GEOTECHNICAL INVESTIGATION

FOR

APARTMENT COMMUNITY

SOUTH PARK ROAD

LOUISVILLE, KENTUCKY

FOR

LDG DEVELOPMENT, LLC

1473 SOUTH FOURTH STREET

LOUISVILLE, KY 40208

BY

GREENBAUM ASSOCIATES, INC.
994 LONGFIELD AVENUE
LOUISVILLE, KENTUCKY 40215
DECEMBER 26, 2019





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1.0 Introduction

LDG Development, LLC intends to build a new 312-unit apartment community on a ±18.64-acre tract located at 4011 South Park Road in Louisville, Kentucky. This property consists of two large residential tracts fronting on South Park Road and one parcel fronting on Blue Lick Road. The area is relatively level with the north central portion of the property being overgrown and partially wooded. The new development is to consist of thirteen three-story apartment buildings, a clubhouse, and a pool. A boring location plan is included in the appendix of this report that shows the approximate locations of the borings and the proposed construction. A site location plan is also included in the appendix.

It is our understanding that limestone has been mined from below the property via horizonal mineshafts that extend from the above-ground quarry present on the opposite side of South Park Road. Geotechnical study relating to mining activities below the property was not performed since that is beyond the scope of this investigation. A geophysical survey could be used to determine the presence of mineshafts with rock core borings used to determine the thickness of the overlying bedrock (roof). Such a study could determine the possibility of catastrophic collapse of the mineshaft roof.

No subsidence or erosion feature was observed on the property. Were such a feature present, it could be due to erosion into a karst feature or into a mineshaft.

We were contracted by LDG Development, LLC to carry out a geotechnical investigation directed at determining the foundation support characteristics of the materials upon which these buildings and associated pavement will be supported. Work was coordinated through Ms. Ramona Vasta of LDG Development, LLC.

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 New Albany Shale and Beechwood Limestone, undifferentiated. This property is near the contact with the underlying Louisville Limestone, so the bedrock below the eastern portion of the development is probably the Beechwood Limestone and the New Albany Shale may be present below the western portion of the development.

The Kentucky Geological Survey describes the New Albany Shale as:

Shale, silty, olive black to grayish black, weathers pale yellowish brown or very light gray; massive; dense where fresh, fissile in thin brittle chips where weathered. Pyrite abundant as veinlets or spherules that weather to stain outcrops with brown and yellow iron oxides and sulfates. Phosphate nodules as much as 2 inches in diameter in upper 10 feet; calcareous, clayey and sandy in lower part; quartz in dike like geodiferous fracture fillings in upper 10 to 20 feet. Fossils include conodonts, silicified wood, spores, fish remains, worm markings, and linguloid brachiopods.

The Kentucky Geological Survey describes the Beechwood Limestone as:

Limestone, light gray to light greenish gray, weathers moderate yellowish brown to dark yellowish orange; fossil fragmental, with coarse to very coarse fossil fragments and whole fossils in a very fine grained matrix; very thin to thin bedded, locally cross-bedded, stylolitic; weathers to rounded massive slabs on which slightly resistant dull white fossil remains stand out in sharp relief from brownish matrix. Remains of the crinoid commonly called Dolatocrinus are distinctive. Pyrite common at top and base. Basal contact marked by zone of fossil trash. Contact with underlying unit unconformable. Unit commonly poorly exposed owing to solution by recent weathering or cover by terrace deposits of Quaternary age.

3.0 Investigation

Thirty-six borings were carried out across the site by standard penetration procedures to auger refusal. Diedrich D-25 and GeoProbe 66DT track-mounted drill rigs were used to carry out the borings through the use of 2 ¼-inch inside diameter hollow stem augers and an automatic hammer. The boring locations were staked using a nylon tape from existing topography, so boring locations are only as accurate at this method allows.

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 number of natural moisture determinations.

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 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 6- to 8-inches of topsoil, for the most part, but one boring found 10 inches of topsoil. Below this soil is moist, soft to very stiff, brown or reddish brown, lean clay, sometimes containing ferromagnesian nodules and sometimes a trace of organics in the top three feet. Deeper soils, below 5- to 6-feet depth, frequently contain chert and/or weathered limestone. Soils are generally very stiff below 5- to 6-feet depth. Auger refusal on apparent bedrock was encountered between 5.5- and 14.8-feet depth.

The soils are softest in the portion of the property that appears as a panhandle extending westward from the main property to Blue Lick Road, This

area is planned for the clubhouse, pool and one apartment building. Elsewhere, shallow soils at the probable foundation bearing level were found to be soft only in borings B-15 and B-33, though there were areas where soils are soft above 2.5 feet depth, possibly the foundation bearing level if these areas are to be filled. However, the vertical extent of these softer soils is limited allowing these soils to be removed and replaced by means of undercut and refill where encountered in foundation bearing surfaces. The more extensive soft soils in borings B-01 through B-05 will limit bearing capacity in this area.

The table below, and continued at the top of the following page, 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 provided.

Depth	B-01 I	3-02	B-03	B-04	B-05	B-06	B-07	B-08	B-09
1 – 2.5 feet	4	5	3	4	5	2	5	7	. 7
3 – 4.5 feet	7	7	9	7	8	17	27	14	12
6 – 7.5 ft	10	21	17	21	18	17	29	18	29
8.5 – 10 ft	50/2"	8		13	50/2"	50/3"	50/3"		25
Refusal	9.8'	10.3'	8.5'	10.5'	8.6'	9.8'	9.8'	8.0'	11.3'

Depth	B-10 B-11 B-12 B-13 B-14 B-15 B-16 B-17 B-18
1 – 2.5 feet	40 13 10 17 9 7
2 – 3.5 feet	7 18 18
3 – 4.5 feet	16 36 20 21 12 17
5 – 6.5 feet	9 26 25
6 – 7.5 feet	16
Refusal	6.6' 8.4' 9.3' 7.2' 8.4' 5.5' 7.7' 7.8' 8.0'

Depth	B-19 B-20 B-21 B-22 B-23 B-24 B-25 B-26 B-27
1 - 2.5 feet	4 5 7 7 4
2 – 3.5 feet	14 21 23 20
3 – 4.5 feet	20 10 27 18 13
5 – 6.5 feet	16 27 29 26
6 – 7.5 feet	21 20 17 22 50/4"
8.5 – 10 feet	5 15 13 22
Refusal	11.0' 14.8' 10.8' 11.0' 7.5' 7.7' 6.8' 6.9' 8.1'

Depth	B-28	B-29	B-30	B-31	B-32	B-33	B-34	B-35	B-36
1 – 2.5 feet	20	13		13	18	4	7	5	
2 – 3.5 feet	100 12 12 13 13 13 13 13 13 13 13 13 13 13 13 13		12						21
3 – 4.5 feet	46	31		30	20	8	17	13	
5 - 6.5 feet			9						48
6 – 7.5 feet						23	27	26	
8.5 - 10 feet						14	25		
10 – 11.5 ft.		**************************************	9						
Refusal	8.0'	7.5'	13.1'	7.8'	6.6'	10.5'	10.3'	8.5'	7.9'

No groundwater was encountered in any of the borings, but water is known to have flooded the mineshafts present below the property.

4.2 Laboratory Results

A sample of soil from shallow depth was tested and classified and was found to be lean clay. 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.

	Grain Size Distrib	ution Atte	rberg Limits	Soil Classification			
Soil Sample	t Sand nt Sillt	t Clay	istic Limit lasticity Index		HT0		
	Percent (Percent Liquid 1	Plastic Li Plasticii Index	Chiffed	AASHTO		
B-24 @ 2' - 3.5'	10 45	45 37	19 18	CL	A-6		

4.3 Historic Aerial Photographs

Aerial photographs, available on Google Earth, dating back to 1993 are available. The portion of the property that is overgrown was relatively clear through 2006, at which point it was allowed to become overgrown. There was a house or barn on the east side of the property near its north-south center through 2017, but that structure is not present in the most recement image.

4.4 Seismicity

By the 2018 edition of the Kentucky/2015 International Building Code, 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:

 $S_s = 0.204 g$

 $S_{MS} = 0.245 g$

 $S_{DS} = 0.164 g$

 $S_1 = 0.106 g$

 $S_{M1} = 0.180 \text{ g}$

 $S_{D1} = 0.120 g$

5.0 Recommendations

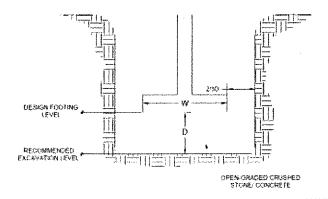
5.1 Foundations

Soil conditions vary across the site, so foundations for these buildings are discussed in two subsections to cover these varying soil conditions.

5.1.1 Panhandle with frontage on Blue Lick Road (Boring B-01 to B-05)

The proposed buildings in this area 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.

Undercut and refill below foundations should be under the direction of a Geotechnical Engineer and should be refilled with Kentucky Number 57 stone in a manner as illustrated in the diagram below. Depth of undercut, D, should be 2 feet unless the Geotechnical Engineer determines that greater depth of undercut is necessary.



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 guarters of an inch.

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.

5.1.2 Main Body of Property

Theses proposed apartment buildings 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 2,500 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 soils. Where soft 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.

Where the building was present on the east side of the property, any foundations that remain must be removed entirely to a level at least two feet below foundation bearing surfaces. Any basements or cellars must be filled with engineered fill as discussed in section 5.3 of this report. If the basement slab is below the foundation bearing level, it may be left in place if perforated with two-inch or larger perforations on four-foot centers.

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.

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.

Some of the soils at this site are relatively silty, so if construction is to take place other than during mid-June to mid-September, shallow soils are likely to be soft. Undercut and refill can be kept to a minimum if construction vehicles traveling over the building pad is kept to a minimum, perhaps delineating areas where construction traffic is acceptable and areas where it is not. Control of construction traffic can prove difficult but has been found to work in some cases.

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 75 pounds per cubic inch

in the area of borings B-01 through B-06 and 100 pounds per cubic inch over the rest of the site.

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 proposed buildings 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. 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.

The soils at this site are very silty, making the soils very sensitive to moisture. It is very likely that extensive undercut and refill or chemical stabilization of the building and pavement subgrades will be required. If earthwork and paving is preformed during the normally dry, warm months of mid-June through mid-September, the need for soil stabilization may be minimized. However, budgeting should take into account the need for either extensive undercut and refill with stone or cement stabilization. These soils are too silty for lime stabilization to be effective.

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 garbage trucks. The concrete pavement should extend throughout the areas that require extensive turning and maneuvering of garbage trucks or other heavy trucks. 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 below for the described light, moderate and special traffic condition.

	(Receipting)	nii (e la Baylen	ranisten	1 2/20/20/20/20/20	
	Li	ght	Mod	lerate	Special
Component	Rigid	Flexible	Rigid	Flexible	Rigid
Reinforced Portland Cement Concrete (PCC)	5 inches		6 inches		7 inches
Hot Mixed Asphalt Concrete (HMAC)		3 inches		4 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.

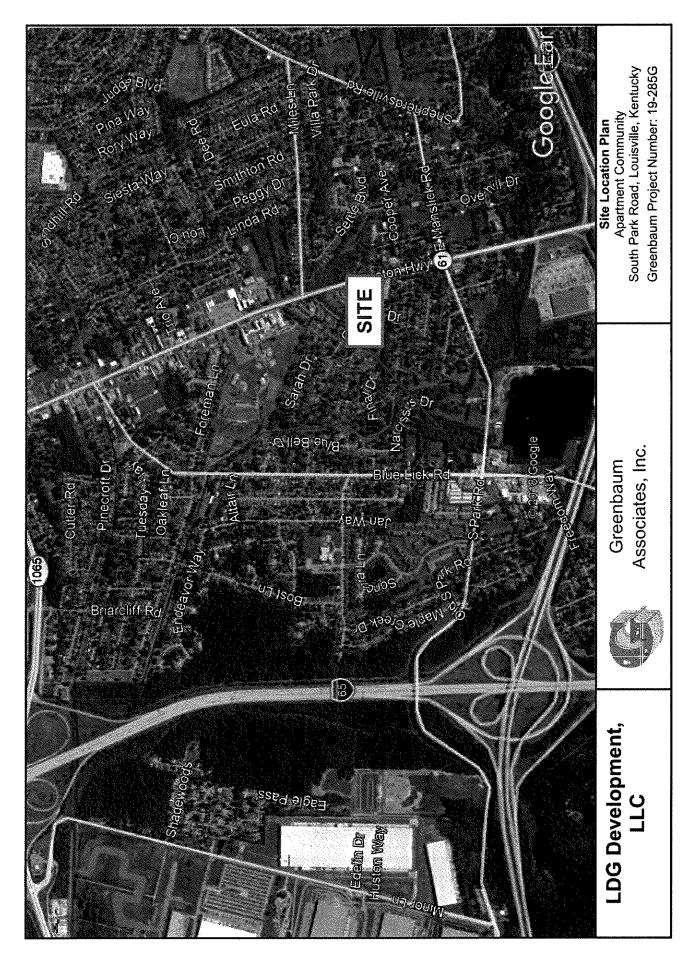
5.7 Limitations

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.

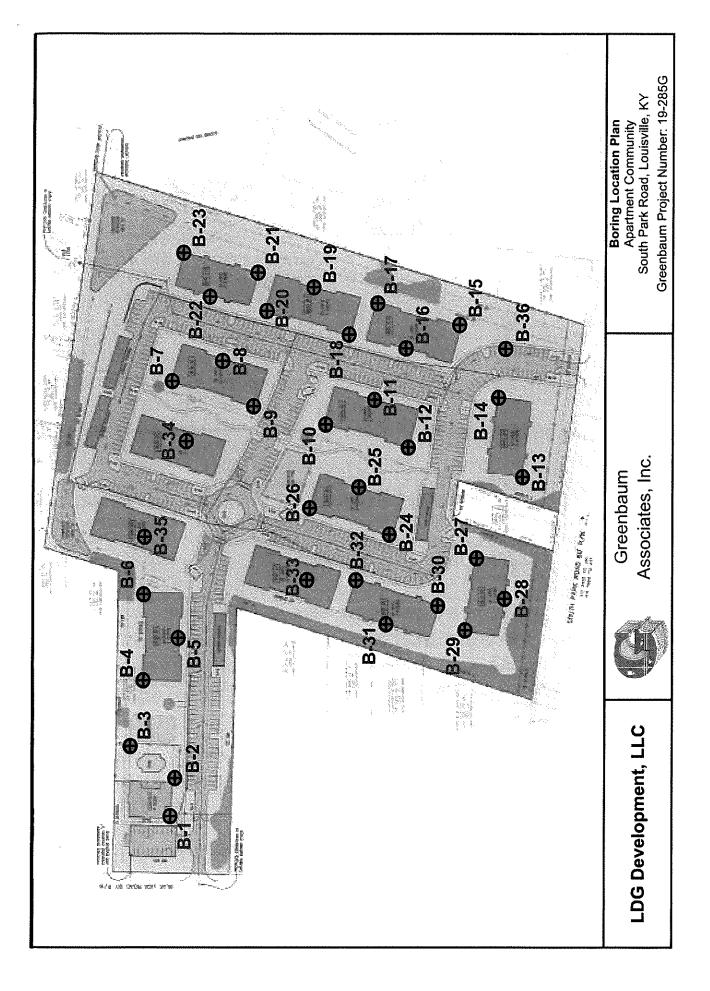
The conclusions and recommendations offered in this report are based on the subsurface conditions encountered in the borings. No warranties can be made regarding the continuity of conditions between or beyond borings. If, during construction, soil conditions are encountered that differ from those indicated 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 buildings and associated pavement at this location 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.



19 - ZONE - 0086



19 - ZONE - 0086

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 CONSISTENCY OF COHESIVE SOILS

<u>Description</u>	Blows/Foot	<u>Description</u>	N-value	<u>g (tsf)</u>
Very Loose	0 to 4	Very Soft	0 to 2	0 to 0.25
Loose	4 to 10	Soft	3 to 4	0.26 to 0.50
Medium Dense	10 to 30	Medium Stiff	5 to 8	0.51 to 1.0
Dense	30 to 50	Stiff	9 to 15	1.1 to 2.0
Very Dense	50 to 80	Very Stiff	16 to 30	2.1 to 4.0
Extremely Dense	80+	Hard	>30	4.1 to 8.0
		Very Hard		8.1 +

PARTICAL SIZES

SOIL MOISTURE

Compone	<u>nts</u>	Size or Sieve No.		Descriptive Term
Boulders		over 12 inches	Dry	Dry of Standard Proctor Optimum
Cobbles		3 to 12 inches	Damp	Moist (sand only)
Gravel -	Coarse	3/4 to 3 inches	Moist	Near Standard Proctor Optimum
	Fine	No. 4 to $^3/_4$ inch	Wet	Wet of Standard Proctor Optimum
Sand -	Coarse	No. 10 to No. 4	Saturated	Free Water in Sample
	Medium	No. 40 to No. 10		
	Fine	No. 200 to No. 40		
Fines (silt	and clay)	Finer than No. 200		

ROCK DESCRIPTION TERMINOLOGY

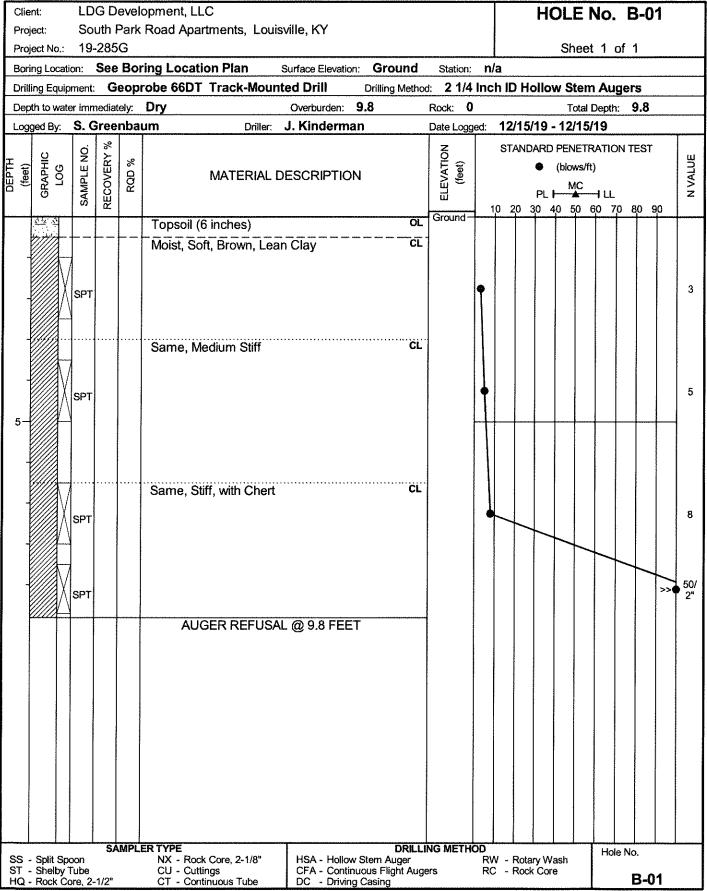
The Rock Quality Determination (Deere et. Al., 1969) method of determining rock quality as reported here was obtained by summing up the total length of core recovered in each run, counting only those pieces of core which are four inches (10 cm.) in length or longer and which are hard and sound. The sum 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



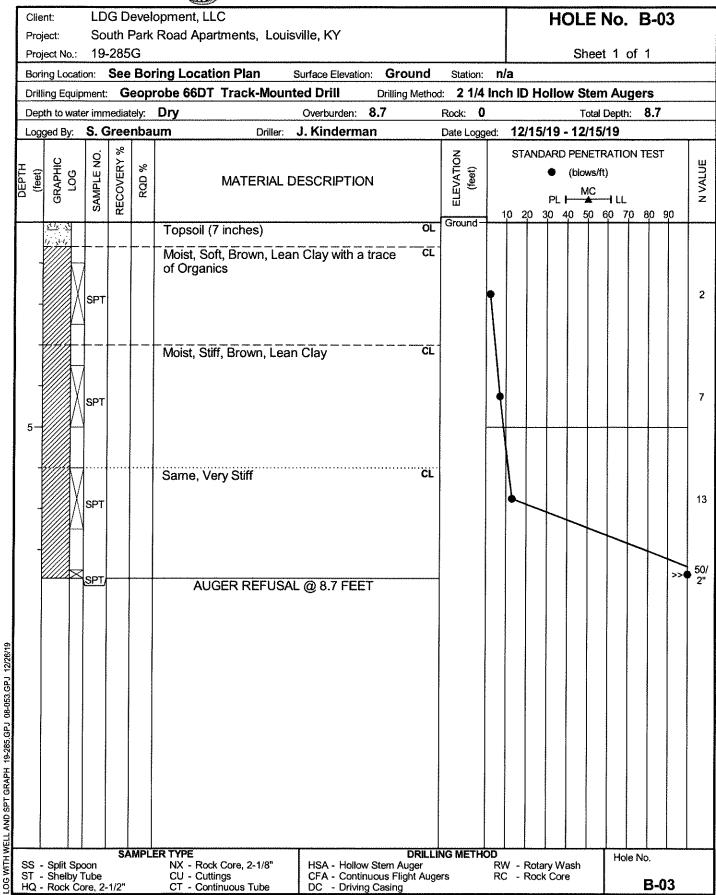
OG WITH WELL AND SPT GRAPH 19-285.GPJ 08-053.GPJ 12/26/19

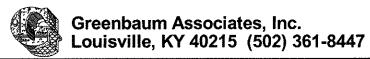




Client: Project:				ppment, LLi Road Apar	C tments, Lo	uisville, K	Y						l	HO	LE	No	. E	3-0	2	
Project No.:		285		,		-								5	Shee	et 1	of 1	1		
Boring Locat	ion:	See	Bor	ing Location	on Plan	Surface E		·····		Station:										
Drilling Equip					Track-Mou	ınted Dri	······································	Orilling Meth				h ID	Hol	low						
Depth to wat						Overbu).3		Rock: 0						l Dept	<u>h: '</u>	10.3		
Logged By:	S. G		nbau	ım	Driller	: J. Kin	derman		[Date Logg	ed:			9 - 1						
(feet) GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %		MATERIAL	_DESCR	IPTION			ELEVATION (feet)	. 1	STA 9 2	F) (b	MC	rrati /ft) —1 L! 60	L		0	
25.3				Topsoil (1	0 inches)			0	L	Ground -										_
	SPT			Moist, Me	dium Stiff, E	Brown, Le	an Clay	Ci	L									whether		
5-	SPT								THE PERSON NAMED OF THE PE			WHEN THE								
	SPT				ff, with Che	rt		ci ci)					***************************************	1		
10	SPT			AUG	ER REFUS	SAL @ 10	.3 FEET								THE TAXABLE PROPERTY OF THE PARTY OF THE PAR					
		- с менения	The state of the s									үн деламананананананананананананананан делама айын айын айын айын айын айын айын айы	——————————————————————————————————————	APPRICATE AND AP				WINDSHIP OF THE PROPERTY OF TH	- Very propose manufacture and the mean and	
	1	SA	MPL	ER TYPE	0 0 1/5"				LIN	NG METH						Тн	ole No). o.		_
SS - Split Sp ST - Shelby HQ - Rock C	Tube	-1/2"		CU - Cutti	Core, 2-1/8" ngs inuous Tube	CFA	Hollow StContinuoDriving C	us Flight Au	тде	rs			Rotary Rock	y Was Core	in		1	B-0	2	

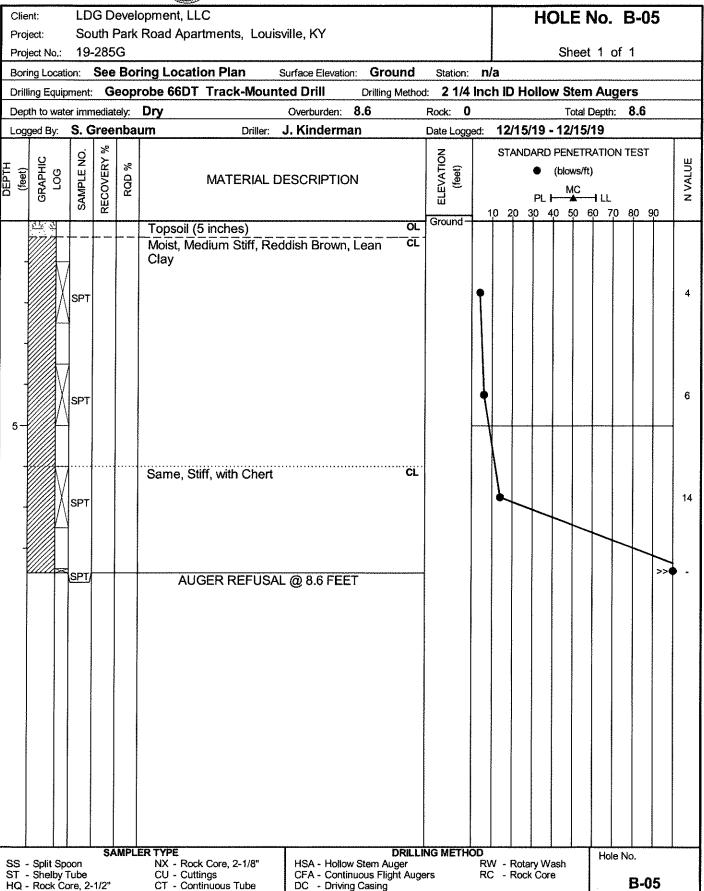




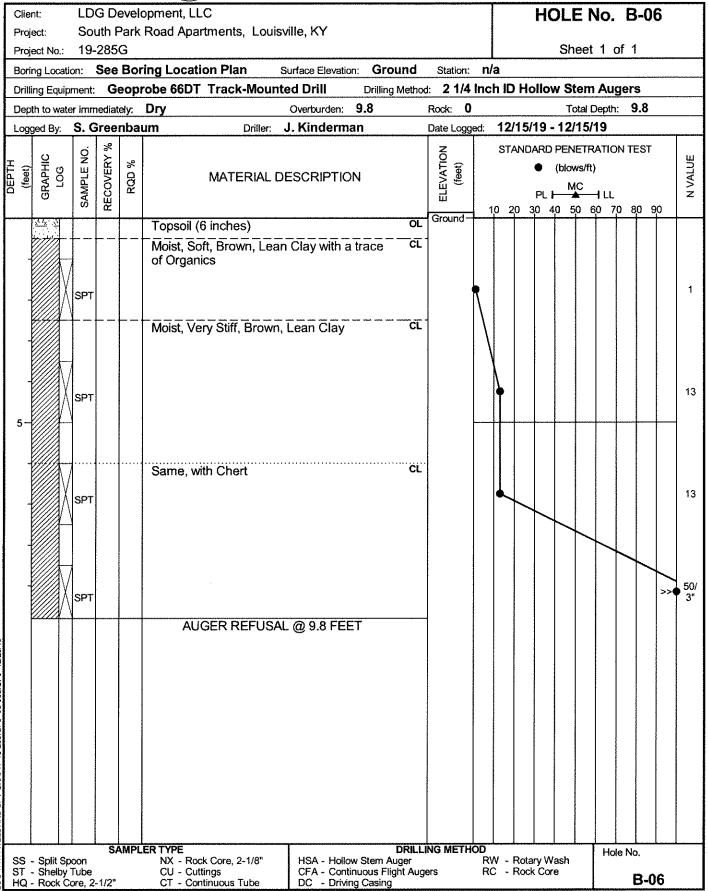


Clie					ppment, LLC		HOLE	No. B-04	
Proje Proje	ect: ect No.:		มtn F 285:		Road Apartments, Louisville, KY		Sheet	t 1 of 1	
					ing Location Plan Surface Elevation: Ground	Station: I	n/a		
Drilli	ng Equip	ment:	G	eopr	obe 66DT Track-Mounted Drill Drilling Meth	nod: 2 1/4 ln	ch ID Hollow Sten	n Augers	
Dep	th to wate	er imm	ediat	ely:	Dry Overburden: 10.5	Rock: 0	Total	Depth: 10.5	
Logg	ged By:	S. G	ree	nbaı	ım Driller: J. Kinderman	Date Logged:	12/15/19 - 12/15	/19	т
(feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION	ELEVATION (feet)	STANDARD PENETF (blows/ft) PL MC PL 40 50 50 50 50 50 50 50 50 50 50 50 50 50	:)	10000000
	711 ^N 77				Topsoil (6 inches)	Ground -			
					Moist, Soft, Brown, Lean Clay	<u>.</u>			
		SPT		осерго серени дення серени дення	Same, Medium Stiff c	•			Andriandeministration
5-	V	SPT		Ж еререре	Same, Medium Suii				
-	V	SPT		*****	Same, Very Stiff, with Chert C	L.			
10		SPT			Same, Stiff ¢				,
William (Monoport List Vol.)					AUGER REFUSAL @ 10.5 FEET				
SS -	- Split Sp	oon	S/	\MPL	NX - Rock Core, 2-1/8" HSA - Hollow Stem Auger	LING METHOD	RW - Rotary Wash	Hole No.	
ST ·	- Shelby - Rock C	Tube	-1/2"		CU - Cuttings	ugers I	RC - Rock Core	B-04	



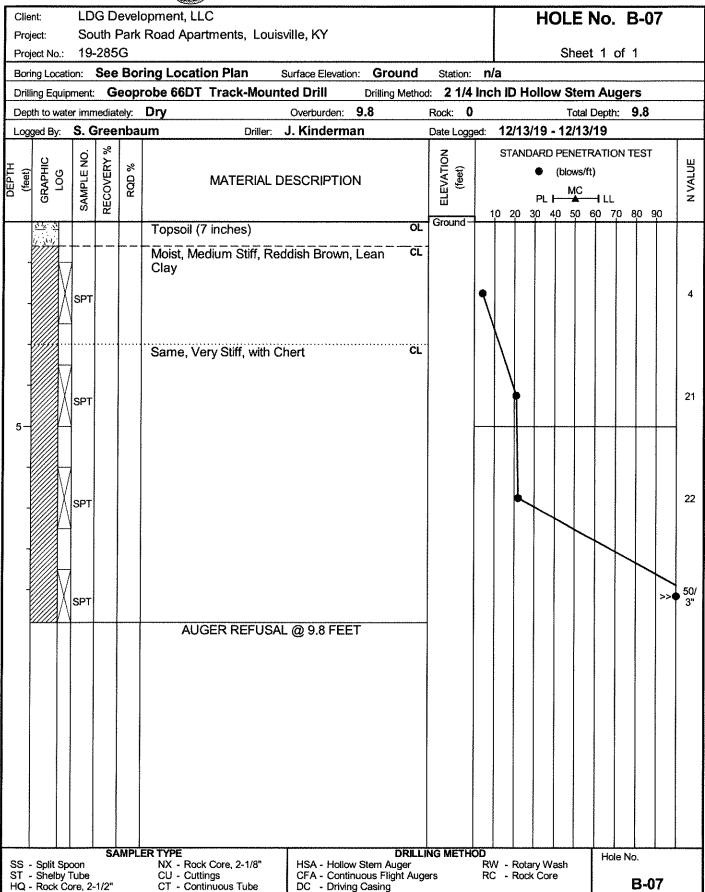








OG WITH WELL AND SPT GRAPH 19-285.GPJ 08-053.GPJ 12/26/19

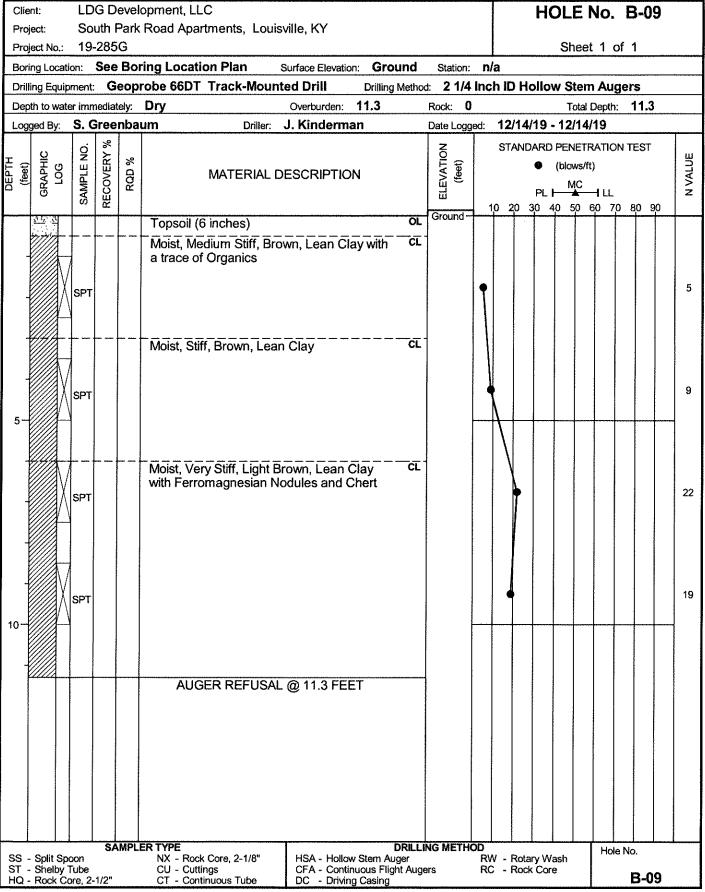


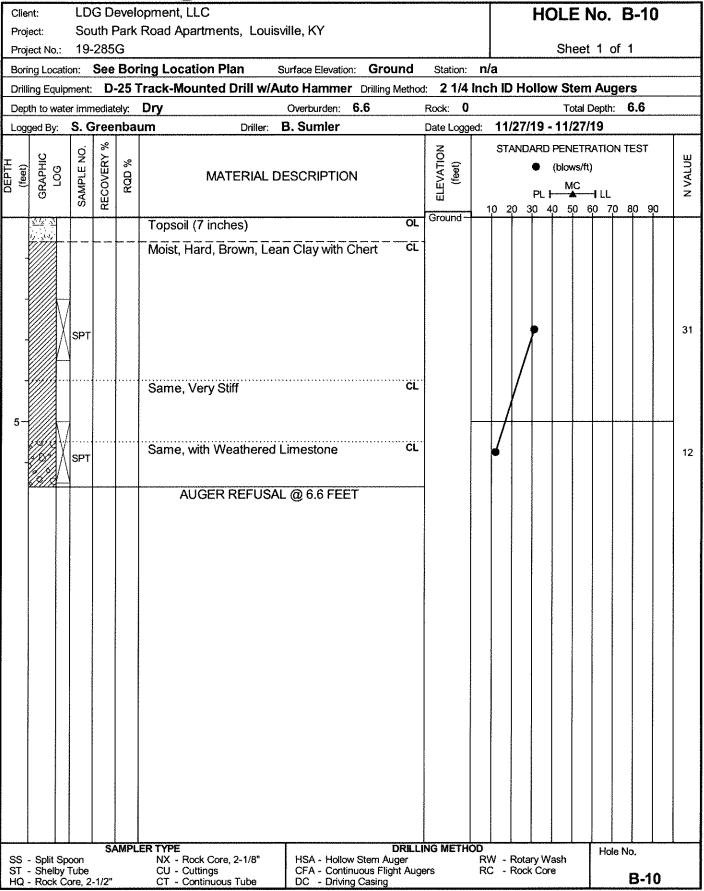


1	ent: oject:				ppment, LL	C tments, Lou	isvilla KV			T		НС	LE	No.	B-	80	
	ject No.:		-285		rtodo ripai	a.i.cins, 200	iidvaio, ivi						Shee	et 1	of 1		
Bor	ring Local	ion:	See	Bor	ing Locatio	on Plan	Surface Elevat	ion: Ground	Station:	n/a	1						
Dril	lling Equi	oment:	G	eopr	obe 66DT	Track-Mou	nted Drill	Drilling Metho	od: 2 1/4	Inch	ID H	ollov	v Stei	n Au	gers		
	oth to wat						Overburden:	······································	Rock: 0						8.0)	
Log	ged By:	<u>S. C</u>	1	nbaı	ım	Driller:	J. Kindern	nan	Date Logg	ed:	12/13	<u>/19 -</u>	12/13	3/19	·····		
DEPTH	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	Rap %		MATERIAL	DESCRIPTION	ON	ELEVATION (feet)		STANE	• PL I	(blows/	ft) LL			103.1434.14
	74 X 77				Topsoil (6	inches)		OL						1			<u> </u>
		SPT	and the same of th		Moist, Me a trace of	dium Stiff, B Organics	rown, Lean C	lay with CL		•	***************************************	ма на			######################################		
5-		SPT			Moist, Stif	f, Brown, Le	an Clay with	Chert CL	-			THE PROPERTY OF THE PROPERTY O				11111	1
		SPT	***	***************************************	Same, Ve	ry Stiff		сı									
		AND THE PROPERTY OF THE PROPER			AUC	GER REFUS	AL @ 8.0 FE	ET					THE PROPERTY OF THE PROPERTY O				
			61	MDI	ER TYPE	· · · · · · · · · · · · · · · · · · ·		ו מפת	LING METH								
	- Split S		4د	arif" Li		Core, 2-1/8"	HSA - Holl	low Stem Auger Itinuous Flight Au		RW	- Rota	ary Wa	ash	Ho	le No.		
	- Rock C		-1/2"			ngs inuous Tube	DC - Driv	ing Casing	yerə	AC.	- 1700	a core	-		B.	-08	

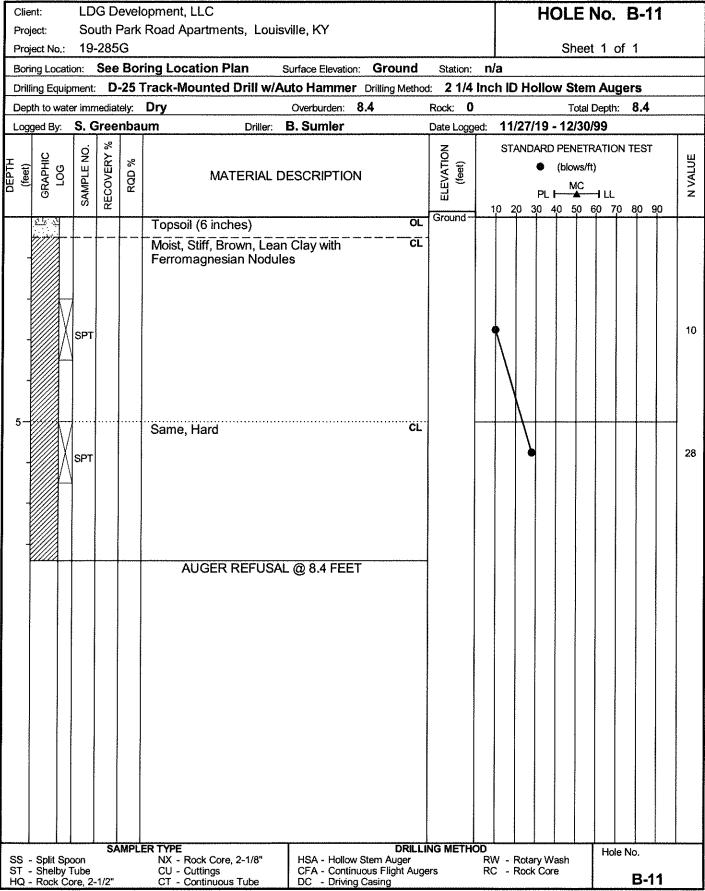


OG WITH WELL AND SPT GRAPH 19-285.GPJ 08-053.GPJ 12/26/19

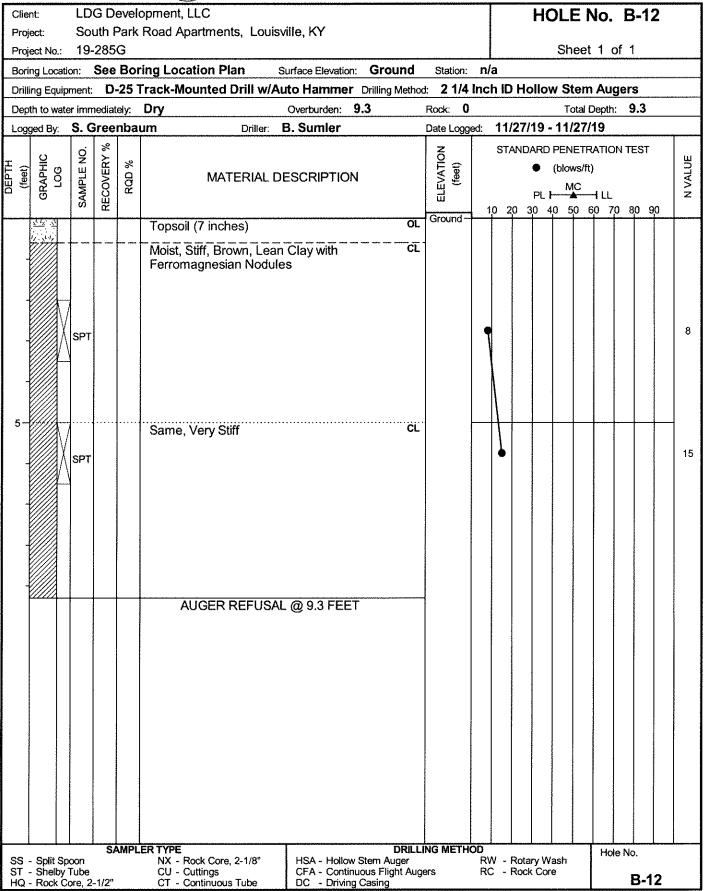














Clie Proj					opment, LLC Road Apartments, Louisv	ille, KY				НС)LE I	No.	B-1	3	
1	ject No,:		285		,						Sheet	t 1 c	f 1		**********
						urface Elevation:		Station: I							
	ling Equip				Γrack-Mounted Drill w/Aι	·····			ch ID	Hollov	***************************************				
	oth to wat					Overburden: 7	'.2	Rock: 0	4410	7/40			7.2		
Log	ged By:	T	T	npaı	um Driller: I	3. Sumler		Date Logged:		27/19 -					
DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DE	ESCRIPTION		ELEVATION (feet)	10 20	PL F	(blows/ft	:) LL			N VALUE
	74.18. 71				Topsoil (7 inches)		OL	Ground							
		SPT		T TO THE PARTY OF	Moist, Very Stiff, Brown,	Lean Clay	CL			THE TAXABLE PROPERTY OF THE TAXABLE PARTY OF TAXABLE PA	minus Hoods	intringer and a second		The state of the s	13
5-	V	SPT		THE THE TAXABLE PROPERTY OF TA											16
		The state of the s			AUGER REFUSAL	@ 7.2 FEET			TOTAL					A ALAN AND THE	
		T THE THE PRODUCTION OF THE PR							TOTAL TOTAL THE TAXABLE PROPERTY OF TAXABLE PROPER						
THE THE SHOP SHOWING AND ADDRESS AND ADDRE		777 - 7777 - 77711111111111111111111111	T T T T T T T T T T T T T T T T T T T	THE REST WITH A AND AND AND AND AND AND AND AND AND A				1 11 11 11 11 11 11 11 11 11 11 11 11 1		10.00	· · · · · · · · · · · · · · · · · · ·	Western the state of the state			
		11	SA	MPLE	ER TYPE			ING METHOD				Hole	No.		
ST -	 Split Sp Shelby Rock C 	Tube	1/2"		NX - Rock Core, 2-1/8" CU - Cuttings CT - Continuous Tube	HSA - Hollow S CFA - Continu DC - Driving	ous Flight Aug			otary Wa ock Core			B-'	13	



Soring Location See Boring Location Plan Surface Elevation: Ground Staticn: n/a	Client: Project:			opment, LLC Road Apartments, Louisv	ille, KY				HOLE	E No.	B-1	4	
Double D	Project No.:	19-28	5G						Sh	eet 1	of 1		
Depth to water immediately: Dry Overburden: 8.4 Rock: 0 Total Depth: 8.4 Logaed By S, Greenbaum Driller: B. Sumler Date Logaed: 11/27/19 - 11/27/19 STANDARD PENETRATION TEST (Glowsh) MATERIAL DESCRIPTION Moist, Stiff, Brown, Lean Clay Topsoil (7 inches) AUGER REFUSAL @ 8.4 FEET AUGER REFUSAL @ 8.4 FEET SS-Spit Spoon SAMPLER TYPE NX. Flock Corg. 2-1/8* HSA - Hollow Stem Auger PRILLING METHOD RW - Roday Wesh Hote No.	······································	******************		·····				~					_
Dig Section Diller B. Sumler Date Logged: 11/27/19 - 11/27/19 - 11/27/19 Dig Section Dig D								ı ID Hol					
Sept Sampler Type National Content National											: 8.4	****************	
Topsoil (7 inches) Moist, Stiff, Brown, Lean Clay AUGER REFUSAL @ 8.4 FEET AUGER REFUSAL @ 8.4 FEET SS - Spitt Spoon SAMPLER TYPE NX - Rock Core, 2-1/8* HSA - Hollow Stern Auger RW - Rotary Wash Hole No.	Logged By:	T		um Driller: I	3. Sumler		gged:				···		_
SPT AUGER REFUSAL @ 8.4 FEET AUGER REFUSAL @ 8.4 FEET SAMPLER TYPE NX - Rock Core, 2-1/8* HSA - Hollow Stem Auger RW - Rotary Wash Hole No.	DEPTH (feet) GRAPHIC LOG	SAMPLE NO.	RQD %	MATERIAL DI		-	10	F	(blow	vs/ft)			F1 - 1 4 7 4 7 4
SPT AUGER REFUSAL @ 8.4 FEET AUGER REFUSAL @ 8.4 FEET DRILLING METHOD NY - Rolary Wash Hole No.	7, 18, 17, 18, 18, 18, 18, 18, 18, 18, 18, 18, 18			Topsoil (7 inches)	(OL Ground							_
SS - Split Spoon SAMPLER TYPE NX - Rock Core, 2-1/8" HSA - Hollow Stern Auger RW - Rotary Wash Hole No.	5			Moist, Stiff, Brown, Lean	Clay	GL 1							
	SS - Split So	oon	SAMPL	ER TYPE	DRI HSA - Hollow Stem Auger	•		/ - Rotan	√ Wash	Hc	ele No.		
ST - Shelby Tube CU - Cuttings CFA - Continuous Flight Augers RC - Rock Core DC - Driving Casing B-14	ST - Shelby	Tube		CU - Cuttings	CFA - Continuous Flight A	Augers					-		



Client: Project:				opment, LLC Road Apartments, Louisv	illa KV					Н	OLI	E No). E	3-15	
Project No.		-285		Trodu Aparenenie, Louisi	ino, iti						Sh	eet 1	of	1	
Boring Loc	ation:	See	Bor	ring Location Plan s	urface Elevation: Gro	ound	Station:	n/	a						
Drilling Equ	uipment	: G e	eopi	robe 66DT Track-Mounte	ed Drill Drilling	g Metho	d: 21/4	Inc	h ID	Hollo	w St	em A	ugei	'S	
Depth to w					Overburden: 5.5		Rock: 0					otal Dep	***************************************	5.5	
Logged By:	S. 0	Gree	nba	um Driller: .	I. Kinderman		Date Logg	ed:	12/	14/19	- 12/	14/19)		
(feet) GRAPHIC	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DI	ESCRIPTION		ELEVATION (feet)		STA 0 20	PL	(blov	vs/ft)	LL.	EST 30 90	
27. 3				Topsoil (7 inches)		OL	Ground -								
	SPT			Moist, Very Soft, Brown, trace of Organics Moist, Stiff, Brown, Lean		CL.	The second secon	•			A PARTAMENTAL MANAGEMENT AND A PARTAMENT AND A				
5	SPT	**************************************	THE RESERVE OF THE PERSON OF T				WANTED THE STATE OF THE STATE O				**************************************			T T T T T T T T T T T T T T T T T T T	
		T T T T T T T T T T T T T T T T T T T	The contract of the contract o	AUGER REFUSAL	@ 5.5 FEET			7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7		T T T T T T T T T T T T T T T T T T T	* A TATALON MANAGEMENT OF THE PROPERTY OF T				
		The state of the s	- Annual state.					THE STATEMENT AND ADDRESS OF THE STATEMENT ADDRESS OF THE STATEMENT AND ADDRESS OF THE STATEMENT AND ADDRESS OF THE STATEMENT AND AD	e per projekti (Wykonsokokokoko)	TO ANALOSSIS STORY AND A SALAS AND A		T THE STATE OF THE			THE REPORT OF THE PERSON OF TH
															-
		SA	MPL	ER TYPE	1104 11-2 0: 4		NG METH						lole No		<u>L</u>
SS - Split S ST - Shelb HQ - Rock	y Tube	-1/2"		NX - Rock Core, 2-1/8" CU - Cuttings CT - Continuous Tube	HSA - Hollow Stem A CFA - Continuous Flig DC - Driving Casing	ght Auge	ers			otary W ock Cor			1	B-15	



Client: Projec					pment, LLC Road Apartments, Louisville, KY			НС	DLE No.	B-16	
Projec			285						Sheet 1 of	1	
					ng Location Plan Surface Elevation: Grou		Station:	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
	g Equip				rack-Mounted Drill w/Auto Hammer Drilling		······································	nch ID Hollov			
	to wate	***************************************			Dry Overburden: 7.7		Rock: 0		Total Depth:	7.7	
Logge	d By:	S. G		nbau	m Driller: B. Sumler		Date Logge	± 11/27/19 -	11/27/19		т-
(feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION	***************************************	ELEVATION (feet)				
12	<u>γ</u> . γ				Topsoil (6 inches)	OL	Ground				
		SPT			Moist, Very Stiff, Brown, Lean Clay with Ferromagnesian Nodules	CL					
5-		SPT			Same, with Weathered Limestone	CL					
					AUGER REFUSAL @ 7.7 FEET						
			SA	MPL I			NG METHO		, Hole	No.	
SS - S	Split Sp Shelby	oon Tube			NX - Rock Core, 2-1/8" HSA - Hollow Stem Aug CU - Cuttings CFA - Continuous Fligh		rs	RW - Rotary W RC - Rock Cor	ash		
HQ - F	Rock C	ore 2	-1/2"		CT - Continuous Tube DC - Driving Casing	ruger	. .		-	B-16	



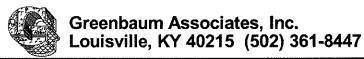
	G Development, LLC uth Park Road Apartments, Louis	ville, KY	·	HOLE I	No. B-17	
	285G	,		Sheet	1 of 1	
	······································	Surface Elevation: Ground	Station: n/			
	D-25 Track-Mounted Drill w/A					
Depth to water imme		Overburden: 7.8	Rock: 0		Depth: 7.8	
Logged By: S. G		B. Sumler		<u> 11/27/19 - 11/27/</u>		Т
DEPTH (feet) GRAPHIC LOG SAMPLE NO.	RECOVERY ROD % O DAINSTANM O	ESCRIPTION	ELEVATION (feet)	STANDARD PENETF) -1 LL	
2/2/3	Topsoil (8 inches)	OL.	Ground			T
SPT SPT	Moist, Very Stiff, Brown, Ferromagnesian Nodule	Lean Clay with CL				
	Same, with Weathered I	Limestone CL	by			
	AUGER REFUSAL					THE
SS - Split Spoon ST - Shelby Tube HQ - Rock Core, 2-1	SAMPLER TYPE NX - Rock Core, 2-1/8" CU - Cuttings 1/2" CT - Continuous Tube	DRILL HSA - Hollow Stem Auger CFA - Continuous Flight Aug DC - Driving Casing	ING METHOD RW ers RC	/ - Rotary Wash	Hole No.	

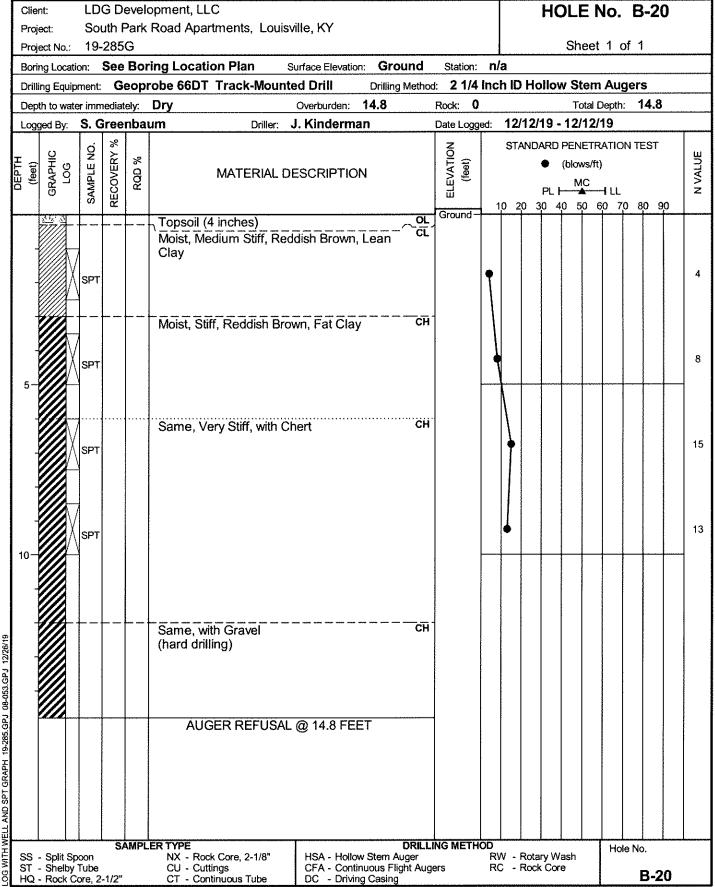


Client: Project: Project No.:	Sout		ark F	pment, LLC Road Apartments, Louisville, KY					НС		No.	B-1	8	
· · · · · · · · ·				ng Location Plan Surface Elevation:	Ground	Station:	n/a	a a		0				
Drilling Equip					illing Metho		*********		iollov	v Stei	m Au	gers		
Depth to water						Rock: 0						8.0		
Logged By:				······································		Date Logge	ed:	12/1	2/19 -	12/12	***************************************			
(feet) 6 GRAPHIC LOG		%	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)		STAN	DARD • PL I	PENET (blows/ MC	TRATIC (ft)	N TEST		
14 A	111			Topsoil (7 inches)	OL	Ground								
	SPT		***************************************	Moist, Medium Stiff, Reddish Brown, Lea Clay	an CL	Abras de la constante de la co								
	SPT		***************************************	Same, Very Stiff, with a little Gravel	CL									
	SPT			Moist, Very Stiff, Reddish Brown, Fat Cla with a little Gravel	ау СН	A	-						· · · · · · · · · · · · · · · · · · ·	
				AUGER REFUSAL @ 8.0 FEET										
SS - Split Sp ST - Shelby HQ - Rock C	Tube		/PLE	R TYPE NX - Rock Core, 2-1/8" CU - Cuttings CT - Continuous Tube R TYPE HSA - Hollow Ste CFA - Continuous DC - Driving Ca	em Auger s Flight Aug	JNG METHO			etary W		Но	le No. B-	18	



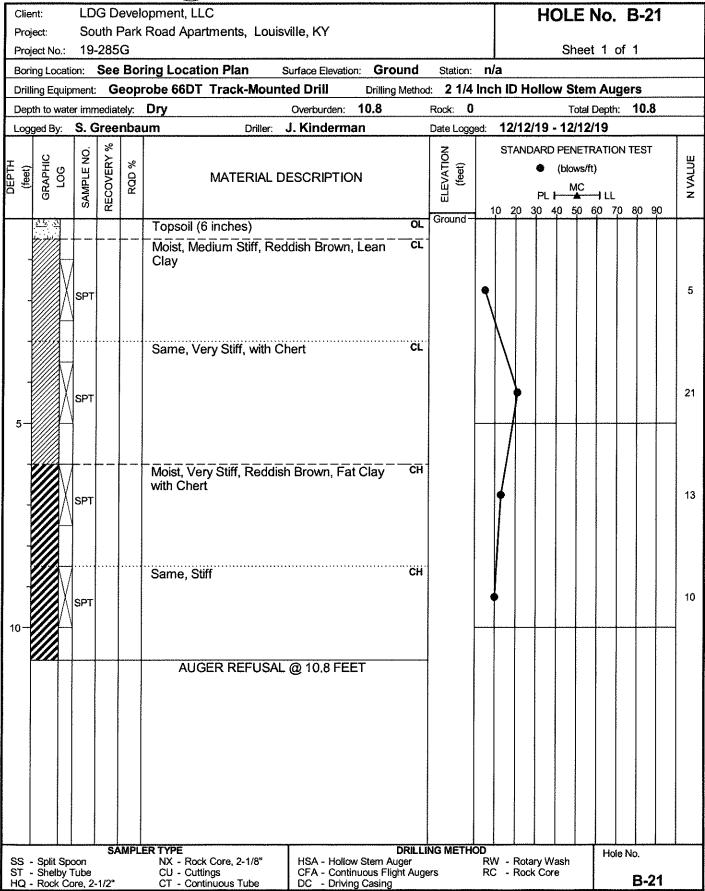
	ent: oject:				ppment, LLC Road Apartments, Louisville, KY					Н	OLI	E No). E	3-19	
	oject No.:		-285		Toda / partifolia, Lonovino, itt						Sh	eet 1	of	1	
					ing Location Plan Surface Elevation		Station:								
	, , , , , , , , ,				obe 66DT Track-Mounted Drill	Drilling Metho			h IC	Holle			····		
	pth to wal					11	Rock: 0			140140		tal Dep	··	11.0	
Log	gged By:	<u>S. G</u>	T	nbai	um Driller: J. Kinderm	an	Date Logg	jed:		/12/19					
r _	J≅	SAMPLE NO.	RECOVERY %	%			ELEVATION (feet)		ST	ANDAR			ION T	EST	<u> </u>
DEPTH (feet)	GRAPHIC	PLE	OVE.	RQD %	MATERIAL DESCRIPTIC	N	EVATI (feet)			•	(blow				14/14/14
	5	SAN	REC	LL.			급	,	10 5			C L		20 00	2
	77.77				Topsoil (8 inches)	OL	Ground	1	10 2	0 30	40 3	U 6U	1 6	30 90	
	7777	<u> </u>	<u> </u>		Moist, Soft, Brown, Lean Clay with a	troot of CI	-		-						
		7			Organics	iliacioi V-									
		SPT						•							
		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\													
								$ \ $					-		
					Moist, Stiff, Reddish Brown, Fat Clay	with CH	1		X						
					Chert										
		SPT							•						1
5 -				İ											
J															
					Same, Very Stiff	СН									
		SPT							•						16
									//						
									/	-					
		<u> </u>			Comp. Madium Ciff	СН		$ \ \ $	1						
-				*	Same, Medium Stiff	On									
	M	SPT	ŀ					•							4
10-															4
										7					
		1			AUGER REFUSAL @ 11.0 FEI	-									
					MODERNIE OUNE W 11.01 E	- '									
				Ì											
	The state of the s														
												-			
ss	- Split Sp	000n	SA	MPL	R TYPE NX - Rock Core, 2-1/8" HSA - Hollon	DRILL w Stem Auger	ING METH			Rotary V	Vash	TH	ole No).	
ST	- Shelby - Rock C	Tube	1/2"		CU - Cuttings CFA - Continuous Tube DC - Drivin	nuous Flight Aug	jers			Rock Co			ı	B-19	

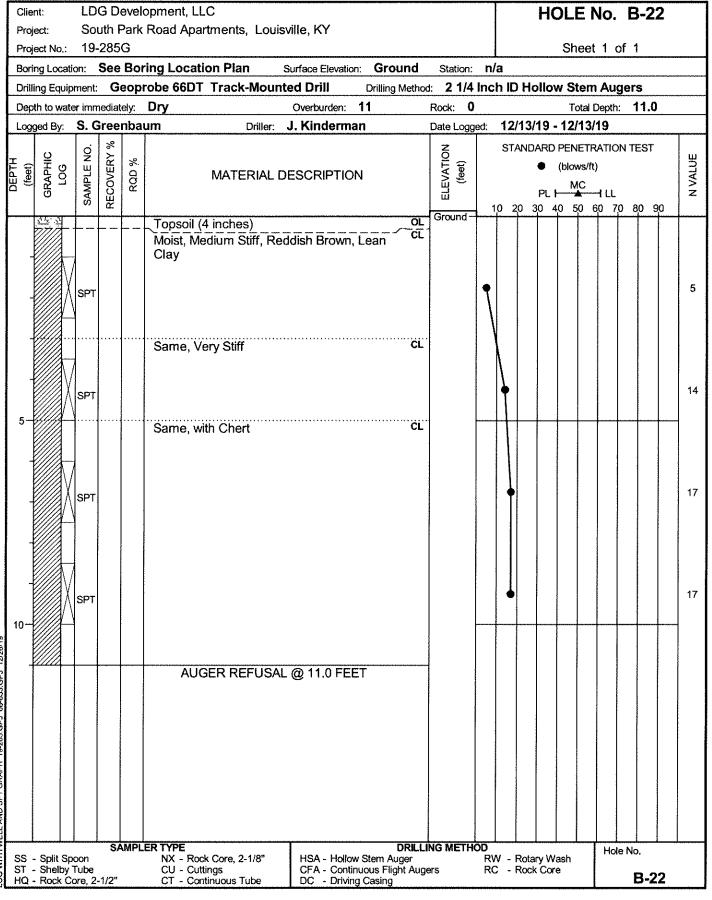






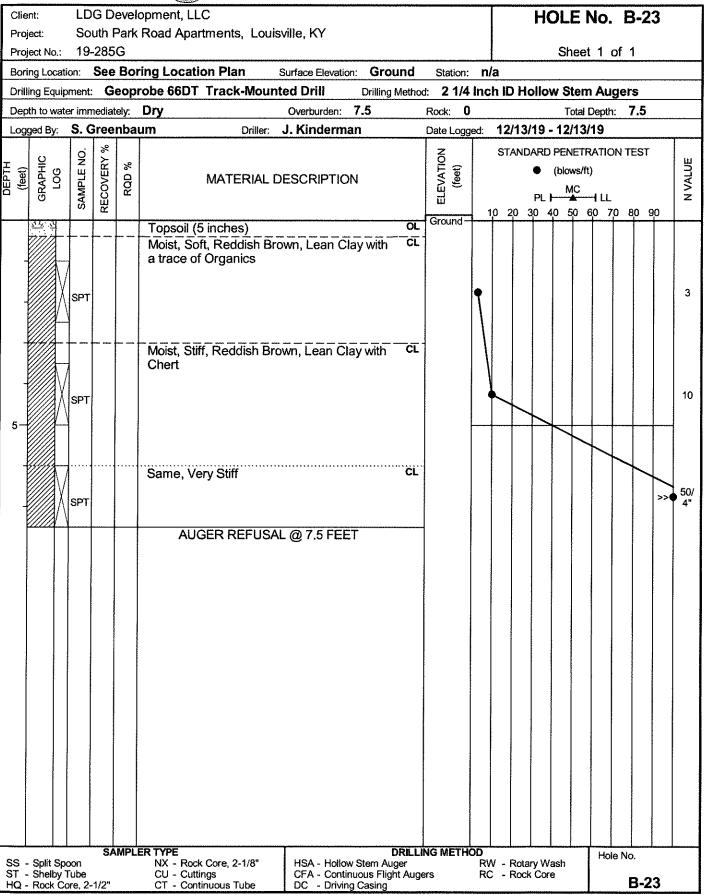
SPT GRAPH 19-285.GPJ 08-053.GPJ 12/26/19







AND SPT GRAPH 19-285.GPJ 08-053.GPJ 12/26/19





Client: Project					opment, LLC Road Apartments, Louisville, KY		i	HOLE No. B-24
Project			285		Toda Apartments, Louisville, IVI			Sheet 1 of 1
Boring	Locatio	on:	See	Bor	ing Location Plan Surface Elevation: Groun	d	Station:	n/a
Drilling	Equip	ment:	D.	25 T	rack-Mounted Drill w/Auto Hammer Drilling Me	thoo	i: 21/4	inch ID Hollow Stem Augers
Depth t	to wate	er imm	ediat	ely:			Rock: 0	Total Depth: 7.6
Logged	l By:	S. C	ree	nbau	ım Driller: B. Sumler		Date Logge	ed: 11/25/19 - 11/25/19
(feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST ● (biows/ft) PL MC
<u>z4 / </u>	ν. 7 <u>,</u>				Topsoil (7 inches)	OL	Ground -	
		SPT			Moist, Stiff, Reddish Brown, Lean Clay with Ferromagnesian Nodules	CL		
5-	V	SPT		and the state of t	Canto, Vory Can	CL		
					Same, with Weathered Limestone	CL		
A VALVE AND A VALV	Anna Anna managang managan		To the second se		AUGER REFUSAL @ 7.7 FEET			
SS - S ST - S HQ - R	helby 1	Tube		MPL	ER TYPE NX - Rock Core, 2-1/8" CU - Cuttings CT - Continuous Tube DR HSA - Hollow Stem Auge CFA - Continuous Flight of DC - Driving Casing	r	NG METHO	RW - Rotary Wash RC - Rock Core Hole No.



Cliei Proj					opment, LLC Road Apartments, Louisville, KY				HOLE	No. I	3-25	
1	ject No.:		285						Shee	t 1 of	1	
Bori	ing Locati	ion:	See	Bor	ing Location Plan Surface Elevation	oп: Ground	Station: I	1/a				
Drilli	ling Equip	ment:	D.	-25 7	rack-Mounted Drill w/Auto Hamme		od: 2 1/4 ln	ch ID Ho	llow Sten	n Auge	rs	
	oth to water					6.8	Rock: 0			Depth:	6.8	
Logo	ged By:	<u>S. G</u>	-	nbaı	m Driller: B. Sumler		Date Logged:	11/25/1	9 - 11/25	/19		
DEPTH (feet)	් <u>ල</u>	SAMPLE NO.	RECOVERY %	ROD %	MATERIAL DESCRIPTION		ELEVATION (feet)	•	RD PENETI (blows/f MC PL MC 3 40 50	t) LL		
	7 7 X				Topsoil (8 inches)	OL	Ground					
		SPT		T ANAMANIN PRINTED LA	Moist, Very Stiff, Brown, Lean Clay	cL		•	1 11 11 11 11 11 11 11 11 11 11 11 11 1			
5		SPT		,	Same, with Weathered Limestone AUGER REFUSAL @ 6.8 FEI	CL =T						
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				8400	- TABLE	Ph. Ph. 24	l l					
	- Split Sp		SA	IMPLE	R TYPE NX - Rock Core, 2-1/8" HSA - Holic	w Stem Auger		W - Rotan		Hole N	0.	
ST - HO -	- Shelby " - Rock Co	Tube ore 2-	1/2"		CU - Cuttings CFA - Cont CT - Continuous Tube DC - Drivit	inuous Flight Aug na Casina	jers F	RC - Rock	Core		B-25	



Clie Proj					opment, LLC Road Apartments, Louisville, KY			HOLE	No. B-26	
1	ect No.:		285					Shee	t 1 of 1	
Bori	ng Locati	ion:	See	Bor	ing Location Plan Surface Elevation:	Ground	Station:	n/a		
Drill	ing Equip	ment:	D	-25 1	rack-Mounted Drill w/Auto Hammer	Drilling Metho	d: 2 1/4 i	nch ID Hollow Ster	n Augers	
	th to wat				Dry Overburden: 6	.9	Rock: 0	·····	Depth: 6.9	
Log	ged By:	S. C	ree	nbaı	ım Driller: B. Sumler		Date Logged	± 11/25/19 - 11/25	/19	
	U	Ō.	% >	1			8	STANDARD PENET	RATION TEST	١.
DEPTH (feet)	<u>F</u> 8	i i	VER	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	• (blows/f	t)	
<u>н</u>	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RC				PL I MC	LL	
		S	22				Ground	10 20 30 40 50	60 70 80 90	1
	10 3 16 15 15 15 15 15 15 15 15 15 15 15 15 15				Topsoil (7 inches)	OL				
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5-		7			Same, with Ferromagnesian Nodules	and CL				
		SPT			Weathered Limestone			WHITE		:
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				·	AUGER REFUSAL @ 6.9 FEET			***************************************		

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	- Split Sp		- 37	WIT E	NX - Rock Core, 2-1/8" HSA - Hollow S	Stem Auger		RW - Rotary Wash	Hole No.	
	 Shelby Rock C 		-1/2"		CU - Cuttings CFA - Continue CT - Continuous Tube DC - Driving (jers	RC - Rock Core	B-26	



Clie Pro						opment, LLC Road Apartments, Louis	villa KV				ŀ	IOL	ΕN	o. I	3-27	
	ject. ject No.	.:		285		Noau Apartments, Louis	viile, Ki					SI	neet '	1 of	1	
			n:	See	Bor	ring Location Plan	Surface Elevation: Gr	ound	Station:	n/a						
Drill	ling Equ	uipn	nent:	D.	-25 1	Frack-Mounted Drill w/A	uto Hammer Drillin	g Metho	od: 2 1/4 li	nch IC) Holl	ow S	tem /	Auge	rs	
Dep	oth to w	ater	imn	ediat	ely:	Dry	Overburden: 8.1		Rock: 0				otal De	pth:	8.1	
Log	ged By:	: ;	S. G	ree	nba	um Driller:	B. Sumler		Date Logged	i: 11.	/25/19) - 11	/25/19	9		
DEPTH (feet)	GRAPHIC	9	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL D	ESCRIPTION		ELEVATION (feet)			(blo	ws/ft)	LL	rest 80 90	The state of the s
	7.7					Topsoil (6 inches)	***************************************	OI.	Ground							
			SPT			Moist, Very Stiff, Reddis	h Brown, Lean Cla	y CL			The second secon	***************************************		ripri in the control of the control		A
5 —						Same, with Ferromagne Weathered Limestone	esian Nodules and	CL								
		TETTER/ALL MARKET AND THE TETTER AND	THE THE PROPERTY OF THE PROPER	Try manual	To the second se	AUGER REFUSA	L @ 8.1 FEET									
	- Split 9			SA	MPL	ER TYPE NX - Rock Core, 2-1/8"	HSA - Hollow Stem A	Auger		RW - I				Hole N	0.	
ST - HQ -	- Shelb - Rock	y Tu Cor	ıbe e, 2-	1/2"		CU - Cuttings CT - Continuous Tube	CFA - Continuous FI DC - Driving Casing	ight Aug	ers	RC -	Rock C	ore			B-27	

Clier Proje					opment, LLC Road Apartments, Louisville, KY					НС	DLE	ΞNo). E	3-28	3	
Proje	ect No.:	19-	285	G			· · · · · · · · · · · · · · · · · · ·				Sh	eet 1	of	1		
_					ing Location Plan Surface Elevation: Ground			n/a								
	,				rack-Mounted Drill w/Auto Hammer Drilling Metr			inch il	H	ollo						
	th to wate		••••••				Rock: 0	. 44	'0 = '			tal De		8.0		
Logo	ged By:	S. C		nbau	ım Driller: B. Sumler]	Date Logge					25/19				
DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	% GDY	MATERIAL DESCRIPTION		ELEVATION pure (feet)	\$T		• PL I	(blow	ETRAT vs/ft) C k 1 0 60	LL		0	HINVN
	7. Y.				Topsoil (6 inches))L.	Glouria									
	V	SPT			Moist, Very Stiff, Reddish Brown, Lean Clay C with Ferromagnesian Nodules	בּב ⁻			**************************************							1:
5					Same, Hard, with Weathered Limestone C	:L						***************************************				
		SPT	-							•				The state of the s		3
					AUGER REFUSAL @ 8.0 FEET	The control of the co			To a recent memory and an analysis of the control o							
	C=#1 C=		SA	MPL		LIN	NG METHO	ם מכן	Det-				Hole N	lo.	I	
ST -	- Split Sp - Shelby - Rock C	Tube	-1/2"		NX - Rock Core, 2-1/8" HSA - Hollow Stem Auger CU - Cuttings CFA - Continuous Flight Au CT - Continuous Tube DC - Driving Casing	uge	rs	RW - RC -	Rock	ry W Cor	asn e			B-2	8	



	ent: oject:				opment, LLC Road Apartments, Louisville, KY					HOL	ΕN	o.	B-2	9	
Pro	ject No.:		285							S	neet	1 of	1		
					ing Location Plan Surface Elevation: Gro	~~~~~	Station:								
					rack-Mounted Drill w/Auto Hammer Drilling	Metho		ich li) Ho						
	oth to wa						Rock: 0						7.5	~~~~	
Log	ged By:		,	nbai	ım Driller: B. Sumler		Date Logged			9 - 11		***************************************			
DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)		1	RD PEI (blo	ws/ft) ИС	ILL		**************************************	Li 1 477 14
	7,1% 7,7				Topsoil (7 inches)	OL	Ground						1		
					Moist, Stiff, Reddish Brown, Lean Clay with Ferromagnesian Nodules	CL.		- double construction of the state of the st	THE PARTY OF THE P	t e e e e e e e e e e e e e e e e e e e		WANTED A A A A A A A A A A A A A A A A A A A	A	, Tribonomius Van	
5-		SPT	AMOUNT TO AMOUNT	Ammyria	Same, Very Stiff, with Weathered	CL		The second secon				VALUE OF THE PROPERTY OF THE P			1
-		SPT	The state of the s	TOTAL MARKET AND A STATE OF THE	Limestone	**************************************				T THE THE THE THE THE THE THE THE THE TH		***************************************	TO THE WASHINGTON AND THE WASHIN	- STATE OF THE STA	2
				The state of the s	AUGER REFUSAL @ 7.5 FEET										
90	Snii+ 6-		SA	MPLE			ING METHOD					Hole	No.		
ST .	Split SpShelbyRock C	Tube	1/2"		NX - Rock Core, 2-1/8" HSA - Hollow Stem Au CU - Cuttings CT - Continuous Tube DC - Driving Casing	yer ht Aug	jers i		Rock (Wash Core			B-2	9	

Clier					opment, LLC						Н	OLE	No	. B	-30	
Proje Proje	ect: ect No.:		uth F 285		Road Apartments, Lou	isville, KY						She	eet 1	of 1		
					ing Location Plan	Surface Elevation: Gr	ound	Station:	n/a	3						
Drilli	ng Equip	ment:	D-	25 T	Frack-Mounted Drill w/	Auto Hammer Drillin	ng Method	i: 21/4	Inch	ı ID I	ollor	w St	em Aı	igers	\$	
Dept	th to wate	r imm	ediat	ely:	Dry	Overburden: 13.1		Rock: 0				To	tal Dept	h: 1	3.1	
Logg	ged By:	S. G	ree	nbau	um Driller:	B. Sumler		Date Logge	ed:	11/2	5/19	- 11/2	25/19			
(feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL	DESCRIPTION		ELEVATION (feet)	1,0		• PL	(blow	ETRATI rs/ft) C 	-		NVALIF
	71 × 71				Topsoil (6 inches)		OL	Ground								1
-		cor	-		Moist, Stiff, Brown, Lea	an Clay	CL.						Accounted			9
5-		SPT														
10	V	SPT			Same, Brown and Gra	y Mottled	CL									
•					AUGER REFUSA	AL @ 13.1 FEET			ан организация от верхительной выполняться в полняться в полняться в полняться в полняться в полняться в полня					***************************************		
		<u></u>	SA	MPL	ER TYPE	1104 110 2		NG METHO				<u> </u>	T H	ole No).	
ST -	 Split Sp Shelby Rock C 	Tube	-1/2"		NX - Rock Core, 2-1/8" CU - Cuttings CT - Continuous Tube	HSA - Hollow Stem CFA - Continuous F DC - Driving Casir	light Aug	ers	RC	- R	otary W ock Co	re re		i	B-30	



Clie Proj	ject:	Sc		Park	opment, LLC Road Apartments, Louis	ville, KY	-			HOLE			1
_	ject No.: ing Loca	····		***************************************	ing Location Plan	Surface Elevation:	Ground	Station:	n/a	Sne	et 1 of		
	ling Equi				Frack-Mounted Drill w/A				***************************************	ollow Ste	m Aua	ers	
	oth to wa					Overburden: 7.8		Rock: 0			al Depth:		
	ged By:					B. Sumler		Date Logge	d: 11/2 5	5/19 - 11/2			
DEPTH (feet)	GRAPHIC	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL D	ESCRIPTION		ELEVATION (feet)	STAN	OARD PENE (blows	s/ft)	TEST	
			2					Ground	10 20	30 40 50	60 70	80 9	0
			- The state of the		Topsoil (6 inches) Moist, Stiff, Reddish Bro Ferromagnesian Nodule		OL With CL					The state of the s	- Leading of the second of the
		SPT	THE PROPERTY OF THE PROPERTY O	THE PROPERTY OF THE PROPERTY O									
5		SPT	***************************************	The second secon	Same, Hard, with Weatl	nered Limestone	e CL						***
To control of the con			179000000000000000000000000000000000000		AUGER REFUSA	L @ 7.8 FEET							
				A MADI	ER TYPE	<u> </u>	NOR I I	NG METHO					
ST -	- Split S _i - Shelby - Rock C	Tube		~!¥!	NX - Rock Core, 2-1/8" CU - Cuttings CT - Continuous Tube	HSA - Hollow Ste CFA - Continuou DC - Driving Ca	em Auger is Flight Auge		RW - Rot RC - Roc		Hole	No. B-3 ′	1

Client:		-	pment, LLC			HOLE No. B-32
Project: Project No.:	South F 19-285		Road Apartments, Louisville, KY			Sheet 1 of 1
			ng Location Plan Surface Elevation: Groun	nd	Station:	n/a
Drilling Equip	ment: D	-25 Tr	rack-Mounted Drill w/Auto Hammer Drilling M	ethod		············
Depth to wate			7		Rock: 0	
Logged By:	· · · · · · · · · · · · · · · · · · ·	nbau	m Driller: B. Sumler		Date Logge	ed: 11/25/19 - 11/25/19
DEPTH (feet) GRAPHIC LOG	SAMPLE NO. RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST
7 2			Topsoil (7 inches)	OL	Ground	
	SPT		Moist, Very Stiff, Reddish Brown, Lean Clay with Ferromagnesian Nodules	CL		•
5-)					
	SPT		AUGER REFUSAL @ 6.6 FEET		<u>.</u>	
		AMPLE			ING METHO	
SS - Split Sp ST - Shelby HQ - Rock Co	Tube		NX - Rock Core, 2-1/8" HSA - Hollow Stern Aug CU - Cuttings CT - Continuous Tube DC - Driving Casing	er t Aug	ers	RW - Rotary Wash RC - Rock Core B-32



					opment, LLC Road Apartments, Louisville, KY			HOLE No. B-33	
Project: Project			285		Troad Apartments, Louisvine, Kr			Sheet 1 of 1	
Boring l	Locatio	on:	See	Bor	ing Location Plan Surface Elevation:	Ground	Station:	n/a	
Drilling	Equip	ment:	G	eopi	obe 66DT Track-Mounted Drill D	rilling Metho	d: 21/4	Inch ID Hollow Stem Augers	
Depth to	o wate	er imm	ediat	ely:		.5	Rock: 0	Total Depth: 10.5	
Logged	Ву:	S. G	ree	nba	um Driller: J. Kinderman		Date Logge	ged: 12/14/19 - 12/14/19	т.
(feet)	007 F0G	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST	
7 <u>1 1</u> 7	- 27				Topsoil (7 inches)	OL	Ground		
		SPT			Moist, Soft, Brown, Lean Clay with a trac of Organics	ce CL			The second secon
5		SPT			Moist, Medium Stiff, Brown, Lean Clay	CL			THE STATE OF THE S
		SPT	- Tigal Association Section Co.		Same, Very Stiff, with Chert	CL	THE		
10-		SPT	The state of the s	- 1 - 1	Same, Stiff	CL			Andreas manual de la companya de la
		The state of the s	THE PROPERTY OF THE PROPERTY O	THE PARTY OF THE P	AUGER REFUSAL @ 10.5 FEET				- FIRM AND
SS - Sp ST - Sh			SA	MPLI	ER TYPE NX - Rock Core, 2-1/8" CU - Cuttings HSA - Hollow Ste CFA - Continuou	m Auger	ING METHO	OD RW - Rotary Wash RC - Rock Core	



Clie					pment, LL	C tments, Lou	invilla VV						HOI	LΕΝ	lo.	B-3	4	
Proj Proj	ject No.:		285		Ruau Apar	unents, Lou	isville, ix i						5	Sheet	1 of	1		
Bori	ing Locati	on.	See	Bor	ing Location	on Plan	Surface Eleva			Station:								_
	ing Equip		***********		~~~~	Track-Mou	nted Drill		Method	d: 2 1/4		ID H					~~~~	
	th to wate				Dry		Overburder			Rock: 0				•		10.3		_
Log	ged By:	S. G		nbaı	ım	Driller:	J. Kinder	man		Date Logg	ed: 1	2/14/	19 - 1	2/14/	19			_
DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %		MATERIAL	DESCRIPT	ION		ELEVATION (feet)				MC	i LL		90	1
	71 /2 Z	1			Topsoil (8	inches)			OL	Ground –								
-		SPT			Moist, Me a trace of	dium Stiff, B	rown, Lean	Clay with	CL	_				***************************************				
5-		SPT			Moist, Ver Mottled, L	y Stiff, Redd ean Clay	lish Brown a	and Tan	CL.									
-	V	SPT																2
10-		SPT			AUG	ER REFUS/	AI @ 103 F	FET		MARIE PORTER DE LA CONTRACTOR DE LA CONT					ALL PROPERTY AND ALL PR			
		, or analysis successful and of the second o	т по положения в положения	Outcomer property of the state									The state of the s					
		L	SA.	MPI	ER TYPE		<u> </u>		DRILL	ING METH	OD				1.1.1.	Nic.		
ST ·	- Split Sp - Shelby - Rock C	Tube		unr L	NX - Rock CU - Cutti	Core, 2-1/8" ngs inuous Tube	CFA - Co	ollow Stem A ontinuous Fliq iving Casing	uger		RW	- Rota - Rock	ry Wasl c Core	h	Hole	No. B-3	4	



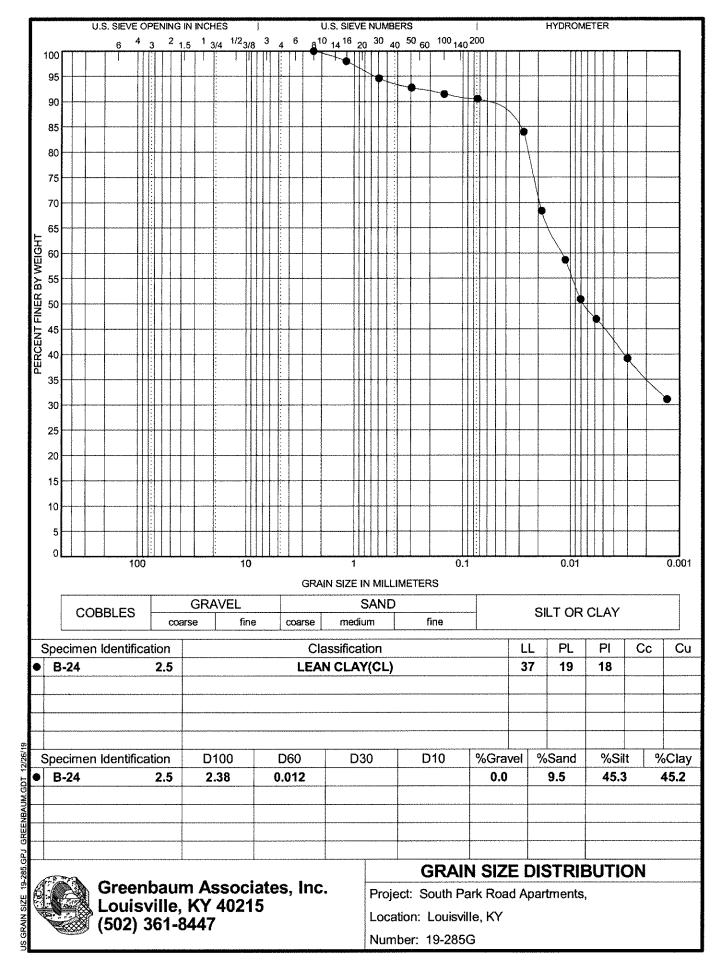
Clie Pro	ject:	So	uth I	Park	opment, LLC Road Apartments, Louisville, KY									B-3	5	-
	ect No.:		-285		Inglesation Blanco (5 Com		a					Shee	t 1 c	of 1		
	ing Local ling Equi	•			ring Location Plan Surface Elevation: Group Tobe 66DT Track-Mounted Drill Drilling M		Station: d: 2 1/4			Но	llow	Ston	- Δι <i>ι</i>	iore		_
	oth to wat						Rock: 0			, 110	IIOW			8.5	······	
	ged By:			nba		••••••	Date Logg		12	/15/1	9 - 1			. 0.0		-
	Ì	T	T	1			I	T						N TEST	T	-
DEPTH (feet)	GRAPHIC	SAMPLE NO.	SAMPLE NO.	ROD %	MATERIAL DESCRIPTION		ELEVATION (feet)		STANDARD PENETRATION TEST (blows/ft) MC PL MC LL						PERMANANAMANAMANAMANAMANAMANAMANAMANAMANAM	N VALUE
	345 31	ß	2				Ground	1	0 2					08 (90	_
	17.77.77 27.77.77	<u></u>		<u> </u>	Topsoil (7 inches)	OL.										
		SPT	WHITE THE PARTY OF	THE REPORT OF THE PERSON NAMED AND ADDRESS OF THE PERSON NAMED ADDRESS OF THE PERSON NAMED AND	Moist, Medium Stiff, Brown, Lean Clay with a trace of Organics	CL		•	TO THE STREET OF THE STREET, AND THE STREET, A		STATE OF THE PROPERTY AND THE PROPERTY A	, and the second				
5—		SPT			Moist, Stiff, Brown and Tan Mottled, Lean Clay	CL	man prisant and a constant and a con	***************************************							A CONTRACTOR OF THE CONTRACTOR	
		SPT			Same, Very Stiff, with Chert	CL	PROPERTY AND A CONTRACT OF THE				***************************************	ATTENDED TO THE PARTY OF THE PA				
				Transition of the state of the	AUGER REFUSAL @ 8.5 FEET						THE PARTY AND TH	T commonwealth.				
- Problems - Life - Common - C		The state of the s	THE PARTY OF THE P	TOTAL AND					The second secon	TTT TO THE	AND THE PROPERTY OF THE PROPER	- Committee Comm		The second secon		
				MOI	R TYPE DE	QHII	NG METH	OP								_
ST -	Split Sp. Shelby Rock C	Tube	-	wir'i	NX - Rock Core, 2-1/8" CU - Cuttings CT - Continuous Tube HSA - Hollow Stem Auge CFA - Continuous Flight DC - Driving Casing	er		RV		Rotary Rock	/ Wasł Core	1	Hole	: No. B-3	5	

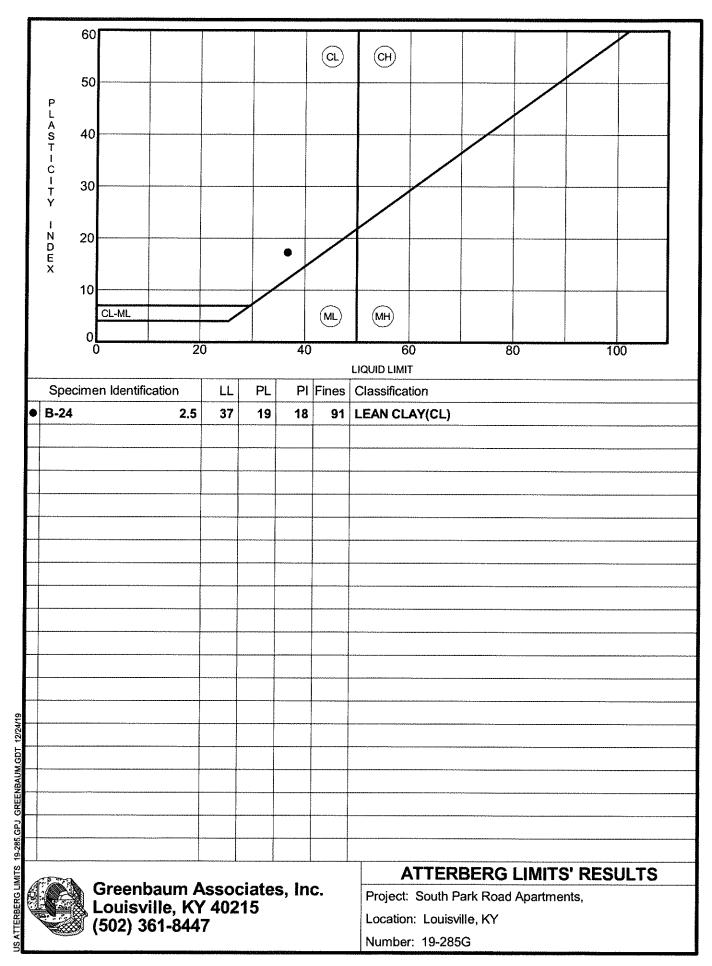
Client: Project:			lopment, LLC Road Apartments,	Louisville, KY				HOI	LE No.	B-3	6	
Project No.:	19-2		,					5	Sheet 1	of 1		
Boring Location	n: S	ee Bo	ring Location Plan	Surface Elevation	on: Ground	Station:	n/a					
Drilling Equipn	nent:	D-25	Track-Mounted Dri	ll w/Auto Hamme	r Drilling Metho	d: 2 1/4 <u>I</u> r	nch ID I	Hollow	Stem Au	igers		_
Depth to water	r imme	diately:	Dry	Overburden:	7.9	Rock: 0			Total Dept	h: 7.9		
Logged By:	S. Gr	eenba	i um D	riller: B. Sumler		Date Logged	: 11/2	7/19 - 1	1/27/19			_
DEPTH (feet) GRAPHIC LOG	SAMPLE NO.	RECOVERY %	MATER	RIAL DESCRIPTIC	N	ELEVATION (feet)		● (b	INETRATION IN INC. INC. INC. INC. INC. INC. INC.	-		N VALUE
			Topsoil (6 inches) Moist, Very Stiff, E Ferromagnesian I	Brown, Lean Clay	OL with CL	Ground -	10 20	30 40	30 80	70 80 3		16
5-	SPT		Same, Hard		CL							
	SPT										3	37
SS - Split Spc ST - Shelby T HQ - Rock Co			AUGER RE	FUSAL @ 7.9 FE	T							
		SAMP	 LER TYPE			ING METHO				ole No.	-	_
SS - Split Spo ST - Shelby T HQ - Rock Co	Tube		NX - Rock Core, 2-1 CU - Cuttings CT - Continuous Tu	CFA - Cont	ow Stem Auger inuous Flight Aug ng Casing	gers		otary Was ock Core	h '`	B-3	36	

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES ASTM D2487 and D2488 Group **Major Divisions Typical Names Laboratory Classification Criteria Symbols** Clean Gravels (Little or Gravels (More than half of coarse fraction Determine percentages of sand and gravel from grain-size curve. Depending Cu=D60/D10 greater than 4 Well-graded gravels, gravel-sand Coarse-grained soils (More than half of material is larger than No. dual symbols^b GW mixtures, little or no fines $C_u = (D_{30})^2 / (D_{10} \times D_{60})$ between 1 and 3 no fines) on percentage of fines (fraction smaller that No. 200 sieve size), coarselarger than No. 4 sieve) Poorly graded gravels, gravel-sand Not meeting all gradation requirements for GP mixtures, little or no fines Appreciable amount d Atterberg limits below **Gravels with fines GM**° Silty gravels, gravel-sand-silt mixtures "A" line with P. I. less Above "A" line with P. of fines) than 4 l. between 4 and 7 are GW, GP, SW, SP GM, GC, SM, SC Atterberg limits below borderline cases 200 sieve size) Clayey gravels, gravel-sand-clay GC "A" line with P. I. requireing us of dual mixtures Borderline greater than 7 symbols Sands (More than half of coarse fraction is Clean Sands (Little or C_u=D₆₀/D₁₀ greater than 6 Well-graded sands, gravelly sands, grained soils are classified as follows: SW little or no fines $C_u = (D_{30})^2 / (D_{10} \times D_{60})$ between 1 and 3 no fines) smaller than No. 4 sieve size) Poorly graded sands, gravelly sands, Not meeting all gradation requirements for SP little or no fines SW More than 12 percent Appreciable amount d Limits plotting in hatched Sands with fines SM^a Silty sands, sand-silt mixtures Atterberg limits above zone with P.I. between 4 of fines) "A" line or P.I. < 4 and 7 are borderline cases Atterberg limits above requireing use of dual SC Clayey sands, sand-clay mixtures "A" lime with P.I. > 7 symbols Inorganic silts and very fine sands, Fine-grained soils (More than half meterial is smaller than (Liquid limit less than 50) ML silty or clayey fine sands, or clayey silts with slight plasticity Silts and clays Inorganic clays of low to medium CL plasticity, gravelly clays, sandy clays, silty clays, lean clays Organic silts and organic siltyclays of Plasticity Index (%) OL low plasticity No. 200 sieve) Inorganic silts, micaceous or 30 (Liquid limit less that 50) MH diatomaceous fine sand or silty soils, elastic silts Silts and clays 20 Inorganic slays of high plasticity, fat CH Organic clays of medium to high OH 50 plasticity, organic silts Liquia Limit (%) organic Plasticity Chart Highly 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 sesignated by combinations of group symbols. For exampls: GW-GC, well-graded gravel-sand misture with clay binder.





(4.4) (1.4) (1.4) (1.4) (1.4) (1.4) (1.4) (1.4)

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