Report of Pavement Exploration
Pee Dee Elementary New Traffic Loop
Conway, South Carolina
S&ME Project No. 1463-18-052

PREPARED FOR:

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January 18, 2019

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Attention: Austin Graham, P.E.

Reference: **Report of Pavement Exploration**
Pee Dee Elementary New Traffic Loop
Conway, South Carolina
S&ME Project No. 1463-18-052

Dear Mr. Graham:

We have completed our geotechnical exploration for the referenced project in Conway, South Carolina. Our exploration was performed in accordance with S&ME Proposal 14-1800412-R1, dated November 28, 2018, and authorized by Robert F. Wilfong on December 4, 2018. The purpose of this exploration was to evaluate surface and subsurface conditions within the construction area as they relate to site preparation, earthwork, and structural support of pavements. This report presents a brief discussion of our understanding of the project, the results of our exploration program, and our geotechnical conclusions and recommendations regarding construction.

♦ Project Information

Project information was initially provided in an email received by Ron Forest (S&ME) on July 16, 2018 from Austin Graham (Castles Engineering). The existing Pee Dee Elementary is planning to potentially expand and overlay sections of the existing pavements, if applicable, and construct two new traffic loops. A Site Vicinity Map is included as Figure 1 in the appendix. In July, 2018, we received a rough sketch of the desired layout of the new traffic loops.

A proposal for this work was originally submitted to Mr. Graham on July 19, 2018; however, he sent a finalized sketch, drawn by Castles Engineering and dated November 15, 2018, to Mr. Forest via email on November 26, 2018, and requested a revised proposal be submitted for the work. Based on the updated proposal, we were requested to perform an exploration of both the existing pavements and the native soils that will be within the footprint of the two proposed traffic loops to be constructed.

Exploration Procedures

Field Exploration

The field work was performed on December 21, 2018, while school was not in session. This included the layout and advancement of eleven hand auger borings with dynamic cone penetrometer (DCP) testing, and the collection of one composite bulk sample from the proposed new pavement areas. The approximate test locations are indicated on Figure 2, attached in the appendix.

At each selected test location, near-surface soils were evaluated by performance of a hand auger boring. Each boring was assigned to be advanced to a depth of 4 feet. DCP testing was performed at approximate one foot depth intervals within each boring in general accordance with ASTM STP 399 procedures, in order to evaluate the consistency of the soil. The water level was measured in each boring at the time of augering.

Upon completion of our field work, we backfilled each hand auger boring with soil cuttings to the original ground surface. Samples of the near-surface soils were also transported to our laboratory for further classification and testing.

Laboratory Testing

After the recovered soil samples were brought to our laboratory, a geotechnical professional examined each sample to estimate the distribution of grain sizes, plasticity, moisture condition, color, presence of lenses and seams, and apparent geologic origin in general accordance with ASTM D2488, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)."

The geotechnical professional's classifications are presented on the boring logs, attached in the appendix. Similar soils were grouped into representative strata on the logs. The strata contact lines represent approximate boundaries between soil types. The actual transitions between soil types in the field are likely more gradual in both the vertical and horizontal directions than those which are indicated on the logs.

We performed the following quantitative ASTM standardized laboratory tests to help classify the soils and to formulate our conclusions and recommendations:

- One bulk sample tested in general accordance with ASTM D 2216, "Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass", to measure the in situ moisture content of the soil.
- One bulk sample tested in general accordance with ASTM D 4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils", to measure the plasticity of the soil.
- One bulk sample tested in general accordance with ASTM D 1140, "Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-µm) Sieve", to measure the percent clay and silt fraction.
- One bulk sample tested in general accordance with ASTM D 1557, "Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 lbf/ft^3)", to measure the moisture-density relationship of the soil.

- One specimen from the bulk sample recompacted and tested in general accordance with ASTM D 1883, "Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils", to evaluate soil support characteristics for pavements.

Please note that the modified Proctor moisture-density curve generated during our exploration may be applicable during construction to evaluate compaction of native, on-site fill materials, but the Proctor values of any fill soil will need to be confirmed. One-point Proctor tests ("check plugs") should be used to confirm the applicability of this Proctor curve at the time that earthwork begins, and new Proctor tests should be performed if the check plugs indicate different moisture-density characteristics for the fill soils than are presented in this report.

The laboratory data sheets and procedures for the above tests are attached to this report in the appendix.

♦ Surface Conditions

The pavement conditions that we observed appear to be generally consistent with our expectations for pavements of these types and ages. The forms of distress observed within the pavement included polished aggregates, in which the bitumen material within the top of the asphalt section has worn away over time, fatigue cracking due to the age of the asphalt and the presence of water in some areas, and depressions. Patchwork in the pavement was also observed at several locations.

Types and Examples of Pavement Distress Observed

"Alligator" Fatigue Cracking

Fatigue, or "alligator" cracking was typically located in areas where it appears that depressions had developed in the surface of the pavement. Alligator cracking generally indicates areas where the base course and/or subgrade are weaker than necessary to support the applied traffic loads, and/or the asphalt is too thin for the wheel loads applied. The deflection of the pavement under traffic loading in these areas eventually causes the asphalt to break up and separate into small pieces due to excess tensile stress and strain at the bottom of the asphalt layer.

Some of the areas explored displayed moderate to severe fatigue cracking, indicating a prolonged period of distress. Areas exhibiting this type of distress were observed near test location P-5 in the car drop off area, on the existing bus loop, and near test location P-1 at the entrance of the car drop off area. (See Figure 2 in the appendix for location references.) Photo 1 below shows the way water collects on the pavement surface, which may be a cause of the fatigue. An image of the pavement surface near test location P-4 is shown in Photo 2 below, illustrating moderate fatigue (or "alligator") cracking.

Photo 1

Date: 12/21/2018

Photographer: Kara Fugate

Location / Orientation	Bus Loop, facing Highway 314
Remarks	Note the fatigue cracking, and standing water in depressions on the pavement.

Photo 2

Date: 12/21/2018
Photographer: Kara Fugate

Location / Orientation	Near test location P-4
Remarks	Alligator fatigue cracking.

Patches

There were some previously patched areas observed in the pavement. These patches may represent areas where either potholes or depressions were present in the past, which were previously repaired, or where utilities were installed after the original paving.

An example of an area that has been patched is shown in Photo 3 below. This is near test location P-5, within the car drop off area. Other patches were observed in the exiting lane of the parent loop. A patch from a previous core sample was observed in the playground asphalt. Patching was observed in the bus loop area as well. It appears patches were used in areas of utilities and along the edges of the pavement.

Photo 3

Date: 12/21/2018

Photographer: Kara Fugate

Location / Orientation	Near test location P-5
Remarks	Patchwork on site associated with a utility (storm sewer).

Asphalt and Base Course Thickness

Beneath the asphaltic concrete ("asphalt") pavement, a marine limestone base course (MLBC) was encountered under the playground asphalt, and macadam graded aggregate base course (GABC) was encountered under the driveway pavements.

At each test location, the individual thickness of the layers observed within the pavement section were measured and recorded, and these results are summarized in Table 1 below. Asphalt thicknesses ranged from 2 ½ to 3 ¼ inches along the school drives, and ranged from 1 inches to 2 inches along the playground section. Base course thicknesses ranged from 6 inches to 16 inches along the existing school drives, and ranged from 8 inches to 9 inches thick at our test locations within the playground section asphalt.

Table 1 – Existing Asphalt and Base Course Material Thickness

Boring ID	Asphalt Thickness (inches)	Base Course Thickness (inches)	Base Course Material Type
P-1	3	8	Macadam
P-2	2	8	Marine Limestone
P-3	1	9	Marine Limestone
P-4	3 ¼	16	Macadam
P-5	3	7	Macadam
P-6	2 ½	6	Macadam

Topsoil Thickness in Unpaved Areas

At test locations where cores were not extracted, labeled N-1 through N-5, we typically encountered organic silty sand (USCS Classification "SM") or organic clayey sand (SC) at the surface. These soils were gray, or brown and orange, and wet upon recovery. The thickness of the organic laden material ranged from 2 inches to 10 inches. This material typically contained a noticeable amount of roots and excess water. Where penetration resistance was measured within these soils, the DCP values ranged from "weight of hammer" (WOH), or where the weight of the hammer causes the instrument to sink through all three measurement increments without blows, to 6 blows per increment (bpi), indicating conditions ranging from very soft/very loose to loose/firm.

♦ Subsurface Conditions

In the subgrade soils across the site we encountered a combination of fat clay (CH) with varying sand contents, clayey sand (SC), silty sand (SM), and poorly graded sand (SP). A majority of the samples collected were fat clays (CH). All of the hand auger borings were advanced to their proposed depth of 5 feet except for boring N-2, which was terminated at a depth of 4 feet due to borehole caving and collapse.

At the test locations N-1 through N-5, under a layer of silty or clayey sands, the borings encountered fat clays (CH). These soils were typically moist to wet and orange, red and tan in color. The DCP values within these clays ranged from 1 bpi to 10 bpi. This indicates a very soft to stiff consistency. Similar clays were encountered under existing pavements at test locations P-1, P-2, P-3, P-5 and P-6. These clays exhibited DCP values ranging from 3 bpi to 11 bpi. This indicates a typically soft to stiff consistency.

Where sands were encountered within the borings, the DCP values ranged from 5 bpi to 14 bpi. This indicates a loose to medium dense relative density. These sands were orange, tan and red in color and moist to wet upon recovery. The silty sands recovered in borings P-6 and P-5 at 2 feet to 2 ½ feet contained some cementation and were dark gray in color. The sands encountered within borings P-2 and P-3, at depths of approximately 10 inches to 2 feet, are likely fill sands. They were likely placed during the construction of the pavement section prior to placement of the base course to bridge out of the soft clays we encountered under the sands. A similar case occurs at test location P-4, but with a greater amount of sand being used, likely to accommodate for bus traffic loading. Clayey sands were encountered to the termination depth of 5 feet.

One composite bulk sample ("Bulk 1"), was recovered from the native soils at test locations N-1 through N-5, at a depth of approximately 1 to 5 feet, and was subjected to laboratory analysis. These clays also represent the clayey soils observed below the pavement at test locations P-1 through P-6. The soil classified as a fat clay with sand (CH). Fines content testing of this sample indicated percent passing the No. 200 sieve of 71.4 percent by weight. Atterberg limits testing indicated a liquid limit value of 62 percent and a corresponding plastic index of 40 percent. The laboratory compaction characteristics of this soil was determined using modified effort (ASTM D 1557), and resulted in a maximum dry density of 118.9 pounds per cubic food (pcf), at an optimum moisture content of 15.9 percent. The natural moisture content of this sample was 24.6 percent, indicating that the soil in place is about 8.7 percent above the optimum moisture content for compaction.

Laboratory California Bearing Ratio (CBR) testing (ASTM D 1883) was conducted upon a soaked specimen of the bulk sampled soils re-compacted to approximately 95 percent of the modified Proctor maximum dry density. A CBR value of 3.7 percent was obtained for the re-compacted sample when dried out to the optimum moisture content for compaction, indicating a relatively weak subgrade support capacity for pavements.

Subsurface Water

At the time of drilling, subsurface water was measured at depths ranging from 4 inches to 4 feet below the ground surface within each boring. Subsurface water levels may fluctuate seasonally at the site, being influenced by rainfall variation and other factors. Site construction activities can also influence water elevations.

Also, the sandy fat clays that were encountered throughout the soil profile may promote development of perched water conditions at the site. Perched water occurs when subsurface water saturates low-permeability clayey layers of soil and accumulates on top of the clay. Perched water conditions can cause difficulties during site grading and contribute to saturated subgrade and base course conditions, promoting premature pavement distress if the pavements are not properly drained.

An example of the surface ponding and shallow perched water caused by poor drainage features is illustrated in Photo 4 below. This photo was collected one day after several days of scattered thunderstorms. It was beyond the scope of this exploration to perform any infiltration testing; however, we can comment based upon our observations of the near-surface clayey soil types and the ponding of water that was present on this site that the infiltration rate into the subgrade soils is likely to be slow.

Photo 4

Date: 12/21/2018

Photographer: Kara Fugate

Location / Orientation	Photo taken from the existing bus loop of proposed bus loop area.
Remarks	Standing water within the footprint of the proposed bus loop expansion.

♦ Conclusions and Recommendations

The exploration results indicate that the site is adaptable for the proposed construction, but that some ground improvement will be required to properly support the pavements due to the low CBR value, poor subgrade support capacity, and poor drainage characteristics of the near-surface soils. Based on the anticipated new path for bus and parent car traffic, the age and distress status of the existing parent loop pavements, and the new bus and parent car loops to be constructed on native soils, we have several different recommendations for the different areas of the site. Figure 3 attached to this report shows a visual representation of where these different recommendation apply, as described in more detail below.

1. In areas of the *existing parent loop* that exhibit severe distress (i.e. areas exhibiting alligator cracking at the surface), we recommend that at least 6 inches of the existing section be removed and replaced with a full-depth asphalt patch. These areas are not specifically shown on Figure 3, but are inside the green

highlighted zone; a judgment call will need to be made at the time of construction to define the limits of these severely distressed areas, which may change between the time of this report and the time that the work is performed.

2. The remainder of the *existing parent loop* surface (portions not severely distressed) should be milled approximately 1 inch to rehabilitate the surface grades, and then overlaid with approximately 2 ½ inches of Type C surface course hot mix asphalt (HMA) . This is the area highlighted in green on Figure 3.
3. The proposed *new parent loop* to be constructed on native soils should be constructed on top of a select fill subbase consisting of approximately 24 inches thick of imported sandy material that has a compacted CBR value of at least 10 percent. This is due to the existing soft, saturated conditions and low CBR value of the existing near-surface clayey soils. Atop the 24 inches of subbase, we recommend a standard-duty pavement section consisting of 2 inches of Type C surface course HMA over 6 inches of compacted graded aggregate base course. This is the area highlighted in purple on Figure 3. Note: This recommendation also applies to any areas where the existing parent loop pavement will be widened into new areas.
4. In areas of the *existing bus loop* that exhibit severe distress (i.e. areas exhibiting alligator cracking at the surface), and which will be utilized for the new bus loop, we recommend that at least 6 inches of the existing section be removed and replaced with a full-depth asphalt patch. These areas are not specifically shown on Figure 3, but are inside the red highlighted zone; a judgment call will need to be made at the time of construction to define the limits of these severely distressed areas, which may change between the time of this report and the time that the work is performed.
5. The remainder of the *existing bus loop* surface should be milled approximately 1 inch to rehabilitate the surface grades, and then overlaid with approximately 1 ½ inches of Type B surface course HMA. This is the area highlighted in red on Figure 3.
6. The proposed *new bus loop* to be constructed on native soils should be constructed on top of a select fill subbase consisting of approximately 24 inches thick of imported sandy material that has a compacted CBR value of at least 10 percent. This is due to the existing soft, saturated conditions and low CBR value of the existing near-surface clayey soils. Atop the 24 inches of subbase, we recommend a heavy-duty pavement section consisting of 1 ½ inches of Type B surface course HMA over 2 inches of Type B intermediate course HMA, over 8 inches of compacted graded aggregate base course. This is the area highlighted in yellow on Figure 3. This recommendation also applies to any areas where the existing bus loop pavement will be widened into new areas.
7. Along the portion of the proposed *new bus loop* that will encircle the back of the building, near test locations P-2 and P-3 and through the existing playground area, we recommend a nominal 4 inch overlay consisting of 2 inches of Type B intermediate course HMA and 2 inches of Type B surface course HMA. The asphalt section is too thin as it currently exists to support the traffic loads anticipated to be generated by the buses. The asphalt is also too thin (~1 Inch) to be milled effectively, and any efforts to do so may cause the deterioration of the existing section. Therefore, the actual thickness of this overlay may need to vary somewhat from about 3 ¾ inches to 4 ¼ inches depending upon any grade adjustments that need to be accommodated without being able to do any milling first. This is the area highlighted in blue on Figure 3.
8. At the entrance of the *new bus loop*, where test location P-1 is located, we recommend the surface to be milled approximately 1 inch to rehabilitate the surface grades, and then overlaid with approximately 2 inches of Type B intermediate course HMA and 2 inches of Type B surface course HMA. This area is highlighted in dark gray on Figure 3.

When reviewing these recommendations, it must be recognized that unexpected subsurface conditions may be encountered between test locations. Unexpected conditions can normally be handled during construction by on-site engineering evaluation.

On-site Borrow Soil Suitability

The available on-site soils within the upper 5 feet appear to contain too much clay, are too wet, too weak, and too highly plastic to be suitable for re-use as borrow fill during construction. The contractor should plan on importing all necessary fill from off site.

Demolition of Existing Pavements

The following general recommendations are provided to be used where existing pavements are to be demolished due to the presence of severe fatigue cracking distress:

1. Identify the extent of the pavement area where moderately severe to severe fatigue cracking distress is observed at the surface. In all areas where moderately severe to severe distress is observed at the surface, we recommend that you completely remove the asphaltic concrete pavement layer and mill or excavate to a depth of 6 inches below finished grade. Remove the old pavement to a distance of at least 5 feet laterally beyond the observable distress zone limits on each end by cutting the pavement with an asphalt saw and removing the section that is to be disposed of.
2. After removal of the asphalt layer and any necessary base course material, the exposed base course should be evaluated by the Geotechnical Engineer or his representative. Where feasible to do so, the Engineer may ask the contractor to proofroll the exposed base materials using a heavily-loaded dump truck. Where the surface ruts or deflects under the weight of the truck, the base material may need to be undercut and replaced with new compacted base course. Where the patch areas are too small to proofroll, the exposed base should be visually observed by the Geotechnical Engineer.
3. Based upon our exploration results, the nominal thickness of the asphaltic concrete to be removed is anticipated to be on the order of 3 inches, but may range from about 2 ½ to 3 ¼ inches or greater.
4. Based on the provided drawing, we assume that a portion of the existing concrete will be demolished for the fire lane. We did not perform testing on the concrete sidewalk and do not know its thickness or the soils beneath it. This area will need demolished prior to the construction of the drives.

Reconstruction of the Roadbed in Full-Depth Repair Sections of Existing Pavement

Where necessary, any new fill soils should be placed in individual lifts not exceeding 8 inches in loose lift thickness and compacted to at least 95 percent of the modified Proctor maximum dry density according to ASTM D 1557. If small, hand-operated compaction equipment is to be used, such as a plate tamp or "jumping jack" hydraulic tamp, the maximum lift thickness should be reduced to 4 inches. After each lift is compacted, it should be tested by a technician working under the direction of the Geotechnical Engineer to measure that the proper level of compaction has been achieved. The Geotechnical Laboratory should evaluate any material that is desired to be used as fill, prior to its use. All fill material used for this work should exhibit a soaked CBR value (ASTM D 1883) of at least 10 percent when specimens are re-compacted in the laboratory to approximately 95 percent of the modified Proctor maximum dry density (ASTM D 1557) at the optimum moisture content for compaction.

In full-depth repair sections, new asphalt aggregate base course (AABC) should then be placed in accordance with Section 309 of the SCDOT Standard Specifications for Highway Construction, 2007 edition. The AABC should be constructed such that the top of the compacted material is the proper depth from the specified finished top-of-pavement grade elevation, such that when the final overlay is constructed the finished grade elevation is correct. Grade elevations should be designed to match the adjoining pavements to each side of the removed section.

After each lift of AABC is compacted, it should be tested by a technician working under the direction of the Engineer to measure that the proper level of compaction has been achieved. AABC construction should be observed by a representative of the Geotechnical Engineer, and should meet the gradation and materials properties as described in Section 309 of the SCDOT Standard Specifications for Highway Construction, 2007 edition.

The minimum recommended AABC compacted thickness in full-depth repair areas is 6 inches, overlain by 3 inches of Type B Surface Course HMA.

- Type B Intermediate Course HMA may be substituted for AABC, if desired.
- Follow all SCDOT recommended lift thickness limitations.

Construction Recommendations for Mill and Overlay of Existing Pavements (non-severely distressed areas)

The existing asphalt pavement along the remainder of the roadway that is not experiencing moderately severe to severe fatigue cracking may be milled and overlaid. Areas within the proposed parent loop should be milled approximately 1 inch, tack should be applied, and approximately 2 ½ inches of Type C Surface Course hot mixed asphalt (HMA) should be overlaid on top the existing roadway. This will result in a net final grade elevation increase of 1 ½ inches, but is necessary in order to retain the existing base layers and still be able to carry the new traffic load expected from the parent loop traffic.

The entrance of the bus loop will require a milling of approximately 1 inch and then tack should be applied. The entrance of the bus loop and the area along the back on the building where the playground is located will require an overlay of approximately 4 inches. This will result in a net final grade elevation increase of 3 inches at the entrance and 4 inches along the back and sides of the structure.

The pavements should be constructed in accordance with the specifications of the South Carolina Department of Transportation Standard Specifications for Highway Construction (2007 edition). It is very important for this project that the HMA be properly compacted. HMA that is insufficiently compacted will show wear much more rapidly than if it were properly compacted. Sufficient testing should be performed during flexible pavement installation to confirm that the required thickness, density, and quality requirements of the pavement specifications are followed.

Site Preparation for New Pavements

Site preparation should begin with the establishment of positive site drainage and the removal of unsuitable surface materials. This should include removal of topsoil, rootmat, and any other unsuitable surface materials that may be encountered. In the event that any areas with a significant percentage (i.e. 5% or greater) of organic material are encountered, those materials should be removed from the construction area.

Because of the soft native clays, we recommend that a minimum 24-inch zone of sandy subbase be constructed within all new pavement areas and shoulders. Subbase soils should consist of materials described in the "Controlled Fill" section below. If design elevations require undercutting in order to achieve the minimum 24-inch sandy subbase zone, then care should be taken by the civil designer to provide sufficient drainage paths such that a "bathtub" situation will not be created within the sandy subbase zone if it is surrounded by the impermeable native clays. Raising the final design grade elevation of the pavement may help to reduce the volume of undercut required to install the sandy subbase layer. If the roadbed is not raised by filling, then gravel-filled underdrains will be required in order to control subsurface water and help prevent the "bathtub" effect.

Based upon the soft consistency of the upper clays observed, we recommend that a soil-reinforcing geosynthetic layer be placed on top of the subgrade soils at cut grade elevation, prior to placement of the sandy subbase zone. We recommend that Mirafi HP-570 geotextile be used. A specification sheet for the HP-570 geotextile is attached to this report in the appendix for your consideration. The geotextile will provide separation as well as reinforcement, and should contribute to subgrade support of the subbase and pavements. The geotextile should be installed in accordance with the manufacturer's recommended procedures and practices. Undercutting should be observed by a representative of the Geotechnical Engineer to confirm that all unsuitable materials are removed and that suitable materials are not over-excavated.

Controlled Fill

Controlled fill material should be cohesionless, non-plastic sandy soil (SP, or SP-SM) containing no more than 10 percent fines (material passing the No. 200 sieve) by weight and having a maximum dry density of at least 105 pounds per cubic foot (pcf) as determined by a laboratory modified Proctor moisture density relationship test (ASTM D1557). The soil must also exhibit a soaked CBR value of at least 10 percent when a specimen is re-compacted in the laboratory to 95 percent of the modified Proctor maximum dry density and tested in accordance with ASTM D 1883 procedures. The soil should be relatively free of organics or other deleterious matter, and should be delivered to the site and placed at a moisture content between 3 percent below to 2 percent above the optimum moisture content for compaction. The first lift of fill above the geotextile may be placed in an approximate 14 inch lift (loose measure) and compacted. The second lift of fill (nominal 10 inches thickness) may then be placed to design subgrade elevation and compacted to at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557).

Fill placement should be observed by a qualified Materials Technician working under the direction of the Geotechnical Engineer. In addition to this visual evaluation, the Technician should perform a sufficient number of in-place field density tests (at least one per each 5,000 sq.ft.) to confirm that the required degree of compaction is being attained.

Pavement Section Design and Construction Recommendations

We assume that new pavement subgrades will be constructed atop structural fill soils compacted to at least 95 percent of the modified Proctor maximum dry density. We have performed our evaluations assuming that a CBR value of at least 3 percent will be available from the native clayey subgrade soils beneath, and that those soils will be overlaid with a compacted sandy subbase layer at least 24 inches thick exhibiting a CBR value of at least 10 percent.

Traffic volumes for the proposed development were not provided to us in preparation for our exploration and pavement section analysis; therefore, we have performed our calculations based on typical pavement section thicknesses. The recommended pavement section components are provided in Table 2 below.

Table 2: Recommended Pavement Sections[(a)]

Pavement Area (Color shading corresponds to Figure 3)	Minimum Theoretical Allowable Traffic Load (ESALs)	HMA Surface Course/Type (inches)	HMA Intermediate Course/Type (inches)	Milling Depth (inches)	Estimated Remaining HMA after milling (inches)	New DOT Graded Aggregate Base Course (inches)	Existing or Remaining Base Course (inches)	Sand Subbase over HP-570 Fabric (inches)
Existing Parent Loop Overlay – Automobile Only	47,500	2.5 Type C	--	1	1.5	--	6	--
New Parent Loop on Native Soils – Automobile Only	50,600	2 Type C	--	--	--	6	--	24
Existing Bus Loop Overlay – Bus and Garbage Truck Traffic	1,504,000	1.5 Type B	--	1	2.25	--	16	--
New Bus Loop on Native Soils – Bus and Garbage Truck Traffic	720,000	1.5 Type B	2 Type B	--	--	8	--	24
Existing Bus Loop Entrance – Bus and Garbage Truck Traffic	560,000	2 Type B	2 Type B	1	2	--	8	--
Existing Bus Loop, Side and Back of Building Overlay – Bus and Garbage Traffic	627,000	2 Type B	2 Type B	0	1	--	9	--

(a)Single-stage construction and soil compaction as recommended is assumed; S&ME, Inc. must observe pavement subgrade preparation and pavement installation operations.

For flexible pavements, the pavement thickness computations were made using the AASHTO method, assuming an initial serviceability of 4.2 and a terminal serviceability index of 2.0, and a reliability factor of 95 percent. Assuming that only SCDOT approved source materials will be used in flexible pavement section construction, we used a structural layer coefficient of 0.44 for the new HMA layers, a coefficient of 0.26 for old asphalt left in place, and a coefficient of 0.18 for the graded aggregate base course (GABC).

Permanent Underdrains

We recommend that in order to provide permanent stabilization for new pavements, the civil engineer should consider including a system of underdrains for pavement area subgrades, where feasible, and where grade elevations will not be built up significantly. Underdrains are particularly important if the landscaped areas surrounding the pavements will be automatically irrigated.

1. The site civil engineer should be consulted regarding the type and location of the underdrains. Our experience is that two types of underdrain systems are commonly used in this locality, depending upon the traffic application and the preferences of the civil engineer. One commonly used system is a gravel-filled, fabric-wrapped trench containing an embedded perforated plastic HDPE pipe. Another type of system that we see used is an edge drain product such as AdvanEdge by ADS, Inc. This is a fabric-wrapped, perforated HDPE slot style drain. Some engineers have used a combination of these two systems. Typically, the underdrains are tied into the storm water system to maintain positive gravity flow.
2. If there are landscaped islands or flower beds, do not fill the islands with clayey or silty (impermeable) spoils that may impede the movement of water into the underdrains.

General Pavement Construction Recommendations

The following general recommendations are provided regarding pavement section construction:

1. Fill placed in pavement areas should be compacted as recommended previously in this report. Prior to pavement section installation, all exposed pavement area subgrades should be methodically proofrolled at final subgrade (FSG) elevation under the observation of S&ME, Inc., and any identified unstable areas should be repaired as directed.
2. The stone base course underlying pavements should consist of a graded aggregate base course (GABC) as specified by the SCDOT 2007 Standard Specifications for Highway Construction, Section 305. Proposed materials for use should be provided by a SCDOT-approved source.

    - Do not substitute Coquina type lime-sand base course materials (as defined in Section 304 of the SCDOT specification) for the recommended GABC material.

3. As stated in the SCDOT Section 305 specification, we recommend that all new base course should be compacted to at least 100 percent of the modified Proctor maximum dry density (SC T-140). Base courses should not exhibit pumping or rutting under equipment traffic. Heavy compaction equipment is likely to be required in order to achieve the required base course compaction, and the moisture content of the material will likely need to be maintained very near the optimum moisture content in order to facilitate

proper compaction. S&ME, Inc. should be contacted to perform field density and thickness testing of the base course prior to paving.

4. Experience indicates that a thin surface overlay of asphalt pavement may be required in about 10 years due to normal wear and weathering of the surface. Such wear is typically visible in several forms of pavement distress, such as aggregate exposure and polishing, aggregate stripping, asphalt bleeding, and various types of cracking. There are means to methodically estimate the remaining pavement life based on a systematic statistical evaluation of pavement distress density and mode of failure. We recommend the pavement be evaluated in about 7 years to assess the pavement condition and remaining life.
5. Construct the HMA surface course in accordance with the specifications of Section 403 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (2007 edition). Construct HMA intermediate courses in accordance with the specifications of Section 402 of this same specification.
6. It is important that the asphaltic concrete be properly compacted, as specified in Section 401.4 of the SCDOT specification. Asphaltic concrete that is insufficiently compacted will show wear much more rapidly than if it were properly compacted.
7. Sufficient testing should be performed during flexible pavement installation to confirm that the required thickness, density, and quality requirements of the pavement specifications are followed.

♦ 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 subsurface exploration. The nature and extent of variations of the soils at the site to those encountered at our boring locations may not become evident until construction. If variations appear evident, then we should be provided the opportunity to re-evaluate the recommendations of this report. In the event that any changes in the nature, design, or location of the structure are planned, the conclusions and recommendations contained in this report will 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, ground water or other materials for environmental contaminants; identification of jurisdictional wetlands, rare or endangered species, geological hazards or potential air quality and noise impacts were beyond the scope of this geotechnical exploration.

Closure

S&ME appreciates this opportunity to provide engineering consulting services to you on this project. Please do not hesitate to contact us with any questions or comments.

Sincerely,

S&ME, Inc.

Kara Fugate, E.I.T.
Geotechnical Staff Professional

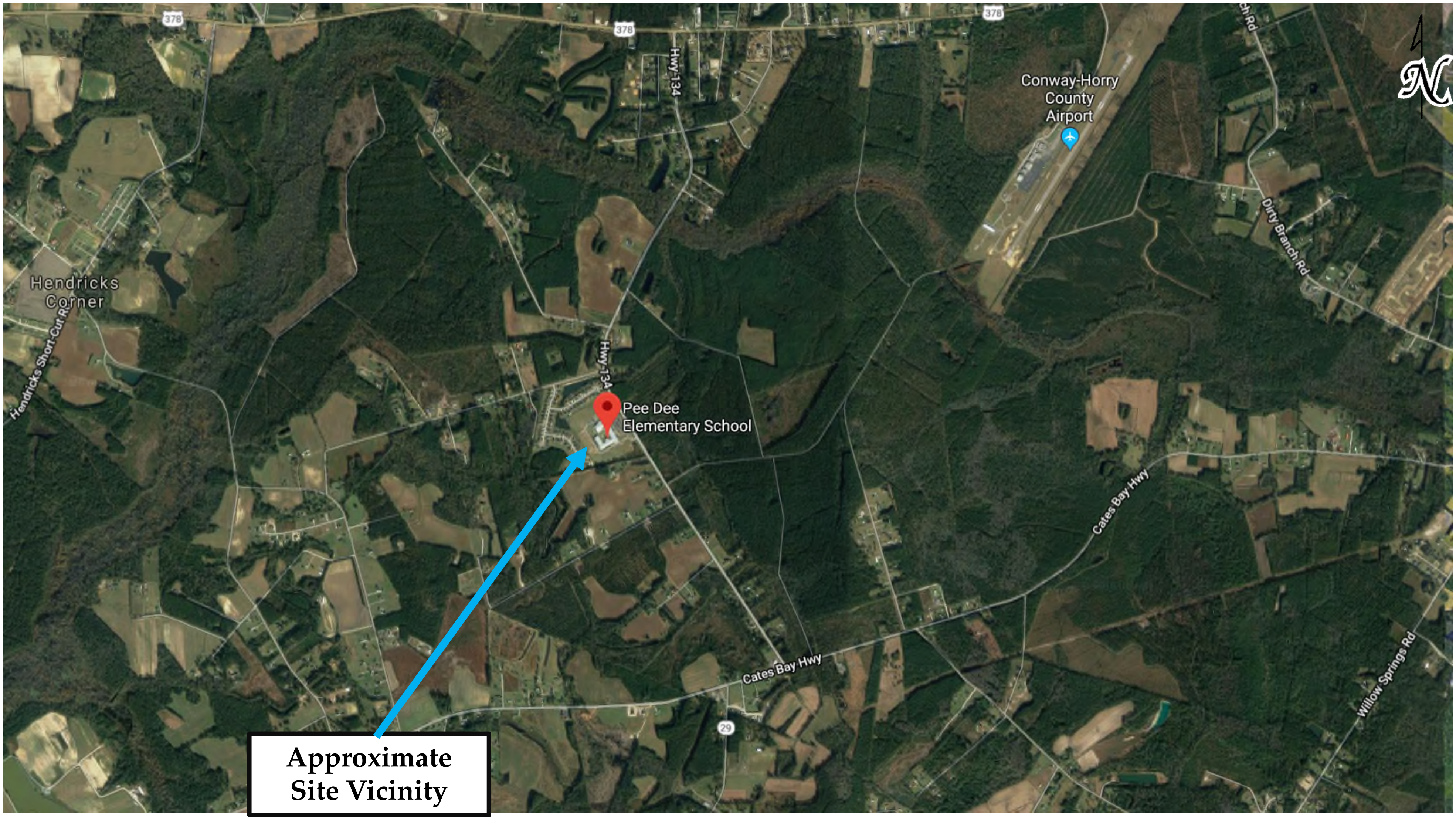
SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION S&ME, INC. No. C00473

Ronald P. Forest, Jr., P.E.
Senior Engineer
Registration No. 21248

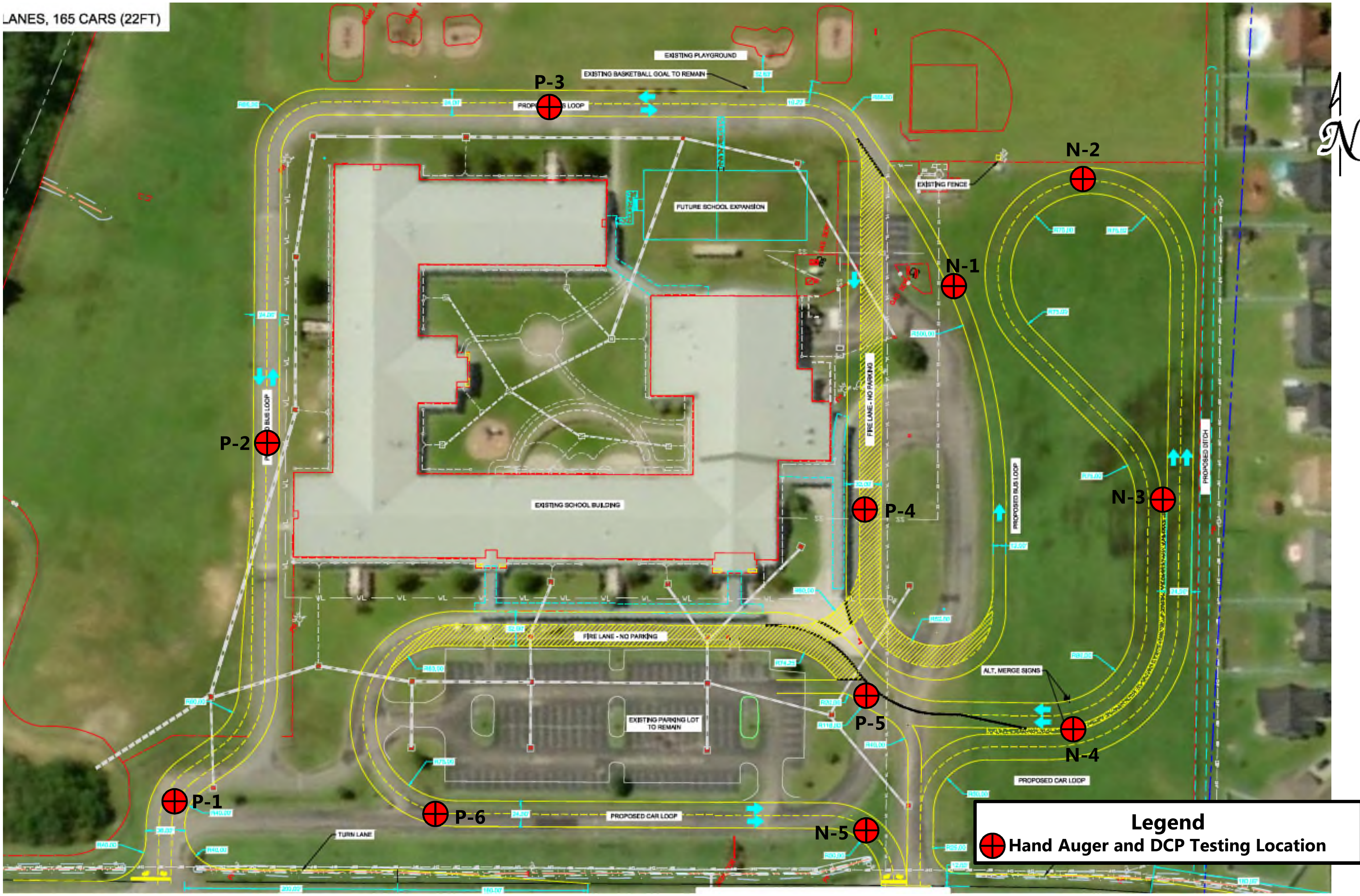
SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 21248 RON FOREST JR. 1/18/19

Attachments: Appendix

Appendix



	Site Vicinity Map	SCALE: AS SHOWN	FIGURE NO. 1
	Pee Dee Elementary Traffic Loop Pee Dee Elementary School Conway, South Carolina	DATE: 12/19/18 PROJECT NUMBER 1463-18-052	



Test Location Sketch

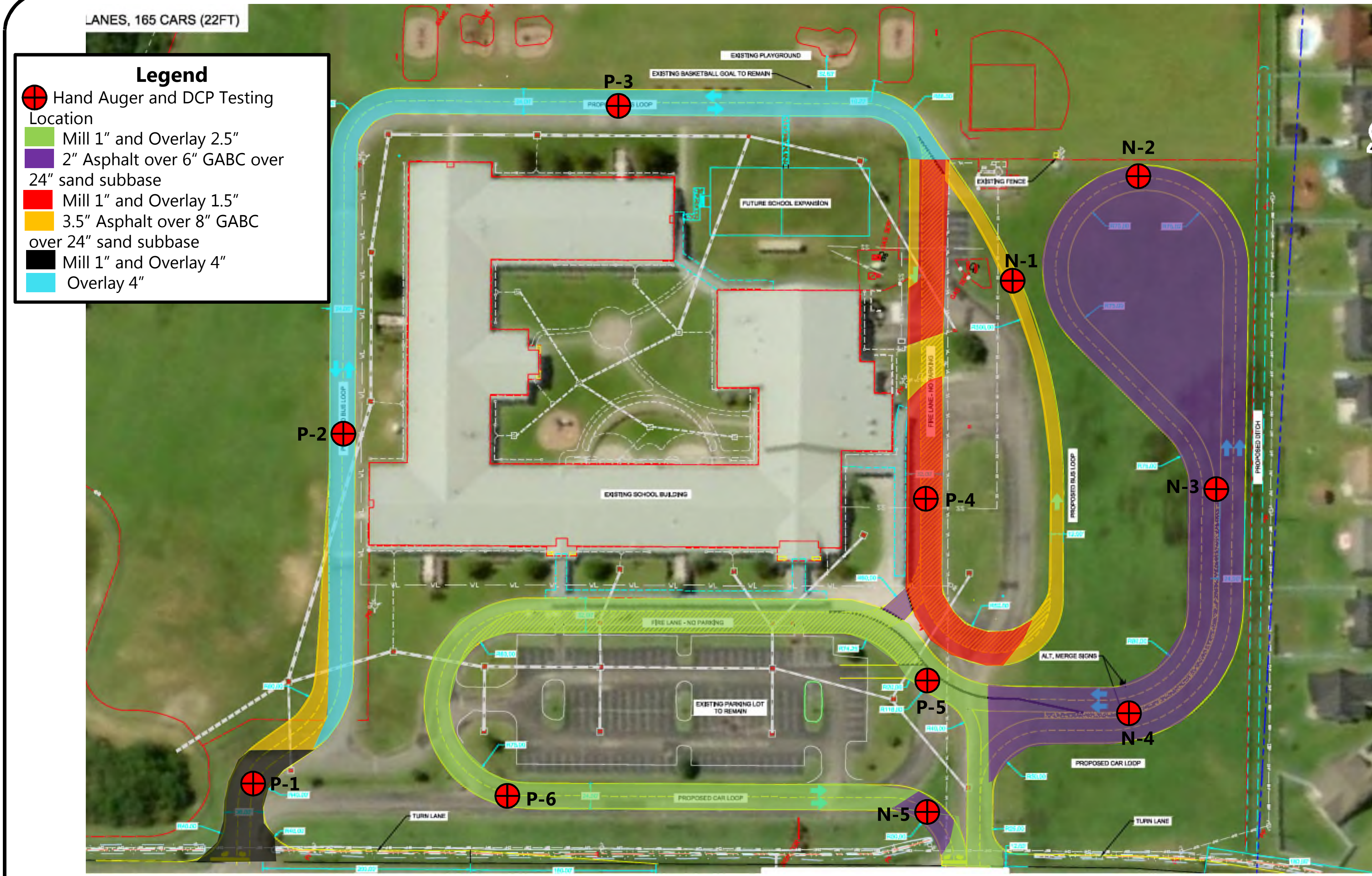
Pee Dee Elementary Traffic Loop
Pee Dee Elementary School
Conway, South Carolina

SCALE: AS SHOWN

DATE: 12/19/18

PROJECT NUMBER 1463-18-052

FIGURE NO. 2



Pavement Recommendation Sketch

Pee Dee Elementary Traffic Loop
Pee Dee Elementary School
Conway, South Carolina

SCALE:	AS SHOWN
DATE:	12/19/18
PROJECT NUMBER	1463-18-052
FIGURE NO.	3

♦ 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

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 South Carolina (SC 811) before we drill or excavate at any site. SC 811 is operated by the major water, sewer, electrical, telephone, CATV, and natural gas suppliers of South Carolina. SC 811 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

Surface Coring of Asphalt Pavement

Asphalt pavement layers were sampled using diamond bit coring in general accordance with ASTM D 979, "*Standard Practice for Sampling Bituminous Paving Mixtures.*" Coring was performed to allow penetration of the pavement layers by soil drilling equipment, so random sampling and averaging of data points, described in paragraph 5.2.6 of the Practice, was not performed.

Hand Auger Borings with Dynamic Cone Penetrometer Testing

Auger borings were advanced using hand operated augers. The soils encountered were identified in the field by cuttings brought to the surface. Soil consistency was qualitatively estimated by the relative difficulty of advancing the augers. Dynamic Cone Penetrometer (DCP) testing was performed in conjunction within the borings in general accordance with ASTM STP 399, "*Dynamic Cone for Shallow In-Situ Penetration Testing*". At selected intervals, the augers were withdrawn and soil consistency measured with a dynamic cone penetrometer. The conical point of the penetrometer was first seated 1-3/4 inches to penetrate any loose cuttings in the boring, then driven two additional 1-3/4 inch increments by a 15 pound hammer falling 20 inches. The number of hammer blows required to achieve this penetration was recorded. When properly evaluated by qualified professional staff, the blow count is an index to the soil strength. Hand auger borings were backfilled with soil cuttings after termination of drilling. Soil cuttings removed from each hole were collected as a bulk sample for laboratory testing.

Water Level Measurement

Subsurface water levels in the boreholes were measured during the onsite exploration by measuring depths from the existing grade to the current water level using a tape.

Backfilling of Borings

Once subsurface water levels were obtained, boring spoils were backfilled into the open bore holes. Bore holes were backfilled to the existing ground surface.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

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

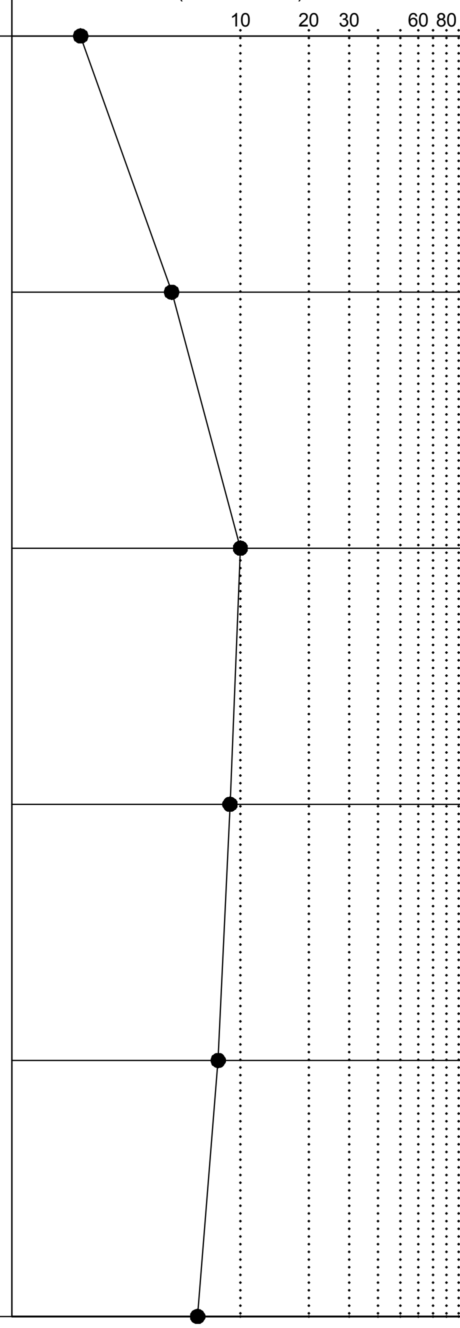
PROJECT: **Pee Dee Elementary Traffic Loop** **Conway, South Carolina** **1463-18-052**	**HAND AUGER BORING LOG: N-1**

DATE STARTED:	**12/21/18**	DATE FINISHED:	**12/21/18**
SAMPLING METHOD:	**Grab Sample**	PERFORMED BY:	**K. Fugate**
WATER LEVEL:	**2.5' ATD**		

NOTES:
Elevation Unknown.

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
0		**CLAYEY SAND (SC)** - Mostly fine to medium sand, some low to medium plasticity fines, brown and orange, moist, very loose.			2
		FAT CLAY (CH) - Mostly medium to high plasticity fines, trace fine sand, red, orange and tan, moist to wet, firm to stiff.			
1					5
2		---- Stiff.			10
2.5		---- Wet.		▽	
3		---- Firm.			9
4					8
5		Boring terminated at 5 ft			7

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)

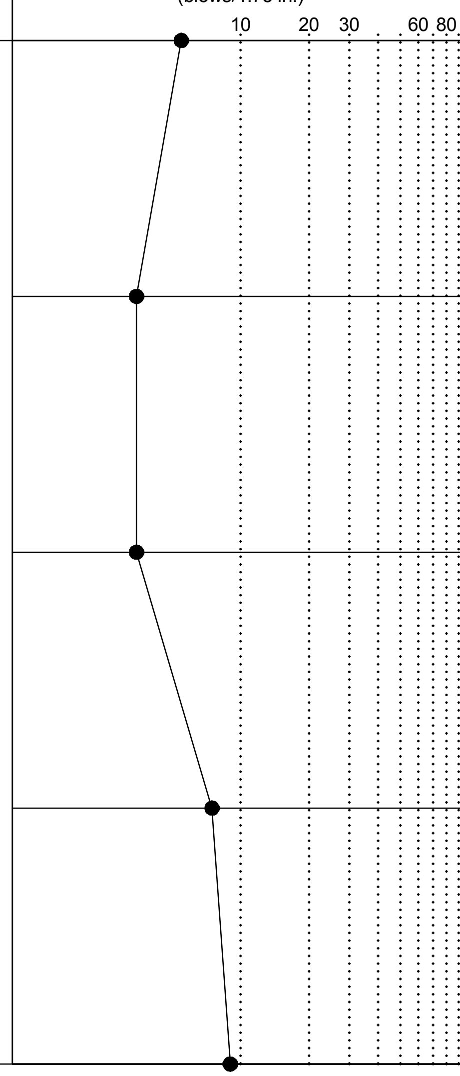


DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT:	Pee Dee Elementary Traffic Loop Conway, South Carolina 1463-18-052	**HAND AUGER BORING LOG: N-2**
DATE STARTED: **12/21/18**	DATE FINISHED: **12/21/18**	NOTES: Elevation Unknown.
SAMPLING METHOD: **Grab Sample**	PERFORMED BY: **K. Fugate**	
WATER LEVEL: **4' ATD**		

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
0		**SILTY SAND (SM)** - Mostly fine sand, some non plastic fines, some organics, dark gray, wet, loose.			6
		CLAYEY SAND (SC) - Mostly fine to medium sand, some medium to high plasticity fines, orange and tan, wet, loose.			
1		**FAT CLAY WITH SAND (CH)** - Mostly medium to high plasticity fines, few fine to medium sands, orange and red, moist, soft.			4
2					4
3		**POORLY GRADED SAND WITH CLAY (SP-SC)** - Mostly fine to medium sand, few medium to high plasticity fines, orange, wet, loose.			8
4		Boring terminated at 4 ft		▽	9

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

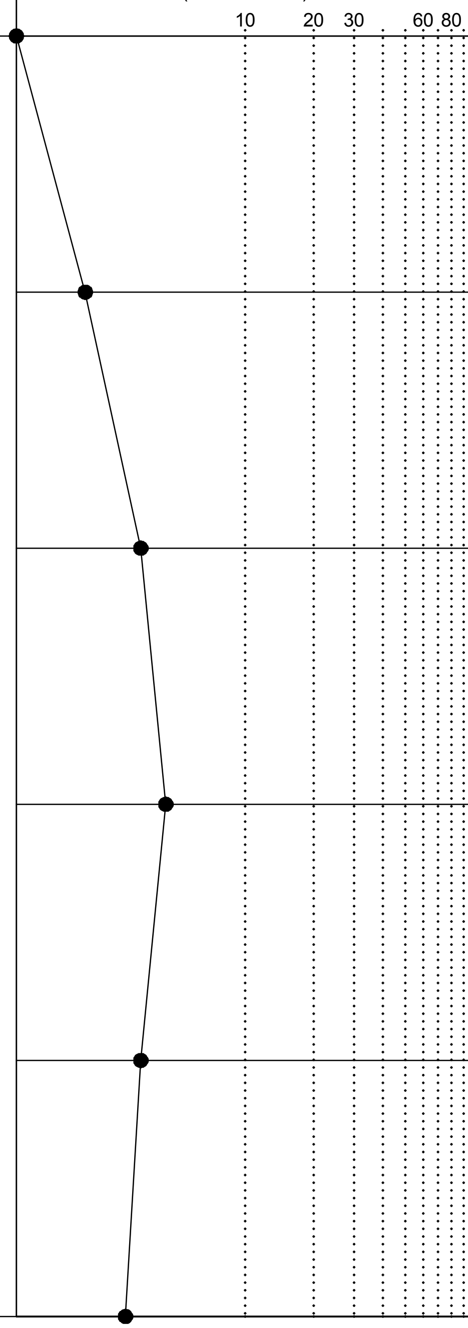
PROJECT:	Pee Dee Elementary Traffic Loop Conway, South Carolina 1463-18-052	**HAND AUGER BORING LOG: N-3**

DATE STARTED:	**12/21/18**	DATE FINISHED:	**12/21/18**
SAMPLING METHOD:	**Grab Sample**	PERFORMED BY:	**K. Fugate**
WATER LEVEL:	**0.33' ATD**		

NOTES:
Elevation Unknown.

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
		SILTY SAND (SM) - Mostly fine sand, some non plastic fines, some roots, dark gray, wet, very loose.		∇	1
		FAT CLAY (CH) - Mostly medium to high plasticity fines, trace fine sand, orange and tan, wet, very soft to firm.			
1					2
2		- - - - Soft.			4
3		- - - - Firm.			5
4		- - - - Soft.			4
5		Boring terminated at 5 ft			3

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)

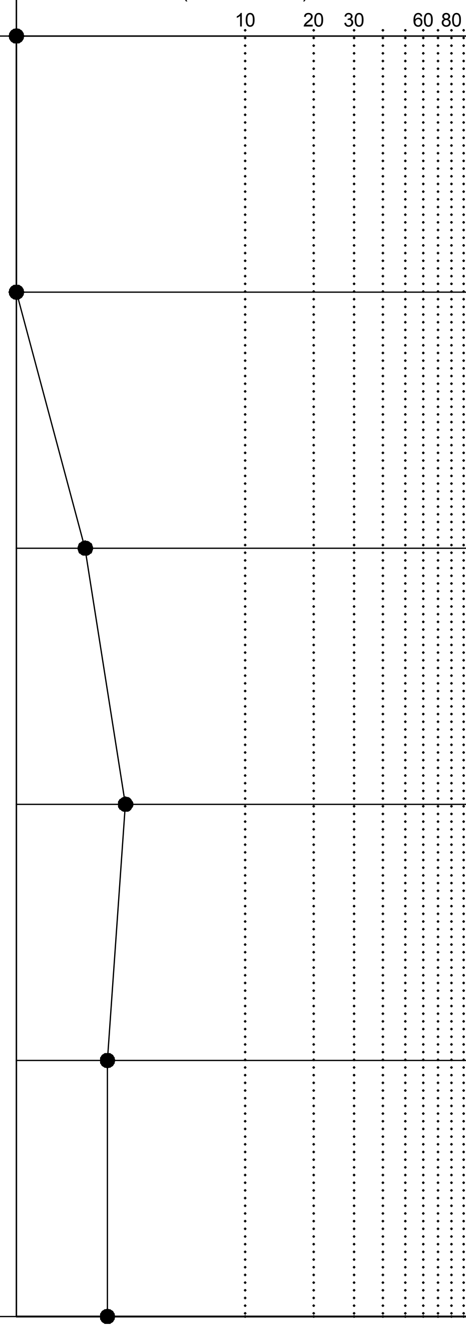


DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT:	**Pee Dee Elementary Traffic Loop** **Conway, South Carolina** **1463-18-052**		# HAND AUGER BORING LOG: N-4
DATE STARTED: **12/21/18**	DATE FINISHED: **12/21/18**		NOTES: Elevation Unknown.
SAMPLING METHOD: **Grab Sample**	PERFORMED BY: **K. Fugate**		
WATER LEVEL: **0.5' ATD**			

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
0		**SILTY SAND (SM)** - Mostly fine sand, some non plastic fines, some roots, dark gray, wet, very loose.		∇	WOH
1		**FAT CLAY WITH SAND (CH)** - Mostly medium to high plasticity fines, few fine to medium sands, orange, red, and gray, wet, very soft to soft.			1
2					2
3		- - - - Soft.			3
4					3
5		Boring terminated at 5 ft			3

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)



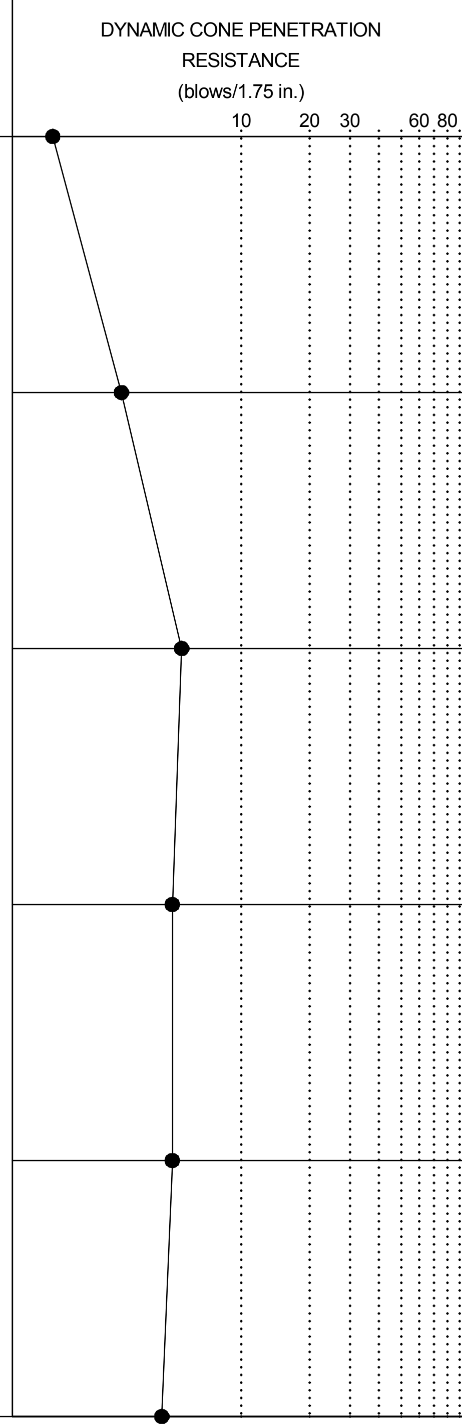
DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT: **Pee Dee Elementary Traffic Loop**
Conway, South Carolina
1463-18-052

HAND AUGER BORING LOG: N-5

DATE STARTED:	**12/21/18**	DATE FINISHED:	**12/21/18**
SAMPLING METHOD:	**Grab Sample**	PERFORMED BY:	**K. Fugate**
WATER LEVEL:	**3.5' ATD**		

NOTES:
Elevation Unknown.



Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
0		**CLAYEY SAND (SC)** - Mostly fine to medium sand, some low to medium plasticity fines, trace asphalt, brown and orange, wet, very loose. Possible fill.			2
1					3
1.5		**FAT CLAY WITH SAND (CH)** - Mostly medium to high plasticity fines, few fine sands, orange, brown, gray, and red, moist to wet, firm.			
2					6
3					5
3.5				▽	
4					5
5		Boring terminated at 5 ft			5

DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

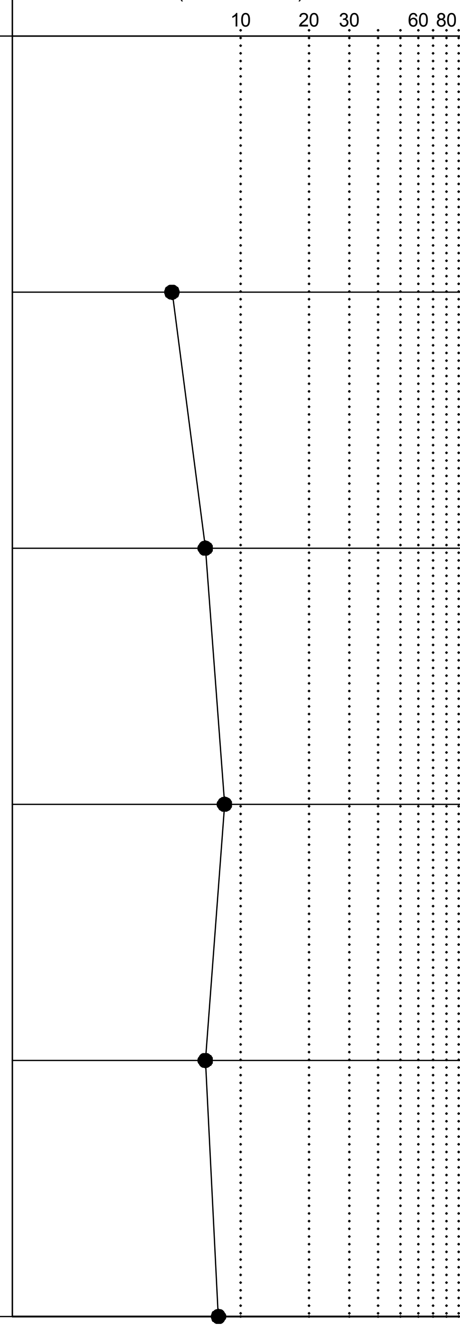
PROJECT:	Pee Dee Elementary Traffic Loop Conway, South Carolina 1463-18-052	**HAND AUGER BORING LOG: P-1**

DATE STARTED:	**12/21/18**	DATE FINISHED:	**12/21/18**
SAMPLING METHOD:	**Grab Sample**	PERFORMED BY:	**K. Fugate**
WATER LEVEL:	**Not encountered.**		

NOTES:
Elevation Unknown.

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
		ASPHALT - Approximately 3 inches thick.			
		MACADAM BASE COURSE - Approximately 8 inches thick.			
1		**FAT CLAY WITH SAND (CH)** - Mostly medium to high plasticity fines, few fine sands, orange and brown, moist, firm.			5
2		**CLAYEY SAND (SC)** - Mostly fine to medium sand, some medium to high plasticity fines, orange, moist, loose.			7
3		**POORLY GRADED SAND WITH CLAY (SP-SC)** - Mostly fine to medium sand, few medium to high plasticity fines, orange, moist, loose.			9
4					7
5		Boring terminated at 5 ft			8

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

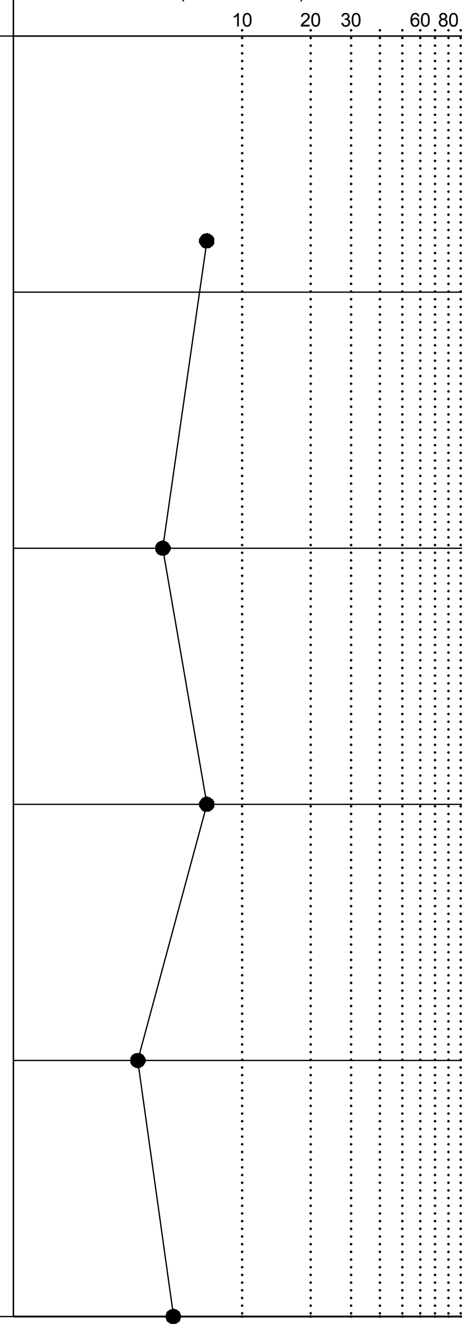
PROJECT:	Pee Dee Elementary Traffic Loop Conway, South Carolina 1463-18-052	**HAND AUGER BORING LOG: P-2**

DATE STARTED:	**12/21/18**	DATE FINISHED:	**12/21/18**
SAMPLING METHOD:	**Grab Sample**	PERFORMED BY:	**K. Fugate**
WATER LEVEL:	**Not encountered.**		

NOTES:
Elevation Unknown.

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
		ASPHALT - Approxiamtely 2 inches thick.			
		MARINE LIMESTONE BASE COURSE - Approximately 8 inches thick.			
1		**FILL** **POORLY GRADED SAND (SP)** - Mostly fine to medium sand, trace fines, tan, moist, loose.			7
2		**FAT CLAY WITH SAND (CH)** - Mostly medium to high plasticity fines, few fine sands, orange, red and grey, moist, firm to soft.			5
3					7
4		- - - - Soft.			4
5		- - - - Firm. Boring terminated at 5 ft			5

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

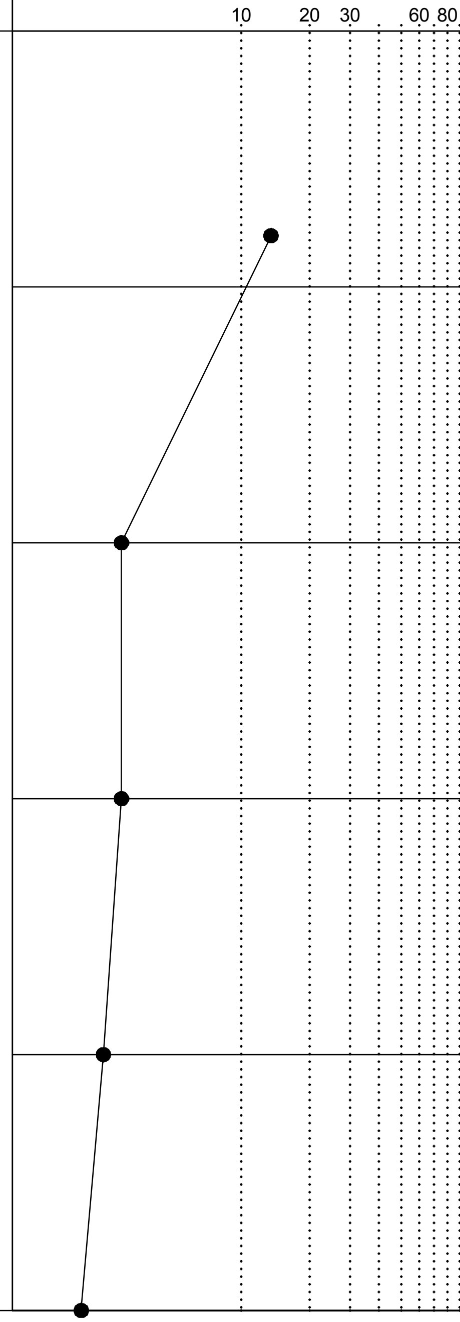
PROJECT:	Pee Dee Elementary Traffic Loop Conway, South Carolina 1463-18-052	**HAND AUGER BORING LOG: P-3**

DATE STARTED:	**12/21/18**	DATE FINISHED:	**12/21/18**
SAMPLING METHOD:	**Grab Sample**	PERFORMED BY:	**K. Fugate**
WATER LEVEL:	**Not encountered.**		

NOTES:
Elevation Unknown.

Depth (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
	ASPHALT - Approximately 1 inch thick.			
	MARINE LIMESTONE BASE COURSE - Approximately 9 inches thick.			14
1	<u>**FILL**</u> **POORLY GRADED SAND (SP)** - Mostly fine to medium sand, trace fines, tan, wet, medium dense to very loose. - - - - Gray, very loose.			
2	**FAT CLAY WITH SAND (CH)** - Mostly medium to high plasticity fines, few fine sands, orange, gray and red, moist, soft to very soft.			3
3				3
4	- - - - Very soft.			3
5	Boring terminated at 5 ft			2

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)

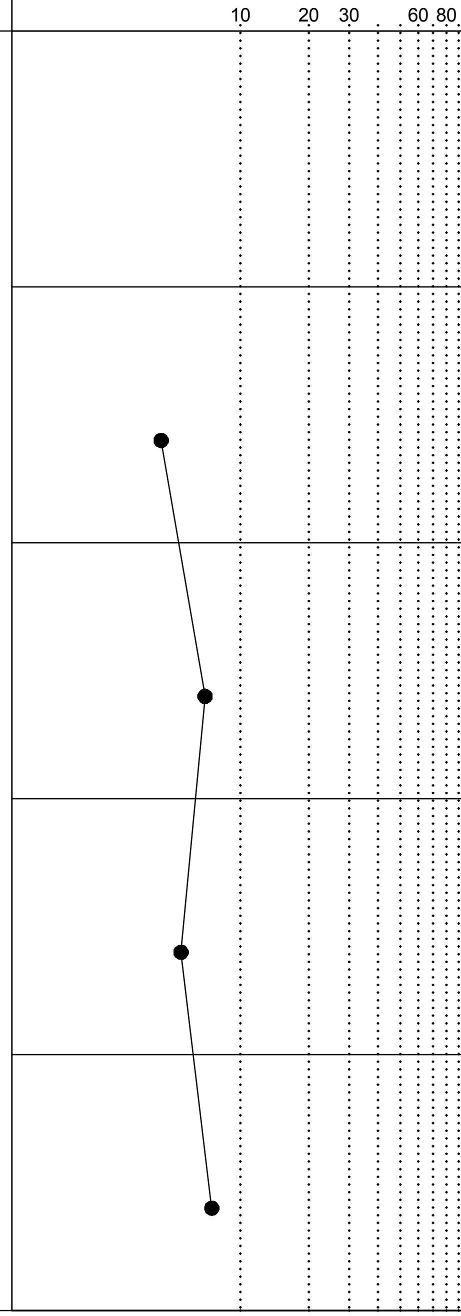


DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT:	Pee Dee Elementary Traffic Loop Conway, South Carolina 1463-18-052	HAND AUGER BORING LOG: P-4

				NOTES:
DATE STARTED:	**12/21/18**	DATE FINISHED:	**12/21/18**	Elevation Unknown.
SAMPLING METHOD:	**Grab Sample**	PERFORMED BY:	**K. Fugate**	
WATER LEVEL:	**Not encountered.**			

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)	DCP VALUE
0		**ASPHALT** - Approximately 3 1/4 inches thick.				
		MACADAM BASE COURSE - Approximately 16 inches of base course.				
1						
		CLAYEY SAND (SC) - Mostly fine to medium sand, some medium to high plasticity fines, orange and red, moist, loose.				5
2						
						7
3						
						6
4						
						8
5		Boring terminated at 5 ft				



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT: **Pee Dee Elementary Traffic Loop**
Conway, South Carolina
1463-18-052

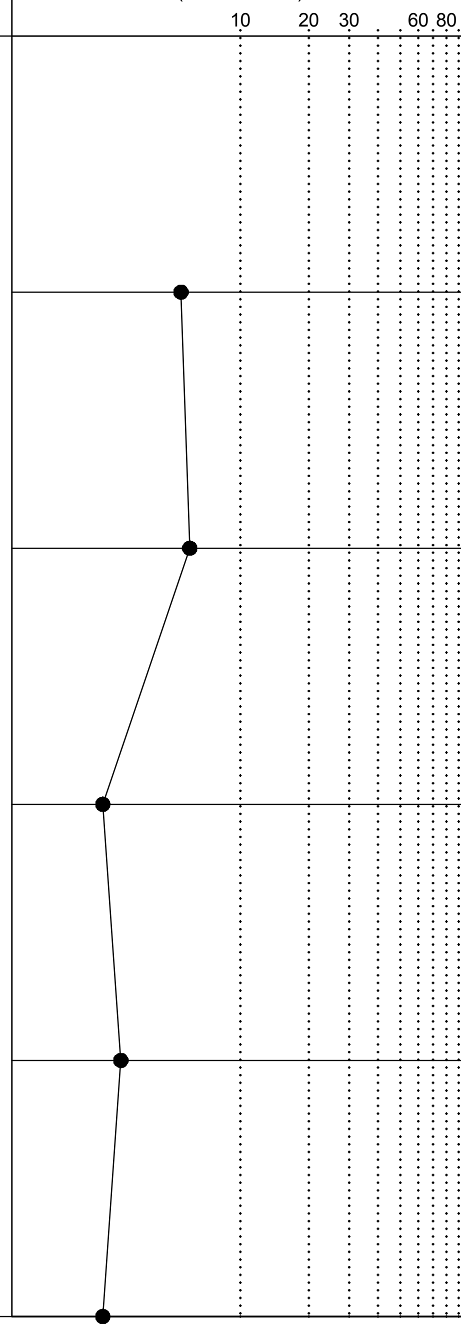
HAND AUGER BORING LOG: P-5

DATE STARTED:	**12/21/18**	DATE FINISHED:	**12/21/18**
SAMPLING METHOD:	**Grab Sample**	PERFORMED BY:	**K. Fugate**
WATER LEVEL:	**4' ATD**		

NOTES:
Elevation Unknown.

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
		ASPHALT - Approximately 3 inches thick.			
		MACADAM BASE COURSE - Approximately 7 inches thick.			
1		**FAT CLAY WITH SAND (CH)** - Mostly medium to high plasticity fines, few fine to medium sands, brown, orange and red, moist, firm.			6
2		**SILTY SAND (SM)** - Mostly fine sand, some non plastic fines, dark gray, moist, loose.			6
		FAT CLAY WITH SAND (CH) - Mostly medium to high plasticity fines, few fine to medium sands, brown, orange and red, moist to wet, soft.			
3					3
		- - - - Wet.			
4				∇	3
5		Boring terminated at 5 ft			3

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)



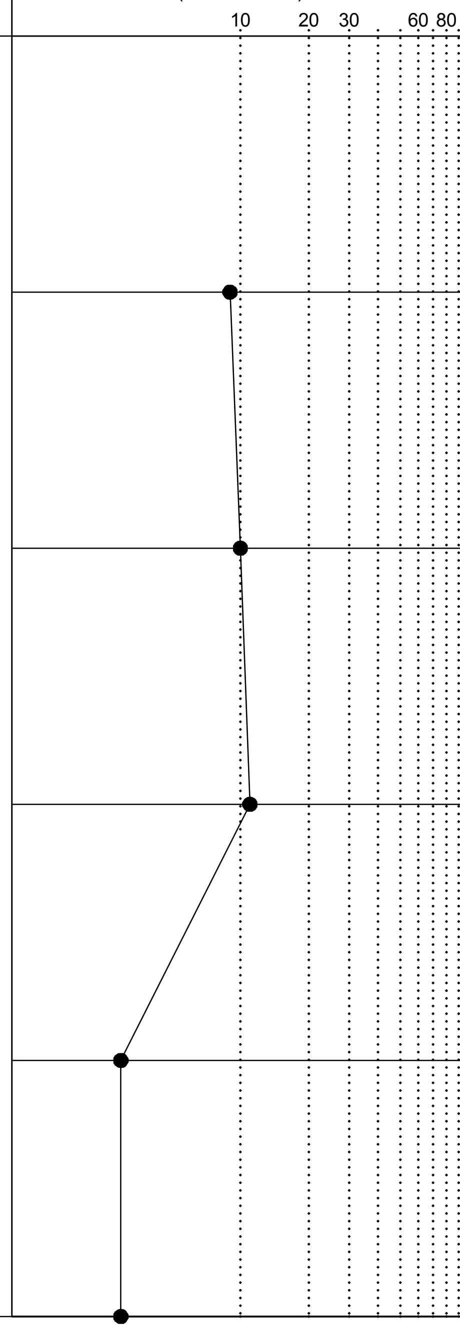
DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

PROJECT:	**Pee Dee Elementary Traffic Loop** **Conway, South Carolina** **1463-18-052**	**HAND AUGER BORING LOG: P-6**

DATE STARTED: **12/21/18**	DATE FINISHED: **12/21/18**	NOTES: Elevation Unknown.		
SAMPLING METHOD: **Grab Sample**	PERFORMED BY: **K. Fugate**			
WATER LEVEL: **Not encountered.**				

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DCP VALUE
		ASPHALT - Approximately 2 1/2 inches thick.			
		MACADAM BASE COURSE - Approximately 6 inches thick.			
		FAT CLAY (CH) - Mostly medium to high plasticity fines, trace fine sand, orange and red, moist, stiff.			
1					9
2		**SILTY SAND (SM)** - Mostly fine sand, some non plastic fines, gray, moist, loose.			10
		FAT CLAY WITH SAND (CH) - Mostly medium to high plasticity fines, trace fine sand, orange, gray, and yellow, moist, stiff to soft.			
3					11
4		- - - - Soft.			3
5		Boring terminated at 5 ft			3

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)



DCP INDEX IS THE DEPTH (IN.) OF PENETRATION PER BLOW OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE.

♦ Summary of Laboratory Procedures

Examination of Recovered Soil Samples

Soil and field records were reviewed in the laboratory by the geotechnical professional. Soils were classified in general accordance with the visual-manual method described in ASTM D 2488, "*Standard Practice for Description and Identification of Soils (Visual-Manual Method)*". Representative soil samples were selected for classification testing to provide grain size and plasticity data to allow classification of the samples in general accordance with the Unified Soil Classification System method described in ASTM D 2487, "*Standard Practice for Classification of Soils for Engineering Purposes*". The geotechnical professional also prepared the final boring and sounding records enclosed with this report.

Moisture Content Testing of Soil Samples by Oven Drying

Moisture content was determined in general conformance with the methods outlined in ASTM D 2216, "*Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil or Rock by Mass*." This method is limited in scope to Group B, C, or D samples of earth materials which do not contain appreciable amounts of organic material, soluble solids such as salt or reactive solids such as cement. This method is also limited to samples which do not contain contamination.

A representative portion of the soil was divided from the sample using one of the methods described in Section 9 of ASTM D 2216. The split portion was then placed in a drying oven and heated to approximately 110 degrees C overnight or until a constant mass was achieved after repetitive weighing. The moisture content of the soil was then computed as the mass of water removed from the sample by drying, divided by the mass of the sample dry, times 100 percent. No attempt was made to exclude any particular particle size from the portion split from the sample.

Percent Fines Determination of Samples

A selected specimen of soils was washed over a No. 200 sieve after being thoroughly mixed and dried. This test was conducted in general accordance with ASTM D 1140, "*Standard Test Method for Amount of Material Finer Than the No. 200 Sieve*." Method A, using water to wash the sample through the sieve without soaking the sample for a prescribed period of time, was used and the percentage by weight of material washing through the sieve was deemed the "percent fines" or percent clay and silt fraction.

Liquid and Plastic Limits Testing

Atterberg limits of the soils was determined generally following the methods described by ASTM D 4318, "*Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.*" Albert Atterberg originally defined "limits of consistency" of fine grained soils in terms of their relative ease of deformation at various moisture contents. In current engineering usage, the *liquid lim*it of a soil is defined as the moisture content, in percent, marking the upper limit of viscous flow and the boundary with a semi-liquid state. The *plastic limit* defines the lower limit of plastic behavior, above which a soil behaves plastically below which it retains its shape upon drying. The *plasticity index* (PI) is the range of water content over which a soil behaves plastically. Numerically, the PI is the difference between liquid limit and plastic limit values.

Representative portions of fine grained Group A, B, C, or D samples were prepared using the wet method described in Section 10.1 of ASTM D 4318. The liquid limit of each sample was determined using the multipoint method (Method A) described in Section 11. The liquid limit is by definition the moisture content where 25 drops of a hand operated liquid limit device are required to close a standard width groove cut in a soil sample placed in the device. After each test, the moisture content of the sample was adjusted and the sample replaced in the device. The test was repeated to provide a minimum of three widely spaced combinations of N versus moisture content. When plotted on semi-log paper, the liquid limit moisture content was determined by straight line interpolation between the data points at N equals 25 blows.

The plastic limit was determined using the procedure described in Section 17 of ASTM D 4318. A selected portion of the soil used in the liquid limit test was kneaded and rolled by hand until it could no longer be rolled to a 3.2 mm thread on a glass plate. This procedure was repeated until at least 6 grams of material was accumulated, at which point the moisture content was determined using the methods described in ASTM D 2216.

Compaction Tests of Soils Using Modified Effort

Soil placed as engineering fill is compacted to a dense state to obtain satisfactory engineering properties. Laboratory compaction tests provide the basis for determining the percent compaction and water content needed to achieve the required engineering properties, and for controlling construction to assure the required compaction and water contents are achieved. Test procedures generally followed those described by ASTM D 1557, *"Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 lbf/ft^3)."*

The relationship between water content and the dry unit weight is determined for soils compacted in either 4 or 6 inch diameter molds with a 10 lbf rammer dropped from a height of 18 inches, producing a compactive effort of 56,000 lbf/ft^3. ASTM D 1557 provides three alternative procedures depending on material gradation:

Method A

All material passes No. 4 sieve size
4 inch diameter mold
Shall be used if 20 percent or less by weight is retained on No. 4 sieve
Soil in 5 layers with 25 blows per layer

Method B

All material passes 3/8 inch sieve
4 inch diameter mold
Shall be used if 20 percent by weight is retained on the No. 4 sieve and 20 percent or less by weight is retained on the 3/8 Inch sieve.
Soil in 5 layers with 25 blows per layer

Method C

All material passes ¾ inch sieve
6-inch diameter mold
Shall be used if more than 20 percent by weight is retained on the 3/8 inch sieve and less than 30 percent is retained on the ¾inch sieve.
Soil in 5 layers with 56 blows per layer

Soil was compacted in the mold in five layers of approximately equal thickness, each compacted with either 25 or 56 blows of the rammer. After compaction of the sample in the mold, the resulting dry density and moisture content was determined and the procedure repeated. Separate soils were used for each sample point, adjusting the moisture content of the soil as described in Section 10.2 (Moist Preparation Method). The procedure was repeated for a sufficient number of water content values to allow the dry density vs. water content values to be plotted and the *maximum dry density* and *optimum moisture content* to be determined from the resulting curvilinear relationship.

Laboratory California Bearing Ratio Tests of Compacted Samples

This method is used to evaluate the potential strength of subgrade, subbase, and base course material, including recycled materials, for use in road and airfield pavements. Laboratory CBR tests were run in general accordance with the procedures laid out in ASTM D 1883, "*Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils*." Specimens were prepared in standard molds using two different levels of compactive effort within plus or minus 0.5 percent of the optimum moisture content value. While embedded in the compaction mold, each sample was inundated for a minimum period of 96 hours to achieve saturation. During inundation the specimen was surcharged by a weight approximating the anticipated weight of the pavement and base course layers. After removing the sample from the soaking bath, the soil was then sheared by jacking a piston having a cross sectional area of 3 square inches into the end surface of the specimen. The piston was jacked 0.5 inches into the specimen at a constant rate of 0.05 inches per minute.

The CBR is defined as the load required to penetrate a material to a predetermined depth, compared to the load required to penetrate a standard sample of crushed stone to the same depth. The CBR value was usually based on the load ratio for a penetration of 0.10 inches, after correcting the load-deflection curves for surface irregularities or upward concavity. However, where the calculated CBR for a penetration of 0.20 inches was greater than the result obtained for a penetration of 0.10 inches, the test was repeated by reversing the specimen and shearing the opposite end surface. Where the second test indicated a greater CBR at 0.20 inches penetration, the CBR for 0.20 inches penetration was used.

Form No: TR-D2216-T265-1
Revision No. 1
Revision Date: 08/16/17

LABORATORY DETERMINATION OF WATER CONTENT

ASTM D 2216 ☑ *AASHTO T 265* ☐

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	1463-18-052	Report Date:	1/7/2019
Project Name:	Pee Dee Elementary Traffic Loop	Test Date(s):	12/31/2019
Client Name:	Castles Engineering		
Client Address:	2024 Corporate Center Dr, Ste 102; Myrtle Beach, SC 29577		
Sample by:	K. Fugate	Sample Date(s):	12/21/2018

Method: **A** **(1%)** ☐ **B** **(0.1%)** ☑

Balance ID.	19608	Calibration Date:	2/28/18
Oven ID.	17745	Calibration Date:	4/8/18

Boring No.	Sample No.	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Water Weight	Percent Moisture	Note
		ft. or m.		grams	grams	grams	grams	%	
N-1 to N-5	C-1	0.5'-5'	CCC	83.10	195.10	173.00	22.10	24.6%	

Notes / Deviations / References

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Ron Forest, P.E.	RPF	Senior Reviewer	9-Jan
Technical Responsibility	*Signature*	*Position*	*Date*

Form No: TR-D1140-1
Revision No. 1
Revision Date: 8/2/17

MATERIAL FINER THAN THE #200 SIEVE

ASTM D1140

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	1463-18-052	Report Date:	1/7/2019
Project Name:	Pee Dee Elementary Traffic Loop	Test Date(s):	1/4/2019
Client Name:	Castles Engineering		
Client Address:	2024 Corporate Center Dr, Ste 102; Myrtle Beach, SC 29577		
Sample by:	K. Fugate	**LAB#**	4888
		Sample Dates:	12/21/2018

Method; A ☐ **B** ☑ Soaked ☑ Soak Time 2 Hrs

Boring #	Sample #	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Tare Wt. + Dry Wt. after Wash	% Passing #200
		ft. or m.		grams	grams	grams	grams	%
N-1 to N-5	C-1	0.5'-5'	CCC	83.10	195.10	173.00	108.80	**71.4%**

Balance ID. *19608* *Calibration Date:* *2/28/2018* *#200 Sieve* *18775* *Calibration Date:* *2/28/2019*

Notes / Deviations / References: ASTM D1140: Amount of Material in Soil Finer Than the No. 200 (75-um)) Sieve

Ron Forest, P.E.	RPF	Senior Reviewer	9-Jan
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D4318-T89-90
Revision No. 1
Revision Date: 7/26/17

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

ASTM D 4318 ☒ AASHTO T 89 ☐ AASHTO T 90 ☐

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

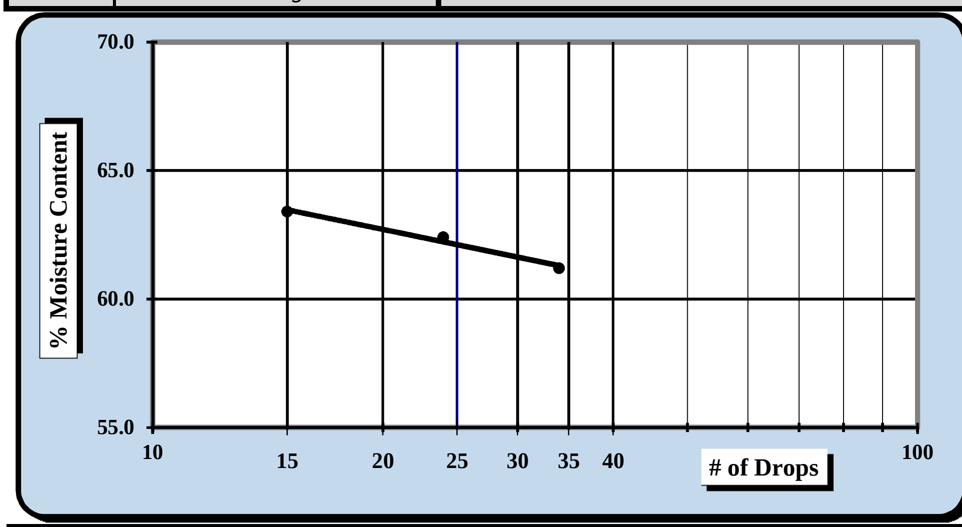
Project #:	1463-18-052	Report Date:	1/7/2019
Project Name:	Pee Dee Elementary Traffic Loop	Test Date(s)	1/4/2019
Client Name:	Castles Engineering		
Client Address:	2024 Corporate Center Dr, Ste 102; Myrtle Beach, SC 29577		

Boring #:	N-1 to N-5	Sample #:	C-1	Sample Date:	12/21/2018
Location:	New Loop	LAB #:	4888	Depth:	0.5'-5'

Sample Description: Reddish Brown Fat Clay with Sand (CH)

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	00401	2/28/2018	Grooving tool	11368	9/1/2018
LL Apparatus	18801	9/1/2018			
Oven	17745	4/8/2018			

Pan #		Liquid Limit						Plastic Limit		
	Tare #:	87	36	95				118	102	
A	Tare Weight	14.87	14.63	14.58				14.87	14.93	
B	Wet Soil Weight + A	31.55	31.63	31.88				21.63	21.59	
C	Dry Soil Weight + A	25.22	25.10	25.17				20.43	20.40	
D	Water Weight (B-C)	6.33	6.53	6.71				1.20	1.19	
E	Dry Soil Weight (C-A)	10.35	10.47	10.59				5.56	5.47	
F	% Moisture (D/E)*100	61.2%	62.4%	63.4%				21.6%	21.8%	
N	# OF DROPS	34	24	15				*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**21.7%**		



One Point Liquid Limit

N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☐

Liquid Limit	**62**
Plastic Limit	**22**
Plastic Index	**40**
Group Symbol	**CH**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☑ Air Dried ☑

Notes / Deviations / References:

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Ron Forest, P.E.	RPF	Senior Reviewer	1/9/2019
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No. TR-D698-2
Revision No. : 1
Revision Date: 07/25/17

MOISTURE - DENSITY REPORT

Quality Assurance

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

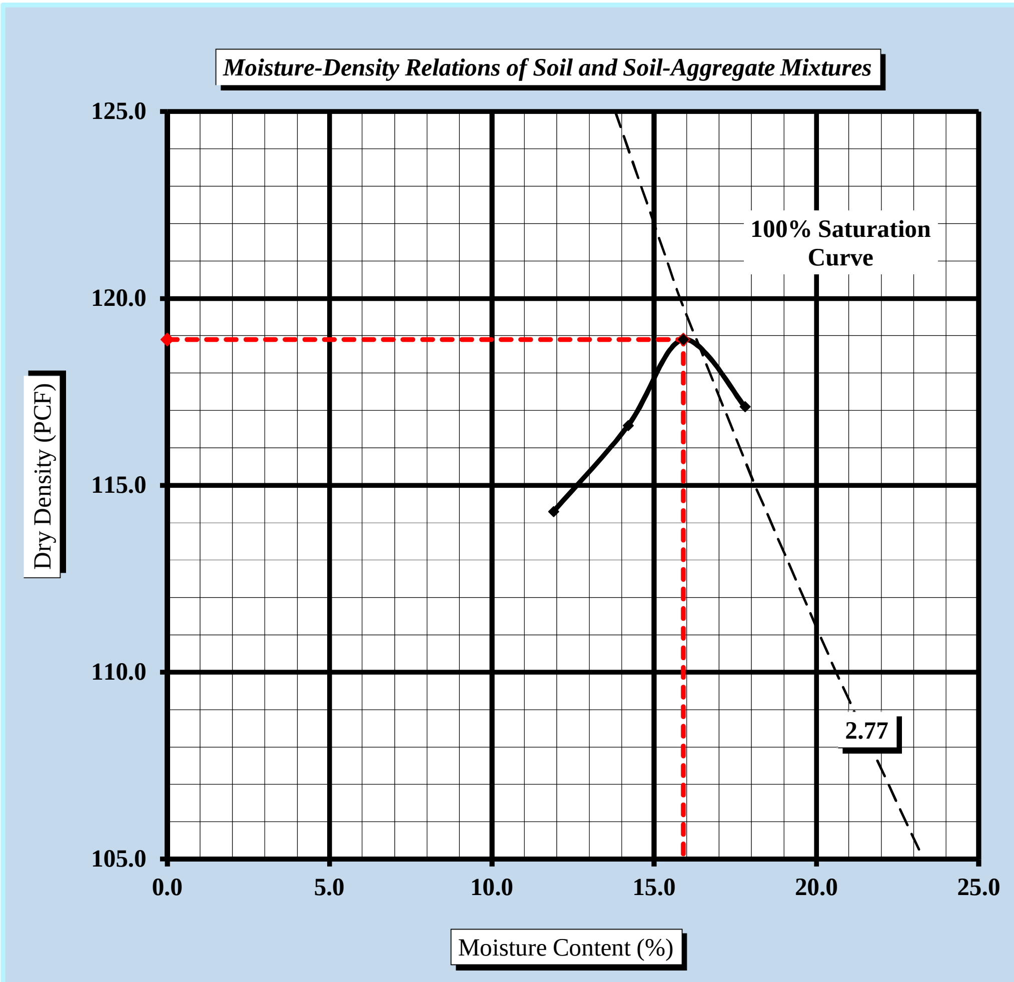
S&ME Project #:	1463-18-052	Report Date:	1/7/2019
Project Name:	Pee Dee Elementary Traffic Loop	Test Date(s):	12/31/2018
Client Name:	Castles Engineering		
Client Address:	2024 Corporate Center Dr, Ste 102; Myrtle Beach, SC		

Boring #:	N-1 to N-5	Sample #:	C-1	Sample Date:	12/21/2018
Location:	New Loop	Lab #:	4888	Depth:	0.5'-5'

Sample Description: Reddish Brown Fat Clay with Sand (CH)

Maximum Dry Density 118.9 PCF. **Optimum Moisture Content 15.9%**

ASTM D1557 - - Method A



Soil Properties

Natural Moisture Content	24.6%
Specific Gravity of Soil	--
Liquid Limit	62
Plastic Limit	22
Plastic Index	40

% Passing	
3/4"	--
3/8"	--
#4	--
#10	--
#40	--
#60	--
#200	71.4%

Oversize Fraction	
Bulk Gravity	--
% Moisture	--
% Oversize	--
MDD	--
Opt. MC	--

Moisture-Density Curve Displayed: Fine Fraction ☒ Corrected for Oversize Fraction (ASTM D 4718) ☐
Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐
Mechanical Rammer ☒ Manual Rammer ☐ Moist Preparation ☐ Dry Preparation ☒

References / Comments / Deviations:
ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort

Ron Forest, P.E.	RPF	Senior Reviewer	1/9/2019
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D1883-T193-3
Revision No. 2
Revision Date: 08/11/17

CBR (CALIFORNIA BEARING RATIO) OF LABORATORY COMPACTED SOIL

ASTM D 1883

S&ME, Inc. - Myrtle Beach: 1330 Highway 501 Business, Conway, SC 29526

Project #:	1463-18-052	Report Date:	1/7/2019
Project Name:	Pee Dee Elementary Traffic Loop	Test Date(s)	12/31/2018
Client Name:	Castles Engineering		
Client Address:	2024 Corporate Center Dr, Ste 102; Myrtle Beach, SC 29577		

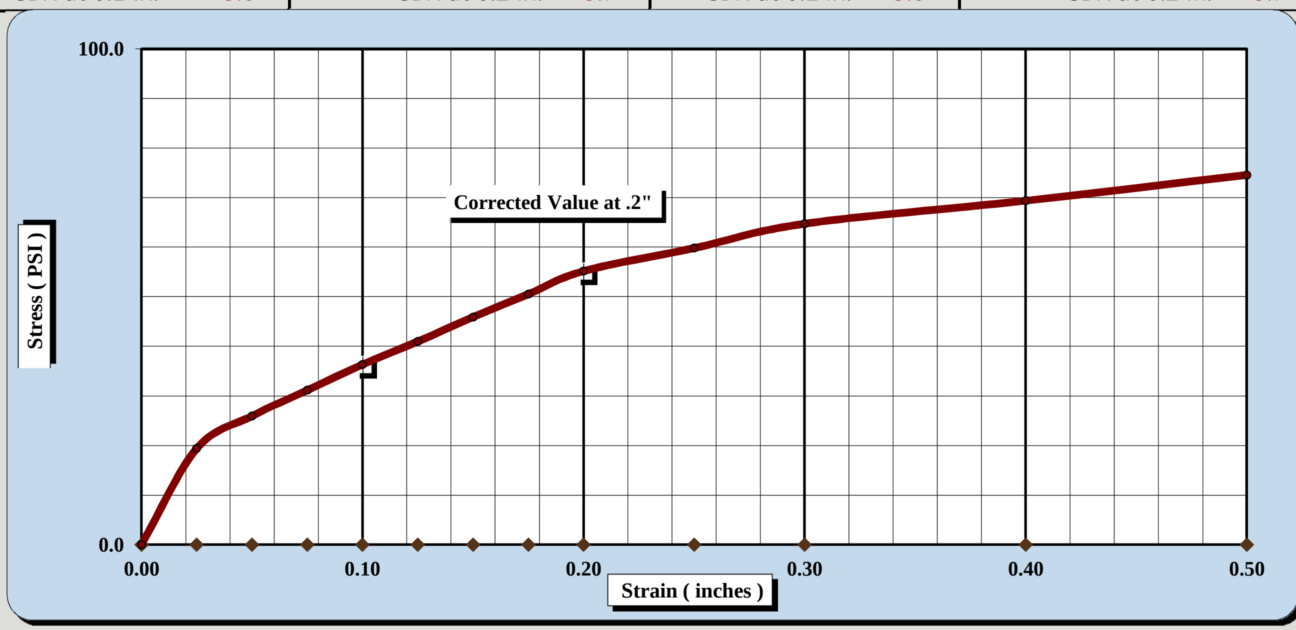
Boring #: N-1 to N-5	Sample #: C-1	Sample Date: 12/21/2018
Location: New Loop	LAB #: 4888	Depth: 0.5'-5'

Sample Description: Reddish Brown Fat Clay with Sand (CH)

ASTM D1557 *Method A* Maximum Dry Density: 118.9 PCF Optimum Moisture Content: 15.9%

Compaction Test performed on grading complying with CBR spec. % Retained on the 3/4" sieve: 1.0%

Uncorrected CBR Values				Corrected CBR Values			
CBR at 0.1 in.	3.6	CBR at 0.2 in.	3.7	CBR at 0.1 in.	3.6	CBR at 0.2 in.	3.7



CBR Sample Preparation:

The entire gradation was used and compacted in a 6" CBR mold in accordance with ASTM D1883, Section 6.1.1

Before Soaking		*After Soaking*	
Compactive Effort (Blows per Layer)	25		
Initial Dry Density (PCF)	113.6	Final Dry Density (PCF)	112.7
Moisture Content of the Compacted Specimen	18.3%	Moisture Content (top 1" after soaking)	28.2%
Percent Compaction	95.5%	Percent Swell	0.8%

Soak Time:	96 hrs.	Surcharge Weight	20.0	Surcharge Wt. per sq. Ft.	102.0
Liquid Limit	62	Plastic Index	40	Apparent Relative Density	--

Notes/Deviations/References: Liquid Limit: ASTM D 4318, Specific Gravity: ASTM D 854, Classification: ASTM D 2487

Ron Forest, P.E.	*RPF*	Senior Reviewer	1/9/2019
Technical Responsibility	*Signature*	*Position*	*Date*