Report of Geotechnical Engineering Investigation
Bardstown Road Self Storage
4627 Bardstown Road
Louisville, KY, 40218

Prepared For:
Williams Properties
1136 South Park Drive
Bowling Green, KY, 42101

STATE OF KENTUCKY
JOHN R. SEWELL
1-08-18
26732
LICENSED PROFESSIONAL ENGINEER

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January 4, 2018

Re: Bardstown Road Self Storage
4627 Bardstown Road
Louisville, KY, 40218
Geotechnical Investigation

Attached is the report of our subsurface investigation for the above referenced project. This report includes detailed logs of the test holes excavated at the proposed project site. Also included in the report are the geotechnical recommendations pertinent to the foundation design for bearing capacity.

We appreciate the opportunity to perform this geotechnical engineering investigation and are looking forward to working with you during the construction phase of the project. If you have any questions regarding this report or if we may be of any additional assistance regarding any geotechnical aspect of the project, please do not hesitate to contact me.

Sincerely,

John Sewell, P.E.

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REPORT OF GEOTECHNICAL ENGINEERING INVESTIGATION

Bardstown Road Self Storage
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1.0 INTRODUCTION

1.1 General

The proposed project involves the construction of new self storage buildings in Louisville, KY. The project is located at 4627 Bardstown Road in Louisville, KY. The results of our geotechnical engineering investigation for the project are represented in this report.

1.2 Purpose and Scope

The purpose of this investigation was to determine the general near surface and subsurface conditions within the project area and to develop the geotechnical engineering recommendations necessary for the design and construction of the proposed construction of the new facility. This was achieved by excavating test holes, performing bearing capacity testing in the field with a dynamic cone penetrometer, and by conducting laboratory tests on samples taken from the test holes. This report contains the results of our findings, an engineering interpretation of these results with respect to the available project information, and recommendations to aid in the design and construction of the proposed building and pavement areas.

2.0 PROJECT INFORMATION

The proposed project involves the construction of new self storage buildings in Louisville, KY. The project is located at 4627 Bardstown Road in Louisville, KY.

Access to the facility will be from Bardstown Road. The proposed self storage buildings will also have associated parking in front of the office building and drive areas. The self storage buildings will be a single story buildings, it is anticipated that shallow foundation elements consisting of interior spread (column) and perimeter (exterior) strip footings and walls to support the structure. It is anticipated that traffic will consist mostly automobiles with some heavy truck traffic.

Structure loads, and traffic volume have not been defined as of this date. It is expected that some structural fill will be required to achieve final design grades at the site.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Conditions

At the time of our field activities the site was well drained and easily accessed by the excavation equipment.

3.2 Subsurface Conditions

Our interpretation of the subsurface conditions is based upon five (5) completed soil test holes excavated on December 29, 2017 at the approximate locations shown on the Test Hole Location Map in Appendix A. All five (5) test holes, T1-T5, were excavated near the proposed building pad to a depth of 5 feet below the existing ground surface with none of the holes reaching solid rock.

The following discussion is general; for more specific information, please refer to the test hole observation report presented in Appendix A. All depths discussed below refer to depths below the existing ground surface.

Topsoil (typically composed of a blend of silts, sands, and clays, with varying amounts of organic matter) with scattered grass and weed growth was observed in the surficial soils and test holes obtained at this project site. Topsoil, approximately 2-12 inches in thickness was encountered at each test hole, with some organics in the holes. Refer to the test hole observation report for specific information for each test hole.

Typically, the surficial topsoil at each test hole is underlain by stiff lean brown or tan sandy clay. Unconfined compressive strengths of the lean clay soils, as determined by a dynamic cone penetrometer ranged from 1000 pounds per square foot (psf) to 3,500 pounds per square foot (psf).

3.3 Groundwater

Groundwater was not observed in the test borings during excavation or after excavation had been completed. All test holes were backfilled with soil excavated from each test hole subsequent to completing tests and checking for groundwater.

The term groundwater pertains to any water that percolates through the soil found on site. This includes any overland flow that permeates through a given depth of soil, perched water, and water that occurs below the "water table", a zone that remains saturated and water-bearing year round. It should be recognized that fluctuations in the groundwater level should be expected over time due to variations in rainfall, other environmental or physical factors as well as site conditions associated with the adjacent drainage ditches or basins. The true static groundwater level can only be determined through observations made in cased holes over a long period of time, the installation of which was beyond the scope of this investigation.

4.0 DESIGN RECOMMENDATIONS

4.1 Basis

Our recommendations are based on data presented in this report, which include soil test holes, laboratory testing and our experience with similar projects. Subsurface variations that may not be indicated by a dispersive exploratory test hole program can exist on any site. If such variations or unexpected conditions are encountered during construction, or if the project information is incorrect or changed, we should be informed immediately since the validity or our recommendations may be affected.

4.2 General

As discussed in the Subsurface Conditions section of the report lean clay soils were encountered in the test holes across the project site. Additional recommendations are provided below for foundations, floor slabs, and pavements. These additional recommendations are established in conjunction with the recommendations provided above.

4.3 Foundations

The proposed structure could be supported on shallow spread and strip foundation elements bearing on the red lean clay soils at shallow depths or well compacted structural fill. These foundation elements should be proportioned using a net allowable soil bearing pressure not exceeding **1,500 psf** for spread (interior column) footings and **1,500 psf** for strip (exterior/wall) footings. For proper performance at the recommended bearing pressure, foundations must be constructed in compliance with the recommendations for footing excavation inspection that are discussed in the **Section 5.0 Construction Considerations** of this report.

In using the above net allowable soil bearing pressures, the weight of the foundation and backfill over the foundation need not be considered. Hence, only load applied at or above the minimum finished grade adjacent to the footing need to be used for dimensioning the foundations. Each new foundation should be positioned so it does not undercut or induce significant pressure on adjacent foundations; or the underlying soils supporting these foundations; otherwise the stress overlap must be considered in the design. All exterior foundations and foundations in unheated areas shall be located at a depth of at least 24 inches below final exterior grade for frost protection. However, interior foundations in heated areas can bear at depths of approximately 18 inches below the finished floor elevation. We recommend that strip footings be at least 18 inches wide and column footings be at least 24 inches wide for bearing capacity considerations.

Positive drainage of surface water, including downspout discharge, should be maintained away from structure foundations to avoid wetting and weakening of the foundation soils both during construction and after construction is complete.

4.4 Slabs-on-Grade

In general the shallow soils are suitable for floor slab support. We recommend that all floor slabs be designed as "floating", that is, fully ground supported and not structurally connected to walls or foundations. This is to minimize the possibility of cracking and displacement of the floor slab because of differential movements between the slab and the foundation. Although the movements are estimated to be within the tolerable limits for the structural safety, such movements could be detrimental to the slabs if they were rigidly connected to the foundations. The building floor slabs should be supported on a minimum 4-inch thick, granular base course, bearing on suitably prepared subgrade (refer to **Section 5.0 Construction Considerations**). The granular base course is expected to help distribute loads and equalize moisture conditions beneath the slab. All slabs should be liberally jointed and designed with the appropriate reinforcement for the anticipated loading conditions.

4.5 Modulus of Subgrade Reaction

Provided that a minimum of 4 inches of a crushed stone base is placed below the floor slab, a modulus subgrade reaction, "K_{30}", value of 100 pounds per cubic inch (pci), is recommended for the design of ground supported floor slabs. It should be noted that the "K_{30}" modulus is based on a 30-inch diameter plate load.

If hydrostatic pressure due to water build-up against the wall is anticipated, the hydrostatic pressure should be added to the lateral earth pressure. Alternatively, perimeter subdrains may be installed around the basement walls. Furthermore, the toe pressure for the retaining wall footing should not exceed the maximum allowable bearing pressure given in Section 4.3. In general, the on-site soil is not suitable for use as backfill immediately against foundation and/or below grade walls.

It has been assumed that the static weight per axle of equipment utilized for the compaction of the backfill materials adjacent to the below-grade wall will not exceed 2 tons per axle for non-vibratory equipment and 1 ton per axle for vibratory equipment. All heavy equipment, including compaction equipment heavier than recommended above, should not be allowed closer to the wall (horizontal distance) than the vertical distance from the backfill surface to the bottom of the wall.

4.6 Groundwater Drainage Control

Positive drainage of surface water, including downspout discharge, should be maintained away from structure foundations to avoid wetting, weakening and/or expansion of the foundation soils both during construction and after construction is complete. Additionally, the water and drainage lines should be located such that if any leakage occurs, water will not be readily accessible to foundation or floor slab soils thereby causing damage.

4.7 Seismic Considerations

For structural design purposes, we recommend using a Site Classification of **C** as defined by the 2015 Kentucky Building Code (modified 2012 International Building Code). Other earthquake resistant design parameters should be applied consistent with the minimum requirements of the Kentucky Building Code.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Site Preparation

All areas that will support foundations, floors, pavements, or if required, newly placed structural fill must be properly prepared. All loose surficial soil, topsoil, vegetation, and other unsuitable materials, if encountered, must be removed. Unsuitable materials include: frozen soil, uncontrolled fill, relatively soft or loose material, relatively wet soils, deleterious material, or soils that exhibit a high organic content.

Topsoil was observed at the test hole locations, and is anticipated to be encountered across the site and will require removal. Although a minimum topsoil stripping depth of 6 inches is typical, actual stripping depth should be verified by ACES in the field. The minimum stripping depth will be required to remove any vegetation or organic material at the surface, followed by the potential for additional stripping and/or scarification and recompaction as may be required to achieve subgrade support.

Prior to construction of floor slabs or pavements or the placement of new structural fill, the exposed subgrade must be evaluated by an ACES representative; which will include proofrolling of the subgrade. Proofrolling should consist of repeated passes of a loaded, pneumatic-tired vehicle such as a tandem-axle dump-truck or scraper. The proofrolling operations should be observed by an ACES representative, and the proofrolling vehicle should be loaded as directed by ACES. Any area to rut, pump, or deflect excessively should be compacted in-place or, if necessary, undercut and replaced with structural fill, compacted as specified below.

If project schedules precludes site grading during optimal weather conditions, our experience shows that typical silty clay soil during wet seasons (i.e., late fall through early spring) has moisture content well above optimum required for compaction. The higher moisture content in the upper soil profile can easily cause degradation of the soil under normal construction traffic. Routine aeration methods do not adequately dry wet soils to meet optimum moisture for compaction under these conditions. During poor weather conditions (above 40 degrees Fahrenheit), lime modification is usually the most cost effective subgrade stabilization. Where determined to be appropriate by the laboratory testing, the lime should be incorporated into the existing on-site soil at a typical rate of approximately 5 percent by dry weight of soil to a depth of approximately 14 to 16 inches. The soil/lime mixture should be properly moistened in order to initiate the hydration of the lime, thoroughly mixed and then recompacted. The 5 percent rate is the most common; however, some soil with lower clay content may require additional lime or even cement. We recommend the appropriate laboratory analysis be performed to determine the appropriate admixture and quantity. All soil modification should be performed by a specialty contractor with specific experience in the application of lime or cement stabilization methods.

Care must be exercised during grading and fill placement operations. The combination of heavy construction equipment traffic and excess surface moisture can cause pumping and deterioration of the near surface soils. The severity of this potential problem depends on the weather conditions prevailing during construction. The contractor must exercise discretion when selecting equipment sizes and make a concerted effort to control construction traffic and surface water while the subgrade soils are exposed. We recommend that heavy construction equipment be rerouted away from the building and pavement areas. If such problems do arise, the operations in the affected area should be halted and the ACES representative contacted to evaluate the condition.

5.2 Foundation Excavations

Upon completion of the foundation excavations and prior to the placement of reinforcing steel, an ACES representative should check the exposed subgrade to confirm that a bearing surface of adequate strength has been reached. Any localized soft or loose soil zones or unsuitable materials encountered at the bearing elevations should be further excavated until adequate support soils are encountered. The area undercut should be backfilled with structural fill or lean clay, or the footing can be poured at the excavated depth. On site soils consisting of lean clay could be used as structural fill beneath footings placed and compacted in accordance with Section 5.3. However, lean concrete or crushed stone placed and compacted in accordance with Section 5.3 could also be utilized as structural fill placed and compacted in accordance with Section 5.3.

If it is necessary to support foundations on structural fill, the fill pad must extend laterally a minimum distance beyond the edge of the footing or foundation system. The minimum structural pad with would correspond with a point at which an imaginary line extending downward from the outside edge of the footing at a 1H:2V slope intersects the surface of the natural soils. Excavation slopes should be maintained within OSHA requirements. In addition, we recommend that any soil stockpiles, fill or heavy equipment be kept at least 5 feet away from the edge of the excavation.

Construction traffic on the exposed surface of the bearing soil will potentially cause some disturbance of the subgrade and consequently loss of bearing capacity. However, the degree of disturbance can by minimized by proper protection of the exposed surface.

5.3 Structural Fill and Fill Placement Control

Structural fill, defined as any fill which will support structural loads, should be clean and free of organic material, debris, deleterious materials, and frozen soils. Samples of the proposed fill materials should be tested prior to initiating the earthwork and backfilling operations to determine the classification, the natural and optimum moisture contents and maximum dry density and overall suitability as a structural fill. Structural fill should have a liquid limit less than 40 and a plasticity index less than 20.

In general, the on-site soil is suitable for use as structural fill for the project.

All structural fill beneath floor slabs and foundations should be compacted to at least 98 percent of its maximum Standard Proctor dry density (ASTM D-698). All structural fill adjacent to foundations, over foundations, and in pavement areas should be compacted to at least 95 percent of the maximum Standard Proctor dry density. Care should be taken to maintain the moisture content of the structural fill to +/- 2% of the optimum moisture content.
To achieve the recommended compaction of the structural fill, we suggest that the fill be placed and compacted in layers not exceeding eight (8) inches in loose thickness. All fill placement should be monitored by an ACES representative. Field density testing should be performed in accordance with ASTM D2922, nuclear gauge method. The frequency of testing should produce a minimum of one (1) density test result per 2,500 square feet, per material lift, and as necessary to adequately represent the area and compaction effort.

6.0 LIMITATIONS OF INVESTIGATION

The recommendations provided herein were developed from the information obtained in the test holes, which depict subsurface conditions only at specific locations. Subsurface conditions at other locations may differ from those occurring at the specific test hole sites.

The nature and extent of variations between test holes may not become evident until the time of construction. If variations become evident, it will be necessary to re-evaluate the recommendations of this report after performing on-site observations during construction and noting the characteristics of any variation.

Our professional services have been performed, findings obtained, and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. This company is not responsible for the independent conclusions, opinions or recommendations made by others based on the field and laboratory data presented in this report.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report or on the test hole logs regarding vegetation types, odors or staining of soils, or other unusual conditions observed are strictly for the information of our client and the owner.

APPENDIX A

Test Hole Location Plan

Test Hole Observation Report

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Phone (270)780-9445
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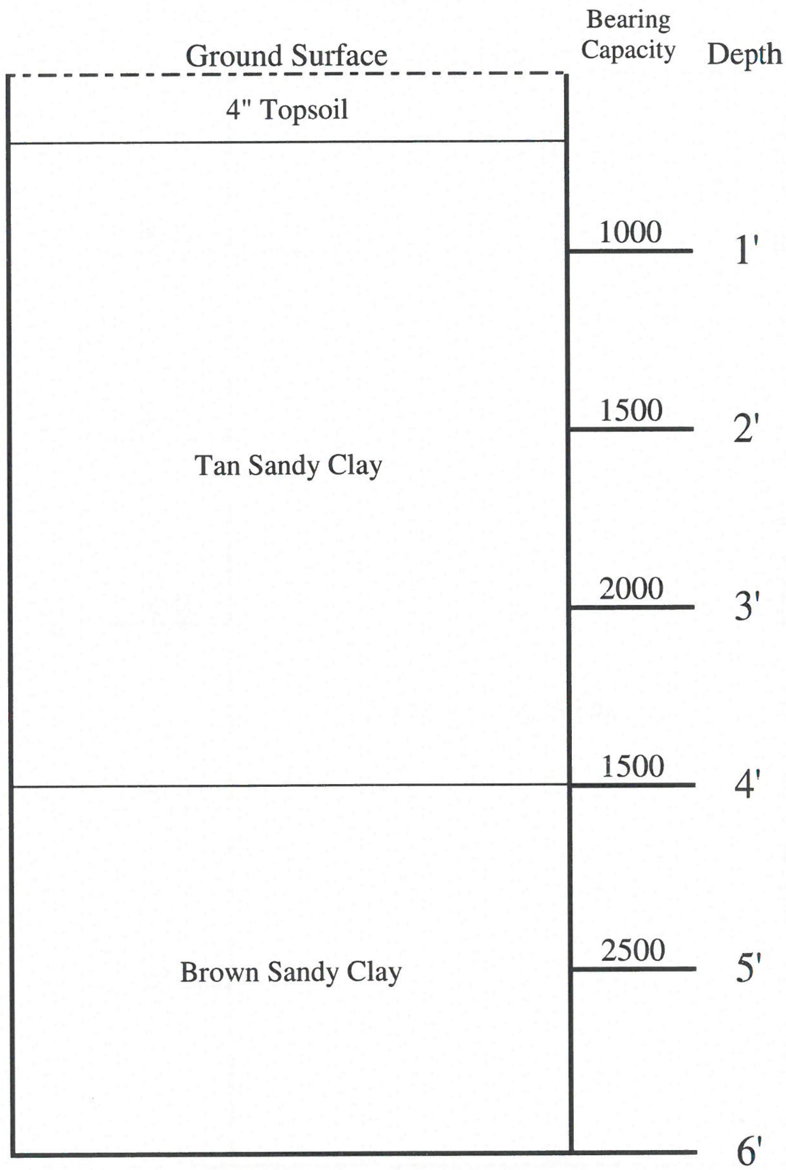
Test Hole: 5



ACES

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Bowling Green, KY 42103

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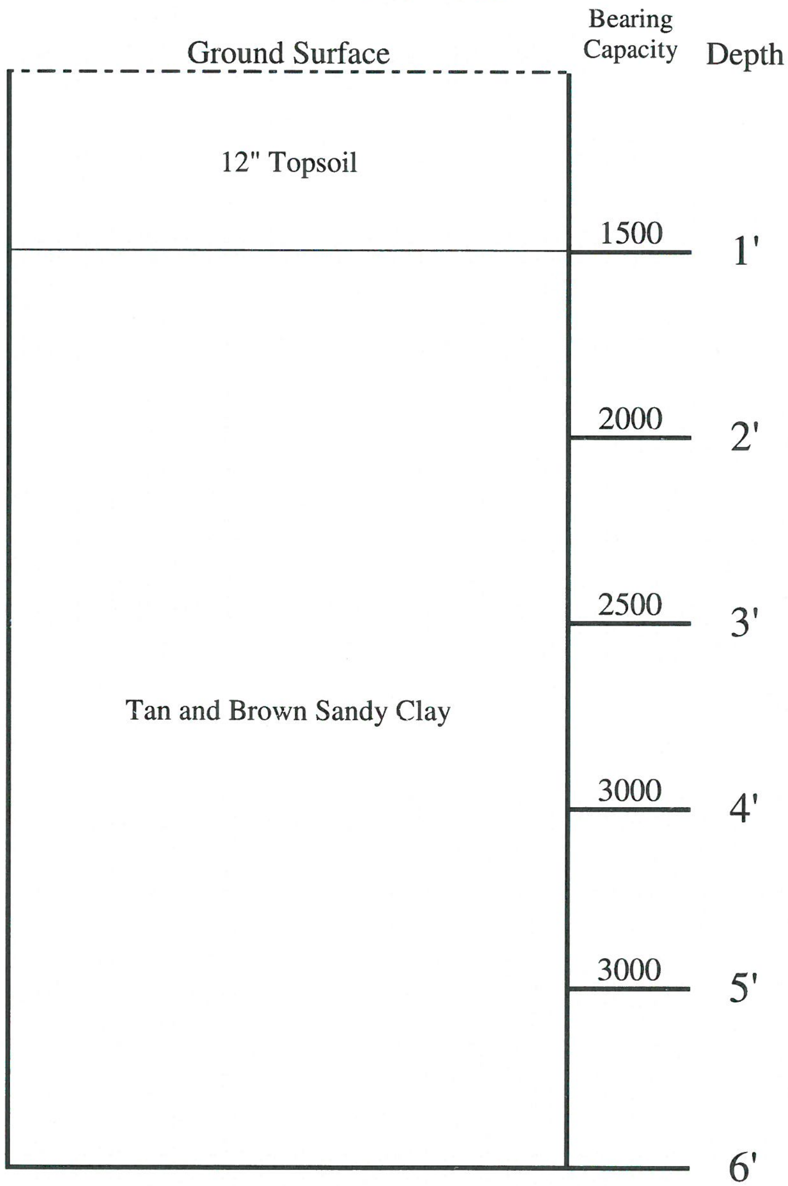
Test Hole 4



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Test Hole: 3

Layer	Bearing Capacity	Depth
Ground Surface		
2" Topsoil		
Tan and Brown Sandy Clay	2500	1'
	2500	2'
	2500	3'
	3000	4'
	3500	5'
		6'

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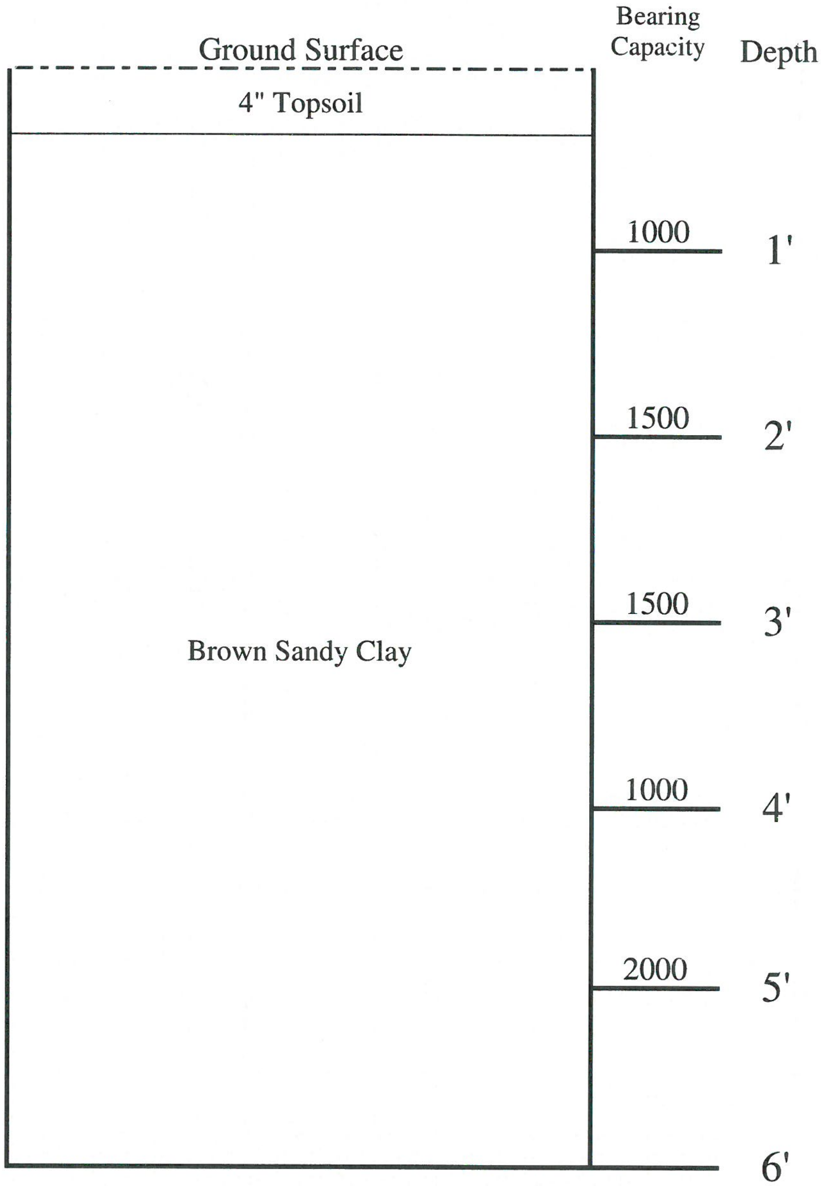
Test Hole: 2



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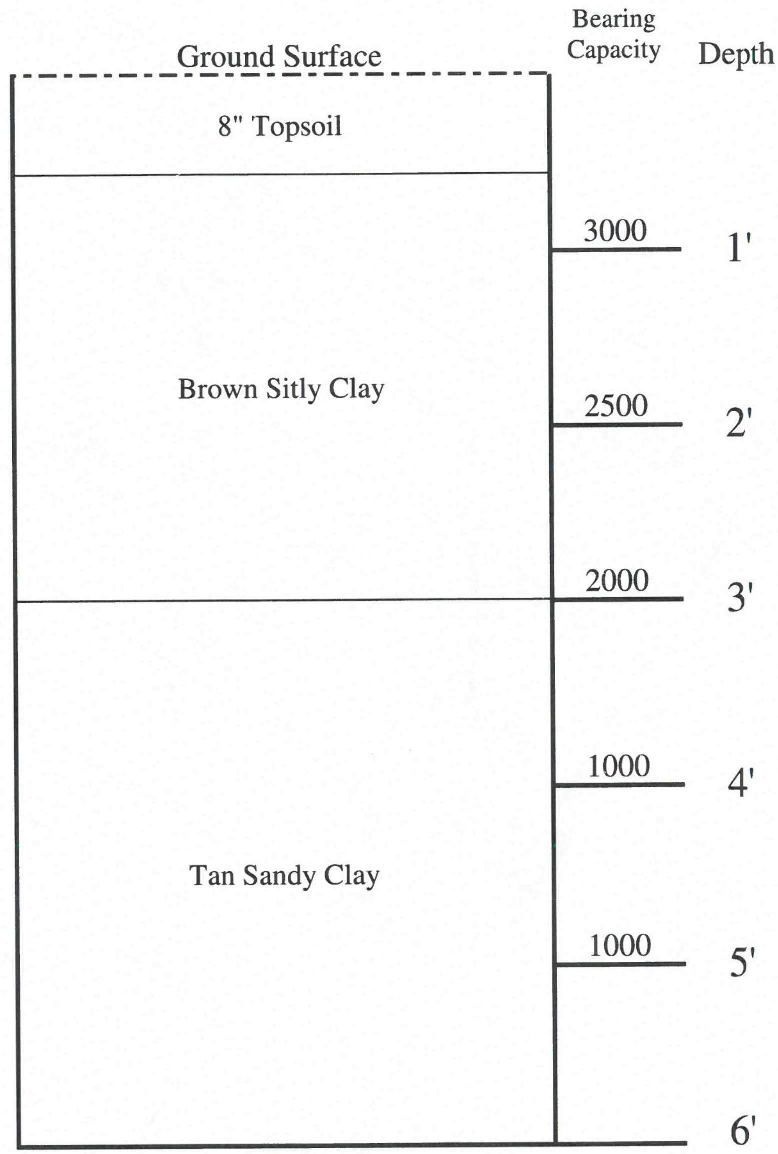
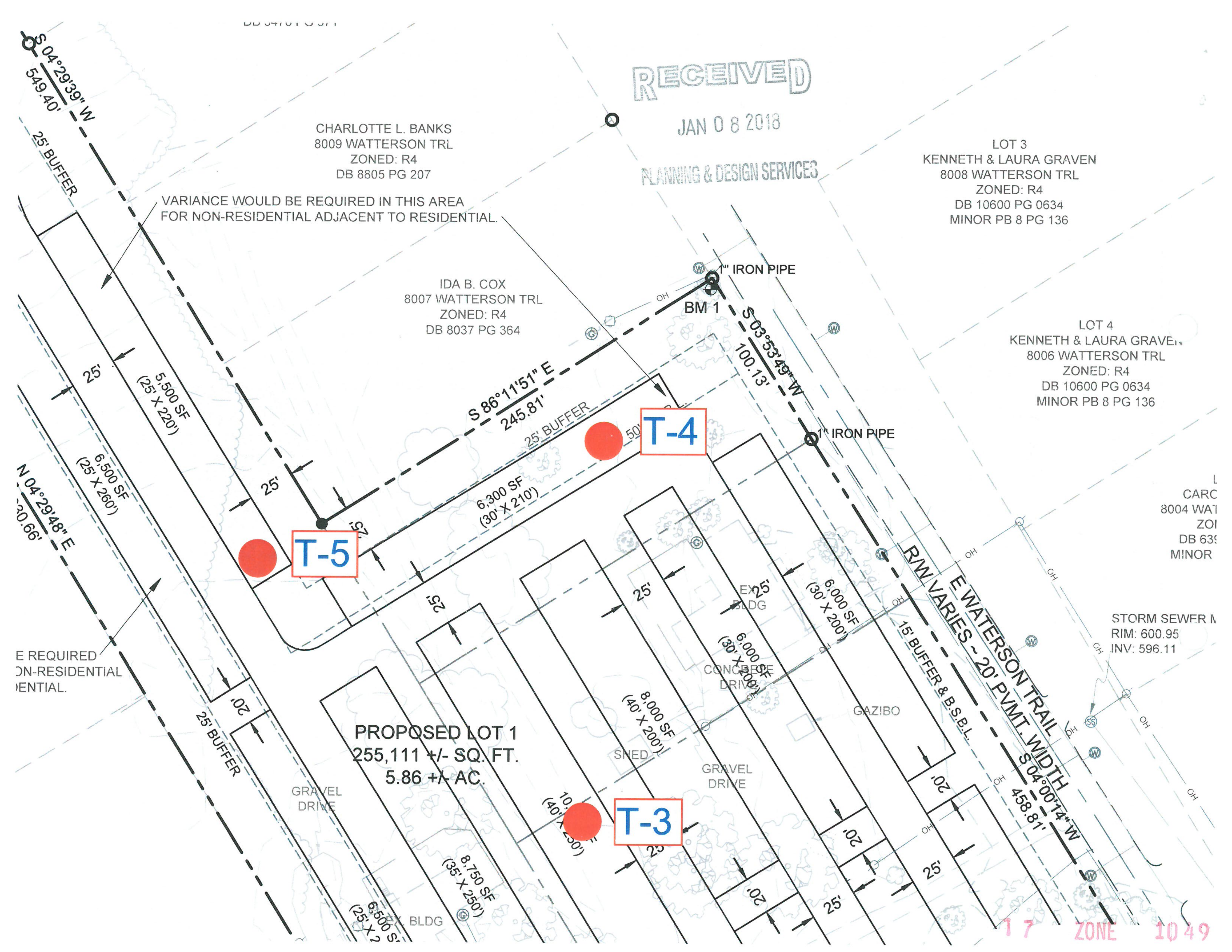
Test Hole: 1



ACES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CHARLOTTE L. BANKS
8009 WATTERSON TRL
ZONED: R4
DB 8805 PG 207
VARIANCE WOULD BE REQUIRED IN THIS AREA
FOR NON-RESIDENTIAL ADJACENT TO RESIDENTIAL.
IDA B. COX
8007 WATTERSON TRL
ZONED: R4
DB 8037 PG 364
LOT 3
KENNETH & LAURA GRAVEN
8008 WATTERSON TRL
ZONED: R4
DB 10600 PG 0634
MINOR PB 8 PG 136
LOT 4
KENNETH & LAURA GRAVEN
8006 WATTERSON TRL
ZONED: R4
DB 10600 PG 0634
MINOR PB 8 PG 136
1" IRON PIPE
BM 1
S 03°53'49" W
100.13'
1" IRON PIPE
S 04°29'39" W
549.40'
25' BUFFER
S 86°11'51" E
245.81'
25' BUFFER
5,500 SF
(25' X 220')
6,500 SF
(25' X 260')
6,300 SF
(30' X 210')
6,000 SF
(30' X 200')
8,000 SF
(40' X 200')
8,750 SF
(35' X 250')
N 04°29'48" E
T-3
T-4
T-5
E WATERSON TRAIL
R/W VARIES ~ 20' PVMT. WIDTH
S 04°00'14" W
458.81'
15' BUFFER & B.S.B.L.
GAZIBO
CONCRETE DRIVE
EX. BLDG
SHED
GRAVEL DRIVE
PROPOSED LOT 1
255,111 +/- SQ. FT.
5.86 +/- AC.
STORM SEWER M
RIM: 600.95
INV: 596.11
17 ZONE 1049