GEOTECHNICAL ENGINEERING STUDY

FOR

LIFT STATION – PRECINCT 30, UNIT 3
VERAMENDI MASTER PLANNED DEVELOPMENT
NEW BRAUNFELS, TEXAS

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Project No. ANA24-015-00
Revised June 21, 2024

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Construction Manager
ASA Properties, LLC
2168 Oak Run Parkway, Suite 101
New Braunfels, Texas 78132

**RE: Geotechnical Engineering Study
Lift Station – Precinct 30, Unit 3
Veramendi Master Planned Development
New Braunfels, Texas**

Dear Mr. Mechler:

RABA KISTNER, Inc. (**RKI**) is pleased to submit the report of our Geotechnical Engineering Study for the above-referenced project. This study was performed in accordance with **RKI** Proposal No. PNA24-031-00 dated May 3, 2024. The purpose of this study was to drill a single boring in the vicinity of the proposed lift station, to perform laboratory testing to classify and characterize subsurface conditions, and to prepare an engineering report presenting foundation design and construction recommendations as well as to provide general guidelines for construction of a gravel driveway area.

The following report contains our design recommendations and considerations based on our current understanding of information provided to us at the time of this study. There may be alternatives for value engineering of the foundation and pavement systems. **RKI** recommends that a meeting be held with the Owner and design team to evaluate if alternatives are available.

We appreciate the opportunity to be of service to you on this project. Should you have any questions about the information presented in this report, or if we may be of additional assistance with value engineering or on the materials testing-quality control program during construction, please call.

Very truly yours,

RABA KISTNER, INC.

Santosh Shrestha, E.I.T.
Graduate Engineer

Ian Perez, P.E.
Vice President

STATE OF TEXAS
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SS/TIP/mmd
Attachments
Copies Submitted: Above (1-electronic)

GEOTECHNICAL ENGINEERING STUDY

For

LIFT STATION – PRECINCT 30, UNIT 3
VERAMENDI MASTER PLANNED DEVELOPMENT
NEW BRAUNFELS, TEXAS

Prepared for

ASA PROPERTIES, LLC
New Braunfels, Texas

Prepared by

RABA KISTNER, INC.
New Braunfels, Texas

PROJECT NO. ANA24-015-00

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RABA KISTNER

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ATTACHMENTS

The following figures are attached and complete this report:

Boring Location Map .... Figure 1
Log of Boring .... Figure 2
Key to Terms and Symbols .... Figure 3
Results of Soil Sample Analyses .... Figure 4
Important Information About Your Geotechnical Engineering Report

INTRODUCTION

RABA KISTNER, Inc. (**RKI**) has completed the authorized subsurface exploration and foundation analysis for the proposed lift station to be located in Precinct 30 – Unit 3 of the Veramendi Master Planned Development in New Braunfels, Texas, as illustrated in Figure 1. This report briefly describes the procedures utilized during this study and presents our findings along with our recommendations for foundation design and construction considerations, as well as provide general guidelines for construction of flexible base pavement sections for the access road.

PROJECT DESCRIPTION

To be considered in this study is a lift station to be located in the northeast portion of Precinct 30 – Unit 3, east of the intersection of Grey Wolf Trail and Plumbago Street in New Braunfels, Texas. Based on the information provided to us, the proposed lift station will extend approximately 30 ft below the ground surface. It is unknown at this time if there will be any ancillary structures to support the lift station operation.

LIMITATIONS

This engineering report has been prepared in accordance with accepted Geotechnical Engineering practices in the region of central Texas and for the use of ASA Properties, LLC (Client) and its representatives for design purposes. This report may not contain sufficient information for purposes of other parties or other uses. This report is not intended for use in determining construction means and methods. The attachments and report text should not be used separately.

The recommendations submitted in this report are based on the data obtained from a single boring drilled at this site, our understanding of the project information provided to us, and the assumption that site grading will result in only minor changes in the existing topography. If the project information described in this report is incorrect, is altered, or if new information is available, we should be retained to review and modify our recommendations.

This report may not reflect the actual variations of the subsurface conditions across the site. This is particularly true of this site with respect to the depth of the upper surficial clays and the potential presence of solution cavities and/or voids that may not have been encountered in our test boring. The nature and extent of variations across the site may not become evident until construction commences. The construction process itself may also alter subsurface conditions. If variations appear evident at the time of construction, it may be necessary to reevaluate our recommendations after performing on-site observations and tests to establish the engineering impact of the variations.

The scope of our Geotechnical Engineering Study does not include an environmental assessment of the air, soil, rock, or water conditions either on or adjacent to the site. No environmental opinions are presented in this report.

If site grading results in elevations that vary significantly from the existing grades (more than plus or minus 1 ft), our office should be informed about these changes. If needed and/or if desired, we will reexamine our analyses and make supplemental recommendations.

BORING AND LABORATORY TESTS

Subsurface conditions at the site were evaluated by a single boring drilled at the location shown on the Boring Location Map, Figure 1. This location is approximate, and distance was measured using a hand-held, recreational-grade GPS locator. The boring was drilled to an approximate depth of 40 ft below the existing ground surface using a truck-mounted drilling rig.

During the drilling operations, split-spoon samples with Standard Penetration Tests (SPT) were collected at the depths annotated on our boring log. Each sample was visually classified in the laboratory by a member of our Geotechnical Engineering staff. The geotechnical engineering properties of the strata were evaluated by moisture content, sulfate content, percent passing a No. 200 sieve, and Atterberg Limits tests.

The laboratory test results are presented in graphical or numerical form on the boring logs illustrated on Figure 2. A key to classification terms and symbols used on the log is presented on Figure 3. The results of the laboratory and field testing are also tabulated on Figure 4 for ease of reference.

Standard Penetration Test results are noted as "blows per ft" on the boring log and Figure 4, where "blows per ft" refers to the number of blows by a falling hammer required for 1 ft of penetration into the soil/weak rock. Where hard or dense materials were encountered, the tests were terminated at 50 blows even if one foot of penetration had not been achieved. When all 50 blows fall within the first 6 in. (seating blows), refusal "ref" for 6 in. or less will be noted on the boring log and on Figure 4.

Sulfate testing was performed on samples collected from the boring. The purpose of the sulfate testing was to determine the concentration of soluble sulfates in the soils to investigate the potential for an adverse reaction to concrete in contact with the native soils. The results of the sulfate content tests are presented in the table below.

Sulfate Testing Results			
Soil Type	**Boring Number**	**Approximate Depth Below Existing Ground Surface (ft)**	**Sulfate Content (ppm)**
Dark Brown Clay	B-1	0 to 1.1	Less than 100
Limestone		28.5 to 30	Less than 100

Samples will be retained in our laboratory for 30 days after submittal of this report. Other arrangements may be provided at the request of the Client.

GENERAL SITE CONDITIONS

GEOLOGY

A review of the *Geologic Atlas of Texas, San Antonio Sheet*, indicates that this site is naturally underlain with the soils/rock (limestone) of the Edwards Group. Edwards limestone is generally considered hard in induration and typically contains harder zones/seams of chert and dolomite. Edwards limestone also typically contains karstic features in the form of open and/or clay-filled vugs, voids, and/or solution cavities that form as a result of solution movement through fractures in the rock mass.

Key geotechnical engineering considerations for development supported on this formation will be the depth to rock, the expansive nature of the overlying clays, the condition of the rock, and the presence/absence of karstic features.

SEISMIC CONSIDERATIONS

The following information has been summarized for seismic considerations associated with this site per ASCE 7-16 edition.

- Site Class Definition: **Class C**. Based on the soil borings conducted for this investigation and our experience in the area, the upper 100 ft of soil may be characterized as very dense soil and soft rock.
- Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United States of 0.2-Second Spectral Response Acceleration (5% Of Critical Damping): **S_s = 0.051g**.
- Risk-Targeted Maximum Considered Earthquake Ground Motion Response Accelerations for the Conterminous United States of 1-Second Spectral Response Acceleration (5% Of Critical Damping): **S_1 = 0.027g**.
- Values of Site Coefficient: **F_a = 1.3**
- Values of Site Coefficient: **F_v = 1.5**
- Where g is the acceleration due to gravity.

The Maximum Considered Earthquake Spectral Response Accelerations are as follows:

- 0.2 sec, adjusted: **S_{ms} = 0.066g**
- 1 sec, adjusted: **S_{m1} = 0.041g**

The Design Spectral Response Acceleration Parameters (SA) are as follows:

- 0.2 sec SA: **S_{DS} = 0.044g**
- 1 sec SA: **S_{D1} = 0.027g**

STRATIGRAPHY

The natural subsurface stratigraphy can generally be described as a thin veneer of highly plastic dark brown clay with limestone fragments overlying light tan and gray limestone. The limestone was encountered at an approximate depth of 1 ft below ground surface existing at the time of our study and extends to at least the boring termination depth.

The boring log should be consulted for more specific stratigraphic information. Each stratum has been designated by grouping soils that possess similar physical and engineering characteristics. Unless noted on the boring log, the lines designating the changes between various strata represent approximate boundaries. The transition between materials may be gradual or may occur between recovered samples.

The stratification given on the boring log, or described herein, is for use by **RKI** in its analyses and should not be used as the basis of design or construction cost estimates without realizing that there can be variation from that shown or described.

The boring log and related information depict subsurface conditions only at the specific locations and times where sampling was conducted. The passage of time may result in changes in conditions, interpreted to exist, at or between the locations where sampling was conducted.

GROUNDWATER

Groundwater was not observed in the boring either during or immediately upon completion of the drilling operations. The boring remained dry during the field exploration phase. However, it is possible for groundwater to exist beneath this site at shallow depths on a transient basis, particularly following periods of precipitation. Fluctuations in groundwater levels occur due to variation in rainfall and surface water run-off. The construction process itself may also cause variations in the groundwater level.

DEGRADATION OF CONCRETE

Degradation of concrete is caused by chemical agents in the soil or groundwater that react with concrete to either dissolve the cement paste or precipitate larger compounds which cause cracking and flaking. The concentration of water-soluble sulfates in the soils is a good indicator of the potential for chemical attack of concrete. Sulfate concentrations in soil can be used to evaluate the need for protection of concrete based on the general guidelines shown in the table below.

Sulfate Attack Potential	
Sulfate Ion Concentration, ppm or mg/kg	**Aggressiveness [1]**
>20,000	Very Severe
2,000 to 20,000	Severe
1,000 to 2,000	Moderate
< 1,000	Negligible

[1] ACI 318-05/ACI 318R-05

On the basis of soil sulfate concentration data presented on *Borings and Laboratory Tests* section of this report and the general guideline from the preceding table, the tested soils have a "*negligible"* potential for attacking concrete. **Cement Types I and II are available for use at this site.**

FOUNDATION ANALYSIS

EXPANSIVE SOIL-RELATED MOVEMENTS

The anticipated ground movements due to swelling of the underlying soils at the site were estimated for slab-on-grade construction using the empirical procedure, Texas Department of Transportation (TxDOT) Tex-124-E, Method for Determining the Potential Vertical Rise (PVR). A PVR value of 1 in. or less was estimated for the stratigraphic conditions encountered in our boring. A surcharge load of 1 psi (concrete slab and sand layer), an active zone of 15 ft, and dry moisture conditions were assumed in estimating the above PVR values.

The TxDOT method of estimating expansive soil-related movements is based on empirical correlations utilizing the measured plasticity indices and assuming typical seasonal fluctuations in moisture content. If desired, other methods of estimating expansive soil-related movements are available, such as estimations based on swell tests and/or soil-suction analyses. However, the performance of these tests and the detailed analysis of expansive soil-related movements were beyond the scope of the current study. It should also be noted that actual movements can exceed the calculated PVR values due to isolated changes in moisture content (such as due to leaks, landscape watering....) or if water seeps into the soils to greater depths than the assumed active zone depth due to deep trenching or excavations.

FOUNDATION RECOMMENDATIONS

SITE GRADING

Site grading plans can result in changes in almost all aspects of foundation recommendations. We have prepared all foundation recommendations based on the existing ground surface, and the stratigraphic conditions encountered at the time of our study. If site grading changes, **RKI** must be retained to review the site grading plans prior to bidding the project for construction. This will enable **RKI** to provide input for any changes in our original recommendations that may be required as a result of site grading operations or other considerations.

WET WELL STRUCTURE

Based on the information provided to us, the proposed wet well structure will extend approximately 30 ft below the grade existing at the time of our study. The excavation method for the construction of the wet well was not known at the time of this report. If open cut excavation techniques are utilized the maximum side slopes of 1-1/2 horizontal to 1 vertical should be anticipated for temporary construction slopes.

Allowable Bearing Capacity

Foundations for the wet well bearing in hard limestone at an approximate depth of 30 feet below the existing ground surface should be designed for a maximum allowable bearing pressure of 18 ksf. The above presented maximum allowable bearing pressures will provide a factor of safety of about 3 with respect to the measured shear strength.

Lateral Earth Pressures

Walls of the wet well will be subjected to lateral earth pressures. Equivalent fluid density values for computation of lateral soil pressures acting on walls were evaluated for various types of backfill materials that may be placed behind the walls of the structure. These values, as well as corresponding lateral earth pressure coefficients and estimated unit weights, are presented below in preferential order for use as backfill materials.

Back Fill Type	Estimated Total Unit Weight (pcf)	Active Condition: Earth Pressure Coefficient, k_a	Active Condition: Equivalent Fluid Density (pcf)	At Rest Condition: Earth Pressure Coefficient, k_o	At Rest Condition: Equivalent Fluid Density (pcf)
Crushed Limestone/ Washed Gravel	145	0.24	35	0.38	55
Clean Sand	120	0.33	40	0.50	60
Pit Run Clayey Gravels or Sands	135	0.32	45	0.48	65
Clays	120	0.59	70	0.74	90

The values tabulated above under “Active Conditions” pertain to flexible retaining walls free to tilt outward as a result of lateral earth pressures. For rigid, non-yielding walls such as the proposed wet well the values under “At-Rest Conditions” should be used.

The values presented above assume the surface of the backfill materials to be level. Sloping the surface of the backfill materials will increase the surcharge load acting on the structures. The above values also do not include the effect of surcharge loads such as construction equipment, vehicular loads, or future storage near the structure. These values also do not include hydrostatic pressures resulting from groundwater seepage entering and ponding within the backfill materials. However, applicable surcharge loads and groundwater pressures should be included in the design for any structures subjected to lateral earth pressures. For design purposes, it should be assumed that hydrostatic pressures will act over the entire depth of the wet well structure.

The on-site surficial clays exhibit significant shrink/swell characteristics. The use of these soils as backfill against the proposed retaining structures is not recommended. These soils generally provide higher design active earthen pressures, as indicated above, but may also exert additional active pressures associated with swelling. Controlling the moisture and density of these materials during placement will help reduce the likelihood and magnitude of future active pressures due to swelling, but this is no guarantee.

Backfill Compaction

Placement and compaction of backfill behind the below grade walls will be critical, particularly at locations where backfill will support adjacent near-grade foundations and/or flatwork. If the backfill is not properly compacted in these areas, the adjacent foundations/flatwork can be subject to settlement.

To reduce potential settlement of adjacent foundations/flatwork, the backfill materials should be placed and compacted as recommended in the *Select Fill* section of this report. Each lift or layer of the backfill should be tested during the backfilling operations to document the degree of compaction. Within at least a 5-ft zone of the walls, we recommend that compaction be accomplished using hand-guided compaction equipment capable of achieving the maximum density in a series of 3 to 5 passes.

RIGID-ENGINEERED BEAM AND SLAB FOUNDATION

Proposed ancillary structures, if any, may be founded on a shallow foundation provided the selected foundation type can be designed to withstand the anticipated soil-related movements (see *Expansive Soil-Related Movements*) without impairing either the structural or the operational performance of the structures.

Differential Settlement in Transition Zone

To reduce the potential for differential settlement at soil/fill and rock transitions, the more positive approach for foundation support would be to extend all footings to rock. Alternatively, the footings may bear on a combination of soil/fill and rock if differential movements can be tolerated. With footings on mixed bearing conditions, the client must recognize and accept a greater than normal risk of differential settlement as hinges may occur at unpredictable locations due to the irregular occurrence of shallow bedrock. Special provisions that should be considered for footings bearing on mixed bearing materials (natural soil/controlled fill and rock) to reduce the effects of differential settlement include the following:

- Frequent jointing of exterior walls;
- Selection of flexible building veneer materials; and
- Overexcavation of footing subgrades to top of rock and backfilling with compacted crushed rock.

Allowable Bearing Capacity

Shallow Foundation Design Parameters	
Minimum depth below final grade	18 in. (1)
Minimum beam or strip footing width	12 in.
Minimum widened beam or spread footing width	18 in.

(1) If intact bedrock is encountered, minimum foundation depth should be discussed with the structural engineer, but may be reduced to 12 in.

Shallow Foundation Type	Maximum Allowable Bearing Pressure
Grade Beams or strip footings	3,000 psf
Widened beams or spread footings	3,500 psf
Foundations on limestone, or weathered limestone	4,500 psf (1)

(1) Mixed bearing conditions (i.e. bearing on soil/fill and bedrock) should be avoided to reduce potential for differential settlement.

The above presented maximum allowable bearing pressures will provide a factor of safety of about 3, provided that fill is placed as discussed herein and the subgrade is prepared in accordance with the recommendations outlined in the *Site Preparation* section of this report.

The foundation subgrade should be observed by the Geotechnical Engineer or their representative prior to placement of reinforcing steel and concrete. This is necessary to observe that the bearing materials at the bottom of the excavations are similar to those encountered in our borings, that excessive loose materials, mixed bearing conditions, and water are not present in the excavations. If soft soils are encountered in the foundation excavations, they should be removed and replaced with compacted engineered fill material, flowable fill, or lean concrete up to the design foundation bearing elevations.

Uplift Resistance

Resistance to vertical force (uplift) is provided by the weight of the concrete footing plus the weight of the soil directly above the footing. For this site, it is recommended that the ultimate uplift resistance be based on total unit weights for soil and concrete of 125 pcf and 150 pcf, respectively. The calculated ultimate uplift resistance should be reduced by a factor of safety of 1.2 to calculate the allowable uplift resistance.

Lateral Resistance

Horizontal loads acting on shallow foundations will be resisted by passive earth pressure acting on one side of the footing and by base adhesion for footings in soil or limestone. Resistance to sliding for foundations bearing on natural/compacted soil or limestone should be calculated utilizing an ultimate coefficient of friction of 0.30 or 0.70, respectively. The ultimate resistance for these foundations should be limited to 1,050 psf (soil) or 3,150 psf (rock). An equivalent fluid pressure of 250 pcf (soil) or 350 pcf (rock) should be utilized to determine the ultimate passive resistance, if required.

AREA FLATWORK

It should be noted that ground-supported flatworks such as walkways, courtyards, etc. will be subject to the same magnitude of potential soil-related movements as discussed previously (see *Expansive Soil-Related Movement* section). Thus, where these types of elements abut rigid structure foundations, differential movements should be anticipated. As a minimum, we recommend that flexible joints be provided where such elements abut the main structure to allow for differential movement at these locations. Where the potential for differential movement is objectionable, it may be beneficial to consider methods of reducing anticipated movements such as transitioning the select fill building pad to beneath critical sections of flatwork.

For flatwork supported by 6 inches of compacted crushed rock, a subgrade modulus (k-value) of 150 pci may be utilized for slabs constructed for this project. The subgrade modulus may be increased to 250 pci if the floor slabs and flatwork are underlain by 2 feet or more of compacted aggregate select fill.

FOUNDATION CONSTRUCTION CONSIDERATIONS

SITE DRAINAGE

Drainage is an important key to the successful performance of any foundation. Good surface drainage should be established prior to and maintained after construction to help prevent water from ponding within or adjacent to the foundation and to facilitate rapid drainage away from the foundation. Failure to provide positive drainage away from the structure can result in localized differential vertical movements in soil supported foundations and floor slabs.

Current ordinances, in compliance with the Americans with Disabilities Act (ADA), may dictate maximum slopes for walks and drives around and into new structures. These slope requirements can result in drainage problems for structures supported on expansive soils. We recommend that, on all sides of the structure, the maximum permissible slope be provided away from the structure.

Where a select fill overbuild is provided outside of the floor slab/foundation footprint, the surface should be sealed with an impermeable layer (pavement or clay cap) to reduce infiltration of both irrigation and surface waters. Careful consideration should also be given to the location of water bearing utilities, as well as to provisions for drainage in the event of leaks in water bearing utilities. All leaks should be immediately repaired.

SITE PREPARATION

All the areas to support select fill should be stripped of all vegetation, organic topsoil, existing fill, if any, pavements, utilities and associated backfill.

Exposed subgrades should be thoroughly proofrolled in order to locate weak, compressible zones. A fully-loaded tandem wheeled dump truck or a similar heavily-loaded piece of construction equipment should be used for planning purposes. Proofrolling operations should be observed by the Geotechnical Engineer or their representative to document subgrade condition and preparation. Weak or soft areas identified during proofrolling should be removed and replaced with suitable, compacted engineered fill, free of organics, oversized materials, and degradable or deleterious materials.

In areas where clay will remain in place or where clays remain after stripping, the exposed subgrade should be moisture conditioned. This should be done after completion of the proofrolling operations and just prior to fill placement and/or slab/foundation construction. Moisture conditioning is done by scarifying to a minimum depth of 6 in. and recompacting to a minimum of 95 percent of the maximum density determined from TxDOT, Tex-114-E or ASTM D698, Compaction Test. The moisture content of the subgrade should be maintained within the range of optimum moisture content to 3 percentage points above optimum moisture content until permanently covered.

ON-SITE ROCK FILL

If excavations extend to significant depths into the limestone formation, consideration can be given to utilizing the excavated limestone for select fill. However, processing of the excavated material will be required to reduce the maximum particle size to 4 in. Furthermore, special care will be required during excavation activities to separate organics and any plastic clay seams encountered. In addition, the processed material must meet the specifications given above for alternative select fill materials. If on-site materials cannot be processed to meet the required criteria, imported select fill materials should be utilized.

SELECT FILL

Materials used as select fill preferably should be crushed stone or gravel aggregate. Recommendations for granular select fill materials are provided below:

Imported Crushed Limestone Base – Imported crushed limestone base materials should be crushed stone or gravel aggregate. We recommend that materials specified for use as select fill meet the TxDOT 2014 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, Item 247, Flexible Base, Type A or B, Grades 1-2 or 3.

Soils classified as CH, MH, ML, SM, GM, OH, OL and Pt under the USCS are not considered suitable for use as select fill materials at this site.

Select Fill Placement and Compaction

Select fill should be placed in loose lifts not exceeding 8 in. in thickness and compacted to at least 95 percent of maximum density as determined by TxDOT, Tex-113-E, Compaction Test, or 98 percent of maximum density as determined by ASTM D698. If fill materials supporting movement sensitive structures are placed that are 8 ft or thicker, we recommend that ASTM D1557 Modified Compaction Test be utilized in lieu of the above compaction methods. The moisture content of the fill should be maintained within the range of 2 percentage points below to 2 percentage points above the optimum moisture content until final compaction for imported crushed limestone base. For low PI and granular pit-run materials, the moisture content of the fill should be maintained within the range of optimum to plus 3 percentage points above the optimum moisture content until final compaction.

General Fill Placement and Compaction

The remaining fill may be compacted to at least 95 percent of maximum density as determined by TxDOT, Tex-114-E, Compaction Test, or ASTM D698. The moisture content of the fill should be maintained within the range of optimum to plus 3 percentage points above the optimum moisture content until final compaction.

SHALLOW FOUNDATION EXCAVATIONS

Shallow foundation excavations should be observed by the Geotechnical Engineer or their representative prior to placement of reinforcing steel and concrete. This is necessary to observe that the bearing soils at the bottom of the excavations are similar to those encountered in our boring and that excessive loose materials and water are not present in the excavations. If soft pockets of soil are encountered in the foundation excavations, they should be removed and replaced with a compacted non-expansive fill material or lean concrete up to the design foundation bearing elevations.

EXCAVATIONS AND TEMPORARY SLOPES

Depending on the planned improvement depth(s), temporary slopes or retention systems may be required. In areas where back slopes are feasible and have heights less than 20 ft, excavation slopes should be consistent with safety regulations. Worker safety and classification of soil type is the responsibility of the contractor. The surficial soils encountered during the boring are anticipated to consist of relatively hard fine-grained soils. Hence, temporary slopes should be classified as OSHA Type A soil. Excavations into intact/competent bedrock may be performed vertically. If weathered bedrock is encountered and depending on the degree of weathering, this material may be considered as Type A material.

For Type A material, the temporary slopes may be constructed at 3/4V:1H. Excavations extending deeper than 20 ft must be evaluated by a professional engineer.

The contractor should be aware that excavation depths and inclinations (including adjacent existing slopes) should not exceed those specified in local, state, or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if not followed, the contractor, or earthwork or utility subcontractors could be subjected to substantial penalties. Construction site safety is the sole responsibility of the contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations.

Temporary slopes left open may undergo sloughing and result in an unstable situation. The contractor should evaluate stability and failure consequences before open cut slopes are made. Minor sloughing of open face slopes may occur. If the slope is expected to remain open for an extended time, an impermeable membrane covering the slopes could be considered as a means to reduce the potential for slope degradation and instability.

It is important to note that soils encountered in the construction excavations may vary across the site and that even if the OSHA criteria are used, there is a potential for slope failure. If different subsurface conditions are encountered at the time of construction, **RKI** should be contacted to evaluate the conditions encountered.

An excavated temporary slope may not be feasible at all locations, and a temporary retention system may be required. While many different types and configurations of retention systems can be used, the more common include trench boxes or braced systems. The design of the system should be performed by the contractor that performs the work. The design should account for the possibility of overexcavating unsuitable or disturbed subgrades. The contractor should also be responsible for monitoring the performance of the retention system. OSHA regulations should be followed with respect to bracing requirements. Worker safety and classification of soil type is the responsibility of the contractor.

EXCAVATION EQUIPMENT

Please note that limestone bedrock was encountered in our boring at relatively shallow depths below the existing ground surface. Therefore, excavations at this site will require removal of the underlying rock formation. The Edwards limestone is hard to very hard in induration, is massive, and commonly contains chert seams. Consequently, excavations penetrating the rock will encounter hard to very hard materials and may be difficult to remove in narrow trenches or footing excavations. **Excavation costs should anticipate hard rock excavation for preliminary planning and construction budget.** Our boring log is not intended for use in determining construction means and methods and may therefore be misleading if used for that purpose. We recommend that earthwork and utility contractors interested in bidding on the work perform their own tests in the form of test pits to determine the quantities of the different materials to be excavated, as well as the preferred excavation methods and equipment for this site.

UTILITIES

Utilities which project through any rigid unit should be designed with either some degree of flexibility or with sleeves. Such design features will help reduce the risk of damage to the utility lines as vertical movements occur.

Our experience indicates that significant settlement of backfill can occur in utility trenches, particularly when trenches are deep, when backfill materials are placed in thick lifts with insufficient compaction, and when water can access and infiltrate the trench backfill materials. The potential for water to access the backfill is increased where water can infiltrate flexible base materials due to insufficient penetration of curbs, and at sites where geological features can influence water migration into utility trenches (such as fractures within a rock mass or at contacts between rock and clay formations). It is our belief that another factor which can significantly impact settlement is the migration of fines within the backfill into the open voids in the underlying free-draining bedding material.

To reduce the potential for settlement in utility trenches, we recommend that consideration be given to the following:

- All backfill materials should be placed and compacted in controlled lifts appropriate for the type of backfill and the type of compaction equipment being utilized and all backfilling procedures should be tested and documented. Trench backfill materials should be placed in loose lifts not exceeding 8 inches in thickness and compacted to at least 95 percent of maximum density as determined by TxDOT, Tex-113-E or Tex-114-E, Compaction Test.
- The moisture content of the fill should be maintained within the range of 2 percentage points below to 2 percentage points above the optimum moisture content for non-cohesive soils and maintained within the range of optimum to 3 percentage points above optimum moisture content for cohesive soils until final compaction.
- Consideration should be given to wrapping free-draining bedding gravels with a geotextile fabric (similar to Mirafi 140N) to reduce the infiltration and loss of fines from backfill material into the interstitial voids in bedding materials.

PAVEMENT RECOMMENDATIONS

Recommendations for a flexible base only roadway are presented in this report. In general, flexible base only pavement systems have a lower initial construction cost. However, maintenance requirements over the life of the pavement are typically much greater for flexible base only pavements. This typically requires regularly scheduled observation and repair. Drainage conditions will have a significant impact on long term performance, particularly where permeable base materials are utilized in the pavement section. Drainage considerations are discussed in more detail in a subsequent section of this report.

SUBGRADE CONDITIONS

We have assumed the subgrade in pavement areas will consist of rock subgrade. A ‘rock subgrade’ condition with a CBR of 10.0 may be utilized for the following conditions:

- If select fill material, in accordance with the Select Fill section of this report, is utilized as the subgrade fill up to the bottom of the pavement section elevation;
- If native, intact rock is exposed prior to select fill placement (if necessary); or
- If 2 ft or less of overburden surficial on-site clays remain.

DESIGN INFORMATION

The pavement section recommendations were prepared using the 1993 "Guide for the Design of Pavement Structures" by the American Association of State Highway and Transportation Officials (AASHTO). We have based our analysis on the following design parameters.

Pavement Design Parameters	
Pavement Design Parameters	Flexible Base Only Pavement
Performance Period	10 years [1]
Estimated California Bearing Ratio (CBR)	10.0
Reliability	70
Roadbed Soil Resilient Modulus for Soil Subgrade	15,000 psi

(1) Performance period estimated, and other alternatives can be provided upon request.

FLEXIBLE BASE ONLY SECTIONS

The design team has requested an option for a flexible base only roadway section. Removing the Hot Mix Asphalt (HMA) layer and leaving the same flex base thickness will shorten the section design life. Also, due to the lack of a relatively impermeable surface, flexible base only sections will be susceptible to weather and environmental conditions. However, without the HMA in place, this makes repairs/re-grading relatively easier. **The Project Civil Engineer or Owner should review anticipated traffic loading and frequencies to verify that the assumed traffic loading and frequency is appropriate for the intended use of the facility and pavement section.** Options for flexible base only sections for this site are listed in the table below:

Option [1]	Flexible Base Thickness (in.)	Lifetime ESAL's	Estimated Traffic Coefficient (Flexible ESAL's per vehicle pass)	Estimated Number of Lifetime Truck Passes
A	6	4,500	2.4	1,875
B	6 [2]	11,000	2.4	4,583
C	8	17,000	2.4	7,083
D	10	55,000	2.4	22,916
E	12	150,000	2.4	62,500
F	12 [2]	480,000	2.4	200,000

(1) Other alternatives are available and can be provided upon request.
(2) Mechanically stabilized layer (Geogrid below the base section)

The geogrid reinforcement should be selected and placed in accordance with a Type II TxDOT approved geogrid that conforms to DMS 6240. The geogrid should be placed at the bottom of the flexible (granular) base section in all cases. An alternative to the above geogrid should not be considered without approval from RKI.

GARBAGE DUMPSTERS

We recommend that reinforced concrete pads be provided in front of and beneath trash receptacles, if any. Concrete pads at this site should be a minimum of 6 in. thick. The dumpster trucks should be parked on the rigid pavement when the receptacles are lifted.

FIRE LANE

Based on available literature, an 80,000-pound fire truck will impart approximately 6.9 ESALs per pass. Therefore, the proposed pavement sections provided herein will be able to support occasional fire truck traffic.

PAVEMENT CONSTRUCTION CONSIDERATIONS

SUBGRADE PREPARATION

Areas to support pavements should be prepared in accordance with the recommendations in the *Site Preparation* section under *Foundation Construction Considerations*.

DRAINAGE CONSIDERATIONS

As with any soil-supported structure, the satisfactory performance of a pavement system is contingent on the provision of adequate surface and subsurface drainage. Insufficient drainage which allows saturation of the pavement subgrade and/or the supporting granular pavement materials will greatly reduce the performance and service life of the pavement systems.

Surface and subsurface drainage considerations crucial to the performance of pavements at this site include (but are not limited to) the following:

- Any known natural or man-made subsurface seepage at the site which may occur at sufficiently shallow depths as to influence moisture contents within the subgrade should be intercepted by drainage ditches or below grade French drains.
- Final site grading should eliminate isolated depressions adjacent to curbs, if any, which may allow surface water to pond and infiltrate into the underlying soils.
- Pavement surfaces should be maintained to help minimize surface ponding and to provide rapid sealing of any developing cracks. These measures will help reduce infiltration of surface water downward through the pavement section.

ONSITE FILL

As discussed previously, the pavement recommendations presented in this report were prepared assuming that 2 ft or less of overburden surficial on-site clays remain. If used, we recommend that onsite soils be placed as described in the *General Fill Placement and Compaction* section of this report.

FLEXIBLE BASE COURSE

The flexible base course should be crushed limestone conforming to TxDOT 2014 Standard Specifications, Item 247, Type A, Grade 1-2. Base course should be placed in loose lifts not exceeding 8 in. in thickness and compacted to at least 95 percent of maximum density as determined by TxDOT, Tex-113-E, Compaction Test, or 98 percent of maximum density as determined by ASTM D698. The moisture content of the fill should be maintained within the range of 2 percentage points below to 2 percentage points above the optimum moisture content until final compaction.

Construction Traffic

Construction traffic on prepared subgrades should be restricted as much as possible until the protective surface pavement is applied. Significant damage to the underlying layers resulting in weakening may occur if heavily loaded vehicles are allowed to use these areas.

CONSTRUCTION RELATED SERVICES

CONSTRUCTION MATERIALS TESTING AND OBSERVATION SERVICES

As presented in the attachment to this report, *Important Information About Your Geotechnical Engineering Report*, subsurface conditions can vary across a project site. The conditions described in this report are based on interpolations derived from a limited number of data points. Variations will be encountered during construction, and only the geotechnical design engineer will be able to determine if these conditions are different than those assumed for design.

Construction problems resulting from variations or anomalies in subsurface conditions are among the most prevalent on construction projects and often lead to delays, changes, cost overruns, and disputes. These variations and anomalies can best be addressed if the geotechnical engineer of record, **RKI** is retained to perform construction observation and testing services during the construction of the project. This is because:

- **RKI** has an intimate understanding of the geotechnical engineering report's findings and recommendations. **RKI** understands how the report should be interpreted and can provide such interpretations on site, on the client's behalf.
- **RKI** knows what subsurface conditions are anticipated at the site.
- **RKI** is familiar with the goals of the owner and project design professionals, having worked with them in the development of the geotechnical workscope. This enables **RKI** to suggest remedial measures (when needed) which help meet the owner's and the design teams' requirements.

- **RKI** has a vested interest in client satisfaction, and thus assigns qualified personnel whose principal concern is client satisfaction. This concern is exhibited by the manner in which contractors' work is tested, evaluated, and reported, and in selection of alternative approaches when such may become necessary.
- **RKI** cannot be held accountable for problems which result due to misinterpretation of our findings or recommendations when we are not on hand to provide the interpretation which is required.

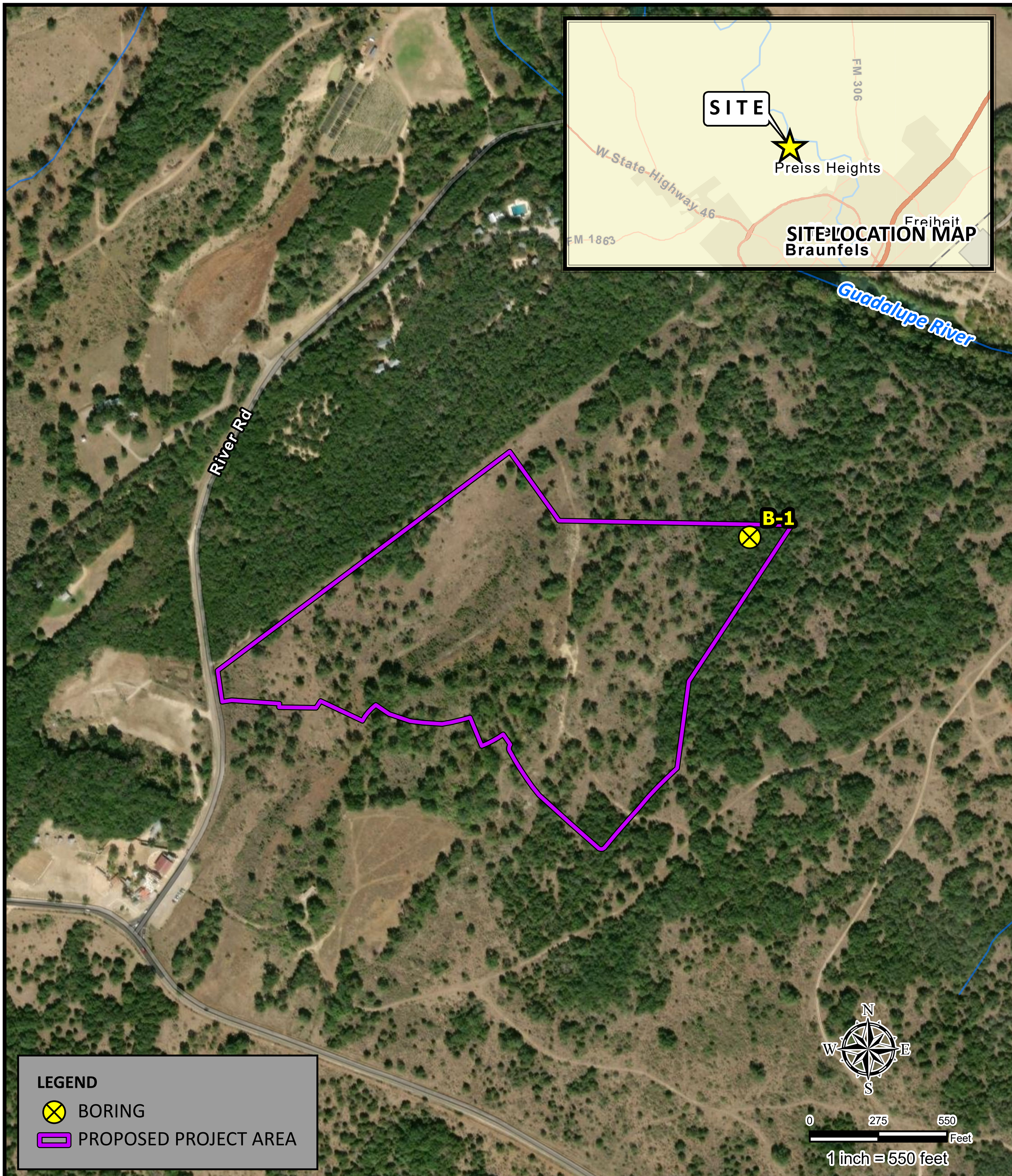
BUDGETING FOR CONSTRUCTION TESTING

Appropriate budgets need to be developed for the required construction testing and observation activities. At the appropriate time before construction, we advise that **RKI** and the project designers meet and jointly develop the testing budgets, as well as review the testing specifications as it pertains to this project.

Once the construction testing budget and scope of work are finalized, we encourage a preconstruction meeting with the selected contractor to review the scope of work to make sure it is consistent with the construction means and methods proposed by the contractor. **RKI** looks forward to the opportunity to provide continued support on this project and would welcome the opportunity to meet with the Project Team to develop both the scope and budget for these services.

* * * * * * * * * * * * * * * * * *

ATTACHMENTS



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TBPE Firm Number 3257

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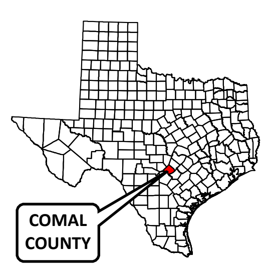
BORING LOCATION MAP

Lift Station – Precinct 30, Unit 3
Veramendi Master Planned Development
New Braunfels, Texas



PROJECT No.:	ANA24-015-00
ISSUE DATE:	5/3/2024
DRAWN BY:	BM
CHECKED BY:	SS
REVIEWED BY:	TIP

FIGURE

1

NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes

LOG OF BORING NO. B-1

Lift Station - Precinct 30, Unit 3
Veramendi Master Planned Development
New Braunfels, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Air Rotary

LOCATION: N 29.75127; W 98.13784

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT^2 (0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70 80)	PLASTICITY INDEX	% -200
			FAT CLAY, Hard, Dark Brown, with limestone fragments	50/7"			52	90
			LIMESTONE, Hard, Light Tan and Gray	ref/1"				
5				ref/1"				
				ref/1"				
				ref/1"				
10								
				ref/1"				
15								
				ref/1"				
20								
				ref/1"				
25								
				ref/1"				
30								
				ref/1"				
35								
				ref/1"				
			Boring Terminated					

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 38.6 ft	**DEPTH TO WATER:** Dry	**PROJ. No.:** ANA24-015-00	
DATE DRILLED: 5/15/2024	**DATE MEASURED:** 5/15/2024	**FIGURE:** 2	

KEY TO TERMS AND SYMBOLS

MATERIAL TYPES

SOIL TERMS

- CALCAREOUS
- CALICHE
- CLAY
- CLAYEY
- GRAVEL
- GRAVELLY
- PEAT
- SAND
- SANDY
- SILT
- SILTY
- FILL

ROCK TERMS

- CHALK
- CLAYSTONE
- CLAY-SHALE
- CONGLOMERATE
- DOLOMITE
- IGNEOUS
- LIMESTONE
- MARL
- METAMORPHIC
- SANDSTONE
- SHALE
- SILTSTONE

OTHER

- ASPHALT
- BASE
- CONCRETE/CEMENT
- BRICKS / PAVERS
- WASTE
- NO INFORMATION

WELL CONSTRUCTION AND PLUGGING MATERIALS

- BLANK PIPE
- SCREEN
- BENTONITE
- CEMENT GROUT
- BENTONITE & CUTTINGS
- CONCRETE/CEMENT
- CUTTINGS
- GRAVEL
- SAND
- VOLCLAY

SAMPLE TYPES

- AIR ROTARY
- GRAB SAMPLE
- CORE
- GEOPROBE SAMPLER
- ROTOSONIC -DAMAGED
- MUD ROTARY
- NO RECOVERY
- NX CORE
- PITCHER
- ROTOSONIC -INTACT
- SHELBY TUBE
- SPLIT BARREL
- SPLIT SPOON
- TEXAS CONE PENETROMETER
- DISTURBED

STRENGTH TEST TYPES

- POCKET PENETROMETER
- TORVANE
- UNCONFINED COMPRESSION
- TRIAXIAL COMPRESSION UNCONSOLIDATED-UNDRAINED
- TRIAXIAL COMPRESSION CONSOLIDATED-UNDRAINED

NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

PROJECT NO. ANA24-015-00

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

RELATIVE DENSITY

Penetration Resistance Blows per ft	Relative Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
> 50	Very Dense

COHESIVE STRENGTH

Resistance Blows per ft	Consistency	Cohesion TSF
0 - 2	Very Soft	0 - 0.125
2 - 4	Soft	0.125 - 0.25
4 - 8	Firm	0.25 - 0.5
8 - 15	Stiff	0.5 - 1.0
15 - 30	Very Stiff	1.0 - 2.0
> 30	Hard	> 2.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0 - 5	None
5 - 10	Low
10 - 20	Moderate
20 - 40	Plastic
> 40	Highly Plastic

ABBREVIATIONS

B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
BTEX = Total BTEX
TPH = Total Petroleum Hydrocarbons
ND = Not Detected
NA = Not Analyzed
NR = Not Recorded/No Recovery
OVA = Organic Vapor Analyzer
ppm = Parts Per Million

Qam, Qas, Qal = Quaternary Alluvium
Qat = Low Terrace Deposits
Qbc = Beaumont Formation
Qt = Fluviatile Terrace Deposits
Qao = Seymour Formation
Qle = Leona Formation
Q-Tu = Uvalde Gravel
Ewi = Wilcox Formation
Emi = Midway Group
Mc = Catahoula Formation
EI = Laredo Formation
Kknm = Navarro Group and Marlbrook Marl
Kpg = Pecan Gap Chalk
Kau = Austin Chalk

Kef = Eagle Ford Shale
Kbu = Buda Limestone
Kdr = Del Rio Clay
Kft = Fort Terrett Member
Kgt = Georgetown Formation
Kep = Person Formation
Kek = Kainer Formation
Kes = Escondido Formation
Kew = Walnut Formation
Kgr = Glen Rose Formation
Kgru = Upper Glen Rose Formation
Kgrl = Lower Glen Rose Formation
Kh = Hensell Sand

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

SAMPLING METHODS

RELATIVELY UNDISTURBED SAMPLING

Cohesive soil samples are to be collected using three-inch thin-walled tubes in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587) and granular soil samples are to be collected using two-inch split-barrel samplers in general accordance with the Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). Cohesive soil samples may be extruded on-site when appropriate handling and storage techniques maintain sample integrity and moisture content.

STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-in.-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows Per Foot	Description
25	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows drove sampler 3 inches during initial 6-inch seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Lift Station - Precinct 30, Unit 3
Veramendi Master Planned Development
New Braunfels, Texas

FILE NAME: ANA24-015-00.GPJ 5/21/2024

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-1	0.0 to 1.1	50/7"	12	74	22	52	CH		90		
	2.5 to 2.6	ref/1"	4								
	4.5 to 4.6	ref/1"	1								
	6.5 to 6.6	ref/1"	1								
	8.5 to 8.6	ref/1"	1								
	13.5 to 13.6	ref/1"	3								
	18.5 to 18.6	ref/1"	2								
	23.5 to 23.6	ref/1"	1								
	28.5 to 28.6	ref/1"	2								
	33.5 to 33.6	ref/1"	3								
	38.5 to 38.6	ref/1"	1								

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial

PROJECT NO. ANA24-015-00

RABAKISTNER

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GBC GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

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