DRAFT

Geotechnical Engineering Report

Lubber Run Recreation Center

Arlington, Virginia

June 23, 2017

Terracon Project No. EW175052

Prepared for:

Bowman Consulting Group
Chantilly, Virginia 20151

Prepared by:

Terracon Consultants, Inc.
Dulles, Virginia

DRAFT

June 23, 2017

Bowman Consulting Group
3863 Centerview Drive, Suite 300
Chantilly, VA 20151

Attn: Mr. Scott Delgado

Re: Geotechnical Engineering Report
Lubber Run Recreation Center
Arlington, Virginia
Terracon Project Number: EW175052

Dear Mr. Delgado,

Terracon Consultants, Inc. (Terracon) has performed geotechnical engineering services for the Lubber Run Recreation Center project. These services were conducted in accordance with Terracon's proposal PEW175052 dated May 25, 2017.

The report presents he findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, paved parking areas, retaining walls, foundation walls and bioretention facilities for the proposed project.

We appreciate the opportunity to be of service to you on this project. Materials testing services are provided by Terracon. We would be pleased to discuss these services with you. Please contact us if you have any questions concerning this report, or if we may be of further service.

Sincerely,
Terracon Consultants, Inc.

Will Kelsey, E.I.T.
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EXECUTIVE SUMMARY

A geotechnical exploration has been performed for the proposed community center to be constructed at 300 North Park Drive, Arlington, Virginia. Nineteen (19) borings, designated B-1 through B-19, and one (1) rock core were performed to depths ranging from 10 to 70 feet beneath existing ground surface. This report specifically addresses recommendations for the proposed community center, retaining walls, bio-filter and parking garage.

Based on the information obtained, the subsurface conditions at the site are suitable for the proposed construction. The following geotechnical considerations were identified:

- The proposed building may be supported on shallow footings bearing on the stiff to hard native soil, or newly placed structural fill.
- Assuming proper site preparation and any necessary subgrade repair, total and differential settlement should be within anticipated client/owner specifications.
- On-site native soils typically appear suitable for use as structural fill.
- The Seismic Site Class for the site is “C”.
- Terracon should be retained during the site grading phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations to the completed subgrade.
- Infiltration will be feasible at the proposed bio-filter location.

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.

DRAFT

GEOTECHNICAL ENGINEERING REPORT
LUBBER RUN RECREATION CENTER
ARLINGTON, VIRGINIA
Terracon Project No. EW175052
June 23, 2017

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed new construction of a recreation center located at 300 North Park Drive in Arlington, Virginia. Our geotechnical engineering scope of work for this project included:

- Advancing nineteen (19) soil test borings to planned depths ranging from 10 to 100 feet below existing site grades.
- Infiltration testing within the footprint of the planned bio-filter facility
- One (1) rock core to determine the quality of on-site rock.
- Test pits to determine the Seasonal High Water Table (SHWT)

The purpose of these services was to provide information and geotechnical engineering recommendations including, but not limited to:

- subsurface soil conditions
- earthwork
- groundwater conditions
- infiltration test results
- foundation design and construction
- pavement design and construction
- floor slab design and construction
- below grade wall design considerations
- retaining wall design considerations
- seismic considerations
- bio-filter design considerations

2.0 PROJECT INFORMATION

2.1 Project Description

Information provided by the client included the following documents:

- *Boring Layout Building Height Diagram* dated May 8, 2017 and provided by Bowman Consulting Group.
- *LRR Schematic Site Plan* dated April 25, 2017 and provided by Bowman Consulting Group.
- *Exterior Views* developed by VMDO and dated May 4, 2017.
- *Scheme – Current Plan* developed by VMDO dated April 24, 2017

ITEM	DESCRIPTION
Proposed construction	■ Demolition of an existing 2 story structure ■ One to three story recreation center with an approximately 40,000 sf footprint. The building will incorporate green roofs and below grade structures. ■ Below-grade parking structure, at the issuance of this report, it has not been determined if the parking structure will be one story or two stories. ■ Three retaining walls with maximum heights of 4, 14 and 16 feet. ■ Bio-filter facility ■ Asphalt parking lot and private drive ■ Athletic fields ■ Entrance drive ■ Sidewalks
Building Construction	■ Parking garage: Cast In Place Concrete ■ Community Center: Cast In Place Concrete ■ Gym: Heavy Timber
Maximum loads	Loading information is presented below based on our correspondence with VMDO: ■ Garage Loading (assuming 2 levels) • Column loading: 750 kips • Wall loading: 18 kips/linear foot ■ Community Center • Building column loading: 350 kips • Wall loading: 12 kips/linear foot • Gym roof columns: 200 kips
Maximum allowable movement	**Recreation Center, Parking Garage and Retaining Walls** ■ Total: 1-inch ■ Differential: ½ inch over 50 feet
Grading	Unknown at this time
Cut and fill slopes	Assumed to be no steeper than 3H:1V (Horizontal to Vertical).

2.2 Site Description

ITEM	DESCRIPTION
Location	The project site is located at the southwest corner of North George Mason Drive and North Park Drive. The site is listed under the address 300 North Park Drive, Arlington, Virginia
Existing Conditions	The site is the location of an existing two-story recreation center, playground and parking lot.
Current ground cover	Predominantly grass with an asphalt parking lot.

ITEM	DESCRIPTION
Existing topography	Accurate current site topographic information was not provided. Based on Arlington County topographic maps, ground elevations range from about 260 feet mean sea level (MSL) in the center of the site to 230 feet MSL in the northwest of the site.

Should any of the above information or assumptions be inconsistent with the planned construction, please let us know so that we may make any necessary modifications to this report.

3.0 SUBSURFACE CONDITIONS

A discussion of the subsurface conditions encountered during our subsurface exploration is presented in the following sections.

3.1 Site Geology

A review of the local geologic information indicates that the site is geologically located in a formation of Miocene sand and gravel, constituting a thin outlier of the Coastal Plain in the easternmost Piedmont Physiographic Province. The Coastal Plain Province consists of a sequence of consolidated deposits of gravel, sand, silt, and clay that are underlain at greater depths by crystalline rock of the Piedmont origin. In this area, Coastal Plain deposits are less than 40 feet thick.

Terrace deposits of the Quaternary Age are typically found along the ridges and elevated portions of the coastal plains. These deposits consist primarily of fine to medium sand with various amounts of silt, clay and quartz gravel. Relatively thin clay seams can be found within the Quaternary deposits; however, these clay layers are generally discontinuous.

The Coastal Plain soil is underlain by soil of the Piedmont Physiographic Province. The Piedmont is a rolling upland surface underlain by complexly folded and faulted crystalline rocks. These metamorphic rocks date to the Cambrian period. The rock units are generally fine to coarse grained, lustrous, greenish-gray to gray, reddish-weathering, quartz-rich schist, and lesser mica schist, phyllite, and gneiss. Veins of quartz boulders should be anticipated in this geology.

The onsite soils, as mapped by USDA Web Soil Survey, are *Urbanland-Sassafras-Neabsco Complex*. *Urbanland* soils have been disturbed from their natural state. *Sassafras-Neabsco Complex* soil has marginal infiltration characteristics, depth to hard bedrock greater than 50 feet and fair foundation support due to poor bearing capacities.

3.2 Typical Subsurface Profile

3.2.1 Subsurface Conditions

Based on the results of the borings, subsurface conditions can be generalized as follows.

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered	Consistency/Density
Existing Fill	6.0 feet	Fine-grained fill consisting of: • Sandy Lean Clay with Gravel (CL) • Sandy Silt with Gravel (ML) Coarse-grained fill consisting of: • Clayey Sand (SC) with various amounts of gravel • Silty Sand (SM) with various amounts of gravel	• Soft to very stiff • Loose to dense
Stratum I Coastal Deposits	8.5 to 23.5 feet	Fine-grained soil consisting of: • Sandy Silt (ML) with various amounts of gravel • Lean Clay (CL) with various amounts of sand and gravel Coarse-grained soil consisting of: • Silty Sand (SM) with various amounts of quartz fragments and gravel • Clayey Sand with Gravel and quartz fragments (SC)	• Medium stiff to hard • Loose to very dense
Stratum II Residuum	23.5 to 40 feet	Fine-grained soil consisting of: • Sandy Silt (ML) trace mica, with various amounts of gravel • Silty Clay (CL/ML) Coarse-grained soil consisting of: • Silty Sand with Gravel (SM)	• Medium stiff to very hard • Very dense
Stratum III Weathered Schist	Unknown, Stratum extents to Maximum Depth Explored	Highly Weathered to Partially Weathered Schist with quartz boulder veins	• Very dense

Split spoon refusal, defined as 50 blows per zero inches of spoon penetration, was encountered at Borings 12 and 13 at depths ranging from 53 to 63.5 feet. Competent rock was not encountered.

Based on rock coring performed at Boring 13, split spoon refusal occurred on quartz boulders. Veins of quartz boulders should be anticipated in this geology.

Specific conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs included in Appendix A of this report.

3.2.2 Groundwater

The open boreholes were observed while drilling and 24 hours after completion for the presence and level of groundwater. Water was encountered at Borings B-7, B-11 and B-13 through B-16 at depths ranging from 13.5 to 21 feet beneath the existing ground surface.

Fluctuations in ground or perched water levels should be expected with variations in factors such as precipitation, surface run-off, construction activity, etc. It should be noted that the stratigraphy inferred from the test boring logs is approximate. Soil strata and groundwater conditions between test borings may vary from conditions observed at each test boring location.

3.3 Analytical

As outlined in the Client's site development criteria and based on our experience, the following analytical laboratory testing was performed by Terracon and independent analytical laboratories.

- Moisture content, soil plasticity, percent fines

The results of the laboratory testing are presented on the individual boring logs and in Appendix B. Soil samples will be stored for a period 6 months following completion of the final report.

3.4 Infiltration Test Results

A total of two infiltration test holes (INF-1A and INF-1B), were prepared by using an ATV mounted drill rig augering to a depth of 5 feet. Solid 4-inch diameter PVC pipes were then installed inside these offset test holes. The test holes were then presoaked with 24 inches of water for a period of 24 hours prior to performing the infiltration tests. The following day, after the 24-hour presoak period, water level measurements were performed in the exploratory test borings and the offset infiltration test holes.

A field infiltration rate between 0.52 and 8.0 inches per hour is required for infiltration to be considered feasible based on Appendix 8-A of the 2013 DEQ Infiltration Practices specification.

Table II: Summary of Infiltration Test Results by Terracon

Test Hole	Test Depth (ft.)	Test Date	Time	Hourly Water Drop (inch/hr)	In-Situ Infiltration Rate (Avg.) (inch/hr)	USDA Textural Classification	Design Infiltration Rate (inch/hr)
INF-1A	17.0	6/15/2017	8:50 9:50 10:50 11:50	4.0 2.25 1.0 2.0	2.31	Loamy Sand	1.15
INF-1 B	17.0	6/15/2017	8:55 10:00 10:50 11:50	1.0 2.0 1.0 1.0	1.0	Loamy Sand	0.50

Soil samples obtained from test boring locations were classified as Loamy Sand. The tests indicate that the subsurface conditions meet the requirements for infiltration testing based on Virginia DEQ Stormwater design specification No. 8 requirements. Based on our field investigation, infiltration is feasible.

Design of infiltration facilities must meet the following conditions set in the Virginia DEQ Stormwater design specification No. 8:

- The invert of the proposed infiltration system must be separated from both the SHWT (Seasonal High Water Table) and bedrock by at least 2 feet.
- Infiltration systems must be located at least 20 feet (horizontal distance) from the foundations of buildings regardless of whether there is a basement.
- No portion of the invert of infiltration systems can be placed in fill soils.
- Infiltration systems must not be on finished slopes greater than 15 percent (6.7H: 1V).
- Infiltration systems must not be sited at a location which could cause water-related problems or slope instability on downslope properties.
- Infiltration systems must be located a minimum of 100 feet (horizontal distance) from septic fields.

4.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

The recommendations contained in this report are based on the field exploration performed at the project site.

It is our opinion that the subject property is suitable for the proposed building additions and site improvements. The following is a presentation of our recommendations regarding subgrade preparation and earthwork operations, fill placement, building foundations, ground-supported slabs, utility installation, seismic site classification and other design and construction considerations.

The major geotechnical considerations for the development of the site are:

1. A Seasonal High Water Table (SHWT) that is above or near the lowest floor elevation of the planned parking garage.
2. The demolition of the existing community center structure.

4.1 Existing Fills

Existing fills were encountered at several of the borings performed within the planned building areas extending to depths up to 5 feet below existing grades. All existing fills within the building additions should be proof-rolled, undercut, and evaluated by the Geotechnical Engineer of Record in accordance with **Section 4.4.1** of this report.

4.2 Suitability of On-site Soils

The non-organic onsite soils encountered in the borings are suitable for re-use as structural fill. In general, material with liquid limit and plasticity index values greater than 40 and 14 including high plasticity clays (CH) or elastic silt (MH) are not suitable for use as structural fill.

Onsite soils may be wet or dry of the optimum moisture required for compaction; therefore, scarifying and drying by spreading and aerating prior to their reuse as compacted structural fill or backfill should be expected.

4.3 Excavation of On-Site Soils

In general, we anticipate that conventional earth-moving equipment will be suitable for the excavation of the onsite soils to achieve proposed grades for building foundations and utility inverts.

4.3.1 Dewatering measures during Construction

We anticipate groundwater may be encountered due to localized perched conditions at foundation elevations during general earthwork construction activities. Groundwater can be handled through temporary dewatering methods, i.e. sump pits and continuous pumping, if work is planned during the wet period of the year. The groundwater table should be maintained at least 2 feet below the bottom of foundation elevation.

4.3.2 Temporary excavations

Temporary excavations greater than 4 feet shall be properly shored or sloped away from the excavation with a minimum grade of 1.5H to 1.0V (horizontal to vertical). If sloping of utility trenches and pits are not desired, then trench boxes should be utilized. All excavations shall be performed in accordance with the OSHA and VOSHA regulations.

Temporary shoring for shallow excavations, such as timber shoring, trench boxes, braced thickened steel plates, and steel sheet piles can be used after they have been designed and approved by a Virginia Registered Professional Engineer. These systems should provide temporary earth retention for near-vertical side slopes, and should provide protection against potential bottom heave of excavations due to groundwater. We recommend using trench boxes or design a shoring plan where the proposed excavations will be performed for utility lines, structures or foundations and located adjacent to existing roadways, structures and existing utility lines. The Contractor should provide measures to protect existing roadway, structures and utilities where present. Temporary support of excavations should be designed by a Virginia Registered Professional Engineer. The temporary support of excavations designs and details should be submitted to the Geotechnical Engineer of Records for review.

Excavations for the proposed underground two-level parking garage will require a temporary or permanent sheeting and shoring system. If a free draining system consisting of soldier piles and wood-lagging is planned, the system should be braced externally using tiebacks. However, adjacent structures and utilities may prevent tiebacks from being used. This condition should be reviewed by the design engineer. Lengths, size and spacing of soldier piles may vary at these locations.

The soldier piles and lagging should be designed for an active lateral earth pressure of 45 psf for every foot of vertical cut. Spacing of the soldier beams and braces should be designed by a Virginia Registered Professional Engineer. However, we recommend that the maximum centerline-to-centerline spacing of the soldier piles not exceed 6 feet. In addition, wooden lagging should have a minimum thickness of 4 inches.

If tiebacks are used, the tieback anchors must be situated beyond a 45-degree slope from the base of the excavation. We recommend that tiebacks be installed at a maximum downward angle of 20 degrees from the horizontal. We also recommend that a performance test be performed on

10 percent of the tiebacks (randomly selected). The performance test evaluates the tieback load carrying capacity, deflections during loading, and movements with respect to time.
In areas where tiebacks are not feasible, an internal bracing system consisting of rakers would be required. Rakers should be braced against toe blocks or other reaction points that have been designed to carry the load. All excavations shall be performed in accordance with the OSHA regulations.

4.4 Earthwork

4.4.1 Proof-rolling

All areas delineated and surveyed in the field to receive structural fill shall be proof-rolled with a fully-loaded rubber-tired dump truck with a minimum axle weight of 10 tons in order to identify all soft or unstable areas to be undercut. The geotechnical engineer or his assigned representative shall decide on the depth of undercut in order to avoid the removal of suitable or otherwise firm soils.

4.4.2 Structural Fill Material

All structural fill material, whether on-site or imported from an off-site source, shall be tested for suitability and quality prior to its use as fill or backfill. We recommend that the material be tested to determine particle gradation, plasticity, and maximum dry density. The following standard tests should be performed to determine the above properties of all structural fill material:

Particle Size Analysis of Soils	ASTM D422
Atterberg Limits	ASTM D4318
Standard Proctor	ASTM D698

Structural fill material should consist of quality, low plasticity, inorganic soil that classify as GW, GP, GM, GC, SW, SP, SC, or SM in accordance with ASTM D2487. Structural fill may consist of soils that classify as ML and CL provided that the material has a liquid limit and plasticity index less than or equal to 40 and 14, respectively; and a maximum of 70% passing a U.S. Standard No. 200 sieve. All fill material should be inorganic, free of ice, snow, construction debris, rock sizes greater than 4 inches, expansive and high plasticity clay, or other deleterious material.

4.4.3 Fill Placement and Testing

Fill material placed in *pavement and sidewalk areas* should be placed in no greater than 8-inch loose lifts and compacted to at least 95% of the maximum dry density as determined per VTM-1 method (ASTM D-698). However, the final foot of fill in pavement should be compacted to 100% of the maximum dry density of the same standard. The fill material should consist of a minimum dry density of 100 pounds per cubic feet (pcf). The moisture content of the fill being placed should be within 2 percentage points of the optimum moisture content of the material. The controlled fill should extend a minimum of 2 feet laterally outside the curb line plus 1 foot for every foot of fill above the subgrade.

Fill materials in *building areas* should be placed in no greater than 8-inch thick loose lifts and compacted to at least 95% of the maximum dry density as determined in accordance with the Standard Proctor (ASTM D-698). When hand-held tampers are used to compact the backfill materials, lift thickness shall be reduced to not more than 6 inches. The moisture content of the fill being placed should be within 2 percentage points of the optimum moisture content of the material.

To ensure proper compaction efforts, field density determinations should be performed in accordance with specifications set forth in ASTM D6938 (nuclear method) or D1556 (sand cone method). We recommend that density tests be performed on every lift of compacted structural fill placed in building areas. The frequency of compaction tests should be performed in accordance with the Schedule of Inspections outlined by the Geotechnical Engineer of Record for this project.

4.5 Site Utilities

All loose or organic materials encountered at the utility pipe subgrade should be removed. The pipe subgrade should be observed and probed for density under the supervision of a Virginia-registered professional engineer or an approved representative to evaluate the suitability of materials encountered. Any relatively isolated, thin, soft or yielding areas should be undercut or replaced with suitable compacted fill or pipe bedding material in accordance with the requirements stipulated in this report.

4.6 Foundation Support

The proposed building additions can be supported on conventional shallow foundations such as continuous wall or column spread footings bearing on natural low-plasticity soils or approved compacted structural fill based on the column loads of 350 to 750 kips and wall loads of 12 to 18 kips/ft.

Existing fill soils were encountered in the test borings performed in the building addition areas extending to depths up to 6 feet. We recommend that all existing fill soils should be assessed within the building foundations. The areas may be undercut and replaced or improved at the direction of the geotechnical engineer.

- Community Center: footings supported on properly-compacted structural fill or natural soils may be designed for an allowable soil bearing pressure of 4,000 psf with spread footings.

- Parking Garage: Footings supported on natural low-plasticity soils may be designed for an allowable soil bearing pressure of 5,000 psf with spread footings.

Footing lines to be located along a transition zone from natural soils to recently-placed fill shall be reinforced with two (2) #5 bars which extends at least 5 feet horizontally in each direction from the transition plane.

As a minimum, wall footings shall not be less than 18 inches in width and column footings shall not be less than 30 inches in size. Adequate frost cover protection for all exterior footings shall be provided at 24 inches below finished exterior grade along the footing lines. Interior footings, however, that are located within permanently heated areas may be located at nominal depth below the floor slab elevation.

The use of the above specified uniform allowable bearing capacity will minimize the total settlement to 1 inch or less with differential settlement of less than ½ inch or less in accordance with standard engineering practices.

If CH/MH type soils are encountered at or near footing subgrade levels during construction, the excavation shall be made to at least 4 feet below planned bottom of footing, or through the CH/MH materials if less than 4 feet below finished exterior grade. The excavation shall be backfilled with granular material such as VDOT-21A, and compacted to backfilled requirements mentioned in section 4.4.3.

All footings and slabs shall be inspected for quality of the subgrade material, concrete formwork and placement of reinforcing steel. The inspection shall be performed by a qualified soil inspector under the direction of a registered Virginia-geotechnical engineer. The inspection shall consist of probing or performing Dynamic Cone Penetrometer (DCP) tests. If visual inspection of the subgrade material and/or hand auger recovery material reveals the presence of high plasticity soils, we recommend that a sample of the subgrade soil to be tested to ensure compliance with **Section 4.4.2** of this report. Footing subgrades should be protected from precipitation, seepage, surface run-off and frost. We recommend that the footings be cast the same day of excavation.

If higher building and column loads are anticipated, we recommend ground improvement prior to at foundations.

4.7 Ground-supported Slabs

We expect that floor slabs will be constructed as ground-supported concrete slabs bearing on approved natural soil or properly compacted structural fill with a modular of subgrade reaction of 150 pounds per cubic inch (pci). If visual inspection of the subgrade material within the cut portion of the pads reveals the presence of clay (CH) and elastic silt (MH), we recommend that the subgrade be undercut to a minimum of two (2) feet or to the depth of a suitable soil layer, whichever comes first and replaced with of properly compacted structural fill.

The existing fill soils in the building areas, as discussed in **Section 4.5** of this report, should be proof-rolled, undercut, and replaced as necessary in accordance with **Section 4.4.2**.

If visual inspection of the subgrade material within the cut portion of the pads reveals the presence of clay (CH) or elastic silt (MH), we recommend that the subgrade be undercut to a minimum of two (2) feet or to the depth of a suitable soil layer, whichever comes first and replaced with properly compacted structural fill.

If the existing fill soils, as discussed in **Section 4.4.1** of this report, are located within the offset stakeout of the proposed house pads, then it shall be evaluated by the geotechnical engineer and removed in its entirety if determined to be unsuitable, and replaced with suitable structural fill material.

We recommend that all grade slabs be designed to be discontinuous at walls and pier footings. The slab should rest upon a minimum of 4 inches of free draining granular base. In areas of the floor slab where loads are in excess of 500 psf, we recommend the granular material beneath the floor be increased to a minimum thickness of 6 inches, and additional reinforcing steel be placed in the floor slab. A 6-mil polyethylene liner or similar vapor barrier should be provided between the underside of the slab and the granular base to limit moisture migration. In addition, we recommend that wire mesh or fiber mesh reinforcement be included in the slab design. This reinforcement will minimize the crack width of any shrinkage cracks that may develop near the surface of the floor slab.

4.8 Seismic Site Classification

The borings at the building addition areas were each extended to the planned boring termination depths varying from 10 to 70 feet below the existing site grades. The natural soils encountered had SPT N-values on the order of 6 bpf to greater than 50 bpf. Although N-values greater than 50 blows per 0 inches of split spoon penetration were encountered,

The International Building Code (IBC) 2012 requires site classification based on the upper 100 feet of a soil profile. Based on the average N-values of the natural soils, we recommend that the design for the building be based on a seismic site classification of Site Class C.

4.9 Foundation Walls, Backfill and Drainage

The proposed buildings may be constructed with below grade foundation walls. The Final Basement Floor Elevation (BFE) is planned at approximately El. 236 to 252 feet MSL as per the site plans provided by the client. We recommend that these walls be designed for an equivalent fluid pressure of 60 psf per foot of wall depth. The equivalent fluid pressure is recommended based on the assumption that the backfill material may consist of on-site or imported soils which

classify as SILT or Sandy SILT (ML). Soils having liquid limit and plasticity index greater than 40 and 15, respectively, shall not be used for backfill against the foundation walls. Backfill material shall not contain rock sizes greater than 4 inches in diameter. An example of a typical foundation drainage detail is included as Figure 2.

The lateral pressure recommended above assumes that adequate drainage behind the wall will be provided to prevent accumulation of free water. The recommendations do not include the effects of surcharge loading which shall be included in the wall design as additional lateral pressure acting uniformly against the wall.

Interior and exterior foundation drains are required around the perimeter of the structures. The exterior drain shall consist of a 4-inch perforated flexible tube embedded in 12 inches of VDOT #57 stone or washed bank run gravel. The stone shall be wrapped with filter fabric (such as Amoco 4545) to avoid clogging with fines. The interior drain shall consist of a 4-inch diameter perforated flexible tube embedded in a 12-inch layer of VDOT No. 57 stone wrapped with geotextile filter fabric. The interior drain shall be installed under the slab and shall tie into the exterior drain via weep holes through the footings. The weep holes, 1.5-inch diameter PVC pipes, shall be spaced at no more than 8 feet on center. An example of an appropriate foundation drain is included as Figure 10 located at the end of this report.

If possible, the invert of the interior drain shall be higher than the exterior drain to allow the flow of groundwater through the weep holes and safely discharge away from the structures. The outlet pipe from the exterior drain shall be tied to the storm sewer or discharge to a point of daylight or a sump pit as directed by the Civil Engineer. However, if daylighting of collected water to lower elevations is not feasible, the invert of the interior drain shall be lower than the exterior drain to allow the flow of groundwater through the weep holes to the sump. If elevator pits extend below the lowest floor slab, the elevator pit shall then be waterproofed and designed for full hydrostatic pressure.

Additionally, we recommend the installation of drainage board behind the foundation wall to minimize hydrostatic pressure. These drainage boards include Geotech drains, Enka Drains, Mira drains or equivalent. After installation, the walls may be backfilled with approved free draining material as specified earlier. If there are any “steps” within the building where there are grade changes, all below grade walls thus developed should have perimeter drain lines installed in the “uphill” side of the slab, which is then directed to flow by gravity into a suitable outlet.

Based on water levels observed within the borings, we anticipate that seasonal perched groundwater levels may rise to foundation elevations for the parking garage during the wet periods of the year, i.e. between November and May. Therefore, exterior foundation drain should consist of a 4-inch perforated flexible tube embedded in 12 inches of VDOT #57 stone or washed bank run gravel. The stone should be wrapped with filter fabric to avoid clogging with fines. Alternatively, a prefabricated drainage system such as a J-Drain may be installed per the manufacturers guidelines. If drainage by gravity is not feasible, the invert of the exterior drain shall be located above the invert of the interior drain and the interior drainpipe shall be extended to the sump pump. The outlet pipe from the exterior

drain or the sump pump shall discharge to a daylight point as directed by the Civil Engineer.

4.10 Retaining Wall Recommendations

The undated site plan provided to us for the preparation of this report indicates that there are four retaining walls planned. These walls are described below:

Retaining Wall Location	Maximum Retaining Wall Height (ft)
Ramp between Community Center and Parking Garage	14.0
Northwest of Community Center	16.0
North of Community Center	4.0

The retaining walls may be constructed as mechanically stabilized earth (MSE) walls, gravity walls or concrete cantilever walls. The following recommendations are provided to assist the project team during the planning and design phases of the retaining wall.

The structural design of retaining walls should be performed in accordance with generally accepted engineering procedures that include minimum factors of safety (FOS) against global stability (FOS:1.25), sliding (FOS:1.5), and overturning (FOS: 2.0).

We recommend that retaining wall footings be supported on approved natural soils or structural fill and the western retaining wall footings be designed for a maximum allowable soil bearing pressure of 4
,000 psf. All footings shall be inspected for quality of subgrade material. High plasticity soils, if encountered at footing subgrade, shall be undercut approximately 4 feet and replaced with properly compacted structural fill. Since the retaining walls are free to rotate, we recommend the following soil parameters be used for the wall design:

Strata - Soil Description	Bulk Unit Weight (pcf)	Angle of Internal Friction	Cohesion (psf)	Coefficient of Earth Pressure		
				Active (K_a)	Passive (K_p)	At Rest (K_0)
Backfill (SM)	125	30	0	.33	3.00	.50

The recommendations are based on the assumption that the walls will be designed to use on-site or off-site borrow materials that classify as sandy SILT (ML) or Silty SAND (SM) having a liquid limit and plasticity index not to exceed 40 and 14, respectively. We recommend that all backfill material be placed in no greater than 8-inch loose lifts and compacted to at least 95% of the maximum dry density as determined in accordance with specifications set forth in ASTM D698 (Standard Proctor).

Retaining walls shall be permanently drained by the installation of a 2-foot thick layer of gravel behind the wall that ties into a 6-inch perforated PVC pipe at the bottom of the wall. Filter fabric shall be used behind the gravel layer to prevent clogging of the gravel with fines. Solid outlet pipes connected to the perforated pipe shall be extended to a safe daylight point away from the wall.

4.11 Pavement Subgrade Preparation

For the design and construction of exterior asphalt or concrete pavements (parking garage, ramps and sidewalks) we recommend that all procedures outlined in this report be followed through the establishment of subgrade elevations. The subgrade for paved areas shall consist of natural low plasticity natural soils or approved compacted structural fill.

If fine-grained soils having liquid limit and plasticity index values greater than 40 and 15, respectively, are encountered at proposed subgrade elevations, these materials shall be undercut to a minimum depth of 2 feet below pavement subgrade and replaced with properly compacted structural fill.

Prior to placement of subbase stone, the subgrade shall be proof-rolled with a loaded dump truck to detect any soft, yielding or high plasticity soils. Unstable areas shall be undercut and replaced with controlled-compacted fill. The fill shall be compacted per **Section 4.4.3**

As the engineering characteristics of the onsite soils vary throughout the site, CBR tests should be performed within the proposed pavement areas at the time of construction in order to permit proper pavement design. However, for preliminary design purposes, an average CBR value between 10 may be anticipated for subgrade soils consisting of on-site fine-grained soils. All pavement materials and construction methods shall comply with current VDOT specifications.

Subgrade soils placed in pavement areas shall be placed in no greater than 8-inch loose lifts, and compacted to at least 95% of the maximum dry density as determined per VTM-1 method. However, the final 2 foot of fill should be compacted to 100% of the maximum dry density as determined per VTM-1 method. The moisture content of the material being placed shall be within 2 percentage points of the optimum moisture content of the material.

Recommended Minimum flexible pavement sections		
Layer	Thickness (inches)	
	Light Duty	Medium Duty
Bituminous Surface Course	1- 1/2	1- 1/2
Intermediate Course	-	1- 1/2
Base Course	3	3
VDOT-21A	6	8

The pavement sections recommended are not designed for construction traffic. Damaged areas due to construction traffic should be repaired prior to placement of final asphalt surface course.

A rigid pavement section, consisting of Portland cement concrete, is recommended in areas of concentrated traffic loads, such as near the trash dumpster area, compactor pads, entrance/exit aprons and truck access roads. We recommend at least 6 inches of PCC be placed over minimum 6 inches of VDOT-21A aggregates. Welded wire fabric reinforcement should be installed within the pavement section. A modulus of subgrade reaction of 150 pci may be used for concrete pavement design.

4.12 Bio-Filter Facility

The site is planned for the installation of an underground bio-filter facility. Groundwater was not encountered in the vicinity of the bio-filter facility. Details of the facility were not available at the issuance of this report. During the installation of the facilities, perched groundwater may be encountered and should be allowed to drain prior to installation. However, after installation of the facilities, perched water infiltration into the drains is anticipated to be limited and have no significant impact on the proper functioning of the detention facilities.

One (1) soil profile boring was drilled to a depth of nineteen feet below ground inside the footprint of the proposed bio-filter facility. The proposed invert of the facility is 250.0 feet MSL. Groundwater was not encountered. Two (2) test pits were excavated within the footprint of the proposed bio-filter facility. The test pits were analyzed by a professional engineer certified in Soil Morphology by the Northern Virginia Soil and Water Conservation District. Indications of the seasonal high water table were not encountered within the excavated depth.

If unsuitable soils, such as high plasticity clay (CH) and elastic silt (MH) with Liquid Limit greater than 40 percent and Plasticity Index greater than 14 percent, are encountered beneath detention facility, they should be undercut and replaced with engineered fill in compliance with **Section 4.4.2.** These high plasticity soils shall not be used as subgrade support for the bio-filter facility. They are known to possess high shrink-swell potential and plastic behavior. Unsuitable soils are classified as soils consisting of organics, ice, snow, construction debris, rock sizes greater than 4 inches, expansive and highly plastic clay/silt, or any other deleterious material.

After stripping of topsoil and any soft surface soils, the subgrade soils encountered within the general vicinity of the SWM facility are considered to be generally suitable for use as fill. All soft, yielding subgrade soils shall be undercut to a bearing stratum approved by the geotechnical engineer or his assigned representative.

5.0 CLOSING REMARKS

5.1 Additional Services

We recommend that quality control testing and geotechnical engineering consulting services be provided during the construction phase of this project. These services shall include:

- Observe undercutting of unsuitable soils and inspect the subgrade for building foundation;
- Perform laboratory testing of material proposed for use as structural fill;
- Perform compaction testing during the placement of approved structural fill material;
- Verify soil bearing capacity and foundation inspections.

These inspections and field testing services shall be performed by a qualified soil and concrete inspector under the supervision of a Virginia-registered professional engineer. Terracon will be pleased to furnish these and other services during the design and construction phases of the project.

5.2 GENERAL COMMENTS

Terracon should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project 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.

Please be advised that although the soil borings and were logged by experienced engineers, it is sometimes difficult to record changes in subsoil stratigraphy within narrow limits; therefore, some deviation in the materials reported on the field logs and the materials encountered at the site should be anticipated. Any change in soil type observed during construction, or change in proposed location

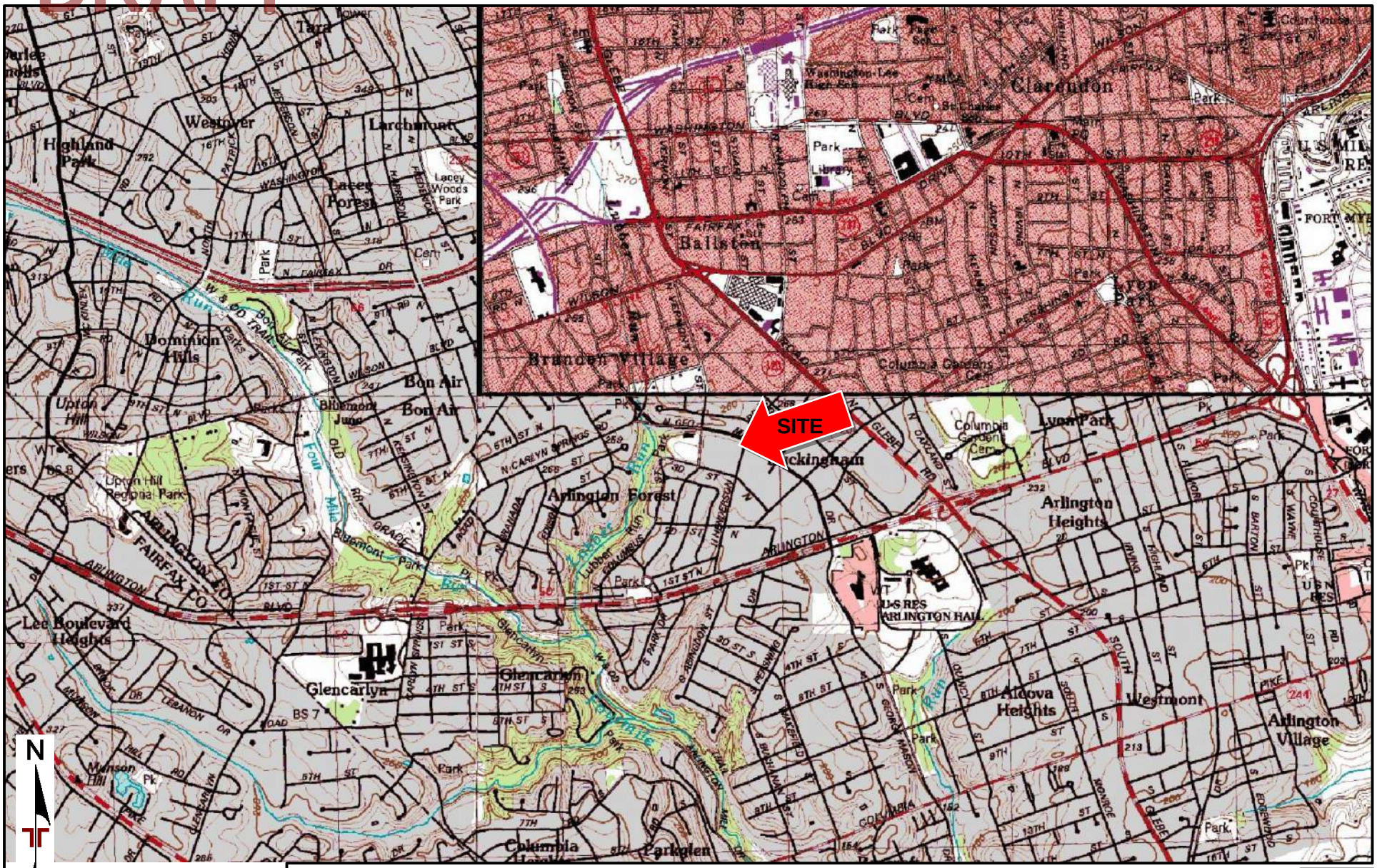
of the structures or grades should be provided to us so that we may have the opportunity to amend the content of this report, if necessary. Any conclusions or recommendations based on data contained in this report that are made by others are the responsibility of others.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION

DRAFT



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: FALLS CHURCH, VA (1/1/1994), WASHINGTON WEST, DC (1/1/1983), ANNANDALE, VA (1/1/1994) and ALEXANDRIA, VA (1/1/1994).
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	MA
Drawn by:	WK
Checked by:	MA
Approved by:	MA

Project No.	EW175052
Scale:	1"=2,000'
File Name:	EW175052.a1
Date:	6/23/2017

Terracon
21505 Greenoak Way
Dulles, VA 20166-9225

SITE LOCATION

Lubber Run Recreation Center
Bowman Consulting Group
300 North Park Drive, Arlington, VA

Exhibit
A-1

DRAFT

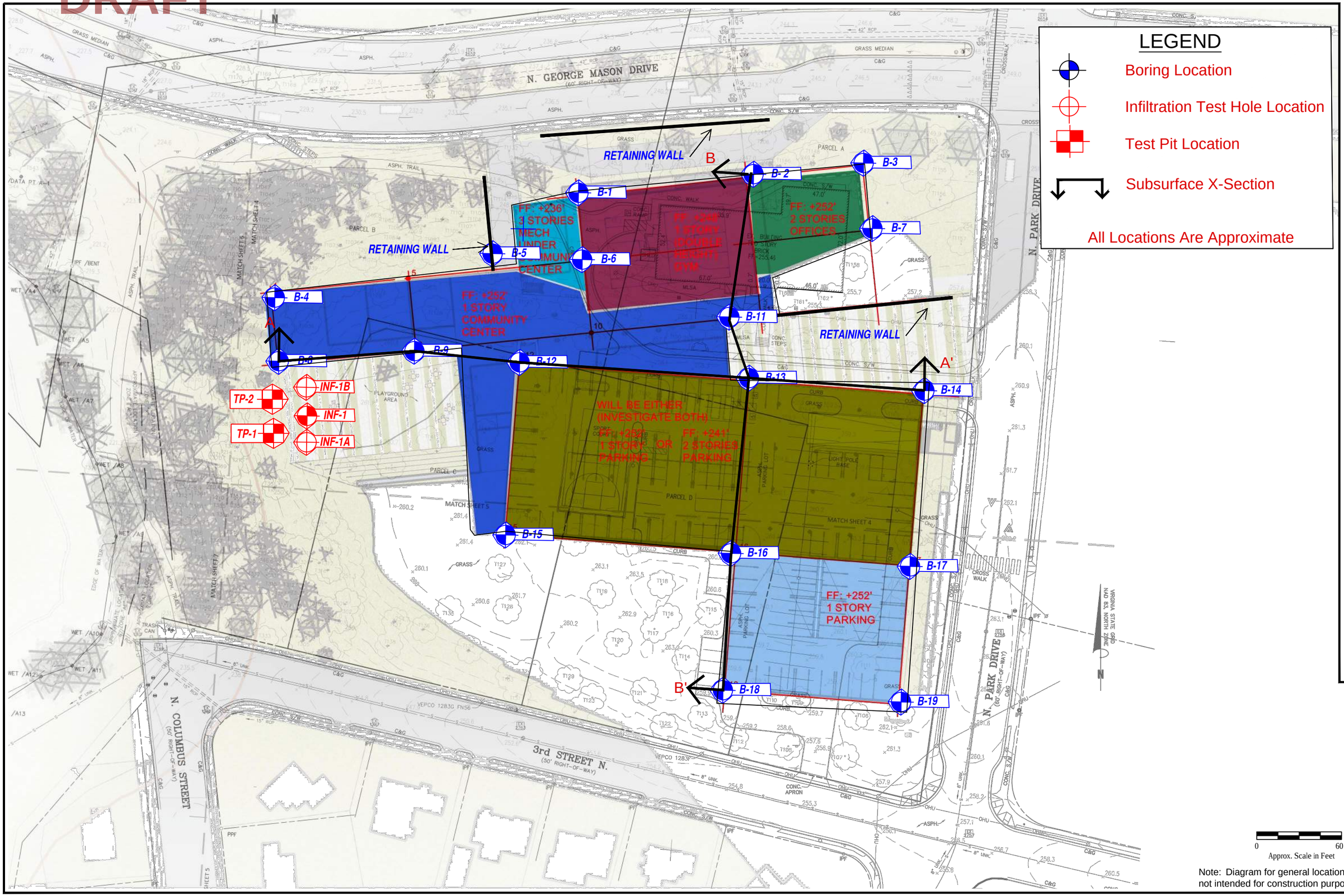


Exhibit No. A-2

BORING LOCATION PLAN
GEOTECHNICAL ENGINEERING REPORT
LUBBER RUN COMMUNITY CENTER
BOWMAN CONSULTING
300 NORTH PARK DRIVE, ARLINGTON, VIRGINIA

Terracon
Consulting Engineers and Scientists
Dulles, Virginia
21506 Greenoak Way
PH. (703) 421-4000

Project No.	EW175052	Project Mngr:	MA
Scale:	AS SHOWN	Drawn By:	WK
File No.	EW175052.A2	Checked By:	MA
Date:	JUNE 23, 2017	Approved By:	MA

Field Exploration Description

The boring locations were located by measuring from existing site features and obtaining latitude / longitude with a hand-held GPS unit. Geographic coordinates were converted to Virginia State Plane Northing / Easting coordinates using computer software. Ground surface elevations were estimated using topographic site drawings provided by Bowman Consulting. The locations of the borings and elevations should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with 4-1/4 inch hollow stem augers or mud rotary methods using a 2-15/16 inch tri-cone bit utilizing a CME 550 drill rig mounted on a track carrier equipped with an automatic hammer. Samples of the soil encountered in the borings were obtained using the split barrel sampling procedures. The samples were tagged for identification, sealed to reduce moisture loss, and taken to the laboratory for further examination, testing, and classification. Following the completion of drilling, the boring was backfilled with soil cuttings.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the boring performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Field logs of the borings were prepared by Terracon's representative. The logs included visual classifications of the materials encountered as well as interpretation of the subsurface conditions between samples. The boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory evaluation of the samples. The boring logs are presented in Appendix A. General notes to log terms and symbols are presented in Exhibit C.

Rock Coring

Split spoon refusal was encountered at borings B-12 and B-13. Samples of quartz boulders and highly weathered rock were obtained using a NQ sized core barrel with a diamond cutting bit. The core sample recovered with the core barrel is approximately 1.9 inches in diameter. The distance cored was 10 feet.

DRAFT

BORING LOG NO. B-1

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873537° Longitude: -77.114566°

Approximate Surface Elev: 246 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
0.2	246+/-	TOPSOIL (2")
		FILL - SANDY SILT WITH GRAVEL, brown, soft, moist.
2.5	243.5+/-	
		FILL - SILTY SAND WITH GRAVEL, light brown, dense, moist.
5.0	241+/-	
		SANDY LEAN CLAY (CL), reddish brown, medium stiff, moist.
8.5	237.5+/-	
		SILTY SAND (SM), greyish brown, loose to dense, moist.
23.6	222.5+/-	
		Boring Terminated at 23.6 Feet

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	4-2-2 N=4		
	15-16-21 N=37		
5	8-4-5 N=9		
	6-4-5 N=9		
10			
	8-10-12 N=22		
15			
	15-20-22 N=42		
20			
	50/1" N=50+		

WATER LEVEL OBSERVATIONS: Cave-in after 24 hours.

SAMPLE TYPE

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
Groundwater not encountered

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/12/2017 | Boring Completed: 6/12/2017
Drill Rig: CME 550/AT V | Driller: Recon Drilling
Project No.: EW175052 | Exhibit: A-4-1

DRAFT

BORING LOG NO. B-2

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873525° Longitude: -77.114222°

Approximate Surface Elev: 248 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.1	248+/-	TOPSOIL (1")			
		FILL - SILTY SAND WITH GRAVEL, reddish brown, medium dense, moist.	6-8-10 N=18		
			15-10-14 N=24		
5.0	243+/-				
		POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), reddish brown, dense, moist.	8-15-17 N=32	5	NP
8.5	239.5+/-				
		SANDY SILT (ML), greyish brown, very stiff, moist.	8-8-9 N=17		
13.5	234.5+/-				
		SILTY SAND (SM), greyish brown, dense, moist.	8-12-14 N=26		
15.0	233+/-				
		Boring Terminated at 15 Feet			

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/15/2017 Boring Completed: 6/15/2017

Drill Rig: CME 550/AT V Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-2

DRAFT

BORING LOG NO. B-3

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.8733554° Longitude: -77.113915°

Approximate Surface Elev: 251 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.2	251+/-	TOPSOIL (2")			
		FILL - SANDY SILT, reddish brown, medium stiff, moist.	3-3-2 N=5		
3.8	247+/-		9-13-11 N=24		
		POORLY GRADED SAND WITH GRAVEL (SP), brown, medium dense to dense, moist.	15-16-14 N=30	3	
8.5	242.5+/-				
		POORLY GRADED GRAVEL (GP), brown, dense, moist.	17-20-14 N=34		
13.5	237.5+/-				
		SANDY SILT (ML), yellowish brown, dense, moist.	8-16-18 N=34		
15.0	236+/-				
		Boring Terminated at 15 Feet			

DEPTH (Ft.): 5, 10, 15

WATER LEVEL OBSERVATIONS: ▨ Cave-in after 24 hours.

SAMPLE TYPE

GRAPHIC LOG

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
Groundwater not encountered

▨ *Cave-in after 24 hours.*

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/15/2017 Boring Completed: 6/15/2017
Drill Rig: CME 550/AT V Driller: Recon Drilling
Project No.: EW175052 Exhibit: A-4-3

DRAFT

BORING LOG NO. B-4

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873258° Longitude: -77.115367°

Approximate Surface Elev: 248 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.2	248+/-						
TOPSOIL (2")							
SANDY SILT WITH GRAVEL, reddish brown, medium stiff, moist.				X	4-4-5 N=9		
			▨	X	10-14-13 N=27		
5.0	243+/-	5					
SANDY LEAN CLAY, reddish brown, hard, moist.				X	10-15-22 N=37		
8.5	239.5+/-						
SANDY SILT (ML), trace mica, reddish brown, very stiff, moist.				X	12-13-15 N=28		
10.0	238+/-	10					
Boring Terminated at 10 Feet							

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

▨ *Cave-in after 24 hours.*

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/13/2017 | Boring Completed: 6/13/2017

Drill Rig: CME-550/ ATV | Driller: Recon Drilling

Project No.: EW175052 | Exhibit: A-4-4

DRAFT

BORING LOG NO. B-5

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873319° Longitude: -77.114943°

Approximate Surface Elev: 253 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.1	253+/-	TOPSOIL (2")
		FILL - SANDY LEAN CLAY, brown, medium stiff, moist.
2.5	250.5+/-	**SILTY SAND**, reddish brown, dense to very dense, moist.
		With quartz fragments below 5.0 feet.
23.5	229.5+/-	**HIGHLY WEATHERED TO PARTIALLY WEATHERED SCHIST**, greyish brown, very dense, moist.

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		2-3-3 N=6		
		5-6-25 N=31		
5		15-17-22 N=39		
		50/5" N=50+		
10				
15		18-6-7 N=13		
		6-7-14 N=21		
20				
		50/5" N=50+		
25				

WATER LEVEL OBSERVATIONS: ▨ Cave-in after 24 hours.

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
Groundwater not encountered

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/14/2017 | Boring Completed: 6/14/2017
Drill Rig: CME-550/ ATV | Driller: Recon Drilling
Project No.: EW175052 | Exhibit: A-4-5

DRAFT

BORING LOG NO. B-5

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873319° Longitude: -77.114943°

Approximate Surface Elev: 253 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	HIGHLY WEATHERED TO PARTIALLY WEATHERED SCHIST, greyish brown, very dense, moist. *(continued)*							
			30			50/2" N=50+		
	33.6	219.5+/-						
	Boring Terminated at 33.6 Feet					50/1" N=50+		

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/14/2017 Boring Completed: 6/14/2017

Drill Rig: CME-550/ ATV Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-5

DRAFT

BORING LOG NO. B-6

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873664° Longitude: -77.11453°

Approximate Surface Elev: 252 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
0.2	252+/-	TOPSOIL (2")
		CLAYEY SAND (SC), brown, medium dense, moist.
2.5	249.5+/-	
		SILTY SAND (SM), light brown, dense to very dense, moist.
13.5	238.5+/-	
		SANDY SILT (ML), greyish brown, very stiff, moist.
20.0	232+/-	
		Boring Terminated at 20 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
			5-6-6 N=12		
			14-28-14 N=42		
5			15-22-26 N=48		
			27-33-25 N=58		
10					
			4-6-11 N=17		
15					
			4-14-17 N=31	20	50-33-17
20					

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/15/2017 | Boring Completed: 6/15/2017

Drill Rig: CME 550/AT V | Driller: Recon Drilling

Project No.: EW175052 | Exhibit: A-4-6

DRAFT

BORING LOG NO. B-7

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873405° Longitude: -77.113749°

Approximate Surface Elev: 254 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.2	254+/-	TOPSOIL (2")
		FILL - SILTY SAND WITH GRAVEL, brown, medium dense, moist.
2.5	251.5+/-	**SILTY SAND (SM)**, trace clay, reddish brown, loose to very dense, moist.
15.0	239+/-	***Boring Terminated at 15 Feet***

DEPTH (Ft.)	FIELD TEST RESULTS
	5-5-6 N=11
	5-5-5 N=10
5	6-10-14 N=24
	15-23-32 N=55
10	
	23-37-6 N=43
15	

WATER LEVEL OBSERVATIONS: ▽ While drilling; ▨ Cave-in after 24 hours.

SAMPLE TYPE

WATER CONTENT (%)

ATTERBERG LIMITS: LL-PL-PI

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
▽ *While drilling*
▨ *Cave-in after 24 hours.*

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/15/2017 | Boring Completed: 6/15/2017
Drill Rig: CME 550/AT V | Driller: Recon Drilling
Project No.: EW175052 | Exhibit: A-4-7

DRAFT

BORING LOG NO. B-8

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873138° Longitude: -77.115392°

Approximate Surface Elev: 251 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION	FIELD TEST RESULTS
0.3	250.5+/-	TOPSOIL (3")	
		FILL - SANDY SILT, reddish brown, medium stiff, moist.	3-3-3 N=6
2.5	248.5+/-		
		SILTY SAND (SM), with quartz fragments, greyish white, very dense, moist.	17-35-35 N=70
			30-32-25 N=57
			27-27-15 N=42
		No quartz fragments at 13.5 feet.	5-6-7 N=13
15.0	236+/-	***Boring Terminated at 15 Feet***	

GRAPHIC LOG | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | ATTERBERG LIMITS LL-PL-PI

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/13/2017 | Boring Completed: 6/13/2017

Drill Rig: CME-550/ ATV | Driller: Recon Drilling

Project No.: EW175052 | Exhibit: A-4-8

DRAFT

BORING LOG NO. B-9

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873115° Longitude: -77.114954°

Approximate Surface Elev: 260 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
0.2	260+/-	TOPSOIL (2")
		FILL - CLAYEY SAND, trace mica, brown, loose, moist.
2.5	257.5+/-	
		CLAYEY SAND (SC), with quartz fragments, reddish brown, medium dense to dense, moist.
8.5	251.5+/-	
		SILTY SAND (SM), with quartz fragments, light brown, dense to very dense, moist.
18.5	241.5+/-	
		SANDY SILT (ML), trace mica, brown, hard, moist.
25.0	235+/-	

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		4-4-5 N=9		
		4-6-6 N=12		
5		6-7-8 N=15		
		22-27-25 N=52		
10				
		17-18-14 N=32		
15				
		10-20-22 N=42		
20				
		15-20-24 N=44		
25				

WATER LEVEL OBSERVATIONS: Cave-in after 24 hours.

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
Groundwater not encountered

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/13/2017 | Boring Completed: 6/13/2017
Drill Rig: CME-550/ ATV | Driller: Recon Drilling
Project No.: EW175052 | Exhibit: A-4-9

DRAFT

BORING LOG NO. B-11

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873268° Longitude: -77.114263°

Approximate Surface Elev: 256 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
0.2	256+/-	TOPSOIL (2")
		FILL - SANDY SILT, reddish brown, stiff, moist.
2.5	253.5+/-	
		FILL - CLAYEY SAND, reddish brown, medium dense, moist.
5.0	251+/-	
		CLAYEY SAND (SC), brown, dense, moist.
13.5	242.5+/-	
		SILTY SAND (SM), greyish brown, medium dense to dense, moist.

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	4-5-6 N=11		
	12-9-13 N=22		
5	13-20-29 N=49		
	40-42-37 N=79		
10			
	5-5-7 N=12		
15			
	7-11-13 N=24		
20			
	12-18-17 N=35		
25			

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

After 24 hours

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/15/2017 | Boring Completed: 6/15/2017
Drill Rig: CME 550/AT V | Driller: Recon Drilling
Project No.: EW175052 | Exhibit: A-4-10

DRAFT

BORING LOG NO. B-11

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873268° Longitude: -77.114263°

Approximate Surface Elev: 256 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
SILTY SAND (SM), greyish brown, medium dense to dense, moist. *(continued)*								
						18-26-21 N=47		
30								
33.5	222.5+/-							
HIGHLY WEATHERED SCHIST, greyish brown, very dense, moist						22-50/5" N=50+		
34.4	221.5+/-							
Boring Terminated at 34.4 Feet								

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *After 24 hours*

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/15/2017 Boring Completed: 6/15/2017

Drill Rig: CME 550/AT V Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-10

DRAFT

BORING LOG NO. B-12

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873189° Longitude: -77.114739°

Approximate Surface Elev: 260 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	STRATUM DESCRIPTION	FIELD TEST RESULTS
0.1	260+/-	TOPSOIL (1")	
		FILL - CLAYEY SAND WITH ASPHALT AND GRAVEL, reddish brown, medium dense, moist.	8-8-6 N=14
			14-10-11 N=21
3.5	256.5+/-	**LEAN CLAY WITH SAND (CL)**, reddish brown, dense, moist.	
5.0	255+/-	**CLAYEY SAND WITH QUARTZ FRAGMENTS (SC)**, reddish brown, medium dense to loose, moist.	8-10-9 N=19
			5-4-2 N=6
13.5	246.5+/-	**POORLY GRADED SAND WITH QAURTZ FRAMGMENTS (SP)**, light brown, medium dense, moist.	30-32-40 N=72
18.5	241.5+/-	**SANDY SILT (ML)**, trace mica, light brown, stiff, moist.	4-8-6 N=14
23.5	236.5+/-	**HIGHLY WEATHERED TO PARTIALLY WEATHERED SCHIST**, with quartz boulders, greyish brown, very dense, moist.	17-30-50/5"

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/12/2017 Boring Completed: 6/12/2017

Drill Rig: CME 550/AT V Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-11

BORING LOG NO. B-12

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873189° Longitude: -77.114739°

Approximate Surface Elev: 260 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		HIGHLY WEATHERED TO PARTIALLY WEATHERED SCHIST, with quartz boulders, greyish brown, very dense, moist. *(continued)*					
	30				39-50/5" N=50+		
	35				50/4" N=50+		
	40				40-50/2" N=50+		
	45				50/1" N=50+		
	50				50/1" N=50+		

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/12/2017 | Boring Completed: 6/12/2017

Drill Rig: CME 550/AT V | Driller: Recon Drilling

Project No.: EW175052 | Exhibit: A-4-11

DRAFT

BORING LOG NO. B-12

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873189° Longitude: -77.114739°

Approximate Surface Elev: 260 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	HIGHLY WEATHERED TO PARTIALLY WEATHERED SCHIST, with quartz boulders, greyish brown, very dense, moist. *(continued)*							
	53.0	207+/-						
	Spoon refusal on quartz boulders at 53 Feet					50/0" N=50+		

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/12/2017 | Boring Completed: 6/12/2017

Drill Rig: CME 550/AT V | Driller: Recon Drilling

Project No.: EW175052 | Exhibit: A-4-11

DRAFT

BORING LOG NO. B-13

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873156° Longitude: -77.114126°

Approximate Surface Elev: 258 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.4	257.5+/-	ASPHALT (5")						
0.5	257.5+/-	GRAVEL (1")						
		FILL - SANDY LEAN CLAY, brown, medium stiff, moist.				8-6-13 N=19		
						9-12-12 N=24	13	
6.0	252+/-		5			13-14-13 N=27	7	
		CLAYEY SAND WITH GRAVEL (SC), light brown, medium dense to dense, moist.						
						13-13-17 N=30	8	
			10					
						23-22-20 N=42	9	
18.5	239.5+/-		15					
		SANDY SILT (ML), with quartz fragments, brown, medium dense to very dense, moist.		▼		5-7-11 N=18	20	
			20	▽				
23.5	234.5+/-							
		SILTY SAND (SM), with quartz fragments, greyish brown, medium dense to dense, moist.				9-14-23 N=37	21	
			25					

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *While drilling*
- ▽ *At completion of drilling*
- ▼ *After 24 hours*
- ▨ *Cave-in after 24 hours.*

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/14/2017 | Boring Completed: 6/14/2017

Drill Rig: CME-550/ ATV | Driller: Recon Drilling

Project No.: EW175052 | Exhibit: A-4-12

DRAFT

BORING LOG NO. B-13

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873156° Longitude: -77.114126°

Approximate Surface Elev: 258 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	SILTY SAND (SM), with quartz fragments, greyish brown, medium dense to dense, moist. *(continued)*							
			30			9-14-23 N=37		
33.5	224.5+/-			▽				
	HIGHLY WEATHERED TO PARTIALLY WEATHERED SCHIST, with quartz boulders, greyish brown, very dense, dry.		35			35-50/6" N=50+		
			40			15-47-50 N=97		
			45			35-41-50/5" N=50+		
			50			50/6" N=50+		

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *While drilling*
- ▽ *At completion of drilling*
- ▼ *After 24 hours*
- ▨ *Cave-in after 24 hours.*

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/14/2017 | Boring Completed: 6/14/2017
Drill Rig: CME-550/ ATV | Driller: Recon Drilling
Project No.: EW175052 | Exhibit: A-4-12

DRAFT

BORING LOG NO. B-13

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873156° Longitude: -77.114126°

Approximate Surface Elev: 258 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
HIGHLY WEATHERED TO PARTIALLY WEATHERED SCHIST (SP), with quartz boulders, greyish brown, very dense, dry. *(continued)*						
		55		50/0" N=50+		
		60		50/0" N=50+		
65.0	193+/-	65		50/0" N=50+		
QUARTZ BOULDER, white, very dense, RQD = 6.6%, dry.						
67.0	191+/-					
HIGHLY WEATHERED TO PARTIALLY WEATHERED SCHIST, greyish brown, very dense, RQD = 0%, dry.		70		N=50+		
		75		N=50+		
75.0	183+/-					

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After 24 hours*
- *Cave-in after 24 hours.*

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/14/2017 | Boring Completed: 6/14/2017
Drill Rig: CME-550/ ATV | Driller: Recon Drilling
Project No.: EW175052 | Exhibit: A-4-12

DRAFT

BORING LOG NO. B-14

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873128° Longitude: -77.113727°

Approximate Surface Elev: 260 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION	FIELD TEST RESULTS
0.5	259.5+/-	ASPHALT (6")	3-4-2 N=6
0.7	259.5+/-	GRAVEL (2")	
		FILL - SANDY LEAN CLAY, brown, medium stiff, moist.	
3.5	256.5+/-	**CLAYEY SAND WITH GRAVEL (SC)**, light brown, medium dense, moist.	5-7-7 N=14
			5-7-8 N=15
			6-8-10 N=18
13.5	246.5+/-	**SILTY SAND WITH GRAVEL (SM)**, with gravel, light brown, dense to very dense, moist.	25-30-35 N=65
			6-10-15 N=25
			8-14-14 N=28

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

After 24 hours

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/14/2017 Boring Completed: 6/14/2017

Drill Rig: CME-550/ ATV Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-13

DRAFT

BORING LOG NO. B-14

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873128° Longitude: -77.113727°

Approximate Surface Elev: 260 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	SILTY SAND WITH GRAVEL (SM), with gravel, light brown, dense to very dense, moist. *(continued)*						
28.5	231.5+/-						
	HIGHLY WEATHERED SCHIST, greyish brown, very dense, dry.	30			20-30-50/5" N=50+		
33.5	226.5+/-						
	SANDY SILT (ML), trace mica, greyish brown, very dense, dry.	35			15-20-25 N=45		
40.0	220+/-	40			15-20-39 N=59		
	Boring Terminated at 40 Feet						

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *After 24 hours*

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/14/2017 Boring Completed: 6/14/2017

Drill Rig: CME-550/ ATV Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-13

DRAFT

BORING LOG NO. B-15

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.872965° Longitude: -77.115069°

Approximate Surface Elev: 262 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	STRATUM DESCRIPTION	FIELD TEST RESULTS
0.1	262+/-	TOPSOIL (1")	
		SANDY LEAN CLAY WITH GRAVEL (CL), brown, very stiff, moist.	6-8-10 N=18
2.5	259.5+/-		
		CLAYEY SAND WITH GRAVEL (SC), reddish brown, medium dense, moist.	4-7-7 N=14
5.0	257+/-		
		LEAN CLAY WITH SAND (CL), reddish brown, very stiff, moist.	8-10-15 N=25
8.5	253.5+/-		
		SANDY SILT (ML), light brown, medium dense, moist.	10-14-15 N=29
			35-50/5" N=50+
18.5	243.5+/-		
		SANDY SILT WITH GRAVEL (ML), trace mica, light brown, stiff, moist.	7-10-14 N=24
			8-10-15 N=25

GRAPHIC LOG | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | FIELD TEST RESULTS | WATER CONTENT (%) | ATTERBERG LIMITS LL-PL-PI

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After 24 hours*
- *Cave-in after 24 hours.*

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/8/2017 | Boring Completed: 6/8/2017

Drill Rig: CME 550/AT V | Driller: Recon Drilling

Project No.: EW175052 | Exhibit: A-4-14

DRAFT

BORING LOG NO. B-15

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.872965° Longitude: -77.115069°

Approximate Surface Elev: 262 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
SANDY SILT WITH GRAVEL (ML), trace mica, light brown, stiff, moist. *(continued)*							
28.5	233.5+/-						
HIGHLY WEATHERED SCHIST, greyish brown, very dense, moist.							
					25-35-50/3"		
33.5	228.5+/-	30					
SANDY SILT (ML), trace mica, greyish brown, very dense, moist.							
					35-28-25 N=53		
		35					
					16-30-27 N=57		
40.0	222+/-	40					
Boring Terminated at 40 Feet							

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After 24 hours*
- *Cave-in after 24 hours.*

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/8/2017 Boring Completed: 6/8/2017

Drill Rig: CME 550/AT V Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-14

DRAFT

BORING LOG NO. B-16

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.872832° Longitude: -77.11421°

Approximate Surface Elev: 260 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Stratum Description
0.5	259.5+/-	ASPHALT 6")
0.7	259.5+/-	**SANDY LEAN CLAY WITH GRAVEL (CL)**, brown, very stiff, moist.
		POORLY GRADED GRAVEL (GP), Gravel (2")
2.5	257.5+/-	**CLAYEY SAND WITH GRAVEL (SC)**, reddish brown, medium dense, moist.
5.0	255+/-	**LEAN CLAY WITH SAND (CL)**, reddish brown, very stiff, moist.
8.5	251.5+/-	**SANDY SILT (ML)**, light brown, medium dense, moist.

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	10-11-7 N=18		
	3-3-4 N=7		
5	3-5-4 N=9		
10	10-18-22 N=40		
15	30-50/6" N=50+		
20	10-14-18 N=32		
25	14-14-20 N=34		

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *After 24 hours*

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/8/2017 | Boring Completed: 6/8/2017

Drill Rig: CME 550/AT V | Driller: Recon Drilling

Project No.: EW175052 | Exhibit: A-4-15

DRAFT

BORING LOG NO. B-16

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.872832° Longitude: -77.11421°

Approximate Surface Elev: 260 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS
	SANDY SILT (ML), light brown, medium dense, moist. *(continued)*			
		30		14-22-30 N=52
33.5	226.5+/-			
	HIGHLY WEATHERED SCHIST, greyish brown, very dense, moist.	35		18-30-50/5"
40.0	220+/-			50/4" N=50+
	Boring Terminated at 40 Feet	40		

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *After 24 hours*

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/8/2017 Boring Completed: 6/8/2017

Drill Rig: CME 550/AT V Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-15

DRAFT

BORING LOG NO. B-17

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.872799° Longitude: -77.113807°

Approximate Surface Elev: 262 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.1	262+/-	TOPSOIL (1")
		FILL - SANDY SILT WITH GRAVEL (ML), brown, very stiff, moist.
2.5	259.5+/-	
		SILTY, CLAYEY SAND (SC-SM), reddish brown, medium dense, moist.
13.5	248.5+/-	
		SILTY SAND WITH GRAVEL (SM), yellowish brown, very dense, moist.
23.5	238.5+/-	
		SILTY CLAY (CL/ML), light brown, hard to very hard, moist.

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	4-4-13 N=17		
	6-9-7 N=16		
5	6-8-8 N=16		
	5-6-8 N=14	12	24-19-5
10	30-50/4" N=50+		
15			
	40-50/3" N=50+		
20			
25	14-18-20 N=38		

WATER LEVEL OBSERVATIONS: ▽ After 24 hours

Cave-in after 24 hours.

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/8/2017 | Boring Completed: 6/8/2017
Drill Rig: CME 550/AT V | Driller: Recon Drilling
Project No.: EW175052 | Exhibit: A-4-16

DRAFT

BORING LOG NO. B-17

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.872799° Longitude: -77.113807°

Approximate Surface Elev: 262 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
SILTY CLAY (CL/ML), light brown, hard to very hard, moist. *(continued)*								
						14-28-40 N=68		
33.5	228.5+/-		30					
ELASTIC SILT (MH), greyish brown, very hard, moist.						21-31-45 N=76		
38.5	223.5+/-		35					
SANDY SILT (ML), trace mica, greyish brown, very hard, moist.								
40.0	222+/-		40					
Boring Terminated at 40 Feet								

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *After 24 hours*

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/8/2017 Boring Completed: 6/8/2017

Drill Rig: CME 550/AT V Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-16

DRAFT

BORING LOG NO. B-18

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.872605° Longitude: -77.114254°

Approximate Surface Elev: 260 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	STRATIFICATION
0.5	259.5+/-	ASPHALT (6")
0.7	259.5+/-	**POORLY GRADED GRAVEL (GP)**, GRAVEL (2")
		CLAYEY SAND (SC), with gravel, reddish brown, medium dense to dense, moist.
6.0	254+/-	
		SILTY SAND WITH QUARTZ FRAGMENTS (SM), trace clay, yellowish brown, very dense, moist.
18.5	241.5+/-	
		SILTY SAND (SM), trace mica, greyish brown, hard, moist.
25.0	235+/-	

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		6-12-13 N=25		
		7-10-10 N=20		
5		14-21-32 N=53		
		30-30-43 N=73		
10		44-50/6" N=50+		
15				
20		10-14-16 N=30		
25		14-16-22 N=38		

WATER LEVEL OBSERVATIONS: ▽ After 24 hours; Cave-in after 24 hours.

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/9/2017 Boring Completed: 6/9/2017
Drill Rig: CME 550/AT V Driller: Recon Drilling
Project No.: EW175052 Exhibit: A-4-17

DRAFT

BORING LOG NO. B-19

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.872554° Longitude: -77.113833°

Approximate Surface Elev: 262 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.2	262+/-	TOPSOIL (2")			
		FILL - SANDY SILT (ML), with gravel brick fragments, brown, stiff, moist.	4-6-7 N=13		
2.5	259.5+/-				
		CLAYEY SAND WITH GRAVEL (SC), reddish brown, dense to medium dense, moist.	10-15-20 N=35		
			13-16-20 N=36		
			8-9-8 N=17		
13.5	248.5+/-				
		SILTY SAND WITH GRAVEL (SM), trace clay, brown, very dense, moist.	22-40-44 N=84		
			50/6" N=50+		
			14-19-18 N=37	19	46-34-12
25.0	237+/-				

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Cave-in after 24 hours.

Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/9/2017 Boring Completed: 6/9/2017

Drill Rig: CME 550/AT V Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-18

DRAFT

BORING LOG NO. INF-1

PROJECT: Lubber Run Recreation Center

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

SITE: 300 North Park Drive
Arlington, Virginia

LOCATION See Exhibit A-2

Latitude: 38.873211° Longitude: -77.115228°

Approximate Surface Elev: 260 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.2	260+/-							
TOPSOIL (2")								
FILL - CLAYEY SAND WITH GRAVEL, brown, medium dense, moist.						4-6-6 N=12	12	
2.5	257.5+/-							
FILL - SANDY SILT WITH GRAVEL, trace clay, light brown, stiff, moist.						3-8-7 N=15	16	
5.0	255+/-		5			5-8-15 N=23	19	
SILTY SAND (SM), with quartz fragments, light brown, medium dense to very dense, moist.								
			10			30-40-45 N=85	6	
						20-22-30-35 N=52		
						13-25-35-25 N=60		
15.5	244.5+/-		15			22-17-18-20 N=35	16	38-34-4
SANDY SILT (ML), greyish brown, very stiff, moist.						7-10-12 N=22		
						5-10-14 N=24		
19.0	241+/-							
Boring Terminated at 19 Feet								

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

Hammer Type: Automatic

Advancement Method:
HSA

Abandonment Method:
Backfilled with Auger Cuttings

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Cave-in after 24 hours.

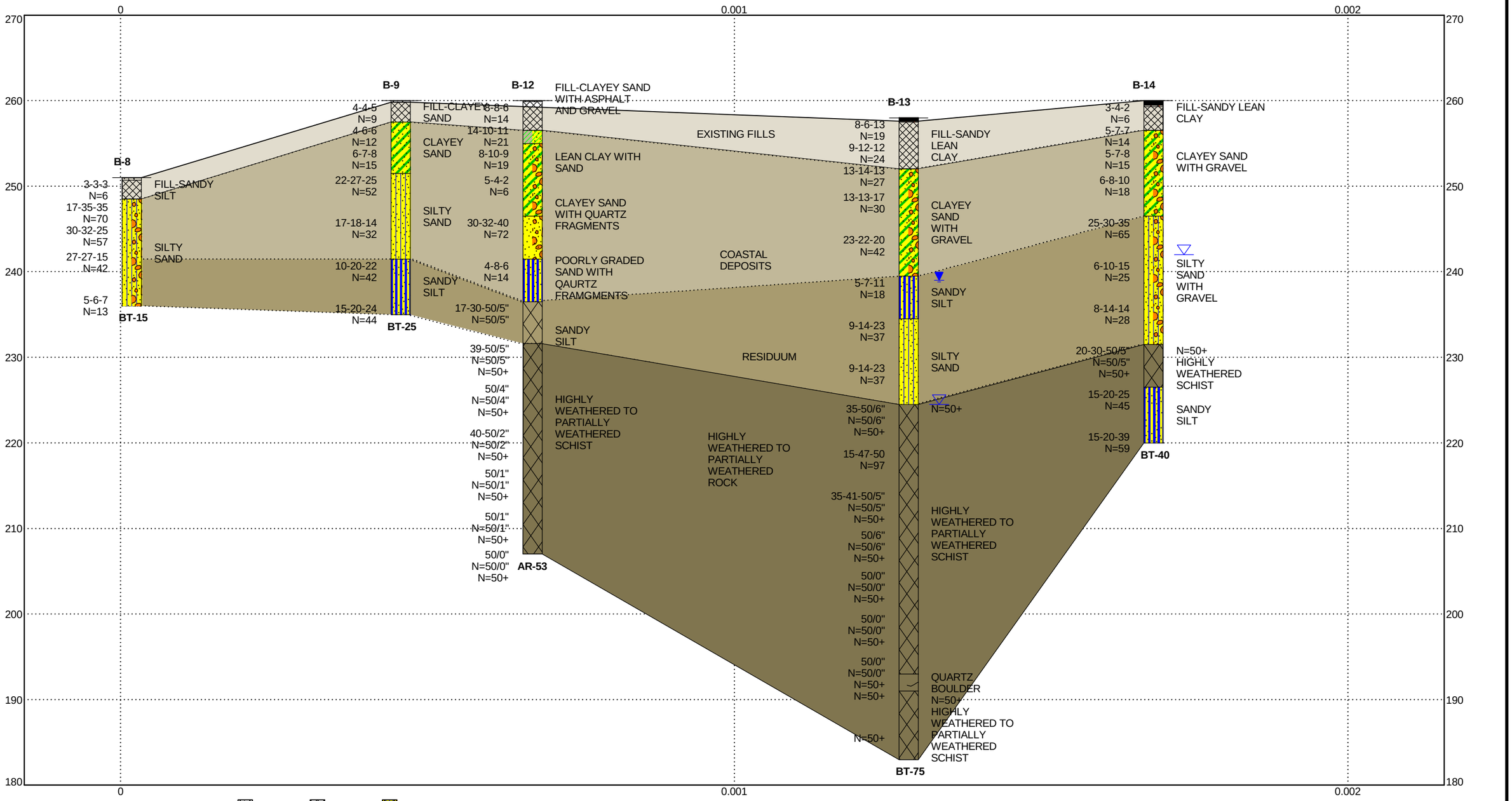
Terracon
21505 Greenoak Way
Dulles, VA

Boring Started: 6/14/2017 Boring Completed: 6/14/2017

Drill Rig: CME-550/ ATV Driller: Recon Drilling

Project No.: EW175052 Exhibit: A-4-19

West ◄ ► East



Explanation

B-8 — Borehole Number
Borehole Lithology
AR / BT — Borehole Termination Type

▽ Water Level Reading at time of drilling.

▼ Water Level Reading after drilling.

Topsoil; Fill (made ground); Silty Sand with Gravel; Clayey Sand; Silty Sand; Sandy Silt

NOTES:

See Exhibit A-2 for orientation of soil profile.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project Manager: Will Kelsey	Project No.: EW175052
Drawn by: WK	Scale: NTS
Approved by: MA	File Name: EW175052.6
Date: 7/5/2017	

Terracon
21505 Greenoak Way
Dulles, VA
PH. 703-421-4000 FAX.

SUBSURFACE PROFILE

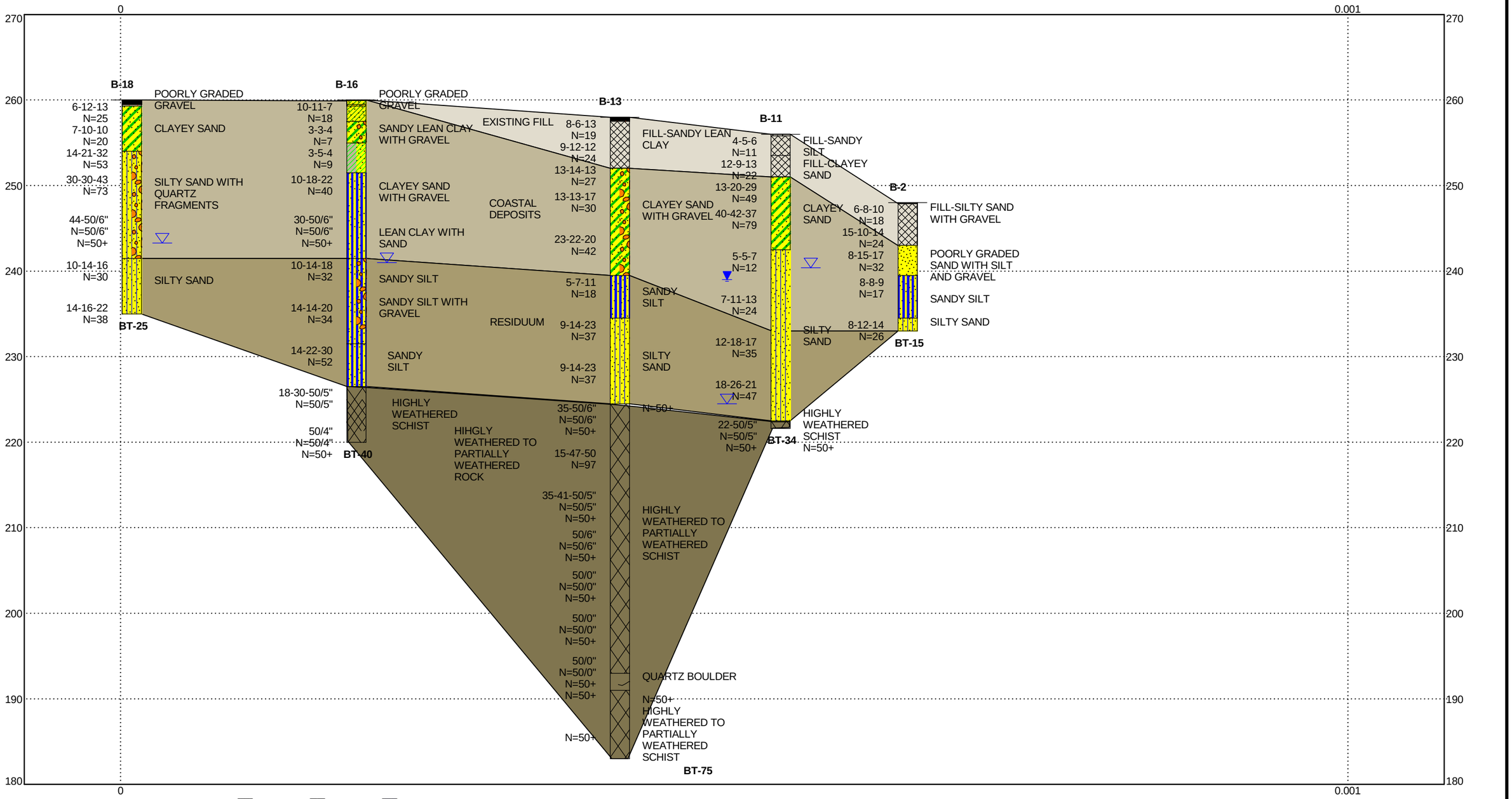
Section A-A'
LUBBER RUN RECREATION CENTER
300 NORTH PARK DRIVE
ARLINGTON, VIRGINIA

EXHIBIT 6

DRAFT

WEST

EAST



Elevation

Distance Along Baseline

Explanation

B-2 — Borehole Number

Borehole Lithology

AR / BT — Borehole Termination Type

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Topsoil

Fill (made ground)

Poorly-graded Sand

Sandy Silt

Silty Sand

Clayey Sand

NOTES:

See Exhibit A-2 for orientation of soil profile.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project Manager: Will Kelsey	Project No.: EW175052	Terracon	**SUBSURFACE PROFILE**
Drawn by: WK	Scale: NTS	21505 Greenoak Way Dulles, VA	SECTION B-B' LUBBER RUN RECREATION CENTER 300 NORTH PARK DRIVE ARLINGTON, VIRGINIA
Approved by: MA	File Name: EW175052.7	PH. 703-421-4000 FAX.	EXHIBIT 7
Date: 7/5/2017			

APPENDIX B
LABORATORY TESTING

Laboratory Testing

The boring logs and samples were reviewed by a geotechnical engineer who selected soil samples for testing. Tests were performed by technicians working under the direction of the engineer. A brief description of the tests performed follows.

Particle size analysis, liquid and plastic limit tests, moisture content measurements and unit weight tests were made to aid in classifying the soils in accordance with the Unified Soil Classification System (USCS). The USCS is summarized in Appendix C.

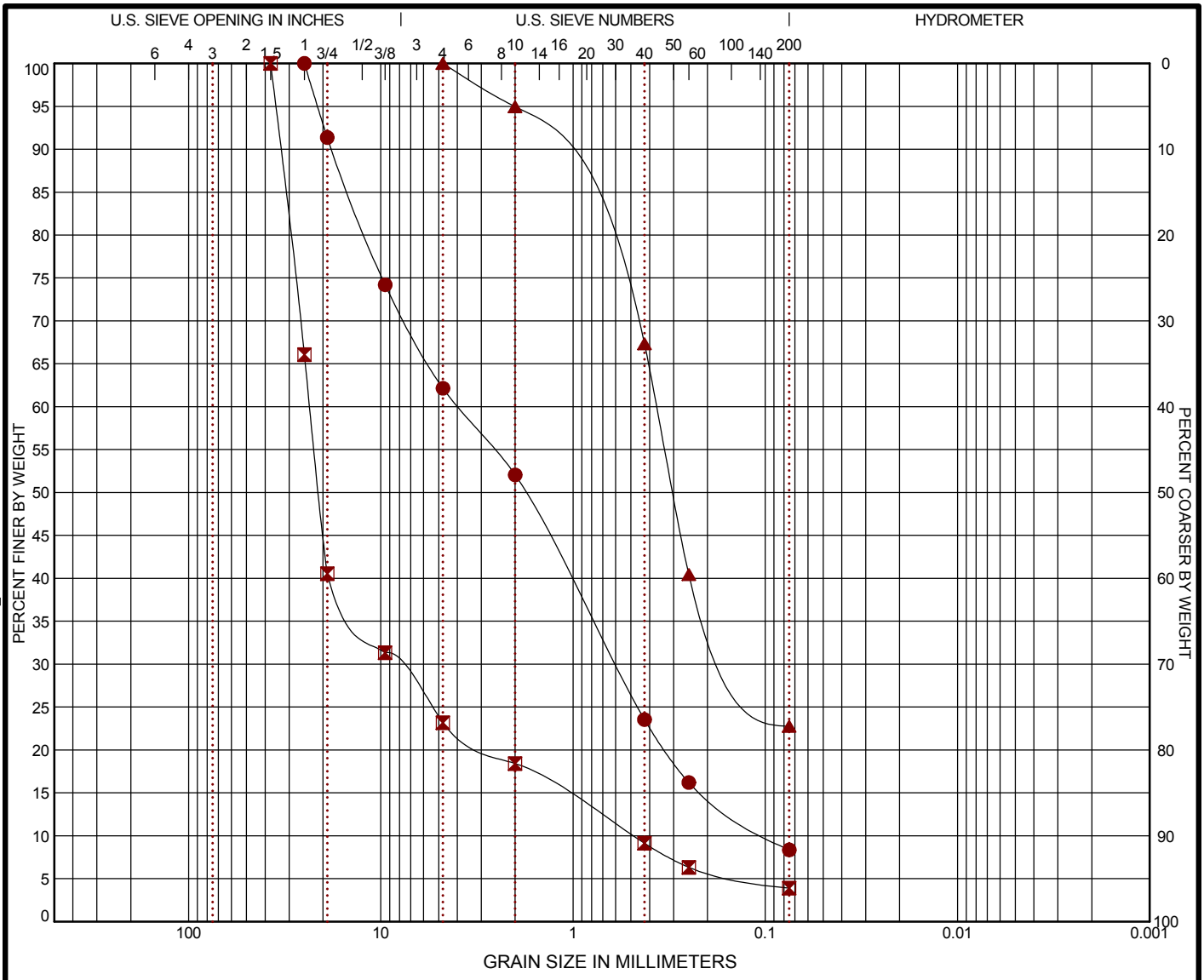
Test procedures may have been modified to reflect local practices or conditions.

The results of the laboratory tests are presented in Appendix B.

DRAFT

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B-2**	**0.0**	**37.9**	**53.8**		**8.4**		**SP-SM**
⊠	**B-3**	**0.0**	**76.8**	**19.3**		**3.9**		**GP**
▲	**B-6**	**0.0**	**0.0**	**77.2**		**22.8**		**SM**

	GRAIN SIZE		
	●	⊠	▲
D_{60}	**3.952**	**23.425**	**0.368**
D_{30}	**0.604**	**8.472**	**0.123**
D_{10}	**0.097**	**0.491**	
	COEFFICIENTS		
C_C	**0.96**	**6.23**	
C_U	**40.95**	**47.66**	

SIEVE (size)	PERCENT FINER		
	●	⊠	▲
	–	–	–

SOIL DESCRIPTION

- ● POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
- ⊠ POORLY GRADED GRAVEL with SAND (GP)
- ▲ SILTY SAND (SM)

REMARKS

- ●
- ⊠
- ▲

PROJECT: Lubber Run Recreation Center

SITE: 300 North Park Drive
Arlington, Virginia

Terracon
21505 Greenoak Way
Dulles, VA

PROJECT NUMBER: EW175052

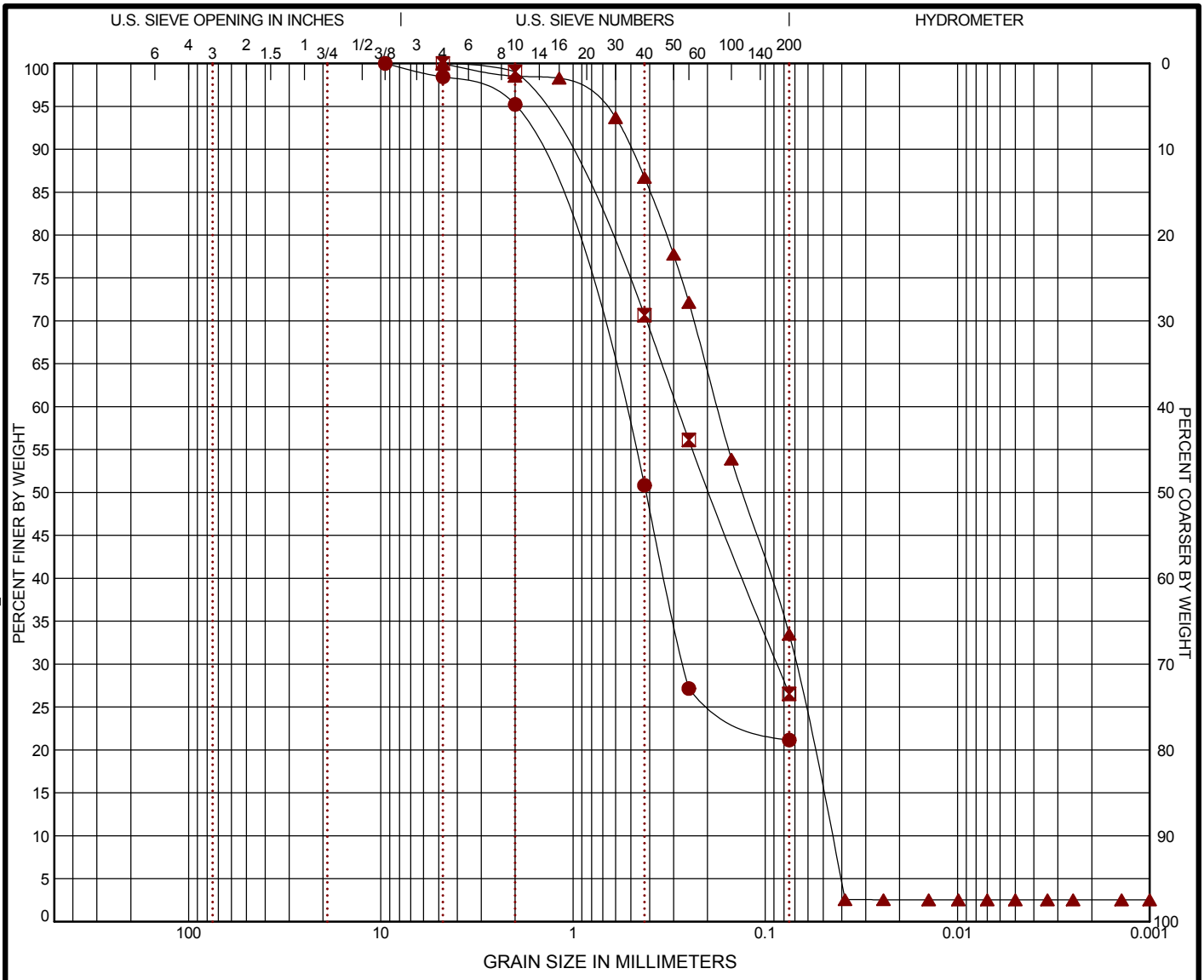
CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

EXHIBIT: B-1

DRAFT

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B-17**	**0.0**	**1.6**	**77.3**		**21.2**		**SC-SM**
⊠	**B-19**	**0.0**	**0.0**	**73.4**		**26.6**		**SM**
▲	**INF-1**	**0.0**	**0.0**	**66.5**	**30.9**		**2.5**	**SM**

	GRAIN SIZE		
	●	⊠	▲
D_{60}	**0.585**	**0.288**	**0.178**
D_{30}	**0.266**	**0.086**	**0.07**
D_{10}			**0.045**
	COEFFICIENTS		
C_C			**0.60**
C_U			**3.94**

SIEVE (size)	PERCENT FINER		
	●	⊠	▲
	–	–	–

SOIL DESCRIPTION
- ● SILTY, CLAYEY SAND (SC-SM)
- ⊠ SILTY SAND (SM)
- ▲ SILTY SAND (SM)

REMARKS
- ●
- ⊠
- ▲

PROJECT: Lubber Run Recreation Center

SITE: 300 North Park Drive
Arlington, Virginia

Terracon
21505 Greenoak Way
Dulles, VA

PROJECT NUMBER: EW175052

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

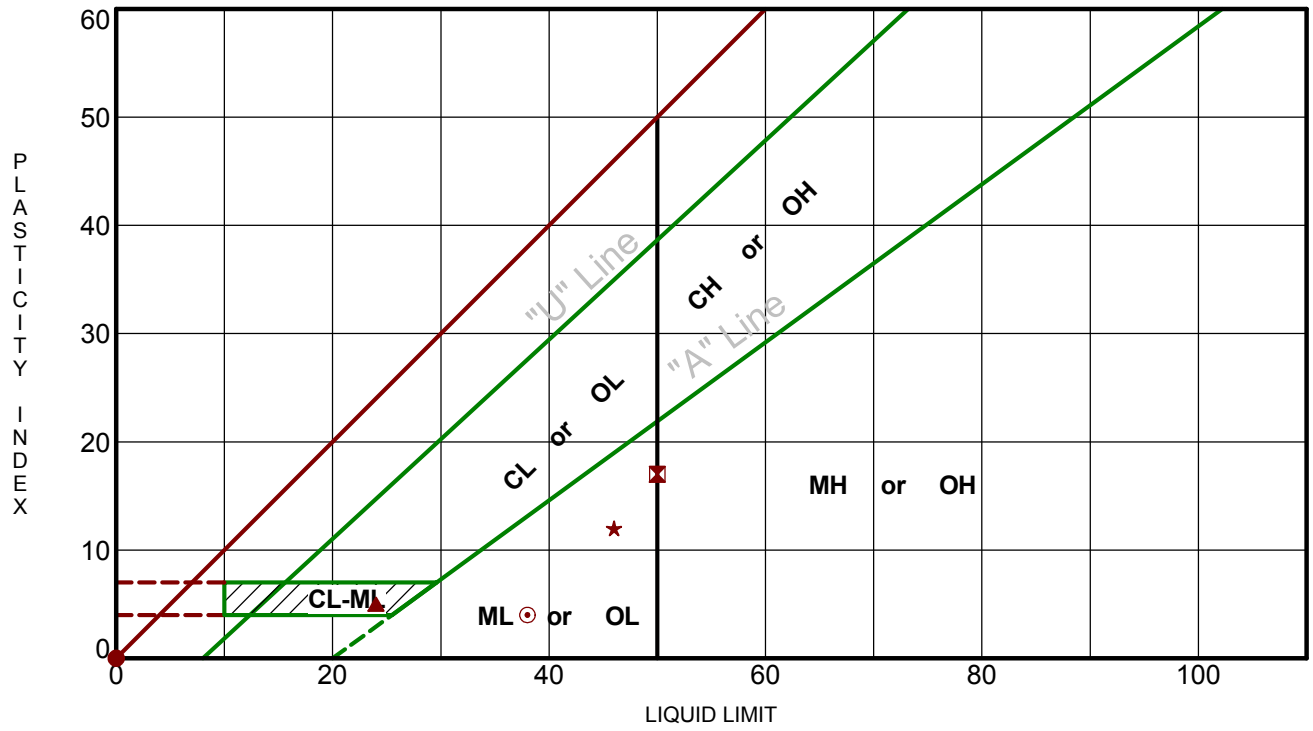
EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 70131102-GRAIN SIZE RPT EW175052 LUBBER RUN RECREA.GPJ TERRACON_DATATEMPLATE.GDT 6/23/17

DRAFT

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
B-2	5 - 6.5	NP	NP	NP	8	SP-SM	POORLY GRADED SAND with SILT and GRAVEL
B-6	18.5 - 20	50	33	17	23	SM	SILTY SAND
B-17	8.5 - 10	24	19	5	21	SC-SM	SILTY, CLAYEY SAND
B-19	23.5 - 25	46	34	12	27	SM	SILTY SAND
INF-1	14 - 16	38	34	4	33	SM	SILTY SAND

PROJECT: Lubber Run Recreation Center

SITE: 300 North Park Drive
Arlington, Virginia

Terracon
21505 Greenoak Way
Dulles, VA

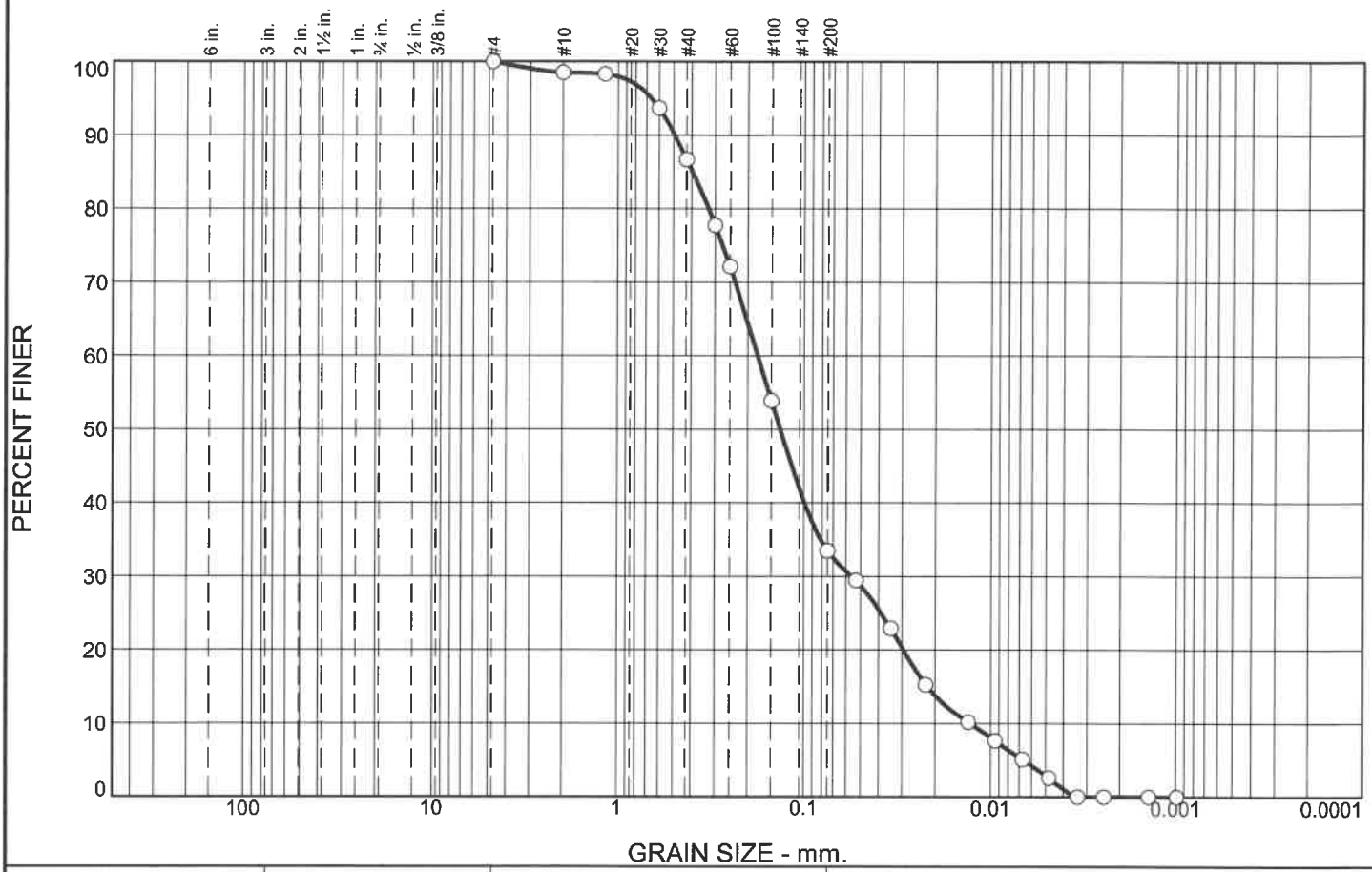
PROJECT NUMBER: EW175052

CLIENT: Bowman Consulting
14020 Thunder Bolt Place Suite 300

EXHIBIT: B-1

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.5	11.8	53.2	30.6	2.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	98.5		
#16	98.3		
#30	93.7		
#40	86.7		
#50	77.8		
#60	72.2		
#100	53.9		
#200	33.5		
#270	29.4		
0.0345 mm.	22.9		
0.0225 mm.	15.3		
0.0132 mm.	10.2		
0.0094 mm.	7.7		
0.0067 mm.	5.1		
0.0048 mm.	2.6		
0.0034 mm.	0.0		
0.0024 mm.	0.0		
0.0014 mm.	0.0		
0.0010 mm.	0.0		

* (no specification provided)

Soil Description

Brown, Silty sand

Atterberg Limits

PL= 34 LL= 38 PI= 4

Coefficients

D_{90}= 0.4921 D_{85}= 0.3954 D_{60}= 0.1770
D_{50}= 0.1348 D_{30}= 0.0559 D_{15}= 0.0220
D_{10}= 0.0129 C_u= 13.76 C_c= 1.37

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

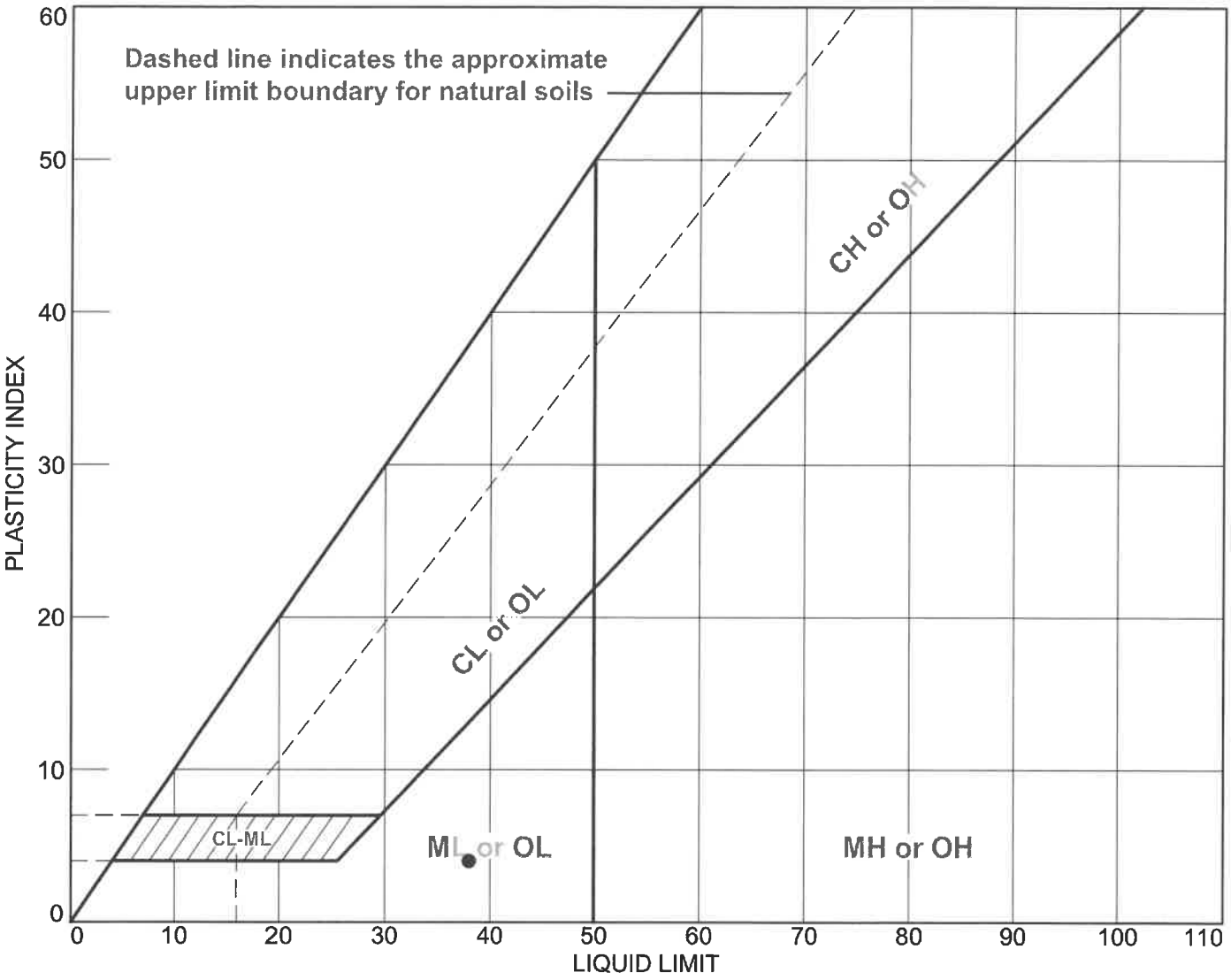
Location: INF-1
Sample Number: S-7 **Depth:** 14.0 - 16.0' **Date:** 06-23-17

Geotechnical Consulting & Testing, Inc.
a Terracon Company
Dulles, VA

Client: Bowman Consulting
Project: Lubber Run Recreation Center

Project No: EW175052 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



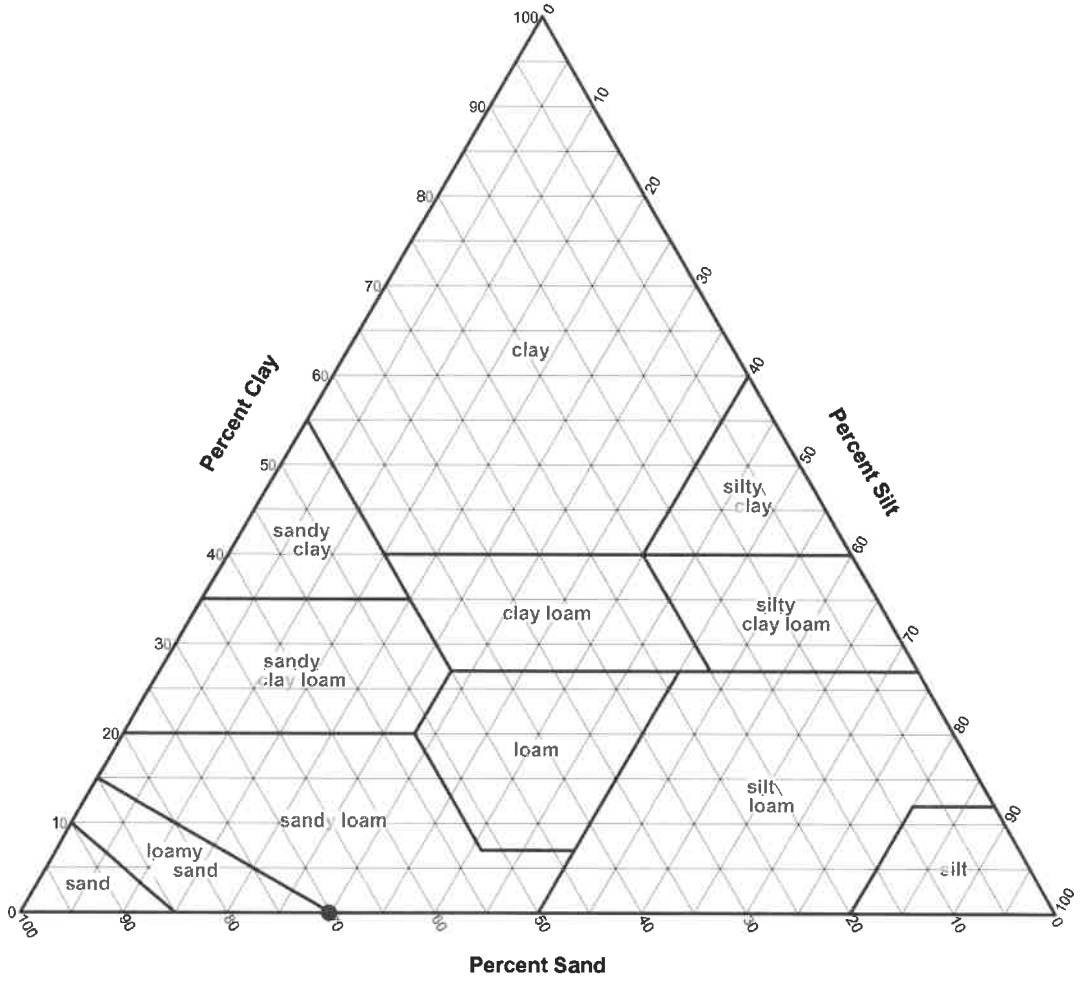
SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	INF-1	S-7	14.0 - 16.0'	15.6	34	38	4	SM

Geotechnical Consulting & Testing, Inc. **a Terracon Company** **Dulles, VA**	**Client:** Bowman Consulting **Project:** Lubber Run Recreation Center **Project No.:** EW175052 **Figure**

DRAFT

USDA Soil Classification



SOIL DATA

	Source	Sample No.	Depth	Percentages From Material Passing a #10 Sieve			Classification
				Sand	Silt	Clay	
●	INF-1	S-7	14.0 - 16.0'	70.2	29.8	0.0	Loamy sand

Geotechnical Consulting & Testing, Inc.
a Terracon Company
Dulles, VA

Client: Bowman Consulting
Project: Lubber Run Recreation Center

Project No.: EW175052 **Figure**