Addendum 1

Geotechnical Engineering Report

Effingham Booster Pump Station
Guyton, Effingham County, Georgia

June 12, 2020
Terracon Project No. ES205101

Prepared for:
Thomas & Hutton
Savannah, Georgia

Prepared by:
Terracon Consultants, Inc.
Savannah, Georgia

Addendum 1

June 12, 2020

Thomas & Hutton
50 Park of Commerce Way
Savannah, Georgia 31405

Attn: Mr. Chris Stovall, P.E., LEED AP
P: (912) 721-4155
E: Stovall.c@tandh.com

Re: Geotechnical Engineering Report
Effingham Booster Pump Station
Guyton, Effingham County, Georgia
Terracon Project No. ES205101

Dear Mr. Stovall:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PES205103 dated March 31, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations for the proposed project.

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

Sincerely,
Terracon Consultants, Inc.

Thomas C. Brackett, P.G., E.I.T.
Senior Staff Geotechnical Engineer

Guoming Lin, Ph.D., P.E., D.GE
Senior Consultant

REPORT TOPICS

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	A new booster pump station will be constructed adjacent to the existing water meter station on Hodgeville Road. The station in includes a an approximately 30 ft. x 50 ft. pump building, a generator pad and associated driveway.
Geotechnical Characterization	Approximately 6 inches of topsoil. Loose/medium dense clayey sands to approximately 20 feet (BGS). Soft/stiff clay soils to approximately 30 feet BGS, Dense silty sands to termination depth of borings. Groundwater encountered between 1 and 2 feet (BGS). The shallow clayey soils have poor drainage characteristics and are prone to the perched water table conditions.
Earthwork	Install a site drainage system, Strip/grub topsoil, Density and proofroll subgrade during subgrade preparation, Repair subgrade with undercutting as necessary. For details, please refer to the **Earthwork** section.
Shallow Foundations	Shallow foundations will be sufficient for the pump station building after the subgrade soils are proofrolled and densified. Allowable bearing pressure = 2,000 lbs/sq ft Expected settlements: < 1 inch total, < ½ inch differential
Pavements	With subgrade prepared as noted in **Earthwork** Asphalt: ■ 2" AC over 7" graded aggregate base (GAB) in Light Duty areas
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

Effingham Booster Pump Station

Guyton, Effingham County, Georgia

Terracon Project No. ES205101

June 12, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed booster pump station to be located in Guyton, Effingham County, Georgia. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Foundation design and construction
- Pavement construction considerations
- Seismic site classification per IBC

The geotechnical engineering Scope of Services for this project included the advancement of 2 Standard Penetration Test (SPT) borings to a depth of approximately to 50 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and/or as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

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

Item	Description
Parcel Information	The project is located at Hodgeville Road in Guyton, Effingham County, Georgia. See **Site Location**
Existing Improvements	An existing meter station with perimeter fence.
Current Ground Cover	Asphalt pavement, gravel, trees, and grass.
Existing Topography	Relatively level.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. Our final understanding of the project conditions is as follows:

Item	Description
Information Provided	A site plan, titled "Vicinity Map", was provided to Terracon on March 24, 2020 by the client. An updated site plan was later provided on May 12, 2020.
Project Description	The project includes construction of a booster located immediately adjacent to the existing meter station on Hodgeville Road in Guyton, Effingham County, Georgia.
Proposed Structure	The proposed booster pump station includes a slab-on-grade structure for pumping equipment and a generator slab.
Maximum Loads	Slab Load: 250 psf (assumed)
Grading	It is anticipated that the site will be graded with up to 3 feet of fill.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The following table provides our geotechnical characterization based on the SPT borings of B-1 to B-4.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/Density
Surface	6 inches	Topsoil: silty sands with tree roots	N/A
1	17 to 22	Clayey sand to sandy lean clay	Loose to medium dense/ stiff
2	30 to 33	Lean clay	Soft to stiff
3	50, termination of borings	Fine silty sands	Dense to very dense

Groundwater

Groundwater was encountered between 1 and 2 feet below ground surface in both SPT borings at the time of our field program. It should be noted that groundwater levels tend to fluctuate with seasonal and climatic variations, as well as with construction activities. Furthermore, the near surface soils contain clays and have poor drainage characteristic. As such, the possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. The groundwater table should be checked prior to construction to assess its effect on site work and other construction activities.

GEOTECHNICAL OVERVIEW

The subsurface conditions at this site are considered adaptable for the proposed development. The generalized soil profile is presented in the **Geotechnical Characterization** Section.

Settlement analyses were performed at boring locations B1 and B2 by using the soil parameters derived from the SPT borings and an assumed slab load of 250 pounds per square foot. Based on the assumed load, total settlements were estimated to be less than 1 inch. Therefore, the proposed structure can be supported on a shallow foundation system.

Soft/loose soils were observed near the surface at both boring locations. It is important that the subgrade is continually inspected it identify weak areas under slab foundations. During site preparation, some undercutting and backfilling may be required to achieve a stable subgrade. We assumed that a limited amount of fill would be placed at the building pad locations. If heavier structural loads are required or if more stringent settlement criteria are required, Terracon should be retained to perform an additional evaluation to determine if ground improvement measures or another foundation option is required.

The shallow groundwater level (less than 2 feet BGS) indicates perched water conditions. This is attributed to the poor drainage characteristics of the underlying clayey soils. Site drainage and moisture content become critical to maintain subgrade stability and reduce the need for subgrade repair. In addition to a site drainage system, permanent subgrade drains may be required beneath slab foundations.

Based on the results of our laboratory analysis, the clayey sands within Stratum 1 contain greater than 25 percent fines. Typically, soils with greater than 25 percent fines are not suitable for use as structural fill.

During the site preparation, no topsoil, organic matter, stumps, undocumented fill, or other unsuitable materials should be left in place below slabs and pavements. Subgrade improvements by undercut may be required to achieve the required stability for the foundation support. Further information regarding subgrade preparation is provided in the **Earthwork** section.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations for utilities, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations. The site work conditions will be largely dependent on the weather conditions and the contractor's means and methods for controlling surface drainage and protecting the subgrade.

Site Preparation

Prior to fill placement on the subgrade, the proposed pump station area should be densified with a heavy-duty static roller to achieve a uniform subgrade. The subgrade underneath the pump station should be thoroughly proofrolled after the completion of densification. Proofrolling will help detect any isolated soft or loose areas that "pump", deflect or rut excessively.

The subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Excessively wet or dry material should either be removed, or moisture conditioned and recompacted.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill. Earthen materials used for structural fill should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Parameters (for Structural Fill)
Granular	GW, GP, GM, GC, SW, SP, SM, SC	Less than 25% Passing No. 200 sieve

1. Structural should consist of approved materials free of organic matter and debris. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Fill Compaction Requirements

Structural fill should meet the following compaction requirements.

Item	Structural Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used

Item	Structural Fill
Minimum Compaction Requirements [1]	95% of max. below foundations and below finished pavement subgrade
Water Content Range [1]	Granular: -3% to +3% of optimum

1. Maximum density and optimum water content as determined by the Modified Proctor test (ASTM D 1557).

Some manipulation of the moisture content (such as wetting, drying) will be required during the filling operations to obtain the required degree of compaction. The manipulation of the moisture content is highly dependent on weather conditions and site drainage conditions. Therefore, the contractor should prepare both dry and wet fill materials to obtain the specified compaction during grading. A sufficient number of density tests should be performed to confirm the required compaction of the fill material.

Utility Trench Backfill

Utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the structure should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the structure. The trench should provide an effective trench plug that extends at least 5 feet from the face of the structure exterior. The plug material should consist of cementitious flowable fill or clayey sand. The trench plug material should be placed to surround the utility line. If used, the clayey sand trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

Grading and Drainage

All grades must provide effective drainage away from the structure during and after construction and should be maintained throughout the life of the structure. Water retained next to the structure can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential foundation movements.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of foundation elements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

The groundwater table could affect excavation efforts, especially for over-excavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps could be necessary to achieve the recommended depth of over-excavation.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

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

Construction Observation and Testing

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

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the booster station areas. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

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

FLOOR SLAB FOUNDATIONS

Foundation Design Recommendations

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for slab foundations.

Description	Parameters
Net allowable bearing pressure [1]	2,000 psf
Minimum embedment of turned down slab below finished grade	12 inches
Approximate total settlement [2]	< 1 inch
Ultimate coefficient of sliding friction [3]	0.32
Floor slab support [4]	Properly compacted structural fill
Base course/capillary break [5]	4 inches of free-draining granular material
Modulus of subgrade reaction	100 pounds per square inch per inch (psi/in)

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the foundation base elevation. It assumes any unsuitable fill or soft soils, if encountered, will be replaced with compacted structural fill.
2. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the foundation, the thickness of compacted fill, and the quality of the earthwork operations.
3. Sliding friction along the base of the foundation will not develop where net uplift conditions exist.
4. We recommend the subgrade be inspected and tested with proofrolling after the topsoil is stripped as outlined in the **Earthwork** section of this report.
5. The monolithic slab foundation design should include a base course comprised of free-draining, compacted, granular material, at least inches thick. The granular subbase may be graded aggregate base (GAB) or sands containing less than 15 percent fines (material passing the #200 sieve). GAB subbase can also help improve the workability of the subgrade especially during rain periods.

The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations.

Foundations should be reinforced as necessary to reduce the potential for the distress caused by differential foundation movement.

Foundation excavations should be observed by the Geotechnical Engineer. If the soil conditions encountered differ significantly from those presented in this report, Terracon should be contacted to provide additional evaluation and supplemental recommendations.

Slab Foundation Construction Considerations

The bottom of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavation to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Extremely wet or dry material, or any loose or disturbed material in the bottom of the excavations

should be removed before concrete is placed. If the soils at bearing level become excessively dry, disturbed or saturated, the affected soils should be removed prior to placing concrete. A lean concrete mud-mat should be placed over the bearing soils if the excavations must remain open overnight or for an extended period of time.

We generally anticipate suitable material will be present at the bottom of the foundation. However, there is a possibility that isolated zones of soft or loose native soils could be encountered below bearing level, even though field density tests are expected to be performed during fill placement. Therefore, it is important that Terracon be retained to observe, test, and evaluate the bearing soil prior to placing reinforcing steel and concrete to determine if additional footing excavation or other subgrade repair is needed for the design loads.

PAVEMENTS

General Pavement Comments

We understand the proposed development will include paved drives and parking areas. This section presents thickness recommendations for asphalt concrete (AC) pavements and general considerations for the pavement construction. Pavement thickness design is dependent upon:

- The traffic loads including traffic pattern and the service life of the pavement;
- Subgrade conditions including soil strength and drainage characteristics;
- Paving material characteristics;
- Climatic conditions of the region.

Traffic patterns and anticipated loading conditions were not available at the time of this report preparation. However, we anticipate that traffic loads will be produced primarily by automobile traffic and pickup trucks.

A light-duty pavement section has been provided. The light duty section is for the areas that receive only car traffic. If heavier traffic loading is expected, the proposed development should be provided with the information and allowed to review these pavement sections. A design life of 20 years was assumed to develop the total traffic used in thickness design. However, as typical for pavement, some maintenance repairs are typically required for a period of 7 to 10 years.

Recommended paving material characteristics, taken from the Georgia Department of Transportation's (GDOT) 2001 edition of *Standard Specifications for Construction of Transportation Systems,* are included for the asphalt concrete sections.

Asphalt Pavement Design Recommendations

Material[1]	Minimum Section Thickness (inch)
	Light Duty Section[2]
	Auto Parking
Asphalt Surface Course	2
Asphalt Intermediate Course	0
Aggregate Base Course[3]	7
Total Pavement Section	**9**
Select fill[4] /improved subgrade[5]	24

1. Asphalt concrete aggregates and base course materials should conform to the following GDOT material specifications.
   - Section 815 for Graded Aggregate
   - Section 828 for Hot Mix Asphalt Concrete Mixture. Surface course may use 9.5 mm Superpave for a smooth surface in the light-duty section. 19 mm and/or 25 mm Superpave is recommended for the intermediate course.
2. Light-duty section assumes only car traffic like staff parking.
3. We recommend the aggregate base course (GAB) be compacted to a minimum of 95% of the maximum dry density based on the modified Proctor compaction test.
4. The select fill should be relatively clean sands with percent fines less than 15%. The fill material should be compacted to a minimum of 95% of the soil's modified Proctor maximum dry density (ASTM D-1557).
5. If SP or SP-SM or SM soils exist at the proposed subgrade elevation extending to a depth at least 24 inches below the proposed subgrade level, the in-situ soils can replace the select fill and the subgrade should be improved using densification as discussed in Earthwork section.

Notes:

6. Proper surface and subgrade drainage system should be installed to avoid saturation of subgrade soils underneath the asphalt pavements. The site drainage should be designed to maintain the groundwater at least 2 feet below the top of the subgrade.
7. Some subgrade soil undercutting and backfilling with suitable structural fill will be required if unstable subgrade soils are encountered during subgrade preparation. The use of geogrid (Tensar BX1100 or equivalent) may be necessary to help reduce the depth of undercut to achieve stability if the unstable subgrade soils extend to greater depths. The need for geogrid and/or the need for undercutting and backfilling should be determined in the field during subgrade preparation.

Pavement Construction Considerations

Pavement subgrades prepared early in the project should be carefully evaluated as the time for pavement construction approaches. We recommend the pavement areas be rough graded and then thoroughly proofrolled with a loaded tandem-axle dump truck.

Particular attention should be paid to the high traffic areas that were rutted and disturbed, and to the areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fill. After

proofrolling and repairing subgrade deficiencies, the entire subgrade should be scarified to a depth of 12 inches, and uniformly compacted to at least 95% of the materials' modified Proctor maximum dry density.

Pavement and Subgrade Drainage

Poor subgrade drainage is the most common cause of pavement failure. Pavement should be sloped to provide rapid drainage of surface water. Water should not be allowed to pond on or adjacent to the pavement which would saturate the subgrade soils and weaken the subgrade support. We recommend the site drainage be designed to maintain the groundwater at least two (2) feet below the top of the subgrade.

Pavement subgrade drainage should be installed surrounding the areas anticipated for frequent wetting or having poor natural drainage, such as landscaped islands, along curbs and gutters and around drainage structures. All landscaped areas in or adjacent to pavements should be sealed to reduce the moisture migration to subgrade soils. Subgrade drains should be installed with the pipe bottom at least two (2) feet below the top of the select fill. The civil engineer should decide the placement of the subgrade drains to avoid the saturation of pavement subgrade.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.

- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. The seismic design parameters are summarized in the table below and presented in the **Supporting Information** section. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with ASCE 7-16.

Description	Value
2018 International Building Code Site Classification	D [2]
Site Latitude	32.1978
Site Longitude	-81.2485
S_{DS} Spectral Acceleration for a Short Period [3]	0.316
S_{D1} Spectral Acceleration for a 1-Second Period [3]	0.177

1. Seismic site classification in general accordance with the *2018 International Building Code*, which refers to ASCE 7-16.
2. The 2018 International Building Code (IBC) uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 50 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.
3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

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

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

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

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Number/Type of Borings	Boring Depth (feet)[1]	Planned Location
2 Standard Penetration Tests (SPT)	50	Booster station area

1. Below ground surface.

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet).

Subsurface Exploration Procedures: We advanced soil borings with standard truck-mounted drilling equipment using solid stem continuous flight augers. Samples were obtained at 2-foot intervals in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was typically performed using open-tube and/or split-barrel sampling procedures.

Granular soils and soils for which good quality open-tube samples could not be recovered were sampled by means of the Standard Penetration Test (SPT). This test consists of measuring the number of blows (N) required for a 140-pound hammer free falling 30 inches to drive a standard split-spoon sampler 12 inches into the subsurface material after being seated six inches. This blow count or SPT “N” value is used to evaluate the stratum.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. The laboratory testing program included the following tests:

- Moisture content
- Atterberg limits
- Particle size analysis of soils

The laboratory testing program includes examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we describe and classify soil samples in accordance with the Unified Soil Classification System (USCS). Samples not tested in the laboratory will be stored for a period of 30 days after submittal of this report and will be discarded after this period, unless we are notified otherwise.

SITE LOCATION AND EXPLORATION PLAN

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SITE LOCATION

Effingham Booster Station ■ Guyton, Georgia
June 12, 2020 ■ Terracon Project No. ES205101

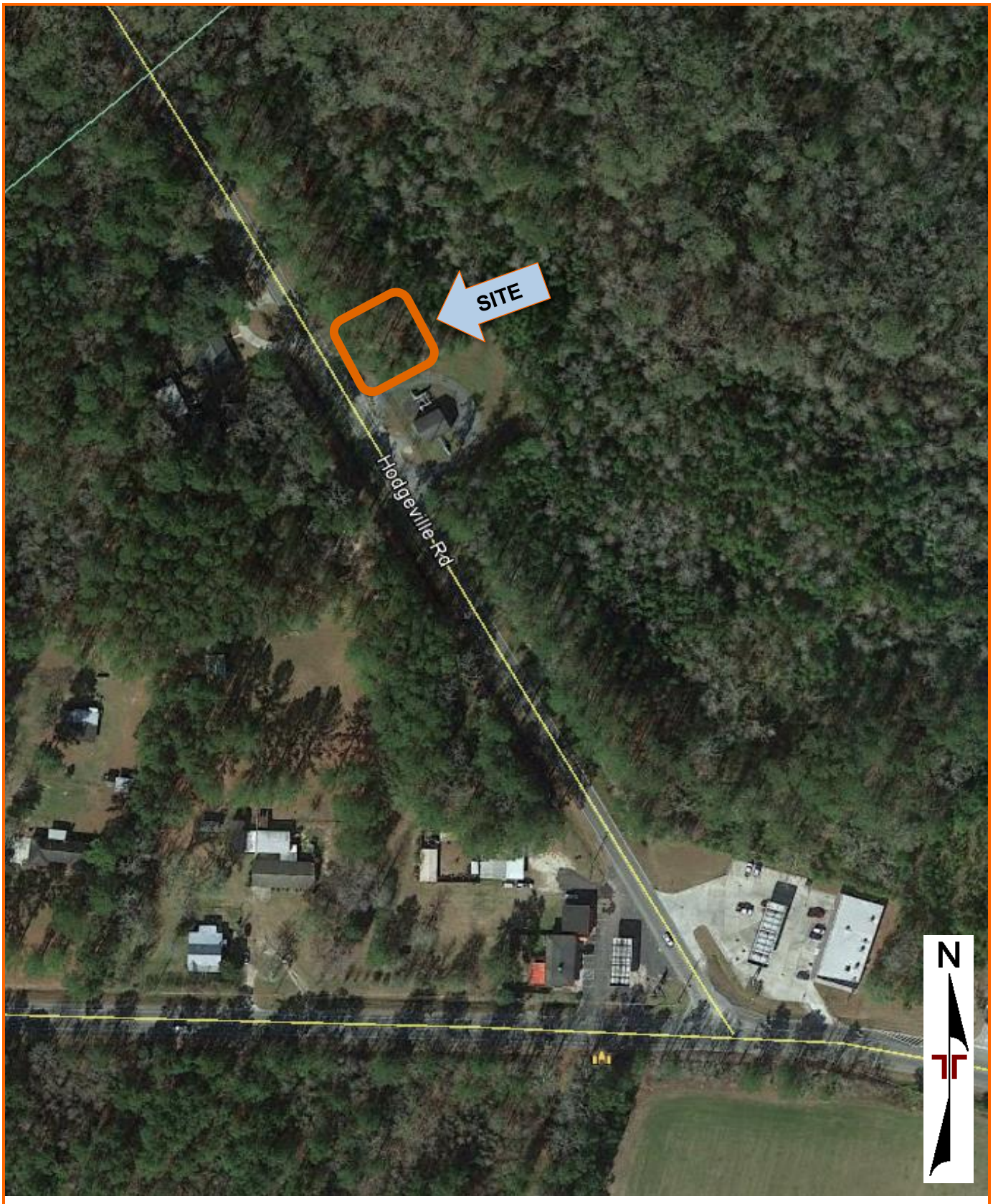

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE MAPS

Addendum 1

EXPLORATION PLAN

Effingham Booster Pump Station ■ Guyton, Georgia

June 12, 2020 ■ Terracon Project No. ES205101

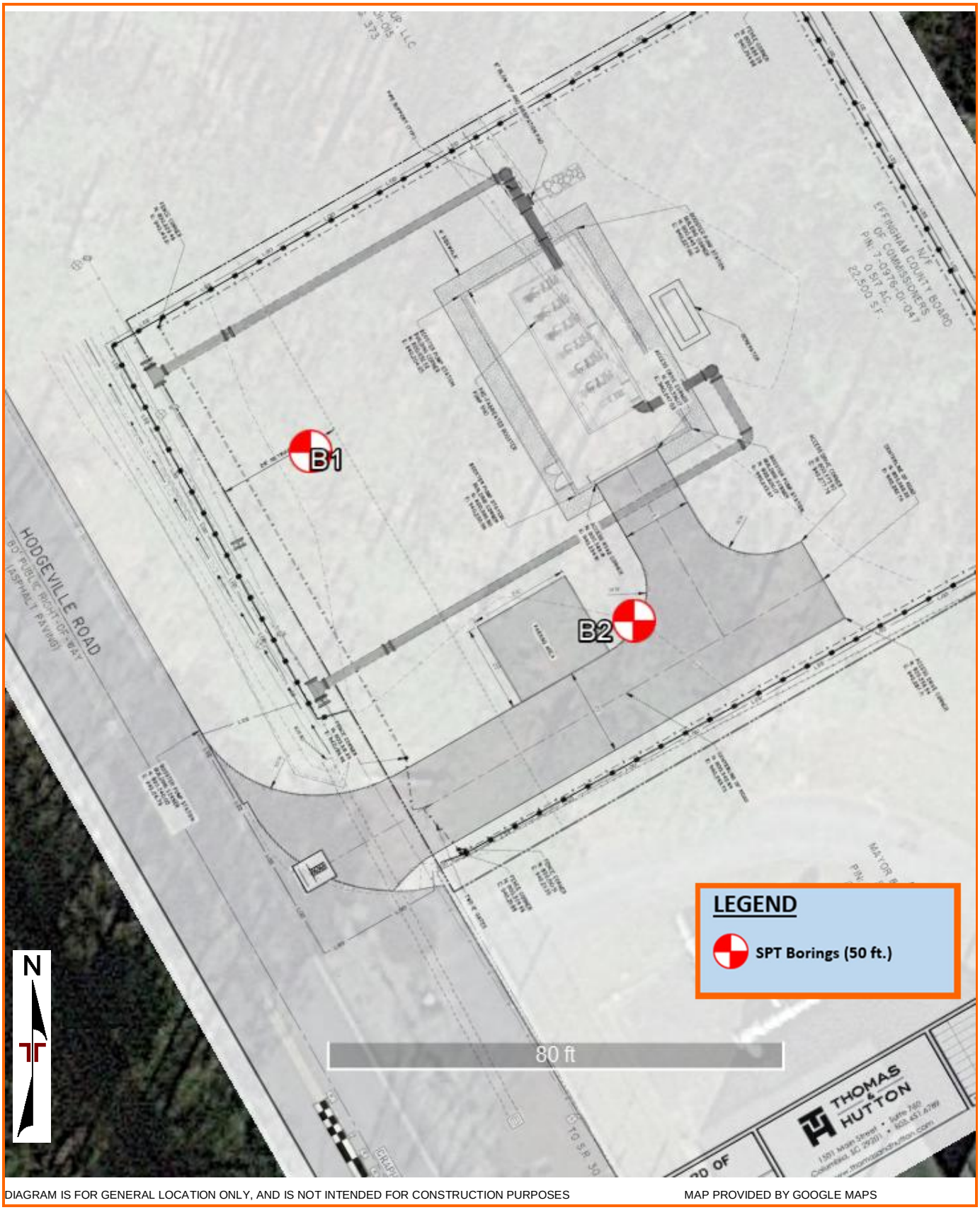

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE MAPS

EXPLORATION RESULTS

Contents:

- SPT Fence
- SPT Boring Logs (B1 and B2)

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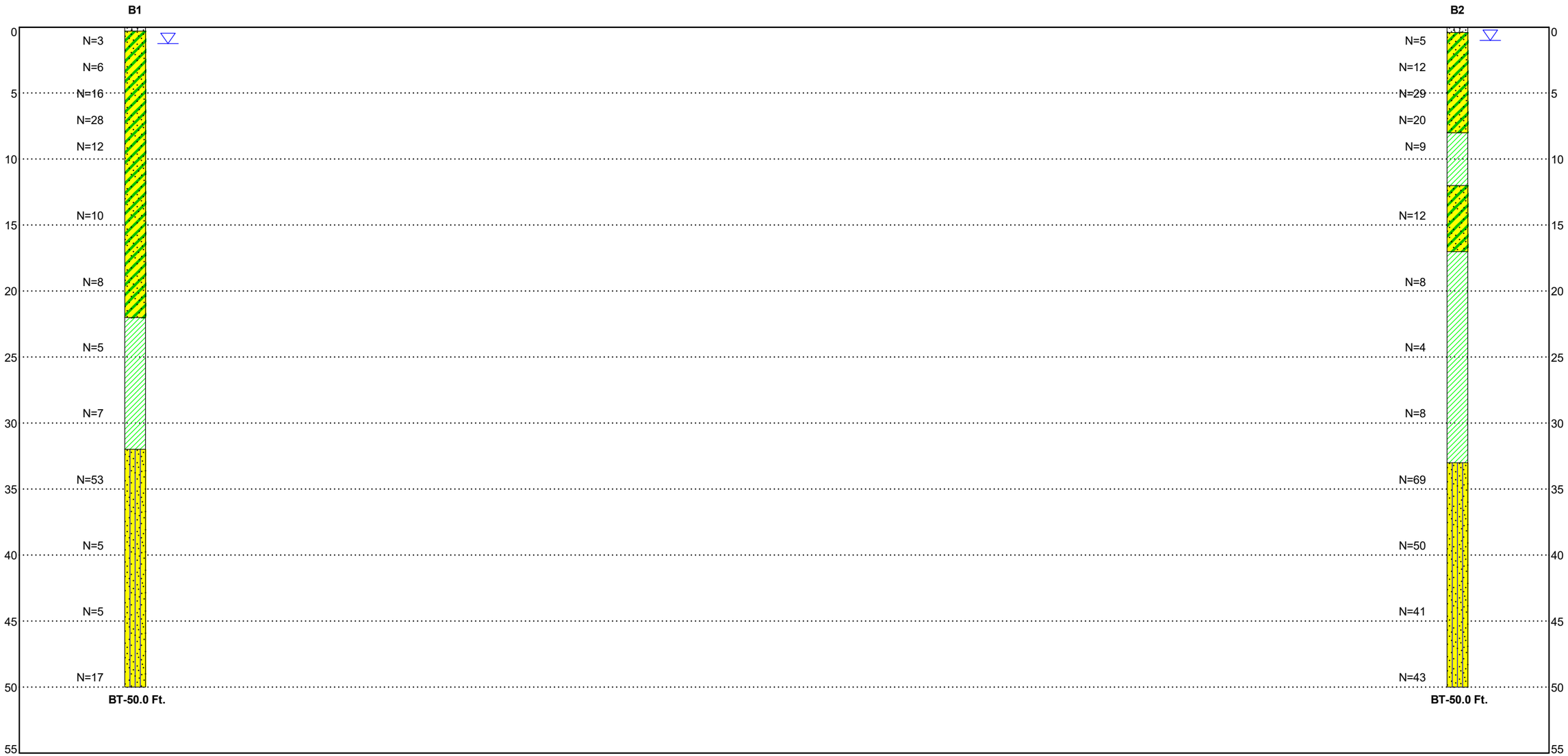


Topsoil | Clayey Sand | Lean Clay | Silty Sand

Explanation

B1 — Borehole Number
Moisture Content — %w
LL PL — Liquid and Plastic Limits
Sampling (See General Notes)
Borehole Lithology
AR
BT
Borehole Termination Type

Water Level Reading at time of drilling.

Water Level Reading after drilling.

NOTES:

See Exploration Plan for orientation of soil profile.
See General Notes in Supporting Information for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project No.: ES205101	Terracon	**SUBSURFACE PROFILE**
Date: 6/10/2020	2201 Rowland Ave Savannah, GA	EFFINGHAM BOOSTER STATION HODGEVILLE RD GUYTON, GA
Scale: N.T.S.		

Addendum 1

BORING LOG NO. B1

PROJECT: Effingham Booster Station

CLIENT: Thomas & Hutton Engineering Co
Savannah, GA

SITE: Hodgeville Rd
Guyton, GA

LOCATION See Exploration Plan

Latitude: 32.1978° Longitude: -81.2485°

DEPTH		WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**TOPSOIL**			
	CLAYEY SAND (SC), fine grained, gray/brown, very loose; 1-1-2-2 N=3			
	with small roots, brown, loose; 3-2-4-5 N=6	22	40-19-21	25
	medium dense; 5-7-9-11 N=16			
	fine grained, brown, medium dense; 14-16-12-10 N=28			
	9-7-5-5 N=12			
	3-4-6 N=10			
	loose; 3-3-5 N=8			
22.0				
	LEAN CLAY (CL), with fine sand, gray, medium stiff; 2-2-3 N=5			
	3-3-4 N=7			
32.0				
	SILTY SAND (SM), with clay, fine grained, gray, very dense; 15-25-28 N=53			
	dense; 2-2-3 N=5			
	2-2-3 N=5			
50.0	dense; 6-9-8 N=17			
	Boring Terminated at 50 Feet			

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

Hammer Type: Rope and Cathead

Advancement Method:
mud rotary

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

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

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

While drilling

Terracon
2201 Rowland Ave
Savannah, GA

Boring Started: 04-08-2020 | Boring Completed: 04-08-2020

Drill Rig: BR1 | Driller: Kevin and DC

Project No.: ES205101

Addendum 1

BORING LOG NO. B2

PROJECT: Effingham Booster Station

CLIENT: Thomas & Hutton Engineering Co
Savannah, GA

SITE: Hodgeville Rd
Guyton, GA

LOCATION See Exploration Plan

Latitude: 32.1977° Longitude: -81.2483°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.4		**TOPSOIL**							
		CLAYEY SAND (SC), with small roots, fine grained, dark gray, loose				2-2-3-4 N=5			
		medium dense				3-5-7-9 N=12			
		fine grained, dark gray, medium dense to dense	5			10-12-17-16 N=29			
8.0		gray/brown				11-11-9-8 N=20	23		38
		LEAN CLAY (CL), with sand, gray, stiff				4-5-4-7 N=9	43	41-21-20	
12.0			10						
		CLAYEY SAND (SC), fine grained, gray/brown, medium dense				4-6-6 N=12			
17.0			15						
		LEAN CLAY (CL), with sand, gray, stiff				3-4-4 N=8			
			20						
		fine grained, gray/brown, soft				3-2-2 N=4			
			25						
		stiff				3-4-4 N=8			
33.0			30						
		SILTY SAND (SM), gray/brown, very dense				21-25-44 N=69			
			35						
						13-20-30 N=50			
		dense	40						
						17-15-26 N=41			
50.0			45						
						14-20-23 N=43			
		Boring Terminated at 50 Feet	50						

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

Hammer Type: Rope and Cathead

Advancement Method:
mud rotary

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

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

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

While drilling

Terracon
2201 Rowland Ave
Savannah, GA

Boring Started: 04-08-2020 | Boring Completed: 04-08-2020

Drill Rig: BR1 | Driller: Kevin and DC

Project No.: ES205101

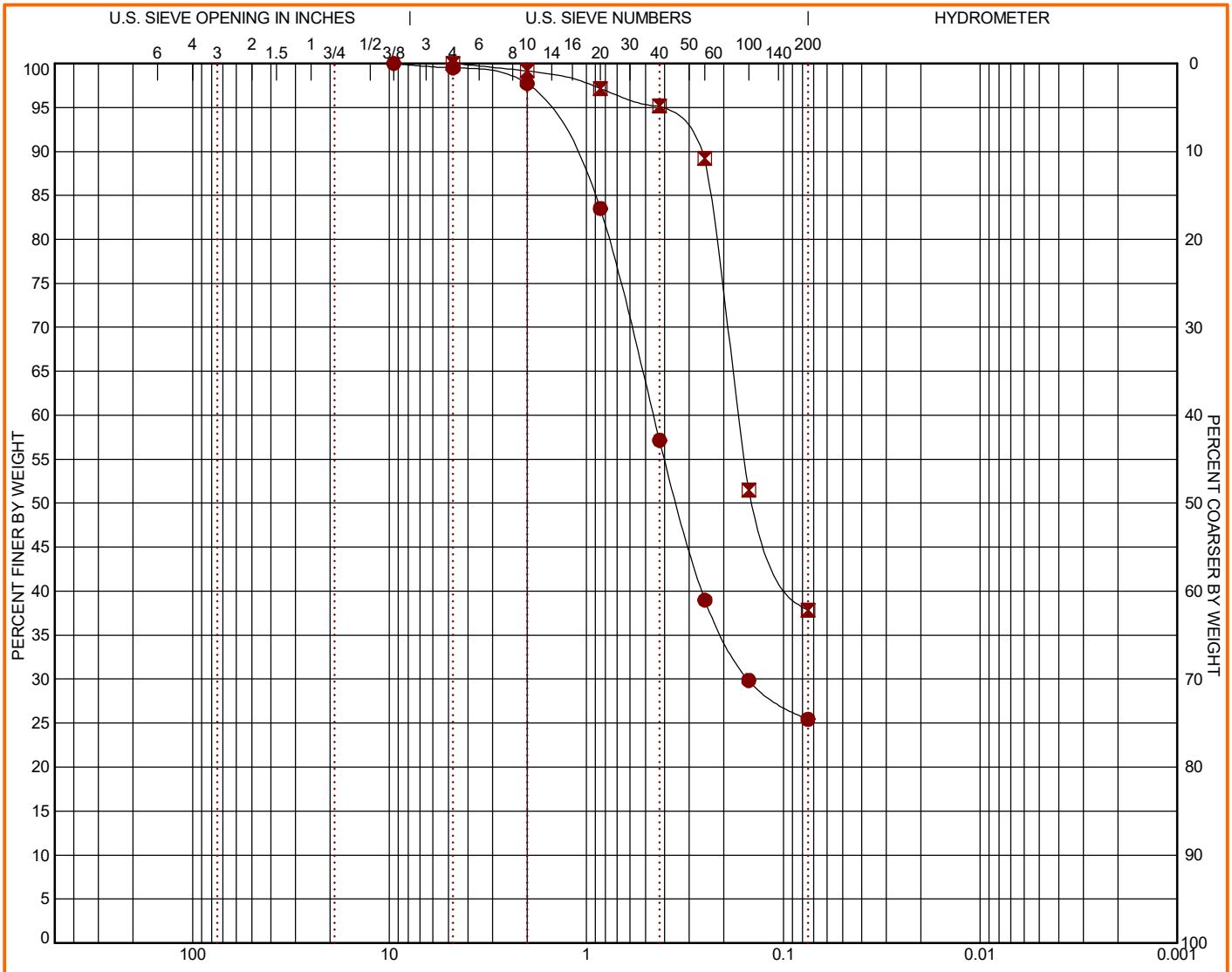
LABORATORY ANALYSIS RESULTS

Contents:

GRAIN SIZE DISTRIBUTION

Addendum 1

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	B1	2 - 4	0.0	0.5	74.1		25.4		SC
⊠	B2	6 - 8	0.0	0.0	62.1		37.9		

GRAIN SIZE	●	⊠	
D_{60}	0.458	0.168	
D_{30}	0.151		
D_{10}			

COEFFICIENTS	●	⊠	
C_C			
C_U			

●		⊠			
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	#4	100.0		
#4	99.5	#10	99.15		
#10	97.71	#20	97.14		
#20	83.52	#40	95.17		
#40	57.16	#60	89.19		
#60	38.98	#100	51.52		
#100	29.86	#200	37.87		
#200	25.44				

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	

REMARKS	
●	
⊠	

PROJECT: Effingham Booster Station

PROJECT NUMBER: ES205101

SITE: Hodgeville Rd
Guyton, GA

Terracon
2201 Rowland Ave
Savannah, GA

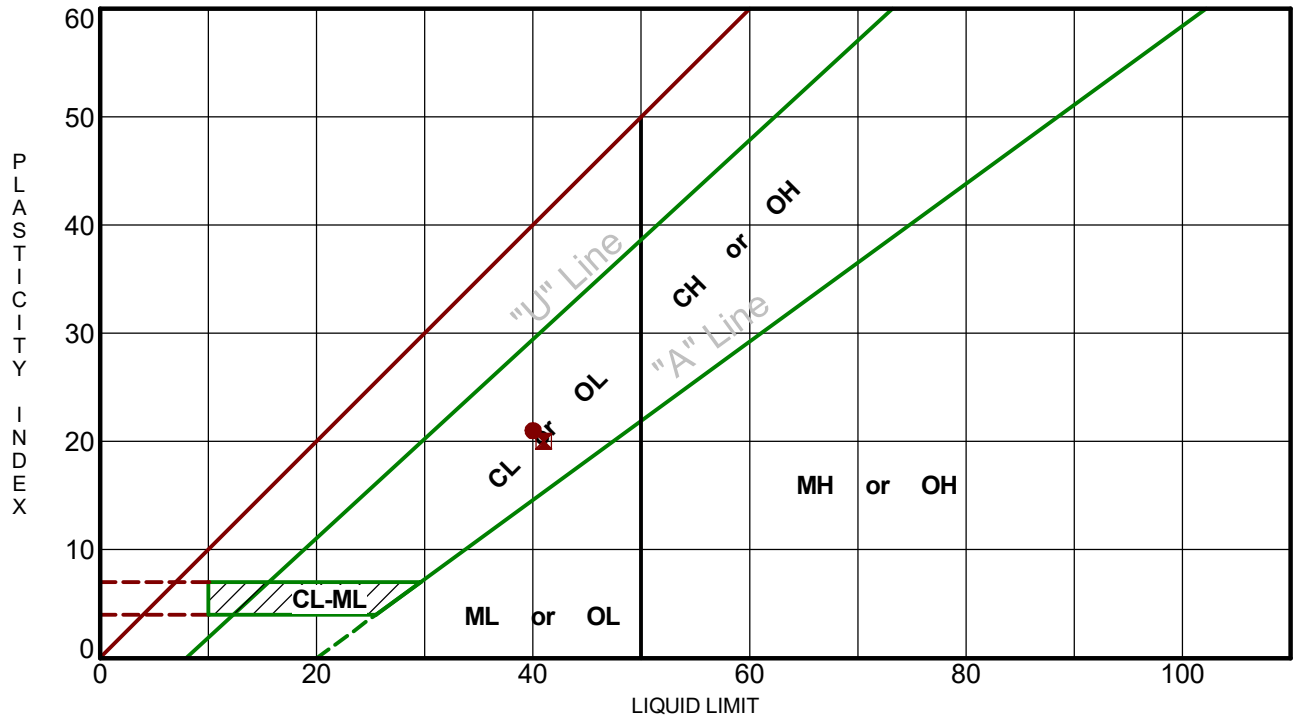
CLIENT: Thomas & Hutton Engineering Co
Savannah, GA

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 ES205101 EFFINGHAM BOOSTER_W_LAB.GPJ TERRACON_DATATEMPLATE.GDT 6/10/20

ATTERBERG LIMITS RESULTS

Addendum 1

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	B1	2 - 4	40	19	21			
⊠	B2	8 - 10	41	21	20			

PROJECT: Effingham Booster Station

PROJECT NUMBER: ES205101

SITE: Hodgeville Rd
Guyton, GA

Terracon
2201 Rowland Ave
Savannah, GA

CLIENT: Thomas & Hutton Engineering Co
Savannah, GA

Addendum 1

SUPPORTING INFORMATION

Contents:

Seismic Design Parameters Based on IBC2018 Code and ASCE 7-16 Standard

Terracon Project Name: Effingham Booster Station

Terracon Project No: ES205101

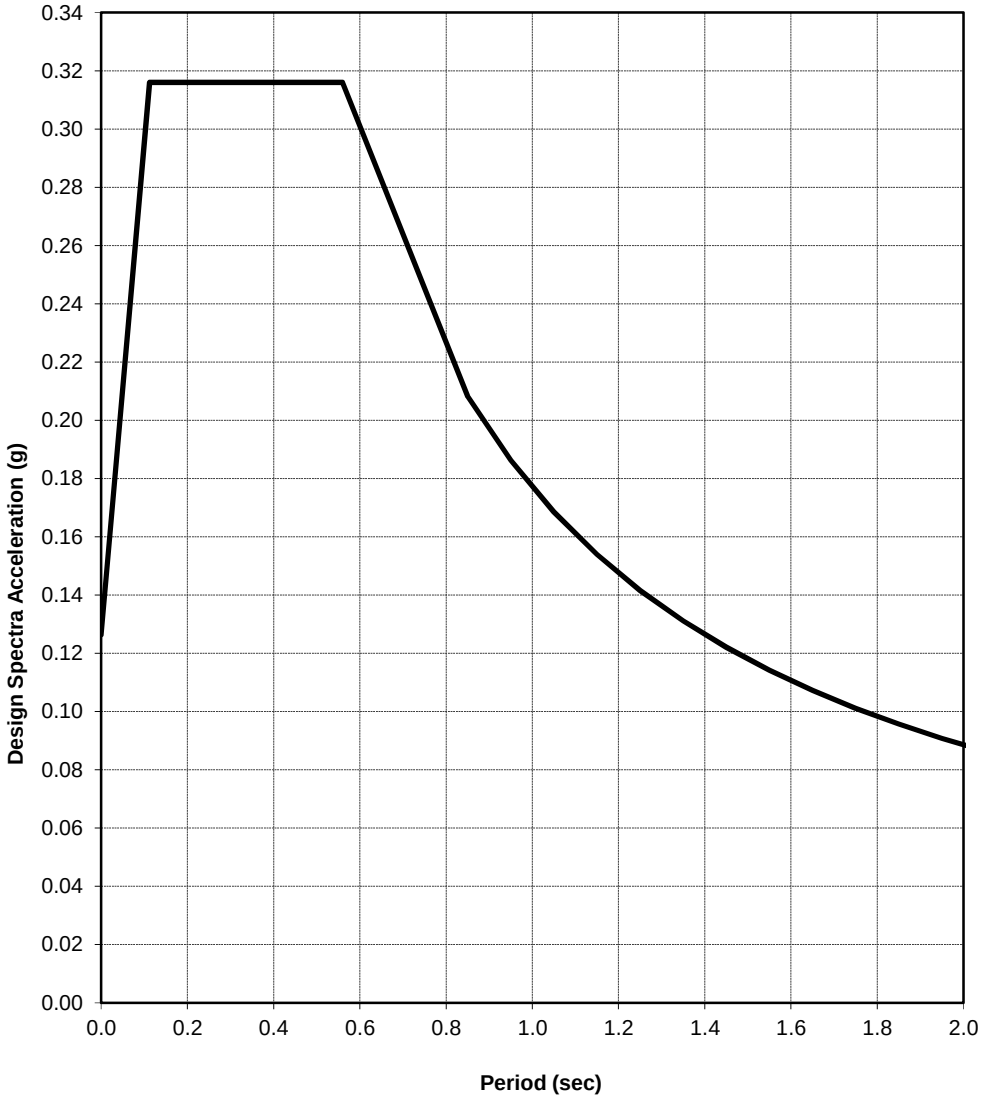
Site Location: Guyton, Georgia
Latitude : 32.1978°
Longitude -81.2485°

Site Class: **D**

Design Response Spectrum for the Site Class

S_s	0.305	S_1	0.112
F_a	1.556	F_v	2.376
S_{MS}	0.475	S_{M1}	0.266
S_{DS}	0.316	S_{D1}	0.177

	Period (sec)	Sa (g)
	0.000	0.126
T_0	0.112	0.316
	0.200	0.316
T_S	0.560	0.316
T	0.850	0.208
	0.950	0.186
	1.050	0.169
	1.150	0.154
	1.250	0.142
	1.350	0.131
	1.450	0.122
	1.550	0.114
	1.650	0.107
	1.750	0.101
	1.850	0.096
	1.950	0.091
	2.050	0.086
	2.150	0.082
	2.250	0.079



GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS
Effingham Booster Station ■ Guyton, GA
Terracon Project No. ES205101

Addendum 1

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

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

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

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

Addendum 1

UNIFIED SOIL CLASSIFICATION SYSTEM

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[Q] PI plots below "A" line.