REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION

Capps II

Mullins, South Carolina
S&ME Project No. 4263-15-023-01

Prepared By:

S&ME

1330 Highway 501 Business
Conway, South Carolina 29526

March 16, 2015

March 16, 2015

Reference: **Report of Preliminary Geotechnical Exploration**
Capps II
Mullins, South Carolina
S&ME Project No. 4263-15-023-01

S&ME, Inc. has completed the preliminary geotechnical exploration for the referenced project after receiving authorization to proceed on February 16, 2015. Our exploration was conducted in general accordance with our Proposal No. 42-1400259r1, dated February 11, 2015.

The purpose of this exploration was to evaluate general subsurface conditions within the specified parcels for site certification purposes. This report characterizes the general surface and subsurface conditions of the site, offers preliminary recommendations regarding site preparation, suitability of on-site soils for use in construction and potential foundation types. The recommendations contained herein should be considered of a preliminary nature and are not valid for design without the confirmation of an additional design level subsurface exploration.

S&ME, Inc. appreciates this opportunity to work as your geotechnical engineering consultant. If you should have any questions concerning this report, please do not hesitate to contact us.

Very truly yours,
S&ME, Inc.

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EXECUTIVE SUMMARY

For your convenience, this report is summarized in outline form below. This brief summary should not be used for design or construction purposes.

This is a preliminary exploration. The number of borings performed is insufficient to allow reliance upon the preliminary conclusions provided in this report for final design purposes. Additional exploration is required to confirm the preliminary conclusions once the site layout plan has been finalized and precise building locations are known.

1. **Soil Conditions:** Beneath an organic surface zone of about 8 to 14 inches of plowzone, the soil profile generally consisted of an upper stratum of stiff fine grained soils (Stratum I) to depths of about 7 to 8 feet. Below that, a stratum of interbedded sands, silts, and clays (Stratum II) was encountered to the maximum exploration depth of about 25 feet in C-1, and depths of 21 to 23 feet in the other soundings. Beneath Stratum II soundings encountered a stratum of sands to the boring termination depth of 25 feet.

2. **Subsurface Water:** At the time of drilling, the subsurface water level was interpreted from pore pressure readings to range from about 1 to 2 feet below the ground surface, generally fluctuating with surface topography. Measured subsurface water levels within the hand auger borings ranged from 2 to 3 feet. Shallow perched water is likely to develop at this site, especially in low-lying portions of the site, due to the poor drainage capacity and low infiltration rate of the upper soil layers. Water levels may vary across the site, due to various influences including perched water, topography, and seasonal fluctuations.

3. **Site Preparation & Surface Stabilization**: Establish positive drainage at the site as soon as possible. About 8 to 14 inches of plowzone was observed at the surface, and may need to be stripped. Organic content testing was beyond the scope of this report, but should be performed during the design level geotechnical exploration to determine if plowzone soils are acceptable for use as subgrade or will need to be stripped. Based on our preliminary observations of hand auger borings, it is our opinion that the organic content of the plowzone soils may be greater than 5 percent by weight, and thus warrant the removal of the plowzone soils. After removal of plowzone, the exposed surface soils within building pad and pavement subgrade areas should be thoroughly densified with a heavy sheepsfoot[1] roller prior to new fill placement. Some overexcavation of soft upper clays should be anticipated to be necessary. Proofrolling of the subgrade by the contractor under the observation of the geotechnical engineer should be used to

[1] The use of a smooth-drum vibratory roller is not recommended in the upper clay soils. The vibrations may tend to draw shallow perched water up to the surface, and the smooth drum may be less effective than the sheepsfoot style compaction equipment that is designed for use in clayey soils.

identify the unstable areas that require more rigorous stabilization efforts prior to new fill placement.

4. **Seismic Site Class:** Cone sounding data and shear wave velocity field test data indicates that this site is best described as IBC 2012 seismic Site Class D. Based on the apparent age and soil structure of the subsurface soils, widespread liquefaction was determined to be unlikely at this site, considering the anticipated ground accelerations associated with the design magnitude earthquake.

5. **Seismic Design Parameters:** Based on the soil profile, the following Site Class D seismic design parameters are applicable: $F_A = 1.41$, $F_V = 2.10$, $S_{DS} = 0.46g$, $S_{D1} = 0.24g$, and Mapped MCE Geometric Mean Peak Ground Acceleration (PGA_M) = 0.33g. For structures in Seismic Risk Category I, II, III, or IV, this indicates Seismic Design Category D.

6. **Foundation Types:** We anticipate the use of shallow foundations will likely be acceptable for lightly loaded structures, utilizing working load bearing pressures of 2,000 psf. Moderately to heavily loaded structures may need to rely on a deep foundation system such as driven pile or drilled piers, or may require preconsolidation of the lower clays through the use of a temporary surcharge embankment prior to construction.

1. PURPOSE AND SCOPE

The purpose of this preliminary exploration was to evaluate the general subsurface conditions at the site, and to generally discuss the findings with regard to future site development. It is important to realize that our preliminary geotechnical report is not of sufficient detail for use in final design and that additional geotechnical exploration and evaluation will be required for each building once the proposed site layout and design plans are finalized.

2. PROJECT AND SITE DESCRIPTION

We have prepared this report in response to the Request for Proposal (RFP) prepared by the North Eastern Strategic Alliance (NESA), dated March 3, 2013. The RFP included information regarding the approximate size and location of the site. The subject property is comprised of a tract of land totaling approximately 160 acres, located north west of Mack Arthur Road, and along both sides of Ed Smith Road in Mullins, Marion County, South Carolina. See Figure 1 in Appendix A for a site vicinity map. Based upon a review of the provided site aerial photograph, the site appears to contain both cleared agricultural land and wooded land, and a railroad track running northeast to southwest through the site.

The purpose of this report is to provide specific due diligence services necessary to satisfy portions of the South Carolina Department of Commerce Industrial Site Certification Program as requested in the RFP.

3. EXPLORATION PROCEDURES

On March 3, 2015, representatives of S&ME, Inc. visited the site. Using the information provided, we performed the following tasks:

- We performed a site walkover, observing features of topography, existing structures, ground cover, and surface soils at the project site.
- We established four cone penetration test (CPT) sounding locations across the parcel, and established MASW (Multichannel Analysis of Surface Waves) and MAM (Microtremor Array Measurement) test locations. The approximate sounding and seismic test locations are shown on the test location sketch included as Figure 2 in Appendix A.
- At each test sounding location, a hand auger boring was advanced to a depth of 4 feet to observe the near surface soils.

A description of the field tests performed during the exploration as well as the CPT sounding logs and hand auger boring logs are attached in Appendix B. No laboratory testing was proposed to be performed as part of this exploration.

4. SURFACE CONDITIONS

Currently the site consists of agricultural fields, and some wooded areas. Ed Smith Road is a dirt road that approximately bisects the site in a northwest to southeast direction; the surrounding agricultural fields appear to range from approximately 6 inches to greater than 1 foot in elevation higher than the dirt road. Plowzone material was observed at all test locations ranging from 8 inches to 14 inches in thickness.

4.1 SCS Soil Series (Near-Surface Soils)

We have reviewed the USDA Soil Conservation Service (SCS) maps for this site, and have identified several different soil series within the project boundaries. Based upon engineering properties interpreted from these maps, we have grouped the soil series into three color-coded categories, which are also shown on Figure 4 in Appendix A. Please note that these soil series groupings are based upon information gathered by USDA from the upper 5 feet of the soil profile, and generally do not consider the characteristics of the deeper soils.

- The **"green"** group of soils is generally not limited for commercial or light industrial development consideration, and includes the Dothan Series. We roughly estimate that this group of soils comprises about 41 percent of the total site area, mainly in the existing agricultural fields.

- The **"yellow"** group of soils is somewhat limited for development consideration due to wetness and weak surface soils, and includes the Goldsboro Series. We roughly estimate that this group of soils comprises about 9 percent of the total site area.

- The **"red"** group of soils is generally very limited for development consideration due to flooding/wetness, and weak surface soils, and includes the Dunbar Series, the Rutlage Series, and the Coxville Series. This group may present some challenges with regard to site development; however, experience indicates that the suitability of this group can be highly variable. Some areas may be wet and unstable at the surface and other areas may be considerably more stable and drier. We roughly estimate that this group of soils comprises about 50 percent of the total site area, mainly in the currently wooded areas.

Please see Table 2 in Appendix A for a summary of the soil properties that we examined in the literature. Note that the soil series presented on the table are listed in the estimated order of percentage 'coverage area' from greatest to least across the site. Please also see Figure 4 in Appendix A for a site layout plan that shows a graphic representation of where each of these soil groups is located on the site.

4.2 Plowzone Soils

A plowzone layer was present throughout the site and ranged in thickness from 8 to 14 inches, with an average thickness of about 10 inches. The surface of this plowzone layer appears to consist of relatively loose, silty sands and soft silts that have been repeatedly disturbed by agricultural activities. Some buried vegetable matter and plant roots were observed near the surface, and should be anticipated to be present within the plow zone, especially the upper few inches.

Our past experience suggests that where plow zone soils contain greater than 5 percent organics, they are unlikely to be suitable for subgrade support or for re-use as structural fill soils. While we did not measure the organic content as part of this exploration, where the organic content is less than 5 percent, some of these plowzone soils may be suitable for use as subgrade or fill; however, it should be anticipated that a portion of the plowzone, typically the top 8 inches or so, may have an organic content above 5 percent which would render it unsuitable. The organic content of the plowzone should be tested and measured if it is desired to leave any plow zone soils in place. Where determined to be unsuitable for re-use as fill and unsuitable for stabilization in place, the plowzone materials should be stripped and removed from the site.

At the time of the exploration, the plow zone soils were wet, but were not saturated; however, it should be recognized that because of their loose condition, plow zone soils can often contribute to a perched water condition during periods of wet weather, complicating grading operations.

5. SUBSURFACE CONDITIONS

The generalized subsurface conditions at the site are described below. For more detailed descriptions and stratifications at specific test locations, the respective Test Records should be reviewed in Appendix B.

5.1 Local Geology

The site is located in the Coastal Plain Physiographic Region of South Carolina. A review of local geologic mapping indicates that the site area likely lies within an outcrop area of the Bear Bluff Formation (Tb), typically inter-layered terrestrial clays, silts, sands, and shell beds laid down during the Upper Pliocene Epoch approximately 1.8 to 2.4 million years ago.

These materials weathered in place and have formed a mantle of clays and sands anticipated to be approximately 25 to 30 feet thick which overlie less weathered, much older, calcareous soils below. The surface has been reworked by erosional processes over geologic time, and the limestone residuum has been masked by deposits of loose to dense sands or stiff to very stiff clays and silts. The upper contact of the lower sands may be irregular due to localized scouring and redisposition of the overlying clays.

5.2 Interpreted Subsurface Soil Profile

A subsurface cross-sectional profile of the soils on the site is attached in Appendix A as Figure 3. The cross-section orientation in plan view is shown on Figure 2. The profiles are given to provide a representation of the conditions over widely spaced locations. Please note that the profile is not to scale and is provided for illustrative purposes only.

Subsurface stratifications may be more gradual than indicated, and conditions will vary between test locations.

Soils encountered at the test locations were grouped into three general strata based on estimated physical properties derived from the CPT sounding results. These strata are discussed in the following sections.

5.2.1 Stratum I: Upper Stiff Fine Grained Soils

Beneath the plowzone material our soundings and hand auger borings encountered mostly cohesive soils that extend to depths of about 7 to 8 feet beneath the ground surface. The soil types observed within the hand auger borings generally consist of clayey sands (SC) and sandy lean clays (CL) to the maximum hand auger exploration depth of 4 feet. Coloration of these soils was tan to gray, and moisture condition of these soils ranged from moist to wet.

These soils exhibited CPT tip stresses ranging from about 10 to 40 tons per square foot (tsf), and sleeve stresses ranged from about 0.1 to 3.0 tsf. These values indicate a soft to stiff consistency in the clays and a very loose to loose relative density in the clayey sands.

5.2.2 Stratum II: Interbedded Sands, Silts, and Clays

Underlying Stratum I and beginning at depths of 7 to 8 feet, the CPT soundings encountered interbedded layers of sands, silts, and clays to the boring termination depth of 25 feet in sounding C-2 and to depths ranging from 21 to 23 feet in the other soundings. In the clay and silt layers tip stress measurements ranged from about 10 to 20 tsf, and sleeve stresses ranged from 0.1 to 0.5 tsf indicating a soft to firm consistency. In the sand layers, tip stresses ranged from 20 to 100 tsf but generally ranged from 20 to 40 tsf, and sleeve stresses were near 0, indicating a generally loose relative density.

5.2.3 Stratum III: Lower Sands

Below Stratum II and beginning at depths of 21 to 23 feet, the CPT soundings encountered a layer of medium dense sands which continued, to the boring termination depth of 25 feet in borings C-1, C-3, and C-4. Tip stress measurements ranged from about 100 to 200 tsf, with sleeve stresses of generaly 1 tsf, indicating a generally medium dense to dense relative density.

5.3 Subsurface Water

The subsurface water level was interpreted to range between 1 to 2 feet below the ground surface at the time of the exploration, based upon the pore pressure readings measured in the CPT soundings. Measured subsurface water levels within the hand auger borings ranged from 2 to 3 feet. We note that higher water levels were typically encountered in areas of lower elevation and lower water levels were typically encountered in areas of higher elevation. Water levels may fluctuate seasonally at the site, being influenced by rainfall variation and oter factors. Site construction activities can also influence water elevations.

Due to the clayey nature of near-surface soils and plowzone soils in some portions of the site, there is potential for perched water conditions to develop following periods of wet weather. These conditions can often be managed by the installation of drainage ditches prior to site grading and maintenance of ditches during construction. Permanent pavement underdrains are advisable where roads and parking lots traverse such zones.

The above description of subsurface conditions is relatively brief and general. More detailed information may be obtained from review of individual sounding and hand boring logs, included in Appendix B of this report.

6. BUILDING CODE SEISMIC PROVISIONS

Seismic-induced ground shaking at the foundation is the effect taken into account by seismic-resistant design provisions of the International Building Code (IBC). Other effects, including landslides and soil liquefaction, must also be considered.

6.1 IBC Site Class

As of July 1, 2013, the 2012 edition of the International Building Code (IBC) has been adopted for use in South Carolina. We classified the site as one of the Site Classes listed in IBC Section 1613.3, using the procedures described in Chapter 20 of ASCE 7-10.

The initial step in site class definition is a check for the four conditions described for Site Class F, which would require a site-specific evaluation to determine site coefficients F_A and F_V. Soils vulnerable to potential failure under item 1) including quick and highly sensitive clays or collapsible weakly cemented soils were not observed in the borings. Three other conditions, 2) peats and highly organic clays; 3) very high plasticity clays (H>25 feet); and 4) very thick soft/medium stiff clays were also not evident in the borings performed.

6.1.1 Liquefaction Potential of Bearing Soils

One other determining characteristic, liquefaction potential under seismic conditions, was assessed. Soils were assessed qualitatively for liquefaction susceptibility based on their age, stratum, mode of deposition, degree of cementation, and size composition. This assessment considered observed liquefaction behavior in various soils in areas of previous seismic activity.

Liquefaction of saturated, loose, cohesionless soils occurs when they are subjected to earthquake loading that causes the pore pressures to increase and the effective overburden stresses to decrease, to the point where large soil deformation or even transformation from a solid to a liquid state results. Earthquake-induced ground surface acceleration at the site was assumed from the building code design peak ground acceleration adjusted for site effects (PGA_M) of 0.33g for this site.

To evaluate liquefaction potential, we performed analyses using the data obtained in the borings, considering the characteristics of the soil and water levels observed in the boring. The liquefaction analysis was performed based on the design earthquake prescribed by the 2012 edition of the International Building Code, the “simplified procedure” as presented in Youd et al. (2001), and recent research concerning the liquefaction resistance of aged sands (Hayati & Andrus, 2008; Andrus et al. 2009; Hayati & Andrus, 2009).

To help evaluate the consequences of liquefaction, we computed the Liquefaction Potential Index (LPI), which is an empirical tool used to evaluate the potential for liquefaction to cause damage. The LPI considers the factor of safety against liquefaction, the depth to the liquefiable soils, and the thickness of the liquefiable soils to compute an index that ranges from 0 to 100. An LPI of 0 means there is no risk of liquefaction; an LPI of 100 means the entire soil profile is expected to liquefy. The level of risk is generally defined below.

- ***LPI < 5*** **–** surface manifestation and liquefaction-induced damage not expected.
- ***5 ≤ LPI ≤ 15*** **–** moderate liquefaction with some surface manifestation possible.
- ***LPI > 15*** **–** severe liquefaction and foundation damage is likely.

The LPI for this site is expected to be less than 1 which indicates that the risk of liquefaction induced damage is low. For this reason, and because the earthquake-related settlements associated with this LPI value are expected to be insignificant, our analysis indicates that liquefaction during the design seismic event is unlikely to be a significant design concern at this site, and therefore Site Class F conditions do not apply.

6.1.2 Site Class Determination

Shear wave velocity data obtained within the limits of the proposed construction extends to a depth of about 180 feet. In accordance with Chapter 20 of ASCE 7-10, an average velocity of 903 feet per second was estimated between our two test array locations in the upper 100 feet of the soil profile (V_{s100}). Based on this data and our knowledge of the geologic conditions in this area, the use of Seismic Site Class “D” parameters appears to be appropriate.

6.1.3 Design Spectral Acceleration Values

Selection of the base shear values for structural design for earthquake loading is the responsibility of the structural engineer. However, for the purpose of evaluating seismic hazards at this site, S&ME has evaluated the spectral response parameters for the site using the general procedures outlined under the 2012 International Building Code Section 1613.3.

This approach utilizes a mapped acceleration response spectrum reflecting a targeted risk of structural collapse equal to 1 percent in 50 years to determine the spectral response acceleration at the top of seismic bedrock for any period. The 2012 IBC seismic provisions of Section 1613 use the 2008 Seismic Hazard Maps published by the National Earthquake Hazard Reduction Program (NEHRP) to define the base rock motion spectra.

The Site Class is used in conjunction with mapped spectral accelerations S_S and S_1 to determine Site Amplification Coefficients F_A and F_V in IBC Section 1613.3.3, tables 1613.3.3(1) and 1613.3.3(2). For purposes of computation, the Code includes probabilistic mapped acceleration parameters at periods of 0.2 seconds (S_S) and 1.0 seconds (S_1), which are then used to derive the remainder of the response spectra at all other periods. The mapped S_S and S_1 values represent motion at the top of seismic bedrock, defined as the Site Class B-C boundary. The surface ground motion response spectrum, accounting for inertial effects within the soil column overlying rock, is then determined for the design earthquake using spectral coefficients F_A and F_V for the appropriate Site Class.

The design ground motion at any period is taken as 2/3 of the smoothed spectral acceleration as allowed in section 1613.3.4. The design spectral response acceleration values at short periods, S_{DS}, and at one second periods, S_{D1}, are tabulated below for the unimproved soil profile using the IBC 2012 criteria.

The 2012 IBC specifically references ASCE 7-10 for determination of peak ground acceleration value for computation of seismic hazard. Peak ground acceleration is separately mapped in ASCE 7-10 and corresponds to the geometric mean Maximum Credible Earthquake (MCE_G). The mapped PGA value is adjusted for site class effects to arrive at a design peak ground acceleration value, designated as PGA_M.

Table 1: Spectral Design Values

	2012 IBC (2008 Seismic Hazard Maps)
S_{MS}	0.69 g
S_{M1}	0.37 g
S_{DS}	0.46 g
S_{D1}	0.24 g
F_A	1.41
F_V	2.10
PGA_M	0.33 g

Under the 2012 IBC, for a structure having a Seismic Risk Category classification of I, II, III, or IV, spectral response acceleration factors given above correspond to Seismic Design Category D.

7. PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

The preliminary conclusions and recommendations included this section are based upon the project information outlined in the introduction, and the data obtained during our exploration at the widely spaced sounding locations.

7.1 Foundation Types

The soil profile encountered appears generally suitable for development of typical lightly loaded structures using shallow foundations. The use of shallow foundations for support of isolated column loads up to 100 kips with a uniformly applied area load of 100 psf, and an allowable shallow foundation bearing pressure of 2,000 pounds per square foot (psf) appears feasible throughout the majority of the site, with total static settlement magnitudes ranging from ¾ to 1 inch for typical structural column spacings, provided that footings are properly constructed, the subgrade is properly prepared, and the fill is properly placed and compacted.

Please note that these settlement estimates are for illustrative purposes only, and do not take into account site grade changes (cut and fill) or specific structural load distribution patterns for any particular structure. Static settlements will need to be estimated for each specific structure during future explorations.

Construction of moderately loaded commercial or industrial buildings with loadings greater than those listed above could result in settlement magnitudes of greater than one inch. Structures such as these may require deep foundations for support of structural loads, or preconsolidation techniques to improve the ground and dissipate some of the settlement potential.

The soft clays and silts of Stratum II are contributing a significant portion of the settlement, these clays and silts can typically be preconsolidated using surcharging techniques. Surcharging involves placing the anticipated pressure of the building on the subsurface soils by temporarily stacking soils above grade. The height of the temporary surcharge embankment depends on factors including subsurface drainage pathways, anticipated building loads, and schedule needs. Experience shows that surcharge embankments in this area typically need to remain in place at full height for about 60 to 90 days.

The settlement of soils in Stratum II can also be mitigated by transferring building loads to the soils in or below Stratum III through a deep foundation system. Deep foundation systems would apply load to soils below the depth of our exploration. Design of a deep foundation system would depend on building loads and subsurface profile below the depth of our borings. Deeper borings should be performed prior to the design of a deep foundation system.

7.2 Site Preparation and Fill Considerations

Soils containing significant amounts of fine-grained material similar to those encountered in the upper 10 feet of the soil profile at the site are likely to become unstable when wet, and be difficult to work. As such, we recommend that grading be performed during the typically drier months of summer and fall, if possible. If grading is performed during periods of wet weather, grading costs may be greater. It may also be necessary to use rigorous stabilization methods, such as placement of a reinforcement geo-textile, or chemical stabilization with quicklime, in order to stabilize wet clayey soils. The potential need for near-surface stabilization may be greater in the lower-lying areas of the site where water levels are closer to the ground surface.

7.2.1 Stripping

Where encountered, organic-laden topsoil and plowzone soils should be stripped to a sufficient depth where exposed soils contain less than about 5 percent organics by weight. Clearing and stripping with relatively light, wide-tracked equipment would help prevent mixing of topsoil and rootmat with the underlying soils, which may otherwise be suitable for use. Excessive use of heavy rubber-tired equipment during stripping and grading, particularly during wet periods, may rut the surface and increase the depth of cut required to reach stable soils. The grading contractor should spoil organics and organic-laden soils outside the building and pavement areas.

7.2.2 Proofrolling

Once stripped, the subgrade soils should be evaluated by proofrolling under the observation of the Geotechnical Engineer prior to the placement of fill material. Proofrolling should be conducted by having the contractor make multiple passes over the soil surface with a fully-loaded tandem axle dump truck, off-road dump truck, or earth-moving pan. Areas of unstable material as indicated by the proofroll may require selective undercutting or further stabilization prior to fill placement, as determined by the Geotechnical Engineer.

7.2.3 Surface Densification

After removal of plowzone, the exposed surface soils within building pad and pavement subgrade areas should be thoroughly densified with a heavy sheepsfoot[2] roller prior to new fill placement. Some overexcavation of soft upper clays should be anticipated to be necessary.

7.2.4 On-Site Soil Suitability for Use as Fill

The clays below the topsoil may be used as fill if properly conditioned; however, these soils are likely to require significant drying in order to achieve moisture contents suitable for compaction. On other local projects, this has required mechanical or chemical stabilization to accomplish, as these soils are unlikely to dry without assistance.

- *Mechanical stabilization:* spread the material out in thin layers and continuously turn it over with a disc harrow during dry weather until moisture content testing indicates that the material is 1 to 2 percent drier than the optimum moisture content.

- *Chemical stabilization:* spread the material out in thin layers and intermix it with 2 to 4 percent by weight of quicklime (calcium-oxide), blend, and compact.

[2] The use of a smooth-drum vibratory roller is not recommended in the upper clay soils. The vibrations may tend to draw shallow perched water up to the surface, and the smooth drum may be less effective than the sheepsfoot style compaction equipment that is designed for use in clayey soils.

The SCS map, included in Appendix A as Figure 4, may provide preliminary indications regarding potential areas of suitable borrow materials. In order to evaluate borrow material suitability at specific areas of interest; test pits should be performed under the direction of S&ME to obtain samples and perform laboratory testing. Where located below the water table, it should be anticipated that the moisture content of borrowed soils may be above the optimum moisture content, and that some drying may be required prior to compaction. If borrow excavation occurs during a wet season, soils above the optimum moisture content may be encountered nearer to the surface.

7.3 Recommendations for Additional Exploration Work

The sounding data provided gives only a general indication of the soil conditions at three widely-spaced locations on the site, and is intended only to give a general overview of the soil conditions across the site. Additional exploration will be necessary to allow us to provide specific design recommendations for any proposed structure. We recommend that additional work include a comprehensive geotechnical exploration based upon the proposed building layout.

The additional geotechnical exploration should include borings or soundings of sufficient number and depth as well as a comprehensive laboratory testing program, to allow us to finalize foundation recommendations once site development and design has advanced beyond a preliminary stage, and building locations and structural loads are known.

8. LIMITATIONS OF REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations in this report are based on the applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

The analyses and recommendations submitted herein are based, in part, upon the data obtained from the preliminary subsurface exploration. The nature and extent of variations between the soundings may not become evident until construction. If variations appear evident, then we should be given the opportunity to re-evaluate the recommendations of this report. In the event that any changes in the nature, design, or location of the building are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions modified or verified in writing by the submitting engineers.

Assessment of site environmental conditions; sampling of soils, groundwater or other materials for environmental contaminants; identification of jurisdictional wetlands, rare or endangered species, geological hazards or potential air quality and noise impacts was beyond the scope of the geotechnical portion of this project.

APPENDIX A

SITE VICINITY MAP

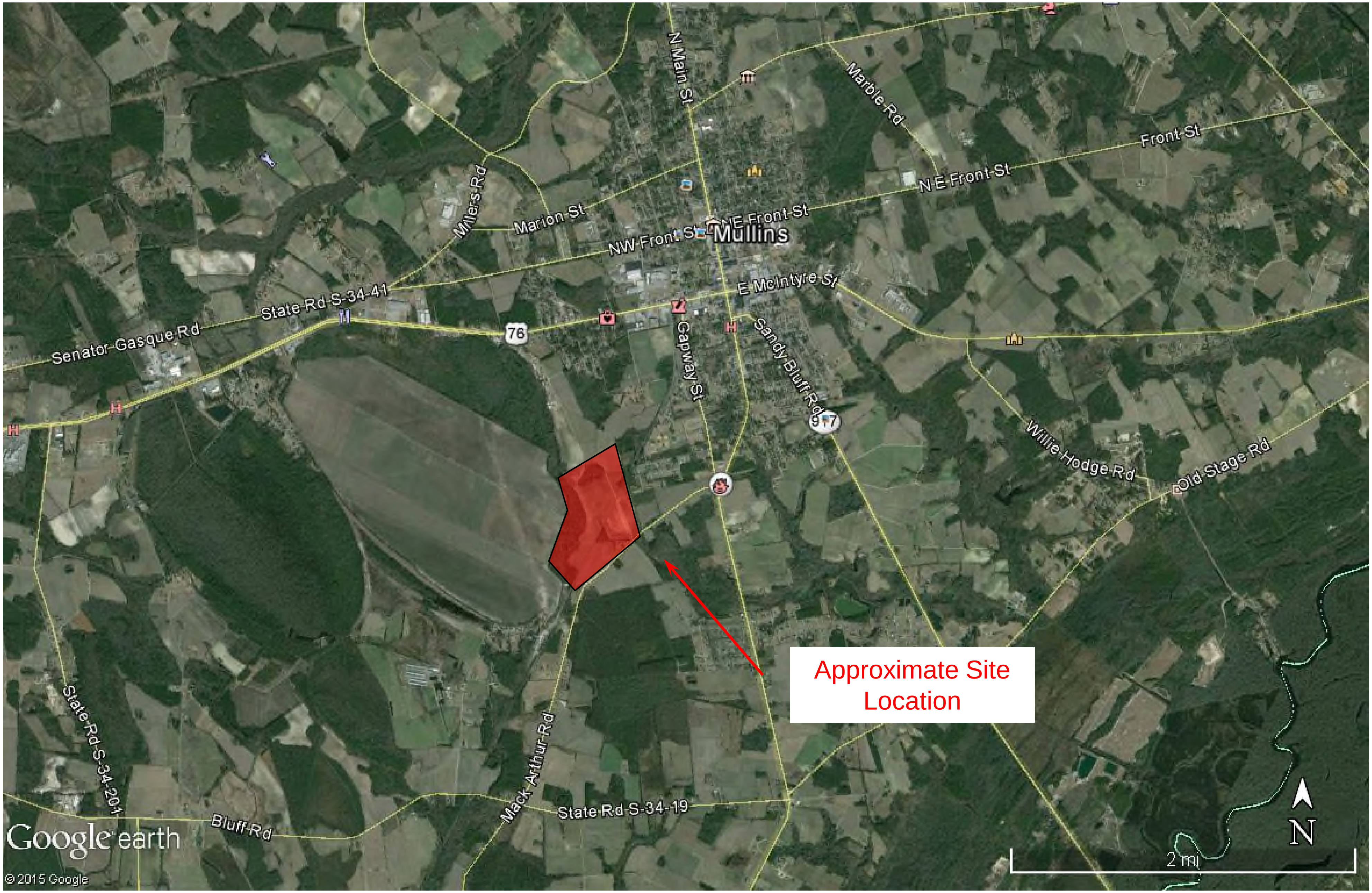
TEST LOCATION SKETCH

SUBSURFACE CROSS-SECTIONAL SOIL PROFILE A-A’

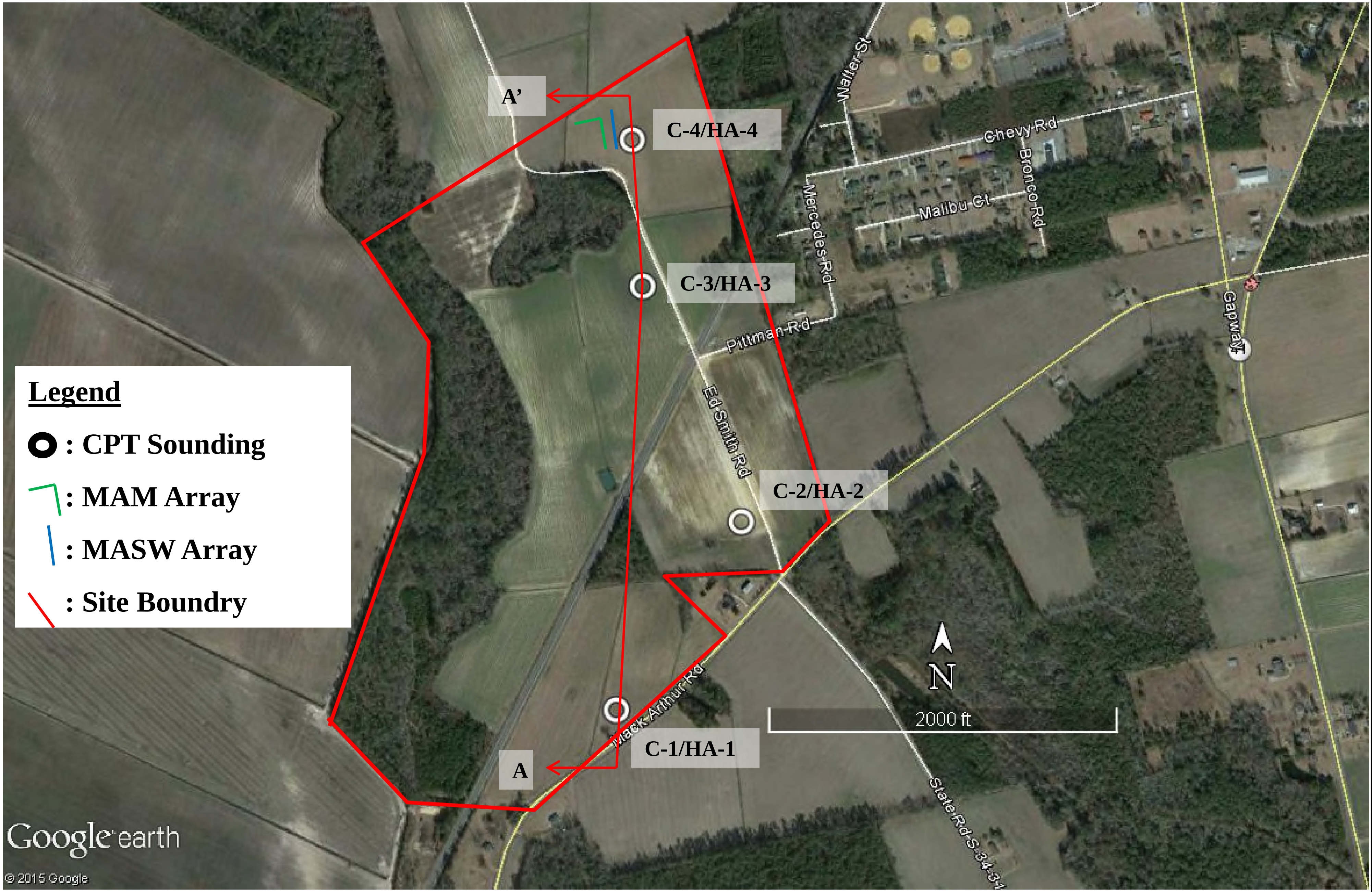
SCS SOIL CLASSIFICATION MAP

SOIL SERIES SUMMARY TABLE

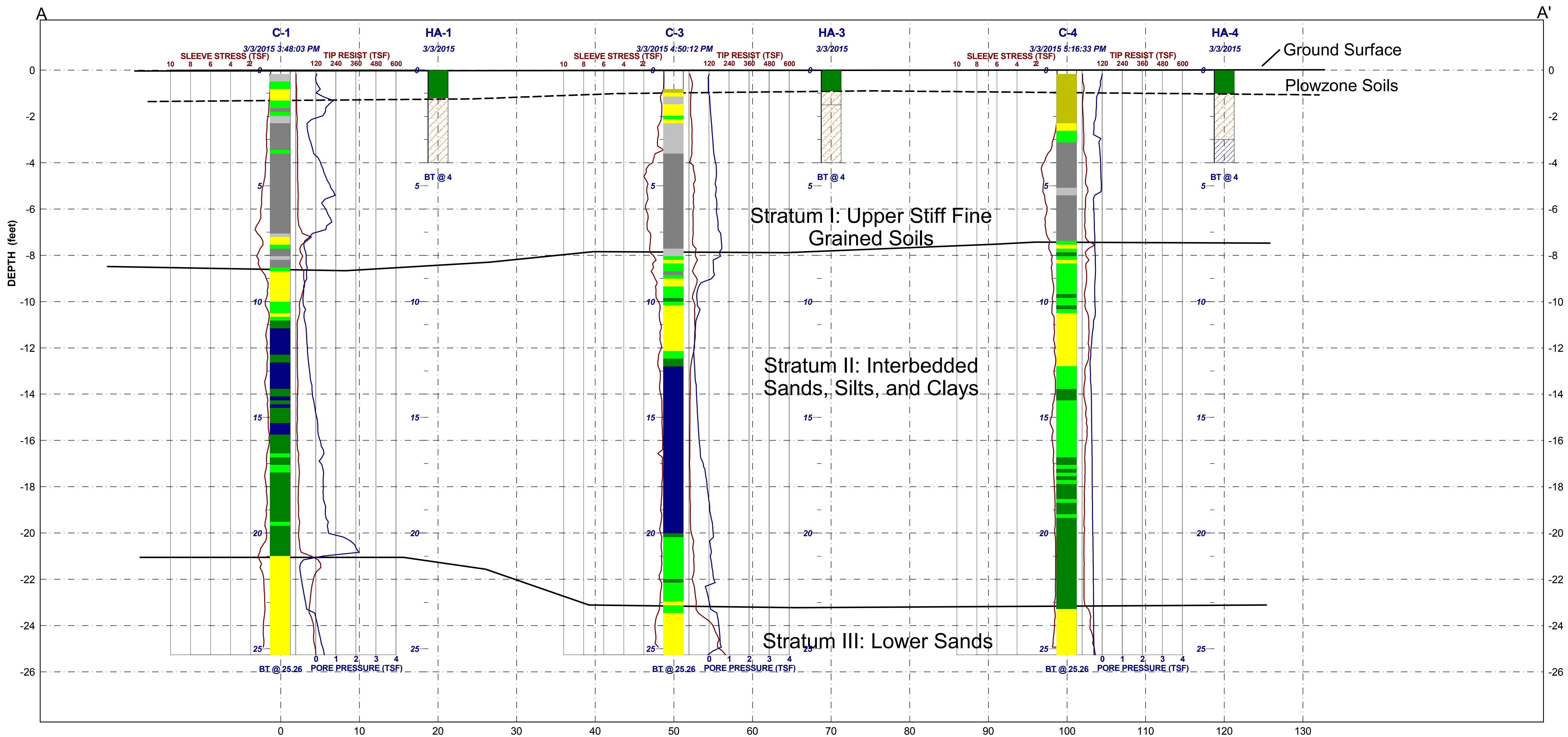
SHEAR WAVE VELOCITY PROFILE

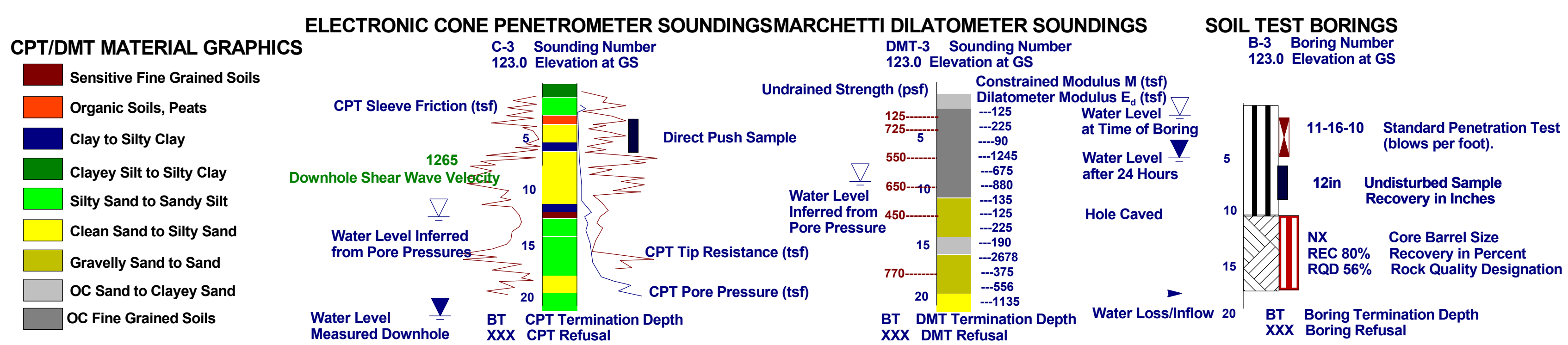


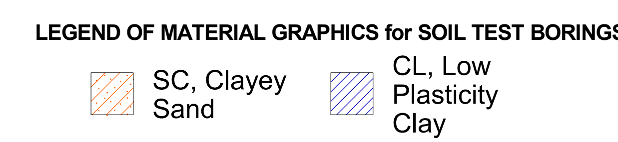
SCALE:	Not To Scale	S&ME	SITE VICINITY MAP **Capps II** **Mullins, South Carolina**	FIGURE NO 1
SOURCE:	Google Earth			
DATE:	January, 2015			
DRAWN BY:	WAG		JOB NO. 4263-15-023-01	



SCALE: NTS	S&ME	**Test Location Sketch** **Capps II** **Mullins, South Carolina**	**FIGURE NO** 2
SOURCE: Google			
SOURCE DATE: Jan, 2015		**PROJECT NO. 4263-15-023-01**	
DATE: March, 2015			

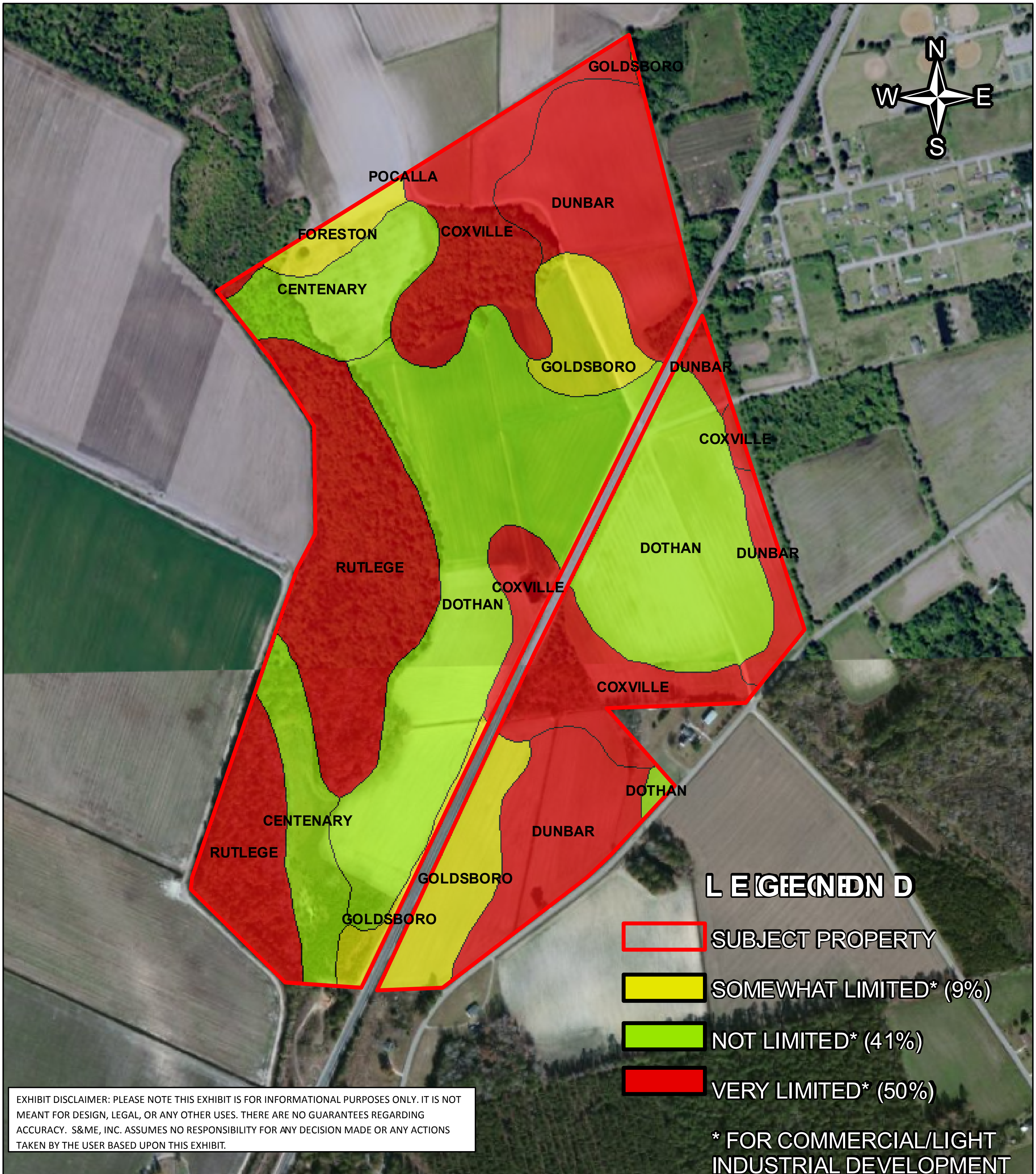






The depicted stratigraphy is shown for illustrative purposes only and is not warranted. Separations between different strata may be gradual and likely vary considerably from those shown. Profiles between nearby borings have been estimated using reasonable engineering care and judgment. The actual subsurface conditions will vary between boring locations.

SUBSURFACE PROFILE	JOB NO: 4263-15-023-01	S&ME
Figure 3		
Diagram: A-A'	DATE: 3/12/15	
PROJECT: Capps II		
LOCATION: Mullins, South Carolina		



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0 300 600 1,200 1,800 2,400 Feet

SCALE:	1"= 600'	**SOIL SURVEY EXHIBIT** **CAPPS II INDUSTRIAL PARK SITE** **MARION COUNTY, SC**	S&ME WWW.SMEINC.COM	FIGURE # **4**
SOURCE:	SCDNR GIS SITE			
SOURCE DATE:	1974			
DATE:	MARCH 2015	S & ME PROJECT # 4263-15-023-01		

TABLE 3: SUMMARY OF USDA SOIL CONSERVATION SERVICE DATA FOR SOIL SERIES MAPPED AT THE SITE

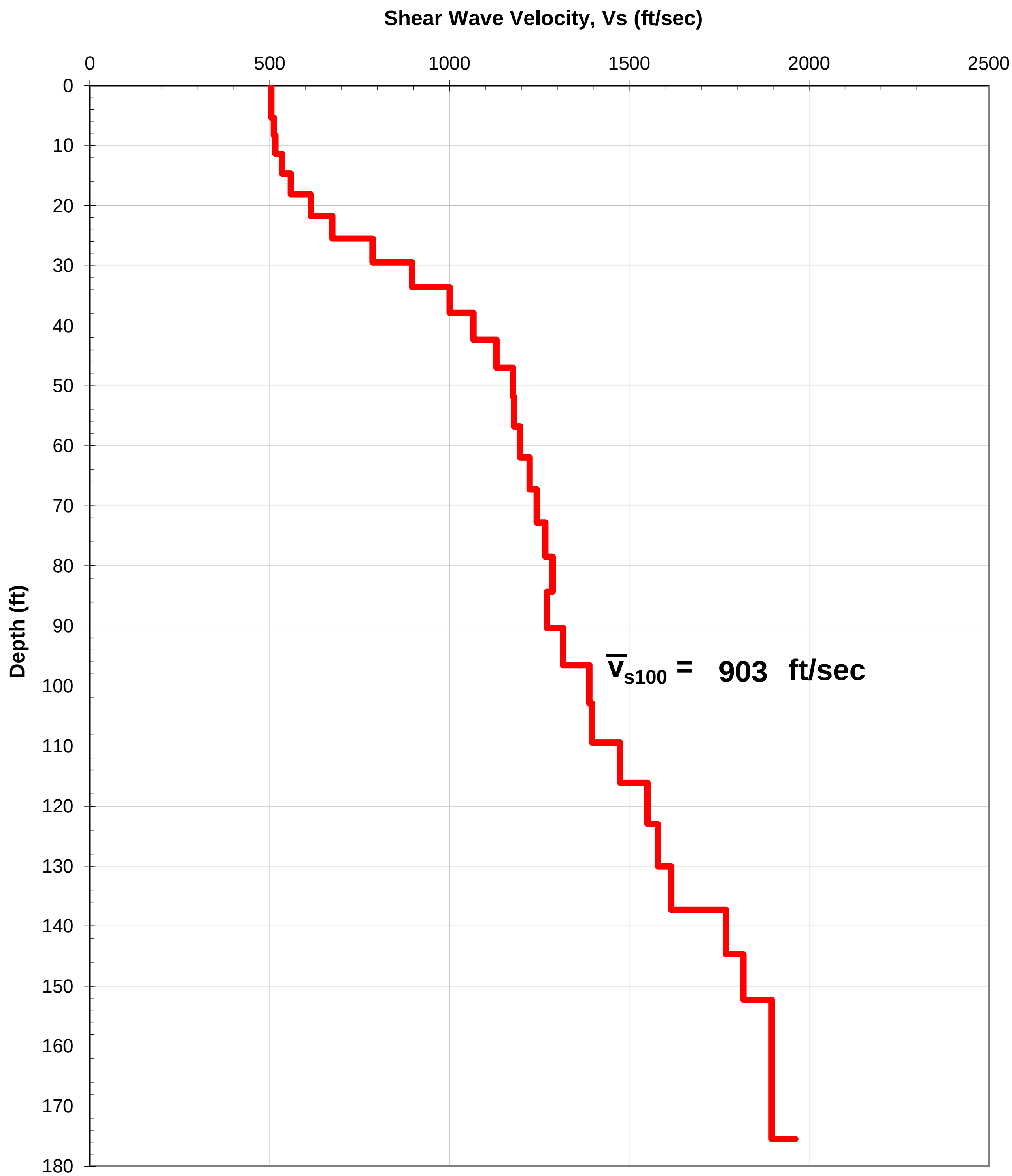
SEE FIGURE 4 FOR REFERENCE:

Approx % Site Area Coverage	Soil Series Name	Sediment Type	Depth to seasonal high water table (ft)	USCS Soil Classifications	Silt/Clay Fines Content (%)	Permeability (iph)	Fill Source	Light Industrial Limitations
32%	Dothan	Loamy sand	3	SM, SM-SC, SC	13 to 30	0.2 to 0.6	Fair	Not Limited
28%	Rutlege	Loamy sand	0 to 0.5	SM, SP-SM	10 to 25	6 to 20	Poor	Very Limited
12%	Dunbar	Loamy sand	1	SM	20 to 35	0.2 to 0.6	Poor	Very Limited
10%	Coxville	Sandy Loam	0 to 0.5	SM, ML, CL	40 to 60	0.2 to 0.6	Poor	Very Limited
9%	Centenary	Sand	3.5	SP, SP-SM, SM	4 to 10	2 to 6	Good	Not Limited
9%	Goldsboro	Loamy sand	2	SM, SM-SC, SC	5 to 20	0.6 to 2	Fair	Limited

LEGEND

41%	Generally dry to moist, sandy soils with only slight limitations to foundation support, and fair to good sourcing of fill
9%	Generally moist to wet, sandy soils, with moderate limitations to foundation support usually due to wetness, and fair to poor sourcing of fill
50%	Generally wet loamy soils, with severe limitations to foundation support usually due to wetness or flooding, and poor sourcing of fill

Figure 5: Shear Wave Velocity Profile SW-1
Capps II Industrial Site
Mullins, South Carolina
4263-15-023



APPENDIX B

SUMMARY OF EXPLORATION PROCEDURES

CPT CLASSIFICATION LEGEND

CPT SOUNDING LOGS

SPT CLASSIFICATION LEGEND

HAND AUGER BORING LOGS

SUMMARY OF EXPLORATION PROCEDURES

The American Society for Testing and Materials (ASTM) publishes standard methods to explore soil, rock and ground water conditions in Practice D-420-98, "*Standard Guide to Site Characterization for Engineering Design and Construction Purposes.*" The boring and sampling plan must consider the geologic or topographic setting. It must consider the proposed construction. It must also allow for the background, training, and experience of the geotechnical engineer. While the scope and extent of the exploration may vary with the objectives of the client, each exploration includes the following key tasks:

- Reconnaissance of the Project Area
- Preparation of Exploration Plan
- Layout and Access to Field Sampling Locations
- Field Sampling and Testing of Earth Materials
- Laboratory Evaluation of Recovered Field Samples
- Evaluation of Subsurface Conditions

The standard methods do not apply to all conditions or to every site. Nor do they replace education and experience, which together make up engineering judgment. Finally, ASTM D 420 does not apply to environmental investigations.

RECONNAISSANCE OF THE PROJECT AREA

Where practical, we reviewed available topographic maps, county soil surveys, reports of nearby investigations and aerial photographs when preparing the boring and sampling plan. Then we walked over the site to note land use, topography, ground cover, and surface drainage. We observed general access to proposed sampling points and noted any existing structures.

Checks for Hazardous Conditions - State law requires that we notify the Palmetto Utility Protection Service (PUPS) before we drill or excavate at any site. PUPS is operated by the major water, sewer, electrical, telephone, CATV, and natural gas suppliers of South Carolina. PUPS forwarded our location request to the participating utilities. Location crews then marked buried lines with colored flags within 72 hours. They did not mark utility lines beyond junction boxes or meters. We checked proposed sampling points for conflicts with marked utilities, overhead power lines, tree limbs, or man-made structures during the site walkover.

BORING AND SAMPLING

Electronic Cone Penetrometer (CPT) Soundings

CPT soundings consist of a conical pointed penetrometer which is hydraulically pushed into the soil at a slow, measured rate. Procedures for measurement of the tip resistance and side friction resistance to push generally follow those described by ASTM D-5778, "*Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils*."

SUMMARY OF EXPLORATION PROCEDURES

A penetrometer with a conical tip having a 60 degree apex angle and a cone base area of 10 cm^2 was advanced into the soil at a constant rate of 20 mm/s. The force on the conical point required to penetrate the soil was measured electronically every 50 mm penetration to obtain the *cone resistance* q_c. A friction sleeve is present on the penetrometer immediately behind the cone tip. The force exerted on the sleeve was measured electronically at a minimum of every 50 mm penetration and divided by the surface area of the sleeve to obtain the *friction sleeve resistance value* f_s A pore pressure element mounted immediately behind the cone tip was used to measure the pore pressure induced during advancement of the cone into the soil.

Refusal to CPT Push

Refusal to the cone penetrometer equipment occurred when the reaction weight of the CPT rig was exceeded by the thrust required to push the conical tip further into the ground. At that point the rig tended to lift off the ground. Refusal may have resulted from encountering hard cemented or indurated soils, soft weathered rock, coarse gravel, cobbles or boulders, thin rock seams, or the upper surface of sound continuous rock. Where fills are present, refusal to the CPT rig may also have resulted from encountering buried debris, building materials, or objects.

CPT Soil Stratification

Using ASTM D-5778 soil samples are not obtained. Soil classification was made on the basis of comparison of the tip resistance, sleeve resistance and pore pressure values to values measured at other locations in known soil types, using experience with similar soils and exercising engineering judgment.

Plots of normalized tip resistance versus friction ratio and normalized tip resistance versus penetration pore pressure were used to determine soil classification (Soil Behavior Type, SBT) as a function of depth using empirical charts developed by P.K. Robertson (1990). The friction ratio soil classification is determined from the chart in the appendix using the normalized corrected tip stress and the normalized corrected tip stress and the normalized friction ratio.

At some depths, the CPT data fell outside of the range of the classification chart. When this occurred, no data was plotted and a break was shown in the classification profile. This occasionally occurred at the top of a penetration as the effective vertical stress is very small and commonly produced normalized tip resistances greater than 1000.

To provide a simplified soil stratigraphy for general interpretation and for comparison to standard boring logs, a statistical layering and classification system was applied the field classification values. Layer thicknesses were determined based on the variability of the soil classification profile, based upon changes in the standard deviation of the SBT classification number with depth. The average SBT number was determined for each successive 6-inch layer, beginning at the surface. Whenever an additional 6-inch increment deviated from the previous increment, a new layer was started, otherwise, this material was added to the layer above and the next 6-inch section evaluated. The soil behavior type for the layer was determined by the mean value for the complete layer.

Water Level Determination

Subsurface water levels in the soundings were interpreted from pore pressure readings obtained during the performance of the CPT soundings, and measured in boreholes.

Multi-Channel analysis of Surface Waves (MASW)

Shear wave velocities were measured at the site using MASW (Multi-Channel analysis of Surface Waves) and MAM (Microtremor Array Method) with non-linear array geometry, combining the dispersion curves from both tests prior to the inversion process. Performing both MASW and MAM provides the greater depth of penetration associated with Microtremor analysis (low frequency surface waves) without sacrificing resolution at shallower depths from MASW (higher frequency surface waves). In addition, our experience indicates using a combination of both methods to develop a shear wave velocity profile is more accurate tha using Refraction Microtremor (ReMi™) exclusively, particularly when the ReMi™ array geometry is linear.

The MASW and MAM testing was conducted using the 16-channel Geometrics ES3000 seismograph and 4.5 Hz vertical geophones. For the MASW testing, the geophones were spaced in a linear geometry at intervals of 7 feet and surface waves generated by a 16-pound sledge hammer striking a metal plate. MAM testing was conducted using an "L-shaped" array geometry with geophone spacing of 30 feet. Because the source locations of the microtremors are not known, the 2-dimensional array geometry is used for the MAM. The analysis was conducted using the OYO Corporation's SeisImager/SW software (*Pickwin v. 3.14* and *WaveEq*).

A combination of active and passive sources was used to develop the wave frequencies required to obtain velocities to a depth of 100 feet. The results of the active and passive sources were combined to produce a single shear wave velocity profile. Based on section 1615.1.5 and Equation 16-44 of 2009 International Building Code, the calculated weighted average shear wave velocities, v_s, using the developed Shear Wave Velocity Profiles were determined.

CPT Soil Classification Legend

Zone	Q_t/N	Description
1	2	Sensitive, Fine Grained
2	1	Organic Soils-Peats
3	1.5	Clays-Clay to Silty Clay
4	2	Silt Mixtures-Clayey Silt to Silty Clay
5	3	Sand Mixtures-Silty Sand to Sandy Silt
6	4.5	Sands-Clean Sand to Silty Sand
7	6	Gravelly Sand to Sand
8	1	Very Stiff Clay to Clayey Sand*
9	2	Very Stiff, Fine Grained*

(*) Heavily Overconsolidated or Cemented

Robertson's Soil Behavior Type (SBT), 1990			
Group #	**Description**	**Ic**	
		Min	**Max**
1	Sensitive, fine grained	N/A	
2	Organic soils - peats	3.60	N/A
3	Clays - silty clay to clay	2.95	3.60
4	Silt mixtures - clayey silt to silty clay	2.60	2.95
5	Sand mixtures - silty sand to sandy silt	2.05	2.60
6	Sands - clean sand to silty sand	1.31	2.05
7	Gravelly sand to dense sand	N/A	1.31
8	Very stiff sand to clayey sand (High OCR or cemented)	N/A	
9	Very stiff, fine grained (High OCR or cemented)	N/A	

Soil behavior type is based on empirical data and may not be representative of soil classification based on plasticity and grain size distribution.

Relative Density and Consistency Table			
SANDS		SILTS and CLAYS	
Cone Tip Stress, qt (tsf)	Relative Density	Cone Tip Stress, qt (tsf)	Consistency
Less than 20	Very Loose	Less than 5	Very Soft
20 - 40	Loose	5 - 15	Soft to Firm
40 - 120	Medium Dense	15 - 30	Stiff
120 - 200	Dense	30 - 60	Very Stiff
Greater than 200	Very Dense	Greater than 60	Hard

S&ME

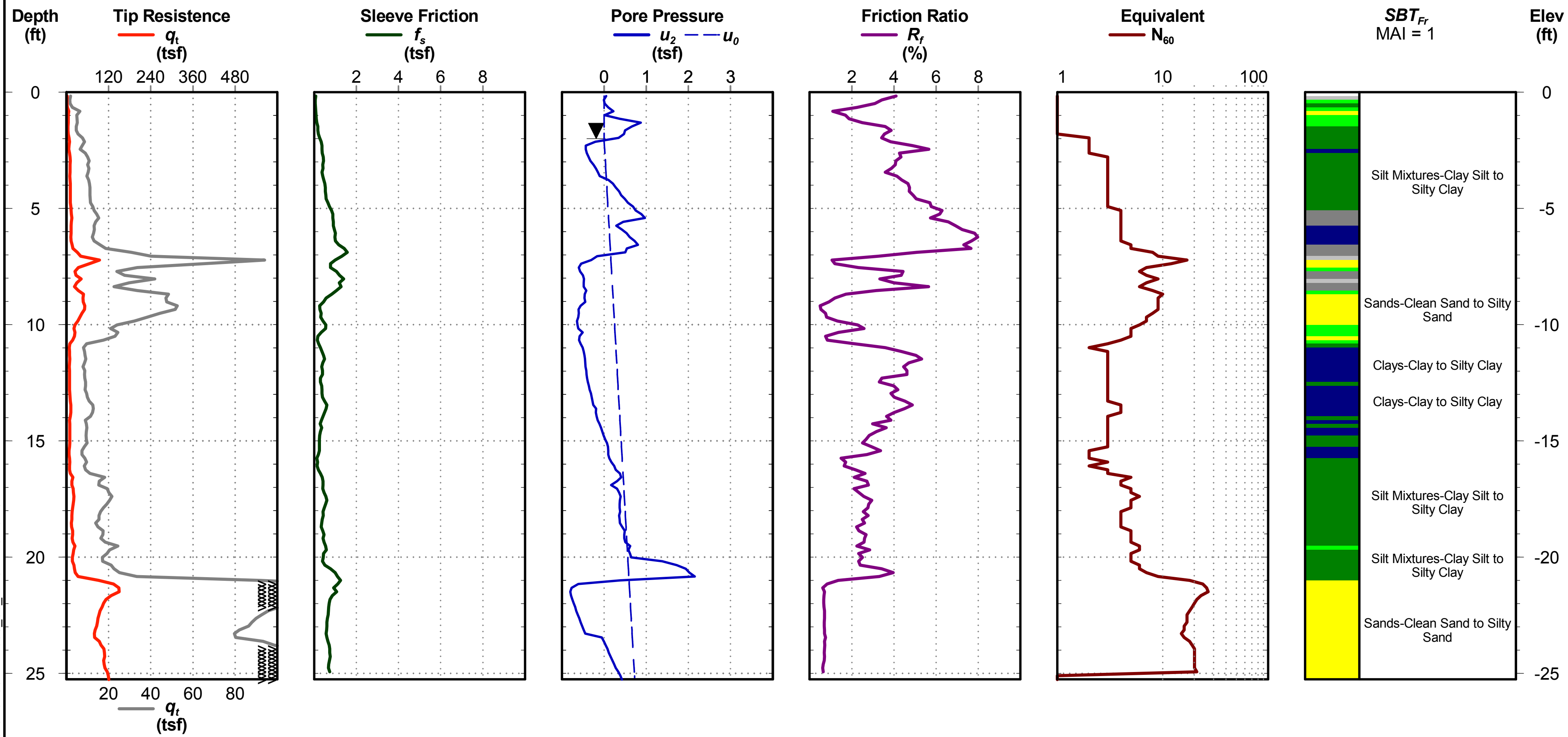
Capps II
Mullins, South Carolina
S&ME Project No: 4263-15-023-01

Cone Penetration Test

C-1

Date: Mar. 3, 2015
Estimated Water Depth: 2 ft
Rig/Operator: Cory Robison

Total Depth: 25.3 ft
Termination Criteria: Target Depth
Cone Size: 1.44



CPT REPORT - DYNAMIC BORING LOGS.GPJ S&ME 2008_06_24.GDT 3/16/15

C-1

Electronic Filename: Capps II Industrial Site C-1.cpt

S&ME

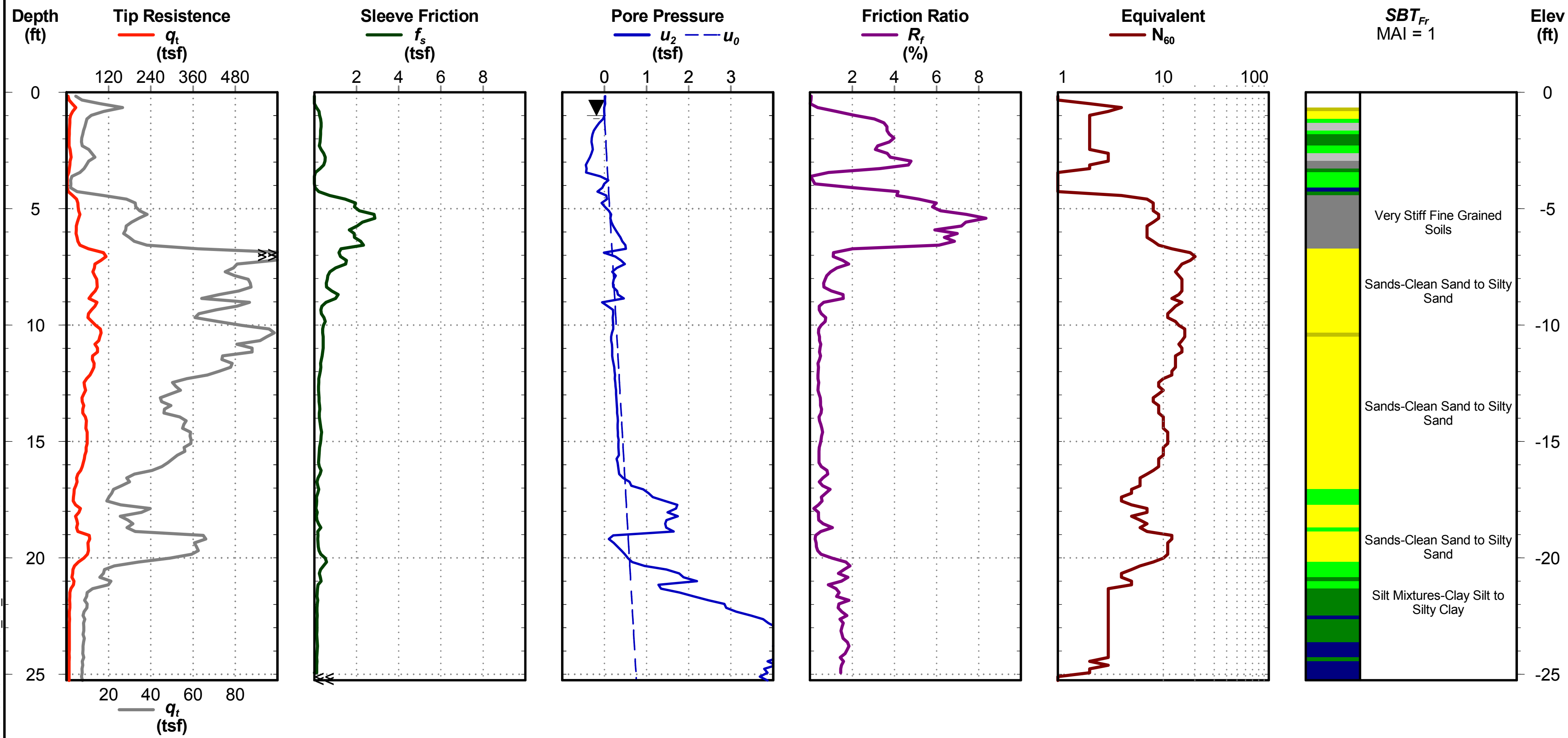
Capps II
Mullins, South Carolina
S&ME Project No: 4263-15-023-01

Cone Penetration Test

C-2

Date: Mar. 3, 2015
Estimated Water Depth: 1 ft
Rig/Operator: Cory Robison

Total Depth: 25.3 ft
Termination Criteria: Target Depth
Cone Size: 1.44



CPT REPORT - DYNAMIC BORING LOGS.GPJ S&ME 2008_06_24.GDT 3/16/15

C-2

Electronic Filename: Capps II Industrial Site C-2.cpt

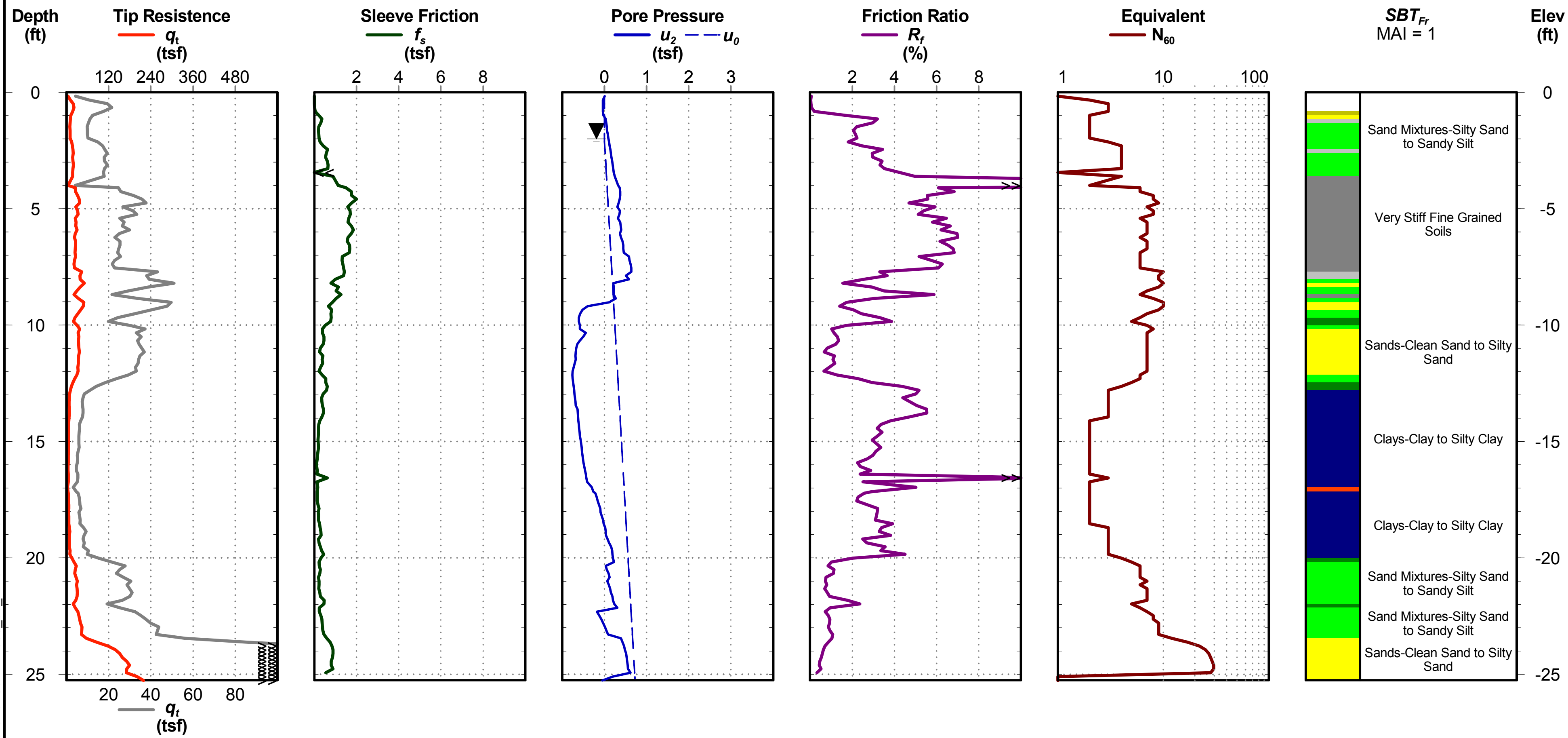
Cone Penetration Test

C-3

Capps II
Mullins, South Carolina
S&ME Project No: 4263-15-023-01

Date: Mar. 3, 2015
Estimated Water Depth: 2 ft
Rig/Operator: Cory Robison

Total Depth: 25.3 ft
Termination Criteria: Target Depth
Cone Size: 1.44



C-3

Electronic Filename: Capps II Industrial Site C-3.cpt

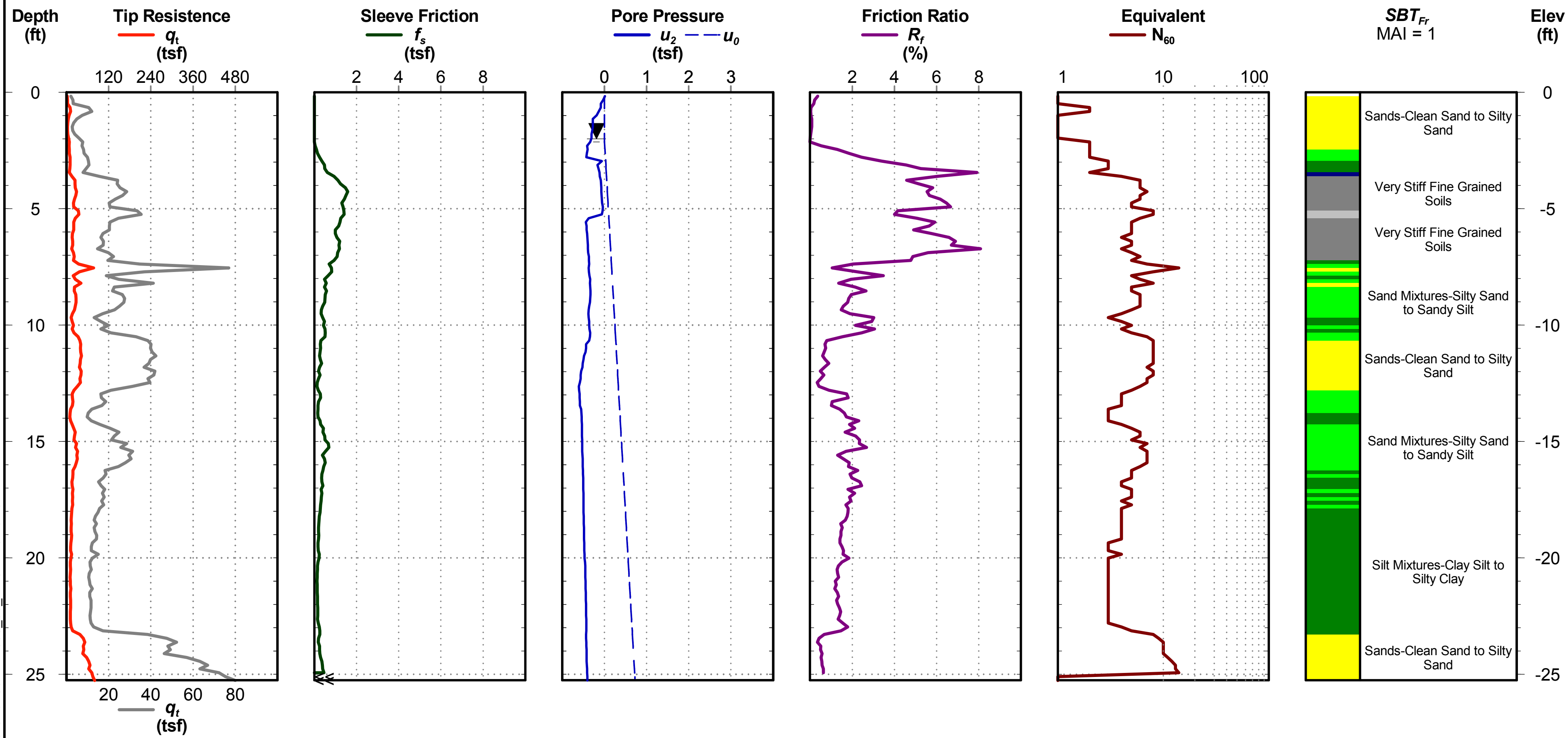
Capps II
Mullins, South Carolina
S&ME Project No: 4263-15-023-01

Cone Penetration Test

C-4

Date: Mar. 3, 2015
Estimated Water Depth: 2 ft
Rig/Operator: Cory Robison

Total Depth: 25.3 ft
Termination Criteria: Target Depth
Cone Size: 1.44



CPT REPORT - DYNAMIC BORING LOGS.GPJ S&ME 2008_06_24.GDT 3/16/15

C-4

Electronic Filename: Capps II Industrial Site C-4.cpt

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

S&ME

PROJECT:	**Capps II** **Mullins, South Carolina** **4263-15-023-01**	**HAND AUGER BORING LOG: HA-1**

DATE STARTED: **3/3/15**	DATE FINISHED: **3/3/15**	NOTES: **Elevation Unknown, Performed at C-1**
SAMPLING METHOD: **Grab Sample**	PERFORMED BY: **Austin Graham**	
WATER LEVEL: **2' ATD**		

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
		PLOWZONE - Approximately 14 inches.		
1			-1.00	
		CLAYEY SAND (SC) - Mostly fine to medium sands, some low plasticity fines, wet.		
2			-2.00	▽
3			-3.00	
4			-4.00	

- - - -- Boring Terminated @ 4'

PROJECT:	**Capps II** **Mullins, South Carolina** **4263-15-023-01**	**HAND AUGER BORING LOG: HA-2**

DATE STARTED:	**3/3/15**	DATE FINISHED:	**3/3/15**	NOTES: **Elevation Unknown, Performed at C-2**
SAMPLING METHOD:	**Grab Sample**	PERFORMED BY:	**Austin Graham**	
WATER LEVEL:	**3' ATD**			

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
		PLOWZONE - Approximately 8 inches thick.		
		SANDY LEAN CLAY (CL) - Mostly low plasticity fines, some fine to medium sands, gray to tan, wet.		
1			-1.00	
2		CLAYEY SAND (SC) - Mostly fine to medium sands, some low plasticity fines, wet.	-2.00	
3			-3.00	▽
4			-4.00	

- - - -- Boring Terminated @ 4'

HAND AUGER BORING LOG: HA-3

PROJECT:	**Capps II** **Mullins, South Carolina** **4263-15-023-01**
DATE STARTED: **3/3/15**	DATE FINISHED: **3/3/15**
SAMPLING METHOD: **Grab Sample**	PERFORMED BY: **Austin Graham**
WATER LEVEL: **2' ATD**	

NOTES: **Elevation Unknown, Performed at C-3**

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
		PLOWZONE - Approximately 9 inches thick.		
1		CLAYEY SAND (SC) - Mostly fine to medium sands, some low plasticity fines, wet.	-1.00	
2		CLAYEY SAND (SC) - Mostly fine to medium sands, some low plasticity fines, tan to gray, wet.	-2.00	▽
3			-3.00	
4			-4.00	

- - - -- Boring Terminated @ 4'

S&ME

PROJECT: Capps II Mullins, South Carolina 4263-15-023-01	HAND AUGER BORING LOG: HA-4

DATE STARTED: **3/3/15**	DATE FINISHED: **3/3/15**	NOTES: **Elevation Unknown, Performed at C-4**
SAMPLING METHOD: **Grab Sample**	PERFORMED BY: **Austin Graham**	
WATER LEVEL: **2' ATD**		

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL
0–1		PLOWZONE - Approximately 1 foot thick.		
1		CLAYEY SAND (SC) - Mostly fine to medium sands, some low plasticity fines, tan, wet.	-1.00	
2			-2.00	▽
3		SANDY LEAN CLAY (CL) - Mostly low plasticity fines, some fine to medium sands, gray to tan, wet.	-3.00	
4			-4.00	

- - - -- Boring Terminated @ 4'

S&ME