GEOTECHNICAL ENGINEERING REPORT

TOWNWEST COMMONS

HUTTO, TEXAS

GEOTECHNICAL ENGINEERING REPORT

Townwest Commons
Hutto, Texas

Prepared by:

Riner Engineering, Inc.

Prepared for:

NewQuest Properties
8827 West Sam Houston Parkway N, Suite 200
Houston, Texas 77040

Attention: Mr. Michael Harney

March 19, 2023

RINER Project No. 23-0080

TEXAS ENGINEERING FIRM REGISTRATION NO. F-17076

Riner Engineering

GEOTECHNICAL AND MATERIALS ENGINEERING, TESTING AND INSPECTION

March 19, 2023

Mr. Michael Harney
NewQuest Properties
8827 West Sam Houston Parkway N, Suite 200
Houston, Texas 77040

Re: GEOTECHNICAL ENGINEERING REPORT
Townwest Commons
Hutto, Texas
RINER Project No. 23-0080

Dear Mr. Harney:

RINER Engineering, Inc. (RINER) is pleased to submit this Geotechnical Engineering Report for the referenced project. We appreciate the opportunity of working with you. Please contact us if you have any questions or require additional services.

Respectfully submitted,

Gary Gai, Ph.D., P.E.
Senior Project Engineer

Anahita Goudarzi, Ph.D., P.E.,
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GEOTECHNICAL ENGINEERING REPORT

Townwest Commons
Hutto, Texas

1.0 INTRODUCTION

Project Location. The project is located on east side of Alliance Boulevard, approximately 600-feet north of its intersection with US-79, in Hutto, Texas. The general location and orientation of the site are provided in Appendix A - Project Location Diagrams.

Project Description. The project consists of consists of the following proposed improvements:

- Two warehouse buildings (footprint approximately EVO building = 53,500 SF and Petco building = 12,529 SF), and
- Four future commercial buildings (footprint approximately building 1= 5,500 SF, building 2 = 10,000 SF, building 3 = 10,500 SF, and building 4 = 10,500 SF),
- Parking and drive areas.

Project Authorization. This geotechnical investigation was authorized by Mr. Michael Harney with NewQuest Properties and performed in accordance with RINER Proposal No. P23-0176 dated February 10, 2023.

Purpose and Methodology. The principal purposes of this investigation were to evaluate the general soil conditions at the proposed site and to develop geotechnical engineering design recommendations. To accomplish its intended purposes, the study was conducted in the following phases: (1) drill sample borings to evaluate the soil conditions at the boring locations and to obtain soil samples; (2) conduct laboratory tests on selected samples recovered from the borings to establish the pertinent engineering characteristics of the soils; and (3) perform engineering analyses, using field and laboratory data, to develop design criteria.

Required Review. Detailed design plans were not available at the time of preparation of this report. Recommendations in our report are contingent upon RINER reviewing and approving in writing the following design items prior to construction:

- Site grading plan, and
- Foundation plan, details, and related structural loads.

Cautionary Statement Regarding Use of this Report. As with any geotechnical engineering report, this report presents technical information and provides detailed technical recommendations for civil and structural engineering design and construction purposes. RINER, by necessity, has assumed the user of this document possesses the technical acumen to understand and properly utilize information and recommendations provided herein. RINER strives to be clear in its presentation and, like the user, does not want potentially detrimental misinterpretation or misunderstanding of this report. Therefore, we encourage any user of this report with questions regarding its content to contact RINER for clarification. Clarification will be provided verbally and/or issued by RINER in the form of a report addendum, as appropriate.

Report Specificity. This report was prepared to meet the specific needs of the client for the specific project identified. Recommendations contained herein should not be applied to any other project at this site by the client or anyone else without the explicit approval of RINER.

This Report is NOT a Specification. Recommendations in this report are not specifications. Geotechnical engineering requires significant experience and professional judgment. Conditions vary in the field which require and/or allow modification to recommendations provided herein at the discretion of the Geotechnical Engineer.

2.0 FIELD INVESTIGATION

Subsurface Investigation. The subsurface investigation for this project is summarized below. Boring locations are provided in Appendix B - Boring Location Diagram.

Boring Nos.	Depth, feet bgs[1]	Date Drilled	Location[2]
B-01 to B-20	20 to 40	2/20 to 3/6/2023	Buildings Area
B-21 to B-23	5 to 10	2/24/2023	Paving Area

Notes:
1. bgs = below ground surface
2. Boring locations provided in Appendix B - Boring Location Diagram were not surveyed and should be considered approximate. Borings were located by recreational hand-held GPS unit. Horizontal accuracy of such units is typically on the order of 20-feet.

Boring Logs. Subsurface conditions were defined using the sample borings. Boring logs generated during this study are included in Appendix C - Boring Logs and Laboratory Results. Borings were advanced between sample intervals using continuous flight auger drilling procedures.

Cohesive Soil Sampling. Cohesive soil samples were generally obtained using Shelby tube samplers in general accordance with American Society for Testing and Materials (ASTM) D1587. The Shelby tube sampler consists of a thin-walled steel tube with a sharp cutting edge connected to a head equipped with a ball valve threaded for rod connection. The tube is pushed into the undisturbed soils by the hydraulic pulldown of the drilling rig. The soil specimens were extruded from the tube in the field, logged, tested for consistency using a hand penetrometer, sealed and packaged to maintain "in situ" moisture content.

Consistency of Cohesive Soils. The consistency of cohesive soil samples was evaluated in the field using a calibrated hand penetrometer. In this test a 0.25-inch diameter piston is pushed into the undisturbed sample at a constant rate to a depth of 0.25-inch. The results of these tests are tabulated at the respective sample depths on the boring logs. When the capacity of the penetrometer is exceeded, the value is tabulated as 4.5+.

Granular Soil Sampling. Granular soil samples were generally obtained using split-barrel sampling procedures in general accordance with ASTM D1586. In the split-barrel procedure, a disturbed sample is obtained in a standard 2-inch outside diameter (OD) split barrel sampling spoon driven 18-inches into the ground using a 140-pound (lb) hammer falling freely 30 inches. The number of blows for the last 12-inches of a standard 18-inch penetration is recorded as the Standard Penetration Test resistance (N-value). The N-values are recorded on the boring logs at the depth of sampling. Samples were sealed and returned to our laboratory for further examination and testing.

Texas Cone Penetration (TCP). Texas Cone Penetration (TCP) test was used to assess the apparent in-place strength characteristics of the soil and rock type materials. In the TCP test procedure, a 3-inch outside diameter (OD) steel cone driven by a 170-pound hammer is dropped 24 inches (340 ft-pounds of energy). The number of blows of the hammer required to provide 12 inches of penetration, or the inches of penetration of the cone due to 100 blows of the hammer (whichever occurs first) are recorded on the field logs (reference: TxDOT, Bridge Design Manual).

Groundwater Observations. Groundwater observations are shown on the boring logs.

Borehole Plugging. Upon completion of the borings, the boreholes were backfilled from the top and plugged at the surface.

3.0 LABORATORY TESTING

RINER performs visual classification and any of a number of laboratory tests, as appropriate, to define pertinent engineering characteristics of the soils encountered. Tests are performed in general accordance with ASTM or other standards and the results included at the respective sample depths on the boring logs or separately tabulated, as appropriate, and included in Appendix C - Boring Logs and Laboratory Results. Laboratory tests and procedures routinely utilized, as appropriate, for geotechnical investigations are tabulated below.

Test Procedure	Description
ASTM D7928	Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

Test Procedure	Description
ASTM D1140	Standard Test Methods for Amount of Material in Soils Finer than the No. 200 (75-µm) Sieve
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
ASTM D1883	Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D2166	Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
ASTM D2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2217	Standard Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
ASTM D2435	Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D2850	Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soil
ASTM D2937	Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D4220	Standard Practices for Preserving and Transporting Soil Samples
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D4546	Standard Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive Soils
ASTM D4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
ASTM D4644	Standard Test Method for Slake Durability of Shales and Similar Weak Rocks
ASTM D4647	Standard Test Method for Identification and Classification of Dispersive Clay Soils by the Pinhole Test
ASTM D4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D4767	Standard Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils
ASTM D4972	Standard Test method for pH of Soils
Manufacturer's Instructions	Soil Strength Determination Using a Torvane
Tex-145-E	Determining Sulfate Content in Soils - Colorimetric Method

4.0 SITE CONDITIONS

4.1 General

Review of Aerial Photographs. Historical aerial photographs of the site were reviewed for potential past alterations to the site which could impact geotechnical design conditions. Specifically, aerial photographs were reviewed to visually assess obvious areas of significant past fill on site. Aerial photographs reviewed for this study are identified below and are included in Appendix D - Aerial Photographs.

Aerial Photographs Reviewed	
Year	Observations Since Prior Aerial Photograph
1995	The site was undeveloped and used for agricultural purposes.
2002	No visible changes were noted.
2006	No visible changes were noted.
2008	Earthwork activities were noted and soil was imported and stockpiled in the center of the site.
2009	Earthwork activities were noted on the exiting stockpile.
2012	The existing rectangular stockpile/fill were noted in the center of the site.
2013	No visible changes were noted
2014	A portion of the stockpile at the west border of the site were removed and grading were noted on the west side of the site.
2019	A portion the stockpile at the east border of the site was removed
2022	No visible changes were noted.

Site Fills. Aerial photographs indicate the site was previously used for agricultural purposes. Therefore, we would expect surficial disturbance of site soils. **Earthwork activities and soil stockpile were noted in the center of the site. Existing soil stockpile recommendations are provided in section 5.11 Existing Stockpile.**

Limitations. Due to the intermittent nature and relatively low resolution of aerial photographs, as well as our lack of detailed information regarding the past land use of the site, our review should not be interpreted as eliminating the possibility of cuts and/or fills on site which could detrimentally affect future construction.

Topography. A United States Geological Survey (USGS) topographic map of the site is provided in Appendix E - USGS Topographic Map.

Site Photographs. Photographs representative of the site at the time of this investigation are provided in Appendix F - Site Photographs.

4.2 Geology

Geologic Formation. Based on available surface geology maps and our experience, it appears this site is located near a mapped contact between the High Gravel Deposits, and the Austin Chalk Formation. A geologic atlas and USGS formation description are provided in Appendix G - Geologic Information. Soils within the High Gravel Deposits consist of gravels, silt and sand. The gravel of the High Gravel Deposits are generally reworked limestone and chert fragments. The Austin Chalk consists of massive blue-gray un-weathered limestone, overlain by tan weathered limestone. Near surface residuals soils associated with the Austin Chalk generally consist of high plasticity clays and/or moderate plasticity calcareous clays.

Geologic Faults. A review of the attached geologic map indicates the nearest geologic fault is about 0.5-miles southeast of the project site. A geologic fault study was beyond the scope of this investigation.

4.3 Soil/Rock

Stratigraphy. Descriptions of the various strata and their approximate depths and thickness per the Unified Soil Classification System (USCS) are provided on the boring logs included in Appendix C - Boring Logs and Laboratory Results. Terms and symbols used in the USCS are presented in Appendix H - Unified Soil Classification System. A brief summary of the stratigraphy indicated by the borings is provided below.

Generalized Subsurface Conditions at Proposed Buildings Location (Borings B-01 to B-05, B-07 and B-09 to B-20)			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	2 to 4	FAT CLAY	Firm to Hard FAT CLAY (CH).
2 to 4	6 to 10	LEAN CLAY	Firm to Hard LEAN CLAY (CL).
6 to 10	20 to 40	WEATHERED LIMESTONE / LIMESTONE	Soft to Very Hard WEATHERED LIMESTONE / LIMESTONE.
Note: Boring Termination Depth = 20 to 40 feet bgs.			

Generalized Subsurface Conditions at Proposed Buildings Location (Borings B-06 and B-08)			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	8	FAT CLAY FILL	**Soft to hard FAT CLAY (CH) FILL (only at borings B-06 and B-08).**
8	10	FAT CLAY	Stiff FAT CLAY (CH).
10	18	LEAN CLAY	Hard LEAN CLAY (CL).
18	35 to 40	WEATHERED LIMESTONE	Very Hard WEATHERED LIMESTONE
Note: Boring Termination Depth = 35 to 40 feet bgs.			

Generalized Subsurface Conditions at Proposed Paving Location (Borings B-21 to B-23)			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	4	FAT CLAY	Stiff FAT CLAY (CH). Exception: Stiff to Hard FAT CLAY (CH) FILL was encountered at boring B-22 from 0 to 6 feet.
4	4 to 10	LEAN CLAY	Hard LEAN CLAY (CL).
Note: Boring Termination Depth = 5 to 10 feet bgs.			

Swell Potential based on Atterberg Limits. Atterberg (plastic and liquid) limits were performed on 36 shallow soil samples obtained at depths between 0- and 10-feet bgs. The plasticity index of the samples was between 14 and 68 with an average of 42 indicating that the soils have a high to very high potential for shrinking and swelling with changes in soil moisture content.

Swell Tests. Swell tests were performed on selected clay soil samples. Swell test details are provided in Appendix C - Boring Logs and Laboratory Results. The results of the tests are summarized below.

Boring No.	Avg. Depth (ft.)	Moisture Content, w, %	Liquid Limit, LL	Plasticity Index, PI	Applied Overburden Stress (psi)	Swell (%)
B-01	3	29	29	54	2.6	1.14
B-01	7	16	16	22	6.1	0.14
B-02	1	35	79	57	0.9	0.39
B-02	5	17	37	22	4.3	0.04
B-03	3	29	78	57	2.6	0.49
B-04	3	28	70	51	2.6	0.36
B-04	7	16	33	18	6.1	0.00
B-05	1	36	80	58	0.9	0.75
B-05	5	21	35	19	4.3	0.00
B-06	3	34	88	65	2.6	0.54
B-06	9	32	79	59	7.8	0.26
B-07	3	31	77	51	2.6	1.09
B-08	3	34	55	39	2.6	0.25
B-09	1	31	77	56	0.9	1.14
B-09	5	16	42	26	4.3	0.00
B-10	1	19	90	68	0.9	1.73
B-10	3	16	31	16	2.6	0.00
B-11	3	17	63	47	2.6	0.00
B-11	5	16	29	14	4.3	0.00
B-12	1	31	-	-	0.9	0.00
B-12	3	23	64	48	2.6	0.34

Boring No.	Avg. Depth (ft.)	Moisture Content, w, %	Liquid Limit, LL	Plasticity Index, PI	Applied Overburden Stress (psi)	Swell (%)
B-12	5	13	29	14	4.3	0.00
B-13	1	35	72	52	0.9	0.19
B-13	5	18	30	15	4.3	0.01
B-14	3	28	71	51	2.6	0.41
B-15	3	32	86	64	2.6	0.40
B-15	5	19	41	25	4.3	1.38
B-16	1	34	75	55	0.9	0.55
B-18	3	32	84	61	2.6	0.34
B-19	1	32	84	62	0.9	0.00
B-20	5	17	32	17	4.3	0.45

Soluble Sulfate. Soluble sulfate testing was performed in accordance with Tex-145-E for this project. Table below summarizes the soil sulfate content for the tested samples.

Boring No.	Sample Depth (feet, bgs)	Soluble Sulfate Content (ppm)
B-01	0-2	307
B-04	0-2	320
B-08	0-2	307

4.4 Groundwater

Groundwater Levels. The borings were advanced using auger drilling, intermittent sampling methods and rock coring in order to observe groundwater seepage levels. Groundwater levels encountered in the borings during this investigation are identified below.

Boring No.	Depth Groundwater Initially Encountered (feet, bgs)	Groundwater Depth after 15 Minutes (feet, bgs)
B-01	Not encountered up to 10-feet	-
B-04	Not encountered up to 10-feet	-
B-06	Not encountered up to 20-feet	-
B-07	Not encountered up to 20-feet	-
B-08	Not encountered up to 18-feet	-
B-09	Not encountered up to 6-feet	-
B-11	Not encountered up to 10-feet	-
B-16	Not encountered up to 15-feet	-
B-20	Not encountered up to 10-feet	-
All other borings	Not Encountered	Not Encountered
Note: 1. Groundwater was not encountered up to the noted depths during dry augering of the borings. Water was introduced into the borings at the noted depths to aid in rock coring operation.		

Long-term Groundwater Monitoring. Long-term monitoring of groundwater conditions via piezometers was not performed during this investigation and was beyond the scope of this study. Long-term monitoring can reveal groundwater levels materially different than those encountered during measurements taken while drilling the borings.

Groundwater Fluctuations. Future construction activities may alter the surface and subsurface drainage characteristics of this site. It is difficult to accurately predict the magnitude of subsurface water fluctuations that might occur based upon short-term observations. The groundwater level should be expected to fluctuate throughout the years with variations in precipitation.

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 Seismic Site Classification

The seismic site classification is based on the 2015 International Building Code (IBC) and is a classification of the site based on the type of soils encountered at the site and their engineering properties. Per Table 20.3-1 of ASCE 7-10, the seismic site classification for this site is C.

5.2 Potential Vertical Soil Movements

Problem Discussion. Most clay soils, when subjected to increases in moisture content, swell. Swelling clay soils exert an outward pressure that can easily exceed 5,000 psf when subjected to moisture increases. Swell potential and swell pressures are a function of several factors including clay mineralogy and antecedent moisture condition. Generally, for a given clay soil, the drier the soil the greater its potential to swell and the higher its swell pressure. Conversely, wetter soils generally have a lower potential to swell and have lower swell pressures. The potential for a clay soil to swell is a variable and cannot be separated from its moisture condition.

The overburden pressure at a given depth above the groundwater table is calculated as the unit weight of the soil times the depth. For a soil with a unit weight of 125 pcf, the overburden pressure at 10-feet would be 1250 psf (125 pcf x 10-feet). Thus, the swell pressure can exceed the overburden at depths of over 40-feet. This means soils at 40-feet exposed to changes in moisture can impact movements at the ground surface.

For a clay soil to swell or shrink, it must be subjected to increases or decreases in moisture content, respectively. The predominant way clay soils are subjected to increases or decreases in moisture content is the weather. As would be expected, extended periods of wet weather cause soil to get wetter and extended dry weather cause soil to get drier. The longer the period of wet or dry weather, the deeper the influence of the weather. Vegetation also causes variations in soil moisture content. Shallow rooted grass and bushes have a shallower impact, deep rooted trees have a deeper impact.

For a clay soil at a given depth to influence surface heave, two things must happen: (1) the soil must be subjected to an increase in moisture, and (2) the swell pressure of the soil must exceed the overburden pressure. Swell is typically calculated by assuming an “active” zone, a depth of soil impacted by weather which predominantly affects surface movements due to soil swell. Expansive soils below the active zone are typically ignored as they are assumed to be exposed to lower increases in moisture, experience higher overburden pressures, and have a less significant impact on the surface heave than the soils in the active zone.

“Deep-seated” soil movement is swelling of the clay soils below the active zone and above the equilibrium depth. The equilibrium depth is the depth at which the overburden pressure and clay swell pressure are equal. Deep-seated soil movement is caused by changes in moisture that are typically not related to weather or vegetation. They can be caused by man-made influences such as leaking deep water or sewer lines. They can be caused by natural influences such as fluctuations in soil moisture content or groundwater levels. They are notoriously hard to accurately predict and may or may not actually occur. Unless stated otherwise, we have not included the effects of deep-seated soil movement in our Potential Vertical Rise (PVR) calculation. The inclusion of deep-seated soil movement drastically increases the depth of the building pad preparation required and may make a slab-on-grade target PVR of 1-inch theoretically unattainable. The inclusion or exclusion of deep-seated soil movement is a matter of professional opinion, on which there is no consensus among consultants. It is also a matter of risk tolerance and cost, of which, the user of this report is being made aware.

As evidenced in this discussion, calculation of PVR is based on soil data, model assumptions, experience, and professional judgment. PVR is a calculated estimate and should not be construed to be an absolute number or a guarantee of performance. PVR can be higher or lower depending on actual site conditions. The PVR estimate we provide is our best estimate of what will be encountered and the user of this report with doubts is encouraged to get another professional opinion prior to using this report. However, based on this discussion, the reader understands variations between the model and reality can introduce significant differences in calculated PVR. The user of this report understands and accepts this risk. If this risk is intolerable, the user of this report should be prepared to utilize a structural slab suspended adequately above the subgrade surface and supported on deep foundations.

Differential swelling of clay soil is generally most pronounced around the perimeter of slabs or pavement where weather and/or vegetative influences are greatest. Unstiffened slabs or paving are generally prone to cracking around 5- to 10-feet from and parallel to the slab edge due to differential soil movements. If this expected cracking is unacceptable or needs to be minimized, the structural engineer should consider slab stiffening using grade beams and/or a flexible slab/wall connection design. We should be consulted by the structural engineer for clarifications and input regarding this type of slab movement if it is deemed critical.

Maintaining a consistent moisture content in the soil is the key to minimizing both heave and shrinkage related structural problems. Therefore, building maintenance and control of water are paramount in the performance of a slab-on-grade and shallow foundations.

<u>PVR or Equivalent Calculations.</u> The PVR or its equivalent can be estimated several ways. RINER utilizes the TxDOT method, swell tests, and a Volflo analysis to provide the best possible understanding of expected PVR and its variability.

<u>Calculated PVR using TxDOT Method Tex-124-E</u>. PVR calculations were performed in general accordance with the Texas Department of Transportation (TxDOT) Method Tex-124-E. The Tex-124-E method is empirical and is based on the Atterberg limits and moisture content of the subsurface soils. The calculated PVR is an empirical estimate of a soil's potential for swell based upon the soil's plasticity index, applied loading (due to structures or overburden), and antecedent moisture condition. **The PVR calculated using TxDOT Method Tex-124-E is about 2.5 to 3-inches assuming a dry to average antecedent moisture condition for borings outside of the stockpile area. Inside the stockpile area, the PVR calculated using TxDOT Method Tex-124-E is about 6-inches assuming a dry to average antecedent moisture condition.** The calculated PVR is consistent with soil moisture conditions at the time this investigation was conducted. A 12-feet zone of seasonal moisture variation was used in our analysis based on local experience.

<u>Calculated PVR using Swell Test Results.</u> The equivalent PVR based on the swell test results is about 1.5-inches. The PVR based on swell test results is dependent on the moisture conditions at the time of testing. A 12-feet zone of seasonal moisture variation was used in our analysis based on local experience.

<u>Calculated PVR using Volflo Analysis.</u> The equivalent PVR based on the Volflo analysis results is about 2.5- to 4-inches for borings outside of the stockpile area. The PVR based on swell test results is dependent on the moisture conditions at the time of testing. A 12-feet zone of seasonal moisture variation was used in our analysis based on local experience.

<u>Soil Moisture Confirmation Prior to Construction</u>. The calculated PVR can vary considerably with prolonged wet or dry periods. We recommend the moisture content for the upper 12-feet (active zone) of soils within the building pad be assessed for consistency with this report prior to construction if: (1) an extended period of time has elapsed between the performance of this investigation and construction of the foundation, or (2) unusually wet or dry weather is experienced between the performance of this investigation and construction of the foundation.

5.3 Soluble Sulfates

Sulfate/sulfide minerals, when exposed to water, will react with calcium-based additives (lime, cement, and Class CS fly ash) and clay soils to form ettringite. As the mineral ettringite forms, it can expand approximately 2 to 2.5 times its original volume. This process is known as sulfate induced heave and is the cause of swell in the treated subgrade soils and the overlying pavement/slab structure. For sulfate concentrations more than 3,000 parts per million (ppm), modified subgrade treatment recommendations are warranted. *Based on the testing results presented in Section 4.3, the sulfate content of tested soil samples is in the range of 307 ppm to 320 ppm indicating that the levels of sulfate are low. Additional sulfate screening testing is recommended to be performed on potential material to receive lime treatment prior to construction.*

5.4 Construction Excavations

Applicability. Recommendations in this section apply to short-term construction-related excavations for this project.

Sloped Excavations. All sloped short-term construction excavations on-site should be designed in accordance with Occupational Safety and Health Administration (OSHA) excavation standards. Borings from this investigation indicated that the soils may be classified per OSHA regulations as Type B from the ground surface to a depth of 10-feet bgs. Short-term construction excavations may be constructed with a maximum slope of 1:1, horizontal to vertical (H:V), to a depth of 10-feet bgs. If excavations are to be deeper than 10-feet, we should be contacted to evaluate the excavation. Recommendations provided herein are not valid for any long-term or permanent slopes on-site.

Shored Excavations. As an alternative to sloped excavations, vertical short-term construction excavations may be used in conjunction with trench boxes or other shoring systems. Shoring systems should be designed using an equivalent fluid weight of 85 pounds per cubic foot (pcf) above the groundwater table and 105 pcf below the groundwater table. Surcharge pressures at the ground surface due to dead and live loads should be added to the lateral earth pressures where they may occur. Lateral surcharge pressures should be assumed to act as a uniform pressure along the upper 10-feet of the excavation based on a lateral earth coefficient of 0.5. Surcharge loads set back behind the excavation at a horizontal distance equal to or greater than the excavation depth may be ignored. We recommend that no more than 200-feet of unshored excavation should be open at any one time to prevent the possibility of failure and excessive ground movement to occur. We also recommend that unshored excavations do not remain open for a period of time longer than 24-hours.

Limitations. Recommendations provided herein assume there are no nearby structures or other improvements which might be detrimentally affected by the construction excavation. Before proceeding, we should be contacted to evaluate construction excavations with the potential to affect nearby structures or other improvements.

Excavation Monitoring. Excavations should be monitored to confirm site soil conditions consistent with those encountered in the borings drilled as part of this study. Discrepancies in soil conditions should be brought to the attention of RINER for review and revision of recommendations, as appropriate.

5.5 Groundwater Control

Groundwater was not encountered during dry augering of the borings and water was introduced into the borings at the noted depths to aid in rock coring operation during the subsurface investigation. If groundwater is encountered during excavation, dewatering to bring the groundwater below the bottom of excavations may be required. Dewatering could consist of standard sump pits and pumping procedures, which may be adequate to control seepage on a local basis during excavation. Supplemental dewatering will be required in areas where standard sump pits and pumping is not effective. Supplemental dewatering could include submersible pumps in slotted casings, well points, or eductors. The contractor should submit a groundwater control plan, prepared by a licensed engineer experienced in that type of work.

5.6 Earthwork

5.6.1 Site Preparation

In the area of improvements, all concrete, trees, stumps, brush, debris, septic tanks, abandoned structures, roots, vegetation, rubbish and any other undesirable matter should be removed and properly disposed. All vegetation should be removed and the exposed surface should be scarified to an additional depth of at least 6 inches. It is the intent of these recommendations to provide a loose surface with no features that would tend to prevent uniform compaction by the equipment to be used.

5.6.2 Proofroll

Building pad and paving subgrades should be proofrolled with a fully loaded tandem axle dump truck or similar pneumatic-tire equipment to locate areas of loose subgrade. In areas to be cut, the proofroll should be performed after the final grade is established. In areas to be filled, the proofroll should be performed prior to fill placement. Areas of loose or soft subgrade encountered in the proofroll should be removed and replaced with engineered fill, moisture conditioned (dried or wetted, as needed) and compacted in place.

5.6.3 Grading and Drainage

Every attempt should be made to limit the extreme wetting or drying of the subsurface soils because swelling and shrinkage of these soils will result. Standard construction practices of providing good surface water drainage should be used. A positive slope of the ground away from any foundation should be provided. Ditches or swales should be provided to carry the run-off water both during and after construction. Stormwater runoff should be collected by gutters and downspouts and should discharge away from the buildings.

Root systems from trees and shrubs can draw a substantial amount of water from the clay soils at this site, causing the clays to dry and shrink. This could cause settlement beneath grade-supported slabs such as floors, walks and paving. Trees and large bushes should be located a distance equal to at least one-half their anticipated mature height away from grade slabs.

Lawn areas should be watered moderately, without allowing the clay soils to become too dry or too wet.

5.6.4 Wet Weather/Soft Subgrade

Soft and/or wet surface soils may be encountered during construction, especially following periods of wet weather. Wet or soft surface soils can present difficulties for compaction and other construction equipment. If specified compaction cannot be achieved due to soft or wet surface soils, one of the following corrective measures will be required:

1. Removal of the wet and/or soft soil and replacement with select fill,
2. Chemical treatment of the wet and/or soft soil to improve the subgrade stability, or
3. If allowed by the schedule, drying by natural means.

Chemical treatment is usually the most effective way to improve soft and/or wet surface soils. RINER should be contacted for additional recommendations if chemical treatment is planned due to wet and/or soft soils.

5.6.5 Fill

<u>Select Fill</u>. Select fill should consist of soil with a liquid limit less than 35 and a Plasticity Index between 7 and 20. The select fill should be placed in loose lifts not exceeding 8-inches and should be compacted to at least 95 percent maximum dry density (per ASTM D-698) and at a moisture content between optimum and 4 percent above optimum moisture content. The subgrade to receive select fill should be scarified to a depth of 6 inches and compacted to 92

to 96 percent of the material's maximum standard Proctor dry density (ASTM D-698) at a workable moisture level at least 4 percentage points above optimum and placed in loose lifts not exceeding 9 inches.

Lime-treated Native Clay Soil. Based on the laboratory testing conducted for this investigation, the native clay on-site soils will not meet specifications for select fill outlined in the section titled "Fill". As an alternative to importing select fill, the native clay soil may be blended with lime to reduce the plasticity index to meet select fill requirements. Based on our experience, we expect that it will require between 4- and 6-percent lime (by dry unit weight) to reduce the plasticity index of the native clay soils to select fill requirements. Prior to selecting this alternative, lime series tests should be performed to assess the amount of lime required. ***Additional sulfate screening testing is recommended to be performed on potential material to receive lime treatment prior to construction. Lime treatment recommendations provided here assume soil sulfate concentrations are less than 3,000 ppm***.

Processed Limestone. Processed limestone or other rock-like materials used as fill should be compacted to at least 95 percent of standard Proctor maximum dry density, at a moisture content of 0 to 4 percentage points above optimum moisture. Individual rock pieces larger than 4 inches in dimension should not be used as fill. However, if rock fill is utilized within 2 ft below the bottom of floor slabs, the maximum allowable size of individual rock pieces should be reduced to 2 inches. Limestone used as fill should incorporate sufficient fines to prevent the presence of voids around larger diameter rock pieces. A gradation of at least 40 percent passing a standard No. 4 sieve is recommended.

General Fill. General fill may be placed in improved areas outside of building pad areas. General fill should consist of material approved by the Geotechnical Engineer with a liquid limit less than 50. General fill should be placed in loose lifts not exceeding 8-inches and should be uniformly compacted to a minimum of 95 percent maximum dry density (per ASTM D-698) and within ±2 percent of the optimum moisture content.

Fill Restrictions. Select fill and general fill should consist of those materials meeting the requirements stated. Select fill and general fill should not contain material greater than 4-inches in any direction, debris, vegetation, waste material, environmentally contaminated material, or any other unsuitable material.

Unsuitable Materials. Materials considered unsuitable for use as select fill or general fill include low and high plasticity silt (ML and MH), silty clay (CL-ML), organic clay and silt (OH and OL) and highly organic soils such as peat (Pt). These soils may be used for site grading and restoration in unimproved areas as approved by the Geotechnical Engineer. Soil placed in unimproved areas should be placed in loose lifts not exceeding 10-inches and should be compacted to at least 92 percent maximum dry density (per ASTM D-698) and at a moisture content within ±4 percentage points of optimum.

Cautionary Note. It is extremely important that select fill placed within building pads be properly characterized using one or more representative proctor samples. The use of a proctor sample which does not adequately represent the select fill being placed can lead to erroneous compaction (moisture and density) results which can significantly increase the potential for swelling of the select fill. The plasticity index of select fill soils placed during construction should be checked every day to confirm conformance to the project specifications and consistency with the proctor being utilized.

5.6.6 Testing

Required Testing and Inspections. Field compaction and classification tests should be performed by RINER. Compaction tests should be performed in each lift of the compacted material. We recommend the following minimum soil compaction testing be performed: one test per lift per 2,500 square feet (SF) in the area of the building pad, one test per lift per 5,000 SF outside the building pad, and one test per lift per 100 linear feet of utility backfill. If the materials fail to meet the density or moisture content specified, the course should be reworked as necessary to obtain the specified compaction. Classification confirmation inspection/testing should be performed daily on select fill materials (whether on-site or imported) to confirm consistency with the specifications. The testing frequency recommended herein can be altered (increased or decreased) at the discretion of the geotechnical engineer.

Liability Limitations. Since proper field inspection and testing are critical to the design recommendations provided herein, RINER cannot assume responsibility or liability for recommendations provided in this report if construction inspection and/or testing is performed by another party.

5.7 Demolition Considerations

Applicability. Recommendations in this section apply to the removal of any existing foundations, utilities or pavement which may be present on this site.

General. Special care should be taken in the demolition and removal of existing floor slabs, foundations, utilities and pavements to minimize disturbance of the subgrade. Excessive disturbance of the subgrade resulting from demolition activities can have serious detrimental effects on planned foundation and paving elements.

Existing Foundations. Existing foundations are typically slabs, shallow footings, or drilled piers. If slab or shallow footings are encountered, they should be completely removed. If drilled piers are encountered, they should be cut off at an elevation at least 24-inches below proposed grade beams or the final subgrade elevation, whichever is deeper. The remainder of the drilled pier should remain in place. Foundation elements to remain in place should be surveyed and superimposed on the proposed development plans to determine the potential for obstructions to the planned construction. RINER should be contacted if drilled piers are to be excavated and removed completely. Additional earthwork activities will be required to make the site suitable for new construction if the piers are to be removed completely.

Existing Utilities. Existing utilities and bedding to be abandoned should be completely removed. Existing utilities and bedding may be abandoned in place if they do not interfere with planned development. Utilities which are abandoned in place should be properly pressure-grouted to completely fill the utility.

Backfill. Excavations resulting from the excavation of existing foundations and utilities should be backfilled in accordance with Section 5.6.5– Fill.

Other Buried Structures. Other types of buried structures (wells, cisterns, etc.) could be located on the site. If encountered, RINER should be contacted to address these types of structures on a case-by-case basis.

5.8 Loading on Buried Structures

Uplift. Buried water-tight structures are subjected to uplift forces caused by differential water levels adjacent to and within the structure. Soils with any appreciable silt or sand content will likely become saturated during periods of heavy rainfall and the effective static water level will be at the ground surface. For design purposes, we recommend the groundwater level be assumed at the ground surface. Resistance to uplift pressure is provided by soil skin friction and the dead weight of the structure. Skin friction should be neglected for the upper 3 feet of soil. A skin friction of 200 pounds per square foot (psf) may be used below a depth of 3 feet.

Lateral Pressure. Lateral pressures on buried structures due to soil loading can be determined using an equivalent fluid weight of 105 pcf. This includes hydrostatic pressure but does not include surcharge loads. The lateral load produced by a surcharge may be computed as 50 percent of the vertical surcharge pressure applied as a constant pressure over the full depth of the buried structure. Surcharge loads located a horizontal distance equal to or greater than the buried structure depth may be ignored.

Vertical Pressure. Vertical pressures on buried structures due to soil loading can be determined using an equivalent fluid weight of 125 pcf. This does not include surcharge loads. The vertical load produced by a surcharge may be computed as 100 percent of the vertical surcharge pressure applied as a constant pressure over the full width of the buried structure.

5.9 Retaining Structures

Applicability. RINER was not notified of any specific retaining structures in conjunction with this project. Recommendations provided in this section are applicable to structures 5-feet or less in height. Retaining structures in excess of 5-feet should be brought to the attention of RINER for a more detailed assessment. *It is imperative that global stability be reviewed by RINER on any retaining structure in excess of 5-feet in height.*

At-Rest Lateral Pressure. Lateral pressures on retaining structures due to soil loading can be determined using an equivalent fluid weight of 85 pcf if fill behind the wall is free-draining and above the groundwater table and 105 pcf if fill behind the wall is not free draining or is below the groundwater table. This does not include surcharge loads. This also assumes a horizontal ground surface behind the structure. The lateral load produced by a surcharge may be computed as 50 percent of the vertical surcharge pressure applied as a constant pressure over the full depth of the buried structure. Surcharge loads set back behind the retaining structure at a horizontal distance equal to or greater than the structure height may be ignored.

Lateral Resistance. Resistance to lateral loads may be provided by the soil adjacent to the structure. We recommend using an equivalent fluid weight of 200 pcf for lateral resistance. The passive resistance should be ignored if the material in front of the wall will be excavated at any time in the future. A coefficient of sliding friction of 0.25 between the retaining structure concrete footings and underlying soil may be combined with the passive lateral resistance. *Appropriate safety factor should be utilized by the structural engineer for external stability analyses of the retaining structures.*

Bearing Capacity. Assuming a minimum embedment depth of 24-inches, an allowable bearing capacity of 2,000 psf may be used for retaining structure footings (using a Factor of Safety of 3).

5.10 Buried Pipe

Applicability. Recommendations in this section are applicable to the design of buried piping placed by open cut methods associated with this project.

Pressure on Buried Pipe. Design recommendations provided in the "Loading on Buried Structures" section of this report apply to buried piping.

Thrust Restraints. Resistance to lateral forces at thrust blocks will be developed by friction developed along the base of the thrust block and passive earth pressure acting on the vertical face of the block. We recommend a coefficient of base friction of 0.25 along the base of the thrust block. Passive resistance on the vertical face of the thrust block may be calculated using the allowable passive earth pressures presented below.

Allowable Passive Earth Pressure by Material Type	
Material	Allowable Passive Pressure (psf)
Native Clay	2,000
Compacted Clay Fill	1,500
Weathered Limestone	3,000
Note: Passive resistance should be neglected for any portion of the thrust block within 3 feet of the final site grade. The allowable passive resistance for native clays and weathered limestone is based on the thrust block bearing directly against vertical, undisturbed cuts in these materials.	

Bedding and Backfill. Pipe bedding and pipe-zone backfill for the water and sanitary sewer piping should be in accordance with TxDOT standard specification Item 400 or the local equivalent. The pipe-zone consists of all materials surrounding the pipe in the trench from six (6) inches below the pipe to 12 inches above the pipe.

Trench Backfill. Excavated site soils will be utilized to backfill the trenches above the pipe-zone. Backfilled soil should be placed in loose lifts not exceeding 8-inches and should be compacted to at least 95 percent maximum dry density (per ASTM D-698) and at a moisture content between optimum and 4 percent above optimum moisture content.

Trench Settlement. Settlement of backfill should be anticipated. Even for properly compacted backfill, fills in excess of 8 to 10 feet 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 for fills beneath streets. Therefore, close coordination and monitoring should be performed to reduce the potential for future movement.

5.11 Existing Stockpile

Borings B-0 6, B-08 and B-22 were drilled at the stockpile fill locations. The stockpile fills varied from 6- to 8-feet high above the natural grade. The stockpile fill materials on the site are generally classified as fat clay. These soils will not meet the requirements for select fill. The stockpile soils can be used for construction of moisture conditioned building pads and for grading purposes in the paving areas. ***The existing stockpile should be removed prior to construction of the building pad.***

5.12 Foundation System

Appropriate Foundation Types. Straight shaft drilled piers is appropriate to the site based on the geotechnical conditions encountered.

Loading Information. The loading information for the future buildings was not available at the time of writing this report,

Foundations Adjacent to Slopes. Foundations placed too close to adjacent slopes steeper than 5:1 (H:V) may experience reduced bearing capacities and/or excessive settlement. Recommendations provided herein assume foundations are not close enough to adjacent slopes in excess of 5:1 (H:V) to be detrimentally affected. Therefore, foundations closer than 5 times the depth of adjacent slopes, pits or excavations in excess of 5:1 (H:V) should be brought to our attention in order that we may review the appropriateness of our recommendations.

Assumed Maximum Cut/Fill Depth. We have assumed that cut/fill of less than 1-foot will be required to bring the site to grade. In the event cut/fill in the building pad exceed 1-foot, we should be notified and allowed to review the design to assess the suitability of the foundation recommendations provided. ***RINER must be allowed to review the finalized grading plan to assess the appropriateness of our recommendations.***

Foundation Plans Review. Our office should be contacted to review the foundation plans, details and related structural loads, prior to finalizing the design to check conformance with the recommendations presented herein.

5.12.1 Straight Shaft Drilled Piers

General Requirement. The proposed office/warehouse buildings and ramp may be supported using straight-shaft piers (auger-excavated, steel reinforced, cast-in-place concrete piers), if recommendations in the section entitled "Slab-on-Grade" are followed. Piers should be founded at least 5-feet into the weathered limestone / limestone. Deeper penetrations into the rock layer may be required to develop the required skin friction capacity and/or uplift and lateral resistance. Drilled piers should be a minimum of 18-inches in diameter. ***The pier excavation and installation operations should be observed in the field by RINER.***

Axial Capacity. We recommend the following geotechnical parameters for axial capacities of straight drilled piers.

Axial Capacities of Drilled Piers			
Soil/Rock Type	Effective Soil Unit Weight (pcf) [1]	Allowable Skin Friction Capacity (psf) [2]	Allowable End Bearing Capacity (psf) [3,& 4]
Native Clay/Clay Fill	125	Ignore	Ignore
Tan Weathered Limestone / Light Gray Limestone	130	1,600	20,000 [5]

Notes:

1. Effective soil unit weight based on assumed groundwater depth of 35-feet bgs.
2. Allowable Skin Friction based on a factor of safety = 2.
3. Allowable End Bearing Capacity based on a factor of safety = 2.
4. Recommendations assume the foundation depth is greater than or equal to 4 times the foundation width.
5. ***The recommended end bearing capacity for Weathered Limestone assumes a minimum penetration of 5-feet into the Tan Weathered Limestone / Light Gray Limestone layer.***

Lateral Resistance. For resistance of lateral loads on straight shaft drilled piers, we recommend the following LPILE design parameters.

Soil/Rock Type Depth (feet bgs) [1]	LPILE Parameters [2 & 3]
Clay Fill (0 to 2-feet)	Soil Type: Medium Clay Effective Soil Unit Weight: 125 pcf Undrained Shear Strength: Ignore Strain @ ½ Peak Strength (ε_{50}): Ignore p-y Modulus (k): Ignore
Native Clay / Clay Fill (Below 2-feet)	Soil Type: Medium Clay Effective Soil Unit Weight: 125 pcf Undrained Shear Strength: 800 psf Strain @ ½ Peak Strength (ε_{50}): 0.01 p-y Modulus (k): 100
Tan Weathered Limestone / Light Gray Limestone	Soil Type: Weak Rock Effective Soil Unit Weight: 130 pcf Young's Modulus (Er): 15,000 psi Uniaxial Compressive Strength: 300 psi K_{rm}: 0.0005

Notes:

1. Depth below existing ground surface.
2. Effective soil unit weight based on assumed groundwater depth greater than 35-feet bgs.
3. **Lateral resistance of piers should be ignored up to 2-feet below the top of the piers (bottom of the pier caps)**.

Uplift: The uplift force on the piers due to swelling of the active clays can be approximated by assuming a uniform uplift pressure 800 psf acting over the perimeter of the shaft to a depth of 10-feet. The shaft should contain sufficient full-length reinforcing steel to resist uplift forces. The uplift force can be ignored over the perimeter of the drilled shaft in the weathered limestone formation.

Pier Spacing. Piers should have a minimum center-to-center spacing of at least 2.5 pier diameters. The design side shear for axial or uplift loads may be considered to vary linearly from the full value at a spacing of 2.5 times the diameter of the larger shaft to 50 percent of the design value at a spacing of 1 time the diameter of the larger shaft.

Settlement. Foundation settlement for drilled piers constructed as described herein should be 1-inch or less.

Groundwater. Groundwater was not encountered during dry augering of the borings and water was introduced into the borings at the noted depths to aid in rock coring operation during the subsurface investigation. If groundwater is encountered during excavation, dewatering to bring the groundwater below the bottom of excavations may be required. Groundwater maybe encountered during pier excavation and the risk of groundwater seepage is increased during or after periods of precipitation. Submersible pumps may be capable of controlling seepage in the pier excavation to allow for concrete placement. If water-bearing granular soil layers are encountered, temporary casing and/or slurry displacement method will likely be required for drilled shafts.

Applicable TxDOT Standards. Drilled pier foundations should be constructed in accordance with the requirements of TxDOT Item 416 (standard specification for construction of drilled pier foundations). This specification includes requirements for construction using casing or the slurry displacement method, as appropriate.

Construction Observation. The construction of all piers should be observed to verify compliance with design assumptions and to verify:

1. the bearing stratum;
2. the removal of all smear zones and cuttings;
3. that groundwater seepage, when encountered, is correctly handled;
4. that the shafts are vertical (within acceptable tolerance); and
5. ensure that the top of the shafts in contact with clay are not enlarged (mushroom shaped).

Concrete Placement. Concrete should be placed immediately after the excavation has been completed. In no event should a pier excavation be allowed to remain open for more than 8 hours. Concrete should have a slump of 5- to 7-inches and should not be allowed to strike the shaft sidewall or steel reinforcement during placement.

5.13 Slab-on-Grade

<u>Assumed Maximum Cut/Fill Depth</u>. The site grading plan was not available at the time of writing this report. For the purpose of this report, we have also assumed that cuts/fills of less than 1-foot will be required in the building pad areas to bring the site to grade. In the event cuts/fills in the building pad exceed 1-foot, we should be notified and allowed to review site grading plan to assess the suitability of our recommendations provided here.

<u>Note: Recommendations provided in the section assumes provided that recommendations in the sections entitled "Existing Stockpile" are followed.</u>

<u>Potential Vertical Slab Movements</u>. Based on the information gathered during this investigation, a slab constructed on-grade will be subject to potential vertical slab movements of up to about 4-inches outside of the stockpile area. ***The existing stockpile should be removed prior to construction of the building pad.***

<u>Subgrade Treatment Using Select Fill</u>. The depth of subgrade treatment is dependent on desired post-construction PVR. To reduce the post-construction PVR to 1-inch, the subgrade soil should be excavated 4-feet below the existing natural grade and replaced with select fill. The subgrade to receive select fill soil should be scarified to a depth of 6-inches. The scarified subgrade should be compacted to 92 to 96 percent of the material's maximum standard Proctor dry density (ASTM D-698) at a workable moisture level at least 4 percentage points above optimum. Further, any additional fill placed on the building pad area (for grading purposes) to achieve the finish grade elevation should consist of select fill. Subgrade treatment should extend at least 5-feet horizontally beyond the perimeter of the building.

<u>Subgrade Treatment Using Moisture Conditioned Soil</u>. The depth of subgrade treatment is dependent on desired post-construction PVR. To reduce the post-construction PVR to 1-inch, the subgrade soil should be excavated 4-feet below the existing natural grade and replaced with moisture conditioned on-site clay. Further, any additional fill placed on the building pad area (for grading purposes) to achieve the finish grade elevation should consist of moisture conditioned soil capped with 8-inches of lime stabilized clay. Lime should be applied at a minimum rate of 36 pounds per square yard for a depth of 8-inches. Lime stabilization should be performed in accordance with TxDOT Standard Specifications, Item 260, "Lime Stabilized Subgrade", or local equivalent. Additional sulfate screening testing is recommended to be performed on potential material to receive lime treatment prior to construction. Lime treatment recommendations provided here assume soil sulfate concentrations are less than 3,000 ppm. As an alternate, flexible base may be used to the same depths as recommended for lime cap. Flexible base should consist of crushed aggregate base meeting TxDOT Standard Specifications, Item 247, Grade 1-2, Type D, or local equivalent. Flexible base should be compacted to at least 95 percent maximum dry density (per ASTM D-698) and within ±2

percent of the optimum moisture content. Subgrade treatment should extend at least 5-feet horizontally beyond the perimeter of the building.

Subgrade Treatment at Exterior Doorways. Subgrade treatment should extend beneath sidewalk areas that abut exterior doorways to the building. Failure to perform subgrade treatment in these areas can increase the probability of differential heaving between exterior sidewalks and doorways, resulting in exterior doors that won't or have difficulty opening outward due to "sticking" caused by heaving sidewalk slabs.

Subgrade Moisture. The slab subgrade is prone to drying after being exposed and should be kept moist prior to slab placement.

Moisture Barrier. A moisture barrier should be used beneath the slab foundation in areas where floor coverings will be utilized (such as, but not limited to, wood flooring, tile, linoleum and carpeting).

Slab Deflection Analysis. Coefficient of subgrade reaction, k, values are soil, load, and settlement dependent. Upon request by the Structural Engineer for this project, k value recommendations will be provided for the specific loading application in question.

5.14 Pavement

Recommendations for rigid pavement and preparation of the pavement subgrade are provided in the following sections. A traffic study indicating the number and type of vehicles on which to base the pavement design was not provided. Therefore, our recommendations are based upon our experience with similar projects assuming normal vehicular loading. Any unusual loading conditions should be brought to our attention prior to finalizing the pavement design so that we may assess and modify our recommendations as necessary.

5.14.1 Rigid Pavement

Portland cement concrete (PCC) with a minimum 28-day compressive strength of 3,500 pounds per square inch (psi) should be utilized for rigid pavement. Grade 60 reinforcing steel should be utilized in the transverse and longitudinal directions. The following pavement thicknesses and reinforcing are recommended:

Paving Use [1]	Thickness (inches)	Reinforcing
Parking Areas for Automobiles and Light Trucks	5	No. 3 bars spaced on 22-inch intervals
Truck Court and Areas Receiving Less Than 10 Loaded Heavy (18-wheel) Trucks Per Day	6	No. 3 bars spaced on 18-inch intervals
Areas Receiving Between 10 and 30 Loaded Heavy (18-wheel) Trucks Per Day	7	No. 3 bars spaced on 16-inch intervals
Areas Receiving Between 30 and 60 Loaded Heavy (18-wheel) Trucks Per Day	8	No. 3 bars spaced on 14-inch intervals
Note: 1. Fully loaded 18-wheel truck with gross weight of 80,000 pounds was assumed in our analysis.		

Pavement Alternate Thickness Option. Concrete pavement thicknesses provided above can be increased an extra 1-inch as a substitution for stabilization of the pavement subgrade, provided a passing proof-roll is achieved prior to placement of reinforcing steel at the pavement subgrade areas.

Pavement Joints. Contraction joints should be spaced at about 24 times the pavement thickness up to a maximum of 15 feet in any direction. Saw cut control joints should be cut within 6 to 12 hours of concrete placement. Expansion joints should be spaced as necessary and should be placed where the pavement abuts any structure. Dowels should have a diameter equal to $^1/_8$ the slab thickness, be spaced on 12-inch intervals, and be embedded at least 9-inches. Where not specified herein, concrete pavement should comply with Texas Department of Transportation (TxDOT) Standard Specifications, Item 360, "Concrete Pavement", or local equivalent. Appropriate joint sealant is recommended to keep water from saturating the pavement subgrade and to prevent the introduction of incompressible material into the joints. Routine monitoring and maintenance of joint sealants are recommended.

5.14.2 Pavement Subgrade

Potential Vertical Soil Movements. We have assumed that site treatment as recommended in Section 5.13 will not be performed within the pavement areas for this project. As a result, pavements will be subjected to the calculated PVR for this site. Based on the information gathered during this investigation, a pavement constructed on-grade will be subject to potential vertical movements of up to about 4-inches. Because heave is generally associated with a source of water, it can occur differentially. Edge lift, excessive cracking, corner breaks, and poor ride quality are just a few of the many examples of pavement issues that can occur when in-situ PVR values are high. We should be contacted to provide PVR mitigation strategies to help reduce potential movements if desired.

Subgrade Preparation. Fat clay and lean clay is expected to be encountered or exposed at pavement subgrade. The pavement subgrade should be placed in loose lifts not exceeding 8-

inches and should be uniformly compacted to a minimum of 95 percent maximum dry density (per ASTM D-698) and within ±2 percent of the optimum moisture content. We recommend the subgrade be stabilized using the following:

Reagent	Concrete Thickness	Application Rate (pounds per square yard)	Application Depth (inches)
Lime	7-inches or less	27	6
Lime	More than 7-inches	36	8

Lime stabilization should be performed in accordance with TxDOT Standard Specifications, Item 260, "Lime Stabilized Subgrade", or local equivalent. Pavement subgrade recommendations provided here assume the subgrade soil receiving lime treatment has sulfate concentrations less than 3,000 ppm. Additional sulfate screening testing is recommended to be performed on potential material to receive lime treatment after mass grading has been performed.

6.0 GENERAL COMMENTS

Data Assumptions. By necessity, geotechnical engineering design recommendations are based on a limited amount of information about subsurface conditions. In the analysis, the geotechnical engineer must assume subsurface conditions are similar to those encountered in the borings. The analyses, conclusions and recommendations contained in this report are based on site conditions as they existed at the time of the field investigation and on the assumption that the exploratory borings are representative of the subsurface conditions throughout the site; that is, the subsurface conditions everywhere are not significantly different from those disclosed by the borings at the time they were completed.

Subsurface Anomalies. Anomalies in subsurface conditions are often revealed during construction. If during construction, different subsurface conditions from those encountered in our borings are observed, or appear to be present in excavations, we must be advised promptly so that we can review these conditions and reconsider our recommendations where necessary.

Change of Conditions. If there is a substantial lapse of time between submission of this report and the start of the work at the site, if conditions have changed due either to natural causes or to construction operations at or adjacent to the site, or if structure locations, structural loads or finish grades are changed, we should be promptly informed and retained to review our report to determine the applicability of the conclusions and recommendations, considering the changed conditions and/or time lapse.

Design Review. Recommendations in our report are contingent upon RINER reviewing and approving in writing the following design items prior to construction:

- Site grading plan, and
- Foundation plan, details, and related structural loads.

Construction Materials Testing and Inspection. RINER should be retained to observe earthwork and foundation installation and perform materials evaluation and testing during the construction phase of the project. This enables RINER's geotechnical engineer to stay abreast of the project and to be readily available to evaluate unanticipated conditions, to conduct additional tests if required and, when necessary, to recommend alternative solutions to unanticipated conditions. It is proposed that construction phase observation and materials testing commence by the project geotechnical engineer (RINER) at the outset of the project. Experience has shown that the most suitable method for procuring these services is for the owner to contact directly with the project geotechnical engineer. This results in a clear, direct line of communication between the owner and the owner's design engineers and the geotechnical engineer.

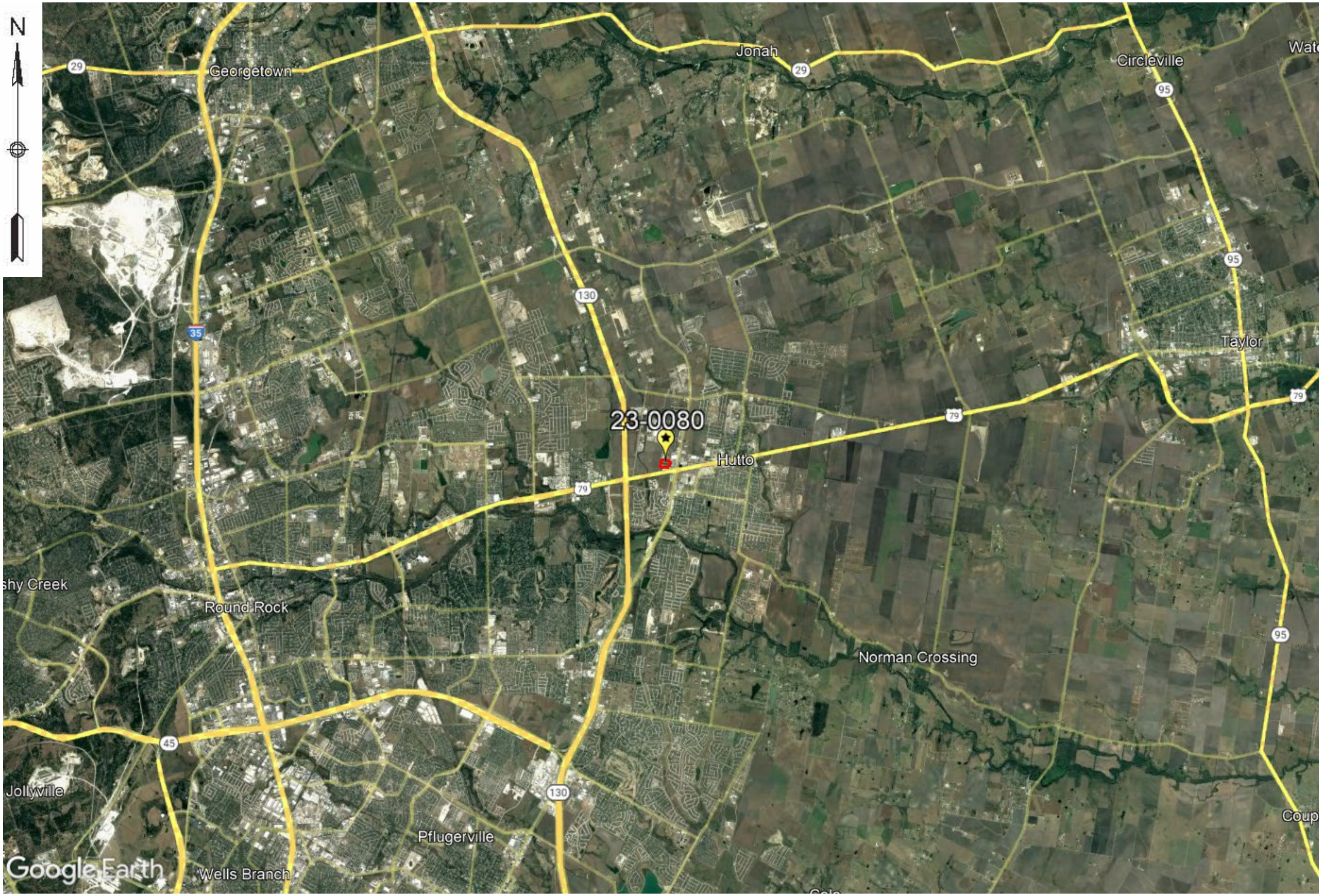
Report Recommendations are Preliminary. Until the recommended construction phase services are performed by RINER, the recommendations contained in this report on such items as final foundation bearing elevations, final depth of undercut of expansive soils for non-expansive earth fill pads and other such subsurface-related recommendations should be considered as preliminary.

Liability Limitation. RINER cannot assume responsibility or liability for recommendations provided in this report if construction inspection and/or testing recommended herein is performed by another party.

Warranty. This report has been prepared for the exclusive use of the Client and their designated agents for specific application to design of this project. We have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No other warranty, expressed or implied, is made or intended.

Appendix A - Project Location Diagrams

PROJECT LOCATION DIAGRAM - GENERAL



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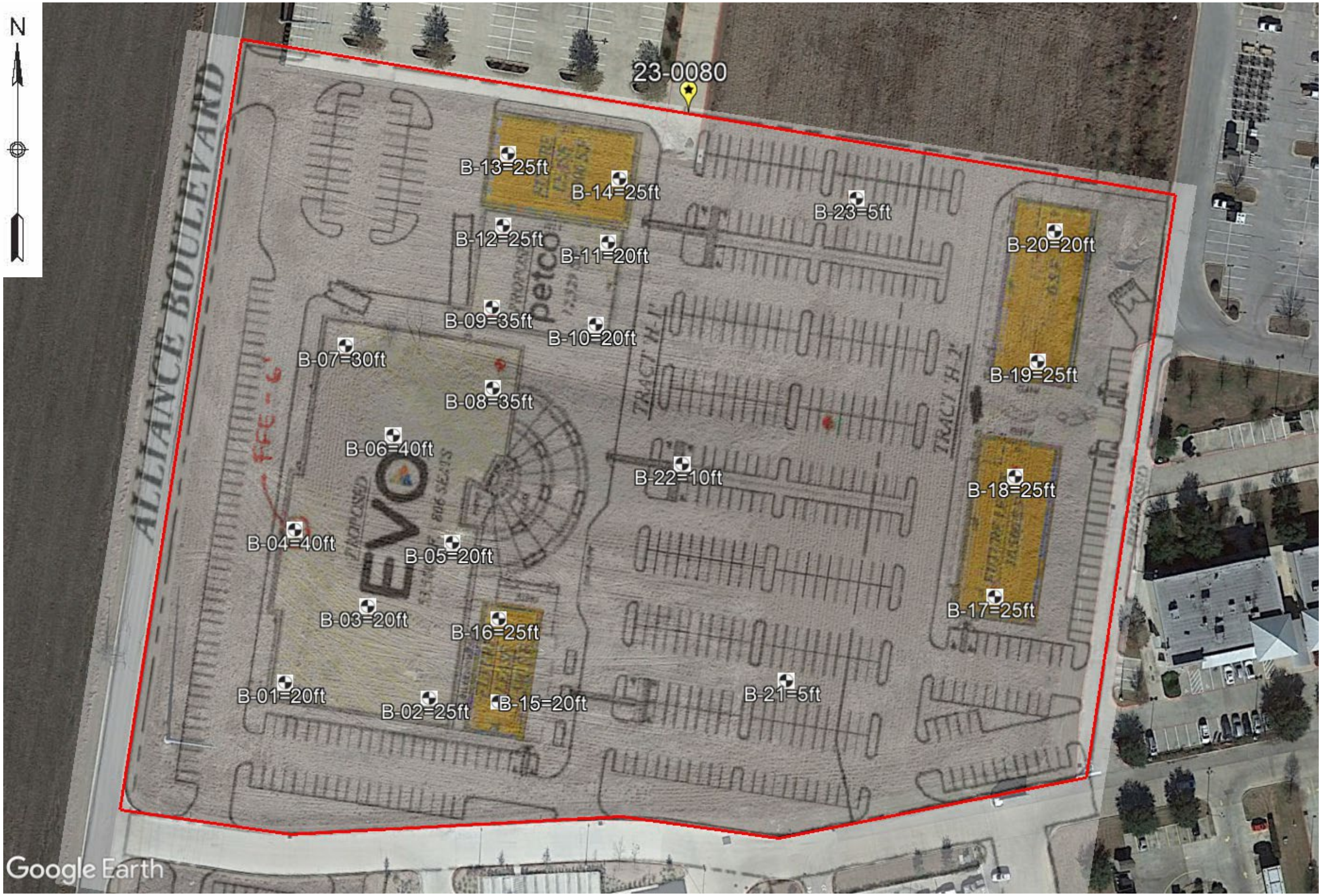
PROJECT LOCATION DIAGRAM - LOCAL

RINER Project No. 23-0080 Townwest Commons

Appendix B - Boring Location Diagram

BORING LOCATION DIAGRAM



RINER Project No. 23-0080 Townwest Commons

Appendix C - Boring Logs and Laboratory Results

Riner Engineering, Inc.
2324 Ridgepoint Drive, Suite E, Austin, Texas 78754
Telephone: 281-469-3347

BORING NUMBER B-01

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/23/23 **COMPLETED** 2/23/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 10-feet, Rock Core 10- to 20-feet
INITIALLY ENCOUNTERED Not encountered up to 10-feet
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. ---
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Stiff to hard, dark brown, with calcareous nodules and limestone fragments.	ST			2.00	1.6				31				
			ST			4.50+					29	76	22	54	54
5		LEAN CLAY (CL) - Hard, light brown and tan, with calcareous clay seams and limestone fragments.	ST			4.50+	1.0								
			ST			4.50+	1.1				16	38	16	22	83
			SS		50/6"										
10		WEATHERED LIMESTONE - Hard to very hard, tan.	TCP		50 (0.25) 50 (0.25)										
			RC	86 (41)											
15			TCP		50 (0.75) 50 (0.5)										
			RC	79 (35)											
20		Bottom of hole at 20.0 feet.	TCP		50 (0.5) 50 (0.5)										

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BORING NUMBER B-02

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/2/23 **COMPLETED** 3/2/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 20-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Stiff to very stiff, dark brown, with calcareous nodules and limestone fragments.	ST			2.00	0.9				35	79	22	57	94
			ST			3.50	1.0								
5		LEAN CLAY (CL) - Hard, light brown and tan, with calcareous clay seams, fossils and limestone fragments.	ST			4.50+	1.5				17	37	15	22	84
			ST			4.50+	1.3								
			SS		27-29-50/4"						17				
10		WEATHERED LIMESTONE - Hard to very hard, tan, with calcareous clay seams.	TCP		50 (0.25) 50 (0.25)										
			SS		38-34-37 (71)										
15			TCP		50 (2.5) 50 (2)										
			SS		50/4"						16				
20		LIMESTONE - Very hard, gray.	TCP		50 (0.5) 50 (0.25)										
			SS		50/3"										
25		Bottom of hole at 25.0 feet.	TCP		50 (0.5) 50 (0.25)										

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BORING NUMBER B-03

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/1/23 **COMPLETED** 3/1/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 20-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Firm to very stiff, dark brown, with calcareous nodules and limestone fragments.	ST			1.50	0.6				34				
			ST			4.50	1.0				29	78	21	57	89
5		LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.5								
			ST			4.50+	1.1				16				
		WEATHERED LIMESTONE - Hard to very hard, tan, with calcareous clay seams.	SS		50/6"										
10			TCP		50 (1.5) 50 (1.5)										
			SS		50/4"						16				
15			TCP		50 (1) 50 (0.5)										
			SS		50/2"										
20		Bottom of hole at 20.0 feet.	TCP		50 (0.75) 50 (0.25)										

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BORING NUMBER B-04

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/23/23 **COMPLETED** 2/23/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 10-feet, Rock Core 10- to 40-feet
INITIALLY ENCOUNTERED Not encountered up to 10-feet
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. ---
NOTES
AFTER ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0	FAT CLAY (CH) - Stiff, dark brown, with calcareous nodules and limestone fragments.	ST			2.00	0.9								
		ST								28	70	19	51	89
5	LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	0.6								
		ST			4.50+	0.9				16	33	15	18	83
		SS		32-50/2"										
10	WEATHERED LIMESTONE - Very hard, tan, with fossils.	TCP		50 (0.25) 50 (0.25)										
		RC	99 (41)							13				
15		TCP		50 (0.5) 50 (0.25)										
		RC	100 (65)											
20		TCP		50 (0.5) 50 (0.25)										
		RC	101 (77)							15				
25		TCP		50 (0.5) 50 (0.25)										
		RC	102 (66)							12				
	LIMESTONE - Very hard, light gray, with clay seams.													
30		TCP		50 (0.25) 50 (0.25)										
		RC	91 (67)											
35		TCP		50 (0.25) 50 (0.25)										
		RC	97 (47)											
40	Bottom of hole at 40.0 feet.	TCP		50 (0.25) 50 (0.25)										

TEST ONLY 2 23-0080.GPJ NEW GINT TEMP.GDT 3/19/23

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BORING NUMBER B-05

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/2/23 **COMPLETED** 3/2/23
GROUND ELEVATION ______ **NORTHING** ______
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING** ______
METHOD Auger 0- to 20-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY** ______
AFTER 15 MIN. Not Measured
NOTES ______
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Firm, dark brown, with calcareous nodules and limestone fragments.	ST			1.50	0.6				36	80	22	58	92
		LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.1								
5			ST			4.50+	1.0				21	35	16	19	82
			SS		33-50/5"										
		WEATHERED LIMESTONE - Hard to very hard, tan, with calcareous clay seams.	SS		50/6"						12				
10			TCP		50 (1) 50 (1)										
			SS		50/3"										
15			TCP		50 (0.25) 50 (0.25)										
			SS		35-50/6"						14				
20		Bottom of hole at 20.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-06

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/24/23 **COMPLETED** 2/24/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 20-feet, Rock Core 20- to 40-feet
INITIALLY ENCOUNTERED Not encountered up to 20-feet
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. ---
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) FILL - Soft to stiff, dark brown, with calcareous nodules and limestone fragments.	ST			1.50	0.6				26				
			ST			1.50	0.6				34	88	23	65	90
5			ST			2.50									
			ST			1.00	0.5				25				
		FAT CLAY (CH) - Stiff, dark brown, with calcareous nodules and limestone fragments.	ST			2.00	0.5				32	79	20	59	89
10		LEAN CLAY (CL) - Hard, tan, with calcareous clay seams and limestone fragments.													
15			ST			4.50+	1.5								
		WEATHERED LIMESTONE - Very hard, tan, with fossils.	SS		50/3"						12				
20			TCP		50 (0.5) 50 (0.25)										
			RC	103 (64)							10				
25			TCP		50 (0.25) 50 (0.25)										
			RC	97 (79)							12				
30			TCP		50 (0.5) 50 (0.25)										
			RC	103 (86)											
35			TCP		50 (0.25) 50 (0.25)										
			RC	99 (79)											
40		Bottom of hole at 40.0 feet.	TCP		50 (0.25) 50 (0.25)										

TEST ONLY 2 23-0080.GPJ NEW GINT TEMP.GDT 3/19/23

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BORING NUMBER B-07

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/1/23 **COMPLETED** 3/1/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 20-feet, Rock Core 20- to 30-feet
INITIALLY ENCOUNTERED Not encountered up to 20-feet
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. ---
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Stiff, dark brown, with calcareous nodules and limestone fragments.	ST			2.00	0.9				33				
			ST			3.00	0.9				31	77	22	55	88
5		LEAN CLAY (CL) - Hard, light brown and tan, with calcareous clay seams and limestone fragments.	ST			4.50+	1.3				18	36	15	21	77
			SS		34-50/4"										
		WEATHERED LIMESTONE - Soft to very hard, tan, with calcareous clay seams.	SS		43-50/3"						14				
10			TCP		50 (1) 50 (1)										
			SS		50/4"										
15			TCP		50 (0.75) 50 (0.5)										
			SS		50/3"										
20			TCP		50 (3.5) 50 (5)										
			RC	83 (69)							15				
25			TCP		50 (0.5) 50 (0.25)										
			RC	93 (43)											
30		Bottom of hole at 30.0 feet.	TCP		50 (0.5) 50 (0.5)										

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BORING NUMBER B-08

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/24/23 **COMPLETED** 2/24/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 18-feet, Rock Core 18- to 35-feet
INITIALLY ENCOUNTERED Not encountered up to 18-feet
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. ---
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) FILL - Soft to hard, dark brown and light brown, with calcareous nodules and limestone fragments.	ST			1.00					19				
			ST			2.00	1.3				34	55	16	39	76
5			ST			4.50+									
			ST			1.50					31				
		FAT CLAY (CH) - Stiff, dark brown and light brown, with calcareous nodules and limestone fragments.	ST			2.50	1.5				32	76	21	55	92
10		LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams and limestone fragments.													
15			ST			4.50+									
		WEATHERED LIMESTONE - Very hard, tan.	TCP RC	87 (0)	50 (0.25) 50 (0.25)										
20			TCP		50 (0.25) 50 (0.25)										
			RC	100 (39)											
25			TCP		50 (0.5) 50 (0.25)										
			RC	100 (82)											
30			TCP		50 (0.25) 50 (0.25)										
			RC	103 (48)											
35		Bottom of hole at 35.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-09

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/27/23 **COMPLETED** 2/27/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 7-feet, Rock Core 7- to 35-feet
INITIALLY ENCOUNTERED Not encountered up to 6-feet
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. ---
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Stiff, dark brown, with calcareous nodules and limestone fragments.	ST			2.50	1.3				31	77	21	56	90
		LEAN CLAY (CL) - Very stiff to hard, brown and light brown, with calcareous clay seams and limestone fragments.	ST			4.50	1.5								
5			ST			4.50+	1.0				16	42	16	26	75
		WEATHERED LIMESTONE - Hard to very hard, tan, with calcareous clay seams.	TCP		50 (2) 50 (1.5)										
			RC	100 (13)											
10			TCP		50 (0.5) 50 (0.5)										
			RC	98 (40)											
15			TCP		50 (0.5) 50 (0.25)										
			RC	101 (53)											
20			TCP		50 (0.5) 50 (0.5)										
			RC	99 (56)											
25			TCP		50 (0.5) 50 (0.25)										
			RC	101 (60)											
30		LIMESTONE - Very hard, gray, with clay seams.	TCP		50 (0.5) 50 (0.25)										
			RC	81 (29)											
35		Bottom of hole at 35.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-10

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/28/23 **COMPLETED** 2/28/23
GROUND ELEVATION ______ **NORTHING** ______
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING** ______
METHOD Auger 0- to 20-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY** ______
AFTER 15 MIN. Not Measured
NOTES ______
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Firm, dark brown, with calcareous nodules and limestone fragments.	ST			1.50	0.5				24	90	22	68	92
		LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.0				16	31	15	16	70
5			ST			4.50+	1.0								
		WEATHERED LIMESTONE - Hard to very hard, tan, with calcareous clay seams.	SS		50/2"						11				
			SS		50/6"										
10															
			SS		50/5"						14				
15			TCP		50 (0.5) 50 (0.25)										
			SS		50/4"										
20		Bottom of hole at 20.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-11

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/28/23 **COMPLETED** 2/28/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 10-feet, Rock Core 10- to 20-feet
INITIALLY ENCOUNTERED Not encountered up to 10-feet
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. ---
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Firm, brown and dark brown, with calcareous nodules and limestone fragments.	ST			1.50	1.0				35				
			ST								17	63	16	47	39
5		LEAN CLAY (CL) - Hard, brown and light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.0				16	29	15	14	80
			SS		50/5"										
		WEATHERED LIMESTONE - Hard to very hard, tan.	SS		50/3"						12				
10			TCP		50 (0.75) 50 (0.5)										
			RC	103 (92)											
15			TCP		50 (0.5) 50 (0.25)										
			RC	96 (39)											
20		Bottom of hole at 20.0 feet.	TCP		50 (0.5) 50 (0.25)										

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BORING NUMBER B-12

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/28/23 **COMPLETED** 2/28/23
GROUND ELEVATION ______ **NORTHING** ______
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING** ______
METHOD Auger 0- to 25-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY** ______
AFTER 15 MIN. Not Measured
NOTES ______
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Stiff, brown and dark brown, with calcareous nodules.	ST			2.00	1.3				31				
			ST			3.00	0.5				23	64	16	48	82
5		LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.3				13	29	15	14	82
		WEATHERED LIMESTONE - Hard to very hard, tan, with calcareous clay seams.	SS		42-50/3"										
			SS		50/4"						12				
10			TCP		50 (0.25) 50 (0.25)										
			SS		50/5"						20				
15			TCP		50 (0.25) 50 (0.25)										
			SS		50/5"										
20			TCP		50 (0.25) 50 (0.25)										
			SS		43-50/5"						14				
25		Bottom of hole at 25.0 feet.	TCP		50 (1) 50 (0.25)										

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BORING NUMBER B-13

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/28/23 **COMPLETED** 2/28/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 25-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTIC LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Stiff, brown and dark brown, with calcareous nodules and limestone fragments.	ST			2.00	0.5				35	72	20	52	92
			ST			2.00	0.3								
5		LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams.	ST			4.50+	1.6				18	30	15	15	82
		WEATHERED LIMESTONE - Very hard, tan, with calcareous clay seams.	SS		50/5"										
			SS		50/4"						14				
10			TCP		50 (0.25) 50 (0.25)										
			SS		50/5"										
15			TCP		50 (0.5) 50 (0.25)										
			SS		50/6"										
20			TCP		50 (0.5) 50 (0.25)										
			SS		50/4"						11				
25		Bottom of hole at 25.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-14

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/1/23 **COMPLETED** 3/1/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 25-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Firm to very stiff, brown and dark brown, with calcareous nodules and limestone fragments.	ST			1.50	0.5				29				
			ST			4.00	1.0				28	71	20	51	90
5		LEAN CLAY (CL) - Firm, light brown, with calcareous clay seams and limestone fragments.	ST			1.50	0.3								
		WEATHERED LIMESTONE - Hard to very hard, tan, with calcareous clay seams.	SS		50/3"						11				
			SS		50/3"										
10			TCP		50 (0.75) 50 (0.25)										
			SS		50/4"						12				
15			TCP		50 (0.75) 50 (0.5)										
			SS		50/3"										
20			TCP		50 (0.5) 50 (0.5)										
			SS		50/3"						17				
25		Bottom of hole at 25.0 feet.	TCP		50 (0.75) 50 (0.25)										

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BORING NUMBER B-15

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/2/23 **COMPLETED** 3/2/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 20-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Soft to stiff, dark brown, with calcareous nodules and limestone fragments.	ST			1.00	0.9				36				
			ST			2.00	1.0				32	86	22	64	94
5		LEAN CLAY (CL) - Hard, brown and light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.6				19	41	16	25	91
			ST			4.50+	1.3				19				
			SS		21-30-50/3"										
10		WEATHERED LIMESTONE - Very hard, tan, with calcareous clay seams.	TCP		50 (0.25) 50 (0.5)										
			SS		50/5"						13				
15			TCP		50 (0.5) 50 (0.25)										
			SS		50/3"										
20		Bottom of hole at 20.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-16

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/2/23 **COMPLETED** 3/2/23
GROUND ELEVATION ______ **NORTHING** ______
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING** ______
METHOD Auger 0- to 15-feet, Rock Core 15- to 25-feet
INITIALLY ENCOUNTERED Not encountered up to 15-feet
LOGGED BY R.C. **CHECKED BY** ______
AFTER 15 MIN. ---
NOTES ______
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Stiff, brown and dark brown, with calcareous nodules and limestone fragments.	ST			2.00	0.9				34	75	20	55	93
			ST			2.50	1.1								
5		LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.4				15				
			SS		31-50/6"										
		WEATHERED LIMESTONE - Hard to very hard, tan, with calcareous clay seams and fossils.	SS		30-50/5"						14				
10			TCP		50 (0.5) 50 (0.5)										
			SS		50/6"										
15			TCP		50 (1.5) 50 (1.5)										
			RC	92 (55)							26				
20			TCP		50 (0.5) 50 (0.25)										
			RC	94 (63)											
25		Bottom of hole at 25.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-17

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/6/23 **COMPLETED** 3/6/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 25-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0	FAT CLAY (CH) - Stiff, brown and dark brown, with calcareous nodules and limestone fragments.	ST			2.00	0.8				35				
		ST								13	52	16	36	33
5	LEAN CLAY (CL) - Hard, brown, with calcareous clay seams and limestone fragments.	ST			4.50+									
	WEATHERED LIMESTONE - Hard to very hard, tan, with calcareous clay seams.	SS		50/2"						12				
		SS		50/3"										
10		TCP		50 (0.5) 50 (0.25)										
		SS		50/3"						13				
15		TCP		50 (0.5) 50 (0.25)										
		SS		43-50/4"										
20		TCP		50 (2) 50 (1)										
	LIMESTONE - Very hard, light gray.	SS		50/2"						12				
25	Bottom of hole at 25.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-18

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/6/23 **COMPLETED** 3/6/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 25-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Firm, dark brown, with calcareous nodules and limestone fragments.	ST			1.50	1.0				32				
			ST			1.50	1.0				32	84	23	61	91
5		LEAN CLAY (CL) - Hard, brown, with calcareous clay seams, limestone fragments and gravel.	SS		11-11-10 (21)										
			ST								23				
		WEATHERED LIMESTONE - Very hard, tan, with calcareous clay seams and fossils.	SS		50/3"										
10			TCP		50 (0.5) 50 (0.5)										
			SS		50/3"						9				
15			TCP		50 (0.25) 50 (0.25)										
			SS		50/3"										
20			TCP		50 (0.25) 50 (0.25)										
		LIMESTONE - Very hard, light gray.	SS		50/3"						10				
25		Bottom of hole at 25.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-19

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 3/6/23 **COMPLETED** 3/6/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 25-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Firm, dark brown, with limestone fragments.	ST			1.50	0.9				32	84	22	62	88
		LEAN CLAY (CL) - Hard, brown and light brown, with calcareous clay seams and limestone fragments.	ST												
5			ST								13				
			SS		15-16-15 (31)										
		WEATHERED LIMESTONE - Hard to very hard, tan.	SS		50/3"										
10			TCP		50 (0.25) 50 (0.25)										
			SS		50/4"						12				
15			TCP		50 (0.25) 50 (0.25)										
			SS		50/4"										
20			TCP		50 (0.75) 50 (0.25)										
		LIMESTONE - Very hard, light gray.	SS		50/3"						11				
25		Bottom of hole at 25.0 feet.	TCP		50 (0.5) 50 (0.25)										

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BORING NUMBER B-20

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/20/23 **COMPLETED** 2/20/23
GROUND ELEVATION ____ **NORTHING** ____
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING** ____
METHOD Auger 0- to 10-feet, Rock Core 10- to 20-feet
INITIALLY ENCOUNTERED Not encountered up to 10-feet
LOGGED BY R.C. **CHECKED BY** ____
AFTER 15 MIN. ---
NOTES ____
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		FAT CLAY (CH) - Stiff, dark brown, with calcareous nodules and limestone fragments.	ST			2.00	0.8				34				
			ST			3.00	1.3								
5		LEAN CLAY (CL) - Stiff to hard, light brown, with calcareous clay seams and limestone fragments.	ST			3.00	1.1				17	32	15	17	69
			ST			4.50+	1.3								
			SS		50/4"						21				
10		WEATHERED LIMESTONE - Hard to very hard, tan.	TCP		50 (0.75) 50 (0.5)										
			RC	98 (53)											
15			TCP		50 (0.5) 50 (0.25)										
			RC	103 (50)							15				
20		Bottom of hole at 20.0 feet.	TCP		50 (0.25) 50 (0.25)										

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BORING NUMBER B-21

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/24/23 **COMPLETED** 2/24/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 5-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		FAT CLAY (CH) - Stiff, dark brown, with calcareous nodules.	ST			2.50	0.9				33				
2.5			ST			3.00	1.3				26	61	17	44	86
		LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.5								
5.0		Bottom of hole at 5.0 feet.													

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BORING NUMBER B-22

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/24/23 **COMPLETED** 2/24/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 10-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		FAT CLAY (CH) FILL - Stiff to hard, brown and dark brown, with calcareous nodules and limestone fragments.	ST			2.00	1.1				34				
2.5			ST			4.00					31	60	16	44	88
5.0			ST			4.50+	1.6								
		LEAN CLAY (CL) - Hard, brown and light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.8				19				
7.5			ST			4.50+	1.1				29				
10.0		Bottom of hole at 10.0 feet.													

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BORING NUMBER B-23

CLIENT NewQuest Properties
PROJECT NAME Townwest Common
PROJECT NUMBER 23-0080
PROJECT LOCATION Hutto, Texas
DATE STARTED 2/24/23 **COMPLETED** 2/24/23
GROUND ELEVATION **NORTHING**
CONTRACTOR Core Tech Drilling
GROUND WATER LEVELS: **EASTING**
METHOD Auger 0- to 5-feet
INITIALLY ENCOUNTERED Not Encountered
LOGGED BY R.C. **CHECKED BY**
AFTER 15 MIN. Not Measured
NOTES
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		FAT CLAY (CH) - Stiff, brown and dark brown, with calcareous nodules and limestone fragments.	ST			2.00	1.1				32				
2.5			ST								15	81	23	58	40
		LEAN CLAY (CL) - Hard, light brown, with calcareous clay seams and limestone fragments.	ST			4.50+	1.4				19				
5.0		Bottom of hole at 5.0 feet.													

ABSORPTION SWELL TEST (ASTM D4546) RESULTS						
Boring No.	B-01	B-01	B-02	B-02	B-03	B-04
Average Sample Depth (ft)	3	7	1	5	3	3
Sample Height (in)	0.8	0.8	0.8	0.8	0.8	0.8
Sample Diameter (in)	2.5	2.5	2.5	2.5	2.5	2.5
Initial Sample Volume (cu in)	3.93	3.93	3.93	3.93	3.93	3.93
Initial Sample Weight (gr)	123.7	130.9	121.4	135.2	123.6	112.7
Initial Moisture (%)	29	16	35	17	29	28
Final Moisture (%)	31	22	36	21	31	32
Initial Wet Unit Weight (pcf)	120	127	118	131	120	109
Initial Dry Unit Weight (pcf)	93	109	87	112	93	85
Applied Over Burden (psi)	2.6	6.1	0.9	4.3	2.6	2.6
Initial Dial Reading (in)	0.0806	0.0438	0.0379	0.1071	0.0509	0.0384
Final Dial Reading (in)	0.0897	0.0449	0.0410	0.1074	0.0548	0.0413
Swell (%)	1.14	0.14	0.39	0.04	0.49	0.36

ABSORPTION SWELL TEST (ASTM D4546) RESULTS						
Boring No.	B-04	B-05	B-05	B-06	B-06	B-07
Average Sample Depth (ft)	7	1	5	3	9	3
Sample Height (in)	0.8	0.8	0.8	0.8	0.8	0.8
Sample Diameter (in)	2.5	2.5	2.5	2.5	2.5	2.5
Initial Sample Volume (cu in)	3.93	3.93	3.93	3.93	3.93	3.93
Initial Sample Weight (gr)	142.4	124.3	123.7	123.7	122.4	122.5
Initial Moisture (%)	16	36	21	34	32	31
Final Moisture (%)	17	35	21	36	35	35
Initial Wet Unit Weight (pcf)	138	120	136	120	119	119
Initial Dry Unit Weight (pcf)	119	89	112	89	90	91
Applied Over Burden (psi)	6.1	0.9	4.3	2.6	7.8	2.6
Initial Dial Reading (in)	0.0706	0.0748	0.0062	0.0255	0.0317	0.0272
Final Dial Reading (in)	0.0706	0.0808	0.0062	0.0298	0.0338	0.0359
Swell (%)	0.00	0.75	0.00	0.54	0.26	1.09

ABSORPTION SWELL TEST (ASTM D4546) RESULTS						
Boring No.	B-08	B-09	B-09	B-10	B-10	B-11
Average Sample Depth (ft)	3	1	5	1	3	3
Sample Height (in)	0.8	0.8	0.8	0.8	0.8	0.8
Sample Diameter (in)	2.5	2.5	2.5	2.5	2.5	2.5
Initial Sample Volume (cu in)	3.93	3.93	3.93	3.93	3.93	3.93
Initial Sample Weight (gr)	137.6	123.8	127.9	120.9	138.0	141.7
Initial Moisture (%)	34	31	16	19	16	17
Final Moisture (%)	-	35	19	37	17	16
Initial Wet Unit Weight (pcf)	133	120	124	117	134	137
Initial Dry Unit Weight (pcf)	93	91	107	98	115	117
Applied Over Burden (psi)	2.6	0.9	4.3	0.9	2.6	2.6
Initial Dial Reading (in)	0.0372	0.0463	0.0884	0.0887	0.0244	0.0481
Final Dial Reading (in)	0.0392	0.0554	0.0884	0.1025	0.0244	0.0481
Swell (%)	0.25	1.14	0.00	1.73	0.00	0.00

ABSORPTION SWELL TEST (ASTM D4546) RESULTS						
Boring No.	B-11	B-12	B-12	B-12	B-13	B-13
Average Sample Depth (ft)	5	1	3	5	1	5
Sample Height (in)	0.8	0.8	0.8	0.8	0.8	0.8
Sample Diameter (in)	2.5	2.5	2.5	2.5	2.5	2.5
Initial Sample Volume (cu in)	3.93	3.93	3.93	3.93	3.93	3.93
Initial Sample Weight (gr)	143.0	123.5	134.2	149.2	121.2	141.3
Initial Moisture (%)	16	29	23	13	35	18
Final Moisture (%)	17	33	22	14	37	17
Initial Wet Unit Weight (pcf)	139	120	130	145	117	137
Initial Dry Unit Weight (pcf)	119	93	106	128	87	116
Applied Over Burden (psi)	4.3	0.9	2.6	4.3	0.9	4.3
Initial Dial Reading (in)	0.0368	0.0120	0.0465	0.0144	0.0266	0.0321
Final Dial Reading (in)	0.0368	0.0120	0.0492	0.0144	0.0281	0.0322
Swell (%)	0.00	0.00	0.34	0.00	0.19	0.01

ABSORPTION SWELL TEST (ASTM D4546) RESULTS						
Boring No.	B-14	B-15	B-15	B-16	B-18	B-19
Average Sample Depth (ft)	3	3	5	1	3	1
Sample Height (in)	0.8	0.8	0.8	0.8	0.8	0.8
Sample Diameter (in)	2.5	2.5	2.5	2.5	2.5	2.5
Initial Sample Volume (cu in)	3.93	3.93	3.93	3.93	3.93	3.93
Initial Sample Weight (gr)	126.3	125.2	137.7	120.1	123.0	118.6
Initial Moisture (%)	28	32	19	34	32	32
Final Moisture (%)	32	32	22	35	35	36
Initial Wet Unit Weight (pcf)	122	121	133	116	119	115
Initial Dry Unit Weight (pcf)	96	92	112	87	90	87
Applied Over Burden (psi)	2.6	2.6	4.3	0.9	2.6	0.9
Initial Dial Reading (in)	0.0733	0.0325	0.0125	0.0291	0.0327	0.0457
Final Dial Reading (in)	0.0766	0.0357	0.0235	0.0335	0.0354	0.0457
Swell (%)	0.41	0.40	1.38	0.55	0.34	0.00

ABSORPTION SWELL TEST (ASTM D4546) RESULTS						
Boring No.	B-20					
Average Sample Depth (ft)	5					
Sample Height (in)	0.8					
Sample Diameter (in)	2.5					
Initial Sample Volume (cu in)	3.93					
Initial Sample Weight (gr)	138.3					
Initial Moisture (%)	17					
Final Moisture (%)	17					
Initial Wet Unit Weight (pcf)	134					
Initial Dry Unit Weight (pcf)	115					
Applied Over Burden (psi)	4.3					
Initial Dial Reading (in)	0.0443					
Final Dial Reading (in)	0.0479					
Swell (%)	0.45					

Riner Engineering Inc.

Soil Laboratory Sulfate Content (Tex-145-E)

Project Name: Townwest Commons **Project No.:** 23-0080 **Date:** 3/16/2023

Boring No. B-01 **Sample No.** 1 **Sample Depth (ft.)** 0-2

Dilution Ratio Used	1:20	Dilution Ratio Used	1:20	Dilution Ratio Used	1:20
Average Reading	16.0	Average Reading	15.0	Average Reading	15.0
Sulfate Content	320	Sulfate Content	300	Sulfate Content	300

Average Sulfate Content: 307 ppm

Boring No. B-04 **Sample No.** 1 **Sample Depth (ft.)** 0-2

Dilution Ratio Used	1:20	Dilution Ratio Used	1:20	Dilution Ratio Used	1:20
Average Reading	17.0	Average Reading	14.0	Average Reading	17.0
Sulfate Content	340	Sulfate Content	280	Sulfate Content	340

Average Sulfate Content: 320 ppm

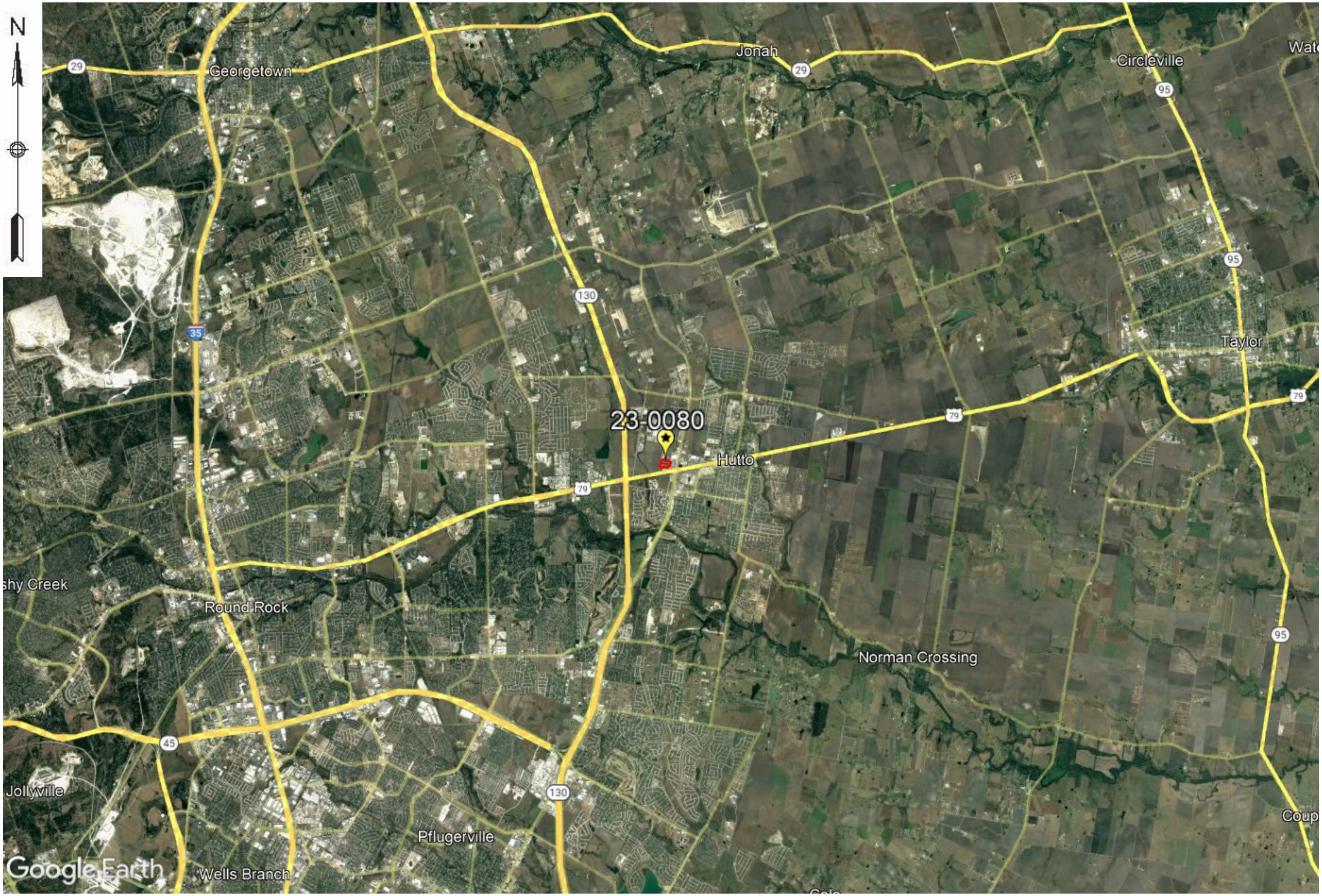
Boring No. B-08 **Sample No.** 1 **Sample Depth (ft.)** 0-2

Dilution Ratio Used	1:20	Dilution Ratio Used	1:20	Dilution Ratio Used	1:20
Average Reading	16.0	Average Reading	15.0	Average Reading	15.0
Sulfate Content	320	Sulfate Content	300	Sulfate Content	300

Average Sulfate Content: 307 ppm

Appendix D - Aerial Photographs

PROJECT LOCATION DIAGRAM - GENERAL



RINER Project No. 23-0080 Townwest Commons

PROJECT LOCATION DIAGRAM - LOCAL

RINER Project No. 23-0080 Townwest Commons

BORING LOCATION DIAGRAM

RINER Project No. 23-0080 Townwest Commons

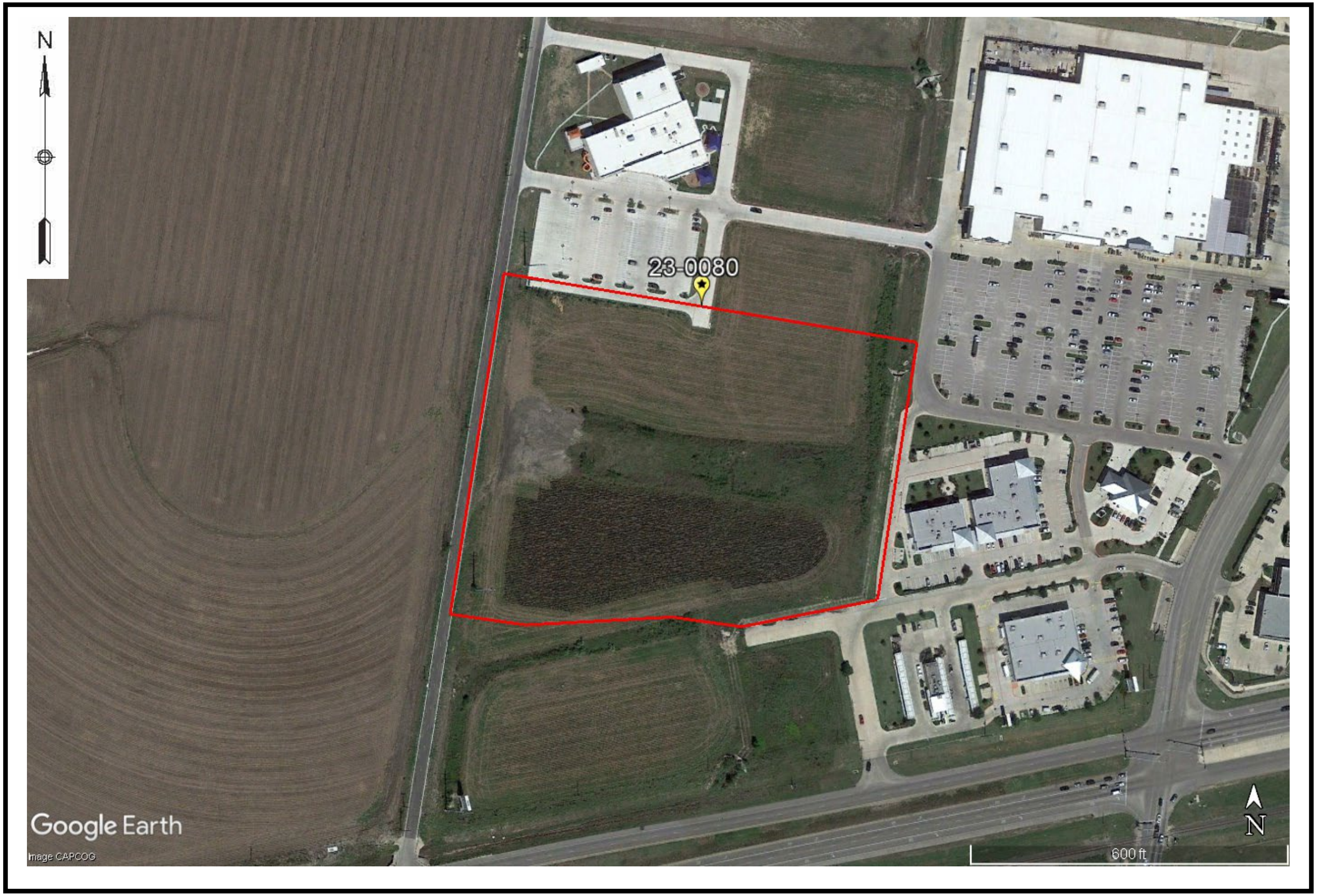
AERIAL PHOTOGRAPH - 2022

RINER Project No. 23-0080 Townwest Commons

AERIAL PHOTOGRAPH - 2019

RINER Project No. 23-0080 Townwest Commons

AERIAL PHOTOGRAPH - 2014



AERIAL PHOTOGRAPH - 2013

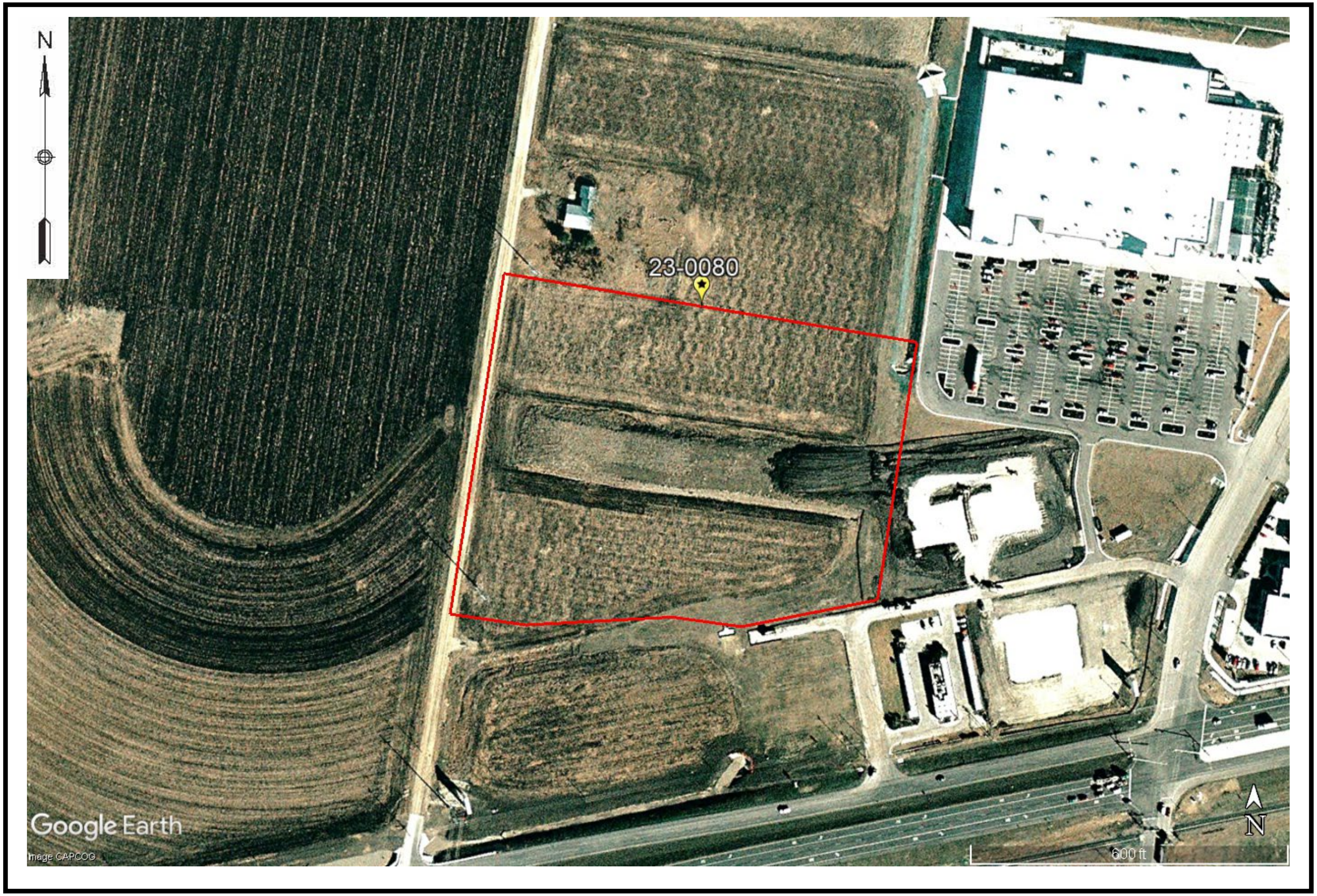
RINER Project No. 23-0080 Townwest Commons

AERIAL PHOTOGRAPH - 2012

RINER Project No. 23-0080 Townwest Commons

AERIAL PHOTOGRAPH - 2009

AERIAL PHOTOGRAPH - 2008



RINER Project No. 23-0080 Townwest Commons

AERIAL PHOTOGRAPH - 2006

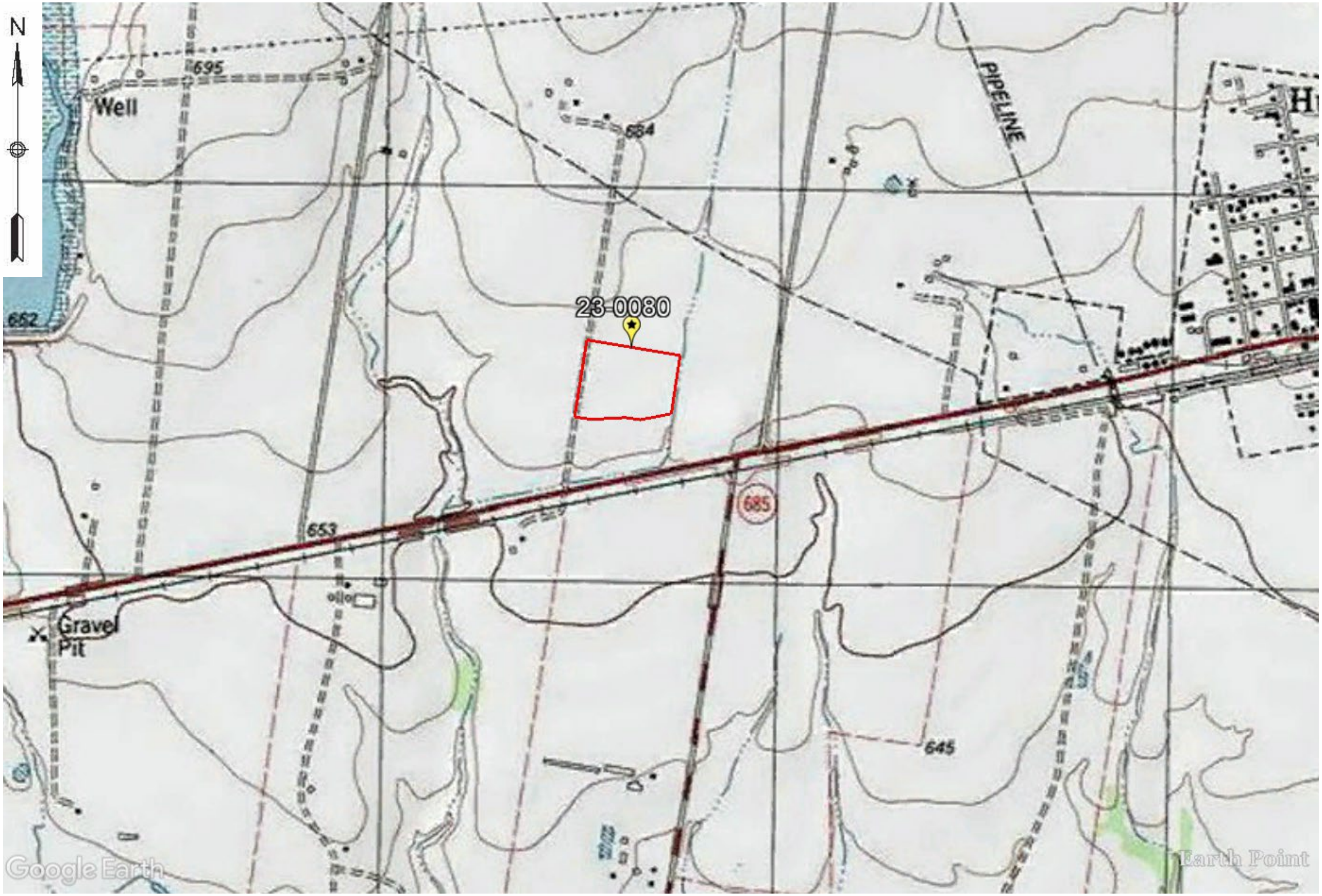
AERIAL PHOTOGRAPH - 2002

AERIAL PHOTOGRAPH - 1995

RINER Project No. 23-0080 Townwest Commons

Appendix E - USGS Topographic Map

USGS TOPOGRAPHIC MAP



RINER Project No. 23-0080 Townwest Commons

Appendix F - Site Photographs

SITE PHOTOGRAPHS

Boring B-01 Facing North

Boring B-02 Facing South

Boring B-03 Facing Northeast

Boring B-04 Facing North

SITE PHOTOGRAPHS

Boring B-05 Facing North

Boring B-06 Facing East

Boring B-07 Facing Southeast

Boring B-08 Facing West

SITE PHOTOGRAPHS

Boring B-09 Facing North

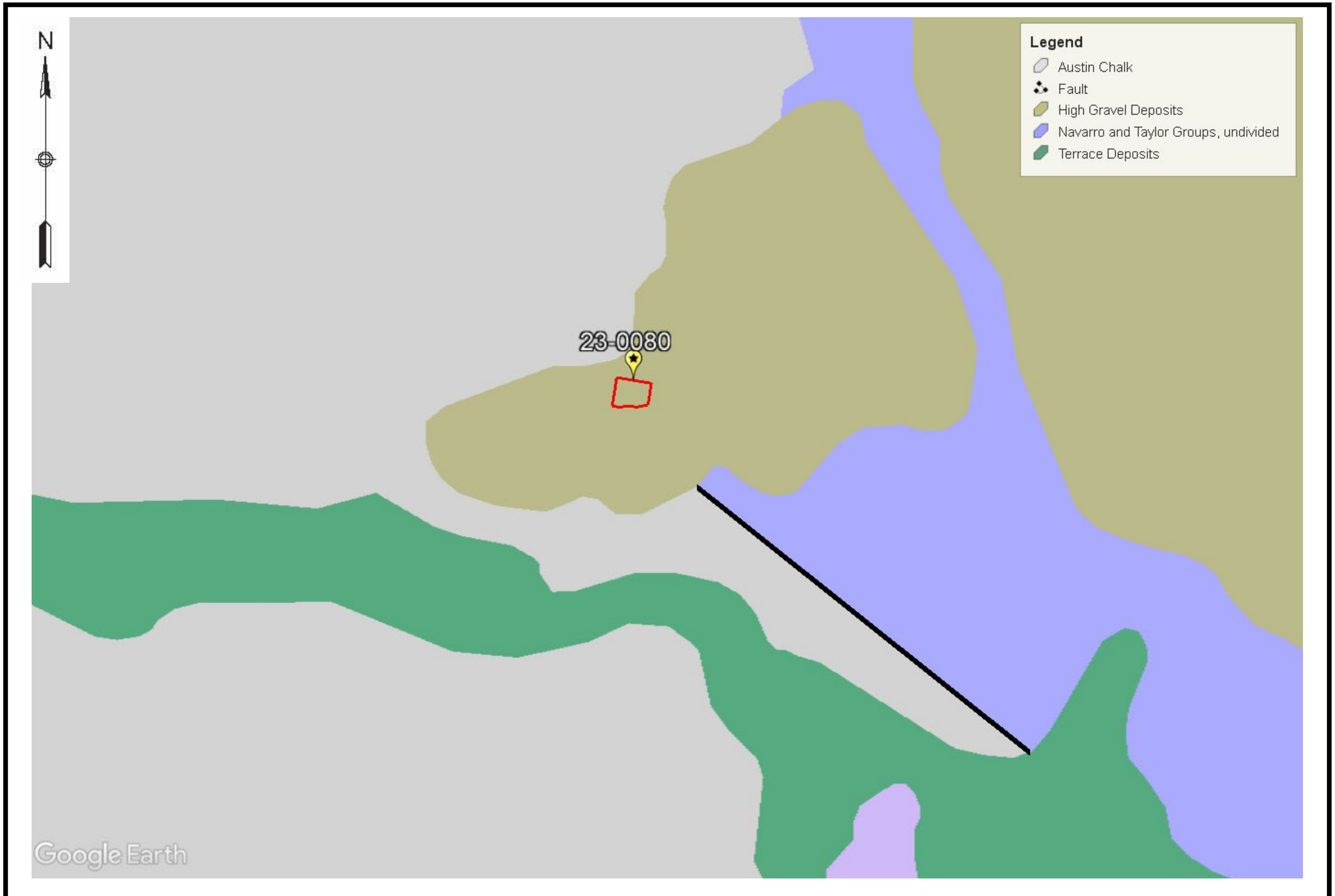
Boring B-11 Facing South

Boring B-13 Facing South

Boring B-15 Facing Northeast

Appendix G - Geologic Information

GEOLOGIC ATLAS



Austin Chalk

Austin Chalk

State	Texas
Name	Austin Chalk
Geologic age	Phanerozoic | Mesozoic | Cretaceous-Late [Gulfian]
Original map label	Kau
Comments	In Eastern part of Trans-Pecos Texas and High Plains- Chalk and marl; chalk mostly microgranular calcite with minor foraminifera tests and Inoceramun prisms, averages ab out 85 percent calcium carbonate, ledge forming, grayish white, white; alternates with marl, bentonitic seams locally recessive; medium gray; pyrite nodules common, weather to limonite; thickness 325-420 ft. In East Texas and Gulf Coast to Rio Grande and In north, central, and south Texas including Quaternary for all of west Texas- Chalk, massive, some interbeds and partings of calcar. clay, lt. gray; middle part mostly thin-bedded marl with interbeds of massive chalk, hard lime mudstone to soft chalk; lt. gray; weathers white; marine megafossils scarce; chalk is mostly microgranular calcite with minor foraminifer tests and Inoceramus prisms, local thin bentonitic beds in lower part, thickness 600 +- ft. thickness 1,200 ft in Crystal City-Eagle Pass Sheet (1976). Ouachita tectonic belt province, Fort Worth syncline. Unit is below Taylor Marl, Ozan Formation, Upson clay, Anacacho Limestone, or Pecan Gap Chalk and is above Eagle Ford Formation or Boquillas Flags.
Primary rock type	limestone
Secondary rock type	mudstone
Other rock types	clay or mud; bentonite; mudstone
Lithologic constituents	Major

Sedimentary > Carbonate > Marlstone (Bed) *chalk predominate*
Sedimentary > Carbonate > Limestone > Chalk (Bed)
Chalk.

Minor

Sedimentary > Clastic > Mudstone > Claystone (Bed)

Map references Bureau of Economic Geology, 1992, Geologic Map of Texas: University of Texas at Austin, Virgil E. Barnes, project supervisor, Hartmann, B.M. and Scranton, D.F., cartography, scale 1:500,000

Unit references Bureau of Economic Geology, 1976, Crystal City-Eagle Pass Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.

Shumard, B.F., 1860, Observations upon the Cretaceous strata of Texas: St. Louis Academy of Science Transactions, v. 1, p. 583-590.

Bureau of Economic Geology, 1974, San Antonio Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.

Bureau of Economic Geology, 1974, Austin Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.

Bureau of Economic Geology, 1977, Del Rio Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.

Geographic coverage Bell - Bexar - Comal - Dallas - Edwards - Ellis - Falls - Grayson - Hays - Hill - Kinney - McLennan - Maverick - Medina - Terrell - Travis - Uvalde - Val Verde - Williamson

Show this information as [XML] - [JSON]

high gravel deposits

high gravel deposits

State	Texas
Name	high gravel deposits
Geologic age	Phanerozoic | Cenozoic | Quaternary | Pleistocene
Original map label	Qhg
Comments	In north, central, and south Texas including Quaternary for all of west Texas- gravel commonly exposed to the surface, in northwest part of Austin Sheet (1974) composed of an upper silty clay unit good for crop production and a lower coarse unit that yields some water (possibly correlates with the Onion Creek Marl). In Waco Sheet (1970) Caliche-cemented cobbles of chert as large as 5 inches in size, pebbles of variegated quartzite, limestone, chert, and quartz; thickness up to 10 ft In East Texas and Gulf Coast to Rio Grande- in SE part of Austin Sheet (1974) gravel commonly exposed to the surface; northwestward, unit composed of an upper silty clay unit good for crop production and a lower coarse unit that yields some water (possibly correlates with the Onion Creek Marl). On Wichita Falls-Lawton Sheet (1987) unit is limestone gravel, sand, and silt; mostly gravel, sandy, silty, in part massive, large-scale crossbeds, mostly loosely consolid. to unconsolidated, locally well-indurated by fine-grained limestone; clasts granules to boulders chiefly ls. with minor quartzite, milky quartz, and sandst and mudstone. Locally in at least 2 topo levels, wedge-shaped in cross section. Thickness of limestone gravel 5-25 ft.
Primary rock type	gravel
Secondary rock type	silt
Other rock types	sand

Lithologic constituents	Major Unconsolidated > Coarse-detrital > Gravel *(Bed)* Minor Unconsolidated > Coarse-detrital > Sand *(Bed)* Incidental Unconsolidated > Fine-detrital > Silt *(Bed)*
Map references	Bureau of Economic Geology, 1992, Geologic Map of Texas: University of Texas at Austin, Virgil E. Barnes, project supervisor, Hartmann, B.M. and Scranton, D.F., cartography, scale 1:500,000
Unit references	Bureau of Economic Geology, 1974, Austin Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000. Bureau of Economic Geology, 1970, Waco Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000. Bureau of Economic Geology, 1987, Wichita Falls-Lawton Sheet, Geologic Atlas of Texas: University of Texas at Austin, Bureau of Economic Geology, scale 1:250,000.
Geographic coverage	Archer - Bastrop - Baylor - Bell - Brazos - Brown - Burleson - Coleman - Concho - Fayette - Gillespie - Hays - Irion - Lee - Leon - Limestone - McCulloch - McLennan - Madison - Milam - Robertson - Runnels - San Saba - Throckmorton - Tom Green - Travis - Washington - Williamson - Young

Show this information as [XML] - [JSON]

Mineral Resources On-Line Spatial Data

Mineral Resources > Online Spatial Data > Geology > by state > Texas

Terrace deposits

Terrace deposits

State	Texas
Name	Terrace deposits
Geologic age	Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
Original map label	Qt
Comments	Sand, silt, clay, and gravel in various proportions, with gravel more prodominent in older, higher terrace deposits. Locally indurated with calcium carbonate (caliche) in terraces along streams. Along Colorado River clasts mostly limest., chert, quartz, and various igneous and metamorphic rocks from Llano region and Edwards Plateau. Includes point bar, natural levee, stream channel deposits along valley walls; probably in large part correlatives of Deweyville, Beaumont, Lissie, and Willis deposits. In upland regions (Rolling Plains, Edwards Plateau, etc.) unit includes fluvial terrace deposits, undivided. Light-brown, reddish-brown, gray, or yellowish-brown, gravelly quartz and lithic sand and silt to sandy gravel (Moore and Wermund, 1993). Deposits become increasingly fine grained on Coastal and Nueces Plains. Locally, calcium carbonate-cemented quartz sand, silt, clay, and gravel intermixed and interbedded. Low terraces of major rivers are capped by 2-4 m of clayey sand and silt. Sandy gravel on higher terraces varies somewhat in composition from river to river. Gravel commonly is rounded to angular limestone and chert pebbles and cobbles, some boulders, sparse igneous pebbles along Brazos river in places. In Bastrop Co., a deposit 27 m above Colorado River contains the Lava Creek B (Pearlette O) volcanic ash (age 0.6 Ma). Along the Frio, Leona, and Sabinal Rivers east of Uvalde, gravel is chiefly basalt and pyclastic clasts, locally cemented by iro oxide. Gravel along the Rio Grande is subrounded clasts of locally derived limestone and chert and rounded clasts of basalt, volcanic

porphyry, quartzite, milky quartz, and banded chalcedony derived from the west.

Primary rock type terrace

Secondary rock type sand

Other rock types gravel; silt; clay or mud

Lithologic constituents Major

Unconsolidated > Fine-detrital > Silt *(Bed)*
Unconsolidated > Coarse-detrital > Sand *(Bed)*

Minor

Unconsolidated > Coarse-detrital > Gravel *(Bed)*
Unconsolidated > Fine-detrital > Clay *(Bed)*

Map references Bureau of Economic Geology, 1992, Geologic Map of Texas: University of Texas at Austin, Virgil E. Barnes, project supervisor, Hartmann, B.M. and Scranton, D.F., cartography, scale 1:500,000

Unit references Moore, D.W. and Wermund, E.G., Jr., 1993a, Quaternary geologic map of the Austin 4 x 6 degree quadrangle, United States: U.S. Geological Survey Miscellaneous Investigations Series Map I-1420 (NH-14), scale 1:1,000,000.
[http://pubs.er.usgs.gov/publication/i1420(NH14)]

Bureau of Economic Geology, 1975, Beeville-Bay City Sheet, Geologic Atlas of Texas, Bureau of Economic Geology, University of Texas at Austin, scale 1:250,000.

Bureau of Economic Geology, 1974, Seguin Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.

Counties Anderson - Angelina - Archer - Armstrong - Atascosa - Austin - Bandera - Bastrop - Baylor - Bee - Bell - Bexar - Blanco - Borden - Bosque - Bowie - Brazos - Brewster - Briscoe - Brown - Burleson - Burnet - Caldwell - Callahan - Camp - Cass - Cherokee - Childress - Clay - Coke - Coleman - Collin - Collingsworth - Colorado - Comal - Comanche - Concho - Cooke - Coryell - Cottle - Crane - Crosby - Dallam - Dallas - Delta - Denton - DeWitt - Dickens - Dimmit - Donley - Duval - Eastland - Ellis - Erath - Falls - Fannin - Fayette - Fisher - Foard - Franklin - Freestone - Frio - Garza - Gillespie - Glasscock - Goliad - Gonzales - Gray - Grayson - Gregg - Grimes - Guadalupe - Hall - Hamilton - Hansford - Hardeman - Hardin - Harris - Harrison - Hartley - Haskell - Hays - Hemphill - Henderson - Hidalgo - Hill - Hood - Hopkins - Houston - Hunt - Hutchinson - Jackson - Jasper - Jeff Davis - Jim Wells - Johnson - Jones - Karnes - Kaufman - Kendall - Kent - Kerr - Kimble - Kinney - Knox - Lamar - Lampasas - La Salle - Lavaca - Lee - Leon - Limestone - Lipscomb - Live Oak - Llano - McCulloch - McLennan - McMullen - Madison - Marion - Mason - Maverick - Medina - Menard - Midland - Milam - Mills - Mitchell - Montague - Montgomery - Moore - Morris - Motley - Nacogdoches - Navarro - Newton - Nolan - Oldham - Palo Pinto - Panola - Parker - Pecos - Polk - Potter - Rains - Reagan - Red River - Reeves - Refugio - Roberts - Robertson - Rockwall - Runnels - Rusk - Sabine - San Augustine - San Jacinto - San Patricio - San Saba - Schleicher - Scurry - Shackelford - Shelby -

Smith - Somervell - Starr - Stephens - Stonewall - Tarrant - Taylor - Throckmorton - Titus - Tom Green - Travis - Trinity - Tyler - Upshur - Uvalde - Val Verde - Van Zandt - Victoria - Walker - Waller - Washington - Webb - Wheeler - Wichita - Wilbarger - Williamson - Wilson - Wise - Wood - Young - Zapata - Zavala

Show this information as [XML] - [JSON]

Navarro Group and Marlbrook Marl, undivided

Navarro Group and Marlbrook Marl, undivided

State Texas

Name Navarro Group and Marlbrook Marl, undivided

Geologic age Phanerozoic | Mesozoic | Cretaceous-Late [Gulfian]

Original map label Knb

Comments Clay, calcareous, variable amount of silt and glauconite, limestone bed in so. Collin Co. 10-13 inches thick, aphanitic, lt. gray, forms scarp 180 ft above base; light yell-gray, marine megafossils, thickness 300 +- ft. Upper 250 ft, mostly silty, calcar. clay with sandst beds and concretionary masses near top, some interbeds of sandst. near base. Lower 200+- ft, quartz sand, fine grained, silty, locally calcar. concretions in discontin. beds, lt. gray; marine megafossils. On Sherman Sheet (1967) east of Sabine River.

Primary rock type clay or mud

Secondary rock type fine-grained mixed clastic

Other rock types sandstone; sand

Lithologic constituents

Major
- Unconsolidated > Fine-detrital > Clay *(Bed)*
- Sedimentary > Clastic > Mixed-clastic > Siltstone-Mudstone *(Bed)*

Minor
- Sedimentary > Clastic > Sandstone *(Bed)*

Incidental
- Sedimentary > Clastic > Sandstone *(Bed)*

Map references Bureau of Economic Geology, 1992, Geologic Map of Texas: University of Texas at Austin, Virgil E. Barnes, project supervisor, Hartmann, B.M. and Scranton, D.F., cartography, scale 1:500,000

Unit references Bureau of Economic Geology, 1972, Dallas sheet, Geologic Atlas of Texas, Bureau of Economic Geology, University of Texas at Austin, scale 1:250,000.

Bureau of Economic Geology, 1967, Sherman Sheet, Geologic Atlas of Texas: University of Texas at Austin, Bureau of Economic Geology, scale 1:250,000.

Bureau of Economic Geology, 1974, Austin Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.

Counties Bell - Bexar - Caldwell - Falls - Guadalupe - Hays - Milam - Travis -

Williamson

Show this information as [XML] - [JSON]

Appendix H - Unified Soil Classification System

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
		Clean Gravels (Less than 5% fines)
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels with fines (More than 12% fines)
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
		Clean Sands (Less than 5% fines)
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
		Sands with fines (More than 12% fines)
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	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

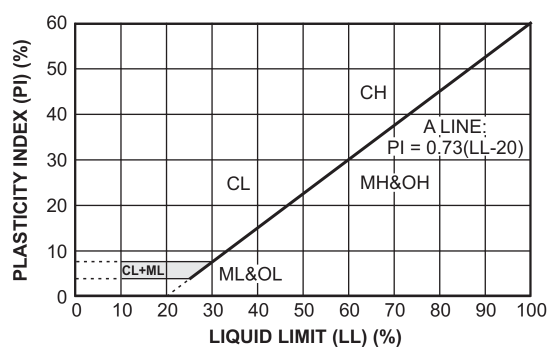
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent . . . . GW, GP, SW, SP
More than 12 percent . . . . GM, GC, SM, SC
5 to 12 percent . . . . Borderline cases requiring dual symbols

PLASTICITY CHART



TERMS DESCRIBING SOIL CONSISTENCY

Fine Grained Soils		Coarse Grained Soils		
Description	Penetrometer Reading (tsf)	Penetration Resistance (blows/ft)	Description	Relative Density
Soft	0.0 to 1.0	0 to 4	Very Loose	0 to 20%
Firm	1.0 to 1.5	4 to 10	Loose	20 to 40%
Stiff	1.5 to 3.0	10 to 30	Medium Dense	40 to 70%
Very Stiff	3.0 to 4.5	30 to 50	Dense	70 to 90%
Hard	4.5+	Over 50	Very Dense	90 to 100%