# ECS Southeast, LLP

## Geotechnical Engineering Report

## Stanley White Rec Center

New Bern, Craven County, North Carolina

ECS Project Number # 22:28890

March 23, 2020

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Mr. George Chiles
c/o City of New Bern
P.O. Box 1129
New Bern, North Carolina 28563

ECS Project No. 22:28890

Reference: Geotechnical Engineering Report
**Stanley White Rec Center**
New Bern, Craven County, North Carolina

Dear Mr. Chiles:

ECS Southeast, LLP (ECS) has completed the subsurface exploration, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our Proposal No. 22:23831, dated January 31, 2020. This report presents our understanding of the geotechnical aspects of the project along, the results of the field exploration conducted, and our design and construction.

It has been our pleasure to be of service to City of New Bern during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify the assumptions of subsurface conditions made for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

**ECS Southeast, LLP**

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# TABLE OF CONTENTS

## APPENDICES

**Appendix A – Drawings & Reports**

- Site Location Diagram
- Exploration Location Diagram

**Appendix B – Field Operations**

- Reference Notes for Sounding Logs
- CPT Sounding Logs (S-1 through S-4)

**Appendix C – Supplemental Report Documents**

- GBA Document

## EXECUTIVE SUMMARY

The following summarizes the main findings of the exploration, particularly those that may have a cost impact on the planned development. Further, our principal foundation recommendations are summarized. Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.

- The geotechnical exploration performed for the site included three (3) electronic cone penetration test (CPT) soundings drilled to termination and refusal depths of approximately 20 to 41 feet.
- The soundings generally encountered coastal plain soils consisting of very loose to dense, Clayey, Silty, and Clean SAND (SC, SM, SP) and very soft to very stiff, Sandy and Clayey SILT (ML), and Silty and Lean CLAY (CL-ML, CL).
- The proposed building can be supported by conventional shallow foundations provided the column and wall loads do not exceed 50 kips and 3 kips per linear foot, respectively. We recommend a maximum net allowable bearing pressure of 2,000 psf be used for design.
- Groundwater was encountered in the soundings at depths ranging from about 1.6 to 3.5 feet below existing grades.
- Due to the soft clays encountered at depths of 4.5 to 6 feet in sounding S-3, isolated undercutting to depths of approximately 6 feet in the vicinity of the sounding should be anticipated.

Please note this Executive Summary is an important part of this report and should be considered a ***"summary"*** only. The subsequent sections of this report constitute our findings, conclusions, and recommendations in their entirety.

# 1.0 INTRODUCTION

## 1.1 GENERAL

The purpose of this study was to provide geotechnical information for the preliminary design of the proposed building located near the existing Stanley White Recreation Center at 901 Chapman Street in New Bern, Craven County, North Carolina.

The recommendations developed for this report are based on project information supplied by Mr. George Chiles of the City of New Bern. This report contains the results of our subsurface explorations, site characterization, engineering analyses, and recommendations for the design and construction of the proposed development.

## 1.2 SCOPE OF SERVICES

To obtain the necessary geotechnical information required for design of the proposed project, four (4) (CPT) soundings were performed. The soundings were advanced to termination and refusal depths of approximately 20 to 41 feet beneath the ground surface.

This report discusses our exploratory and testing procedures, presents our findings and evaluations and includes the following.

- A brief review and description of our field test procedures and the results of testing conducted;
- A review of surface topographical features and site conditions;
- A review of area and site geologic conditions;
- A review of subsurface soil stratigraphy with pertinent available physical properties;
- Preliminary foundation recommendations;
  - Allowable bearing pressure;
  - Settlement estimates (total and differential);
- Deep foundation recommendations;
- Site development recommendations;
- Suitability of soils for use as fill material;
- Seismic site class and liquefaction recommendations;
- Discussion of groundwater impact;
- Compaction recommendations;
- Special conditions encountered;
- Site vicinity map;
- Exploration location plan; and
- CPT sounding logs.

## 1.3 AUTHORIZATION

Our services were provided in accordance with our Proposal No. 22.23831, dated January 31, 2020, as authorized by Mr. George Chiles of the City of New Bern on February 17, 2020, and include the Terms and Conditions of Service outlined with our Proposal.

## 2.0 PROJECT INFORMATION

### 2.1 PROJECT LOCATION

The proposed site is located the existing Stanley White Recreation Center facility at 901 Chapman Street in New Bern, Craven County, North Carolina. The site is currently bounded on the east by Chapman Street, on the south by the existing recreation center parking lot, on the west by a park, and on the north by residential houses. Figure 2.1.1 below shows an image of where the site is located.


**Figure 2.1.1 Site Location**

### 2.2 CURRENT SITE CONDITIONS

The site currently consists of open grass fields and an existing baseball field with a fence around it. The existing recreation center building and associated pavements are currently on the site. Based on our site visit, approximate elevations taken from Google Earth, the site is relatively level with typical elevations ranging from around 2 to 6 feet.

### 2.3 PROPOSED CONSTRUCTION

ECS understands that the proposed construction will consist of a new building near the existing recreation center.

### 2.3.1 Structural Information/Loads

At the time of this report, additional project information including structural loads and grading information was not available. The following information explains the assumed anticipated structural loads and assumed grading information for the purpose of the recommendations made in this report:

**Table 2.3.1.1 Structural Design Values**

| SUBJECT | DESIGN INFORMATION / EXPECTATIONS |
|---|---|
| Usage | Recreation Center |
| Finished Floor Elevation | Within +/- 3 feet of existing grades |
| Column Loads | Up to 50 kips |
| Wall Loads | Up to 3 kips/ft. |

# 3.0 FIELD EXPLORATION

## 3.1 FIELD EXPLORATION PROGRAM

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate subsequent field data to assist in the determination of geotechnical recommendations.

### 3.1.1 Cone Penetrometer Soundings

The subsurface conditions were explored by drilling four (4) electronic cone penetration test (CPT) soundings on the proposed site. The soundings were advanced to termination and refusal depths of approximately 20 to 41 feet.

Sounding locations were located in the field by an ECS representative using a hand held GPS unit and referencing existing site features. The approximate as-drilled sounding location is shown on the Exploration Location Diagram in Appendix A.

The CPT soundings were conducted in general accordance with ASTM D 5778. The cone used in the soundings has a tip area of 10 $cm^2$ and a sleeve area of 150 $cm^2$. The CPT soundings recorded tip resistance and sleeve friction measurements to assist in determining pertinent index and engineering properties of the site soils. The ratio of the sleeve friction to tip resistance is then used to aid in assessing the soil types through which the tip is advanced. The results of the CPT soundings are presented in Appendix B.

Within sounding S-2, seismic tests were performed at approximately three foot intervals to termination depth to measure the shear wave velocity ($v_s$) of the subsurface materials to aid in assessing the dynamic response properties of the site subsurface materials. The seismic shear waves are generated by making impact with a 20-pound sledgehammer onto a steel beam. The impacts are initiated on the right and left sides of the CPT rig and the corresponding wave traces recorded on an oscilloscope are analyzed to determine the shear wave velocity of the tested material. The waves are measured with three geophones that are installed in the cone. The results of the CPT soundings are presented in Appendix B.

## 3.2 REGIONAL/SITE GEOLOGY

The site is located in the Coastal Plain Physiographic Province of North Carolina. The Coastal Plain is composed of seven terraces, each representing a former level of the Atlantic Ocean. Soils in this area generally consist of sedimentary materials transported from other areas by the ocean or rivers. These deposits vary in thickness from a thin veneer along the western edge of the region to more than 10,000 feet near the coast. The sedimentary deposits of the Coastal Plain rest upon consolidated rocks similar to those underlying the Piedmont and Mountain Physiographic Provinces. In general, shallow unconfined groundwater movement within the overlying soils is largely controlled by topographic gradients. Recharge occurs primarily by infiltration along higher elevations and typically discharges into streams or other surface water bodies. The elevation of the shallow water table is transient and can vary greatly with seasonal fluctuations in precipitation.

Based on the U.S. Geological Survey[1,2], the site of the proposed construction is underlain by the River Bend Formation (Tertiary). The formation typically consists of sands underlain by limestone. The coastal plain soils generally consist of clayey, silty, and clean sands, silts, and silty and lean clays. An overview of the general site geology is illustrated in Figure 3.2.1 below.

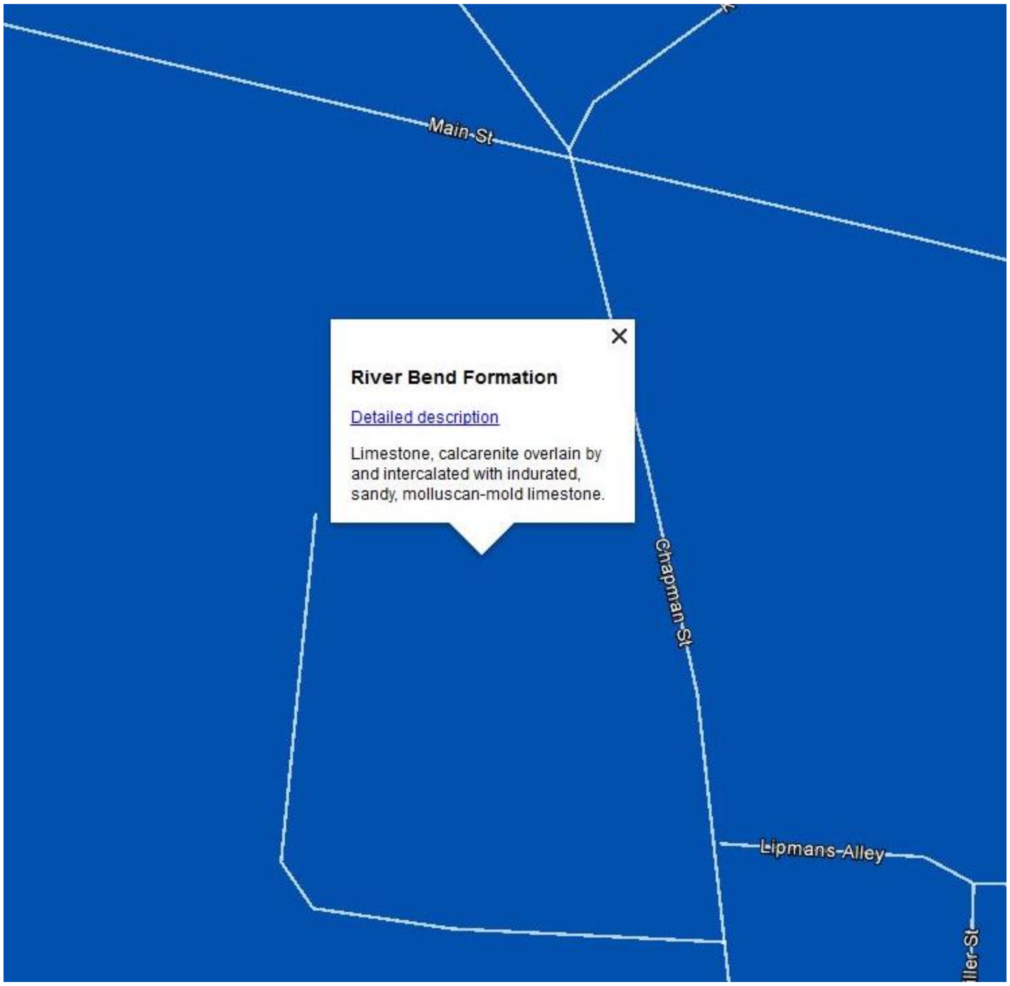



**Figure 3.2.1**

Geologic map for Figure 3.2.1 obtained from The North Carolina Dept. of Environment, Health, and Natural Resources, Division of Land Resources, NC Geological Survey, in cooperation with the NC Center for Geographic Information and Analysis, 1998, Geology - North Carolina (1:250,000), coverage data file geol250 and Google Earth.

[1] Rhodes, Thomas S., and Conrad, Stephen G., 1985, Geologic Map of North Carolina: Department of Natural Resources and Community Development, Division of Land Resources, and the NC Geological Survey, compiled by Brown, Philip M., et al, and Parker, John M. III, and in association with the State Geologic Map Advisory Committee, scale 1:500,000.

[2] The North Carolina Dept. of Environment, Health, and Natural Resources, Division of Land Resources, NC Geological Survey, in cooperation with the NC Center for Geographic Information and Analysis, 1998 (updated 2007), Geology - North Carolina (1:250,000), coverage data file geol250. The data represents the digital equivalent of the official State Geology map (1:500,000 scale), but was digitized from (1:250,000 scale) base maps.

## 3.3 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil encountered during our subsurface exploration. For subsurface information at a specific location, refer to the CPT Sounding Logs in Appendix B.

**Table 3.3.1 Subsurface Stratigraphy**

| Approximate Depth Range (ft.) | Stratum | Description | Ranges of N*-Values(1) blows per foot (bpf) |
|---|---|---|---|
| 0 to 4 | I | Very Loose to Dense, Clayey, Silty and Clean SAND (SC, SM, SP) | 1 to 33 |
| 4 to 20 | II | Very Loose to Medium Dense, Silty and Clean SAND (SM, SP) ) with interbedded layers of very soft to stiff, Sandy and Clayey SILT (ML) and Silty and Lean CLAY (CL-ML, CL) | 1 to 26 |
| 20 to 26 | III | Loose to Medium Dense, Silty and Clean SAND (SM, SP) with occasional interbedded layers of firm to very stiff, Sandy and Clayey SILT (ML) | 5 to 28 |
| 26 to 38 | IV | Medium Dense to Dense, Silty and Clean SAND (SM, SP) | 12 to 43 |
| 38 to 41 | V | Loose to Dense, Silty and Clean SAND (SM, SP) with occasional interbedded layers of soft to firm, Silty and Lean CLAY (CL-ML, CL) | 3 to 43 |

Notes: (1) Equivalent Corrected Standard Penetration Test Resistances

## 3.4 GROUNDWATER OBSERVATIONS

Porewater pressure measurements were made at the sounding locations during exploration as noted on the CPT sounding logs in Appendix B. The apparent groundwater depths were observed at the time of drilling and during field exploration to have approximately ranged from 1.6 to 3.5 feet below ground surface.

The highest groundwater observations are normally encountered in the late winter and early spring. Variations in the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, construction activities, and other factors not immediately apparent at the time of this exploration. If long term water levels are crucial to the development of this site, it would be prudent to verify water levels with the use of perforated pipes or piezometers.

## 4.0 DESIGN RECOMMENDATIONS

### 4.1 BUILDING DESIGN

The following sections provide recommendations for foundation design, soil supported slabs, and pavement design.

#### 4.1.1 Foundations

Provided subgrades and structural fills are prepared as discussed herein and anticipated structural loads provided in Table 2.3.1.1 are not exceeded, the proposed structures can be supported by conventional shallow foundations: individual column footings and continuous wall footings. The design of the foundation shall utilize the following parameters:

**Table 4.1.1.1 Foundation Design**

| Design Parameter | Column Footing | Wall Footing |
|---|---|---|
| Net Allowable Bearing Pressure[1] | 2,000 psf | 2,000 psf |
| Acceptable Bearing Soil Material | Stratum I Soils (SANDS) or Approved Structural Fill | Stratum I Soils (SANDS) or Approved Structural Fill |
| Minimum Width | 30 inches | 18 inches |
| Minimum Footing Embedment Depth (below slab or finished grade) | 12 inches | 12 inches |
| Estimated Total Settlement | 1 inch | 1 inch |
| Estimated Differential Settlement | Less than 0.5 inches | Less than 0.5 inches |

1. Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.

It will be important to have the geotechnical engineer of record observe the foundation subgrade prior to placing foundation concrete; to confirm the bearing soils are what was anticipated. If soft or unsuitable soils are observed at the footing bearing elevations, the unsuitable soils should be undercut and removed. The undercut areas should be backfilled with approved structural fill up to the original design bottom of footing elevation; the original footing shall be constructed on top of the structural fill. The depth and lateral extent of the undercut should be determined in the field during undercutting operation. An ECS representative must be on site during the undercut and backfill of the areas in order to provide a report stating that the repairs were in accordance with our recommendations. Due to the soft clays encountered at depths of 4.5 to 6 feet in sounding S-3, isolated undercutting to depths of approximately 6 feet in the vicinity of the sounding should be anticipated.

### 4.1.2 Floor Slabs

The on-site soils are generally considered suitable for support of the floor slabs. Moisture control during earthwork operations, including the use of discing or appropriate drying equipment, may be necessary. Assuming the finished floor elevation is around the current site elevations, it appears that the slabs for the structure will likely bear on the near surface Stratum I soils or Approved Structural Fill. These materials are suitable for the support of a slab-on-grade, however, there may be areas of soft or yielding soils that should be removed and replaced with compacted structural fill in accordance with the recommendations included in this report. The following graphic depicts our soil-supported slab recommendations:

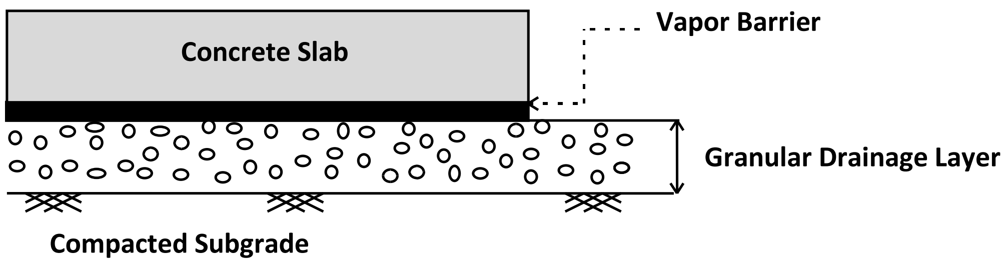



**Figure 4.1.2.1**

1. Drainage Layer Thickness: 6 inches
2. Drainage Layer Material: GRAVEL (GP, GW), SAND containing <20% passing the #100 sieve (SP, SW, SM)
3. Subgrade compacted to 98% maximum dry density per ASTM D698

**Subgrade Modulus:** Provided the placement of structural fill and granular drainage layer per the recommendations discussed herein, the slab may be designed assuming a modulus of subgrade reaction, k of 125 pci (lbs/cu. inch). The modulus of subgrade reaction value is based on a 1 ft by 1 ft plate load test basis.

**Slab Isolation:** Ground-supported slabs should be isolated from the foundations and foundation-supported elements of the structures so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration (turn down slabs or post tension mats) prevents the use of a free-floating slab, the slab should be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab. Maximum differential settlement of soils supporting interior slabs is anticipated to be less than 0.5 inches in 50 feet.

### 4.1.3 Seismic Design Considerations

**Seismic Site Classification:** The International Building Code (IBC) 2015 requires site classification for seismic design based on the upper 100 feet of a soil profile. Three methods are utilized in classifying sites, namely the shear wave velocity ($v_s$) method; the unconfined compressive strength ($s_u$) method; and the Standard Penetration Resistance (N-value) method. The first method (shear wave velocity) was used in classifying these sites.

The results of the shear wave velocity profiles are contained in Appendix B. The seismic site class definitions for the weighted average of shear wave velocity or SPT N-value in the upper 100 feet of the soil profile are shown in the following table:

**Table 4.1.3.1: Seismic Site Classification**

| Site Class | Soil Profile Name | Shear Wave Velocity, Vs, (ft./s) | N value (bpf) |
|---|---|---|---|
| A | Hard Rock | Vs > 5,000 fps | N/A |
| B | Rock | 2,500 < Vs ≤ 5,000 fps | N/A |
| C | Very dense soil and soft rock | 1,200 < Vs ≤ 2,500 fps | >50 |
| D | Stiff Soil Profile | 600 ≤ Vs ≤ 1,200 fps | 15 to 60 |
| E | Soft Soil Profile | Vs < 600 fps | <15 |

The seismic Site Class for the site was determined by calculating a weighted average of the shear velocities of the overburden to the depth of rock/refusal. The CPT test data indicates that the existing natural, overburden soils at the site have shear velocities ranging from approximately 269 ft/sec to 930 ft/sec. The method for determining the weighted average value is presented in Section 1613.5.5 of the IBC 2015. The weighted average value for the site is 823.5 ft/sec. Based on the results of the CPT soundings and our evaluation of the sites, the sites shall be assigned a seismic class "D".

**Liquefaction:** The potential for liquefaction at the sites is considered low based upon the CPT results and the liquefaction index procedure developed by Iwasaki (1982). Based on our CPT results and our evaluation using a site peak ground acceleration of 0.10, an earthquake event with a magnitude of 7.3 and procedures developed by Robertson (2009) and Boulanger & Idriss (2014), the liquefaction induced settlement at the subject sites is estimated to be approximately 2 inches.

**Ground Motion Parameters:** In addition to the seismic site classification noted above, ECS has determined the design spectral response acceleration parameters following the IBC 2015 methodology. The mapped responses were estimated from the free ATC Hazards by Location Tool available from the USGS website (https://hazards.atcouncil.org). The design responses for the short (0.2 sec, $S_{DS}$) and 1-second period ($S_{D1}$) are noted in bold at the far right end of the following table.

**Table 4.1.3.2: Ground Motion Parameters (IBC 2015 Method)**

| Period (sec) | Mapped Spectral Response Accelerations (g) | | Values of Site Coefficient for Site Class | | Maximum Spectral Response Acceleration Adjusted for Site Class (g) | | Design Spectral Response Acceleration (g) | |
|---|---|---|---|---|---|---|---|---|
| Reference | Figures 1613.3.1 (1) & (2) | | Tables 1613.3.3 (1) & (2) | | Eqs. 16-37 & 16-38 | | Eqs. 16-39 & 16-40 | |
| 0.2 | $S_S$ | 0.125 | $F_a$ | 1.6 | $S_{MS}=F_aS_s$ | 0.200 | $S_{DS}=2/3\ S_{MS}$ | 0.133 |
| 1.0 | $S_1$ | 0.063 | $F_v$ | 2.4 | $S_{M1}=F_vS_1$ | 0.150 | $S_{D1}=2/3\ S_{M1}$ | 0.100 |

The Site Class definition should not be confused with the Seismic Design Category designation, which the structural engineer typically assesses.

# 5.0 SITE CONSTRUCTION RECOMMENDATIONS

## 5.1 SUBGRADE PREPARATION

### 5.1.1 Stripping and Grubbing

The subgrade preparation should consist of stripping vegetation, rootmat, topsoil, existing fill, and any other soft or unsuitable materials from the 10-foot expanded building and 5-foot expanded pavement limits and to 5 feet beyond the toe of structural fills. ECS should be called to verify that topsoil, roots, existing pavements, and unsuitable surficial materials have been removed prior to the placement of structural fill or construction of structures.

### 5.1.2 Proofrolling

After removing unsuitable surface materials, cutting to the proposed grade, and prior to the placement of any structural fill or other construction materials, the exposed subgrade should be examined by the geotechnical engineer or authorized representative. The exposed subgrade should be proofrolled with previously approved construction equipment having a minimum axle load of 10 tons (e.g. fully loaded tandem-axle dump truck). The areas subject to proofrolling should be traversed by the equipment in two perpendicular (orthogonal) directions with overlapping passes of the vehicle under the observation of the geotechnical engineer or authorized representative. This procedure is intended to assist in identifying any localized yielding materials. In the event that unstable or "pumping" subgrade is identified by the proofrolling, those areas should be marked for repair prior to the placement of any subsequent structural fill or other construction materials. Methods of repair of unstable subgrade, such as undercutting or moisture conditioning, should be discussed with the geotechnical engineer to determine the appropriate procedure with regard to the existing conditions causing the instability. A test pit(s) may be excavated to explore the shallow subsurface materials in the area of the instability to help in determined the cause of the observed unstable materials and to assist in the evaluation of the appropriate remedial action to stabilize the subgrade. Due to the soft clays encountered at depths of 4.5 to 6 feet in sounding S-3, isolated undercutting to depths of approximately 6 feet in the vicinity of the sounding should be anticipated.

### 5.1.3 Site Temporary Dewatering

**Subsurface Water:** Based upon our subsurface exploration at this site, as well as significant experience on sites in nearby areas of similar geologic setting, we believe construction dewatering at this site may be needed for removing accumulated rain water and during construction of foundations and utilities.

Deep wells will not be required for the temporary dewatering system. However, the dewatering operations can be handled by the use of conventional submersible pumps directly in the excavation or temporary trenches. If temporary sump pits are used, we recommend they be established at an elevation 3 to 5 feet below the bottom of the excavation subgrade or bottom of footing. A perforated 55 gallon drum or other temporary structure could be used to house the pump. We recommend continuous dewatering of the excavations using electric pumps or manned gasoline pumps be used during construction.

## 5.2 EARTHWORK OPERATIONS

### 5.2.1 Structural Fill Materials

**Product Submittals:** Prior to placement of structural fill, representative bulk samples (about 50 pounds) of on-site and off-site borrow should be submitted to ECS for laboratory testing, which will include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications.

**Satisfactory Structural Fill Materials:** Materials satisfactory for use as structural fill should consist of inorganic soils classified as SM, SC, SW, SP, GW, GP, GM and GC, or a combination of these group symbols, per ASTM D 2487. Natural fine-grained soils classified as clays or silts (CL, ML) should not be considered for use as engineered fill, but may be evaluated by the geotechnical engineer to determine their suitability at the contractor's request. The materials should be free of organic matter, debris, and should contain no particle sizes greater than 4 inches in the largest dimension. Open graded materials, such as gravels (GP), which contain void space in their mass should not be used in structural fills unless properly encapsulated with filter fabric. Suitable structural fill material should have the index properties shown in Table 5.2.1.1.

**Table 5.2.1.1 Structural Fill Index Properties**

| Location with Respect to Final Grade | Liquid Limit | Plasticity Index |
|---|---|---|
| Building Areas, upper 4 feet | 35 max | 9 max |
| Pavement Areas, upper 2 feet | 35 max | 9 max |

**Unsatisfactory Materials:** Materials that should not be used as engineered fill include topsoil, organic materials (OH, OL), and high plasticity clays and silts (CH, MH). Such materials removed during grading operations should be either stockpiled for later use in landscape fills, or placed in approved on or off-site disposal areas.

**On-Site Borrow Suitability:** The on-site near surface sands (SP, SM) with fines contents less than 20 percent and that are free of roots and deleterious materials should be suitable for re-use as structural fill. However, moisture conditioning should be anticipated for the soils to achieve the optimum moisture content for fill placement.

### 5.2.2 Compaction

**Structural Fill Compaction:** Structural fill within the expanded building and pavement limits should be placed in maximum 8-inch loose lifts, moisture conditioned as necessary to within -3 and +3 % of the soil's optimum moisture content, and be compacted with suitable equipment to a dry density of at least 98% of the Standard Proctor maximum dry density (ASTM D698). Beyond these areas, compaction of at least 95% should be achieved. ECS should be called to document that proper fill compaction has been achieved.

**Fill Compaction Control:** The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for buildings, pavements, and slopes, etc., at the time of fill placement. Grade controls should be maintained throughout the filling operations. Filling operations should be observed on a full-time basis by a qualified representative of the geotechnical engineer or construction testing laboratory to determine that the minimum compaction requirements are being achieved. Field density testing of fills should be performed at the frequencies shown in Table 5.2.2.1, but not less than one test per lift.

**Table 5.2.2.1 Frequency of Compaction Tests in Fill Areas**

| Location | Frequency of Tests |
|---|---|
| Expanded Building Limits | 1 test per 2,500 sq. ft. per lift |
| Pavement Areas | 1 test per 5,000 sq. ft. per lift |
| Utility Trenches | 1 test per 200 linear ft. per lift |
| Other Non-Critical Areas | 1 test per 10,000 sq. ft. per lift |

**Compaction Equipment:** Compaction equipment suitable to the soil type being compacted should be used to compact the subgrades and fill materials. A vibratory steel drum roller should be used for compaction of coarse-grained soils (Sands and Gravels) as well as for sealing compacted surfaces.

**Fill Placement Considerations:** Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and frozen or frost-heaved soils should be removed prior to placement of structural fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

At the end of each work day, fill areas should be graded to facilitate drainage of any precipitation and the surface should be sealed by use of a smooth-drum roller to limit infiltration of surface water.

Drying and compaction of wet soils is typically difficult during the cold, winter months. Accordingly, earthwork should be performed during the warmer, drier times of the year, if practical. Proper drainage should be maintained during the earthwork phases of construction to prevent ponding of water which has a tendency to degrade subgrade soils.

Fill material should be placed in horizontal lifts. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 inches to 4 inches may be required to achieve specified degrees of compaction.

We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. We do not anticipate significant problems in controlling moisture within the fill during dry weather, but moisture control may be difficult during winter months or extended periods of rain. The control of moisture content of higher plasticity soils is difficult when these soils become wet. Further, such soils are easily degraded by construction traffic when the moisture content is elevated.

### 5.3 FOUNDATION OBSERVATIONS

**Protection of Foundation Excavations:** Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 1 to 3-inch thick "mud mat" of "lean" concrete should be placed on the bearing soils before the placement of reinforcing steel.

**Footing Subgrade Observations:** It will be important to have the geotechnical engineer of record observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated. Soft or unsuitable soils observed at the footing bearing elevations should be undercut and removed. Any undercut should be backfilled with approved structural fill or DOT size No. 57 stone up to the original design bottom of footing elevation; the original footing shall be constructed on top of the approved fill. The depth and lateral extent of the undercut should be determined in the field during undercutting operation. An ECS representative must be on site during the undercut and backfill of the areas in order to provide a report stating that the repairs were in accordance with our recommendations.

**Slab Subgrade Verification:** A representative of ECS should be called to observe exposed subgrades within the expanded building limits prior to structural fill placement to confirm that adequate subgrade preparation has been achieved. Proofrolling using a drum roller or loaded dump truck should be performed in their presence at that time. Once subgrades have been prepared to the satisfaction of ECS, subgrades should be properly compacted and new structural fill can be placed.

Structural fill should be moisture conditioned to within -3/+3 percentage points of optimum moisture content then be compacted to the required density. If there will be a significant time lag between the site grading work and final grading of concrete slab areas prior to the placement of the subbase stone and concrete, a representative of ECS should be called to verify the condition of the prepared subgrade. Prior to final slab construction, the subgrade may require scarification, moisture conditioning, and re-compaction to restore stable conditions.

### 5.4 UTILITY INSTALLATIONS

**Utility Subgrades:** The near surface soils encountered in our exploration are expected to be generally suitable for support of utility pipes. The pipe subgrade should be observed and probed for stability by ECS to evaluate the suitability of the materials encountered. Any loose or unsuitable materials encountered at the utility pipe subgrade elevation should be removed and replaced with suitable compacted structural fill or pipe bedding material.

**Utility Backfilling:** Granular bedding material, if required, should be at least 4 inches thick, but not less than that specified by the project drawings and specifications. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for structural fill given in this report. Compacted backfill should be free of topsoil, roots, ice, or any other material designated by ECS as unsuitable. The backfill should be moisture conditioned, placed, and compacted in accordance with the recommendations of this report.

**Utility Excavation Dewatering:** It is likely that groundwater will be encountered by utility excavations which extend more than 2 feet below existing grades. It is expected that removal of water which seeps into excavations could be accomplished by pumping from sumps excavated in the trench bottom and which are backfilled with DOT size No. 57 stone or open graded bedding material. Should water conditions beyond the capability of sump pumping be encountered, the contractor should submit a Dewatering Plan in accordance with project specifications.

### 5.5 GENERAL CONSTRUCTION CONSIDERATIONS

**Moisture Conditioning:** During the cooler and wetter periods of the year, delays and additional costs should be anticipated. At these times, reduction of soil moisture may need to be accomplished by mechanical manipulation in order to lower moisture contents to levels appropriate for compaction. Alternatively, during the drier times of the year, such as the summer months, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

**Subgrade Protection:** Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas.

**Surface Drainage:** Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to minimize infiltration of surface water.

**Excavation Safety:** Cuts or excavations associated with utility excavations may require forming or bracing, slope flattening, or other physical measures to control sloughing and/or prevent slope failures. Contractors should comply with applicable OSHA regulations to confirm that adequate protection of the excavations and trench walls is provided. The contractor is solely responsible for designing and constructing stable, temporary excavations and slopes and should shore, slope, or bench the sides of the excavations and slopes as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

**Excavation Considerations:** Based on the results of the borings, we expect that the natural Coastal Plain soils encountered on this site can be excavated with conventional earth moving equipment such as loaders, bulldozers, rubber tired backhoes, etc.

The site soils are OSHA Type C soils for the purpose of temporary excavation support. Excavations should be constructed in compliance with current OSHA standards for excavation and trenching safety. Excavations should be observed by a "competent person," as defined by OSHA, who should evaluate the specific soil type and other conditions, which may control the excavation side slopes or the need for shoring or bracing. Regardless, site safety shall be the sole responsibility of the contractor and their subcontractors. Exposed earth slopes shall be protected during periods of inclement weather.

**Erosion Control:** The surface soils may be erodible. Therefore, the contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. Erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

## 6.0 CLOSING

ECS has prepared this report of findings, evaluations, and recommendations to guide geotechnical-related design and construction aspects of the project.

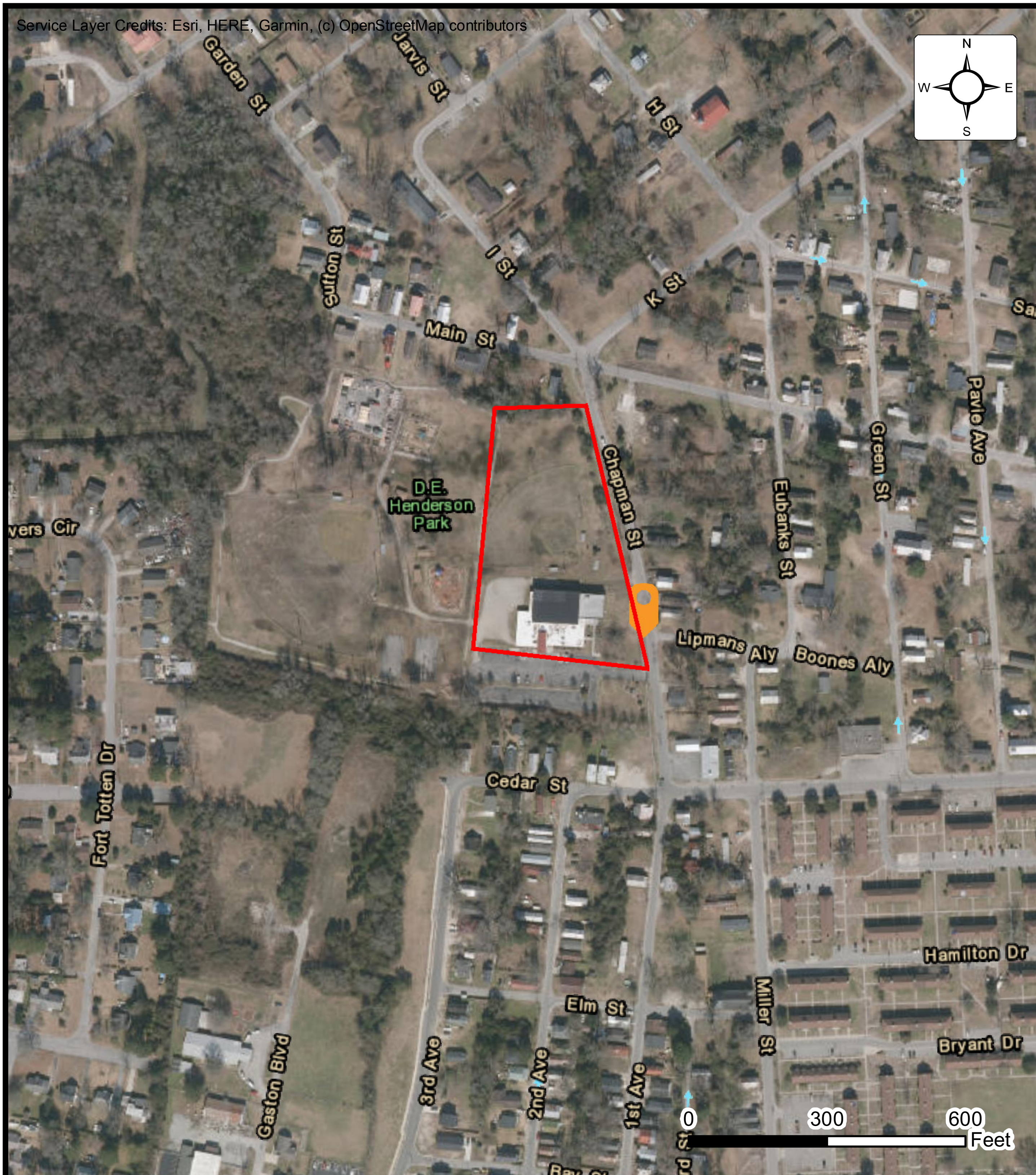
The description of the proposed project is based on information provided to ECS by Mr. George Chiles of the City of New Bern. If any of this information is inaccurate, either due to our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted immediately so that we can review the report in light of the changes and provide additional or alternate recommendations as may be required to reflect the proposed construction.

We recommend that ECS review the project's plans and specifications pertaining to our work so that we may ascertain consistency of those plans/specifications with the intent of the geotechnical report.

Field observations, monitoring, and quality assurance testing during earthwork and foundation installation are an extension of and integral to the geotechnical design recommendation. We recommend that the owner retain these quality assurance services and that ECS be allowed to continue our involvement throughout these critical phases of construction to provide general consultation as issues arise. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

# APPENDIX A – Drawings & Reports

Site Location Diagram
Exploration Location Diagram




# SIte Location Diagram
# STANLEY WHITE REC CENTER

**901 CHAPMAN STREET, NEW BERN, NORTH**

**CITY OF NEW BERN**

| | |
|---|---|
| ENGINEER | WEG |
| SCALE | 1 " = 300 ' |
| PROJECT NO. | 22:28890 |
| SHEET | 1 OF 2 |
| DATE | 3/20/2020 |


# Boring Location Diagram

# STANLEY WHITE REC CENTER

901 CHAPMAN STREET, NEW BERN, NORTH

CITY OF NEW BERN

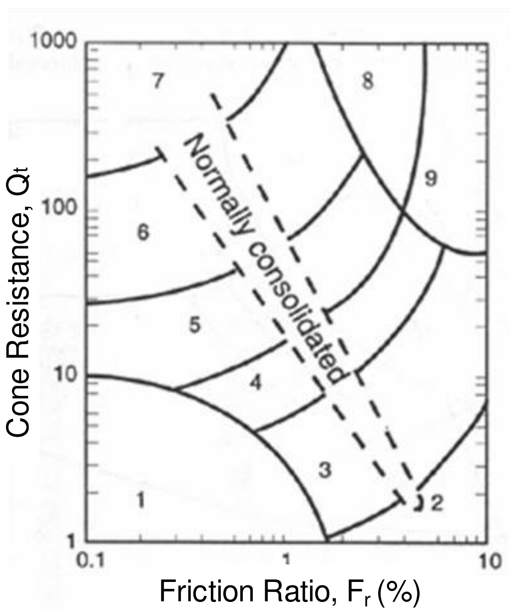
| | |
|---|---|
| ENGINEER | WEG |
| SCALE | 1 " = 100 ' |
| PROJECT NO. | 22:28890 |
| SHEET | 2 OF 2 |
| DATE | 3/20/2020 |

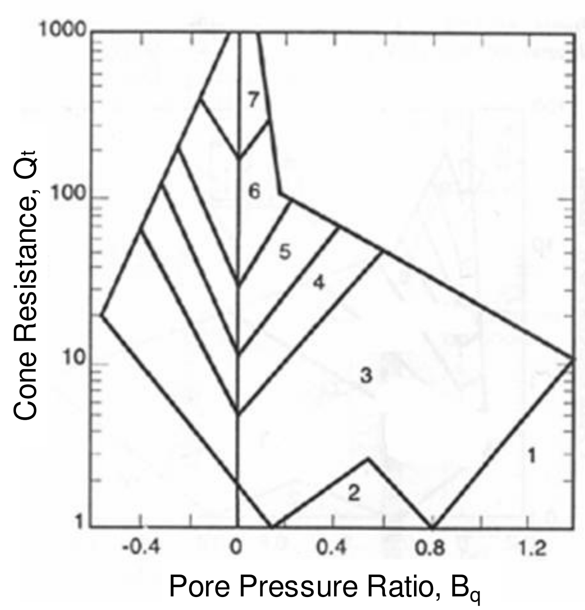
# APPENDIX B – Field Operations

Reference Notes for Sounding Logs
CPT Sounding Logs (S-1 through S-4)

**REFERENCE NOTES FOR CONE PENETRATION TEST (CPT) SOUNDINGS**

In the CPT sounding procedure (ASTM-D-5778), an electronically instrumented cone penetrometer is hydraulically advanced through soil to measure point resistance ($q_c$), pore water pressure ($u_2$), and sleeve friction ($f_s$). These values are recorded continuously as the cone is pushed to the desired depth. CPT data is corrected for depth and used to estimate soil classifications and intrinsic soil parameters such as angle of internal friction, preconsolidation pressure, and undrained shear strength. The graphs below represent one of the accepted methods of CPT soil behavior classification (Robertson, 1990).




1. Sensitive, Fine Grained
2. Organic Soils-Peats
3. Clays; Clay to Silty Clay
4. Clayey Silt to Silty Clay
5. Silty Sand to Sandy Silt
6. Clean Sands to Silty Sands
7. Gravelly Sand to Sand
8. Very Stiff Sand to Clayey Sand
9. Very Stiff Fine Grained

The following table presents a correlation of corrected cone tip resistance ($q_c$) to soil consistency or relative density:

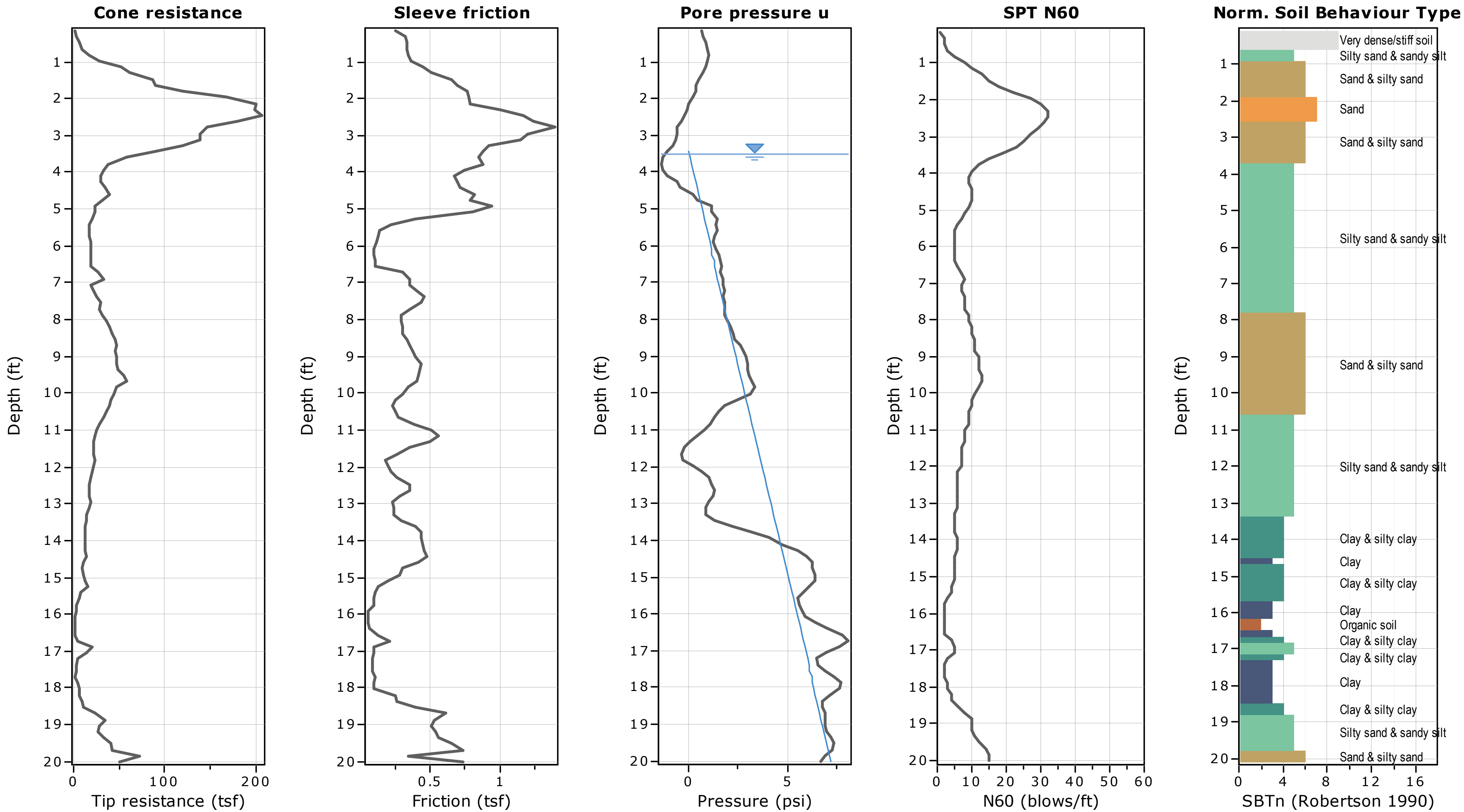
| SAND | | SILT/CLAY | |
|---|---|---|---|
| Corrected Cone Tip Resistance ($q_c$) (tsf) | Relative Density | Corrected Cone Tip Resistance ($q_c$) (tsf) | Relative Density |
| <20 | Very Loose | <5 | Very Soft |
| 20-40 | Loose | 5-10 | Soft |
| 40-120 | Medium Dense | 10-15 | Medium Stiff |
| | | 15-30 | Stiff |
| 120-200 | Dense | 30-45 | Very Stiff |
| >200 | Very Dense | 45-60 | Hard |
| | | >60 | Very Hard |

**ECS Southeast, LLP**
6714 Netherlands Drive
Wilmington, North Carolina 28405
ECS Project 22.28890

**CPT: S-1**

**Project:** **Stanley White Rec Center**
**Location:** **New Bern, Craven County, North Carolina**

Total depth: 20.01 ft, Date: 3/4/2020
Cone Operator: Austin Fowler

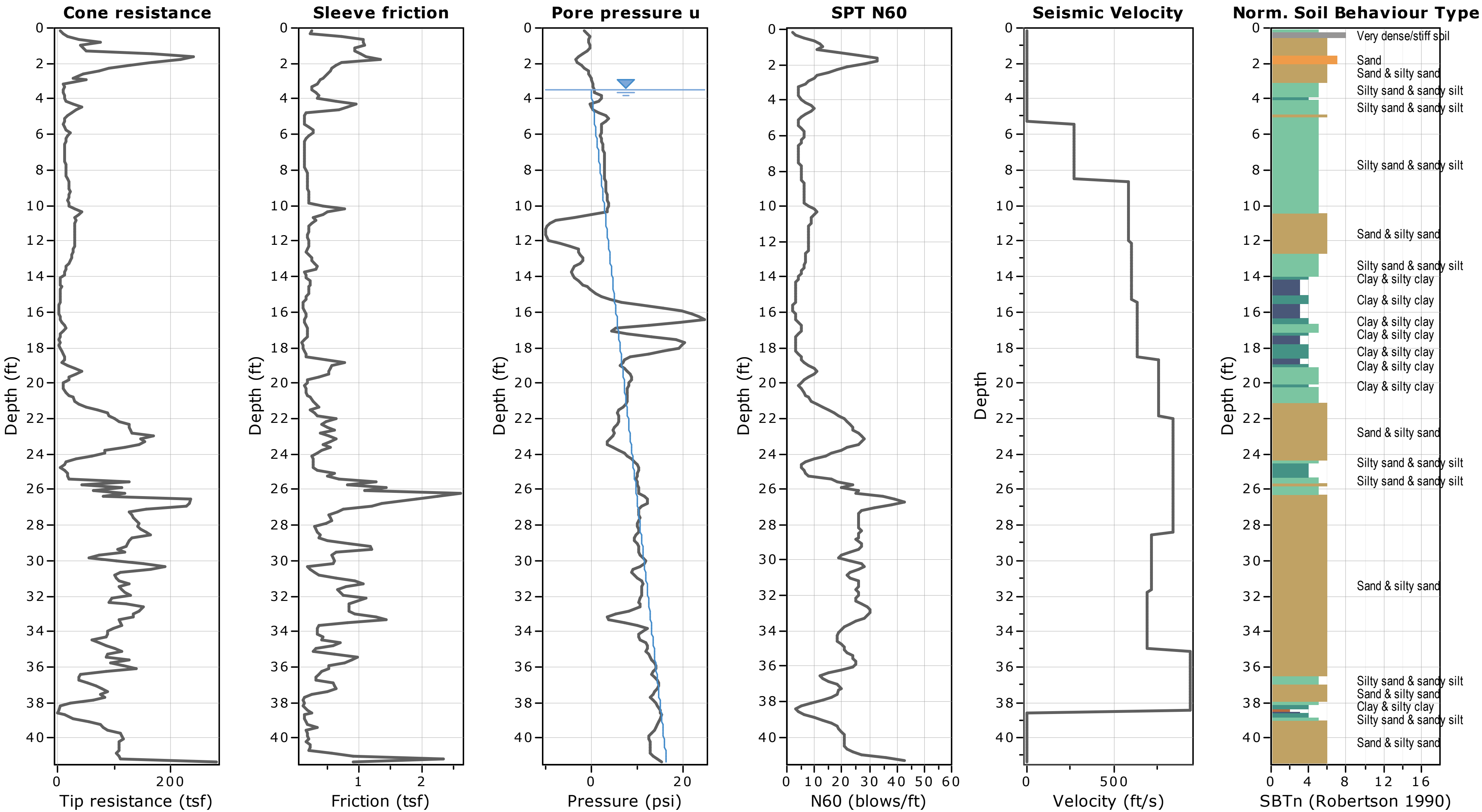


**ECS Southeast, LLP**
6714 Netherlands Drive
Wilmington, North Carolina 28405
ECS Project 22.28890

**CPT: S-2**

**Project: Stanley White Rec Center**
**Location: New Bern, Craven County, North Carolina**

Total depth: 41.34 ft, Date: 3/4/2020
Cone Operator: Austin Fowler

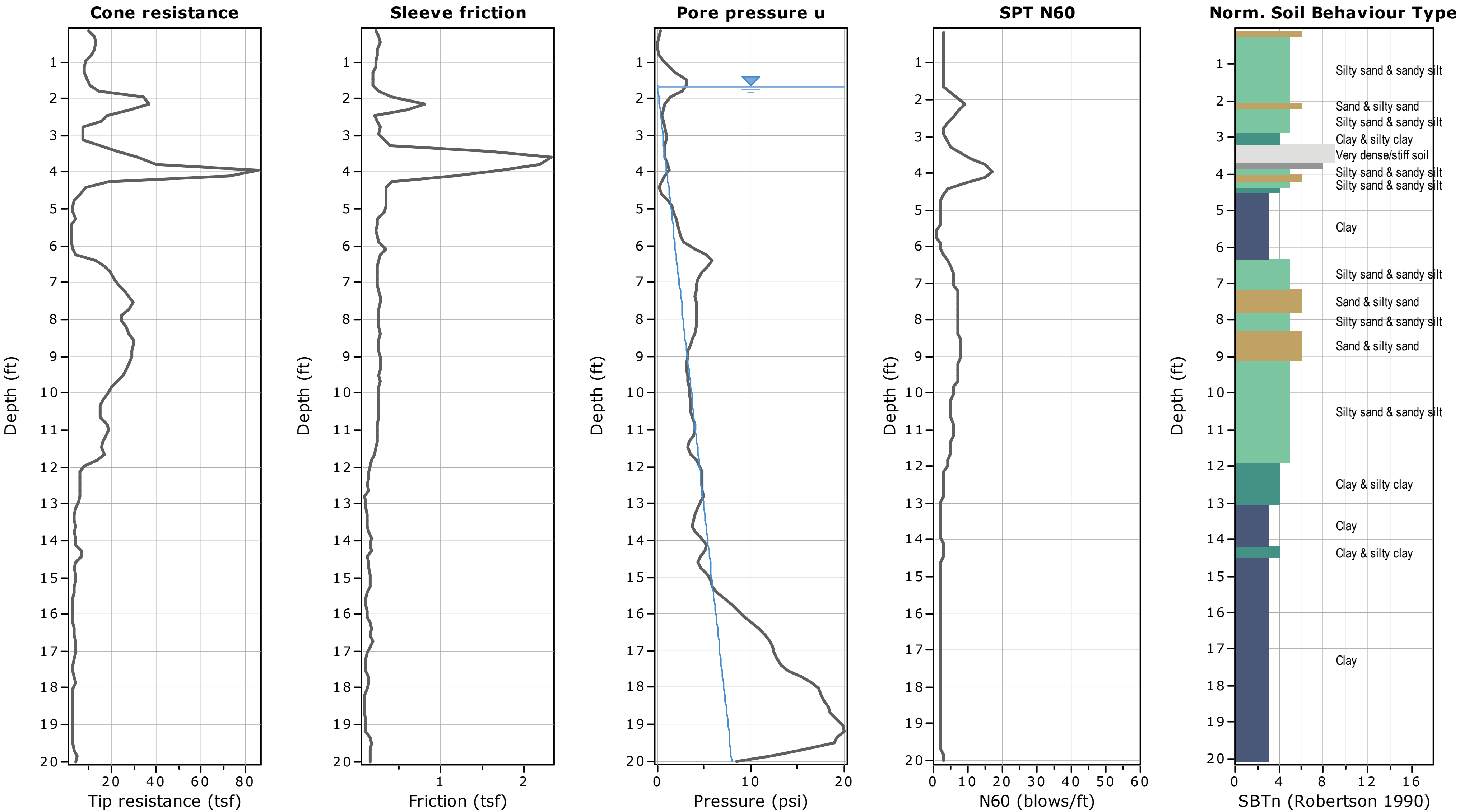


ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, North Carolina 28405
ECS Project 22.28890

**CPT: S-3**

**Project:** **Stanley White Rec Center**
**Location:** **New Bern, Craven County, North Carolina**

Total depth: 20.01 ft, Date: 3/4/2020
Cone Operator: Austin Fowler

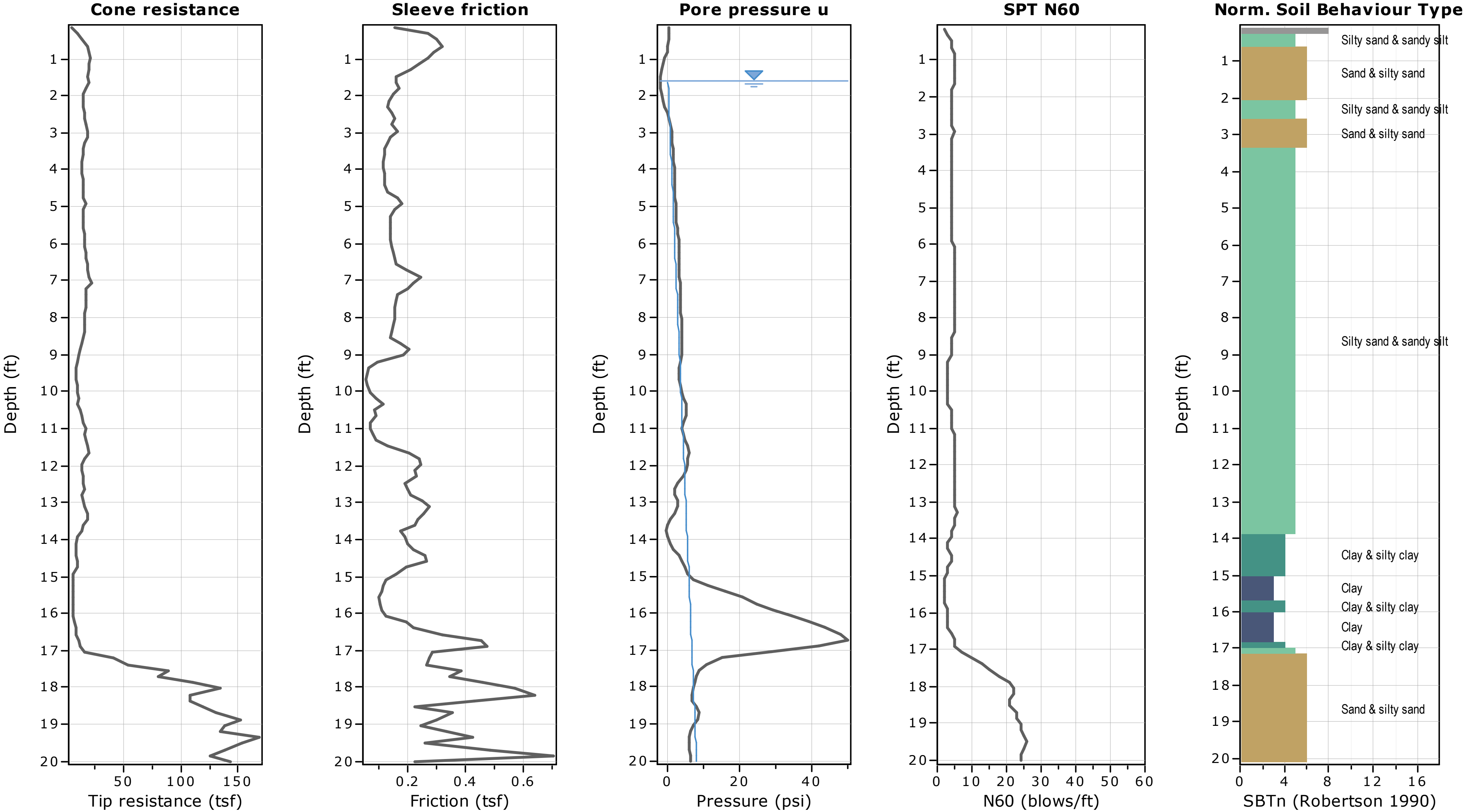


**ECS Southeast, LLP**
6714 Netherlands Drive
Wilmington, North Carolina 28405
ECS Project 22.28890

**CPT: S-4**

**Project:** **Stanley White Rec Center**
**Location:** **New Bern, Craven County, North Carolina**

Total depth: 20.01 ft, Date: 3/4/2020
Cone Operator: Austin Fowler



## APPENDIX C – Supplemental Report Documents

GBA Document

# Important Information about This

# Geotechnical-Engineering Report

**Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.**

**While you cannot eliminate all such risks, you can manage them. The following information is provided to help.**

**The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.**

## Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

## Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

## You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

## This Report May Not Be Reliable

*Do not rely on this report* if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

## Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

## This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

## This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

## Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

## Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

## Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***


GEOPROFESSIONAL BUSINESS ASSOCIATION

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