ECS Mid-Atlantic, LLC

Geotechnical Engineering Report

PWCS – Pennington Traditional School Additions

9305 Stonewall Road
City of Manassas, Virginia

ECS Project No. 01:33391

September 26, 2024

ECS MID-ATLANTIC, LLC
Geotechnical • Construction Materials • Environmental • Facilities

September 26, 2024

Mr. Steven Orlansky, AIA, LEED AP
Hord Coplan Macht
1925 Ballenger Avenue
Suite 525
Alexandria, Virginia 22314

ECS Project No. 01:33391

Reference: Geotechnical Engineering Report
PWCS – Pennington Traditional School Additions
9305 Stonewall Road, City of Manassas, Virginia

Dear Mr. Orlansky:

ECS Mid-Atlantic, LLC (ECS) has completed the subsurface exploration and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our Proposal No. 01:69993-GP, dated April 22, 2024. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration conducted and our design and construction recommendations.

We are pleased to be of service to Hord Coplan Macht during this project's design phase. We would appreciate the chance to remain involved during the design phase's continuation, and we would like to provide our services during construction phase operations to verify subsurface conditions assumed for this report. If you have questions about the information in this report or if we can help you further, please contact us.

Respectfully submitted,

ECS MID-ATLANTIC, LLC

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"ONE FIRM. ONE MISSION."

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APPENDICES

EXECUTIVE SUMMARY

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

- The subsurface conditions have been explored by drilling and evaluating a total of four borings (B-01 through B-04). An all-terrain vehicle (ATV)-mounted drill rig was utilized to drill the soil test borings and the borings evaluated for the study were advanced to refusal depths, which ranged between 7.0± feet and 14.5± feet below the existing ground surface.

- Beneath existing topsoil, ECS borings encountered residual soils to depths on the order of up to 2.5± feet below the existing ground surface. The residual soils were classified as LEAN CLAY WITH SAND (CL). These soils were generally underlain by weathered SILTSTONE to boring termination.

- Groundwater was not encountered within the ECS borings. Variations in the location of the long-term water table may occur because of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration.

- Rock excavation techniques may be required to achieve the lowest elevations of the footings and deep utilities excavations. Weathered rock and rock removed via hoe ramming can be reused as compacted fill if it is processed into soil-sized particles.

- Based upon our understanding of the project information and subsurface conditions, the site is considered suitable for the proposed development. We recommend the proposed building addition should be supported on shallow foundation systems consisting of spread and continuous footings. For footings placed to bear on properly compacted and controlled engineered fill or approved natural soils, we recommend a net allowable soil bearing pressure of 3,000 pounds per square foot (psf).

- Based upon our estimate and assumed proposed bearing elevations of the structures, and risk category III, we recommend that a **Site Classification of BC** be used for the structures. This recommendation is in accordance with the procedure outlined in ASCE 7-22.

1.0 INTRODUCTION

This study provides geotechnical information for the design and construction of a school building addition with a footprint of about 18,476 square feet Gross Floor Area (GFA). Other site improvements are also proposed consisting of an underground stormwater management detention facility with a footprint of about 2,500 square feet, underground utilities, two parking rows on the east side of the property, and sidewalks with related pavement infrastructure. The recommendations developed for this report are based on project information supplied by the project team.

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

a. Observations from our site reconnaissance including current site conditions, surface drainage features, and surface topographic conditions.

b. A review of the published geologic conditions and their relevance to your planned development.

c. A subsurface characterization and a description of the field exploration performed. Ground water concerns relative to the planned construction have been summarized.

d. Logs of the soil borings and records of the field exploration prepared in accordance with the standard practice for geotechnical engineering. A boring location plan is included, and the results of the laboratory tests are plotted on the final boring logs and included on separate test report sheets.

e. Recommended allowable soil bearing pressures for conventional shallow foundations (spread footings) and estimates of predicted foundation settlement.

f. Recommendations for slab-on-grade construction, including recommendations for subgrade improvements.

g. Design and construction recommendations for underground stormwater management facility.

h. Evaluation of the on-site soil characteristics encountered in the soil borings. Specifically, we discuss the suitability of the on-site materials for reuse as engineered fill to support building foundation, grade slabs, and pavements. The report also includes compaction requirements and suitable material guidelines.

i. Provide preliminary estimated CBR values for the soils encountered and recommendations for use in preliminary design of asphalt concrete pavements.

j. Recommendations for seismic site classification in accordance with the Virginia Construction Code 2021 (VCC), which incorporates ASCE 7-22, Minimum design Loads and Associated Criteria for Building and Other Structures into the building code, in respect to seismic site classification.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE/PAST SITE USE

The project site is at the Pennington Traditional School located at the northeast of the intersection of Stonewall Road and Center Street in the City of Manassas, Virginia. Based on the City of Manassas GIS website, the tax map number of the property is 101/01 00/264. The general location of the site is depicted below, and a Site Location Diagram is included in Appendix A.

Figure 2.1.1 Site Location

Based on historic aerial imagery and publicly available data, the school building was constructed at some point between 1964 and 1979, and the parking lot was expanded on the northeast side sometime between 2003 and 2005. The overall existing topography of the project site range from an existing high point of EL. 274 ft at the southwest corner, which then slopes downwards to a low point of EL. 264 ft at the northwest portion of the site before sloping back upwards to an approximate elevation of EL. 271 ft at the northeast end of the project site.

2.2 PROPOSED CONSTRUCTION

The following information explains our understanding of the planned development including proposed building addition and related infrastructure:

Table 2.2.1 Project information

SUBJECT	DESIGN INFORMATION / UNDERSTANDINGS
Building Addition Footprint(2)	Approximately 18,476 square feet GFA
# of Stories	2-stories above grade
Height	27.33 ft
Usage	School
Column Loads(1)	85 kips max
Wall Loads(1)	10 kips per linear foot (klf) max
Slab load(1)	40-125 pounds per square foot (psf)
Lowest Finish Floor Elevation(2)	EL. 268.88 feet

Notes:

(1) Provided by Elhert Bryan, the project structural engineer via an email dated 09/17/2024.
(2) Based on provided grading plan prepared by Timmons Group dated 04/10/23.

In addition to the building, the following site improvements are also proposed:

- Underground stormwater management detention facility with a footprint of about 2,500 square feet.
- Underground utilities.
- Two parking rows on the east side of the property.
- Sidewalks and other pavement infrastructure.

If any of this information is in error, either due to our misunderstanding or due to any design changes that may occur later, we recommend ECS be contacted so that we may review our recommendations and provide any alternate or additional recommendations considered warranted at that time.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION PROGRAM

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

The subsurface conditions have been explored by drilling and evaluating a total of four borings (B-01 through B-04). An all-terrain vehicle (ATV)-mounted drill rig was utilized to drill the soil test borings and the borings evaluated for the study were advanced to refusal depths, which ranged between 7.0± feet and 14.5± feet below the existing ground surface.

The boring locations for the site were identified and located in the field by ECS personnel. The approximate boring locations are shown on the Boring Location Diagram within Appendix A. Ground surface elevations that are noted on the attached boring logs were interpolated from provided site grading plans prepared by the project civil engineer, Timmons Group.

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

3.2 REGIONAL/SITE GEOLOGY

The site is within the Triassic Basin, a structural trough filled with sedimentary and igneous rocks of the Mesozoic Age bordering the eastern margin of the Blue Ridge in Northern Virginia. The basin is a massive formation extending locally from the Rapidan River near Madison, Virginia, northward across the Potomac River and terminates just west of Frederick, Maryland. In the area of question, the basin formed a “playa” type lake which was filled with predominantly micaceous silty and sandy materials. These materials have been compressed and thermally altered by local and regional metamorphism to produce reddish to purplish brown, calcareous siltstone and sandstone materials.

After the Triassic Basin was formed and largely filled, volcanic action resulted in magma penetrating portions of the now partially lithified sediments within the Triassic Basin. This solidified magma is locally identified as diabase. At the contact zones between the diabase and the siltstone, the siltstone nearest the intrusion will be thermally altered (metamorphosed) into a rock material known as hornfels or "baked" siltstone. Commonly, interfingering of the diabase and siltstone occurs, due to dike and sill intrusions. Where solidified magma is exposed as a result of subsequent erosion, it often weathers to produce a highly plastic clay which overlies typically granular soils, and ultimately, unweathered rock. As a result, the residual soil weathered from the diabase, in the area where hornfels is typically contacted, can be both highly plastic and expansive. Although expansive soils were not encountered in our soil borings, care should be taken if any high plasticity or expansive soils are encountered at other areas of the site during construction.

The natural soils which have resulted from the in place physical and chemical weathering of the diabase are comprised primarily of residual clayey or silty surficial soils with minor amounts of fine sand. The granular nature of the residual soils generally increases with depth, as does the percentage of rock fragments. These layers are termed weathered rock due to their rocklike structure but exhibit characteristics which qualify them as soil. The weathered rock strata often abruptly transition into relatively unweathered rock. Based on the Geologic Map of Virginia produced by the USGS, the bedrock is mapped locally as Jurassic Interbedded Sandstone and Siltstone member of the Newark Supergroup. Jurassic Interbedded Sandstone and Siltstone is typically interbedded fine to coarse grained, pebbly, reddish-brown, arkosic sandstone and reddish-brown siltstone. Shale beds are also common. The weathered rock materials encountered in our borings were identified as siltstone.

3.3 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil and rock strata. Please refer to the boring logs in Appendix B.

Table 3.3.1: Soil Strata Summary

Approximate Depth (ft)	Stratum	Description	Ranges of SPT$^{(2)}$ N-values (bpf)
0.0-0.3 ft	n/a	**Surface Cover** – 2 to 4 inches of Topsoil	N/A
0.2-2.5 ft	I	Stiff to Hard LEAN CLAY WITH SAND (CL)	15 to 38
0.3-14.5 ft	II	Very Dense Weathered SILTSTONE	77 to 50/0$^{(2)}$

Notes:

(1) Standard Penetration Testing
(2) 50 blows with 0 inch of sampler penetration (50/0)

3.4 GROUNDWATER OBSERVATIONS

In Hollow Stem Auger drilling operations, water is not introduced into the boreholes and the groundwater position can often be determined by observing water flowing into the boreholes. Furthermore, visual observation of the soil samples retrieved during the drilling operations can often be used in evaluating the groundwater conditions. Groundwater observations were made during drilling operations, after completion of drilling, after the auger is removed from the ground, as well as at the end of the workday, prior to backfilling the borings. Groundwater was not encountered in any of the ECS borings.

Groundwater on sites with a generally shallow rock surface, such as this one, is sometimes found to be partially perched. Specifically, rainfall that enters the site, either directly or from overland flow, begins to percolate through the low to moderately permeable surficial soils. Once the water percolation reaches the bedrock, which is virtually impermeable, it perches and begins to flow at the interface of the rock and the soil and within the fractured surface of the bedrock. This groundwater flow continues downhill, with the water table occasionally surfacing to form as wet springs and intermittent streams. The groundwater is related to rainfall, although springs may exist in the lower lying areas for extended periods of time without recharge from precipitation. Therefore, the groundwater conditions at this site are expected to be significantly influenced by surface water runoff and rainfall, especially during high precipitation seasons.

> **“**Perched water is typically of limited quantity, replenished or recharged very slowly. When encountered in an excavation, perched water will typically drain off very quickly, with limited continuous flow or bleeding, unless a source of recharge, such as a leaking utility is present.”
>
> From: *Construction Dewatering and Groundwater Control – New Methods and Applications, 3rd Addition*

The highest groundwater observations are normally encountered in the late winter and early spring. Variations in the long-term water table's location may occur due to changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration. Massive earthwork operations, especially in the winter and spring, are more likely to encounter difficulties with perched conditions than those operations undertaken in the summer or fall.

3.5 LABORATORY TESTING

ECS laboratory testing consisted of selected tests performed on samples obtained during our field exploration operations. Classification and index property tests were performed on representative soil samples. The complete laboratory testing program including moisture content tests, Atterberg Limits tests, and grain size sieve analyses is included within this report.

Selected samples were visually classified based on texture and plasticity in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) and including USCS classification symbols, and ASTM D2487 Standard Practice for Classification for Engineering Purposes (Unified Soil Classification System (USCS)). After classification, the samples were grouped in the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses along with the soil descriptions. The stratification lines between strata on the logs are approximate; in situ, the transitions may be gradual.

4.0 DESIGN RECOMMENDATIONS

4.1 BUILDING FOUNDATIONS

Within the proposed building addition footprint, no more than 2-3 ft of cuts and fills are anticipated. Provided subgrades and structural fills are prepared as recommended in this report, the proposed structure can be supported by shallow foundations including column footings and continuous wall footings. We recommend the foundation design use the following parameters.

Table 4.1.1: Summary of Design Recommendations

Design Parameter	Column Footing	Wall Footing
Soil – Net Allowable Bearing Pressure(1)	3,000 psf	3,000 psf
Suitable Subgrade Bearing Materials	Engineered Fill/Approved Natural Soils N-value > 8 bpf	Engineered Fill/Approved Natural Soils N-value > 8 bpf
Minimum Width	24 inches	18 inches
Minimum Footing Embedment Depth (below slab or finished grade) (2)	24 inches	30 inches
Estimated Total Settlement	Less than 1-inch	Less than 1-inch

Notes:

(1) Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.
(2) For bearing considerations, frost penetration requirements or expansive soil concerns

During construction, the bearing capacity at the final footing excavation should be documented in the field by an experienced soil engineer to ensure that the in-situ bearing capacity at the bottom of each footing excavation is adequate for the design loads.

Most of the soils at the foundation bearing elevation are anticipated to be suitable for support of the proposed structures. However, if unsuitable soils (organics, soft, wet, etc.) are encountered, they should be undercut and removed. Any undercut should be backfilled with controlled low strength material (CLSM) up to the original design bottom of footing elevation; the original footing shall be constructed on top of the hardened CLSM.

Controlled Low Strength Material (CLSM): Prior to placement of CLSM in foundation undercuts, remove all loose material from the foundation excavation. Soil at the base of the undercut should be confirmed to be capable of supporting the allowable bearing pressure for the undercut foundation. CLSM should be mixed according to guidance in ACI 229R-13 *Report on Controlled Low-Strength Materials* Chapter 7 and have a minimum compressive strength of 200 psi measured according to ASTM D4832. The CLSM should consist of a mixture of fine aggregate (max particle size 1/4 inch), cement (Type I, II, or I/II), and water provided by a Ready-Mix plant and having a slump of at least 8 inches. Additives and cement replacements (such as fly ash) may be used. A mix design should be submitted to ECS for review. Place CLSM evenly in the excavation in one continuous operation to the design foundation bearing elevation.

Confirm approved mix is delivered to the site from batch tickets. Obtain samples of CLSM for testing according to ASTM D5971. Test slump (ASTM C143) at least once per day and if observable changes in consistency are noted. Obtain compressive strength samples at least once per 50 cubic yards cumulatively throughout the project by obtaining at least 3 test cylinders (4 inch x 8 inch) per ASTM D4832 broken at 28-days. Additional samples may be obtained to facilitate the construction schedule. Do not add water to the CLSM on site.

4.2 SLABS ON GRADE

Provided subgrades and structural fills are prepared as discussed herein, the proposed floor slabs can be constructed as ground supported slabs (or slab on grade). The following graphic depicts our soil-supported slab recommendations:

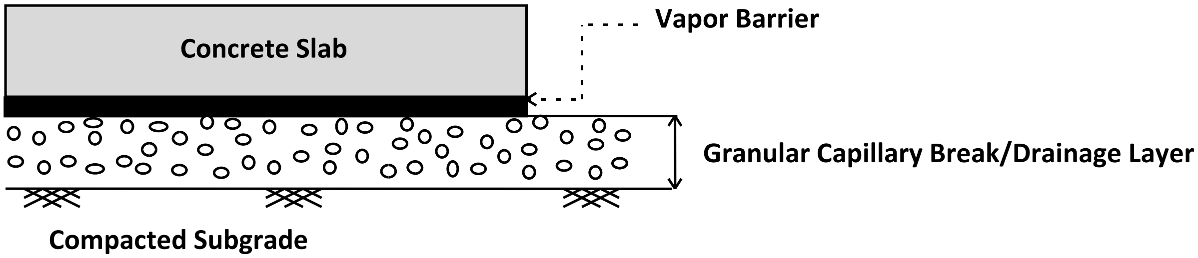


Figure 4.2.1

1. Drainage Layer Thickness: 6 inches
2. Drainage Layer Material: 6 inches of VDOT #57 Stone or similar material

Soft or yielding soils may be encountered in some areas. Those soils should be removed and replaced with compacted structural fill in accordance with the recommendations included in this report.

Subgrade Modulus: Provided the structural fill and granular drainage layer are constructed in accordance with our recommendations, the slab may be designed assuming a modulus of subgrade reaction, k_1 of 125 pci (lbs./cu. inch).

Vapor Barrier: Before the placement of concrete, a vapor barrier (6 mil thick polyethylene, or equivalent) may be placed on top of the granular drainage layer to provide additional protection against moisture penetration through the floor slab. When a vapor barrier is used, special attention should be given to surface curing of the slab to reduce the potential for uneven drying, curling and/or cracking of the slab. Depending on proposed flooring material types, the structural engineer and/or the architect may choose to eliminate the vapor barrier.

Slab Isolation: Soil-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration prevents the use of a free-floating slab such as in a drop-down footing/monolithic slab configuration, the slab should be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab.

4.3 SEISMIC DESIGN CONSIDERATIONS

The Commonwealth of Virginia has adopted Virginia Construction Code 2021 (VCC). The current version of VCC incorporates ASCE 7-22, Minimum design Loads and Associated Criteria for Building and Other Structures into the building code. This adoption supersedes section 16 of International Building Code (IBC) 2021, in respect to seismic site classification.

ASCE 7-22, Chapter 20 has updated the procedure for determining Site Classification. This chapter requires that site classification be conducted based on the average shear wave velocity of the top 100 feet of the site. The shear velocity can either be measured or estimated based on established correlations. If site classification is based on estimated values of shear wave velocity (v_s), the site class shall be derived using V_s, $V_s/1.3$ and $V_s(1.3)$. The seismic site class definitions for the weighted average shear wave velocities in the upper 100 feet of the soil profile are presented in Chapter 20 of ASCE 7-22 and in the table below.

Table 4.3.1: Seismic Site Classification

Site Class	Soil Profile Name	Shear Wave Velocity, Vs, (ft./s)
A	Hard Rock	> 5,000
B	Rock	>3,000 to 5,000
BC	Soft Rock	>2,100 to 3,000
C	Very Dense Sand or Hard Clay	>1,450 to 2,100
CD	Dense Sand or Very Stiff Clay	>1,000 to 1,450
D	Medium Dense Sand or Stiff Clay	>700 to 1,000
DE	Loose Sand or Medium Stiff Clay	>500 to 700
E	Very Loose Sand of Soft Clay	≥500

In this project shear wave velocity of the soil profile was estimated based on the soil densities and rock type observed. Based upon our estimate and assumed proposed bearing elevations of the structures, and risk category III, we recommend that a **Site Classification of BC** be used for the structures. This recommendation is in accordance with the procedure outlined in ASCE 7-22.

4.4 PAVEMENTS

The site pavement designs shall conform to the latest VDOT Road and Bridge Standards and Specifications. The subgrade preparation for pavements should consist of stripping all soft or unsuitable material from the parking lot areas. After stripping to the desired grade, and prior to any fill placement, the stripped surface should be observed by an experienced geotechnical engineer or his authorized representative.

Proofrolling using a loaded dump truck, having an axle weight of at least 10 tons, should be used to aid in identifying localized soft or unsuitable material which should be removed and replaced with an approved backfill compacted to the criteria presented in the Structural Fill section of this report. The undercut depth may be limited to a maximum of 2 feet by utilizing a geotextile reinforcement consisting of geogrid such as Tensar® TriAx®, Tensar® BX-1200 or approved equivalent, in cases where unsuitable materials are encountered to depths greater than 2 feet.

An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should reduce the possibility of the subgrade materials being saturated over a long time. We would be pleased to be of further assistance to you in the design of the project pavements by providing additional recommendations during construction of the project.

For preliminary design purposes, we recommend using a design California Bearing Ratio (CBR) value of 5 for the native site soils; however, we suggest that additional laboratory testing (i.e., CBR and Atterberg Limits tests) be performed in the proposed pavement areas on actual subgrade materials to permit proper design of these pavements.

Rutting of pavement and ultimately pavement failure is typically experienced due to front loading garbage trucks imposing concentrated wheel loads on pavements. Therefore, we recommend that the pavement in the dumpster enclosure area consist of a reinforced concrete pavement underlain by VDOT 21A subbase. We recommend concrete pavement designs be developed in accordance with applicable VDOT requirements. Such a design should be based on anticipated traffic loading conditions and soil subgrade conditions.

We recommend that sidewalks be underlain by a minimum of 4 inches of granular material having a maximum aggregate size of 1.5 inches and no more than 2% passing the #200 sieve or in accordance with the local requirements. This granular layer will reduce the potential for frost heaving of the exterior sidewalk slabs.

The design of both flexible and rigid pavement sections is beyond the scope of this report. If necessary, ECS can provide design sections for both flexible and rigid pavements based on anticipated traffic loading conditions and soil subgrade materials at the time of construction. In general, heavy-duty sections are areas subjected to trucks, buses, or other similar vehicles including main drive lanes of the development. Light duty sections are appropriate for vehicular traffic and parking areas. Prior to subbase placement and paving, CBR testing of the subgrade soils (both natural and fill soils) should be performed to determine the soil engineering properties for final pavement design.

4.5 UNDERGROUND STORMWATER MANAGEMENT FACILITY

Per the provided civil grading plans, an underground stormwater detention facility with an approximate footprint of about 2,500 square foot is proposed within the green area located to the north of parking lot. This will likely be a proprietary system that should be designed and constructed in accordance with the manufacturer's design manual, specifications, and details. In addition, we recommend that the facilities should be installed in general accordance with the design guidelines specified in the Virginia Storm Water Management Handbook.

Based on the fine-grained soil and location of weathered rock encountered at this site, infiltration practices of stormwater management are not feasible for this site and the facilities should be designed so that infiltration is not required. Underdrain outlet pipes should be installed to have positive drainage and/or be constructed to prevent stormwater backflow if these structures are clogged. The underdrain pipes should be tied to nearby storm structures or daylighted to an appropriate location.

Site drainage should be directed away from the facility during construction operations. The prepared subgrade should be carefully observed prior to installation of the Detention facilities as well as stormfilter structures, storm sewer pipes and underdrains to help identify any localized soft, unsuitable soils. Subgrade observations should be performed in conjunction with limited probing to assist in the identification of unsuitable soils which should be removed and replaced in accordance with the recommendations presented in this report. All loose or organic materials encountered at the subgrade elevation should be removed. The systems shall be designed as such that the seasonal highwater table and shallow rock shall be maintained at least two feet below the bottom of the proposed underground facilities.

The foundations for the systems should bear on suitable natural soil and be designed for a net allowable bearing capacity of 3,000 psf. The bearing capacity of the subgrade should be observed by the GER or his authorized representative. For subgrade where the bearing capacity of the subgrade is observed to be less than 3,000 psf, the GER may make recommendations including; increasing the stone foundation beneath the chambers, use of geogrids or other remedial measures to ensure adequate bearing.

Due to the weathered rock on site, perched water should be expected over the dense encountered materials. The contractor should be prepared to dewater the excavation during construction by means of sump pits and trenching. Proper observation, testing and documentation of the installation procedures and materials is an important aspect of the construction of underground SWM facilities. Therefore, we recommend that all installation operations be observed full-time by the GER or his qualified authorized representative to determine if the installation requirements are being met, prior to pavement installation above the facility.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 SUBGRADE PREPARATION

5.1.1 Stripping and Grubbing

The subgrade preparation should consist of stripping all existing vegetation, rootmat, topsoil, and any soft or unsuitable materials from the 10-foot expanded building and 5-foot expanded pavement limits, and 5 feet beyond the toe of structural fills. Stripping should be extended 1 foot for each foot of fill required. ECS should be called on to verify that unsuitable surficial materials have been completely removed prior to the placement of structural fill or construction of structures.

5.1.2 Proofrolling

After removing all unsuitable surface materials, cutting to the proposed grade, and prior to the placement of any structural fill or other construction materials, the exposed subgrade should be examined by the Geotechnical Engineer or their authorized representative. The exposed subgrade should be thoroughly proofrolled with previously approved construction equipment having a minimum axle load of 10 tons (e.g. fully loaded tandem-axle dump truck). The areas subject to proofrolling should be traversed by the equipment in two perpendicular (orthogonal) directions with overlapping passes of the vehicle under the observation of the Geotechnical Engineer or authorized representative. This procedure is intended to assist in identifying any localized yielding materials. In the event that unstable or “pumping” subgrade is identified by the proofrolling, those areas should be marked for repair prior to the placement of any subsequent structural fill or other construction materials.

Methods of repair of unstable subgrade, such as undercutting or moisture conditioning, should be discussed with the Geotechnical Engineer to determine the appropriate procedure with regard to the existing conditions causing the instability. A test pit(s) may be excavated to explore the shallow subsurface materials in the area of the instability to help in determining the cause of the observed unstable materials and to assist in the evaluation of the appropriate remedial action to stabilize the subgrade.

5.1.3 Site Temporary Dewatering

The contractor shall make their own assessment of temporary dewatering needs based upon the limited subsurface groundwater information presented in this report. Soil sampling is not continuous, and thus soil and groundwater conditions may vary between sampling intervals (typically 5 feet). If the contractor believes additional subsurface information is needed to assess dewatering needs, they should obtain such information at their own expense. ECS makes no warranties or guarantees regarding the adequacy of the information provided to determine dewatering requirements; such recommendations are beyond our scope of services.

Dewatering systems are a critical component of many construction projects. Dewatering systems must be selected, designed, and maintained by a qualified and experienced (specialty or other) contractor familiar with the succinct geotechnical and other aspects of the project. The failure to properly design and maintain a dewatering system for a given project can result in delayed construction, unnecessary foundation subgrade undercuts, detrimental phenomena such as 'running sand' conditions, internal erosion (i.e., 'piping'), the migration of 'fines' down-gradient towards the dewatering system, localized settlement of nearby infrastructure, foundations, slabs-on-grade and pavements, etc. Water discharged from any site dewatering system shall be discharged in accordance with all local, state, and federal requirements.

Strategies for Addressing Perched Groundwater:

The typical primary strategy for addressing perched groundwater seeping into excavations is pumping from trench (or French) and sump pits with sump pumps. A typical sump pump drain (found in a sump pit or along a French drain) is depicted below. The inlet of the sump pump is placed at the bottom of the corrugated pipe and the discharge end of the sump is directed to an appropriate stormwater drain.

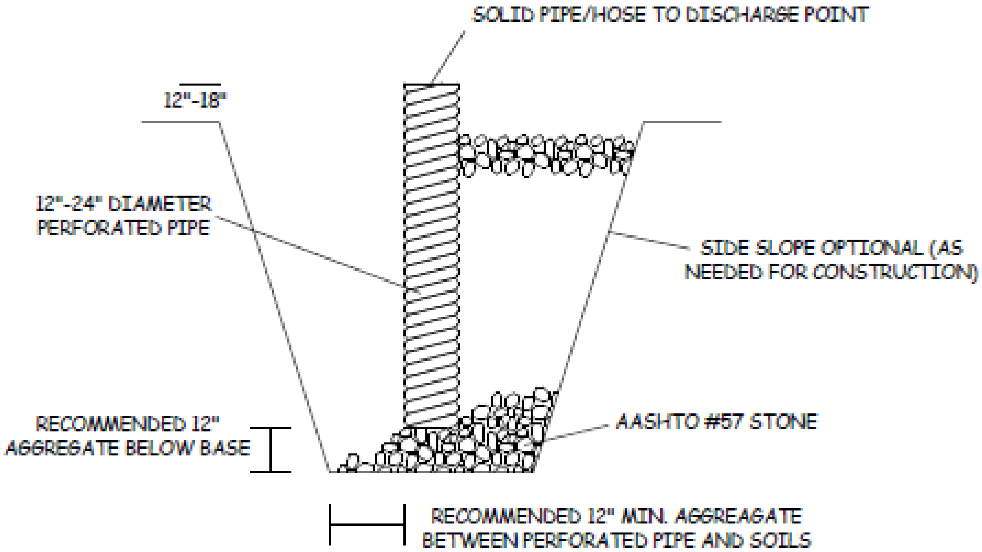


Figure 5.1.3.1: Sump Pit/Pump Diagram

Details of a typical French drainage installation are included in Appendix D. A typical French drain consists of an 18 to 24-inch wide by 18 to 24-inch deep bed of AASHTO #57 (or similar open graded aggregate) aggregate wrapped in a medium duty, non-woven geotextile and (sometimes) containing a 6-inch diameter, Schedule 40 PVC perforated or slotted pipe. Actual dimensions should be as determined necessary by ECS during construction. After the installation has been completed, the geotextile should be wrapped over the top of the aggregate and pipe followed by placement of backfill. The top of the drain should be positioned at least 18 inches below the design subgrade elevation. Drains should not be routed within the expanded building limits.

Pumping wells or a vacuum system could also be used to address perched groundwater. These techniques often are only effective during the initial depletion of the perched water quantity and may quickly be ineffective at addressing accumulation of water from rain, snow, etc.

5.1.4 Subgrade Stabilization

In some non-structural areas, undercutting of excessively soft materials may be considered inefficient. In such areas, the use of a reinforcing geotextile or geogrid might be employed, under the advisement of ECS. Suitable stabilization materials may include medium duty woven geotextile fabrics or geogrids. The suitability and employment of reinforcing or stabilization products should be determined in the field by ECS personnel, in accordance with project specifications.

5.2 EARTHWORK OPERATIONS

5.2.1 Potentially Expansive Soils

Within the proposed project limits, high plasticity soils and potentially expansive soils (CH/MH) were not encountered; however, because these types of soils are common in this area, care should be taken to limit moisture variations to reduce potential volume changes. If the field work is conducted during the winter or early spring months, even the low-plasticity clay/silt soils at the surface may need to be removed or dried before filling placement. However, if expansive clays and silts and clay-silt mixtures are encountered, they should not be used as fill for roadway, curb, gutter, and sidewalk subgrade, within utility trenches, or within embankment slopes.

For suitability of natural soils and structural fill soils (on-site and off-site borrow materials) to be used in foundations and floor slabs, soils meeting all four of the following provisions shall be considered expansive per IBC 2012, except that tests to show compliance with Items 1, 2, and 3 shall not be required if the test prescribed in Item 4 is conducted:

1. Plasticity Index (PI) of 15 or greater, determined in accordance with ASTM D 4318.

2. More than 10 percent of the soil particles pass a No. 200 sieve (0.75 µm), determined in accordance with ASTM D 422.

3. More than 10 percent of the soil particles are less than 5 micrometers in size, determined in accordance with ASTM D 422.

4. Expansion Index greater than 20, determined in accordance with ASTM D4829.

**If the Plasticity Index (PI) of the soil is 20 or less and the Liquid Limit (LL) is 45 or less, the Plasticity Index Corrected (PI cor) or the Expansion Index Corrected (E1 cor) may be substituted in the definition of Expansive Soil. Where PI cor and E1 cor are determined as follows:*

PI cor = PI x (% Passing No.40 sieve)/100 and EI cor = EI x (% Passing No. 4 Sieve)/100

Floor slabs placed in areas where potentially expansive (CH/MH) soils are encountered should be underlain by at least 2 feet of compacted suitable fill. In proposed pavement areas, we recommend undercutting and replacing the expansive soils to provide at least 2 feet of non-expansive soil fill below the pavement subgrade.

5.2.2 Weathered Rock and Rock

Weathered rock was encountered as shallow as 0.25± feet below the existing ground surface with auger refusal occurring as shallow as 7.0± feet below the existing ground surface. Rock excavation will likely be required for installation of any deep utilities. Typically, for excavations in such rock material, ripping is practical for excavations extending down to about 2 to 3 feet below the depth of auger refusal. For general excavations below this level, hard rock requiring blasting for removal is normally encountered. In local excavations for utility infrastructure, we anticipate that hoe-ramming or rock trenching will be feasible if the excavation is to extend only a few feet below these levels.

For excavations necessary for utilities and foundations in diabase, excavation of materials with conventional earthwork equipment is practical to auger refusal depths: however, hoe-ramming for removal of weathered rock or rock will likely be required below the depth of auger refusal. For the construction planning and final pay quantities, we recommend that the following definition be utilized in the project specification to define rock:

"For footings, trenches and pits, rock shall be defined as those materials that cannot be excavated with a Caterpillar Model No. 320L track-type hydraulic excavator, equipped with a 42-inch wide short-tip radius rock bucket, rated at not less than 120 hp flywheel power with a maximum drawbar pull force of not less than 39,700 lbs. Boulders or masses of rock exceeding one-half cubic yard in volume shall also be considered rock excavation. This classification does not include materials such as loose rock, concrete, or other materials that can be removed by means other than drilling and blasting, hoe-ramming, or rock trenching, but which for reasons of economy in excavating, the contractor chooses to remove by drilling and blasting, hoe-ramming, or rock trenching techniques." However, due to the presence of the existing school building, we do not recommend blasting for this project.

5.2.3 Structural Fill

Product Submittals: Prior to placement of structural fill, representative bulk samples (about 50 pounds) of on-site and/or off-site borrow should be submitted to ECS for laboratory testing, which will typically include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships (i.e., proctors) for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications. Alternatively, proctor data from other accredited laboratories can be submitted if the test results are within the last 180 days.

Satisfactory Structural Fill Materials: The low plasticity natural soils at this site are expected to be suitable for use as controlled fill; however, they may require moisture content adjustments, via discing or other drying techniques or spraying of water to the soil prior to their use as controlled fill material. Additionally, any debris or other unsuitable materials must be removed, as necessary, from the on-site materials prior to their reuse as engineered fill. The planning of earthwork operations should recognize and account for these efforts and increased costs. Materials satisfactory for use as Structural Fill should be free of organics with the following engineering properties and compaction requirements.

Table 5.2.3.1: Structural Fill Index Properties

Subject	Property
Building and Structural Areas	LL < 40, PI<15
Pavement Areas	LL < 45, PI<20
Max. Particle Size	4 inches

Table 5.2.3.2: Structural Fill Compaction Requirements

Subject	Requirement
Compaction Standard	Standard Proctor, ASTM D698/ Virginia Test Method (VTM-1)
Required Compaction	95% of Max. Dry Density for fill less than 8 feet
	98% of Max. Dry Density for fill greater than 8 feet
Moisture Content	-2 to +2 % points of the soil's optimum value
Loose Thickness	8 inches prior to compaction

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

5.3 TEMPORARY AND PERMANENT SLOPES

Because of the erodibility of the natural soil at the site, special care should be taken to prevent erosion. We recommend that temporary slopes established during construction be constructed no steeper than 1H:1V and maintained for no more than 30 days.

Slopes steeper than 3H:1V should be analyzed and certified by the (GER). Landscape berms can be constructed as steep as 2H:1V; however, it should be noted that the site soil is highly erodible and that adequate measures must be taken to prevent erosion of slopes steeper than 3H:1V. All slopes must be protected from erosion by a ground cover of adequate vegetation and erosion control measures. All excavations should be performed in accordance with the current OSHA and VOSHA regulations.

5.4 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally suitable for support of utility pipes. The pipe subgrades should be observed and probed for stability by ECS. Any loose or unsuitable materials encountered should be removed and replaced with suitable compacted Structural Fill, or pipe stone bedding material.

Utility Backfilling: The granular bedding material (often #57 stone) should be at least 4 inches thick, but not less than that specified by the civil engineer's project drawings and specifications. We recommend that the bedding materials be placed up to the springline of the pipe. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for Structural Fill and Fill Placement.

Excavation Safety: All excavations and slopes should be constructed and maintained in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing, constructing, and maintaining stable temporary excavations and slopes. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.0 CONSTRUCTION OBSERVATIONS

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

Footing Subgrade Observations: Most of the soils at the foundation bearing elevation are anticipated to be suitable for support of the proposed structures. It is important to have ECS observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated.

Slab Subgrade Verification: Prior to placement of a drainage layer, the subgrade should be prepared in accordance with the recommendations found in the slab section of the report.

7.0 CLOSING

ECS has prepared this report to guide the geotechnical-related design and construction aspects of the project. We performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity in the region. No other representation expressed or implied, and no warranty or guarantee is included or intended in this report.

The description of the proposed project is based on information provided to ECS by the client. No detailed architectural or structural drawings were provided at the time of our report; hence, we have made some assumptions for our analyses. If any of this information is inaccurate or changes, either because of our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so we can review our recommendations and provide additional or alternate recommendations that reflect the proposed construction.

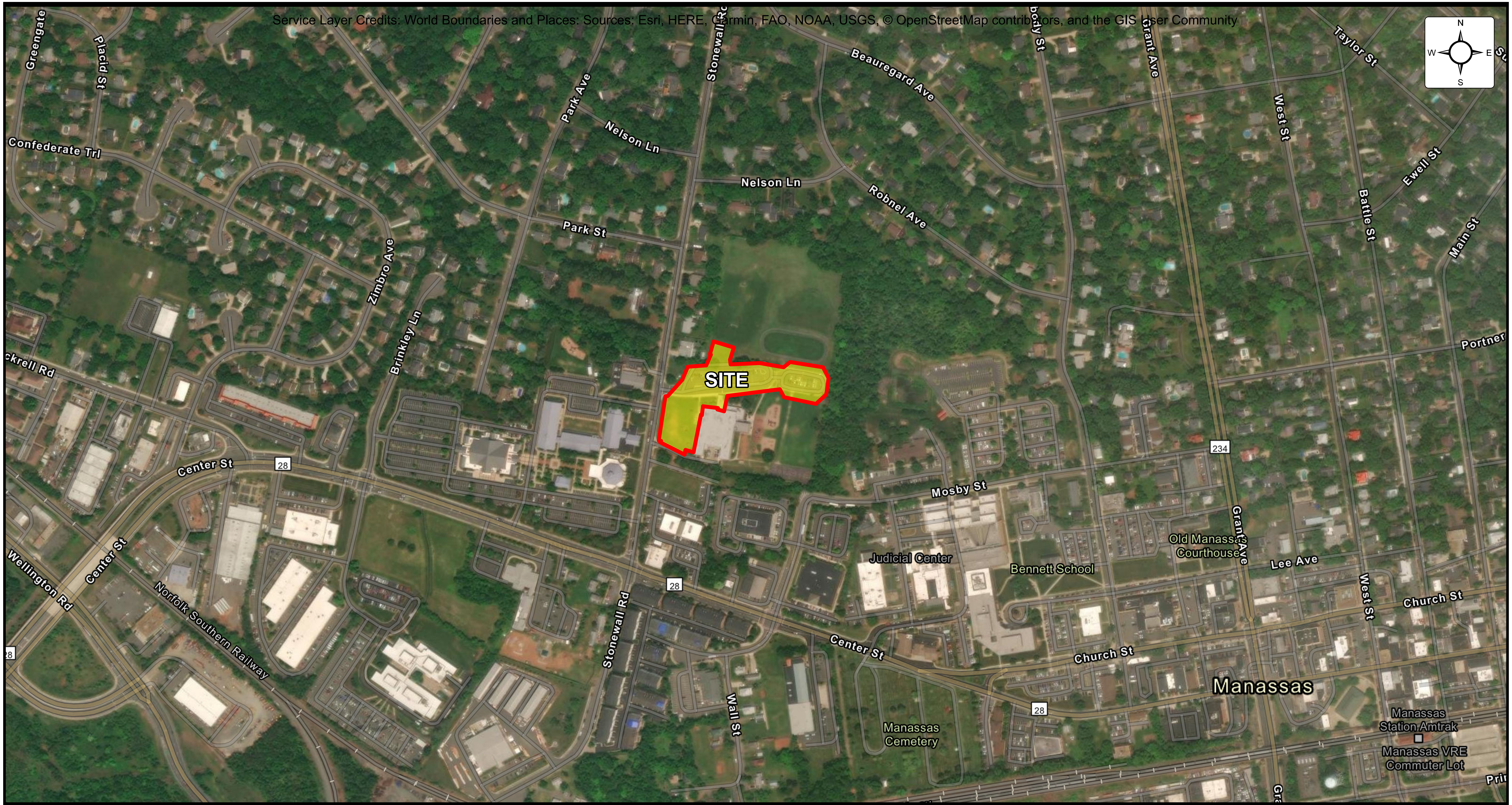
We recommend that ECS review the project plans and specifications so we can confirm that those plans/specifications are in accordance with the recommendations of this geotechnical report.

Field observations, and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design. We recommend that ECS be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendation should issues arise.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

Appendix A - Drawings and Reports

Site Location Diagram
Boring Location Diagram(s)
Subsurface Cross-Section(s)



Service Layer Credits: World Boundaries and Places: Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

SITE LOCATION DIAGRAM

PWCS - Pennington Traditional School Addition

9305 Stonewall Road, Manassas, Virginia

Hord Coplan Macht, Inc.

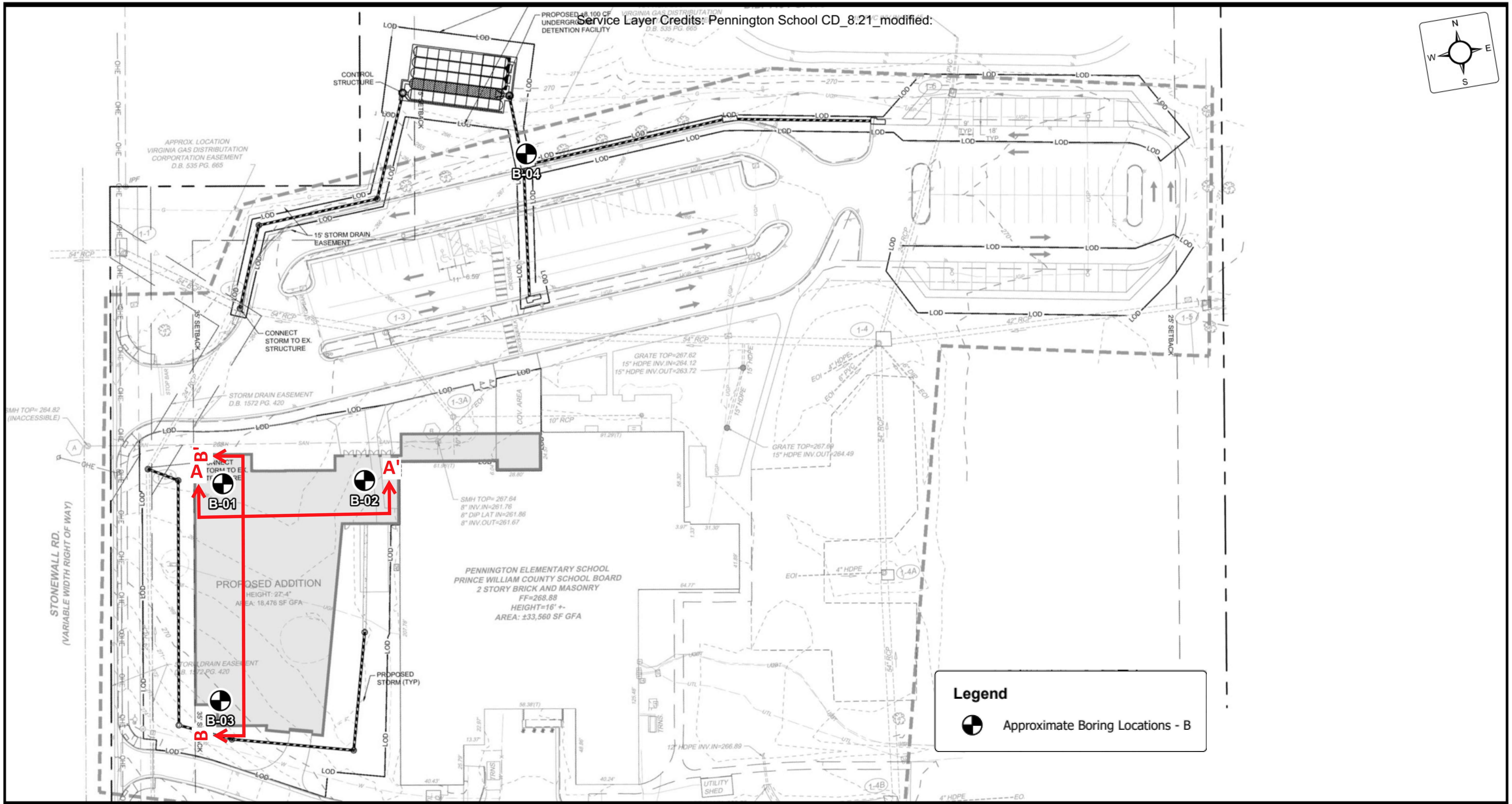
ENGINEER
AF3

SCALE
1" = 400'

PROJECT NO.
01:33391

SHEET

DATE
9/24/2024



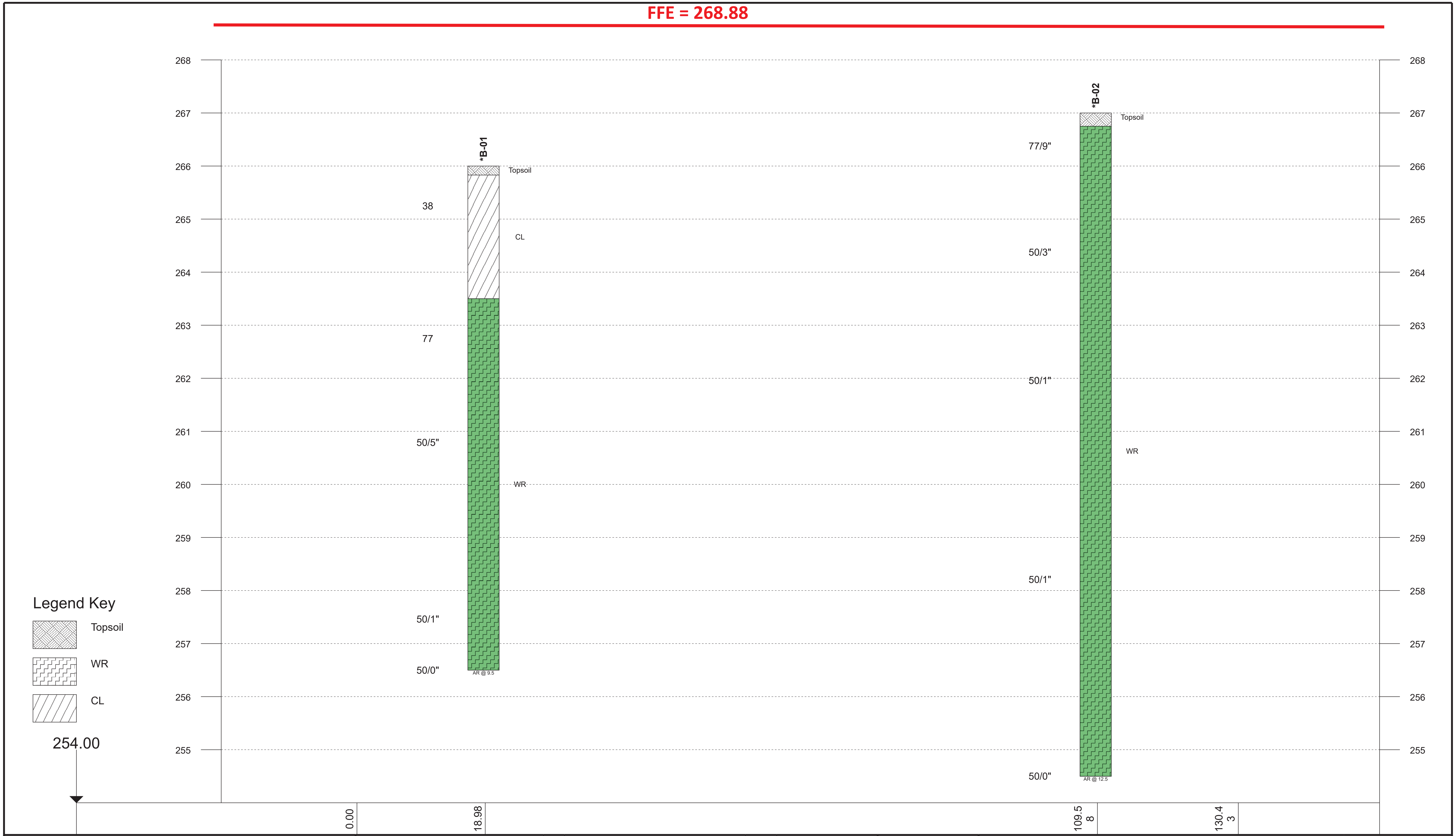
BORING LOCATION DIAGRAM

PWCS - Pennington Traditional School Addition

9305 Stonewall Road, Manassas, Virginia
Hord Coplan Macht, Inc.

ENGINEER
AF3
SCALE
1" = 60'
PROJECT NO.
01:33391
SHEET

DATE
9/24/2024



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.

2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.

3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.

4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit X——●——△	▽	WL (First Encountered)	🟥	Fill
[FINES CONTENT %]	▼	WL (Completion)	🟪	Possible Fill
BOTTOM OF CASING	▽	WL (Seasonal High Water)	🟥	Probable Fill
LOSS OF CIRCULATION	▽	WL (Stabilized)	🟩	Rock

GENERALIZED SUBSURFACE PROFILE A-A'

PWCS - Pennington Traditional School Addition
Hord Coplan Macht, Inc.
9305 Stonewall Road, Manassas, Virginia, 20110

Project No:	01:33391	Date:	09/24/2024

Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit X———●———△	▽	WL (First Encountered)	🟥	Fill
[FINES CONTENT %]	▼	WL (Completion)	🟪	Possible Fill
◀ BOTTOM OF CASING	▽	WL (Seasonal High Water)	▨	Probable Fill
LOSS OF CIRCULATION	▽	WL (Stabilized)	🟩	Rock

GENERALIZED SUBSURFACE PROFILE B-B'

PWCS - Pennington Traditional School Addition
Hord Coplan Macht, Inc.
9305 Stonewall Road, Manassas, Virginia, 20110

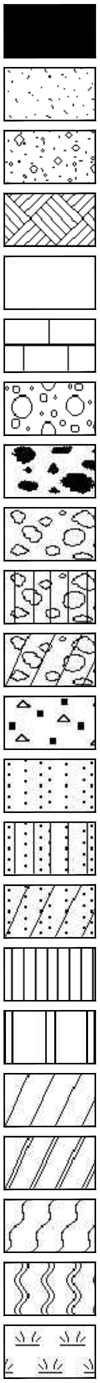
Project No: 01:33391 Date: 09/24/2024

Appendix B – Field Operations

- Reference Notes
- Exploration Procedures
- Boring Logs

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]



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

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

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

PARTICLE SIZE IDENTIFICATION

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

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, QP[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<2	Very Soft
0.25 - <0.50	2 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

WATER LEVELS[6]

▽	WL (First Encountered)
▼	WL (Completion)
▼	WL (Seasonal High Water)
▽	WL (Stabilized)

FILL AND ROCK

🟥	🟪	▢	🟩
FILL	**POSSIBLE FILL**	**PROBABLE FILL**	**ROCK**

---

[1] Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

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

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

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

[5] Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

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

[7] Minor deviation from ASTM D 2488-17 Note 14.

[8] Percentages are estimated to the nearest 5% per ASTM D 2488-17.

SUBSURFACE EXPLORATION PROCEDURE: STANDARD PENETRATION TESTING (SPT)

ASTM D 1586

Split-Barrel Sampling

Standard Penetration Testing, or **SPT**, is the most frequently used subsurface exploration test performed worldwide. This test provides samples for identification purposes, as well as a measure of penetration resistance, or N-value. The N-Value, or blow counts, when corrected and correlated, can approximate engineering properties of soils used for geotechnical design and engineering purposes.

SPT Procedure:

- Involves driving a hollow tube (split-spoon) into the ground by dropping a 140-lb hammer a height of 30-inches at desired depth

- Recording the number of hammer blows required to drive split-spoon a distance of 18-24 inches (in 3 or 4 Increments of 6 inches each)

- Auger is advanced* and an additional SPT is performed

- One SPT typically performed for every two to five feet. An approximate 1.5 inch diameter soil sample is recovered.

**Drilling Methods May Vary—* The predominant drilling methods used for SPT are open hole fluid rotary drilling and hollow-stem auger drilling.

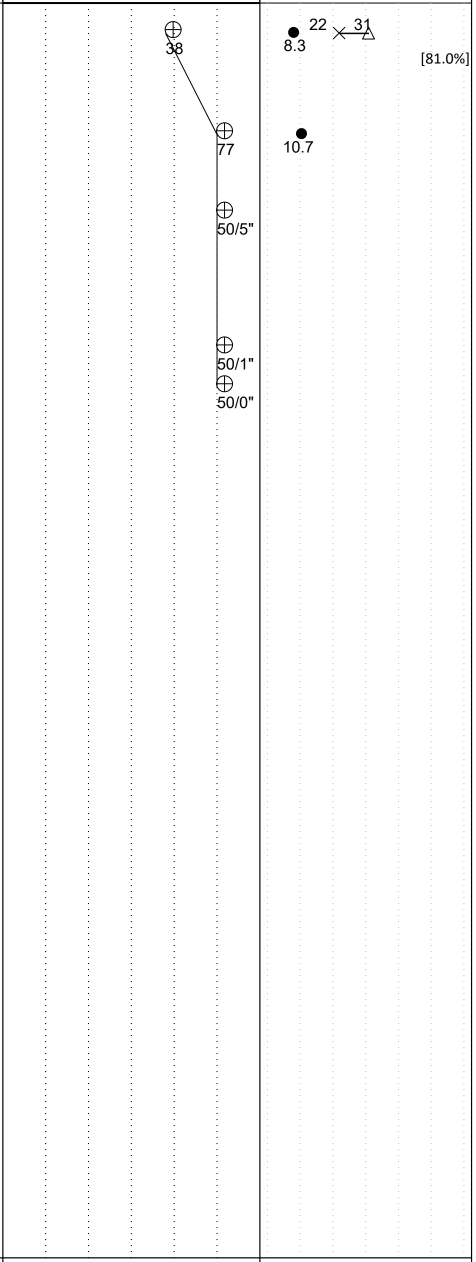
CLIENT: **Hord Coplan Macht, Inc.**	PROJECT NO.: **01:33391**	BORING NO.: **B-01**	SHEET: **1 of 1**
PROJECT NAME: **PWCS - Pennington Traditional School Addition**	DRILLER/CONTRACTOR: **Connelly and Associates, Inc.**		
SITE LOCATION: **9305 Stonewall Road, Manassas, Virginia, 20110**	LOSS OF CIRCULATION	100%	
	BOTTOM OF CASING		

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION: **266**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
	S-1	SS	18	12	Topsoil Thickness [2"] (CL) LEAN CLAY WITH SAND, trace mica, reddish brown, moist, hard			6-11-27 (38)
	S-2	SS	18	13	WEATHERED SILTSTONE SAMPLED AS SANDY SILT, reddish brown, moist, very dense			16-40-37 (77)
5	S-3	SS	5	5			261	50/5" (50/5")
	S-4	SS	1	1				50/1" (50/1")
	S-5	SS	0	0				50/0" (50/0")
10					**AUGER REFUSAL AT 9.5 FT**		256	
15							251	
20							246	
25							241	
30							236	

⊕ STANDARD PENETRATION BLOWS/FT
10 20 30 40 50
20 40 60 80 100
ROCK QUALITY DESIGNATION & RECOVERY
🟥 RQD
— REC
☒ MC SAMPLER BLOWS/FT
10 20 30 40 50
▼ TEXAS CONE PENETRATION BLOWS/FT

△ LIQUID LIMIT
✕ PLASTIC LIMIT
○ CALIBRATED PENETROMETER TSF
1 2 3 4 5
● WATER CONTENT %
[FINES CONTENT] %
10 20 30 40 50



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

▽ WL (First Encountered)	**Dry**	BORING STARTED:	**Sep 04 2024**	CAVE IN DEPTH:	**6.0**
▼ WL (Completion)	**Dry**	BORING COMPLETED:	**Sep 04 2024**	HAMMER TYPE:	**Auto**
▽ WL (Seasonal High Water)	**NOT EVALUATED**	EQUIPMENT: **CME 55**	LOGGED BY: **AF3**	DRILLING METHOD:	**Hollow Stem Auger**
▽ WL (Stabilized)	**NOT DETERMINED**				

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Hord Coplan Macht, Inc.	**01:33391**	**B-02**	**1 of 1**

PROJECT NAME: **PWCS - Pennington Traditional School Addition**

DRILLER/CONTRACTOR: **Connelly and Associates, Inc.**

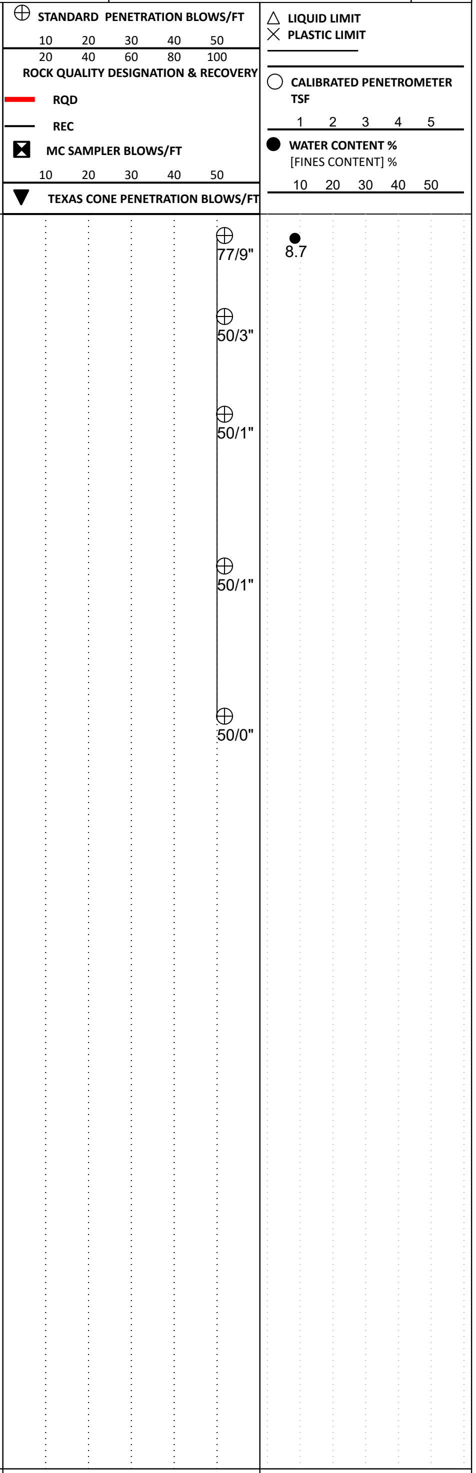
SITE LOCATION: **9305 Stonewall Road, Manassas, Virginia, 20110**

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
			267

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
	S-1	SS	15	3	Topsoil Thickness [3"] WEATHERED SILTSTONE SAMPLED AS SANDY SILT, reddish brown, moist, very dense			15-27-50/3" (77/9")
	S-2	SS	3	3				50/3" (50/3")
5	S-3	SS	1	1			262	50/1" (50/1")
	S-4	SS	7	5				45-50/1" (50/1")
10							257	
	S-5	SS	0	0	**AUGER REFUSAL AT 12.5 FT**			50/0" (50/0")
15							252	
20							247	
25							242	
30							237	



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

▽ WL (First Encountered)	**Dry**
▼ WL (Completion)	**Dry**
▼ WL (Seasonal High Water)	**NOT EVALUATED**
▽ WL (Stabilized)	**NOT DETERMINED**

BORING STARTED: **Sep 04 2024**

BORING COMPLETED: **Sep 04 2024**

EQUIPMENT: **CME 55**

LOGGED BY: **AF3**

CAVE IN DEPTH: **7.0**

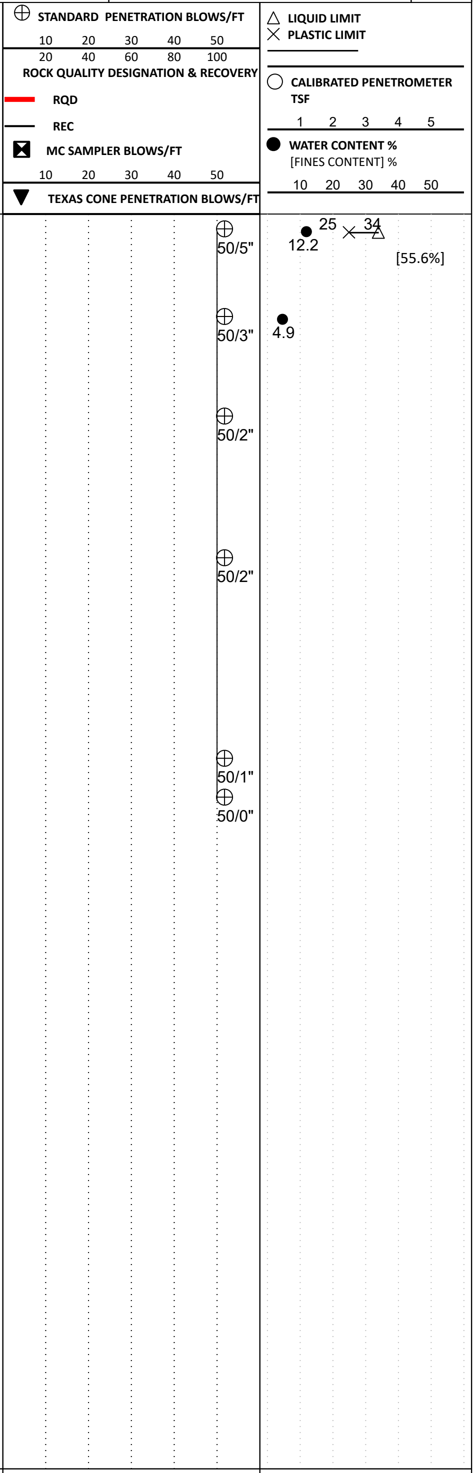
HAMMER TYPE: **Auto**

DRILLING METHOD: **Hollow Stem Auger**

GEOTECHNICAL BOREHOLE LOG

CLIENT: **Hord Coplan Macht, Inc.**	PROJECT NO.: **01:33391**	BORING NO.: **B-03**	SHEET: **1 of 1**	
PROJECT NAME: **PWCS - Pennington Traditional School Addition**	DRILLER/CONTRACTOR: **Connelly and Associates, Inc.**			
SITE LOCATION: **9305 Stonewall Road, Manassas, Virginia, 20110**			LOSS OF CIRCULATION	⟩100%⟩
LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION: **270**	BOTTOM OF CASING ▰

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
	S-1	SS	11	9	Topsoil Thickness [4"] WEATHERED SILTSTONE SAMPLED AS SANDY SILT, reddish brown, moist, very dense			6-50/5" (50/5")
	S-2	SS	3	3				50/3" (50/3")
5	S-3	SS	2	2			265	50/2" (50/2")
	S-4	SS	2	2				50/2" (50/2")
10							260	
	S-5	SS	1	1				50/1" (50/1")
	S-6	SS	0	0	**AUGER REFUSAL AT 14.5 FT**			50/0" (50/0")
15							255	
20							250	
25							245	
30							240	



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

▽ WL (First Encountered) **Dry**	BORING STARTED: **Sep 04 2024**		CAVE IN DEPTH: **8.5**
▼ WL (Completion) **Dry**	BORING COMPLETED: **Sep 04 2024**		HAMMER TYPE: **Auto**
▽ WL (Seasonal High Water) **NOT EVALUATED**	EQUIPMENT: **CME 55**	LOGGED BY: **AF3**	DRILLING METHOD: **Hollow Stem Auger**
▽ WL (Stabilized) **NOT DETERMINED**			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Hord Coplan Macht, Inc.	**01:33391**	**B-04**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
PWCS - Pennington Traditional School Addition	**Connelly and Associates, Inc.**

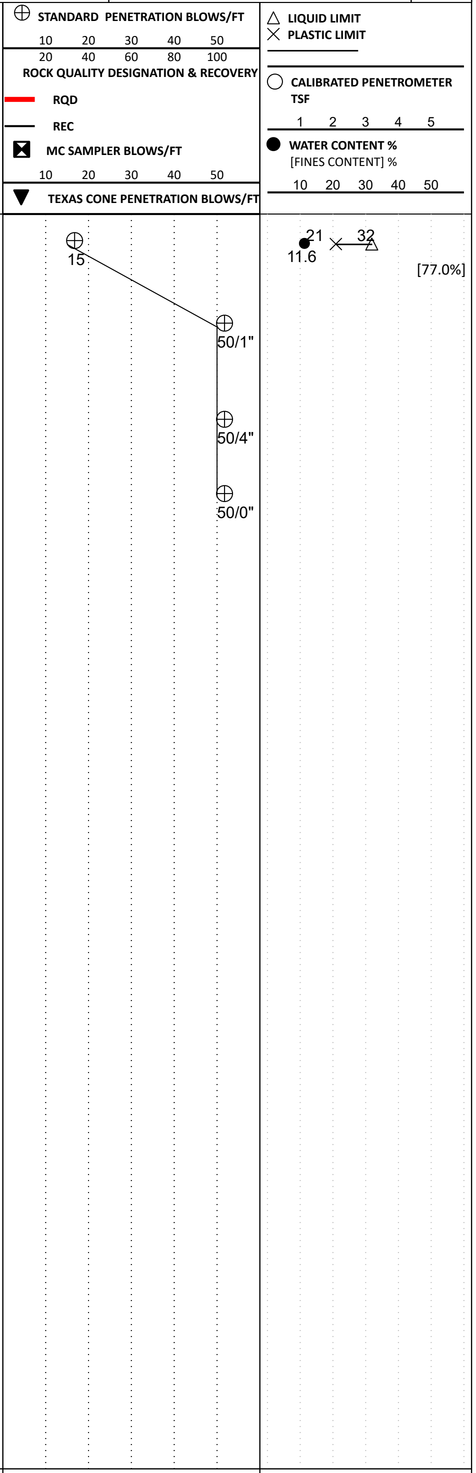
SITE LOCATION:
9305 Stonewall Road, Manassas, Virginia, 20110

LOSS OF CIRCULATION ⟩100%⟩

BOTTOM OF CASING ◤

LATITUDE:	LONGITUDE:	STATION:	SURFACE ELEVATION:
			266

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
	S-1	SS	18	10	Topsoil Thickness [2"] (CL) LEAN CLAY WITH SAND, trace mica reddish brown, moist, stiff			3-6-9 (15)
	S-2	SS	7	1	WEATHERED SILTSTONE SAMPLED AS CLAYEY SAND, reddish brown, moist, very dense			41-50/1" (50/1")
5	S-3	SS	4	3			261	50/4" (50/4")
	S-4	SS	0	0	**AUGER REFUSAL AT 7.0 FT**			50/0" (50/0")
10							256	
15							251	
20							246	
25							241	
30							236	



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

▽ WL (First Encountered)	**Dry**	BORING STARTED: **Sep 04 2024**	CAVE IN DEPTH: **4.0**
▼ WL (Completion)	**Dry**	BORING COMPLETED: **Sep 04 2024**	HAMMER TYPE: **Auto**
▽ WL (Seasonal High Water)	**NOT EVALUATED**	EQUIPMENT: **CME 55** / LOGGED BY: **AF3**	DRILLING METHOD: **Hollow Stem Auger**
▽ WL (Stabilized)	**NOT DETERMINED**		

GEOTECHNICAL BOREHOLE LOG

Appendix C – Laboratory Testing

Laboratory Testing Summary

Sample Location	Sample Number	Depth (ft)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)	0.1 in.	0.2 in.	
B-01	S-1	0.0-1.5	8.3	CL	31	22	9	81.0					
B-01	S-2	2.5-4.0	10.7										
B-02	S-1	0.0-1.3	8.7										
B-03	S-1	0.0-0.9	12.2	ML	34	25	9	55.6					
B-03	S-2	2.5-2.8	4.9										
B-04	S-1	0.0-1.5	11.6	CL	32	21	11	77.0					

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1 < See test report for D4718 corrected values

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

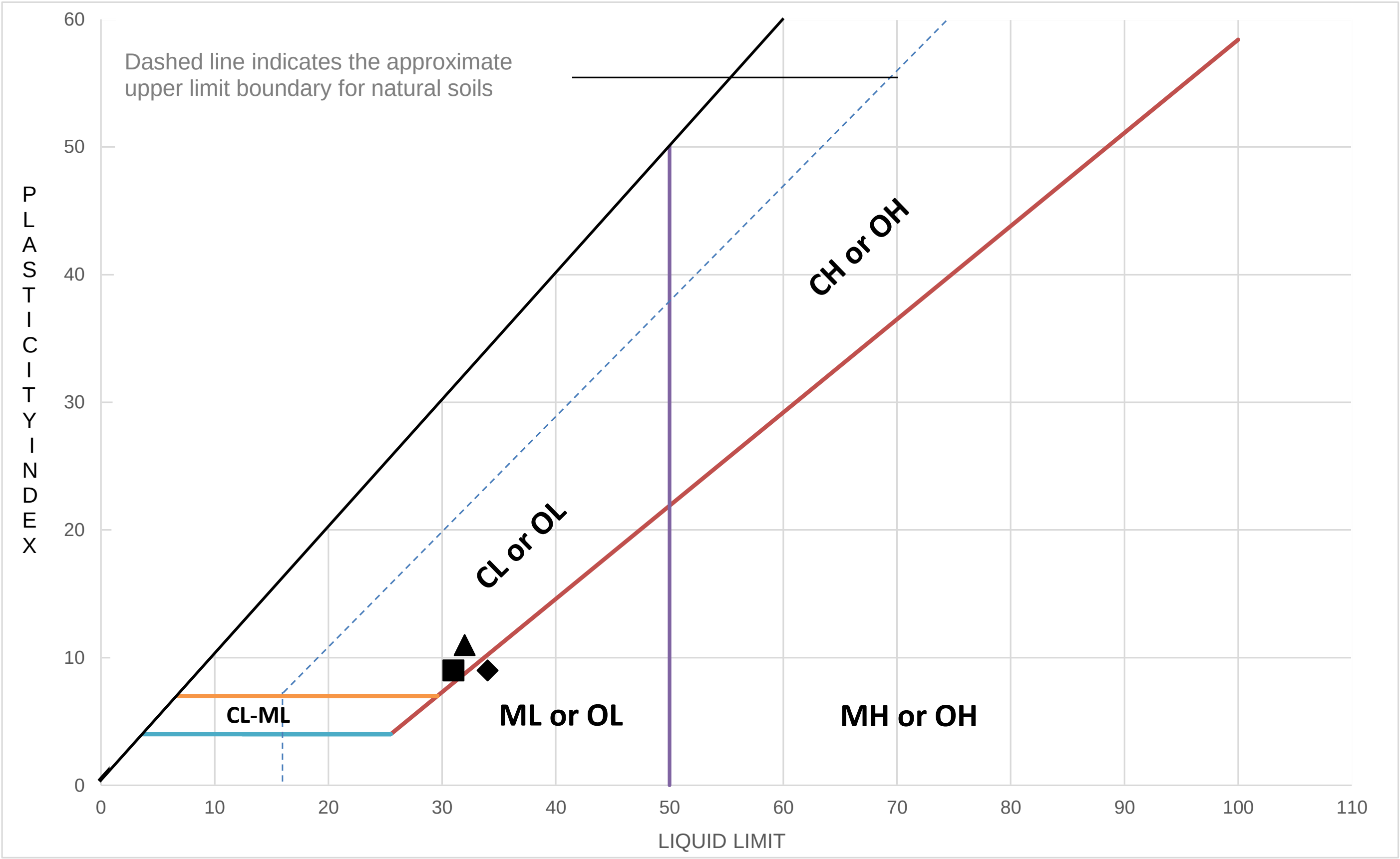
Project: PWCS - Pennington Traditional School Addition
Client: Hord Coplan Macht, Inc.

Project No.: 01:33391
Date Reported: 9/24/2024

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chantilly	14026 Thunderbolt Place Suite 100 Chantilly, VA 20151-3232	(703)471-8400 (703)834-5527

Tested by	Checked by	Approved by	Date Received
jvong	Htran	MUzun	9/10/2024

LIQUID AND PLASTIC LIMITS TEST REPORT



TEST RESULTS (ASTM D4318-10 (MULTIPOINT TEST))

	Sample Location	Sample Number	Sample Depth (ft)	LL	PL	PI	%<#40	%<#200	AASHTO	USCS	Material Description
■	B-01	S-1	0.00-1.50	31	22	9	91.3	81.0	A-4	CL	Lean Clay with Sand Trace Mica Reddish Brown
◆	B-03	S-1	0.00-0.92	34	25	9	65.3	55.6	A-4	ML	Sandy Silt Trace Mica Reddish Brown
▲	B-04	S-1	0.00-1.50	32	21	11	84.2	77.0	A-6	CL	Lean Clay with Sand Trace Mica Reddish Brown

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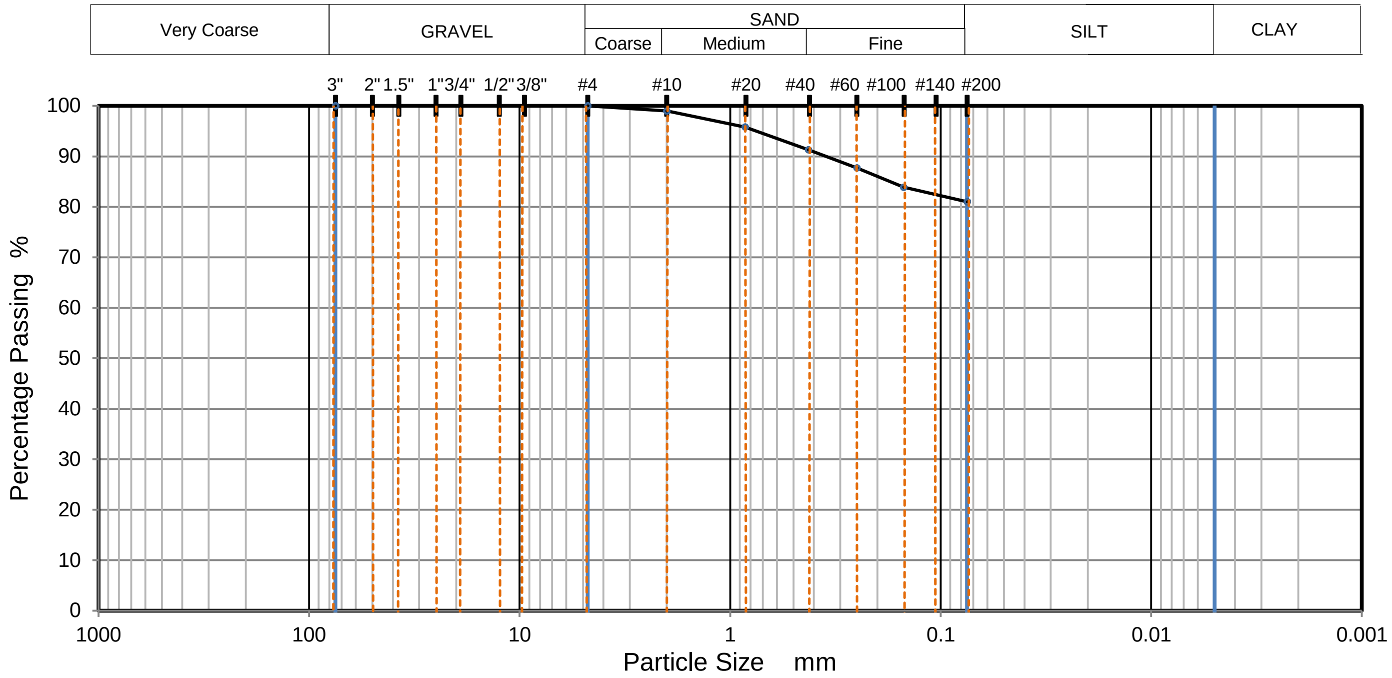
Tested by	Checked by	Approved by	Date Received
jvong	Htran	MUzun	9/10/2024

PARTICLE SIZE DISTRIBUTION



TEST RESULTS (ASTM D422-63(2007))

Sieving		Hydrometer Sedimentation	
Particle Size	% Passing	Particle Size mm	% Passing
3"	100.0		
#4	100.0		
#10	99.0		
#20	95.8		
#40	91.3		
#60	87.7		
#100	83.9		
#200	81.0		

Dry Mass of sample, g	40.6

Sample Proportions	% dry mass
Very coarse, >3" sieve	0.0
Gravel, 3" to # 4 sieve	0.0
Coarse Sand, #4 to #10 sieve	1.0
Medium Sand, #10 to #40	7.7
Fine Sand, #40 to #200	10.3
Fines <#200	81.0

USCS	CL	Liquid Limit	31	D90	0.351	D50		D10	
AASHTO	A-4	Plastic Limit	22	D85	0.174	D30		Cu	
USCS Group Name	Lean clay with sand	Plasticity Index	9	D60		D15		Cc	

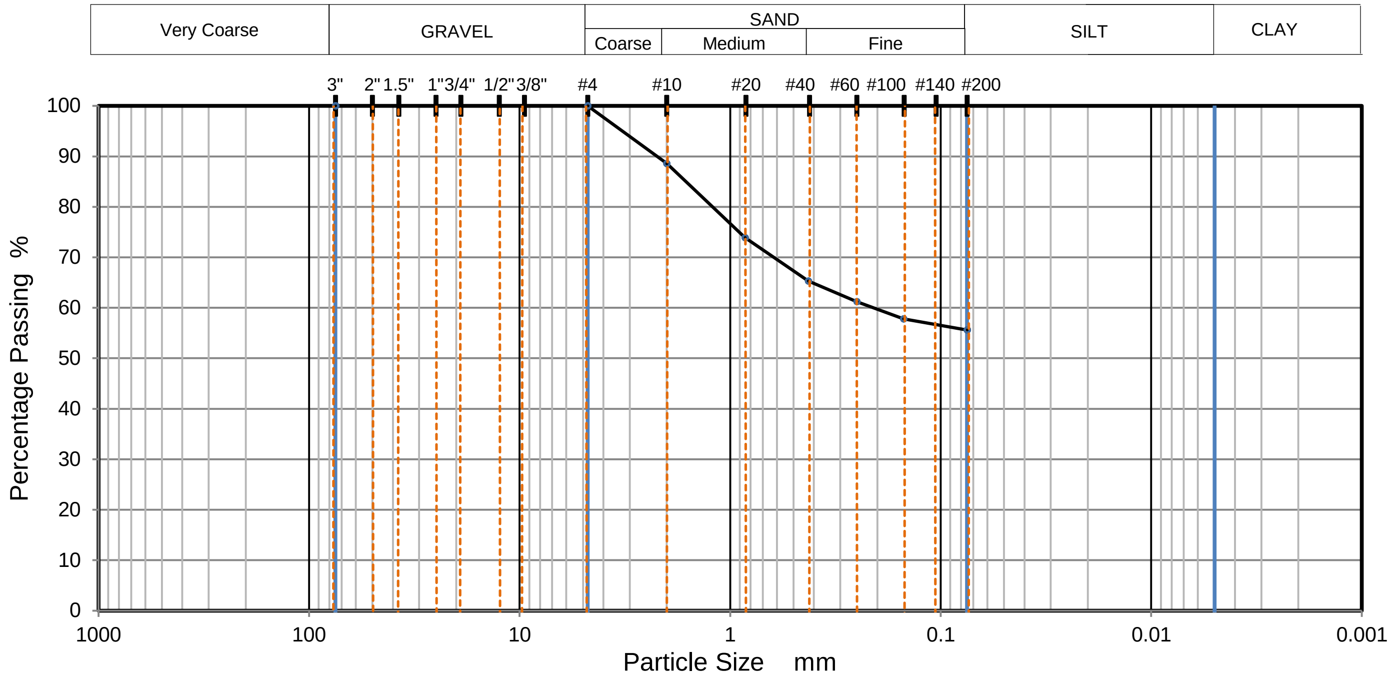
Project: PWCS - Pennington Traditional School Addition
Client: Hord Coplan Macht, Inc.
Sample Description: Lean Clay with Sand Trace Mica Reddish Brown
Sample Source: B-01

Project No.: 01:33391
Depth (ft): 0.0 - 1.5
Sample No.: S-1
Date Reported: 9/24/2024

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chantilly	14026 Thunderbolt Place Suite 100 Chantilly, VA 20151-3232	(703)471-8400 (703)834-5527

Tested by	Checked by	Approved by	Date Received	Remarks
jvong	Htran	MUzun	9/10/2024	

PARTICLE SIZE DISTRIBUTION



TEST RESULTS (ASTM D422-63(2007))

Sieving		Hydrometer Sedimentation	
Particle Size	% Passing	Particle Size mm	% Passing
3"	100.0		
#4	100.0		
#10	88.6		
#20	73.9		
#40	65.3		
#60	61.2		
#100	57.8		
#200	55.6		

Dry Mass of sample, g	42.7

Sample Proportions	% dry mass
Very coarse, >3" sieve	0.0
Gravel, 3" to # 4 sieve	0.0
Coarse Sand, #4 to #10 sieve	11.4
Medium Sand, #10 to #40	23.3
Fine Sand, #40 to #200	9.7
Fines <#200	55.6

USCS	ML	Liquid Limit	34	D90	2.224	D50		D10	
AASHTO	A-4	Plastic Limit	25	D85	1.622	D30		Cu	
USCS Group Name	Sandy silt	Plasticity Index	9	D60	0.209	D15		Cc	

Project: PWCS - Pennington Traditional School Addition

Client: Hord Coplan Macht, Inc.

Sample Description: Sandy Silt Trace Mica Reddish Brown

Sample Source: B-03

Project No.: 01:33391

Depth (ft): 0.0 - 0.9

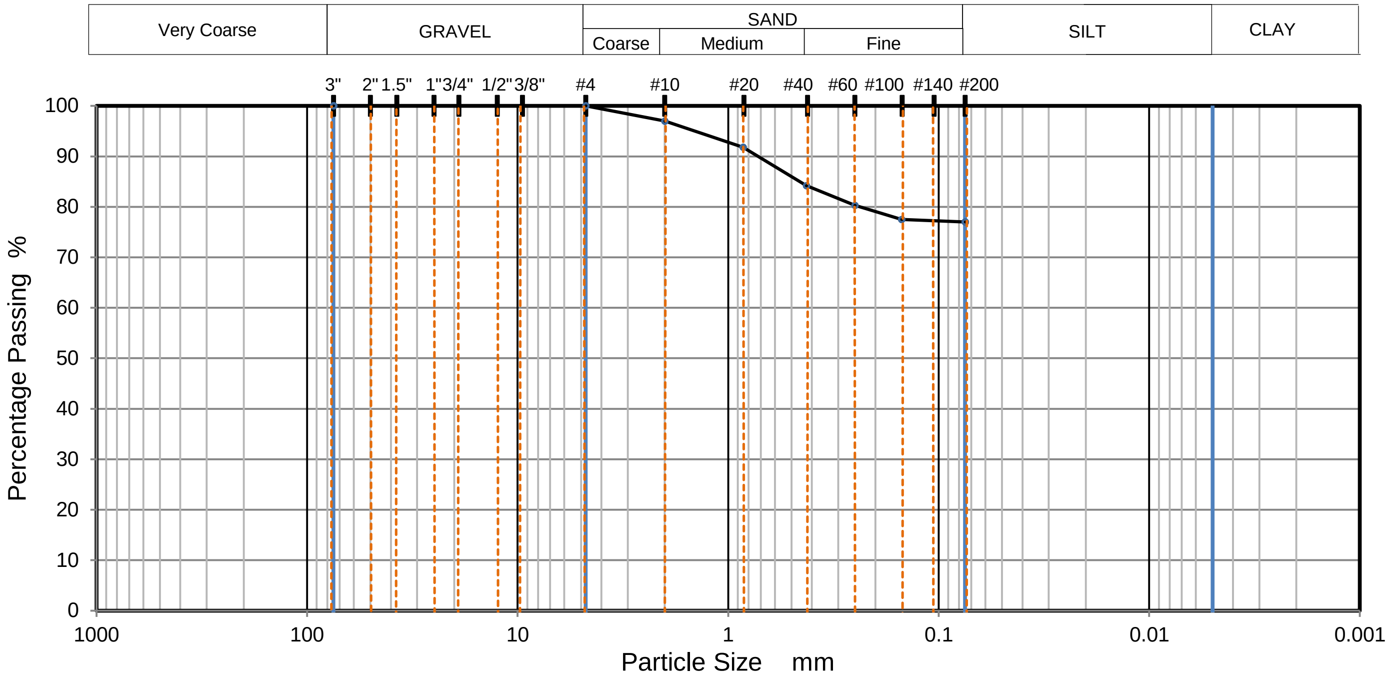
Sample No.: S-1

Date Reported: 9/24/2024

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chantilly	14026 Thunderbolt Place Suite 100 Chantilly, VA 20151-3232	(703)471-8400 (703)834-5527

Tested by	Checked by	Approved by	Date Received	Remarks
jvong	Htran	MUzun	9/10/2024	

PARTICLE SIZE DISTRIBUTION



TEST RESULTS (ASTM D422-63(2007))

Sieving		Hydrometer Sedimentation	
Particle Size	% Passing	Particle Size mm	% Passing
3"	100.0		
#4	100.0		
#10	97.0		
#20	91.8		
#40	84.2		
#60	80.3		
#100	77.5		
#200	77.0		

Dry Mass of sample, g: 41.5

Sample Proportions	% dry mass
Very coarse, >3" sieve	0.0
Gravel, 3" to # 4 sieve	0.0
Coarse Sand, #4 to #10 sieve	3.0
Medium Sand, #10 to #40	12.8
Fine Sand, #40 to #200	7.2
Fines <#200	77.0

USCS	CL	Liquid Limit	32	D90	0.721	D50		D10	
AASHTO	A-6	Plastic Limit	21	D85	0.457	D30		Cu	
USCS Group Name	Lean clay with sand	Plasticity Index	11	D60		D15		Cc	

Project: PWCS - Pennington Traditional School Addition
Client: Hord Coplan Macht, Inc.
Sample Description: Lean Clay with Sand Trace Mica Reddish Brown
Sample Source: B-04

Project No.: 01:33391
Depth (ft): 0.0 - 1.5
Sample No.: S-1
Date Reported: 9/24/2024

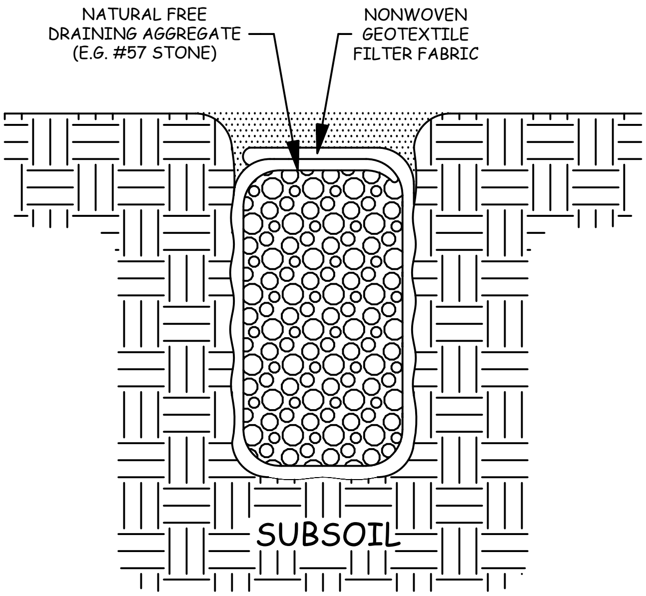
Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Chantilly	14026 Thunderbolt Place Suite 100 Chantilly, VA 20151-3232	(703)471-8400 (703)834-5527

Tested by	Checked by	Approved by	Date Received	Remarks
jvong	Htran	MUzun	9/10/2024	

Appendix D – Supplemental Documents

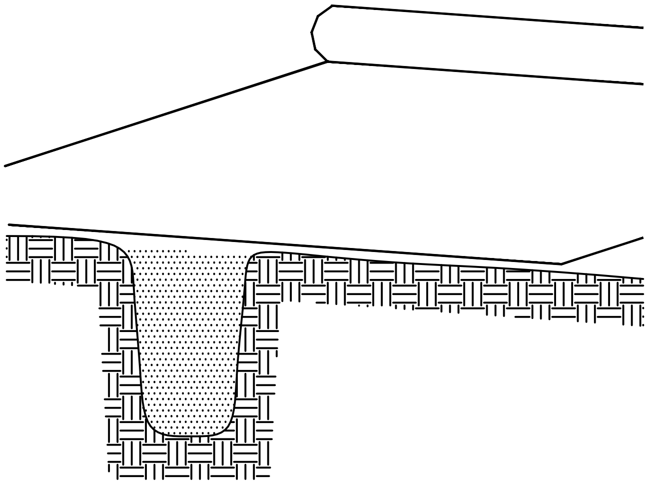
Drawings/Details

FINAL CONFIGURATION



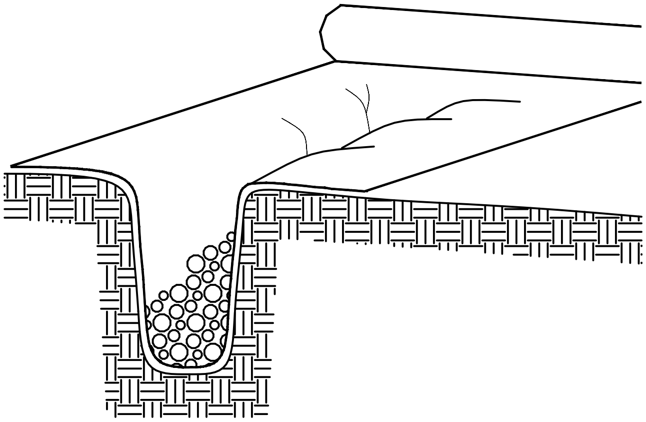
SUBDRAIN USING FILTER FABRIC

STEP 1



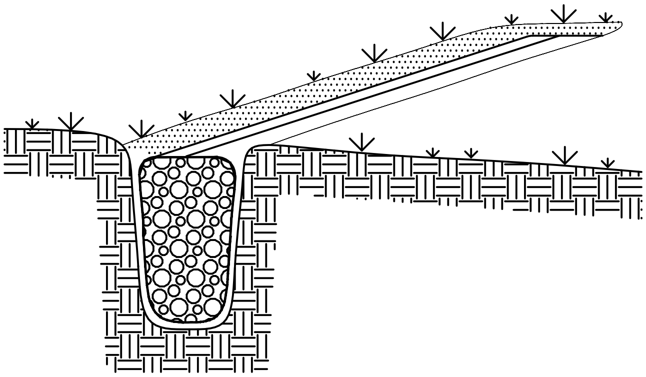
FABRIC IS UNROLLED DIRECTLY OVER TRENCH

STEP 2



THE TRENCH IS FILLED WITH AGGREGATE

STEP 3



THE FABRIC IS LAPPED CLOSED AND
COVERED WITH BASE STONE

FRENCH DRAIN
INSTALLATION PROCEDURE

NOT TO SCALE