ECS Southwest, LLP

Geotechnical Engineering Report

Retail Center – Gosling Road

Near Gosling Road and Dovershire Drive

Spring, Texas

ECS Project Number 43:1552

September 12, 2018

ECS
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"Setting the Standard for Service"
Geotechnical • Construction Materials • Environmental • Facilities
TX Registered Engineering Firm F-8461

September 12, 2018

Mr. Nick Gruy
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Houston, TX 77068

ECS Project No. 43:1552

Reference: Geotechnical Engineering Report, Retail Center – Gosling Road, Near Gosling Road and Dovershire Drive, Spring, Texas

Dear Mr. Gruy:

ECS Southwest (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our Proposal No. 43:1367-GP, dated July 12, 2018. The notice-to-proceed was received through your authorization to our 'Proposal Acceptance Form', dated August 28, 2018 from your office. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted. The report also contains our findings and recommendations for design and construction for the proposed retail development and associated site work.

It has been our pleasure to be of service to Triad Real Estate Consulting Group, LLC during the design phase of this project. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

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INTRODUCTION

GENERAL

The purpose of this study was to provide geotechnical information for the design and construction of a retail development with associated parking areas, driveways and site improvements.

The recommendations developed for this report are based on project information provided by Triad Real Estate Consulting Group, LLC. This report contains the results of our subsurface explorations and geotechnical laboratory testing programs, engineering analyses, and recommendations for the design and construction of the proposed retail plaza and associated site work.

SCOPE OF SERVICES

To obtain the necessary geotechnical information required for the evaluation of subsurface soil conditions supporting the planned developments, eleven (11) soil test borings were performed, as requested by the client, at locations selected by representatives of ECS. A laboratory-testing program was also implemented to characterize the physical and geotechnical engineering properties of the subsurface soils.

This report discusses our exploratory and testing procedures, presents our findings and evaluations and includes the following:

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface topographical features and site conditions.
- A review of area and site geologic conditions.
- A review of subsurface soil stratigraphy with pertinent available physical properties.
- A final copy of our soil test borings.
- Recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills.
- Recommended foundation type(s) with pertinent design recommendations.
- Evaluation and recommendations relative to groundwater control.
- An evaluation of soil excavation issues.

AUTHORIZATION

Our services were performed in general accordance with our Proposal No. 43:1367-GP, dated July 12, 2018. The notice-to-proceed was received through your authorization to our 'Proposal Acceptance Form', dated August 28, 2018 from your office.

PROJECT INFORMATION

PROJECT LOCATION

The project is located near Gosling Road and Dovershire Drive in Spring, Texas. The location is presented in Appendix A of the report.

PAST SITE HISTORY/USES

The project site is generally flat with elevations ranging from ±120 feet MSL to ±123 feet MSL. The elevations and topographic variations were obtained from the U.S. Geological Survey website (http://www.usgs.gov), which provided elevation contours in 5 feet intervals.

While preparing this report, we reviewed available documents consisting of historical aerial photos, USGS topographic maps, FWS wetland maps, and USDA soil maps. The project site contains existing residences and is covered with light vegetative growth and scattered trees. A final grading plan is currently unavailable at the time when this report is prepared.

We reviewed Historical Aerial photographs to identify the past usage and location of the previously existing development (if there was any) within the project site. Our aerial photo review summary is presented below:

Year	Subject Property Usage	Adjacent Property Usage
2007	Contains existing residences, light vegetation, and scattered trees	Generally undeveloped. Retail and Restaurants to the south.
2012	No special improvements were noted.	Construction of a commercial development to the north.
2017	No special improvements were noted.	Construction of a subdivision to the east.

CURRENT SITE CONDITIONS

The project site contains existing residences and is covered with light vegetative growth and scattered trees. Commercial and Residential developments are located in the vicinity of the site. No special features were noted from our review of the topographic map.

PROPOSED CONSTRUCTION

The proposed development will include two retail buildings, each with approximately 15,000 SF. The proposed buildings will be supported on slab on-grade with drilled piers and/or spread footings. Detailed structural loading information is not available at this time of this report. We have assumed that the depth of the detention pond will be maximum 6 feet. We understand that the parking areas and driveways will consist of either rigid concrete or flexible asphalt pavements. While site grading was not provided, we anticipate that final grades will largely be within 2 feet of the existing contours without any major cut/fill across the site.

FIELD EXPLORATION

FIELD EXPLORATION PROGRAM

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate subsequent field and laboratory data to assist in the determination of geotechnical recommendations.

TEST BORINGS

Pursuant to the request of our client, the subsurface conditions were explored by drilling a total of eleven (11) borings. The borings were drilled to depths ranging from 5 feet to 20 feet below the existing site grades. The boring schedule is presented below:

Facility	Boring Numbers	Depth of Borings (feet)
Retail Buildings	B-1 through B-4	20
Detention Pond	B-5 through B-7	10
Paving Areas	B-8 through B-11	5

The boring locations were selected by representatives of ECS based on the site plan provided by the client. The approximate as-drilled boring locations are shown on the Boring Location Diagram in Appendix A. The ground surface elevations noted in this report were obtained from the U.S. Geological Survey website (http://www.usgs.gov), which provided elevation contours in 5 feet intervals.

The soil borings were performed with a truck mounted auger drill rig, which utilized continuous-flight, solid-stem augers to advance the boreholes. Drilling fluid was not used in this process. Following completion of the drilling process, the boreholes were backfilled with the spoils generated during drilling operations.

Representative soil samples were obtained by means of the split-barrel and Shelby tube sampling procedures in accordance with ASTM Specifications D 1586 and D 1587, respectively. In the split-barrel sampling procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by means of a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval is termed the Standard Penetration Test (SPT) value and is indicated for each sample on the boring logs. In the Shelby tube sampling procedure, a thin walled, steel seamless tube with sharp cutting edges is pushed hydraulically into the soil, and a relatively undisturbed sample is obtained.

Field logs of the soils encountered in the borings were maintained by the drill crew. After recovery, each geotechnical soil sample was removed for the sampler and visually classified. Representative portions of each soil sample was then wrapped in plastic and transported to our laboratory for further visual examination and laboratory testing.

REGIONAL GEOLOGY

Based on the Houston Sheet, Texas, Geologic Atlas of Texas (Bureau of Economic Geology, University of Texas, 1982), the project site is located within the Lissie Formation (Ql). The Lissie Formation is heterogeneous and composed of interbedded clays, silts, and clayey and/or silty sands, deposited in a higher energy depositional environmental than the younger Beaumont Formation. The clay present in the formation was preconsolidated by a process of desiccation. Numerous wetting and drying cycles produced a network of randomly oriented and closely spaced joints, which are sometimes slickensided, with shiny appearance when exposed. The sand deposits are typically clayey or silty but may also include clean, poorly graded sand and, infrequently, gravel, and random cobbles. The sand layers vary in compactness from loose to very dense, and in thickness from a fraction of an inch to many feet due to an irregular depositional environment. Sands are generally subrounded to subangular and vary from course to very fine, are poorly graded, and often contain significant amounts of silt-sized particles in the sand matrix. Buried stream channels may occur sporadically within finer grained over bank deposits throughout the Lissie Formation.

SOIL SURVEY MAPPING

Based on our review of the Soil Survey (USDA - Natural Resources Conservation Service (websoilsurvey.ncrs.usda.gov), the site soils are mapped as Kenny loamy fine sand (Kn), 0 to 2 percent slopes, and Segno fine sandy loam (SeB), 1 to 3 percent slopes. Please refer to the 'Soil Survey of Harris County, Texas' for the detailed soil characteristics and additional information.

SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil strata encountered during our subsurface exploration. For subsurface information specific information refer to the Boring Logs in Appendix B.

Approximate Depth Below Grade (ft)	Material Description	Consistency
0 – 2	SANDY SILT FILL (ML FILL), Dark Brown, Tan, Light Brown, Reddish Brown, with roots and wood (B-3, B-6, B-8 through B- 10)	Stiff to Hard
0 – 2	SILTY SANDY CLAY FILL (CL-ML FILL), Dark Brown, Reddish Brown with roots (B-2 only)	Hard
0 – 2	LEAN CLAY FILL (CL FILL), Light Brown, Dark Brown, with roots (B-4 only)	Hard
0 – 2	SANDY SILT (ML) Dark Brown, Light Gray with Roots (B-1, B-11 only)	Hard (B-1)/Medium Dense (B-11)
(0-2) – (2-4)	SILTY SANDY CLAY (CL-ML) Dark Brown, Light Brown, Dark Gray, Reddish Brown, with Roots (B-1, B-5, B-7 only)	Hard
(2-4) – (5-20)	LEAN CLAY (CL), Brown, Light Brown, Dark Brown, Tan, Reddish Brown, Light Gray, with Silt, Sand, Roots and Ferrous Nodules	Stiff to Hard
10 – 20	SILTY SANDY (SM) Tan, Light Brown (B-1 only)	Medium Dense
8 - 20	FAT CLAY (CH) Light Gray, Tan, Dark Brown, with Roots, Sand, and Ferrous Nodules (B-3 only)	Very Stiff to Hard

Please refer to the attached boring logs and laboratory data summary for this field exploration for a more detailed description of the subsurface conditions encountered in the borings as the stratification descriptions above are generalized for presentation purposes.

GROUNDWATER OBSERVATIONS

Groundwater level observations were made in the borings during drilling operations. In auger drilling operations, water is not introduced into the borehole and the groundwater position can often be determined by observing water flowing into and out of the excavation. Furthermore, visual observation of soil samples retrieved can often be used in evaluating the groundwater conditions. Groundwater was not encountered in any of the borings during drilling and/or shortly after completion of drilling.

The highest groundwater observations are normally encountered in the late winter and early spring. Fluctuation in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, construction activities and other factors not immediately apparent at the time of his investigation. Therefore, the groundwater conditions at this site are expected to be significantly influenced by surface water runoff and rainfall.

LABORATORY TESTING

The laboratory testing was performed by an experienced Geotechnical Engineer on selected samples obtained during our field exploration operations. Classification and index property tests were performed on representative soil samples obtained from the test borings in order to aid in classifying soils according to the Unified Soil Classification System and to quantify and correlate engineering properties. The soil samples were tested for moisture content (ASTM D 2216), and Atterberg Limits (ASTM D 4318), minus 200 grain size analysis by washed sieve method (ASTM D 1140) and Unconfined Compression tests (ASTM D 2166).

An experienced Geotechnical Engineer visually classified each soil sample from the test borings on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS) and ASTM D 2488 (Description and Identification of Soils-Visual/Manual Procedures). After classification, the geotechnical engineer grouped the various soil types into the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in situ, the transitions may be gradual.

The soil samples will be retained in our laboratory for a period of 30 days, after which, they will be discarded unless other instructions are received as to their disposition.

DESIGN RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions. If there are any changes to the project characteristics or if different subsurface conditions are encountered during construction, ECS should be consulted so that the recommendations of this report can be reviewed. Site grading information was not provided during this report; however, we have assumed that the foundation elevation will be within 2 feet from the existing site elevations. If the finished floor elevation deviates from this assumed site grades, the recommendations provided below should be evaluated by our office.

EXISTING FILL MATERIALS

Existing fill soils were encountered within borings B-2 to B-4, B-6, B-8 to B-10 that extended to a depth of about 2 feet below the existing ground surface. The presence of this undocumented fill raises concerns for the uniformity of the soil density and may cause differential settlements of the proposed structures beyond tolerable limits. The depths of the fill may vary across the site and should be identified at the time of construction under the supervision of an authorized direct representative of the Geotechnical Engineer of Record (GER). Without controlled density tests, these soils should be removed, reworked, and/or replaced in accordance to the 'Site Construction Recommendations' section of this report.

POTENTIAL VERTICAL MOVEMENTS

The subsoils encountered at this site are considered to be low active. These soils can subject slabs, foundations and paving to minor movements (due to shrinking and swelling) with fluctuations in their moisture content, throughout the life of the structures. Based on test method TEX-124-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, and our experience with similar soils, we estimate potential vertical soil movements (PVM) to be less than 1.0 inch for the surface supported structures in 'dry' condition. These potential movements reflect moisture changes in the soil that can occur over the life of the building and after construction is complete.

Our laboratory test results indicate that the project site is generally underlain by relatively cohesionless soils and low plasticity clay soils with low swell-shrinkage potential. Therefore, we do not recommend any special subgrade improvements to limit the PVM at the subject site for the proposed structures.

FOUNDATION RECOMMENDATIONS

Based on our subsurface exploration and laboratory testing, we are providing the following recommendations to support the proposed retail plaza buildings on slab on-grade supported by shallow foundations and/or drilled piers. The suitable foundation systems should be selected based upon the discussion between the owner and by the design team members (The Owner, Project Architect and Structural Engineer of Record).

SPREAD AND/OR CONTINUOUS FOOTINGS

Existing fill soils were encountered within borings B-2 to B-4, B-6, B-8 to B-10 that extended to a depth of about 2 feet below the existing ground surface. The spread and/continuous footings should not be supported on the existing undocumented fill soils; unless the existing undocumented fill soils are removed, reworked and/or recompacted in accordance to the 'Site Construction Recommendations' section of the report. The actual depth of fill soils may vary at different locations across the site and must be identified at the time of construction under the supervision of an authorized representative of the Geotechnical Engineer of Record (GER).

The shallow foundations may be designed for a net allowable soil bearing capacity of 4,000 psf. In order to achieve this bearing capacity column footings and continuous footings should be supported on properly placed and compacted fill and/or natural subgrades as defined in this report. Shallow foundations should be placed at a minimum depth of 36 inches (spread footing) and 24 inches (continuous footing), below existing site grades and should have a minimum lateral dimension of 18 inches to avoid punching shear. Any shallow foundation supported on engineered fill soils should be designed with a maximum net allowable soil bearing capacity of 3,000 psf.

The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure. The final footing and/or grade beam elevation should be evaluated by competent geotechnical engineering personnel to verify that the bearing soils are capable of supporting the recommended net allowable bearing pressure and suitable for foundation construction. These evaluations should include visual observations and use of the Dynamic Cone Penetrometer (DCP). Evaluations should be performed within each column footing excavation (minimum of 2 tests per column footing) and at intervals not greater than 25 feet in continuous footings. The DCP testing should extend at least 2 feet below the final foundation subgrade. A minimum DCP value of 10 blows may be used for the evaluation of the foundations.

The settlement of a structure is a function of the compressibility of the bearing materials, bearing pressure, actual structural loads, fill depths, and the bearing elevation of footings with respect to the final ground surface elevation. Estimates of settlement for foundations bearing on engineered or non-engineered fills are strongly dependent on the quality of fill placed. Factors that may affect the quality of fill include maximum loose lift thickness of the fills placed and the amount of compactive effort placed on each lift. If the recommendations outlined in this report are followed, we expect total settlements for the proposed construction to be in the range of 1 inch or less, while the differential settlement will be approximately half of the anticipated total settlement. This evaluation is based on our engineering experience and the anticipated loadings for this type of structure, and is intended to aid the structural engineer with his design.

Exposure to the environment may weaken the soils at the foundation bearing level if the foundation excavations remain exposed during periods of inclement weather. Therefore, foundation concrete should be placed the same day that final excavation is achieved and the design bearing pressure verified. If the bearing soils are softened by surface water absorption or exposure to the environment, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the foundation excavation must remain open overnight, or if rainfall is apparent while the bearing soils are exposed, we recommend that a 1 to 3-inch thick "mud mat" of "lean" concrete be placed over the exposed bearing soils before the placement of reinforcing steel.

DRILLED PIER FOUNDATIONS

As an alternative, a drilled pier foundation system may be utilized to support the proposed structures. Drilled piers should be proportioned and founded at sufficient depths to provide both axial compressive load capacity and uplift resistance. Based on the results from the field exploration and laboratory test results data the allowable loads for the drilled piers are recommended as:

Drilled Piers Recommendations	
Foundation Type	Under-reamed
Minimum Depth below Existing Grade	9 Feet
Net Allowable Bearing Pressure for Dead Load (Dead and Sustained Live Load)	4,000 PSF
Net Allowable Bearing Pressure for Total Load (Dead Load and Live Load)	6,000 PSF

The above recommended drilled pier allowable end bearing pressures incorporate a design safety factor of 3 against axial compression dead loads plus sustained live loads and a design safety factor of 2 against axial compression dead loads plus sustained and transient live loads. The minimum clear spacing between edges of adjacent piers should be at least one (1) bell diameter, with larger bell size governing. Drilled pier foundations that are designed and constructed in accordance with the recommendations in this report could be subjected to long term total and differential movements of about 1.0 and 0.5 inch, respectfully.

The following items should be considered during the design and construction of the drilled piers:

- The bell to shaft ratio of 3:1 should be ideal. The bell to shaft ratio should be limited to 2:1 should there be any borehole collapsing (cave in conditions) at the time of construction.

- Based on our current groundwater observations, the drilled pier excavations should not encounter groundwater. If groundwater is encountered during construction, water inflow must be pumped out immediately using a sump-pump. The drilling contractor must be prepared for this condition and be prepared to case the piers.

- We anticipate that the drilled pier may be installed using dry method of construction. However, a slurry method of construction may be required for the drilled pier installations due to the potential seasonal variations in groundwater depth, variations in the subsoils stratigraphy, strengths and corresponding potential borehole collapsing. The drilling contractor should be prepared to encounter for any such situations.

Due to the potential subsoil variations and potential groundwater fluctuations, we recommend that the four corner and two center piers be drilled first to better evaluate the constructability of the drilled piers recommended herein. Once this information is field verified, other piers need to be constructed accordingly.

The drilled pier excavations should be free of loose materials and water prior to concrete placements. Concrete should be poured immediately after drilling the pier holes. The drilled piers installations should be followed in accordance with the American Concrete Institute (ACI) Reference Specifications for the construction of drilled piers (ACI 336.1) and commentary (ACI 336.1R-98). Additionally, The U.S. Department of Transportation publication No. FHWA-NHI-10-016, “Drilled Shafts: Construction Procedures and LRFD Design Methods” should be followed during the design and construction of the drilled piers.

The construction of the piers should be observed as a means to verify compliance with design assumptions and to verify: (1) the bearing stratum; (2) length and diameter; (3) the removal of smear zones and cuttings; (4) that groundwater seepage, when encountered, is correctly handled; and (5) that the piers are vertical (within the acceptable tolerance).

UPLIFT CONSIDERATIONS

The drilled piers should contain sufficient reinforcing steel throughout their entire length to resist uplift (tensile) forces due to post-construction heave of the clay soils. The magnitude of uplift is difficult to predict and will vary with the in-situ moisture contents at the time of construction. Based on the planned building subgrade preparation, we recommend using a uniform uplift of 1,400 psf over the entire pier perimeter to a depth of 8 feet. This uniform uplift may be ignored within the select fill zone.

The uplift forces created due to the expansive soils and imposed structural loadings can be resisted by the underreamed portion the pier, weight of the pier itself and the dead load on the pier. The uplift resistance of underreamed drilled piers at the site can be estimated using the following equation:

$$U_r = B_r + W_p + P_{DL}$$

Where:
U_r = Uplift resistance of the pier (kips)
B_r = Resistance contributed by the underreamed portion of the pier (kips)
W_p = Weight of the pier (kips)
P_{DL} = Dead Load acting on the pier (kips)

The resistance contributed by the underreamed portion of the pier should be calculated as shown in the following equations. The following formulas incorporate a factor of safety of approximately 2.

$B_r = 1 \bullet (D^2 - d^2)$ Piers at least 12 feet below adjacent finished grade
$B_r = 3 \bullet (D^2 - d^2)$ Piers at least 15 feet below adjacent finished grade
$B_r = 7 \bullet (D^2 - d^2)$ Piers at least 18 feet below adjacent finished grade
B_r should be ignored should the pier depth is less than 12 feet below adjacent finished grade

Where:
D = Diameter of the under-ream (feet)
d = Diameter of the pier shaft (feet)

LATERAL CONSIDERATIONS

Resistance to lateral loads and the expected pier behavior under the applied loading conditions will depend not only on the subsurface conditions, but also on loading conditions, the pier size, and the engineering properties of the pier. We recommend the designer use a performance based design methodology using non-linear soil support springs (“p-y curves”) to model the soil behavior. Several computer programs are commercially available for this purpose; we recommend LPILE (Ensoft, Inc.) since the software is relatively current and actively supported.

The graphical relationship between the soil resistance (p) and pile deflection (y) is commonly referred to as a “p-y curve”. Along the depth of the shaft, soil resistance (p) is expressed as a non-linear function of lateral shaft deflection (y). Various researchers developed “p-y” criteria for different kinds of soils. The “p-y” curves can be automatically generated by LPILE. Recommended design soil properties needed for generating “p-y” curves are provided in the table below.

Description	Approximate Depth (ft)	Effective Unit Weight (pcf)	Allowable Passive Pressure (psf)	Cohesion (psf)	Friction Angle (degree)	E_{50}	K_s (pci)
Clay	0 to 4	115	Disregard Capacities				
Clay	4 to 10	115	2,000	2,000	-	0.005	750
Sand	10 to 20	115	1,750	-	30	-	90

SLAB ON-GRADE

Upon addressing the undocumented fill soils, the the floor slab can be supported on engineered fill soils as recommended in 'Site Construction Recommendations' section of the geotechnical report. We recommend that the upper six-inch of subgrade soils in the floor slab areas be compacted to at least 95% of standard density (ASTM D 698) at a moisture content within ±2% of the Proctor optimum value. A soil modulus of subgrade reaction (ks) of 120 pci can be used in the design of floor slab. Positive drainage should be developed and strictly maintained during the lifetime of the structure to drain surface water away from the structure.

We recommend that floor slabs be isolated from the foundation footings so differential settlement of the structure will not induce shear stresses in the floor slab. Furthermore, the existing undocumented fill soils and/or loose materials, if any, should be removed and compacted prior to the slab construction. In order to minimize the crack width of shrinkage cracks that may develop near the surface of the slab, we recommend mesh reinforcement be included in the design of the floor slab. The mesh should be in the top half of the slab to be effective.

A bedding layer of leveling sand, one to two inch in thickness, may be placed beneath the floor slab. If floor treatments that are sensitive to moisture will be used, a 10-mil vapor barrier of polyethylene sheeting or similar material should be placed beneath the slab to minimize moisture migration through the slab. If a vapor barrier is considered to provide moisture protection, special attention should be given to the surface curing of the slabs to minimize uneven drying of the slabs and associated cracking and/or slab curling. The use of a blotter or cushion layer above the vapor barrier can also be considered for project specific reasons. Please refer to ACI 302.1R96 Guide for Concrete Floor and Slab Construction and ASTM E 1643 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs for additional guidance on this issue.

While site grading was not provided, we anticipate that planned grading will largely be within 2 feet of the existing contours across the site. In the event that fill is placed on the site, specifications should require placement in accordance with our recommendations given in the "Site Preparation" section.

GRADE BEAMS AND PERIMETER CONDITIONS

Soils placed along the exterior of grade beams should be on-site clay soils placed and compacted in accordance with this report. The purpose of this backfill is to reduce the opportunity for surface or subsurface water infiltration beneath the structure. The overbuild zone of select granular soils should be removed outside of the perimeter grade beams and backfilled with on-site clay soils.

We recommend paving/sidewalks be placed adjacent to the structures to reduce seasonal drying of the moisture conditioned soils near the perimeter of the structures. Irrigation of lawn and landscaped areas should be moderate, with no excessive wetting or drying of soils around the perimeter of the structures allowed. Positive drainage away from the structures should also be provided.

Trees and bushes/shrubs planted near the perimeter of the structures can withdraw large amounts of water from the soils. We recommend trees not be planted or left in place (existing trees) closer than half the canopy diameter of mature trees from the grade beams, typically a minimum of 20 feet. If vegetation is planted closer than the anticipated mature height away from the buildings then a root barrier should be installed to a depth of at least 5 feet below finished grade.

DETENTION POND DESIGN CONSIDERATIONS

We understand that a detention basin will be constructed within the project site. The maximum depths of the detention ponds were not available at the time this report was prepared. However, we have assumed that the depths of the detention pond will be maximum 6 feet.

A total of three (3) borings (Borings B-5 through B-7) were drilled within the detention pond areas. Based on our subsurface exploration and laboratory test data, the generalized subsoil profile within the detention pond area can be presented below:

Boring No.	Soil Type	Depth (feet)	Consistency
B-5	Silty Sandy Clay (CL-ML) Lean Clay (CL)	0 – 4 4 – 10	Very Stiff to Hard Very Stiff to Hard
B-6	Sandy Silt FILL (ML FILL) Lean Clay (CL)	0 – 2 2 – 10	Stiff Very Stiff
B-7	Silty Sandy Clay (CL-ML) Lean Clay (CL)	0 – 2 2 – 10	Hard Stiff to Hard

SIDE SLOPE

Based upon our laboratory test results, a side slope of 3.5(H):1(V) can be considered as a stable configuration of the side slope of proposed detention basin. However, a flatter slope may be required, if cohesionless soils and/or soft clayey subgrade soils are encountered. ECS should be immediately contacted if any cohesionless soils and/or soft clay soils are encountered at the time of construction to provide additional recommendations for the clay liner requirements.

Performing detailed slope stability analyses was beyond the scope of our work. If a deeper depth is planned, the stability of the side slopes should be evaluated by ECS.

PAVEMENT SUBGRADE AND PRELIMINARY PAVEMENT SECTIONS

Existing fill soils were encountered within borings B-2 to B-4, B-6, B-8 to B-10 that extended to a depth of about 2 feet below the existing ground surface. These undocumented fill soils should be removed and reworked/replaced in accordance to our "Site Construction Recommendations" section. Proposed paved areas should be proofrolled with heavy compaction equipment with load of at least 25 tons to attempt to locate soft or undesirable soils so they can be removed and replaced with properly placed and compacted soils. Pumping or rutting identified during proofroll should be conducted in accordance with TxDOT Standard Specification Item 216. The proofrolling operations should be observed by the representative of Geotechnical Engineer of Record.

Specific traffic loading information was not provided; however, light duty (automobile parking) pavements are expected to receive passenger vehicles. Based on our experience with local soils, we assumed CBR values of the onsite subsoil should range from 3 to 5. Our pavement section recommendations for heavy duty (drives) pavements should accommodate occasional heavier loadings due to fire trucks, delivery vehicles and light truck traffic and may be considered for main drives. Typical pavement sections are presented below. Actual pavements sections and joint spacing should be designed by the Civil Engineer of Record based on specific traffic loads.

Material Designation	**Asphaltic Concrete**		**Portland Cement Concrete**	
	Light Duty	**Heavy Duty**	**Light Duty**	**Heavy Duty**
Asphalt Surface Course	2 inches	2 inches	-	-
Asphalt Binder Course[1]	3 inches	4.5 inches	-	-
Portland Cement Concrete	-	-	5 inches	6 inches
Lime-Fly Ash Stabilized Subgrade[2]	6 inches	6 inches	6 inches	6 inches

[1] Flexible base material may be used in lieu of asphalt binder using a substitute ratio of three inches of flexible base for each inch of asphalt binder.

[2] Lime-Fly Ash stabilized subgrade in accordance with TxDOT Specification 265.

For estimating purposes, we recommend that 3 percent hydrated lime and 7 percent fly ash by dry weight can be considered for subgrade stabilization. For construction purposes, we recommend that the lime-fly ash content of the subgrade soils be determined by appropriate laboratory testing. The soil-lime-fly ash mixture should be moist-cured a minimum of 3 days before covering with pavement. The selected Fly-Ash component should be in accordance with ASTM C 618, Class C or F; and have a minimum CaO content of 20 percent. Lime-Fly Ash treated subgrade soils should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D698 at a moisture content between ±2 percent of the optimum moisture content.

An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, a softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, positive drainage will reduce the possibility of the subgrade materials becoming saturated during the normal service period of the pavement.

Please note, the recommended pavement sections provided above are considered the minimum necessary to provide satisfactory performance based on the provided traffic loading. In some cases, jurisdictional minimum standards for pavement section construction may exceed those provided above.

Front-loading trash dumpsters frequently impose concentrated front-wheel loads on pavements during loading. This type of loading typically results in rutting of bituminous pavements and ultimately pavement failures and costly repairs. Therefore, we suggest that the pavements in trash pickup areas utilize a 7-inch thick Portland Cement Concrete (PCC) pavement section. Appropriate jointing should also be incorporated into the design of the PCC pavement.

Pavement should be specified, constructed and tested to meet the following requirements:

1. Reinforcing steel may consist of #3 reinforcing steel bars placed at 18 inches on center all directions. Saw cuts contraction joints should be spaced 15 feet in any directions. Expansion joints should be maintained 60 feet apart through the entire depth of pavement.

2. Hot Mix Asphaltic Concrete: Item 340 of the TxDOT Standard Specifications, Type A or B Base Course (binder), Type D Surface Course. The coarse aggregate in the surface course should be crushed limestone rather than gravel.

3. Portland Cement Concrete: Minimum compressive strength of 3,500 lbs. per sq. inch at 28 days. Concrete should be designed with 3 to 6 percent entrained air.

4. Crushed Limestone Base Material: Item 247 of the TxDOT Standard Specifications, Type A or B, Grade 2 or better. The material should be compacted to a minimum 95 percent of standard Proctor maximum dry density (ASTM D 698) and within ±2 percent of optimum moisture content.

SITE CONSTRUCTION RECOMMENDATIONS

SUBGRADE PREPARATION

The project site is underlain by semi-cohesive or cohesionless Sandy Silt Fill (ML FILL), Silty Clay FILL (CL-ML FILL), Sandy Silt (ML), and Silty Clay (CL-ML) type soils. These soils, underlain by low-permeability clays, can generate perched water condition during wet season, poor site drainage or site geohydrology. These soils become very soft in presence of water presenting an undesirable platform for construction (pumping and rutting). These conditions should be anticipated before commencing the construction operation during wet season. However, these soils can be opened up for natural drying purposes and/or removed and replaced with select fill. Additional subsoil stabilization/improvements may be required if a very aggressive construction schedule is expected.

A portion of the project site is underlain by fill soils to a depth of about 2 feet. These undocumented fill soils should be removed and reworked/replaced. Good site drainage should be maintained during earthwork operations, which would help maintain the integrity of the soil. The surface of the site should be kept properly graded in order to enhance drainage of the surface water away from the proposed building areas during the construction phase. We recommend that an attempt be made to enhance the natural drainage without interrupting its pattern.

The soils at the site are moisture and disturbance sensitive, and contain fines which are considered moderately erodible. Therefore, the contractor should carefully plan his operation to minimize exposure of the subgrade to weather and construction equipment traffic, and provide and maintain good site drainage during earthwork operations to help maintain the integrity of the surficial soils. Erosion and sedimentation shall be controlled in accordance with sound engineering practice and current jurisdictional requirements.

STRIPPING AND GRUBBING

In preparing the site for construction, all loose, poorly compacted existing soils, vegetation, organic soil, foundations or utilities, existing fill material, or other unsuitable materials should be removed from all proposed building and paving areas, and any areas receiving new fill.

PROOFROLLING

After stripping and removing all unsuitable surface materials, cutting to the proposed grade, and prior to the placement of any structural fill, the exposed subgrade should be examined by the Geotechnical Engineer or authorized representative. The exposed subgrade should be thoroughly proof rolled with previously approved construction equipment having a minimum axle load of 25 tons (e.g. fully loaded tandem-axle dump truck). The areas subject to proof rolling should be traversed by the equipment in two perpendicular (orthogonal) directions with overlapping passes of the vehicle under the observation of the Geotechnical Engineer or authorized representative. This procedure is intended to assist in identifying any localized yielding materials. In the event that unstable or "pumping" subgrade is identified by the proof rolling, those areas should be marked for repair prior to the placement of any subsequent structural fill or other construction materials. Methods of repair of unstable subgrade, such as undercutting or moisture conditioning or chemical stabilization, should be discussed with the Geotechnical Engineer to determine the appropriate procedure with regard to the existing conditions causing the instability.

EARTHWORK OPERATIONS

The onsite soil has a tendency to pumping during the construction at wet season. In order to avoid pumping, the surficial soils can either be opened to dry up naturally, or replaced with select fill, or chemically stabilized. If chemical stabilization is selected, Fly Ash can be considered in accordance to TxDOT Specifications, Item 265. For estimating purposes, we recommend that 5 percent (moist subgrade condition) to 10 percent (wet and soggy subgrade condition) fly ash by dry weight may be used for this purpose. The application rate corresponding to this additive amount would be approximately 23 to 45 pounds fly ash per square yard for 'moist subgrade' to 'wet and soggy subgrade' conditions, respectively at every six-inch of compacted thickness.

The subgrade soils should be exposed and stockpiled to a depth of 2 feet (or more) below existing site grade. The soils below a depth of 2 feet should be modified to a depth of 1 foot. These soils should be compacted to a minimum of 95 percent of Standard Proctor density (ASTM D 698). The stockpiled soils should then be modified and replaced in six-inch lifts and compacted to 95 percent of maximum dry density as determined by ASTM D 698 at moisture contents within ±2% of optimum moisture content.

In preparing the site for construction, loose, poorly compacted existing soils, vegetation, tree roots and root balls, organic soil, existing pavements, foundations or utilities, existing fill material, or other unsuitable materials should be removed from proposed structure and paving areas, and areas receiving new fill. After stripping the site and prior to placing fill, we recommend proofrolling the area with heavy construction equipment such as a fully loaded scraper or tandem axle dump truck with a minimum axle load of 25 tons. The purpose of the proofrolling is to attempt to locate soft or compressible soils prior to placing new fill. Unsuitable materials located during proofrolling should be undercut/removed to firm ground and replaced with properly compacted fill.

Prior to placement of new fill, subgrades should be scarified to a minimum depth of 6 inches, moisture conditioned and compacted to at least 95% of Maximum Dry Density as obtained by the Standard Proctor Method (ASTM D 698) moisture conditioned within ±2% of the optimum value.

Soil moisture levels should be preserved (by various methods that can include covering with plastic, watering, etc.) until new fill, pavements or slabs are placed. Fill soils should be placed in 8 inch loose lifts for mass grading operations and 4 inches for trench type excavations where walk behind or “jumping jack” compaction equipment is used.

Upon completion of the filling operations, care should be taken to maintain the soil moisture content prior to construction of floor slabs and pavements. If the soil becomes desiccated, the affected material should be removed and replaced, or these materials should be scarified, moisture conditioned and recompacted.

Utility cuts should not be left open for extended periods of time and should be properly backfilled. Backfilling should be accomplished with properly compacted on-site soils, rather than granular materials. If granular materials are used, a utility trench cut-off at the structure line is recommended to help prevent water from migrating through the utility trench backfill to beneath the proposed structure.

Field density and moisture tests should be performed on each lift as necessary to verify that adequate compaction is achieved. As a guide, one test per 2,500 square feet per lift is recommended in the foundation slab and paving areas (two tests minimum per lift). Utility trench backfill should be tested at a rate of one test per lift per each 150 linear feet of trench (two tests minimum per lift). Certain jurisdictional requirements may require testing in addition to that noted previously. Therefore, these specifications should be reviewed and the more stringent specifications should be followed.

MATERIAL SPECIFICATIONS

Final site grading plan was not available at the time of this report’s preparation. However, we anticipate that imported fill soils may be required to raise the site grade.

For the purposes of this report, select fill soil may consist of imported material that is free of debris and organic matter and have a Plasticity Indices (PI) ranging 8 to 18. Soils classified as CH, MH, ML, SM, GM, OH, OL and Pt in accordance to USCS should not be considered as suitable material as select fill materials. Based on our limited test information performed during the current geotechnical study, we anticipate that some of the native onsite Lean Clay (CL) materials may qualify to be used as select fill material within the structural area. However, the properties of the excavated materials must be verified prior to use as ‘Select Fill’ within the structural area by the representative of Geotechnical Engineer of Record (GER).

Crushed limestone may be used for this purpose. The crushed limestone used for this process should have a minimum Dry Density of 115 pcf. The properties of this material should be evaluated by ECS at the time of construction and will largely be based on the gradation, rather than the PI. The crushed limestone should have a maximum dimension of 1 inch (if used within the final 4 feet of fill) or 4 inches if used deeper than 4 feet below the slab subgrade.

This material should be placed and compacted at workable moisture contents within ±2% of optimum moisture content and compacted to at least 95% of the Maximum Dry Density within the structural and paving area as obtain using the Standard Proctor Method (ASTM D-698).

CONSTRUCTION GROUNDWATER CONTROL

Groundwater was not encountered during field exploration. However, these conditions should be anticipated and can be handled through the use of trenching and pumping. One of the more cost effective techniques that can be utilized is through the prudent utilization of spot drains, and in planning utility installations. For example, any utility installation that requires a gravity feed can be effectively converted into a drainage line to help assist in groundwater control during construction.

If groundwater is encountered during construction of footings or buried utilities, an ECS geotechnical engineer should be consulted to determine if additional permanent drainage provisions are necessary in the design and construction. Groundwater levels should be maintained at least 3 feet below subgrade levels to provide dry working condition and firm bedding. Sump pumping and surface runoff ditches may be adequate for temporary control of surface runoff and groundwater during construction.

The surface of the site should be kept property graded to enhance drainage of surface water away from the proposed construction area during construction. ECS recommends that an attempt be made to enhance the natural drainage without interrupting its pattern.

EXCAVATION

Based on soils strength data, temporary (less than 24 hours), open trenched, non-surcharged and unsupported excavations can be built on a slope flatter than 1.5(h) : 1(v) provided this will not impact the stability of the existing/nearby structures. Flatter slopes may be required in the areas where soft soils or a large amount of sands are encountered. Vertical cuts can be constructed, provided shoring and bracing is used for excavation wall stability. Benched excavation can also be used with average slopes of about 1(h):1(v) and steps should not be higher than five-ft. In all cases, excavation construction should conform to OSHA (Occupational Safety and Health Administration) guidelines.

Excavations should be performed with equipment capable of providing a relatively clean bearing area. Excavation equipment should not disturb the soil beneath the design excavation bottom and should not leave large amounts of loose soil in the excavation. Foundation excavations should be protected against significant change in soil moisture content and disturbance by construction activity. Specification should require that water not be allowed to pond in excavations.

CLOSING

ECS has prepared this report of findings, evaluations, and recommendations to guide geotechnical-related design and construction aspects of the project.

The description of the proposed project is based on information provided to ECS by Triad Real Estate Consultants, LLC. If any of this information is inaccurate, either due to our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted immediately in order that we can review the report in light of the changes and provide additional or alternate recommendations as may be required to reflect the proposed construction.

We recommend that ECS be allowed to review the project’s plans and specifications pertaining to our work so that we may ascertain consistency of those plans/specifications with the intent of the geotechnical report.

Field observations, monitoring, and quality assurance testing during earthwork and foundation installation are an extension of and integral to the geotechnical design recommendation. We recommend that the owner retain these quality assurance services and that ECS be allowed to continue our involvement throughout these critical phases of construction to provide general consultation as issues arise. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

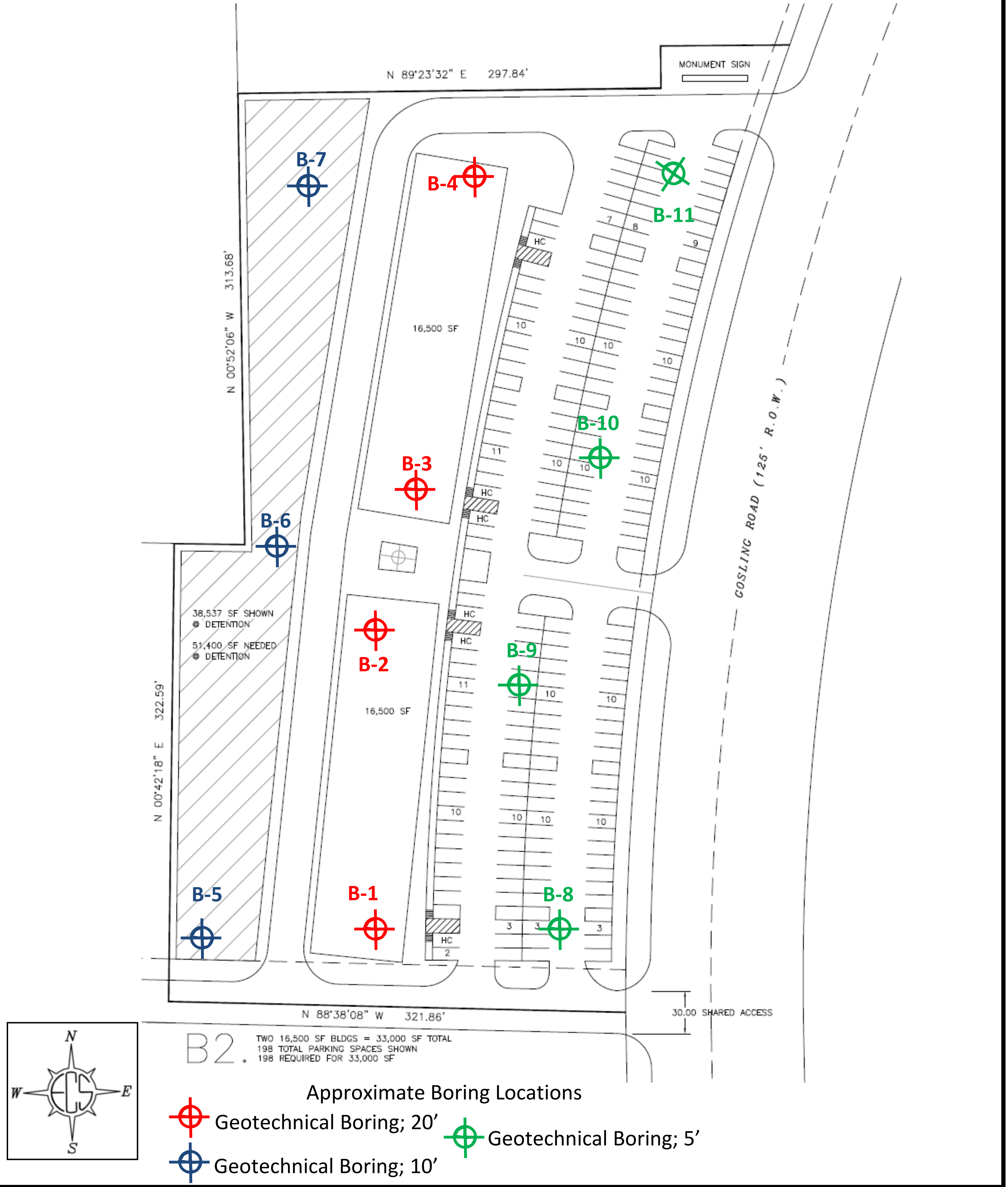
APPENDIX A – Figures

Site Location Map
Boring Location Diagram
Regional Geology
Aerial Photograph – 2017
Aerial Photograph – 2012
Aerial Photograph – 2007
Topographic Map

Site Location Map
Retail Center - Gosling Road
Near Gosling Road and Dovershire Drive
Spring, Texas

ECS SOUTHWEST, LLP
1050 North Post Oak Road, Suite 130
Houston, Texas 77055

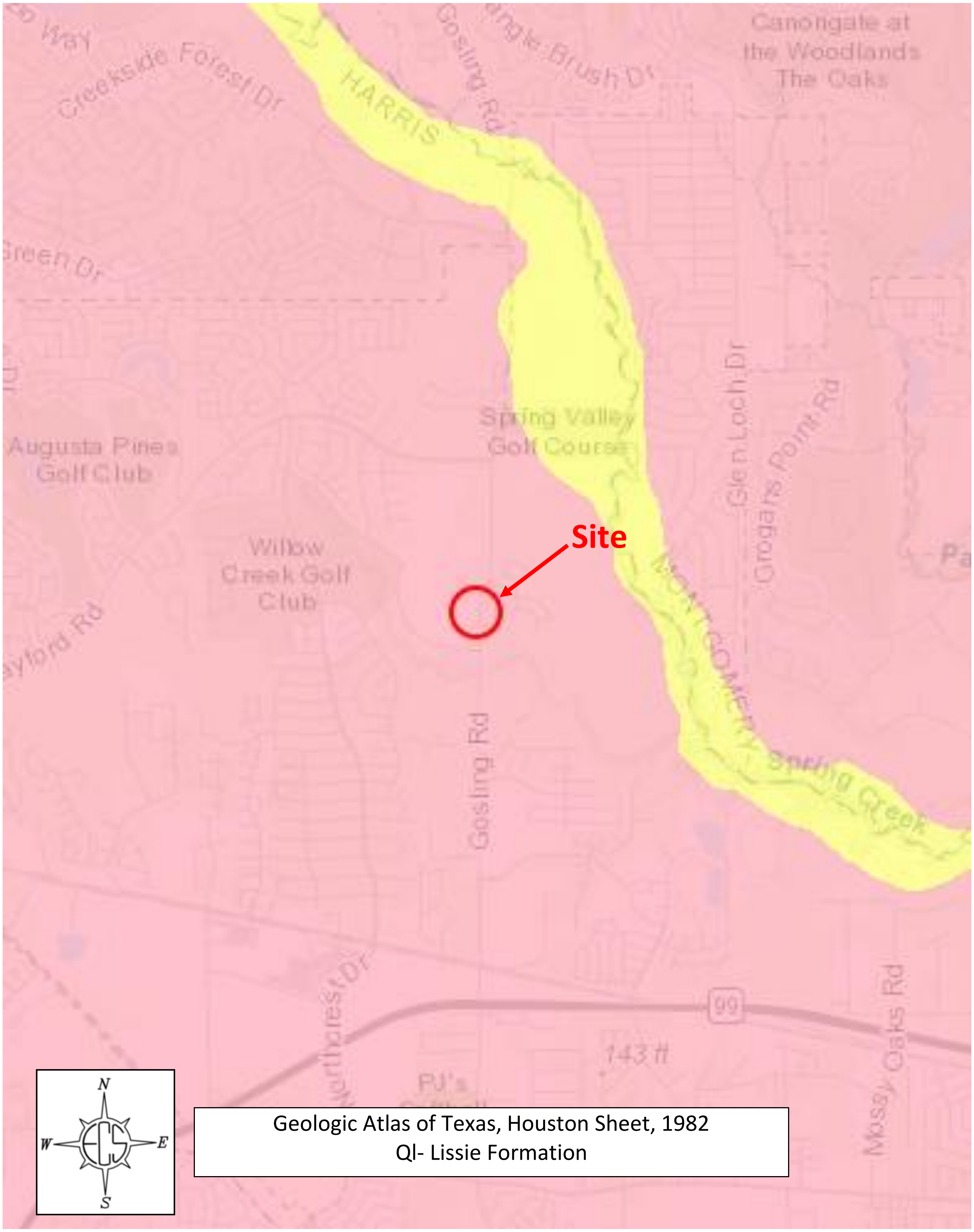
	Scale: NTS	PROJECT NO: 43:1552
PM: DRB	Date: 09/12/2018	FIGURE: TRC



Boring Location Diagram
Retail Center - Gosling Road
Near Gosling Road and Dovershire Drive
Spring, Texas

ECS SOUTHWEST, LLP
1050 North Post Oak Road, Suite 130
Houston, Texas 77055

	Scale: NTS	PROJECT NO: 43:1552
PM: DRB	Date: 09/12/2018	FIGURE: TRC



Geologic Atlas of Texas, Houston Sheet, 1982
Ql- Lissie Formation

Regional Geology Map
Retail Center - Gosling Road
Near Gosling Road and Dovershire Drive
Spring, Texas

ECS SOUTHWEST, LLP
1050 North Post Oak Road, Suite 130
Houston, Texas 77055

Scale: NTS
PROJECT NO: 43: 1552
PM: BJB
Date: 09/12/2018
FIGURE: TRC

Aerial Photograph- 2017

Retail Center - Gosling Road
Near Gosling Road and Dovershire Drive
Spring, Texas

ECS SOUTHWEST, LLP
1050 North Post Oak Road, Suite 130
Houston, Texas 77055

	Scale: NTS	PROJECT NO: 43:1552
PM: DRB	Date: 09/12/2018	FIGURE: TRC

Aerial Photograph - 2012

Retail Center - Gosling Road
Near Gosling Road and Dovershire Drive
Spring, Texas

ECS SOUTHWEST, LLP
1050 North Post Oak Road, Suite 130
Houston, Texas 77055

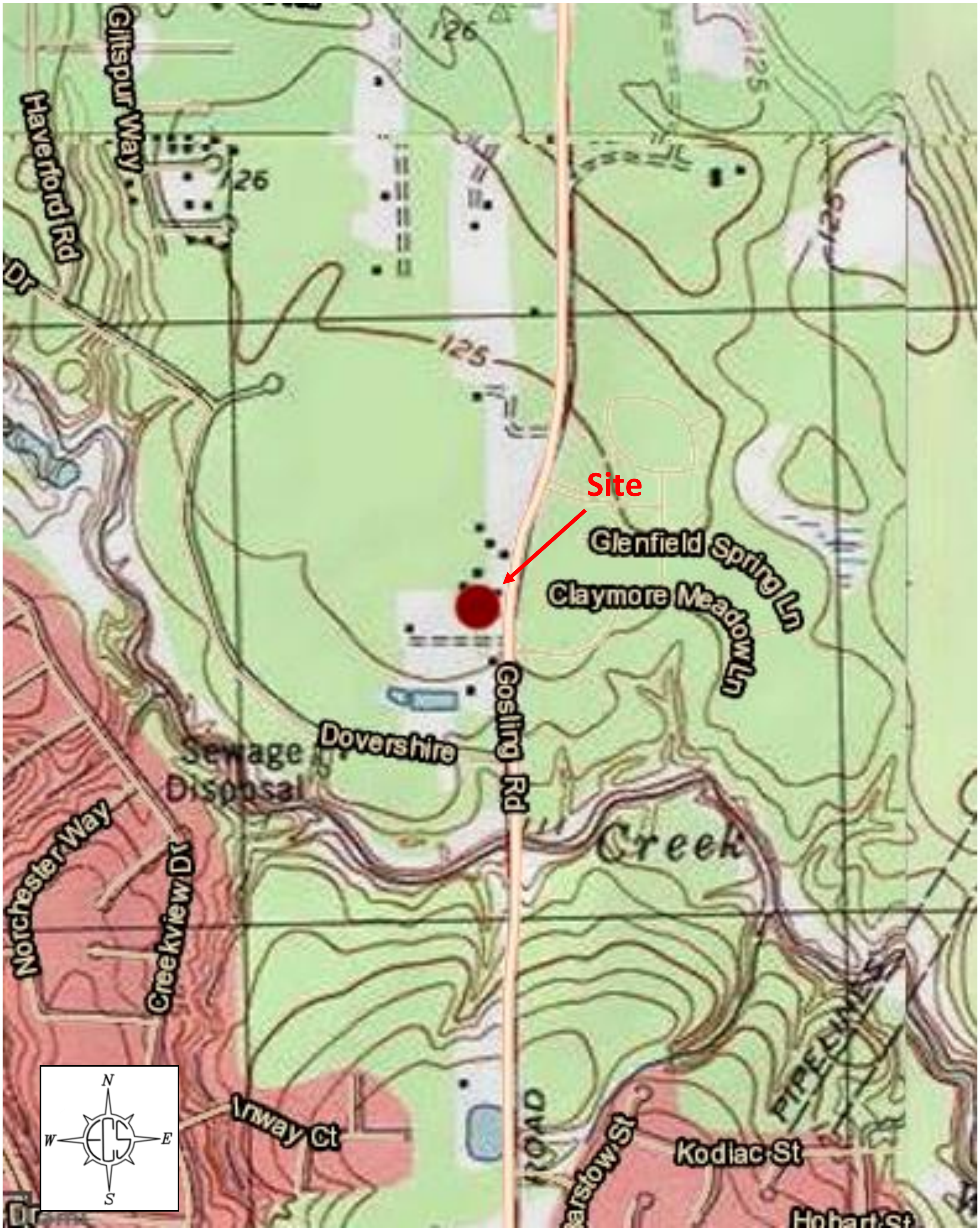
Scale: NTS
PROJECT NO: 43:1552
PM: DRB
Date: 09/12/2018
FIGURE: TRC

Aerial Photograph- 2007

Retail Center - Gosling Road
Near Gosling Road and Dovershire Drive
Spring, Texas

ECS SOUTHWEST, LLP
1050 North Post Oak Road, Suite 130
Houston, Texas 77055

	Scale: NTS	PROJECT NO: 43:1552
PM: DRB	Date: 09/12/2018	FIGURE: TRC



Topography Map
Retail Center - Gosling Road
Near Gosling Road and Dovershire Drive
Spring, Texas

ECS SOUTHWEST, LLP
1050 North Post Oak Road, Suite 130
Houston, Texas 77055

Scale: NTS
PROJECT NO: 43:1552
PM: DRB
Date: 09/12/2018
FIGURE: TRC

Appendix B – Field Operations

Reference Notes for Boring Logs
Unified Soil Classification System
Boring Logs B-1 through B-11

REFERENCE NOTES FOR BORING LOGS

MATERIALS[1,2]

■	**ASPHALT**	
▨	**CONCRETE**	
▨	**GRAVEL**	
▨	**TOPSOIL**	
□	**VOID**	
▦	**BRICK**	
▨	**ABC STONE**	
▨	**FILL**[3]	Man-placed or disturbed soils
▨	**GW**	**WELL-GRADED GRAVEL** gravel-sand mixtures, little or no fines
▨	**GP**	**POORLY-GRADED GRAVEL** gravel-sand mixtures, little or no fines
▨	**GM**	**SILTY GRAVEL** gravel-sand-silt mixtures
▨	**GC**	**CLAYEY GRAVEL** gravel-sand-clay mixtures
▨	**SW**	**WELL-GRADED SAND** gravelly sand, little or no fines
▨	**SP**	**POORLY-GRADED SAND** gravelly sand, little or no fines
▨	**SM**	**SILTY SAND** sand-silt mixtures
▨	**SC**	**CLAYEY SAND** sand-clay mixtures
▥	**ML**	**SILT** non-plastic to medium plasticity
▥	**MH**	**ELASTIC SILT** high plasticity
▨	**CL**	**LEAN CLAY** low to medium plasticity
▨	**CH**	**FAT CLAY** high plasticity
▨	**OL**	**ORGANIC SILT or CLAY** non-plastic to low plasticity
■	**OH**	**ORGANIC SILT or CLAY** high plasticity
▨	**PT**	**PEAT** highly organic soils
+	**IGNEOUS ROCK**	
▨	**METAMORPHIC ROCK**	
▦	**SEDIMENTARY ROCK**	

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

WATER LEVELS[4]

▽	WL	Water Level (WS)(WD) (WS) While Sampling (WD) While Drilling
▽	SHW	Seasonal High WL
▼	ACR	After Casing Removal
▽	WL	Water Level as stated
	DCI	Dry Cave-In
	WCI	Wet Cave-In

RELATIVE PROPORTIONS	COARSE GRAINED	FINE GRAINED
Trace	<5%	<5%
Dual Symbol *(ex: SW-SM)*	10%	
With	15% - 20%	15%-25%
Adjective *(ex: "Silty")*	25% - <50%	30% - <50%

COHESIVE SILTS & CLAYS

UNCONFINED COMP. STRENGTH, Q_P[5] (TSF)	SPT[6] (BPF)	CONSISTENCY (COHESIVE
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Medium Stiff
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[6]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
51 - 99	Very Dense
100+	Partially Weathered Rock to Intact Rock

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[1] Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.

[2] To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types.

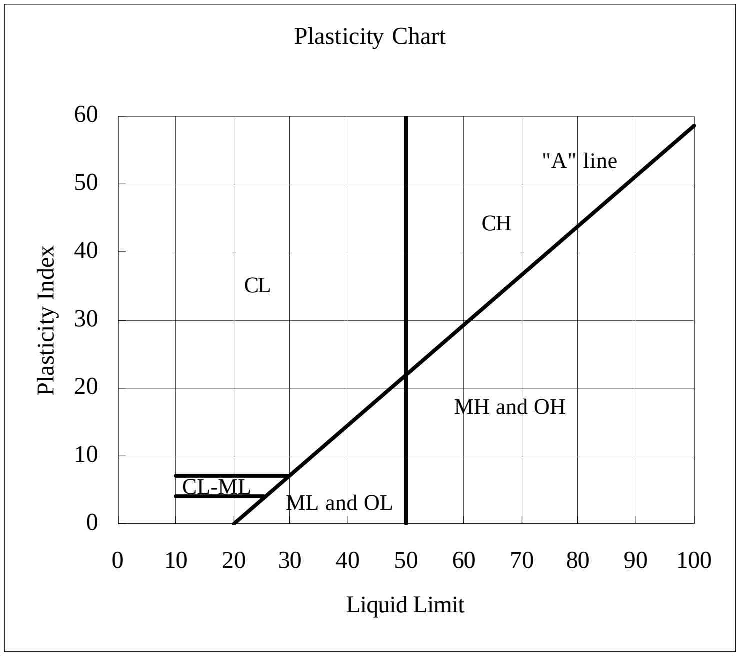
[3] Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-***FILL***)].

[4] The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally taken.

[5] Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[6] Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

Major Divisions			Group Symbols		Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is larger than No. 200 Sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	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 [b]	$C_u = D_{60}/D_{10}$ greater than 4 $C_c = (D_{30})^2/(D_{10}xD_{60})$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand mixtures		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
				u				
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line or P.I. less than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ greater than 6 $C_c = (D_{30})^2/(D_{10}xD_{60})$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or P.I. less than 4	Limits plotting in CL-ML zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 Sieve)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or 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 greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly Organic soils		Pt		Peat and other highly organic soils			

[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder. (From Table 2.16 - Winterkorn and Fang, 1975)

CLIENT	Job #:	BORING #	SHEET
Triad Real Estate Consulting Group, LLC	43:1552	B-1	1 OF 1

PROJECT NAME: Retail Center - Gosling Road

ARCHITECT-ENGINEER:

SITE LOCATION: Near Gosling Road and Dovershire Drive, Spring, TX

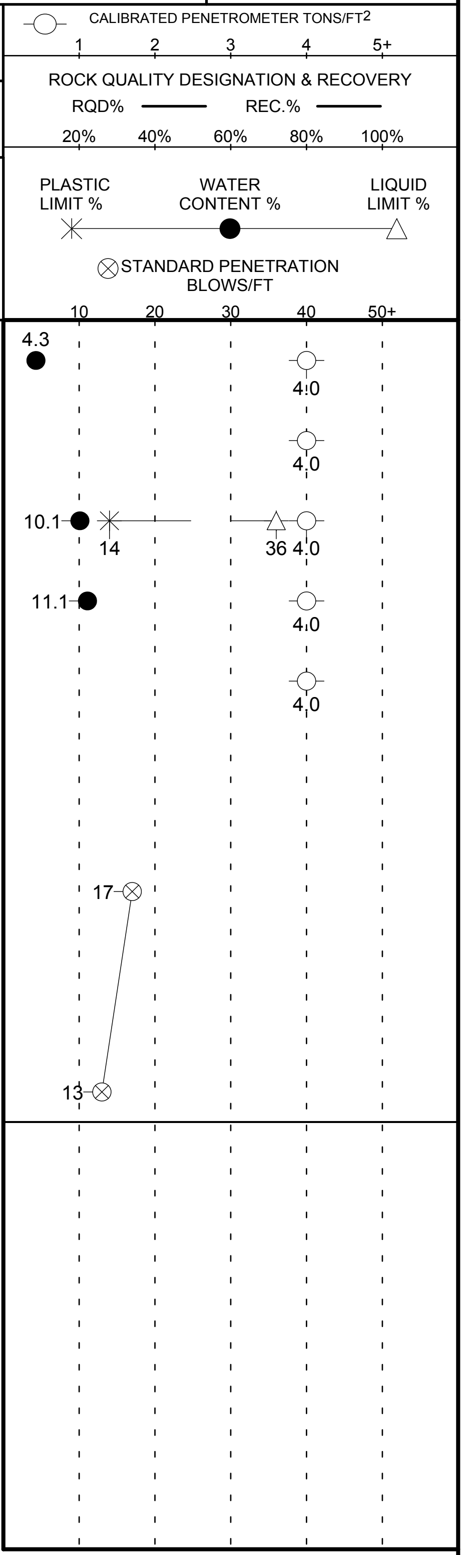
NORTHING: EASTING: STATION:

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 121

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	ST	24	24	(ML) SANDY SILT, brown, light gray, hard, with roots		120	
	S-2	ST	24	24	(CL-ML) SILTY SANDY CLAY, dark brown, hard, with roots			
5	S-3	ST	24	24	(CL) LEAN CLAY, brown, light brown, tan, reddish-brown, hard, with silt and ferrous nodules		115	
	S-4	ST	24	24	***- Dry Unit Weight = 124.8 pcf & Su = 3.7 tsf***			
	S-5	ST	24	24				
10					(SM) SILTY SAND, tan, light brown, medium dense		110	
	S-6	ST	18	18				7 8 9
15							105	
	S-7	ST	18	18				6 6 7
20					END OF BORING @ 20'		100	
25							95	
30								



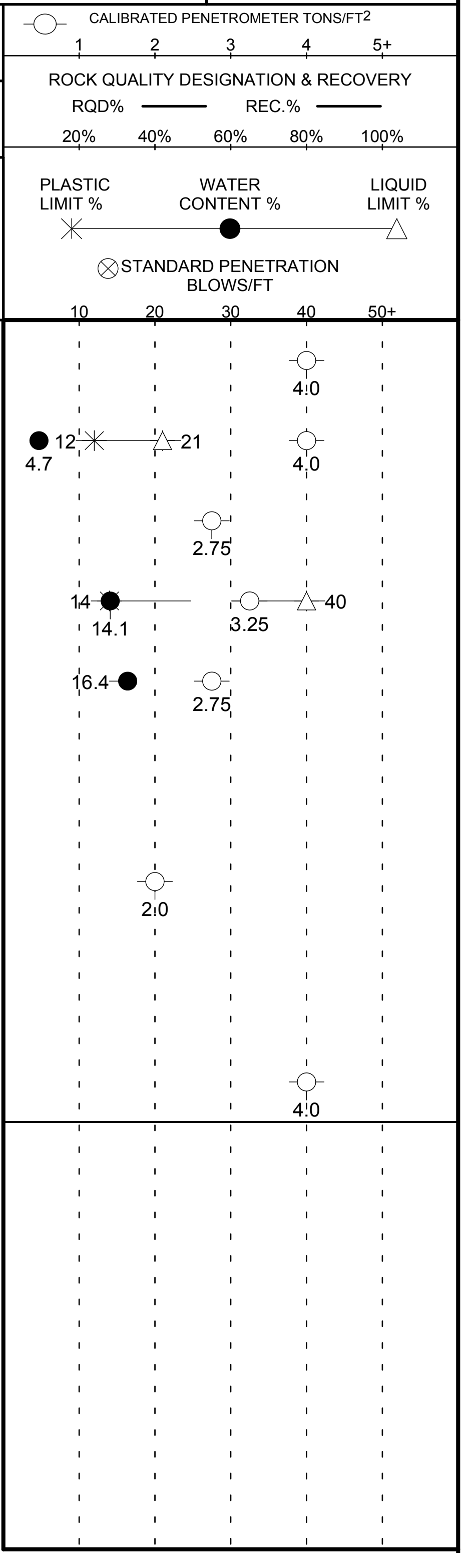
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 08/29/18	CAVE IN DEPTH
WL(SHW) WL(ACR)	BORING COMPLETED 08/29/18	HAMMER TYPE Manual
WL Dry 15 mins.	RIG Truck FOREMAN HDC	DRILLING METHOD ASTM D 1586 & ASTM D 1587

CLIENT Triad Real Estate Consulting Group, LLC
Job #: 43:1552
BORING # B-2
SHEET 1 OF 1
PROJECT NAME Retail Center - Gosling Road
ARCHITECT-ENGINEER
SITE LOCATION Near Gosling Road and Dovershire Drive, Spring, TX
NORTHING
EASTING
STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING — LOSS OF CIRCULATION
SURFACE ELEVATION 122

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	ST	24	24	(CL-ML FILL) SILTY SANDY CLAY, dark brown, reddish-brown, hard, with roots			
							120	
	S-2	ST	24	24	(CL) LEAN CLAY, light brown, tan, light gray, reddish-brown, very stiff to hard, with silt, sand, and ferrous nodules			
5	S-3	ST	24	24				
	S-4	ST	24	24			115	
	S-5	ST	24	24	***- Dry Unit Weight = 115.0 pcf & Su = 1.14 tsf***			
10								
							110	
	S-6	ST	24	24				
15								
							105	
	S-7	ST	24	24				
20					END OF BORING @ 20'			
							100	
25								
							95	
30								



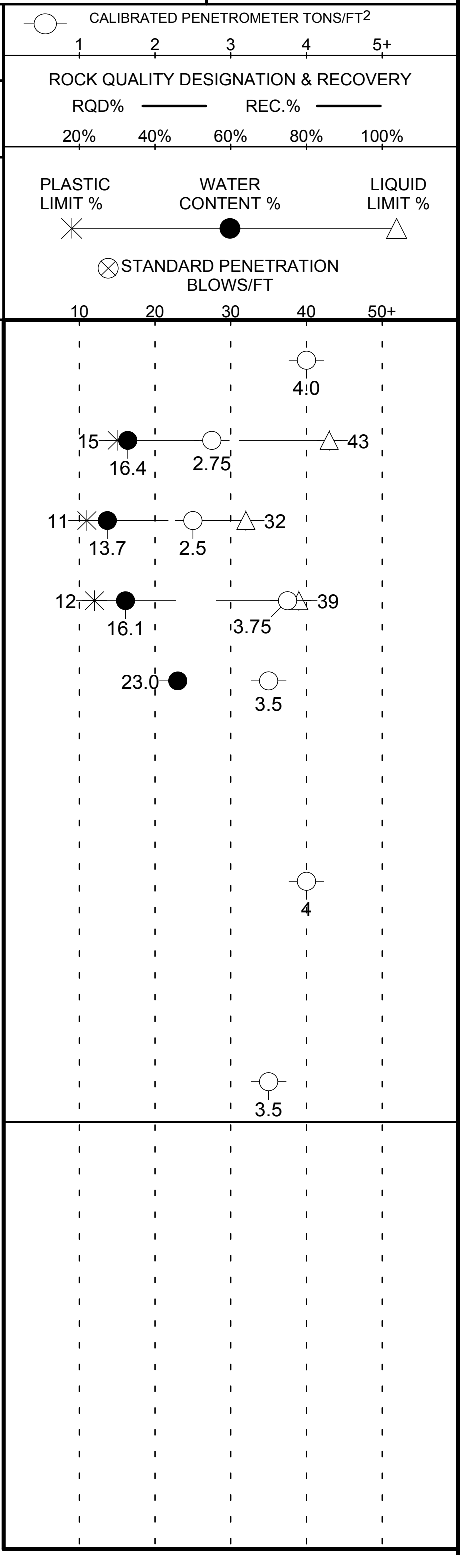
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒
BORING STARTED 08/29/18
CAVE IN DEPTH
WL(SHW) WL(ACR)
BORING COMPLETED 08/29/18
HAMMER TYPE Manual
WL Dry 15 mins.
RIG Truck FOREMAN HDC
DRILLING METHOD ASTM D 1587

CLIENT: Triad Real Estate Consulting Group, LLC
Job #: 43:1552
BORING #: B-3
SHEET: 1 OF 1
PROJECT NAME: Retail Center - Gosling Road
ARCHITECT-ENGINEER:
SITE LOCATION: Near Gosling Road and Dovershire Drive, Spring, TX
NORTHING:
EASTING:
STATION:

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING — LOSS OF CIRCULATION
SURFACE ELEVATION 123

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL
S-1	ST	24	24	(ML FILL) SANDY SILT, dark brown, tan, hard, with roots
S-2	ST	24	24	(CL) LEAN CLAY, dark gray, reddish-brown, light brown, very stiff, with roots, sand, silt, and ferrous nodules
S-3	ST	24	24	
S-4	ST	24	24	
S-5	ST	24	24	(CH) FAT CLAY, light gray, tan, dark brown, very stiff to hard, with roots, sand, and ferrous nodules ***- Dry Unit Weignt = 104.3 pcf & Su = 1.0 tsf***
S-6	ST	24	24	
S-7	ST	24	24	
				END OF BORING @ 20'



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒
BORING STARTED 08/29/18
CAVE IN DEPTH
WL(SHW) WL(ACR)
BORING COMPLETED 08/29/18
HAMMER TYPE Manual
WL Dry 15 mins.
RIG Truck
FOREMAN HDC
DRILLING METHOD ASTM D 1587

CLIENT
Triad Real Estate Consulting Group, LLC

Job #: 43:1552

BORING # B-4

SHEET 1 OF 1

PROJECT NAME
Retail Center - Gosling Road

ARCHITECT-ENGINEER

SITE LOCATION
Near Gosling Road and Dovershire Drive, Spring, TX

NORTHING

EASTING

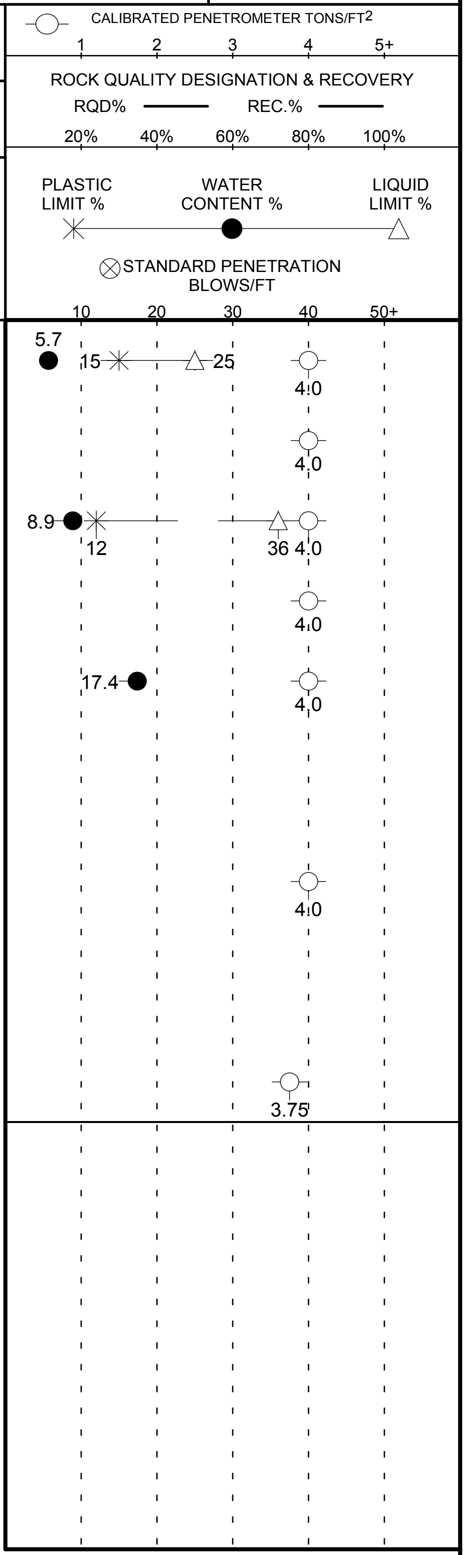
STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➡ LOSS OF CIRCULATION

SURFACE ELEVATION 123

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	ST	24	24	(CL FILL) LEAN CLAY, light brown, dark brown, hard, with roots			
	S-2	ST	24	24	(CL) LEAN CLAY, light gray, light brown, dark brown, tan, reddish-brown, very stiff to hard, with roots and ferrous nodules		120	
5	S-3	ST	24	24				
	S-4	ST	24	24				
							115	
	S-5	ST	24	24	***- Dry Unit Weignt = 118.6 pcf & Su = 5.5 tsf***			
10								
							110	
	S-6	ST	24	24				
15								
							105	
	S-7	ST	24	24				
20					END OF BORING @ 20'			
							100	
25								
							95	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 08/29/18	CAVE IN DEPTH
WL(SHW) WL(ACR)	BORING COMPLETED 08/29/18	HAMMER TYPE Manual
WL Dry 15 mins.	RIG Truck FOREMAN HDC	DRILLING METHOD ASTM D 1587

CLIENT
Triad Real Estate Consulting Group, LLC

Job #: 43:1552

BORING # B-5

SHEET 1 OF 1

PROJECT NAME
Retail Center - Gosling Road

ARCHITECT-ENGINEER

SITE LOCATION
Near Gosling Road and Dovershire Drive, Spring, TX

NORTHING

EASTING

STATION

CALIBRATED PENETROMETER TONS/FT2 — 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY
RQD% ——— REC.% ———
20% 40% 60% 80% 100%

PLASTIC LIMIT % ✳ — WATER CONTENT % ● — LIQUID LIMIT % △

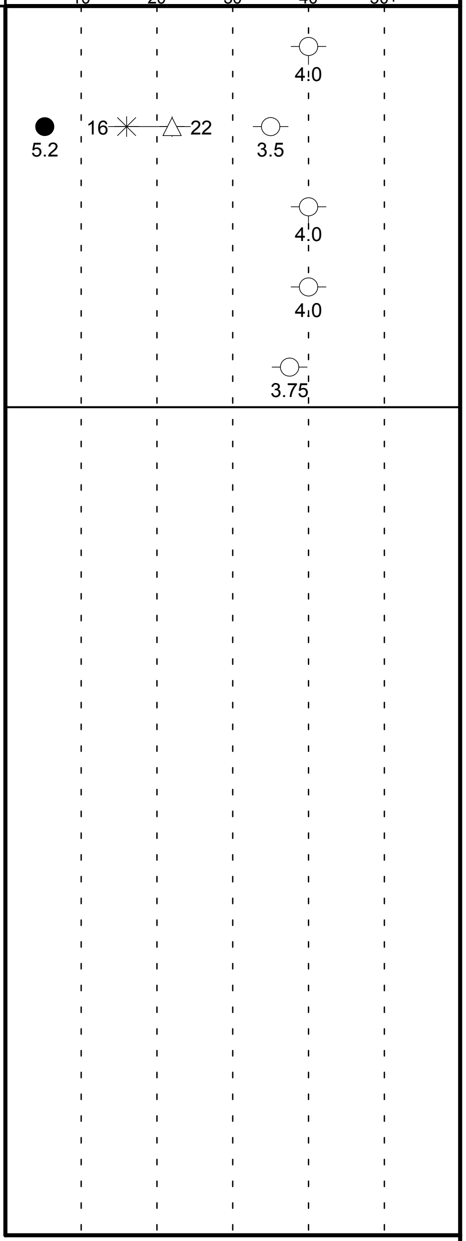
⊗ STANDARD PENETRATION BLOWS/FT
10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 121

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0								
	S-1	ST	24	24	(CL-ML) SILTY SANDY CLAY, light brown, dark brown, very stiff to hard, with roots		120	
	S-2	ST	24	24				
5	S-3	ST	24	24	(CL) LEAN CLAY, light brown, reddish-brown, very stiff to hard, with sand and ferrous nodules			
							115	
	S-4	ST	24	24				
	S-5	ST	24	24				
10					END OF BORING @ 10'			
							110	
15								
							105	
20								
							100	
25								
							95	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 08/29/18	CAVE IN DEPTH
WL(SHW) WL(ACR)	BORING COMPLETED 08/29/18	HAMMER TYPE Manual
WL Dry 15 mins.	RIG Truck FOREMAN HDC	DRILLING METHOD ASTM D 1587

CLIENT
Triad Real Estate Consulting Group, LLC

Job #: 43:1552

BORING # B-6

SHEET 1 OF 1

PROJECT NAME
Retail Center - Gosling Road

ARCHITECT-ENGINEER

SITE LOCATION
Near Gosling Road and Dovershire Drive, Spring, TX

NORTHING

EASTING

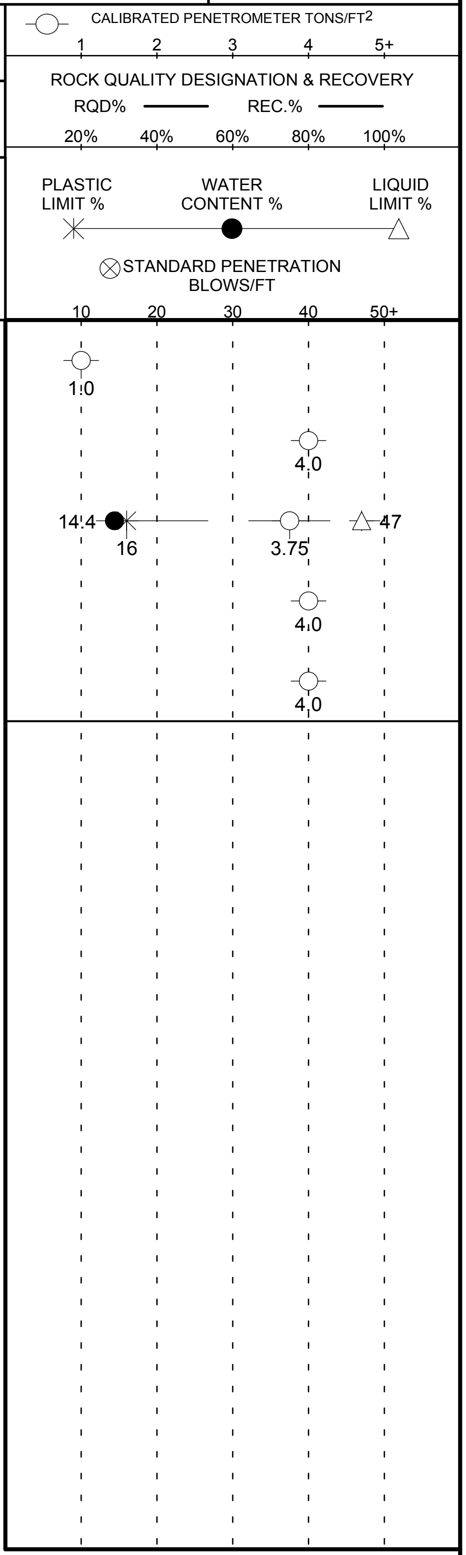
STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ — LOSS OF CIRCULATION ⟫100%⟫

SURFACE ELEVATION 122

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	ST	24	24	(ML FILL) SANDY SILT, dark brown, light brown, stiff, with roots			
							120	
	S-2	ST	24	24	(CL) LEAN CLAY, light brown, reddish-brown, very stiff to hard, with roots, sand, and ferrous nodules			
5	S-3	ST	24	24				
	S-4	ST	24	24			115	
	S-5	ST	24	24				
10					END OF BORING @ 10'			
							110	
15								
							105	
20								
							100	
25								
							95	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 08/29/18	CAVE IN DEPTH
WL(SHW) WL(ACR)	BORING COMPLETED 08/29/18	HAMMER TYPE Manual
WL Dry 15 mins.	RIG Truck FOREMAN HDC	DRILLING METHOD ASTM D 1587

CLIENT
Triad Real Estate Consulting Group, LLC

Job #: 43:1552

BORING # B-7

SHEET 1 OF 1

PROJECT NAME
Retail Center - Gosling Road

ARCHITECT-ENGINEER

SITE LOCATION
Near Gosling Road and Dovershire Drive, Spring, TX

NORTHING

EASTING

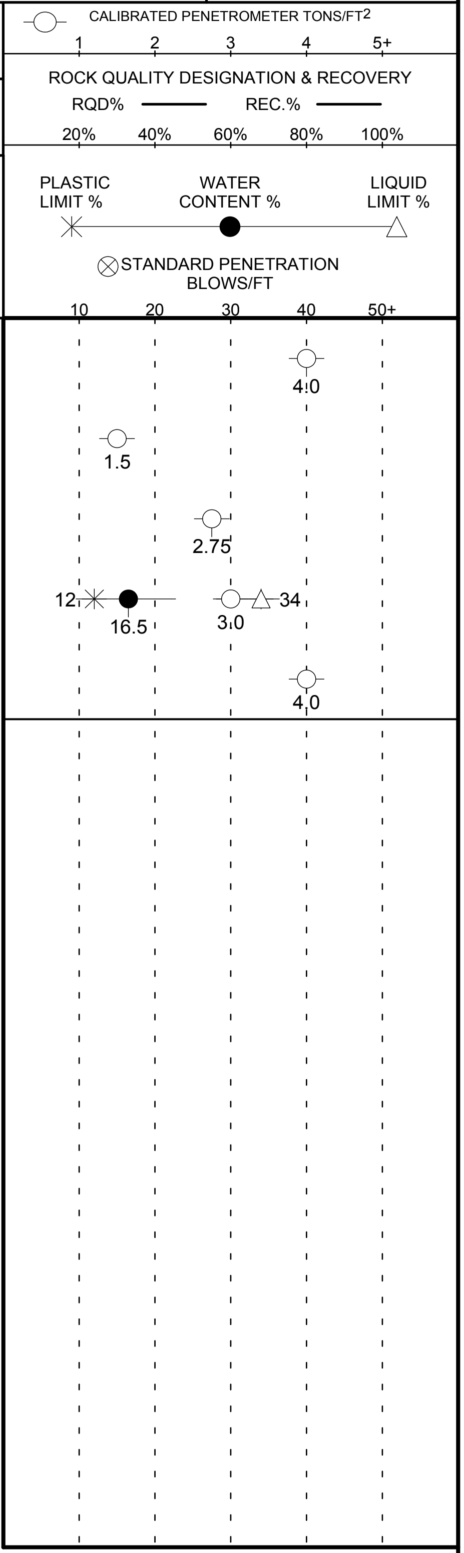
STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION 100%

SURFACE ELEVATION 122

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	ST	24	24	(CL-ML) SILTY SANDY CLAY, dark gray, reddish-brown, hard, with roots			
	S-2	ST	24	24	(CL) LEAN CLAY, dark gray, light brown, reddish-brown, stiff to hard, with sand, silt and ferrous nodules		120	
5	S-3	ST	24	24				
	S-4	ST	24	24			115	
	S-5	ST	24	24				
10					END OF BORING @ 10'			
							110	
15								
							105	
20								
							100	
25								
							95	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒

BORING STARTED 08/29/18

CAVE IN DEPTH

WL(SHW) WL(ACR)

BORING COMPLETED 08/29/18

HAMMER TYPE Manual

WL Dry 15 mins.

RIG Truck FOREMAN HDC

DRILLING METHOD ASTM D 1587

CLIENT
Triad Real Estate Consulting Group, LLC

Job #: 43:1552

BORING # B-8

SHEET 1 OF 1

PROJECT NAME
Retail Center - Gosling Road

ARCHITECT-ENGINEER

SITE LOCATION
Near Gosling Road and Dovershire Drive, Spring, TX

NORTHING

EASTING

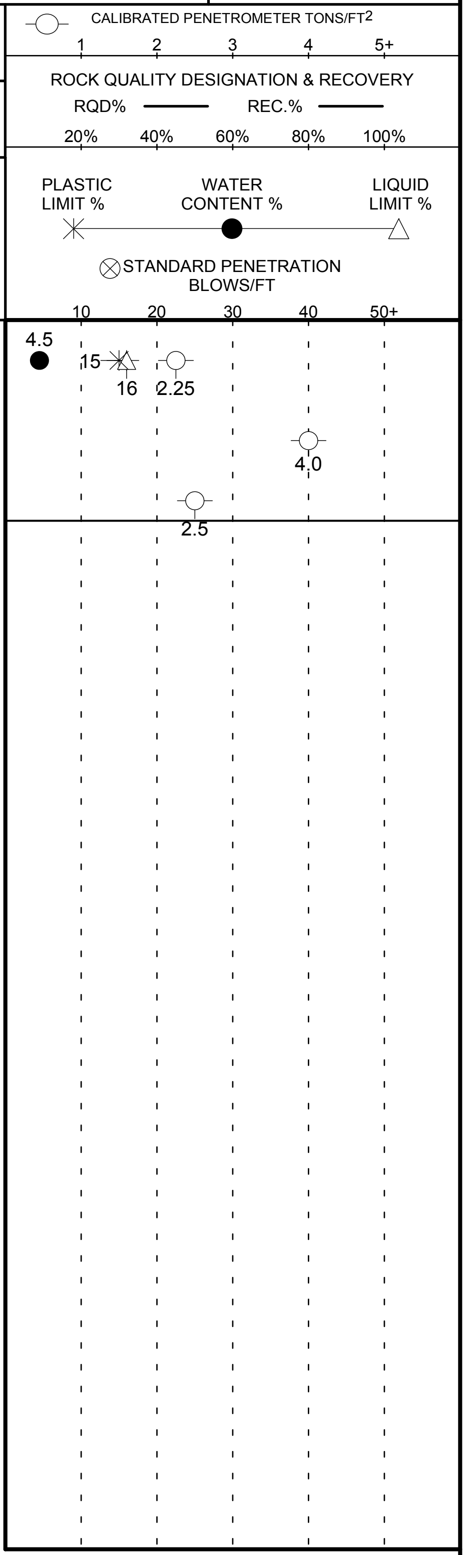
STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 120

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	ST	24	24	(ML FILL) SANDY SILT, dark brown, tan, very stiff, with roots		120	
	S-2	ST	24	24	(CL) LEAN CLAY, dark brown, tan, very stiff to hard, with roots			
	S-3	ST	12	12				
5					END OF BORING @ 5'		115	
10							110	
15							105	
20							100	
25							95	
30							90	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒

BORING STARTED 08/29/18

CAVE IN DEPTH

WL(SHW) WL(ACR)

BORING COMPLETED 08/29/18

HAMMER TYPE Manual

WL Dry 15 mins.

RIG Truck FOREMAN HDC

DRILLING METHOD ASTM D 1587

CLIENT Triad Real Estate Consulting Group, LLC	Job #: 43:1552	BORING # B-9	SHEET 1 OF 1
PROJECT NAME Retail Center - Gosling Road	ARCHITECT-ENGINEER		

SITE LOCATION
Near Gosling Road and Dovershire Drive, Spring, TX

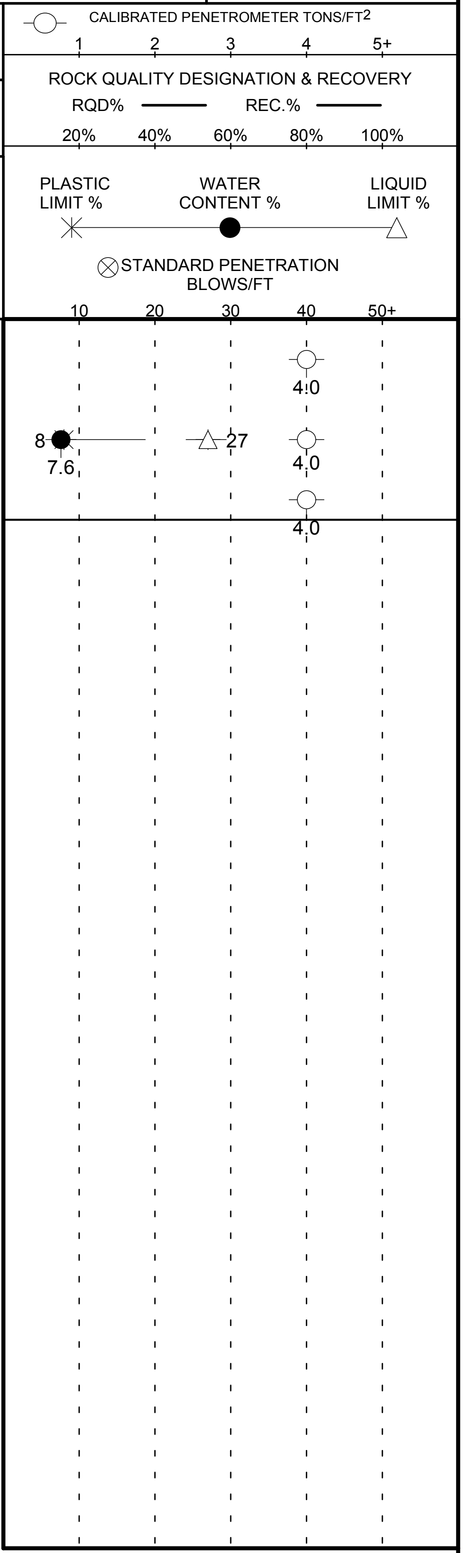
NORTHING
EASTING
STATION

ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 122

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	ST	24	24	(ML FILL) SANDY SILT, brown, dark brown, hard, with roots and wood			
	S-2	ST	24	24	(CL) LEAN CLAY, light brown, dark brown, reddish-brown, hard, with roots		120	
	S-3	ST	12	12				
5					END OF BORING @ 5'			
10							115	
15							110	
20							105 100	
25							95	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 08/29/18	CAVE IN DEPTH
WL(SHW) WL(ACR)	BORING COMPLETED 08/29/18	HAMMER TYPE Manual
WL Dry 15 mins.	RIG Truck FOREMAN HDC	DRILLING METHOD ASTM D 1587

CLIENT	Job #:	BORING #	SHEET
Triad Real Estate Consulting Group, LLC	43:1552	B-10	1 OF 1

PROJECT NAME: Retail Center - Gosling Road

ARCHITECT-ENGINEER:

SITE LOCATION: Near Gosling Road and Dovershire Drive, Spring, TX

NORTHING:

EASTING:

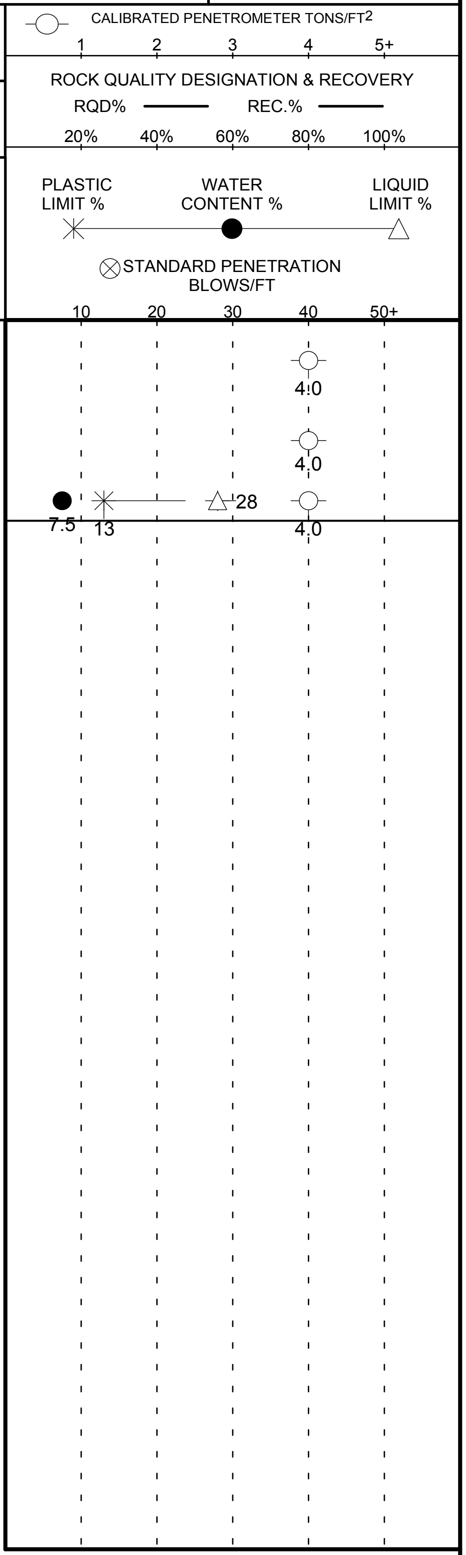
STATION:

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ — LOSS OF CIRCULATION

SURFACE ELEVATION 123

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	ST	24	24	(ML FILL) SANDY SILT, dark brown, reddish-brown, light brown, hard, with roots			
	S-2	ST	24	24	(CL) LEAN CLAY, dark brown, reddish-brown, light brown, hard, with roots		120	
	S-3	ST	12	12				
5					END OF BORING @ 5'			
							115	
10								
							110	
15								
							105	
20								
							100	
25								
							95	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 08/29/18	CAVE IN DEPTH
WL(SHW) WL(ACR)	BORING COMPLETED 08/29/18	HAMMER TYPE Manual
WL Dry 15 mins.	RIG Truck FOREMAN HDC	DRILLING METHOD ASTM D 1587

CLIENT	Job #:	BORING #	SHEET
Triad Real Estate Consulting Group, LLC	43:1552	B-11	1 OF 1

PROJECT NAME: Retail Center - Gosling Road

ARCHITECT-ENGINEER:

SITE LOCATION: Near Gosling Road and Dovershire Drive, Spring, TX

NORTHING:

EASTING:

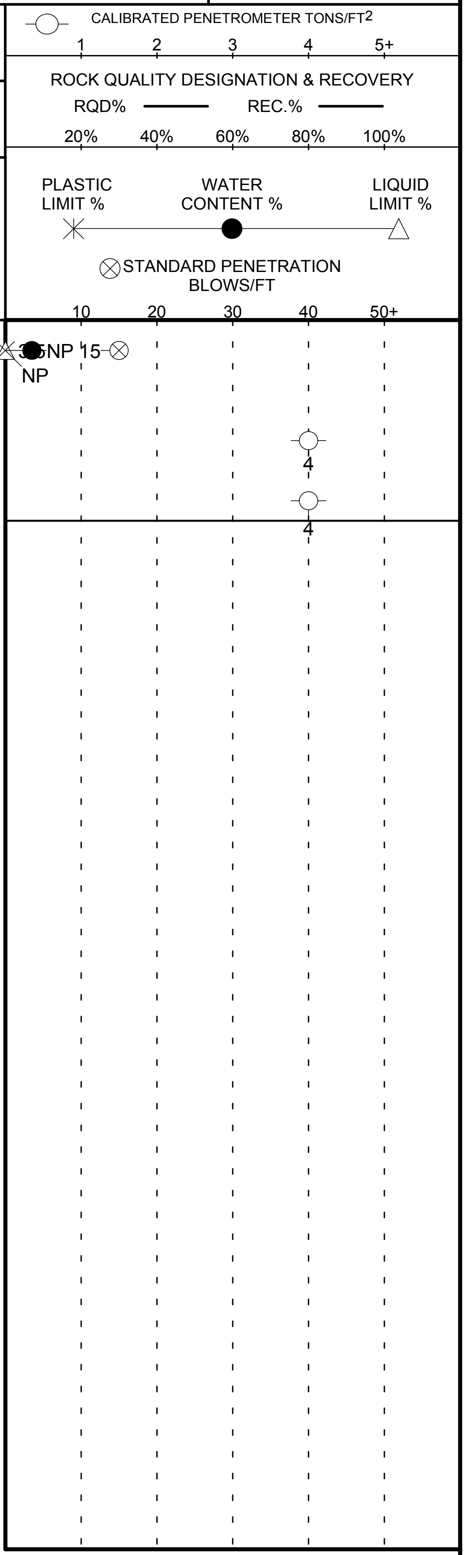
STATION:

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 123

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	(ML) SANDY SILT, dark brown, medium dense, with roots			4 7 8
	S-2	ST	24	24	(CL) LEAN CLAY, light brown, reddish-brown, hard, with ferrous nodules		120	
	S-3	ST	12	12				
5					END OF BORING @ 5'			
10							115	
15							110	
20							105	
25							100	
30							95	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 08/29/18	CAVE IN DEPTH
WL(SHW) WL(ACR)	BORING COMPLETED 08/29/18	HAMMER TYPE Manual
WL Dry 15 mins.	RIG Truck FOREMAN HDC	DRILLING METHOD ASTM D 1587

Appendix C – Laboratory Testing

Laboratory Testing Summary

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-1												
	S-1	0.00 - 2.00	4.3	ML				90.9				
	S-3	4.00 - 6.00	10.1	CL	36	14	22					
	S-4	6.00 - 8.00	11.1	CL								
B-2												
	S-2	2.00 - 4.00	4.7	CL	21	12	9	74.9				
	S-4	6.00 - 8.00	14.1	CL	40	14	26					
	S-5	8.00 - 10.00	16.4	CL								
B-3												
	S-2	2.00 - 4.00	16.4	CL	43	15	28	91.9				
	S-3	4.00 - 6.00	13.7	CL	32	11	21					
	S-4	6.00 - 8.00	16.1	CL	39	12	27					
	S-5	8.00 - 10.00	23.0	CH								
B-4												
	S-1	0.00 - 2.00	5.7	CL FILL	25	15	10	94.6				
	S-3	4.00 - 6.00	8.9	CL	36	12	24					
	S-5	8.00 - 10.00	17.4	CL								
B-5												
	S-2	2.00 - 4.00	5.2	CL-ML	22	16	6	92.5				
B-6												
	S-3	4.00 - 6.00	14.4	CL	47	16	31	78.1				
B-7												
	S-4	6.00 - 8.00	16.5	CL	34	12	22					
B-8												
	S-1	0.00 - 2.00	4.5	ML FILL	16	15	1	76.4				
B-9												
	S-2	2.00 - 4.00	7.6	CL	27	8	19					
B-10												

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No. 43:1552
Project Name: Retail Center - Gosling Road
PM: BJB
PE: SRM
Printed On: Monday, September 10, 2018

ECS SOUTHWEST, LLP
1050 North Post Oak Road, Suite 130
Houston, TX 77055
Phone: (713) 955-1980
Fax: (281) 520-4367

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC1 (%)	Soil Type2	Atterberg Limits3			Percent Passing No. 200 Sieve4	Moisture - Density (Corr.)5		CBR Value6	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
	S-3	4.00 - 5.00	7.5	CL	28	13	15					
B-11												
	S-1	0.00 - 1.50	3.5	ML	NP	NP	NP					

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No. 43:1552
Project Name: Retail Center - Gosling Road
PM: BJB
PE: SRM
Printed On: Monday, September 10, 2018

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