



ECS Southeast, LLP

Preliminary Geotechnical Engineering Report DMV Properties

1010 US 70 West (Cornelius Street)
Hillsborough, North Carolina

ECS Project Number 06:23731

January 29, 2018





ECS SOUTHEAST, LLP

Geotechnical • Construction Materials • Environmental • Facilities

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January 29, 2018

Mr. Jeff Thompson
Orange County Asset Management & Purchasing
131 West Margaret Lane
P.O. Box 8181
Hillsborough, North Carolina 27278

ECS Project No. 06:23731

Reference: Preliminary Geotechnical Engineering Report
DMV Properties
1010 US 70 West (Cornelius Street)
Hillsborough, Orange County, North Carolina

Dear Mr. Thompson:

ECS Southeast, LLP (ECS) has completed the preliminary subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with ECS Proposal No. 06:20604-GP, dated December 19, 2017. This report presents our understanding of the geotechnical aspects of the project, the results of the field exploration and laboratory testing conducted, and our preliminary recommendations regarding geotechnical-related design and construction considerations for the site.

It has been our pleasure to be of service to Orange County Asset Management & Purchasing 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,

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EXECUTIVE SUMMARY

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

- The preliminary geotechnical exploration performed for the planned development included 12 soil test borings drilled to depths between 11 and 20 feet.
- The natural soils encountered at the project site generally consisted of firm to very hard SILT (ML) or Elastic SILT (MH) underlain by Partially Weathered Rock (PWR).
- Auger or spoon refusal was encountered at depths ranging from 11 to 18.5 feet below existing grades in Borings B-4, B-5 and B-6, which indicates the presence of material such as rock with sufficient hardness to permit no further advancement of the drilling.
- Elastic SILT (MH) soils were encountered below the topsoil at Borings B-2 through B-6, B-8, B-9, B-11 and B-12. These soils may require moisture adjustments, localized undercutting and replacement, or other appropriate remedial activities if they exist at the finished subgrade elevation within proposed construction areas.
- Due to the relatively shallow depths at which partially weathered rock was encountered at Borings B-4, B-5, B-6 and B-9, difficult excavation should be anticipated if the finished grades or utility installations in these areas are near the surface of partially weathered rock.
- There is evidence that previous grading activities have occurred at the site. Unexpected conditions including areas of soft or loose fill, debris-laden fill, and other obstructions or conditions may exist that were not encountered at the boring locations. These conditions should be addressed during supplemental geotechnical explorations and/or by on-site engineering evaluation during construction.
- Lightly loaded 1- to 3-story structures (column loads less than 200 kips and wall loads less than 3 kips per foot) can be supported by shallow foundations bearing on undisturbed residual soils, new engineered fill, or approved existing fill. Moderately loaded structures (column loads on the order of 200 to 800 kips and wall loads on the order of 3 to 8 kips per foot) would require additional testing and detailed settlement analyses to determine if shallow foundations are adequate. Heavily loaded structures at this site should be supported by either shallow foundations bearing on or just above ground improvement elements (aggregate piers or rigid inclusions) or by deep foundations (driven piles, drilled piles, or drilled shafts).
- Based on the 2012 North Carolina State Building Code and the preliminary borings, a Site Class of "C" can be used for seismic design of the proposed building(s).

1 INTRODUCTION

1.1 GENERAL

The purpose of this study was to provide geotechnical information for the potential future development of the site. The project is currently still in the conceptual phase and building construction type, size, height, positioning on this site, finished grade elevations, and foundation loads have not been determined at this time. ECS understands that the primary project concerns are determining the properties and excavation characteristics of the natural soils as they relate to potential future development of the site.

This report contains the results of our subsurface explorations and laboratory testing programs, site characterization, engineering analyses, and preliminary recommendations for the design and construction of the potential development.

1.2 SCOPE OF SERVICES

To obtain the necessary geotechnical information required for design of the project, twelve soil test borings were performed at locations recommended by Civil Consultants, Inc. These borings were located at regular intervals throughout the potential development area. A laboratory-testing program was also implemented to characterize the physical and engineering properties of the subsurface soils.

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

- A brief review and description of our field and laboratory 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.
- Final copies of our preliminary soil exploration test boring logs.
- Preliminary recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills and delineation of potentially unsuitable soils and/or soils exhibiting excessive moisture at the time of sampling.
- Preliminary foundation recommendations.
- Preliminary recommendations for slab-on-grade construction.
- Preliminary pavement recommendations.
- Recommendations for seismic site classification in accordance with the 2012 North Carolina Building Code.
- Recommendations for additional testing and/or consultation that might be required to complete the geotechnical assessment and related engineering for this project.

1.3 AUTHORIZATION

Our services were provided in accordance with our Proposal No. 06:20604-GP, dated December 19, 2017, as authorized via email correspondence by Mr. Jeff Thompson on December 28, 2017. We understand that Mr. Thompson would like to apply the geotechnical services for this project to the existing purchase order established previously for the Colman Loop Parcel project which was cancelled.

2 PROJECT INFORMATION

2.1 PROJECT LOCATION

The site consists of three adjoining parcels located along the south side of US Highway 70 West (Cornelius Street) in Hillsborough, North Carolina at the approximate location on Figure 1 in Appendix A. The site is in an undeveloped agricultural area across the street and to the south of the Driver's License Office.

2.2 PAST SITE HISTORY/USES

Mr. Tony Whitaker with Civil Consultants informed us of an old pond located within the southwest portion of the site that showed up on older mapping records. Based on visual observations of the site during our preliminary exploration, it appears that this pond has been backfilled. Based on our review of historical aerial images of the site, it appears that the pond may have been backfilled sometime in 2010. From our site observations, it also appears that additional fill materials may have been imported and stockpiled within the old pond area where the grades appeared to have been raised. Historical images indicate that the fill may have been placed sometime in 2015.

2.3 CURRENT SITE CONDITIONS

The property is currently an undeveloped grass-covered parcel with wooded areas along the west and south perimeters. Orange County GIS indicates that the existing ground surface ranges from Elevation 610 to 645 feet sloping downward from north to south; however, there is evidence that fill may have been placed within portions of the site in the past and the topographic information provided on the Orange County GIS may not be accurate.

2.4 PROPOSED CONSTRUCTION

The project is currently still in the conceptual phase and building construction type, size, height, positioning on this site, finished grade elevations, and foundation loads have not been determined at this time.

3 FIELD EXPLORATION

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

The subsurface conditions were explored by drilling twelve soil test borings within the potential development area. An all-terrain vehicle (ATV)-mounted drill rig was utilized to drill the soil test borings. Borings were generally advanced to depths ranging from 11 to 20 feet below the current ground surface. Subsurface explorations were completed under the general supervision of an ECS geotechnical engineer or geologist.

Boring locations were identified in the field by ECS personnel using GPS techniques prior to mobilization of our drilling equipment. The approximate as-drilled boring locations are shown on the Boring Location Diagram in Appendix A. Ground surface elevations noted on our boring logs were interpolated from Orange County GIS topographic maps.

Standard penetration tests (SPTs) were conducted in the borings at regular intervals in general accordance with ASTM D 1586. Small representative samples were obtained during these tests and were used to classify the soils encountered. The standard penetration resistances obtained provide a general indication of soil shear strength and compressibility.

4 LABORATORY TESTING

An experienced geotechnical professional visually classified each soil sample from the test borings on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS) and ASTM D-2488 (Description and Identification of Soils-Visual/Manual Procedures). After classification, the geotechnical professional grouped the various soil types into the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in situ, the transitions may be gradual.

The laboratory testing performed by ECS for this project consisted of selected tests performed on samples obtained during our field exploration operations. Classification and index property tests were performed on representative soil samples obtained from the test borings in order to aid in classifying soils according to the Unified Soil Classification System and to quantify and correlate engineering properties. The laboratory test results are attached in Appendix C.

5 SUBSURFACE CONDITIONS

5.1 REGIONAL/SITE GEOLOGY

The site is located within the Piedmont physiographic province of the contiguous United States. The Piedmont is characterized by residual overburden soils weathered in place from the underlying igneous, metamorphic, and sedimentary rock.

The topography and relief of the Piedmont uplands have developed from differential weathering of the metamorphic and igneous bedrock. Because of the continued chemical and physical weathering, the bedrock in the Piedmont is now generally covered with a mantle of soil that has weathered in place from the parent bedrock. These soils have variable thicknesses and are referred to as residuum or residual soils. The residuum is typically finer grained and has higher clay content near the surface because of the advanced weathering. Similarly, the soils typically become coarser grained with increasing depth because of decreased weathering. As the degree of weathering decreases, the residual soils generally retain the overall appearance, texture, gradation and foliations of the parent rock.

The boundary between soil and rock in the Piedmont is not sharply defined. A transitional zone termed "partially weathered rock" is normally found overlying the parent bedrock. Partially weathered rock (PWR) is defined for engineering purposes as residual material with Standard Penetration Resistances (N-values) exceeding 100 blows per foot. The transition between hard/dense residual soils and partially weathered rock occurs at irregular depths due to variations in degree of weathering. Also, it is not unusual to find lenses and boulders of hard rock and/or zones of partially weathered rock within the soil mantle well above the general bedrock level.

According to the *1985 Geologic Map of North Carolina*, the site is underlain by phyllite and schist of Cambrian/Late Proterozoic age.

It is important to note that the natural geology within portions of the site may have been modified in the past that included the placement of fill materials. The quality of man-made fills can vary significantly, and it is often difficult to assess the engineering properties of existing fills.

5.2 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological information and our experience with local soils, rock, and groundwater. Generalized characterizations of the soil and rock strata encountered during our subsurface exploration are provided below. For subsurface information at a specific location, refer to the boring logs in Appendix B.

A surficial layer of organic-laden topsoil, approximately 1 to 2 inches in thickness, was encountered at the boring locations with the exception of Borings B-6 and B-10. The natural soils encountered below the topsoil, where encountered, generally consisted of SILT (ML) or Elastic SILT (MH). The SPT N-values within these soils ranged from 6 to 68 bpf, indicating a consistency varying between firm and very hard.

Partially Weathered Rock (PWR), which is classified as material with SPT blow counts greater than 50 blows per 6 inches of penetration, was encountered at Borings B-1 through B-11 at depths ranging from approximately 0.2 to 18.5 feet below existing grades. Auger or spoon refusal was encountered at depths ranging from 11 to 18.5 feet below existing grades in Borings B-4, B-5 and B-6. Auger or spoon refusal indicates the presence of material such as rock with sufficient hardness to permit no further advancement of the drilling.

5.3 GROUNDWATER OBSERVATIONS

Groundwater seepage into the borings was not observed during our exploration at the depths explored. We did observe borehole caving at depths of 7 to 16 feet which may be an indicator of groundwater presence.

Water levels should be expected to vary depending on seasonal fluctuations in precipitation, evaporation, surface water absorption characteristics, construction activities, nearby surface water bodies, and other factors, and may be present at higher elevations in the future. Also, perched water conditions should be anticipated on top of low permeability soil layers. Perched water may also be present in areas of coarse-grained soils, existing fill soils, and partially weathered rock. Consequently, the designer and contractor should be aware of this possibility while designing and constructing this project. Extended monitoring of the groundwater using wells would be required to determine the fluctuation of the groundwater level over time.

6 PRELIMINARY DESIGN RECOMMENDATIONS

6.1 BUILDING DESIGN

The following sections provide preliminary recommendations for foundation design, soil supported slabs, pavements and seismic design parameters.

6.1.1 Preliminary Foundation Recommendations

Lightly loaded 1- to 3-story structures (column loads less than 200 kips and wall loads less than 3 kips per foot) can be supported by shallow foundations bearing on undisturbed residual soils, new engineered fill, or approved existing fill. Moderately loaded structures (column loads on the order of 200 to 800 kips and wall loads on the order of 3 to 8 kips per foot) would require additional testing and detailed settlement analyses to determine if shallow foundations are adequate. Heavily loaded structures at this site should be supported by either shallow foundations bearing on or just above ground improvement elements (aggregate piers or rigid inclusions) or by deep foundations (driven piles, drilled piles, or drilled shafts).

6.1.2 Floor Slabs

ECS recommends ground floor slabs be designed as a slabs-on-grade over existing natural soils or new compacted structural fill that are stable when proofrolled. A preliminary modulus of subgrade reaction of 100 pci is recommended for design of floor slabs bearing on firm natural soils and newly-placed and properly-compacted structural fill soils that can be successfully proofrolled according to the recommendations in this report. This value is appropriate for a 1-foot square loaded area. If the method of structural analysis of the slab utilizes subgrade reaction values adjusted for the size and shape of the loaded area, please contact us for modifications to the subgrade reaction values. In order to allow for some relative displacement, the floor slabs should be structurally separated from both columns and load bearing walls. In addition, slabs should be provided with sufficient joints to control cracking associated with concrete volume changes. To help reduce curling of the slab and any resulting cracking, proper curing techniques should be used.

6.1.3 Seismic Design Considerations

Seismic Site Classification: The 2012 North Carolina Building Code 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 N-value method was used for this project.

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:

Seismic Site Classification

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

The 2012 North Carolina Building Code (2009 International Building Code with North Carolina Amendments) requires that a Site Class be assigned for the seismic design of new structures. The Site Class for the site was determined by calculating a weighted average SPT N-Value for the top 100 feet of the subsurface profile. Based on the conditions encountered in the borings, we recommend that a Site Class "C," as defined in the NCSBC, 2012, be used for the proposed buildings.

Our experience indicates that evaluation of seismic site class in North Carolina using N-values can be overly conservative. If it is determined that significant advantage could be gained with an improved Site Class, additional site testing could be performed to measure actual shear wave velocities using ReMi test methods and possibly a site specific seismic analysis. ECS can provide a proposal for these services upon request.

6.2 SITE DESIGN CONSIDERATIONS

6.2.1 Cut and Fill Slopes

We recommend that any cut and fill slopes with less than 20 feet vertical grade change be constructed at 2.5H:1V (horizontal to vertical) or flatter. Higher slopes should be evaluated on an individual basis. A slope of 3H:1V or flatter is recommended for ease of operation of mowing equipment. Fill slopes should be compacted to at least 95 percent of the standard Proctor maximum dry density. Fill slopes should be overbuilt and cut back to expose well compacted fill on the face of the slopes.

To protect the integrity of exposed soils, we recommend that the slopes be adequately vegetated to reduce the risk of erosion. Slopes should be graded such that surface water does not flow over the face of the slope. Drains should be extended to below the toe of the slope rather than discharged onto the face of the slope.

6.2.2 Preliminary Pavement Recommendations

Undisturbed low-plasticity residual soils or newly placed engineered fill can provide adequate support for a pavement structure designed for appropriate subgrade strength and traffic characteristics. For the design and construction of pavements, the subgrades should be prepared in accordance with the recommendations provided in Section 7.1 of this report.

Based on the results of our soil test borings, it appears that the soils that will be exposed as pavement subgrades, exposed in cuts and placed as fill, will consist mainly of SILT (ML) and Elastic

SILT (MH). These soils typically demonstrate laboratory CBR values ranging from 1 to 10, with a numeric average of approximately 3 to 5. A preliminary design CBR value of 3 and a design modulus of subgrade reaction of 100 psi/in are recommended for this project. These values should be confirmed by CBR sampling and testing during the design phase of the project.

Elastic SILT (MH) soils were encountered below the topsoil at Borings B-2 through B-6, B-8, B-9, B-11 and B-12. These soils may require moisture adjustments, localized undercutting and replacement, or other appropriate remedial activities if they exist within approximately 2 feet of the finished subgrade elevation within proposed pavement areas.

We emphasize that good base course drainage is essential for successful pavement performance. Water buildup in the base course will result in premature pavement failures. The subgrade and pavement should be graded to provide effective runoff to either the outer limits of the paved area or to catch basins so that standing water will not accumulate on the subgrade or pavement.

The pavement at locations for refuse dumpsters should be properly designed for the high axial loads and twisting movements of the trucks. Consideration should be given to the use of Portland cement concrete (PCC) pavement for the dumpster and approach areas. We recommend that the refuse collector be consulted to determine the size and thickness of the concrete pads for dumpsters. At locations where delivery truck, semi-trailers, and/or buses will be turning and maneuvering, the flexible pavement section should be designed to resist the anticipated shear stress on the pavement throughout the required pavement service life.

6.3 FINAL DESIGN GEOTECHNICAL EXPLORATION

The preliminary conclusions and recommendations submitted in this report are based upon the data obtained from a limited subsurface exploration program and are intended to provide a general assessment of geotechnical conditions at select locations on the site. Once final grades, building locations, pavement locations, site retaining wall locations, and stormwater control measure locations have been determined, we recommend that additional soil test borings and laboratory CBR testing be performed to develop final geotechnical design and construction recommendations. Also, determination of the seasonal high water table elevations, soil infiltration rates, and/or remolded permeabilities of on-site soils should be performed for design and permitting of the stormwater control measures.

Once preliminary grades, building locations, foundation layout, and foundation loads have been determined, this information should be provided to ECS. We may be able to modify our recommendations once additional project information is available.

7 PRELIMINARY SITE CONSTRUCTION RECOMMENDATIONS

7.1 SUBGRADE PREPARATION

7.1.1 Previous Site Development

When reviewing our recommendations, please note that there is evidence that previous grading activities have likely occurred on this site. Our experience with previously graded sites indicates that unexpected conditions can exist that were not encountered by the soil test borings. Unexpected conditions could include areas of soft or loose fill, debris-laden fill, and other obstructions or conditions. These conditions should be addressed by ECS during supplemental geotechnical explorations and/or by on-site engineering evaluation during construction.

7.1.2 Stripping and Grubbing

The subgrade preparation should consist of stripping all 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. The borings generally encountered 1 to 2 inches of topsoil. Deeper topsoil or organic laden soils are likely present in wet, low-lying, and poorly drained areas. In the wooded areas, the rootmat may extend as deep as about 1 to 2 feet and will require additional localized stripping and grubbing depth to completely remove the organics. In agricultural areas, organics within the cultivated soil are anticipated primarily to a depth of about 6 inches. ECS should be called on to verify that topsoil and unsuitable surficial materials have been completely removed prior to the placement of structural fill or construction of structures and pavements.

7.1.3 Proofrolling

After removing all 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 thoroughly 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 or chemical stabilization, should be discussed with the Geotechnical engineer to determine the appropriate procedure with regard to the existing conditions causing the instability. Test pits and/or hand auger borings 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.

7.2 EARTHWORK OPERATIONS

7.2.1 Existing Fill

Uncontrolled and/or undocumented fill poses risks associated with under-compacted soil, undetected deleterious inclusions within the fill, and/or deleterious materials at the virgin ground fill interface that are covered by the fill. ECS does not recommend supporting building foundations and pavements on under-compacted existing fill or existing fill with excessive organics or excessive inert debris. Therefore, we recommend that these conditions be addressed by on-site engineering evaluation by ECS during construction, including proofrolling and test pits. Under-compacted fill and fill with excessive organics/debris should be over-excavated and replaced with compacted structural fill.

7.2.2 High Plasticity Soils

Elastic SILT (MH) soils were encountered below the topsoil at Borings B-2 through B-6, B-8, B-9, B-11 and B-12. These soils may require moisture adjustments, localized undercutting and replacement, or other appropriate remedial activities if they exist at the finished subgrade elevation within proposed construction areas.

7.2.3 Excavation Considerations

Excavation Safety: All excavations and slopes should be made and maintained in accordance with OSHA excavation safety standards. 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.

Construction Dewatering: Based on the borings, our experience with groundwater fluctuations on similar sites, and anticipated design grades, most of the temporary excavations are unlikely to encounter groundwater. However, the contractor should be prepared to remove any precipitation or groundwater that may seep into temporary construction excavations using open pumping. Open pumping utilizes submersible sump pumps in pits or trenches dug below the bottom of the excavation and backfilled with No. 57 stone.

Excavability: Due to the relatively shallow depths at which partially weathered rock was encountered at Borings B-4, B-5, B-6 and B-9, difficult excavation should be anticipated if the finished grades or utility installations in these areas are near the surface of partially weathered rock.

It has been our experience that subsurface material with a Standard Penetration Resistance N-value of 50/6, 50/5, and 50/4 inches of penetration can likely be loosened and ripped using a D-8

dozer (or similar) equipped with a single-tooth ripper. For confined excavations, such material may be removed with a CAT 330 or equivalent excavator equipped with rock teeth. Subsurface materials that exhibit a Standard Penetration Resistance N-value of 50/3, 50/2, and 50/1 inches of penetration or less will likely require rock excavation methods.

Excavation below the level of auger or spoon refusal in the borings will likely require rock excavation methods such as blasting or pneumatic equipment.

We have included a rock excavation clause in Appendix D that may be incorporated into the contract documents.

7.2.4 Structural fill Materials

Product Submittals: Prior to placement of structural fill, representative bulk samples (about 50 pounds) of on-site and/or 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 CL, ML, SM, SC, SW, SP, GW, GP, GM and GC, or a combination of these group symbols, per ASTM D 2487. The materials should be free of organic matter and debris, and should contain no particle sizes greater than 3 inches in the largest dimension. The fill should exhibit a maximum dry density of at least 90 pounds per cubic foot, as determined by a Standard Proctor compaction test (ASTM D 698). Open graded materials, such as gravels (GW and GP), which contain void space in their mass, should not be used in structural fills unless properly encapsulated with filter fabric. Elastic SILT (MH) is satisfactory for use as structural fill, provided it is placed at depths greater than 3 feet below building slab-on-grade bearing levels and 1 foot below pavement subgrades.

Unsuitable Materials: Unsuitable fill materials include materials which do not satisfy the requirements for suitable materials, such as topsoil, organic materials, debris, debris-laden fill, and Fat CLAY (CH).

On-Site Borrow Suitability: The on-site soils meeting the classifications for recommended satisfactory structural fill, plus meeting the restrictions on organic content and debris, may be used as structural fill. We anticipate that the majority of soils encountered in the borings within the anticipated excavation depths will be satisfactory for use as compacted structural fill backfill. Given the significant presence of Elastic SILT (MH) on this site, and to reduce the amount of import material to the site, this material can be used as structural fill at depths greater than 3 feet below building slab-on-grade bearing levels in building areas or 1 foot below pavement subgrades.

On-site soils used as structural fill will require careful moisture control in order to achieve compaction and stability. Any soils excavated from below the water table will require significant drying to achieve the recommended moisture content and minimum compaction. Soils above the water table may also be relatively dry at the time of construction and require wetting to achieve the recommended moisture content and minimum compaction.

As indicated on the Laboratory Test Results Summary of Appendix C, natural moisture contents of the samples tested were observed to generally be at or above 20%. Therefore, moisture conditioning (drying) of subgrades and onsite excavated fill should be anticipated.

Rip Rock and Blast Rock: The gradation of the material removed by ripping or blasting will probably be quite varied. Excavated rock and partially weathered rock are generally only suitable for use in the deeper parts of embankment fills or outside the zone of structural fill. Rock or partially weathered fragments placed in non-structural areas should be well choked with fill soil and compacted.

When the available borrow material consists primarily of rock or intact partially weathered rock fragments, these materials may be used as structural fill provided they are placed in accordance with project specifications. We recommend that when rock fragments are used as fill, they be spread out evenly and choked off with rock fines and soil, so that voids between the rock fragments are filled. In general, the larger rock fragments should be placed at the bottom of the fill, but no fragment should exceed 3 feet in its maximum dimension. Between 10 feet and 3 feet below the final subgrade elevation, no rock fragment should exceed 24 inches in its maximum dimension. Within 3 feet of the subgrade elevation, no rock fragment should exceed 3 inches in maximum dimension.

7.2.5 Compaction

Structural fill Compaction: Structural fill within the expanded building, pavement, retaining wall, hardscape, embankment, or other structural limits should be placed in maximum 8-inch loose lifts and moisture conditioned as necessary to within -3 and +3 % of the soil's optimum moisture content. Structural fill should be compacted with suitable equipment to a dry density of at least 95% of the Standard Proctor maximum dry density (ASTM D698) more than 12 inches below the finish subgrade elevation and to a least 98% in the upper 12 inches. ECS should be called on 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. All filling operations should be observed on a full-time basis by a qualified representative of the construction testing laboratory to determine that the minimum compaction requirements are being achieved. Field density testing of fills will be performed at the frequencies shown in the following table, but not less than 1 test per lift.

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 100 linear ft. per lift
Outparcels/Stormwater Control Measures	1 test per 5,000 sq. ft. per lift
All 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. Sheepsfoot compaction equipment should be suitable for the fine-grained soils (Clays and Silts). A vibratory steel drum roller should be used for compaction of coarse-grained soils (Sands) 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 all 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, all 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. During placement and compaction of new fill at the beginning of each workday, the Contractor may need to scarify existing subgrades to a depth on the order of 4 inches so that a weak plane will not be formed between the new fill and the existing subgrade soils.

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. Alternatively, if these soils cannot be stabilized by conventional methods as previously discussed, additional modifications to the subgrade soils such as lime or cement stabilization may be utilized to adjust the moisture content. If lime or cement are utilized to control moisture contents and/or for stabilization, Quick Lime, Calciment® or regular Type 1 cement can be used. The construction testing laboratory should evaluate proposed lime or cement soil modification procedures, such as quantity of additive and mixing and curing procedures, before implementation. The contractor should be required to minimize dusting or implement dust control measures, as required.

Where fill materials will be placed to widen existing embankment fills, or placed up against sloping ground, the soil subgrade should be scarified and the new fill benched or keyed into the existing material. Fill material should be placed in horizontal lifts. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 4 inches to 6 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.

Moisture Conditioning: The on-site soils are moisture sensitive and can be difficult to work. These difficulties can include softening of exposed subgrade soils, excessive rutting or deflection under construction traffic, and the inability to adequately dry and compact wet soil. 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 a combination of mechanical manipulation and the use of chemical additives, such as lime or cement, in order to lower moisture contents to levels appropriate for compaction. Alternatively, removal and replacement with drier, off-site materials may be necessary. 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. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to prevent construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with excess depths of aggregate to protect those subgrades. The aggregate can later be removed and used in pavement areas.

Site subgrade conditions will be significantly influenced by weather conditions and some site soil may degrade rapidly if exposed to water. Subgrades that are evaluated after periods of rainfall will not respond as well to proofrolling as subgrades that are evaluated after periods of more favorable weather. We recommend that rubber tire equipment not be used if subgrade conditions exhibit elevated moisture conditions. The contractor should use tracked equipment to help minimize the degradation of exposed subgrades.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction areas, and the work areas should be sloped away from the construction areas 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.

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. All erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

8 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. 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 in order 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.

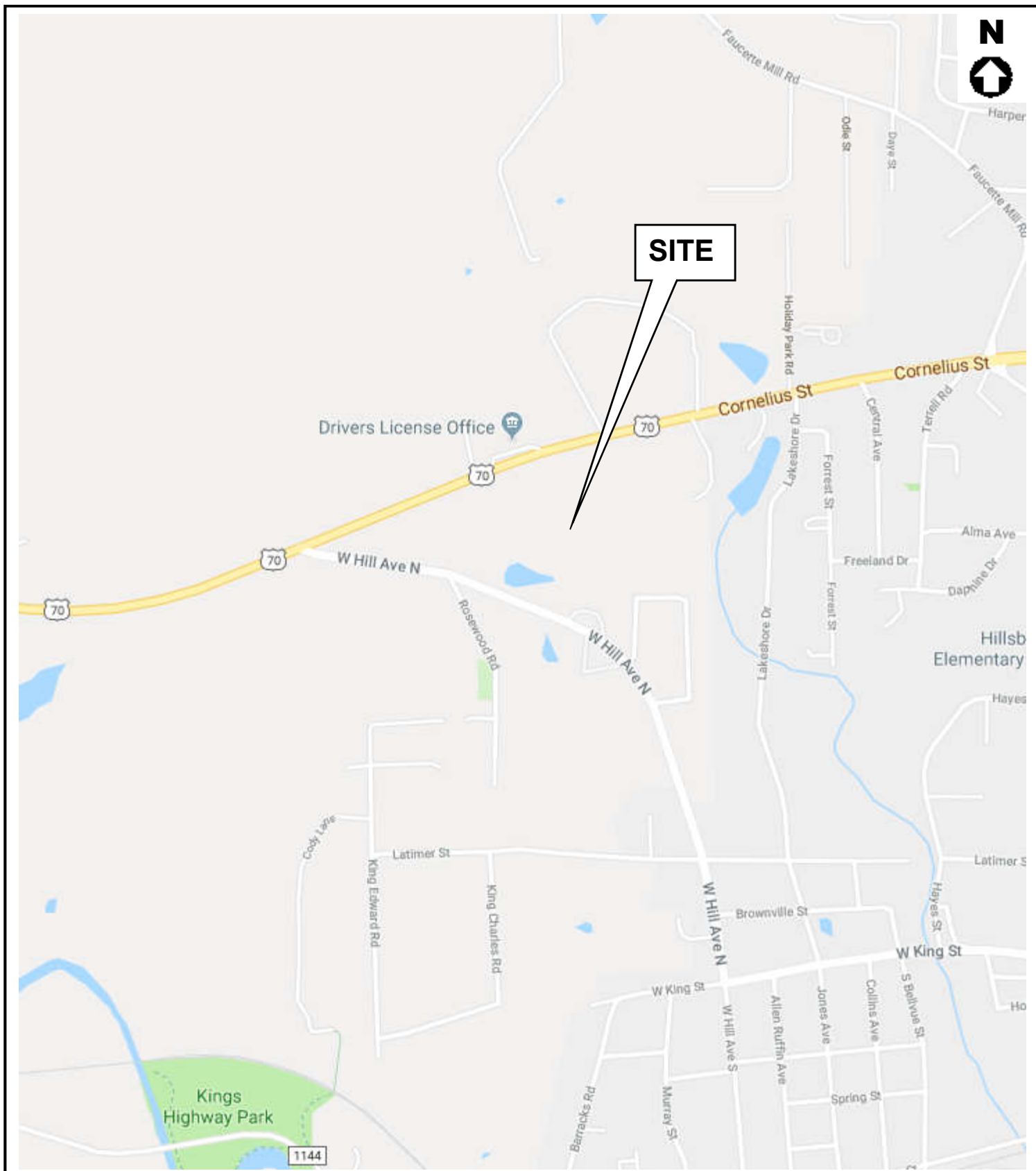
We recommend that ECS be allowed to review the project's plans and specifications pertaining to our work so that we may ascertain consistency of those plans/specifications with the intent of the geotechnical report.

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

Boring Location Diagram



SITE VICINITY MAP

DMV Properties
1010 US 70 West (Cornelius Street)
Hillsborough, North Carolina

JOB NO.
06:23731

DRAWN BY
APL

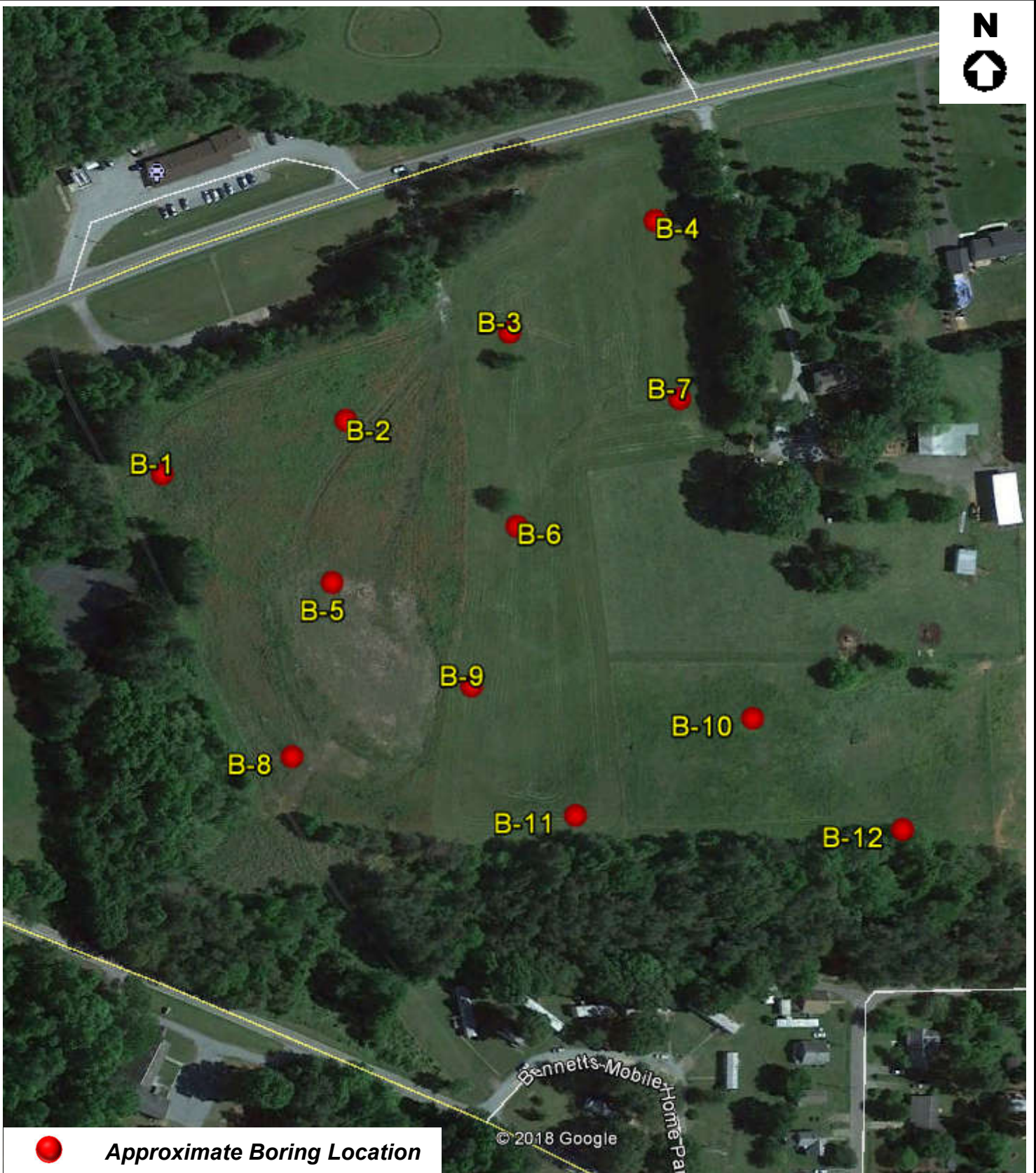
SCALE
NTS

FIGURE NO.
1

CHECKED BY
TMS

DATE
1-23-18

SOURCE: Google Maps



BORING LOCATION DIAGRAM

DMV Properties
1010 US 70 West (Cornelius Street)
Hillsborough, North Carolina

JOB NO.
06:23731

FIGURE NO.
2

DRAWN BY
APL

CHECKED BY
TMS

SCALE
NTS

DATE
1-23-18

SOURCE: Google Earth

APPENDIX B – Field Operations

Reference Notes for Boring Logs
Boring Logs B-1 through B-12
Generalized Subsurface Profiles



REFERENCE NOTES FOR BORING LOGS

MATERIAL ^{1,2}	
	ASPHALT
	CONCRETE
	GRAVEL
	TOPSOIL
	VOID
	BRICK
	AGGREGATE BASE COURSE
	FILL³ MAN-PLACED SOILS
	GW WELL-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GP POORLY-GRADED GRAVEL gravel-sand mixtures, little or no fines
	GM SILTY GRAVEL gravel-sand-silt mixtures
	GC CLAYEY GRAVEL gravel-sand-clay mixtures
	SW WELL-GRADED SAND gravelly sand, little or no fines
	SP POORLY-GRADED SAND gravelly sand, little or no fines
	SM SILTY SAND sand-silt mixtures
	SC CLAYEY SAND sand-clay mixtures
	ML SILT non-plastic to medium plasticity
	MH ELASTIC SILT high plasticity
	CL LEAN CLAY low to medium plasticity
	CH FAT CLAY high plasticity
	OL ORGANIC SILT or CLAY non-plastic to low plasticity
	OH ORGANIC SILT or CLAY high plasticity
	PT PEAT highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS			
SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION		
DESIGNATION	PARTICLE SIZES	
Boulders	12 inches (300 mm) or larger	
Cobbles	3 inches to 12 inches (75 mm to 300 mm)	
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")	<0.074 mm (smaller than a No. 200 sieve)	

COHESIVE SILTS & CLAYS		
UNCONFINED COMPRESSIVE STRENGTH, Q_p ⁴	SPT ⁵ (BPF)	CONSISTENCY ⁷ (COHESIVE)
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

RELATIVE AMOUNT ⁷	COARSE GRAINED (%) ⁸	FINE GRAINED (%) ⁸
Trace	≤5	≤5
Dual Symbol (ex: SW-SM)	10	10
With	15 - 20	15 - 25
Adjective (ex: "Silty")	≥25	≥30

GRAVELS, SANDS & NON-COHESIVE SILTS	
SPT ⁵	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

WATER LEVELS ⁶		
	WL	Water Level (WS)(WD) (WS) While Sampling (WD) While Drilling
	SHW	Seasonal High WT
	ACR	After Casing Removal
	SWT	Stabilized Water Table
	DCI	Dry Cave-In
	WCI	Wet Cave-In

¹Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.

²To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

³Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

⁴Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

⁵Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).

⁶The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

⁷Minor deviation from ASTM D 2488-09 Note 16.

⁸Percentages are estimated to the nearest 5% per ASTM D 2488-09.

[illegible]

CLIENT Orange County Asset Mgmt. & Purchasing			Job #: 06:23731		BORING # B-2		SHEET 1 OF 1			
PROJECT NAME DMV Properties			ARCHITECT-ENGINEER							
SITE LOCATION 1010 US 70 West, Hillsborough, Orange County, NC										
NORTHING			EASTING			STATION			○ CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - REC% _____ PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% ✕ ● △ ⊗ STANDARD PENETRATION BLOWS/FT	

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ENGLISH UNITS	WATER LEVELS ELEVATION (FT)	BLOWS/6"
					BOTTOM OF CASING	LOSS OF CIRCULATION		
					SURFACE ELEVATION	640		
0					Topsoil Depth [1.00"]			640
	S-1	SS	18	18	(MH) ELASTIC SILT, reddish brown, moist, stiff			2
								4
	S-2	SS	18	18				6
								13
5					(ML) SILT, orangish brown, moist, firm to very stiff			4
	S-3	SS	18	18				6
								8
	S-4	SS	18	18				20
10								
	S-5	SS	18	18				
15								
	S-6	SS	11	10	PARTIALLY WEATHERED ROCK SAMPLED AS SILT, orangish brown, moist [Weathered ROCK]			28
20					END OF BORING @ 19.42'			50/5
25								
30								

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.		
WL Dry WS WD WL(SHW) WL(ACR) WL	BORING STARTED 01/11/18 BORING COMPLETED 01/11/18 RIG CME 550 FOREMAN Higgins	CAVE IN DEPTH @ 15.0' HAMMER TYPE Manual DRILLING METHOD 2.25 ID HSA

CLIENT Orange County Asset Mgmt. & Purchasing				Job #: 06:23731		BORING # B-3		SHEET 1 OF 1			
PROJECT NAME DMV Properties				ARCHITECT-ENGINEER							
SITE LOCATION 1010 US 70 West, Hillsborough, Orange County, NC											
NORTHING				EASTING		STATION		—○— CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC% ———			
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL		ENGLISH UNITS		WATER LEVELS ELEVATION (FT)	BLOWS/6"	PLASTIC LIMIT% ——— ● ——— LIQUID LIMIT% WATER CONTENT%
					BOTTOM OF CASING LOSS OF CIRCULATION		SURFACE ELEVATION 645				STANDARD PENETRATION BLOWS/FT
0					Topsoil Depth [2.00"] (MH) ELASTIC SILT, reddish brown, moist, stiff to very stiff				645		
5	S-1	SS	18	18					640		
	S-2	SS	18	18					635		
	S-3	SS	18	18					630		
	S-4	SS	18	18					625		
15	S-5	SS	18	18	PARTIALLY WEATHERED ROCK SAMPLED AS SILT, tan, moist [Weathered ROCK] END OF BORING @ 18.92'				50/5		
20	S-6	SS	5	5					615		
25											
30											

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 01/10/18	CAVE IN DEPTH @ 14.0'
WL(SHW) WL(ACR)	BORING COMPLETED 01/10/18	HAMMER TYPE Manual
WL	RIG CME 550 FOREMAN Higgins	DRILLING METHOD 2.25 ID HSA

CLIENT Orange County Asset Mgmt. & Purchasing				Job #: 06:23731		BORING # B-4		SHEET 1 OF 1		
PROJECT NAME DMV Properties				ARCHITECT-ENGINEER						
SITE LOCATION 1010 US 70 West, Hillsborough, Orange County, NC										
NORTHING				EASTING		STATION		—○— CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC% ———— PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% ✕ ● △ ⊗ STANDARD PENETRATION BLOWS/FT		
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ENGLISH UNITS	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	
					BOTTOM OF CASING LOSS OF CIRCULATION 100% SURFACE ELEVATION 637					
0					Topsoil Depth [2.00"] (MH) ELASTIC SILT, contains slight roots, tan, moist, very stiff			635	4 9 16	
	S-1	SS	18	14						
	S-2	SS	5	5	PARTIALLY WEATHERED ROCK SAMPLED AS SILT, tan, moist [Weathered ROCK]			50/5	50/5	
5								630	33 50/4	
	S-3	SS	10	10						
	S-4	SS	18	18	(ML) SILT, contains slight rock fragments, tan, moist, very stiff			625	11 11 13	
10										
	S-5	SS	5	5	PARTIALLY WEATHERED ROCK SAMPLED AS SILT, tan, moist [Weathered ROCK]			620	50/5	
15										
	S-6	SS	0	0	SPOON REFUSAL @ 18.50'			615	50/0	
20										
								610		
25										
30										
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.										
WL Dry WS ☐ WD ☒		BORING STARTED 01/10/18			CAVE IN DEPTH @ 14.0'					
WL(SHW) WL(ACR)		BORING COMPLETED 01/10/18			HAMMER TYPE Manual					
WL		RIG CME 550 FOREMAN Higgins			DRILLING METHOD 2.25 ID HSA					

CLIENT		Job #:	BORING #	SHEET	
Orange County Asset Mgmt. & Purchasing		06:23731	B-5	1 OF 1	
PROJECT NAME		ARCHITECT-ENGINEER			
DMV Properties					
SITE LOCATION					
1010 US 70 West, Hillsborough, Orange County, NC					
NORTHING		EASTING		STATION	
DEPTH (FT) 0 5 10 15 20 25 30 SAMPLE NO. S-1 S-2 S-3 S-4 SAMPLE TYPE SS SS SS SS SAMPLE DIST. (IN) 18 5 8 1 RECOVERY (IN) 18 5 4 1 DESCRIPTION OF MATERIAL Topsoil Depth [1.00"] (MH) ELASTIC SILT, orangish brown, moist, stiff PARTIALLY WEATHERED ROCK SAMPLED AS SILT, tan, moist [Weathered ROCK] AUGER REFUSAL @ 13.00' ENGLISH UNITS LOSS OF CIRCULATION WATER LEVELS ELEVATION (FT) 630 625 620 615 610 605 600 BLOWS/6" 4 6 7 50/5 15 50/2 50/1					
○ CALIBRATED PENETROMETER TONS/FT² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - REC% - - - PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% ⊗ STANDARD PENETRATION BLOWS/FT					
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL. WL Dry WS WD BORING STARTED 01/11/18 CAVE IN DEPTH @ 8.0' WL(SHW) WL(ACR) BORING COMPLETED 01/11/18 HAMMER TYPE Manual WL RIG CME 550 FOREMAN Higgins DRILLING METHOD 2.25 ID HSA					

CLIENT Orange County Asset Mgmt. & Purchasing				Job #: 06:23731		BORING # B-6		SHEET 1 OF 1			
PROJECT NAME DMV Properties				ARCHITECT-ENGINEER							
SITE LOCATION 1010 US 70 West, Hillsborough, Orange County, NC											
NORTHING				EASTING		STATION		—○— CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC% ———			
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL		ENGLISH UNITS		WATER LEVELS ELEVATION (FT)	BLOWS/6"	PLASTIC LIMIT% ——— ● ——— LIQUID LIMIT% STANDARD PENETRATION BLOWS/FT
					BOTTOM OF CASING LOSS OF CIRCULATION 100% SURFACE ELEVATION 633						
0					(MH) ELASTIC SILT, tan, moist, stiff				6		
	S-1	SS	18	18					630		
5		S-2	SS	14					10		4 12 50/2
	S-3	SS	1	1					625		50/1
10		S-4	SS	11	5	PARTIALLY WEATHERED ROCK SAMPLED AS SILT, tan, moist [Weathered ROCK]				11 50/5	
					620						
15					615						
20					610						
25					AUGER REFUSAL @ 11.00'				605		
30											
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.											
WL Dry WS WD					BORING STARTED 01/10/18			CAVE IN DEPTH @ 7.0'			
WL(SHW) WL(ACR)					BORING COMPLETED 01/10/18			HAMMER TYPE Manual			
WL					RIG CME 550 FOREMAN Higgins			DRILLING METHOD 2.25 ID HSA			

CLIENT Orange County Asset Mgmt. & Purchasing				Job #: 06:23731		BORING # B-7		SHEET 1 OF 1		
PROJECT NAME DMV Properties				ARCHITECT-ENGINEER						
SITE LOCATION 1010 US 70 West, Hillsborough, Orange County, NC										
NORTHING		EASTING		STATION		ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - REC% _____				
						PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% STANDARD PENETRATION BLOWS/FT				
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ENGLISH UNITS	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	
					BOTTOM OF CASING LOSS OF CIRCULATION 100% SURFACE ELEVATION 633					
0					Topsoil Depth [2.00"] (ML) SILT, trace clay, contains slight roots and rock fragments, brown to tan, moist, stiff			630	10	
5	S-2	SS	18	18	(ML) SILT, brown to tan, moist, hard to very hard			628	42	
	S-3	SS	18	18				625	35	
10	S-4	SS	18	18				623	54	
15	S-5	SS	18	18				620	58	
20	S-6	SS	5	5	PARTIALLY WEATHERED ROCK SAMPLED AS SILT, brownish tan, moist [Weathered ROCK] END OF BORING @ 18.92'			615	50/5	
25								610		
30								605		
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.										
WL Dry		WS		WD		BORING STARTED 01/10/18		CAVE IN DEPTH @ 14.0'		
WL(SHW)		WL(ACR)				BORING COMPLETED 01/10/18		HAMMER TYPE Manual		
WL						RIG CME 550 FOREMAN Higgins		DRILLING METHOD 2.25 ID HSA		

CLIENT Orange County Asset Mgmt. & Purchasing				Job #: 06:23731		BORING # B-8		SHEET 1 OF 1			
PROJECT NAME DMV Properties				ARCHITECT-ENGINEER							
SITE LOCATION 1010 US 70 West, Hillsborough, Orange County, NC											
NORTHING				EASTING		STATION		○ CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - REC% _____ PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% ✕ ● △ ⊗ STANDARD PENETRATION BLOWS/FT			
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL		ENGLISH UNITS		WATER LEVELS ELEVATION (FT)	BLOWS/6"	
					BOTTOM OF CASING LOSS OF CIRCULATION 100% SURFACE ELEVATION 615						
0					Topsoil Depth [2.00"] (MH) ELASTIC SILT, reddish brown to tan, moist, very stiff				615	5 7 13 4 6 10 19 35 50/4 50/5 50/4	
	S-1	SS	18	18							
	S-2	SS	18	18	PARTIALLY WEATHERED ROCK SAMPLED AS SILT, tan, moist [Weathered ROCK]				610	16 85/10 50/5 50/4	
5											
	S-3	SS	16	10					605		
	S-4	SS	5	5							
10									600		
	S-5	SS	4	4							
15					END OF BORING @ 16.50'				595		
20											
25									590		
30									585		
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.											
WL Dry WS ☐ WD ☒					BORING STARTED 01/11/18			CAVE IN DEPTH @ 12.0'			
WL(SHW) WL(ACR) ☒					BORING COMPLETED 01/11/18			HAMMER TYPE Manual			
WL ☒					RIG CME 550 FOREMAN Higgins			DRILLING METHOD 2.25 ID HSA			

CLIENT Orange County Asset Mgmt. & Purchasing				Job #: 06:23731		BORING # B-9		SHEET 1 OF 1			
PROJECT NAME DMV Properties				ARCHITECT-ENGINEER							
SITE LOCATION 1010 US 70 West, Hillsborough, Orange County, NC											
NORTHING				EASTING		STATION		—○— CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% — — — REC% ———— PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% X ————— ● ————— △ ⊗ STANDARD PENETRATION BLOWS/FT			

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ENGLISH UNITS	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					BOTTOM OF CASING	LOSS OF CIRCULATION		625	
					SURFACE ELEVATION 625				
0	S-1	SS	7	6	Topsoil Depth [2.00"] PARTIALLY WEATHERED ROCK SAMPLED AS ELASTIC SILT, contains rock fragments, reddish brown, moist [Weathered ROCK]			625	50/1
5	S-2	SS	18	18	(MH) ELASTIC SILT, reddish brown, moist, stiff to very stiff			620	16
	S-3	SS	18	10					15
10	S-4	SS	18	18	(ML) SANDY SILT, brown, moist, very hard			615	68
15	S-5	SS	18	18				610	63
20	S-6	SS	5	5	PARTIALLY WEATHERED ROCK SAMPLED AS SANDY SILT, brown, moist [Weathered ROCK] END OF BORING @ 18.92'			605	50/5
25								600	
30								595	

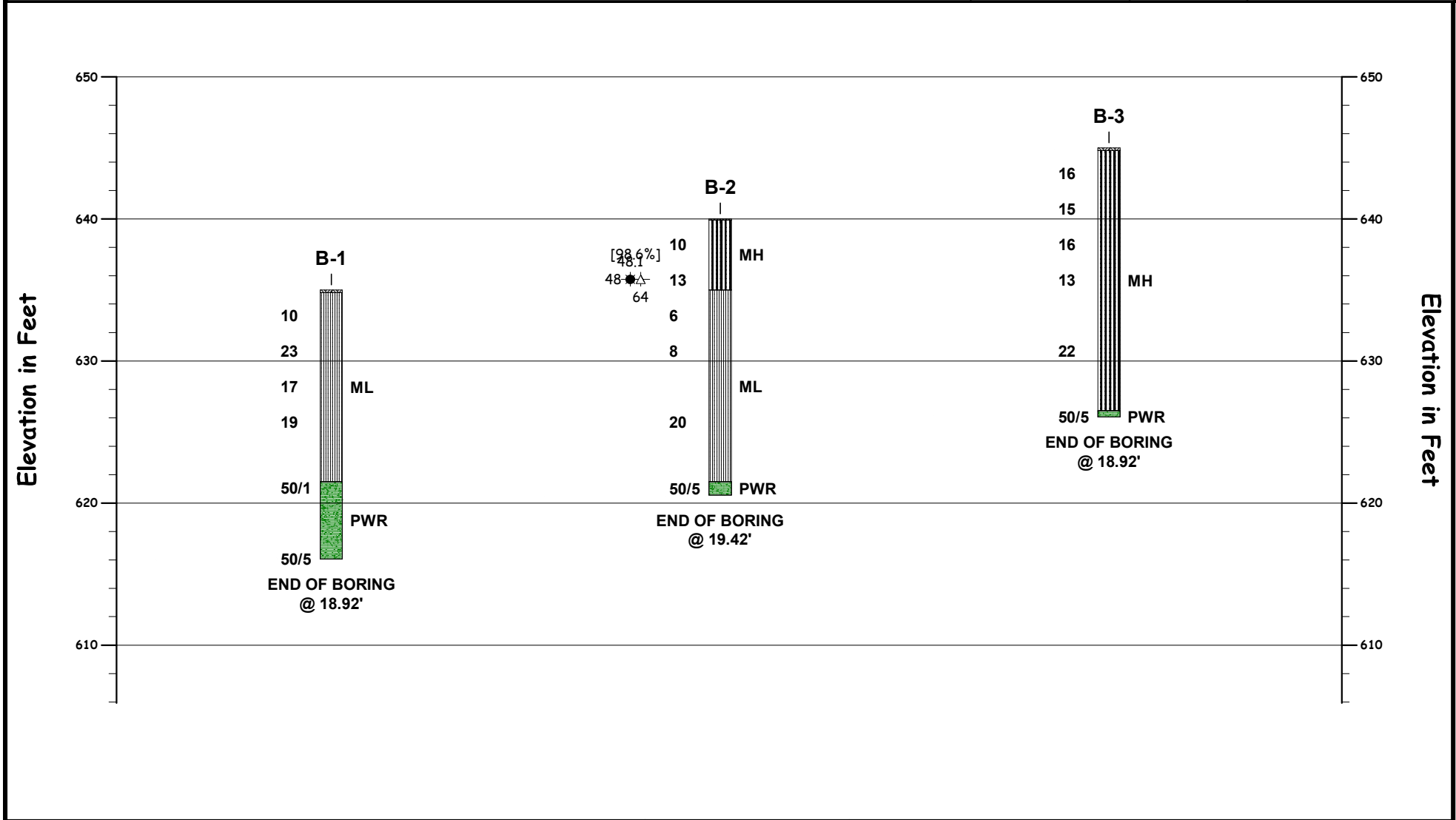
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 01/10/18	CAVE IN DEPTH @ 14.0'
WL(SHW) WL(ACR)	BORING COMPLETED 01/10/18	HAMMER TYPE Manual
WL	RIG CME 550 FOREMAN Higgins	DRILLING METHOD 2.25 ID HSA

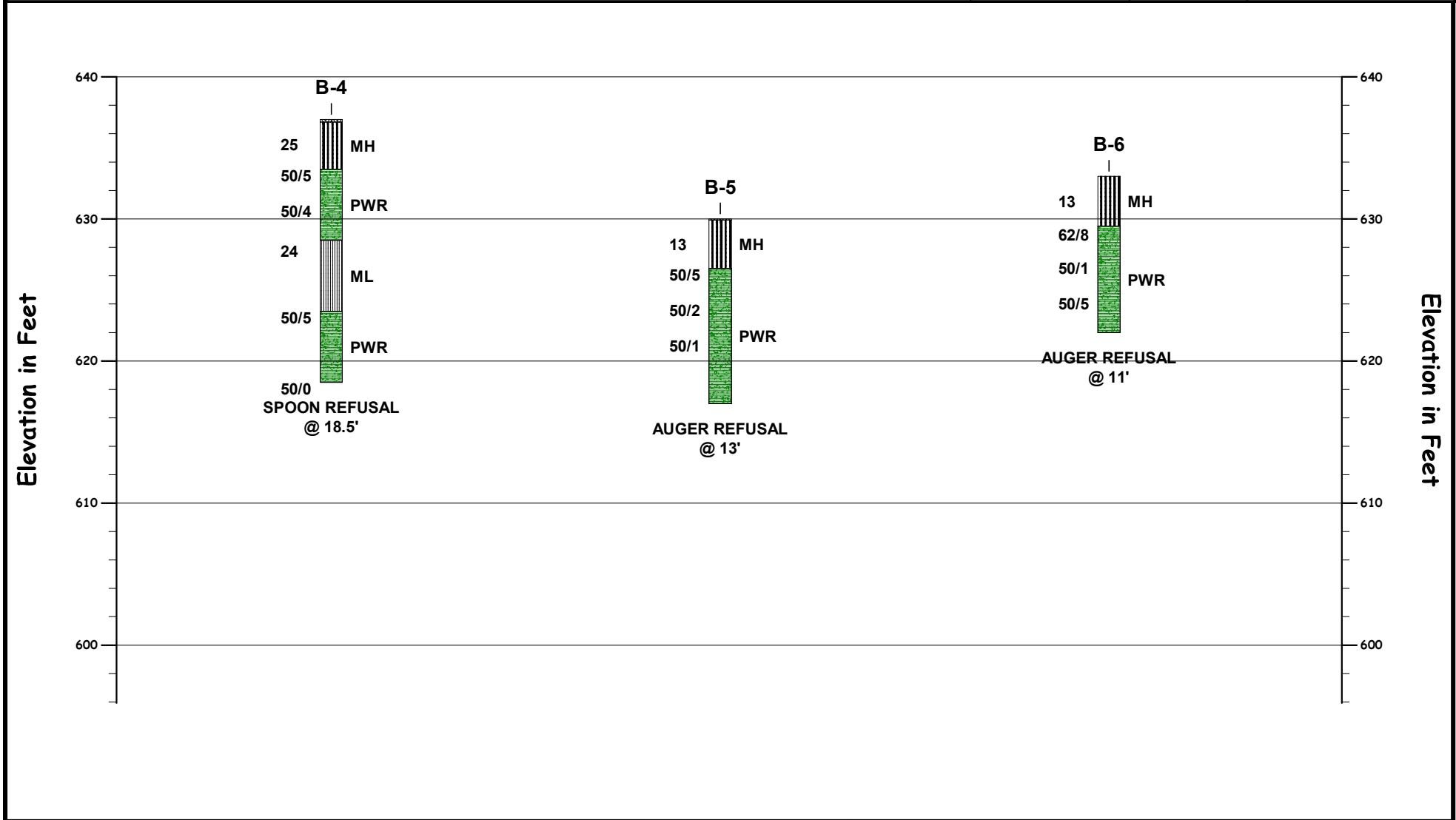
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CLIENT Orange County Asset Mgmt. & Purchasing						Job #: 06:23731		BORING # B-12		SHEET 1 OF 1		
PROJECT NAME DMV Properties						ARCHITECT-ENGINEER						
SITE LOCATION 1010 US 70 West, Hillsborough, Orange County, NC												
NORTHING			EASTING			STATION			---○--- CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - REC% -----			
									PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% ● △ ⊗ STANDARD PENETRATION BLOWS/FT			
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ENGLISH UNITS	WATER LEVELS ELEVATION (FT)	BLOWS/6"				
					BOTTOM OF CASING ■ LOSS OF CIRCULATION ▯▮▮							
					SURFACE ELEVATION 623							
0					Topsoil Depth [2.00"]							
1	S-1	SS	18	12	(MH) ELASTIC SILT, contains slight roots, brown, moist, stiff		620	10				
2								9				
3	S-2	SS	18	18	(ML) SILT, orangish brown, moist, stiff to very stiff		615	16				
4								22				
5	S-3	SS	18	18				22				
6								22				
7	S-4	SS	18	18				13				
8												
9												
10												
11	S-5	SS	18	4								
12												
13												
14												
15												
16												
17												
18												
19	S-6	SS	18	1								
20					END OF BORING @ 20.00'							
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.												
WL Dry WS □ WD ☒						BORING STARTED 01/10/18			CAVE IN DEPTH @ 16.0'			
WL(SHW) WL(ACR)						BORING COMPLETED 01/10/18			HAMMER TYPE Manual			
WL						RIG CME 550 FOREMAN Higgins			DRILLING METHOD 2.25 ID HSA			

SOIL CLASSIFICATION LEGEND				SURFACE MATERIALS		ROCK TYPES	SYMBOL LEGEND
GW - WELL GRADED GRAVEL	GC - CLAYEY GRAVEL	CL - LOW PLASTICITY CLAY	SP - POORLY GRADED SAND	OH - HIGH PLASTICITY ORGANIC SILTS AND CLAYS	WR - WEATHERED ROCK	IGNEOUS	WATER LEVEL - DURING DRILLING/SAMPLING
GM - SILTY GRAVEL	SW - WELL GRADED SAND	MH - HIGH PLASTICITY SILT	SC - CLAYEY SAND	OL - LOW PLASTICITY ORGANIC SILTS AND CLAY	PWR - PARTIALLY WEATHERED ROCK	METAMORPHIC	WATER LEVEL - SEASONAL, HIGH WATER
GP - POORLY GRADED GRAVEL	ML - LOW PLASTICITY SILT	SM - SILTY SAND	CH - HIGH PLASTICITY CLAY	PT - PEAT		SEDIMENTARY	WATER LEVEL - AFTER CASING REMOVAL
							WATER LEVEL - AFTER 24 HOURS
							PLASTIC LIMIT% WATER % PASSING #200 SIEVE LIQUID LIMIT% (88%)



NOTES: 1 SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION. 2 PENETRATION TEST RESISTANCE IN BLOWS PER FOOT (ASTM D1586). 3 HORIZONTAL DISTANCES ARE NOT TO SCALE.		Subsurface Soil Profile	
		DMV Properties	
		Orange County Asset Mgmt. & Purchasing	
		1010 US 70 West, Hillsborough, Orange County, NC	
		PROJECT NO.: 23731	VERTICAL SCALE: 1"=10'
		DATE: 1/23/2018	



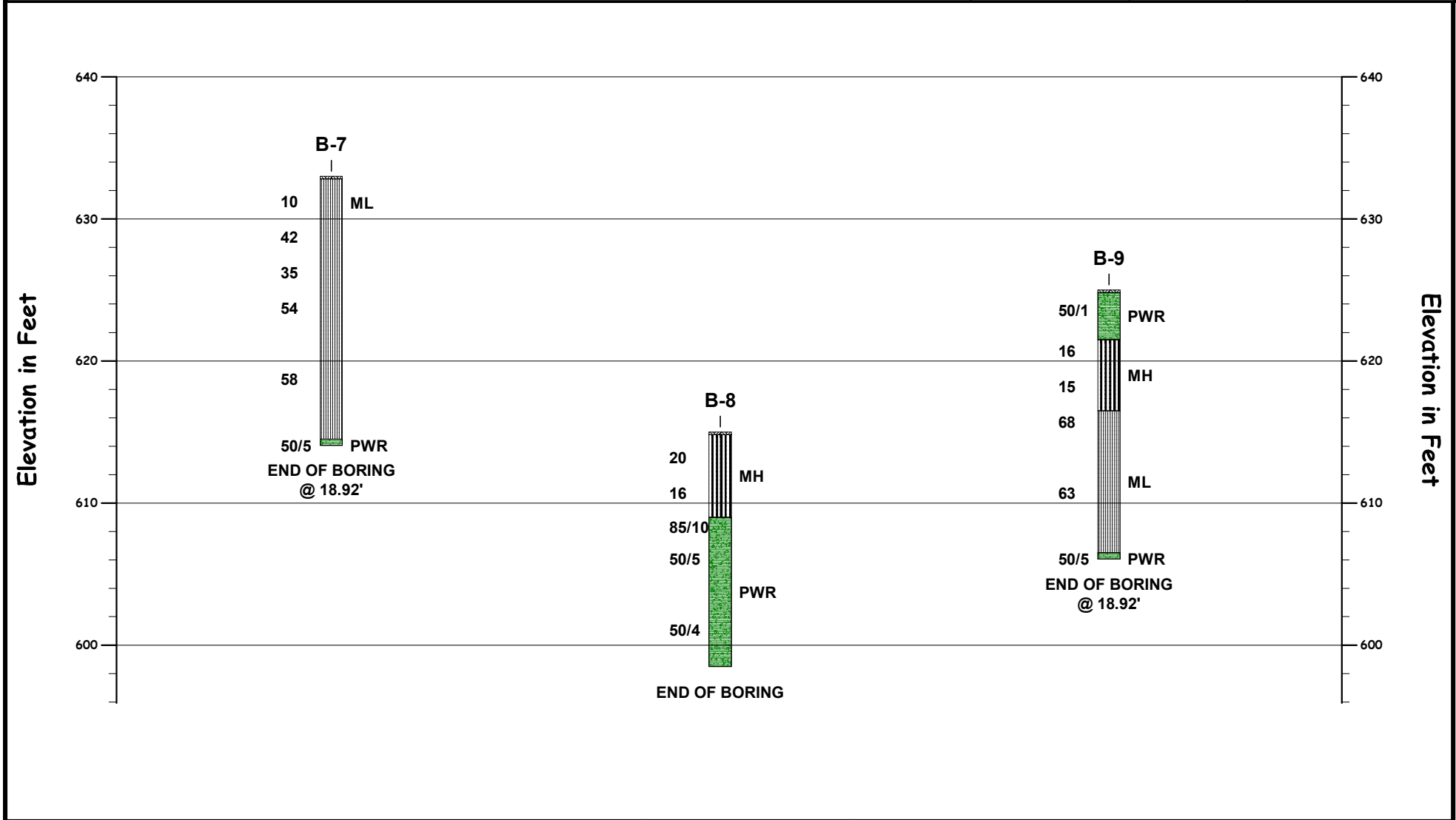
NOTES:

- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.
- PENETRATION TEST RESISTANCE IN BLOWS PER FOOT (ASTM D1586).
- HORIZONTAL DISTANCES ARE NOT TO SCALE.

Subsurface Soil Profile

DMV Properties	
Orange County Asset Mgmt. & Purchasing	
1010 US 70 West, Hillsborough, Orange County, NC	
PROJECT NO.: 23731	VERTICAL SCALE: 1"=10'
DATE: 1/23/2018	

SOIL CLASSIFICATION LEGEND										SURFACE MATERIALS				ROCK TYPES		SYMBOL LEGEND									
GW - WELL GRADED GRAVEL		GC - CLAYEY GRAVEL		CL - LOW PLASTICITY CLAY		SP - POORLY GRADED SAND		OH - HIGH PLASTICITY ORGANIC SILTS AND CLAYS		WR - WEATHERED ROCK		FILL		TOPSOIL		CONCRETE		IGNEOUS		WATER LEVEL - DURING DRILLING/SAMPLING					
GM - SILTY GRAVEL		SW - WELL GRADED SAND		MH - HIGH PLASTICITY SILT		SC - CLAYEY SAND		OL - LOW PLASTICITY ORGANIC SILTS AND CLAY		PWR - PARTIALLY WEATHERED ROCK		POSSIBLE FILL		ASPHALT		VOID		METAMORPHIC		WATER LEVEL - AFTER CASING REMOVAL					
GP - POORLY GRADED GRAVEL		ML - LOW PLASTICITY SILT		SM - SILTY SAND		CH - HIGH PLASTICITY CLAY		PT - PEAT				PROBABLE FILL						SEDIMENTARY		WATER LEVEL - AFTER 24 HOURS					
																		PLASTIC LIMITS		WATER CONTENT		% PASSING #200 SIEVE (68%)		LIQUID LIMIT	



NOTES: 1 SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION. 2 PENETRATION TEST RESISTANCE IN BLOWS PER FOOT (ASTM D1586). 3 HORIZONTAL DISTANCES ARE NOT TO SCALE.				Subsurface Soil Profile	
				DMV Properties Orange County Asset Mgmt. & Purchasing 1010 US 70 West, Hillsborough, Orange County, NC	
				PROJECT NO.: 23731 DATE: 1/23/2018	
				VERTICAL SCALE: 1"=10'	

SOIL CLASSIFICATION LEGEND

GW - WELL GRADED GRAVEL	GC - CLAYEY GRAVEL	CL - LOW PLASTICITY CLAY	SP - POORLY GRADED SAND	OH - HIGH PLASTICITY ORGANIC SILTS AND CLAYS	WR - WEATHERED ROCK	FILL
GM - SILTY GRAVEL	SW - WELL GRADED SAND	MH - HIGH PLASTICITY SILT	SC - CLAYEY SAND	OL - LOW PLASTICITY ORGANIC SILTS AND CLAY	PWR - PARTIALLY WEATHERED ROCK	POSSIBLE FILL
GP - POORLY GRADED GRAVEL	ML - LOW PLASTICITY SILT	SM - SILTY SAND	CH - HIGH PLASTICITY CLAY	PT - PEAT		PROBABLE FILL

SURFACE MATERIALS

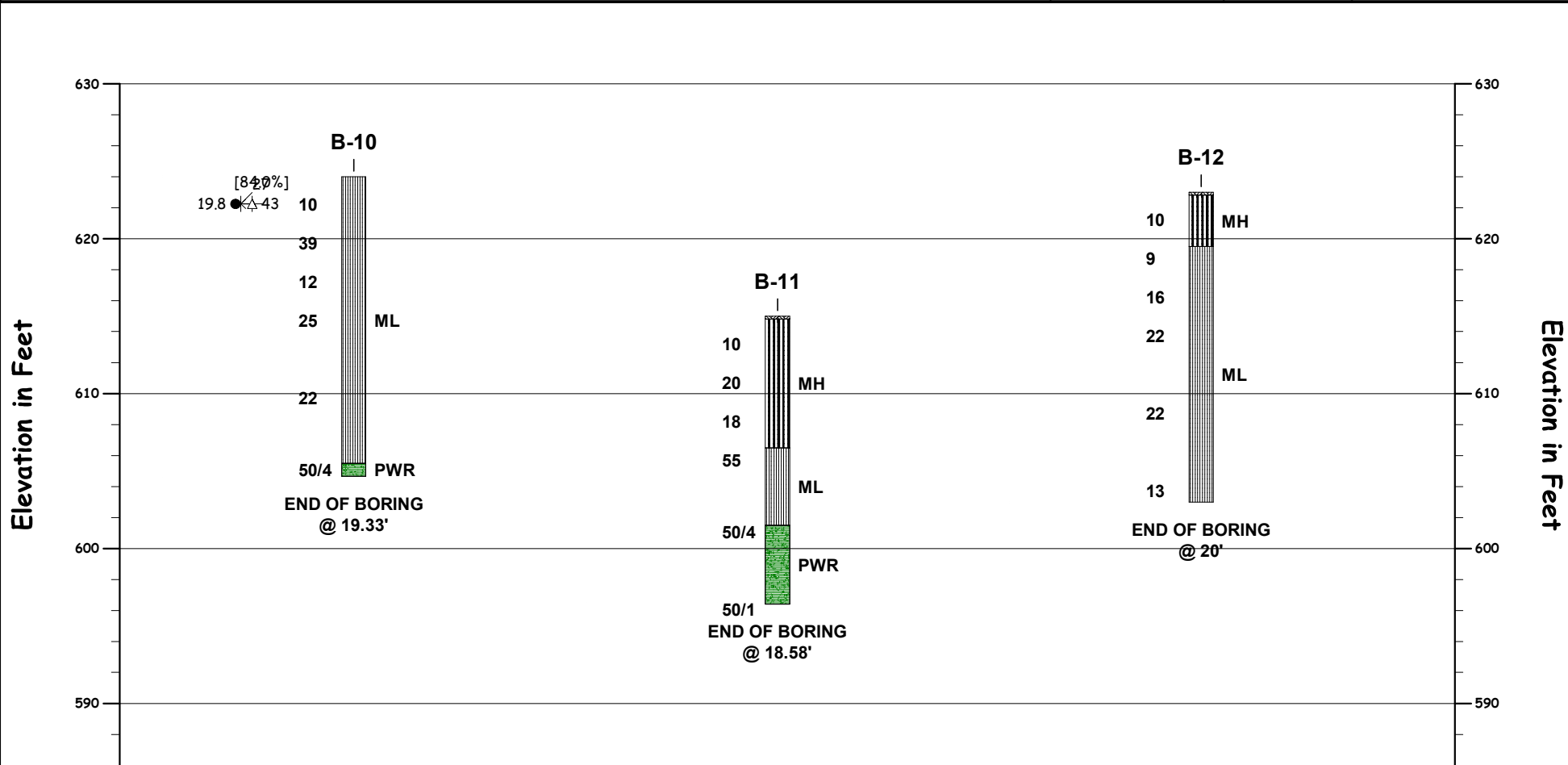
TOPSOIL	CONCRETE
ASPHALT	VOID
GRAVEL	

ROCK TYPES

IGNEOUS
METAMORPHIC
SEDIMENTARY

SYMBOL LEGEND

	WATER LEVEL - DURING DRILLING/SAMPLING
	WATER LEVEL - SEASONAL, HIGH WATER
	WATER LEVEL - AFTER CASING REMOVAL
	WATER LEVEL - AFTER 24 HOURS
	PLASTIC LIMITS
	WATER CONTENT
	% PASSING #200 SIEVE (88%)
	LIQUID LIMITS



NOTES:

- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.
- PENETRATION TEST RESISTANCE IN BLOWS PER FOOT (ASTM D1586).
- HORIZONTAL DISTANCES ARE NOT TO SCALE.



Subsurface Soil Profile

DMV Properties	
Orange County Asset Mgmt. & Purchasing	
1010 US 70 West, Hillsborough, Orange County, NC	
PROJECT NO.: 23731	VERTICAL SCALE: 1"=10'
DATE: 1/23/2018	

APPENDIX C – Laboratory Testing

Laboratory Test Results Summary

Laboratory Testing Summary

Page 1 of 1

Sample Source	Sample Number	Depth (feet)	MC ¹ (%)	Soil Type ²	Atterberg Limits ³			Percent Passing No. 200 Sieve ⁴	Moisture - Density (Corr.) ⁵		CBR Value ⁶	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-2												
	S-2	3.50 - 5.00	48.1	MH	64	48	16	98.6				
B-10												
	S-1	1.00 - 2.50	19.8	ML	43	27	16	84.0				

Notes:

1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions:

MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No. 06:23731
Project Name: DMV Properties
PM: Aubrey P. Lankford
PE: Tom Schipporeit
Printed On: Tuesday, January 23, 2018



APPENDIX D – Supplemental Report Documents

Rock Excavation Clause

ROCK EXCAVATION CLAUSE

EXCAVATION

Excavation consists of removal and disposal of material encountered when establishing required finish grade elevations.

EXCAVATION CLASSIFICATIONS:

If the following classifications of excavation are encountered in work:

Do not perform such work until material to be excavated has been cross-sectioned and classified by a geotechnical engineer. Such excavation will be paid on basis of contract conditions relative to changes in work.

Earth excavation includes removal and disposal of pavements and other obstruction visible on ground surface, underground structures and utilities indicated to be demolished and removed, material of any classification indicated in data on subsurface conditions, and other materials encountered that are not classified as rock excavation or unauthorized excavation.

Rock excavation consists of the removal and disposal of a formation that cannot be excavated without systematic drilling and blasting, except such materials that are classified as earth excavation.

Boulders larger than 1/2 cubic yard or more in volume shall be classified as rock. Typical of materials classified as rock are:

- “Rip” rock – all subsurface materials that cannot be excavated using pans / scrapers, loaders, bulldozers, etc. and required pre-loosening with a bulldozer equipped with a single tooth ripper having a minimum bar pull rating of at least 56,000 pounds. (i.e. Caterpillar D-8K), or a Caterpillar 977 track loader (or its equivalent to achieve excavation.
- Blast rock – all subsurface materials that cannot be excavated or pre-loosened with the above described equipment or its equivalent and occupying an original volume of at least one cubic yard.
- Trench rock – all subsurface materials that cannot be excavated or pre-loosened with a track mounted backhoe having a minimum bucket curling force rating of at least 25,500 pounds and occupying an original volume of at least ½ cubic yard.

The Contractor may provide a demonstration that materials encountered cannot be ripped with the above rated equipment and should be classified as rock.

The Contractor, at the A/E option, shall provide equipment specification data verifying the above minimum equipment will be used for the demonstration.

The Designer shall be the final judge as to what is to be classified as rock excavation.

Intermittent drilling or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

Payments for rock excavation over and above the amount estimated shall be as described in the Special Conditions Section.