BUNNELL LAMMONS ENGINEERING

August 29, 2018

Office of the County Manager
215 N. Main Street
Waynesville, NC 28786

Attention: Mr. David B. Francis
Program Administrator

Subject: **Preliminary Geotechnical Exploration**
Jonathan Creek Soil Reclamation Project
Waynesville, North Carolina
BLE Project No. J18-12047-02

Dear Mr. Francis:

Bunnell-Lammons Engineering, Inc. (BLE) is pleased to present this report for preliminary geotechnical exploration for the Jonathan Creek Reclamation project. This report has been performed in general accordance with BLE Contract Number P18-12047-02 dated June 26, 2018 and authorized on July 16, 2018 by Mr. James W. Kirkpatrick, III, Chairman of the Board of County Commissioners. The purpose of this exploration was to develop information about the site and subsurface soil conditions that could be used in evaluating the feasibility of prospective construction at the site. This report details the findings of the preliminary geotechnical exploration performed. Project information was provided to us by correspondence with Mr. David Francis with Haywood County and Mr. Andy Alexander, P.G., with BLE and from a review of drawing C-102 dated May 2018 prepared by McGill Associates. Additional project information was obtained from a site visit performed by BLE during the course of the geotechnical exploration.

PROJECT INFORMATION

We understand that Haywood County is planning the development of a 12-acre parcel of land located to the west of Jonathan Creek Road (US 276) and to the south of Potts Drive in Waynesville, North Carolina. The provided drawing C-102 dated May 2018 prepared by McGill Associates shows the minimum soil required to raise the 12-acre area of the site 0.5 feet above BFE, which will allow the site to be developed for commercial use. The exact building type and orientation and site layout is speculative at this time. No concept site plans or structural loading information was available at the time this report was written. However, we anticipate that prospective buildings would be single story structures with typical light commercial construction with concrete grade slabs and shallow foundation system. Associated parking areas and roadways are also anticipated. Based on our correspondence, 45,000 to 60,000 cubic yards of soil will be removed from a potential nearby borrow site (Dennis Farm Road Property) to raise the site grade by approximately 2 feet typically. The borrow soil will be hauled to the subject site and a grading contactor hired by Haywood County will be responsible for spreading and compacting the imported soil to the proposed subgrade elevation.

At this preliminary stage, detailed structural information has not been provided; however, based on the anticipated construction, our experience on similar projects, we assumed the future buildings would be relatively lightly loaded with maximum individual column (if applicable) and continuous wall loads that will not exceed 50 kips and 2 kips per linear foot, respectively.

FIELD EXPLORATION

The site was explored by performing twelve (12) soil test borings at the approximate locations shown on the attached Boring Location Plan (reference Figure 1). The soil test borings were performed using a truck-mounted drill rig turning 2-1/4 inch I.D. hollow-stem augers. The soil test borings ranged in depth from 3 to 8 feet (Auger refusal depth) below the existing ground surface. Soil samples were obtained in accordance with ASTM D 1586 by driving a 1-3/8 inch I.D. split-spoon sampler with a 140-pound safety hammer. The boring locations were established in the field by BLE personnel using point coordinates developed from the provide drawing and a hand-held GPS unit with 3 to 5 meter accuracy. As such, the boring locations referenced in this report and shown on the figures and field records should be considered approximate. The Soil Test Boring Records and a description of our field procedures are attached.

AREA GEOLOGY

The project site is located in the Blue Ridge Physiographic Province. The bedrock in this region is a complex crystalline formation that has been faulted and contorted by past tectonic movements. The rock has weathered to residual soils which form the mantle for the hillsides and hilltops. The typical residual soil profile in areas not disturbed by erosion or human activities consists of clayey soils near the surface where weathering is more advanced, underlain by sandy silts and silty sands.

The boundary between soil and rock is not sharply defined, and there often is a transitional zone, termed "partially weathered rock," overlying the parent bedrock. Partially weathered rock is defined, for engineering purposes, as residual material with standard penetration resistances in excess of 100 blows per foot (bpf). Weathering is facilitated by fractures, joints, and the presence of less resistant rock types. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and/or zones of partially weathered rock within the soil mantle, well above the general bedrock level.

The upper soils along drainage features and in flood plain areas are generally water-deposited (alluvial) materials that have been eroded and washed down from adjacent higher ground. Alluvial soils are usually soft and compressible, having never been consolidated by pressures in excess of their present overburden. Terraced alluvium is a type of alluvium that is typically found on the lower hillsides near major rivers and is thought to be much older than alluvium found in the flood plain. Unlike the consistency of typical alluvial deposits in the flood plain, it is usually of a higher consistency and lower moisture content.

SITE CONDITIONS

Site conditions were observed by Mr. Sam C. Interlicchia during our site reconnaissance. The subject property consists of an approximate 12-acre parcel of property located in Haywood County, North Carolina. The property is bordered to the east by US-276 (Jonathan Creek Road), to the north by Potts Drive and to the south by residential properties. Jonathan Creek is located along the western boundary of the property. Based on our review of publicly available current and historical aerial photography, the

property has primarily been utilized as an agriculture field. However, based on our past experience at the site, we know that the property was initially stripped of 4 inches of surface organics in late January 2018. Several efforts by BLE to proofroll the subgrade were made, but due to the weather conditions portions of the ground surface were frozen, muddy or had standing water. Several areas were also noted to have some remaining surface organic material. As such proofrolling could not be performed. No other site visits were made by BLE, until the recent site visit for the subject exploration. Based on the provided drawing C-102, 12-Arcre Site Plan, we also understand that the site has increased in size to the northwest.

The site is currently overgrown with thick underbrush and weeds. Several scattered round hay bales are located on the site. The topography is relatively flat within the existing agriculture area; however, the site generally slopes towards the west toward Jonathan Creek. Due to the thick vegetative growth, the creek was not observed during our site visit. No visible rock outcroppings were observed during our recent site visit; however, we did note that the ground surface was observed to have an abundance of cobbles and rock fragments. Some rocks were also noted to be partially buried. We note that this is a large site and we did not observe all surface conditions, due to the size of the property and the overgrown weeds and underbrush. Conditions differing from the above-described are plausible.

Subsurface Conditions

The descriptions below provides a general summary of the subsurface conditions encountered. The appended test boring records contain detailed information recorded at each boring location. The boring logs represent our interpretation of the field logs based on engineering examination of the field samples. The lines designating the interfaces between various strata represent approximate boundaries and the transition between strata may be gradual. It should be noted that the soil conditions will vary between boring locations. Due to the disturbed conditions of the soil samples and the rocky condition of the soils, it was difficult to discern the difference between fill and alluvial soils. The soils have similar appearance and the transition was not easily identifiable. In addition, based on our past experience at the site, we understand that the site was initially stripped of approximately 4 inches of organic material, however, due to our limited involvement after our January 29, 2018 site visit, we are uncertain if the site received any fill soil.

Surface Material

A layer of grass/weed and organic-laden surface soil was encountered in all twelve soil test boring locations and ranged in depth from 3 to 5 inches.

Cultivated Soil/Alluvium

Soil interpreted as, cultivated soil/alluvium was encountered at all twelve boring locations to depths of between 3 feet and 8 feet (auger refusal) below the existing ground surface. The material generally consisted of silty sand with cobbles and rock fragments. SPT blow counts ranged from 8 to over 50 blows per foot (bpf). The cobbles and rock fragments in the soil matrix are believed to have inflated the blow counts (N-values). The encountered soil was generally free of organics and deleterious materials, but it should be noted that the content and quality of these soils can vary significantly.

Material sufficiently hard to cause refusal to the power auger drilling equipment was encountered in all twelve soil test borings at depths of between 3 feet and 8 feet below the ground surface. Borings B-1, B-2, B-3, B-5, B-6 and B-10 were offset and encountered similar refusal depths. Refusal may result from boulders, lenses, ledges or layers of relatively hard rock underlain by partially weathered rock or residual soil; refusal may also represent the surface of relatively continuous bedrock. However, refusal is believed to have been caused by the presence of the cobbles and/or rock fragments in the soil matrix. Core drilling procedures and/or test pit excavations performed by a large track hoe are required to penetrate this material and determine their character and continuity. Core drilling or excavation of test pits with a large track hoe were beyond the current scope of this exploration.

Groundwater was not encountered in the soil test borings at the time of drilling. Because these borings refused at shallow depths and the encountered soil was dry, these borings were backfilled shortly after drilling thus precluding 24-hour groundwater measurements. It should be noted that groundwater levels may fluctuate several feet with seasonal and rainfall variations and with changes in the water level in nearby Jonathan Creek. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall. Groundwater level will also fluctuate due to construction activity.

PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

These preliminary recommendations have been developed from the obtained boring data, our experience with similar soil conditions, and the assumed foundation loading. Additional soil test borings, laboratory testing and analysis may be needed as the project advances. Assuming subsurface conditions encountered at the boring locations are representative of subsurface conditions elsewhere on the site the following preliminary conclusions and recommendations should generally be applicable for this site.

Assessment

The site generally consists of cultivated soils underlain by moderate consistency alluvial soils. The approach to building support will ultimately depend on the selected type of structure and the thickness of fill placed to raise grade. From a geotechnical perspective, thicker fill depths are preferable; ideally there would exist at least 5 feet of engineered fill between the bottom of the footing and the underlying alluvial soils. This could alleviate the need for foundation improvements for lightweight, flexible buildings after grading is complete. Depending on the final elevation of the foundations, footings may bear in new fill or in the existing soil. Provided building loads do not exceed that outlined in this report and that foundation bearing soils are closely evaluated by BLE during construction, it is anticipated that a shallow foundation system can be used to be support the buildings, though field modifications should be planned for, particularly where foundations will bear in or below the existing soils. The approach to building support will ultimately depend on the selected type of structure. Light metal buildings can likely be supported by partial undercut and replacement methods, if some potential for settlement is tolerable. Heavier, span deformation intolerant structures may require more methodical soil improvement, such as aggregate piers.

Stripping activities will need to balance the need to remove organic laden soils without excessively disturbing the subgrade. Site preparation measures will be heavily dependent on prevailing weather conditions at the time of grading, as cultivated soils are highly moisture-sensitive. If groundwater is encountered remedial subgrade stabilization will need, BLE should be contact if ground water is encountered and appropriate recommendations can be made based on the encountered conditions.

Please note it is possible that these borings may not fully represent the conditions across the entire site. Our experience has been that soft or loose pockets of soil may be encountered between the test locations. Likewise, uncontrolled fill and or disturbed soils may also be encountered on the site. We recommend that an allowance be budget to perform remedial repair on some of the existing soils.

Once the site layout and building designs are finalized, we recommend that additional exploration be performed by the geotechnical engineer at the time of construction to confirm the presence of suitable soils. The additional exploration should consist of test pits.

Foundations – Preliminary Design Parameters

Lightweight, flexible structures can be supported on shallow foundations bearing in evaluated and approved existing fill and/or alluvial soils with some modifications, provided the maximum column loads do not exceed 50 kips and 2 kips per linear foot. Foundations may be sized for a uniform allowable bearing pressure of 2,000 psf, subject to the criteria and site preparation recommendations in this report. Widespread over-excavation of foundation excavations and replacement with crushed washed stone should be anticipated. Very heavy and/or settlement-sensitive structures could require intermediate or deep foundation support, but the need for this will vary depending on the magnitude of the loads, site location and the foundation bearing depth. Once a building layout is established and detailed foundation loads and bearing elevations are determined, we can provide more specific recommendations. As these are preliminary recommendations, we have not performed a detailed settlement evaluation.

We recommend that the minimum widths for individual column and continuous wall footings be 24 and 18 inches, respectively. The minimum widths are considered advisable to provide a margin of safety against a local or punching shear failure of the foundation soils. Exterior/perimeter footings should bear at least 30 inches below final exterior grade for embedment needed to develop the recommended allowable design bearing pressure range and to provide frost protection. Interior footings beneath heated space that will be protected from frost heave should bear at least 16-inches below the floor slab. We recommend that bearing elevations in sloping areas be selected such that the footings have at least 5 feet of soil cover measured horizontally to the slope face. This may result in the footings bearing deeper than the recommended minimum frost embedment depth to provide 5 feet horizontally from a slope face.

We recommend that foundation excavations be observed and tested by an experienced engineering technician working under the direction of the BLE geotechnical engineer. This observation will document that the design bearing conditions are present and allow recommendations for any needed adjustments in foundation size or bearing elevation to be made at specific locations. There will be areas encountered where foundation bearing capacity will need to be improved prior to constructing the footing. This may include increasing the foundation size, lowering the foundation bearing elevation, or over-excavating and replacing soft soils with either compacted aggregate, engineered fill or concrete.

Grade Slab

Conventional grade slabs may be supported on properly compacted fill assuming that the site is prepared in accordance with the recommendations in this report. It is recommended that the slab on grade be uniformly supported on a layer of aggregate base coarse, as specified in the North Carolina Department of Transportation Standard Specifications for Roads and Structures, 2012 Edition. Based on previous experience with similar soils, a maximum modulus of subgrade reaction (k) equal to 100 pounds per cubic inch should be used for design of slabs on properly prepared subgrades supported by an adequate depth of base coarse. Completed slabs should be protected from excessive surface moisture prior to and during periods of prolonged below-freezing temperatures to prevent subgrade freezing and resulting heave.

GENERAL GRADING RECOMMENDATIONS

Site Preparation

Existing cultivated soil and other plant growth, disturbed soils and surface soils containing organic matter or other deleterious materials should be stripped from within the proposed fill areas. A stripping depth of 4-inches can be assumed for preliminary evaluation of grading costs. However, we recommend that a number of shallow test pits be excavated through the site to confirm this assumed depth. After stripping, we recommend that areas to provide support for the structural fill be carefully inspected by BLE for soft surficial soils and proofrolled with a 25 to 30 ton, four wheeled, rubber-tired roller, dump truck or similar approved equipment. The stability of the subgrade will vary across the site, with some areas being marginally stable, and other areas being soft and unstable under wheel loads and will also be highly depended on the weather at the time of construction. Areas where unstable subgrade material is encountered should be stabilize before commence of any overlying fill soil or prior to the commencement of construction. We anticipate that subgrade stability can typically be achieved by undercutting portion of the unsuitable soils (the depth of undercutting should be determined in the field by BLE at the time of construction) and backfilled with properly compacted new fill. A heavy woven geotextile or biaxial geogrid may also be required along with the use of crushed rock to provide a suitable subgrade. As such we recommend that an allowance be budgeted to undercut some of the existing soils and performed remediation as generally noted above. The proofrolling and excavating operations should be carefully monitored by an experienced engineering technician working under the direction of the geotechnical engineer. Proofrolling should not be performed when the ground is frozen or wet from recent precipitation.

Excavation and Ground Water Control

Confined excavations such as for utility installation should conform to OSHA regulations. All excavations should be sloped or shored in accordance with local, state, and federal regulations, including OSHA (29 CFR Part 1926) excavation trench safety standards. The contractor is solely responsible for site safety.

The borings did not encounter groundwater within the depths explored, but should be anticipated during deep utility installation or possible undercutting operations. Excavations could also encounter perched groundwater within the existing fill/alluvial material. Contractors will need to be prepared to control groundwater by means and methods appropriate to the task at hand. The contractor should also be prepared to promptly remove surface water from the general construction area.

If perched or high ground water levels are encountered, installation of french drains around the site may help lower the ground water within the site and capture perched water that may be above the general groundwater level. A french drain can be constructed by excavating a trench, lining the trench with filter fabric (Mirafi 140N or equal), backfilling the trench with about 6 inches of washed, crushed size No. 57 stone, placing a perforated pipe in the stone, filling over top of the pipe with an additional 12 inches of stone, wrapping the fabric over the top of the crushed stone, and then covering the drain with soil. The drains should be sloped toward an outlet on the low side of the site or tie into the storm drain system. BLE should be consulted, if higher than anticipated groundwater levels are encountered.

Engineered Fill

Fill used for raising site grades should be uniformly compacted in thin lifts to at least 95 percent of the ASTM D-698 maximum dry density. The upper 12 inches of subgrade fill beneath the floor slabs and parking areas should be compacted to at least 98 percent of the maximum dry density. As a rule, the moisture content of the fill soils compacted to 95 percent of the standard maximum dry density should be maintained within plus or minus 3 percent of the optimum moisture content as determined from the standard compaction test. This provision may require the contractor to dry soils during periods of wet weather or to wet soils during dry periods. The fill soils should have a Plasticity Index (PI) of less than 30, and a maximum dry density of no less than 90 pounds per cubic foot (pcf). Fill soils should contain no more than 3 percent organic matter by weight.

Based on our off-site borrow study (Dennis Farm Road Property) addressed under separate cover, the potential borrow site soil is a suitable source for structural fill. The laboratory data indicates that the soils are within plus or minus 3 percent of the optimum moisture content. However, it should be noted that moisture contents on a grading project will be dictated to some degree by the prevailing weather at the time of construction.

If additional borrow sites will be used for fill import, representative samples of each proposed fill material should be collected and tested to determine the compaction and classification characteristics, prior to being utilized on site. Once compaction begins, a sufficient number of density tests should be performed by an experienced engineering technician working under the direction of the geotechnical engineer to measure the degree of compaction being obtained.

Subgrade surface soils can deteriorate and lose their support capabilities when exposed to environmental changes. Deterioration can occur in the form of freezing, formation of erosion gullies, extreme drying, exposure for a long period of time or rutting by vehicular traffic. We recommend that the surface subgrades that have deteriorated or softened be recompacted and reassessed by BLE prior to construction of the proposed structure. Additionally, any excavations through the subgrade soils (such as utility trenches) should be properly backfilled in compacted lifts.

BASIS OF RECOMMENDATIONS

Our evaluation and recommendations for this preliminary geotechnical exploration has been based on our understanding of the project and site information and data obtained in our exploration and provided to us. The general subsurface conditions utilized in our evaluations and analyses are based on interpolation of subsurface data between the widely spaced borings.

Once the site plan and building design are finalized, we recommend a number of test pits be performed and observed by BLE prior to grading activities, particularly to evaluate the depth and character of the existing fill/alluvial.

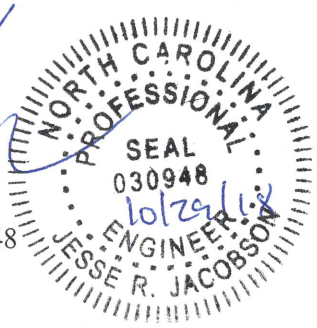
CLOSING

We appreciate the opportunity to provide our professional services on this project. We look forward to providing additional services as the project progresses. If you have any questions regarding this preliminary report, please do not hesitate to call us.

Sincerely,
BUNNELL-LAMMONS ENGINEERING, INC.
Firm Registration No. C-1538

Sam C. Interlicchia
Project Manager

Jesse R. Jacobson, P.E.
Asheville Branch Manager
NC Registration No. 030948



Attachments:

APPENDIX:

Boring Location Plan
Soil Test Boring Records
Field Exploration Procedures
Key To Soil Symbols and Classification

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Approximate Soil Test Boring Locations

Reference Drawing: Drawing provided by McGill Associates

Drawn By: SCI	Date: 8/27/2018	Revisions			BLE INC.	Boring Location Plan Dennis Hall Property Waynesville, North Carolina	Figure No. 1
		No.	Description	By			
Checked By: JRJ	Job No: J18-12047-02						
					BUNNELL-LAMMONS ENGINEERING, INC. GEOTECHNICAL, ENVIRONMENTAL, AND CONSTRUCTION MATERIALS CONSULTANTS 130 OVAL ROAD, SUITE 200 • ARDEN, NORTH CAROLINA 28704 • (828) 277-0100		

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-1

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02

CLIENT: Haywood County — START: 08/07/18 END: 08/07/18

LOCATION: Waynesville, NC — ELEVATION:

DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia

DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger

DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Dense, damp, grayish brown, silty fine to coarse SAND with rock fragments - (cultivated soil)		15 22 12	
5			22 32 50/2	50/2
	Auger refusal at 5.5 feet. Offset similar refusal depth. No groundwater encountered at time of boring.			
10				
15				

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BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-2

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02

CLIENT: Haywood County — START: 08/07/18 END: 08/07/18

LOCATION: Waynesville, NC — ELEVATION:

DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia

DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger

DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Dense, damp, brownish gray, silty fine to coarse SAND (SM) with rock fragments - (cultivated soil)			16 22 35
5	Auger refusal at 3 feet. Offset similar refusal depth. No groundwater encountered at time of boring.			
10				
15				

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BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-3

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02

CLIENT: Haywood County — START: 08/07/18 END: 08/07/18

LOCATION: Waynesville, NC — ELEVATION:

DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia

DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger

DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Very dense, damp, grayish brown, silty fine to coarse SAND (SM) with rock fragments - (cultivated soil)		22 35 42	●
5	Auger refusal at 3 feet. Offset similar refusal depth. No groundwater encountered at time of boring.			
10				
15				

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BLB INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-4

PROJECT: Jonathan Creek Soil Reclaimation
PROJECT NO.: J18-12047-02
CLIENT: Haywood County
START: 08/07/18 END: 08/07/18
LOCATION: Waynesville, NC
ELEVATION:
DRILLER: METRO DRILL, INC., Tim & Ryan
LOGGED BY: S. Interlicchia
DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger
DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Very dense, dark grayish brown, silty fine to coarse SAND (SM) with rock fragments - (cultivated soil)		15 22 38 50/4	50/4
5	Auger refusal at 4.5 feet. No groundwater encountered at time of boring.			
10				
15				

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BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-5

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02
CLIENT: Haywood County — START: 08/07/18 END: 08/07/18
LOCATION: Waynesville, NC — ELEVATION:
DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia
DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger
DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Very dense, tan brown, silty fine to coarse SAND (SM) with rock fragments - (cultivated soil)		35 42 48	
5	Auger refusal at 3 feet. Offset similar refusal depth. No groundwater encountered at time of boring.			
10				
15				

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BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-6

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02
CLIENT: Haywood County — START: 08/07/18 END: 08/07/18
LOCATION: Waynesville, NC — ELEVATION:
DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia
DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger
DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Dense, dark brown, silty fine to coarse SAND (SM) with rock fragments - (cultivated soil)		15 22	
5	Auger refusal at 3 feet. Offset similar refusal depth. No groundwater encountered at time of boring.			
10				
15				

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-7

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02
CLIENT: Haywood County — START: 08/07/18 END: 08/07/18
LOCATION: Waynesville, NC — ELEVATION:
DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia
DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger
DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Loose to very firm, brown to dark brown, silty fine to coarse SAND (SM) with scatterered rock - (cultivated soil)			6 7 6 8 10 15
5	Dense, tan, silty fine to coarse SAND (SM) with rock fragments - (possible alluvium)			15 22 28
	Auger refusal at 8 feet. No groundwater encountered at time of boring.			
10				
15				

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BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-8

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02

CLIENT: Haywood County — START: 08/07/18 END: 08/07/18

LOCATION: Waynesville, NC — ELEVATION:

DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia

DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger

DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Firm to very dense, dark brown, silty fie to coarse SAND (SM) with rock fragments - (cultivated soil)		7 8 11 50/5.5	50/5.5
5				
	Auger refusal at 6 feet. No groundwater encountered at time of boring.			
10				
15				

GEOT_NOWELL 12047-02A.GPJ 8/29/18

BLB INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-9

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02

CLIENT: Haywood County — START: 08/07/18 END: 08/07/18

LOCATION: Waynesville, NC — ELEVATION:

DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia

DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger

DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL			
	Very dense, grayish brown, slightly micaceous, silty fine to coarse SAND (SM) with rock fragments - (cultivated soil)			22 28 32
				22 28 38
5				
	Auger refusal at 5.5 feet.			
	No groundwater encountered at time of boring.			
10				
15				

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-10

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02

CLIENT: Haywood County — START: 08/07/18 END: 08/07/18

LOCATION: Waynesville, NC — ELEVATION:

DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia

DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger

DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Very dense, tan brown, silty fine to coarse SAND (SM) with rock fragments - (cultivated soil)		15 22 35	
5	Auger refusal at 3 feet. Offset similar refusal depth. No groundwater encountered at time of boring.			
10				
15				

GEOT_NOWELL 12047-02A.GPJ 8/29/18

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-11

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02

CLIENT: Haywood County — START: 08/07/18 END: 08/07/18

LOCATION: Waynesville, NC — ELEVATION:

DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia

DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger

DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL Dense, grayish brown, silty fine to coarse SAND (SM) with rock fragments - (cultivated soil)		18 25 25	●
5			35 21 20	●
	Auger refusal at 6 feet. Offset similar refusal depth. No groundwater encountered at time of boring.			
10				
15				

GEOT_NOWELL 12047-02A.GPJ 8/29/18

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL BORING NO. B-12

PROJECT: Jonathan Creek Soil Reclaimation — PROJECT NO.: J18-12047-02
CLIENT: Haywood County — START: 08/07/18 END: 08/07/18
LOCATION: Waynesville, NC — ELEVATION:
DRILLER: METRO DRILL, INC., Tim & Ryan — LOGGED BY: S. Interlicchia
DRILLING METHOD: CME 45, 2 1/4" Hollow Stem Auger
DEPTH TO - WATER> INITIAL: ▽ _____ AFTER 24 HOURS: ▼ _____ CAVING> _____

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
	3 inches ROOTS/TOPSOIL			
	Loose, damp, dark brown to gray, very silty fine to medium SAND (SM) - (cultivated soil)		5 5 5	●
			3 4 4	●
5	Loose, damp, grayish reddish brown, silty fine to medium SAND (SM) - (possible alluvium)		4 5 5	●
	Auger refusal at 8 feet. Offset similar refusal depth. No groundwater encountered at time of boring.			
10				
15				

Field Exploration Procedures

SOIL TEST BORINGS

The borings were made by mechanically twisting a continuous flight steel auger into the soil. Soil sampling and penetration testing were performed in accordance with ASTM D-1586. At assigned intervals, soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches was recorded and is designated the "standard penetration resistance." The penetration resistance, once properly evaluated, is an index to the strength of the soil and foundation supporting capability. Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined by a geotechnical engineer and visually classified. Soil Test Boring Records are attached showing the soil descriptions and penetration resistance.

KEY TO SOIL CLASSIFICATIONS AND CONSISTENCY DESCRIPTIONS

BUNNELL-LAMMONS ENGINEERING, INC.
ASHEVILLE, NORTH CAROLINA

Penetration Resistance* Blows per Foot	Relative Density
SANDS	
0 to 4	Very Loose
5 to 10	Loose
11 to 20	Firm
21 to 30	Very Firm
31 to 50	Dense
over 50	Very Dense

Penetration Resistance* Blows per Foot	Consistency
SILTS and CLAYS	
0 to 2	Very Soft
3 to 4	Soft
5 to 8	Firm
9 to 15	Stiff
16 to 30	Very Stiff
31 to 50	Hard
over 50	Very Hard

*ASTM D 1586

Particle Size Identification

Boulder: Greater than 300 mm
Cobble: 75 to 300 mm
Gravel:
Coarse - 19 to 75 mm
Fine - 4.75 to 19 mm
Sand:
Coarse - 2 to 4.75 mm
Medium - 0.425 to 2 mm
Fine - 0.075 to 0.425 mm
Silt & Clay: Less than 0.075 mm

12	Number of blows in first 6-inches
15	Number of blows in second 6-inches
16	Number of blows in third 6-inches

KEY TO DRILLING SYMBOLS


Grab Sample


Split Spoon Sample


Undistrurbed Sample


Groundwater Table at Time of Drilling

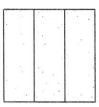

Groundwater Table 24 Hours after Completion of Drilling

KEY TO SOIL CLASSIFICATIONS


Well-graded Gravel
GW

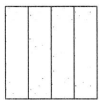

Low Plasticity Clay
CL

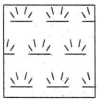

Clayey Silt
MH


Silty Sand
SM

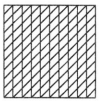

Poorly-graded Gravel
GP

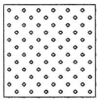

Sandy Clay
CLS

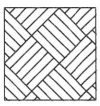

Sandy Silt
MLS


Topsoil
TOPSOIL

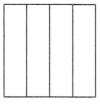

Partially Weathered Rock
BLDRCBBL

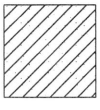

Silty Clay
CL-ML


Sand
SW


Bedrock
BEDROCK


High Plasticity Clay
CH


Silt
ML


Clayey Sand
SC


Concrete
A5