GEOTECHNICAL SPECIFICATIONS

WAWA – SUDLEY ROAD
Prince William County, Virginia
ECS Project No. 29:2077
August 31, 2018

The following geotechnical specifications have been developed from ECS Mid-Atlantic, LLC Revised Report of Subsurface Exploration and Geotechnical Engineering Analysis, No. 29:2077 dated August 31, 2018. Information regarding subsurface exploration procedures, soil conditions observed, and discussion of recommendations may be found in that report.

EXISTING MAN-PLACED FILL

1. In accordance with PWC requirements, without proper documentation, the existing fill material shall be considered undocumented fill and shall be removed and reworked or replaced within the structural building and canopy foundation footprint areas.
2. Proofrolling using a loaded dump truck, having an axle weight of at least 10 tons, shall be used within proposed parking lot areas to aid in identifying localized soft or unsuitable material which shall be removed. New engineered fill materials shall be selected and compacted per the criteria presented within the report.
3. It may be feasible to remove and re-compact some of the low plasticity existing fill materials; however, further laboratory testing shall be performed at the time of construction to confirm that these materials satisfy the requirements for an engineered fill. Some moisture conditioning of the soils may be necessary prior to placement in order to achieve proper compaction..

SUBGRADE PREPARATION

1. The subgrade preparation shall consist of stripping all surface cover materials, asphalt, subbase, debris, and any other soft or unsuitable material from the proposed structural areas. An average thickness on the order of 12 inches shall be considered for stripping purposes. Additionally, clearing shall be extended a minimum of 10 feet beyond structural limits.
2. After stripping to the desired grade, and prior to fill placement, the stripped surface shall be observed by the Geotechnical Engineer of Record (GER) or his authorized representative.
3. Proofrolling using a loaded dump truck, having an axle weight of at least 10 tons, shall be used at this time to aid in identifying localized soft or unsuitable material which shall be removed.

4. Any soft or unsuitable materials encountered during this proofrolling shall be removed and replaced with an approved backfill selected and compacted per the criteria given in the sections entitled POTENTIALLY EXPANSIVE SOILS and FILL PLACEMENT AND COMPACTION.
5. The preparation of fill subgrades, as well as proposed building footprint and roadway subgrades, shall be observed on a full-time basis. These observations shall be performed by an experienced geotechnical engineer, or their representative, to ensure that all unsuitable materials have been removed, and that the subgrade is suitable for support of the proposed construction and/or fills.

ROCK EXCAVATION AND BLASTING OPERATIONS

1. For excavations in relatively unweathered rock, ripping is practical for excavations extending to strata corresponding to Standard Penetration Test (SPT) N-values of about 100 blows per 2 inches of sampler penetration or 50 blows per 1 inch of sampler penetration.
2. For general excavations below this level, hard rock requiring blasting or rock trenching for removal is normally encountered. In excavations for utility infrastructure, hoe-ramming will be feasible if the excavation is to extend only a few feet below these levels.
3. Due to the proximity of the existing buildings, blasting is not considered to be an option for rock excavation operations on-site.

WEATHERED SILTSTONE CONSIDERATIONS

1. Larger pieces of weathered rock, which break up as rock-like fragments in the initial excavation, shall be compacted with sufficient compaction energy to substantially break them down into soil size particles during construction.
2. Nondurable weathered rock materials removed in blast and ripping excavations may be used as fill if suitably decomposed by mechanical effort. For the purposes of this project, all siltstone materials at the site shall be considered nondurable.
3. Any weathered rock excavated from the site and used as earthwork fill shall have a well-graded grain size distribution with rock and soil particles ranging from clay or silt size particles to a maximum size of 4 inches in diameter with 2 inch thick plates. Particles larger than this shall be broken down by mechanical compaction equipment to achieve the desired grain size distribution.
4. A minimum uniformity coefficient of 6 shall be used to identify the proper grain size distribution and the samples shall have a minimum of 20% passing the #200 sieve and 50% passing the #40 sieve. Variations from these recommendations shall be approved by the GER, at the time the samples are prepared.

FILL PLACEMENT AND COMPACTION

1. Fill material underneath the proposed structures and pavements shall consist of an approved material (CL, ML, SC, SM or more granular), free of debris, organics, and cobbles greater than 4 inches.
2. The structural fill in the "active zone" under the building pad shall have a Liquid Limit (LL) no greater than 40 and Plasticity Index (PI) less than 15, and shall be non-expansive as classified per IBC 2012, in addition to meeting all the other requirements for a suitable structural fill material.
3. The "active zone" is defined by PWC as a buffer of at least four feet below the final exterior grades or two feet below the bottom of the foundation, whichever is greater. Fill below the "active zone" for structures, and below subgrade for slopes and pavement (curb and gutter, sidewalk, etc.) shall have LL and PI no greater than 45 and 20, respectively, unless it can be shown to have very low expansion potential per IBC 2012.
4. If no structural fill is required, the upper two feet of existing soil shall meet these criteria. Under no circumstances shall high plasticity (CH, MH) soil be used as fill material in proposed structural areas.
5. The low plasticity natural soils and existing fill materials at the site are expected to be suitable for use as controlled fill; however, they may require moisture content adjustments, via discing or other drying techniques or spraying of water to the soil prior to their use as controlled fill material.
6. Any debris or other unsuitable materials shall be removed, as necessary, from the on-site materials prior to their reuse as engineered fill. The planning of earthwork operations shall recognize and account for these efforts and increased costs.
7. Fill materials shall be placed in lifts not exceeding 8 inches in loose thickness and moisture conditioned to within 2 percentage points of the optimum moisture content.
8. Controlled fill soil in the structural areas shall be compacted to a minimum of 95% of the maximum dry density obtained in accordance with the Virginia Test Method (VTM-1) or Standard Proctor Method (ASTM D698).
9. In areas where more than 8 feet of compacted fill is required to reach design grades, the fill shall be compacted to 98% of VTM-1 or ASTM D698 for the full height of fill placed.
10. Fill placed within the upper one foot of any pavement, parking lot, or curb and gutter within VDOT right-of-ways, shall be compacted to a minimum of 100% of the maximum dry density determined in accordance with VTM-1 or ASTM D698.
11. The expanded footprint of the proposed building pad and fill areas shall be well defined, including the limits of the fill zones at the time of fill placement. Grade control shall be maintained throughout the fill placement operations.

12. All fill operations shall be observed on a full-time basis by a qualified soil technician to document that the specified compaction requirements have been met. A minimum of one compaction test per 2,500 square feet area shall be tested in each placed lift. The elevation and location of the tests shall be clearly identified at the time of fill placement.
13. Compaction equipment suitable to the soil type used as fill shall be used to compact the fill material. Theoretically, any equipment type can be used as long as the required density is achieved. Ideally, a steel drum roller would be most efficient for compacting and sealing the surface soil while a sheepsfoot roller would be utilized for the compaction of cohesive soils and nondurable siltstone materials.
14. All areas receiving fill shall be graded to facilitate positive drainage from building pad and pavement areas of any free water associated with precipitation and surface runoff.
15. Fill material shall not be placed on frozen soil. All frozen soil shall be removed prior to continuation of fill operations. Borrow fill materials shall not contain frozen material at the time of placement. All frost-heaved soil shall be removed prior to placement of fill, stone, concrete, or asphalt.

POTENTIALLY EXPANSIVE SOILS

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

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

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

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

   d. Expansion Index greater than 20, determined in accordance with ASTM D4829.
2. In accordance with applicable Prince William County guidelines and in consideration of their definition of the "active zone", these soils shall not be reused as engineered fill.
3. When these soils are encountered in cut areas, they shall be undercut to 4 feet below finished exterior grade or to 2 feet below the bottom of footing, whichever is deeper, and backfilled with controlled, compacted fill.
4. If the bottom of the plastic soils extends to depths less than 4 feet below the finished exterior grade, the undercutting and replacement may be limited to the depth of the high plasticity soils.
5. Alternatively, the footings can be "stepped down" to bear either at 4 feet below exterior grade or at 2 feet below normal footing subgrade, whichever is deeper, bearing in the

plastic soils. If the plastic soils are found to be less than 4 feet in thickness, the footing needs bear only below the plastic soils and the frost line.

6. Floor slabs placed in areas where highly plastic soils are encountered shall be underlain by at least 2 feet of compacted suitable fill.
7. In proposed pavement areas, we recommend undercutting and replacement of the expansive soils in order to provide at least 2 feet of non-expansive soil fill below the pavement subgrade.

BUILDING FOUNDATIONS

1. The foundation subgrade shall be prepared in accordance with the recommendations provided within the sections entitled EXISTING MAN-PLACED FILL, SUBGRADE PREPARATION, POTENTIALLY EXPANSIVE SOILS, and FILL PLACEMENT AND COMPACTION.
2. The proposed building shall be supported on a shallow spread/continuous foundation system. For spread footings placed to bear on natural soils or on properly compacted and controlled engineered fill, an allowable soil bearing pressure of 3,000 pounds per square foot (psf) shall be utilized.
3. For foundations placed to bear completely in competent rock, we recommend an allowable soil bearing pressure of 6,000 pounds per square foot (psf).
4. In order to reduce the potential for differential settlement, we recommend that all foundations for the structures be designed to either bear entirely on rock or bear entirely on natural soil and/or engineered fill. Hence, in a case where foundations are designed to bear on natural soil and/or controlled engineered fill, we recommend the foundations excavated in rock areas be over-excavated a minimum of 2 feet and replaced with a "cushion" layer of engineered fill.
5. At the time of footing construction, the soil subgrade shall be thoroughly checked to verify that the soil type and bearing capacity meet the aforementioned requirements. Probing of the footing subgrade shall be performed with a hand auger and Dynamic Cone Penetrometer at frequent intervals to a minimum depth of 2 feet below the base of the footing.
6. If expansive soil is encountered within 2 feet of the foundation bearing elevation, foundations shall be lowered to 4 feet below the final exterior grade or completely through the high plasticity material, whichever is less.
7. For the structure, it is permissible to undercut to the 4 foot depth below the final exterior grade and then re-establish the design foundation elevation with lean concrete or engineered fill soil.
8. Foundation concrete shall be placed the same day that excavations are made. If the bearing soil is softened by surface water intrusion or exposure, the softened soil must be removed from the foundation excavation bottom immediately prior to placement of concrete.

9. If the excavation must remain open overnight or if rainfall becomes imminent while the bearing soil is exposed, a 1 to 3-inch thick "mud mat" of lean concrete shall be placed on the bearing soil before the placement of reinforcing steel.
10. Should the footings bear entirely on either approved firm soils or rock, for the anticipated loads, total settlement values on the order of 1 inch are expected, and differential settlement along any 30 foot length of wall should be on the order of ½ inch.
11. Continuous footings shall have a minimum width of 18 inches and isolated column footings shall have a minimum lateral dimension of 24 inches. In addition, perimeter footings shall be placed at a depth to provide adequate frost cover protection, which in this area is at a minimum depth of 24 inches below the finished grade.

FUEL CANOPY FOUNDATIONS

1. The proposed fuel canopy shall be supported on a shallow foundation system designed for a net allowable soil bearing pressure of 3,000 psf. In the event that higher bearing capacities are desired, a net allowable soil bearing pressure of 6,000 psf may be utilized if these foundations are designed to bear entirely on weathered rock.
2. During construction, the bearing capacity at the final footing bearing elevation shall be observed in the field by an experienced soil technician to document that the in-situ bearing capacity at the bottom of each footing excavation is adequate for the design loads.
3. For the design of the canopy foundation to resist uplift and overturning, the following soil parameters shall be utilized. These parameters assume the foundation is in contact with stable, undisturbed natural on-site soils or properly placed and compacted engineered fill soils properly evaluated and approved by the Geotechnical Engineer.

	Sandy SILT (ML)/Silty SAND (SM)
Coefficient of Earth Pressure at Rest (K_o):	0.53
Coefficient of Active Earth Pressure (K_a):	0.36
Coefficient of Passive Earth Pressure (K_p):	2.77
Compacted or In-Situ Soil Moist Unit Weight (δ):	115 pcf
Cohesion (C):	0 psf
Angle of Internal Friction (ø):	28°
Sliding Friction Coefficient [Concrete on Soil] (μ):	0.30
Skin Friction [Concrete cast against Soil] (F_s) [1]:	250 psf

Note 1: Skin friction should be neglected for the top 3 feet below finished grade.

4. The structural design of the fueling station canopy foundation shall be submitted separately for approval and appropriate permitting to Prince William County Building Division prior to site implementation

FLOOR SLAB DESIGN

1. For the design and construction of any interior slab-on-grade for the proposed structure, all existing surface cover materials, asphalt, subbase, and any other soft or unsuitable materials shall be removed in accordance with the section entitled SUBGRADE PREPARATION.
2. All stripped areas shall be observed by a representative of the GER during the time of construction in order to aid in locating all such unsuitable materials which shall be removed and to document removal.
3. Where new fill material is required to reach the design floor slab subgrade elevation, material selection and placement shall be carried out in accordance with the sections entitled POTENTIALLY EXPANSIVE SOILS and FILL PLACEMENT AND COMPACTION.
4. For slabs bearing on natural soils or engineered fill, a modulus of subgrade reaction (k) of 150 pounds per cubic inch (pci) shall be utilized for the slab design.
5. The floor slab-on-grade shall be isolated from the foundation footings so differential movement of the structure will not induce shear stresses in the floor slab.
6. The slab design and construction shall consider the proper placement of control joints, and the slab panels shall be properly sized and jointed to control cracking and reduce the effects of differential settlements.
7. Mesh reinforcement shall be included in the design of the floor slab. Welded wire fabric, if used, shall be in the top half of the slab to be effective.
8. The slab-on-grade shall be underlain by a minimum of 4 inches of granular material having a maximum aggregate size of 1.5 inches, such as VDOT 21A/B or No. 57 stone. A recycled concrete material meeting this gradation may also be considered for use; however, samples of the material shall be submitted in advance for testing and approval by the design team prior to use.
9. Prior to placing the granular material, the floor subgrade soil shall be properly compacted, proofrolled, and free of standing water, mud, and frozen soil.
10. Before the placement of concrete in areas where floor covering or coatings will be used, a vapor barrier shall be placed on top of the granular material to provide additional moisture protection. Special attention shall be given to the surface curing of the slab in order to minimize uneven drying of the slab and associated cracking.
11. Footing excavations and unpoured diamond leaveouts within the slab area shall be pumped out to reduce water flow into the subbase materials, and any joints in the slab or at the walls shall be sealed to reduce surface water flow into the subbase materials.

UNDERGROUND FUEL TANKS

1. The fuel tank excavation shall be observed by the GER during excavation, particularly if the excavation cannot be temporarily sloped at a gradient of 1H:1V or flatter. The excavation for the tanks shall also be performed in accordance with the current OSHA and VOSHA regulations.
2. The contractor shall not stockpile excavated materials or equipment immediately adjacent to the excavation slopes. Stockpiled materials shall be kept back from the excavation a minimum distance equal to half the excavation depth to limit surcharging the excavation walls. If this is impractical due to space constraints, the excavation walls shall be designed to account for the anticipated surcharge load.
3. The underground fuel tanks shall be installed in accordance with the manufacturer design specifications for installation and construction.
4. A net allowable soil bearing pressure of 6,000 psf may be used for design of the vault facility, if it is to be founded on the suitable weathered rock or rock materials.
5. If unsuitable soil types or bearing conditions are found to exist at the foundation level, then the base of the excavation shall be lowered to suitable materials and the grade restored using an approved backfill material.
6. The walls of the tanks shall be designed for a laterally increasing at-rest earth pressure of 60 psf per foot of wall height in soil and a uniform lateral earth pressure of 300 psf in rock. This recommended value does not include the influence of any surcharge loads. Any surcharge loads, such as those transmitted by traffic or surface structures imposed within a 45 degree slope of the base of the tanks shall be considered in the tank design.
7. The parameters recommended above also assume that relatively freely draining materials (VDOT No. 57 stone or soils classified as SM or more granular) are used as backfill immediately adjacent to the tanks and that adequate drainage will be provided at the base of the tanks (within two feet of the structure) or as indicated by the manufacturer.
8. Materials proposed for backfill of the tanks shall be approved by the GER. Backfill soils shall not contain particles larger than 3 inches in diameter, shall be placed in lifts not exceeding 8 inches in loose thickness, moisture-conditioned to within 2 percentage points on either side of the optimum moisture content, and compacted to a minimum of 95% of the maximum dry density determined in accordance with Virginia Test Method, VTM-1.
9. Excavation for the tanks shall proceed in an expeditious manner in order to reduce exposure of the bedding soils. The foundation excavation shall be observed and the bearing pressure of the tank subgrade confirmed by an authorized representative of the GER.
10. Perched water shall be anticipated above weathered rock and at the interface of fill materials and natural soils. If the base of the tanks cannot be suitably drained, the design

of the tanks shall include tie-downs and the lateral earth pressure shall be increased to 90 psf per foot of height.

SEISMIC DESIGN CONSIDERATIONS

1. According to the International Building Code, 2012 Edition, Table 1613.5.2, the results of our subsurface exploration, and our experience in the area, the proposed development shall be designed in consideration of the project as a seismic Site Class C.

EXTERIOR PAVEMENT DESIGNS

1. The pavements shall be designed in accordance with current *VDOT Road and Bridge Standards and Specifications* and Prince William County standards.
2. The subgrade preparation for pavements and roadways shall be in accordance with the sections entitled SUBGRADE PREPARATION and POTENTIALLY EXPANSIVE SOILS. Unsuitable material shall be removed and replaced to a maximum depth of 2 feet with an approved backfill compacted to the criteria given in the FILL PLACEMENT AND COMPACTION section.
3. The stripped surface shall be proofrolled and carefully observed at the time of construction in order to aid in identifying the localized soft or unsuitable material that shall be removed. Once these areas have been established to subgrade elevations, the placement of all roadway design elements shall proceed in a timely manner.
4. Where standing water develops, either at the subgrade level or somewhere within the new proposed pavement design section (on the pavement surface) or within the base course layer, softening of the subgrade or other problems related to deterioration of pavement shall be expected. Therefore, good drainage shall be maintained throughout all new pavement sections during the construction phase.
5. A design CBR value of 13 obtained through California Bearing Ratio (CBR) testing performed on bulk samples has been utilized for pavement design of the parking lot, provided the subgrade is prepared as discussed above. This value can be used for preliminary pavement design sections; however, additional CBR tests shall be performed during construction to determine the CBR at the final subgrade elevations.
6. If the subgrade is in a cut section, the CBR shall be performed on the existing soils at the subgrade elevation. If the subgrade is in a fill section, the CBR shall be performed on the proposed fill material.
7. Minimum pavement sections have been determined and detailed in the table below. The pavement materials shall be as required by current *VDOT Road and Bridge Standards and Specifications*.

20-Year Performance Period

Pavement Material	Pavement Thickness (inches)	
	Asphalt Pavement Section	Concrete Pavement Section
Hot Mix Asphalt surface course, SM-9.5	1.25	---
Hot Mix Asphalt base course, BM-25.0	3.0	---
Portland Cement Concrete	--	4.0
Aggregate Base Material, Type VDOT 21A	6.0	6.0
Total Pavement System Thickness	10.25	10.0

8. All pavement materials and construction shall be in accordance with the most current version of the *VDOT Road and Bridge Standards and Specifications* and Prince William County standards.
9. The new concrete pavement section shall consist of a minimum of 4 inches of air-entrained Portland cement concrete having a minimum 28-day compressive strength of 4,000 pounds per square inch (psi). The concrete pavement shall be underlain by a minimum of 6 inches of compacted dense-graded aggregate base course stone (VDOT 21A) placed over a stable soil subgrade compacted to at least 98% of the maximum dry density determined by the Standard Proctor Method (ASTM 698).
10. Exterior concrete slabs such as sidewalks, curbs, and gutter shall be underlain by a minimum of 4 inches of granular material having a maximum aggregate size of 1.5 inches and no more than 2% passing the #200 sieve or in accordance with the Prince William County DCSM.
11. Exterior concrete exposed to the weather shall be air-entrained.

UTILITY INSTALLATION

1. Hoe ramming may be required for installation of deeper utilities. Where rock is encountered at the subgrade, the rock shall be removed to at least 4 inches below and 8 inches outside the pipe.
2. All loose or organic materials encountered at the utility pipe subgrade shall be removed. The pipe subgrade shall be observed and probed for density by the geotechnical engineer or his authorized representative to evaluate the suitability of materials encountered. Any relatively isolated, thin, soft, or yielding areas shall be undercut or replaced with suitable compacted fill or pipe bedding material.
3. Fill placed for support of the utilities shall meet the requirements for compacted backfill given in this report. The utility pipes shall be provided with granular bedding material consisting of at least 6 inches of coarse, granular material having a maximum aggregate size of 1.5 inches, such as VDOT 21A/B or No. 57 stone.

4. Compacted backfill shall be free of debris, ice, and any other material designated by the geotechnical engineer as unsuitable.
5. The backfill shall be placed in shallow horizontal layers of maximum 8-inch loose thickness and compacted with the necessary type of compaction equipment to obtain at least 95 or 90% of the maximum dry density per ASTM D698, Standard Proctor Method or VTM-1 in paved and nonpaved (landscaped) areas, respectively.
6. Backfill shall be placed and compacted at a moisture content to facilitate adequate compaction without significant yielding of the surface, and shall generally be within 2 percentage points of the optimum moisture content per Standard Proctor tests.

TEMPORARY AND PERMANENT SLOPES

1. Temporary fill slopes constructed of on-site native silty or clayey soils shall be limited to a slope of 2H:1V or flatter. The temporary slopes shall also be thoroughly vegetated to help minimize erosion of the surficial soils. Temporary excavation slopes cut into the native soils shall be no steeper than 1H:1V, or as indicated by OSHA protocol.
2. Permanent slopes constructed of native soils shall generally be 3H:1V or flatter, unless they are located in areas where highly plastic soils are noted and flatter gradients may apply.
3. Small landscape berms up to 2 feet in height may be as steep as 2H:1V but shall be compacted as structural fill and thoroughly vegetated immediately upon completion.
4. All slopes must be protected from erosion by a ground cover of adequate vegetation and erosion control measures. All excavations shall be performed in accordance with the current OSHA and VOSHA regulations.

CONSTRUCTION CONSIDERATIONS

1. Perched water shall be expected at the fill/natural soil interface and above very dense weathered rock material. Controlling perched groundwater conditions and a shallow water surface elevation by means of sump pits and trenching may be necessary depending upon recent rainfall and should be anticipated.
2. Prior to the placement of footing concrete, the footings shall be cleaned and free of standing water, mud, or other deleterious materials that may affect the performance of the footings. Furthermore, the GER or his authorized representative shall carefully observe and test all footing subgrades to confirm adequate bearing capacity of the subgrade soils.
3. Proper compaction of controlled fill is an important aspect of this project. Therefore, we recommend that all fill operations be observed on a full-time basis by a qualified soil technician to determine if minimum compaction requirements are being met.

4. The surficial soils contain fines that are considered moderately to highly erodible. All erosion and sedimentation shall be controlled in accordance with sound engineering practice and current County requirements.
5. In a dry and undisturbed state, the majority of the soil at the site will provide good subgrade support for fill placement and construction operations. However, when wet, this soil will degrade quickly with disturbance from contractor operations. Therefore, good site drainage shall be maintained during earthwork operations which will help maintain the integrity of the soil.

GENERAL NOTES

1. If the development changes from the development evaluated in the geotechnical report, ECS shall be notified so that modifications to the geotechnical recommendations and specifications can be made, if necessary.
2. All construction involving problem soils shall be performed under the full-time observation of the geotechnical engineer.
3. The geotechnical engineer shall furnish a written opinion to the County as to whether or not the work has been performed in accordance with the approved plans prior to the issuance of an occupancy permit.
4. Review and approval of plans, specifications, and reports by the County shall in no way relieve the developer of the responsibility for the design, construction and performance of the structures, pavement, and slopes on the project and damage to surrounding properties.

We hereby certify that we have reviewed the site plan drawing by Kimley-Horn and Associates, Inc. dated June 26, 2018. We hereby certify that these geotechnical specifications are in accordance with the ECS Mid-Atlantic, LLC Revised Report of Subsurface Exploration and Geotechnical Engineering Analysis, No. 29:2077 dated August 31, 2018.

Dominic O. Agyepong, P.E. — DATE 08-31-18

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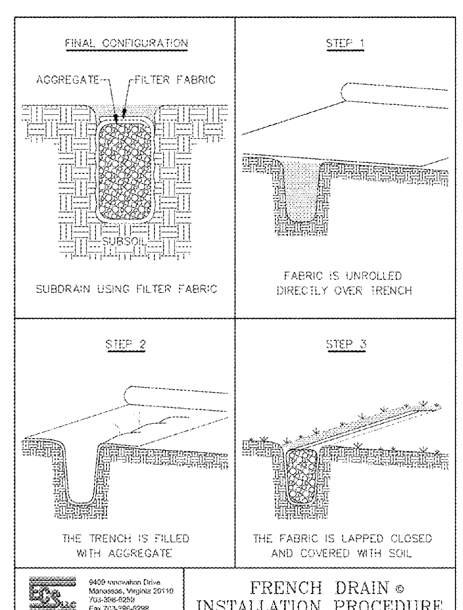
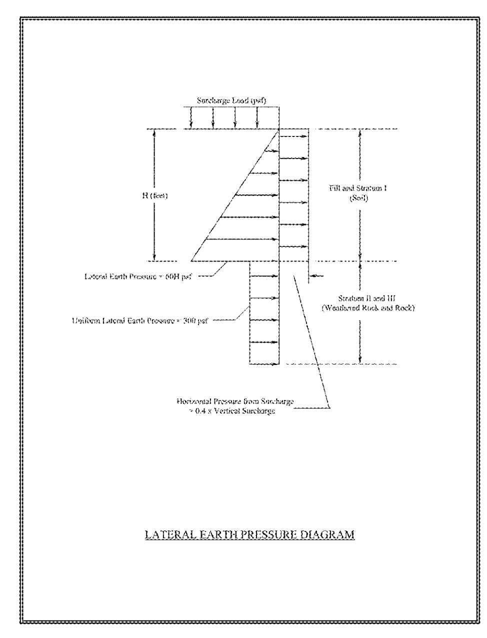
Attachments: Lateral Earth Pressure Diagram
French Drain Installation Procedure



FRENCH DRAIN © INSTALLATION PROCEDURE



LATERAL EARTH PRESSURE DIAGRAM

No.	REVISIONS	DATE	BY
1	PWC COMMENTS – 1ST ROUND	09/10/2018	CAH
2	PWC COMMENTS – 2ND ROUND	11/02/2018	CAH
3	PWC COMMENTS – SIGNATURE SET	02/06/2019	CAH
4	UTILITY REVISIONS	07/25/2019	CMH

Kimley»Horn

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KHA PROJECT 110499001
DATE
SCALE AS SHOWN
DESIGNED BY JLM
DRAWN BY JLM
CHECKED BY RSS

GEOTECHNICAL RECOMMENDATIONS

WAWA - SUDLEY ROAD
PREPARED FOR
FRONTIER DEVELOPMENT
PRINCE WILLIAM COUNTY VA

SHEET NUMBER
C-230