Geotechnical Engineering Services
Laboratory Addition Science Building J-157
Kennesaw State University
Kennesaw, Georgia
ATC Project Number 066.23271.5780

Prepared For:

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April 1, 2010

Perkins+ Will
1382 Peachtree Street NE
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Attention: Mr. Michael Reid, AIA LEED AP BD+C
Associate Principal

Subject: Geotechnical Engineering Services
Laboratory Addition Science Building J-157
Kennesaw State University
Kennesaw, Georgia
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Gentlemen:

ATC Associates Inc. has completed the authorized Geotechnical Engineering Services for the subject **Laboratory Addition Science Building J-157** project at Kennesaw State University. The attached report discusses our exploration procedures, describes existing site and subsurface conditions, and presents our geotechnical evaluations, conclusions, and recommendations.

A Stage One Statement of Geotechnical Engineer is provided in the report Appendix. The Stage Two Statement will be prepared following review of final drawings.

We have enjoyed working with you on this project. Please contact us if you have questions regarding this report, or if we may be of further service.

Sincerely,
ATC Associates Inc.

Alex Goharioon
Vice President

David J. McConnell, PE
Principal Engineer

GEORGIA REGISTERED NO. 025578 PROFESSIONAL ENGINEER DAVID J. McCONNELL

Philip Manavi, PE
Staff Engineer

Copies submitted: Addressee (3, 1 via email)

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EXECUTIVE SUMMARY

The following information is provided as a brief summary of the recommendations provided within the enclosed report. The report should be read in its entirety prior to the implementation into design and construction of this project.

- We understand that the planned Laboratory Addition Science Building J-157 at Kennesaw State University will occupy about 53,000 square feet. The building will be a 4-story building with a subsurface basement for main mechanical and electrical equipment. There will be a connecting atrium to the existing Math and Sciences Building. The anticipated floor-to-floor height is 15 feet 4 inches. Anticipated maximum column loads may be in the 450 to 500 kip range. The partial basement finish floor elevation will be at EL1048 feet. A large retaining wall will be located south of the building. The wall will be approximately 350 feet in length and will have a maximum height of approximately 25 to 30 feet.

- Twelve (12) soil test borings were drilled at the subject site for the purpose of evaluating the subsurface conditions. The borings were designated B-1 through B-12. The borings were drilled to auger refusal depths ranging from about 5 to 73 feet below the existing ground surfaces. The approximate locations of the borings are shown on the Boring Location Plan in the Appendix. Descriptions of the materials and conditions encountered in the soil borings are shown on the Test Boring Records in the Appendix. Below the ground surface, the soil test borings encountered surface materials, fill materials, residual soils, partially weathered rock, auger refusal materials, and groundwater. Data from the soil test borings are shown on the Test Boring Records in the Appendix.

- We recommend that spread footings be utilized for foundation support of the proposed building. Based on the soil test boring information, the footings will bear on or near auger refusal (rock) materials or on natural residual soils. In order to minimize potential differential settlements between the footings on or near rock and the footings underlain by residual soils, we recommend that the footings underlain by residual soils be supported on a thickness of well-compacted GAB (graded aggregate base) materials. We recommend designing all the footings for allowable bearing pressures of 5,000 psf subject to the provisions outlined in this report.

- Should the FFE of the building ground floor or at the partial basement be about 5 feet or less above existing rock elevations, it would be possible to support the structure on shallow foundations essentially bearing on the rock. We recommend that blasting or excavation allow for a 1-foot thickness of well-compacted GAB to be installed between the rock and the bottom of footings. For this foundation type, we anticipate that total and differential settlements will be minimal. Each footing should be evaluated by a geotechnical engineer to verify that the required bearing capacity of 5,000 psf is attained.

- Where the FFE of the building ground floor or at the partial basement is more than about 5 feet above existing rock elevations, we recommend installing a thickness of well-compacted GAB below footings in order to reduce settlements. Considering the subsurface conditions and the anticipated maximum column loads, we recommend installing the thicknesses of GAB materials below footings as indicated in the following table. The GAB should extend horizontally beyond the edges of the footings distances of at least 2 feet. The GAB should be compacted to at least 95% of the Modified Proctor maximum dry density.

Maximum Footing Column Load (kips)	Recommended Thickness Of GAB Below Footing (feet)
100 to 200 kips	1
200 to 300 kips	2
300 to 400 kips	3
400 to 500 kips	4

  For this foundation type, we estimate that total and differential settlements would be on the order of ½ inch or less. Each undercut footing subgrade bottom should be evaluated by a geotechnical engineer to verify that a suitable bearing capacity is available.

- We have reviewed the 2006 International Building Code (IBC 2006) criteria for establishing a Site Class Definition per Sections 1613.5.2 and 1613.5.5 for the project site. Based on the project information and the test boring N-values, it is our opinion that the average subsurface conditions correspond to Site Class "C" as described in Table 1613.5.2. Mapped spectral response acceleration values are S_1=0.093 and Ss=0.280. Mapped spectral response acceleration values are S_1=0.093 and Ss=0.280. Calculated design spectral response values are S_{d1}=.105 and S_{ds}=0.224.

- Difficult excavation techniques will be necessary for planned excavations in any dense residual soils, any partially weathered rock (PWR), and auger refusal materials. Based on the planned FFEs, there is a possibility that several feet of partially weathered rock and auger refusal materials will have to be excavated in some building areas.

- Groundwater was encountered only in Boring B-11 after approximately 24 hours at a depth of about 43 feet (Elevation 1044 feet). Cave depths were noted between depths of about 3 to 55 feet. Based on the available groundwater measurement data, it appears that the basement FFE at EL 1048 feet may be close to the recorded groundwater level in Boring B-11 at EL 1044 feet. Temporary dewatering will be necessary if the groundwater is encountered during construction. We recommend that a permanent dewatering system be planned for the basement level.

Geotechnical Engineering Services
Laboratory Addition Science Building J-157
Kennesaw State University
Kennesaw, Georgia

ATC Project Number 066.23271.5780

1.0 INTRODUCTION

1.1 Project Information

We understand that the planned Laboratory Addition Science Building J-157 at Kennesaw State University will occupy about 53,000 square feet. The building will be a 4-story building with a subsurface basement for main mechanical and electrical equipment. There will be a connecting atrium to the existing Math and Sciences Building.

The anticipated floor-to-floor height is 15 feet 4 inches. Anticipated maximum column loads may be in the 450 to 500 kip range. The partial basement finish floor elevation will be at EL1048 feet.

A large retaining wall will be located south of the building. The wall will be approximately 350 feet in length and will have a maximum height of approximately 25 to 30 feet.

1.2 Purpose & Scope of Services

The purpose of our Geotechnical Engineering Services was to assess subsurface soil conditions at the site of the planned project and to provide geotechnical recommendations regarding project design and construction.

Specifically, our services were directed to providing the information requested in the RFQ letter dated February 9, 2010, and clarifications made in the addendum issued via email on February 17, 2010, as outlined below:

1. Soil types and characteristics
2. Recommended values for footings bearing on rock where rock is shallow
3. Recommendations for other types of column foundation support (such as Geopiers and VibroPiers)
4. Elevation of water table and management of groundwater
5. Foundation support of the structure and floor slab recommendations
6. Recommended retaining wall design values
7. Anticipated total and differential settlements for each bearing component
8. Expansive or collapse potential of soils

9. Location of fault lines
10. Permeability rate
11. Recommendations or requirements for cut/fill activities
12. Identification of any unsuitable soils and quantities
13. Slope stabilization, including maximum grades
14. Boring logs
15. Design spectral acceleration, short period (S_{ds}) and 1-second period (S_{d1})
16. Stage One and Stage Two Statements of Geotechnical Engineer

The services were provided in general accordance with our Proposal dated March 5, 2010.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site. A Phase I Environmental Site Assessment and a GEPA study will be submitted for the project as separate reports. Any statements in this report or on the Test Boring Records regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client.

2.0 EXPLORATION PROCEDURES

2.1 Site Reconnaissance

Prior to the field exploration, the site and surrounding areas were visually evaluated by an engineer from our office. The observations made were used in planning this exploration and in determining areas of special interest.

2.2 Field Exploration

Twelve (12) soil test borings were drilled at the subject site for the purpose of evaluating the subsurface conditions. The borings were designated B-1 through B-12. The borings were drilled to auger refusal depths ranging from about 5 to 73 feet below the existing ground surfaces. The approximate locations of the borings are shown on the Boring Location Plan in the Appendix. Descriptions of the materials and conditions encountered in the soil borings are shown on the Test Boring Records in the Appendix.

Boring locations were established in the field by estimating distances and right angles from existing site features. Boring elevations were estimated from available topographic information. The locations shown on the Boring Location Plan and elevations indicated on the Test Boring Records should be considered approximate.

All soil sampling and standard penetration testing were performed in general accordance with ASTM Standard D-1586. The soil test borings were advanced by mechanically turning hollow-stem augers into the soil. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., 2.0-inch O.D., split-barrel sampler. The sampler was first seated 6 inches and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the final foot was recorded and is designated the “standard penetration resistance.” Penetration resistance, when properly evaluated, is an index of the soil strength and foundation support capability.

The borings were drilled using an Automatic Hammer to drive the split-spoon sampler. The Automatic Hammer is more efficient than the traditional safety hammer and imparts more energy to the split-spoon sampler. Thus the resistance values are slightly lower than the traditional rope-cathead equipment.

Representative portions of the soil samples obtained with the split-barrel sampler were sealed in glass jars and transported to our laboratory. In the laboratory, they were examined by a geotechnical engineer and classified using the Unified Soil Classification System. The soil descriptions and classifications are based on visual examination and should be considered approximate.

2.3 Laboratory Testing

Atterberg Limits, grain-size testing, and moisture content tests were conducted on selected soil samples obtained from our soil test borings. The tests were performed for classification and correlation purposes. The test results are provided in the Appendix.

Based on review of the grain-size testing, we estimate a coefficient of permeability rate of k = 0.1 to 0.2 inches per hour for the SM soils underlying the site. Permeability testing can be performed at the site if a test location and test depth are specified.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Description

The site of the proposed building location is on the Kennesaw State University campus in a landscaped and wooded area just south of the College of Science and Mathematics and the Clendenin Computer Science and Mathematics Buildings. The site slopes upward from north to south. An existing retaining wall separates the landscape and wooded areas and is located south of the Clendenin Building.

3.2 Area Geology

The site is located in the Piedmont Physiographic Province, an area underlain by ancient igneous and metamorphic rocks. The upland soils in this area are the residual product of in-place weathering of the parent rock. A typical residual soil profile consists of clayey soils near the surface, where soil weathering is more advanced, underlain by sandy silts and silty sands that generally become less weathered and denser with depth to the top of parent bedrock. The boundary between soil and rock is usually not clearly defined.

A transitional zone called “partially weathered rock” is normally found above the parent bedrock. Partially weathered rock is defined for engineering purposes, as residual material with standard penetration resistances in excess of 100 blows per foot and which can be penetrated by soil drilling equipment. Weathering is facilitated by fractures, joints, and the presence of less resistant rock types. Consequently, partially weathered rock and the hard rock profiles are irregular, and zones of partially weathered rock or rock may occur within the soil mantle well above the general bedrock level.

Our review of geologic maps indicates no fault lines in the area.

3.3 General Subsurface Conditions

Data from the soil test borings are shown on the Test Boring Records in the Appendix. The subsurface conditions discussed in the following paragraphs and those shown on the Test Boring Records represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. We note that the transition between different soil strata is less distinct than those shown on the Test Boring Records. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times.

Subsurface Cross Sections indicating subsurface conditions encountered in the borings are presented in the Appendix.

Below the ground surface, the soil test borings encountered surface materials, fill materials, residual soils, partially weathered rock, auger refusal materials, and groundwater. These materials are described in the following paragraphs.

3.3.1 Surface Materials

Most of the borings initially encountered a thin topsoil layer beginning at the ground surface. The thickness of the topsoil was measured as 1 to 4 inches. Topsoil thicknesses should be expected to vary somewhat across the site. Approximately 6 inches of concrete was measured at Boring B-1 within the sidewalk.

3.3.2 Fill Materials

Fill material may be any material that has been transported and deposited by man. Soils described as fill and possible fill were encountered in Borings B-2 through B-5 to depths of about 3 to 5 feet. The fill materials were described as loose to medium dense silty sands (SM) with occasional rock fragments, fine roots, and a small piece of textile fabric in Boring B-5. Standard Penetration Test resistances ranged from 7 to 21 blows per foot (bpf).

3.3.3 Residual Soils

Residual soil, formed by in-place weathering of the parent rock, was encountered in all the borings (except Borings B-5 and B-8) beneath the surface and fill materials. The residuum consisted of sands (SP), silty sands (SM), clayey sands (SC), and clays (CH). Many of the samples contained various amounts of quartz and rock fragments. Standard penetration resistance values ranged between 4 to 77 bpf, but were typically between 10 to 23 bpf. The materials generally became more stiff and dense with increasing depth.

3.3.4 Partially Weathered Rock

Partially weathered rock (PWR) is a transitional material between soil and rock, which retains the relic structure of the rock and has very hard or very dense consistencies. Partially weathered rock is locally defined as material with standard penetration resistances greater than 100 blows per foot, which can be penetrated by the power auger. Partially weathered rock was encountered in a majority of the borings below residual soils or surface materials. The partially weathered rock was encountered at depths ranging between the ground surface (Boring B-8) to about 38 feet (Elevations 1069 to 1034 feet). The PWR generally extended to auger refusal depths. The partially weathered rock was generally described as very dense silty sands (SM) and sands (SP) with varying amounts of rock fragments. A table is presented on page 7 indicating approximate depths to encountered partially weathered rock.

3.3.5 Auger Refusal Material

Refusal is a designation applied to any material that cannot be further penetrated by the power auger and is normally indicative of very hard to very dense material, such as boulders, lenses, or the upper surface of bedrock. Auger refusal materials were encountered in all of the soil test borings at depths ranging from about 5 to 73 feet (Elevations 1057 to 1014 feet) below the existing ground surfaces. The following table summarizes the encountered PWR and auger refusal depths.

Soil Test Boring Location	Depth to Partially Weathered Rock (feet)	PWR Elevation (feet)	Depth to Auger Refusal (feet)	Auger Refusal Elevation (feet)
B-1	28	1034	30	1032
B-2	NE	NE	14	1047
B-3	NE	NE	13	1049
B-4	18	1044	19	1043
B-5	3	1060	6	1057
B-6	NE	NE	17	1056
B-7	NE	NE	41.5	1039.5
B-8	0	1053	5	1048
B-9	13(lense)/ 23	1063/ 1053	26	1050
B-10	NE	NE	27	1057
B-11	18(lense)/ 43(lense)/ 63	1069/ 1044/ 1024	73	1014
B-12	38	1040	39	1039

Notes: Elevations and depths are approximate.
NE = Not Encountered

3.3.6 Groundwater

Groundwater was encountered only in Boring B-11 after approximately 24 hours at a depth of about 43 feet (Elevation 1044 feet). Cave depths were noted between depths of about 3 to 55 feet. Groundwater levels fluctuate with seasonal and climatic variations and may be different at other times and locations than those stated in the report.

4.0 DESIGN RECOMMENDATIONS

4.1 General

The following conclusions and recommendations are based on our observations at the site, interpretation of the field data obtained during the study, and our experience with similar subsurface conditions. Subsurface conditions in unexplored locations may vary somewhat from those encountered. If structure location, loads, or elevations are changed, we request that we be advised so that we may review our recommendations.

4.2 Foundation Support

4.2.1 General

We recommend that spread footings be utilized for foundation support of the proposed building. Based on the soil test boring information, the footings will bear on or near auger refusal (rock) materials or on natural residual soils.

In order to minimize potential differential settlements between the footings on or near rock and the footings underlain by residual soils, we recommend that the footings underlain by residual soils be supported on a thickness of well-compacted GAB (graded aggregate base) materials. We recommend designing all the footings for allowable bearing pressures of 5,000 psf subject to the provisions outlined in the following paragraphs.

An alternative to installing a thickness of GAB below footings underlain by soils could be to use aggregate piers, such as Geopiers or Hayward Baker VibroPiers.

4.2.2 Spread Footings On Rock

Should the FFE of the building ground floor or at the partial basement be about 5 feet or less above existing rock elevations, it would be possible to support the structure on shallow foundations essentially bearing on the rock.

We recommend that blasting or excavation allow for a 1-foot thickness of well-compacted GAB to be installed between the rock and the bottom of footings.

For this foundation type, we anticipate that total and differential settlements will be minimal. Each footing should be evaluated by a geotechnical engineer to verify that the required bearing capacity of 5,000 psf is attained.

Bottoms of foundation excavations should be evaluated by a geotechnical engineer prior to placement of reinforcing steel and concrete to verify that adequate bearing materials are present and that all debris, mud, and loose, frozen or water-softened soils are removed. Foundation excavations should be concreted as soon as practical after they are excavated. Water should not be allowed to pond in any excavation.

Lateral loads on spread footings may be resisted by (a) friction between the concrete footing and the underlying rock subgrade considering a coefficient of friction of 0.5, and (b) an allowable soil passive earth pressure of 160 pounds per square foot per foot of depth.

All footings should be embedded so that the bottom of the foundation is a minimum of 18 inches below the adjacent compacted grades on all sides. Strip or wall footings should be a minimum of 18 inches wide and pad or column footings should be a minimum of 24 inches wide. The minimum footing sizes should be used regardless of whether or not the foundation loads and allowable bearing pressures dictate a smaller size. These minimum footing sizes tend to provide adequate load bearing area to develop overall bearing capacity and account for minor variations in the bearing materials.

4.2.3 Spread Footings Underlain by Residual Soils

Where the FFE of the building ground floor or at the partial basement is more than about 5 feet above existing rock elevations, we recommend installing a thickness of well-compacted GAB below footings to reduce settlements.

Considering the subsurface conditions and the anticipated maximum column loads, we recommend installing the thicknesses of GAB materials below footings as indicated in the following table. The GAB should extend horizontally beyond the edges of the footings distances of at least 2 feet. The GAB should be compacted to at least 95% of the Modified Proctor maximum dry density.

Maximum Footing Column Load (kips)	Recommended Thickness Of GAB Below Footing (feet)
100 to 200 kips	1
200 to 300 kips	2
300 to 400 kips	3
400 to 500 kips	4

For this foundation type, we estimate that total and differential settlements would be on the order of ½ inch or less. Each undercut footing subgrade bottom should be evaluated by a geotechnical engineer to verify that a suitable bearing capacity is available.

Bottoms of foundation excavations should be evaluated by a geotechnical engineer prior to placement of reinforcing steel and concrete to verify that adequate bearing materials are present and that all debris, mud, and loose, frozen or water-softened soils are removed. Foundation excavations should be concreted as soon as practical after they are excavated. Water should not be allowed to pond in any excavation.

Lateral loads on spread footings may be resisted by (a) friction between the concrete footing and the underlying GAB considering a coefficient of friction of 0.5, and (b) an allowable soil passive earth pressure of 160 pounds per square foot per foot of depth.

All footings should be embedded so that the bottom of the foundation is a minimum of 18 inches below the adjacent compacted grades on all sides. Strip or wall footings should be a minimum of 18 inches wide and pad or column footings should be a minimum of 24 inches wide. The minimum footing sizes should be used regardless of whether or not the foundation loads and allowable bearing pressures dictate a smaller size. These minimum footing sizes tend to provide adequate load bearing area to develop overall bearing capacity and account for minor variations in the bearing materials.

4.2.4 Rock Depths

Depths to rock at specific column locations can be evaluated by the planned future airtrack drilling. Foundation support conditions can then be established at each column location for design and construction considerations.

4.3 Soil-Supported Slabs

Floor slabs may be soil-supported on competent existing residual soils or structural fill installed above residual soils. Soil-supported slabs should be jointed around columns and along walls to minimize cracking as a result of possible differential movement. We also recommend use of an impermeable membrane to reduce dampness from soil moisture. A 4-inch thick layer of GAB installed below slabs would provide added support and would serve as a good working surface during construction. A Modulus of Subgrade value of 140 psi/inch may be used for slab design.

4.4 Seismic Site Class Definition

We have reviewed the 2006 International Building Code (IBC 2006) criteria for establishing a Site Class Definition per Sections 1613.5.2 and 1613.5.5 for the project site. Based on the project information and the test boring N-values, it is our opinion that the average subsurface conditions correspond to Site Class "C" as described in Table 1613.5.2.

Mapped spectral response acceleration values are S_1=0.093 and Ss=0.280. Calculated design spectral response values are S_{d1}=.105 and S_{ds}=0.224.

4.5 Retaining/Below Grade Walls

Earth pressures on walls below grade are influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are the active and at-rest conditions.

Active conditions apply to relatively flexible earth retention structures, such as free-standing walls, where some movement and rotation may occur to mobilize soil shear strength. Walls which are rigidly restrained, such as basement, pit and tunnel walls, should be designed for the at-rest condition. A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures. Because significant wall movements are required to develop the passive pressure, the total calculated passive pressure should be reduced by one-half for design purposes.

Based on previous experience with similar soils and construction, we recommend the following earth pressure coefficients and equivalent fluid pressures for design of reinforced concrete retaining or below grade walls:

Earth Pressure Conditions	**Coefficient**	**Recommended Equivalent Fluid Pressure (psf/ft)**
Active (K_a)	0.36	43
At-Rest (K_o)	0.53	64
Passive (K_p)	2.77	166

A moist soil unit weight of 120 pounds per cubic foot should be used for design calculations. An allowable bearing capacity of 3,000 psf may be used for design of retaining wall footings established in competent existing fills, natural soils, or new structural fill. A coefficient of friction value of 0.35 may be used between the concrete footing and soils.

Our recommendations assume that the ground surface above the wall is level and that residual soils similar to those found in our borings will be used for wall backfill.

The recommended equivalent fluid pressures assume that constantly functioning drainage systems are installed between walls and soil backfill to prevent the accidental buildup of hydrostatic pressures and lateral stresses in excess of those stated. If a functioning drainage system is not installed, then lateral earth pressures should be determined using the buoyant weight of the soil (approximately 58 pcf). Hydrostatic pressures calculated with the unit weight of water (62.4 pcf) should be added to these earth pressures to obtain the total stresses for design.

Tractors and other heavy equipment should not operate within 6 feet of below grade walls to prevent lateral pressures in excess of those cited. If footings or other surcharge loadings are located a short distance outside below grade walls, they may also exert appreciable additional lateral pressures that must be considered in the design of the wall.

These retaining wall/below grade wall recommendations should not be correlated with soil parameters for use in any Mechanically Stabilized Earth (MSE) wall design. We recommend that soil parameters for any MSE retaining wall design be established through appropriate laboratory testing by the wall designer.

4.6 Slope Stability

Our exploration did not include a detailed analysis of slope stability for any temporary or permanent condition. However, we recommend temporary slopes no steeper than 1.5(H):1.0(V) and permanent slopes no steeper than 2.0(H):1.0(V) for construction in competent natural soils or new structural fill.

A minimum building setback from the top of all slopes of 10 feet is recommended. In pavement areas, a minimum top of slope setback of 5 feet is recommended.

During construction, temporary slopes should be regularly evaluated for signs of movement or unsafe condition. Soil slopes should be covered for protection from rain, and surface runoff should be diverted away from the slopes. For erosion protection, a protective cover of grass or other vegetation should be established on permanent soil slopes as soon as possible.

5.0 CONSTRUCTION RECOMMENDATIONS

5.1 Site and Subgrade Preparation

We recommend that any existing sidewalks, pavements, trees, utilities, vegetation, root systems, refuse, or other deleterious non-soil materials be removed/stripped from proposed construction areas and properly disposed of offsite. Underlying utility lines should be removed. The removal/stripping should extend at least 5 feet beyond planned construction limits.

After stripping and excavation as necessary, all areas intended to support floor slabs, pavements, and new fill should be carefully evaluated by an ATC engineer. At that time, the engineer may require proofrolling of the subgrade with a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The purpose of the proofrolling is to locate soft, weak, or excessively wet soils present at the time of construction. Any unsuitable materials observed during the evaluation and proofrolling operations should be undercut and replaced with compacted structural fill or stabilized in-place.

We recommend that an allowance or provision be made in the contract documents for undercutting and replacement of the existing fill, or other poor quality subgrade materials in case they are found during construction.

5.2 Structural Fill

Fill used to replace undercut areas or to establish desired finished grades should not be excessively plastic (Plasticity Index less than 30) and should be generally free of deleterious materials and rock fragments larger than 3 inches in diameter. We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting of fill soils. We do not anticipate significant problems in controlling moistures within the fill during dry weather, but moisture control may be difficult during winter months or extended periods of rain.

We expect that most of the onsite materials should be suitable for re-use as structural fill, although any proposed fill materials should be tested to establish suitability. Highly micaceous soils are typically difficult to compact. Clayey soils may be difficult to work with because of moisture control and conditioning issues.

Structural fill should be placed in lifts of 6 to 8 inches or less loose measure. We recommend that structural fill be compacted to at least 95 percent of the Standard Proctor (ASTM D-698) maximum dry density. The upper 12 inches beneath slabs and pavements should be compacted to at least 98 percent of the same criteria. Moisture content of the fill should be maintained within a range of +\- 3% of the optimum moisture.

All fill material should be placed in horizontal lifts and adequately keyed into stripped and scarified subgrade soils. All new fill should also be benched into any existing slopes.

In excavated areas, the upper 12 inches of soils intended to support floor slabs and pavements should be scarified and recompacted to at least 98 percent of the Standard Proctor maximum dry density. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 to 4 inches may be required to achieve specified degrees of compaction.

During fill placement, field density tests should be performed by an ATC soils technician to determine the degree of compaction and compliance with the project specifications. For underfloor areas, at least one field density test should be made per 5,000 square feet of fill area for each 1-foot thickness of compacted soil. Testing frequency should be increased in confined areas. Any areas that do not meet the compaction specifications should be recompacted to achieve compliance.

5.3 Excavation Conditions

Based on review of the boring data and the proposed construction, we anticipate that materials requiring difficult excavation techniques will be encountered in the planned excavations.

Difficult excavation techniques will be necessary for planned excavations in any dense residual soils, any partially weathered rock (PWR), and auger refusal materials. Based on the planned lowest FFE, several feet of partially weathered rock and auger refusal materials will have to be excavated in some building areas.

In mass excavations for general site work, dense soils (soils with standard penetration resistances of 30 or more blows per foot) can usually be removed by ripping with a single-tooth ripper attached to a large crawler tractor or by breaking it out with a large front-end loader. In confined excavations such as foundations, utility trenches, etc., removal of partially weathered rock typically requires use of large backhoes, pneumatic spades, or light blasting. Refusal materials will normally require blasting for removal in all types of excavations.

The definition of rock can be a source of conflict during construction. The following definitions have been incorporated into specifications on other projects and are provided for your general reference:

GENERAL EXCAVATION:

Rip Rock - Any material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and requires the use of a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8T or equivalent).

Blast Rock - Any material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8T or equivalent) or by a Caterpillar 977 front-end loader or equivalent; and occupying an original volume of at least one (1) cubic yard.

TRENCH EXCAVATION:

Blast Rock - Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 25,700 pounds (Caterpillar Model 320D or equivalent), and occupying an original volume of at least one-half (1/2) cubic yard.

If blasting is required, special precautions must be taken to safeguard the project. We recommend the following:

- A pre-blast survey should be made of all existing structures within 300 feet of the perimeter of the site. This survey will document existing conditions to provide a level of protection for the owner/contractor against unfounded claims.
- A blasting program must be submitted to the structural and geotechnical engineers prior to starting work.
- Light charges should be used during initial blasting to assess the site behavior characteristics. After confirmation that the blasting contractor has reasonably modeled the ground motion characteristics with these lighter charges, then stronger charges may be used.
- Peak particle velocity induced by blasting should be limited to 2 inches per second. Peak particle velocity, when measured at locations adjacent to nearby structures, should not exceed 1 inch per second.
- All blasting should be monitored by an independent vibration consultant to confirm compliance with Specification requirements.

5.4 Groundwater Conditions

Groundwater was encountered only in Boring B-11 after approximately 24 hours at a depth of about 43 feet (Elevation 1044 feet). Cave depths were noted between depths of about 3 to 55 feet. Groundwater levels are subject to seasonal, climatic, and other variations and may be different at other times and locations than those stated in this report. It is expected that rainwater and runoff which accumulate in excavations may be pumped from small dug sumps.

Based on the available groundwater measurement data, it appears that the basement FFE at EL 1048 feet may be close to the recorded groundwater level in Boring B-11 at EL 1044 feet. Temporary dewatering will be necessary if the groundwater is encountered during construction. We recommend that a permanent dewatering system be planned for the basement level.

5.5 Foundation Construction and Evaluation

Bottoms of foundation excavations should be evaluated by an ATC geotechnical engineer prior to placement of reinforcing steel and concrete to verify that adequate bearing materials are present, and that all debris, mud, and loose, frozen or water-softened soils are removed.

Spread foundation and floor slab excavations should be concreted as soon as practical after they are excavated. Water should not be allowed to pond in any excavation. If an excavation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Foundation concrete should not be placed on frozen or saturated subgrades.

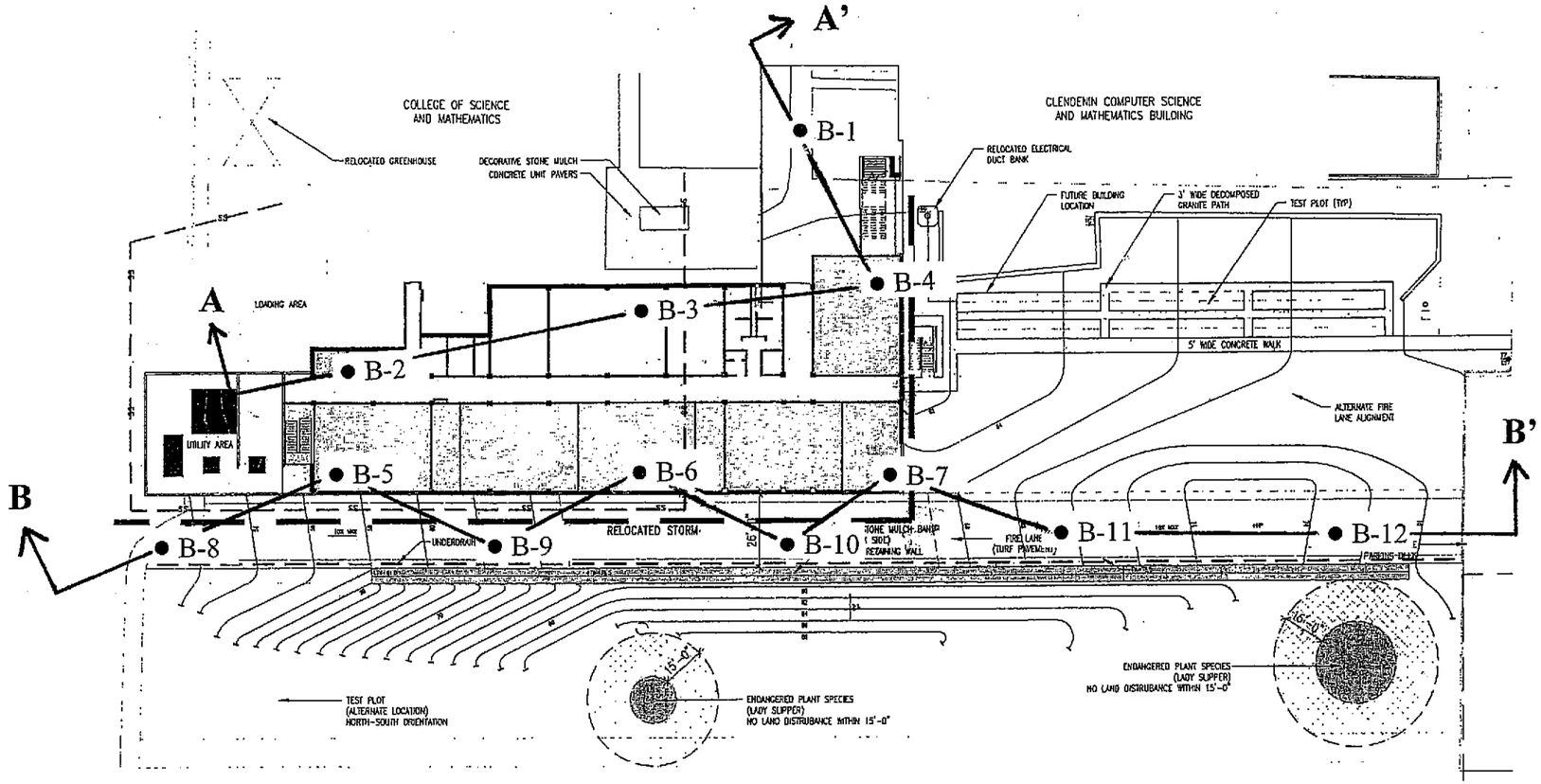
6.0 QUALIFICATION OF RECOMMENDATIONS

Our geotechnical recommendations for project design and construction conditions have been based on our understanding of the site, the project information, and the data obtained during our field exploration. The general subsurface conditions used were based on interpolation of the subsurface data between the borings. Regardless of the thoroughness of a subsurface exploration, there is the always the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, geotechnical engineers should evaluate earthwork and foundation construction to verify that the conditions anticipated in design actually exist.

The design recommendations in this report have been developed on the basis of the previously described project characteristics and subsurface conditions. If project criteria, or locations change, we should be permitted to determine if the recommendations must be modified.

The nature and extent of variations between the borings may not become evident until the course of construction. If such variations then appear evident, it will be necessary to re-evaluate the recommendations of this report after on-site observations of the conditions.

Our professional services have been performed, our findings derived, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. This company is not responsible for the conclusions, opinions or recommendations of others based on these data.



MATERIALS AND GRADING PLAN

Kennesaw State University

LABORATORY ADDITION SCIENCE BUILDING

Project Number: J-157

PERKINS + WILL www.perkinswill.com

LEGEND

- B-1 – Soil Test Boring Location

A – Subsurface Cross-section

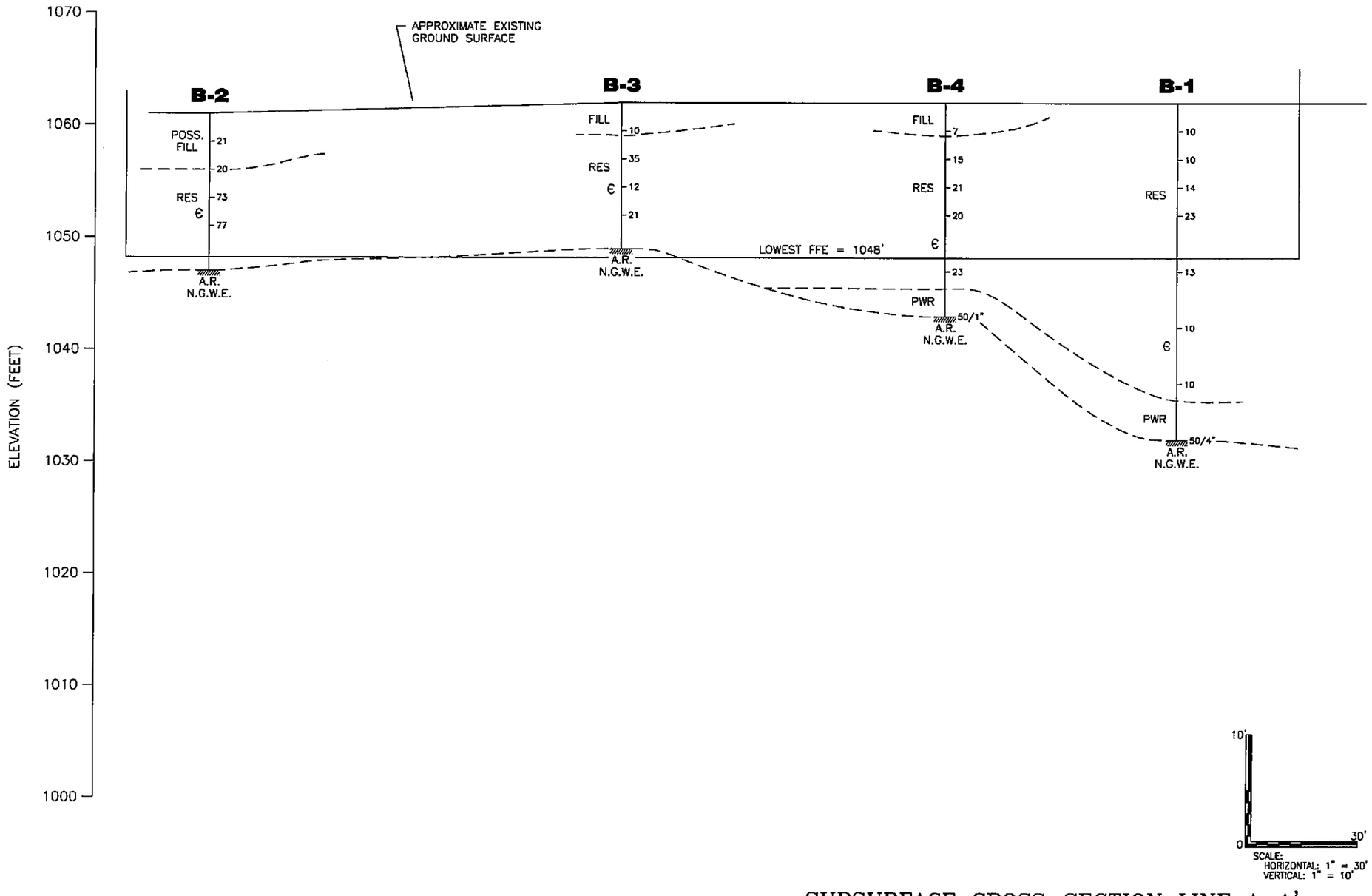
ATC
1841 West Oak Parkway
Marietta, Georgia 30062
(770)427-9456

ISSUED: DATE	NO.	BY: REVISION	BY

BORING LOCATION PLAN
Laboratory Addition Science Building J-157
Kennesaw State University
Kennesaw, Georgia
ATC Project Number 066.23271.5780

SCALE: 1" = 50'

REFERENCE:



LEGEND

62	– STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT)
FILL	– EXISTING FILL MATERIAL
RES	– RESIDUUM
PWR	– PARTIALLY WEATHERED ROCK (PWR)
REC	– PERCENT RECOVERY
RQD	– ROCK QUALITY DESIGNATION
C.T.	– CORING TERMINATED
B.T.	– BORING TERMINATED
A.R.	– AUGER REFUSAL
ϵ	– CAVE DEPTH
▽	– GROUNDWATER AT TIME OF BORING
▼	– GROUNDWATER AT LEAST 24 HOURS LATER
N.G.W.E.	– NO GROUNDWATER ENCOUNTERED AT TIME OF BORING

SUBSURFACE CROSS-SECTION LINE A-A'

NOTE:
WHILE INDIVIDUAL TEST BORING RECORDS ARE CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS ON THE DATES DRILLED, IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES. THE SUBSURFACE CONDITIONS SHOWN ON THE FOLLOWING PROFILES ARE NOT WARRANTED, BUT ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND REASONABLE ENGINEERING JUDGEMENT. PROVIDED UNIFIED CLASSIFICATION SYMBOLS (i.e. ML, SM, CL, ETC.) ARE GENERALLY BASED ON VISUAL OBSERVATION AND SHOULD BE CONSIDERED APPROXIMATE.

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Marietta, Georgia 30062
(770)427-9456

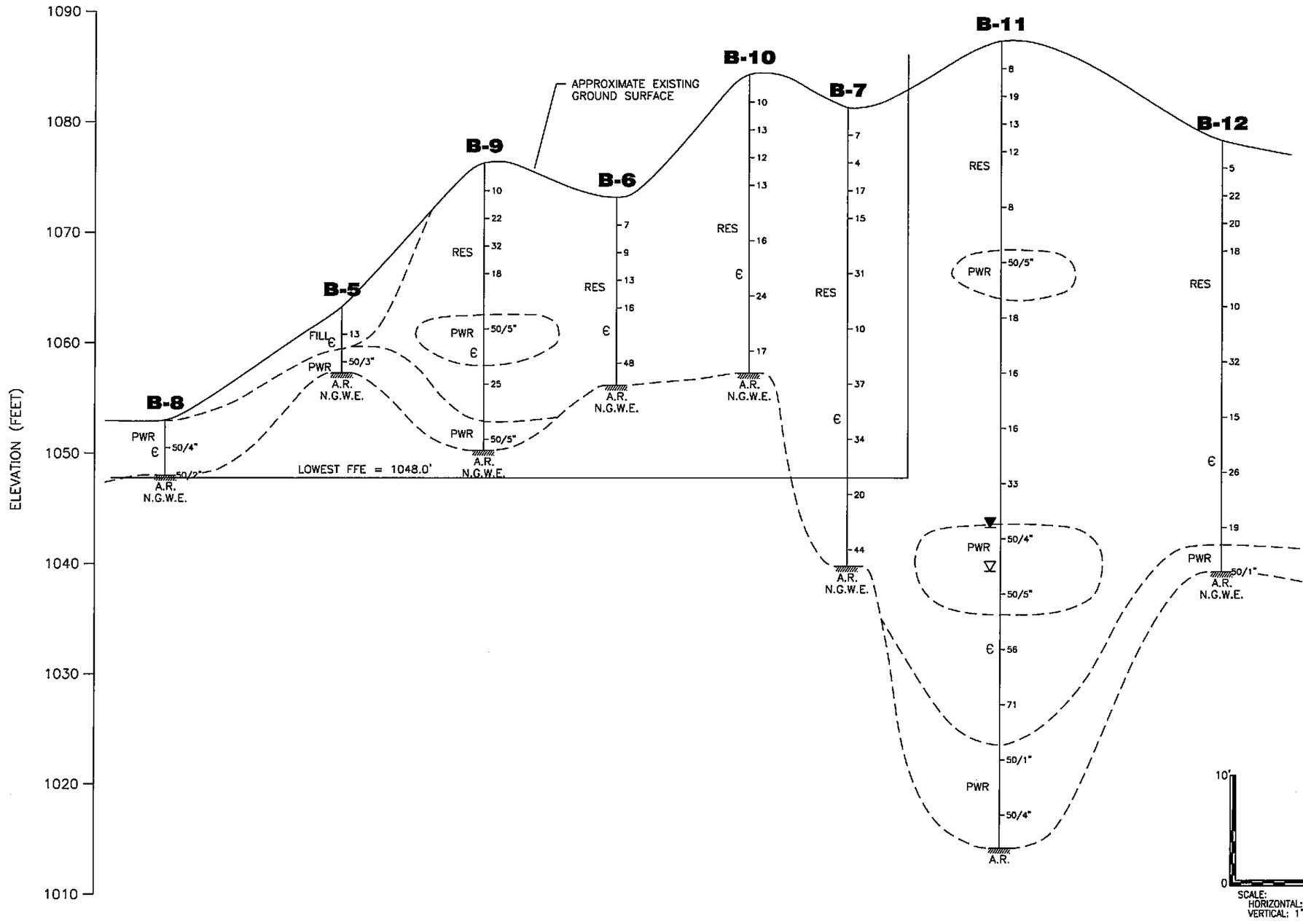
ISSUED: DATE	NO.	REVISION	BY: BY

LABORATORY ADDITION - SCIENCE BUILDING J-157
KENNESAW STATE UNIVERSITY

KENNESAW, GEORGIA
ATC PROJECT NUMBER: 66.23271.5780

SCALE: AS SHOWN

REFERENCE:
4-1-10(A66-5780)RMC



LEGEND

62	– STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT)
FILL	– EXISTING FILL MATERIAL
RES	– RESIDUUM
PWR	– PARTIALLY WEATHERED ROCK (PWR)
REC	– PERCENT RECOVERY
RQD	– ROCK QUALITY DESIGNATION
C.T.	– CORING TERMINATED
B.T.	– BORING TERMINATED
A.R.	– AUGER REFUSAL
ϵ	– CAVE DEPTH
▽	– GROUNDWATER AT TIME OF BORING
▼	– GROUNDWATER AT LEAST 24 HOURS LATER
N.G.W.E.	– NO GROUNDWATER ENCOUNTERED AT TIME OF BORING

SUBSURFACE CROSS-SECTION LINE B–B'

NOTE:
WHILE INDIVIDUAL TEST BORING RECORDS ARE CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS ON THE DATES DRILLED, IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES. THE SUBSURFACE CONDITIONS SHOWN ON THE FOLLOWING PROFILES ARE NOT WARRANTED, BUT ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND REASONABLE ENGINEERING JUDGEMENT. PROVIDED UNIFIED CLASSIFICATION SYMBOLS (i.e. ML, SM, CL, ETC.) ARE GENERALLY BASED ON VISUAL OBSERVATION AND SHOULD BE CONSIDERED APPROXIMATE.

ATC
1841 West Oak Parkway
Marietta, Georgia 30062
(770)427-9456

ISSUED:		BY:	
DATE	NO.	REVISION	BY

LABORATORY ADDITION - SCIENCE BUILDING J-157
KENNESAW STATE UNIVERSITY

KENNESAW, GEORGIA
ATC PROJECT NUMBER: 66.23271.5780

SCALE: AS SHOWN

REFERENCE:
4-1-10(A66-5780)RMC

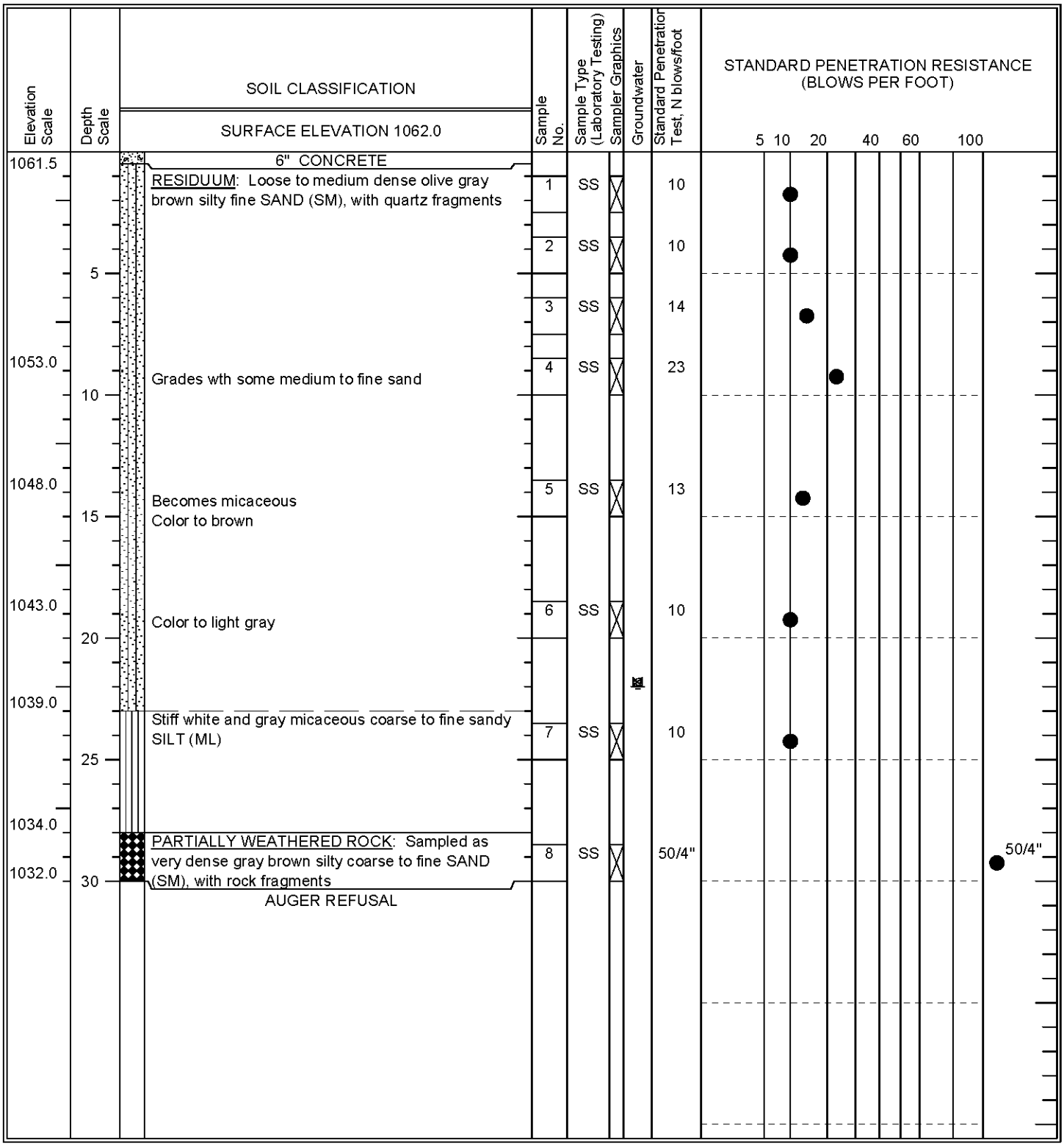
ATC ASSOCIATES INC.
1841 West Oak Parkway, Suite F
Marietta, GA 30062
770-427-9456
Fax 770-427-1907

TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 1**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/17/10** DATE COMPLETED **3/17/10** BORING METHOD **AUTO HAMMER**



Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion NONE ft.
After -- hours -- ft.
Cave Depth 22.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 2**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/17/10** DATE COMPLETED **3/17/10** BORING METHOD **AUTO HAMMER**

SURFACE ELEVATION 1061.0

Elevation Scale	Depth Scale	SOIL CLASSIFICATION	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot
		POSSIBLE FILL: Medium dense brown silty medium to fine SAND (SM), with large rock fragments	1	SS			21
			2	SS			20
1056.0	5	RESIDUUM: Very dense brown gray silty medium to fine SAND (SM), with rock fragments	3	SS			73
			4	SS		▼	77
	10						
1047.0		AUGER REFUSAL					

STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT)

5 10 20 40 60 100

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
● Noted on Drilling Rods -- ft.
▽ At Completion NONE ft.
▼ After 24 hours NONE ft.
▣ Cave Depth 9.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 3**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/17/10** DATE COMPLETED **3/17/10** BORING METHOD **AUTO HAMMER**

SURFACE ELEVATION 1062.0

Elevation Scale	Depth Scale	SOIL CLASSIFICATION	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot
1061.8		3" TOPSOIL					
		FILL: Loose brown micaceous silty fine SAND (SM), with occasional rock fragments	1	SS			10
1059.0		RESIDUUM: Dense light gray medium to fine SAND (SP), with rock fragments	2	SS			35
	5						
1056.0		Medium dense gray brown micaceous silty fine SAND (SM)	3	SS			12
1053.0		Grades with occasional small rock fragments	4	SS			21
	10						
1049.0		AUGER REFUSAL					

STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT)

5 10 20 40 60 100

Sample Type
- SS - Driven Split Spoon
- UD - Shelby Tube
- RC - Rock Core
- CU - Cuttings

Laboratory Testing
- MC - Moisture Content
- GS - Grain Size
- C - Consolidation
- A - Atterberg Limits
- T - Triaxial

Depth to Groundwater
- Noted on Drilling Rods -- ft.
- At Completion NONE ft.
- After 24 hours NONE ft.
- Cave Depth 8.0 ft.

Boring Method
- HSA - Hollow Stem Augers
- MD - Mud Drilling

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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 4**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/18/10** DATE COMPLETED **3/18/10** BORING METHOD **AUTO HAMMER**

SURFACE ELEVATION 1062.0

Elevation Scale	Depth Scale	SOIL CLASSIFICATION	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot	STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT) 5 10 20 40 60 100
1061.8		3" TOPSOIL						
		FILL: Loose dark brown and gray micaceous silty fine SAND (SM), with fine roots and rock fragments	1	SS			7	
1059.0		RESIDUUM: Medium dense black olive gray micaceous silty fine SAND (SM)	2	SS			15	
	5		3	SS			21	
			4	SS			20	
	10							
			5	SS			23	
	15							
1044.0								
1043.0		PARTIALLY WEATHERED ROCK: Sampled as very dense black gray silty fine SAND (SM), with rock fragments	6	SS			50/1"	50/1"
		AUGER REFUSAL						

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion NONE ft.
After 24 hours NONE ft.
Cave Depth 13.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 5**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/17/10** DATE COMPLETED **3/17/10** BORING METHOD **AUTO HAMMER**

Elevation Scale	Depth Scale	SOIL CLASSIFICATION	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot	STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT) 5 10 20 40 60 100
		SURFACE ELEVATION 1063.0						
1062.8		2" TOPSOIL						
		FILL: Medium dense dark brown silty fine SAND (SM), with rock fragments and small piece of textile fabric	1	SS			13	●
1060.0		PARTIALLY WEATHERED ROCK: Sampled as very dense gray medium to fine SAND (SP), with rock fragments	2	SS			50/3"	● 50/3"
1057.0	5	AUGER REFUSAL						
		Offset multiple times with similar refusal.						

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion NONE ft.
After 24 hours NONE ft.
Cave Depth 3.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 6**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/19/10** DATE COMPLETED **3/19/10** BORING METHOD **AUTO HAMMER**

Elevation Scale	Depth Scale	SOIL CLASSIFICATION	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot
		SURFACE ELEVATION 1073.0					
		RESIDUUM: Loose to dense gray brown micaceous silty fine SAND (SM), with rock fragments	1	SS			7
			2	SS			9
	5						
1067.0		Grades with medium to fine sand	3	SS			13
			4	SS			16
	10						
1059.0		Color to dark olive brown	5	SS			48
	15	Grades with occasional small rock fragments					
1056.0		AUGER REFUSAL					

STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT)

5 10 20 40 60 100

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion NONE ft.
After -- hours -- ft.
Cave Depth 12.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 7**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/18/10** DATE COMPLETED **3/18/10** BORING METHOD **AUTO HAMMER**

SURFACE ELEVATION 1081.0

Elevation Scale	Depth Scale	SOIL CLASSIFICATION	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot
1080.8		3" TOPSOIL					
		RESIDUUM: Loose red brown slightly micaceous silty fine SAND (SM)	1	SS			7
1078.0		Loose brown slightly micaceous clayey fine SAND (SC), with occasional small gravel	2	SS			4
	5						
1075.0		Medium dense to dense gray brown silty coarse to fine SAND (SM), with quartz fragments	3	SS			17
			4	SS			15
	10						
1067.0		Becomes micaceous	5	SS			31
	15						
1062.0		Color to brown	6	SS			10
	20						
1058.0		Dense gray silty medium to fine SAND (SM), with occasional rock fragments	7	SS			37
	25						
			8	SS			34
	30						
1048.0		Medium dense gray brown micaceous silty medium to fine SAND (SM)	9	SS			20
	35						
1043.0		Dense orange black micaceous silty coarse to fine SAND (SM), with rock fragments	10	SS			44
	40						

STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT)

5 10 20 40 60 100

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion NONE ft.
After 24 hours NONE ft.
Cave Depth 28.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

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1841 West Oak Parkway, Suite F
Marietta, GA 30062
770-427-9456
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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 7**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/18/10** DATE COMPLETED **3/18/10** BORING METHOD **AUTO HAMMER**

Elevation Scale	Depth Scale	SOIL CLASSIFICATION (continued)	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot	STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT) 5 10 20 40 60 100
1039.5		AUGER REFUSAL						

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion NONE ft.
After 24 hours NONE ft.
Cave Depth 28.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 8**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/17/10** DATE COMPLETED **3/17/10** BORING METHOD **AUTO HAMMER**

Elevation Scale	Depth Scale	SOIL CLASSIFICATION SURFACE ELEVATION 1053.0	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot	STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT) 5 10 20 40 60 100
1052.7		4" TOPSOIL						
		PARTIALLY WEATHERED ROCK: Sampled as very dense gray medium to fine SAND (SP), with large rock fragments	1	SS			50/4"	50/4"
			2	SS			50/2"	50/2"
1048.0	5	AUGER REFUSAL						
		Offset multiple times with similar refusal.						

Sample Type
- SS - Driven Split Spoon
- UD - Shelby Tube
- RC - Rock Core
- CU - Cuttings

Laboratory Testing
- MC - Moisture Content
- GS - Grain Size
- C - Consolidation
- A - Atterberg Limits
- T - Triaxial

Depth to Groundwater
- Noted on Drilling Rods -- ft.
- At Completion NONE ft.
- After 24 hours NONE ft.
- Cave Depth 3.0 ft.

Boring Method
- HSA - Hollow Stem Augers
- MD - Mud Drilling

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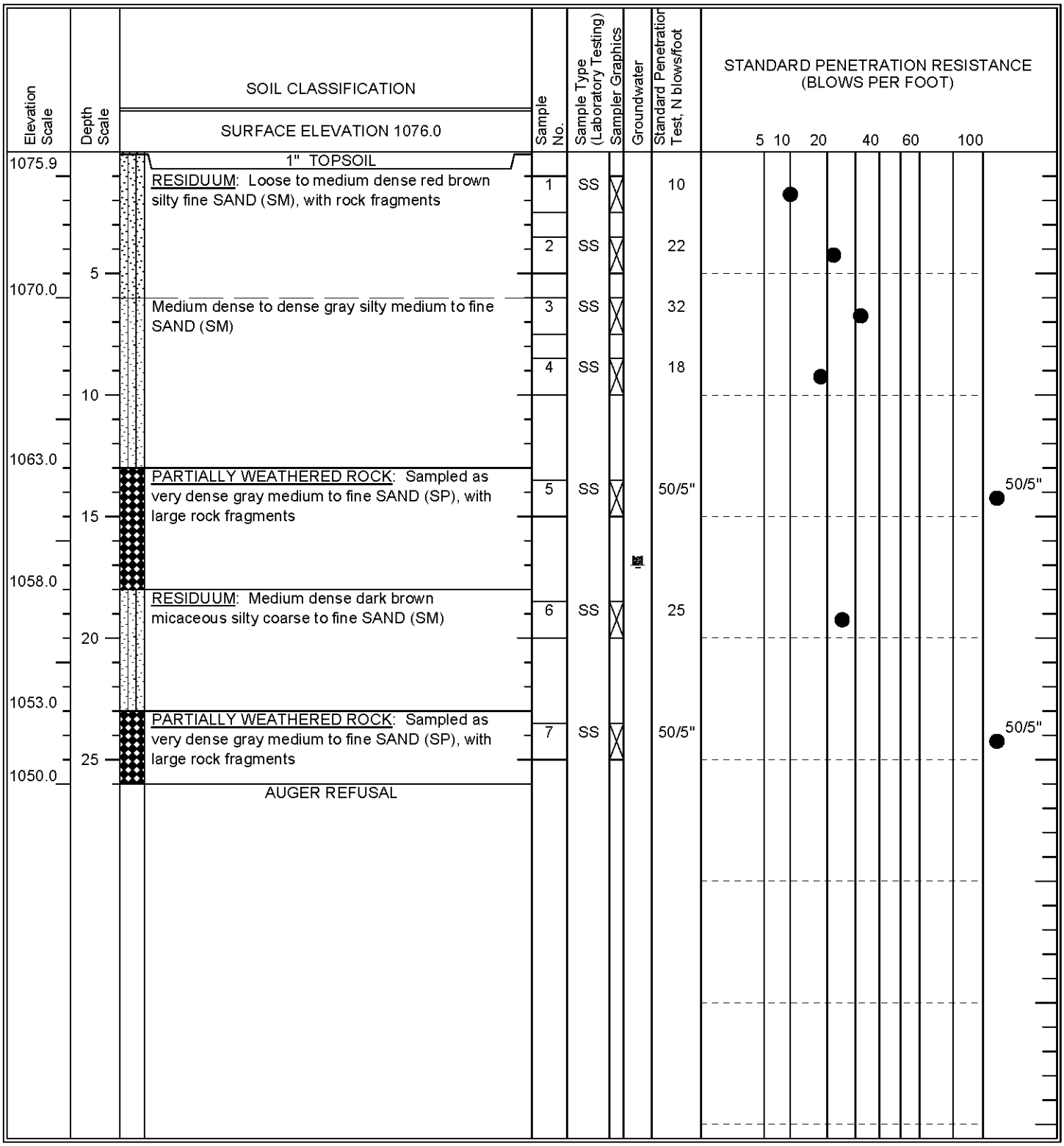
TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B- 9**

PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**

DATE STARTED **3/19/10** DATE COMPLETED **3/19/10** BORING METHOD **AUTO HAMMER**



Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion NONE ft.
After -- hours -- ft.
Cave Depth 17.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B-10**
PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**
DATE STARTED **3/19/10** DATE COMPLETED **3/19/10** BORING METHOD **AUTO HAMMER**

Elevation Scale	Depth Scale	SOIL CLASSIFICATION	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot
		SURFACE ELEVATION 1084.0					
1083.9		1" TOPSOIL					
		RESIDUUM: Loose black red brown slightly micaceous silty fine SAND (SM)	1	SS			10
1081.0		Medium dense black red brown silty coarse to fine SAND (SM), with occasional small gravel	2	SS			13
	5		3	SS			12
			4	SS			13
	10						
1070.0		Color to black olive brown	5	SS			16
	15	Grades with rock fragments					
			6	SS			24
	20						
1061.0		Medium dense black olive gray silty fine SAND (SM)	7	SS			17
	25						
1057.0		AUGER REFUSAL					

STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT)
5 10 20 40 60 100

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

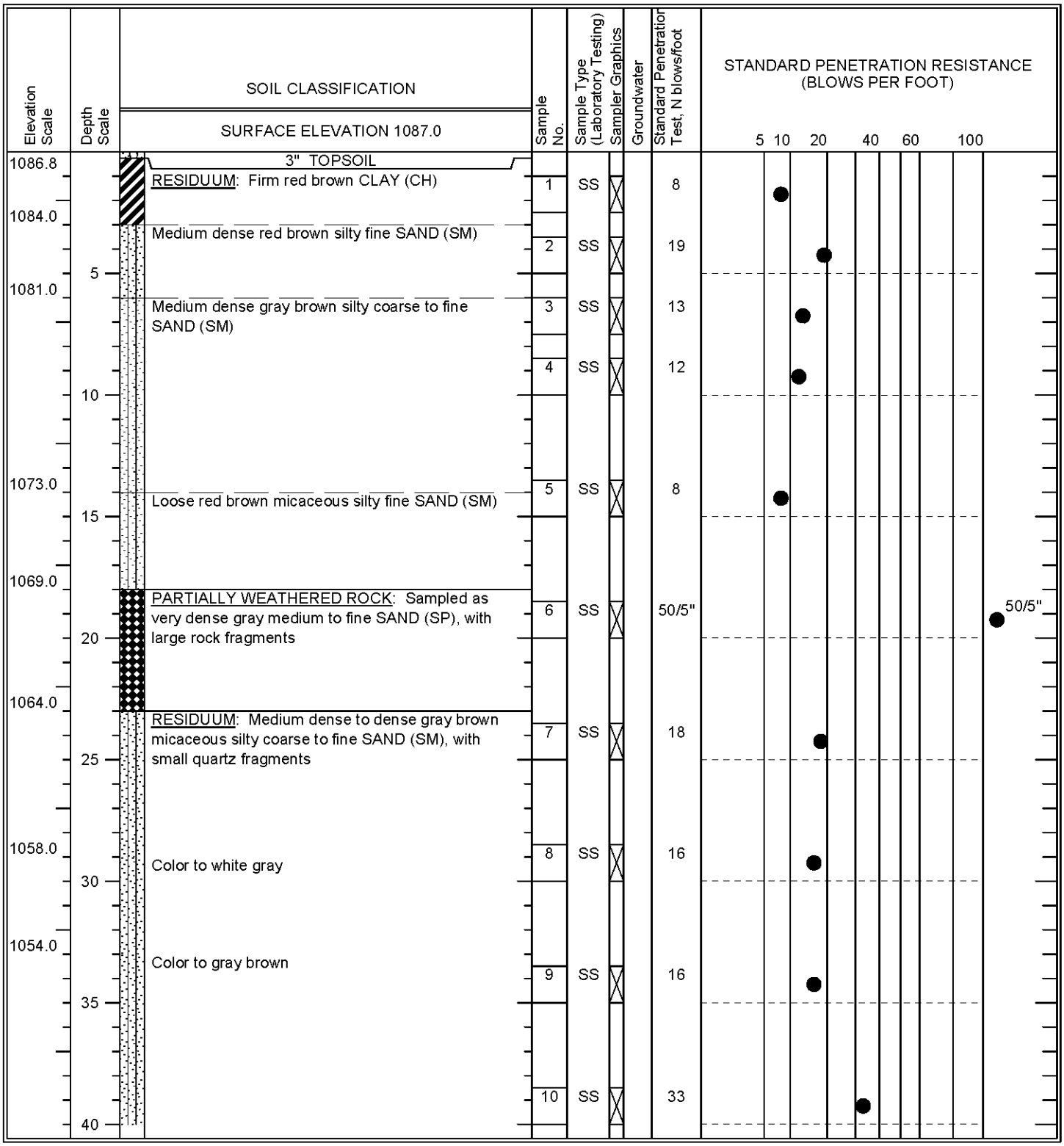
Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion NONE ft.
After -- hours -- ft.
Cave Depth 18.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

ATC ASSOCIATES INC.
1841 West Oak Parkway, Suite F
Marietta, GA 30062
770-427-9456
Fax 770-427-1907

TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B-11**
PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**
DATE STARTED **3/18/10** DATE COMPLETED **3/18/10** BORING METHOD **AUTO HAMMER**



Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion 48.0 ft.
After 24 hours 43.0 ft.
Cave Depth 55.0 ft.

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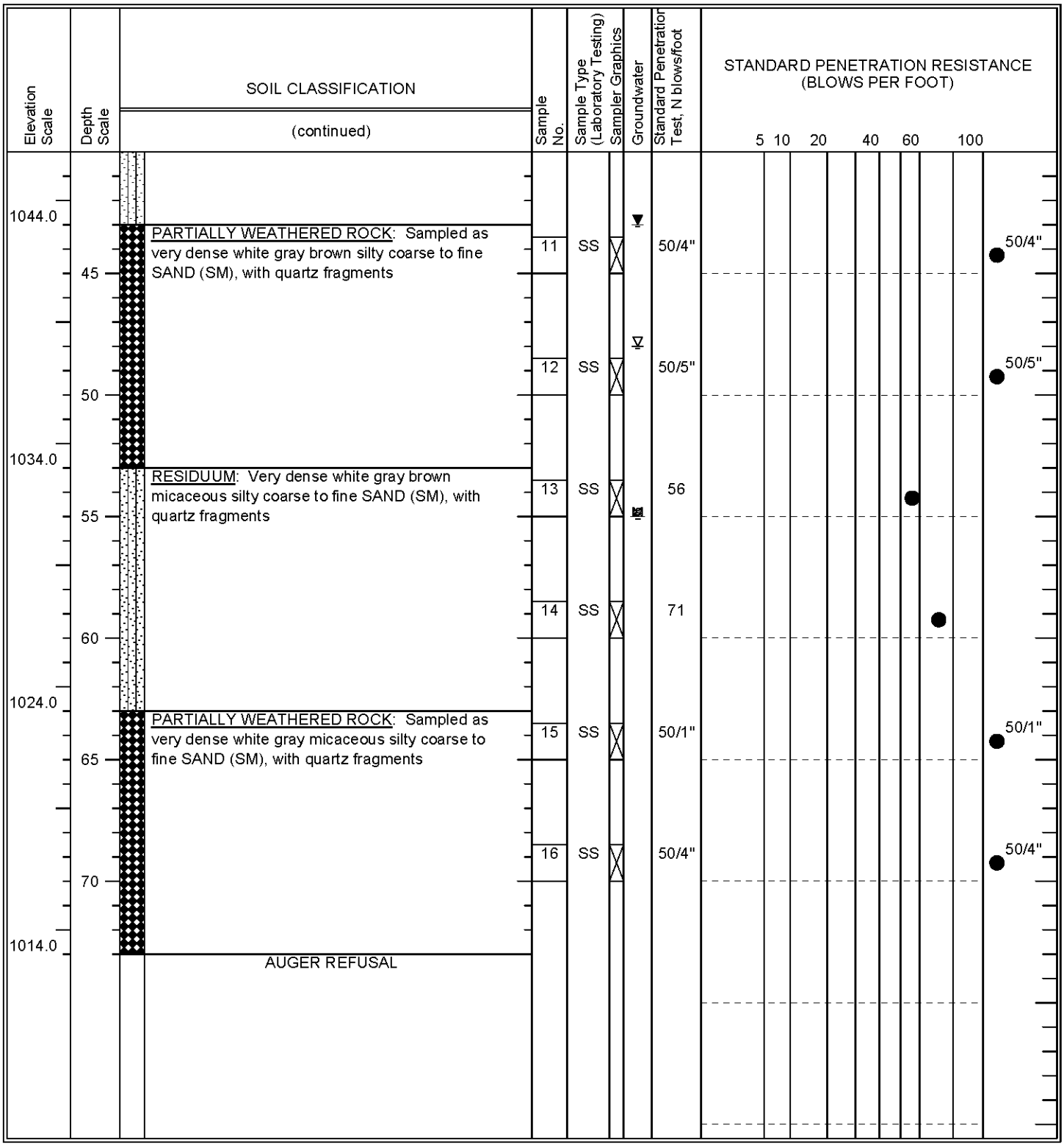

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion 48.0 ft.
After 24 hours 43.0 ft.
Cave Depth 55.0 ft.

Boring Method
HSA - Hollow Stem Augers
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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B-12**
PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**
DATE STARTED **3/18/10** DATE COMPLETED **3/18/10** BORING METHOD **AUTO HAMMER**

Elevation Scale	Depth Scale	SOIL CLASSIFICATION SURFACE ELEVATION 1078.0	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot	STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT) 5 10 20 40 60 100
1077.8		3" TOPSOIL						
		RESIDUUM: Loose dark brown clayey fine SAND (SC), with occasional gravel	1	SS			5	
1075.0		Medium dense to dense red brown micaceous silty medium to fine SAND (SM)	2	SS			22	
	5							
1072.0		Color to olive brown	3	SS			20	
			4	SS			18	
	10							
1064.0		Grades with small quartz fragments	5	SS			10	
	15							
			6	SS			32	
	20							
			7	SS			15	
	25							
1049.0		Grades to coarse to fine sand	8	SS		▨	26	
	30	Color to dark brown gray						
			9	SS			19	
	35							
1040.0								
1039.0		PARTIALLY WEATHERED ROCK: Sampled as very dense gray brown silty fine SAND (SM), with	10	SS			50/1"	50/1"

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
● Noted on Drilling Rods -- ft.
▽ At Completion NONE ft.
▼ After 24 hours NONE ft.
▨ Cave Depth 29.0 ft.

Boring Method
HSA - Hollow Stem Augers
MD - Mud Drilling

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TEST BORING RECORD

PROJECT NAME **KSU LAB ADDITION J-157** BORING # **B-12**
PROJECT NUMBER **066.10.23271.5780** DRILL FOREMAN **PIEDMONT**
DATE STARTED **3/18/10** DATE COMPLETED **3/18/10** BORING METHOD **AUTO HAMMER**

Elevation Scale	Depth Scale	SOIL CLASSIFICATION (continued)	Sample No.	Sample Type (Laboratory Testing)	Sampler Graphics	Groundwater	Standard Penetration Test, N blows/foot	STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT) 5 10 20 40 60 100
		rock fragments AUGER REFUSAL						

Sample Type
SS - Driven Split Spoon
UD - Shelby Tube
RC - Rock Core
CU - Cuttings

Laboratory Testing
MC - Moisture Content
GS - Grain Size
C - Consolidation
A - Atterberg Limits
T - Triaxial

Depth to Groundwater
Noted on Drilling Rods -- ft.
At Completion NONE ft.
After 24 hours NONE ft.
Cave Depth 29.0 ft.

Boring Method
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REPORT OF: MOISTURE CONTENTS

PROJECT: KSU New Lab Addition **DATE:** 3-30-10

CLIENT: Perkins and Will **ATC JOB NO:** 066.23271.5780

TEST METHOD: ASTM D-2216

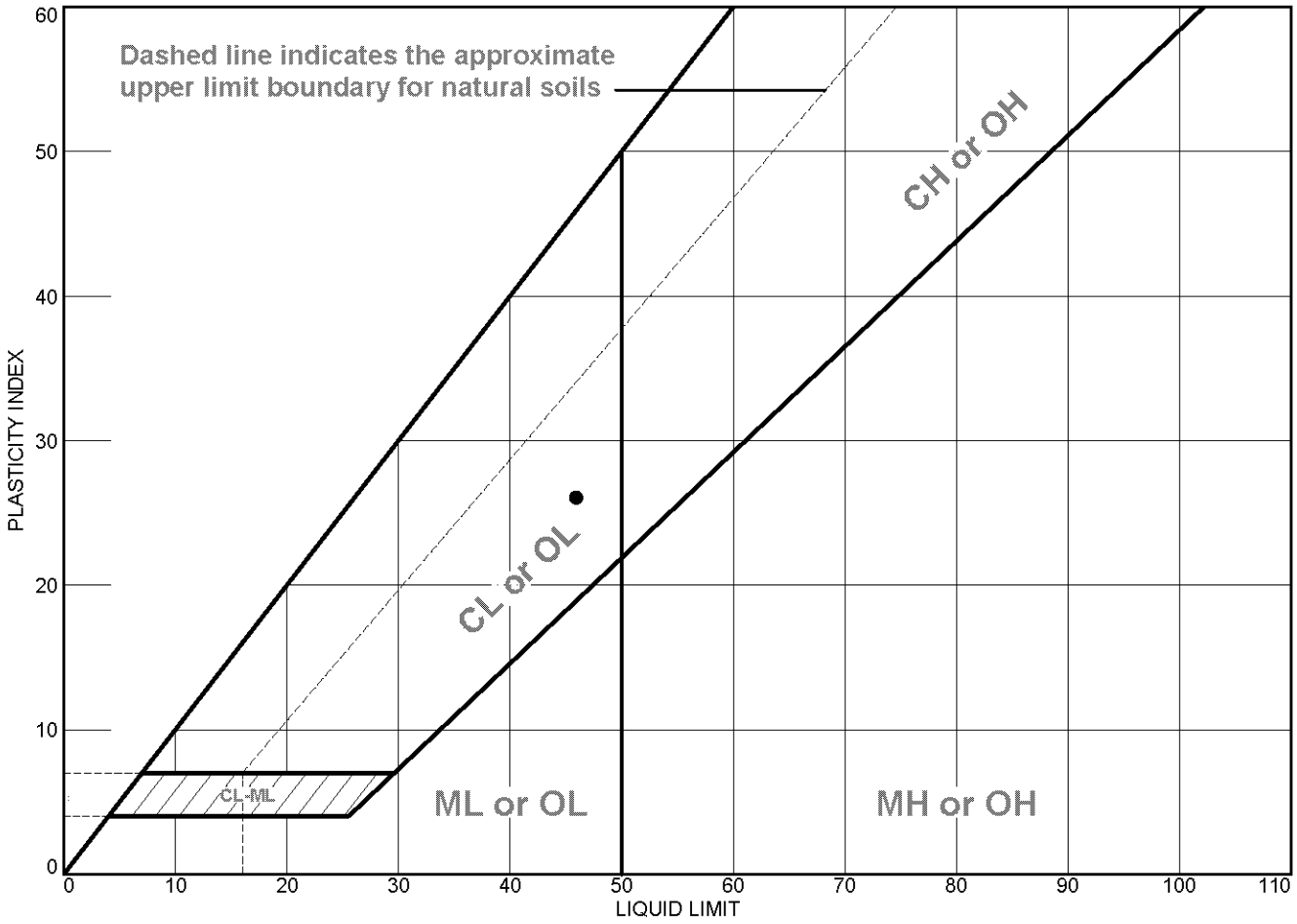
SAMPLE ID	M.C. %
B-4 @ 0-1.5'	24.2
B-4 @ 3.5-5.0'	14.4
B-4 @ 6.0-7.5'	15.0
B-4 @ 8.5-10.0'	15.9
B-4 @ 13.5-15.0'	14.8

SAMPLE ID	M.C. %
B-10 @ 3.5-5.0'	15.8
B-10 @ 8.5-10.0'	12.9
B-10 @ 13.5-15.0'	15.5
B-10 @ 18.5-20.0'	14.1
B-10 @ 23.5-25.0'	29.1

Sincerely,
ATC Associates Inc.

Mary Lynn Smith, P.G.
Laboratory Manager

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	% <#40	% <#200	USCS
●	Brown sandy CLAY	46	20	26			

Project No. 066.23271.5780 **Client:** Perkins and Will

Project: KSU New Lab Addition J-157

●**Location:** B-7 @ 3.5-5' **Sample Number:** B-7 @ 3.5-5'

Remarks:

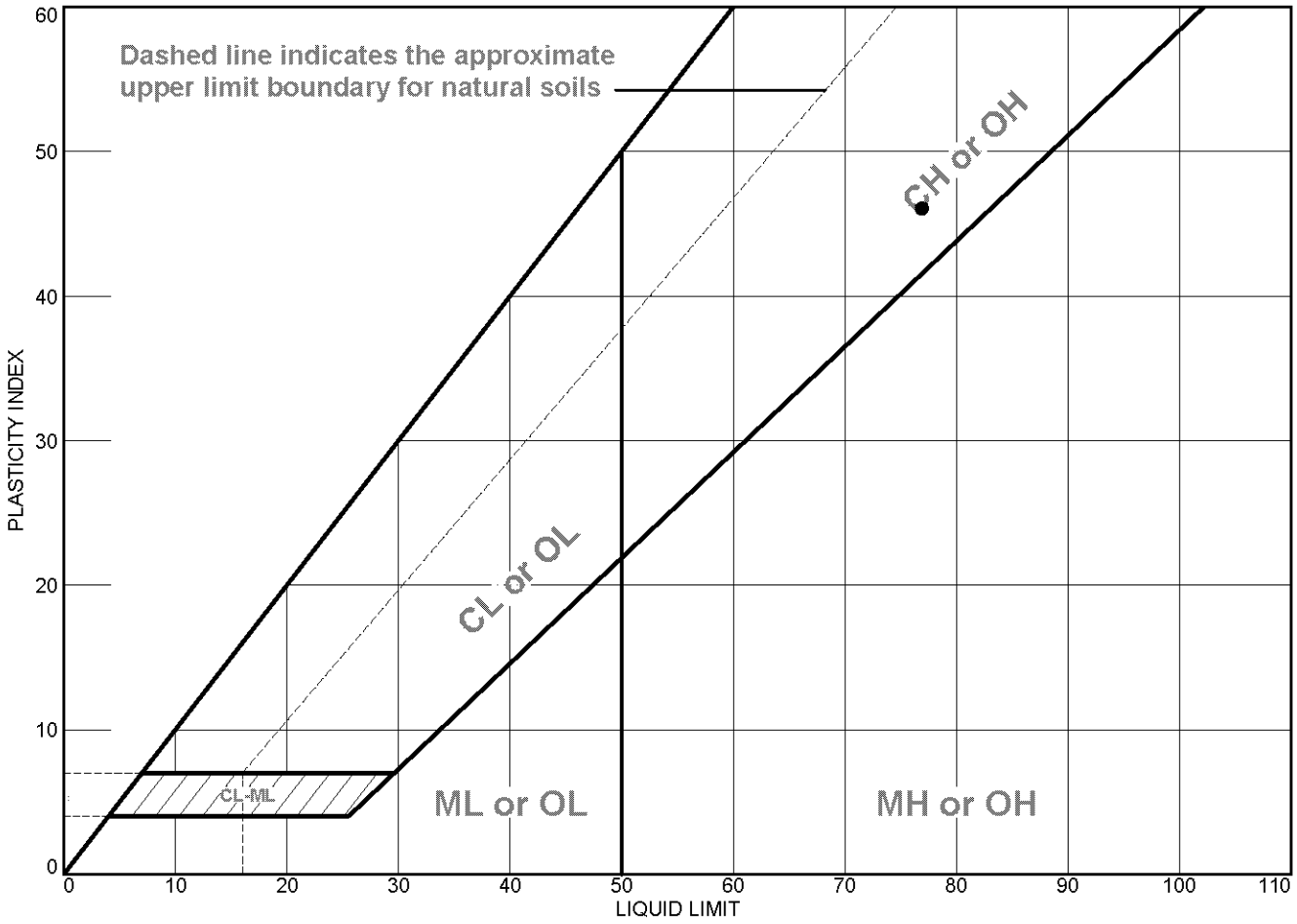
●3/26/10

ATC ASSOCIATES INC.

Marietta, Georgia

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	% <#40	% <#200	USCS
●	Reddish brown fat CLAY	77	31	46			

Project No. 066.23271.5780 **Client:** Perkins and Will

Project: KSU New Lab Addition J-157

●**Location:** B-11 @ 0-1.5' **Sample Number:** B-11 @ 0-1.5'

Remarks:

●3/26/10

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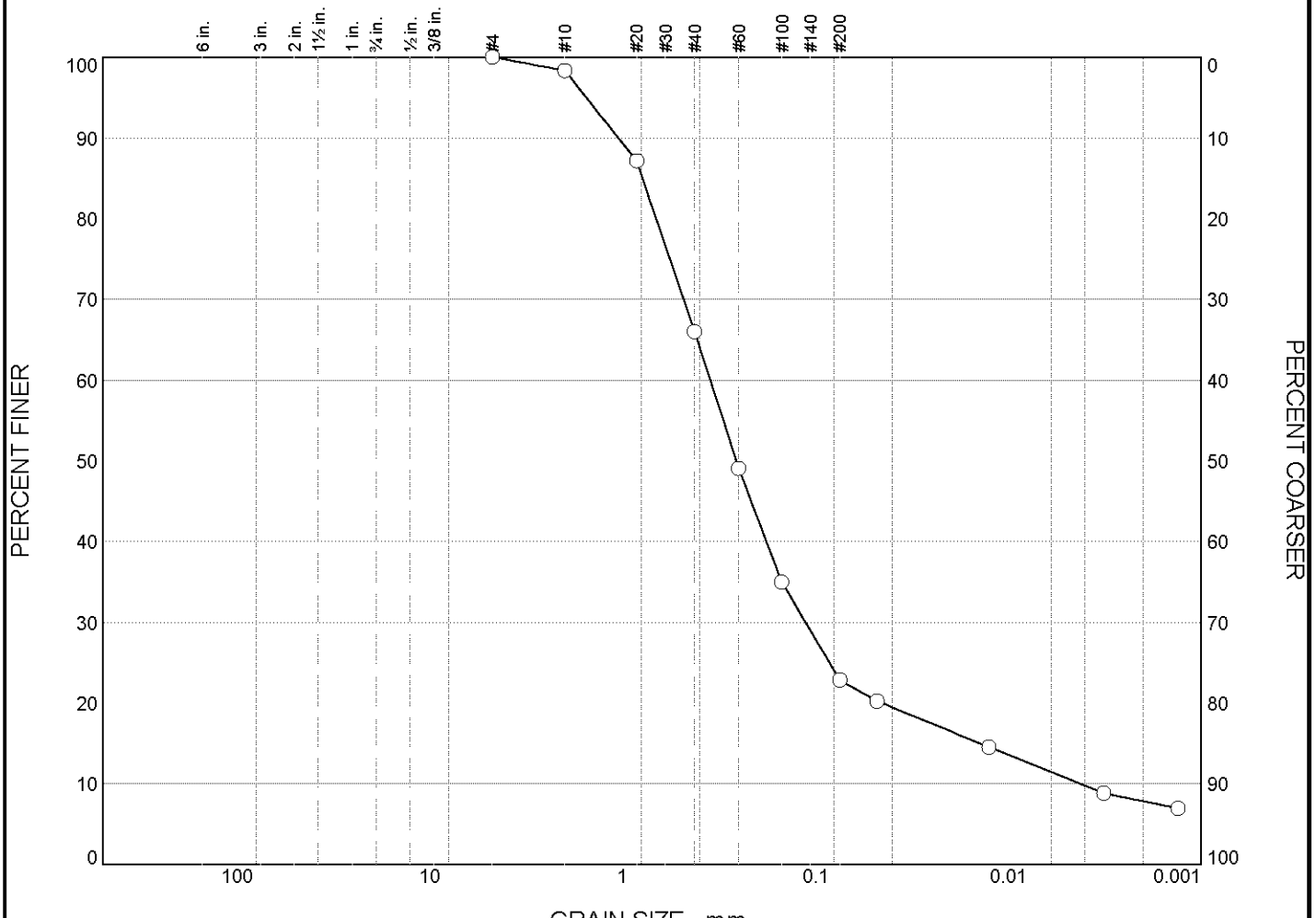
Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	1.7	32.3	43.1	12.2	10.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.7922	0.3523	0.2578	0.1129	0.0140	0.0042	8.56	83.42

Material Description	USCS	AASHTO
○ Brown silty SAND		

Project No. 066.23271.5780 **Client:** Perkins and Will

Project: KSU New Lab Addition J-157

○ **Location:** B-6 @ 3.5-5' **Sample Number:** B-6 @ 3.5-5'

Remarks:

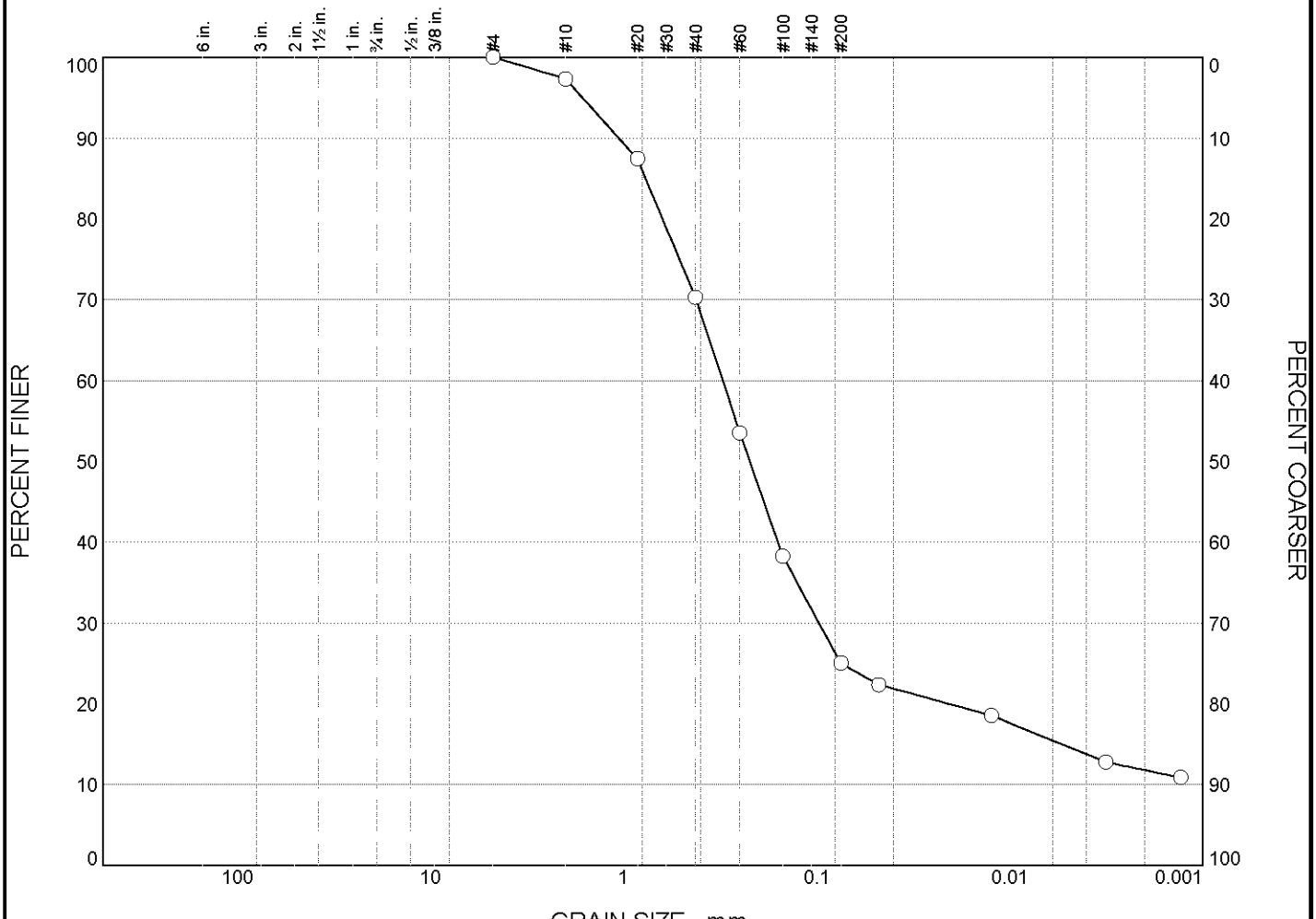
○3/26/10

ATC ASSOCIATES INC.

Marietta, Georgia

Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	2.7	27.0	45.3	10.3	14.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.7715	0.3072	0.2224	0.0974	0.0054			

Material Description	USCS	AASHTO
○ Orange brown silty SAND		

Project No. 066.23271.5780 **Client:** Perkins and Will

Project: KSU New Lab Addition J-157

○ **Location:** B-10 @ 6-7.5' **Sample Number:** B-10 @ 6-7.5'

Remarks:

○3/26/10

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Marietta, Georgia

Figure

KEY TO SYMBOLS AND CLASSIFICATIONS

•	STANDARD PENETRATION RESISTANCE
100/2"	NUMBER OF BLOWS (100) TO DRIVE THE SPOON SAMPLER A NUMBER OF INCHES (2)
AX, BX, NX	ROCK CORE BARREL SIZES
REC	PERCENTAGE OF ROCK CORE RECOVERED
RQD	ROCK QUALITY DESIGNATION-% OF CORE SIGMENTS 4 OR MORE INCHES LONG
ϵ	CAVED LEVEL
▼	WATER TABLE AT LEAST 24 HOURS AFTER DRILLING
U	UNIT WEIGHT TEST PERFORMED
A	ATTERBERG LIMITS TEST PERFORMED
C	CONSOLIDATION TEST PERFORMED
GS	GRAIN SIZE TEST PERFORMED
T	TRIAXIAL SHEAR TEST PERFORMED
P	PERMEABILITY TEST PERFORMED
V	FIELD VANE SHEAR TEST PERFORMED

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

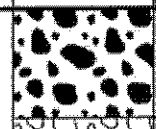
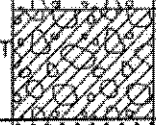
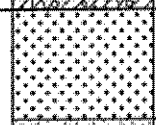
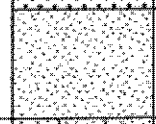
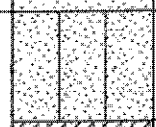
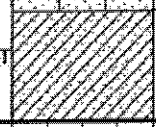
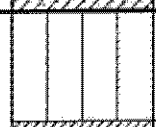
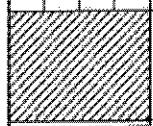
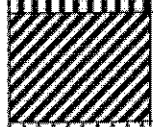
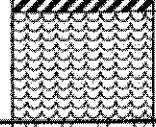
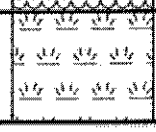
	NUMBER OF BLOWS, N	***APPROXIMATE RELATIVE DENSITY***
SANDS		
	0 - 4	VERY LOOSE
	5 – 10	LOOSE
	11 – 30	MEDIUM DENSE
	31 – 50	DENSE
	OVER 50	VERY DENSE

		APPROXIMATE CONSISTENCY
SILTS AND CLAYS		
	0 - 1	VERY SOFT
	2 - 4	SOFT
	5 - 8	FIRM
	9 - 15	STIFF
	16 - 20	VERY STIFF
	OVER 30	HARD

DRILLING PROCEDURES

SOIL SAMPLING AND STANDARD PENETRATION TESTING PERFORMED IN ACCORDANCE WITH ASTM D-1586. THE STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS OF A 140 POUND HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. 1.4 INCH I.D. SPLIT BARREL SAMPLER ONE FOOT. CORE DRILLING CONDUCTED IN ACCORDANCE WITH ASTM DESIGNATION D 2113. THE UNDISTURBED SAMPLING PROCEDURE IS DESCRIBED BY ASTM SPECIFICATION D 1587. SOIL AND ROCK SAMPLES WILL BE DISCARDED 30 DAYS AFTER THE DATE OF THE FINAL REPORT UNLESS OTHERWISE DIRECTED.

SOIL CLASSIFICATION CHART

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Important Information About Your

Geotechnical Engineering Report

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

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one—not even you*—should apply the report for any purpose or project except the one originally contemplated.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject To Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations", many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE PROFESSIONAL FIRMS PRACTICING IN THE GEOSCIENCES

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