VIA ELECTRONIC MAIL

March 10, 2022

William Zeli, P.E.
Environment Program Manager
Apex Companies, LLC
1600 Commerce Circle
Trafford, PA 15085

Subject: **Summarization of Terracon Geotechnical Report and WSP's Recommendations**
Senate Street Pavement Investigation, Congaree River Remediation Project
Columbia, South Carolina

Dear Mr. Zeli:

Terracon had a crew on site on September 7, 2021 and performed 5 hand-augered borings (with 4 of the borings to a depth of 1 to 2 feet below the existing pavement and 1 boring to a total depth of 5 feet) along Senate St. Data from these borings, including the asphalt cores, obtained from this operation were documented in their report (provided as Attachment A) and are summarized below. WSP's recommendations for preventative measures, maintenance during construction as well as final pavement reconstruction of Senate St are also noted at the end of this letter.

As observed by Terracon, the refusal encountered in 4 of the borings "appears to occur on a former pavement surface". These findings, which limit the availability of deeper subgrade information, along Senate St., result in some uncertainty in this analysis.

SUMMARIZATION OF THE TERRACON GEOTECHNICAL REPORT

1. The current condition of Senate St appears to be in fair condition. [This is consistent with WSP's findings presented in the *Initial Pavement Assessment Report* dated February 1, 2021.]

2. The previous asphalt overlay appears to be approximately 7 years old with an approximate 10-year design life span.

3. The asphalt thickness from the 5 cores taken within Senate St average around 4 inches thick.

4. The estimated pavement design, while working "satisfactorily" under the light duty residential traffic, is expected to deteriorate during full-scale construction activities.

5. During construction, it is recommended to frequently monitor the roadway for deterioration. If areas of deterioration are found, they should be patched immediately.

Post Construction

6. Two methods to repair the roadway once construction traffic is done:

    a. Milling and Overlay – Milling the existing asphalt a minimum of 2 inches and then placing a new asphalt course.

    b. Asphalt Reclamation – Milling the asphalt and underlying soil up to 8 inches, mixing with cement in-place and compacting. Once this is done an asphalt overlay is placed at approximately 2 inches thick.

7. Prior to the two methods mentioned above, the exposed soil subgrade should be evaluated. Any unsatisfactory areas should be properly repaired and tested to achieve the recommended compaction requirements. Once the subgrade is sufficient, one of the two methods mentioned above should be implemented.

8. Positive drainage of water should be maintained at all times during construction.

9. Any earthwork should be monitored and tested by the Geotechnical Engineer.

WSP RECOMMENDATIONS

Based on the Terracon Report (Attachment A) WSP has developed recommendations for preventative measures, maintenance during construction, and final pavement reconstruction, summarized in the following sections.

The addition of a 2-inch asphalt lift layer over the existing pavement was also considered as a preventative measure to provide a “buffer” for the expected construction traffic. The aim of the lift would be to reduce deterioration of the pavement surface during the construction period, in order to maintain the rideability of the pavement surface for the traveling public and reduce any necessary repairs during or after construction. However, after further deliberation the addition of this lift layer is not recommended because it is considered that the short term benefits are limited and it is unlikely that the lift will result in any cost-effective long-term enhancement of the roadway.

1. Preventative Measures:

    a. Complete preemptive patching and repair work at the intersection of Gist St and Senate St.

2. Maintenance During Construction

    a. Monitor the existing pavement for deterioration during construction. Any noted areas should be patched/repaired as soon as possible. It is also recommended to have an asphalt contractor on standby for the project so that repairs can be made quickly.

    b. Depending on the location and extent of an area needing repaired, road plates can be installed temporarily over problem areas to protect motorists until the repairs can be made. Long term use of road plates is not recommended due to causing a rougher ride for the local residents.

    c. Construction activities are anticipated to take a temporary stoppage between the start and completion of the project; therefore, it is recommended that the existing roadway be evaluated prior to the construction season ending. Any deteriorated areas should be patched/repaired. This will help keep the road in good condition between the construction periods as well as minimize the impacts to rideability for the surrounding residents.

3. Final Pavement Reconstruction

    a. Mill and Overlay as noted in the Terracon Report would be performed by mill the existing roadway, patching/repairing any deteriorated areas and then paving an asphalt surface course.

        i. Note that this recommendation is best suited for minor deterioration to the roadway caused by the construction traffic.

    b. Asphalt Reclamation includes milling and mixing not only the asphalt but also the underlying substructure, mix with cement and then compact the material. Once this material is cured, an asphalt surface course can be placed as the riding surface of the reclaimed roadway.

        i. Note that this recommendation is best suited for a more deteriorated roadway caused by the construction traffic.

Yours sincerely,

T Edwards

Tom Edwards
WSP Project Manager

ATTACHMENT A

CONGAREE RIVER REMEDIATION – SENATE STREET PAVEMENTS

GEOTECHNICAL ENGINEERING REPORT

OCTOBER 18, 2021

TERRACON CONSULTANTS, INC.

Geotechnical Engineering Report

Congaree River Remediation – Senate Street Pavements

Columbia, SC

October 18, 2021

Terracon Project No. 73215043

Prepared for:

WSP USA Inc.

Columbia, SC

Prepared by:

Terracon Consultants, Inc.

Columbia, SC

October 18, 2021

WSP USA Inc.
1330 Lady Street, Suite 205
Columbia, SC 29201

Attn: Mr. Tom Edwards, PE
P: 412-535-9818
E: thomas.edwards@wsp.com

Re: Geotechnical Engineering Report
Congaree River Remediation – Senate Street Pavements
Columbia, SC
Terracon Project No. 73215043

Dear Mr. Edwards:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P73215043.R2 dated July 16, 2021 and authorized on July 27, 2021. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning the design and construction of the pavements for the proposed project.

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

Sincerely,
Terracon Consultants, Inc.

Rajshekhar Sarkar, EIT
Senior Staff Engineer

Phillip A. Morrison, P.E.
Geotechnical Department Manager
SC Registration No. 17275

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 17275 PHILLIP A. MORRISON

SOUTH CAROLINA TERRACON CONSULTANTS, INC. No. 2220 CERTIFICATE OF AUTHORIZATION

REPORT TOPICS

Note: This report was originally delivered in a web-based format. Orange Bold text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the *GeoReport* logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Congaree River Remediation – Senate Street Pavements

Columbia, SC

Terracon Project No. 73215043

October 18, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for for Senate Street between Gist Street and Huger Street in Columbia, SC. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- groundwater conditions
- pavement design and construction

As requested by WSP, our geotechnical engineering scope of services included the advancement of five hand auger borings to depths of up to 5 feet below existing site grades with penetrometer (DCP) testing to estimate the consistency of the soils underlying the existing pavements. Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

SITE CONDITIONS

The following description of the site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Site Location	The subject section of Senate Street is located between Gist Street and Huger Street in Columbia, South Carolina. For additional location information, see **Site Location**.
Existing Improvements	The referenced segment of Senate Street is a two-lane asphalt roadway with concrete curbing along most edges. Parallel, perpendicular and angle parking spaces flank most of the. Roadway edges.
Current Pavement	Asphalt
Additional Observations	Based on a review of aerial photographs, the original roadway segment has been present since prior to the 1930's. Various modifications have been made since the original layout. The most recent appears to the addition of some of northside parking and curbing, added between 2010

Item	Description
	and 2014. The area also appears to have been received an overlay about 2015.
Existing Topography	The topography of the roadway slopes down gradually to the west. Based on available Richland GIS topographic information, surface elevations range from 170 feet msl to 150 feet msl.
Underground utilities	Underground water lines were observed near Borings B-4 and B-5. Underground gas lines and storm drain lines were also present near Boring B-5. A storm drain lines was also observed on the pavement shoulder of Senate Street near Borings B-1 and B-2.
Geology	The site is located in the upper Coastal Plain physiographic province of South Carolina, very near the Fall Line (the transition from the Coastal Plain to the Piedmont province). The Coastal Plain is a wedge-shaped cross section of water and wind deposited soil. Its thickness ranges from a featheredge at the surface contact of the Piedmont to several thousand feet at the present-day coastline. The sediments range in age from the Cretaceous and Tertiary periods at the contact with the bedrock to the Recent period at the present coastline. The sediments include clays, silts, sands, and gravels, as well as organics. The underlying Piedmont physiographic province consists of soils generated by the in-place chemical and mechanical weathering of the parent sedimentary and metamorphic rock. A common soil profile includes a surficial clayey or silty layer transitioning to coarser material at depth. Generally dividing the soil layer from the bedrock is a very dense layer referred to as "partially weathered rock". Partially weathered rock is composed of irregular zones of very dense soil and rock. Partially weathered rock exhibits standard penetration test values of 100 blows per foot (bpf) or more. The topography of the underlying bedrock surface and the thickness of the various soil and weathered rock strata vary greatly in short, horizontal distances because of variation in mineralogy of the material, previous and present groundwater conditions, and past tectonic activity (faulting, folding, intrusions, etc.). Further, the presence of boulders and rock pinnacles is possible within the soil matrix. Fill soils are those soils that have been placed or reworked in conjunction with past construction grading or farming. Fill can be composed of different soil types from various sources and can contain debris from building demolition, organics, topsoil, trash, etc. The engineering properties of the fill depend primarily on its composition, density, and moisture content.
Existing Pavements	Based on our recent observations of the roadway, the existing pavement appears to be in fair condition. The primary distresses observed included low- to medium-severity transverse/longitudinal cracking at the east end of the roadway segment near the Huger Street intersection. Medium severity

Item	Description
	block cracking was also observed near Borings B-2 and B-3. Moderate severity alligator cracking was observed at the intersection of Gist Street and Senate Street. See Photographs 1 through 4 in the **Photography Log**.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Project Description	We understand that WSP is planning remediation work within the Congaree River just south of the Gervais Street bridge on behalf of Dominion Energy. As part of the work, the contractor will haul materials to and from the work area at the river along the subject section of Senate Street (between Gist Street and Huger Street). They estimate that the work will generate 3,800 loads of material from the river area. Each truck is expected to be either a triaxle or dump trailer truck, hauling approx. 20 tons per load. We understand that there is interest in the construction traffic's impact on the condition of the existing roadway. This is the focus of this report.
Pavements	We understand that rehabilitation or replacement of the existing pavement system along the noted segment of Senate Street may be included as part of the overall Congaree River Remediation project.
Estimated Start of Construction	May 2022

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	Existing Fill	Medium dense silty sand
2	Coastal Plain	Medium dense clayey sand

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

With the exception of Boring B-3, each of the borings encountered practical auger refusal at depths ranging from 1 to 2 feet below the existing pavement surface. From our field observations, the refusal appears to occur on a former pavement surface. However, this cannot be confirmed without either mechanized drilling to attempt to penetrate the layer or open hole excavation to expose it.

The data from the individual asphalt cores is summarized in the table below. This includes the pavement thickness and the presence (and thickness, if applicable) of the base material. Photographs of the asphalt cores are in **Photography Log** (see Photographs 5 through 9).

Core No.	Asphalt Thickness, in.	Stone Base Thickness, in.
B-1	3-½	None
B-2	5-½	4
B-3	4-½	None
B-4	3-½	None
B-5	4	None

Groundwater was not encountered in the borings at the time of field exploration. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions, and other factors.

Based on the field and laboratory data, the primary shallow soil type is silty sand. Representative samples from the upper 1 to 2 foot had fines contents ranging from 12 to 28 percent. These soils were underlain by clayey sand with fines contents of about 46 percent. In-situ moisture contents of the tested samples in the upper 3 feet were between 4 to 13 percent, indicating the moisture contents appear to be near to dry of their optimum values.

PAVEMENTS

Overview

Based on our reconnaissance, the subject existing pavement is in fair condition. Areas of medium severity transverse and longitudinal cracking were noted in the east extreme near Huger Street. Medium severity block cracking was observed near Borings B-2 and B-3. Medium severity alligator cracking was observed near Boring B-5 at the intersection of Gist Street. Based on a review of available data, the age of the original pavement is unknown, but likely 30+ years old. From a review of aerial photographs available on the Richland County GIS system, the overlay is estimated to be 7 years old. The design period used in proportioning the overlay is not available, though it is typical to use a design period of 10 years. The existing pavement appears to be performing satisfactorily under the assumed light-duty traffic generated primarily by the residential properties in the area.

The existing asphalt pavement thickness is between 3-½ and 5-½ inches at the test locations, averaging 4 inches. The underlying soils are existing fill consisting of silty sands. Based on our experience with the area soils, we expect it to have a CBR value on the order of 5. Traffic information for the current pavement is not available. Using the City of Columbia pavement design guidelines, we estimate that the design ESALs (equivalent daily 18-KIP single axle loads) were likely between 1,100 and 5,800, depending on the actual subgrade and existing pavement assumptions made. Based on the assumed design period and the approximate overlay construction, the pavement has likely experienced about 70 percent of the noted design ESALs. The planned construction traffic associated with hauling material from the river will generate about 4,200 ESALs, also based on the City of Columbia's design methodology. This amount of additional ESALs will progress the existing pavement past its cumulative design traffic load. Considering the likely ESALs used in the overlay design (estimated to be between 1,100 and 5,800 ESALs), the pavement condition could be moderately to thoroughly distressed.

To return the pavement to its current condition, two general options are available. These are:

Milling and Overlay: This would include milling the existing surface, repairing any areas of moderate- to high-severity distress by patching and then overlaying the full roadway with a new asphalt surface course.

Asphalt Reclamation: This includes grinding the existing asphalt into small fragments and mixing the fragment into the underlying soil along with cement, compacting the mixture resulting in a cement modified recycled base (CMRB), and then overlaying it with an asphalt surface course.

The more cost-effective method will depend on the actual pavement condition at the conclusion of the planned construction project. Typically, milling and overlaying may be more cost effective if patching is needed in less than about 40 percent of the area. For a greater level of patching, widespread rutting, or issues such as time constraints (CMRB can be much faster than conventional pavement repair), asphalt reclamation would likely be the preferred option.

Pavement Thickness Design

As noted earlier, we estimate that the existing pavement system was proportioned using up to about 5,800 ESALs. This is roughly equivalent to the following traffic volume over a 10-year design period:

- 1 trash truck per week
- 1 tractor trailer per week
- 3 to 4 delivery trucks per week day
- 500 cars and light duty trucks per day

Based on our experience with the area soil conditions, we have used a CBR value of 5 for the design. Subgrade preparation in the pavement areas should be performed as outlined in the **Earthwork** section of this report. Our recommendations for pavement replacement and pavement reclamation are summarized in the table below.

Pavement Options	Material	Layer Thickness (inches)
Asphalt Reclamation Section (Asphalt over CMRB)	HMA Surface Course (Type C)	2
	Prime Coat (If required)	0.30 gal/sy
	Cement Modified Recycled Base (CMRB)	8
Mill and Overlay	HMA Surface Course (Type C)	2
	Tack Coat	0.04 to 0.08 gal/sy
	Existing Asphalt Pavement, repaired as needed	Varies

The above sections represent minimum thicknesses and, as such, periodic maintenance should be anticipated. Pavements subjected to traffic loads higher than noted above will require thicker pavement sections.

General Design Recommendations

Asphaltic cement concrete should be an approved mix design selected from the current SCDOT Standard Type C (SCDOT Section 402 and 403). Compaction levels of the asphalt and Macadam Base Course materials should conform to SCDOT requirements. A discussion of the CMRB is provided in the Subgrade Preparation (CMRB Pavements) section. If needed as part of the patching, aggregate base course should be SCDOT Macadam Base Course (SCDOT Section 305).

Construction Considerations (Mill and Overlay)

Should milling and overlaying be the preferred pavement repair option, we recommend milling at least 1 inch and applying a minimum 2-inch overlay. Slightly greater milling could be performed along the pavement edges to better tie the overlay into the parking spaces and curb and gutters. Cleaning and crack sealing should be performed across the exposed surface after milling. Patching should be performed in any localized areas of moderate- to high-severity distress. Prior placing the tack coat in preparation for the overlaying, the general surface should be power-broomed to remove the milling dust and other debris. A detailed discussion on crack sealing and patching is provided below.

Cleaning and Crack Sealing: After milling the asphalt surface, the existing cracks in the exposed asphalt surface should be sealed. Prior to sealing, all cracks should be cleaned with pressurized air and filled with rubberized asphalt crack sealer. Cracks less than ¼-inch in width generally do not require sealing, unless the cracking is abundant and then a fluid slurry seal may be used. Cracks of ¼- to ¾-inch in width are usually routed or as a minimum cleaned of all old sealant and blown out with compressed air to remove dirt and debris. Cracks ¾- to 1-inch wide should be cleaned of all old sealant and blown with compressed air. If cracks are over ¾-inch deep, a backer rod can be installed to conserve sealant. An asphalt emulsion sealant should be used in cracks of ¼- to 1-inch in width. Cracks over 1-inch wide should be cleaned and blown with compressed air and sealed with asphalt emulsion slurry or fine-grained hot mix asphalt. Severely cracked or deteriorated areas may require patching, as discussed below.

Existing Asphalt Patching: After milling the asphalt surface, we recommend the exposed asphalt by evaluated by the Geotechnical Engineer, including proofrolling with heavy construction equipment such as a loaded tandem-axle dump truck. Proofrolling will aid in locating unstable areas that require remedial work. Proofrolling should not be performed in visibly unstable areas, as this will increase disturbance and subgrade instability. All areas of instability and moderate- to high-severity distressed areas should be removed and replaced with a full-depth patch. This should include removal of asphalt, unstable base, and unstable subgrade materials until firm support is reached. Where areas to be patched are too small to proofroll, they should be evaluated by probing and visual observations.

Care should be taken that patched areas are saw cut to achieve a smooth edge and that at least 2 sides of the patch are at right angles to the direction of traffic. Tack coat should be placed on the exposed pavement edges, prior to placing the asphalt material. The actual depth of the patch thickness should be determined by the geotechnical engineer at the time of construction. For planning purposes, we anticipate the patches will have a minimum thickness of 4 inches. If excavation extends to a greater depth, aggregate base course can be used as backfill up to the depth of the patch subgrade.

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration.

Future performance of pavements constructed on the site will be dependent upon maintaining stable moisture content of the subgrade soils; and, providing for a planned program of preventative maintenance. The performance of all pavements can be enhanced by minimizing excess moisture that can reach the subgrade soils. The following recommendations should be considered at minimum:

- Site grading at a minimum 2 percent grade away from the pavements;
- Sealing all landscaped areas in, or adjacent to pavements to reduce moisture migration to subgrade soils;
- Placing compacted backfill against the exterior side of curb and gutter; and,
- Placing curb, gutter and/or sidewalk directly on subgrade soils without the use of base course materials.

Pavement Maintenance

Preventative maintenance should be planned and provided through an on-going pavement management program to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment.

Preventative maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventative maintenance.

EARTHWORK

The following presents recommendations for subgrade preparation for the proposed pavement system. The recommendations presented for the design and construction of the pavements are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, and other geotechnical conditions exposed during the construction of the project.

Subgrade Preparation (Milling and Overlay)

After milling the asphalt surface, we recommend the exposed surface be proofrolled with heavy construction equipment such as a loaded tandem-axle dump truck. Proofrolling will aid in locating unstable subgrade materials near the surface. Proofrolling should not be performed in visibly unstable areas, as this will increase disturbance and subgrade instability. If conditions are found to be unstable, the area should be undercut to soils that would provide a firm base for the compaction of the structural fill. Should they extend deeper than the planned patch depth, the undercut soils should be replaced with compacted stone base, placed as described in following sections of this report. Pavement construction may commence after proofrolling has been successfully completed.

The exposed subgrade soils will be composed of silty sands. Traffic exposure to wet subgrades can destabilize otherwise satisfactory conditions, requiring remedial work to repair them. As a precaution, we recommend that once the planned subgrade levels have been achieved, the stone base be placed to protect them.

Positive drainage should be maintained to prevent ponding of stormwater and direct surface runoff away from areas of active construction. This will prevent the weakening of prepared subgrade soils.

Subgrade Preparation (CMRB Pavements)

Based on the results of the boring data, we anticipate finding generally firm subgrade conditions throughout the majority of the pavement areas. When CMRB is used as a pavement base, there is limited opportunity to evaluate the existing subgrade. Therefore, we recommend that a qualified soils technician under the direction of the geotechnical engineer observe the reclamation activities to watch for signs of yielding subgrades such as pumping, rutting, and fracturing of the ground subgrade under the wheel loads of the various construction equipment. Any areas that show signs of yielding should be further evaluated to see whether remedial subgrade preparations are needed. Generally, subgrade repairs would include mixing cement into the subgrade, either at a greater percentage or greater depth depending on the conditions identified.

We recommend that the asphalt reclamation be performed in general accordance with the Suggested Specifications for Soil-Cement Base Course Construction prepared by the Portland Cement Association (Document No. IS008). Below, we have reiterated key steps of the process.

- Subgrade conditions (shape, grade, etc.) should be verified by the engineer prior to beginning the stabilization process. All subgrade instability issues should be resolved prior to that time.

- Mixing activities should not occur during periods when the soils are frozen or when it will not be possible to maintain the recommended moisture content in the soil.

- The moisture content of the soil mixture should be within 2 percent of the optimum moisture or adjusted to be so.

- The cement should be spread in a regulated manner so that the recommended quantity can be evenly spread and in a way that will limit losses due to dust. If a slurry placement is used, spreading should begin within 60 minutes of mixing the slurry and mixing of the cement and soil should begin within 30 minutes of cement placement.

- Once the Type II cement is placed, mix until the layer is of uniform color and has the required moisture content throughout the layer. Excavations should be made at regular intervals to see the cement has been uniformly mixed.

- Adjust the moisture content to within 2±-percent of the optimum moisture and compact the layer to a minimum compaction requirement of 96 percent of the standard Proctor based on a 5-test moving average with no test below 94 percent. No area should be left undisturbed for more than 30 minutes and the entire compaction process should be completed in 2 hours from the start of mixing. All finishing work should be completed in 4 hours from start of mixing. Fogging should be performed to limit the loss of moisture.

- At the end of each day's construction, a straight transverse construction joint should be formed by cutting back into the completed work to form a true vertical face.

- The completed area should be cured for a period of 7 days either by means of applying a sealing layer or by the application of a continuous fog. The completed areas should be protected from traffic during the 7-day curing period and until authorized by the engineer. Compressive strength samples should be collected periodically to verify the mixture's in-place strength.

Terracon considers the soil-cement process to be a specialty construction service. Therefore, we recommend that the selected construction firm have at least 5 years of experience in this field. Representative projects should be submitted for review in the bidding process.

A test strip of about 100 feet should be established prior to commencing the general work to check the contractor's procedures for mixing and compacting the soil-cement layer. The cement application rates can be determined at this time. Typically, this is done by spreading the cement with the production equipment over an area covered by plywood of sufficient length to verify the uniformity of the application. Several attempts may be needed to accurately adjust the flow rate and equipment speed.

Fill Material Types

Earthen materials used for structural fill below the minimum stone base layer indicated in **Pavements** should meet the following material property requirements:

Fill Type [1]	SCDOT Classification	Acceptable Location for Placement
Imported Structural Fill	Macadam Aggregate Base (SCDOT 305)	All locations and elevations

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.

Fill Compaction Requirements

Structural and general fill should meet the following compaction requirements.

ITEM	DESCRIPTION
Fill Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used. 4 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used.
Compaction Requirements [1]	100% of the material's modified Proctor maximum dry unit weight (ASTM D 1557)
Moisture Content	Within the range of -2 percent and +2 percent of the optimum moisture content as determined by the standard Proctor test at the time of placement and compaction

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

Excavation

The boring data indicate that the site soils should generally be excavatable using conventional construction equipment. Groundwater was not encountered in the borings at the time of field exploration. Groundwater related excavation issues are not expected at the site.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Construction site safety is the sole responsibility of the contractor who controls the means, methods and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean that Terracon is assuming any responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of the pavement system. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to pavement construction.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proofrolling; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of the pavements.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 3,000 square feet, with a minimum of one test in isolated patch areas.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather.

The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Five test borings were drilled at the site on September 7, 2021. The borings were drilled to depths ranging from approximately 1 foot to 5 feet below the existing pavement system at the approximate locations shown on the attached **Exploration Plan**.

Boring Layout and Elevations: The borings were located in the field by using the proposed site plan and our field observations of the existing pavement at the site. The boring locations shown on the **Exploration Plan** are approximate and should be considered accurate only to the degree implied by the method of location.

Subsurface Exploration Procedures: After coring the asphalt, the test borings were advanced using manual augers to check the soil composition. In each of the borings, penetration testing using a dynamic cone penetrometer (DCP) was performed at regular intervals within the borehole. The penetrometer values represent the number of blows of a standardized hammer required to advance the penetrometer in 1-¾-inch increments and are an indication of the consistency or density of the soil.

Representative disturbed soil samples were obtained from the borings and were placed in sealed containers and returned to our laboratory where our engineer visually reviewed and classified them. The purposes of this review were to check the drillers' field classifications and visually estimate the soils' relative constituents (sand, clay, etc.). The soil types and penetrometer values are shown on the Boring Logs. These records represent our interpretation of the field conditions based on the driller's field logs and our engineer's review of the soil samples. The lines designating the interfaces between various strata represent approximate boundaries only, as transitions between materials may be gradual.

At the conclusion of the drilling activities, the borings were checked for the presence of groundwater. After which, the borings were backfilled with the soil cuttings and capped with cold-patch asphalt.

Our exploration services include storing the collected soil samples and making them available for inspection for 60 days from the report date. The samples will then be discarded unless requested otherwise.

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in the **Supporting Documents**. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- Fines Content — ASTM D1140-06
- Moisture Content — ASTM D2216-10
- Atterberg Limits — ASTM D4318-10

PHOTOGRAPHY LOG

Photo 1: Longitudinal/Transverse cracks near Boring B-1

Photo 2: Longitudinal/Transverse cracks near Boring B-2

Photo 3: Block cracking near Boring B-3

Photo 4: Alligator cracking near Boring B-5

Photo 5: Core sample of Boring B-1

Photo 6: Core sample of Boring B-2

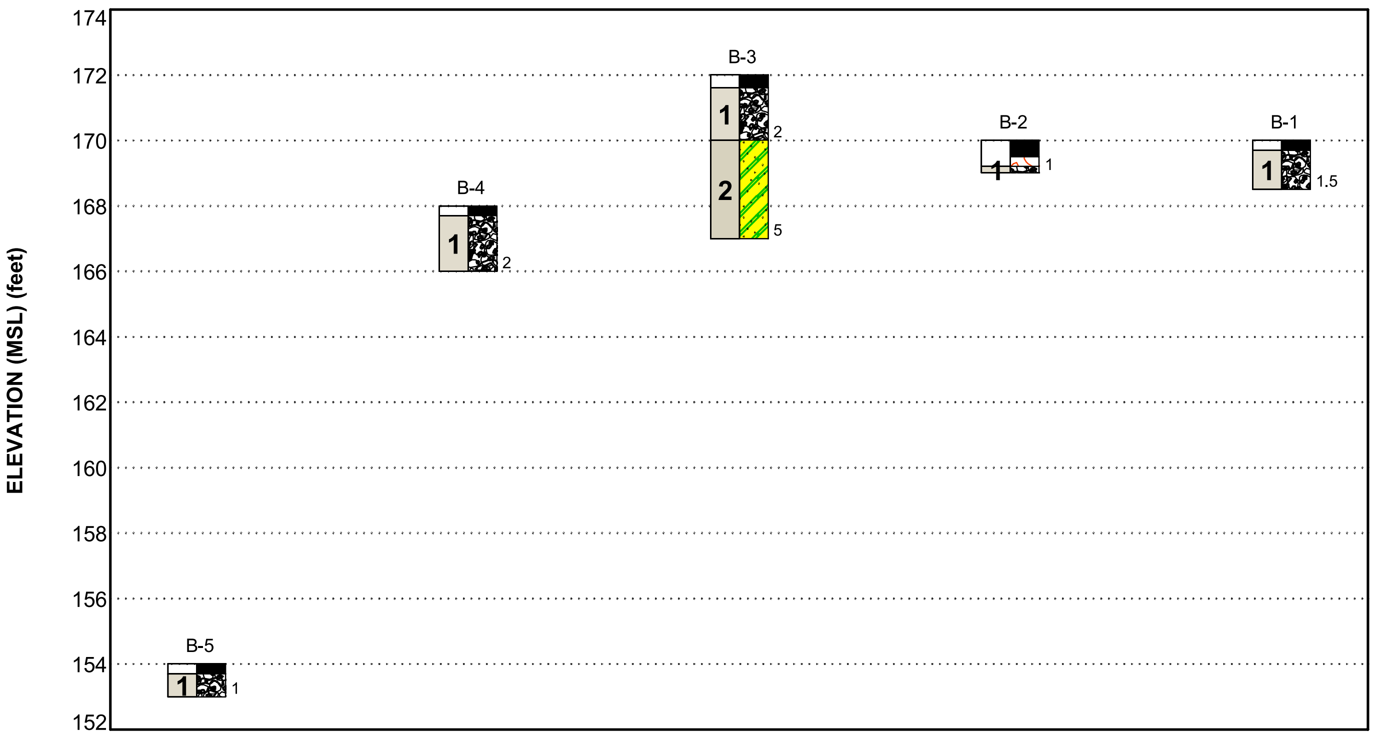
Photo 7: Core sample of Boring B-3

Photo 8: Core sample of Boring B-4

Photo 9: Core sample of Boring B-5

GEOMODEL

Congaree River Remediation - Senate Street Pavements ■ Columbia, SC
Terracon Project No. 73215043



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Existing Fill	Medium dense silty sand (SM)
2	Clayey Sand	Medium dense clayey sand (SC)

LEGEND

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

Congaree River Remediation - Senate Street Pavements ■ Columbia, SC

Terracon Project No. 73215043

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: COLUMBIA NORTH, SC (1/1/1997) and SOUTHWEST COLUMBIA, SC (1/1/1994).

EXPLORATION PLAN
Congaree River Remediation - Senate Street Pavements ■ Columbia, SC
Terracon Project No. 73215043

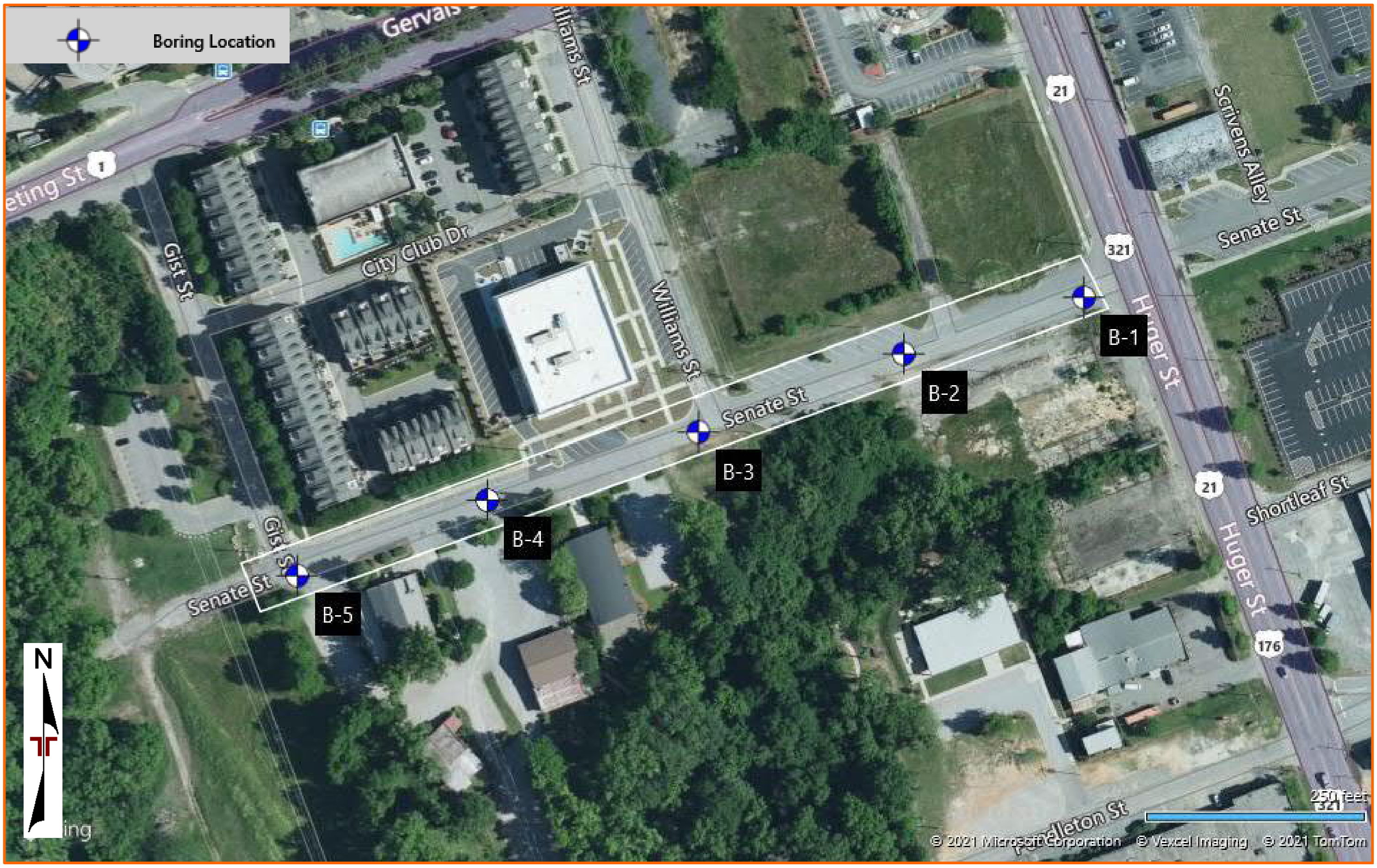


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: Congaree River Remediation - Senate Street Pavements

CLIENT: WSP USA Inc Charleston, SC

SITE: Senate Street Columbia, SC

LOCATION See Exploration Plan

Latitude: 33.9963° Longitude: -81.0445°

Approximate Surface Elev.: 170 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.3	**ASPHALT**, (3.5 inches)	169.5+/-							
1		1.5	**FILL - SILTY SAND (SM)**, fine to medium grained, dark brown, with glass pieces and crushed aggregate	168.5+/-	1		Hand Auger	25+ DCP	3.9		12
			Practical Hand Auger Refusal at 1.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: DCP

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with bentonite grout upon completion.
Surface capped with cold patch asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Asphalt encountered at 1.5'. Could not penetrate any further with a hand auger. Similar observations were noted in an offset boring 5 feet away.
Relative surface elevations obtained from available Richland GIS topographic information.

WATER LEVEL OBSERVATIONS

No free water observed at end of drilling

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 09-07-2021	Boring Completed: 09-07-2021
Drill Rig: Hand Auger	Driller: C. Costner
Project No.: 73215043	

BORING LOG NO. B-2

PROJECT: Congaree River Remediation - Senate Street Pavements

CLIENT: WSP USA Inc Charleston, SC

SITE: Senate Street Columbia, SC

LOCATION See Exploration Plan

Latitude: 33.9961° Longitude: -81.0452°

Approximate Surface Elev.: 170 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.5	**ASPHALT**, (5.5 inches)	169.5+/-							
		0.8	**AGGREGATE BASE COURSE**, (4 inches)	169+/-							
1		1.0	**FILL - SILTY SAND (SM)**, fine to medium grained, dark brown, with glass pieces and crushed aggregate	169+/-	1		Hand auger	25+ DCP	13.3		20
			Practical Hand Auger Refusal at 1 Foot								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: DCP

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with bentonite grout upon completion.
Surface capped with cold patch asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Asphalt encountered at 1'. Could not penetrate any further with a hand auger. Similar observations were noted in an offset boring 5 feet away.
Relative surface elevations obtained from available Richland GIS topographic information.

WATER LEVEL OBSERVATIONS

No free water observed at end of drilling

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 09-07-2021	Boring Completed: 09-07-2021
Drill Rig: Hand Auger	Driller: C. Costner
Project No.: 73215043	

BORING LOG NO. B-3

PROJECT: Congaree River Remediation - Senate Street Pavements

CLIENT: WSP USA Inc Charleston, SC

SITE: Senate Street Columbia, SC

LOCATION See Exploration Plan

Latitude: 33.9959° Longitude: -81.0459°

Approximate Surface Elev.: 172 (Ft.) +/-

MODEL LAYER	DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.4	**ASPHALT**, (4.5 inches)	171.5+/-							
1	2.0	**FILL - SILTY SAND (SM)**, fine to medium grained, brown, with glass pieces and crushed aggregate	170+/-	1		Hand	25+ DCP			
				2		Hand	25+ DCP	13.0	40-16-24	46
2	5.0	**CLAYEY SAND (SC)**, fine to medium grained, reddish brown	167+/-	3		Hand	25+ DCP			
				4		Hand	25+ DCP			
				5		Hand	25+ DCP			
		Boring Terminated at 5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: DCP

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with bentonite grout upon completion.
Surface capped with cold patch asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Relative surface elevations obtained from available Richland GIS topographic information.

WATER LEVEL OBSERVATIONS

No free water observed at end of drilling

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 09-07-2021	Boring Completed: 09-07-2021
Drill Rig: Hand Auger	Driller: C. Costner
Project No.: 73215043	

BORING LOG NO. B-4

PROJECT: Congaree River Remediation - Senate Street Pavements

CLIENT: WSP USA Inc Charleston, SC

SITE: Senate Street Columbia, SC

LOCATION See Exploration Plan

Latitude: 33.9957° Longitude: -81.0467°

Approximate Surface Elev.: 168 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.3	**ASPHALT**, (3.5 inches)	167.5+/-							
1			**FILL - SILTY SAND (SM)**, fine to medium grained, brown, with crushed aggregate				Hand	25+ DCP	7.4		24
					1						
		2.0		166+/-	2		Hand	25+ DCP			
			Practical Hand Auger Refusal at 2 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: DCP

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with bentonite grout upon completion.
Surface capped with cold patch asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Asphalt encountered at 2'. Could not penetrate any further with a hand auger. Similar observations were noted in an offset boring 5 feet away.
Relative surface elevations obtained from available Richland GIS topographic information.

WATER LEVEL OBSERVATIONS

No free water observed at end of drilling

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 09-07-2021	Boring Completed: 09-07-2021
Drill Rig: Hand Auger	Driller: C. Costner
Project No.: 73215043	

BORING LOG NO. B-5

PROJECT: Congaree River Remediation - Senate Street Pavements

CLIENT: WSP USA Inc Charleston, SC

SITE: Senate Street Columbia, SC

LOCATION See Exploration Plan

Latitude: 33.9954° Longitude: -81.0474°

Approximate Surface Elev.: 154 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.3	**ASPHALT**, (4 inches)	153.5+/-							
1		1.0	**FILL - SILTY SAND (SM)**, fine to medium grained, brown, with crushed aggregate	153+/-	1		Hand Auger	25+ DCP	9.6		28
			Practical Hand Auger Refusal at 1 Foot								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: DCP

Advancement Method:
Hand Auger

Abandonment Method:
Boring backfilled with bentonite grout upon completion.
Surface capped with cold patch asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Asphalt encountered at 1'. Could not penetrate any further with a hand auger. Similar observations were noted in an offset boring 5 feet away.
Relative surface elevations obtained from available Richland GIS topographic information.

WATER LEVEL OBSERVATIONS

No free water observed at end of drilling

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 09-07-2021	Boring Completed: 09-07-2021
Drill Rig: Hand Auger	Driller: C. Costner
Project No.: 73215043	

Summary of Laboratory Results

BORING ID	Depth (Ft.)	Liquid Limit	Plastic Limit	Plasticity Index	% Fines	Water Content (%)
B-1	0-1				12.1	3.9
B-2	0-1				19.7	13.3
B-3	2-3	40	16	24	45.9	13.0
B-4	0-1				23.9	7.4
B-5	0-1				28.4	9.6

PROJECT: Congaree River Remediation - Senate Street Pavements

SITE: Senate Street Columbia, SC

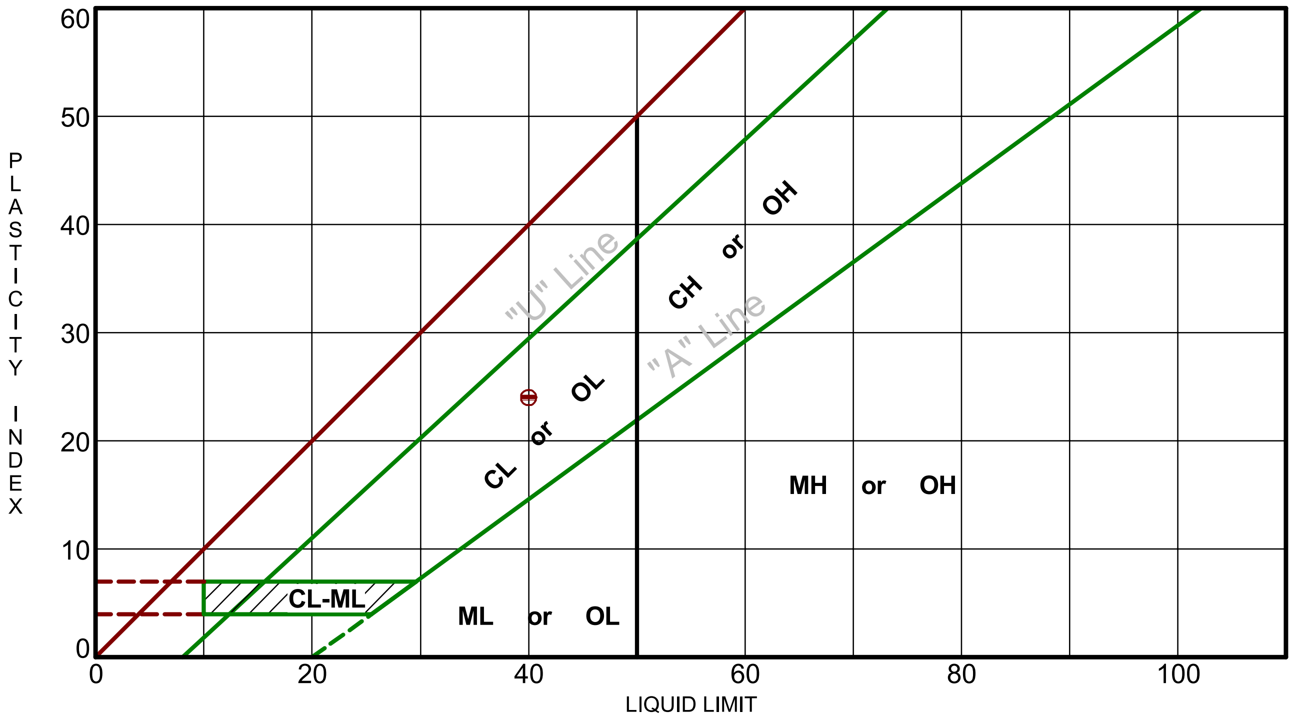
Terracon
521 Clemson Rd
Columbia, SC

PROJECT NUMBER: 73215043

CLIENT: WSP USA Inc Charleston, SC

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
⊖	B-3	2 - 3	40	16	24	45.9	SC	CLAYEY SAND

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 73215043 CONGAREE RIVER RE.GPJ TERRACON_DATATEMPLATE.GDT 9/14/21

PROJECT: Congaree River Remediation - Senate Street Pavements

SITE: Senate Street Columbia, SC

Terracon
521 Clemson Rd
Columbia, SC

PROJECT NUMBER: 73215043

CLIENT: WSP USA Inc Charleston, SC

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

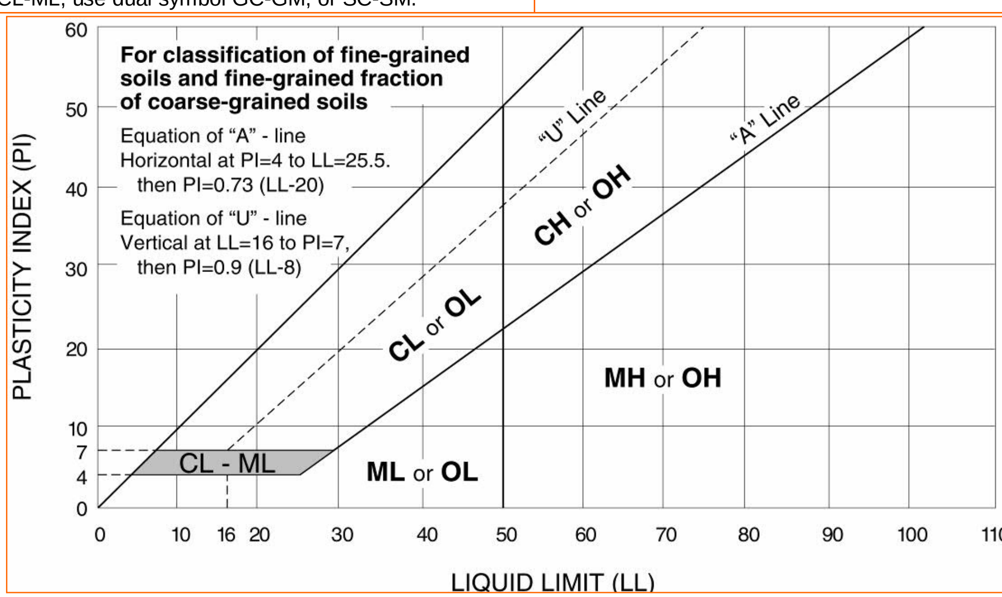
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Grab Sample	Water Initially Encountered	**N** – Standard Penetration Test Resistance (Blows/Ft.)
Split Spoon	Water Level After a Specified Period of Time	**(HP)** – Hand Penetrometer
	Water Level After a Specified Period of Time	**(T)** – Torvane
	Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**(DCP)** – Dynamic Cone Penetrometer
		UC – Unconfined Compressive Strength
		(PID) – Photo-Ionization Detector
		(OVA) – Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		