Geotechnical Evaluation Report

Proposed I-10 Property Pavements/Roadways and
Preliminary Foundation Evaluation
South Side of I-10 and North of Intersection of
Industrial Road and Fannett Road
Beaumont, Texas

Prepared for

Parigi Property management, Ltd.
c/o Mr. Sam C. Parigi Jr.
445 North 14th Street
Beaumont, Texas 77702

01-18-2019

STATE OF TEXAS
EDEN W. THOMAS
126445
LICENSED
PROFESSIONAL ENGINEER

Eden W. Thomas, P.E.
Project Geotechnical Engineer
License Number: 126445
January 18, 2019

Project B1813347

Braun Intertec Corporation
TBPE Firm Registration No. F-12228

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January 18, 2019 Project B1813347

Parigi Property Mangement, Ltd.
c/o Mr. Sam C. Parigi, Jr.
445 North 14th Street
Beaumont, Texas 77702

Re: Geotechnical Evaluation Report
Proposed I-10 Property Pavements/Roadways and Preliminary Foundation Evaluation
South Side of I-10 and North of Intersection of Industrial Road and Fannett Road
Beaumont Texas

Dear Mr. Parigi:

We are pleased to present this Geotechnical Evaluation Report for the proposed new pavements/roadways to be located on a parcel of land located on the south side of Interstate 10 and north of intersection of Industrial Road and Fannett Road in Beaumont, Texas. The attached report contains a descriptive review of available information, our field exploration program, laboratory test results and recommendations for the design of the proposed pavements/roadways.

As requested by the Client, this report also presents preliminary foundation recommendations, and general guidelines with regard to geotechnical considerations for use in feasibility studies and cost estimating purposes for the construction of a proposed warehouse to be located in the general vicinity of the project site. A detailed design for the warehouse foundations is beyond the scope of this study and this report does not pertain to any final level of design study for actual construction of the warehouse. A future study with additional borings will be performed when structure types and locations are finalized.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have any questions about this report, or if we can provide other services in support of our work to date, please contact Eden Thomas at 409-948-8494 (ethomas@braunintertec.com) or Amal Dutta at 409-948-8494 (adutta@braunintertec.com).

Sincerely:

BRAUN INTERTEC CORPORATION
TBPE Firm Registration No. F-12228

Eden W. Thomas., P.E.
Project Geotechnical Engineer

Amal K. Dutta, Ph.D., P.E.
Principal Geotechnical Engineer

Table of Contents

A. Introduction

A.1. Project Description

Parigi Property Management Inc. contracted Braun Intertec Corporation to perform a geotechnical evaluation for the proposed pavements/roadways to be constructed on the south side of Interstate 10 and north of intersection of Industrial Road and Fannett Road in Beaumont, Texas. In addition, this report also presents preliminary foundation recommendations, and general guidelines with regard to geotechnical considerations for use in feasibility studies and cost estimating purposes for the construction of a proposed warehouse to be located in the general vicinity of the project site.

Based on the information provided by of Parigi Property Management Inc., Braun Intertec understands that the project consists of construction of new pavements/roadways on a parcel of land at the above referenced project site. The proposed pavements/roadway alignments are shown on the site and boring location plan attached in the appendix of this report. The details of traffic loading information is not available at the time of this report, however, based on the information provided by the Client it is understood that the traffic for the proposed pavements/roadways could include lightly loaded cars/pick-up trucks, delivery vans or trucks, dump trucks and occasional 18-wheeler truck traffic.

Based on the information provided by the Client, Braun Intertec also understands that the Client intends to construct a warehouse at the project site in the future. However, the exact footprint area and the location of the proposed warehouse building is yet to be determined and the Client has requested that Braun Intertec perform a preliminary geotechnical study to evaluate the subsurface soil conditions and to provide preliminary foundation design recommendations for the future warehouse building. The structural loading information are also not available, however it is understood that the proposed warehouse building will be lightly loaded.

As requested, the scope of services for the geotechnical study for the warehouse building are preliminary in nature and will not be used for construction of structure or foundations. Braun Intertec understands that a detailed geotechnical investigation with additional site specific soil borings will be performed at the subject property once the design and location of the proposed building is finalized.

While detailed final grading information is not available at this time, finished site grades are anticipated to be within two (2) feet of the existing grade.

A.2. Site Conditions and History

Based on our site visit and a review of historical areal imagery from Google Earth (most recent dated January 2018) indicates that the majority of the site has remained undeveloped at least as far back as 1938. However, our review of historical Google Earth images indicated the presence of several structures, driveways and a storage yard at the southwestern boundary of the project site and immediately east side of the proposed roadways where it connects to the Industrial Road. Our review also indicated that a drainage ditch is crossing the proposed roadway alignment at this location. It is understood that the existing drainage ditch will remain at this location and suitable culvert under the road will be designed and constructed by others.

During the time of our field exploration, Braun Intertec personnel observed the ground surface was relatively level, and generally covered with grass with sparse trees along the project site boundaries. At the time of the field program, the ground was fairly well drained.

A.3. Purpose and Scope of Services

Our scope of services for this project was to perform field exploration in general accordance with Braun Intertec's Proposal No. QTB087865-R, dated December 11, 2018, which was authorized by Mr. Parigi of Parigi Property Management Inc. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services:

- Drilling and sampling a total of eight (8) soil borings at the project site including five (5) borings along the proposed pavements/roadway alignment as depicted by the Client.
- Performing laboratory testing on selected soil samples collected during the field exploration program to aid in soil classification and engineering analysis.
- Providing general rigid and flexible pavement design recommendations.
- Providing preliminary geotechnical recommendations for conceptual foundation design for the future warehouse building.

Our scope of services does not include environmental services. Braun Intertec personnel performing the geotechnical evaluation are not trained to provide environmental services or testing. However, we can provide these services or testing at your request.

A.3.a. Subsurface Exploration Program

As requested by the Client, the subsurface soil conditions at the project site were evaluated by performing eight (8) soil borings. As defined by the Client, five (5) soil borings were drilled to a depth of about six (6) feet below the existing ground surface along the proposed roadway alignment; and three (3) soil borings were drilled in the general vicinity of the project site to a depth of about twenty (20) feet below the existing grade. The exploration locations were based on discussions and information provided by Mr. Parigi of Parigi Property Management Inc. Braun Intertec was provided with a drawing showing the conceptual layout of the proposed roadway alignment, pavement areas and general vicinity of the future development. The approximate locations of the borings are shown on the site and boring location plan included in the Appendix.

The soil borings were drilled with a truck mounted drilling rig using solid flight auger drilling technique. Samples were obtained continuously from the ground surface to a depth of 10 feet and at five-foot intervals thereafter. Undisturbed samples of cohesive soils were generally obtained using three-inch-diameter thin-wall tube samplers (Shelby Tube) in general accordance with the procedures for “Thin-Walled Tube Geotechnical Sampling of Soils” (ASTM D1587).

The undisturbed samples were immediately extruded from the sampling barrel in the field. Pocket penetrometer tests were performed on the soil samples to provide a general indication of their shear strength or consistency. The results of these tests are shown on the boring logs in the Appendix under the column heading "PP." All samples were inspected and visually classified by Braun Intertec’s onsite soil technician. Representative portions of the samples were placed in moisture proof containers and returned to Braun Intertec’s certified laboratory for additional testing.

A.3.b. Geotechnical Laboratory Testing Program

The soil samples obtained during the field exploration were transported to Braun Intertec’s laboratory and selected soil samples were tested to determine material properties for engineering evaluation. Laboratory testing was accomplished in general accordance with ASTM procedures. Laboratory testing on selected samples included the following:

- *Moisture content tests (ASTM D2216)* – intended to aid in classification, evaluation of moisture condition, and estimation of engineering parameters;
- *Atterberg limits tests (ASTM D4318)* – intended to evaluate the soils’ plasticity, estimate whether the materials have the potential for shrink/swell, to aid in estimation of engineering parameters, and to evaluate the reusability of proposed cut/balance materials, and;
- *Percent Passing #200 sieve (ASTM D1140) and/or Sieve Analysis (ASTM D 422)* – intended to aid in classification and determination of the sand and clay sized particle distribution.
- *Unconfined compression tests (ASTM D2166)* – tests performed to measure the soils’ undrained shear strength.

Results of these laboratory analyses can be found on the boring logs in the appendix.

B. Results

B.1. Geologic Overview

Braun Intertec's review of published geological information indicates the project site is mapped in an area identified as part of the Beaumont Formation. Based on the geologic atlas and USGS formation description, the Beaumont Formation consists of mostly clay, silt and sand; includes mainly stream channel, point-bar, natural levee, backswamp, and to lesser extent coastal marsh and mud-flat deposits; concretions of calcium carbonized by relict river channels shown by meander patterns and pimple mounds on meanderbelt ridges.

B.2. Soil Boring Results

The Appendix includes Log of Borings sheets for our test borings. The logs present the results of laboratory tests performed on selected soil samples with details description of soils, and groundwater information as encountered during the time of our field exploration. A descriptive terminology key in the Appendix can be used to interpret terms used in the logs.

Stratigraphy boundaries were inferred from observations in the field, review of the samples and laboratory test results. The boundaries are still only approximate, likely vary away from the specific boring locations, and may also occur as gradual rather than abrupt transitions.

Table 1 provides a generalized subsoil strata summary of the materials encountered during the subsurface exploration performed at the site.

Table 1: Subsoil Strata Summary

Strata	Soil Type - ASTM Classification	Depth (feet)*	Commentary and Details
Clays	Fill	0 – 6	▪ Moisture condition: generally moist ▪ Dark brown and black in Color ▪ With root fibers
Clays	CH	0 - 20	▪ Moisture condition: generally moist ▪ Dark brown, light brown and gray in Color ▪ Typically medium to stiff ▪ With root fibers to 6 feet

*Note: Reference from the existing grade at the boring locations

B.3. Groundwater

Groundwater was encountered in 2 of the 8 borings (only in Borings B-6 and B-7) at depths ranging from 17 to 19 feet below the existing ground surface during and immediately after the drilling activities. The groundwater levels are recorded on the boring logs presented in the appendix. It should be realized that the groundwater level was recorded during and immediately after initial encounter and do not represent stabilized ground water readings.

It is to be noted that free groundwater may take days or longer to reach full equilibrium in the boreholes. Boreholes were immediately backfilled with auger cuttings in accordance with our scope of work. Should the project team identify a need for a more accurate determination of groundwater depth, Braun Intertec will be available to install piezometers upon request. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal cycles, surface drainage modifications, and other factors. We recommend that the Contractor determine the actual groundwater levels at the area at the particular time of a given construction activity.

B.4. Laboratory Test Results

Braun Intertec performed Unconfined Compression tests (ASTM D 2166), Atterberg Limit tests (ASTM D4318), percent passing a No. 200 sieve (ASTM D 422), and Moisture Content tests (ASTM D2216). The individual test results are presented on the Log of Boring sheets in the Appendix.

The moisture content of the soils encountered generally varied from approximately 29 to 58 percent throughout the depths of the borings. Liquid limits determined for the selected cohesive soils tested generally ranged from 56 to 120 with corresponding plasticity indices generally ranging from 38 to 90. Atterberg limit testing helps in the classification of the soils, and provides an indication of shrink-swell potential. These results of Atterberg Limit testing

C. Preliminary Evaluation and Recommendations

C.1 Geotechnical Discussion

Braun Intertec understands that the proposed construction will include pavements and roadways at the project site.

Additionally, it is understood that the property at the project site might be used for construction of a warehouse building. It is also understood that the property is being evaluated for its suitability for the proposed construction. The exact location of the building, specific structural details and anticipated loading information was not available at the time of this report. It is anticipated that once design plans are finalized, Braun Intertec will be contacted to conduct a detailed geotechnical exploration within the plan area of the proposed building to provide final recommendations. Information regarding the building foundation provided in this report should not be used for design and construction purposes.

However, our pavement recommendations provided in this report can be used for the construction of the proposed pavements/roadways.

Highly expansive fat clays were encountered in all the borings at the project site. In designing the floor slab or foundation system, the structural engineer should take the potential for shrink/swell movement into account.

The site is generally suitable for the proposed construction. The preliminary recommendations for the warehouse building provided in the following sections are prepared based on the assumption that the final grade elevation for the proposed structures will be within two feet of the existing site grade. The preliminary recommendations for the proposed building construction are presented in the following report sections. Additionally, our recommendations for rigid and flexible pavements are also presented in this report.

C.2 Soil Shrink-Swell Potential

The laboratory test results indicated that the subsurface natural soils at the project site have high potential for shrink-swell with moisture variation. The soils have a tendency to swell when soil moisture increases and shrink when the soil moisture decreases. Moisture variations occur in soils due to seasonal changes for a depth known as active depth. The active depth in this area is about seven (7) feet. The amount of potential movement to shrink and swell with soil moisture variations is represented or indicated by Potential Vertical Rise (PVR). In designing the foundation system, the structural engineer should take the potential for shrink/swell movement into account.

A PVR value of approximately $3^{1}/_{2}$ to $4^{1}/_{2}$ inches were calculated for this site using the Texas Department of Transportation (TxDOT) TEX-124-E method. A PVR value of about 2 to $2^{1}/_{4}$ inches were calculated for this site using the method developed by the American Association of State Highway Transportation Officials (AASHTO).

For this site, in order to reduce the PVR to less than one (1) inch, it is recommended that a minimum of three and half ($3^{1}/_{2}$) feet of low plasticity structural fill should be placed between the natural soils and the structure (floor-slab). This thickness can be achieved through excavation and replacement, placement of new fill over the existing soils, or combination thereof. The structural fill should be placed within the plan area of the structure and to a distance of at least five feet beyond the perimeter of the structure. Soil Property requirements for the structural fill are provided in the Site Preparation Section of this report.

C.3 Site Preparation

The site preparation recommendations provided in this section are for grade supported structures such as floor slabs. In the event a structurally supported floor slab is used, the site preparation recommendations in this section can be waived and only general subgrade preparation is required, which is expected to include, but not limited to, stripping and removal of any debris, pavements, topsoil, and organic materials from construction areas.

As previously discussed, the subsurface natural soils at this site are high plasticity clays with a high potential for shrink-swell behavior. For this site, to reduce the PVR to one (1) inch or less, it is recommended that at least $3^{1}/_{2}$-feet of low plasticity structural fill be placed between the natural soils and floor slab. The structural fill should be placed within the plan area of the structure and to a distance of at least five (5) feet beyond the perimeter of the structure.

Braun Intertec recommends clearing the site of surficial vegetation (if any), topsoil, debris, organic matter, and other deleterious materials. After clearing, stripping, and excavating to the required grade depth, the exposed soil should be proof-rolled to locate any soft or loose areas. Proof-rolling can be performed in accordance with Item 216 of TxDOT Specification. Soils that are observed to rut or deflect under the moving load should be undercut and replaced with properly compacted structural fill.

Structural fill materials should be sandy clay or clayey sand soils free of organic or other deleterious materials, have a maximum clay lump size of less than three inches, and have a liquid limit not greater than 40 and a plasticity index between 10 and 20. Structural fill should be compacted to at least 95 percent of standard Proctor maximum dry density as determined by ASTM D 698.

C.4 Preliminary Recommendations of Drilled and Underreamed Piers

The proposed warehouse building can be supported on drilled and underreamed piers. The drilled and under-reamed piers should be placed on stiff clays at a minimum depth of twelve (12) feet. Based on the results of field exploration, laboratory testing and bearing capacity theory, allowable loads for drilled footings will be as shown in Table 2:

Table 2. Allowable Capacity of Drilled and Underreamed Piers

Foundation Type	**Footing Depth**	**Allowable Net Bearing Pressure, psf**	
		Dead Load (Dead + Sustained Live Load)	Total Load (Dead + Live)
Drilled and Underreamed Piers	Minimum 12 feet below existing grade	3,000	4,500

Foundations proportioned in accordance with these values will have a factor of safety of 3.0 and 2.0 with respect to shearing failure for dead and total loading, respectively. Footing weight below final grade can be neglected in the determination of design loading.

Based on the field and laboratory testing data, it is our opinion that the drilled footings should be designed and constructed as follows:

- The recommended bell to shaft ratio is 3:1
- In case of borehole sloughing, bell to shaft ratio required to be 2:1 .
- Based on our current groundwater observations, the drilled footing excavations will probably not encounter groundwater.
- Drilled footings can probably be installed using a dry method of construction.

C.5 Preliminary Slab-on-Grade Recommendations

For this site, in order to reduce the PVR to one inch or less, it is recommended that at least $3^1/_2$ feet of low plasticity structural fill should be placed between the natural soils and the final grade.

Provided the site work outlined in the Site Preparation section is performed, the floor slab could be grade supported on compacted structural fill soils. A modulus of subgrade reaction, k, of 125 pci (based on published data from 1'x1' plate load test) could be obtained for slab design when the structural fill soils is compacted to at least 95 percent of the standard Proctor maximum dry density by ASTM D698

As an alternative to providing structural fill between the slab and underlying natural soil, the effects of swelling soil movements or fill settlement on the floor slab may be avoided by providing structural floor slab supported above the soil spanning between the drilled and underreamed pier foundations. A minimum of six (6) inches of void space should be provided between the structurally supported floor-slab and the soil.

C.6 Pavement Recommendations

In order to design a pavement, the subgrade soil conditions and anticipated levels of traffic must be known. The subgrade soils are evaluated based on our limited testing. The anticipated traffic on the proposed pavement is not known at this time. Based on our previous experience with similar facilities, the traffic for the proposed pavement could include lightly loaded cars/pick-up trucks, delivery vans or trucks, dump trucks and occasional 18-wheeler truck traffic

Pavement Subgrade Preparation: It is recommended that any vegetation, fill soils, roots, and organic material be removed from the site and disposed. Voids created after removal of tree stumps and roots, should be compacted with properly compacted structural fill soils. Positive drainage should be maintained after stripping such that water is not allowed to pond on the subgrade.

The results of laboratory plasticity tests indicate that the subsurface soils at this site have high potential to shrink or swell. Pavements placed on soils with high shrink-swell potential would experience movements. Therefore, as a minimum, at least the upper six (6) inches of the natural clays soils should be lime stabilized.

After stripping and excavating to the desired grade, the exposed subgrade should be proof-rolled to locate any soft or loose areas. Proof rolling can be performed in accordance with Item 216 of TxDOT Specification. Soils that are observed to rut or deflect under the moving load should be undercut and replaced with properly compacted structural fill. The proof-rolling and undercutting activities should be witnessed by a Braun Intertec representative and should be performed during periods of dry weather. It is anticipated that the upper six (6) inches of exposed soils would require a lime application of about six (6) to seven (7) percent, (expressed as percent of the dry weight of the soil to be treated). In order to determine the exact percentage of lime addition, lime series testing should be performed in accordance with ASTM D 6276 or TxDOT test method TEX-112-E. Lime stabilization should be performed in accordance with the applicable provisions of Item 260 of the TxDOT Specification. Lime stabilized subgrade should be compacted to at least 95 percent of standard Proctor maximum dry density as determined by ASTM D 698 within zero (0) to plus three (+3) percentage points of the optimum moisture content.

In lieu of lime stabilization, if at least 12 inches of sandy clay structural fill is provided below the pavement materials, lime stabilization is not necessary. Structural fill materials should be sandy clay soils free of organic or other deleterious materials, have a maximum clay lump size of less than three inches, and have a liquid limit not greater than 40 and a plasticity index between 10 and 20. Structural fill should be compacted to at least 95 percent of standard Proctor maximum dry density as determined by ASTM D 698. Each lift of structural fill should be compacted and tested by a representative of the geotechnical engineer prior to placement of subsequent lifts. Care should be taken to apply uniform compactive effort throughout the fill and fill scope areas. The moisture content and the degree of compaction of the structural fill soils should be maintained until the subgrade areas are paved.

Pavement Design: AASHTO design methodology could be used to design the pavements. According to AASHTO design methodology, the pavement design thickness considers pavement performance, traffic, subgrade soils, pavement materials, environment, drainage and reliability. Traffic includes several types of vehicles with various magnitudes of axle loads that may be subjected to the pavement during its service life. The design involves a traffic analyses that converts various types of vehicles with various magnitudes axle loads to a number of 18-kip equivalent single axle load repetitions. The design engineer should perform the traffic analyses to compute the number of ESALs repetitions that would be subjected to the pavement during its service life or design life. Based on the computed ESALs, an economical and appropriate pavement can be designed accordingly.

Based on AASHTO design methodology and our experience with similar projects in the local area, we are providing pavement thickness for both rigid pavement and flexible pavement systems in Tables 3.1 and 3.2 respectively. The tables include pavement sections corresponding to generic traffic levels (total ESALs). In general, pavement thicknesses corresponding to the lower traffic conditions may be considered for parking areas, while the higher traffic conditions may be considered for driveways, exit and entry lanes and frequently used areas. Pavements within trash pick-up areas should be Portland cement concrete with at least 7 inches in thickness.

TABLE 3. 1: RIGID PAVEMENT DESIGN THICKNESS

Pavement Material(s)	Design Thickness	
Life Expectancy, ESALs	Light Duty (1) 115,000	Heavy Duty (2) 700,000
Portland Cement Concrete	5.0 in.	7.0 in.
Subgrade or Subbase	As Discussed Previously	

TABLE 3. 2: FLEXIBLE PAVEMENT DESIGN THICKNESS

Pavement Material(s)	Design Thickness	
Life Expectancy, ESALs	Light Duty(1) 15,000	Heavy Duty(2) 75,000
Approx. Structural Number, SN = $\sum ai * t i$	1.6	2.3
Hot Mix Asphalt Concrete Item 340. TXDOT-Type D	2.0 in.	3.0 in.
Crushed Limestone Base Item 247. TXDOT-Type A, Grade 1	6.0 in.	8.0 in.
Subgrade or Subbase	As Discussed Previously	

(1) *Light duty pavement sections should be placed in the proposed passenger vehicle parking areas. This should be considered in areas not expected to be traversed by "heavy" truck traffic.*
(2) *Heavy duty pavement sections should be placed in the proposed drive lanes and entrance/exit areas.*

The Client also requested Braun Intertec to provide flexible pavement design thickness considering hot mix asphalt concrete layer thickness of about 1.5 inches. Accordingly, Table 3.3 provides pavement thickness with reduced thickness of asphalt concrete layer.

TABLE 3. 3: FLEXIBLE PAVEMENT DESIGN THICKNESS

Pavement Material(s)	Design Thickness	
Life Expectancy, ESALs	Light Duty(1) 15,000	Heavy Duty(2) 75,000
Approx. Structural Number, SN = $\sum ai * t i$	1.6	2.3
Hot Mix Asphalt Concrete Item 340. TXDOT-Type D	1.5 in.	1.5 in.
Crushed Limestone Base Item 247. TXDOT-Type A, Grade 1	8.0 in.	14.0 in.
Subgrade or Subbase	As Discussed Previously	

(1) *Light duty pavement sections should be placed in the proposed passenger vehicle parking areas. This should be considered in areas not expected to be traversed by "heavy" truck traffic.*
(2) *Heavy duty pavement sections should be placed in the proposed drive lanes and entrance/exit areas.*

The final pavement sections should be adjusted by the project Civil Engineer based the actual design traffic loading criteria for the project when that information becomes available. We understand that budgetary considerations sometimes warrant thinner pavement sections than those presented in Tables 3.1 and 3.2. However, the Owner, and the project designers should be aware that thinner pavement sections (as shown in Table 3.3) may result in increased maintenance costs and lower than anticipated pavement life.

Related civil design factors such as drainage, cross-sectional configurations, surface elevations and environmental factors which will significantly affect the service life of the pavement, must be included in the preparation of the construction drawings and specifications. Concrete pavement slabs should be provided with adequate steel reinforcement. Proper finishing of concrete pavements requires the use of sawed and sealed joints. Joint spacing is recommended at maximum 15-foot intervals for plain concrete. Dowel bars should be used to transfer loads at the transverse joints. Normal periodic maintenance will be required.

Surface water infiltration to the pavement subgrade layers may soften the subgrade soils. Considering several factors in the pavement design can reduce surface infiltration. To summarize, the following are some of the factors that need to be emphasized in order to maintain proper drainage.

1) Appropriate slopes should be provided.
2) Joints should be properly sealed and maintained.
3) Side drains or sub drains along a pavement section may be provided.
4) Proper pavement maintenance programs such as sealing surface cracks, and immediate repair of distressed pavement areas should be adopted.
5) During and after the construction, site grading should be kept in such a way that the water drains freely off the site and off any prepared or unprepared subgrade soils.
6) Excavations should not be kept open for a long period of time.

D. Procedures

D.1. Test Boring Drilling and Sampling

Braun Intertec drilled the test boring with an all-terrain mounted core and auger drill equipped with a rotary wash system. We performed the borings in general accordance with ASTM Standards taking penetration or Shelby tube samples at 2-foot or 5-foot intervals in general accordance to ASTM D1586.

D.2. Boring Logs

The Appendix includes Log of Boring sheets for our test borings. The logs identify and describe the penetrated geologic materials, and present the results of SPT blow counts, pocket pen readings and other in-situ tests performed. The logs also present the results of laboratory tests performed on penetration test samples, and groundwater measurements.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

D.3. Material Classification and Testing

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used. The logs of borings located in the Appendix note the results of the laboratory tests performed on geologic material samples. Braun performed the tests in general accordance with ASTM procedures.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

Braun Intertec has developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work, or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

E.2. Continuity of Professional Responsibility

E.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. Braun Intertec should be retained to review all geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

E.2.b. Construction Observations and Testing

We recommend retaining Braun Intertec to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

E.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix

SITE AND BORING LOCATION PLAN

I-10 Property Roadway and Preliminary Foundation Evaluation	Beaumont, Texas	Project B1813347

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LOG OF BORING

Braun Project B1813347
I-10 Property-Roadway and Preliminary Foundation Evaluation
Beaumont, TX

BORING: **B-1**

LOCATION:

DRILLER: E.McClanahan | METHOD: Solid Flight Auger | DATE: **12/20/18** | SCALE: **1" = 4.4'**

Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PP	MC %	DD pcf	LL	PL	PI	P200 %	Tests or Notes
2.0	FILL	Drak Brown, FAT CLAY (CH) (Possible Fill Soils) -with root fibers @ 0 to 2'			2.25	39						
6.0	CH	Drak Brown, FAT CLAY (CH), Medium to Stiff			1.50	46	74	120	30	90	93	UC = 0.78 tsf
					1.50	45						
		-No groundwater was encountered while drilling. -Boring backfilled with soil cuttings upon completion.										

LOG OF BORING - SOUTH N:\GINT\PROJECTS\AX PROJECTS\2018\B1813347 I-10 PROPERTY WAREHOUSE.GPJ BRAUN_V8_CURRENT.GDT 1/10/19 12:55 (See Descriptive Terminology sheet for explanation of abbreviations)

BRAUN INTERTEC

LOG OF BORING

Braun Project B1813347 I-10 Property-Roadway and Preliminary Foundation Evaluation Beaumont, TX	BORING: **B-2** LOCATION:
DRILLER: E.McClanahan / METHOD: Solid Flight Auger	DATE: **12/20/18** / SCALE: **1" = 4.4'**

Depth feet 0.0	Symbol		Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PP	MC %	DD pcf	LL	PL	PI	P200 %	Tests or Notes
	FILL		Dark Brown & Black, FAT CLAY (CH) (Possible Fill Soils) -with root fibers @ 0 to 6'			3.00	43	76	102	26	76	91	UC = 1.32 tsf
						1.25	44						
						1.75	50						
6.0			-No groundwater was encountered while drilling. -Boring backfilled with soil cuttings upon completion.										

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING - SOUTH N:\GINT\PROJECTS\AX PROJECTS\2018\B1813347 I-10 PROPERTY WAREHOUSE.GPJ BRAUN_V8_CURRENT.GDT 1/10/19 12:56

BRAUN INTERTEC

LOG OF BORING

Braun Project B1813347
I-10 Property-Roadway and Preliminary Foundation Evaluation
Beaumont, TX

BORING: **B-3**
LOCATION:

DRILLER: E.McClanahan | METHOD: Solid Flight Auger | DATE: **12/20/18** | SCALE: **1" = 4.4'**

Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PP	MC %	DD pcf	LL	PL	PI	P200 %	Tests or Notes
	CH	Dark Brown, FAT CLAY (CH), Medium -with root fibers @ 0 to 4'			1.25	55						
					0.75	58						
					1.75	42	79	107	27	80	96	UC = 0.74 tsf
6.0												
		-No groundwater was encountered while drilling. -Boring backfilled with soil cuttings upon completion.										

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING - SOUTH N:\GINT\PROJECTS\AX PROJECTS\2018\B1813347 I-10 PROPERTY WAREHOUSE.GPJ BRAUN_V8_CURRENT.GDT 1/10/19 12:56

LOG OF BORING

Braun Project B1813347
I-10 Property-Roadway and Preliminary Foundation Evaluation
Beaumont, TX

BORING: **B-4**
LOCATION:

DRILLER: E.McClanahan | METHOD: Solid Flight Auger | DATE: **12/20/18** | SCALE: **1" = 4.4'**

Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PP	MC %	DD pcf	LL	PL	PI	P200 %	Tests or Notes
	CH	Dark Brown, FAT CLAY (CH), Medium to Stiff -with root fibers @ 0 to 4'			1.25	43						
					0.75	49	77	100	25	75	91	UC = 0.74 tsf
					2.25	39						
6.0												
		-No groundwater was encountered while drilling. -Boring backfilled with soil cuttings upon completion.										

(See Descriptive Terminology sheet for explanation of abbreviations)

BRAUN INTERTEC

LOG OF BORING

Braun Project B1813347 I-10 Property-Roadway and Preliminary Foundation Evaluation Beaumont, TX	BORING: **B-5** LOCATION:
DRILLER: E.McClanahan / METHOD: Solid Flight Auger	DATE: **12/20/18** / SCALE: **1" = 4.4'**

Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PP	MC %	DD pcf	LL	PL	PI	P200 %	Tests or Notes
	CH	Dark Brown & Gray, FAT CLAY (CH), Soft to Very Stiff -with root fibers @ 0 to 4'			1.50	51	71	102	25	77	96	UC = 0.44 tsf
					1.50	42						
		-with trace SAND @ 4' to 6'			3.50	24						
6.0		-No groundwater was encountered while drilling. -Boring backfilled with soil cuttings upon completion.										

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING - SOUTH N:\GINT\PROJECTS\AX PROJECTS\2018\B1813347 I-10 PROPERTY WAREHOUSE.GPJ BRAUN_V8_CURRENT.GDT 1/10/19 12:57

BRAUN INTERTEC

LOG OF BORING

Braun Project B1813347 I-10 Property-Roadway and Preliminary Foundation Evaluation Beaumont, TX	BORING: B-6 LOCATION:
DRILLER: E.McClanahan · METHOD: Solid Flight Auger	DATE: 12/20/18 · SCALE: 1" = 4.4'

Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PP	MC %	DD pcf	LL	PL	PI	P200 %	Tests or Notes
	CH	Dark Brown, FAT CLAY (CH), Medium to Stiff -with root fibers @ 0 to 4'			1.25	44						
					1.50	42	79	93	24	69	96	UC = 0.59 tsf
		-becomes light Brown @ 4' to 8'			1.75	36						
		-with trace GRAVEL @ 6' to 8'			2.25	29		72	20	52		
					1.00	34	86					UC = 0.48 tsf
					3.00	40						
				▼ ▽								
					2.75	39						
20.0		-Ground water encountered @ 18 feet and rose to 17 feet after 15 minutes -Boring backfilled with soil cuttings upon completion.										

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING - SOUTH N:\GINT\PROJECTS\2018\B1813347 I-10 PROPERTY WAREHOUSE.GPJ BRAUN_V8_CURRENT.GDT 1/10/19 12:52

BRAUN℠ INTERTEC

LOG OF BORING

Braun Project B1813347
I-10 Property-Roadway and Preliminary Foundation Evaluation
Beaumont, TX

BORING:	**B-7**
LOCATION:	
DRILLER: E.McClanahan	METHOD: Solid Flight Auger
DATE: **12/20/18**	SCALE: **1" = 4.4'**

Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PP	MC %	DD pcf	LL	PL	PI	P200 %	Tests or Notes
	CH	Dark Brown & Light Brown, FAT CLAY (CH), Medium to Stiff - with root fibers @ 0 to 6'			1.25	32	90	71	22	49	93	UC = 0.84 tsf
					1.75	39						
					2.25	35		89	21	68		
					2.00	33						
					1.75	39						
					2.50	36	87	98	27	71		UC = 1.08 tsf
				▼ ▽	2.75	33						
20.0		-Ground water encountered @ 19 feet and rose to 18 feet after 15 minutes -Boring backfilled with soil cuttings upon completion.										

(See Descriptive Terminology sheet for explanation of abbreviations)

Braun Project B1813347
I-10 Property-Roadway and Preliminary Foundation Evaluation
Beaumont, TX

BORING: **B-8**

LOCATION:

DRILLER: E.McClanahan | METHOD: Solid Flight Auger | DATE: **12/20/18** | SCALE: **1" = 4.4'**

Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PP	MC %	DD pcf	LL	PL	PI	P200 %	Tests or Notes
	CH	Dark Brown, FAT CLAY (CH), Medium to Stiff - with root fibers @ 0 to 2'			2.00	33						
					1.25	38		96	23	73	96	
					2.25	35	86					UC = 1.19 tsf
					2.25	33						
					2.50	30	98	56	18	38		UC = 1.57 tsf
					2.75	39						
20.0					2.75	41						
		-No groundwater was encountered while drilling. -Boring backfilled with soil cuttings upon completion.										

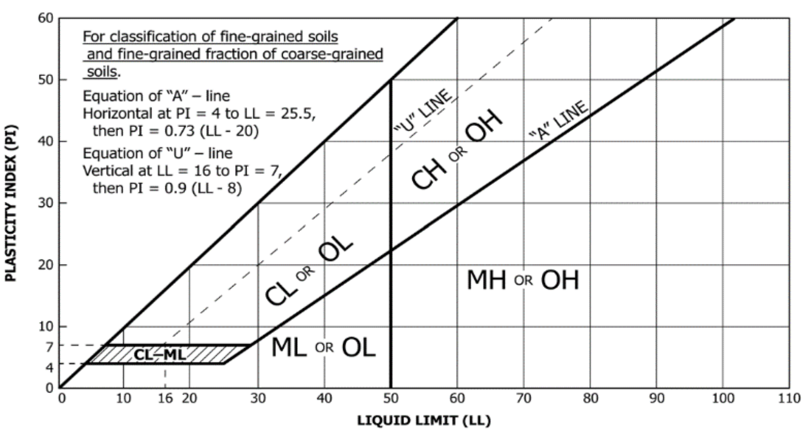
(See Descriptive Terminology sheet for explanation of abbreviations)

Descriptive Terminology of Soil

Based on Standards ASTM D 2487-11/2488-09a
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: 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])	$C_u \geq 4$ and $1 \leq C_c \leq 3$[D]	GW	Well-graded gravel[E]
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$)[D]	GP	Poorly graded gravel[E]
		Gravels with Fines (More than 12% fines[C])	Fines classify as ML or MH	GM	Silty gravel[E F G]
			Fines Classify as CL or CH	GC	Clayey gravel[E F G]
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines[H])	$C_u \geq 6$ and $1 \leq C_c \leq 3$[D]	SW	Well-graded sand[I]
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$)[D]	SP	Poorly graded sand[I]
		Sands with Fines (More than 12% fines[H])	Fines classify as ML or MH	SM	Silty sand[F G I]
			Fines classify as CL or CH	SC	Clayey sand[F G I]
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K L M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OL	Organic clay[K L M N] / Organic silt[K L M O]
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OH	Organic clay[K L M P] / Organic silt[K L M Q]
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. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \, x \, D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. 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
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
M. If soil contains ≥ 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



Particle Size Identification

Boulders............. over 12"
Cobbles............... 3" to 12"
Gravel
  Coarse............ 3/4" to 3" (19.00 mm to 75.00 mm)
  Fine................ No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
  Coarse............. No. 10 to No. 4 (2.00 mm to 4.75 mm)
  Medium........... No. 40 to No. 10 (0.425 mm to 2.00 mm)
  Fine................. No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt....................... No. 200 (0.075 mm) to .005 mm
Clay..................... < .005 mm

Relative Proportions[L, M]

trace............................ 0 to 5%
little............................. 6 to 14%
with............................. ≥ 15%

Inclusion Thicknesses

lens.............................. 0 to 1/8"
seam............................ 1/8" to 1"
layer............................. over 1"

Apparent Relative Density of Cohesionless Soils

Very loose .... 0 to 4 BPF
Loose .... 5 to 10 BPF
Medium dense............. 11 to 30 BPF
Dense........................... 31 to 50 BPF
Very dense................... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft	0 to 1 BPF	< 1/4 tsf
Soft	2 to 4 BPF	1/4 to 1/2 tsf
Medium	5 to 8 BPF	1/2 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6 inches into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6-inch increments, and added to get BPF.

Partial Penetration: If the sampler cannot be driven the full 12 inches beyond the initial 6-inch set, the number of blows for that partial penetration is shown as "No./X" (i.e., 50/2"). If the sampler cannot be advanced beyond the initial 6-inch set, the depth of penetration will be recorded in the Notes column as "No. to set X" (i.e., 50 to set 4").

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

WL: WL indicates the water level measured by the drillers either while drilling or following drilling.

Laboratory Tests

DD	Dry Density, pcf	**OC**	Organic content, %	**PL**	Plastic limit, %
WD	Wet Density, pcf	**q_p**	Pocket penetrometer strength	**LL**	Liquid limit, %
P200	% Passing #200 sieve	**MC**	Moisture conent, %	**PI**	Plasticity Index, %