
4	9.5	98.4	547.2	8.0	10.5	15.2	15.2	1	SP	Sand-Like	Full Liquefaction	47.9	0.1	NP	NP				35		32		13		32			
5	11.5	96.4	645.4	19.0	25.0	22.0	27.5	2	ML	NS Clay-Like	No Strength Loss		50.2	8.0	35.0					1876		1670		1670			29	
6	16.5	91.4	883.4	15.0	19.8	18.3	23.8	3	ML	NS Clay-Like	No Strength Loss		52.4	8.0	35.0					1481		1480		1480			29	
7	21.5	86.4	1137.4	15.0	19.8	25.1	30.5	4	SM	Sand-Like	No Liquefaction		32.8	3.0	37.0				40		36		36		36			
8	26.5	81.4	1400.4	12.0	15.8	18.4	23.9	5	SM	Sand-Like	No Liquefaction		49.8	3.0	37.0				37		36		36		36			
9	31.5	76.4	1663.4	20.0	26.3	28.5	34.0	6	SM	Sand-Like	No Liquefaction		49.4	3.0	37.0				41		36		36		36			
10	36.5	71.4	1926.4	21.0	27.7	28.2	33.7	6	SM	Sand-Like	No Liquefaction		49.4	3.0	37.0				41		36		36		36			
11	41.5	66.4	2189.4	39.0	50.0	49.1	46.0	6	SM	Sand-Like	No Liquefaction		49.4	3.0	37.0				45		36		36		36			
12	46.5	61.4	2452.4	17.0	22.4	20.2	25.7	6	SM	Sand-Like	No Liquefaction		49.4	3.0	37.0				38		36		36		36			
13	51.5	56.4	2715.4	23.0	30.3	26.0	31.5	7	SM	Sand-Like	No Liquefaction		42.6	3.0	37.0				40		36		36		36			
14	56.5	51.4	2978.4	36.0	47.4	38.8	44.3	7	SM	Sand-Like	No Liquefaction		42.6	3.0	37.0				44		36		36		36			
15	61.5	46.4	3241.4	26.0	34.2	26.9	32.4	7	SM	Sand-Like	No Liquefaction		42.6	3.0	37.0				40		36		36		36			
16	66.5	41.4	3504.4	50.0	50.0	49.7	46.0	8	SM	Sand-Like	No Liquefaction		33.5	3.0	36.0				45		36		36		36			
17	71.5	36.4	3767.4	20.0	26.3	19.2	24.7	8	SM	Sand-Like	No Liquefaction		33.5	3.0	36.0				37		36		36		36			
18	76.5	31.4	4030.4	35.0	46.1	32.5	37.9	8	SM	Sand-Like	No Liquefaction		33.5	3.0	36.0				42		36		36		36			
19	81.5	26.4	4293.4	50.0	50.0	44.9	46.0	9	SM	Sand-Like	No Liquefaction		27.3	3.0	33.0				45		36		36		36			
20	86.5	21.4	4568.9	41.0	50.0	35.7	35.7	10	SP-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				43		36		36		36			
21	91.5	16.4	4856.9	50.0	50.0	42.2	42.2	11	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				45		36		36		36			
22	96.5	11.4	5144.9	50.0	50.0	41.0	41.0	11	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				45		36		36		36			
23	101.5	6.4	5432.9	50.0	50.0	39.9	39.9	11	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				45		36		36		36			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0002	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: — $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: — $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: — $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis
R =	**63.5**	**64.2**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: — R < 20 km; ε = 0.015(R-20)
$D_{a5\text{-}95}$	30.15	30.09	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48 — R ≥ 20 km; ε = 0

SPT Correction Summary

GSE No.:	41503-0002-0002	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-5	No. of Soil Layers =	12	each	Hammer Type =	Automatic
Boring Station =	5950+98.00	No. of Split Spoon Samples =	25	each	Energy Ratio =	79
Boring Offset =	8 ft LT	Total Profile Thickness =	101	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	105.5	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	0	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	105.5	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	105.5														
1	3.5	102.0	4.0	1.32	1.00	0.75	1.00	184.1	1.70	12.0	2.1	5.3	6.7	8.8	1	SM
2	5.5	100.0	16.0	1.32	1.00	0.78	1.00	299.8	1.70	3.8	0.0	21.1	27.8	27.8	2	SW
3	7.5	98.0	7.0	1.32	1.00	0.82	1.00	398.0	1.00	59.9	5.5	9.2	7.5	13.0	3	ML
4	8.3	97.2	50.0	1.32	1.00	0.83	1.00	438.6	1.70	47.8	5.5	50.0	50.0	46.0	4	SM
5	10	95.5	50.0	1.32	1.00	0.86	1.00	528.0	1.70	47.8	5.5	50.0	50.0	46.0	4	SM
6	11	94.5	50.0	1.32	1.00	0.87	1.00	580.6	1.70	47.8	5.5	50.0	50.0	46.0	5	SM
7	16	89.5	50.0	1.32	1.00	0.92	1.00	843.6	1.54	47.8	5.5	50.0	50.0	46.0	5	SM
8	21	84.5	50.0	1.32	1.00	0.96	1.00	1,106.6	1.34	47.8	5.5	50.0	50.0	46.0	5	SM
9	26	79.5	50.0	1.32	1.00	0.97	1.00	1,369.6	1.21	47.8	5.5	50.0	50.0	46.0	5	SM
10	31	74.5	50.0	1.32	1.00	0.98	1.00	1,632.6	1.11	47.8	5.5	50.0	50.0	46.0	5	SM
11	33.9	71.6	14.0	1.32	1.00	1.00	1.00	1,785.1	1.06	41.2	5.5	18.4	19.5	25.0	6	SM
12	36.5	69.0	21.0	1.32	1.00	1.00	1.00	1,921.9	1.02	41.2	5.5	27.7	28.2	33.7	6	SM
13	41.5	64.0	30.0	1.32	1.00	1.00	1.00	2,184.9	0.96	52.3	5.5	39.5	37.8	43.3	7	SM
14	46.5	59.0	32.0	1.32	1.00	1.00	1.00	2,447.9	0.90	52.3	5.5	42.1	38.1	43.6	7	SM
15	51.5	54.0	23.0	1.32	1.00	1.00	1.00	2,644.9	1.00	50.1	5.5	30.3	30.3	35.8	8	ML
16	56.5	49.0	21.0	1.32	1.00	1.00	1.00	2,882.9	1.00	50.1	5.5	27.7	27.7	33.2	9	ML
17	61.5	44.0	23.0	1.32	1.00	1.00	1.00	3,136.9	0.80	12.0	2.1	30.3	24.2	26.3	10	SM
18	66.5	39.0	1.0	1.32	1.00	1.00	1.00	3,415.9	0.77	2.6	0.0	1.3	1.0	1.0	11	SW
19	71.5	34.0	2.0	1.32	1.00	1.00	1.00	3,703.9	0.73	2.6	0.0	2.6	1.9	1.9	11	SW
20	76.5	29.0	50.0	1.32	1.00	1.00	1.00	3,991.9	0.71	5.0	0.0	50.0	46.6	46.0	12	SW-SM
21	81.5	24.0	50.0	1.32	1.00	1.00	1.00	4,279.9	0.68	5.0	0.0	50.0	45.0	45.0	12	SW-SM
22	86.5	19.0	41.0	1.32	1.00	1.00	1.00	4,567.9	0.66	5.0	0.0	50.0	35.7	35.7	12	SW-SM
23	91.5	14.0	50.0	1.32	1.00	1.00	1.00	4,855.9	0.64	5.0	0.0	50.0	42.2	42.3	12	SW-SM
24	96.5	9.0	46.0	1.32	1.00	1.00	1.00	5,143.9	0.62	5.0	0.0	50.0	37.8	37.8	12	SW-SM
25	101.3	4.2	50.0	1.32	1.00	1.00	1.00	5,420.4	0.61	5.0	0.0	50.0	40.0	40.0	12	SW-SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0002	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-5	**No. of Soil Layers =**	12	each
Boring Station =	5950+98.00	**No. of Split Spoon Samples =**	25	each
Boring Offset =	8 ft LT	**Total Profile Thickness =**	101	feet
Ground Elevation at Boring (ft msl) =	105.5			
Water Table Depth (Dw) (ft) =	0			
Water Table Elevation (msl ft) =	105.5			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	105.5														
1	3.5	102.0	4.0	8.8	1	SM	115.0	Quaternary	Holocene	Alluvium	1.20	12.0		15	8	7
2	5.5	100.0	16.0	27.8	2	SW	120.0	Quaternary	Holocene	Alluvium	1.20	3.8	16.8	NP	NP	NP
3	7.5	98.0	7.0	13.0	3	ML	110.0	Quaternary	Holocene	Alluvium	1.20	59.9		30	27	3
4	8.3	97.2	50.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	30	36	30	6
5	10	95.5	50.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	30	36	30	6
6	11	94.5	50.0	46.0	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	30	36	30	6
7	16	89.5	50.0	46.0	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	30	36	30	6
8	21	84.5	50.0	46.0	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	30	36	30	6
9	26	79.5	50.0	46.0	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	30	36	30	6
10	31	74.5	50.0	46.0	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	30	36	30	6
11	33.9	71.6	14.0	25.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	41.2	36.4	36	30	6
12	36.5	69.0	21.0	33.7	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	41.2	36.4	36	30	6
13	41.5	64.0	30.0	43.3	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	52.3	37	45	33	12
14	46.5	59.0	32.0	43.6	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	52.3	37	45	33	12
15	51.5	54.0	23.0	35.8	8	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	50.1	100	43	40	3
16	56.5	49.0	21.0	33.2	9	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	50.1	100	43	40	3
17	61.5	44.0	23.0	26.3	10	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	12.0		15	8	7
18	66.5	39.0	1.0	1.0	11	SW	120.0	Paleogene	Eocene	Congaree Formation	2.10	2.6	45.4	NP	NP	NP
19	71.5	34.0	2.0	1.9	11	SW	120.0	Paleogene	Eocene	Congaree Formation	2.10	2.6	45.4	NP	NP	NP
20	76.5	29.0	50.0	46.0	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
21	81.5	24.0	50.0	45.0	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
22	86.5	19.0	41.0	35.7	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
23	91.5	14.0	50.0	42.3	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
24	96.5	9.0	46.0	37.8	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
25	101.3	4.2	50.0	40.0	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0002**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number = **B-5**
Boring Station = **595098**
Boring Offset = **8 ft LT**
Ground Elevation at Boring (ft msl) = **105.5**
Water Table Depth (Dw) (ft) = **0**
Water Table Elevation (msl ft) = **105.5**

Design EQ = **SEE**
Site Class = **D**
PGA (g) = **0.43**
M_W = **7.4**
R (km) = **0**
D_{a5-95} (sec) = **30.15**

SSL Water Table Depth (ft) = **0.0**
SSL Water Table Elev. (msl ft) = **110.0**

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	105.5														
1	3.5	102.0	8.8	SM	SSL	Sand-Like	4.07	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.75	7.43	1.69	11.73
2	5.5	100.0	27.8	SW	NSL-S	Sand-Like			No Liquefaction		38.0			5.68		10.04
3	7.5	98.0	13.0	ML	SSL	Sand-Like	3.13	0.90	Full Liquefaction	0.70 - 1.00	8.0		0.68	5.68	0.76	10.04
4	8.3	97.2	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			5.00		9.28
5	10.0	95.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			5.00		9.28
6	11.0	94.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			5.00		9.28
7	16.0	89.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			5.00		9.28
8	21.0	84.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			5.00		9.28
9	26.0	79.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			5.00		9.28
10	31.0	74.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			5.00		9.28
11	33.9	71.6	25.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			5.00		9.28
12	36.5	69.0	33.7	SM	NSL-S	Sand-Like			No Liquefaction		36.0			5.00		9.28
13	41.5	64.0	43.3	SM	PSL	NS Clay-Like	0.69	0.90	No Strength Loss			2090.0		5.00		9.28
14	46.5	59.0	43.6	SM	PSL	NS Clay-Like	0.75	0.90	No Strength Loss			2160.0		5.00		9.28
15	51.5	54.0	35.8	ML	NSL-S	Sand-Like			No Liquefaction		30.0			5.00		9.28
16	56.5	49.0	33.2	ML	NSL-S	Sand-Like			No Liquefaction		30.0			5.00		9.28
17	61.5	44.0	26.3	SM	SSL	Sand-Like	0.72	0.75	No Liquefaction	0.19	36.0			5.00		9.28
18	66.5	39.0	1.0	SW	SSL	Sand-Like	3.29	0.90	Full Liquefaction	0.70 - 1.00	2.0		2.50	5.00	4.97	9.28
19	71.5	34.0	1.9	SW	SSL	Sand-Like	3.00	0.90	Full Liquefaction	0.70 - 1.00	2.0		2.50	2.50	4.31	4.31
20	76.5	29.0	46.0	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
21	81.5	24.0	45.0	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
22	86.5	19.0	35.7	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
23	91.5	14.0	42.3	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
24	96.5	9.0	37.8	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
25	101.3	4.2	40.0	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00

7.43
LDI Total (feet)

11.73
S Total (inches)

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0002	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-5	Design EQ =	SEE	No. of Soil Layers =	12 each
Boring Station =	5950+98.00	Site Class =	D	No. of Split Spoon Samples =	25 each
Boring Offset =	8 ft LT	PGA (g) =	0.43	Total Profile Thickness =	101 feet
Ground Elevation at Boring (ft msl) =	105.5	M_W =	7.37		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	105.5	$D_{a5\text{-}95}$ (sec) =	30.15		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	
	0	105.5	0.0																							
1	3.5	102.0	184.1	4.0	5.3	6.7	8.8	1	SM	Sand-Like	Full Liquefaction	33.8	12.0	7.0	15.0				30		30		5		30			
2	5.5	100.0	299.8	16.0	21.1	27.8	27.8	2	SW	Sand-Like	No Liquefaction		3.8	NP	NP				41		38		38		38			
3	7.5	98.0	398	7.0	9.2	7.5	13.0	3	ML	Sand-Like	Full Liquefaction	44.8	59.9	3.0	30.0				31		30		8		30			
4	8.3	97.2	438.58	50.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		47.8	6.0	36.0				45		36		36		36			
5	10	95.5	528	50.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		47.8	6.0	36.0				45		36		36		36			
6	11	94.5	580.6	50.0	50.0	50.0	46.0	5	SM	Sand-Like	No Liquefaction		47.8	6.0	36.0				45		36		36		36			
7	16	89.5	843.6	50.0	50.0	50.0	46.0	5	SM	Sand-Like	No Liquefaction		47.8	6.0	36.0				45		36		36		36			
8	21	84.5	1106.6	50.0	50.0	50.0	46.0	5	SM	Sand-Like	No Liquefaction		47.8	6.0	36.0				45		36		36		36			
9	26	79.5	1369.6	50.0	50.0	50.0	46.0	5	SM	Sand-Like	No Liquefaction		47.8	6.0	36.0				45		36		36		36			
10	31	74.5	1632.6	50.0	50.0	50.0	46.0	5	SM	Sand-Like	No Liquefaction		47.8	6.0	36.0				45		36		36		36			
11	33.9	71.6	1785.14	14.0	18.4	19.5	25.0	6	SM	Sand-Like	No Liquefaction		41.2	6.0	36.0				37		36		36		36			
12	36.5	69.0	1921.9	21.0	27.7	28.2	33.7	6	SM	Sand-Like	No Liquefaction		41.2	6.0	36.0				41		36		36		36			
13	41.5	64.0	2184.9	30.0	39.5	37.8	43.3	7	SM	NS Clay-Like	No Strength Loss		52.3	12.0	45.0					5925		2090		2090				27	
14	46.5	59.0	2447.9	32.0	42.1	38.1	43.6	7	SM	NS Clay-Like	No Strength Loss		52.3	12.0	45.0					6320		2160		2160				27	
15	51.5	54.0	2644.9	23.0	30.3	30.3	35.8	8	ML	Sand-Like	No Liquefaction		50.1	3.0	43.0				42		30		30		30			
16	56.5	49.0	2882.9	21.0	27.7	27.7	33.2	9	ML	Sand-Like	No Liquefaction		50.1	3.0	43.0				41		30		30		30			
17	61.5	44.0	3136.9	23.0	30.3	24.2	26.3	10	SM	Sand-Like	No Liquefaction	81.1	12.0	7.0	15.0				39		36		36		36			
18	66.5	39.0	3415.9	1.0	1.3	1.0	1.0	11	SW	Sand-Like	Full Liquefaction	16.9	2.6	NP	NP				24		24		2		24			
19	71.5	34.0	3703.9	2.0	2.6	1.9	1.9	11	SW	Sand-Like	Full Liquefaction	23.9	2.6	NP	NP				25		26		2		26			
20	76.5	29.0	3991.9	50.0	50.0	46.6	46.0	12	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				45		36		36		36			
21	81.5	24.0	4279.9	50.0	50.0	45.0	45.0	12	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				45		36		36		36			
22	86.5	19.0	4567.9	41.0	50.0	35.7	35.7	12	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				43		36		36		36			
23	91.5	14.0	4855.9	50.0	50.0	42.2	42.3	12	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				45		36		36		36			
24	96.5	9.0	5143.9	46.0	50.0	37.8	37.8	12	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				44		36		36		36			
25	101.3	4.2	5420.38	50.0	50.0	40.0	40.0	12	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				45		36		36		36			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	**0.490**	**0.180**	g
k_{max} = **PGA =**	**0.430**	**0.200**	g
β = S_{D1}/PGA =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	**7.37**	**7.36**	
R =	**63.5**	**64.2**	km
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec
Z_{HR} =	**494.5**	**494.5**	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \le \beta \le 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20ft$ $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-5A	No. of Soil Layers =	9	each	Hammer Type = Safety
Boring Station =	5950+99.11	No. of Split Spoon Samples =	33	each	Energy Ratio = 76
Boring Offset =	8.13 ft RT	Total Profile Thickness =	120	feet	Energy Correction (C_E) = 1.27
Ground Elevation at Boring (ft msl) =	107.6	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	0	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	107.6	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	107.6														
1	4	103.6	9.0	1.27	1.00	0.75	1.00	210.4	1.70	12.0	2.1	11.5	14.6	16.7	1	SM
2	6	101.6	18.0	1.27	1.00	0.79	1.00	315.6	1.70	12.0	2.1	22.9	30.7	32.7	1	SM
3	8	99.6	30.0	1.27	1.00	0.83	1.00	430.8	1.70	0.0	0.0	38.2	50.0	46.0	2	SP
4	9	98.6	50.0	1.27	1.00	0.84	1.00	488.4	1.70	0.0	0.0	50.0	50.0	46.0	2	SP
5	10	97.6	50.0	1.27	1.00	0.86	1.00	541.0	1.70	47.9	5.5	50.0	50.0	46.0	3	SM
6	15	92.6	50.0	1.27	1.00	0.91	1.00	804.0	1.58	47.9	5.5	50.0	50.0	46.0	3	SM
7	20	87.6	34.0	1.27	1.00	0.95	1.00	1,067.0	1.37	47.9	5.5	43.3	50.0	46.0	3	SM
8	25	82.6	14.0	1.27	1.00	0.97	1.00	1,312.5	1.00	63.4	5.5	17.8	17.3	22.8	4	ML
9	30	77.6	15.0	1.27	1.00	0.98	1.00	1,550.5	1.00	63.4	5.5	19.1	18.8	24.3	4	ML
10	35	72.6	50.0	1.27	1.00	1.00	1.00	1,788.5	1.00	52.3	5.5	50.0	50.0	46.0	4	ML
11	40	67.6	20.0	1.27	1.00	1.00	1.00	2,026.5	1.00	52.3	5.5	25.5	25.5	31.0	4	ML
12	45	62.6	32.0	1.27	1.00	1.00	1.00	2,264.5	1.00	66.3	5.5	40.7	40.7	46.0	4	ML
13	50	57.6	41.0	1.27	1.00	1.00	1.00	2,502.5	1.00	66.3	5.5	50.0	50.0	46.0	4	ML
14	55	52.6	38.0	1.27	1.00	1.00	1.00	2,740.5	1.00	67.6	5.5	48.4	48.4	46.0	4	ML
15	60	47.6	46.0	1.27	1.00	1.00	1.00	2,978.5	1.00	67.6	5.5	50.0	50.0	46.0	4	ML
16	62	45.6	36.0	1.27	1.00	1.00	1.00	3,073.7	1.00	67.6	5.5	45.8	45.8	46.0	4	ML
17	64	43.6	50.0	1.27	1.00	1.00	1.00	3,168.9	1.00	67.6	5.5	50.0	50.0	46.0	4	ML
18	66	41.6	50.0	1.27	1.00	1.00	1.00	3,264.1	1.00	67.6	5.5	50.0	50.0	46.0	4	ML
19	68	39.6	49.0	1.27	1.00	1.00	1.00	3,359.3	1.00	67.6	5.5	50.0	50.0	46.0	4	ML
20	70	37.6	50.0	1.27	1.00	1.00	1.00	3,454.5	1.00	67.6	5.5	50.0	50.0	46.0	4	ML
21	72	35.6	46.0	1.27	1.00	1.00	1.00	3,549.7	1.00	67.6	5.5	50.0	50.0	46.0	4	ML
22	74	33.6	50.0	1.27	1.00	1.00	1.00	3,644.9	1.00	67.6	5.5	50.0	50.0	46.0	4	ML
23	76	31.6	50.0	1.27	1.00	1.00	1.00	3,740.1	1.00	67.6	5.5	50.0	50.0	46.0	4	ML
24	78	29.6	30.0	1.27	1.00	1.00	1.00	3,845.3	0.72	19.2	4.3	38.2	27.5	31.9	5	SM
25	80	27.6	37.0	1.27	1.00	1.00	1.00	3,950.5	0.71	19.2	4.3	47.1	33.5	37.9	5	SM
26	85	22.6	50.0	1.27	1.00	1.00	1.00	4,213.5	0.69	13.2	2.6	50.0	43.9	46.0	6	SC
27	88.9	18.7	50.0	1.27	1.00	1.00	1.00	4,418.6	0.67	13.2	2.6	50.0	42.8	45.4	6	SC
28	95	12.6	50.0	1.27	1.00	1.00	1.00	4,739.5	0.65	13.2	2.6	50.0	41.4	43.9	6	SC
29	100	7.6	50.0	1.27	1.00	1.00	1.00	5,002.5	0.63	13.2	2.6	50.0	40.3	42.8	6	SC
30	105	2.6	36.0	1.27	1.00	1.00	1.00	5,249.5	1.00	61.0	5.5	45.8	45.8	46.0	7	CH
31	110	-2.4	50.0	1.27	1.00	1.00	1.00	5,503.5	0.60	12.0	2.1	50.0	38.4	40.5	8	SM
32	115	-7.4	50.0	1.27	1.00	1.00	1.00	5,766.5	0.59	12.0	2.1	50.0	37.5	39.6	8	SM
33	120	-12.4	50.0	1.27	1.00	1.00	1.00	6,013.5	1.00	65.0	5.5	50.0	50.0	46.0	9	MH

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-5A	**No. of Soil Layers =**	9 each
Boring Station =	5950+99.11	**No. of Split Spoon Samples =**	33 each
Boring Offset =	8.13 ft RT	**Total Profile Thickness =**	120 feet
Ground Elevation at Boring (ft msl) =	107.6		
Water Table Depth (Dw) (ft) =	0		
Water Table Elevation (msl ft) =	107.6		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	107.6														
1	4	103.6	9.0	16.7	1	SM	115.0	Quaternary	Holocene	Alluvium	1.00	12.0		15	8	7
2	6	101.6	18.0	32.7	1	SM	115.0	Quaternary	Holocene	Alluvium	1.00	12.0		15	8	7
3	8	99.6	30.0	46.0	2	SP	120.0	Quaternary	Holocene	Alluvium	1.00	0.0		NP	NP	NP
4	9	98.6	50.0	46.0	2	SP	120.0	Quaternary	Holocene	Alluvium	1.00	0.0		NP	NP	NP
5	10	97.6	50.0	46.0	3	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.9	31.8	29	23	6
6	15	92.6	50.0	46.0	3	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.9	31.8	29	23	6
7	20	87.6	34.0	46.0	3	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.9	31.8	29	23	6
8	25	82.6	14.0	22.8	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	63.4	35.3	32	28	4
9	30	77.6	15.0	24.3	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	63.4	35.3	32	28	4
10	35	72.6	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	52.3	36.8	28	25	3
11	40	67.6	20.0	31.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	52.3	36.8	28	25	3
12	45	62.6	32.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	66.3	34.9	35	30	5
13	50	57.6	41.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	66.3	34.9	35	30	5
14	55	52.6	38.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
15	60	47.6	46.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
16	62	45.6	36.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
17	64	43.6	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
18	66	41.6	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
19	68	39.6	49.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
20	70	37.6	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
21	72	35.6	46.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
22	74	33.6	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
23	76	31.6	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	67.6	35.3	34	28	6
24	78	29.6	30.0	31.9	5	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	19.2	32.8	NP	NP	NP
25	80	27.6	37.0	37.9	5	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	19.2	32.8	NP	NP	NP
26	85	22.6	50.0	46.0	6	SC	115.0	Paleogene	Eocene	Congaree Formation	2.10	13.2	32.4	61	17	44
27	88.9	18.7	50.0	45.4	6	SC	115.0	Paleogene	Eocene	Congaree Formation	2.10	13.2	32.4	61	17	44
28	95	12.6	50.0	43.9	6	SC	115.0	Paleogene	Eocene	Congaree Formation	2.10	13.2	32.4	61	17	44
29	100	7.6	50.0	42.8	6	SC	115.0	Paleogene	Eocene	Congaree Formation	2.10	13.2	32.4	61	17	44
30	105	2.6	36.0	46.0	7	CH	110.0	Paleogene	Eocene	Congaree Formation	1.00	61.0	48.2	53	20	33
31	110	-2.4	50.0	40.5	8	SM	115.0	Paleogene	Eocene	Subcongaree Formation	2.10	12.0		15	8	7
32	115	-7.4	50.0	39.6	8	SM	115.0	Paleogene	Eocene	Subcongaree Formation	2.10	12.0		15	8	7
33	120	-12.4	50.0	46.0	9	MH	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	65.0	66	85	53	32

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-5A	Design EQ =	SEE	SSL Water Table Depth (ft) =	0.0
Boring Station =	595099.11	Site Class =	D	SSL Water Table Elev. (msl ft) =	110.0
Boring Offset =	8.13 ft RT	PGA (g) =	0.43		
Ground Elevation at Boring (ft msl) =	107.6	M_W =	7.4		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	107.6	D_{a5-95} (sec) =	30.15		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	107.6														
1	4.0	103.6	16.7	SM	SSL	Sand-Like	3.13	0.90	Full Liquefaction	0.70 - 1.00	19.0		0.92	0.92	1.28	1.28
2	6.0	101.6	32.7	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
3	8.0	99.6	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
4	9.0	98.6	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
5	10.0	97.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
6	15.0	92.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
7	20.0	87.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
8	25.0	82.6	22.8	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
9	30.0	77.6	24.3	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
10	35.0	72.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
11	40.0	67.6	31.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
12	45.0	62.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
13	50.0	57.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
14	55.0	52.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
15	60.0	47.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
16	62.0	45.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
17	64.0	43.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
18	66.0	41.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
19	68.0	39.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
20	70.0	37.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
21	72.0	35.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
22	74.0	33.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
23	76.0	31.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
24	78.0	29.6	31.9	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
25	80.0	27.6	37.9	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
26	85.0	22.6	46.0	SC	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
27	88.9	18.7	45.4	SC	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
28	95.0	12.6	43.9	SC	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
29	100.0	7.6	42.8	SC	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
30	105.0	2.6	46.0	CH	PSL	HS Clay-Like	0.87	0.90	No Strength Loss			4000.0		0.00		0.00
31	110.0	-2.4	40.5	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
32	115.0	-7.4	39.6	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
33	120.0	-12.4	46.0	MH	NSL-C				No Strength Loss			3110.0		0.00		0.00
													0.92		1.28	
													LDI Total (feet)		S Total (inches)	

[D]Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-5A	Design EQ =	SEE	No. of Soil Layers =	9 each
Boring Station =	5950+99.11	Site Class =	D	No. of Split Spoon Samples =	33 each
Boring Offset =	8.13 ft RT	PGA (g) =	0.43	Total Profile Thickness =	120 feet
Ground Elevation at Boring (ft msl) =	107.6	M_W =	7.37		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	107.6	$D_{a5\text{-}95}$ (sec) =	30.15		

																		Total Soil Shear Strengths						Effective Soil Shear Strengths			
																		Short Term Loading				Cyclic Loading		Long Term Loading			
																		Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																		ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	107.6	0.0																								
1	4	103.6	210.4	9.0	11.5	14.6	16.7	1	SM	Sand-Like	Full Liquefaction	49.9	12.0	7.0	15.0				35		35		19		35			
2	6	101.6	315.6	18.0	22.9	30.7	32.7	1	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				42		36		36		36			
3	8	99.6	430.8	30.0	38.2	50.0	46.0	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP				45		32		32		32			
4	9	98.6	488.4	50.0	50.0	50.0	46.0	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP				45		32		32		32			
5	10	97.6	541	50.0	50.0	50.0	46.0	3	SM	Sand-Like	No Liquefaction		47.9	6.0	29.0				45		36		36		36		30	
6	15	92.6	804	50.0	50.0	50.0	46.0	3	SM	Sand-Like	No Liquefaction		47.9	6.0	29.0				45		36		36		36		30	
7	20	87.6	1067	34.0	43.3	50.0	46.0	3	SM	Sand-Like	No Liquefaction		47.9	6.0	29.0				45		36		36		36		30	
8	25	82.6	1312.5	14.0	17.8	17.3	22.8	4	ML	Sand-Like	No Liquefaction		63.4	4.0	32.0				36		30		30		30		32	
9	30	77.6	1550.5	15.0	19.1	18.8	24.3	4	ML	Sand-Like	No Liquefaction		63.4	4.0	32.0				37		30		30		30		32	
10	35	72.6	1788.5	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		52.3	3.0	28.0				45		30		30		30		34	
11	40	67.6	2026.5	20.0	25.5	25.5	31.0	4	ML	Sand-Like	No Liquefaction		52.3	3.0	28.0				40		30		30		30		34	
12	45	62.6	2264.5	32.0	40.7	40.7	46.0	4	ML	Sand-Like	No Liquefaction		66.3	5.0	35.0				45		30		30		30		31	
13	50	57.6	2502.5	41.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		66.3	5.0	35.0				45		30		30		30		31	
14	55	52.6	2740.5	38.0	48.4	48.4	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
15	60	47.6	2978.5	46.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
16	62	45.6	3073.7	36.0	45.8	45.8	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
17	64	43.6	3168.9	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
18	66	41.6	3264.1	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
19	68	39.6	3359.3	49.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
20	70	37.6	3454.5	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
21	72	35.6	3549.7	46.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
22	74	33.6	3644.9	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
23	76	31.6	3740.1	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		67.6	6.0	34.0				45		30		30		30		30	
24	78	29.6	3845.3	30.0	38.2	27.5	31.9	5	SM	Sand-Like	No Liquefaction		19.2	NP	NP				41		36		36		36			
25	80	27.6	3950.5	37.0	47.1	33.5	37.9	5	SM	Sand-Like	No Liquefaction		19.2	NP	NP				43		36		36		36			
26	85	22.6	4213.5	50.0	50.0	43.9	46.0	6	SC	Sand-Like	No Liquefaction		13.2	44.0	61.0				45		30		30		30			
27	88.9	18.7	4418.64	50.0	50.0	42.8	45.4	6	SC	Sand-Like	No Liquefaction		13.2	44.0	61.0				45		30		30		30			
28	95	12.6	4739.5	50.0	50.0	41.4	43.9	6	SC	Sand-Like	No Liquefaction		13.2	44.0	61.0				45		30		30		30			
29	100	7.6	5002.5	50.0	50.0	40.3	42.8	6	SC	Sand-Like	No Liquefaction		13.2	44.0	61.0				45		30		30		30			
30	105	2.6	5249.5	36.0	45.8	45.8	46.0	7	CH	HS Clay-Like	No Strength Loss		61.0	33.0	53.0	0.004	18.7	3.3		6876		4000		4000		1	23	400
31	110	-2.4	5503.5	50.0	50.0	38.4	40.5	8	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				44		36		36		36			
32	115	-7.4	5766.5	50.0	50.0	37.5	39.6	8	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				44		36		36		36			
33	120	-12.4	6013.5	50.0	50.0	50.0	46.0	9	MH		No Strength Loss		65.0	32.0	85.0					7500		3110		3110		1	23	311

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0001-0002	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: — $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: — $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: — $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis
R =	**63.5**	**64.2**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: — R < 20 km; ε = 0.015(R-20)
$D_{a5\text{-}95}$	30.15	30.09	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48 — R ≥ 20 km; ε = 0

SPT Correction Summary

GSE No.:	41503-0001-0002	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-6	No. of Soil Layers =	8	each	Hammer Type =	Automatic
Boring Station =	5951+41.00	No. of Split Spoon Samples =	10	each	Energy Ratio =	79
Boring Offset =	8 ft RT	Total Profile Thickness =	35	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	107.8	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	0	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	107.8	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	107.8														
1	3.5	104.3	7.0	1.32	1.00	0.75	1.00	184.1	1.70	12.0	2.1	9.2	11.8	13.8	1	SM
2	5.5	102.3	11.0	1.32	1.00	0.78	1.00	299.8	1.70	1.6	0.0	14.5	19.1	19.1	2	SP
3	7.5	100.3	28.0	1.32	1.00	0.82	1.00	415.0	1.70	4.0	0.0	36.9	50.0	46.0	3	SP
4	9.5	98.3	7.0	1.32	1.00	0.85	1.00	530.2	1.70	2.1	0.0	9.2	13.3	13.3	4	SP
5	11.5	96.3	3.0	1.32	1.00	0.88	1.00	645.4	1.70	8.8	0.6	4.0	5.9	6.5	5	SP-SM
6	15.2	92.6	50.0	1.32	1.00	0.92	1.00	849.0	1.53	35.0	5.5	50.0	50.0	46.0	6	SM
7	20.2	87.6	50.0	1.32	1.00	0.95	1.00	1,112.0	1.34	35.0	5.5	50.0	50.0	46.0	7	SM
8	25.2	82.6	50.0	1.32	1.00	0.97	1.00	1,375.0	1.21	35.0	5.5	50.0	50.0	46.0	7	SM
9	30.2	77.6	50.0	1.32	1.00	0.98	1.00	1,638.0	1.10	60.0	5.5	50.0	50.0	46.0	8	SM
10	35.2	72.6	50.0	1.32	1.00	1.00	1.00	1,901.0	1.03	60.0	5.5	50.0	50.0	46.0	8	SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0001-0002	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-6	**No. of Soil Layers =**	8 each
Boring Station =	5951+41.00	**No. of Split Spoon Samples =**	10 each
Boring Offset =	8 ft RT	**Total Profile Thickness =**	35 feet
Ground Elevation at Boring (ft msl) =	107.8		
Water Table Depth (Dw) (ft) =	0		
Water Table Elevation (msl ft) =	107.8		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	107.8														
1	3.5	104.3	7.0	13.8	1	SM	115.0	Quaternary	Holocene	Alluvium	1.20	12.0		15	8	7
2	5.5	102.3	11.0	19.1	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	1.6	12.7	NP	NP	NP
3	7.5	100.3	28.0	46.0	3	SP	120.0	Quaternary	Holocene	Alluvium	1.20	4.0	14	NP	NP	NP
4	9.5	98.3	7.0	13.3	4	SP	120.0	Quaternary	Holocene	Alluvium	1.20	2.1	17	NP	NP	NP
5	11.5	96.3	3.0	6.5	5	SP-SM	120.0	Quaternary	Holocene	Alluvium	1.20	8.8		10	6	4
6	15.2	92.6	50.0	46.0	6	SM	115.0	Quaternary	Holocene	Alluvium	1.20	35.0	30	36	30	6
7	20.2	87.6	50.0	46.0	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	35.0	30	36	30	6
8	25.2	82.6	50.0	46.0	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	35.0	30	36	30	6
9	30.2	77.6	50.0	46.0	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	60.0	30	36	30	6
10	35.2	72.6	50.0	46.0	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	60.0	30	36	30	6

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0001-0002**	**File No.:**		**Latitude:**	**33.457**		**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**		**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**				

Boring Number =	**B-6**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**0.0**
Boring Station =	**595141**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**8 ft RT**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**107.8**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**0**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**107.8**	**D_{a5-95} (sec) =**	**30.15**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	107.8														
1	3.5	104.3	13.8	SM	SSL	Sand-Like	3.05	0.90	Full Liquefaction	0.70 - 1.00	10.0		1.09	2.75	1.28	3.15
2	5.5	102.3	19.1	SP	NSL-S	Sand-Like			No Liquefaction		32.0			1.66		1.87
3	7.5	100.3	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			1.66		1.87
4	9.5	98.3	13.3	SP	SSL	Sand-Like	2.98	0.90	Full Liquefaction	0.70 - 1.00	9.0		0.66	1.66	0.75	1.87
5	11.5	96.3	6.5	SP-SM	SSL	Sand-Like	4.46	0.90	Full Liquefaction	0.70 - 1.00	4.0		1.00	1.00	1.12	1.12
6	15.2	92.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
7	20.2	87.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
8	25.2	82.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
9	30.2	77.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
10	35.2	72.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00

2.75	**3.15**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0001-0002	File No.:			Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:				

Boring Number =	B-6	Design EQ =	SEE	No. of Soil Layers =	8	each
Boring Station =	5951+41.00	Site Class =	D	No. of Split Spoon Samples =	10	each
Boring Offset =	8 ft RT	PGA (g) =	0.43	Total Profile Thickness =	35	feet
Ground Elevation at Boring (ft msl) =	107.8	M_W =	7.37			
Water Table Depth (Dw) (ft) =	0	R (km) =	0			
Water Table Elevation (msl ft) =	107.8	D_{a5-95} (sec) =	30.15			

SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																			Short Term Loading				Cyclic Loading		Long Term Loading			
																			Correlated Static		Static		Seismic		Static			
																			Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																			ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	107.8	0.0																									
1	3.5	104.3	184.1	7.0	9.2	11.8	13.8	1	SM	Sand-Like	Full Liquefaction	44.8	12.0	7.0	15.0				33		34		10		34			
2	5.5	102.3	299.8	11.0	14.5	19.1	19.1	2	SP	Sand-Like	No Liquefaction		1.6	NP	NP				37		32		32		32			
3	7.5	100.3	415	28.0	36.9	50.0	46.0	3	SP	Sand-Like	No Liquefaction		4.0	NP	NP				45		32		32		32			
4	9.5	98.3	530.2	7.0	9.2	13.3	13.3	4	SP	Sand-Like	Full Liquefaction	44.8	2.1	NP	NP				34		32		9		32			
5	11.5	96.3	645.4	3.0	4.0	5.9	6.5	5	SP-SM	Sand-Like	Full Liquefaction	29.3	8.8	4.0	10.0				30		30		4		30			
6	15.2	92.6	849.02	50.0	50.0	50.0	46.0	6	SM	Sand-Like	No Liquefaction		35.0	6.0	36.0				45		36		36		36			
7	20.2	87.6	1112.02	50.0	50.0	50.0	46.0	7	SM	Sand-Like	No Liquefaction		35.0	6.0	36.0				45		36		36		36			
8	25.2	82.6	1375.02	50.0	50.0	50.0	46.0	7	SM	Sand-Like	No Liquefaction		35.0	6.0	36.0				45		36		36		36			
9	30.2	77.6	1638.02	50.0	50.0	50.0	46.0	8	SM	Sand-Like	No Liquefaction		60.0	6.0	36.0				45		36		36		36			
10	35.2	72.6	1901.02	50.0	50.0	50.0	46.0	8	SM	Sand-Like	No Liquefaction		60.0	6.0	36.0				45		36		36		36			

^{D}Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	**0.490**	**0.180**	g
k_{max} = **PGA =**	**0.430**	**0.200**	g
β = S_{D1}/PGA =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	**7.37**	**7.36**	
R =	**63.5**	**64.2**	km
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec
Z_{HR} =	**494.5**	**494.5**	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \le \beta \le 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20ft$ $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-6A	No. of Soil Layers =	11	each	Hammer Type = Safety
Boring Station =	5951+42.68	No. of Split Spoon Samples =	33	each	Energy Ratio = 76
Boring Offset =	7.28 ft LT	Total Profile Thickness =	120	feet	Energy Correction (C_E) = 1.27
Ground Elevation at Boring (ft msl) =	108.6	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	0	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	108.6	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	108.6														
1	2	106.6	1.0	1.27	1.00	0.75	1.00	95.2	1.00	51.0	5.5	1.3	1.0	6.5	1	ML
2	4	104.6	7.0	1.27	1.00	0.75	1.00	210.4	1.70	0.0	0.0	8.9	11.4	11.4	2	SP
3	6	102.6	10.0	1.27	1.00	0.79	1.00	325.6	1.70	0.0	0.0	12.7	17.0	17.0	2	SP
4	8	100.6	26.0	1.27	1.00	0.83	1.00	440.8	1.70	0.0	0.0	33.1	46.4	46.0	2	SP
5	10	98.6	12.0	1.27	1.00	0.86	1.00	556.0	1.70	5.0	0.0	15.3	22.3	22.3	3	SP-SM
6	15	93.6	50.0	1.27	1.00	0.91	1.00	828.0	1.55	34.6	5.5	50.0	50.0	46.0	4	SM
7	20	88.6	50.0	1.27	1.00	0.95	1.00	1,091.0	1.35	34.6	5.5	50.0	50.0	46.0	4	SM
8	25	83.6	50.0	1.27	1.00	0.97	1.00	1,354.0	1.22	34.6	5.5	50.0	50.0	46.0	4	SM
9	30	78.6	29.0	1.27	1.00	0.98	1.00	1,603.5	1.00	59.9	5.5	36.9	36.3	41.8	5	ML
10	35	73.6	50.0	1.27	1.00	1.00	1.00	1,841.5	1.00	59.9	5.5	50.0	50.0	46.0	5	ML
11	40	68.6	27.0	1.27	1.00	1.00	1.00	2,079.5	1.00	59.9	5.5	34.4	34.4	39.9	5	ML
12	45	63.6	40.0	1.27	1.00	1.00	1.00	2,317.5	1.00	68.2	5.5	50.0	50.0	46.0	5	ML
13	50	58.6	45.0	1.27	1.00	1.00	1.00	2,555.5	1.00	68.2	5.5	50.0	50.0	46.0	5	ML
14	55	53.6	50.0	1.27	1.00	1.00	1.00	2,793.5	1.00	68.2	5.5	50.0	50.0	46.0	5	ML
15	60	48.6	50.0	1.27	1.00	1.00	1.00	3,031.5	1.00	72.2	5.5	50.0	50.0	46.0	6	ML
16	62	46.6	44.0	1.27	1.00	1.00	1.00	3,126.7	1.00	72.2	5.5	50.0	50.0	46.0	6	ML
17	64	44.6	50.0	1.27	1.00	1.00	1.00	3,221.9	1.00	72.2	5.5	50.0	50.0	46.0	6	ML
18	66	42.6	50.0	1.27	1.00	1.00	1.00	3,317.1	1.00	72.2	5.5	50.0	50.0	46.0	6	ML
19	68	40.6	50.0	1.27	1.00	1.00	1.00	3,412.3	1.00	70.9	5.5	50.0	50.0	46.0	6	ML
20	70	38.6	50.0	1.27	1.00	1.00	1.00	3,507.5	1.00	70.9	5.5	50.0	50.0	46.0	6	ML
21	72	36.6	50.0	1.27	1.00	1.00	1.00	3,602.7	1.00	70.9	5.5	50.0	50.0	46.0	6	ML
22	74	34.6	50.0	1.27	1.00	1.00	1.00	3,697.9	1.00	70.9	5.5	50.0	50.0	46.0	6	ML
23	76	32.6	50.0	1.27	1.00	1.00	1.00	3,793.1	1.00	70.9	5.5	50.0	50.0	46.0	6	ML
24	78	30.6	50.0	1.27	1.00	1.00	1.00	3,888.3	1.00	70.9	5.5	50.0	50.0	46.0	6	ML
25	80	28.6	28.0	1.27	1.00	1.00	1.00	3,993.5	0.71	21.2	4.7	35.7	25.2	29.9	7	SC
26	85	23.6	50.0	1.27	1.00	1.00	1.00	4,272.5	0.68	11.5	1.8	50.0	43.6	45.4	8	SP-SM
27	90	18.6	50.0	1.27	1.00	1.00	1.00	4,560.5	0.66	11.5	1.8	50.0	42.2	44.0	8	SP-SM
28	95	13.6	50.0	1.27	1.00	1.00	1.00	4,848.5	0.64	11.5	1.8	50.0	40.9	42.7	8	SP-SM
29	100	8.6	50.0	1.27	1.00	1.00	1.00	5,136.5	0.62	11.5	1.8	50.0	39.7	41.6	8	SP-SM
30	105	3.6	30.0	1.27	1.00	1.00	1.00	5,392.5	1.00	56.0	5.5	38.2	38.2	43.7	9	CL
31	110	-1.4	50.0	1.27	1.00	1.00	1.00	5,646.5	0.60	17.8	4.0	50.0	37.9	41.9	10	SM
32	115	-6.4	50.0	1.27	1.00	1.00	1.00	5,909.5	0.58	17.8	4.0	50.0	37.0	41.1	10	SM
33	120	-11.4	50.0	1.27	1.00	1.00	1.00	6,149.0	1.00	80.0	5.5	50.0	50.0	46.0	11	MH

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-6A	**No. of Soil Layers =**	11	each
Boring Station =	5951+42.68	**No. of Split Spoon Samples =**	33	each
Boring Offset =	7.28 ft LT	**Total Profile Thickness =**	120	feet
Ground Elevation at Boring (ft msl) =	108.6			
Water Table Depth (Dw) (ft) =	0			
Water Table Elevation (msl ft) =	108.6			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	108.6														
1	2	106.6	1.0	6.5	1	ML	110.0	Quaternary	Holocene	Alluvium	1.20	51.0		30	27	3
2	4	104.6	7.0	11.4	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
3	6	102.6	10.0	17.0	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
4	8	100.6	26.0	46.0	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
5	10	98.6	12.0	22.3	3	SP-SM	120.0	Quaternary	Holocene	Alluvium	1.20	5.0		10	6	4
6	15	93.6	50.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	34.6	27.4	24	22	2
7	20	88.6	50.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	34.6	27.4	24	22	2
8	25	83.6	50.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	34.6	27.4	24	22	2
9	30	78.6	29.0	41.8	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	59.9	34.1	31	28	3
10	35	73.6	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	59.9	34.1	31	28	3
11	40	68.6	27.0	39.9	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	59.9	34.1	31	28	3
12	45	63.6	40.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.2	39.9	32	31	1
13	50	58.6	45.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.2	39.9	32	31	1
14	55	53.6	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.2	39.9	32	31	1
15	60	48.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	72.2	41.2	38	29	9
16	62	46.6	44.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	72.2	41.2	38	29	9
17	64	44.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	72.2	41.2	38	29	9
18	66	42.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	72.2	41.2	38	29	9
19	68	40.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	70.9	32	35	23	12
20	70	38.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	70.9	32	35	23	12
21	72	36.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	70.9	32	35	23	12
22	74	34.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	70.9	32	35	23	12
23	76	32.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	70.9	32	35	23	12
24	78	30.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	70.9	32	35	23	12
25	80	28.6	28.0	29.9	7	SC	115.0	Paleogene	Eocene	Congaree Formation	2.10	21.2	31.5	49	22	27
26	85	23.6	50.0	45.4	8	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	11.5	29.1	NP	NP	NP
27	90	18.6	50.0	44.0	8	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	11.5	29.1	NP	NP	NP
28	95	13.6	50.0	42.7	8	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	11.5	29.1	NP	NP	NP
29	100	8.6	50.0	41.6	8	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	11.5	29.1	NP	NP	NP
30	105	3.6	30.0	43.7	9	CL	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	56.0	40.1	40	19	21
31	110	-1.4	50.0	41.9	10	SM	115.0	Paleogene	Eocene	Subcongaree Formation	2.10	17.8	38	NP	NP	NP
32	115	-6.4	50.0	41.1	10	SM	115.0	Paleogene	Eocene	Subcongaree Formation	2.10	17.8	38	NP	NP	NP
33	120	-11.4	50.0	46.0	11	MH	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	80.0		75	55	20

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-6A	Design EQ =	SEE	SSL Water Table Depth (ft) =	0.0
Boring Station =	595142.68	Site Class =	D	SSL Water Table Elev. (msl ft) =	110.0
Boring Offset =	7.28 ft LT	PGA (g) =	0.43		
Ground Elevation at Boring (ft msl) =	108.6	M_W =	7.4		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	108.6	D_{a5-95} (sec) =	30.15		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	108.6														
1	2.0	106.6	6.5	ML	SSL	Sand-Like	5.00	0.90	Full Liquefaction	0.70 - 1.00	4.0		1.00	2.26	1.13	2.59
2	4.0	104.6	11.4	SP	SSL	Sand-Like	3.49	0.90	Full Liquefaction	0.70 - 1.00	7.0		0.82	1.26	0.83	1.46
3	6.0	102.6	17.0	SP	SSL	Sand-Like	2.50	0.90	Full Liquefaction	0.70 - 1.00	21.0		0.44	0.44	0.63	0.63
4	8.0	100.6	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
5	10.0	98.6	22.3	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
6	15.0	93.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
7	20.0	88.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
8	25.0	83.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
9	30.0	78.6	41.8	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
10	35.0	73.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
11	40.0	68.6	39.9	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
12	45.0	63.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
13	50.0	58.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
14	55.0	53.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
15	60.0	48.6	46.0	ML	PSL	NS Clay-Like	0.88	0.90	No Strength Loss			2310.0		0.00		0.00
16	62.0	46.6	46.0	ML	PSL	NS Clay-Like	0.90	0.90	No Strength Loss			2340.0		0.00		0.00
17	64.0	44.6	46.0	ML	NSL-C				No Strength Loss			2360.0		0.00		0.00
18	66.0	42.6	46.0	ML	NSL-C				No Strength Loss			2390.0		0.00		0.00
19	68.0	40.6	46.0	ML	NSL-C				No Strength Loss			2410.0		0.00		0.00
20	70.0	38.6	46.0	ML	NSL-C				No Strength Loss			2440.0		0.00		0.00
21	72.0	36.6	46.0	ML	NSL-C				No Strength Loss			2470.0		0.00		0.00
22	74.0	34.6	46.0	ML	NSL-C				No Strength Loss			2490.0		0.00		0.00
23	76.0	32.6	46.0	ML	NSL-C				No Strength Loss			2520.0		0.00		0.00
24	78.0	30.6	46.0	ML	NSL-C				No Strength Loss			2540.0		0.00		0.00
25	80.0	28.6	29.9	SC	NSL-C				No Strength Loss			2570.0		0.00		0.00
26	85.0	23.6	45.4	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
27	90.0	18.6	44.0	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
28	95.0	13.6	42.7	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
29	100.0	8.6	41.6	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
30	105.0	3.6	43.7	CL	PSL	HS Clay-Like	0.90	0.90	No Strength Loss			4000.0		0.00		0.00
31	110.0	-1.4	41.9	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
32	115.0	-6.4	41.1	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
33	120.0	-11.4	46.0	MH	NSL-C				No Strength Loss			3150.0		0.00		0.00
													2.26		2.59	
													LDI Total (feet)		S Total (inches)	

[D]Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-6A	Design EQ =	SEE	No. of Soil Layers =	11 each
Boring Station =	5951+42.68	Site Class =	D	No. of Split Spoon Samples =	33 each
Boring Offset =	7.28 ft LT	PGA (g) =	0.43	Total Profile Thickness =	120 feet
Ground Elevation at Boring (ft msl) =	108.6	M_W =	7.37		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	108.6	$D_{a5\text{-}95}$ (sec) =	30.15		

																		Total Soil Shear Strengths						Effective Soil Shear Strengths			
																		Short Term Loading				Cyclic Loading		Long Term Loading			
																		Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																		ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	108.6	0.0																								
1	2	106.6	95.2	1.0	1.3	1.0	6.5	1	ML	Sand-Like	Full Liquefaction	16.6	51.0	3.0	30.0			24		24		4		24			
2	4	104.6	210.4	7.0	8.9	11.4	11.4	2	SP	Sand-Like	Full Liquefaction	44.0	0.0	NP	NP			33		32		7		32			
3	6	102.6	325.6	10.0	12.7	17.0	17.0	2	SP	Sand-Like	Full Liquefaction	52.6	0.0	NP	NP			36		32		21		32			
4	8	100.6	440.8	26.0	33.1	46.4	46.0	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP			45		32		32		32			
5	10	98.6	556	12.0	15.3	22.3	22.3	3	SP-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0			39		36		36		36			
6	15	93.6	828	50.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		34.6	2.0	24.0			45		36		36		36			
7	20	88.6	1091	50.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		34.6	2.0	24.0			45		36		36		36			
8	25	83.6	1354	50.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		34.6	2.0	24.0			45		36		36		36			
9	30	78.6	1603.5	29.0	36.9	36.3	41.8	5	ML	Sand-Like	No Liquefaction		59.9	3.0	31.0			44		30		30		30			
10	35	73.6	1841.5	50.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		59.9	3.0	31.0			45		30		30		30			
11	40	68.6	2079.5	27.0	34.4	34.4	39.9	5	ML	Sand-Like	No Liquefaction		59.9	3.0	31.0			43		30		30		30			
12	45	63.6	2317.5	40.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		68.2	1.0	32.0			45		30		30		30			
13	50	58.6	2555.5	45.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		68.2	1.0	32.0			45		30		30		30			
14	55	53.6	2793.5	50.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		68.2	1.0	32.0			45		30		30		30			
15	60	48.6	3031.5	50.0	50.0	50.0	46.0	6	ML	NS Clay-Like	No Strength Loss		72.2	9.0	38.0				3750		2310		2310			29	
16	62	46.6	3126.7	44.0	50.0	50.0	46.0	6	ML	NS Clay-Like	No Strength Loss		72.2	9.0	38.0				3750		2340		2340			29	
17	64	44.6	3221.9	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		72.2	9.0	38.0				3750		2360		2360			29	
18	66	42.6	3317.1	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		72.2	9.0	38.0				3750		2390		2390			29	
19	68	40.6	3412.3	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		70.9	12.0	35.0				7500		2410		2410			27	
20	70	38.6	3507.5	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		70.9	12.0	35.0				7500		2440		2440			27	
21	72	36.6	3602.7	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		70.9	12.0	35.0				7500		2470		2470			27	
22	74	34.6	3697.9	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		70.9	12.0	35.0				**7500**		2490		2490			27	
23	76	32.6	3793.1	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		70.9	12.0	35.0				7500		2520		2520			27	
24	78	30.6	3888.3	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		70.9	12.0	35.0				7500		2540		2540			27	
25	80	28.6	3993.5	28.0	35.7	25.2	29.9	7	SC		No Strength Loss		21.2	27.0	49.0				5348		2570		2570			23	
26	85	23.6	4272.5	50.0	50.0	43.6	45.4	8	SP-SM	Sand-Like	No Liquefaction		11.5	NP	NP			45		36		36		36			
27	90	18.6	4560.5	50.0	50.0	42.2	44.0	8	SP-SM	Sand-Like	No Liquefaction		11.5	NP	NP			45		36		36		36			
28	95	13.6	4848.5	50.0	50.0	40.9	42.7	8	SP-SM	Sand-Like	No Liquefaction		11.5	NP	NP			45		36		36		36			
29	100	8.6	5136.5	50.0	50.0	39.7	41.6	8	SP-SM	Sand-Like	No Liquefaction		11.5	NP	NP			45		36		36		36			
30	105	3.6	5392.5	30.0	38.2	38.2	43.7	9	CL	HS Clay-Like	No Strength Loss		56.0	21.0	40.0	0.006	15.2	3.1		5730		4000		4000		2	25	400
31	110	-1.4	5646.5	50.0	50.0	37.9	41.9	10	SM	Sand-Like	No Liquefaction		17.8	NP	NP			44		36		36		36			
32	115	-6.4	5909.5	50.0	50.0	37.0	41.1	10	SM	Sand-Like	No Liquefaction		17.8	NP	NP			44		36		36		36			
33	120	-11.4	6149	50.0	50.0	50.0	46.0	11	MH		No Strength Loss		80.0	20.0	75.0				7500		3150		3150		1	26	315

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: — $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: — $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	$\mathbf{k}_h$ = Average seismic horizontal coefficient due to wave scattering: — $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis
R =	**63.5**	**64.2**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: — R < 20 km; ε = 0.015(R-20)
$D_{a5\text{-}95}$	30.15	30.09	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48 — R ≥ 20 km; ε = 0

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-7	No. of Soil Layers =	7	each	Hammer Type =	Automatic
Boring Station =	5951+86.00	No. of Split Spoon Samples =	12	each	Energy Ratio =	79
Boring Offset =	8 ft LT	Total Profile Thickness =	41	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	105	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	0	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	105	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	105.0														
1	3.5	101.5	4.0	1.32	1.00	0.75	1.00	201.6	1.70	0.0	0.0	5.3	6.7	6.7	1	SP
2	5.5	99.5	5.0	1.32	1.00	0.78	1.00	316.8	1.70	0.0	0.0	6.6	8.7	8.7	1	SP
3	8	97.0	50.0	1.32	1.00	0.83	1.00	435.8	1.00	56.5	5.5	50.0	50.0	46.0	2	ML
4	9.5	95.5	50.0	1.32	1.00	0.85	1.00	507.2	1.00	50.7	5.5	50.0	50.0	46.0	3	ML
5	11.5	93.5	41.0	1.32	1.00	0.88	1.00	612.4	1.70	40.6	5.5	50.0	50.0	46.0	4	SM
6	16.5	88.5	26.0	1.32	1.00	0.93	1.00	875.4	1.51	64.2	5.5	34.2	48.0	46.0	5	SM
7	20.1	84.9	50.0	1.32	1.00	0.95	1.00	1,064.8	1.37	64.0	5.5	50.0	50.0	46.0	6	SM
8	21	84.0	50.0	1.32	1.00	0.96	1.00	1,112.1	1.34	64.0	5.5	50.0	50.0	46.0	6	SM
9	26	79.0	50.0	1.32	1.00	0.97	1.00	1,375.1	1.21	64.0	5.5	50.0	50.0	46.0	7	SM
10	31	74.0	50.0	1.32	1.00	0.98	1.00	1,638.1	1.10	64.0	5.5	50.0	50.0	46.0	7	SM
11	36	69.0	50.0	1.32	1.00	1.00	1.00	1,901.1	1.03	64.0	5.5	50.0	50.0	46.0	7	SM
12	41	64.0	50.0	1.32	1.00	1.00	1.00	2,164.1	0.96	64.0	5.5	50.0	50.0	46.0	7	SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-7	**No. of Soil Layers =**	7	each
Boring Station =	5951+86.00	**No. of Split Spoon Samples =**	12	each
Boring Offset =	8 ft LT	**Total Profile Thickness =**	41	feet
Ground Elevation at Boring (ft msl) =	105			
Water Table Depth (Dw) (ft) =	0			
Water Table Elevation (msl ft) =	105			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	105.0														
1	3.5	101.5	4.0	6.7	1	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
2	5.5	99.5	5.0	8.7	1	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
3	8	97.0	50.0	46.0	2	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	56.5		30	27	3
4	9.5	95.5	50.0	46.0	3	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	50.7		30	27	3
5	11.5	93.5	41.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	40.6	30.9	31	25	6
6	16.5	88.5	26.0	46.0	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	64.2	30	31	25	6
7	20.1	84.9	50.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	64.0	30	31	25	6
8	21	84.0	50.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	64.0	30	31	25	6
9	26	79.0	50.0	46.0	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	64.0	30	31	25	6
10	31	74.0	50.0	46.0	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	64.0	30	31	25	6
11	36	69.0	50.0	46.0	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	64.0	30	31	25	6
12	41	64.0	50.0	46.0	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	64.0	30	31	25	6

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**B-7**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**0.0**
Boring Station =	**595186**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**8 ft LT**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**105**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**0**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**105**	**D_{a5-95} (sec) =**	**30.15**		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	105.0														
1	3.5	101.5	6.7	SP	SSL	Sand-Like	4.41	0.90	Full Liquefaction	0.70 - 1.00	4.0		1.75	2.75	1.94	2.91
2	5.5	99.5	8.7	SP	SSL	Sand-Like	3.88	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.00	1.00	0.97	0.97
3	8.0	97.0	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
4	9.5	95.5	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
5	11.5	93.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
6	16.5	88.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
7	20.1	84.9	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
8	21.0	84.0	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
9	26.0	79.0	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
10	31.0	74.0	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
11	36.0	69.0	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
12	41.0	64.0	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
													2.75		**2.91**	
													LDI Total (feet)		**S Total (inches)**	

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-7	Design EQ =	SEE	No. of Soil Layers =	7 each
Boring Station =	5951+86.00	Site Class =	D	No. of Split Spoon Samples =	12 each
Boring Offset =	8 ft LT	PGA (g) =	0.43	Total Profile Thickness =	41 feet
Ground Elevation at Boring (ft msl) =	105	M_W =	7.37		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	105	$D_{a5\text{-}95}$ (sec) =	30.15		

																		Total Soil Shear Strengths						Effective Soil Shear Strengths			
																		Short Term Loading				Cyclic Loading		Long Term Loading			
																		Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																		ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	105.0	0.0																								
1	3.5	101.5	201.6	4.0	5.3	6.7	6.7	1	SP	Sand-Like	Full Liquefaction	33.8	0.0	NP	NP				30		30		4		30			
2	5.5	99.5	316.8	5.0	6.6	8.7	8.7	1	SP	Sand-Like	Full Liquefaction	37.8	0.0	NP	NP				32		32		5		32			
3	8	97.0	435.8	50.0	50.0	50.0	46.0	2	ML	Sand-Like	No Liquefaction		56.5	3.0	30.0				45		30		30		30			
4	9.5	95.5	507.2	50.0	50.0	50.0	46.0	3	ML	Sand-Like	No Liquefaction		50.7	3.0	30.0				45		30		30		30			
5	11.5	93.5	612.4	41.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		40.6	6.0	31.0				45		36		36		36			
6	16.5	88.5	875.4	26.0	34.2	48.0	46.0	5	SM	Sand-Like	No Liquefaction		64.2	6.0	31.0				45		36		36		36			
7	20.1	84.9	1064.76	50.0	50.0	50.0	46.0	6	SM	Sand-Like	No Liquefaction		64.0	6.0	31.0				45		36		36		36			
8	21	84.0	1112.1	50.0	50.0	50.0	46.0	6	SM	Sand-Like	No Liquefaction		64.0	6.0	31.0				45		36		36		36			
9	26	79.0	1375.1	50.0	50.0	50.0	46.0	7	SM	Sand-Like	No Liquefaction		64.0	6.0	31.0				45		36		36		36			
10	31	74.0	1638.1	50.0	50.0	50.0	46.0	7	SM	Sand-Like	No Liquefaction		64.0	6.0	31.0				45		36		36		36			
11	36	69.0	1901.1	50.0	50.0	50.0	46.0	7	SM	Sand-Like	No Liquefaction		64.0	6.0	31.0				45		36		36		36			
12	41	64.0	2164.1	50.0	50.0	50.0	46.0	7	SM	Sand-Like	No Liquefaction		64.0	6.0	31.0				45		36		36		36			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	**0.490**	**0.180**	g
k_{max} = **PGA =**	**0.430**	**0.200**	g
β = S_{D1}/PGA =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	**7.37**	**7.36**	
R =	**63.5**	**64.2**	km
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec
Z_{HR} =	**494.5**	**494.5**	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \le \beta \le 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20ft$ $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-7A	No. of Soil Layers =	12	each	Hammer Type = Safety
Boring Station =	5951+87.63	No. of Split Spoon Samples =	33	each	Energy Ratio = 76
Boring Offset =	8.39 ft RT	Total Profile Thickness =	120	feet	Energy Correction (C_E) = 1.27
Ground Elevation at Boring (ft msl) =	108.3	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	0	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	108.3	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	108.3														
1	2	106.3	1.0	1.27	1.00	0.75	1.00	95.2	1.00	51.0	5.5	1.3	1.0	6.5	1	ML
2	4	104.3	1.0	1.27	1.00	0.75	1.00	190.4	1.00	51.0	5.5	1.3	1.0	6.5	1	ML
3	6	102.3	3.0	1.27	1.00	0.79	1.00	305.6	1.70	5.9	0.0	3.8	5.1	5.1	2	SP-SM
4	8	100.3	8.0	1.27	1.00	0.83	1.00	420.8	1.70	7.4	0.2	10.2	14.3	14.5	2	SP-SM
5	10	98.3	47.0	1.27	1.00	0.86	1.00	526.0	1.70	47.8	5.5	50.0	50.0	46.0	3	SM
6	15	93.3	50.0	1.27	1.00	0.91	1.00	789.0	1.59	47.8	5.5	50.0	50.0	46.0	3	SM
7	20	88.3	50.0	1.27	1.00	0.95	1.00	1,052.0	1.38	47.8	5.5	50.0	50.0	46.0	3	SM
8	25	83.3	41.0	1.27	1.00	0.97	1.00	1,297.5	1.00	61.1	5.5	50.0	50.0	46.0	4	ML
9	30	78.3	50.0	1.27	1.00	0.98	1.00	1,535.5	1.00	61.1	5.5	50.0	50.0	46.0	4	ML
10	35	73.3	28.0	1.27	1.00	1.00	1.00	1,773.5	1.00	64.0	5.5	35.7	35.7	41.2	4	ML
11	40	68.3	36.0	1.27	1.00	1.00	1.00	2,011.5	1.00	64.0	5.5	45.8	45.8	46.0	4	ML
12	45	63.3	50.0	1.27	1.00	1.00	1.00	2,249.5	1.00	64.0	5.5	50.0	50.0	46.0	4	ML
13	50	58.3	50.0	1.27	1.00	1.00	1.00	2,487.5	1.00	76.0	5.5	50.0	50.0	46.0	5	ML
14	55	53.3	50.0	1.27	1.00	1.00	1.00	2,725.5	1.00	76.0	5.5	50.0	50.0	46.0	5	ML
15	60	48.3	50.0	1.27	1.00	1.00	1.00	2,963.5	1.00	76.0	5.5	50.0	50.0	46.0	5	ML
16	62	46.3	50.0	1.27	1.00	1.00	1.00	3,058.7	1.00	76.0	5.5	50.0	50.0	46.0	5	ML
17	64	44.3	43.0	1.27	1.00	1.00	1.00	3,153.9	1.00	68.0	5.5	50.0	50.0	46.0	6	ML
18	66	42.3	50.0	1.27	1.00	1.00	1.00	3,249.1	1.00	68.0	5.5	50.0	50.0	46.0	6	ML
19	68	40.3	50.0	1.27	1.00	1.00	1.00	3,344.3	1.00	68.0	5.5	50.0	50.0	46.0	6	ML
20	70	38.3	50.0	1.27	1.00	1.00	1.00	3,439.5	1.00	68.0	5.5	50.0	50.0	46.0	6	ML
21	72	36.3	6.0	1.27	1.00	1.00	1.00	3,544.7	0.75	16.1	3.6	7.6	5.7	9.3	7	SM
22	74	34.3	7.0	1.27	1.00	1.00	1.00	3,649.9	0.74	16.1	3.6	8.9	6.6	10.2	7	SM
23	76	32.3	7.0	1.27	1.00	1.00	1.00	3,755.1	0.73	16.1	3.6	8.9	6.5	10.1	7	SM
24	78	30.3	50.0	1.27	1.00	1.00	1.00	3,860.3	0.72	16.4	3.7	50.0	45.8	46.0	8	SM
25	80	28.3	50.0	1.27	1.00	1.00	1.00	3,965.5	0.71	16.4	3.7	50.0	45.2	46.0	8	SM
26	85	23.3	50.0	1.27	1.00	1.00	1.00	4,228.5	0.69	16.4	3.7	50.0	43.8	46.0	8	SM
27	90	18.3	50.0	1.27	1.00	1.00	1.00	4,491.5	0.67	16.4	3.7	50.0	42.5	46.0	8	SM
28	95	13.3	50.0	1.27	1.00	1.00	1.00	4,779.5	0.65	8.5	0.5	50.0	41.2	41.7	9	SP-SM
29	100	8.3	50.0	1.27	1.00	1.00	1.00	5,012.5	1.00	51.0	5.5	50.0	50.0	46.0	10	CL
30	105	3.3	50.0	1.27	1.00	1.00	1.00	5,268.0	0.62	12.0	2.1	50.0	39.2	41.3	11	SM
31	110	-1.7	50.0	1.27	1.00	1.00	1.00	5,531.0	0.60	12.0	2.1	50.0	38.3	40.4	11	SM
32	115	-6.7	50.0	1.27	1.00	1.00	1.00	5,781.5	1.00	80.0	5.5	50.0	50.0	46.0	12	MH
33	120	-11.7	50.0	1.27	1.00	1.00	1.00	6,019.5	1.00	80.0	5.5	50.0	50.0	46.0	12	MH

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-7A	**No. of Soil Layers =**	12	each
Boring Station =	5951+87.63	**No. of Split Spoon Samples =**	33	each
Boring Offset =	8.39 ft RT	**Total Profile Thickness =**	120	feet
Ground Elevation at Boring (ft msl) =	108.3			
Water Table Depth (Dw) (ft) =	0			
Water Table Elevation (msl ft) =	108.3			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	108.3														
1	2	106.3	1.0	6.5	1	ML	110.0	Quaternary	Holocene	Alluvium	1.20	51.0		30	27	3
2	4	104.3	1.0	6.5	1	ML	110.0	Quaternary	Holocene	Alluvium	1.20	51.0		30	27	3
3	6	102.3	3.0	5.1	2	SP-SM	120.0	Quaternary	Holocene	Alluvium	1.20	5.9	20.3	NP	NP	NP
4	8	100.3	8.0	14.5	2	SP-SM	120.0	Quaternary	Holocene	Alluvium	1.20	7.4	19.9	NP	NP	NP
5	10	98.3	47.0	46.0	3	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	33.6	25	22	3
6	15	93.3	50.0	46.0	3	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	33.6	25	22	3
7	20	88.3	50.0	46.0	3	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	47.8	33.6	25	22	3
8	25	83.3	41.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	61.1	42.8	36	35	1
9	30	78.3	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	61.1	42.8	36	35	1
10	35	73.3	28.0	41.2	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	64.0	36.2	27	23	4
11	40	68.3	36.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	64.0	36.2	27	23	4
12	45	63.3	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	64.0	36.2	27	23	4
13	50	58.3	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	76.0	43.3	44	31	13
14	55	53.3	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	76.0	43.3	44	31	13
15	60	48.3	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	76.0	43.3	44	31	13
16	62	46.3	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	76.0	43.3	44	31	13
17	64	44.3	43.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.0	44.7	43	31	12
18	66	42.3	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.0	44.7	43	31	12
19	68	40.3	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.0	44.7	43	31	12
20	70	38.3	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	68.0	44.7	43	31	12
21	72	36.3	6.0	9.3	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	16.1	55.9	NP	NP	NP
22	74	34.3	7.0	10.2	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	16.1	55.9	NP	NP	NP
23	76	32.3	7.0	10.1	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	16.1	55.9	NP	NP	NP
24	78	30.3	50.0	46.0	8	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	16.4	36.1	NP	NP	NP
25	80	28.3	50.0	46.0	8	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	16.4	36.1	NP	NP	NP
26	85	23.3	50.0	46.0	8	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	16.4	36.1	NP	NP	NP
27	90	18.3	50.0	46.0	8	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	16.4	36.1	NP	NP	NP
28	95	13.3	50.0	41.7	9	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	8.5	26.7	NP	NP	NP
29	100	8.3	50.0	46.0	10	CL	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	51.0		30	10	20
30	105	3.3	50.0	41.3	11	SM	115.0	Paleogene	Eocene	Subcongaree Formation	2.10	12.0		15	8	7
31	110	-1.7	50.0	40.4	11	SM	115.0	Paleogene	Eocene	Subcongaree Formation	2.10	12.0		15	8	7
32	115	-6.7	50.0	46.0	12	MH	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	80.0		75	55	20
33	120	-11.7	50.0	46.0	12	MH	110.0	Paleogene	Eocene	Subcongaree Formation	1.00	80.0		75	55	20

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-7A	Design EQ =	SEE	SSL Water Table Depth (ft) =	0.0
Boring Station =	595187.63	Site Class =	D	SSL Water Table Elev. (msl ft) =	110.0
Boring Offset =	8.39 ft RT	PGA (g) =	0.43		
Ground Elevation at Boring (ft msl) =	108.3	M_W =	7.4		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	108.3	D_{a5-95} (sec) =	30.15		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	108.3														
1	2.0	106.3	6.5	ML	SSL	Sand-Like	5.00	0.90	Full Liquefaction	0.70 - 1.00	4.0		1.00	6.44	1.13	6.92
2	4.0	104.3	6.5	ML	SSL	Sand-Like	4.97	0.90	Full Liquefaction	0.70 - 1.00	4.0		1.00	5.44	1.13	5.79
3	6.0	102.3	5.1	SP-SM	SSL	Sand-Like	5.19	0.90	Full Liquefaction	0.70 - 1.00	4.0		1.00	4.44	1.25	4.66
4	8.0	100.3	14.5	SP-SM	SSL	Sand-Like	2.90	0.90	Full Liquefaction	0.70 - 1.00	11.0		0.58	3.44	0.71	3.42
5	10.0	98.3	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			2.86		2.71
6	15.0	93.3	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			2.86		2.71
7	20.0	88.3	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			2.86		2.71
8	25.0	83.3	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.86		2.71
9	30.0	78.3	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.86		2.71
10	35.0	73.3	41.2	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.86		2.71
11	40.0	68.3	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.86		2.71
12	45.0	63.3	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.86		2.71
13	50.0	58.3	46.0	ML	PSL	NS Clay-Like	0.77	0.90	No Strength Loss			2170.0		2.86		2.71
14	55.0	53.3	46.0	ML	PSL	NS Clay-Like	0.82	0.90	No Strength Loss			2230.0		2.86		2.71
15	60.0	48.3	46.0	ML	PSL	NS Clay-Like	0.87	0.90	No Strength Loss			2290.0		2.86		2.71
16	62.0	46.3	46.0	ML	PSL	NS Clay-Like	0.89	0.90	No Strength Loss			2320.0		2.86		2.71
17	64.0	44.3	46.0	ML	NSL-C				No Strength Loss			2350.0		2.86		2.71
18	66.0	42.3	46.0	ML	NSL-C				No Strength Loss			2370.0		2.86		2.71
19	68.0	40.3	46.0	ML	NSL-C				No Strength Loss			2400.0		2.86		2.71
20	70.0	38.3	46.0	ML	NSL-C				No Strength Loss			2420.0		2.86		2.71
21	72.0	36.3	9.3	SM	SSL	Sand-Like	1.90	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.00	2.86	0.93	2.71
22	74.0	34.3	10.2	SM	SSL	Sand-Like	1.79	0.90	Full Liquefaction	0.70 - 1.00	6.0		0.93	1.86	0.89	1.78
23	76.0	32.3	10.1	SM	SSL	Sand-Like	1.78	0.90	Full Liquefaction	0.70 - 1.00	6.0		0.93	0.93	0.89	0.89
24	78.0	30.3	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
25	80.0	28.3	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
26	85.0	23.3	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
27	90.0	18.3	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
28	95.0	13.3	41.7	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
29	100.0	8.3	46.0	CL	PSL	NS Clay-Like	0.83	0.90	No Strength Loss			4000.0		0.00		0.00
30	105.0	3.3	41.3	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
31	110.0	-1.7	40.4	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
32	115.0	-6.7	46.0	MH	NSL-C				No Strength Loss			3050.0		0.00		0.00
33	120.0	-11.7	46.0	MH	NSL-C				No Strength Loss			3110.0		0.00		0.00
													6.44		6.92	
													LDI Total (feet)		S Total (inches)	

[D]Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-7A	Design EQ =	SEE	No. of Soil Layers =	12 each
Boring Station =	5951+87.63	Site Class =	D	No. of Split Spoon Samples =	33 each
Boring Offset =	8.39 ft RT	PGA (g) =	0.43	Total Profile Thickness =	120 feet
Ground Elevation at Boring (ft msl) =	108.3	M_W =	7.37		
Water Table Depth (Dw) (ft) =	0	R (km) =	0		
Water Table Elevation (msl ft) =	108.3	$D_{a5\text{-}95}$ (sec) =	30.15		

																		Total Soil Shear Strengths						Effective Soil Shear Strengths			
																		Short Term Loading				Cyclic Loading		Long Term Loading			
																		Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																		ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	108.3	0.0																								
1	2	106.3	95.2	1.0	1.3	1.0	6.5	1	ML	Sand-Like	Full Liquefaction	16.6	51.0	3.0	30.0				24		24		4		24			
2	4	104.3	190.4	1.0	1.3	1.0	6.5	1	ML	Sand-Like	Full Liquefaction	16.6	51.0	3.0	30.0				24		24		4		24			
3	6	102.3	305.6	3.0	3.8	5.1	5.1	2	SP-SM	Sand-Like	Full Liquefaction	28.8	5.9	NP	NP	0.119	7.4	1.5	29		29		4		29			
4	8	100.3	420.8	8.0	10.2	14.3	14.5	2	SP-SM	Sand-Like	Full Liquefaction	47.1	7.4	NP	NP	0.096	7.8	2.1	35		35		11		35			
5	10	98.3	526	47.0	50.0	50.0	46.0	3	SM	Sand-Like	No Liquefaction		47.8	3.0	25.0				45		36		36		36			
6	15	93.3	789	50.0	50.0	50.0	46.0	3	SM	Sand-Like	No Liquefaction		47.8	3.0	25.0				45		36		36		36			
7	20	88.3	1052	50.0	50.0	50.0	46.0	3	SM	Sand-Like	No Liquefaction		47.8	3.0	25.0				45		36		36		36			
8	25	83.3	1297.5	41.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		61.1	1.0	36.0				45		30		30		30			
9	30	78.3	1535.5	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		61.1	1.0	36.0				45		30		30		30			
10	35	73.3	1773.5	28.0	35.7	35.7	41.2	4	ML	Sand-Like	No Liquefaction		64.0	4.0	27.0	0.003	21.3	1.9	43		30		30		30			
11	40	68.3	2011.5	36.0	45.8	45.8	46.0	4	ML	Sand-Like	No Liquefaction		64.0	4.0	27.0				45		30		30		30			
12	45	63.3	2249.5	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		64.0	4.0	27.0				45		30		30		30			
13	50	58.3	2487.5	50.0	50.0	50.0	46.0	5	ML	NS Clay-Like	No Strength Loss		76.0	13.0	44.0	0.003	14.7	0.5		7500		2170		2170			27	
14	55	53.3	2725.5	50.0	50.0	50.0	46.0	5	ML	NS Clay-Like	No Strength Loss		76.0	13.0	44.0					7500		2230		2230			27	
15	60	48.3	2963.5	50.0	50.0	50.0	46.0	5	ML	NS Clay-Like	No Strength Loss		76.0	13.0	44.0					7500		2290		2290			27	
16	62	46.3	3058.7	50.0	50.0	50.0	46.0	5	ML	NS Clay-Like	No Strength Loss		76.0	13.0	44.0					7500		2320		2320			27	
17	64	44.3	3153.9	43.0	50.0	50.0	46.0	6	ML		No Strength Loss		68.0	12.0	43.0	0.003	17.1	0.7		7500		2350		2350			27	
18	66	42.3	3249.1	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		68.0	12.0	43.0					7500		2370		2370			27	
19	68	40.3	3344.3	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		68.0	12.0	43.0					7500		2400		2400			27	
20	70	38.3	3439.5	50.0	50.0	50.0	46.0	6	ML		No Strength Loss		68.0	12.0	43.0					7500		2420		2420			27	
21	72	36.3	3544.7	6.0	7.6	5.7	9.3	7	SM	Sand-Like	Full Liquefaction	40.8	16.1	NP	NP				29		29		5		29			
22	74	34.3	3649.9	7.0	8.9	6.6	10.2	7	SM	Sand-Like	Full Liquefaction	44.0	16.1	NP	NP				30		30		6		30			
23	76	32.3	3755.1	7.0	8.9	6.5	10.1	7	SM	Sand-Like	Full Liquefaction	44.0	16.1	NP	NP				30		30		6		30			
24	78	30.3	3860.3	50.0	50.0	45.8	46.0	8	SM	Sand-Like	No Liquefaction		16.4	NP	NP				45		36		36		36			
25	80	28.3	3965.5	50.0	50.0	45.2	46.0	8	SM	Sand-Like	No Liquefaction		16.4	NP	NP				45		36		36		36			
26	85	23.3	4228.5	50.0	50.0	43.8	46.0	8	SM	Sand-Like	No Liquefaction		16.4	NP	NP				45		36		36		36			
27	90	18.3	4491.5	50.0	50.0	42.5	46.0	8	SM	Sand-Like	No Liquefaction		16.4	NP	NP				45		36		36		36			
28	95	13.3	4779.5	50.0	50.0	41.2	41.7	9	SP-SM	Sand-Like	No Liquefaction		8.5	NP	NP	0.093	5.3	1.6	45		36		36		36			
29	100	8.3	5012.5	50.0	50.0	50.0	46.0	10	CL	NS Clay-Like	No Strength Loss		51.0	20.0	30.0					7500		4000		4000		2	26	400
30	105	3.3	5268	50.0	50.0	39.2	41.3	11	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				45		36		36		36			
31	110	-1.7	5531	50.0	50.0	38.3	40.4	11	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0				44		36		36		36			
32	115	-6.7	5781.5	50.0	50.0	50.0	46.0	12	MH		No Strength Loss		80.0	20.0	75.0					7500		3050		3050		1	26	305
33	120	-11.7	6019.5	50.0	50.0	50.0	46.0	12	MH		No Strength Loss		80.0	20.0	75.0					7500		3110		3110		1	26	311

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457470000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.648210000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: — $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: — $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: — $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis
R =	**63.5**	**64.2**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: — R < 20 km; ε = 0.015(R-20)
$D_{a5\text{-}95}$	30.15	30.09	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48 — R ≥ 20 km; ε = 0

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.45747	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.64821	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-8	No. of Soil Layers =	10	each	Hammer Type = Automatic
Boring Station =	5952+17.00	No. of Split Spoon Samples =	24	each	Energy Ratio = 79
Boring Offset =	8' RT	Total Profile Thickness =	101	feet	Energy Correction (C_E) = 1.32
Ground Elevation at Boring (ft msl) =	120	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	10.4	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	109.6	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	120.0														
1	3.5	116.5	13.0	1.32	1.00	0.75	1.00	420.0	1.70	11.9	2.0	17.1	21.8	23.9	1	SW-SM
2	5.5	114.5	11.0	1.32	1.00	0.78	1.00	660.0	1.70	0.0	0.0	14.5	19.1	19.1	2	SP
3	7.5	112.5	4.0	1.32	1.00	0.82	1.00	900.0	1.49	0.0	0.0	5.3	6.4	6.4	2	SP
4	9.5	110.5	5.0	1.32	1.00	0.85	1.00	1,140.0	1.32	0.0	0.0	6.6	7.4	7.4	2	SP
5	11.5	108.5	5.0	1.32	1.00	0.88	1.00	1,302.9	1.24	20.1	4.5	6.6	7.2	11.7	3	SM
6	21.5	98.5	2.0	1.32	1.00	0.96	1.00	1,869.9	1.03	1.8	0.0	2.6	2.6	2.6	4	SP
7	26.5	93.5	34.0	1.32	1.00	0.98	1.00	2,140.4	0.97	42.0	5.5	44.8	42.2	46.0	5	SM
8	30.3	89.7	50.0	1.32	1.00	0.98	1.00	2,340.2	0.92	42.0	5.5	50.0	50.0	46.0	5	SM
9	30.4	89.6	36.0	1.32	1.00	0.98	1.00	2,345.5	0.92	42.0	5.5	47.4	43.1	46.0	6	SM
10	31.3	88.7	36.0	1.32	1.00	0.99	1.00	2,392.8	0.91	42.0	5.5	47.4	42.7	46.0	6	SM
11	36.3	83.7	36.0	1.32	1.00	1.00	1.00	2,655.8	0.87	42.0	5.5	47.4	41.1	46.0	6	SM
12	41.3	78.7	36.0	1.32	1.00	1.00	1.00	2,918.8	0.83	42.0	5.5	47.4	39.2	44.7	6	SM
13	46.3	73.7	36.0	1.32	1.00	1.00	1.00	3,181.8	0.79	42.0	5.5	47.4	37.6	43.1	7	SM
14	51.3	68.7	36.0	1.32	1.00	1.00	1.00	3,444.8	0.76	42.0	5.5	47.4	36.1	41.6	7	SM
15	56.5	63.5	22.0	1.32	1.00	1.00	1.00	3,718.4	0.73	42.0	5.5	29.0	21.2	26.7	8	SM
16	61.5	58.5	36.0	1.32	1.00	1.00	1.00	3,981.4	0.71	42.0	5.5	47.4	33.6	39.1	8	SM
17	66.5	53.5	44.0	1.32	1.00	1.00	1.00	4,244.4	0.69	42.0	5.5	50.0	39.8	45.3	8	SM
18	71.5	48.5	40.0	1.32	1.00	1.00	1.00	4,507.4	0.67	42.0	5.5	50.0	35.1	40.6	8	SM
19	76.5	43.5	39.0	1.32	1.00	1.00	1.00	4,770.4	0.65	42.0	5.5	50.0	33.2	38.7	8	SM
20	81.5	38.5	44.0	1.32	1.00	1.00	1.00	5,033.4	0.63	42.0	5.5	50.0	36.5	42.0	8	SM
21	86.5	33.5	42.0	1.32	1.00	1.00	1.00	5,296.4	0.61	42.0	5.5	50.0	34.0	39.5	8	SM
22	91.5	28.5	39.0	1.32	1.00	1.00	1.00	5,576.9	0.60	5.0	0.0	50.0	30.8	30.8	9	SP-SM
23	96.5	23.5	50.0	1.32	1.00	1.00	1.00	5,864.9	0.58	5.0	0.0	50.0	38.4	38.4	10	SW-SM
24	101.4	18.6	50.0	1.32	1.00	1.00	1.00	6,147.1	0.57	5.0	0.0	50.0	37.6	37.6	10	SW-SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.45747	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.64821	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	B-8	**No. of Soil Layers =**	10	each
Boring Station =	5952+17.00	**No. of Split Spoon Samples =**	24	each
Boring Offset =	8' RT	**Total Profile Thickness =**	101	feet
Ground Elevation at Boring (ft msl) =	120			
Water Table Depth (Dw) (ft) =	10.4			
Water Table Elevation (msl ft) =	109.6			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	120.0														
1	3.5	116.5	13.0	23.9	1	SW-SM	120.0	Recent	Recent	Fill	1.00	11.9	8.3	NP	NP	NP
2	5.5	114.5	11.0	19.1	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
3	7.5	112.5	4.0	6.4	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
4	9.5	110.5	5.0	7.4	2	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
5	11.5	108.5	5.0	11.7	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	20.1	33.4	31	28	3
6	21.5	98.5	2.0	2.6	4	SP	120.0	Quaternary	Holocene	Alluvium	1.20	1.8	15	NP	NP	NP
7	26.5	93.5	34.0	46.0	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
8	30.3	89.7	50.0	46.0	5	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
9	30.4	89.6	36.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
10	31.3	88.7	36.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
11	36.3	83.7	36.0	46.0	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
12	41.3	78.7	36.0	44.7	6	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
13	46.3	73.7	36.0	43.1	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
14	51.3	68.7	36.0	41.6	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
15	56.5	63.5	22.0	26.7	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
16	61.5	58.5	36.0	39.1	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
17	66.5	53.5	44.0	45.3	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
18	71.5	48.5	40.0	40.6	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
19	76.5	43.5	39.0	38.7	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
20	81.5	38.5	44.0	42.0	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
21	86.5	33.5	42.0	39.5	8	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	42.0	30	36	30	6
22	91.5	28.5	39.0	30.8	9	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
23	96.5	23.5	50.0	38.4	10	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
24	101.4	18.6	50.0	37.6	10	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.45747**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.64821**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**B-8**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**10.0**
Boring Station =	**595217**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**8' RT**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**120**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**10.4**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**109.6**	**D_{a5-95} (sec) =**	**30.15**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	120.0														
1	3.5	116.5	23.9	SW-SM	NSL-S	Sand-Like			No Liquefaction		38.0			5.79		8.75
2	5.5	114.5	19.1	SP	NSL-S	Sand-Like			No Liquefaction		32.0			5.79		8.75
3	7.5	112.5	6.4	SP	NSL-S	Sand-Like			No Liquefaction		30.0			5.79		8.75
4	9.5	110.5	7.4	SP	NSL-S	Sand-Like			No Liquefaction		31.0			5.79		8.75
5	11.5	108.5	11.7	SM	SSL	Sand-Like	1.75	0.90	Full Liquefaction	0.70 - 1.00	7.0		0.79	5.79	0.82	8.75
6	21.5	98.5	2.6	SP	SSL	Sand-Like	3.98	0.90	Full Liquefaction	0.70 - 1.00	3.0		5.00	5.00	7.94	7.94
7	26.5	93.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
8	30.3	89.7	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
9	30.4	89.6	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
10	31.3	88.7	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
11	36.3	83.7	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
12	41.3	78.7	44.7	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
13	46.3	73.7	43.1	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
14	51.3	68.7	41.6	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
15	56.5	63.5	26.7	SM	SSL	Sand-Like	0.58	0.75	No Liquefaction	0.19	36.0			0.00		0.00
16	61.5	58.5	39.1	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
17	66.5	53.5	45.3	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
18	71.5	48.5	40.6	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
19	76.5	43.5	38.7	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
20	81.5	38.5	42.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
21	86.5	33.5	39.5	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
22	91.5	28.5	30.8	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
23	96.5	23.5	38.4	SW-SM	NSL-S	Sand-Like			No Liquefaction		38.0			0.00		0.00
24	101.4	18.6	37.6	SW-SM	NSL-S	Sand-Like			No Liquefaction		38.0			0.00		0.00

5.79	**8.75**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.45747	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.64821	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-8	Design EQ =	SEE	No. of Soil Layers =	10 each
Boring Station =	5952+17.00	Site Class =	D	No. of Split Spoon Samples =	24 each
Boring Offset =	8' RT	PGA (g) =	0.43	Total Profile Thickness =	101 feet
Ground Elevation at Boring (ft msl) =	120	M_W =	7.37		
Water Table Depth (Dw) (ft) =	10.4	R (km) =	0		
Water Table Elevation (msl ft) =	109.6	$D_{a5\text{-}95}$ (sec) =	30.15		

																		Total Soil Shear Strengths						Effective Soil Shear Strengths			
																		Short Term Loading				Cyclic Loading		Long Term Loading			
																		Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																		ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	120.0	0.0																								
1	3.5	116.5	420	13.0	17.1	21.8	23.9	1	SW-SM	Sand-Like	No Liquefaction		11.9	NP	NP												
2	5.5	114.5	660	11.0	14.5	19.1	19.1	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP												
3	7.5	112.5	900	4.0	5.3	6.4	6.4	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP												
4	9.5	110.5	1140	5.0	6.6	7.4	7.4	2	SP	Sand-Like	No Liquefaction		0.0	NP	NP												
5	11.5	108.5	1302.86	5.0	6.6	7.2	11.7	3	SM	Sand-Like	Full Liquefaction	37.8	20.1	3.0	31.0												
6	21.5	98.5	1869.86	2.0	2.6	2.6	2.6	4	SP	Sand-Like	Full Liquefaction	23.9	1.8	NP	NP												
7	26.5	93.5	2140.36	34.0	44.8	42.2	46.0	5	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
8	30.3	89.7	2340.24	50.0	50.0	50.0	46.0	5	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
9	30.4	89.6	2345.5	36.0	47.4	43.1	46.0	6	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
10	31.3	88.7	2392.84	36.0	47.4	42.7	46.0	6	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
11	36.3	83.7	2655.84	36.0	47.4	41.1	46.0	6	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
12	41.3	78.7	2918.84	36.0	47.4	39.2	44.7	6	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
13	46.3	73.7	3181.84	36.0	47.4	37.6	43.1	7	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
14	51.3	68.7	3444.84	36.0	47.4	36.1	41.6	7	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
15	56.5	63.5	3718.36	22.0	29.0	21.2	26.7	8	SM	Sand-Like	No Liquefaction	79.4	42.0	6.0	36.0												
16	61.5	58.5	3981.36	36.0	47.4	33.6	39.1	8	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
17	66.5	53.5	4244.36	44.0	50.0	39.8	45.3	8	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
18	71.5	48.5	4507.36	40.0	50.0	35.1	40.6	8	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
19	76.5	43.5	4770.36	39.0	50.0	33.2	38.7	8	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
20	81.5	38.5	5033.36	44.0	50.0	36.5	42.0	8	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
21	86.5	33.5	5296.36	42.0	50.0	34.0	39.5	8	SM	Sand-Like	No Liquefaction		42.0	6.0	36.0												
22	91.5	28.5	5576.86	39.0	50.0	30.8	30.8	9	SP-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0												
23	96.5	23.5	5864.86	50.0	50.0	38.4	38.4	10	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0												
24	101.4	18.6	6147.1	50.0	50.0	37.6	37.6	10	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0												

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D		
Design Earthquake:	**SEE**	**FEE**	
S_{D1} =	**0.490**	**0.180**	g
k_{max} = **PGA =**	**0.430**	**0.200**	g
β = S_{D1}/PGA =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	**7.37**	**7.36**	
R =	**63.5**	**64.2**	km
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec
Z_{HR} =	**494.5**	**494.5**	meters
ε =	0.000	0.000	
D_{a5-95}	30.15	30.09	sec

β = Ground Motion Index: $0.50 \le \beta \le 1.5$

α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20ft$ $\alpha_w = 1.0$

k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$

M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis

R = Site-to-Source Distance

$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet

Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output

ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0

D_{a5-95} = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-9	No. of Soil Layers =	12	each	Hammer Type =	Automatic
Boring Station =	5952+28.00	No. of Split Spoon Samples =	23	each	Energy Ratio =	79
Boring Offset =	8 ft LT	Total Profile Thickness =	102	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	120	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	12.6	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	107.4	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	120.0														
1	3.5	116.5	7.0	1.32	1.00	0.75	1.00	402.5	1.70	18.9	4.3	9.2	11.8	16.0	1	SM
2	5.5	114.5	5.0	1.32	1.00	0.78	1.00	640.0	1.70	0.0	0.0	6.6	8.7	8.7	2	SW
3	7.5	112.5	4.0	1.32	1.00	0.82	1.00	880.0	1.51	5.6	0.0	5.3	6.5	6.5	3	SP-SM
4	9.5	110.5	3.0	1.32	1.00	0.85	1.00	1,120.0	1.34	0.0	0.0	4.0	4.5	4.5	4	SW
5	11.5	108.5	2.0	1.32	1.00	0.88	1.00	1,351.5	1.22	21.0	4.6	2.6	2.8	7.4	5	SM
6	16.5	103.5	27.0	1.32	1.00	0.93	1.00	1,699.1	1.08	4.6	0.0	35.6	35.8	35.8	6	SW
7	21.5	98.5	50.0	1.32	1.00	0.96	1.00	1,972.1	1.01	48.4	5.5	50.0	50.0	46.0	7	SM
8	26.5	93.5	36.0	1.32	1.00	0.98	1.00	2,235.1	0.95	35.7	5.5	47.4	43.7	46.0	8	SC-SM
9	31.5	88.5	35.0	1.32	1.00	0.99	1.00	2,498.1	0.89	35.7	5.5	46.1	40.6	46.0	8	SC-SM
10	36.5	83.5	21.0	1.32	1.00	1.00	1.00	2,745.1	1.00	59.4	5.5	27.7	27.7	33.2	9	ML
11	41.5	78.5	27.0	1.32	1.00	1.00	1.00	2,983.1	1.00	59.4	5.5	35.6	35.6	41.1	9	ML
12	46.5	73.5	24.0	1.32	1.00	1.00	1.00	3,221.1	1.00	59.4	5.5	31.6	31.6	37.1	9	ML
13	51.5	68.5	50.0	1.32	1.00	1.00	1.00	3,459.1	1.00	59.4	5.5	50.0	50.0	46.0	9	ML
14	56.5	63.5	20.0	1.32	1.00	1.00	1.00	3,697.1	1.00	59.4	5.5	26.3	26.3	31.8	9	ML
15	61.5	58.5	31.0	1.32	1.00	1.00	1.00	3,935.1	1.00	59.4	5.5	40.8	40.8	46.0	9	ML
16	66.5	53.5	43.0	1.32	1.00	1.00	1.00	4,173.1	1.00	59.4	5.5	50.0	50.0	46.0	9	ML
17	71.5	48.5	27.0	1.32	1.00	1.00	1.00	4,411.1	1.00	59.4	5.5	35.6	35.6	41.1	9	ML
18	76.5	43.5	34.0	1.32	1.00	1.00	1.00	4,649.1	1.00	59.4	5.5	44.8	44.8	46.0	9	ML
19	81.5	38.5	49.0	1.32	1.00	1.00	1.00	4,887.1	1.00	59.4	5.5	50.0	50.0	46.0	9	ML
20	86.5	33.5	43.0	1.32	1.00	1.00	1.00	5,125.1	1.00	59.4	5.5	50.0	50.0	46.0	9	ML
21	91.5	28.5	7.0	1.32	1.00	1.00	1.00	5,398.1	0.61	5.0	0.0	9.2	5.6	5.6	10	SP-SM
22	96.5	23.5	50.0	1.32	1.00	1.00	1.00	5,670.1	0.59	12.0	2.1	50.0	39.1	41.2	11	SM
23	101.5	18.5	24.0	1.32	1.00	1.00	1.00	5,955.6	0.58	5.0	0.0	31.6	18.3	18.3	12	SW-SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**B-9**	**No. of Soil Layers =**	**12** each
Boring Station =	**5952+28.00**	**No. of Split Spoon Samples =**	**23** each
Boring Offset =	**8 ft LT**	**Total Profile Thickness =**	**102** feet
Ground Elevation at Boring (ft msl) =	**120**		
Water Table Depth (Dw) (ft) =	**12.6**		
Water Table Elevation (msl ft) =	**107.4**		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	120.0														
1	3.5	116.5	7.0	16.0	1	SM	115.0	Recent	Recent	Fill	1.00	18.9	13.3	20	18	2
2	5.5	114.5	5.0	8.7	2	SW	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
3	7.5	112.5	4.0	6.5	3	SP-SM	120.0	Quaternary	Holocene	Alluvium	1.20	5.6	10.5	NP	NP	NP
4	9.5	110.5	3.0	4.5	4	SW	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
5	11.5	108.5	2.0	7.4	5	SM	115.0	Quaternary	Holocene	Alluvium	1.20	21.0		31	29	2
6	16.5	103.5	27.0	35.8	6	SW	120.0	Paleogene	Eocene	Santee Limestone	2.10	4.6		NP	NP	NP
7	21.5	98.5	50.0	46.0	7	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	48.4	24.1	34	28	6
8	26.5	93.5	36.0	46.0	8	SC-SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	35.7	23.3	26	21	5
9	31.5	88.5	35.0	46.0	8	SC-SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	35.7	23.3	26	21	5
10	36.5	83.5	21.0	33.2	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
11	41.5	78.5	27.0	41.1	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
12	46.5	73.5	24.0	37.1	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
13	51.5	68.5	50.0	46.0	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
14	56.5	63.5	20.0	31.8	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
15	61.5	58.5	31.0	46.0	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
16	66.5	53.5	43.0	46.0	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
17	71.5	48.5	27.0	41.1	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
18	76.5	43.5	34.0	46.0	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
19	81.5	38.5	49.0	46.0	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
20	86.5	33.5	43.0	46.0	9	ML	110.0	Paleogene	Eocene	Congaree Formation	2.10	59.4	41.7	41	40	1
21	91.5	28.5	7.0	5.6	10	SP-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4
22	96.5	23.5	50.0	41.2	11	SM	115.0	Paleogene	Eocene	Congaree Formation	2.10	12.0		15	8	7
23	101.5	18.5	24.0	18.3	12	SW-SM	120.0	Paleogene	Eocene	Congaree Formation	2.10	5.0		10	6	4

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**B-9**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**10.0**
Boring Station =	**595228**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**8 ft LT**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**120**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**12.6**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**107.4**	**D_{a5-95} (sec) =**	**30.15**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	120.0														
1	3.5	116.5	16.0	SM	NSL-S	Sand-Like			No Liquefaction		34.0			3.66		4.64
2	5.5	114.5	8.7	SW	NSL-S	Sand-Like			No Liquefaction		32.0			3.66		4.64
3	7.5	112.5	6.5	SP-SM	NSL-S	Sand-Like			No Liquefaction		30.0			3.66		4.64
4	9.5	110.5	4.5	SW	NSL-S	Sand-Like			No Liquefaction		28.0			3.66		4.64
5	11.5	108.5	7.4	SM	SSL	Sand-Like	2.26	0.90	Full Liquefaction	0.70 - 1.00	4.0		1.00	3.66	1.05	4.64
6	16.5	103.5	35.8	SW	NSL-S	Sand-Like			No Liquefaction		38.0			2.66		3.59
7	21.5	98.5	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			2.66		3.59
8	26.5	93.5	46.0	SC-SM	NSL-S	Sand-Like			No Liquefaction		36.0			2.66		3.59
9	31.5	88.5	46.0	SC-SM	NSL-S	Sand-Like			No Liquefaction		36.0			2.66		3.59
10	36.5	83.5	33.2	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
11	41.5	78.5	41.1	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
12	46.5	73.5	37.1	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
13	51.5	68.5	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
14	56.5	63.5	31.8	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
15	61.5	58.5	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
16	66.5	53.5	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
17	71.5	48.5	41.1	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
18	76.5	43.5	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
19	81.5	38.5	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
20	86.5	33.5	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			2.66		3.59
21	91.5	28.5	5.6	SP-SM	SSL	Sand-Like	1.95	0.90	Full Liquefaction	0.70 - 1.00	4.0		2.50	2.66	3.00	3.59
22	96.5	23.5	41.2	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.16		0.59
23	101.5	18.5	18.3	SW-SM	SSL	Sand-Like	0.97	0.90	Full Liquefaction	0.70 - 1.00	31.0		0.16	0.16	0.59	0.59

3.66	**4.64**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	B-9	Design EQ =	SEE	No. of Soil Layers =	12 each
Boring Station =	5952+28.00	Site Class =	D	No. of Split Spoon Samples =	23 each
Boring Offset =	8 ft LT	PGA (g) =	0.43	Total Profile Thickness =	102 feet
Ground Elevation at Boring (ft msl) =	120	M_W =	7.37		
Water Table Depth (Dw) (ft) =	12.6	R (km) =	0		
Water Table Elevation (msl ft) =	107.4	$D_{a5\text{-}95}$ (sec) =	30.15		

																		Total Soil Shear Strengths						Effective Soil Shear Strengths			
																		Short Term Loading				Cyclic Loading		Long Term Loading			
																		Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																		ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	120.0	0.0																								
1	3.5	116.5	402.5	7.0	9.2	11.8	16.0	1	SM	Sand-Like	No Liquefaction		18.9	2.0	20.0					33		34		34		34			
2	5.5	114.5	640	5.0	6.6	8.7	8.7	2	SW	Sand-Like	No Liquefaction		0.0	NP	NP					32		32		32		32			
3	7.5	112.5	880	4.0	5.3	6.5	6.5	3	SP-SM	Sand-Like	No Liquefaction		5.6	NP	NP					30		30		30		30			
4	9.5	110.5	1120	3.0	4.0	4.5	4.5	4	SW	Sand-Like	No Liquefaction		0.0	NP	NP					28		28		28		28			
5	11.5	108.5	1351.5	2.0	2.6	2.8	7.4	5	SM	Sand-Like	Full Liquefaction	23.9	21.0	2.0	31.0					27		27		4		27			
6	16.5	103.5	1699.14	27.0	35.6	35.8	35.8	6	SW	Sand-Like	No Liquefaction		4.6	NP	NP					43		38		38		38			
7	21.5	98.5	1972.14	50.0	50.0	50.0	46.0	7	SM	Sand-Like	No Liquefaction		48.4	6.0	34.0					45		36		36		36			
8	26.5	93.5	2235.14	36.0	47.4	43.7	46.0	8	SC-SM	Sand-Like	No Liquefaction		35.7	5.0	26.0					45		36		36		36			
9	31.5	88.5	2498.14	35.0	46.1	40.6	46.0	8	SC-SM	Sand-Like	No Liquefaction		35.7	5.0	26.0					45		36		36		36			
10	36.5	83.5	2745.14	21.0	27.7	27.7	33.2	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					41		30		30		30			
11	41.5	78.5	2983.14	27.0	35.6	35.6	41.1	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					43		30		30		30			
12	46.5	73.5	3221.14	24.0	31.6	31.6	37.1	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					42		30		30		30			
13	51.5	68.5	3459.14	50.0	50.0	50.0	46.0	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					45		30		30		30			
14	56.5	63.5	3697.14	20.0	26.3	26.3	31.8	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					40		30		30		30			
15	61.5	58.5	3935.14	31.0	40.8	40.8	46.0	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					45		30		30		30			
16	66.5	53.5	4173.14	43.0	50.0	50.0	46.0	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					45		30		30		30			
17	71.5	48.5	4411.14	27.0	35.6	35.6	41.1	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					43		30		30		30			
18	76.5	43.5	4649.14	34.0	44.8	44.8	46.0	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					45		30		30		30			
19	81.5	38.5	4887.14	49.0	50.0	50.0	46.0	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					45		30		30		30			
20	86.5	33.5	5125.14	43.0	50.0	50.0	46.0	9	ML	Sand-Like	No Liquefaction		59.4	1.0	41.0					45		30		30		30			
21	91.5	28.5	5398.14	7.0	9.2	5.6	5.6	10	SP-SM	Sand-Like	Full Liquefaction	44.8	5.0	4.0	10.0					29		29		4		29			
22	96.5	23.5	5670.14	50.0	50.0	39.1	41.2	11	SM	Sand-Like	No Liquefaction		12.0	7.0	15.0					45		36		36		36			
23	101.5	18.5	5955.64	24.0	31.6	18.3	18.3	12	SW-SM	Sand-Like	Full Liquefaction	82.9	5.0	4.0	10.0					37		36		31		36			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	0

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake; M_w & R = Deaggregation Analysis
R =	**63.3**	**64.1**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity; $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0
$D_{a5\text{-}95}$	30.12	30.07	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-1	No. of Soil Layers =	5	each	Hammer Type =	Automatic
Boring Station =	5947+73.00	No. of Split Spoon Samples =	11	each	Energy Ratio =	79
Boring Offset =	20' Lt	Total Profile Thickness =	41	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	119.9	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	8.8	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	111.1	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.9														
1	3.5	116.4	12.0	1.32	1.00	0.75	1.00	402.5	1.70	29.5	5.3	15.8	20.1	25.5	1	SC
2	5.5	114.4	7.0	1.32	1.00	0.78	1.00	632.5	1.70	12.8	2.4	9.2	12.2	14.6	2	SM
3	7.5	112.4	4.0	1.32	1.00	0.82	1.00	862.5	1.52	12.8	2.4	5.3	6.5	9.0	2	SM
4	9.9	110.0	1.0	1.32	1.00	0.86	1.00	1,069.9	1.37	43.4	5.5	1.3	1.5	7.0	3	SC-SM
5	11.4	108.5	7.0	1.32	1.00	0.88	1.00	1,148.8	1.32	43.4	5.5	9.2	10.7	16.2	3	SC-SM
6	16.4	103.5	16.0	1.32	1.00	0.93	1.00	1,428.8	1.18	4.3	0.0	21.1	23.1	23.1	4	SP
7	21.4	98.5	50.0	1.32	1.00	0.96	1.00	1,672.8	1.00	52.9	5.5	50.0	50.0	46.0	5	ML
8	25.4	94.5	50.0	1.32	1.00	0.97	1.00	1,863.2	1.00	52.9	5.5	50.0	50.0	46.0	5	ML
9	31.4	88.5	21.0	1.32	1.00	0.99	1.00	2,148.8	1.00	52.9	5.5	27.7	27.2	32.7	5	ML
10	36.4	83.5	14.0	1.32	1.00	1.00	1.00	2,386.8	1.00	52.9	5.5	18.4	18.4	23.9	5	ML
11	41.4	78.5	24.0	1.32	1.00	1.00	1.00	2,624.8	1.00	52.9	5.5	31.6	31.6	37.1	5	ML

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	RW-1	**No. of Soil Layers =**	5	each
Boring Station =	5947+73.00	**No. of Split Spoon Samples =**	11	each
Boring Offset =	20' Lt	**Total Profile Thickness =**	41	feet
Ground Elevation at Boring (ft msl) =	119.9			
Water Table Depth (Dw) (ft) =	8.8			
Water Table Elevation (msl ft) =	111.1			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	119.9														
1	3.5	116.4	12.0	25.5	1	SC	115.0	Recent	Recent	Roadway Embankment	1.00	29.5	12.7	33	19	14
2	5.5	114.4	7.0	14.6	2	SM	115.0	Quaternary	Holocene	Alluvium	1.20	12.8	11	NP	NP	NP
3	7.5	112.4	4.0	9.0	2	SM	115.0	Quaternary	Holocene	Alluvium	1.20	12.8	11	NP	NP	NP
4	9.9	110.0	1.0	7.0	3	SC-SM	115.0	Quaternary	Holocene	Alluvium	1.20	43.4	18	23	16	7
5	11.4	108.5	7.0	16.2	3	SC-SM	115.0	Quaternary	Holocene	Alluvium	1.20	43.4	18	23	16	7
6	16.4	103.5	16.0	23.1	4	SP	120.0	Quaternary	Holocene	Alluvium	1.20	4.3	16.8	NP	NP	NP
7	21.4	98.5	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	52.9	26.4	37	31	6
8	25.4	94.5	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	52.9	26.4	37	31	6
9	31.4	88.5	21.0	32.7	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	52.9	26.4	37	31	6
10	36.4	83.5	14.0	23.9	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	52.9	26.4	37	31	6
11	41.4	78.5	24.0	37.1	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	52.9	26.4	37	31	6

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**		

Designer:	**G. Burnworth - GSE**
Date:	**3/9/2016**

Boring Number =	**RW-1**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**9.9**
Boring Station =	**594773**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**20' Lt**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**119.9**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**8.8**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**111.1**	**D_{a5-95} (sec) =**	**30.12**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	119.9														
1	3.5	116.4	25.5	SC	PSL	NS Clay-Like	0.08	0.90	No Strength Loss			1610.0		0.00		0.00
2	5.5	114.4	14.6	SM	NSL-S	Sand-Like			No Liquefaction		34.0			0.00		0.00
3	7.5	112.4	9.0	SM	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
4	9.9	110.0	7.0	SC-SM	PSL	NS Clay-Like	3.52	0.90	Strength Loss			80.0		0.00		0.00
5	11.4	108.5	16.2	SC-SM	PSL	NS Clay-Like	0.58	0.90	No Strength Loss			690.0		0.00		0.00
6	16.4	103.5	23.1	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
7	21.4	98.5	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
8	25.4	94.5	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
9	31.4	88.5	32.7	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
10	36.4	83.5	23.9	ML	SSL	Sand-Like	0.72	0.75	No Liquefaction	0.19	30.0			0.00		0.00
11	41.4	78.5	37.1	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
													0.00		**0.00**	
													LDI Total (feet)		**S Total (inches)**	

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^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-1	Design EQ =	SEE	No. of Soil Layers =	5 each
Boring Station =	5947+73.00	Site Class =	D	No. of Split Spoon Samples =	11 each
Boring Offset =	20' Lt	PGA (g) =	0.43	Total Profile Thickness =	41 feet
Ground Elevation at Boring (ft msl) =	119.9	M_W =	7.37		
Water Table Depth (Dw) (ft) =	8.8	R (km) =	0		
Water Table Elevation (msl ft) =	111.1	$D_{a5\text{-}95}$ (sec) =	30.12		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	
																	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	119.9	0.0																							
1	3.5	116.4	402.5	12.0	15.8	20.1	25.5	1	SC	NS Clay-Like	No Strength Loss		29.5	14.0	33.0					2370		1610		1610			26	
2	5.5	114.4	632.5	7.0	9.2	12.2	14.6	2	SM	Sand-Like	No Liquefaction		12.8	NP	NP				34		34		34		34			
3	7.5	112.4	862.5	4.0	5.3	6.5	9.0	2	SM	Sand-Like	No Liquefaction		12.8	NP	NP				30		30		30		30			
4	9.9	110.0	1069.86	1.0	1.3	1.5	7.0	3	SC-SM	NS Clay-Like	Strength Loss		43.4	7.0	23.0					99		100		80			30	
5	11.4	108.5	1148.76	7.0	9.2	10.7	16.2	3	SC-SM	NS Clay-Like	No Strength Loss		43.4	7.0	23.0					691		690		690			30	
6	16.4	103.5	1428.76	16.0	21.1	23.1	23.1	4	SP	Sand-Like	No Liquefaction		4.3	NP	NP				39		32		32		32			
7	21.4	98.5	1672.76	50.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		52.9	6.0	37.0				45		30		30		30			
8	25.4	94.5	1863.16	50.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		52.9	6.0	37.0				45		30		30		30			
9	31.4	88.5	2148.76	21.0	27.7	27.2	32.7	5	ML	Sand-Like	No Liquefaction		52.9	6.0	37.0				40		30		30		30			
10	36.4	83.5	2386.76	14.0	18.4	18.4	23.9	5	ML	Sand-Like	No Liquefaction	63.3	52.9	6.0	37.0				37		30		30		30			
11	41.4	78.5	2624.76	24.0	31.6	31.6	37.1	5	ML	Sand-Like	No Liquefaction		52.9	6.0	37.0				42		30		30		30			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	0

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake; M_w & R = Deaggregation Analysis
R =	**63.3**	**64.1**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity; $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0
$D_{a5\text{-}95}$	30.12	30.07	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-2	No. of Soil Layers =	6	each	Hammer Type = Automatic
Boring Station =	5948+38.00	No. of Split Spoon Samples =	11	each	Energy Ratio = 79
Boring Offset =	18' Rt	Total Profile Thickness =	42	feet	Energy Correction (C_E) = 1.32
Ground Elevation at Boring (ft msl) =	119.1	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	8	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	111.1	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.1														
1	3.5	115.6	6.0	1.32	1.00	0.75	1.00	402.5	1.70	15.4	3.4	7.9	10.1	13.5	1	SM
2	5.5	113.6	4.0	1.32	1.00	0.78	1.00	640.0	1.70	7.3	0.2	5.3	7.0	7.1	2	SW-SM
3	7.5	111.6	2.0	1.32	1.00	0.82	1.00	872.5	1.51	35.0	5.5	2.6	3.3	8.8	3	SM
4	9.5	109.6	3.0	1.32	1.00	0.85	1.00	1,008.9	1.41	35.0	5.5	4.0	4.7	10.2	4	SM
5	11.5	107.6	5.0	1.32	1.00	0.88	1.00	1,114.1	1.34	35.0	5.5	6.6	7.7	13.2	4	SM
6	16.5	102.6	25.0	1.32	1.00	0.93	1.00	1,399.6	1.20	2.5	0.0	32.9	36.5	36.5	5	SP
7	21.5	97.6	29.0	1.32	1.00	0.96	1.00	1,637.6	1.00	51.1	5.5	38.2	36.6	42.1	6	ML
8	26.5	92.6	50.0	1.32	1.00	0.98	1.00	1,875.6	1.00	51.0	5.5	50.0	50.0	46.0	6	ML
9	31.5	87.6	22.0	1.32	1.00	0.99	1.00	2,113.6	1.00	51.0	5.5	29.0	28.6	34.1	6	ML
10	36.5	82.6	16.0	1.32	1.00	1.00	1.00	2,351.6	1.00	51.0	5.5	21.1	21.1	26.6	6	ML
11	41.5	77.6	23.0	1.32	1.00	1.00	1.00	2,589.6	1.00	51.0	5.5	30.3	30.3	35.8	6	ML

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	RW-2	**No. of Soil Layers =**	6	each
Boring Station =	5948+38.00	**No. of Split Spoon Samples =**	11	each
Boring Offset =	18' Rt	**Total Profile Thickness =**	42	feet
Ground Elevation at Boring (ft msl) =	119.1			
Water Table Depth (Dw) (ft) =	8			
Water Table Elevation (msl ft) =	111.1			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	119.1														
1	3.5	115.6	6.0	13.5	1	SM	115.0	Recent	Recent	Roadway Embankment	1.00	15.4	14	18	17	1
2	5.5	113.6	4.0	7.1	2	SW-SM	120.0	Quaternary	Holocene	Alluvium	1.20	7.3	8.5	NP	NP	NP
3	7.5	111.6	2.0	8.8	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	35.0	18.9	21	19	2
4	9.5	109.6	3.0	10.2	4	SM	115.0	Quaternary	Holocene	Alluvium	1.20	35.0	18.9	21	19	2
5	11.5	107.6	5.0	13.2	4	SM	115.0	Quaternary	Holocene	Alluvium	1.20	35.0	18.9	21	19	2
6	16.5	102.6	25.0	36.5	5	SP	120.0	Quaternary	Holocene	Alluvium	1.20	2.5	25.7	NP	NP	NP
7	21.5	97.6	29.0	42.1	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.1	30.6	39	31	8
8	26.5	92.6	50.0	46.0	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0	31	37	31	6
9	31.5	87.6	22.0	34.1	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0	31	37	31	6
10	36.5	82.6	16.0	26.6	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0	31	37	31	6
11	41.5	77.6	23.0	35.8	6	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0	31	37	31	6

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-2	Design EQ =	SEE	SSL Water Table Depth (ft) =	9.1
Boring Station =	594838	Site Class =	D	SSL Water Table Elev. (msl ft) =	110.0
Boring Offset =	18' Rt	PGA (g) =	0.43		
Ground Elevation at Boring (ft msl) =	119.1	M_W =	7.4		
Water Table Depth (Dw) (ft) =	8	R (km) =	0		
Water Table Elevation (msl ft) =	111.1	D_{a5-95} (sec) =	30.12		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	119.1														
1	3.5	115.6	13.5	SM	NSL-S	Sand-Like			No Liquefaction		33.0			1.59		1.64
2	5.5	113.6	7.1	SW-SM	NSL-S	Sand-Like			No Liquefaction		30.0			1.59		1.64
3	7.5	111.6	8.8	SM	NSL-S	Sand-Like			No Liquefaction		27.0			1.59		1.64
4	9.5	109.6	10.2	SM	SSL	Sand-Like	1.80	0.90	Full Liquefaction	0.70 - 1.00	6.0		0.92	1.59	0.88	1.64
5	11.5	107.6	13.2	SM	SSL	Sand-Like	1.67	0.90	Full Liquefaction	0.70 - 1.00	9.0		0.67	0.67	0.75	0.75
6	16.5	102.6	36.5	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
7	21.5	97.6	42.1	ML	PSL	NS Clay-Like	0.38	0.90	No Strength Loss			1940.0		0.00		0.00
8	26.5	92.6	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
9	31.5	87.6	34.1	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
10	36.5	82.6	26.6	ML	SSL	Sand-Like	0.59	0.75	No Liquefaction	0.19	30.0			0.00		0.00
11	41.5	77.6	35.8	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
														1.59		1.64
														LDI Total (feet)		S Total (inches)

[D]Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:		Latitude:	33.457	Designer:	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			Longitude:	-80.647	Date:	3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-2	Design EQ =	SEE	No. of Soil Layers =	6 each
Boring Station =	5948+38.00	Site Class =	D	No. of Split Spoon Samples =	11 each
Boring Offset =	18' Rt	PGA (g) =	0.43	Total Profile Thickness =	42 feet
Ground Elevation at Boring (ft msl) =	119.1	M_W =	7.37		
Water Table Depth (Dw) (ft) =	8	R (km) =	0		
Water Table Elevation (msl ft) =	111.1	$D_{a5\text{-}95}$ (sec) =	30.12		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	
																									OCR CL-ML, CL, CH		
																	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)		ϕ' (degrees)	τ = c (psf)
	0	119.1	0.0																							
1	3.5	115.6	402.5	6.0	7.9	10.1	13.5	1	SM	Sand-Like	No Liquefaction		15.4	1.0	18.0				32		33		33		33			
2	5.5	113.6	640	4.0	5.3	7.0	7.1	2	SW-SM	Sand-Like	No Liquefaction		7.3	NP	NP				30		30		30		30			
3	7.5	111.6	872.5	2.0	2.6	3.3	8.8	3	SM	Sand-Like	No Liquefaction		35.0	2.0	21.0				27		27		27		27			
4	9.5	109.6	1008.9	3.0	4.0	4.7	10.2	4	SM	Sand-Like	Full Liquefaction	29.3	35.0	2.0	21.0				29		29		6		29			
5	11.5	107.6	1114.1	5.0	6.6	7.7	13.2	4	SM	Sand-Like	Full Liquefaction	37.8	35.0	2.0	21.0				31		31		9		31			
6	16.5	102.6	1399.6	25.0	32.9	36.5	36.5	5	SP	Sand-Like	No Liquefaction		2.5	NP	NP				44		32		32		32			
7	21.5	97.6	1637.6	29.0	38.2	36.6	42.1	6	ML	NS Clay-Like	No Strength Loss		51.1	8.0	39.0					2864		1940		1940		29		
8	26.5	92.6	1875.6	50.0	50.0	50.0	46.0	6	ML	Sand-Like	No Liquefaction		51.0	6.0	37.0				45		30		30		30			
9	31.5	87.6	2113.6	22.0	29.0	28.6	34.1	6	ML	Sand-Like	No Liquefaction		51.0	6.0	37.0				41		30		30		30			
10	36.5	82.6	2351.6	16.0	21.1	21.1	26.6	6	ML	Sand-Like	No Liquefaction	67.7	51.0	6.0	37.0				38		30		30		30			
11	41.5	77.6	2589.6	23.0	30.3	30.3	35.8	6	ML	Sand-Like	No Liquefaction		51.0	6.0	37.0				42		30		30		30			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	0

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake; M_w & R = Deaggregation Analysis
R =	**63.3**	**64.1**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity; $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0
$D_{a5\text{-}95}$	30.12	30.07	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-3	No. of Soil Layers =	4	each	Hammer Type = Automatic
Boring Station =	5948+83.00	No. of Split Spoon Samples =	10	each	Energy Ratio = 79
Boring Offset =	19' Lt	Total Profile Thickness =	34	feet	Energy Correction (C_E) = 1.32
Ground Elevation at Boring (ft msl) =	119.9	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	8.5	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	111.4	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.9														
1	3.5	116.4	31.0	1.32	1.00	0.75	1.00	420.0	1.70	10.3	1.3	40.8	50.0	46.0	1	SP-SM
2	5.5	114.4	6.0	1.32	1.00	0.78	1.00	660.0	1.70	10.3	1.3	7.9	10.4	11.7	1	SP-SM
3	7.5	112.4	4.0	1.32	1.00	0.82	1.00	900.0	1.49	10.3	1.3	5.3	6.4	7.7	1	SP-SM
4	9.5	110.4	5.0	1.32	1.00	0.85	1.00	1,077.6	1.36	10.3	1.3	6.6	7.6	8.9	1	SP-SM
5	11.5	108.4	1.0	1.32	1.00	0.88	1.00	1,175.8	1.00	60.8	5.5	1.3	1.2	6.7	2	CL
6	16.5	103.4	5.0	1.32	1.00	0.93	1.00	1,429.8	1.18	21.0	4.6	6.6	7.2	11.9	3	SM
7	21.5	98.4	27.0	1.32	1.00	0.96	1.00	1,670.3	1.00	51.4	5.5	35.6	34.0	39.5	4	ML
8	26.5	93.4	50.0	1.32	1.00	0.98	1.00	1,908.3	1.00	51.0	5.5	50.0	50.0	46.0	4	ML
9	31.5	88.4	40.0	1.32	1.00	0.99	1.00	2,146.3	1.00	51.0	5.5	50.0	50.0	46.0	4	ML
10	33.7	86.2	50.0	1.32	1.00	1.00	1.00	2,251.0	1.00	51.0	5.5	50.0	50.0	46.0	4	ML

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	RW-3	**No. of Soil Layers =**	4 each
Boring Station =	5948+83.00	**No. of Split Spoon Samples =**	10 each
Boring Offset =	19' Lt	**Total Profile Thickness =**	34 feet
Ground Elevation at Boring (ft msl) =	119.9		
Water Table Depth (Dw) (ft) =	8.5		
Water Table Elevation (msl ft) =	111.4		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	119.9														
1	3.5	116.4	31.0	46.0	1	SP-SM	120.0	Recent	Recent	Roadway Embankment	1.00	10.3	12	NP	NP	NP
2	5.5	114.4	6.0	11.7	1	SP-SM	120.0	Recent	Recent	Roadway Embankment	1.00	10.3	12	NP	NP	NP
3	7.5	112.4	4.0	7.7	1	SP-SM	120.0	Recent	Recent	Roadway Embankment	1.00	10.3	12	NP	NP	NP
4	9.5	110.4	5.0	8.9	1	SP-SM	120.0	Recent	Recent	Roadway Embankment	1.00	10.3	12	NP	NP	NP
5	11.5	108.4	1.0	6.7	2	CL	110.0	Quaternary	Holocene	Alluvium	1.20	60.8	28	25	16	9
6	16.5	103.4	5.0	11.9	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	21.0	28	31	28	3
7	21.5	98.4	27.0	39.5	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.4	28.4	38	31	7
8	26.5	93.4	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0	28	37	31	6
9	31.5	88.4	40.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0	28	37	31	6
10	33.7	86.2	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0	28	37	31	6

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**RW-3**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**9.9**
Boring Station =	**594883**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**19' Lt**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**119.9**	**M_w =**	**7.4**		
Water Table Depth (Dw) (ft) =	**8.5**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**111.4**	**D_{a5-95} (sec) =**	**30.12**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	119.9														
1	3.5	116.4	46.0	SP-SM	NSL-S	Sand-Like			No Liquefaction		36.0			1.93		2.02
2	5.5	114.4	11.7	SP-SM	NSL-S	Sand-Like			No Liquefaction		33.0			1.93		2.02
3	7.5	112.4	7.7	SP-SM	NSL-S	Sand-Like			No Liquefaction		30.0			1.93		2.02
4	9.5	110.4	8.9	SP-SM	NSL-S	Sand-Like			No Liquefaction		31.0			1.93		2.02
5	11.5	108.4	6.7	CL	PSL	HS Clay-Like	4.18	0.90	Strength Loss			50.0		1.93		2.02
6	16.5	103.4	11.9	SM	SSL	Sand-Like	2.04	0.90	Full Liquefaction	0.70 - 1.00	7.0		1.93	1.93	2.02	2.02
7	21.5	98.4	39.5	ML	PSL	NS Clay-Like	0.38	0.90	No Strength Loss			1950.0		0.00		0.00
8	26.5	93.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
9	31.5	88.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
10	33.7	86.2	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
																1.93		**2.02**	
													LDI Total (feet)		**S Total (inches)**	

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-3	Design EQ =	SEE	No. of Soil Layers =	4 each
Boring Station =	5948+83.00	Site Class =	D	No. of Split Spoon Samples =	10 each
Boring Offset =	19' Lt	PGA (g) =	0.43	Total Profile Thickness =	34 feet
Ground Elevation at Boring (ft msl) =	119.9	M_W =	7.37		
Water Table Depth (Dw) (ft) =	8.5	R (km) =	0		
Water Table Elevation (msl ft) =	111.4	$D_{a5\text{-}95}$ (sec) =	30.12		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	
																	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	119.9	0.0																							
1	3.5	116.4	420	31.0	40.8	50.0	46.0	1	SP-SM	Sand-Like	No Liquefaction		10.3	NP	NP				45		36		36		36			
2	5.5	114.4	660	6.0	7.9	10.4	11.7	1	SP-SM	Sand-Like	No Liquefaction		10.3	NP	NP				33		33		33		33			
3	7.5	112.4	900	4.0	5.3	6.4	7.7	1	SP-SM	Sand-Like	No Liquefaction		10.3	NP	NP				30		30		30		30			
4	9.5	110.4	1077.6	5.0	6.6	7.6	8.9	1	SP-SM	Sand-Like	No Liquefaction		10.3	NP	NP				31		31		31		31			
5	11.5	108.4	1175.8	1.0	1.3	1.2	6.7	2	CL	HS Clay-Like	Strength Loss		60.8	9.0	25.0					99		100		50		1	29	
6	16.5	103.4	1429.8	5.0	6.6	7.2	11.9	3	SM	Sand-Like	Full Liquefaction	37.8	21.0	3.0	31.0				31		31		7		31			
7	21.5	98.4	1670.3	27.0	35.6	34.0	39.5	4	ML	NS Clay-Like	No Strength Loss		51.4	7.0	38.0					2666		1950		1950			30	
8	26.5	93.4	1908.3	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		51.0	6.0	37.0				45		30		30		30			
9	31.5	88.4	2146.3	40.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		51.0	6.0	37.0				45		30		30		30			
10	33.7	86.2	2251.02	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		51.0	6.0	37.0				45		30		30		30			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	0

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake; M_w & R = Deaggregation Analysis
R =	**63.3**	**64.1**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity; $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0
$D_{a5\text{-}95}$	30.12	30.07	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-3B	No. of Soil Layers =	4	each	Hammer Type =	Safety
Boring Station =	5948+82.94	No. of Split Spoon Samples =	8	each	Energy Ratio =	91
Boring Offset =	7' Lt	Total Profile Thickness =	16	feet	Energy Correction (C_E) =	1.52
Ground Elevation at Boring (ft msl) =	120.2	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	6.7	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	113.5	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	120.2														
1	2	118.2	32.0	1.52	1.00	0.75	1.00	240.0	1.70	0.0	0.0	48.7	50.0	46.0	1	SP
2	4	116.2	19.0	1.52	1.00	0.75	1.00	480.0	1.70	0.0	0.0	28.9	36.9	36.9	1	SP
3	6	114.2	11.0	1.52	1.00	0.79	1.00	720.0	1.67	0.0	0.0	16.7	22.0	22.0	1	SP
4	8	112.2	3.0	1.52	1.00	0.83	1.00	878.9	1.51	0.0	0.0	4.6	5.7	5.7	1	SP
5	10	110.2	2.0	1.52	1.00	0.86	1.00	983.1	1.00	63.1	5.5	3.0	2.6	8.1	2	CL
6	12	108.2	3.0	1.52	1.00	0.88	1.00	1,078.3	1.00	63.1	5.5	4.6	4.0	9.5	2	CL
7	14	106.2	6.0	1.52	1.00	0.91	1.00	1,181.0	1.30	21.0	4.6	9.1	10.8	15.4	3	SC
8	16	104.2	8.0	1.52	1.00	0.92	1.00	1,286.2	1.25	12.0	2.1	12.2	14.0	16.1	4	SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	RW-3B	**No. of Soil Layers =**	4	each
Boring Station =	5948+82.94	**No. of Split Spoon Samples =**	8	each
Boring Offset =	7' Lt	**Total Profile Thickness =**	16	feet
Ground Elevation at Boring (ft msl) =	120.2			
Water Table Depth (Dw) (ft) =	6.7			
Water Table Elevation (msl ft) =	113.5			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	120.2														
1	2	118.2	32.0	46.0	1	SP	120.0	Recent	Recent	Fill	1.00	0.0		NP	NP	NP
2	4	116.2	19.0	36.9	1	SP	120.0	Recent	Recent	Fill	1.00	0.0		NP	NP	NP
3	6	114.2	11.0	22.0	1	SP	120.0	Recent	Recent	Fill	1.00	0.0		NP	NP	NP
4	8	112.2	3.0	5.7	1	SP	120.0	Recent	Recent	Fill	1.00	0.0		NP	NP	NP
5	10	110.2	2.0	8.1	2	CL	110.0	Quaternary	Holocene	Alluvium	1.20	63.1	30.8	35	15	20
6	12	108.2	3.0	9.5	2	CL	110.0	Quaternary	Holocene	Alluvium	1.20	63.1	30.8	35	15	20
7	14	106.2	6.0	15.4	3	SC	115.0	Quaternary	Holocene	Alluvium	1.20	21.0	30	15	8	7
8	16	104.2	8.0	16.1	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	12.0	30	36	30	6

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**RW-3B**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**10.2**
Boring Station =	**594882.94**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**7' Lt**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**120.2**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**6.7**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**113.5**	**D_{a5-95} (sec) =**	**30.12**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	120.2														
1	2.0	118.2	46.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.04		0.18
2	4.0	116.2	36.9	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.04		0.18
3	6.0	114.2	22.0	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.04		0.18
4	8.0	112.2	5.7	SP	NSL-S	Sand-Like			No Liquefaction		29.0			0.04		0.18
5	10.0	110.2	8.1	CL	PSL	HS Clay-Like	0.65	0.90	No Strength Loss			500.0		0.04		0.18
6	12.0	108.2	9.5	CL	PSL	HS Clay-Like	0.55	0.90	No Strength Loss			700.0		0.04		0.18
7	14.0	106.2	15.4	SC	PSL	NS Clay-Like	0.64	0.90	No Strength Loss			700.0		0.04		0.18
8	16.0	104.2	16.1	SM	SSL	Sand-Like	0.90	0.90	Limited Liquefaction	0.4	23.0		0.04	0.04	0.18	0.18

0.04	**0.18**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-3B	Design EQ =	SEE	No. of Soil Layers =	4 each
Boring Station =	5948+82.94	Site Class =	D	No. of Split Spoon Samples =	8 each
Boring Offset =	7' Lt	PGA (g) =	0.43	Total Profile Thickness =	16 feet
Ground Elevation at Boring (ft msl) =	120.2	M_W =	7.37		
Water Table Depth (Dw) (ft) =	6.7	R (km) =	0		
Water Table Elevation (msl ft) =	113.5	$D_{a5\text{-}95}$ (sec) =	30.12		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static				Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like		
																									Static			
																									Clay-Like			
																	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	120.2	0.0																							
1	2	118.2	240	32.0	48.7	50.0	46.0	1	SP	Sand-Like	No Liquefaction		0.0	NP	NP				45		32		32		32			
2	4	116.2	480	19.0	28.9	36.9	36.9	1	SP	Sand-Like	No Liquefaction		0.0	NP	NP				44		32		32		32			
3	6	114.2	720	11.0	16.7	22.0	22.0	1	SP	Sand-Like	No Liquefaction		0.0	NP	NP				38		32		32		32			
4	8	112.2	878.88	3.0	4.6	5.7	5.7	1	SP	Sand-Like	No Liquefaction		0.0	NP	NP				29		29		29		29			
5	10	110.2	983.08	2.0	3.0	2.6	8.1	2	CL	HS Clay-Like	No Strength Loss		63.1	20.0	35.0	0.001	42.3	0.3		457		500		500		2	26	50
6	12	108.2	1078.28	3.0	4.6	4.0	9.5	2	CL	HS Clay-Like	No Strength Loss		63.1	20.0	35.0					685		700		700		3	26	70
7	14	106.2	1180.98	6.0	9.1	10.8	15.4	3	SC	NS Clay-Like	No Strength Loss		21.0	7.0	15.0					685		700		700			30	
8	16	104.2	1286.18	8.0	12.2	14.0	16.1	4	SM	Sand-Like	Limited Liquefaction	51.4	12.0	6.0	36.0				35		35		23		35			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: — $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: — $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: — $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis
R =	**63.3**	**64.1**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: — R < 20 km; ε = 0.015(R-20)
$D_{a5\text{-}95}$	30.12	30.07	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48 — R ≥ 20 km; ε = 0

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-4	No. of Soil Layers =	4	each	Hammer Type =	Automatic
Boring Station =	5952+50.00	No. of Split Spoon Samples =	9	each	Energy Ratio =	79
Boring Offset =	20' Rt	Total Profile Thickness =	25	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	119.5	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	6.5	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	113	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.5														
1	3.5	116.0	4.0	1.32	1.00	0.75	1.00	402.5	1.70	20.2	4.5	5.3	6.7	11.2	1	SM
2	5.5	114.0	3.0	1.32	1.00	0.78	1.00	641.0	1.70	4.1	0.0	4.0	5.2	5.2	2	SW
3	7.5	112.0	5.0	1.32	1.00	0.82	1.00	818.6	1.56	4.1	0.0	6.6	8.4	8.4	2	SW
4	9.5	110.0	4.0	1.32	1.00	0.85	1.00	933.8	1.46	4.1	0.0	5.3	6.5	6.5	2	SW
5	11.4	108.1	8.0	1.32	1.00	0.88	1.00	1,035.2	1.39	21.3	4.7	10.5	12.8	17.5	3	SM
6	16.4	103.1	12.0	1.32	1.00	0.93	1.00	1,298.2	1.24	21.3	4.7	15.8	18.2	22.8	3	SM
7	21.4	98.1	50.0	1.32	1.00	0.96	1.00	1,561.2	1.13	49.3	5.5	50.0	50.0	46.0	4	SM
8	24.7	94.8	50.0	1.32	1.00	0.97	1.00	1,734.8	1.07	49.3	5.5	50.0	50.0	46.0	4	SM
9	25.1	94.4	50.0	1.32	1.00	0.97	1.00	1,755.9	1.07	49.3	5.5	50.0	50.0	46.0	4	SM

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	RW-4	**No. of Soil Layers =**	4 each
Boring Station =	5952+50.00	**No. of Split Spoon Samples =**	9 each
Boring Offset =	20' Rt	**Total Profile Thickness =**	25 feet
Ground Elevation at Boring (ft msl) =	119.5		
Water Table Depth (Dw) (ft) =	6.5		
Water Table Elevation (msl ft) =	113		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	119.5														
1	3.5	116.0	4.0	11.2	1	SM	115.0	Recent	Recent	Fill	1.00	20.2	18.3	20	16	4
2	5.5	114.0	3.0	5.2	2	SW	120.0	Quaternary	Holocene	Alluvium	1.20	4.1	10.6	NP	NP	NP
3	7.5	112.0	5.0	8.4	2	SW	120.0	Quaternary	Holocene	Alluvium	1.20	4.1	10.6	NP	NP	NP
4	9.5	110.0	4.0	6.5	2	SW	120.0	Quaternary	Holocene	Alluvium	1.20	4.1	10.6	NP	NP	NP
5	11.4	108.1	8.0	17.5	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	21.3	30	36	30	6
6	16.4	103.1	12.0	22.8	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	21.3	30	36	30	6
7	21.4	98.1	50.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	49.3	32.2	34	28	6
8	24.7	94.8	50.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	49.3	32.2	34	28	6
9	25.1	94.4	50.0	46.0	4	SM	115.0	Paleogene	Eocene	Santee Limestone	2.10	49.3	32.2	34	28	6

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	

Designer: **G. Burnworth - GSE**
Date: **3/9/2016**

Boring Number =	**RW-4**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**9.5**
Boring Station =	**595250**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**20' Rt**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**119.5**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**6.5**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**113**	**D_{a5-95} (sec) =**	**30.12**		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	119.5														
1	3.5	116.0	11.2	SM	NSL-S	Sand-Like			No Liquefaction		30.0			0.21		0.58
2	5.5	114.0	5.2	SW	NSL-S	Sand-Like			No Liquefaction		29.0			0.21		0.58
3	7.5	112.0	8.4	SW	NSL-S	Sand-Like			No Liquefaction		31.0			0.21		0.58
4	9.5	110.0	6.5	SW	NSL-S	Sand-Like			No Liquefaction		30.0			0.21		0.58
5	11.4	108.1	17.5	SM	SSL	Sand-Like	1.28	0.90	Full Liquefaction	0.70 - 1.00	24.0		0.21	0.21	0.58	0.58
6	16.4	103.1	22.8	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
7	21.4	98.1	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
8	24.7	94.8	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
9	25.1	94.4	46.0	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00

0.21	**0.58**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-4	Design EQ =	SEE	No. of Soil Layers =	4 each
Boring Station =	5952+50.00	Site Class =	D	No. of Split Spoon Samples =	9 each
Boring Offset =	20' Rt	PGA (g) =	0.43	Total Profile Thickness =	25 feet
Ground Elevation at Boring (ft msl) =	119.5	M_W =	7.37		
Water Table Depth (Dw) (ft) =	6.5	R (km) =	0		
Water Table Elevation (msl ft) =	113	$D_{a5\text{-}95}$ (sec) =	30.12		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like			
																								Static			
																								Clay-Like			
																	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	119.5	0.0																							
1	3.5	116.0	402.5	4.0	5.3	6.7	11.2	1	SM	Sand-Like	No Liquefaction		20.2	4.0	20.0				30		30		30		30			
2	5.5	114.0	641	3.0	4.0	5.2	5.2	2	SW	Sand-Like	No Liquefaction		4.1	NP	NP				29		29		29		29			
3	7.5	112.0	818.6	5.0	6.6	8.4	8.4	2	SW	Sand-Like	No Liquefaction		4.1	NP	NP				31		31		31		31			
4	9.5	110.0	933.8	4.0	5.3	6.5	6.5	2	SW	Sand-Like	No Liquefaction		4.1	NP	NP				30		30		30		30			
5	11.4	108.1	1035.24	8.0	10.5	12.8	17.5	3	SM	Sand-Like	Full Liquefaction	47.9	21.3	6.0	36.0				34		34		24		34			
6	16.4	103.1	1298.24	12.0	15.8	18.2	22.8	3	SM	Sand-Like	No Liquefaction		21.3	6.0	36.0				37		36		36		36			
7	21.4	98.1	1561.24	50.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		49.3	6.0	34.0				45		36		36		36			
8	24.7	94.8	1734.82	50.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		49.3	6.0	34.0				45		36		36		36			
9	25.1	94.4	1755.86	50.0	50.0	50.0	46.0	4	SM	Sand-Like	No Liquefaction		49.3	6.0	34.0				45		36		36		36			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: — $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: — $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: — $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake — M_w & R = Deaggregation Analysis
R =	**63.3**	**64.1**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity — $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: — R < 20 km; ε = 0.015(R-20)
$D_{a5\text{-}95}$	30.12	30.07	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48 — R ≥ 20 km; ε = 0

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-5	No. of Soil Layers =	4	each	Hammer Type =	Automatic
Boring Station =	5952+70.00	No. of Split Spoon Samples =	11	each	Energy Ratio =	79
Boring Offset =	22' Lt	Total Profile Thickness =	41	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	119.4	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	8.1	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	111.3	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.4														
1	3.5	115.9	15.0	1.32	1.00	0.75	1.00	420.0	1.70	11.3	1.8	19.8	25.2	26.9	1	SW-SM
2	5.5	113.9	6.0	1.32	1.00	0.78	1.00	660.0	1.70	11.3	1.8	7.9	10.4	12.2	1	SW-SM
3	7.5	111.9	6.0	1.32	1.00	0.82	1.00	900.0	1.49	11.5	1.8	7.9	9.6	11.5	2	SW-SM
4	9.5	109.9	4.0	1.32	1.00	0.85	1.00	1,052.6	1.38	11.5	1.8	5.3	6.2	8.0	2	SW-SM
5	11.4	108.0	2.0	1.32	1.00	0.88	1.00	1,154.6	1.32	41.0	5.5	2.6	3.0	8.5	3	SM
6	16.4	103.0	1.0	1.32	1.00	0.93	1.00	1,417.6	1.19	41.0	5.5	1.3	1.4	6.9	3	SM
7	21.4	98.0	17.0	1.32	1.00	0.96	1.00	1,664.6	1.00	59.9	5.5	22.4	21.4	26.9	4	ML
8	26.4	93.0	23.0	1.32	1.00	0.97	1.00	1,902.6	1.00	60.0	5.5	30.3	29.5	35.0	4	ML
9	31.4	88.0	25.0	1.32	1.00	0.99	1.00	2,140.6	1.00	60.0	5.5	32.9	32.4	37.9	4	ML
10	35	84.4	50.0	1.32	1.00	1.00	1.00	2,311.9	1.00	60.0	5.5	50.0	50.0	46.0	4	ML
11	41.4	78.0	15.0	1.32	1.00	1.00	1.00	2,616.6	1.00	60.0	5.5	19.8	19.8	25.3	4	ML

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	RW-5	**No. of Soil Layers =**	4	each
Boring Station =	5952+70.00	**No. of Split Spoon Samples =**	11	each
Boring Offset =	22' Lt	**Total Profile Thickness =**	41	feet
Ground Elevation at Boring (ft msl) =	119.4			
Water Table Depth (Dw) (ft) =	8.1			
Water Table Elevation (msl ft) =	111.3			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	119.4														
1	3.5	115.9	15.0	26.9	1	SW-SM	120.0	Recent	Recent	Fill	1.00	11.3	6.7	NP	NP	NP
2	5.5	113.9	6.0	12.2	1	SW-SM	120.0	Recent	Recent	Fill	1.00	11.3	6.7	NP	NP	NP
3	7.5	111.9	6.0	11.5	2	SW-SM	120.0	Quaternary	Holocene	Alluvium	1.20	11.5	11.7	NP	NP	NP
4	9.5	109.9	4.0	8.0	2	SW-SM	120.0	Quaternary	Holocene	Alluvium	1.20	11.5	11.7	NP	NP	NP
5	11.4	108.0	2.0	8.5	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	41.0	60.2	20	19	1
6	16.4	103.0	1.0	6.9	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	41.0	60.2	20	19	1
7	21.4	98.0	17.0	26.9	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	59.9	31.3	38	30	8
8	26.4	93.0	23.0	35.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	60.0	42	41	40	1
9	31.4	88.0	25.0	37.9	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	60.0	42	41	40	1
10	35	84.4	50.0	46.0	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	60.0	42	41	40	1
11	41.4	78.0	15.0	25.3	4	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	60.0	42	41	40	1

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**RW-5**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**9.4**
Boring Station =	**595270**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**22' Lt**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**119.4**	**M_w =**	**7.4**		
Water Table Depth (Dw) (ft) =	**8.1**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**111.3**	**D_{a5-95} (sec) =**	**30.12**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth[D] (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	119.4														
1	3.5	115.9	26.9	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			4.45		4.67
2	5.5	113.9	12.2	SW-SM	NSL-S	Sand-Like			No Liquefaction		33.0			4.45		4.67
3	7.5	111.9	11.5	SW-SM	NSL-S	Sand-Like			No Liquefaction		32.0			4.45		4.67
4	9.5	109.9	8.0	SW-SM	SSL	Sand-Like	2.03	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.00	4.45	1.01	4.67
5	11.4	108.0	8.5	SM	SSL	Sand-Like	2.16	0.90	Full Liquefaction	0.70 - 1.00	5.0		0.95	3.45	0.93	3.65
6	16.4	103.0	6.9	SM	SSL	Sand-Like	2.79	0.90	Full Liquefaction	0.70 - 1.00	4.0		2.50	2.50	2.72	2.72
7	21.4	98.0	26.9	ML	PSL	NS Clay-Like	0.45	0.90	No Strength Loss			1680.0		0.00		0.00
8	26.4	93.0	35.0	ML	NSL-S	Sand-Like			No Liquefaction		41.3			0.00		0.00
9	31.4	88.0	37.9	ML	NSL-S	Sand-Like			No Liquefaction		42.4			0.00		0.00
10	35.0	84.4	46.0	ML	NSL-S	Sand-Like			No Liquefaction		45.0			0.00		0.00
11	41.4	78.0	25.3	ML	NSL-C				No Strength Loss			1480.0		0.00		0.00
													4.45		**4.67**	
													LDI Total (feet)		**S Total (inches)**	

[D] Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-5	Design EQ =	SEE	No. of Soil Layers =	4 each
Boring Station =	5952+70.00	Site Class =	D	No. of Split Spoon Samples =	11 each
Boring Offset =	22' Lt	PGA (g) =	0.43	Total Profile Thickness =	41 feet
Ground Elevation at Boring (ft msl) =	119.4	M_W =	7.37		
Water Table Depth (Dw) (ft) =	8.1	R (km) =	0		
Water Table Elevation (msl ft) =	111.3	$D_{a5\text{-}95}$ (sec) =	30.12		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like			
																									Static			
																	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	119.4	0.0																									
1	3.5	115.9	420	15.0	19.8	25.2	26.9	1	SW-SM	Sand-Like	No Liquefaction		11.3	NP	NP				40		36		36		36			
2	5.5	113.9	660	6.0	7.9	10.4	12.2	1	SW-SM	Sand-Like	No Liquefaction		11.3	NP	NP				33		33		33		33			
3	7.5	111.9	900	6.0	7.9	9.6	11.5	2	SW-SM	Sand-Like	No Liquefaction		11.5	NP	NP				32		32		32		32			
4	9.5	109.9	1052.64	4.0	5.3	6.2	8.0	2	SW-SM	Sand-Like	Full Liquefaction	33.8	11.5	NP	NP				30		30		5		30			
5	11.4	108.0	1154.58	2.0	2.6	3.0	8.5	3	SM	Sand-Like	Full Liquefaction	23.9	41.0	1.0	20.0				27		27		5		27			
6	16.4	103.0	1417.58	1.0	1.3	1.4	6.9	3	SM	Sand-Like	Full Liquefaction	16.9	41.0	1.0	20.0				25		25		4		25			
7	21.4	98.0	1664.58	17.0	22.4	21.4	26.9	4	ML	NS Clay-Like	No Strength Loss		59.9	8.0	38.0					1679		1680		1680			29	
8	26.4	93.0	1902.58	23.0	30.3	29.5	35.0	4	ML	Sand-Like	No Liquefaction		60.0	1.0	41.0				41		41	2010	41		41		39	
9	31.4	88.0	2140.58	25.0	32.9	32.4	37.9	4	ML	Sand-Like	No Liquefaction		60.0	1.0	41.0				42		42	2070	42		42		39	
10	35	84.4	2311.94	50.0	50.0	50.0	46.0	4	ML	Sand-Like	No Liquefaction		60.0	1.0	41.0				45		45	2120	45		45		39	
11	41.4	78.0	2616.58	15.0	19.8	19.8	25.3	4	ML		No Strength Loss		60.0	1.0	41.0					1481		1480		1480			39	

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	0

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake; M_w & R = Deaggregation Analysis
R =	**63.3**	**64.1**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity; $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0
$D_{a5\text{-}95}$	30.12	30.07	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-6	No. of Soil Layers =	5	each	Hammer Type = Automatic
Boring Station =	5953+15.00	No. of Split Spoon Samples =	8	each	Energy Ratio = 79
Boring Offset =	22' Rt	Total Profile Thickness =	21	feet	Energy Correction (C_E) = 1.32
Ground Elevation at Boring (ft msl) =	119.2	Sampler Configuration:			Borehole Diameter (in) = 4
Water Table Depth (Dw) (ft) =	8	Liner Required =	N		Borehole Correction (CB) = 1.00
Water Table Elevation (msl ft) =	111.2	Liner Used =	N		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.2														
1	3.5	115.7	3.0	1.32	1.00	0.75	1.00	402.5	1.70	16.0	3.6	4.0	5.0	8.6	1	SM
2	5.5	113.7	4.0	1.32	1.00	0.78	1.00	641.0	1.70	5.0	0.0	5.3	7.0	7.0	2	SW-SM
3	7.5	111.7	1.0	1.32	1.00	0.82	1.00	881.0	1.51	5.0	0.0	1.3	1.6	1.6	2	SW-SM
4	9.5	109.7	2.0	1.32	1.00	0.85	1.00	1,018.9	1.40	25.1	5.1	2.6	3.1	8.2	3	SM
5	11.5	107.7	8.0	1.32	1.00	0.88	1.00	1,124.1	1.33	25.1	5.1	10.5	12.3	17.4	3	SM
6	16.5	102.7	21.0	1.32	1.00	0.93	1.00	1,403.1	1.19	0.0	0.0	27.7	30.6	30.6	4	SP
7	20.3	98.9	50.0	1.32	1.00	0.95	1.00	1,619.0	1.00	51.0	5.5	50.0	50.0	46.0	5	ML
8	20.9	98.3	50.0	1.32	1.00	0.95	1.00	1,647.5	1.00	51.0	5.5	50.0	50.0	46.0	5	ML

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	RW-6	**No. of Soil Layers =**	5 each
Boring Station =	5953+15.00	**No. of Split Spoon Samples =**	8 each
Boring Offset =	22' Rt	**Total Profile Thickness =**	21 feet
Ground Elevation at Boring (ft msl) =	119.2		
Water Table Depth (Dw) (ft) =	8		
Water Table Elevation (msl ft) =	111.2		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	119.2														
1	3.5	115.7	3.0	8.6	1	SM	115.0	Recent	Recent	Roadway Embankment	1.00	16.0	14.4	NP	NP	NP
2	5.5	113.7	4.0	7.0	2	SW-SM	120.0	Quaternary	Holocene	Alluvium	1.20	5.0		10	6	4
3	7.5	111.7	1.0	1.6	2	SW-SM	120.0	Quaternary	Holocene	Alluvium	1.20	5.0		10	6	4
4	9.5	109.7	2.0	8.2	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	25.1	21.3	NP	NP	NP
5	11.5	107.7	8.0	17.4	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	25.1	21.3	NP	NP	NP
6	16.5	102.7	21.0	30.6	4	SP	120.0	Quaternary	Holocene	Alluvium	1.20	0.0		NP	NP	NP
7	20.3	98.9	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0		30	27	3
8	20.9	98.3	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0		30	27	3

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**	**Designer:**	**G. Burnworth - GSE**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**	**Date:**	**3/9/2016**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**			

Boring Number =	**RW-6**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**9.2**
Boring Station =	**595315**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**22' Rt**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**119.2**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**8**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**111.2**	**D_{a5-95} (sec) =**	**30.12**		

N-value Summary					**SSL Screening Summary**		**SSL Triggering Summary**				**Soil Shear Strength for Seismic Analysis Summary**		**Geotechnical Seismic Hazards Summary**			
SPT Sample Number	**Depth^D (ft)**	**Elevation (ft msl)**	**$N^*_{1,60,CS}$**	**Soil Type (USCS)**	**SSL Potential**	**Sand-like or Clay-like**	**$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}**	**φ_{SL}**	**(D/C)SL ≤ φSL**	**R_u**	**φ' (degrees)**	**τ (psf)**	**ΔLDI_i (feet)**	**$\sum \Delta LDI_i$ (feet)**	**ΔS_i (inches)**	**$\sum S_i$ (inches)**
	0.0	119.2														
1	3.5	115.7	8.6	SM	NSL-S	Sand-Like			No Liquefaction		29.0			1.27		1.62
2	5.5	113.7	7.0	SW-SM	NSL-S	Sand-Like			No Liquefaction		30.0			1.27		1.62
3	7.5	111.7	1.6	SW-SM	NSL-S	Sand-Like			No Liquefaction		25.0			1.27		1.62
4	9.5	109.7	8.2	SM	SSL	Sand-Like	2.03	0.90	Full Liquefaction	0.70 - 1.00	5.0		1.00	1.27	1.00	1.62
5	11.5	107.7	17.4	SM	SSL	Sand-Like	1.31	0.90	Full Liquefaction	0.70 - 1.00	23.0		0.27	0.27	0.62	0.62
6	16.5	102.7	30.6	SP	NSL-S	Sand-Like			No Liquefaction		32.0			0.00		0.00
7	20.3	98.9	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
8	20.9	98.3	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00

1.27	**1.62**
LDI Total (feet)	**S Total (inches)**

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-6	Design EQ =	SEE	No. of Soil Layers =	5 each
Boring Station =	5953+15.00	Site Class =	D	No. of Split Spoon Samples =	8 each
Boring Offset =	22' Rt	PGA (g) =	0.43	Total Profile Thickness =	21 feet
Ground Elevation at Boring (ft msl) =	119.2	M_W =	7.37		
Water Table Depth (Dw) (ft) =	8	R (km) =	0		
Water Table Elevation (msl ft) =	111.2	$D_{a5\text{-}95}$ (sec) =	30.12		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	
																									OCR CL-ML, CL, CH		
																	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)		ϕ' (degrees)	τ = c (psf)
	0	119.2	0.0																							
1	3.5	115.7	402.5	3.0	4.0	5.0	8.6	1	SM	Sand-Like	No Liquefaction		16.0	NP	NP				29		29		29		29			
2	5.5	113.7	641	4.0	5.3	7.0	7.0	2	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				30		30		30		30			
3	7.5	111.7	881	1.0	1.3	1.6	1.6	2	SW-SM	Sand-Like	No Liquefaction		5.0	4.0	10.0				25		25		25		25			
4	9.5	109.7	1018.9	2.0	2.6	3.1	8.2	3	SM	Sand-Like	Full Liquefaction	23.9	25.1	NP	NP				27		37		5		37			
5	11.5	107.7	1124.1	8.0	10.5	12.3	17.4	3	SM	Sand-Like	Full Liquefaction	47.9	25.1	NP	NP				34		34		23		34			
6	16.5	102.7	1403.1	21.0	27.7	30.6	30.6	4	SP	Sand-Like	No Liquefaction		0.0	NP	NP				42		32		32		32			
7	20.3	98.9	1618.98	50.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		51.0	3.0	30.0				45		30		30		30			
8	20.9	98.3	1647.54	50.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		51.0	3.0	30.0				45		30		30		30			

[D]Depth at bottom of Split-Spoon Sampler.

SPT-Based Soil Shear Strength Loss Evaluation

Idriss and Boulanger Procedure (2008) - GeoStellar Engineering v2.5.8 - 20160315

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457000000	**Designer:**	G. Burnworth - GSE
Route:	US 301	**County:**	38 - Orangeburg	**Longitude:**	-80.647000000	**Date:**	3/9/2016
Project:	RBO Four Hole Swamp						
Location:						**Finished Embankment Height (ft)[1] =**	0

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Seismic Data:

Site Class =	D			
Design Earthquake:	**SEE**	**FEE**		
S_{D1} =	**0.490**	**0.180**	g	
k_{max} = **PGA =**	**0.430**	**0.200**	g	
β = S_{D1}/PGA =	1.140	0.900		β = Ground Motion Index: $0.50 \le \beta \le 1.5$
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	**7.37**	**7.36**		M_w = Moment Magnitude of Design Earthquake; M_w & R = Deaggregation Analysis
R =	**63.3**	**64.1**	km	R = Site-to-Source Distance
$\bar{V}_s$ =	**1005.4**	**1005.4**	ft/sec	$\bar{V}_s$ = Average Shear Wave Velocity; $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
Z_{HR} =	**494.5**	**494.5**	meters	Z_{HR} = Depth from ground surface to hard rock V_s > 5,000 ft/sec; from SCENARIO_PC 2006 output
ε =	0.000	0.000		ε = Near-fault directivity correction: R < 20 km; ε = 0.015(R-20); R ≥ 20 km; ε = 0
$D_{a5\text{-}95}$	30.12	30.07	sec	$D_{a5\text{-}95}$ = Duration of Earthquake as a function of acceleration: Use Eq. 12-48

SPT Correction Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-7	No. of Soil Layers =	5	each	Hammer Type =	Automatic
Boring Station =	5953+66.00	No. of Split Spoon Samples =	8	each	Energy Ratio =	79
Boring Offset =	20' Lt	Total Profile Thickness =	22	feet	Energy Correction (C_E) =	1.32
Ground Elevation at Boring (ft msl) =	119.7	Sampler Configuration:			Borehole Diameter (in) =	4
Water Table Depth (Dw) (ft) =	7.9	Liner Required =	N		Borehole Correction (CB) =	1.00
Water Table Elevation (msl ft) =	111.8	Liner Used =	N			

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	C_E	C_B	C_R	C_S	σ'_{vo} (psf)	C_N	Fines Content (FC)	$\Delta N^*_{1,60}$	N_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)
	0	119.7														
1	3.5	116.2	12.0	1.32	1.00	0.75	1.00	402.5	1.70	13.7	2.8	15.8	20.1	22.9	1	SM
2	5.5	114.2	4.0	1.32	1.00	0.78	1.00	641.0	1.70	7.3	0.2	5.3	7.0	7.1	2	SP-SM
3	7.5	112.2	2.0	1.32	1.00	0.82	1.00	881.0	1.51	7.3	0.2	2.6	3.2	3.4	2	SP-SM
4	9.5	110.2	7.0	1.32	1.00	0.85	1.00	1,021.2	1.40	7.3	0.2	9.2	11.0	11.2	2	SP-SM
5	11.5	108.2	4.0	1.32	1.00	0.88	1.00	1,127.9	1.33	21.0	4.6	5.3	6.2	10.8	3	SM
6	16.5	103.2	14.0	1.32	1.00	0.93	1.00	1,406.9	1.19	12.0	2.1	18.4	20.4	22.5	4	SW-SM
7	21.5	98.2	50.0	1.32	1.00	0.96	1.00	1,659.9	1.00	51.0	5.5	50.0	50.0	46.0	5	ML
8	21.8	97.9	50.0	1.32	1.00	0.96	1.00	1,674.1	1.00	51.0	5.5	50.0	50.0	46.0	5	ML

[D]Depth at bottom of Split-Spoon Sampler.

Subsurface Geology Classification Summary

GSE No.:	41503-0002-0001	**File No.:**		**Latitude:**	33.457	**Designer:**	G. Burnworth - GSE
Project:	RBO Four Hole Swamp			**Longitude:**	-80.647	**Date:**	3/9/2016
Route:	US 301	**County:**	38 - Orangeburg	**Location:**			

Boring Number =	RW-7	**No. of Soil Layers =**	5 each
Boring Station =	5953+66.00	**No. of Split Spoon Samples =**	8 each
Boring Offset =	20' Lt	**Total Profile Thickness =**	22 feet
Ground Elevation at Boring (ft msl) =	119.7		
Water Table Depth (Dw) (ft) =	7.9		
Water Table Elevation (msl ft) =	111.8		

SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	N_{Meas}	$N^{*}_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Unit Weight (pcf)	General Geology	Epoch	Formation	K_{DR}	Fines Content (FC)	Natural Moisture Content (%)	Atterberg Limits		
														LL	PL	PI
	0	119.7														
1	3.5	116.2	12.0	22.9	1	SM	115.0	Recent	Recent	Roadway Embankment	1.00	13.7	11.3	NP	NP	NP
2	5.5	114.2	4.0	7.1	2	SP-SM	120.0	Quaternary	Holocene	Alluvium	1.20	7.3	15.1	NP	NP	NP
3	7.5	112.2	2.0	3.4	2	SP-SM	120.0	Quaternary	Holocene	Alluvium	1.20	7.3	15.1	NP	NP	NP
4	9.5	110.2	7.0	11.2	2	SP-SM	120.0	Quaternary	Holocene	Alluvium	1.20	7.3	15.1	NP	NP	NP
5	11.5	108.2	4.0	10.8	3	SM	115.0	Quaternary	Holocene	Alluvium	1.20	21.0	20	Np	NP	NP
6	16.5	103.2	14.0	22.5	4	SW-SM	120.0	Quaternary	Holocene	Alluvium	1.20	12.0	25.1	NP	NP	NP
7	21.5	98.2	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0		30	27	3
8	21.8	97.9	50.0	46.0	5	ML	110.0	Paleogene	Eocene	Santee Limestone	2.10	51.0		30	27	3

[D]Depth at bottom of Split-Spoon Sampler.

Seismic Hazard Summary

GSE No.:	**41503-0002-0001**	**File No.:**		**Latitude:**	**33.457**
Project:	**RBO Four Hole Swamp**			**Longitude:**	**-80.647**
Route:	**US 301**	**County:**	**38 - Orangeburg**	**Location:**	

Designer: G. Burnworth - GSE
Date: 3/9/2016

Boring Number =	**RW-7**	**Design EQ =**	**SEE**	**SSL Water Table Depth (ft) =**	**9.7**
Boring Station =	**595366**	**Site Class =**	**D**	**SSL Water Table Elev. (msl ft) =**	**110.0**
Boring Offset =	**20' Lt**	**PGA (g) =**	**0.43**		
Ground Elevation at Boring (ft msl) =	**119.7**	**M_W =**	**7.4**		
Water Table Depth (Dw) (ft) =	**7.9**	**R (km) =**	**0**		
Water Table Elevation (msl ft) =	**111.8**	**D_{a5-95} (sec) =**	**30.12**		

N-value Summary					SSL Screening Summary		SSL Triggering Summary				Soil Shear Strength for Seismic Analysis Summary		Geotechnical Seismic Hazards Summary			
SPT Sample Number	Depth^D (ft)	Elevation (ft msl)	$N^*_{1,60,CS}$	Soil Type (USCS)	SSL Potential	Sand-like or Clay-like	$(D/C)_{SL}$ = CSR^*_{eq}/CRR^*_{eq}	φ_{SL}	(D/C)SL ≤ φSL	R_u	φ' (degrees)	τ (psf)	ΔLDI_i (feet)	$\sum \Delta LDI_i$ (feet)	ΔS_i (inches)	$\sum S_i$ (inches)
	0.0	119.7														
1	3.5	116.2	22.9	SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.87		0.86
2	5.5	114.2	7.1	SP-SM	NSL-S	Sand-Like			No Liquefaction		30.0			0.87		0.86
3	7.5	112.2	3.4	SP-SM	NSL-S	Sand-Like			No Liquefaction		27.0			0.87		0.86
4	9.5	110.2	11.2	SP-SM	NSL-S	Sand-Like			No Liquefaction		33.0			0.87		0.86
5	11.5	108.2	10.8	SM	SSL	Sand-Like	1.86	0.90	Full Liquefaction	0.70 - 1.00	6.0		0.87	0.87	0.86	0.86
6	16.5	103.2	22.5	SW-SM	NSL-S	Sand-Like			No Liquefaction		36.0			0.00		0.00
7	21.5	98.2	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
8	21.8	97.9	46.0	ML	NSL-S	Sand-Like			No Liquefaction		30.0			0.00		0.00
													0.87		**0.86**	
													LDI Total (feet)		**S Total (inches)**	

^{D}Depth at bottom of Split-Spoon Sampler.

Soil Shear Strength Summary

GSE No.:	41503-0002-0001	File No.:			Latitude:	33.457	Designer: G. Burnworth - GSE
Project:	RBO Four Hole Swamp				Longitude:	-80.647	Date: 3/9/2016
Route:	US 301	County:	38 - Orangeburg	Location:			

Boring Number =	RW-7	Design EQ =	SEE	No. of Soil Layers =	5 each
Boring Station =	5953+66.00	Site Class =	D	No. of Split Spoon Samples =	8 each
Boring Offset =	20' Lt	PGA (g) =	0.43	Total Profile Thickness =	22 feet
Ground Elevation at Boring (ft msl) =	119.7	M_W =	7.37		
Water Table Depth (Dw) (ft) =	7.9	R (km) =	0		
Water Table Elevation (msl ft) =	111.8	$D_{a5\text{-}95}$ (sec) =	30.12		

																	Total Soil Shear Strengths						Effective Soil Shear Strengths			
																	Short Term Loading				Cyclic Loading		Long Term Loading			
																	Correlated Static		Static		Seismic		Static			
SPT Sample Number	Depth[D] (ft)	Elevation (ft msl)	σ'_{vo} (psf)	N_{Meas}	N^*_{60}	$N^*_{1,60}$	$N^*_{1,60,CS}$	Soil Layer No.	Soil Type (USCS)	Screening Sand-Like or Clay-Like	Triggering $(D/C)_{SL} \leq \varphi_{SL}$	D_R (%)	Fines Content (%)	PI (%)	LL (%)	D_{10} (%)	C_u	C_c	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like	Sand-Like	Clay-Like			
																	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	τ = c (psf)	ϕ' (degrees)	OCR CL-ML, CL, CH	ϕ' (degrees)	τ = c (psf)
	0	119.7	0.0																								
1	3.5	116.2	402.5	12.0	15.8	20.1	22.9	1	SM	Sand-Like	No Liquefaction		13.7	NP	NP				38		36		36		36			
2	5.5	114.2	641	4.0	5.3	7.0	7.1	2	SP-SM	Sand-Like	No Liquefaction		7.3	NP	NP				30		30		30		30			
3	7.5	112.2	881	2.0	2.6	3.2	3.4	2	SP-SM	Sand-Like	No Liquefaction		7.3	NP	NP				27		27		27		27			
4	9.5	110.2	1021.16	7.0	9.2	11.0	11.2	2	SP-SM	Sand-Like	No Liquefaction		7.3	NP	NP				33		33		33		33			
5	11.5	108.2	1127.86	4.0	5.3	6.2	10.8	3	SM	Sand-Like	Full Liquefaction	33.8	21.0	NP	Np				30		30		6		30			
6	16.5	103.2	1406.86	14.0	18.4	20.4	22.5	4	SW-SM	Sand-Like	No Liquefaction		12.0	NP	NP				38		36		36		36			
7	21.5	98.2	1659.86	50.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		51.0	3.0	30.0				45		30		30		30			
8	21.8	97.9	1674.14	50.0	50.0	50.0	46.0	5	ML	Sand-Like	No Liquefaction		51.0	3.0	30.0				45		30		30		30			

[D]Depth at bottom of Split-Spoon Sampler.

APPENDIX C

AXIAL COMPRESSION PILE CAPACITY ANALYSES

GeoStellar Engineering

APPENDIX C
AXIAL PILE COMPRESSION CAPACITY ANALYSES

Pile capacity analyses were performed using APILE version 2014 with the option for FHWA design methodology. Axial pile compression capacity charts vs. depth have been developed for the Strength limit state. Axial pile capacity analyses for determining the required pile capacity for pile capacity verification were also performed. The APILE soil model input properties for the piles at Bent 3 are shown in the following tables. Table C1 shows soil model input properties for the Service limit state and Table C2 shows properties for the Strength limit state.

Table C1. APILE – Service Limit State Soil Input Properties for Bent 3 Piles

Layer	Soil Type	Depth[1] Below Ground Surface (ft)	Depth[1] Below Top of Pile (ft)	Effective Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
1	Sand	0 – 10	10 – 20	52.6	32	---[2]
2	Sand	10 – 57	20 – 67	57.6	36	---[2]
3	Sand	57 – 80	67 – 90	22 / 57.6 [3]	24 / 36 [3]	---[2]
4	Sand	80 - 102	90 - 112	57.6	36	---[2]
5	Sand	102 - 200	112 - 210	57.6	36	---[2]

[1] Assumed Pile Head Elevation 120 ft-msl; Ground Surface Elev. 110 ft-msl
[2] Not applicable input for selected soil type
[3] Weak Soil Zone Encountered / Weak Soil Zone not Encountered

Table C2. APILE – Strength Limit State Soil Input Properties for Bent 3 Piles

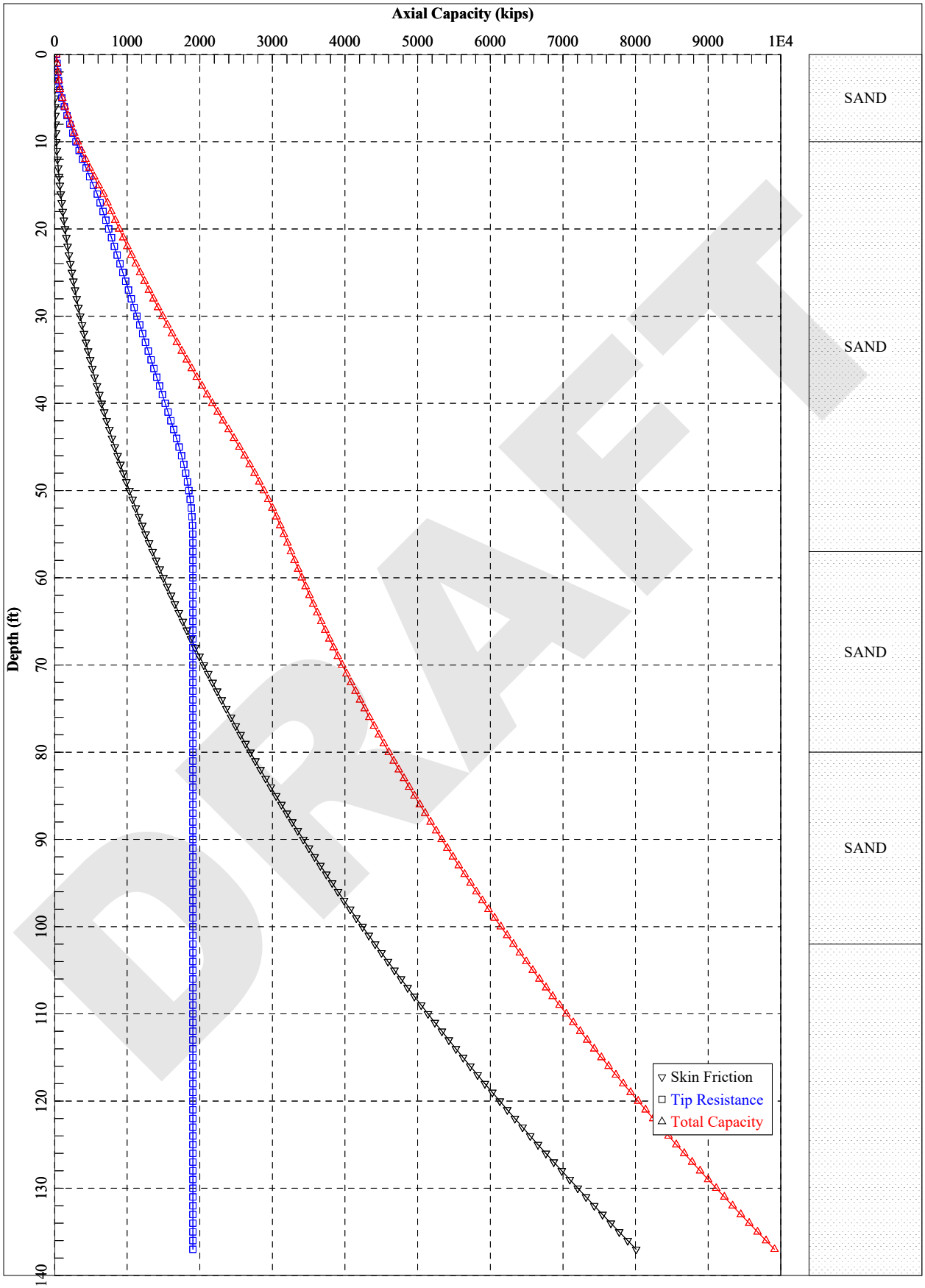
Layer	Soil Type	Depth[1] Below Ground Surface (ft)	Depth[1] Below Top of Pile (ft)	Effective Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
1	Sand	0 – 30	33 – 63	57.6	36	---[2]
2	Sand	30 – 53	63 – 86	22 / 57.6 [3]	24 / 36 [3]	---[2]
3	Sand	53 – 75	86 – 108	57.6	36	---[2]
4	Sand	75 - 200	108 - 233	57.6	36	---[2]

[1] Assumed Pile Head Elevation 116 ft-msl; Ground Surface Elev. after scour event 83 ft-msl
[2] Not applicable input for selected soil type
[3] Weak Soil Zone Encountered / Weak Soil Zone not Encountered

The following axial pile compression capacity analyses have been included in this appendix:

- Bent 3 Strength Limit State Axial Pile Capacity Analysis – Weak Soil Zone Encountered
- Bent 3 Strength Limit State Axial Pile Capacity Analysis – No Weak Soil Zone Encountered

48” Pipe Pile
Bent 3 Axial Pile Compression Capacity Analyses


Axial Capacity (kips)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E4
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
SAND
SAND
SAND
SAND
Skin Friction
Tip Resistance
Total Capacity

```
=========================================================================

                 APILE for Windows, Version 2014.6.10

                  Serial Number :  297187724

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                

=========================================================================


This program is licensed to :

GeoStellar Engineering, LLC
Arroyo Grande, CA

Path to file locations      : P:\Four Hole Swamp\APILE\2016-03-03\
Name of input data file     : FHS_4-1.5OEP_1-noweakzone-plugged - driveability.ap6d
Name of output file         : FHS_4-1.5OEP_1-noweakzone-plugged - driveability.ap6o
Name of plot output file    : FHS_4-1.5OEP_1-noweakzone-plugged - driveability.ap6p

-------------------------------------------------------------------------
                    Time and Date of Analysis
-------------------------------------------------------------------------

          Date:  March 14, 2016     Time:  15:06:58



1
      **********************
      * INPUT INFORMATION *
      **********************



      US 301 RBO Four Hole Swamp: 48"OEP (1.5"t) weak zone, unplugged

      DESIGNER   : Gabriel Burnworth

      JOB NUMBER : 41503-0002-0001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
```

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.300E+08 PSI
- CROSS SECTION AREA = 219.13 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 48.00 IN.
- INTERNAL DIAMETER, ID = 45.00 IN.
- TOTAL PILE LENGTH, TL = 143.00 FT.
- PILE STICKUP LENGTH, PSL = 6.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 143.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 45.00 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Plugged for open-ended pile

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	57.60	36.00	0.00
80.00	SAND	0.00	57.60	36.00	0.00
80.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
200.00	SAND	0.00	57.60	36.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
10.00	1.000	1.000
10.00	1.000	1.000
57.00	1.000	1.000
57.00	1.000	1.000
80.00	1.000	1.000
80.00	1.000	1.000
102.00	1.000	1.000
102.00	1.000	1.000
200.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	25.1	25.1
1.00	0.2	33.4	33.7
2.00	1.0	43.9	44.8
3.00	2.2	55.7	57.8
4.00	3.8	68.9	72.7
5.00	6.0	100.2	106.2
6.00	8.6	134.7	143.3
7.00	11.7	172.4	184.2
8.00	15.3	211.3	226.7
9.00	19.4	252.1	271.5
10.00	23.9	294.7	318.6
11.00	30.7	339.2	369.9
12.00	39.9	385.5	425.4
13.00	50.0	433.7	483.7
14.00	60.9	483.7	544.6
15.00	72.7	535.6	608.3
16.00	85.4	589.3	674.7
17.00	99.0	628.2	727.2
18.00	113.4	667.2	780.5
19.00	128.6	706.1	834.7
20.00	144.8	745.1	889.8
21.00	161.8	784.0	945.8
22.00	179.6	823.0	1002.6
23.00	198.4	861.9	1060.2
24.00	217.9	900.8	1118.8
25.00	238.4	939.8	1178.2
26.00	259.7	978.7	1238.5
27.00	281.9	1017.7	1299.6
28.00	305.0	1056.6	1361.6
29.00	328.9	1095.6	1424.5
30.00	353.7	1134.5	1488.2
31.00	379.4	1173.4	1552.8
32.00	405.9	1212.4	1618.3
33.00	433.3	1251.3	1684.6
34.00	461.5	1290.3	1751.8
35.00	490.7	1329.2	1819.9
36.00	520.7	1368.2	1888.8

37.00	551.5	1407.1	1958.6
38.00	583.2	1446.1	2029.3
39.00	615.8	1485.0	2100.8
40.00	649.3	1523.9	2173.2
41.00	683.6	1562.9	2246.5
42.00	718.8	1601.8	2320.6
43.00	754.8	1640.8	2395.6
44.00	791.7	1679.4	2471.1
45.00	829.5	1716.0	2545.5
46.00	868.2	1749.4	2617.5
47.00	907.7	1779.5	2687.2
48.00	948.0	1806.4	2754.5
49.00	989.3	1830.1	2819.3
50.00	1031.4	1850.5	2881.9
51.00	1074.4	1867.6	2942.0
52.00	1118.2	1881.5	2999.7
53.00	1162.9	1892.2	3055.1
54.00	1208.5	1899.6	3108.1
55.00	1254.9	1903.8	3158.7
56.00	1302.2	1905.1	3207.3
57.00	1350.4	1905.1	3255.5
58.00	1399.5	1905.1	3304.5
59.00	1449.4	1905.1	3354.4
60.00	1500.1	1905.1	3405.2
61.00	1551.8	1905.1	3456.8
62.00	1604.3	1905.1	3509.3
63.00	1657.6	1905.1	3562.7
64.00	1711.9	1905.1	3616.9
65.00	1767.0	1905.1	3672.0
66.00	1822.9	1905.1	3728.0
67.00	1879.8	1905.1	3784.8
68.00	1937.5	1905.1	3842.5
69.00	1996.0	1905.1	3901.1
70.00	2055.4	1905.1	3960.5
71.00	2115.7	1905.1	4020.8
72.00	2176.9	1905.1	4082.0
73.00	2238.9	1905.1	4144.0
74.00	2301.8	1905.1	4206.9
75.00	2365.6	1905.1	4270.6
76.00	2430.2	1905.1	4335.3
77.00	2495.7	1905.1	4400.7
78.00	2562.0	1905.1	4467.1
79.00	2629.3	1905.1	4534.3
80.00	2697.3	1905.1	4602.4
81.00	2766.3	1905.1	4671.4
82.00	2836.1	1905.1	4741.2
83.00	2906.8	1905.1	4811.9
84.00	2978.4	1905.1	4883.4
85.00	3050.8	1905.1	4955.8
86.00	3124.1	1905.1	5029.1
87.00	3198.2	1905.1	5103.3
88.00	3273.2	1905.1	5178.3
89.00	3349.1	1905.1	5254.2
90.00	3425.8	1905.1	5330.9
91.00	3503.5	1905.1	5408.5
92.00	3581.9	1905.1	5487.0
93.00	3661.3	1905.1	5566.3
94.00	3741.5	1905.1	5646.5
95.00	3822.6	1905.1	5727.6
96.00	3904.5	1905.1	5809.6
97.00	3987.3	1905.1	5892.4
98.00	4071.0	1905.1	5976.0
99.00	4155.5	1905.1	6060.6
100.00	4240.9	1905.1	6146.0
101.00	4327.2	1905.1	6232.3
102.00	4414.3	1905.1	6319.4
103.00	4502.3	1905.1	6407.4
104.00	4591.2	1905.1	6496.3

105.00	4680.9	1905.1	6586.0
106.00	4771.5	1905.1	6676.6
107.00	4863.0	1905.1	6768.1
108.00	4955.3	1905.1	6860.4
109.00	5048.5	1905.1	6953.6
110.00	5142.6	1905.1	7047.7
111.00	5237.5	1905.1	7142.6
112.00	5333.3	1905.1	7238.4
113.00	5430.0	1905.1	7335.1
114.00	5527.5	1905.1	7432.6
115.00	5625.9	1905.1	7531.0
116.00	5725.2	1905.1	7630.2
117.00	5825.3	1905.1	7730.4
118.00	5926.3	1905.1	7831.4
119.00	6028.2	1905.1	7933.2
120.00	6130.9	1905.1	8035.9
121.00	6234.5	1905.1	8139.5
122.00	6338.9	1905.1	8244.0
123.00	6444.2	1905.1	8349.3
124.00	6550.4	1905.1	8455.5
125.00	6657.5	1905.1	8562.5
126.00	6765.4	1905.1	8670.5
127.00	6874.2	1905.1	8779.2
128.00	6983.8	1905.1	8888.9
129.00	7094.3	1905.1	8999.4
130.00	7205.7	1905.1	9110.8
131.00	7318.0	1905.1	9223.0
132.00	7431.1	1905.1	9336.2
133.00	7545.1	1905.1	9450.1
134.00	7659.9	1905.1	9565.0
135.00	7775.6	1905.1	9680.7
136.00	7892.2	1905.1	9797.3
137.00	8009.6	1905.1	9914.7

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.3970E-01	0.1000E-01
			0.7940E-01	0.2000E-01
			0.1588E+00	0.4000E-01
			0.2382E+00	0.6000E-01
			0.3176E+00	0.8000E-01
			0.3573E+00	0.9000E-01
			0.3970E+00	0.1000E+00
			0.3970E+00	0.5000E+00
			0.3970E+00	0.2000E+01
2	10	0.5025E+01		
			0.0000E+00	0.0000E+00
			0.1588E+00	0.1000E-01
			0.3176E+00	0.2000E-01
			0.6352E+00	0.4000E-01
			0.9528E+00	0.6000E-01

```
                                0.1270E+01      0.8000E-01
                                0.1429E+01      0.9000E-01
                                0.1588E+01      0.1000E+00
                                0.1588E+01      0.5000E+00
                                0.1588E+01      0.2000E+01
3          10       0.9958E+01
                                0.0000E+00      0.0000E+00
                                0.3131E+00      0.1000E-01
                                0.6262E+00      0.2000E-01
                                0.1252E+01      0.4000E-01
                                0.1879E+01      0.6000E-01
                                0.2505E+01      0.8000E-01
                                0.2818E+01      0.9000E-01
                                0.3131E+01      0.1000E+00
                                0.3131E+01      0.5000E+00
                                0.3131E+01      0.2000E+01
4          10       0.1000E+02
                                0.0000E+00      0.0000E+00
                                0.4418E+00      0.1000E-01
                                0.8835E+00      0.2000E-01
                                0.1767E+01      0.4000E-01
                                0.2651E+01      0.6000E-01
                                0.3534E+01      0.8000E-01
                                0.3976E+01      0.9000E-01
                                0.4418E+01      0.1000E+00
                                0.4418E+01      0.5000E+00
                                0.4418E+01      0.2000E+01
5          10       0.3353E+02
                                0.0000E+00      0.0000E+00
                                0.1585E+01      0.1000E-01
                                0.3171E+01      0.2000E-01
                                0.6342E+01      0.4000E-01
                                0.9512E+01      0.6000E-01
                                0.1268E+02      0.8000E-01
                                0.1427E+02      0.9000E-01
                                0.1585E+02      0.1000E+00
                                0.1585E+02      0.5000E+00
                                0.1585E+02      0.2000E+01
6          10       0.5696E+02
                                0.0000E+00      0.0000E+00
                                0.2686E+01      0.1000E-01
                                0.5372E+01      0.2000E-01
                                0.1074E+02      0.4000E-01
                                0.1612E+02      0.6000E-01
                                0.2149E+02      0.8000E-01
                                0.2417E+02      0.9000E-01
                                0.2686E+02      0.1000E+00
                                0.2686E+02      0.5000E+00
                                0.2686E+02      0.2000E+01
7          10       0.5700E+02
                                0.0000E+00      0.0000E+00
                                0.2734E+01      0.1000E-01
                                0.5468E+01      0.2000E-01
                                0.1094E+02      0.4000E-01
                                0.1640E+02      0.6000E-01
                                0.2187E+02      0.8000E-01
                                0.2460E+02      0.9000E-01
                                0.2734E+02      0.1000E+00
                                0.2734E+02      0.5000E+00
                                0.2734E+02      0.2000E+01
8          10       0.6853E+02
                                0.0000E+00      0.0000E+00
                                0.3260E+01      0.1000E-01
                                0.6520E+01      0.2000E-01
                                0.1304E+02      0.4000E-01
                                0.1956E+02      0.6000E-01
                                0.2608E+02      0.8000E-01
                                0.2934E+02      0.9000E-01
```

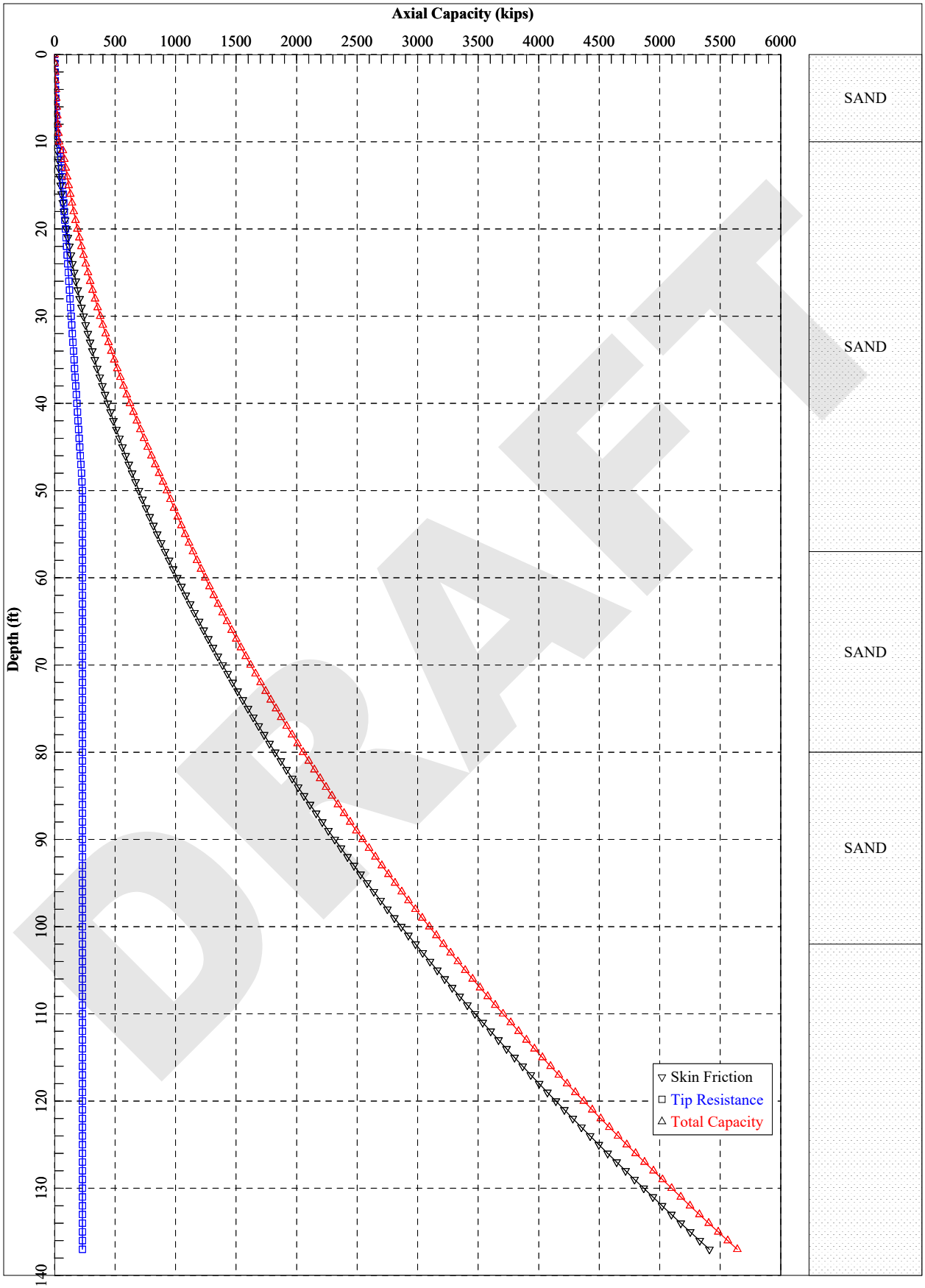
```
                                0.3260E+02      0.1000E+00
                                0.3260E+02      0.5000E+00
                                0.3260E+02      0.2000E+01
 9          10      0.7996E+02
                                0.0000E+00      0.0000E+00
                                0.3787E+01      0.1000E-01
                                0.7573E+01      0.2000E-01
                                0.1515E+02      0.4000E-01
                                0.2272E+02      0.6000E-01
                                0.3029E+02      0.8000E-01
                                0.3408E+02      0.9000E-01
                                0.3787E+02      0.1000E+00
                                0.3787E+02      0.5000E+00
                                0.3787E+02      0.2000E+01
10          10      0.8000E+02
                                0.0000E+00      0.0000E+00
                                0.3834E+01      0.1000E-01
                                0.7669E+01      0.2000E-01
                                0.1534E+02      0.4000E-01
                                0.2301E+02      0.6000E-01
                                0.3068E+02      0.8000E-01
                                0.3451E+02      0.9000E-01
                                0.3834E+02      0.1000E+00
                                0.3834E+02      0.5000E+00
                                0.3834E+02      0.2000E+01
11          10      0.9103E+02
                                0.0000E+00      0.0000E+00
                                0.4361E+01      0.1000E-01
                                0.8722E+01      0.2000E-01
                                0.1744E+02      0.4000E-01
                                0.2616E+02      0.6000E-01
                                0.3489E+02      0.8000E-01
                                0.3925E+02      0.9000E-01
                                0.4361E+02      0.1000E+00
                                0.4361E+02      0.5000E+00
                                0.4361E+02      0.2000E+01
12          10      0.1020E+03
                                0.0000E+00      0.0000E+00
                                0.4839E+01      0.1000E-01
                                0.9679E+01      0.2000E-01
                                0.1936E+02      0.4000E-01
                                0.2904E+02      0.6000E-01
                                0.3871E+02      0.8000E-01
                                0.4355E+02      0.9000E-01
                                0.4839E+02      0.1000E+00
                                0.4839E+02      0.5000E+00
                                0.4839E+02      0.2000E+01
13          10      0.1020E+03
                                0.0000E+00      0.0000E+00
                                0.4887E+01      0.1000E-01
                                0.9774E+01      0.2000E-01
                                0.1955E+02      0.4000E-01
                                0.2932E+02      0.6000E-01
                                0.3910E+02      0.8000E-01
                                0.4398E+02      0.9000E-01
                                0.4887E+02      0.1000E+00
                                0.4887E+02      0.5000E+00
                                0.4887E+02      0.2000E+01
14          10      0.1510E+03
                                0.0000E+00      0.0000E+00
                                0.6490E+01      0.1000E-01
                                0.1298E+02      0.2000E-01
                                0.2596E+02      0.4000E-01
                                0.3894E+02      0.6000E-01
                                0.5192E+02      0.8000E-01
                                0.5841E+02      0.9000E-01
                                0.6490E+02      0.1000E+00
                                0.6490E+02      0.5000E+00
```

```
                                        0.6490E+02      0.2000E+01
   15         10      0.2000E+03
                                        0.0000E+00      0.0000E+00
                                        0.6490E+01      0.1000E-01
                                        0.1298E+02      0.2000E-01
                                        0.2596E+02      0.4000E-01
                                        0.3894E+02      0.6000E-01
                                        0.5192E+02      0.8000E-01
                                        0.5841E+02      0.9000E-01
                                        0.6490E+02      0.1000E+00
                                        0.6490E+02      0.5000E+00
                                        0.6490E+02      0.2000E+01
```

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1191E+03	0.2400E-01
0.2381E+03	0.4800E-01
0.4763E+03	0.9600E-01
0.9525E+03	0.6240E+00
0.1429E+04	0.2016E+01
0.1715E+04	0.3504E+01
0.1905E+04	0.4800E+01
0.1905E+04	0.7200E+01
0.1905E+04	0.9600E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.6320E+02	0.7131E-02	0.4961E+00	0.1000E-03
0.6444E+03	0.7241E-01	0.4961E+01	0.1000E-02
0.2670E+04	0.3351E+00	0.2481E+02	0.5000E-02
0.3950E+04	0.5558E+00	0.4961E+02	0.1000E-01
0.7305E+04	0.1306E+01	0.2481E+03	0.5000E-01
0.8396E+04	0.1626E+01	0.4799E+03	0.1000E+00
0.8757E+04	0.2120E+01	0.8407E+03	0.5000E+00
0.8997E+04	0.2683E+01	0.1081E+04	0.1000E+01
0.9339E+04	0.3772E+01	0.1423E+04	0.2000E+01


Axial Capacity (kips)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
SAND
SAND
SAND
SAND
Skin Friction
Tip Resistance
Total Capacity

```
==========================================================================

                 APILE for Windows, Version 2014.6.10

                  Serial Number :  297187724

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                

==========================================================================


This program is licensed to :

GeoStellar Engineering, LLC
Arroyo Grande, CA

Path to file locations      : P:\Four Hole Swamp\APILE\2016-03-03\
Name of input data file     : FHS_4-1.5OEP_1-noweakzone-unplugged - driveability.ap6d
Name of output file         : FHS_4-1.5OEP_1-noweakzone-unplugged - driveability.ap6o
Name of plot output file    : FHS_4-1.5OEP_1-noweakzone-unplugged - driveability.ap6p

--------------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  March 14, 2016     Time:  15:08:18



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      **********************
      * INPUT INFORMATION *
      **********************



      US 301 RBO Four Hole Swamp: 48"OEP (1.5"t) weak zone, unplugged

      DESIGNER   : Gabriel Burnworth

      JOB NUMBER : 41503-0002-0001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
```

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.300E+08 PSI
- CROSS SECTION AREA = 219.13 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 48.00 IN.
- INTERNAL DIAMETER, ID = 45.00 IN.
- TOTAL PILE LENGTH, TL = 143.00 FT.
- PILE STICKUP LENGTH, PSL = 6.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 143.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 45.00 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	57.60	36.00	0.00
80.00	SAND	0.00	57.60	36.00	0.00
80.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
200.00	SAND	0.00	57.60	36.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
10.00	1.000	1.000
10.00	1.000	1.000
57.00	1.000	1.000
57.00	1.000	1.000
80.00	1.000	1.000
80.00	1.000	1.000
102.00	1.000	1.000
102.00	1.000	1.000
200.00	1.000	1.000

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****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0*	0.0
1.00	0.2	2.0*	2.2
2.00	0.7	4.0*	4.7
3.00	1.5	6.1*	7.6
4.00	2.7	8.1*	10.8
5.00	4.3	10.1*	14.4
6.00	6.1	12.1*	18.3
7.00	8.4	14.2*	22.5
8.00	10.9	16.2*	27.1
9.00	13.8	18.2*	32.0
10.00	17.1	20.2*	37.3
11.00	21.8	47.8*	69.5
12.00	28.0	52.5*	80.5
13.00	34.8	57.2*	92.0
14.00	42.2	61.9*	104.1
15.00	50.1	66.6*	116.8
16.00	58.7	71.4*	130.0
17.00	67.8	76.1*	143.9
18.00	77.6	80.8*	158.3
19.00	87.9	85.5*	173.4
20.00	98.8	90.2*	189.0
21.00	110.2	94.9*	205.2
22.00	122.3	99.7*	222.0
23.00	135.0	104.4*	239.3
24.00	148.2	109.1*	257.3
25.00	162.0	113.8*	275.8
26.00	176.4	118.5*	294.9
27.00	191.4	123.2*	314.6
28.00	207.0	127.9*	334.9
29.00	223.1	132.7*	355.8
30.00	239.9	137.4*	377.3
31.00	257.2	142.1*	399.3
32.00	275.1	146.8*	421.9
33.00	293.6	151.5*	445.2
34.00	312.7	156.2*	469.0
35.00	332.4	161.0*	493.3
36.00	352.6	165.7*	518.3

37.00	373.5	170.4*	543.9
38.00	394.9	175.1*	570.0
39.00	416.9	179.8*	596.7
40.00	439.5	184.5*	624.0
41.00	462.7	189.3*	651.9
42.00	486.4	194.0*	680.4
43.00	510.8	198.7*	709.5
44.00	535.7	203.4*	739.1
45.00	561.2	208.1*	769.3
46.00	587.3	212.8*	800.2
47.00	614.0	217.6*	831.6
48.00	641.3	222.3*	863.5
49.00	669.1	227.0*	896.1
50.00	697.6	230.7*	928.3
51.00	726.6	230.7*	957.3
52.00	756.2	230.7*	986.9
53.00	786.4	230.7*	1017.1
54.00	817.2	230.7*	1047.9
55.00	848.6	230.7*	1079.2
56.00	880.5	230.7*	1111.2
57.00	913.0	230.7*	1143.7
58.00	946.2	230.7*	1176.8
59.00	979.9	230.7*	1210.5
60.00	1014.1	230.7*	1244.8
61.00	1049.0	230.7*	1279.7
62.00	1084.5	230.7*	1315.2
63.00	1120.5	230.7*	1351.2
64.00	1157.1	230.7*	1387.8
65.00	1194.4	230.7*	1425.0
66.00	1232.2	230.7*	1462.8
67.00	1270.5	230.7*	1501.2
68.00	1309.5	230.7*	1540.2
69.00	1349.1	230.7*	1579.7
70.00	1389.2	230.7*	1619.9
71.00	1429.9	230.7*	1660.6
72.00	1471.2	230.7*	1701.9
73.00	1513.1	230.7*	1743.8
74.00	1555.6	230.7*	1786.3
75.00	1598.6	230.7*	1829.3
76.00	1642.3	230.7*	1873.0
77.00	1686.5	230.7*	1917.2
78.00	1731.3	230.7*	1962.0
79.00	1776.7	230.7*	2007.4
80.00	1822.7	230.7*	2053.4
81.00	1869.3	230.7*	2100.0
82.00	1916.4	230.7*	2147.1
83.00	1964.2	230.7*	2194.9
84.00	2012.5	230.7*	2243.2
85.00	2061.4	230.7*	2292.1
86.00	2110.9	230.7*	2341.6
87.00	2161.0	230.7*	2391.7
88.00	2211.6	230.7*	2442.3
89.00	2262.9	230.7*	2493.6
90.00	2314.7	230.7*	2545.4
91.00	2367.1	230.7*	2597.8
92.00	2420.1	230.7*	2650.8
93.00	2473.7	230.7*	2704.4
94.00	2527.9	230.7*	2758.6
95.00	2582.7	230.7*	2813.3
96.00	2638.0	230.7*	2868.7
97.00	2693.9	230.7*	2924.6
98.00	2750.4	230.7*	2981.1
99.00	2807.5	230.7*	3038.2
100.00	2865.2	230.7*	3095.9
101.00	2923.5	230.7*	3154.2
102.00	2982.3	230.7*	3213.0
103.00	3041.8	230.7*	3272.4
104.00	3101.8	230.7*	3332.5

105.00	3162.4	230.7*	3393.1
106.00	3223.6	230.7*	3454.3
107.00	3285.3	230.7*	3516.0
108.00	3347.7	230.7*	3578.4
109.00	3410.6	230.7*	3641.3
110.00	3474.2	230.7*	3704.9
111.00	3538.3	230.7*	3769.0
112.00	3603.0	230.7*	3833.7
113.00	3668.3	230.7*	3899.0
114.00	3734.1	230.7*	3964.8
115.00	3800.6	230.7*	4031.3
116.00	3867.6	230.7*	4098.3
117.00	3935.2	230.7*	4165.9
118.00	4003.5	230.7*	4234.1
119.00	4072.2	230.7*	4302.9
120.00	4141.6	230.7*	4372.3
121.00	4211.6	230.7*	4442.3
122.00	4282.1	230.7*	4512.8
123.00	4353.3	230.7*	4583.9
124.00	4425.0	230.7*	4655.7
125.00	4497.3	230.7*	4728.0
126.00	4570.2	230.7*	4800.9
127.00	4643.6	230.7*	4874.3
128.00	4717.7	230.7*	4948.4
129.00	4792.3	230.7*	5023.0
130.00	4867.5	230.7*	5098.2
131.00	4943.4	230.7*	5174.0
132.00	5019.8	230.7*	5250.4
133.00	5096.7	230.7*	5327.4
134.00	5174.3	230.7*	5405.0
135.00	5252.4	230.7*	5483.1
136.00	5331.2	230.7*	5561.9
137.00	5410.5	230.7*	5641.2

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.2832E-01	0.1000E-01
			0.5664E-01	0.2000E-01
			0.1133E+00	0.4000E-01
			0.1699E+00	0.6000E-01
			0.2266E+00	0.8000E-01
			0.2549E+00	0.9000E-01
			0.2832E+00	0.1000E+00
			0.2832E+00	0.5000E+00
			0.2832E+00	0.2000E+01
2	10	0.5025E+01		
			0.0000E+00	0.0000E+00
			0.1133E+00	0.1000E-01
			0.2266E+00	0.2000E-01
			0.4531E+00	0.4000E-01
			0.6797E+00	0.6000E-01

			0.9063E+00	0.8000E-01
			0.1020E+01	0.9000E-01
			0.1133E+01	0.1000E+00
			0.1133E+01	0.5000E+00
			0.1133E+01	0.2000E+01
3	10	0.9958E+01		
			0.0000E+00	0.0000E+00
			0.2187E+00	0.1000E-01
			0.4375E+00	0.2000E-01
			0.8750E+00	0.4000E-01
			0.1312E+01	0.6000E-01
			0.1750E+01	0.8000E-01
			0.1969E+01	0.9000E-01
			0.2187E+01	0.1000E+00
			0.2187E+01	0.5000E+00
			0.2187E+01	0.2000E+01
4	10	0.1000E+02		
			0.0000E+00	0.0000E+00
			0.3009E+00	0.1000E-01
			0.6017E+00	0.2000E-01
			0.1203E+01	0.4000E-01
			0.1805E+01	0.6000E-01
			0.2407E+01	0.8000E-01
			0.2708E+01	0.9000E-01
			0.3009E+01	0.1000E+00
			0.3009E+01	0.5000E+00
			0.3009E+01	0.2000E+01
5	10	0.3353E+02		
			0.0000E+00	0.0000E+00
			0.1071E+01	0.1000E-01
			0.2141E+01	0.2000E-01
			0.4283E+01	0.4000E-01
			0.6424E+01	0.6000E-01
			0.8566E+01	0.8000E-01
			0.9637E+01	0.9000E-01
			0.1071E+02	0.1000E+00
			0.1071E+02	0.5000E+00
			0.1071E+02	0.2000E+01
6	10	0.5696E+02		
			0.0000E+00	0.0000E+00
			0.1814E+01	0.1000E-01
			0.3628E+01	0.2000E-01
			0.7256E+01	0.4000E-01
			0.1088E+02	0.6000E-01
			0.1451E+02	0.8000E-01
			0.1633E+02	0.9000E-01
			0.1814E+02	0.1000E+00
			0.1814E+02	0.5000E+00
			0.1814E+02	0.2000E+01
7	10	0.5700E+02		
			0.0000E+00	0.0000E+00
			0.1846E+01	0.1000E-01
			0.3693E+01	0.2000E-01
			0.7385E+01	0.4000E-01
			0.1108E+02	0.6000E-01
			0.1477E+02	0.8000E-01
			0.1662E+02	0.9000E-01
			0.1846E+02	0.1000E+00
			0.1846E+02	0.5000E+00
			0.1846E+02	0.2000E+01
8	10	0.6853E+02		
			0.0000E+00	0.0000E+00
			0.2202E+01	0.1000E-01
			0.4404E+01	0.2000E-01
			0.8807E+01	0.4000E-01
			0.1321E+02	0.6000E-01
			0.1761E+02	0.8000E-01
			0.1982E+02	0.9000E-01

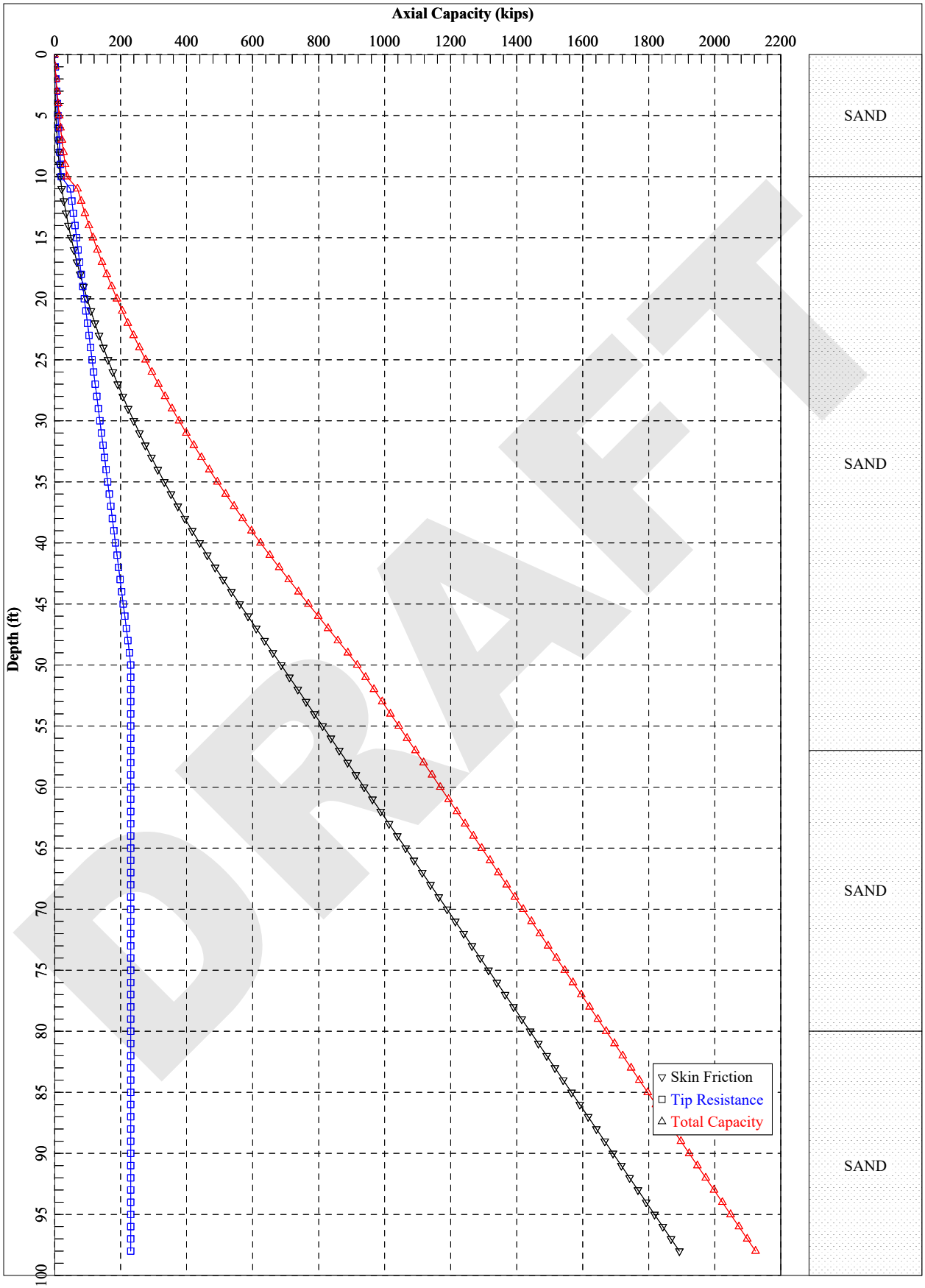
```
                                0.2202E+02      0.1000E+00
                                0.2202E+02      0.5000E+00
                                0.2202E+02      0.2000E+01
 9          10      0.7996E+02
                                0.0000E+00      0.0000E+00
                                0.2557E+01      0.1000E-01
                                0.5115E+01      0.2000E-01
                                0.1023E+02      0.4000E-01
                                0.1534E+02      0.6000E-01
                                0.2046E+02      0.8000E-01
                                0.2302E+02      0.9000E-01
                                0.2557E+02      0.1000E+00
                                0.2557E+02      0.5000E+00
                                0.2557E+02      0.2000E+01
10          10      0.8000E+02
                                0.0000E+00      0.0000E+00
                                0.2590E+01      0.1000E-01
                                0.5179E+01      0.2000E-01
                                0.1036E+02      0.4000E-01
                                0.1554E+02      0.6000E-01
                                0.2072E+02      0.8000E-01
                                0.2331E+02      0.9000E-01
                                0.2590E+02      0.1000E+00
                                0.2590E+02      0.5000E+00
                                0.2590E+02      0.2000E+01
11          10      0.9103E+02
                                0.0000E+00      0.0000E+00
                                0.2945E+01      0.1000E-01
                                0.5890E+01      0.2000E-01
                                0.1178E+02      0.4000E-01
                                0.1767E+02      0.6000E-01
                                0.2356E+02      0.8000E-01
                                0.2651E+02      0.9000E-01
                                0.2945E+02      0.1000E+00
                                0.2945E+02      0.5000E+00
                                0.2945E+02      0.2000E+01
12          10      0.1020E+03
                                0.0000E+00      0.0000E+00
                                0.3268E+01      0.1000E-01
                                0.6537E+01      0.2000E-01
                                0.1307E+02      0.4000E-01
                                0.1961E+02      0.6000E-01
                                0.2615E+02      0.8000E-01
                                0.2941E+02      0.9000E-01
                                0.3268E+02      0.1000E+00
                                0.3268E+02      0.5000E+00
                                0.3268E+02      0.2000E+01
13          10      0.1020E+03
                                0.0000E+00      0.0000E+00
                                0.3301E+01      0.1000E-01
                                0.6601E+01      0.2000E-01
                                0.1320E+02      0.4000E-01
                                0.1980E+02      0.6000E-01
                                0.2641E+02      0.8000E-01
                                0.2971E+02      0.9000E-01
                                0.3301E+02      0.1000E+00
                                0.3301E+02      0.5000E+00
                                0.3301E+02      0.2000E+01
14          10      0.1510E+03
                                0.0000E+00      0.0000E+00
                                0.4383E+01      0.1000E-01
                                0.8767E+01      0.2000E-01
                                0.1753E+02      0.4000E-01
                                0.2630E+02      0.6000E-01
                                0.3507E+02      0.8000E-01
                                0.3945E+02      0.9000E-01
                                0.4383E+02      0.1000E+00
                                0.4383E+02      0.5000E+00
```

```
                                        0.4383E+02      0.2000E+01
   15         10      0.2000E+03
                                        0.0000E+00      0.0000E+00
                                        0.4383E+01      0.1000E-01
                                        0.8767E+01      0.2000E-01
                                        0.1753E+02      0.4000E-01
                                        0.2630E+02      0.6000E-01
                                        0.3507E+02      0.8000E-01
                                        0.3945E+02      0.9000E-01
                                        0.4383E+02      0.1000E+00
                                        0.4383E+02      0.5000E+00
                                        0.4383E+02      0.2000E+01
```

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1442E+02	0.2400E-01
0.2884E+02	0.4800E-01
0.5767E+02	0.9600E-01
0.1153E+03	0.6240E+00
0.1730E+03	0.2016E+01
0.2076E+03	0.3504E+01
0.2307E+03	0.4800E+01
0.2307E+03	0.7200E+01
0.2307E+03	0.9600E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.2185E+02	0.2770E-02	0.6008E-01	0.1000E-03
0.2200E+03	0.2781E-01	0.6008E+00	0.1000E-02
0.1110E+04	0.1407E+00	0.3004E+01	0.5000E-02
0.1977E+04	0.2690E+00	0.6008E+01	0.1000E-01
0.4545E+04	0.8068E+00	0.3004E+02	0.5000E-01
0.5406E+04	0.1061E+01	0.5811E+02	0.1000E+00
0.5450E+04	0.1473E+01	0.1018E+03	0.5000E+00
0.5479E+04	0.1980E+01	0.1309E+03	0.1000E+01
0.5520E+04	0.2991E+01	0.1724E+03	0.2000E+01


Axial Capacity (kips)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
SAND
SAND
SAND
SAND
Skin Friction
Tip Resistance
Total Capacity

```
==========================================================================

                 APILE for Windows, Version 2014.6.10

                  Serial Number :  297187724

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                

==========================================================================


This program is licensed to :

GeoStellar Engineering, LLC
Arroyo Grande, CA

Path to file locations      : P:\Four Hole Swamp\APILE\2016-03-03\
Name of input data file     : FHS_4-1.5OEP_1-noweakzone-unplugged - service.ap6d
Name of output file         : FHS_4-1.5OEP_1-noweakzone-unplugged - service.ap6o
Name of plot output file    : FHS_4-1.5OEP_1-noweakzone-unplugged - service.ap6p

--------------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  March 14, 2016     Time:  15:08:47



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      **********************
      * INPUT INFORMATION *
      **********************



      US 301 RBO Four Hole Swamp: 48"OEP (1.5"t) weak zone, unplugged

      DESIGNER   : Gabriel Burnworth

      JOB NUMBER : 41503-0002-0001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
```

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.300E+08 PSI
- CROSS SECTION AREA = 219.13 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 48.00 IN.
- INTERNAL DIAMETER, ID = 45.00 IN.
- TOTAL PILE LENGTH, TL = 108.00 FT.
- PILE STICKUP LENGTH, PSL = 10.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 108.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 45.00 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	57.60	36.00	0.00
80.00	SAND	0.00	57.60	36.00	0.00
80.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
200.00	SAND	0.00	57.60	36.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
10.00	1.000	1.000
10.00	1.000	1.000
57.00	1.000	1.000
57.00	1.000	1.000
80.00	1.000	1.000
80.00	1.000	1.000
102.00	1.000	1.000
102.00	1.000	1.000
200.00	1.000	1.000

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****
* COMPUTATION RESULT *
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****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0*	0.0
1.00	0.2	2.0*	2.2
2.00	0.7	4.0*	4.7
3.00	1.5	6.1*	7.6
4.00	2.7	8.1*	10.8
5.00	4.3	10.1*	14.4
6.00	6.1	12.1*	18.3
7.00	8.4	14.2*	22.5
8.00	10.9	16.2*	27.1
9.00	13.8	18.2*	32.0
10.00	17.1	20.2*	37.3
11.00	21.8	47.8*	69.5
12.00	28.0	52.5*	80.5
13.00	34.8	57.2*	92.0
14.00	42.2	61.9*	104.1
15.00	50.1	66.6*	116.8
16.00	58.7	71.4*	130.0
17.00	67.8	76.1*	143.9
18.00	77.6	80.8*	158.3
19.00	87.9	85.5*	173.4
20.00	98.8	90.2*	189.0
21.00	110.2	94.9*	205.2
22.00	122.3	99.7*	222.0
23.00	135.0	104.4*	239.3
24.00	148.2	109.1*	257.3
25.00	162.0	113.8*	275.8
26.00	176.4	118.5*	294.9
27.00	191.4	123.2*	314.6
28.00	207.0	127.9*	334.9
29.00	223.1	132.7*	355.8
30.00	239.9	137.4*	377.3
31.00	257.2	142.1*	399.3
32.00	275.1	146.8*	421.9
33.00	293.6	151.5*	445.2
34.00	312.7	156.2*	469.0
35.00	332.4	161.0*	493.3
36.00	352.6	165.7*	518.3

37.00	373.5	170.4*	543.9
38.00	394.9	175.1*	570.0
39.00	416.9	179.8*	596.7
40.00	439.5	184.5*	624.0
41.00	462.7	189.3*	651.9
42.00	486.4	194.0*	680.4
43.00	510.8	198.7*	709.5
44.00	535.7	203.4*	739.1
45.00	560.8	208.1*	769.0
46.00	586.0	212.8*	798.8
47.00	611.1	217.6*	828.7
48.00	636.2	222.3*	858.5
49.00	661.4	227.0*	888.4
50.00	686.5	230.7*	917.2
51.00	711.6	230.7*	942.3
52.00	736.8	230.7*	967.5
53.00	761.9	230.7*	992.6
54.00	787.0	230.7*	1017.7
55.00	812.2	230.7*	1042.9
56.00	837.3	230.7*	1068.0
57.00	862.4	230.7*	1093.1
58.00	887.6	230.7*	1118.3
59.00	912.7	230.7*	1143.4
60.00	937.8	230.7*	1168.5
61.00	963.0	230.7*	1193.7
62.00	988.1	230.7*	1218.8
63.00	1013.2	230.7*	1243.9
64.00	1038.4	230.7*	1269.1
65.00	1063.5	230.7*	1294.2
66.00	1088.6	230.7*	1319.3
67.00	1113.8	230.7*	1344.5
68.00	1138.9	230.7*	1369.6
69.00	1164.0	230.7*	1394.7
70.00	1189.2	230.7*	1419.9
71.00	1214.3	230.7*	1445.0
72.00	1239.4	230.7*	1470.1
73.00	1264.6	230.7*	1495.2
74.00	1289.7	230.7*	1520.4
75.00	1314.8	230.7*	1545.5
76.00	1340.0	230.7*	1570.6
77.00	1365.1	230.7*	1595.8
78.00	1390.2	230.7*	1620.9
79.00	1415.4	230.7*	1646.0
80.00	1440.5	230.7*	1671.2
81.00	1465.6	230.7*	1696.3
82.00	1490.8	230.7*	1721.4
83.00	1515.9	230.7*	1746.6
84.00	1541.0	230.7*	1771.7
85.00	1566.2	230.7*	1796.8
86.00	1591.3	230.7*	1822.0
87.00	1616.4	230.7*	1847.1
88.00	1641.5	230.7*	1872.2
89.00	1666.7	230.7*	1897.4
90.00	1691.8	230.7*	1922.5
91.00	1716.9	230.7*	1947.6
92.00	1742.1	230.7*	1972.8
93.00	1767.2	230.7*	1997.9
94.00	1792.3	230.7*	2023.0
95.00	1817.5	230.7*	2048.2
96.00	1842.6	230.7*	2073.3
97.00	1867.7	230.7*	2098.4
98.00	1892.9	230.7*	2123.6

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

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**********************************************
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING                      *
**********************************************
```

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.2832E-01	0.1000E-01
			0.5664E-01	0.2000E-01
			0.1133E+00	0.4000E-01
			0.1699E+00	0.6000E-01
			0.2266E+00	0.8000E-01
			0.2549E+00	0.9000E-01
			0.2832E+00	0.1000E+00
			0.2832E+00	0.5000E+00
			0.2832E+00	0.2000E+01
2	10	0.5025E+01		
			0.0000E+00	0.0000E+00
			0.1133E+00	0.1000E-01
			0.2266E+00	0.2000E-01
			0.4531E+00	0.4000E-01
			0.6797E+00	0.6000E-01
			0.9063E+00	0.8000E-01
			0.1020E+01	0.9000E-01
			0.1133E+01	0.1000E+00
			0.1133E+01	0.5000E+00
			0.1133E+01	0.2000E+01
3	10	0.9958E+01		
			0.0000E+00	0.0000E+00
			0.2187E+00	0.1000E-01
			0.4375E+00	0.2000E-01
			0.8750E+00	0.4000E-01
			0.1312E+01	0.6000E-01
			0.1750E+01	0.8000E-01
			0.1969E+01	0.9000E-01
			0.2187E+01	0.1000E+00
			0.2187E+01	0.5000E+00
			0.2187E+01	0.2000E+01
4	10	0.1000E+02		
			0.0000E+00	0.0000E+00
			0.3009E+00	0.1000E-01
			0.6017E+00	0.2000E-01
			0.1203E+01	0.4000E-01
			0.1805E+01	0.6000E-01
			0.2407E+01	0.8000E-01
			0.2708E+01	0.9000E-01
			0.3009E+01	0.1000E+00
			0.3009E+01	0.5000E+00
			0.3009E+01	0.2000E+01
5	10	0.3353E+02		
			0.0000E+00	0.0000E+00
			0.1071E+01	0.1000E-01
			0.2141E+01	0.2000E-01
			0.4283E+01	0.4000E-01
			0.6424E+01	0.6000E-01
			0.8566E+01	0.8000E-01
			0.9637E+01	0.9000E-01
			0.1071E+02	0.1000E+00
			0.1071E+02	0.5000E+00
			0.1071E+02	0.2000E+01
6	10	0.5696E+02		

```
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
 7          10      0.5700E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
 8          10      0.6853E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
 9          10      0.7996E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
10          10      0.8000E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
11          10      0.9103E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
12          10      0.1020E+03
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
```

```
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   13         10      0.1020E+03
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   14         10      0.1510E+03
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   15         10      0.2000E+03
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01

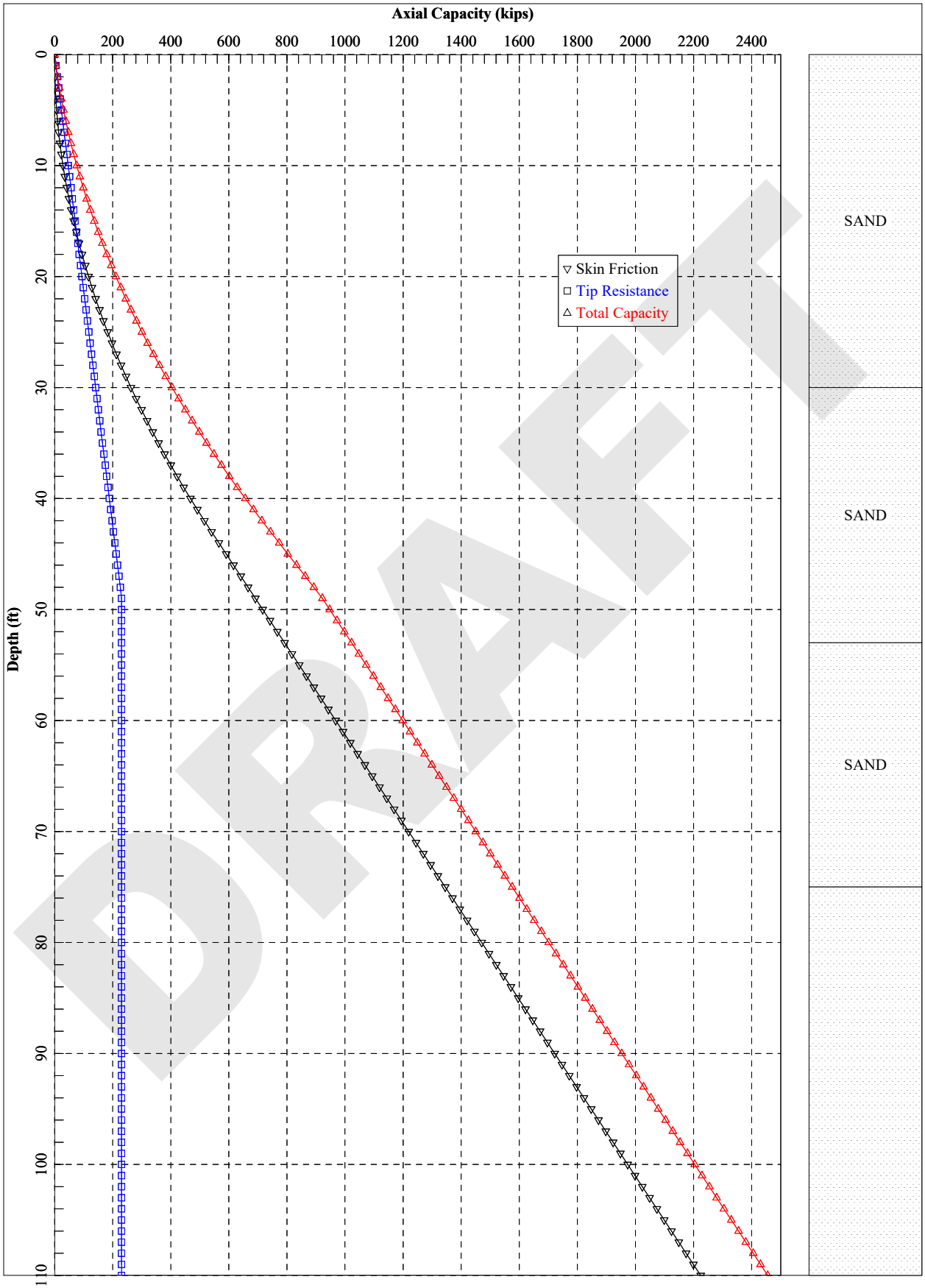

 TIP   LOAD          TIP MOVEMENT
     KIP                IN.

 0.0000E+00          0.0000E+00
 0.1442E+02          0.2400E-01
 0.2884E+02          0.4800E-01
 0.5767E+02          0.9600E-01
 0.1153E+03          0.6240E+00
 0.1730E+03          0.2016E+01
 0.2076E+03          0.3504E+01
 0.2307E+03          0.4800E+01
 0.2307E+03          0.7200E+01
 0.2307E+03          0.9600E+01


               LOAD VERSUS SETTLEMENT CURVE
               ****************************


 TOP  LOAD      TOP MOVEMENT        TIP  LOAD       TIP MOVEMENT
    KIP             IN.               KIP             IN.
0.2996E+01       0.4387E-03       0.6008E-01       0.1000E-03
```

0.2996E+02	0.4387E-02	0.6008E+00	0.1000E-02
0.1503E+03	0.2197E-01	0.3004E+01	0.5000E-02
0.3017E+03	0.4405E-01	0.6008E+01	0.1000E-01
0.1400E+04	0.2147E+00	0.3004E+02	0.5000E-01
0.1925E+04	0.3480E+00	0.5811E+02	0.1000E+00
0.1969E+04	0.7566E+00	0.1018E+03	0.5000E+00
0.1998E+04	0.1262E+01	0.1309E+03	0.1000E+01
0.2039E+04	0.2271E+01	0.1724E+03	0.2000E+01


Axial Capacity (kips)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
Skin Friction
Tip Resistance
Total Capacity
SAND
SAND
SAND

```
==========================================================================

                 APILE for Windows, Version 2014.6.10

                  Serial Number :  297187724

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                

==========================================================================


This program is licensed to :

GeoStellar Engineering, LLC
Arroyo Grande, CA

Path to file locations      : P:\Four Hole Swamp\APILE\2016-03-03\
Name of input data file     : FHS_4-1.5OEP_1-noweakzone-unplugged.ap6d
Name of output file         : FHS_4-1.5OEP_1-noweakzone-unplugged.ap6o
Name of plot output file    : FHS_4-1.5OEP_1-noweakzone-unplugged.ap6p

--------------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  March 03, 2016     Time:  15:02:22



1
      **********************
      * INPUT INFORMATION *
      **********************



      US 301 RBO Four Hole Swamp: 48"OEP (1.5"t) weak zone, unplugged

      DESIGNER   : Gabriel Burnworth

      JOB NUMBER : 41503-0002-0001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
```

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.300E+08 PSI
- CROSS SECTION AREA = 219.13 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 48.00 IN.
- INTERNAL DIAMETER, ID = 45.00 IN.
- TOTAL PILE LENGTH, TL = 143.00 FT.
- PILE STICKUP LENGTH, PSL = 33.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 143.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 45.00 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	57.60	36.00	0.00
30.00	SAND	0.00	57.60	36.00	0.00
30.00	SAND	0.00	57.60	36.00	0.00
53.00	SAND	0.00	57.60	36.00	0.00
53.00	SAND	0.00	57.60	36.00	0.00
75.00	SAND	0.00	57.60	36.00	0.00
75.00	SAND	0.00	57.60	36.00	0.00
200.00	SAND	0.00	57.60	36.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING

0.00	1.000	1.000
30.00	1.000	1.000
30.00	1.000	1.000
53.00	1.000	1.000
53.00	1.000	1.000
75.00	1.000	1.000
75.00	1.000	1.000
200.00	1.000	1.000

1

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**********************
* COMPUTATION RESULT *
**********************
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****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0*	0.0
1.00	0.3	4.7*	5.0
2.00	1.2	9.4*	10.6
3.00	2.6	14.1*	16.8
4.00	4.7	18.9*	23.5
5.00	7.3	23.6*	30.9
6.00	10.5	28.3*	38.8
7.00	14.3	33.0*	47.3
8.00	18.7	37.7*	56.4
9.00	23.7	42.4*	66.1
10.00	29.2	47.2*	76.4
11.00	35.4	51.9*	87.3
12.00	42.1	56.6*	98.7
13.00	49.4	61.3*	110.7
14.00	57.3	66.0*	123.3
15.00	65.8	70.7*	136.5
16.00	74.9	75.5*	150.3
17.00	84.5	80.2*	164.7
18.00	94.7	84.9*	179.6
19.00	105.6	89.6*	195.2
20.00	117.0	94.3*	211.3
21.00	128.9	99.0*	228.0
22.00	141.5	103.7*	245.3
23.00	154.7	108.5*	263.1
24.00	168.4	113.2*	281.6
25.00	182.8	117.9*	300.6
26.00	197.7	122.6*	320.3
27.00	213.2	127.3*	340.5
28.00	229.2	132.0*	361.3
29.00	245.9	136.8*	382.7
30.00	263.2	141.5*	404.6
31.00	281.0	146.2*	427.2
32.00	299.4	150.9*	450.3
33.00	318.4	155.6*	474.0
34.00	338.0	160.3*	498.4
35.00	358.2	165.1*	523.2
36.00	379.0	169.8*	548.7
37.00	400.3	174.5*	574.8
38.00	422.2	179.2*	601.4
39.00	444.7	183.9*	628.7
40.00	467.8	188.6*	656.5
41.00	491.5	193.3*	684.9
42.00	515.8	198.1*	713.9

43.00	540.7	202.8*	743.4
44.00	565.8	207.5*	773.3
45.00	590.9	212.2*	803.1
46.00	616.0	216.9*	833.0
47.00	641.2	221.6*	862.8
48.00	666.3	226.4*	892.7
49.00	691.4	230.7*	922.1
50.00	716.6	230.7*	947.3
51.00	741.7	230.7*	972.4
52.00	766.8	230.7*	997.5
53.00	792.0	230.7*	1022.7
54.00	817.1	230.7*	1047.8
55.00	842.2	230.7*	1072.9
56.00	867.4	230.7*	1098.1
57.00	892.5	230.7*	1123.2
58.00	917.6	230.7*	1148.3
59.00	942.8	230.7*	1173.5
60.00	967.9	230.7*	1198.6
61.00	993.0	230.7*	1223.7
62.00	1018.2	230.7*	1248.9
63.00	1043.3	230.7*	1274.0
64.00	1068.4	230.7*	1299.1
65.00	1093.6	230.7*	1324.3
66.00	1118.7	230.7*	1349.4
67.00	1143.8	230.7*	1374.5
68.00	1169.0	230.7*	1399.7
69.00	1194.1	230.7*	1424.8
70.00	1219.2	230.7*	1449.9
71.00	1244.4	230.7*	1475.1
72.00	1269.5	230.7*	1500.2
73.00	1294.6	230.7*	1525.3
74.00	1319.8	230.7*	1550.5
75.00	1344.9	230.7*	1575.6
76.00	1370.0	230.7*	1600.7
77.00	1395.2	230.7*	1625.9
78.00	1420.3	230.7*	1651.0
79.00	1445.4	230.7*	1676.1
80.00	1470.6	230.7*	1701.3
81.00	1495.7	230.7*	1726.4
82.00	1520.8	230.7*	1751.5
83.00	1546.0	230.7*	1776.7
84.00	1571.1	230.7*	1801.8
85.00	1596.2	230.7*	1826.9
86.00	1621.4	230.7*	1852.0
87.00	1646.5	230.7*	1877.2
88.00	1671.6	230.7*	1902.3
89.00	1696.8	230.7*	1927.4
90.00	1721.9	230.7*	1952.6
91.00	1747.0	230.7*	1977.7
92.00	1772.2	230.7*	2002.8
93.00	1797.3	230.7*	2028.0
94.00	1822.4	230.7*	2053.1
95.00	1847.6	230.7*	2078.2
96.00	1872.7	230.7*	2103.4
97.00	1897.8	230.7*	2128.5
98.00	1922.9	230.7*	2153.6
99.00	1948.1	230.7*	2178.8
100.00	1973.2	230.7*	2203.9
101.00	1998.3	230.7*	2229.0
102.00	2023.5	230.7*	2254.2
103.00	2048.6	230.7*	2279.3
104.00	2073.7	230.7*	2304.4
105.00	2098.9	230.7*	2329.6
106.00	2124.0	230.7*	2354.7
107.00	2149.1	230.7*	2379.8
108.00	2174.3	230.7*	2405.0
109.00	2199.4	230.7*	2430.1
110.00	2224.5	230.7*	2455.2

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.4848E-01	0.1000E-01
			0.9695E-01	0.2000E-01
			0.1939E+00	0.4000E-01
			0.2909E+00	0.6000E-01
			0.3878E+00	0.8000E-01
			0.4363E+00	0.9000E-01
			0.4848E+00	0.1000E+00
			0.4848E+00	0.5000E+00
			0.4848E+00	0.2000E+01
2	10	0.1503E+02		
			0.0000E+00	0.0000E+00
			0.5171E+00	0.1000E-01
			0.1034E+01	0.2000E-01
			0.2068E+01	0.4000E-01
			0.3102E+01	0.6000E-01
			0.4137E+01	0.8000E-01
			0.4654E+01	0.9000E-01
			0.5171E+01	0.1000E+00
			0.5171E+01	0.5000E+00
			0.5171E+01	0.2000E+01
3	10	0.2996E+02		
			0.0000E+00	0.0000E+00
			0.9695E+00	0.1000E-01
			0.1939E+01	0.2000E-01
			0.3878E+01	0.4000E-01
			0.5817E+01	0.6000E-01
			0.7756E+01	0.8000E-01
			0.8726E+01	0.9000E-01
			0.9695E+01	0.1000E+00
			0.9695E+01	0.5000E+00
			0.9695E+01	0.2000E+01
4	10	0.3000E+02		
			0.0000E+00	0.0000E+00
			0.1002E+01	0.1000E-01
			0.2004E+01	0.2000E-01
			0.4007E+01	0.4000E-01
			0.6011E+01	0.6000E-01
			0.8015E+01	0.8000E-01
			0.9017E+01	0.9000E-01
			0.1002E+02	0.1000E+00
			0.1002E+02	0.5000E+00
			0.1002E+02	0.2000E+01
5	10	0.4153E+02		
			0.0000E+00	0.0000E+00
			0.1357E+01	0.1000E-01
			0.2715E+01	0.2000E-01
			0.5429E+01	0.4000E-01
			0.8144E+01	0.6000E-01

```
                                0.1086E+02      0.8000E-01
                                0.1222E+02      0.9000E-01
                                0.1357E+02      0.1000E+00
                                0.1357E+02      0.5000E+00
                                0.1357E+02      0.2000E+01
 6          10      0.5296E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
 7          10      0.5300E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
 8          10      0.6403E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
 9          10      0.7496E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
10          10      0.7500E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
11          10      0.1375E+03
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
```

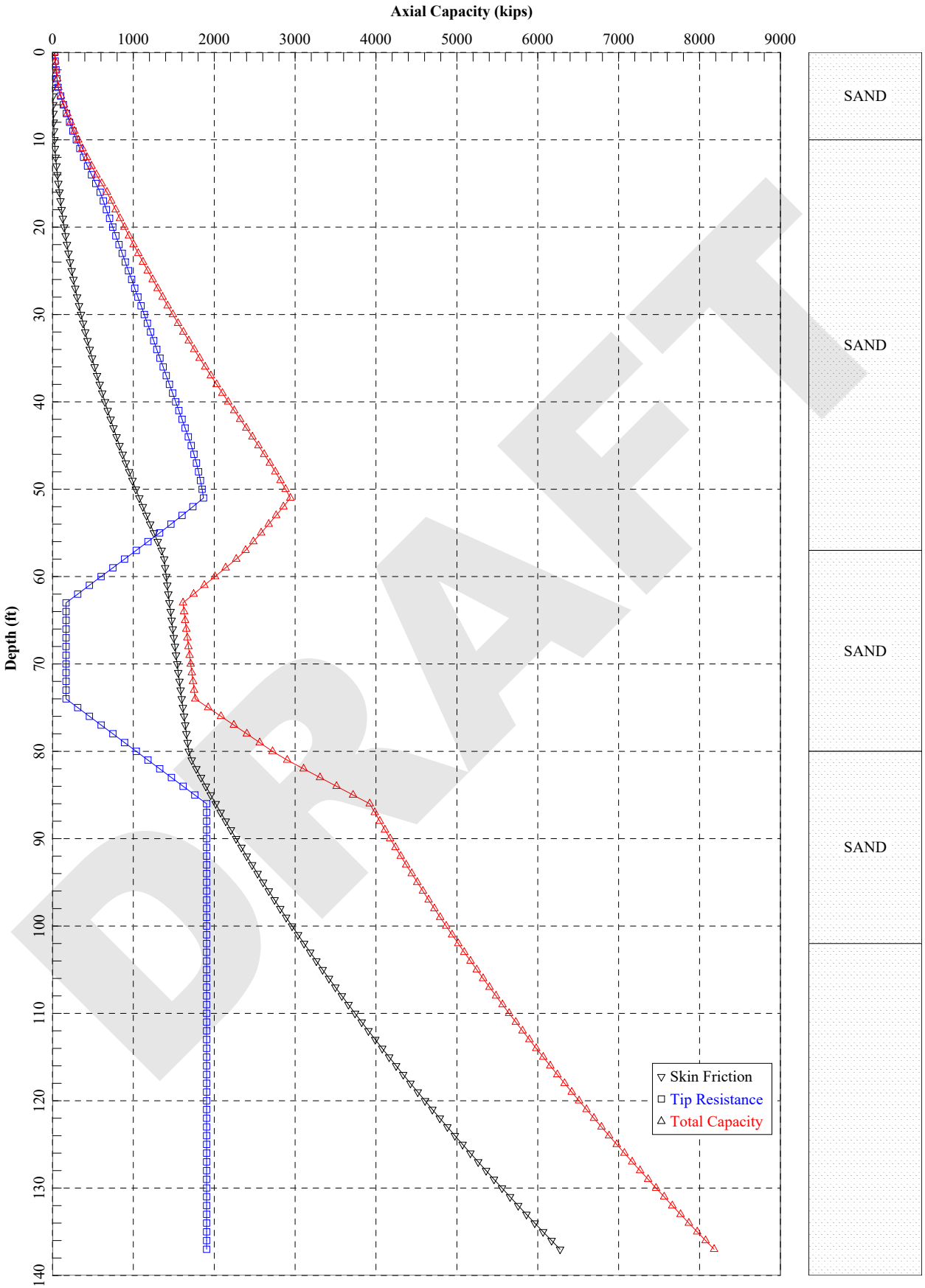
```
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   12         10      0.2000E+03
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
```

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1442E+02	0.2400E-01
0.2884E+02	0.4800E-01
0.5767E+02	0.9600E-01
0.1153E+03	0.6240E+00
0.1730E+03	0.2016E+01
0.2076E+03	0.3504E+01
0.2307E+03	0.4800E+01
0.2307E+03	0.7200E+01
0.2307E+03	0.9600E+01

LOAD VERSUS SETTLEMENT CURVE

****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.4157E+01	0.7545E-03	0.6008E-01	0.1000E-03
0.4157E+02	0.7545E-02	0.6008E+00	0.1000E-02
0.2095E+03	0.3792E-01	0.3004E+01	0.5000E-02
0.4204E+03	0.7606E-01	0.6008E+01	0.1000E-01
0.1771E+04	0.3466E+00	0.3004E+02	0.5000E-01
0.2300E+04	0.5140E+00	0.5811E+02	0.1000E+00
0.2343E+04	0.9254E+00	0.1018E+03	0.5000E+00
0.2373E+04	0.1433E+01	0.1309E+03	0.1000E+01
0.2414E+04	0.2444E+01	0.1724E+03	0.2000E+01


Axial Capacity (kips)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
SAND
SAND
SAND
SAND
Skin Friction
Tip Resistance
Total Capacity

```
==========================================================================

                 APILE for Windows, Version 2014.6.10

                  Serial Number :  297187724

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2014
                      All Rights Reserved

==========================================================================


This program is licensed to :

GeoStellar Engineering, LLC
Arroyo Grande, CA

Path to file locations      : P:\Four Hole Swamp\APILE\2016-03-03\
Name of input data file     : FHS_4-1.5OEP_1-weakzone-plugged - driveability.ap6d
Name of output file         : FHS_4-1.5OEP_1-weakzone-plugged - driveability.ap6o
Name of plot output file    : FHS_4-1.5OEP_1-weakzone-plugged - driveability.ap6p

--------------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  March 14, 2016     Time:  15:09:30



1
      **********************
      * INPUT INFORMATION *
      **********************



      US 301 RBO Four Hole Swamp: 48"OEP (1.5"t) weak zone, unplugged

      DESIGNER   : Gabriel Burnworth

      JOB NUMBER : 41503-0002-0001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
```

```
DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY     = 0.300E+08 PSI
- CROSS SECTION AREA        =    219.13 IN2


CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD      =     48.00 IN.
- INTERNAL DIAMETER, ID     =     45.00 IN.
- TOTAL PILE LENGTH, TL     =    143.00 FT.
- PILE STICKUP LENGTH, PSL  =      6.00 FT.
- ZERO FRICTION LENGTH, ZFL =      0.00 FT.
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION       =      1.00 FT.
- LENGTH OF ENHANCED
  END SECTION               =    143.00 FT.
- INTERNAL DIAMETER OF
  ENHANCED END SECTION      =     45.00 IN.


PLUGGED/UNPLUGGED CONDITIONS :
Plugged for open-ended pile


SOIL INFORMATIONS :
```

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	22.00	24.00	0.00
80.00	SAND	0.00	22.00	24.00	0.00
80.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
200.00	SAND	0.00	57.60	36.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

```
* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
  PLAN TO LIMIT THE COMPUTED DATA.
```

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
10.00	1.000	1.000
10.00	1.000	1.000
57.00	1.000	1.000
57.00	1.000	1.000
80.00	1.000	1.000
80.00	1.000	1.000
102.00	1.000	1.000
102.00	1.000	1.000
200.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	25.1	25.1
1.00	0.2	33.4	33.7
2.00	1.0	43.9	44.8
3.00	2.2	55.7	57.8
4.00	3.8	68.9	72.7
5.00	6.0	100.2	106.2
6.00	8.6	134.7	143.3
7.00	11.7	172.4	184.2
8.00	15.3	211.3	226.7
9.00	19.4	252.1	271.5
10.00	23.9	294.7	318.6
11.00	30.7	339.2	369.9
12.00	39.9	385.5	425.4
13.00	50.0	433.7	483.7
14.00	60.9	483.7	544.6
15.00	72.7	535.6	608.3
16.00	85.4	589.3	674.7
17.00	99.0	628.2	727.2
18.00	113.4	667.2	780.5
19.00	128.6	706.1	834.7
20.00	144.8	745.1	889.8
21.00	161.8	784.0	945.8
22.00	179.6	823.0	1002.6
23.00	198.4	861.9	1060.2
24.00	217.9	900.8	1118.8
25.00	238.4	939.8	1178.2
26.00	259.7	978.7	1238.5
27.00	281.9	1017.7	1299.6
28.00	305.0	1056.6	1361.6
29.00	328.9	1095.6	1424.5
30.00	353.7	1134.5	1488.2
31.00	379.4	1173.4	1552.8
32.00	405.9	1212.4	1618.3
33.00	433.3	1251.3	1684.6
34.00	461.5	1290.3	1751.8
35.00	490.7	1329.2	1819.9
36.00	520.7	1368.2	1888.8

37.00	551.5	1407.1	1958.6
38.00	583.2	1446.1	2029.3
39.00	615.8	1485.0	2100.8
40.00	649.3	1523.9	2173.2
41.00	683.6	1562.9	2246.5
42.00	718.8	1601.8	2320.6
43.00	754.8	1640.8	2395.6
44.00	791.7	1679.4	2471.1
45.00	829.5	1716.0	2545.5
46.00	868.2	1749.4	2617.5
47.00	907.7	1779.5	2687.2
48.00	948.0	1806.4	2754.5
49.00	989.3	1830.1	2819.3
50.00	1031.4	1850.5	2881.9
51.00	1074.4	1867.6	2942.0
52.00	1118.2	1736.7	2854.9
53.00	1162.9	1602.6	2765.5
54.00	1208.5	1465.2	2673.7
55.00	1254.9	1324.6	2579.5
56.00	1302.2	1181.0	2483.3
57.00	1350.4	1036.2	2386.6
58.00	1381.2	891.4	2272.6
59.00	1394.1	746.6	2140.7
60.00	1407.1	601.8	2008.9
61.00	1420.2	457.0	1877.2
62.00	1433.3	312.2	1745.5
63.00	1446.6	167.4	1614.0
64.00	1459.9	167.4	1627.3
65.00	1473.4	167.4	1640.8
66.00	1486.9	167.4	1654.3
67.00	1500.5	167.4	1667.9
68.00	1514.2	167.4	1681.6
69.00	1528.0	167.4	1695.4
70.00	1541.9	167.4	1709.3
71.00	1555.8	167.4	1723.2
72.00	1569.9	167.4	1737.3
73.00	1584.0	167.4	1751.4
74.00	1598.2	167.4	1765.6
75.00	1612.5	312.2	1924.7
76.00	1626.9	457.0	2083.9
77.00	1641.4	601.8	2243.2
78.00	1656.0	746.6	2402.6
79.00	1670.6	891.4	2562.0
80.00	1685.4	1036.2	2721.6
81.00	1721.3	1181.0	2902.3
82.00	1778.8	1325.8	3104.7
83.00	1837.2	1470.6	3307.8
84.00	1896.4	1615.4	3511.9
85.00	1956.5	1760.3	3716.8
86.00	2017.5	1905.1	3922.6
87.00	2079.4	1905.1	3984.4
88.00	2142.1	1905.1	4047.1
89.00	2205.6	1905.1	4110.7
90.00	2270.1	1905.1	4175.1
91.00	2335.4	1905.1	4240.4
92.00	2401.5	1905.1	4306.6
93.00	2468.6	1905.1	4373.6
94.00	2536.5	1905.1	4441.5
95.00	2605.2	1905.1	4510.3
96.00	2674.9	1905.1	4579.9
97.00	2745.4	1905.1	4650.4
98.00	2816.7	1905.1	4721.8
99.00	2889.0	1905.1	4794.0
100.00	2962.1	1905.1	4867.1
101.00	3036.0	1905.1	4941.1
102.00	3110.9	1905.1	5015.9
103.00	3186.5	1905.1	5091.6
104.00	3263.1	1905.1	5168.2

105.00	3340.5	1905.1	5245.6
106.00	3418.8	1905.1	5323.9
107.00	3498.0	1905.1	5403.0
108.00	3578.0	1905.1	5483.1
109.00	3658.9	1905.1	5564.0
110.00	3740.7	1905.1	5645.7
111.00	3823.3	1905.1	5728.3
112.00	3906.8	1905.1	5811.8
113.00	3991.1	1905.1	5896.2
114.00	4076.3	1905.1	5981.4
115.00	4162.4	1905.1	6067.5
116.00	4249.4	1905.1	6154.4
117.00	4337.2	1905.1	6242.2
118.00	4425.9	1905.1	6330.9
119.00	4515.4	1905.1	6420.5
120.00	4605.8	1905.1	6510.9
121.00	4697.1	1905.1	6602.2
122.00	4789.3	1905.1	6694.3
123.00	4882.3	1905.1	6787.3
124.00	4976.1	1905.1	6881.2
125.00	5070.9	1905.1	6975.9
126.00	5166.5	1905.1	7071.6
127.00	5263.0	1905.1	7168.0
128.00	5360.3	1905.1	7265.4
129.00	5458.5	1905.1	7363.6
130.00	5557.6	1905.1	7462.7
131.00	5657.5	1905.1	7562.6
132.00	5758.3	1905.1	7663.4
133.00	5860.0	1905.1	7765.1
134.00	5962.5	1905.1	7867.6
135.00	6065.9	1905.1	7971.0
136.00	6170.2	1905.1	8075.3
137.00	6275.4	1905.1	8180.4

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.3970E-01	0.1000E-01
			0.7940E-01	0.2000E-01
			0.1588E+00	0.4000E-01
			0.2382E+00	0.6000E-01
			0.3176E+00	0.8000E-01
			0.3573E+00	0.9000E-01
			0.3970E+00	0.1000E+00
			0.3970E+00	0.5000E+00
			0.3970E+00	0.2000E+01
2	10	0.5025E+01		
			0.0000E+00	0.0000E+00
			0.1588E+00	0.1000E-01
			0.3176E+00	0.2000E-01
			0.6352E+00	0.4000E-01
			0.9528E+00	0.6000E-01

```
                                0.1270E+01      0.8000E-01
                                0.1429E+01      0.9000E-01
                                0.1588E+01      0.1000E+00
                                0.1588E+01      0.5000E+00
                                0.1588E+01      0.2000E+01
3          10       0.9958E+01
                                0.0000E+00      0.0000E+00
                                0.3131E+00      0.1000E-01
                                0.6262E+00      0.2000E-01
                                0.1252E+01      0.4000E-01
                                0.1879E+01      0.6000E-01
                                0.2505E+01      0.8000E-01
                                0.2818E+01      0.9000E-01
                                0.3131E+01      0.1000E+00
                                0.3131E+01      0.5000E+00
                                0.3131E+01      0.2000E+01
4          10       0.1000E+02
                                0.0000E+00      0.0000E+00
                                0.4418E+00      0.1000E-01
                                0.8835E+00      0.2000E-01
                                0.1767E+01      0.4000E-01
                                0.2651E+01      0.6000E-01
                                0.3534E+01      0.8000E-01
                                0.3976E+01      0.9000E-01
                                0.4418E+01      0.1000E+00
                                0.4418E+01      0.5000E+00
                                0.4418E+01      0.2000E+01
5          10       0.3353E+02
                                0.0000E+00      0.0000E+00
                                0.1585E+01      0.1000E-01
                                0.3171E+01      0.2000E-01
                                0.6342E+01      0.4000E-01
                                0.9512E+01      0.6000E-01
                                0.1268E+02      0.8000E-01
                                0.1427E+02      0.9000E-01
                                0.1585E+02      0.1000E+00
                                0.1585E+02      0.5000E+00
                                0.1585E+02      0.2000E+01
6          10       0.5696E+02
                                0.0000E+00      0.0000E+00
                                0.2180E+01      0.1000E-01
                                0.4361E+01      0.2000E-01
                                0.8721E+01      0.4000E-01
                                0.1308E+02      0.6000E-01
                                0.1744E+02      0.8000E-01
                                0.1962E+02      0.9000E-01
                                0.2180E+02      0.1000E+00
                                0.2180E+02      0.5000E+00
                                0.2180E+02      0.2000E+01
7          10       0.5700E+02
                                0.0000E+00      0.0000E+00
                                0.1206E+01      0.1000E-01
                                0.2412E+01      0.2000E-01
                                0.4825E+01      0.4000E-01
                                0.7237E+01      0.6000E-01
                                0.9649E+01      0.8000E-01
                                0.1086E+02      0.9000E-01
                                0.1206E+02      0.1000E+00
                                0.1206E+02      0.5000E+00
                                0.1206E+02      0.2000E+01
8          10       0.6853E+02
                                0.0000E+00      0.0000E+00
                                0.7642E+00      0.1000E-01
                                0.1528E+01      0.2000E-01
                                0.3057E+01      0.4000E-01
                                0.4585E+01      0.6000E-01
                                0.6113E+01      0.8000E-01
                                0.6878E+01      0.9000E-01
```

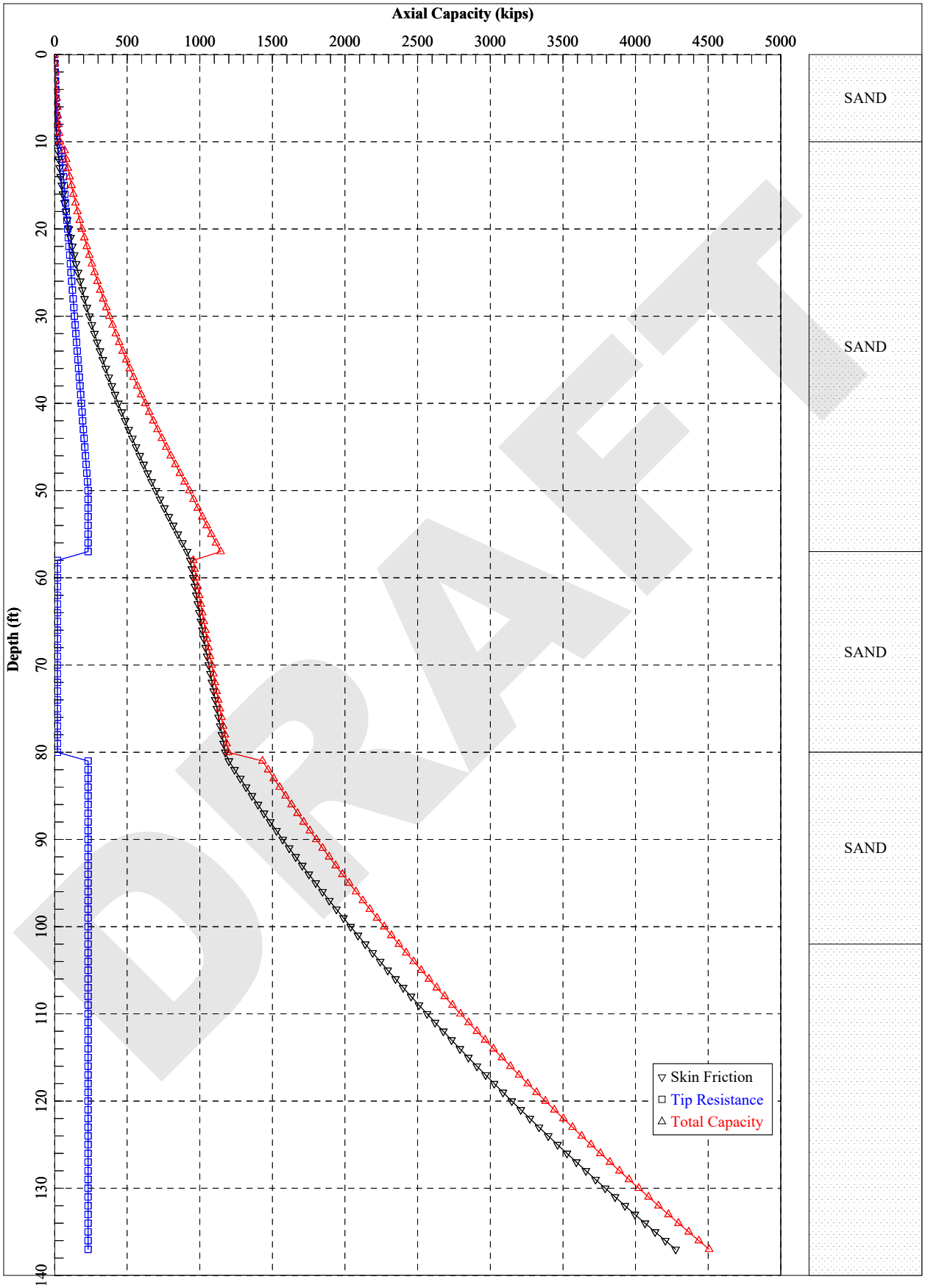
```
                                0.7642E+01      0.1000E+00
                                0.7642E+01      0.5000E+00
                                0.7642E+01      0.2000E+01
 9          10      0.7996E+02
                                0.0000E+00      0.0000E+00
                                0.1400E+01      0.1000E-01
                                0.2800E+01      0.2000E-01
                                0.5601E+01      0.4000E-01
                                0.8401E+01      0.6000E-01
                                0.1120E+02      0.8000E-01
                                0.1260E+02      0.9000E-01
                                0.1400E+02      0.1000E+00
                                0.1400E+02      0.5000E+00
                                0.1400E+02      0.2000E+01
10          10      0.8000E+02
                                0.0000E+00      0.0000E+00
                                0.2582E+01      0.1000E-01
                                0.5164E+01      0.2000E-01
                                0.1033E+02      0.4000E-01
                                0.1549E+02      0.6000E-01
                                0.2065E+02      0.8000E-01
                                0.2324E+02      0.9000E-01
                                0.2582E+02      0.1000E+00
                                0.2582E+02      0.5000E+00
                                0.2582E+02      0.2000E+01
11          10      0.9103E+02
                                0.0000E+00      0.0000E+00
                                0.3681E+01      0.1000E-01
                                0.7361E+01      0.2000E-01
                                0.1472E+02      0.4000E-01
                                0.2208E+02      0.6000E-01
                                0.2944E+02      0.8000E-01
                                0.3313E+02      0.9000E-01
                                0.3681E+02      0.1000E+00
                                0.3681E+02      0.5000E+00
                                0.3681E+02      0.2000E+01
12          10      0.1020E+03
                                0.0000E+00      0.0000E+00
                                0.4159E+01      0.1000E-01
                                0.8318E+01      0.2000E-01
                                0.1664E+02      0.4000E-01
                                0.2495E+02      0.6000E-01
                                0.3327E+02      0.8000E-01
                                0.3743E+02      0.9000E-01
                                0.4159E+02      0.1000E+00
                                0.4159E+02      0.5000E+00
                                0.4159E+02      0.2000E+01
13          10      0.1020E+03
                                0.0000E+00      0.0000E+00
                                0.4207E+01      0.1000E-01
                                0.8414E+01      0.2000E-01
                                0.1683E+02      0.4000E-01
                                0.2524E+02      0.6000E-01
                                0.3366E+02      0.8000E-01
                                0.3786E+02      0.9000E-01
                                0.4207E+02      0.1000E+00
                                0.4207E+02      0.5000E+00
                                0.4207E+02      0.2000E+01
14          10      0.1510E+03
                                0.0000E+00      0.0000E+00
                                0.5810E+01      0.1000E-01
                                0.1162E+02      0.2000E-01
                                0.2324E+02      0.4000E-01
                                0.3486E+02      0.6000E-01
                                0.4648E+02      0.8000E-01
                                0.5229E+02      0.9000E-01
                                0.5810E+02      0.1000E+00
                                0.5810E+02      0.5000E+00
```

```
                                        0.5810E+02      0.2000E+01
   15         10      0.2000E+03
                                        0.0000E+00      0.0000E+00
                                        0.5810E+01      0.1000E-01
                                        0.1162E+02      0.2000E-01
                                        0.2324E+02      0.4000E-01
                                        0.3486E+02      0.6000E-01
                                        0.4648E+02      0.8000E-01
                                        0.5229E+02      0.9000E-01
                                        0.5810E+02      0.1000E+00
                                        0.5810E+02      0.5000E+00
                                        0.5810E+02      0.2000E+01
```

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1191E+03	0.2400E-01
0.2381E+03	0.4800E-01
0.4763E+03	0.9600E-01
0.9525E+03	0.6240E+00
0.1429E+04	0.2016E+01
0.1715E+04	0.3504E+01
0.1905E+04	0.4800E+01
0.1905E+04	0.7200E+01
0.1905E+04	0.9600E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3597E+02	0.4224E-02	0.4961E+00	0.1000E-03
0.3636E+03	0.4254E-01	0.4961E+01	0.1000E-02
0.1732E+04	0.2113E+00	0.2481E+02	0.5000E-02
0.2663E+04	0.3689E+00	0.4961E+02	0.1000E-01
0.5583E+04	0.1029E+01	0.2481E+03	0.5000E-01
0.6607E+04	0.1332E+01	0.4799E+03	0.1000E+00
0.6968E+04	0.1827E+01	0.8407E+03	0.5000E+00
0.7208E+04	0.2389E+01	0.1081E+04	0.1000E+01
0.7550E+04	0.3479E+01	0.1423E+04	0.2000E+01


Axial Capacity (kips)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
SAND
SAND
SAND
SAND
Skin Friction
Tip Resistance
Total Capacity

```
==========================================================================

                 APILE for Windows, Version 2014.6.10

                  Serial Number :  297187724

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2014
                     All Rights Reserved

==========================================================================


This program is licensed to :

GeoStellar Engineering, LLC
Arroyo Grande, CA

Path to file locations      : P:\Four Hole Swamp\APILE\2016-03-03\
Name of input data file     : FHS_4-1.5OEP_1-weakzone-unplugged - driveability.ap6d
Name of output file         : FHS_4-1.5OEP_1-weakzone-unplugged - driveability.ap6o
Name of plot output file    : FHS_4-1.5OEP_1-weakzone-unplugged - driveability.ap6p

--------------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  March 14, 2016     Time:  15:09:57



1
      **********************
      * INPUT INFORMATION *
      **********************



      US 301 RBO Four Hole Swamp: 48"OEP (1.5"t) weak zone, unplugged

      DESIGNER   : Gabriel Burnworth

      JOB NUMBER : 41503-0002-0001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
```

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.300E+08 PSI
- CROSS SECTION AREA = 219.13 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 48.00 IN.
- INTERNAL DIAMETER, ID = 45.00 IN.
- TOTAL PILE LENGTH, TL = 143.00 FT.
- PILE STICKUP LENGTH, PSL = 6.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 143.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 45.00 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	22.00	24.00	0.00
80.00	SAND	0.00	22.00	24.00	0.00
80.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
200.00	SAND	0.00	57.60	36.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
10.00	1.000	1.000
10.00	1.000	1.000
57.00	1.000	1.000
57.00	1.000	1.000
80.00	1.000	1.000
80.00	1.000	1.000
102.00	1.000	1.000
102.00	1.000	1.000
200.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0*	0.0
1.00	0.2	2.0*	2.2
2.00	0.7	4.0*	4.7
3.00	1.5	6.1*	7.6
4.00	2.7	8.1*	10.8
5.00	4.3	10.1*	14.4
6.00	6.1	12.1*	18.3
7.00	8.4	14.2*	22.5
8.00	10.9	16.2*	27.1
9.00	13.8	18.2*	32.0
10.00	17.1	20.2*	37.3
11.00	21.8	47.8*	69.5
12.00	28.0	52.5*	80.5
13.00	34.8	57.2*	92.0
14.00	42.2	61.9*	104.1
15.00	50.1	66.6*	116.8
16.00	58.7	71.4*	130.0
17.00	67.8	76.1*	143.9
18.00	77.6	80.8*	158.3
19.00	87.9	85.5*	173.4
20.00	98.8	90.2*	189.0
21.00	110.2	94.9*	205.2
22.00	122.3	99.7*	222.0
23.00	135.0	104.4*	239.3
24.00	148.2	109.1*	257.3
25.00	162.0	113.8*	275.8
26.00	176.4	118.5*	294.9
27.00	191.4	123.2*	314.6
28.00	207.0	127.9*	334.9
29.00	223.1	132.7*	355.8
30.00	239.9	137.4*	377.3
31.00	257.2	142.1*	399.3
32.00	275.1	146.8*	421.9
33.00	293.6	151.5*	445.2
34.00	312.7	156.2*	469.0
35.00	332.4	161.0*	493.3
36.00	352.6	165.7*	518.3

37.00	373.5	170.4*	543.9
38.00	394.9	175.1*	570.0
39.00	416.9	179.8*	596.7
40.00	439.5	184.5*	624.0
41.00	462.7	189.3*	651.9
42.00	486.4	194.0*	680.4
43.00	510.8	198.7*	709.5
44.00	535.7	203.4*	739.1
45.00	561.2	208.1*	769.3
46.00	587.3	212.8*	800.2
47.00	614.0	217.6*	831.6
48.00	641.3	222.3*	863.5
49.00	669.1	227.0*	896.1
50.00	697.6	230.7*	928.3
51.00	726.6	230.7*	957.3
52.00	756.2	230.7*	986.9
53.00	786.4	230.7*	1017.1
54.00	817.2	230.7*	1047.9
55.00	848.6	230.7*	1079.2
56.00	880.5	230.7*	1111.2
57.00	913.0	230.7*	1143.7
58.00	934.5	20.3*	954.8
59.00	944.8	20.3*	965.0
60.00	955.1	20.3*	975.4
61.00	965.5	20.3*	985.7
62.00	975.9	20.3*	996.2
63.00	986.4	20.3*	1006.7
64.00	997.0	20.3*	1017.2
65.00	1007.6	20.3*	1027.9
66.00	1018.3	20.3*	1038.6
67.00	1029.1	20.3*	1049.4
68.00	1040.0	20.3*	1060.2
69.00	1050.9	20.3*	1071.2
70.00	1061.9	20.3*	1082.2
71.00	1073.0	20.3*	1093.2
72.00	1084.1	20.3*	1104.4
73.00	1095.3	20.3*	1115.5
74.00	1106.5	20.3*	1126.8
75.00	1117.9	20.3*	1138.2
76.00	1129.3	20.3*	1149.6
77.00	1140.8	20.3*	1161.0
78.00	1152.3	20.3*	1172.6
79.00	1163.9	20.3*	1184.2
80.00	1175.6	20.3*	1195.9
81.00	1200.7	230.7*	1431.4
82.00	1239.6	230.7*	1470.3
83.00	1279.0	230.7*	1509.7
84.00	1319.0	230.7*	1549.7
85.00	1359.6	230.7*	1590.3
86.00	1400.8	230.7*	1631.5
87.00	1442.5	230.7*	1673.2
88.00	1484.9	230.7*	1715.6
89.00	1527.8	230.7*	1758.5
90.00	1571.3	230.7*	1802.0
91.00	1615.5	230.7*	1846.1
92.00	1660.1	230.7*	1890.8
93.00	1705.4	230.7*	1936.1
94.00	1751.3	230.7*	1982.0
95.00	1797.7	230.7*	2028.4
96.00	1844.7	230.7*	2075.4
97.00	1892.4	230.7*	2123.0
98.00	1940.6	230.7*	2171.2
99.00	1989.3	230.7*	2220.0
100.00	2038.7	230.7*	2269.4
101.00	2088.7	230.7*	2319.3
102.00	2139.2	230.7*	2369.9
103.00	2190.3	230.7*	2421.0
104.00	2242.0	230.7*	2472.7

105.00	2294.3	230.7*	2525.0
106.00	2347.2	230.7*	2577.9
107.00	2400.6	230.7*	2631.3
108.00	2454.7	230.7*	2685.4
109.00	2509.3	230.7*	2740.0
110.00	2564.5	230.7*	2795.2
111.00	2620.3	230.7*	2851.0
112.00	2676.7	230.7*	2907.4
113.00	2733.7	230.7*	2964.4
114.00	2791.2	230.7*	3021.9
115.00	2849.4	230.7*	3080.1
116.00	2908.1	230.7*	3138.8
117.00	2967.4	230.7*	3198.1
118.00	3027.3	230.7*	3258.0
119.00	3087.8	230.7*	3318.5
120.00	3148.9	230.7*	3379.5
121.00	3210.5	230.7*	3441.2
122.00	3272.7	230.7*	3503.4
123.00	3335.6	230.7*	3566.2
124.00	3399.0	230.7*	3629.6
125.00	3462.9	230.7*	3693.6
126.00	3527.5	230.7*	3758.2
127.00	3592.7	230.7*	3823.4
128.00	3658.4	230.7*	3889.1
129.00	3724.7	230.7*	3955.4
130.00	3791.6	230.7*	4022.3
131.00	3859.1	230.7*	4089.8
132.00	3927.2	230.7*	4157.9
133.00	3995.9	230.7*	4226.6
134.00	4065.1	230.7*	4295.8
135.00	4135.0	230.7*	4365.7
136.00	4205.4	230.7*	4436.1
137.00	4276.4	230.7*	4507.1

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.2832E-01	0.1000E-01
			0.5664E-01	0.2000E-01
			0.1133E+00	0.4000E-01
			0.1699E+00	0.6000E-01
			0.2266E+00	0.8000E-01
			0.2549E+00	0.9000E-01
			0.2832E+00	0.1000E+00
			0.2832E+00	0.5000E+00
			0.2832E+00	0.2000E+01
2	10	0.5025E+01		
			0.0000E+00	0.0000E+00
			0.1133E+00	0.1000E-01
			0.2266E+00	0.2000E-01
			0.4531E+00	0.4000E-01
			0.6797E+00	0.6000E-01

```
                                0.9063E+00      0.8000E-01
                                0.1020E+01      0.9000E-01
                                0.1133E+01      0.1000E+00
                                0.1133E+01      0.5000E+00
                                0.1133E+01      0.2000E+01
3          10       0.9958E+01
                                0.0000E+00      0.0000E+00
                                0.2187E+00      0.1000E-01
                                0.4375E+00      0.2000E-01
                                0.8750E+00      0.4000E-01
                                0.1312E+01      0.6000E-01
                                0.1750E+01      0.8000E-01
                                0.1969E+01      0.9000E-01
                                0.2187E+01      0.1000E+00
                                0.2187E+01      0.5000E+00
                                0.2187E+01      0.2000E+01
4          10       0.1000E+02
                                0.0000E+00      0.0000E+00
                                0.3009E+00      0.1000E-01
                                0.6017E+00      0.2000E-01
                                0.1203E+01      0.4000E-01
                                0.1805E+01      0.6000E-01
                                0.2407E+01      0.8000E-01
                                0.2708E+01      0.9000E-01
                                0.3009E+01      0.1000E+00
                                0.3009E+01      0.5000E+00
                                0.3009E+01      0.2000E+01
5          10       0.3353E+02
                                0.0000E+00      0.0000E+00
                                0.1071E+01      0.1000E-01
                                0.2141E+01      0.2000E-01
                                0.4283E+01      0.4000E-01
                                0.6424E+01      0.6000E-01
                                0.8566E+01      0.8000E-01
                                0.9637E+01      0.9000E-01
                                0.1071E+02      0.1000E+00
                                0.1071E+02      0.5000E+00
                                0.1071E+02      0.2000E+01
6          10       0.5696E+02
                                0.0000E+00      0.0000E+00
                                0.1493E+01      0.1000E-01
                                0.2987E+01      0.2000E-01
                                0.5973E+01      0.4000E-01
                                0.8960E+01      0.6000E-01
                                0.1195E+02      0.8000E-01
                                0.1344E+02      0.9000E-01
                                0.1493E+02      0.1000E+00
                                0.1493E+02      0.5000E+00
                                0.1493E+02      0.2000E+01
7          10       0.5700E+02
                                0.0000E+00      0.0000E+00
                                0.8772E+00      0.1000E-01
                                0.1754E+01      0.2000E-01
                                0.3509E+01      0.4000E-01
                                0.5263E+01      0.6000E-01
                                0.7017E+01      0.8000E-01
                                0.7894E+01      0.9000E-01
                                0.8772E+01      0.1000E+00
                                0.8772E+01      0.5000E+00
                                0.8772E+01      0.2000E+01
8          10       0.6853E+02
                                0.0000E+00      0.0000E+00
                                0.6055E+00      0.1000E-01
                                0.1211E+01      0.2000E-01
                                0.2422E+01      0.4000E-01
                                0.3633E+01      0.6000E-01
                                0.4844E+01      0.8000E-01
                                0.5449E+01      0.9000E-01
```

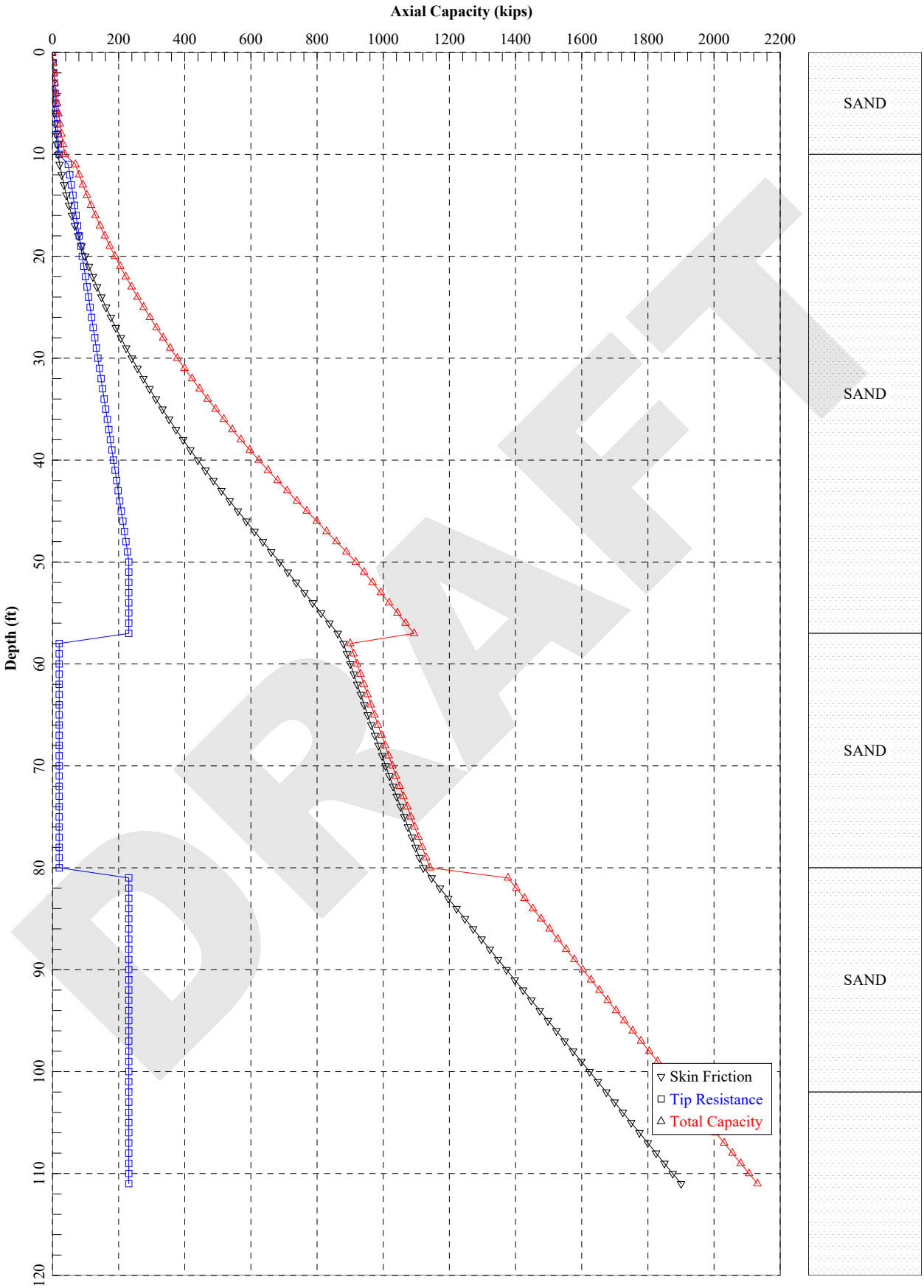
```
                                0.6055E+01      0.1000E+00
                                0.6055E+01      0.5000E+00
                                0.6055E+01      0.2000E+01
 9          10      0.7996E+02
                                0.0000E+00      0.0000E+00
                                0.1017E+01      0.1000E-01
                                0.2034E+01      0.2000E-01
                                0.4069E+01      0.4000E-01
                                0.6103E+01      0.6000E-01
                                0.8137E+01      0.8000E-01
                                0.9154E+01      0.9000E-01
                                0.1017E+02      0.1000E+00
                                0.1017E+02      0.5000E+00
                                0.1017E+02      0.2000E+01
10          10      0.8000E+02
                                0.0000E+00      0.0000E+00
                                0.1768E+01      0.1000E-01
                                0.3535E+01      0.2000E-01
                                0.7070E+01      0.4000E-01
                                0.1061E+02      0.6000E-01
                                0.1414E+02      0.8000E-01
                                0.1591E+02      0.9000E-01
                                0.1768E+02      0.1000E+00
                                0.1768E+02      0.5000E+00
                                0.1768E+02      0.2000E+01
11          10      0.9103E+02
                                0.0000E+00      0.0000E+00
                                0.2486E+01      0.1000E-01
                                0.4971E+01      0.2000E-01
                                0.9943E+01      0.4000E-01
                                0.1491E+02      0.6000E-01
                                0.1989E+02      0.8000E-01
                                0.2237E+02      0.9000E-01
                                0.2486E+02      0.1000E+00
                                0.2486E+02      0.5000E+00
                                0.2486E+02      0.2000E+01
12          10      0.1020E+03
                                0.0000E+00      0.0000E+00
                                0.2809E+01      0.1000E-01
                                0.5618E+01      0.2000E-01
                                0.1124E+02      0.4000E-01
                                0.1685E+02      0.6000E-01
                                0.2247E+02      0.8000E-01
                                0.2528E+02      0.9000E-01
                                0.2809E+02      0.1000E+00
                                0.2809E+02      0.5000E+00
                                0.2809E+02      0.2000E+01
13          10      0.1020E+03
                                0.0000E+00      0.0000E+00
                                0.2841E+01      0.1000E-01
                                0.5682E+01      0.2000E-01
                                0.1136E+02      0.4000E-01
                                0.1705E+02      0.6000E-01
                                0.2273E+02      0.8000E-01
                                0.2557E+02      0.9000E-01
                                0.2841E+02      0.1000E+00
                                0.2841E+02      0.5000E+00
                                0.2841E+02      0.2000E+01
14          10      0.1510E+03
                                0.0000E+00      0.0000E+00
                                0.3924E+01      0.1000E-01
                                0.7848E+01      0.2000E-01
                                0.1570E+02      0.4000E-01
                                0.2354E+02      0.6000E-01
                                0.3139E+02      0.8000E-01
                                0.3531E+02      0.9000E-01
                                0.3924E+02      0.1000E+00
                                0.3924E+02      0.5000E+00
```

```
                                        0.3924E+02      0.2000E+01
   15         10      0.2000E+03
                                        0.0000E+00      0.0000E+00
                                        0.3924E+01      0.1000E-01
                                        0.7848E+01      0.2000E-01
                                        0.1570E+02      0.4000E-01
                                        0.2354E+02      0.6000E-01
                                        0.3139E+02      0.8000E-01
                                        0.3531E+02      0.9000E-01
                                        0.3924E+02      0.1000E+00
                                        0.3924E+02      0.5000E+00
                                        0.3924E+02      0.2000E+01
```

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1442E+02	0.2400E-01
0.2884E+02	0.4800E-01
0.5767E+02	0.9600E-01
0.1153E+03	0.6240E+00
0.1730E+03	0.2016E+01
0.2076E+03	0.3504E+01
0.2307E+03	0.4800E+01
0.2307E+03	0.7200E+01
0.2307E+03	0.9600E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.1360E+02	0.1812E-02	0.6008E-01	0.1000E-03
0.1363E+03	0.1813E-01	0.6008E+00	0.1000E-02
0.6898E+03	0.9159E-01	0.3004E+01	0.5000E-02
0.1336E+04	0.1819E+00	0.6008E+01	0.1000E-01
0.3435E+04	0.6287E+00	0.3004E+02	0.5000E-01
0.4237E+04	0.8683E+00	0.5811E+02	0.1000E+00
0.4281E+04	0.1280E+01	0.1018E+03	0.5000E+00
0.4310E+04	0.1787E+01	0.1309E+03	0.1000E+01
0.4351E+04	0.2798E+01	0.1724E+03	0.2000E+01


Axial Capacity (kips)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
SAND
SAND
SAND
SAND
Skin Friction
Tip Resistance
Total Capacity

```
==========================================================================

                 APILE for Windows, Version 2014.6.10

                  Serial Number :  297187724

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                (c) Copyright ENSOFT, Inc., 1987-2014
                     All Rights Reserved

==========================================================================


This program is licensed to :

GeoStellar Engineering, LLC
Arroyo Grande, CA

Path to file locations      : P:\Four Hole Swamp\APILE\2016-03-03\
Name of input data file     : FHS_4-1.5OEP_1-weakzone-unplugged - service.ap6d
Name of output file         : FHS_4-1.5OEP_1-weakzone-unplugged - service.ap6o
Name of plot output file    : FHS_4-1.5OEP_1-weakzone-unplugged - service.ap6p

--------------------------------------------------------------------------
                    Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  March 14, 2016     Time:  15:10:25



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      **********************
      * INPUT INFORMATION *
      **********************



      US 301 RBO Four Hole Swamp: 48"OEP (1.5"t) weak zone, unplugged

      DESIGNER   : Gabriel Burnworth

      JOB NUMBER : 41503-0002-0001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
```

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.300E+08 PSI
- CROSS SECTION AREA = 219.13 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 48.00 IN.
- INTERNAL DIAMETER, ID = 45.00 IN.
- TOTAL PILE LENGTH, TL = 121.00 FT.
- PILE STICKUP LENGTH, PSL = 10.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 121.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 45.00 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	52.60	32.00	0.00
10.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	57.60	36.00	0.00
57.00	SAND	0.00	22.00	24.00	0.00
80.00	SAND	0.00	22.00	24.00	0.00
80.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
102.00	SAND	0.00	57.60	36.00	0.00
200.00	SAND	0.00	57.60	36.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
10.00	1.000	1.000
10.00	1.000	1.000
57.00	1.000	1.000
57.00	1.000	1.000
80.00	1.000	1.000
80.00	1.000	1.000
102.00	1.000	1.000
102.00	1.000	1.000
200.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0*	0.0
1.00	0.2	2.0*	2.2
2.00	0.7	4.0*	4.7
3.00	1.5	6.1*	7.6
4.00	2.7	8.1*	10.8
5.00	4.3	10.1*	14.4
6.00	6.1	12.1*	18.3
7.00	8.4	14.2*	22.5
8.00	10.9	16.2*	27.1
9.00	13.8	18.2*	32.0
10.00	17.1	20.2*	37.3
11.00	21.8	47.8*	69.5
12.00	28.0	52.5*	80.5
13.00	34.8	57.2*	92.0
14.00	42.2	61.9*	104.1
15.00	50.1	66.6*	116.8
16.00	58.7	71.4*	130.0
17.00	67.8	76.1*	143.9
18.00	77.6	80.8*	158.3
19.00	87.9	85.5*	173.4
20.00	98.8	90.2*	189.0
21.00	110.2	94.9*	205.2
22.00	122.3	99.7*	222.0
23.00	135.0	104.4*	239.3
24.00	148.2	109.1*	257.3
25.00	162.0	113.8*	275.8
26.00	176.4	118.5*	294.9
27.00	191.4	123.2*	314.6
28.00	207.0	127.9*	334.9
29.00	223.1	132.7*	355.8
30.00	239.9	137.4*	377.3
31.00	257.2	142.1*	399.3
32.00	275.1	146.8*	421.9
33.00	293.6	151.5*	445.2
34.00	312.7	156.2*	469.0
35.00	332.4	161.0*	493.3
36.00	352.6	165.7*	518.3

37.00	373.5	170.4*	543.9
38.00	394.9	175.1*	570.0
39.00	416.9	179.8*	596.7
40.00	439.5	184.5*	624.0
41.00	462.7	189.3*	651.9
42.00	486.4	194.0*	680.4
43.00	510.8	198.7*	709.5
44.00	535.7	203.4*	739.1
45.00	560.8	208.1*	769.0
46.00	586.0	212.8*	798.8
47.00	611.1	217.6*	828.7
48.00	636.2	222.3*	858.5
49.00	661.4	227.0*	888.4
50.00	686.5	230.7*	917.2
51.00	711.6	230.7*	942.3
52.00	736.8	230.7*	967.5
53.00	761.9	230.7*	992.6
54.00	787.0	230.7*	1017.7
55.00	812.2	230.7*	1042.9
56.00	837.3	230.7*	1068.0
57.00	862.4	230.7*	1093.1
58.00	880.1	20.3*	900.4
59.00	890.3	20.3*	910.6
60.00	900.6	20.3*	920.9
61.00	911.0	20.3*	931.3
62.00	921.4	20.3*	941.7
63.00	932.0	20.3*	952.2
64.00	942.5	20.3*	962.8
65.00	953.2	20.3*	973.4
66.00	963.9	20.3*	984.2
67.00	974.7	20.3*	995.0
68.00	985.5	20.3*	1005.8
69.00	996.5	20.3*	1016.7
70.00	1007.4	20.3*	1027.7
71.00	1018.5	20.3*	1038.8
72.00	1029.6	20.3*	1049.9
73.00	1040.8	20.3*	1061.1
74.00	1052.1	20.3*	1072.4
75.00	1063.4	20.3*	1083.7
76.00	1074.8	20.3*	1095.1
77.00	1086.3	20.3*	1106.6
78.00	1097.9	20.3*	1118.1
79.00	1109.5	20.3*	1129.7
80.00	1121.2	20.3*	1141.4
81.00	1146.3	230.7*	1377.0
82.00	1171.4	230.7*	1402.1
83.00	1196.5	230.7*	1427.2
84.00	1221.7	230.7*	1452.4
85.00	1246.8	230.7*	1477.5
86.00	1271.9	230.7*	1502.6
87.00	1297.1	230.7*	1527.8
88.00	1322.2	230.7*	1552.9
89.00	1347.3	230.7*	1578.0
90.00	1372.5	230.7*	1603.2
91.00	1397.6	230.7*	1628.3
92.00	1422.7	230.7*	1653.4
93.00	1447.9	230.7*	1678.6
94.00	1473.0	230.7*	1703.7
95.00	1498.1	230.7*	1728.8
96.00	1523.3	230.7*	1754.0
97.00	1548.4	230.7*	1779.1
98.00	1573.5	230.7*	1804.2
99.00	1598.7	230.7*	1829.4
100.00	1623.8	230.7*	1854.5
101.00	1648.9	230.7*	1879.6
102.00	1674.1	230.7*	1904.8
103.00	1699.2	230.7*	1929.9
104.00	1724.3	230.7*	1955.0

105.00	1749.5	230.7*	1980.2
106.00	1774.6	230.7*	2005.3
107.00	1799.7	230.7*	2030.4
108.00	1824.9	230.7*	2055.6
109.00	1850.0	230.7*	2080.7
110.00	1875.1	230.7*	2105.8
111.00	1900.3	230.7*	2131.0

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.2832E-01	0.1000E-01
			0.5664E-01	0.2000E-01
			0.1133E+00	0.4000E-01
			0.1699E+00	0.6000E-01
			0.2266E+00	0.8000E-01
			0.2549E+00	0.9000E-01
			0.2832E+00	0.1000E+00
			0.2832E+00	0.5000E+00
			0.2832E+00	0.2000E+01
2	10	0.5025E+01		
			0.0000E+00	0.0000E+00
			0.1133E+00	0.1000E-01
			0.2266E+00	0.2000E-01
			0.4531E+00	0.4000E-01
			0.6797E+00	0.6000E-01
			0.9063E+00	0.8000E-01
			0.1020E+01	0.9000E-01
			0.1133E+01	0.1000E+00
			0.1133E+01	0.5000E+00
			0.1133E+01	0.2000E+01
3	10	0.9958E+01		
			0.0000E+00	0.0000E+00
			0.2187E+00	0.1000E-01
			0.4375E+00	0.2000E-01
			0.8750E+00	0.4000E-01
			0.1312E+01	0.6000E-01
			0.1750E+01	0.8000E-01
			0.1969E+01	0.9000E-01
			0.2187E+01	0.1000E+00
			0.2187E+01	0.5000E+00
			0.2187E+01	0.2000E+01
4	10	0.1000E+02		
			0.0000E+00	0.0000E+00
			0.3009E+00	0.1000E-01
			0.6017E+00	0.2000E-01
			0.1203E+01	0.4000E-01
			0.1805E+01	0.6000E-01
			0.2407E+01	0.8000E-01
			0.2708E+01	0.9000E-01
			0.3009E+01	0.1000E+00
			0.3009E+01	0.5000E+00

```
                                0.3009E+01      0.2000E+01
 5          10      0.3353E+02
                                0.0000E+00      0.0000E+00
                                0.1071E+01      0.1000E-01
                                0.2141E+01      0.2000E-01
                                0.4283E+01      0.4000E-01
                                0.6424E+01      0.6000E-01
                                0.8566E+01      0.8000E-01
                                0.9637E+01      0.9000E-01
                                0.1071E+02      0.1000E+00
                                0.1071E+02      0.5000E+00
                                0.1071E+02      0.2000E+01
 6          10      0.5696E+02
                                0.0000E+00      0.0000E+00
                                0.1183E+01      0.1000E-01
                                0.2365E+01      0.2000E-01
                                0.4730E+01      0.4000E-01
                                0.7095E+01      0.6000E-01
                                0.9461E+01      0.8000E-01
                                0.1064E+02      0.9000E-01
                                0.1183E+02      0.1000E+00
                                0.1183E+02      0.5000E+00
                                0.1183E+02      0.2000E+01
 7          10      0.5700E+02
                                0.0000E+00      0.0000E+00
                                0.7709E+00      0.1000E-01
                                0.1542E+01      0.2000E-01
                                0.3083E+01      0.4000E-01
                                0.4625E+01      0.6000E-01
                                0.6167E+01      0.8000E-01
                                0.6938E+01      0.9000E-01
                                0.7709E+01      0.1000E+00
                                0.7709E+01      0.5000E+00
                                0.7709E+01      0.2000E+01
 8          10      0.6853E+02
                                0.0000E+00      0.0000E+00
                                0.6055E+00      0.1000E-01
                                0.1211E+01      0.2000E-01
                                0.2422E+01      0.4000E-01
                                0.3633E+01      0.6000E-01
                                0.4844E+01      0.8000E-01
                                0.5449E+01      0.9000E-01
                                0.6055E+01      0.1000E+00
                                0.6055E+01      0.5000E+00
                                0.6055E+01      0.2000E+01
 9          10      0.7996E+02
                                0.0000E+00      0.0000E+00
                                0.1017E+01      0.1000E-01
                                0.2034E+01      0.2000E-01
                                0.4069E+01      0.4000E-01
                                0.6103E+01      0.6000E-01
                                0.8137E+01      0.8000E-01
                                0.9154E+01      0.9000E-01
                                0.1017E+02      0.1000E+00
                                0.1017E+02      0.5000E+00
                                0.1017E+02      0.2000E+01
10          10      0.8000E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5555E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
11          10      0.9103E+02
```

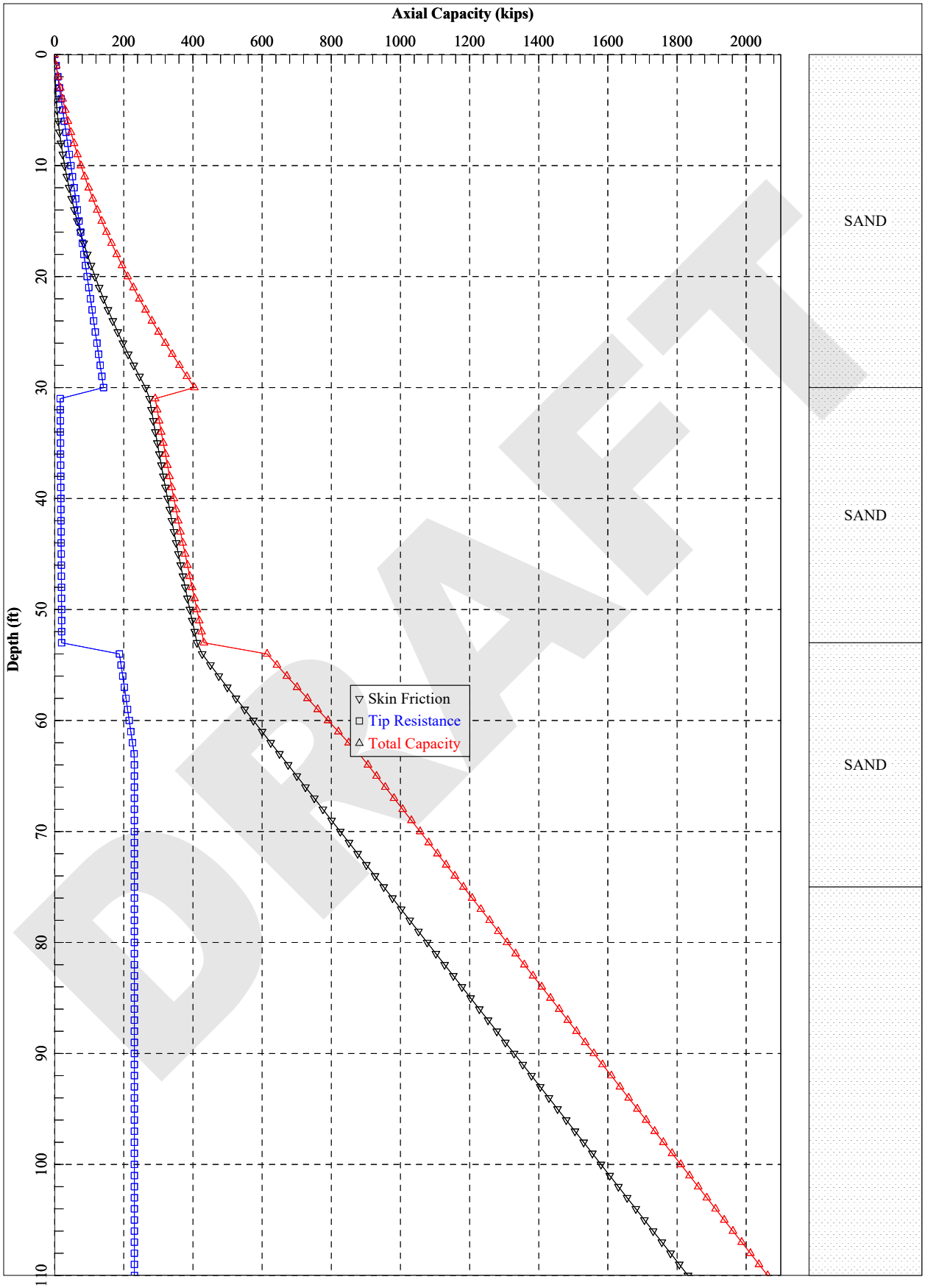
```
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   12          10       0.1020E+03
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   13          10       0.1020E+03
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   14          10       0.1510E+03
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   15          10       0.2000E+03
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
```

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1442E+02	0.2400E-01
0.2884E+02	0.4800E-01
0.5767E+02	0.9600E-01
0.1153E+03	0.6240E+00
0.1730E+03	0.2016E+01
0.2076E+03	0.3504E+01
0.2307E+03	0.4800E+01

0.2307E+03 0.7200E+01
0.2307E+03 0.9600E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3315E+01	0.4960E-03	0.6008E-01	0.1000E-03
0.3315E+02	0.4960E-02	0.6008E+00	0.1000E-02
0.1664E+03	0.2484E-01	0.3004E+01	0.5000E-02
0.3338E+03	0.4979E-01	0.6008E+01	0.1000E-01
0.1467E+04	0.2371E+00	0.3004E+02	0.5000E-01
0.1944E+04	0.3755E+00	0.5811E+02	0.1000E+00
0.1988E+04	0.7852E+00	0.1018E+03	0.5000E+00
0.2017E+04	0.1292E+01	0.1309E+03	0.1000E+01
0.2058E+04	0.2301E+01	0.1724E+03	0.2000E+01


Axial Capacity (kips)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
Skin Friction
Tip Resistance
Total Capacity
SAND
SAND
SAND

```
==========================================================================

                 APILE for Windows, Version 2014.6.10

                  Serial Number :  297187724

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
                

==========================================================================


This program is licensed to :

GeoStellar Engineering, LLC
Arroyo Grande, CA

Path to file locations      : P:\Four Hole Swamp\APILE\2016-03-03\
Name of input data file     : FHS_4-1.5OEP_1-weakzone-unplugged.ap6d
Name of output file         : FHS_4-1.5OEP_1-weakzone-unplugged.ap6o
Name of plot output file    : FHS_4-1.5OEP_1-weakzone-unplugged.ap6p

--------------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  March 03, 2016     Time:  13:25:15



1
      **********************
      * INPUT INFORMATION *
      **********************



      US 301 RBO Four Hole Swamp: 48"OEP (1.5"t) weak zone, unplugged

      DESIGNER   : Gabriel Burnworth

      JOB NUMBER : 41503-0002-0001


      METHOD FOR UNIT LOAD TRANSFERS :

      - FHWA (Federal Highway Administration)
        Unfactored Unit Side Friction and Unit Side Resistance are used.



      COMPUTATION METHOD(S) FOR PILE CAPACITY :

      - FHWA (Federal Highway Administration)


      TYPE OF LOADING :
      - COMPRESSION


      PILE TYPE :

      Steel pipe pile or non-tapered portion of monotube pile
```

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.300E+08 PSI
- CROSS SECTION AREA = 219.13 IN2

CIRCULAR PILE PROPERTIES :

- OUTSIDE DIAMETER, OD = 48.00 IN.
- INTERNAL DIAMETER, ID = 45.00 IN.
- TOTAL PILE LENGTH, TL = 143.00 FT.
- PILE STICKUP LENGTH, PSL = 33.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.
- LENGTH OF ENHANCED END SECTION = 143.00 FT.
- INTERNAL DIAMETER OF ENHANCED END SECTION = 45.00 IN.

PLUGGED/UNPLUGGED CONDITIONS :
Unplugged for open-ended pile

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	0.00	57.60	36.00	0.00
30.00	SAND	0.00	57.60	36.00	0.00
30.00	SAND	0.00	22.00	24.00	0.00
53.00	SAND	0.00	22.00	24.00	0.00
53.00	SAND	0.00	57.60	36.00	0.00
75.00	SAND	0.00	57.60	36.00	0.00
75.00	SAND	0.00	57.60	36.00	0.00
200.00	SAND	0.00	57.60	36.00	0.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.20E+01	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING

0.00	1.000	1.000
30.00	1.000	1.000
30.00	1.000	1.000
53.00	1.000	1.000
53.00	1.000	1.000
75.00	1.000	1.000
75.00	1.000	1.000
200.00	1.000	1.000

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	0.0*	0.0
1.00	0.3	4.7*	5.0
2.00	1.2	9.4*	10.6
3.00	2.6	14.1*	16.8
4.00	4.7	18.9*	23.5
5.00	7.3	23.6*	30.9
6.00	10.5	28.3*	38.8
7.00	14.3	33.0*	47.3
8.00	18.7	37.7*	56.4
9.00	23.7	42.4*	66.1
10.00	29.2	47.2*	76.4
11.00	35.4	51.9*	87.3
12.00	42.1	56.6*	98.7
13.00	49.4	61.3*	110.7
14.00	57.3	66.0*	123.3
15.00	65.8	70.7*	136.5
16.00	74.9	75.5*	150.3
17.00	84.5	80.2*	164.7
18.00	94.7	84.9*	179.6
19.00	105.6	89.6*	195.2
20.00	117.0	94.3*	211.3
21.00	128.9	99.0*	228.0
22.00	141.5	103.7*	245.3
23.00	154.7	108.5*	263.1
24.00	168.4	113.2*	281.6
25.00	182.8	117.9*	300.6
26.00	197.7	122.6*	320.3
27.00	213.2	127.3*	340.5
28.00	229.2	132.0*	361.3
29.00	245.9	136.8*	382.7
30.00	263.2	141.5*	404.6
31.00	274.7	16.5*	291.2
32.00	280.2	16.7*	296.9
33.00	285.8	16.9*	302.7
34.00	291.4	17.1*	308.5
35.00	297.2	17.3*	314.5
36.00	303.0	17.5*	320.5
37.00	308.8	17.7*	326.5
38.00	314.7	17.9*	332.7
39.00	320.7	18.1*	338.9
40.00	326.8	18.3*	345.2
41.00	332.9	18.5*	351.5
42.00	339.2	18.8*	357.9

43.00	345.4	19.0*	364.4
44.00	351.8	19.2*	370.9
45.00	358.2	19.4*	377.6
46.00	364.7	19.6*	384.3
47.00	371.2	19.8*	391.0
48.00	377.8	20.0*	397.8
49.00	384.5	20.2*	404.7
50.00	391.3	20.3*	411.6
51.00	398.1	20.3*	418.4
52.00	405.0	20.3*	425.3
53.00	412.0	20.3*	432.2
54.00	427.1	187.6*	614.7
55.00	450.7	192.3*	643.0
56.00	474.8	197.0*	671.9
57.00	499.5	201.8*	701.3
58.00	524.7	206.5*	731.2
59.00	549.8	211.2*	761.0
60.00	574.9	215.9*	790.9
61.00	600.1	220.6*	820.7
62.00	625.2	225.3*	850.5
63.00	650.3	230.1*	880.4
64.00	675.5	230.7*	906.2
65.00	700.6	230.7*	931.3
66.00	725.7	230.7*	956.4
67.00	750.9	230.7*	981.6
68.00	776.0	230.7*	1006.7
69.00	801.1	230.7*	1031.8
70.00	826.3	230.7*	1057.0
71.00	851.4	230.7*	1082.1
72.00	876.5	230.7*	1107.2
73.00	901.7	230.7*	1132.4
74.00	926.8	230.7*	1157.5
75.00	951.9	230.7*	1182.6
76.00	977.1	230.7*	1207.8
77.00	1002.2	230.7*	1232.9
78.00	1027.3	230.7*	1258.0
79.00	1052.5	230.7*	1283.2
80.00	1077.6	230.7*	1308.3
81.00	1102.7	230.7*	1333.4
82.00	1127.9	230.7*	1358.5
83.00	1153.0	230.7*	1383.7
84.00	1178.1	230.7*	1408.8
85.00	1203.3	230.7*	1433.9
86.00	1228.4	230.7*	1459.1
87.00	1253.5	230.7*	1484.2
88.00	1278.7	230.7*	1509.3
89.00	1303.8	230.7*	1534.5
90.00	1328.9	230.7*	1559.6
91.00	1354.1	230.7*	1584.7
92.00	1379.2	230.7*	1609.9
93.00	1404.3	230.7*	1635.0
94.00	1429.5	230.7*	1660.1
95.00	1454.6	230.7*	1685.3
96.00	1479.7	230.7*	1710.4
97.00	1504.8	230.7*	1735.5
98.00	1530.0	230.7*	1760.7
99.00	1555.1	230.7*	1785.8
100.00	1580.2	230.7*	1810.9
101.00	1605.4	230.7*	1836.1
102.00	1630.5	230.7*	1861.2
103.00	1655.6	230.7*	1886.3
104.00	1680.8	230.7*	1911.5
105.00	1705.9	230.7*	1936.6
106.00	1731.0	230.7*	1961.7
107.00	1756.2	230.7*	1986.9
108.00	1781.3	230.7*	2012.0
109.00	1806.4	230.7*	2037.1
110.00	1831.6	230.7*	2062.3

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
  IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
  OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *
****

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00		
			0.0000E+00	0.0000E+00
			0.4848E-01	0.1000E-01
			0.9695E-01	0.2000E-01
			0.1939E+00	0.4000E-01
			0.2909E+00	0.6000E-01
			0.3878E+00	0.8000E-01
			0.4363E+00	0.9000E-01
			0.4848E+00	0.1000E+00
			0.4848E+00	0.5000E+00
			0.4848E+00	0.2000E+01
2	10	0.1503E+02		
			0.0000E+00	0.0000E+00
			0.5171E+00	0.1000E-01
			0.1034E+01	0.2000E-01
			0.2068E+01	0.4000E-01
			0.3102E+01	0.6000E-01
			0.4137E+01	0.8000E-01
			0.4654E+01	0.9000E-01
			0.5171E+01	0.1000E+00
			0.5171E+01	0.5000E+00
			0.5171E+01	0.2000E+01
3	10	0.2996E+02		
			0.0000E+00	0.0000E+00
			0.7948E+00	0.1000E-01
			0.1590E+01	0.2000E-01
			0.3179E+01	0.4000E-01
			0.4769E+01	0.6000E-01
			0.6358E+01	0.8000E-01
			0.7153E+01	0.9000E-01
			0.7948E+01	0.1000E+00
			0.7948E+01	0.5000E+00
			0.7948E+01	0.2000E+01
4	10	0.3000E+02		
			0.0000E+00	0.0000E+00
			0.4706E+00	0.1000E-01
			0.9412E+00	0.2000E-01
			0.1882E+01	0.4000E-01
			0.2823E+01	0.6000E-01
			0.3765E+01	0.8000E-01
			0.4235E+01	0.9000E-01
			0.4706E+01	0.1000E+00
			0.4706E+01	0.5000E+00
			0.4706E+01	0.2000E+01
5	10	0.4153E+02		
			0.0000E+00	0.0000E+00
			0.3449E+00	0.1000E-01
			0.6898E+00	0.2000E-01
			0.1380E+01	0.4000E-01
			0.2069E+01	0.6000E-01

```
                                0.2759E+01      0.8000E-01
                                0.3104E+01      0.9000E-01
                                0.3449E+01      0.1000E+00
                                0.3449E+01      0.5000E+00
                                0.3449E+01      0.2000E+01
 6          10      0.5296E+02
                                0.0000E+00      0.0000E+00
                                0.6106E+00      0.1000E-01
                                0.1221E+01      0.2000E-01
                                0.2442E+01      0.4000E-01
                                0.3663E+01      0.6000E-01
                                0.4885E+01      0.8000E-01
                                0.5495E+01      0.9000E-01
                                0.6106E+01      0.1000E+00
                                0.6106E+01      0.5000E+00
                                0.6106E+01      0.2000E+01
 7          10      0.5300E+02
                                0.0000E+00      0.0000E+00
                                0.1069E+01      0.1000E-01
                                0.2138E+01      0.2000E-01
                                0.4276E+01      0.4000E-01
                                0.6414E+01      0.6000E-01
                                0.8553E+01      0.8000E-01
                                0.9622E+01      0.9000E-01
                                0.1069E+02      0.1000E+00
                                0.1069E+02      0.5000E+00
                                0.1069E+02      0.2000E+01
 8          10      0.6403E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
 9          10      0.7496E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
10          10      0.7500E+02
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
                                0.1389E+02      0.1000E+00
                                0.1389E+02      0.5000E+00
                                0.1389E+02      0.2000E+01
11          10      0.1375E+03
                                0.0000E+00      0.0000E+00
                                0.1389E+01      0.1000E-01
                                0.2778E+01      0.2000E-01
                                0.5556E+01      0.4000E-01
                                0.8333E+01      0.6000E-01
                                0.1111E+02      0.8000E-01
                                0.1250E+02      0.9000E-01
```

```
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
   12         10      0.2000E+03
                                        0.0000E+00      0.0000E+00
                                        0.1389E+01      0.1000E-01
                                        0.2778E+01      0.2000E-01
                                        0.5556E+01      0.4000E-01
                                        0.8333E+01      0.6000E-01
                                        0.1111E+02      0.8000E-01
                                        0.1250E+02      0.9000E-01
                                        0.1389E+02      0.1000E+00
                                        0.1389E+02      0.5000E+00
                                        0.1389E+02      0.2000E+01
```

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1442E+02	0.2400E-01
0.2884E+02	0.4800E-01
0.5767E+02	0.9600E-01
0.1153E+03	0.6240E+00
0.1730E+03	0.2016E+01
0.2076E+03	0.3504E+01
0.2307E+03	0.4800E+01
0.2307E+03	0.7200E+01
0.2307E+03	0.9600E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3100E+01	0.6162E-03	0.6008E-01	0.1000E-03
0.3100E+02	0.6162E-02	0.6008E+00	0.1000E-02
0.1558E+03	0.3090E-01	0.3004E+01	0.5000E-02
0.3127E+03	0.6198E-01	0.6008E+01	0.1000E-01
0.1371E+04	0.2916E+00	0.3004E+02	0.5000E-01
0.1896E+04	0.4585E+00	0.5811E+02	0.1000E+00
0.1939E+04	0.8699E+00	0.1018E+03	0.5000E+00
0.1968E+04	0.1377E+01	0.1309E+03	0.1000E+01
0.2010E+04	0.2388E+01	0.1724E+03	0.2000E+01

APPENDIX D

LATERAL PILE RESPONSE

GeoStellar Engineering

APPENDIX D
LATERAL PILE RESPONSE

The top of the pile lateral response has been evaluated by specifying several displacements and then solving for the pile top shear load required to produce the displacement specified. The pile top boundary condition used for interior bent piles is "fixed head" and "free head". The fixed head boundary conditions is defined by LPILE Load Type 5 (Pile Top Boundary Condition): Load 1 = Pile Head Displacement, inches, and Load 2 = Pile Head Rotation = 0 radians. The free head boundary conditions is defined by LPILE Load Type 4 (Pile Top Boundary Condition): Load 1 = Pile Head Displacement, inches, and Load 2 = Pile Head Moment = 0 in-lbs. The LPILE soil model input properties for the piles at Bent 3 and Bent 4 are shown in Table D1 and Table D2, respectively.

Table D1. LPILE – Service Limit State Soil Input Properties for Bent 3 Piles

Layer	Soil Type	Depth[1] Below Top of Pile (ft)	Effective Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	p-y Modulus (pci)	Strain Factor
1	Sand (Reese)	33 – 63	57.6	36	---[2]	default	---[2]
2	Sand (Reese)	63 – 86	22 / 57.6 [3]	24 / 36	---[2]	default	---[2]
3	Sand (Reese)	86 - 108	57.6	36	---[2]	default	---[2]
4	Sand (Reese)	108 - 206	57.6	36	---[2]	default	---[2]

[1] Assumed Pile Head Elevation 116 ft-msl; Ground Surface Elev. after scour event 83 ft-msl
[2] Not applicable input for selected soil type
[3] Weak Soil Zone Encountered / Weak Soil Zone not Encountered

Table D2. LPILE – Service Limit State Soil Input Properties for Bent 4 Piles

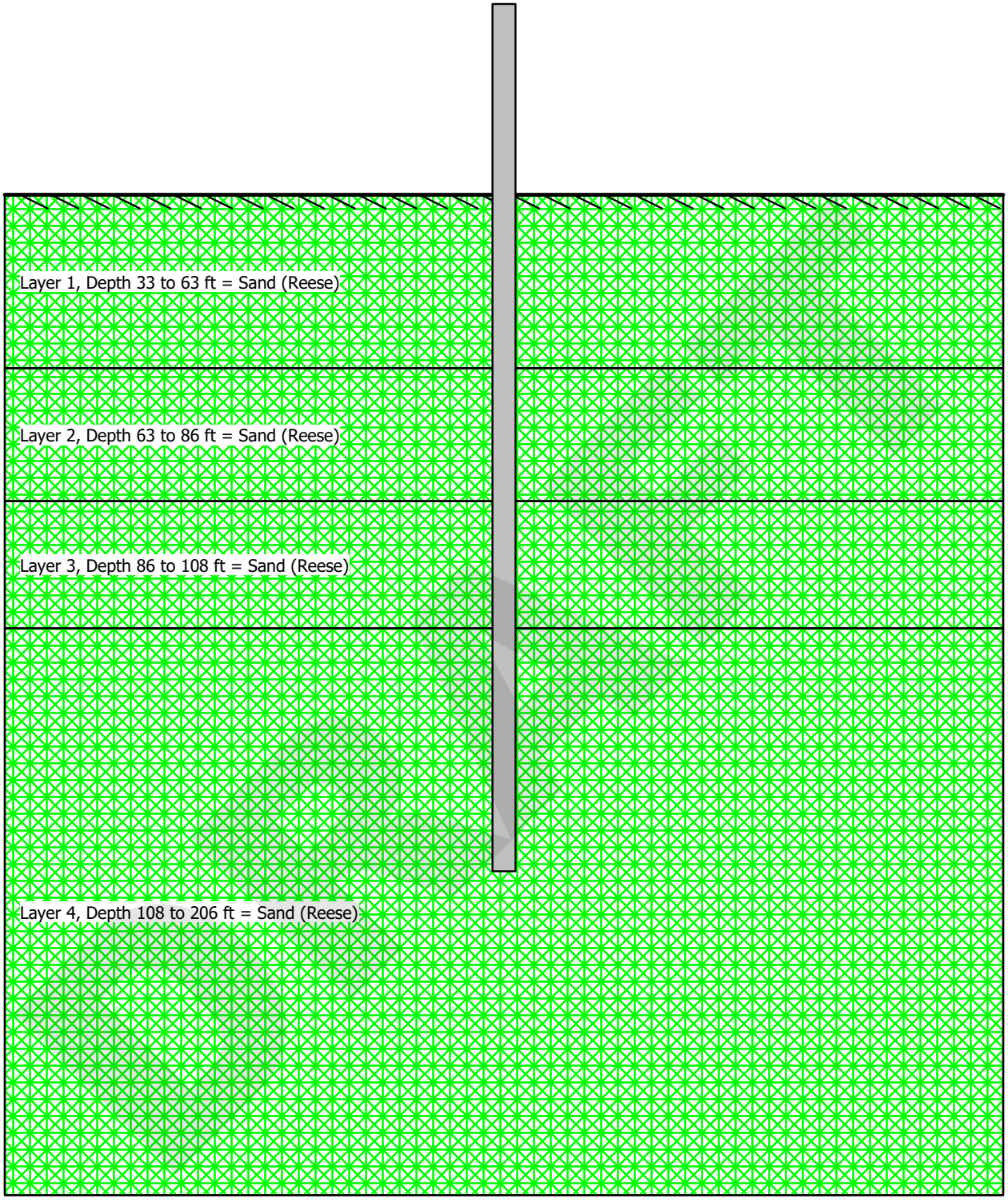
Layer	Soil Type	Depth[1] Below Top of Pile (ft)	Effective Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	p-y Modulus (pci)	Strain Factor
1	Sand (Reese)	21 – 63	57.6	36	---[2]	default	---[2]
2	Sand (Reese)	63 – 86	22 / 57.6 [3]	24 / 36	---[2]	default	---[2]
3	Sand (Reese)	86 - 108	57.6	36	---[2]	default	---[2]
4	Sand (Reese)	108 - 206	57.6	36	---[2]	default	---[2]

[1] Assumed Pile Head Elevation 116 ft-msl; Ground Surface Elev. after scour event 94 ft-msl
[2] Not applicable input for selected soil type
[3] Weak Soil Zone Encountered / Weak Soil Zone not Encountered

The following lateral pile responses LPILE analyses have been performed and are included in this appendix.

- Interior Bent – Service Limit State – Deep Scour, Weak Soil Zone Encountered
- Interior Bent – Service Limit State – Deep Scour, No Weak Soil Zone Encountered
- Interior Bent – Service Limit State – Shallow Scour, Weak Soil Zone Encountered
- Interior Bent – Service Limit State – Shallow Scour, No Weak Soil Zone Encountered

Bent 3 – Service Limit State
LPILE Analyses



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                  LPile Plus for Windows, Version 2013-07.007

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        P:\Four Hole Swamp\LPILE\2016-03-02\
Name of input data file:       FHS_4-1.5OEP_NWZ_deepscour_load_type_4.lp7d
Name of output report file:    FHS_4-1.5OEP_NWZ_deepscour_load_type_4.lp7o
Name of plot output file:      FHS_4-1.5OEP_NWZ_deepscour_load_type_4.lp7p
Name of runtime messeage file: FHS_4-1.5OEP_NWZ_deepscour_load_type_4.lp7r


--------------------------------------------------------------------------------
                          Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  March 2, 2016    Time:  16:47:27


--------------------------------------------------------------------------------
                               Problem Title
--------------------------------------------------------------------------------

Project Name: US 301 RBO Four Hole Swamp


Job Number: 41503-0002-0001


Client: SCDOT


Engineer: Gabriel Burnworth


Description: 48" OEP (1.5" walls) Weak Zone, 83' scour elev., Free Head



--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
```

- Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

Computational Options:
- Use unfactored loads in computations (conventional analysis)
- Compute pile response under loading and nonlinear bending properties of pile (only if nonlinear pile properties are input)
- Use of p-y modification factors for p-y curves not selected
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- No p-y curves to be computed and reported for user-specified depths
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1

Pile Structural Properties and Geometry

Total number of pile sections = 1

Total length of pile = 150.00 ft

Depth of ground surface below top of pile = 33.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile.

Point	Depth X ft	Pile Diameter in
1	0.00000	48.0000000
2	150.000000	48.0000000

Input Structural Properties:

Pile Section No. 1:

Section Type = Steel Pipe Pile
Section Length = 150.00000 ft
Pile Diameter = 48.00000 in

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

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Pile Batter Angle                                   =        0.000 degrees
                                                    =        0.000 radians


--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
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The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     33.00000 ft
   Distance from top of pile to bottom of layer     =     63.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     63.00000 ft
   Distance from top of pile to bottom of layer     =     86.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     86.00000 ft
   Distance from top of pile to bottom of layer     =    108.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =    108.00000 ft
   Distance from top of pile to bottom of layer     =    206.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

   (Depth of lowest soil layer extends   56.00 ft below pile tip)


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Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	kpy pci
1	Sand (Reese, et al.)	33.000	57.600	36.000	default
		63.000	57.600	36.000	default
2	Sand (Reese, et al.)	63.000	57.600	36.000	default
		86.000	57.600	36.000	default
3	Sand (Reese, et al.)	86.000	57.600	36.000	default
		108.000	57.600	36.000	default
4	Sand (Reese, et al.)	108.000	57.600	36.000	default
		206.000	57.600	36.000	default

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	4	y = 0.12500 in	M = 0.0000 in-lbs	552000.	No
2	4	y = 0.25000 in	M = 0.0000 in-lbs	552000.	No
3	4	y = 0.50000 in	M = 0.0000 in-lbs	552000.	No
4	4	y = 1.00000 in	M = 0.0000 in-lbs	552000.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel Pipe Pile:

Length of Section	=	150.00000 ft
Outer Diameter of Pipe	=	48.00000 in
Pipe Wall Thickness	=	1.50000 in
Yield Stress of Pipe	=	36.00000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	219.12609 sq. in.

Moment of Inertia = 59287. in^4
Elastic Bending Stiffness = 1.7193E+09 kip-in^2
Plastic Modulus, Z = 3244.50000 in^3
Plastic Moment Capacity = Fy Z = 116802. in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As = 7888.539 kips
Nominal Axial Tensile Capacity = -7888.539 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	552.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 552.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.000001054	1811.9939796	1719329760.	106.4231912	3.2452738	
0.000002108	3623.9879591	1719329760.	65.2115956	3.9714500	
0.000003162	5435.9819387	1719329760.	51.4743971	4.6976261	
0.000004216	7247.9759182	1719329760.	44.6057978	5.4238024	
0.000005269	9059.9698978	1719329760.	40.4846382	6.1499785	
0.000006323	10872.	1719329760.	37.7371985	6.8761547	
0.000007377	12684.	1719329760.	35.7747416	7.6023309	
0.000008431	14496.	1719329760.	34.3028989	8.3285071	
0.000009485	16308.	1719329760.	33.1581324	9.0546833	
0.0000105	18120.	1719329760.	32.2423191	9.7808595	
0.0000116	19932.	1719329760.	31.4930174	10.5070357	
0.0000126	21744.	1719329760.	30.8685993	11.2332119	
0.0000137	23556.	1719329760.	30.3402455	11.9593881	
0.0000148	25368.	1719329760.	29.8873708	12.6855643	
0.0000158	27180.	1719329760.	29.4948794	13.4117405	
0.0000169	28992.	1719329760.	29.1514494	14.1379167	
0.0000179	30804.	1719329760.	28.8484230	14.8640929	
0.0000190	32616.	1719329760.	28.5790662	15.5902690	
0.0000200	34428.	1719329760.	28.3380627	16.3164452	
0.0000211	36240.	1719329760.	28.1211596	17.0426214	
0.0000221	38052.	1719329760.	27.9249139	17.7687976	
0.0000232	39864.	1719329760.	27.7465087	18.4949738	
0.0000242	41676.	1719329760.	27.5836170	19.2211500	
0.0000253	43488.	1719329760.	27.4342996	19.9473262	
0.0000263	45300.	1719329760.	27.2969276	20.6735024	
0.0000274	47112.	1719329760.	27.1701227	21.3996786	
0.0000285	48924.	1719329760.	27.0527108	22.1258548	
0.0000295	50736.	1719329760.	26.9436854	22.8520310	
0.0000306	52548.	1719329760.	26.8421790	23.5782071	
0.0000316	54360.	1719329760.	26.7474397	24.3043833	
0.0000327	56172.	1719329760.	26.6588126	25.0305595	
0.0000337	57984.	1719329760.	26.5757247	25.7567357	
0.0000348	59796.	1719329760.	26.4976725	26.4829119	
0.0000358	61608.	1719329760.	26.4242115	27.2090881	
0.0000369	63420.	1719329760.	26.3549483	27.9352643	
0.0000379	65232.	1719329760.	26.2895331	28.6614405	

0.0000390	67044.	1719329760.	26.2276538	29.3876167	
0.0000400	68856.	1719329760.	26.1690313	30.1137929	
0.0000411	70668.	1719329760.	26.1134152	30.8399691	
0.0000432	74292.	1719329760.	26.0103217	32.2923214	
0.0000453	77916.	1719329760.	25.9168184	33.7446738	
0.0000474	81540.	1719329760.	25.8316265	35.1970262	
0.0000495	85116.	1718362204.	25.7600931	36.0000000	Y
0.0000516	88307.	1710016821.	25.7450077	36.0000000	Y
0.0000537	91055.	1694080982.	25.7890002	36.0000000	Y
0.0000559	93523.	1674351216.	25.8662156	36.0000000	Y
0.0000580	95738.	1651681538.	25.9596148	36.0000000	Y
0.0000601	97623.	1625104154.	26.0427887	36.0000000	Y
0.0000622	99187.	1595157458.	26.1020741	36.0000000	Y
0.0000643	100520.	1563590959.	26.1477997	36.0000000	Y
0.0000664	101682.	1531456607.	26.1850574	36.0000000	Y
0.0000685	102694.	1499106584.	26.2156802	36.0000000	Y
0.0000706	103596.	1467136166.	26.2418156	36.0000000	Y
0.0000727	104405.	1435730900.	26.2645753	36.0000000	Y
0.0000748	105133.	1405018933.	26.2847462	36.0000000	Y
0.0000769	105792.	1375089517.	26.3029308	36.0000000	Y
0.0000790	106389.	1345978545.	26.3190684	36.0000000	Y
0.0000811	106931.	1317694704.	26.3327277	36.0000000	Y
0.0000833	107428.	1290308271.	26.3451305	36.0000000	Y
0.0000854	107888.	1263831958.	26.3565441	36.0000000	Y
0.0000875	108312.	1238223529.	26.3683587	36.0000000	Y
0.0000896	108694.	1213357023.	26.3774987	36.0000000	Y
0.0000917	109054.	1189386837.	26.3862330	36.0000000	Y
0.0000938	109391.	1166251589.	26.3947955	36.0000000	Y
0.0000959	109694.	1143784328.	26.4021331	36.0000000	Y
0.0000980	109986.	1122168893.	26.4094502	36.0000000	Y
0.0001001	110251.	1101186709.	26.4155900	36.0000000	Y
0.0001022	110504.	1080953128.	26.4221100	36.0000000	Y
0.0001043	110737.	1061349948.	26.4271609	36.0000000	Y
0.0001064	110958.	1042412273.	26.4331747	36.0000000	Y
0.0001086	111162.	1024055458.	26.4372983	36.0000000	Y
0.0001107	111360.	1006332490.	26.4430476	36.0000000	Y
0.0001128	111538.	989106469.	26.4463756	36.0000000	Y
0.0001149	111715.	972490789.	26.4505626	36.0000000	Y
0.0001170	111873.	956324994.	26.4547068	36.0000000	Y
0.0001191	112028.	940701885.	26.4572535	36.0000000	Y
0.0001212	112175.	925549270.	26.4625617	36.0000000	Y
0.0001233	112309.	910814943.	26.4645327	36.0000000	Y
0.0001254	112442.	896572199.	26.4666389	36.0000000	Y
0.0001338	112900.	843517796.	26.4797710	36.0000000	Y
0.0001423	113275.	796164739.	26.4878891	36.0000000	Y
0.0001507	113588.	753702530.	26.4950904	36.0000000	Y
0.0001591	113853.	715434459.	26.5018328	36.0000000	Y
0.0001676	114076.	680768908.	26.5058505	36.0000000	Y
0.0001760	114269.	649250909.	26.5078046	36.0000000	Y
0.0001844	114433.	620460993.	26.5135095	36.0000000	Y
0.0001929	114577.	594085861.	26.5174169	36.0000000	Y
0.0002013	114703.	569829556.	26.5179765	36.0000000	Y
0.0002097	114814.	547451379.	26.5235253	36.0000000	Y
0.0002182	114912.	526743116.	26.5225624	36.0000000	Y
0.0002266	114999.	507525905.	26.5269002	36.0000000	Y
0.0002350	115077.	489651076.	26.5278306	36.0000000	Y

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip
1	552.000	115077.2

Note that the values in the above table are not factored by a strength

reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.125000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1250	0.000	2878.9275	-0.000311	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.1194	54909.	2878.9275	-0.000311	2541.3253	1.719E+12	0.000	0.000	0.000
3.000	0.1138	109813.	2878.9275	-0.000310	2563.5506	1.719E+12	0.000	0.000	0.000
4.500	0.1083	164705.	2878.9275	-0.000308	2585.7714	1.719E+12	0.000	0.000	0.000
6.000	0.1027	219579.	2878.9275	-0.000306	2607.9852	1.719E+12	0.000	0.000	0.000
7.500	0.0972	274431.	2878.9275	-0.000304	2630.1897	1.719E+12	0.000	0.000	0.000
9.000	0.0918	329255.	2878.9275	-0.000300	2652.3827	1.719E+12	0.000	0.000	0.000
10.500	0.0864	384044.	2878.9275	-0.000297	2674.5619	1.719E+12	0.000	0.000	0.000
12.000	0.0811	438793.	2878.9275	-0.000292	2696.7248	1.719E+12	0.000	0.000	0.000
13.500	0.0759	493497.	2878.9275	-0.000288	2718.8693	1.719E+12	0.000	0.000	0.000
15.000	0.0708	548149.	2878.9275	-0.000282	2740.9930	1.719E+12	0.000	0.000	0.000
16.500	0.0657	602744.	2878.9275	-0.000276	2763.0937	1.719E+12	0.000	0.000	0.000
18.000	0.0608	657277.	2878.9275	-0.000269	2785.1689	1.719E+12	0.000	0.000	0.000
19.500	0.0560	711741.	2878.9275	-0.000262	2807.2165	1.719E+12	0.000	0.000	0.000
21.000	0.0514	766131.	2878.9275	-0.000255	2829.2341	1.719E+12	0.000	0.000	0.000
22.500	0.0469	820442.	2878.9275	-0.000246	2851.2194	1.719E+12	0.000	0.000	0.000
24.000	0.0425	874667.	2878.9275	-0.000237	2873.1702	1.719E+12	0.000	0.000	0.000
25.500	0.0383	928801.	2878.9275	-0.000228	2895.0841	1.719E+12	0.000	0.000	0.000
27.000	0.0343	982839.	2878.9275	-0.000218	2916.9590	1.719E+12	0.000	0.000	0.000
28.500	0.0305	1036774.	2878.9275	-0.000207	2938.7924	1.719E+12	0.000	0.000	0.000
30.000	0.0268	1090601.	2878.9275	-0.000196	2960.5822	1.719E+12	0.000	0.000	0.000
31.500	0.0234	1144315.	2878.9275	-0.000185	2982.3261	1.719E+12	0.000	0.000	0.000
33.000	0.0202	1197910.	2878.9275	-0.000172	3004.0218	1.719E+12	0.000	0.000	0.000
34.500	0.0172	1251381.	2609.8073	-0.000159	3025.6671	1.719E+12	-29.9022	31290.	0.000
36.000	0.0144	1295033.	1888.5784	-0.000146	3043.3377	1.719E+12	-50.2343	62580.	0.000
37.500	0.0119	1322274.	876.0500	-0.000132	3054.3652	1.719E+12	-62.2689	93870.	0.000
39.000	0.009681	1329202.	-290.1984	-0.000119	3057.1699	1.719E+12	-67.3143	125160.	0.000
40.500	0.007672	1314183.	-1496.1599	-0.000105	3051.0899	1.719E+12	-66.6814	156450.	0.000
42.000	0.005911	1277422.	-2651.1155	-9.116E-05	3036.2087	1.719E+12	-61.6470	187740.	0.000
43.500	0.004390	1220554.	-3686.7020	-7.809E-05	3013.1883	1.719E+12	-53.4182	219030.	0.000
45.000	0.003099	1146252.	-4555.3783	-6.570E-05	2983.1102	1.719E+12	-43.1014	250321.	0.000
46.500	0.002025	1057866.	-5228.3840	-5.416E-05	2947.3308	1.719E+12	-31.6770	281611.	0.000
48.000	0.001149	959107.	-5693.3155	-4.360E-05	2907.3521	1.719E+12	-19.9820	312901.	0.000
49.500	0.000455	853773.	-5951.4551	-3.411E-05	2864.7123	1.719E+12	-8.7001	344191.	0.000
51.000	-7.863E-05	745532.	-6014.9953	-2.574E-05	2820.8954	1.719E+12	1.6401	375481.	0.000
52.500	-0.000472	637745.	-5904.2876	-1.850E-05	2777.2622	1.719E+12	10.6607	406771.	0.000
54.000	-0.000745	533346.	-5645.2319	-1.237E-05	2735.0004	1.719E+12	18.1233	438061.	0.000
55.500	-0.000917	434763.	-5266.8965	-7.304E-06	2695.0932	1.719E+12	23.9140	469351.	0.000
57.000	-0.001008	343883.	-4799.4404	-3.228E-06	2658.3041	1.719E+12	28.0255	500641.	0.000
58.500	-0.001033	262047.	-4272.3804	-5.619E-08	2625.1764	1.719E+12	30.5367	531931.	0.000

60.000	-0.001010	190078.	-3713.2219	2.310E-06	2596.0427	1.719E+12	31.5920	563221.	0.000
61.500	-0.000950	128325.	-3146.4555	3.977E-06	2571.0446	1.719E+12	31.3820	594511.	0.000
63.000	-0.000866	76727.	-2593.4466	5.051E-06	2550.1571	1.719E+12	30.0634	624535.	0.000
64.500	-0.000768	34861.	-2070.9299	5.635E-06	2533.2094	1.719E+12	27.9940	655825.	0.000
66.000	-0.000664	2061.0494	-1590.9916	5.828E-06	2519.9319	1.719E+12	25.3325	687116.	0.000
67.500	-0.000559	-22531.	-1162.3752	5.721E-06	2528.2183	1.719E+12	22.2915	718406.	0.000
69.000	-0.000458	-39898.	-790.1935	5.394E-06	2535.2487	1.719E+12	19.0620	749696.	0.000
70.500	-0.000364	-51085.	-476.3631	4.918E-06	2539.7773	1.719E+12	15.8080	780986.	0.000
72.000	-0.000281	-57145.	-220.1144	4.351E-06	2542.2303	1.719E+12	12.6640	812276.	0.000
73.500	-0.000208	-59096.	-18.5350	3.743E-06	2543.0200	1.719E+12	9.7337	843566.	0.000
75.000	-0.000146	-57887.	132.8870	3.130E-06	2542.5306	1.719E+12	7.0910	874856.	0.000
76.500	-9.500E-05	-54374.	239.7494	2.543E-06	2541.1086	1.719E+12	4.7826	906146.	0.000
78.000	-5.436E-05	-49306.	308.2710	2.000E-06	2539.0571	1.719E+12	2.8309	937436.	0.000
79.500	-2.300E-05	-43316.	344.8907	1.515E-06	2536.6323	1.719E+12	1.2380	968726.	0.000
81.000	1.894E-07	-36920.	355.9377	1.095E-06	2534.0432	1.719E+12	-0.0105	1000016.	0.000
82.500	1.642E-05	-30524.	347.3740	7.421E-07	2531.4540	1.719E+12	-0.9410	1031306.	0.000
84.000	2.691E-05	-24429.	324.6098	4.545E-07	2528.9868	1.719E+12	-1.5884	1062596.	0.000
85.500	3.278E-05	-18847.	292.3831	2.279E-07	2526.7270	1.719E+12	-1.9924	1093886.	0.000
87.000	3.511E-05	-13908.	254.6986	5.648E-08	2524.7277	1.719E+12	-2.1948	1125139.	0.000
88.500	3.482E-05	-9679.0102	214.8133	-6.699E-08	2523.0157	1.719E+12	-2.2369	1156429.	0.000
90.000	3.270E-05	-6173.5848	175.2615	-1.500E-07	2521.5967	1.719E+12	-2.1577	1187719.	0.000
91.500	2.942E-05	-3366.6170	137.9109	-1.999E-07	2520.4604	1.719E+12	-1.9923	1219009.	0.000
93.000	2.550E-05	-1204.8201	104.0362	-2.238E-07	2519.5853	1.719E+12	-1.7715	1250299.	0.000
94.500	2.136E-05	383.1339	74.4046	-2.281E-07	2519.2527	1.719E+12	-1.5209	1281589.	0.000
96.000	1.729E-05	1478.2808	49.3665	-2.184E-07	2519.6960	1.719E+12	-1.2611	1312879.	0.000
97.500	1.350E-05	2164.6679	28.9441	-1.993E-07	2519.9739	1.719E+12	-1.0080	1344169.	0.000
99.000	1.011E-05	2524.2301	12.9158	-1.748E-07	2520.1194	1.719E+12	-0.7729	1375459.	0.000
100.500	7.206E-06	2633.1083	0.8908	-1.478E-07	2520.1635	1.719E+12	-0.5632	1406749.	0.000
102.000	4.794E-06	2559.2360	-7.6252	-1.206E-07	2520.1336	1.719E+12	-0.3830	1438039.	0.000
103.500	2.865E-06	2360.9982	-13.1768	-9.485E-08	2520.0533	1.719E+12	-0.2338	1469329.	0.000
105.000	1.380E-06	2086.7545	-16.3164	-7.157E-08	2519.9423	1.719E+12	-0.1150	1500620.	0.000
106.500	2.880E-07	1775.0283	-17.5722	-5.136E-08	2519.8161	1.719E+12	-0.0245	1531910.	0.000
108.000	-4.692E-07	1455.1765	-17.4293	-3.445E-08	2519.6867	1.719E+12	0.0404	1549327.	0.000
109.500	-9.521E-07	1148.2572	-16.3134	-2.082E-08	2519.5624	1.719E+12	0.0836	1580618.	0.000
111.000	-1.219E-06	868.3063	-14.5788	-1.026E-08	2519.4491	1.719E+12	0.1091	1611908.	0.000
112.500	-1.322E-06	623.6227	-12.5109	-2.453E-09	2519.3500	1.719E+12	0.1206	1643198.	0.000
114.000	-1.307E-06	417.9620	-10.3309	2.999E-09	2519.2668	1.719E+12	0.1216	1674488.	0.000
115.500	-1.214E-06	251.6498	-8.2017	6.504E-09	2519.1995	1.719E+12	0.1150	1705778.	0.000
117.000	-1.073E-06	122.5726	-6.2349	8.463E-09	2519.1472	1.719E+12	0.1035	1737068.	0.000
118.500	-9.089E-07	27.0251	-4.4996	9.246E-09	2519.1085	1.719E+12	0.0893	1768358.	0.000
120.000	-7.399E-07	-39.5952	-3.0302	9.181E-09	2519.1136	1.719E+12	0.0740	1799648.	0.000
121.500	-5.784E-07	-82.2434	-1.8349	8.543E-09	2519.1309	1.719E+12	0.0588	1830938.	0.000
123.000	-4.324E-07	-105.8217	-0.9029	7.558E-09	2519.1404	1.719E+12	0.0447	1862228.	0.000
124.500	-3.063E-07	-114.8966	-0.2103	6.403E-09	2519.1441	1.719E+12	0.0322	1893518.	0.000
126.000	-2.018E-07	-113.5209	0.2739	5.207E-09	2519.1435	1.719E+12	0.0216	1924808.	0.000
127.500	-1.188E-07	-105.1404	0.5843	4.063E-09	2519.1402	1.719E+12	0.0129	1956098.	0.000
129.000	-5.558E-08	-92.5660	0.7557	3.028E-09	2519.1351	1.719E+12	0.006136	1987388.	0.000
130.500	-9.797E-09	-77.9938	0.8209	2.135E-09	2519.1292	1.719E+12	0.001099	2018678.	0.000
132.000	2.129E-08	-63.0575	0.8089	1.397E-09	2519.1231	1.719E+12	-0.002424	2049969.	0.000
133.500	4.049E-08	-48.9000	0.7450	8.107E-10	2519.1174	1.719E+12	-0.004681	2081259.	0.000
135.000	5.047E-08	-36.2542	0.6495	3.649E-10	2519.1123	1.719E+12	-0.005923	2112549.	0.000
136.500	5.362E-08	-25.5239	0.5387	4.156E-11	2519.1079	1.719E+12	-0.006387	2143839.	0.000
138.000	5.197E-08	-16.8602	0.4247	-1.803E-10	2519.1044	1.719E+12	-0.006280	2175129.	0.000
139.500	4.713E-08	-10.2293	0.3162	-3.221E-10	2519.1017	1.719E+12	-0.005778	2206419.	0.000
141.000	4.037E-08	-5.4693	0.2191	-4.043E-10	2519.0998	1.719E+12	-0.005019	2237709.	0.000
142.500	3.258E-08	-2.3349	0.1369	-4.451E-10	2519.0985	1.719E+12	-0.004107	2268999.	0.000
144.000	2.435E-08	-0.5308	0.0720	-4.601E-10	2519.0978	1.719E+12	-0.003111	2300289.	0.000
145.500	1.601E-08	0.2653	0.0253	-4.615E-10	2519.0977	1.719E+12	-0.002074	2331579.	0.000
147.000	7.732E-09	0.3893	-0.002501	-4.581E-10	2519.0978	1.719E+12	-0.001015	2362869.	0.000
148.500	-4.775E-10	0.1843	-0.0111	-4.551E-10	2519.0977	1.719E+12	6.351E-05	2394159.	0.000
150.000	-8.652E-09	0.000	0.000	-4.541E-10	2519.0976	1.719E+12	0.001166	1212725.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =      0.1250000 inches
Computed slope at pile head      =     -0.0003108 radians
Maximum bending moment           =       1329202. inch-lbs
Maximum shear force              =  -6014.9952521 lbs
Depth of maximum bending moment  =     39.0000000 feet below pile head
Depth of maximum shear force     =     51.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.250000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2500	0.000	5757.8551	-0.000622	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.2388	109818.	5757.8551	-0.000621	2563.5529	1.719E+12	0.000	0.000	0.000
3.000	0.2276	219625.	5757.8551	-0.000619	2608.0037	1.719E+12	0.000	0.000	0.000
4.500	0.2165	329409.	5757.8551	-0.000616	2652.4451	1.719E+12	0.000	0.000	0.000
6.000	0.2054	439159.	5757.8551	-0.000612	2696.8728	1.719E+12	0.000	0.000	0.000
7.500	0.1945	548863.	5757.8551	-0.000607	2741.2819	1.719E+12	0.000	0.000	0.000
9.000	0.1836	658510.	5757.8551	-0.000601	2785.6679	1.719E+12	0.000	0.000	0.000
10.500	0.1728	768088.	5757.8551	-0.000594	2830.0261	1.719E+12	0.000	0.000	0.000
12.000	0.1622	877587.	5757.8551	-0.000585	2874.3521	1.719E+12	0.000	0.000	0.000
13.500	0.1518	986994.	5757.8551	-0.000575	2918.6410	1.719E+12	0.000	0.000	0.000
15.000	0.1415	1096298.	5757.8551	-0.000564	2962.8885	1.719E+12	0.000	0.000	0.000
16.500	0.1315	1205489.	5757.8551	-0.000552	3007.0897	1.719E+12	0.000	0.000	0.000
18.000	0.1216	1314554.	5757.8551	-0.000539	3051.2402	1.719E+12	0.000	0.000	0.000
19.500	0.1121	1423483.	5757.8551	-0.000525	3095.3353	1.719E+12	0.000	0.000	0.000
21.000	0.1027	1532263.	5757.8551	-0.000509	3139.3705	1.719E+12	0.000	0.000	0.000
22.500	0.0937	1640884.	5757.8551	-0.000493	3183.3412	1.719E+12	0.000	0.000	0.000
24.000	0.0850	1749334.	5757.8551	-0.000475	3227.2428	1.719E+12	0.000	0.000	0.000
25.500	0.0766	1857602.	5757.8551	-0.000456	3271.0707	1.719E+12	0.000	0.000	0.000
27.000	0.0686	1965677.	5757.8551	-0.000436	3314.8204	1.719E+12	0.000	0.000	0.000
28.500	0.0609	2073548.	5757.8551	-0.000415	3358.4873	1.719E+12	0.000	0.000	0.000
30.000	0.0537	2181203.	5757.8551	-0.000393	3402.0669	1.719E+12	0.000	0.000	0.000
31.500	0.0468	2288631.	5757.8551	-0.000369	3445.5546	1.719E+12	0.000	0.000	0.000
33.000	0.0404	2395821.	5757.8551	-0.000345	3488.9460	1.719E+12	0.000	0.000	0.000
34.500	0.0344	2502761.	5219.6147	-0.000319	3532.2365	1.719E+12	-59.8045	31290.	0.000
36.000	0.0289	2590065.	3777.1568	-0.000292	3567.5778	1.719E+12	-100.4686	62580.	0.000
37.500	0.0239	2644548.	1752.0999	-0.000265	3589.6327	1.719E+12	-124.5377	93870.	0.000
39.000	0.0194	2658405.	-580.3969	-0.000237	3595.2422	1.719E+12	-134.6286	125160.	0.000
40.500	0.0153	2628366.	-2992.3198	-0.000209	3583.0822	1.719E+12	-133.3628	156450.	0.000
42.000	0.0118	2554844.	-5302.2310	-0.000182	3553.3198	1.719E+12	-123.2940	187740.	0.000
43.500	0.008780	2441109.	-7373.4041	-0.000156	3507.2789	1.719E+12	-106.8364	219030.	0.000
45.000	0.006199	2292505.	-9110.7565	-0.000131	3447.1228	1.719E+12	-86.2028	250321.	0.000
46.500	0.004049	2115733.	-10457.	-0.000108	3375.5640	1.719E+12	-63.3541	281611.	0.000
48.000	0.002299	1918214.	-11387.	-8.721E-05	3295.6066	1.719E+12	-39.9641	312901.	0.000
49.500	0.000910	1707547.	-11903.	-6.823E-05	3210.3269	1.719E+12	-17.4003	344191.	0.000
51.000	-0.000157	1491065.	-12030.	-5.149E-05	3122.6931	1.719E+12	3.2803	375481.	0.000
52.500	-0.000943	1275490.	-11809.	-3.700E-05	3035.4268	1.719E+12	21.3214	406771.	0.000
54.000	-0.001489	1066691.	-11290.	-2.474E-05	2950.9032	1.719E+12	36.2465	438061.	0.000
55.500	-0.001834	869525.	-10534.	-1.461E-05	2871.0887	1.719E+12	47.8280	469351.	0.000
57.000	-0.002015	687765.	-9598.8809	-6.456E-06	2797.5107	1.719E+12	56.0511	500641.	0.000
58.500	-0.002067	524094.	-8544.7607	-1.124E-07	2731.2552	1.719E+12	61.0734	531931.	0.000

60.000	-0.002019	380156.	-7426.4438	4.621E-06	2672.9879	1.719E+12	63.1841	563221.	0.000
61.500	-0.001900	256650.	-6292.9111	7.954E-06	2622.9917	1.719E+12	62.7640	594511.	0.000
63.000	-0.001733	153453.	-5186.8931	1.010E-05	2581.2167	1.719E+12	60.1269	624535.	0.000
64.500	-0.001537	69721.	-4141.8599	1.127E-05	2547.3213	1.719E+12	55.9879	655825.	0.000
66.000	-0.001327	4122.0989	-3181.9833	1.166E-05	2520.7663	1.719E+12	50.6650	687116.	0.000
67.500	-0.001117	-45062.	-2324.7504	1.144E-05	2537.3390	1.719E+12	44.5831	718406.	0.000
69.000	-0.000915	-79796.	-1580.3870	1.079E-05	2551.3998	1.719E+12	38.1240	749696.	0.000
70.500	-0.000729	-102170.	-952.7263	9.836E-06	2560.4570	1.719E+12	31.6161	780986.	0.000
72.000	-0.000561	-114290.	-440.2288	8.702E-06	2565.3631	1.719E+12	25.3281	812276.	0.000
73.500	-0.000415	-118191.	-37.0701	7.485E-06	2566.9425	1.719E+12	19.4673	843566.	0.000
75.000	-0.000292	-115773.	265.7740	6.261E-06	2565.9635	1.719E+12	14.1820	874856.	0.000
76.500	-0.000190	-108748.	479.4988	5.085E-06	2563.1197	1.719E+12	9.5652	906146.	0.000
78.000	-0.000109	-98612.	616.5420	4.000E-06	2559.0167	1.719E+12	5.6618	937436.	0.000
79.500	-4.601E-05	-86632.	689.7815	3.030E-06	2554.1669	1.719E+12	2.4759	968726.	0.000
81.000	3.787E-07	-73840.	711.8753	2.190E-06	2548.9888	1.719E+12	-0.0210	1000016.	0.000
82.500	3.285E-05	-61048.	694.7480	1.484E-06	2543.8103	1.719E+12	-1.8820	1031306.	0.000
84.000	5.381E-05	-48859.	649.2196	9.090E-07	2538.8761	1.719E+12	-3.1767	1062596.	0.000
85.500	6.557E-05	-37694.	584.7662	4.559E-07	2534.3565	1.719E+12	-3.9848	1093886.	0.000
87.000	7.022E-05	-27816.	509.3973	1.130E-07	2530.3579	1.719E+12	-4.3895	1125139.	0.000
88.500	6.964E-05	-19358.	429.6266	-1.340E-07	2526.9339	1.719E+12	-4.4739	1156429.	0.000
90.000	6.540E-05	-12347.	350.5229	-2.999E-07	2524.0958	1.719E+12	-4.3154	1187719.	0.000
91.500	5.884E-05	-6733.2341	275.8218	-3.998E-07	2521.8233	1.719E+12	-3.9847	1219009.	0.000
93.000	5.101E-05	-2409.6402	208.0724	-4.477E-07	2520.0730	1.719E+12	-3.5430	1250299.	0.000
94.500	4.272E-05	766.2678	148.8093	-4.563E-07	2519.4078	1.719E+12	-3.0418	1281589.	0.000
96.000	3.458E-05	2956.5615	98.7330	-4.368E-07	2520.2944	1.719E+12	-2.5223	1312879.	0.000
97.500	2.700E-05	4329.3358	57.8882	-3.987E-07	2520.8501	1.719E+12	-2.0160	1344169.	0.000
99.000	2.023E-05	5048.4603	25.8315	-3.496E-07	2521.1413	1.719E+12	-1.5458	1375459.	0.000
100.500	1.441E-05	5266.2165	1.7816	-2.956E-07	2521.2294	1.719E+12	-1.1264	1406749.	0.000
102.000	9.589E-06	5118.4720	-15.2504	-2.412E-07	2521.1696	1.719E+12	-0.7660	1438039.	0.000
103.500	5.729E-06	4721.9964	-26.3537	-1.897E-07	2521.0091	1.719E+12	-0.4677	1469329.	0.000
105.000	2.759E-06	4173.5089	-32.6329	-1.431E-07	2520.7871	1.719E+12	-0.2300	1500620.	0.000
106.500	5.760E-07	3550.0566	-35.1444	-1.027E-07	2520.5347	1.719E+12	-0.0490	1531910.	0.000
108.000	-9.383E-07	2910.3529	-34.8586	-6.889E-08	2520.2757	1.719E+12	0.0808	1549327.	0.000
109.500	-1.904E-06	2296.5143	-32.6269	-4.164E-08	2520.0272	1.719E+12	0.1672	1580618.	0.000
111.000	-2.437E-06	1736.6125	-29.1577	-2.053E-08	2519.8006	1.719E+12	0.2183	1611908.	0.000
112.500	-2.643E-06	1247.2453	-25.0218	-4.906E-09	2519.6025	1.719E+12	0.2413	1643198.	0.000
114.000	-2.614E-06	835.9241	-20.6618	5.999E-09	2519.4360	1.719E+12	0.2432	1674488.	0.000
115.500	-2.427E-06	503.2997	-16.4033	1.301E-08	2519.3013	1.719E+12	0.2300	1705778.	0.000
117.000	-2.146E-06	245.1452	-12.4698	1.693E-08	2519.1968	1.719E+12	0.2071	1737068.	0.000
118.500	-1.818E-06	54.0503	-8.9991	1.849E-08	2519.1195	1.719E+12	0.1786	1768358.	0.000
120.000	-1.480E-06	-79.1903	-6.0603	1.836E-08	2519.1297	1.719E+12	0.1480	1799648.	0.000
121.500	-1.157E-06	-164.4868	-3.6698	1.709E-08	2519.1642	1.719E+12	0.1177	1830938.	0.000
123.000	-8.647E-07	-211.6435	-1.8057	1.512E-08	2519.1833	1.719E+12	0.0895	1862228.	0.000
124.500	-6.125E-07	-229.7933	-0.4207	1.281E-08	2519.1906	1.719E+12	0.0644	1893518.	0.000
126.000	-4.037E-07	-227.0419	0.5478	1.041E-08	2519.1895	1.719E+12	0.0432	1924808.	0.000
127.500	-2.376E-07	-210.2808	1.1686	8.126E-09	2519.1827	1.719E+12	0.0258	1956098.	0.000
129.000	-1.112E-07	-185.1320	1.5115	6.056E-09	2519.1725	1.719E+12	0.0123	1987388.	0.000
130.500	-1.959E-08	-155.9876	1.6417	4.270E-09	2519.1607	1.719E+12	0.002197	2018678.	0.000
132.000	4.257E-08	-126.1149	1.6179	2.793E-09	2519.1486	1.719E+12	-0.004848	2049969.	0.000
133.500	8.097E-08	-97.8001	1.4900	1.621E-09	2519.1372	1.719E+12	-0.009362	2081259.	0.000
135.000	1.009E-07	-72.5085	1.2991	7.299E-10	2519.1269	1.719E+12	-0.0118	2112549.	0.000
136.500	1.072E-07	-51.0478	1.0775	8.312E-11	2519.1183	1.719E+12	-0.0128	2143839.	0.000
138.000	1.039E-07	-33.7203	0.8495	-3.606E-10	2519.1112	1.719E+12	-0.0126	2175129.	0.000
139.500	9.427E-08	-20.4587	0.6325	-6.442E-10	2519.1059	1.719E+12	-0.0116	2206419.	0.000
141.000	8.074E-08	-10.9387	0.4381	-8.086E-10	2519.1020	1.719E+12	-0.0100	2237709.	0.000
142.500	6.516E-08	-4.6698	0.2739	-8.903E-10	2519.0995	1.719E+12	-0.008214	2268999.	0.000
144.000	4.869E-08	-1.0616	0.1439	-9.203E-10	2519.0980	1.719E+12	-0.006223	2300289.	0.000
145.500	3.203E-08	0.5306	0.0506	-9.230E-10	2519.0978	1.719E+12	-0.004149	2331579.	0.000
147.000	1.546E-08	0.7785	-0.005002	-9.162E-10	2519.0979	1.719E+12	-0.002030	2362869.	0.000
148.500	-9.550E-10	0.3687	-0.0221	-9.102E-10	2519.0977	1.719E+12	0.000127	2394159.	0.000
150.000	-1.730E-08	0.000	0.000	-9.083E-10	2519.0976	1.719E+12	0.002332	1212725.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection              =      0.2500000 inches
Computed slope at pile head       =     -0.0006217 radians
Maximum bending moment            =       2658405. inch-lbs
Maximum shear force               =        -12030. lbs
Depth of maximum bending moment   =     39.0000000 feet below pile head
Depth of maximum shear force      =     51.0000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.500000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5000	0.000	11516.	-0.001243	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.4776	219636.	11516.	-0.001242	2608.0083	1.719E+12	0.000	0.000	0.000
3.000	0.4553	439250.	11516.	-0.001239	2696.9097	1.719E+12	0.000	0.000	0.000
4.500	0.4330	658818.	11516.	-0.001233	2785.7927	1.719E+12	0.000	0.000	0.000
6.000	0.4109	878317.	11516.	-0.001225	2874.6479	1.719E+12	0.000	0.000	0.000
7.500	0.3889	1097726.	11516.	-0.001215	2963.4661	1.719E+12	0.000	0.000	0.000
9.000	0.3672	1317019.	11516.	-0.001202	3052.2381	1.719E+12	0.000	0.000	0.000
10.500	0.3457	1536176.	11516.	-0.001187	3140.9547	1.719E+12	0.000	0.000	0.000
12.000	0.3244	1755173.	11516.	-0.001170	3229.6065	1.719E+12	0.000	0.000	0.000
13.500	0.3035	1973988.	11516.	-0.001150	3318.1845	1.719E+12	0.000	0.000	0.000
15.000	0.2830	2192597.	11516.	-0.001128	3406.6793	1.719E+12	0.000	0.000	0.000
16.500	0.2629	2410978.	11516.	-0.001104	3495.0818	1.719E+12	0.000	0.000	0.000
18.000	0.2433	2629108.	11516.	-0.001078	3583.3828	1.719E+12	0.000	0.000	0.000
19.500	0.2241	2846965.	11516.	-0.001049	3671.5731	1.719E+12	0.000	0.000	0.000
21.000	0.2055	3064526.	11516.	-0.001018	3759.6434	1.719E+12	0.000	0.000	0.000
22.500	0.1875	3281768.	11516.	-0.000985	3847.5848	1.719E+12	0.000	0.000	0.000
24.000	0.1700	3498668.	11516.	-0.000950	3935.3879	1.719E+12	0.000	0.000	0.000
25.500	0.1533	3715205.	11516.	-0.000912	4023.0438	1.719E+12	0.000	0.000	0.000
27.000	0.1372	3931355.	11516.	-0.000872	4110.5431	1.719E+12	0.000	0.000	0.000
28.500	0.1219	4147096.	11516.	-0.000830	4197.8770	1.719E+12	0.000	0.000	0.000
30.000	0.1073	4362406.	11516.	-0.000785	4285.0362	1.719E+12	0.000	0.000	0.000
31.500	0.0936	4577262.	11516.	-0.000738	4372.0117	1.719E+12	0.000	0.000	0.000
33.000	0.0808	4791641.	11516.	-0.000689	4458.7944	1.719E+12	0.000	0.000	0.000
34.500	0.0688	5005523.	10439.	-0.000638	4545.3754	1.719E+12	-119.6090	31290.	0.000
36.000	0.0578	5180130.	7554.3136	-0.000585	4616.0580	1.719E+12	-200.9372	62580.	0.000
37.500	0.0478	5289095.	3504.1998	-0.000530	4660.1679	1.719E+12	-249.0754	93870.	0.000
39.000	0.0387	5316809.	-1160.7937	-0.000474	4671.3869	1.719E+12	-269.2572	125160.	0.000
40.500	0.0307	5256731.	-5984.6395	-0.000419	4647.0667	1.719E+12	-266.7257	156450.	0.000
42.000	0.0236	5109687.	-10604.	-0.000365	4587.5421	1.719E+12	-246.5879	187740.	0.000
43.500	0.0176	4882217.	-14747.	-0.000312	4495.4603	1.719E+12	-213.6728	219030.	0.000
45.000	0.0124	4585009.	-18222.	-0.000263	4375.1480	1.719E+12	-172.4056	250321.	0.000
46.500	0.008099	4231465.	-20914.	-0.000217	4232.0303	1.719E+12	-126.7081	281611.	0.000
48.000	0.004598	3836427.	-22773.	-0.000174	4072.1157	1.719E+12	-79.9281	312901.	0.000
49.500	0.001820	3415094.	-23806.	-0.000136	3901.5563	1.719E+12	-34.8006	344191.	0.000
51.000	-0.000315	2982129.	-24060.	-0.000103	3726.2887	1.719E+12	6.5605	375481.	0.000
52.500	-0.001887	2550980.	-23617.	-7.401E-05	3551.7560	1.719E+12	42.6429	406771.	0.000
54.000	-0.002979	2133383.	-22581.	-4.949E-05	3382.7089	1.719E+12	72.4930	438061.	0.000
55.500	-0.003668	1739050.	-21068.	-2.922E-05	3223.0799	1.719E+12	95.6561	469351.	0.000
57.000	-0.004031	1375530.	-19198.	-1.291E-05	3075.9238	1.719E+12	112.1022	500641.	0.000
58.500	-0.004133	1048188.	-17090.	-2.248E-07	2943.4128	1.719E+12	122.1467	531931.	0.000

60.000	-0.004039	760312.	-14853.	9.242E-06	2826.8782	1.719E+12	126.3681	563221.	0.000
61.500	-0.003801	513300.	-12586.	1.591E-05	2726.8858	1.719E+12	125.5280	594511.	0.000
63.000	-0.003466	306906.	-10374.	2.020E-05	2643.3357	1.719E+12	120.2538	624535.	0.000
64.500	-0.003073	139442.	-8283.7198	2.254E-05	2575.5450	1.719E+12	111.9759	655825.	0.000
66.000	-0.002654	8244.1977	-6363.9665	2.331E-05	2522.4349	1.719E+12	101.3301	687116.	0.000
67.500	-0.002234	-90124.	-4649.5008	2.288E-05	2555.5805	1.719E+12	89.1661	718406.	0.000
69.000	-0.001831	-159593.	-3160.7740	2.158E-05	2583.7020	1.719E+12	76.2480	749696.	0.000
70.500	-0.001457	-204340.	-1905.4525	1.967E-05	2601.8163	1.719E+12	63.2322	780986.	0.000
72.000	-0.001123	-228580.	-880.4576	1.740E-05	2611.6286	1.719E+12	50.6561	812276.	0.000
73.500	-0.000831	-236383.	-74.1401	1.497E-05	2614.7873	1.719E+12	38.9347	843566.	0.000
75.000	-0.000584	-231546.	531.5480	1.252E-05	2612.8295	1.719E+12	28.3640	874856.	0.000
76.500	-0.000380	-217496.	958.9975	1.017E-05	2607.1417	1.719E+12	19.1304	906146.	0.000
78.000	-0.000217	-197225.	1233.0839	8.000E-06	2598.9357	1.719E+12	11.3236	937436.	0.000
79.500	-9.201E-05	-173264.	1379.5630	6.061E-06	2589.2362	1.719E+12	4.9518	968726.	0.000
81.000	7.574E-07	-147681.	1423.7506	4.381E-06	2578.8800	1.719E+12	-0.0421	1000016.	0.000
82.500	6.570E-05	-122096.	1389.4959	2.969E-06	2568.5230	1.719E+12	-3.7640	1031306.	0.000
84.000	0.000108	-97718.	1298.4391	1.818E-06	2558.6546	1.719E+12	-6.3534	1062596.	0.000
85.500	0.000131	-75388.	1169.5323	9.118E-07	2549.6154	1.719E+12	-7.9696	1093886.	0.000
87.000	0.000140	-55633.	1018.7945	2.259E-07	2541.6182	1.719E+12	-8.7791	1125139.	0.000
88.500	0.000139	-38716.	859.2532	-2.680E-07	2534.7702	1.719E+12	-8.9477	1156429.	0.000
90.000	0.000131	-24694.	701.0459	-5.999E-07	2529.0941	1.719E+12	-8.6309	1187719.	0.000
91.500	0.000118	-13466.	551.6436	-7.996E-07	2524.5489	1.719E+12	-7.9694	1219009.	0.000
93.000	0.000102	-4819.2804	416.1448	-8.954E-07	2521.0485	1.719E+12	-7.0860	1250299.	0.000
94.500	8.544E-05	1532.5355	297.6186	-9.126E-07	2519.7180	1.719E+12	-6.0835	1281589.	0.000
96.000	6.916E-05	5913.1230	197.4660	-8.736E-07	2521.4913	1.719E+12	-5.0445	1312879.	0.000
97.500	5.399E-05	8658.6715	115.7765	-7.973E-07	2522.6027	1.719E+12	-4.0321	1344169.	0.000
99.000	4.046E-05	10097.	51.6630	-6.991E-07	2523.1849	1.719E+12	-3.0916	1375459.	0.000
100.500	2.883E-05	10532.	3.5632	-5.912E-07	2523.3612	1.719E+12	-2.2528	1406749.	0.000
102.000	1.918E-05	10237.	-30.5008	-4.824E-07	2523.2416	1.719E+12	-1.5321	1438039.	0.000
103.500	1.146E-05	9443.9928	-52.7074	-3.794E-07	2522.9206	1.719E+12	-0.9353	1469329.	0.000
105.000	5.519E-06	8347.0178	-65.2658	-2.863E-07	2522.4765	1.719E+12	-0.4601	1500620.	0.000
106.500	1.152E-06	7100.1132	-70.2887	-2.054E-07	2521.9718	1.719E+12	-0.0980	1531910.	0.000
108.000	-1.877E-06	5820.7059	-69.7173	-1.378E-07	2521.4539	1.719E+12	0.1615	1549327.	0.000
109.500	-3.808E-06	4593.0286	-65.2538	-8.327E-08	2520.9569	1.719E+12	0.3344	1580618.	0.000
111.000	-4.875E-06	3473.2251	-58.3154	-4.105E-08	2520.5036	1.719E+12	0.4365	1611908.	0.000
112.500	-5.286E-06	2494.4907	-50.0437	-9.812E-09	2520.1074	1.719E+12	0.4826	1643198.	0.000
114.000	-5.228E-06	1671.8481	-41.3237	1.200E-08	2519.7744	1.719E+12	0.4863	1674488.	0.000
115.500	-4.854E-06	1006.5993	-32.8067	2.602E-08	2519.5051	1.719E+12	0.4600	1705778.	0.000
117.000	-4.291E-06	490.2905	-24.9396	3.385E-08	2519.2961	1.719E+12	0.4141	1737068.	0.000
118.500	-3.636E-06	108.1006	-17.9982	3.699E-08	2519.1414	1.719E+12	0.3572	1768358.	0.000
120.000	-2.960E-06	-158.3806	-12.1207	3.672E-08	2519.1617	1.719E+12	0.2959	1799648.	0.000
121.500	-2.313E-06	-328.9737	-7.3396	3.417E-08	2519.2308	1.719E+12	0.2353	1830938.	0.000
123.000	-1.729E-06	-423.2870	-3.6114	3.023E-08	2519.2689	1.719E+12	0.1789	1862228.	0.000
124.500	-1.225E-06	-459.5866	-0.8413	2.561E-08	2519.2836	1.719E+12	0.1289	1893518.	0.000
126.000	-8.074E-07	-454.0838	1.0955	2.083E-08	2519.2814	1.719E+12	0.0863	1924808.	0.000
127.500	-4.752E-07	-420.5617	2.3373	1.625E-08	2519.2678	1.719E+12	0.0516	1956098.	0.000
129.000	-2.223E-07	-370.2640	3.0230	1.211E-08	2519.2475	1.719E+12	0.0245	1987388.	0.000
130.500	-3.919E-08	-311.9751	3.2834	8.540E-09	2519.2239	1.719E+12	0.004395	2018678.	0.000
132.000	8.514E-08	-252.2299	3.2357	5.587E-09	2519.1997	1.719E+12	-0.009697	2049969.	0.000
133.500	1.619E-07	-195.6002	2.9799	3.243E-09	2519.1768	1.719E+12	-0.0187	2081259.	0.000
135.000	2.019E-07	-145.0170	2.5982	1.460E-09	2519.1563	1.719E+12	-0.0237	2112549.	0.000
136.500	2.145E-07	-102.0955	2.1550	1.662E-10	2519.1389	1.719E+12	-0.0255	2143839.	0.000
138.000	2.079E-07	-67.4407	1.6990	-7.212E-10	2519.1249	1.719E+12	-0.0251	2175129.	0.000
139.500	1.885E-07	-40.9173	1.2649	-1.288E-09	2519.1142	1.719E+12	-0.0231	2206419.	0.000
141.000	1.615E-07	-21.8774	0.8763	-1.617E-09	2519.1065	1.719E+12	-0.0201	2237709.	0.000
142.500	1.303E-07	-9.3396	0.5477	-1.781E-09	2519.1014	1.719E+12	-0.0164	2268999.	0.000
144.000	9.739E-08	-2.1232	0.2879	-1.841E-09	2519.0985	1.719E+12	-0.0124	2300289.	0.000
145.500	6.406E-08	1.0611	0.1012	-1.846E-09	2519.0980	1.719E+12	-0.008297	2331579.	0.000
147.000	3.093E-08	1.5570	-0.0100	-1.832E-09	2519.0982	1.719E+12	-0.004060	2362869.	0.000
148.500	-1.910E-09	0.7374	-0.0443	-1.820E-09	2519.0979	1.719E+12	0.000254	2394159.	0.000
150.000	-3.461E-08	0.000	0.000	-1.817E-09	2519.0976	1.719E+12	0.004663	1212725.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection              =      0.5000000 inches
Computed slope at pile head       =     -0.0012433 radians
Maximum bending moment            =       5316809. inch-lbs
Maximum shear force               =        -24060. lbs
Depth of maximum bending moment   =     39.0000000 feet below pile head
Depth of maximum shear force      =     51.0000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 1.000000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	0.000	22647.	-0.002474	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.9555	432238.	22647.	-0.002472	2694.0714	1.719E+12	0.000	0.000	0.000
3.000	0.9110	864432.	22647.	-0.002465	2869.0269	1.719E+12	0.000	0.000	0.000
4.500	0.8667	1296536.	22647.	-0.002454	3043.9461	1.719E+12	0.000	0.000	0.000
6.000	0.8227	1728504.	22647.	-0.002438	3218.8107	1.719E+12	0.000	0.000	0.000
7.500	0.7789	2160293.	22647.	-0.002418	3393.6025	1.719E+12	0.000	0.000	0.000
9.000	0.7356	2591857.	22647.	-0.002393	3568.3033	1.719E+12	0.000	0.000	0.000
10.500	0.6928	3023152.	22647.	-0.002363	3742.8950	1.719E+12	0.000	0.000	0.000
12.000	0.6505	3454132.	22647.	-0.002330	3917.3594	1.719E+12	0.000	0.000	0.000
13.500	0.6089	3884753.	22647.	-0.002291	4091.6783	1.719E+12	0.000	0.000	0.000
15.000	0.5681	4314970.	22647.	-0.002248	4265.8337	1.719E+12	0.000	0.000	0.000
16.500	0.5280	4744737.	22647.	-0.002201	4439.8073	1.719E+12	0.000	0.000	0.000
18.000	0.4888	5174012.	22647.	-0.002149	4613.5812	1.719E+12	0.000	0.000	0.000
19.500	0.4506	5602748.	22647.	-0.002092	4787.1372	1.719E+12	0.000	0.000	0.000
21.000	0.4135	6030901.	22647.	-0.002032	4960.4572	1.719E+12	0.000	0.000	0.000
22.500	0.3775	6458427.	22647.	-0.001966	5133.5233	1.719E+12	0.000	0.000	0.000
24.000	0.3427	6885281.	22647.	-0.001896	5306.3175	1.719E+12	0.000	0.000	0.000
25.500	0.3092	7311419.	22647.	-0.001822	5478.8217	1.719E+12	0.000	0.000	0.000
27.000	0.2771	7736796.	22647.	-0.001743	5651.0180	1.719E+12	0.000	0.000	0.000
28.500	0.2465	8161369.	22647.	-0.001660	5822.8886	1.719E+12	0.000	0.000	0.000
30.000	0.2174	8585092.	22647.	-0.001572	5994.4155	1.719E+12	0.000	0.000	0.000
31.500	0.1899	9007923.	22647.	-0.001480	6165.5808	1.719E+12	0.000	0.000	0.000
33.000	0.1641	9429817.	22647.	-0.001384	6336.3669	1.719E+12	0.000	0.000	0.000
34.500	0.1401	9850729.	21180.	-0.001283	6506.7559	1.719E+12	-163.0820	20958.	0.000
36.000	0.1179	10217779.	16689.	-0.001178	6655.3405	1.719E+12	-335.8528	51274.	0.000
37.500	0.0977	10474949.	9243.6155	-0.001069	6759.4452	1.719E+12	-491.4455	90575.	0.000
39.000	0.0794	10571801.	-148.3610	-0.000959	6798.6518	1.719E+12	-552.1074	125160.	0.000
40.500	0.0631	10488671.	-10056.	-0.000849	6764.9999	1.719E+12	-548.7117	156450.	0.000
42.000	0.0488	10226667.	-19578.	-0.000741	6658.9385	1.719E+12	-509.3624	187740.	0.000
43.500	0.0365	9798566.	-28157.	-0.000636	6485.6396	1.719E+12	-443.7663	219030.	0.000
45.000	0.0259	9225665.	-35398.	-0.000536	6253.7245	1.719E+12	-360.8517	250321.	0.000
46.500	0.0172	8534889.	-41063.	-0.000443	5974.0925	1.719E+12	-268.5592	281611.	0.000
48.000	0.009992	7756211.	-45043.	-0.000358	5658.8773	1.719E+12	-173.6923	312901.	0.000
49.500	0.004280	6920451.	-47343.	-0.000281	5320.5544	1.719E+12	-81.8327	344191.	0.000
51.000	-0.000129	6057457.	-48055.	-0.000213	4971.2071	1.719E+12	2.6824	375481.	0.000
52.500	-0.003395	5194702.	-47340.	-0.000154	4621.9566	1.719E+12	76.7272	406771.	0.000
54.000	-0.005683	4356266.	-45405.	-0.000104	4282.5507	1.719E+12	138.3055	438061.	0.000
55.500	-0.007150	3562188.	-42483.	-6.284E-05	3961.1012	1.719E+12	186.4321	469351.	0.000
57.000	-0.007945	2828143.	-38816.	-2.939E-05	3663.9538	1.719E+12	220.9878	500641.	0.000
58.500	-0.008208	2165404.	-34644.	-3.254E-06	3395.6715	1.719E+12	242.5597	531931.	0.000

60.000	-0.008063	1581030.	-30190.	1.636E-05	3159.1118	1.719E+12	252.2763	563221.	0.000
61.500	-0.007619	1078228.	-25655.	3.028E-05	2955.5734	1.719E+12	251.6469	594511.	0.000
63.000	-0.006973	656848.	-21213.	3.936E-05	2784.9952	1.719E+12	241.9213	624535.	0.000
64.500	-0.006202	313782.	-17002.	4.444E-05	2646.1192	1.719E+12	225.9737	655825.	0.000
66.000	-0.005373	43899.	-13122.	4.631E-05	2536.8682	1.719E+12	205.0905	687116.	0.000
67.500	-0.004535	-159539.	-9647.5012	4.571E-05	2583.6805	1.719E+12	180.9933	718406.	0.000
69.000	-0.003727	-304319.	-6621.4412	4.328E-05	2642.2887	1.719E+12	155.2356	749696.	0.000
70.500	-0.002977	-398771.	-4061.8992	3.960E-05	2680.5236	1.719E+12	129.1580	780986.	0.000
72.000	-0.002302	-451335.	-1964.7135	3.515E-05	2701.8017	1.719E+12	103.8627	812276.	0.000
73.500	-0.001711	-470200.	-308.0969	3.033E-05	2709.4384	1.719E+12	80.2058	843566.	0.000
75.000	-0.001210	-463029.	942.9895	2.544E-05	2706.5356	1.719E+12	58.8038	874856.	0.000
76.500	-0.000796	-436758.	1832.6783	2.073E-05	2695.9007	1.719E+12	40.0505	906146.	0.000
78.000	-0.000464	-397464.	2410.4234	1.636E-05	2679.9945	1.719E+12	24.1434	937436.	0.000
79.500	-0.000206	-350307.	2727.7301	1.245E-05	2660.9050	1.719E+12	11.1129	968726.	0.000
81.000	-1.541E-05	-299513.	2835.4522	9.048E-06	2640.3432	1.719E+12	0.8562	1000016.	0.000
82.500	0.000119	-248411.	2781.6783	6.180E-06	2619.6565	1.719E+12	-6.8311	1031306.	0.000
84.000	0.000207	-199496.	2610.1923	3.835E-06	2599.8552	1.719E+12	-12.2229	1062596.	0.000
85.500	0.000257	-154520.	2359.4663	1.982E-06	2581.6487	1.719E+12	-15.6355	1093886.	0.000
87.000	0.000278	-114594.	2062.1293	5.731E-07	2565.4864	1.719E+12	-17.4019	1125139.	0.000
88.500	0.000278	-80295.	1744.8175	-4.471E-07	2551.6017	1.719E+12	-17.8549	1156429.	0.000
90.000	0.000262	-51772.	1428.3529	-1.138E-06	2540.0554	1.719E+12	-17.3078	1187719.	0.000
91.500	0.000237	-28852.	1128.1714	-1.560E-06	2530.7770	1.719E+12	-16.0457	1219009.	0.000
93.000	0.000206	-11127.	854.9006	-1.770E-06	2523.6019	1.719E+12	-14.3177	1250299.	0.000
94.500	0.000173	1959.9259	615.0409	-1.818E-06	2519.8910	1.719E+12	-12.3334	1281589.	0.000
96.000	0.000141	11051.	411.6869	-1.750E-06	2523.5710	1.719E+12	-10.2615	1312879.	0.000
97.500	0.000110	16815.	245.2442	-1.604E-06	2525.9046	1.719E+12	-8.2321	1344169.	0.000
99.000	8.295E-05	19911.	114.1046	-1.411E-06	2527.1578	1.719E+12	-6.3390	1375459.	0.000
100.500	5.942E-05	20951.	15.2563	-1.198E-06	2527.5788	1.719E+12	-4.6442	1406749.	0.000
102.000	3.984E-05	20484.	-55.1888	-9.807E-07	2527.3898	1.719E+12	-3.1830	1438039.	0.000
103.500	2.412E-05	18984.	-101.5565	-7.741E-07	2526.7824	1.719E+12	-1.9689	1469329.	0.000
105.000	1.198E-05	16844.	-128.2622	-5.865E-07	2525.9160	1.719E+12	-0.9984	1500620.	0.000
106.500	3.005E-06	14378.	-139.5494	-4.231E-07	2524.9180	1.719E+12	-0.2558	1531910.	0.000
108.000	-3.256E-06	11828.	-139.3289	-2.859E-07	2523.8858	1.719E+12	0.2802	1549327.	0.000
109.500	-7.288E-06	9367.9860	-131.0470	-1.750E-07	2522.8898	1.719E+12	0.6400	1580618.	0.000
111.000	-9.555E-06	7114.0663	-117.5867	-8.869E-08	2521.9774	1.719E+12	0.8556	1611908.	0.000
112.500	-1.048E-05	5136.6273	-101.2752	-2.456E-08	2521.1769	1.719E+12	0.9568	1643198.	0.000
114.000	-1.044E-05	3468.6466	-83.9245	2.049E-08	2520.5017	1.719E+12	0.9711	1674488.	0.000
115.500	-9.743E-06	2114.9374	-66.8749	4.971E-08	2519.9537	1.719E+12	0.9233	1705778.	0.000
117.000	-8.649E-06	1060.1632	-51.0530	6.633E-08	2519.5268	1.719E+12	0.8347	1737068.	0.000
118.500	-7.355E-06	275.7114	-37.0377	7.333E-08	2519.2092	1.719E+12	0.7226	1768358.	0.000
120.000	-6.009E-06	-274.6506	-25.1271	7.333E-08	2519.2088	1.719E+12	0.6008	1799648.	0.000
121.500	-4.715E-06	-630.3200	-15.4031	6.859E-08	2519.3528	1.719E+12	0.4796	1830938.	0.000
123.000	-3.540E-06	-830.5247	-7.7904	6.095E-08	2519.4338	1.719E+12	0.3662	1862228.	0.000
124.500	-2.521E-06	-911.9849	-2.1075	5.183E-08	2519.4668	1.719E+12	0.2652	1893518.	0.000
126.000	-1.674E-06	-907.4228	1.8906	4.230E-08	2519.4649	1.719E+12	0.1790	1924808.	0.000
127.500	-9.982E-07	-844.7628	4.4781	3.313E-08	2519.4396	1.719E+12	0.1085	1956098.	0.000
129.000	-4.814E-07	-746.8685	5.9328	2.480E-08	2519.3999	1.719E+12	0.0532	1987388.	0.000
130.500	-1.054E-07	-631.6738	6.5176	1.758E-08	2519.3533	1.719E+12	0.0118	2018678.	0.000
132.000	1.515E-07	-512.5826	6.4687	1.159E-08	2519.3051	1.719E+12	-0.0173	2049969.	0.000
133.500	3.119E-07	-399.0302	5.9888	6.821E-09	2519.2591	1.719E+12	-0.0361	2081259.	0.000
135.000	3.971E-07	-297.1220	5.2447	3.177E-09	2519.2179	1.719E+12	-0.0466	2112549.	0.000
136.500	4.263E-07	-210.2838	4.3683	5.213E-10	2519.1827	1.719E+12	-0.0508	2143839.	0.000
138.000	4.159E-07	-139.8749	3.4590	-1.312E-09	2519.1542	1.719E+12	-0.0503	2175129.	0.000
139.500	3.791E-07	-85.7344	2.5885	-2.493E-09	2519.1323	1.719E+12	-0.0465	2206419.	0.000
141.000	3.262E-07	-46.6412	1.8053	-3.186E-09	2519.1165	1.719E+12	-0.0405	2237709.	0.000
142.500	2.644E-07	-20.6801	1.1404	-3.538E-09	2519.1060	1.719E+12	-0.0333	2268999.	0.000
144.000	1.988E-07	-5.5163	0.6118	-3.675E-09	2519.0998	1.719E+12	-0.0254	2300289.	0.000
145.500	1.321E-07	1.4173	0.2291	-3.697E-09	2519.0982	1.719E+12	-0.0171	2331579.	0.000
147.000	6.571E-08	2.8060	-0.002521	-3.674E-09	2519.0987	1.719E+12	-0.008626	2362869.	0.000
148.500	-1.628E-10	1.3996	-0.0800	-3.652E-09	2519.0982	1.719E+12	2.166E-05	2394159.	0.000
150.000	-6.577E-08	0.000	0.000	-3.645E-09	2519.0976	1.719E+12	0.008863	1212725.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =      1.0000000 inches
Computed slope at pile head      =     -0.0024743 radians
Maximum bending moment           =      10571801. inch-lbs
Maximum shear force              =        -48055. lbs
Depth of maximum bending moment  =     39.0000000 feet below pile head
Depth of maximum shear force     =     51.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              5
```

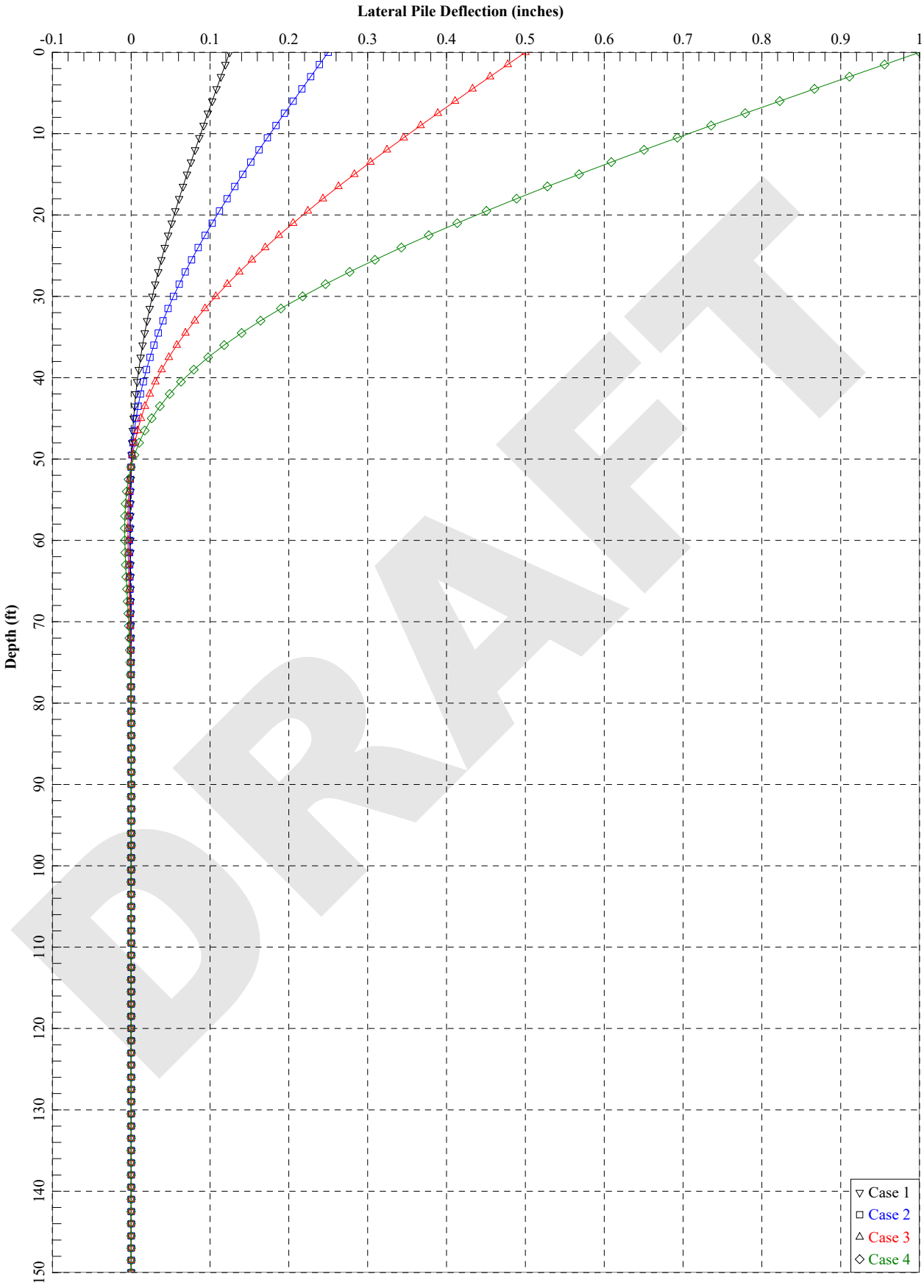
Summary of Pile Response(s)

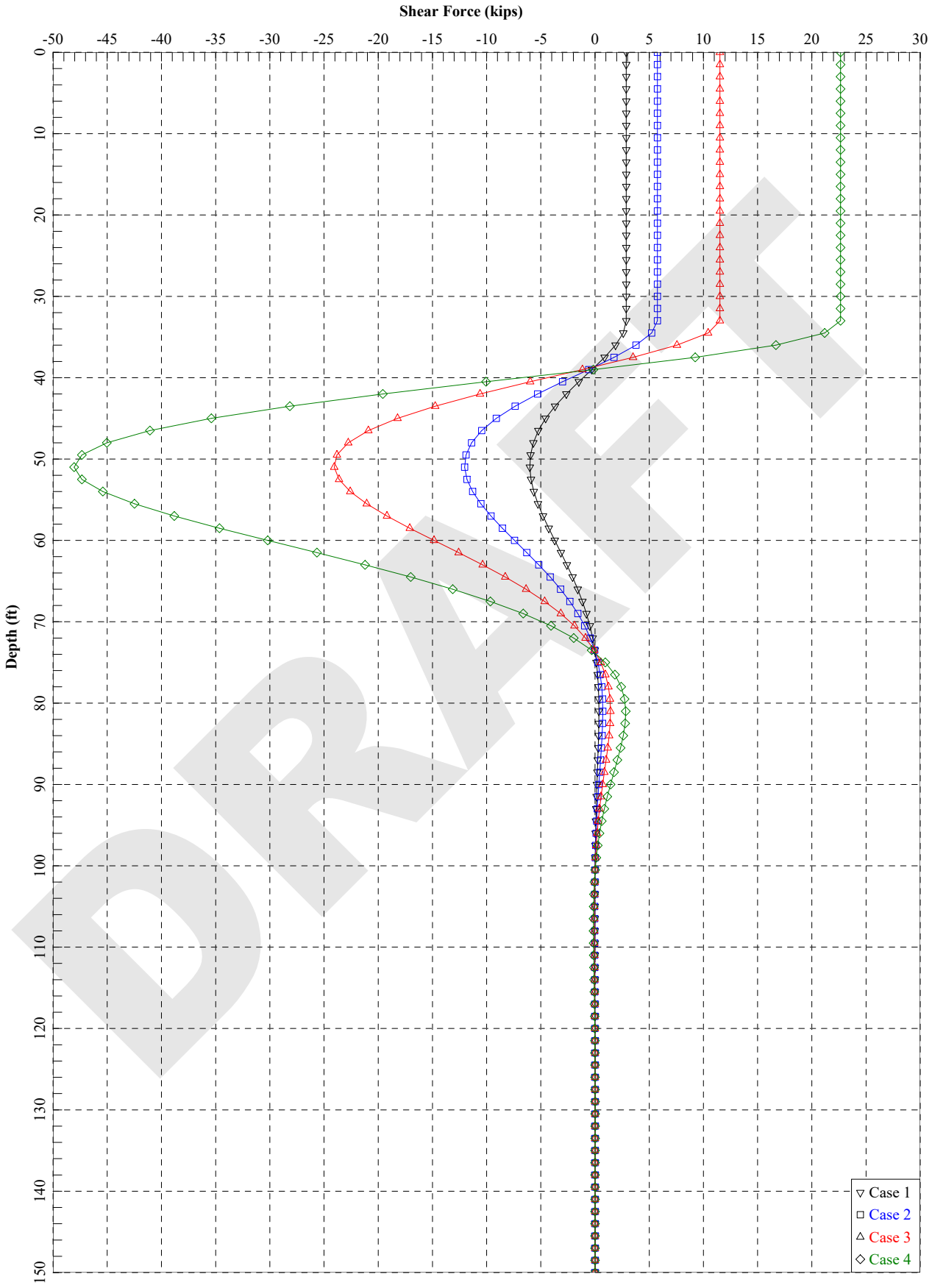
Definitions of Pile-head Loading Conditions:

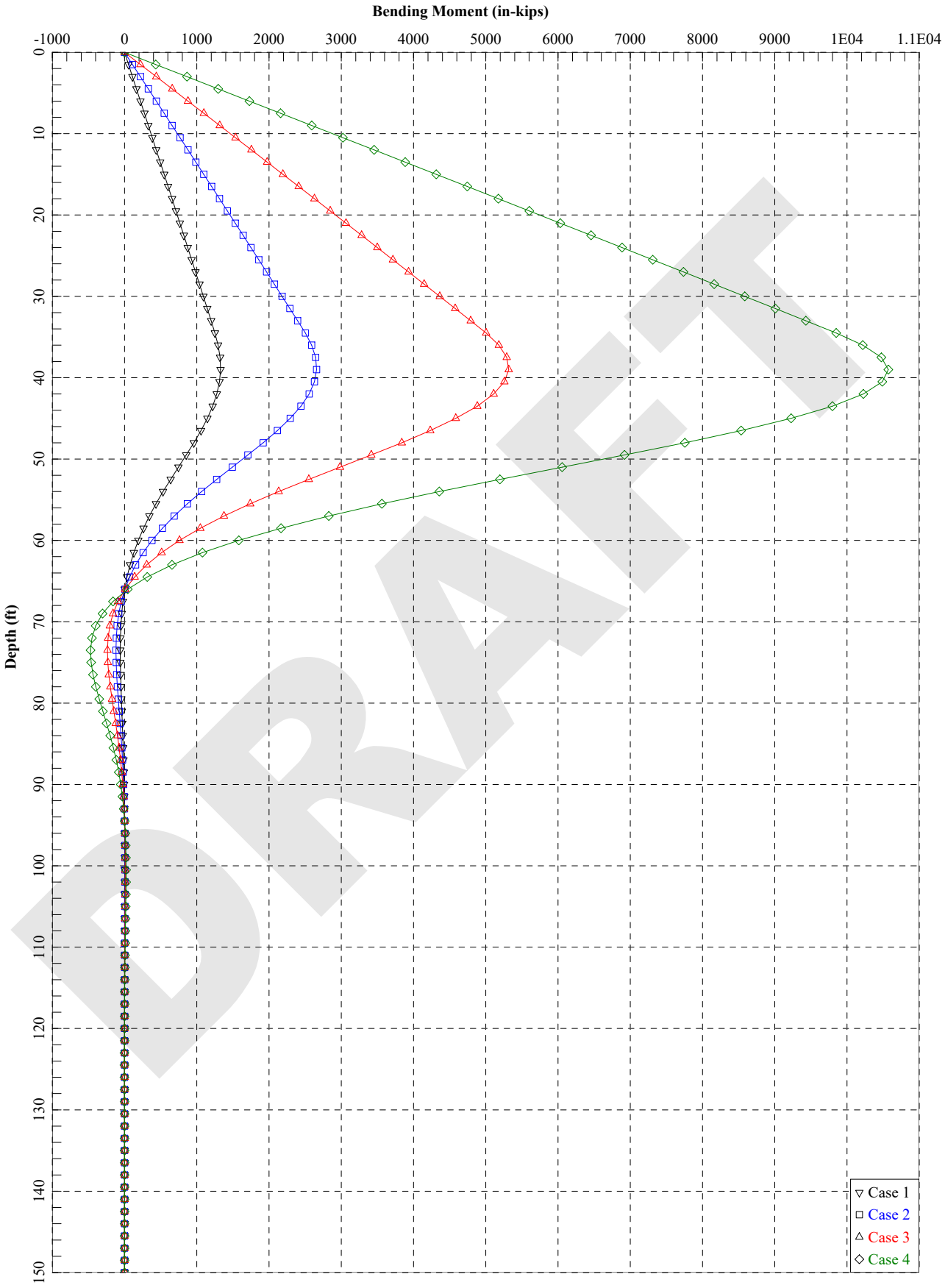
Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

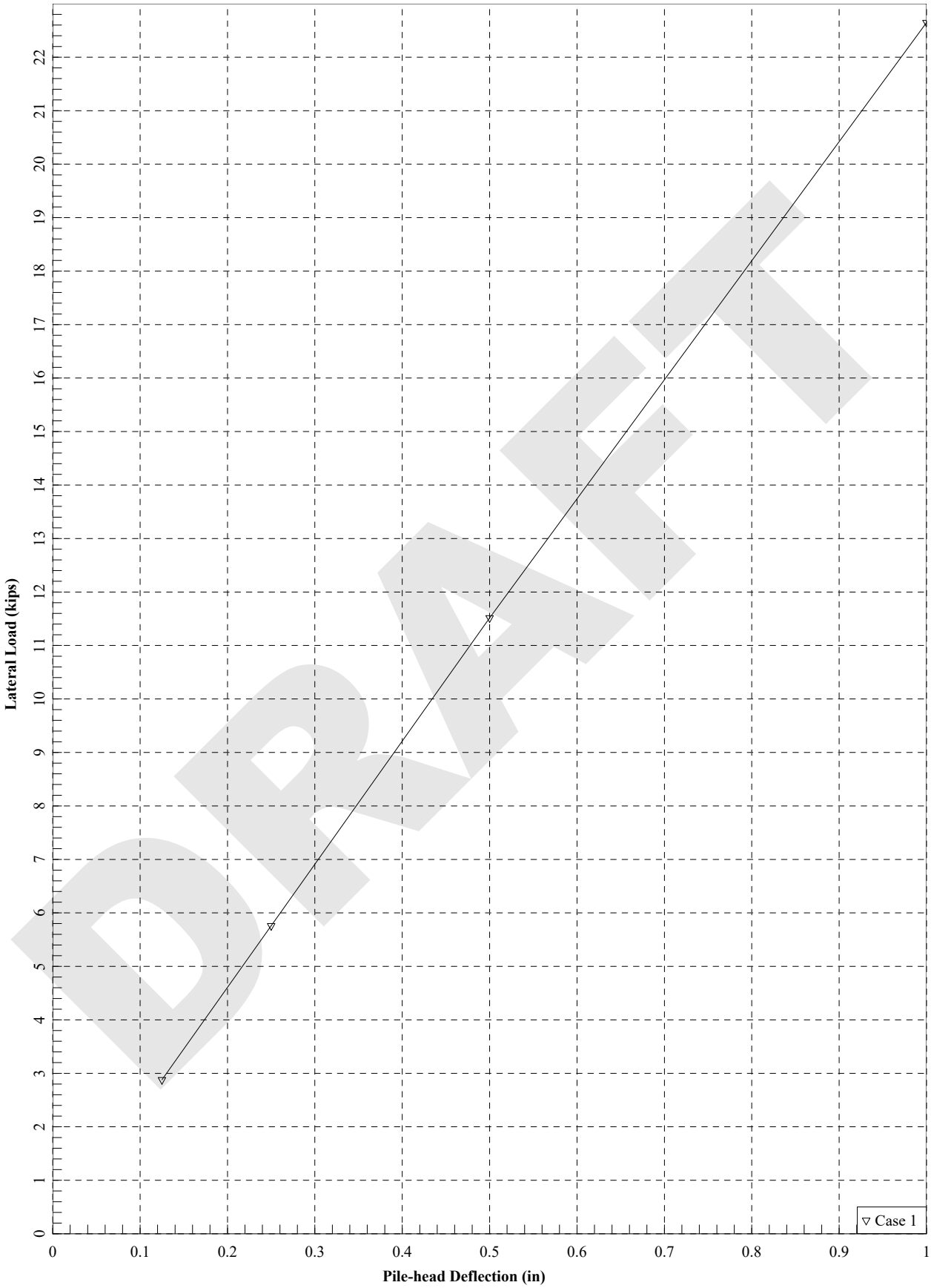
Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	4	y = 0.1250	M = 0.000	552000.	0.12500000	1329202.	-6014.9953	-0.00031083
2	4	y = 0.2500	M = 0.000	552000.	0.25000000	2658405.	-12030.	-0.00062166
3	4	y = 0.5000	M = 0.000	552000.	0.50000000	5316809.	-24060.	-0.00124333
4	4	y = 1.0000	M = 0.000	552000.	1.00000000	10571801.	-48055.	-0.00247427

The analysis ended normally.


Lateral Pile Deflection (inches)
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Shear Force (kips)
-50
-45
-40
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Bending Moment (in-kips)
-1000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E04
1.1E04
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Lateral Load (kips)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pile-head Deflection (in)
▽ Case 1

```
================================================================================

                  LPile Plus for Windows, Version 2013-07.007

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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================================================================================

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--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        P:\Four Hole Swamp\LPILE\2016-03-02\
Name of input data file:       FHS_4-1.5OEP_NWZ_deepscour_load_type_5.lp7d
Name of output report file:    FHS_4-1.5OEP_NWZ_deepscour_load_type_5.lp7o
Name of plot output file:      FHS_4-1.5OEP_NWZ_deepscour_load_type_5.lp7p
Name of runtime messeage file: FHS_4-1.5OEP_NWZ_deepscour_load_type_5.lp7r


--------------------------------------------------------------------------------
                          Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  March 2, 2016     Time:  16:48:18


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Project Name: US 301 RBO Four Hole Swamp


Job Number: 41503-0002-0001


Client: SCDOT


Engineer: Gabriel Burnworth


Description: 48" OEP (1.5" walls) Weak Zone, 83' scour elev., Fixed Head



--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
```

```
 - Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed                =          500
- Deflection tolerance for convergence                =   1.0000E-05 in
- Maximum allowable deflection                        =     100.0000 in
- Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
 - Compute pile response under loading and nonlinear bending properties of pile
   (only if nonlinear pile properties are input)
 - Use of p-y modification factors for p-y curves not selected
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - No p-y curves to be computed and reported for user-specified depths
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1


---------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Total number of pile sections                        =         1

Total length of pile                                 =     150.00 ft

Depth of ground surface below top of pile            =      33.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile.

Point         Depth              Pile
                X              Diameter
                ft                in
-----       ---------        -----------
  1          0.00000         48.0000000
  2        150.000000        48.0000000


Input Structural Properties:
----------------------------

Pile Section No. 1:

   Section Type                                      = Steel Pipe Pile
   Section Length                                    =    150.00000 ft
   Pile Diameter                                     =     48.00000 in


---------------------------------------------------------------------------
                      Ground Slope and Pile Batter Angles
---------------------------------------------------------------------------

Ground Slope Angle                                   =        0.000 degrees
                                                     =        0.000 radians
```

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	33.00000 ft
Distance from top of pile to bottom of layer	=	63.00000 ft
Effective unit weight at top of layer	=	57.60000 pcf
Effective unit weight at bottom of layer	=	57.60000 pcf
Friction angle at top of layer	=	36.00000 deg.
Friction angle at bottom of layer	=	36.00000 deg.
Subgrade k at top of layer	=	0.0000 pci
Subgrade k at bottom of layer	=	0.0000 pci

NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	63.00000 ft
Distance from top of pile to bottom of layer	=	86.00000 ft
Effective unit weight at top of layer	=	57.60000 pcf
Effective unit weight at bottom of layer	=	57.60000 pcf
Friction angle at top of layer	=	36.00000 deg.
Friction angle at bottom of layer	=	36.00000 deg.
Subgrade k at top of layer	=	0.0000 pci
Subgrade k at bottom of layer	=	0.0000 pci

NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	86.00000 ft
Distance from top of pile to bottom of layer	=	108.00000 ft
Effective unit weight at top of layer	=	57.60000 pcf
Effective unit weight at bottom of layer	=	57.60000 pcf
Friction angle at top of layer	=	36.00000 deg.
Friction angle at bottom of layer	=	36.00000 deg.
Subgrade k at top of layer	=	0.0000 pci
Subgrade k at bottom of layer	=	0.0000 pci

NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	108.00000 ft
Distance from top of pile to bottom of layer	=	206.00000 ft
Effective unit weight at top of layer	=	57.60000 pcf
Effective unit weight at bottom of layer	=	57.60000 pcf
Friction angle at top of layer	=	36.00000 deg.
Friction angle at bottom of layer	=	36.00000 deg.
Subgrade k at top of layer	=	0.0000 pci
Subgrade k at bottom of layer	=	0.0000 pci

NOTE: Internal default values for subgrade k will be computed for this soil layer.

(Depth of lowest soil layer extends 56.00 ft below pile tip)

Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	kpy pci
1	Sand (Reese, et al.)	33.000	57.600	36.000	default
		63.000	57.600	36.000	default
2	Sand (Reese, et al.)	63.000	57.600	36.000	default
		86.000	57.600	36.000	default
3	Sand (Reese, et al.)	86.000	57.600	36.000	default
		108.000	57.600	36.000	default
4	Sand (Reese, et al.)	108.000	57.600	36.000	default
		206.000	57.600	36.000	default

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	5	y = 0.12500 in	S = 0.0000 in/in	552000.	No
2	5	y = 0.25000 in	S = 0.0000 in/in	552000.	No
3	5	y = 0.50000 in	S = 0.0000 in/in	552000.	No
4	5	y = 1.00000 in	S = 0.0000 in/in	552000.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel Pipe Pile:

Length of Section	=	150.00000 ft
Outer Diameter of Pipe	=	48.00000 in
Pipe Wall Thickness	=	1.50000 in
Yield Stress of Pipe	=	36.00000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	219.12609 sq. in.

Moment of Inertia = 59287. in^4
Elastic Bending Stiffness = 1.7193E+09 kip-in^2
Plastic Modulus, Z = 3244.50000 in^3
Plastic Moment Capacity = Fy Z = 116802. in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As = 7888.539 kips
Nominal Axial Tensile Capacity = -7888.539 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	552.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 552.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.000001054	1811.9939796	1719329760.	106.4231912	3.2452738	
0.000002108	3623.9879591	1719329760.	65.2115956	3.9714500	
0.000003162	5435.9819387	1719329760.	51.4743971	4.6976261	
0.000004216	7247.9759182	1719329760.	44.6057978	5.4238024	
0.000005269	9059.9698978	1719329760.	40.4846382	6.1499785	
0.000006323	10872.	1719329760.	37.7371985	6.8761547	
0.000007377	12684.	1719329760.	35.7747416	7.6023309	
0.000008431	14496.	1719329760.	34.3028989	8.3285071	
0.000009485	16308.	1719329760.	33.1581324	9.0546833	
0.0000105	18120.	1719329760.	32.2423191	9.7808595	
0.0000116	19932.	1719329760.	31.4930174	10.5070357	
0.0000126	21744.	1719329760.	30.8685993	11.2332119	
0.0000137	23556.	1719329760.	30.3402455	11.9593881	
0.0000148	25368.	1719329760.	29.8873708	12.6855643	
0.0000158	27180.	1719329760.	29.4948794	13.4117405	
0.0000169	28992.	1719329760.	29.1514494	14.1379167	
0.0000179	30804.	1719329760.	28.8484230	14.8640929	
0.0000190	32616.	1719329760.	28.5790662	15.5902690	
0.0000200	34428.	1719329760.	28.3380627	16.3164452	
0.0000211	36240.	1719329760.	28.1211596	17.0426214	
0.0000221	38052.	1719329760.	27.9249139	17.7687976	
0.0000232	39864.	1719329760.	27.7465087	18.4949738	
0.0000242	41676.	1719329760.	27.5836170	19.2211500	
0.0000253	43488.	1719329760.	27.4342996	19.9473262	
0.0000263	45300.	1719329760.	27.2969276	20.6735024	
0.0000274	47112.	1719329760.	27.1701227	21.3996786	
0.0000285	48924.	1719329760.	27.0527108	22.1258548	
0.0000295	50736.	1719329760.	26.9436854	22.8520310	
0.0000306	52548.	1719329760.	26.8421790	23.5782071	
0.0000316	54360.	1719329760.	26.7474397	24.3043833	
0.0000327	56172.	1719329760.	26.6588126	25.0305595	
0.0000337	57984.	1719329760.	26.5757247	25.7567357	
0.0000348	59796.	1719329760.	26.4976725	26.4829119	
0.0000358	61608.	1719329760.	26.4242115	27.2090881	
0.0000369	63420.	1719329760.	26.3549483	27.9352643	
0.0000379	65232.	1719329760.	26.2895331	28.6614405	

0.0000390	67044.	1719329760.	26.2276538	29.3876167	
0.0000400	68856.	1719329760.	26.1690313	30.1137929	
0.0000411	70668.	1719329760.	26.1134152	30.8399691	
0.0000432	74292.	1719329760.	26.0103217	32.2923214	
0.0000453	77916.	1719329760.	25.9168184	33.7446738	
0.0000474	81540.	1719329760.	25.8316265	35.1970262	
0.0000495	85116.	1718362204.	25.7600931	36.0000000	Y
0.0000516	88307.	1710016821.	25.7450077	36.0000000	Y
0.0000537	91055.	1694080982.	25.7890002	36.0000000	Y
0.0000559	93523.	1674351216.	25.8662156	36.0000000	Y
0.0000580	95738.	1651681538.	25.9596148	36.0000000	Y
0.0000601	97623.	1625104154.	26.0427887	36.0000000	Y
0.0000622	99187.	1595157458.	26.1020741	36.0000000	Y
0.0000643	100520.	1563590959.	26.1477997	36.0000000	Y
0.0000664	101682.	1531456607.	26.1850574	36.0000000	Y
0.0000685	102694.	1499106584.	26.2156802	36.0000000	Y
0.0000706	103596.	1467136166.	26.2418156	36.0000000	Y
0.0000727	104405.	1435730900.	26.2645753	36.0000000	Y
0.0000748	105133.	1405018933.	26.2847462	36.0000000	Y
0.0000769	105792.	1375089517.	26.3029308	36.0000000	Y
0.0000790	106389.	1345978545.	26.3190684	36.0000000	Y
0.0000811	106931.	1317694704.	26.3327277	36.0000000	Y
0.0000833	107428.	1290308271.	26.3451305	36.0000000	Y
0.0000854	107888.	1263831958.	26.3565441	36.0000000	Y
0.0000875	108312.	1238223529.	26.3683587	36.0000000	Y
0.0000896	108694.	1213357023.	26.3774987	36.0000000	Y
0.0000917	109054.	1189386837.	26.3862330	36.0000000	Y
0.0000938	109391.	1166251589.	26.3947955	36.0000000	Y
0.0000959	109694.	1143784328.	26.4021331	36.0000000	Y
0.0000980	109986.	1122168893.	26.4094502	36.0000000	Y
0.0001001	110251.	1101186709.	26.4155900	36.0000000	Y
0.0001022	110504.	1080953128.	26.4221100	36.0000000	Y
0.0001043	110737.	1061349948.	26.4271609	36.0000000	Y
0.0001064	110958.	1042412273.	26.4331747	36.0000000	Y
0.0001086	111162.	1024055458.	26.4372983	36.0000000	Y
0.0001107	111360.	1006332490.	26.4430476	36.0000000	Y
0.0001128	111538.	989106469.	26.4463756	36.0000000	Y
0.0001149	111715.	972490789.	26.4505626	36.0000000	Y
0.0001170	111873.	956324994.	26.4547068	36.0000000	Y
0.0001191	112028.	940701885.	26.4572535	36.0000000	Y
0.0001212	112175.	925549270.	26.4625617	36.0000000	Y
0.0001233	112309.	910814943.	26.4645327	36.0000000	Y
0.0001254	112442.	896572199.	26.4666389	36.0000000	Y
0.0001338	112900.	843517796.	26.4797710	36.0000000	Y
0.0001423	113275.	796164739.	26.4878891	36.0000000	Y
0.0001507	113588.	753702530.	26.4950904	36.0000000	Y
0.0001591	113853.	715434459.	26.5018328	36.0000000	Y
0.0001676	114076.	680768908.	26.5058505	36.0000000	Y
0.0001760	114269.	649250909.	26.5078046	36.0000000	Y
0.0001844	114433.	620460993.	26.5135095	36.0000000	Y
0.0001929	114577.	594085861.	26.5174169	36.0000000	Y
0.0002013	114703.	569829556.	26.5179765	36.0000000	Y
0.0002097	114814.	547451379.	26.5235253	36.0000000	Y
0.0002182	114912.	526743116.	26.5225624	36.0000000	Y
0.0002266	114999.	507525905.	26.5269002	36.0000000	Y
0.0002350	115077.	489651076.	26.5278306	36.0000000	Y

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip
1	552.000	115077.2

Note that the values in the above table are not factored by a strength

reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.125000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1250	-3455698.	11472.	0.000	3917.9934	1.719E+12	0.000	0.000	0.000
1.500	0.1247	-3249022.	11472.	-3.510E-05	3834.3289	1.719E+12	0.000	0.000	0.000
3.000	0.1237	-3042007.	11472.	-6.803E-05	3750.5277	1.719E+12	0.000	0.000	0.000
4.500	0.1222	-2834676.	11472.	-9.879E-05	3666.5983	1.719E+12	0.000	0.000	0.000
6.000	0.1202	-2627050.	11472.	-0.000127	3582.5495	1.719E+12	0.000	0.000	0.000
7.500	0.1176	-2419151.	11472.	-0.000154	3498.3902	1.719E+12	0.000	0.000	0.000
9.000	0.1146	-2211000.	11472.	-0.000178	3414.1289	1.719E+12	0.000	0.000	0.000
10.500	0.1112	-2002619.	11472.	-0.000200	3329.7746	1.719E+12	0.000	0.000	0.000
12.000	0.1074	-1794030.	11472.	-0.000220	3245.3359	1.719E+12	0.000	0.000	0.000
13.500	0.1033	-1585254.	11472.	-0.000238	3160.8217	1.719E+12	0.000	0.000	0.000
15.000	0.0989	-1376313.	11472.	-0.000253	3076.2408	1.719E+12	0.000	0.000	0.000
16.500	0.0942	-1167229.	11472.	-0.000266	2991.6019	1.719E+12	0.000	0.000	0.000
18.000	0.0893	-958024.	11472.	-0.000278	2906.9138	1.719E+12	0.000	0.000	0.000
19.500	0.0842	-748719.	11472.	-0.000287	2822.1854	1.719E+12	0.000	0.000	0.000
21.000	0.0790	-539336.	11472.	-0.000293	2737.4254	1.719E+12	0.000	0.000	0.000
22.500	0.0736	-329897.	11472.	-0.000298	2652.6428	1.719E+12	0.000	0.000	0.000
24.000	0.0683	-120424.	11472.	-0.000300	2567.8463	1.719E+12	0.000	0.000	0.000
25.500	0.0628	89062.	11472.	-0.000300	2555.1505	1.719E+12	0.000	0.000	0.000
27.000	0.0574	298538.	11472.	-0.000298	2639.9484	1.719E+12	0.000	0.000	0.000
28.500	0.0521	507984.	11472.	-0.000294	2724.7337	1.719E+12	0.000	0.000	0.000
30.000	0.0469	717376.	11472.	-0.000288	2809.4976	1.719E+12	0.000	0.000	0.000
31.500	0.0417	926694.	11472.	-0.000279	2894.2313	1.719E+12	0.000	0.000	0.000
33.000	0.0368	1135916.	11472.	-0.000268	2978.9259	1.719E+12	0.000	0.000	0.000
34.500	0.0321	1345019.	10970.	-0.000255	3063.5728	1.719E+12	-55.7791	31290.	0.000
36.000	0.0276	1535910.	9603.8217	-0.000240	3140.8471	1.719E+12	-96.0230	62580.	0.000
37.500	0.0234	1695530.	7639.4450	-0.000223	3205.4626	1.719E+12	-122.2411	93870.	0.000
39.000	0.0196	1815368.	5313.9088	-0.000205	3253.9738	1.719E+12	-136.1518	125160.	0.000
40.500	0.0161	1890903.	2831.9812	-0.000186	3284.5511	1.719E+12	-139.6179	156450.	0.000
42.000	0.0129	1921006.	364.2744	-0.000166	3296.7368	1.719E+12	-134.5717	187740.	0.000
43.500	0.0101	1907307.	-1953.3375	-0.000146	3291.1915	1.719E+12	-122.9407	219030.	0.000
45.000	0.007664	1853577.	-4018.9939	-0.000126	3269.4412	1.719E+12	-106.5767	250321.	0.000
46.500	0.005573	1765124.	-5762.9458	-0.000107	3233.6345	1.719E+12	-87.1957	281611.	0.000
48.000	0.003816	1648235.	-7144.6744	-8.902E-05	3186.3171	1.719E+12	-66.3297	312901.	0.000
49.500	0.002369	1509684.	-8149.2688	-7.249E-05	3130.2306	1.719E+12	-45.2919	344191.	0.000
51.000	0.001206	1356302.	-8783.3158	-5.749E-05	3068.1401	1.719E+12	-25.1577	375481.	0.000
52.500	0.000299	1194627.	-9070.5525	-4.414E-05	3002.6929	1.719E+12	-6.7575	406771.	0.000
54.000	-0.000383	1030639.	-9047.5131	-3.249E-05	2936.3090	1.719E+12	9.3174	438061.	0.000
55.500	-0.000871	869563.	-8759.3686	-2.254E-05	2871.1038	1.719E+12	22.6987	469351.	0.000
57.000	-0.001194	715750.	-8256.1214	-1.424E-05	2808.8392	1.719E+12	33.2177	500641.	0.000
58.500	-0.001383	572625.	-7589.2733	-7.498E-06	2750.9011	1.719E+12	40.8765	531931.	0.000

60.000	-0.001464	442685.	-6809.0433	-2.183E-06	2698.3002	1.719E+12	45.8157	563221.	0.000
61.500	-0.001462	327543.	-5962.1715	1.849E-06	2651.6898	1.719E+12	48.2812	594511.	0.000
63.000	-0.001398	228010.	-5091.1947	4.757E-06	2611.3980	1.719E+12	48.4940	624535.	0.000
64.500	-0.001291	144165.	-4231.5579	6.705E-06	2577.4570	1.719E+12	47.0212	655825.	0.000
66.000	-0.001156	75541.	-3411.1175	7.855E-06	2549.6771	1.719E+12	44.1389	687116.	0.000
67.500	-0.001008	21209.	-2651.8732	8.362E-06	2527.6832	1.719E+12	40.2216	718406.	0.000
69.000	-0.000855	-20093.	-1969.2850	8.367E-06	2527.2314	1.719E+12	35.6215	749696.	0.000
70.500	-0.000707	-49851.	-1372.7915	8.001E-06	2539.2779	1.719E+12	30.6555	780986.	0.000
72.000	-0.000567	-69672.	-866.5242	7.376E-06	2547.3016	1.719E+12	25.5964	812276.	0.000
73.500	-0.000441	-81193.	-450.1430	6.586E-06	2551.9651	1.719E+12	20.6682	843566.	0.000
75.000	-0.000330	-86008.	-119.7256	5.711E-06	2553.9145	1.719E+12	16.0449	874856.	0.000
76.500	-0.000235	-85616.	131.3456	4.812E-06	2553.7559	1.719E+12	11.8519	906146.	0.000
78.000	-0.000157	-81376.	311.5432	3.938E-06	2552.0391	1.719E+12	8.1700	937436.	0.000
79.500	-9.365E-05	-74479.	430.4365	3.122E-06	2549.2474	1.719E+12	5.0403	968726.	0.000
81.000	-4.447E-05	-65942.	498.0346	2.387E-06	2545.7914	1.719E+12	2.4706	1000016.	0.000
82.500	-7.711E-06	-56597.	524.2459	1.746E-06	2542.0087	1.719E+12	0.4418	1031306.	0.000
84.000	1.838E-05	-47104.	518.4555	1.203E-06	2538.1656	1.719E+12	-1.0852	1062596.	0.000
85.500	3.560E-05	-37957.	489.2182	7.578E-07	2534.4628	1.719E+12	-2.1634	1093886.	0.000
87.000	4.566E-05	-29507.	444.0588	4.047E-07	2531.0423	1.719E+12	-2.8543	1125139.	0.000
88.500	5.017E-05	-21979.	389.3629	1.351E-07	2527.9948	1.719E+12	-3.2230	1156429.	0.000
90.000	5.053E-05	-15493.	330.3490	-6.100E-08	2525.3691	1.719E+12	-3.3341	1187719.	0.000
91.500	4.797E-05	-10085.	271.1039	-1.949E-07	2523.1801	1.719E+12	-3.2487	1219009.	0.000
93.000	4.351E-05	-5728.9575	214.6638	-2.777E-07	2521.4167	1.719E+12	-3.0224	1250299.	0.000
94.500	3.797E-05	-2351.5849	163.1281	-3.200E-07	2520.0495	1.719E+12	-2.7038	1281589.	0.000
96.000	3.199E-05	150.0118	117.7923	-3.315E-07	2519.1583	1.719E+12	-2.3335	1312879.	0.000
97.500	2.604E-05	1895.5259	79.2888	-3.208E-07	2519.8649	1.719E+12	-1.9446	1344169.	0.000
99.000	2.045E-05	3010.7828	47.7262	-2.951E-07	2520.3164	1.719E+12	-1.5623	1375459.	0.000
100.500	1.542E-05	3619.5350	22.8213	-2.604E-07	2520.5628	1.719E+12	-1.2049	1406749.	0.000
102.000	1.107E-05	3837.5242	4.0169	-2.214E-07	2520.6511	1.719E+12	-0.8845	1438039.	0.000
103.500	7.448E-06	3768.5410	-9.4155	-1.815E-07	2520.6231	1.719E+12	-0.6080	1469329.	0.000
105.000	4.536E-06	3502.1753	-18.2905	-1.435E-07	2520.5153	1.719E+12	-0.3781	1500620.	0.000
106.500	2.283E-06	3112.9362	-23.4420	-1.089E-07	2520.3577	1.719E+12	-0.1943	1531910.	0.000
108.000	6.166E-07	2660.4281	-25.6681	-7.864E-08	2520.1746	1.719E+12	-0.0531	1549327.	0.000
109.500	-5.482E-07	2190.4479	-25.7125	-5.325E-08	2519.9843	1.719E+12	0.0481	1580618.	0.000
111.000	-1.300E-06	1735.8371	-24.2313	-3.269E-08	2519.8003	1.719E+12	0.1164	1611908.	0.000
112.500	-1.725E-06	1318.7710	-21.7660	-1.670E-08	2519.6314	1.719E+12	0.1575	1643198.	0.000
114.000	-1.902E-06	952.5933	-18.7566	-4.813E-09	2519.4832	1.719E+12	0.1769	1674488.	0.000
115.500	-1.898E-06	643.6303	-15.5454	3.542E-09	2519.3581	1.719E+12	0.1799	1705778.	0.000
117.000	-1.774E-06	392.8893	-12.3854	8.968E-09	2519.2566	1.719E+12	0.1712	1737068.	0.000
118.500	-1.576E-06	197.5759	-9.4516	1.206E-08	2519.1776	1.719E+12	0.1548	1768358.	0.000
120.000	-1.340E-06	52.3929	-6.8528	1.337E-08	2519.1188	1.719E+12	0.1340	1799648.	0.000
121.500	-1.094E-06	-49.3917	-4.6453	1.338E-08	2519.1176	1.719E+12	0.1113	1830938.	0.000
123.000	-8.581E-07	-115.1053	-2.8445	1.252E-08	2519.1442	1.719E+12	0.0888	1862228.	0.000
124.500	-6.435E-07	-152.0435	-1.4363	1.112E-08	2519.1591	1.719E+12	0.0677	1893518.	0.000
126.000	-4.576E-07	-167.0318	-0.3866	9.453E-09	2519.1652	1.719E+12	0.0489	1924808.	0.000
127.500	-3.032E-07	-166.1472	0.3504	7.709E-09	2519.1649	1.719E+12	0.0330	1956098.	0.000
129.000	-1.801E-07	-154.5690	0.8260	6.031E-09	2519.1602	1.719E+12	0.0199	1987388.	0.000
130.500	-8.612E-08	-136.5319	1.0919	4.507E-09	2519.1529	1.719E+12	0.009658	2018678.	0.000
132.000	-1.786E-08	-115.3516	1.1971	3.188E-09	2519.1443	1.719E+12	0.002034	2049969.	0.000
133.500	2.866E-08	-93.5002	1.1856	2.095E-09	2519.1354	1.719E+12	-0.003314	2081259.	0.000
135.000	5.756E-08	-72.7129	1.0949	1.225E-09	2519.1270	1.719E+12	-0.006756	2112549.	0.000
136.500	7.276E-08	-54.1068	0.9561	5.611E-10	2519.1195	1.719E+12	-0.008666	2143839.	0.000
138.000	7.776E-08	-38.3029	0.7936	7.738E-11	2519.1131	1.719E+12	-0.009397	2175129.	0.000
139.500	7.555E-08	-25.5395	0.6257	-2.568E-10	2519.1079	1.719E+12	-0.009260	2206419.	0.000
141.000	6.852E-08	-15.7739	0.4657	-4.731E-10	2519.1040	1.719E+12	-0.008518	2237709.	0.000
142.500	5.852E-08	-8.7663	0.3226	-6.015E-10	2519.1011	1.719E+12	-0.007376	2268999.	0.000
144.000	4.686E-08	-4.1477	0.2023	-6.691E-10	2519.0993	1.719E+12	-0.005989	2300289.	0.000
145.500	3.443E-08	-1.4690	0.1083	-6.985E-10	2519.0982	1.719E+12	-0.004459	2331579.	0.000
147.000	2.171E-08	-0.2349	0.0425	-7.074E-10	2519.0977	1.719E+12	-0.002850	2362869.	0.000
148.500	8.958E-09	0.0756	0.006135	-7.083E-10	2519.0976	1.719E+12	-0.001192	2394159.	0.000
150.000	-3.784E-09	0.000	0.000	-7.079E-10	2519.0976	1.719E+12	0.000510	1212725.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
Values of total stress due to combined axial and bending stresses are computed only
for elastic sections only and do not equal the actual stresses in concrete and steel.
Stresses in concrete and steel may be interpolated from the output for nonlinear
bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =      0.1250000 inches
Computed slope at pile head      =   -0.000001082 radians
Maximum bending moment           =      -3455698. inch-lbs
Maximum shear force              =         11472. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =       0.000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.250000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2500	-6911397.	22944.	0.000	5316.8892	1.719E+12	0.000	0.000	0.000
1.500	0.2493	-6498043.	22944.	-7.019E-05	5149.5603	1.719E+12	0.000	0.000	0.000
3.000	0.2475	-6084014.	22944.	-0.000136	4981.9577	1.719E+12	0.000	0.000	0.000
4.500	0.2445	-5669352.	22944.	-0.000198	4814.0990	1.719E+12	0.000	0.000	0.000
6.000	0.2404	-5254100.	22944.	-0.000255	4646.0015	1.719E+12	0.000	0.000	0.000
7.500	0.2353	-4838301.	22944.	-0.000308	4477.6828	1.719E+12	0.000	0.000	0.000
9.000	0.2293	-4422000.	22944.	-0.000356	4309.1603	1.719E+12	0.000	0.000	0.000
10.500	0.2225	-4005238.	22944.	-0.000400	4140.4516	1.719E+12	0.000	0.000	0.000
12.000	0.2149	-3588059.	22944.	-0.000440	3971.5743	1.719E+12	0.000	0.000	0.000
13.500	0.2066	-3170508.	22944.	-0.000475	3802.5459	1.719E+12	0.000	0.000	0.000
15.000	0.1978	-2752626.	22944.	-0.000506	3633.3840	1.719E+12	0.000	0.000	0.000
16.500	0.1884	-2334459.	22944.	-0.000533	3464.1061	1.719E+12	0.000	0.000	0.000
18.000	0.1786	-1916048.	22944.	-0.000555	3294.7300	1.719E+12	0.000	0.000	0.000
19.500	0.1684	-1497438.	22944.	-0.000573	3125.2732	1.719E+12	0.000	0.000	0.000
21.000	0.1580	-1078672.	22944.	-0.000587	2955.7533	1.719E+12	0.000	0.000	0.000
22.500	0.1473	-659795.	22944.	-0.000596	2786.1880	1.719E+12	0.000	0.000	0.000
24.000	0.1365	-240848.	22944.	-0.000600	2616.5949	1.719E+12	0.000	0.000	0.000
25.500	0.1257	178123.	22944.	-0.000601	2591.2035	1.719E+12	0.000	0.000	0.000
27.000	0.1149	597077.	22944.	-0.000597	2760.7992	1.719E+12	0.000	0.000	0.000
28.500	0.1042	1015967.	22944.	-0.000588	2930.3698	1.719E+12	0.000	0.000	0.000
30.000	0.0937	1434753.	22944.	-0.000575	3099.8976	1.719E+12	0.000	0.000	0.000
31.500	0.0835	1853389.	22944.	-0.000558	3269.3650	1.719E+12	0.000	0.000	0.000
33.000	0.0736	2271832.	22944.	-0.000537	3438.7543	1.719E+12	0.000	0.000	0.000
34.500	0.0642	2690039.	21940.	-0.000511	3608.0480	1.719E+12	-111.5583	31290.	0.000
36.000	0.0552	3071821.	19208.	-0.000480	3762.5966	1.719E+12	-192.0460	62580.	0.000
37.500	0.0469	3391061.	15279.	-0.000447	3891.8275	1.719E+12	-244.4821	93870.	0.000
39.000	0.0392	3630735.	10628.	-0.000410	3988.8499	1.719E+12	-272.3037	125160.	0.000
40.500	0.0321	3781806.	5663.9624	-0.000371	4050.0046	1.719E+12	-279.2358	156450.	0.000
42.000	0.0258	3842011.	728.5489	-0.000331	4074.3761	1.719E+12	-269.1435	187740.	0.000
43.500	0.0202	3814614.	-3906.6750	-0.000291	4063.2854	1.719E+12	-245.8814	219030.	0.000
45.000	0.0153	3707154.	-8037.9879	-0.000252	4019.7849	1.719E+12	-213.1534	250321.	0.000
46.500	0.0111	3530247.	-11526.	-0.000214	3948.1715	1.719E+12	-174.3915	281611.	0.000
48.000	0.007631	3296470.	-14289.	-0.000178	3853.5366	1.719E+12	-132.6593	312901.	0.000
49.500	0.004737	3019369.	-16299.	-0.000145	3741.3635	1.719E+12	-90.5839	344191.	0.000
51.000	0.002412	2712604.	-17567.	-0.000115	3617.1826	1.719E+12	-50.3155	375481.	0.000
52.500	0.000598	2389255.	-18141.	-8.827E-05	3486.2881	1.719E+12	-13.5149	406771.	0.000
54.000	-0.000766	2061278.	-18095.	-6.497E-05	3353.5205	1.719E+12	18.6348	438061.	0.000
55.500	-0.001741	1739125.	-17519.	-4.508E-05	3223.1101	1.719E+12	45.3973	469351.	0.000
57.000	-0.002389	1431500.	-16512.	-2.848E-05	3098.5807	1.719E+12	66.4354	500641.	0.000
58.500	-0.002766	1145250.	-15179.	-1.500E-05	2982.7046	1.719E+12	81.7531	531931.	0.000

60.000	-0.002928	885370.	-13618.	-4.366E-06	2877.5028	1.719E+12	91.6314	563221.	0.000
61.500	-0.002924	655086.	-11924.	3.698E-06	2784.2819	1.719E+12	96.5624	594511.	0.000
63.000	-0.002795	456020.	-10182.	9.514E-06	2703.6984	1.719E+12	96.9881	624535.	0.000
64.500	-0.002581	288331.	-8463.1158	1.341E-05	2635.8164	1.719E+12	94.0423	655825.	0.000
66.000	-0.002313	151081.	-6822.2349	1.571E-05	2580.2567	1.719E+12	88.2778	687116.	0.000
67.500	-0.002016	42418.	-5303.7463	1.672E-05	2536.2689	1.719E+12	80.4432	718406.	0.000
69.000	-0.001711	-40186.	-3938.5700	1.673E-05	2535.3651	1.719E+12	71.2431	749696.	0.000
70.500	-0.001413	-99703.	-2745.5830	1.600E-05	2559.4581	1.719E+12	61.3111	780986.	0.000
72.000	-0.001134	-139345.	-1733.0484	1.475E-05	2575.5055	1.719E+12	51.1928	812276.	0.000
73.500	-0.000882	-162386.	-900.2859	1.317E-05	2584.8327	1.719E+12	41.3364	843566.	0.000
75.000	-0.000660	-172017.	-239.4511	1.142E-05	2588.7314	1.719E+12	32.0897	874856.	0.000
76.500	-0.000471	-171233.	262.6911	9.625E-06	2588.4141	1.719E+12	23.7038	906146.	0.000
78.000	-0.000314	-162751.	623.0864	7.876E-06	2584.9806	1.719E+12	16.3401	937436.	0.000
79.500	-0.000187	-148958.	860.8729	6.245E-06	2579.3972	1.719E+12	10.0807	968726.	0.000
81.000	-8.894E-05	-131884.	996.0692	4.775E-06	2572.4853	1.719E+12	4.9412	1000016.	0.000
82.500	-1.542E-05	-113195.	1048.4918	3.492E-06	2564.9198	1.719E+12	0.8836	1031306.	0.000
84.000	3.676E-05	-94207.	1036.9110	2.406E-06	2557.2336	1.719E+12	-2.1703	1062596.	0.000
85.500	7.120E-05	-75914.	978.4364	1.516E-06	2549.8281	1.719E+12	-4.3268	1093886.	0.000
87.000	9.133E-05	-59014.	888.1175	8.093E-07	2542.9869	1.719E+12	-5.7086	1125139.	0.000
88.500	0.000100	-43958.	778.7258	2.703E-07	2536.8920	1.719E+12	-6.4460	1156429.	0.000
90.000	0.000101	-30985.	660.6980	-1.220E-07	2531.6406	1.719E+12	-6.6682	1187719.	0.000
91.500	9.594E-05	-20170.	542.2077	-3.898E-07	2527.2626	1.719E+12	-6.4974	1219009.	0.000
93.000	8.702E-05	-11458.	429.3275	-5.553E-07	2523.7359	1.719E+12	-6.0448	1250299.	0.000
94.500	7.595E-05	-4703.1697	326.2562	-6.399E-07	2521.0015	1.719E+12	-5.4075	1281589.	0.000
96.000	6.399E-05	300.0236	235.5846	-6.630E-07	2519.2190	1.719E+12	-4.6671	1312879.	0.000
97.500	5.208E-05	3791.0518	158.5776	-6.416E-07	2520.6322	1.719E+12	-3.8893	1344169.	0.000
99.000	4.089E-05	6021.5656	95.4525	-5.902E-07	2521.5352	1.719E+12	-3.1246	1375459.	0.000
100.500	3.083E-05	7239.0700	45.6426	-5.208E-07	2522.0280	1.719E+12	-2.4098	1406749.	0.000
102.000	2.214E-05	7675.0484	8.0337	-4.427E-07	2522.2045	1.719E+12	-1.7690	1438039.	0.000
103.500	1.490E-05	7537.0820	-18.8309	-3.631E-07	2522.1487	1.719E+12	-1.2160	1469329.	0.000
105.000	9.071E-06	7004.3507	-36.5809	-2.870E-07	2521.9330	1.719E+12	-0.7562	1500620.	0.000
106.500	4.565E-06	6225.8723	-46.8839	-2.177E-07	2521.6179	1.719E+12	-0.3885	1531910.	0.000
108.000	1.233E-06	5320.8562	-51.3362	-1.573E-07	2521.2515	1.719E+12	-0.1061	1549327.	0.000
109.500	-1.096E-06	4380.8958	-51.4250	-1.065E-07	2520.8710	1.719E+12	0.0963	1580618.	0.000
111.000	-2.600E-06	3471.6741	-48.4626	-6.539E-08	2520.5030	1.719E+12	0.2329	1611908.	0.000
112.500	-3.450E-06	2637.5421	-43.5320	-3.341E-08	2520.1653	1.719E+12	0.3150	1643198.	0.000
114.000	-3.803E-06	1905.1866	-37.5131	-9.626E-09	2519.8688	1.719E+12	0.3538	1674488.	0.000
115.500	-3.797E-06	1287.2605	-31.0908	7.085E-09	2519.6187	1.719E+12	0.3598	1705778.	0.000
117.000	-3.548E-06	785.7786	-24.7709	1.794E-08	2519.4157	1.719E+12	0.3424	1737068.	0.000
118.500	-3.151E-06	395.1518	-18.9032	2.412E-08	2519.2576	1.719E+12	0.3096	1768358.	0.000
120.000	-2.680E-06	104.7857	-13.7057	2.673E-08	2519.1400	1.719E+12	0.2679	1799648.	0.000
121.500	-2.189E-06	-98.7835	-9.2907	2.677E-08	2519.1376	1.719E+12	0.2226	1830938.	0.000
123.000	-1.716E-06	-230.2106	-5.6890	2.504E-08	2519.1908	1.719E+12	0.1776	1862228.	0.000
124.500	-1.287E-06	-304.0870	-2.8725	2.225E-08	2519.2207	1.719E+12	0.1354	1893518.	0.000
126.000	-9.153E-07	-334.0637	-0.7731	1.891E-08	2519.2328	1.719E+12	0.0979	1924808.	0.000
127.500	-6.064E-07	-332.2943	0.7009	1.542E-08	2519.2321	1.719E+12	0.0659	1956098.	0.000
129.000	-3.602E-07	-309.1380	1.6519	1.206E-08	2519.2227	1.719E+12	0.0398	1987388.	0.000
130.500	-1.722E-07	-273.0639	2.1837	9.014E-09	2519.2081	1.719E+12	0.0193	2018678.	0.000
132.000	-3.572E-08	-230.7031	2.3942	6.377E-09	2519.1910	1.719E+12	0.004068	2049969.	0.000
133.500	5.732E-08	-187.0004	2.3711	4.190E-09	2519.1733	1.719E+12	-0.006628	2081259.	0.000
135.000	1.151E-07	-145.4258	2.1899	2.450E-09	2519.1565	1.719E+12	-0.0135	2112549.	0.000
136.500	1.455E-07	-108.2137	1.9123	1.122E-09	2519.1414	1.719E+12	-0.0173	2143839.	0.000
138.000	1.555E-07	-76.6058	1.5872	1.548E-10	2519.1286	1.719E+12	-0.0188	2175129.	0.000
139.500	1.511E-07	-51.0791	1.2513	-5.136E-10	2519.1183	1.719E+12	-0.0185	2206419.	0.000
141.000	1.370E-07	-31.5477	0.9313	-9.461E-10	2519.1104	1.719E+12	-0.0170	2237709.	0.000
142.500	1.170E-07	-17.5326	0.6452	-1.203E-09	2519.1047	1.719E+12	-0.0148	2268999.	0.000
144.000	9.372E-08	-8.2954	0.4047	-1.338E-09	2519.1010	1.719E+12	-0.0120	2300289.	0.000
145.500	6.885E-08	-2.9380	0.2166	-1.397E-09	2519.0988	1.719E+12	-0.008919	2331579.	0.000
147.000	4.343E-08	-0.4699	0.0850	-1.415E-09	2519.0978	1.719E+12	-0.005701	2362869.	0.000
148.500	1.792E-08	0.1511	0.0123	-1.417E-09	2519.0977	1.719E+12	-0.002383	2394159.	0.000
150.000	-7.567E-09	0.000	0.000	-1.416E-09	2519.0976	1.719E+12	0.001020	1212725.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection              =      0.2500000 inches
Computed slope at pile head       =   -0.000002164 radians
Maximum bending moment            =      -6911397. inch-lbs
Maximum shear force               =         22944. lbs
Depth of maximum bending moment   =       0.000000 feet below pile head
Depth of maximum shear force      =       0.000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.500000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5000	-13716161.	45325.	0.000	8071.5151	1.719E+12	0.000	0.000	0.000
1.500	0.4987	-12899603.	45325.	-0.000139	7740.9656	1.719E+12	0.000	0.000	0.000
3.000	0.4950	-12081703.	45325.	-0.000270	7409.8729	1.719E+12	0.000	0.000	0.000
4.500	0.4890	-11262547.	45325.	-0.000392	7078.2715	1.719E+12	0.000	0.000	0.000
6.000	0.4809	-10442219.	45325.	-0.000506	6746.1958	1.719E+12	0.000	0.000	0.000
7.500	0.4708	-9620804.	45325.	-0.000611	6413.6804	1.719E+12	0.000	0.000	0.000
9.000	0.4589	-8798389.	45325.	-0.000707	6080.7599	1.719E+12	0.000	0.000	0.000
10.500	0.4453	-7975059.	45325.	-0.000795	5747.4689	1.719E+12	0.000	0.000	0.000
12.000	0.4302	-7150900.	45325.	-0.000874	5413.8420	1.719E+12	0.000	0.000	0.000
13.500	0.4138	-6325996.	45325.	-0.000945	5079.9141	1.719E+12	0.000	0.000	0.000
15.000	0.3962	-5500434.	45325.	-0.001007	4745.7198	1.719E+12	0.000	0.000	0.000
16.500	0.3776	-4674300.	45325.	-0.001060	4411.2938	1.719E+12	0.000	0.000	0.000
18.000	0.3581	-3847680.	45325.	-0.001105	4076.6710	1.719E+12	0.000	0.000	0.000
19.500	0.3378	-3020660.	45325.	-0.001141	3741.8862	1.719E+12	0.000	0.000	0.000
21.000	0.3170	-2193325.	45325.	-0.001168	3406.9742	1.719E+12	0.000	0.000	0.000
22.500	0.2958	-1365763.	45325.	-0.001187	3071.9699	1.719E+12	0.000	0.000	0.000
24.000	0.2743	-538058.	45325.	-0.001196	2736.9080	1.719E+12	0.000	0.000	0.000
25.500	0.2527	289703.	45325.	-0.001198	2636.3717	1.719E+12	0.000	0.000	0.000
27.000	0.2312	1117433.	45325.	-0.001190	2971.4440	1.719E+12	0.000	0.000	0.000
28.500	0.2098	1945048.	45325.	-0.001174	3306.4693	1.719E+12	0.000	0.000	0.000
30.000	0.1889	2772460.	45325.	-0.001150	3641.4126	1.719E+12	0.000	0.000	0.000
31.500	0.1685	3599583.	45325.	-0.001116	3976.2393	1.719E+12	0.000	0.000	0.000
33.000	0.1487	4426332.	45325.	-0.001074	4310.9143	1.719E+12	0.000	0.000	0.000
34.500	0.1298	5252621.	43888.	-0.001024	4645.4030	1.719E+12	-159.6766	22146.	0.000
36.000	0.1119	6026628.	39474.	-0.000965	4958.7276	1.719E+12	-330.7682	53230.	0.000
37.500	0.0951	6692840.	32109.	-0.000898	5228.4155	1.719E+12	-487.4871	92311.	0.000
39.000	0.0795	7200409.	22745.	-0.000825	5433.8839	1.719E+12	-552.9476	125160.	0.000
40.500	0.0653	7528074.	12657.	-0.000748	5566.5256	1.719E+12	-567.9605	156450.	0.000
42.000	0.0526	7670937.	2609.2482	-0.000669	5624.3577	1.719E+12	-548.4803	187740.	0.000
43.500	0.0413	7635295.	-6847.1678	-0.000589	5609.9293	1.719E+12	-502.2326	219030.	0.000
45.000	0.0314	7436135.	-15297.	-0.000510	5529.3076	1.719E+12	-436.6626	250321.	0.000
46.500	0.0229	7094722.	-22455.	-0.000434	5391.1010	1.719E+12	-358.6868	281611.	0.000
48.000	0.0158	6636357.	-28154.	-0.000362	5205.5510	1.719E+12	-274.4945	312901.	0.000
49.500	0.009905	6088366.	-32329.	-0.000295	4983.7195	1.719E+12	-189.4064	344191.	0.000
51.000	0.005167	5478374.	-35004.	-0.000235	4736.7894	1.719E+12	-107.7901	375481.	0.000
52.500	0.001462	4832887.	-36271.	-0.000181	4475.4911	1.719E+12	-33.0314	406771.	0.000
54.000	-0.001333	4176196.	-36277.	-0.000133	4209.6570	1.719E+12	32.4463	438061.	0.000
55.500	-0.003341	3529583.	-35200.	-9.307E-05	3947.9026	1.719E+12	87.1203	469351.	0.000
57.000	-0.004684	2910830.	-33244.	-5.936E-05	3697.4261	1.719E+12	130.2755	500641.	0.000
58.500	-0.005478	2333983.	-30614.	-3.191E-05	3463.9137	1.719E+12	161.8889	531931.	0.000

60.000	-0.005833	1809346.	-27515.	-1.022E-05	3251.5360	1.719E+12	182.5014	563221.	0.000
61.500	-0.005846	1343651.	-24135.	6.286E-06	3063.0187	1.719E+12	193.0847	594511.	0.000
63.000	-0.005606	940375.	-20646.	1.824E-05	2899.7693	1.719E+12	194.5173	624535.	0.000
64.500	-0.005189	600025.	-17194.	2.631E-05	2761.9929	1.719E+12	189.0709	655825.	0.000
66.000	-0.004659	320872.	-13892.	3.113E-05	2648.9893	1.719E+12	177.8586	687116.	0.000
67.500	-0.004069	99312.	-10829.	3.333E-05	2559.2998	1.719E+12	162.3902	718406.	0.000
69.000	-0.003460	-69645.	-8070.9736	3.348E-05	2547.2903	1.719E+12	144.0893	749696.	0.000
70.500	-0.002863	-191909.	-5656.0107	3.211E-05	2596.7839	1.719E+12	124.2399	780986.	0.000
72.000	-0.002304	-273899.	-3602.3024	2.967E-05	2629.9743	1.719E+12	103.9499	812276.	0.000
73.500	-0.001795	-322181.	-1909.5626	2.655E-05	2649.5193	1.719E+12	84.1323	843566.	0.000
75.000	-0.001348	-343171.	-562.8885	2.307E-05	2658.0161	1.719E+12	65.4982	874856.	0.000
76.500	-0.000965	-342904.	463.6671	1.948E-05	2657.9079	1.719E+12	48.5635	906146.	0.000
78.000	-0.000646	-326866.	1203.7044	1.597E-05	2651.4158	1.719E+12	33.6628	937436.	0.000
79.500	-0.000390	-299888.	1695.4045	1.269E-05	2640.4947	1.719E+12	20.9705	968726.	0.000
81.000	-0.000189	-266084.	1978.8666	9.730E-06	2626.8106	1.719E+12	10.5253	1000016.	0.000
82.500	-3.939E-05	-228842.	2093.9064	7.139E-06	2611.7347	1.719E+12	2.2569	1031306.	0.000
84.000	6.755E-05	-190845.	2078.3319	4.942E-06	2596.3533	1.719E+12	-3.9874	1062596.	0.000
85.500	0.000139	-154120.	1966.6838	3.136E-06	2581.4868	1.719E+12	-8.4179	1093886.	0.000
87.000	0.000180	-120107.	1789.4082	1.701E-06	2567.7178	1.719E+12	-11.2793	1125139.	0.000
88.500	0.000200	-89735.	1572.3997	6.023E-07	2555.4232	1.719E+12	-12.8327	1156429.	0.000
90.000	0.000202	-63512.	1336.8693	-1.999E-07	2544.8079	1.719E+12	-13.3373	1187719.	0.000
91.500	0.000193	-41604.	1099.4759	-7.502E-07	2535.9393	1.719E+12	-13.0397	1219009.	0.000
93.000	0.000175	-23916.	872.6406	-1.093E-06	2528.7791	1.719E+12	-12.1642	1250299.	0.000
94.500	0.000153	-10167.	664.9979	-1.272E-06	2523.2134	1.719E+12	-10.9072	1281589.	0.000
96.000	0.000129	48.9049	481.9248	-1.325E-06	2519.1174	1.719E+12	-9.4342	1312879.	0.000
97.500	0.000106	7208.3629	326.1052	-1.287E-06	2522.0156	1.719E+12	-7.8790	1344169.	0.000
99.000	8.303E-05	11814.	198.0907	-1.187E-06	2523.8801	1.719E+12	-6.3448	1375459.	0.000
100.500	6.278E-05	14363.	96.8303	-1.050E-06	2524.9119	1.719E+12	-4.9064	1406749.	0.000
102.000	4.523E-05	15321.	20.1490	-8.945E-07	2525.2997	1.719E+12	-3.6138	1438039.	0.000
103.500	3.058E-05	15106.	-34.8379	-7.353E-07	2525.2128	1.719E+12	-2.4959	1469329.	0.000
105.000	1.876E-05	14081.	-71.3796	-5.825E-07	2524.7979	1.719E+12	-1.5643	1500620.	0.000
106.500	9.606E-06	12548.	-92.8165	-4.431E-07	2524.1772	1.719E+12	-0.8175	1531910.	0.000
108.000	2.813E-06	10749.	-102.3536	-3.211E-07	2523.4488	1.719E+12	-0.2421	1549327.	0.000
109.500	-1.955E-06	8869.9180	-102.9879	-2.184E-07	2522.6882	1.719E+12	0.1716	1580618.	0.000
111.000	-5.051E-06	7045.6504	-97.3724	-1.351E-07	2521.9497	1.719E+12	0.4523	1611908.	0.000
112.500	-6.819E-06	5367.1955	-87.6990	-7.015E-08	2521.2703	1.719E+12	0.6225	1643198.	0.000
114.000	-7.576E-06	3889.8788	-75.7532	-2.169E-08	2520.6722	1.719E+12	0.7048	1674488.	0.000
115.500	-7.600E-06	2640.5115	-62.9279	1.249E-08	2520.1665	1.719E+12	0.7202	1705778.	0.000
117.000	-7.127E-06	1624.2270	-50.2560	3.481E-08	2519.7551	1.719E+12	0.6877	1737068.	0.000
118.500	-6.347E-06	830.6033	-38.4545	4.766E-08	2519.4338	1.719E+12	0.6235	1768358.	0.000
120.000	-5.411E-06	238.9190	-27.9739	5.326E-08	2519.1943	1.719E+12	0.5410	1799648.	0.000
121.500	-4.429E-06	-177.5171	-19.0502	5.358E-08	2519.1695	1.719E+12	0.4506	1830938.	0.000
123.000	-3.482E-06	-447.9527	-11.7533	5.031E-08	2519.2789	1.719E+12	0.3602	1862228.	0.000
124.500	-2.618E-06	-601.6346	-6.0325	4.482E-08	2519.3411	1.719E+12	0.2754	1893518.	0.000
126.000	-1.868E-06	-666.0124	-1.7554	3.818E-08	2519.3672	1.719E+12	0.1998	1924808.	0.000
127.500	-1.244E-06	-665.5893	1.2592	3.121E-08	2519.3670	1.719E+12	0.1352	1956098.	0.000
129.000	-7.448E-07	-621.3010	3.2159	2.447E-08	2519.3491	1.719E+12	0.0822	1987388.	0.000
130.500	-3.628E-07	-550.3045	4.3222	1.834E-08	2519.3204	1.719E+12	0.0407	2018678.	0.000
132.000	-8.455E-08	-466.0672	4.7750	1.302E-08	2519.2863	1.719E+12	0.009629	2049969.	0.000
133.500	1.059E-07	-378.6617	4.7515	8.598E-09	2519.2509	1.719E+12	-0.0122	2081259.	0.000
135.000	2.250E-07	-295.1841	4.4036	5.071E-09	2519.2171	1.719E+12	-0.0264	2112549.	0.000
136.500	2.885E-07	-220.2313	3.8568	2.373E-09	2519.1867	1.719E+12	-0.0344	2143839.	0.000
138.000	3.104E-07	-156.3868	3.2100	4.015E-10	2519.1609	1.719E+12	-0.0375	2175129.	0.000
139.500	3.029E-07	-104.6794	2.5382	-9.651E-10	2519.1400	1.719E+12	-0.0371	2206419.	0.000
141.000	2.757E-07	-64.9912	1.8956	-1.853E-09	2519.1239	1.719E+12	-0.0343	2237709.	0.000
142.500	2.362E-07	-36.4000	1.3192	-2.384E-09	2519.1123	1.719E+12	-0.0298	2268999.	0.000
144.000	1.898E-07	-17.4514	0.8329	-2.666E-09	2519.1047	1.719E+12	-0.0243	2300289.	0.000
145.500	1.402E-07	-6.3616	0.4511	-2.791E-09	2519.1002	1.719E+12	-0.0182	2331579.	0.000
147.000	8.939E-08	-1.1559	0.1820	-2.830E-09	2519.0981	1.719E+12	-0.0117	2362869.	0.000
148.500	3.834E-08	0.2482	0.0305	-2.835E-09	2519.0977	1.719E+12	-0.005100	2394159.	0.000
150.000	-1.266E-08	0.000	0.000	-2.833E-09	2519.0976	1.719E+12	0.001706	1212725.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection              =      0.5000000 inches
Computed slope at pile head       =   -0.000004274 radians
Maximum bending moment            =     -13716161. inch-lbs
Maximum shear force               =         45325. lbs
Depth of maximum bending moment   =       0.000000 feet below pile head
Depth of maximum shear force      =       0.000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 1.000000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	-25817896.	82824.	0.000	12970.	1.719E+12	0.000	0.000	0.000
1.500	0.9976	-24325725.	82824.	-0.000262	12366.	1.719E+12	0.000	0.000	0.000
3.000	0.9906	-22831024.	82824.	-0.000509	11761.	1.719E+12	0.000	0.000	0.000
4.500	0.9792	-21333948.	82824.	-0.000741	11155.	1.719E+12	0.000	0.000	0.000
6.000	0.9639	-19834653.	82824.	-0.000956	10548.	1.719E+12	0.000	0.000	0.000
7.500	0.9448	-18333294.	82824.	-0.001156	9940.5697	1.719E+12	0.000	0.000	0.000
9.000	0.9223	-16830029.	82824.	-0.001340	9332.0352	1.719E+12	0.000	0.000	0.000
10.500	0.8966	-15325012.	82824.	-0.001508	8722.7919	1.719E+12	0.000	0.000	0.000
12.000	0.8680	-13818402.	82824.	-0.001661	8112.9033	1.719E+12	0.000	0.000	0.000
13.500	0.8368	-12310354.	82824.	-0.001798	7502.4328	1.719E+12	0.000	0.000	0.000
15.000	0.8033	-10801026.	82824.	-0.001919	6891.4440	1.719E+12	0.000	0.000	0.000
16.500	0.7677	-9290574.	82824.	-0.002024	6280.0003	1.719E+12	0.000	0.000	0.000
18.000	0.7304	-7779156.	82824.	-0.002113	5668.1655	1.719E+12	0.000	0.000	0.000
19.500	0.6917	-6266928.	82824.	-0.002187	5056.0030	1.719E+12	0.000	0.000	0.000
21.000	0.6517	-4754049.	82824.	-0.002244	4443.5767	1.719E+12	0.000	0.000	0.000
22.500	0.6109	-3240675.	82824.	-0.002286	3830.9501	1.719E+12	0.000	0.000	0.000
24.000	0.5694	-1726964.	82824.	-0.002312	3218.1871	1.719E+12	0.000	0.000	0.000
25.500	0.5276	-213073.	82824.	-0.002322	2605.3514	1.719E+12	0.000	0.000	0.000
27.000	0.4858	1300840.	82824.	-0.002317	3045.6885	1.719E+12	0.000	0.000	0.000
28.500	0.4442	2814617.	82824.	-0.002295	3658.4784	1.719E+12	0.000	0.000	0.000
30.000	0.4032	4328102.	82824.	-0.002258	4271.1497	1.719E+12	0.000	0.000	0.000
31.500	0.3630	5841136.	82824.	-0.002204	4883.6389	1.719E+12	0.000	0.000	0.000
33.000	0.3238	7353563.	82824.	-0.002135	5495.8821	1.719E+12	0.000	0.000	0.000
34.500	0.2861	8865225.	81035.	-0.002050	6107.8156	1.719E+12	-198.7327	12504.	0.000
36.000	0.2500	10311576.	75489.	-0.001950	6693.3104	1.719E+12	-417.5424	30061.	0.000
37.500	0.2159	11621570.	66125.	-0.001835	7223.6071	1.719E+12	-622.9046	51936.	0.000
39.000	0.1839	12728534.	53444.	-0.001708	7671.7154	1.719E+12	-786.1040	76924.	0.000
40.500	0.1544	13579476.	38214.	-0.001570	8016.1840	1.719E+12	-906.1270	105632.	0.000
42.000	0.1274	14135421.	21318.	-0.001425	8241.2351	1.719E+12	-971.1363	137182.	0.000
43.500	0.1031	14375247.	3847.5303	-0.001276	8338.3187	1.719E+12	-970.0437	169346.	0.000
45.000	0.0815	14299283.	-12852.	-0.001126	8307.5680	1.719E+12	-885.5057	195575.	0.000
46.500	0.0626	13934928.	-27832.	-0.000978	8160.0741	1.719E+12	-778.9212	224026.	0.000
48.000	0.0463	13316754.	-40367.	-0.000835	7909.8318	1.719E+12	-613.8780	238675.	0.000
49.500	0.0325	12498297.	-50070.	-0.000700	7578.5137	1.719E+12	-464.2297	256972.	0.000
51.000	0.0211	11528130.	-57754.	-0.000574	7185.7818	1.719E+12	-389.4620	332332.	0.000
52.500	0.0118	10430578.	-63668.	-0.000459	6741.4836	1.719E+12	-267.6392	406771.	0.000
54.000	0.004558	9245226.	-67075.	-0.000356	6261.6431	1.719E+12	-110.9239	438061.	0.000
55.500	-0.000985	8022973.	-67842.	-0.000266	5766.8647	1.719E+12	25.6919	469351.	0.000
57.000	-0.005017	6808210.	-66355.	-0.000188	5275.1182	1.719E+12	139.5286	500641.	0.000
58.500	-0.007765	5637945.	-63034.	-0.000123	4801.3853	1.719E+12	229.4667	531931.	0.000

60.000	-0.009451	4541441.	-58307.	-6.989E-05	4357.5114	1.719E+12	295.7158	563221.	0.000
61.500	-0.0103	3540277.	-52590.	-2.758E-05	3952.2317	1.719E+12	339.5599	594511.	0.000
63.000	-0.0104	2648762.	-46272.	4.815E-06	3591.3389	1.719E+12	362.3608	624535.	0.000
64.500	-0.0101	1874377.	-39697.	2.849E-05	3277.8611	1.719E+12	368.2648	655825.	0.000
66.000	-0.009418	1219114.	-33147.	4.468E-05	3012.6051	1.719E+12	359.5163	687116.	0.000
67.500	-0.008499	680207.	-26858.	5.463E-05	2794.4513	1.719E+12	339.2018	718406.	0.000
69.000	-0.007451	251132.	-21012.	5.950E-05	2620.7578	1.719E+12	310.3527	749696.	0.000
70.500	-0.006357	-77416.	-15737.	6.041E-05	2550.4362	1.719E+12	275.8090	780986.	0.000
72.000	-0.005277	-316593.	-11111.	5.835E-05	2647.2572	1.719E+12	238.1176	812276.	0.000
73.500	-0.004256	-478588.	-7173.1893	5.419E-05	2712.8339	1.719E+12	199.4671	843566.	0.000
75.000	-0.003326	-575905.	-3923.1164	4.867E-05	2752.2287	1.719E+12	161.6521	874856.	0.000
76.500	-0.002504	-620787.	-1333.6496	4.240E-05	2770.3974	1.719E+12	126.0664	906146.	0.000
78.000	-0.001799	-624759.	644.3940	3.588E-05	2772.0052	1.719E+12	93.7162	937436.	0.000
79.500	-0.001212	-598302.	2075.1087	2.948E-05	2761.2952	1.719E+12	65.2521	968726.	0.000
81.000	-0.000738	-550641.	3031.4752	2.347E-05	2742.0016	1.719E+12	41.0109	1000016.	0.000
82.500	-0.000368	-489635.	3590.1671	1.802E-05	2717.3060	1.719E+12	21.0660	1031306.	0.000
84.000	-8.944E-05	-421753.	3827.2812	1.325E-05	2689.8267	1.719E+12	5.2800	1062596.	0.000
85.500	0.000109	-352116.	3815.0105	9.199E-06	2661.6372	1.719E+12	-6.6434	1093886.	0.000
87.000	0.000242	-284595.	3619.2344	5.866E-06	2634.3042	1.719E+12	-15.1095	1125139.	0.000
88.500	0.000320	-221940.	3297.9337	3.215E-06	2608.9409	1.719E+12	-20.5906	1156429.	0.000
90.000	0.000357	-165934.	2900.3459	1.184E-06	2586.2689	1.719E+12	-23.5858	1187719.	0.000
91.500	0.000363	-117551.	2466.7463	-2.997E-07	2566.6834	1.719E+12	-24.5919	1219009.	0.000
93.000	0.000347	-77125.	2028.7082	-1.319E-06	2550.3183	1.719E+12	-24.0790	1250299.	0.000
94.500	0.000316	-44492.	1609.7308	-1.955E-06	2537.1082	1.719E+12	-22.4740	1281589.	0.000
96.000	0.000276	-19136.	1226.1165	-2.288E-06	2526.8438	1.719E+12	-20.1498	1312879.	0.000
97.500	0.000233	-305.9992	887.9953	-2.390E-06	2519.2215	1.719E+12	-17.4193	1344169.	0.000
99.000	0.000190	12880.	600.4083	-2.324E-06	2524.3114	1.719E+12	-14.5349	1375459.	0.000
100.500	0.000150	21355.	364.3804	-2.145E-06	2527.7422	1.719E+12	-11.6905	1406749.	0.000
102.000	0.000113	26040.	177.9292	-1.897E-06	2529.6388	1.719E+12	-9.0263	1438039.	0.000
103.500	8.129E-05	27798.	36.9726	-1.615E-06	2530.3505	1.719E+12	-6.6355	1469329.	0.000
105.000	5.483E-05	27403.	-63.8879	-1.326E-06	2530.1906	1.719E+12	-4.5712	1500620.	0.000
106.500	3.354E-05	25524.	-130.7185	-1.049E-06	2529.4301	1.719E+12	-2.8544	1531910.	0.000
108.000	1.706E-05	22718.	-169.6219	-7.968E-07	2528.2941	1.719E+12	-1.4682	1549327.	0.000
109.500	4.856E-06	19434.	-186.6733	-5.761E-07	2526.9646	1.719E+12	-0.4264	1580618.	0.000
111.000	-3.683E-06	16009.	-187.5427	-3.906E-07	2525.5783	1.719E+12	0.3298	1611908.	0.000
112.500	-9.205E-06	12690.	-177.0114	-2.404E-07	2524.2347	1.719E+12	0.8403	1643198.	0.000
114.000	-1.234E-05	9641.7598	-159.1205	-1.235E-07	2523.0007	1.719E+12	1.1476	1674488.	0.000
115.500	-1.365E-05	6964.2216	-137.1509	-3.653E-08	2521.9168	1.719E+12	1.2935	1705778.	0.000
117.000	-1.365E-05	4705.0544	-113.6530	2.455E-08	2521.0022	1.719E+12	1.3174	1737068.	0.000
118.500	-1.277E-05	2872.2240	-90.5097	6.422E-08	2520.2603	1.719E+12	1.2541	1768358.	0.000
120.000	-1.134E-05	1445.4309	-69.0193	8.682E-08	2519.6827	1.719E+12	1.1337	1799648.	0.000
121.500	-9.640E-06	385.8027	-49.9908	9.640E-08	2519.2538	1.719E+12	0.9806	1830938.	0.000
123.000	-7.869E-06	-356.1547	-33.8390	9.656E-08	2519.2418	1.719E+12	0.8141	1862228.	0.000
124.500	-6.164E-06	-834.3194	-20.6765	9.033E-08	2519.4353	1.719E+12	0.6484	1893518.	0.000
126.000	-4.617E-06	-1102.3051	-10.3974	8.019E-08	2519.5438	1.719E+12	0.4937	1924808.	0.000
127.500	-3.277E-06	-1210.2201	-2.7489	6.808E-08	2519.5875	1.719E+12	0.3561	1956098.	0.000
129.000	-2.166E-06	-1202.6181	2.6085	5.545E-08	2519.5844	1.719E+12	0.2391	1987388.	0.000
130.500	-1.281E-06	-1117.4156	6.0535	4.331E-08	2519.5499	1.719E+12	0.1436	2018678.	0.000
132.000	-6.066E-07	-985.5543	7.9681	3.230E-08	2519.4966	1.719E+12	0.0691	2049969.	0.000
133.500	-1.180E-07	-831.2076	8.7126	2.279E-08	2519.4341	1.719E+12	0.0136	2081259.	0.000
135.000	2.139E-07	-672.3530	8.6095	1.492E-08	2519.3698	1.719E+12	-0.0251	2112549.	0.000
136.500	4.191E-07	-521.5626	7.9343	8.672E-09	2519.3087	1.719E+12	-0.0499	2143839.	0.000
138.000	5.261E-07	-386.8922	6.9128	3.916E-09	2519.2542	1.719E+12	-0.0636	2175129.	0.000
139.500	5.601E-07	-272.7791	5.7227	4.630E-10	2519.2080	1.719E+12	-0.0687	2206419.	0.000
141.000	5.428E-07	-180.8831	4.4975	-1.912E-09	2519.1708	1.719E+12	-0.0675	2237709.	0.000
142.500	4.913E-07	-110.8298	3.3329	-3.439E-09	2519.1425	1.719E+12	-0.0619	2268999.	0.000
144.000	4.190E-07	-60.8307	2.2936	-4.337E-09	2519.1222	1.719E+12	-0.0535	2300289.	0.000
145.500	3.352E-07	-28.1725	1.4211	-4.803E-09	2519.1090	1.719E+12	-0.0434	2331579.	0.000
147.000	2.460E-07	-9.5774	0.7396	-5.001E-09	2519.1015	1.719E+12	-0.0323	2362869.	0.000
148.500	1.551E-07	-1.4461	0.2632	-5.058E-09	2519.0982	1.719E+12	-0.0206	2394159.	0.000
150.000	6.394E-08	0.000	0.000	-5.066E-09	2519.0976	1.719E+12	-0.008616	1212725.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =      1.0000000 inches
Computed slope at pile head      =   -0.000007811 radians
Maximum bending moment           =     -25817896. inch-lbs
Maximum shear force              =         82824. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     18.0000000 feet below pile head
Number of iterations             =             10
Number of zero deflection points =              5
```

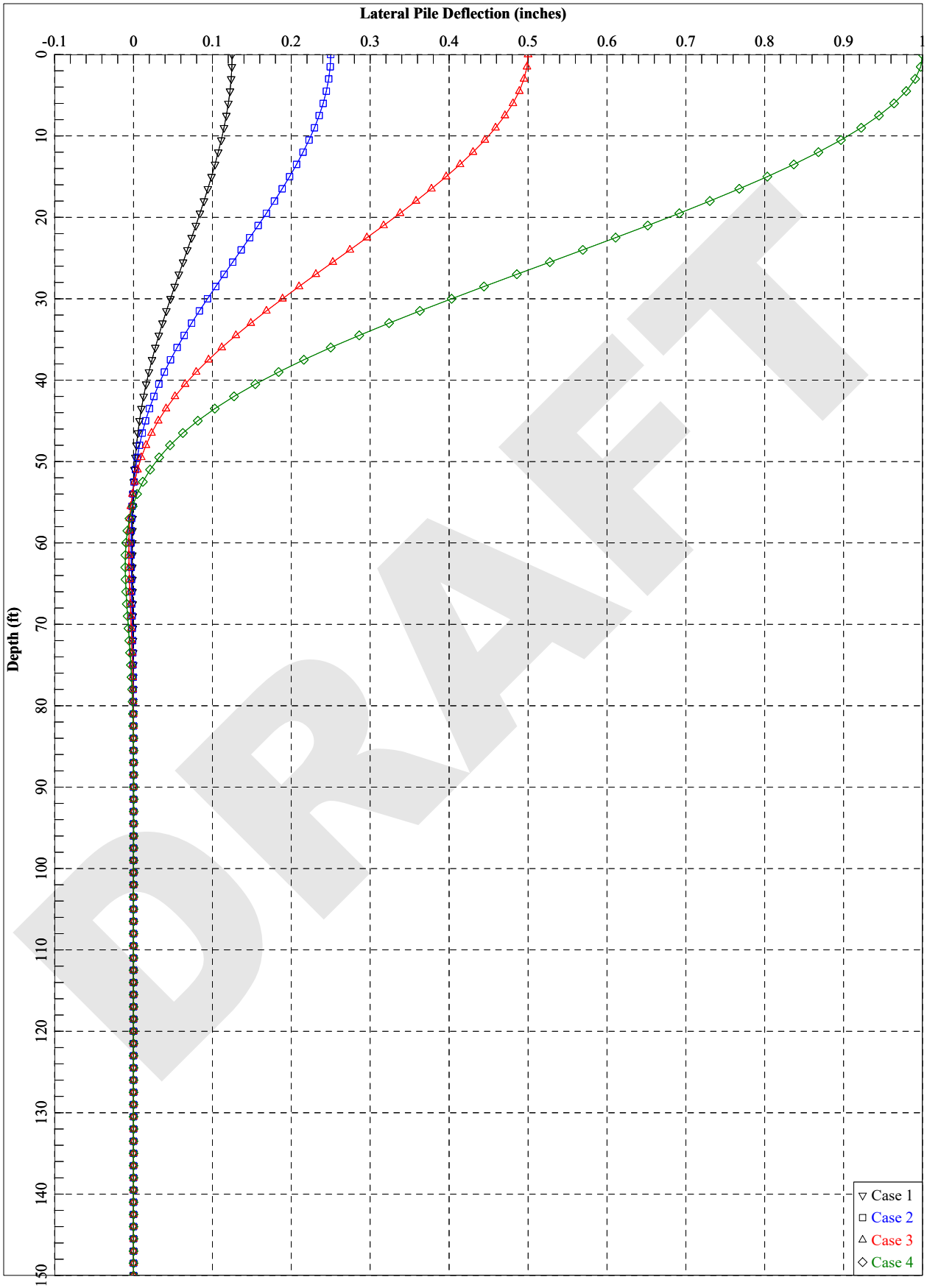
Summary of Pile Response(s)

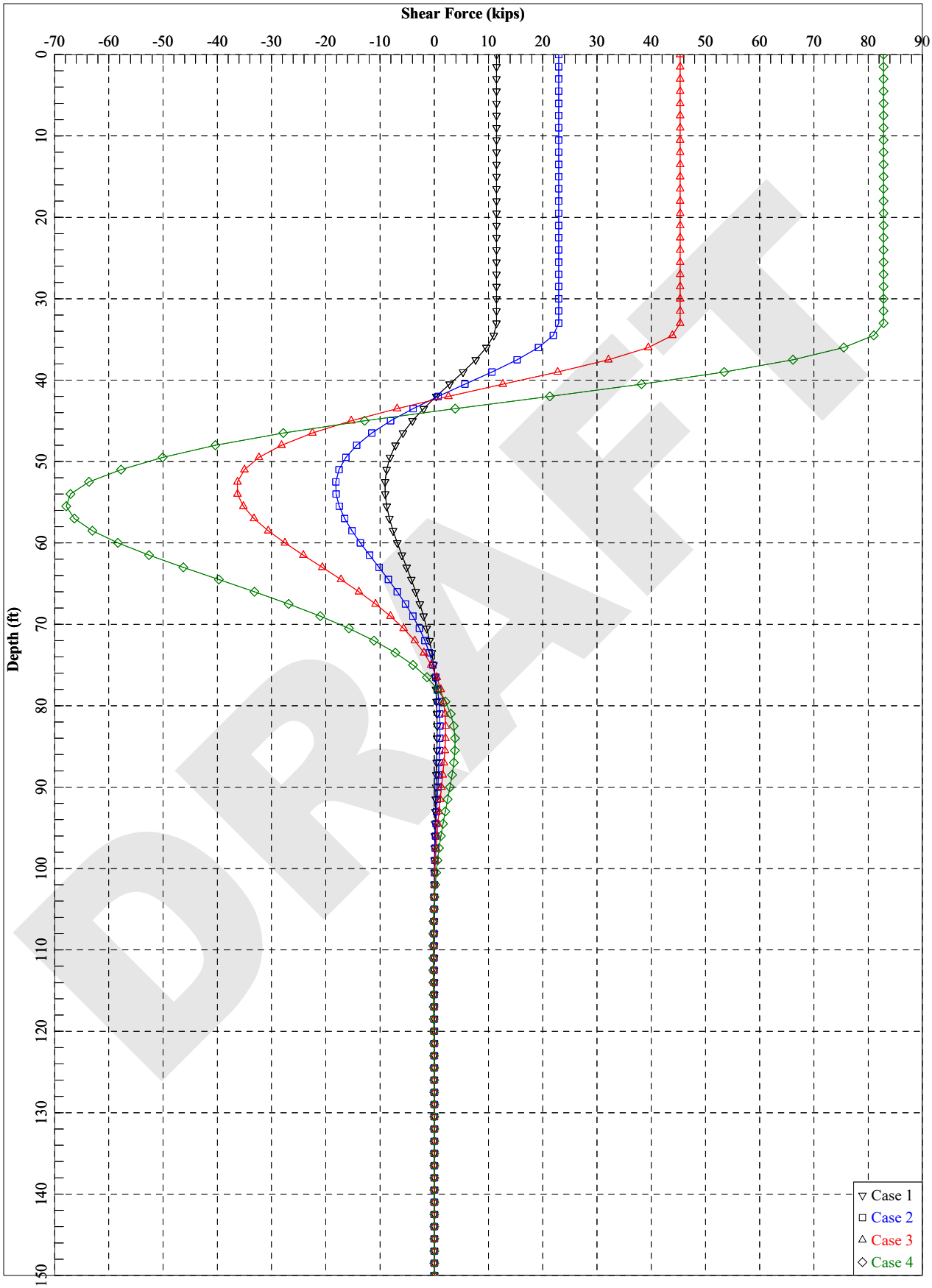
Definitions of Pile-head Loading Conditions:

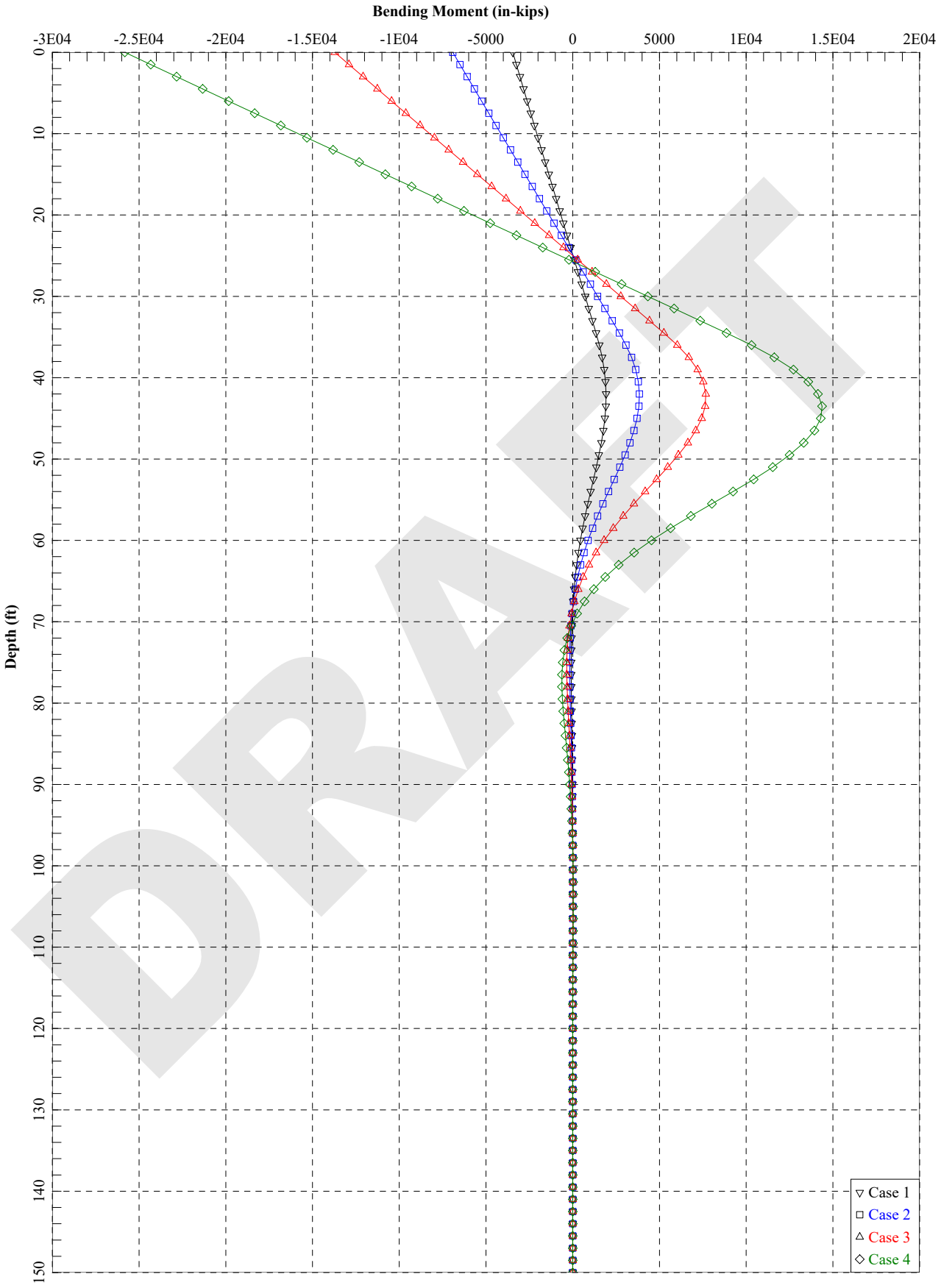
Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

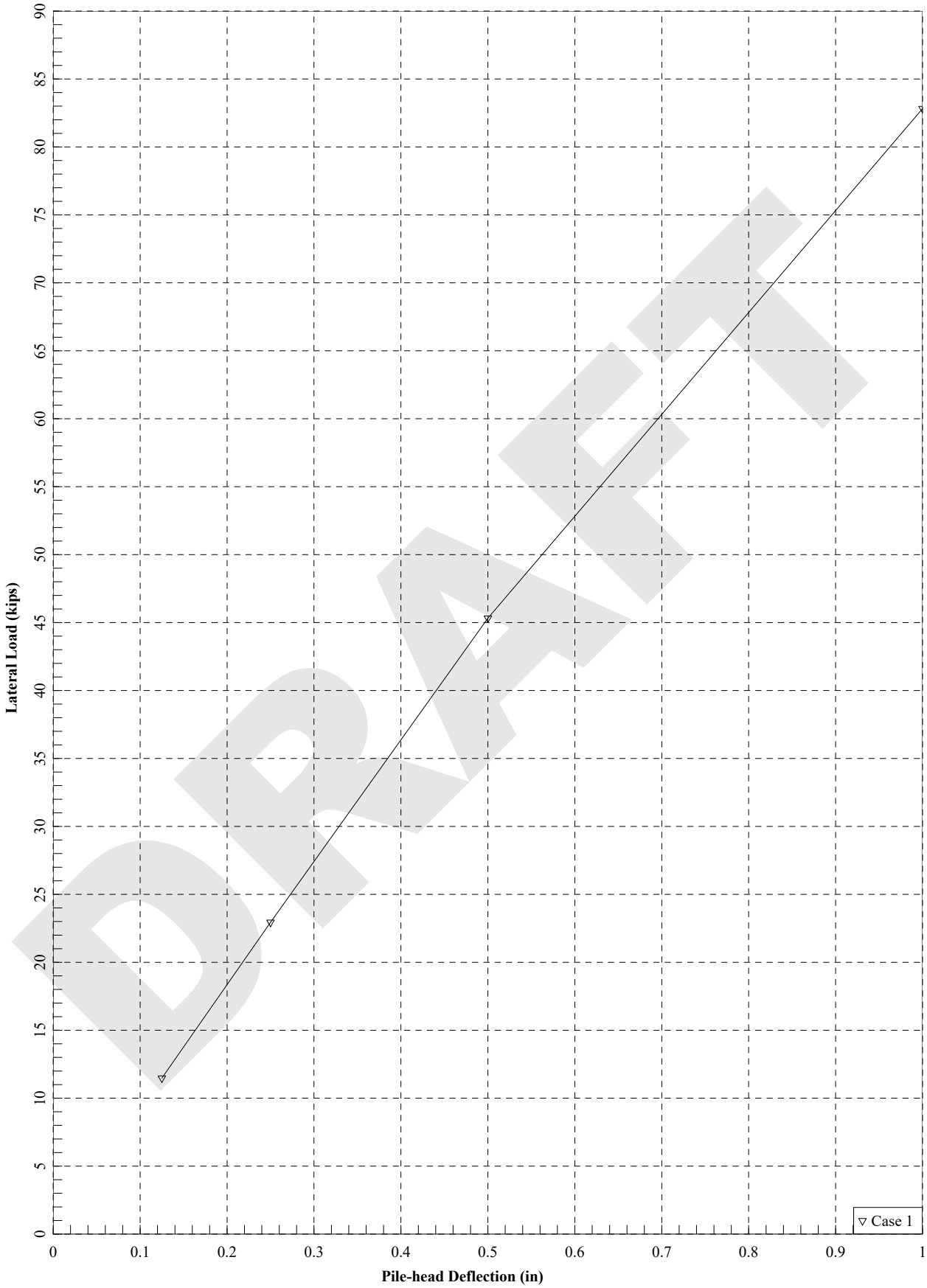
Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	5	y = 0.1250	S = 0.000	552000.	0.12500000	-3455698.	11472.	-0.00000108
2	5	y = 0.2500	S = 0.000	552000.	0.25000000	-6911397.	22944.	-0.00000216
3	5	y = 0.5000	S = 0.000	552000.	0.50000000	-13716161.	45325.	-0.00000427
4	5	y = 1.0000	S = 0.000	552000.	1.00000000	-25817896.	82824.	-0.00000781

The analysis ended normally.


Lateral Pile Deflection (inches)
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Shear Force (kips)
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Bending Moment (in-kips)
-3E04
-2.5E04
-2E04
-1.5E04
-1E04
-5000
0
5000
1E04
1.5E04
2E04
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Lateral Load (kips)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pile-head Deflection (in)
▽ Case 1

```
================================================================================

                  LPile Plus for Windows, Version 2013-07.007

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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================================================================================

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--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        P:\Four Hole Swamp\LPILE\2016-03-02\
Name of input data file:       FHS_4-1.5OEP_WZ_deepscour_load_type_4.lp7d
Name of output report file:    FHS_4-1.5OEP_WZ_deepscour_load_type_4.lp7o
Name of plot output file:      FHS_4-1.5OEP_WZ_deepscour_load_type_4.lp7p
Name of runtime messeage file: FHS_4-1.5OEP_WZ_deepscour_load_type_4.lp7r


--------------------------------------------------------------------------------
                          Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  March 2, 2016     Time:  16:39:30


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Project Name: US 301 RBO Four Hole Swamp


Job Number: 41503-0002-0001


Client: SCDOT


Engineer: Gabriel Burnworth


Description: 48" OEP (1.5" walls) Weak Zone, 83' scour elev., Free Head



--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
```

```
 - Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed                =          500
- Deflection tolerance for convergence                =   1.0000E-05 in
- Maximum allowable deflection                        =     100.0000 in
- Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
 - Compute pile response under loading and nonlinear bending properties of pile
   (only if nonlinear pile properties are input)
 - Use of p-y modification factors for p-y curves not selected
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - No p-y curves to be computed and reported for user-specified depths
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1


---------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Total number of pile sections                        =         1

Total length of pile                                 =     150.00 ft

Depth of ground surface below top of pile            =      33.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile.

Point         Depth              Pile
                X              Diameter
                ft                in
-----       ---------        -----------
  1          0.00000         48.0000000
  2        150.000000        48.0000000


Input Structural Properties:
----------------------------

Pile Section No. 1:

   Section Type                                      = Steel Pipe Pile
   Section Length                                    =    150.00000 ft
   Pile Diameter                                     =     48.00000 in


---------------------------------------------------------------------------
                      Ground Slope and Pile Batter Angles
---------------------------------------------------------------------------

Ground Slope Angle                                   =        0.000 degrees
                                                     =        0.000 radians
```

```
Pile Batter Angle                                   =        0.000 degrees
                                                    =        0.000 radians


---------------------------------------------------------------------------
                      Soil and Rock Layering Information
---------------------------------------------------------------------------

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     33.00000 ft
   Distance from top of pile to bottom of layer     =     63.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     63.00000 ft
   Distance from top of pile to bottom of layer     =     86.00000 ft
   Effective unit weight at top of layer            =     22.00000 pcf
   Effective unit weight at bottom of layer         =     22.00000 pcf
   Friction angle at top of layer                   =     24.00000 deg.
   Friction angle at bottom of layer                =     24.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     86.00000 ft
   Distance from top of pile to bottom of layer     =    108.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =    108.00000 ft
   Distance from top of pile to bottom of layer     =    206.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

   (Depth of lowest soil layer extends   56.00 ft below pile tip)


---------------------------------------------------------------------------
```

Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	kpy pci
1	Sand (Reese, et al.)	33.000	57.600	36.000	default
		63.000	57.600	36.000	default
2	Sand (Reese, et al.)	63.000	22.000	24.000	default
		86.000	22.000	24.000	default
3	Sand (Reese, et al.)	86.000	57.600	36.000	default
		108.000	57.600	36.000	default
4	Sand (Reese, et al.)	108.000	57.600	36.000	default
		206.000	57.600	36.000	default

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	4	y = 0.12500 in	M = 0.0000 in-lbs	552000.	No
2	4	y = 0.25000 in	M = 0.0000 in-lbs	552000.	No
3	4	y = 0.50000 in	M = 0.0000 in-lbs	552000.	No
4	4	y = 1.00000 in	M = 0.0000 in-lbs	552000.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel Pipe Pile:

Length of Section	=	150.00000 ft
Outer Diameter of Pipe	=	48.00000 in
Pipe Wall Thickness	=	1.50000 in
Yield Stress of Pipe	=	36.00000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	219.12609 sq. in.

```
Moment of Inertia                                  =       59287. in^4
Elastic Bending Stiffness                          =   1.7193E+09 kip-in^2
Plastic Modulus, Z                                 =   3244.50000 in^3
Plastic Moment Capacity = Fy Z                     =      116802. in-kip

Axial Structural Capacities:
----------------------------

Nom. Axial Structural Capacity = Fy As             =     7888.539 kips
Nominal Axial Tensile Capacity                     =    -7888.539 kips



Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

   Number     Axial Thrust Force
                     kips
   ------     ------------------
      1              552.000

Definition of Run Messages:

   Y = part of pipe section has yielded.


Axial Thrust Force =    552.000 kips

    Bending       Bending       Bending       Depth to     Max Total    Run
   Curvature      Moment       Stiffness       N Axis        Stress     Msg
    rad/in.       in-kip        kip-in2          in           ksi
 ------------- ------------- ------------- ------------- ------------- ---
   0.000001054  1811.9939796  1719329760.   106.4231912     3.2452738
   0.000002108  3623.9879591  1719329760.    65.2115956     3.9714500
   0.000003162  5435.9819387  1719329760.    51.4743971     4.6976261
   0.000004216  7247.9759182  1719329760.    44.6057978     5.4238024
   0.000005269  9059.9698978  1719329760.    40.4846382     6.1499785
   0.000006323       10872.   1719329760.    37.7371985     6.8761547
   0.000007377       12684.   1719329760.    35.7747416     7.6023309
   0.000008431       14496.   1719329760.    34.3028989     8.3285071
   0.000009485       16308.   1719329760.    33.1581324     9.0546833
     0.0000105       18120.   1719329760.    32.2423191     9.7808595
     0.0000116       19932.   1719329760.    31.4930174    10.5070357
     0.0000126       21744.   1719329760.    30.8685993    11.2332119
     0.0000137       23556.   1719329760.    30.3402455    11.9593881
     0.0000148       25368.   1719329760.    29.8873708    12.6855643
     0.0000158       27180.   1719329760.    29.4948794    13.4117405
     0.0000169       28992.   1719329760.    29.1514494    14.1379167
     0.0000179       30804.   1719329760.    28.8484230    14.8640929
     0.0000190       32616.   1719329760.    28.5790662    15.5902690
     0.0000200       34428.   1719329760.    28.3380627    16.3164452
     0.0000211       36240.   1719329760.    28.1211596    17.0426214
     0.0000221       38052.   1719329760.    27.9249139    17.7687976
     0.0000232       39864.   1719329760.    27.7465087    18.4949738
     0.0000242       41676.   1719329760.    27.5836170    19.2211500
     0.0000253       43488.   1719329760.    27.4342996    19.9473262
     0.0000263       45300.   1719329760.    27.2969276    20.6735024
     0.0000274       47112.   1719329760.    27.1701227    21.3996786
     0.0000285       48924.   1719329760.    27.0527108    22.1258548
     0.0000295       50736.   1719329760.    26.9436854    22.8520310
     0.0000306       52548.   1719329760.    26.8421790    23.5782071
     0.0000316       54360.   1719329760.    26.7474397    24.3043833
     0.0000327       56172.   1719329760.    26.6588126    25.0305595
     0.0000337       57984.   1719329760.    26.5757247    25.7567357
     0.0000348       59796.   1719329760.    26.4976725    26.4829119
     0.0000358       61608.   1719329760.    26.4242115    27.2090881
     0.0000369       63420.   1719329760.    26.3549483    27.9352643
     0.0000379       65232.   1719329760.    26.2895331    28.6614405
```

0.0000390	67044.	1719329760.	26.2276538	29.3876167	
0.0000400	68856.	1719329760.	26.1690313	30.1137929	
0.0000411	70668.	1719329760.	26.1134152	30.8399691	
0.0000432	74292.	1719329760.	26.0103217	32.2923214	
0.0000453	77916.	1719329760.	25.9168184	33.7446738	
0.0000474	81540.	1719329760.	25.8316265	35.1970262	
0.0000495	85116.	1718362204.	25.7600931	36.0000000	Y
0.0000516	88307.	1710016821.	25.7450077	36.0000000	Y
0.0000537	91055.	1694080982.	25.7890002	36.0000000	Y
0.0000559	93523.	1674351216.	25.8662156	36.0000000	Y
0.0000580	95738.	1651681538.	25.9596148	36.0000000	Y
0.0000601	97623.	1625104154.	26.0427887	36.0000000	Y
0.0000622	99187.	1595157458.	26.1020741	36.0000000	Y
0.0000643	100520.	1563590959.	26.1477997	36.0000000	Y
0.0000664	101682.	1531456607.	26.1850574	36.0000000	Y
0.0000685	102694.	1499106584.	26.2156802	36.0000000	Y
0.0000706	103596.	1467136166.	26.2418156	36.0000000	Y
0.0000727	104405.	1435730900.	26.2645753	36.0000000	Y
0.0000748	105133.	1405018933.	26.2847462	36.0000000	Y
0.0000769	105792.	1375089517.	26.3029308	36.0000000	Y
0.0000790	106389.	1345978545.	26.3190684	36.0000000	Y
0.0000811	106931.	1317694704.	26.3327277	36.0000000	Y
0.0000833	107428.	1290308271.	26.3451305	36.0000000	Y
0.0000854	107888.	1263831958.	26.3565441	36.0000000	Y
0.0000875	108312.	1238223529.	26.3683587	36.0000000	Y
0.0000896	108694.	1213357023.	26.3774987	36.0000000	Y
0.0000917	109054.	1189386837.	26.3862330	36.0000000	Y
0.0000938	109391.	1166251589.	26.3947955	36.0000000	Y
0.0000959	109694.	1143784328.	26.4021331	36.0000000	Y
0.0000980	109986.	1122168893.	26.4094502	36.0000000	Y
0.0001001	110251.	1101186709.	26.4155900	36.0000000	Y
0.0001022	110504.	1080953128.	26.4221100	36.0000000	Y
0.0001043	110737.	1061349948.	26.4271609	36.0000000	Y
0.0001064	110958.	1042412273.	26.4331747	36.0000000	Y
0.0001086	111162.	1024055458.	26.4372983	36.0000000	Y
0.0001107	111360.	1006332490.	26.4430476	36.0000000	Y
0.0001128	111538.	989106469.	26.4463756	36.0000000	Y
0.0001149	111715.	972490789.	26.4505626	36.0000000	Y
0.0001170	111873.	956324994.	26.4547068	36.0000000	Y
0.0001191	112028.	940701885.	26.4572535	36.0000000	Y
0.0001212	112175.	925549270.	26.4625617	36.0000000	Y
0.0001233	112309.	910814943.	26.4645327	36.0000000	Y
0.0001254	112442.	896572199.	26.4666389	36.0000000	Y
0.0001338	112900.	843517796.	26.4797710	36.0000000	Y
0.0001423	113275.	796164739.	26.4878891	36.0000000	Y
0.0001507	113588.	753702530.	26.4950904	36.0000000	Y
0.0001591	113853.	715434459.	26.5018328	36.0000000	Y
0.0001676	114076.	680768908.	26.5058505	36.0000000	Y
0.0001760	114269.	649250909.	26.5078046	36.0000000	Y
0.0001844	114433.	620460993.	26.5135095	36.0000000	Y
0.0001929	114577.	594085861.	26.5174169	36.0000000	Y
0.0002013	114703.	569829556.	26.5179765	36.0000000	Y
0.0002097	114814.	547451379.	26.5235253	36.0000000	Y
0.0002182	114912.	526743116.	26.5225624	36.0000000	Y
0.0002266	114999.	507525905.	26.5269002	36.0000000	Y
0.0002350	115077.	489651076.	26.5278306	36.0000000	Y

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip
1	552.000	115077.2

Note that the values in the above table are not factored by a strength

reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.125000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1250	0.000	2852.4294	-0.000310	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.1194	54424.	2852.4294	-0.000310	2541.1289	1.719E+12	0.000	0.000	0.000
3.000	0.1138	108843.	2852.4294	-0.000309	2563.1580	1.719E+12	0.000	0.000	0.000
4.500	0.1083	163250.	2852.4294	-0.000307	2585.1824	1.719E+12	0.000	0.000	0.000
6.000	0.1028	217640.	2852.4294	-0.000305	2607.2000	1.719E+12	0.000	0.000	0.000
7.500	0.0973	272007.	2852.4294	-0.000303	2629.2085	1.719E+12	0.000	0.000	0.000
9.000	0.0919	326347.	2852.4294	-0.000300	2651.2054	1.719E+12	0.000	0.000	0.000
10.500	0.0865	380652.	2852.4294	-0.000296	2673.1887	1.719E+12	0.000	0.000	0.000
12.000	0.0812	434917.	2852.4294	-0.000292	2695.1559	1.719E+12	0.000	0.000	0.000
13.500	0.0760	489138.	2852.4294	-0.000287	2717.1047	1.719E+12	0.000	0.000	0.000
15.000	0.0709	543307.	2852.4294	-0.000282	2739.0330	1.719E+12	0.000	0.000	0.000
16.500	0.0659	597420.	2852.4294	-0.000276	2760.9384	1.719E+12	0.000	0.000	0.000
18.000	0.0610	651471.	2852.4294	-0.000269	2782.8187	1.719E+12	0.000	0.000	0.000
19.500	0.0562	705454.	2852.4294	-0.000262	2804.6715	1.719E+12	0.000	0.000	0.000
21.000	0.0515	759364.	2852.4294	-0.000254	2826.4946	1.719E+12	0.000	0.000	0.000
22.500	0.0470	813195.	2852.4294	-0.000246	2848.2858	1.719E+12	0.000	0.000	0.000
24.000	0.0427	866941.	2852.4294	-0.000237	2870.0427	1.719E+12	0.000	0.000	0.000
25.500	0.0385	920597.	2852.4294	-0.000228	2891.7630	1.719E+12	0.000	0.000	0.000
27.000	0.0345	974157.	2852.4294	-0.000218	2913.4447	1.719E+12	0.000	0.000	0.000
28.500	0.0306	1027616.	2852.4294	-0.000207	2935.0853	1.719E+12	0.000	0.000	0.000
30.000	0.0270	1080968.	2852.4294	-0.000196	2956.6826	1.719E+12	0.000	0.000	0.000
31.500	0.0236	1134208.	2852.4294	-0.000185	2978.2344	1.719E+12	0.000	0.000	0.000
33.000	0.0203	1187329.	2852.4294	-0.000173	2999.7385	1.719E+12	0.000	0.000	0.000
34.500	0.0174	1240327.	2580.9508	-0.000160	3021.1925	1.719E+12	-30.1643	31290.	0.000
36.000	0.0146	1283423.	1852.9764	-0.000147	3038.6381	1.719E+12	-50.7218	62580.	0.000
37.500	0.0121	1309951.	830.0769	-0.000133	3049.3770	1.719E+12	-62.9337	93870.	0.000
39.000	0.009793	1315953.	-349.1926	-0.000119	3051.8065	1.719E+12	-68.0962	125160.	0.000
40.500	0.007767	1299755.	-1569.6160	-0.000106	3045.2493	1.719E+12	-67.5064	156450.	0.000
42.000	0.005985	1261549.	-2739.0044	-9.237E-05	3029.7833	1.719E+12	-62.4257	187740.	0.000
43.500	0.004441	1202986.	-3787.2293	-7.947E-05	3006.0766	1.719E+12	-54.0438	219030.	0.000
45.000	0.003124	1126788.	-4664.6463	-6.728E-05	2975.2309	1.719E+12	-43.4470	250321.	0.000
46.500	0.002019	1036396.	-5340.0060	-5.595E-05	2938.6394	1.719E+12	-31.5930	281611.	0.000
48.000	0.001110	935660.	-5797.9783	-4.563E-05	2897.8606	1.719E+12	-19.2929	312901.	0.000
49.500	0.000377	828575.	-6036.4340	-3.640E-05	2854.5119	1.719E+12	-7.2022	344191.	0.000
51.000	-0.000200	719071.	-6063.6308	-2.829E-05	2810.1838	1.719E+12	4.1804	375481.	0.000
52.500	-0.000642	610847.	-5895.4448	-2.133E-05	2766.3736	1.719E+12	14.5070	406771.	0.000
54.000	-0.000968	507259.	-5552.7768	-1.548E-05	2724.4404	1.719E+12	23.5673	438061.	0.000
55.500	-0.001199	411255.	-5059.2424	-1.067E-05	2685.5769	1.719E+12	31.2699	469351.	0.000
57.000	-0.001353	325339.	-4439.2366	-6.816E-06	2650.7974	1.719E+12	37.6196	500641.	0.000
58.500	-0.001445	251578.	-3716.4437	-3.796E-06	2620.9383	1.719E+12	42.6907	531931.	0.000

60.000	-0.001489	191622.	-2912.8424	-1.476E-06	2596.6678	1.719E+12	46.5983	563221.	0.000
61.500	-0.001498	146745.	-2048.2413	2.949E-07	2578.5010	1.719E+12	49.4685	594511.	0.000
63.000	-0.001479	117880.	-1405.1873	1.680E-06	2566.8162	1.719E+12	21.9820	267598.	0.000
64.500	-0.001437	96124.	-1155.9539	2.800E-06	2558.0096	1.719E+12	5.7106	71518.	0.000
66.000	-0.001378	76210.	-1053.3111	3.702E-06	2549.9479	1.719E+12	5.6941	74390.	0.000
67.500	-0.001304	58132.	-951.6906	4.406E-06	2542.6298	1.719E+12	5.5970	77261.	0.000
69.000	-0.001219	41861.	-852.4687	4.929E-06	2536.0434	1.719E+12	5.4276	80132.	0.000
70.500	-0.001127	27345.	-756.8671	5.291E-06	2530.1670	1.719E+12	5.1948	83003.	0.000
72.000	-0.001029	14509.	-665.9441	5.510E-06	2524.9709	1.719E+12	4.9078	85875.	0.000
73.500	-0.000928	3261.3709	-580.5890	5.603E-06	2520.4178	1.719E+12	4.5761	88746.	0.000
75.000	-0.000827	-6503.7474	-501.5210	5.587E-06	2521.7304	1.719E+12	4.2092	91617.	0.000
76.500	-0.000727	-14904.	-429.2895	5.474E-06	2525.1310	1.719E+12	3.8165	94488.	0.000
78.000	-0.000630	-22067.	-364.2773	5.281E-06	2528.0305	1.719E+12	3.4071	97359.	0.000
79.500	-0.000537	-28123.	-306.7052	5.018E-06	2530.4822	1.719E+12	2.9898	100231.	0.000
81.000	-0.000449	-33208.	-256.6374	4.697E-06	2532.5405	1.719E+12	2.5733	103102.	0.000
82.500	-0.000368	-37456.	-213.9879	4.327E-06	2534.2599	1.719E+12	2.1656	105973.	0.000
84.000	-0.000293	-40998.	-178.5264	3.917E-06	2535.6938	1.719E+12	1.7746	108844.	0.000
85.500	-0.000227	-43960.	-149.8845	3.472E-06	2536.8931	1.719E+12	1.4078	111716.	0.000
87.000	-0.000168	-46462.	-57.1680	2.999E-06	2537.9060	1.719E+12	8.8940	950188.	0.000
88.500	-0.000119	-46078.	81.2212	2.514E-06	2537.7504	1.719E+12	6.4826	981478.	0.000
90.000	-7.798E-05	-43588.	179.0504	2.045E-06	2536.7426	1.719E+12	4.3873	1012768.	0.000
91.500	-4.528E-05	-39673.	242.1726	1.609E-06	2535.1575	1.719E+12	2.6263	1044059.	0.000
93.000	-2.006E-05	-34902.	276.5921	1.219E-06	2533.2263	1.719E+12	1.1981	1075349.	0.000
94.500	-1.410E-06	-29740.	288.1558	8.802E-07	2531.1365	1.719E+12	0.0867	1106639.	0.000
96.000	1.163E-05	-24546.	282.3187	5.960E-07	2529.0341	1.719E+12	-0.7353	1137929.	0.000
97.500	2.005E-05	-19588.	263.9825	3.650E-07	2527.0270	1.719E+12	-1.3021	1169219.	0.000
99.000	2.477E-05	-15050.	237.3955	1.837E-07	2525.1900	1.719E+12	-1.6520	1200509.	0.000
100.500	2.666E-05	-11046.	206.1092	4.706E-08	2523.5689	1.719E+12	-1.8243	1231799.	0.000
102.000	2.646E-05	-7630.9820	172.9779	-5.071E-08	2522.1867	1.719E+12	-1.8570	1263089.	0.000
103.500	2.483E-05	-4817.3126	140.1939	-1.159E-07	2521.0477	1.719E+12	-1.7857	1294379.	0.000
105.000	2.229E-05	-2581.6984	109.3467	-1.546E-07	2520.1427	1.719E+12	-1.6418	1325669.	0.000
106.500	1.927E-05	-877.7601	81.4985	-1.727E-07	2519.4529	1.719E+12	-1.4524	1356959.	0.000
108.000	1.608E-05	355.6809	57.5622	-1.754E-07	2519.2416	1.719E+12	-1.2072	1351716.	0.000
109.500	1.295E-05	1197.9646	37.7423	-1.673E-07	2519.5825	1.719E+12	-0.9950	1383007.	0.000
111.000	1.005E-05	1717.7290	21.6787	-1.520E-07	2519.7929	1.719E+12	-0.7898	1414297.	0.000
112.500	7.477E-06	1981.4178	9.1661	-1.327E-07	2519.8997	1.719E+12	-0.6005	1445587.	0.000
114.000	5.275E-06	2050.3437	-0.1339	-1.116E-07	2519.9276	1.719E+12	-0.4328	1476877.	0.000
115.500	3.460E-06	1978.8142	-6.6389	-9.049E-08	2519.8986	1.719E+12	-0.2899	1508167.	0.000
117.000	2.018E-06	1813.1424	-10.8015	-7.064E-08	2519.8316	1.719E+12	-0.1726	1539457.	0.000
118.500	9.174E-07	1591.3627	-13.0753	-5.281E-08	2519.7418	1.719E+12	-0.0801	1570747.	0.000
120.000	1.167E-07	1343.4794	-13.8893	-3.745E-08	2519.6414	1.719E+12	-0.0104	1602037.	0.000
121.500	-4.309E-07	1092.0919	-13.6309	-2.470E-08	2519.5397	1.719E+12	0.0391	1633327.	0.000
123.000	-7.726E-07	853.2584	-12.6359	-1.452E-08	2519.4430	1.719E+12	0.0715	1664617.	0.000
124.500	-9.536E-07	637.4865	-11.1843	-6.716E-09	2519.3557	1.719E+12	0.0898	1695907.	0.000
126.000	-1.014E-06	450.7577	-9.4996	-1.020E-09	2519.2801	1.719E+12	0.0973	1727197.	0.000
127.500	-9.903E-07	295.5194	-7.7529	2.887E-09	2519.2172	1.719E+12	0.0967	1758487.	0.000
129.000	-9.105E-07	171.5958	-6.0674	5.332E-09	2519.1671	1.719E+12	0.0905	1789777.	0.000
130.500	-7.983E-07	76.9866	-4.5257	6.633E-09	2519.1288	1.719E+12	0.0808	1821067.	0.000
132.000	-6.717E-07	8.5383	-3.1767	7.081E-09	2519.1011	1.719E+12	0.0691	1852357.	0.000
133.500	-5.434E-07	-37.5151	-2.0428	6.929E-09	2519.1128	1.719E+12	0.0569	1883648.	0.000
135.000	-4.222E-07	-65.1393	-1.1267	6.392E-09	2519.1240	1.719E+12	0.0449	1914938.	0.000
136.500	-3.133E-07	-78.2026	-0.4175	5.641E-09	2519.1293	1.719E+12	0.0339	1946228.	0.000
138.000	-2.191E-07	-80.2813	0.1041	4.812E-09	2519.1301	1.719E+12	0.0241	1977518.	0.000
139.500	-1.401E-07	-74.5512	0.4615	4.001E-09	2519.1278	1.719E+12	0.0156	2008808.	0.000
141.000	-7.509E-08	-63.7477	0.6788	3.277E-09	2519.1234	1.719E+12	0.008511	2040098.	0.000
142.500	-2.211E-08	-50.1799	0.7783	2.681E-09	2519.1179	1.719E+12	0.002544	2071388.	0.000
144.000	2.143E-08	-35.7827	0.7787	2.231E-09	2519.1121	1.719E+12	-0.002503	2102678.	0.000
145.500	5.821E-08	-22.1927	0.6940	1.928E-09	2519.1066	1.719E+12	-0.006901	2133968.	0.000
147.000	9.082E-08	-10.8364	0.5336	1.755E-09	2519.1020	1.719E+12	-0.0109	2165258.	0.000
148.500	1.214E-07	-3.0187	0.3019	1.682E-09	2519.0988	1.719E+12	-0.0148	2196548.	0.000
150.000	1.514E-07	0.000	0.000	1.666E-09	2519.0976	1.719E+12	-0.0187	1113919.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =      0.1250000 inches
Computed slope at pile head      =     -0.0003100 radians
Maximum bending moment           =       1315953. inch-lbs
Maximum shear force              =  -6063.6307528 lbs
Depth of maximum bending moment  =     39.0000000 feet below pile head
Depth of maximum shear force     =     51.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              4
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.250000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2500	0.000	5704.8588	-0.000620	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.2388	108848.	5704.8588	-0.000619	2563.1603	1.719E+12	0.000	0.000	0.000
3.000	0.2277	217685.	5704.8588	-0.000618	2607.2184	1.719E+12	0.000	0.000	0.000
4.500	0.2166	326499.	5704.8588	-0.000615	2651.2673	1.719E+12	0.000	0.000	0.000
6.000	0.2056	435280.	5704.8588	-0.000611	2695.3025	1.719E+12	0.000	0.000	0.000
7.500	0.1946	544015.	5704.8588	-0.000606	2739.3193	1.719E+12	0.000	0.000	0.000
9.000	0.1838	652693.	5704.8588	-0.000600	2783.3133	1.719E+12	0.000	0.000	0.000
10.500	0.1730	761304.	5704.8588	-0.000592	2827.2797	1.719E+12	0.000	0.000	0.000
12.000	0.1624	869835.	5704.8588	-0.000584	2871.2141	1.719E+12	0.000	0.000	0.000
13.500	0.1520	978276.	5704.8588	-0.000574	2915.1119	1.719E+12	0.000	0.000	0.000
15.000	0.1418	1086615.	5704.8588	-0.000563	2958.9685	1.719E+12	0.000	0.000	0.000
16.500	0.1317	1194841.	5704.8588	-0.000551	3002.7793	1.719E+12	0.000	0.000	0.000
18.000	0.1219	1302943.	5704.8588	-0.000538	3046.5398	1.719E+12	0.000	0.000	0.000
19.500	0.1124	1410909.	5704.8588	-0.000524	3090.2454	1.719E+12	0.000	0.000	0.000
21.000	0.1031	1518728.	5704.8588	-0.000509	3133.8917	1.719E+12	0.000	0.000	0.000
22.500	0.0941	1626390.	5704.8588	-0.000492	3177.4739	1.719E+12	0.000	0.000	0.000
24.000	0.0854	1733882.	5704.8588	-0.000475	3220.9877	1.719E+12	0.000	0.000	0.000
25.500	0.0770	1841194.	5704.8588	-0.000456	3264.4285	1.719E+12	0.000	0.000	0.000
27.000	0.0689	1948315.	5704.8588	-0.000436	3307.7918	1.719E+12	0.000	0.000	0.000
28.500	0.0613	2055232.	5704.8588	-0.000415	3351.0730	1.719E+12	0.000	0.000	0.000
30.000	0.0540	2161936.	5704.8588	-0.000393	3394.2676	1.719E+12	0.000	0.000	0.000
31.500	0.0471	2268415.	5704.8588	-0.000370	3437.3713	1.719E+12	0.000	0.000	0.000
33.000	0.0407	2374658.	5704.8588	-0.000345	3480.3794	1.719E+12	0.000	0.000	0.000
34.500	0.0347	2480655.	5161.9017	-0.000320	3523.2875	1.719E+12	-60.3286	31290.	0.000
36.000	0.0292	2566846.	3705.9527	-0.000294	3558.1786	1.719E+12	-101.4435	62580.	0.000
37.500	0.0241	2619903.	1660.1537	-0.000266	3579.6564	1.719E+12	-125.8675	93870.	0.000
39.000	0.0196	2631906.	-698.3852	-0.000239	3584.5155	1.719E+12	-136.1924	125160.	0.000
40.500	0.0155	2599509.	-3139.2319	-0.000212	3571.4010	1.719E+12	-135.0128	156450.	0.000
42.000	0.0120	2523098.	-5478.0088	-0.000185	3540.4690	1.719E+12	-124.8513	187740.	0.000
43.500	0.008883	2405972.	-7574.4586	-0.000159	3493.0555	1.719E+12	-108.0875	219030.	0.000
45.000	0.006248	2253576.	-9329.2926	-0.000135	3431.3642	1.719E+12	-86.8940	250321.	0.000
46.500	0.004039	2072792.	-10680.	-0.000112	3358.1812	1.719E+12	-63.1859	281611.	0.000
48.000	0.002220	1871320.	-11596.	-9.126E-05	3276.6235	1.719E+12	-38.5857	312901.	0.000
49.500	0.000753	1657151.	-12073.	-7.279E-05	3189.9262	1.719E+12	-14.4045	344191.	0.000
51.000	-0.000401	1438143.	-12127.	-5.659E-05	3101.2699	1.719E+12	8.3607	375481.	0.000
52.500	-0.001284	1221694.	-11791.	-4.267E-05	3013.6496	1.719E+12	29.0139	406771.	0.000
54.000	-0.001937	1014519.	-11106.	-3.096E-05	2929.7833	1.719E+12	47.1345	438061.	0.000
55.500	-0.002398	822509.	-10118.	-2.134E-05	2852.0563	1.719E+12	62.5398	469351.	0.000
57.000	-0.002705	650677.	-8878.4732	-1.363E-05	2782.4973	1.719E+12	75.2392	500641.	0.000
58.500	-0.002889	503155.	-7432.8873	-7.592E-06	2722.7791	1.719E+12	85.3814	531931.	0.000

60.000	-0.002978	383244.	-5825.6848	-2.953E-06	2674.2381	1.719E+12	93.1967	563221.	0.000
61.500	-0.002996	293489.	-4096.4826	5.899E-07	2637.9045	1.719E+12	98.9369	594511.	0.000
63.000	-0.002957	235759.	-2810.3747	3.360E-06	2614.5349	1.719E+12	43.9640	267598.	0.000
64.500	-0.002875	192249.	-2311.9079	5.601E-06	2596.9216	1.719E+12	11.4212	71518.	0.000
66.000	-0.002756	152419.	-2106.6223	7.405E-06	2580.7982	1.719E+12	11.3883	74390.	0.000
67.500	-0.002608	116263.	-1903.3812	8.811E-06	2566.1620	1.719E+12	11.1941	77261.	0.000
69.000	-0.002438	83722.	-1704.9374	9.858E-06	2552.9891	1.719E+12	10.8552	80132.	0.000
70.500	-0.002253	54690.	-1513.7343	1.058E-05	2541.2365	1.719E+12	10.3896	83003.	0.000
72.000	-0.002057	29018.	-1331.8882	1.102E-05	2530.8442	1.719E+12	9.8156	85875.	0.000
73.500	-0.001856	6522.7418	-1161.1780	1.121E-05	2521.7381	1.719E+12	9.1522	88746.	0.000
75.000	-0.001654	-13007.	-1003.0420	1.117E-05	2524.3631	1.719E+12	8.4184	91617.	0.000
76.500	-0.001454	-29809.	-858.5790	1.095E-05	2531.1644	1.719E+12	7.6330	94488.	0.000
78.000	-0.001260	-44134.	-728.5547	1.056E-05	2536.9634	1.719E+12	6.8142	97359.	0.000
79.500	-0.001074	-56247.	-613.4105	1.004E-05	2541.8667	1.719E+12	5.9796	100231.	0.000
81.000	-0.000899	-66416.	-513.2749	9.394E-06	2545.9834	1.719E+12	5.1465	103102.	0.000
82.500	-0.000736	-74911.	-427.9758	8.654E-06	2549.4223	1.719E+12	4.3312	105973.	0.000
84.000	-0.000587	-81995.	-357.0527	7.833E-06	2552.2900	1.719E+12	3.5492	108844.	0.000
85.500	-0.000454	-87921.	-299.7690	6.944E-06	2554.6887	1.719E+12	2.8157	111716.	0.000
87.000	-0.000337	-92925.	-114.3360	5.997E-06	2556.7144	1.719E+12	17.7880	950188.	0.000
88.500	-0.000238	-92156.	162.4425	5.028E-06	2556.4031	1.719E+12	12.9652	981478.	0.000
90.000	-0.000156	-87177.	358.1009	4.089E-06	2554.3875	1.719E+12	8.7746	1012768.	0.000
91.500	-9.056E-05	-79346.	484.3452	3.218E-06	2551.2174	1.719E+12	5.2525	1044059.	0.000
93.000	-4.011E-05	-69804.	553.1843	2.437E-06	2547.3550	1.719E+12	2.3963	1075349.	0.000
94.500	-2.821E-06	-59479.	576.3115	1.760E-06	2543.1754	1.719E+12	0.1734	1106639.	0.000
96.000	2.326E-05	-49092.	564.6375	1.192E-06	2538.9705	1.719E+12	-1.4705	1137929.	0.000
97.500	4.009E-05	-39176.	527.9650	7.299E-07	2534.9565	1.719E+12	-2.6042	1169219.	0.000
99.000	4.954E-05	-30100.	474.7911	3.673E-07	2531.2823	1.719E+12	-3.3040	1200509.	0.000
100.500	5.331E-05	-22091.	412.2184	9.412E-08	2528.0402	1.719E+12	-3.6485	1231799.	0.000
102.000	5.293E-05	-15262.	345.9559	-1.014E-07	2525.2758	1.719E+12	-3.7140	1263089.	0.000
103.500	4.966E-05	-9634.6251	280.3878	-2.317E-07	2522.9978	1.719E+12	-3.5713	1294379.	0.000
105.000	4.458E-05	-5163.3968	218.6934	-3.092E-07	2521.1878	1.719E+12	-3.2836	1325669.	0.000
106.500	3.853E-05	-1755.5202	162.9971	-3.454E-07	2519.8082	1.719E+12	-2.9049	1356959.	0.000
108.000	3.215E-05	711.3618	115.1244	-3.509E-07	2519.3856	1.719E+12	-2.4143	1351716.	0.000
109.500	2.590E-05	2395.9293	75.4846	-3.346E-07	2520.0675	1.719E+12	-1.9901	1383007.	0.000
111.000	2.010E-05	3435.4580	43.3573	-3.041E-07	2520.4883	1.719E+12	-1.5796	1414297.	0.000
112.500	1.495E-05	3962.8355	18.3321	-2.654E-07	2520.7018	1.719E+12	-1.2010	1445587.	0.000
114.000	1.055E-05	4100.6874	-0.2678	-2.232E-07	2520.7576	1.719E+12	-0.8657	1476877.	0.000
115.500	6.921E-06	3957.6285	-13.2777	-1.810E-07	2520.6997	1.719E+12	-0.5799	1508167.	0.000
117.000	4.036E-06	3626.2849	-21.6031	-1.413E-07	2520.5655	1.719E+12	-0.3452	1539457.	0.000
118.500	1.835E-06	3182.7253	-26.1507	-1.056E-07	2520.3860	1.719E+12	-0.1601	1570747.	0.000
120.000	2.333E-07	2686.9588	-27.7786	-7.490E-08	2520.1853	1.719E+12	-0.0208	1602037.	0.000
121.500	-8.618E-07	2184.1838	-27.2618	-4.941E-08	2519.9818	1.719E+12	0.0782	1633327.	0.000
123.000	-1.545E-06	1706.5169	-25.2719	-2.904E-08	2519.7884	1.719E+12	0.1429	1664617.	0.000
124.500	-1.907E-06	1274.9730	-22.3686	-1.343E-08	2519.6137	1.719E+12	0.1797	1695907.	0.000
126.000	-2.029E-06	901.5153	-18.9993	-2.039E-09	2519.4625	1.719E+12	0.1947	1727197.	0.000
127.500	-1.981E-06	591.0388	-15.5058	5.774E-09	2519.3369	1.719E+12	0.1935	1758487.	0.000
129.000	-1.821E-06	343.1917	-12.1348	1.066E-08	2519.2365	1.719E+12	0.1811	1789777.	0.000
130.500	-1.597E-06	153.9732	-9.0514	1.327E-08	2519.1599	1.719E+12	0.1615	1821067.	0.000
132.000	-1.343E-06	17.0766	-6.3534	1.416E-08	2519.1045	1.719E+12	0.1382	1852357.	0.000
133.500	-1.087E-06	-75.0302	-4.0855	1.386E-08	2519.1280	1.719E+12	0.1137	1883648.	0.000
135.000	-8.445E-07	-130.2785	-2.2534	1.278E-08	2519.1503	1.719E+12	0.0898	1914938.	0.000
136.500	-6.266E-07	-156.4051	-0.8350	1.128E-08	2519.1609	1.719E+12	0.0678	1946228.	0.000
138.000	-4.383E-07	-160.5626	0.2082	9.624E-09	2519.1626	1.719E+12	0.0482	1977518.	0.000
139.500	-2.802E-07	-149.1024	0.9230	8.003E-09	2519.1580	1.719E+12	0.0313	2008808.	0.000
141.000	-1.502E-07	-127.4954	1.3576	6.555E-09	2519.1492	1.719E+12	0.0170	2040098.	0.000
142.500	-4.421E-08	-100.3598	1.5566	5.362E-09	2519.1382	1.719E+12	0.005088	2071388.	0.000
144.000	4.285E-08	-71.5654	1.5573	4.462E-09	2519.1266	1.719E+12	-0.005006	2102678.	0.000
145.500	1.164E-07	-44.3853	1.3880	3.855E-09	2519.1156	1.719E+12	-0.0138	2133968.	0.000
147.000	1.816E-07	-21.6728	1.0672	3.510E-09	2519.1064	1.719E+12	-0.0218	2165258.	0.000
148.500	2.428E-07	-6.0374	0.6039	3.364E-09	2519.1000	1.719E+12	-0.0296	2196548.	0.000
150.000	3.028E-07	0.000	0.000	3.333E-09	2519.0976	1.719E+12	-0.0375	1113919.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection              =      0.2500000 inches
Computed slope at pile head       =     -0.0006200 radians
Maximum bending moment            =       2631906. inch-lbs
Maximum shear force               =        -12127. lbs
Depth of maximum bending moment   =     39.0000000 feet below pile head
Depth of maximum shear force      =     51.0000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              4
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.500000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5000	0.000	11410.	-0.001240	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.4777	217696.	11410.	-0.001239	2607.2229	1.719E+12	0.000	0.000	0.000
3.000	0.4554	435370.	11410.	-0.001236	2695.3391	1.719E+12	0.000	0.000	0.000
4.500	0.4332	652999.	11410.	-0.001230	2783.4370	1.719E+12	0.000	0.000	0.000
6.000	0.4111	870559.	11410.	-0.001222	2871.5073	1.719E+12	0.000	0.000	0.000
7.500	0.3892	1088029.	11410.	-0.001212	2959.5410	1.719E+12	0.000	0.000	0.000
9.000	0.3675	1305386.	11410.	-0.001199	3047.5289	1.719E+12	0.000	0.000	0.000
10.500	0.3460	1522607.	11410.	-0.001184	3135.4618	1.719E+12	0.000	0.000	0.000
12.000	0.3249	1739670.	11410.	-0.001167	3223.3306	1.719E+12	0.000	0.000	0.000
13.500	0.3040	1956552.	11410.	-0.001148	3311.1262	1.719E+12	0.000	0.000	0.000
15.000	0.2835	2173230.	11410.	-0.001126	3398.8393	1.719E+12	0.000	0.000	0.000
16.500	0.2635	2389682.	11410.	-0.001102	3486.4610	1.719E+12	0.000	0.000	0.000
18.000	0.2439	2605885.	11410.	-0.001076	3573.9820	1.719E+12	0.000	0.000	0.000
19.500	0.2247	2821818.	11410.	-0.001048	3661.3933	1.719E+12	0.000	0.000	0.000
21.000	0.2061	3037457.	11410.	-0.001017	3748.6857	1.719E+12	0.000	0.000	0.000
22.500	0.1881	3252780.	11410.	-0.000984	3835.8503	1.719E+12	0.000	0.000	0.000
24.000	0.1707	3467764.	11410.	-0.000949	3922.8779	1.719E+12	0.000	0.000	0.000
25.500	0.1540	3682388.	11410.	-0.000912	4009.7594	1.719E+12	0.000	0.000	0.000
27.000	0.1379	3896629.	11410.	-0.000872	4096.4859	1.719E+12	0.000	0.000	0.000
28.500	0.1226	4110465.	11410.	-0.000830	4183.0483	1.719E+12	0.000	0.000	0.000
30.000	0.1080	4323873.	11410.	-0.000786	4269.4377	1.719E+12	0.000	0.000	0.000
31.500	0.0943	4536831.	11410.	-0.000739	4355.6449	1.719E+12	0.000	0.000	0.000
33.000	0.0814	4749317.	11410.	-0.000691	4441.6611	1.719E+12	0.000	0.000	0.000
34.500	0.0694	4961309.	10324.	-0.000640	4527.4773	1.719E+12	-120.6571	31290.	0.000
36.000	0.0584	5133692.	7411.9055	-0.000587	4597.2595	1.719E+12	-202.8871	62580.	0.000
37.500	0.0483	5239806.	3320.3075	-0.000533	4640.2153	1.719E+12	-251.7349	93870.	0.000
39.000	0.0392	5263813.	-1396.7704	-0.000478	4649.9333	1.719E+12	-272.3848	125160.	0.000
40.500	0.0311	5199019.	-6278.4639	-0.000423	4623.7043	1.719E+12	-270.0255	156450.	0.000
42.000	0.0239	5046196.	-10956.	-0.000369	4561.8404	1.719E+12	-249.7027	187740.	0.000
43.500	0.0178	4811945.	-15149.	-0.000318	4467.0135	1.719E+12	-216.1751	219030.	0.000
45.000	0.0125	4507152.	-18659.	-0.000269	4343.6309	1.719E+12	-173.7880	250321.	0.000
46.500	0.008077	4145584.	-21360.	-0.000224	4197.2648	1.719E+12	-126.3718	281611.	0.000
48.000	0.004439	3742639.	-23192.	-0.000183	4034.1495	1.719E+12	-77.1714	312901.	0.000
49.500	0.001507	3314302.	-24146.	-0.000146	3860.7549	1.719E+12	-28.8089	344191.	0.000
51.000	-0.000802	2876286.	-24255.	-0.000113	3683.4423	1.719E+12	16.7215	375481.	0.000
52.500	-0.002568	2443388.	-23582.	-8.533E-05	3508.2017	1.719E+12	58.0279	406771.	0.000
54.000	-0.003874	2029037.	-22211.	-6.192E-05	3340.4690	1.719E+12	94.2690	438061.	0.000
55.500	-0.004797	1645019.	-20237.	-4.269E-05	3185.0150	1.719E+12	125.0796	469351.	0.000
57.000	-0.005410	1301355.	-17757.	-2.726E-05	3045.8969	1.719E+12	150.4785	500641.	0.000
58.500	-0.005778	1006310.	-14866.	-1.518E-05	2926.4605	1.719E+12	170.7628	531931.	0.000

60.000	-0.005957	766489.	-11651.	-5.905E-06	2829.3786	1.719E+12	186.3933	563221.	0.000
61.500	-0.005991	586978.	-8192.9651	1.180E-06	2756.7114	1.719E+12	197.8738	594511.	0.000
63.000	-0.005914	471518.	-5620.7494	6.721E-06	2709.9722	1.719E+12	87.9279	267598.	0.000
64.500	-0.005749	384498.	-4623.8158	1.120E-05	2674.7456	1.719E+12	22.8425	71518.	0.000
66.000	-0.005511	304838.	-4213.2445	1.481E-05	2642.4987	1.719E+12	22.7765	74390.	0.000
67.500	-0.005216	232527.	-3806.7624	1.762E-05	2613.2264	1.719E+12	22.3881	77261.	0.000
69.000	-0.004877	167445.	-3409.8748	1.972E-05	2586.8806	1.719E+12	21.7105	80132.	0.000
70.500	-0.004506	109379.	-3027.4686	2.117E-05	2563.3753	1.719E+12	20.7791	83003.	0.000
72.000	-0.004115	58035.	-2663.7763	2.204E-05	2542.5907	1.719E+12	19.6311	85875.	0.000
73.500	-0.003713	13045.	-2322.3561	2.241E-05	2524.3785	1.719E+12	18.3044	88746.	0.000
75.000	-0.003308	-26015.	-2006.0840	2.235E-05	2529.6287	1.719E+12	16.8369	91617.	0.000
76.500	-0.002908	-59618.	-1717.1580	2.190E-05	2543.2313	1.719E+12	15.2660	94488.	0.000
78.000	-0.002520	-88268.	-1457.1093	2.112E-05	2554.8292	1.719E+12	13.6283	97359.	0.000
79.500	-0.002148	-112493.	-1226.8209	2.007E-05	2564.6358	1.719E+12	11.9593	100231.	0.000
81.000	-0.001797	-132832.	-1026.5498	1.879E-05	2572.8692	1.719E+12	10.2931	103102.	0.000
82.500	-0.001471	-149822.	-855.9516	1.731E-05	2579.7470	1.719E+12	8.6623	105973.	0.000
84.000	-0.001174	-163990.	-714.1055	1.567E-05	2585.4823	1.719E+12	7.0984	108844.	0.000
85.500	-0.000907	-175842.	-599.5379	1.389E-05	2590.2798	1.719E+12	5.6314	111716.	0.000
87.000	-0.000674	-185850.	-228.6721	1.199E-05	2594.3312	1.719E+12	35.5760	950188.	0.000
88.500	-0.000476	-184312.	324.8849	1.006E-05	2593.7087	1.719E+12	25.9304	981478.	0.000
90.000	-0.000312	-174354.	716.2017	8.179E-06	2589.6775	1.719E+12	17.5493	1012768.	0.000
91.500	-0.000181	-158691.	968.6903	6.436E-06	2583.3372	1.719E+12	10.5050	1044059.	0.000
93.000	-8.022E-05	-139609.	1106.3685	4.874E-06	2575.6124	1.719E+12	4.7926	1075349.	0.000
94.500	-5.641E-06	-118959.	1152.6230	3.521E-06	2567.2532	1.719E+12	0.3468	1106639.	0.000
96.000	4.652E-05	-98184.	1129.2750	2.384E-06	2558.8435	1.719E+12	-2.9410	1137929.	0.000
97.500	8.018E-05	-78352.	1055.9300	1.460E-06	2550.8153	1.719E+12	-5.2084	1169219.	0.000
99.000	9.908E-05	-60200.	949.5822	7.346E-07	2543.4670	1.719E+12	-6.6080	1200509.	0.000
100.500	0.000107	-44182.	824.4369	1.882E-07	2536.9829	1.719E+12	-7.2970	1231799.	0.000
102.000	0.000106	-30524.	691.9117	-2.028E-07	2531.4539	1.719E+12	-7.4280	1263089.	0.000
103.500	9.933E-05	-19269.	560.7757	-4.635E-07	2526.8979	1.719E+12	-7.1427	1294379.	0.000
105.000	8.917E-05	-10327.	437.3867	-6.184E-07	2523.2780	1.719E+12	-6.5672	1325669.	0.000
106.500	7.707E-05	-3511.0403	325.9941	-6.908E-07	2520.5189	1.719E+12	-5.8097	1356959.	0.000
108.000	6.430E-05	1422.7235	230.2487	-7.018E-07	2519.6735	1.719E+12	-4.8286	1351716.	0.000
109.500	5.180E-05	4791.8586	150.9693	-6.692E-07	2521.0374	1.719E+12	-3.9802	1383007.	0.000
111.000	4.021E-05	6870.9160	86.7146	-6.082E-07	2521.8790	1.719E+12	-3.1592	1414297.	0.000
112.500	2.991E-05	7925.6710	36.6642	-5.307E-07	2522.3060	1.719E+12	-2.4019	1445587.	0.000
114.000	2.110E-05	8201.3747	-0.5356	-4.463E-07	2522.4176	1.719E+12	-1.7314	1476877.	0.000
115.500	1.384E-05	7915.2569	-26.5555	-3.619E-07	2522.3018	1.719E+12	-1.1597	1508167.	0.000
117.000	8.072E-06	7252.5697	-43.2061	-2.825E-07	2522.0335	1.719E+12	-0.6904	1539457.	0.000
118.500	3.670E-06	6365.4507	-52.3014	-2.113E-07	2521.6744	1.719E+12	-0.3202	1570747.	0.000
120.000	4.667E-07	5373.9176	-55.5572	-1.498E-07	2521.2730	1.719E+12	-0.0415	1602037.	0.000
121.500	-1.724E-06	4368.3675	-54.5235	-9.881E-08	2520.8659	1.719E+12	0.1564	1633327.	0.000
123.000	-3.091E-06	3413.0338	-50.5438	-5.808E-08	2520.4792	1.719E+12	0.2858	1664617.	0.000
124.500	-3.814E-06	2549.9461	-44.7371	-2.686E-08	2520.1298	1.719E+12	0.3594	1695907.	0.000
126.000	-4.058E-06	1803.0306	-37.9986	-4.079E-09	2519.8275	1.719E+12	0.3894	1727197.	0.000
127.500	-3.961E-06	1182.0776	-31.0116	1.155E-08	2519.5761	1.719E+12	0.3870	1758487.	0.000
129.000	-3.642E-06	686.3834	-24.2696	2.133E-08	2519.3754	1.719E+12	0.3621	1789777.	0.000
130.500	-3.193E-06	307.9464	-18.1029	2.653E-08	2519.2223	1.719E+12	0.3231	1821067.	0.000
132.000	-2.687E-06	34.1533	-12.7068	2.832E-08	2519.1114	1.719E+12	0.2765	1852357.	0.000
133.500	-2.174E-06	-150.0604	-8.1711	2.772E-08	2519.1583	1.719E+12	0.2275	1883648.	0.000
135.000	-1.689E-06	-260.5570	-4.5067	2.557E-08	2519.2031	1.719E+12	0.1797	1914938.	0.000
136.500	-1.253E-06	-312.8102	-1.6700	2.257E-08	2519.2242	1.719E+12	0.1355	1946228.	0.000
138.000	-8.766E-07	-321.1253	0.4163	1.925E-08	2519.2276	1.719E+12	0.0963	1977518.	0.000
139.500	-5.604E-07	-298.2048	1.8459	1.601E-08	2519.2183	1.719E+12	0.0625	2008808.	0.000
141.000	-3.004E-07	-254.9907	2.7152	1.311E-08	2519.2008	1.719E+12	0.0340	2040098.	0.000
142.500	-8.843E-08	-200.7197	3.1131	1.072E-08	2519.1788	1.719E+12	0.0102	2071388.	0.000
144.000	8.570E-08	-143.1308	3.1146	8.924E-09	2519.1555	1.719E+12	-0.0100	2102678.	0.000
145.500	2.329E-07	-88.7707	2.7761	7.711E-09	2519.1335	1.719E+12	-0.0276	2133968.	0.000
147.000	3.633E-07	-43.3456	2.1343	7.019E-09	2519.1151	1.719E+12	-0.0437	2165258.	0.000
148.500	4.855E-07	-12.0748	1.2078	6.729E-09	2519.1025	1.719E+12	-0.0593	2196548.	0.000
150.000	6.055E-07	0.000	0.000	6.666E-09	2519.0976	1.719E+12	-0.0749	1113919.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection              =      0.5000000 inches
Computed slope at pile head       =     -0.0012401 radians
Maximum bending moment            =       5263813. inch-lbs
Maximum shear force               =        -24255. lbs
Depth of maximum bending moment   =     39.0000000 feet below pile head
Depth of maximum shear force      =     51.0000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              4
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 1.000000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	0.000	22413.	-0.002467	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.9556	427938.	22413.	-0.002465	2692.3304	1.719E+12	0.000	0.000	0.000
3.000	0.9113	855831.	22413.	-0.002458	2865.5452	1.719E+12	0.000	0.000	0.000
4.500	0.8671	1283635.	22413.	-0.002447	3038.7240	1.719E+12	0.000	0.000	0.000
6.000	0.8232	1711306.	22413.	-0.002431	3211.8487	1.719E+12	0.000	0.000	0.000
7.500	0.7796	2138799.	22413.	-0.002411	3384.9013	1.719E+12	0.000	0.000	0.000
9.000	0.7364	2566069.	22413.	-0.002386	3557.8639	1.719E+12	0.000	0.000	0.000
10.500	0.6937	2993072.	22413.	-0.002357	3730.7184	1.719E+12	0.000	0.000	0.000
12.000	0.6515	3419764.	22413.	-0.002324	3903.4469	1.719E+12	0.000	0.000	0.000
13.500	0.6100	3846100.	22413.	-0.002286	4076.0314	1.719E+12	0.000	0.000	0.000
15.000	0.5692	4272036.	22413.	-0.002243	4248.4539	1.719E+12	0.000	0.000	0.000
16.500	0.5293	4697528.	22413.	-0.002196	4420.6965	1.719E+12	0.000	0.000	0.000
18.000	0.4902	5122531.	22413.	-0.002145	4592.7414	1.719E+12	0.000	0.000	0.000
19.500	0.4520	5547001.	22413.	-0.002089	4764.5705	1.719E+12	0.000	0.000	0.000
21.000	0.4150	5970894.	22413.	-0.002029	4936.1660	1.719E+12	0.000	0.000	0.000
22.500	0.3790	6394167.	22413.	-0.001964	5107.5102	1.719E+12	0.000	0.000	0.000
24.000	0.3443	6816774.	22413.	-0.001895	5278.5850	1.719E+12	0.000	0.000	0.000
25.500	0.3108	7238671.	22413.	-0.001821	5449.3728	1.719E+12	0.000	0.000	0.000
27.000	0.2787	7659816.	22413.	-0.001743	5619.8559	1.719E+12	0.000	0.000	0.000
28.500	0.2480	8080164.	22413.	-0.001661	5790.0163	1.719E+12	0.000	0.000	0.000
30.000	0.2189	8499672.	22413.	-0.001574	5959.8365	1.719E+12	0.000	0.000	0.000
31.500	0.1914	8918295.	22413.	-0.001483	6129.2988	1.719E+12	0.000	0.000	0.000
33.000	0.1655	9335991.	22413.	-0.001387	6298.3856	1.719E+12	0.000	0.000	0.000
34.500	0.1414	9752716.	20941.	-0.001287	6467.0792	1.719E+12	-163.5193	20812.	0.000
36.000	0.1192	10115446.	16437.	-0.001183	6613.9153	1.719E+12	-336.8959	50886.	0.000
37.500	0.0988	10367969.	8966.4362	-0.001076	6716.1389	1.719E+12	-493.1789	89830.	0.000
39.000	0.0804	10459624.	-505.3396	-0.000967	6753.2416	1.719E+12	-559.2406	125160.	0.000
40.500	0.0640	10368997.	-10545.	-0.000858	6716.5550	1.719E+12	-556.2994	156450.	0.000
42.000	0.0495	10097050.	-20202.	-0.000751	6606.4687	1.719E+12	-516.6378	187740.	0.000
43.500	0.0370	9656662.	-28900.	-0.000648	6428.1960	1.719E+12	-449.8223	219030.	0.000
45.000	0.0262	9069528.	-36230.	-0.000550	6190.5190	1.719E+12	-364.6216	250321.	0.000
46.500	0.0172	8363312.	-41931.	-0.000458	5904.6370	1.719E+12	-268.7948	281611.	0.000
48.000	0.009719	7569138.	-45870.	-0.000375	5583.1483	1.719E+12	-168.9414	312901.	0.000
49.500	0.003683	6719438.	-48024.	-0.000300	5239.1829	1.719E+12	-70.4188	344191.	0.000
51.000	-0.001087	5846224.	-48454.	-0.000234	4885.6986	1.719E+12	22.6747	375481.	0.000
52.500	-0.004755	4979749.	-47283.	-0.000178	4534.9420	1.719E+12	107.4542	406771.	0.000
54.000	-0.007484	4147571.	-44677.	-0.000130	4198.0692	1.719E+12	182.1481	438061.	0.000
55.500	-0.009432	3373977.	-40824.	-9.056E-05	3884.9119	1.719E+12	245.9518	469351.	0.000
57.000	-0.0107	2679721.	-35920.	-5.887E-05	3603.8711	1.719E+12	298.8438	500641.	0.000
58.500	-0.0116	2082011.	-30158.	-3.394E-05	3361.9131	1.719E+12	341.3747	531931.	0.000

60.000	-0.0120	1594690.	-23716.	-1.470E-05	3164.6415	1.719E+12	374.4352	563221.	0.000
61.500	-0.0121	1228520.	-16755.	8.042E-08	3016.4129	1.719E+12	399.0126	594511.	0.000
63.000	-0.0120	991503.	-11563.	1.170E-05	2920.4663	1.719E+12	177.8589	267598.	0.000
64.500	-0.0117	812008.	-9545.6434	2.114E-05	2847.8055	1.719E+12	46.3266	71518.	0.000
66.000	-0.0112	647439.	-8712.0266	2.878E-05	2781.1866	1.719E+12	46.2975	74390.	0.000
67.500	-0.0106	497804.	-7884.9587	3.478E-05	2720.6127	1.719E+12	45.5989	77261.	0.000
69.000	-0.009951	362890.	-7075.8865	3.928E-05	2665.9985	1.719E+12	44.2980	80132.	0.000
70.500	-0.009209	242291.	-6295.0011	4.245E-05	2617.1790	1.719E+12	42.4670	83003.	0.000
72.000	-0.008422	135426.	-5551.1616	4.443E-05	2573.9193	1.719E+12	40.1818	85875.	0.000
73.500	-0.007610	41566.	-4851.8484	4.535E-05	2535.9240	1.719E+12	37.5197	88746.	0.000
75.000	-0.006790	-40142.	-4203.1452	4.536E-05	2535.3472	1.719E+12	34.5585	91617.	0.000
76.500	-0.005977	-110648.	-3609.7412	4.457E-05	2563.8890	1.719E+12	31.3753	94488.	0.000
78.000	-0.005185	-170978.	-3074.9527	4.310E-05	2588.3109	1.719E+12	28.0456	97359.	0.000
79.500	-0.004425	-222203.	-2600.7571	4.104E-05	2609.0473	1.719E+12	24.6428	100231.	0.000
81.000	-0.003708	-265421.	-2187.8359	3.849E-05	2626.5421	1.719E+12	21.2374	103102.	0.000
82.500	-0.003040	-301730.	-1835.6221	3.552E-05	2641.2404	1.719E+12	17.8975	105973.	0.000
84.000	-0.002429	-332209.	-1542.3493	3.220E-05	2653.5786	1.719E+12	14.6884	108844.	0.000
85.500	-0.001881	-357894.	-1305.0974	2.859E-05	2663.9763	1.719E+12	11.6729	111716.	0.000
87.000	-0.001400	-379761.	-534.9388	2.473E-05	2672.8279	1.719E+12	73.9002	950188.	0.000
88.500	-0.000991	-377644.	616.3169	2.076E-05	2671.9709	1.719E+12	54.0171	981478.	0.000
90.000	-0.000653	-357986.	1432.9059	1.691E-05	2664.0132	1.719E+12	36.7151	1012768.	0.000
91.500	-0.000382	-326395.	1962.6957	1.333E-05	2651.2250	1.719E+12	22.1505	1044059.	0.000
93.000	-0.000173	-287593.	2254.9252	1.011E-05	2635.5179	1.719E+12	10.3195	1075349.	0.000
94.500	-1.778E-05	-245419.	2357.6401	7.324E-06	2618.4451	1.719E+12	1.0933	1106639.	0.000
96.000	9.092E-05	-202864.	2315.7485	4.977E-06	2601.2186	1.719E+12	-5.7479	1137929.	0.000
97.500	0.000161	-162151.	2169.6632	3.067E-06	2584.7375	1.719E+12	-10.4838	1169219.	0.000
99.000	0.000201	-124817.	1954.4680	1.564E-06	2569.6246	1.719E+12	-13.4268	1200509.	0.000
100.500	0.000218	-91821.	1699.5373	4.303E-07	2556.2674	1.719E+12	-14.8989	1231799.	0.000
102.000	0.000217	-63642.	1428.5233	-3.834E-07	2544.8605	1.719E+12	-15.2138	1263089.	0.000
103.500	0.000204	-40386.	1159.6308	-9.280E-07	2535.4463	1.719E+12	-14.6631	1294379.	0.000
105.000	0.000183	-21877.	906.0981	-1.254E-06	2527.9536	1.719E+12	-13.5071	1325669.	0.000
106.500	0.000159	-7741.9068	676.8123	-1.409E-06	2522.2316	1.719E+12	-11.9691	1356959.	0.000
108.000	0.000133	2516.1302	479.4192	-1.436E-06	2520.1161	1.719E+12	-9.9635	1351716.	0.000
109.500	0.000107	9545.7270	315.7141	-1.373E-06	2522.9618	1.719E+12	-8.2259	1383007.	0.000
111.000	8.324E-05	13909.	182.8150	-1.250E-06	2524.7281	1.719E+12	-6.5406	1414297.	0.000
112.500	6.205E-05	16152.	79.1019	-1.093E-06	2525.6360	1.719E+12	-4.9830	1445587.	0.000
114.000	4.389E-05	16779.	1.8414	-9.207E-07	2525.8897	1.719E+12	-3.6015	1476877.	0.000
115.500	2.890E-05	16236.	-52.3674	-7.478E-07	2525.6703	1.719E+12	-2.4217	1508167.	0.000
117.000	1.697E-05	14908.	-87.2267	-5.848E-07	2525.1325	1.719E+12	-1.4515	1539457.	0.000
118.500	7.850E-06	13108.	-106.4557	-4.382E-07	2524.4038	1.719E+12	-0.6850	1570747.	0.000
120.000	1.198E-06	11084.	-113.5807	-3.115E-07	2523.5847	1.719E+12	-0.1066	1602037.	0.000
121.500	-3.365E-06	9025.2422	-111.7926	-2.063E-07	2522.7511	1.719E+12	0.3053	1633327.	0.000
123.000	-6.227E-06	7064.0188	-103.8618	-1.220E-07	2521.9572	1.719E+12	0.5759	1664617.	0.000
124.500	-7.758E-06	5288.6428	-92.1004	-5.738E-08	2521.2385	1.719E+12	0.7309	1695907.	0.000
126.000	-8.293E-06	3749.5437	-78.3604	-1.006E-08	2520.6154	1.719E+12	0.7957	1727197.	0.000
127.500	-8.120E-06	2467.8668	-64.0592	2.248E-08	2520.0966	1.719E+12	0.7933	1758487.	0.000
129.000	-7.483E-06	1442.9670	-50.2227	4.295E-08	2519.6817	1.719E+12	0.7441	1789777.	0.000
130.500	-6.574E-06	658.9964	-37.5401	5.396E-08	2519.3644	1.719E+12	0.6651	1821067.	0.000
132.000	-5.541E-06	90.4509	-26.4224	5.788E-08	2519.1342	1.719E+12	0.5702	1852357.	0.000
133.500	-4.490E-06	-293.3607	-17.0615	5.682E-08	2519.2163	1.719E+12	0.4699	1883648.	0.000
135.000	-3.495E-06	-524.8906	-9.4856	5.253E-08	2519.3101	1.719E+12	0.3719	1914938.	0.000
136.500	-2.599E-06	-635.8848	-3.6095	4.646E-08	2519.3550	1.719E+12	0.2810	1946228.	0.000
138.000	-1.823E-06	-655.7573	0.7222	3.970E-08	2519.3630	1.719E+12	0.2003	1977518.	0.000
139.500	-1.170E-06	-610.6758	3.6998	3.307E-08	2519.3448	1.719E+12	0.1306	2008808.	0.000
141.000	-6.324E-07	-523.2208	5.5202	2.713E-08	2519.3094	1.719E+12	0.0717	2040098.	0.000
142.500	-1.934E-07	-412.4868	6.3656	2.223E-08	2519.2646	1.719E+12	0.0223	2071388.	0.000
144.000	1.680E-07	-294.5000	6.3893	1.853E-08	2519.2168	1.719E+12	-0.0196	2102678.	0.000
145.500	4.738E-07	-182.8401	5.7071	1.603E-08	2519.1716	1.719E+12	-0.0562	2133968.	0.000
147.000	7.452E-07	-89.3613	4.3948	1.461E-08	2519.1338	1.719E+12	-0.0896	2165258.	0.000
148.500	9.998E-07	-24.9177	2.4900	1.401E-08	2519.1077	1.719E+12	-0.1220	2196548.	0.000
150.000	1.250E-06	0.000	0.000	1.388E-08	2519.0976	1.719E+12	-0.1547	1113919.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =      1.0000000 inches
Computed slope at pile head      =     -0.0024670 radians
Maximum bending moment           =      10459624. inch-lbs
Maximum shear force              =        -48454. lbs
Depth of maximum bending moment  =     39.0000000 feet below pile head
Depth of maximum shear force     =     51.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              4
```

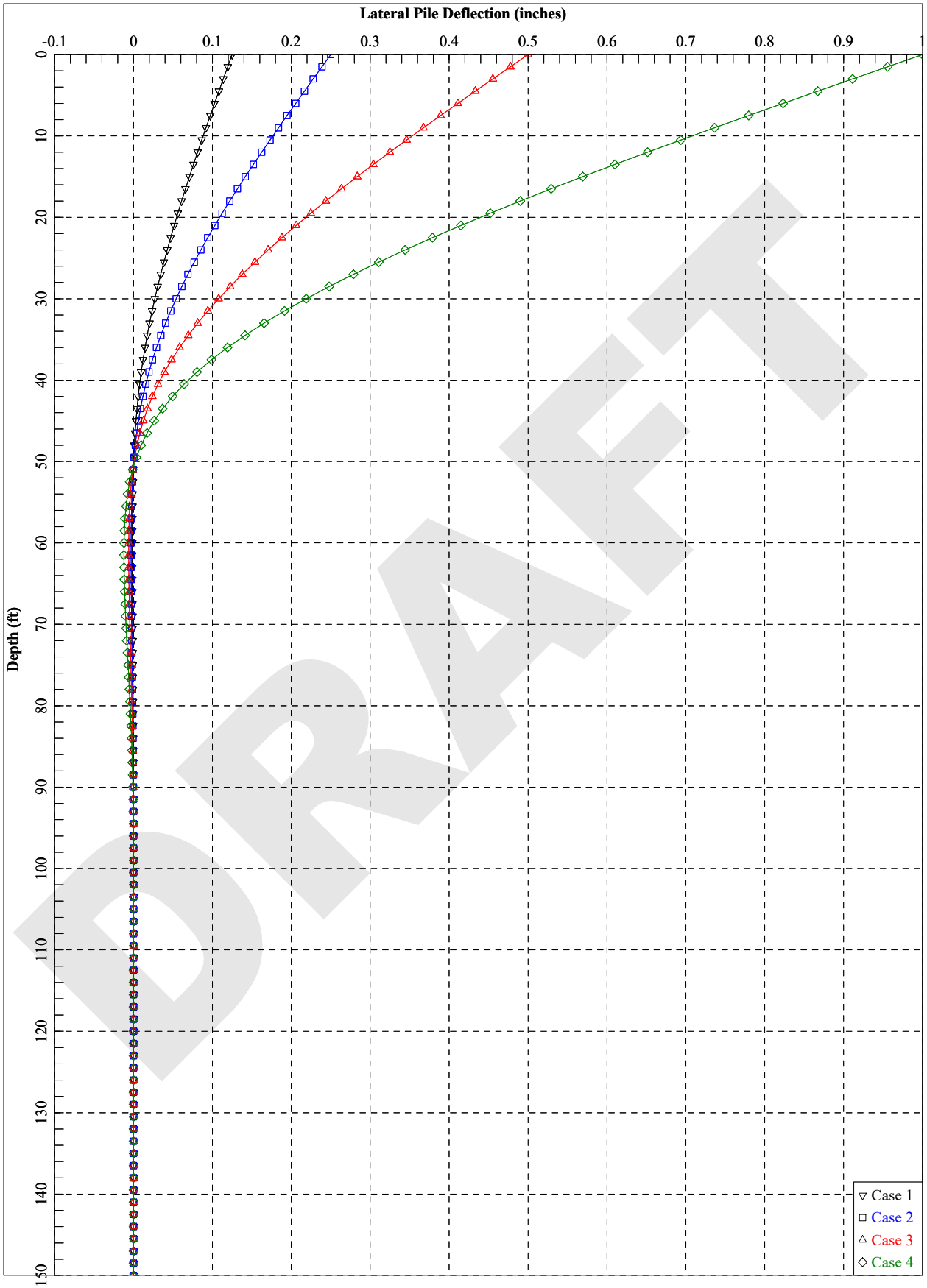
Summary of Pile Response(s)

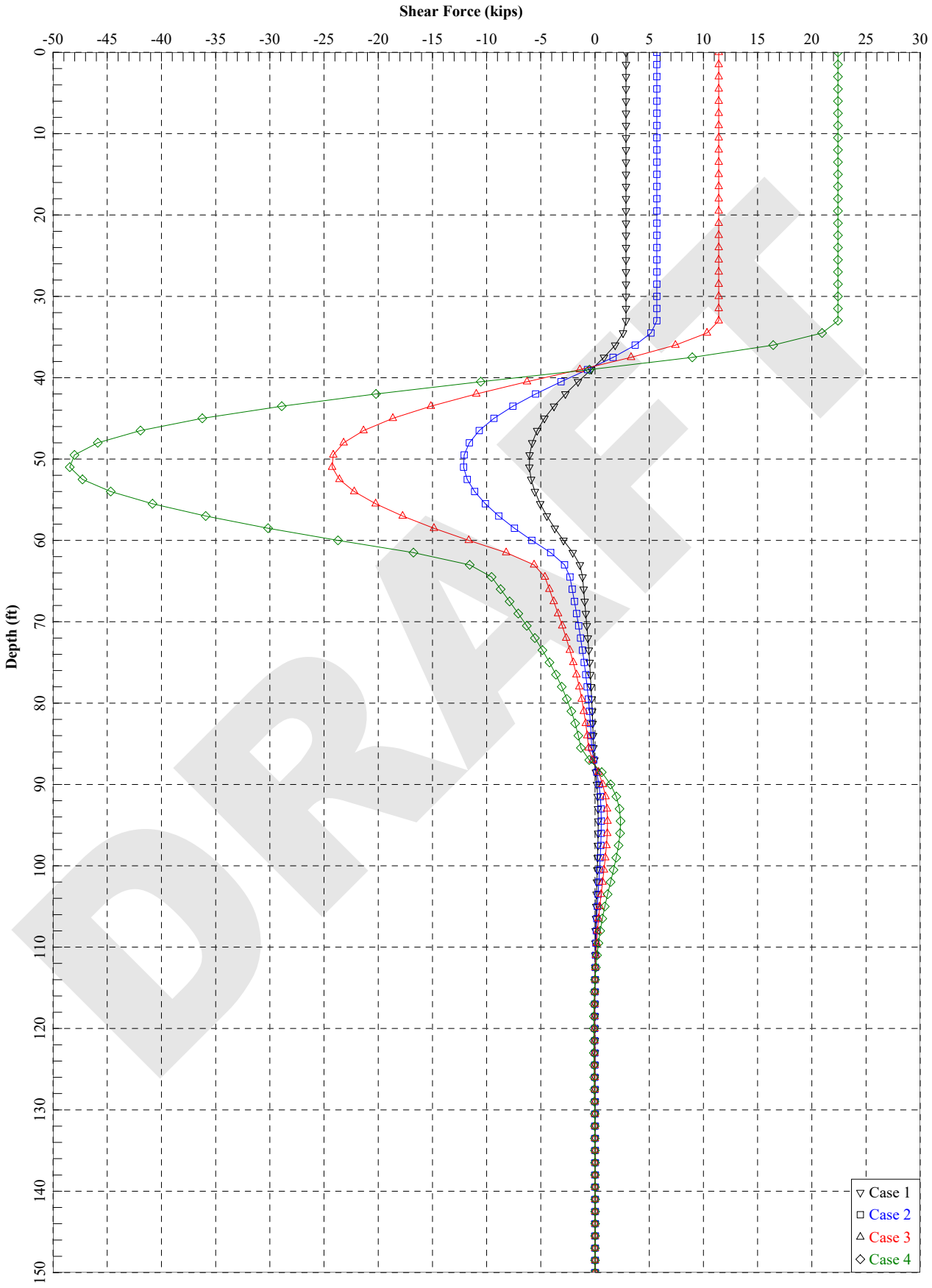
Definitions of Pile-head Loading Conditions:

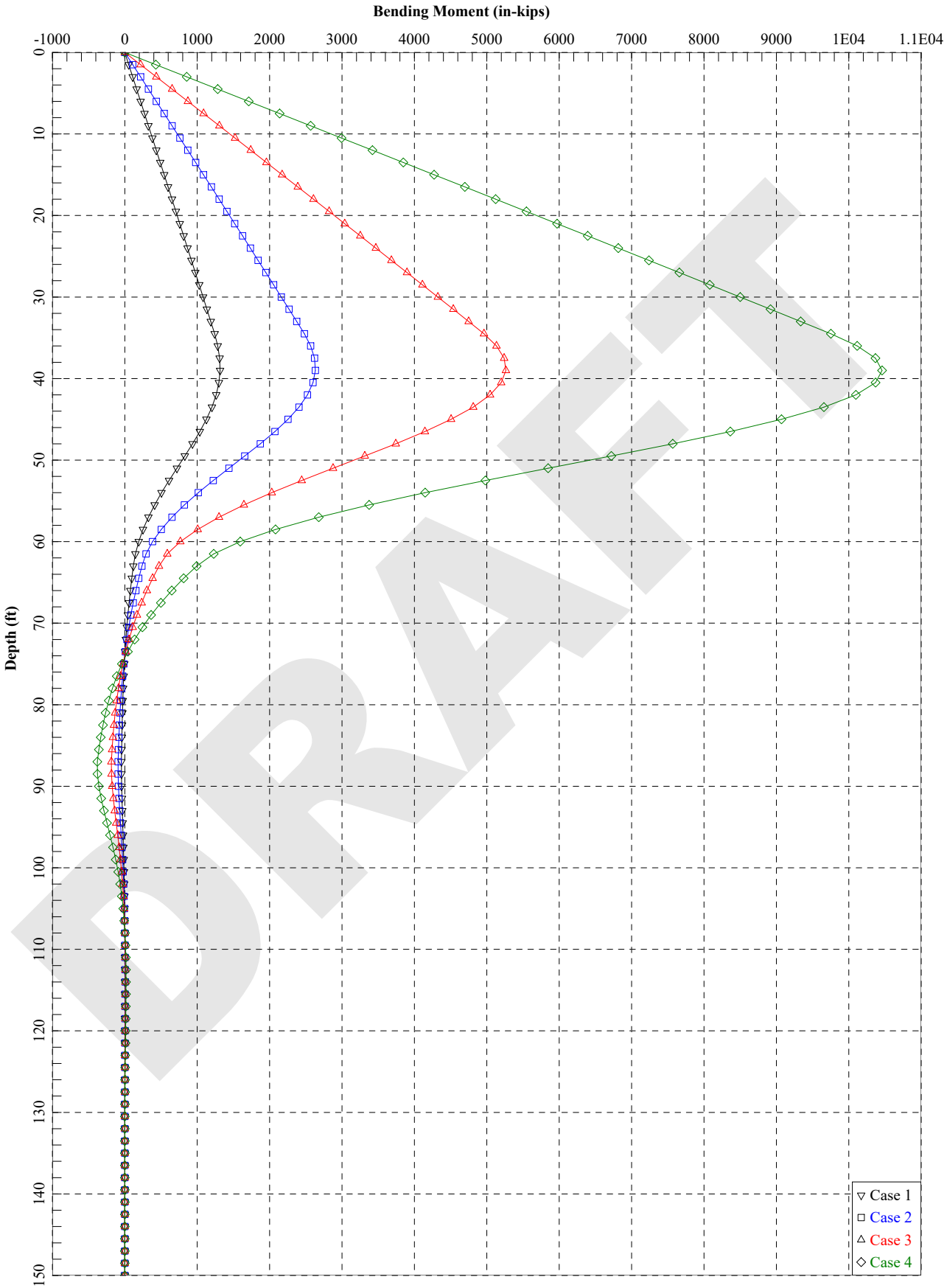
Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

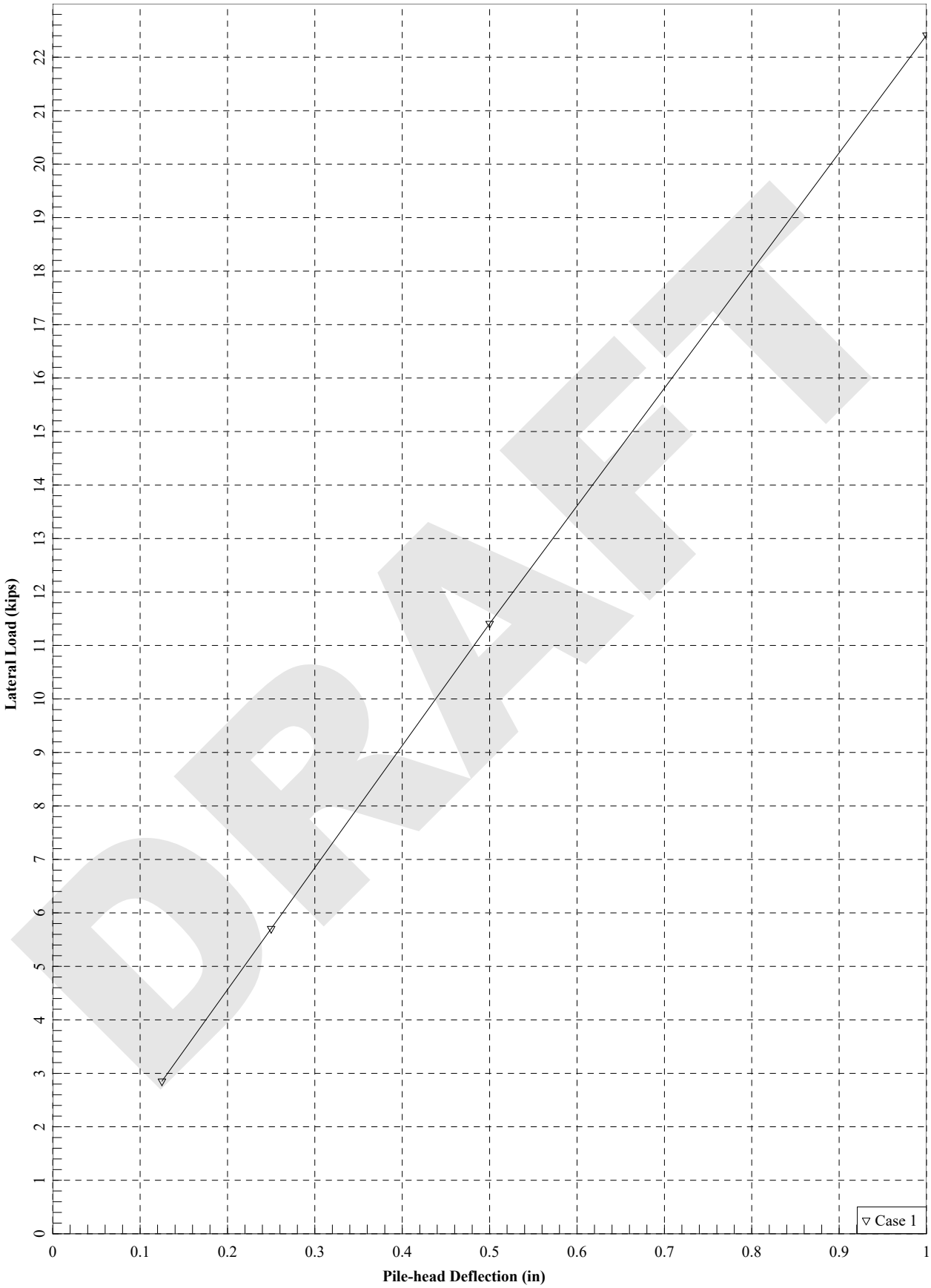
Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	4	y = 0.1250	M = 0.000	552000.	0.12500000	1315953.	-6063.6308	-0.00031002
2	4	y = 0.2500	M = 0.000	552000.	0.25000000	2631906.	-12127.	-0.00062004
3	4	y = 0.5000	M = 0.000	552000.	0.50000000	5263813.	-24255.	-0.00124009
4	4	y = 1.0000	M = 0.000	552000.	1.00000000	10459624.	-48454.	-0.00246703

The analysis ended normally.


Lateral Pile Deflection (inches)
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Shear Force (kips)
-50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30
Depth (ft)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Case 1
Case 2
Case 3
Case 4


Bending Moment (in-kips)
-1000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E04
1.1E04
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Lateral Load (kips)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pile-head Deflection (in)
▽ Case 1

```
================================================================================

                  LPile Plus for Windows, Version 2013-07.007

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        P:\Four Hole Swamp\LPILE\2016-03-02\
Name of input data file:       FHS_4-1.5OEP_WZ_deepscour_load_type_5.lp7d
Name of output report file:    FHS_4-1.5OEP_WZ_deepscour_load_type_5.lp7o
Name of plot output file:      FHS_4-1.5OEP_WZ_deepscour_load_type_5.lp7p
Name of runtime messeage file: FHS_4-1.5OEP_WZ_deepscour_load_type_5.lp7r


--------------------------------------------------------------------------------
                          Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  March 2, 2016     Time:  16:40:49


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Project Name: US 301 RBO Four Hole Swamp


Job Number: 41503-0002-0001


Client: SCDOT


Engineer: Gabriel Burnworth


Description: 48" OEP (1.5" walls) Weak Zone, 83' scour elev., Fixed Head



--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
```

```
 - Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed                =          500
- Deflection tolerance for convergence                =   1.0000E-05 in
- Maximum allowable deflection                        =     100.0000 in
- Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
 - Compute pile response under loading and nonlinear bending properties of pile
   (only if nonlinear pile properties are input)
 - Use of p-y modification factors for p-y curves not selected
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - No p-y curves to be computed and reported for user-specified depths
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1


---------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Total number of pile sections                        =       1

Total length of pile                                 =     150.00 ft

Depth of ground surface below top of pile            =      33.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile.

Point         Depth              Pile
                X              Diameter
                ft                in
-----       ---------        -----------
  1          0.00000         48.0000000
  2        150.000000        48.0000000


Input Structural Properties:
----------------------------

Pile Section No. 1:

   Section Type                                      = Steel Pipe Pile
   Section Length                                    =    150.00000 ft
   Pile Diameter                                     =     48.00000 in


---------------------------------------------------------------------------
                      Ground Slope and Pile Batter Angles
---------------------------------------------------------------------------

Ground Slope Angle                                   =        0.000 degrees
                                                     =        0.000 radians
```

```
Pile Batter Angle                                   =        0.000 degrees
                                                    =        0.000 radians


--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     33.00000 ft
   Distance from top of pile to bottom of layer     =     63.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     63.00000 ft
   Distance from top of pile to bottom of layer     =     86.00000 ft
   Effective unit weight at top of layer            =     22.00000 pcf
   Effective unit weight at bottom of layer         =     22.00000 pcf
   Friction angle at top of layer                   =     24.00000 deg.
   Friction angle at bottom of layer                =     24.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     86.00000 ft
   Distance from top of pile to bottom of layer     =    108.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =    108.00000 ft
   Distance from top of pile to bottom of layer     =    206.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

   (Depth of lowest soil layer extends   56.00 ft below pile tip)


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Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	kpy pci
1	Sand (Reese, et al.)	33.000	57.600	36.000	default
		63.000	57.600	36.000	default
2	Sand (Reese, et al.)	63.000	22.000	24.000	default
		86.000	22.000	24.000	default
3	Sand (Reese, et al.)	86.000	57.600	36.000	default
		108.000	57.600	36.000	default
4	Sand (Reese, et al.)	108.000	57.600	36.000	default
		206.000	57.600	36.000	default

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	5	y = 0.12500 in	S = 0.0000 in/in	552000.	No
2	5	y = 0.25000 in	S = 0.0000 in/in	552000.	No
3	5	y = 0.50000 in	S = 0.0000 in/in	552000.	No
4	5	y = 1.00000 in	S = 0.0000 in/in	552000.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel Pipe Pile:

Length of Section	=	150.00000 ft
Outer Diameter of Pipe	=	48.00000 in
Pipe Wall Thickness	=	1.50000 in
Yield Stress of Pipe	=	36.00000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	219.12609 sq. in.

```
Moment of Inertia                                  =       59287. in^4
Elastic Bending Stiffness                          =   1.7193E+09 kip-in^2
Plastic Modulus, Z                                 =   3244.50000 in^3
Plastic Moment Capacity = Fy Z                     =      116802. in-kip

Axial Structural Capacities:
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Nom. Axial Structural Capacity = Fy As             =     7888.539 kips
Nominal Axial Tensile Capacity                     =    -7888.539 kips



Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

   Number     Axial Thrust Force
                     kips
   ------     ------------------
      1              552.000

Definition of Run Messages:

   Y = part of pipe section has yielded.


Axial Thrust Force =    552.000 kips

    Bending       Bending       Bending       Depth to     Max Total    Run
   Curvature      Moment       Stiffness       N Axis        Stress     Msg
    rad/in.       in-kip        kip-in2          in           ksi
 ------------- ------------- ------------- ------------- ------------- ---
   0.000001054  1811.9939796  1719329760.   106.4231912     3.2452738
   0.000002108  3623.9879591  1719329760.    65.2115956     3.9714500
   0.000003162  5435.9819387  1719329760.    51.4743971     4.6976261
   0.000004216  7247.9759182  1719329760.    44.6057978     5.4238024
   0.000005269  9059.9698978  1719329760.    40.4846382     6.1499785
   0.000006323       10872.   1719329760.    37.7371985     6.8761547
   0.000007377       12684.   1719329760.    35.7747416     7.6023309
   0.000008431       14496.   1719329760.    34.3028989     8.3285071
   0.000009485       16308.   1719329760.    33.1581324     9.0546833
     0.0000105       18120.   1719329760.    32.2423191     9.7808595
     0.0000116       19932.   1719329760.    31.4930174    10.5070357
     0.0000126       21744.   1719329760.    30.8685993    11.2332119
     0.0000137       23556.   1719329760.    30.3402455    11.9593881
     0.0000148       25368.   1719329760.    29.8873708    12.6855643
     0.0000158       27180.   1719329760.    29.4948794    13.4117405
     0.0000169       28992.   1719329760.    29.1514494    14.1379167
     0.0000179       30804.   1719329760.    28.8484230    14.8640929
     0.0000190       32616.   1719329760.    28.5790662    15.5902690
     0.0000200       34428.   1719329760.    28.3380627    16.3164452
     0.0000211       36240.   1719329760.    28.1211596    17.0426214
     0.0000221       38052.   1719329760.    27.9249139    17.7687976
     0.0000232       39864.   1719329760.    27.7465087    18.4949738
     0.0000242       41676.   1719329760.    27.5836170    19.2211500
     0.0000253       43488.   1719329760.    27.4342996    19.9473262
     0.0000263       45300.   1719329760.    27.2969276    20.6735024
     0.0000274       47112.   1719329760.    27.1701227    21.3996786
     0.0000285       48924.   1719329760.    27.0527108    22.1258548
     0.0000295       50736.   1719329760.    26.9436854    22.8520310
     0.0000306       52548.   1719329760.    26.8421790    23.5782071
     0.0000316       54360.   1719329760.    26.7474397    24.3043833
     0.0000327       56172.   1719329760.    26.6588126    25.0305595
     0.0000337       57984.   1719329760.    26.5757247    25.7567357
     0.0000348       59796.   1719329760.    26.4976725    26.4829119
     0.0000358       61608.   1719329760.    26.4242115    27.2090881
     0.0000369       63420.   1719329760.    26.3549483    27.9352643
     0.0000379       65232.   1719329760.    26.2895331    28.6614405
```

0.0000390	67044.	1719329760.	26.2276538	29.3876167	
0.0000400	68856.	1719329760.	26.1690313	30.1137929	
0.0000411	70668.	1719329760.	26.1134152	30.8399691	
0.0000432	74292.	1719329760.	26.0103217	32.2923214	
0.0000453	77916.	1719329760.	25.9168184	33.7446738	
0.0000474	81540.	1719329760.	25.8316265	35.1970262	
0.0000495	85116.	1718362204.	25.7600931	36.0000000	Y
0.0000516	88307.	1710016821.	25.7450077	36.0000000	Y
0.0000537	91055.	1694080982.	25.7890002	36.0000000	Y
0.0000559	93523.	1674351216.	25.8662156	36.0000000	Y
0.0000580	95738.	1651681538.	25.9596148	36.0000000	Y
0.0000601	97623.	1625104154.	26.0427887	36.0000000	Y
0.0000622	99187.	1595157458.	26.1020741	36.0000000	Y
0.0000643	100520.	1563590959.	26.1477997	36.0000000	Y
0.0000664	101682.	1531456607.	26.1850574	36.0000000	Y
0.0000685	102694.	1499106584.	26.2156802	36.0000000	Y
0.0000706	103596.	1467136166.	26.2418156	36.0000000	Y
0.0000727	104405.	1435730900.	26.2645753	36.0000000	Y
0.0000748	105133.	1405018933.	26.2847462	36.0000000	Y
0.0000769	105792.	1375089517.	26.3029308	36.0000000	Y
0.0000790	106389.	1345978545.	26.3190684	36.0000000	Y
0.0000811	106931.	1317694704.	26.3327277	36.0000000	Y
0.0000833	107428.	1290308271.	26.3451305	36.0000000	Y
0.0000854	107888.	1263831958.	26.3565441	36.0000000	Y
0.0000875	108312.	1238223529.	26.3683587	36.0000000	Y
0.0000896	108694.	1213357023.	26.3774987	36.0000000	Y
0.0000917	109054.	1189386837.	26.3862330	36.0000000	Y
0.0000938	109391.	1166251589.	26.3947955	36.0000000	Y
0.0000959	109694.	1143784328.	26.4021331	36.0000000	Y
0.0000980	109986.	1122168893.	26.4094502	36.0000000	Y
0.0001001	110251.	1101186709.	26.4155900	36.0000000	Y
0.0001022	110504.	1080953128.	26.4221100	36.0000000	Y
0.0001043	110737.	1061349948.	26.4271609	36.0000000	Y
0.0001064	110958.	1042412273.	26.4331747	36.0000000	Y
0.0001086	111162.	1024055458.	26.4372983	36.0000000	Y
0.0001107	111360.	1006332490.	26.4430476	36.0000000	Y
0.0001128	111538.	989106469.	26.4463756	36.0000000	Y
0.0001149	111715.	972490789.	26.4505626	36.0000000	Y
0.0001170	111873.	956324994.	26.4547068	36.0000000	Y
0.0001191	112028.	940701885.	26.4572535	36.0000000	Y
0.0001212	112175.	925549270.	26.4625617	36.0000000	Y
0.0001233	112309.	910814943.	26.4645327	36.0000000	Y
0.0001254	112442.	896572199.	26.4666389	36.0000000	Y
0.0001338	112900.	843517796.	26.4797710	36.0000000	Y
0.0001423	113275.	796164739.	26.4878891	36.0000000	Y
0.0001507	113588.	753702530.	26.4950904	36.0000000	Y
0.0001591	113853.	715434459.	26.5018328	36.0000000	Y
0.0001676	114076.	680768908.	26.5058505	36.0000000	Y
0.0001760	114269.	649250909.	26.5078046	36.0000000	Y
0.0001844	114433.	620460993.	26.5135095	36.0000000	Y
0.0001929	114577.	594085861.	26.5174169	36.0000000	Y
0.0002013	114703.	569829556.	26.5179765	36.0000000	Y
0.0002097	114814.	547451379.	26.5235253	36.0000000	Y
0.0002182	114912.	526743116.	26.5225624	36.0000000	Y
0.0002266	114999.	507525905.	26.5269002	36.0000000	Y
0.0002350	115077.	489651076.	26.5278306	36.0000000	Y

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip
1	552.000	115077.2

Note that the values in the above table are not factored by a strength

reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.125000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1250	-3438884.	11381.	0.000	3911.1867	1.719E+12	0.000	0.000	0.000
1.500	0.1247	-3233838.	11381.	-3.493E-05	3828.1826	1.719E+12	0.000	0.000	0.000
3.000	0.1237	-3028457.	11381.	-6.771E-05	3745.0424	1.719E+12	0.000	0.000	0.000
4.500	0.1222	-2822760.	11381.	-9.834E-05	3661.7747	1.719E+12	0.000	0.000	0.000
6.000	0.1202	-2616770.	11381.	-0.000127	3578.3880	1.719E+12	0.000	0.000	0.000
7.500	0.1177	-2410507.	11381.	-0.000153	3494.8912	1.719E+12	0.000	0.000	0.000
9.000	0.1147	-2203994.	11381.	-0.000177	3411.2929	1.719E+12	0.000	0.000	0.000
10.500	0.1113	-1997251.	11381.	-0.000199	3327.6018	1.719E+12	0.000	0.000	0.000
12.000	0.1075	-1790301.	11381.	-0.000219	3243.8266	1.719E+12	0.000	0.000	0.000
13.500	0.1034	-1583165.	11381.	-0.000237	3159.9760	1.719E+12	0.000	0.000	0.000
15.000	0.0990	-1375864.	11381.	-0.000252	3076.0587	1.719E+12	0.000	0.000	0.000
16.500	0.0943	-1168419.	11381.	-0.000266	2992.0835	1.719E+12	0.000	0.000	0.000
18.000	0.0894	-960853.	11381.	-0.000277	2908.0591	1.719E+12	0.000	0.000	0.000
19.500	0.0844	-753188.	11381.	-0.000286	2823.9943	1.719E+12	0.000	0.000	0.000
21.000	0.0791	-545443.	11381.	-0.000292	2739.8977	1.719E+12	0.000	0.000	0.000
22.500	0.0738	-337643.	11381.	-0.000297	2655.7782	1.719E+12	0.000	0.000	0.000
24.000	0.0685	-129807.	11381.	-0.000300	2571.6444	1.719E+12	0.000	0.000	0.000
25.500	0.0630	78043.	11381.	-0.000300	2550.6900	1.719E+12	0.000	0.000	0.000
27.000	0.0577	285884.	11381.	-0.000298	2634.8260	1.719E+12	0.000	0.000	0.000
28.500	0.0523	493696.	11381.	-0.000294	2718.9499	1.719E+12	0.000	0.000	0.000
30.000	0.0471	701456.	11381.	-0.000288	2803.0530	1.719E+12	0.000	0.000	0.000
31.500	0.0420	909144.	11381.	-0.000279	2887.1266	1.719E+12	0.000	0.000	0.000
33.000	0.0370	1116736.	11381.	-0.000269	2971.1619	1.719E+12	0.000	0.000	0.000
34.500	0.0323	1324213.	10876.	-0.000256	3055.1502	1.719E+12	-56.1512	31290.	0.000
36.000	0.0278	1513359.	9500.1722	-0.000241	3131.7180	1.719E+12	-96.7302	62580.	0.000
37.500	0.0236	1671007.	7520.5833	-0.000224	3195.5352	1.719E+12	-123.2241	93870.	0.000
39.000	0.0197	1788556.	5175.6246	-0.000206	3243.1201	1.719E+12	-137.3268	125160.	0.000
40.500	0.0162	1861425.	2671.8255	-0.000187	3272.6183	1.719E+12	-140.8731	156450.	0.000
42.000	0.0130	1888458.	182.0947	-0.000167	3283.5615	1.719E+12	-135.7637	187740.	0.000
43.500	0.0102	1871307.	-2154.7888	-0.000148	3276.6186	1.719E+12	-123.8900	219030.	0.000
45.000	0.007699	1813821.	-4233.3662	-0.000128	3253.3478	1.719E+12	-107.0630	250321.	0.000
46.500	0.005558	1721458.	-5979.5030	-0.000110	3215.9585	1.719E+12	-86.9522	281611.	0.000
48.000	0.003741	1600744.	-7347.4098	-9.253E-05	3167.0922	1.719E+12	-65.0375	312901.	0.000
49.500	0.002227	1458791.	-8315.9281	-7.652E-05	3109.6283	1.719E+12	-42.5757	344191.	0.000
51.000	0.000987	1302891.	-8884.3463	-6.206E-05	3046.5189	1.719E+12	-20.5819	375481.	0.000
52.500	-7.707E-06	1140187.	-9068.0159	-4.927E-05	2980.6551	1.719E+12	0.1742	406771.	0.000
54.000	-0.000787	977422.	-8894.0243	-3.819E-05	2914.7661	1.719E+12	19.1582	438061.	0.000
55.500	-0.001383	820761.	-8397.1531	-2.878E-05	2851.3487	1.719E+12	36.0497	469351.	0.000
57.000	-0.001823	675696.	-7616.3257	-2.094E-05	2792.6250	1.719E+12	50.7089	500641.	0.000
58.500	-0.002137	546990.	-6591.7093	-1.454E-05	2740.5237	1.719E+12	63.1373	531931.	0.000

60.000	-0.002347	438683.	-5362.6058	-9.384E-06	2696.6803	1.719E+12	73.4297	563221.	0.000
61.500	-0.002474	354123.	-3966.2345	-5.234E-06	2662.4494	1.719E+12	81.7227	594511.	0.000
63.000	-0.002535	296003.	-2891.5295	-1.831E-06	2638.9221	1.719E+12	37.6890	267598.	0.000
64.500	-0.002540	250064.	-2461.4925	1.028E-06	2620.3256	1.719E+12	10.0929	71518.	0.000
66.000	-0.002498	207369.	-2277.7385	3.422E-06	2603.0422	1.719E+12	10.3242	74390.	0.000
67.500	-0.002417	167997.	-2091.4505	5.387E-06	2587.1043	1.719E+12	10.3744	77261.	0.000
69.000	-0.002304	131970.	-1905.7602	6.958E-06	2572.5200	1.719E+12	10.2578	80132.	0.000
70.500	-0.002167	99252.	-1723.5251	8.168E-06	2559.2755	1.719E+12	9.9905	83003.	0.000
72.000	-0.002010	69760.	-1547.2994	9.053E-06	2547.3372	1.719E+12	9.5901	85875.	0.000
73.500	-0.001841	43369.	-1379.3139	9.645E-06	2536.6537	1.719E+12	9.0750	88746.	0.000
75.000	-0.001663	19913.	-1221.4619	9.976E-06	2527.1587	1.719E+12	8.4641	91617.	0.000
76.500	-0.001482	-801.8989	-1075.2921	1.008E-05	2519.4222	1.719E+12	7.7769	94488.	0.000
78.000	-0.001300	-18997.	-942.0055	9.972E-06	2526.7879	1.719E+12	7.0327	97359.	0.000
79.500	-0.001123	-34912.	-822.4569	9.690E-06	2533.2304	1.719E+12	6.2505	100231.	0.000
81.000	-0.000951	-48798.	-717.1586	9.252E-06	2538.8516	1.719E+12	5.4493	103102.	0.000
82.500	-0.000789	-60914.	-626.2856	8.678E-06	2543.7560	1.719E+12	4.6477	105973.	0.000
84.000	-0.000639	-71517.	-549.6824	7.984E-06	2548.0483	1.719E+12	3.8638	108844.	0.000
85.500	-0.000502	-80861.	-486.8685	7.187E-06	2551.8308	1.719E+12	3.1155	111716.	0.000
87.000	-0.000380	-89187.	-278.1780	6.297E-06	2555.2013	1.719E+12	20.0723	950188.	0.000
88.500	-0.000275	-91001.	37.5752	5.354E-06	2555.9354	1.719E+12	15.0114	981478.	0.000
90.000	-0.000188	-87941.	267.6325	4.417E-06	2554.6968	1.719E+12	10.5505	1012768.	0.000
91.500	-0.000116	-81454.	423.2984	3.530E-06	2552.0707	1.719E+12	6.7457	1044059.	0.000
93.000	-6.043E-05	-72772.	516.5017	2.723E-06	2548.5564	1.719E+12	3.6102	1075349.	0.000
94.500	-1.828E-05	-62914.	559.1071	2.013E-06	2544.5656	1.719E+12	1.1237	1106639.	0.000
96.000	1.202E-05	-52684.	562.3811	1.407E-06	2540.4247	1.719E+12	-0.7599	1137929.	0.000
97.500	3.239E-05	-42696.	536.6061	9.082E-07	2536.3813	1.719E+12	-2.1040	1169219.	0.000
99.000	4.471E-05	-33385.	490.8305	5.099E-07	2532.6120	1.719E+12	-2.9822	1200509.	0.000
100.500	5.075E-05	-25036.	432.7356	2.041E-07	2529.2324	1.719E+12	-3.4728	1231799.	0.000
102.000	5.206E-05	-17810.	368.6013	-2.019E-08	2526.3073	1.719E+12	-3.6533	1263089.	0.000
103.500	5.002E-05	-11766.	303.3494	-1.750E-07	2523.8606	1.719E+12	-3.5970	1294379.	0.000
105.000	4.576E-05	-6886.1585	240.6446	-2.726E-07	2521.8852	1.719E+12	-3.3703	1325669.	0.000
106.500	4.021E-05	-3097.4698	183.0340	-3.249E-07	2520.3515	1.719E+12	-3.0309	1356959.	0.000
108.000	3.406E-05	-290.4779	132.7326	-3.426E-07	2519.2152	1.719E+12	-2.5581	1351716.	0.000
109.500	2.787E-05	1687.7139	90.4373	-3.353E-07	2519.7808	1.719E+12	-2.1414	1383007.	0.000
111.000	2.199E-05	2971.9295	55.6126	-3.109E-07	2520.3007	1.719E+12	-1.7281	1414297.	0.000
112.500	1.668E-05	3695.9464	28.0065	-2.760E-07	2520.5937	1.719E+12	-1.3393	1445587.	0.000
114.000	1.206E-05	3985.6478	7.0501	-2.358E-07	2520.7110	1.719E+12	-0.9892	1476877.	0.000
115.500	8.187E-06	3954.4357	-8.0263	-1.943E-07	2520.6984	1.719E+12	-0.6860	1508167.	0.000
117.000	5.063E-06	3700.5604	-18.0971	-1.542E-07	2520.5956	1.719E+12	-0.4330	1539457.	0.000
118.500	2.636E-06	3306.0047	-24.0647	-1.175E-07	2520.4359	1.719E+12	-0.2301	1570747.	0.000
120.000	8.326E-07	2836.5679	-26.8021	-8.536E-08	2520.2459	1.719E+12	-0.0741	1602037.	0.000
121.500	-4.365E-07	2342.8257	-27.1126	-5.824E-08	2520.0460	1.719E+12	0.0396	1633327.	0.000
123.000	-1.264E-06	1861.6726	-25.7040	-3.623E-08	2519.8512	1.719E+12	0.1169	1664617.	0.000
124.500	-1.741E-06	1418.2025	-23.1756	-1.907E-08	2519.6717	1.719E+12	0.1640	1695907.	0.000
126.000	-1.950E-06	1027.7288	-20.0150	-6.262E-09	2519.5136	1.719E+12	0.1872	1727197.	0.000
127.500	-1.966E-06	697.7872	-16.6017	2.771E-09	2519.3801	1.719E+12	0.1921	1758487.	0.000
129.000	-1.851E-06	430.0134	-13.2166	8.674E-09	2519.2717	1.719E+12	0.1840	1789777.	0.000
130.500	-1.654E-06	221.8177	-10.0543	1.209E-08	2519.1874	1.719E+12	0.1673	1821067.	0.000
132.000	-1.416E-06	67.8184	-7.2371	1.360E-08	2519.1250	1.719E+12	0.1457	1852357.	0.000
133.500	-1.164E-06	-38.9877	-4.8293	1.375E-08	2519.1134	1.719E+12	0.1219	1883648.	0.000
135.000	-9.205E-07	-106.3102	-2.8513	1.299E-08	2519.1406	1.719E+12	0.0979	1914938.	0.000
136.500	-6.967E-07	-141.8929	-1.2920	1.169E-08	2519.1550	1.719E+12	0.0753	1946228.	0.000
138.000	-4.995E-07	-153.0554	-0.1202	1.015E-08	2519.1596	1.719E+12	0.0549	1977518.	0.000
139.500	-3.313E-07	-146.4205	0.7065	8.582E-09	2519.1569	1.719E+12	0.0370	2008808.	0.000
141.000	-1.906E-07	-127.7920	1.2337	7.146E-09	2519.1493	1.719E+12	0.0216	2040098.	0.000
142.500	-7.400E-08	-102.1510	1.5047	5.943E-09	2519.1389	1.719E+12	0.008516	2071388.	0.000
144.000	2.334E-08	-73.7403	1.5568	5.022E-09	2519.1274	1.719E+12	-0.002727	2102678.	0.000
145.500	1.068E-07	-46.2053	1.4183	4.394E-09	2519.1163	1.719E+12	-0.0127	2133968.	0.000
147.000	1.815E-07	-22.7675	1.1079	4.033E-09	2519.1068	1.719E+12	-0.0218	2165258.	0.000
148.500	2.520E-07	-6.4026	0.6346	3.880E-09	2519.1002	1.719E+12	-0.0307	2196548.	0.000
150.000	3.212E-07	0.000	0.000	3.847E-09	2519.0976	1.719E+12	-0.0398	1113919.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =      0.1250000 inches
Computed slope at pile head      =   -0.000001073 radians
Maximum bending moment           =      -3438884. inch-lbs
Maximum shear force              =         11381. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     33.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              4
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.250000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2500	-6877767.	22763.	0.000	5303.2757	1.719E+12	0.000	0.000	0.000
1.500	0.2494	-6467677.	22763.	-6.986E-05	5137.2676	1.719E+12	0.000	0.000	0.000
3.000	0.2475	-6056913.	22763.	-0.000135	4970.9872	1.719E+12	0.000	0.000	0.000
4.500	0.2445	-5645520.	22763.	-0.000197	4804.4517	1.719E+12	0.000	0.000	0.000
6.000	0.2404	-5233539.	22763.	-0.000254	4637.6785	1.719E+12	0.000	0.000	0.000
7.500	0.2353	-4821014.	22763.	-0.000306	4470.6849	1.719E+12	0.000	0.000	0.000
9.000	0.2294	-4407988.	22763.	-0.000355	4303.4883	1.719E+12	0.000	0.000	0.000
10.500	0.2226	-3994503.	22763.	-0.000399	4136.1061	1.719E+12	0.000	0.000	0.000
12.000	0.2150	-3580602.	22763.	-0.000438	3968.5556	1.719E+12	0.000	0.000	0.000
13.500	0.2068	-3166329.	22763.	-0.000474	3800.8544	1.719E+12	0.000	0.000	0.000
15.000	0.1980	-2751727.	22763.	-0.000504	3633.0199	1.719E+12	0.000	0.000	0.000
16.500	0.1886	-2336838.	22763.	-0.000531	3465.0695	1.719E+12	0.000	0.000	0.000
18.000	0.1789	-1921707.	22763.	-0.000553	3297.0207	1.719E+12	0.000	0.000	0.000
19.500	0.1687	-1506375.	22763.	-0.000571	3128.8910	1.719E+12	0.000	0.000	0.000
21.000	0.1583	-1090887.	22763.	-0.000585	2960.6978	1.719E+12	0.000	0.000	0.000
22.500	0.1477	-675285.	22763.	-0.000594	2792.4587	1.719E+12	0.000	0.000	0.000
24.000	0.1369	-259613.	22763.	-0.000599	2624.1912	1.719E+12	0.000	0.000	0.000
25.500	0.1261	156086.	22763.	-0.000600	2582.2825	1.719E+12	0.000	0.000	0.000
27.000	0.1153	571769.	22763.	-0.000596	2750.5544	1.719E+12	0.000	0.000	0.000
28.500	0.1046	987392.	22763.	-0.000588	2918.8022	1.719E+12	0.000	0.000	0.000
30.000	0.0942	1402913.	22763.	-0.000575	3087.0084	1.719E+12	0.000	0.000	0.000
31.500	0.0839	1818287.	22763.	-0.000558	3255.1556	1.719E+12	0.000	0.000	0.000
33.000	0.0741	2233473.	22763.	-0.000537	3423.2262	1.719E+12	0.000	0.000	0.000
34.500	0.0646	2648426.	21752.	-0.000512	3591.2027	1.719E+12	-112.3025	31290.	0.000
36.000	0.0556	3026718.	19000.	-0.000482	3744.3384	1.719E+12	-193.4604	62580.	0.000
37.500	0.0473	3342013.	15041.	-0.000448	3871.9727	1.719E+12	-246.4483	93870.	0.000
39.000	0.0395	3577112.	10351.	-0.000412	3967.1427	1.719E+12	-274.6537	125160.	0.000
40.500	0.0324	3722851.	5343.6510	-0.000374	4026.1390	1.719E+12	-281.7461	156450.	0.000
42.000	0.0260	3776917.	364.1895	-0.000335	4048.0254	1.719E+12	-271.5274	187740.	0.000
43.500	0.0204	3742615.	-4309.5775	-0.000295	4034.1397	1.719E+12	-247.7801	219030.	0.000
45.000	0.0154	3627643.	-8466.7325	-0.000257	3987.5981	1.719E+12	-214.1260	250321.	0.000
46.500	0.0111	3442917.	-11959.	-0.000220	3912.8194	1.719E+12	-173.9044	281611.	0.000
48.000	0.007483	3201488.	-14695.	-0.000185	3815.0868	1.719E+12	-130.0749	312901.	0.000
49.500	0.004453	2917581.	-16632.	-0.000153	3700.1590	1.719E+12	-85.1514	344191.	0.000
51.000	0.001973	2605782.	-17769.	-0.000124	3573.9401	1.719E+12	-41.1638	375481.	0.000
52.500	-1.541E-05	2280375.	-18136.	-9.855E-05	3442.2125	1.719E+12	0.3483	406771.	0.000
54.000	-0.001574	1954843.	-17788.	-7.638E-05	3310.4346	1.719E+12	38.3165	438061.	0.000
55.500	-0.002765	1641523.	-16794.	-5.755E-05	3183.5999	1.719E+12	72.0993	469351.	0.000
57.000	-0.003646	1351392.	-15233.	-4.189E-05	3066.1524	1.719E+12	101.4179	500641.	0.000
58.500	-0.004273	1093980.	-13183.	-2.909E-05	2961.9498	1.719E+12	126.2747	531931.	0.000

60.000	-0.004693	877367.	-10725.	-1.877E-05	2874.2631	1.719E+12	146.8594	563221.	0.000
61.500	-0.004949	708245.	-7932.4689	-1.047E-05	2805.8012	1.719E+12	163.4453	594511.	0.000
63.000	-0.005070	592006.	-5783.0590	-3.661E-06	2758.7466	1.719E+12	75.3780	267598.	0.000
64.500	-0.005080	500128.	-4922.9851	2.056E-06	2721.5535	1.719E+12	20.1858	71518.	0.000
66.000	-0.004996	414738.	-4555.4771	6.845E-06	2686.9869	1.719E+12	20.6485	74390.	0.000
67.500	-0.004834	335995.	-4182.9010	1.077E-05	2655.1110	1.719E+12	20.7489	77261.	0.000
69.000	-0.004608	263939.	-3811.5205	1.392E-05	2625.9424	1.719E+12	20.5156	80132.	0.000
70.500	-0.004333	198503.	-3447.0502	1.634E-05	2599.4534	1.719E+12	19.9811	83003.	0.000
72.000	-0.004020	139521.	-3094.5988	1.811E-05	2575.5767	1.719E+12	19.1802	85875.	0.000
73.500	-0.003681	86738.	-2758.6278	1.929E-05	2554.2098	1.719E+12	18.1499	88746.	0.000
75.000	-0.003326	39827.	-2442.9238	1.995E-05	2535.2198	1.719E+12	16.9283	91617.	0.000
76.500	-0.002963	-1603.7977	-2150.5842	2.015E-05	2519.7468	1.719E+12	15.5539	94488.	0.000
78.000	-0.002600	-37995.	-1884.0111	1.994E-05	2534.4782	1.719E+12	14.0653	97359.	0.000
79.500	-0.002245	-69825.	-1644.9139	1.938E-05	2547.3632	1.719E+12	12.5010	100231.	0.000
81.000	-0.001903	-97597.	-1434.3171	1.850E-05	2558.6056	1.719E+12	10.8986	103102.	0.000
82.500	-0.001579	-121828.	-1252.5712	1.736E-05	2568.4145	1.719E+12	9.2954	105973.	0.000
84.000	-0.001278	-143034.	-1099.3649	1.597E-05	2576.9990	1.719E+12	7.7276	108844.	0.000
85.500	-0.001004	-161722.	-973.7370	1.437E-05	2584.5641	1.719E+12	6.2311	111716.	0.000
87.000	-0.000760	-178374.	-556.3560	1.259E-05	2591.3050	1.719E+12	40.1446	950188.	0.000
88.500	-0.000551	-182001.	75.1503	1.071E-05	2592.7732	1.719E+12	30.0228	981478.	0.000
90.000	-0.000375	-175882.	535.2649	8.834E-06	2590.2960	1.719E+12	21.1011	1012768.	0.000
91.500	-0.000233	-162907.	846.5967	7.060E-06	2585.0438	1.719E+12	13.4914	1044059.	0.000
93.000	-0.000121	-145545.	1033.0034	5.446E-06	2578.0153	1.719E+12	7.2205	1075349.	0.000
94.500	-3.655E-05	-125827.	1118.2143	4.025E-06	2570.0336	1.719E+12	2.2474	1106639.	0.000
96.000	2.404E-05	-105369.	1124.7621	2.815E-06	2561.7518	1.719E+12	-1.5198	1137929.	0.000
97.500	6.478E-05	-85392.	1073.2122	1.816E-06	2553.6649	1.719E+12	-4.2079	1169219.	0.000
99.000	8.943E-05	-66769.	981.6610	1.020E-06	2546.1264	1.719E+12	-5.9644	1200509.	0.000
100.500	0.000101	-50072.	865.4712	4.082E-07	2539.3673	1.719E+12	-6.9456	1231799.	0.000
102.000	0.000104	-35620.	737.2026	-4.037E-08	2533.5170	1.719E+12	-7.3065	1263089.	0.000
103.500	0.000100	-23532.	606.6989	-3.500E-07	2528.6236	1.719E+12	-7.1939	1294379.	0.000
105.000	9.152E-05	-13772.	481.2892	-5.453E-07	2524.6727	1.719E+12	-6.7405	1325669.	0.000
106.500	8.041E-05	-6194.9396	366.0680	-6.498E-07	2521.6054	1.719E+12	-6.0618	1356959.	0.000
108.000	6.813E-05	-580.9559	265.4653	-6.853E-07	2519.3328	1.719E+12	-5.1162	1351716.	0.000
109.500	5.574E-05	3375.4278	180.8747	-6.706E-07	2520.4640	1.719E+12	-4.2827	1383007.	0.000
111.000	4.399E-05	5943.8590	111.2252	-6.219E-07	2521.5037	1.719E+12	-3.4561	1414297.	0.000
112.500	3.335E-05	7391.8929	56.0129	-5.521E-07	2522.0899	1.719E+12	-2.6786	1445587.	0.000
114.000	2.411E-05	7971.2956	14.1002	-4.716E-07	2522.3244	1.719E+12	-1.9784	1476877.	0.000
115.500	1.637E-05	7908.8713	-16.0526	-3.885E-07	2522.2992	1.719E+12	-1.3719	1508167.	0.000
117.000	1.013E-05	7401.1209	-36.1942	-3.084E-07	2522.0936	1.719E+12	-0.8660	1539457.	0.000
118.500	5.273E-06	6612.0094	-48.1293	-2.350E-07	2521.7742	1.719E+12	-0.4601	1570747.	0.000
120.000	1.665E-06	5673.1359	-53.6042	-1.707E-07	2521.3941	1.719E+12	-0.1482	1602037.	0.000
121.500	-8.730E-07	4685.6515	-54.2252	-1.165E-07	2520.9944	1.719E+12	0.0792	1633327.	0.000
123.000	-2.528E-06	3723.3451	-51.4080	-7.247E-08	2520.6048	1.719E+12	0.2338	1664617.	0.000
124.500	-3.482E-06	2836.4050	-46.3513	-3.813E-08	2520.2458	1.719E+12	0.3280	1695907.	0.000
126.000	-3.901E-06	2055.4575	-40.0300	-1.252E-08	2519.9297	1.719E+12	0.3743	1727197.	0.000
127.500	-3.933E-06	1395.5745	-33.2034	5.541E-09	2519.6625	1.719E+12	0.3842	1758487.	0.000
129.000	-3.701E-06	860.0267	-26.4332	1.735E-08	2519.4457	1.719E+12	0.3680	1789777.	0.000
130.500	-3.308E-06	443.6355	-20.1086	2.417E-08	2519.2772	1.719E+12	0.3347	1821067.	0.000
132.000	-2.831E-06	135.6367	-14.4742	2.720E-08	2519.1525	1.719E+12	0.2914	1852357.	0.000
133.500	-2.329E-06	-77.9754	-9.6586	2.751E-08	2519.1292	1.719E+12	0.2437	1883648.	0.000
135.000	-1.841E-06	-212.6205	-5.7026	2.599E-08	2519.1837	1.719E+12	0.1959	1914938.	0.000
136.500	-1.393E-06	-283.7857	-2.5840	2.339E-08	2519.2125	1.719E+12	0.1507	1946228.	0.000
138.000	-9.991E-07	-306.1107	-0.2403	2.030E-08	2519.2215	1.719E+12	0.1098	1977518.	0.000
139.500	-6.626E-07	-292.8410	1.4130	1.716E-08	2519.2161	1.719E+12	0.0739	2008808.	0.000
141.000	-3.812E-07	-255.5839	2.4673	1.429E-08	2519.2011	1.719E+12	0.0432	2040098.	0.000
142.500	-1.480E-07	-204.3021	3.0094	1.189E-08	2519.1803	1.719E+12	0.0170	2071388.	0.000
144.000	4.668E-08	-147.4805	3.1136	1.004E-08	2519.1573	1.719E+12	-0.005453	2102678.	0.000
145.500	2.136E-07	-92.4106	2.8367	8.788E-09	2519.1350	1.719E+12	-0.0253	2133968.	0.000
147.000	3.631E-07	-45.5351	2.2157	8.066E-09	2519.1160	1.719E+12	-0.0437	2165258.	0.000
148.500	5.040E-07	-12.8052	1.2691	7.761E-09	2519.1028	1.719E+12	-0.0615	2196548.	0.000
150.000	6.425E-07	0.000	0.000	7.694E-09	2519.0976	1.719E+12	-0.0795	1113919.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
Values of total stress due to combined axial and bending stresses are computed only
for elastic sections only and do not equal the actual stresses in concrete and steel.
Stresses in concrete and steel may be interpolated from the output for nonlinear
bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =      0.2500000 inches
Computed slope at pile head      =   -0.000002147 radians
Maximum bending moment           =      -6877767. inch-lbs
Maximum shear force              =         22763. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     16.5000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              4
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.500000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5000	-13643152.	44933.	0.000	8041.9606	1.719E+12	0.000	0.000	0.000
1.500	0.4987	-12833657.	44933.	-0.000139	7714.2702	1.719E+12	0.000	0.000	0.000
3.000	0.4950	-12022827.	44933.	-0.000269	7386.0394	1.719E+12	0.000	0.000	0.000
4.500	0.4890	-11210747.	44933.	-0.000390	7057.3024	1.719E+12	0.000	0.000	0.000
6.000	0.4810	-10397500.	44933.	-0.000503	6728.0933	1.719E+12	0.000	0.000	0.000
7.500	0.4709	-9583172.	44933.	-0.000608	6398.4463	1.719E+12	0.000	0.000	0.000
9.000	0.4591	-8767847.	44933.	-0.000704	6068.3959	1.719E+12	0.000	0.000	0.000
10.500	0.4456	-7951609.	44933.	-0.000792	5737.9762	1.719E+12	0.000	0.000	0.000
12.000	0.4306	-7134545.	44933.	-0.000871	5407.2217	1.719E+12	0.000	0.000	0.000
13.500	0.4142	-6316739.	44933.	-0.000941	5076.1667	1.719E+12	0.000	0.000	0.000
15.000	0.3967	-5498275.	44933.	-0.001003	4744.8458	1.719E+12	0.000	0.000	0.000
16.500	0.3781	-4679240.	44933.	-0.001056	4413.2933	1.719E+12	0.000	0.000	0.000
18.000	0.3587	-3859717.	44933.	-0.001101	4081.5438	1.719E+12	0.000	0.000	0.000
19.500	0.3385	-3039794.	44933.	-0.001137	3749.6318	1.719E+12	0.000	0.000	0.000
21.000	0.3177	-2219554.	44933.	-0.001164	3417.5917	1.719E+12	0.000	0.000	0.000
22.500	0.2966	-1399083.	44933.	-0.001183	3085.4582	1.719E+12	0.000	0.000	0.000
24.000	0.2751	-578467.	44933.	-0.001194	2753.2658	1.719E+12	0.000	0.000	0.000
25.500	0.2536	242210.	44933.	-0.001196	2617.1462	1.719E+12	0.000	0.000	0.000
27.000	0.2321	1062861.	44933.	-0.001189	2949.3527	1.719E+12	0.000	0.000	0.000
28.500	0.2108	1883402.	44933.	-0.001173	3281.5145	1.719E+12	0.000	0.000	0.000
30.000	0.1899	2703747.	44933.	-0.001149	3613.5971	1.719E+12	0.000	0.000	0.000
31.500	0.1694	3523810.	44933.	-0.001117	3945.5657	1.719E+12	0.000	0.000	0.000
33.000	0.1497	4343507.	44933.	-0.001075	4277.3860	1.719E+12	0.000	0.000	0.000
34.500	0.1307	5162752.	43493.	-0.001026	4609.0234	1.719E+12	-159.9950	22031.	0.000
36.000	0.1127	5929622.	39069.	-0.000968	4919.4587	1.719E+12	-331.5301	52930.	0.000
37.500	0.0959	6588459.	31686.	-0.000902	5186.1616	1.719E+12	-488.7531	91751.	0.000
39.000	0.0803	7088255.	22264.	-0.000831	5388.4832	1.719E+12	-558.1316	125160.	0.000
40.500	0.0660	7406479.	12079.	-0.000755	5517.3029	1.719E+12	-573.5344	156450.	0.000
42.000	0.0531	7538108.	1932.9365	-0.000676	5570.5871	1.719E+12	-553.8425	187740.	0.000
43.500	0.0416	7489507.	-7611.3744	-0.000598	5550.9131	1.719E+12	-506.6365	219030.	0.000
45.000	0.0316	7275977.	-16124.	-0.000520	5464.4743	1.719E+12	-439.1969	250321.	0.000
46.500	0.0229	6919390.	-23301.	-0.000446	5320.1250	1.719E+12	-358.2546	281611.	0.000
48.000	0.0155	6446009.	-28953.	-0.000376	5128.4963	1.719E+12	-269.7919	312901.	0.000
49.500	0.009356	5884545.	-32992.	-0.000312	4901.2109	1.719E+12	-178.9030	344191.	0.000
51.000	0.004301	5264504.	-35409.	-0.000253	4650.2131	1.719E+12	-89.7155	375481.	0.000
52.500	0.000238	4614848.	-36265.	-0.000202	4387.2268	1.719E+12	-5.3720	406771.	0.000
54.000	-0.002956	3962971.	-35666.	-0.000157	4123.3415	1.719E+12	71.9332	438061.	0.000
55.500	-0.005402	3333988.	-33751.	-0.000118	3868.7240	1.719E+12	140.8681	469351.	0.000
57.000	-0.007221	2750300.	-30675.	-8.662E-05	3632.4421	1.719E+12	200.8348	500641.	0.000
58.500	-0.008521	2231396.	-26602.	-6.055E-05	3422.3854	1.719E+12	251.8073	531931.	0.000

60.000	-0.009401	1793845.	-21688.	-3.948E-05	3245.2613	1.719E+12	294.1424	563221.	0.000
61.500	-0.009942	1451410.	-16085.	-2.249E-05	3106.6407	1.719E+12	328.3707	594511.	0.000
63.000	-0.0102	1215217.	-11764.	-8.531E-06	3011.0275	1.719E+12	151.7894	267598.	0.000
64.500	-0.0102	1028076.	-10031.	3.212E-06	2935.2715	1.719E+12	40.7225	71518.	0.000
66.000	-0.0101	854023.	-9289.4211	1.306E-05	2864.8132	1.719E+12	41.7181	74390.	0.000
67.500	-0.009779	693397.	-8536.1968	2.116E-05	2799.7907	1.719E+12	41.9735	77261.	0.000
69.000	-0.009333	546299.	-7784.5156	2.765E-05	2740.2441	1.719E+12	41.5466	80132.	0.000
70.500	-0.008783	412605.	-7046.0729	3.267E-05	2686.1237	1.719E+12	40.5026	83003.	0.000
72.000	-0.008156	291991.	-6331.3381	3.636E-05	2637.2981	1.719E+12	38.9124	85875.	0.000
73.500	-0.007474	183954.	-5649.4686	3.885E-05	2593.5639	1.719E+12	36.8509	88746.	0.000
75.000	-0.006758	87838.	-5008.2523	4.028E-05	2554.6553	1.719E+12	34.3954	91617.	0.000
76.500	-0.006024	2857.0505	-4414.0753	4.075E-05	2520.2542	1.719E+12	31.6243	94488.	0.000
78.000	-0.005291	-71878.	-3871.9088	4.039E-05	2548.1945	1.719E+12	28.6164	97359.	0.000
79.500	-0.004570	-137334.	-3385.3123	3.929E-05	2574.6917	1.719E+12	25.4499	100231.	0.000
81.000	-0.003876	-194530.	-2956.4476	3.756E-05	2597.8451	1.719E+12	22.2018	103102.	0.000
82.500	-0.003218	-244513.	-2586.0998	3.526E-05	2618.0784	1.719E+12	18.9480	105973.	0.000
84.000	-0.002607	-288331.	-2273.7008	3.247E-05	2635.8162	1.719E+12	15.7630	108844.	0.000
85.500	-0.002050	-327011.	-2017.3525	2.925E-05	2651.4745	1.719E+12	12.7201	111716.	0.000
87.000	-0.001554	-361536.	-1164.6412	2.564E-05	2665.4506	1.719E+12	82.0256	950188.	0.000
88.500	-0.001126	-369448.	126.3271	2.182E-05	2668.6532	1.719E+12	61.4154	981478.	0.000
90.000	-0.000768	-357422.	1068.1900	1.801E-05	2663.7851	1.719E+12	43.2361	1012768.	0.000
91.500	-0.000478	-331351.	1706.7874	1.441E-05	2653.2313	1.719E+12	27.7192	1044059.	0.000
93.000	-0.000250	-296264.	2090.5636	1.112E-05	2639.0278	1.719E+12	14.9226	1075349.	0.000
94.500	-7.751E-05	-256312.	2267.7549	8.229E-06	2622.8547	1.719E+12	4.7653	1106639.	0.000
96.000	4.646E-05	-214789.	2284.2064	5.763E-06	2606.0458	1.719E+12	-2.9374	1137929.	0.000
97.500	0.000130	-174195.	2181.7924	3.727E-06	2589.6131	1.719E+12	-8.4419	1169219.	0.000
99.000	0.000181	-136318.	1997.3880	2.102E-06	2574.2803	1.719E+12	-12.0474	1200509.	0.000
100.500	0.000206	-102331.	1762.3203	8.523E-07	2560.5219	1.719E+12	-14.0712	1231799.	0.000
102.000	0.000211	-72891.	1502.2224	-6.489E-08	2548.6047	1.719E+12	-14.8286	1263089.	0.000
103.500	0.000203	-48249.	1237.2023	-6.990E-07	2538.6293	1.719E+12	-14.6181	1294379.	0.000
105.000	0.000186	-28338.	982.2499	-1.100E-06	2530.5692	1.719E+12	-13.7100	1325669.	0.000
106.500	0.000164	-12866.	747.8024	-1.316E-06	2524.3060	1.719E+12	-12.3397	1356959.	0.000
108.000	0.000139	-1391.2633	542.9403	-1.390E-06	2519.6608	1.719E+12	-10.4227	1351716.	0.000
109.500	0.000114	6707.0698	370.5552	-1.362E-06	2521.8127	1.719E+12	-8.7312	1383007.	0.000
111.000	8.975E-05	11976.	228.5105	-1.265E-06	2523.9455	1.719E+12	-7.0515	1414297.	0.000
112.500	6.811E-05	14959.	115.8161	-1.124E-06	2525.1530	1.719E+12	-5.4701	1445587.	0.000
114.000	4.930E-05	16168.	30.1837	-9.607E-07	2525.6423	1.719E+12	-4.0447	1476877.	0.000
115.500	3.353E-05	16064.	-31.5000	-7.920E-07	2525.6006	1.719E+12	-2.8091	1508167.	0.000
117.000	2.078E-05	15049.	-72.7806	-6.291E-07	2525.1897	1.719E+12	-1.7776	1539457.	0.000
118.500	1.088E-05	13457.	-97.3233	-4.799E-07	2524.5450	1.719E+12	-0.9493	1570747.	0.000
120.000	3.509E-06	11555.	-108.6780	-3.490E-07	2523.7752	1.719E+12	-0.3123	1602037.	0.000
121.500	-1.684E-06	9551.2092	-110.1138	-2.385E-07	2522.9640	1.719E+12	0.1528	1633327.	0.000
123.000	-5.076E-06	7595.7818	-104.5139	-1.487E-07	2522.1724	1.719E+12	0.4694	1664617.	0.000
124.500	-7.037E-06	5791.6637	-94.3215	-7.864E-08	2521.4421	1.719E+12	0.6630	1695907.	0.000
126.000	-7.907E-06	4201.7708	-81.5253	-2.633E-08	2520.7985	1.719E+12	0.7587	1727197.	0.000
127.500	-7.985E-06	2857.2748	-67.6756	1.062E-08	2520.2542	1.719E+12	0.7801	1758487.	0.000
129.000	-7.525E-06	1765.2385	-53.9206	3.482E-08	2519.8122	1.719E+12	0.7482	1789777.	0.000
130.500	-6.732E-06	915.4400	-41.0572	4.885E-08	2519.4682	1.719E+12	0.6811	1821067.	0.000
132.000	-5.766E-06	286.2098	-29.5871	5.514E-08	2519.2135	1.719E+12	0.5934	1852357.	0.000
133.500	-4.747E-06	-150.7903	-19.7760	5.585E-08	2519.1586	1.719E+12	0.4967	1883648.	0.000
135.000	-3.756E-06	-426.8344	-11.7095	5.283E-08	2519.2704	1.719E+12	0.3995	1914938.	0.000
136.500	-2.845E-06	-573.3827	-5.3452	4.759E-08	2519.3297	1.719E+12	0.3076	1946228.	0.000
138.000	-2.042E-06	-620.2073	-0.5574	4.134E-08	2519.3487	1.719E+12	0.2244	1977518.	0.000
139.500	-1.357E-06	-594.2702	2.8245	3.499E-08	2519.3382	1.719E+12	0.1514	2008808.	0.000
141.000	-7.828E-07	-519.2194	4.9856	2.916E-08	2519.3078	1.719E+12	0.0887	2040098.	0.000
142.500	-3.069E-07	-415.3678	6.1020	2.427E-08	2519.2657	1.719E+12	0.0353	2071388.	0.000
144.000	9.072E-08	-300.0295	6.3245	2.052E-08	2519.2190	1.719E+12	-0.0106	2102678.	0.000
145.500	4.318E-07	-188.0934	5.7684	1.797E-08	2519.1737	1.719E+12	-0.0512	2133968.	0.000
147.000	7.375E-07	-92.7243	4.5093	1.650E-08	2519.1351	1.719E+12	-0.0887	2165258.	0.000
148.500	1.026E-06	-26.0877	2.5844	1.587E-08	2519.1082	1.719E+12	-0.1252	2196548.	0.000
150.000	1.309E-06	0.000	0.000	1.574E-08	2519.0976	1.719E+12	-0.1620	1113919.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection              =      0.5000000 inches
Computed slope at pile head       =   -0.000004237 radians
Maximum bending moment            =     -13643152. inch-lbs
Maximum shear force               =         44933. lbs
Depth of maximum bending moment   =       0.000000 feet below pile head
Depth of maximum shear force      =     28.5000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              4
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 1.000000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	-25636535.	81864.	0.000	12897.	1.719E+12	0.000	0.000	0.000
1.500	0.9976	-24161647.	81864.	-0.000261	12300.	1.719E+12	0.000	0.000	0.000
3.000	0.9906	-22684245.	81864.	-0.000506	11702.	1.719E+12	0.000	0.000	0.000
4.500	0.9794	-21204484.	81864.	-0.000736	11103.	1.719E+12	0.000	0.000	0.000
6.000	0.9641	-19722517.	81864.	-0.000950	10503.	1.719E+12	0.000	0.000	0.000
7.500	0.9452	-18238499.	81864.	-0.001149	9902.1957	1.719E+12	0.000	0.000	0.000
9.000	0.9228	-16752583.	81864.	-0.001332	9300.6845	1.719E+12	0.000	0.000	0.000
10.500	0.8972	-15264925.	81864.	-0.001499	8698.4679	1.719E+12	0.000	0.000	0.000
12.000	0.8688	-13775678.	81864.	-0.001651	8095.6084	1.719E+12	0.000	0.000	0.000
13.500	0.8378	-12284999.	81864.	-0.001788	7492.1689	1.719E+12	0.000	0.000	0.000
15.000	0.8044	-10793042.	81864.	-0.001909	6888.2121	1.719E+12	0.000	0.000	0.000
16.500	0.7691	-9299962.	81864.	-0.002014	6283.8008	1.719E+12	0.000	0.000	0.000
18.000	0.7320	-7805915.	81864.	-0.002103	5678.9979	1.719E+12	0.000	0.000	0.000
19.500	0.6934	-6311056.	81864.	-0.002177	5073.8662	1.719E+12	0.000	0.000	0.000
21.000	0.6536	-4815540.	81864.	-0.002235	4468.4689	1.719E+12	0.000	0.000	0.000
22.500	0.6129	-3319524.	81864.	-0.002278	3862.8687	1.719E+12	0.000	0.000	0.000
24.000	0.5716	-1823162.	81864.	-0.002305	3257.1288	1.719E+12	0.000	0.000	0.000
25.500	0.5299	-326610.	81864.	-0.002316	2651.3121	1.719E+12	0.000	0.000	0.000
27.000	0.4882	1169975.	81864.	-0.002312	2992.7135	1.719E+12	0.000	0.000	0.000
28.500	0.4467	2666439.	81864.	-0.002292	3598.4947	1.719E+12	0.000	0.000	0.000
30.000	0.4057	4162626.	81864.	-0.002256	4204.1636	1.719E+12	0.000	0.000	0.000
31.500	0.3655	5658379.	81864.	-0.002205	4809.6573	1.719E+12	0.000	0.000	0.000
33.000	0.3263	7153544.	81864.	-0.002137	5414.9126	1.719E+12	0.000	0.000	0.000
34.500	0.2885	8647965.	80071.	-0.002055	6019.8667	1.719E+12	-199.1982	12428.	0.000
36.000	0.2523	10076946.	74511.	-0.001957	6598.3303	1.719E+12	-418.6656	29864.	0.000
37.500	0.2181	11369231.	65120.	-0.001844	7121.4582	1.719E+12	-624.7835	51570.	0.000
39.000	0.1859	12457903.	52398.	-0.001720	7562.1620	1.719E+12	-788.7278	76352.	0.000
40.500	0.1562	13289732.	37115.	-0.001585	7898.8934	1.719E+12	-909.4325	104826.	0.000
42.000	0.1289	13825523.	20156.	-0.001443	8115.7858	1.719E+12	-974.8483	136148.	0.000
43.500	0.1042	14044024.	2618.8646	-0.001297	8204.2370	1.719E+12	-973.7207	168186.	0.000
45.000	0.0822	13945579.	-14141.	-0.001151	8164.3856	1.719E+12	-888.4457	194582.	0.000
46.500	0.0628	13557827.	-29157.	-0.001007	8007.4203	1.719E+12	-780.0527	223622.	0.000
48.000	0.0459	12915927.	-41681.	-0.000868	7747.5739	1.719E+12	-611.5161	239569.	0.000
49.500	0.0315	12074553.	-51291.	-0.000737	7406.9786	1.719E+12	-456.2801	260422.	0.000
51.000	0.0194	11084088.	-58737.	-0.000616	7006.0300	1.719E+12	-370.9704	344127.	0.000
52.500	0.009359	9972276.	-63979.	-0.000506	6555.9589	1.719E+12	-211.5086	406771.	0.000
54.000	0.001194	8790897.	-66144.	-0.000408	6077.7269	1.719E+12	-29.0603	438061.	0.000
55.500	-0.005315	7599189.	-65158.	-0.000322	5595.3133	1.719E+12	138.5803	469351.	0.000
57.000	-0.0104	6451590.	-61310.	-0.000248	5130.7555	1.719E+12	289.0200	500641.	0.000
58.500	-0.0143	5396962.	-54918.	-0.000186	4703.8333	1.719E+12	421.1816	531931.	0.000

60.000	-0.0171	4478236.	-46313.	-0.000135	4331.9252	1.719E+12	534.9435	563221.	0.000
61.500	-0.0191	3732366.	-35822.	-9.157E-05	4029.9907	1.719E+12	630.7200	594511.	0.000
63.000	-0.0204	3190460.	-27417.	-5.534E-05	3810.6228	1.719E+12	303.1731	267598.	0.000
64.500	-0.0211	2746451.	-23934.	-2.426E-05	3630.8842	1.719E+12	83.7893	71518.	0.000
66.000	-0.0213	2329304.	-22389.	2.310E-06	3462.0196	1.719E+12	87.8884	74390.	0.000
67.500	-0.0210	1940391.	-20787.	2.466E-05	3304.5842	1.719E+12	90.1601	77261.	0.000
69.000	-0.0204	1580487.	-19159.	4.309E-05	3158.8922	1.719E+12	90.7207	80132.	0.000
70.500	-0.0195	1249813.	-17535.	5.791E-05	3025.0324	1.719E+12	89.7079	83003.	0.000
72.000	-0.0183	948074.	-15942.	6.941E-05	2902.8859	1.719E+12	87.2766	85875.	0.000
73.500	-0.0170	674514.	-14404.	7.791E-05	2792.1465	1.719E+12	83.5943	88746.	0.000
75.000	-0.0155	427968.	-12942.	8.368E-05	2692.3428	1.719E+12	78.8379	91617.	0.000
76.500	-0.0139	206922.	-11574.	8.700E-05	2602.8612	1.719E+12	73.1906	94488.	0.000
78.000	-0.0124	9567.2211	-10314.	8.813E-05	2522.9705	1.719E+12	66.8390	97359.	0.000
79.500	-0.0108	-166132.	-9172.6679	8.731E-05	2586.3494	1.719E+12	59.9715	100231.	0.000
81.000	-0.009214	-322384.	-8157.9314	8.476E-05	2649.6013	1.719E+12	52.7770	103102.	0.000
82.500	-0.007719	-461502.	-7273.9451	8.065E-05	2705.9176	1.719E+12	45.4437	105973.	0.000
84.000	-0.006311	-585849.	-6521.5177	7.517E-05	2756.2541	1.719E+12	38.1593	108844.	0.000
85.500	-0.005013	-697771.	-5898.0860	6.845E-05	2801.5610	1.719E+12	31.1109	111716.	0.000
87.000	-0.003846	-799540.	-3790.7263	6.061E-05	2842.7581	1.719E+12	203.0402	950188.	0.000
88.500	-0.002831	-835441.	-574.2711	5.205E-05	2857.2913	1.719E+12	154.3437	981478.	0.000
90.000	-0.001972	-821248.	1813.5874	4.338E-05	2851.5458	1.719E+12	110.9739	1012768.	0.000
91.500	-0.001269	-771014.	3474.7251	3.505E-05	2831.2106	1.719E+12	73.5969	1044059.	0.000
93.000	-0.000711	-696855.	4519.1843	2.736E-05	2801.1902	1.719E+12	42.4541	1075349.	0.000
94.500	-0.000284	-608867.	5058.2683	2.053E-05	2765.5722	1.719E+12	17.4441	1106639.	0.000
96.000	2.842E-05	-515165.	5199.0964	1.465E-05	2727.6407	1.719E+12	-1.7965	1137929.	0.000
97.500	0.000243	-421991.	5040.5800	9.740E-06	2689.9231	1.719E+12	-15.8164	1169219.	0.000
99.000	0.000379	-333898.	4670.7099	5.783E-06	2654.2621	1.719E+12	-25.2803	1200509.	0.000
100.500	0.000452	-253960.	4165.0020	2.706E-06	2621.9028	1.719E+12	-30.9095	1231799.	0.000
102.000	0.000476	-184011.	3585.9198	4.130E-07	2593.5869	1.719E+12	-33.4330	1263089.	0.000
103.500	0.000467	-124875.	2983.0817	-1.204E-06	2569.6482	1.719E+12	-33.5490	1294379.	0.000
105.000	0.000433	-76596.	2394.0626	-2.258E-06	2550.1044	1.719E+12	-31.8975	1325669.	0.000
106.500	0.000385	-38644.	1845.6099	-2.862E-06	2534.7411	1.719E+12	-29.0417	1356959.	0.000
108.000	0.000330	-10098.	1361.1451	-3.117E-06	2523.1852	1.719E+12	-24.7878	1351716.	0.000
109.500	0.000273	10419.	949.2552	-3.115E-06	2523.3153	1.719E+12	-20.9778	1383007.	0.000
111.000	0.000218	24138.	606.3416	-2.934E-06	2528.8687	1.719E+12	-17.1237	1414297.	0.000
112.500	0.000167	32306.	331.2372	-2.639E-06	2532.1752	1.719E+12	-13.4434	1445587.	0.000
114.000	0.000123	36115.	119.4644	-2.281E-06	2533.7171	1.719E+12	-10.0869	1476877.	0.000
115.500	8.529E-05	36652.	-35.6321	-1.900E-06	2533.9345	1.719E+12	-7.1460	1508167.	0.000
117.000	5.455E-05	34870.	-141.9314	-1.525E-06	2533.2131	1.719E+12	-4.6650	1539457.	0.000
118.500	3.037E-05	31572.	-207.7706	-1.178E-06	2531.8784	1.719E+12	-2.6505	1570747.	0.000
120.000	1.215E-05	27413.	-241.3580	-8.689E-07	2530.1947	1.719E+12	-1.0815	1602037.	0.000
121.500	-9.055E-07	22901.	-250.3515	-6.055E-07	2528.3680	1.719E+12	0.0822	1633327.	0.000
123.000	-9.646E-06	18413.	-241.5833	-3.892E-07	2526.5512	1.719E+12	0.8921	1664617.	0.000
124.500	-1.492E-05	14211.	-220.9052	-2.184E-07	2524.8505	1.719E+12	1.4055	1695907.	0.000
126.000	-1.751E-05	10464.	-193.1338	-8.928E-08	2523.3336	1.719E+12	1.6802	1727197.	0.000
127.500	-1.813E-05	7260.4511	-162.0697	3.503E-09	2522.0367	1.719E+12	1.7713	1758487.	0.000
129.000	-1.738E-05	4629.7399	-130.5706	6.574E-08	2520.9718	1.719E+12	1.7286	1789777.	0.000
130.500	-1.576E-05	2558.6023	-100.6592	1.034E-07	2520.1333	1.719E+12	1.5949	1821067.	0.000
132.000	-1.366E-05	1003.9553	-73.6504	1.220E-07	2519.5040	1.719E+12	1.4060	1852357.	0.000
133.500	-1.137E-05	-95.2381	-50.2856	1.268E-07	2519.1361	1.719E+12	1.1901	1883648.	0.000
135.000	-9.099E-06	-808.8446	-30.8630	1.220E-07	2519.4250	1.719E+12	0.9680	1914938.	0.000
136.500	-6.978E-06	-1208.7328	-15.3601	1.115E-07	2519.5869	1.719E+12	0.7545	1946228.	0.000
138.000	-5.086E-06	-1364.0250	-3.5408	9.802E-08	2519.6498	1.719E+12	0.5587	1977518.	0.000
139.500	-3.450E-06	-1338.1495	4.9528	8.387E-08	2519.6393	1.719E+12	0.3850	2008808.	0.000
141.000	-2.066E-06	-1187.3912	10.5256	7.065E-08	2519.5783	1.719E+12	0.2342	2040098.	0.000
142.500	-9.065E-07	-960.6307	13.5722	5.941E-08	2519.4865	1.719E+12	0.1043	2071388.	0.000
144.000	7.232E-08	-699.9721	14.4350	5.071E-08	2519.3809	1.719E+12	-0.008448	2102678.	0.000
145.500	9.192E-07	-441.9779	13.3782	4.474E-08	2519.2765	1.719E+12	-0.1090	2133968.	0.000
147.000	1.683E-06	-219.2463	10.5755	4.128E-08	2519.1863	1.719E+12	-0.2024	2165258.	0.000
148.500	2.405E-06	-62.0796	6.1121	3.980E-08	2519.1227	1.719E+12	-0.2935	2196548.	0.000
150.000	3.116E-06	0.000	0.000	3.948E-08	2519.0976	1.719E+12	-0.3856	1113919.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =      1.0000000 inches
Computed slope at pile head      =   -0.000007720 radians
Maximum bending moment           =     -25636535. inch-lbs
Maximum shear force              =         81864. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     27.0000000 feet below pile head
Number of iterations             =             10
Number of zero deflection points =              4
```

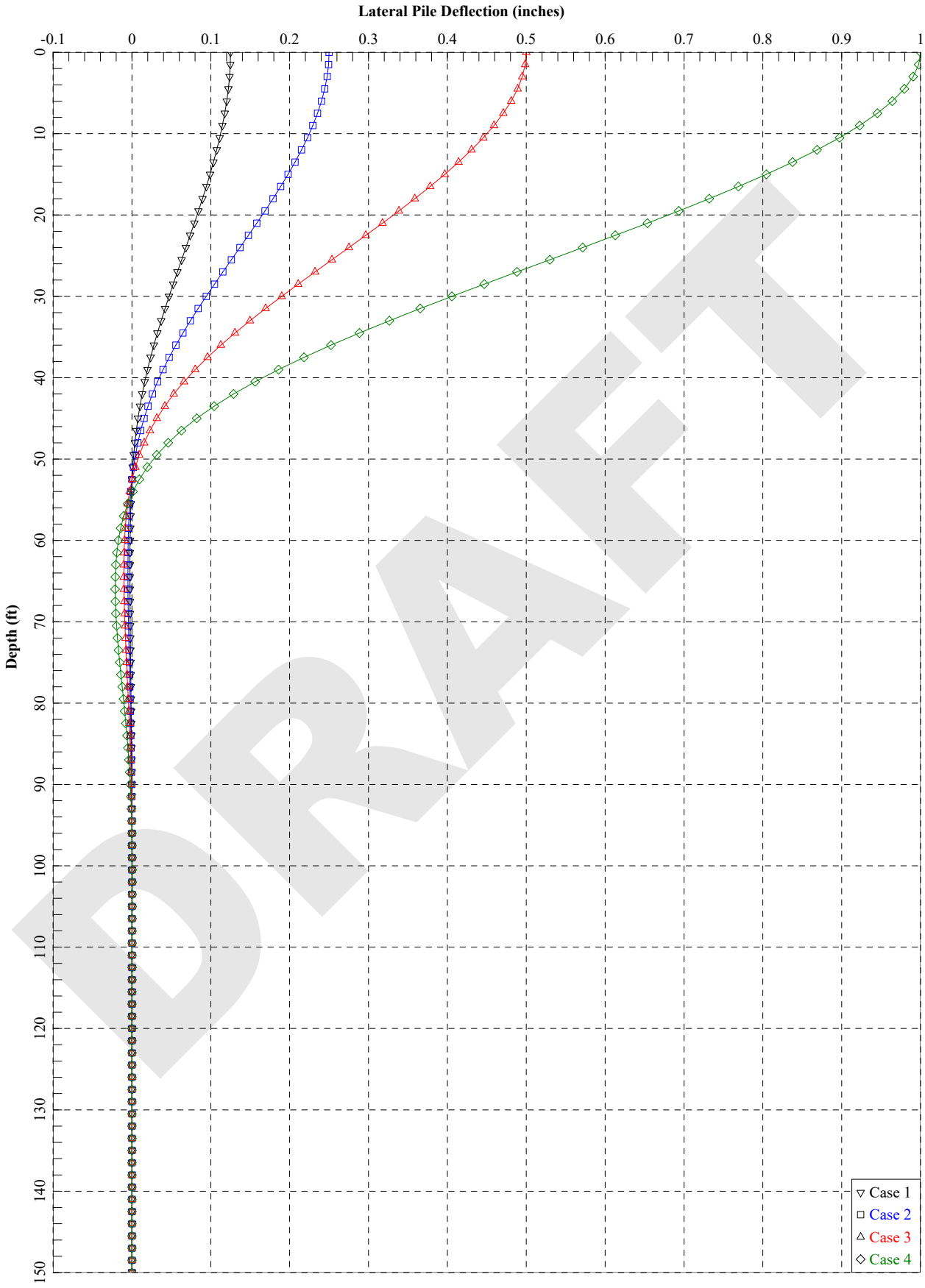
Summary of Pile Response(s)

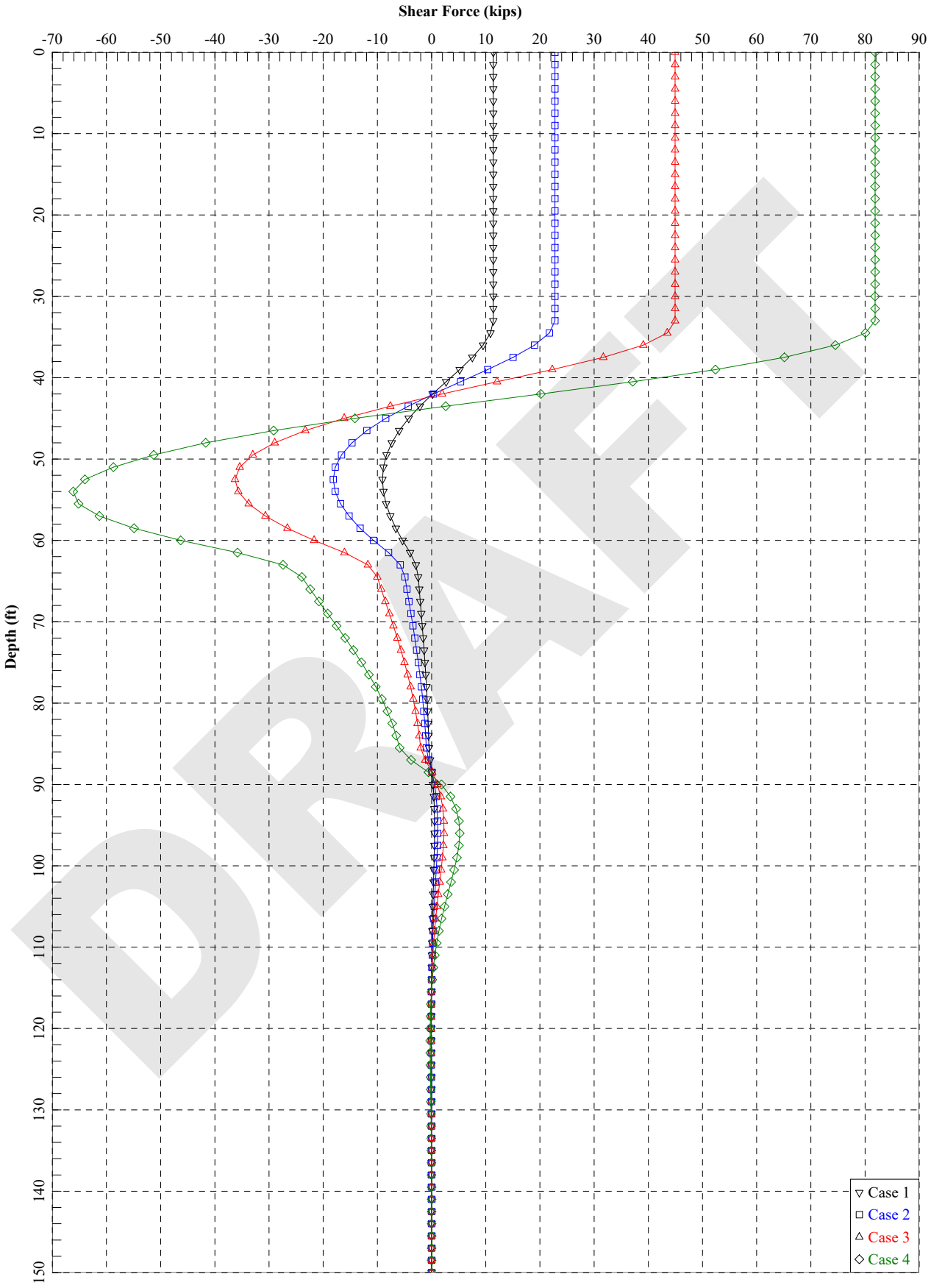
Definitions of Pile-head Loading Conditions:

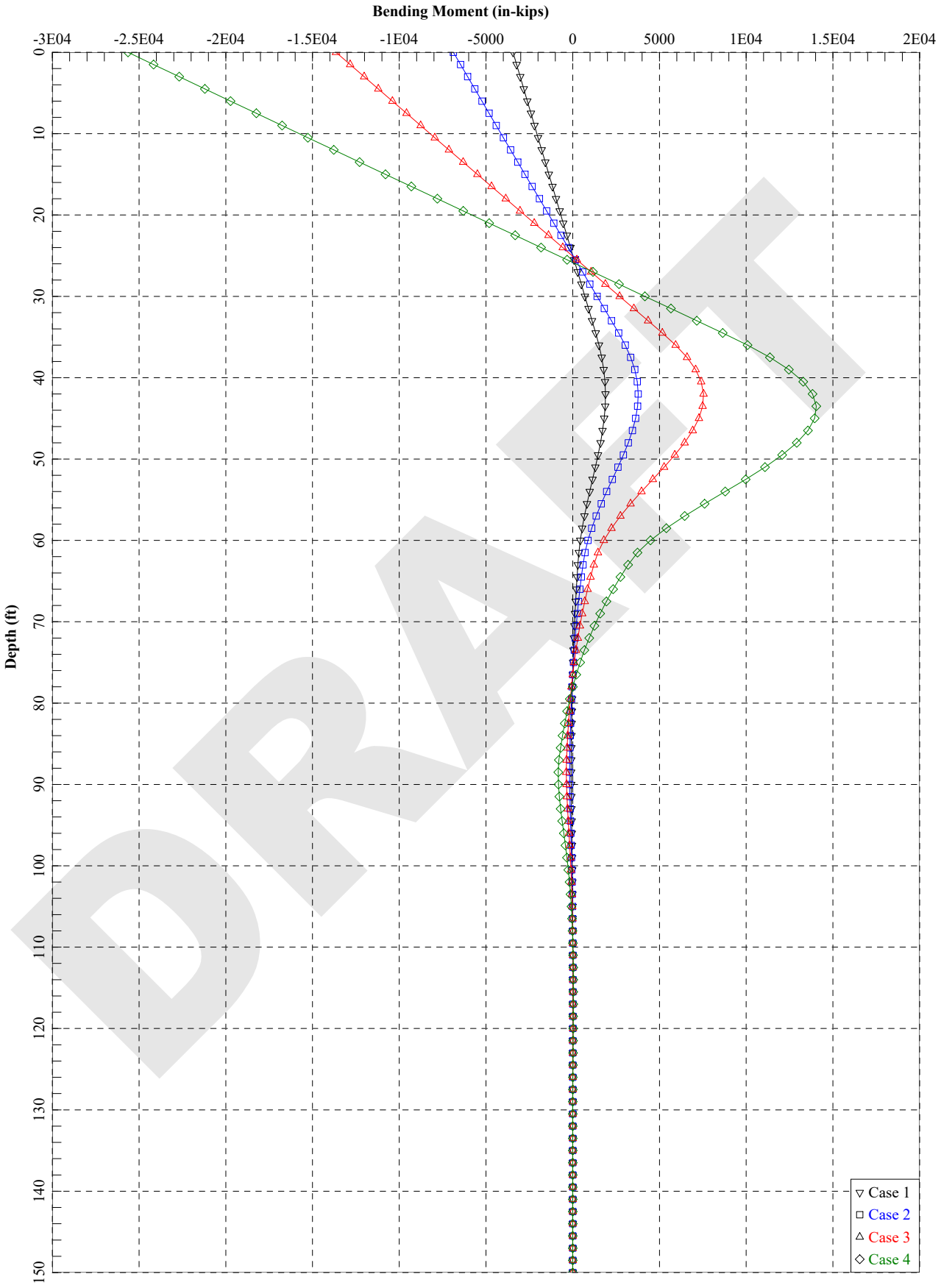
Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

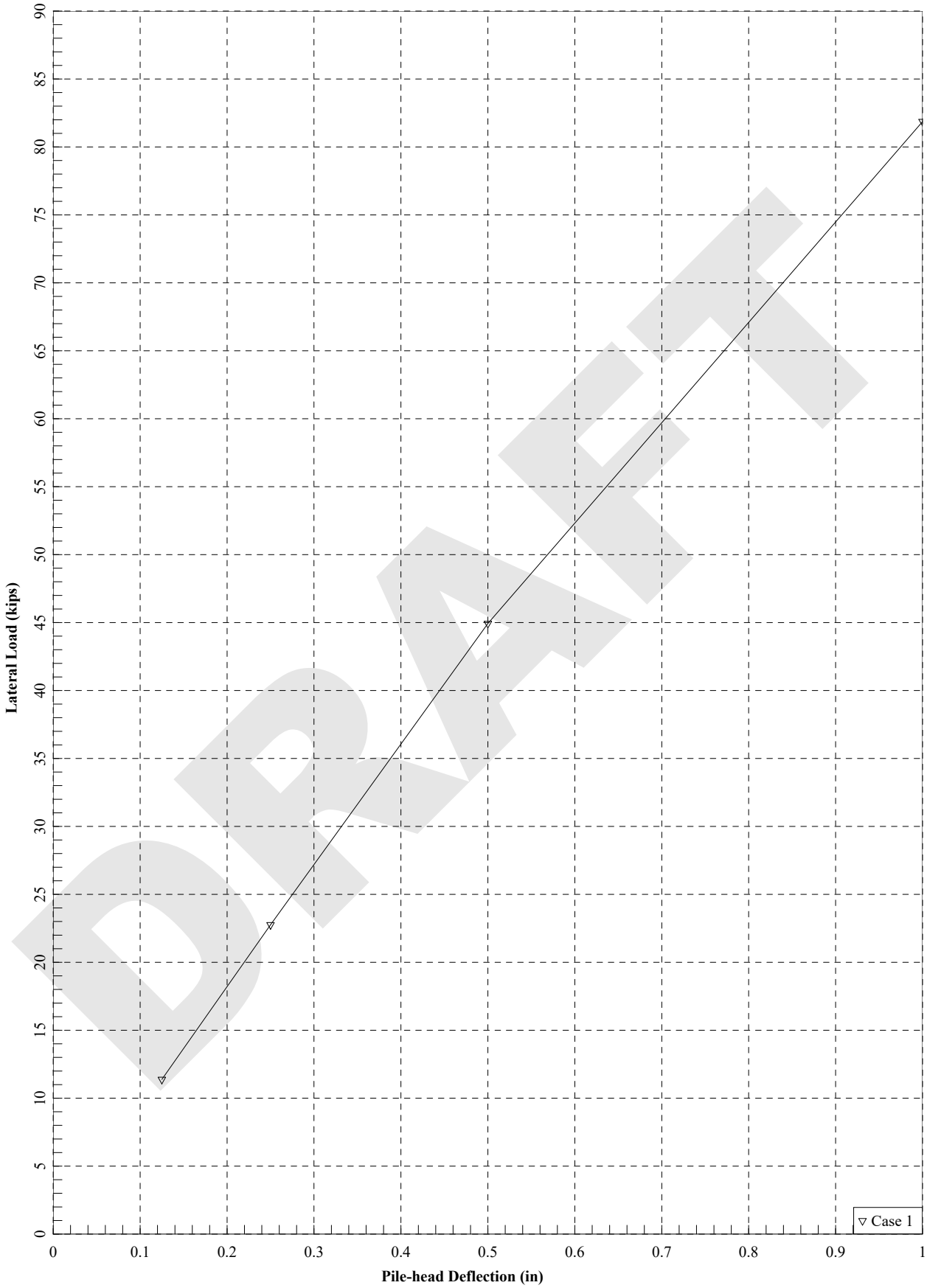
Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	5	y = 0.1250	S = 0.000	552000.	0.12500000	-3438884.	11381.	-0.00000107
2	5	y = 0.2500	S = 0.000	552000.	0.25000000	-6877767.	22763.	-0.00000215
3	5	y = 0.5000	S = 0.000	552000.	0.50000000	-13643152.	44933.	-0.00000424
4	5	y = 1.0000	S = 0.000	552000.	1.00000000	-25636535.	81864.	-0.00000772

The analysis ended normally.

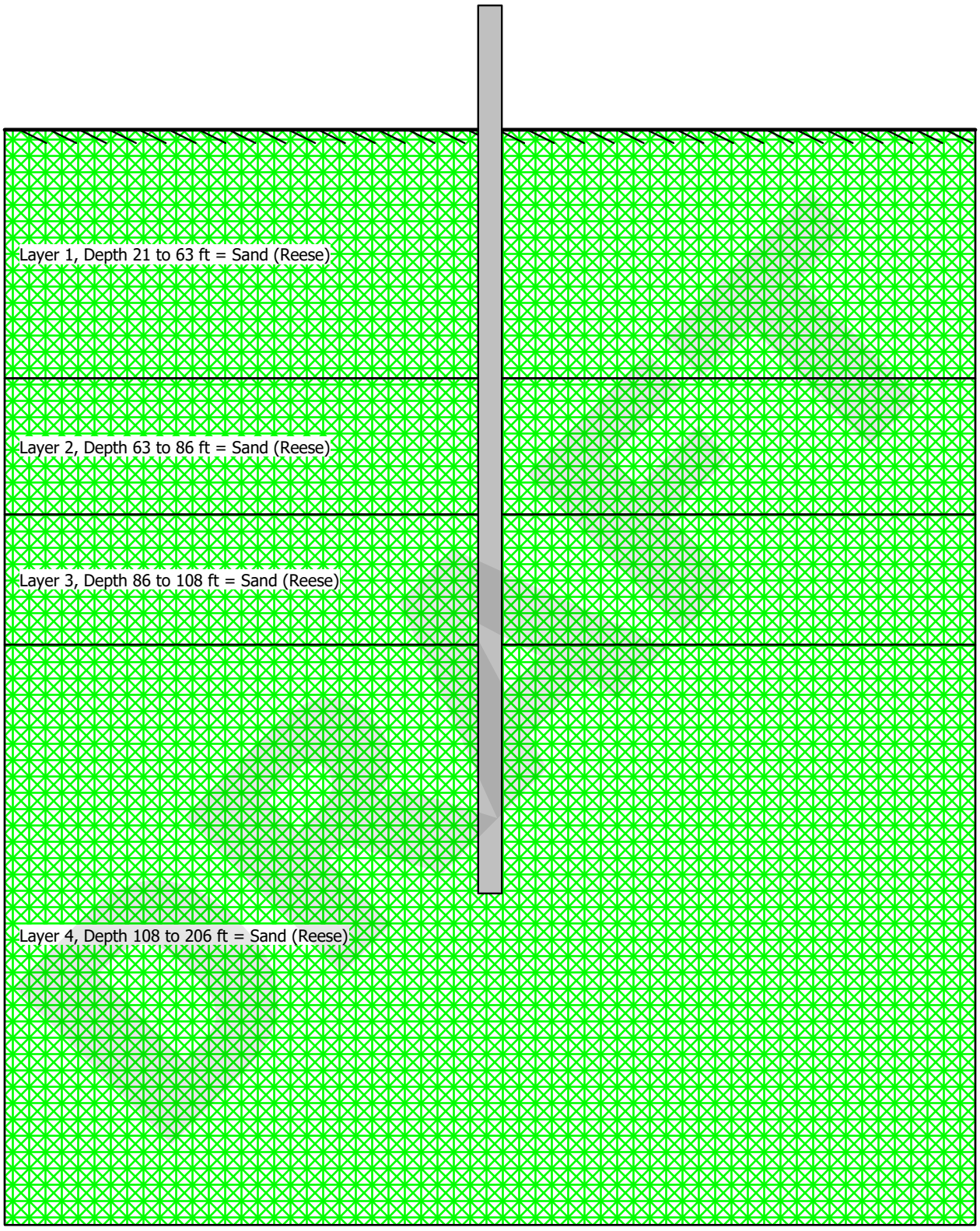

Lateral Pile Deflection (inches)
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Shear Force (kips)
-70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90
Depth (ft)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Case 1
Case 2
Case 3
Case 4


Bending Moment (in-kips)
-3E04
-2.5E04
-2E04
-1.5E04
-1E04
-5000
0
5000
1E04
1.5E04
2E04
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Lateral Load (kips)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pile-head Deflection (in)
▽ Case 1

Bent 4 – Service Limit State
LPILE Analyses



```
================================================================================

                  LPile Plus for Windows, Version 2013-07.007

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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================================================================================

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--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        P:\Four Hole Swamp\LPILE\2016-03-02\
Name of input data file:       FHS_4-1.5OEP_NWZ_shallowscour_load_type_4.lp7d
Name of output report file:    FHS_4-1.5OEP_NWZ_shallowscour_load_type_4.lp7o
Name of plot output file:      FHS_4-1.5OEP_NWZ_shallowscour_load_type_4.lp7p
Name of runtime messeage file: FHS_4-1.5OEP_NWZ_shallowscour_load_type_4.lp7r


--------------------------------------------------------------------------------
                          Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  March 2, 2016     Time:  16:46:11


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Project Name: US 301 RBO Four Hole Swamp


Job Number: 41503-0002-0001


Client: SCDOT


Engineer: Gabriel Burnworth


Description: 48" OEP (1.5" walls) No Weak Zone, 94' scour elev., Free




--------------------------------------------------------------------------------
                          Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
```

```
 - Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed                =          500
- Deflection tolerance for convergence                =   1.0000E-05 in
- Maximum allowable deflection                        =     100.0000 in
- Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
 - Compute pile response under loading and nonlinear bending properties of pile
   (only if nonlinear pile properties are input)
 - Use of p-y modification factors for p-y curves not selected
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - No p-y curves to be computed and reported for user-specified depths
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1


---------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Total number of pile sections                        =        1

Total length of pile                                 =     150.00 ft

Depth of ground surface below top of pile            =      21.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile.

Point         Depth              Pile
                X              Diameter
                ft                in
-----       ---------        -----------
  1          0.00000         48.0000000
  2        150.000000        48.0000000


Input Structural Properties:
----------------------------

Pile Section No. 1:

   Section Type                                      = Steel Pipe Pile
   Section Length                                    =    150.00000 ft
   Pile Diameter                                     =     48.00000 in


---------------------------------------------------------------------------
                      Ground Slope and Pile Batter Angles
---------------------------------------------------------------------------

Ground Slope Angle                                   =        0.000 degrees
                                                     =        0.000 radians
```

```
Pile Batter Angle                                   =        0.000 degrees
                                                    =        0.000 radians


--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     21.00000 ft
   Distance from top of pile to bottom of layer     =     63.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     63.00000 ft
   Distance from top of pile to bottom of layer     =     86.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     86.00000 ft
   Distance from top of pile to bottom of layer     =    108.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =    108.00000 ft
   Distance from top of pile to bottom of layer     =    206.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

   (Depth of lowest soil layer extends   56.00 ft below pile tip)


--------------------------------------------------------------------------------
```

Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	kpy pci
1	Sand (Reese, et al.)	21.000	57.600	36.000	default
		63.000	57.600	36.000	default
2	Sand (Reese, et al.)	63.000	57.600	36.000	default
		86.000	57.600	36.000	default
3	Sand (Reese, et al.)	86.000	57.600	36.000	default
		108.000	57.600	36.000	default
4	Sand (Reese, et al.)	108.000	57.600	36.000	default
		206.000	57.600	36.000	default

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	4	y = 0.12500 in	M = 0.0000 in-lbs	552000.	No
2	4	y = 0.25000 in	M = 0.0000 in-lbs	552000.	No
3	4	y = 0.50000 in	M = 0.0000 in-lbs	552000.	No
4	4	y = 1.00000 in	M = 0.0000 in-lbs	552000.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel Pipe Pile:

Length of Section	=	150.00000 ft
Outer Diameter of Pipe	=	48.00000 in
Pipe Wall Thickness	=	1.50000 in
Yield Stress of Pipe	=	36.00000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	219.12609 sq. in.

Moment of Inertia = 59287. in^4
Elastic Bending Stiffness = 1.7193E+09 kip-in^2
Plastic Modulus, Z = 3244.50000 in^3
Plastic Moment Capacity = Fy Z = 116802. in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As = 7888.539 kips
Nominal Axial Tensile Capacity = -7888.539 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	552.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 552.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.000001054	1811.9939796	1719329760.	106.4231912	3.2452738	
0.000002108	3623.9879591	1719329760.	65.2115956	3.9714500	
0.000003162	5435.9819387	1719329760.	51.4743971	4.6976261	
0.000004216	7247.9759182	1719329760.	44.6057978	5.4238024	
0.000005269	9059.9698978	1719329760.	40.4846382	6.1499785	
0.000006323	10872.	1719329760.	37.7371985	6.8761547	
0.000007377	12684.	1719329760.	35.7747416	7.6023309	
0.000008431	14496.	1719329760.	34.3028989	8.3285071	
0.000009485	16308.	1719329760.	33.1581324	9.0546833	
0.0000105	18120.	1719329760.	32.2423191	9.7808595	
0.0000116	19932.	1719329760.	31.4930174	10.5070357	
0.0000126	21744.	1719329760.	30.8685993	11.2332119	
0.0000137	23556.	1719329760.	30.3402455	11.9593881	
0.0000148	25368.	1719329760.	29.8873708	12.6855643	
0.0000158	27180.	1719329760.	29.4948794	13.4117405	
0.0000169	28992.	1719329760.	29.1514494	14.1379167	
0.0000179	30804.	1719329760.	28.8484230	14.8640929	
0.0000190	32616.	1719329760.	28.5790662	15.5902690	
0.0000200	34428.	1719329760.	28.3380627	16.3164452	
0.0000211	36240.	1719329760.	28.1211596	17.0426214	
0.0000221	38052.	1719329760.	27.9249139	17.7687976	
0.0000232	39864.	1719329760.	27.7465087	18.4949738	
0.0000242	41676.	1719329760.	27.5836170	19.2211500	
0.0000253	43488.	1719329760.	27.4342996	19.9473262	
0.0000263	45300.	1719329760.	27.2969276	20.6735024	
0.0000274	47112.	1719329760.	27.1701227	21.3996786	
0.0000285	48924.	1719329760.	27.0527108	22.1258548	
0.0000295	50736.	1719329760.	26.9436854	22.8520310	
0.0000306	52548.	1719329760.	26.8421790	23.5782071	
0.0000316	54360.	1719329760.	26.7474397	24.3043833	
0.0000327	56172.	1719329760.	26.6588126	25.0305595	
0.0000337	57984.	1719329760.	26.5757247	25.7567357	
0.0000348	59796.	1719329760.	26.4976725	26.4829119	
0.0000358	61608.	1719329760.	26.4242115	27.2090881	
0.0000369	63420.	1719329760.	26.3549483	27.9352643	
0.0000379	65232.	1719329760.	26.2895331	28.6614405	

0.0000390	67044.	1719329760.	26.2276538	29.3876167	
0.0000400	68856.	1719329760.	26.1690313	30.1137929	
0.0000411	70668.	1719329760.	26.1134152	30.8399691	
0.0000432	74292.	1719329760.	26.0103217	32.2923214	
0.0000453	77916.	1719329760.	25.9168184	33.7446738	
0.0000474	81540.	1719329760.	25.8316265	35.1970262	
0.0000495	85116.	1718362204.	25.7600931	36.0000000	Y
0.0000516	88307.	1710016821.	25.7450077	36.0000000	Y
0.0000537	91055.	1694080982.	25.7890002	36.0000000	Y
0.0000559	93523.	1674351216.	25.8662156	36.0000000	Y
0.0000580	95738.	1651681538.	25.9596148	36.0000000	Y
0.0000601	97623.	1625104154.	26.0427887	36.0000000	Y
0.0000622	99187.	1595157458.	26.1020741	36.0000000	Y
0.0000643	100520.	1563590959.	26.1477997	36.0000000	Y
0.0000664	101682.	1531456607.	26.1850574	36.0000000	Y
0.0000685	102694.	1499106584.	26.2156802	36.0000000	Y
0.0000706	103596.	1467136166.	26.2418156	36.0000000	Y
0.0000727	104405.	1435730900.	26.2645753	36.0000000	Y
0.0000748	105133.	1405018933.	26.2847462	36.0000000	Y
0.0000769	105792.	1375089517.	26.3029308	36.0000000	Y
0.0000790	106389.	1345978545.	26.3190684	36.0000000	Y
0.0000811	106931.	1317694704.	26.3327277	36.0000000	Y
0.0000833	107428.	1290308271.	26.3451305	36.0000000	Y
0.0000854	107888.	1263831958.	26.3565441	36.0000000	Y
0.0000875	108312.	1238223529.	26.3683587	36.0000000	Y
0.0000896	108694.	1213357023.	26.3774987	36.0000000	Y
0.0000917	109054.	1189386837.	26.3862330	36.0000000	Y
0.0000938	109391.	1166251589.	26.3947955	36.0000000	Y
0.0000959	109694.	1143784328.	26.4021331	36.0000000	Y
0.0000980	109986.	1122168893.	26.4094502	36.0000000	Y
0.0001001	110251.	1101186709.	26.4155900	36.0000000	Y
0.0001022	110504.	1080953128.	26.4221100	36.0000000	Y
0.0001043	110737.	1061349948.	26.4271609	36.0000000	Y
0.0001064	110958.	1042412273.	26.4331747	36.0000000	Y
0.0001086	111162.	1024055458.	26.4372983	36.0000000	Y
0.0001107	111360.	1006332490.	26.4430476	36.0000000	Y
0.0001128	111538.	989106469.	26.4463756	36.0000000	Y
0.0001149	111715.	972490789.	26.4505626	36.0000000	Y
0.0001170	111873.	956324994.	26.4547068	36.0000000	Y
0.0001191	112028.	940701885.	26.4572535	36.0000000	Y
0.0001212	112175.	925549270.	26.4625617	36.0000000	Y
0.0001233	112309.	910814943.	26.4645327	36.0000000	Y
0.0001254	112442.	896572199.	26.4666389	36.0000000	Y
0.0001338	112900.	843517796.	26.4797710	36.0000000	Y
0.0001423	113275.	796164739.	26.4878891	36.0000000	Y
0.0001507	113588.	753702530.	26.4950904	36.0000000	Y
0.0001591	113853.	715434459.	26.5018328	36.0000000	Y
0.0001676	114076.	680768908.	26.5058505	36.0000000	Y
0.0001760	114269.	649250909.	26.5078046	36.0000000	Y
0.0001844	114433.	620460993.	26.5135095	36.0000000	Y
0.0001929	114577.	594085861.	26.5174169	36.0000000	Y
0.0002013	114703.	569829556.	26.5179765	36.0000000	Y
0.0002097	114814.	547451379.	26.5235253	36.0000000	Y
0.0002182	114912.	526743116.	26.5225624	36.0000000	Y
0.0002266	114999.	507525905.	26.5269002	36.0000000	Y
0.0002350	115077.	489651076.	26.5278306	36.0000000	Y

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip
1	552.000	115077.2

Note that the values in the above table are not factored by a strength

reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.125000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1250	0.000	6617.2581	-0.000403	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.1177	123115.	6617.2581	-0.000402	2568.9357	1.719E+12	0.000	0.000	0.000
3.000	0.1105	246218.	6617.2581	-0.000400	2618.7685	1.719E+12	0.000	0.000	0.000
4.500	0.1033	369294.	6617.2581	-0.000397	2668.5911	1.719E+12	0.000	0.000	0.000
6.000	0.0962	492333.	6617.2581	-0.000393	2718.3980	1.719E+12	0.000	0.000	0.000
7.500	0.0892	615320.	6617.2581	-0.000387	2768.1843	1.719E+12	0.000	0.000	0.000
9.000	0.0823	738243.	6617.2581	-0.000380	2817.9446	1.719E+12	0.000	0.000	0.000
10.500	0.0755	861089.	6617.2581	-0.000371	2867.6738	1.719E+12	0.000	0.000	0.000
12.000	0.0689	983846.	6617.2581	-0.000362	2917.3668	1.719E+12	0.000	0.000	0.000
13.500	0.0625	1106501.	6617.2581	-0.000351	2967.0184	1.719E+12	0.000	0.000	0.000
15.000	0.0563	1229040.	6617.2581	-0.000339	3016.6233	1.719E+12	0.000	0.000	0.000
16.500	0.0503	1351451.	6617.2581	-0.000325	3066.1765	1.719E+12	0.000	0.000	0.000
18.000	0.0446	1473722.	6617.2581	-0.000310	3115.6728	1.719E+12	0.000	0.000	0.000
19.500	0.0391	1595840.	6617.2581	-0.000294	3165.1071	1.719E+12	0.000	0.000	0.000
21.000	0.0340	1717792.	6617.2581	-0.000277	3214.4741	1.719E+12	0.000	0.000	0.000
22.500	0.0292	1839564.	6161.0789	-0.000258	3263.7688	1.719E+12	-50.6866	31290.	0.000
24.000	0.0247	1944724.	4932.6049	-0.000239	3306.3381	1.719E+12	-85.8105	62580.	0.000
25.500	0.0206	2021878.	3194.7626	-0.000218	3337.5708	1.719E+12	-107.2830	93870.	0.000
27.000	0.0168	2064062.	1175.1680	-0.000196	3354.6473	1.719E+12	-117.1164	125160.	0.000
28.500	0.0135	2068086.	-935.1784	-0.000175	3356.2761	1.719E+12	-117.3666	156450.	0.000
30.000	0.0106	2033868.	-2982.1079	-0.000153	3342.4243	1.719E+12	-110.0700	187740.	0.000
31.500	0.007986	1963775.	-4847.3644	-0.000132	3314.0504	1.719E+12	-97.1807	219030.	0.000
33.000	0.005790	1861992.	-6446.6133	-0.000112	3272.8477	1.719E+12	-80.5136	250321.	0.000
34.500	0.003944	1733929.	-7726.5237	-9.347E-05	3221.0065	1.719E+12	-61.6986	281611.	0.000
36.000	0.002425	1585695.	-8661.1264	-7.610E-05	3161.0002	1.719E+12	-42.1461	312901.	0.000
37.500	0.001204	1423640.	-9247.6740	-6.034E-05	3095.3992	1.719E+12	-23.0259	344191.	0.000
39.000	0.000252	1253978.	-9502.2397	-4.633E-05	3026.7183	1.719E+12	-5.2592	375481.	0.000
40.500	-0.000464	1082480.	-9455.2774	-3.410E-05	2957.2948	1.719E+12	10.4773	406771.	0.000
42.000	-0.000975	914265.	-9147.3423	-2.365E-05	2889.1998	1.719E+12	23.7377	438061.	0.000
43.500	-0.001315	753646.	-8625.1375	-1.491E-05	2824.1798	1.719E+12	34.2850	469351.	0.000
45.000	-0.001512	604057.	-7938.0108	-7.807E-06	2763.6248	1.719E+12	42.0624	500641.	0.000
46.500	-0.001596	468033.	-7134.9881	-2.195E-06	2708.5611	1.719E+12	47.1623	531931.	0.000
48.000	-0.001591	347241.	-6262.3877	2.072E-06	2659.6635	1.719E+12	49.7932	563221.	0.000
49.500	-0.001521	242545.	-5362.0256	5.159E-06	2617.2821	1.719E+12	50.2470	594511.	0.000
51.000	-0.001406	154105.	-4469.9888	7.236E-06	2581.4807	1.719E+12	48.8682	625801.	0.000
52.500	-0.001261	81482.	-3615.9317	8.469E-06	2552.0822	1.719E+12	46.0270	657091.	0.000
54.000	-0.001101	23763.	-2822.8313	9.020E-06	2528.7172	1.719E+12	42.0953	688381.	0.000
55.500	-0.000936	-20319.	-2107.1238	9.038E-06	2527.3229	1.719E+12	37.4278	719671.	0.000
57.000	-0.000775	-52273.	-1479.1432	8.658E-06	2540.2580	1.719E+12	32.3478	750962.	0.000
58.500	-0.000624	-73740.	-943.7797	7.998E-06	2548.9483	1.719E+12	27.1370	782252.	0.000

60.000	-0.000487	-86408.	-501.2806	7.160E-06	2554.0762	1.719E+12	22.0296	813542.	0.000
61.500	-0.000367	-91929.	-148.1249	6.226E-06	2556.3111	1.719E+12	17.2100	844832.	0.000
63.000	-0.000263	-91864.	121.9692	5.264E-06	2556.2849	1.719E+12	12.8005	875210.	0.000
64.500	-0.000177	-87642.	317.4701	4.325E-06	2554.5760	1.719E+12	8.9218	906500.	0.000
66.000	-0.000108	-80521.	448.2056	3.444E-06	2551.6932	1.719E+12	5.6043	937790.	0.000
67.500	-5.316E-05	-71575.	524.4006	2.648E-06	2548.0719	1.719E+12	2.8618	969080.	0.000
69.000	-1.223E-05	-61695.	556.2738	1.951E-06	2544.0723	1.719E+12	0.6797	1000370.	0.000
70.500	1.707E-05	-51588.	553.5859	1.358E-06	2539.9810	1.719E+12	-0.9783	1031660.	0.000
72.000	3.665E-05	-41793.	525.3032	8.689E-07	2536.0158	1.719E+12	-2.1642	1062950.	0.000
73.500	4.835E-05	-32695.	479.3723	4.790E-07	2532.3327	1.719E+12	-2.9393	1094240.	0.000
75.000	5.389E-05	-24545.	422.5906	1.794E-07	2529.0337	1.719E+12	-3.3698	1125530.	0.000
76.500	5.481E-05	-17485.	360.5612	-4.065E-08	2526.1757	1.719E+12	-3.5223	1156820.	0.000
78.000	5.243E-05	-11564.	297.7149	-1.927E-07	2523.7789	1.719E+12	-3.4606	1188111.	0.000
79.500	4.787E-05	-6763.4339	237.3836	-2.886E-07	2521.8355	1.719E+12	-3.2429	1219401.	0.000
81.000	4.204E-05	-3012.6607	181.9099	-3.398E-07	2520.3171	1.719E+12	-2.9208	1250691.	0.000
82.500	3.564E-05	-207.9228	132.7801	-3.567E-07	2519.1818	1.719E+12	-2.5380	1281981.	0.000
84.000	2.920E-05	1774.5120	90.7665	-3.485E-07	2519.8159	1.719E+12	-2.1301	1313271.	0.000
85.500	2.309E-05	3066.5977	56.0719	-3.231E-07	2520.3390	1.719E+12	-1.7248	1344561.	0.000
87.000	1.756E-05	3799.5211	28.4667	-2.872E-07	2520.6357	1.719E+12	-1.3424	1375812.	0.000
88.500	1.275E-05	4097.1054	7.4135	-2.459E-07	2520.7561	1.719E+12	-0.9968	1407102.	0.000
90.000	8.712E-06	4071.2945	-7.8235	-2.031E-07	2520.7457	1.719E+12	-0.6962	1438392.	0.000
91.500	5.440E-06	3819.4962	-18.0865	-1.618E-07	2520.6438	1.719E+12	-0.4442	1469682.	0.000
93.000	2.887E-06	3423.3955	-24.2507	-1.239E-07	2520.4834	1.719E+12	-0.2408	1500973.	0.000
94.500	9.799E-07	2948.9325	-27.1682	-9.053E-08	2520.2913	1.719E+12	-0.0834	1532263.	0.000
96.000	-3.718E-07	2447.1376	-27.6283	-6.228E-08	2520.0882	1.719E+12	0.0323	1563553.	0.000
97.500	-1.262E-06	1955.5525	-26.3310	-3.924E-08	2519.8892	1.719E+12	0.1118	1594843.	0.000
99.000	-1.784E-06	1500.0022	-23.8736	-2.115E-08	2519.7048	1.719E+12	0.1612	1626133.	0.000
100.500	-2.024E-06	1096.5246	-20.7457	-7.557E-09	2519.5415	1.719E+12	0.1863	1657423.	0.000
102.000	-2.056E-06	753.3069	-17.3323	2.126E-09	2519.4025	1.719E+12	0.1929	1688713.	0.000
103.500	-1.947E-06	472.5189	-13.9214	8.543E-09	2519.2889	1.719E+12	0.1861	1720003.	0.000
105.000	-1.749E-06	251.9653	-10.7155	1.234E-08	2519.1996	1.719E+12	0.1702	1751293.	0.000
106.500	-1.503E-06	86.5150	-7.8445	1.411E-08	2519.1326	1.719E+12	0.1489	1782583.	0.000
108.000	-1.241E-06	-30.7160	-5.4074	1.440E-08	2519.1100	1.719E+12	0.1219	1768648.	0.000
109.500	-9.847E-07	-108.4361	-3.4237	1.367E-08	2519.1415	1.719E+12	0.0985	1799938.	0.000
111.000	-7.488E-07	-154.2419	-1.8519	1.230E-08	2519.1600	1.719E+12	0.0762	1831228.	0.000
112.500	-5.420E-07	-175.3483	-0.6615	1.057E-08	2519.1686	1.719E+12	0.0561	1862518.	0.000
114.000	-3.683E-07	-178.2643	0.1921	8.720E-09	2519.1698	1.719E+12	0.0387	1893808.	0.000
115.500	-2.281E-07	-168.6070	0.7604	6.904E-09	2519.1658	1.719E+12	0.0244	1925098.	0.000
117.000	-1.198E-07	-151.0268	1.0972	5.231E-09	2519.1587	1.719E+12	0.0130	1956388.	0.000
118.500	-3.984E-08	-129.2135	1.2539	3.764E-09	2519.1499	1.719E+12	0.004399	1987678.	0.000
120.000	1.574E-08	-105.9615	1.2776	2.533E-09	2519.1405	1.719E+12	-0.001765	2018968.	0.000
121.500	5.134E-08	-83.2704	1.2091	1.542E-09	2519.1313	1.719E+12	-0.005848	2050258.	0.000
123.000	7.125E-08	-62.4654	1.0823	7.793E-10	2519.1229	1.719E+12	-0.008240	2081548.	0.000
124.500	7.940E-08	-44.3236	0.9243	2.203E-10	2519.1155	1.719E+12	-0.009319	2112838.	0.000
126.000	7.918E-08	-29.1967	0.7555	-1.646E-10	2519.1094	1.719E+12	-0.009432	2144129.	0.000
127.500	7.347E-08	-17.1228	0.5907	-4.070E-10	2519.1045	1.719E+12	-0.008879	2175419.	0.000
129.000	6.453E-08	-7.9240	0.4396	-5.381E-10	2519.1008	1.719E+12	-0.007911	2206709.	0.000
130.500	5.410E-08	-1.2876	0.3078	-5.864E-10	2519.0981	1.719E+12	-0.006726	2237999.	0.000
132.000	4.342E-08	3.1697	0.1980	-5.765E-10	2519.0989	1.719E+12	-0.005474	2269289.	0.000
133.500	3.334E-08	5.8530	0.1104	-5.293E-10	2519.1000	1.719E+12	-0.004262	2300579.	0.000
135.000	2.437E-08	7.1550	0.0436	-4.612E-10	2519.1005	1.719E+12	-0.003157	2331869.	0.000
136.500	1.674E-08	7.4335	-0.004543	-3.848E-10	2519.1006	1.719E+12	-0.002198	2363159.	0.000
138.000	1.051E-08	6.9991	-0.0369	-3.093E-10	2519.1004	1.719E+12	-0.001399	2394449.	0.000
139.500	5.606E-09	6.1109	-0.0563	-2.407E-10	2519.1001	1.719E+12	-0.000755	2425739.	0.000
141.000	1.850E-09	4.9773	-0.0654	-1.826E-10	2519.0996	1.719E+12	-0.000253	2457029.	0.000
142.500	-9.681E-10	3.7614	-0.0664	-1.369E-10	2519.0991	1.719E+12	0.000134	2488319.	0.000
144.000	-3.077E-09	2.5884	-0.0614	-1.036E-10	2519.0986	1.719E+12	0.000431	2519609.	0.000
145.500	-4.699E-09	1.5547	-0.0515	-8.194E-11	2519.0982	1.719E+12	0.000666	2550899.	0.000
147.000	-6.027E-09	0.7366	-0.0377	-6.995E-11	2519.0979	1.719E+12	0.000865	2582189.	0.000
148.500	-7.217E-09	0.1986	-0.0205	-6.505E-11	2519.0977	1.719E+12	0.001048	2613479.	0.000
150.000	-8.369E-09	0.000	0.000	-6.401E-11	2519.0976	1.719E+12	0.001230	1322385.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =      0.1250000 inches
Computed slope at pile head      =     -0.0004030 radians
Maximum bending moment           =       2068086. inch-lbs
Maximum shear force              =  -9502.2397158 lbs
Depth of maximum bending moment  =     28.5000000 feet below pile head
Depth of maximum shear force     =     39.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.250000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2500	0.000	13235.	-0.000806	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.2355	246230.	13235.	-0.000805	2618.7737	1.719E+12	0.000	0.000	0.000
3.000	0.2210	492435.	13235.	-0.000801	2718.4395	1.719E+12	0.000	0.000	0.000
4.500	0.2067	738589.	13235.	-0.000794	2818.0845	1.719E+12	0.000	0.000	0.000
6.000	0.1924	984665.	13235.	-0.000785	2917.6985	1.719E+12	0.000	0.000	0.000
7.500	0.1784	1230640.	13235.	-0.000774	3017.2709	1.719E+12	0.000	0.000	0.000
9.000	0.1646	1476486.	13235.	-0.000760	3116.7916	1.719E+12	0.000	0.000	0.000
10.500	0.1510	1722179.	13235.	-0.000743	3216.2501	1.719E+12	0.000	0.000	0.000
12.000	0.1378	1967692.	13235.	-0.000724	3315.6360	1.719E+12	0.000	0.000	0.000
13.500	0.1250	2213001.	13235.	-0.000702	3414.9391	1.719E+12	0.000	0.000	0.000
15.000	0.1126	2458080.	13235.	-0.000677	3514.1490	1.719E+12	0.000	0.000	0.000
16.500	0.1006	2702903.	13235.	-0.000650	3613.2554	1.719E+12	0.000	0.000	0.000
18.000	0.0892	2947445.	13235.	-0.000621	3712.2480	1.719E+12	0.000	0.000	0.000
19.500	0.0783	3191680.	13235.	-0.000589	3811.1165	1.719E+12	0.000	0.000	0.000
21.000	0.0680	3435583.	13235.	-0.000554	3909.8506	1.719E+12	0.000	0.000	0.000
22.500	0.0583	3679129.	12322.	-0.000517	4008.4400	1.719E+12	-101.3732	31290.	0.000
24.000	0.0494	3889447.	9865.2097	-0.000477	4093.5786	1.719E+12	-171.6211	62580.	0.000
25.500	0.0411	4043755.	6389.5253	-0.000435	4156.0439	1.719E+12	-214.5661	93870.	0.000
27.000	0.0337	4128124.	2350.3360	-0.000393	4190.1970	1.719E+12	-234.2327	125160.	0.000
28.500	0.0270	4136171.	-1870.3567	-0.000349	4193.4547	1.719E+12	-234.7331	156450.	0.000
30.000	0.0211	4067735.	-5964.2157	-0.000306	4165.7511	1.719E+12	-220.1401	187740.	0.000
31.500	0.0160	3927550.	-9694.7289	-0.000265	4109.0031	1.719E+12	-194.3614	219030.	0.000
33.000	0.0116	3723984.	-12893.	-0.000225	4026.5977	1.719E+12	-161.0273	250321.	0.000
34.500	0.007887	3467857.	-15453.	-0.000187	3922.9155	1.719E+12	-123.3973	281611.	0.000
36.000	0.004849	3171389.	-17322.	-0.000152	3802.9027	1.719E+12	-84.2922	312901.	0.000
37.500	0.002408	2847281.	-18495.	-0.000121	3671.7008	1.719E+12	-46.0517	344191.	0.000
39.000	0.000504	2507955.	-19004.	-9.266E-05	3534.3389	1.719E+12	-10.5184	375481.	0.000
40.500	-0.000927	2164961.	-18911.	-6.819E-05	3395.4919	1.719E+12	20.9545	406771.	0.000
42.000	-0.001951	1828530.	-18295.	-4.729E-05	3259.3021	1.719E+12	47.4755	438061.	0.000
43.500	-0.002630	1507292.	-17250.	-2.983E-05	3129.2620	1.719E+12	68.5700	469351.	0.000
45.000	-0.003025	1208113.	-15876.	-1.561E-05	3008.1520	1.719E+12	84.1248	500641.	0.000
46.500	-0.003192	936065.	-14270.	-4.391E-06	2898.0247	1.719E+12	94.3247	531931.	0.000
48.000	-0.003183	694481.	-12525.	4.144E-06	2800.2294	1.719E+12	99.5865	563221.	0.000
49.500	-0.003043	485091.	-10724.	1.032E-05	2715.4665	1.719E+12	100.4940	594511.	0.000
51.000	-0.002811	308210.	-8939.9776	1.447E-05	2643.8637	1.719E+12	97.7364	625801.	0.000
52.500	-0.002522	162964.	-7231.8635	1.694E-05	2585.0669	1.719E+12	92.0540	657091.	0.000
54.000	-0.002201	47527.	-5645.6627	1.804E-05	2538.3368	1.719E+12	84.1905	688381.	0.000
55.500	-0.001872	-40638.	-4214.2477	1.808E-05	2535.5483	1.719E+12	74.8556	719671.	0.000
57.000	-0.001551	-104545.	-2958.2864	1.732E-05	2561.4185	1.719E+12	64.6957	750962.	0.000
58.500	-0.001249	-147481.	-1887.5594	1.600E-05	2578.7990	1.719E+12	54.2740	782252.	0.000

60.000	-0.000975	-172816.	-1002.5613	1.432E-05	2589.0548	1.719E+12	44.0591	813542.	0.000
61.500	-0.000733	-183857.	-296.2498	1.245E-05	2593.5246	1.719E+12	34.4199	844832.	0.000
63.000	-0.000527	-183728.	243.9384	1.053E-05	2593.4722	1.719E+12	25.6010	875210.	0.000
64.500	-0.000354	-175285.	634.9402	8.650E-06	2590.0544	1.719E+12	17.8437	906500.	0.000
66.000	-0.000215	-161042.	896.4112	6.889E-06	2584.2888	1.719E+12	11.2086	937790.	0.000
67.500	-0.000106	-143151.	1048.8011	5.297E-06	2577.0463	1.719E+12	5.7236	969080.	0.000
69.000	-2.446E-05	-123390.	1112.5476	3.901E-06	2569.0471	1.719E+12	1.3594	1000370.	0.000
70.500	3.414E-05	-103177.	1107.1717	2.715E-06	2560.8644	1.719E+12	-1.9567	1031660.	0.000
72.000	7.330E-05	-83586.	1050.6065	1.738E-06	2552.9340	1.719E+12	-4.3283	1062950.	0.000
73.500	9.670E-05	-65389.	958.7446	9.580E-07	2545.5678	1.719E+12	-5.8785	1094240.	0.000
75.000	0.000108	-49090.	845.1812	3.587E-07	2538.9698	1.719E+12	-6.7396	1125530.	0.000
76.500	0.000110	-34970.	721.1224	-8.130E-08	2533.2537	1.719E+12	-7.0447	1156820.	0.000
78.000	0.000105	-23128.	595.4298	-3.854E-07	2528.4602	1.719E+12	-6.9212	1188111.	0.000
79.500	9.574E-05	-13527.	474.7671	-5.773E-07	2524.5734	1.719E+12	-6.4858	1219401.	0.000
81.000	8.407E-05	-6025.3214	363.8199	-6.796E-07	2521.5367	1.719E+12	-5.8417	1250691.	0.000
82.500	7.127E-05	-415.8456	265.5603	-7.134E-07	2519.2659	1.719E+12	-5.0761	1281981.	0.000
84.000	5.839E-05	3549.0240	181.5331	-6.970E-07	2520.5343	1.719E+12	-4.2603	1313271.	0.000
85.500	4.618E-05	6133.1954	112.1438	-6.463E-07	2521.5804	1.719E+12	-3.4496	1344561.	0.000
87.000	3.513E-05	7599.0422	56.9334	-5.744E-07	2522.1738	1.719E+12	-2.6848	1375812.	0.000
88.500	2.550E-05	8194.2108	14.8271	-4.917E-07	2522.4147	1.719E+12	-1.9936	1407102.	0.000
90.000	1.742E-05	8142.5891	-15.6470	-4.062E-07	2522.3938	1.719E+12	-1.3924	1438392.	0.000
91.500	1.088E-05	7638.9924	-36.1730	-3.236E-07	2522.1899	1.719E+12	-0.8883	1469682.	0.000
93.000	5.774E-06	6846.7911	-48.5014	-2.478E-07	2521.8692	1.719E+12	-0.4815	1500973.	0.000
94.500	1.960E-06	5897.8651	-54.3365	-1.811E-07	2521.4851	1.719E+12	-0.1668	1532263.	0.000
96.000	-7.436E-07	4894.2751	-55.2565	-1.246E-07	2521.0788	1.719E+12	0.0646	1563553.	0.000
97.500	-2.525E-06	3911.1049	-52.6619	-7.847E-08	2520.6808	1.719E+12	0.2237	1594843.	0.000
99.000	-3.569E-06	3000.0045	-47.7471	-4.230E-08	2520.3120	1.719E+12	0.3224	1626133.	0.000
100.500	-4.047E-06	2193.0492	-41.4914	-1.511E-08	2519.9854	1.719E+12	0.3727	1657423.	0.000
102.000	-4.113E-06	1506.6139	-34.6646	4.253E-09	2519.7075	1.719E+12	0.3859	1688713.	0.000
103.500	-3.894E-06	945.0377	-27.8429	1.709E-08	2519.4802	1.719E+12	0.3721	1720003.	0.000
105.000	-3.498E-06	503.9307	-21.4310	2.467E-08	2519.3016	1.719E+12	0.3403	1751293.	0.000
106.500	-3.006E-06	173.0301	-15.6889	2.821E-08	2519.1676	1.719E+12	0.2977	1782583.	0.000
108.000	-2.482E-06	-61.4320	-10.8147	2.880E-08	2519.1225	1.719E+12	0.2439	1768648.	0.000
109.500	-1.969E-06	-216.8722	-6.8475	2.734E-08	2519.1854	1.719E+12	0.1969	1799938.	0.000
111.000	-1.498E-06	-308.4837	-3.7038	2.459E-08	2519.2225	1.719E+12	0.1524	1831228.	0.000
112.500	-1.084E-06	-350.6966	-1.3229	2.114E-08	2519.2396	1.719E+12	0.1122	1862518.	0.000
114.000	-7.366E-07	-356.5286	0.3841	1.744E-08	2519.2419	1.719E+12	0.0775	1893808.	0.000
115.500	-4.563E-07	-337.2141	1.5208	1.381E-08	2519.2341	1.719E+12	0.0488	1925098.	0.000
117.000	-2.395E-07	-302.0535	2.1943	1.046E-08	2519.2199	1.719E+12	0.0260	1956388.	0.000
118.500	-7.967E-08	-258.4270	2.5078	7.527E-09	2519.2022	1.719E+12	0.008798	1987678.	0.000
120.000	3.147E-08	-211.9231	2.5552	5.065E-09	2519.1834	1.719E+12	-0.003530	2018968.	0.000
121.500	1.027E-07	-166.5409	2.4182	3.084E-09	2519.1650	1.719E+12	-0.0117	2050258.	0.000
123.000	1.425E-07	-124.9308	2.1646	1.559E-09	2519.1482	1.719E+12	-0.0165	2081548.	0.000
124.500	1.588E-07	-88.6472	1.8485	4.406E-10	2519.1335	1.719E+12	-0.0186	2112838.	0.000
126.000	1.584E-07	-58.3934	1.5110	-3.291E-10	2519.1212	1.719E+12	-0.0189	2144129.	0.000
127.500	1.469E-07	-34.2456	1.1814	-8.141E-10	2519.1115	1.719E+12	-0.0178	2175419.	0.000
129.000	1.291E-07	-15.8480	0.8791	-1.076E-09	2519.1040	1.719E+12	-0.0158	2206709.	0.000
130.500	1.082E-07	-2.5752	0.6157	-1.173E-09	2519.0986	1.719E+12	-0.0135	2237999.	0.000
132.000	8.684E-08	6.3394	0.3961	-1.153E-09	2519.1002	1.719E+12	-0.0109	2269289.	0.000
133.500	6.669E-08	11.7061	0.2208	-1.059E-09	2519.1023	1.719E+12	-0.008523	2300579.	0.000
135.000	4.873E-08	14.3101	0.0873	-9.224E-10	2519.1034	1.719E+12	-0.006313	2331869.	0.000
136.500	3.348E-08	14.8670	-0.009085	-7.697E-10	2519.1036	1.719E+12	-0.004395	2363159.	0.000
138.000	2.103E-08	13.9983	-0.0738	-6.186E-10	2519.1033	1.719E+12	-0.002797	2394449.	0.000
139.500	1.121E-08	12.2219	-0.1126	-4.813E-10	2519.1025	1.719E+12	-0.001511	2425739.	0.000
141.000	3.700E-09	9.9546	-0.1307	-3.652E-10	2519.1016	1.719E+12	-0.000505	2457029.	0.000
142.500	-1.936E-09	7.5227	-0.1329	-2.737E-10	2519.1006	1.719E+12	0.000268	2488319.	0.000
144.000	-6.155E-09	5.1768	-0.1227	-2.073E-10	2519.0997	1.719E+12	0.000862	2519609.	0.000
145.500	-9.397E-09	3.1094	-0.1030	-1.639E-10	2519.0989	1.719E+12	0.001332	2550899.	0.000
147.000	-1.205E-08	1.4732	-0.0754	-1.399E-10	2519.0982	1.719E+12	0.001729	2582189.	0.000
148.500	-1.443E-08	0.3971	-0.0410	-1.301E-10	2519.0978	1.719E+12	0.002096	2613479.	0.000
150.000	-1.674E-08	0.000	0.000	-1.280E-10	2519.0976	1.719E+12	0.002459	1322385.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =      0.2500000 inches
Computed slope at pile head      =     -0.0008061 radians
Maximum bending moment           =       4136171. inch-lbs
Maximum shear force              =        -19004. lbs
Depth of maximum bending moment  =     28.5000000 feet below pile head
Depth of maximum shear force     =     39.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.500000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5000	0.000	26171.	-0.001607	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.4711	487042.	26171.	-0.001604	2716.2563	1.719E+12	0.000	0.000	0.000
3.000	0.4422	974033.	26171.	-0.001597	2913.3945	1.719E+12	0.000	0.000	0.000
4.500	0.4136	1460923.	26171.	-0.001584	3110.4917	1.719E+12	0.000	0.000	0.000
6.000	0.3852	1947662.	26171.	-0.001566	3307.5274	1.719E+12	0.000	0.000	0.000
7.500	0.3572	2434197.	26171.	-0.001543	3504.4811	1.719E+12	0.000	0.000	0.000
9.000	0.3297	2920479.	26171.	-0.001515	3701.3323	1.719E+12	0.000	0.000	0.000
10.500	0.3027	3406458.	26171.	-0.001482	3898.0605	1.719E+12	0.000	0.000	0.000
12.000	0.2763	3892082.	26171.	-0.001444	4094.6452	1.719E+12	0.000	0.000	0.000
13.500	0.2507	4377301.	26171.	-0.001401	4291.0661	1.719E+12	0.000	0.000	0.000
15.000	0.2259	4862065.	26171.	-0.001352	4487.3026	1.719E+12	0.000	0.000	0.000
16.500	0.2020	5346323.	26171.	-0.001299	4683.3344	1.719E+12	0.000	0.000	0.000
18.000	0.1791	5830025.	26171.	-0.001240	4879.1411	1.719E+12	0.000	0.000	0.000
19.500	0.1573	6313121.	26171.	-0.001177	5074.7022	1.719E+12	0.000	0.000	0.000
21.000	0.1368	6795560.	26171.	-0.001108	5269.9976	1.719E+12	0.000	0.000	0.000
22.500	0.1174	7277292.	24773.	-0.001034	5465.0067	1.719E+12	-155.3218	23805.	0.000
24.000	0.0995	7707943.	20497.	-0.000956	5639.3378	1.719E+12	-319.7551	57839.	0.000
25.500	0.0830	8034191.	13723.	-0.000874	5771.4059	1.719E+12	-432.9894	93870.	0.000
27.000	0.0681	8219315.	5566.4942	-0.000789	5846.3456	1.719E+12	-473.2370	125160.	0.000
28.500	0.0546	8250255.	-2966.7921	-0.000702	5858.8705	1.719E+12	-474.9059	156450.	0.000
30.000	0.0428	8126468.	-11256.	-0.000617	5808.7602	1.719E+12	-446.1345	187740.	0.000
31.500	0.0324	7857287.	-18824.	-0.000533	5699.7937	1.719E+12	-394.7468	219030.	0.000
33.000	0.0236	7459391.	-25329.	-0.000453	5538.7222	1.719E+12	-328.0237	250321.	0.000
34.500	0.0161	6954440.	-30554.	-0.000377	5334.3136	1.719E+12	-252.5137	281611.	0.000
36.000	0.0100	6366951.	-34392.	-0.000308	5096.4930	1.719E+12	-173.8934	312901.	0.000
37.500	0.005067	5722458.	-36828.	-0.000244	4835.5969	1.719E+12	-96.8803	344191.	0.000
39.000	0.001208	5045981.	-37927.	-0.000188	4561.7531	1.719E+12	-25.1980	375481.	0.000
40.500	-0.001700	4360814.	-37808.	-0.000139	4284.3919	1.719E+12	38.4105	406771.	0.000
42.000	-0.003786	3687639.	-36633.	-9.658E-05	4011.8849	1.719E+12	92.1288	438061.	0.000
43.500	-0.005177	3043930.	-34589.	-6.134E-05	3751.3061	1.719E+12	134.9789	469351.	0.000
45.000	-0.005994	2443638.	-31874.	-3.262E-05	3508.3027	1.719E+12	166.7108	500641.	0.000
46.500	-0.006351	1897105.	-28685.	-9.895E-06	3287.0618	1.719E+12	187.6760	531931.	0.000
48.000	-0.006350	1411183.	-25207.	7.423E-06	3090.3562	1.719E+12	198.6956	563221.	0.000
49.500	-0.006084	989491.	-21611.	1.999E-05	2919.6517	1.719E+12	200.9298	594511.	0.000
51.000	-0.005631	632797.	-18041.	2.848E-05	2775.2591	1.719E+12	195.7543	625801.	0.000
52.500	-0.005058	339462.	-14617.	3.357E-05	2656.5145	1.719E+12	184.6507	657091.	0.000
54.000	-0.004422	105918.	-11433.	3.590E-05	2561.9741	1.719E+12	169.1109	688381.	0.000
55.500	-0.003766	-72845.	-8556.0877	3.608E-05	2548.5858	1.719E+12	150.5611	719671.	0.000
57.000	-0.003123	-202818.	-6028.3146	3.463E-05	2601.2001	1.719E+12	130.3026	750962.	0.000
58.500	-0.002519	-290552.	-3870.3505	3.205E-05	2636.7156	1.719E+12	109.4712	782252.	0.000

60.000	-0.001969	-342788.	-2083.9855	2.873E-05	2657.8609	1.719E+12	89.0138	813542.	0.000
61.500	-0.001485	-366147.	-655.7630	2.502E-05	2667.3169	1.719E+12	69.6776	844832.	0.000
63.000	-0.001069	-366892.	438.9746	2.119E-05	2667.6187	1.719E+12	51.9599	875210.	0.000
64.500	-0.000722	-350765.	1233.7926	1.743E-05	2661.0901	1.719E+12	36.3532	906500.	0.000
66.000	-0.000441	-322822.	1767.8343	1.390E-05	2649.7787	1.719E+12	22.9847	937790.	0.000
67.500	-0.000221	-287399.	2081.9370	1.071E-05	2635.4391	1.719E+12	11.9156	969080.	0.000
69.000	-5.564E-05	-248085.	2217.0054	7.906E-06	2619.5246	1.719E+12	3.0920	1000370.	0.000
70.500	6.330E-05	-207744.	2212.1809	5.520E-06	2603.1941	1.719E+12	-3.6281	1031660.	0.000
72.000	0.000143	-168556.	2103.4795	3.550E-06	2587.3306	1.719E+12	-8.4499	1062950.	0.000
73.500	0.000191	-132089.	1922.8677	1.977E-06	2572.5684	1.719E+12	-11.6181	1094240.	0.000
75.000	0.000214	-99372.	1697.7332	7.650E-07	2559.3244	1.719E+12	-13.3968	1125530.	0.000
76.500	0.000219	-70986.	1450.6889	-1.267E-07	2547.8333	1.719E+12	-14.0525	1156820.	0.000
78.000	0.000210	-47145.	1199.6512	-7.451E-07	2538.1823	1.719E+12	-13.8406	1188111.	0.000
79.500	0.000192	-27784.	958.1263	-1.137E-06	2530.3447	1.719E+12	-12.9955	1219401.	0.000
81.000	0.000169	-12630.	735.6444	-1.349E-06	2524.2103	1.719E+12	-11.7247	1250691.	0.000
82.500	0.000143	-1273.6880	538.2864	-1.422E-06	2519.6132	1.719E+12	-10.2040	1281981.	0.000
84.000	0.000118	6776.6108	369.2549	-1.393E-06	2521.8408	1.719E+12	-8.5773	1313271.	0.000
85.500	9.313E-05	12047.	229.4504	-1.294E-06	2523.9744	1.719E+12	-6.9566	1344561.	0.000
87.000	7.097E-05	15063.	118.0229	-1.152E-06	2525.1950	1.719E+12	-5.4243	1375812.	0.000
88.500	5.164E-05	16319.	32.8714	-9.881E-07	2525.7036	1.719E+12	-4.0370	1407102.	0.000
90.000	3.539E-05	16266.	-28.9167	-8.176E-07	2525.6820	1.719E+12	-2.8283	1438392.	0.000
91.500	2.221E-05	15294.	-70.6923	-6.524E-07	2525.2888	1.719E+12	-1.8134	1469682.	0.000
93.000	1.191E-05	13734.	-95.9498	-5.004E-07	2524.6571	1.719E+12	-0.9930	1500973.	0.000
94.500	4.194E-06	11850.	-108.1003	-3.665E-07	2523.8945	1.719E+12	-0.3571	1532263.	0.000
96.000	-1.286E-06	9849.2673	-110.3084	-2.529E-07	2523.0847	1.719E+12	0.1117	1563553.	0.000
97.500	-4.911E-06	7883.8150	-105.3871	-1.601E-07	2522.2890	1.719E+12	0.4351	1594843.	0.000
99.000	-7.049E-06	6058.5118	-95.7397	-8.711E-08	2521.5501	1.719E+12	0.6369	1626133.	0.000
100.500	-8.047E-06	4438.9183	-83.3397	-3.216E-08	2520.8945	1.719E+12	0.7409	1657423.	0.000
102.000	-8.207E-06	3058.9221	-69.7415	7.087E-09	2520.3359	1.719E+12	0.7700	1688713.	0.000
103.500	-7.791E-06	1928.0820	-56.1110	3.319E-08	2519.8781	1.719E+12	0.7445	1720003.	0.000
105.000	-7.012E-06	1038.2656	-43.2700	4.872E-08	2519.5179	1.719E+12	0.6823	1751293.	0.000
106.500	-6.038E-06	369.3932	-31.7485	5.609E-08	2519.2471	1.719E+12	0.5979	1782583.	0.000
108.000	-4.993E-06	-105.7932	-21.9516	5.747E-08	2519.1404	1.719E+12	0.4906	1768648.	0.000
109.500	-3.969E-06	-422.0076	-13.9643	5.471E-08	2519.2684	1.719E+12	0.3969	1799938.	0.000
111.000	-3.024E-06	-609.5958	-7.6240	4.930E-08	2519.3444	1.719E+12	0.3076	1831228.	0.000
112.500	-2.194E-06	-697.4499	-2.8124	4.246E-08	2519.3799	1.719E+12	0.2270	1862518.	0.000
114.000	-1.495E-06	-711.6854	0.6463	3.509E-08	2519.3857	1.719E+12	0.1573	1893808.	0.000
115.500	-9.306E-07	-674.8803	2.9578	2.783E-08	2519.3708	1.719E+12	0.0995	1925098.	0.000
117.000	-4.933E-07	-605.7574	4.3361	2.113E-08	2519.3428	1.719E+12	0.0536	1956388.	0.000
118.500	-1.701E-07	-519.2003	4.9877	1.524E-08	2519.3078	1.719E+12	0.0188	1987678.	0.000
120.000	5.522E-08	-426.5027	5.1010	1.029E-08	2519.2702	1.719E+12	-0.006194	2018968.	0.000
121.500	2.002E-07	-335.7677	4.8401	6.296E-09	2519.2335	1.719E+12	-0.0228	2050258.	0.000
123.000	2.819E-07	-252.3853	4.3415	3.217E-09	2519.1998	1.719E+12	-0.0326	2081548.	0.000
124.500	3.160E-07	-179.5379	3.7143	9.562E-10	2519.1703	1.719E+12	-0.0371	2112838.	0.000
126.000	3.163E-07	-118.6896	3.0414	-6.049E-10	2519.1456	1.719E+12	-0.0377	2144129.	0.000
127.500	2.942E-07	-70.0362	2.3823	-1.593E-09	2519.1259	1.719E+12	-0.0356	2175419.	0.000
129.000	2.590E-07	-32.8964	1.7765	-2.132E-09	2519.1109	1.719E+12	-0.0317	2206709.	0.000
130.500	2.175E-07	-6.0391	1.2474	-2.335E-09	2519.1000	1.719E+12	-0.0270	2237999.	0.000
132.000	1.749E-07	12.0578	0.8057	-2.304E-09	2519.1025	1.719E+12	-0.0220	2269289.	0.000
133.500	1.345E-07	23.0103	0.4525	-2.120E-09	2519.1069	1.719E+12	-0.0172	2300579.	0.000
135.000	9.854E-08	28.3889	0.1828	-1.851E-09	2519.1091	1.719E+12	-0.0128	2331869.	0.000
136.500	6.789E-08	29.6284	-0.0123	-1.548E-09	2519.1096	1.719E+12	-0.008914	2363159.	0.000
138.000	4.283E-08	27.9768	-0.1438	-1.246E-09	2519.1089	1.719E+12	-0.005697	2394449.	0.000
139.500	2.303E-08	24.4765	-0.2230	-9.715E-10	2519.1075	1.719E+12	-0.003104	2425739.	0.000
141.000	7.853E-09	19.9678	-0.2606	-7.389E-10	2519.1057	1.719E+12	-0.001072	2457029.	0.000
142.500	-3.565E-09	15.1097	-0.2658	-5.553E-10	2519.1037	1.719E+12	0.000493	2488319.	0.000
144.000	-1.214E-08	10.4097	-0.2461	-4.217E-10	2519.1018	1.719E+12	0.001699	2519609.	0.000
145.500	-1.874E-08	6.2591	-0.2069	-3.344E-10	2519.1001	1.719E+12	0.002656	2550899.	0.000
147.000	-2.417E-08	2.9684	-0.1518	-2.861E-10	2519.0988	1.719E+12	0.003468	2582189.	0.000
148.500	-2.904E-08	0.8011	-0.0826	-2.664E-10	2519.0979	1.719E+12	0.004217	2613479.	0.000
150.000	-3.376E-08	0.000	0.000	-2.622E-10	2519.0976	1.719E+12	0.004961	1322385.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection              =      0.5000000 inches
Computed slope at pile head       =     -0.0016070 radians
Maximum bending moment            =       8250255. inch-lbs
Maximum shear force               =        -37927. lbs
Depth of maximum bending moment   =     28.5000000 feet below pile head
Depth of maximum shear force      =     39.0000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 1.000000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	0.000	48312.	-0.003134	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.9436	900752.	48312.	-0.003130	2883.7295	1.719E+12	0.000	0.000	0.000
3.000	0.8873	1801410.	48312.	-0.003115	3248.3235	1.719E+12	0.000	0.000	0.000
4.500	0.8314	2701881.	48312.	-0.003092	3612.8417	1.719E+12	0.000	0.000	0.000
6.000	0.7760	3602070.	48312.	-0.003059	3977.2461	1.719E+12	0.000	0.000	0.000
7.500	0.7213	4501885.	48312.	-0.003016	4341.4988	1.719E+12	0.000	0.000	0.000
9.000	0.6674	5401232.	48312.	-0.002965	4705.5619	1.719E+12	0.000	0.000	0.000
10.500	0.6146	6300017.	48312.	-0.002903	5069.3976	1.719E+12	0.000	0.000	0.000
12.000	0.5629	7198146.	48312.	-0.002833	5432.9680	1.719E+12	0.000	0.000	0.000
13.500	0.5126	8095527.	48312.	-0.002753	5796.2353	1.719E+12	0.000	0.000	0.000
15.000	0.4638	8992066.	48312.	-0.002663	6159.1617	1.719E+12	0.000	0.000	0.000
16.500	0.4167	9887669.	48312.	-0.002564	6521.7094	1.719E+12	0.000	0.000	0.000
18.000	0.3715	10782244.	48312.	-0.002456	6883.8408	1.719E+12	0.000	0.000	0.000
19.500	0.3283	11675697.	48312.	-0.002339	7245.5182	1.719E+12	0.000	0.000	0.000
21.000	0.2873	12567935.	48312.	-0.002212	7606.7039	1.719E+12	0.000	0.000	0.000
22.500	0.2487	13458867.	46591.	-0.002075	7967.3604	1.719E+12	-191.1751	13837.	0.000
24.000	0.2126	14286457.	41285.	-0.001930	8302.3760	1.719E+12	-398.3955	33730.	0.000
25.500	0.1792	14983482.	32397.	-0.001777	8584.5373	1.719E+12	-589.1931	59181.	0.000
27.000	0.1486	15488049.	20469.	-0.001617	8788.7903	1.719E+12	-736.0476	89140.	0.000
28.500	0.1210	15752525.	6306.3708	-0.001454	8895.8527	1.719E+12	-837.6303	124632.	0.000
30.000	0.0963	15743971.	-9189.3918	-0.001289	8892.3898	1.719E+12	-884.1211	165277.	0.000
31.500	0.0746	15447324.	-24928.	-0.001126	8772.3046	1.719E+12	-864.6357	208716.	0.000
33.000	0.0558	14868928.	-39572.	-0.000967	8538.1650	1.719E+12	-762.4168	246124.	0.000
34.500	0.0398	14041962.	-52031.	-0.000816	8203.4023	1.719E+12	-621.9122	281611.	0.000
36.000	0.0264	13012036.	-61757.	-0.000674	7786.4795	1.719E+12	-458.7552	312901.	0.000
37.500	0.0155	11832120.	-68550.	-0.000544	7308.8395	1.719E+12	-296.0341	344191.	0.000
39.000	0.006802	10555058.	-72491.	-0.000427	6791.8740	1.719E+12	-141.8982	375481.	0.000
40.500	0.000112	9230923.	-73791.	-0.000323	6255.8530	1.719E+12	-2.5370	406771.	0.000
42.000	-0.004838	7905005.	-72754.	-0.000234	5719.1105	1.719E+12	117.7492	438061.	0.000
43.500	-0.008299	6616417.	-69747.	-0.000158	5197.4789	1.719E+12	216.4041	469351.	0.000
45.000	-0.0105	5397255.	-65167.	-9.475E-05	4703.9518	1.719E+12	292.4128	500641.	0.000
46.500	-0.0117	4272273.	-59421.	-4.414E-05	4248.5496	1.719E+12	346.0625	531931.	0.000
48.000	-0.0121	3258971.	-52898.	-4.714E-06	3838.3564	1.719E+12	378.6825	563221.	0.000
49.500	-0.0119	2368023.	-45959.	2.474E-05	3477.6932	1.719E+12	392.3810	594511.	0.000
51.000	-0.0112	1603960.	-38919.	4.553E-05	3168.3942	1.719E+12	389.7926	625801.	0.000
52.500	-0.0102	966023.	-32047.	5.899E-05	2910.1520	1.719E+12	373.8462	657091.	0.000
54.000	-0.009088	449112.	-25554.	6.639E-05	2700.9020	1.719E+12	347.5630	688381.	0.000
55.500	-0.007851	44765.	-19601.	6.898E-05	2537.2188	1.719E+12	313.8883	719671.	0.000
57.000	-0.006605	-257887.	-14296.	6.786E-05	2623.4926	1.719E+12	275.5596	750962.	0.000
58.500	-0.005408	-471231.	-9700.6298	6.405E-05	2709.8561	1.719E+12	235.0116	782252.	0.000

60.000	-0.004299	-608383.	-5836.6932	5.839E-05	2765.3761	1.719E+12	194.3147	813542.	0.000
61.500	-0.003306	-682513.	-2691.5543	5.164E-05	2795.3846	1.719E+12	155.1452	844832.	0.000
63.000	-0.002440	-706305.	-227.3336	4.437E-05	2805.0158	1.719E+12	118.6571	875210.	0.000
64.500	-0.001708	-691579.	1614.8664	3.705E-05	2799.0544	1.719E+12	86.0317	906500.	0.000
66.000	-0.001107	-648906.	2908.0117	3.003E-05	2781.7802	1.719E+12	57.6511	937790.	0.000
67.500	-0.000627	-587487.	3730.7274	2.356E-05	2756.9173	1.719E+12	33.7618	969080.	0.000
69.000	-0.000258	-515068.	4163.8092	1.779E-05	2727.6015	1.719E+12	14.3584	1000370.	0.000
70.500	1.333E-05	-437943.	4286.1595	1.280E-05	2696.3807	1.719E+12	-0.7639	1031660.	0.000
72.000	0.000202	-361021.	4171.6687	8.619E-06	2665.2418	1.719E+12	-11.9573	1062950.	0.000
73.500	0.000324	-287935.	3887.0010	5.222E-06	2635.6559	1.719E+12	-19.6725	1094240.	0.000
75.000	0.000390	-221192.	3490.2054	2.557E-06	2608.6381	1.719E+12	-24.4159	1125530.	0.000
76.500	0.000416	-162338.	3030.0451	5.491E-07	2584.8134	1.719E+12	-26.7130	1156820.	0.000
78.000	0.000410	-112122.	2545.9230	-8.875E-07	2564.4854	1.719E+12	-27.0783	1188111.	0.000
79.500	0.000384	-70667.	2068.2762	-1.844E-06	2547.7042	1.719E+12	-25.9935	1219401.	0.000
81.000	0.000344	-37627.	1619.3141	-2.411E-06	2534.3293	1.719E+12	-23.8911	1250691.	0.000
82.500	0.000297	-12324.	1213.9872	-2.673E-06	2524.0864	1.719E+12	-21.1452	1281981.	0.000
84.000	0.000248	6129.6075	861.0815	-2.705E-06	2521.5789	1.719E+12	-18.0666	1313271.	0.000
85.500	0.000200	18729.	564.3562	-2.575E-06	2526.6792	1.719E+12	-14.9029	1344561.	0.000
87.000	0.000155	26498.	323.6568	-2.338E-06	2529.8240	1.719E+12	-11.8414	1375812.	0.000
88.500	0.000115	30427.	135.9421	-2.040E-06	2531.4147	1.719E+12	-9.0157	1407102.	0.000
90.000	8.147E-05	31432.	-3.7946	-1.716E-06	2531.8216	1.719E+12	-6.5106	1438392.	0.000
91.500	5.354E-05	30324.	-101.7314	-1.393E-06	2531.3732	1.719E+12	-4.3713	1469682.	0.000
93.000	3.132E-05	27797.	-164.5761	-1.089E-06	2530.3502	1.719E+12	-2.6114	1500973.	0.000
94.500	1.433E-05	24421.	-199.0612	-8.156E-07	2528.9836	1.719E+12	-1.2202	1532263.	0.000
96.000	1.954E-06	20647.	-211.5710	-5.797E-07	2527.4558	1.719E+12	-0.1697	1563553.	0.000
97.500	-6.535E-06	16816.	-207.8873	-3.836E-07	2525.9050	1.719E+12	0.5790	1594843.	0.000
99.000	-1.186E-05	13171.	-193.0364	-2.266E-07	2524.4294	1.719E+12	1.0711	1626133.	0.000
100.500	-1.469E-05	9871.5261	-171.2197	-1.060E-07	2523.0937	1.719E+12	1.3530	1657423.	0.000
102.000	-1.567E-05	7009.3030	-145.8093	-1.765E-08	2521.9350	1.719E+12	1.4703	1688713.	0.000
103.500	-1.533E-05	4622.7425	-119.3926	4.324E-08	2520.9689	1.719E+12	1.4648	1720003.	0.000
105.000	-1.412E-05	2710.3108	-93.8484	8.162E-08	2520.1948	1.719E+12	1.3734	1751293.	0.000
106.500	-1.239E-05	1242.5777	-70.4435	1.023E-07	2519.6006	1.719E+12	1.2271	1782583.	0.000
108.000	-1.043E-05	172.3114	-50.1733	1.097E-07	2519.1673	1.719E+12	1.0251	1768648.	0.000
109.500	-8.441E-06	-565.8416	-33.3504	1.077E-07	2519.3267	1.719E+12	0.8441	1799938.	0.000
111.000	-6.557E-06	-1030.4407	-19.7496	9.930E-08	2519.5147	1.719E+12	0.6671	1831228.	0.000
112.500	-4.867E-06	-1278.8020	-9.2140	8.722E-08	2519.6153	1.719E+12	0.5036	1862518.	0.000
114.000	-3.417E-06	-1363.8768	-1.4462	7.338E-08	2519.6497	1.719E+12	0.3595	1893808.	0.000
115.500	-2.225E-06	-1332.3226	3.9311	5.927E-08	2519.6369	1.719E+12	0.2379	1925098.	0.000
117.000	-1.284E-06	-1223.5357	7.3281	4.589E-08	2519.5929	1.719E+12	0.1395	1956388.	0.000
118.500	-5.728E-07	-1069.4222	9.1529	3.389E-08	2519.5305	1.719E+12	0.0633	1987678.	0.000
120.000	-6.360E-08	-894.7038	9.7864	2.361E-08	2519.4598	1.719E+12	0.007134	2018968.	0.000
121.500	2.770E-07	-717.5810	9.5666	1.517E-08	2519.3881	1.719E+12	-0.0316	2050258.	0.000
123.000	4.824E-07	-550.6061	8.7806	8.527E-09	2519.3205	1.719E+12	-0.0558	2081548.	0.000
124.500	5.840E-07	-401.6473	7.6617	3.543E-09	2519.2602	1.719E+12	-0.0685	2112838.	0.000
126.000	6.099E-07	-274.8562	6.3909	1.464E-12	2519.2089	1.719E+12	-0.0727	2144129.	0.000
127.500	5.840E-07	-171.5755	5.1018	-2.335E-09	2519.1670	1.719E+12	-0.0706	2175419.	0.000
129.000	5.258E-07	-91.1463	3.8863	-3.711E-09	2519.1345	1.719E+12	-0.0645	2206709.	0.000
130.500	4.505E-07	-31.5940	2.8021	-4.353E-09	2519.1104	1.719E+12	-0.0560	2237999.	0.000
132.000	3.691E-07	9.8156	1.8792	-4.467E-09	2519.1016	1.719E+12	-0.0465	2269289.	0.000
133.500	2.896E-07	36.1467	1.1272	-4.227E-09	2519.1122	1.719E+12	-0.0370	2300579.	0.000
135.000	2.170E-07	50.4803	0.5411	-3.773E-09	2519.1180	1.719E+12	-0.0281	2331869.	0.000
136.500	1.538E-07	55.7019	0.1064	-3.217E-09	2519.1201	1.719E+12	-0.0202	2363159.	0.000
138.000	1.011E-07	54.3755	-0.1964	-2.641E-09	2519.1196	1.719E+12	-0.0135	2394449.	0.000
139.500	5.872E-08	48.6844	-0.3887	-2.102E-09	2519.1173	1.719E+12	-0.007914	2425739.	0.000
141.000	2.548E-08	40.4242	-0.4912	-1.635E-09	2519.1140	1.719E+12	-0.003478	2457029.	0.000
142.500	-1.433E-10	31.0329	-0.5223	-1.261E-09	2519.1102	1.719E+12	1.981E-05	2488319.	0.000
144.000	-1.992E-08	21.6447	-0.4971	-9.854E-10	2519.1064	1.719E+12	0.002788	2519609.	0.000
145.500	-3.562E-08	13.1578	-0.4266	-8.032E-10	2519.1029	1.719E+12	0.005047	2550899.	0.000
147.000	-4.883E-08	6.3048	-0.3181	-7.013E-10	2519.1001	1.719E+12	0.007005	2582189.	0.000
148.500	-6.086E-08	1.7209	-0.1755	-6.593E-10	2519.0983	1.719E+12	0.008837	2613479.	0.000
150.000	-7.257E-08	0.000	0.000	-6.503E-10	2519.0976	1.719E+12	0.0107	1322385.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =      1.0000000 inches
Computed slope at pile head      =     -0.0031343 radians
Maximum bending moment           =      15752525. inch-lbs
Maximum shear force              =        -73791. lbs
Depth of maximum bending moment  =     28.5000000 feet below pile head
Depth of maximum shear force     =     40.5000000 feet below pile head
Number of iterations             =              7
Number of zero deflection points =              5
```

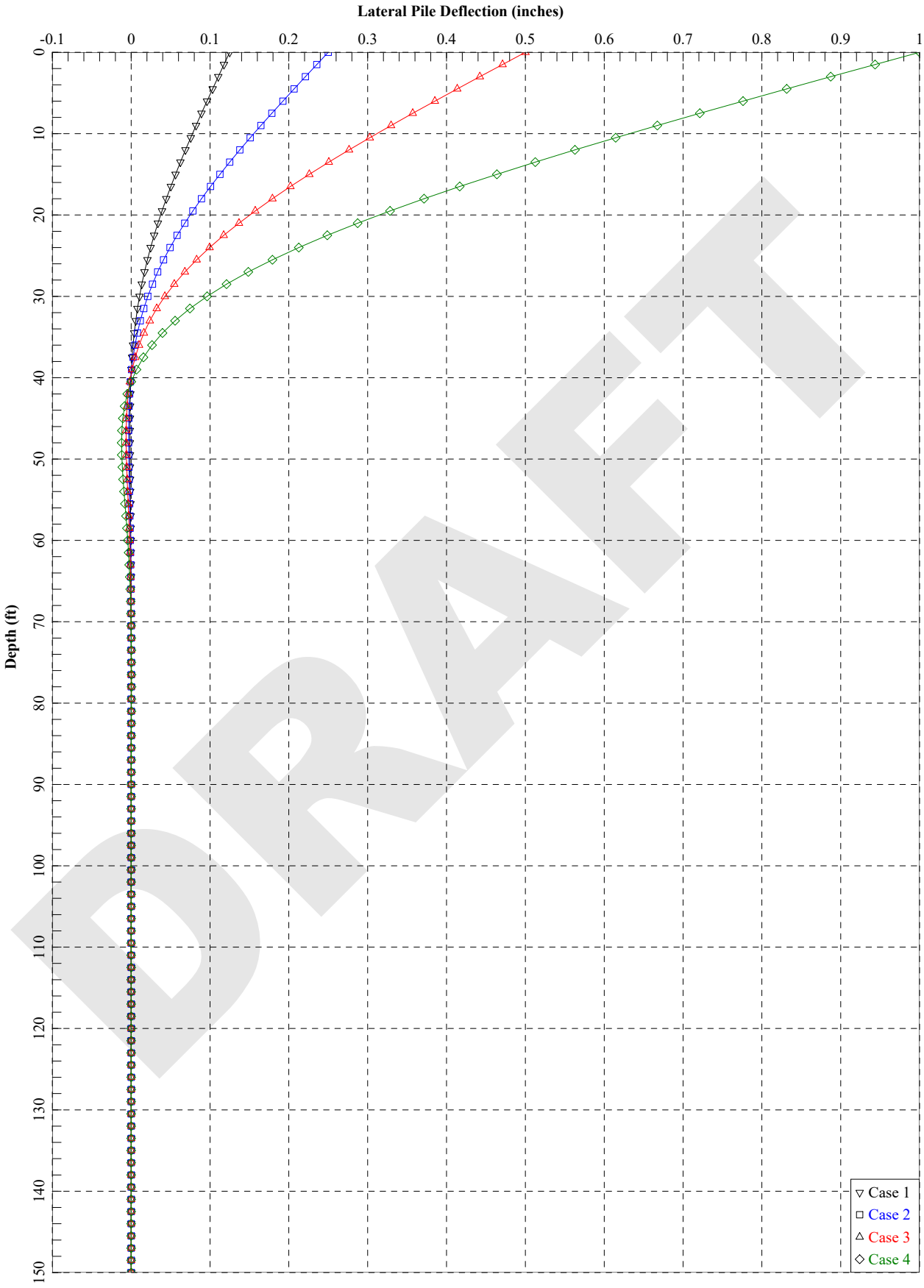
Summary of Pile Response(s)

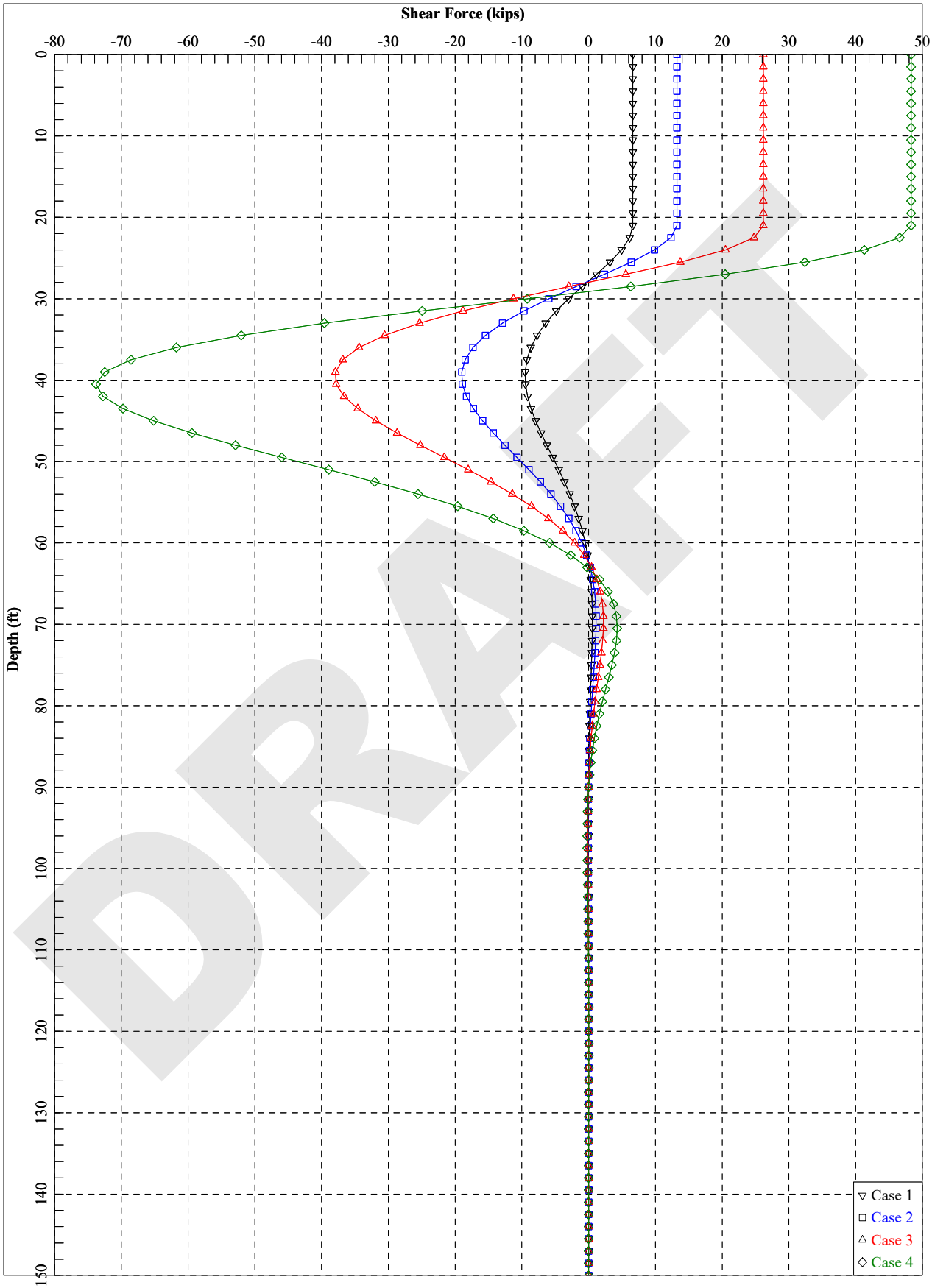
Definitions of Pile-head Loading Conditions:

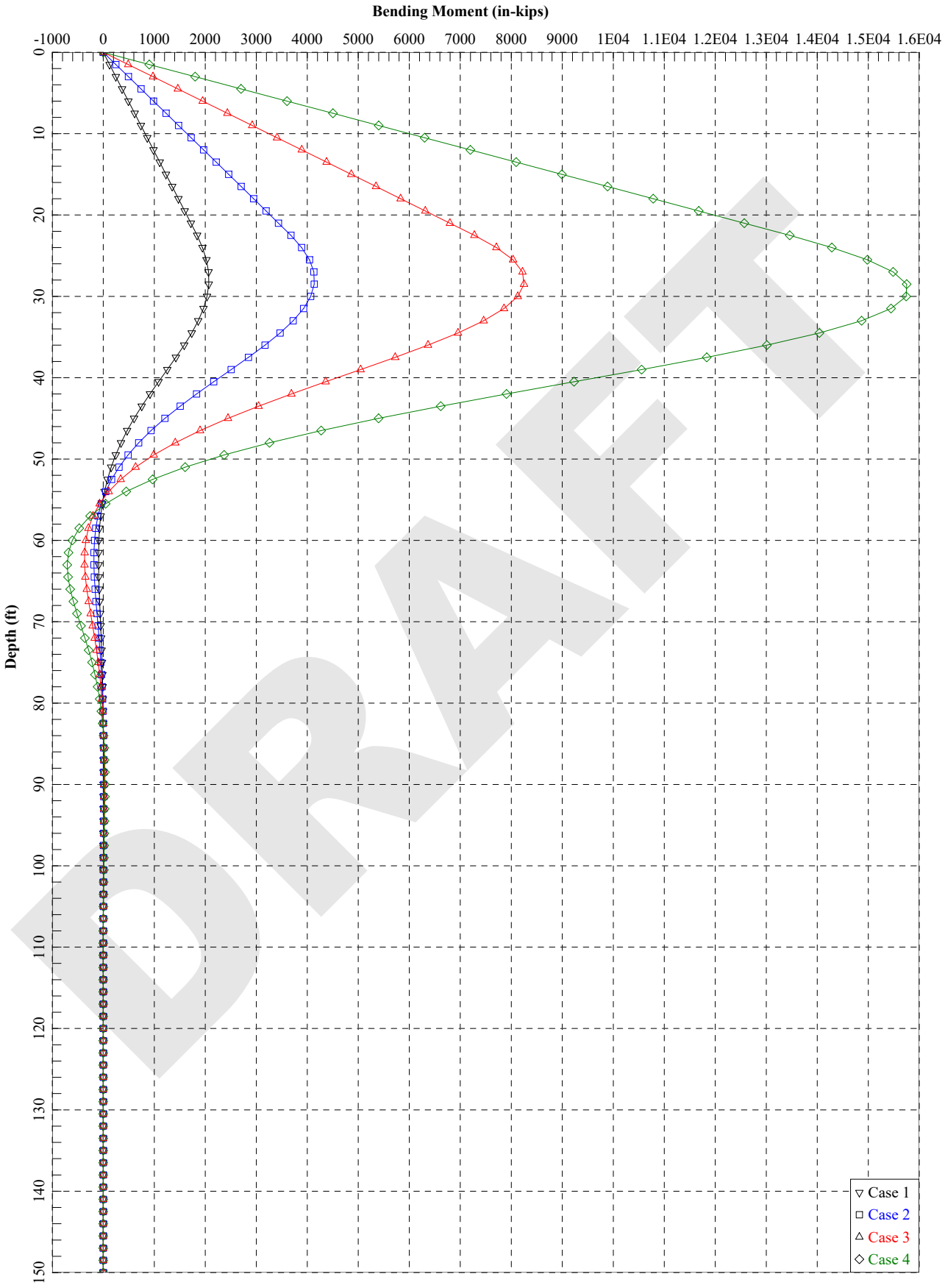
Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

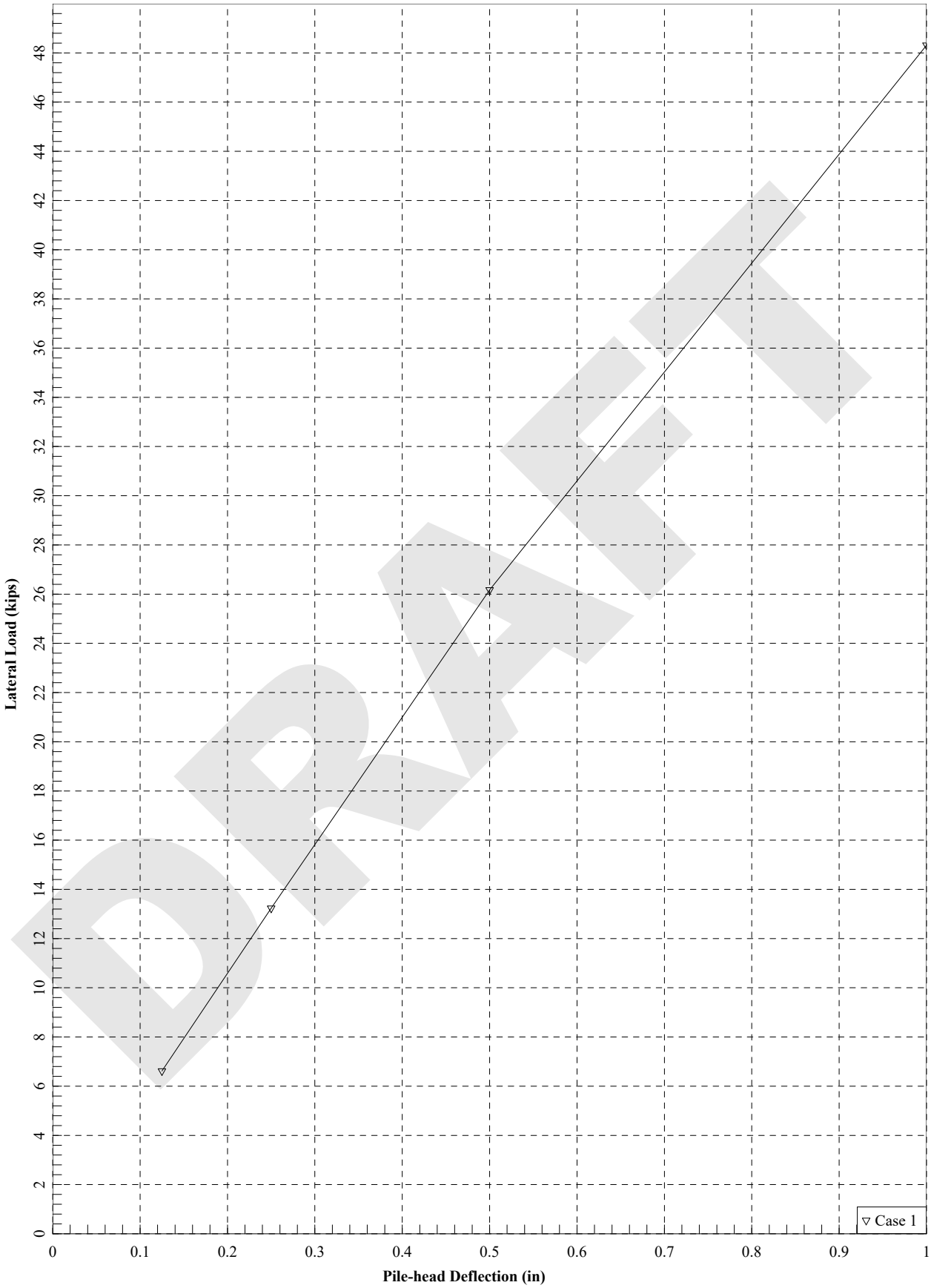
Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	4	y = 0.1250	M = 0.000	552000.	0.12500000	2068086.	-9502.2397	-0.00040303
2	4	y = 0.2500	M = 0.000	552000.	0.25000000	4136171.	-19004.	-0.00080607
3	4	y = 0.5000	M = 0.000	552000.	0.50000000	8250255.	-37927.	-0.00160701
4	4	y = 1.0000	M = 0.000	552000.	1.00000000	15752525.	-73791.	-0.00313428

The analysis ended normally.


Lateral Pile Deflection (inches)
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Shear Force (kips)
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Bending Moment (in-kips)
-1000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E04
1.1E04
1.2E04
1.3E04
1.4E04
1.5E04
1.6E04
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Lateral Load (kips)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pile-head Deflection (in)
▽ Case 1

```
================================================================================

                  LPile Plus for Windows, Version 2013-07.007

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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================================================================================

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--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        P:\Four Hole Swamp\LPILE\2016-03-02\
Name of input data file:       FHS_4-1.5OEP_NWZ_shallowscour_load_type_5.lp7d
Name of output report file:    FHS_4-1.5OEP_NWZ_shallowscour_load_type_5.lp7o
Name of plot output file:      FHS_4-1.5OEP_NWZ_shallowscour_load_type_5.lp7p
Name of runtime messeage file: FHS_4-1.5OEP_NWZ_shallowscour_load_type_5.lp7r


--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  March 2, 2016     Time:  16:45:30


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Project Name: US 301 RBO Four Hole Swamp


Job Number: 41503-0002-0001


Client: SCDOT


Engineer: Gabriel Burnworth


Description: 48" OEP (1.5" walls) No Weak Zone, 94' scour elev., Fixed



--------------------------------------------------------------------------------
                           Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
```

```
 - Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed                =          500
- Deflection tolerance for convergence                =   1.0000E-05 in
- Maximum allowable deflection                        =     100.0000 in
- Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
 - Compute pile response under loading and nonlinear bending properties of pile
   (only if nonlinear pile properties are input)
 - Use of p-y modification factors for p-y curves not selected
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - No p-y curves to be computed and reported for user-specified depths
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1


---------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Total number of pile sections                        =        1

Total length of pile                                 =     150.00 ft

Depth of ground surface below top of pile            =      21.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile.

Point         Depth              Pile
                X              Diameter
                ft                in
-----       ---------        -----------
  1          0.00000         48.0000000
  2        150.000000        48.0000000


Input Structural Properties:
----------------------------

Pile Section No. 1:

   Section Type                                      = Steel Pipe Pile
   Section Length                                    =    150.00000 ft
   Pile Diameter                                     =     48.00000 in


---------------------------------------------------------------------------
                      Ground Slope and Pile Batter Angles
---------------------------------------------------------------------------

Ground Slope Angle                                   =        0.000 degrees
                                                     =        0.000 radians
```

```
Pile Batter Angle                                   =        0.000 degrees
                                                    =        0.000 radians


--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     21.00000 ft
   Distance from top of pile to bottom of layer     =     63.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     63.00000 ft
   Distance from top of pile to bottom of layer     =     86.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     86.00000 ft
   Distance from top of pile to bottom of layer     =    108.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =    108.00000 ft
   Distance from top of pile to bottom of layer     =    206.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

   (Depth of lowest soil layer extends   56.00 ft below pile tip)


--------------------------------------------------------------------------------
```

Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	kpy pci
1	Sand (Reese, et al.)	21.000	57.600	36.000	default
		63.000	57.600	36.000	default
2	Sand (Reese, et al.)	63.000	57.600	36.000	default
		86.000	57.600	36.000	default
3	Sand (Reese, et al.)	86.000	57.600	36.000	default
		108.000	57.600	36.000	default
4	Sand (Reese, et al.)	108.000	57.600	36.000	default
		206.000	57.600	36.000	default

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	5	y = 0.12500 in	S = 0.0000 in/in	552000.	No
2	5	y = 0.25000 in	S = 0.0000 in/in	552000.	No
3	5	y = 0.50000 in	S = 0.0000 in/in	552000.	No
4	5	y = 1.00000 in	S = 0.0000 in/in	552000.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel Pipe Pile:

Length of Section	=	150.00000 ft
Outer Diameter of Pipe	=	48.00000 in
Pipe Wall Thickness	=	1.50000 in
Yield Stress of Pipe	=	36.00000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	219.12609 sq. in.

Moment of Inertia = 59287. in^4
Elastic Bending Stiffness = 1.7193E+09 kip-in^2
Plastic Modulus, Z = 3244.50000 in^3
Plastic Moment Capacity = Fy Z = 116802. in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As = 7888.539 kips
Nominal Axial Tensile Capacity = -7888.539 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	552.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 552.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.000001054	1811.9939796	1719329760.	106.4231912	3.2452738	
0.000002108	3623.9879591	1719329760.	65.2115956	3.9714500	
0.000003162	5435.9819387	1719329760.	51.4743971	4.6976261	
0.000004216	7247.9759182	1719329760.	44.6057978	5.4238024	
0.000005269	9059.9698978	1719329760.	40.4846382	6.1499785	
0.000006323	10872.	1719329760.	37.7371985	6.8761547	
0.000007377	12684.	1719329760.	35.7747416	7.6023309	
0.000008431	14496.	1719329760.	34.3028989	8.3285071	
0.000009485	16308.	1719329760.	33.1581324	9.0546833	
0.0000105	18120.	1719329760.	32.2423191	9.7808595	
0.0000116	19932.	1719329760.	31.4930174	10.5070357	
0.0000126	21744.	1719329760.	30.8685993	11.2332119	
0.0000137	23556.	1719329760.	30.3402455	11.9593881	
0.0000148	25368.	1719329760.	29.8873708	12.6855643	
0.0000158	27180.	1719329760.	29.4948794	13.4117405	
0.0000169	28992.	1719329760.	29.1514494	14.1379167	
0.0000179	30804.	1719329760.	28.8484230	14.8640929	
0.0000190	32616.	1719329760.	28.5790662	15.5902690	
0.0000200	34428.	1719329760.	28.3380627	16.3164452	
0.0000211	36240.	1719329760.	28.1211596	17.0426214	
0.0000221	38052.	1719329760.	27.9249139	17.7687976	
0.0000232	39864.	1719329760.	27.7465087	18.4949738	
0.0000242	41676.	1719329760.	27.5836170	19.2211500	
0.0000253	43488.	1719329760.	27.4342996	19.9473262	
0.0000263	45300.	1719329760.	27.2969276	20.6735024	
0.0000274	47112.	1719329760.	27.1701227	21.3996786	
0.0000285	48924.	1719329760.	27.0527108	22.1258548	
0.0000295	50736.	1719329760.	26.9436854	22.8520310	
0.0000306	52548.	1719329760.	26.8421790	23.5782071	
0.0000316	54360.	1719329760.	26.7474397	24.3043833	
0.0000327	56172.	1719329760.	26.6588126	25.0305595	
0.0000337	57984.	1719329760.	26.5757247	25.7567357	
0.0000348	59796.	1719329760.	26.4976725	26.4829119	
0.0000358	61608.	1719329760.	26.4242115	27.2090881	
0.0000369	63420.	1719329760.	26.3549483	27.9352643	
0.0000379	65232.	1719329760.	26.2895331	28.6614405	

0.0000390	67044.	1719329760.	26.2276538	29.3876167	
0.0000400	68856.	1719329760.	26.1690313	30.1137929	
0.0000411	70668.	1719329760.	26.1134152	30.8399691	
0.0000432	74292.	1719329760.	26.0103217	32.2923214	
0.0000453	77916.	1719329760.	25.9168184	33.7446738	
0.0000474	81540.	1719329760.	25.8316265	35.1970262	
0.0000495	85116.	1718362204.	25.7600931	36.0000000	Y
0.0000516	88307.	1710016821.	25.7450077	36.0000000	Y
0.0000537	91055.	1694080982.	25.7890002	36.0000000	Y
0.0000559	93523.	1674351216.	25.8662156	36.0000000	Y
0.0000580	95738.	1651681538.	25.9596148	36.0000000	Y
0.0000601	97623.	1625104154.	26.0427887	36.0000000	Y
0.0000622	99187.	1595157458.	26.1020741	36.0000000	Y
0.0000643	100520.	1563590959.	26.1477997	36.0000000	Y
0.0000664	101682.	1531456607.	26.1850574	36.0000000	Y
0.0000685	102694.	1499106584.	26.2156802	36.0000000	Y
0.0000706	103596.	1467136166.	26.2418156	36.0000000	Y
0.0000727	104405.	1435730900.	26.2645753	36.0000000	Y
0.0000748	105133.	1405018933.	26.2847462	36.0000000	Y
0.0000769	105792.	1375089517.	26.3029308	36.0000000	Y
0.0000790	106389.	1345978545.	26.3190684	36.0000000	Y
0.0000811	106931.	1317694704.	26.3327277	36.0000000	Y
0.0000833	107428.	1290308271.	26.3451305	36.0000000	Y
0.0000854	107888.	1263831958.	26.3565441	36.0000000	Y
0.0000875	108312.	1238223529.	26.3683587	36.0000000	Y
0.0000896	108694.	1213357023.	26.3774987	36.0000000	Y
0.0000917	109054.	1189386837.	26.3862330	36.0000000	Y
0.0000938	109391.	1166251589.	26.3947955	36.0000000	Y
0.0000959	109694.	1143784328.	26.4021331	36.0000000	Y
0.0000980	109986.	1122168893.	26.4094502	36.0000000	Y
0.0001001	110251.	1101186709.	26.4155900	36.0000000	Y
0.0001022	110504.	1080953128.	26.4221100	36.0000000	Y
0.0001043	110737.	1061349948.	26.4271609	36.0000000	Y
0.0001064	110958.	1042412273.	26.4331747	36.0000000	Y
0.0001086	111162.	1024055458.	26.4372983	36.0000000	Y
0.0001107	111360.	1006332490.	26.4430476	36.0000000	Y
0.0001128	111538.	989106469.	26.4463756	36.0000000	Y
0.0001149	111715.	972490789.	26.4505626	36.0000000	Y
0.0001170	111873.	956324994.	26.4547068	36.0000000	Y
0.0001191	112028.	940701885.	26.4572535	36.0000000	Y
0.0001212	112175.	925549270.	26.4625617	36.0000000	Y
0.0001233	112309.	910814943.	26.4645327	36.0000000	Y
0.0001254	112442.	896572199.	26.4666389	36.0000000	Y
0.0001338	112900.	843517796.	26.4797710	36.0000000	Y
0.0001423	113275.	796164739.	26.4878891	36.0000000	Y
0.0001507	113588.	753702530.	26.4950904	36.0000000	Y
0.0001591	113853.	715434459.	26.5018328	36.0000000	Y
0.0001676	114076.	680768908.	26.5058505	36.0000000	Y
0.0001760	114269.	649250909.	26.5078046	36.0000000	Y
0.0001844	114433.	620460993.	26.5135095	36.0000000	Y
0.0001929	114577.	594085861.	26.5174169	36.0000000	Y
0.0002013	114703.	569829556.	26.5179765	36.0000000	Y
0.0002097	114814.	547451379.	26.5235253	36.0000000	Y
0.0002182	114912.	526743116.	26.5225624	36.0000000	Y
0.0002266	114999.	507525905.	26.5269002	36.0000000	Y
0.0002350	115077.	489651076.	26.5278306	36.0000000	Y

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip
1	552.000	115077.2

Note that the values in the above table are not factored by a strength

reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.125000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1250	-5717920.	25053.	0.000	4833.7598	1.719E+12	0.000	0.000	0.000
1.500	0.1245	-5266661.	25053.	-5.750E-05	4651.0865	1.719E+12	0.000	0.000	0.000
3.000	0.1229	-4814855.	25053.	-0.000110	4468.1914	1.719E+12	0.000	0.000	0.000
4.500	0.1205	-4362547.	25053.	-0.000158	4285.0936	1.719E+12	0.000	0.000	0.000
6.000	0.1172	-3909786.	25053.	-0.000202	4101.8120	1.719E+12	0.000	0.000	0.000
7.500	0.1132	-3456618.	25053.	-0.000240	3918.3659	1.719E+12	0.000	0.000	0.000
9.000	0.1086	-3003091.	25053.	-0.000274	3734.7742	1.719E+12	0.000	0.000	0.000
10.500	0.1034	-2549251.	25053.	-0.000303	3551.0560	1.719E+12	0.000	0.000	0.000
12.000	0.0977	-2095146.	25053.	-0.000327	3367.2305	1.719E+12	0.000	0.000	0.000
13.500	0.0916	-1640823.	25053.	-0.000347	3183.3167	1.719E+12	0.000	0.000	0.000
15.000	0.0852	-1186330.	25053.	-0.000362	2999.3339	1.719E+12	0.000	0.000	0.000
16.500	0.0786	-731713.	25053.	-0.000372	2815.3011	1.719E+12	0.000	0.000	0.000
18.000	0.0718	-277020.	25053.	-0.000377	2631.2375	1.719E+12	0.000	0.000	0.000
19.500	0.0650	177702.	25053.	-0.000378	2591.0330	1.719E+12	0.000	0.000	0.000
21.000	0.0582	632406.	25053.	-0.000373	2775.1008	1.719E+12	0.000	0.000	0.000
22.500	0.0515	1087043.	24247.	-0.000364	2959.1419	1.719E+12	-89.6106	31290.	0.000
24.000	0.0451	1512534.	22029.	-0.000351	3131.3842	1.719E+12	-156.7782	62580.	0.000
25.500	0.0389	1887071.	18791.	-0.000333	3283.0000	1.719E+12	-202.9892	93870.	0.000
27.000	0.0331	2195644.	14893.	-0.000312	3407.9127	1.719E+12	-230.2208	125160.	0.000
28.500	0.0277	2429396.	10653.	-0.000287	3502.5377	1.719E+12	-240.8328	156450.	0.000
30.000	0.0228	2584866.	6348.6493	-0.000261	3565.4733	1.719E+12	-237.4426	187740.	0.000
31.500	0.0183	2663136.	2206.5199	-0.000234	3597.1575	1.719E+12	-222.7940	219030.	0.000
33.000	0.0144	2668943.	-1595.3193	-0.000206	3599.5084	1.719E+12	-199.6325	250321.	0.000
34.500	0.0109	2609792.	-4927.3441	-0.000178	3575.5635	1.719E+12	-170.5924	281611.	0.000
36.000	0.007945	2495098.	-7705.6016	-0.000151	3529.1342	1.719E+12	-138.1028	312901.	0.000
37.500	0.005455	2335398.	-9887.3639	-0.000126	3464.4865	1.719E+12	-104.3152	344191.	0.000
39.000	0.003406	2141658.	-11466.	-0.000103	3386.0587	1.719E+12	-71.0538	375481.	0.000
40.500	0.001761	1924673.	-12463.	-8.134E-05	3298.2215	1.719E+12	-39.7887	406771.	0.000
42.000	0.000478	1694597.	-12926.	-6.240E-05	3205.0846	1.719E+12	-11.6295	438061.	0.000
43.500	-0.000486	1460576.	-12917.	-4.588E-05	3110.3510	1.719E+12	12.6630	469351.	0.000
45.000	-0.001174	1230506.	-12509.	-3.180E-05	3017.2168	1.719E+12	32.6498	500641.	0.000
46.500	-0.001630	1010887.	-11781.	-2.006E-05	2928.3131	1.719E+12	48.1770	531931.	0.000
48.000	-0.001896	806772.	-10814.	-1.055E-05	2845.6856	1.719E+12	59.3301	563221.	0.000
49.500	-0.002010	621796.	-9682.4619	-3.070E-06	2770.8058	1.719E+12	66.3862	594511.	0.000
51.000	-0.002007	458264.	-8457.1077	2.584E-06	2704.6068	1.719E+12	69.7643	625801.	0.000
52.500	-0.001917	317289.	-7199.4246	6.644E-06	2647.5387	1.719E+12	69.9783	657091.	0.000
54.000	-0.001767	198953.	-5961.2757	9.346E-06	2599.6354	1.719E+12	67.5938	688381.	0.000
55.500	-0.001580	102497.	-4784.2154	1.092E-05	2560.5892	1.719E+12	63.1907	719671.	0.000
57.000	-0.001374	26504.	-3699.5148	1.160E-05	2529.8266	1.719E+12	57.3316	750962.	0.000
58.500	-0.001163	-30916.	-2728.6852	1.158E-05	2531.6127	1.719E+12	50.5383	782252.	0.000

60.000	-0.000957	-71959.	-1884.3762	1.104E-05	2548.2271	1.719E+12	43.2738	813542.	0.000
61.500	-0.000766	-98973.	-1171.5298	1.014E-05	2559.1627	1.719E+12	35.9314	844832.	0.000
63.000	-0.000592	-114335.	-588.9510	9.026E-06	2565.3815	1.719E+12	28.7996	875210.	0.000
64.500	-0.000441	-120355.	-130.0503	7.798E-06	2567.8182	1.719E+12	22.1894	906500.	0.000
66.000	-0.000312	-119172.	215.7540	6.544E-06	2567.3395	1.719E+12	16.2333	937790.	0.000
67.500	-0.000205	-112718.	461.1944	5.330E-06	2564.7266	1.719E+12	11.0378	969080.	0.000
69.000	-0.000120	-102675.	620.4053	4.203E-06	2560.6613	1.719E+12	6.6523	1000370.	0.000
70.500	-5.372E-05	-90466.	707.9878	3.192E-06	2555.7192	1.719E+12	3.0791	1031660.	0.000
72.000	-4.797E-06	-77251.	738.2490	2.314E-06	2550.3694	1.719E+12	0.2833	1062950.	0.000
73.500	2.957E-05	-63936.	724.6189	1.575E-06	2544.9792	1.719E+12	-1.7977	1094240.	0.000
75.000	5.189E-05	-51196.	679.2364	9.720E-07	2539.8221	1.719E+12	-3.2448	1125530.	0.000
76.500	6.456E-05	-39502.	612.6884	4.973E-07	2535.0885	1.719E+12	-4.1494	1156820.	0.000
78.000	6.979E-05	-29149.	533.8825	1.379E-07	2530.8974	1.719E+12	-4.6068	1188111.	0.000
79.500	6.953E-05	-20285.	450.0298	-1.209E-07	2527.3092	1.719E+12	-4.7102	1219401.	0.000
81.000	6.544E-05	-12946.	366.7144	-2.948E-07	2524.3381	1.719E+12	-4.5471	1250691.	0.000
82.500	5.891E-05	-7077.7036	288.0268	-3.996E-07	2521.9627	1.719E+12	-4.1960	1281981.	0.000
84.000	5.105E-05	-2568.6323	216.7387	-4.501E-07	2520.1374	1.719E+12	-3.7249	1313271.	0.000
85.500	4.271E-05	733.8339	154.5013	-4.597E-07	2519.3947	1.719E+12	-3.1904	1344561.	0.000
87.000	3.450E-05	3002.5500	102.0527	-4.402E-07	2520.3131	1.719E+12	-2.6373	1375812.	0.000
88.500	2.686E-05	4416.4777	59.4174	-4.013E-07	2520.8854	1.719E+12	-2.1000	1407102.	0.000
90.000	2.006E-05	5149.5504	26.0937	-3.513E-07	2521.1822	1.719E+12	-1.6026	1438392.	0.000
91.500	1.422E-05	5362.8308	1.2221	-2.962E-07	2521.2685	1.719E+12	-1.1609	1469682.	0.000
93.000	9.391E-06	5199.4329	-16.2733	-2.410E-07	2521.2024	1.719E+12	-0.7831	1500973.	0.000
94.500	5.543E-06	4781.7819	-27.5678	-1.887E-07	2521.0333	1.719E+12	-0.4719	1532263.	0.000
96.000	2.597E-06	4210.7430	-33.8452	-1.416E-07	2520.8021	1.719E+12	-0.2256	1563553.	0.000
97.500	4.445E-07	3566.1704	-36.2301	-1.009E-07	2520.5412	1.719E+12	-0.0394	1594843.	0.000
99.000	-1.036E-06	2908.4656	-35.7421	-6.703E-08	2520.2750	1.719E+12	0.0936	1626133.	0.000
100.500	-1.969E-06	2280.7859	-33.2682	-3.987E-08	2520.0209	1.719E+12	0.1813	1657423.	0.000
102.000	-2.471E-06	1711.6019	-29.5500	-1.897E-08	2519.7905	1.719E+12	0.2319	1688713.	0.000
103.500	-2.652E-06	1217.3637	-25.1828	-3.639E-09	2519.5904	1.719E+12	0.2534	1720003.	0.000
105.000	-2.602E-06	805.0942	-20.6235	6.947E-09	2519.4235	1.719E+12	0.2532	1751293.	0.000
106.500	-2.402E-06	474.7790	-16.2042	1.365E-08	2519.2898	1.719E+12	0.2378	1782583.	0.000
108.000	-2.111E-06	221.4719	-12.1968	1.729E-08	2519.1872	1.719E+12	0.2074	1768648.	0.000
109.500	-1.779E-06	35.3524	-8.7287	1.864E-08	2519.1119	1.719E+12	0.1779	1799938.	0.000
111.000	-1.440E-06	-93.1313	-5.8089	1.833E-08	2519.1353	1.719E+12	0.1465	1831228.	0.000
112.500	-1.119E-06	-174.1306	-3.4480	1.693E-08	2519.1681	1.719E+12	0.1158	1862518.	0.000
114.000	-8.306E-07	-217.5949	-1.6193	1.488E-08	2519.1857	1.719E+12	0.0874	1893808.	0.000
115.500	-5.832E-07	-232.7211	-0.2714	1.253E-08	2519.1918	1.719E+12	0.0624	1925098.	0.000
117.000	-3.797E-07	-227.6129	0.6614	1.012E-08	2519.1897	1.719E+12	0.0413	1956388.	0.000
118.500	-2.190E-07	-209.1103	1.2505	7.831E-09	2519.1822	1.719E+12	0.0242	1987678.	0.000
120.000	-9.777E-08	-182.7496	1.5669	5.780E-09	2519.1716	1.719E+12	0.0110	2018968.	0.000
121.500	-1.096E-08	-152.8166	1.6768	4.023E-09	2519.1595	1.719E+12	0.001248	2050258.	0.000
123.000	4.706E-08	-122.4632	1.6391	2.582E-09	2519.1472	1.719E+12	-0.005442	2081548.	0.000
124.500	8.200E-08	-93.8603	1.5035	1.450E-09	2519.1356	1.719E+12	-0.009625	2112838.	0.000
126.000	9.925E-08	-68.3661	1.3105	6.006E-10	2519.1253	1.719E+12	-0.0118	2144129.	0.000
127.500	1.036E-07	-46.6952	1.0914	-1.718E-12	2519.1165	1.719E+12	-0.0125	2175419.	0.000
129.000	9.919E-08	-29.0769	0.8692	-3.984E-10	2519.1094	1.719E+12	-0.0122	2206709.	0.000
130.500	8.928E-08	-15.3954	0.6599	-6.311E-10	2519.1038	1.719E+12	-0.0111	2237999.	0.000
132.000	7.647E-08	-5.3088	0.4732	-7.395E-10	2519.0997	1.719E+12	-0.009640	2269289.	0.000
133.500	6.265E-08	1.6550	0.3144	-7.587E-10	2519.0983	1.719E+12	-0.008008	2300579.	0.000
135.000	4.915E-08	6.0240	0.1850	-7.185E-10	2519.1000	1.719E+12	-0.006368	2331869.	0.000
136.500	3.679E-08	8.3292	0.0842	-6.433E-10	2519.1010	1.719E+12	-0.004830	2363159.	0.000
138.000	2.600E-08	9.0685	0.009623	-5.523E-10	2519.1013	1.719E+12	-0.003458	2394449.	0.000
139.500	1.691E-08	8.6866	-0.0420	-4.593E-10	2519.1011	1.719E+12	-0.002279	2425739.	0.000
141.000	9.460E-09	7.5654	-0.0741	-3.742E-10	2519.1007	1.719E+12	-0.001291	2457029.	0.000
142.500	3.436E-09	6.0250	-0.0900	-3.031E-10	2519.1000	1.719E+12	-0.000475	2488319.	0.000
144.000	-1.452E-09	4.3301	-0.0925	-2.489E-10	2519.0993	1.719E+12	0.000203	2519609.	0.000
145.500	-5.524E-09	2.7007	-0.0836	-2.121E-10	2519.0987	1.719E+12	0.000783	2550899.	0.000
147.000	-9.087E-09	1.3245	-0.0648	-1.910E-10	2519.0981	1.719E+12	0.001304	2582189.	0.000
148.500	-1.240E-08	0.3706	-0.0369	-1.821E-10	2519.0977	1.719E+12	0.001800	2613479.	0.000
150.000	-1.564E-08	0.000	0.000	-1.802E-10	2519.0976	1.719E+12	0.002299	1322385.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =      0.1250000 inches
Computed slope at pile head       =   -0.000002362 radians
Maximum bending moment            =      -5717920. inch-lbs
Maximum shear force               =         25053. lbs
Depth of maximum bending moment   =       0.000000 feet below pile head
Depth of maximum shear force      =       0.000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.250000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2500	-11403069.	49864.	0.000	7135.1561	1.719E+12	0.000	0.000	0.000
1.500	0.2489	-10504916.	49864.	-0.000115	6771.5760	1.719E+12	0.000	0.000	0.000
3.000	0.2459	-9605669.	49864.	-0.000220	6407.5535	1.719E+12	0.000	0.000	0.000
4.500	0.2410	-8705424.	49864.	-0.000316	6043.1266	1.719E+12	0.000	0.000	0.000
6.000	0.2345	-7804273.	49864.	-0.000402	5678.3331	1.719E+12	0.000	0.000	0.000
7.500	0.2265	-6902310.	49864.	-0.000479	5313.2109	1.719E+12	0.000	0.000	0.000
9.000	0.2173	-5999629.	49864.	-0.000547	4947.7981	1.719E+12	0.000	0.000	0.000
10.500	0.2068	-5096324.	49864.	-0.000605	4582.1326	1.719E+12	0.000	0.000	0.000
12.000	0.1955	-4192489.	49864.	-0.000653	4216.2526	1.719E+12	0.000	0.000	0.000
13.500	0.1833	-3288218.	49864.	-0.000693	3850.1960	1.719E+12	0.000	0.000	0.000
15.000	0.1705	-2383605.	49864.	-0.000722	3484.0009	1.719E+12	0.000	0.000	0.000
16.500	0.1573	-1478744.	49864.	-0.000743	3117.7055	1.719E+12	0.000	0.000	0.000
18.000	0.1438	-573729.	49864.	-0.000753	2751.3478	1.719E+12	0.000	0.000	0.000
19.500	0.1302	331346.	49864.	-0.000755	2653.2292	1.719E+12	0.000	0.000	0.000
21.000	0.1167	1236386.	49864.	-0.000746	3019.5971	1.719E+12	0.000	0.000	0.000
22.500	0.1033	2141298.	48515.	-0.000729	3385.9130	1.719E+12	-149.9143	26114.	0.000
24.000	0.0904	2997414.	44367.	-0.000702	3732.4762	1.719E+12	-311.0050	61913.	0.000
25.500	0.0781	3752454.	37904.	-0.000666	4038.1224	1.719E+12	-407.1369	93870.	0.000
27.000	0.0664	4375190.	30082.	-0.000624	4290.2114	1.719E+12	-461.8999	125160.	0.000
28.500	0.0556	4847816.	21575.	-0.000576	4481.5343	1.719E+12	-483.3544	156450.	0.000
30.000	0.0457	5163330.	12934.	-0.000523	4609.2573	1.719E+12	-476.7289	187740.	0.000
31.500	0.0368	5323848.	4616.1562	-0.000468	4674.2361	1.719E+12	-447.5113	219030.	0.000
33.000	0.0288	5338818.	-3022.2131	-0.000412	4680.2961	1.719E+12	-401.1964	250321.	0.000
34.500	0.0219	5223245.	-9720.5229	-0.000357	4633.5111	1.719E+12	-343.0603	281611.	0.000
36.000	0.0160	4995977.	-15310.	-0.000304	4541.5112	1.719E+12	-277.9711	312901.	0.000
37.500	0.0110	4678127.	-19704.	-0.000253	4412.8427	1.719E+12	-210.2430	344191.	0.000
39.000	0.006881	4291671.	-22888.	-0.000206	4256.4023	1.719E+12	-143.5363	375481.	0.000
40.500	0.003576	3858263.	-24907.	-0.000163	4080.9552	1.719E+12	-80.8027	406771.	0.000
42.000	0.000997	3398274.	-25852.	-0.000125	3894.7477	1.719E+12	-24.2721	438061.	0.000
43.500	-0.000941	2930067.	-25850.	-9.232E-05	3705.2136	1.719E+12	24.5240	469351.	0.000
45.000	-0.002326	2469502.	-25047.	-6.406E-05	3518.7727	1.719E+12	64.7001	500641.	0.000
46.500	-0.003247	2029642.	-23601.	-4.051E-05	3340.7137	1.719E+12	95.9414	531931.	0.000
48.000	-0.003784	1620656.	-21672.	-2.140E-05	3175.1527	1.719E+12	118.4147	563221.	0.000
49.500	-0.004017	1249868.	-19412.	-6.372E-06	3025.0546	1.719E+12	132.6709	594511.	0.000
51.000	-0.004014	921935.	-16962.	4.997E-06	2892.3046	1.719E+12	139.5467	625801.	0.000
52.500	-0.003837	639119.	-14446.	1.317E-05	2777.8185	1.719E+12	140.0695	657091.	0.000
54.000	-0.003540	401620.	-11967.	1.862E-05	2681.6766	1.719E+12	135.3716	688381.	0.000
55.500	-0.003167	207939.	-9609.0875	2.181E-05	2603.2729	1.719E+12	126.6143	719671.	0.000
57.000	-0.002755	55259.	-7435.2285	2.318E-05	2541.4670	1.719E+12	114.9256	750962.	0.000
58.500	-0.002332	-60190.	-5488.7337	2.316E-05	2543.4631	1.719E+12	101.3516	782252.	0.000

60.000	-0.001921	-142795.	-3795.1787	2.210E-05	2576.9024	1.719E+12	86.8212	813542.	0.000
61.500	-0.001537	-197256.	-2364.6698	2.032E-05	2598.9484	1.719E+12	72.1242	844832.	0.000
63.000	-0.001190	-228327.	-1194.9894	1.809E-05	2611.5264	1.719E+12	57.8403	875210.	0.000
64.500	-0.000885	-240635.	-273.0788	1.563E-05	2616.5086	1.719E+12	44.5943	906500.	0.000
66.000	-0.000627	-238469.	422.1519	1.313E-05	2615.6318	1.719E+12	32.6536	937790.	0.000
67.500	-0.000413	-225698.	916.1292	1.070E-05	2610.4621	1.719E+12	22.2328	969080.	0.000
69.000	-0.000242	-205701.	1237.1159	8.438E-06	2602.3670	1.719E+12	13.4324	1000370.	0.000
70.500	-0.000109	-181330.	1414.3325	6.412E-06	2592.5014	1.719E+12	6.2583	1031660.	0.000
72.000	-1.086E-05	-154912.	1476.4303	4.652E-06	2581.8073	1.719E+12	0.6414	1062950.	0.000
73.500	5.828E-05	-128271.	1450.3193	3.170E-06	2571.0226	1.719E+12	-3.5427	1094240.	0.000
75.000	0.000103	-102764.	1360.3344	1.960E-06	2560.6972	1.719E+12	-6.4557	1125530.	0.000
76.500	0.000129	-79338.	1227.7096	1.007E-06	2551.2141	1.719E+12	-8.2804	1156820.	0.000
78.000	0.000139	-58586.	1070.3195	2.850E-07	2542.8137	1.719E+12	-9.2074	1188111.	0.000
79.500	0.000139	-40812.	902.6427	-2.353E-07	2535.6185	1.719E+12	-9.4234	1219401.	0.000
81.000	0.000131	-26086.	735.8990	-5.855E-07	2529.6575	1.719E+12	-9.1037	1250691.	0.000
82.500	0.000118	-14308.	578.3137	-7.970E-07	2524.8895	1.719E+12	-8.4058	1281981.	0.000
84.000	0.000102	-5251.1561	435.4679	-8.993E-07	2521.2233	1.719E+12	-7.4660	1313271.	0.000
85.500	8.565E-05	1386.9869	310.6950	-9.196E-07	2519.6591	1.719E+12	-6.3977	1344561.	0.000
87.000	6.923E-05	5952.1357	205.4948	-8.811E-07	2521.5071	1.719E+12	-5.2912	1375812.	0.000
88.500	5.393E-05	8802.3084	119.9339	-8.039E-07	2522.6608	1.719E+12	-4.2155	1407102.	0.000
90.000	4.029E-05	10286.	53.0211	-7.040E-07	2523.2613	1.719E+12	-3.2192	1438392.	0.000
91.500	2.858E-05	10725.	3.0447	-5.940E-07	2523.4392	1.719E+12	-2.3337	1469682.	0.000
93.000	1.890E-05	10407.	-32.1436	-4.834E-07	2523.3105	1.719E+12	-1.5761	1500973.	0.000
94.500	1.118E-05	9577.4954	-54.8937	-3.788E-07	2522.9746	1.719E+12	-0.9517	1532263.	0.000
96.000	5.265E-06	8438.4947	-67.5749	-2.845E-07	2522.5136	1.719E+12	-0.4573	1563553.	0.000
97.500	9.390E-07	7150.4520	-72.4394	-2.029E-07	2521.9922	1.719E+12	-0.0832	1594843.	0.000
99.000	-2.039E-06	5834.7086	-71.5304	-1.349E-07	2521.4595	1.719E+12	0.1842	1626133.	0.000
100.500	-3.917E-06	4578.0397	-66.6261	-8.040E-08	2520.9508	1.719E+12	0.3607	1657423.	0.000
102.000	-4.933E-06	3437.7661	-59.2143	-3.844E-08	2520.4892	1.719E+12	0.4628	1688713.	0.000
103.500	-5.301E-06	2447.0891	-50.4899	-7.631E-09	2520.0882	1.719E+12	0.5066	1720003.	0.000
105.000	-5.208E-06	1620.2815	-41.3706	1.366E-08	2519.7535	1.719E+12	0.5067	1751293.	0.000
106.500	-4.809E-06	957.4768	-32.5237	2.715E-08	2519.4852	1.719E+12	0.4763	1782583.	0.000
108.000	-4.230E-06	448.8895	-24.4960	3.451E-08	2519.2793	1.719E+12	0.4157	1768648.	0.000
109.500	-3.567E-06	74.9340	-17.5449	3.726E-08	2519.1279	1.719E+12	0.3567	1799938.	0.000
111.000	-2.889E-06	-183.4669	-11.6894	3.669E-08	2519.1719	1.719E+12	0.2939	1831228.	0.000
112.500	-2.246E-06	-346.6152	-6.9524	3.391E-08	2519.2379	1.719E+12	0.2324	1862518.	0.000
114.000	-1.668E-06	-434.4274	-3.2810	2.983E-08	2519.2735	1.719E+12	0.1755	1893808.	0.000
115.500	-1.172E-06	-465.3255	-0.5729	2.512E-08	2519.2860	1.719E+12	0.1254	1925098.	0.000
117.000	-7.641E-07	-455.5513	1.3030	2.030E-08	2519.2820	1.719E+12	0.0830	1956388.	0.000
118.500	-4.417E-07	-418.8218	2.4894	1.572E-08	2519.2671	1.719E+12	0.0488	1987678.	0.000
120.000	-1.982E-07	-366.2452	3.1285	1.161E-08	2519.2459	1.719E+12	0.0222	2018968.	0.000
121.500	-2.379E-08	-306.4260	3.3530	8.088E-09	2519.2216	1.719E+12	0.002710	2050258.	0.000
123.000	9.291E-08	-245.6970	3.2807	5.198E-09	2519.1971	1.719E+12	-0.0107	2081548.	0.000
124.500	1.633E-07	-188.4237	3.0115	2.925E-09	2519.1739	1.719E+12	-0.0192	2112838.	0.000
126.000	1.982E-07	-137.3421	2.6264	1.220E-09	2519.1532	1.719E+12	-0.0236	2144129.	0.000
127.500	2.072E-07	-93.8963	2.1885	9.421E-12	2519.1356	1.719E+12	-0.0250	2175419.	0.000
129.000	1.986E-07	-58.5556	1.7440	-7.886E-10	2519.1213	1.719E+12	-0.0243	2206709.	0.000
130.500	1.788E-07	-31.0957	1.3248	-1.258E-09	2519.1102	1.719E+12	-0.0222	2237999.	0.000
132.000	1.533E-07	-10.8372	0.9508	-1.477E-09	2519.1020	1.719E+12	-0.0193	2269289.	0.000
133.500	1.257E-07	3.1616	0.6323	-1.518E-09	2519.0989	1.719E+12	-0.0161	2300579.	0.000
135.000	9.864E-08	11.9565	0.3728	-1.438E-09	2519.1024	1.719E+12	-0.0128	2331869.	0.000
136.500	7.388E-08	16.6098	0.1705	-1.289E-09	2519.1043	1.719E+12	-0.009699	2363159.	0.000
138.000	5.224E-08	18.1189	0.0206	-1.107E-09	2519.1049	1.719E+12	-0.006949	2394449.	0.000
139.500	3.402E-08	17.3745	-0.0832	-9.213E-10	2519.1046	1.719E+12	-0.004585	2425739.	0.000
141.000	1.907E-08	15.1429	-0.1479	-7.511E-10	2519.1037	1.719E+12	-0.002604	2457029.	0.000
142.500	6.981E-09	12.0662	-0.1800	-6.087E-10	2519.1025	1.719E+12	-0.000965	2488319.	0.000
144.000	-2.839E-09	8.6755	-0.1851	-5.001E-10	2519.1011	1.719E+12	0.000397	2519609.	0.000
145.500	-1.102E-08	5.4127	-0.1675	-4.264E-10	2519.0998	1.719E+12	0.001562	2550899.	0.000
147.000	-1.819E-08	2.6554	-0.1299	-3.841E-10	2519.0987	1.719E+12	0.002609	2582189.	0.000
148.500	-2.485E-08	0.7432	-0.0740	-3.663E-10	2519.0979	1.719E+12	0.003608	2613479.	0.000
150.000	-3.138E-08	0.000	0.000	-3.624E-10	2519.0976	1.719E+12	0.004610	1322385.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection              =      0.2500000 inches
Computed slope at pile head       =   -0.000004701 radians
Maximum bending moment            =     -11403069. inch-lbs
Maximum shear force               =         49864. lbs
Depth of maximum bending moment   =       0.000000 feet below pile head
Depth of maximum shear force      =      1.5000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.500000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5000	-21575572.	91678.	0.000	11253.	1.719E+12	0.000	0.000	0.000
1.500	0.4980	-19924253.	91678.	-0.000217	10585.	1.719E+12	0.000	0.000	0.000
3.000	0.4922	-18270862.	91678.	-0.000417	9915.2968	1.719E+12	0.000	0.000	0.000
4.500	0.4829	-16615571.	91678.	-0.000600	9245.2208	1.719E+12	0.000	0.000	0.000
6.000	0.4706	-14958551.	91678.	-0.000765	8574.4451	1.719E+12	0.000	0.000	0.000
7.500	0.4554	-13299975.	91678.	-0.000913	7903.0396	1.719E+12	0.000	0.000	0.000
9.000	0.4377	-11640015.	91678.	-0.001044	7231.0740	1.719E+12	0.000	0.000	0.000
10.500	0.4178	-9978845.	91678.	-0.001157	6558.6183	1.719E+12	0.000	0.000	0.000
12.000	0.3961	-8316637.	91678.	-0.001252	5885.7423	1.719E+12	0.000	0.000	0.000
13.500	0.3728	-6653563.	91678.	-0.001331	5212.5162	1.719E+12	0.000	0.000	0.000
15.000	0.3482	-4989798.	91678.	-0.001392	4539.0099	1.719E+12	0.000	0.000	0.000
16.500	0.3226	-3325513.	91678.	-0.001435	3865.2934	1.719E+12	0.000	0.000	0.000
18.000	0.2965	-1660883.	91678.	-0.001461	3191.4370	1.719E+12	0.000	0.000	0.000
19.500	0.2700	3920.4486	91678.	-0.001470	2520.6846	1.719E+12	0.000	0.000	0.000
21.000	0.2436	1668723.	91678.	-0.001461	3194.6109	1.719E+12	0.000	0.000	0.000
22.500	0.2174	3333353.	90020.	-0.001435	3868.4668	1.719E+12	-184.1943	15249.	0.000
24.000	0.1919	4937956.	84881.	-0.001392	4518.0239	1.719E+12	-386.7492	36275.	0.000
25.500	0.1673	6416739.	76206.	-0.001332	5116.6478	1.719E+12	-577.2284	62097.	0.000
27.000	0.1439	7707833.	64451.	-0.001258	5639.2934	1.719E+12	-728.7906	91136.	0.000
28.500	0.1220	8761997.	50333.	-0.001172	6066.0278	1.719E+12	-839.9306	123909.	0.000
30.000	0.1017	9543112.	34668.	-0.001076	6382.2297	1.719E+12	-900.5724	159331.	0.000
31.500	0.0833	10031448.	18471.	-0.000974	6579.9125	1.719E+12	-899.1442	194379.	0.000
33.000	0.0667	10227419.	3015.6627	-0.000868	6659.2429	1.719E+12	-818.1037	220854.	0.000
34.500	0.0520	10157260.	-10804.	-0.000761	6630.8420	1.719E+12	-717.3609	248233.	0.000
36.000	0.0393	9853619.	-22342.	-0.000656	6507.9257	1.719E+12	-564.6634	258805.	0.000
37.500	0.0284	9366003.	-31293.	-0.000556	6310.5344	1.719E+12	-429.9394	272646.	0.000
39.000	0.0193	8738111.	-38487.	-0.000461	6056.3588	1.719E+12	-369.3678	345181.	0.000
40.500	0.0118	7989636.	-44208.	-0.000374	5753.3697	1.719E+12	-266.3156	406771.	0.000
42.000	0.005814	7154044.	-47878.	-0.000294	5415.1148	1.719E+12	-141.4888	438061.	0.000
43.500	0.001191	6271864.	-49431.	-0.000224	5058.0012	1.719E+12	-31.0561	469351.	0.000
45.000	-0.002250	5378971.	-49148.	-0.000163	4696.5503	1.719E+12	62.5756	500641.	0.000
46.500	-0.004677	4505792.	-47340.	-0.000111	4343.0801	1.719E+12	138.2153	531931.	0.000
48.000	-0.006255	3676926.	-44335.	-6.843E-05	4007.5483	1.719E+12	195.7253	563221.	0.000
49.500	-0.007140	2911093.	-40451.	-3.394E-05	3697.5325	1.719E+12	235.8366	594511.	0.000
51.000	-0.007477	2221368.	-35989.	-7.075E-06	3418.3261	1.719E+12	259.9532	625801.	0.000
52.500	-0.007395	1615637.	-31220.	1.301E-05	3173.1210	1.719E+12	269.9588	657091.	0.000
54.000	-0.007009	1097204.	-26378.	2.721E-05	2963.2551	1.719E+12	268.0360	688381.	0.000
55.500	-0.006415	665501.	-21657.	3.644E-05	2788.4980	1.719E+12	256.5029	719671.	0.000
57.000	-0.005697	316836.	-17209.	4.158E-05	2647.3553	1.719E+12	237.6753	750962.	0.000
58.500	-0.004919	45144.	-13146.	4.348E-05	2537.3723	1.719E+12	213.7548	782252.	0.000

60.000	-0.004132	-157296.	-9541.8262	4.289E-05	2582.7722	1.719E+12	186.7438	813542.	0.000
61.500	-0.003375	-299214.	-6435.6355	4.050E-05	2640.2219	1.719E+12	158.3885	844832.	0.000
63.000	-0.002674	-389783.	-3840.0496	3.689E-05	2676.8851	1.719E+12	130.0099	875210.	0.000
64.500	-0.002047	-438189.	-1742.3755	3.256E-05	2696.4801	1.719E+12	103.0650	906500.	0.000
66.000	-0.001502	-453156.	-110.6195	2.789E-05	2702.5389	1.719E+12	78.2412	937790.	0.000
67.500	-0.001042	-442725.	1098.6398	2.320E-05	2698.3166	1.719E+12	56.1210	969080.	0.000
69.000	-0.000666	-414066.	1937.0916	1.872E-05	2686.7149	1.719E+12	37.0404	1000370.	0.000
70.500	-0.000369	-373362.	2460.5795	1.460E-05	2670.2377	1.719E+12	21.1250	1031660.	0.000
72.000	-0.000141	-325775.	2725.6627	1.094E-05	2650.9740	1.719E+12	8.3287	1062950.	0.000
73.500	2.511E-05	-275455.	2786.8820	7.789E-06	2630.6043	1.719E+12	-1.5266	1094240.	0.000
75.000	0.000139	-225602.	2694.7192	5.166E-06	2610.4232	1.719E+12	-8.7137	1125530.	0.000
76.500	0.000211	-178548.	2494.2033	3.050E-06	2591.3754	1.719E+12	-13.5658	1156820.	0.000
78.000	0.000249	-135871.	2224.0937	1.404E-06	2574.0994	1.719E+12	-16.4464	1188111.	0.000
79.500	0.000262	-98509.	1916.5532	1.775E-07	2558.9748	1.719E+12	-17.7248	1219401.	0.000
81.000	0.000256	-66879.	1597.2194	-6.882E-07	2546.1707	1.719E+12	-17.7567	1250691.	0.000
82.500	0.000237	-40995.	1285.5795	-1.253E-06	2535.6928	1.719E+12	-16.8699	1281981.	0.000
84.000	0.000210	-20573.	995.5597	-1.575E-06	2527.4258	1.719E+12	-15.3545	1313271.	0.000
85.500	0.000180	-5123.7597	736.2505	-1.710E-06	2521.1717	1.719E+12	-13.4576	1344561.	0.000
87.000	0.000149	5965.8659	512.6997	-1.705E-06	2521.5126	1.719E+12	-11.3813	1375812.	0.000
88.500	0.000119	13367.	326.7058	-1.604E-06	2524.5088	1.719E+12	-9.2846	1407102.	0.000
90.000	9.116E-05	17759.	177.5836	-1.441E-06	2526.2866	1.719E+12	-7.2845	1438392.	0.000
91.500	6.689E-05	19789.	62.8690	-1.245E-06	2527.1083	1.719E+12	-5.4616	1469682.	0.000
93.000	4.635E-05	20047.	-21.0725	-1.036E-06	2527.2129	1.719E+12	-3.8653	1500973.	0.000
94.500	2.959E-05	19051.	-78.5320	-8.314E-07	2526.8096	1.719E+12	-2.5191	1532263.	0.000
96.000	1.642E-05	17237.	-114.0432	-6.414E-07	2526.0751	1.719E+12	-1.4266	1563553.	0.000
97.500	6.501E-06	14958.	-132.0664	-4.729E-07	2525.1528	1.719E+12	-0.5760	1594843.	0.000
99.000	-6.019E-07	12492.	-136.7612	-3.292E-07	2524.1543	1.719E+12	0.0544	1626133.	0.000
100.500	-5.351E-06	10041.	-131.8374	-2.113E-07	2523.1624	1.719E+12	0.4927	1657423.	0.000
102.000	-8.208E-06	7749.5933	-120.4727	-1.181E-07	2522.2347	1.719E+12	0.7700	1688713.	0.000
103.500	-9.604E-06	5706.6016	-105.2827	-4.771E-08	2521.4077	1.719E+12	0.9177	1720003.	0.000
105.000	-9.925E-06	3960.3651	-88.3319	2.893E-09	2520.7008	1.719E+12	0.9657	1751293.	0.000
106.500	-9.500E-06	2526.5966	-71.1734	3.685E-08	2520.1204	1.719E+12	0.9408	1782583.	0.000
108.000	-8.599E-06	1397.3910	-55.1019	5.739E-08	2519.6633	1.719E+12	0.8449	1768648.	0.000
109.500	-7.434E-06	541.7876	-40.8074	6.754E-08	2519.3169	1.719E+12	0.7434	1799938.	0.000
111.000	-6.167E-06	-73.0163	-28.4701	6.999E-08	2519.1272	1.719E+12	0.6274	1831228.	0.000
112.500	-4.914E-06	-484.5256	-18.2467	6.708E-08	2519.2937	1.719E+12	0.5085	1862518.	0.000
114.000	-3.753E-06	-731.2322	-10.1170	6.071E-08	2519.3936	1.719E+12	0.3948	1893808.	0.000
115.500	-2.729E-06	-849.9439	-3.9373	5.244E-08	2519.4417	1.719E+12	0.2918	1925098.	0.000
117.000	-1.865E-06	-874.0156	0.5134	4.341E-08	2519.4514	1.719E+12	0.2027	1956388.	0.000
118.500	-1.166E-06	-832.3251	3.4962	3.448E-08	2519.4345	1.719E+12	0.1287	1987678.	0.000
120.000	-6.236E-07	-748.8373	5.2844	2.620E-08	2519.4007	1.719E+12	0.0699	2018968.	0.000
121.500	-2.225E-07	-642.6086	6.1420	1.892E-08	2519.3577	1.719E+12	0.0253	2050258.	0.000
123.000	5.747E-08	-528.1008	6.3103	1.279E-08	2519.3114	1.719E+12	-0.006645	2081548.	0.000
124.500	2.379E-07	-415.6912	5.9991	7.850E-09	2519.2659	1.719E+12	-0.0279	2112838.	0.000
126.000	3.401E-07	-312.2875	5.3832	4.040E-09	2519.2240	1.719E+12	-0.0405	2144129.	0.000
127.500	3.834E-07	-221.9763	4.6016	1.243E-09	2519.1875	1.719E+12	-0.0463	2175419.	0.000
129.000	3.848E-07	-146.6536	3.7600	-6.867E-10	2519.1570	1.719E+12	-0.0472	2206709.	0.000
130.500	3.586E-07	-86.6012	2.9341	-1.908E-09	2519.1327	1.719E+12	-0.0446	2237999.	0.000
132.000	3.161E-07	-40.9875	2.1741	-2.576E-09	2519.1142	1.719E+12	-0.0399	2269289.	0.000
133.500	2.659E-07	-8.2833	1.5095	-2.833E-09	2519.1009	1.719E+12	-0.0340	2300579.	0.000
135.000	2.141E-07	13.4097	0.9539	-2.807E-09	2519.1030	1.719E+12	-0.0277	2331869.	0.000
136.500	1.649E-07	26.1129	0.5094	-2.600E-09	2519.1082	1.719E+12	-0.0216	2363159.	0.000
138.000	1.206E-07	31.7995	0.1702	-2.297E-09	2519.1105	1.719E+12	-0.0160	2394449.	0.000
139.500	8.221E-08	32.2869	-0.0738	-1.961E-09	2519.1107	1.719E+12	-0.0111	2425739.	0.000
141.000	4.995E-08	29.1813	-0.2349	-1.639E-09	2519.1094	1.719E+12	-0.006819	2457029.	0.000
142.500	2.320E-08	23.8634	-0.3251	-1.362E-09	2519.1073	1.719E+12	-0.003207	2488319.	0.000
144.000	9.334E-10	17.5041	-0.3552	-1.145E-09	2519.1047	1.719E+12	-0.000131	2519609.	0.000
145.500	-1.803E-08	11.1006	-0.3333	-9.954E-10	2519.1021	1.719E+12	0.002555	2550899.	0.000
147.000	-3.490E-08	5.5239	-0.2653	-9.084E-10	2519.0998	1.719E+12	0.005007	2582189.	0.000
148.500	-5.073E-08	1.5688	-0.1539	-8.713E-10	2519.0982	1.719E+12	0.007366	2613479.	0.000
150.000	-6.627E-08	0.000	0.000	-8.630E-10	2519.0976	1.719E+12	0.009737	1322385.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection              =      0.5000000 inches
Computed slope at pile head       =   -0.000008644 radians
Maximum bending moment            =     -21575572. inch-lbs
Maximum shear force               =         91678. lbs
Depth of maximum bending moment   =       0.000000 feet below pile head
Depth of maximum shear force      =     16.5000000 feet below pile head
Number of iterations              =              9
Number of zero deflection points  =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 1.000000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	-38346595.	154440.	0.000	18042.	1.719E+12	0.000	0.000	0.000
1.500	0.9964	-35564677.	154440.	-0.000387	16916.	1.719E+12	0.000	0.000	0.000
3.000	0.9861	-32779059.	154440.	-0.000745	15788.	1.719E+12	0.000	0.000	0.000
4.500	0.9696	-29990032.	154440.	-0.001073	14659.	1.719E+12	0.000	0.000	0.000
6.000	0.9474	-27197885.	154440.	-0.001373	13529.	1.719E+12	0.000	0.000	0.000
7.500	0.9202	-24402909.	154440.	-0.001643	12398.	1.719E+12	0.000	0.000	0.000
9.000	0.8883	-21605394.	154440.	-0.001884	11265.	1.719E+12	0.000	0.000	0.000
10.500	0.8524	-18805632.	154440.	-0.002095	10132.	1.719E+12	0.000	0.000	0.000
12.000	0.8129	-16003914.	154440.	-0.002277	8997.6169	1.719E+12	0.000	0.000	0.000
13.500	0.7704	-13200531.	154440.	-0.002430	7862.7838	1.719E+12	0.000	0.000	0.000
15.000	0.7254	-10395775.	154440.	-0.002554	6727.3949	1.719E+12	0.000	0.000	0.000
16.500	0.6784	-7589937.	154440.	-0.002648	5591.5682	1.719E+12	0.000	0.000	0.000
18.000	0.6301	-4783310.	154440.	-0.002713	4455.4219	1.719E+12	0.000	0.000	0.000
19.500	0.5808	-1976185.	154440.	-0.002748	3319.0741	1.719E+12	0.000	0.000	0.000
21.000	0.5311	831145.	154440.	-0.002754	2855.5520	1.719E+12	0.000	0.000	0.000
22.500	0.4817	3638389.	152374.	-0.002731	3991.9480	1.719E+12	-229.5551	8578.7937	0.000
24.000	0.4328	6370878.	145903.	-0.002678	5098.0827	1.719E+12	-489.4740	20355.	0.000
25.500	0.3852	8944115.	134833.	-0.002598	6139.7509	1.719E+12	-740.5737	34603.	0.000
27.000	0.3393	11276476.	119621.	-0.002492	7083.9102	1.719E+12	-949.6215	50375.	0.000
28.500	0.2955	13299987.	101022.	-0.002363	7903.0444	1.719E+12	-1116.8867	68029.	0.000
30.000	0.2542	14960242.	79954.	-0.002216	8575.1299	1.719E+12	-1224.0140	86662.	0.000
31.500	0.2158	16222361.	57591.	-0.002052	9086.0463	1.719E+12	-1260.7484	105179.	0.000
33.000	0.1803	17074311.	35344.	-0.001878	9430.9225	1.719E+12	-1211.2116	120888.	0.000
34.500	0.1482	17532051.	14155.	-0.001697	9616.2197	1.719E+12	-1143.0556	138879.	0.000
36.000	0.1193	17617618.	-5065.3310	-0.001513	9650.8578	1.719E+12	-992.5565	149809.	0.000
37.500	0.0937	17379763.	-21590.	-0.001330	9554.5724	1.719E+12	-843.4826	162059.	0.000
39.000	0.0714	16866813.	-36311.	-0.001150	9346.9258	1.719E+12	-792.2637	199761.	0.000
40.500	0.0523	16095414.	-49825.	-0.000978	9034.6572	1.719E+12	-709.2937	244255.	0.000
42.000	0.0362	15092531.	-61905.	-0.000815	8628.6813	1.719E+12	-632.9122	314840.	0.000
43.500	0.0229	13883013.	-72501.	-0.000663	8139.0585	1.719E+12	-544.3767	427085.	0.000
45.000	0.0123	12495674.	-80484.	-0.000525	7577.4517	1.719E+12	-342.6104	500641.	0.000
46.500	0.004048	10996029.	-84644.	-0.000402	6970.3827	1.719E+12	-119.6174	531931.	0.000
48.000	-0.002151	9456483.	-85115.	-0.000295	6347.1619	1.719E+12	67.2915	563221.	0.000
49.500	-0.006567	7937757.	-82557.	-0.000204	5732.3687	1.719E+12	216.8921	594511.	0.000
51.000	-0.009487	6488478.	-77636.	-0.000128	5145.6883	1.719E+12	329.8414	625801.	0.000
52.500	-0.0112	5145393.	-70993.	-6.738E-05	4601.9961	1.719E+12	408.3084	657091.	0.000
54.000	-0.0119	3934064.	-63218.	-1.986E-05	4111.6401	1.719E+12	455.5960	688381.	0.000
55.500	-0.0119	2869940.	-54836.	1.576E-05	3680.8734	1.719E+12	475.7741	719671.	0.000
57.000	-0.0113	1959667.	-46294.	4.104E-05	3312.3875	1.719E+12	473.3427	750962.	0.000
58.500	-0.0104	1202554.	-37957.	5.759E-05	3005.9017	1.719E+12	452.9361	782252.	0.000

60.000	-0.009272	592067.	-30109.	6.699E-05	2758.7714	1.719E+12	419.0769	813542.	0.000
61.500	-0.008011	117300.	-22953.	7.070E-05	2566.5814	1.719E+12	375.9828	844832.	0.000
63.000	-0.006727	-235662.	-16626.	7.008E-05	2614.4955	1.719E+12	327.0859	875210.	0.000
64.500	-0.005488	-482623.	-11195.	6.632E-05	2714.4675	1.719E+12	276.3683	906500.	0.000
66.000	-0.004339	-639991.	-6672.7018	6.045E-05	2778.1712	1.719E+12	226.0806	937790.	0.000
67.500	-0.003312	-724041.	-3033.3357	5.331E-05	2812.1957	1.719E+12	178.2935	969080.	0.000
69.000	-0.002420	-750250.	-218.0487	4.559E-05	2822.8051	1.719E+12	134.5162	1000370.	0.000
70.500	-0.001670	-732797.	1854.2885	3.783E-05	2815.7401	1.719E+12	95.7435	1031660.	0.000
72.000	-0.001059	-684247.	3278.6445	3.041E-05	2796.0866	1.719E+12	62.5183	1062950.	0.000
73.500	-0.000576	-615370.	4156.3514	2.360E-05	2768.2046	1.719E+12	35.0047	1094240.	0.000
75.000	-0.000209	-535088.	4588.9645	1.758E-05	2735.7056	1.719E+12	13.0634	1125530.	0.000
76.500	5.715E-05	-450517.	4673.4789	1.242E-05	2701.4706	1.719E+12	-3.6730	1156820.	0.000
78.000	0.000238	-367089.	4498.8468	8.143E-06	2667.6984	1.719E+12	-15.7306	1188111.	0.000
79.500	0.000350	-288720.	4143.6851	4.711E-06	2635.9740	1.719E+12	-23.7318	1219401.	0.000
81.000	0.000408	-218010.	3675.0212	2.058E-06	2607.3500	1.719E+12	-28.3420	1250691.	0.000
82.500	0.000424	-156460.	3147.9068	9.778E-08	2582.4341	1.719E+12	-30.2263	1281981.	0.000
84.000	0.000411	-104688.	2605.7179	-1.269E-06	2561.4760	1.719E+12	-30.0169	1313271.	0.000
85.500	0.000379	-62629.	2080.9673	-2.145E-06	2544.4504	1.719E+12	-28.2887	1344561.	0.000
87.000	0.000334	-29730.	1596.4731	-2.629E-06	2531.1326	1.719E+12	-25.5440	1375812.	0.000
88.500	0.000284	-5104.0004	1166.7113	-2.811E-06	2521.1637	1.719E+12	-22.2073	1407102.	0.000
90.000	0.000233	12327.	799.2688	-2.773E-06	2524.0878	1.719E+12	-18.6196	1438392.	0.000
91.500	0.000184	23725.	496.2965	-2.584E-06	2528.7016	1.719E+12	-15.0440	1469682.	0.000
93.000	0.000140	30245.	255.8560	-2.302E-06	2531.3412	1.719E+12	-11.6716	1500973.	0.000
94.500	0.000101	32981.	73.1362	-1.971E-06	2532.4487	1.719E+12	-8.6306	1532263.	0.000
96.000	6.902E-05	32918.	-58.4955	-1.626E-06	2532.4229	1.719E+12	-5.9952	1563553.	0.000
97.500	4.285E-05	30908.	-146.6245	-1.292E-06	2531.6093	1.719E+12	-3.7969	1594843.	0.000
99.000	2.251E-05	27665.	-199.1014	-9.852E-07	2530.2965	1.719E+12	-2.0339	1626133.	0.000
100.500	7.386E-06	23760.	-223.5270	-7.160E-07	2528.7157	1.719E+12	-0.6801	1657423.	0.000
102.000	-3.263E-06	19632.	-226.8925	-4.889E-07	2527.0448	1.719E+12	0.3062	1688713.	0.000
103.500	-1.021E-05	15601.	-215.3534	-3.044E-07	2525.4131	1.719E+12	0.9760	1720003.	0.000
105.000	-1.422E-05	11885.	-194.1151	-1.606E-07	2523.9089	1.719E+12	1.3839	1751293.	0.000
106.500	-1.599E-05	8616.3705	-167.4053	-5.325E-08	2522.5856	1.719E+12	1.5839	1782583.	0.000
108.000	-1.614E-05	5859.7482	-138.8769	2.253E-08	2521.4697	1.719E+12	1.5859	1768648.	0.000
109.500	-1.518E-05	3616.3541	-110.9397	7.213E-08	2520.5615	1.719E+12	1.5182	1799938.	0.000
111.000	-1.354E-05	1864.4847	-84.8752	1.008E-07	2519.8524	1.719E+12	1.3778	1831228.	0.000
112.500	-1.155E-05	558.8434	-61.7158	1.135E-07	2519.3238	1.719E+12	1.1954	1862518.	0.000
114.000	-9.457E-06	-359.5385	-42.0019	1.146E-07	2519.2431	1.719E+12	0.9950	1893808.	0.000
115.500	-7.429E-06	-955.5022	-25.8960	1.077E-07	2519.4844	1.719E+12	0.7945	1925098.	0.000
117.000	-5.581E-06	-1293.9354	-13.2858	9.589E-08	2519.6214	1.719E+12	0.6066	1956388.	0.000
118.500	-3.977E-06	-1435.6962	-3.8740	8.161E-08	2519.6788	1.719E+12	0.4392	1987678.	0.000
120.000	-2.643E-06	-1435.0210	2.7468	6.658E-08	2519.6785	1.719E+12	0.2965	2018968.	0.000
121.500	-1.580E-06	-1338.1357	7.0349	5.206E-08	2519.6393	1.719E+12	0.1800	2050258.	0.000
123.000	-7.691E-07	-1182.7985	9.4551	3.887E-08	2519.5764	1.719E+12	0.0889	2081548.	0.000
124.500	-1.809E-07	-998.5234	10.4467	2.745E-08	2519.5018	1.719E+12	0.0212	2112838.	0.000
126.000	2.191E-07	-807.2640	10.4029	1.800E-08	2519.4244	1.719E+12	-0.0261	2144129.	0.000
127.500	4.669E-07	-624.3750	9.6602	1.050E-08	2519.3503	1.719E+12	-0.0564	2175419.	0.000
129.000	5.971E-07	-459.7039	8.4936	4.826E-09	2519.2837	1.719E+12	-0.0732	2206709.	0.000
130.500	6.406E-07	-318.7019	7.1179	7.516E-10	2519.2266	1.719E+12	-0.0797	2237999.	0.000
132.000	6.241E-07	-203.4747	5.6928	-1.982E-09	2519.1800	1.719E+12	-0.0787	2269289.	0.000
133.500	5.693E-07	-113.7210	4.3298	-3.642E-09	2519.1436	1.719E+12	-0.0728	2300579.	0.000
135.000	4.930E-07	-47.5306	3.1001	-4.486E-09	2519.1168	1.719E+12	-0.0639	2331869.	0.000
136.500	4.078E-07	-2.0295	2.0434	-4.746E-09	2519.0984	1.719E+12	-0.0535	2363159.	0.000
138.000	3.222E-07	26.1253	1.1758	-4.620E-09	2519.1082	1.719E+12	-0.0429	2394449.	0.000
139.500	2.415E-07	40.3912	0.4972	-4.271E-09	2519.1139	1.719E+12	-0.0325	2425739.	0.000
141.000	1.684E-07	44.1084	-0.002629	-3.829E-09	2519.1154	1.719E+12	-0.0230	2457029.	0.000
142.500	1.036E-07	40.3726	-0.3385	-3.387E-09	2519.1139	1.719E+12	-0.0143	2488319.	0.000
144.000	4.649E-08	31.9902	-0.5260	-3.008E-09	2519.1105	1.719E+12	-0.006508	2519609.	0.000
145.500	-4.641E-09	21.4961	-0.5787	-2.728E-09	2519.1063	1.719E+12	0.000658	2550899.	0.000
147.000	-5.172E-08	11.2128	-0.5060	-2.557E-09	2519.1021	1.719E+12	0.007420	2582189.	0.000
148.500	-9.669E-08	3.3324	-0.3128	-2.481E-09	2519.0989	1.719E+12	0.0140	2613479.	0.000
150.000	-1.410E-07	0.000	0.000	-2.463E-09	2519.0976	1.719E+12	0.0207	1322385.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =      1.0000000 inches
Computed slope at pile head      =     -0.0000146 radians
Maximum bending moment           =     -38346595. inch-lbs
Maximum shear force              =        154440. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =       0.000000 feet below pile head
Number of iterations             =             10
Number of zero deflection points =              5
```

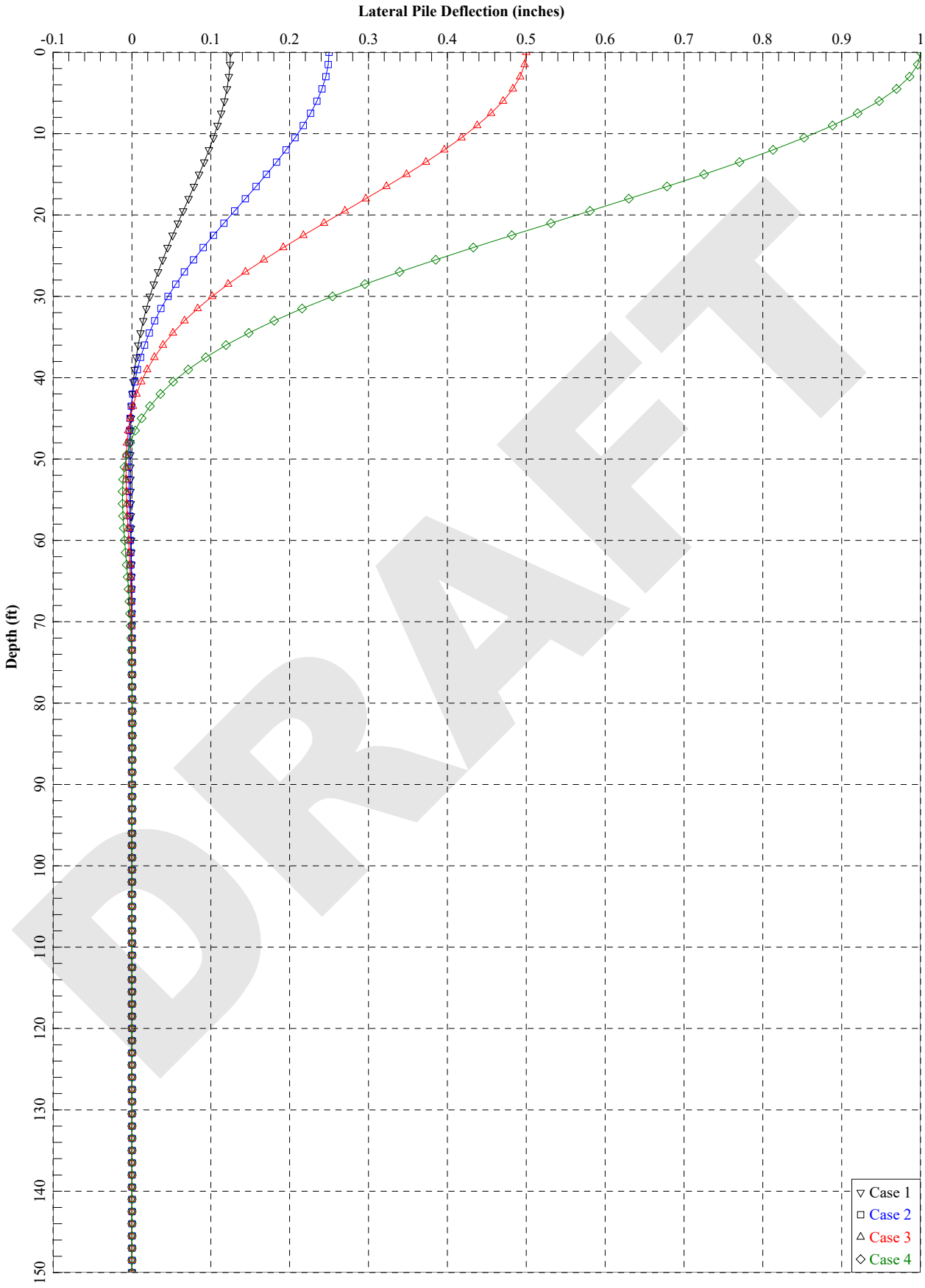
Summary of Pile Response(s)

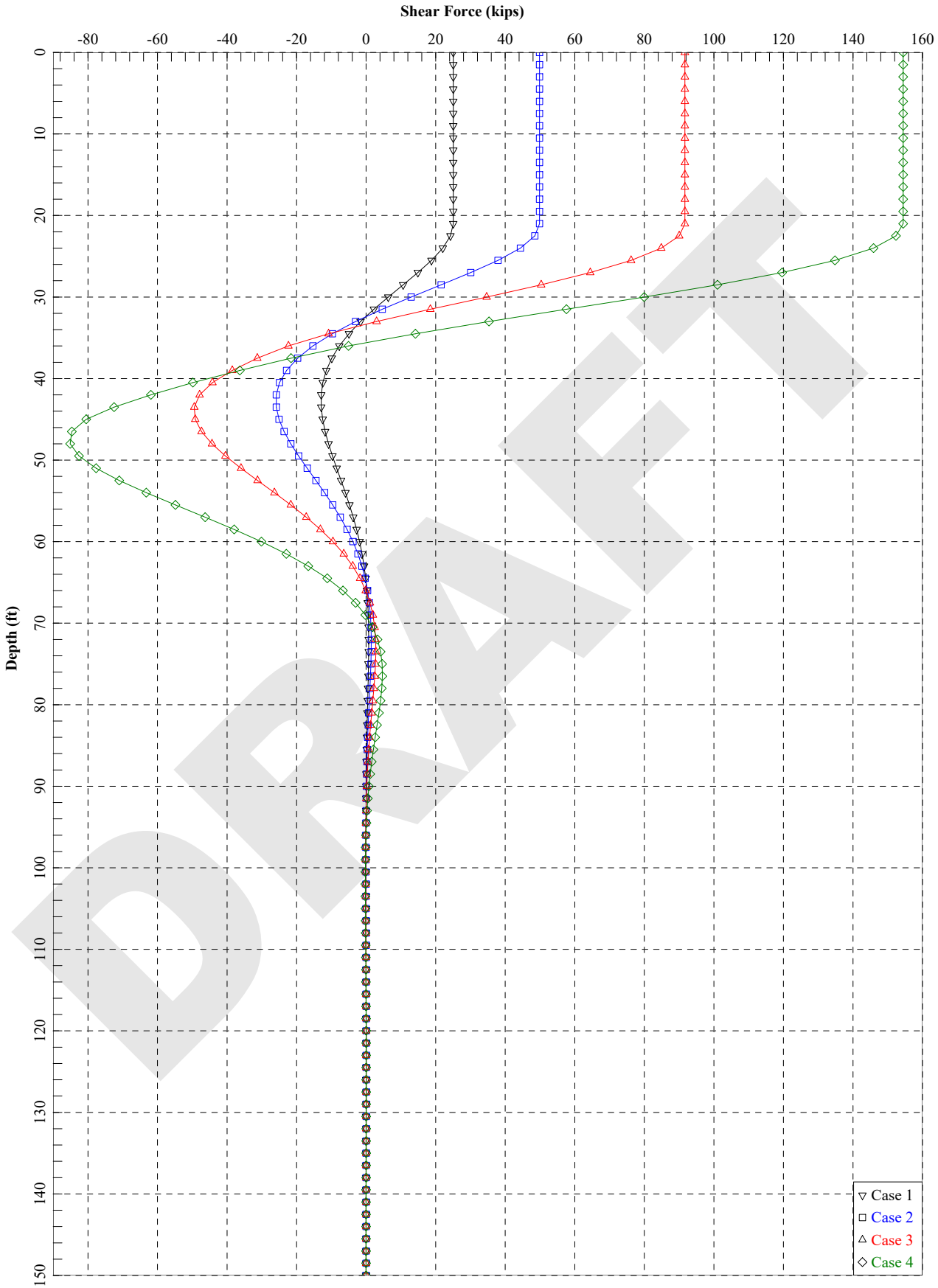
Definitions of Pile-head Loading Conditions:

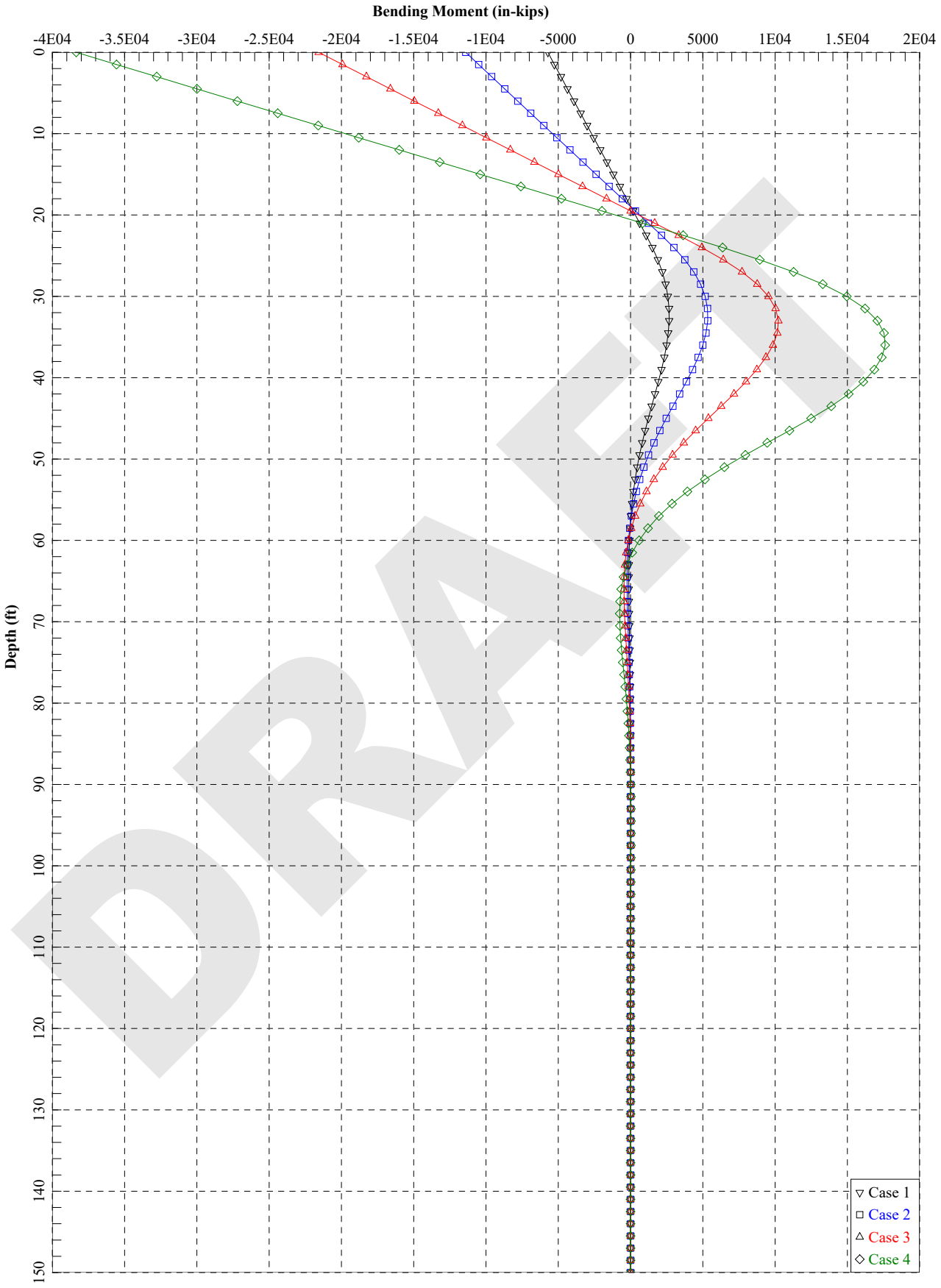
Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

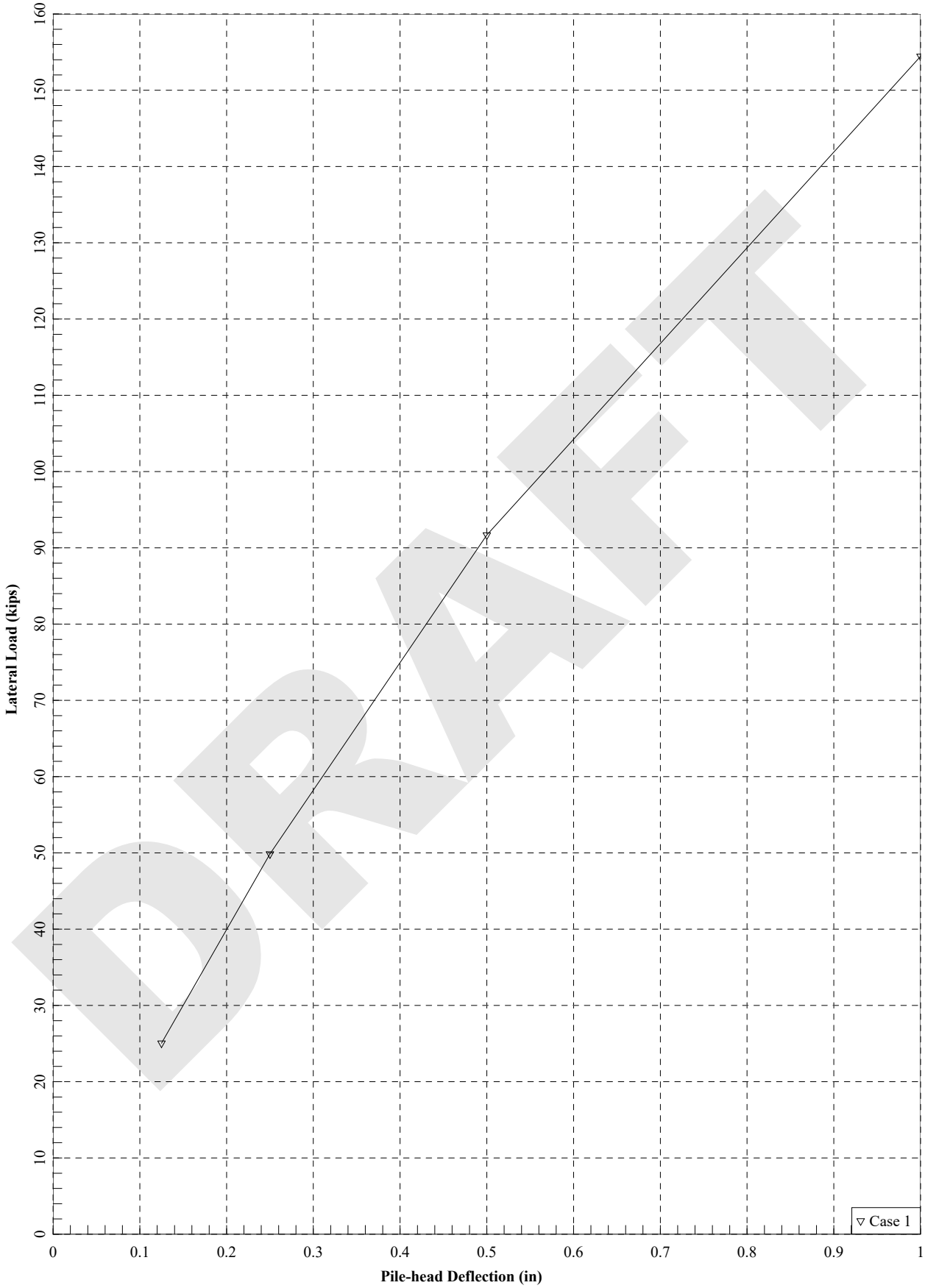
Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	5	y = 0.1250	S = 0.000	552000.	0.12500000	-5717920.	25053.	-0.00000236
2	5	y = 0.2500	S = 0.000	552000.	0.25000000	-11403069.	49864.	-0.00000470
3	5	y = 0.5000	S = 0.000	552000.	0.50000000	-21575572.	91678.	-0.00000864
4	5	y = 1.0000	S = 0.000	552000.	1.00000000	-38346595.	154440.	-0.00001456

The analysis ended normally.


Lateral Pile Deflection (inches)
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Shear Force (kips)
-80
-60
-40
-20
0
20
40
60
80
100
120
140
160
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Bending Moment (in-kips)
-4E04
-3.5E04
-3E04
-2.5E04
-2E04
-1.5E04
-1E04
-5000
0
5000
1E04
1.5E04
2E04
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Lateral Load (kips)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pile-head Deflection (in)
▽ Case 1

```
================================================================================

                  LPile Plus for Windows, Version 2013-07.007

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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================================================================================

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--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        P:\Four Hole Swamp\LPILE\2016-03-02\
Name of input data file:       FHS_4-1.5OEP_WZ_shallowscour_load_type_4.lp7d
Name of output report file:    FHS_4-1.5OEP_WZ_shallowscour_load_type_4.lp7o
Name of plot output file:      FHS_4-1.5OEP_WZ_shallowscour_load_type_4.lp7p
Name of runtime messeage file: FHS_4-1.5OEP_WZ_shallowscour_load_type_4.lp7r


--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  March 2, 2016     Time:  17:48:44


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Project Name: US 301 RBO Four Hole Swamp


Job Number: 41503-0002-0001


Client: SCDOT


Engineer: Gabriel Burnworth


Description: 48" OEP (1.5" walls) Weak Zone, 94' scour elev., Free Head



--------------------------------------------------------------------------------
                           Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
```

```
 - Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed                =          500
- Deflection tolerance for convergence                =   1.0000E-05 in
- Maximum allowable deflection                        =     100.0000 in
- Number of pile increments                           =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
 - Compute pile response under loading and nonlinear bending properties of pile
   (only if nonlinear pile properties are input)
 - Use of p-y modification factors for p-y curves not selected
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Computation of pile-head foundation stiffness matrix not selected
 - Push-over analysis of pile not selected
 - Buckling analysis of pile not selected

Output Options:
 - No p-y curves to be computed and reported for user-specified depths
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1


---------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
---------------------------------------------------------------------------

Total number of pile sections                        =         1

Total length of pile                                 =     150.00 ft

Depth of ground surface below top of pile            =      21.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile.

Point         Depth              Pile
                X              Diameter
                ft                in
-----       ---------        -----------
  1          0.00000         48.0000000
  2        150.000000        48.0000000


Input Structural Properties:
----------------------------

Pile Section No. 1:

   Section Type                                      = Steel Pipe Pile
   Section Length                                    =    150.00000 ft
   Pile Diameter                                     =     48.00000 in


---------------------------------------------------------------------------
                      Ground Slope and Pile Batter Angles
---------------------------------------------------------------------------

Ground Slope Angle                                   =        0.000 degrees
                                                     =        0.000 radians
```

```
Pile Batter Angle                                   =        0.000 degrees
                                                    =        0.000 radians


--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     21.00000 ft
   Distance from top of pile to bottom of layer     =     63.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     63.00000 ft
   Distance from top of pile to bottom of layer     =     86.00000 ft
   Effective unit weight at top of layer            =     22.00000 pcf
   Effective unit weight at bottom of layer         =     22.00000 pcf
   Friction angle at top of layer                   =     24.00000 deg.
   Friction angle at bottom of layer                =     24.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     86.00000 ft
   Distance from top of pile to bottom of layer     =    108.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =    108.00000 ft
   Distance from top of pile to bottom of layer     =    206.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

   (Depth of lowest soil layer extends   56.00 ft below pile tip)


--------------------------------------------------------------------------------
```

Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	kpy pci
1	Sand (Reese, et al.)	21.000	57.600	36.000	default
		63.000	57.600	36.000	default
2	Sand (Reese, et al.)	63.000	22.000	24.000	default
		86.000	22.000	24.000	default
3	Sand (Reese, et al.)	86.000	57.600	36.000	default
		108.000	57.600	36.000	default
4	Sand (Reese, et al.)	108.000	57.600	36.000	default
		206.000	57.600	36.000	default

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	4	y = 0.12500 in	M = 0.0000 in-lbs	552000.	No
2	4	y = 0.25000 in	M = 0.0000 in-lbs	552000.	No
3	4	y = 0.50000 in	M = 0.0000 in-lbs	552000.	No
4	4	y = 1.00000 in	M = 0.0000 in-lbs	552000.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel Pipe Pile:

Length of Section	=	150.00000 ft
Outer Diameter of Pipe	=	48.00000 in
Pipe Wall Thickness	=	1.50000 in
Yield Stress of Pipe	=	36.00000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	219.12609 sq. in.

```
Moment of Inertia                                  =       59287. in^4
Elastic Bending Stiffness                          =   1.7193E+09 kip-in^2
Plastic Modulus, Z                                 =   3244.50000 in^3
Plastic Moment Capacity = Fy Z                     =      116802. in-kip

Axial Structural Capacities:
----------------------------

Nom. Axial Structural Capacity = Fy As             =     7888.539 kips
Nominal Axial Tensile Capacity                     =    -7888.539 kips



Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

   Number     Axial Thrust Force
                      kips
   ------     ------------------
      1              552.000

Definition of Run Messages:

   Y = part of pipe section has yielded.


Axial Thrust Force =    552.000 kips

    Bending       Bending       Bending       Depth to     Max Total    Run
   Curvature      Moment       Stiffness       N Axis        Stress     Msg
    rad/in.       in-kip        kip-in2          in           ksi
 ------------- ------------- ------------- ------------- ------------- ---
   0.000001054  1811.9939796  1719329760.   106.4231912     3.2452738
   0.000002108  3623.9879591  1719329760.    65.2115956     3.9714500
   0.000003162  5435.9819387  1719329760.    51.4743971     4.6976261
   0.000004216  7247.9759182  1719329760.    44.6057978     5.4238024
   0.000005269  9059.9698978  1719329760.    40.4846382     6.1499785
   0.000006323       10872.   1719329760.    37.7371985     6.8761547
   0.000007377       12684.   1719329760.    35.7747416     7.6023309
   0.000008431       14496.   1719329760.    34.3028989     8.3285071
   0.000009485       16308.   1719329760.    33.1581324     9.0546833
     0.0000105       18120.   1719329760.    32.2423191     9.7808595
     0.0000116       19932.   1719329760.    31.4930174    10.5070357
     0.0000126       21744.   1719329760.    30.8685993    11.2332119
     0.0000137       23556.   1719329760.    30.3402455    11.9593881
     0.0000148       25368.   1719329760.    29.8873708    12.6855643
     0.0000158       27180.   1719329760.    29.4948794    13.4117405
     0.0000169       28992.   1719329760.    29.1514494    14.1379167
     0.0000179       30804.   1719329760.    28.8484230    14.8640929
     0.0000190       32616.   1719329760.    28.5790662    15.5902690
     0.0000200       34428.   1719329760.    28.3380627    16.3164452
     0.0000211       36240.   1719329760.    28.1211596    17.0426214
     0.0000221       38052.   1719329760.    27.9249139    17.7687976
     0.0000232       39864.   1719329760.    27.7465087    18.4949738
     0.0000242       41676.   1719329760.    27.5836170    19.2211500
     0.0000253       43488.   1719329760.    27.4342996    19.9473262
     0.0000263       45300.   1719329760.    27.2969276    20.6735024
     0.0000274       47112.   1719329760.    27.1701227    21.3996786
     0.0000285       48924.   1719329760.    27.0527108    22.1258548
     0.0000295       50736.   1719329760.    26.9436854    22.8520310
     0.0000306       52548.   1719329760.    26.8421790    23.5782071
     0.0000316       54360.   1719329760.    26.7474397    24.3043833
     0.0000327       56172.   1719329760.    26.6588126    25.0305595
     0.0000337       57984.   1719329760.    26.5757247    25.7567357
     0.0000348       59796.   1719329760.    26.4976725    26.4829119
     0.0000358       61608.   1719329760.    26.4242115    27.2090881
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     0.0000379       65232.   1719329760.    26.2895331    28.6614405
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0.0000390	67044.	1719329760.	26.2276538	29.3876167	
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0.0000432	74292.	1719329760.	26.0103217	32.2923214	
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0.0000495	85116.	1718362204.	25.7600931	36.0000000	Y
0.0000516	88307.	1710016821.	25.7450077	36.0000000	Y
0.0000537	91055.	1694080982.	25.7890002	36.0000000	Y
0.0000559	93523.	1674351216.	25.8662156	36.0000000	Y
0.0000580	95738.	1651681538.	25.9596148	36.0000000	Y
0.0000601	97623.	1625104154.	26.0427887	36.0000000	Y
0.0000622	99187.	1595157458.	26.1020741	36.0000000	Y
0.0000643	100520.	1563590959.	26.1477997	36.0000000	Y
0.0000664	101682.	1531456607.	26.1850574	36.0000000	Y
0.0000685	102694.	1499106584.	26.2156802	36.0000000	Y
0.0000706	103596.	1467136166.	26.2418156	36.0000000	Y
0.0000727	104405.	1435730900.	26.2645753	36.0000000	Y
0.0000748	105133.	1405018933.	26.2847462	36.0000000	Y
0.0000769	105792.	1375089517.	26.3029308	36.0000000	Y
0.0000790	106389.	1345978545.	26.3190684	36.0000000	Y
0.0000811	106931.	1317694704.	26.3327277	36.0000000	Y
0.0000833	107428.	1290308271.	26.3451305	36.0000000	Y
0.0000854	107888.	1263831958.	26.3565441	36.0000000	Y
0.0000875	108312.	1238223529.	26.3683587	36.0000000	Y
0.0000896	108694.	1213357023.	26.3774987	36.0000000	Y
0.0000917	109054.	1189386837.	26.3862330	36.0000000	Y
0.0000938	109391.	1166251589.	26.3947955	36.0000000	Y
0.0000959	109694.	1143784328.	26.4021331	36.0000000	Y
0.0000980	109986.	1122168893.	26.4094502	36.0000000	Y
0.0001001	110251.	1101186709.	26.4155900	36.0000000	Y
0.0001022	110504.	1080953128.	26.4221100	36.0000000	Y
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0.0001086	111162.	1024055458.	26.4372983	36.0000000	Y
0.0001107	111360.	1006332490.	26.4430476	36.0000000	Y
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0.0001149	111715.	972490789.	26.4505626	36.0000000	Y
0.0001170	111873.	956324994.	26.4547068	36.0000000	Y
0.0001191	112028.	940701885.	26.4572535	36.0000000	Y
0.0001212	112175.	925549270.	26.4625617	36.0000000	Y
0.0001233	112309.	910814943.	26.4645327	36.0000000	Y
0.0001254	112442.	896572199.	26.4666389	36.0000000	Y
0.0001338	112900.	843517796.	26.4797710	36.0000000	Y
0.0001423	113275.	796164739.	26.4878891	36.0000000	Y
0.0001507	113588.	753702530.	26.4950904	36.0000000	Y
0.0001591	113853.	715434459.	26.5018328	36.0000000	Y
0.0001676	114076.	680768908.	26.5058505	36.0000000	Y
0.0001760	114269.	649250909.	26.5078046	36.0000000	Y
0.0001844	114433.	620460993.	26.5135095	36.0000000	Y
0.0001929	114577.	594085861.	26.5174169	36.0000000	Y
0.0002013	114703.	569829556.	26.5179765	36.0000000	Y
0.0002097	114814.	547451379.	26.5235253	36.0000000	Y
0.0002182	114912.	526743116.	26.5225624	36.0000000	Y
0.0002266	114999.	507525905.	26.5269002	36.0000000	Y
0.0002350	115077.	489651076.	26.5278306	36.0000000	Y

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip
1	552.000	115077.2

Note that the values in the above table are not factored by a strength

reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.125000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1250	0.000	6616.2621	-0.000403	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.1177	123097.	6616.2621	-0.000402	2568.9283	1.719E+12	0.000	0.000	0.000
3.000	0.1105	246181.	6616.2621	-0.000400	2618.7538	1.719E+12	0.000	0.000	0.000
4.500	0.1033	369240.	6616.2621	-0.000397	2668.5690	1.719E+12	0.000	0.000	0.000
6.000	0.0962	492260.	6616.2621	-0.000393	2718.3686	1.719E+12	0.000	0.000	0.000
7.500	0.0892	615229.	6616.2621	-0.000387	2768.1475	1.719E+12	0.000	0.000	0.000
9.000	0.0823	738134.	6616.2621	-0.000380	2817.9005	1.719E+12	0.000	0.000	0.000
10.500	0.0755	860962.	6616.2621	-0.000371	2867.6224	1.719E+12	0.000	0.000	0.000
12.000	0.0689	983701.	6616.2621	-0.000362	2917.3081	1.719E+12	0.000	0.000	0.000
13.500	0.0625	1106337.	6616.2621	-0.000351	2966.9523	1.719E+12	0.000	0.000	0.000
15.000	0.0563	1228859.	6616.2621	-0.000339	3016.5499	1.719E+12	0.000	0.000	0.000
16.500	0.0503	1351252.	6616.2621	-0.000325	3066.0958	1.719E+12	0.000	0.000	0.000
18.000	0.0446	1473505.	6616.2621	-0.000310	3115.5848	1.719E+12	0.000	0.000	0.000
19.500	0.0391	1595605.	6616.2621	-0.000294	3165.0118	1.719E+12	0.000	0.000	0.000
21.000	0.0340	1717538.	6616.2621	-0.000277	3214.3715	1.719E+12	0.000	0.000	0.000
22.500	0.0292	1839293.	6160.0157	-0.000258	3263.6590	1.719E+12	-50.6940	31290.	0.000
24.000	0.0247	1944432.	4931.3401	-0.000239	3306.2200	1.719E+12	-85.8255	62580.	0.000
25.500	0.0206	2021561.	3193.1642	-0.000218	3337.4425	1.719E+12	-107.3052	93870.	0.000
27.000	0.0168	2063713.	1173.1115	-0.000196	3354.5059	1.719E+12	-117.1451	125160.	0.000
28.500	0.0135	2067695.	-937.8032	-0.000175	3356.1180	1.719E+12	-117.4010	156450.	0.000
30.000	0.0106	2033424.	-2985.3904	-0.000153	3342.2449	1.719E+12	-110.1087	187740.	0.000
31.500	0.007990	1963267.	-4851.3646	-0.000132	3313.8445	1.719E+12	-97.2218	219030.	0.000
33.000	0.005793	1861405.	-6451.3516	-0.000112	3272.6100	1.719E+12	-80.5546	250321.	0.000
34.500	0.003946	1733250.	-7731.9692	-9.351E-05	3220.7318	1.719E+12	-61.7363	281611.	0.000
36.000	0.002426	1584912.	-8667.1823	-7.614E-05	3160.6835	1.719E+12	-42.1763	312901.	0.000
37.500	0.001205	1422745.	-9254.1602	-6.039E-05	3095.0366	1.719E+12	-23.0435	344191.	0.000
39.000	0.000252	1252963.	-9508.8727	-4.639E-05	3026.3075	1.719E+12	-5.2579	375481.	0.000
40.500	-0.000465	1081347.	-9461.6468	-3.417E-05	2956.8360	1.719E+12	10.5052	406771.	0.000
42.000	-0.000978	913022.	-9152.8846	-2.373E-05	2888.6968	1.719E+12	23.8017	438061.	0.000
43.500	-0.001319	752315.	-8629.1069	-1.501E-05	2823.6409	1.719E+12	34.3958	469351.	0.000
45.000	-0.001518	602673.	-7939.4498	-7.919E-06	2763.0647	1.719E+12	42.2327	500641.	0.000
46.500	-0.001604	466652.	-7132.6974	-2.321E-06	2708.0022	1.719E+12	47.4064	531931.	0.000
48.000	-0.001602	345942.	-6254.9001	1.932E-06	2659.1378	1.719E+12	50.1266	563221.	0.000
49.500	-0.001535	241437.	-5347.5860	5.007E-06	2616.8333	1.719E+12	50.6861	594511.	0.000
51.000	-0.001422	153329.	-4446.5465	7.073E-06	2581.1666	1.719E+12	49.4294	625801.	0.000
52.500	-0.001280	81221.	-3581.1510	8.301E-06	2551.9764	1.719E+12	46.7256	657091.	0.000
54.000	-0.001123	24243.	-2774.1285	8.853E-06	2528.9113	1.719E+12	42.9436	688381.	0.000
55.500	-0.000961	-18824.	-2041.7418	8.882E-06	2526.7176	1.719E+12	38.4327	719671.	0.000
57.000	-0.000803	-49436.	-1394.2756	8.524E-06	2539.1098	1.719E+12	33.5079	750962.	0.000
58.500	-0.000654	-69187.	-836.7591	7.903E-06	2547.1051	1.719E+12	28.4383	782252.	0.000

60.000	-0.000519	-79717.	-369.8470	7.124E-06	2551.3676	1.719E+12	23.4408	813542.	0.000
61.500	-0.000398	-82643.	9.2070	6.274E-06	2552.5522	1.719E+12	18.6763	844832.	0.000
63.000	-0.000293	-79510.	231.9727	5.425E-06	2551.2839	1.719E+12	6.0754	373524.	0.000
64.500	-0.000203	-74400.	296.6492	4.620E-06	2549.2153	1.719E+12	1.1109	98691.	0.000
66.000	-0.000126	-68922.	313.0693	3.869E-06	2546.9979	1.719E+12	0.7136	101563.	0.000
67.500	-6.331E-05	-63206.	322.7974	3.178E-06	2544.6841	1.719E+12	0.3673	104434.	0.000
69.000	-1.207E-05	-57365.	326.7508	2.547E-06	2542.3193	1.719E+12	0.0719	107305.	0.000
70.500	2.837E-05	-51494.	325.8357	1.977E-06	2539.9428	1.719E+12	-0.1736	110176.	0.000
72.000	5.909E-05	-45674.	320.9329	1.468E-06	2537.5868	1.719E+12	-0.3711	113048.	0.000
73.500	8.122E-05	-39970.	312.8854	1.020E-06	2535.2776	1.719E+12	-0.5230	115919.	0.000
75.000	9.581E-05	-34430.	302.4875	6.304E-07	2533.0353	1.719E+12	-0.6323	118790.	0.000
76.500	0.000104	-29093.	290.4761	2.978E-07	2530.8745	1.719E+12	-0.7023	121661.	0.000
78.000	0.000107	-23979.	277.5220	2.003E-08	2528.8046	1.719E+12	-0.7370	124533.	0.000
79.500	0.000105	-19102.	264.2236	-2.055E-07	2526.8303	1.719E+12	-0.7406	127404.	0.000
81.000	9.913E-05	-14463.	251.1012	-3.812E-07	2524.9523	1.719E+12	-0.7175	130275.	0.000
82.500	9.091E-05	-10055.	238.5919	-5.095E-07	2523.1679	1.719E+12	-0.6724	133146.	0.000
84.000	8.079E-05	-5863.5916	227.0454	-5.929E-07	2521.4712	1.719E+12	-0.6105	136018.	0.000
85.500	6.957E-05	-1869.4770	216.7201	-6.333E-07	2519.8544	1.719E+12	-0.5368	138889.	0.000
87.000	5.799E-05	1950.9184	178.3095	-6.329E-07	2519.8873	1.719E+12	-3.7311	1158133.	0.000
88.500	4.678E-05	4562.2412	116.9086	-5.988E-07	2520.9444	1.719E+12	-3.0912	1189423.	0.000
90.000	3.643E-05	6171.5286	66.8509	-5.426E-07	2521.5959	1.719E+12	-2.4707	1220713.	0.000
91.500	2.725E-05	6979.6570	27.5581	-4.738E-07	2521.9230	1.719E+12	-1.8951	1252003.	0.000
93.000	1.938E-05	7173.0339	-1.9307	-3.997E-07	2522.0013	1.719E+12	-1.3814	1283293.	0.000
94.500	1.286E-05	6918.0960	-22.8140	-3.259E-07	2521.8981	1.719E+12	-0.9390	1314583.	0.000
96.000	7.642E-06	6358.2070	-36.4075	-2.564E-07	2521.6714	1.719E+12	-0.5714	1345873.	0.000
97.500	3.625E-06	5612.5227	-44.0463	-1.938E-07	2521.3696	1.719E+12	-0.2774	1377163.	0.000
99.000	6.659E-07	4776.3912	-47.0114	-1.394E-07	2521.0311	1.719E+12	-0.0521	1408453.	0.000
100.500	-1.393E-06	3922.8808	-46.4774	-9.386E-08	2520.6856	1.719E+12	0.1114	1439743.	0.000
102.000	-2.713E-06	3105.0690	-43.4789	-5.707E-08	2520.3546	1.719E+12	0.2217	1471033.	0.000
103.500	-3.448E-06	2358.7750	-38.8934	-2.847E-08	2520.0524	1.719E+12	0.2878	1502324.	0.000
105.000	-3.738E-06	1705.4739	-33.4369	-7.199E-09	2519.7880	1.719E+12	0.3185	1533614.	0.000
106.500	-3.707E-06	1155.1884	-27.6699	7.776E-09	2519.5652	1.719E+12	0.3223	1564904.	0.000
108.000	-3.458E-06	709.2047	-22.0865	1.754E-08	2519.3847	1.719E+12	0.2981	1551470.	0.000
109.500	-3.076E-06	359.7243	-16.9697	2.313E-08	2519.2432	1.719E+12	0.2705	1582760.	0.000
111.000	-2.626E-06	97.8352	-12.4167	2.553E-08	2519.1372	1.719E+12	0.2354	1614050.	0.000
112.500	-2.157E-06	-87.7839	-8.5234	2.558E-08	2519.1331	1.719E+12	0.1972	1645340.	0.000
114.000	-1.705E-06	-209.5155	-5.3199	2.402E-08	2519.1824	1.719E+12	0.1588	1676630.	0.000
115.500	-1.292E-06	-279.7774	-2.7874	2.146E-08	2519.2109	1.719E+12	0.1226	1707920.	0.000
117.000	-9.321E-07	-310.2883	-0.8734	1.837E-08	2519.2232	1.719E+12	0.0901	1739211.	0.000
118.500	-6.307E-07	-311.5854	0.4955	1.512E-08	2519.2237	1.719E+12	0.0620	1770501.	0.000
120.000	-3.879E-07	-292.7509	1.4033	1.195E-08	2519.2161	1.719E+12	0.0388	1801791.	0.000
121.500	-2.004E-07	-261.3042	1.9364	9.053E-09	2519.2034	1.719E+12	0.0204	1833081.	0.000
123.000	-6.202E-08	-223.2194	2.1779	6.517E-09	2519.1880	1.719E+12	0.006424	1864371.	0.000
124.500	3.425E-08	-183.0301	2.2032	4.390E-09	2519.1717	1.719E+12	-0.003607	1895661.	0.000
126.000	9.603E-08	-143.9903	2.0782	2.679E-09	2519.1559	1.719E+12	-0.0103	1926951.	0.000
127.500	1.307E-07	-108.2664	1.8578	1.358E-09	2519.1414	1.719E+12	-0.0142	1958241.	0.000
129.000	1.449E-07	-77.1374	1.5857	3.875E-10	2519.1288	1.719E+12	-0.0160	1989531.	0.000
130.500	1.446E-07	-51.1901	1.2954	-2.842E-10	2519.1183	1.719E+12	-0.0162	2020821.	0.000
132.000	1.347E-07	-30.4984	1.0110	-7.118E-10	2519.1099	1.719E+12	-0.0154	2052111.	0.000
133.500	1.190E-07	-14.7786	0.7489	-9.488E-10	2519.1036	1.719E+12	-0.0138	2083401.	0.000
135.000	1.005E-07	-3.5201	0.5186	-1.045E-09	2519.0990	1.719E+12	-0.0118	2114691.	0.000
136.500	8.140E-08	3.9121	0.3250	-1.043E-09	2519.0992	1.719E+12	-0.009704	2145981.	0.000
138.000	6.300E-08	8.1997	0.1690	-9.791E-10	2519.1009	1.719E+12	-0.007621	2177271.	0.000
139.500	4.615E-08	10.0173	0.0495	-8.838E-10	2519.1016	1.719E+12	-0.005662	2208561.	0.000
141.000	3.118E-08	9.9994	-0.0364	-7.790E-10	2519.1016	1.719E+12	-0.003880	2239852.	0.000
142.500	1.810E-08	8.7231	-0.0919	-6.810E-10	2519.1011	1.719E+12	-0.002284	2271142.	0.000
144.000	6.669E-09	6.7057	-0.1201	-6.002E-10	2519.1003	1.719E+12	-0.000853	2302432.	0.000
145.500	-3.504E-09	4.4114	-0.1237	-5.420E-10	2519.0994	1.719E+12	0.000454	2333722.	0.000
147.000	-1.284E-08	2.2637	-0.1044	-5.071E-10	2519.0985	1.719E+12	0.001688	2365012.	0.000
148.500	-2.176E-08	0.6626	-0.0632	-4.918E-10	2519.0979	1.719E+12	0.002897	2396302.	0.000
150.000	-3.055E-08	0.000	0.000	-4.883E-10	2519.0976	1.719E+12	0.004120	1213796.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =      0.1250000 inches
Computed slope at pile head      =     -0.0004030 radians
Maximum bending moment           =       2067695. inch-lbs
Maximum shear force              =  -9508.8727477 lbs
Depth of maximum bending moment  =     28.5000000 feet below pile head
Depth of maximum shear force     =     39.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.250000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2500	0.000	13233.	-0.000806	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.2355	246194.	13233.	-0.000805	2618.7590	1.719E+12	0.000	0.000	0.000
3.000	0.2210	492363.	13233.	-0.000801	2718.4101	1.719E+12	0.000	0.000	0.000
4.500	0.2067	738480.	13233.	-0.000794	2818.0404	1.719E+12	0.000	0.000	0.000
6.000	0.1924	984520.	13233.	-0.000785	2917.6397	1.719E+12	0.000	0.000	0.000
7.500	0.1784	1230458.	13233.	-0.000774	3017.1975	1.719E+12	0.000	0.000	0.000
9.000	0.1646	1476268.	13233.	-0.000760	3116.7034	1.719E+12	0.000	0.000	0.000
10.500	0.1510	1721925.	13233.	-0.000743	3216.1473	1.719E+12	0.000	0.000	0.000
12.000	0.1378	1967402.	13233.	-0.000724	3315.5186	1.719E+12	0.000	0.000	0.000
13.500	0.1250	2212675.	13233.	-0.000702	3414.8070	1.719E+12	0.000	0.000	0.000
15.000	0.1126	2457717.	13233.	-0.000677	3514.0023	1.719E+12	0.000	0.000	0.000
16.500	0.1006	2702504.	13233.	-0.000650	3613.0941	1.719E+12	0.000	0.000	0.000
18.000	0.0892	2947010.	13233.	-0.000621	3712.0721	1.719E+12	0.000	0.000	0.000
19.500	0.0783	3191209.	13233.	-0.000589	3810.9260	1.719E+12	0.000	0.000	0.000
21.000	0.0680	3435076.	13233.	-0.000554	3909.6455	1.719E+12	0.000	0.000	0.000
22.500	0.0583	3678586.	12320.	-0.000517	4008.2203	1.719E+12	-101.3881	31290.	0.000
24.000	0.0494	3888864.	9862.6801	-0.000477	4093.3425	1.719E+12	-171.6510	62580.	0.000
25.500	0.0412	4043122.	6386.3283	-0.000435	4155.7874	1.719E+12	-214.6104	93870.	0.000
27.000	0.0337	4127426.	2346.2231	-0.000393	4189.9143	1.719E+12	-234.2902	125160.	0.000
28.500	0.0270	4135390.	-1875.6064	-0.000349	4193.1384	1.719E+12	-234.8019	156450.	0.000
30.000	0.0211	4066848.	-5970.7808	-0.000307	4165.3921	1.719E+12	-220.2174	187740.	0.000
31.500	0.0160	3926533.	-9702.7292	-0.000265	4108.5914	1.719E+12	-194.4435	219030.	0.000
33.000	0.0116	3722810.	-12903.	-0.000225	4026.1225	1.719E+12	-161.1092	250321.	0.000
34.500	0.007892	3466500.	-15464.	-0.000187	3922.3661	1.719E+12	-123.4725	281611.	0.000
36.000	0.004852	3169825.	-17334.	-0.000152	3802.2693	1.719E+12	-84.3526	312901.	0.000
37.500	0.002410	2845489.	-18508.	-0.000121	3670.9756	1.719E+12	-46.0870	344191.	0.000
39.000	0.000504	2505925.	-19018.	-9.278E-05	3533.5173	1.719E+12	-10.5158	375481.	0.000
40.500	-0.000930	2162694.	-18923.	-6.834E-05	3394.5743	1.719E+12	21.0105	406771.	0.000
42.000	-0.001956	1826045.	-18306.	-4.746E-05	3258.2959	1.719E+12	47.6034	438061.	0.000
43.500	-0.002638	1504629.	-17258.	-3.002E-05	3128.1842	1.719E+12	68.7917	469351.	0.000
45.000	-0.003037	1205346.	-15879.	-1.584E-05	3007.0317	1.719E+12	84.4655	500641.	0.000
46.500	-0.003208	933304.	-14265.	-4.643E-06	2896.9068	1.719E+12	94.8128	531931.	0.000
48.000	-0.003204	691884.	-12510.	3.865E-06	2799.1780	1.719E+12	100.2532	563221.	0.000
49.500	-0.003069	482874.	-10695.	1.001E-05	2714.5691	1.719E+12	101.3721	594511.	0.000
51.000	-0.002843	306659.	-8893.0930	1.415E-05	2643.2356	1.719E+12	98.8589	625801.	0.000
52.500	-0.002560	162442.	-7162.3019	1.660E-05	2584.8553	1.719E+12	93.4512	657091.	0.000
54.000	-0.002246	48486.	-5548.2569	1.771E-05	2538.7250	1.719E+12	85.8871	688381.	0.000
55.500	-0.001923	-37648.	-4083.4836	1.776E-05	2534.3377	1.719E+12	76.8655	719671.	0.000
57.000	-0.001606	-98873.	-2788.5513	1.705E-05	2559.1221	1.719E+12	67.0159	750962.	0.000
58.500	-0.001309	-138374.	-1673.5181	1.581E-05	2575.1126	1.719E+12	56.8767	782252.	0.000

60.000	-0.001037	-159433.	-739.6939	1.425E-05	2583.6376	1.719E+12	46.8815	813542.	0.000
61.500	-0.000796	-165286.	18.4141	1.255E-05	2586.0069	1.719E+12	37.3527	844832.	0.000
63.000	-0.000586	-159020.	463.9454	1.085E-05	2583.4702	1.719E+12	12.1508	373524.	0.000
64.500	-0.000405	-148800.	593.2984	9.239E-06	2579.3331	1.719E+12	2.2218	98691.	0.000
66.000	-0.000253	-137845.	626.1385	7.739E-06	2574.8983	1.719E+12	1.4271	101563.	0.000
67.500	-0.000127	-126413.	645.5947	6.355E-06	2570.2705	1.719E+12	0.7347	104434.	0.000
69.000	-2.414E-05	-114730.	653.5016	5.093E-06	2565.5411	1.719E+12	0.1439	107305.	0.000
70.500	5.673E-05	-102988.	651.6715	3.954E-06	2560.7880	1.719E+12	-0.3472	110176.	0.000
72.000	0.000118	-91348.	641.8658	2.936E-06	2556.0760	1.719E+12	-0.7423	113048.	0.000
73.500	0.000162	-79939.	625.7707	2.040E-06	2551.4576	1.719E+12	-1.0461	115919.	0.000
75.000	0.000192	-68861.	604.9751	1.261E-06	2546.9730	1.719E+12	-1.2646	118790.	0.000
76.500	0.000208	-58185.	580.9523	5.957E-07	2542.6514	1.719E+12	-1.4046	121661.	0.000
78.000	0.000213	-47958.	555.0440	4.006E-08	2538.5115	1.719E+12	-1.4740	124533.	0.000
79.500	0.000209	-38204.	528.4472	-4.110E-07	2534.5630	1.719E+12	-1.4812	127404.	0.000
81.000	0.000198	-28926.	502.2023	-7.624E-07	2530.8071	1.719E+12	-1.4349	130275.	0.000
82.500	0.000182	-20110.	477.1838	-1.019E-06	2527.2382	1.719E+12	-1.3449	133146.	0.000
84.000	0.000162	-11727.	454.0909	-1.186E-06	2523.8449	1.719E+12	-1.2210	136018.	0.000
85.500	0.000139	-3738.9540	433.4402	-1.267E-06	2520.6112	1.719E+12	-1.0735	138889.	0.000
87.000	0.000116	3901.8368	356.6189	-1.266E-06	2520.6771	1.719E+12	-7.4622	1158133.	0.000
88.500	9.356E-05	9124.4824	233.8173	-1.198E-06	2522.7913	1.719E+12	-6.1825	1189423.	0.000
90.000	7.286E-05	12343.	133.7018	-1.085E-06	2524.0942	1.719E+12	-4.9415	1220713.	0.000
91.500	5.449E-05	13959.	55.1161	-9.476E-07	2524.7484	1.719E+12	-3.7903	1252003.	0.000
93.000	3.875E-05	14346.	-3.8613	-7.994E-07	2524.9050	1.719E+12	-2.7628	1283293.	0.000
94.500	2.571E-05	13836.	-45.6280	-6.519E-07	2524.6986	1.719E+12	-1.8780	1314583.	0.000
96.000	1.528E-05	12716.	-72.8150	-5.129E-07	2524.2453	1.719E+12	-1.1428	1345873.	0.000
97.500	7.250E-06	11225.	-88.0926	-3.876E-07	2523.6416	1.719E+12	-0.5547	1377163.	0.000
99.000	1.332E-06	9552.7823	-94.0229	-2.788E-07	2522.9646	1.719E+12	-0.1042	1408453.	0.000
100.500	-2.787E-06	7845.7615	-92.9549	-1.877E-07	2522.2736	1.719E+12	0.2229	1439743.	0.000
102.000	-5.426E-06	6210.1380	-86.9578	-1.141E-07	2521.6115	1.719E+12	0.4435	1471033.	0.000
103.500	-6.896E-06	4717.5500	-77.7867	-5.695E-08	2521.0073	1.719E+12	0.5755	1502324.	0.000
105.000	-7.476E-06	3410.9477	-66.8739	-1.440E-08	2520.4784	1.719E+12	0.6370	1533614.	0.000
106.500	-7.414E-06	2310.3768	-55.3397	1.555E-08	2520.0329	1.719E+12	0.6446	1564904.	0.000
108.000	-6.917E-06	1418.4093	-44.1731	3.507E-08	2519.6718	1.719E+12	0.5962	1551470.	0.000
109.500	-6.152E-06	719.4485	-33.9394	4.626E-08	2519.3888	1.719E+12	0.5409	1582760.	0.000
111.000	-5.251E-06	195.6704	-24.8334	5.105E-08	2519.1768	1.719E+12	0.4709	1614050.	0.000
112.500	-4.314E-06	-175.5678	-17.0468	5.116E-08	2519.1687	1.719E+12	0.3943	1645340.	0.000
114.000	-3.409E-06	-419.0310	-10.6398	4.804E-08	2519.2672	1.719E+12	0.3176	1676630.	0.000
115.500	-2.584E-06	-559.5547	-5.5748	4.292E-08	2519.3241	1.719E+12	0.2452	1707920.	0.000
117.000	-1.864E-06	-620.5766	-1.7468	3.674E-08	2519.3488	1.719E+12	0.1801	1739211.	0.000
118.500	-1.261E-06	-623.1708	0.9910	3.023E-08	2519.3499	1.719E+12	0.1241	1770501.	0.000
120.000	-7.759E-07	-585.5017	2.8066	2.391E-08	2519.3346	1.719E+12	0.0777	1801791.	0.000
121.500	-4.007E-07	-522.6084	3.8729	1.811E-08	2519.3092	1.719E+12	0.0408	1833081.	0.000
123.000	-1.240E-07	-446.4389	4.3558	1.303E-08	2519.2783	1.719E+12	0.0128	1864371.	0.000
124.500	6.850E-08	-366.0602	4.4065	8.781E-09	2519.2458	1.719E+12	-0.007214	1895661.	0.000
126.000	1.921E-07	-287.9807	4.1565	5.357E-09	2519.2142	1.719E+12	-0.0206	1926951.	0.000
127.500	2.614E-07	-216.5328	3.7156	2.716E-09	2519.1852	1.719E+12	-0.0284	1958241.	0.000
129.000	2.898E-07	-154.2748	3.1713	7.751E-10	2519.1600	1.719E+12	-0.0320	1989531.	0.000
130.500	2.893E-07	-102.3803	2.5907	-5.684E-10	2519.1390	1.719E+12	-0.0325	2020821.	0.000
132.000	2.694E-07	-60.9968	2.0221	-1.424E-09	2519.1223	1.719E+12	-0.0307	2052111.	0.000
133.500	2.380E-07	-29.5572	1.4977	-1.898E-09	2519.1096	1.719E+12	-0.0275	2083401.	0.000
135.000	2.011E-07	-7.0402	1.0372	-2.089E-09	2519.1004	1.719E+12	-0.0236	2114691.	0.000
136.500	1.628E-07	7.8242	0.6499	-2.085E-09	2519.1008	1.719E+12	-0.0194	2145981.	0.000
138.000	1.260E-07	16.3994	0.3381	-1.958E-09	2519.1042	1.719E+12	-0.0152	2177271.	0.000
139.500	9.230E-08	20.0347	0.0990	-1.768E-09	2519.1057	1.719E+12	-0.0113	2208561.	0.000
141.000	6.237E-08	19.9987	-0.0728	-1.558E-09	2519.1057	1.719E+12	-0.007761	2239852.	0.000
142.500	3.621E-08	17.4462	-0.1837	-1.362E-09	2519.1047	1.719E+12	-0.004569	2271142.	0.000
144.000	1.334E-08	13.4115	-0.2402	-1.200E-09	2519.1030	1.719E+12	-0.001706	2302432.	0.000
145.500	-7.008E-09	8.8227	-0.2474	-1.084E-09	2519.1012	1.719E+12	0.000909	2333722.	0.000
147.000	-2.569E-08	4.5274	-0.2088	-1.014E-09	2519.0994	1.719E+12	0.003375	2365012.	0.000
148.500	-4.352E-08	1.3252	-0.1263	-9.836E-10	2519.0981	1.719E+12	0.005794	2396302.	0.000
150.000	-6.110E-08	0.000	0.000	-9.766E-10	2519.0976	1.719E+12	0.008240	1213796.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =      0.2500000 inches
Computed slope at pile head      =     -0.0008060 radians
Maximum bending moment           =       4135390. inch-lbs
Maximum shear force              =        -19018. lbs
Depth of maximum bending moment  =     28.5000000 feet below pile head
Depth of maximum shear force     =     39.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.500000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5000	0.000	26167.	-0.001607	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.4711	486963.	26167.	-0.001604	2716.2245	1.719E+12	0.000	0.000	0.000
3.000	0.4422	973876.	26167.	-0.001597	2913.3309	1.719E+12	0.000	0.000	0.000
4.500	0.4136	1460688.	26167.	-0.001584	3110.3964	1.719E+12	0.000	0.000	0.000
6.000	0.3852	1947347.	26167.	-0.001566	3307.4003	1.719E+12	0.000	0.000	0.000
7.500	0.3572	2433804.	26167.	-0.001543	3504.3222	1.719E+12	0.000	0.000	0.000
9.000	0.3297	2920008.	26167.	-0.001515	3701.1416	1.719E+12	0.000	0.000	0.000
10.500	0.3027	3405908.	26167.	-0.001482	3897.8381	1.719E+12	0.000	0.000	0.000
12.000	0.2763	3891454.	26167.	-0.001444	4094.3911	1.719E+12	0.000	0.000	0.000
13.500	0.2507	4376595.	26167.	-0.001401	4290.7803	1.719E+12	0.000	0.000	0.000
15.000	0.2259	4861281.	26167.	-0.001352	4486.9852	1.719E+12	0.000	0.000	0.000
16.500	0.2020	5345461.	26167.	-0.001299	4682.9854	1.719E+12	0.000	0.000	0.000
18.000	0.1791	5829085.	26167.	-0.001240	4878.7604	1.719E+12	0.000	0.000	0.000
19.500	0.1574	6312103.	26167.	-0.001177	5074.2901	1.719E+12	0.000	0.000	0.000
21.000	0.1368	6794464.	26167.	-0.001108	5269.5539	1.719E+12	0.000	0.000	0.000
22.500	0.1175	7276118.	24769.	-0.001034	5464.5316	1.719E+12	-155.3287	23802.	0.000
24.000	0.0995	7706689.	20493.	-0.000956	5638.8304	1.719E+12	-319.7726	57831.	0.000
25.500	0.0830	8032852.	13717.	-0.000874	5770.8639	1.719E+12	-433.0862	93870.	0.000
27.000	0.0681	8217860.	5558.8734	-0.000789	5845.7565	1.719E+12	-473.3628	125160.	0.000
28.500	0.0547	8248643.	-2976.9037	-0.000702	5858.2177	1.719E+12	-475.0568	156450.	0.000
30.000	0.0428	8124649.	-11269.	-0.000617	5808.0242	1.719E+12	-446.3048	187740.	0.000
31.500	0.0325	7855208.	-18840.	-0.000533	5698.9521	1.719E+12	-394.9287	219030.	0.000
33.000	0.0236	7456993.	-25348.	-0.000453	5537.7511	1.719E+12	-328.2069	250321.	0.000
34.500	0.0162	6951663.	-30577.	-0.000377	5333.1893	1.719E+12	-252.6850	281611.	0.000
36.000	0.0100	6363740.	-34417.	-0.000308	5095.1931	1.719E+12	-174.0359	312901.	0.000
37.500	0.005071	5718767.	-36856.	-0.000245	4834.1027	1.719E+12	-96.9730	344191.	0.000
39.000	0.001209	5041780.	-37956.	-0.000188	4560.0527	1.719E+12	-25.2147	375481.	0.000
40.500	-0.001704	4356099.	-37836.	-0.000139	4282.4833	1.719E+12	38.5019	406771.	0.000
42.000	-0.003795	3682440.	-36658.	-9.692E-05	4009.7804	1.719E+12	92.3666	438061.	0.000
43.500	-0.005193	3038324.	-34608.	-6.174E-05	3749.0369	1.719E+12	135.4086	469351.	0.000
45.000	-0.006018	2437765.	-31883.	-3.308E-05	3505.9254	1.719E+12	167.3851	500641.	0.000
46.500	-0.006384	1891185.	-28679.	-1.042E-05	3284.6652	1.719E+12	188.6546	531931.	0.000
48.000	-0.006393	1405532.	-25181.	6.838E-06	3088.0689	1.719E+12	200.0443	563221.	0.000
49.500	-0.006138	984548.	-21556.	1.935E-05	2917.6508	1.719E+12	202.7184	594511.	0.000
51.000	-0.005697	629141.	-17949.	2.780E-05	2773.7793	1.719E+12	198.0537	625801.	0.000
52.500	-0.005137	337839.	-14479.	3.286E-05	2655.8577	1.719E+12	187.5276	657091.	0.000
54.000	-0.004514	107261.	-11237.	3.519E-05	2562.5176	1.719E+12	172.6212	688381.	0.000
55.500	-0.003870	-67400.	-8290.9625	3.540E-05	2546.3816	1.719E+12	154.7397	719671.	0.000
57.000	-0.003239	-191917.	-5681.9473	3.404E-05	2596.7874	1.719E+12	135.1509	750962.	0.000
58.500	-0.002645	-272626.	-3431.1229	3.161E-05	2629.4590	1.719E+12	114.9407	782252.	0.000

60.000	-0.002102	-316066.	-1541.7891	2.853E-05	2647.0438	1.719E+12	94.9852	813542.	0.000
61.500	-0.001618	-328698.	-3.4927	2.515E-05	2652.1571	1.719E+12	75.9366	844832.	0.000
63.000	-0.001196	-316692.	903.3333	2.177E-05	2647.2970	1.719E+12	24.8219	373524.	0.000
64.500	-0.000834	-296610.	1167.8891	1.856E-05	2639.1679	1.719E+12	4.5732	98691.	0.000
66.000	-0.000528	-275016.	1235.8565	1.557E-05	2630.4265	1.719E+12	2.9787	101563.	0.000
67.500	-0.000274	-252429.	1276.9501	1.281E-05	2621.2829	1.719E+12	1.5872	104434.	0.000
69.000	-6.679E-05	-229301.	1294.8190	1.029E-05	2611.9205	1.719E+12	0.3982	107305.	0.000
70.500	9.677E-05	-206020.	1293.0717	8.009E-06	2602.4961	1.719E+12	-0.5923	110176.	0.000
72.000	0.000222	-182909.	1275.2198	5.973E-06	2593.1408	1.719E+12	-1.3912	113048.	0.000
73.500	0.000312	-160231.	1244.6276	4.177E-06	2583.9603	1.719E+12	-2.0079	115919.	0.000
75.000	0.000372	-138186.	1204.4691	2.614E-06	2575.0363	1.719E+12	-2.4541	118790.	0.000
76.500	0.000406	-116922.	1157.6899	1.279E-06	2566.4284	1.719E+12	-2.7435	121661.	0.000
78.000	0.000418	-96534.	1106.9758	1.617E-07	2558.1755	1.719E+12	-2.8914	124533.	0.000
79.500	0.000412	-77074.	1054.7254	-7.471E-07	2550.2977	1.719E+12	-2.9142	127404.	0.000
81.000	0.000391	-58549.	1003.0269	-1.457E-06	2542.7988	1.719E+12	-2.8300	130275.	0.000
82.500	0.000359	-40936.	953.6380	-1.978E-06	2535.6687	1.719E+12	-2.6576	133146.	0.000
84.000	0.000320	-24179.	907.9685	-2.319E-06	2528.8855	1.719E+12	-2.4168	136018.	0.000
85.500	0.000276	-8202.8225	867.0640	-2.488E-06	2522.4182	1.719E+12	-2.1282	138889.	0.000
87.000	0.000230	7084.7123	714.5782	-2.494E-06	2521.9655	1.719E+12	-14.8147	1158133.	0.000
88.500	0.000186	17572.	470.6118	-2.365E-06	2526.2107	1.719E+12	-12.2927	1189423.	0.000
90.000	0.000145	24074.	271.4041	-2.147E-06	2528.8428	1.719E+12	-9.8415	1220713.	0.000
91.500	0.000109	27385.	114.7580	-1.878E-06	2530.1832	1.719E+12	-7.5636	1252003.	0.000
93.000	7.753E-05	28242.	-3.0593	-1.586E-06	2530.5303	1.719E+12	-5.5272	1283293.	0.000
94.500	5.163E-05	27306.	-86.7423	-1.296E-06	2530.1514	1.719E+12	-3.7709	1314583.	0.000
96.000	3.089E-05	25145.	-141.4650	-1.021E-06	2529.2766	1.719E+12	-2.3094	1345873.	0.000
97.500	1.488E-05	22234.	-172.4937	-7.730E-07	2528.0980	1.719E+12	-1.1382	1377163.	0.000
99.000	3.058E-06	18951.	-184.8916	-5.574E-07	2526.7691	1.719E+12	-0.2393	1408453.	0.000
100.500	-5.190E-06	15589.	-183.3096	-3.766E-07	2525.4080	1.719E+12	0.4151	1439743.	0.000
102.000	-1.050E-05	12359.	-171.8511	-2.303E-07	2524.1007	1.719E+12	0.8581	1471033.	0.000
103.500	-1.348E-05	9406.6155	-154.0021	-1.164E-07	2522.9055	1.719E+12	1.1251	1502324.	0.000
105.000	-1.469E-05	6817.5181	-132.6119	-3.145E-08	2521.8574	1.719E+12	1.2515	1533614.	0.000
106.500	-1.461E-05	4633.2107	-109.9140	2.849E-08	2520.9732	1.719E+12	1.2704	1564904.	0.000
108.000	-1.366E-05	2860.0466	-87.8806	6.771E-08	2520.2554	1.719E+12	1.1777	1551470.	0.000
109.500	-1.218E-05	1468.1647	-67.6457	9.037E-08	2519.6919	1.719E+12	1.0706	1582760.	0.000
111.000	-1.041E-05	423.0041	-49.6089	1.003E-07	2519.2688	1.719E+12	0.9335	1614050.	0.000
112.500	-8.566E-06	-319.7466	-34.1606	1.008E-07	2519.2270	1.719E+12	0.7830	1645340.	0.000
114.000	-6.781E-06	-808.7795	-21.4289	9.490E-08	2519.4250	1.719E+12	0.6317	1676630.	0.000
115.500	-5.149E-06	-1093.0724	-11.3467	8.495E-08	2519.5401	1.719E+12	0.4886	1707920.	0.000
117.000	-3.723E-06	-1218.9489	-3.7116	7.284E-08	2519.5910	1.719E+12	0.3598	1739211.	0.000
118.500	-2.527E-06	-1228.1392	1.7631	6.003E-08	2519.5948	1.719E+12	0.2486	1770501.	0.000
120.000	-1.562E-06	-1156.6711	5.4073	4.755E-08	2519.5658	1.719E+12	0.1564	1801791.	0.000
121.500	-8.151E-07	-1034.4227	7.5616	3.608E-08	2519.5163	1.719E+12	0.0830	1833081.	0.000
123.000	-2.631E-07	-885.1722	8.5539	2.603E-08	2519.4559	1.719E+12	0.0273	1864371.	0.000
124.500	1.221E-07	-727.0002	8.6834	1.759E-08	2519.3919	1.719E+12	-0.0129	1895661.	0.000
126.000	3.703E-07	-572.9185	8.2110	1.079E-08	2519.3295	1.719E+12	-0.0396	1926951.	0.000
127.500	5.105E-07	-431.6202	7.3544	5.531E-09	2519.2723	1.719E+12	-0.0555	1958241.	0.000
129.000	5.694E-07	-308.2713	6.2881	1.658E-09	2519.2224	1.719E+12	-0.0629	1989531.	0.000
130.500	5.702E-07	-205.2811	5.1456	-1.030E-09	2519.1807	1.719E+12	-0.0640	2020821.	0.000
132.000	5.323E-07	-123.0098	4.0233	-2.749E-09	2519.1474	1.719E+12	-0.0607	2052111.	0.000
133.500	4.712E-07	-60.3877	2.9863	-3.709E-09	2519.1220	1.719E+12	-0.0545	2083401.	0.000
135.000	3.988E-07	-15.4309	2.0737	-4.106E-09	2519.1038	1.719E+12	-0.0468	2114691.	0.000
136.500	3.234E-07	14.3482	1.3051	-4.111E-09	2519.1034	1.719E+12	-0.0386	2145981.	0.000
138.000	2.508E-07	31.6328	0.6850	-3.871E-09	2519.1104	1.719E+12	-0.0303	2177271.	0.000
139.500	1.841E-07	39.0863	0.2088	-3.501E-09	2519.1134	1.719E+12	-0.0226	2208561.	0.000
141.000	1.247E-07	39.2180	-0.1342	-3.091E-09	2519.1135	1.719E+12	-0.0155	2239852.	0.000
142.500	7.281E-08	34.3160	-0.3566	-2.706E-09	2519.1115	1.719E+12	-0.009187	2271142.	0.000
144.000	2.734E-08	26.4338	-0.4708	-2.388E-09	2519.1083	1.719E+12	-0.003498	2302432.	0.000
145.500	-1.314E-08	17.4155	-0.4869	-2.158E-09	2519.1046	1.719E+12	0.001704	2333722.	0.000
147.000	-5.035E-08	8.9476	-0.4120	-2.020E-09	2519.1012	1.719E+12	0.006615	2365012.	0.000
148.500	-8.587E-08	2.6220	-0.2496	-1.960E-09	2519.0987	1.719E+12	0.0114	2396302.	0.000
150.000	-1.209E-07	0.000	0.000	-1.946E-09	2519.0976	1.719E+12	0.0163	1213796.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =      0.5000000 inches
Computed slope at pile head      =     -0.0016069 radians
Maximum bending moment           =       8248643. inch-lbs
Maximum shear force              =        -37956. lbs
Depth of maximum bending moment  =     28.5000000 feet below pile head
Depth of maximum shear force     =     39.0000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 1.000000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	0.000	48296.	-0.003134	2519.0976	1.719E+12	0.000	0.000	0.000
1.500	0.9436	900474.	48296.	-0.003129	2883.6170	1.719E+12	0.000	0.000	0.000
3.000	0.8874	1800854.	48296.	-0.003115	3248.0985	1.719E+12	0.000	0.000	0.000
4.500	0.8314	2701047.	48296.	-0.003091	3612.5042	1.719E+12	0.000	0.000	0.000
6.000	0.7761	3600959.	48296.	-0.003058	3976.7962	1.719E+12	0.000	0.000	0.000
7.500	0.7213	4500496.	48296.	-0.003016	4340.9365	1.719E+12	0.000	0.000	0.000
9.000	0.6675	5399566.	48296.	-0.002964	4704.8873	1.719E+12	0.000	0.000	0.000
10.500	0.6146	6298073.	48296.	-0.002903	5068.6107	1.719E+12	0.000	0.000	0.000
12.000	0.5630	7195925.	48296.	-0.002832	5432.0689	1.719E+12	0.000	0.000	0.000
13.500	0.5127	8093029.	48296.	-0.002752	5795.2241	1.719E+12	0.000	0.000	0.000
15.000	0.4639	8989291.	48296.	-0.002663	6158.0386	1.719E+12	0.000	0.000	0.000
16.500	0.4168	9884618.	48296.	-0.002564	6520.4745	1.719E+12	0.000	0.000	0.000
18.000	0.3716	10778917.	48296.	-0.002456	6882.4941	1.719E+12	0.000	0.000	0.000
19.500	0.3284	11672094.	48296.	-0.002338	7244.0599	1.719E+12	0.000	0.000	0.000
21.000	0.2874	12564058.	48296.	-0.002212	7605.1342	1.719E+12	0.000	0.000	0.000
22.500	0.2488	13454714.	46576.	-0.002075	7965.6794	1.719E+12	-191.1919	13834.	0.000
24.000	0.2127	14282025.	41269.	-0.001930	8300.5817	1.719E+12	-398.4389	33721.	0.000
25.500	0.1793	14978756.	32380.	-0.001777	8582.6242	1.719E+12	-589.2718	59163.	0.000
27.000	0.1487	15483004.	20451.	-0.001618	8786.7483	1.719E+12	-736.1688	89107.	0.000
28.500	0.1211	15747123.	6284.9137	-0.001454	8893.6660	1.719E+12	-837.8032	124579.	0.000
30.000	0.0964	15738156.	-9214.4732	-0.001289	8890.0361	1.719E+12	-884.3509	165193.	0.000
31.500	0.0746	15441023.	-24958.	-0.001126	8769.7538	1.719E+12	-864.9271	208589.	0.000
33.000	0.0558	14862046.	-39607.	-0.000967	8535.3793	1.719E+12	-762.7711	245949.	0.000
34.500	0.0398	14034386.	-52078.	-0.000816	8200.3355	1.719E+12	-622.8385	281611.	0.000
36.000	0.0264	13003466.	-61820.	-0.000675	7783.0105	1.719E+12	-459.6493	312901.	0.000
37.500	0.0155	11822268.	-68629.	-0.000545	7304.8513	1.719E+12	-296.8381	344191.	0.000
39.000	0.006833	10543664.	-72583.	-0.000428	6787.2616	1.719E+12	-142.5408	375481.	0.000
40.500	0.000130	9217780.	-73892.	-0.000324	6250.5325	1.719E+12	-2.9306	406771.	0.000
42.000	-0.004837	7889987.	-72859.	-0.000235	5713.0310	1.719E+12	117.7116	438061.	0.000
43.500	-0.008316	6599513.	-69848.	-0.000159	5190.6360	1.719E+12	216.8512	469351.	0.000
45.000	-0.0106	5378611.	-65255.	-9.607E-05	4696.4048	1.719E+12	293.4984	500641.	0.000
46.500	-0.0118	4252244.	-59482.	-4.565E-05	4240.4419	1.719E+12	347.9664	531931.	0.000
48.000	-0.0122	3238176.	-52916.	-6.444E-06	3829.9384	1.719E+12	381.6111	563221.	0.000
49.500	-0.0120	2347412.	-45912.	2.279E-05	3469.3498	1.719E+12	396.5653	594511.	0.000
51.000	-0.0114	1584892.	-38784.	4.338E-05	3160.6752	1.719E+12	395.4825	625801.	0.000
52.500	-0.0104	950343.	-31792.	5.665E-05	2903.8044	1.719E+12	381.3015	657091.	0.000
54.000	-0.009336	439237.	-25147.	6.392E-05	2696.9043	1.719E+12	357.0377	688381.	0.000
55.500	-0.008144	43765.	-19004.	6.645E-05	2536.8141	1.719E+12	325.6081	719671.	0.000
57.000	-0.006944	-246214.	-13466.	6.539E-05	2618.7671	1.719E+12	289.6902	750962.	0.000
58.500	-0.005790	-442308.	-8594.1780	6.179E-05	2698.1475	1.719E+12	251.6157	782252.	0.000

60.000	-0.004719	-556832.	-4409.9651	5.656E-05	2744.5079	1.719E+12	213.2969	813542.	0.000
61.500	-0.003754	-602190.	-904.6624	5.049E-05	2762.8694	1.719E+12	176.1812	844832.	0.000
63.000	-0.002902	-590403.	1222.8811	4.425E-05	2758.0979	1.719E+12	60.2125	373524.	0.000
64.500	-0.002161	-559046.	1871.4195	3.823E-05	2745.4041	1.719E+12	11.8473	98691.	0.000
66.000	-0.001525	-523792.	2055.5022	3.256E-05	2731.1330	1.719E+12	8.6063	101563.	0.000
67.500	-0.000989	-485695.	2184.5768	2.728E-05	2715.7110	1.719E+12	5.7353	104434.	0.000
69.000	-0.000543	-445689.	2265.3422	2.240E-05	2699.5164	1.719E+12	3.2386	107305.	0.000
70.500	-0.000182	-404588.	2304.5163	1.795E-05	2682.8782	1.719E+12	1.1140	110176.	0.000
72.000	0.000103	-363083.	2308.7197	1.393E-05	2666.0768	1.719E+12	-0.6470	113048.	0.000
73.500	0.000320	-321751.	2284.3718	1.035E-05	2649.3451	1.719E+12	-2.0583	115919.	0.000
75.000	0.000476	-281052.	2237.5994	7.194E-06	2632.8697	1.719E+12	-3.1386	118790.	0.000
76.500	0.000579	-241340.	2174.1557	4.459E-06	2616.7942	1.719E+12	-3.9107	121661.	0.000
78.000	0.000636	-202871.	2099.3509	2.134E-06	2601.2214	1.719E+12	-4.4010	124533.	0.000
79.500	0.000655	-165806.	2017.9911	2.041E-07	2586.2173	1.719E+12	-4.6390	127404.	0.000
81.000	0.000643	-130227.	1934.3263	-1.346E-06	2571.8146	1.719E+12	-4.6571	130275.	0.000
82.500	0.000607	-96144.	1852.0046	-2.531E-06	2558.0173	1.719E+12	-4.4898	133146.	0.000
84.000	0.000552	-63505.	1774.0308	-3.366E-06	2544.8048	1.719E+12	-4.1740	136018.	0.000
85.500	0.000486	-32212.	1702.7297	-3.867E-06	2532.1371	1.719E+12	-3.7484	138889.	0.000
87.000	0.000413	-2129.5470	1429.7565	-4.047E-06	2519.9597	1.719E+12	-26.5820	1158133.	0.000
88.500	0.000340	19340.	988.2588	-3.957E-06	2526.9266	1.719E+12	-22.4733	1189423.	0.000
90.000	0.000271	33526.	620.7785	-3.680E-06	2532.6694	1.719E+12	-18.3578	1220713.	0.000
91.500	0.000208	41761.	325.5935	-3.286E-06	2536.0029	1.719E+12	-14.4405	1252003.	0.000
93.000	0.000152	45313.	97.8445	-2.830E-06	2537.4407	1.719E+12	-10.8649	1283293.	0.000
94.500	0.000106	45340.	-69.4289	-2.356E-06	2537.4516	1.719E+12	-7.7210	1314583.	0.000
96.000	6.759E-05	42860.	-184.4011	-1.894E-06	2536.4479	1.719E+12	-5.0537	1345873.	0.000
97.500	3.753E-05	38739.	-255.7294	-1.467E-06	2534.7795	1.719E+12	-2.8717	1377163.	0.000
99.000	1.478E-05	33683.	-291.9831	-1.088E-06	2532.7329	1.719E+12	-1.1565	1408453.	0.000
100.500	-1.627E-06	28249.	-301.2200	-7.636E-07	2530.5332	1.719E+12	0.1302	1439743.	0.000
102.000	-1.271E-05	22855.	-290.6996	-4.961E-07	2528.3493	1.719E+12	1.0388	1471033.	0.000
103.500	-1.949E-05	17794.	-266.7125	-2.833E-07	2526.3008	1.719E+12	1.6265	1502324.	0.000
105.000	-2.291E-05	13259.	-234.5061	-1.208E-07	2524.4648	1.719E+12	1.9520	1533614.	0.000
106.500	-2.384E-05	9354.1923	-198.2875	-2.421E-09	2522.8842	1.719E+12	2.0723	1564904.	0.000
108.000	-2.300E-05	6120.2612	-161.7968	7.858E-08	2521.5751	1.719E+12	1.9823	1551470.	0.000
109.500	-2.101E-05	3527.9464	-127.3320	1.291E-07	2520.5257	1.719E+12	1.8472	1582760.	0.000
111.000	-1.835E-05	1533.7435	-95.8980	1.556E-07	2519.7185	1.719E+12	1.6455	1614050.	0.000
112.500	-1.541E-05	72.5277	-68.4144	1.640E-07	2519.1270	1.719E+12	1.4082	1645340.	0.000
114.000	-1.245E-05	-932.4327	-45.3057	1.595E-07	2519.4751	1.719E+12	1.1594	1676630.	0.000
115.500	-9.664E-06	-1561.6468	-26.6181	1.464E-07	2519.7298	1.719E+12	0.9170	1707920.	0.000
117.000	-7.176E-06	-1893.5936	-12.1252	1.283E-07	2519.8641	1.719E+12	0.6933	1739211.	0.000
118.500	-5.044E-06	-2000.7052	-1.4203	1.080E-07	2519.9075	1.719E+12	0.4961	1770501.	0.000
120.000	-3.289E-06	-1946.8682	6.0078	8.730E-08	2519.8857	1.719E+12	0.3292	1801791.	0.000
121.500	-1.901E-06	-1786.1595	10.7132	6.776E-08	2519.8206	1.719E+12	0.1936	1833081.	0.000
123.000	-8.497E-07	-1562.5387	13.2477	5.023E-08	2519.7301	1.719E+12	0.0880	1864371.	0.000
124.500	-9.285E-08	-1310.2396	14.1278	3.519E-08	2519.6280	1.719E+12	0.009779	1895661.	0.000
126.000	4.171E-07	-1054.6358	13.8140	2.281E-08	2519.5245	1.719E+12	-0.0447	1926951.	0.000
127.500	7.283E-07	-813.3899	12.6990	1.303E-08	2519.4269	1.719E+12	-0.0792	1958241.	0.000
129.000	8.863E-07	-597.7323	11.1042	5.646E-09	2519.3396	1.719E+12	-0.0980	1989531.	0.000
130.500	9.316E-07	-413.7519	9.2812	3.512E-10	2519.2651	1.719E+12	-0.1046	2020821.	0.000
132.000	8.989E-07	-263.6150	7.4176	-3.195E-09	2519.2043	1.719E+12	-0.1025	2052111.	0.000
133.500	8.166E-07	-146.6555	5.6446	-5.342E-09	2519.1570	1.719E+12	-0.0945	2083401.	0.000
135.000	7.066E-07	-60.3039	4.0468	-6.425E-09	2519.1220	1.719E+12	-0.0830	2114691.	0.000
136.500	5.853E-07	-0.8431	2.6717	-6.746E-09	2519.0979	1.719E+12	-0.0698	2145981.	0.000
138.000	4.638E-07	36.0100	1.5388	-6.561E-09	2519.1122	1.719E+12	-0.0561	2177271.	0.000
139.500	3.491E-07	54.6834	0.6484	-6.087E-09	2519.1197	1.719E+12	-0.0428	2208561.	0.000
141.000	2.447E-07	59.4745	-0.0110	-5.489E-09	2519.1217	1.719E+12	-0.0304	2239852.	0.000
142.500	1.515E-07	54.3955	-0.4570	-4.893E-09	2519.1196	1.719E+12	-0.0191	2271142.	0.000
144.000	6.850E-08	43.1192	-0.7079	-4.383E-09	2519.1150	1.719E+12	-0.008763	2302432.	0.000
145.500	-6.320E-09	28.9994	-0.7794	-4.005E-09	2519.1093	1.719E+12	0.000819	2333722.	0.000
147.000	-7.568E-08	15.1420	-0.6825	-3.774E-09	2519.1037	1.719E+12	0.009943	2365012.	0.000
148.500	-1.422E-07	4.5048	-0.4226	-3.671E-09	2519.0994	1.719E+12	0.0189	2396302.	0.000
150.000	-2.078E-07	0.000	0.000	-3.648E-09	2519.0976	1.719E+12	0.0280	1213796.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =      1.0000000 inches
Computed slope at pile head      =     -0.0031339 radians
Maximum bending moment           =      15747123. inch-lbs
Maximum shear force              =        -73892. lbs
Depth of maximum bending moment  =     28.5000000 feet below pile head
Depth of maximum shear force     =     40.5000000 feet below pile head
Number of iterations             =              7
Number of zero deflection points =              5
```

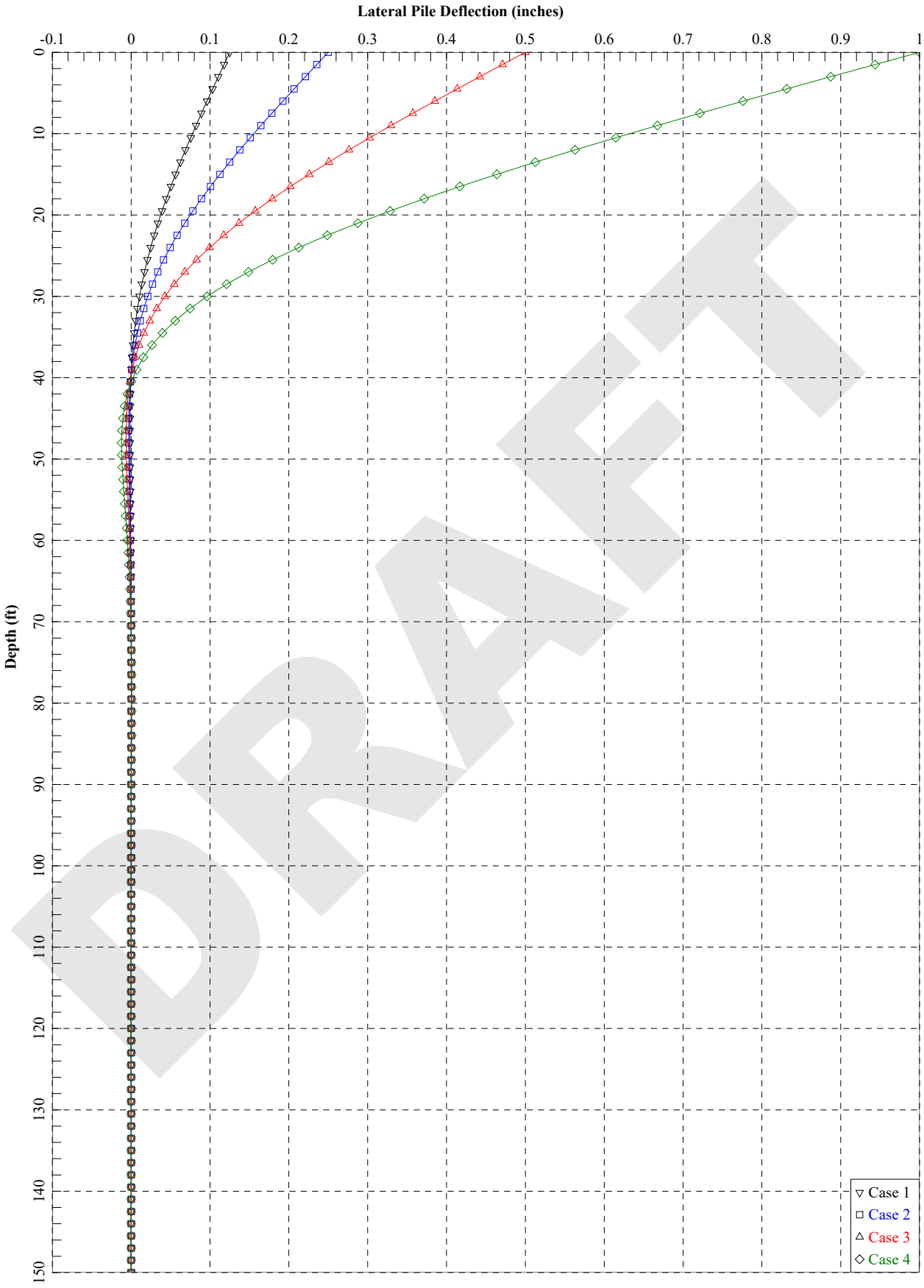
Summary of Pile Response(s)

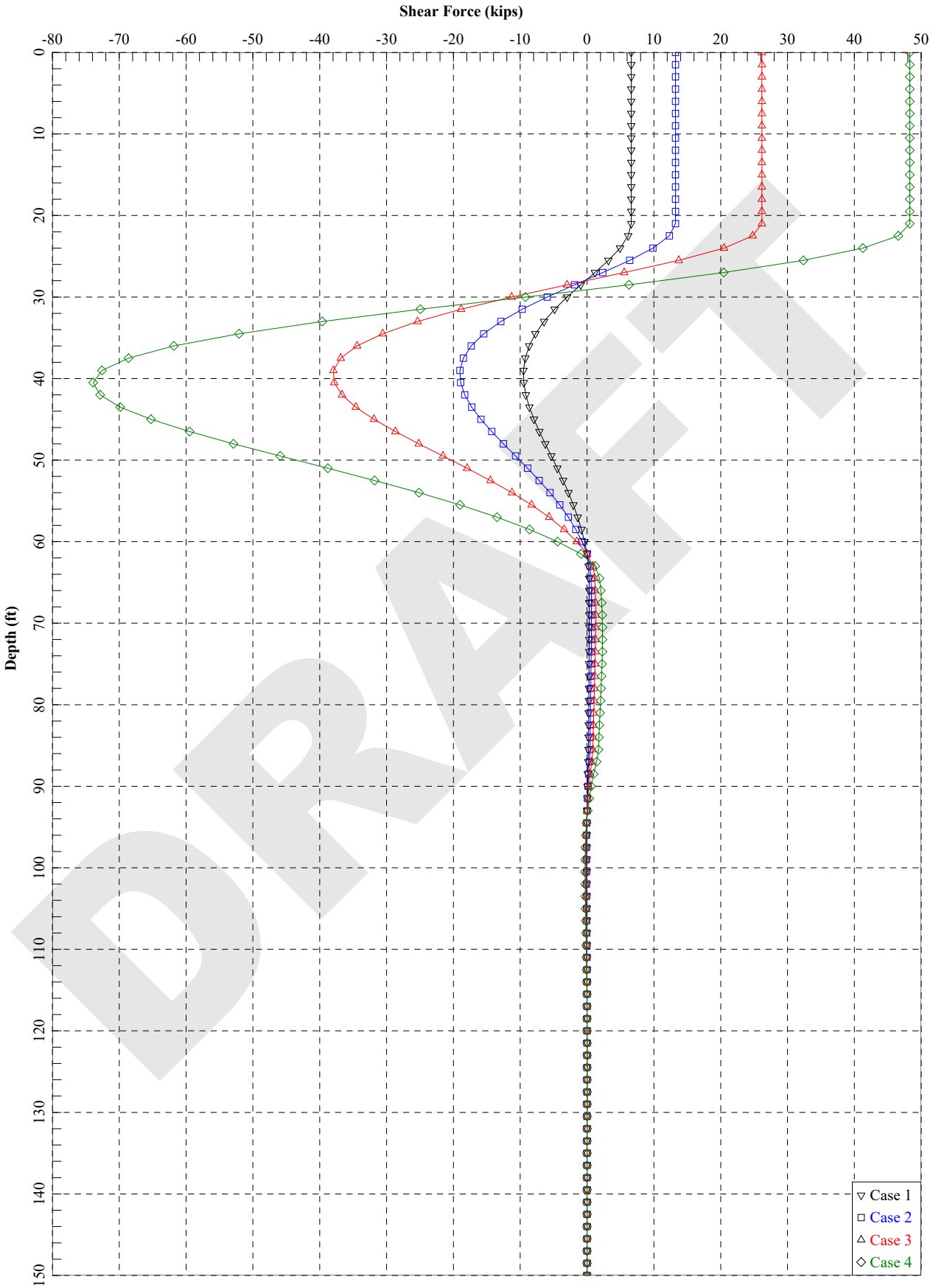
Definitions of Pile-head Loading Conditions:

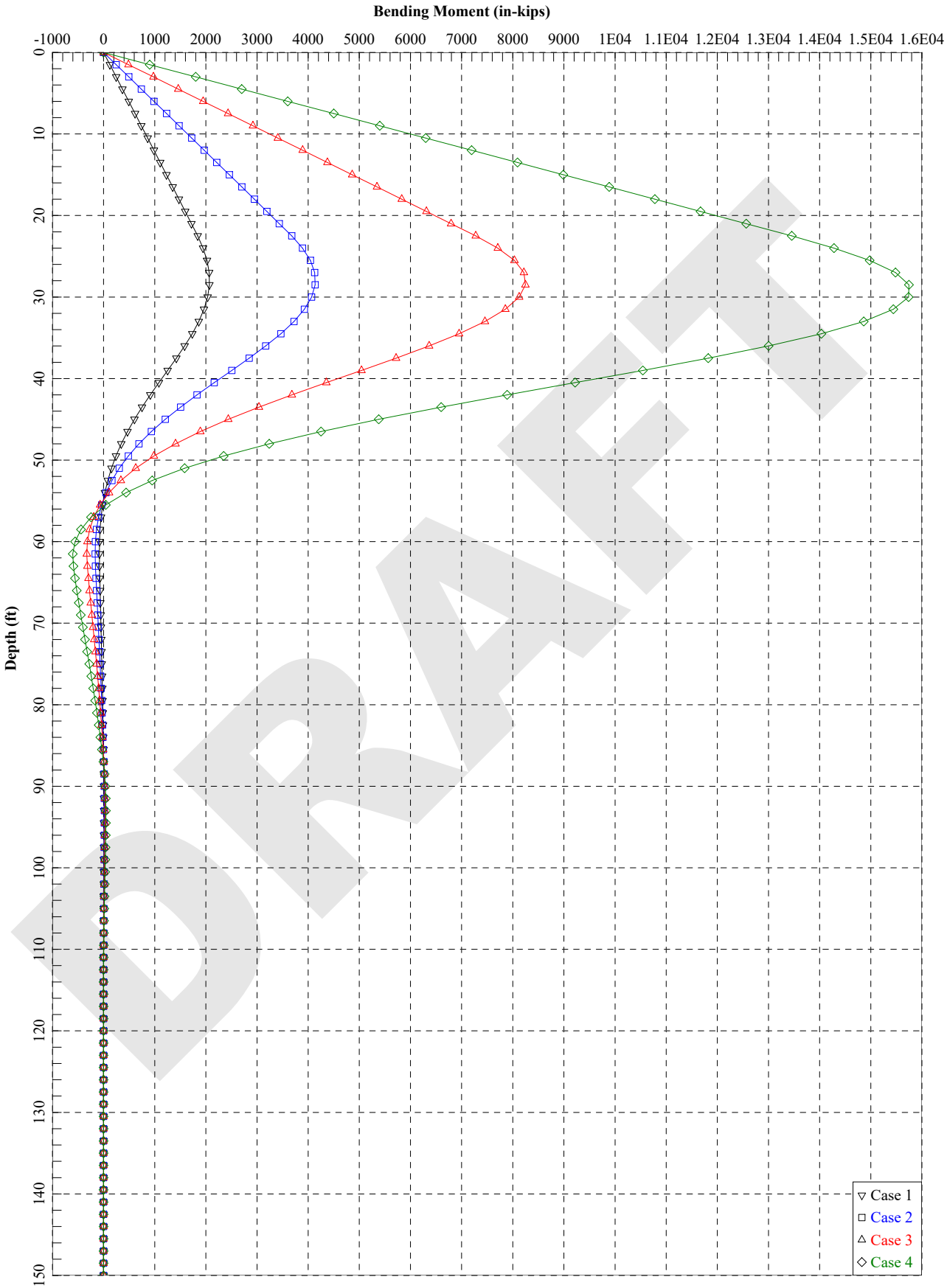
Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

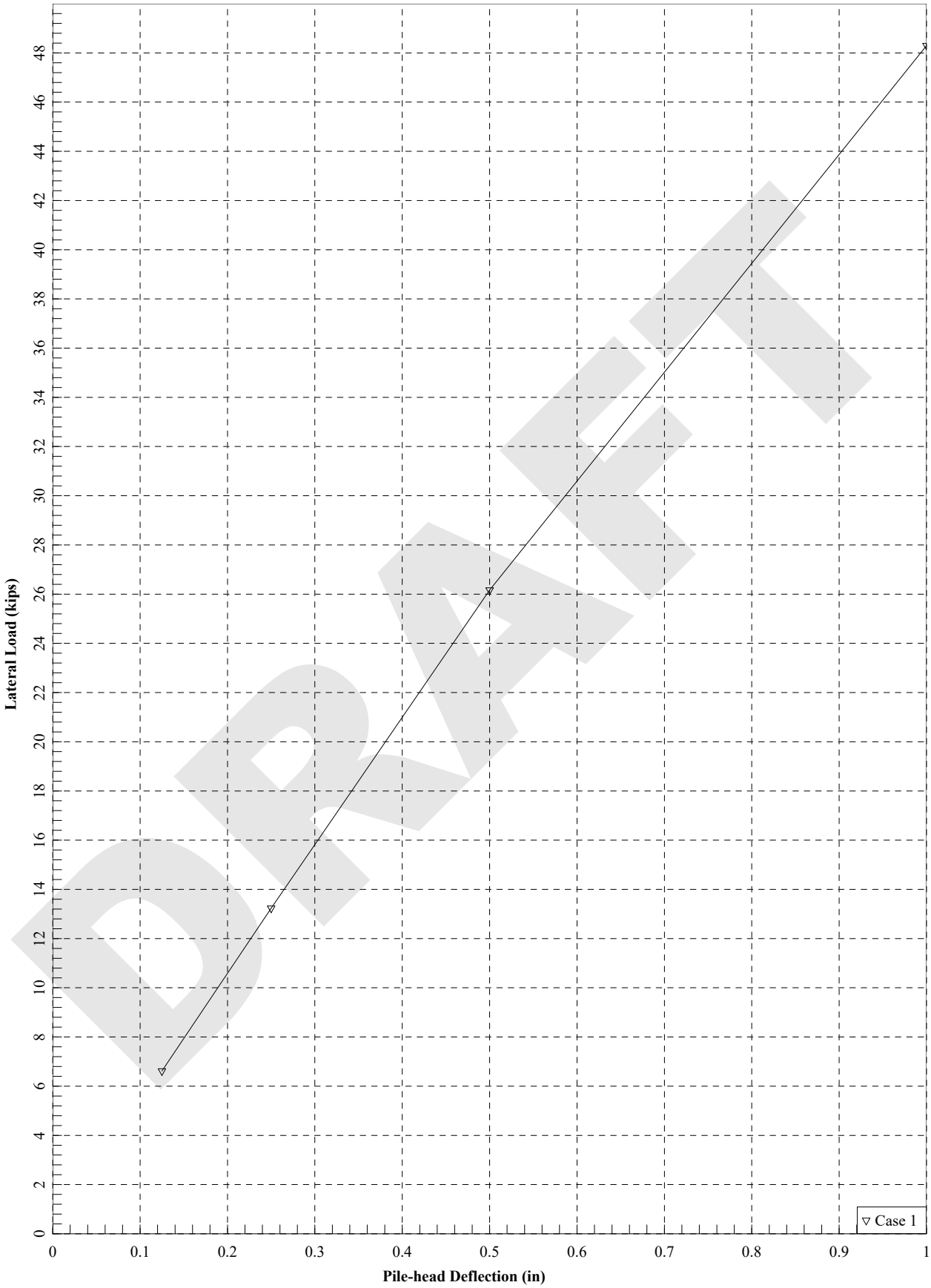
Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	4	y = 0.1250	M = 0.000	552000.	0.12500000	2067695.	-9508.8727	-0.00040301
2	4	y = 0.2500	M = 0.000	552000.	0.25000000	4135390.	-19018.	-0.00080602
3	4	y = 0.5000	M = 0.000	552000.	0.50000000	8248643.	-37956.	-0.00160691
4	4	y = 1.0000	M = 0.000	552000.	1.00000000	15747123.	-73892.	-0.00313388

The analysis ended normally.


Lateral Pile Deflection (inches)
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Shear Force (kips)
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Bending Moment (in-kips)
-1000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E04
1.1E04
1.2E04
1.3E04
1.4E04
1.5E04
1.6E04
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Lateral Load (kips)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pile-head Deflection (in)
▽ Case 1

```
================================================================================

                  LPile Plus for Windows, Version 2013-07.007

               Analysis of Individual Piles and Drilled Shafts
              Subjected to Lateral Loading Using the p-y Method

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--------------------------------------------------------------------------------
                           Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:        P:\Four Hole Swamp\LPILE\2016-03-02\
Name of input data file:       FHS_4-1.5OEP_WZ_shallowscour_load_type_5.lp7d
Name of output report file:    FHS_4-1.5OEP_WZ_shallowscour_load_type_5.lp7o
Name of plot output file:      FHS_4-1.5OEP_WZ_shallowscour_load_type_5.lp7p
Name of runtime messeage file: FHS_4-1.5OEP_WZ_shallowscour_load_type_5.lp7r


--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  March 2, 2016     Time:  17:49:56


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Project Name: US 301 RBO Four Hole Swamp


Job Number: 41503-0002-0001


Client: SCDOT


Engineer: Gabriel Burnworth


Description: 48" OEP (1.5" walls) Weak Zone, 94' scour elev., Fixed Head



--------------------------------------------------------------------------------
                           Program Options and Settings
--------------------------------------------------------------------------------

Engineering Units of Input Data and Computations:
```

- Engineering units are US Customary Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

Computational Options:
- Use unfactored loads in computations (conventional analysis)
- Compute pile response under loading and nonlinear bending properties of pile (only if nonlinear pile properties are input)
- Use of p-y modification factors for p-y curves not selected
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- No p-y curves to be computed and reported for user-specified depths
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1

Pile Structural Properties and Geometry

Total number of pile sections = 1

Total length of pile = 150.00 ft

Depth of ground surface below top of pile = 21.00 ft

Pile diameter values used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile.

Point	Depth X ft	Pile Diameter in
1	0.00000	48.0000000
2	150.000000	48.0000000

Input Structural Properties:

Pile Section No. 1:

Section Type = Steel Pipe Pile
Section Length = 150.00000 ft
Pile Diameter = 48.00000 in

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
= 0.000 radians

```
Pile Batter Angle                                   =        0.000 degrees
                                                    =        0.000 radians


---------------------------------------------------------------------------
                      Soil and Rock Layering Information
---------------------------------------------------------------------------

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     21.00000 ft
   Distance from top of pile to bottom of layer     =     63.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     63.00000 ft
   Distance from top of pile to bottom of layer     =     86.00000 ft
   Effective unit weight at top of layer            =     22.00000 pcf
   Effective unit weight at bottom of layer         =     22.00000 pcf
   Friction angle at top of layer                   =     24.00000 deg.
   Friction angle at bottom of layer                =     24.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =     86.00000 ft
   Distance from top of pile to bottom of layer     =    108.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

Layer 4 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer        =    108.00000 ft
   Distance from top of pile to bottom of layer     =    206.00000 ft
   Effective unit weight at top of layer            =     57.60000 pcf
   Effective unit weight at bottom of layer         =     57.60000 pcf
   Friction angle at top of layer                   =     36.00000 deg.
   Friction angle at bottom of layer                =     36.00000 deg.
   Subgrade k at top of layer                       =       0.0000 pci
   Subgrade k at bottom of layer                    =       0.0000 pci

   NOTE: Internal default values for subgrade k will be computed for this soil layer.

   (Depth of lowest soil layer extends   56.00 ft below pile tip)


---------------------------------------------------------------------------
```

Summary of Soil Properties

Layer Num.	Layer Soil Type (p-y Curve Criteria)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	kpy pci
1	Sand (Reese, et al.)	21.000	57.600	36.000	default
		63.000	57.600	36.000	default
2	Sand (Reese, et al.)	63.000	22.000	24.000	default
		86.000	22.000	24.000	default
3	Sand (Reese, et al.)	86.000	57.600	36.000	default
		108.000	57.600	36.000	default
4	Sand (Reese, et al.)	108.000	57.600	36.000	default
		206.000	57.600	36.000	default

Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 4

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length
1	5	y = 0.12500 in	S = 0.0000 in/in	552000.	No
2	5	y = 0.25000 in	S = 0.0000 in/in	552000.	No
3	5	y = 0.50000 in	S = 0.0000 in/in	552000.	No
4	5	y = 1.00000 in	S = 0.0000 in/in	552000.	No

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel Pipe Pile:

Length of Section	=	150.00000 ft
Outer Diameter of Pipe	=	48.00000 in
Pipe Wall Thickness	=	1.50000 in
Yield Stress of Pipe	=	36.00000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	219.12609 sq. in.

Moment of Inertia = 59287. in^4
Elastic Bending Stiffness = 1.7193E+09 kip-in^2
Plastic Modulus, Z = 3244.50000 in^3
Plastic Moment Capacity = Fy Z = 116802. in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As = 7888.539 kips
Nominal Axial Tensile Capacity = -7888.539 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	552.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 552.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.000001054	1811.9939796	1719329760.	106.4231912	3.2452738	
0.000002108	3623.9879591	1719329760.	65.2115956	3.9714500	
0.000003162	5435.9819387	1719329760.	51.4743971	4.6976261	
0.000004216	7247.9759182	1719329760.	44.6057978	5.4238024	
0.000005269	9059.9698978	1719329760.	40.4846382	6.1499785	
0.000006323	10872.	1719329760.	37.7371985	6.8761547	
0.000007377	12684.	1719329760.	35.7747416	7.6023309	
0.000008431	14496.	1719329760.	34.3028989	8.3285071	
0.000009485	16308.	1719329760.	33.1581324	9.0546833	
0.0000105	18120.	1719329760.	32.2423191	9.7808595	
0.0000116	19932.	1719329760.	31.4930174	10.5070357	
0.0000126	21744.	1719329760.	30.8685993	11.2332119	
0.0000137	23556.	1719329760.	30.3402455	11.9593881	
0.0000148	25368.	1719329760.	29.8873708	12.6855643	
0.0000158	27180.	1719329760.	29.4948794	13.4117405	
0.0000169	28992.	1719329760.	29.1514494	14.1379167	
0.0000179	30804.	1719329760.	28.8484230	14.8640929	
0.0000190	32616.	1719329760.	28.5790662	15.5902690	
0.0000200	34428.	1719329760.	28.3380627	16.3164452	
0.0000211	36240.	1719329760.	28.1211596	17.0426214	
0.0000221	38052.	1719329760.	27.9249139	17.7687976	
0.0000232	39864.	1719329760.	27.7465087	18.4949738	
0.0000242	41676.	1719329760.	27.5836170	19.2211500	
0.0000253	43488.	1719329760.	27.4342996	19.9473262	
0.0000263	45300.	1719329760.	27.2969276	20.6735024	
0.0000274	47112.	1719329760.	27.1701227	21.3996786	
0.0000285	48924.	1719329760.	27.0527108	22.1258548	
0.0000295	50736.	1719329760.	26.9436854	22.8520310	
0.0000306	52548.	1719329760.	26.8421790	23.5782071	
0.0000316	54360.	1719329760.	26.7474397	24.3043833	
0.0000327	56172.	1719329760.	26.6588126	25.0305595	
0.0000337	57984.	1719329760.	26.5757247	25.7567357	
0.0000348	59796.	1719329760.	26.4976725	26.4829119	
0.0000358	61608.	1719329760.	26.4242115	27.2090881	
0.0000369	63420.	1719329760.	26.3549483	27.9352643	
0.0000379	65232.	1719329760.	26.2895331	28.6614405	

0.0000390	67044.	1719329760.	26.2276538	29.3876167	
0.0000400	68856.	1719329760.	26.1690313	30.1137929	
0.0000411	70668.	1719329760.	26.1134152	30.8399691	
0.0000432	74292.	1719329760.	26.0103217	32.2923214	
0.0000453	77916.	1719329760.	25.9168184	33.7446738	
0.0000474	81540.	1719329760.	25.8316265	35.1970262	
0.0000495	85116.	1718362204.	25.7600931	36.0000000	Y
0.0000516	88307.	1710016821.	25.7450077	36.0000000	Y
0.0000537	91055.	1694080982.	25.7890002	36.0000000	Y
0.0000559	93523.	1674351216.	25.8662156	36.0000000	Y
0.0000580	95738.	1651681538.	25.9596148	36.0000000	Y
0.0000601	97623.	1625104154.	26.0427887	36.0000000	Y
0.0000622	99187.	1595157458.	26.1020741	36.0000000	Y
0.0000643	100520.	1563590959.	26.1477997	36.0000000	Y
0.0000664	101682.	1531456607.	26.1850574	36.0000000	Y
0.0000685	102694.	1499106584.	26.2156802	36.0000000	Y
0.0000706	103596.	1467136166.	26.2418156	36.0000000	Y
0.0000727	104405.	1435730900.	26.2645753	36.0000000	Y
0.0000748	105133.	1405018933.	26.2847462	36.0000000	Y
0.0000769	105792.	1375089517.	26.3029308	36.0000000	Y
0.0000790	106389.	1345978545.	26.3190684	36.0000000	Y
0.0000811	106931.	1317694704.	26.3327277	36.0000000	Y
0.0000833	107428.	1290308271.	26.3451305	36.0000000	Y
0.0000854	107888.	1263831958.	26.3565441	36.0000000	Y
0.0000875	108312.	1238223529.	26.3683587	36.0000000	Y
0.0000896	108694.	1213357023.	26.3774987	36.0000000	Y
0.0000917	109054.	1189386837.	26.3862330	36.0000000	Y
0.0000938	109391.	1166251589.	26.3947955	36.0000000	Y
0.0000959	109694.	1143784328.	26.4021331	36.0000000	Y
0.0000980	109986.	1122168893.	26.4094502	36.0000000	Y
0.0001001	110251.	1101186709.	26.4155900	36.0000000	Y
0.0001022	110504.	1080953128.	26.4221100	36.0000000	Y
0.0001043	110737.	1061349948.	26.4271609	36.0000000	Y
0.0001064	110958.	1042412273.	26.4331747	36.0000000	Y
0.0001086	111162.	1024055458.	26.4372983	36.0000000	Y
0.0001107	111360.	1006332490.	26.4430476	36.0000000	Y
0.0001128	111538.	989106469.	26.4463756	36.0000000	Y
0.0001149	111715.	972490789.	26.4505626	36.0000000	Y
0.0001170	111873.	956324994.	26.4547068	36.0000000	Y
0.0001191	112028.	940701885.	26.4572535	36.0000000	Y
0.0001212	112175.	925549270.	26.4625617	36.0000000	Y
0.0001233	112309.	910814943.	26.4645327	36.0000000	Y
0.0001254	112442.	896572199.	26.4666389	36.0000000	Y
0.0001338	112900.	843517796.	26.4797710	36.0000000	Y
0.0001423	113275.	796164739.	26.4878891	36.0000000	Y
0.0001507	113588.	753702530.	26.4950904	36.0000000	Y
0.0001591	113853.	715434459.	26.5018328	36.0000000	Y
0.0001676	114076.	680768908.	26.5058505	36.0000000	Y
0.0001760	114269.	649250909.	26.5078046	36.0000000	Y
0.0001844	114433.	620460993.	26.5135095	36.0000000	Y
0.0001929	114577.	594085861.	26.5174169	36.0000000	Y
0.0002013	114703.	569829556.	26.5179765	36.0000000	Y
0.0002097	114814.	547451379.	26.5235253	36.0000000	Y
0.0002182	114912.	526743116.	26.5225624	36.0000000	Y
0.0002266	114999.	507525905.	26.5269002	36.0000000	Y
0.0002350	115077.	489651076.	26.5278306	36.0000000	Y

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip
1	552.000	115077.2

Note that the values in the above table are not factored by a strength

reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.125000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1250	-5716778.	25048.	0.000	4833.2976	1.719E+12	0.000	0.000	0.000
1.500	0.1245	-5265623.	25048.	-5.749E-05	4650.6661	1.719E+12	0.000	0.000	0.000
3.000	0.1229	-4813920.	25048.	-0.000110	4467.8128	1.719E+12	0.000	0.000	0.000
4.500	0.1205	-4361716.	25048.	-0.000158	4284.7569	1.719E+12	0.000	0.000	0.000
6.000	0.1172	-3909058.	25048.	-0.000202	4101.5172	1.719E+12	0.000	0.000	0.000
7.500	0.1132	-3455994.	25048.	-0.000240	3918.1130	1.719E+12	0.000	0.000	0.000
9.000	0.1086	-3002570.	25048.	-0.000274	3734.5632	1.719E+12	0.000	0.000	0.000
10.500	0.1034	-2548834.	25048.	-0.000303	3550.8870	1.719E+12	0.000	0.000	0.000
12.000	0.0977	-2094832.	25048.	-0.000327	3367.1034	1.719E+12	0.000	0.000	0.000
13.500	0.0916	-1640613.	25048.	-0.000347	3183.2317	1.719E+12	0.000	0.000	0.000
15.000	0.0852	-1186223.	25048.	-0.000362	2999.2908	1.719E+12	0.000	0.000	0.000
16.500	0.0786	-731710.	25048.	-0.000372	2815.3000	1.719E+12	0.000	0.000	0.000
18.000	0.0718	-277121.	25048.	-0.000377	2631.2784	1.719E+12	0.000	0.000	0.000
19.500	0.0650	177497.	25048.	-0.000377	2590.9500	1.719E+12	0.000	0.000	0.000
21.000	0.0582	632097.	25048.	-0.000373	2774.9758	1.719E+12	0.000	0.000	0.000
22.500	0.0516	1086631.	24241.	-0.000364	2958.9750	1.719E+12	-89.6337	31290.	0.000
24.000	0.0451	1512011.	22023.	-0.000351	3131.1723	1.719E+12	-156.8279	62580.	0.000
25.500	0.0389	1886421.	18784.	-0.000333	3282.7366	1.719E+12	-203.0683	93870.	0.000
27.000	0.0331	2194840.	14883.	-0.000312	3407.5875	1.719E+12	-230.3317	125160.	0.000
28.500	0.0277	2428404.	10641.	-0.000287	3502.1362	1.719E+12	-240.9768	156450.	0.000
30.000	0.0228	2583639.	6334.0021	-0.000261	3564.9765	1.719E+12	-237.6199	187740.	0.000
31.500	0.0183	2661616.	2188.3920	-0.000234	3596.5424	1.719E+12	-223.0034	219030.	0.000
33.000	0.0144	2667064.	-1617.4750	-0.000206	3598.7475	1.719E+12	-199.8707	250321.	0.000
34.500	0.0109	2607475.	-4953.9928	-0.000178	3574.6256	1.719E+12	-170.8535	281611.	0.000
36.000	0.007960	2492259.	-7737.0738	-0.000151	3527.9852	1.719E+12	-138.3777	312901.	0.000
37.500	0.005470	2331950.	-9923.7888	-0.000126	3463.0905	1.719E+12	-104.5906	344191.	0.000
39.000	0.003419	2137510.	-11507.	-0.000103	3384.3797	1.719E+12	-71.3113	375481.	0.000
40.500	0.001770	1919743.	-12509.	-8.153E-05	3296.2258	1.719E+12	-40.0035	406771.	0.000
42.000	0.000484	1688815.	-12975.	-6.264E-05	3202.7443	1.719E+12	-11.7690	438061.	0.000
43.500	-0.000485	1453899.	-12967.	-4.619E-05	3107.6481	1.719E+12	12.6402	469351.	0.000
45.000	-0.001179	1222927.	-12558.	-3.217E-05	3014.1486	1.719E+12	32.7956	500641.	0.000
46.500	-0.001643	1002453.	-11826.	-2.053E-05	2924.8990	1.719E+12	48.5549	531931.	0.000
48.000	-0.001918	797607.	-10849.	-1.110E-05	2841.9755	1.719E+12	60.0161	563221.	0.000
49.500	-0.002043	612123.	-9701.2713	-3.724E-06	2766.8900	1.719E+12	67.4690	594511.	0.000
51.000	-0.002052	448435.	-8451.9443	1.828E-06	2700.6278	1.719E+12	71.3451	625801.	0.000
52.500	-0.001977	307816.	-7160.3189	5.787E-06	2643.7042	1.719E+12	72.1688	657091.	0.000
54.000	-0.001844	190548.	-5876.1833	8.395E-06	2596.2332	1.719E+12	70.5129	688381.	0.000
55.500	-0.001675	96107.	-4638.9422	9.896E-06	2558.0024	1.719E+12	66.9583	719671.	0.000
57.000	-0.001488	23350.	-3477.7735	1.052E-05	2528.5498	1.719E+12	62.0604	750962.	0.000
58.500	-0.001296	-29302.	-2412.3456	1.049E-05	2530.9593	1.719E+12	56.3205	782252.	0.000

60.000	-0.001110	-63703.	-1453.9849	1.000E-05	2544.8852	1.719E+12	50.1640	813542.	0.000
61.500	-0.000936	-81844.	-607.1907	9.241E-06	2552.2289	1.719E+12	43.9242	844832.	0.000
63.000	-0.000777	-85746.	-66.7182	8.364E-06	2553.8082	1.719E+12	16.1283	373524.	0.000
64.500	-0.000635	-84412.	109.7587	7.473E-06	2553.2685	1.719E+12	3.4802	98691.	0.000
66.000	-0.000508	-81943.	166.8869	6.602E-06	2552.2687	1.719E+12	2.8673	101563.	0.000
67.500	-0.000397	-78536.	213.4262	5.762E-06	2550.8895	1.719E+12	2.3037	104434.	0.000
69.000	-0.000301	-74374.	250.2945	4.962E-06	2549.2048	1.719E+12	1.7928	107305.	0.000
70.500	-0.000218	-69624.	278.4624	4.208E-06	2547.2819	1.719E+12	1.3370	110176.	0.000
72.000	-0.000149	-64433.	298.9306	3.506E-06	2545.1806	1.719E+12	0.9373	113048.	0.000
73.500	-9.219E-05	-58932.	312.7095	2.861E-06	2542.9537	1.719E+12	0.5937	115919.	0.000
75.000	-4.625E-05	-53232.	320.8000	2.274E-06	2540.6465	1.719E+12	0.3052	118790.	0.000
76.500	-1.034E-05	-47428.	324.1763	1.747E-06	2538.2970	1.719E+12	0.0699	121661.	0.000
78.000	1.663E-05	-41597.	323.7700	1.281E-06	2535.9363	1.719E+12	-0.1150	124533.	0.000
79.500	3.576E-05	-35798.	320.4566	8.755E-07	2533.5889	1.719E+12	-0.2531	127404.	0.000
81.000	4.815E-05	-30078.	315.0422	5.307E-07	2531.2733	1.719E+12	-0.3485	130275.	0.000
82.500	5.487E-05	-24467.	308.2533	2.452E-07	2529.0021	1.719E+12	-0.4059	133146.	0.000
84.000	5.698E-05	-18985.	300.7258	1.773E-08	2526.7830	1.719E+12	-0.4305	136018.	0.000
85.500	5.551E-05	-13641.	292.9965	-1.531E-07	2524.6197	1.719E+12	-0.4283	138889.	0.000
87.000	5.147E-05	-8434.4588	259.3402	-2.686E-07	2522.5119	1.719E+12	-3.3113	1158133.	0.000
88.500	4.584E-05	-4299.6583	202.2797	-3.353E-07	2520.8381	1.719E+12	-3.0288	1189423.	0.000
90.000	3.940E-05	-1145.7282	150.9756	-3.638E-07	2519.5614	1.719E+12	-2.6717	1220713.	0.000
91.500	3.274E-05	1142.6924	106.4354	-3.638E-07	2519.5602	1.719E+12	-2.2772	1252003.	0.000
93.000	2.630E-05	2693.1747	69.0658	-3.437E-07	2520.1878	1.719E+12	-1.8750	1283293.	0.000
94.500	2.037E-05	3635.8899	38.8048	-3.106E-07	2520.5694	1.719E+12	-1.4874	1314583.	0.000
96.000	1.512E-05	4096.3181	15.2449	-2.701E-07	2520.7558	1.719E+12	-1.1304	1345873.	0.000
97.500	1.064E-05	4190.0744	-2.2566	-2.267E-07	2520.7938	1.719E+12	-0.8142	1377163.	0.000
99.000	6.956E-06	4019.5878	-14.4830	-1.838E-07	2520.7248	1.719E+12	-0.5443	1408453.	0.000
100.500	4.027E-06	3672.3389	-22.2803	-1.435E-07	2520.5842	1.719E+12	-0.3221	1439743.	0.000
102.000	1.790E-06	3220.3485	-26.4958	-1.074E-07	2520.4012	1.719E+12	-0.1463	1471033.	0.000
103.500	1.601E-07	2720.6238	-27.9328	-7.631E-08	2520.1989	1.719E+12	-0.0134	1502324.	0.000
105.000	-9.571E-07	2216.2856	-27.3191	-5.047E-08	2519.9948	1.719E+12	0.0815	1533614.	0.000
106.500	-1.657E-06	1738.1387	-25.2888	-2.977E-08	2519.8012	1.719E+12	0.1440	1564904.	0.000
108.000	-2.029E-06	1306.4792	-22.4186	-1.383E-08	2519.6265	1.719E+12	0.1749	1551470.	0.000
109.500	-2.155E-06	931.3424	-19.1396	-2.118E-09	2519.4746	1.719E+12	0.1895	1582760.	0.000
111.000	-2.105E-06	617.4961	-15.7355	5.989E-09	2519.3476	1.719E+12	0.1888	1614050.	0.000
112.500	-1.939E-06	364.7450	-12.4414	1.113E-08	2519.2452	1.719E+12	0.1773	1645340.	0.000
114.000	-1.704E-06	169.3850	-9.4173	1.393E-08	2519.1662	1.719E+12	0.1588	1676630.	0.000
115.500	-1.438E-06	25.4448	-6.7607	1.495E-08	2519.1079	1.719E+12	0.1364	1707920.	0.000
117.000	-1.166E-06	-74.2981	-4.5187	1.469E-08	2519.1277	1.719E+12	0.1127	1739211.	0.000
118.500	-9.089E-07	-137.5212	-2.6999	1.358E-08	2519.1533	1.719E+12	0.0894	1770501.	0.000
120.000	-6.773E-07	-171.7652	-1.2851	1.196E-08	2519.1671	1.719E+12	0.0678	1801791.	0.000
121.500	-4.782E-07	-184.0235	-0.2366	1.010E-08	2519.1721	1.719E+12	0.0487	1833081.	0.000
123.000	-3.137E-07	-180.4845	0.4941	8.193E-09	2519.1707	1.719E+12	0.0325	1864371.	0.000
124.500	-1.833E-07	-166.3989	0.9602	6.377E-09	2519.1650	1.719E+12	0.0193	1895661.	0.000
126.000	-8.414E-08	-146.0431	1.2150	4.741E-09	2519.1567	1.719E+12	0.009008	1926951.	0.000
127.500	-1.256E-08	-122.7536	1.3084	3.334E-09	2519.1473	1.719E+12	0.001366	1958241.	0.000
129.000	3.590E-08	-99.0086	1.2849	2.174E-09	2519.1377	1.719E+12	-0.003968	1989531.	0.000
130.500	6.569E-08	-76.5389	1.1829	1.255E-09	2519.1286	1.719E+12	-0.007375	2020821.	0.000
132.000	8.106E-08	-56.4507	1.0333	5.585E-10	2519.1204	1.719E+12	-0.009242	2052111.	0.000
133.500	8.580E-08	-39.3510	0.8608	5.705E-11	2519.1135	1.719E+12	-0.009931	2083401.	0.000
135.000	8.312E-08	-25.4647	0.6835	-2.822E-10	2519.1079	1.719E+12	-0.009765	2114691.	0.000
136.500	7.564E-08	-14.7397	0.5144	-4.927E-10	2519.1036	1.719E+12	-0.009018	2145981.	0.000
138.000	6.538E-08	-6.9349	0.3621	-6.061E-10	2519.1004	1.719E+12	-0.007909	2177271.	0.000
139.500	5.382E-08	-1.6917	0.2315	-6.513E-10	2519.0983	1.719E+12	-0.006603	2208561.	0.000
141.000	4.193E-08	1.4122	0.1251	-6.528E-10	2519.0982	1.719E+12	-0.005218	2239852.	0.000
142.500	3.032E-08	2.8252	0.0437	-6.306E-10	2519.0987	1.719E+12	-0.003825	2271142.	0.000
144.000	1.923E-08	2.9985	-0.0129	-6.001E-10	2519.0988	1.719E+12	-0.002460	2302432.	0.000
145.500	8.715E-09	2.3744	-0.0452	-5.720E-10	2519.0986	1.719E+12	-0.001130	2333722.	0.000
147.000	-1.357E-09	1.3839	-0.0537	-5.523E-10	2519.0982	1.719E+12	0.000178	2365012.	0.000
148.500	-1.117E-08	0.4511	-0.0387	-5.427E-10	2519.0978	1.719E+12	0.001487	2396302.	0.000
150.000	-2.089E-08	0.000	0.000	-5.403E-10	2519.0976	1.719E+12	0.002818	1213796.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =      0.1250000 inches
Computed slope at pile head      =   -0.000002362 radians
Maximum bending moment           =      -5716778. inch-lbs
Maximum shear force              =         25048. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     13.5000000 feet below pile head
Number of iterations             =              6
Number of zero deflection points =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.250000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.2500	-11400667.	49852.	0.000	7134.1837	1.719E+12	0.000	0.000	0.000
1.500	0.2489	-10502734.	49852.	-0.000115	6770.6930	1.719E+12	0.000	0.000	0.000
3.000	0.2459	-9603709.	49852.	-0.000220	6406.7601	1.719E+12	0.000	0.000	0.000
4.500	0.2410	-8703685.	49852.	-0.000316	6042.4228	1.719E+12	0.000	0.000	0.000
6.000	0.2345	-7802756.	49852.	-0.000402	5677.7189	1.719E+12	0.000	0.000	0.000
7.500	0.2265	-6901015.	49852.	-0.000479	5312.6865	1.719E+12	0.000	0.000	0.000
9.000	0.2173	-5998556.	49852.	-0.000547	4947.3635	1.719E+12	0.000	0.000	0.000
10.500	0.2069	-5095473.	49852.	-0.000605	4581.7880	1.719E+12	0.000	0.000	0.000
12.000	0.1955	-4191860.	49852.	-0.000653	4215.9978	1.719E+12	0.000	0.000	0.000
13.500	0.1833	-3287811.	49852.	-0.000692	3850.0311	1.719E+12	0.000	0.000	0.000
15.000	0.1706	-2383420.	49852.	-0.000722	3483.9260	1.719E+12	0.000	0.000	0.000
16.500	0.1573	-1478781.	49852.	-0.000742	3117.7206	1.719E+12	0.000	0.000	0.000
18.000	0.1438	-573988.	49852.	-0.000753	2751.4528	1.719E+12	0.000	0.000	0.000
19.500	0.1302	330864.	49852.	-0.000754	2653.0343	1.719E+12	0.000	0.000	0.000
21.000	0.1167	1235682.	49852.	-0.000746	3019.3123	1.719E+12	0.000	0.000	0.000
22.500	0.1034	2140372.	48503.	-0.000729	3385.5382	1.719E+12	-149.9253	26109.	0.000
24.000	0.0904	2996263.	44354.	-0.000702	3732.0101	1.719E+12	-311.0345	61898.	0.000
25.500	0.0781	3751067.	37889.	-0.000666	4037.5612	1.719E+12	-407.3004	93870.	0.000
27.000	0.0665	4373516.	30064.	-0.000624	4289.5337	1.719E+12	-462.1284	125160.	0.000
28.500	0.0556	4845780.	21552.	-0.000576	4480.7102	1.719E+12	-483.6505	156450.	0.000
30.000	0.0457	5160837.	12906.	-0.000523	4608.2481	1.719E+12	-477.0930	187740.	0.000
31.500	0.0368	5320780.	4580.3574	-0.000468	4672.9941	1.719E+12	-447.9403	219030.	0.000
33.000	0.0289	5335036.	-3066.2583	-0.000413	4678.7651	1.719E+12	-401.6836	250321.	0.000
34.500	0.0220	5218592.	-9773.7551	-0.000357	4631.6275	1.719E+12	-343.5938	281611.	0.000
36.000	0.0160	4990280.	-15373.	-0.000304	4539.2051	1.719E+12	-278.5324	312901.	0.000
37.500	0.0110	4671205.	-19777.	-0.000253	4410.0408	1.719E+12	-210.8053	344191.	0.000
39.000	0.006906	4283343.	-22971.	-0.000206	4253.0310	1.719E+12	-144.0623	375481.	0.000
40.500	0.003595	3848359.	-24998.	-0.000164	4076.9460	1.719E+12	-81.2424	406771.	0.000
42.000	0.001009	3386653.	-25951.	-0.000126	3890.0433	1.719E+12	-24.5601	438061.	0.000
43.500	-0.000938	2916637.	-25952.	-9.294E-05	3699.7767	1.719E+12	24.4714	469351.	0.000
45.000	-0.002337	2454246.	-25146.	-6.482E-05	3512.5970	1.719E+12	64.9873	500641.	0.000
46.500	-0.003272	2012655.	-23691.	-4.144E-05	3333.8375	1.719E+12	96.6964	531931.	0.000
48.000	-0.003828	1602185.	-21743.	-2.252E-05	3167.6758	1.719E+12	119.7905	563221.	0.000
49.500	-0.004083	1230361.	-19451.	-7.691E-06	3017.1581	1.719E+12	134.8466	594511.	0.000
51.000	-0.004105	902099.	-16953.	3.472E-06	2884.2747	1.719E+12	142.7261	625801.	0.000
52.500	-0.003958	619986.	-14368.	1.144E-05	2770.0731	1.719E+12	144.4781	657091.	0.000
54.000	-0.003693	384619.	-11797.	1.670E-05	2674.7948	1.719E+12	141.2492	688381.	0.000
55.500	-0.003357	194978.	-9317.4910	1.973E-05	2598.0262	1.719E+12	134.2034	719671.	0.000
57.000	-0.002983	48798.	-6989.5769	2.101E-05	2538.8513	1.719E+12	124.4537	750962.	0.000
58.500	-0.002600	-57065.	-4852.4417	2.096E-05	2542.1978	1.719E+12	113.0057	782252.	0.000

60.000	-0.002228	-126307.	-2928.9723	2.001E-05	2570.2277	1.719E+12	100.7131	813542.	0.000
61.500	-0.001880	-162905.	-1228.3560	1.849E-05	2585.0429	1.719E+12	88.2443	844832.	0.000
63.000	-0.001563	-170895.	-142.3159	1.674E-05	2588.2774	1.719E+12	32.4269	373524.	0.000
64.500	-0.001277	-168361.	212.5578	1.497E-05	2587.2516	1.719E+12	7.0036	98691.	0.000
66.000	-0.001024	-163541.	327.5793	1.323E-05	2585.3002	1.719E+12	5.7766	101563.	0.000
67.500	-0.000801	-156831.	421.3973	1.155E-05	2582.5842	1.719E+12	4.6476	104434.	0.000
69.000	-0.000608	-148600.	495.8390	9.955E-06	2579.2521	1.719E+12	3.6237	107305.	0.000
70.500	-0.000443	-139179.	552.8386	8.448E-06	2575.4384	1.719E+12	2.7096	110176.	0.000
72.000	-0.000304	-128866.	594.3921	7.045E-06	2571.2634	1.719E+12	1.9075	113048.	0.000
73.500	-0.000189	-117921.	622.5163	5.753E-06	2566.8329	1.719E+12	1.2174	115919.	0.000
75.000	-9.659E-05	-106569.	639.2103	4.578E-06	2562.2377	1.719E+12	0.6375	118790.	0.000
76.500	-2.422E-05	-95000.	646.4208	3.523E-06	2557.5545	1.719E+12	0.1637	121661.	0.000
78.000	3.024E-05	-83368.	646.0110	2.590E-06	2552.8457	1.719E+12	-0.2092	124533.	0.000
79.500	6.900E-05	-71795.	639.7323	1.777E-06	2548.1609	1.719E+12	-0.4884	127404.	0.000
81.000	9.423E-05	-60373.	629.1988	1.085E-06	2543.5371	1.719E+12	-0.6820	130275.	0.000
82.500	0.000108	-49166.	615.8658	5.121E-07	2539.0003	1.719E+12	-0.7995	133146.	0.000
84.000	0.000113	-38212.	601.0084	5.472E-08	2534.5662	1.719E+12	-0.8514	136018.	0.000
85.500	0.000110	-27530.	585.7038	-2.894E-07	2530.2421	1.719E+12	-0.8491	138889.	0.000
87.000	0.000102	-17121.	518.8543	-5.232E-07	2526.0283	1.719E+12	-6.5786	1158133.	0.000
88.500	9.122E-05	-8841.2698	405.3999	-6.591E-07	2522.6766	1.719E+12	-6.0275	1189423.	0.000
90.000	7.852E-05	-2513.5137	303.2274	-7.185E-07	2520.1151	1.719E+12	-5.3250	1220713.	0.000
91.500	6.535E-05	2089.1960	214.3928	-7.207E-07	2519.9433	1.719E+12	-4.5455	1252003.	0.000
93.000	5.257E-05	5218.9487	139.7492	-6.825E-07	2521.2103	1.719E+12	-3.7482	1283293.	0.000
94.500	4.078E-05	7133.7277	79.2094	-6.178E-07	2521.9854	1.719E+12	-2.9784	1314583.	0.000
96.000	3.033E-05	8082.7622	31.9910	-5.381E-07	2522.3696	1.719E+12	-2.2681	1345873.	0.000
97.500	2.141E-05	8296.0984	-3.1634	-4.524E-07	2522.4559	1.719E+12	-1.6380	1377163.	0.000
99.000	1.405E-05	7977.8709	-27.7974	-3.672E-07	2522.3271	1.719E+12	-1.0992	1408453.	0.000
100.500	8.189E-06	7302.6881	-43.5848	-2.872E-07	2522.0538	1.719E+12	-0.6550	1439743.	0.000
102.000	3.707E-06	6414.5272	-52.2061	-2.154E-07	2521.6942	1.719E+12	-0.3029	1471033.	0.000
103.500	4.335E-07	5427.5478	-55.2582	-1.534E-07	2521.2947	1.719E+12	-0.0362	1502324.	0.000
105.000	-1.817E-06	4428.2807	-54.1906	-1.018E-07	2520.8902	1.719E+12	0.1548	1533614.	0.000
106.500	-3.233E-06	3478.7107	-50.2677	-6.046E-08	2520.5058	1.719E+12	0.2811	1564904.	0.000
108.000	-3.993E-06	2619.8463	-44.6402	-2.853E-08	2520.1581	1.719E+12	0.3442	1551470.	0.000
109.500	-4.260E-06	1872.2323	-38.1709	-5.020E-09	2519.8555	1.719E+12	0.3746	1582760.	0.000
111.000	-4.174E-06	1245.7954	-31.4308	1.130E-08	2519.6019	1.719E+12	0.3743	1614050.	0.000
112.500	-3.853E-06	740.5002	-24.8921	2.170E-08	2519.3974	1.719E+12	0.3522	1645340.	0.000
114.000	-3.393E-06	349.2489	-18.8777	2.740E-08	2519.2390	1.719E+12	0.3160	1676630.	0.000
115.500	-2.867E-06	60.3592	-13.5852	2.955E-08	2519.1220	1.719E+12	0.2720	1707920.	0.000
117.000	-2.329E-06	-140.4040	-9.1115	2.913E-08	2519.1544	1.719E+12	0.2251	1739211.	0.000
118.500	-1.818E-06	-268.2334	-5.4764	2.699E-08	2519.2062	1.719E+12	0.1788	1770501.	0.000
120.000	-1.358E-06	-338.0920	-2.6438	2.382E-08	2519.2345	1.719E+12	0.1359	1801791.	0.000
121.500	-9.608E-07	-363.8848	-0.5402	2.014E-08	2519.2449	1.719E+12	0.0978	1833081.	0.000
123.000	-6.325E-07	-357.9381	0.9301	1.636E-08	2519.2425	1.719E+12	0.0655	1864371.	0.000
124.500	-3.717E-07	-330.7274	1.8720	1.276E-08	2519.2315	1.719E+12	0.0391	1895661.	0.000
126.000	-1.732E-07	-290.7985	2.3913	9.505E-09	2519.2153	1.719E+12	0.0185	1926951.	0.000
127.500	-2.955E-08	-244.8305	2.5871	6.701E-09	2519.1967	1.719E+12	0.003215	1958241.	0.000
129.000	6.799E-08	-197.7954	2.5484	4.384E-09	2519.1777	1.719E+12	-0.007515	1989531.	0.000
130.500	1.283E-07	-153.1746	2.3512	2.547E-09	2519.1596	1.719E+12	-0.0144	2020821.	0.000
132.000	1.597E-07	-113.2036	2.0577	1.152E-09	2519.1434	1.719E+12	-0.0182	2052111.	0.000
133.500	1.697E-07	-79.1187	1.7171	1.456E-10	2519.1296	1.719E+12	-0.0196	2083401.	0.000
135.000	1.649E-07	-51.3913	1.3659	-5.376E-10	2519.1184	1.719E+12	-0.0194	2114691.	0.000
136.500	1.504E-07	-29.9359	1.0302	-9.633E-10	2519.1097	1.719E+12	-0.0179	2145981.	0.000
138.000	1.302E-07	-14.2868	0.7270	-1.195E-09	2519.1034	1.719E+12	-0.0158	2177271.	0.000
139.500	1.074E-07	-3.7401	0.4666	-1.289E-09	2519.0991	1.719E+12	-0.0132	2208561.	0.000
141.000	8.382E-08	2.5382	0.2542	-1.295E-09	2519.0986	1.719E+12	-0.0104	2239852.	0.000
142.500	6.074E-08	5.4367	0.0913	-1.254E-09	2519.0998	1.719E+12	-0.007664	2271142.	0.000
144.000	3.869E-08	5.8514	-0.0222	-1.195E-09	2519.1000	1.719E+12	-0.004949	2302432.	0.000
145.500	1.774E-08	4.6620	-0.0874	-1.140E-09	2519.0995	1.719E+12	-0.002300	2333722.	0.000
147.000	-2.337E-09	2.7271	-0.1053	-1.101E-09	2519.0987	1.719E+12	0.000307	2365012.	0.000
148.500	-2.190E-08	0.8914	-0.0763	-1.082E-09	2519.0980	1.719E+12	0.002915	2396302.	0.000
150.000	-4.129E-08	0.000	0.000	-1.077E-09	2519.0976	1.719E+12	0.005568	1213796.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection              =      0.2500000 inches
Computed slope at pile head       =   -0.000004700 radians
Maximum bending moment            =     -11400667. inch-lbs
Maximum shear force               =         49852. lbs
Depth of maximum bending moment   =       0.000000 feet below pile head
Depth of maximum shear force      =     21.0000000 feet below pile head
Number of iterations              =              6
Number of zero deflection points  =              5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 3

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.500000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5000	-21564937.	91621.	0.000	11249.	1.719E+12	0.000	0.000	0.000
1.500	0.4980	-19914632.	91621.	-0.000217	10581.	1.719E+12	0.000	0.000	0.000
3.000	0.4922	-18262255.	91621.	-0.000417	9911.8125	1.719E+12	0.000	0.000	0.000
4.500	0.4830	-16607979.	91621.	-0.000600	9242.1474	1.719E+12	0.000	0.000	0.000
6.000	0.4706	-14951974.	91621.	-0.000765	8571.7829	1.719E+12	0.000	0.000	0.000
7.500	0.4554	-13294415.	91621.	-0.000913	7900.7889	1.719E+12	0.000	0.000	0.000
9.000	0.4377	-11635472.	91621.	-0.001043	7229.2350	1.719E+12	0.000	0.000	0.000
10.500	0.4179	-9975320.	91621.	-0.001156	6557.1911	1.719E+12	0.000	0.000	0.000
12.000	0.3961	-8314129.	91621.	-0.001252	5884.7273	1.719E+12	0.000	0.000	0.000
13.500	0.3728	-6652074.	91621.	-0.001330	5211.9133	1.719E+12	0.000	0.000	0.000
15.000	0.3482	-4989327.	91621.	-0.001391	4538.8192	1.719E+12	0.000	0.000	0.000
16.500	0.3227	-3326061.	91621.	-0.001435	3865.5150	1.719E+12	0.000	0.000	0.000
18.000	0.2966	-1662448.	91621.	-0.001461	3192.0707	1.719E+12	0.000	0.000	0.000
19.500	0.2701	1336.7994	91621.	-0.001470	2519.6387	1.719E+12	0.000	0.000	0.000
21.000	0.2437	1665122.	91621.	-0.001461	3193.1529	1.719E+12	0.000	0.000	0.000
22.500	0.2175	3328734.	89963.	-0.001435	3866.5970	1.719E+12	-184.2221	15243.	0.000
24.000	0.1920	4932311.	84824.	-0.001391	4515.7388	1.719E+12	-386.8231	36258.	0.000
25.500	0.1675	6410045.	76146.	-0.001332	5113.9379	1.719E+12	-577.3661	62062.	0.000
27.000	0.1441	7700045.	64389.	-0.001258	5636.1409	1.719E+12	-729.0083	91075.	0.000
28.500	0.1222	8753046.	50266.	-0.001172	6062.4045	1.719E+12	-840.2490	123810.	0.000
30.000	0.1019	9532896.	34594.	-0.001076	6378.0942	1.719E+12	-901.0059	159179.	0.000
31.500	0.0834	10019828.	18388.	-0.000974	6575.2084	1.719E+12	-899.7070	194158.	0.000
33.000	0.0668	10214212.	2921.1898	-0.000868	6653.8969	1.719E+12	-818.8066	220564.	0.000
34.500	0.0522	10142241.	-10912.	-0.000762	6624.7623	1.719E+12	-718.2278	247860.	0.000
36.000	0.0394	9836509.	-22467.	-0.000657	6500.9994	1.719E+12	-565.6443	258370.	0.000
37.500	0.0285	9346485.	-31437.	-0.000557	6302.6336	1.719E+12	-431.0017	272128.	0.000
39.000	0.0194	8715844.	-38651.	-0.000462	6047.3449	1.719E+12	-370.6022	344358.	0.000
40.500	0.0119	7964222.	-44402.	-0.000375	5743.0818	1.719E+12	-268.4095	406771.	0.000
42.000	0.005884	7124806.	-48107.	-0.000296	5403.2792	1.719E+12	-143.1910	438061.	0.000
43.500	0.001233	6238256.	-49685.	-0.000226	5044.3961	1.719E+12	-32.1438	469351.	0.000
45.000	-0.002243	5340641.	-49413.	-0.000165	4681.0343	1.719E+12	62.3767	500641.	0.000
46.500	-0.004712	4462682.	-47598.	-0.000114	4325.6288	1.719E+12	139.2387	531931.	0.000
48.000	-0.006340	3629371.	-44560.	-7.145E-05	3988.2977	1.719E+12	198.3706	563221.	0.000
49.500	-0.007284	2859955.	-40609.	-3.748E-05	3676.8316	1.719E+12	240.5732	594511.	0.000
51.000	-0.007689	2168187.	-36038.	-1.116E-05	3396.7981	1.719E+12	267.3207	625801.	0.000
52.500	-0.007686	1562806.	-31107.	8.371E-06	3151.7346	1.719E+12	280.5614	657091.	0.000
54.000	-0.007388	1048164.	-26039.	2.204E-05	2943.4032	1.719E+12	282.5274	688381.	0.000
55.500	-0.006892	624952.	-21017.	3.080E-05	2772.0833	1.719E+12	275.5602	719671.	0.000
57.000	-0.006279	290956.	-16179.	3.559E-05	2636.8790	1.719E+12	261.9571	750962.	0.000
58.500	-0.005611	41804.	-11627.	3.733E-05	2536.0202	1.719E+12	243.8393	782252.	0.000

60.000	-0.004935	-128348.	-7424.7941	3.688E-05	2571.0541	1.719E+12	223.0427	813542.	0.000
61.500	-0.004283	-226221.	-3608.1272	3.502E-05	2610.6739	1.719E+12	201.0314	844832.	0.000
63.000	-0.003674	-258937.	-1112.6709	3.248E-05	2623.9174	1.719E+12	76.2415	373524.	0.000
64.500	-0.003114	-266923.	-272.8474	2.973E-05	2627.1503	1.719E+12	17.0722	98691.	0.000
66.000	-0.002604	-269350.	13.0224	2.692E-05	2628.1328	1.719E+12	14.6911	101563.	0.000
67.500	-0.002144	-266989.	257.2191	2.412E-05	2627.1771	1.719E+12	12.4418	104434.	0.000
69.000	-0.001735	-260570.	462.3097	2.136E-05	2624.5784	1.719E+12	10.3460	107305.	0.000
70.500	-0.001376	-250771.	631.2057	1.868E-05	2620.6116	1.719E+12	8.4202	110176.	0.000
72.000	-0.001063	-238217.	767.0757	1.612E-05	2615.5300	1.719E+12	6.6764	113048.	0.000
73.500	-0.000795	-223476.	873.2620	1.370E-05	2609.5626	1.719E+12	5.1220	115919.	0.000
75.000	-0.000570	-207052.	953.2018	1.145E-05	2602.9141	1.719E+12	3.7602	118790.	0.000
76.500	-0.000383	-189388.	1010.3533	9.374E-06	2595.7636	1.719E+12	2.5900	121661.	0.000
78.000	-0.000232	-170866.	1048.1289	7.488E-06	2588.2655	1.719E+12	1.6073	124533.	0.000
79.500	-0.000114	-151805.	1069.8332	5.799E-06	2580.5494	1.719E+12	0.8043	127404.	0.000
81.000	-2.356E-05	-132467.	1078.6066	4.311E-06	2572.7214	1.719E+12	0.1705	130275.	0.000
82.500	4.155E-05	-113060.	1077.3751	3.026E-06	2564.8654	1.719E+12	-0.3074	133146.	0.000
84.000	8.536E-05	-93742.	1068.8038	1.943E-06	2557.0450	1.719E+12	-0.6450	136018.	0.000
85.500	0.000111	-74622.	1055.2557	1.062E-06	2549.3052	1.719E+12	-0.8603	138889.	0.000
87.000	0.000124	-55774.	975.9531	3.791E-07	2541.6752	1.719E+12	-7.9511	1158133.	0.000
88.500	0.000125	-39495.	829.9675	-1.196E-07	2535.0856	1.719E+12	-8.2695	1189423.	0.000
90.000	0.000119	-25892.	682.7431	-4.619E-07	2529.5790	1.719E+12	-8.0887	1220713.	0.000
91.500	0.000109	-14907.	542.0118	-6.754E-07	2525.1322	1.719E+12	-7.5481	1252003.	0.000
93.000	9.496E-05	-6366.4696	413.1509	-7.868E-07	2521.6748	1.719E+12	-6.7698	1283293.	0.000
94.500	8.019E-05	-18.3118	299.5122	-8.202E-07	2519.1050	1.719E+12	-5.8567	1314583.	0.000
96.000	6.543E-05	4432.2690	202.7730	-7.971E-07	2520.8918	1.719E+12	-4.8921	1345873.	0.000
97.500	5.150E-05	7297.3566	123.2844	-7.357E-07	2522.0516	1.719E+12	-3.9400	1377163.	0.000
99.000	3.894E-05	8885.1283	60.4008	-6.510E-07	2522.6944	1.719E+12	-3.0471	1408453.	0.000
100.500	2.806E-05	9484.7229	12.7772	-5.549E-07	2522.9371	1.719E+12	-2.2444	1439743.	0.000
102.000	1.897E-05	9356.1332	-21.3731	-4.562E-07	2522.8850	1.719E+12	-1.5500	1471033.	0.000
103.500	1.164E-05	8724.3583	-44.0640	-3.616E-07	2522.6293	1.719E+12	-0.9712	1502324.	0.000
105.000	5.950E-06	7777.0150	-57.3667	-2.752E-07	2522.2458	1.719E+12	-0.5069	1533614.	0.000
106.500	1.728E-06	6664.6260	-63.2813	-1.996E-07	2521.7955	1.719E+12	-0.1503	1564904.	0.000
108.000	-1.237E-06	5502.8550	-63.6745	-1.359E-07	2521.3252	1.719E+12	0.1066	1551470.	0.000
109.500	-3.165E-06	4375.0457	-60.2107	-8.422E-08	2520.8686	1.719E+12	0.2783	1582760.	0.000
111.000	-4.268E-06	3336.9430	-54.2615	-4.385E-08	2520.4484	1.719E+12	0.3827	1614050.	0.000
112.500	-4.743E-06	2422.5020	-46.9148	-1.370E-08	2520.0782	1.719E+12	0.4336	1645340.	0.000
114.000	-4.762E-06	1648.2840	-39.0210	7.611E-09	2519.7648	1.719E+12	0.4435	1676630.	0.000
115.500	-4.469E-06	1017.5939	-31.2128	2.157E-08	2519.5095	1.719E+12	0.4241	1707920.	0.000
117.000	-3.985E-06	524.1930	-23.9308	2.964E-08	2519.3098	1.719E+12	0.3851	1739211.	0.000
118.500	-3.402E-06	155.4960	-17.4534	3.319E-08	2519.1605	1.719E+12	0.3347	1770501.	0.000
120.000	-2.790E-06	-104.7889	-11.9278	3.346E-08	2519.1400	1.719E+12	0.2793	1801791.	0.000
121.500	-2.198E-06	-274.5714	-7.3998	3.147E-08	2519.2087	1.719E+12	0.2238	1833081.	0.000
123.000	-1.657E-06	-371.8089	-3.8408	2.809E-08	2519.2481	1.719E+12	0.1716	1864371.	0.000
124.500	-1.187E-06	-413.3969	-1.1714	2.398E-08	2519.2649	1.719E+12	0.1250	1895661.	0.000
126.000	-7.938E-07	-414.4554	0.7181	1.965E-08	2519.2654	1.719E+12	0.0850	1926951.	0.000
127.500	-4.793E-07	-387.9361	1.9522	1.545E-08	2519.2546	1.719E+12	0.0521	1958241.	0.000
129.000	-2.378E-07	-344.4835	2.6580	1.161E-08	2519.2370	1.719E+12	0.0263	1989531.	0.000
130.500	-6.122E-08	-292.4796	2.9564	8.278E-09	2519.2160	1.719E+12	0.006873	2020821.	0.000
132.000	6.023E-08	-238.2186	2.9564	5.500E-09	2519.1940	1.719E+12	-0.006866	2052111.	0.000
133.500	1.368E-07	-186.1575	2.7521	3.279E-09	2519.1730	1.719E+12	-0.0158	2083401.	0.000
135.000	1.783E-07	-139.2066	2.4212	1.575E-09	2519.1539	1.719E+12	-0.0209	2114691.	0.000
136.500	1.935E-07	-99.0265	2.0251	3.284E-10	2519.1377	1.719E+12	-0.0231	2145981.	0.000
138.000	1.901E-07	-66.3105	1.6105	-5.371E-10	2519.1244	1.719E+12	-0.0230	2177271.	0.000
139.500	1.742E-07	-41.0369	1.2113	-1.099E-09	2519.1142	1.719E+12	-0.0214	2208561.	0.000
141.000	1.505E-07	-22.6829	0.8504	-1.433E-09	2519.1068	1.719E+12	-0.0187	2239852.	0.000
142.500	1.226E-07	-10.3949	0.5426	-1.606E-09	2519.1018	1.719E+12	-0.0155	2271142.	0.000
144.000	9.271E-08	-3.1174	0.2967	-1.676E-09	2519.0989	1.719E+12	-0.0119	2302432.	0.000
145.500	6.224E-08	0.3181	0.1173	-1.691E-09	2519.0977	1.719E+12	-0.008070	2333722.	0.000
147.000	3.183E-08	1.1391	0.007035	-1.683E-09	2519.0981	1.719E+12	-0.004182	2365012.	0.000
148.500	1.636E-09	0.6049	-0.0326	-1.674E-09	2519.0978	1.719E+12	-0.000218	2396302.	0.000
150.000	-2.844E-08	0.000	0.000	-1.671E-09	2519.0976	1.719E+12	0.003836	1213796.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 3:

```
Pile-head deflection             =      0.5000000 inches
Computed slope at pile head      =   -0.000008639 radians
Maximum bending moment           =     -21564937. inch-lbs
Maximum shear force              =         91621. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =      12.0000000 feet below pile head
Number of iterations             =               9
Number of zero deflection points =               5
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 4

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 1.000000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 552000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/in	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.0000	-38300450.	154203.	0.000	18023.	1.719E+12	0.000	0.000	0.000
1.500	0.9964	-35522800.	154203.	-0.000386	16899.	1.719E+12	0.000	0.000	0.000
3.000	0.9861	-32741456.	154203.	-0.000744	15773.	1.719E+12	0.000	0.000	0.000
4.500	0.9696	-29956706.	154203.	-0.001072	14646.	1.719E+12	0.000	0.000	0.000
6.000	0.9475	-27168839.	154203.	-0.001371	13517.	1.719E+12	0.000	0.000	0.000
7.500	0.9203	-24378146.	154203.	-0.001641	12388.	1.719E+12	0.000	0.000	0.000
9.000	0.8884	-21584918.	154203.	-0.001881	11257.	1.719E+12	0.000	0.000	0.000
10.500	0.8525	-18789444.	154203.	-0.002093	10125.	1.719E+12	0.000	0.000	0.000
12.000	0.8131	-15992016.	154203.	-0.002275	8992.8006	1.719E+12	0.000	0.000	0.000
13.500	0.7706	-13192924.	154203.	-0.002428	7859.7046	1.719E+12	0.000	0.000	0.000
15.000	0.7257	-10392460.	154203.	-0.002551	6726.0531	1.719E+12	0.000	0.000	0.000
16.500	0.6788	-7590915.	154203.	-0.002645	5591.9640	1.719E+12	0.000	0.000	0.000
18.000	0.6305	-4788580.	154203.	-0.002710	4457.5552	1.719E+12	0.000	0.000	0.000
19.500	0.5812	-1985747.	154203.	-0.002745	3322.9448	1.719E+12	0.000	0.000	0.000
21.000	0.5316	817292.	154203.	-0.002752	2849.9445	1.719E+12	0.000	0.000	0.000
22.500	0.4822	3620247.	152137.	-0.002728	3984.6041	1.719E+12	-229.6246	8572.0184	0.000
24.000	0.4334	6348426.	145663.	-0.002676	5088.9942	1.719E+12	-489.6590	20336.	0.000
25.500	0.3858	8917296.	134588.	-0.002596	6128.8943	1.719E+12	-740.9175	34565.	0.000
27.000	0.3399	11245181.	119368.	-0.002491	7071.2417	1.719E+12	-950.1632	50311.	0.000
28.500	0.2962	13264043.	100758.	-0.002362	7888.4941	1.719E+12	-1117.6778	67928.	0.000
30.000	0.2549	14919398.	79673.	-0.002215	8558.5957	1.719E+12	-1225.0878	86512.	0.000
31.500	0.2164	16176272.	57288.	-0.002052	9067.3891	1.719E+12	-1262.1461	104968.	0.000
33.000	0.1810	17022529.	35011.	-0.001878	9409.9608	1.719E+12	-1212.9947	120616.	0.000
34.500	0.1488	17474004.	13786.	-0.001698	9592.7218	1.719E+12	-1145.3325	138535.	0.000
36.000	0.1199	17552574.	-5479.0961	-0.001514	9624.5276	1.719E+12	-995.2689	149414.	0.000
37.500	0.0943	17306851.	-22056.	-0.001332	9525.0569	1.719E+12	-846.5738	161603.	0.000
39.000	0.0720	16785038.	-36838.	-0.001153	9313.8225	1.719E+12	-795.8917	199109.	0.000
40.500	0.0528	16003610.	-50421.	-0.000982	8997.4938	1.719E+12	-713.3636	243331.	0.000
42.000	0.0366	14989387.	-62578.	-0.000820	8586.9279	1.719E+12	-637.3663	313420.	0.000
43.500	0.0233	13767098.	-73255.	-0.000669	8092.1352	1.719E+12	-548.9881	424770.	0.000
45.000	0.0125	12365506.	-81329.	-0.000532	7524.7586	1.719E+12	-348.1562	500641.	0.000
46.500	0.004102	10849824.	-85553.	-0.000411	6911.1978	1.719E+12	-121.2070	531931.	0.000
48.000	-0.002270	9293742.	-86005.	-0.000305	6281.2830	1.719E+12	71.0265	563221.	0.000
49.500	-0.006890	7759707.	-83318.	-0.000216	5660.2924	1.719E+12	227.5666	594511.	0.000
51.000	-0.0100	6298596.	-78126.	-0.000142	5068.8223	1.719E+12	349.3306	625801.	0.000
52.500	-0.0120	4950013.	-71033.	-8.358E-05	4522.9044	1.719E+12	438.7438	657091.	0.000
54.000	-0.0131	3743067.	-62590.	-3.808E-05	4034.3228	1.719E+12	499.3353	688381.	0.000
55.500	-0.0134	2697518.	-53278.	-4.363E-06	3611.0754	1.719E+12	535.3342	719671.	0.000
57.000	-0.0132	1825135.	-43499.	1.931E-05	3257.9278	1.719E+12	551.2819	750962.	0.000
58.500	-0.0127	1131179.	-33572.	3.479E-05	2977.0082	1.719E+12	551.6719	782252.	0.000

60.000	-0.0120	615846.	-23742.	4.393E-05	2768.3972	1.719E+12	540.6212	813542.	0.000
61.500	-0.0111	275610.	-14182.	4.860E-05	2630.6670	1.719E+12	521.5760	844832.	0.000
63.000	-0.0102	104337.	-7580.3677	5.059E-05	2561.3341	1.719E+12	211.9118	373524.	0.000
64.500	-0.009292	1711.9319	-5214.6620	5.114E-05	2519.7906	1.719E+12	50.9444	98691.	0.000
66.000	-0.008371	-84407.	-4331.0787	5.071E-05	2553.2664	1.719E+12	47.2315	101563.	0.000
67.500	-0.007466	-155215.	-3516.1409	4.945E-05	2581.9298	1.719E+12	43.3171	104434.	0.000
69.000	-0.006590	-211971.	-2772.6901	4.753E-05	2604.9053	1.719E+12	39.2885	107305.	0.000
70.500	-0.005755	-255976.	-2102.0684	4.508E-05	2622.7188	1.719E+12	35.2250	110176.	0.000
72.000	-0.004967	-288541.	-1504.2620	4.223E-05	2635.9016	1.719E+12	31.1979	113048.	0.000
73.500	-0.004234	-310969.	-978.0528	3.909E-05	2644.9803	1.719E+12	27.2698	115919.	0.000
75.000	-0.003560	-324528.	-521.1741	3.577E-05	2650.4694	1.719E+12	23.4945	118790.	0.000
76.500	-0.002947	-330442.	-130.4661	3.234E-05	2652.8632	1.719E+12	19.9175	121661.	0.000
78.000	-0.002396	-329868.	197.9714	2.888E-05	2652.6308	1.719E+12	16.5756	124533.	0.000
79.500	-0.001907	-323889.	468.6329	2.546E-05	2650.2105	1.719E+12	13.4979	127404.	0.000
81.000	-0.001479	-313503.	686.4684	2.212E-05	2646.0062	1.719E+12	10.7060	130275.	0.000
82.500	-0.001111	-299616.	856.7550	1.892E-05	2640.3845	1.719E+12	8.2147	133146.	0.000
84.000	-0.000798	-283036.	984.9785	1.587E-05	2633.6728	1.719E+12	6.0324	136018.	0.000
85.500	-0.000539	-264472.	1076.7275	1.300E-05	2626.1579	1.719E+12	4.1620	138889.	0.000
87.000	-0.000330	-244532.	1305.4658	1.033E-05	2618.0861	1.719E+12	21.2534	1158133.	0.000
88.500	-0.000167	-217680.	1596.2649	7.915E-06	2607.2164	1.719E+12	11.0576	1189423.	0.000
90.000	-4.537E-05	-187223.	1723.4778	5.796E-06	2594.8872	1.719E+12	3.0771	1220713.	0.000
91.500	4.131E-05	-155750.	1725.3119	4.000E-06	2582.1466	1.719E+12	-2.8733	1252003.	0.000
93.000	9.864E-05	-125192.	1636.1574	2.530E-06	2569.7762	1.719E+12	-7.0327	1283293.	0.000
94.500	0.000132	-96899.	1485.8474	1.367E-06	2558.3230	1.719E+12	-9.6684	1314583.	0.000
96.000	0.000148	-71728.	1299.3265	4.846E-07	2548.1338	1.719E+12	-11.0561	1345873.	0.000
97.500	0.000150	-50133.	1096.6501	-1.533E-07	2539.3917	1.719E+12	-11.4635	1377163.	0.000
99.000	0.000142	-32246.	893.2328	-5.845E-07	2532.1510	1.719E+12	-11.1384	1408453.	0.000
100.500	0.000129	-17965.	700.2745	-8.473E-07	2526.3698	1.719E+12	-10.3014	1439743.	0.000
102.000	0.000112	-7019.1836	525.2981	-9.781E-07	2521.9390	1.719E+12	-9.1405	1471033.	0.000
103.500	9.358E-05	965.5103	372.7416	-1.010E-06	2519.4884	1.719E+12	-7.8103	1502324.	0.000
105.000	7.549E-05	6419.5792	244.5608	-9.711E-07	2521.6963	1.719E+12	-6.4320	1533614.	0.000
106.500	5.862E-05	9788.9963	140.8071	-8.863E-07	2523.0603	1.719E+12	-5.0961	1564904.	0.000
108.000	4.359E-05	11506.	61.1303	-7.748E-07	2523.7554	1.719E+12	-3.7568	1551470.	0.000
109.500	3.072E-05	12005.	3.0045	-6.517E-07	2523.9574	1.719E+12	-2.7016	1582760.	0.000
111.000	2.012E-05	11627.	-37.5500	-5.280E-07	2523.8044	1.719E+12	-1.8045	1614050.	0.000
112.500	1.171E-05	10664.	-63.4274	-4.114E-07	2523.4144	1.719E+12	-1.0708	1645340.	0.000
114.000	5.315E-06	9352.1508	-77.5201	-3.066E-07	2522.8834	1.719E+12	-0.4951	1676630.	0.000
115.500	6.776E-07	7879.1496	-82.5543	-2.164E-07	2522.2871	1.719E+12	-0.0643	1707920.	0.000
117.000	-2.475E-06	6384.4961	-80.9809	-1.417E-07	2521.6821	1.719E+12	0.2391	1739211.	0.000
118.500	-4.424E-06	4966.6536	-74.9124	-8.230E-08	2521.1081	1.719E+12	0.4352	1770501.	0.000
120.000	-5.437E-06	3689.2860	-66.0974	-3.699E-08	2520.5910	1.719E+12	0.5443	1801791.	0.000
121.500	-5.756E-06	2587.8834	-55.9236	-4.128E-09	2520.1452	1.719E+12	0.5861	1833081.	0.000
123.000	-5.586E-06	1676.1199	-45.4411	1.819E-08	2519.7761	1.719E+12	0.5786	1864371.	0.000
124.500	-5.101E-06	951.6424	-35.3993	3.195E-08	2519.4828	1.719E+12	0.5372	1895661.	0.000
126.000	-4.436E-06	401.1096	-26.2909	3.903E-08	2519.2600	1.719E+12	0.4749	1926951.	0.000
127.500	-3.696E-06	4.3954	-18.3985	4.115E-08	2519.0994	1.719E+12	0.4020	1958241.	0.000
129.000	-2.954E-06	-262.0557	-11.8411	3.980E-08	2519.2037	1.719E+12	0.3266	1989531.	0.000
130.500	-2.263E-06	-422.6761	-6.6159	3.622E-08	2519.2687	1.719E+12	0.2540	2020821.	0.000
132.000	-1.651E-06	-500.9479	-2.6361	3.138E-08	2519.3004	1.719E+12	0.1882	2052111.	0.000
133.500	-1.133E-06	-518.1988	0.2376	2.605E-08	2519.3074	1.719E+12	0.1311	2083401.	0.000
135.000	-7.128E-07	-492.9122	2.1714	2.076E-08	2519.2971	1.719E+12	0.0837	2114691.	0.000
136.500	-3.856E-07	-440.4420	3.3388	1.587E-08	2519.2759	1.719E+12	0.0460	2145981.	0.000
138.000	-1.415E-07	-373.0301	3.9066	1.161E-08	2519.2486	1.719E+12	0.0171	2177271.	0.000
139.500	3.242E-08	-300.0356	4.0248	8.089E-09	2519.2191	1.719E+12	-0.003978	2208561.	0.000
141.000	1.498E-07	-228.2989	3.8213	5.324E-09	2519.1900	1.719E+12	-0.0186	2239852.	0.000
142.500	2.241E-07	-162.5763	3.3991	3.278E-09	2519.1634	1.719E+12	-0.0283	2271142.	0.000
144.000	2.678E-07	-105.9970	2.8364	1.872E-09	2519.1405	1.719E+12	-0.0342	2302432.	0.000
145.500	2.915E-07	-60.5034	2.1881	1.000E-09	2519.1221	1.719E+12	-0.0378	2333722.	0.000
147.000	3.038E-07	-27.2466	1.4888	5.408E-10	2519.1086	1.719E+12	-0.0399	2365012.	0.000
148.500	3.109E-07	-6.9181	0.7571	3.620E-10	2519.1004	1.719E+12	-0.0414	2396302.	0.000
150.000	3.168E-07	0.000	0.000	3.258E-10	2519.0976	1.719E+12	-0.0427	1213796.	0.000

* This analysis computed pile response using nonlinear moment-curvature relationships.
  Values of total stress due to combined axial and bending stresses are computed only
  for elastic sections only and do not equal the actual stresses in concrete and steel.
  Stresses in concrete and steel may be interpolated from the output for nonlinear
  bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =      1.0000000 inches
Computed slope at pile head      =     -0.0000145 radians
Maximum bending moment           =     -38300450. inch-lbs
Maximum shear force              =        154203. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =     21.0000000 feet below pile head
Number of iterations             =             10
Number of zero deflection points =              4
```

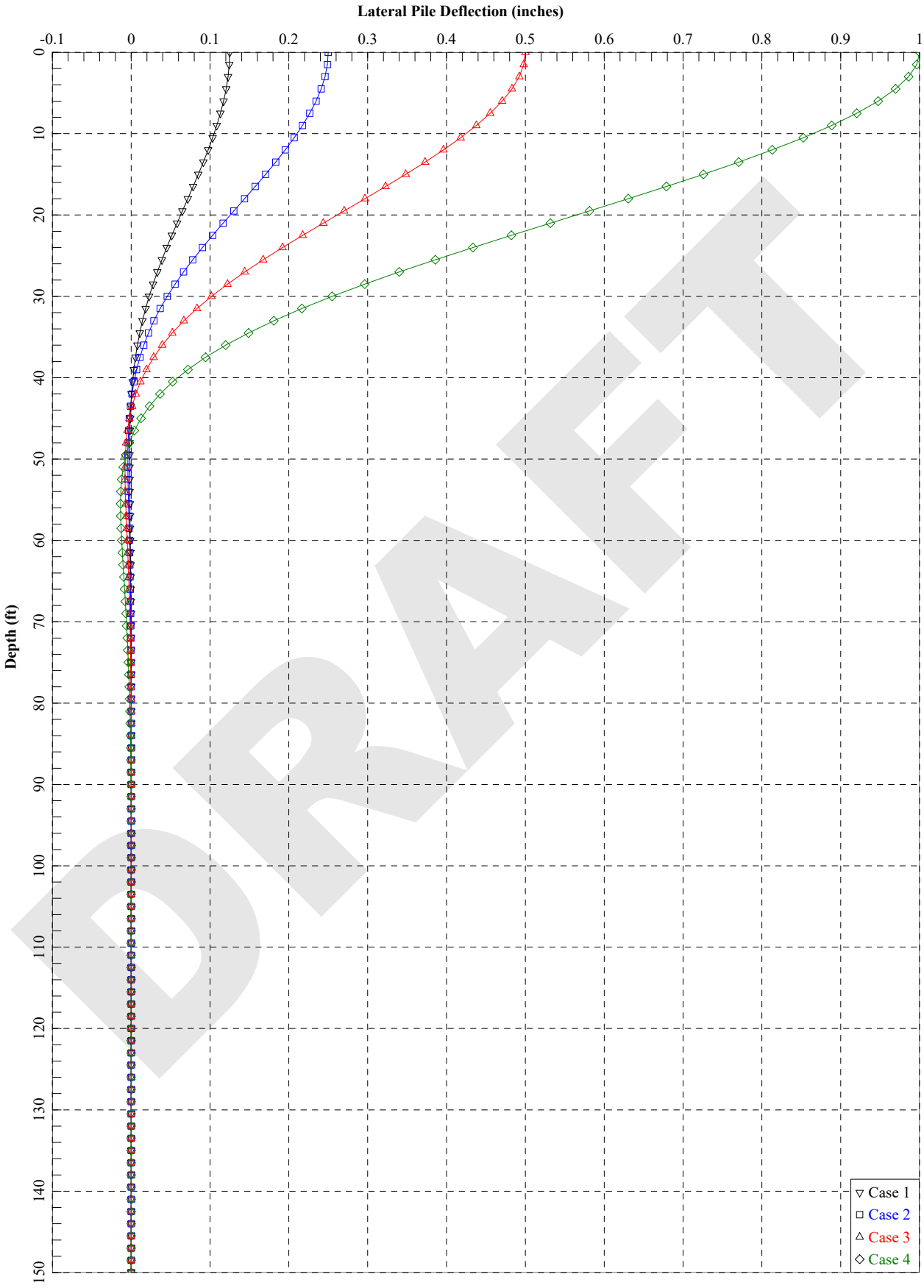
Summary of Pile Response(s)

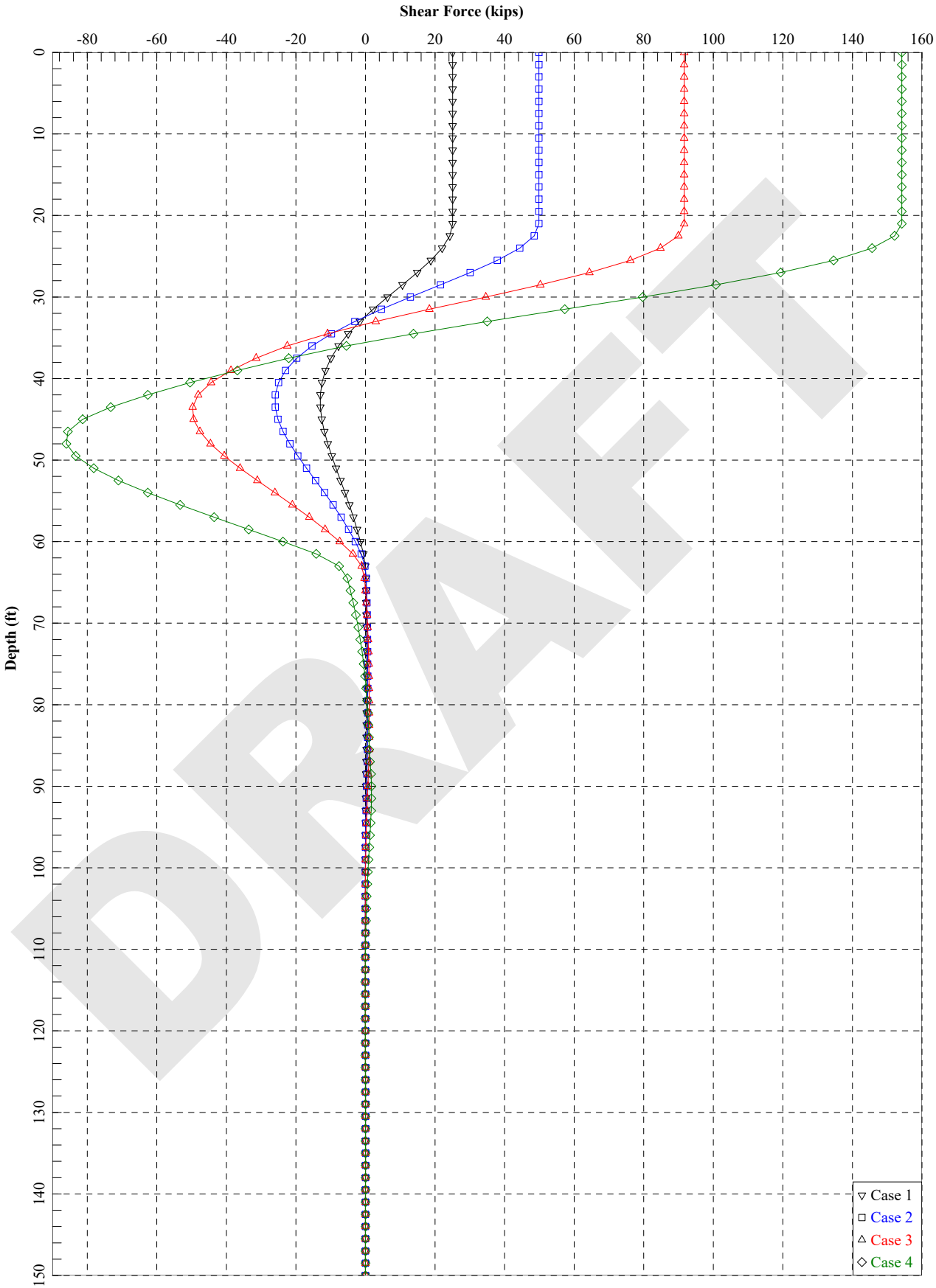
Definitions of Pile-head Loading Conditions:

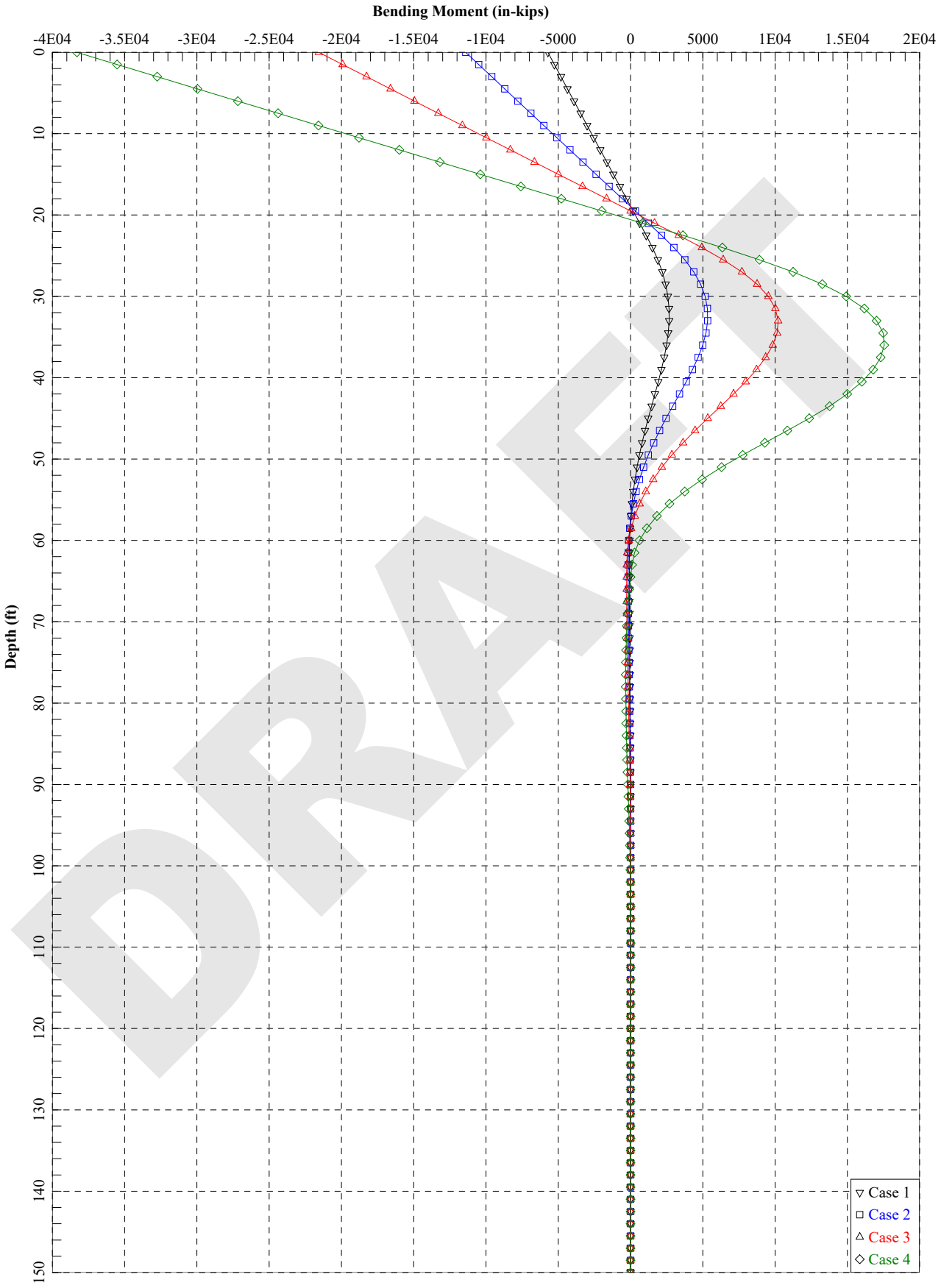
Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

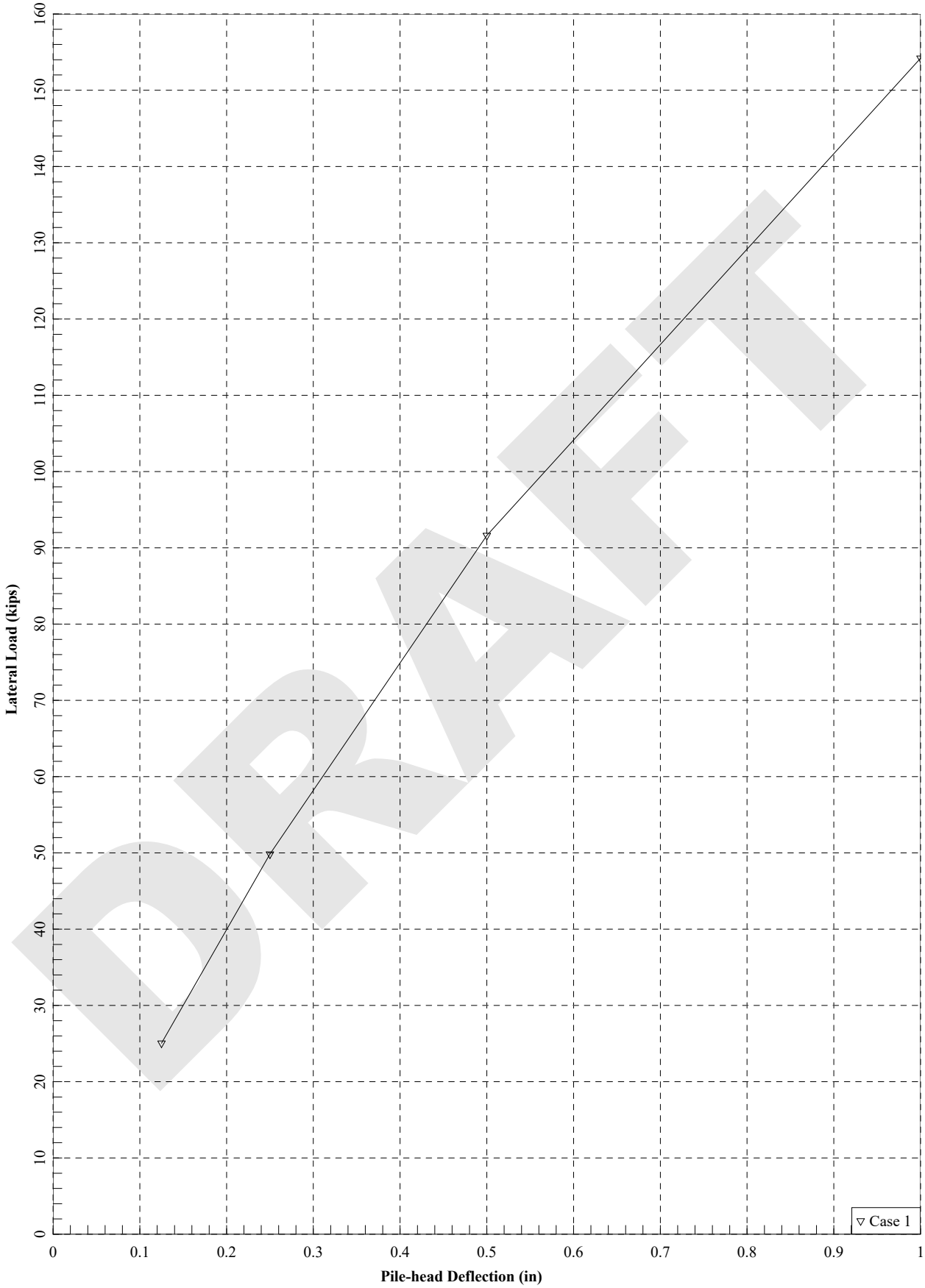
Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or y(inches)	Pile-head Condition 2 in-lb, rad., or in-lb/rad.	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in Pile in-lbs	Maximum Shear in Pile lbs	Pile-head Rotation radians
1	5	y = 0.1250	S = 0.000	552000.	0.12500000	-5716778.	25048.	-0.00000236
2	5	y = 0.2500	S = 0.000	552000.	0.25000000	-11400667.	49852.	-0.00000470
3	5	y = 0.5000	S = 0.000	552000.	0.50000000	-21564937.	91621.	-0.00000864
4	5	y = 1.0000	S = 0.000	552000.	1.00000000	-38300450.	154203.	-0.00001454

The analysis ended normally.


Lateral Pile Deflection (inches)
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Shear Force (kips)
-80
-60
-40
-20
0
20
40
60
80
100
120
140
160
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Bending Moment (in-kips)
-4E04
-3.5E04
-3E04
-2.5E04
-2E04
-1.5E04
-1E04
-5000
0
5000
1E04
1.5E04
2E04
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Case 1
Case 2
Case 3
Case 4


Lateral Load (kips)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Pile-head Deflection (in)
▽ Case 1

APPENDIX E

PILE DRIVEABILITY ANALYSES

GeoStellar Engineering

APPENDIX E
PILE DRIVEABILITY ANALYSES

The following WEAP driveability analyses are included in this appendix:

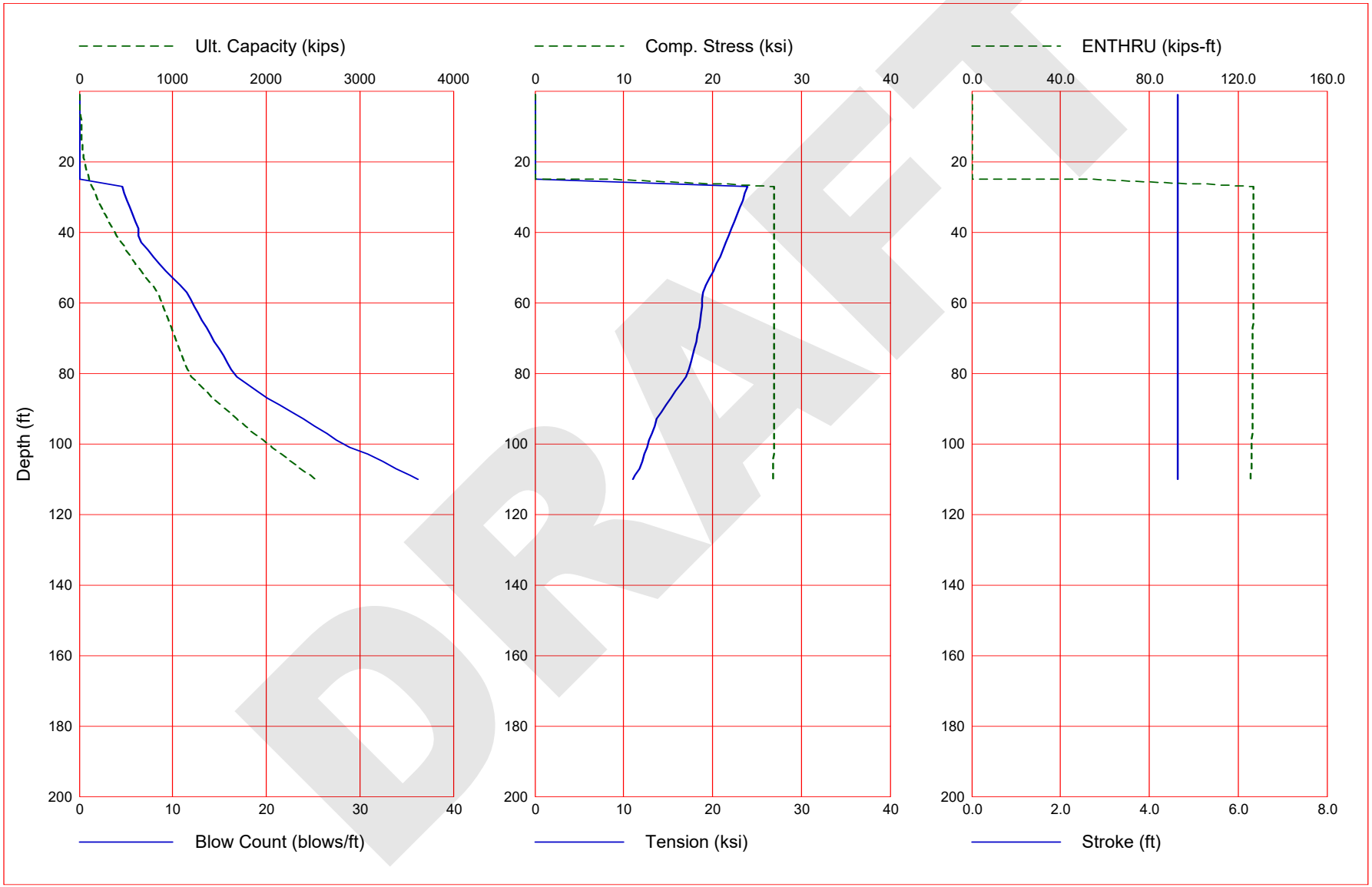
- GRLWEAP Driveability Graphical and Tabular Results

GRLWEAP Driveability Graphical and Tabular Results

GeoStellar Engineering, LLC
RBO Four Hole Swamp 4' OEP weak zone

Mar 08 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	0.3	0.3	0.0	0.0	0.000	0.000	4.65	0.0
3.0	2.7	2.6	0.1	0.0	0.000	0.000	4.65	0.0
5.0	7.5	7.3	0.2	0.0	0.000	0.000	4.65	0.0
7.0	14.5	14.3	0.2	0.0	0.000	0.000	4.65	0.0
9.0	22.3	22.2	0.1	0.0	0.000	0.000	4.65	0.0
11.0	23.4	23.4	0.0	0.0	0.000	0.000	4.65	0.0
13.0	24.4	24.3	0.1	0.0	0.000	0.000	4.65	0.0
15.0	31.4	31.2	0.1	0.0	0.000	0.000	4.65	0.0
17.0	40.1	40.0	0.1	0.0	0.000	0.000	4.65	0.0
19.0	49.8	49.7	0.1	0.0	0.000	0.000	4.65	0.0
21.0	62.2	61.8	0.4	0.0	0.000	0.000	4.65	0.0
23.0	84.7	84.0	0.7	0.0	0.000	0.000	4.65	0.0
25.0	110.6	109.9	0.8	0.0	0.000	0.000	4.65	0.0
27.0	138.9	138.0	0.8	4.6	26.886	-23.919	4.65	126.8
29.0	169.4	168.5	0.9	4.8	26.886	-23.659	4.65	126.8
31.0	202.3	201.4	1.0	5.1	26.886	-23.362	4.65	126.8
33.0	237.6	236.5	1.0	5.4	26.886	-23.065	4.65	126.8
35.0	275.1	274.0	1.1	5.7	26.886	-22.745	4.65	126.8
37.0	315.1	314.0	1.2	6.0	26.886	-22.437	4.65	126.8
39.0	357.4	356.2	1.2	6.3	26.886	-22.141	4.65	126.8
41.0	402.0	400.7	1.3	6.3	26.886	-21.822	4.65	126.8
43.0	449.0	447.7	1.3	6.6	26.886	-21.509	4.65	126.8
45.0	498.3	496.9	1.4	7.3	26.886	-21.174	4.65	126.8
47.0	549.9	548.5	1.5	7.9	26.886	-20.825	4.65	126.8
49.0	604.0	602.5	1.5	8.6	26.886	-20.462	4.65	126.8
51.0	660.4	658.8	1.6	9.3	26.886	-20.078	4.65	126.8
53.0	718.9	717.3	1.6	10.0	26.886	-19.694	4.65	126.8
55.0	779.8	778.2	1.6	10.8	26.886	-19.292	4.65	126.8
57.0	837.6	836.7	0.9	11.5	26.886	-18.944	4.65	126.8
59.0	869.0	868.9	0.1	11.9	26.886	-18.871	4.65	126.8
61.0	896.9	896.8	0.1	12.3	26.886	-18.806	4.65	126.8
63.0	925.3	925.2	0.1	12.7	26.886	-18.726	4.65	126.8
65.0	954.0	953.8	0.1	13.1	26.886	-18.610	4.65	126.8
67.0	982.9	982.7	0.1	13.6	26.886	-18.481	4.65	126.7
69.0	1012.3	1012.1	0.1	14.0	26.886	-18.339	4.65	126.7
71.0	1041.9	1041.8	0.1	14.4	26.886	-18.163	4.65	126.7
73.0	1072.1	1071.9	0.1	14.9	26.886	-17.987	4.65	126.7
75.0	1102.5	1102.3	0.1	15.4	26.886	-17.792	4.65	126.7
77.0	1133.2	1133.0	0.1	15.8	26.886	-17.585	4.65	126.7
79.0	1164.3	1164.2	0.1	16.3	26.886	-17.362	4.65	126.7
81.0	1202.0	1201.1	0.9	16.9	26.886	-17.062	4.65	126.6
83.0	1273.6	1272.0	1.6	17.9	26.886	-16.468	4.65	126.6
85.0	1352.0	1350.4	1.6	19.0	26.886	-15.860	4.65	126.6
87.0	1432.9	1431.3	1.6	20.1	26.892	-15.297	4.65	126.5
89.0	1516.1	1514.5	1.6	21.4	26.895	-14.762	4.65	126.5
91.0	1601.6	1600.0	1.6	22.7	26.900	-14.230	4.65	126.4
93.0	1689.3	1687.7	1.6	23.9	26.899	-13.747	4.65	126.4
95.0	1779.5	1777.9	1.6	25.2	26.903	-13.458	4.65	126.3
97.0	1872.0	1870.4	1.6	26.5	26.898	-13.170	4.65	126.3
99.0	1966.8	1965.2	1.6	27.5	26.899	-12.895	4.65	126.2
101.0	2064.0	2062.4	1.6	28.9	26.889	-12.616	4.65	126.1
103.0	2163.5	2161.9	1.6	30.8	26.884	-12.350	4.65	126.1
105.0	2265.3	2263.7	1.6	32.5	26.870	-12.074	4.65	126.0

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
95.0	1779.5	1777.9	1.6	25.2	26.903	-13.458	4.65	126.3
97.0	1872.0	1870.4	1.6	26.5	26.898	-13.170	4.65	126.3
99.0	1966.8	1965.2	1.6	27.5	26.899	-12.895	4.65	126.2
101.0	2064.0	2062.4	1.6	28.9	26.889	-12.616	4.65	126.1
103.0	2163.5	2161.9	1.6	30.8	26.884	-12.350	4.65	126.1
105.0	2265.3	2263.7	1.6	32.5	26.870	-12.074	4.65	126.0
107.0	2369.6	2368.0	1.6	33.9	26.857	-11.772	4.65	125.9
109.0	2476.2	2474.6	1.6	35.4	26.840	-11.297	4.65	125.8
110.0	2530.3	2528.7	1.6	36.2	26.825	-11.045	4.65	125.8

Total Number of Blows: 1304

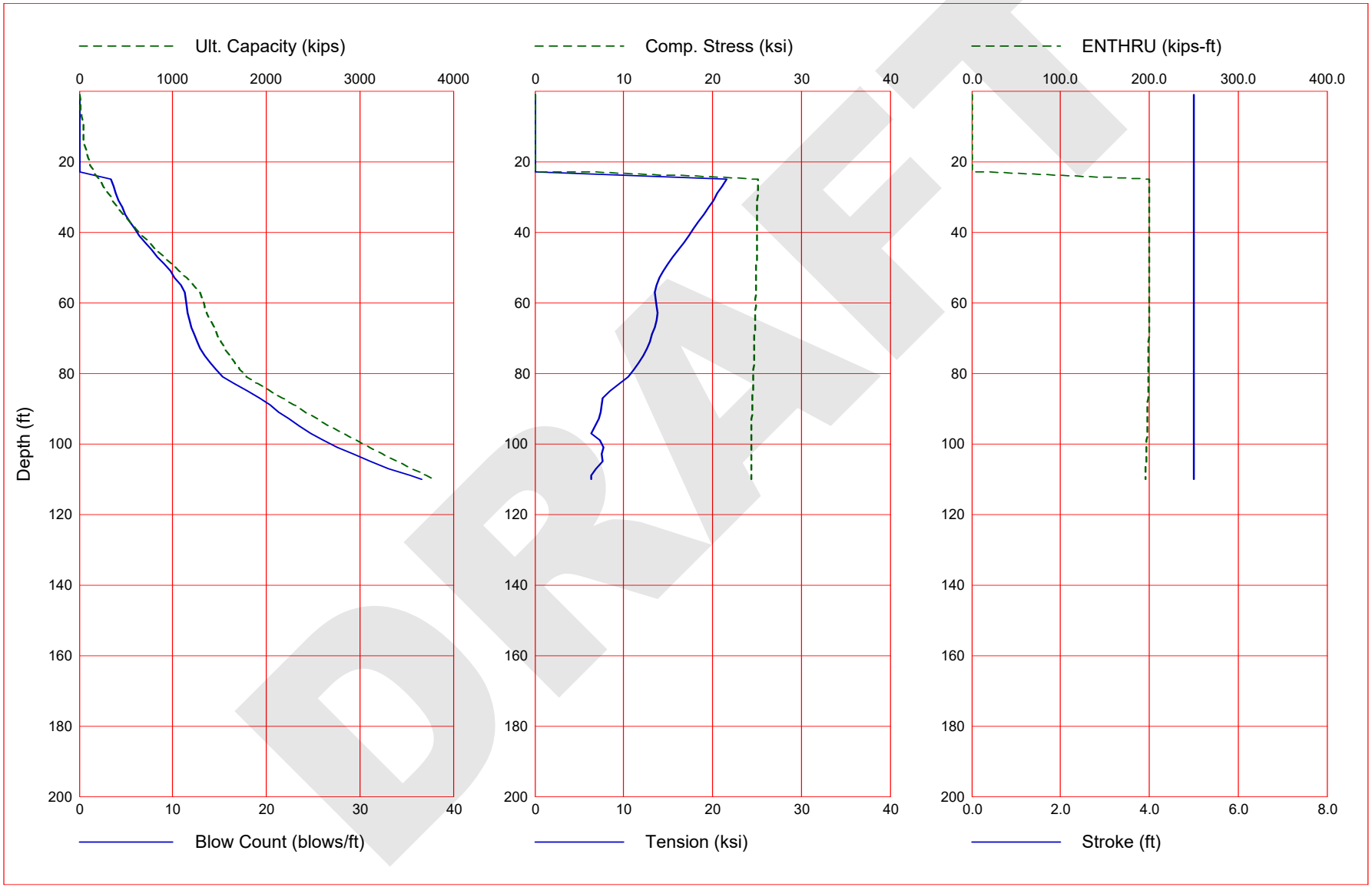
Driving Time (min):	43	32	26	21	18	16	14	13	11	10
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

GeoStellar Engineering, LLC
RBO Four Hole Swamp 4'PP plug weak zone

Mar 08 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	5.0	0.4	4.6	0.0	0.000	0.000	5.00	0.0
3.0	10.6	3.9	6.7	0.0	0.000	0.000	5.00	0.0
5.0	18.3	10.8	7.5	0.0	0.000	0.000	5.00	0.0
7.0	28.9	21.2	7.7	0.0	0.000	0.000	5.00	0.0
9.0	41.1	32.9	8.2	0.0	0.000	0.000	5.00	0.0
11.0	42.9	34.6	8.3	0.0	0.000	0.000	5.00	0.0
13.0	43.6	35.9	7.7	0.0	0.000	0.000	5.00	0.0
15.0	55.2	45.3	9.9	0.0	0.000	0.000	5.00	0.0
17.0	73.7	57.1	16.6	0.0	0.000	0.000	5.00	0.0
19.0	94.7	70.3	24.4	0.0	0.000	0.000	5.00	0.0
21.0	119.3	87.1	32.2	0.0	0.000	0.000	5.00	0.0
23.0	160.0	119.7	40.3	0.0	0.000	0.000	5.00	0.0
25.0	207.1	157.9	49.2	3.4	25.090	-21.584	5.00	200.2
27.0	255.8	199.6	56.2	3.7	25.086	-21.068	5.00	200.2
29.0	305.4	244.8	60.6	3.9	25.080	-20.581	5.00	200.2
31.0	358.4	293.6	64.8	4.2	25.062	-20.060	5.00	200.1
33.0	415.1	345.6	69.4	4.6	25.043	-19.538	5.00	200.1
35.0	475.2	401.2	74.0	4.9	25.019	-18.993	5.00	200.1
37.0	538.8	460.2	78.6	5.4	25.014	-18.435	5.00	200.1
39.0	605.7	522.8	82.9	5.9	25.007	-17.888	5.00	200.1
41.0	676.1	588.9	87.2	6.4	24.993	-17.322	5.00	200.0
43.0	750.1	658.3	91.8	7.0	25.003	-16.755	5.00	200.0
45.0	827.3	731.2	96.1	7.7	24.977	-16.159	5.00	200.0
47.0	907.7	807.6	100.2	8.4	24.992	-15.555	5.00	200.0
49.0	991.0	887.4	103.6	9.1	24.945	-14.956	5.00	200.0
51.0	1072.5	970.7	101.8	9.8	24.952	-14.423	5.00	199.9
53.0	1148.6	1057.4	91.2	10.2	24.911	-14.060	5.00	199.9
55.0	1223.4	1147.6	75.8	10.9	24.890	-13.741	5.00	199.9
57.0	1293.2	1233.8	59.4	11.3	24.882	-13.483	5.00	199.8
59.0	1320.5	1277.6	42.8	11.4	24.853	-13.597	5.00	199.8
61.0	1340.8	1314.6	26.2	11.5	24.854	-13.746	5.00	199.7
63.0	1365.8	1352.0	13.7	11.6	24.831	-13.817	5.00	199.7
65.0	1399.6	1390.0	9.6	11.8	24.804	-13.686	5.00	199.6
67.0	1438.0	1428.4	9.6	12.0	24.795	-13.461	5.00	199.5
69.0	1477.0	1467.4	9.6	12.3	24.735	-13.216	5.00	199.5
71.0	1516.4	1506.8	9.6	12.6	24.739	-12.940	5.00	199.4
73.0	1556.2	1546.6	9.6	12.9	24.687	-12.666	5.00	199.3
75.0	1604.7	1586.8	17.9	13.4	24.664	-12.235	5.00	199.2
77.0	1662.0	1627.5	34.6	14.0	24.649	-11.678	5.00	199.1
79.0	1720.0	1668.7	51.3	14.6	24.604	-11.150	5.00	198.9
81.0	1787.2	1719.2	68.0	15.3	24.603	-10.538	5.00	198.8
83.0	1908.0	1823.4	84.6	16.6	24.563	-9.527	5.00	198.7
85.0	2040.8	1939.5	101.3	18.0	24.535	-8.466	5.00	198.5
87.0	2168.7	2059.1	109.6	19.3	24.508	-7.605	5.00	198.4
89.0	2291.9	2182.3	109.6	20.4	24.445	-7.522	5.00	198.2
91.0	2418.5	2308.9	109.6	21.3	24.434	-7.394	5.00	198.0
93.0	2548.5	2438.9	109.6	22.4	24.407	-7.164	5.00	197.8
95.0	2681.9	2572.3	109.6	23.5	24.407	-6.793	5.00	197.6
97.0	2818.9	2709.3	109.6	24.8	24.407	-6.352	5.00	197.4
99.0	2959.3	2849.8	109.6	26.1	24.407	-7.294	5.00	197.2
101.0	3103.1	2993.5	109.6	27.6	24.407	-7.709	5.00	196.9
103.0	3250.4	3140.8	109.6	29.3	24.407	-7.565	5.00	196.7
105.0	3401.2	3291.6	109.6	31.1	24.408	-7.586	5.00	196.4

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

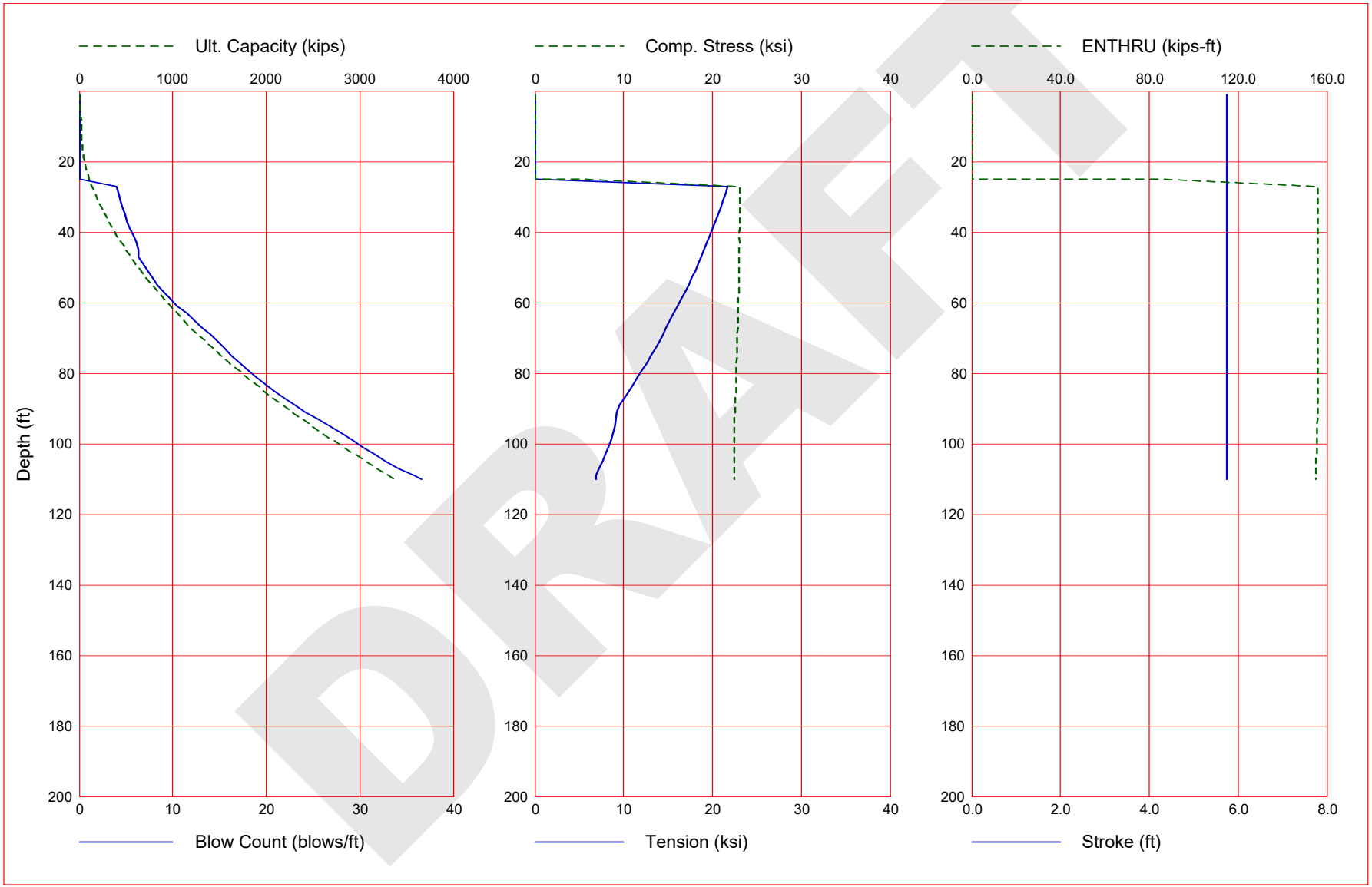
Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
95.0	2681.9	2572.3	109.6	23.5	24.407	-6.793	5.00	197.6
97.0	2818.9	2709.3	109.6	24.8	24.407	-6.352	5.00	197.4
99.0	2959.3	2849.8	109.6	26.1	24.407	-7.294	5.00	197.2
101.0	3103.1	2993.5	109.6	27.6	24.407	-7.709	5.00	196.9
103.0	3250.4	3140.8	109.6	29.3	24.407	-7.565	5.00	196.7
105.0	3401.2	3291.6	109.6	31.1	24.408	-7.586	5.00	196.4
107.0	3555.5	3445.9	109.6	33.1	24.408	-6.907	5.00	196.1
109.0	3713.3	3603.7	109.6	35.4	24.408	-6.368	5.00	195.9
110.0	3793.4	3683.9	109.6	36.6	24.408	-6.302	5.00	195.7

Total Number of Blows: 1239

Driving Time (min):	41	30	24	20	17	15	13	12	11	10
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	0.3	0.3	0.0	0.0	0.000	0.000	5.75	0.0
3.0	2.7	2.6	0.1	0.0	0.000	0.000	5.75	0.0
5.0	7.5	7.3	0.2	0.0	0.000	0.000	5.75	0.0
7.0	14.5	14.3	0.2	0.0	0.000	0.000	5.75	0.0
9.0	22.3	22.2	0.1	0.0	0.000	0.000	5.75	0.0
11.0	23.4	23.4	0.0	0.0	0.000	0.000	5.75	0.0
13.0	24.4	24.3	0.1	0.0	0.000	0.000	5.75	0.0
15.0	31.4	31.2	0.1	0.0	0.000	0.000	5.75	0.0
17.0	40.1	40.0	0.1	0.0	0.000	0.000	5.75	0.0
19.0	49.8	49.7	0.1	0.0	0.000	0.000	5.75	0.0
21.0	62.2	61.8	0.4	0.0	0.000	0.000	5.75	0.0
23.0	84.7	84.0	0.7	0.0	0.000	0.000	5.75	0.0
25.0	110.6	109.9	0.8	0.0	0.000	0.000	5.75	0.0
27.0	138.9	138.0	0.8	4.0	23.091	-21.720	5.75	156.1
29.0	169.4	168.5	0.9	4.2	23.086	-21.475	5.75	156.1
31.0	202.3	201.4	1.0	4.4	23.078	-21.198	5.75	156.1
33.0	237.6	236.5	1.0	4.6	23.060	-20.919	5.75	156.1
35.0	275.1	274.0	1.1	4.9	23.047	-20.611	5.75	156.1
37.0	315.1	314.0	1.2	5.1	23.045	-20.303	5.75	156.1
39.0	357.4	356.2	1.2	5.4	23.042	-19.999	5.75	156.1
41.0	402.0	400.7	1.3	5.8	23.038	-19.694	5.75	156.1
43.0	449.0	447.7	1.3	6.1	23.049	-19.394	5.75	156.1
45.0	498.3	496.9	1.4	6.3	23.028	-19.086	5.75	156.1
47.0	549.9	548.5	1.5	6.3	23.036	-18.768	5.75	156.1
49.0	604.0	602.5	1.5	6.8	22.997	-18.434	5.75	156.1
51.0	660.4	658.8	1.6	7.3	22.996	-18.063	5.75	156.1
53.0	718.9	717.3	1.6	7.8	22.965	-17.686	5.75	156.1
55.0	779.8	778.2	1.6	8.4	22.943	-17.288	5.75	156.1
57.0	843.1	841.5	1.6	9.1	22.946	-16.882	5.75	156.1
59.0	908.7	907.1	1.6	9.8	22.916	-16.471	5.75	156.1
61.0	976.6	975.0	1.6	10.5	22.912	-16.050	5.75	156.1
63.0	1046.9	1045.3	1.6	11.5	22.887	-15.638	5.75	156.1
65.0	1119.5	1117.9	1.6	12.3	22.867	-15.226	5.75	156.1
67.0	1194.5	1192.9	1.6	13.1	22.850	-14.821	5.75	156.1
69.0	1271.8	1270.2	1.6	14.0	22.808	-14.446	5.75	156.1
71.0	1351.5	1349.9	1.6	14.8	22.801	-14.019	5.75	156.1
73.0	1433.5	1431.9	1.6	15.5	22.759	-13.580	5.75	156.1
75.0	1517.9	1516.3	1.6	16.3	22.741	-13.100	5.75	156.0
77.0	1604.6	1603.0	1.6	17.2	22.717	-12.613	5.75	156.0
79.0	1693.5	1691.9	1.6	18.0	22.680	-12.105	5.75	156.0
81.0	1784.8	1783.2	1.6	18.9	22.675	-11.593	5.75	156.0
83.0	1878.5	1876.9	1.6	19.8	22.643	-11.097	5.75	156.0
85.0	1974.5	1972.9	1.6	20.8	22.621	-10.577	5.75	155.9
87.0	2072.8	2071.2	1.6	21.9	22.599	-10.058	5.75	155.9
89.0	2173.6	2172.0	1.6	23.0	22.556	-9.537	5.75	155.9
91.0	2276.6	2275.0	1.6	24.2	22.545	-9.209	5.75	155.8
93.0	2381.9	2380.3	1.6	25.5	22.502	-9.091	5.75	155.8

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
95.0	2489.7	2488.1	1.6	26.8	22.483	-8.963	5.75	155.7
97.0	2599.8	2598.2	1.6	28.1	22.467	-8.801	5.75	155.6
99.0	2712.2	2710.6	1.6	29.2	22.467	-8.577	5.75	155.6
101.0	2827.0	2825.4	1.6	30.3	22.467	-8.302	5.75	155.5
103.0	2944.1	2942.5	1.6	31.5	22.467	-7.987	5.75	155.4
105.0	3063.5	3061.9	1.6	32.8	22.467	-7.607	5.75	155.3
107.0	3185.2	3183.6	1.6	34.2	22.467	-7.191	5.75	155.2
109.0	3309.3	3307.7	1.6	35.8	22.468	-6.849	5.75	155.1
110.0	3372.2	3370.6	1.6	36.6	22.469	-6.854	5.75	155.0

Total Number of Blows: 1304

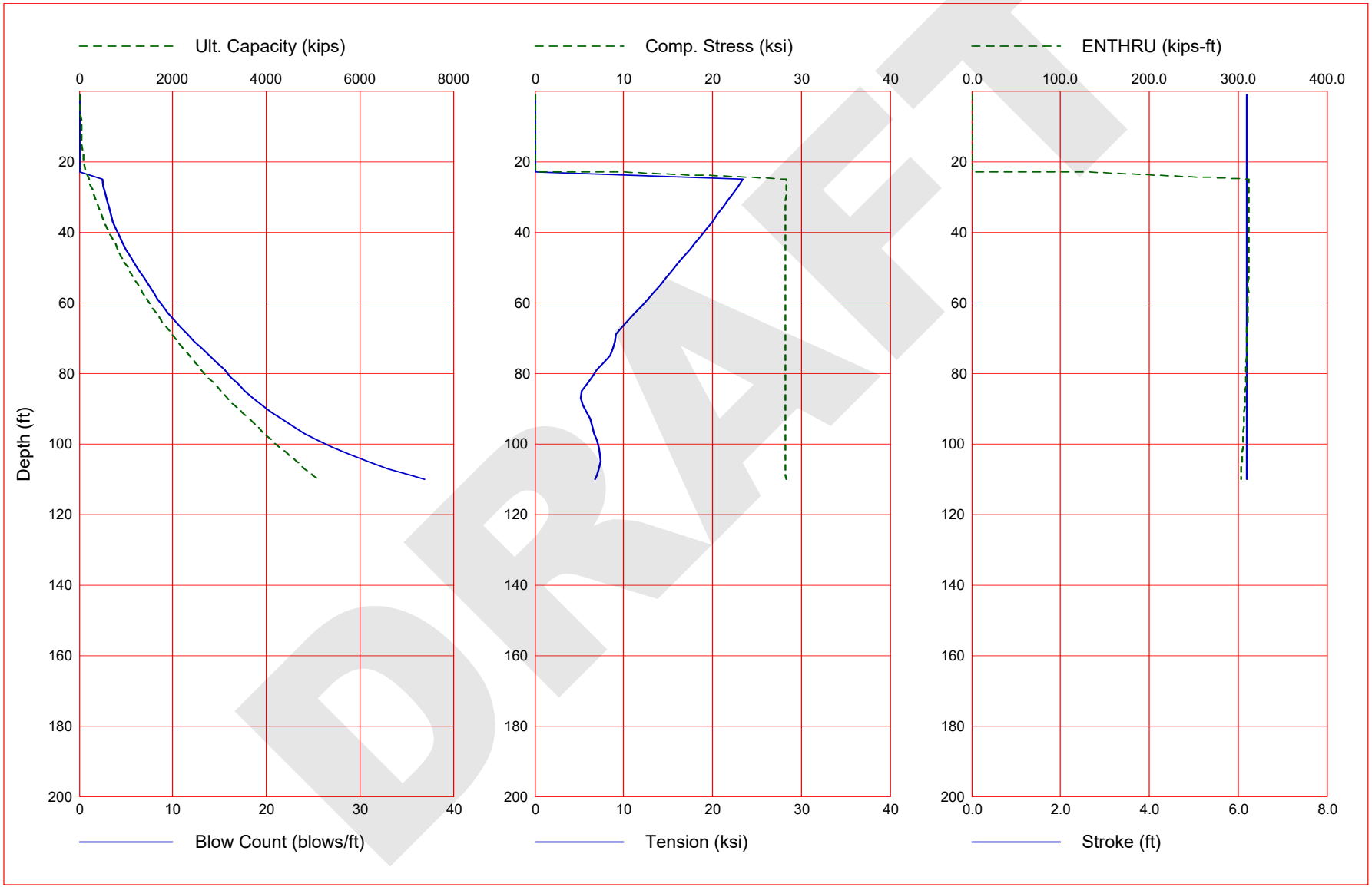
Driving Time (min):	43	32	26	21	18	16	14	13	11	10
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

GeoStellar Engineering, LLC
RBO Four Hole Swamp 4'PP plug

Mar 08 2016
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.0	5.0	0.4	4.6	0.0	0.000	0.000	6.20	0.0
3.0	10.6	3.9	6.7	0.0	0.000	0.000	6.20	0.0
5.0	18.3	10.8	7.5	0.0	0.000	0.000	6.20	0.0
7.0	28.9	21.2	7.7	0.0	0.000	0.000	6.20	0.0
9.0	41.1	32.9	8.2	0.0	0.000	0.000	6.20	0.0
11.0	42.9	34.6	8.3	0.0	0.000	0.000	6.20	0.0
13.0	43.6	35.9	7.7	0.0	0.000	0.000	6.20	0.0
15.0	55.2	45.3	9.9	0.0	0.000	0.000	6.20	0.0
17.0	73.7	57.1	16.6	0.0	0.000	0.000	6.20	0.0
19.0	94.7	70.3	24.4	0.0	0.000	0.000	6.20	0.0
21.0	119.3	87.1	32.2	0.0	0.000	0.000	6.20	0.0
23.0	160.0	119.7	40.3	0.0	0.000	0.000	6.20	0.0
25.0	207.1	157.9	49.2	2.5	28.276	-23.390	6.20	312.3
27.0	255.8	199.6	56.2	2.6	28.275	-22.827	6.20	312.3
29.0	305.4	244.8	60.6	2.8	28.267	-22.301	6.20	312.3
31.0	358.4	293.6	64.8	3.0	28.249	-21.727	6.20	312.3
33.0	415.1	345.6	69.4	3.2	28.234	-21.156	6.20	312.3
35.0	475.2	401.2	74.0	3.4	28.234	-20.563	6.20	312.3
37.0	538.8	460.2	78.6	3.6	28.234	-19.959	6.20	312.2
39.0	605.7	522.8	82.9	3.9	28.234	-19.351	6.20	312.2
41.0	676.1	588.9	87.2	4.3	28.234	-18.708	6.20	312.2
43.0	750.1	658.3	91.8	4.6	28.246	-18.063	6.20	312.1
45.0	827.3	731.2	96.1	5.0	28.234	-17.396	6.20	312.0
47.0	907.7	807.6	100.2	5.5	28.234	-16.722	6.20	311.9
49.0	991.0	887.4	103.6	5.9	28.234	-16.065	6.20	311.8
51.0	1076.8	970.7	106.2	6.4	28.234	-15.405	6.20	312.0
53.0	1165.3	1057.4	107.9	6.9	28.234	-14.763	6.20	311.5
55.0	1256.4	1147.6	108.8	7.4	28.234	-14.091	6.20	311.3
57.0	1350.7	1241.3	109.3	7.9	28.234	-13.402	6.20	311.6
59.0	1448.1	1338.6	109.6	8.4	28.234	-12.697	6.20	310.9
61.0	1548.7	1439.1	109.6	9.0	28.234	-11.966	6.20	310.7
63.0	1652.7	1543.2	109.6	9.5	28.234	-11.234	6.20	310.6
65.0	1760.3	1650.7	109.6	10.2	28.234	-10.477	6.20	310.4
67.0	1871.4	1761.8	109.6	10.9	28.234	-9.717	6.20	310.3
69.0	1985.7	1876.2	109.6	11.6	28.234	-9.125	6.20	310.1
71.0	2103.6	1994.0	109.6	12.3	28.234	-9.023	6.20	309.9
73.0	2225.0	2115.4	109.6	13.1	28.234	-8.839	6.20	309.6
75.0	2349.9	2240.3	109.6	13.9	28.234	-8.477	6.20	309.4
77.0	2478.3	2368.7	109.6	14.7	28.234	-7.694	6.20	309.1
79.0	2610.0	2500.4	109.6	15.5	28.234	-7.022	6.20	308.9
81.0	2745.2	2635.7	109.6	16.2	28.234	-6.413	6.20	308.6
83.0	2884.0	2774.4	109.6	17.0	28.234	-5.873	6.20	308.3
85.0	3026.2	2916.6	109.6	17.7	28.234	-5.258	6.20	308.0
87.0	3171.7	3062.1	109.6	18.6	28.234	-5.208	6.20	307.7
89.0	3320.8	3211.2	109.6	19.5	28.234	-5.377	6.20	307.4
91.0	3473.3	3363.7	109.6	20.5	28.234	-5.847	6.20	307.0
93.0	3629.4	3519.8	109.6	21.6	28.234	-6.211	6.20	306.7
95.0	3788.9	3679.4	109.6	22.8	28.234	-6.441	6.20	306.3
97.0	3951.8	3842.2	109.6	24.1	28.234	-6.670	6.20	306.0
99.0	4118.2	4008.6	109.6	25.5	28.234	-7.002	6.20	305.6
101.0	4288.1	4178.5	109.6	27.1	28.234	-7.228	6.20	305.2
103.0	4461.5	4351.9	109.6	28.8	28.234	-7.318	6.20	304.7
105.0	4638.4	4528.8	109.6	30.8	28.234	-7.403	6.20	304.3

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000 (Continued)

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
95.0	3788.9	3679.4	109.6	22.8	28.234	-6.441	6.20	306.3
97.0	3951.8	3842.2	109.6	24.1	28.234	-6.670	6.20	306.0
99.0	4118.2	4008.6	109.6	25.5	28.234	-7.002	6.20	305.6
101.0	4288.1	4178.5	109.6	27.1	28.234	-7.228	6.20	305.2
103.0	4461.5	4351.9	109.6	28.8	28.234	-7.318	6.20	304.7
105.0	4638.4	4528.8	109.6	30.8	28.234	-7.403	6.20	304.3
107.0	4818.6	4709.0	109.6	33.0	28.236	-7.248	6.20	303.9
109.0	5002.3	4892.8	109.6	35.5	28.254	-6.947	6.20	303.5
110.0	5095.5	4985.9	109.6	36.9	28.272	-6.796	6.20	303.3

Total Number of Blows: 1133

Driving Time (min):	37	28	22	18	16	14	12	11	10	9
@Blow Rate (b/min):	30	40	50	60	70	80	90	100	110	120

Driving Time for continuously running hammer; any wait times not included

APPENDIX F

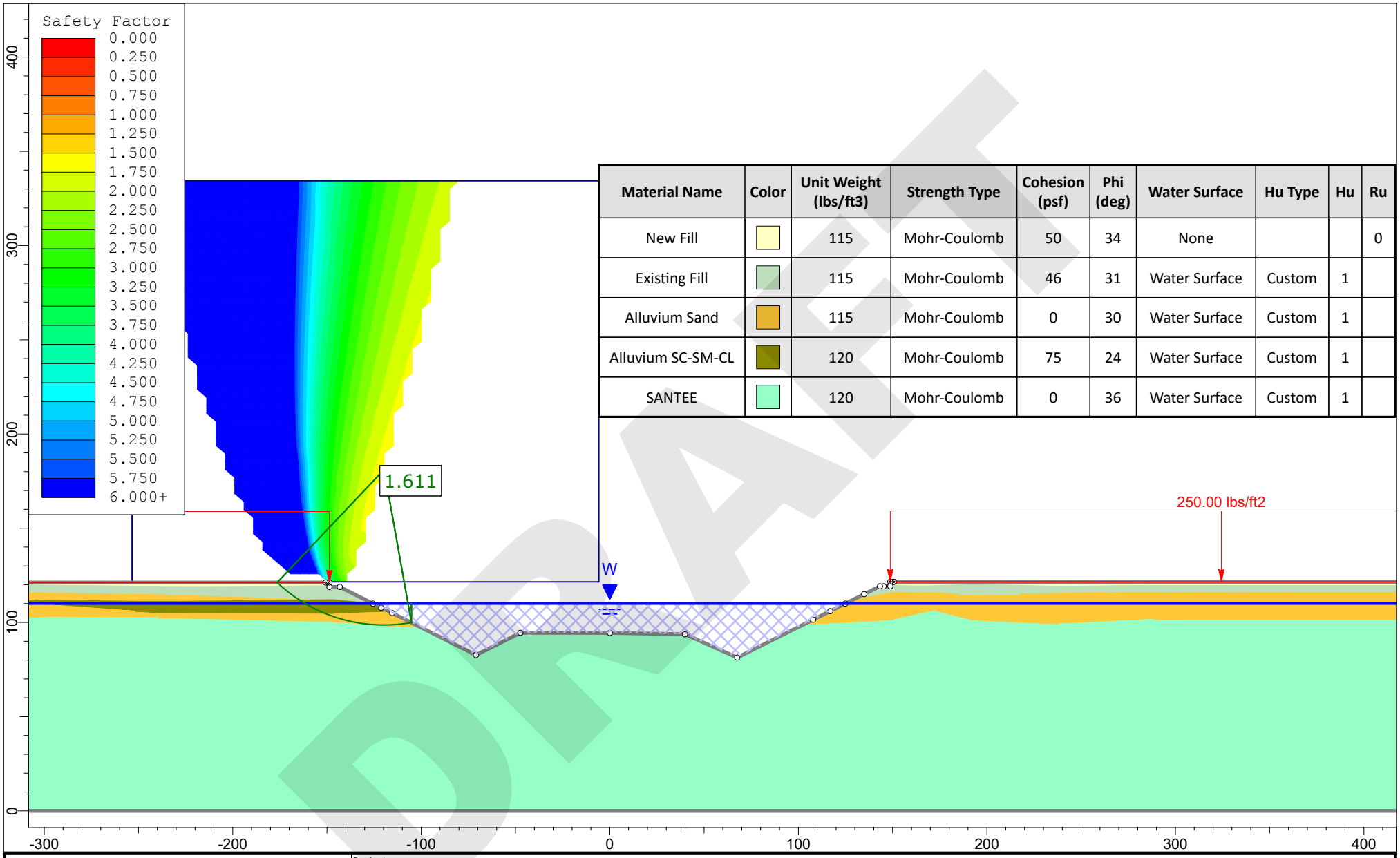
BRIDGE APPROACH EMBANKMENT SLOPE STABILITY ANALYSES

GeoStellar Engineering

APPENDIX F
BRIDGE APPROACH EMBANKMENT SLOPE STABILITY ANALYSES

The following slope stability analyses have been included in this appendix.

- Bent 1 – Longitudinal Circular Short-Term Static Service Limit State Slope Stability
- Bent 1 – Longitudinal Circular SEE EEI Limit State Slope Stability
- Bent 8 – Longitudinal Circular Short-Term Static Service Limit State Slope Stability
- Bent 8 – Longitudinal Circular SEE EEI Limit State Slope Stability

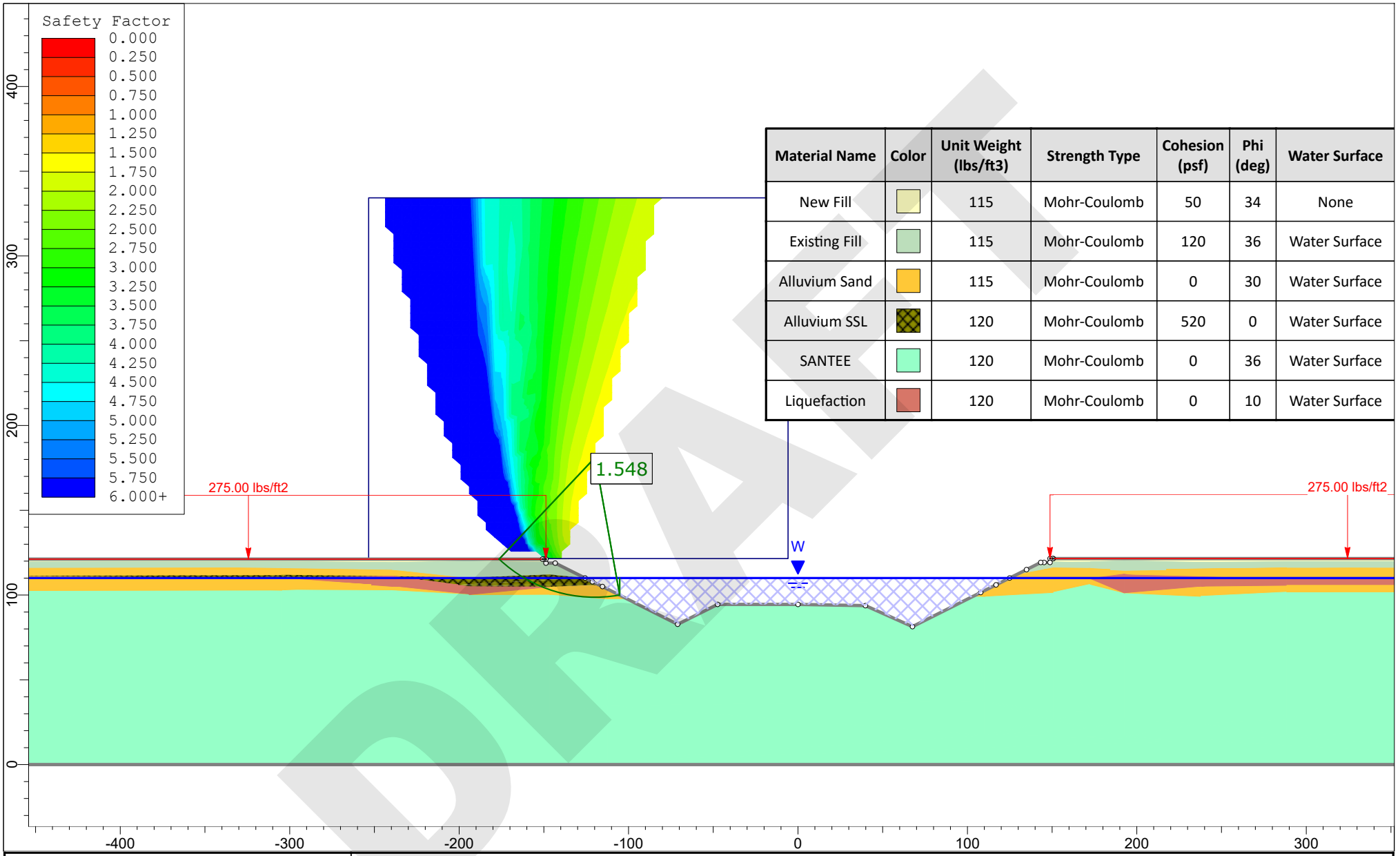


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
New Fill		115	Mohr-Coulomb	50	34	None			0
Existing Fill		115	Mohr-Coulomb	46	31	Water Surface	Custom	1	
Alluvium Sand		115	Mohr-Coulomb	0	30	Water Surface	Custom	1	
Alluvium SC-SM-CL		120	Mohr-Coulomb	75	24	Water Surface	Custom	1	
SANTEE		120	Mohr-Coulomb	0	36	Water Surface	Custom	1	

GeoStellar Engineering

SLIDEINTERPRET 7.013

Project	**RBO Four Hole Swamp**
Analysis Description	Bent 1 Circular Static Short Term
Company	**GeoStellar Engineering, LLC**
GSE Project No.	
Date	2016-03-03
Figure No.	

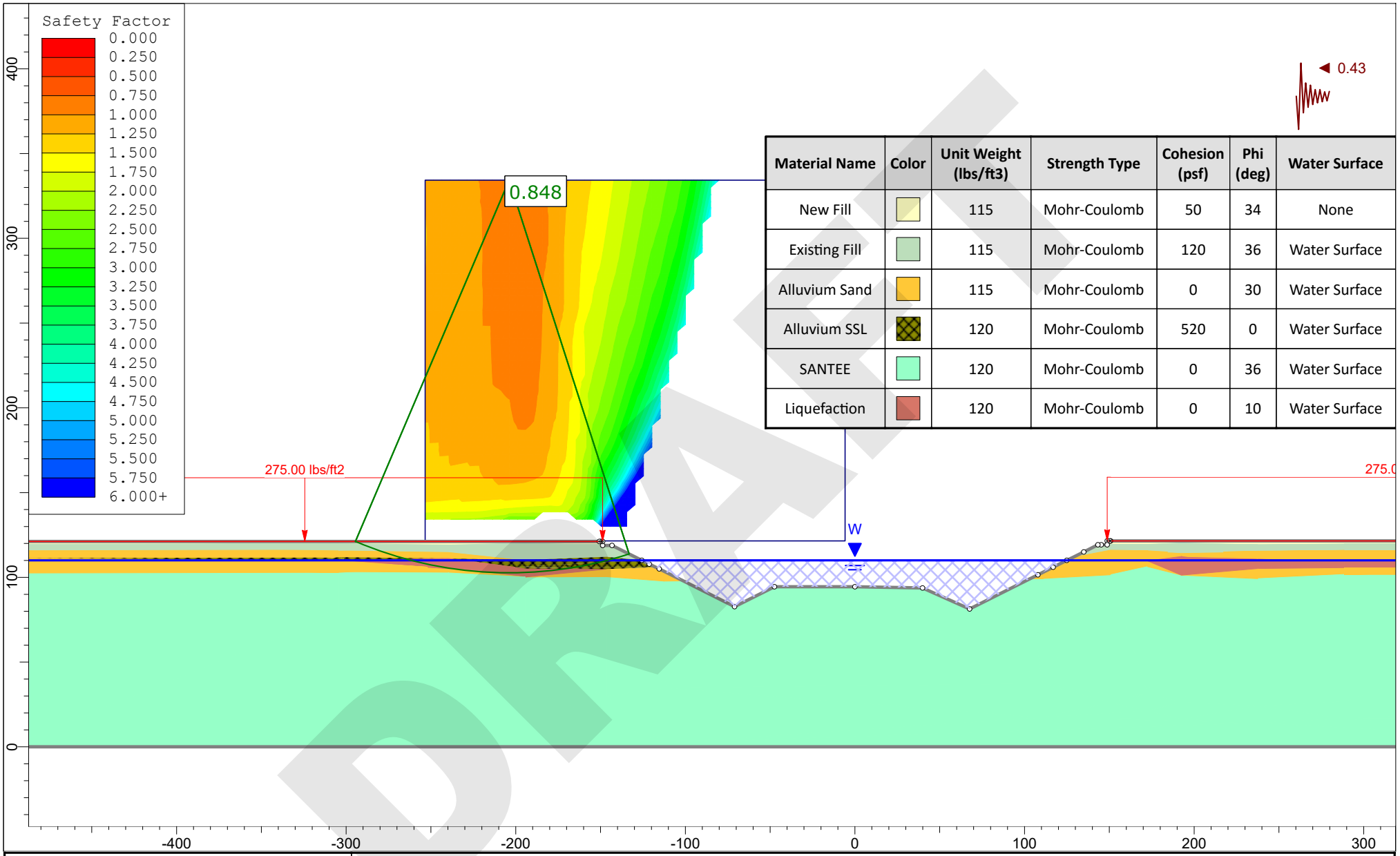


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
New Fill		115	Mohr-Coulomb	50	34	None
Existing Fill		115	Mohr-Coulomb	120	36	Water Surface
Alluvium Sand		115	Mohr-Coulomb	0	30	Water Surface
Alluvium SSL		120	Mohr-Coulomb	520	0	Water Surface
SANTEE		120	Mohr-Coulomb	0	36	Water Surface
Liquefaction		120	Mohr-Coulomb	0	10	Water Surface

GeoStellar Engineering

SLIDEINTERPRET 7.013

Project	**US 301 RBO Four Hole Swamp**
Analysis Description	Bent 1 Circular SEE Flow Failure
Company	**GeoStellar Engineering, LLC**
GSE Project No.	
Date	2016-03-03
Figure No.	

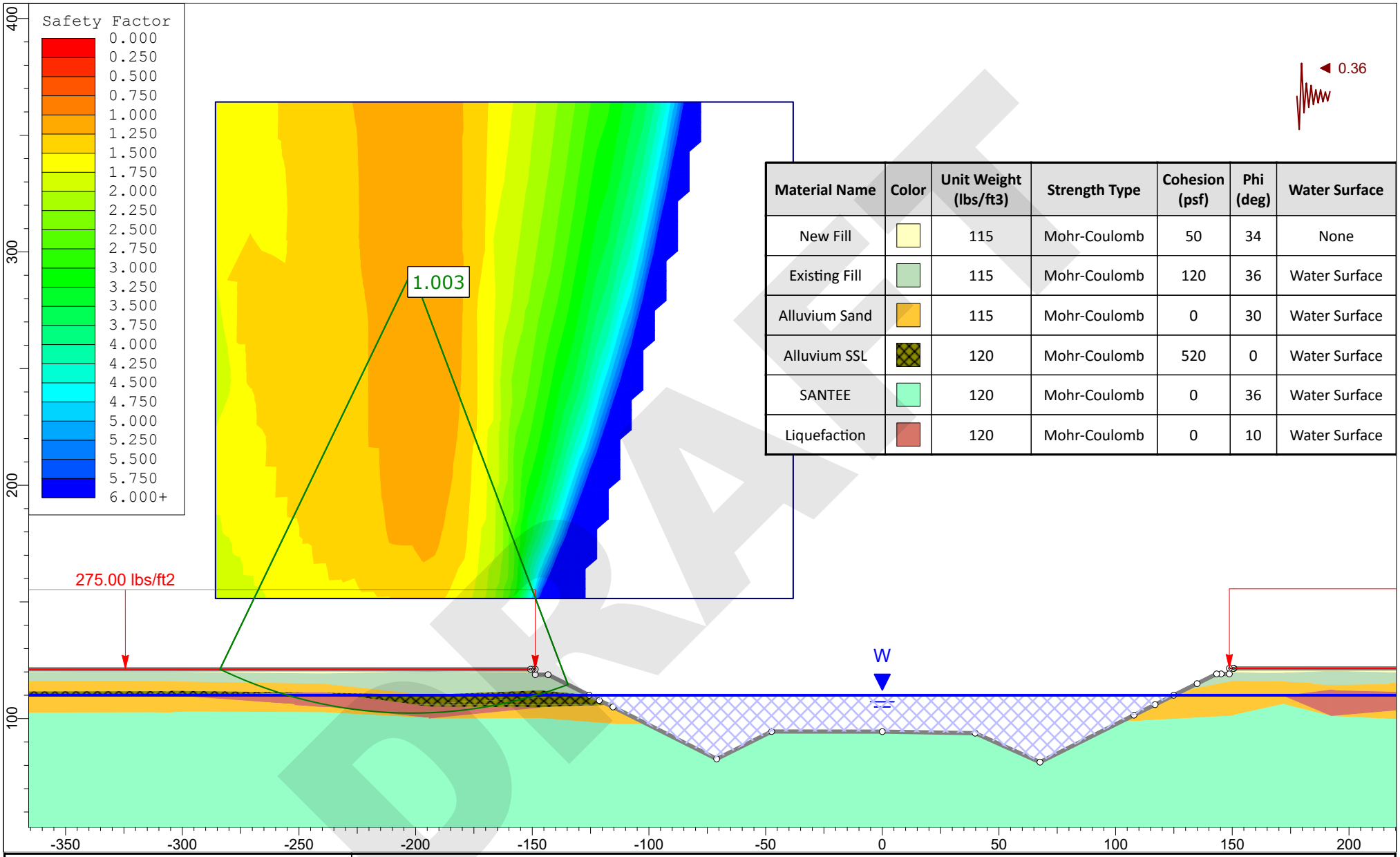


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
New Fill		115	Mohr-Coulomb	50	34	None
Existing Fill		115	Mohr-Coulomb	120	36	Water Surface
Alluvium Sand		115	Mohr-Coulomb	0	30	Water Surface
Alluvium SSL		120	Mohr-Coulomb	520	0	Water Surface
SANTEE		120	Mohr-Coulomb	0	36	Water Surface
Liquefaction		120	Mohr-Coulomb	0	10	Water Surface

GeoStellar Engineering

SLIDEINTERPRET 7.013

Project	**US 301 RBO Four Hole Swamp**
Analysis Description	Bent 1 Circular SEE
Company	**GeoStellar Engineering, LLC**
GSE Project No.	
Date	2016-03-03
Figure No.	

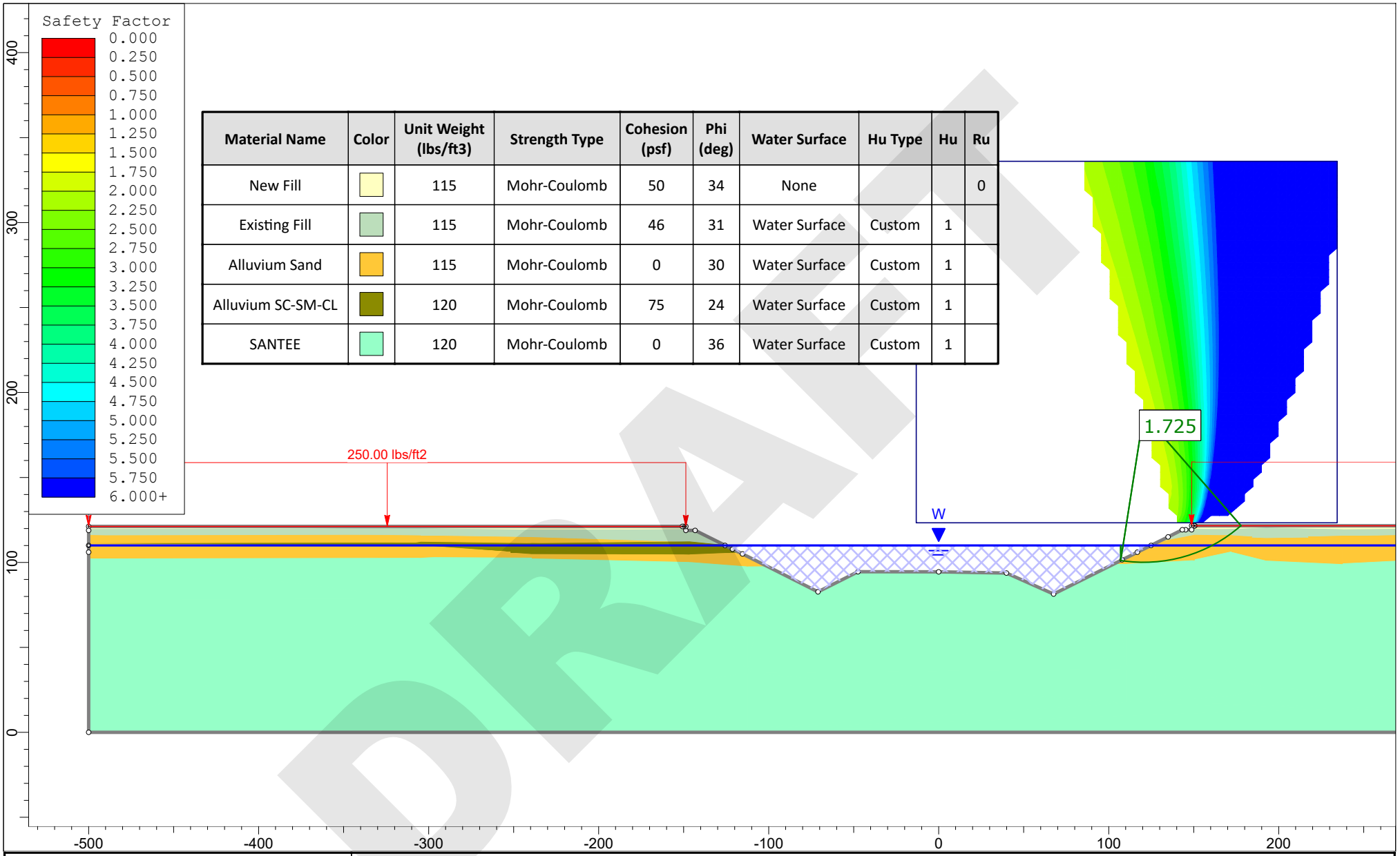


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
New Fill		115	Mohr-Coulomb	50	34	None
Existing Fill		115	Mohr-Coulomb	120	36	Water Surface
Alluvium Sand		115	Mohr-Coulomb	0	30	Water Surface
Alluvium SSL		120	Mohr-Coulomb	520	0	Water Surface
SANTEE		120	Mohr-Coulomb	0	36	Water Surface
Liquefaction		120	Mohr-Coulomb	0	10	Water Surface

GeoStellar Engineering

SLIDEINTERPRET 7.013

Project	**US 301 RBO Four Hole Swamp**
Analysis Description	Bent 1 Circular SEE - Yield
Company	**GeoStellar Engineering, LLC**
GSE Project No.	
Date	2016-03-03
Figure No.	

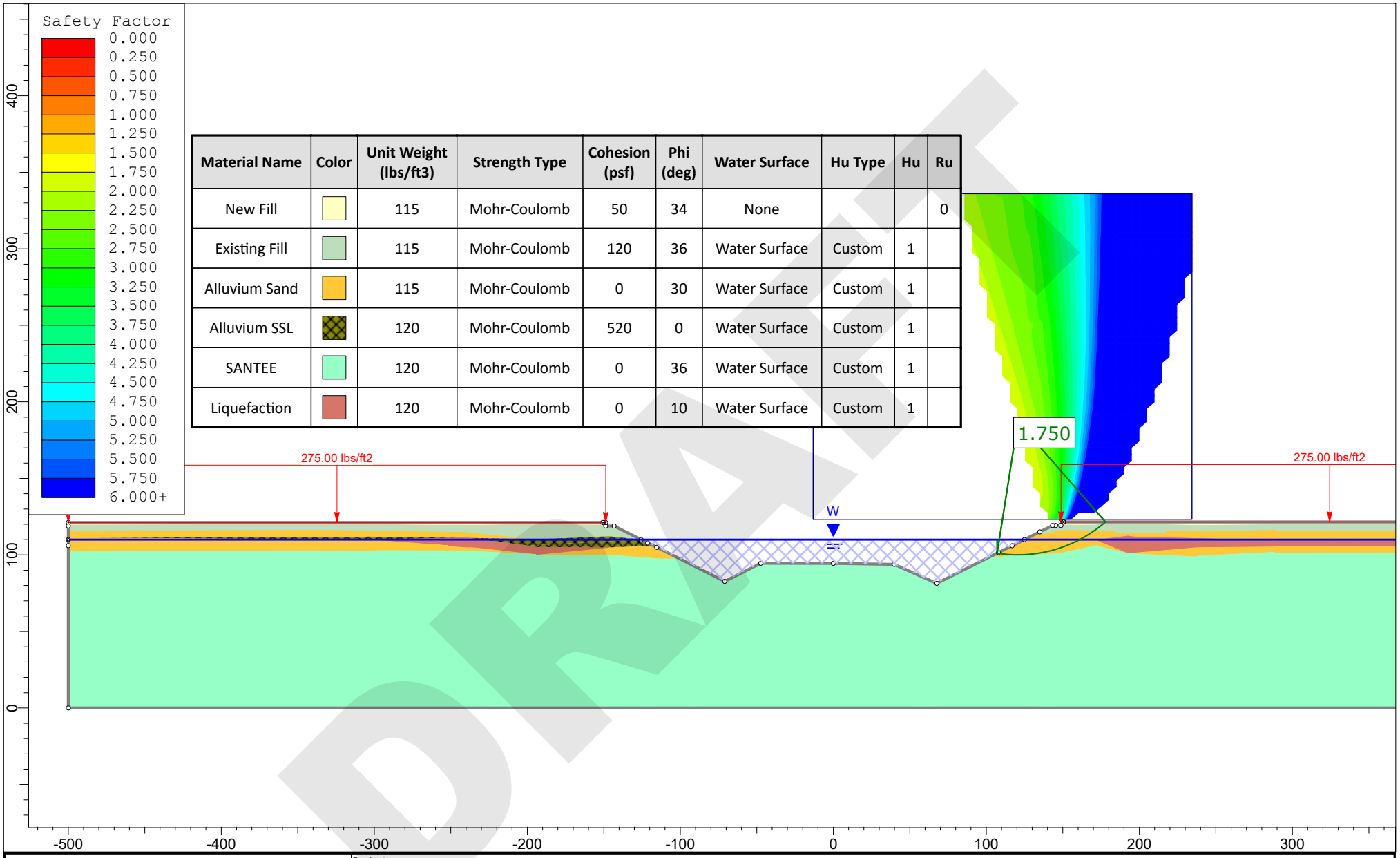


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
New Fill		115	Mohr-Coulomb	50	34	None			0
Existing Fill		115	Mohr-Coulomb	46	31	Water Surface	Custom	1	
Alluvium Sand		115	Mohr-Coulomb	0	30	Water Surface	Custom	1	
Alluvium SC-SM-CL		120	Mohr-Coulomb	75	24	Water Surface	Custom	1	
SANTEE		120	Mohr-Coulomb	0	36	Water Surface	Custom	1	

GeoStellar Engineering

SLIDEINTERPRET 7.013

Project	**RBO Four Hole Swamp**
Analysis Description	Bent 8 Circular Static Short Term
Company	**GeoStellar Engineering, LLC**
GSE Project No.	
Date	2016-03-03
Figure No.	

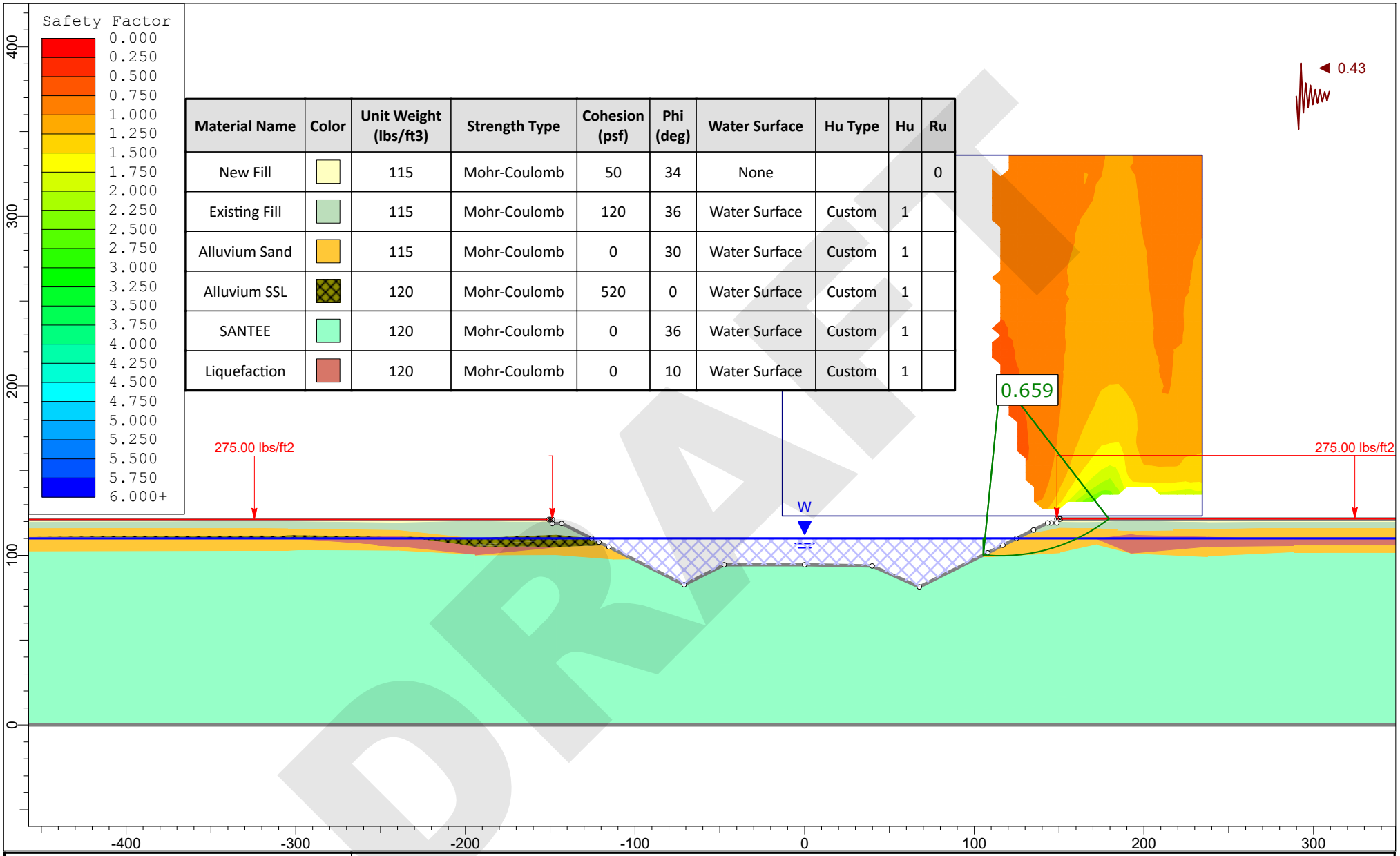


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
New Fill		115	Mohr-Coulomb	50	34	None			0
Existing Fill		115	Mohr-Coulomb	120	36	Water Surface	Custom	1	
Alluvium Sand		115	Mohr-Coulomb	0	30	Water Surface	Custom	1	
Alluvium SSL		120	Mohr-Coulomb	520	0	Water Surface	Custom	1	
SANTEE		120	Mohr-Coulomb	0	36	Water Surface	Custom	1	
Liquefaction		120	Mohr-Coulomb	0	10	Water Surface	Custom	1	

GeoStellar Engineering

SLIDEINTERPRET 7.013

Project	**US 301 RBO Four Hole Swamp**	
Analysis Description	Bent 8 Circular SEE Flow Failure	
Company	**GeoStellar Engineering, LLC**	*GSE Project No.*
Date	2016-03-03	*Figure No.*

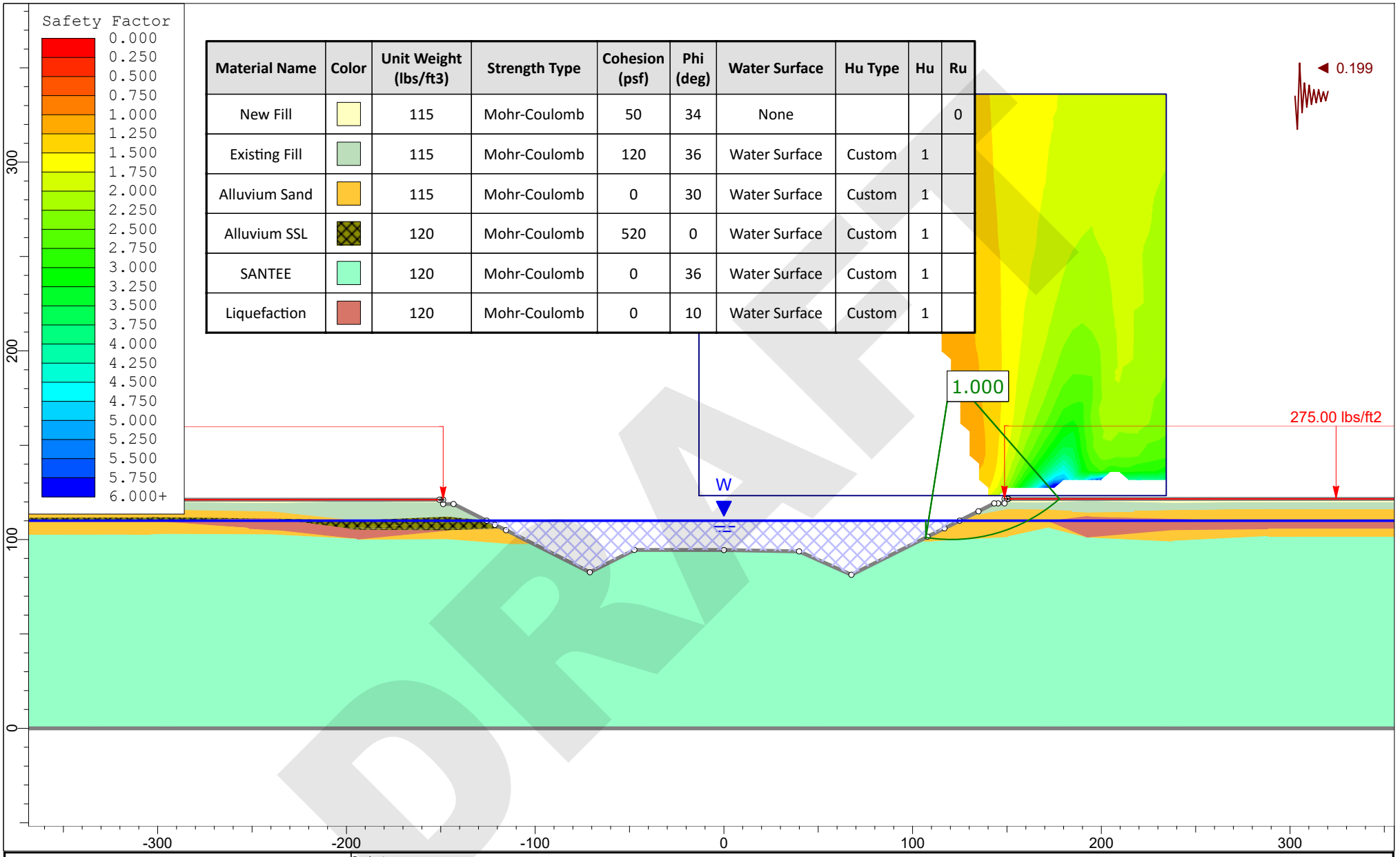


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
New Fill		115	Mohr-Coulomb	50	34	None			0
Existing Fill		115	Mohr-Coulomb	120	36	Water Surface	Custom	1	
Alluvium Sand		115	Mohr-Coulomb	0	30	Water Surface	Custom	1	
Alluvium SSL		120	Mohr-Coulomb	520	0	Water Surface	Custom	1	
SANTEE		120	Mohr-Coulomb	0	36	Water Surface	Custom	1	
Liquefaction		120	Mohr-Coulomb	0	10	Water Surface	Custom	1	

GeoStellar Engineering

SLIDEINTERPRET 7.013

Project	**US 301 RBO Four Hole Swamp**
Analysis Description	Bent 8 Circular SEE
Company	**GeoStellar Engineering, LLC**
Date	2016-03-03
GSE Project No.	
Figure No.	



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
New Fill		115	Mohr-Coulomb	50	34	None			0
Existing Fill		115	Mohr-Coulomb	120	36	Water Surface	Custom	1	
Alluvium Sand		115	Mohr-Coulomb	0	30	Water Surface	Custom	1	
Alluvium SSL		120	Mohr-Coulomb	520	0	Water Surface	Custom	1	
SANTEE		120	Mohr-Coulomb	0	36	Water Surface	Custom	1	
Liquefaction		120	Mohr-Coulomb	0	10	Water Surface	Custom	1	

GeoStellar Engineering

SLIDEINTERPRET 7.013

Project	**US 301 RBO Four Hole Swamp**
Analysis Description	Bent 8 Circular SEE
Company	**GeoStellar Engineering, LLC**
GSE Project No.	
Date	2016-03-03
Figure No.	

Simplified Newmark Charts

SCDOT GDM 13.17.2 (NCHRP 12-70, 2007)

GSE No.:	41503-0002-0001	File No.:		Latitude:		Designer:	G. Burnworth - GSE
Route:	US 301	County:	38 - Orangeburg	Longitude:		Date:	3/3/2016
Project:	RBO Four Hole Swamp						
Location:	Circular Slope Stability at End Bent 1			Station:		Finished Embankment Height (ft)[1] =	2

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Slope Stability Yield Acceleration"

K_y = 0.36000 g

Seismic Data:

	SEE	FEE		
Site Class =	D			
Design Earthquake:	SEE	FEE		
S_{D1} =	0.490	0.180	g	
k_{max} = PGA =	0.430	0.200	g	
$\beta = S_{D1}/PGA$ =	1.140	0.900		β = Ground Motion Index: 0.50 ≤ β ≤ 1.5
α_w =	1.000	1.000		α_w = Wave Scattering Scaling Factor: $1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft α_w = 1.0
$k_h = k_{avg}$ =	0.430	0.200	g	k_h = Average seismic horizontal coefficient due to wave scattering: $k_h = k_{avg} = \alpha_w k_{max}$
M_w =	7.37	7.36		M_w = Moment Magnitude of Design Earthquake: M_w & R = Deaggregation Analysis
R =	63.5	64.2	km	R = Site-to-Source Distance
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec	V_s = Average Shear Wave Velocity: $\bar{V}_s$ from Three-Point Method Excel Spreadsheet
V_{Peak} =	26.95	9.9	in/sec	v_{Peak} = Peak ground velocity
K_y/K_{max} =	0.837	0.000		

Displacement (CEUS-Soil): 0.02 inches

Simplified Newmark Charts

SCDOT GDM 13.17.2 (NCHRP 12-70, 2007)

GSE No.:	41503-0002-0001	File No.:		Latitude:		Designer:	G. Burnworth - GSE
Route:	US 301	County:	38 - Orangeburg	Longitude:		Date:	3/3/2016
Project:	RBO Four Hole Swamp						
Location:	Circular Slope Stability at End Bent 8			Station:		Finished Embankment Height (ft)[1] =	2

[1]Embankment height measured from natural ground surface

Bridge & Roadway Information:

OC =	II
ROC =	II

Slope Stability Yield Acceleration"

K_y = 0.20000 g

Seismic Data:

	SEE	FEE	
Site Class =	D		
Design Earthquake:	SEE	FEE	
S_{D1} =	0.490	0.180	g
k_{max} = PGA =	0.430	0.200	g
$\beta = S_{D1}/PGA$ =	1.140	0.900	
α_w =	1.000	1.000	
$k_h = k_{avg}$ =	0.430	0.200	g
M_w =	7.37	7.36	
R =	63.5	64.2	km
$\bar{V}_s$ =	1,005.40	1,005.40	ft/sec
V_{Peak} =	26.95	9.9	in/sec
K_y / K_{max} =	0.465	0.000	

β = Ground Motion Index:	$0.50 \le \beta \le 1.5$	
α_w = Wave Scattering Scaling Factor:	$1+0.01h_{slope}[(0.5\beta)-1] \le 1.0$: for $h_{slope} \le 20$ft $\alpha_w = 1.0$	
k_h = Average seismic horizontal coefficient due to wave scattering:	$k_h = k_{avg} = \alpha_w k_{max}$	
M_w = Moment Magnitude of Design Earthquake	M_w & R = Deaggregation Analysis	
R = Site-to-Source Distance		
V_s = Average Shear Wave Velocity	$\bar{V}_s$ from Three-Point Method Excel Spreadsheet	
v_{Peak} = Peak ground velocity		

Displacement (CEUS-Soil): 2.46 inches