



- GEOTECHNICAL ENGINEERING
- CONSTRUCTION MATERIALS
ENGINEERING & TESTING
- SOILS • ASPHALT • CONCRETE

January 7, 2020

HMT Engineering & Surveying
290 S. Castell Avenue, Ste. 100
New Braunfels, Texas 78130

Attention: Chris Van Heerde, P.E.

**SUBJECT: SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM
AND PAVEMENT EVALUATION
FOR THE PROPOSED SCHOENTHAL RANCH PROJECT
1005 SCHOENTHAL ROAD
NEW BRAUNFELS, TEXAS
RETL Project No.: 219597**

Dear Mr. Van Heerde,

In accordance with our agreement, we have conducted a subsurface exploration, laboratory testing program and pavement evaluation for the above referenced project. The results of this exploration, together with our recommendations, are to be found in the accompanying report, an electronic copy of which is being transmitted herewith. RETL will provide up to two (2) versions of this report in hard copy at the request of the client.

Often, because of design and construction details that occur on a project, questions arise concerning soil conditions and Rock Engineering and Testing Laboratory, Inc. (RETL), would be pleased to continue its role as the Geotechnical Engineer during project implementation.

RETL also has great interest in providing materials testing and observation services during the construction phase of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Sincerely,

A handwritten signature in blue ink, appearing to read "Kyle D. Hammock". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Kyle D. Hammock, P.E.
Vice President - San Antonio

**SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM,
AND PAVEMENT EVALUATION
FOR THE PROPOSED
SCHOENTHAL RANCH PROJECT
1005 SCHOENTHAL ROAD
NEW BRAUNFELS, TEXAS, TEXAS**

RETL PROJECT NUMBER: 219597

PREPARED FOR:

**HMT ENGINEERING & SURVEYING
290 S. CASTELL AVENUE, SUITE 100
NEW BRAUNFELS, TEXAS 78130**

JANUARY 7, 2020

PREPARED BY:

**ROCK ENGINEERING AND TESTING LABORATORY, INC.
10856 VANDALE STREET
SAN ANTONIO, TEXAS 78216
PHONE: (210) 495-8000; FAX: (210) 495-8015**

**TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NUMBER 2101**



**Kyle D. Hammock, P.E.
Vice President - San Antonio**



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INTRODUCTION

This report presents the results of a subsurface exploration, laboratory testing program and pavement evaluation for the proposed Schoenthal Ranch Project to be constructed 1005 Schoenthal Road in New Braunfels, Texas. This study was conducted for HMT Engineering & Surveying.

Authorization

The work for this project was performed in accordance with RETL Proposal Number P111519B dated November 18, 2019. The proposal contained a scope of work, lump sum fee and limitations. The proposal was approved and signed by Chris Van Heerde, P.E. on December 12, 2019 and returned to RETL via email.

Purpose and Scope

The purpose of this exploration was to evaluate the soil conditions at the site and to provide pavement recommendations suitable for the proposed subdivision roadway.

The scope of the exploration and evaluation included the subsurface exploration, field and laboratory testing, engineering analysis and evaluation of the subsurface soils, provision of pavement recommendations, and preparation of this report.

The scope of services did not include an environmental assessment. Any statements in this report, or on the boring logs, regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of the client.

General

The exploration and analysis of the subsurface conditions reported herein are considered sufficient in detail and scope to form a reasonable basis for the pavement design. The recommendations submitted for the proposed project are based on the available soil information and the preliminary design details provided by HMT Engineering & Surveying. If the civil engineer requires additional soil parameters to complete the pavement design, and the requested information can be obtained from the agreed upon scope of work, RETL will provide the requested information as a supplement to this report.

The Geotechnical Engineer states that the findings, recommendations, specifications or professional advice contained herein, have been presented after being prepared in a manner consistent with the level of care and skill ordinarily exercised by reputable members of the Geotechnical Engineer's profession practicing contemporaneously under similar conditions in the locality of the project. RETL operates in general accordance with "*Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction*", (ASTM D3740). No other representations are expressed or implied, and no warranty or guarantee is included or intended.

This report has been prepared for the exclusive use of HMT Engineering & Surveying for the specific application towards the proposed Schoenthal Ranch Project to be constructed 1005 Schoenthal Road in New Braunfels, Texas.

FIELD EXPLORATION

Scope

The field exploration was completed in order to evaluate the engineering characteristics of the pavement materials and included a reconnaissance of the project site, drilling the test borings, and recovering disturbed split spoon samples.

Five (5) borings were performed at the site to a depth of 10-feet. RETL determined the number, depth and general location of the borings and staked the borings in the field. RETL performed the boring operations under the supervision of RETL. Upon completion of the drilling operations and obtaining the groundwater observations, the bore holes were backfilled with excavated soil and rock and the site cleaned as required. A Boring Location Plan is provided in the Appendix of this report.

Drilling and Sampling Procedures

The borings were performed using a drilling rig equipped with a rotary head and solid flight auger drilling methods were used to advance the boreholes to their desired depths. Disturbed samples were obtained employing split-barrel sampling procedures in general accordance with the procedures for "*Penetration Test and Split-Barrel Sampling of Soils*" (ASTM D1586).

The samples were classified in the field, placed in plastic bags, marked according to their boring number, depth and any other pertinent field data, stored in special containers and delivered to the laboratory for testing.

Field Tests and Measurements

Penetration Tests - During the sampling procedures, standard penetration tests (SPT) were performed to obtain the standard penetration value of the soil and rock. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer falling 30 inches required to advance the split-barrel sampler 1-foot into the soil or rock. The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows is recorded for each of three successive 6-inch penetrations. The "N" value is obtained by adding the second and third 6-inch increment number of blows. The results of standard penetration tests indicate the relative density of cohesionless soils and comparative consistency of cohesive soils, thereby providing a basis for estimating the relative strength and compressibility of the soil profile components.

Water Level Observations - Water level observations were obtained during the test boring operations and are noted on the boring logs provided in the Appendix. The amount of water in open boreholes largely depends on the permeability of the soils encountered at the boring locations. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. In relatively impervious soils, a suitable estimate of the groundwater depth may not be possible, even after several days of observation. Seasonal variations, temperature, land-use, proximity to a body of water, and recent rainfall conditions may influence the depth to the groundwater.

Ground Surface Elevations - Ground surface elevations were not provided at the boring locations. All depths referred to in this report are reported from the actual ground surface elevations at the boring locations during the time of our field investigation.

LABORATORY TESTING PROGRAM

In addition to the field investigation, a laboratory-testing program was conducted to determine additional pertinent engineering characteristics of the subgrade materials necessary in developing the pavement recommendations for the roadway.

The laboratory-testing program included supplementary visual classification (ASTM D2487) on all samples. In addition, selected samples were subjected water content tests (ASTM D2216), Atterberg limits tests (ASTM D4318), and percent material finer than the #200 sieve tests (ASTM D1140).

All phases of the laboratory-testing program were conducted in general accordance with applicable ASTM Specifications. The results of these tests are to be found in this report or on the accompanying boring logs and test reports provided in the Appendix.

SUBSURFACE CONDITIONS

General

The types of subsurface materials encountered in the test borings have been visually classified and are described in detail on the boring logs. The results of the standard penetration tests, water level observations and laboratory tests are presented on the boring logs in numerical form.

Representative samples of the soils were placed in polyethylene bags and are now stored in the laboratory for further analysis, if desired. Unless notified to the contrary, all samples will be disposed of 6 months after issuance of this report.

The stratification of the soil and rock, as shown on the boring logs, represents the soil and rock conditions at the actual boring locations. Variations may occur between, or beyond, the boring locations. Lines of demarcation represent the approximate boundary between different soil types, but the transition may be gradual, or not clearly defined. It should be noted that, whereby the test borings were drilled and sampled by experienced technicians, it is sometimes difficult to record changes in stratification within narrow limits. In the absence of foreign substances, it is also difficult to distinguish between discolored soils and clean soil fill.

Generalized Soil and Rock Conditions

The soil and rock conditions at the project site generally consist of lean clay (CL) soils underlain by weathered limestone and limestone which extend to the boring termination depths of 10-feet. Boring B-5 consisted of fat clay (CH) soils underlain by lean clay (CL) soils. The depth to rock was relatively shallow at borings B-1 to B-3, slightly deeper at B-4 and rock was not encountered at boring B-5. The fat clay soils in boring B-5 are high in plasticity and the lean clay soils in the remaining borings are low to moderate in plasticity. Tested liquid limits of the fat clay soils were 52-percent and the plasticity indices (PI) ranged from 31 to 32. Tested liquid limits of the lean clay soils ranged from 32 to 49-percent and the plasticity indices (PI) ranged from 20 to 31.

Groundwater Observations

Groundwater was not encountered during the drilling nor measured in the borings upon completion of the drilling. Based on observations made in the field and moisture contents obtained in the laboratory, it appears that the depth to groundwater at this site during the time of our field investigation is greater than the 10-foot depth, the deepest boring termination depth. It should be noted that water levels in open boreholes may require anywhere from several hours to several days to stabilize depending on the permeability of the soils and that groundwater levels at this site may be subject to seasonal conditions, recent rainfall, drought or temperature effects.

PVR Discussion

The laboratory test results indicate that the fat clay soils within the active zone at this site are high in plasticity and the lean clay soils are low to moderate in plasticity. **The maximum calculated total potential vertical rise (PVR) based on the soils encountered in the borings performed at this site and the results of the laboratory tests, is less than 1-inch at borings B-1 to B-3, approximately 1-inch at boring B-4 and approximately 1½-inches at boring B-5.** The PVR was calculated using the Texas Department of Transportation Method TEX-124E and took into account the depth of the active zone, estimated to extend to a depth to the top of the rock stratum or approximately 10-feet at this site, and the Atterberg limits test results of the soils encountered within the active zone.

The estimated PVR values provided above are based on a slab or pavement applying a sustained surcharge load of approximately 1.0 pound per square inch (144 psf) on the subgrade soils. The value represents the vertical rise that can be experienced by dry subsoils if they are subjected to conditions that allow them to become saturated, such as poor drainage. The actual movement of the subsoils is dependent upon their change in moisture content. Differential vertical movements can potentially be equal to the expected total movements. Differential vertical movements associated with the soils and rock at this site may occur over a distance equal to the active zone.

PAVEMENT RECOMMENDATIONS

Based on the information provided to RETL, the proposed project will consist of the construction of 2,700 LF of subdivision roadway. In designing the proposed pavement, the existing subgrade conditions must be considered together with the expected traffic use and loading conditions.

The conditions that influence pavement design can be summarized as follows:

1. Bearing values of the subgrade. These values can be represented by a California Bearing Ratio (CBR) for the design of flexible asphalt pavements.
2. Vehicular traffic, in terms of the number and frequency of vehicles and their range of axle loads.
3. Probable increase in vehicular use over the life of the pavement.
4. The availability of suitable materials to be used in the construction of the pavement and their relative costs.

Specific laboratory testing to define the subgrade strength (i.e. CBR/K values) has not been performed for this analysis. **Based upon the plasticity indices and strengths of the natural clay subgrade soils, a CBR value of 3 has been selected for design.**

We have evaluated the proposed new subdivision roadway considering the City of New Braunfels Street Design Standards, which are designated as "One and Two Family Residential Local" and "Residential Collector" streets. The typical section for the above street designations are indicated on drawing numbers ST-011 and ST-007 dated 07/2008. **Based on our calculations, the AASHTO 18-kip ESAL for the City of New Braunfels "One and Two Family Residential Local" and "Residential Collector" streets are 58,000 and 279,000, respectively.**

RETL used the following pavement design parameters for the flexible pavement design:

AASHTO PAVEMENT DESIGN PARAMETER	DESIGN VALUE
Reliability (R)	70%
Overall Deviation	0.45
Initial/Terminal Serviceability	4.2 / 2.0
Subgrade Design CBR	3
Design Life	20 years

The following lime treated subgrade, limestone base, and hot mix asphaltic concrete layer coefficients were selected for the pavement design:

Pavement Constituent	Layer Coefficient (α)
New Crushed Limestone Base (TxDOT Item 247 Type A, Grade 1-2)	0.14
Type D HMAC	0.44

The recommended hot mixed asphaltic concrete (HMAC) pavement sections are provided in the following tables:

“ONE AND TWO FAMILY RESIDENTIAL LOCAL” (Required AASHTO 18-KIP ESAL = 58,000)			
Hot Mix Asphaltic Concrete	2"	2"	2"
Crushed Limestone Base Material (TxDOT Item 247 Type A; Gr. 2)	10"	6"	7.5"
TENSAR Geogrid	---	TX-5	BX-1200
Moisture Conditioned Subgrade	6"	6"	6"
Calculated AASHTO 18-kip ESAL	58,000	109,000	58,000

“RESIDENTIAL COLLECTOR” (Required AASHTO 18-KIP ESAL = 279,000)			
Hot Mix Asphaltic Concrete	2"	2"	2"
Crushed Limestone Base Material (TxDOT Item 247 Type A; Gr. 2)	14.5"	9"	11"
TENSAR Geogrid	---	TX-5	BX-1200
Moisture Conditioned Subgrade	6"	6"	---
Calculated AASHTO 18-kip ESAL	279,000	357,000	279,000

Moisture Conditioned Subgrade

After all surface organics and deleterious materials have been removed and the desired subgrade elevation has been achieved, the upper 6-inches of exposed subgrade soils should be compacted to a minimum density of 95-percent of the maximum dry unit weight of the subgrade soils as determined by TEX 114E and at or above the optimum moisture content. Any fill required to achieve the final subgrade elevation shall be placed in maximum 8-inch loose lifts and compacted as specified above.

Triaxial Geogrid

The TENSAR TX-5 or BX-1200 Geogrid shall be placed in accordance with the manufacturer's recommendations. Geogrid is recommended to reduce the magnitude of cracking, reduce maintenance costs and increase the life of the flexible pavements. Alternate geogrid products will not be considered unless the submittal contains a pavement design sealed by a licensed engineer. The geogrid option is recommended in the areas of boring B-5 due to the presence of expansive fat clay subgrade soils.

Limestone Base

Limestone base materials in flexible pavement areas should meet the requirements set forth in the Texas Department of Transportation (TxDOT) 2014 Standard Specifications for Construction of Highways, Streets and Bridges; Item 247, Type A, Grade 1-2. The base material should be placed in maximum 8-inch thick loose lifts and compacted to a minimum density of 100-percent of the maximum dry density as determined by TEX 113E and within -2 to +2 percent of the optimum moisture content.

Hot Mix Asphalt

Hot mix asphaltic concrete should meet the requirements set forth in TxDOT Item 340 or Item 341; Type D surface course. The asphaltic concrete should be compacted to between 92 and 97-percent of the maximum theoretical density as determined by the Rice specific gravity.

Drainage

Proper drainage is very important for the adequate performance of asphaltic pavements. Ruts and birdbaths in asphalt pavements allow for quick deterioration of the pavement primarily due to saturation of the underlying base materials and subgrade soils.

The pavement design recommendations in this report are based on the assumption that the pavements will have good drainage. A minimum of 1-percent slope in the pavement surface is recommended.

GENERAL COMMENTS

If significant changes are made in the character or location of the proposed project, a consultation should be arranged to review any changes with respect to the prevailing soil conditions. At that time, it may be necessary to submit supplementary recommendations.

It is recommended that the services of RETL be engaged to test and evaluate the subgrade soils in the pavement areas prior to placing pavement constituents in order to verify that the bearing soils are consistent with those encountered in the borings. RETL cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the pavements if not engaged to also provide construction observation and testing for this project. If it is required for RETL to accept any liability, then RETL must agree with the plans and perform such observation during construction as we recommend.

All sheeting, shoring and bracing of trenches, pits and excavations should be made the responsibility of the contractor and should comply with all current and applicable local, state and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration.

APPENDIX

BORING LOCATION PLAN

NO SCALE
BORING LOCATIONS ARE APPROXIMATE



January 7, 2020
HMT Engineering & Surveying
RETL Project No.: 219597

SCHOENTHAL RANCH PROJECT
1005 Schoenthal Road
New Braunfels, Texas



ROCK ENGINEERING AND TESTING LABORATORY, INC.
10856 VANDALE STREET
SAN ANTONIO, TEXAS 78216
(210) 495-8000

LOG OF BORING B-1



SHEET 1 of 1



Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: HMT Engineering & Surveying
PROJECT: Schoenthal Ranch Project
LOCATION: 1005 Schoenthal Road; New Braunfels, TX
NUMBER: 219597

DATE(S) DRILLED: 12/11/19

	FIELD DATA				LABORATORY DATA							DRILLING METHOD(S):	
SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	Air Rotary	
						LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX				GROUNDWATER INFORMATION:	
						LL	PL	PI				Groundwater was not encountered during drilling, nor measured upon the completion of the drilling.	
												SURFACE ELEVATION: N/A	
												DESCRIPTION OF STRATUM	
	1	SPT S-1	N= 26		17	32	12	20			88	<u>LEAN CLAY</u> , dark brown, moist, very stiff. (CL)	
	2												
	3	SPT S-2	N= 67		8						41	<u>WEATHERED LIMESTONE</u> light brown, dry, hard.	
	4												
	5	SPT S-3	N= 50/2"		1							Same as above, very hard.	
	6												
	7	SPT S-4	N= 50/0"		5							<u>LIMESTONE</u> light brown, dry, very hard.	
	8												
	9	SPT S-5	N= 50/0"		3							Same as above.	
	10											Boring terminated at a depth of 10-feet.	
N - STANDARD PENETRATION TEST RESISTANCE P - POCKET PENETROMETER RESISTANCE T - POCKET TORVANE SHEAR STRENGTH												REMARKS: Boring location determined by RETL. Drilling operations performed by RETL. GPS Coordinates: N 29.67388°, W -98.28861°	

LOG_OF_BORING 219597 LOGS.GPJ ROCK_ETL.GDT 1/7/20

LOG OF BORING B-2

SHEET 1 of 1



Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: HMT Engineering & Surveying
PROJECT: Schoenthal Ranch Project
LOCATION: 1005 Schoenthal Road; New Braunfels, TX
NUMBER: 219597

DATE(S) DRILLED: 12/11/19

FIELD DATA										LABORATORY DATA						DRILLING METHOD(S): Air Rotary	
SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	GROUNDWATER INFORMATION: Groundwater was not encountered during drilling, nor measured upon the completion of the drilling.					
						LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX				SURFACE ELEVATION: N/A					
						LL	PL	PI				DESCRIPTION OF STRATUM					
	1	SPT S-1	N= 25	12	41	18	23				85	<u>LEAN CLAY</u> , dark brown, slightly moist, very stiff. (CL)					
	2																
	3	SPT S-2	N= 57	5	23	14	9				62	<u>WEATHERED LIMESTONE</u> light brown, dry, hard.					
	4																
	5	SPT S-3	N= 50/1"	4								<u>LIMESTONE</u> light brown, dry, very hard.					
	6																
	7	SPT S-4	N= 50/0"	2								Same as above.					
	8																
	9	SPT S-5	N= 50/0"	1								Same as above.					
	10											Boring terminated at a depth of 10-feet.					

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.67354°, W -98.29056°

LOG OF BORING B-3



SHEET 1 of 1



Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: HMT Engineering & Surveying
PROJECT: Schoenthal Ranch Project
LOCATION: 1005 Schoenthal Road; New Braunfels, TX
NUMBER: 219597

DATE(S) DRILLED: 12/11/19

	FIELD DATA					LABORATORY DATA							DRILLING METHOD(S):	
SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	Air Rotary		
						LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX				GROUNDWATER INFORMATION:		
						LL	PL	PI				Groundwater was not encountered during drilling, nor measured upon the completion of the drilling.		
												SURFACE ELEVATION: N/A		
												DESCRIPTION OF STRATUM		
	1	SPT S-1	N= 39-50/1"	7								<u>LEAN CLAY</u> , brown, dry, very hard.		
	2											<u>LIMESTONE</u> light brown, dry, very hard. Same as above. Same as above.		
3	SPT S-2	N= 50/0"	4											
4														
5	SPT S-3	N= 50/0"	3											
6														
	7	SPT S-4	N= 50/0"	1								Same as above.		
	8											<u>LIMESTONE</u> light brown, dry, very hard.		
	9	SPT S-5	N= 50/0"	1										
	10											Boring terminated at a depth of 10-feet.		
N - STANDARD PENETRATION TEST RESISTANCE P - POCKET PENETROMETER RESISTANCE T - POCKET TORVANE SHEAR STRENGTH												REMARKS: Boring location determined by RETL. Drilling operations performed by RETL. GPS Coordinates: N 29.67282°, W -98.29218°		

LOG_OF_BORING 219597 LOGS.GPJ ROCK_ETL.GDT 1/7/20

LOG OF BORING B-4

SHEET 1 of 1



Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: HMT Engineering & Surveying
PROJECT: Schoenthal Ranch Project
LOCATION: 1005 Schoenthal Road; New Braunfels, TX
NUMBER: 219597

DATE(S) DRILLED: 12/11/19

FIELD DATA													LABORATORY DATA													DRILLING METHOD(S):
SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	Air Rotary														
						LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX				GROUNDWATER INFORMATION:														
						LL	PL	PI				Groundwater was not encountered during drilling, nor measured upon the completion of the drilling.														
																										SURFACE ELEVATION: N/A
													DESCRIPTION OF STRATUM													
	1	SPT S-1	N= 30	8	41	17	24				79	<u>LEAN CLAY</u> , with gravel, brown, dry, hard. (CL)														
	2																									
	3	SPT S-2	N= 31	13								Same as above, light brown, slightly moist.														
	4																									
	5	SPT S-3	N= 39	11	49	18	31				92	<u>LEAN CLAY</u> , light brown, slightly moist, hard. (CL)														
	6																									
	7	SPT S-4	N= 50/0"	2								<u>LIMESTONE</u> , light brown, dry, very hard.														
	8																									
	9	SPT S-5	N= 50/1"	2								Same as above.														
	10											Boring terminated at a depth of 10-feet.														

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.67313°, W -98.29415°

LOG OF BORING B-5

SHEET 1 of 1

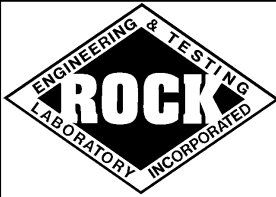


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CLIENT: HMT Engineering & Surveying
PROJECT: Schoenthal Ranch Project
LOCATION: 1005 Schoenthal Road; New Braunfels, TX
NUMBER: 219597

DATE(S) DRILLED: 12/11/19

FIELD DATA										LABORATORY DATA						DRILLING METHOD(S):	
SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS			DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	GROUNDWATER INFORMATION:					
						LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX				Groundwater was not encountered during drilling, nor measured upon the completion of the drilling.					
												SURFACE ELEVATION: N/A					
DESCRIPTION OF STRATUM																	
	1	SPT S-1	N= 28	19	52	20	32			86	FAT CLAY , dark brown, moist, very stiff. (CH)						
	2																
	3	SPT S-2	N= 21	16	52	21	31			87	Same as above, brown, slightly moist. (CH)						
	4																
	5	SPT S-3	N= 23	7							LEAN CLAY , light brown, dry, very stiff.						
	6																
	7	SPT S-4	N= 31	10	41	15	26			92	Same as above, slightly moist, hard. (CL)						
	8																
	9	SPT S-5	N= 28	11							Same as above, with calcareous, very stiff.						
	10										Boring terminated at a depth of 10-feet.						
N - STANDARD PENETRATION TEST RESISTANCE P - POCKET PENETROMETER RESISTANCE T - POCKET TORVANE SHEAR STRENGTH												REMARKS: Boring location determined by RETL. Drilling operations performed by RETL. GPS Coordinates: N 29.67272°, W -98.29604°					



Engineering & Testing
Laboratory, Inc.

Rock Engineering & Testing Laboratory
10856 Vandale
San Antonio, TX 78216
Telephone: 210-495-8000
Fax: 210-495-8015

KEY TO SOIL CLASSIFICATION AND SYMBOLS

UNIFIED SOIL CLASSIFICATION SYSTEM				TERMS CHARACTERIZING SOIL STRUCTURE
MAJOR DIVISIONS		SYMBOL	NAME	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well Graded Gravels or Gravel-Sand mixtures, little or no fines	SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical LAMINATED (VARVED) - composed of thin layers of varying color and texture, usually grading from sand or silt at the bottom to clay at the top
		GP	Poorly Graded Gravels or Gravel-Sand mixtures, little or no fines	
		GM	Silty Gravels, Gravel-Sand-Silt mixtures	
		GC	Clayey Gravels, Gravel-Sand-Clay Mixtures	
	SAND AND SANDY SOILS	SW	Well Graded Sands or Gravelly Sands, little or no fines	CRUMBLY - cohesive soils which break into small blocks or crumbs on drying CALCAREOUS - containing appreciable quantities of calcium carbonate, generally nodular WELL GRADED - having wide range in grain sizes and substantial amounts of all intermediate particle sizes POORLY GRADED - predominantly of one grain size uniformly graded) or having a range of sizes with some intermediate size missing (gap or skip graded)
		SP	Poorly Graded Sands or Gravelly Sands, little or no fines	
		SM	Silty Sands, Sand-Silt Mixtures	
		SC	Clayey Sands, Sand-Clay mixtures	
FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML	Inorganic Silts and very fine Sands, Rock Flour, Silty or Clayey fine Sands or Clayey Silts	<div>SYMBOLS FOR TEST DATA</div> <div> — Groundwater Level (Initial Reading) — Groundwater Level (Final Reading) — Shelby Tube Sample — SPT Samples — Auger Sample — Rock Core </div>
		CL	Inorganic Clays of low to medium plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays	
		OL	Organic Silts and Organic Silt-Clays of low plasticity	
	SILTS AND CLAYS LL > 50	MH	Inorganic Silts, Micaceous or Diatomaceous fine Sandy or Silty soils, Elastic Silts	
		CH	Inorganic Clays of high plasticity, Fat Clays	
		OH	Organic Clays of medium to high plasticity, Organic Silts	
HIGHLY ORGANIC SOILS		PT	Peat and other Highly Organic soils	

TERMS DESCRIBING CONSISTENCY OF SOIL

COARSE GRAINED SOILS		FINE GRAINED SOILS		
DESCRIPTIVE TERM	NO. BLOWS/FT. STANDARD PEN. TEST	DESCRIPTIVE TERM	NO. BLOWS/FT. STANDARD PEN. TEST	UNCONFINED COMPRESSION TONS PER SQ. FT.
Very Loose	0 - 4	Very Soft	< 2	< 0.25
Loose	4 - 10	Soft	2 - 4	0.25 - 0.50
Medium	10 - 30	Firm	4 - 8	0.50 - 1.00
Dense	30 - 50	Stiff	8 - 15	1.00 - 2.00
Very Dense	over 50	Very Stiff	15 - 30	2.00 - 4.00
		Hard	over 30	over 4.00

Field Classification for "Consistency" is determined with a 0.25" diameter penetrometer