Mr. David Rothenberg
Mountain Top Estates, LLC
17913 Lafayette Park Road
Jonestown, Texas 78645
June 21, 2024

GESSNER ENGINEERING

GEOTECHNICAL ENGINEERING STUDY

11400 Mountain Top Circle
Jonestown, Texas
Gessner Engineering Job No. 24-0424

GESSNER ENGINEERING

June 21, 2024

Mr. David Rothenberg
Mountain Top Estates, LLC
17913 Lafayette Park Road
Jonestown, Texas

Re: Geotechnical Engineering Study
11400 Mountain Top Circle
Jonestown, Texas
Gessner Engineering Job No. 24-0424

Dear Mr. Rothenberg:

This report conveys our geotechnical engineering study conducted for the proposed 11400 Mountain Top Circle Project to be located in Jonestown, Texas. The following report contains our design recommendations and considerations based on our understanding of the information provided to us. The purpose of this study was to drill a boring within the proposed project site, to perform laboratory testing to classify and characterize subsurface conditions, and to prepare an engineering report presenting pavement design and construction recommendations. We trust that this report is responsive to your project needs. Please contact us if you have any questions or if we can be of further assistance.

We are happy to be of service to you on this phase of the project and look forward to the opportunity to provide additional services for geotechnical engineering, structural engineering, civil engineering, land surveying, and construction materials testing as the project progresses.

Sincerely,
GESSNER ENGINEERING, LLC TBPELS no. F-7451

Emily Torres, E.I.T.

Prashant M. Patil, M.S., P.E.

STATE OF TEXAS
06/21/2024
PRASHANT MADHUKAR PATIL
146403
LICENSED
PROFESSIONAL ENGINEER

Copies Submitted:
Mr. David Rothenberg

CONTENTS

Introduction

This report describes the procedures utilized during this study and presents the results of our geotechnical engineering investigation for the proposed 11400 Mountain Top Circle Project. Gessner Engineering was authorized to provide the subsurface investigation and report for this project by Mr. David Rothenberg on May 7, 2024.

Project Description

The project consists of the proposed construction of pavements at the site located at 11400 Mountain Top Circle in Jonestown, Texas, in Travis County.

Engineering recommendations are provided on the basis of existing conditions at the time of drilling.

Scope of Services

The Texas Section of the American Society of Civil Engineers defines an engineered foundation as one that includes a geotechnical engineering investigation. To act as this first phase of an engineered foundation, our scope of work for this project consisted of:

1. Drilling 1 test boring at the selected location within the project site to evaluate the subsurface arrangement of strata and groundwater conditions.

2. Performing geotechnical laboratory tests on recovered samples to evaluate the physical and engineering properties of the strata observed.

3. Engineering analysis to develop recommendations with respect to:

    - Site, subgrade, and fill preparation
    - Pavement design and construction

SITE INVESTIGATION PROCEDURES

Subsurface conditions at the site were evaluated by drilling 1 boring at the location shown on the *Project Layout* in the Appendix. The location is approximate and distances were measured using a hand-held GPS locator. On June 12, 2024, the boring was drilled until auger refusal to a depth of approximately 2 feet below the existing ground surface using a track-mounted drill rig.

The *Log of Boring*, presenting the subsurface soil descriptions, type of sampling used, laboratory results, and additional field data, is presented in the Appendix. The *Symbols and Terms*, which defines the terms and descriptive symbols used on the log, is also provided in the Appendix.

Samples were taken continuously to the termination of the boring.

One sample of soil was obtained by means of a Split-Spoon with Standard Penetration Test (SPT). This test consists of measuring the number of blows required for a free-falling hammer to drive a standard Split-Spoon sampler 12 inches into the subsurface material after being seated 6 inches. The test is terminated after 50 blows regardless of whether 12 inches of penetration has been achieved. If all 50 blows fall within the first 6 inches (seating blows), then refusal (Ref.) for 6 inches or less will be denoted on the *Log of Boring*. This blow count, or SPT "N" value, is used to evaluate the engineering properties of the stratum. Correlations between the unconfined compressive strength and the "N" value for the in situ soils have been developed to estimate the bearing capacity of the soils.

Texas Highway Department Cone Penetrometer (TCP) tests was performed at a depth of 2 feet below existing grade. TCP test results are noted as "blows per foot" on the *Log of Boring* (divided into 6 inch increments), where "blows per foot" refers to the number of blows by a falling hammer required for 1 foot of penetration into soil/weak rock. Where hard or dense materials were encountered, each increment was terminated at 50 blows even if 6 inches of penetration had not been achieved in that increment.

All samples were removed from samplers in the field, visually classified, and sealed in sample containers to preserve their in situ moisture contents.

Throughout the report, the soils are referred to in terms used to describe their consistency. The term consistency refers to the degree of adhesion between the soil particles and to the resistance offered against forces that tend to deform or rupture the soil aggregate. Consistency of clays and other cohesive soils is usually described as very soft, soft, firm, stiff, very stiff, and hard. Additional consistency terms used on cohesive soils are plastic, lean, and fat. As a soil approaches the characteristics of a clay soil, the greater the variety of states of consistency in which it may be found. The physical properties of a plastic soil change depending upon the moisture content of the soil. The degree of plasticity is sometimes expressed by the terms fat and lean. Lean clay is only slightly plastic; whereas fat clay has a high plasticity.

LABORATORY TESTING

Samples obtained during the field program were visually classified in the laboratory by a geotechnical engineer or their representative. A testing program was conducted on selected samples in accordance with the ASTM Standard Test Procedures, as directed by the geotechnical engineer, to aid in classification and evaluation of engineering properties required for analysis.

The laboratory testing program for this project included sieve analyses, moisture contents, and Atterberg limits.

Sieve analyses were performed by passing the sample through a series of sieves to classify the soil based on their particle size. This allows a determination of the type of soils, distribution of the particle sizes and the interaction between the particles. Sieves used for this test include a series of screens of various sizes to determine the amount of various particle sizes in a sample.

Moisture content tests were performed in accordance with ASTM D 2216 by placing a sample into an oven with a constant temperature and comparing the mass before oven drying to the mass after oven drying. Changes in the moisture content have an effect on the behavior of plastic soils. Variations in the moisture content from the state observed during investigation to the moisture content from the state observed during construction can result in expansive soil-related movements. If the moisture content of the soil increases after construction, for example, the soil can induce uplift forces on the structure it is supporting.

The structure of clay consists of a random arrangement of flat plates. Edges of the particles are positively charged, and the face is negatively charged. Negative charges on the face of the clays bond with positive water ions in the soil, causing a volumetric change resulting in expansion of the soils. This water may be released with the application of pressure from load, evaporation, or suction from gravity or vegetation. The specific chemical makeup of the various clays causes them to have a stronger or weaker ability to bond with water.

In order to relate moisture content and soil consistency, Atterberg limit tests were performed on the samples in accordance with ASTM D 4318. The Atterberg limit test is comprised of 2 separate tests: plastic limit and liquid limit. The plastic limit test determines the moisture content of the soil in its dry state while the liquid limit test determines the moisture content as the soil nears a liquid state.

The plastic limit is described as the moisture content of the soil where it transitions between brittle and plastic behavior. This point is determined by rolling the samples in threads 1/8 inch (3 mm) in diameter to the point at which they begin to crack and/or crumble.

The liquid limit describes the moisture content of the soil where it transitions between plastic and liquid behavior. In conducting this test, the sample is placed in the Casagrande cup, or liquid limit device. A standard grooving tool is used to create a gap in the center of the sample 0.53 inches (13.5 mm) in width. The cup is then dropped repeatedly onto the hard rubber base at a rate of 120 blows per minute. The liquid limit is the moisture content at which the groove closes at 25 blows.


Liquid Limit Device

The plasticity index (PI) is the difference between the liquid limit and the plastic limit and provides a description of the moisture states a soil can experience. The PI is an indicator of the potential for expansion or contraction of the soil.

Results of the laboratory tests are presented on the *Log of Boring* in the Appendix and are discussed in the following sections. Samples will be retained in our laboratory for 30 days after submittal of this report.

All samples were returned to our laboratory and samples not tested in the lab will be stored for a period of thirty (30) days subsequent to submittal of this report and will be discarded after this period, unless Gessner Engineering is notified otherwise. Whenever possible, samples are used to fill subsequently drilled borings, or used to fill washed out areas or holes to prevent adding unnecessary waste to landfills.

SITE CONDITIONS

Site Geology

Major soil formations provide information with regards to the depth and magnitude of the conditions, as well as anticipated features of the soils in this area. This information provides typical data for the area. While it is valid as a general reference, it does not provide data accurate enough to replace site specific engineering analysis.

The site is mapped as being underlain by the Edwards Limestone Formation as indicated on the Geologic Atlas of Texas, Austin Sheet as published by the University of Texas at Austin. The Edwards Limestone is composed of limestone, dolomite, and chert. The limestone is aphanitic to fine grained, hard, brittle, and much miliolid biosparite. The dolomite is fine to very fine grained, porous, and medium gray to grayish brown. The chert has nodules and plates common with a mostly white to light gray color.

In addition, the Upper Glen Rose Limestone Formation and Bee Cave Marl Formation (limestone, dolomite, and marl) are also mapped nearby. Although not specifically mapped at the site, these may be encountered at construction.

Surface Conditions

Based on visual observation, the topography is gently sloping across the proposed project site. At the time of drilling, ground cover for the proposed site consisted of a cleared area.

Subsurface Conditions

Subsurface stratigraphy at this site can be described as clay overlying limestone. The limestone was encountered at a depth of approximately 1.5 feet below the existing ground surface. The *Log of Boring* should be consulted for more specific stratigraphic information. Each stratum has been designated by grouping soils that possess similar physical and engineering characteristics. Lines designating the interfaces between strata on the log represent approximate boundaries, and transitions between strata may be gradual.

These soils generally exhibit very low potential for volumetric change due to moisture variations, as indicated by the measured PI for each sample, which are presented on the *Log of Boring* in the Appendix.

Groundwater Conditions

The boring was dry augered to its completed depth in an attempt to observe groundwater conditions. Groundwater seepage was not observed in the borings during drilling operations. It should be noted that groundwater at the site may occur in the form of “perched” water traveling along pervious seams or layers within the soils. The frequency of such groundwater is expected to increase during and soon after periods of wet weather. The direction of flow of subsurface moisture is unknown and many times will differ from the surface topography. Caution should be taken when constructing in wet seasons and all water accumulated during construction shall be removed prior to concrete placement.

An extensive groundwater study is beyond the scope of this report. Should construction activities require further evaluation of groundwater volumes, seasonal fluctuations, and direction, contact Gessner Engineering.

Pavement Recommendations

Recommendations for both rigid and flexible pavements are presented in this report. The Owner and/or design team may select either pavement type depending on the performance criteria established for the project. In general, flexible pavement systems have a lower initial construction cost as compared to rigid pavements. However, maintenance requirements over the life of the pavement are typically much greater for flexible pavements. This typically requires regularly scheduled observation and repair, as well as overlays and/or other pavement rehabilitation at approximately one-half to two-thirds of the design life. Rigid pavements are generally more durable and require less maintenance after construction.

For either pavement type, drainage conditions will have an impact on long-term performance, particularly where permeable base materials are utilized in the pavement section. Pavement design should be in accordance with the *Pavement Drainage Considerations* section of this report.

Subgrade Conditions

Gessner Engineering assumes that the subgrade in pavement areas will consist of the recompacted on-site materials, placed and compacted as recommended in the *Pavement Earthwork* section of this report. Based on our experience with similar subgrade soils, a California Bearing Ratio (CBR) value of 10.0 has been assigned for use in pavement thickness design analyses.

Design Information

Rigid pavement recommendations were prepared assuming traffic categories A and B for light-duty and C for heavy-duty pavements. An average daily truck traffic (ADTT) of 10, 25, and 100 were assigned for light and heavy-duty pavements, respectively. Flexible pavement recommendations will be prepared assuming a 20-year design life and Equivalent Single Axle Loads (ESAL's) ranging between 30,000 and 120,000.

The Project Civil Engineer should review anticipated traffic loading and frequencies to verify that the assumed traffic loading and frequency is appropriate for the intended use of the facility.

Rigid Pavement

It is recommended that rigid pavements be considered in areas of channelized traffic, particularly in areas where truck or bus traffic is planned, and particularly where such traffic will make frequent turns, such as garbage dumpsters as described in the *Garbage Dumpsters* section of this report.

For the concrete parking lots, sidewalks and drives, frequent control joints should be used to direct shrinkage cracking with a maximum joint spacing as shown in the table below. It should be noted that the pavement thicknesses listed are minimum recommendations only and are not based on a pavement system design. Expansion joints shall be placed at anticipated stress points and dowels shall be placed across these joints. The concrete section may be reinforced and designed in accordance with ACI standard practices or may be designed as a jointed system in accordance with ACI 330R-08.

Structure	Traffic Category	Concrete Thickness (inches)	Control Joint Maximum Spacing (feet)	Average Daily Truck Traffic (ADTT)
Sidewalks	-	4.0	Sidewalk Width	-
Light-Duty Pavements	A	5.0	12.5	10
	B	6.0	15.0	25
Heavy-Duty Pavements	C	7.0	15.0	100

Table 1: Rigid Pavement System Recommendations

It is recommended that the concrete pavements be reinforced with bar mats. Concrete reinforcing should be centered in the slab. Reinforcing should not extend across expansion joints.

All control joints should be formed or sawed to a depth of at least 1/4 the thickness of the concrete slab. Sawing of control joints should begin as soon as the cutting can be performed without raveling of the concrete. Control joints may be hand formed or formed by using a premolded filler. It is recommended that all longitudinal and transverse construction joints be dowelled to promote load transfer. Expansion joints are needed to separate the concrete slab from fixed objects such as drop inlets, light standards and buildings. No expansion or construction joints should be located in a swale or drainage collection locations.

Based on Formula 3-3 in the ACI 330R-08 Guide for the Design and Construction of Concrete Parking Lots, the minimum area of steel required for a reinforced section shall be computed by the drag formula:

Formula 1: Drag Formula

$$A = \frac{(LC_f wh)}{24 f_s}$$

Where:

- A = area of steel reinforcement (in^2/ft)
- L = distance between joints (ft)
- C_f = Coefficient of subgrade resistance (use 1.5)
- w = density of concrete (lb/ft^3)
- h = slab thickness (in)
- f_s = allowable tensile stress in steel reinforcement (psi)

If possible, the pavement should develop a minimum slope of 0.015 feet/feet to provide surface drainage. Reinforced concrete pavement should cure a minimum of 3 and 7 days before allowing automobile and truck traffic, respectively.

Portland Cement Concrete

Portland cement concrete should have a maximum slump of 5 inches and should have a minimum 28-day compressive strength of 4,000 psi. Air entrainment is recommended and should meet the recommendations as outlined in ACI-330R-08, Table 4.1. A liquid membrane-forming curing compound should be applied as soon as practical after broom finishing the concrete surface. The curing compound will help reduce the loss of water from the concrete. The reduction in the rapid loss in water will help reduce shrinkage cracking of the concrete.

The M_r of concrete is a measure of the flexural strength of the concrete as determined by breaking concrete beam test specimens. An M_r of approximately 450 to 550 psi at 28 days was used in the analysis and is typical of local concrete production.

Garbage Dumpsters

Where flexible pavements are constructed at any site, it is recommended that reinforced concrete pads be provided in front of and beneath trash receptacles. Dumpster trucks, if any, should be parked on the rigid pavement when trash receptacles are lifted.

It is suggested that such pads also be provided in drives where the dumpster trucks make turns with small radii to access the receptacles.

Sidewalks

Concrete sidewalks are planned throughout the facility for pedestrian traffic. Reference the concrete section above and subgrade section below for details.

Flexible Pavement

Flexible pavement sections recommended for this site are as listed in the table below:

Structure	Pavement Section	Asphaltic Concrete Thickness (inches)	Flexible Base Course Thickness (inches)	Estimated ESALs
Light-Duty Pavements	Design Section 1	2.0	6.0	30,000
	Design Section 2	2.0	8.0	70,000
Heavy-Duty Pavements	Design Section 3	3.0	6.0	120,000

Table 2: Flexible Pavement System Recommendations

Asphaltic Concrete Surface Course

Asphaltic concrete surface course should conform to TxDOT Standard Specifications, Item 340, Type D. Asphaltic concrete should be compacted to a minimum of 92 percent of the maximum theoretical specific gravity (Rice) of the mixture determined according to Test Method Tex-227-F. Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method Tex-207-F. The nuclear-density gauge or other methods that correlate satisfactorily with results obtained from project roadway specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required roadway specimens at their expense and in a manner and at locations selected by the Engineer.

Flexible Base Course

Flexible base course should be crushed limestone conforming to TxDOT Standard Specifications, Item 247, Type A, Grades 1 or 2. Base course should be placed on prepared surfaces in lifts not to exceed 8 inches loose measure, with compacted thickness not to exceed 6 inches. Base course should be compacted to a minimum of 95 percent of the maximum density at a moisture content within the range of 2 percentage points below to 2 percentage points above the optimum moisture content as determined by Tex-113-E.

Additional Considerations

It is important that proper perimeter drainage be provided so that infiltration of surface water from unpaved areas surrounding the pavement is minimized, or if this is not possible, curbs should extend through the base and into the subgrade. A crack sealant compatible to both asphalt and concrete should be provided at concrete-asphalt interfaces. It should be noted that post-construction subgrade movements and cracking of asphaltic pavements is not uncommon for subgrade conditions such as those observed at this site.

Pavement Earthwork

In pavement areas, the surface soils should be stripped a minimum of 6 inches or as needed to remove roots and organics. This undercut should extend a minimum of 24 inches horizontally beyond all paving limits. The exposed subgrade should be proof rolled as described in the foundation earthwork section and any weak yielding material should be replaced with select fill. The exposed subgrade should be compacted to a minimum of 95% of the maximum dry density as determined by the modified moisture/density relation (ASTM D 1557) at -2 to +2 percent of the optimum moisture content. (As an alternative, compaction to at least 98 percent of the ASTM D 698 maximum dry density may be considered). The prepared subgrade should also be proof rolled to confirm proper preparation and uniformity.

If required, fill used beneath pavement shall have a PI between 8 and 30. Any fill beneath pavement shall be compacted to a minimum of 95 percent of the maximum density as determined by the modified moisture/density relation (ASTM D 1557) at -2 to +2 percent of the optimum moisture content. (As an alternative, compaction to at least 98 percent of the ASTM D 698 maximum dry density may be considered).

Pavement Drainage Considerations

As with any soil-supported structure, the satisfactory performance of a pavement system is contingent on the provision of adequate surface and subsurface drainage. Insufficient drainage that allows saturation of the pavement subgrade and/or the supporting granular pavement materials will reduce the performance and service life of the pavement systems.

Surface and subsurface drainage considerations crucial to the performance of pavements at this site include (but are not limited to) the following:

1) Any known natural or man-made subsurface seepage at the site that may occur at sufficiently shallow depths as to influence moisture contents within the subgrade should be intercepted by drainage ditches or below grade French drains.

2) Final site grading should eliminate isolated depressions adjacent to curbs which may allow surface water to pond and infiltrate into the underlying soils. **Curbs, adjacent to flexible pavements, should completely penetrate subgrade materials and should be installed to sufficient depth to reduce infiltration of water beneath the curbs.**

3) Pavement surfaces should be maintained to help minimize surface ponding and to provide rapid sealing of any developing cracks. These measures will help reduce infiltration of surface water downward through the pavement section.

Construction Materials Testing

The performance of pavements is dependent upon the quality of construction. Compaction testing of fill material and concrete strength tests are required by the 2018 International Building Code. We would be pleased to develop a plan for construction monitoring to be incorporated in the overall quality control program. For more information, please contact Gessner Engineering's dedicated dispatch number for materials testing at 979-325-TEST (8378).

General Comments

The analysis and recommendations presented in this report are based upon the data obtained from the boring performed at the indicated location and from other information discussed in this report. This report does not reflect variations that may occur between boring, across the site or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, Gessner Engineering should be immediately notified so that further evaluation and supplemental recommendations can be provided.

Limitations

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

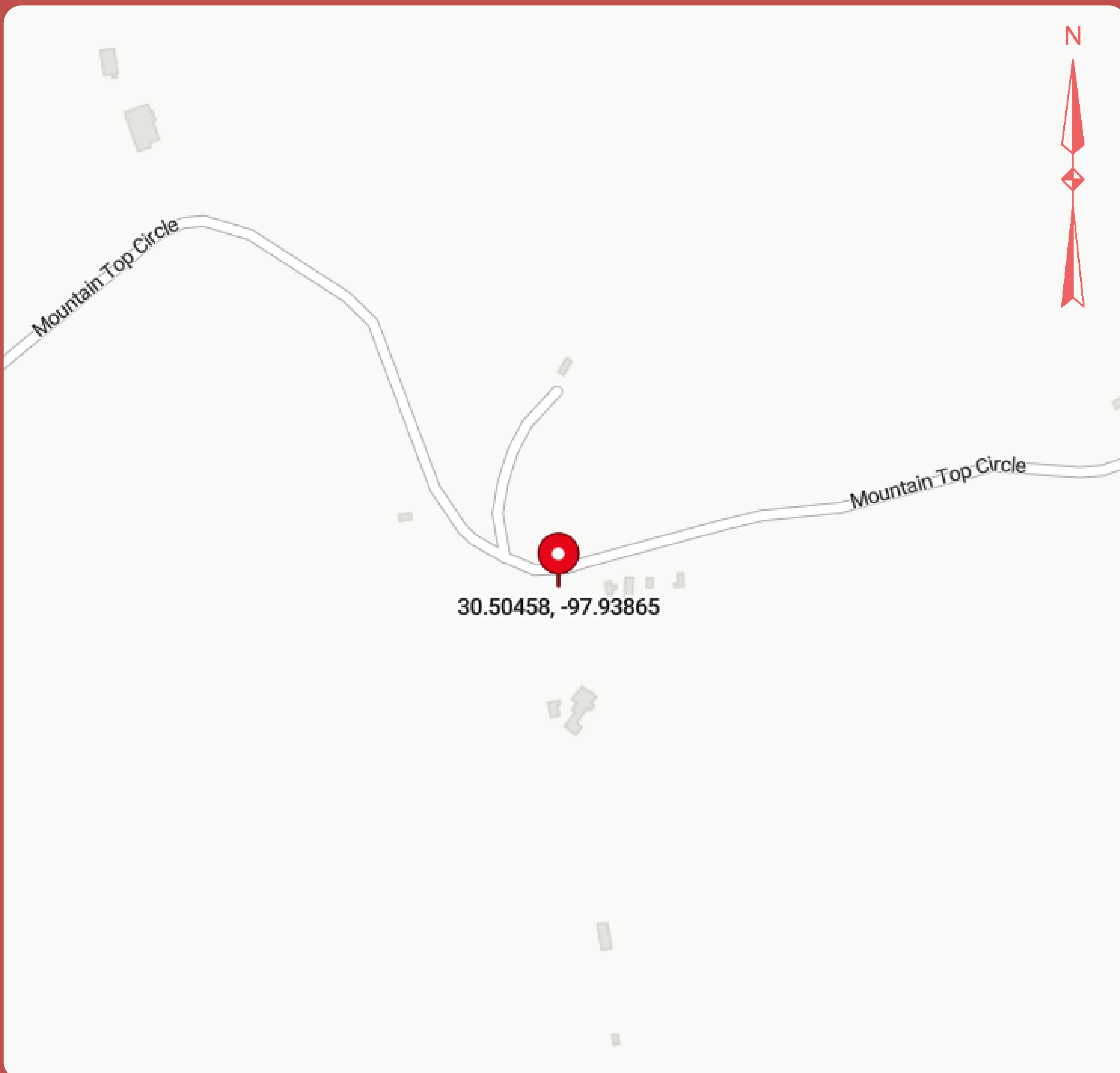
For any excavation construction activities at this site, all Occupational Safety and Health Administration (OSHA) guidelines and directives should be followed by the Contractor during construction to ensure a safe working environment. In regards to worker safety, OSHA Safety and Health Standards require the protection of workers from excavation instability in trench situations.

This report has been prepared for the use of Mr. David Rothenberg with Mountain Top Estates, LLC and their design representatives for the specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. This report was written and recommendations were made based on the soil data collected on June 12, 2024. If construction is delayed or the proposed area experiences severe weather conditions, please contact the geotechnical engineer prior to construction. No warranties, either expressed or implied, are intended or made. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Gessner Engineering reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX

- ✓ Project Location
- ✓ Project Layout
- ✓ Log of Boring
- ✓ Symbols and Terms
- ✓ Glossary of Geological Terms

Mobile B-37 Drill Rig: Bubba Red



GESSNER ENGINEERING

11400 MOUNTAIN TOP CIRCLE
JONESTOWN, TEXAS

PROJECT LOCATION

Corporate: 401 W 26th Street, Suite 3 | Bryan, Texas 77803
www.gessnerengineering.com |1-877-GESSNER
Bryan | Brenham | Fort Worth | Georgetown | San Antonio

TBPLS F-1093910 PLAN | DESIGN | VERIFY TBPE F-7451

Scale:	NTS
Job No.	24-0424
Drawn By:	KRG
Checked By:	KKW
Drawn Date:	05.24.24
Drawing No.	1

Boring	Approximate Location
BH-1	30.50458, -97.93865

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ENGINEERING

11400 MOUNTAIN TOP CIRCLE
JONESTOWN, TEXAS

PROJECT LAYOUT

Corporate: 401 W 26th Street, Suite 3 | Bryan, Texas 77803
www.gessnerengineering.com |1-877-GESSNER
Bryan | Brenham | Fort Worth | Georgetown | San Antonio

TBPLS F-1093910 PLAN | DESIGN | VERIFY TBPE F-7451

Scale:	NTS
Job No.	24-0424
Drawn By:	KRG
Checked By:	KKW
Drawn Date:	05.24.24
Drawing No.	2

LOG OF BORING NO: BH-1

GESSNER ENGINEERING

CLIENT: Mountain Top Estates, LLC
PROJECT: 11400 Mountain Top Circle
Jonestown, Texas

PROJECT NO: 24-0424
DATE: 6/12/2024
DRILLER: Gessner Engineering

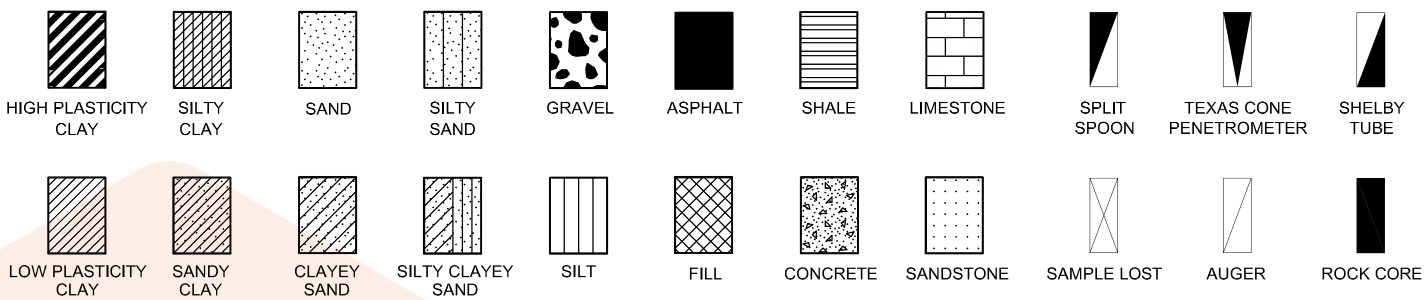
BOREHOLE LOCATION: 30.50459, -97.93664
GROUND SURFACE ELEVATION: 1068 feet
BOREHOLE TERMINATION DEPTH: 2.5 feet
INITIAL GROUNDWATER DEPTH: Not Encountered
FINAL GROUNDWATER DEPTH: Dry at Completion
GROUND COVER: Cleared Area
***ALL DEPTHS, ELEVATIONS, AND LOCATIONS ARE APPROXIMATE**

DEPTH (ft)	WATER LEVEL	GRAPHIC LOG	SAMPLE TYPE	PENETROMETER OR BLOW COUNT	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	FINES CONTENT (%)	UNCONFINED COMPRESSION (tsf)	USCS CLASSIFICATION	MATERIAL DESCRIPTION
0–1				6/12/ 50-1"	39	13	7.7		53		CL	CLAY, Sandy, Hard, Brown, with gravel
2				50-0"/ 50-0"								LIMESTONE, Weathered, Tan

The borehole was terminated at a depth of approximately 2 feet due to auger refusal.

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL SYMBOLS AND DESCRIPTION / SAMPLER TYPES



GROUNDWATER SYMBOLS AND DESCRIPTION

▽ - GROUNDWATER ENCOUNTERED DURING DRILLING

▼ - GROUNDWATER DEPTH UPON DRILLING COMPLETION

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (Major Portion Retained on No. 200 Sieve): Includes (1) clean gravels and sands and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

Standard Penetration, N-Value, blows/ft	Relative Density
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
>50	Very Dense

FINE GRAINED SOILS (Major Portion Passing No. 200 Sieve): Includes (1) inorganic and organic silts and clays; (2) gravelly, sandy, or silty clays; and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

Standard Penetration, N-Value, blows/ft	Pocket Penetrometer Reading	Consistency	Cohesive Strength, tons/sf
0-2	0-0.25	Very Soft	less than 0.125
2-4	0.25-0.5	Soft	0.125 to 0.25
4-8	0.5-1.0	Firm	0.25 to 0.50
8-15	1.0-2.0	Stiff	0.50 to 1.00
15-30	2.0-4.0	Very Stiff	1.00 to 2.00
>30	>4.0	Hard	2.00 and higher

Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above due to planes of weakness or cracks in the soil.

EXPANSION POTENTIAL OF COHESIVE SOILS

Plasticity Index	Degree of Expansive Potential
0-5	Nonplastic
5-10	Low
10-20	Moderate
20-40	High
>40	Very High

ROCK QUALITY DESIGNATION

RQD=Rock Quality Designation
The percentage of intact rock retrieved from a bore hole. All pieces of intact rock core equal to or greater than 4 inches long are summed and divided by the total length of the core run.

REC = Recovery
This is the total percentage of material recovered from a run.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	- having inclined planes of weakness that are slick and glossy in appearance
Fissured	- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical
Laminated	- composed of thin layers of varying color and texture
Interbedded	- composed of alternate layers of different soil types
Calcareous	- containing appreciable quantities of calcium carbonate
Well graded	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Poorly graded	- predominantly of one grain size, or having a range of sizes with some intermediate size missing
Flocculated	- pertaining to cohesive silts that exhibit a loose knit or flakey structure

GLOSSARY OF GEOLOGIC TERMS

Aphanitic - dense, homogeneous rock with constituents so fine that they cannot be seen by the naked eye
Argillaceous - containing, made of, or resembling clay; clayey
Bentonitic - an absorbent aluminum silicate clay formed from volcanic ash and used in various adhesives, cements, and ceramic fillers
Carbonaceous - consisting of, containing, relating to, or yielding carbon
Chert - a siliceous rock of chalcedonic or opaline silica occurring in limestone
Conchoidal - of, relating to, or being a surface characterized by smooth, shell-like convexities and concavities, as on fractured obsidian
Crossbedded - intersecting layers of distinct soil deposits
Fluviatile - produced by the action of a river or stream
Fossiliferous - containing fossils
Friable - readily crumbled, brittle
Glauconitic - a greenish mineral of the mica group, a hydrous silicate of potassium, iron, aluminum, or magnesium found in *greensand* and used as a fertilizer and water softener
Gypsiferous - containing gypsum; a widespread colorless, white, or yellowish mineral, used in the manufacture of various plaster products, and fertilizers
Igneous - rocks formed by solidification from a molten state; pyrogenic
Inclusion - a solid, liquid, or gaseous foreign body enclosed in a mineral or rock.
Indurated - hardened soil that has been changed by extreme climate
Laminated - a soil deposit divided into thin layers
Lateritic - pertaining to red residual soil in humid tropical and subtropical regions that is leached of soluble minerals, aluminum hydroxides, and silica but still contains concentrations of iron oxides and iron hydroxides.
Lenticular - lens-shaped grains of soil or rock
Lignitic - pertaining to soft, brownish-black coal in which the alteration of vegetable matter has proceeded further than in peat but not as far as in bituminous coal; also called *brown coal*
Marl - a loose and crumbling earthy deposit consisting mainly of calcite or dolomite; used as a fertilizer for soils deficient in lime
Metamorphic - rocks changed in structure or composition as a result of metamorphism caused by chemical reaction or heat and pressure
Micaceous - containing mica; any of a group of chemically and physically related aluminum silicate minerals, common in igneous and metamorphic rocks, characteristically splitting into flexible sheets used in insulation and electrical equipment
Montmorillonitic - clays that are comprised mostly of montmorillonite; one of the three types of clay soil grains (illite, kaolinite, and montmorillonite)
Morphology - refers to the geological characteristics, configuration, and evolution of rocks and landforms
Porous - admitting the passage of gas or liquid through pores or interstices
Pyrite - a brass-colored mineral occurring widely and used as an iron ore and in producing sulfur dioxide for sulfuric acid; also called *fool's gold*
Scarp - a long steep slope or cliff at the edge of a plateau or ridge; usually formed by erosion
Siliceous - containing, resembling, relating to, or consisting of silica; a white or colorless crystalline compound occurring abundantly as quartz, sand, flint, agate, and many other minerals and used to manufacture a wide variety of materials, especially glass and concrete
Surficial - of, relating to, or occurring on or near the surface of the earth
Tuffaceous - comprising rocks made of compacted volcanic ash varying in size from fine sand to coarse gravel; also called *tufa*