GREENBAUM ASSOCIATES, INC.
GEOTECHNICAL & MATERIALS ENGINEERS
994 Longfield Avenue
Louisville, Kentucky 40215
502/361-8447
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October 6, 2020

Mr. Brendan McAuliffe
RLM Construction Company, Inc.
3522 Frankfort Avenue
Louisville, KY 40207

Re: Geotechnical Investigation
Olmsted Place Subdivision
2050 Millvale Road
Louisville, Kentucky
Project Number 20-194G

Dear Mr. McAuliffe:

Attached is the report of the geotechnical investigation that we carried out for the above referenced single-family residential development. Soils at this site are relatively stiff and competent to support spread footings designed based on an allowable, net bearing capacity of up to 2,000 pounds per square foot. This site slopes so gently that there is no concern with slope stability given the geology of the site.

Soil bearing foundations and other geotechnical considerations are discussed in detail in the body of the attached geotechnical report.

If you have any questions in regard to this report, please call.

Sincerely,

GREENBAUM ASSOCIATES, INC.

Sandor R. Greenbaum

Sandor R. Greenbaum, P.E.
Principal Engineer

GEOTECHNICAL INVESTIGATION

FOR

OLMSTED PLACE SUBDIVISION

2050 MILLVALE ROAD

LOUISVILLE, KENTUCKY

FOR

RLM CONSTRUCTION COMPANY, INC.

3522 FRANKFORT AVENUE

LOUISVILLE, KENTUCKY 40207

BY

GREENBAUM ASSOCIATES, INC.

994 LONGFIELD AVENUE

LOUISVILLE, KENTUCKY 40215

OCTOBER 6, 2020

STATE OF KENTUCKY
SANDOR R. GREENBAUM
15067
LICENSED
PROFESSIONAL ENGINEER

Table of Contents

APPENDIX

1.0 Introduction

RLM Construction Company, Inc. has acquired a ±4.9-acre parcel of land located at 2050 Millvale Road in the Highlands neighborhood of Louisville, Kentucky. The site is to be developed into a six-lot, single-family, residential subdivision. A boring location plan is included in the appendix of this report that shows the proposed development and approximate boring locations. A site location plan is also included in the appendix.

This site is undeveloped and covered by turf with wooded sections. The topography is that of a gently sloping hillside with elevation ranging from 520 near the center of the south property line to 480 at the northwest corner and 490 at the northeast corner of the property. Slopes are generally in the range of 9- to 12-percent in areas proposed for construction of residences. Slopes are 17- to 18-percent in the northeast and northwest corners, away from areas proposed for construction other than the entrance drive in the northeast corner of the site.

We were contracted by RLM Construction Company, Inc. to carry out a geotechnical investigation directed at determining the foundation and pavement support characteristics of the materials upon which this single-family, residential development will be supported. Work was coordinated through Messrs. Brendan and Bob McAuliffe of RLM Construction Company, Inc.

2.0 General Geology

Soils at this site are shown by the Kentucky Geological Survey to be residuum, the residual product of weathering of the local bedrock. Bedrock is shown to be the Louisville Limestone which the Geological Survey describes as:

> Dolomitic limestone, light gray, yellowish gray, and light brownish gray, mottled medium dark gray; weathers yellowish gray and grayish orange to very pale orange; micro-grained to fine grained; very thin to thick bedded; stylolitic. Bedding locally nodular or thinly laminated. Six to 10 feet above base is persistent shaly zone 1 to 2 feet thick. Fossils, commonly as casts, include the distinctive chain coral Halysites, the brachiopod Conchidium, stromatoporoids, and colonial corals such as Arachvophyllum and Favosites. Calcite filled joints half an inch wide trend N. 10? E., extend into overlying Jeffersonville Limestone; rare calcite filled vugs as much as 0.5

foot across; chert locally common in discontinuous 0.2-foot thick layers in upper part. Unit forms distinctive northwest inclined plain in southeastern part of quadrangle. Basal contact distinct; exposed at only three localities in quadrangle: in underground mine at quarry northeast of Poplar Level Road interchange of Watterson Expressway, in tributary to Fern Creek in southeastern part of quadrangle, and along Middle Fork Beargrass Creek in Cherokee Park.

3.0 Investigation

Eleven borings were carried out across the site by standard penetration procedures to auger refusal. A Diedrich D-25 track-mounted drill rig was used to carry out the borings through the use of 3 ¼-inch inside diameter hollow stem augers and an automatic hammer. Boring locations were staked using a nylon tape from existing topography, so boring locations are only as accurate as this procedure allows. In addition, the thickness of the pavement of the existing drive was determined by drilling through the pavement.

The standard penetration procedure involves driving a standard 2-inch diameter split spoon in the formation at selected intervals using a 140-pound hammer falling through 30 inches. The blow counts for each 6 inches of drive, to a total of 18 inches, are recorded and the number of blows for the 12 inches after the first 6 inches is a standard measure of the condition of the soil. As the split spoon is removed from the ground, it retrieves a sample of the soil in a disturbed condition. Nevertheless, this sample is suitable for certain classification tests and is representative of the soils at the depth tested.

Soil samples were returned to the laboratory where a program of testing was carried out. This testing included a grain size analysis, an Atterberg Limits test and a natural moisture determination.

Grain size determination arrives at a curve of grain size against that fraction of the soil that is finer than that particular grain size. It also allows the determination of the clay fraction, silt fraction, sand fraction, etc. in any particular soil sample. Based on this division of grain sizes, the field soils classifications are refined and the boring logs adjusted. In the case of fine grained soils, the soils are largely silt and clay; thus requiring that the soils be suspended in an aqueous medium and the rate at which the particles drop out is measured in order to arrive at the grain size distribution. Silt and clay grains are so fine that sieve analysis alone will not function in this range. The coarse fraction of this sample is separated from the fine and run through a nest of sieves in order to further detail the grain size distribution in the coarse range. In this case only the sieve analysis portion of the test was performed since little sand and silt was present in the soil samples selected for testing.

The Atterberg Limits determination arrives at those moisture contents at which the soil turns from a solid state to a plastic condition (the Plastic Limit) and then from a plastic condition to a liquid condition (The Liquid Limit). The points in question are arrived at by standard procedures that accept specific cohesive and flow properties of the soil as standards for these limits. Knowing the moisture content of the soil in relation to these limits provides a broad measure of the soil strength and soil characteristics. The arithmetic difference between these two limits is called the Plasticity Index and all three together are used for classifying the soils in a number of standard systems.

The natural moisture determination arrives at the in-situ moisture content of the soil and is useful for correlating the strength of various samples of like texture and in conjunction with the Atterberg limits, gives a strong measure of the strength range the soils are likely to be found in.

4.0 Findings

4.1 Boring Results

This site is covered by about 5- to 6-inches of topsoil. Underlying soils are moist, stiff to very stiff, reddish brown, lean clay over most of the site, but moist, brown, loose to medium dense, brown silt was encountered in many areas across the site. Auger refusal was encountered on apparent limestone bedrock between 1.3- and 7.4-feet depth. No groundwater was encountered in any of the borings.

The table below provides a tabulation of N-values as measured by the standard penetration test and corrected for the energy of the automatic hammer. Depth to auger refusal is also indicated.

Depth	B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08	B-09	B-10	B-11
0 – 1.5 ft		7					50/3"			8	8
2 – 3.5 ft	13		30	50/4"	8	9		50/1"	50/3"		
6 – 11.5 ft	50/4"					13					
Refusal	5.5'	2.0'	4.0'	2.8'	3.7'	7.4'	1.3'	3.1'	3.6'	2.0'	5.2'

Drilling through the existing pavement found a very thin pavement section, two inches of asphalt over one inch of crushed stone base course.

4.2 Laboratory Results

A sample of soil from shallow depth was tested and classified and was found to be silt. The result of this testing is summarized in the table below with more detailed results provided in the appendix of this report. Moisture content is shown graphically on the boring logs.

Soil Sample	Grain Size Distribution			Atterberg Limits			Soil Classification	
	Percent Sand	Percent Silt	Percent Clay	Liquid Limit	Plastic Limit	Plasticity Index	Unified	AASHTO
B-06 @ 2′ – 3.5′	1	68	31	30	30	NP	ML	A-4

4.3 Seismicity

By the 2018 edition of the Kentucky/2015 International Building Code for structures supported on rock, this is a Very Dense Soil and Soft Rock Profile, Site Class C. The Spectral Response Acceleration Coefficients, for this area, as provided by U.S.G.S., FEMA Design Parameters are:

$S_S = 0.193$ g $S_{MS} = 0.251$ g $S_{DS} = 0.167$ g

$S_1 = 0.098$ g $S_{M1} = 0.147$ g $S_{D1} = 0.098$ g

5.0 Recommendations

5.1 Foundations

The proposed residences may be supported on spread footings bearing on shallow soil or structural fill placed in accordance with section 5.3 of this report. These foundations may be designed based on an allowable net bearing capacity of up to 2,000 pounds per square foot.

Once foundation bearing surfaces are exposed, an engineer or senior engineering technician from this office should be present to view all bearing surfaces to determine the presence of soft or loose soils. Where soft or loose soils are encountered, undercut will need to extend to firm material or to a level determined to be acceptable by the geotechnical engineer and should be refilled with either lean concrete (fc′ = 2,000 psi) or open-graded stone such as Number 57 stone.

Based on the depths to auger refusal, limestone will probably be present at the foundation bearing level in one or more residences, depending on site grading. Where rock is encountered in foundation bearing surfaces, the rock will need to be excavated to a level at least one foot below the foundation bearing surface and the resulting excavation should be refilled with lean clay, silt or sand compacted to between 88- and 92-percent of the soils maximum dry density as determined by the Standard Proctor Test (ASTM D-698). Foundations bearing directly on rock will undergo negligible settlement, so this rock removal and refill with soil will provide for some compression of this material as a means to reduce differential settlement over that which would occur if portions of the foundations were to bear directly on rock and adjacent portions of foundations on soil.

Soil bearing foundations exposed to weather must bear at least 30 inches below finished grade in order to insulate the bearing strata from freezing. Interior foundations protected from freezing are exempt from this requirement. Continuous footings must be at least 16 inches wide and isolated footings must be at least 24 inches wide.

Settlement of foundations designed based on the above criteria should be below that which is considered acceptable for this type of construction; that is total settlement should be less than one inch and differential settlement should be less than three quarters of an inch. Settlement of rock bearing foundations will be negligible. This estimate of settlement is based on empirical data. Consolidation testing, which can provide a more accurate estimate of settlement, is beyond the scope of this investigation.

For shallow foundations, friction along the base of the footing can be used to resist lateral forces. A friction coefficient of 0.35 may be used, which assumes that the footing concrete is placed directly against the natural cut faces. The coefficient of friction value recommended is an ultimate value and a minimum factor of safety of 1.5 must be applied when determining the allowable sliding resistance.

5.2 Slab-On-Grade

Prior to placement of the fill in the slab area, the subgrade must be proofrolled and carefully examined by a geotechnical engineer for areas of soft or loose soil. If soft or loose soils are encountered, they must be undercut and refilled in accordance with instructions given by the geotechnical engineer's on-site representative. Undercut and refill in soft areas consists of excavating to a depth up to two feet below subgrade elevation and refill should be with "Surge Rock", 6-inch minus or Number 3 stone. Large rock should not be used in areas where trenching will be required to install piping or conduit.

A slab-on-grade that is structurally separated from the walls, columns and foundations is preferable, though thickened slab may be used. Separation of slab-on-grade from foundations will minimize the stress caused by possible differential settlement between the slabs and the foundations and between adjacent slabs. A vapor barrier must be incorporated into the design and at least four inches of Dense Graded Aggregate (DGA) should underlie the slab. The floor slab may be designed based on a Modulus of Subgrade Reaction of 90 pounds per cubic inch.

5.3 Site Preparation and Earthwork

Prior to fill placement all vegetation and topsoil (soil containing more than 4 percent organic content) must be removed from below the area to be filled. Where trees or bushes have been present, the entire rootball should be removed and the resulting excavation should be refilled with soil compacted as described in this section of the report. Then, prior to placement of fill, the exposed subgrade should be proofrolled by a fully loaded tri-axle truck to delineate any yielding or rutting areas that may require treatment such as undercut and refill or drying.

All fill should be placed in lifts not exceeding 8 inches in uncompacted thickness and must be compacted to at least 98 percent of the soils maximum dry density as determined by the Standard Proctor (ASTM D-698). Soil moisture content should be within 2 percent of optimum as determined from the Standard Proctor.

Soil from any off-site borrow sources should be tested and approved by this office prior to being used on the site. Satisfactory borrow materials are those falling in one of the following classifications: GC, SM, SC, ML, or CL. Soil types MH, CH and OH soils and peat are unsatisfactory borrow materials.

The site should be maintained in a well-drained condition both during and after construction. Site grading should provide for drainage of surface run-off away from buildings, other structures and pavement.

The placement of compacted fill should be carried out by an experienced excavator with the proper materials. The excavator must be prepared to adapt his procedures, equipment and materials to the type of project, to weather conditions, and the structural requirements of the engineer. Methods and materials used in summer may not be applicable in winter; soil used in proposed fill may require wetting or drying for proper placement and compaction. Conditions may also vary during the course of a project or in different areas of this site. These needs should be addressed in the project drawings and specifications.

During freezing conditions, the fill must **not** be frozen when delivered to the site. It also must not be allowed to freeze during or after compaction. Since the ability to work the soil while keeping it from freezing depends in part on the soil type, the specifications should require the contractor to submit a sample of his proposed fill before construction starts, for laboratory testing. If the soil engineer determines that it is not suitable, it should be rejected. In general, silty sand, clayey sand, and cohesive/semi-cohesive soils should not be used as fill under freezing conditions. All frozen soil of any type should be rejected for use as compacted fill.

It is important that compacted fill be protected from freezing after it is placed. The excavator should be required to submit a plan for protecting the soil. The plan should include details on the type and amount of material (straw, blankets, extra loose fill, topsoil, etc.) proposed for use as frost protection. The need to protect the soil from freezing is ongoing throughout construction and applies both before **and** after concrete is placed, until backfilling for final frost protection is completed. Foundations placed on frozen soil can experience heaving and significant settlement, rotation, or other movement as the soil thaws. Such movement can also occur if the soil is allowed to freeze **after** the concrete is placed and then allowed to thaw. The higher the percentage of fines (clay and silt) in the fill, the more critical is the need for protection from freezing.

The contractor should be required to adjust the moisture content of the soil to within a narrow range near the optimum moisture content (as defined by the applicable Proctor or AASHTO Test). In general, fill should be placed within 2% of optimum moisture. The need for moisture control is more critical as the percentage of fines increases. Naturally occurring cohesive/semi-cohesive soil are often much wetter than the optimum. Placing and attempting to compact such soils to the specified density may be difficult. Even if compacted to the specified density, excessively wet soils may not be suitable as pavement subgrades due to pumping under applied load. This is especially true when wet cohesive/semi-cohesive soil is used as backfill in utility trenches and like situations. Excessively wet soil in thick fill sections may cause post-construction settlement beyond that estimated for fill placed at or near (±2%) the optimum moisture content.

5.4 Earth Pressures

Any retaining walls should be constructed with a drainage blanket of sand or a synthetic drainage material. Synthetic drainage media should be available from suppliers of geotextile. The wall should be drained at its base by a perforated PVC underdrain or weepholes at a spacing of not more than 10 feet. Where a relatively thin drainage blanket is used, the retaining wall should be designed based on a coefficient of active earth pressure (K_a) of 0.36 and a soil unit weight (γ_w) of 130 pounds per cubic foot. This results in an equivalent fluid pressure of 47 pounds per cubic foot. Where granular backfill completely fills the area defined by a plane extending upward from the base of the wall at a 45 degree angle, the retaining wall may be designed based on a coefficient of active earth pressure (K_a) of 0.27 and a soil unit weight (γ_w) of 130 pounds per cubic foot. This results in an equivalent fluid pressure of 35 pounds per cubic foot.

However, where the wall is restrained from movement, as in the case of building basement walls bearing against the basement slab or building frame, the wall must be designed based on the “at rest” earth pressure. The coefficient of “at rest” earth pressure (K_0) is 0.47 with a soil unit weight (γ_w) of 130 pounds per cubic foot in the case of a thin drainage blanket behind the wall, resulting in an equivalent fluid of 61 pounds per cubic foot unit weight. Where granular backfill completely fills the area defined by a plane extending upward from the base of the wall at a 45 degree angle, the retaining wall may be designed based on a coefficient of “at rest” earth pressure (K_0) of 0.43 and a soil unit weight (γ_w) of 130 pounds per cubic foot. This results in an equivalent fluid pressure of 56 pounds per cubic foot.

The table below summarizes the design earth pressures.

	Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	Coefficient of Earth Pressure at Rest (K_0)	Equivalent Fluid Pressure on Cantilever Walls	Equivalent Fluid Pressure on Braced Walls
Fill Material/Local Soils	0.36	2.77	0.47	47 pcf	61 pcf
Granular Backfill	0.27	3.69	0.43	35 pcf	56 pcf

Surcharge above the wall will add additional load. A uniform surcharge must be multiplied by the appropriate coefficient of earth pressure to determine the additional load applied to the wall.

Any retaining wall design must use appropriate factors of safety. It is critical that drainage be provided as mentioned earlier in this section in order to avoid hydrostatic pressure. Hydrostatic pressure would increase pressure against the wall substantially.

5.5 Light- and Heavy-Duty Pavement

Pavement subgrade should be examined and proofrolled as described under "Floor Slabs". If soft areas are encountered, the soft soils will need to be undercut and refilled in accordance with the instructions of the geotechnical engineer's on-site representative. Soils at this site are silty, so they will become soft readily when exposed to moisture through precipitation or by some other means. Subgrade stabilization was discussed in section 5.2 for slab-on-grade. The same approach should be taken for pavement subgrade, but the requirement for a stable, non-yielding subgrade is even more important in the case of asphalt pavement.

A pavement analysis was conducted using a life cycle of 20 years and a cumulative 18-kip equivalent single axle load of 20,000 for light traffic loads and 160,000 for moderate traffic loads. Recommendations are provided for both flexible and rigid pavement systems. However, rigid pavement should be used in special truck traffic areas, such as those areas which receive frequent traffic by fire trucks. The concrete pavement should extend throughout the areas that require extensive turning and maneuvering of forklifts, box trucks or other trucks like at loading docks and overhead doors. Heavily loaded pavement areas that are not designed to accommodate these conditions often experience localized pavement failures, particularly if flexible pavement sections are used.

The minimum recommended thickness for both hot mixed asphalt concrete (HMAC) and reinforced Portland cement concrete (PCC) pavement sections are presented in the table at the top of the following page for the described light, moderate and special traffic condition.

Recommended Pavement Section					
Component	Light		Moderate		Special
	Rigid	Flexible	Rigid	Flexible	Rigid
Reinforced Portland Cement Concrete (PCC)	5 inches		6 inches		7 inches
Hot Mixed Asphalt Concrete (HMAC)		3 inches		5 inches	
Crushed Limestone Base (Dense Graded Aggregate)	4 inches	8 inches	4 inches	8 inches	4 inches
Prepared Subgrade	6 inches	6 inches	6 inches	6 inches	6 inches

The Portland cement concrete should be air-entrained and conform to ASTM C-94 (Standard Specifications for Ready-Mixed Concrete) and have a minimum compressive strength of 4,000 pounds per square inch. Reinforcing should meet the requirements of ACI.

Hot mix asphalt concrete and Dense Graded Aggregate should meet the requirements of the Kentucky Transportation Cabinet. The top inch of asphalt should be a surface mix, the remainder being a base mix.

5.6 Temporary Earth Slopes or Cuts

Temporary earth cuts necessary to construct foundations or utility lines should be no deeper than 4 feet without benching or sloping. Cuts deeper than this should be sloped no steeper than one horizontal to one vertical or should have benches every 2 feet of height equating to this slope. If vertical faces deeper than 4 feet are used, bracing designed for short term loads may be used. Excavations should comply with OSHA regulations.

5.7 Limitations

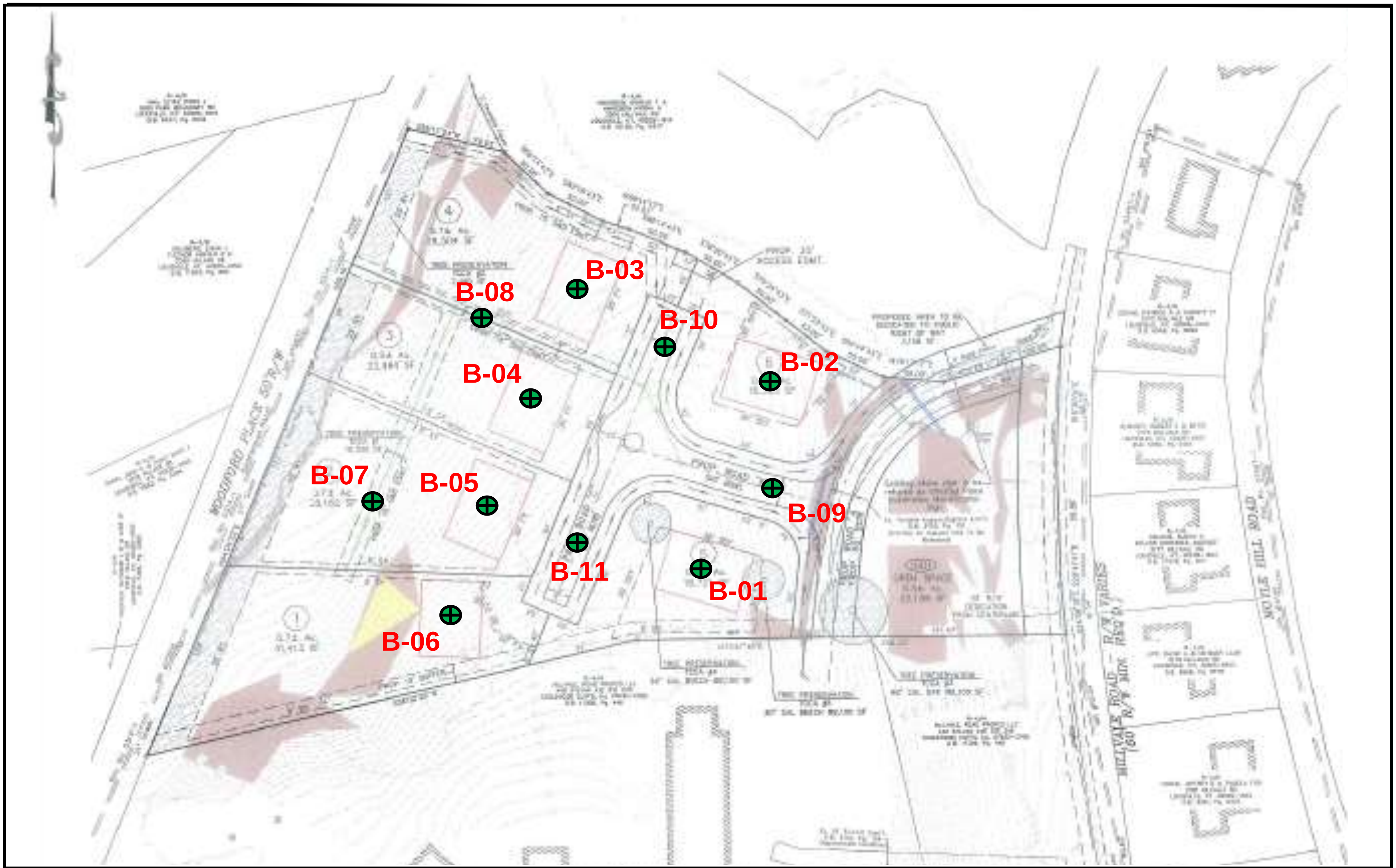
We strongly recommend that bearing surfaces and compaction be monitored by Greenbaum Associates, Inc. Our technicians will be available to further assist you in providing these and other normally specified quality control services. The report is preliminary until such time as these examinations are completed to confirm conditions consistent with those discovered in the investigation.

The conclusions and recommendations offered in this report are based on the subsurface conditions encountered in the borings. No warranties can be made regarding the continuity of conditions between or beyond borings. If, during construction, soil conditions are encountered that differ from those indicated in this report, a representative of Greenbaum Associates, Inc. should inspect the site to determining if design modification is required.

This study was directed at specific single-family residential buildings and associated pavement at specific locations to be constructed within a reasonably short period after this study. Use for any other location, structures or substantial changes in construction period may invalidate the recommendations. The geotechnical engineer should be consulted relative to any substantial change in these.

This study is directed at mechanical properties of the soils and includes no sampling, testing or evaluation for environmental considerations.

RLM Construction Co., Inc.	Greenbaum Associates, Inc.	**Site Location Plan** Olmsted Place Subdivision Louisville, Kentucky Greenbaum Project Number: 20-194G



RLM Construction Co., Inc.	Greenbaum Associates, Inc.	**Boring Location Plan** Olmsted Place Subdivision Louisville, Kentucky Greenbaum Project Number: 20-194G

SOIL DESCRIPTION TERMINOLOGY

Soils are identified and classified in this report according the the Unified Classification System with the following modifiers:

RELATIVE DENSITY OF GRANULAR SOILS

Description	Blows/Foot
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 to 80
Extremely Dense	81+

CONSISTENCY OF COHESIVE SOILS

Description	N-value	q_u (tsf)
Very Soft	0 to 2	0 to 0.25
Soft	3 to 4	0.26 to 0.50
Medium Stiff	5 to 8	0.51 to 1.0
Stiff	9 to 15	1.1 to 2.0
Very Stiff	16 to 30	2.1 to 4.0
Hard	>30	4.1 to 8.0
Very Hard		8.1+

PARTICAL SIZES

Components		Size or Sieve No.
Boulders		over 12 inches
Cobbles		3 to 12 inches
Gravel -	Coarse	$^3/_4$ to 3 inches
	Fine	No. 4 to $^3/_4$ inch
Sand -	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40
Fines (silt and clay)		Finer than No. 200

SOIL MOISTURE

	Descriptive Term
Dry	Dry of Standard Proctor Optimum
Damp	Moist (sand only)
Moist	Near Standard Proctor Optimum
Wet	Wet of Standard Proctor Optimum
Saturated	Free Water in Sample

ROCK DESCRIPTION TERMINOLOGY

The Rock Quality Determination (Deere et. Al., 1969) method of determining rock quality as reported here was obtained by summing up the total length of core recovered in each run, counting only those pieces of core which are four inches (10 cm.) in length or longer and which are hard and sound. The sum is then represented as a percentage over the length of the run. If the core is broken by handling or by the drilling process, the fresh broken pieces are fitted together and counted as one piece provided that they the requisite length of four inches (10 cm.). RQD is reported as a percentage.

RELATIONSHIP BETWEEN RQD AND ROCK QUALITY

RQD (%)	Description of Rock Quality
0 to 25	Very Poor
26 to 50	Poor
51 to 75	Fair
76 to 90	Good
91 to 100	Excellent

Greenbaum Associates, Inc.
Louisville, KY 40215 (502) 361-8447

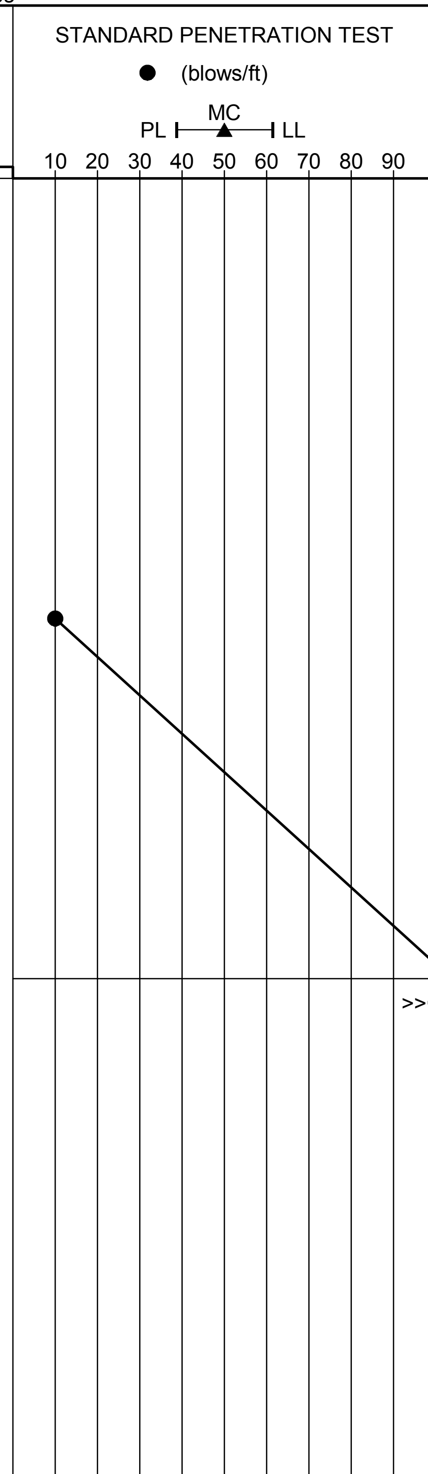
Client: RLM Construction Company
Project: Olmsted Place Subdivision, Louisville, KY
Project No.: 20-194G

HOLE No. B-01

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **5.5** Rock: **0** Total Depth: **5.5**
Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N VALUE
					Topsoil (6 inches)	OL	Ground	
					Moist, Stiff, Reddish Brown, Lean Clay	ML		
		SPT						10
5		SPT						50/ 4"
					AUGER REFUSAL @ 5.5 FEET			



LOG WITH WELL AND SPT GRAPH 20-194.GPJ 08-053.GPJ 10/6/20

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-01**

Greenbaum Associates, Inc.
Louisville, KY 40215 (502) 361-8447

Client: RLM Construction Company Project: Olmsted Place Subdivision, Louisville, KY Project No.: 20-194G	**HOLE No. B-02** Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **2** Rock: **0** Total Depth: **2.0**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST ● (blows/ft) PL ⊢ MC ▲ ⊣ LL 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches)	**OL**	Ground		
		SPT			Moist, Medium Stiff, Reddish Brown, Lean Clay	**CL**		●	5
					AUGER REFUSAL @ 2.0 FEET				

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		**B-02**

Greenbaum Associates, Inc.
Louisville, KY 40215 (502) 361-8447

Client: RLM Construction Company	**HOLE No. B-03**
Project: Olmsted Place Subdivision, Louisville, KY	
Project No.: 20-194G	Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **4** Rock: **0** Total Depth: **4.0**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST ● (blows/ft) PL ⊢ MC ▲ ⊣ LL 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches)	**OL**	Ground		
					Moist, Medium Dense, Brown, Silt	**CL**			
		SPT						●	23
					AUGER REFUSAL @ 4.0 FEET				

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		**B-03**

LOG WITH WELL AND SPT GRAPH 20-194.GPJ 08-053.GPJ 10/6/20

Greenbaum Associates, Inc.
Louisville, KY 40215 (502) 361-8447

Client: RLM Construction Company		**HOLE No. B-04**
Project: Olmsted Place Subdivision, Louisville, KY		
Project No.: 20-194G		Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **2.8** Rock: **0** Total Depth: **2.8**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST ● (blows/ft) PL ⊢ MC ▲ ⊣ LL 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches)	OL	Ground		
					Moist, Very Stiff, Reddish Brown, Lean Clay	CL			
		SPT						>>●	50/ 4"
					AUGER REFUSAL @ 2.8 FEET				

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		**B-04**

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Client: RLM Construction Company Project: Olmsted Place Subdivision, Louisville, KY Project No.: 20-194G	**HOLE No. B-05** Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **3.7** Rock: **0** Total Depth: **3.7**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST ● (blows/ft); PL ⊢ MC ▲ ⊣ LL; 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches)	**OL**	Ground		
					Moist, Medium Stiff, Reddish Brown, Lean Clay	**CL**			
		SPT						●	6
					AUGER REFUSAL @ 3.7 FEET				

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		**B-05**

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Client: RLM Construction Company Project: Olmsted Place Subdivision, Louisville, KY Project No.: 20-194G	**HOLE No. B-06** Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **7.4** Rock: **0** Total Depth: **7.4**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST ● (blows/ft) PL ⊢ MC ▲ ⊣ LL 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches)	**OL**	Ground		
					Moist, Loose, Brown, Silt	**ML**			
		SPT						● ; MC >>	7
5					Same, Medium Dense	**ML**			
		SPT						●	10
					AUGER REFUSAL @ 7.4 FEET				

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	**B-06**
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		

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Client:	RLM Construction Company	**HOLE No. B-07**
Project:	Olmsted Place Subdivision, Louisville, KY	
Project No.:	20-194G	Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **1.3** Rock: **0** Total Depth: **1.3**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST ● (blows/ft) PL ├─▲─┤ LL (MC) 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches)	**OL**	Ground		
		SPT			Moist, Loose, Brown, Silt with Limestone	**ML**		>>●	50/ 3"
					AUGER REFUSAL @ 1.3 FEET				

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		**B-07**

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Client: RLM Construction Company Project: Olmsted Place Subdivision, Louisville, KY Project No.: 20-194G	**HOLE No. B-08** Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **3.1** Rock: **0** Total Depth: **3.1**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST ● (blows/ft) PL ⊢▲⊣ LL (MC) 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches)	**OL**	Ground		
					Moist, Very Stiff, Brown, Lean Clay with Limestone	**CL**			
		SPT						>>●	50/ 1"
					AUGER REFUSAL @ 3.1 FEET				

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		**B-08**

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Client: RLM Construction Company Project: Olmsted Place Subdivision, Louisville, KY Project No.: 20-194G	**HOLE No. B-09** Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **3.6** Rock: **0** Total Depth: **3.6**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION	ELEVATION (feet)	STANDARD PENETRATION TEST ● (blows/ft) PL ├ MC ▲ ┤ LL 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches) **OL**	Ground		
					Moist, Medium Stiff, Brown, Lean Clay **CL**			
		SPT					>>●	50/ 5"
					AUGER REFUSAL @ 3.6 FEET			

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		**B-09**

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Client: RLM Construction Company
Project: Olmsted Place Subdivision, Louisville, KY
Project No.: 20-194G

HOLE No. B-10

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **2** Rock: **0** Total Depth: **2.0**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST ● (blows/ft) PL MC LL 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches)	**OL**	Ground		
		SPT			Moist, Loose, Brown, Silt	**ML**		●	6
					AUGER REFUSAL @ 2.0 FEET				

SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	**B-10**
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		

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Client: RLM Construction Company	**HOLE No. B-11**
Project: Olmsted Place Subdivision, Louisville, KY	
Project No.: 20-194G	Sheet 1 of 1

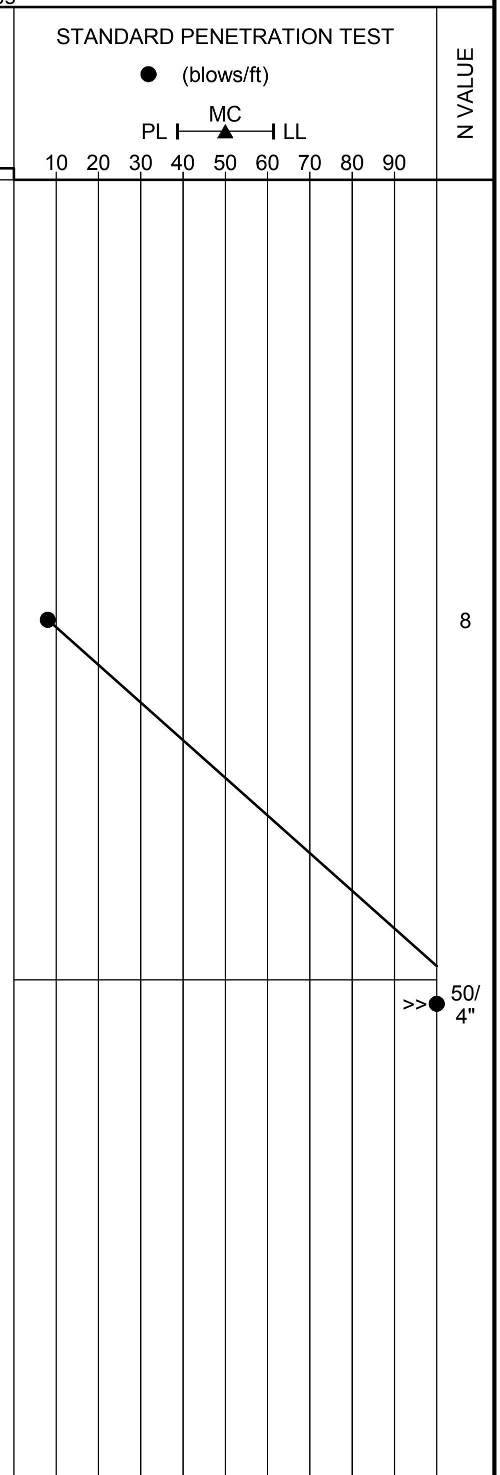
Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **5.3** Rock: **0** Total Depth: **5.3**

Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **9/24/20 - 9/24/20**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N VALUE
					Topsoil (5 inches)	**OL**	Ground	
					Moist, Loose, Brown, Silt	**ML**		
		SPT						8
5		SPT						50/ 4"
					AUGER REFUSAL @ 5.3 FEET			

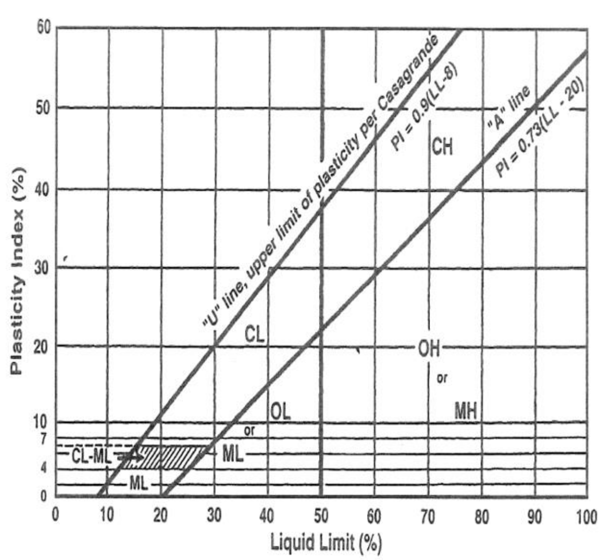


SAMPLER TYPE		DRILLING METHOD		Hole No.
SS - Split Spoon	NX - Rock Core, 2-1/8"	HSA - Hollow Stem Auger	RW - Rotary Wash	
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core	
HQ - Rock Core, 2-1/2"	CT - Continuous Tube	DC - Driving Casing		**B-11**

LOG WITH WELL AND SPT GRAPH 20-194.GPJ 08-053.GPJ 10/6/20

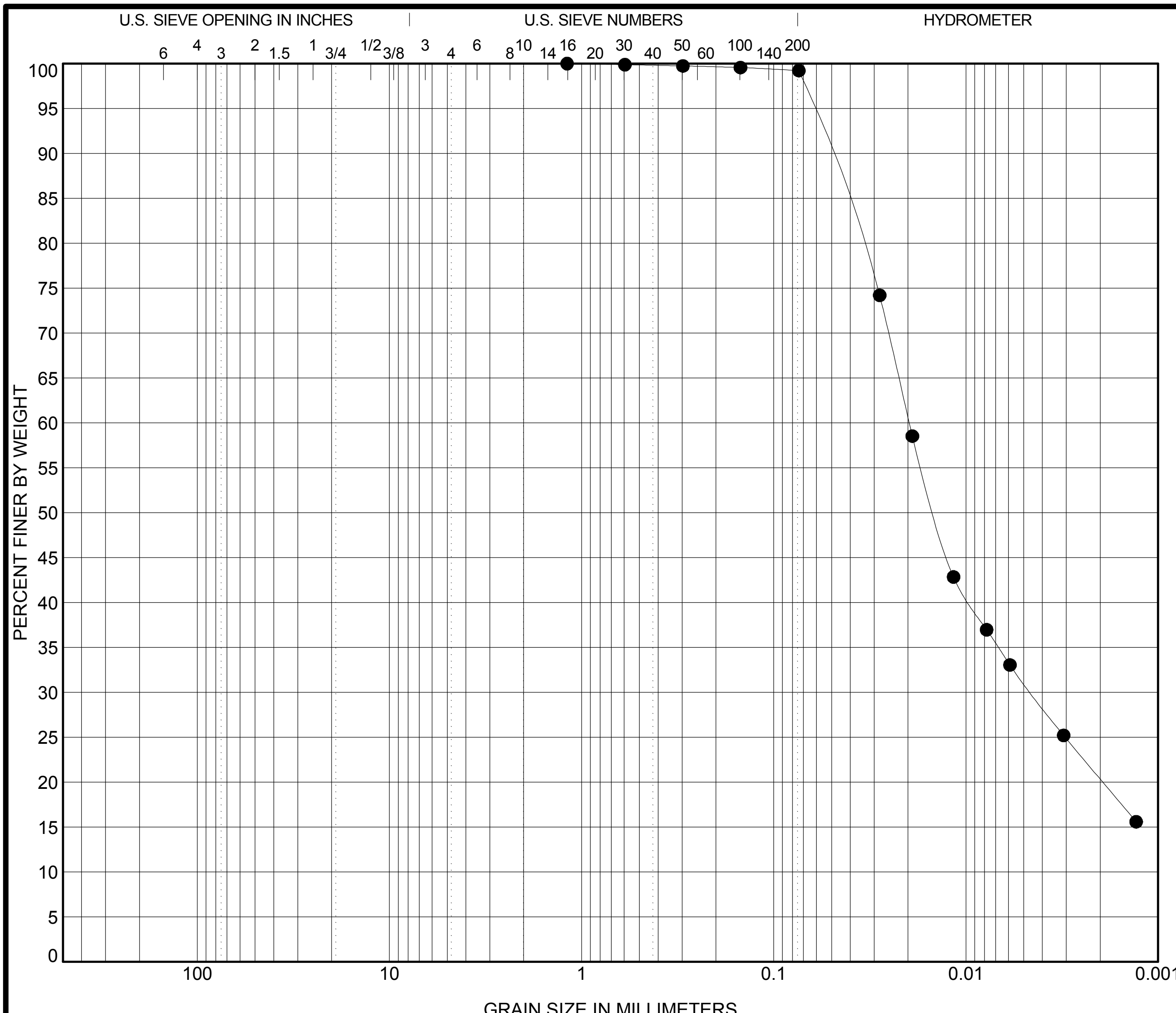
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM D2487 and D2488

Major Divisions			Group Symbols		Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is *larger* than No. 200 sieve size)	**Gravels** (More than half of coarse fraction larger than No. 4 sieve)	**Clean Gravels** (Little or no fines)	**GW**		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller that No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent *Borderline* cases requireing dual symbols[b]	C_u=D_{60}/D_{10} greater than 4 C_u=$(D_{30})^2/(D_{10}\times D_{60})$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	**GM**[a]	d	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line with P. I. less than 4	Above "A" line with P. I. between 4 and 7 are *borderline* cases requireing us of dual symbols
				u				
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line with P. I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	**Clean Sands** (Little or no fines)	**SW**		Well-graded sands, gravelly sands, little or no fines		C_u=D_{60}/D_{10} greater than 6 C_u=$(D_{30})^2/(D_{10}\times D_{60})$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	**SM**[a]	d	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or P.I. < 4	Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requireing use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" lime with P.I. > 7	
Fine-grained soils (More than half meterial is smaller than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		**ML**		Inorganic silts and very fine sands, silty or clayey fine sands, or clayey silts with slight plasticity	 Plasticity Chart		
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL		Organic silts and organic siltyclays of low plasticity			
	Silts and clays (Liquid limit less that 50)		**MH**		Inorganic silts, micaceous or diatomaceous fine sand or silty soils, elastic silts			
			CH		Inorganic slays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		**Pt**		Peat and other highly organic soils			

[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits :suffix d used when L. L. is 28 or less and the P. I. is 6 or les; the suffix u used when L. L. is greater than 28.

[b] Borderline classifications, used for soils possessing characeristics of two groups, are designated by combinations of group symbols. For exampls: GW-GC, well-graded gravel-sand misture with clay binder.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-06	2.5	**SILT(ML)**	**30**	**30**	**NP**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-06	2.5	**1.19**	**0.02**	**0.005**		**0.0**	**0.8**	**68.2**	**31.0**

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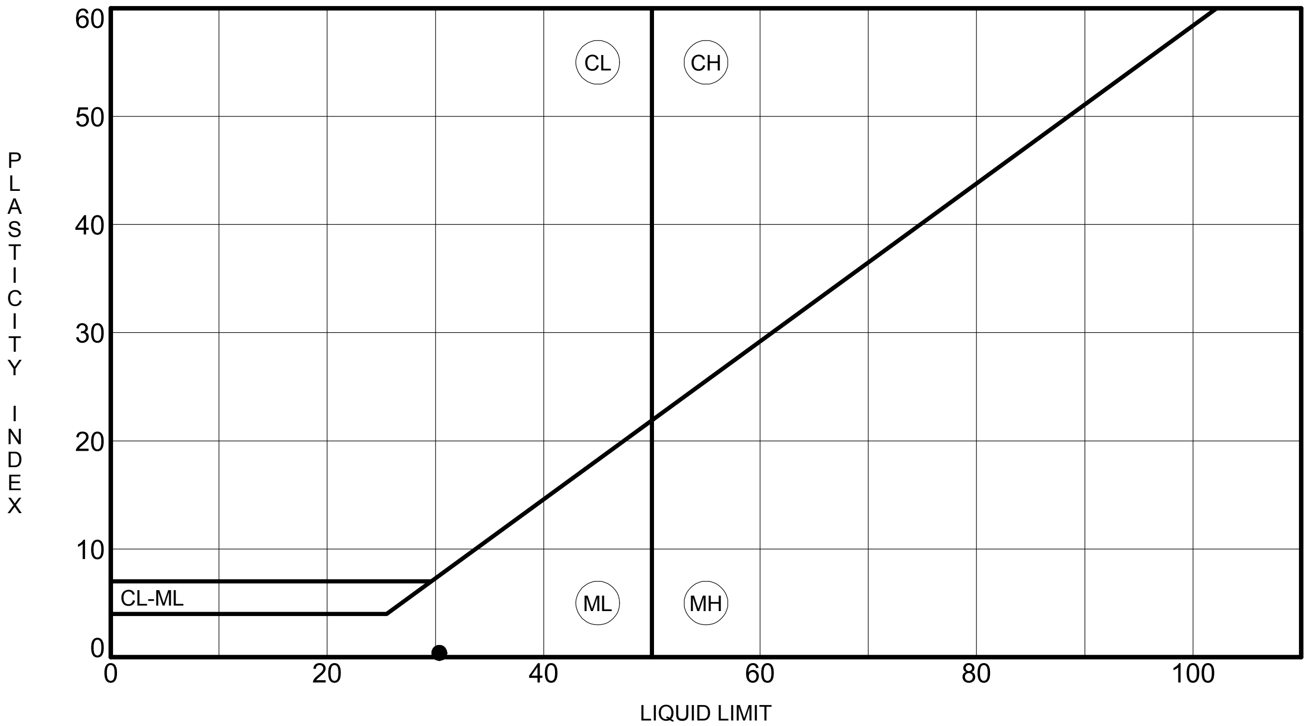
GRAIN SIZE DISTRIBUTION

Project: Olmsted Place Subdivision,

Location: Louisville, KY

Number: 20-194G



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-06**	**2.5**	**30**	**30**	**NP**	**99**	**SILT(ML)**

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ATTERBERG LIMITS' RESULTS

Project: Olmsted Place Subdivision,

Location: Louisville, KY

Number: 20-194G