



# Geotechnical Engineering Report

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**Taco Bell and Coffee Shop  
Lee's Summit, Missouri**

April 30, 2019

Terracon Project No. 02195092

**Prepared for:**

First Street Development, LLC  
Phoenix, Arizona

**Prepared by:**

Terracon Consultants, Inc.  
Lenexa, Kansas



April 30, 2019

First Street Development, LLC  
4455 E Camelback Road, C241  
Phoenix, Arizona 85018



Attn: Mr. Chris Czyz  
P: 602.295.6247  
E: chris@firststreetdev.com

Re: Geotechnical Engineering Report  
Taco Bell and Coffee Shop  
851 NE Woods Chapel Road  
Lee's Summit, Missouri  
Terracon Project No. 02195092

Dear Mr. Czyz:

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. P02195092, dated April 1, 2019. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, and pavements for the project.

We appreciate the opportunity to be of service to you on this project. 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  
Missouri: PE 2013010325

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**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](http://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

**Taco Bell and Coffee Shop  
851 NE Woods Chapel Road**

**Lee's Summit, Missouri**

**Terracon Project No. 02195092**

**April 30, 2019**

## INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering evaluation performed for the proposed Taco Bell and Coffee Shop to be located at 851 NE Woods Chapel Road in Lee's Summit, Missouri. Eight exploratory borings were performed at the site to depths ranging from approximately 3 to 8½ feet below existing site grades. This report describes the subsurface conditions encountered at the boring locations, presents the test data, and provides geotechnical recommendations for the following items:

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

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
<b>Project Location</b>	The project is located southeast at 851 NE Woods Chapel Road in Lee's Summit, Missouri.
<b>Existing Improvements</b>	The project site is a vacant lot with a Price Chopper grocery store and parking lot located to the south and a County Club Bank located to the west. The north side of the lot is bounded by NE Woods Chapel Road and the east side of the lot is bounded by an entrance ramp to southbound I-470. Overhead lines run along the north and northeast parts of the site.
<b>Existing Topography</b>	A topographic site plan was not provided. Based on elevation data obtained from online mapping software, we estimate site grades slope gradually down to the southwest.

## PROJECT DESCRIPTION

Item	Description
<b>Proposed Buildings</b>	A coffee shop and Taco Bell restaurant will be constructed on the lot. The Taco Bell building will be a single-story structure with a footprint area of approximately 2,000 square feet, and the coffee shop will be a single-story structure with a footprint area of 545 square feet. Specific details concerning building construction were not provided. Based on our experience with similar structures, we anticipate the buildings will have steel and/or wood framing and grade-supported floor slabs.
<b>Finished Floor Elevation</b>	The FFEs of the structures were not provided. We anticipate the FFE's will be within $\pm 3$ feet of existing grades.
<b>Maximum Loads</b>	The following maximum loads were provided by FSD: <ul style="list-style-type: none"> <li>■ Columns: 20 kips</li> <li>■ Walls: 3 kips per linear foot</li> <li>■ Slabs: 100 pounds per square foot</li> </ul>
<b>Free-Standing Retaining Walls</b>	A retaining wall is planned on the north and east sides of the lot. The retaining wall will have a length of approximately 230 feet and a maximum exposed height of approximately 6 feet. We understand the wall will either be a cast-in-place concrete cantilever-type wall.
<b>Grading</b>	A site grading plan was not provided. We have considered less than 6 feet of cut and/or fill will be required to develop final grades. Deeper excavations may be required at the proposed retaining wall.
<b>Below-Grade Structures</b>	No below-grade structures are planned.
<b>Pavements</b>	A parking lot with 32 parking stalls and drive-through lane pavements are planned. No information regarding anticipated vehicle types, axle loads, or traffic volumes was provided. We anticipate the pavements will be utilized primarily by passenger vehicles (cars, pickup trucks, SUV's) with occasional panel delivery trucks, trash collection trucks, and food delivery semi-tractor trailers.

## 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	FILL	Fat clay with shale and limestone fragments
2	Fat Clay (CH)	Native clay, stiff to very stiff
3	Limestone	Highly Weathered

The boreholes were observed during drilling for the presence and level of groundwater. Groundwater was not observed in the boreholes 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, 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

Based on conditions encountered at the boring locations, it appears feasible to support the new buildings on shallow spread footings bearing on highly weathered limestone, stiff native clay, or engineered fill materials.

Excavation of limestone bedrock may be required to develop the planned floor slab subgrade elevation for the buildings, depending on the planned finished floor elevations. In our experience, highly weathered limestone bedrock (bedrock penetrated with our flight augers) can generally be excavated with conventional excavating equipment such as scrapers and loaders. Excavation of harder (moderately to slightly weathered) limestone strata will be difficult and will require the use of large pneumatic breakers or other rock excavating techniques. Excavation of rock formations in confined excavations such as utility trenches or footings is more difficult, regardless of the degree of weathering.

Existing fill materials composed of fat clay were encountered to depths of 1½ feet at some of our boring locations. Fill could extend to greater depths in other areas of the site where no borings were performed. Based on field and laboratory test data, it appears that some compactive effort was applied to portions of the fill encountered at the boring locations. However, no documentation regarding placement and compaction of the fill was provided for our review. Existing fill should be completely removed from the planned building footprints and be replaced with properly compacted engineered fill.

Fat clay soils were encountered at the site. These materials have the potential to shrink and swell with seasonal fluctuations in the soil moisture content. We recommend the floor slabs be supported on at least 24 inches of low volume change (LVC) material. In areas that are currently above or less than 2 feet below the planned bottom of floor slab level, native fat clay soils should be undercut to accommodate placement of LVC material. In areas where more than 2 feet of fill will be placed below the bottom-of-floor-slab level, at least the upper 24 inches of new engineered fill should consist of LVC material. Placement of a layer of LVC material below floor slabs, as recommended in this report, will not eliminate all future subgrade volume change and resultant floor slab movements. However, use of an LVC zone should reduce the potential for subgrade volume change. Details regarding the LVC zone are provided in **Earthwork**.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and at least minor cracking in the structure could still occur. The severity of cracking and other cosmetic damage caused by movement of the floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and cosmetic distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request. 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, slabs, and pavements 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.

The soils within the planned building areas should be further undercut as necessary to remove existing fill and accommodate placement of the recommended 24-inch thick LVC layer below floor slabs. The undercut areas should extend a minimum of 5 feet laterally outside the building wall lines. Undercutting to facilitate placement of the LVC layer would not be necessary in areas where existing fill is not present and more than 2 feet of fill will be placed to develop the floor slab subgrade level.

Following initial stripping and any necessary undercutting, 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 <sup>1</sup>	USCS Classification	Acceptable Location for Placement
Low Volume Change (LVC) material	GM <sup>2</sup> or CL (LL<45 and PI<23)	All locations and elevations, except where free-draining material is required.
On-site soils	CH (native clay soils and existing fill soils)	Pavement areas and at depths greater than 24 inches below building finished grade. 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 <sup>3</sup>	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.

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. Soils that meet the LVC criteria were not encountered in the borings. Therefore, the use of imported LVC materials should be expected. 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 <sup>1</sup>		At least 95 percent of the material’s maximum dry density <sup>1</sup>
Moisture Content of Clay Soil	LL<45	-2 to +2 percent of optimum moisture content value <sup>1</sup>
	LL>45	0 to 4 percent above the optimum moisture content value <sup>1</sup>
Moisture Content of Granular Material		Sufficient to achieve compaction without pumping when proofrolled

<sup>1</sup>. 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**

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.

## SHALLOW FOUNDATIONS

### Foundation Design Parameters

Depending on the final designed finished floor elevation, the buildings are anticipated to be supported on native clay, engineered fill or limestone bedrock. Each building should be evaluated individually and the bearing material should be determined prior to construction. The footings for each building should either bear entirely on native soil and/or engineered fill, or entirely on limestone bedrock. Bearing on multiple material types may result in abrupt differential settlement resulting in cracking and differential movement of buildings.

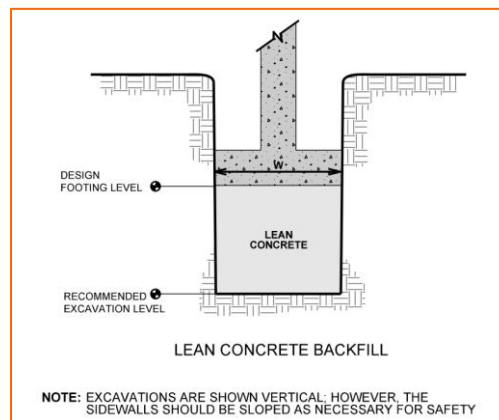
Description	Value
<b>Maximum net allowable bearing pressure</b> <sup>1</sup>	<u><b>Bearing on Native Clay and/or Engineered Fill</b></u>
	2,500 psf <u><b>Bearing on Limestone Bedrock</b></u> 5,000 psf
<b>Minimum embedment below finished grade for frost protection</b> <sup>2, 3</sup>	3 feet
<b>Minimum footing widths</b>	Isolated footings: 30 inches Continuous footings: 16 inches
<b>Estimated total settlement</b> <sup>4</sup>	1 inch or less
<b>Estimated differential settlement</b> <sup>4</sup>	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 for perimeter footings and footings beneath unheated areas to provide frost protection and to reduce the effects of seasonal moisture variations in the foundation bearing soils. Interior footings in heated areas may be supported at shallower depths, provided they are not exposed to freezing conditions during construction.
3. If sound, moderately weathered limestone is encountered shallower than the minimum embedment depth, shallower footing depths may be considered provided the limestone at the bearing elevation is observed and approved by a representative from Terracon.
4. 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.

## 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.



## SEISMIC CONSIDERATIONS

Code	Site Classification
2012 International Building Code (IBC)	C <sup>1</sup>
<p>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 limestone bedrock at a maximum depth of 8½ feet. Our opinion of site classification is based on boring data and our knowledge of local geological and geotechnical conditions.</p>	

## FLOOR SLABS

### Floor Slab Design Parameters

Item	Description
<b>Floor Slab Support</b>	At least 24 inches of low volume change (LVC) material
<b>Modulus of Subgrade Reaction</b>	100 pounds per square inch per inch of deflection (psi/in or pci) for point loading conditions
<b>Granular Leveling Course Layer Thickness</b> <sup>1,2</sup>	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.
2. These granular materials may be considered part of the LVC zone.

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,

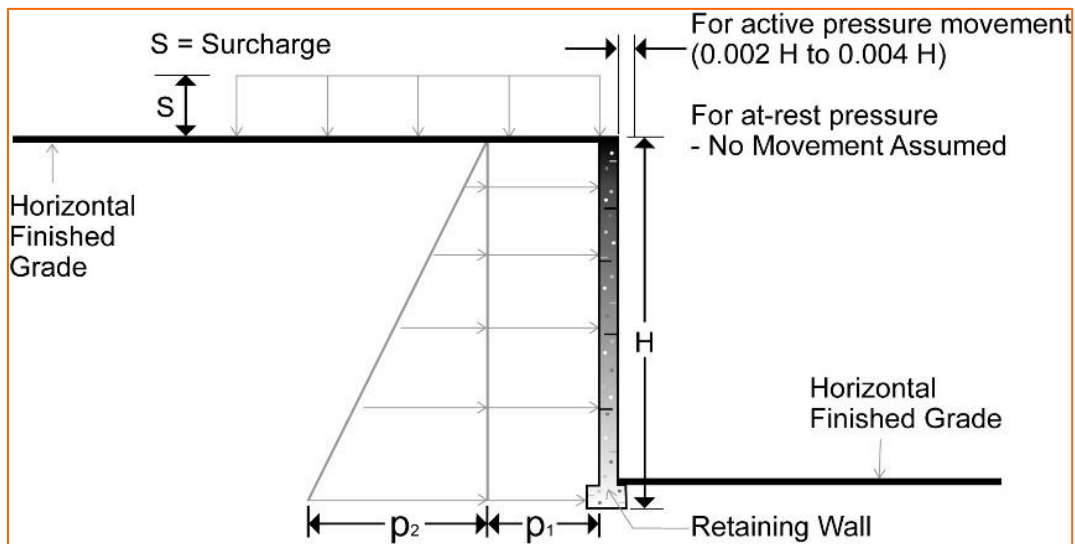
construction traffic, desiccation, rainfall etc. As a result, the floor slab subgrade soils may not be suitable for placement of the granular course and/or concrete at the time of building construction, and corrective action may be required.

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

The cast-in-place concrete retaining wall 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 <sub>1</sub> (psf)	Earth Pressure, p <sub>2</sub> (psf)
Active (K <sub>a</sub> )	Granular - 0.3	40	(0.3)S	(40)H
	Clay - 0.42	50	(0.42)S	(50)H
At-Rest (K <sub>o</sub> )	Granular - 0.47	60	(0.47)S	(60)H
	Clay - 0.60	70	(0.60)S	(70)H
Passive (K <sub>p</sub> )	Granular - 3.3	420	---	---
	Clay - 2.4	290	---	---

Applicable conditions to the above include:

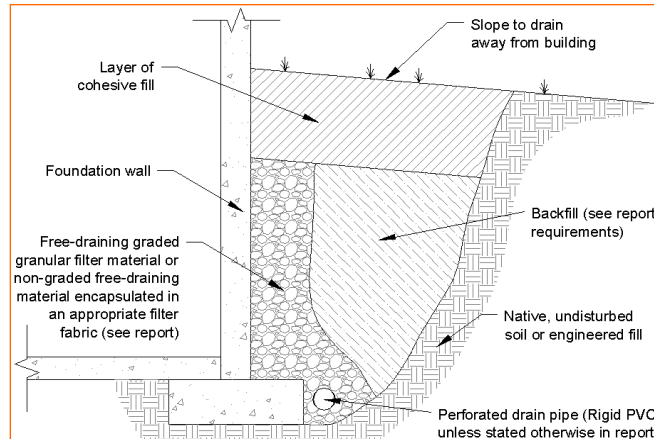
- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 H to 0.004 H, where H is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance
- Uniform surcharge, where S is surcharge pressure
- Clay soil backfill: unit weight = 120 pcf (maximum), and  $\phi = 24$  degrees (minimum)
- Granular material backfill: unit weight = 130 pcf (maximum), and  $\phi = 32$  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.

## PAVEMENTS

### Pavement Subgrade Preparation

Pavement subgrades are expected to consist of on-site native clay soils. The pavement subgrades should be proofrolled as recommended in **Earthwork**. If soft or otherwise unsuitable areas are observed, additional over-excavation and replacement will be needed.

Grading and paving are commonly performed by separate contractors and there is often a time lapse between the end of grading operations and the commencement of paving. Subgrades prepared early in the construction process may become disturbed by construction traffic. Non-uniform subgrades often result in poor pavement performance and local failures relatively soon after pavements are constructed. Depending on the paving equipment used by the contractor, measures may be required to improve subgrade strength to greater depths for support of heavily loaded concrete/asphalt trucks.

We recommend the moisture content and density of the subgrade be evaluated and the pavement subgrades be proofrolled (using a loaded tandem-axle dump truck with a minimum gross weight of 20 tons or similarly loaded rubber-tire equipment) within two days prior to commencement of actual paving operations. Areas not in compliance with the required ranges of moisture or density should be scarified, moisture conditioned, and compacted. Particular attention should be paid to

high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills. The subgrade should be in its finished form at the time of the final review.

### Opinions of Minimum Pavement Thickness

Pavement thickness depends upon many factors including but not limited to:

- applied wheel/axle loads and number of repetitions
- subgrade and pavement material characteristics
- climate conditions
- site and pavement drainage

Specific information regarding anticipated vehicle types, axle loads and traffic volumes was not provided at the time of this report. The “Parking Lots” pavement section considers 4-tire, 2-axle personal vehicle traffic only (cars, vans, pickups and SUVs). The “Drives” pavement section considers personal vehicle traffic and a maximum of ten delivery trucks/trash collection trucks per week. Our recommendations for full depth asphaltic cement concrete (ACC) pavement, ACC pavement over aggregate base, and Portland cement concrete (PCC) pavement sections are outlined in the following table.

Pavement Type	Parking Lots	Drives
<b>Full depth ACC</b>	2 inches ACC surface 4 inches ACC base	2 inches ACC surface 6 inches ACC base
<b>ACC over aggregate base</b>	2 inches ACC surface 2 inches ACC base 6 inches aggregate base (MoDOT Type 5 or similar)	2 inches ACC surface 4 inches ACC base 6 inches aggregate base (MoDOT Type 5 or similar)
<b>PCC</b>	5 inches PCC 4 inches open graded rock (ASTM C33 Size No. 57 aggregate or similar)	6 inches PCC 4 inches open graded rock (ASTM C33 Size No. 57 aggregate or similar)

1. For trash container pads, we recommend a PCC pavement section be used consisting of 7 inches (minimum) of PCC over 4 inches (minimum) of open graded rock (ASTM C33 Size No. 57 aggregate or similar) on a compacted soil subgrade. The trash container pad should be large enough to support the container and the tipping axle of the collection truck.

PCC pavements will perform better than ACC in areas where short-radii turning and braking are expected (i.e., entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavement will perform better in areas subject to heavy static loads.

Construction traffic on the pavements was not considered in developing our opinions of minimum pavement thickness. If the pavements will be subject to construction equipment/vehicles, the pavement sections should be revised to consider the additional loading.

Pavements and subgrades will be subject to freeze-thaw cycles and seasonal fluctuations in moisture content. Pavement thickness design methods are intended to provide adequate thickness of structural materials over a particular subgrade such that wheel loads are reduced to a level that the subgrade can support. The subgrade support parameters for pavement thickness design do not account for shrink/swell movements of a subgrade constructed of expansive clay soils. Therefore, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade.

The pavement sections provided above consider that the subgrade soils will not experience significant increases in moisture content. Paved areas should be sloped to provide rapid drainage of surface water and to drain water away from the pavement edges. Pavements should be designed so water does not accumulate on or adjacent to the pavement, since this could saturate and soften the subgrade soils and subsequently accelerate pavement deterioration.

Periodic maintenance of the pavements will be required. Cracks should be sealed, and areas exhibiting distress should be repaired promptly to help prevent further deterioration. Even with periodic maintenance, some movement and related cracking may still occur and repairs may be required.

## **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.

## Geotechnical Engineering Report

Taco Bell and Coffee Shop ■ Lee's Summit, Missouri

April 30, 2019 ■ Terracon Project No. 02195092



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.

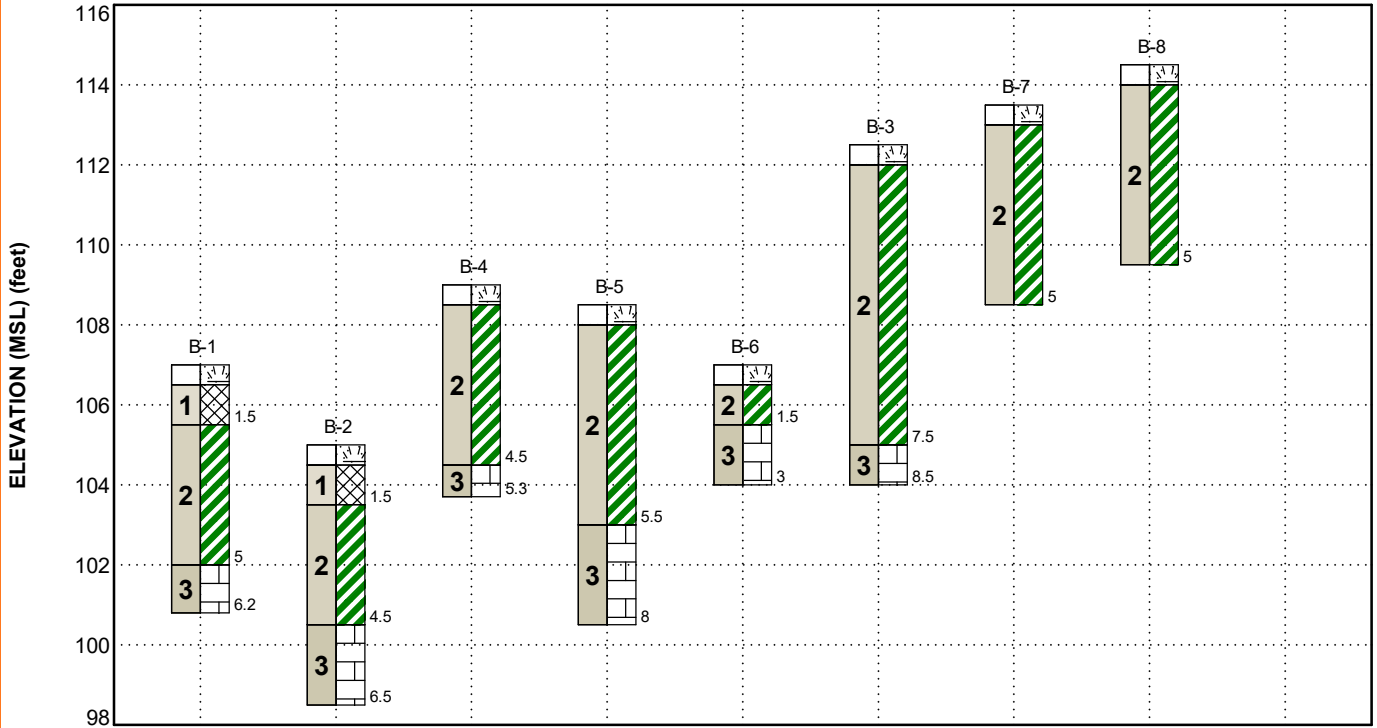
## FIGURES

### Contents:

GeoModel

**GEOMODEL**

Taco Bell ■ Lee's Summit, Missouri  
 4/29/2019 ■ Terracon Project No. 02195092



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	FILL	Fat Clay with shale and limestone fragments
2	Fat Clay (CH)	Native clay, stiff to very stiff
3	Limestone	Highly weathered

**LEGEND**

- Topsoil
- Limestone
- Fill
- Fat Clay

- First Water Observation
- Second Water Observation
- Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

**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  $\pm 20$  feet. Ground surface elevations indicated on the boring logs were measured using a level and grade rod. Elevations were referenced to a manhole cover that was assigned an elevation of 100 feet as shown on the attached **Exploration Plan**.

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 the borings 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.

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.

## Geotechnical Engineering Report

Taco Bell and Coffee Shop ■ Lee's Summit, Missouri

April 30, 2019 ■ Terracon Project No. 02195092



### Laboratory Testing

Representative soil samples were tested in the laboratory to measure their natural water content, dry unit weight, 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.

## SITE LOCATION

Taco Bell ■ Lee's Summit, MO

April 29, 2019 ■ Terracon Project No. 02195092

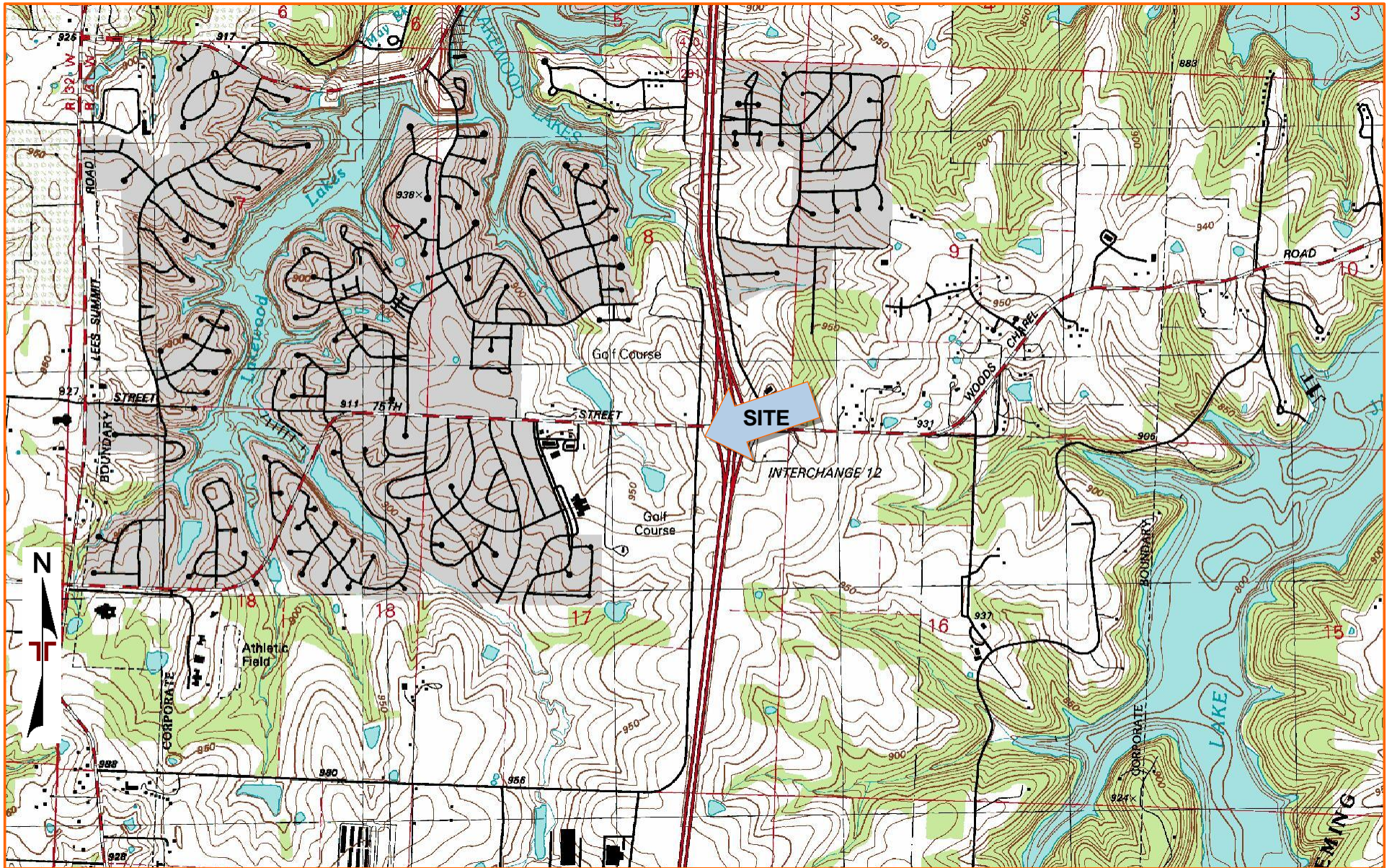


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT  
INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY  
QUADRANGLES INCLUDE: LEES SUMMIT, MO (1/1/1996) and LAKE JACOMO, MO  
(1/1/1996).

**EXPLORATION PLAN**

Taco Bell ■ Lee's Summit, MO

April 29, 2019 ■ Terracon Project No. 02195092

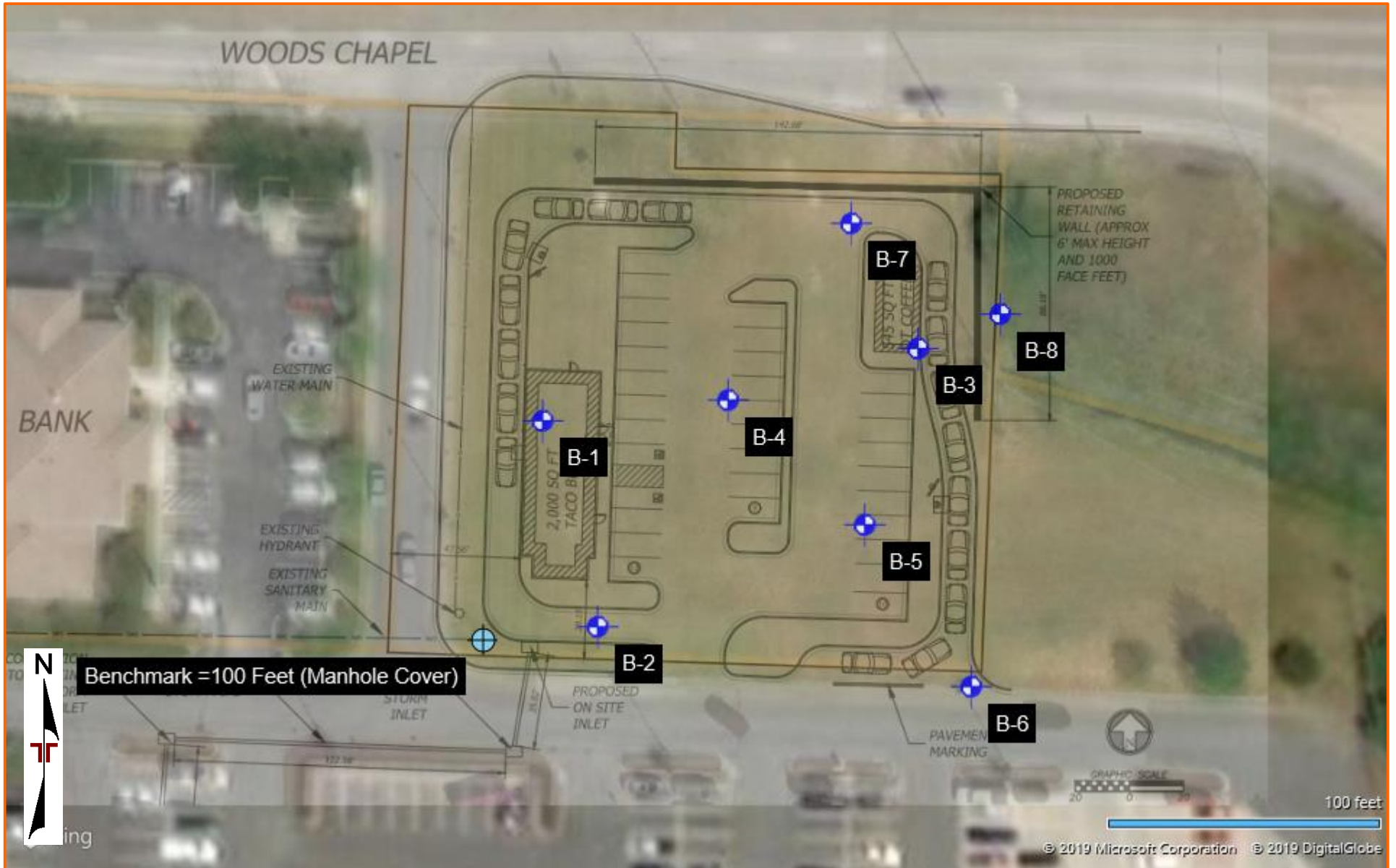


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

## **EXPLORATION RESULTS**

### **Contents:**

Boring Logs (B-1 through B-8)





Note: All attachments are one page unless noted above.

# BORING LOG NO. B-1

**PROJECT:** Taco Bell and Coffee Shop

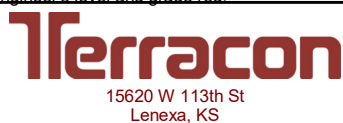
**CLIENT:** First Street Development LLC  
Phoenix, Arizona

**SITE:** 851 NE Woods Chapel Road  
Lee's Summit, Missouri

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 38.9821° Longitude: -94.3584°  Approximate Surface Elev.: 107.0 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (1st)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS  LL-PL-PI
		<b>6" ROOT ZONE</b>	0.5								
1		<b>FILL - FAT CLAY</b> , with shale fragments, gray to brown	1.5								
2		<b>FAT CLAY (CH)</b> , brown, stiff	5.0		18		4-5-5 N=10		26		63-26-37
3		<b>LIMESTONE</b> , gray to light brown, highly weathered	6.2		19			2.75	26	99	
		<b>Auger Refusal at 6.2 Feet</b>	101+/-								

Stratification lines are approximate. In-situ, the transition may be gradual.  
Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

<p>Advancement Method: Continuous Flight Augers</p> <p>Abandonment Method: Boring backfilled with Auger Cuttings and/or Bentonite</p>	<p>See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any).</p> <p>See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.</p> <p>Elevations were measured in the field using an engineer's level and grade rod.</p>	<p>Notes:</p>						
<p><b>WATER LEVEL OBSERVATIONS</b> <i>Groundwater not encountered</i></p>	 <p>15620 W 113th St Lenexa, KS</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Boring Started: 04-26-2019</td> <td style="width: 50%;">Boring Completed: 04-26-2019</td> </tr> <tr> <td>Drill Rig: Acker</td> <td>Driller: JW</td> </tr> <tr> <td colspan="2">Project No.: 02195092</td> </tr> </table>	Boring Started: 04-26-2019	Boring Completed: 04-26-2019	Drill Rig: Acker	Driller: JW	Project No.: 02195092	
Boring Started: 04-26-2019	Boring Completed: 04-26-2019							
Drill Rig: Acker	Driller: JW							
Project No.: 02195092								

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. 02195092 TACO BELL GPJ MODEL LAYER GPJ 4/30/19

# BORING LOG NO. B-2

**PROJECT:** Taco Bell and Coffee Shop

**CLIENT:** First Street Development LLC  
Phoenix, Arizona

**SITE:** 851 NE Woods Chapel Road  
Lee's Summit, Missouri

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 38.9819° Longitude: -94.3583°  Approximate Surface Elev.: 105.0 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (1st)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS  LL-PL-PI
	<b>6" ROOT ZONE</b>		0.5								
1		<b>FILL - FAT CLAY</b> , with limestone fragments, dark brown	1.5								
2		<b>FAT CLAY (CH)</b> , trace limestone fragments, brown, stiff	4.5		12		3-6-4 N=10		19		
3		<b>LIMESTONE</b> , gray to light brown, highly weathered	6.5		14			2.5	28	98	
		<b>Auger Refusal at 6.5 Feet</b>	98.5+/-								

Stratification lines are approximate. In-situ, the transition may be gradual.  
Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:  
Continuous Flight Augers

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

Notes:

Abandonment Method:  
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

**WATER LEVEL OBSERVATIONS**  
*Groundwater not encountered*

15620 W 113th St  
Lenexa, KS

Boring Started: 04-26-2019

Boring Completed: 04-26-2019

Drill Rig: Acker

Driller: JW

Project No.: 02195092




THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. 02195092 TACO BELL.GPJ MODEL LAYER.GPJ 4/30/19

# BORING LOG NO. B-3

**PROJECT:** Taco Bell and Coffee Shop

**CLIENT:** First Street Development LLC  
Phoenix, Arizona

**SITE:** 851 NE Woods Chapel Road  
Lee's Summit, Missouri

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 38.9822° Longitude: -94.3579°  Approximate Surface Elev.: 112.5 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (1sf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS  LL-PL-PI
		<b>6" ROOT ZONE</b>	0.5								
		<b>FAT CLAY (CH)</b> , brown, stiff	112+/-								
2					18		3-5-5 N=10		28		
					24			1.75	27	94	
					15		3-14-50/3"		33		
		<b>LIMESTONE</b> , gray to light brown, highly weathered	7.5								
3			105+/-								
		<b>Auger Refusal at 8.5 Feet</b>	8.5								
			104+/-								

Stratification lines are approximate. In-situ, the transition may be gradual.  
Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:  
Continuous Flight Augers

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


Notes:

Abandonment Method:  
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

**WATER LEVEL OBSERVATIONS**  
*Groundwater not encountered*



15620 W 113th St  
Lenexa, KS

Boring Started: 04-26-2019	Boring Completed: 04-26-2019
Drill Rig: Acker	Driller: JW
Project No.: 02195092	





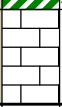
THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_02195092 TACO BELL.GPJ MODEL LAYER.GPJ 4/30/19

# BORING LOG NO. B-4

**PROJECT:** Taco Bell and Coffee Shop

**CLIENT:** First Street Development LLC  
Phoenix, Arizona

**SITE:** 851 NE Woods Chapel Road  
Lee's Summit, Missouri

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 38.9822° Longitude: -94.3581°  Approximate Surface Elev.: 109.0 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS  LL-PL-PI
		<b>6" ROOT ZONE</b>	0.5								
2		<b>FAT CLAY (CH)</b> , brown, stiff	108.5+/-								
						18	3-5-6 N=11		27		
						11		2.0	27	95	
3		<b>LIMESTONE</b> , gray to light brown, highly weathered	4.5								
			104.5+/-								
			5.3								
		<b>Auger Refusal at 5.3 Feet</b>	103.5+/-								

Stratification lines are approximate. In-situ, the transition may be gradual.  
Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:  
Continuous Flight Augers

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


Notes:

Abandonment Method:  
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

**WATER LEVEL OBSERVATIONS**  
*Groundwater not encountered*



15620 W 113th St  
Lenexa, KS

Boring Started: 04-26-2019	Boring Completed: 04-26-2019
Drill Rig: Acker	Driller: JW
Project No.: 02195092	



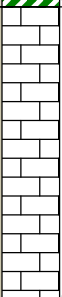
THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. 02195092 TACO BELL.GPJ MODEL LAYER.GPJ 4/30/19

# BORING LOG NO. B-5

**PROJECT:** Taco Bell and Coffee Shop

**CLIENT:** First Street Development LLC  
Phoenix, Arizona

**SITE:** 851 NE Woods Chapel Road  
Lee's Summit, Missouri

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 38.982° Longitude: -94.3579°  Approximate Surface Elev.: 108.5 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	HAND PENETROMETER (1sf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS  LL-PL-PI
		<b>6" ROOT ZONE</b>	0.5								
2		<b>FAT CLAY (CH)</b> , brown, stiff	5.5			18	2-2-4 N=6	2.0	27	97	51-21-30
3		<b>LIMESTONE</b> , gray to light brown, highly weathered	8.0			18	9-9-12 N=21		29		
		<b>Auger Refusal at 8 Feet</b>	100.5+/-								

Stratification lines are approximate. In-situ, the transition may be gradual.  
Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:  
Continuous Flight Augers

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

Notes:

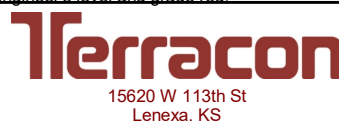
Abandonment Method:  
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*



Boring Started: 04-26-2019

Boring Completed: 04-26-2019

Drill Rig: Acker

Driller: JW

Project No.: 02195092





THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_02195092 TACO BELL.GPJ MODEL LAYER.GPJ 4/30/19

# BORING LOG NO. B-6

**PROJECT:** Taco Bell and Coffee Shop

**CLIENT:** First Street Development LLC  
Phoenix, Arizona

**SITE:** 851 NE Woods Chapel Road  
Lee's Summit, Missouri

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 38.9819° Longitude: -94.3578°  Approximate Surface Elev.: 107.0 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (1st)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS  LL-PL-PI
		<b>6" ROOT ZONE</b>	0.5								
2		<b>FAT CLAY (CH)</b> , brown	1.5								
3		<b>LIMESTONE</b> , gray to light brown, highly weathered	3.0			15	6-35-30 N=65		7		
		<b>Auger Refusal at 3 Feet</b>	104+/-								

Stratification lines are approximate. In-situ, the transition may be gradual.  
Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:  
Continuous Flight Augers

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

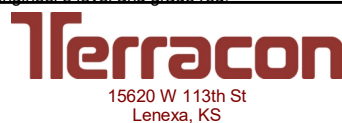
Notes:

Abandonment Method:  
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

**WATER LEVEL OBSERVATIONS**  
*Groundwater not encountered*



Boring Started: 04-26-2019

Boring Completed: 04-26-2019

Drill Rig: Acker

Driller: JW

Project No.: 02195092



THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_02195092 TACO BELL.GPJ MODEL LAYER.GPJ 4/30/19

# BORING LOG NO. B-7

**PROJECT:** Taco Bell and Coffee Shop

**CLIENT:** First Street Development LLC  
Phoenix, Arizona

**SITE:** 851 NE Woods Chapel Road  
Lee's Summit, Missouri

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 38.9823° Longitude: -94.358°  Approximate Surface Elev.: 113.5 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (1sf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS  LL-PL-PI
		<b>6" ROOT ZONE</b>	0.5								
2		<b>FAT CLAY (CH)</b> , brown, stiff to very stiff	5.0			18	3-5-6 N=11		28		
			5			18	9-10-11 N=21		28		
		<b>Boring Terminated at 5 Feet</b>									

Stratification lines are approximate. In-situ, the transition may be gradual.  
Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:  
Continuous Flight Augers

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


Notes:

Abandonment Method:  
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

**WATER LEVEL OBSERVATIONS**  
*Groundwater not encountered*



15620 W 113th St  
Lenexa, KS

Boring Started: 04-26-2019  
Drill Rig: Acker  
Project No.: 02195092

Boring Completed: 04-26-2019  
Driller: JW



THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. 02195092 TACO BELL GPJ MODEL LAYER GPJ 4/30/19

# BORING LOG NO. B-8

**PROJECT:** Taco Bell and Coffee Shop


**CLIENT:** First Street Development LLC  
Phoenix, Arizona

**SITE:** 851 NE Woods Chapel Road  
Lee's Summit, Missouri

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 38.9822° Longitude: -94.3578°  Approximate Surface Elev.: 114.5 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (1st)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS  LL-PL-PI
		<b>6" ROOT ZONE</b>	0.5								
2		<b>FAT CLAY (CH)</b> , brown, stiff	5.0			18	3-3-8 N=11		28		63-26-37
			5			18	3-5-6 N=11		27		
		<b>Boring Terminated at 5 Feet</b>									

Stratification lines are approximate. In-situ, the transition may be gradual.  
Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

<p>Advancement Method: Continuous Flight Augers</p>	<p>See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any).</p> <p>See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.</p> <p>Elevations were measured in the field using an engineer's level and grade rod.</p>	<p>Notes:</p>						
<p>Abandonment Method: Boring backfilled with Auger Cuttings and/or Bentonite</p>								
<p><b>WATER LEVEL OBSERVATIONS</b> <i>Groundwater not encountered</i></p>	 15620 W 113th St Lenexa, KS	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Boring Started: 04-26-2019</td> <td style="width: 50%;">Boring Completed: 04-26-2019</td> </tr> <tr> <td>Drill Rig: Acker</td> <td>Driller: JW</td> </tr> <tr> <td colspan="2">Project No.: 02195092</td> </tr> </table>	Boring Started: 04-26-2019	Boring Completed: 04-26-2019	Drill Rig: Acker	Driller: JW	Project No.: 02195092	
Boring Started: 04-26-2019	Boring Completed: 04-26-2019							
Drill Rig: Acker	Driller: JW							
Project No.: 02195092								

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. 02195092 TACO BELL GPJ MODEL LAYER.GPJ 4/30/19

## **SUPPORTING INFORMATION**

### **Contents:**

General Notes  
Unified Soil Classification System  
Description of Rock Properties






Note: All attachments are one page unless noted above.

# GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Taco Bell ■ Lee's Summit, Missouri

April 29, 2019 ■ Terracon Project No. 02195092

SAMPLING	WATER LEVEL	FIELD TESTS
 Shelby Tube  Split Spoon	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  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.	(N) Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (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		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 (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	Particle Size	Term	Plasticity Index
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm)	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

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

<sup>A</sup> Based on the material passing the 3-inch (75-mm) sieve.

<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup> 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.

<sup>D</sup> 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.

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

<sup>F</sup> If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

<sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup> If fines are organic, add "with organic fines" to group name.

<sup>I</sup> If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

<sup>J</sup> If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup> If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

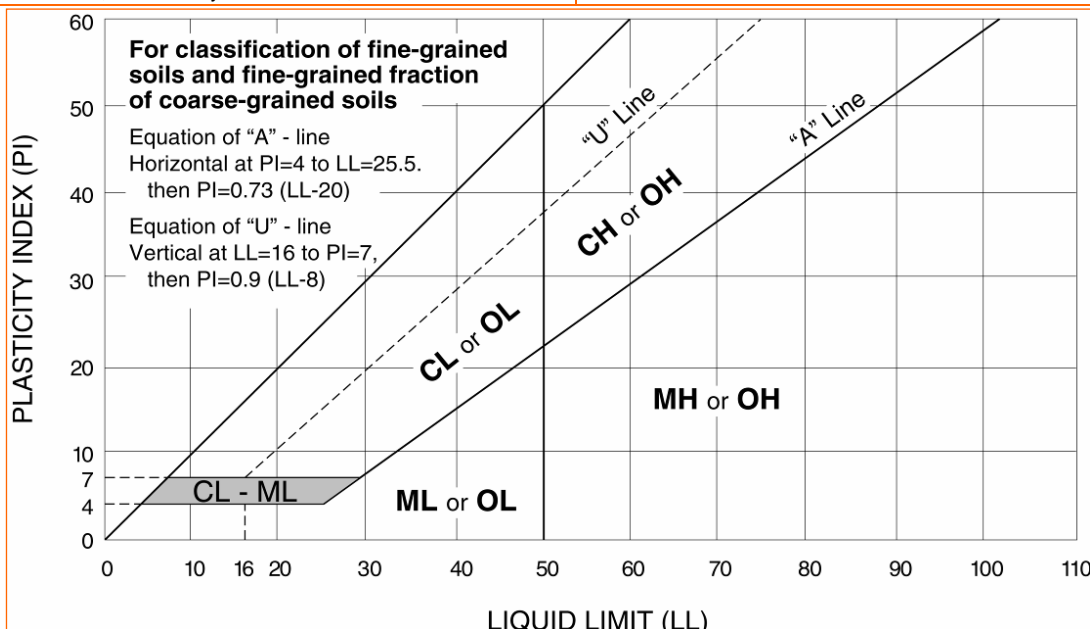
<sup>M</sup> If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup>  $PI \geq 4$  and plots on or above "A" line.

<sup>O</sup>  $PI < 4$  or plots below "A" line.

<sup>P</sup>  $PI$  plots on or above "A" line.

<sup>Q</sup>  $PI$  plots below "A" line.



WEATHERING	
Term	Description
<b>Unweathered</b>	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
<b>Slightly weathered</b>	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.
<b>Moderately weathered</b>	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.
<b>Highly weathered</b>	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.
<b>Completely weathered</b>	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
<b>Residual soil</b>	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)
<b>Extremely weak</b>	Indented by thumbnail	40-150 (0.3-1)
<b>Very weak</b>	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
<b>Weak rock</b>	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)
<b>Medium strong</b>	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)
<b>Strong rock</b>	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
<b>Very strong</b>	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
<b>Extremely strong</b>	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
<b>Extremely close</b>	< ¼ in (<19 mm)	<b>Laminated</b>	< ½ in (<12 mm)
<b>Very close</b>	¼ in – 2-1/2 in (19 - 60 mm)	<b>Very thin</b>	½ in – 2 in (12 – 50 mm)
<b>Close</b>	2-1/2 in – 8 in (60 – 200 mm)	<b>Thin</b>	2 in – 1 ft. (50 – 300 mm)
<b>Moderate</b>	8 in – 2 ft. (200 – 600 mm)	<b>Medium</b>	1 ft. – 3 ft. (300 – 900 mm)
<b>Wide</b>	2 ft. – 6 ft. (600 mm – 2.0 m)	<b>Thick</b>	3 ft. – 10 ft. (900 mm – 3 m)
<b>Very Wide</b>	6 ft. – 20 ft. (2.0 – 6 m)	<b>Massive</b>	> 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) <sup>1</sup>	
Description	RQD Value (%)
<b>Very Poor</b>	0 - 25
<b>Poor</b>	25 – 50
<b>Fair</b>	50 – 75
<b>Good</b>	75 – 90
<b>Excellent</b>	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