Geotechnical and Environmental Engineering Report

Harris Teeter Fuel Center Store #329
Warrenton, VA 20186
March 3, 2020
Terracon Project No. JD205028

Prepared for:
Kimley-Horn & Associates
Charlotte, NC

Prepared by:
Terracon Consultants, Inc.
Ashburn, Virginia

March 3, 2020

Kimley-Horn & Associates
200 South Tryon Street
Charlotte, NC 28202

Attn: Ms. Maggie Jones
P: (704) 409 1812
E: Maggie.Jones@kimley-horn.com

Re: Geotechnical and Environmental Engineering Report
Harris Teeter Fuel Center Store #329
530 Fletcher Drive,
Warrenton, VA 20186
Terracon Project No. JD205028

Dear Ms. Jones:

We have completed the Geotechnical and Environmental Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PJD205028 dated January 27, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

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

Sincerely,
Terracon Consultants, Inc.

COMMONWEALTH OF VIRGINIA
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REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

EXECUTIVE SUMMARY

A geotechnical investigation has been performed for the proposed fuel center at 530 Fletcher Drive, Warrenton, Virginia. The investigation at the project site included eight test borings, designated B-01 through B-08, performed to depths of approximately 10 to 35 feet below the existing ground surface.

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. The following geotechnical considerations were identified:

- Support of floor slabs and pavements on or above existing fill materials is discussed in this report. However, even with the recommended construction procedures, there is inherent risk for the owner that compressible fill or unsuitable material, within or buried by the fill, will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by following the recommendations contained in this report. To take advantage of the cost benefit of not removing the entire amount of undocumented fill, the owner must be willing to accept the risk associated with building over the undocumented fills following the recommended reworking of the material. Should this be the case, development may be supported on a shallow foundation system.
- Based on the results of our field testing and Section 20.4 of ASCE 7 and the International Building Code (IBC), the seismic site classification is C.
- Environmental sampling/screening of select borings was performed at the same time as our geotechnical investigation. The results of the photo-ionization detector (PID) screening are included on the borings logs. The full results of our environmental services are provided in a separate report.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **General Comments** should be read for an understanding of the report limitations.

Geotechnical and Environmental Engineering Report

Harris Teeter Fuel Center Store #329
530 Fletcher Drive,
Warrenton, VA 20186
Terracon Project No. JD205028
March 3, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed fuel center store to be located at 530 Fletcher Drive, in Warrenton, VA 20186. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Dewatering considerations
- Stormwater pond considerations
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification per IBC
- Lateral earth pressures
- Pavement design and construction
- Frost considerations

The geotechnical engineering Scope of Services for this project included the advancement of eight test borings to depths ranging from approximately 10 to 35 feet below existing site grades.

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

SITE CONDITIONS

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

Item	Description
Parcel Information	The project is located at 530 Fletcher Drive, Warrenton, VA 20186. See **Site Location**
Existing Improvements	Existing Harris Teeter building with associated paved parking and drive areas.
Current Ground Cover	Asphalt Pavement

Item	Description
Existing Topography (from Google Earth)	Relatively level, between EL 518 and EL 520.
Geology	Piedmont Physiographic Region. See **Geology**.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. Aspects of the project, undefined or assumed, are highlighted as shown below. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Overall Concept Plan provided by Kimley-Horn.
Project Description	The project includes a walk-in kiosk building, fuel center canopy, and two fuel tanks. The building will be slab-on-grade (non-basement).
Building Construction	Load-bearing masonry walls, slab-on-grade, and steel-framed fuel canopy.
Finished Floor Elevation	Assumed close to existing grades.
Maximum Loads	■ Columns: 50 kips ■ Walls: 3 kips per linear foot (klf) ■ Slabs: 100 pounds per square foot (psf)
Grading/Slopes	Up to 10 feet of cut may be required for the underground storage tank installation. We assume final grades will be close to existing grades.
Below-Grade Structures	Two fuel tanks.
Free-Standing Retaining Walls	None.
Below-Grade Areas	Storm Tie-in area.
Pavements	We assume both rigid (concrete) and flexible (asphalt) pavement sections will be considered. Anticipated traffic is as follows: ■ Autos/light trucks: 1,000 vehicles per day ■ Light delivery and trash collection vehicles: 100 vehicles per week ■ Tractor-trailer trucks: 1 vehicle per week The pavement design period is 20 years.

GEOTECHNICAL CHARACTERIZATION

Geology

The project site is located in the Piedmont Physiographic Province, an area underlain by igneous and metamorphic rocks. The residual soils in this area are the product of in-place chemical weathering of rock. The 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 harder with depth to the top of parent bedrock. Alluvial soils are typically present within floodplain areas along creeks and rivers in the Piedmont. According to the 1993 Geologic Map of Virginia, the site is mapped within the Catoctin Formation. The bedrock underlying the site generally consists of metabasalt.

The boundary between soil and rock in the Piedmont is not sharply defined. A transitional zone termed "Intermediate Geo-Material" is normally found overlying the parent bedrock. Intermediate Geo-Material (IGM) is defined for engineering purposes as residual material with a standard penetration test resistance exceeding 50 blows per six inches. The transition between hard/dense residual soils and partially weathered rock occurs at irregular depths due to variations in degree of weathering.

Groundwater is typically present in fractures within the partially weathered rock or underlying bedrock in upland areas of the Piedmont. Fluctuations in groundwater levels on the order of 2 to 4 feet are typical in residual soils and partially weathered rock in the Piedmont, depending on variations in precipitation, evaporation, and surface water runoff. Seasonal high groundwater level fluctuations should also be considered.

Subsurface Profile

The table below summarizes the subsurface conditions encountered at each boring location:

Boring ID	Boring Depth (ft)[1]	Asphalt or Stone Thickness (feet)	Depth of Existing Fill Soils Encountered (ft)[1]	Depth of Residual Soils Encountered (ft)[1]	Depth of IGM Encountered (ft)[1]
B-01	19.4	0.75	0.75 to 1.25	1.25 to 19.4	NE
B-02	15	0.75	0.75 to 3	3 to 15	NE
B-03	19.9	NE	0 to 2.5	2.5 to 13.5	13.5 to 19.9
B-04	34.4	NE	NE	0 to 23.5	23.5 to 34.4
B-05	20	NE	NE	0 to 20	NE
B-06	10	NE	0 to 1.5	1.5 to 10	NE
B-07	10	0.75	0.75 to 3	3 to 10	NE
B-08	10	0.75	0.75 to 3	3 to 10	NE

1. Feet below existing ground surface.
2. NE = Not encountered.

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

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are summarized in the following table.

Boring Number	Approximate Depth to Groundwater (feet) [1]	Approximate Depth to Groundwater (feet) [1]
B-01 through B-03, and B-05 through B-08	Not encountered	Not encountered
B-04	14.5 feet upon completion of drilling	15 feet after 7 days

1. Below ground surface.

As summarized in the table above, groundwater was not observed in the remaining borings while drilling, or for the short duration the borings could remain open. However, this does not necessarily mean the borings terminated above groundwater, or the water levels summarized above are stable groundwater levels. A relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to more accurately define groundwater levels.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Infiltration Testing

Two methods were used to estimate infiltration capabilities on the subject site: in-situ infiltration testing and published correlations with soil classifications. Infiltration structure details were not finalized at the time of the field investigation, and so the test was performed at a generic depth that was discussed with the client. Based on the results of the in-situ infiltration tests, the infiltration rates have been calculated and are presented below:

Boring Number	Approximate Test Depth (ft) [1]	Approximate Test Elevation (ft) [1]	Field Infiltration Rate (inches/hour)
B-06A	5	514	0.6

1. Below ground surface.

Based on a Soil Survey Report from the USDA, the site is mapped primarily as a hydrologic soil group rating of B. According to the VA DEQ Stormwater Design Specification No. 8, soils with a hydrologic soil group rating of B have moderate infiltration rates even when thoroughly wetted. The USDA report is included in the Supporting Information section of this report.

GEOTECHNICAL OVERVIEW

Existing fill materials were encountered in Borings B-01, B-02, B-03, B-06, B-07, and B-08. Support of foundations, floor slabs and pavements on or above existing fill materials is discussed in this report. However, even with the recommended construction procedures, there is an inherent risk for the owner that compressible fill or unsuitable material, within or buried by the fill, will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by following the recommendations contained in this report. To take advantage of the cost benefit of not removing the entire amount of undocumented fill, the owner must be willing to accept the risk associated with building over the undocumented fills following the recommended reworking of the material. Should this be the case, the structures may be supported on a shallow foundation system.

The proposed gas station structures may be supported on conventional spread and strip footings with an allowable bearing pressure of 3,000 psf. These recommendations should be considered preliminary and should be verified during final design with additional investigations. Further details and recommendations are provided herein.

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

EARTHWORK

Earthwork is anticipated to include demolition, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Site preparation should begin with the demolition of the existing structure and debris removal. As part of the demolition, buried utilities and/or concrete foundations should also be removed. Existing utilities that are to be abandoned should be removed or filled with grout. The excavations resulting from foundation and utility removal should be properly backfilled with compacted engineered fill as described in the following subsections. Utilities that are to remain in service should be accurately located horizontally and vertically to minimize conflict with new foundation construction.

Existing vegetation, topsoil, and any otherwise unsuitable material should be removed from the construction areas prior to placing fill. Stripped materials consisting of vegetation and organic materials should be wasted off site, or used to vegetate landscaped areas or exposed slopes after completion of grading operations. The exposed subgrade soils should be proofrolled to detect soft or loose soils and identify unsuitable or poorly compacted fill. Proofrolling should be performed with a fully-loaded, tandem-axle dump truck or similar pneumatic-tired construction equipment. A Terracon representative should observe this operation to aid in delineating unstable soil areas. Proofrolling should be performed after a suitable period of dry weather to avoid degrading an otherwise acceptable subgrade. Soils which continue to rut or deflect excessively under the proofrolling operations should be remediated as recommended by the geotechnical engineer.

Existing Fill

As noted in **Geotechnical Characterization**, borings B-01, B-02, B-03, B-06, B-07, and B-08 encountered existing fill to depths ranging from about 0 to 3 feet below existing grades. The fill appears to have been placed in a controlled manner, but we have no records to indicate the degree of control. Support of footings, floor slabs, and pavements, on or above existing fill soils, is discussed in this report. However, even with the recommended construction procedures, there is inherent risk for the owner that compressible fill or unsuitable material, within or buried by the fill will, not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by following the recommendations contained in this report.

If the owner elects to construct the footings and floor slabs on the existing fill, the following protocol should be followed. Once materials have been removed, the entire area should be proofrolled with heavy, rubber tire construction equipment, to aid in delineating areas of soft or otherwise unsuitable soil. Once unsuitable materials have been remediated, and the subgrade has passed the proofroll test, the existing and undocumented fill that was removed can be evaluated for reuse as structural fill.

If the owner elects to construct pavements on the existing fill, the following protocol should be followed. Once the planned subgrade elevation has been reached the entire pavement area should be proofrolled. Areas of soft or otherwise unsuitable material should be undercut and replaced with either new structural fill or suitable, existing on site materials.

Fill Material Types

Structural fill should meet the following compaction requirements.

Soil Type [1]	USCS Classification	Acceptable Location for Placement
Low Plasticity Cohesive [2]	CL, ML, CL-ML	Not acceptable
High Plasticity Cohesive [2]	CH, MH	Not acceptable
Granular	GW, GP, GM, GC, SW, SP, SM, SC	Less than 10% Passing No. 200 sieve.

1. Structural fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. Cohesive soils should not be used as structural fill for this project.

Fill Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Description
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used. 4 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used.
Minimum Compaction Requirements [1, 2, 3]	Minimum 95% of the material's maximum standard Proctor dry density (ASTM D 698). The upper 12 inches of subgrade in pavement areas should be compacted to at least 100% of the materials maximum standard Proctor dry density (ASTM D 698).
Water Content Range [1]	Within 3% of optimum moisture content

1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254).

Underground Storage Tanks

We recommend using pea gravel as backfill around the tanks and up to one to two feet above the tops of tanks. The pea gravel should be compacted with vibratory energy, such as through the use of a hand operated sled-tamper, prior to the placement of the overlying backfill or pavement materials. In addition, we recommend placing a separation geotextile between the pea gravel and adjoining soil to help prevent soil piping.

Utility Trench Backfill

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

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

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

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

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

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

Construction Observation and Testing

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

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

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

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

SHALLOW FOUNDATIONS

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

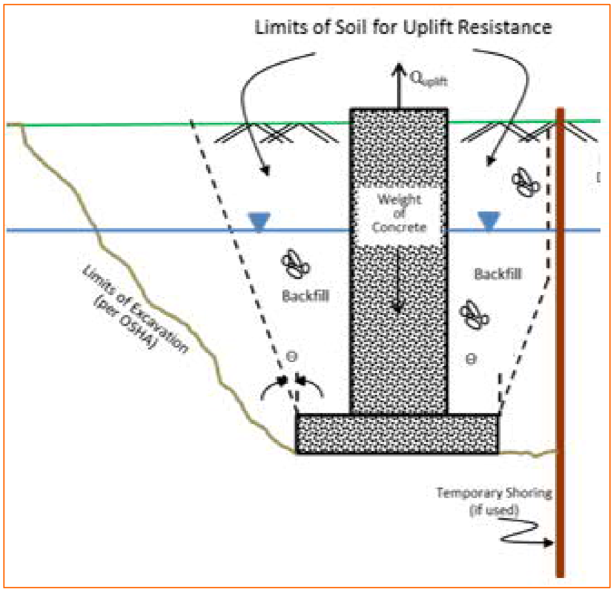
Design Parameters – Compressive Loads

Item	Description
Allowable Bearing pressure [1]	3,000 psf
Minimum Foundation Dimensions[2]	Columns: 48 inches
Minimum Embedment below Finished Grade [4]	24 inches
Ultimate Coefficient of Sliding Friction[5]	0.6 (New Structural Fill material)
Estimated Total Settlement from Structural Loads [2]	Less than about 0.5 inches
Estimated Differential Settlement [2, 6]	About 1/2 of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in **Project Description**.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the **Earthwork**.
4. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
6. Differential settlements are as measured over a span of 50 feet.

Design Parameters - Uplift Loads

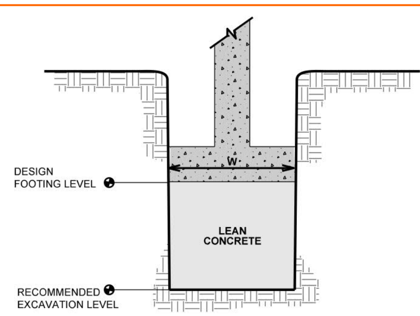
Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils. As illustrated on the subsequent figure, the effective weight of the soil prism defined by diagonal planes extending up from the top of the perimeter of the foundation to the ground surface at an angle, θ, of 20 degrees from the vertical can be included in uplift resistance. The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A maximum total unit weight of 100 pcf should be used for the backfill. This unit weight should be reduced to 40 pcf for portions of the backfill or natural soils below the groundwater elevation.



Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



LEAN CONCRETE BACKFILL

NOTE: EXCAVATIONS ARE SHOWN VERTICAL; HOWEVER, THE SIDEWALLS SHOULD BE SLOPED AS NECESSARY FOR SAFETY

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the Seismic Site Classification is C. Subsurface explorations at this site were extended to a maximum depth of 35 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

FLOOR SLABS

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1]	Suitable existing soils or new engineered fill compacted in accordance with **Earthwork** section of this report. [1]
Estimated Modulus of Subgrade Reaction [2]	100 pounds per square inch per inch (psi/in) for point loads
Aggregate base course/capillary break [3]	Minimum 4 inches of free-draining granular material (less than 5% passing the U.S. No. 200 sieve)

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
3. Free-draining granular material should have less than 5% fines (material passing the No. 200 sieve). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Settlement of floor slabs supported on existing fill materials cannot be accurately predicted, but could be larger than normal and result in some cracking. Mitigation measures, as noted in **Existing Fill** within **Earthwork**, are critical to the performance of floor slabs. In addition to the mitigation measures, the floor slab can be stiffened by adding steel reinforcement, grade beams and/or post-tensioned elements.

Floor Slab Construction Considerations

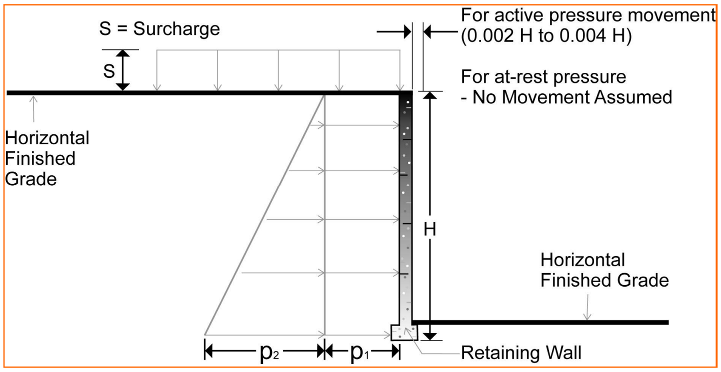
Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

LATERAL EARTH PRESSURES

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be 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. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3, 4, 5] p_1 (psf)	Effective Fluid Pressures (psf) [2, 4, 5]	
			Unsaturated	Submerged
Active (Ka)	Existing Fill - 0.33 Residual - 0.33	(0.33)S (0.33)S	(40)H (40)H	(80)H (80)H
At-Rest (Ko)	Existing Fill - 0.5 Residual - 0.5	(0.5)S (0.5)S	(60)H (60)H	(100)H (100)H
Passive (Kp)	Existing Fill – 3.0 Residual - 3.0	--- ---	(360)H (360)H	(200)H (200)H

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 95% of the ASTM D 698 maximum dry density, rendering a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values. Passive pressure should include a safety factor for design.

Backfill placed against structures should consist of granular soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

Design of Asphaltic Concrete (AC) pavements are based on the procedures outlined in the National Asphalt Pavement Association (NAPA) Information Series 109 (IS-109). Design of Portland Cement Concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330; Guide for Design and Construction of Concrete Parking Lots.

A subgrade CBR of 5 was used for the AC pavement designs, and a modulus of subgrade reaction of 250 pci was used for the PCC pavement designs. The values were empirically derived based upon our experience with the fine-grained subgrade soils and our understanding of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in **Earthwork**. A modulus of rupture of 500 psi was used for pavement concrete.

Pavement Section Thicknesses

The following table provides options for AC and PCC Sections:

Asphaltic Concrete Design			
Material	Grading[1]	Recommended Minimum Pavement Section Thickness (inches)[2]	
		Automobile Areas (Light Duty)	Main Drives & Truck Access Areas (Heavy Duty)
Asphalt Concrete Surface Course	SM-9.5A	1.5	1.5
Asphalt Concrete Intermediate Course	BM-25.0	3	5
Aggregate Base	ABC	6	8

1. Based on anticipated traffic loading as described in **Project Description** section.
2. We have based our recommendations on the parameters described in the **Project Description** section.

Portland Cement Concrete Design			
Layer	Specification[2]	Minimum Thickness (inches) [2]	
		Automobile Areas [1]	Main Drives & Truck Access Areas [1]
Portland Cement Concrete	4,000 psi	6	7
Aggregate Base	--	6	6

1. Based on anticipated traffic loading as described in Project Description section.
2. We have based our recommendations on the parameters described in the **Project Description** section.

Pavement Maintenance

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

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

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

FROST CONSIDERATIONS

The soils on this site are frost susceptible, and small amounts of water can affect the performance of the slabs on-grade, sidewalks, and pavements. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of non-frost susceptible (NFS) fill or structural slabs (for instance, structural stoops in front of building doors). Placement of NFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the building and slabs, and toward the site storm drainage system.
- Install drains around the perimeter of the building, stoops, below exterior slabs and pavements, and connect them to the storm drainage system.
- Grade clayey subgrades, so groundwater potentially perched in overlying more permeable subgrades, such as sand or aggregate base, slope toward a site drainage system.
- Place NFS fill as backfill beneath slabs and pavements critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between NFS fill and other soils.
- Place NFS materials in critical sidewalk areas.

As an alternative to extending NFS fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of NFS material.

GENERAL COMMENTS

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

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

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

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

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
3	19 to 35	tank area
2	15 to 20	fuel island and kiosk
3	10	pavement

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from GoogleEarth. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted rotary drill rig using continuous flight augers. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, most borings were backfilled with auger cuttings after their completion. Pavements were patched with cold-mix asphalt and/or pre-mixed concrete, as appropriate. Some borings were backfilled up to 7 days after drilling for long term water readings.

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

In-situ Infiltration Testing: In-situ infiltration tests are performed in the field to observe the rate at which water will permeate the soil under saturated conditions. One test boring was drilled for this purpose. The test boring was initially drilled to a depth of at least 4 feet below the planned infiltration invert elevations, and allowed to remain open for a period of approximately 24 hours to allow any groundwater levels within the borehole to stabilize. An offset infiltration test hole was drilled at the boring locations to planned infiltration invert elevations. Four-inch diameter PVC casing was set to the bottom of the test holes. The purpose of the casing is to prevent caving of test hole sidewalls. After setting the PVC casing, the borehole was filled with water to saturate the bottom subsoils. The following day, the test hole was refilled with water and the water level in each test hole was recorded every hour for a 4-hour period. Using this procedure, the average change in the water level over the 4-hour period is considered the infiltration rate.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Detailed results of our laboratory testing can be found in in the **Exploration Results** section and are attached herein. Our laboratory testing program includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we describe and classify soil samples in accordance with the Unified Soil Classification System (USCS).

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

Harris Teeter Fuel Center Store #329 ■ Warrenton, VA 20186

March 3, 2020 ■ Terracon Project No. JD205028

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

MAP PROVIDED BY MICROSOFT BING MAPS

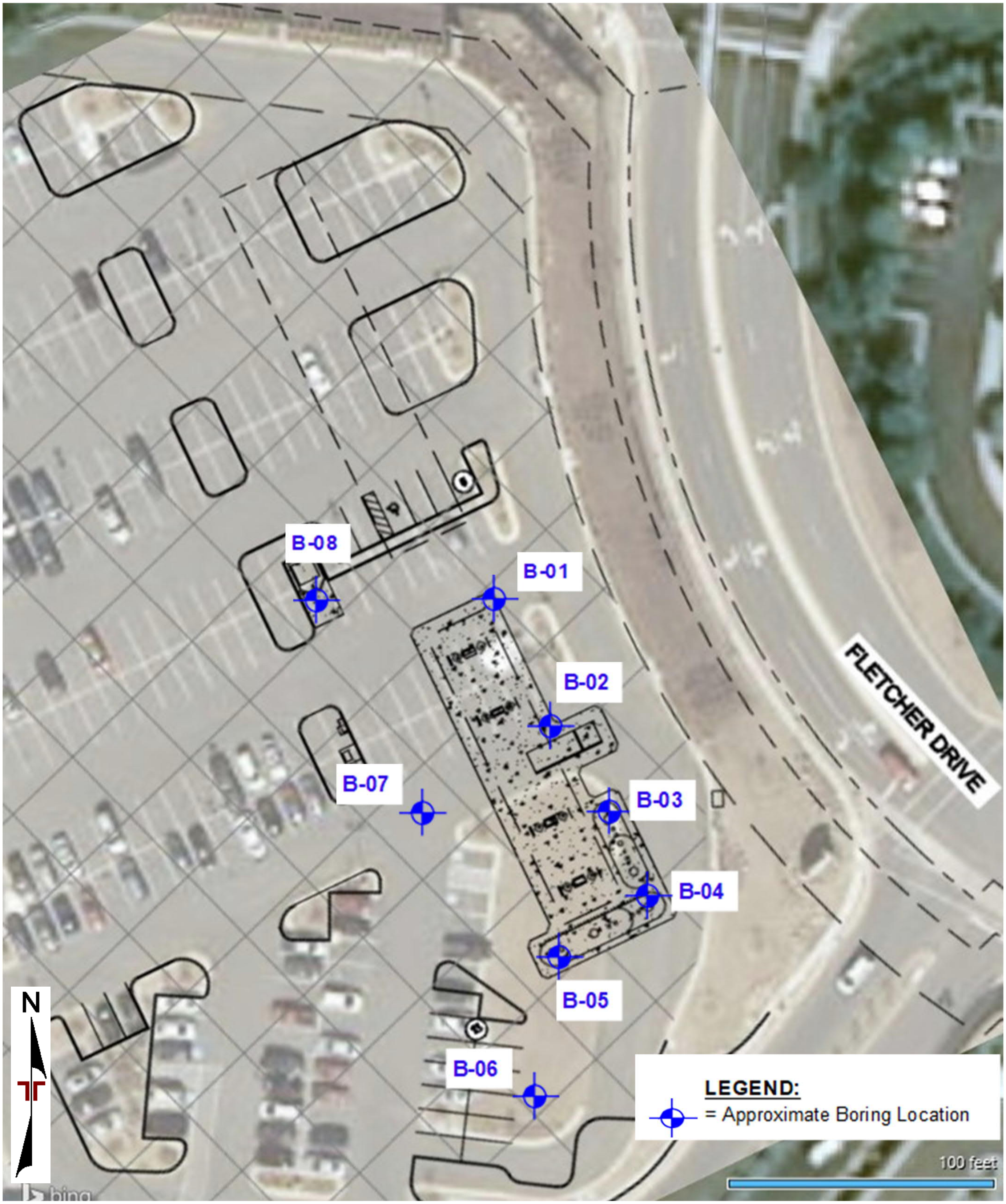


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: Harris Teeter Fuel Center Store #329

**CLIENT: Kimley-Horn & Associates Inc
Charlotte, NC**

**SITE: Fletcher Drive
Warrenton, VA**

LOCATION See Exploration Plan

Latitude: 38.727414° Longitude: -77.794613°

Approximate Surface Elev.: 518 (Ft.) +/-

DEPTH	Material Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	PID (ppm)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**Asphalt**	517.5+/-									
0.8	**Crushed stone**	517.5+/-									
1.3	**FILL - GRAVELLY SILT (ML)**, micaceous, orange brown, moist, hard	517+/-			X	1.67	7-8-26-29 N=34				
	RESIDUAL - SANDY SILT (ML), fine, light orange brown to dark brown, moist, hard				X	1.33	13-18-18 N=36				
	white gray to light orange		5		X	1.33	18-34-43 N=77				
	light gray orange		10		X	1.5	8-13-27 N=40				
	gray brown to red		15		X	1.5	11-19-23 N=42		13	33-26-7	52
19.4		498.5+/-		Caved	X	0.5	38-50/5"				

Boring Terminated at 19.42 Feet

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

Hammer Type: Automatic Hammer

Advancement Method:
2.25" ID HSA

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were estimated using GoogleEarth

Notes:

PID readings were not performed at borings outside of the proposed tank area.

WATER LEVEL OBSERVATIONS

No free water observed

Caved: 18.7 ft.

Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

Boring Started: 02-18-2020	Boring Completed: 02-18-2020
Drill Rig: D 50	Driller: Garrett Wilson
Project No.: JD205028	

BORING LOG NO. B-2

PROJECT: Harris Teeter Fuel Center Store #329

CLIENT: Kimley-Horn & Associates Inc Charlotte, NC

SITE: Fletcher Drive Warrenton, VA

LOCATION See Exploration Plan

Latitude: 38.727333° Longitude: -77.794573°

Approximate Surface Elev.: 518 (Ft.) +/-

DEPTH	Material Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	PID (ppm)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**Asphalt**	517.5+/-									
0.8	**Crushed stone**	517.5+/-									
3.0	**FILL - SANDY SILT WITH GRAVEL (ML)**, micaceous, light orange brown, moist, very stiff	515+/-			X	1.5	6-10-17-30 N=27				
5.0	**RESIDUAL - SANDY SILT (ML)**, micaceous, fine, orange brown, moist, hard	513+/-	5		X	1.5	13-16-20 N=36				
	RESIDUAL - SILT (ML), micaceous, light orange brown, moist, hard to very stiff				X	1.5	21-22-24 N=46		14		
13.5		504.5+/-	10		X	1.5	10-14-16 N=30				
15.0	**RESIDUAL - SANDY SILT (ML)**, micaceous, fine, orange brown, moist, very stiff	503+/-	15	Caved	X	1.5	5-7-15 N=22				

Boring Terminated at 15 Feet

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

Hammer Type: Automatic Hammer

Advancement Method:
2.25" ID HSA

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were estimated using GoogleEarth

Notes:

PID readings were not performed at borings outside of the proposed tank area.

WATER LEVEL OBSERVATIONS

No free water observed

Caved: 14.5 ft.

Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

Boring Started: 02-18-2020	Boring Completed: 02-18-2020
Drill Rig: D 50	Driller: Garrett Wilson
Project No.: JD205028	

BORING LOG NO. B-3

PROJECT: Harris Teeter Fuel Center Store #329

CLIENT: Kimley-Horn & Associates Inc Charlotte, NC

SITE: Fletcher Drive Warrenton, VA

LOCATION See Exploration Plan

Latitude: 38.727204° Longitude: -77.794492°

Approximate Surface Elev.: 518 (Ft.) +/-

DEPTH	Material Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	PID (ppm)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	**Topsoil**	518+/-									
	FILL - SANDY SILT (ML), micaceous, light brown, moist, hard, contains roots				X	1.5	13-12-28-20 N=40	0			
2.5		515.5+/-									
	RESIDUAL - SANDY SILT (ML), micaceous, fine, light orange brown, moist, very stiff to hard				X	1.5	11-11-11 N=22	0			
			5		X	1.5	21-27-35 N=62	0			
8.5		509.5+/-									
	RESIDUAL - SILT WITH GRAVEL (ML), micaceous, fine to medium, light orange brown, moist, hard, Quartz fragments encountered				X	1.5	10-25-34 N=59	0			
			10								
13.5		504.5+/-									
	IGM - WELL-GRADED GRAVEL WITH SILT AND SAND (GW), medium to coarse, white, moist, very dense, Quartz fragments encountered				X	0.83	40-50/4"	0			
			15								
18.5		499.5+/-		Caved							
	IGM - SANDY SILT (ML), micaceous, fine, light orange brown, moist, hard				X	1.42	20-31-50/5"	0			
19.9		498+/-									

Boring Terminated at 19.92 Feet

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

Hammer Type: Automatic Hammer

Advancement Method:
2.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were estimated using GoogleEarth

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Caved: 18 ft.

Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

Boring Started: 02-18-2020	Boring Completed: 02-18-2020
Drill Rig: D 50	Driller: Garrett Wilson
Project No.: JD205028	

BORING LOG NO. B-4

PROJECT: Harris Teeter Fuel Center Store #329

CLIENT: Kimley-Horn & Associates Inc Charlotte, NC

SITE: Fletcher Drive Warrenton, VA

LOCATION See Exploration Plan

Latitude: 38.727123° Longitude: -77.794519°

Approximate Surface Elev.: 519 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)
0.2	**Topsoil**	519+/-
	RESIDUAL - SANDY SILT (ML), micaceous, fine to medium, light brown, moist, very stiff to hard	
23.5	**IGM - SILT (ML)**, micaceous, fine, light brown, moist, hard	495.5+/-
34.4	***Boring Terminated at 34.42 Feet***	484.5+/-

RECOVERY (Ft.)	FIELD TEST RESULTS	PID (ppm)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1.5	8-13-17-23 N=30	0			
1.42	18-37-50/5"	0			
1.5	21-31-37 N=68	0	14		
0.83	26-50/4"	0			
0.92	34-50/5"	0			
1.5	9-12-17 N=29	0			
0.92	26-50/5"	0	12		
0.42	50/5"	0			
0.92	31-50/5"	0			

Water level observed at approximately 14.5 ft (after 168 hours).

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

Temporary standpipe location

Hammer Type: Automatic Hammer

Advancement Method:
2.25" ID HSA

Abandonment Method:
Standpipe Installed

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were estimated using GoogleEarth

Notes:

WATER LEVEL OBSERVATIONS

- *At completion of drilling*
- *After 168 hours*

Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

Boring Started: 02-18-2020	Boring Completed: 02-18-2020
Drill Rig: D 50	Driller: Garrett Wilson
Project No.: JD205028	

BORING LOG NO. B-5

PROJECT: Harris Teeter Fuel Center Store #329

CLIENT: Kimley-Horn & Associates Inc
Charlotte, NC

SITE: Fletcher Drive
Warrenton, VA

LOCATION See Exploration Plan

Latitude: 38.727038° Longitude: -77.794618°

Approximate Surface Elev.: 520 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	PID (ppm)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	520+/-	**Topsoil**									
		RESIDUAL - SILT (ML), micaceous, light orange brown, moist, very stiff to hard			X	1.83	4-8-10-18 N=18	0			
					X	1.5	11-17-17 N=34	0			
5.0	515+/-	**RESIDUAL - SILT WITH SAND (ML)**, micaceous, fine, light orange brown, moist, hard	5		X	0.92	30-50/5"	1			
					X	1.42	39-42-50/5"	28.0			
			10								
					X	1.5	10-19-28 N=47	0	18	41-29-12	83
			15								
				Caved	X	1.5	9-29-48 N=77	0			
20.0	500+/-	***Boring Terminated at 20 Feet***	20								

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

Hammer Type: Automatic Hammer

Advancement Method:
2.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were estimated using GoogleEarth

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Caved: 18.5 ft.

Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

Boring Started: 02-18-2020	Boring Completed: 02-18-2020
Drill Rig: D 50	Driller: Garrett Wilson
Project No.: JD205028	

BORING LOG NO. B-6

PROJECT: Harris Teeter Fuel Center Store #329

**CLIENT: Kimley-Horn & Associates Inc
Charlotte, NC**

**SITE: Fletcher Drive
Warrenton, VA**

LOCATION See Exploration Plan

Latitude: 38.726931° Longitude: -77.794548°

Approximate Surface Elev.: 519 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	PID (ppm)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**Topsoil**	519+/-									
1.5	**FILL - SILT (ML)**, micaceous, light orange brown, moist, stiff, contains roots	517.5+/-			X	2	3-3-10-16 N=13				
2.5	**RESIDUAL - WELL-GRADED GRAVEL WITH SAND (GW)**, micaceous, fine to medium, dark red brown, moist, medium dense, Quartz fragments encountered	516.5+/-			X	1.5	10-21-31 N=52				
10.0	**RESIDUAL - SANDY SILT (ML)**, micaceous, fine, light orange brown, moist, hard	509+/-	5		X	0.92	21-50/5"				
				Caved	X	1.25	15-16-16 N=32				
			10								

Boring Terminated at 10 Feet

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

Hammer Type: Automatic Hammer

Advancement Method:
2.25" ID HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were estimated using GoogleEarth

Notes:

PID readings were not performed at borings outside of the proposed tank area.

WATER LEVEL OBSERVATIONS

No free water observed

No free water observed after 168 hours

Caved: 8.7 ft.

Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

Boring Started: 02-18-2020	Boring Completed: 02-18-2020
Drill Rig: D 50	Driller: Garrett Wilson
Project No.: JD205028	

BORING LOG NO. B-7

PROJECT: Harris Teeter Fuel Center Store #329

CLIENT: Kimley-Horn & Associates Inc
Charlotte, NC

SITE: Fletcher Drive
Warrenton, VA

LOCATION See Exploration Plan

Latitude: 38.727307° Longitude: -77.794749°

Approximate Surface Elev.: 519 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	PID (ppm)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.4	**Asphalt**	518.5+/-									
0.8	**Crushed stone**	518.5+/-									
3.0	**FILL - SILT (ML)**, micaceous, light orange brown, moist, medium stiff	516+/-			X	1.83	3-3-5-7 N=8				
5.0	**RESIDUAL - SILT (ML)**, micaceous, light orange brown, moist, very stiff	514+/-	5		X	1.5	3-7-10 N=17				
	RESIDUAL - ELASTIC SILT (MH), micaceous, light orange brown, moist, very stiff				X	1.5	8-11-14 N=25		22		
10.0		509+/-	10	Caved	X	1.5	7-12-10 N=22				

Boring Terminated at 10 Feet

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

Hammer Type: Automatic Hammer

Advancement Method:
2.25" ID HSA

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were estimated using GoogleEarth

Notes:

PID readings were not performed at borings outside of the proposed tank area.

WATER LEVEL OBSERVATIONS

No free water observed

Caved: 7 ft.

Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

Boring Started: 02-18-2020	Boring Completed: 02-18-2020
Drill Rig: D 50	Driller: Garrett Wilson
Project No.: JD205028	

BORING LOG NO. B-8

PROJECT: Harris Teeter Fuel Center Store #329

CLIENT: Kimley-Horn & Associates Inc
Charlotte, NC

SITE: Fletcher Drive
Warrenton, VA

LOCATION See Exploration Plan

Latitude: 38.727429° Longitude: -77.79485°

Approximate Surface Elev.: 520 (Ft.) +/-

GRAPHIC LOG	DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	PID (ppm)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3	**Asphalt**	519.5+/-									
	0.8	**Crushed stone**	519.5+/-									
	3.0	**FILL - SILT (ML)**, micaceous, light orange brown, moist, hard	517+/-			X	2	13-13-18-20 N=31				
	10.0	**RESIDUAL - SANDY SILT (ML)**, micaceous, fine, brown orange, moist, very stiff to hard	510+/-			X	1.5	10-11-16 N=27				
				5	Caved	X	1.5	22-26-34 N=60		16		
				10		X	1.5	13-15-21 N=36				

Boring Terminated at 10 Feet

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

Hammer Type: Automatic Hammer

Advancement Method:
2.25" ID HSA

Abandonment Method:
Boring backfilled with Auger Cuttings
Surface capped with asphalt

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were estimated using GoogleEarth

Notes:

PID readings were not performed at borings outside of the proposed tank area.

WATER LEVEL OBSERVATIONS

No free water observed

Caved: 6.5 ft.

Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

Boring Started: 02-18-2020	Boring Completed: 02-18-2020
Drill Rig: D 50	Driller: Garrett Wilson
Project No.: JD205028	

SUMMARY OF LABORATORY RESULTS

BORING ID	Depth (Ft.)	Soil Classification USCS	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Gravel	% Sand	% Fines
B-1	13.5 - 15	SANDY SILT(ML)	13	33	26	7	1.7	46.3	52.1
B-2	5 - 6.5		14						
B-4	5 - 6.5		14						
B-4	23.5 - 24.42		12						
B-5	13.5 - 15	SILT with SAND(ML)	18	41	29	12	0.0	17.3	82.7
B-7	5 - 6.5		22						
B-8	5 - 6.5		16						

PROJECT: Harris Teeter Fuel Center Store #329

SITE: Fletcher Drive
Warrenton, VA

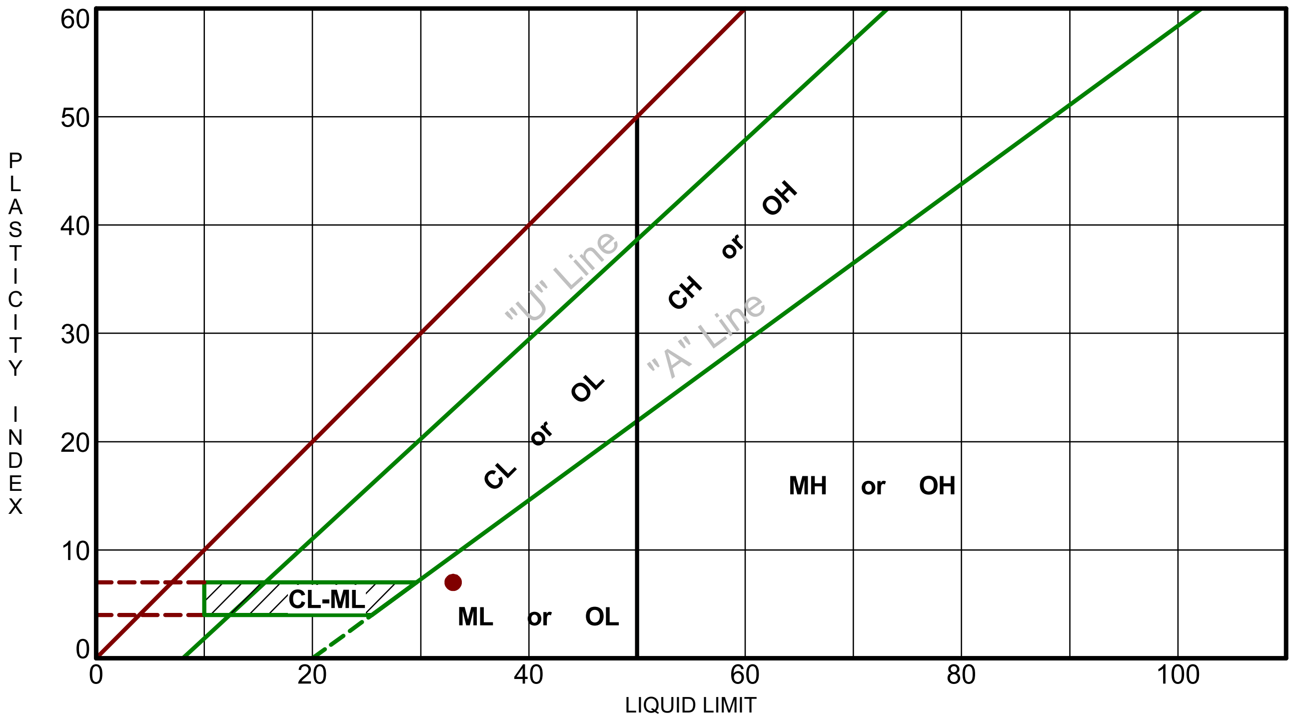
Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA
PH. 703-726-8030 FAX.

PROJECT NUMBER: JD205028

CLIENT: Kimley-Horn & Associates Inc
Charlotte, NC

ATTERBERG LIMITS RESULTS

ASTM D4318



	Sample ID	LL	PL	PI	Fines	USCS	Description
●	B-1	33	26	7	52.1	ML	SANDY SILT

PROJECT: Harris Teeter Fuel Center Store #329

SITE: Fletcher Drive Warrenton, VA

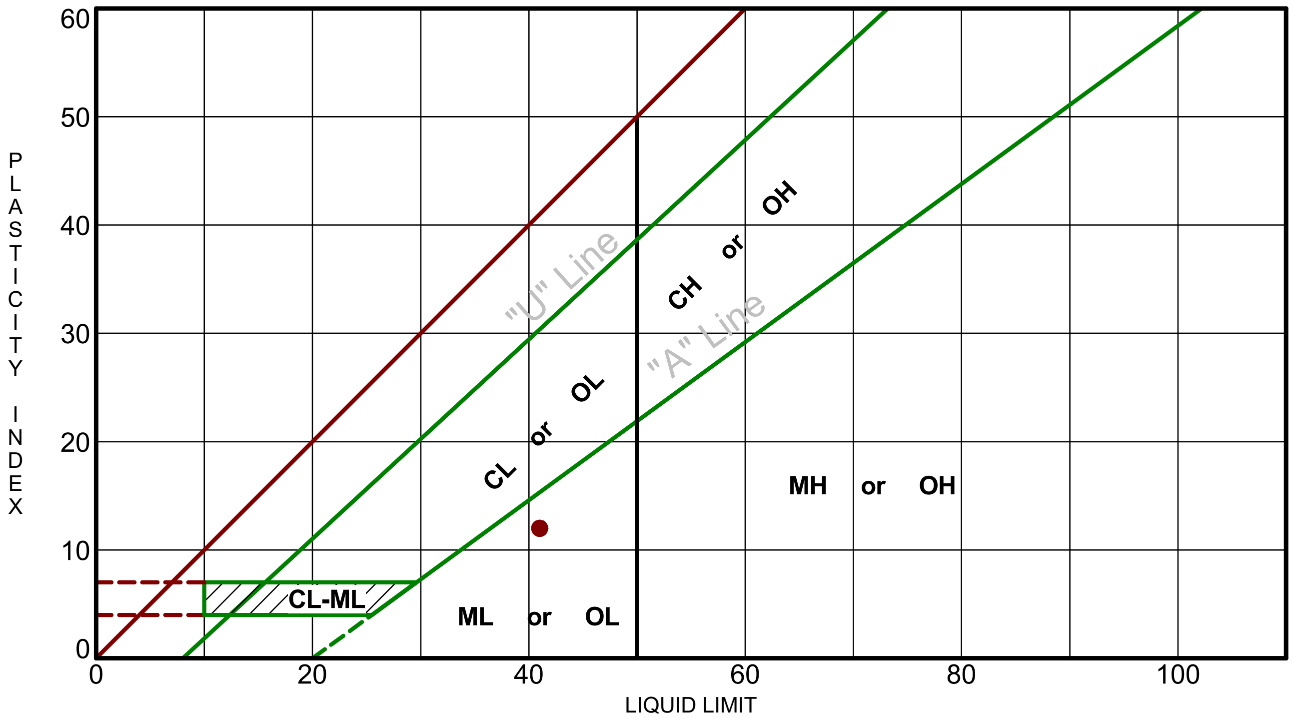
Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

PROJECT NUMBER: JD205028

CLIENT: Kimley-Horn & Associates Inc Charlotte, NC

ATTERBERG LIMITS RESULTS

ASTM D4318



	Sample ID	LL	PL	PI	Fines	USCS	Description
●	B-5	41	29	12	82.7	ML	SILT with SAND

PROJECT: Harris Teeter Fuel Center Store #329

SITE: Fletcher Drive
Warrenton, VA

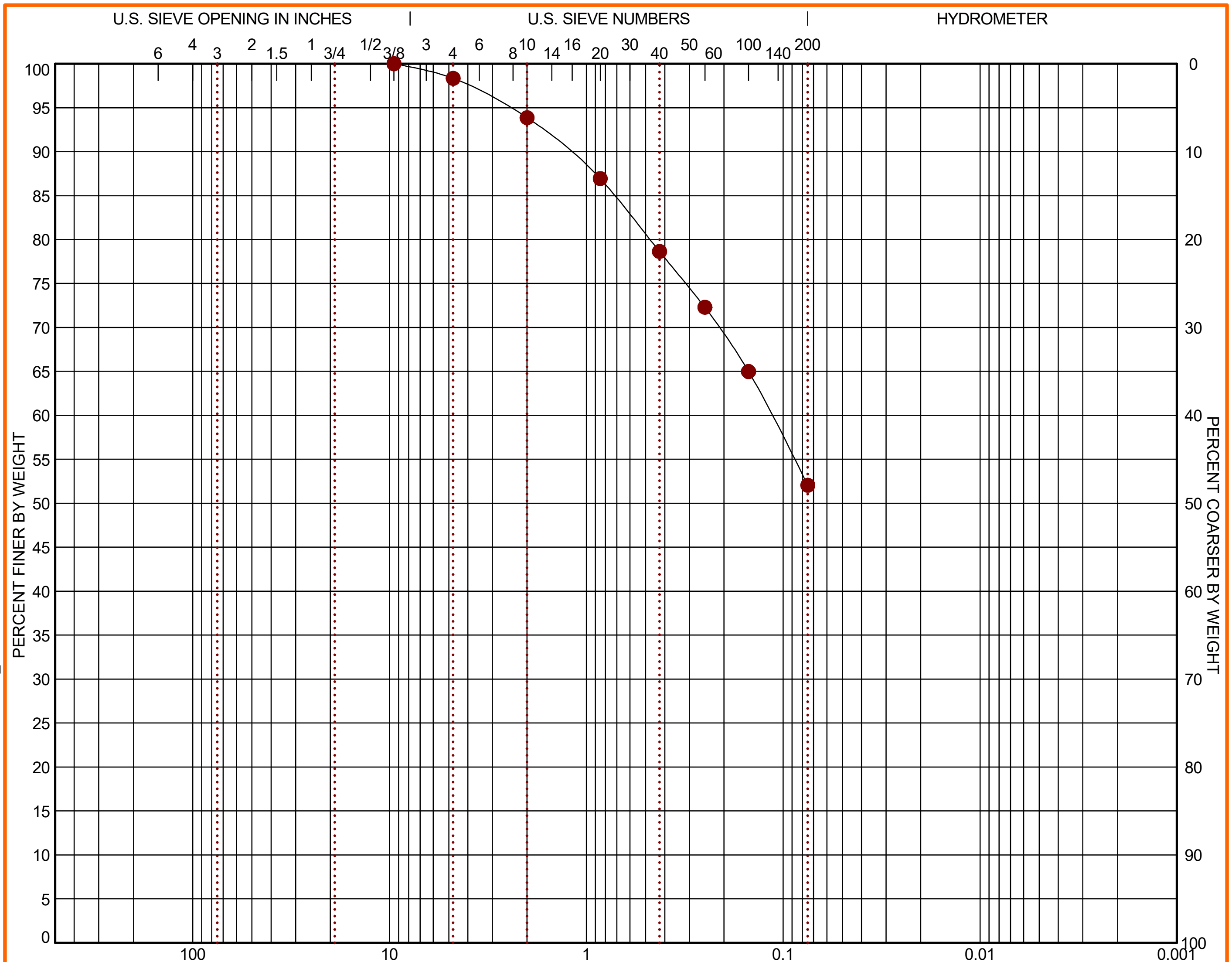
Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

PROJECT NUMBER: JD205028

CLIENT: Kimley-Horn & Associates Inc
Charlotte, NC

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	SAMPLE ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	B-1	13.5 - 15	0.0	1.7	46.3		52.1		ML

GRAIN SIZE	●		
D_{60}	0.115		
D_{30}			
D_{10}			

COEFFICIENTS	●		
C_C			
C_U			

● Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0				
#4	98.34				
#10	93.85				
#20	86.93				
#40	78.64				
#60	72.3				
#100	64.99				
#200	52.05				

SOIL DESCRIPTION

● SANDY SILT (ML)

REMARKS

●

PROJECT: Harris Teeter Fuel Center Store #329

SITE: Fletcher Drive
Warrenton, VA

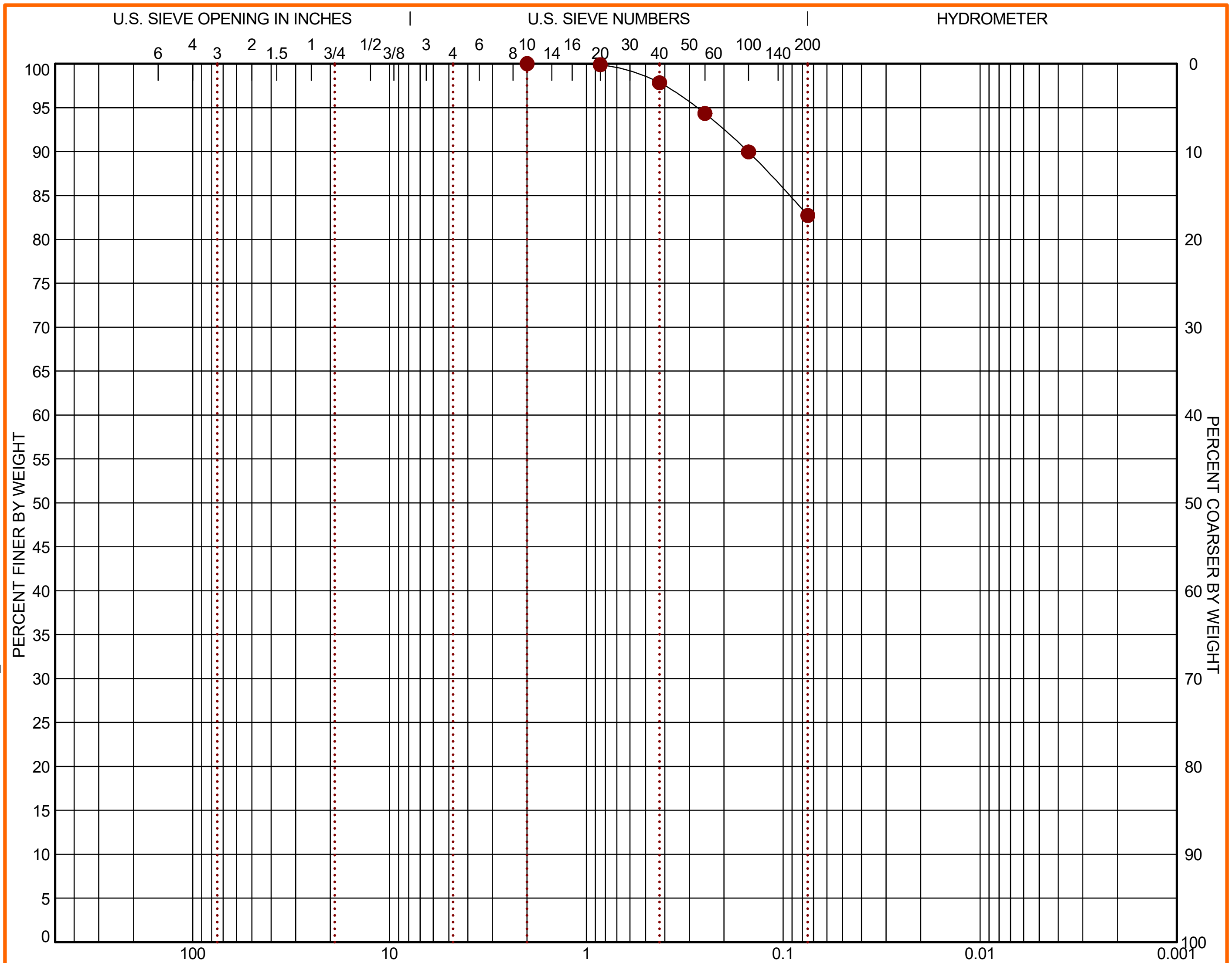
Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

PROJECT NUMBER: JD205028

CLIENT: Kimley-Horn & Associates Inc
Charlotte, NC

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	SAMPLE ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	B-5	13.5 - 15	0.0	0.0	17.3		82.7		ML

GRAIN SIZE

	●		
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS

	●		
C_C			
C_U			

●					
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#10	100.0				
#20	99.88				
#40	97.83				
#60	94.33				
#100	89.95				
#200	82.72				

SOIL DESCRIPTION

●	SILT with SAND (ML)

REMARKS

●	

PROJECT: Harris Teeter Fuel Center Store #329

SITE: Fletcher Drive
Warrenton, VA

Terracon
19955 Highland Vista Dr Ste 170
Ashburn, VA

PROJECT NUMBER: JD205028

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Charlotte, NC

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Harris Teeter Fuel Center Store #329 ■ Warrenton, VA

Terracon Project No. JD205028

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
No Recovery; Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**N** Standard Penetration Test Resistance (Blows/Ft.) **(HP)** Hand Penetrometer **(T)** Torvane **(DCP)** Dynamic Cone Penetrometer **UC** Unconfined Compressive Strength **(PID)** Photo-Ionization Detector **(OVA)** Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

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

LOCATION AND ELEVATION NOTES

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

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 4	Very Soft	less than 0.25	0 - 2
Loose	5 - 10	Soft	0.25 to 0.50	3 - 4
Medium Dense	11 - 30	Medium Stiff	0.50 to 1.00	5 - 8
Dense	31 - 50	Stiff	1.00 to 2.00	9 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	16 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

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

UNIFIED SOIL CLASSIFICATION SYSTEM

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

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

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

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

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

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

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

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

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

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

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

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

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

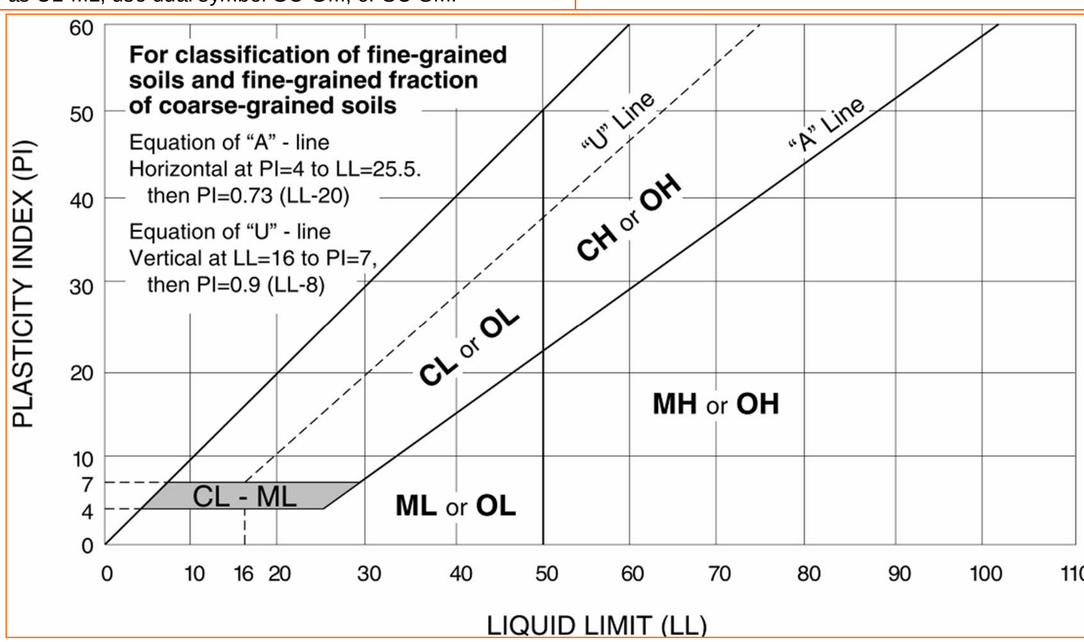
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

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

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

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

[Q] PI plots below "A" line.



United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Fauquier County, Virginia

February 24, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

77° 47' 50" W
77° 47' 36" W
38° 43' 41" N
38° 43' 34" N
256830 256860 256890 256920 256950 256980 257010 257040 257070 257100 257130 257160
4290320 4290290 4290260 4290230 4290200 4290170 4290140 4290110
211
12A
40D
40C
Fletcher Dr
Soil Map may not be valid at this scale.
Map Scale: 1:1,610 if printed on A landscape (11" x 8.5") sheet.
Meters
0 20 40 80 120
Feet
0 50 100 200 300
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Fauquier County, Virginia
Survey Area Data: Version 15, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 28, 2018—Jul 25, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
12A	Rohrersville loam, 0 to 2 percent slopes, frequently flooded	2.5	33.3%
40C	Myersville silt loam, 7 to 15 percent slopes	0.3	3.7%
40D	Myersville silt loam, 15 to 25 percent slopes, stony	4.7	63.0%
Totals for Area of Interest		**7.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Fauquier County, Virginia

12A—Rohrersville loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 21m56
Mean annual precipitation: 34 to 46 inches
Mean annual air temperature: 43 to 66 degrees F
Frost-free period: 174 to 211 days
Farmland classification: Prime farmland if protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Rohrersville and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rohrersville

Setting

Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from greenstone and/or colluvium derived from greenstone

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 14 inches: loam
H3 - 14 to 25 inches: loam
H4 - 25 to 42 inches: silt loam
H5 - 42 to 60 inches: gravelly clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 10 to 20 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: C/D
Hydric soil rating: No

40C—Myersville silt loam, 7 to 15 percent slopes

Map Unit Setting

National map unit symbol: 21m6s
Mean annual precipitation: 34 to 46 inches
Mean annual air temperature: 43 to 66 degrees F
Frost-free period: 174 to 211 days
Farmland classification: Not prime farmland

Map Unit Composition

Myersville and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Myersville

Setting

Landform: Mountainsides
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from greenstone

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 43 inches: silty clay loam
H3 - 43 to 55 inches: silt loam
H4 - 55 to 71 inches: bedrock

Properties and qualities

Slope: 7 to 15 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

40D—Myersville silt loam, 15 to 25 percent slopes, stony

Map Unit Setting

National map unit symbol: 21m6t
Mean annual precipitation: 34 to 46 inches
Mean annual air temperature: 43 to 66 degrees F
Frost-free period: 174 to 211 days
Farmland classification: Not prime farmland

Map Unit Composition

Myersville and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Myersville

Setting

Landform: Mountainsides
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from greenstone

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 43 inches: silty clay loam
H3 - 43 to 55 inches: silt loam
H4 - 55 to 71 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Percent of area covered with surface fragments: 0.1 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Map—Hydrologic Soil Group

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Fauquier County, Virginia
Survey Area Data: Version 15, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 28, 2018—Jul 25, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
12A	Rohrersville loam, 0 to 2 percent slopes, frequently flooded	C/D	2.5	33.3%
40C	Myersville silt loam, 7 to 15 percent slopes	B	0.3	3.7%
40D	Myersville silt loam, 15 to 25 percent slopes, stony	B	4.7	63.0%
Totals for Area of Interest			**7.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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