

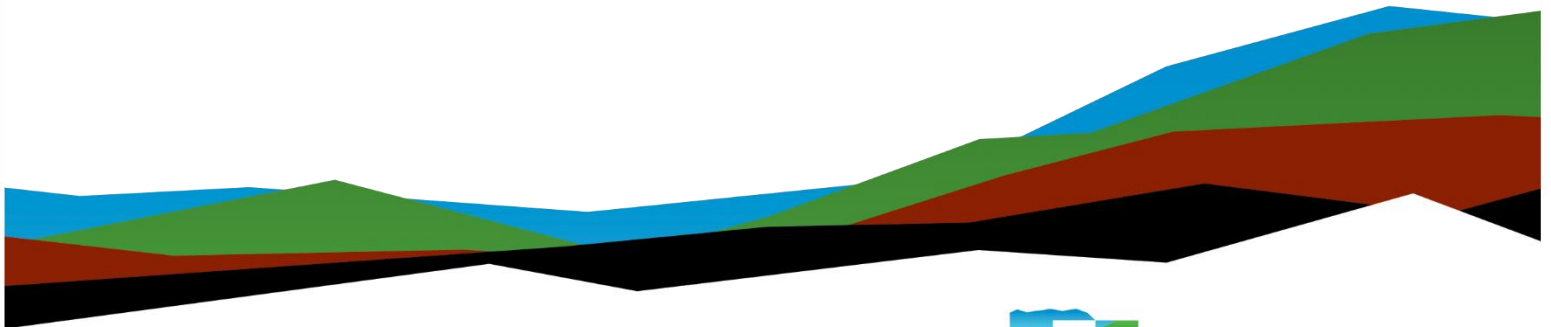
Creekside - Retail 25B

Geotechnical Engineering Report

August 13, 2024 | Terracon Project No. 90245230

Prepared for:

NewQuest Properties
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August 13, 2024

NewQuest Properties
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Attn: Mr. Benjamin Keillor
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Re: Geotechnical Engineering Report
Creekside - Retail 25B
Creekside Crossing
New Braunfels, Texas
Terracon Project No. 90245230

Dear Mr. Keillor:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. P90245230 dated July 25, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning the construction of foundation, and pavements for the proposed project.

We appreciate the opportunity to work with you on this project and look forward to contributing to the ongoing success of this project by providing Materials Testing services during construction. If you have any questions concerning this report, or if we may be of further service, please contact us

Sincerely,

Terracon
(Firm Registration No. F3272)

Ali Hashemi
Project Manager

Arin Barkataki, P.E.
Principal



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Geotechnical Engineering Report

Creekside - Retail 25B | New Braunfels, Texas
August 13, 2024 | Terracon Project No. 90245230



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GeoModel

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Exploration and Testing Procedures
Site Location and Exploration Plans
Exploration and Laboratory Results
Supporting Information

Report Summary

Topic ¹	Overview Statement ²
Project Description	The project includes the construction of a new retail store with associated parking.
Geotechnical Characterization	Site Geology: Leona Formation FAT CLAY (CH) to about 6 feet below ground surface (bgs) underlain by LEAN CLAY (CL) and CLAYEY GRAVEL (GC). No free water was observed during our exploration.
Earthwork	Remove any vegetation and loose soil and replace 4 feet of the fat clay with select fill.
Shallow Foundations	The structure will be supported on a shallow slab-on-grade foundation. Allowable bearing pressure = 2,000 Expected settlements: < 1-inch total
Pavements	Both rigid (concrete) and flexible (asphalt) pavement parameters provided for light and heavy-duty traffic.
General Comments	This section contains important information about the limitations of this geotechnical engineering report. This report should be provided in its entirety to the key members of the design team, namely the Architect, Civil Engineer, and Structural. In addition, the MEP engineer, the Landscape Architect, and others should be provided a copy as there may be geotechnical recommendations included herein related to their services

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed construction of new Retail Store 25B located at Creekside Crossing in New Braunfels, Texas. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification per IBC
- Site preparation and earthwork
- Foundation recommendations
- Asphalt and concrete pavement recommendations

The Geotechnical Engineering Scope of Services for this project included drilling, laboratory testing, engineering analysis, and preparation of this report. The field program for this project included the advancement of four (4) test borings drilled to depths of 6 to 20 feet below existing site grades.

Drawings showing the site and boring locations are shown on the [Site Location](#) and [Exploration Plan](#), respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs and separate graphs in the [Exploration Results](#) section.

Project Description

Our final understanding of the project conditions is as follows:

Item	Description
Information Provided	We have been provided project details by the client via an email dated July 23, 2024.
Project Description	The project includes the construction of a new retail store with associated parking.
Proposed Construction	We anticipate the building will be wood or light metal frame building supported on shallow foundations.
Pavements	We have assumed both rigid (concrete) and flexible (asphalt) pavements will be considered.
Site Grading	A grading plan was not provided at this time of the report.

Item	Description
Finished Floor Elevation	The Finished Floor Elevation (FFE) at the building was not provided at this time of the report.
Maximum Loads (Assumed)	We assumed the following loads: <ul style="list-style-type: none"> ■ Columns: up to 50 kips ■ Walls: 3 kips ■ Floor slab: 100 psf
Retaining Wall	Not anticipated.

Terracon should be notified if any of the above information is inconsistent with the planned construction, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at Creekside Crossing in New Braunfels, Texas. Site Coordinates: 29.722876° N, 98.074362° W See Site Location
Existing Improvements	Undeveloped, vacant lot.
Current Ground Cover	Bare soil and grass
Site Topography	Based on our visit, the site is relatively level. Based on Google Earth imagery, the site has elevation between 669 feet and 671 feet.

Geotechnical Characterization

Site Geology

The Geologic Atlas of Texas, San Antonio Sheet, 1974, published by the University of Texas at Austin, Bureau of Economic Geology, has mapped the **Leona Formation (Qle)** of the Pleistocene geologic age in the vicinity of this site. The Leona Formation generally consists of gravel, sand, silt, and clay.

Subsurface Conditions

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel in [Figure](#) section of this report.

Model Layer	Layer Name	General Description
1	FAT CLAY (CH) ¹	Dark Gray; Stiff to Hard
2	LEAN CLAY (CL) ²	Tan; Very Stiff to Hard
3	CLAYEY GRAVEL (GC) ³	Tan; Medium Dense to Very Dense

1. The FAT CLAY (CH) materials could undergo high to very high volumetric changes (shrink/swell) should they experience changes in their in-place moisture content
2. The native LEAN CLAY (CL) materials could undergo moderate volumetric changes (shrink/swell) should they experience changes in their in-place moisture content
3. The CLAYEY GRAVEL (GC) soils are primarily granular in nature and are expected to possess a negligible potential for volumetric changes as a result of moisture fluctuations. **This stratum may become water bearing and prone to sloughing.**

The individual logs can be found in the [Exploration Results](#) section of this report. It should be emphasized the stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The borings were advanced to the required depths using dry drilling techniques to evaluate groundwater conditions at the time of our field program. The boreholes were observed for the presence of groundwater during and after completion of drilling. Groundwater was not observed in any of the borings.

Seasonal variations such as amount of rainfall and runoff, climatic conditions and other factors generally result in fluctuations of the groundwater level over time. A relatively long period may be necessary for groundwater level to develop and stabilize in a borehole. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The

foundation contractor should check the groundwater conditions just before foundation excavation activities.

Sulfate Considerations

Sulfate testing were performed on selected soil samples collected from the project site to check for a possible adverse reaction with concrete. Testing was not performed on all borings nor at all depths.

Sulfate content concentrations for some of the borings along with their location and approximate depth are as follow:

Boring	Sample Depth (feet)	Soil Description	Sulfate Content (ppm)
P-1	0-2	Fat Clay (CH)	175
P-2	2.5-4	Fat Clay (CH)	29.3

Based on the test results, the sulfate effect at this site is considered low and the severity of potential exposure of concrete to sulfate attack falls under Class 0 to 1.

Water Soluble Sulfate Content in Soil (mg/kg)	Severity of Potential Exposure
> 10,000	Class 3
1,500 – 10,000	Class 2
150 – 1,500	Class 1
0 – 150	Class 0

Seismic Site Class

Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with 1613.2.2 in the 2021 IBC and Table 20.3-1 in the 2016 ASCE-7. Based on the soil properties observed at the site and as described in the exploration logs and results, our professional opinion is that a **Seismic Site Classification of D** be considered for the project. Subsurface explorations at this site

were extended to a maximum depth of 20 feet. The site properties below the boring depth of 100 feet were estimated based on our experience and knowledge of the geologic conditions of the general area.

Geotechnical Overview

Terracon understands that shallow foundations will be considered to support the proposed restaurant building. The desired foundation system may be used at this site provided the building pad and foundations are designed and constructed as recommended in this report. Terracon would be pleased to discuss other foundation alternatives upon request.

Expansion Potential

Based on our findings, the subsurface soils at this site generally exhibit moderate to high shrink/swell potential. Based on the information developed from our field and laboratory programs and on method TEX-124-E of the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, we estimate that the subgrade soils at this site exhibit a Potential Vertical Rise (PVR) of about 2 to 2½ to inches in their present condition. It should be emphasized that the actual movements could be greater than the values presented in this report because of inadequate drainage, ponded water and moisture infiltration beneath the structures after construction.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and (at least minor) cracking in the pavement and the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and distress may not be feasible unless the slab is suspended and supported by drilled pier foundations. However, it may be possible to further reduce the risk of movement for grade supported slab if the building pad preparation measures are followed.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the [Exploration Results](#)), engineering analyses, and our current understanding of the proposed project. The [General Comments](#) section provides an understanding of the report limitations.

Earthwork

Earthwork will include clearing and grubbing, excavations and fill replacement. The following sections provide recommendations for use in the preparation of specifications for the work. These recommendations include critical quality criteria as necessary to

render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Prior to construction, the work area should be cleared of any vegetation and any otherwise unsuitable materials. After stripping and grubbing, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with a fully loaded dump truck or comparable pneumatic tired vehicle. Soils that are observed to rut or deflect excessively (typically greater than 1-inch) under the moving load should be undercut and replaced with properly compacted on-site soils. The proof rolling and undercutting activities should be witnessed by a representative of the Geotechnical Engineer and should be performed during a period of dry weather. Construction operations may encounter difficulties due to the wet or soft surface soils becoming a general hindrance to equipment due to rutting and pumping of the soil surface, especially during and soon after periods of wet weather. If the subgrade cannot be adequately compacted to minimum densities as described in the Fill Compaction Requirements section of this report, one of the following measures may be required:

- Removal and replacement with select fill.
- Chemical treatment of the soil to dry and increase the stability of the subgrade.
- Drying by natural means if the schedule allows.

Building Pad Preparation

The following structure pad preparation recommendations should be performed for the proposed structure prior to foundation construction. As previously mentioned, the existing PVR at this site is about 2 to 2½ inches. The near surface FAT CLAY (CH) should be removed beneath the building footprint to essentially reduce the heave potential. Recommendations for at-grade pad preparation to reduce the PVR to about 1 inch and provide uniform support to the grade supported slab and flatwork for this project site are provided below. Since a grading plan and the Finished Floor Elevation (FFE) was not available, the pad preparation recommendations are based on the FFE within 1 foot of the existing grades.

- After completing stripping operations as discussed in the [Site Preparation](#) section, excavate the on-site soil to a depth of about 4 feet or to the bottom of the dark gray clay (CH) layer whichever is deeper from the building pad area. The building pad area is defined as the area that extends at least 5 feet (horizontal) beyond the perimeter of the proposed building and to the outside edge of any movement sensitive flatwork. The limits of the building pad should be indicated on the drawings for the project. The excavated soil

should be wasted from the building pad areas as it is **not** suitable for reuse. The soil may be used to adjust grades in pavement areas or landscape areas.

- After excavating to the depth specified above, the exposed subgrade should be proof rolled with a fully loaded dump truck to evidence any weak yielding zones. A Terracon geotechnical engineer or their representative should be present to observe proof rolling operations.
- Over-excavate any confirmed weak yielding zones, both vertically and horizontally, to expose competent soil. The exposed subgrade should be moisture conditioned between -2 and +2 percentage points of the optimum moisture content and then compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.
- Place 4 feet of imported select fill soil in loose lifts of about 8 inches to achieve the Finished Building Pad Elevation (FBPE). Each lift should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content, and then compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

This should result in about 4 feet of moisture conditioned and compacted imported select fill having plasticity index (PI) of between 7 and 20 and will reduce the potential vertical rise (PVR) to about 1 inch. If grades are to be raised, then select fill should be used to achieve FBPE. We recommend the uppermost 6 inches of the pad be prepared with Granular Select Fill so that it acts as an all-weathering course and protects the pad from the elements of nature.

- Clay Cap- If not covered with concrete flatwork or pavements, the upper 2 feet (clay "cap") of the 5-foot (horizontal) overbuild should consist of a cohesive clay with a PI between 25 to 40 percent. The purpose of the clay cap is to reduce the potential for water to infiltrate the building pad causing the subgrade soils to swell. The clay "cap" material should have at least 70 percent by weight passing the No. 200 Sieve and no more than 15 percent by weight retained in the No. 4 Sieve. The clay "cap" may be replaced with concrete flatwork or pavement extending to the edge of the foundation. Properly compacted, this clay layer should help to reduce migration of moisture into the select fill below. On-site dark brown clay soil may be used for the clay "cap" provided it meets the criteria listed above.

Details regarding select fill materials, placement and compaction are presented in the following sections [Fill Material Types](#) and [Fill Compaction Requirements](#).

Flatwork

Grade-supported flatwork, or sidewalks, adjacent to the building will be subject to the movements unless proper measures are taken. Differential movement between the flatwork and building slab may result in a trip hazard. Doweling the flatwork to the foundation at common openings will help limit differential movements and trip hazards. The flatwork can be prepared as the building pad if performance of the flatwork similar to the building is desired as is recommended. All joints in the flatwork surrounding the structure should be kept sealed and properly maintained.

The flatwork immediately adjacent to the structures should be sloped as much as possible to maintain positive drainage away from the structure. If measures are not taken to address differential movement in the design stage, this issue may become a constant maintenance issue during the life of the building.

Fill Material Types

Fill Type ¹	USCS Classification	Comments
Select Fill	CL, SC, GC > LL ≤ 40 and 7 < PI ≤ 20 > % passing #200 sieve ≥ 35% > Maximum particle size 1½"	Note 1
General Fill (Onsite Soils)²	CH, CL, GC	Note 2
Granular Select Fill (Crushed Limestone meeting TxDOT Item 247, Type A, Grade 1-2)³	Varies	Upper 6 inches of the pad to act as all-weather course.

1. Prior to any filling operations, samples of the proposed borrow and on-site materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate those proper levels of compaction, including dry unit weight and moisture content, are being attained.
2. Onsite CH soils should not be used as select fill. CH soils may be used in landscaping. CL and GC soils may be used as select fill if it meets the select fill criteria.
3. Granular select fill should consist of crushed limestone base material meeting the requirements of 2014 TxDOT Item 247, Type A, Grade 1-2

Fill Placement and Compaction Requirements

Select and general fill should meet the following compaction requirements.

Item	Requirements
Fill Lift Thickness	All fill should be placed in thin, loose lifts of about 8 inches, with compacted thickness not exceeding 6 inches.
Compaction of On-Site Soil and Select Fill	95 percent of the material’s Standard Proctor maximum dry density (ASTM D 698)
Moisture Content of On-Site Soil	Between 0 and +4 percentage points of the optimum moisture content.
Moisture Content of Select Fill and Granular Select Fill	The materials should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content

Grading and Drainage

Effective drainage should be provided during construction and maintained throughout the life of the new improvements. After pad construction, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary, as part of the structure’s maintenance program.

Proper site drainage should be maintained during the entire construction phase so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access, particularly in cut areas. During construction, it is possible that the surficial soils may become excessively wet because of inclement weather conditions. If such conditions create a hindrance to compaction operations or site access, lime may be mixed with these soils to improve their workability. The additive can be mixed as per 2014 TxDOT Item 260. The purpose of the additive is to dry out the subgrade and improve site access. The strict requirements for curing and actual quantity of additive can be at the discretion of the contractor.

Flatwork and pavements will be subjected to post-construction movement. Maximum grades that are feasible should be used for paving and flatwork to prevent water from ponding. Allowances in final grades should also consider post-construction movement of flatwork, particularly if such movements are deemed critical. Where paving or flatwork abuts the structure, joints should be effectively sealed and maintained to prevent surface water infiltration. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with a grade of at least five percent for at least 10 feet from perimeter walls (except in areas where ADA ramps are

required; these should comply with state and local regulations). Backfill against grade beams, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of construction debris to reduce the possibility of moisture infiltration.

Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utility to be supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

On-site materials are considered suitable for backfill of utility and pipe trenches from 1 foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended. Utility trench backfill compaction should be 95 percent of Standard Proctor compaction for paved and structure areas and 90 percent of Standard Proctor compaction for unpaved and non-structure areas.

Utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

Earthwork Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Based upon the subsurface conditions determined from the geotechnical exploration, subgrade soils exposed during construction are

anticipated to be relatively stable. However, the stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If conditions develop, workability may be improved by scarifying and drying.

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of foundation elements and pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Shallow Foundations

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable.

Design Parameters – Slab on Grade Foundation

Slab on grade foundations can be used if the pad is prepared as described in the Pad Preparation section of this report. Parameters commonly used to design this type of foundation are provided on the table below. The slab foundation design parameters presented in the table are based on Conventional method and the criteria published by the Wire Reinforcement Institute (WRI).

Conventional Method Parameters	Value
Net Allowable Bearing Pressures ¹	2,000 psf
Subgrade Modulus (k)	100 pci
Potential Vertical Rise (PVR) ²	Less than 1 inch

Conventional Method Parameters	Value
WRI Method Parameters	
Design Plasticity Index (PI) ²	24
Climatic Rating (C_w)	17
Soil – Climate Support Index (1-C)	0.09

1. The net allowable bearing pressure provided above includes a Factor of Safety (FS) of at least 3.
2. Based on pad preparation recommended in this report.

We recommend that exterior grade beams be at least 30 inches below the finished exterior grade. Interior grade beams (if any) should bear 24 inches from the FFE. These recommendations are for a proper development of bearing capacity for the continuous beam sections of the foundation system and to reduce the potential for water to migrate beneath the slab foundation. These recommendations are not based on structural considerations. Grade beam depths may need to be greater than recommended herein for structural considerations and should be properly evaluated and designed by the Structural Engineer. The grade beams or slab portions may be thickened and widened to serve as spread footings at concentrated load areas.

For a slab foundation system designed and constructed as recommended in this report, post construction settlements should be less than 1 inch. Settlement response of a select fill supported slab is influenced more by the quality of construction than by soil-structure interaction. Therefore, it is essential that the recommendations for foundation construction be strictly followed during the construction phases of the pad and foundation.

The use of a vapor retarder should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slabs will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 for procedures and cautions about the use and placement of a vapor retarder.

Design Parameters – Spread Footings

Item	Description
Maximum Net Allowable Bearing Pressure ^{1, 2}	2,000 psf
Required Bearing Stratum ³	Structural fill extending to undisturbed native soils.
Minimum Foundation Dimensions	30 inches
Ultimate Passive Resistance ⁴ (equivalent fluid pressures)	400 psf
Sliding Resistance ⁵	0.30 coefficient of friction
Minimum Embedment below Finished Grade ⁶	Exterior footings: 36 inches Interior footings: 24 inches
Estimated Total Settlement from Structural Loads ²	About 1 inch
Estimated Differential Settlement ^{2, 7}	About ½ of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. The net allowable bearing pressure provided above include a factor of safety of at least 3.
2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated.
3. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in **Earthwork**.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed, and compacted structural fill be placed against the vertical footing face. Assumes no hydrostatic pressure. The passive pressure provided above include a factor of safety of at least 2.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for granular materials is dependent on the bearing pressure which may vary due to load combinations. For fine-grained materials, lateral resistance using cohesion should not exceed ½ the dead load.
6. Embedment necessary to minimize the effects of desiccation. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
7. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

Foundation Construction Considerations

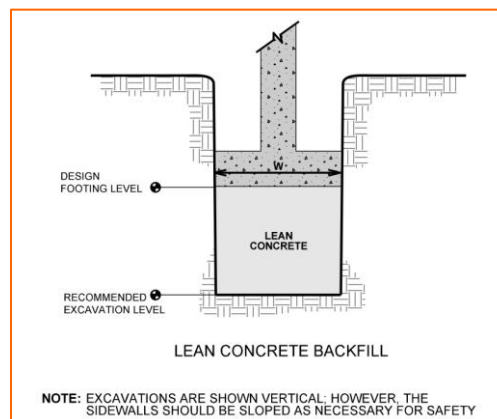
As noted in **Earthwork**, the grade beam or footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Care should be taken to prevent

wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed. To reduce the potential for water infiltration into the excavations and to minimize disturbance to the bearing area, we recommend that concrete and steel be placed as soon as possible after the excavations are completed. Excavations should not be left open for a prolonged period of time. The bearing surface of the grade beams or the footings should be evaluated after excavation is completed and immediately prior to placing concrete. If not, a seal slab consisting of lean concrete should be poured to protect the exposed bearing surface.

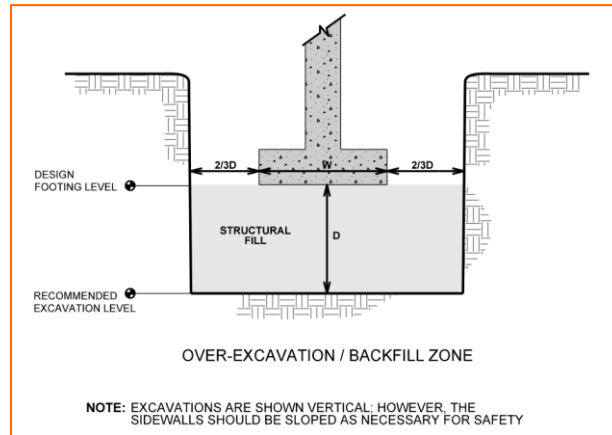
The bearing surface should be excavated with a slight slope to create an internal sump for runoff water collection and removal. If surface runoff water in excess of 1 inch accumulates at the bottom of the excavation, it should be pumped out prior to concrete placement. Under no circumstances should water be allowed to adversely affect the quality of the bearing surface.

Sensitive soils exposed at the surface of footing excavations may require surficial compaction with hand-held dynamic compaction equipment prior to placing select fill, steel, and/or concrete. Should surficial compaction not be adequate, construction of a working surface consisting of either crushed stone or a lean concrete mud mat may be required prior to the placement of reinforcing steel and construction of foundations

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with select fill placed, as recommended in the [Earthwork](#) section.



Pavements

Both flexible and rigid pavement systems may be considered for the project. Based on our knowledge of the project, we anticipate that traffic loads will be produced primarily by automobile traffic, delivery and trash removal trucks.

Subgrade Preparation

Prior to construction, any vegetation, and any otherwise unsuitable materials should be removed from proposed pavement areas. After stripping, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with a 15-ton roller or fully loaded dump truck. Wet, soft, low-density or dry material should either be removed or moisture conditioned and recompacted to the moisture contents and densities described in section [Compaction Requirements](#) prior to placing fill. Pavement movement should be expected unless the subgrade is prepared similar to the building pad.

Pavement Design Recommendations

For this project Light and Heavy pavement section alternatives have been provided. Light is for areas expected to receive only car traffic. Heavy assumes areas with heavy traffic, such as trash pickup areas, fire lanes, delivery areas and main access drive areas.

The flexible and rigid pavement section was designed with a typical traffic expected for a similar facility. If heavier traffic loading is expected, Terracon should be provided with the information and allowed to review these pavement sections:

Layer	Minimum Recommended Flexible Pavement Section Thickness (inches)			
	Raw Subgrade		Modified Subgrade	
	Light Duty	Heavy Duty	Light Duty	Heavy Duty
Hot Mix Asphaltic Concrete	2.0	3.0	2.0	3.0
Granular Base Material	10	14.0	6.0	10.0
Lime Treated Subgrade	--	--	6.0	6.0
Moisture Conditioned Raw Subgrade	6.0	6.0	--	--

Layer	Minimum Recommended Rigid Pavement Section Thickness (inches)			
	Raw Subgrade		Modified Subgrade	
	Light Duty	Heavy Duty	Light Duty	Heavy Duty
Reinforced Concrete	5.5	6.5	5.0	6.0
Lime Treated Subgrade	--	--	6.0	6.0
Moisture Conditioned Raw Subgrade	6.0	6.0	--	--

1. Dumpster pad should be constructed as heavy-duty rigid section.

Pavement areas that will be subjected to heavy wheel and traffic volumes, such as waste bin or "dumpster" areas, entrance/exit ramps, and delivery areas, should be a rigid pavement section constructed of reinforced concrete.

Pavement areas that will be subjected to heavy wheel and traffic volumes, such as waste bin or "dumpster" areas, entrance/exit ramps, and delivery areas, should be a heavy-duty rigid pavement section constructed of reinforced concrete. The concrete pavement areas should be large enough to properly accommodate the vehicular traffic and loads. For example:

- The dumpster pad should be large enough so that the wheels of the collection truck are entirely supported on the concrete pavement during lifting of the waste bin; and
- The concrete pavement should extend beyond any areas that require extensive turning, stopping, and maneuvering.

- The pavement design engineer should consider these and other similar situations when planning and designing pavement areas. Waste bin and other areas that are not designed to accommodate these situations often result in localized pavement failures.

The pavement section has been designed using generally recognized structural coefficients for the pavement materials. These structural coefficients reflect the relative strength of the pavement materials and their contribution to the structural integrity of the pavement. If the pavement does not drain properly, it is likely that ponded water will infiltrate the pavement materials resulting in a weakening of the materials. As a result, the structural coefficients of the pavement materials will be reduced and the life and performance of the pavement will be shortened. The Asphalt Institute recommends a minimum of 2 percent slope for asphalt pavements. The importance of proper drainage cannot be overemphasized and should be thoroughly considered by the project team.

Pavement Section Materials

Presented below are selection and preparation guidelines for various materials that may be used to construct the pavement sections. Submittals should be made for each pavement material. The submittals should be reviewed by the Geotechnical Engineer and appropriate members of the design team and should provide test information necessary to verify full compliance with the recommended or specified material properties.

- **Hot Mix Asphaltic Concrete Surface Course** - The asphaltic surface material should meet the specification requirements of 2014 TxDOT Standard Specification Item 341 or SS3076/3077, Type D.
- **Concrete** - Concrete should have a minimum 28-day design compressive strength of 4,000 psi.
- **Granular Base Material** - Base material may be composed of crushed limestone base meeting all of the requirements of 2014 TxDOT Item 247, Type A, Grade 1-2; including triaxial strength. The material should be compacted to at least 95 percent of the maximum dry density as determined in accordance with ASTM D 1557 at moisture contents ranging from -2 and +3 percentage points of the optimum moisture content.
- **Lime Treated Subgrade** - Due to the presence of clay at this site, the subgrade may be modified with hydrated lime in accordance with TxDOT Item 260 in order to improve its strength and improve its load carrying capacity. We anticipate that approximately 6 percent hydrated lime will be required. This is equivalent to about 30 pounds of hydrated lime per square yard for a 6-inch treatment depth. However, the actual percentage should be determined by laboratory tests on samples of the

clayey subgrade prior to construction. The optimum lime content should result in a soil-lime mixture with a pH of at least 12.4 when tested in accordance with ASTM C 977, Appendix XI and should reduce the Plasticity Index to 20 or less.

The lime should initially be blended with a mixing device such as a Pulvermixer, sufficient water added, and be allowed to cure for at least 48 hours. After curing, the lime-soil should be remixed to meet the in-place gradation requirements of Item 260 and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698 at moisture contents ranging from optimum and 4 percentage points above the optimum moisture content

- **Moisture Conditioned Subgrade** - The subgrade should be scarified to a depth of 6 inches and then moisture conditioned between -2 and +3 percentage points of the optimum moisture content and then compacted to at least 95 percent of the maximum dry density determined as per ASTM D 698.

Details regarding subgrade preparation, fill materials, placement and compaction are presented in **Earthwork** section under subsections **Fill Material Types** and **Fill Placement and Compaction Requirements**.

Pavement Joints and Reinforcement

The following is recommended for all concrete pavement sections in this report. Refer to ACI 330 "Guide for Design and Construction of Concrete Parking Lots" for additional information.

Item	Description
Distributed Reinforcing Steel	No. 3 reinforcing steel bars at 18 inches on-center-each-way, Grade 60. It is imperative that the distributed steel be positioned accurately in the pavement cross section, namely 2 inches from the top of the pavement.
Contraction Joint Spacing	12.5 feet each way for pavement thickness of 5 to 5.5 inches. 15 feet each way for pavement thickness of 6 inches or greater. Saw cut control joints should be cut within 6 to 12 hours of concrete placement.
Contraction Joint Depth	At least ¼ of pavement thickness.
Contraction Joint Width	One-fourth inch or as required by joint sealant manufacturer.

Item	Description
Construction Joint Spacing	To attempt to limit the quantity of joints in the pavement, consideration can be given to installing construction joints at contraction joint locations, where it is applicable.
Construction Joint Depth/Width	Full depth of pavement thickness. Construct sealant reservoir along one edge of the joint. Width of reservoir to be ¼ inch or as required by joint sealant manufacturer. Depth of reservoir to be at least ¼ of pavement thickness.
Isolation Joint Spacing	As required to isolate pavement from structures, etc.
Isolation Joint Depth	Full depth of pavement thickness.
Isolation Joint Width	½ to 1 inch or as required by the joint sealant manufacturer.
Expansion Joint	In this locale, drying shrinkage of concrete typically significantly exceeds anticipated expansion due to thermal affects. As a result, the need for expansion joints is eliminated provided all joints (including saw cuts) are sealed. Construction of an unnecessary joint may also become a maintenance problem. <u>All</u> joints should be sealed. If all joints, including sawcuts, are not sealed then expansion joints should be installed.

All construction joints have dowels. Dowel information varies with pavement thickness as presented as follows:

Parameter	5 and 5½ inches	6 and 6½ inches
Dowels	⅝ inch diameter	¾ inch diameter
Dowel Spacing	12 inches on center	12 inches on center
Dowel Length	12 inches long	14 inches long
Dowel Embedment	5 inches	6 inches

Pavement Drainage and Maintenance

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventative maintenance. The following recommendations should be implemented to help promote long-term pavement performance:

- The subgrade and the pavement surface should be designed to promote proper surface drainage, preferably at a minimum grade of 2 percent.
- Install joint sealant and seal cracks immediately.
- Extend curbs into the subgrade for a depth of at least 4 inches or top of limestone to help reduce moisture migration into the subgrade soils beneath the pavement section.
- Place compacted, low permeability clayey backfill against the exterior side of the curb and gutter.
- Slope subgrade in landscape islands to low points should drain to an appropriate outlet.
- Edge drains are recommended along pavement/ landscape borders.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in

accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation cost. Any parties charged with design of excavation support, dewatering, or working platforms should seek their own site characterization for specific purposes to obtain the specific level of detail necessary. Site safety, and construction cost estimating are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Geotechnical Engineering Report

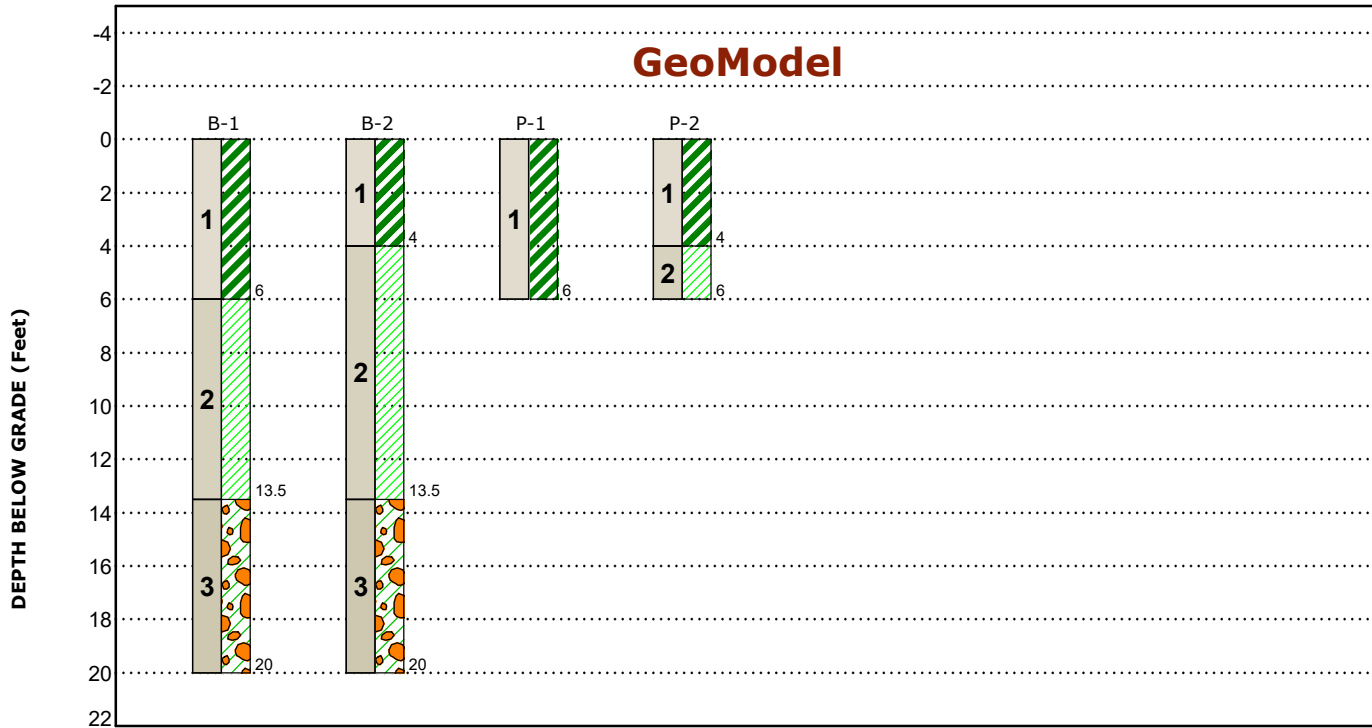
Creekside - Retail 25B | New Braunfels, Texas
August 13, 2024 | Terracon Project No. 90245230



Figure

Contents:

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description	Legend	
1	Fat Clay (CH)	dark brown; stiff to hard	Fat Clay	Lean Clay
2	Lean Clay (CH)	tan; very stiff to hard	Clayey Gravel	
3	Clayey Gravel (GC)	tan; medium dense to hard		

NOTES:
 Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
 Numbers adjacent to soil column indicate depth below ground surface.

Geotechnical Engineering Report

Creekside - Retail 25B | New Braunfels, Texas
August 13, 2024 | Terracon Project No. 90245230



Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Boring Depth (feet) ¹	Planned Location
2 (B-1 and B-2)	20	Building area
2 (P-1 through P-2)	6	Parking/driveway areas

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features.

Subsurface Exploration Procedures: We advanced the soil borings with a truck-mounted drill rig using continuous flight augers (solid stem and/or hollow stem, as necessary, depending on soil conditions). Soils were sampled by means of split barrel sampling procedure. In the split barrel sampling procedure, a standard 2-inch outer diameter split barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration was recorded as the Standard Penetration Test (SPT) resistance value. The samples were removed from the samplers in the field, visually classified, and appropriately sealed in sample containers to preserve in-situ moisture contents. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

Our exploration team prepared field boring logs as part of the drilling operations. The sampling depths, visual classification of the materials encountered, SPT values, pocket penetrometer readings, other pertinent sampling information were recorded on the field boring logs.

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in this Appendix. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the development of foundation and earthwork recommendations. Laboratory tests were performed in general

Geotechnical Engineering Report

Creekside - Retail 25B | New Braunfels, Texas

August 13, 2024 | Terracon Project No. 90245230



accordance with the applicable ASTM, local or other accepted standards. Selected soil samples obtained from the site were tested for the following engineering properties:

- Moisture Content
- Atterberg Limits
- Percent Passing No.200 Sieve
- Sulfate Tests

Final boring logs that were prepared represented the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

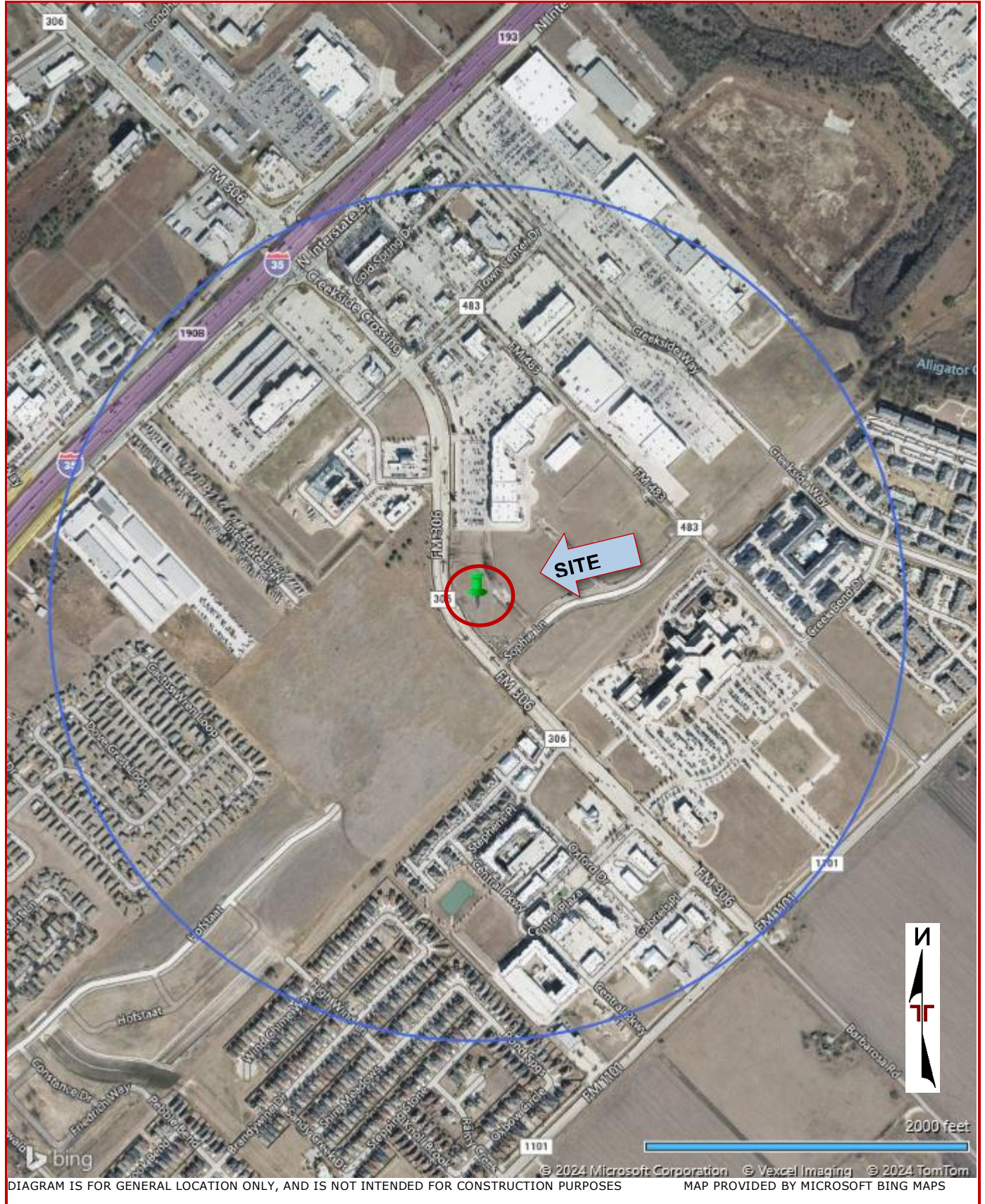
Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location



Exploration Plan



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS




Exploration and Laboratory Results

Contents:

Boring Logs (B-1 thru B-2 and P-1 thru P-2)
Atterberg Limits
Grain Size
Sulfate Test Results

Note: All attachments are one page unless noted above.

Boring Log No. B-1

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.7230° Longitude: -98.0745° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	
								LL-PL-PI	Percent Fines
1		FAT CLAY (CH) , dark brown, stiff to very stiff	5	X	X	2-3-6 N=9	28.4	72-20-52	
						4-6-10 N=16	22.0		
						3.75 (HP)	22.9		
2		LEAN CLAY (CL) , with gravel, tan, very stiff to hard	10	X	X	10-14-20 N=34	7.7	27-15-12	
						16-50	6.7		
3		CLAYEY GRAVEL (GC) , tan, medium dense to hard	15	X	X	14-9-16 N=25	4.0	13	
						27-37-40 N=77	3.3		
Boring Terminated at 20 Feet			20						

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Water Level Observations
 No free water observed during augering

Drill Rig
 B-51

Hammer Type
 Automatic

Driller
 Carlos

Notes

Advancement Method
 F.A

Logged by
 BD

Abandonment Method
 Boring backfilled with soil cuttings upon completion.

Boring Started
 07-31-2024

Boring Completed
 07-31-2024

Boring Log No. B-2

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.7232° Longitude: -98.0746° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	
								LL-PL-PI	Percent Fines
1		FAT CLAY (CH) , dark brown, very stiff to hard				2.75 (HP)	27.7		
			4.0			4.5+ (HP)	25.3	72-17-55	92
2		LEAN CLAY (CL) , with gravel, tan, very stiff to hard	5			8-10-10 N=20	14.7		
						12-13-18 N=31	15.2		
			10			12-23-42 N=65		37-16-21	94
3		CLAYEY GRAVEL (GC) , tan, medium dense to hard	15			28-28-30 N=58	1.9		
			20			21-32-33 N=65	4.2		19
Boring Terminated at 20 Feet			20						

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Water Level Observations
 No free water observed during augering

Drill Rig
 B-51

Hammer Type
 Automatic

Driller
 Carlos

Notes

Advancement Method
 F.A

Logged by
 BD

Abandonment Method
 Boring backfilled with soil cuttings upon completion.

Boring Started
 07-31-2024

Boring Completed
 07-31-2024

Boring Log No. P-1

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.7229° Longitude: -98.0742° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	
								LL-PL-PI	Percent Fines
1		<p>FAT CLAY (CH), dark brown, very stiff to hard</p>	<p>3.5</p> <p>4</p> <p>5</p>			<p>3.5 (HP)</p> <p>4 (HP)</p> <p>4.5+ (HP)</p>	<p>30.4</p> <p>21.7</p> <p>16.6</p>	<p></p> <p>66-23-43</p> <p></p>	<p></p> <p>94</p> <p></p>
		<p>Boring Terminated at 6 Feet</p>							

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations No free water observed during augering</p>	<p>Drill Rig B-51</p> <p>Hammer Type Automatic</p> <p>Driller Carlos</p>
<p>Notes</p>	<p>Advancement Method F.A</p> <p>Abandonment Method Boring backfilled with soil cuttings upon completion.</p>	<p>Logged by BD</p> <p>Boring Started 07-31-2024</p> <p>Boring Completed 07-31-2024</p>

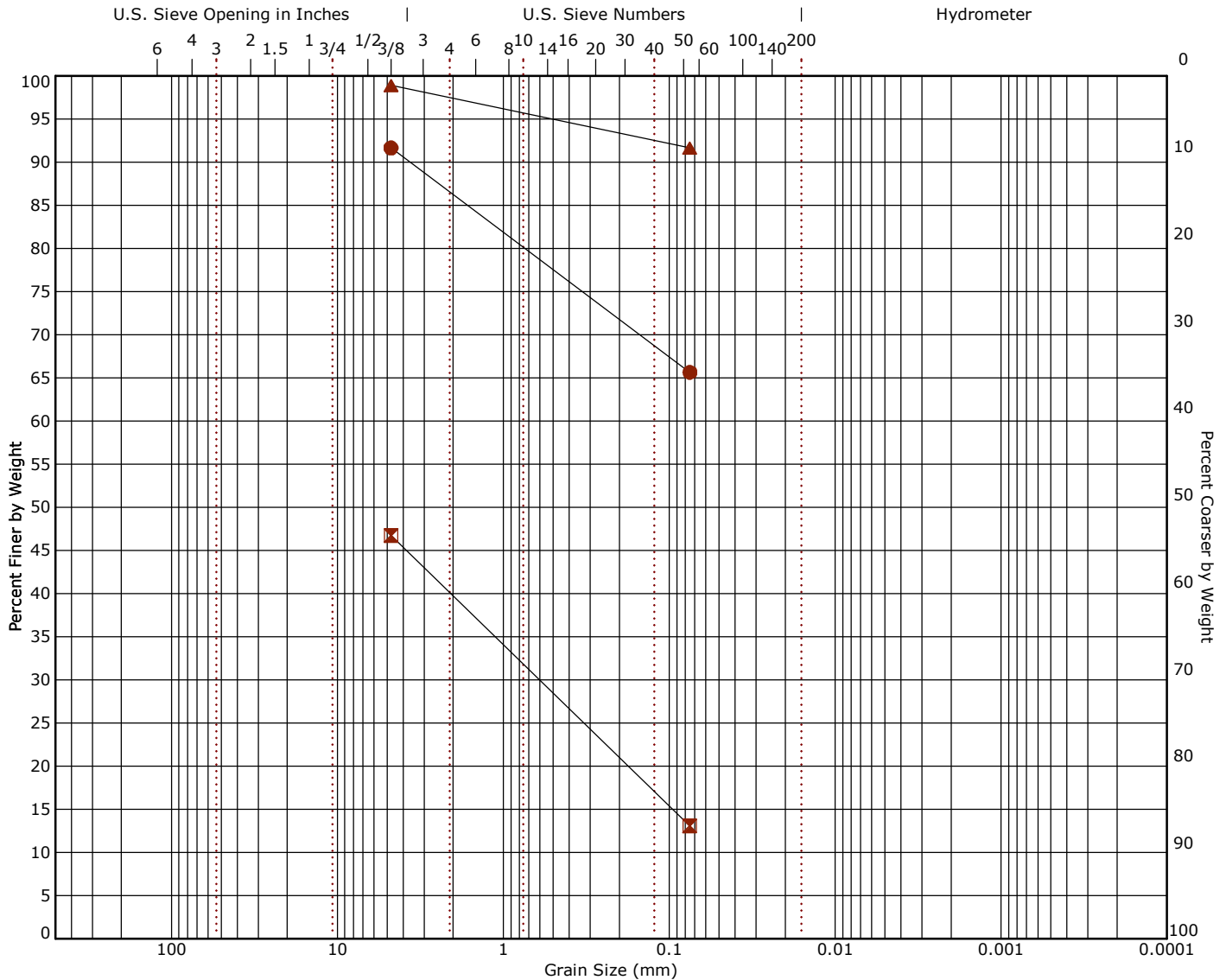
Boring Log No. P-2

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.7232° Longitude: -98.0749° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	
								LL-PL-PI	Percent Fines
1		FAT CLAY (CH) , dark brown, very stiff to hard	4.0			2.5 (HP)	31.9		
2		LEAN CLAY (CL) , with gravel, tan, hard	6.0		X	10-18-27 N=45	9.7	32-15-17	70
Boring Terminated at 6 Feet									

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations No free water observed during augering</p>	<p>Drill Rig B-51</p> <p>Hammer Type Automatic</p> <p>Driller Carlos</p>
<p>Notes</p>	<p>Advancement Method F.A</p> <p>Abandonment Method Boring backfilled with soil cuttings upon completion.</p>	<p>Logged by BD</p> <p>Boring Started 07-31-2024</p> <p>Boring Completed 07-31-2024</p>

Grain Size Distribution

ASTM D422 / ASTM C136 / AASHTO T27

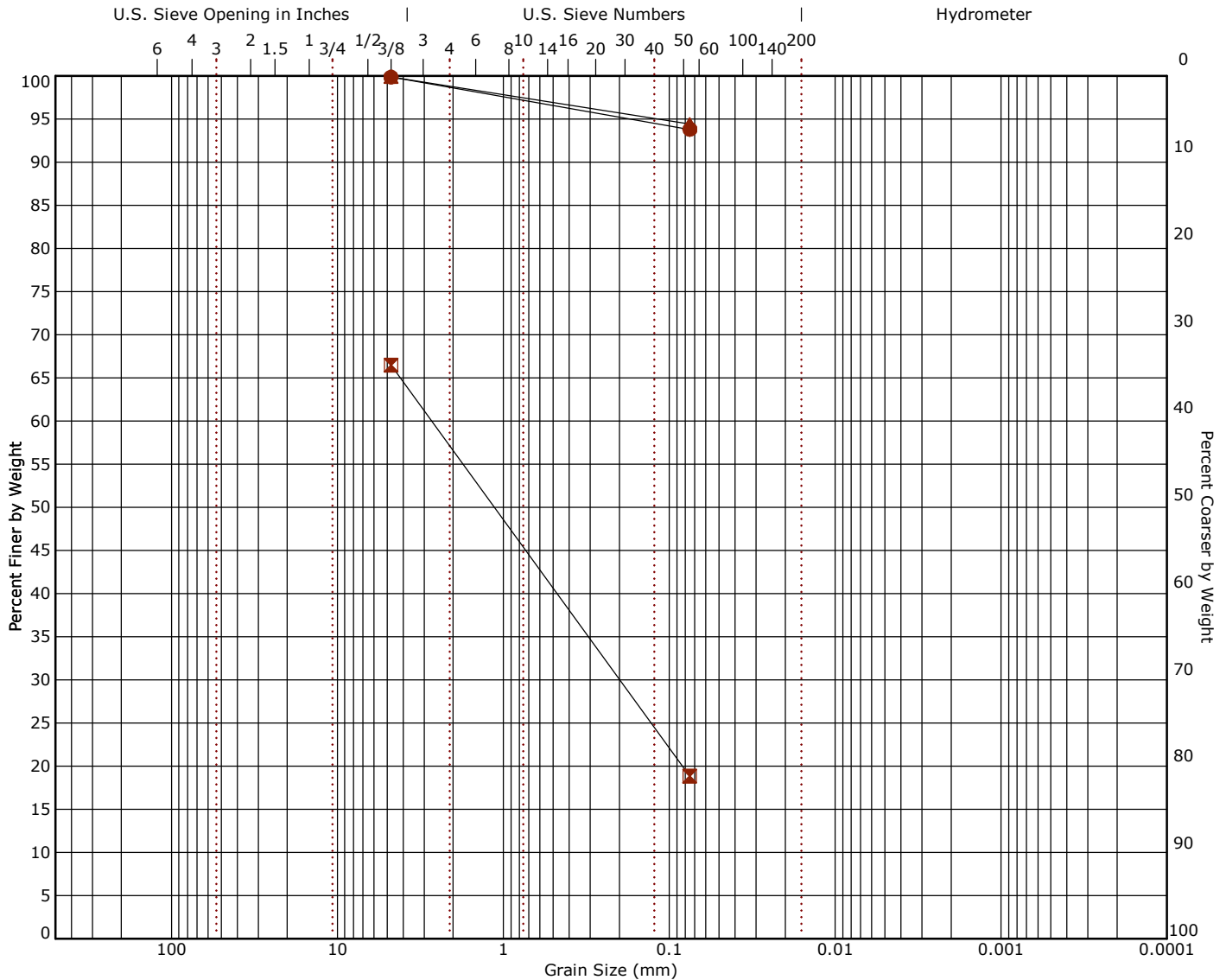


	Cobbles	Gravel		Sand			Silt or Clay		USCS
		coarse	fine	coarse	medium	fine	% Silt	% Clay	
● B-1						26.0	65.6		CL
◻ B-1						33.6	13.1		
▲ B-2						7.2	91.6		CH

Description	●		◻		▲		Grain Size		
● SANDY LEAN CLAY	Sieve	% Finer	Sieve	% Finer	Sieve	% Finer	●	◻	▲
◻	#4	91.65	#4	46.74	#4	98.88	D ₆₀		
▲ FAT CLAY	#200	65.64	#200	13.11	#200	91.63	D ₁₀		
Remarks							Coefficients		
●							●	◻	▲
◻							C _c		
▲							C _u		

Grain Size Distribution

ASTM D422 / ASTM C136 / AASHTO T27

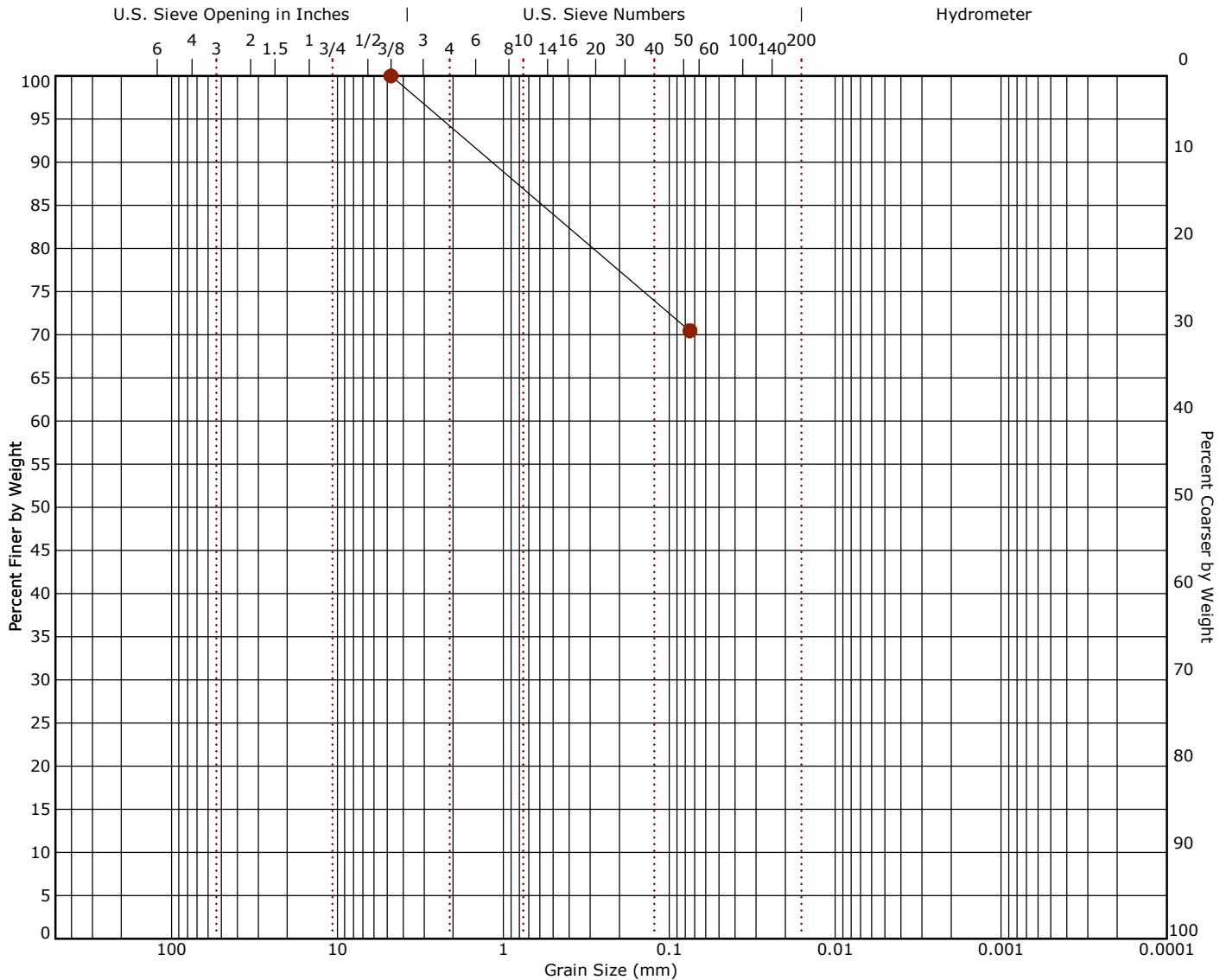


	Cobbles	Gravel		Sand			Silt or Clay		USCS
		coarse	fine	coarse	medium	fine	% Silt	% Clay	
●	B-2					6.1	93.8		CL
■	B-2					47.6	18.9		
▲	P-1					5.4	94.4		CH

Description	●		■		▲		Grain Size			
● LEAN CLAY	Sieve	% Finer	Sieve	% Finer	Sieve	% Finer		●	■	▲
■	#4	99.86	#4	66.47	#4	99.85	D ₆₀		2.703	
▲ FAT CLAY	#200	93.81	#200	18.87	#200	94.44	D ₁₀			
Remarks										
●							Coefficients			
■							●	■	▲	
▲							C _c			
							C _u			

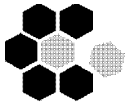
Grain Size Distribution

ASTM D422 / ASTM C136 / AASHTO T27



	Cobbles	Gravel		Sand			Silt or Clay		USCS
		coarse	fine	coarse	medium	fine	% Silt	% Clay	
●	P-2	4 - 5.5	0.0	0.0	29.5	70.5			CL

Description	●		●		●		Grain Size				
● LEAN CLAY with SAND	Sieve	% Finer	Sieve	% Finer	Sieve	% Finer		●			
	#4	100.0					D ₆₀				
	#200	70.47					D ₁₀				
Remarks							Coefficients				
●							●				
							C _c				
							C _u				



CLIENT: Terracon Consultants, Inc.
Lab Order: 2408005

Project: 90245230

Alamo Lab ID	Client ID	Collection Date	Analyses	Matrix	Result	MDL	PQL	Units	DF	Qua
TestName: TEX-620-J-SO4			TestNo: TX620J	Date Analyzed	8/9/2024 10:00:00 AM			Initials: YK		
2408005-01A	P - 1 0 - 2	7/31/2024	Sulfate	Solid	175	0	25	mg/Kg	1	
2408005-02A	P - 2 2.5 - 4	7/31/2024	Sulfate	Solid	29.3	0	25	mg/Kg	1	

Approved by: Reddy Gosala, Laboratory Direc

H Holding times for preparation or analysis exceeded; J - Analyte detected below quantitation limits

* Non-NELAP Standards ** Sub Contracted

Report of Laboratory Analysis

Note: The analysis contained in this report applies only to the samples tested and for the exclusive use of the addressed client. Reproduction of this report wholly or in part requires written permission of the client.







Supporting Information

Contents:

General Notes
Unified Soil Classification System

Note: All attachments are one page unless noted above.

General Notes

Sampling	Water Level	Field Tests
 Shelby Tube  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification	
				Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F
		Gravels with Fines: More than 12% fines ^C	$Cu < 4$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F
		Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW
	Sands with Fines: More than 12% fines ^D	Sands with Fines: More than 12% fines ^D	$Cu < 6$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	SP	Poorly graded sand ^I
	Silts and Clays: Liquid limit less than 50	Inorganic:	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots above "A" line ^J	CL	Lean clay ^{K, L, M}
		Organic:	$\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$	OL	Organic clay ^{K, L, M, N}
		Inorganic:	PI < 4 or plots below "A" line ^J	ML	Silt ^{K, L, M}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K, L, M}
		Organic:	PI plots below "A" line	MH	Elastic silt ^{K, L, M}
		Inorganic:	$\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$	OH	Organic clay ^{K, L, M, P}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

^E $Cu = \frac{D_{60}}{D_{10}}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N PI ≥ 4 and plots on or above "A" line.

^O PI < 4 or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.

