BURGE ENGINEERING
& ASSOCIATES, INC.

REPORT OF

PAVEMENT DESIGN

SADDLE RIDGE ESTATES SUBDIVISION
IH-35 FRONTAGE ROAD
LYTLE, TEXAS
BEA PROJECT NO. 12-18-0097

FOR

BRAVO COMMERCIAL REALTY
806 LONDON STREET
CASTROVILLE, TEXAS 78009

MAY 30, 2018

BURGE ENGINEERING & ASSOCIATES, INC.
Geotechnical Engineering • Environmental • Testing

May 30, 2018

Mr. Willie Kempf
Bravo Commercial Realty
806 London Street
Castroville, Texas 78009

RE: Pavement Design
Saddle Ridge Estates Subdivision
IH-35 Frontage Road
Lytle, Texas
BEA Project No. 12-18-0097

Dear Mr. Kempf:

Burge Engineering & Associates, Inc. (BEA) has completed the subsurface exploration and geotechnical engineering analysis for the above referenced project, in accordance with Proposal No. P12-18-086, dated April 17, 2018. 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 program, 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 construction 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, INC.
Texas Registered Engineering Firm F-7740
Geotechnical Engineering Services

5/30/18

STATE OF TEXAS
ROBERT WILLIAM BURGE, JR.
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TABLE OF CONTENTS

PROJECT OVERVIEW

Project Location

This report presents the results of our subsurface exploration and engineering analysis for the proposed construction of Saddle Ridge Estates Subdivision located off of the IH-35 Frontage Road in Lytle, 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 our site visits to the project site and on the soil samples gathered from 20 borings (B-1 through B-3 and B-5 through B-21) performed by Allstar Drilling on May 14 through 18, 2018. Boring B-4 was not drilled due to it being inaccessible for the truck-mounted drill rig. The borings were drilled within the proposed street alignments and extended to termination depths ranging from seven (7) to ten (10) feet below the existing ground surface elevations. In addition to the boreholes, two (2) bulk samples of the predominant subgrade material were obtained for California Bearing Ratio (CBR) testing.

Proposed Construction

Based on information provided to us, the project will include the construction of the roadways and installation of primary utilities for the approximate 90-acre residential development. The roadways are approximately 15,145 lineal feet and provide access to 315 residential lots; therefore, we anticipate that there are *Minor Streets* and possibly a *Collector Street* or *Secondary Street* for the main entrance. In addition to the roadways, an existing pond in the property will need to be re-constructed and three (3) new ponds are currently proposed.

The *Boring Location Plan* was developed from the *Preliminary Land Plan Version 2,* prepared by Red Oak Engineering, dated November 2017. The elevations are noted on the boring logs. The borings were located in the field based on the existing improvements identified on the above-referenced drawing.

Purposes of Exploration

The purposes of this study were to explore the subsurface soil and groundwater conditions at the site and to develop engineering recommendations to guide design and construction of the proposed streets. We accomplished these purposes by:

1. reviewing available geologic and soil survey maps of the project area,
2. drilling 20 boreholes to explore the subsurface soil and groundwater conditions,

3. performing laboratory tests on selected representative soil samples from the borings and two bulk composite samples to evaluate pertinent engineering properties, and
4. analyzing the field and laboratory data to develop appropriate engineering recommendations.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

The soil borings conducted as part of BEA's field exploration program were performed with a standard, truck-mounted drill rig, which utilized continuous, solid-stem flight augers to advance the boreholes. No drilling fluid was utilized during drilling operations. Upon completion of the borings, the boreholes were backfilled with spoils generated during the drilling process and the excess spoils were mounded over the boreholes.

Representative samples of the subsurface soil were obtained employing split-spoon sampling procedures in general accordance with ASTM D-1586. The split-spoon sampling procedure collects relatively disturbed samples were obtained at selected depths in the borings 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.

An engineering technician maintained field logs of the soil and groundwater conditions encountered in the borings. After recovery, each sample was removed from the sampler and visually classified. Representative portions of each sample were then placed into plastic bags that were sealed and delivered to our laboratory for further visual examination and testing.

Laboratory Testing Program

Representative soil 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, percent passing the No. 200 Sieve, Atterberg Limits, soluble sulfate analyses, and California Bearing Ratio (CBR) 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 or as separate attachments 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 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 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

The existing property is undeveloped and vegetated with native grasses, brush, and trees. The property is mostly overgrown with brush or heavily wooded. The property is used for ranching purposes with livestock. Most of the boring locations had to be cleared with a backhoe to provide access for the truck-mounted drill rig. Drainage across the property ranged from poor to fair. There is an existing pond within one of the proposed street alignments that will be backfilled during development. The surrounding properties included a combination of commercial development, agricultural, and undeveloped property.

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 Wilcox Group, Ewi. This Tertiary Age Formation consists mostly of mudstone with varying amounts of sandstone and lignite. Material is commonly glauconitic in the uppermost and lowermost parts. Mudstone is massive to thin-bedded, some silt and very fine sand laminae, pale brown to yellowish brown in upper part, and medium to dark gray in lower part. Sandstone in upper part is medium to fine-grained and light gray to pale yellowish brown, while lower part is fine-grained and yellowish brown to brown. Lignite is mostly found in middle part. Thickness is about 440 to 1,200 feet.

The Soil Survey of Atascosa County, Texas published by the United States Department of Agriculture, National Cooperative Soil Survey, indicates that the shallow soils in the general vicinity of the roadway alignments are classified as a combination of Amphion Sandy Clay Loam, 0 to 1 percent slopes (#2); Floresville Fine Sandy Loam, 1 to 3 percent slopes (#14); Poth Loamy Fine Sand, 0 to 3 percent slopes (#37); and Webb Fine Sandy Loam, 1 to 3 percent slopes (#42).

- Amphion Sandy Clay Loam, 0 to 1 percent slopes – This is a deep, well-drained, nearly level soil on uplands. Typically, the surface layer is dark gray sandy clay loam about 12 inches thick. The subsoil, to a depth of 18 inches, is dark gray sandy clay. To a depth of 37 inches, it is dark grayish brown and grayish brown sandy clay. To a depth of 80 inches, it is brown sandy clay. Runoff is slow and permeability is moderately slow. The available water capacity is high. Water erosion is a slight hazard.

- Floresville Fine Sandy Loam, 1 to 3 percent slopes – This is a deep, well-drained, gently sloping soil on uplands. Typically, the surface layer is reddish brown fine sandy loam about 11 inches thick. The subsoil is red and yellowish red clay about 22 inches thick. The substratum is reddish yellow sandy clay loam that has a few masses of lime to a

depth of 62 inches. Runoff is medium and permeability is slow. The available water capacity is medium. Water erosion is a moderate hazard.

- Poth Loamy Fine Sand, 0 to 3 percent slopes – This is a deep, well-drained, nearly level to gently sloping soil on uplands. Typically, the surface layer is loamy fine sand about 30 inches thick. It is brown in the upper part and very pale brown in the lower part. The subsoil, to a depth of 55 inches, is yellowish brown and strong brown sandy clay loam. The substratum is hard and brittle sandstone. Runoff is slow and permeability is slow. Water moves rapidly into the surface layer and slowly through the subsoil. The available water capacity is medium.

- Webb Fine Sandy Loam, 1 to 3 percent slopes – This is a deep, well drained, gently sloping soil on uplands. Typically, the surface layer is reddish brown fine sandy loam about 12 inches thick. The subsoil, to a depth of 17 inches, is yellowish red sandy clay. To a depth of 56 inches, it is yellowish red to reddish yellow sandy clay loam. To a depth of 72 inches, it is calcareous reddish yellow fine sandy loam. The layer below that is calcareous brownish yellow fine sandy loam to a depth of 80 inches. Runoff is medium and permeability is moderately slow. The available water capacity is high. Water erosion is a moderate hazard.

Soil Conditions

The natural, near surface deposits, which were studied by our field exploration program, are generally consistent with the local soil survey and regional geology. Based on our observations at the time of our field study, the stratigraphy of the subsurface materials at this site generally consisted of sandy soils overlying clayey soils.

The subsurface soil was variable at each boring location. There were different soil classifications for each soil layer at each of the 20 boring locations. As such, we did not identify any common stratums for the boring locations. The soil classifications encountered in the borings generally had ranged from firm to hard, brown, reddish brown, reddish tan, pale brown to dark brown, tan, or tan and light gray LEAN CLAY (CL), SANDY LEAN CLAY (CL), SILTY CLAY with sand (CL-ML), and FAT CLAY (CH) to very loose to dense, CLAYEY SAND (SC) or SILTY SAND (SM) with some calcareous deposits and gravel in some samples. Auger refusal at borings B-6 and B-15 was encountered at seven (7) feet due to very hard soils. The various soils had Liquid Limits ranging from 22 to 68 with Plasticity Indices ranging from 7 to 48. Representative samples collected from the sandy soils had 20 to 41 percent, by dry weight, passing the Number 200 Sieve.

Groundwater Observations

Groundwater was not encountered during drilling operations. Observations for groundwater were made during sampling and upon completion of the drilling operations. During the drilling operations, water is not introduced into the boreholes, and the groundwater position can often be determined by observing water flowing into or out of the borings. Furthermore, visual

observation of the soil samples retrieved during the 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.

ANALYSIS AND RECOMMENDATIONS

The following recommendations are based on the 20 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.

It should be noted that it has been our experience that pavements constructed on expansive sites experience cracking due to the expansive clay soils encountered in this area. Expansive soils were generally encountered below two feet of the existing ground surface across the property. As such, longitudinal cracking should be expected with these pavements regardless of the pavement section thicknesses installed. Furthermore, it should be noted that the streets are not designed for construction traffic.

Pavement Design

The streets for this subdivision have been designed in accordance with the City of Lytle *Subdivision II. – Design Standards, Section 136.* Our pavement analysis was generally based on the design procedure developed by AASHTO's *Guide for Design of Pavement Structures*, 1993. Based on the site location and proposed use, we utilized an effective pavement life of 20 years. Also, as part of our scope of service, two CBR (California Bearing Ratio) tests were performed. The results are as follows:

CBR No.	CBR Sample Location	CBR Sample Depth	CBR Value (%)	CBR Design Value (%)
CBR-1	B-6	0 to 2 feet	5.7 %	4.0 %
CBR-2	B-16, B-18, & B-19*	0 to 2 feet	6.3 %	4.0 %

* This CBR sample was a composite sample collected from B-16, B-18, and B-19.

As noted in the above table, a CBR design value of 4.0 percent for the near surface soils is being used for our pavement design. BEA designed the proposed streets based on a combination of our laboratory results, the CBR laboratory results, our experience with pavement designs in similar geology, the design guidelines set forth by AASHTO, and the design parameters outlined by City of Lytle. Since BEA was not provided with street classifications or traffic loading, we made the following assumptions and are providing an option for a *Minor Street*, *Collector Street*, and *Secondary Street*.

The following design parameters and criteria were considered in our analyses for the proposed streets:

- Resilient Modulus: 6,000 psi
- Reliability: 70 percent for Minor & Collector Streets, 90 percent for Secondary Streets
- Overall Standard Deviation: 0.45 for flexible pavement
- Initial Serviceability: 4.2 for flexible pavement
- Terminal Serviceability: 2.0 for Minor & Collector Streets, 2.5 percent for Secondary Streets

Minor Street

The pavement section detailed in this report assumes the pavements are maintained on a regular basis. A design structural number of 2.00 was calculated using the stated design criteria for a Minor Street. The following table presents a pavement section for a Minor Street:

Pavement Material	**Thickness, (in)**
Type D, Hot Mix Asphaltic Concrete	2
Crushed Limestone Base Material	8
Compacted Subgrade	6
18-Kip ESAL's	**50,000**
Structural Number (SN)	**2.00**

Collector Street

The pavement section detailed in this report assumes the pavements are maintained on a regular basis. A design structural number of 2.28 was calculated using the stated design criteria for a Collector Street. The following table presents a pavement section for a Collector Street:

Pavement Material	**Thickness, (in)**
Type D, Hot Mix Asphaltic Concrete	2
Crushed Limestone Base Material	10
Compacted Subgrade	6
18-Kip ESAL's	**113,000**
Structural Number (SN)	**2.28**

Secondary Street

The pavement section detailed in this report assumes the pavements are maintained on a regular basis. A design structural number of 3.00 was calculated using the stated design criteria for a Secondary Street. The following table presents a pavement section for a Secondary Street:

Pavement Material	**Thickness, (in)**
Type D, Hot Mix Asphaltic Concrete	3
Crushed Limestone Base Material	12
Compacted Subgrade	6
18-Kip ESAL's	**245,000**
Structural Number (SN)	**3.00**

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

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 1993 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. The asphalt cement content by percent of total mixture weight should fall within a tolerance of ± 0.3 percent asphalt cement from the specific mix design and should be compacted to between 92 and 97 percent of the maximum theoretical density as determined in accordance with ASTM D 2041. 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 1or 2, Type A. The base should be compacted to a minimum of 95 percent of the maximum dry density as determined by the moisture-density relationship in accordance with ASTM D1557, Modified Proctor or TEX-113-E at -2 to +3 percentage points of optimum moisture content.

Compacted Subgrade - The subgrade should be moisture conditioned between minus two (-2) and plus three (+3) percentage points above optimum moisture content and compacted to at least 95 percent of the maximum dry density as determined in accordance with TEX-114-E.

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.

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. In addition, any existing trees or landscaping along the pavement shoulder will affect the moisture levels of the clay subgrade soils. Water moisture fluctuations usually results in degradation of the pavement section with time, especially where vehicular traffic traverses areas of moisture infiltration. In addition, any concrete curb and gutter installed will be affected by these moisture fluctuations.

Where curbs are needed, we suggest the curbs extend through the base and at least six (6) inches into the subgrade. Although not required, this will help reduce migration of groundwater into the pavement base course from adjacent areas. 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.

Soluble sulfate testing was conducted on three subgrade samples along the proposed street alignment. The results are as follows:

Sample Location / Depth	Soluble Sulfates
B-3 / 0-1.5 feet	190 mg/Kg
B-7 / 0-1.5 feet	262 mg/Kg
CBR-2 Composite	74.2 mg/Kg

These soluble sulfate tests were performed in the event that subgrade is lime treated. Based on the National Lime Association's *Lime-Treated Soil Construction Manual* (January 2004), sulfate concentrations less than 3,000 ppm are unlikely to cause problems when soils are stabilized with lime. Although lime-stabilization is a viable alternative for the existing subgrade soils, it is not deemed necessary given the low plasticity indices of the soils that will be the predominant subgrade materials.

Subgrade Preparation and Earthwork Operations

If the street alignments require to be raised for grading purposes, then the general fill material shall be placed in maximum six (6) inch thick compacted lifts, moisture conditioned between minus two (-2) and plus three (+3) percentage points of optimum moisture content and compacted to at least 95 percent of the maximum dry density in accordance with TEX-114-E or ASTM D698. Similarly, for fill placed on any lots, including backfill material placed in the existing pond, the fill material shall be placed in maximum six (6) inch thick compacted lifts, moisture conditioned between minus two (-2) and plus three (+3) percentage points of optimum moisture content and compacted to at least 95 percent of the maximum dry density in accordance with ASTM D698. Each lift shall be tested for moisture content and in-place density prior to placing additional lifts of fill material. The over-excavated subgrade shall be tested for in-place density with a nuclear gauge at a frequency of at least one test per 100 linear feet.

Following approval of the subgrade, the base material should be placed up to the required elevations. The base material should be placed in six (6) inch maximum thick lifts. The base material should be moisture conditioned between -2 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 D1557, Modified Proctor Method or TEX-113-E. One nuclear density test should be performed every 100 linear feet, or a minimum of three (3) nuclear density tests per lift, whichever results in more tests.

When placing the base material, care should be taken to avoid water ponding in the base 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 base material.

Detention Pond Recommendations

It should be noted that there is an existing pond located between Borings B-3 and B-5 that will be re-constructed during development of the subdivision. Based on our review of the existing topography that was provided to us by our client, there appears to be significant grade change in the area of the existing pond (>> 30 feet). Due to the lack of details regarding the pond, we are only providing general recommendations at this time. We can provide additional information once more details come available. Side slopes should not exceed 3H:1V, unless otherwise approved. We anticipate that the majority of the on-site soils below the top two feet should be suitable as a clay liner. Verification testing would be required of any import or on-site soils utilized as a clay liner, if required.

Any general fill placed for grading purposes should be placed in lifts not exceeding eight (8) inches in loose thickness, moisture conditioned and compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D698, Standard Proctor Method. Coarse-grained soils (SC, GC, or more granular) should be moisture conditioned to between -2 and +3 percentage points of optimum moisture content and fine-grained soils (CH, CL, ML, or MH) should be moisture conditioned between 0 and +4 percentage points above optimum moisture content. General fill should be free of debris and have a maximum particle size of three (3) inches. One nuclear density test should be performed for each 5,000 square feet, or a minimum of three (3) nuclear density tests per lift, whichever results in more tests.

If a clay liner is required, we recommend that a minimum of 12 inches of suitable clay where soil is the exposed subgrade. The clay liner should consist of material having a coefficient of permeability of $1.0x10^{-7}$ cm/sec or less, PI greater than or equal to 20, liquid limit greater than 35, greater than 50% passing the #200 Sieve, and a maximum particle size of one (1) inch. This material should be placed in lifts not exceeding eight (8) inches in loose thickness, moisture conditioned to between 0 and +4 percentage points of the optimum moisture content, and compacted with a sheepsfoot roller to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D698, Standard Proctor Method. In order to protect the liner from erosion and moisture loss during the course of construction, we suggest that a minimum of 12 inches of general fill material, including 4 inches of topsoil, be placed over the completed liner. This protective soil layer may consist of either on-site or import fill materials, provided the material is free of debris and has a maximum particle size of three (3) inches.

Penetrations of the clay liner, if required, should be properly constructed in order to prevent leakage. Due to the inability to properly compact around the bottom half of any pipes, we suggest that either a flowable fill be utilized to fill these areas or anti-seep collars be installed. If necessary, BEA could review the grading plan, details, and cross-sections of the detention pond once completed, in order to provide further recommendations concerning the design and construction of the detention pond.

Utility Trench Recommendations

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 differential settlement is minimized. 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.

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 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.

Construction Considerations

Cracking, particularly longitudinal cracking within one (1) to six (6) feet of the pavement edges, should be expected of any pavements constructed on this site. The cracking occurs as the moderately expansive soils adjacent to and below the pavements shrink and swell with seasonal moisture fluctuations. However, this type of longitudinal cracking can also occur at distances further from the curb lines as well. Therefore, proper maintenance, including sealing all cracks on a timely manner, should be conducted throughout the life of these pavements.

The surface soils in on this property are moisture sensitive, and so any uncontrolled surface flow across the site could result in undesired infiltration and future difficulties with swell. For this reason, it is strongly urged that fill operations be performed in such a manner as to enhance natural water flow and control erosion.

In a dry and undisturbed state, the surficial soil at the site will provide sufficient subgrade support for fill placement and construction operations. However, when wet, these soils will degrade quickly with disturbance from contractor operations. Therefore, good site drainage should be maintained during earthwork operations which will help maintain the integrity of the soil.

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 changes 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 borings performed at the locations indicated in the *Boring Location Plan*, and from other information described in this report. This report does not reflect any variations that may occur between the 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 conditions exist on most sites between the 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 (Figure 1)

Boring Location Plan (Figure 2)

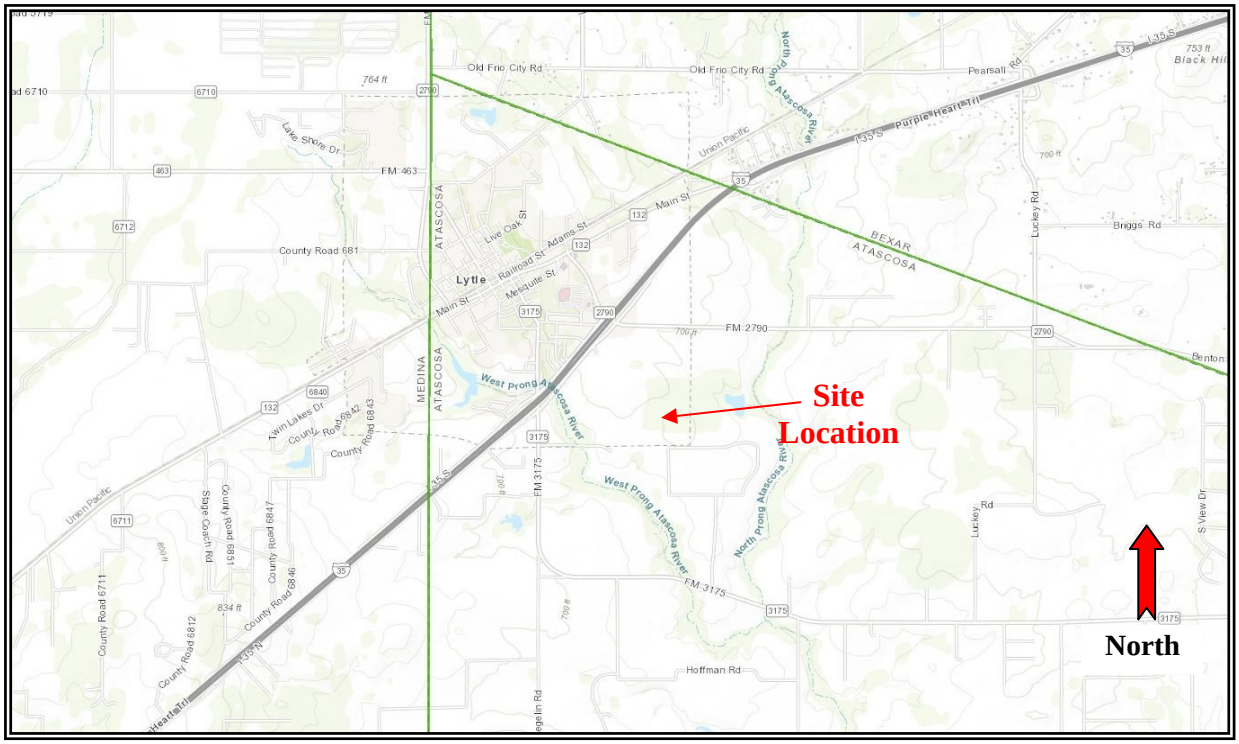
Boring Logs (B-1 through B-3 and B-5 through B-21)

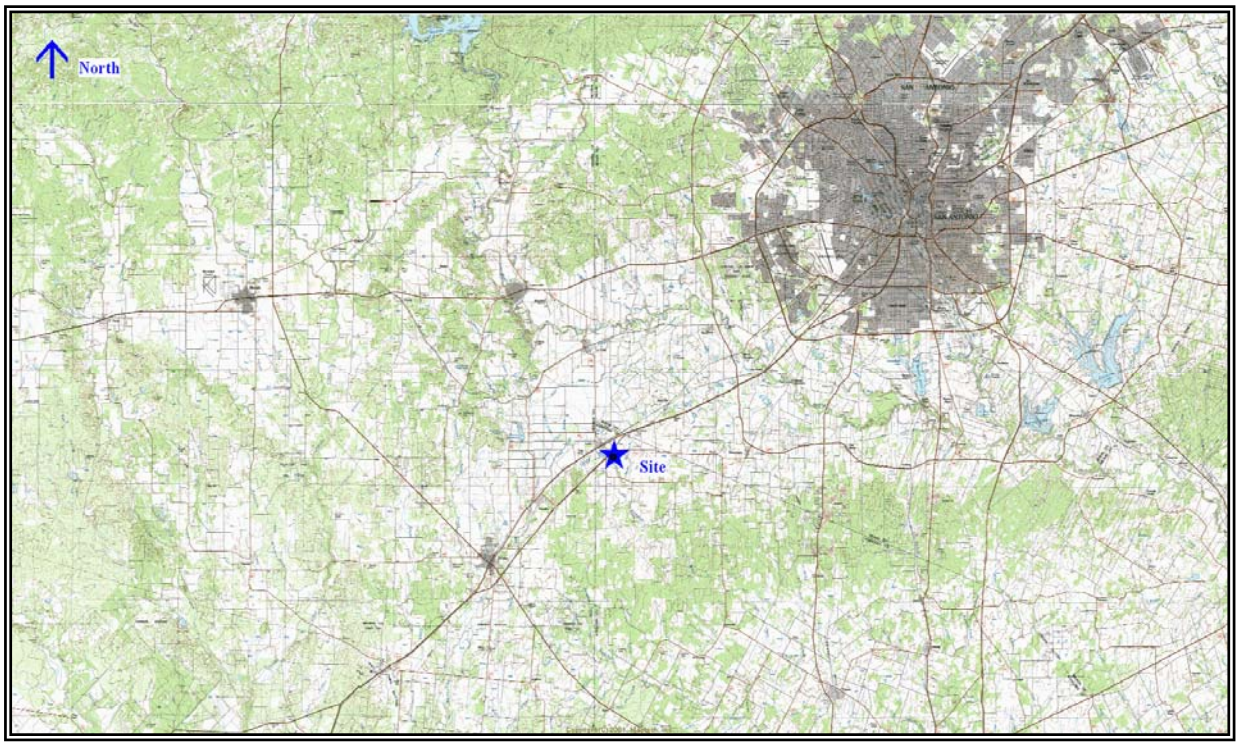
Soil Classification Chart

CBR Graphs

Soluble Sulfate Analytical Report

Laboratory and Field Test Procedures





Pavement Design Study
Saddle Ridge Estates Subdivision
IH-35 Frontage Road
Lytle, Texas
BEA Project No. 12-18-0097

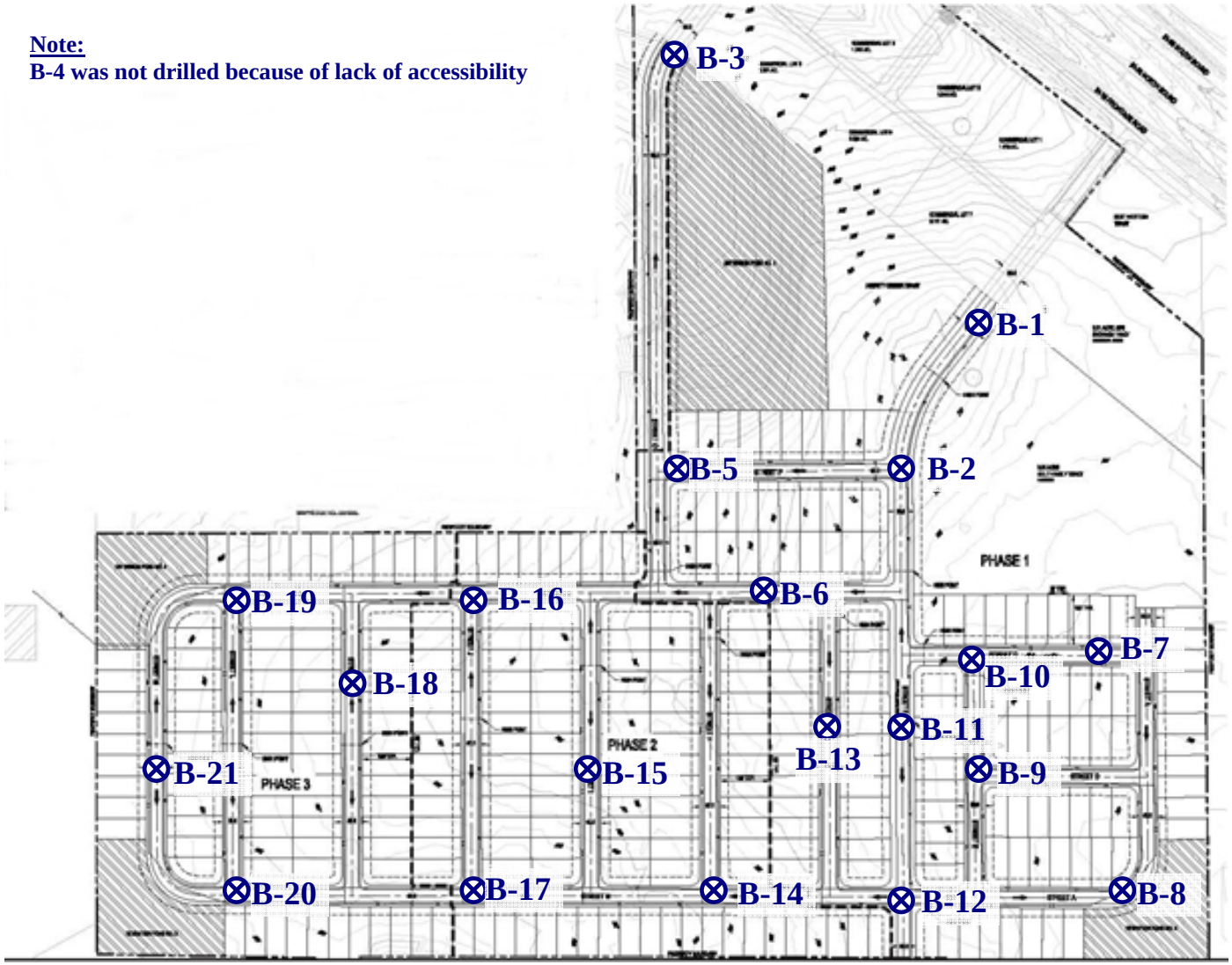
BURGE ENGINEERING & ASSOCIATES, INC.

FIGURE 1

SITE VICINITY MAP

North

Note:
B-4 was not drilled because of lack of accessibility



Pavement Design Study
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Lytle, Texas
BEA Project No. 12-18-0097

BURGE ENGINEERING & ASSOCIATES, INC.

FIGURE 2

BORING LOCATION PLAN

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

BORING NUMBER B-01

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/15/18 **COMPLETED** 5/15/18
GROUND ELEVATION 713.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Medium dense, brown CLAYEY SAND (SC)	SS 1		4-6-5 (11)			10	27	17	10	
2.5		Very stiff, reddish brown SANDY LEAN CLAY (CL)	SS 2		5-7-9 (16)			8				
5.0			SS 3		6-11-12 (23)			5				
		- grades to reddish tan clay with sand below 6 feet										
7.5			SS 4		8-13-12 (25)			11				
			SS 5		7-8-10 (18)			9				
10.0		Bottom of hole at 10.0 feet.										

Burge Engineering & Associates, Inc.
3453 North Pan Am Expressway, Suite 201
San Antonio, Texas 78219
Telephone: 210-646-8566
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BORING NUMBER B-02

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/16/18 **COMPLETED** 5/16/18
GROUND ELEVATION 712.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Medium dense, brown CLAYEY SAND (SC)	SS 1		2-6-8 (14)			3				21
2.5		Stiff to very stiff, reddish tan LEAN CLAY (CL) with sand	SS 2		5-7-8 (15)			9	41	18	23	
5.0			SS 3		6-8-10 (18)			10				
		- decrease in sand content below 6 feet										
7.5			SS 4		9-14-13 (27)			8				
			SS 5		7-7-10 (17)			15				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-03

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/18/18 **COMPLETED** 5/18/18
GROUND ELEVATION 684 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Medium dense, brown CLAYEY SAND (SC)	SS 1		3-7-7 (14)			4	25	16	9	41
2.5		Stiff, brown LEAN CLAY (CL)	SS 2		3-7-8 (15)			13				
5.0		- seam of very stiff, tan calcareous LEAN CLAY (CL) with some gravel from 4 to 6 feet	SS 3		5-8-9 (17)			7	46	15	31	
7.5		Very stiff to hard, tan SANDY LEAN CLAY (CL)	SS 4		6-10-15 (25)			10	49	14	35	
			SS 5		8-16-19 (35)			12				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-05

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/15/18 **COMPLETED** 5/15/18
GROUND ELEVATION 703 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Loose, brown SILTY SAND (SM)	SS 1		2-3-7 (10)			3				20
2.5		Very stiff to hard, reddish tan SANDY LEAN CLAY (CL)	SS 2		4-9-11 (20)			10				
5.0			SS 3		7-10-13 (23)			8				
		- grades to tan and light gray in color below 6 feet	SS 4		9-14-20 (34)			9				
7.5		Hard, tan and light gray FAT CLAY (CH)	SS 5		10-15-30 (45)			22				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-06

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/18/18 **COMPLETED** 5/18/18
GROUND ELEVATION 709.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Loose, brown SILTY SAND (SM)	SS 1		2-4-6 (10)			4				21
2.5		Stiff to hard, tan and light gray FAT CLAY (CH)	SS 2		4-6-9 (15)			13	68	20	48	
		- with calcareous deposits from 4 to 6 feet										
5.0			SS 3		6-10-50/4"			12				
		- becomes very hard below 5.5 feet										
		- auger refusal at 7 feet	AU 4					9				
		Bottom of hole at 7.0 feet.										

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BORING NUMBER B-07

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/14/18 **COMPLETED** 5/14/18
GROUND ELEVATION 703 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Loose, brown CLAYEY SAND (SC)	SS 1		4-4-5 (9)			19	24	13	11	
2.5		Very stiff to hard, brown to reddish tan FAT CLAY (CH) with calcareous deposits	SS 2		6-7-13 (20)			15				
		- grades to tan and light gray in color below 4 feet										
5.0			SS 3		6-9-13 (22)			15				
7.5			SS 4		10-17-17 (34)			13				
			SS 5		7-14-20 (34)			15				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-08

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/14/18 **COMPLETED** 5/14/18
GROUND ELEVATION 703 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Firm, brown SANDY LEAN CLAY (CL)	SS 1		2-2-4 (6)			13	37	14	23	
2.5		Stiff, reddish tan LEAN CLAY (CL)	SS 2		3-4-7 (11)			15				
		- with some sand and trace calcareous deposits from 4 to 6 feet										
5.0			SS 3		4-6-10 (16)			11				
		Very stiff to hard, tan and light gray FAT CLAY (CH) with calcareous deposits										
7.5			SS 4		5-12-17 (29)			9				
			SS 5		8-15-25 (40)			13				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-09

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/16/18 **COMPLETED** 5/16/18
GROUND ELEVATION 705 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Stiff, brown SILTY CLAY with sand (CL-ML)	SS 1		2-5-5 (10)			6	22	15	7	
2.5		Very stiff, tan and light gray LEAN CLAY (CL) with trace sand	SS 2		4-7-10 (17)			12				
		- with calcareous deposits from 4 to 6 feet										
5.0			SS 3		6-9-14 (23)			15				
		- increace in sand content from 6 to 8 feet										
7.5			SS 4		13-11-10 (21)			11				
		Dense, tan CLAYEY SAND (SC) with some gravel										
			SS 5		12-17-16 (33)			5				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-10

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/14/18 **COMPLETED** 5/14/18
GROUND ELEVATION 705.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Stiff, dark brown SANDY LEAN CLAY (CL)	SS 1		4-4-5 (9)			8	23	15	8	
2.5		Very stiff, brown FAT CLAY (CH)	SS 2		4-9-12 (21)			15				
		- grades to reddish brown in color and trace calcareous deposits from 4 to 6 feet										
5.0			SS 3		7-11-15 (26)			15				
		Very stiff, tan LEAN CLAY (CL) with trace sand and calcareous deposits	SS 4		6-10-13 (23)			12				
7.5		- increase in sand content below 8 feet										
			SS 5		7-11-13 (24)			8				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-11

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/15/18 **COMPLETED** 5/15/18
GROUND ELEVATION 710.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Medium dense, brown CLAYEY SAND (SC)	SS 1		4-6-7 (13)			16	26	14	12	
2.5		Very stiff, reddish tan FAT CLAY (CH), trace sand	SS 2		5-9-11 (20)			12				
5.0			SS 3		7-12-12 (24)			13				
		- grades to tan and light gray in color from 6 to 8 feet	SS 4		6-10-16 (26)			14				
7.5		Dense, tan SILTY SAND (SM)	SS 5		9-20-17 (37)			3				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-12

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/16/18 **COMPLETED** 5/16/18
GROUND ELEVATION 708 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Medium dense, brown SILTY SAND (SM)	SS 1		4-11-12 (23)			2				21
2.5		Stiff to very stiff, reddish tan and light gray FAT CLAY (CH)	SS 2		4-5-9 (14)			18	61	17	44	
5.0			SS 3		5-9-16 (25)			12				
7.5			SS 4		2-10-14 (24)			11				
		Very loose, brown CLAYEY SAND (SC)	SS 5		1-2-2 (4)			10				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-13

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/16/18 **COMPLETED** 5/16/18
GROUND ELEVATION 707 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Medium dense, brown SILTY SAND (SM)	SS 1		2-5-8 (13)			2				20
2.5		Very stiff, reddish tan FAT CLAY (CH)	SS 2		7-8-11 (19)			13	55	19	36	
		- with trace sand below 4 feet	SS 3		8-13-15 (28)			9				
5.0			SS 4		5-12-14 (26)			7				
7.5		Very stiff, tan SANDY LEAN CLAY (CL) with calcareous deposits	SS 5		7-13-15 (28)			15				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-14

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/15/18 **COMPLETED** 5/15/18
GROUND ELEVATION 701 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Loose, brown SILTY SAND (SM)	SS 1		2-5-5 (10)			3				21
2.5		Stiff to very stiff, tan and light gray FAT CLAY (CH)	SS 2		6-6-9 (15)			12				
		- becomes reddish tan in color from 4 to 6 feet										
5.0			SS 3		6-8-13 (21)			13				
		Very stiff, reddish tan LEAN CLAY (CL) with some sand	SS 4		5-8-8 (16)			8				
7.5		Medium dense, tan CLAYEY SAND (SC)	SS 5		2-5-10 (15)			8				
10.0		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-15

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/16/18 **COMPLETED** 5/16/18
GROUND ELEVATION 701 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Firm, brown LEAN CLAY (CL) with sand	SS 1		2-3-4 (7)			9	25	15	10	
2.5		Stiff to hard, reddish tan and light gray FAT CLAY (CH)	SS 2		4-6-8 (14)			13				
5.0			SS 3		6-9-15 (24)			13				
		- becomes very hard below 6 feet										
		- auger refusal at 7 feet	AU 4					9				
		Bottom of hole at 7.0 feet.										

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BORING NUMBER B-16

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/14/18 **COMPLETED** 5/14/18
GROUND ELEVATION 698 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Medium dense, reddish brown CLAYEY SAND (SC)	SS 1		4-4-7 (11)			10	40	15	25	
2.5		Very stiff to hard, reddish tan FAT CLAY (CH)	SS 2		6-8-11 (19)			11				
		- grades to tan in color with calcareous nodules below 4 feet										
5.0			SS 3		6-9-11 (20)			9				
7.5			SS 4		8-17-23 (40)			11				
		- fissured below 8 feet										
10.0			SS 5		8-15-25 (40)			11				
		Bottom of hole at 10.0 feet.										

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BORING NUMBER B-17

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/15/18 **COMPLETED** 5/15/18
GROUND ELEVATION 695 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Stiff, brown SANDY LEAN CLAY (CL)	SS 1		4-5-6 (11)			5	27	16	11	
2.5		Very stiff, pale brown FAT CLAY (CH)	SS 2		4-7-10 (17)			12				
		- with trace calcareous deposits from 4 to 6 feet										
5.0			SS 3		7-11-14 (25)			11				
		Dense, tan CLAYEY SAND (SC)										
7.5			SS 4		13-16-22 (38)			5				
			SS 5		10-16-30 (46)			4				
10.0		Bottom of hole at 10.0 feet.										

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

BORING NUMBER B-18

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/14/18 **COMPLETED** 5/14/18
GROUND ELEVATION 698 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Stiff, brown SANDY LEAN CLAY (CL)	SS 1		2-4-4 (8)			13	45	16	29	
2.5		Very stiff to hard, pale brown FAT CLAY (CH) with calcareous deposits	SS 2		5-8-11 (19)			10				
		- grades to tan in color below 4 feet										
5.0			SS 3		7-9-13 (22)			14				
7.5			SS 4		8-14-21 (35)			13				
			SS 5		9-16-21 (37)			14				
10.0		Bottom of hole at 10.0 feet.										

Burge Engineering & Associates, Inc.
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San Antonio, Texas 78219
Telephone: 210-646-8566
Fax: 210-590-7476

BORING NUMBER B-19

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/14/18 **COMPLETED** 5/14/18
GROUND ELEVATION 694 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Stiff, brown SANDY LEAN CLAY (CL)	SS 1		4-6-6 (12)			7	27	15	12	
2.5		Very stiff, reddish brown FAT CLAY (CH) - with calcaroeus deposits from 2 to 4 feet	SS 2		6-10-10 (20)			12				
		- grades to tan in color below 4 feet										
5.0			SS 3		7-9-13 (22)			8				
		Hard, tan and light gray LEAN CLAY (CL) with calcareous deposits and sand; fissured										
7.5			SS 4		9-16-19 (35)			10				
			SS 5		9-19-26 (45)			10				
10.0		Bottom of hole at 10.0 feet.										

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

BORING NUMBER B-20

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/14/18 **COMPLETED** 5/14/18
GROUND ELEVATION 693.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was 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 (%)
0.0		Stiff, brown LEAN CLAY (CL)	SS 1		4-5-6 (11)			12	45	17	28	
2.5		Very stiff to hard, reddish tan FAT CLAY (CH) with calcareous deposits	SS 2		5-8-10 (18)			11				
		- grades to tan and light gray in color below 4 feet										
5.0			SS 3		9-21-27 (48)			9				
7.5			SS 4		9-19-27 (46)			9				
			SS 5		9-17-25 (42)			11				
10.0		Bottom of hole at 10.0 feet.										

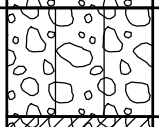
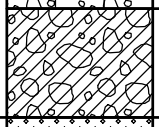
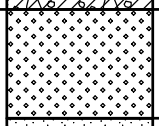
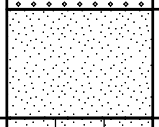
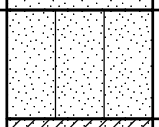
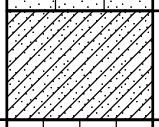
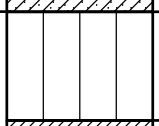
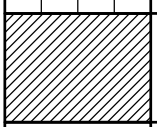
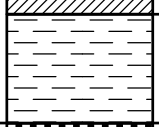
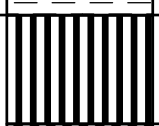
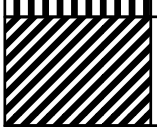
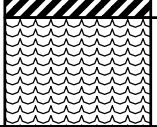
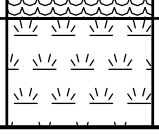
Burge Engineering & Associates, Inc.
3453 North Pan Am Expressway, Suite 201
San Antonio, Texas 78219
Telephone: 210-646-8566
Fax: 210-590-7476

BORING NUMBER B-21

CLIENT Bravo Commercial Realty
PROJECT NAME Saddle Ridge Estates Subdivision
PROJECT NUMBER 12-18-0097
PROJECT LOCATION IH-35 Frontage Road, Lytle, Texas
DATE STARTED 5/15/18 **COMPLETED** 5/15/18
GROUND ELEVATION 693 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Allstar Drilling
GROUND WATER LEVELS:
DRILLING METHOD Dry Auger
AT TIME OF DRILLING ---
LOGGED BY Angelica **CHECKED BY** R. Burge
AT END OF DRILLING ---
NOTES Groundwater was not encountered during drilling.
AFTER DRILLING ---

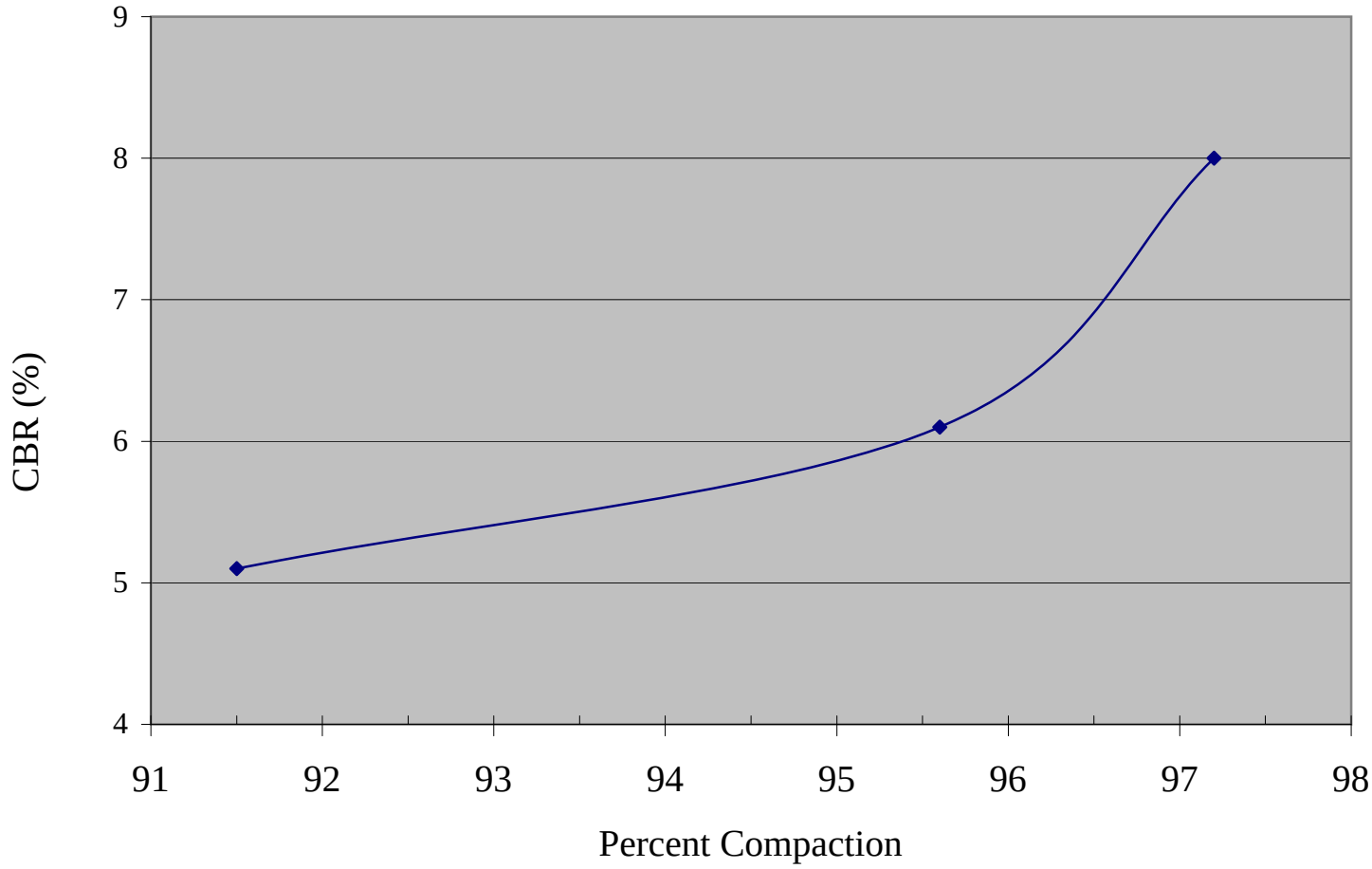
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Stiff, brown SANDY LEAN CLAY (CL)	SS 1		4-5-7 (12)			4	24	14	10	
2.5		Very stiff to hard, reddish brown FAT CLAY (CH)	SS 2		8-10-13 (23)			11				
		- grades to tan in color below 4 feet - with calcareous deposits from 4 to 8 feet										
5.0			SS 3		6-10-14 (24)			12				
7.5			SS 4		11-20-25 (45)			10				
		- grades to tan and light gray in color below 8 feet										
10.0			SS 5		10-19-27 (46)			10				
		Bottom of hole at 10.0 feet.										

SOIL CLASSIFICATION CHART

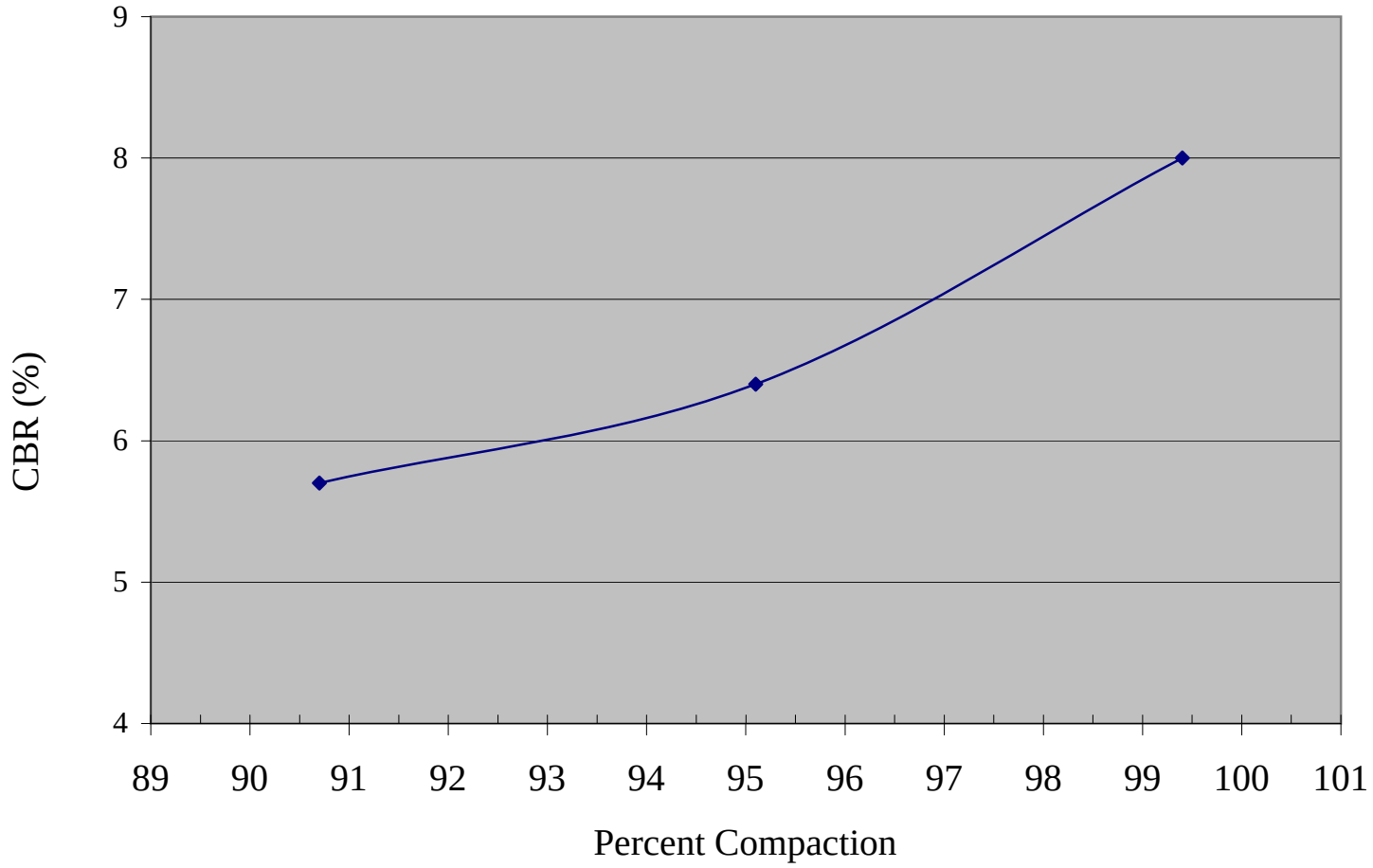
MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND 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

CBR Curve - 1
Saddle Ridge Estates Subdivison



CBR Curve - 2
Saddle Ridge Estates Subdivison



ALAMO ANALYTICAL LABORATORIES, LTD.
Main: 10526 Gulfdale • San Antonio, Texas 78216-3601 • (210) 340-8121 . Fax. (210) 340-8123

REPORT NARRATIVE 5/25/2018

Benny Krieger
BMC Consulting
3453 N PanAm Expressway
Ste 201
San Antonio , TX - 78219
TEL: (210) 646-8566 Email: Benny@burgemartinez.com
FAX: (210) 590-7476

RE: 12-18-0097 Saddle Ridge Estates

Dear Benny Krieger: Order No.: 1805151

Enclosed please find the analytical report for the sample/s received on 5/18/2018.

HOLDING TIMES: All samples were within prescribed holding times. The samples were analyzed in accordance with the Sample Acceptance Policy unless otherwise noted in the report.

QA/QC: All method blanks, laboratory spikes, and/or matrix spikes met quality assurance objectives, except as noted in the report with data qualifiers.

SUBCONTRACTED: No analyses were subcontracted.

COMMENTS: No significant observations were made.

If you have any questions regarding these test results call (210) 340-8121.

Thank you,

Reddy Gosala, Ph.D

Laboratory Director

Report of Laboratory Analysis

NELAP Certificate# San Antonio : T104704367-17-9

ALAMO ANALYTICAL LABORATORIES, LTD.

Analytical Results Report

CLIENT: BMC Consulting **Project:** 12-18-0097 Saddle Ridge Estates
Lab Order: 1805151

Alamo Lab ID	Client ID	Collection Date	Analyses	Matrix	Result	MDL	PQL	Units	DF	Qua
TestName: TEX-620-J		**TestNo:** TX620J	**Date Analyzed** 5/25/2018 9:30:00 AM				Initials: YK			
1805151-01A	B-7-2 B-7, Sample 24A	5/14/2018 2:00:00 PM	Sulfate	Soil	262	0	25	mg/Kg	1	
1805151-02A	CBR Composite	5/16/2018 9:00:00 AM	Sulfate	Soil	74.2	0	25	mg/Kg	1	
1805151-03A	B-3-2 B-3, Sample 2-4A	5/18/2018 8:00:00 AM	Sulfate	Soil	190	0	25	mg/Kg	1	

N : Non-Nelac parameter

Approved by:

Report of Laboratory Analysis

NELAP Certificate# San Antonio : T104704367-17-9

ALAMO ANALYTICAL LABORATORIES, LTD.

CLIENT: BMC Consulting
Work Order: 1805151 **Project:** 12-18-0097 Saddle Ridge Estates

QC SUMMARY REPORT

Analyte	BLK	SPK value	%REC LCS	MS	%REC MSD	RPD %	RPD Limit	Low - High Limit
Batch ID: TX620J-SO4-5/25/2018	**TestName:** TEX-620-J							
Run ID: UV1_180525A	**Test Code:** TX620J		**Units:** mg/Kg		**Analysis Date:** 5/25/2018 9:30:00 AM		**Prep Date:** 5/24/2018 4:10:00	
Sulfate	<25	250	96.0%	96.1%	99.6%	2.000	30.0	80 - 120

Approved by:

Laboratory QC Report

NELAP Certificate# San Antonio : T104704367-17-9

ALAMO ANALYTICAL LABORATORIES LTD.

CHAIN OF CUSTODY RECORD

COC#: 025017

MUST BE COMPLETED BY CLIENT

Alamo's Client: Burgé Engd Assoc	Client's P.O. #:
Project Manager: Benny Krieger	Phone #: 210-646-8566
Address: 3453 N. Pan Am Exp, Ste 201	Email: benny@burge-eng.com
Project Number: 12-18-0097	Project Name: Saddle Ridge Estates
Project Location: Cythe, TX	Sampler Signature:

Turnaround time: Standard(7) ☑ **(in working days)**

RUSH: 1☐ 2☐ 3-5☐ **Days** (additional charges)

TRRP 13 Report: Yes☐ No☐ (additional charges)

Analysis for Permit Compliance: Yes☐ No☐

DMR Form Required: Yes☐ No☐

Main Office: 10526 Gulfdale
San Antonio, Texas 78216
(210) 340-8121 • Fax (210) 340-8123

Branch: 2500 Montana Avenue
El Paso, Texas 79903
(915) 599-2182

www.alamoanalytical.com
reports@alamoanalytical.com

LAB ID# (Do not use)	Sampling Date	Sampling Time	Composite	Grab	Matrix	FIELD ID#	FIELD DESCRIPTION	No. of Containers	ANALYSIS: Tex 620J Sulfates	REMARKS (Preservation, Size/Amount, Etc.)
180515-01	5/14/18	2PM		X	Soil	B-7-2	B-7, Sample 2-4A.	1	X	
-02	5/16/18	9AM	X			CBR	CBR Composite	1	X	
-03	5/18/18	8AM		X		B-3-2	B-3, Sample 2-4A.	1	X	

	Relinquished by: (Signature / Print Name)	Date	Time	Received by: (Signature)
1	Benny Krieger	5/14/18	1550	
2				
3				
4		5/18/18	15:50	

Headspace Properly Sealed ☑ — If Yes, Amt. N/A

Chilled ≤4° C ☑ — If No, Explain

If No, Temp. 2.3°C / 2.3°C

Comments:

ALAMO ANALYTICAL LABORATORIES, LTD.

10526 Gulfdale
San Antonio, TX – 78216;
Ph. (210) 340-8121; Fax: (210) 340-8123

www.alamoanalytical.com

2500 Montana Avenue
El Paso, TX – 79903
Ph. (915) 599-2182

Sample Log-In Checklist

DATE: 05/18/18 **TIME:** 15:55 **INITIALS:** [illegible]

CLIENT: Burns Eng. (Alamo T) **PROJECT: W.O#** 1805151

1. Is a Chain of Custody present? (Yes) No
2. Is a Chain of Custody properly completed? (Yes) No
3. Are custody seals present? Yes (No)
   If yes, are they intact? Yes No
   Are they on: Sample _____ or on Shipping Container _____
4. Are all samples tagged or labeled? (Yes) No
   If yes, do the labels match the Chain of Custody? (Yes) No
5. Do all shipping documents agree (i.e., number of coolers arrived vs. on tickets)
   If not, describe below. Yes No (N/A)
6. Are samples preserved properly? *If not*, describe below. (Yes) No
7. Are all samples within holding times on arrival? (Yes) No
   If not, describe below.
8. Condition of shipping container: Intact ✓ or _____
9. Condition of samples: Intact ✓ or _____
10. Temperature of samples: Temp. (°C): 23.2 Corrected Temp. (°C): 23.2 Thermometer ID: **DT1 or L2**
11. pH strip lot#: — Samples out of pH range: _____
12. Delivery agent: Client ✓ UPS ____ Fed-Ex ____ Lone Star ____ Alamo P/U ____ Other _____
13. Sample disposal: Return to client _____ Alamo Analytical Disposal ✓

Comments: (Reference checklist item number from above, or for comments on resolution below):

_____

_____

_____

[signature]

Record of contacting client for resolution of sample discrepancies (first and retry contact)
Contacted How?

Name: _____ Phone ___ Fax ___ Date: ____/____/____ Time: _____
Name: _____ Phone ___ Fax ___ Date: ____/____/____ Time: _____

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 logs.

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 logs.

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.

Pocket Penetrometer (PP): This test method is an accepted modification of ASTM D1558 test method for establishing the moisture-penetration resistance relationships of fine-grained soils. The test results are measured in tons per square foot, tsf. The strength values provided by this method should be considered qualitatively.

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