REPORT OF PRELIMINARY
GEOTECHNICAL EXPLORATION

THE VILLAGE AT FOREST BROOKE

Harford County, Maryland

July 8, 2014

Prepared For:

Orr Partners
11180 Sunrise Valley Drive Suite 300
Reston, Virginia 20191

Attn: Mr. Grid Gremi

Prepared By:

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GTA Project No: 140988

GEO-TECHNOLOGY ASSOCIATES, INC.

GEOTECHNICAL AND
ENVIRONMENTAL CONSULTANTS

A Practicing ASFE Member Firm

July 8, 2014

Orr Partners
11180 Sunrise Valley Drive, Suite 300
Reston, Virginia 20191

Attn: Mr. Grid Gremi

Re: Report of Preliminary Geotechnical Exploration
The Village at Forest Brooke
Harford County, Maryland

Gentlemen:

In accordance with our agreement, Geo-Technology Associates, Inc. (GTA) has performed a preliminary geotechnical exploration for the proposed Village at Forest Brooke site located in Harford County, Maryland. The exploration consisted of performing Standard Penetration Test (SPT) borings at 13 locations, evaluating the recovered materials to identify their engineering characteristics, and performing limited laboratory soil testing. The results of the geotechnical exploration and recommendations regarding design and construction of the proposed improvements are included in the attached Report.

GTA appreciates the opportunity to have been of assistance to you on this project. Should you have any questions or require any additional information, please contact our office at (410) 515-9446.

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland. License No.: 33973, Expiration Date: 07/14/2015.

STATE OF MARYLAND
THOMAS MICHAEL WIRTH
No. 33973
PROFESSIONAL ENGINEER

Sincerely,
GEO-TECHNOLOGY ASSOCIATES, INC.

Eric J. Kussman
Project Scientist

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REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION

THE VILLAGE AT FOREST BROOKE
HARFORD COUNTY, MARYLAND
JULY 8, 2014

INTRODUCTION

This Report presents the results of the preliminary geotechnical exploration performed for the Village at Forest Brooke site located in Harford County, Maryland. In conjunction with this exploration, Geo-Technology Associates, Inc. (GTA) was provided with the *Preliminary Site Plan* (Plan) prepared by Morris & Ritchie Associates, Inc. (MRA), dated May 28, 2014. The Plan depicts existing and proposed grades as well as the location of the proposed buildings, pavement areas, retaining walls, and stormwater management (SWM) facilities. Based on the plans and our conversations, GTA understands that the site will be developed for residential use.

To facilitate the design of the proposed site improvements, GTA was retained to perform a preliminary geotechnical exploration at the project site. The scope of this study included a field exploration, laboratory testing, and engineering analysis as described in our *Proposal for Preliminary Geotechnical Exploration*, dated June 4, 2014. The results and recommendations regarding design and construction of the proposed site improvements are included in this Report.

SITE CONDITIONS

The site is located east of the intersection of Bush Chapel Road and Kretlow Drive in the Aberdeen area of Harford County, Maryland. The proposed development site is bounded by Bush Chapel Road and Kretlow Drive to the west, Schofield Road to the north, a mature heavily wooded area to the east, and Woodland Green Way to the south. At the time of the investigation, the majority of the site consisted of mature woods, with light underbrush in the low areas of the site. The southern portion of the site consisted of non-tidal wetlands.

The topography of the site is generally gently sloping, with drainage generally directed to the southwestern portion of the site. Site topography depicted on the Plan indicates that the ground surface elevations range from a high of approximately elevation (EL) 150 in the northwestern corner of the site, to a low of approximately (EL) 110 along the southern boundary of the site. The United States Geological Survey (USGS) Topographic Quadrangle Map (Aberdeen, Maryland) for the site vicinity depicts similar topographic conditions as those indicated by MRA. A *Topographic Map* for the site and vicinity, based on the United States Geological Survey (USGS) Topographic Quadrangle Map (Aberdeen, Maryland, Photo revised 2011), is attached hereto as *Figure 2* within Appendix A.

RELEVANT GEOLOGY

According to the *Geologic Map of Harford County* (Map), dated August 1968 and published by the Maryland Geological Survey in coordination with the United States Geological Survey, the site vicinity is situated within the transition zone between the Atlantic Coastal Plain and the Piedmont Physiographic provinces, a boundary commonly referred to as the Fall Line or Fall Zone. The Fall Zone in this area is characterized by a relatively thin capping of Coastal Plain soils over residual soils and the rocks of the Piedmont. Coastal Plain soils are sedimentary in nature, generally deposited in an alluvial marine environment during periods of fluctuating sea levels resulting in stratified deposits. The Piedmont is characterized by strongly folded and faulted metamorphic rock and the residual soils derived from the in-situ decomposition of the parent bedrock.

The Coastal Plain deposits located near the site are identified on the Map as the Potomac Group, consisting of interlayered sand, silt, and clay. The sand in this group is typically white to light gray with orange brown staining and is predominately quartz sand. This group also contains thick lenses of dark gray lignitic silty clay and bright red and yellow clay. The Piedmont rocks are identified on the Map as the Mettagabbro and Amphibolite. The residual soils derived from the weathering of the bedrock typically consist of silt and silty sand, with some clay. It is common in this Formation that the granular percentages increase with depth.

The *Soil Survey of Harford County,* published by the United States Department of Agriculture (USDA) Soil Conservation Service in 1975, indicates the soils underlying the site consist of Fallsington, Beltsville, and Sassafras series. Please refer to the aforementioned publications for more detailed information. A description of each soil type is provided in the following table:

SOIL TYPE	DESCRIPTION
Fallsington Series	Deep, poorly drained, nearly level soils on upland interfluvial flats of the Coastal Plain. Available moisture capacity is high, and is moderately permeable, but the water table is seasonally at or near the surface.
Beltsville Series	Nearly level to moderately sloping, moderately well-drained soils on the uplands of the Coastal Plain. Available moisture capacity is moderate, and is slowly permeable, but they are frequently wet in spring.
Sassafras Series	Deep, well-drained, gently to steeply sloping soils on undulating uplands of the Coastal Plain. Available moisture capacity is moderate to high, and is moderately permeable.

SUBSURFACE EXPLORATION

The subsurface conditions at the site were evaluated by performing 13 Standard Penetration Test (SPT) borings throughout the site, designated B-1 through B-13. The explorations were performed during the period of June 16 through 26, 2014. The exploration locations were selected and field located by a GTA engineer using Global Positioning System (GPS), and are depicted on *Figure 1, Exploration Location Plan*, attached to this Report in Appendix A.

The 13 test borings were advanced to the final depths using a Timberjack 820A mounted B-57 drill rig, equipped with 3¼-inch hollow-stem augers. Standard Penetration Tests were conducted in the boreholes, with four tests performed within the upper 10 feet of drilling and at 5-foot intervals thereafter. Standard Penetration Testing involves driving a 2-inch outside diameter (O.D.), 1⅜-inch inside diameter (I.D.) split-spoon sampler into the soil a distance of 24 inches using a 140-pound hammer free-falling 30 inches. The number of blows required to drive the sampler through the middle 12 inches of penetration is termed the SPT N-value and is indicated for each test interval on the test boring logs. The SPT N-values are reported as the number of blows per foot (bpf) of sampler penetration. A sample was collected at each SPT location from the split barrel sampler. GTA's drilling subcontractor employed a manual hammer to perform the SPT.

Soil samples recovered from the explorations were returned to GTA's laboratory in Abingdon, Maryland for limited laboratory testing. Soil descriptions and group classifications provided on the logs are made by GTA's geologist in general accordance with the procedures as described in ASTM D2488 (ASTM International's version of the Unified Soil Classification System [USCS]). The results of the laboratory testing were used to aid in the identification and classification of the soils. Attached to this Report are the *Notes for Exploration Logs* that provides a brief explanation of the soil descriptions and other information contained on the logs. The ground surface elevations at the exploration locations indicated within this Report were interpolated from the site topography shown on the Plan prepared by MRA. As such, elevations, as well as transitions in soil strata indicated on the exploration logs, should be considered approximate. The exploration logs are presented in Appendix B attached to this Report.

SUBSURFACE CONDITIONS

In agreement with the published geology, the explorations encountered soils associated with the Potomac Group throughout the depths of drilling. No soils associated with the Piedmont Physiographic Providence were encountered during our exploration. Topsoil was encountered at each SPT boring with thicknesses ranging from 3 to 5 inches, averaging approximately 4 inches.

Below the topsoil, the borings encountered interlayered granular and cohesive sediments of the Potomac Formation. The granular soils were classified as Silty SAND (SM), Clayey SAND (SC), and Silty, Clayey SAND (SC-SM) with subordinate amounts of gravel. The SPT N-values for the granular soils ranged from 9 to 44 bpf, averaging approximately 22 bpf, indicating that the majority of the granular sediments are in a medium dense condition. The fine-grained soils were classified as Lean CLAY (CL), Fat CLAY (CH), and SILT (ML). The SPT N-values for the fine-grained soils ranged from 2 to 35 bpf, averaging approximately 16 bpf, indicating that the majority of the fine-grained sediments were very stiff.

Soft and loose soil conditions were encountered throughout the site. The majority of the soft/loose conditions were encountered near the existing ground surface. The loose conditions encountered in granular soils are typically associated with a low confining pressure at the surface as the split spoon is advanced. Isolated layers of loose granular soils were also encountered at greater depths. Loose conditions are also often encountered in granular soils at the approximate groundwater elevation. This condition is often induced by the drilling process and does not necessarily indicate that the in-situ soils are loose.

Water measurements were generally performed during drilling, at the completion of drilling, and approximately 24 to 72 hours after the completion. Water was encountered within six of the borings at depths ranging from 2.5 to 13.0 ft bgs. A summary of the water levels and cave-in depths is included in the table below. It should be noted that cave-in depths may be at or near groundwater levels as the sidewalls slough into the explorations. Fluctuations in groundwater levels by as much as 2 to 3 feet may occur due to variations in rainfall, evaporation, construction activity, surface runoff, and other site-specific factors. Perched groundwater conditions can also develop in this geology as water becomes "trapped" in granular layers above a less permeable fine-grained layer.

SUMMARY OF WATER AND CAVE-IN DEPTHS

Boring No.	Water Observed During Drilling (ft bgs)	Water and Cave-In Depths Observed Immediately After Drilling (ft bgs)	Water and Cave-In Depths Observed 24 Hours After Drilling (ft bgs)	Approximate Groundwater Elevation
B-1	None	Dry / 4.4	Dry / 4.0	--
B-2	None	Dry / 3.5	3.0 / 3.5	EL 124
B-3	None	Dry / 3.6	Dry / 3.5	--
B-4	13.0	5.8 / 8.4	5.0 / 6.0	EL 134
B-5	None	Dry / 3.0	2.5 / 3.0	EL 130
B-6	None	Dry / 5.6	Dry / 5.5	--
B-7	13.0	Dry / 5.0	Dry / 5.0	EL 138
B-8	None	Dry / 5.0	Dry / 5.0	--
B-9	None	Dry / 6.8	4.5 / 6.5	EL 112
B-10	8.0	2.8 / 6.1	BOC	EL 121
B-11	None	Dry / 1.8	Dry / 1.0	--
B-12	None	Dry / 5.8	Dry / 5.5	--
B-13	None	Dry / 4.7	Dry / 4.5	--

BOC = Backfilled on completion

LABORATORY TESTING

Selected samples obtained from the borings were tested for grain size analysis, Atterberg limits, and natural moisture contents. The laboratory test reports are included in Appendix C. A summary of the test results are as follows:

SUMMARY OF GRAIN SIZE AND LIMIT TESTING

EXPLORATION NO.	DEPTH (ft.)	USCS CLASSIFICATION	PERCENT PASSING NO. 200	NMC (%)	LL (%)	PI (%)
B-1	4-6'	Clayey SAND with gravel (SC)	34.1	13.8	28	13
B-7	8-10'	Silty, Clayey SAND (SC-SM)	47.5	16.2	19	4
B-10	13-15'	Sandy Fat CLAY (CH)	62.9	32.8	69	51

NMC = Natural Moisture Content LL = Liquid Limit PI = Plasticity Index

CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of this study, it is our opinion that construction of the proposed improvements are feasible, given that the following recommendations are observed, and that the standard level of care is maintained during construction. However, it is anticipated that certain findings of the investigation will complicate construction and escalate the cost of the development. The findings include wet, moderately- to highly-plastic soils, and shallow groundwater. Discussions of these issues, as well as general site development issues, are included in the following paragraphs.

Site Preparations

Clearing, grubbing, and the stripping of organic surface soils should be performed in advance of any grading operations. The proposed building, pavement, and SWM areas should then be proofrolled to locate any soft or loose areas on the fill subgrade. Soft subgrade soils were encountered during drilling within the central and southern portions of the site. Soils identified as being unsuitable or unstable should be undercut to a stable stratum and backfilled with controlled, compacted fill, or chemically stabilized in place as discussed in the *Earthwork* section below.

The topsoil throughout the site generally ranged from approximately 3 to 5 inches in thickness. Mildly organic subsoil as well as roots from the mature tree growth may extend to depths exceeding 12 inches. The stripping thickness will depend on topsoil development, season of construction, and contractor care. Due to these variables, GTA recommends an average stripping thickness of 8 inches for the purposes of site design to develop a balanced grading plan.

The removal of organics, proofrolling, undercutting of any unsuitable or unstable material, and placement of controlled, compacted fill should be observed by the Geotechnical Engineer or their qualified representative.

Earthwork

Based on the referenced plan, site grading will require excavations and fills of as much as 12 and 8 feet, respectively, to achieve the proposed subgrade elevations for the buildings, pavement areas, retaining walls, and SWM facilities. Our observations and the results of the laboratory testing indicate that the majority of the on-site soils will be wet of their optimum moisture content (OMC) for compaction. The granular soils may be dried by aeration until the moisture content is reduced to compactable ranges. The majority of the soils encountered on site generally consisted of fine-grained, cohesive soils (CL, CH, and ML) and will likely comprise a significant proportion of the fill material used in areas of the site. These soils retain their moisture and are difficult to dry by aeration, even during the summer months.

Based on our experiences, the predominately wet cohesive soils encountered throughout the site may be slow to dry by aeration, even during the summer months. As such, the structural fills may need to be dried with quicklime, lime kiln dust, or Portland cement in order to achieve compaction and reduce the risk of settlements. The use of chemicals to modify the on-site soils may reduce construction costs by utilizing the on-site materials rather than removing the wet, plastic soils and replacing them with suitable imported soils. Additionally, due to the time associated with aerating the soils, the use of chemicals to dry the soils may accelerate the construction process.

It should be noted that chemically modified soils may not be used during SWM construction. As such, GTA recommends that the dry, on-site soils be initially reserved to complete the construction of the SWM embankments. The remaining dry soils available for use as fill may then be utilized to grade the building pads, retaining walls, and pavement areas.

Structural fills should be constructed in maximum 8-inch-thick loose lifts and be compacted to the following specifications:

COMPACTION SPECIFICATIONS

Structure / Fill Location	Compaction / Moisture Specification
Within the top 1-foot of pavement subgrade	97% of ASTM D1557 MDD Moisture: ± 3% of OMC
Below foundations & floor slabs, Fills below 1 foot of pavement subgrades, Fill slopes	92% of ASTM D1557 MDD Moisture: ± 3% of OMC
Fills in SWM Facility areas	95% of ASTM D698 MDD Moisture: 0 to 5% above OMC

Due to the limited quantity of dry soil on site, GTA recommends considering alternative compaction methods only within the pavement areas similar to those used by Baltimore and Harford Counties. These methods include placing the soil as fill without extensive drying efforts and compacting it in 8-inch-thick loose lifts to the maximum effort of the compaction equipment. Once the fills are complete, the fills within the pavement areas are given 60 days to settle prior to placing the asphalt pavements.

Structural fill should be free of vegetation, topsoil, frozen material, muck, organic matter, and other degradable materials, and have no individual particles exceeding 6 inches in any dimension. Based on the Plan, the majority of the site will be stripped of topsoil to an average depth of approximately 8 inches to accommodate the building pads and pavement areas.

Off-site borrow, if required, should meet USCS designation SM, SP, SW, GP, GM, or GW, and be approved by the geotechnical engineer. Consideration of off-site borrow meeting USCS classifications of ML and CL would be made based on the location and depth at which these materials are to be placed.

New fills constructed on slopes steeper than 5H:1V (horizontal to vertical) should be keyed into existing slopes to protect the stability of the embankment. All fill slopes steeper than 5H:1V should be placed as structural fill. The grading contractor should provide positive drainage at all times during earthwork activities.

Water was encountered at six boring locations during and after drilling in the lower areas of the site. Based on the location and depth at which water was encountered, it is unlikely that water will affect site grading activities except possibly for the deeper excavations required in the SWM areas along the southern boundary of the site. Should water be encountered along the face or toe of excavated slopes, seepage control measures such as blanket drains or chimney drains may be necessary to control the flow of water and maintain stability within the slopes. During grading operations, surface grades should be maintained to prevent pooling or ponding of water and direct surface runoff to the proper sediment control or SWM facilities.

In-place density testing by sand cone or nuclear method should be conducted on structural fills to verify that the compaction achieved meets the specifications herein. Structural fill construction should be observed and tested by a soils technician on a full-time basis, under the supervision of a Geotechnical Engineer as required by the International Building Code.

Subsurface Utilities

GTA anticipates that the utilities will consist of gravity sewer, water, storm drain, electric, and telecommunications conduits primarily within the pavement areas. The natural soils are considered suitable for support of below grade utilities; however, a 6-inch-thick granular bedding layer is generally required to provide uniform support, as dictated by site conditions and as required by local code. The granular bedding may also aid in providing localized dewatering at the site. If during utility installation unsuitable soils incapable of providing adequate support are encountered at the bottom of the utility trench excavation, these soils should be over-excavated to suitable soils and replaced with approved bedding materials.

Water was encountered at six of the exploration locations at depths as shallow as 2.5 ft bgs and will likely be encountered during utility installation. Problems associated with groundwater include seepage into the excavation, partial loss of stability, and sloughing of soils. Due to the potential for collapse of unsupported excavation in the more granular materials observed at greater depths, utility contractors should provide adequate earth support and dewatering systems in utility trench excavations as groundwater will likely be encountered and perched water conditions may develop. Water within utility excavations may be reduced at the time of construction through the use of "sump and pump" dewatering techniques. It should be noted that where cohesionless (granular) soils are encountered below the groundwater table, there is the potential for a "running sand" condition to be encountered. These conditions will require dewatering through the use of closely spaced well points.

It is recommended that placement and compaction of the soils be performed as specified in the *Earthwork* section of this Report. The results of the laboratory tests indicate that the moisture contents of the native, predominately cohesive, soils encountered throughout the site will generally have elevated moisture contents and will likely require drying or chemical treatment prior to placement and compaction within the trench. If drying of the soils is required, the excavated soils should be spread in thin layers and aerated by discing to within 3 percentage points of the optimum moisture content. Settlement and instability are likely if the on-site soils are used as backfill at moisture levels more than 3 percentage points above optimum moisture content. Due to the project schedule, GTA recommends that all fill material that requires drying be chemically treated with lime to maintain the project schedule.

Due to the extensive drying efforts likely required to achieve compaction, GTA recommends considering alternate compaction methods as discussed in the *Earthwork* section of this report. This utility trench backfill method permits the use of on-site soils as trench backfill material despite their wet condition. Upon completion of all utility installation, the trenches must be allowed to sit for 60 days to permit the trenches to settle and stabilize. Pending a proof-roll of the pavement subgrade soils, construction of the soil-cement or pavement section may proceed following the 60 day period. The City of Aberdeen should approve alternative compaction procedures within their utility easements.

Foundation Recommendations

Based on the planned construction, our assumptions, and results of the subsurface investigation, it appears the structures can be supported on shallow spread footings. For the assumed loading conditions, a design net allowable bearing capacity of 2,500 pounds per square foot (psf) is feasible for footings bearing on suitable natural soils and controlled compacted fill or stiff/medium dense original soils.

Soft/loose soils were encountered at near-surface elevations throughout the site. If unsuitable conditions are encountered during the foundation excavation process, these materials should be removed and replaced with open-graded stone or lean-mix concrete as depicted in *Figure 3 – Footing Subgrade Modification Detail*. The decision to perform the over-excavation procedures should be made by the Geotechnical Engineer or their designated representative.

Standard footing details should prove acceptable for this project. Minimum widths for wall footings of 24 inches and column footings of 36 inches are recommended when design based on the above bearing pressures results in a more narrow footing. Exterior footings should be founded a minimum of 30 inches below final exterior grade to provide protection from frost action. Interior foundations in heated portions of the structure may be established at depths below the floor slabs equal to the minimum footing thickness. Although soft soils were encountered at greater depths in some areas of the site, GTA's analysis indicates a maximum settlement on the order of 1-inch total and ½-inch differential can be anticipated based upon on maximum wall loads of 5klf and maximum column loads of 100 kips. However, actual settlements will depend on the actual loads, depth of footings, the soils encountered, and the thickness of structural fills. GTA requests the opportunity to review the architectural and structural plans, as well as the loading information prior to finalizing the foundation design.

The IBC specifies that a detailed foundation bearing surface evaluation be performed for each footing excavation during construction. The foundation bearing surface evaluations should be performed using a combination of visual observations, hand-rod probing, and Dynamic Cone Penetrometer (DCP) testing by a Geotechnical Engineer or their designated representative. A detailed geotechnical exploration may be warranted for the structures subsequent to mass grading and after review of the loading information and structural plans.

Floor Design

Based on the results of the investigation, it is anticipated that floor slabs can be designed as concrete slabs on grade. All subgrades for support of the slabs should be observed to evaluate stability prior to the placement of the drainage layer and concrete. It is recommended that design of the floor slabs be based on a subgrade modulus of 100 pounds per square inch per inch (psi/in) if founded on untreated, native soils.

If the slabs are to be founded on moderately- to highly-plastic soils, the subgrade must be protected from becoming dried out or saturated. It is recommended that if the slab subgrade consists of moderately plastic, cohesive soils, then these materials be placed, compacted, and maintained at moisture levels of approximately 2 to 4 percentage points above optimum levels prior to constructing the slab section. High-plastic soils, if encountered, should be removed and replaced with granular soils or chemically stabilized in place. If the slabs are founded on chemically-stabilized soils, the design of the floor slabs may be based on a subgrade modulus of 200 psi/in.

GTA recommends that the concrete floor slab supported on grade be founded on a minimum 6-inch-thick, layer of AASHTO M43, Size No. 57 aggregate covered with polyethylene vapor barrier. The aggregate layer will interrupt the rise of capillary moisture through the slab as well as provide drainage for the slab subgrade. The slabs may bear on wall projections, but they should be jointed so that the foundation walls can settle independently from the slab.

Construction activities and exposure to the environment often cause deterioration of slab subgrades. Therefore, we recommend that the slab subgrade soils be evaluated by a representative of the Geotechnical Engineer immediately prior to stone and concrete placement. This evaluation may include a combination of visual observations, proofrolling, hand-rod probing, and field density tests to confirm that the subgrade soils have been prepared properly. If soft or loose soils are encountered, recommendations for remedial measures should be provided by the Geotechnical Engineer at the time of construction.

Pavement Design

The pavement section is designed based on anticipated subgrade conditions and traffic. Following grading activities, the exposed native soils that will provide support for new pavements consist of predominantly fine-grained and cohesive soils. Based on the laboratory testing, and our experience with similar soils, the on-site clayey soils compacted to at least 95 percent Modified Proctor MDD may exhibit a CBR value of less than 5 percent.

Details on the traffic volumes and vehicles distributions were not available at the time this Report was prepared. Therefore, analyses of the flexible pavement section is based upon our experience with similar projects and the assumed traffic of 140,000 equivalent single-axle load (ESALs) applications over a design period of 20 years. The assumed traffic included a variety of vehicle types including passenger vehicles and single- to multi-axle trucks, but does not include vehicle loads associated with construction traffic. If higher traffic volumes are anticipated for the site, then additional analysis will be necessary to develop a suitable flexible pavement section. The recommended preliminary flexible pavement section placed on a subgrade with an assumed CBR value of 3 percent.

FLEXIBLE PAVEMENT SPECIFICATIONS

Pavement Materials	Compacted Layer Thickness (Inches)	
	Roads	Parking
Hot-Mix Asphalt Surface Course - 9.5 mm*	1.5	1.5
Hot-Mix Asphalt Base Course - 12.5 mm*	3.0	2.5
Aggregate Base (CR-6)	10.0	7.0

Notes:
* Compaction: Level 1 (50 Gyrations), Binder Type: PG64-22

In order to support the anticipated construction traffic, and as an alternative to removing and replacing the unsuitable cohesive soils at the pavement subgrade, GTA recommends considering chemically treating the pavement subgrade with Portland cement to increase the subgrade strength and reduce the soil's plasticity and swell potential. Prior testing on cement-treated soils has yielded CBR values on the order of 50 to more than 200 percent. GTA proposes the following pavement sections founded on a cement-stabilized subgrade:

CEMENT STABILIZED FLEXIBLE PAVEMENT SPECIFICATIONS

Pavement Materials	Compacted Layer Thickness (Inches)	
	Roads	Parking
Hot-Mix Asphalt Surface Course - 9.5 mm*	1.5	1.5
Hot-Mix Asphalt Base Course - 12.5 mm*	2.5	2.0
Aggregate Base (CR-6)	4.0	4.5
Cement-Stabilized Subgrade (CBR > 50)	12.0	12.0

Notes:
* Compaction: Level 1 (50 Gyrations), Binder Type: PG64-22

The total pavement thicknesses of 8 inches matches the height of the curb face for constructability purposes. GTA recommends that the subgrade be stabilized prior to curb installation. Additional laboratory testing should be performed prior to pavement construction to determine the appropriate proportions of soil, cement, and water to achieve the required CBR within the subgrade soil. Cement stabilized pavement sections are also more capable of supporting construction traffic without premature deterioration. Prior to the new pavement construction, the subgrade should be reviewed by the Geotechnical Engineer to evaluate design parameters and proof-rolled with a loaded tandem-axle dump truck to evaluate stability.

The above-stated pavement section assumes that the subgrade soils and aggregate base course materials have been uniformly compacted to 97 percent of Modified Proctor MDD. We recommend that testing be performed to evaluate soil plasticity and CBR values prior to the construction to verify that the subgrade materials meet the CBR requirements mentioned above.

It is recommended that the Compaction Level and the Binder Type for Superpave materials be indicated on the drawings or in project specifications. The pavement materials and construction should be in accordance with the current *Standard Specifications for Construction and Materials* of the Maryland Department of Transportation, State Highway Administration (MSHA).

Rigid pavements will be used for the loading areas or dumpster pads that support heavy concentrated static or wheel loads. To provide uniform support beneath a rigid pavement, a minimum 6-inch-thick layer of MSHA graded aggregate base should be utilized. For preliminary planning purposes, and based on the anticipated pavement subgrade soils, a minimum 6-inch-thick rigid pavement should be used. It should be noted that the rigid pavement should be comprised of air-entrained Portland cement concrete with compressive strength of 4,200 pounds per square inch (psi), as specified for Mix No. 7 in Table 902 A of the MSHA *Standard Specifications for Construction and Materials*. The rigid pavement should be reinforced with 6x6 welded wire fabric sized according to American Concrete Institute (ACI) standards. Construction joints should be spaced according to ACI 360 standards, but not exceed 15 feet. Subgrades for rigid pavement should be prepared as stated earlier in this section.

The engineering properties of the pavement subgrades soil can be significantly affected by water. In areas where near-surface water conditions are encountered, underdrains should be constructed to protect the pavement subgrade from the effects of water. The underdrains should be constructed behind and parallel to the curb with a slope of at least 1 percent to discharge into nearby storm drain structures.

Stormwater Management Facilities

The Plan indicates that stormwater will be managed by at least four quantity management facilities in the northeastern and southern portions of the site. Excavations and fills of up to 10 feet are anticipated within the SWM facilities in order to excavate the basins and construct the embankments.

GTA anticipates that the SWM facility will be designed in accordance with the latest version of the Natural Resources Conservation Service (NRCS), Maryland Code 378 – Pond Standards and Specifications (MD Code 378). MD Code 378 specifications indicate that the moisture content for all fills should be within 2 percentage points of optimum; however, published references, standard practice, and our experience indicate that moisture contents between 0 and 5 percentage points above optimum are better suited for placement and compaction of cut-off trench and impervious core. Embankment fill beyond the cut-off trench and core should be within 2 percentage points of optimum. The results of laboratory testing indicate that the majority of the on-site soils will be above the working range of optimum.

Drying of soils, wet of their approved compaction range, should be performed in accordance with the *Earthwork* section of this Report.

Due to the cohesive soils, GTA recommends that all slopes be designed with a geometry no steeper than 3H:1V in areas that could be affected by water. Slopes constructed steeper than this geometry will be unstable in areas of high groundwater and are susceptible to erosion and sloughing. The earthwork contractor should anticipate excavation activities will be performed as water is infiltrating into the excavation, especially as the excavations increase in depth. We recommend that the completed facility be stabilized and covered with vegetation as quickly as possible to reduce the potential for erosion.

Construction of the cut-off trench and impervious core for the facilities will require low permeable material (Unified Classification SC, CH or CL). Suitable material for use in constructing these elements was encountered throughout the site, however, these soils will likely be wet of their OMC for compaction. Prior to construction of the SWM facility, GTA recommends excavating test pits to more accurately define the location and quantity of the clayey soils, as well as their ability to be excavated without being contaminated with granular soils.

Groundwater will likely be encountered during the excavation of the SWM facilities throughout the site and should be managed as previously discussed in the *Earthwork* section of this Report. Once the design nears completion, GTA should be provided the opportunity to review the plans and details to evaluate if the geotechnical considerations have been addressed.

<u>Additional Work</u>

GTA understands that the site design was underway at the time this report was prepared. An additional geotechnical exploration should be considered for the final building design, and will likely be required for SWM facilities. As an additional service, GTA also recommends that testing be performed to determine the chemical application rate to modify/stabilize the on-site soil to be used as fill in structural areas.

LIMITATIONS

This Report, including all supporting exploration logs, field data, field notes, laboratory test data, calculations, estimates, and other documents prepared by GTA in connection with this project, has been prepared for the exclusive use of Orr Partners, pursuant to the agreement between GTA and Orr Partners, dated June 4, 2014, and in accordance with generally accepted engineering practice. All terms and conditions set forth in the Agreement and the General Provisions attached thereto are incorporated herein by reference. No warranty, express or implied, is given herein. Use and reproduction of this Report by any other person without the expressed written permission of GTA and Orr Partners is unauthorized and such use is at the sole risk of the user.

The analysis and recommendations contained in this Report are based on the data obtained from limited observation and testing of the encountered soils. Explorations indicate soil conditions only at specific locations and times, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between the exploration locations. Consequently, the analysis and recommendations must be considered preliminary until the subsurface conditions can be confirmed by direct observation at the time of construction. If variations in subsurface conditions from those described are noted during construction, recommendations in this Report may need to be re-evaluated.

In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this Report should not be considered valid unless the changes are reviewed and conclusions of this Report are verified in writing. GTA is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analysis without the expressed written authorization of GTA.

The scope of our services for this geotechnical exploration did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or around this site. Any statements in this Report or on the logs regarding odors, unusual, or suspicious items or conditions observed are strictly for the information of our Client.

This Report and the attached logs are instruments of service. If certain conditions or items are noted during our investigation, GTA may be required by prevailing statutes to notify and provide information to regulatory or enforcement agencies. GTA will notify our Client should a required disclosure condition exist.

140988 **GEO-TECHNOLOGY ASSOCIATES, INC.**

******* END OF REPORT *******

Important Information About Your

Geotechnical Engineering Report

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

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

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

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

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

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

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

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

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

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

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

Subsurface Conditions Can Change

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

Most Geotechnical Findings Are Professional Opinions

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

A Report's Recommendations Are *Not* Final

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

A Geotechnical Engineering Report Is Subject to Misinterpretation

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

Do Not Redraw the Engineer's Logs

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

Give Contractors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are Not Covered

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

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

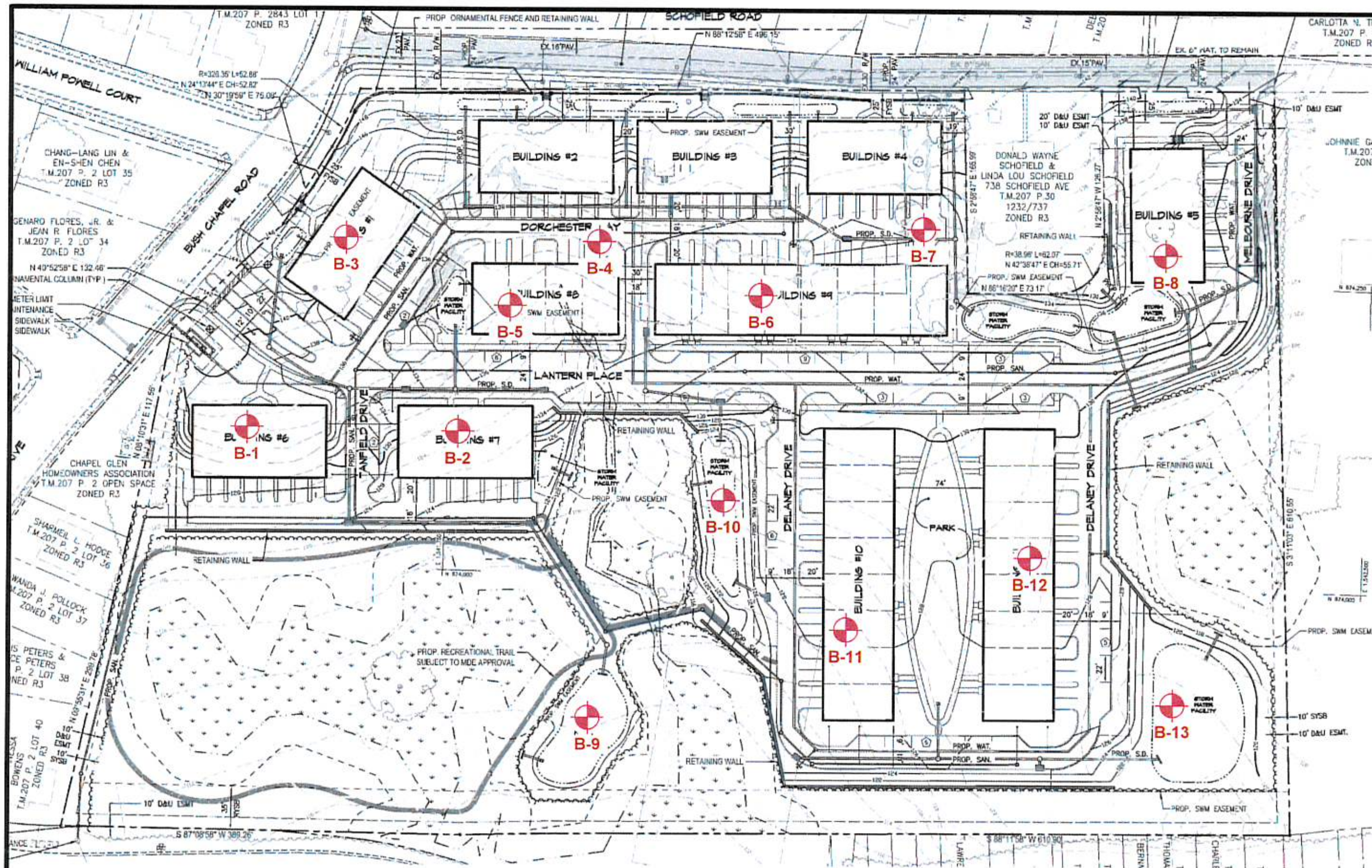
Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

APPENDIX A

FIGURES



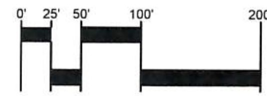
VICINITY MAP
SCALE: 1" = 2000'

SOURCE: PLAN ADAPTED FROM A PDF TITLED "PRELIMINARY SITE PLAN"
PRODUCED BY MORRIS & RITCHIE ASSOCIATES, INC. AND DATED MAY 28, 2014

LEGEND

SUBJECT PROPERTY

APPROXIMATE BORING LOCATION
B-1



SCALE: 1"=100'

N

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
3445-A BOX HILL CORPORATE CENTER DRIVE
ABINGDON, MARYLAND 21009
410-515-9446
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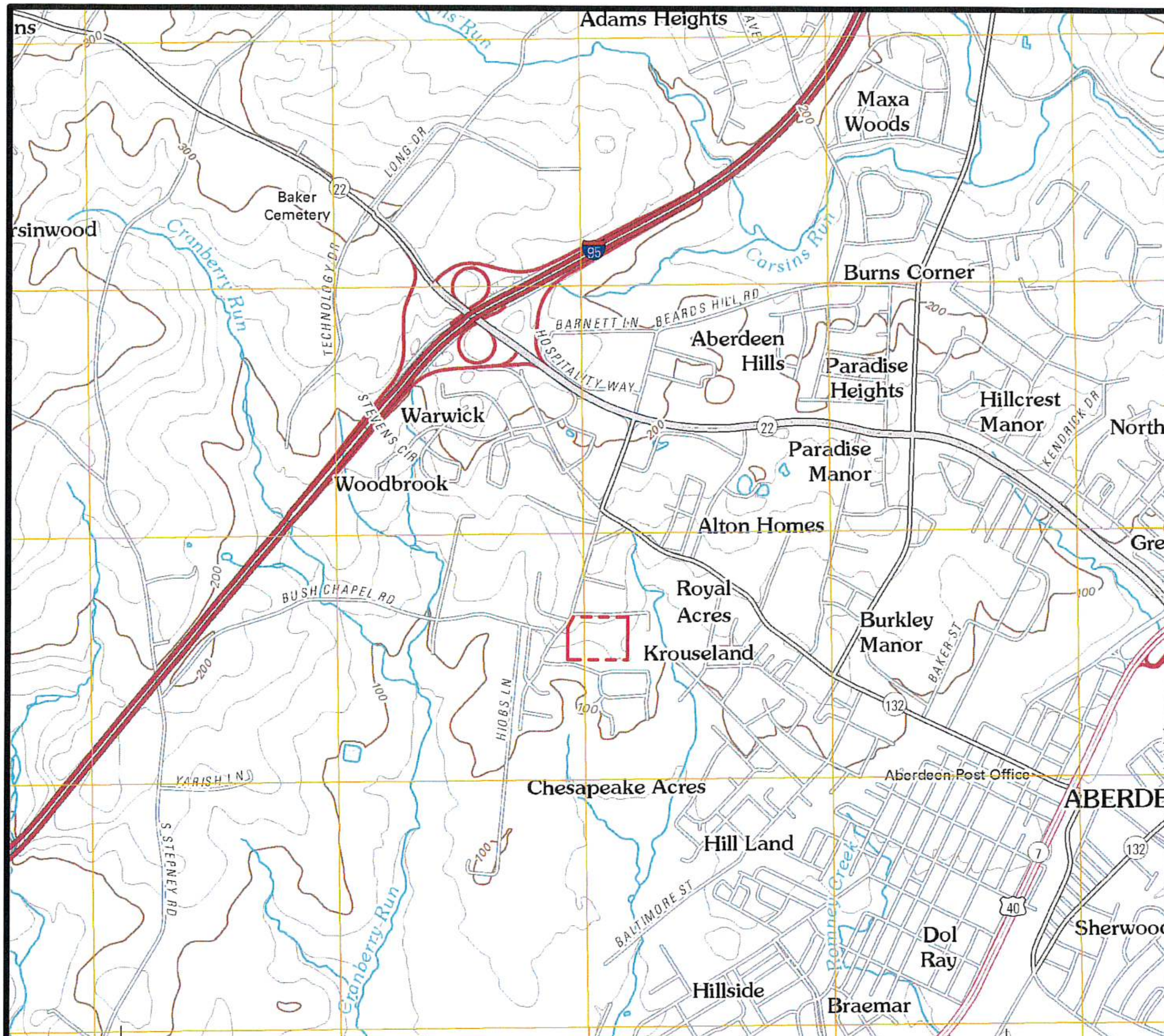
BORING LOCATION PLAN
THE VILLAGE AT FOREST BROOKE
HARFORD COUNTY, MARYLAND

JOB NO.	140988	SCALE:	1"=100'	DATE:	JULY 2014	DRAWN BY:	EBC	REVIEW BY:	TMW	FIGURE:	1

G:\GTA\The Village at Forest Brooke\PlotBLP



SOURCE: PLAN ADAPTED FROM THE 2011 USGS TOPOGRAPHIC QUADRANGLE OF ABERDEEN, MARYLAND.

LEGEND

SUBJECT PROPERTY

NORTH

0' 500' 1,000' 2,000' 4,000'

SCALE: 1"=2,000'

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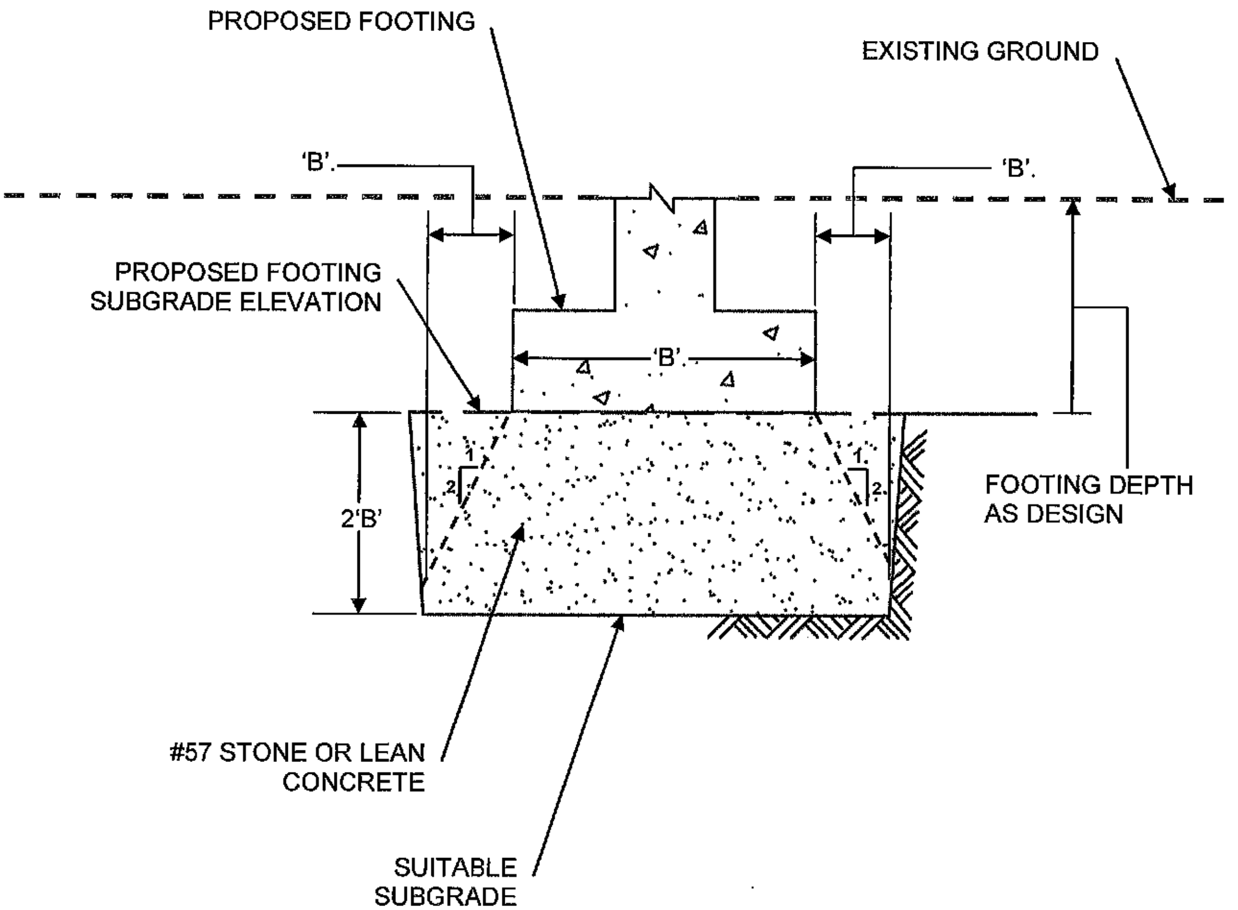
TOPOGRAPHIC MAP
THE VILLAGE AT FOREST BROOKE
HARFORD COUNTY, MARYLAND

JOB NO.	140988	SCALE:	1"=2000'	DATE:	JULY 2014	DRAWN BY:	JMW	REVIEW BY:	TMW	FIGURE:	2

G:\GTA\VILLAGE AT FOREST BROOKE\PLOT\BLP.DWG



NOTE:
SLOPE OF THE EXCAVATION SHOULD BE A MINIMUM OF 1 HORIZONTAL TO 1 VERTICAL (1:1)

GTA	GEO-TECHNOLOGY ASSOCIATES, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS 3445-A BOX HILL CORPORATE CENTER DRIVE ABINGDON, MARYLAND 21009 410-515-9446 FAX 410-515-4895	FOOTING SUBGRADE MODIFICATION DETAIL THE VILLAGE AT FOREST BROOKE HARFORD COUNTY, MARYLAND

JOB NO. 140988	SCALE: NTS	DATE: July 2014	DRAWN BY: EJK	REVIEW BY: TMW	FIGURE: 3

APPENDIX B

LOGS OF EXPLORATION

NOTES FOR EXPLORATION LOGS

KEY TO USCS TERMINOLOGY AND GRAPHIC SYMBOLS

MAJOR DIVISIONS (BASED UPON ASTM D 2488)			SYMBOLS: GRAPHIC	SYMBOLS: LETTER
COARSE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 15% PASSING THE NO. 200 SIEVE)		GW
				GP
		GRAVELS WITH FINES (MORE THAN 15% PASSING THE NO. 200 SIEVE)		GM
				GC
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LESS THAN 15% PASSING THE NO. 200 SIEVE)		SW
				SP
		SANDS WITH FINES (MORE THAN 15% PASSING THE NO. 200 SIEVE)		SM
				SC
FINE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILT OR CLAY (<15% RETAINED ON THE NO. 200 SIEVE) SILT OR CLAY WITH SAND OR GRAVEL (15% TO 30% RETAINED ON THE NO. 200 SIEVE) SANDY OR GRAVELLY SILT OR CLAY (>30% RETAINED ON THE NO. 200 SIEVE)	SILTS AND LEAN CLAYS LIQUID LIMIT LESS THAN 50		ML
				CL
				OL
		ELASTIC SILTS AND FAT CLAYS LIQUID LIMIT GREATER THAN 50		MH
				CH
				OH
HIGHLY ORGANIC SOILS				PT

NOTE: DUAL SYMBOLS ARE USED TO INDICATE COARSE-GRAINED SOILS WHICH CONTAIN AN ESTIMATED 5 TO 15% FINES BASED ON VISUAL CLASSIFICATION OR BETWEEN 5 AND 12% FINES BASED ON LABORATORY TESTING; AND FINE-GRAINED SOILS WHEN THE PLOT OF LIQUID LIMIT & PLASTICITY INDEX VALUES FALLS IN THE PLASTICITY CHART'S CROSS-HATCHED AREA. FINE-GRAINED SOILS ARE CLASSIFIED AS ORGANIC (OL OR OH) WHEN ENOUGH ORGANIC PARTICLES ARE PRESENT TO INFLUENCE ITS PROPERTIES. LABORATORY TEST RESULTS ARE USED TO SUPPLEMENT SOIL CLASSIFICATION BY THE VISUAL-MANUAL PROCEDURES OF ASTM D 2488.

ADDITIONAL TERMINOLOGY AND GRAPHIC SYMBOLS

	DESCRIPTION		GRAPHIC SYMBOLS
ADDITIONAL DESIGNATIONS	TOPSOIL		
	MAN MADE FILL		
	GLACIAL TILL		
	COBBLES AND BOULDERS		
RESIDUAL SOIL DESIGNATIONS	DESCRIPTION	"N" VALUE	
	HIGHLY WEATHERED ROCK	50 TO 50/1"	
	PARTIALLY WEATHERED ROCK	MORE THAN 50 BLOWS FOR 1" OF PENETRATION OR LESS, AUGER PENETRABLE	

COARSE-GRAINED SOILS
(GRAVEL AND SAND)

DESIGNATION	BLOWS PER FOOT (BPF) "N"
VERY LOOSE	0 - 4
LOOSE	5 - 10
MEDIUM DENSE	11 - 30
DENSE	31 - 50
VERY DENSE	>50

NOTE: "N" VALUE DETERMINED AS PER ASTM D 1586

FINE-GRAINED SOILS
(SILT AND CLAY)

CONSISTENCY	BPF "N"
VERY SOFT	<2
SOFT	2 - 4
MEDIUM STIFF	5 - 8
STIFF	9 - 15
VERY STIFF	16 - 30
HARD	>30

NOTE: ADDITIONAL DESIGNATIONS TO ADVANCE SAMPLER INDICATED IN BLOW COUNT COLUMN:
WOH = WEIGHT OF HAMMER
WOR = WEIGHT OF ROD(S)

SAMPLE TYPE

DESIGNATION	SYMBOL
SOIL SAMPLE	S-
SHELBY TUBE	U-
ROCK CORE	R-

WATER DESIGNATION

DESCRIPTION	SYMBOL
ENCOUNTERED DURING DRILLING	▽
UPON COMPLETION OF DRILLING	▼
24 HOURS AFTER COMPLETION	▼

NOTE: WATER OBSERVATIONS WERE MADE AT THE TIME INDICATED. POROSITY OF SOIL STRATA, WEATHER CONDITIONS, SITE TOPOGRAPHY, ETC. MAY CAUSE WATER LEVEL CHANGES.

LOG OF BORING NO. B-1

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft):	Dry	Dry	
DATE:	6/18/14	6/20/14	
CAVED (ft):	4.4	4.0	

DATE STARTED: **6/18/2014**
DATE COMPLETED: **6/18/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **134**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					134.0	0	ML		Brown, moist, medium stiff, SILT	Topsoil = 3 inches
S-1	0.0	10	3-4-3-2	7						
									Brown, moist, very stiff, SILT	
S-2	2.0	18	5-8-10-13	18		3				
					130.0		SC		Orange, moist, medium dense, Clayey SAND with gravel	
S-3	4.0	12	3-9-13-12	22						
						6				
					126.0		SM		Gray/ brown, moist, medium dense, Silty SAND	
S-4	8.0	12	5-4-13-20	17		9				
						12				
									Brown, moist, medium dense, Silty SAND	
S-5	13.0	24	9-10-13-15	23						
					119.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

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Abingdon, MD 21009

LOG OF BORING NO. B-2

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft): Dry | 3.0 |
DATE: 6/18/14 | 6/20/14 |
CAVED (ft): 3.5 | 3.5 |

DATE STARTED: **6/18/2014**
DATE COMPLETED: **6/18/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **124**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					124.0	0	CL		Brown, moist, medium stiff, Lean CLAY	Topsoil = 4 inches
S-1	0.0	12	3-2-3-3	5						
S-2	2.0	24	10-12-15-18	27		3			Gray, brown, moist, very stiff, Lean CLAY	▽
S-3	4.0	24	8-10-17-25	27					Same	
						6				
S-4	8.0	24	7-11-14-17	25		9			Orange/ brown, moist, very stiff, Lean CLAY	
						12				
S-5	13.0	24	7-10-10-18	20	111.0		CH		Purple, moist, very stiff, Fat CLAY	
					109.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

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Abingdon, MD 21009

LOG OF BORING NO. B-3

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft):	Dry	Dry	
DATE:	6/18/14	6/20/14	
CAVED (ft):	3.6	3.5	

DATE STARTED: **6/18/2014**
DATE COMPLETED: **6/18/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **147**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					147.0	0	ML		Dark brown, moist, soft, SILT	Topsoil = 4 inches
S-1	0.0	8	1-2-2-9	4						
					145.0		SM		Orange, moist, medium dense, Silty SAND with gravel	
S-2	2.0	10	4-10-13-17	23		3				
									Same	
S-3	4.0	10	2-6-6-8	12						
						6				
									Light brown, moist, medium dense, Silty SAND	
S-4	8.0	16	5-11-11-13	22		9				
						12				
									Same	
S-5	13.0	20	6-13-14-18	27						
					132.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

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LOG OF BORING NO. B-4

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft): 5.8 | 5.0
DATE: 6/17/14 | 6/18/14
CAVED (ft): 8.4 | 6.0

DATE STARTED: **6/17/2014**
DATE COMPLETED: **6/17/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **13.0**
GROUND SURFACE ELEVATION: **134**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					134.0	0	CL		Brown, wet, soft, Lean CLAY	Topsoil = 3 inches
S-1	0.0	6	2-1-1-2	2						
									Orangish brown, moist, medium stiff, Lean CLAY	
S-2	2.0	24	3-3-4-8	7		3				
									Orangish brown, moist, very stiff, Lean CLAY	
S-3	4.0	24	6-8-10-13	18						
						6				
									Gray/ orangish brown, moist, stiff, Lean CLAY	
S-4	8.0	20	3-6-8-8	14		9				
						12				
					121.0		SM		Brown, wet, medium dense, Silty SAND	
S-5	13.0	18	3-7-12-14	19						
					119.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

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3445-A Box Hill Corporate Center Drive
Abingdon, MD 21009

LOG OF BORING NO. B-4

LOG OF BORING NO. B-5

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft):	Dry	2.5	
DATE:	6/18/14	6/20/14	
CAVED (ft):	3.0	3.0	

DATE STARTED: **6/18/2014**
DATE COMPLETED: **6/18/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **130**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
S-1	0.0	8	1-2-3-6	5	130.0	0	ML		Brown, moist, soft, SILT	Topsoil = 4 inches
S-2	2.0	24	3-6-10-12	16	128.0	3	SM		Light brown, moist to wet, Silty SAND	
S-3	4.0	18	2-7-7-5	14		6			Same	
S-4	8.0	12	3-8-10-10	18	122.0	9	CL		Orange, moist, very stiff, Lean CLAY	
						12				
S-5	13.0	14	3-3-10-8	13					Orange, moist, stiff, Lean CLAY	
					115.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

LOG OF BORING NO. B-6

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft): Dry | Dry |
DATE: 6/17/14 | 6/18/14 |
CAVED (ft): 5.6 | 5.5 |

DATE STARTED: **6/17/2014**
DATE COMPLETED: **6/17/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **133**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					133.0	0	SM		Brown, dry to moist, medium dense, Silty SAND	Topsoil = 3 inches
S-1	0.0	10	4-5-8-15	13						
S-2	2.0	24	15-21-23-25	44		3			Orangish brown, dry to moist, dense, Silty SAND with gravel	
S-3	4.0	24	21-20-23-18	43					Orange, moist, dense, Silty SAND	
						6				
S-4	8.0	18	2-5-10-13	15		9			Orange, moist, medium dense, Silty SAND	
						12				
S-5	13.0	24	2-5-10-13	15	120.0		CH		Orange, moist, very stiff, Fat CLAY	
					118.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

GEO-TECHNOLOGY
ASSOCIATES, INC.

3445-A Box Hill Corporate Center Drive
Abingdon, MD 21009

LOG OF BORING NO. B-7

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft): Dry | Dry |
DATE: 6/17/14 | 6/18/14 |
CAVED (ft): 5.0 | 5.0 |

DATE STARTED: **6/17/2014**
DATE COMPLETED: **6/17/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **13.0**
GROUND SURFACE ELEVATION: **138**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
S-1	0.0	24	2-2-4-3	6	138.0	0	CL		Light brown, moist, medium stiff, Lean CLAY	Topsoil = 4 inches
S-2	2.0	0	7-9-13-16	22		3			No Recovery	
S-3	4.0	24	7-14-21-25	35	134.0		SC		Brown, moist, dense, Clayey SAND	
S-4	6.0	6	14-14-16-17	30	132.0	6	CL		Light brown, moist, very stiff, Lean CLAY with sand	
S-5	8.0	18	8-8-14-15	22	130.0	9	SC-SM		Brown, moist, very stiff, Silty, Clayey SAND	
						12				
S-6	13.0	8	2-4-5-7	9	125.0		SM		Brown, wet, loose, Silty SAND	
					123.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

LOG OF BORING NO. B-8

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft):	Dry	Dry	
DATE:	6/26/14	6/27/14	
CAVED (ft):	5.0	5.0	

DATE STARTED: **6/26/2014**
DATE COMPLETED: **6/26/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **129**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					129.0	0	ML		Tan, moist, stiff, SILT with gravel	Topsoil = 4 inches
S-1	0.0	15	7-7-8-10	15						
									Brown, moist, very stiff, SILT	
S-2	2.0	10	8-9-10-15	19		3				
					125.0		CL		Brown, moist, very stiff, Lean CLAY	
S-3	4.0	18	11-11-12-18	23						
						6				
									Dark brown, moist, very stiff, Lean CLAY	
S-4	8.0	24	11-14-16-18	30		9				
						12				
					116.0		SM		Brown, moist, medium dense, Silty SAND	
S-5	13.0	20	8-7-7-8	14						
					114.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

LOG OF BORING NO. B-9

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft):	Dry	4.5	
DATE:	6/26/14	6/27/14	
CAVED (ft):	6.8	6.5	

DATE STARTED: **6/18/2014**
DATE COMPLETED: **6/26/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **112**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					112.0	0	ML		Dark brown, moist, meidum stiff, SILT	Topsoil = 3 inches
S-1	0.0	18	2-2-3-4	5						
					110.0		CL		Brown, moist, medium stiff, Lean CLAY	
S-2	2.0	16	2-5-3-5	8		3				
									Brown, moist, very stiff, Lean CLAY	
S-3	4.0	8	10-9-11-13	20						
						6				
					104.0		SC		Brown/ gray, moist, medium dense, Clayey SAND	
S-4	8.0	18	14-15-12-12	27		9				
						12				
									Brown, moist, medium dense, Clayey SAND with gravel	
S-5	13.0	15	6-9-11-11	20						
					97.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

LOG OF BORING NO. B-10

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft): 2.8 | BOC |
DATE: 6/17/14
CAVED (ft): 6.1

DATE STARTED: **6/17/2014**
DATE COMPLETED: **6/17/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **8.0**
GROUND SURFACE ELEVATION: **121**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					121.0	0	CL		Light brown, moist, soft, Lean CLAY	Topsoil = 4 inches
S-1	0.0	24	1-1-2-4	3						
									Orangish brown, moist, very stiff, Lean CLAY with gravel	
S-2	2.0	8	2-7-10-11	17		3				
									Orangish brown/ gray, moist, stiff, Lean CLAY	
S-3	4.0	24	3-7-7-8	14						
						6				
					113.0		SM		Orange, wet, loose, Silty SAND	
S-4	8.0	20	2-4-6-6	10		9				
						12				
					108.0		CH		Brown/ purple, moist to wet, stiff, Sandy Fat CLAY	
S-5	13.0	24	4-5-6-8	11						
					106.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate. BOC = Backfilled on completion.**

LOG OF BORING NO. B-11

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft):	Dry	Dry	
DATE:	6/26/14	6/27/14	
CAVED (ft):	1.8	1.0	

DATE STARTED: **6/26/2014**
DATE COMPLETED: **6/26/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **117**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					117.0	0	CL		Tan, moist, medium stiff, Lean CLAY	Topsoil = 5 inches
S-1	0.0	20	3-3-4-6	7						
S-2	2.0	22	4-5-6-10	11		3			Tan/ gray, moist, stiff, Lean CLAY	
S-3	4.0	18	7-8-10-17	18					Tan/ gray, moist, very stiff, Lean CLAY	
						6				
S-4	8.0	22	6-9-8-11	17		9			Brown, moist, stiff, Lean CLAY	
						12				
S-5	13.0	24	11-15-20-28	35	104.0		CH		Purple, moist, hard, Fat CLAY	
					102.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

LOG OF BORING NO. B-12

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft):	Dry	Dry	
DATE:	6/26/14	6/27/14	
CAVED (ft):	5.8	5.5	

DATE STARTED: **6/26/2014**
DATE COMPLETED: **6/26/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **125**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					125.0	0	ML		Brown, dry to moist, stiff, SILT	Topsoil = 4 inches
S-1	0.0	18	3-4-8-9	12						
									Brown, dry to moist, very stiff, SILT	
S-2	2.0	20	9-11-16-18	27		3				
									Brown/ gray, moist, hard, SILT	
S-3	4.0	16	4-12-20-22	32						
						6				
					117.0		SM		Tan, moist, dense, Silty SAND with gravel	
S-4	8.0	22	16-19-22-15	41		9				
						12				
									Tan, moist, medium dense, Silty SAND	
S-5	13.0	22	8-11-12-12	23						
					110.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

LOG OF BORING NO. B-13

PROJECT: **The Village at Forest Brooke**
PROJECT NO.: **140988**
PROJECT LOCATION: **Harford County, Maryland**

WATER LEVEL (ft): **Dry** | **Dry** |
DATE: **6/26/14** | **6/27/14** |
CAVED (ft): **4.7** | **4.5** |

DATE STARTED: **6/26/2014**
DATE COMPLETED: **6/26/2014**
DRILLING CONTRACTOR: **MDA Drilling, Inc.**
DRILLER: **D. Addison**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split-Spoon**

WATER ENCOUNTERED DURING DRILLING (ft) **None**
GROUND SURFACE ELEVATION: **120**
DATUM: **Topo**
EQUIPMENT: **B-57**
LOGGED BY: **E. Powell**
CHECKED BY: **E. Kussman**

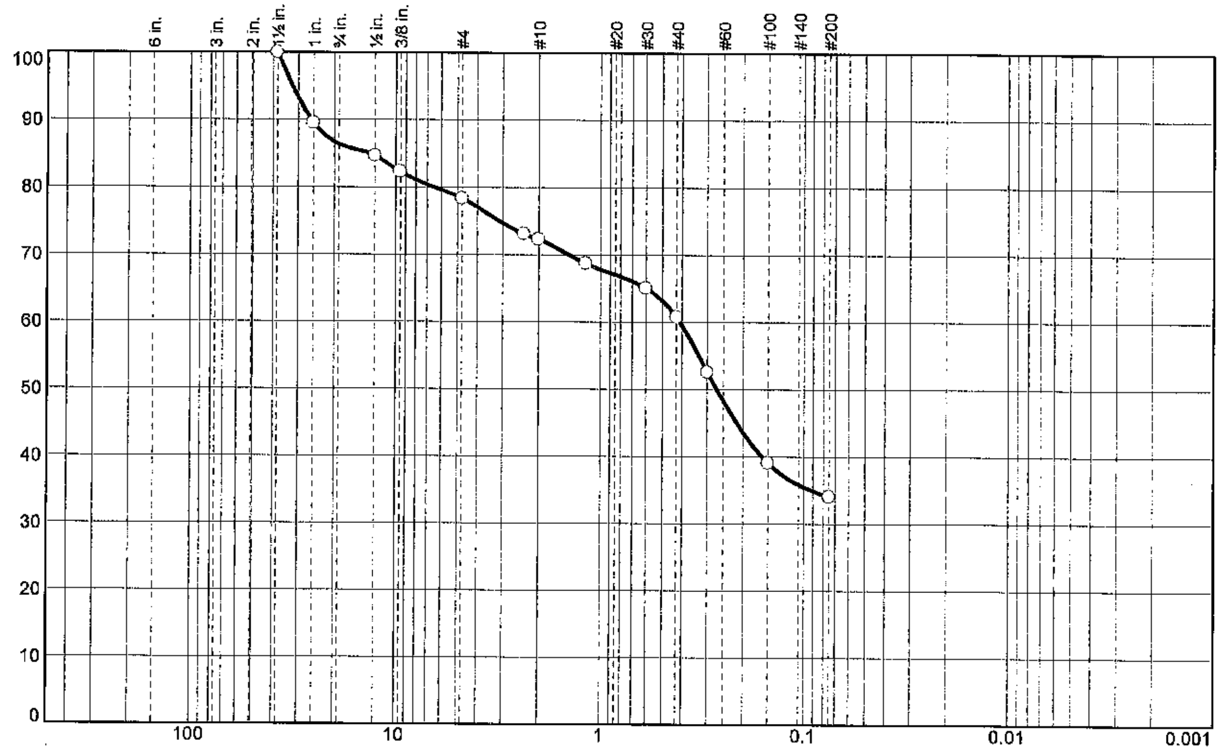
SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					120.0	0	CL		Red, moist, soft, Lean CLAY	Topsoil = 4.5 inches
S-1	0.0	18	2-2-2-4	4						
					118.0		ML		Red, moist, very stiff, SILT	
S-2	2.0	18	5-10-11-12	21		3				
									Same	
S-3	4.0	18	5-10-10-10	20						
						6				
					112.0		CL		Gray, moist, very stiff, Lean CLAY	
S-4	8.0	24	11-11-11-11	22		9				
						12				
					107.0		SM		White/ gray, moist, medium dense, Silty SAND	
S-5	13.0	24	7-7-10-10	17						
					105.0	15			Boring Terminated at 15 feet	
						18				

NOTES: **Elevations and locations are approximate.**

APPENDIX C

LABORATORY DATA

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	13.6	8.1	6.0	11.6	26.6	34.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
1	89.5		
1/2	84.6		
3/8	82.3		
#4	78.3		
#8	73.1		
#10	72.3		
#16	68.7		
#30	65.0		
#40	60.7		
#50	52.6		
#100	39.1		
#200	34.1		

* (no specification provided)

Soil Description

Orange, moist, medium dense, Clayey SAND with gravel

Atterberg Limits

PL= 15 LL= 28 PI= 13 NM= 13.8

Coefficients

D_{90}= 26.0822 D_{85}= 13.5590 D_{60}= 0.4092
D_{50}= 0.2696 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

Source of Sample: B-1 **Depth:** 4
Sample Number: S-3

Date: 6/25/2014

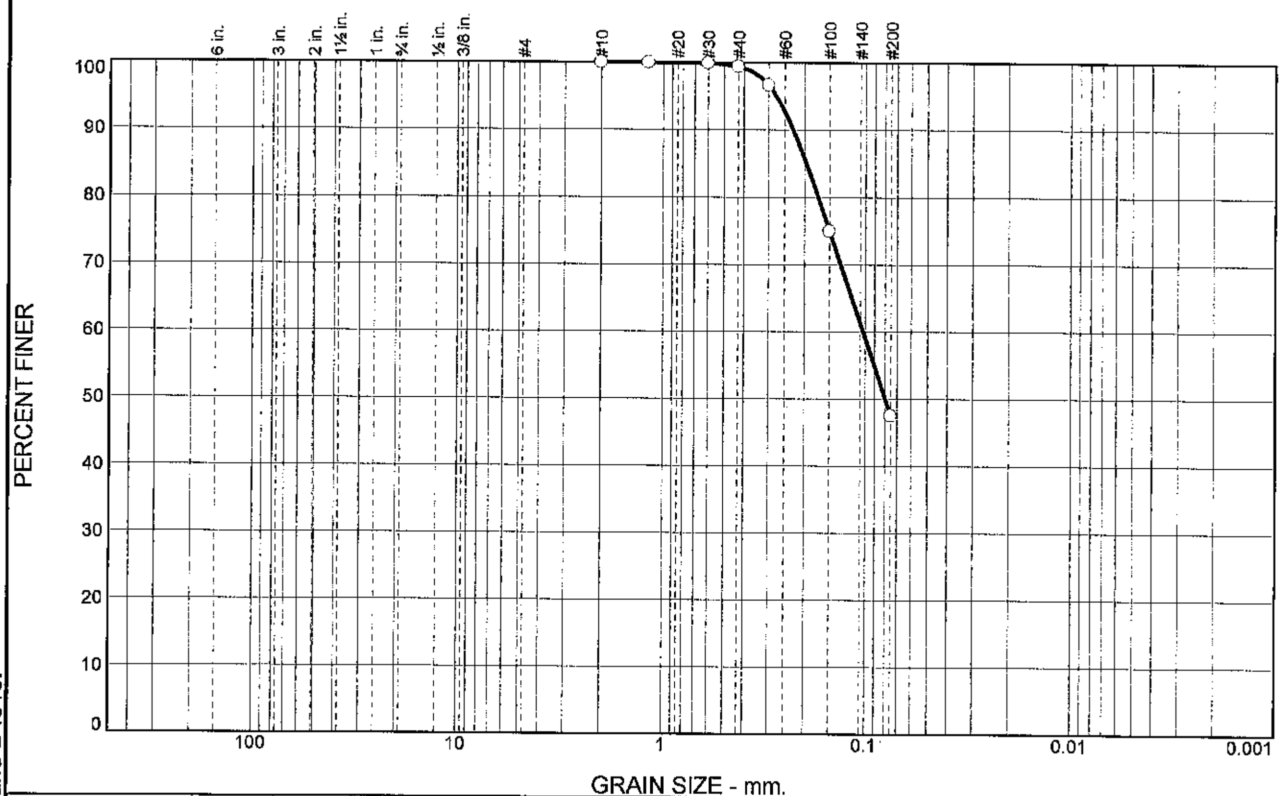
GEO-TECHNOLOGY ASSOCIATES, INC.
3445-A Box Hill Corporate Center Drive
Abingdon, MD 21009

Client: Orr Partners
Project: The Village at Forest Brooke
Project No: 140988

ASTM Specifications performed may include: D421, D422, D2216, D2217, and D4318.

Tested By: E. Kussman **Checked By:** T. Wirth

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	51.9	47.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#16	100.0		
#30	99.9		
#40	99.4		
#50	96.6		
#100	74.9		
#200	47.5		

* (no specification provided)

Soil Description

Brown, moist, very stiff, Silty, Clayey SAND

Atterberg Limits

PL= 15 LL= 19 PI= 4 NM= 16.2

Coefficients

D_{90}= 0.2276 D_{85}= 0.1957 D_{60}= 0.1027
D_{50}= 0.0799 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-4(0)

Remarks

Source of Sample: B-7 **Depth:** 8
Sample Number: S-5

Date: 6/25/2014

GEO-TECHNOLOGY ASSOCIATES, INC.
3445-A Box Hill Corporate Center Drive
Abingdon, MD 21009

Client: Orr Partners
Project: The Village at Forest Brooke
Project No: 140988

ASTM Specifications performed may include: D421, D422, D2216, D2217, and D4318.

Tested By: E. Kussman **Checked By:** T. Wirth