Terracon GeoReport

Geotechnical Engineering Report

Paragon Star Village
Lee's Summit, Missouri
August 2, 2019
Terracon Project No. 02195181

Prepared for:
GBA
Lenexa, Kansas

Prepared by:
Terracon Consultants, Inc.
Lenexa, Kansas

August 2, 2019

Terracon GeoReport

GBA
9801 Renner Boulevard
Lenexa, Kansas 66219

Attn: Mr. Clint Loumaster, P.E.
P: (913) 577-8266
E: cloumaster@gbateam.com

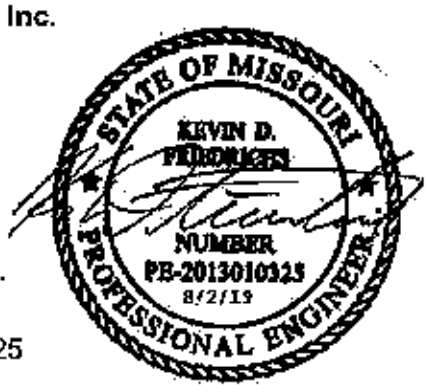
Re: Geotechnical Engineering Report
Paragon Star Village
I-470 and View High Drive
Lee's Summit, Missouri
Terracon Project No. 02195181

Dear Mr. Loumaster:

We have completed a subsurface exploration and geotechnical engineering evaluation for the referenced project. This study was performed in general accordance with Terracon Proposal No. P02195181, dated July 16, 2019. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the project. Preliminary geotechnical considerations for future structures, along with a discussion of additional subsurface exploration requirements for future structures, are also provided.

We appreciate the opportunity to be of continued service to you on the Paragon Star development. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.



Kevin D. Friedrichs, P.E.
Project Engineer
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REPORT TOPICS

Note: This report was originally delivered in a web-based format. Orange **Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each Individual Attachment for a listing of contents.

Geotechnical Engineering Report
Paragon Star Village
I-470 and View High Drive
Lee's Summit, Missouri
Terracon Project No. 02195181
August 2, 2019

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering evaluation performed for the proposed Paragon Star Village development to be located at I-470 and View High Drive in Lee's Summit, Missouri. Fourteen exploratory borings (designated B-1 to B-14) were performed for the initial phase of development for Paragon Star Village. The intial phase of development will consist of a planned 3-story office building and 2 two-story retail/restaurant/office buildings, and this report provides geotechnical design and construction recommendations for these structures. This report describes the subsurface conditions encountered at the boring locations for the initial development, presents the test data, and provides geotechnical recommendations for the following items:

- earthwork
- foundations
- floor slabs
- lateral earth pressures
- seismic site class

Seven auger probes (designated B-15 to B-21) were performed at the site of future structures planned in the development for preliminary planning purposes. Borings and auger probes were advanced to depths ranging from approximately 20 to 50 feet below existing site grades. This report provides preliminary geotechnical considerations to assist in the planning stage of these future structures. Additional exploration will be required for future structures to provide site specific design and construction recommendations based on final design, grading, and foundation loads.

Maps showing the site and boring locations are shown in the **Site Location and Exploration Plan** section. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

SITE CONDITIONS

Item	Description
Project Location	The project is located northeast of I-470 and View High Drive in Lee's Summit, Missouri.
Existing Improvements	The site is presently a grass-covered, undeveloped field.
Existing Topography	The site is relatively flat.

PROJECT DESCRIPTION

Item	Description
Project Description	Paragon Star Village is a master-planned development. The initial development will include a three-story office building and 2 two-story retail/restaurant/office buildings. The buildings will be steel framed with grade-supported concrete floor slabs. Future development includes multi-family buildings, restaurants, hotels and other mixed-use development.
Finished Floor Elevation	The FFEs of the structures were not provided. We anticipate the FFEs of the proposed buildings will be within ±5 feet of existing grades.
Maximum Loads	Anticipated structural loads for the new building were not provided. Based on our experience with similar structures, we have considered the following maximum loads: ■ Columns: 300 kips ■ Walls: 5 kips per linear foot ■ Slabs: 100 pounds per square foot
Grading	A site grading plan was not provided. We have considered up to 2 feet of cut and 5 feet of fill will be required to develop final grades.
Below-Grade Structures	No basements or free-standing retaining walls are planned. The buildings will have elevator pits.
Pavements	No borings were requested in the parking and drive areas. Therefore, recommendations regarding pavements and pavement subgrade preparation are not included in Terracon's scope of services.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the Exploration Results section and the GeoModel can be found in the Figures section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	Native Clay	Lean Clay (CL) – very soft to medium stiff
2	Shale	Shale – highly to moderately weathered

The boreholes were observed during drilling for the presence and level of groundwater. Groundwater was consistently observed in the boreholes at elevations ranging from approximately 800 to 802 feet during our subsurface exploration. Long-term observations in piezometers or observation wells, sealed from the influence of surface water, would be needed to develop more detailed groundwater information. Groundwater level fluctuations occur due to variations in rainfall, runoff, water level in the nearby Little Blue River, and other factors not evident at the time we performed the borings. The potential for groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

The soils in the 5 to 10 feet generally consisted of lean clay with consistencies ranging from medium stiff to stiff. However, the soils below this upper zone consisted of very soft alluvial (river-deposited) clays that extended from depths of about 5 to 10 feet below the existing ground surface to the shale bedrock at a depth of 40 to 45 feet.

The loads induced by structures and new fill placed about these very soft soils could result in significant settlement. Support of new structures on conventional shallow footing foundations bearing in the native soils is not recommended, as new structures supported in this manner could experience larger-than-normal total settlement and excessive differential settlement, resulting in cracking, uneven floors, and other damage to the buildings. Based on conditions encountered at the boring locations, it appears feasible to support the new buildings on drilled shafts bearing in the underlying shale bedrock, or on shallow foundations constructed on subgrade that has been improved with a ground improvement system such as rammed aggregate piers or stone columns.

We understand the existing grade will be raised 1 to 2 feet within the planned building pads. Provided the thickness of new fill is no more than 2 feet above existing grades, settlement of the underlying soft alluvial soils under the weight of the new fill is not expected to be significant. However, if the grading plans are revised such that more than 2 feet of new fill will be placed, Terracon should be notified so we can review the grading plans and provide additional geotechnical recommendations regarding settlement monitoring and time delays between completion of fill placement and commencement of building construction.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Site preparation, excavation, subgrade preparation and placement of engineered fills should conform to recommendations presented in this section. The recommendations presented for design and construction of earth-supported elements including foundations and floor slabs are contingent upon the recommendations outlined in this section being followed. We recommend earthwork on this project be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of subgrade preparation, engineered fill, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

Site Preparation

Vegetation, topsoil, and any loose, soft or otherwise unsuitable soils present within the proposed construction areas should be stripped. Based on information obtained at the boring locations, stripping depths on the order of 6 inches should be anticipated to remove the root zone materials. However, greater stripping depths may be required in areas not explored by the borings. Organic soils removed during site preparation should not be used as fill beneath the proposed new building and pavement areas.

Following initial stripping, the exposed soils should be proofrolled. A Terracon representative should observe the proofrolling. Proofrolling can be accomplished using a loaded tandem-axle dump truck with a gross weight of at least 20 tons, or similarly loaded equipment. Areas that display excessive deflection (pumping) or rutting during proofroll operations should be improved by scarification/compaction or by removal and replacement with engineered fill.

Fill Material Types

A sample of each fill material type should be tested prior to being used on the site. Our professional opinions concerning suitability of fill materials are presented in the following table.

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Low Volume Change (LVC) material	GM [2] or CL (LL<45 and PI<23)	All locations and elevations, except where free-draining material is required
On-site soils	CL (native clay soils and existing fill soils)	All locations and elevations, except where free-draining material is required (provided the soils have an LL<45 and PI<23) [4] Existing fill should be observed, tested and approved by Terracon. Organics, rock/rubble fragments larger than 3 inches, debris, or other unsuitable materials should be removed prior to re-use of the existing fill in engineered fill sections.
Well-graded granular	GW [3]	Where free-draining material is required

1. Engineered fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.
2. MoDOT Type 5 or an approved alternate gradation of crushed limestone aggregate
3. Granular materials with less than 5 percent fines (material passing the #200 sieve), such as ASTM C33 Size No. 57 aggregate or an approved alternate gradation
4. The on-site soils classified as lean clay. However, of the 8 samples tested for Atterberg limits, 5 samples had either an LL>45 and/or a PI>23, so a significant portion of the on-site soils do not meet the LVC requirements. Additional sampling and testing will be required during construction to define locations and depths where LVC material is present. If on-site soils will be used as LVC materials, the contractor should expect that separation, stockpiling, and double-handling of these materials should be expected. There may also be delays during construction to allow laboratory testing to confirm that the materials meet the LVC criteria.

We understand the existing grade will be raised 1 to 2 feet within the planned building pads. Low volume change (LVC) material placed below the building floor slabs can consist of well-graded crushed stone aggregate (e.g., MoDOT Type 5). Lean clay soils with a liquid limit less than 45 and plasticity index less than 23 could also be used as LVC material, but these soils would be susceptible to softening and disturbance if they become wetted by surface water and precipitation. If a granular leveling course (such as crushed stone aggregate) is used immediately below the floor slabs, this material can be considered part of the LVC zone.

Fill Compaction Requirements

Item		Description
Lift Thickness (maximum)		9 inches in loose thickness when large, self-propelled compaction equipment is used. 4 inches when small, hand-guided equipment (plate or "jumping jack" compactor) is used.
Minimum Compaction Requirements [1]		At least 95 percent of the material's maximum dry density [1]
Moisture Content of Clay Soil	LL<45	-2 to +2 percent of optimum moisture content value [1]
	LL>45	0 to 4 percent above the optimum moisture content value [1]
Moisture Content of Granular Material		Sufficient to achieve compaction without pumping when proofrolled

1. As determined by the standard Proctor test (ASTM D 698)

We recommend that engineered fill be tested for moisture content and compaction during placement. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of clay fill to reduce the infiltration and conveyance of surface water through the trench backfill.

Utility trenches are common sources of water infiltration and migration. All utility trenches that penetrate beneath buildings should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. We recommend constructing an effective "trench plug" that extends at least 5 feet out from the face of the building exterior. The plug material should consist of clay compacted as recommended in **Earthwork**. The clay fill should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report. Alternatively, flowable fill could be used to construct the trench plug.

Grading and Drainage

During construction, grades should be developed to direct surface water flow away from or around the site. Exposed subgrades should be sloped to provide positive drainage so that saturation of subgrades is avoided. Surface water should not be permitted to accumulate on the site. Final surrounding grades should promote rapid surface drainage away from the structures. Accumulation

of water adjacent to the structure could contribute to significant moisture increases in the subgrade soils and subsequent softening/settlement or expansion/heave.

After construction of the structures and pavements have been completed, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted as necessary, as part of the structure's maintenance program.

Earthwork Construction Considerations

Due to the presence of soils with high moisture content and relatively low strength, some means of subgrade stabilization may be required to facilitate construction, especially if wet soils are encountered during site preparation or if the subgrade becomes saturated by precipitation during site preparation/earthwork operations. In general (weather permitting), scarifying, drying and compacting the exposed subgrades is expected to be the most economical means of improving these soils prior to placing new fill. However, this option is typically less effective where soft/wet soils are more than about one foot thick. Alternatives for subgrade stabilization could include undercutting unsuitable (wet, low strength, and/or disturbed) soils followed by the addition of crushed stone aggregate (typically on the order of 12 to 18 inches thick) to improve subgrade stability, or the incorporation of a chemical additive such as class C fly ash, portland cement, lime, or lime kiln dust ("Code L"). The need for stabilization and most appropriate type of stabilization will be dependent upon soil, groundwater and weather conditions, as well as the proposed grading plan, the construction schedule and construction methods. Terracon should be retained during construction to help provide recommendations as needed.

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proofrolling, placement and compaction of engineered fill, backfilling of excavations into completed subgrades, and just prior to construction of foundations, slabs, and pavements.

Care should be taken to avoid disturbance of prepared subgrades. Unstable subgrade conditions can develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. If unstable subgrade conditions develop, stabilization measures will need to be employed. Construction traffic over the completed subgrade should be avoided to the extent practical. If the subgrade becomes frozen, desiccated, saturated, or disturbed, the affected materials should be removed or these materials should be scarified, moisture conditioned, and compacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, state, and federal safety regulations. The contractor should be aware that slope height, slope inclination, and excavation depth should in no instance exceed those specified by these safety regulations.

Flatter slopes than those dictated by these regulations may be required depending upon the soil conditions encountered and other external factors. These regulations are strictly enforced and if they are not followed, the owner, contractor, and/or earthwork and utility subcontractor could be liable and subject to substantial penalties. Under no circumstances should the information provided in this report be interpreted to mean that Terracon is responsible for construction site safety or the contractor's activities. Construction site safety is the sole responsibility of the contractor who shall also be solely responsible for the means, methods, and sequencing of the construction operations.

DEEP FOUNDATIONS

We recommend the 3-story office building, and 2-story retail/restaurant/office buildings be supported on drilled shaft foundations that extend at least 2 shaft diameters into the moderately weathered shale bedrock. At our boring locations, the upper contact elevation of the moderately weathered shale bedrock ranged from approximately 768 to 772 feet.

Drilled Shaft Design Parameters

Description	Value
Allowable end bearing pressure[1]	40 ksf
Minimum shaft diameter	30 inches
Minimum penetration into shale	2 shaft diameters
Estimated total settlement	½ inch
Estimated differential settlement	<½ inch between columns

1. Allowable compressive capacity may be computed by multiplying the end area of the shaft times the end bearing value. The base of the drilled shaft must extend at least two shaft diameters into shale bedrock. The structural engineer should refer to the appended boring logs and exploration plan to evaluate the estimated shaft tip elevations based on the structural loading, shaft diameter, and embedment depth.

Drilled Shaft Lateral Resistance

Recommended soil parameters for analyzing lateral resistance and deflection of drilled shaft foundations under design loading conditions using the computer program LPILE are provided in the following table. LPILE analyzes pile deflection as a function of the design loads and subsurface soil and rock conditions.

Description (elevation)	LPILE p-y Curve Model	Total Unit Weight, γ	Strain Factor (soil), ε_{50} K_{rm} (rock)	Undrained Shear Strength (soil), s_u Uniaxial Compressive Strength (rock), q_u	Initial Modulus of Rock Mass (rock)
Lean Clay (CL) (from 3 feet below top of shaft to between 768 and 772 feet) [1]	Soft clay	120 pcf	0.02	500 psf	N/A
Shale Bedrock (below 768 to 772 feet)	Weak Rock	135 pcf	0.0005	100 psi	10,000 psi

1. The lateral parameters within the upper 3 feet of the shaft should be ignored for frost considerations.

If center to center spacing between drilled shafts will be less than 3 diameters in the direction of loading, appropriate reduction factors should be applied to these parameters. If closely-spaced shafts are planned, Terracon should be retained to review the proposed foundation configuration and provide appropriate reduction factors.

The structural capacity of the drilled shafts should be analyzed using the combined stresses induced by axial and lateral forces. The response of drilled shafts to lateral loads is dependent upon the soil/structure interaction as well as the actual cross section, length, stiffness, and "fixity" (fixed or free head condition) of the shafts.

Drilled Shaft Construction Considerations

We recommend that Terracon be retained to observe each drilled shaft excavation to verify that conditions in the excavation are consistent with those encountered in our exploratory borings. If unsuitable materials are encountered, it may be necessary to deepen the shaft excavation.

The contractor is responsible for determining the means and methods for effectively performing the shaft excavations. In our opinion, use of a rock auger will likely be required to penetrate the shale bedrock due to the limestone seams encountered in our exploration. We recommend the contractor have at least two types of rock augers (e.g., a spade-tooth bit and bullet-tooth bit) available on-site for each planned shaft diameter.

Based on the groundwater levels encountered in the borings and the proximity to the Little Blue River, seepage should be expected in the drilled shaft excavations. Due to the likelihood of seepage and the presence of soft clay soils that will tend to cave from the excavation sidewalls, temporary casing will be required to complete the drilled shaft excavations. The contractor should also be prepared to dewater the drilled shaft excavations. To facilitate construction, reinforcing steel should be ready and on site, and concrete should be available within a very short period of time for

placement after the excavation is completed. If shaft excavations must remain open for an extended time, the bearing conditions at the bottom of the shaft excavation should be re-evaluated immediately prior to placing concrete. The concrete mixture for drilled shafts be designed to have a slump in the range of 5 to 7 inches.

We do not expect that personnel will enter the excavation to clean or observe the bearing materials; however, temporary steel casing must be installed if personnel will enter the shaft excavation. While removing temporary casing from a shaft excavation during concrete placement, the concrete inside the casing should be maintained at a sufficient level to prevent soil intrusion into the shaft excavation and resist any earth pressures outside the casing during the entire casing removal procedure.

GROUND IMPROVEMENT

As an alternative to deep foundations, the client could consider ground improvement as a means of improving the existing very soft to medium stiff native soils encountered at the site. A ground improvement system (such as rammed aggregate piers or stone columns) could be utilized to increase the bearing capacity of the on-site soils and decrease the potential settlement. A ground improvement system generally consists of aggregate-filled piers, which results in partial replacement of on-site soils and improves the foundation support capability of the adjacent remaining soils. Where ground improvement will be used, it may be necessary to place a layer of crushed stone aggregate to protect the subgrade from disturbance by the construction equipment. Once the ground improvement system is installed, the buildings could then be supported on conventional shallow footing foundations bearing above the improved soil. Ground improvement systems are procured on a design-build basis from specialty contractors. The design-build specialty contractor would use the subsurface information summarized on the attached boring logs and other project information from the design team to perform their analysis, formulate a design, and prepare a cost estimate. Upon request, Terracon can provide contact information for specialty contractors experienced in these ground improvement methods.

SHALLOW FOUNDATIONS FOR ANCILLARY STRUCTURES

As discussed above, the new building should be supported on drilled shaft foundations or on shallow foundations bearing on a ground improvement system such as rammed aggregate piers or stone columns. However, we understand lightly-loaded features that are not structurally connected to the building (e.g., site retaining walls, planters, and HVAC equipment) are planned to be supported on shallow footing foundations. Specific details concerning these structures (locations, bearing elevations, and structural loads) were not available at the time this report was prepared. In our opinion, these lightly-loaded structures can be supported by conventional spread footing foundations bearing on medium stiff native clay soils or newly placed engineered fill.

Shallow Foundation Design Parameters for Ancillary Structures Only

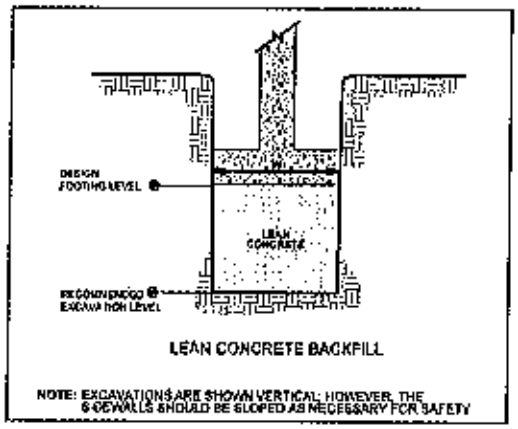
Description	Value
Maximum net allowable bearing pressure [1]	1,500 psf
Minimum embedment below finished grade for frost protection [2]	3 feet
Minimum footing widths	Isolated footings: 30 inches Continuous footings: 16 inches
Estimated total settlement [3]	1 inch or less
Estimated differential settlement [3]	1/2 to 2/3 of the total settlement over a horizontal distance of 50 feet

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. This pressure assumes that any soft soils or other unsuitable materials, if encountered, will be undercut and replaced with engineered fill.
2. This embedment depth is recommended to provide frost protection and to reduce the effects of seasonal moisture variations in the foundation bearing soils.
3. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of engineered fill below the footings, and the quality of the earthwork operations and footing construction.

Shallow Foundation Construction Considerations

The base of all foundation excavations should be free of water and loose materials prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. If the soils at the bearing level become excessively dry, disturbed, saturated, or frozen, the affected soil should be removed prior to placing concrete. If the excavations must remain open overnight or for an extended period of time, placement of a lean concrete mud-mat over the bearing soils should be considered.

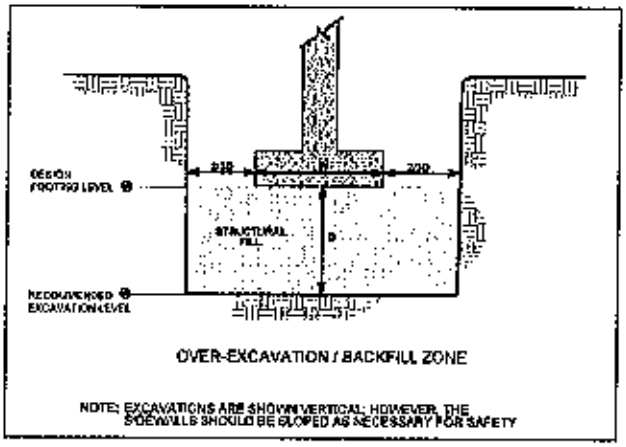
All footing bearing surfaces should be observed and tested by Terracon. If unsuitable conditions are encountered, footing excavations should be extended deeper to suitable bearing materials. Footings can bear directly on suitable soils at the lower level or on lean concrete backfill as shown in the following figure.



LEAN CONCRETE BACKFILL

NOTE: EXCAVATIONS ARE SHOWN VERTICAL; HOWEVER, THE SIDEWALLS SHOULD BE SLOPED AS NECESSARY FOR SAFETY

The footings could also bear on properly compacted backfill extending down to suitable soils as shown in the following figure. Overexcavation for compacted engineered fill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing elevation. The overexcavation should then be backfilled up to the footing base elevation with well graded granular material (e.g., MoDOT Type 5 aggregate or an approved alternate gradation) placed and compacted as recommended in Earthwork.



OVER-EXCAVATION / BACKFILL ZONE

NOTE: EXCAVATIONS ARE SHOWN VERTICAL; HOWEVER, THE SIDEWALLS SHOULD BE SLOPED AS NECESSARY FOR SAFETY

SEISMIC CONSIDERATIONS

Code	Site Class
2012 International Building Code (IBC)	D [1]

1. The 2012 International Building Code (IBC) seismic site class definitions are based on average properties of the subsurface profile to a depth of 100 feet. The exploratory borings terminated within shale bedrock at a maximum depth of 50 feet. Our opinion of site class is based on boring data and our knowledge of local geological and geotechnical conditions.

FLOOR SLABS

Floor Slab Design Parameters

Item	Description
Floor Slab Support	Native soils or newly placed engineered fill materials that meet low volume change (LVC) criteria
Modulus of Subgrade Reaction	100 pounds per square inch per inch of deflection (psi/in or pci) for point loading conditions
Granular Leveling Course Layer Thickness [1]	4 inches (minimum)

1. Well graded crushed stone (e.g., MoDOT Type 5 aggregate) or open-graded crushed stone (e.g. ASTM C33, Size No. 57 aggregate) can be used as the leveling course.

As noted in the Earthwork section, the on-site soils classified as lean clay. However, of the 8 samples tested for Atterberg limits, 5 samples had either an LL>45 and/or a PI>23, so some of the on-site soils do not meet the LVC requirements. Additional sampling and testing will be required during construction to define locations and depths where LVC material is present. If on-site soils will be used as LVC materials, the contractor should expect that separation, stockpiling, and double-handling of these materials should be expected. There may also be delays during construction to allow laboratory testing to confirm that the materials meet the LVC criteria.

Joints should be constructed in slabs at regular intervals as recommended by the American Concrete Institute (ACI) to help control the location of cracks. Joints or any cracks that develop in the floor slab should be sealed with a water-proof, non-extruding compressible compound.

Loads on footings that support structural walls and column loads are typically greater than floor slab loads. Consequently, footings should be expected to settle more than the adjacent floor slabs. The structural engineer should consider the potential for differential movement between foundations and grade-supported floor slabs.

Typically, some increase in the floor slab subgrade moisture content will occur because of gradual accumulation of capillary moisture, which would otherwise evaporate if the floor slab had not been constructed. The use of a vapor retarder should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Floor Slab Construction Considerations

If LVC materials consist of clay, the subgrade should be maintained in a relatively moist condition until the floor slab is constructed. If the subgrade becomes desiccated prior to construction of the

floor slab, the affected material should be removed or the materials should be scarified, moistened, and compacted. Upon completion of grading operations in the building area, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the building floor slab.

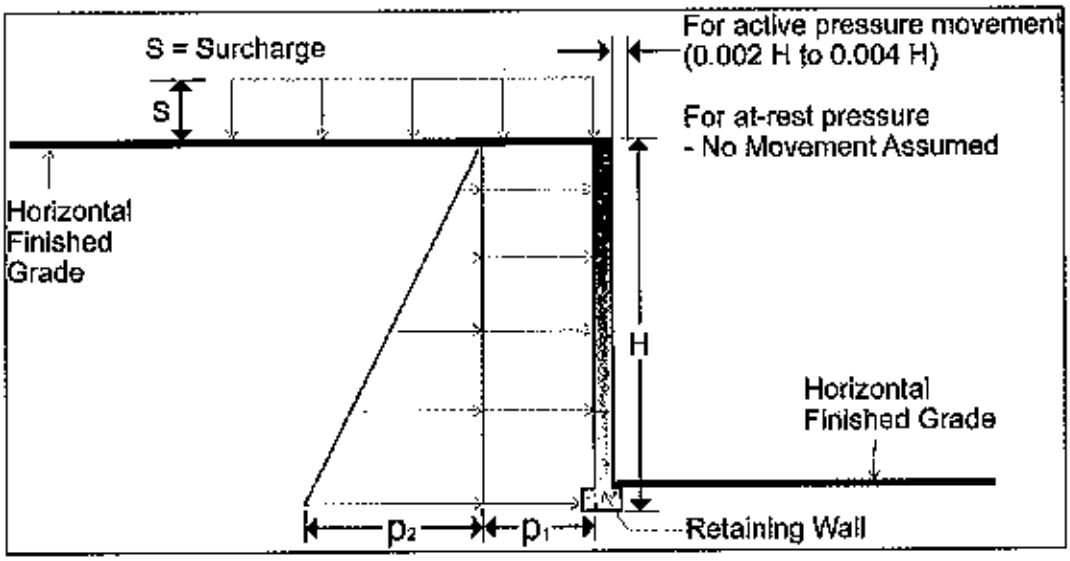
On most project sites, the site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall etc. As a result, the floor slab subgrade soils may not be suitable for placement of the granular course and/or concrete at the time of building construction, and corrective action may be required.

Terracon should evaluate the condition of the floor slab subgrades immediately prior to placement of the granular leveling course and construction of the slabs. Particular attention should be paid to areas containing backfilled trenches and high traffic areas that were previously disturbed during construction. Where unsuitable conditions are located within the floor slab subgrade soils, the subgrade should be improved by removing and replacing the affected material with properly compacted fill.

LATERAL EARTH PRESSURES

Lateral Earth Pressure Design Parameters

Below grade walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction, and/or compaction and the strength of materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls where wall movement is permitted. The at-rest condition considers no wall movement is permitted. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Lateral Earth Pressure Parameters

Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Unit Weight (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (K_a)	Granular - 0.3	40	(0.3)S	(40)H
	Clay - 0.42	50	(0.42)S	(50)H
At-Rest (K_o)	Granular - 0.47	60	(0.47)S	(60)H
	Clay - 0.60	70	(0.60)S	(70)H
Passive (K_p)	Granular - 3.3	420	---	---
	Clay - 2.4	290	---	---

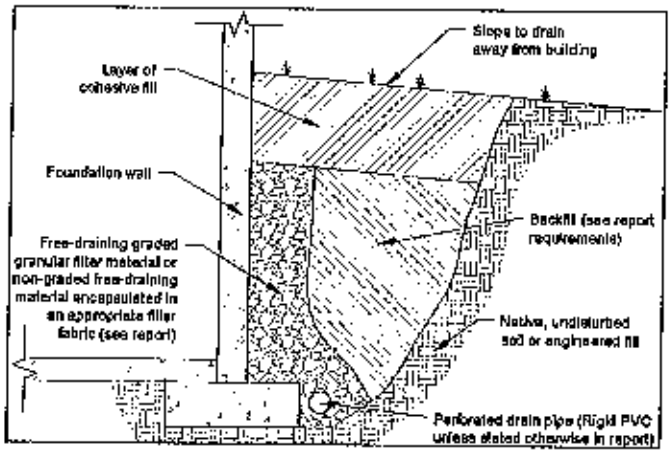
Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 H to 0.004 H, where H is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance
- Uniform surcharge, where S is surcharge pressure
- Clay soil backfill: unit weight = 120 pcf (maximum), and ϕ = 24 degrees (minimum)
- Granular material backfill: unit weight = 130 pcf (maximum), and ϕ = 32 degrees (minimum)
- Horizontal backfill, compacted as recommended in the report
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No loading from nearby footing or slabs
- No dynamic loading
- No safety factor included in soil parameters
- Ignore passive pressure in frost zone

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 degrees from vertical for the active and at-rest cases, and at an angle of 60 degrees from vertical for the passive case. To calculate the resistance to sliding, a value of 0.3 should be used as the ultimate coefficient of friction where the footing bears on native clay soils or engineered fill

Subsurface Drainage for Below Grade Walls

To prevent hydrostatic pressure on below-grade walls, we recommend drains be installed at the foundation level. Each drain line should be sloped to provide positive gravity drainage and should be surrounded by free-draining granular material graded to prevent the intrusion of fines, or an alternative free-draining granular material encapsulated with suitable filter fabric. At least a 2-foot wide section of free-draining granular fill should be used for backfill above the drain line and adjacent to the wall. The free-draining granular fill should extend to within 2 feet of final grade and should be capped with compacted cohesive fill to minimize infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a pre-fabricated drainage structure may be used. A pre-fabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion, and is fastened to the wall prior to placing backfill.

PRELIMINARY CONSIDERATIONS FOR FUTURE STRUCTURES

Deep foundations should be considered for the future structures due to the presence of very soft to medium stiff alluvial clays at the site. Future structures should be supported on drilled shaft foundations that extend to moderately weathered shale.

As an alternative to deep foundations, the client could consider ground improvement as a means of improving the existing very soft to medium stiff native soils encountered at the site. A ground improvement system (such as rammed aggregate piers or stone columns) could be utilized to increase the bearing capacity of the on-site soils and decrease the potential settlement. A ground improvement system generally consists of aggregate-filled piers, which results in partial replacement of on-site soils and improves the foundation support capability of the adjacent remaining soils.

ADDITIONAL EXPLORATION FOR FUTURE STRUCTURES

The preliminary subsurface exploration program conducted for the planned future structures consisted of seven auger probes (i.e., borings where no soil or rock samples were obtained for laboratory testing) spread across the future development areas. Specific information about the anticipated building configuration, foundation loads, planned finish floor elevation(s) and site grading for these future structures was not available at the time of our exploration. Terracon should be retained to perform additional field exploration and laboratory testing and to prepare a design-phase geotechnical engineering report for each future building when more detailed information becomes available.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between boring locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client.

Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, cost estimating, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

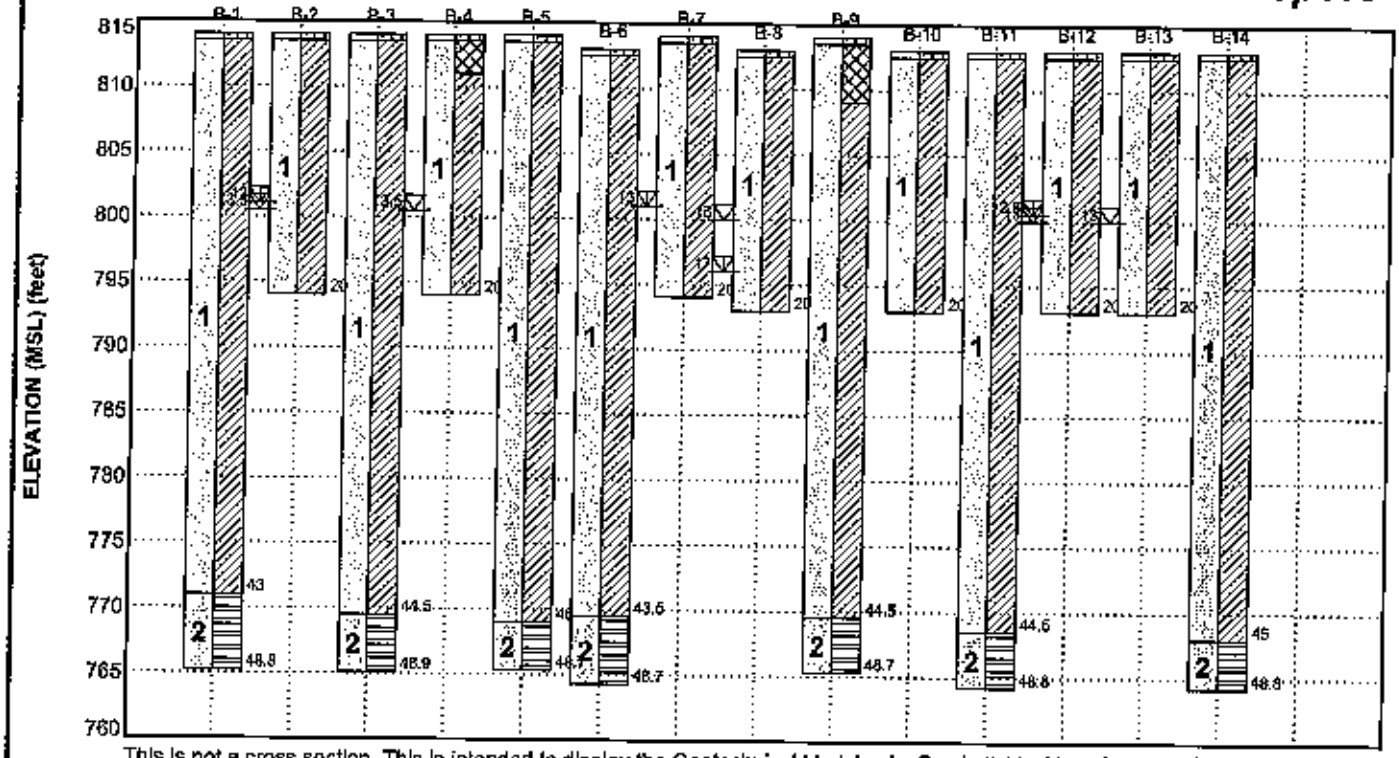
FIGURES

Contents:

GEOMODEL

Paragon Star Village ■ Lee's Summit, MO
Terracon Project No. 02195161

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Native Clay	Lean Clay (CL) - very soft to medium stiff
2	Shale	Shale - highly to moderately weathered

LEGEND

- Topsoil
- Fill
- Lean Clay
- Shale

▽ First Water Observation
▽ Second Water Observation

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

The borings were located in the field by Terracon personnel using a hand-held GPS unit with a horizontal accuracy of ±20 feet. Ground surface elevations indicated on the boring logs were estimated by interpolation from a site specific grading plan provided by GBA. Elevations are reported to the nearest 1 foot.

The borings were drilled with a track-mounted, rotary drill rig using solid-stem, continuous flight augers to advance the boreholes. Samples of the soil encountered in Borings B-1 through B-14 were obtained using thin-walled tube and split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch outside diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. Borings B-15 through B-21 were drilled as auger probes, so no soil samples were obtained for laboratory testing.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. The drill crew backfilled the borings with auger cuttings after completion of drilling/sampling and prior to leaving the site.

The drill crew prepared a field log of each boring to record data including visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The final boring logs included with this report represent the engineer's interpretation of the subsurface conditions at the borings based on field and laboratory data and observation of the samples.

Laboratory Testing

Representative soil samples were tested in the laboratory to measure their natural water content, dry unit weight, unconfined compressive strength, and Atterberg limits. A pocket penetrometer was used to estimate the consistency of selected cohesive samples. The test results are provided on the boring logs included in **Exploration Results**.

The soil samples were classified in the laboratory based on visual observation, texture, plasticity, and the laboratory testing described above. The soil descriptions presented on the boring logs are in accordance with the enclosed General Notes and Unified Soil Classification System (USCS). The estimated USCS group symbols for native soils are shown on the boring logs, and a brief description of the USCS is included in this report.

The bedrock materials encountered in the borings were described in accordance with the appended Description of Rock Properties on the basis of drilling characteristics and visual classification of disturbed auger cuttings. Petrographic analysis and rock core may indicate other rock types.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

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■ Terracon Project No. 02195181

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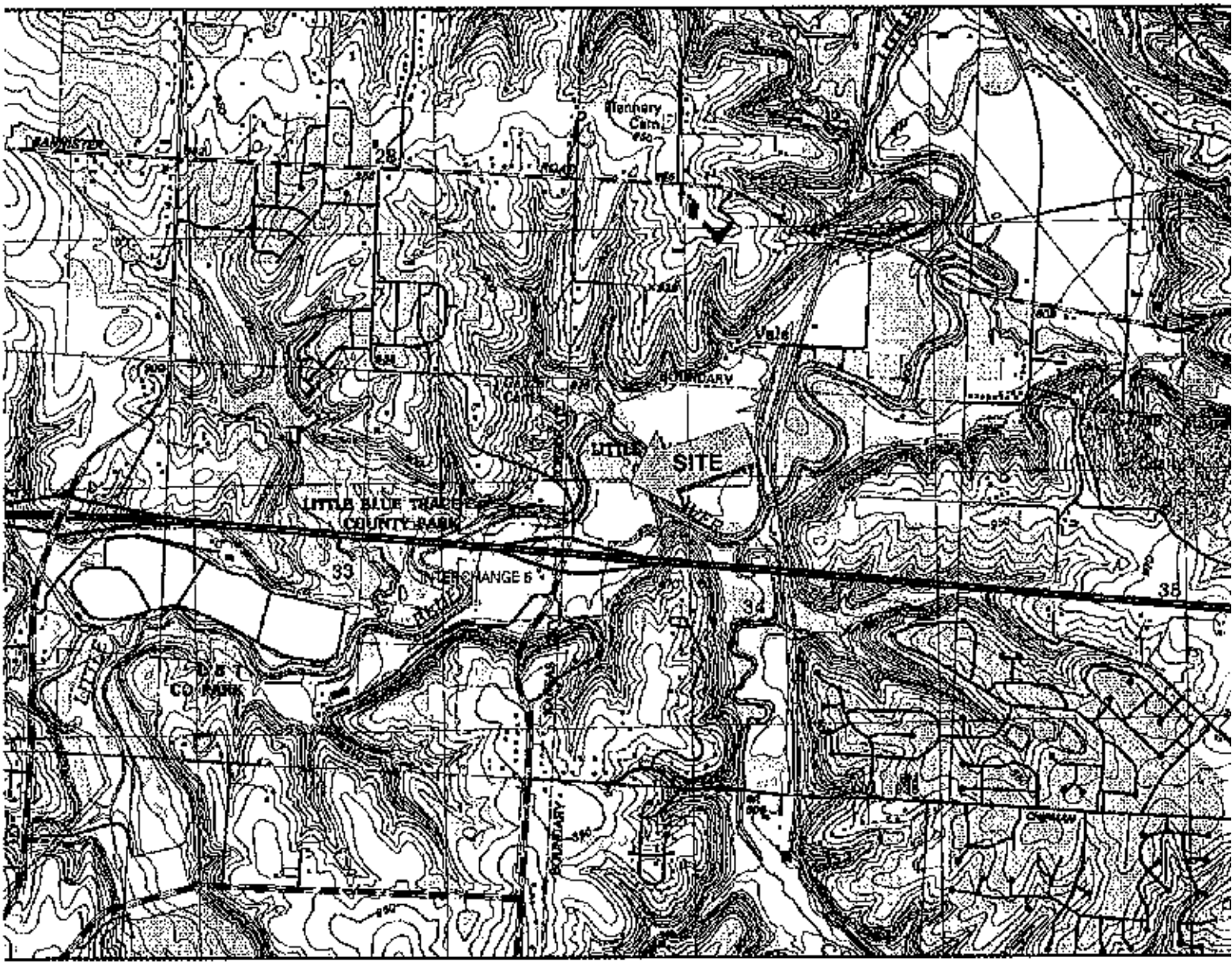

ENERAL LOCATION ONLY, AND IS NOT
OR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEO
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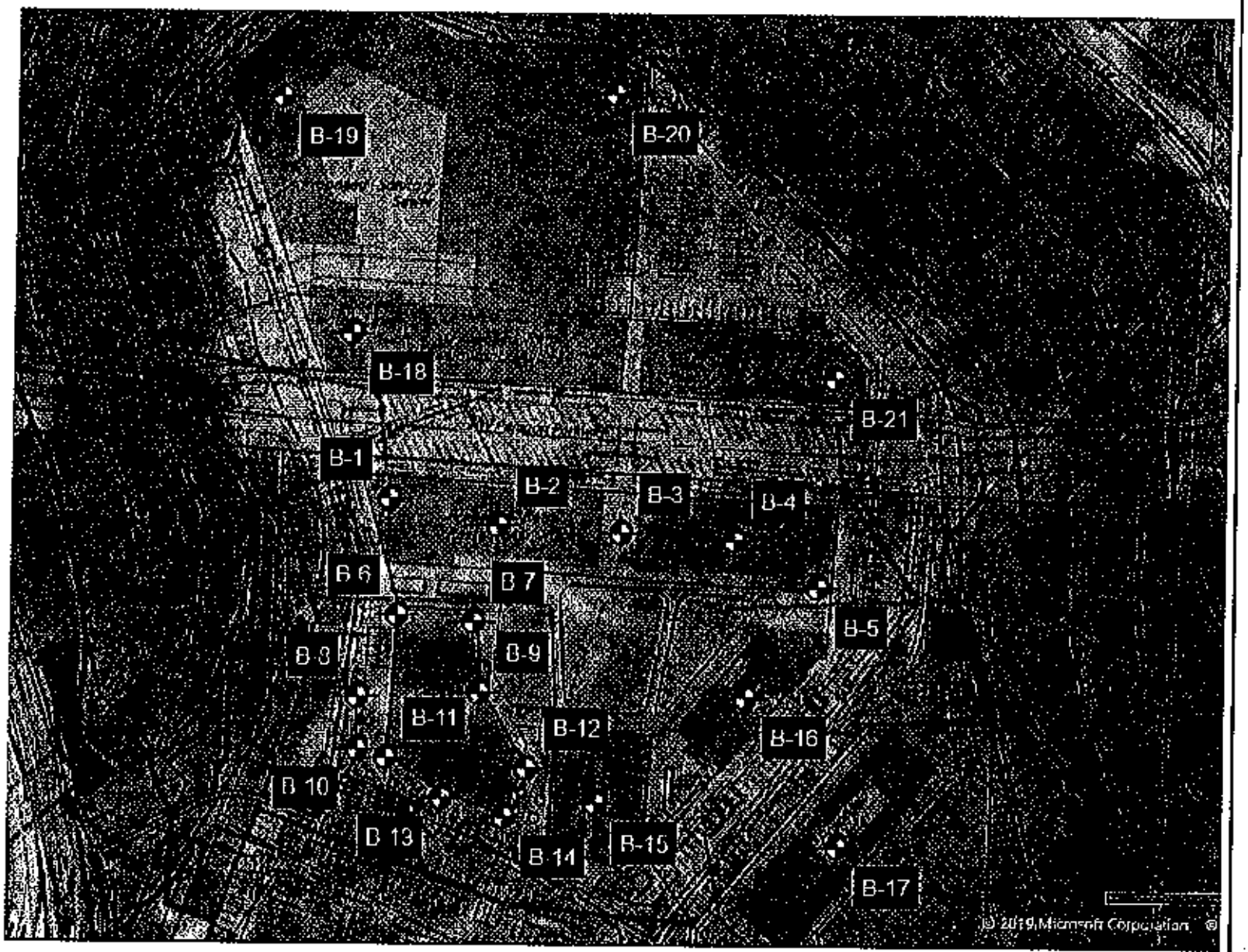

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: CONSTRUCTION PURPOSES

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EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through B-21)

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan
Latitude: 38.9388° Longitude: -94.4484°
Approximate Surface Elev.: 814 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	MATERIAL DESCRIPTION	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
0.5	813.5+/-	6" ROOT ZONE								
		LEAN CLAY (CL), brown to gray, medium stiff			18	5-3-4 N=7		20		43-17-26
					8		1.09	31	95	
		- becoming very soft below 6.5 feet			18	0-0-0 N=0		27		
					12	0-0-0 N=0		27		
					9	0-0-0 N=0		31		
					10	0-0-0 N=0		29		
					18	0-0-0 N=0		35		
					18	0-0-0 N=0		35		
					18	0-1-1 N=2		35		
		- becoming stiff below 38.5 feet			18	3-5-9 N=14		28		
43.0	771+/-									
		SHALE, gray, moderately weathered			10	35-50/4"		18		
46.8	765+/-									
		Refusal at 48.8 Feet			2	50/2"		29		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS
Groundwater not encountered

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-22-2019 | Boring Completed: 07-22-2019
Drill Rig: 754 | Driller: JW
Project No.: 02195181

BORING LOG NO. B-2

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9387° Longitude: -94.446°

Approximate Surface Elev.: 814 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (FL)	DEPTH (FT.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		0.5	813.5+/-										
			8" ROOT ZONE										
1			**LEAN CLAY (CL)**, brown to gray, medium stiff to stiff				18	1-3-4 N=7			25		34-18-16
							11		1.0		24	100	
				5									
							18	1-4-5 N=9			25		
			- becoming very soft below 8.5 feet				18	0-0-1 N=1			27		
				10									
							18	0-0-0 N=0			32		
				15									
		20.0	794+/-				18	0-0-0 N=0			33		
			Boring Terminated at 20 Feet	20									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous Flight Augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

▽ *13.5 ft. while drilling*

▽ *13 ft. upon completion*

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-23-2019 | Boring Completed: 07-23-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195161

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195161 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-3

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9387° Longitude: -94.4455°

Approximate Surface Elev.: 814 (FL) +/-

DEPTH	ELEVATION (Ft.)
0.5	813.5+/-
44.5	769.5+/-
48.9	765+/-

6" ROOT ZONE

LEAN CLAY (CL), brown to gray, stiff

- becoming very soft below 6.5 feet

- medium stiff from 28.5 to 20 feet

SHALE, with limestone seams, gray, moderately weathered

Refusal at 48.9 Feet

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
0						
		18	5-3-4 N=7		21	
		15		2.0	23	104
5						
		18	0-0-0 N=0		29	
		18	0-0-0 N=0		30	
10						
		18	0-0-0 N=0		31	
15						
		18	0-0-0 N=0		29	
20						
		18	0-0-0 N=0		32	
25						
		18	1-4-5 N=9		31	
30						
		18	0-0-0 N=0		34	
35						
		18	0-0-0 N=0		38	
40						
		18	0-1-7 N=8		33	
45						
		3	50/3"		15	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

WATER LEVEL OBSERVATIONS

Groundwater not encountered

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-23-2019 | Boring Completed: 07-23-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

BORING LOG NO. B-4

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9387° Longitude: -94.4451°

Approximate Surface Elev.: 814 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		0.5	813.5+/-										
			6" ROOT ZONE										
		3.0	811+/-										42-18-24
			FILL - LEAN CLAY, trace roots										
1			**LEAN CLAY (CL)**, brown, stiff to medium stiff	5			18	10-13-11 N=24					
							13			3.02	24	103	
							18	3-4-5 N=9			22	103	
				10			18	0-1-4 N=5			26		
			- becoming very soft below 13.5 feet		▽								
				15			18	0-0-0 N=0			27		
		20.0	794+/-	20			18	0-0-0 N=0			24		
			Boring Terminated at 20 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous Flight Augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

▽ *13.5 ft. while drilling*

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-23-2019 | Boring Completed: 07-23-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

BORING LOG NO. B-5

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9385° Longitude: -94.4448°

Approximate Surface Elev.: 814 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	MODEL LAYER	GRAPHIC LOG	DESCRIPTION
0.5	813.5+/-	1		6" ROOT ZONE
				LEAN CLAY (CL), brown to gray, medium stiff
				- becoming very soft below 8.5 feet
45.0	769+/-	2		SHALE, gray, moderately weathered
48.7	765.5+/-			*Refusal at 48.7 Feet*

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		X	18	2-2-4 N=6			28		46-19-27
		■	20		1.0		27	96	
5		X	12	1-3-5 N=8			30		
		X	12	0-1-1 N=2			29		
10									
		X	18	0-0-0 N=0			29		
15									
		X	18	0-0-2 N=2			30		
20									
		X	18	0-0-0 N=0			33		
25									
		X	18	0-0-0 N=0			32		
30									
		X	18	0-0-0 N=0			36		
35									
		X	18	0-0-0 N=0			38		
40									
		X	18	0-0-0 N=0			35		
45									
			1	50/1"			16		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-23-2019 | Boring Completed: 07-23-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

BORING LOG NO. B-6

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9385° Longitude: -94.4463°

Approximate Surface Elev.: 813 (Ft.) +/-

DEPTH	ELEVATION (Ft.)
0.5	812.5+/-
43.5	769.5+/-
48.7	764.5+/-

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		18	2-3-1 N=4	22		35-19-16
		24		27	98	
5						
		18	1-3-5 N=8	27		
		18	0-1-1 N=2	28		
10						
		18	0-0-0 N=0	31		
15						
		18	1-3-4 N=7	30		
20						
		18	0-0-0 N=0	34		
25						
		18	0-0-0 N=0	33		
30						
		18	0-0-0 N=0	35		
35						
		18	1-1-2 N=3	27		
40						
		8	40-50/2"	17		
45						
		1	50/1"	20		

UNCONFINED COMPRESSIVE STRENGTH (tsf): 1.03

HAND PENETROMETER (tsf)

WATER LEVEL OBSERVATIONS

MODEL LAYER

GRAPHIC LOG

0.5 6" ROOT ZONE

LEAN CLAY (CL), brown to gray, soft to very soft

- medium stiff from 18.5 to 20 feet

SHALE, gray, moderately weathered

Refusal at 48.7 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-19-2019 | Boring Completed: 07-19-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-7

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9384° Longitude: -94.4461°

Approximate Surface Elev.: 814 (Ft.) +/-

DEPTH	ELEVATION (Ft.)
0.5	813.5+/-
20.0	794+/-

MODEL LAYER	GRAPHIC LOG	DEPTH (ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
				X	18	4-7-6 N=13			20		
				■	24		1.5		25	100	
		5									
				X	18	0-0-1 N=1			26		
1				X	7	0-0-0 N=0			27		
		10	▽								
				X	18	0-0-1 N=1					
		15									
				X	18	0-0-0 N=0			30		
		20									

6" ROOT ZONE

LEAN CLAY (CL), brown, stiff

- becoming very soft below 6.5 feet

Boring Terminated at 20 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous Flight Augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

▽ 13 ft. while drilling

▽ 13 ft. upon completion

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-23-2019 | Boring Completed: 07-23-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 9/1/19

BORING LOG NO. B-8

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan
Latitude: 38.9382° Longitude: -94.4465°
Approximate Surface Elev.: 813 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.5	812.5+/-	6" ROOT ZONE
		LEAN CLAY (CL), brown to gray, medium stiff
		- becoming soft to very soft below 8.5 feet
20.0	793+/-	*Boring Terminated at 20 Feet*

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
			18	3-3-5 N=8			24		
			22			1.20	24	100	
5			18	2-3-4 N=7			24		
			18	0-1-3 N=4			26		
10	▽								
			18	0-0-0 N=0			28		
15	▽								
			18	0-1-3 N=4			30		
20									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous Flight Augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

▽ 13

▽ 17 ft. upon completion

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-20-2019 | Boring Completed: 07-20-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILLGPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-9

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9382° Longitude: -94.446°

Approximate Surface Elev.: 814 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		0.5	813.5+/-										
			6" ROOT ZONE										
1			**FILL - LEAN CLAY**, trace roots			X	18	17-22-15 N=37			20		46-18-28
							13		3.5		23	101	
		5.0	809+/-	5									
			LEAN CLAY (CL), brown to gray, stiff to medium stiff			X	18	3-5-9 N=14			24		
						X	18	1-2-4 N=6			24		
				10									
			- becoming very soft to soft below 13.5 feet			X	18	0-0-0 N=0			29		
				15									
						X	18	0-0-0 N=0			29		
				20									
			- medium stiff from 23.5 to 25 feet			X	18	0-0-5 N=5			33		
				25									
						X	18	0-0-0 N=0			33		
				30									
						X	18	0-0-0 N=0			33		
				35									
						X	18	0-0-1 N=1			35		
				40									
2		44.6	769.5+/-			X	18	1-1-3 N=4			29		
			SHALE, gray, moderately weathered	45									
		48.7	765.6+/-										
			Refusal at 48.8 Feet				2	50/2"			23		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

WATER LEVEL OBSERVATIONS

Groundwater not encountered

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-19-2019 | Boring Completed: 07-19-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-10

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9381° Longitude: -94.4465°

Approximate Surface Elev.: 813 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (FL)	DEPTH (FL)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		0.5	812.5+/-										
			6" ROOT ZONE										
			LEAN CLAY (CL), brown to gray, stiff				9	4-5-5 N=10			21		40-18-22
							17		2.0		23	101	
				5									
							18	2-5-6 N=11			26		
1			- becoming soft to very soft below 8.5 feet				18	0-1-2 N=3			27		
				10									
							18	0-0-0 N=0			27		
				15									
		20.0	793+/-				18	0-2-4 N=6			31		
			Boring Terminated at 20 Feet	20									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous Flight Augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-19-2019 | Boring Completed: 07-19-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-11

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.938° Longitude: -94.4464°

Approximate Surface Elev.: 813 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (FT)	DEPTH (FT)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.5	812.5+/-										
						X	18	2-2-3 N=5			22		
						■	15		0.5		25	102	
				5									
						X	18	0-0-0 N=0			28		
						X	18	0-0-1 N=1			29		
				10									
						X	18	0-0-0 N=0			30		
				15									
						X	14	0-0-1 N=1			31		
				20									
						X	14	0-0-1 N=1			30		
				25									
						X	9	1-1-1 N=2			35		
				30									
						X	18	0-1-1 N=2			29		
				35									
						X	18	1-3-8 N=11			28		
				40									
2		44.5	768.5+/-			X	11	11-16-19 N=35					
				45									
		48.8	764+/-				2	50/2"			21		

- LEAN CLAY (CL), brown to gray, medium stiff
- becoming very soft to soft below 6.5 feet
- becoming stiff to hard below 38.5 feet
- 6" ROOT ZONE
- SHALE, gray, moderately weathered
- *Refusal at 48.8 Feet*

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-20-2019 | Boring Completed: 07-20-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195161

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195161 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-12

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.938° Longitude: -94.4459°

Approximate Surface Elev.: 813 (Ft) +/-

DEPTH	ELEVATION (Ft.)
0.5	812.5+/-
20.0	793+/-

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.5				6" ROOT ZONE					
				X	18	2-3-4 N=7			23		
				■	13		3.0		24	103	
		5									
				X	18	2-4-4 N=8			24		
				X	18	2-2-4 N=6			25		
		10	▽								
				X	18	0-0-0 N=0			30		
		15									
				X	18	0-0-0 N=0			29		
		20									

LEAN CLAY (CL), brown to gray, medium stiff

- becoming very soft below 13.5 feet

Boring Terminated at 20 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous Flight Augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan

Notes:
W.O.H.: Weight of Hammer

WATER LEVEL OBSERVATIONS

▽ *13 ft. while drilling*

▽ *12.5 ft. upon completion*

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-22-2019 | Boring Completed: 07-22-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-13

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9379° Longitude: -94.4462°

Approximate Surface Elev.: 813 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
0.5	812.6+/-												
6" ROOT ZONE													
LEAN CLAY (CL), brown to gray, stiff to medium stiff		1				X	18	4-5-7 N=12			20		
							20		3.0		23	102	
				5		X	18	2-4-5 N=9			27		
						X	18	0-2-4 N=6			28		
				10	▽								
- becoming very soft below 13.5 feet						X	18	0-0-0 N=0			27		
				15									
20.0	793+/-					X	18	0-0-0 N=0			29		
Boring Terminated at 20 Feet				20									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous Flight Augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

▽ *13 ft. while drilling*

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-19-2019 | Boring Completed: 07-19-2019

Drill Rig: 754 | Driller: JW

Project No.: 02196181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02196181 PARAGON STAR VILLGPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-14

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9379° Longitude: -94.4458°

Approximate Surface Elev.: 813 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0.5	812.5+/-										
			6" ROOT ZONE										
			LEAN CLAY (CL), brown to gray, stiff			X	18	3-5-8 N=13			23		47-19-28
							6		1.5		31	88	
			- becoming soft to very soft below 6.5 feet	5		X	18	1-1-2 N=3			27		
				10		X	18	0-1-3 N=4			27		
				15		X	18	0-0-0 N=0			28		
				20		X	18	0-0-0 N=0			35		
				25		X	18	0-0-0 N=0			35		
				30		X	18	0-0-0 N=0			35		
				35		X	18	0-0-0 N=0			34		
				40		X	18	0-0-0 N=0			35		
		45.0	768+/-	45		X	18	0-0-0 N=0			32		
2			**SHALE**, gray, highly to moderately weathered										
		48.8	764+/-				2	50/2"			16		
			Refusal at 48.8 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-22-2019 | Boring Completed: 07-22-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-15

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9379° Longitude: -94.4466°

Approximate Surface Elev.: 814 (Ft.) +/-

DEPTH	ELEVATION (FL)
0.5	813.5+/-
46.0	768+/-
50.0	764+/-

6" ROOT ZONE

LEAN CLAY (CL), brown to gray

SHALE, gray

Boring Terminated at 50 Feet

MODEL LAYER	GRAPHIC LOG	DEPTH (FL)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		5									
		10									
		15									
		20									
		25									
		30									
		35									
		40									
		45									
2		50									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

WATER LEVEL OBSERVATIONS

Groundwater not encountered

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-24-2019 | Boring Completed: 07-24-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILLGPJ TERRACON_DATATEMPLATE.GDT 9/1/19

BORING LOG NO. B-16

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9382° Longitude: -94.4451°

Approximate Surface Elev.: 814 (Ft.) +/-

DEPTH	ELEVATION (Ft.)
0.5	813.5+/-
45.5	768.5+/-
50.0	764+/-

6" ROOT ZONE

LEAN CLAY (CL), brown to gray

SHALE, gray

Boring Terminated at 50 Feet

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0									
		5									
		10									
		15									
		20									
		25									
		30									
		35									
		40									
		45									
2		50									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-24-2019	Boring Completed: 07-24-2019
Drill Rig: 754	Driller: JW
Project No.: 02195181	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VIL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-17

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9378° Longitude: -94.4447°

Approximate Surface Elev.: 813 (FL) +/-

DEPTH	ELEVATION (FL)
0.5	812.5+/-
46.5	766.5+/-
50.0	763+/-

6" ROOT ZONE

LEAN CLAY (CL), brown to gray

SHALE, gray

Boring Terminated at 50 Feet

MODEL LAYER	GRAPHIC LOG	DEPTH (FL)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0									
		5									
		10									
		15									
		20									
		25									
		30									
		35									
		40									
		45									
2		50									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

WATER LEVEL OBSERVATIONS

Groundwater not encountered

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

Terracon
16620 W 113th St
Lenexa, KS

Boring Started: 07-24-2019	Boring Completed: 07-24-2019
Drill Rig: 754	Driller: JW
Project No.: 02195181	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILLGPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-18

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9393° Longitude: -94.4465°

Approximate Surface Elev.: 813 (FL) +/-

DEPTH	ELEVATION (Ft.)
0.5	812.5+/-
41.0	772+/-
50.0	763+/-

6" ROOT ZONE

LEAN CLAY (CL), brown to gray

SHALE, gray

Boring Terminated at 50 Feet

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0									
		5									
		10									
		15									
		20									
		25									
		30									
		35									
		40									
2		45									
		50									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

WATER LEVEL OBSERVATIONS

Groundwater not encountered

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-23-2019 | Boring Completed: 07-23-2019

Drill Rig: 754 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILLG.PJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-19

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9399° Longitude: -94.4468°

Approximate Surface Elev.: 806 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
0.5	805.5+/-	6" ROOT ZONE
		LEAN CLAY (CL), brown to gray
40.0	766+/-	SHALE, gray
50.0	756+/-	*Boring Terminated at 50 Feet*

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		5									
		10									
		15									
		20									
		25									
		30									
		35									
		40									
2		45									
		50									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

WATER LEVEL OBSERVATIONS

Groundwater not encountered

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:
W.O.H.: Weight of hammer

Terracon
15620 W 113th St
Lenexa, KS

Boring Started: 07-24-2019	Boring Completed: 07-24-2019
Drill Rig: 754	Driller: JW
Project No.: 02195181	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILLGPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-20

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.9399° Longitude: -94.4456°

Approximate Surface Elev.: 803 (Ft.) +/-

DEPTH	ELEVATION (Ft.)
0.5	802.5+/-
40.0	763+/-
50.0	753+/-

6" ROOT ZONE

LEAN CLAY (CL), brown to gray

SHALE, with limestone lenses, gray

Boring Terminated at 50 Feet

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0									
		5									
		10									
		15									
		20									
		25									
		30									
		35									
		40									
2		45									
		50									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Wash Bore

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan

Notes:
W.O.H.: Weight of hammer

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
16620 W 113th St
Lenexa, KS

Boring Started: 07-24-2019 | Boring Completed: 07-24-2019

Drill Rig: 764 | Driller: JW

Project No.: 02195181

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

BORING LOG NO. B-21

PROJECT: Paragon Star Village

CLIENT: GBA
Lenexa, KS

SITE: I-470 and View High Drive
Lee's Summit, MO

LOCATION See Exploration Plan

Latitude: 38.8391° Longitude: -94.4447°

Approximate Surface Elev.: 804 (Ft.) +/-

DEPTH	ELEVATION (Ft.)
0.5	803.5+/-
40.5	763.5+/-
50.0	754+/-

6" ROOT ZONE

LEAN CLAY (CL), brown to gray

SHALE, gray

Boring Terminated at 50 Feet

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		0	▽								
		5									
		10	▽								
		15									
		20									
		25									
		30									
		35									
		40									
2		45									
		50									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Continuous Flight Augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

WATER LEVEL OBSERVATIONS

▽ *13 ft. while drilling*

▽ *3 ft. upon completion*

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan

Notes:
W.O.H.: Weight of hammer

Terracon
16620 W 113th St
Lenexa, KS

Boring Started: 07-23-2019	Boring Completed: 07-23-2019
Drill Rig: 754	Driller: JW
Project No.: 02195181	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 02195181 PARAGON STAR VILL.GPJ TERRACON_DATATEMPLATE.GDT 8/1/19

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Paragon Star Village ■ Lee's Summit, MO

Terracon Project No. 02195181

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Shelby Tube	Water Initially Encountered	N Standard Penetration Test Resistance (Blows/Ft.)
Split Spoon	Water Level After a Specified Period of Time	(HP) Hand Penetrometer
	Water Level After a Specified Period of Time	(T) Torvane
	Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	(DCP) Dynamic Cone Penetrometer
		UC Unconfined Compressive Strength
		(PID) Photo-Ionization Detector
		(OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS
(More than 50% retained on No. 200 sieve.)
Density determined by Standard Penetration Resistance

Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 50
Very Dense	> 50

CONSISTENCY OF FINE-GRAINED SOILS
(50% or more passing the No. 200 sieve.)
Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance

Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Soft	less than 0.25	0 - 1
Soft	0.25 to 0.50	2 - 4
Medium Stiff	0.50 to 1.00	4 - 8
Stiff	1.00 to 2.00	8 - 15
Very Stiff	2.00 to 4.00	15 - 30
Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15
With	15-29
Modifier	>30

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<5
With	5-12
Modifier	>12

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [$Cc<1$ or $Cc>3.0$] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [$Cc<1$ or $Cc>3.0$] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K, L, M, N] / Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K, L, M, P] / Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

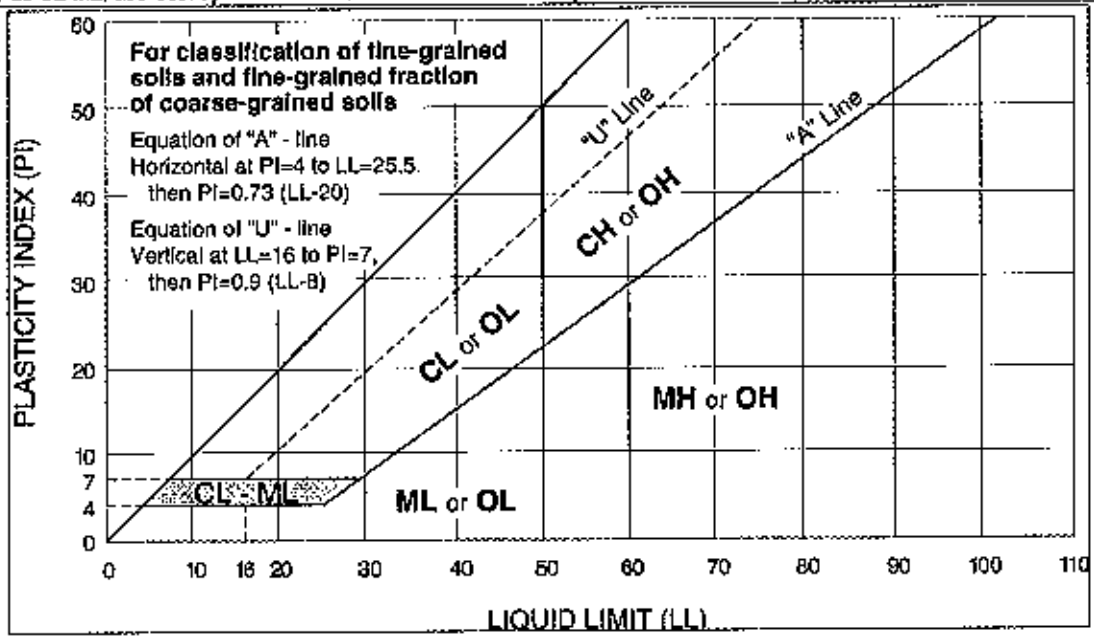
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

Terracon GeoReport

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	Laminated	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	Very thin	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	Thin	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	Medium	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	Thick	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	Massive	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements