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Elevating the Standard

Date: September 23, 2011

To: Thomas Klein, San Antonio Water System

From: P. Russell Yeager, Coyle Engineering

Reference: SAWS Far West Relief Main (FW-01)

Subject: Geotechnical Supplemental Information

The attached geotechnical report by Addula Consulting Engineering dated April 27th, 2011 is provided as supplemental information and does not supersede San Antonio Water System construction details, specifications, special conditions or the Contract Documents.

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GEOTECHNICAL EXPLORATION
on
SAWS FAR WEST SEWER RELIEF MAIN
Highway 90 near Hunt Lane
San Antonio, Texas
Addula Report No. H100155

Prepared for:

COYLE ENGINEERING, INC.
9120 Old Dietz Elkhorn Road
San Antonio, Texas 78015
Attention: Ms. Mia Herbold
April 26, 2010

Prepared By:

ADDULA CONSULTING ENGINEERS
12706 O'Connor Road
San Antonio, Texas 78233
TBPE Firm No. - 11220

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April 26, 2010

Coyle Engineering, Inc.
9120 Old Dietz Elkhorn Road
San Antonio, TX 78015
Attention: Ms. Mia Herbold

Re: Geotechnical Exploration
SAWS Far West Sewer Relief Main
Highway 90 near Hunt Lane
San Antonio, Texas
Addula Report No. H100155

Attached is the report of the geotechnical exploration performed for the project referenced above. This study was authorized by Mr. Mike Coyle on February 18, 2010 and performed in accordance with ADDULA Proposal No. 26072 dated November 25, 2009.

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 a new sewer line.

Addula Consulting Engineers, 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,

Addula Consulting Engineers, LLC
TBPE Firm No. 11220

4/27/10

J. L. HILLHOUSE
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Jim L Hillhouse, P.E.
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President

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Copies: (3) Client

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ADDULA REPORT NO. H100155

1.0 PURPOSE AND SCOPE

The purpose of this geotechnical exploration is to evaluate some of the physical and engineering properties of subsurface materials at the subject site with respect to formulation of appropriate geotechnical conditions for the proposed construction. The field exploration was accomplished by securing subsurface samples from widely spaced test borings performed along the proposed sewer line alignment. 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 test 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. The scope of work may not fully define the variability of subsurface materials that is 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

It is proposed to construct a new sanitary sewer line adjacent to an existing alignment. Present plans provide for the construction of approximately 4,000 lineal feet of new sanitary sewer line across a densely wooded tract of land owned by SAWS at the Medio Creek WRC (2231 S. Hunt Lane) in San Antonio, Texas.

Most of the existing sewer line route was clear of trees and brush. The existing creek crosses both the northern and southern ends of the proposed alignment. Further, according to the current available information, we understand most of the sewer line will be installed at an average depth of about 10 to 12 ft. A site plan illustrating the general outline of the proposed construction is provided as Figure 1, the Boring Location Plan, in the Appendix of this report.

3.0 FIELD EXPLORATION

Subsurface conditions along the proposed sanitary sewer line were explored by drilling a total of nine (9) test borings in general accordance with ASTM D 420 to a depth of up to 15 to 20 ft each using standard rotary drilling equipment. The approximate location of each test 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.

Borings 1 and 2 (southern end of proposed alignment) were accessed via a security gate near the intersection of Hunt Lane and Highway 90. Borings 3 through 8 were accessed via a security gate on Hunt Lane. Boring 9 (northern end of proposed alignment) was accessed via the main plant entrance at 2231 S. Hunt Lane.

Subsurface types encountered during the field exploration are presented on Log of Boring sheets 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 trench excavations 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 Log of Boring sheets also enclosed in the Appendix.

5.0 GENERAL SUBSURFACE CONDITIONS

Within the 20-ft maximum depth explored on the site, subsurface materials consist generally of moderate to high plasticity silty clay, clay, shaly clay and marly clay with intermittent gravel seams/layers. In addition, the upper 4 ft of clay in Boring 1 and the upper 2 ft of clay in Boring 4 were judged to be possible fill. More detailed stratigraphic information is presented on the Log of Boring Sheets attached to this report.

Most of the subsurface materials are relatively impermeable and are anticipated to have a slow response to water movement. Therefore, several days of observation will 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.

During field explorations, no free groundwater was noted on drilling tools or in open boreholes upon completion. However, it is common to detect seasonal groundwater either from natural fractures within the clayey matrix, gravel layers/seams, near the clay/marly clay or clay/shaly clay interface or from fractures in these materials, 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 Log of Boring sheets provided in the Appendix of this report.

6.0 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, including location on the site, 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 review prior to construction.

6.1 Excavations and Backfilling

It is anticipated trench excavation depths for new utility lines will be at an average depth of about 10 to 12 ft. Results of test borings indicate predominately moderate to highly plastic clay, shaly clay and marly clay will be encountered within the depth of the utility excavations. Some gravel layers/seams may also be encountered. The surficial clayey soils and deeper soils contain numerous planes of weakness. Locally, this matrix is known to be unstable unless cut at reasonably flat slopes. Sudden and un-forewarned collapse of even shallow trenches (i.e. less than 5 ft) can occur unless trench walls are cut at safe slopes. All excavations should be shored, braced or cut at stable slopes in accordance with Occupational Safety and Health Administration (OSHA) requirements.

No unusual problems are anticipated excavating the clayey type soils. Lower unconfined compressive strengths (less than 1.0 tsf) of the various clay soils were generally encountered within the upper 4 to 8 ft of the borings. In addition, several of the borings contained gravel seams and layers at various depths. These softer soils and gravels can have a higher likelihood to slough and cave, particularly if groundwater is encountered. Excavation of the deeper marly clay and/or shaly clay (unconfined compressive strengths ranging from 1.4 to 5.5 tsf) may be more difficult. These materials are generally harder with depth and may require special equipment by a contractor experienced in the area.

All excavations should be monitored to verify the lines bear on suitable material. The bearing stratum exposed in the base of all excavations should be protected against any detrimental change in conditions. Surface runoff water should be drained away from excavations and not allowed to collect. All bedding/backfill should be placed as soon as practical after the excavation is made. Compaction for backfill is described in Section 7.2 below. All bedding and backfill should conform to SAWS requirements.

Settlement of backfill should be anticipated. Even though backfill is properly compacted as recommended above, fills in excess of about 8 to 10 ft are still subject to settlements over time of about 1 to 2 percent of the total fill thickness. This level of settlement can be significant especially where relatively deep utilities are located beneath areas to be paved. Therefore, close coordination and monitoring should be performed during construction to reduce the potential for future movement. This would include proper benching of backfill into side excavations to limit the potential of differential movements across the trench backfill and natural soils. Also, fills in excess of 10 ft deep should be compacted to a minimum of 100 percent of the material's maximum standard Proctor dry density, as described in Section 7.2 Fill Compaction, below.

6.2 Groundwater

Groundwater was not encountered at the boring locations. However, from our experience, groundwater seepage could occur along the proposed sewer alignment during construction. The risk of encountering seepage increases with depth of excavation and during or after periods of precipitation. Standard diversion methods, and sump pits and pumping may be adequate to control seepage on a local basis. Where these methods are not suitable, supplemental dewatering techniques may be required in some areas, especially where granular (gravel) soils are encountered. Supplemental dewatering measures could consist of submersible pumps in slotted casings and well points. In any dewatering method, care must be taken to provide the correct filtering around each dewatering well to prevent the migration of fines and loss of ground around the well. The need for these or other de-watering devices should be carefully addressed during construction. Dewatering systems should be designed by a licensed professional engineer experienced in that type of work.

The contractor should have an excavation and groundwater control plan in-place prior to beginning work at this site. A contractor experienced in this area should be selected for construction and installation of the planned sewer line.

7.0 GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS

Variations in subsurface conditions could be encountered during construction. To permit correlation between test boring data and actual subsurface conditions encountered during construction, it is recommended a registered Professional Engineering firm be retained to observe construction procedures and materials.

Some construction problems, particularly degree or magnitude, cannot be anticipated until the course of construction. The recommendations offered in the following paragraphs are intended not to limit or preclude other conceivable solutions, but rather to provide our observations based on our experience and understanding of the project characteristics and subsurface conditions encountered in the boring.

7.1 Site Preparation and Grading

All areas to receive new fill should be properly prepared. After completion of the necessary stripping, clearing, and excavating and prior to placing any required fill, the exposed soil subgrade should be carefully evaluated by probing and testing. Any undesirable material (organic material, wet, soft, or loose soil) still in place should be removed and replaced with well-compacted material as outlined in Section 7.2. Prior to placement of any fill, the exposed soil subgrade should then be scarified to a minimum depth of 6 inches and recompacted as outlined in Section 7.2.

If fill is to be placed on existing slopes (natural or constructed) steeper than six horizontal to one vertical (6:1), the fill materials should be benched into the existing slopes in such a manner as to provide a minimum bench-key width of five (5) feet. This should provide a good contact between the existing soils and new fill materials, reduce potential sliding planes, and allow relatively horizontal lift placements.

Slope stability analysis of embankments (natural or constructed) was not within the scope of this study.

All excavations should be shored, braced or cut at stable slopes in accordance with Occupational Safety and Health Administration (OSHA) requirements. Additionally, evaluation of excavation slopes or bracing for below-grade retention systems is beyond the scope of this geotechnical exploration. The contractor should provide an excavation safety plan to the Client.

Due to the nature of the clayey soils found near the surface at the borings, traffic of heavy equipment (including heavy compaction equipment) may create pumping and general deterioration of shallow soils. Therefore, some construction difficulties should be anticipated during periods when these soils are saturated.

7.2 Fill Compaction

Sandy or silty clay materials with a plasticity index below 25 should be compacted to a dry density of at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of 1 percentage point below to 3 percentage points above the material's optimum moisture content.

Clay soils with a plasticity index equal to or greater than 25 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 a minimum of 2 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.

Non-plastic granular materials should be compacted to a dry density of at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of 2 percentage point below to 2 percentage points above the material's optimum moisture content.

In cases where either mass fills or utility lines are more than 10 ft deep, the fill/backfill 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/backfill shallower than 10 ft should be compacted as outlined above.

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. As a guide, backfill should be tested at a rate of one test per lift per each 200 lineal feet of trench.

8.0 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.

ADDULA is not responsible for conclusions, opinions or recommendations made by others based on this data. Information contained in this report is intended for exclusive use of the Client (and their design representatives) and design of specific structure outlined in Section 2.0. Recommendations presented in this report should not be used for design of any other structure except that specifically described in this report. 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.

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, ADDULA is not responsible for damages resulting from workmanship of designers or contractors and 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

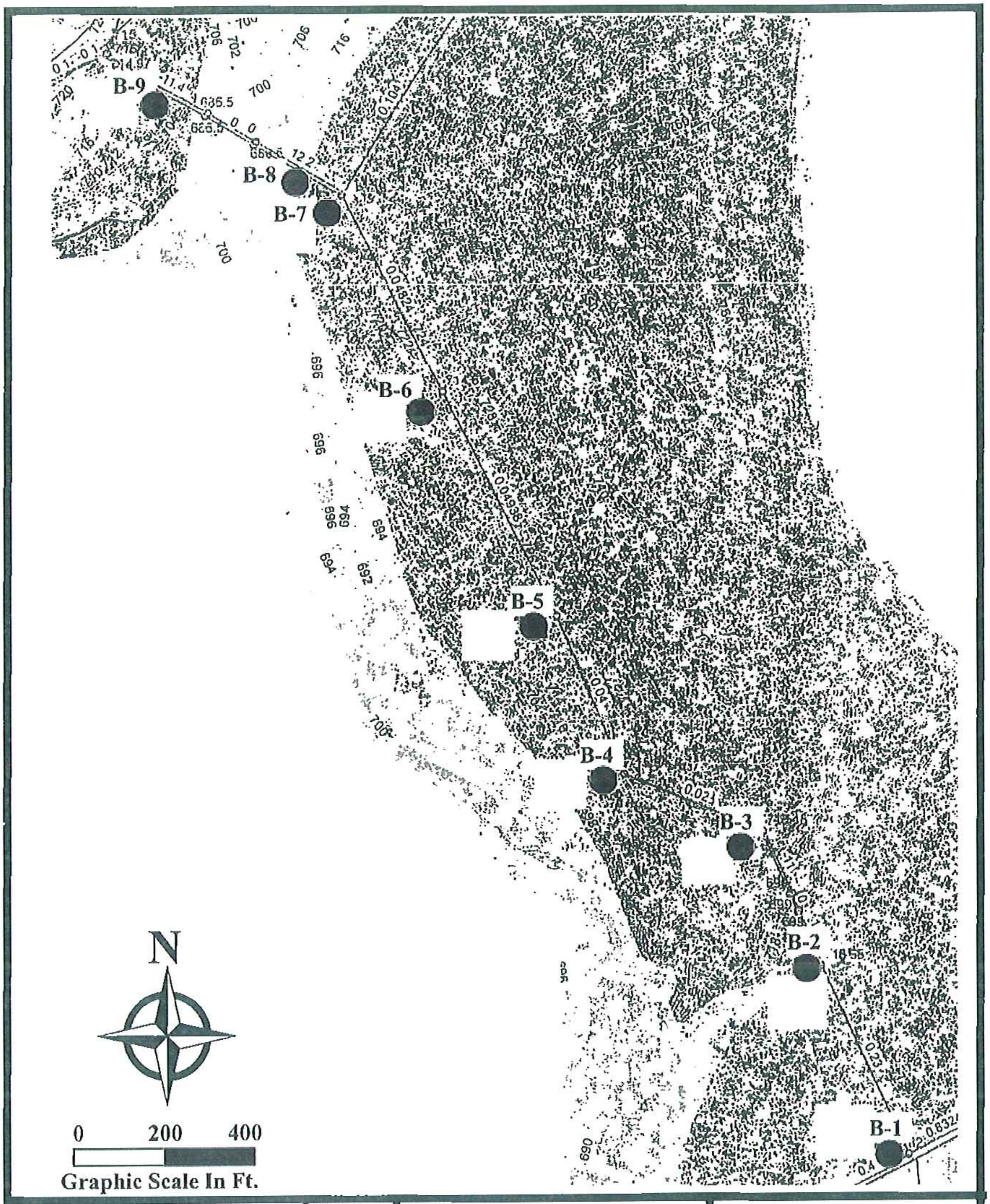
A-1 METHODS OF FIELD EXPLORATION

Using standard rotary drilling equipment mounted on an all-terrain vehicle, a total of nine (9) test borings were performed for this geotechnical exploration at the approximate locations shown on the Boring Location Plan, Figure 1. Borings 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 location of test borings shown on the Boring Location Plan is considered accurate only to the degree implied by the method used to locate the borings.

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 examined visually. One representative portion of each sample was sealed in a plastic bag for use in future visual examinations and possible testing in the laboratory.

Other representative samples were obtained using split-spoon sampling procedures in 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 Log of Boring sheets.

Logs of all borings are included in the Appendix of this report. The logs show visual descriptions of subsurface strata encountered using the Unified Soil Classification System. Sampling information, pertinent field data, and field observations are also included. 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
SAWS Far West Sewer Relief Main
Highway 90 near Hunt Lane
San Antonio, Texas
Addula Report No. H100155
April 26, 2010

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Boring Location Plan
Figure 1

B-1 METHODS OF LABORATORY TESTING

Representative samples were examined 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), Atterberg-limit tests (ASTM D 4318), gradation tests (percentage of material passing a No. 200 sieve) and dry unit weight determinations were performed on selected samples. In addition, unconfined compression (ASTM D 2166) and pocket-penetrometer tests are conducted on selected soil samples to evaluate the soil shear strength. Results of all laboratory tests described above are provided on the accompanying Log of Boring sheets.

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LOG OF BORING NO.: 1

Sheet 1 of 1

PROJECT NO.: H100155

Client: COYLE ENGINEERING
Project: SAWS FAR WEST SEWER RELIEF MAIN
Start Date: 4/8/2010 **End Date:** 4/8/2010
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: SAN ANTONIO, TEXAS
Surface Elevation:
Longitude:
Latitude:
Hammer Drop (lbs / in):

GROUND WATER OBSERVATIONS
∇ On Rods (ft): NONE
▼ After Drilling (ft): DRY
∇ After ___ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	TX Cone or Std Pen. (blows/ft,in)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
	▨	Dark Tan and Tan CLAY with silt and gravel seams -possible fill	■			2.0				19	67	24	43
	▨		■			2.5				23			
	▨	4.0	■										
5	▨	Dark Brown to Tan CLAY	■			2.5	0.6		90	30	60	22	38
	▨	-tan with silt layers below 6'	■			1.75				24			
	▨		■			4.5+				24			
10	▨												
	▨	13.0											
	▨	Tan SHALY CLAY with marl seams	■			4.0				22	75	24	51
15	▨	-blocky structure											
	▨		■			4.5+				17			
20	▨	20.0	■										
		TEST BORING TERMINATED AT 20 FT											
25													

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LOG OF BORING NO.: 2

Sheet 1 of 1

PROJECT NO.: H100155

Client: COYLE ENGINEERING
Project: SAWS FAR WEST SEWER RELIEF MAIN
Start Date: 4/8/2010 **End Date:** 4/8/2010
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: SAN ANTONIO, TEXAS
Surface Elevation:
Longitude:
Latitude:
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	TX Cone or Std. Pen. (blows/ft,in)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
	▨	Tan CALCAREOUS CLAY	■			3.0				29			
	▨	-gravel seams below 2'											
5	▨		☒		25					17			
	▨	6.0											
	▨	Tan SILTY CLAY with iron oxide deposits	■			4.0				16			
	▨		■			4.5+	1.4		112	18	43	19	24
10	▨	-gravel seam below 10'											
	▨	12.0											
	▨	Tan MARLY CLAY with calcareous deposits	■			4.5+				18			
15	▨	15.0											
		TEST BORING TERMINATED AT 15 FT											
20													
25													

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LOG OF BORING NO.: 3

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PROJECT NO.: H100155

Client: COYLE ENGINEERING
Project: SAWS FAR WEST SEWER RELIEF MAIN
Start Date: 4/8/2010 **End Date:** 4/8/2010
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: SAN ANTONIO, TEXAS
Surface Elevation:
Longitude:
Latitude:
Hammer Drop (lbs / in):

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

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	TX Cone or Std. Pen. (blows/ft,in)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
	▨	Dark Brown CLAY with calcareous nodules	■			2.25				29			
	▨		■			2.0				27			
5	▨		■			4.5+	0.9		90	27	67	20	47
	▨	6.0	■										
	▨	Tan and Gray MARLY CLAY	■			4.5+				20			
	▨		■			4.5+				23			
10	▨												
	▨		■			4.5+	2.7		102	22	76	28	48
15	▨												
	▨		■			4.5+				23			
20	▨	20.0	■										
		TEST BORING TERMINATED AT 20 FT											
25													

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LOG OF BORING NO.: 4

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PROJECT NO.: H100155

Client: COYLE ENGINEERING
Project: SAWS FAR WEST SEWER RELIEF MAIN
Start Date: 4/8/2010 **End Date:** 4/8/2010
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: SAN ANTONIO, TEXAS
Surface Elevation:
Longitude:
Latitude:
Hammer Drop (lbs / in):

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

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	TX Cone or Std. Pen. (blows/ft,in)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
	▨	Tan CLAY with silt seams -possible fill				2.25	0.7		97	26	65	25	40
	▨	2.0											
	▨	Dark Brown CLAY with calcareous nodules				1.5				30			
5	▨	-gravel seams 4' to 6'				4.25				23			
	▨	6.0											
	▨	Tan SHALY CLAY with oxide deposits				4.5+				25			
	▨					4.5+	5.5		104	21	67	25	42
10	▨												
	▨	-blocky structure below 13'				4.5+				20			
15	▨	15.0											
		TEST BORING TERMINATED AT 15 FT											
20													
25													

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LOG OF BORING NO.: 5

Sheet 1 of 1

PROJECT NO.: H100155

Client: COYLE ENGINEERING
Project: SAWS FAR WEST SEWER RELIEF MAIN
Start Date: 4/8/2010 **End Date:** 4/8/2010
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: SAN ANTONIO, TEXAS
Surface Elevation:
Longitude:
Latitude:
Hammer Drop (lbs / in):

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

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % ROD	TX Cone or Std. Pen. (blows/ft,in)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
	▨	Dark Brown CLAY with silt seams	■			2.0	0.7		90	31	66	24	42
	▨		■			2.25				30			
	▨	4.0											
5	▨	Tan and Gray SHALY CLAY with silt seams	■			4.5				26			
	▨		■			4.5+	2.1		98	23	68	27	41
	▨		■			4.5+				18			
10	▨												
	▨	-blocky structure below 13'	■			4.5+				18			
15	▨												
	▨		■			4.5+				20			
20	▨	20.0											
		TEST BORING TERMINATED AT 20 FT											
25													

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LOG OF BORING NO.: 6

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PROJECT NO.: H100155

Client: COYLE ENGINEERING
Project: SAWS FAR WEST SEWER RELIEF MAIN
Start Date: 4/8/2010 **End Date:** 4/8/2010
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: SAN ANTONIO, TEXAS
Surface Elevation:
Longitude:
Latitude:
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	TX Cone or Std. Pen. (blows/ft.in)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
	▨	Dark Brown CLAY with calcareous nodules and silt seams	■			2.25				37			
	▨		■			2.5				34			
5	▨		■			3.0	0.6		86	31	64	24	40
	▨	-increase in silt seams below 6'	■										
	▨	8.0	■			4.5+				19			
		Tan CLAYEY GRAVEL											
10			☒		42					8			
		13.0											
	▨	Tan and Gray SHALY CLAY with iron oxide deposits	■			4.5+	4.5		107	18	69	25	44
15	▨	15.0	■										
		TEST BORING TERMINATED AT 15 FT											
20													
25													

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LOG OF BORING NO.: 7

Sheet 1 of 1

PROJECT NO.: H100155

Client: COYLE ENGINEERING
Project: SAWS FAR WEST SEWER RELIEF MAIN
Start Date: 4/8/2010 **End Date:** 4/8/2010
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: SAN ANTONIO, TEXAS
Surface Elevation:
Longitude:
Latitude:
Hammer Drop (lbs / in):

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

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	TX Cone or Std. Pen. (blows/ft,in)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
	▨	Dark Brown CLAY with a trace of silt and calcareous nodules	■			2.0				38			
	▨		■			2.0				32			
5	▨		■			1.75				32			
	▨		■			2.25	0.7		95	27	72	22	50
	▨	8.0	■										
	▨	Tan MARLY CLAY with calcareous nodules	■			4.5+				20			
10	▨		■										
	▨		■			4.5+				21			
15	▨	-gravel seam below 15'											
	▨	17.0											
	▨	Tan and Gray MARLY CLAY	■			4.5+	2.2		116	32	87	26	61
20	▨	20.0	■										
		TEST BORING TERMINATED AT 20 FT											
25													

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LOG OF BORING NO.: 8

Sheet 1 of 1

PROJECT NO.: H100155

Client: COYLE ENGINEERING
Project: SAWS FAR WEST SEWER RELIEF MAIN
Start Date: 4/8/2010 **End Date:** 4/8/2010
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: SAN ANTONIO, TEXAS
Surface Elevation:
Longitude:
Latitude:
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	TX Cone or Std. Pen. (blows/ft,in)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
	▨	Dark Brown CLAY with calcareous nodules	■										
	▨		■			2.5				32			
	▨		■			2.5				26			
	▨	4.0	■										
	▨	Dark Tan and Gray CLAY with calcareous nodules	■										
5	▨		■			2.75	0.5		95	24	71	21	50
	▨		■							19			
	▨	8.0	■										
	▩	Tan CLAYEY GRAVEL											
10	▩		☒		29			26		18			
	▩	12.0											
	▨	Tan and Gray CLAY with iron oxide deposits											
	▨		■			4.5+				20	67	22	45
15	▨	15.0	■										
		TEST BORING TERMINATED AT 15 FT											
20													
25													

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LOG OF BORING NO.: 9
Sheet 1 of 1

PROJECT NO.: H100155

Client: COYLE ENGINEERING
Project: SAWS FAR WEST SEWER RELIEF MAIN
Start Date: 4/8/2010 **End Date:** 4/8/2010
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: SAN ANTONIO, TEXAS
Surface Elevation:
Longitude:
Latitude:
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	TX Cone or Std. Pen. (blows/ft,in)	Pocket Penetrometer (tsf)	Unconfined Comp Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
	▨	Dark Brown CLAY with silt	■										
	▨		■			2.5				31			
	▨		■			2.0	0.9		88	31			
5	▨		■			2.5				31			
	▨	6.0	■										
	▨	Brown SILTY CLAY	■			4.5	2.6		97	24	48	24	24
	▨	8.0	■										
		Tan CLAYEY GRAVEL											
10			☒		42					10			
		12.0											
	▨	Tan and Gray MARLY CLAY with silt											
	▨		■			4.5	2.8		101	21			
15	▨												
	▨		■			4.5+				18			
20	▨	20.0	■										
		TEST BORING TERMINATED AT 20 FT											
25													

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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

SAMLING 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