GEOTECHNICAL ENGINEERING STUDY

BRIGGS RANCH
BEXAR COUNTY, TEXAS
PAVEMENT DESIGN

FROST GEOSCIENCES, INC. PROJECT NO.: FGS-G 21118

REVISED

NOVEMBER 23, 2021

Prepared Exclusively for:

Mr. Randall Allsup
PulteGroup
San Antonio, Texas 78259

Frost GeoSciences

Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

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Frost GeoSciences

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Revised
November 23, 2021

Mr. Randall Allsup
PulteGroup
San Antonio, Texas 78213

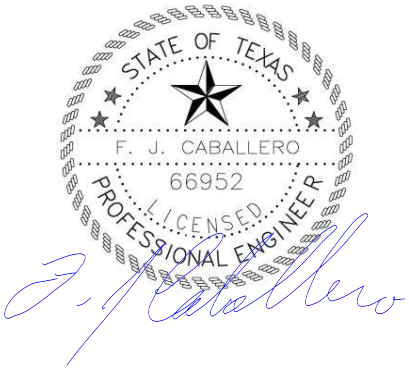
SUBJECT:
Geotechnical Engineering Services
Briggs Ranch Development
Bexar County, Texas
FGS Project No: FGS-G21118

Dear Mr. Allsup;

Frost GeoSciences, Inc. (FGS) is a geotechnical engineering company registered with the Texas Board of Professional Engineers, with registration No. F-9227, and is pleased to submit the results of our Geotechnical Engineering Study for the above referenced project. This report includes the results of field and laboratory testing along with our recommendations for use in preparation of the appropriate design and construction documents for this project.

We appreciate the opportunity to be of service to you in this phase of your project and future projects. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,
Frost GeoSciences, Inc.



F. J. Caballero, P.E.
Project Engineer

FGS-G-21118

Copies Submitted:
i. One (1) Electronic: Mr. Randall Allsup, PulteGroup, San Antonio, Texas
ii. One (1) File

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PROJECT INFORMATION

Project Authorization:

Frost GeoSciences, Inc. (FGS) has completed a geotechnical engineering study for new pavements to be constructed in the **Briggs Ranch Development, in Bexar County, Texas**. This project was authorized by Mr. Randall Allsup of PulteGroup, through acceptance of Frost GeoSciences **Proposal No.: FGS-P-G21133 dated May 24, 2021.** Our scope of services for this project is as outlined in that proposal.

Project Description:

We understand that the **Briggs Ranch Development** involves the design and construction of both **Type "A"** and **Type "B**" residential streets and **Collector** streets. The pavement section design will be in accordance with the **Bexar County Texas Pavement Design Criteria.** A Vicinity Map showing the location of the project is included in the section of this report entitled Illustrations

Purpose and Scope of Services:

The purpose of the geotechnical investigation is to evaluate the subsurface conditions at the project site and develop geotechnical engineering recommendations and guidelines for use in preparing the appropriate design and other related construction documents for this project. Therefore, our scope of services for this project include the following:

- Drill borings and excavate test pits at selected locations within the project limits to evaluate subsurface conditions and to observe the potential presence of subsurface water;
- Perform geotechnical engineering laboratory tests on selected samples recovered during our field activities to evaluate their physical and engineering properties;
- Perform Engineering analyses to develop the appropriate geotechnical engineering recommendations and guidelines, to include:
- Appropriate pavement section thickness recommendations;
- Pavement section material requirements and specifications;
- General site and subgrade preparation within the construction limits; and
- General comments regarding construction methods, sequences and potential difficulties that may arise during overall construction as it relates to the geotechnical engineering aspects of this project.

- Prepare a written report that includes a boring location plan, boring log at each bore site, and results of the laboratory testing program, descriptions of the subsurface conditions encountered and our geotechnical engineering recommendations and guidelines developed for this project.

Our scope of services for this project did not include the assessment of any potential environmental concerns at this site. Therefore, such concerns are not addressed in this report.

SITE AND SUBSURFACE CONDITIONS

Site Description:

The site conditions were assessed using a combination of aerial photography and observations made by the FGS personnel during our field operations. The following site conditions were noted:

- The site is the Briggs Ranch Development at the Northeast Corner of Hwy 90 & Hwy 211 in Bexar County Texas.

Site Geology:

According to the Bureau of Economic Geology: Geologic Atlas of Texas, San Antonio Sheet (1982), the Site is located entirely on the following geologic formation

- **The Navarro Group and Marlbrook Marl ("upper Taylor marl") undivided (Kknm)** is made up of two parts. The upper part consists of marl, clay, sandstone, and siltstone. The marl and clay are typically glauconitic and contain concretions of limonite and siderite. The sandstone portion is fine-grained and the siltstone portion is yellow-brown, with concretions of hard bluish-gray siliceous limestone 2-10' in diameter. Sandstone beds have little lateral continuity, becoming more abundant in the western portions. This formation's thickness can be up to 580'.

Soil Description:

According to the United States Department of Agricultural (USDA) Natural Resources Conservation Service (NRCS) Soil Survey of Bexar County (1966), the Site is located on the following soils:

- **The Austin silty clay, 1-3% slopes (AuB)** is found on low, broad ridge tops. Typically, the surface layer of this soil is grayish-brown silty clay, about 28 inches thick. To the maximum plow depth, the soil's structure is granular. Below the plow layer, the soil's structure is fine, subangular blocky. The subsurface layer is approximately 18 inches thick. This layer is pale-brown silty clay, which contains a little more clay than the surface layer. It has moderate, medium, and fine, subangular blocky structure and is very hard when dry and firm but crumbly when moistened. The underlying material is chalky marl that contains much lime and many shale fragments. It is firm but crumbly when moist. This layer is also easily penetrated by plant roots. The soil is well drained, internal drainage is medium, and the capacity to hold water is good.

- **The Austin silty clay, 3-5% slopes (AuC)** consists of clayey soils that are moderately deep, moderately dark colored, and very strongly calcareous. They developed under grass, in material weathered from chalk or chalky marl. The surface layer is dark grayish-brown silty clay. It is about 16" thick. The subsurface layer is about 14" thick. This layer is pale-brown silty clay and is somewhat more clayey than the surface layer. It has moderate, medium and fine, subangular blocky structure and is very hard when dry and firm but crumbly when moist. The underlying material is chalky marl that contains much lime and many shale fragments and is firm but crumbly when moist. Roots easily penetrate this layer. These soils are well drained and their capacity to hold water is good. Internal drainage is medium. Permeability is moderate. The large amount of free lime tends to make some plant nutrients unavailable and increases susceptibility to water erosion.

- **The Hilly Gravelly Land (HgD)** consists of bed of caliche or of gravelly, very strongly calcareous, loamy alluvium that is approximately 10-20' or more in thickness. The upper 3-12" of the caliche layer is generally hard and platy. There are a few nearly level areas approximately 100' wide, and on these has formed a 4-8" thick mantle of limy, dark grayish brown loam or clay loam. On the slopes, there is very little soil; it is estimated that only approximately 15% of this land is actually soil. In some places, there is a 2-3' bed of weak conglomerate consisting of sediments cemented with calcium carbonate.

- **The Houston Black gravelly clay, 1-3% slopes (HuB)** has a black surface layer that is about 38" thick. Wide cracks form when this layer is dry. Gravel makes up 8-18% of this layer, by volume. Gravel may be near 60% along ridge tops. The underlying layer is approximately 12" thick, is clay or gravelly clay. The gravel is discontinuous, but where it occurs, it can make up 30-60% of this layer, by volume. Pebbles can range in size from half an inch to 3" in diameter. This soil has medium to slow runoff. Pebbles on the surface can reduce the risk of water erosion. The hazard of water erosion is none to slight.

- **The Houston Black gravelly clay, 3-5% slopes (HuC)** consists of clayey soils that are deep, dark gray to black and calcareous with some gravel. The surface layer is black and about 36" thick. Gravel ordinarily makes up 10-18% of this layer by volume. On a few minor ridge tops, gravel may compose of 60% of the soil. The subsurface layer is about 12" thick. Water intake is slow and erosion due to water is a hazard. The formation of plowpans is common.

- **Houston Black gravelly clay, 5 to 8 percent slopes HuD** occurs as convex slopes that parallel the higher narrow ridges or as concave slopes or basins at the head of major drainage ways. It is mainly in the southwestern part of the county. The surface layer is black and is about 34" thick. When dry, the layer will form large cracks. Gravel makes up approximately 10-20% of this layer, by volume. The sub surface layer is clay or gravelly clay and is approximately 10" thick. Wide cracks also form in this layer when the soil is dry. Water erosion and lack of soil moisture are the main limitations

Subsurface Conditions:

Subsurface conditions at the site were evaluated by drilling a total of **Sixteen (16)** soil borings to a depth of **Fifteen (15)** feet and **Three (3)** test pits to approximately **two (2) feet depth** we0re excavated to obtain **soil samples to determine the California Bearing Ratio (CBR)** of the soil samples. The number of borings and test pits, their locations and their depths were selected by FGS. The borings and test pits were located in the field by FGS personnel using Global Positioning System (GPS) technology. The borings were advanced using solid flight auger drilling methods and soil samples were routinely obtained during the drilling process; the test pits are routinely excavated to the appropriate depth. Drilling and sampling techniques were accomplished in general accordance with ASTM procedures. Logs of the borings are presented in the Appendix section at the end of the report. A Borehole Location Plan with the location of each boring is presented in the Illustrations section of this report.

The soil samples obtained during our field exploration were transported to our laboratory where they were reviewed by qualified geotechnical engineering personnel. Representative samples were selected and tested to determine pertinent engineering properties and characteristics for use in evaluating the project site. Laboratory testing and soil classification were accomplished in general accordance with ASTM procedures.

Based on the field and laboratory data, it is determined that the stratigraphy of the site is generally as follows:

Stratum	Range of Depth, (feet)	Stratum Description and Classification
I	0.0 to 2.0	Silty Clay (CH), Black
II	2.0 to 15.0	Silty Clay (CH), Tan
III		

The subsurface descriptions shown above are general in nature and highlight major subsurface stratification features and material types. The boring logs included in Appendix A should be reviewed for specific information such as soil or rock material descriptions, stratifications, sampling depths and intervals, field test data and laboratory test data. The stratifications shown on each boring log only represent the conditions and approximate boundaries between strata at that actual boring location. The actual transitions between strata may be gradual. Variations will occur and should be expected at locations away from each boring location. Subsurface water level observations made during field operations are also shown on the boring logs. The indicated stratum depths and any subsurface water levels are measured from the ground surface and are estimated to the nearest one-half (½) foot. Portions of any samples that are not altered or consumed by laboratory testing will be retained for 30 days from the date of issuance of this report. Unless otherwise requested by the client and/or depending upon project requirements, all soil samples will be discarded after that retention period.

The **P.I. values** obtained from the soil samples taken **near the surface ranged from 49 to 55 in** the **CLAY** subgrade soil. Due to the characteristics of the materials found in the area, FGS is of the opinion that the sulfate contents of the materials will **NOT** pose a problem. In the case where the P.I. value of the material near the surface is greater than 20 the PI could be reduced if lime is applied to the subgrade material or the native Clay material is replaced with a more suitable material.

Soil Corrosiveness:

Subsurface soil samples were sent to SAN ANTONIO TESTING LABORATORY for analysis of sulfate content. It was determined that these soils contain a sulfate value of **8.08 ppm** which is very low compared to the accepted maximum value of 3,000 ppm. We therefore conclude that corrosiveness due to sulfate will not be a problem. We have included the laboratory results in the appendix for your review.

Subsurface Water Information:

The borings were advanced using dry drilling techniques to their full depths in an attempt to detect the potential presence of subsurface water in the material. **Subsurface water WAS NOT Encountered in any of the Borings** upon completion of drilling operations. The boreholes were backfilled with soil cuttings upon completion of drilling and sampling operations. Short-term field observations generally do not provide accurate subsurface water levels for evaluation at most sites. Subsurface water levels are generally influenced by seasonal and climatic conditions that result in fluctuations of subsurface water levels over time. The earthwork contractor should check for subsurface water during excavation activities especially when sand and/or gravel are encountered.

ENGINEERING ANALYSIS AND RECOMMENDATIONS

Pavement Design:

Flexible pavements should be designed and constructed in accordance with the requirements established by local municipalities and the American Association of State Highway and Transportation Officials (AASHTO) “Guide for Design of Pavement Structures”, for this project, the Bexar County Flexible Pavement Design Criteria was used.

Below is a table which outlines the Bexar County Flexible Pavement Design Criteria, which was used in the design of the proposed street sections for this project:

Input Parameters used in Asphalt Pavement Section Calculation

Pavement Specifications								
	Primary and Secondary Arterials		Collector Streets		Local Type "B"		Local Type "A"	
W18	ESAL = 3,000,000		ESAL = 2,000,000		ESAL = 2,000,000		ESAL = 1,000,000	
R	95%		90%		90%		70%	
So	Flexible	Rigid	Flexible	Rigid	Flexible	Rigid	Flexible	Rigid
	0.45	0.35	0.45	0.35	0.45	0.35	0.45	0.35
Po	4.2	4.5	4.2	4.5	4.2	4.5	4.2	4.5
Pt	2.5	2.5	2.5	2.5	2.0	2.5	2.0	2.0
ΔPSI	1.7	2.0	1.7	2.0	2.2	2.0	2.2	2.5
T	20		20		20		20	
SN	Min.	Max	Min.	Max.	Min.	Max.	Min.	Max.
	3.80	5.76	2.92	5.05	2.98	5.05	2.58	4.20

In addition to the parameters shown above, the soil resilient modulus, M_R, of the subgrade soil, must be determined. Typically, this value is obtained through California Bearing Ratio (CBR) testing. Field investigations show that all the soil samples obtained within the subgrade at the site are very similar with very similar (CBR) values. These soils are **Dark Black Clay (CH)** **with similar Plasticity and CBR values, for all samples. The CBR values range between 1.8 and 2.1.** We will **use a CBR value of 1.9 which is on the lower end of the laboratory results for the design of our pavement sections**. Information regarding the moisture density relationships of the bulk samples of subgrade soil collected at this site and the CBR test results are presented in the Appendix section of this report.

The Pavement Sections for Clay soils with a **CBR value of 1.9** are presented in the tables below. **It should be noted, the P.I. value of the Clay subgrade at this site varies between 49 and 55**. The subgrade soils with a **P.I. value greater than 20 should be stabilized with lime to reduce their P.I.** value or be replaced with better material approved by the Project Engineer. It will be important that once the field work starts, personnel from FGS be present to identify the areas where lime should be applied to reduce the P.I. value of the subgrade soil.

For the purposes of developing layer thicknesses for the pavement sections shown below, we have used the following structural coefficients in the calculation of pavement structural numbers:

Material Type	Structural Coefficient	Drainage Coefficient
TXDOT Item 340, Hot Mixed Asphaltic Concrete	0.44	1.00
TXDOT Items 292 or 340, Asphalt Treated Base	0.38	1.00
TXDOT Item 247, Flexible Base - Crushed Limestone	0.14	1.00
TXDOT Item 247, Flexible Base	0.14	1.00
Lime Stabilized Subgrade, (6 inch Min.)	0.08	1.00

Bexar County Minimum Layer Thickness Requirements:

	Type "A"	Type "B"	Collector	Arterials
PAVEMENT LAYER	**Min. Thickness Inches**	**Min. Thickness Inches**	**Min. Thickness Inches**	**Min. Thickness Inches**
HMAC	2.0	3.0	3.0	4.0
Aggregate Base Course	8.0	8.0	8.0	8.0
Asphalt Treated Base Course	6.0	6.0	6.0	6.0
Lime & Cement Base Course	6.0	6.0	6.0	6.0
Mechanically Stabilized Layer	8.0	8.0	8.0	8.0
Moisture Conditioned Subgrade	6.0	6.0	6.0	6.0

THE NEW TENSAR PROGRAM CALCULATE THE RESILIENT MODULUS (MR) VALUE WITH THE USE OF THE LABORATORY CALIFORNIA BEARING RATIO, (CBR). In this case the **MR value calculates to 2,850 psi.**

WE WILL USE MR=2,850 PSI FOR OUR PAVEMENT DESIGN.

In accordance with the **Bexar County, Texas** design parameters we have developed the following flexible pavement recommendations for a **"Type "A" Street** on a Clay subgrade.

COMPONENT	FLEXIBLE DESIGN SECTION (inches)			
	TYPE "A"			
	Option # 1	Option # 2	Option # 3	Option # 4
Type D HMAC Surface	2.0 inches	2.0 inches		
Type B HMAC Base	N/A	N/A		
Flexible Base, (Type A or Type B, Grade 2)	11.25 inches	8.0 inches		
Lime Stabilized Subgrade (6 inch Min.)	YES	YES		
*3 X 5 Rock Wrapped in Mirafi 180N Filter Fabric	NO	NO		
TENSAR GEOGRID (TX-7)	NO	YES		
Design ESAL Value	100,000	100,000		
Actual ESAL Value	102,100	130,900		

In accordance with the **Bexar County, Texas** design parameters we have developed the following flexible pavement recommendations for a **"Type "B" Street** on a Clay subgrade.

COMPONENT	FLEXIBLE DESIGN SECTION (inches)			
	TYPE "B"			
	Option # 1	Option # 2	Option # 3	Option # 4
Type D HMAC Surface	4.75 inches	3.0 inches		
Type B HMAC Base	N/A	N/A		
Flexible Base, (Type A or Type B, Grade 2)	18.0 inches	17.75 inches		
Lime Stabilized Subgrade (6 inch Min.)	YES	YES		
*3 X 5 Rock Wrapped in Mirafi 180N Filter Fabric	NO	NO		
TENSAR GEOGRID (TX-7)	NO	YES		
Design ESAL Value	2,000,000	2,000,000		
Actual ESAL Value	2,147,900	2,017,400		

In accordance with the **Bexar County, Texas** design parameters we have developed the following flexible pavement recommendations for a **Collector Street** on a Clay subgrade.

COMPONENT	FLEXIBLE DESIGN SECTION (inches)			
	COLLECTOR			
	Option # 1	Option # 2	Option # 3	Option # 4
Type D HMAC Surface	3.0 inches	5.75 inches	3.75	
Type B HMAC Base	6.0 inches	N/A	N/A	
Flexible Base, (Type A or Type B, Grade 2)	9.75 inches	18.0 inches	18.0 inches	
Lime Stabilized Subgrade (6 inch Min.)	YES	YES	YES	
*3 X 5 Rock Wrapped in Mirafi 180N Filter Fabric	NO	NO	NO	
TENSAR GEOGRID (TX-7)	NO	NO	YES	
Design ESAL Value	2,000,000	2,000,000	2,000,000	
Actual ESAL Value	2,063,100	2,309,900	2,022,100	

Pavement Analysis:

The pavement designs presented in the previous paragraphs include designs for lime stabilized subgrade and lime treated subgrade, to be used on pavement sections with a Clay subgrade and a P.I. value greater than 20. The **Bexar County pavement design criteria** requires that a minimum of six (6) inches of subgrade soil below the pavement structure be treated or stabilized if the subgrade has a P.I. value greater than 20. If a Geogrid fabric is used to reduce the base course thickness, treatment or stabilization of the underlying high P.I. soil is still required. In the case that subgrade fill is required to bring the subgrade elevation up to final grade, fills should be made with flexible base, on-site Chalk millings or other material approved by the Project Engineer. Fill material compaction shall be in accordance with subgrade compaction requirement for **Bexar County, Texas.**

Pavement Material Specifications:

The following guidelines have been prepared for use in the selection and preparation of various materials that may be used to construct the pavement sections. Submittals should be made for each pavement material and should be reviewed by the Geotechnical Engineer and other appropriate members of the design team. The submittals should provide the test information necessary to verify full compliance of the materials with the recommended or specified material properties.

Fill Material - If fill is used to raise the grade, approved fill material underneath the pavement should be used. The fill should be free of deleterious material with a **minimum CBR value of 2.0** and preferably a **Plastic Index below 20**. If the material has a PI greater than 20 the lime application rates should be re-evaluated and sulfate content tested for the fill material. The material should be placed as per applicable city or county guidelines.

Hot-Mix Asphaltic Surface Course – Asphaltic concrete should be plant mixed, hot laid, **Type D** meeting the 2014 TX DOT Standard Specification Item 340. Mix should be compacted to between 92 and 97 percent of the maximum theoretical density as determined by TEX-227-F.

Asphalt Treated Base – Asphalt treated base should be placed in **maximum six (6) inch compacted lifts**. These materials should conform to the requirements of the 2014 TX DOT Standard Specification Item 292, Grade 1 or Item 340, Type A or B.

Flexible Base Course – Flexible base materials should be placed in maximum eight (8) inch **compacted lifts.** The base materials should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557. Flexible base materials should be moisture conditioned to between plus or minus two (+-2) percentage points of the optimum moisture content. Flexible base materials should meet all requirements specified in 2014 TX DOT Standard Specification Item 247, Type A or B, Grade 1 or 2.

Lime Treated Subgrade – Clay subgrade (with P.I. values greater than 20) should be treated with hydrated lime to reduce its plasticity and improve its strength and load carrying ability. Hydrated lime should be mixed with the subgrade soils in accordance with Bexar County Specifications for Lime Treatment to reduce the P.I. value to 20 or less.

Lime Stabilized Subgrade – Clay subgrade **(with P.I. values greater than 20)** should be stabilized with hydrated lime to reduce its plasticity and improve its strength and load carrying ability. Hydrated lime should be mixed with the subgrade soils **in accordance with BEXAR COUNTY, Texas Specifications for Lime Stabilization.** We estimate that approximately **SIX (6) percent** (by weight) hydrated lime will be required to properly stabilize these soils. This is equivalent to **about 27 pounds of hydrated lime per square yard for a six (6) inch depth.** The optimum lime content should result in a soil-lime mixture with a pH of at least 12.4 when tested in accordance with ASTM C 977, Appendix XI and should reduce the P.I. to 20 or less.

3 X 5 Rock Wrapped in Filter Fabric – The City may allow 3 X 5 rock wrapped in Filter Fabric instead of lime stabilization, however the **wrapping fabric must be Mirafi 180N Filter Fabric or equal, and prior approval must be obtained.**

Geogrid – Tensar TX7 geogrid may be used to provide additional structural support to flexible base materials. The geogrid should be placed as per manufacturer's recommendations at the interface between the flexible base and subgrade.

Moisture Conditioned Subgrade – Exposed subgrade soils that do not need to be stabilized or treated should be scarified and moisture conditioned to between plus or minus three (+-3) percentage points of optimum to a depth of at least six (6) inches. The soils should then be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 698.

Lime Series Curve and Unconfined Compressive Strength:

A Lime Series Curve was developed for the project to determine the optimum amount of hydrated lime required to stabilize the subgrade in accordance with **Bexar County, Texas** design criteria. The optimum lime content should result in a soil-lime mixture with a pH of at least 12.4 when tested in accordance with ASTM C 977 and should reduce the Plasticity Index to 20 or less. The lime series curve depicts the percent lime added to the subgrade and the resulting pH/P.I. A strength verification test was performed on the lime stabilized subgrade to determine the Unconfined Compressive Strength (UCS) of the soil-lime mixture. **Bexar County requires an UCS of 160 psi, a pH of 12.4 or greater and a P.I. of 20 or less. Results of the** Lime Series Curve and the Unconfined Compressive Strength test are presented in the Appendix section of this report. **A 6 % of lime is required to reduce the plasticity value**, this translates into **approximately 27 lbs. of lime per square yard** of subgrade. Additional field verification testing will be required during the subgrade stabilization process once the project has started.

Subgrade Preparation:

The pavement alignment should be stripped of topsoil, vegetation, roots, loose or soft soils and any other deleterious materials. The stripped materials should be removed from the site and properly disposed of or used elsewhere on site. Upon completion of stripping operations, the alignment may be either excavated or filled as necessary to achieve the desired pavement elevation. Prior to the placement of any fill for grade adjustments or the construction of the pavement section, the exposed subgrade should be proof rolled with appropriate construction equipment weighing at least 20 tons. Unstable or non-uniform areas should be removed to expose stable soils and may be replaced with clean, properly compacted flexible base material or other more suitable material approved by the Project Engineer. All fill placed within the paved areas should be free of any deleterious materials and should not contain stones larger than the maximum lift thickness. The fill materials should be placed on prepared surfaces in lifts not to exceed eight (8) inches compacted measure. All fill materials placed in paved areas should be moisture conditioned to between plus or minus three (+-3) percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density as determined by ASTM D 698.

Drainage:

Proper pavement perimeter drainage should be provided and maintained to minimize the infiltration of surface water into the pavement section from surrounding unpaved areas. The infiltration of water into the pavement section typically results in the accelerated degradation of the section with time as vehicular traffic traverses the infiltrated area. Curbs used in paved areas should extend at least three (3) inches into the base materials to help reduce the potential for water infiltration into the pavement section. Prefabricated strip drains or small “French” drains may also be installed behind curbs to intercept and remove water from the pavement perimeter before water infiltrates the pavement section. Furthermore, all concrete and asphalt interfaces should be sealed using a sealant that is compatible with both asphalt and concrete.

Proper pavement drainage is a critical component in the long-term performance of a pavement section. The pavement section recommendations shown above are based on generally recognized structural coefficients. These coefficients reflect the relative strength of each pavement material type and their contribution to the structural integrity of the pavement. The infiltration of water into these pavement materials will generally weaken the materials and result in the degradation of the pavement's performance. Therefore, proper drainage of the pavement should be carefully considered by the project design team to ensure that water rapidly drains from the pavement and does not pond on or around the pavement.

Utilities:

Care should be exercised to make sure that utility lines do not serve as conduits that transmit water beneath foundations or pavements at this site. Secondary backfill for utility lines that are located beneath pavement, sidewalk and building areas should consist of lean clay (CL), flowable fill or other material in accordance with local municipality or utility provider specifications. Proper compaction of trench backfill is essential in pavement areas where settlement of the trench backfill can cause significant distress to the overlaying pavement. Flowable fill materials should be as described in the American Concrete Institute ACI 229R. Granular materials such as sand or gravel are not recommended as secondary backfill in utility trenches located in building pad or pavement areas.

Excavations:

As was discussed previously, these materials that are penetrated by geotechnical augers can generally be excavated with conventional earthmoving equipment. It should be noted that excavation equipment varies and field conditions may vary. Generally, geologic processes (such as faulting, weathering, etc.) are erratic and large variations can occur in small lateral distances. Details regarding "means and methods" to accomplish the work (such as excavation equipment and technique selection) are the sole responsibility of the project contractor.

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926, Revised October 1989), require that excavations be constructed in accordance with the current OSHA guidelines. Furthermore, the State of Texas requires that detailed plans and specifications meeting OSHA standards be prepared for trench and excavation retention systems used during construction. The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavation as part of the contractor's safety procedures.

In no case should slope height, slope inclination or excavation depth exceed those specified in local, state and Federal safety regulations. OSHA addresses the construction of slopes in large excavations that are less than 20 feet deep on OSHA Table B-1. We have provided this information solely as a service to our client. The OSHA regulations and OSHA Table B-1 should be consulted prior to any excavations that would be subject to OSHA regulations. FGS does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state and Federal safety or other regulations.

QUALITY CONTROL

Document Review:

Due to the uniqueness of each project and construction site, it is important that all engineering reports, drawings, specifications, change orders and other related documents accurately reflect the recommendations intended by the respective design professionals involved in the project. The performance of the pavements planned for this project will depend on the correct interpretation and implementation of our geotechnical engineering report and guidelines. We should be provided the opportunity to review the final design and construction documents to check that our geotechnical recommendations are properly interpreted and implemented in these documents. This review is not a part of our scope of services for this project and would be an additional service. We cannot be responsible for misinterpretation of our geotechnical recommendations if we have not had an opportunity to review these documents.

Construction Materials Testing:

As the Geotechnical Engineer of Record, we recommend that Frost GeoSciences be retained to monitor the pavement installation and earthwork related activities for this project. Due to our familiarity with this project, it is important that FGS provide these services to make certain that our geotechnical recommendations are interpreted properly and to make certain that actual field conditions are those described in our geotechnical report. We believe this technical overview and on-site surveillance during these activities is essential to provide well-constructed pavements and to check that the intent of these geotechnical recommendations is met.

REPORT LIMITATIONS

The recommendations and guidelines submitted in this report are based on the available subsurface information developed by FGS and project information provided by the client. If there are any changes in the nature, design or location of the project, the opinions, conclusions, recommendations and guidelines submitted in this report should not be used until we are able to review the changes and respond in writing as to whether the information contained within this report remains applicable.

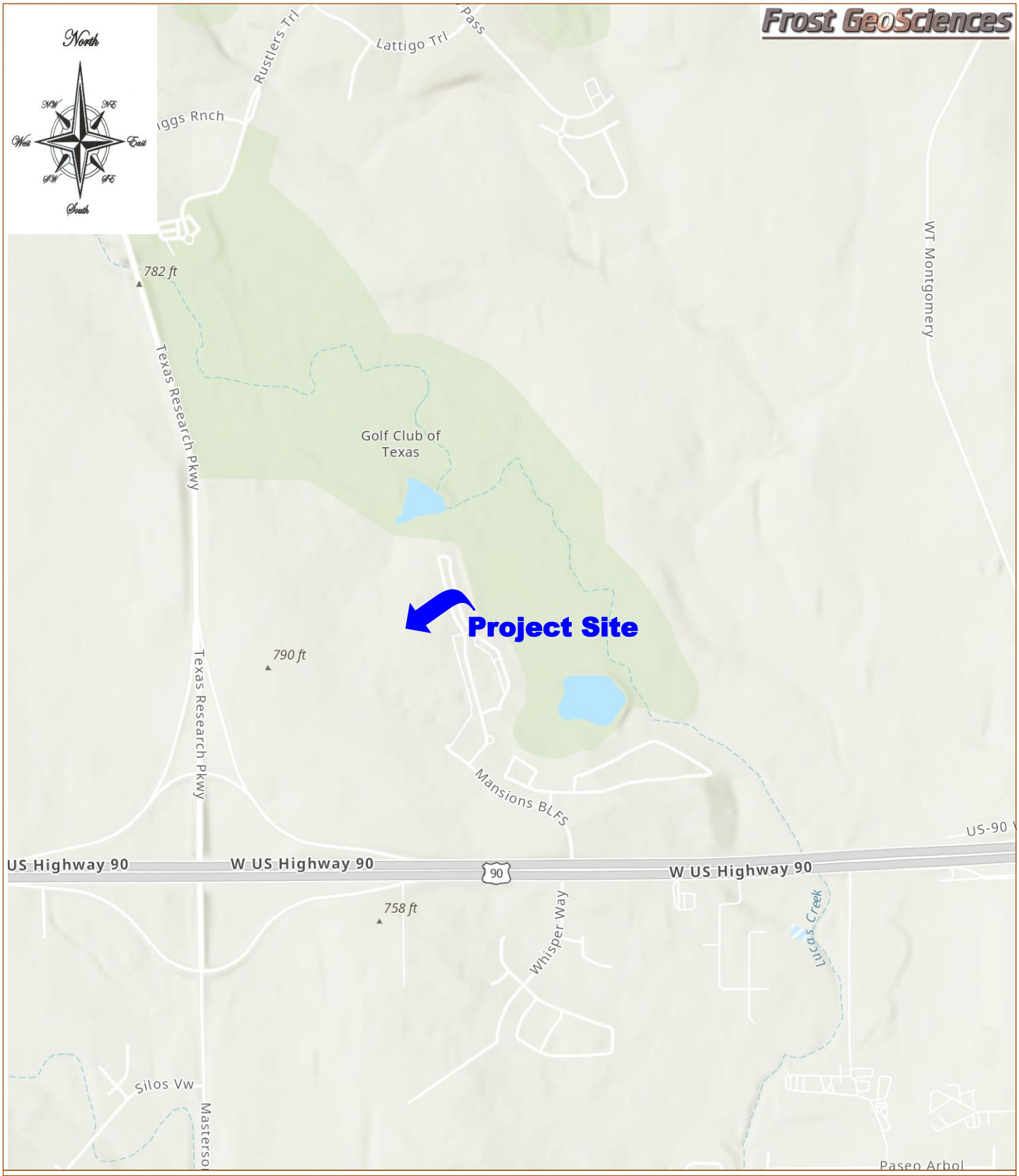
Subsurface conditions at this site have been observed and interpreted at the Boring Locations only. Substantial variations in subsurface materials resulting from local geologic conditions or previous site use may occur away from the boring locations. These variations may not become evident until construction begins. Therefore, any conditions that vary significantly from those described in our report should be reported to FGS immediately. FGS will then determine whether our conclusions, opinions and recommendations remain valid or whether additional investigation and/or engineering analysis is required.

This study has been performed in accordance with accepted geotechnical engineering practice using the standard of care and skill currently exercised by geotechnical engineers practicing in this area. No warranty, expressed or implied, is made or intended. This report has been prepared exclusively for the specified client; project and client's authorized project team for use in preparing the appropriate design and construction documents for this project. This report may be included in the construction documents for this project provided the report is reproduced in its entirety. This report shall not be reproduced or used for any other purpose without the express written consent of Frost GeoSciences, Inc.

ILLUSTRATIONS

Vicinity Map
Boring Location Plan

VICINITY MAP



PROJECT NAME:

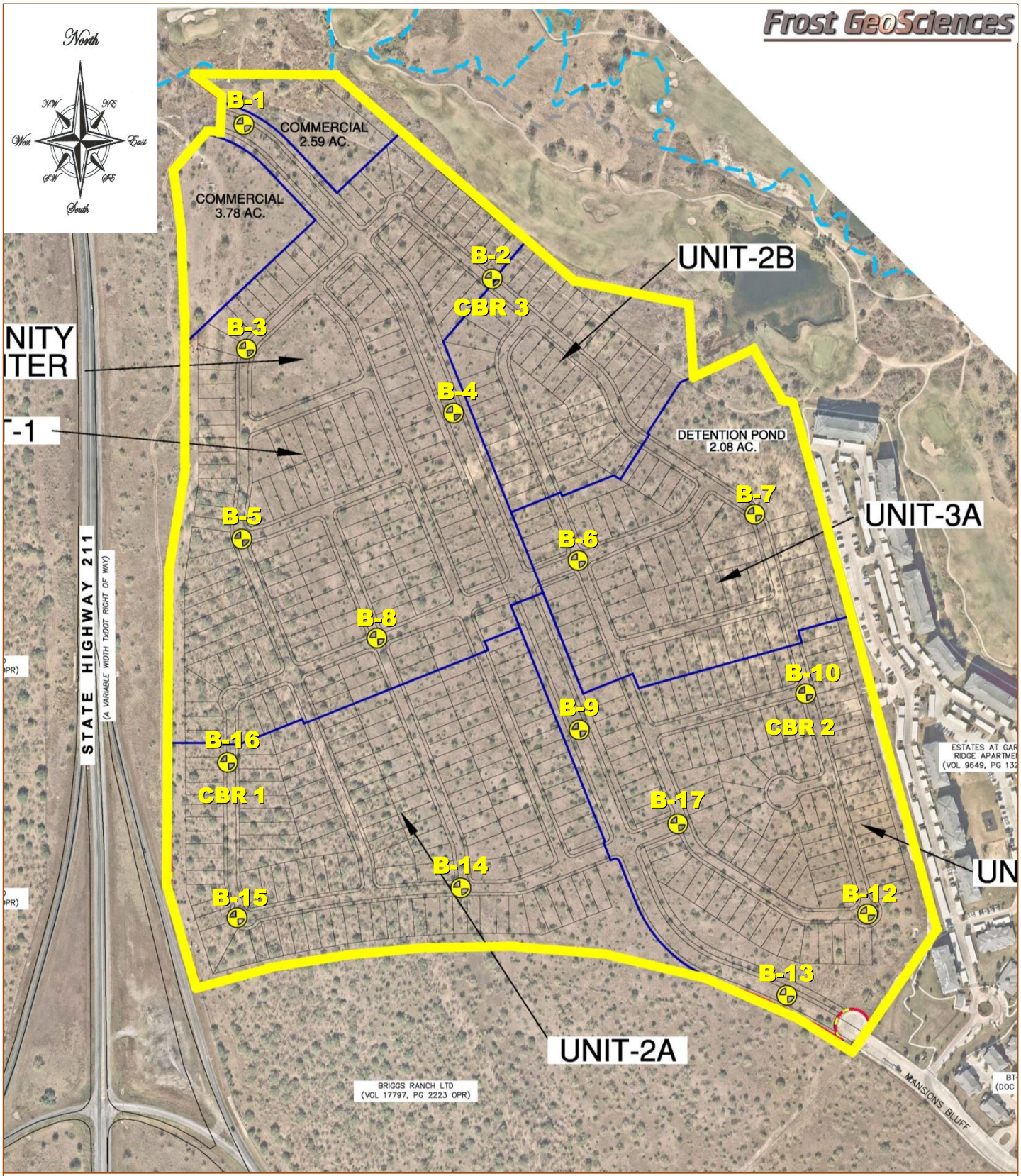
Geotechnical Investigation
BRIGGS RANCH
BEXAR COUNTY, TEXAS

VICINITY MAP

PROJECT NO.:	DATE CREATED:
FGS-G-21118	July 21, 2021

BORING PLAN

FGS Project No: FGS-G21118



PROJECT NAME:

Geotechnical Investigation
BRIGGS RANCH
BEXAR COUNTY, TEXAS

BORING LOCATIONS

PROJECT NO.:	DATE CREATED:
FGS-G-21118	July 21, 2021

APPENDIX "A"

Boring Logs
PVR Values
Symbol Key Sheet

BORING LOGS

FGS Project No.: FGS-G21118

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-01
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 22	24	66	17	49						Black Grey Clay
			N = 74										Tan Marly Clay at 2'
	5		N = 70										
			N = 40	11									
	10												
			N = 55		52	14	38						
	15												Boring Terminated at 15 feet of Depth
	20												

DRILLING METHOD(S):

Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:

Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:

GPS 0522025 3250750

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-02
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

FIELD DATA			LABORATORY DATA									
				ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES (N: BLOWS/FT, P: TONS/SQ FT, T: BLOWS, R: %, RQD: %)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0	N = 9										Black Grey Clay
		N = 31	25	73	18	55						Olive Grey Clay with Calcareous at 2'
	5	N = 34										Tan Marly Clay at 4'
	10	N = 82										
	15	N = 42	14	50								Boring Terminated at 15 feet of Depth
	20											

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

REMARKS:
GPS 0523225 3250600

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-03
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0		N = 19	26	71	16	55						Black Grey Clay
			N = 42										Tan Marly Clay at 2'
	5		N = 57	14	53	15	38						
			N = 59										
	10												
			N = 73	14	54	13	41						
	15												Boring Terminated at 15 feet of Depth
	20												

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS 0522050 3250550

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-04
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 4		69	18	51						Black Grey Clay
			N = 30	27									Olive Grey Clay with Calcareous at 1.5'
	5		N = 31										Tan Marly Clay at 4'
	10		N = 72	14									
			N = 58		52	15	37						
	15												Boring Terminated at 15 feet of Depth
	20												

DRILLING METHOD(S):

Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:

Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:

GPS 0523125 3250495

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-05
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0	N = 12	25	72	18	54						Black Grey Clay
		N = 60										
	5	N = 61	20	53	15	38						Tan Marly Clay at 4'
	10	N = 35										
	15	N = 55	22	49	14	35						Boring Terminated at 15 feet of Depth
	20											

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

REMARKS:
GPS 0522050 3250350

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-06
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

FIELD DATA			LABORATORY DATA									
				ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
		N = 4										Black Grey Clay
		N = 51	16	70	18	52						
	5	N = 48										Tan Marly Clay at 4.5'
		N = 60	12	67	18	49						
	10											
		N = 84										
	15											Boring Terminated at 15 feet of Depth
	20											

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

REMARKS:
GPS 0523250 3250350

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-07
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0		N = 11	10	68	16	52						Black Grey Clay
			N = 44										Tan Marly Clay at 2'
	5		N = 41	8	53	14	39						
			N = 54										
	10												
			N = 73										
	15												Boring Terminated at 15 feet of Depth
	20												

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS 0523425 3250395

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-08
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

PAGE 1 of 1

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 21										Black Grey Clay
			N = 43										Tan Marly Clay at 2'
	5		N = 34										
			N = 44	17	50	16	34						
	10												
			N = 53	20	52								
	15												Boring Terminated at 15 feet of Depth
	20												

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS 0523095 3250275

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

This log is not valid if separated from the report.

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-09
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

PAGE 1 of 1

FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0	N = 10										Black Grey Clay
		N = 16	20									Tan Marly Clay at 2'
	5	N = 31		51	17	34						
		N = 49	18	52	14	38						
	10											
		N = 71										
	15											Boring Terminated at 15 feet of Depth
	20											

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS 0523250 3250195

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

This log is not valid if separated from the report.

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-10
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

FIELD DATA			LABORATORY DATA									
				ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0	N = 10	15	70	17	53						Black Grey Clay
		N = 72										
	5	N = 90	9	53	15	38						Tan Marly Clay at 4.5'
	10	N = 94										
	15	N = 94	10	50	16	34						Boring Terminated at 15 feet of Depth
	20											

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

REMARKS:
GPS 0523495 3250200

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-11
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

SOIL SYMBOL	DEPTH (FT)	SAMPLES (N: BLOWS/FT, P: TONS/SQ FT, T: BLOWS, R: %, RQD: %)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
		N = 12										Black Grey Clay
		N = 21	24	53	16	37						Tan Marly Clay at 2'
	5	N = 37										
		N = 46	14	52	17	35						
	10											
		N = 72										
	15											Boring Terminated at 15 feet of Depth
	20											

DRILLING METHOD(S):

Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:

Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:

GPS 0523350 3250100

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-12
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

PAGE 1 of 1

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 14	9	69	17	52						Black Grey Clay
			N = 48		54	16	38						
	5		N = 55	8									Tan Marly Clay at 4.5'
	10		N = 70										
	15		N = 73	13	52	15	37						Boring Terminated at 15 feet of Depth
	20												

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

REMARKS:
GPS 0523525 3250000

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

This log is not valid if separated from the report.

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-13
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Black Grey Clay
				21	51	16	35						Tan Marly Clay at 2'
	5												
				12	50	15	35						
	10												
	15												Boring Terminated at 15 feet of Depth
	20												

DRILLING METHOD(S):

Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:

Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:

GPS 0523450 3249025

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-14
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

PAGE 1 of 1

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
				19	70	17	53						Black Grey Clay
	5			18	53	15	38						Tan Marly Clay at 4.5'
	10												
	15			13	51	16	35						Boring Terminated at 15 feet of Depth
	20												

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

REMARKS:
GPS 0523150 3250025

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-15
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Black Grey Clay
	5			17	51	16	35						Tan Marly Clay at 4.5'
	10												
				19	52								
	15												Boring Terminated at 15 feet of Depth
	20												

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

REMARKS:
GPS 0522025 3250000

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

LOG OF BORING

Frost GeoSciences
Geologic ▪ Environmental
Geotechnical

PROJECT: Briggs Ranch
Hwy 211
San Antonio, Tx

CLIENT:

PROJECT NO.: Briggs Ranch
BORING NO.: B-16
DRILLING DATE: 6/18/2021
SURFACE ELEVATION:

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
				25	69	16	53						Black Grey Clay
	5			19	51	16	35						Tan Marly Clay at 4.5'
	10												
	15			19	50	15	35						
													Boring Terminated at 15 feet of Depth
	20												

FIELD DATA

LABORATORY DATA

DRILLING METHOD(S):
Dry auger drilling techniques were used to the termination depth of the boring.

SUBSURFACE WATER INFORMATION:
Subsurface water was not encountered either during or upon completion of drilling operations and subsurface water observations.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS 0522025 3250150

FROST LOG FGS-G21118.GPJ FROST.GDT 7/15/21

PVR VALUES

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 1

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	49	3.5	X		
II	50	6.0	X		
III	49	9.0		X	
IV	40	12.0		X	
V	38	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.74** inches

Effective Plasticity Index

BRAB	PCI
47	47

Soil Support Index

BRAB	PCI
0.66	0.66

Soil/Climatic Rating Factor

$1 - C_w$ = **0.34**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 2

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	55	3.5	X		
II	55	6.0	X		
III	54	9.0		X	
IV	53	12.0		X	
V	50	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **4.69** inches

Effective Plasticity Index

BRAB	PCI
55	54

Soil Support Index

BRAB	PCI
0.61	0.61

Soil/Climatic Rating Factor

$1 - C_w$ = **0.39**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 3

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	55	3.5	X		
II	55	6.0	X		
III	38	9.0		X	
IV	40	12.0		X	
V	41	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.92** inches

Effective Plasticity Index

BRAB	PCI
55	48

Soil Support Index

BRAB	PCI
0.61	0.64

Soil/Climatic Rating Factor

$1 - C_w$ = **0.36**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 4

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	51	3.5	X		
II	48	6.0	X		
III	48	9.0		X	
IV	40	12.0		X	
V	37	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.74** inches

Effective Plasticity Index

BRAB	PCI
51	47

Soil Support Index

BRAB	PCI
0.61	0.66

Soil/Climatic Rating Factor

$1 - C_w$ = **0.34**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 5

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	54	3.5	X		
II	48	6.0	X		
III	38	9.0		X	
IV	37	12.0		X	
V	35	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.56** inches

Effective Plasticity Index

BRAB	PCI
54	45

Soil Support Index

BRAB	PCI
0.61	0.67

Soil/Climatic Rating Factor

$1 - C_w$ = **0.33**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 6

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	52	3.5	X		
II	51	6.0	X		
III	50	9.0		X	
IV	49	12.0		X	
V	49	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **4.25** inches

Effective Plasticity Index

BRAB	PCI
52	51

Soil Support Index

BRAB	PCI
0.61	0.61

Soil/Climatic Rating Factor

$1 - C_w$ = **0.39**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 7

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	52	3.5	X		
II	40	6.0	X		
III	39	9.0		X	
IV	38	12.0		X	
V	39	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.32** inches

Effective Plasticity Index

BRAB	PCI
52	44

Soil Support Index

BRAB	PCI
0.61	0.69

Soil/Climatic Rating Factor

$1 - C_w$ = **0.31**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 8

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	50	3.5	X		
II	40	6.0	X		
III	34	9.0		X	
IV	34	12.0		X	
V	35	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **2.99** inches

Effective Plasticity Index

BRAB	PCI
50	41

Soil Support Index

BRAB	PCI
0.61	0.71

Soil/Climatic Rating Factor

$1 - C_w$ = **0.29**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 9

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	50	3.5	X		
II	40	6.0	X		
III	34	9.0		X	
IV	38	12.0		X	
V	38	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.09** inches

Effective Plasticity Index

BRAB	PCI
50	42

Soil Support Index

BRAB	PCI
0.61	0.71

Soil/Climatic Rating Factor

$1 - C_w$ = **0.29**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 10

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	53	3.5	X		
II	52	6.0	X		
III	38	9.0		X	
IV	36	12.0		X	
V	34	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.63** inches

Effective Plasticity Index

BRAB	PCI
53	46

Soil Support Index

BRAB	PCI
0.61	0.67

Soil/Climatic Rating Factor

$1 - C_w$ = **0.33**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 11

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	52	3.5	X		
II	37	6.0	X		
III	38	9.0		X	
IV	35	12.0		X	
V	35	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.13** inches

Effective Plasticity Index

BRAB	PCI
52	42

Soil Support Index

BRAB	PCI
0.61	0.71

Soil/Climatic Rating Factor

$1 - C_w$ = **0.29**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 12

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	52	3.5	X		
II	38	6.0	X		
III	38	9.0		X	
IV	37	12.0		X	
V	37	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.21** inches

Effective Plasticity Index

BRAB	PCI
52	43

Soil Support Index

BRAB	PCI
0.61	0.70

Soil/Climatic Rating Factor

$1 - C_w$ = **0.30**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 13

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	52	3.5	X		
II	35	6.0	X		
III	36	9.0		X	
IV	35	12.0		X	
V	35	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.04** inches

Effective Plasticity Index

BRAB	PCI
52	41

Soil Support Index

BRAB	PCI
0.61	0.71

Soil/Climatic Rating Factor

$1 - C_w$ = **0.29**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 14

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	53	3.5	X		
II	38	6.0	X		
III	38	9.0		X	
IV	35	12.0		X	
V	35	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.19** inches

Effective Plasticity Index

BRAB	PCI
53	43

Soil Support Index

BRAB	PCI
0.61	0.70

Soil/Climatic Rating Factor

$1 - C_w$ = **0.30**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 15

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	53	3.5	X		
II	53	6.0	X		
III	35	9.0		X	
IV	35	12.0		X	
V	35	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.58** inches

Effective Plasticity Index

BRAB	PCI
53	45

Soil Support Index

BRAB	PCI
0.61	0.67

Soil/Climatic Rating Factor

$1 - C_w$ = **0.33**

RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

PVR Calculator

Frost GeoSciences, Inc.
13402 Western Oak
Helotes, Texas 78023

Project Name:	BRIGGS RANCH
Project Location:	Hwy 211
Project City:	SAN ANTONIO, TEXAS
Project Number:	FGS-G-21118
Boring Number:	B - 16

Surcharge Pressure: 1.00 **psi** **Climatic Rating, C_w:** 16

Stratum	Plasticity Index	Bottom Depth (feet)	Moisture Condition		
			Dry	Average	Optimum
I	53	3.5	X		
II	54	6.0	X		
III	35	9.0		X	
IV	35	12.0		X	
V	35	15.0			X
VI					
VII					
VIII					

PVR Results

PVR = **3.61** inches

Effective Plasticity Index

BRAB	PCI
45	45

Soil Support Index

BRAB	PCI
0.67	0.67

Soil/Climatic Rating Factor

$1 - C_w$ = **0.33**

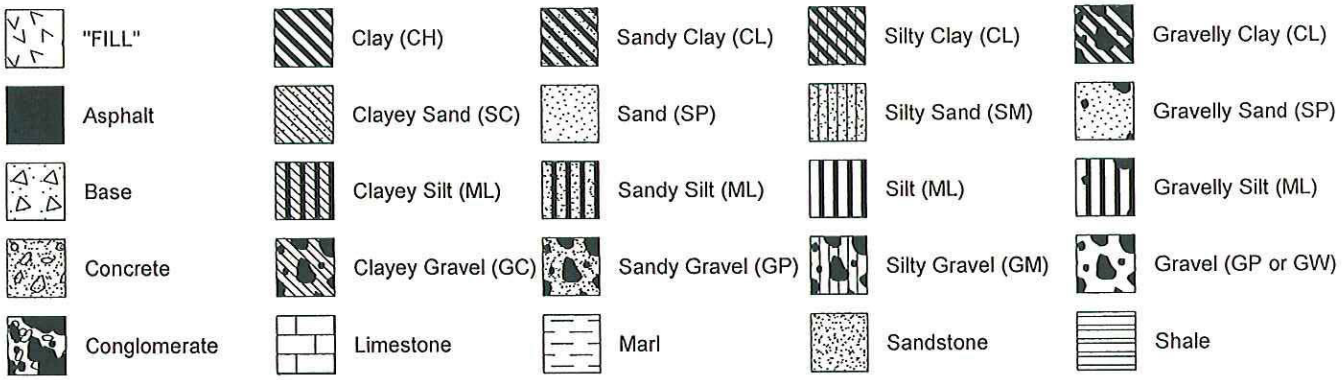
RULES

1.) Depths should not extend greater than 15 feet.
2.) Use only one moisture condition per stratum.
3.) Moisture conditions must be selected using an "x".
4.) Integers or one-half foot intervals must be used.
5.) Use PI = 8 for none expansive layers.
6.) DO NOT USE PI = 0 FOR NON-EXPANSIVE LAYERS.
7.) **Error checking is limited.**

SYMBOL KEY

Symbol Key Sheet

Material Symbols



Strength of Cohesive Soils

Consistency	Undrained Shear Strength, KSF
Very Soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very Stiff	2.00 to 4.00
Hard	greater than 4.00

Soil Plasticity

Degree of Plasticity	Plasticity Index (PI)
None	0 to 5
Low	5 to 10
Moderate	10 to 20
Plastic	20 to 40
Highly Plastic	more than 40

Density of Granular Soils

Descriptive Term	SPT Blow Count (blows/ft)
Very Loose	less than 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	more than 50

Standard Penetration Test (ASTM D 1586) Driving Record

Note: Driving is limited to 50 blows per interval, or 25 blows for 0.25 inch advancement, whichever controls. This is done to avoid damaging sampling tools.

Blows Per Foot	Description
25	Sampler was seated 6 inches, then 25 blows were required to advance the sampler 12 inches.
75/8"	Sampler was seated 6 inches, 25 blows were required for the second 6 inch increment and the 50 blow limit was reached at 2 inches of the last increment.
Ref/2"	Sampler could only be driven 2 inches of the 6 inch seating penetration before the 50 blow limit was reached.

Terms Characterizing Structure

Soil Terms	Description
Blocky	Contains cracks or failure planes resulting in rough cubes of material.
Calcareous	Contains appreciable quantities of calcium carbonate.
Fissured	Contains shrinkage cracks, which are frequently filled with fine sand or silt. The fissures are usually near vertical in orientation.
Interbedded	Composed of alternating layers of different soil types.
Laminated	Composed of thin layers of varying color and texture.
Nodules	Secondary inclusions that appear as small lumps about 0.1 to 0.3 inch in diameter.
Partings	Inclusion of different material less than 1/8 inch thick extending through the sample.
Pockets	Inclusion of different material that is smaller than the diameter of the sample.
Seams	Inclusion of different material between 1/8 and 3 inches thick, and extends through the sample.
Slickensided	Has inclined planes of weakness that are slick and glossy in appearance. Slickensides are commonly thought to be randomly oriented.
Streaks or Stains	Stains of limited extent that appear as short stripes, spots or blotches.

Rock Terms	
Bedding Plane	A surface parallel to the surface of deposition, generally marked by changes in color or grain size.
Fracture	A natural break in rock along which no displacement has occurred.
Joint	A natural break along which no displacement has occurred, and which generally intersects primary surfaces.
% Recovery	The ratio of total length of recovery to the total length of core run, expressed as a percentage.
RQD - Rock Quality Designation	The ratio of total recovered length of fragments longer than 4 inches to the total run length, expressed as a percentage.
Weathering	The process by which rock is broken down and decomposed.

Sampler Symbols

APPENDIX "B"

Moisture Density Relationship
CBR Test Results
Lime Series Curves
Sulfate Report
Spectra Pave Design Analysis

MOISTURE DENSITY

13406 Western Oak
Helotes, TX 78023
(210) 372-1315 phone (210) 372-1318 fax

Frost GeoSciences
Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

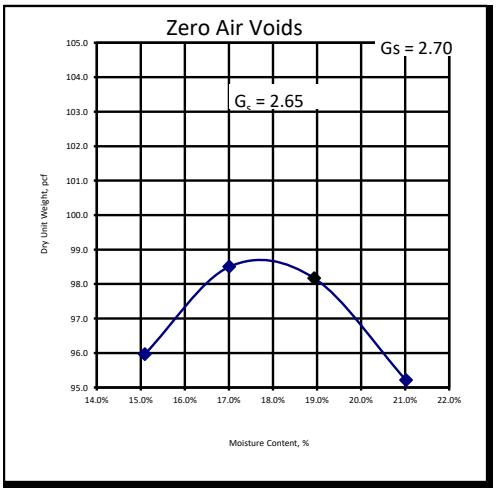
Project #: **FGS-G-21118**

Project: **Briggs Ranch**

Report Date: 7/13/2021
Sample Date: 7/7/2021

Client:	Pulte Group		
Report:	ASTM - Standard Proctor	LAB NO:	4102
Material:	Subgrade	Report #:	S1

Moisture-Density Relationship - Subgrade Soil



Test Results

% Moisture	Dry Density Lbs./ft^3
15.1%	96.0
17.0%	98.5
18.9%	98.2
21.0%	95.2

Optimum = 17.9

Maximum = 98.5

Sieve	% Passing
3 inch	100.0%
3/4 inch	100.0%
3/8 inch	100.0%
No. 4	100.0%
No.10	61.9%
No. 40	29.5%
No.100	13.3%
No.200	4.7%

Color:	Black Grey
Description:	Clay
Liquid Limit:	73
Plastic Limit:	21
Plasticity Index:	52

Location: Project Site

Desc of Rammer: Mechanical
Preparation Method: Dry
Remarks: No comments at this time.

Test Method (As Applicable): ASTM D-698 A
ASTM D-4318

Respectfully Submitted,
Frost GeoSciences, Inc.

F.J.Caballero, P. E. , Project Manager

13406 Western Oak
Helotes, TX 78023
(210) 372-1315 phone (210) 372-1318 fax

Frost GeoSciences
Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

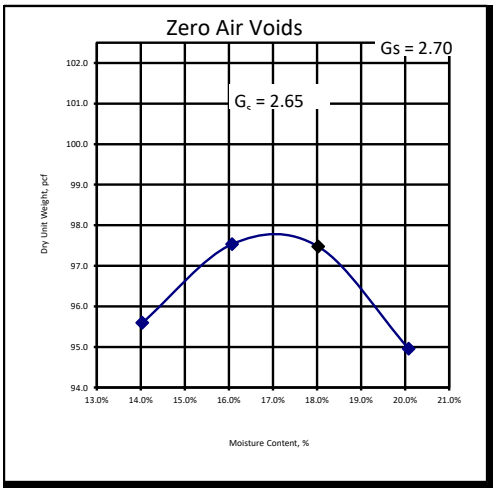
Project #: **FGS-G-21118**

Project: **Briggs Ranch**

Report Date: 7/21/2021
Sample Date: 7/7/2021

Client:	Pulte Group		
Report:	ASTM - Standard Proctor	LAB NO:	4102
Material:	Subgrade	Report #:	S2

Moisture-Density Relationship - Subgrade Soil



Test Results

% Moisture	Dry Density Lbs./ft^3
14.0%	95.6
16.1%	97.5
18.0%	97.5
20.1%	95.0

Optimum = 17

Maximum = 97.5

Sieve	% Passing
3 inch	100.0%
3/4 inch	100.0%
3/8 inch	100.0%
No. 4	100.0%
No.10	48.8%
No. 40	22.1%
No.100	10.4%
No.200	3.1%

Color:	Black Grey
Description:	Clay
Liquid Limit:	69
Plastic Limit:	18
Plasticity Index:	51

Location: Project Site

Desc of Rammer: Mechanical
Preparation Method: Dry
Remarks: No comments at this time.

Test Method (As Applicable): ASTM D-698 A
ASTM D-4318

Respectfully Submitted,
Frost GeoSciences, Inc.

F.J.Caballero, P. E. , Project Manager

13406 Western Oak
Helotes, TX 78023
(210) 372-1315 phone (210) 372-1318 fax

Frost GeoSciences
Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

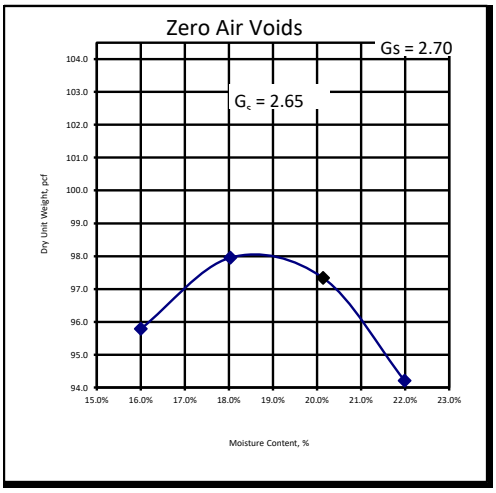
Project #: **FGS-G-21118**

Project: **Briggs Ranch**

Report Date: 7/21/2021
Sample Date: 7/7/2021

Client:	Pulte Group		
Report:	ASTM - Standard Proctor	LAB NO:	4102
Material:	Subgrade	Report #:	S3

Moisture-Density Relationship - Subgrade Soil



Test Results

% Moisture	Dry Density Lbs./ft^3
16.0%	95.8
18.0%	98.0
20.1%	97.3
22.0%	94.2

Optimum = 18.5

Maximum = 98

Sieve	% Passing
3 inch	100.0%
3/4 inch	100.0%
3/8 inch	100.0%
No. 4	100.0%
No.10	29.9%
No. 40	11.2%
No.100	1.5%
No.200	0.9%

Color:	Black Grey
Description:	Clay
Liquid Limit:	73
Plastic Limit:	18
Plasticity Index:	55

Location: Project Site

Desc of Rammer: Mechanical
Preparation Method: Dry
Remarks: No comments at this time.

Test Method (As Applicable): ASTM D-698 A
ASTM D-4318

Respectfully Submitted,
Frost GeoSciences, Inc.

F.J.Caballero, P. E. , Project Manager

CBR RESULTS

Frost GeoSciences, Inc.
13406 Western Oak
Helotes, Texas 78023

CBR (California Bearing Ratio)
ASTM D1883

Project Name: Briggs Ranch Project #: FGS-G21118
Soil Desc. Black Grey Clay CBR #1
Tested By: Miguel Gonzalez Jr. Test Date: 07/15/21

Compaction Energy: Rammer: 5.5 lbs. # layers: 3 Blows: 56
w at compaction: 17.90% Mold Dia. 6 in. Soil Ht. 4.584 in.
Volume 0.075 ft.^{3} Opt. M.C. 17.9
Opt. Dry Unit wt. 98.5

	Initial	Final	%S
Date/Time	7/12/21 8:00am	7/13/21 8:15am	
Swell Data	0.000	0.041	0.89

Mold #	1
Surcharge, lbs.	10
Initial mass of wet soil + mold, lbs.	26.336
Final mass of wet soil + mold, lbs.	26.666
Mass of Mold, lbs.	18.066
Initial mass of wet soil, lbs.	8.27

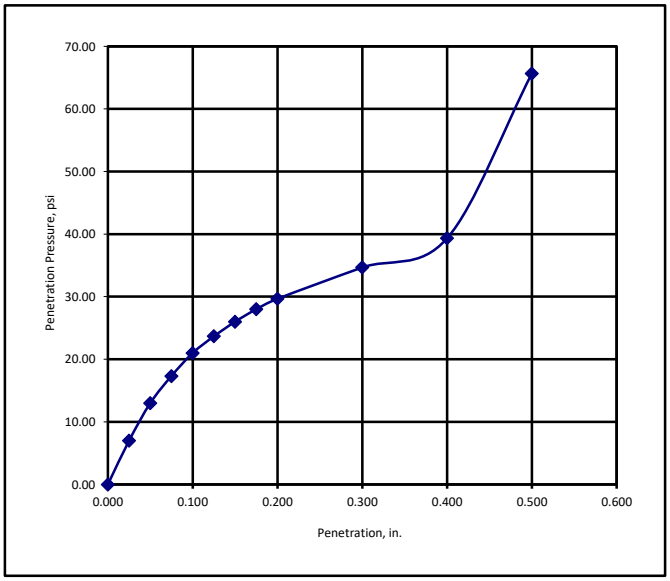
Dry density = 98.5 Comp. 1.00047
Moisture = 18.0 Points Opt. 0.08151

ASTM D2216 Moisture Content

Compaction	Project #	Can No.	Wet Wt. (1)	Dry Wt. (2)	Tare Wt. (3)	(1) - (2) = A	(2) - (3) = B	%MC = A/B*100
Before	GS-G21118		676.08	611.92	174.06	64.16	437.86	14.65309
After	GS-G21118		654.85	570.81	176.44	84.04	394.37	21.30994

ASTM D1883 Date: 7/15/2021
Time: 8:30am

Strain, in.	Load, lbs	Stress, psi	CBR
0.000	0.00	0.00	
0.025	21.00	7.00	
0.050	39.00	13.00	
0.075	52.00	17.33	
0.100	63.00	21.00	2.1
0.125	71.00	23.67	
0.150	78.00	26.00	
0.175	84.00	28.00	
0.200	89.00	29.67	2.0
0.300	104.00	34.67	
0.400	118.00	39.33	
0.500	197.00	65.67	



Frost GeoSciences, Inc.
13406 Western Oak
Helotes, Texas 78023

CBR (California Bearing Ratio)
ASTM D1883

Project Name: Briggs Ranch — Project #: FGS-G21118
Soil Desc. Black Grey Clay CBR #2
Tested By: Miguel Gonzalez Jr. — Test Date: 07/15/21

Compaction Energy: Rammer: 5.5 lbs. # layers: 3 Blows: 56
w at compaction: 17.00% Mold Dia. 6 in. Soil Ht. 4.584 in.
Volume 0.075 $ft.^3$

	Initial	Final	%S
Date/Time	7/12/21 8:15am	7/13/21 8:30am	
Swell Data	0.000	0.05	1.09

Opt. M.C.	17.0
Opt. Dry Unit wt.	97.5
Mold #	2
Surcharge, lbs.	10
Initial mass of wet soil + mold, lbs.	26.231
Final mass of wet soil + mold, lbs.	26.516
Mass of Mold, lbs.	18.098
Initial mass of wet soil, lbs.	8.133

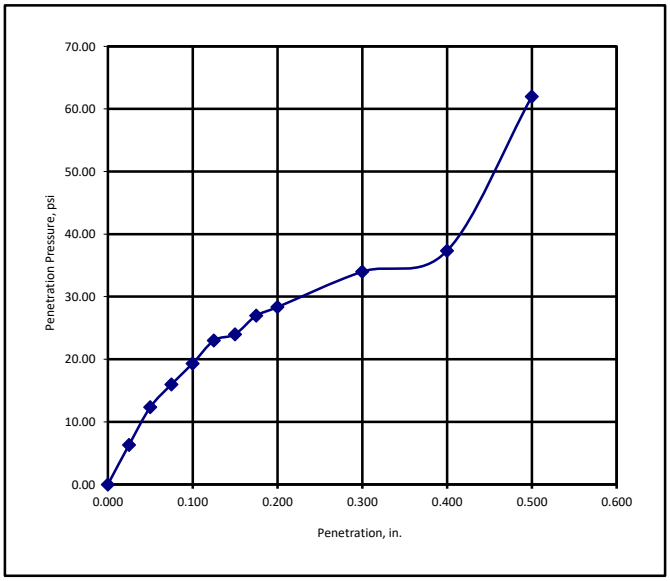
Dry density = 97.3 Comp. 1.00047
Moisture = 17.2 Points Opt. 0.21784

ASTM D2216 Moisture Content

Compaction	Project #	Can No.	Wet Wt. (1)	Dry Wt. (2)	Tare Wt. (3)	(1) - (2) = A	(2) - (3) = B	%MC = A/B*100
Before	GS-G21118		656.08	618.92	172.33	37.16	446.59	8.320831
After	GS-G21118		634.85	538.81	171.05	96.04	367.76	26.11486

ASTM D1883 Date: 7/15/2021
Time: 8:45am

Strain, in.	Load, lbs	Stress, psi	CBR
0.000	0.00	0.00	
0.025	19.00	6.33	
0.050	37.00	12.33	
0.075	48.00	16.00	
0.100	58.00	19.33	1.9
0.125	69.00	23.00	
0.150	72.00	24.00	
0.175	81.00	27.00	
0.200	85.00	28.33	1.9
0.300	102.00	34.00	
0.400	112.00	37.33	
0.500	186.00	62.00	



Frost GeoSciences, Inc.
13406 Western Oak
Helotes, Texas 78023

CBR (California Bearing Ratio)
ASTM D1883

Project Name: Briggs Ranch Project #: FGS-G21118
Soil Desc. Black Grey Clay CBR #3
Tested By: Miguel Gonzalez Jr. Test Date: 07/15/21

Compaction Energy: Rammer: 5.5 lbs. # layers: 3 Blows: 56
w at compaction: 18.50% Mold Dia. 6 in. Soil Ht. 4.584 in.
Volume 0.075 ft.^{3} Opt. M.C. 18.5
Opt. Dry Unit wt. 98

	Initial	Final	%S
Date/Time	7/12/21 8:30am	7/13/21 8:45am	
Swell Data	0.000	0.35	7.64

Mold #	3
Surcharge, lbs.	10
Initial mass of wet soil + mold, lbs.	26.451
Final mass of wet soil + mold, lbs.	26.606
Mass of Mold, lbs.	18.15
Initial mass of wet soil, lbs.	8.301

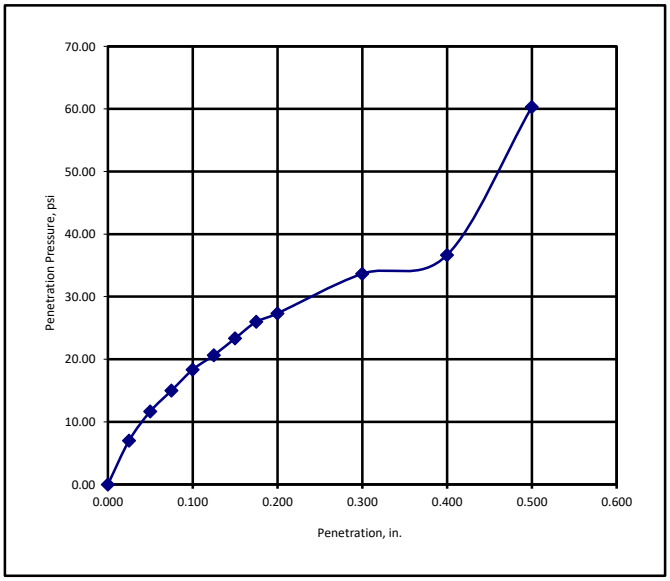
Dry density = 97.8 Comp. 1.00047
Moisture = 18.3 Points Opt. -0.23679

ASTM D2216 Moisture Content

Compaction	Project #	Can No.	Wet Wt. (1)	Dry Wt. (2)	Tare Wt. (3)	(1) - (2) = A	(2) - (3) = B	%MC = A/B*100
Before	GS-G21118		586.08	484.92	171.36	101.16	313.56	32.26177
After	GS-G21118		634.85	615.81	169.35	19.04	446.46	4.26466

ASTM D1883 Date: 7/15/2021
Time: 9:00am

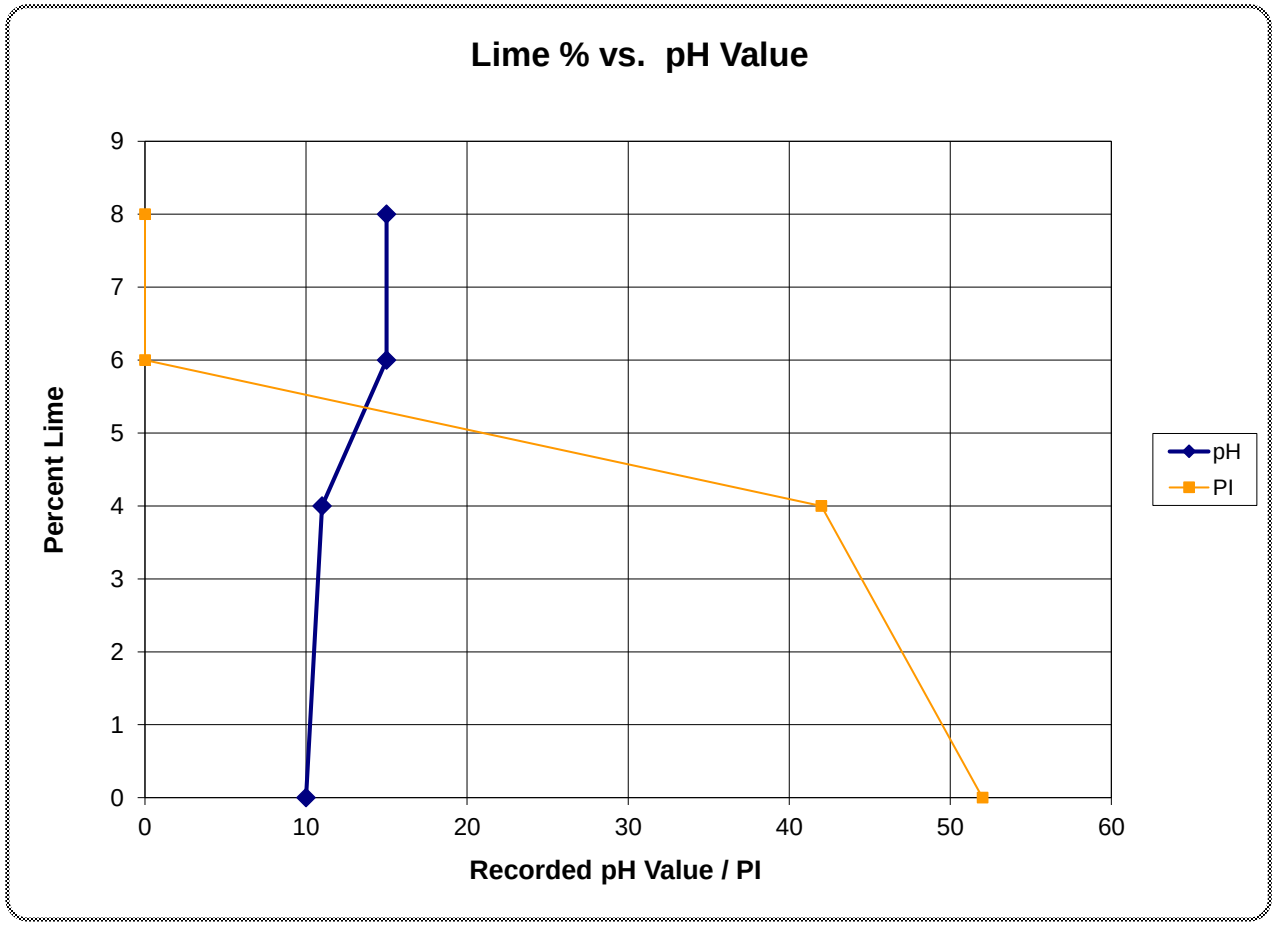
Strain, in.	Load, lbs	Stress, psi	CBR
0.000	0.00	0.00	
0.025	21.00	7.00	
0.050	35.00	11.67	
0.075	45.00	15.00	
0.100	55.00	18.33	1.8
0.125	62.00	20.67	
0.150	70.00	23.33	
0.175	78.00	26.00	
0.200	82.00	27.33	1.8
0.300	101.00	33.67	
0.400	110.00	36.67	
0.500	181.00	60.33	



Frost GeoSciences

LIME SERIES CURVES

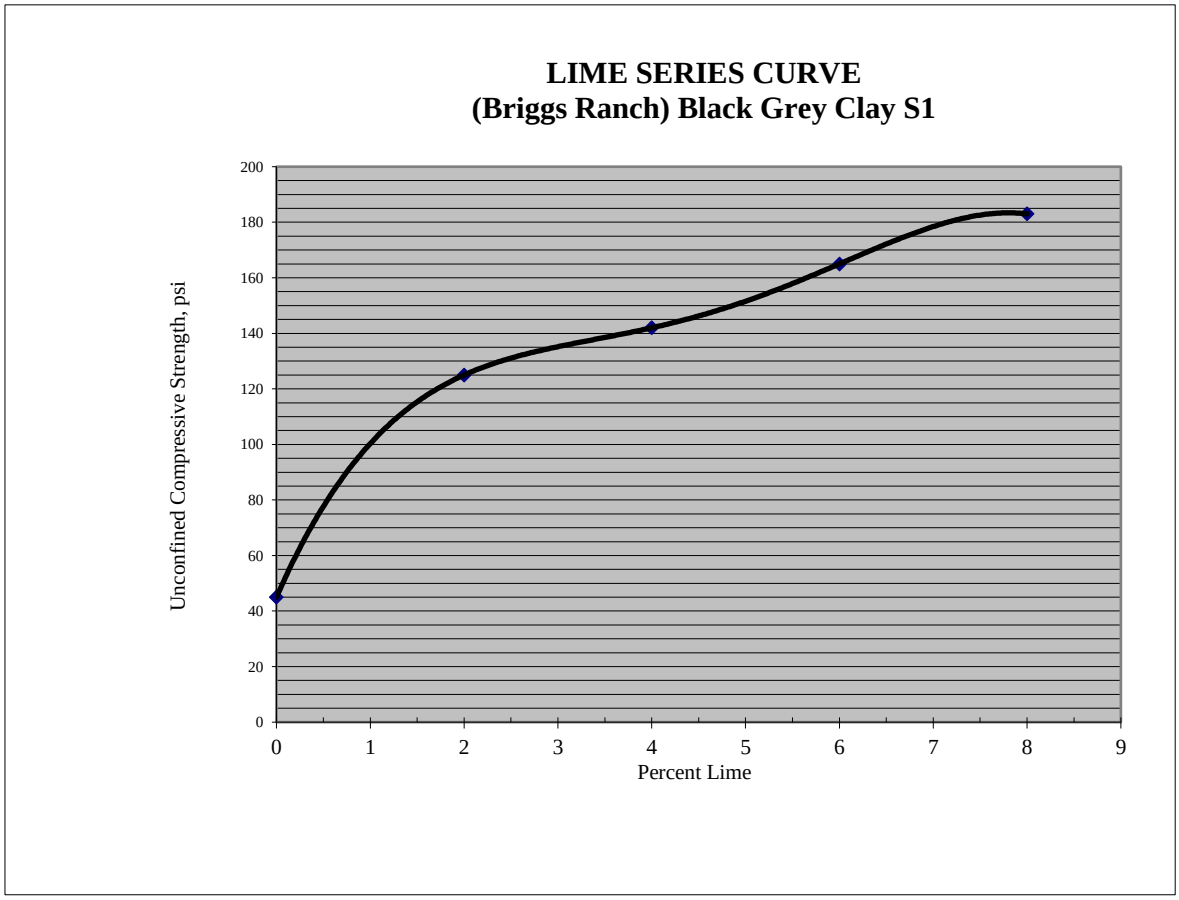
FGS Project No.: FGS-G21118

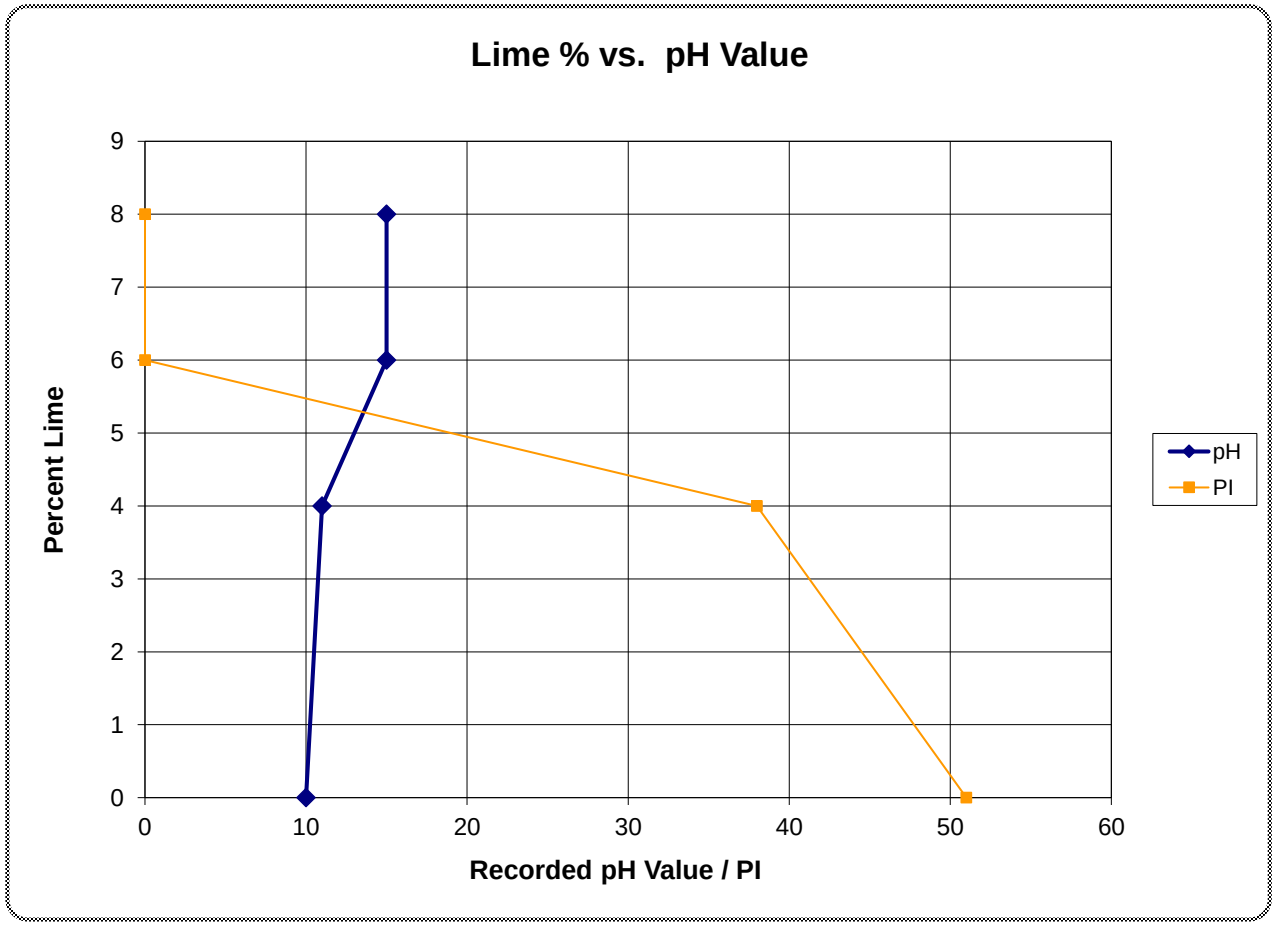


Project Name: Briggs Rach
Project Number: FGS-G-21118
Soil Description: Black Grey Clay S1

%Lime	pH	PI
0	10	52
4	11	42
6	15	0
8	15	0

0	45
2	125
4	142
6	165
8	183

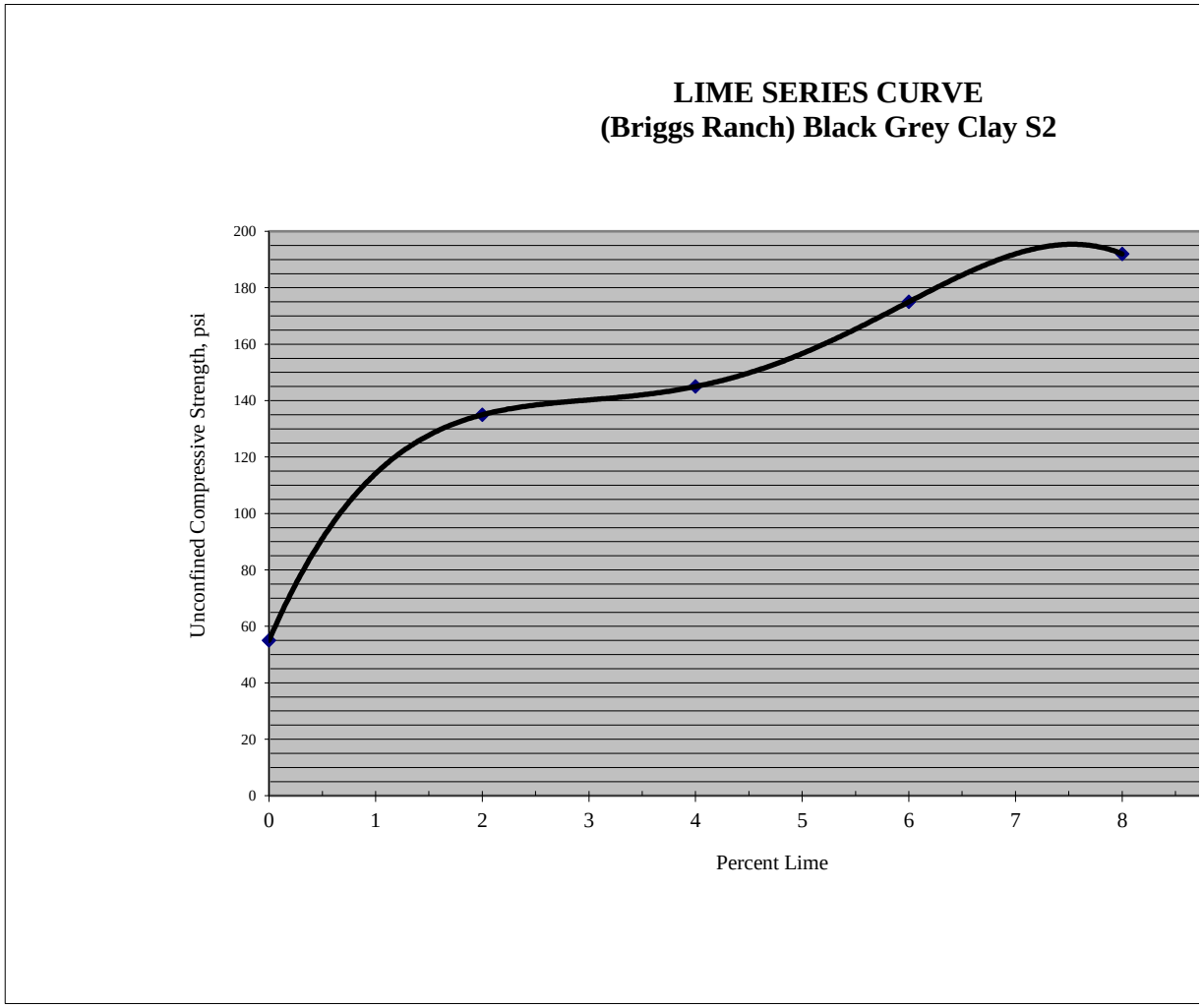


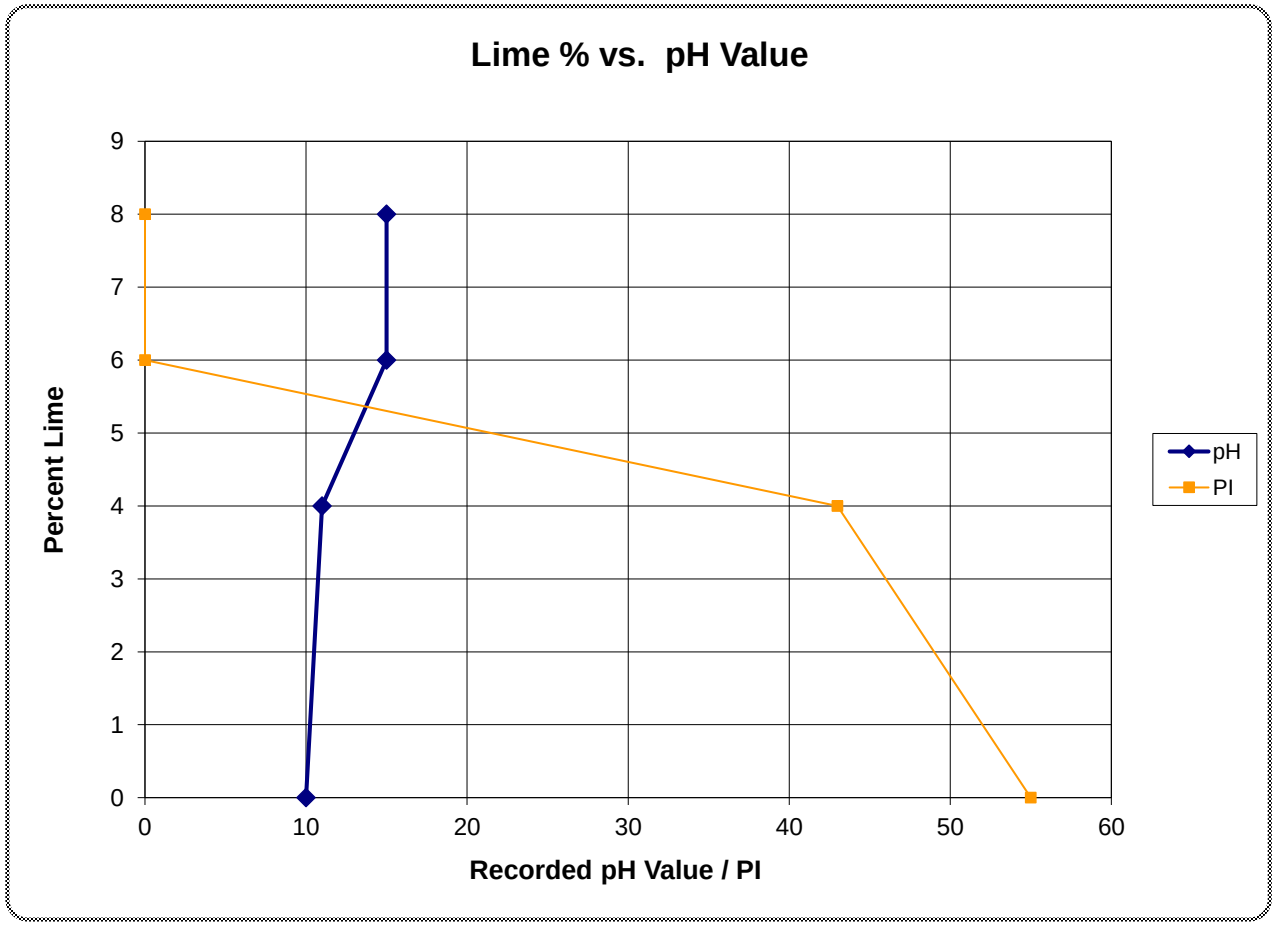


Project Name: Briggs Rach
Project Number: FGS-G-21118
Soil Description: Black Grey Clay S2

%Lime	pH	PI
0	10	51
4	11	38
6	15	0
8	15	0

0	55
2	135
4	145
6	175
8	192

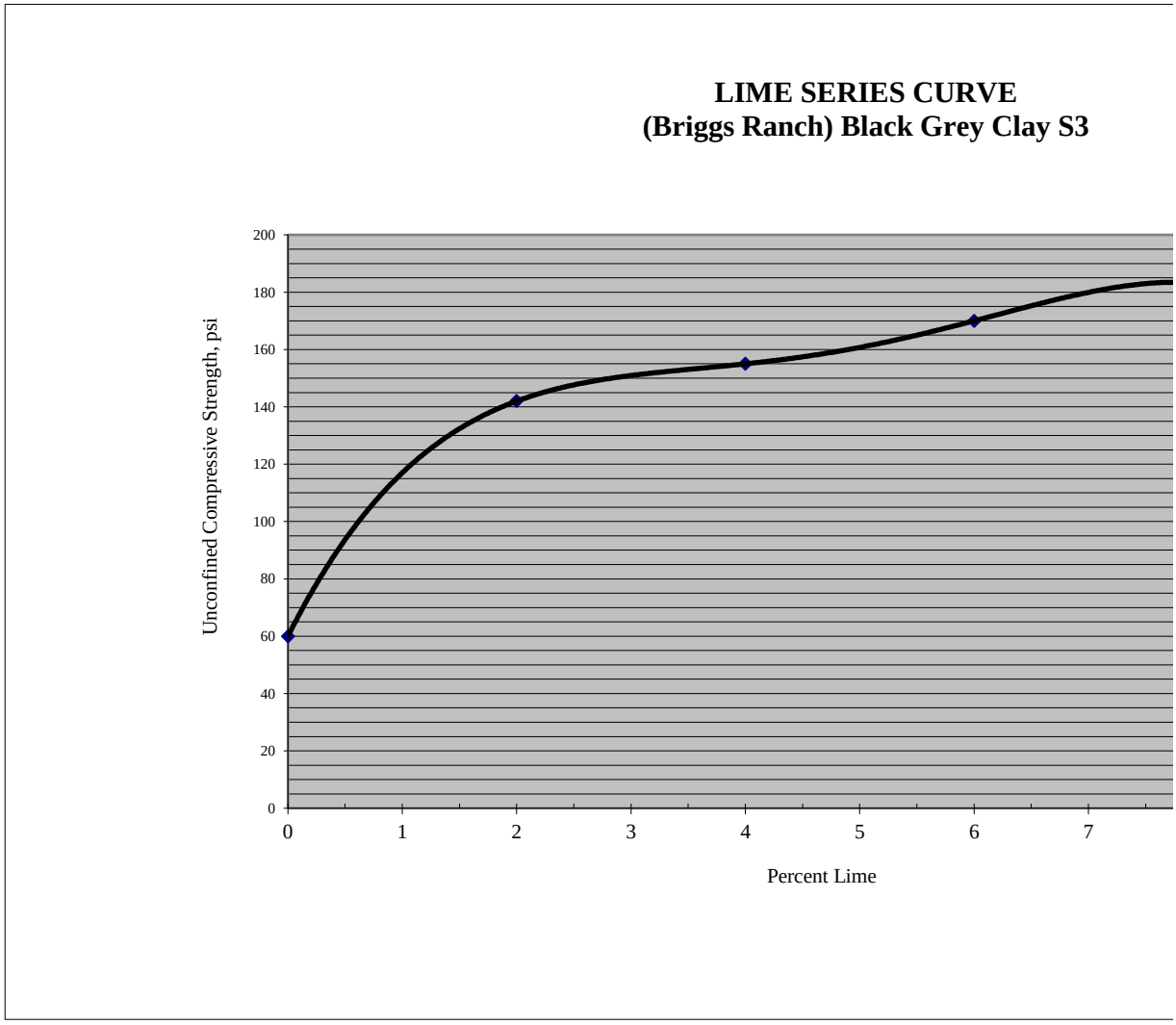




Project Name: Briggs Rach
Project Number: FGS-G-21118
Soil Description: Black Grey Clay S3

%Lime	pH	PI
0	10	55
4	11	43
6	15	0
8	15	0

0	60
2	142
4	155
6	170
8	183



Frost GeoSciences

SULFATE REPORT

FGS Project No.: FGS-G21118

SAN ANTONIO TESTING LABORATORY

July 09, 2021

Miguel Gonzalez
Frost GeoSciences, Inc
13406 Western Oak
Helotes, TX 78023

SATL Report No.: 2106475
RE: Briggs Ranch Hwy 211 San Antonio TX
Project Number: FGS-6-21118

Dear Miguel Gonzalez

SATL received 1 Sample(s) on 06/30/2021 for analyses identified on the chain of custody. The analyses were performed using methods indicated on the laboratory report. Any deviations observed at sample receiving are notated on the Sample Receipt Checklist and/or Chain of Custody documents attached as part of this analytical report.

Sincerely,

For San Antonio Testing Laboratory, Inc.

Richard Hawk,
General Manager

Frost GeoSciences, Inc
13406 Western Oak
Helotes TX, 78023

Project Manager: Miguel Gonzalez
Project: Briggs Ranch Hwy 211 San Antonio TX
Project Number: FGS-6-21118

Reported:
07/09/21 17:43
Received:
06/30/21 12:21

Additional Notes:

Report No. 2106475

SAMPLE SUMMARY

Total Samples received in this work order: **1**

The following samples were requested for analysis as per the CoC. Any re-runs or re-analyses requested are identified as such.

Sample ID	Laboratory ID	Matrix	Sampling Method	Date Sampled	Date Received
B-02 Black & Grey Clay	2106475-01	Solid	Grab	06/30/21 11:40	06/30/21 12:21

Notes

All quality control samples and checks are within acceptance limits unless otherwise indicated.
Test results pertain only to those items tested.
All samples were in good condition when received by the laboratory unless otherwise noted.

Frost GeoSciences, Inc
13406 Western Oak
Helotes TX, 78023

Additional Notes:

Project Manager: Miguel Gonzalez
Project: Briggs Ranch Hwy 211 San Antonio TX
Project Number: FGS-6-21118

Reported:
07/09/21 17:43
Received:
06/30/21 12:21

Report No. 2106475

Sample ID #: B-02 Black & Grey Clay **Sampling Method: Grab** **Lab Sample ID #: 2106475-01**

Sample Matrix: Solid **Date/Time Collected: 06/30/21 11:40**

Analyte	Result	Units	PQL	Prep Method	Batch	Analyzed	Method	Analyst	Notes
Anions by Ion Chromatography									
Sulfate *	8.08	mg/kg	0.20	EPA 300.0	B128245	07/08/21 23:21	EPA 300.0	SG	

Frost GeoSciences, Inc
13406 Western Oak
Helotes TX, 78023

Additional Notes:

Project Manager: Miguel Gonzalez
Project: Briggs Ranch Hwy 211 San Antonio TX
Project Number: FGS-6-21118

Reported:
07/09/21 17:43
Received:
06/30/21 12:21

Report No. 2106475

Anions by Ion Chromatography - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B128245 - EPA 300.0									
Blank (B128245-BLK1)				Prepared: 07/08/21 16:00		Analyzed: 07/08/21 18:36			
Sulfate	<0.10	0.10	mg/kg						
LCS (B128245-BS1)				Prepared: 07/08/21 16:00		Analyzed: 07/08/21 18:53			
Sulfate	51.7	0.10	mg/kg	50.0		103	90-110		
LCS Dup (B128245-BSD1)				Prepared: 07/08/21 16:00		Analyzed: 07/08/21 19:11			
Sulfate	51.5	0.10	mg/kg	50.0		103	90-110	0.5	30
Duplicate (B128245-DUP1)		**Source: 2106475-01**		Prepared: 07/08/21 16:00		Analyzed: 07/08/21 23:39			
Sulfate	7.76	0.20	mg/kg		8.08			4	20

Frost GeoSciences, Inc
13406 Western Oak
Helotes TX, 78023

Project Manager: Miguel Gonzalez
Project: Briggs Ranch Hwy 211 San Antonio TX
Project Number: FGS-6-21118

Reported:
07/09/21 17:43
Received:
06/30/21 12:21

Additional Notes:

Report No. 2106475

DEFINITIONS

*	TNI / NELAC accredited analyte
PQL	Practical Quantitation Limit
MCL	Maximum Contaminant Level
mg/Kg	Milligrams per Kilogram (Parts per Million)
mg/L	Milligrams per Liter (Parts per Million)
PPM	Parts per Million
L	LCS recovery is outside QC acceptance limits, the results may have a slight bias.
M	MS recovery is outside QC limits, the results may have a slight bias due to possible matrix interferences.
NR	Not Recovered due to source sample concentration exceeds spiked concentration.
RMCCL	Recommended Maximum Concentration of Contaminants Level
Surr L	Surrogate recovery is low outside QC limits.
Surr H	Surrogate recovery is high outside QC limits.
HT	Sample received past holdtime
IC	Improper Container
IT	Improper Temperature
V	Inssuficient Volume
B	Sample collected in Bulk
S	RPD is outside QC limits.
AB	VOA Vial contained air bubbles.
OP	ortho-Phosphate was not filtered in the field within 15minutes of collection.
CCV	Continuing Calibration Verification Standard.
ICV	Initial Calibration Verification Standard.

Test Methods followed by the laboratory are referenced in the following approved methodology, unless otherwise specified.

Standard Methods for the Examination of Water and Wastewater, 22nd Edition
Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, Rev. March 1983
EPA SW Test Methods for the Examination of Solid Waste, SW-846, 1996

Gina Peachey For Marcela Gracia Hawk, President For

Richard Hawk, General Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

SPECTRA PAVE

FGS Project No.: FGS-G21118

LOCAL "A"

FGS Project No.: FGS-G21118

Pavement Optimization

Design Analysis

Parameters

Project Information

Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
2,850 psi	100,000	70%	0.45	4.2	2

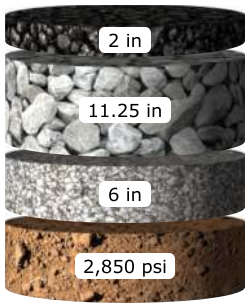
Results

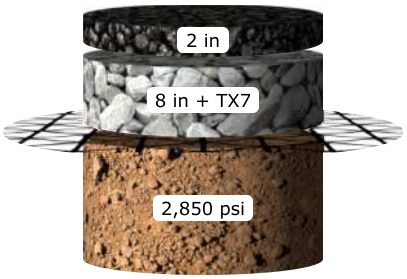
Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	2 in	0.440	0.880
Aggregate base	11.25 in	0.140	1.575
Subbase	6 in	0.080	0.480
Structural number (SN)			2.935
Calculated traffic (ESALs)			102,100

TriAx Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	2 in	0.440	0.880
Mechanically stabilized layer	8 in	0.271	2.168
Structural number (SN)			3.048
Calculated traffic (ESALs)			130,900





Limitations of this Report
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Design	TYPE -A	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	7/25/2021

This report was prepared using the Tensar app.

Tensar

Pavement Optimization

Cost Analysis

Parameters

Project Size

Project length	2,500 ft
Project width	25 ft

Unstabilized Pavement Section Costs

HMA layer 1	$90/ton
Aggregate base	$20/ton
Subbase	$16/ton

Stabilized Pavement Section Costs

HMA layer 1	$90/ton
Mechanically stabilized layer	$20/ton

Grading Requirements

Grade offset	Meet existing grade
Excavation cost	$5/yd³

Geosynthetic Costs

TX7	$5/yd²

Results

Initial Construction Costs

	Unstabilized	Stabilized
HMA layer 1	$69,383	$69,383
Aggregate base	$79,084	$56,237
Subbase	$33,742	$0
Geogrid		$34,722
Excavation	$18,567	$9,645
Total cost	$200,776	$169,987
Unit cost	$28.91/yd²	$24.48/yd²
Savings		$30,788 (15%)

Additional Considerations

	Unstabilized	Stabilized
Construction time	26 days	14 days
Dump truck trips	803	416
Fuel required	4,283 gal	2,219 gal
Water required	83,204 gal	38,587 gal

Lifecycle Cost

	Unstabilized	Stabilized
Total	$1,346,609	$968,598
Net present value	$1,095,214	$818,782

Design	TYPE -A	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	7/25/2021

Tensar

LOCAL "B"

FGS Project No.: FGS-G21118

Pavement Optimization

Design Analysis

Parameters

Project Information

Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
2,850 psi	2,000,000	90%	0.45	4.2	2

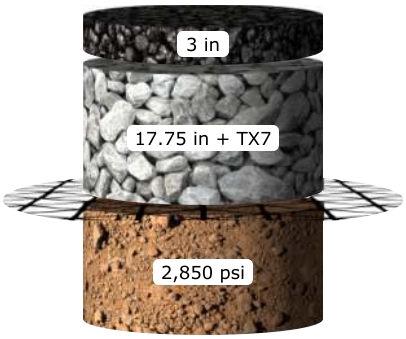
Results

Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	4.75 in	0.440	2.090
Aggregate base	18 in	0.140	2.520
Subbase	6 in	0.080	0.480
Structural number (SN)			5.090
Calculated traffic (ESALs)			2,147,900

TriAx Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	3 in	0.440	1.320
Mechanically stabilized layer	17.75 in	0.210	3.727
Structural number (SN)			5.047
Calculated traffic (ESALs)			2,017,400



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Design	TYPE -B	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	7/25/2021

This report was prepared using the Tensar app.

Tensar

Pavement Optimization

Cost Analysis

Parameters

Project Size

Project length	2,500 ft
Project width	25 ft

Unstabilized Pavement Section Costs

HMA layer 1	$90/ton
Aggregate base	$20/ton
Subbase	$16/ton

Stabilized Pavement Section Costs

HMA layer 1	$90/ton
Mechanically stabilized layer	$20/ton

Grading Requirements

Grade offset	Meet existing grade
Excavation cost	$5/yd³

Geosynthetic Costs

TX7	$5/yd²

Results

Initial Construction Costs

	Unstabilized	Stabilized
HMA layer 1	$164,784	$104,074
Aggregate base	$126,534	$124,776
Subbase	$33,742	$0
Geogrid		$34,722
Excavation	$27,730	$20,014
Total cost	$352,790	$283,587
Unit cost	$50.80/yd²	$40.84/yd²
Savings		$69,203 (20%)

Additional Considerations

	Unstabilized	Stabilized
Construction time	39 days	28 days
Dump truck trips	1,195	863
Fuel required	6,373 gal	4,603 gal
Water required	115,761 gal	85,615 gal

Lifecycle Cost

	Unstabilized	Stabilized
Total	$1,498,623	$1,082,198
Net present value	$1,247,229	$932,381

Design	TYPE -B	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	7/25/2021

Tensar

COLLECTOR

FGS Project No.: FGS-G21118

Pavement Optimization

Design Analysis

Parameters

Project Information

Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
2,850 psi	2,000,000	90%	0.45	4.2	2.5

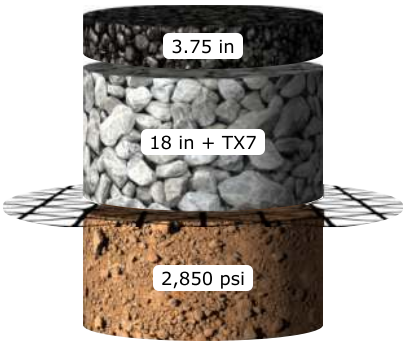
Results

Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	5.75 in	0.440	2.530
Aggregate base	18 in	0.140	2.520
Subbase	6 in	0.080	0.480
Structural number (SN)			5.530
Calculated traffic (ESALs)			2,309,900

TriAx Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	3.75 in	0.440	1.650
Mechanically stabilized layer	18 in	0.210	3.780
Structural number (SN)			5.430
Calculated traffic (ESALs)			2,022,100



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Design	COLLECTOR, NO BLACK BASE	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	7/25/2021

This report was prepared using the Tensar app.

Pavement Optimization

Cost Analysis

Parameters

Project Size

Project length	2,500 ft
Project width	25 ft

Unstabilized Pavement Section Costs

HMA layer 1	$90/ton
Aggregate base	$20/ton
Subbase	$16/ton

Stabilized Pavement Section Costs

HMA layer 1	$90/ton
Mechanically stabilized layer	$20/ton

Grading Requirements

Grade offset	Meet existing grade
Excavation cost	$5/yd³

Geosynthetic Costs

TX7	$5/yd²

Results

Initial Construction Costs

	Unstabilized	Stabilized
HMA layer 1	$199,476	$130,093
Aggregate base	$126,534	$126,534
Subbase	$33,742	$0
Geogrid		$34,722
Excavation	$28,694	$20,978
Total cost	$388,446	$312,327
Unit cost	$55.94/yd²	$44.98/yd²
Savings		$76,119 (20%)

Additional Considerations

	Unstabilized	Stabilized
Construction time	41 days	30 days
Dump truck trips	1,235	905
Fuel required	6,586 gal	4,826 gal
Water required	115,761 gal	86,821 gal

Lifecycle Cost

	Unstabilized	Stabilized
Total	$1,534,279	$1,110,938
Net present value	$1,282,884	$961,121

Design	COLLECTOR, NO BLACK BASE	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	7/25/2021

Tensar

Frost GeoSciences

COLLECTOR
Black Base

FGS Project No.: FGS-G21118

Pavement Optimization

Design Analysis

Parameters

Project Information

Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
2,850 psi	2,000,000	90%	0.45	4.2	2.5

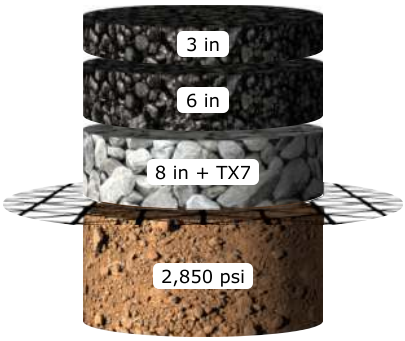
Results

Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	3 in	0.440	1.320
HMA layer 2	6 in	0.380	2.280
Aggregate base	9.75 in	0.140	1.365
Subbase	6 in	0.080	0.480
Structural number (SN)			5.445
Calculated traffic (ESALs)			2,063,100

TriAx Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	3 in	0.440	1.320
HMA layer 2	6 in	0.380	2.280
Mechanically stabilized layer	8 in	0.271	2.168
Structural number (SN)			5.768
Calculated traffic (ESALs)			3,152,700



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Design	COLLECTOR, BLACK BASE	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	7/25/2021

Tensar

Pavement Optimization

Cost Analysis

Parameters

Project Size

Project length	2,500 ft
Project width	25 ft

Unstabilized Pavement Section Costs

HMA layer 1	$90/ton
HMA layer 2	$75/ton
Aggregate base	$20/ton
Subbase	$16/ton

Stabilized Pavement Section Costs

HMA layer 1	$90/ton
HMA layer 2	$75/ton
Mechanically stabilized layer	$20/ton

Grading Requirements

Grade offset	Meet existing grade
Excavation cost	$5/yd³

Geosynthetic Costs

TX7	$5/yd²

Results

Initial Construction Costs

	Unstabilized	Stabilized
HMA layer 1	$104,074	$104,074
HMA layer 2	$173,457	$173,457
Aggregate base	$68,539	$56,237
Subbase	$33,742	$0
Geogrid		$34,722
Excavation	$23,872	$16,397
Total cost	$403,685	$384,888
Unit cost	$58.13/yd²	$55.42/yd²
Savings		$18,797 (5%)

Additional Considerations

	Unstabilized	Stabilized
Construction time	35 days	25 days
Dump truck trips	1,022	698
Fuel required	5,450 gal	3,723 gal
Water required	75,968 gal	38,587 gal

Lifecycle Cost

	Unstabilized	Stabilized
Total	$1,549,518	$1,183,499
Net present value	$1,298,123	$1,033,682

Design	COLLECTOR, BLACK BASE	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	7/25/2021

GEOTECHNICAL ENGINEERING STUDY

BRIGGS RANCH
BEXAR COUNTY, TEXAS
REVISED
LOCAL "B" AND COLLECTOR PAVEMENT DESIGN

FROST GEOSCIENCES, INC. PROJECT NO.: FGS-G 21118, S-1

REVISED

FEBRUARY 9, 2022

Prepared Exclusively for:

Mr. Evan Kasprowicz
PAPE DAWSON ENGINEERING
San Antonio, Texas

Frost GeoSciences
Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

Frost GeoSciences
Construction Materials ▪ Forensics
Environmental ▪ Geotechnical

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TBPE Firm Registration # F-9227
TBPG Firm Registration # 50040

Revised
February 9, 2022

Mr. Evan Kasprowicz
PAPE DAWSON ENGINEERING
San Antonio, Texas 78213

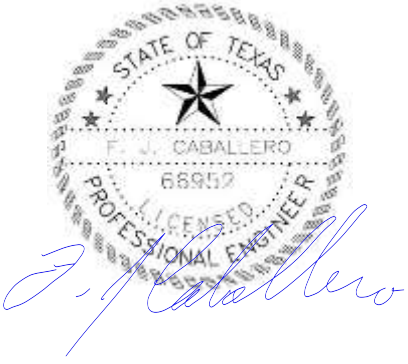
SUBJECT:
Geotechnical Engineering Services
Briggs Ranch Development
Bexar County, Texas
FGS Project No: FGS-G21118, S-1

Dear Mr. Kasprowicz;

Attached, please find the revised pavement designs for Local "B" and Collector Streets in Bexar County. These designs use Type "C" and Type "D" HMAC. You also need to keep in mind that at **Six (6) % by weight, the lime will increase** to **36 pounds of hydrated line per square yard** for an eight **(8) inch depth** of subgrade. We have included the TENSAR pavement designs for your files.

We appreciate the opportunity to be of service to you in this phase of your project and future projects. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,
Frost GeoSciences, Inc.



F. J. Caballero, P.E.
Project Engineer

FGS-G-21118, S-1

Copies Submitted:
i. One (1) Electronic: Mr. Evan Kasprowicz, P.E., PAPE DAWSON, San Antonio, Texas

Input Parameters used in Asphalt Pavement Section Calculation

BEXAR COUNTY Pavement Specifications								
	Primary and Secondary Arterials		Collector Streets		Local Type "B"		Local Type "A"	
W18	ESAL = 3,000,000		ESAL = 2,000,000		ESAL = 2,000,000		ESAL = 1,000,000	
R	95%		90%		90%		70%	
So	Flexible	Rigid	Flexible	Rigid	Flexible	Rigid	Flexible	Rigid
	0.45	0.35	0.45	0.35	0.45	0.35	0.45	0.35
Po	4.2	4.5	4.2	4.5	4.2	4.5	4.2	4.5
Pt	2.5	2.5	2.5	2.5	2.0	2.5	2.0	2.0
ΔPSI	1.7	2.0	1.7	2.0	2.2	2.0	2.2	2.5
T	20		20		20		20	
SN	Min.	Max	Min.	Max.	Min.	Max.	Min.	Max.
	3.80	5.76	2.92	5.05	2.98	5.05	2.58	4.20

for the purposes of developing layer thicknesses for the pavement sections shown below, we have used the following structural coefficients in the calculation of pavement structural numbers:

Material Type	Structural Coefficient	Drainage Coefficient
TXDOT Item 340, Hot Mixed Asphaltic Concrete	0.44	1.00
TXDOT Items 292 or 340, Asphalt Treated Base	0.38	1.00
TXDOT Item 247, Flexible Base - Crushed Limestone	0.14	1.00
TXDOT Item 247, Flexible Base	0.14	1.00
Lime Stabilized Subgrade, (6 inch Min.)	0.08	1.00

Bexar County Minimum Layer Thickness Requirements:				
	Type "A"	Type "B"	Collector	Arterials
PAVEMENT LAYER	Min. Thickness Inches	Min. Thickness Inches	Min. Thickness Inches	Min. Thickness Inches
HMAC	2.0	3.0	3.0	4.0
Aggregate Base Course	8.0	8.0	8.0	8.0
Asphalt Treated Base Course	6.0	6.0	6.0	6.0
Lime & Cement Base Course	6.0	6.0	6.0	6.0
Mechanically Stabilized Layer	8.0	8.0	8.0	8.0
Moisture Conditioned Subgrade	6.0	6.0	6.0	6.0

In accordance with the **Bexar County, Texas** design parameters we have developed the following flexible pavement recommendations for a **"Type "B" Street** on a Clay subgrade.

COMPONENT	FLEXIBLE DESIGN SECTION (inches)			
	TYPE "B"			
	Option # 1	Option # 2	Option # 3	Option # 4
Type D HMAC Surface	1.5 inches	1.5 inches		
Type C HMAC Surface	2.5 inches	2.5 inches		
Flexible Base, (Type A or Type B, Grade 2)	11.25 inches	19.0 inches		
Lime Stabilized Subgrade (8 inch Min.)	YES	YES		
TENSAR GEOGRID (TX-7)	YES	NO		
Design ESAL Value	2,000,000	2,000,000		
Actual ESAL Value	2,006,200	2,055,000		

In accordance with the **Bexar County, Texas** design parameters we have developed the following flexible pavement recommendations for a **Collector Street** on a Clay subgrade.

COMPONENT	FLEXIBLE DESIGN SECTION (inches)			
	COLLECTOR			
	Option # 1	Option # 2	Option # 3	Option # 4
Type D HMAC Surface	1.5 inches	1.5 inches		
Type C HMAC Surface	2.5 inches	2.5inches		
Flexible Base, (Type A or Type B, Grade 2)	13.75 inches	21.75 inches		
Lime Stabilized Subgrade (8 inch Min.)	YES	YES		
TENSAR GEOGRID (TX-7)	YES	NO		
Design ESAL Value	2,000,000	2,000,000		
Actual ESAL Value	2,008,600	2,063,100		

Pavement Optimization

Design Analysis

Parameters

Project Information

Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
2,850 psi	2,000,000	90%	0.45	4.2	2

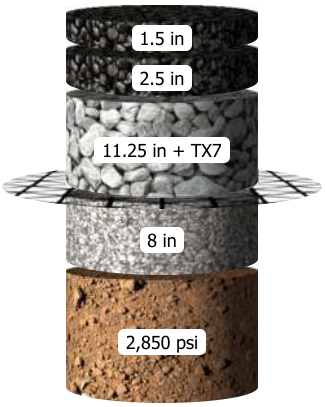
Results

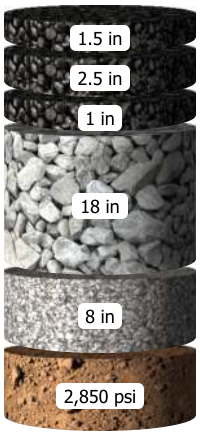
TriAx Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	1.5 in	0.440	0.660
HMA layer 2	2.5 in	0.440	1.100
Mechanically stabilized layer	11.25 in	0.235	2.644
Subbase	8 in	0.080	0.640
Structural number (SN)			5.044
Calculated traffic (ESALs)			2,006,200

Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	1.5 in	0.440	0.660
HMA layer 2	2.5 in	0.440	1.100
HMA layer 3	1 in	0.140	0.140
Aggregate base	18 in	0.140	2.520
Subbase	8 in	0.080	0.640
Structural number (SN)			5.060
Calculated traffic (ESALs)			2,055,000





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Design	O2-09-2022, Revised, local "B", TYPE C & D	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	2/9/2022

Pavement Optimization

Design Analysis

Parameters

Project Information

Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
2,850 psi	2,000,000	90%	0.45	4.2	2.5

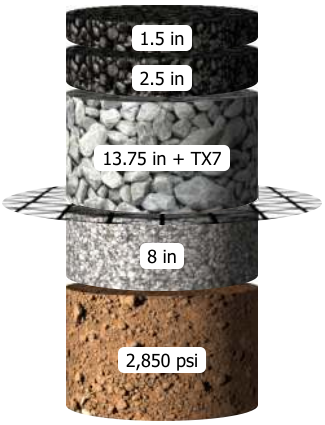
Results

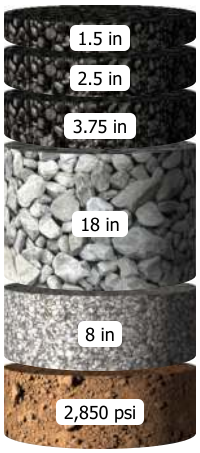
TriAx Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	1.5 in	0.440	0.660
HMA layer 2	2.5 in	0.440	1.100
Mechanically stabilized layer	13.75 in	0.220	3.025
Subbase	8 in	0.080	0.640
Structural number (SN)			5.425
Calculated traffic (ESALs)			2,008,600

Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	1.5 in	0.440	0.660
HMA layer 2	2.5 in	0.440	1.100
HMA layer 3	3.75 in	0.140	0.525
Aggregate base	18 in	0.140	2.520
Subbase	8 in	0.080	0.640
Structural number (SN)			5.445
Calculated traffic (ESALs)			2,063,100





Total HMA thickness should be within the same range on both pavement sections for accurate comparison
2-3 in | 3-6 in | 6-14 in

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Design	02-09-2022, Revised, COLLECTOR, TYPE C & D	Project	BRIGGS RANCH
Company	FROST GEOSCIENCES, Inc.	Location	Bexar County, TX, USA
Designer	FLORENTINO CABALLERO, P. E.	Date	2/9/2022