REPORT OF

GEOTECHNICAL ENGINEERING STUDY

SINNERS & SAINTS
19186 FM 2252
GARDEN RIDGE, TEXAS

BEA PROJECT NO. 12-23-0224

FOR

ROCK'EM REALTY
7703 RAMBLE RIDGE
SAN ANTONIO, TEXAS 78266

JUNE 9, 2023

BURGE ENGINEERING & ASSOCIATES
Geotechnical Engineering • Environmental • Testing

June 9, 2023

Mr. Eric Fischer
Rock'em Realty
7703 Ramble Ridge
San Antonio, Texas 78266

RE: Geotechnical Engineering Study
Sinners & Saints
19186 FM 2252
Garden Ridge, Texas
BEA Project No. 12-23-0224

Dear Mr. Fischer:

Burge Engineering & Associates (BEA) has completed the subsurface exploration and geotechnical engineering analysis for the above-referenced project, in general accordance with BEA Proposal No. P12-23-105, dated May 24, 2023. Our report, which includes the results of our subsurface exploration program, laboratory testing program, and geotechnical engineering analysis, is enclosed with this letter.

Based on the results of the field exploration and laboratory testing programs, the site is considered suitable for the proposed construction, provided that the recommendations enclosed in this report are followed.

We appreciate the opportunity to be of service to you during the design phase of this project. We look forward to continuing our involvement with this project during the construction phase by providing any special inspection and materials testing services. If you have any questions regarding the information contained in this report or if we can be of further assistance to you, please feel free to contact us.

Respectfully submitted,
BURGE ENGINEERING & ASSOCIATES
Texas Registered Engineering Firm F-7740
Geotechnical Engineering Services

6/9/23

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PROJECT OVERVIEW

Project Location

This report presents the results of our subsurface exploration and engineering analysis for the proposed development located at 19186 FM 2252 in Garden Ridge, Texas. The approximate site location is shown on the *Site Vicinity Map* provided in the Appendix.

Scope of Work

The conclusions and recommendations contained in this report are based on six (6) soil/rock borings performed by BEA on May 31, 2023. Borings B-01 through B-03 were drilled within the proposed building areas and extended to a termination depth of approximately 14 feet below the existing ground surface elevations. Borings B-4 through B-6 were drilled in the proposed pavement areas and extended to a termination depth of five (5) feet below the existing ground surface elevations.

Proposed Construction

Based on information provided to us, the project will include the design and construction of a restaurant/entertainment facility that will include repurposed shipping containers and canopies covering an overall area of approximately 7,000 square feet. There is also a future structure on the property that will be approximately 4,000 square feet in plan area. Development will include pavement areas, concrete flatwork, and underground utilities. We anticipate that the new structures will be supported by a combination of monolithic slab-on-grade foundation systems and shallow spread footings for the canopies. The proposed construction is shown in relation to the borings on the *Boring Location Plan* provided in the Appendix.

It should be noted that BEA was not provided with any structural information, proposed grades, or finished floor elevations. Based on observations made during our field program, we anticipate approximately 4 to 5 feet of cut/fill will be required for each building for grading purposes.

The *Boring Location Plan* was developed from the *Proposed Site Plan* (Sheet C1.0) prepared by Laijas Project Resource Group, dated January 2023. Since existing elevations were provided on the site plan, the elevations are included on the boring logs. The borings were located in the field based on pacing/taping procedures from existing landmarks identified on the available plan.

Purposes of Exploration

The purposes of this study were to explore the subsurface soil/rock and groundwater conditions at the site and to develop engineering recommendations to guide design and construction of the soil/rock-supported elements of the project. We accomplished these purposes by:

1. reviewing available geologic and soil survey maps of the project area,

2. drilling six (6) borings to explore the subsurface soil/rock and groundwater conditions,

3. performing laboratory tests on selected representative soil/rock samples from the borings to evaluate pertinent engineering properties, and

4. analyzing the field and laboratory data to develop appropriate engineering recommendations.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

The borings were performed with a standard, truck-mounted drill rig, which utilized continuous, solid-stem flight augers to advance the boreholes. No drilling fluid was used during the drilling program. Upon completion of the borings, the boreholes were backfilled with spoils generated during the drilling process and capped with on-site soil.

Representative samples of the subsurface soil/rock were obtained employing split-spoon sampling procedures in general accordance with ASTM D-1586. The split-spoon sampler collects relatively disturbed samples at selected depths in the boring with the split-spoon sampler by driving a standard two (2) inch outer diameter split-spoon sampler 18 inches into the subsurface material using a 140 pound hammer falling 30 inches. The number of blows required to drive the split-spoon sampler the final 12 inches of penetration (N-value) is recorded in the "SPT N-value" column of the boring logs. Where limited sample was recovered or rock was encountered, grab samples were collected directly of the cuttings.

The drilling crew maintained the field logs of the soil/rock encountered in the borings. After recovery, each sample was removed from the sampler and visually classified. Representative portions of each sample were then sealed and delivered to our laboratory for further visual examination and laboratory testing.

Laboratory Testing Program

Representative soil/rock samples were selected and tested in our laboratory to check field classifications and to determine pertinent engineering properties. The laboratory testing program included visual classifications, moisture contents, sieve analyses, and Atterberg Limits tests. Visual classifications conducted in the laboratory were performed by a licensed professional engineer. All data obtained from the laboratory tests are included on the respective boring logs in the Appendix.

Each soil sample was classified on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS). A brief explanation of the USCS is included with this report. The various soil/rock types were grouped into the major zones noted on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs and profiles are approximate; in situ, the transitions may be gradual. The soil/rock samples will be retained in our laboratory for a period of 30 days, after which, they will be discarded unless other instructions are received by the client.

EXPLORATION RESULTS

Site Conditions

At the time of our field exploration, the property was undeveloped and heavily vegetated with native grasses, brush, and trees. A portion of the site had been cleared of the brush and undergrowth which allowed for completion of the field exploration program. The property has strong relief that slopes down to the east-southeast. The neighboring properties include a combination of undeveloped properties and residential and commercial development.

Regional Geology and Soil Survey

According to the Bureau of Economic Geology at The University of Texas at Austin, San Antonio Sheet, the proposed site is located in the Austin Chalk (Kau). This Upper Cretaceous Age formation consists of alternating layers of chalk and marl. The chalk is grayish white to white and averages about 85 percent calcium carbonate. The marl is medium gray with bentonitic seams locally. Thickness is about 350 to 580 feet.

The Soil Survey of Comal and Hays Counties, Texas published by the United States Department of Agriculture, National Cooperative Soil Survey, indicates that the shallow soils in the site area are classified as Real Gravelly Loam, 1 to 8 percent slopes (RaD). This is a shallow, well-drained, gently sloping to sloping soil on slopes of low hills and ridges on uplands. Typically, the surface layer is dark grayish brown gravelly loam about 9 inches thick. The layer below to a depth of 14 inches is dark grayish brown extremely stony loam that is about 80 percent chalk fragments. This underlying material is strongly-cemented chalk. The soil is moderately alkaline and calcareous throughout. Permeability is moderate, and the available water capacity is low.

Soil/Rock Conditions

The natural, near surface deposits, which were studied by our field exploration program, are consistent with the local soil survey and regional geology. Below any topsoil, the stratigraphy of the subsurface materials at this site can generally be described as presented in the following table:

Stratum	Range in Depth (ft)	Soil Description and Classification
I	0 – 1	Medium dense to very dense, brown, dark brown or tan CLAYEY GRAVEL WITH SAND (GC) and stiff, dark brown FAT CLAY (CH) with limestone fragments
II	0.5 – 14	Very dense, tan LIMESTONE; chalky

Stratum I – This stratum was comprised of medium dense to very dense, brown, dark brown or tan CLAYEY GRAVEL WITH SAND (GC) and stiff, dark brown FAT CLAY (CH) with limestone fragments. Atterberg Limits tests conducted on representative samples of this stratum indicated this soil to have Liquid Limits (LL's) ranging from 35 to 77 with corresponding Plasticity Indices (PI's) ranging from 14 to 46. Representative samples of this stratum had 18 to 19 percent, by dry weight, pass a No. 200 Sieve and 49 to 56 percent, by dry weight, retained on a No. 4 Sieve. Based on these measured indices, this stratum has a moderate to high potential for changes in volume if fluctuations in the soil's moisture content occur. However, this stratum was relatively thin across the site and is not anticipated to undergo significant shrink/swell related movements.

Stratum II – This stratum was comprised of very dense, tan LIMESTONE that was generally chalky and massive. **This stratum is very hard bedrock material, and will require rock excavating equipment to cut into this stratum at greater depths.** Typically, blow counts of 50 blows for 2 inches or less (as noted by sampler refusal on the boring logs) is not deemed ripable and usually requires removal through milling/sawing or other removal methods. The contractor and site and utility contractors should review the boring logs, as well as the entire geotechnical report, during preparation of their bids.

Groundwater Observations

Groundwater was not encountered during drilling operations. Observations for groundwater were made during sampling and upon completion of the drilling operations. In dry auger drilling operations, water is not introduced into the borehole, and the groundwater position can often be determined by observing water flowing into or out of the borehole. Furthermore, visual observation of the soil samples retrieved during the auger drilling operations can often be used in evaluating the groundwater conditions. It should be noted that groundwater conditions can fluctuate due to seasonal and climatic variations, and should be measured (checked) prior to construction activities.

Due to the bedrock geology, it is expected that groundwater conditions will be significantly influenced by surface water runoff, especially during high precipitation seasons. In addition, perched groundwater is typically encountered at the interface of soil and bedrock during wet seasons.

ANALYSIS AND RECOMMENDATIONS

The following recommendations are based on the six (6) borings performed at the site, laboratory test results, and the limited design information provided to us. We recommend that if there are any changes to the project characteristics as discussed in this report, BEA should be retained to review them so it can be determined if changes to the recommendations are necessary. The subject site is suitable for supporting the proposed structures on monolithic slab-on-grade foundation systems or shallow foundations in conjunction with grade-supported floor slabs. The canopy structures may also be supported by isolated spread footings. The following sections discuss these foundation systems, as well as other design and construction related recommendations.

Expansive Soil Conditions

Based on the existing subsurface soil/rock conditions, the project site is considered to be expansive, as defined by the 2018 International Building Code (IBC) Section 1803.5.3. However, it is our opinion that non-stiffened slabs may be constructed on this project given the soil/rock conditions. The potential vertical rise (PVR) for the subsurface soil/rock stratigraphy encountered in the borings drilled at this site was calculated using the Texas Department of Transportation (TxDOT) Method TEX-124-E. These calculations indicate potential vertical movements less than one (1) inch with a corresponding effective design plasticity index of 15. These calculations are based on the existing site conditions, a shallow active zone, and accounts for an approximate 1 psi of overburden pressure.

In order to provide a consistent design condition across the building areas, it is our recommendation that any highly expansive Stratum I material be over-excavated, as needed, to provide a minimum of 8 to 12 inches of select structural fill below each floor slab and to provide a uniform bearing surface. With these modifications, an effective design plasticity index of 15 may be used and the PVR will be less than one (1) inch**. If a non-stiffened slab is desired, then all expansive clay, if encountered, must be removed and replaced with select structural fill material as recommended in the following sections.**

Typically, a PVR of one (1) inch is deemed acceptable for at-grade construction. Despite the design condition, this does not mean that soil-related movements are eliminated. It only means that the slab and foundation can be structurally designed for the magnitude of movement without failure of the foundation system. However, this movement does not take into account the movement criteria that is required or perceived by the building owner/occupants. These "operational" performance criteria may be, and often are, more restrictive than the structural criteria or tolerances.

The building pad recommendations are provided in the *Subgrade Preparation and Earthwork Operations* section and *Slab-on-Grade Foundation Systems* section. Furthermore, the recommendations presented in the study can be modified, if needed, once more detailed information of the final topography and the finished floor elevations for the proposed structures are provided by the design team.

Slab-on-Grade Foundation Systems

The subsurface conditions encountered at the site are determined to be suitable for supporting the proposed structures on monolithic slab-on-grade foundation systems. Based on the anticipated structural loading and soil/bedrock strength values, we recommend that the monolithic slab-on-grade foundation system be designed for a maximum net allowable end bearing capacity of 2,500 psf bearing into the in-situ soil or select fill material. If the grade beams are bearing at least six (6) inches into undisturbed Stratum II Limestone, then the net allowable end bearing capacity may be increased to 4,000 psf.

We recommend that the beams have a minimum width of 12 inches and extend a minimum of 18 inches into approved in-situ soil or compacted select structural fill material. These recommendations are for proper development of bearing capacity for the continuous beam sections of the foundation systems and are NOT based on structural considerations. Grade beam widths and depths for structural considerations may need to be greater than recommended herein and should be properly evaluated and designed by the structural engineer.

If Stratum II Limestone is encountered prior to reaching these minimum penetration depths, then the following recommendations may be followed. The beams may be terminated shallower provided they are at least six (6) inches into bedrock. The grade beams should bear in similar materials and not on both rock and soil. If a portion of the grade beam is to bear on both rock and select fill (or soil) then the rock should be over-excavated a minimum of six (6) inches and replaced with select fill material or the entire grade beam excavated to bear completely on intact bedrock.

The following table presents the design criteria published by the Building Research Advisory Board (BRAB), Wire Reinforcement Institute (WRI), and the Post-Tensioning Institute (PTI), 3rd Edition. These values were based on our understanding of the proposed project, our interpretation of the information and data collected as part of this study, the criteria publications, and on our past experience with similar projects.

Based on the soil/rock conditions, the proposed structures may be supported using Type II or III reinforced slab-on-grade foundation systems in accordance with BRAB (or suitable alternative). If designing a non-stiffened slab, then all expansive clay must be removed from the building area prior to placement of the required select fill.

Slab-on-Grade Design Criteria

Recommended BRAB, WRI, & PTI Criteria For Slab-on-Grade Foundations	**Modified Condition**
Design Criteria	**CASE I**
Minimum Over-excavation	Note 2
Minimum Select Fill Pad Thickness	8 to 12 inches
Potential Vertical Rise (PVR)	<1 inch
Effective Design Plasticity Index (PI) / BRAB PI	15
Slope Correction Coefficient	1.05
Constant Soil Suction, pF	3.8
Climatic Rating (C_w)	17
Unconfined Compressive Strength (tsf)	2.5
Soil Support Index, c	1.0
Edge Moisture Variation Distance, e_m, Center	9.0 feet
Edge Moisture Variation Distance, e_m, Edge	4.6 feet
Thornthwaite Index (I_m)	-12
Differential Soil Movement, y_m, Center Lift	0.3 inch
Differential Soil Movement, y_m, Edge Lift	0.6 inch

Notes 1.) Over-excavate, as needed, to provide at least 8 to 12 inches of select structural fill material below the floor slabs.

Following any over-excavation and site preparation processes and if required by final grade elevations, the proposed building pads should be built-up and leveled using additional select structural fill material, as detailed in the *Subgrade Preparation and Earthwork Operations* section.

For the monolithic slab-on-grade foundation systems, designed and constructed as recommended in this report, post construction settlements should be one (1) inch or less. Settlement response of a fill supported slab is influenced more by the quality of construction than by soil-structure interaction. Therefore, it is essential that the recommendations for both the foundation and the building pad construction be strictly followed throughout the construction phase of the proposed building's foundation.

Spread Footing Foundations

Shallow spread/strip footings in conjunction with grade-supported floor slabs may also be utilized to support the proposed structures, as deemed suitable by the design team. It is our opinion that the type of structures and perceived movement tolerances will allow for this conventional foundation system. All expansive clay (CH) soil must be removed if this foundation system is to be utilized. Furthermore, the canopy structures may be supported by isolated spread footing foundations. Where necessary, the floor slabs may be designed utilizing a modulus of subgrade reaction of 200 pci, provided any expansive clay (CH) soil is removed and replaced with select structural fill material in accordance with the *Subgrade Preparation and Earthwork Operations* section.

Based on the anticipated structural loading and the SPT values, as monitored during drilling of our borings, we recommend that the spread/strip footings be founded at least 24 inches below finished grade and designed for a maximum net allowable end bearing capacity of 3,000 psf. If the spread/strip footings are bearing at least six (6) inches into undisturbed Stratum II Limestone, then the net allowable end bearing capacity may be increased to 4,000 psf. We recommend that any continuous footings have a minimum width of 12 inches and that isolated spread footings have a minimum lateral dimension of 30 inches. These minimum dimensions are for proper strength development only and NOT based on structural considerations. Footing widths and depths for structural considerations may need to be greater than recommended herein, and should be evaluated and designed by a structural engineer.

Similar to the slab-on-grade foundation system, these shallow foundations may be terminated shallower provided they are at least six (6) inches into bedrock. The footings should bear in similar materials and not on both rock and soil. If a portion of the footing is to bear on both rock and select fill (or soil) then the rock should be over-excavated a minimum of six (6) inches and replaced with select fill material or the entire footing excavated to bear completely on intact bedrock.

The structures can be expected to obtain excellent support from the spread/strip footings placed directly into approved in-situ material or select structural fill. Loose debris or caving soil at the bearing surface of the foundations excavations must be removed prior to steel or concrete placement.

Settlement of individual footings, designed in accordance with our recommendations presented in this report, is expected to be small and within tolerable limits for the proposed structures. Maximum total settlement is expected to be less than one (1) inch. Maximum differential settlement between adjacent columns is expected to one-half of the total settlement. These settlement values are based on our engineering experience of the soil/rock and the anticipated structural loading, and are to guide the structural engineer with the design.

Subgrade Preparation and Earthwork Operations

After excavating to the desired depth within the building pad areas, and prior to fill placement, the exposed subgrade surfaces should be observed by the Geotechnical Engineer or authorized representative. The following site preparation would be necessary for the monolithic slab-on-grade foundation systems or any grade-supported floor slabs:

1) Existing topsoil, vegetation, and any existing loose materials should be stripped and removed from the proposed building footprints. Any existing trees and stumps should be grubbed and removed from the site.

2) Following stripping and grubbing operations, the floor slab areas should be over-excavated as required to provide at least 8 to 12 inches of select structural fill material below the floor slabs. **If a non-stiffened slab or grade-supported slab is to be utilized for either structure, then all expansive clay (CH) soil shall be removed and replaced with select structural fill material.** The over-excavation area should extend a minimum of three (3) feet beyond the horizontal limits of each proposed building footprint.

3) Following excavation, the exposed subgrade areas should be proof-rolled to expose any weak, soft, wet, or otherwise unsuitable soils that should be removed. Any weak, soft, wet, or unsuitable soils observed during proof-rolling shall be removed and replaced with suitable material.

4) Following approval of the subgrade, the select fill should be placed up to the required final building pad elevations. The select fill should be placed in eight (8) inch maximum thick loose lifts. The select fill should be moisture conditioned between -3 and +3 percentage points of optimum moisture content and compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D698, Standard Proctor Method. A minimum of three (3) nuclear density tests should be performed per lift for each building.

When placing the select fill, care should be taken to avoid water ponding in the select fill layer. This could cause post-construction movements, which exceed the estimated values. Care must be taken to prevent landscape watering, surface drainage, leaking utility lines or other sources of water from entering the select fill.

Any import or select fill should be an approved inorganic material, free of debris. The select fill material should be approved by the Geotechnical Engineer prior to importing on site. Select fill material should be placed in lifts not exceeding eight (8) inches in loose thickness, moisture-conditioned to within ± 3 percentage points of the optimum moisture content, and compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D698, Standard Proctor Method. Select fill material should have a Plasticity Index (PI) ranging between 5 and 17 and have a maximum particle size of three (3) inches.

The design team should consider the use of a vapor retarder (or damp-proofing) as required to meet moisture protection requirements of interior finishing materials for the proposed structures. However, where utilized, special consideration should be given to the surface curing of the slabs in order to minimize uneven drying of the slabs and associated cracking.

Seismic Considerations

According to the 2018 IBC (Section 1613.2.2), the site shall be classified in accordance with Chapter 20 of ASCE 7-16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures. According to the ASCE 7-16 and IBC documents, the site classification is based on the subsurface soil/rock profile to a depth of 100 feet. Since the maximum depth explored for this study was 14 feet, we have assumed that the geologic formation condition extends to a depth of at least 100 feet. Based on the soil/rock profile encountered and these assumptions, the Site Class is "C" as defined by ASCE 7-16.

Pavement Design

General parking areas and drive areas will be provided primarily for general automobile traffic, and some heavy truck traffic for deliveries and trash pick up. No detailed information regarding the expected traffic loads were known at the time of our report preparation. Therefore, assumptions were made regarding the anticipated traffic conditions.

Our pavement analysis was generally based on the design procedure developed by AASHTO's *Guide for Design of Pavement Structures*, 1993, as well as the American Concrete Institute's (ACI's) *Commercial Concrete Parking Lots and Site Paving Design and Construction Guide*, ACI PRC-330-21.

Based on the site location and facility type, we utilized an effective pavement life of 20 years. Also for this analysis, we estimated a CBR (California Bearing Ratio) value of three (3) percent for the existing subgrade conditions, which will likely be the predominant subgrade material following rough grading operations. We estimated this CBR value since evaluation of CBR values by either field or laboratory testing was not included in the scope of our services. We selected this value based on our knowledge and experience with similar soil conditions in this region. Additional testing may be conducted on the actual subgrade materials at the time of construction in order to verify the assumptions in this report.

The following design parameters and criteria were considered in our analyses:

- Resilient Modulus: 4,500 psi
- Reliability: 70 % for flexible pavement; 90 % for rigid pavement
- Overall Standard Deviation: 0.45 for flexible pavement; 0.35 for rigid pavement
- Initial Serviceability: 4.2
- Terminal Serviceability: 2.0

The minimum recommended thicknesses for flexible pavement sections (asphaltic concrete) are presented in the table on the following page. Entrances to the new development as well as areas expected to require excessive maneuvering, such as dumpster areas or areas expected to accommodate heavy truck traffic, should consist of a rigid (concrete) pavement system. Minimum thicknesses for rigid pavement sections are also provided.

	Light Duty Pavement Section	Medium Duty Pavement Section	Heavy Duty Pavement Section
Pavement Material	**Thickness, (in)**	**Thickness, (in)**	**Thickness, (in)**
Reinforced Concrete	---	---	6
Type D, Hot Mix Asphaltic Concrete	1.5	2	---
Crushed Limestone Base	9[1]	10[1]	Note 2
Compacted Subgrade[3]	6	6	6

Notes 1.) If the pavement section is bearing directly on Stratum II Limestone following rough grading operations, then this thickness may be reduced by three (3) inches. However, the geotechnical engineer or his representative shall verify that the Stratum II Limestone is the remaining subgrade if the thinner pavement section is to be used.

2.) Although not required as a structural layer, crushed limestone base may be used as a level-up course.

3.) If the bedrock is the exposed subgrade then a proofroll will be sufficient for acceptance.

For the above pavement sections, we have calculated traffic loading conditions equal to or greater than 20,000 18-kip equivalent single-axle loads (ESALs) for the light-duty section and 58,000 for the medium-duty section. Typically, the light-duty section will meet the requirements for the parking spaces, while the medium-duty section will meet the requirements for the drive lanes and emergency vehicle access lanes, due to infrequency of loading. If our assumptions or the traffic loading conditions do not meet the intended use or if further information comes available, we would be happy to provide further design recommendations.

The following paragraphs specify the pavement materials to be used to construct the proposed pavement areas:

Reinforced Concrete - Concrete should be designed to exhibit a flexural strength (third point loading) of at least 630 psi at 28 days (this is a compressive strength of about 4,000 psi). The flexural strength (M_r) may be approximated by the following formula from ACI 330R-08: $M_r=10\ (f_c')^{1/2}$, where f_c' is the average 28 day compressive strength of the concrete test cylinders. The actual relationship between flexural and compressive strength for the proposed mix should be evaluated in the laboratory.

Hot Mix Asphaltic Concrete Surface Course - The asphaltic concrete surface course should be plant mixed, hot laid Type D (Fine Graded Surface Course) meeting the 2014 Texas Department of Transportation (TxDOT) specification, Item 340 and specific criteria for the job mix formula. The mix should be designed for a stability of at least 40 and should be compacted to between 91 and 95 percent of the maximum theoretical density as determined in accordance with Tex-207-F. The asphalt cement content by percent of total mixture weight should fall within a tolerance of $\pm$ 0.3 percent asphalt cement from the specific mix design. In addition, the mix should be designed so that 75 to 85 percent of the voids in the mineral aggregate (VMA) are filled with asphalt cement.

Crushed Limestone Base - Base material should be composed of crushed limestone meeting the requirements of TxDOT Item 247, Grade 1-2, Type A. The base should be compacted to a minimum of 95 percent of the maximum dry density as determined by the standard moisture-density relationship (ASTM D-698) at -2 to +2 percentage points of optimum moisture content.

Compacted Subgrade - Subgrade should be moisture-conditioned between optimum and plus four (+4) percentage points above optimum moisture content and compacted to at least 95 percent of the maximum dry density as determined in accordance with ASTM D-698. If the exposed subgrade is the Stratum I clayey gravel or the Stratum II Limestone, then the exposed subgrade areas should be proof-rolled to expose any weak, soft, wet, or otherwise unsuitable soils that should be removed. Any weak, soft, wet, or unsuitable soils observed during proof-rolling shall be removed and replaced with suitable material.

In the event that the rigid pavements are utilized throughout, the following recommendations are provided for reinforcement and jointing.

Type of Joint	Joint Spacing	Joint Depth	Joint Width[2]
Contraction (Control)	15 feet each way	One-fourth (¼) of slab thickness	One-eighth (⅛) to one-fourth (¼) inch
Construction	At location of contraction joints	Full depth of pavement thickness	One-eighth (⅛) to one-fourth (¼) inch
Isolation	As required to isolate from structures	Full depth of pavement thickness	Three-fourths (¾) to one (1) inch
Expansion[1]	60 feet each way	Full depth of pavement thickness	Three-fourths (¾) to one (1) inch

Notes: 1.) Serious consideration should be given to the total elimination of expansion joints. In this region, drying shrinkage of concrete typically significantly exceeds anticipated expansion due to thermal affects. As a result, the need for expansion joints is eliminated. Construction of an unnecessary joint may be also become a maintenance problem.
2.) All joint widths should be as noted above or as required by the joint sealant manufacturer.

Distributed Steel: Steel reinforcement may consist of either steel bars or welded wire fabric (WWF) described below:

No. 3 reinforcing steel bars at 18 inches on center each way, Grade 60; or

WWF: W2.9 X W2.9, six (6) inches by six (6) inches, flat sheets only; or W1.4 X W1.4, four (4) inches by four (4) inches, flat sheets only.

Note: It is imperative that the distributed steel be positioned accurately in the pavement cross section. Properly supported, this is typically easier to accomplish with steel bars than with WWF.

All construction joints shall have dowels, and dowel information varies with pavement thickness. The applicable dowel information for this project is provided below:

Pavement Thickness:	6 inches
Dowels	¾-inch diameter
Dowel Spacing	12 inches on center
Dowel Length	14 inches long
Dowel Embedment	6 inches minimum

Any general fill material placed in the pavement areas should be an approved inorganic material, free of debris, and have a maximum particle size of three (3) inches. Any import fill material should be approved by the Geotechnical Engineer prior to importing on site. The on-site soils may be utilized provided the recommendations provided herein are met. This material should be placed in lifts not exceeding eight (8) inches in loose thickness. Coarse-grained soils (SC, GC, or more granular) should be moisture-conditioned to within ±3 percentage points of the optimum moisture content and compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D698. Fine-grained soils (CH, ML, or CL-ML) should be moisture-conditioned between 0 and +4 percentage points above optimum moisture content and compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D698.

Proper perimeter drainage in and around pavement sections is very important, and should be provided so that infiltration of surface water from unpaved areas surrounding the pavement areas is minimized. We do not recommend installation of landscape beds or islands in the pavement. Such features provide an avenue for water to enter into the pavement section and the underlying subgrade soil. Water penetration usually results in degradation of the pavement section with time, and as vehicular traffic traverses the area of moisture infiltration.

Proper maintenance, including sealing all cracks on a timely manner, should be conducted throughout the life of any asphalt pavements. A crack sealant compatible to both asphalt and concrete should be provided at all concrete-asphalt interfaces, and at all interfaces of existing/new pavement areas.

Utility Trench Recommendations

The contractor should take the necessary precautions with regard to sloping, benching, and shoring these soils on this site to maintain stability of the excavation sides and bottom. Furthermore, the contractor should evaluate the soil exposed in the excavations as part of their safety precautions. It should be noted that any trench and excavation safety recommendations presented in this report does not relieve the contractor from performing additional safety measures that are required to maintain health and safety. Furthermore, it is the contractor's sole responsibility to maintain safety at all times.

It is vital that all backfill being placed into utility trenches be moisture-conditioned and compacted to a degree that meets or exceeds the compaction of the adjacent areas, so that no settlement will occur. Additionally, it is important that proper backfill material be used. Generally, the material that is excavated from the trenches is stockpiled on site and subsequently used as backfill material in the trenches. **It is important that the excavated material is not stockpiled near the edge of the unsupported sloped/benched areas as that material will add additional surcharge pressures to the slope.**

Additionally, it is our recommendation that all backfill material used in the utility trenches be moisture-conditioned to within three (3) percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density as determined in accordance with ASTM D-698. Furthermore, it is our recommendation that the backfill material be placed in six (6) inch compacted lifts. The backfill material should be tested for moisture content and compaction for each six (6) inch lift at a minimum frequency of one (1) test per 100 linear feet.

For narrow trenches that would be too confined to sufficiently compact the backfill materials, it is our recommendation that a flowable fill material be used to backfill the trench. In non-structural areas, the utilities should be backfilled to at least 90 percent of the maximum dry density, as determined by ASTM D-698, or in accordance with local requirements, whichever is more stringent.

Note: Although the above recommendations are provided, local requirements may supersede these recommendations. It is the contractor's responsibility to adhere to any local requirements for installation and backfill of on-site utilities. Specifically, SAWS requires that all utilities are compacted to at least 98 percent of the maximum dry density.

General Construction Considerations

The site should be graded such that surface water runoff is directed away from any excavations during construction. In addition, site grading should allow for surface and roof drainage away from the structures during their design lives. We suggest verifying final grades to document that effective drainage has been achieved.

Exposure to the environment may weaken the soils at the foundation bearing level if the excavation remains open for extended periods of time. Therefore, foundation concrete and select fill material should be placed as soon as possible after the excavation is completed. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete or select fill material. If rainfall becomes imminent while the bearing soils are exposed, we recommend that a 1-to 3-inch thick "mud-mat" of "lean" concrete be placed on the bearing soils.

Limitations

This report has been prepared to aid in the evaluation of subsurface conditions at this site and to assist design professionals in the geotechnical related design of this project. It is intended for use with regard to the specific project as described in this report. Any substantial differences in the project characteristics as discussed herein should be brought to our attention so that we may determine any effect on the recommendations provided in this report.

The scope of our study did not include an environmental assessment of the soil, rock, or water conditions either on or adjacent to the site. As such, no environmental opinions are presented in this report.

The opinions and conclusions expressed in this report are those of BEA and represent interpretation of the subsurface conditions based on tests and the results of our analyses. BEA is not responsible for the interpretation or implementation by others of recommendations provided in this report. This report has been prepared in accordance with generally accepted principles of geotechnical engineering practice and no warranties are included, expressed, or implied, as to the professional services provided under the terms of our agreement.

The analysis and recommendations submitted in this report are based upon the data obtained from the test borings performed at the locations indicated on the *Boring Location Plan*, and from other information described in this report. This report does not reflect any variations that may occur around the test borings. In the performance of the subsurface exploration, specific information is obtained at specific locations and times. However, it should be noted that variations in soil/rock conditions exist on most sites around the test boring locations, and conditions such as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction.

If variations appear evident, BEA should be allowed to perform on-site observations during the construction period and note characteristics and variations to determine if a re-evaluation of the recommendations in this report will be necessary.

Closing

We recommend that the construction activities be monitored on a call-out basis by a qualified Geotechnical Engineer, or representative. We also recommend that once the plans are prepared, BEA be retained to review them so it can be determined if changes to the recommendations are necessary or if additional recommendations are required.

APPENDIX

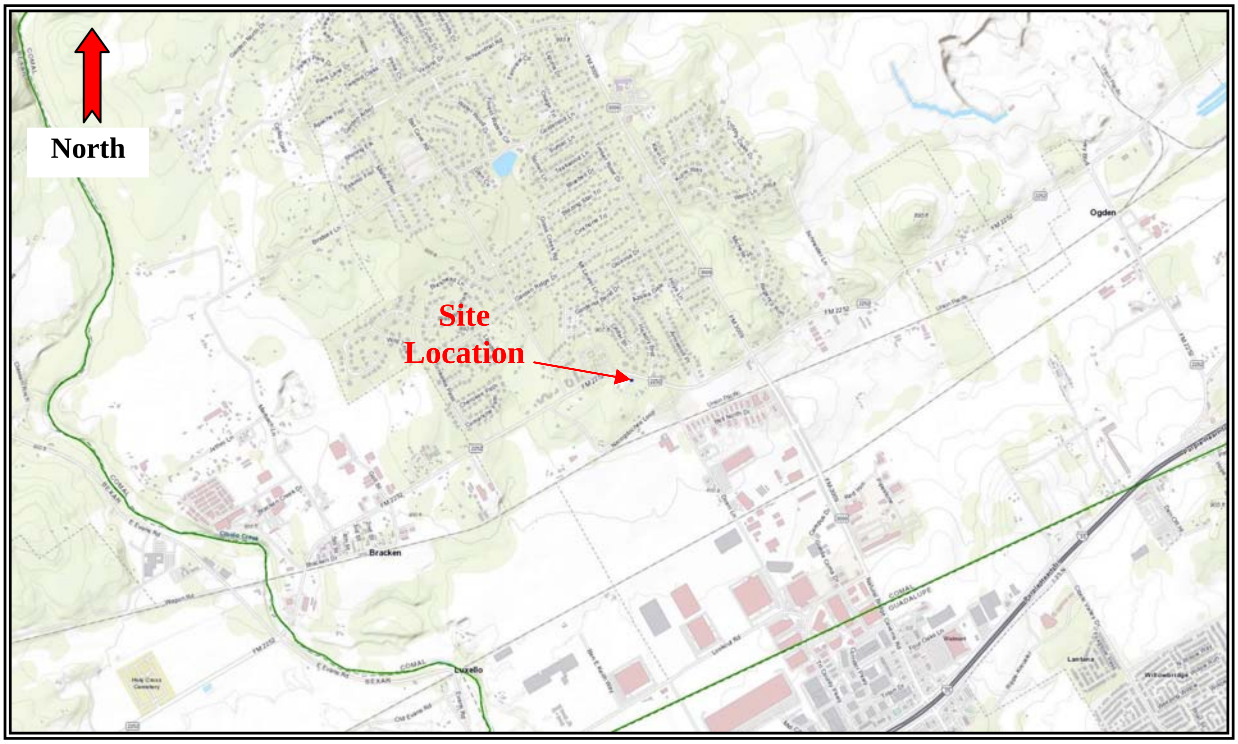
Site Vicinity Map

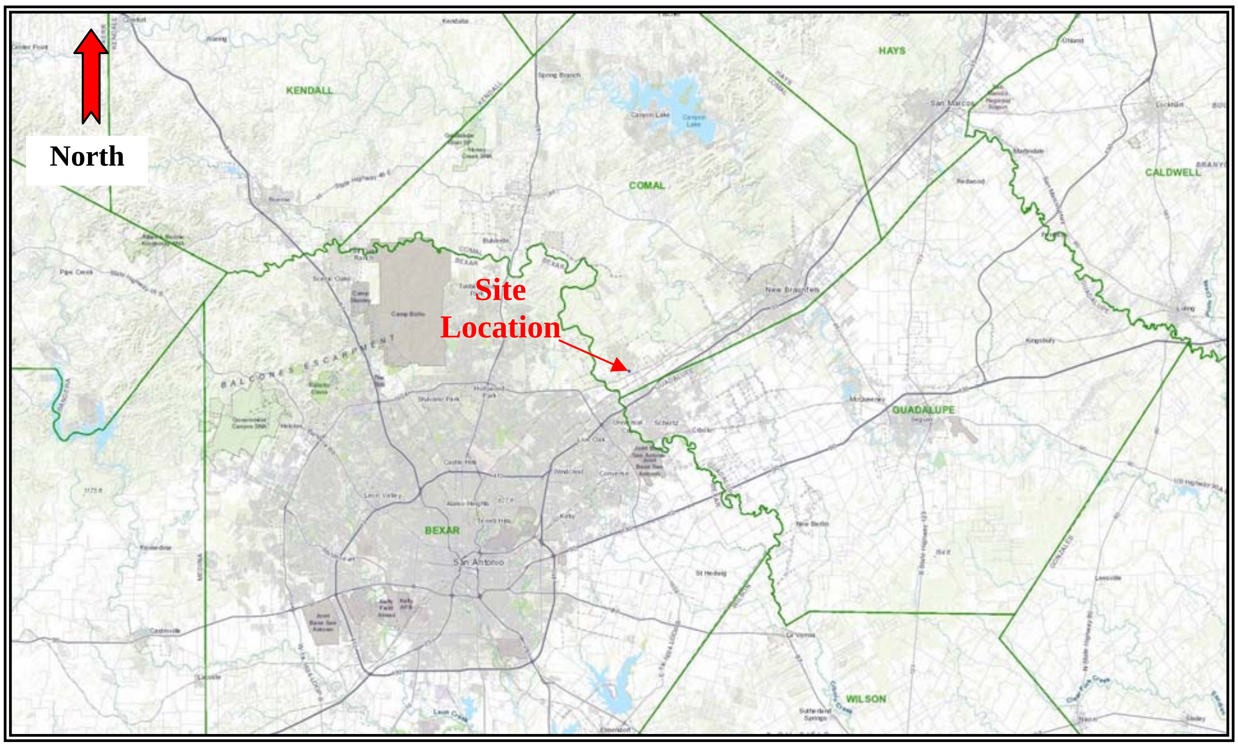
Boring Location Plan

Boring Logs (B-1 through B-6)

Soil Classification Chart

Laboratory and Field Test Procedures





Geotechnical Engineering Study
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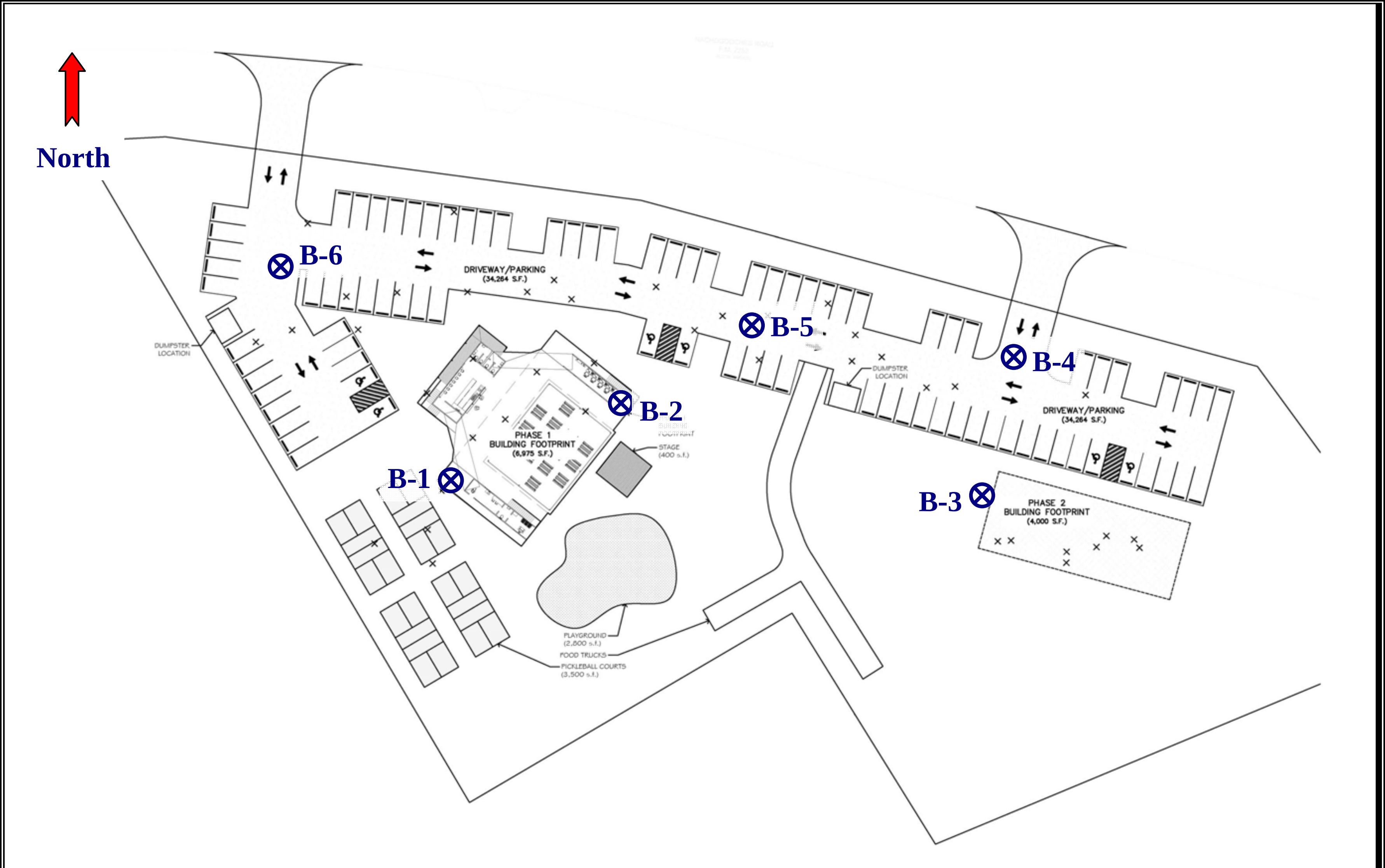
Garden Ridge, Texas
BEA Project No. 12-23-0224

FIGURE 1

SITE VICINITY MAP



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BEA Project No. 12-23-0224

FIGURE 2

BORING LOCATION PLAN

Burge Engineering & Associates
3453 North Pan Am Expressway, Suite 201
San Antonio, Texas 78219
Telephone: 210-646-8566
Fax: 210-590-7476

BORING NUMBER B-1

CLIENT Rock'em Realty
PROJECT NAME Sinners & Saints
PROJECT NUMBER 12-23-0224
PROJECT LOCATION 19186 FM 2252, Garden Ridge, Tx
DATE STARTED 5/31/23 **COMPLETED** 5/31/23
GROUND ELEVATION 885 ft **HOLE SIZE** 5"
DRILLING CONTRACTOR BEA
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY C. Simms **CHECKED BY** B. Krieger
AT END OF DRILLING ---
NOTES Groundwater not encountered during drilling.
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Stratum I: Dense, brown CLAYEY GRAVEL WITH SAND (GC) {Weathered limestone}	SS 1		17-24-50/1"			12	35	20	15	
		Stratum II: Very dense, tan LIMESTONE; chalky										
		- grab samples collected of cuttings due to sampler refusal	SS 2		50/2"			7				
5			SS 3		50/1"			5				
			SS 4		50/1"			6				
			SS 5		50/2"			8				
10												
			GB 6					8				
		Bottom of hole at 14.0 feet.										

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BORING NUMBER B-2

CLIENT Rock'em Realty
PROJECT NAME Sinners & Saints
PROJECT NUMBER 12-23-0224
PROJECT LOCATION 19186 FM 2252, Garden Ridge, Tx
DATE STARTED 5/31/23 **COMPLETED** 5/31/23
GROUND ELEVATION 882 ft **HOLE SIZE** 5"
DRILLING CONTRACTOR BEA
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY C. Simms **CHECKED BY** B. Krieger
AT END OF DRILLING ---
NOTES Groundwater not encountered during drilling.
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Stratum I: Medium dense, tan CLAYEY GRAVEL WITH SAND (GC) {Weathered limestone} - 56% gravel, 26% sand & 18% fines	SS 1		7-9-50/3"			11	36	22	14	18
		Stratum II: Very dense, tan LIMESTONE; chalky										
		- grab samples collected of cuttings due to sampler refusal	SS 2		50/2"			4				
5			SS 3		50/1"			4				
			SS 4		50/1"			5				
			SS 5		50/2"			5				
10												
			GB 6					5				
		Bottom of hole at 14.0 feet.										

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BORING NUMBER B-3

CLIENT Rock'em Realty
PROJECT NAME Sinners & Saints
PROJECT NUMBER 12-23-0224
PROJECT LOCATION 19186 FM 2252, Garden Ridge, Tx
DATE STARTED 5/31/23 **COMPLETED** 5/31/23
GROUND ELEVATION 871.5 ft **HOLE SIZE** 5"
DRILLING CONTRACTOR BEA
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY C. Simms **CHECKED BY** B. Krieger
AT END OF DRILLING ---
NOTES Groundwater not encountered during drilling.
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Stratum I: Very dense, dark brown CLAYEY GRAVEL WITH SAND (GC) {Weathered limestone} - 49% gravel, 32% sand & 19% fines	SS 1		4-50/4"			25				19
		Stratum II: Very dense, tan LIMESTONE; chalky										
		- grab samples collected of cuttings due to sampler refusal	SS 2		50/3"			4				
5			SS 3		50/1"			3				
			GB 4					5				
			SS 5		50/5"			6				
10												
			SS 6		50/5"			5				
		Bottom of hole at 14.0 feet.										

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BORING NUMBER B-4

CLIENT Rock'em Realty
PROJECT NAME Sinners & Saints
PROJECT NUMBER 12-23-0224
PROJECT LOCATION 19186 FM 2252, Garden Ridge, Tx
DATE STARTED 5/31/23 **COMPLETED** 5/31/23
GROUND ELEVATION 872 ft **HOLE SIZE** 5"
DRILLING CONTRACTOR BEA
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY C. Simms **CHECKED BY** B. Krieger
AT END OF DRILLING ---
NOTES Groundwater not encountered during drilling.
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Stratum I: Stiff, dark brown FAT CLAY (CH) with limestone fragments	SS 1		7-50/3"			21	62	28	34	
		Stratum II: Very dense, tan LIMESTONE; chalky										
		- grab samples collected of cuttings due to sampler refusal	SS 2		50/3"			7				
5			SS 3		50/1"			4				
		Bottom of hole at 5.0 feet.										

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BORING NUMBER B-5

CLIENT Rock'em Realty
PROJECT NAME Sinners & Saints
PROJECT NUMBER 12-23-0224
PROJECT LOCATION 19186 FM 2252, Garden Ridge, Tx
DATE STARTED 5/31/23 **COMPLETED** 5/31/23
GROUND ELEVATION 878 ft **HOLE SIZE** 5"
DRILLING CONTRACTOR BEA
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY C. Simms **CHECKED BY** B. Krieger
AT END OF DRILLING ---
NOTES Groundwater not encountered during drilling.
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Stratum I: Stiff, dark brown FAT CLAY (CH) with limestone fragments	SS 1		4-50/5"			28				
		Stratum II: Very dense, tan LIMESTONE; chalky										
		- grab samples collected of cuttings due to sampler refusal	SS 2		50/1"			9				
5			GB 3					4				
		Bottom of hole at 5.0 feet.										

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Fax: 210-590-7476

BORING NUMBER B-6

CLIENT Rock'em Realty
PROJECT NAME Sinners & Saints
PROJECT NUMBER 12-23-0224
PROJECT LOCATION 19186 FM 2252, Garden Ridge, Tx
DATE STARTED 5/31/23 **COMPLETED** 5/31/23
GROUND ELEVATION 888 ft **HOLE SIZE** 5"
DRILLING CONTRACTOR BEA
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY C. Simms **CHECKED BY** B. Krieger
AT END OF DRILLING ---
NOTES Groundwater not encountered during drilling.
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Stratum I: Stiff, dark brown FAT CLAY (CH) with limestone fragments	SS 1		4-50/5"			10	77	31	46	
		Stratum II: Very dense, tan LIMESTONE; chalky										
		- grab samples collected of cuttings due to sampler refusal	SS 2		50/2"			4				
5			SS 3		50/1"			4				
		Bottom of hole at 5.0 feet.										

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Laboratory and Field Test Procedures

Soil Classification per ASTM D2487
This soil testing standard was used for classifying soils according to the Unified Soil Classification System. The soil classifications of the earth materials encountered are as noted in the attached boring log.

Soil Water Content per ASTM D2216
This test determines the water content of soil or rock expressed as a percentage of the solid mass of the soil. The test results are listed under Moisture Content in the attached boring log.

Soil Liquid Limit per ASTM D4318
The soil Liquid Limit identifies the upper limit soil water content at which the soil changes from a moldable (plastic) physical state to a liquid state. The Liquid Limit water content is expressed as a percentage of the solid mass of the soil.

Soil Plastic Limit per ASTM D4318
The soil Plastic Limit identifies a lower limit soil water content at which the soil changes from a moldable (plastic) physical state to a non-moldable (semi-solid) physical state. The Plastic Limit water content is expressed as a percentage of the solid mass of the soil.

Plasticity Index per ASTM D4318
This is the numeric difference between the Liquid Limit and Plastic Limit. This index also defines the range of water content over which the soil-water system acts as a moldable (plastic) material. Higher Plasticity Index (PI) values indicate that the soil has a greater ability to change in soil volume or shrink and swell with lower or higher water contents, respectively.

Standard Penetration Test (SPT) and Split Spoon Sampler (SS) per ASTM D1586
This is the standard test method for both the penetration test and split-barrel (spoon) sampling of soils. This sampling method is used for soils or rock too hard for sampling using Shelby Tubes. The method involves penetration of a split spoon sampler into the soil or rock through successive blows of a 140 pound hammer in a prescribed manner.

Blow Counts (N) per ASTM D1586
This is the number of blows required to drive a Split Spoon Sampler by means of a 140 pound hammer for a distance of 12 inches in accordance with the variables stated in the test procedures.

Minus No. 200 Sieve per ASTM D1140
This test method covers determination of the amount of material finer than a #200 sieve by washing. The results are stated as a percentage of the total dry weight of the sample.

Boring Log: This is a summary of the above described information at each boring location.