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GEOTECHNICAL INVESTIGATION

FOREST SERVICE BRIDGE NO. 115-2.3 LIBERTY COUNTY, FL

FILE NO.: T04-303

DECEMBER 21, 2004

Tallahassee, FL

870-3 Blountstown Highway
Tallahassee, FL 32304

Tel.: (850) 576-4652
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SOUTHERN EARTH SCIENCES, inc.

Geotechnical &
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USDA Forest Service
National Forests in Florida
325 John Knox Road - Suite F100
Tallahassee, Florida 32303-4160

December 21, 2004
File No.: T04-303

ATTENTION: Ms. Kathy O'Bryan

SUBJECT: Report of Geotechnical Investigation for Bridge Replacement
Forest Service Bridge No. 115-2.3
Apalachicola National Forest
Liberty County, Florida

Dear Ms. O'Bryan:

As requested, Southern Earth Sciences, Inc. (SESI) has completed the geotechnical investigation for the above referenced project in Liberty County, Florida. Authorization for our services was provided by Mr. Curtis J. Gruver, Contracting Officer for the USDA Forest Service, in the form of Purchase Order No. 43-4283-4-0131. This report describes our field testing techniques, includes data obtained during the investigation, and presents our soil related recommendations with regard to the support of the proposed bridge structure.

SITE AND PROJECT INFORMATION

Project information was provided by Ms. Kathy O'Bryan of the USDA Forest Service. At the time of our investigation, SESI was not provided with a Site Plan or any detailed structural information. The project site is located in the Apalachicola National Forest in Liberty County approximately 9 miles northwest of Sumatra, Florida. A Site Location map is included in this report as Figure 1. The site was accessed from State Road 379 and Forest Road 115.

The project consists of the replacement of a one lane wooden bridge on timber piles in approximately the same location. We understand that the proposed bridge structure will be constructed of concrete and that 18 inch square concrete piles or shallow foundations are desired. We have been informed that an allowable capacity of 55 tons is needed for the replacement piles. No loading information has been given for shallow foundations.

FIELD INVESTIGATIVE PROCEDURES

As proposed, a total of two (2) standard penetration test soil borings were performed off each end of the existing bridge structure. Borings were performed using a mud rotary drilling technique to a depth of 50 feet below existing grade. Borings B-5 and B-6 were performed at the west and east ends of the bridge, respectively.

Boring information is in the form of standard penetration tests and small soil samples from selected depth intervals which were used for classification purposes. Standard penetration tests give a general indication of soil strength and the samples are used for classification purposes. The penetration test results and visual soil classifications are shown on the attached Subsurface Profile and Log of Boring sheets. Soil test borings were drilled in general accordance with ASTM D 1586.

LABORATORY TESTING PROCEDURES

Laboratory testing of the site soils consisted of physical examination of samples obtained during the soil test borings operation. Soil samples were visually classified in the laboratory in accordance with the Unified Soil Classification System. Evaluation of these samples, in conjunction with penetration resistances, have been used to estimate soil characteristics.

SOIL CONDITIONS

For discussion purposes, the site soils may be divided into four (4) strata. The Stratum 1 soils generally consisted of loose to firm sands and clayey sands to depths ranging from about 12 to 17 feet below existing grades. Stratum 2 consisted of soft silty sandy clays to depths of about 20 to 22 feet below existing grades. The Stratum 3 soils consisted of firm to very firm sands to depths ranging from about 42 to 47 feet below existing grades. Stratum 4 consisted of stiff to very stiff silty sandy clays and highly plastic clays to the termination depth of our borings at 50 feet below existing grades. For additional details regarding soil conditions at each boring location, please refer to the attached Log of Boring sheets.

On the date of our field testing (November 2 & 3, 2004), the groundwater level was measured at a depth of about 8 feet below existing grades. Fluctuations in the water table will occur due to seasonal precipitation differences; therefore, water levels should be verified prior to construction.

FOUNDATION RECOMMENDATIONS

Our evaluation of foundation conditions has been based on information presented in this report and subsurface data obtained during our investigation. In evaluating soil test borings, we have used correlations made between standard penetration resistances and foundation stabilities observed in soil conditions similar to those encountered at your site.

Deep Foundations

Allowable Pile Capacity - We have calculated allowable compressive capacities for concrete piles with widths of 14, 18 and 24 inches and varying penetration depths. The relevant allowable compressive capacities, which include a factor of safety of 2, are detailed below. (**Notes:** The complete output from our computer analysis is included in the Appendix of this report. *All pile capacities include 10 feet of unsupported pile length to account for the interior bents and minimal scour. Pile lengths are referenced from top of boring elevation*.)

14 inch pile: 55 ton allowable capacity not obtained within depth of boring
18 inch pile: 55.7 ton allowable capacity at 40 foot length
24 inch pile: 67.9 ton allowable capacity at 34 foot length

Actual pile penetrations (bearing depths) could deviate significantly from the estimates presented above. Penetrations will depend upon driving conditions encountered during construction and installation procedures employed.

Pile capacities were also computed using an FDOT computer program called SPT97 which is based on Research Bulletin 121 (RB-121) prepared by Dr. John Schmertman for FDOT. Output from this program appeared to be extremely conservative as evidenced by factors of safety ranging from 3 to 4 for allowable compressive capacity. Therefore, we do not recommend using the values computed by this program. However, the computer output is included in the Appendix of this report for your review.

Lateral Capacity - Lateral pile loading has not been considered for this preliminary evaluation. If lateral capacities are required, this can be performed under separate contract once we have received specific loading information.

Negative Skin Friction - Significant thicknesses of soft compressible soils were not encountered within our soil borings and no indications of embankment settlement were observed at the existing bridge abutments. Therefore, we consider the potential for developing negative skin friction to be minimal.

Preforming (Predrilling) - Predrilling may be performed to a depth of up to 10 feet at the pile locations to penetrate any near surface dense materials. Predrilling should be performed in accordance with Standard FDOT Specifications for "Preformed Pile Holes", Section 455-10. Jetting should only be performed if environmental conditions allow.

Wave Equation / Dynamic Analysis - A wave equation / dynamic analysis of the selected pile section should be performed to assess the constructability of the foundation using the intended driving equipment. This analysis will provide driving criteria for the installation of the project piling - required blows per foot to obtain the desired capacity.

Test Pile Program - We do not anticipate the need for static pile load testing to verify pile design loads provided that each pile achieves the anticipated pile tip elevation. Instead, we recommend the use of Pile Driving Analysis (PDA) equipment at production pile locations. A minimum of three (3) piles should be checked to verify the driving criteria and pile capacity. If necessary, final recommendations regarding pile load testing will be made following evaluation of the PDA data.

Shallow Foundations

As previously mentioned, consideration of shallow foundations for support of the proposed bridge structure is desired. However, because loading information has not been provided for this alternative, complete recommendations including a settlement analysis cannot be provided. The bearing pressure values presented below are estimates, only, in that the footing geometry, which plays a significant part in the bearing capacity calculations, was estimated.

Based upon the soil testing performed, it appears that a shallow foundation system *for the end supports* could be designed using an allowable soil bearing pressure of up to 2000 psf. This value assumes that the water table is at the bottom of footing elevation and that the bearing soil has a cohesion value of 250 psf. A shallow foundation system *for the interior support* could be designed using an allowable soil bearing pressure of up to 1000 psf. This value also assumes that the water table is at the bottom of footing elevation and that the bearing soil has no cohesion.

Construction Considerations: 1.) The interior support footing bearing elevation should be a minimum of 3 feet below the scour elevation (to be determined by others). 2.) End support footings should be protected from erosion by construction of wing walls or equivalent alternative. 3.) Dewatering and/or re-routing of the creek would be required to allow construction of the interior footing "in the dry".

ENVIRONMENTAL CLASSIFICATIONS

One (1) soil sample from boring B-5 and one (1) water sample from the creek were obtained and tested for Chlorides, pH, Sulfates and Specific Conductance. The results of these corrosion tests are attached in the Appendix of this report. Based upon the test reports and the information presented in the FDOT's Structures Design Guidelines, SESI evaluated the environmental classification of the substructure at the proposed bridge location.

The substructure environment at the proposed bridge location was considered to be extremely aggressive in both the soil and water due to low pH values. The low pH values are most likely the result of decomposition of organic matter in low / wet areas which is known to produce acidic conditions.

GENERAL COMMENTS

The soil samples obtained as a part of this geotechnical investigation will be held for a minimum period of 30 days. After this period, the samples will be disposed of unless we are specifically requested in writing to do otherwise.

This report has been prepared in order to aid in the evaluation of this property and to assist the engineers in the structural design. It is intended for use with regard to the specific project discussed herein, and any substantial changes in the loads, locations, or assumed grades should be brought to our attention so that we may determine how such changes may affect our conclusions and recommendations.

While the soil test borings performed for this project are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local variations of the subsurface material are anticipated and may be encountered. The boring logs and related information are based on the driller's logs and visual examination of selected samples in the laboratory. Delineation between soil types shown on the logs is approximate, and soil descriptions represent our interpretation of subsurface conditions at the designated boring locations on the particular date drilled.

We appreciate the opportunity to be of service to you on this project. Should additional information be required, please do not hesitate to contact us.

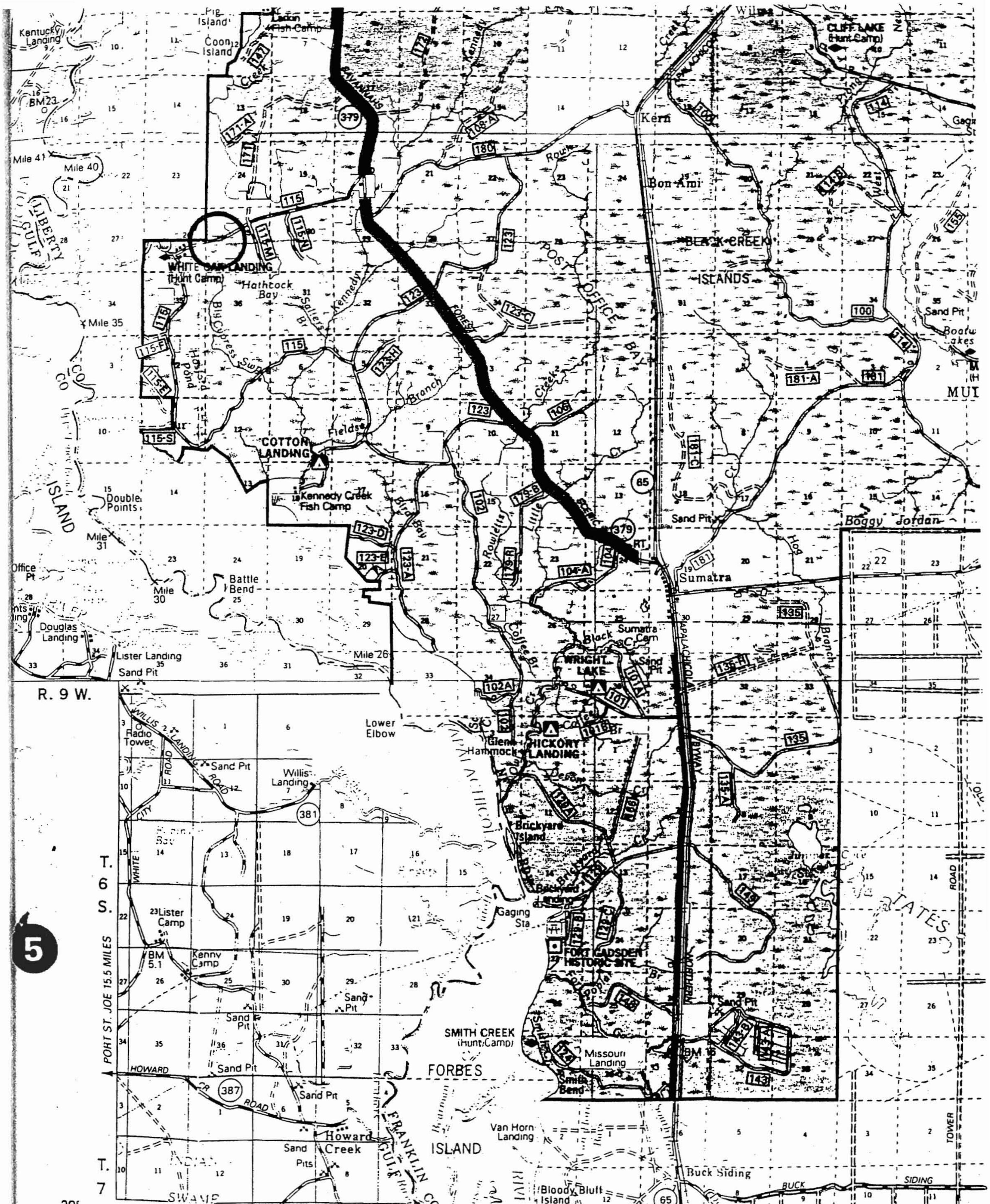
Sincerely,

SOUTHERN EARTH SCIENCES, INC.

Mark E. Wilson, P.E.
Eng. Reg. No.: 47707
State of Florida

12-21-04

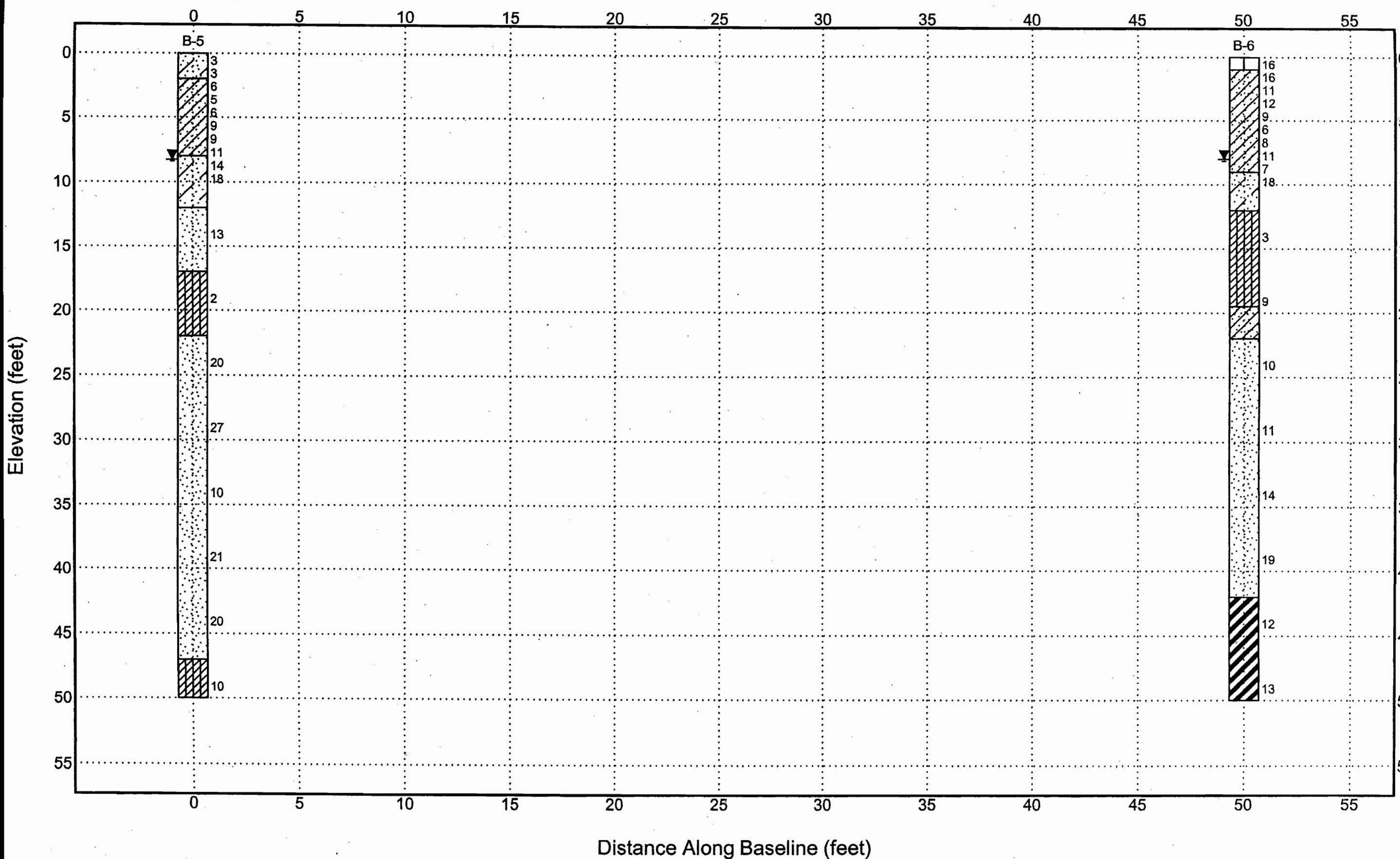
MEW/mv



Bridges 115-2.3&2.5: Are located approx. 7 miles northwest of Sumatra on C.R. 379, 22 miles south of Bristol following C.R. 12 to C.R. 379, then 2.3 and 2.5 miles down forest road #115. (Bristol is approximately 33 miles west of Tallahassee.)

B C

FIGURE 1



STRATIGRAPHY AND WATER LEVELS T04-303.GPJ SES PC FL.GDT 12/14/04

SOUTHERN EARTH SCIENCES, inc.

USCS Poorly-graded Sand with Clay	USCS Clayey Sand	USCS Poorly-graded Sand
USCS Low Plasticity Silty Clay	Limestone	USCS High Plasticity Clay

SUBSURFACE PROFILE

Project: National Forestry Service Bridges

Location: Bridges 115-2.3

Number: T04-303

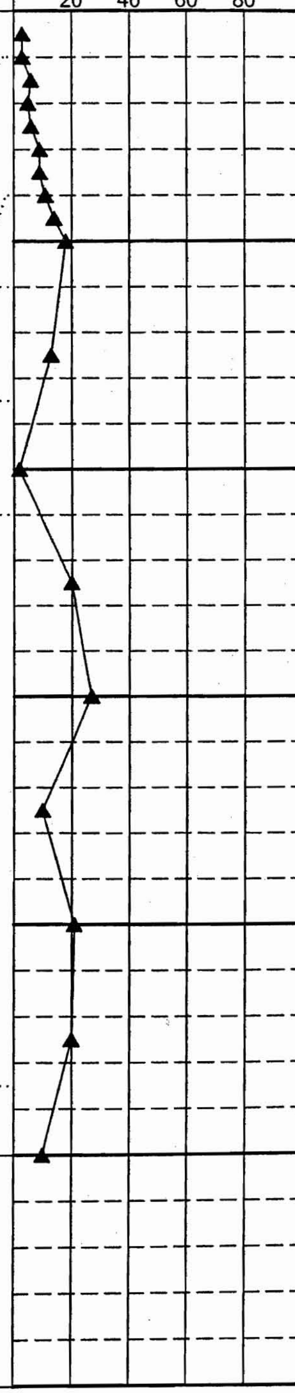
LOG OF BORING B-5

PROJECT: National Forestry Service Bridges
LOCATION: Apalachicola National Forest
PROJECT NO.: T04-303
DATE: 11/02/04

METHOD: Mud Rotary
DRILLER: E. Thomas
ENGR / GEOL: G. Englert
SURFACE ELEVATION: Unknown

LOCATION: **Bridge 115-2.3 West**

Elevation / Depth	Soil Symbols Sampler Symbols and Field Test Data	USCS	MATERIAL DESCRIPTION
0	3, 3	SP-SC	Brown/Orange Slightly Clayey Fine SAND
	6, 5, 6, 9, 9, 11	SC	Brown/Tan Clayey Very Fine SAND Brown/Orange Clayey Very Fine SAND Brown/Orange/Grey Clayey Very Fine SAND
10	14, 18	SP-SC	Light Grey Slightly Clayey Fine SAND
	13	SP	Light Grey Medium-Fine SAND
20	2	CL-ML	Dark Grey Silty Sandy CLAY
30 / 40	20, 27, 10, 21, 20	SP	Tan Medium-Fine SAND Tan Medium SAND
50	10	CL-ML	Light Grey/Tan Silty Sandy CLAY
60			



NATURAL MOISTURE (%) | ATTERBERG LIMITS (%): LIQUID LIMIT (LL), PLASTIC LIMIT (PL), PLASTICITY INDEX (PI) | PASSING #200 SIEVE (%)

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Notes:

Water Observations: **Water Measured @ 8'3"**

N - SPT Data (Blows/Ft) P - Pocket Penetrometer (tsf)

Sample Key: SPT Shelby Tube

SOUTHERN EARTH SCIENCES, inc.

LOG OF BORING B-6

PROJECT: National Forestry Service Bridges
LOCATION: Apalachicola National Forest
PROJECT NO.: T04-303
DATE: 11/03/04

METHOD: Mud Rotary
DRILLER: E. Thomas
ENGR / GEOL: G. Englert
SURFACE ELEVATION: **Unknown**

LOCATION: **Bridge 115-2.3 East**

Elevation / Depth	Soil Symbols Sampler Symbols and Field Test Data (N)	USCS	MATERIAL DESCRIPTION
0	16		Limestone
	16, 11, 12	SC	Brown/Orange Clayey Fine SAND
	9, 6		Tan/Light Grey Clayey Fine SAND
	8, 11, 7		Tan/Light Grey/Orange Clayey Fine SAND
10	18	SP-SC	Tan/Light Grey Slightly Clayey Fine SAND
	3, 9	CL-ML	Dark Grey Silty Sandy CLAY w/ Organics
20		SC	Light Grey/Tan Clayey Fine SAND
30	10, 11, 14, 19	SP	Light Grey Medium-Fine SAND
40	12, 13	CH	Tan/Grey Highly Plastic CLAY
50			
60			

▲ N Value (blows/ft): 20 40 60 80

Atterberg Limits / Natural Moisture: PL MC LL; 20 40 60 80

NATURAL MOISTURE (%) | ATTERBERG LIMITS (%): LIQUID LIMIT (LL), PLASTIC LIMIT (PL), PLASTICITY INDEX (PI) | PASSING #200 SIEVE (%)

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Notes:

Water Observations: **Water Measured @ 8'**

N - SPT Data (Blows/Ft) P - Pocket Penetrometer (tsf)

Sample Key: SPT Shelby Tube

SOUTHERN EARTH SCIENCES, inc.

ANF BRIDGE 115-2.3
ANF
T04-303

SUMMARY OF STRATUM DATA

STRATUM 1

THICKNESS (FT)=	10
UNIT WT (PCF)=	0
COHESION (PSF)=	0
PHI=	0
KS=	0
NQ=	0

STRATUM 2

THICKNESS (FT)=	10
UNIT WT (PCF)=	55
COHESION (PSF)=	500
PHI=	0
KS=	1
NQ=	9

STRATUM 3

THICKNESS (FT)=	12
UNIT WT (PCF)=	58
COHESION (PSF)=	0
PHI=	30
KS=	1
NQ=	21

STRATUM 4

THICKNESS (FT)=	12
UNIT WT (PCF)=	60
COHESION (PSF)=	0
PHI=	33
KS=	1
NQ=	35

PENETRATION DEPTH VS ALLOWABLE COMPRESSIVE CAPACITY
ANF BRIDGE 115-2.3
ANF
T04-303

ALLOWABLE COMPRESSIVE CAPACITY (TONS)
SQUARE PILE SECTION
F.S.= 2

	PILE SIZE IN INCHES		
PENETRATION (FEET)	14	18	24
30	17.2	25.1	39.3
32	19.2	27.9	43.8
34	28	42	67.9
36	31	46.4	74.9
38	34.2	51	82
40	37.5	55.7	89.4
42	40.9	60.6	97

NOTE: SKIN FRICTION REDUCED 10 PERCENT FOR JETTING OR PREDRILLING

NOTE: PILE CAPACITIES ARE BASED ON SOIL-PILE INTERACTION AND DO NOT CONSIDER THE STRUCTURAL ASPECTS OF THE PILE

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+------------------------------------------------------------------------------+
| STATIC PILE BEARING CAPACITY ANALYSIS     - SPT97                  Page    1 |
+------------------------------------------------------------------------------+
| Project No: T04-303                BRIDGE 115-2.3 (West)
|
| Boring No:  B-5                                                              |
+------------------------------------------------------------------------------+
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FLORIDA DEPARTMENT OF TRANSPORTATION
STRUCTURES DESIGN OFFICE
STATIC PILE BEARING CAPACITY ANALYSIS PROGRAM
SPT97 - VERSION 1.2 FEBRUARY, 1997
BASED ON RESEARCH BULLETIN RB-121
"GUIDELINES FOR USE IN THE SOILS INVESTIGATION
AND DESIGN OF FOUNDATIONS FOR
BRIDGE STRUCTURES IN THE STATE OF FLORIDA" AND
RESEARCH STUDY REPORT BY UNIVERSITY OF FLORIDA
"DESIGN OF STEEL PIPE AND H PILES"

NOTE - THIS PROGRAM IS EXPANDED FROM SPT91
IS ALSO KNOWN AS SPT94
TO INCLUDE STEEL H AND PIPE PILES

A. GENERAL INFORMATION

INPUT FILE NAME	115B-5.in
RUN DATE	11/12/04
RUN TIME	15:12:41
PROJECT NUMBER	T04-303
JOB NAME	BRIDGE 115-2.3 (West)
SUBMITTING ENGINEER	M. WILSON
BORING NO.	B-5
DRILLING DATE	11-02-04
STATION NO.	NA
GROUND SURFACE ELEVATION	.00 FEET
TYPE OF ANALYSIS	2 - DETERMINATION OF STATIC PILE BEARING CAPACITIES FOR A RANGE OF PILE LENGTHS (CAPACITY VS. TIP ELEVATION)

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+------------------------------------------------------------------------------+
| STATIC PILE BEARING CAPACITY ANALYSIS     - SPT97                  Page    2 |
+------------------------------------------------------------------------------+
| Project No: T04-303                BRIDGE 115-2.3 (West)
|
| Boring No:  B-5                                                              |
+------------------------------------------------------------------------------+
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B. BORING LOG

ENTRY NO.	DEPTH (FT) D(I)	ELEVATION (FT)	SPT BLOWS/FT N(I)	SOIL TYPE ST(I)
1	.0	.0	16.0	5
2	2.0	-2.0	9.0	5
3	4.0	-4.0	5.0	5
4	6.0	-6.0	8.0	5
5	8.0	-8.0	6.0	5
6	13.5	-13.5	13.0	3

7	18.5	-18.5	2.0	1
8	23.5	-23.5	20.0	3
9	28.5	-28.5	27.0	3
10	33.5	-33.5	10.0	3
11	38.5	-38.5	21.0	3
12	43.5	-43.5	20.0	3
13	48.5	-48.5	10.0	1
14	53.5	-53.5	10.0	2
15	58.5	-58.5	10.0	2
16	63.5	-63.5	10.0	2

SOIL TYPE LEGEND

0 - BOTTOM OF BORING
1 - PLASTIC CLAYS
2 - CLAY/SILT SAND MIXTURES, SILTS & MARLS
3 - CLEAN SAND
4 - SOFT LIMESTONE, VERY SHELLY SANDS
5 - VOID (NO CAPACITY)

STATIC PILE BEARING CAPACITY ANALYSIS - SPT97	Page 3
Project No: T04-303	BRIDGE 115-2.3 (West)
Boring No: B-5	

C. PILE INFORMATION

TEST PILE SECTION ISECT = 1
{concrete pile, square section}
WIDTH OF PILE WP = 14.00 INCHES

D. PILE CAPACITY VS. PENETRATION

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	ULTIMATE SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED DAVISSON CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
26.0	-26.0	14.64	23.37	38.01	19.00	84.74
28.0	-28.0	18.33	24.65	42.98	21.49	92.28
30.0	-30.0	22.79	24.73	47.52	23.76	96.98
32.0	-32.0	26.27	24.75	51.02	25.51	100.51
34.0	-34.0	28.19	26.17	54.36	27.18	106.71
36.0	-36.0	30.63	27.32	57.94	28.97	112.58
38.0	-38.0	33.78	27.05	60.83	30.41	114.92
40.0	-40.0	37.45	26.35	63.80	31.90	116.51
42.0	-42.0	41.07	24.83	65.91	32.95	115.58
44.0	-44.0	44.65	21.66	66.31	33.16	109.64
46.0	-46.0	48.52	17.39	65.91	32.95	100.70
48.0	-48.0	52.81	14.20	67.02	33.51	95.43

*** THE MAXIMUM PILE LENGTH HAS BEEN REACHED

NOTES

1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.

2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.

3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.

4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.

PROBLEM COMPLETED ANALYSIS NO. 1

STATIC PILE BEARING CAPACITY ANALYSIS - SPT97	Page 4
Project No: T04-303	BRIDGE 115-2.3 (West)
Boring No: B-5	

C. PILE INFORMATION

TEST PILE SECTION ISECT = 1
{concrete pile, square section}
WIDTH OF PILE WP = 18.00 INCHES

D. PILE CAPACITY VS. PENETRATION

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	ULTIMATE SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED DAVISSON CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
26.0	-26.0	19.30	39.27	58.57	29.29	137.11
28.0	-28.0	25.09	39.11	64.20	32.10	142.42
30.0	-30.0	31.06	37.98	69.04	34.52	145.00
32.0	-32.0	34.78	39.59	74.37	37.18	153.54
34.0	-34.0	36.18	42.97	79.15	39.58	165.09
36.0	-36.0	38.55	46.04	84.60	42.30	176.68
38.0	-38.0	42.51	46.91	89.42	44.71	183.24
40.0	-40.0	47.21	44.49	91.70	45.85	180.69
42.0	-42.0	51.87	38.89	90.75	45.38	168.53
44.0	-44.0	56.46	31.74	88.21	44.10	151.69
46.0	-46.0	61.42	27.02	88.44	44.22	142.47
48.0	-48.0	66.93	24.38	91.32	45.66	140.08

*** THE MAXIMUM PILE LENGTH HAS BEEN REACHED

NOTES

1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.

2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.

3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.

4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.

PROBLEM COMPLETED ANALYSIS NO. 2

STATIC PILE BEARING CAPACITY ANALYSIS - SPT97	Page 5
Project No: T04-303 BRIDGE 115-2.3 (West)	
Boring No: B-5	

C. PILE INFORMATION

TEST PILE SECTION ISECT = 1
{concrete pile, square section}
WIDTH OF PILE WP = 24.00 INCHES

D. PILE CAPACITY VS. PENETRATION

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	ULTIMATE SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED DAVISSON CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
26.0	-26.0	25.99	66.27	92.26	46.13	224.79
28.0	-28.0	33.81	64.71	98.52	49.26	227.95
30.0	-30.0	41.41	62.52	103.93	51.96	228.97
32.0	-32.0	47.03	65.79	112.82	56.41	244.40
34.0	-34.0	48.39	70.20	118.60	59.30	259.01
36.0	-36.0	50.43	75.99	126.42	63.21	278.40
38.0	-38.0	55.04	79.40	134.44	67.22	293.24
40.0	-40.0	62.51	76.57	139.08	69.54	292.23
42.0	-42.0	71.08	67.19	138.27	69.14	272.65
44.0	-44.0	77.21	55.58	132.79	66.40	243.95
46.0	-46.0	83.85	46.42	130.27	65.13	223.11
48.0	-48.0	91.23	41.93	133.16	66.58	217.03

*** THE MAXIMUM PILE LENGTH HAS BEEN REACHED

NOTES

1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.
2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.
3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.
4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.

PROBLEM COMPLETED ANALYSIS NO. 3

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+----------------------------------------------------------------------------+
| STATIC PILE BEARING CAPACITY ANALYSIS     - SPT97                  Page   1 |
+----------------------------------------------------------------------------+
| Project No: T04-303                BRIDGE 115-2.3 (East)
|
| Boring No:  B-6                                                            |
+----------------------------------------------------------------------------+
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FLORIDA DEPARTMENT OF TRANSPORTATION
STRUCTURES DESIGN OFFICE
STATIC PILE BEARING CAPACITY ANALYSIS PROGRAM
SPT97 - VERSION 1.2 FEBRUARY, 1997
BASED ON RESEARCH BULLETIN RB-121
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BRIDGE STRUCTURES IN THE STATE OF FLORIDA" AND
RESEARCH STUDY REPORT BY UNIVERSITY OF FLORIDA
"DESIGN OF STEEL PIPE AND H PILES"

NOTE - THIS PROGRAM IS EXPANDED FROM SPT91
IS ALSO KNOWN AS SPT94
TO INCLUDE STEEL H AND PIPE PILES

A. GENERAL INFORMATION

INPUT FILE NAME	115B-6.in
RUN DATE	11/12/04
RUN TIME	15:18:11
PROJECT NUMBER	T04-303
JOB NAME	BRIDGE 115-2.3 (East)
SUBMITTING ENGINEER	M. WILSON
BORING NO.	B-6
DRILLING DATE	11-03-04
STATION NO.	NA
GROUND SURFACE ELEVATION	.00 FEET
TYPE OF ANALYSIS	2 - DETERMINATION OF STATIC PILE BEARING CAPACITIES FOR A RANGE OF PILE LENGTHS (CAPACITY VS. TIP ELEVATION)

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+----------------------------------------------------------------------------+
| STATIC PILE BEARING CAPACITY ANALYSIS     - SPT97                  Page   2 |
+----------------------------------------------------------------------------+
| Project No: T04-303                BRIDGE 115-2.3 (East)
|
| Boring No:  B-6                                                            |
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B. BORING LOG

ENTRY NO.	DEPTH (FT) D(I)	ELEVATION (FT)	SPT BLOWS/FT N(I)	SOIL TYPE ST(I)
1	.0	.0	16.0	5
2	2.0	-2.0	9.0	5
3	4.0	-4.0	5.0	5
4	6.0	-6.0	8.0	5
5	8.0	-8.0	6.0	5
6	13.5	-13.5	3.0	1

7	18.5	-18.5	9.0	2
8	23.5	-23.5	10.0	3
9	28.5	-28.5	11.0	3
10	33.5	-33.5	14.0	3
11	38.5	-38.5	19.0	3
12	43.5	-43.5	12.0	1
13	48.5	-48.5	13.0	1
14	53.5	-53.5	10.0	2
15	58.5	-58.5	10.0	2
16	63.5	-63.5	10.0	2

SOIL TYPE LEGEND

0 - BOTTOM OF BORING
1 - PLASTIC CLAYS
2 - CLAY/SILT SAND MIXTURES, SILTS & MARLS
3 - CLEAN SAND
4 - SOFT LIMESTONE, VERY SHELLY SANDS
5 - VOID (NO CAPACITY)

STATIC PILE BEARING CAPACITY ANALYSIS - SPT97	Page 3
Project No: T04-303	BRIDGE 115-2.3 (East)
Boring No: B-6	

C. PILE INFORMATION

TEST PILE SECTION ISECT = 1
{concrete pile, square section}
WIDTH OF PILE WP = 14.00 INCHES

D. PILE CAPACITY VS. PENETRATION

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	ULTIMATE SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED DAVISSON CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
26.0	-26.0	13.43	11.74	25.16	12.58	48.64
28.0	-28.0	14.81	12.88	27.69	13.84	53.46
30.0	-30.0	16.23	14.69	30.93	15.46	60.31
32.0	-32.0	17.88	17.21	35.10	17.55	69.52
34.0	-34.0	19.84	20.59	40.43	20.21	81.61
36.0	-36.0	22.46	21.88	44.33	22.17	88.09
38.0	-38.0	25.41	20.44	45.85	22.92	86.72
40.0	-40.0	28.82	16.72	45.53	22.77	78.97
42.0	-42.0	32.99	13.51	46.49	23.25	73.51
44.0	-44.0	41.42	3.90	45.32	22.66	53.12
46.0	-46.0	46.92	4.08	51.01	25.50	59.17
48.0	-48.0	52.68	4.53	57.21	28.61	66.28

*** THE MAXIMUM PILE LENGTH HAS BEEN REACHED

NOTES

1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.
2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.

3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.

4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS
   3 x THE MOBILIZED END BEARING.

PROBLEM COMPLETED ANALYSIS NO. 4

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+-----------------------------------------------------------------------------+
| STATIC PILE BEARING CAPACITY ANALYSIS     - SPT97                  Page   4 |
+-----------------------------------------------------------------------------+
| Project No: T04-303              BRIDGE 115-2.3 (East)
|
| Boring No:   B-6                                                            |
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C. PILE INFORMATION
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TEST PILE SECTION ISECT = 1
{concrete pile, square section}

WIDTH OF PILE WP = 18.00 INCHES

D. PILE CAPACITY VS. PENETRATION
=================================

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	ULTIMATE SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED DAVISSON CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
26.0	-26.0	17.23	18.03	35.26	17.63	71.32
28.0	-28.0	18.89	19.56	38.45	19.23	77.57
30.0	-30.0	20.53	22.07	42.60	21.30	86.74
32.0	-32.0	22.36	25.67	48.03	24.01	99.37
34.0	-34.0	24.53	30.20	54.73	27.37	115.14
36.0	-36.0	27.62	32.83	60.44	30.22	126.10
38.0	-38.0	31.51	30.58	62.08	31.04	123.24
40.0	-40.0	35.81	25.28	61.09	30.55	111.65
42.0	-42.0	41.07	21.49	62.56	31.28	105.53
44.0	-44.0	53.25	6.50	59.75	29.88	72.76
46.0	-46.0	60.16	6.90	67.06	33.53	80.87
48.0	-48.0	67.42	7.79	75.21	37.61	90.80

*** THE MAXIMUM PILE LENGTH HAS BEEN REACHED

NOTES
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1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.

2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA,
   AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.

3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.

4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS
   3 x THE MOBILIZED END BEARING.

PROBLEM COMPLETED ANALYSIS NO. 5

+---+

| Project No: T04-303 BRIDGE 115-2.3 (East)

| Boring No: B-6 |

C. PILE INFORMATION

TEST PILE SECTION ISECT = 1
{concrete pile, square section}
WIDTH OF PILE WP = 24.00 INCHES

D. PILE CAPACITY VS. PENETRATION

TEST PILE LENGTH (FT)	PILE TIP ELEV (FT)	ULTIMATE SIDE FRICTION (TONS)	MOBILIZED END BEARING (TONS)	ESTIMATED DAVISSON CAPACITY (TONS)	ALLOWABLE PILE CAPACITY (TONS)	ULTIMATE PILE CAPACITY (TONS)
26.0	-26.0	22.99	30.16	53.16	26.58	113.48
28.0	-28.0	25.15	32.07	57.22	28.61	121.36
30.0	-30.0	27.10	35.48	62.58	31.29	133.53
32.0	-32.0	29.20	40.40	69.60	34.80	150.40
34.0	-34.0	32.02	44.76	76.78	38.39	166.30
36.0	-36.0	36.07	46.25	82.32	41.16	174.82
38.0	-38.0	41.76	43.95	85.72	42.86	173.63
40.0	-40.0	49.18	39.82	89.00	44.50	168.64
42.0	-42.0	57.78	36.05	93.82	46.91	165.92
44.0	-44.0	71.00	11.97	82.97	41.48	106.90
46.0	-46.0	80.13	12.79	92.92	46.46	118.51
48.0	-48.0	89.22	14.50	103.72	51.86	132.73

*** THE MAXIMUM PILE LENGTH HAS BEEN REACHED

NOTES

1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.
2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.
3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.
4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.

PROBLEM COMPLETED ANALYSIS NO. 6

Ackuritlabs, Inc.

3345 North Monroe Street, Tallahassee, FL 32303 • Telephone (850) 562-7751

Environmental Services Section

REPORT OF ANALYSIS

THIS REPORT MEETS NELAC STANDARDS

Southern Earth Science
Attn: Mark Wilson
870-3 Blountstown Highway
Tallahassee, FL 32304

Report #: 11018
Report Date: November 9, 2004
NELAC/FDOH#: E81350
FDEPQA#: 920087G
Project#: 24485
Sampled By: Eric Thomas
Sample Site: Forest Service Bridges
Sample Date: 11-01-04

Table 1. Samples received 11-01-04.

Sample Location:	**115 – 2.3**
Lab ID#:	**#47721**
Sample Time:	**12:19**

Parameter Monitored	**Units**	**Analysis Result**	**Detection Limit**	**Analysis Date**	**Analyst**
Inorganics:					
Chlorides, EPA 325.3	mg/L	7.80	1.3	11-03-04 08:50	TA
pH, EPA 150.1	SU	4.47	1.0	11-01-04 16:15	TA
Sulfate, EPA 375.4	mg/L	2.66	1.5	11-03-04 10:30	TA
Sp. Conductance, EPA 120.1	uhmos/cm	139.6	0.02	11-01-04 16:00	TA

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Environmental Services Section

REPORT OF ANALYSIS

THIS REPORT MEETS NELAC STANDARDS

Report #: 11016
Report Date: November 19, 2004
NELAC/FDOH#: E81350
FDEPQA#: 920087G
Project#: 24485
Sampled By: Mark Wilson
Sample Site: Forest Service Bridges
Sample Date: 11-05-04

Southern Earth Science
Attn: Mark Wilson
870-3 Blountstown Highway
Tallahassee, FL 32304

Table 1. Sample received 11-05-04.

Sample Location: 115-2.3/B-A 8-10'
Lab ID#: #47777
Sample Time: 15:00

Parameter Monitored	Units	Analysis Result	Detection Limit	Analysis Date	Analyst
Inorganics:					
Chlorides, EPA 9252	mg/kg	87.9	1.78	11-16-04 14:20	TA
pH, EPA 9045	SU	5.38	1.0	11-16-04 13:50	TA
Sulfate, EPA 9038	mg/kg	1.54 U	1.54	11-16-04 15:40	TA
Sp. Conductance, EPA 9050	uhmos/cm	17.0	0.02	11-11-04 16:00	TA
% Solids, SM 2450 G	%	84.4	---	11-16-04 08:00	TA

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No 1101

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CLIENT NAME & ADDRESS:	Southern Earth Sciences	PROJECT #:	T04-303 2448
PROJECT NAME:	Forest Service Bridges	CONTACT PERSON:	Mark Wilson

SAMPLE CONTAINERS

QUANTITY	N HNO_3	S H_2SO_4	H HCl	B NaOH	Z $Zn(C_2H_3O_2)_2$	T $Na_2S_2O_3$	C NONE	OTHER	125 mL	250 mL	500 mL	1 Liter	2 Liter	4 Liter	WHIRLPAK		40 mL	125 mL	250 mL	1 Liter	2 Liter	4 Liter	TRIP BLANK	REMARKS
4							X					X												C

PRESERVATIVE: N–C, OTHER; PLASTIC CONTAINERS: 125 mL – WHIRLPAK; GLASS CONTAINERS: 40 mL – 4 Liter

PRECLEANED CONTAINERS RELINQUISHED BY:	RECEIVED BY:	DATE:	TIME:
[signature]	[signature]	10/27	8:30

SAMPLE COLLECTION

SAMPLERS: (PRINT NAME) Eric Thomas

SAMPLERS: (SIGNATURE) Eric Thomas

FIELD ID NUMBER	DATE	TIME	STATION LOCATION/NUMBER	MATRIX	GRAB OR COMPOSITE	NO. OF CONTAINERS	pH	resist	Cl-	SO4	LAB ID#
S-1W	11/1	10:35 AM	353-0.20	W	G	1	X	X	X	X	47719
S-2W	11/1	11:18 AM	125-6.8	W	|	1	|	|	|	|	47720
S-3W	11/1	12:19 PM	115-2.3	W	|	1	|	|	|	|	4772,
S-4W	11/1	12:16 PM	115-2.5	W	|	1	|	|	|	|	4772.

ANALYSES REQUESTED

COMMENTS

H2O Samples 870-3 Blountstown Hwy

$ 56.00 Clan TLH, FL

RELINQUISHED BY: (SIGNATURE)	RECEIVED BY: (SIGNATURE)	DATE:	TIME:
Eric Thomas	[signature]	11-1-01	1410
RELINQUISHED BY: (SIGNATURE)	RECEIVED BY: (SIGNATURE)	DATE:	TIME:

MATRIX TYPES: SW SURFACE WATER, WW WASTE WATER, GW GROUND WATER, DW DRINKING WATER, FT FISH TISSUE, S SOIL/SEDIMENT, SL SLUDGE, MI MACROBENTHIC INVERTEBRATES, SH SHELLFISH, HZ HAZARDOUS WASTE, OT OTHER

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№ 1101

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CLIENT NAME & ADDRESS:	Southern Earth Sciences	PROJECT #:	T04-303 / 2444
PROJECT NAME:	Forest Service Bridges	CONTACT PERSON:	Mark Wilson

SAMPLE CONTAINERS	PRESERVATIVE								PLASTIC CONTAINERS								GLASS CONTAINERS								
	N	S	H	B	Z	T	C																		
QUANTITY	HNO_3	H_2SO_4	HCl	NaOH	$Zn(C_2H_3O_2)_2$	$Na_2S_2O_3$	NONE	OTHER	125 mL	250 mL	500 mL	1 Liter	2 Liter	4 Liter	WHIRLPAK		40 mL	125 mL	250 mL	1 Liter	2 Liter	4 Liter		TRIP BLANK	REMARKS
4							X			X															C

PRECLEANED CONTAINERS RELINQUISHED BY:	RECEIVED BY:	DATE:	TIME:
[signature]	[signature]	10-27	8:30

SAMPLE COLLECTION

SAMPLERS: (PRINT NAME) X Mark E. Wilson

SAMPLERS: (SIGNATURE) X [signature]

FIELD ID NUMBER	DATE	TIME	STATION LOCATION/NUMBER	MATRIX	GRAB OR COMPOSITE	NO. OF CONTAINERS	pH	resist.	Cl⁻	SO4	LAB ID#
S-1S	11-4	3:00	353-0.20 / B-B 8-10'	S		1	X	X	X	X	4777
S-2S	11-4	3:00	125-6.8 / B-A 8-10'	S		1	|	|	|	|	4777
S-3S	11-4	3:00	115-2.3 / B-A 8-10'	S		1	|	|	|	|	4777
S-4S	11-4	3:00	115-2.5 / B-B 8-10'	S		1	|	|	|	|	4777

COMMENTS

Soil Samples

$70.00 (ea)

RELINQUISHED BY: (SIGNATURE)	RECEIVED BY: (SIGNATURE)	DATE:	TIME:
[signature]	[signature]	11-5-04	1252
RELINQUISHED BY: (SIGNATURE)	RECEIVED BY: (SIGNATURE)	DATE:	TIME:

MATRIX TYPES: SW SURFACE WATER, WW WASTE WATER, GW GROUND WATER, DW DRINKING WATER, FT FISH TISSUE, S SOIL/SEDIMENT, SL SLUDGE, MI MACROBENTHIC INVERTEBRATES, SH SHELLFISH, HZ HAZARDOUS WASTE, OT OTHER

APPENDIX

DRILLING AND PENETRATION TESTING PROCEDURES

The borings were advanced by a rotary drilling process which utilizes a viscous bentonite drilling fluid to flush the cuttings and stabilize the hole. At regular intervals, the drilling tools were withdrawn and soil samples obtained with a standard 1.4-inch I.D., 2.0-inch O.D., split-tube sampler.

The sampler was initially seated six inches to penetrate loose cuttings, then driven an additional foot with blows of a 140 pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated the "penetration resistance". Penetration resistance is an index to the soil strength and density which may be evaluated in engineering design.

The samples were classified in the field by the driller as they were obtained. Representative portions of each soil sample were then sealed in plastic bags and transported to our laboratory where they were examined by an Engineer or Geologist to verify the field classifications.

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, thanks to the Association of Soil and Foundation Engineers (ASFE).

When ASFE was founded in 1969, subsurface problems were frequently being resolved through lawsuits. In fact, the situation had grown to such alarming proportions that consulting geotechnical engineers had the worst professional liability record of all design professionals. By 1980, *ASFE-member consulting soil and foundation engineers had the best professional liability record.* This dramatic turn-about can be attributed directly to client acceptance of problem-solving programs and materials developed by ASFE for its members' application. *This acceptance was gained because clients perceived the ASFE approach to be in their own best interests.* Disputes benefit only those who earn their living from others' disagreements.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of his report may affect his recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used*:

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

A geotechnical engineer cannot accept responsibility for problems which may develop if he is not consulted after factors considered in his report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by the geotechnical engineer who then renders an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those opined to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. For example, the actual interface between materials may be far more gradual or abrupt than the report indicates, and actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultant through the construction stage,* to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by the geotechnical engineer based upon his interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report*. Those who do not provide such access may proceed under the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgement and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist the geotechnical engineer's liabilities onto someone else. Rather, they are definitive clauses which identify where the geotechnical engineer's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, the Association of Soil and Foundation Engineers has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

Published by

ASFE

ASSOCIATION OF SOIL AND FOUNDATION ENGINEERS

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