Geotechnical Engineering Consulting Report

Taco Bell, Bellevue, Kentucky
Bellevue, Campbell County, Kentucky
November 18, 2021
Terracon Project No. N1215364

Prepared for:
Ampler Development LLC
Oklahoma City, Oklahoma

Prepared by:
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Cincinnati, Ohio

November 18, 2021

Ampler Development LLC
P.O Box 721888
Oklahoma City, Oklahoma 73172

Attn: Mr. Dan Peyton
P: (513) 484 0965
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Re: Geotechnical Engineering Consulting Report
Taco Bell, Bellevue, Kentucky
55 Donnermeyer Drive
Bellevue, Campbell County, Kentucky
Terracon Project No. N1215364

Dear Mr. Peyton:

We have completed the Geotechnical Engineering Consulting services for the proposed Taco Bell restaurant project. This study was performed in accordance with Terracon Proposal No. PN1215364 dated November 4, 2021. This report provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project. Our geotechnical study was based on historical subsurface information developed previously by Terracon in the project area.

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.

STATE OF KENTUCKY
CRAIG M. DAVIS
22686
LICENSED
PROFESSIONAL ENGINEER
11/18/2021

Ayanda T. Ncube
Staff Engineer

Craig M. Davis, P.E., CPESC
Geotechnical Department Manager

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

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

Geotechnical Engineering Consulting Report

Taco Bell, Bellevue, Kentucky
55 Donnermeyer Drive
Bellevue, Campbell County, Kentucky
Terracon Project No. N1215364
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INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed Taco Bell restaurant to be located at 55 Donnermeyer Drive in Bellevue, Campbell County, Kentucky. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Pavement design and construction
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification per IBC

The subsurface conditions at the project site have been characterized using test borings performed previously (in 2011 and 2014) by Terracon in the vicinity of the proposed Taco Bell restaurant. New test borings and laboratory testing were beyond the scope of this study.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively.

SITE CONDITIONS

The following description of site conditions is derived from our review of 2011 and 2014 test borings and associated laboratory test results. No new test borings were performed for the proposed Taco Bell restaurant.

Item	Description
Parcel Information	■ The project is located at 55 Donnermeyer Drive in Bellevue, Campbell County, Kentucky. ■ Latitude/Longitude 39.0990, -84.4808 (approximate) (See **Site Location**)

Item	Description
Existing Improvements	The site was formerly developed as a car wash facility on an outlot on an existing Kroger store. The car wash structures were demolished in 2019. Based upon the pavement condition in available aerial imagery, it does not appear that below-grade storage tanks (if any) have been removed. The entire site is paved with concrete and asphalt sections and contain associated underground utilities. Residential buildings border the east side of the site with an asphalt parking lot and driveways to the west side of the site.
Existing Topography	Grades on site vary from an elevation of about 491 feet to about 495 feet, MSL.

PROJECT DESCRIPTION

Our understanding of the project conditions is as follows:

Item	Description
Information Provided	Information for this project was provided via email correspondence with Mr. Peyton in October 2021, including the Site Sketch (dated 05/19/2021)
Project Description	New Taco Bell restaurant with drive-thru window to be constructed on a 0.3-acre lot in Bellevue Kentucky.
Proposed Structure	The project includes a single-story building with a footprint of about 2,000 square feet.
Finished Floor Elevation	Anticipated to match existing site grades
Maximum Loads (needs to be confirmed by a structural engineer)	■ Columns: 20 to 50 kips ■ Walls: <3 kips per linear foot (klf) ■ Slabs: 100 pounds per square foot (psf)
Grading/Slopes	No grading plan is available at the time of this report. The site is relatively flat, and we anticipate less than 2 feet of cut/fill will be required to achieve finished grades.
Below-Grade Structures	None anticipated
Free-Standing Retaining Walls	None anticipated
Pavements	Traffic loads not available at the time of this proposal, anticipated as follows: ■ Autos/light trucks: 1000 vehicles per day ■ Light delivery and trash collection vehicles: 10 vehicles per week ■ Tractor-trailer trucks: <3 vehicles per week The pavement design period is 20 years.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of our historical subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization forms the basis of our geotechnical evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the subsurface profile summary in the **Exploration Results** section of this report.

The test borings encountered surficial pavement and uncontrolled fill underlain by moderately compressible natural lean clays, sands and silts. Conditions encountered at each boring location are indicated on the subsurface profile summary.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view, refer to the subsurface profile summary in the **Exploration Results**.

Layer Name	General Description
Pavement	Asphalt/Concrete
Fill	Variable including lean clay, sandy lean clay, sand and gravel
Natural Soil	Lean clay, sandy lean clay, silty sand, sandy silt, clayey sand, sand

Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. No groundwater was encountered during drilling in 2011. In 2014 however, the water levels observed in the boreholes are summarized below:

Boring Number	Depth to groundwater while drilling, feet	Depth to groundwater after drilling, feet
F-1	11 and 15 (trace)	Not encountered
F-2	10 and 17	Not encountered
F-3	Not encountered	Not encountered
F-4	Not encountered	Not encountered

These short-term water levels do not necessarily represent the static groundwater table at the site. Due to the low permeability of some soils encountered in the borings, a relatively long period of time may be necessary for a groundwater level to develop and stabilize in a borehole in these materials. Long-term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, river stage, and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

The 2011 and 2014 test boring and laboratory results were evaluated to develop recommendations for site preparation and foundation design and construction. Due to client confidentiality, these logs are not provided herein however, the data was provided in the GeoModel and subsurface profile summary. The lab data is also summarized below:

Boring Number	Boring Depth, feet	Water Content, %	Atterberg Limits			Dry Unit Weight, pcf	Unconfined Strength, psf
			LL	PL	PI		
B-1	2.5	11					9000[1]
B-1	7.5	15					
B-2	7.5	15					
B-3	7.5	13					
B-4	7.5					10	
B-4	11.5					10	
F-1	2.5	15					
F-1	4.0	18	27	17	10		
F-1	6.5	18					
F-1	9.0	13					
F-1	11.5	13					
F-1	14.0	14					
F-2	2.5	16					
F-2	14.0	30					
F-3	14.0	27					
F-4	4.0	21	35	20	15		
F-4	6.5	20					
F-4	14.0	25	28	20	8		

1. Calibrated Hand Penetrometer

Existing fill soil was encountered in the borings to depths of about 10 to 15 feet below the existing grade. The existing fill consists of both cohesive (clay) and granular (sand and gravel) materials. Based upon the low relative stiffness of the cohesive soils (determined by hand penetrometer readings) and the low density of the granular soils (by N-value), it appears that the fill was not engineered/controlled during its placement and is not considered suitable for direct support of the building foundations or pavement.

Special measures need to be taken to reduce building-load-induced settlement due to the presence of existing uncontrolled fill and underlying alluvial soils. Based upon the Owner's willingness to accept varying levels of risk, the following options are available to develop the site:

1. The least risk would be to completely remove the fill and replace it with engineered material. This would be an invasive process and costly due to the limited room available for the process. We presume that this option would be cost and schedule-prohibitive.
2. Insitu ground improvement to support the structure with a limited undercut and replacement to support the pavements. A commonly implemented ground improvement to support structures of this size and loads is "aggregate piers". This process consists of installing compacted aggregate-filled shafts at a regular spacing beneath the footing alignments. The design of these systems is proprietary with common names as Vibropiers® or Geopiers®. Rammed Aggregate Piers®. These systems typically incorporate a design bearing capacity for the overriding footings of 4,000 to 6,000 psf. To support the pavements and floor slabs, the site could be undercut to a depth of 3 feet below final (sub)grades and replaced with engineered fill. This would alleviate some of the concerns with non-uniform subgrade support, the potential for unknown buried debris, voids, or large fragments.
3. A deep foundation system consisting of auger-cast-in-place (ACIP) piles, helical piles, or grouted micropiles could be used for foundation support. However, these are expected to be costlier than ground improvements and would require additional deeper borings to capture/assess the full load distribution zone. Additional deep foundation support details are not discussed herein but can be provided upon request.
4. Since the site is currently paved and has supported traffic loadings of a similar magnitude to the proposed development, the pavement and floor slab subgrades could be supported on the existing fill without the aforementioned 3-foot undercut. If the Owner is willing to accept the additional risk, the subgrade surface could be evaluated with a proofroll and only undercut where deficiencies are identified.

If weather and schedule permit, we anticipate that the undercut materials can be air-dried and recompacted as engineered fill to backfill the undercuts. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section. The **Floor Slabs** section addresses slab-on-grade support of the building. The **Pavements** section addresses the design of pavement systems.

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

EARTHWORK

Earthwork is anticipated to include pavement removal, excavations for foundations and utilities, and fill placement (primarily backfill of excavations and undercuts). The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Prior to placing fill, the existing pavement should be stripped and disposed of off site (reclaimed asphalt or crushed concrete should not be reused as engineered fill). Options for subgrade support were provided in the Geotechnical Overview section of this report. Depending upon the Owner's acceptance of risk, the project site may be undercut to a depth of 3 feet and replaced with engineered fill or proof-rolled to identify deficient subgrade support areas and thereby limited undercuts. Proof rolling of subgrades should be performed with a minimum 20-ton tandem-axle dump truck or similarly loaded equipment that represents the heaviest construction or service load.

We recommend proof rolling be performed in the presence of a Terracon representative in order to aid in evaluating unstable subgrade areas and identifying appropriate remedial measures. If weather and schedule permit, we anticipate that the undercut materials can be air dried and re-compacted as engineered fill to backfill the undercuts.

Existing Fill

As noted in **Geotechnical Characterization**, our historical test borings encountered existing fill to depths ranging from about 0.3 to 12.5 feet, but we have no records to indicate the degree of control. Support of footings, floor slabs, and pavements, on or above existing fill soils, is discussed in this report. However, even with the recommended construction procedures, there is inherent risk for the owner that compressible fill or unsuitable material, within or buried by the fill will, not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report.

Fill Material Types

Earthen materials used for engineered fill should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Parameters (for Structural Fill)
Lean Clay	CL (LL<40)	All locations and elevations
Well Graded Granular	GW, GW-GM, SW, SW-SM	All locations and elevations
On-Site Soils	Varies	The on-site clay soils typically appear suitable for use as fill; however, thorough mixing and moisture conditioning (drying) will be needed to create a uniform, compactable material.

1. Engineered fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Fill Compaction Requirements

Engineered fill should meet the following compaction requirements.

Item	Structural Fill
Maximum Lift Thickness	■ 8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used ■ 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1, 2]	98% of the materials Standard Proctor maximum dry density (ASTM D 698)
Water Content Range [1]	■ Within -2% to +3% of optimum moisture content (OMC) determined by the Standard Proctor test at the time of placement and compaction (Low Plasticity Cohesive Soil) ■ Within -3% to +3% of OMC/within workable moisture levels to achieve firm unyielding conditions (granular Material)

1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 80% relative density (ASTM D 4253 and D 4254).

Utility Trench Backfill

For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks.

The final ground surface should be sloped and maintained at a minimum 5% away from the building over lawns and 2% over pavement, for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure’s maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to the construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted 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, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proof rolling, and mitigation of areas delineated by the proof roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

Ground Improvement

Based on settlement analyses, total settlements greater than 1 inch may occur if the proposed building is supported on conventional spread footings. A ground improvement process of aggregate piers could to be installed to provide adequate capacity for the support of the proposed structure on conventional spread footings.

Aggregate piers, sometimes referred to as stone columns or rigid inclusions, are not typically designed as individual bear elements extended to a suitable bearing stratum but rather as a ground improvement. Aggregate piers systems are used beneath spread footing foundations to improve the bearing capacity of soils and control settlement. The system is a proprietary design that depends upon the means of aggregate delivery, compaction method and whether the soil profile can maintain an open shaft. Typically, the Specialty Contractor is provided a design spread footing bearing capacity and a settlement tolerance. The standard foundation system can then be installed directly on the soil/stone column system.

The aggregate piers are constructed by excavating a hole (typically 24 to 30 inches in diameter) to the specified design depth by auguring or advancing a mandrel into the ground. The soil at the bottom of the hole is then densified with a high impact densification system. Thin lifts (6- to 12-

inch-thick) of select aggregate (typically crushed stone, or equivalent) are then compacted in the cavity. The building can then be supported on spread footings bearing on soil improved by the aggregate pier system.

From experience, spread footings bearing on soils improved with aggregate pier systems can be designed based on an estimated allowable bearing capacity of 4,000 to 6,000 psf. However, the final design will be performed by aggregate pier specialty contractor and higher bearing capacities can be recommended based on aggregate pier element spacing and length. The aggregate pier depths would need to be determined by the specialty contractor's engineer, based upon tolerable settlement criteria set by the project structural engineer.

The length and spacing of aggregate pier elements will depend on the foundation loads and settlement tolerance. Generally, column footings are supported by a group of at least three aggregate pier columns. Wall footings are typically supported on regularly spaced aggregate pier columns located in a staggered pattern along the centerline of the wall footing. Detailed foundation design will be performed by the aggregate pier specialty contractor based on a performance basis.

Load testing (modulus testing) is recommended to confirm the performance of the aggregate pier system.

If the site has been prepared as described above and in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Item	Description
Maximum Net Allowable Bearing pressure	To be provided by aggregate pier specialty contractor. Generally > 4,000 psf
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 18 inches
Minimum Embedment below Finished Grade [1]	Exterior footings in unheated areas: 30 inches Interior footings in heated areas: 12 inches
Estimated Total Settlement from Structural Loads	To be provided by aggregate pier specialty contractor. Generally, less than 1-inch.
Estimated Differential Settlement	To be provided by aggregate pier specialty contractor. Generally, less than ½ -inch.

1. Embedment necessary to minimize the effects of frost and/or seasonal water content variations.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is D**. Historical subsurface explorations at this site were extended to a maximum depth of 21.5 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

FLOOR SLABS

The floor slab subgrade should be prepared as described in the Earthwork section of this report. All floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to the placement of the aggregate base and concrete.

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1]	Presence of existing fill, special subgrade preparation is required. See Geotechnical Overview and **Earthwork** sections fo this report.
Estimated Modulus of Subgrade Reaction [2]	100 pounds per square inch per inch (psi/in) for point loads

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

The use of a vapor retarder should be considered beneath concrete slabs on grade 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.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Settlement of floor slabs supported on existing fill materials cannot be accurately predicted but could be larger than normal and result in some cracking. Mitigation measures, as noted in **Earthwork**, are critical to the performance of floor slabs. In addition to the mitigation measures, the floor slab can be stiffened by adding steel reinforcement, grade beams and/or post-tensioned elements.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

PAVEMENTS

General Pavement Comments

Specific traffic loads for the Bellevue, Kentucky Taco Bell were not available at the time of this report. Minimum pavement section designs are provided for the estimated traffic conditions and pavement life conditions as noted in **Project Description** and the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Support characteristics of subgrade for pavement design do not account for shrink/swell movements of an expansive clay subgrade, such as soils encountered on this project. Thus, the pavement may be adequate from a structural standpoint, yet still, experience cracking and deformation due to shrink/swell-related movement of the subgrade.

Pavement Design Parameters

For subgrade prepared as recommended in this report, a subgrade CBR of 3 has been used for the AC pavement designs and a modulus of subgrade reaction of 100 pci for the PCC pavement designs. The values were empirically derived based upon our experience with the sandy lean clay subgrade soils and our understanding of the quality of the subgrade as prescribed by the Site Preparation conditions as outlined in **Earthwork**. A modulus of rupture of 600 psi was used for pavement concrete.

Pavement Section Thicknesses

The following table provides options for AC and PCC Sections:

Typical Pavement Section Thickness (inches)						
Traffic Area	**Pavement Type**	**Asphalt Concrete Surface Course**	**Asphalt Concrete Base Course[1]**	**Portland Cement Concrete[2]**	**Aggregate Base Course**	**Total Thickness**
Light Duty	PCC	-	-	5.0	5.0	10.0
	AC	1.5	2.5	-	8.0	12.0
Heavy Duty	PCC	-	-	6.0	6.0	12.0
	AC	2.5	2.5	-	10.0	15.0
Dumpster Pad	PCC	-	-	7.0	5.0	12.0

1. 4,000 psi at 28 days, 4-inch maximum slump, up to 5 to 7 percent air entrainment, 6-sack minimum mix. PCC pavements are recommended for the dumpster pads and at all other locations subject to heavy wheel loads and/or turning traffic.
2. ODOT Item 304 crushed limestone base material
3. In accordance with assumed traffic loads (See **Project Description**)
4. The dumpster pad minimum dimensions should accommodate the dumpster container and the tipping axle of the trash collection truck.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Based on the possibility of shallow and/or perched groundwater, we recommend installing a pavement subdrain system to control groundwater, improve stability, and improve long-term pavement performance.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an ongoing pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- The final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of the curb and gutter.
- Place curb, gutter, and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

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 exploration point 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 as the Geotechnical Engineer, where noted in this report, 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 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 site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, 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.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Test Boring Layout and Elevations: The following test borings were selected for specific review to characterize the subsurface in the vicinity of the proposed Taco Bell restaurant.

Number of Borings	Boring Depth (feet) [1]
B-1 (2011)	15
B-2 (2011)	11.2
B-3 (2011)	25
B-4 (2011)	11.4
F-1 (2014)	21.5
F-2 (2014)	21.5
F-3 (2014)	16.5
F-4 (2014)	16.5

1. Below existing grades at the time of drilling

Soil borings were advanced with drill rigs using continuous-flight hollow-stem augers. Representative samples were obtained by the split-barrel sampling procedures. In the split-barrel sampling procedure, a standard, 2-inch O.D., split-barrel sampling spoon is driven into the boring with a 140-pound automatic SPT (Standard Penetration Test) hammer falling 30 inches. We recorded the number of blows required to advance the sampling spoon in the last 12 inches of an 18-inch sampling interval as the standard penetration resistance value, N. In the field, we placed the samples into containers, sealed them, and returned them to the laboratory for observation, testing, and classification.

Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Groundwater observations were also recorded. Final boring logs were prepared from the field logs. The final logs represent the engineer's interpretation of the field logs and include modifications based on observations and tests on the samples in the laboratory.

Laboratory Testing

No laboratory testing was performed for this study. Laboratory testing was performed previously during the referenced geotechnical studies.

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- Natural moisture content
- Atterberg limits
- Unconfined compressive strength
- Dry unit weight

The laboratory testing program often included an examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

Taco Bell, Bellevue, Kentucky ■ Bellevue, Campbell County, Kentucky
November 18, 2021 ■ Terracon Project No. N1215364

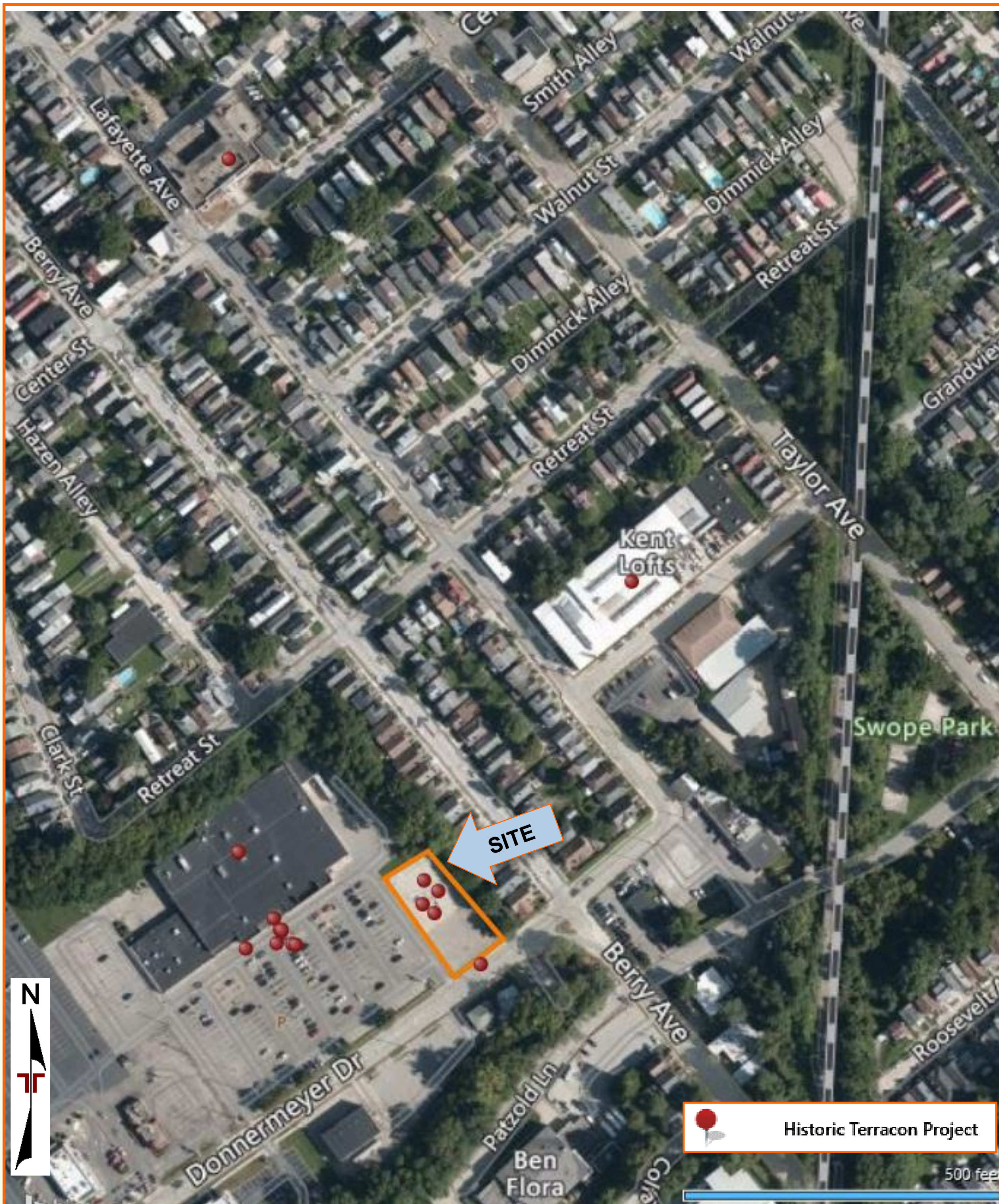

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

ARCHIVE EXPLORATION PLAN WITH CURRENT PROJECT OVERLAY

Taco Bell, Bellevue, Kentucky ■ Bellevue, Campbell County, Kentucky

November 18, 2021 ■ Terracon Project No. N1215364

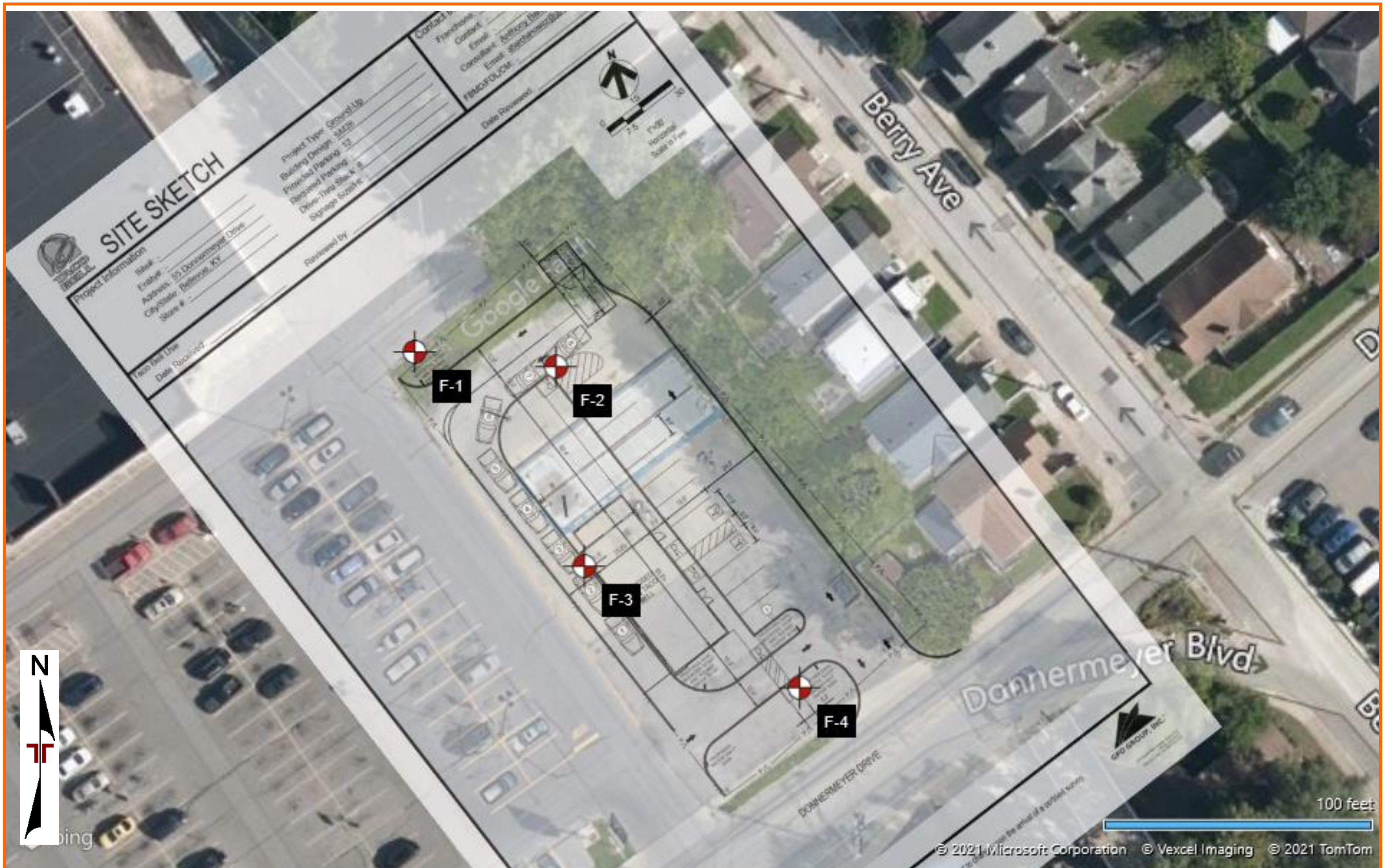

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

SUBSURFACE PROFILE SUMMARY

Taco Bell, Bellevue, KY ■ Bellevue, KY
November 18, 2021 ■ Terracon Project No. N1215364

Terracon GeoReport

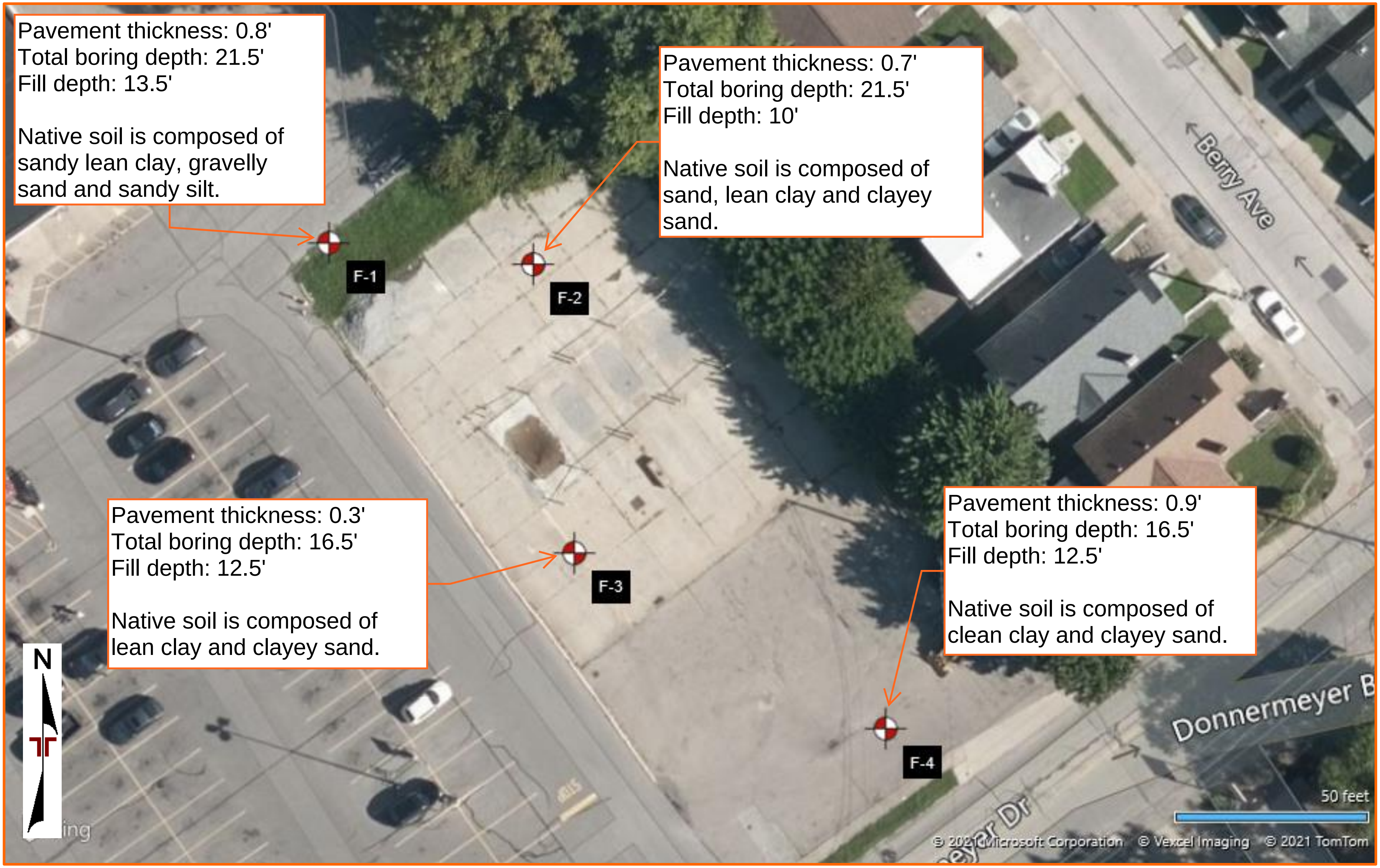

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: 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 ≥ 4 and 1 ≤ Cc ≤ 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 ≥ 6 and 1 ≤ Cc ≤ 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” line [J]	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] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[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.