GEOTECHNICAL EXPLORATION

PAVEMENT DESIGN
SCHUCHART RANCH PHASES 1 AND 2
FM 1283 near FM 471
San Antonio, Texas
ALPHA Report No. A220543
May 3, 2022

Prepared for:

FORESTAR REAL ESTATE GROUP, INC.
10700 Pecan Park Boulevard, Suite 150
Austin, Texas 78750
Attention: Emiliano Z. Guerrero

Prepared By:

ALPHA TESTING
WHERE IT ALL BEGINS

ALPHA TESTING
WHERE IT ALL BEGINS

Geotechnical
Construction Materials
Environmental
TBPE Firm No. 813

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San Antonio, Texas 78217

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May 3, 2022

Forestar Real Estate Group, Inc.
10700 Pecan Park Boulevard, Suite 150
Austin, Texas 78750

Attention: Emiliano Z. Guerrero

Re: Geotechnical Exploration
Pavement Design
Schuchart Ranch Phases 1 and 2
FM 1283 near FM 471
San Antonio, Texas
ALPHA Report No. A220543

Attached is the report of the geotechnical exploration performed for the project referenced above. This study was performed in accordance with ALPHA Proposal No. 89253 dated February 11, 2022.

This report contains results of field explorations and laboratory testing and an engineering interpretation of these with respect to available project characteristics. The results and analyses were used to develop recommendations to aid design and construction of pavements.

ALPHA TESTING, LLC appreciates the opportunity to be of service on this project. If we can be of further assistance, such as providing materials testing services during construction, please contact our office.

Sincerely,

ALPHA TESTING, LLC

STATE OF TEXAS
ADAM J. HEIMAN
106047
LICENSED
PROFESSIONAL ENGINEER
5/3/2022

Colin J. Dlugosh, P.E.
Senior Geotechnical Engineer
ORD/CJD/AJH

Adam J. Heiman, P.E.
Geotechnical Department Manager

Copy: Forestar; Emiliano Z. Guerrero; via email

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ALPHA REPORT NO. A220543

1.0 PURPOSE AND SCOPE

The purpose of this geotechnical exploration is for ALPHA TESTING, LLC (ALPHA) to evaluate for FORESTAR REAL ESTATE GROUP, INC. (Client) some of the physical and engineering properties of subsurface materials at selected locations on the subject site with respect to formulation of appropriate geotechnical design parameters for the proposed construction. The field exploration was accomplished by securing subsurface samples from widely spaced borings performed across the expanse of the site. Engineering analyses were performed from results of the field exploration and results of laboratory tests performed on representative samples.

Also included are general comments pertaining to reasonably anticipated construction problems and recommendations concerning earthwork and quality control testing during construction. This information can be used to evaluate subsurface conditions and to aid in ascertaining construction meets project specifications.

Recommendations provided in this report were developed from information obtained in the borings depicting subsurface conditions only at the specific boring locations and at the particular time designated on the logs. Subsurface conditions at other locations may differ from those observed at the boring locations, and subsurface conditions at boring locations may vary at different times of the year. The scope of work may not fully define the variability of subsurface materials and conditions that are present on the site.

The nature and extent of variations between borings may not become evident until construction. If significant variations then appear evident, our office should be contacted to re-evaluate our recommendations after performing on-site observations and possibly other tests.

2.0 PROJECT CHARACTERISTICS

The project involves the design and construction of residential streets for Phase 1 and Phase 2 within the proposed Schuchart Ranch subdivision to be located off FM 471 near FM 1283 in San Antonio, Texas. A grading plan with initial and final elevations was not available at the time of this study. For the purposes of this study, we have assumed the streets will be constructed within 1 ft of existing grade.

We understand the new residential streets within this subdivision will be designed according to the City of San Antonio, 2012 Capital Improvements Management Services (COSA/CIMS) Design Guidance Manual.

We anticipate the streets will consist of the following City of San Antonio classifications:

- **Local Type A Street without Bus Traffic**.
- **Local Type A Street with Bus Traffic**.
- **Local Type B Street.**
- **Collector Streets**;

The street classification is based on the pavement design guidelines included in the COSA/CIMS Design Guidance Manual (February 2012). If this information changes, ALPHA should be contacted to review and revise our recommendations as appropriate.

3.0 FIELD EXPLORATION

Subsurface conditions on the site were explored by drilling a total of 11 borings in general accordance with ASTM D 420 using standard rotary drilling equipment. The corresponding location of each boring is provided in Table A.

TABLE A		
Locations	**Boring No.**	**Boring Depth, ft**
Phase 1: Residential Streets (approximately 5,200 LF)	B-1 to B-5	10
Phase 2: Residential Streets (approximately 6,000 LF)	B-6 to B-11	10

The approximate location of each boring is shown on the Boring Location Plan, Figure 1, enclosed in the Appendix of this report. Details of drilling and sampling operations are briefly summarized in Methods of Field Exploration, Section A-1 of the Appendix.

Subsurface types encountered during the field exploration are presented on the Log of Boring sheets (boring logs) included in the Appendix of this report. The boring logs contain our Field Technician's and Engineer's interpretation of conditions believed to exist between actual samples retrieved. Therefore, these boring logs contain both factual and interpretive information. Lines delineating subsurface strata on the boring logs are approximate and the actual transition between strata may be gradual.

4.0 LABORATORY TESTS

Selected samples of the subsurface materials were tested in the laboratory to evaluate their engineering properties as a basis in providing recommendations for foundation design and earthwork construction. A brief description of testing procedures used in the laboratory can be found in Methods of Laboratory Testing, Section B-1 of the Appendix. Individual test results are presented on boring logs or summary data sheets also enclosed in the Appendix.

A moisture-density relationship test (Standard Proctor, ASTM D 698) was performed on a bulk sample of the pavement subgrade near Boring B-6 at this site and test results are shown on Figure 2 included in the Appendix. Soaked California Bearing Ratio (CBR, ASTM D 1883) tests were also performed on the bulk sample of the subgrade material. The CBR tests results are shown on the CBR Data Sheet, Figure 3 included in the Appendix.

A lime series test was also performed on the bulk sample of the subgrade material in accordance with ASTM C 977, Appendix XI. The purpose of the lime series is to determine the optimum lime content that results in a soil-lime mixture with a pH of at least 12.4 while reducing the PI to 20 or less. The test results given in the Appendix (Figure 4) are plotted as Plasticity Index or pH versus Percent Hydrated Lime (by dry weight of soil). The sulfate content on the bulk sample of the subgrade material was tested using TxDOT Test Method Tex 145-E. The test result is given in the Appendix as Figure 5.

5.0 GENERAL SUBSURFACE CONDITIONS

The Geologic Map of Texas, published by the University of Texas at Austin, Bureau of Economic Geology, has mapped the Leona (Qle) formation and the Austin Chalk (Kau) formation in the general area of the project site. The Leona formation generally consists of river sediments composed of calcareous silt that grades downward into coarse gravel. The Austin Chalk formation generally consists of clay, chalk, marl, and limestone. Although not common, Karst features such as caves, sinkholes, solution zones and collapse breccia may be encountered in the Austin Chalk Formation. No Karst features were encountered in the borings drilled at this site.

Within the 10-ft maximum depth explored on the site, subsurface materials consist generally of low to very high plasticity FAT CLAY with SAND (CH), SANDY LEAN CLAY (CL), and LEAN CLAY with SAND (CL) overlying MARL. Marl (rock) was encountered at a depth of about 3 ft below the existing ground surface at Borings B-3 and B-4 at this site. The letters in parenthesis represent the soils' classification according to the Unified Soil Classification System (ASTM D 2488). More detailed stratigraphic information is presented on the boring logs attached to this report.

Marl is defined in ASTM D 653-90 Standard Terminology Relating to Soil, Rock and Contained Fluids as "calcareous clay usually containing from 35 to 65 percent calcium carbonate." The calcium carbonate is an indication of a cemented matrix of sand, silt or clay. When submerged in water, marl will begin to slake. *Note*: *However, when being excavated or drilled this material typically behaves more like a rock than soil thereby requiring construction equipment and procedures typically used for rock.* ***The contractor selected should have experience with excavation and drilling in this material***.

The clayey materials and rock (marl) encountered are considered relatively impermeable and are anticipated to have a relatively slow response to water movement. Therefore, several days of observation would be required to evaluate actual groundwater levels within the depths explored. Also, the groundwater level at the site is anticipated to fluctuate seasonally depending on the amount of rainfall, prevailing weather conditions and subsurface drainage characteristics.

Groundwater was not encountered during drilling at this site. However, it is common to detect seasonal groundwater from natural fractures within the clayey matrix and at the soil/rock (marl) interface, particularly during or after periods of precipitation. If more detailed groundwater information is required, monitoring wells or piezometers can be installed. Further details concerning subsurface materials and conditions encountered can be obtained from the boring logs provided in the Appendix.

6.0 PAVEMENT DESIGN RECOMMENDATIONS

The following design recommendations were developed on the basis of the previously described Project Characteristics (Section 2.0) and General Subsurface Conditions (Section 5.0). If project criteria should change, our office should conduct a review to determine if modifications to the recommendations are required. Further, it is recommended our office be provided with a copy of the final plans and specifications for our review prior to construction.

6.1 Residential Streets

We understand that the proposed street construction will consist of the following City of Seguin and COSA/CIMS street classifications:

- Local Type A Street without Bus Traffic – A minimum of 100,000 ESALs shall be used in the design.
- Local Type A Street with Bus Traffic – A minimum of 1,000,000 ESALs shall be used in the design.
- Local Type B Street – A minimum of 2,000,000 ESALs shall be used in the design.
- Collector Streets – A minimum of 2,000,000 ESALs shall be used in the design.

The street classification is based on the pavement design guidelines included in the COSA/CIMS Design Guidance Manual (February, 2012). If this information changes, ALPHA should be contacted to review and revise our recommendations as appropriate.

6.1.1 Design Parameters

Pavement sections are typically designed using a California Bearing Ratio (CBR) value for flexible pavements. Based on our lab testing and experience with similar projects in the area, we recommend a CBR value of about 3 percent be used for the proposed pavement subgrade.

The 1993 AASHTO pavement design method is typically used in this area. The AASHTO design parameters are included in Tables B and C.1 to C.4. *Note: Design parameters provided in the COSA Unified Development Code (UDC, dated January 1, 2006) and the COSA Design Guidance Manual were used for this project:*

TABLE B AASHTO DESIGN PARAMETERS	
18-kip Equivalent Single Axle Loads (ESAL), W_{18}	Reliability, R
Total Change in Serviceability Index, $\Delta_{PSI} = p_o - p_t$	Initial Serviceability Index, p_o
Effective Road Bed Soil Resilient Modulus, Mr [1]	Minimum Serviceability Index, p_t
Structural Number, SN	Standard Deviation, S_o
Pavement Service Life, T	
[1] *Mr, is equal to the CBR value x 1,500 psi*	

Design parameters used in the design of flexible pavements are presented below.

TABLE C.1 LOCAL TYPE A STREET WITHOUT BUS TRAFFIC (100,000 ESALs)			
SN=	**2.48 (design)** [1]	S_o [2] =	0.45
	2.02 (minimum)	p_o [2] =	4.2
	3.18 (maximum)	p_t [2] =	2.0
R =	70 percent	Δ_{PSI} [2] =	2.2
T [2] =	20-year service life	Mr =	4,500 psi
[1]	*The AASHTO design procedure requires a minimum design SN of 2.48 for 100,000 ESAL's*		
[2]	*Per COSA design parameters*		

TABLE C.2 LOCAL TYPE A STREET WITHOUT BUS TRAFFIC (1,000,000 ESALs)			
SN=	**3.53 (design)** [1]	S_o [2] =	0.45
	2.58 (minimum)	p_o [2] =	4.2
	4.20 (maximum)	p_t [2] =	2.0
R =	70 percent	Δ_{PSI} [2] =	2.2
T [2] =	20-year service life	Mr =	4,500 psi
[1]	*The AASHTO design procedure requires a minimum design SN of 3.53 for 1,000,000 ESAL's*		
[2]	*Per COSA design parameters*		

TABLE C.3 LOCAL TYPE B STREET (2,000,000 ESALs)			
SN=	**4.36 (design)** [1]	S_o [2] =	0.45
	2.92 (minimum)	p_o [2] =	4.2
	5.08 (maximum)	p_t [2] =	2.0
R =	90 percent	Δ_{PSI} [2] =	2.2
T [2] =	20-year service life	Mr =	4,500 psi
[1]	*The AASHTO design procedure requires a minimum design SN of 4.36 for 2,000,000 ESAL's*		
[2]	*Per COSA design parameters*		

TABLE C.4 COLLECTOR STREETS (2,000,000 ESALs)			
SN=	**4.66 (design)** [1]	S_o [2] =	0.45
	2.92 (minimum)	p_o [2] =	4.2
	5.08 (maximum)	p_t [2] =	2.5
R =	90 percent	Δ_{PSI} [2] =	1.7
T [2] =	20-year service life	Mr =	4,500 psi
[1]	*The AASHTO design procedure requires a minimum design SN of 4.66 for 2,000,000 ESAL's*		
[2]	*Per COSA design parameters*		

Recommended approximate structural coefficients, and drainage coefficients used in the design are provided in Table D:

TABLE D PAVEMENT LAYER DESIGN PARAMETERS		
Pavement Components	**Structural Coefficient**	**Drainage Coefficient (m)**
HMAC Surface Course – Type D	0.44	1.00
HMAC Base Course – Type B	0.38	1.00
Flexible (Granular) Base	0.14	1.00
Lime Treated Subgrade	0.08	1.00

The drainage coefficient (m) is dependent on the quality of drainage in the flexible base and lime treated clay layer of the flexible pavement section. Good drainage (i.e. Drainage Coefficient, m = 1) corresponds to water being removed from each layer in one day; and the pavement structure is exposed to moisture levels approaching saturation from 5 to 25 percent of the time. If improper materials are used or standing water can develop due to construction or design deficiencies, the quality of drainage would be fair to very poor, which would reduce the drainage coefficient, m, and ultimately the structural capacity of the pavement. The AASHTO design procedure provides more guidance and discussion regarding this issue.

6.1.2 Flexible Pavement Sections

Depending on the proposed design ESALs, the resulting flexible pavement sections in units of inches for various pavement thicknesses are provided in Tables E.1 to E.4:

TABLE E.1
LOCAL TYPE A STREET WITHOUT BUS TRAFFIC (W18 = 100,000 ESALs)

	Thickness, inches		
Components:	**Option 1**	**Option 2**	**Option 3**
HMAC Surface Course – Type D	2.0	2.5	3.0
HMAC Base Course – Type B	----	----	----
Flexible Base	9.0	7.0	6.0
Lime Treated Subgrade	6.0	6.0	6.0
Required Structural Number	*2.48*	*2.48*	*2.48*
Actual Structural Number	*2.62*	*2.56*	*2.64*

TABLE E.2
LOCAL TYPE A STREET WITH BUS TRAFFIC (W18 = 1,000,000 ESALs)

	Thickness, inches		
Components:	**Option 1**	**Option 2**	**Option 3**
HMAC Surface Course – Type D	3.0	4.0	2.0
HMAC Base Course – Type B	----	----	3.0
Flexible Base	13.0	10.0	8.0
Lime Treated Subgrade	6.0	6.0	6.0
Required Structural Number	*3.53*	*3.53*	*3.53*
Actual Structural Number	*3.62*	*3.64*	*3.62*

TABLE E.3
LOCAL TYPE B STREET (W18 = 2,000,000 ESALs)

	Thickness, inches		
Components:	**Option 1**	**Option 2**	**Option 3**
HMAC Surface Course – Type D	2.0	2.0	3.0
HMAC Base Course – Type B	3.0	4.0	4.0
Flexible Base	14.0	11.0	8.0
Lime Treated Subgrade	6.0	6.0	6.0
Required Structural Number	*4.36*	*4.36*	*4.36*
Actual Structural Number	*4.46*	*4.42*	*4.44*

TABLE E.4 COLLECTOR STREETS (W18 = 2,000,000 ESALs)			
	Thickness, inches		
Components:	**Option 1**	**Option 2**	**Option 3**
HMAC Surface Course – Type D	2.0	2.0	3.0
HMAC Base Course – Type B	3.0	4.0	4.0
Flexible Base	16.0	13.0	10.0
Lime Treated Subgrade	6.0	6.0	6.0
Required Structural Number	*4.66*	*4.66*	*4.66*
Actual Structural Number	*4.74*	*4.70*	*4.72*

Note: Alternative pavement sections with relatively thicker asphalt concrete and thinner flexible base could be utilized. ALPHA would be pleased to discuss alternative pavement sections if desired.

6.1.3 Pavement Materials

The pavement materials should meet the criteria listed in the City of San Antonio Pavement Design Standards. Presented below are various materials that may be used to construct the pavement sections at this site.

Hot Mix Asphaltic Concrete (HMAC) Surface Course - The HMAC surface course should be plant mixed, hot laid Type D. The HMAC base course should also be plant mixed, hot laid Type B. Each mix should meet the master specifications requirements of 2014 TxDOT Standard Specifications Item 341, Item SS 3224 (2011) and specific criteria for the job mix formula.

Flexible Base – Flexible base should meet TxDOT Standard Specification Item 247 Grade 1-2, Type A. Flexible base should be compacted to a minimum of 95 percent of the materials maximum modified Proctor dry density (ASTM D 1557) at a moisture content of -2 to +2 percentage points of optimum moisture.

Lime Treated Subgrade – Due to the presence of clayey soils (with a PI over 20) at this site, the pavement subgrade should be treated with hydrated lime. The subgrade should be scarified to a depth of 6 inches and mixed with a minimum 7 percent hydrated lime (by dry soil weight) in conformance with TxDOT Standard Specification Item 260. Based on an in-place unit weight of 94 pcf for the pavement subgrade soils, this percentage of lime equates to about 30 lbs of lime per square yard of treated subgrade. The clay soils near Boring B-6 at the surface were tested for the presence of soluble sulfates prior to the use of lime and test results showed a minimal amount of sulfates (153 ppm) in the soil. This value should not be a concern for the lime treated subgrade. The sulfate test results are shown on the Report of Soluble Sulfate Content, Figure 5 included in the Appendix.

The soil-lime mixture should be compacted to at least 95 percent of TxDOT Test Method Tex-113-E maximum dry density and within the range of 0 to 4 percentage points above the mixture's optimum moisture content. In all areas where hydrated lime is used to treat subgrade soil, routine Atterberg-limit tests should be performed to verify the resulting plasticity index of the soil-lime mixture is at/or below 20 percent.

6.2 Drainage

Adequate drainage should be provided to reduce seasonal variations in the moisture content of subgrade soils. Final grades within 5 ft of the pavement should be adjusted to slope away from the pavement at a minimum slope of 2 percent. **Maintaining positive surface drainage throughout the life of the pavement is essential.**

6.3 Fill Materials and Compaction

The following fill compaction recommendations provided below are applicable for general site grading. Imported soils used as general fill should consist of material with a PI not greater than 60 percent.

> General Fill (Clay) – Clay soils should be compacted to a dry density between 95 and 100 percent of standard Proctor maximum dry density (ASTM D 698). The compacted moisture content of the clays during placement should be within the range of 0 to 4 percentage points above optimum. Clayey materials used as fill should be processed and the largest particle or clod should be less than 6 inches prior to compaction.
>
> General Fill (Granular) – Granular materials should be compacted to a dry density between 95 and 100 percent of standard Proctor maximum dry density (ASTM D 698). The compacted moisture content of the granular soils during placement should be within the range of -2 to +2 percentage points of optimum.

Prior to placement of any fill the subgrade should be scarified to a depth of 6 inches and recompacted to a dry density of at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to +4 percentage points of the material's optimum moisture content.

In cases where mass fills outside the structure areas are more than 10 ft deep, the fill below 10 ft should be compacted to at least 100 percent of standard Proctor maximum dry density (ASTM D-698) and within 2 percentage points of the material's optimum moisture content. The portion of the fill shallower than 10 ft should be compacted as outlined above. *Note: Even if fill is properly compacted, fills in excess of about 10 ft are still subject to settlements over time of up to about 1 to 2 percent of the total fill thickness. This should be considered when designing wall backfill.*

Compaction should be accomplished by placing fill in about 8-inch thick loose lifts and compacting each lift to at least the specified minimum dry density. Field density and moisture content tests should be performed on each lift. A qualified geotechnical engineering firm should be retained to perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris or materials exceeding 4 inches in maximum dimension.

7.0 LIMITATIONS

Professional services provided in this geotechnical exploration were performed, findings obtained, and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. The scope of services provided herein does not include an environmental assessment of the site or investigation for the presence or absence of hazardous materials in the soil, surface water or groundwater. ALPHA, upon written request, can be retained to provide these services.

ALPHA is not responsible for conclusions, opinions or recommendations made by others based on this data. Information contained in this report is intended for the exclusive use of the Client (and their designated design representatives), and is related solely to design of the specific structures outlined in Section 2.0. No party other than the Client (and their designated design representatives) shall use or rely upon this report in any manner whatsoever unless such party shall have obtained ALPHA's written acceptance of such intended use. Any such third party using this report after obtaining ALPHA's written acceptance shall be bound by the limitations and limitations of liability contained herein, including ALPHA's liability being limited to the fee paid to it for this report. Recommendations presented in this report should not be used for design of any other structures except those specifically described in this report. In all areas of this report in which ALPHA may provide additional services if requested to do so in writing, it is presumed that such requests have not been made if not evidenced by a written document accepted by ALPHA. Further, subsurface conditions can change with passage of time. Recommendations contained herein are not considered applicable for an extended period of time after the completion date of this report. It is recommended our office be contacted for a review of the contents of this report for construction commencing more than one (1) year after completion of this report. Non-compliance with any of these requirements by the Client or anyone else shall release ALPHA from any liability resulting from the use of, or reliance upon, this report.

Recommendations provided in this report are based on our understanding of information provided by the Client about characteristics of the project. If the Client notes any deviation from the facts about project characteristics, our office should be contacted immediately since this may materially alter the recommendations. Further, ALPHA is not responsible for damages resulting from workmanship of designers or contractors. It is recommended the Owner retain qualified personnel, such as a Geotechnical Engineering firm, to verify construction is performed in accordance with plans and specifications.

APPENDIX

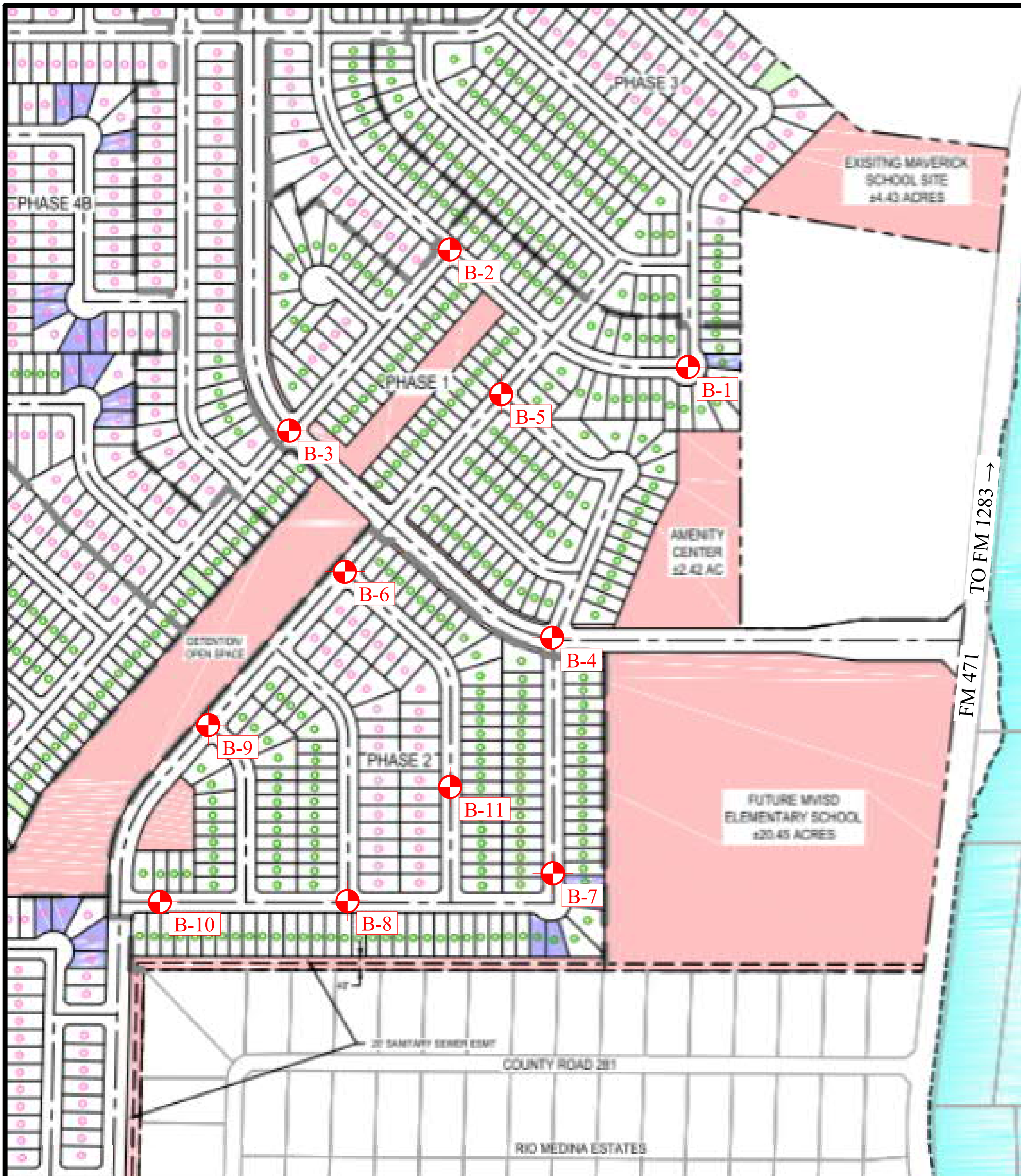
A-1 METHODS OF FIELD EXPLORATION

A truck-mounted, rotary drill rig equipped with continuous flight augers was used to advance the boreholes. A total of 11 borings were performed for this geotechnical exploration at the approximate locations shown on the Boring Location Plan, Figure 1. The boring locations were staked by either pacing or taping and estimating right angles from landmarks which could be identified in the field and as shown on the site plan provided during this study. The locations of the borings shown on the Boring Location Plan are considered accurate only to the degree implied by the methods used to define them. The approximate latitude and longitude coordinates at each boring location were obtained using a handheld GPS device.

Relatively undisturbed samples of the cohesive subsurface materials were obtained by hydraulically pressing 3-inch O.D. thin-wall sampling tubes into the underlying soils at selected depths (ASTM D 1587). These samples were removed from the sampling tubes in the field and evaluated visually. One representative portion of each sample was sealed in a plastic bag for use in future visual evaluations and possible testing in the laboratory.

Samples of granular and cohesive materials were obtained using split-spoon sampling procedures in general accordance with ASTM Standard D 1586. Disturbed samples were obtained at selected depths in the borings by driving a standard 2-inch O.D. split-spoon sampler 18 inches into the subsurface material using a 140-pound hammer falling 30 inches. The number of blows required to drive the split-spoon sampler the final 12 inches of penetration (N-value) is recorded in the appropriate column on the boring logs. However, if the sampler was not driven the initial 6-inch seating increment with 50 hammer blows, refusal (i.e. “ref”) is recorded along with the inches driven on the logs.

Our field representative prepared field logs as part of the field exploration. The field logs included visual descriptions of the materials encountered during drilling and their interpretation of the subsurface conditions between samples. The Log of Boring sheets included in this report represent the engineer’s interpretation of the field logs and include modifications based on visual observations using the Unified Soil Classification System (USCS) and testing of the samples in the laboratory. **Samples not consumed by testing will be retained in our laboratory for at least 30 days and then discarded unless the Client requests otherwise.**



GEOTECHNICAL EXPLORATION
SCHUCHART RANCH PHASES 1 AND 2 - PAVEMENT DESIGN
FM 1283 NEAR FM 471
SAN ANTONIO, TEXAS
ALPHA PROJECT NO. A220543

APPROXIMATE BORING LOCATIONS

ALPHA TESTING

BORING LOCATION PLAN
FIGURE 1

B-1 METHODS OF LABORATORY TESTING

Representative samples were inspected and classified by a qualified member of the Geotechnical Division and the boring logs were edited as necessary. To aid in classifying the subsurface materials and to determine the general engineering characteristics, natural moisture content tests (ASTM D 2216) and Atterberg-limit tests (ASTM D 4318) were performed on selected samples. Pocket penetrometer tests were conducted on all undisturbed samples. Results of all laboratory tests described above are provided on the accompanying boring logs as noted.

Moisture-Density Relationship (Standard Proctor, ASTM D 698) tests, and soaked California Bearing Ratio tests (CBR, ASTM D 1883) were performed for one bulk sample of the clay material encountered near Boring B-6. The results of these tests are provided in the Appendix as Figures 2 and 3, respectively.

A lime series test was performed in accordance with ASTM C 977, Appendix XI. The purpose of the lime series is to determine the optimum lime content that results in a soil-lime mixture with a pH of at least 12.4 while reducing the PI to 20 or less. The test results given in the Appendix (Figure 4) are plotted as Plasticity Index or pH versus Percent Hydrated Lime (by dry weight of soil).

The sulfate content was tested using TxDOT Test Method Tex 145-E. The test result is provided in the Appendix as Figure 5.

ALPHA TESTING

ALPHA REPORT NO.: A220543 DATE: 4/4/22

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San Antonio, Texas 78217
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MATERIAL DESCRIPTION: BROWN CLAY

CLASSIFICATION: FAT CLAY (CH)
SAMPLE LOCATION: NEAR BORING B-6

TEST METHOD: ASTM D 698-B

TESTED FOR: Forestar Real Estate Group, Inc.
Austin, Texas

PROJECT: Schuchart Ranch Phases 1 and 2 - Pavement Design
San Antonio, Texas

TECHNICIAN: Chris Shipman

SOIL ID NUMBER:	1	
MAXIMUM DRY UNIT WEIGHT:	93.1	PCF
OPTIMUM MOISTURE CONTENT:	25.9	%
LIQUID LIMIT:	53	
PLASTIC LIMIT:	21	
PLASTICITY INDEX:	32	
% FINER THAN NO. 200 SIEVE:	90	%

MOISTURE DENSITY RELATIONSHIP

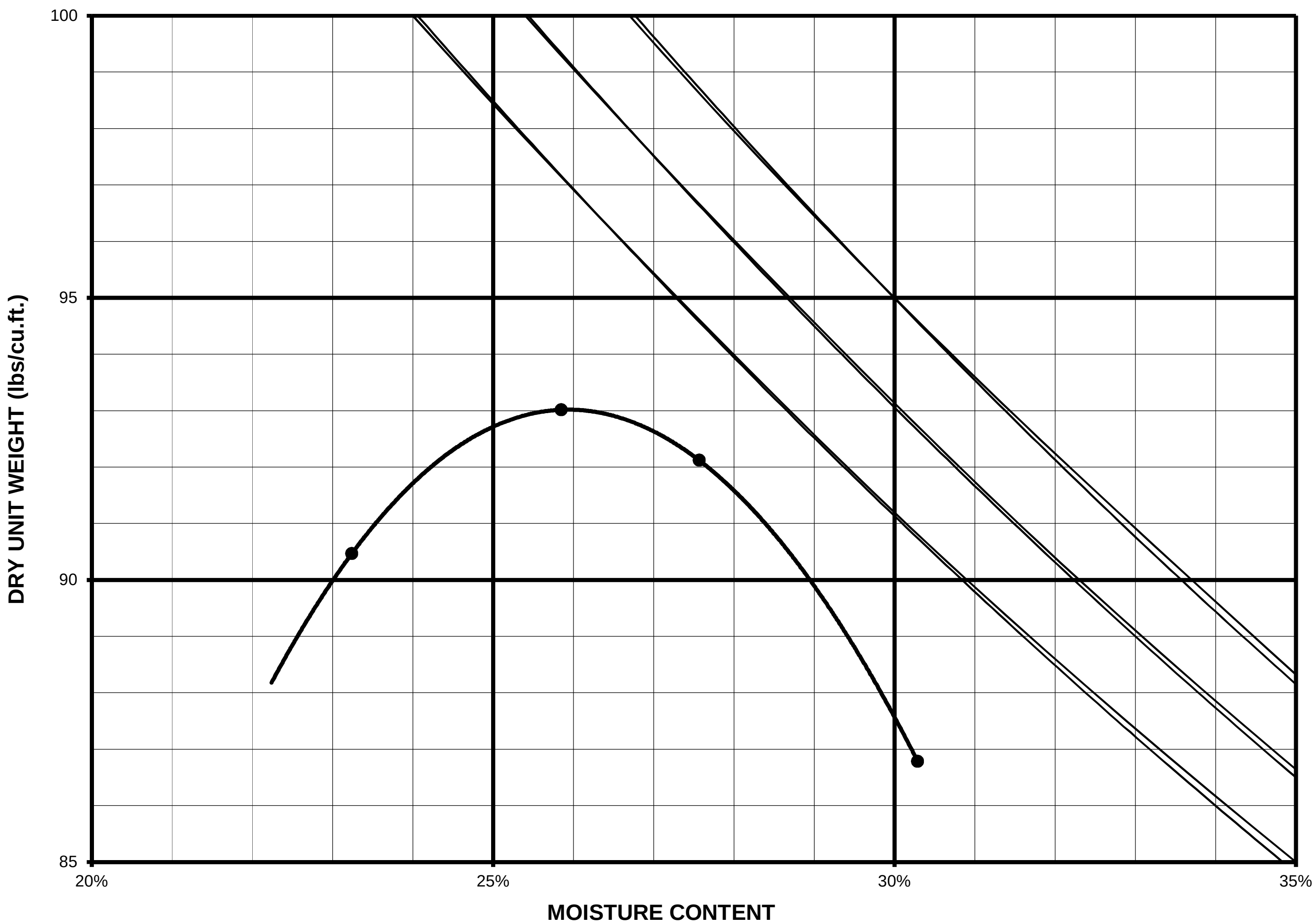

FIGURE 2

ALPHA TESTING

4740 Perrin Creek, Suite 480
San Antonio, Texas 78217
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www.alphatesting.com
TBPE Firm No. 813

ALPHA REPORT NO.: A220543 DATE: 4/4/22

MATERIAL DESCRIPTION: BROWN CLAY

CLASSIFICATION: FAT CLAY (CH)
SAMPLE LOCATION: NEAR BORING B-6

TEST METHOD: ASTM D 1883

TESTED FOR: Forestar Real Estate Group, Inc.
Austin, Texas

PROJECT: Schuchart Ranch Phases 1 and 2 - Pavement Design
San Antonio, Texas

TECHNICIAN: Chris Shipman

Percent of Maximum Density	93	96	98
CBR Value at 0.1" deflection	6.0%	6.5%	7.5%
CBR Value at 0.2" deflection	5.2%	5.5%	6.3%
Compacted Dry Density, PCF	86.9	89.4	91
Compacted Moisture Content	26.2%	26.7%	26.1%
Moisture Relative to Optimum	0.3	0.8	0.2

CBR DATA SHEET

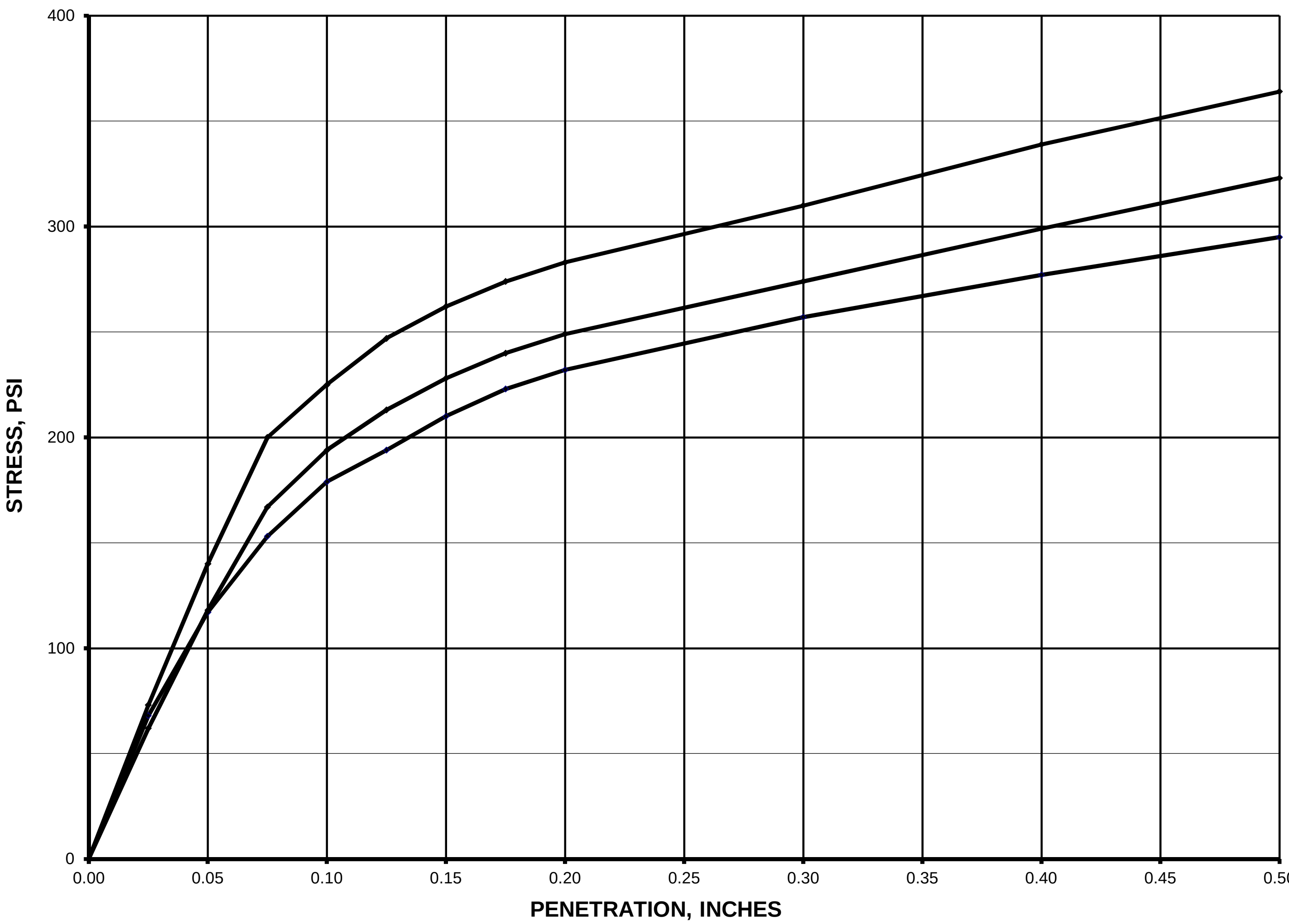

FIGURE 3

ALPHA TESTING

12766 O'Connor Road
San Antonio, Texas 78233
Geotechnical I Construction Materials I Environmental
www.alphatesting.com
TBPE Firm No. 813

ALPHA REPORT NO.: A220543 DATE: 4/4/22

MATERIAL DESCRIPTION: BROWN CLAY

CLASSIFICATION: FAT CLAY (CH)
SAMPLE LOCATION: NEAR BORING B-6

TEST METHOD: TEX-112-E
ASTM C 977

TESTED FOR: Forestar Real Estate Group, Inc.
Austin, Texas

PROJECT: Schuchart Ranch Phases 1 and 2 - Pavement Design
San Antonio, Texas

TECHNICIAN: Chris Shipman

LIME SERIES CURVES

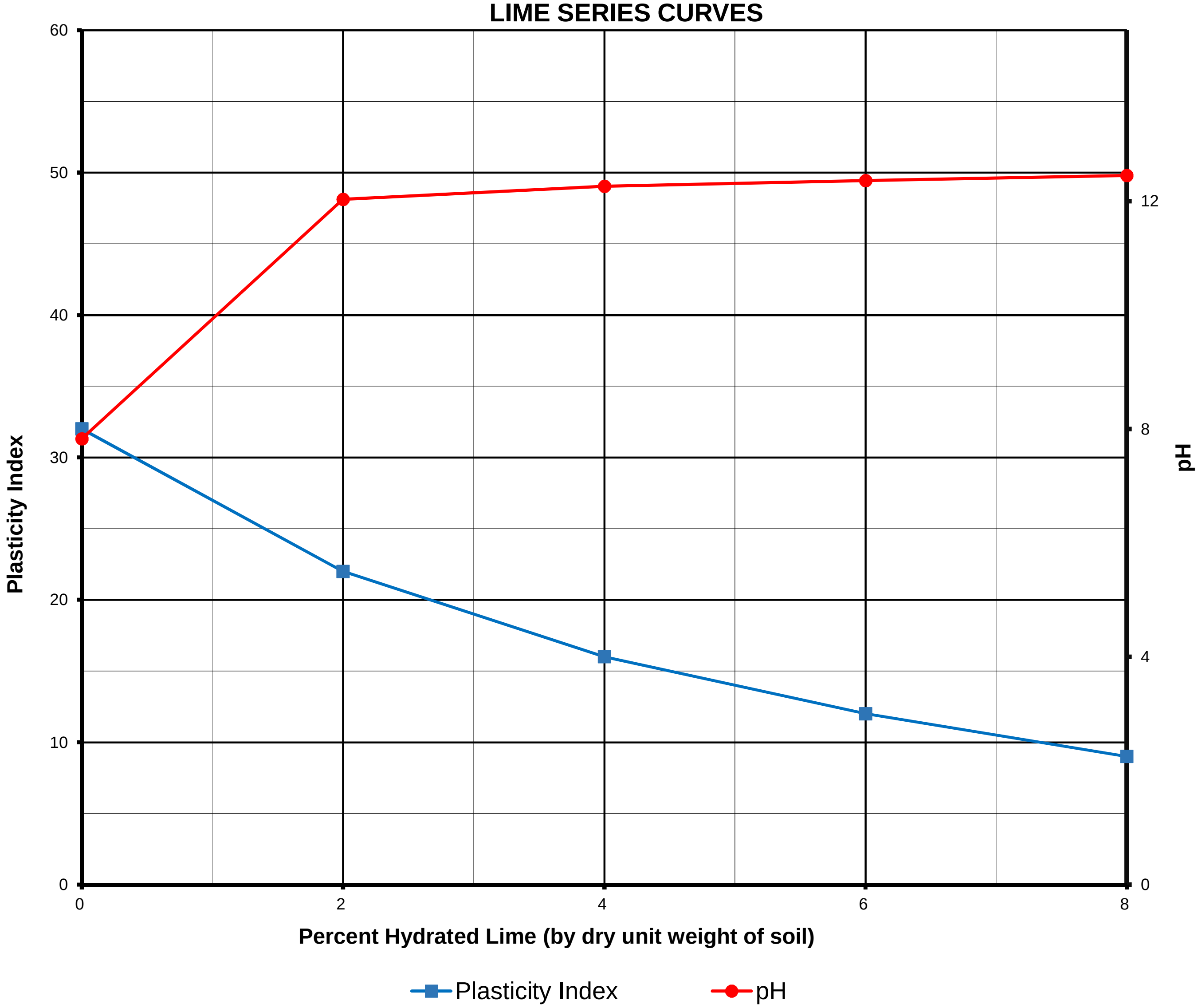

FIGURE 4

ALPHA TESTING

4740 Perrin Creek, Suite 480
San Antonio, Texas 78217
Geotechnical I Construction Materials I Environmental
www.alphatesting.com
TBPE Firm No. 813

ALPHA REPORT NO.: A220543
DATE: 04/04/22

TEST METHOD: TxDOT Designation: TEX-145-E PART II

TESTED FOR: Forestar Real Estate Group, Inc.
Austin, Texas

PROJECT: Schuchart Ranch Phases 1 and 2 - Pavement Design
San Antonio, Texas

DETERMINING SULFATE CONTENT IN SOILS

SAMPLE NO.	SAMPLE LOCATION AND MATERIAL DESCRIPTION	SOLUBLE SULFATE CONTENT
1	BROWN FAT CLAY - NEAR BORING B-6	153 ppm

FIGURE 5

ALPHA TESTING
WHERE IT ALL BEGINS

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Suite 480
San Antonio, Texas
Phone: 210-249-2100
Fax: 210-249-2101
www.alphatesting.com

BORING NO.: B- 1
Sheet 1 of 1
PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Location: San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Surface Elevation:
Start Date: 4/16/2022 **End Date:** 4/16/2022
Longitude: -98.82237
Drilling Contractor:
Latitude: 29.51088
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
- On Rods (ft): NONE
- After Drilling (ft): DRY
- After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		SANDY LEAN CLAY (CL) brown with gravel			26					6	28	15	13
		2.0											
		SANDY LEAN CLAY (CL) tan with gravel			29					2			
5					39					2			
					42					2			
										5			
10		10.0											
		BORING TERMINATED AT 10 FEET											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

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BORING NO.: B- 2

PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Location: San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Surface Elevation:
Start Date: 4/16/2022 **End Date:** 4/16/2022
Longitude: -98.82455
Drilling Contractor:
Latitude: 29.51183
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
- On Rods (ft): NONE
- After Drilling (ft): DRY
- After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		SANDY LEAN CLAY (CL) dark brown (to 1.0)	X		10					19	45	17	28
		SANDY LEAN CLAY (CL) tan with gravel	X		23			52		11	34	13	21
5		- becoming reddish-tan with gravel below 4½ feet	X		17					7			
			X		14					9			
10		(to 10.0)	X		18					9			
		BORING TERMINATED AT 10 FEET											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

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BORING NO.: B- 3

PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Location: San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Surface Elevation:
Start Date: 4/16/2022 **End Date:** 4/16/2022
Longitude: -98.82604
Drilling Contractor:
Latitude: 29.51036
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
On Rods (ft): NONE
After Drilling (ft): DRY
After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		FAT CLAY with SAND (CH) dark brown			7					23	83	25	58
		2.0											
		SANDY LEAN CLAY (CL) tan with gravel			81/9"					5			
		3.0											
		MARL tan; weathered with clay seams and LIMESTONE fragments and layers											
5					ref/2"					3			
					ref/2"					3			
					ref/0"					4			
10		10.0											
		BORING TERMINATED AT 10 FEET											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

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Fax: 210-249-2101
www.alphatesting.com

BORING NO.: B- 4

PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Location: San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Surface Elevation:
Start Date: 4/16/2022 **End Date:** 4/16/2022
Longitude: -98.82361
Drilling Contractor:
Latitude: 29.50869
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
On Rods (ft): NONE
After Drilling (ft): DRY
After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
0.0–2.0		**FAT CLAY with SAND (CH)** dark brown			24					16	60	22	38
2.0–3.0		**SANDY LEAN CLAY (CL)** tan with gravel			83/9"					5			
3.0–10.0		**MARL** tan; weathered with clay seams and LIMESTONE fragments and layers			ref/3"					3			
					ref/2"					3			
					ref/0"					3			
10.0		**BORING TERMINATED AT 10 FEET**											

ALPHA TESTING
WHERE IT ALL BEGINS

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BORING NO.: B- 5

PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Start Date: 4/16/2022 **End Date:** 4/16/2022
Drilling Contractor:
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: San Antonio, Texas
Surface Elevation:
Longitude: -98.82408
Latitude: 29.51065
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
On Rods (ft): NONE
After Drilling (ft): DRY
After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
0–2.0		**FAT CLAY with SAND (CH)** brown			13					18	61	18	43
2.0		**LEAN CLAY with SAND (CL)** tan with gravel			30					15			
5		- becoming reddish-tan with gravel below 4½ feet			22					11			
					32					10			
10					40					7			
10.0		**BORING TERMINATED AT 10 FEET**											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

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BORING NO.: B- 6
Sheet 1 of 1
PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Location: San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Surface Elevation:
Start Date: 4/16/2022 **End Date:** 4/16/2022
Longitude: -98.82552
Drilling Contractor:
Latitude: 29.50922
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
- On Rods (ft): NONE
- After Drilling (ft): DRY
- After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		FAT CLAY with SAND (CH) dark brown with gravel			15					20	67	21	46
		2.0											
		SANDY LEAN CLAY (CL) tan with gravel			34					9			
5					90/11"					6			
		- partially cemented layer at 6½ feet			50/3"					4			
					23					13			
10		10.0											
		BORING TERMINATED AT 10 FEET											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

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BORING NO.: B- 7

PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc. **Location:** San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design **Surface Elevation:**
Start Date: 4/16/2022 **End Date:** 4/16/2022 **Longitude:** -98.82361
Drilling Contractor: **Latitude:** 29.50679
Drilling Method: CONTINUOUS FLIGHT AUGER **Hammer Drop (lbs / in):** 140 / 30

GROUND WATER OBSERVATIONS
On Rods (ft): NONE
After Drilling (ft): DRY
After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
0–2.0		**FAT CLAY with SAND (CH)** brown with gravel (2.0)			12					17	58	18	40
2.0–10.0		**LEAN CLAY with SAND (CL)** reddish-tan with gravel			23					12			
5					13			81		16			
					12					17	35	13	22
10		(10.0)			14					16			
		BORING TERMINATED AT 10 FEET											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

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BORING NO.: B- 8

PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Location: San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Surface Elevation:
Start Date: 4/16/2022 **End Date:** 4/16/2022
Longitude: -98.8255
Drilling Contractor:
Latitude: 29.50656
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
- On Rods (ft): NONE
- After Drilling (ft): DRY
- After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		FAT CLAY with SAND (CH) brown			12					16	53	18	35
		1.0											
		LEAN CLAY with SAND (CL) reddish-tan with gravel											
					21					11			
5					11					15			
					13					13			
					15					13			
10		10.0											
		BORING TERMINATED AT 10 FEET											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

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BORING NO.: B- 9
Sheet 1 of 1
PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Location: San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Surface Elevation:
Start Date: 4/16/2022 **End Date:** 4/16/2022
Longitude: -98.82675
Drilling Contractor:
Latitude: 29.508
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
- On Rods (ft): NONE
- After Drilling (ft): DRY
- After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		FAT CLAY with SAND (CH) brown — 0.5	X		12					16	52	21	31
		SANDY LEAN CLAY (CL) reddish-tan with gravel											
			X		24					12			
5			X		15					12			
			X		21					10			
10		10.0	X		15			65		12			
		BORING TERMINATED AT 10 FEET											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

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BORING NO.: B-10
Sheet 1 of 1
PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Location: San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Surface Elevation:
Start Date: 4/16/2022 **End Date:** 4/16/2022
Longitude: -98.82723
Drilling Contractor:
Latitude: 29.50655
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
On Rods (ft): NONE
After Drilling (ft): DRY
After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		FAT CLAY with SAND (CH) dark brown			11					18	69	22	47
2.5		**SANDY LEAN CLAY (CL)** reddish-tan with gravel			27					8			
5					21					15			
					28					7			
					80					9			
10 (10.0)		**BORING TERMINATED AT 10 FEET**											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

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Fax: 210-249-2101
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BORING NO.: B-11

PROJECT NO.: A220543

Client: Forestar (USA) Real Estate Group, Inc.
Location: San Antonio, Texas
Project: Schuchart Ranch Phases 1 and 2 - Pavement Design
Surface Elevation:
Start Date: 4/16/2022 **End Date:** 4/16/2022
Longitude: -98.82455
Drilling Contractor:
Latitude: 29.50748
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
- On Rods (ft): NONE
- After Drilling (ft): DRY
- After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
0–2.0		**FAT CLAY with SAND (CH)** dark brown with gravel (2.0)	X		13					22	71	20	51
2.0–10.0		**LEAN CLAY with SAND (CL)** tan with gravel	X		21					17			
			X		16					15			
5			X		37					10	38	15	23
10		(10.0)	X		12					10			
		BORING TERMINATED AT 10 FEET											
15													

ALPHA TESTING
WHERE IT ALL BEGINS

KEY TO SOIL SYMBOLS AND CLASSIFICATIONS

SOIL & ROCK SYMBOLS

- (CH), High Plasticity CLAY
- (CL), Low Plasticity CLAY
- (SC), CLAYEY SAND
- (SP), Poorly Graded SAND
- (SW), Well Graded SAND
- (SM), SILTY SAND
- (ML), SILT
- (MH), Elastic SILT
- LIMESTONE
- SHALE / MARL
- SANDSTONE
- (GP), Poorly Graded GRAVEL
- (GW), Well Graded GRAVEL
- (GC), CLAYEY GRAVEL
- (GM), SILTY GRAVEL
- (OL), ORGANIC SILT
- (OH), ORGANIC CLAY
- FILL

SAMPLING SYMBOLS

- SHELBY TUBE (3" OD except where noted otherwise)
- SPLIT SPOON (2" OD except where noted otherwise)
- AUGER SAMPLE
- TEXAS CONE PENETRATION
- ROCK CORE (2" ID except where noted otherwise)

RELATIVE DENSITY OF COHESIONLESS SOILS (blows/ft)

VERY LOOSE	0 TO 4
LOOSE	5 TO 10
MEDIUM	11 TO 30
DENSE	31 TO 50
VERY DENSE	OVER 50

SHEAR STRENGTH OF COHESIVE SOILS (tsf)

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	OVER 4.00

RELATIVE DEGREE OF PLASTICITY (PI)

LOW	4 TO 15
MEDIUM	16 TO 25
HIGH	26 TO 35
VERY HIGH	OVER 35

RELATIVE PROPORTIONS (%)

TRACE	1 TO 10
LITTLE	11 TO 20
SOME	21 TO 35
AND	36 TO 50

PARTICLE SIZE IDENTIFICATION (DIAMETER)

BOULDERS	8.0" OR LARGER
COBBLES	3.0" TO 8.0"
COARSE GRAVEL	0.75" TO 3.0"
FINE GRAVEL	5.0 mm TO 3.0"
COURSE SAND	2.0 mm TO 5.0 mm
MEDIUM SAND	0.4 mm TO 5.0 mm
FINE SAND	0.07 mm TO 0.4 mm
SILT	0.002 mm TO 0.07 mm
CLAY	LESS THAN 0.002 mm