CITY OF MISSION

"Home of the Grapefruit"

August 17, 2020

RE: **Addendum No. 1/ RFB 20-279-08-20 Pre-Engineered Metal Pavilion at Birdwell Park**

Dear Prospective Bidder:

The following is to be corrected/added/changed/clarified: Changes are marked with a vertical line on the right-hand side.

a. This addendum is being provided to all bidders.

b. Question: We are currently bidding on the plans designed by the City of Mission, if the structural engineer designs deeper piers and/or if we encounter water during the drilling of these piers, then please stipulate that the owner's allowance will cover the additional cost that may be incurred?

Answer: By the depth of the water in the drain ditch, there shouldn't be any ground water encountered. If water is encountered allowance will cover the additional cost.

c. Does existing foundation have any beams or just slab?

Answer: Basketball court slab appears to be about 5.5" thick. There is no apparent perimeter beam.

d. Question: Has a Geotech Report been prepared for this project, if so, can you please provide a copy?

Answer: Geotech report is included in this addendum.

e. Question: How are the pavilion lights to be controlled?

Answer: Installation of a light timer is to be installed in panel box at Pavilion.

f. Question: What is the distance to the power source?

Answer: Approximately 225 ft. from SW corner of existing basketball court.

g. Question: Where is the panel box, that is referenced on the plans, to be located?

Answer: A commercial grade locking panel box is to be installed on the SW leg of the pavilion. Height is to be determined during construction.

h. No additional questions will be entertained.

i. The bid due date has not changed. The date for receipt of bids is **Thursday, August 20, 2020 at 2:00 P.M. CST**.

NOTE: This form must be completed and submitted with your bid response. ***WARNING: Failure of an Offeror to acknowledge receipt of this Addendum, as described herein, may result in REJECTION OF THE OFFER.***

We apologize for any inconvenience this may have caused. Authorized signature is needed. Everything else shall remain the same. If you have any questions, please email Contracts Administrator, Edgar Chapa, at echapa@missiontexas.us.

Sincerely,

Eduardo Belmarez,
Purchasing Director

__________________________ Acknowledge receipt of Addendum No. 1
Authorized Signature

__________________________ __________________________
Printed Name Company Name

L&G Engineering
Transportation Consultants

GEOTECHNICAL INVESTIGATION
FOR THE
MISSION TENNIS CENTER AT BIRDWELL PARK
HIDALGO COUNTY, TEXAS

Prepared For:
City of Mission

Prepared By:
L&G Consulting Engineers, Inc.
(L&G Engineering Laboratory – A Division of L&G)
Mercedes, Texas 78570
[Texas Registered Engineering Firm F-4105]

L&G Project No. G17004
April 30, 2017

STATE OF TEXAS
DAVID A. SAENZ
102365
LICENSED
PROFESSIONAL ENGINEER

04/30/2017

David A. Saenz, P.E., C.F.M.
Project Manager / Project Engineer

INTRODUCTION

L&G Consulting Engineers, Inc. (L&G Engineering Laboratory – A Division of L&G (L&G)) was contracted by **City of Mission (Mission)** to perform a subsurface geotechnical investigation for the proposed Mission Tennis Center at Birdwell Park. This report addresses foundation recommendations, parameters for slab foundation design criteria based on the Post Tension Institute (3rd Edition) and Wire Reinforcement Institute specifications, as well as recommendations for maximum allowable bearing capacity of shallow foundations. Also included in this report are pavement recommendations, boring logs, and several figures addressing the potential vertical rise and existing geology of the proposed construction site.

GENERAL PROJECT OVERVIEW

Project Description

L&G is pleased to submit this document presenting our findings as the result of a subsurface geotechnical exploration performed at the request of **Mission**. The project site is located within Mission, Texas, approximately two-tenths (0.2) of a mile north of FM 495 on the north-west corner of Stewart Rd and 24th St at the existing Birdwell Park. It is our understanding that the project involves the construction of concrete tennis courts, pavilion, covered seating areas, pro shop building, concession/restroom/storage building, sidewalks, and paved parking lot (as shown on preliminary layout). A preliminary general site plan sheet/project layout for the proposed facility was provided by the Client (**Mission**) and is included in Appendix C. No grading plans or structural loads for the building/structures were provided; thus all foundation and site improvement recommendations as provided in this report are based on the geotechnical properties of the soils and generalized assumptions as noted.

Scope and Limitations of Investigation

This report has been prepared in general accordance with accepted geotechnical engineering practices for the subject project site and the anticipated construction. No specific warranty program or other special standards, except acceptable industry standards for the general South Texas area, were followed during the course of this investigation and analysis. This geotechnical report is intended for use by **Mission**, and any direct representatives or affiliates. This geotechnical report may not contain sufficient information for purposes of other parties, or other uses in determining construction means and methods.

The strata, shown on the boring logs (included in Appendix B), represent the subsurface conditions at the boring locations at the time of our investigation. These strata designate approximate boundaries between subsurface materials; however, their actual transition may be gradual or may occur at varying depths. Variations may occur due to unexpected deposits of soft clays, silts or other undesirable soil material not detected through our investigation. It should be noted that the exploratory borings were performed within the limits of the proposed project as approved and agreed upon by all previously noted parties prior to the commencement of our field operations.

The benchmarks of this geotechnical study are to:

1. explore the general existing subsurface conditions at the site
2. evaluate the relevant engineering properties of the subsurface materials
3. provide the potential vertical rise and recommendations to minimize shrink/swell
4. provide the maximum allowable bearing capacity of in-situ soils for shallow foundations
5. provide design parameters for several foundation design methods including WRI and PTI
6. provide recommendations for pavement thicknesses and materials
7. provide recommendations for foundation construction

The scope of this geotechnical engineering study does not include an environmental assessment of the air, soil, rock or water conditions on or adjacent to the site. No environmental opinions are presented in this report. If environmental clearances are needed prior to construction, please contact our offices for assistance in this matter.

EXISTING SURFACE AND SUB-SURFACE CONDITIONS

Site Location / Description

The project site is located within Mission, Texas, approximately two-tenths (0.2) of a mile north of FM 495 on the north-west corner of Stewart Rd and 24th St at the existing Birdwell Park. The boring locations were drilled as close as possible to the locations specified by the Client as shown on Figure 2 in Appendix A. No surveyor was contracted to determine the exact coordinates for the borings, as this was not a part of the scope of work for the project; however, field handheld GPS coordinates were retrieved and are noted on the boring logs in Appendix B. Elevations were approximated using the surveyed elevations shown on the Client provided site layout (Included in Appendix D of this report). The property had minimal vegetation at the time of drilling (short grass). The existing facilities founded on shallow, slab on grade foundations (covered seating areas, restrooms, concrete basketball court and concrete tennis courts) showed little to no distress due to soil movements as shown in Figures 1 through 4.


Figure 1 – Restroom Facility


Figure 2 – Covered Seating Area

Figure 3 – Basketball Court
**showing typical low severity linear cracking (hairline) noted throughout structure*

Figure 4 – Tennis Court
**showing typical low severity corner break cracking noted near center of courts*

The existing asphalt pavement sidewalks showed little to no signs of distress as shown in Figure 5. The existing asphalt pavement parking lot showed signs of general wear including raveling, alligator cracking, potholes and patching as shown in Figures 6 and 7.

Figure 5 – Asphalt Pavement Sidewalk

Figure 6 – Parking Lot (Overview)
**showing general wear of pavement surface (medium severity raveling)*

Figure 7 – Parking Lot (Localized Failure)

**showing localized pavement distress and repair (medium to high severity alligator cracking at a low severity depression causing medium severity pothole and fill/patching)*

Geology

The Geologic Atlas of Texas, McAllen-Brownsville Sheet, dated 1976, indicates that the subject site is located within the *Windblown Deposits – Stabilized Sand Dune Deposits* (Qds) section of the Quaternary epoch (Recent (Holocene) period). The description of the materials is as follows:

Windblown Deposits – Stabilized Sand Dune Deposits – "Strong relict eolian grain, sparse grass; includes active blowout areas with depressed relief, hummocky, locally becomes fresh-water marsh in wet season, and well-stabilized sand dunes with dense live-oak mottes and scrub; 'moderate to very high permeability, low to moderate water-holding capacity, low compressibility, low shrink-swell potential, good to fair drainage, high shear strength, low plasticity, shallow water table.'"

Soil Survey Description

According to the Soil Survey of Hidalgo County, Texas, published by the United States Department of Agriculture, the proposed site is located within the Hidalgo Sandy Clay Loam, 0 to 1 percent slopes (Soil Map Unit #28) (see Figure 3 in Appendix A for USDA Soils Map).

Hidalgo Sandy Clay Loam (0 to 1 percent slopes) (Soil Map Unit #28) – These soils are deep, nearly level soils on convex uplands. This unit is well drained with a moderate available water capacity (about 7.8 inches) and moderate permeability. It is non-saline to slightly saline (about 0.0 to 4.0 mmhos/cm) with no frequency of flooding or ponding. The typical profile for this soil is 0 to 17 inches: dark grayish brown sandy clay loam; 17 to 28 inches: brown sandy clay loam; 28 to 38 inches: pale brown clay loam; and 38 to 80 inches: pale brown sandy clay loam. The soil is calcareous throughout.

Rainfall

The mean annual precipitation for this area of Hidalgo County is approximately 20-24 inches, as reported by the U.S. Department of Agriculture Soil Conservation Service. Our geotechnical investigation, performed April 2017 was conducted during a non-drought condition (None, as noted by the National Weather Service and U.S. Drought Monitor). The National Oceanic and Atmospheric Administration (NOAA) reports for the subject date indicated that no significant rainfall observations (at least one inch) occurred prior to or during our exploration that could have had significant effects on any groundwater levels or moisture content of surface soils.

SITE INVESTIGATION

Soil Borings and Laboratory Tests

Subsurface conditions at the site were evaluated through three (3) structural borings (designated as B-#) drilled to a depth of twenty (20) feet below natural ground elevation at the locations shown on Figure 2 of Appendix A. The soil borings were drilled and sampled in general accordance with American Society of Testing Materials Procedures (ASTM) D1452 and D1586 using a truck mounted drilling rig (Simco 2800 HS (HT)) and solid stem augers.

As part of the sampling procedures, split barrel (spoon) and Standard Penetration Tests (SPT) were performed and recorded. Standard Penetration Test results are noted on the boring logs as blows per foot or twelve (12) inch increment. The sampler was advanced through three (3) consecutive six inch increments; however, the first six inch increment is considered the seating drive, which eliminates the effect of cuttings or disturbances on the test result. The sum of the blows for the last two six (6) inch increments is considered the “standard penetration resistance value” or “field N-value”. Where hard or very dense materials were encountered, the SPT was terminated and noted on the boring log when one of the following situations occurred:

1. *a total of 50 blows were applied on one six inch increment*
2. *a total of 100 blows were applied during the test*
3. *no advancement of the sampler was observed during the application of ten (10) consecutive blows from the hammer*

Representative portions of the split barrel samples were identified, packaged, sealed in containers to reduce moisture loss, and transported to our laboratory for subsequent testing. In the laboratory, each sample was evaluated and visually classified by a member of our geotechnical engineering staff. The properties of each stratum were evaluated by a series of laboratory index tests. A summary of the laboratory data and their corresponding depths are presented on the boring logs. 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 to hold the samples through the construction process.

Subsurface Stratigraphy

Based on the results of the field and laboratory sample analyses, the subsurface stratigraphy at the project location can generally be characterized as 5 feet of very soft to stiff dark, brown sandy lean clay (CL) overlain a mixture of medium stiff to hard, brown fat clays (CH) with varying percentages of sand content.

It should be noted, the Soil Strata and Description provided, are typical summarized representation of the site stratigraphy. The lines designating the interfaces between strata on the boring logs represent approximate boundaries. Transitions between strata may be gradual and may occur at varying depths.

Water Strikes

During the drilling operations, water strikes were encountered at two of the three boring locations. Water level readings were recorded at all boring locations 24 hours after the drilling. It should be noted that fluctuations in groundwater levels are influenced by variations in rainfall and surface water run-off from season to season. The construction process itself may also cause variations in the groundwater level. If the water level is critical to the construction process, **L&G** recommends that the Contractor check the subsurface water conditions immediately prior to construction excavation through the installation of piezometer wells.

GEOTECHNICAL BORING ANALYSIS

Moisture Content

The moisture content of a soil is defined as the ratio of the weight of the water in the sample to the dry weight of the soil sample. The moisture contents for the samples obtained as part of our geotechnical exploration were performed in compliance with ASTM procedure D2216 (and Tex-103-E). A comprehensive list of all moisture contents by corresponding depth can be found on the boring logs.

Plasticity Index

The Plasticity Index (PI) is defined as the difference between the liquid limit and the plastic limit of a soil. These limits are commonly referred to as the Atterberg limits, which describe the consistency of soils with respect to their varying moisture contents. The plasticity indices for the samples obtained as part of our geotechnical exploration were performed in compliance with ASTM procedure D4318 (and Tex-104-E thru Tex-106-E). A comprehensive list of all plasticity indices by corresponding depth can be found on the boring logs.

Particle Size Analysis (Determination of Fines Content)

The standard grain size analysis is used to determine the relative proportions of different grain sizes as they are distributed along a range of different sized sieves. The minus 200 sieve analysis is used commonly as a tool for soil classification and identification using the Unified Soils Classification System. Results for this test are reported as a percentage of soil passing the No. 200 sieve, which has openings 0.075mm wide. The particle size analyses for the samples obtained as part of our geotechnical exploration were performed in compliance with ASTM procedure D1140 (and Tex-111-E). A comprehensive list of all fines contents by corresponding depth can be found on the boring logs.

Sulfate Content of Soil (Concrete Structures)

The presence of high concentrations of water-soluble sulfates (SO_4) in soils can be detrimental to concrete structures in direct contact. Concrete exposed to these sulfate rich soils (buried concrete structures, foundations, slabs-on-grade) are vulnerable to deterioration in the form of expansion, cracking and spalling. In order to detect levels of water-soluble sulfates in the soils, we performed testing on these soils in accordance with Tex-145-E (Determining Sulfate Content in Soils – Colorimetric Method). To ensure we got an accurate reading with regard to the water levels impacting the soils, we performed these tests at various depths below top of natural ground at the locations of the borings and at bulk sample locations. The general site specific results are presented in Table 1.

Boring	*Sample Depth (ft.)	Water-Soluble Sulfate Level (Parts Per Million)
B-01	0.5	< 100
B-02	4.5	2820
B-03	2.5	1740

Table 1 – Summary of Sulfate Contents

**all depths are referenced from existing natural ground*

It should be noted, Texas Department of Transportation (TxDOT) Pharr District Master General Notes specifies the use of Sulfate Resistant Concrete when sulfate concentrations in the soil are greater than 1,000 ppm. In accordance with this and based our test results, **L&G** recommends the use of Sulfate Resistant Concrete for concrete structures in the vicinity of Borings B-02 and B-03.

FOUNDATION RECOMMENDATIONS

Proposed Project Foundation System Information

The proposed facilities, as previously noted, will be constructed throughout the project site. At the time this report was written, the Client had specified general slab on grade construction with potential shallow square footings at column/high load locations and perimeter grade beams was to be the primary foundation system (if possible) for shallow foundations on-site. No specific construction techniques were provided to **L&G** at the time this report was written. It should be noted, the selection of an appropriate type of foundation design is based on several factors including, but not limited to, soil conditions, site drainage, economics, climate, vegetation, city/government codes, and the level of risk acceptable to the owner/developer.

The most commonly constructed and typically most cost effective foundation system built in the South Texas Area is the Slab on Grade system (including a steel reinforced concrete slab). The Slab on Grade foundation is intended to be supported in the shallow surface soils through the use of a monolithic slab; however, these foundations can be complemented through the use of exterior and interior stiffened grade beams and/or shallow footings to support concentrated perimeter or wall loads and column loads respectively. For these systems, the compatibility between foundation rigidity and the type of superstructure to be built on the foundation must be considered in order to avoid damage to the superstructure and architectural components.

The foundation system selected for construction must be designed with sufficient bearing capacity to resist the imposed loadings without experiencing failure of the underlying soils. The foundation system must also resist soil movements, or volume change, from expansion and contraction of soils due to changes in moisture content. The following sections will provide allowable bearing capacities, potential vertical rise (including earthwork recommendations to minimize shrink and swell), and Slab on Grade design parameters (Welded Reinforcement Institute – WRI, Post-Tensioning Institute – PTI). It should be noted that the recommendations provided are based on geotechnical properties of the project soils and assumptions of construction of this type since no structural loadings were provided. If structural loadings exceed capacities as provided in this report, **L&G** should be advised of the loadings to re-analyze and provide alternate recommendations, if needed.

It is important to stress the fact that maintenance of Slab on Grade foundations will help to reduce the potential for structural damage in the present and for the life of the structure. Maintenance can include, but is not limited to procedures such as:

1. Ensure positive drainage around the perimeter of the foundation through site grading
2. Incorporate paving or sidewalks adjacent to foundations for moisture protection
3. Do not plant vegetation closer to the foundation than its mature height
4. Extend canopies or roof drains away from foundation to prevent ponding near foundation
5. Avoid excess wetting or drying of soils around foundations

Bearing Capacity of Soils (Shallow Foundations)

The bearing capacity of the existing natural ground is defined as the ability of a foundation to safely support the imposed loadings (surcharge), without experiencing any form of shear failure. The ultimate bearing capacity is a measure of the soil's maximum resistance immediately prior to a bearing capacity failure. The ultimate bearing capacity was estimated using the methods and equations, as recommended by the USACE in Manual EM 1110-1-1905 titled "Bearing Capacity of Soils"

$$q_u = c\, N_c \zeta_c + \tfrac{1}{2} B\, \gamma_h\, N_\gamma \zeta_\gamma + \sigma\, N_q \zeta_q$$

where:

q_u = ultimate bearing capacity
c = soil cohesion
B = effective width of foundation
γ_h = effective unit weight of soil within failure zone
σ = effective soil surcharge pressure at depth
N_c, N_γ, N_q = Bearing capacity factors
$\zeta_c\ \zeta_\gamma\ \zeta_q$ = dimensionless correction factors for cohesion, soil unit weight, and surcharge

Nc, Nγ, and Nq are the dimensionless bearing capacity factors developed by Meyerhof, Hansen, and Vesic for general shear failure listed in Table 4-4 of EM 1110-1-1905. Cohesion values for cohesive soils and angle of friction values for granular soils were estimated using a correlation with the Standard Penetration Tests performed in the field. All correlations used were in accordance with the applicable USACE manuals. Where cohesive material was prevalent, the angle of friction value was conservatively assumed to equal zero.

The factor of safety used in our analysis was equal to 3.0, as recommended by Chapter 1 of EM 1110-1-1905. The absolute minimum factor of safety, as recommended by Chapter 1 of EM 1110-1-1905 for this construction is 2.0. The maximum allowable bearing capacity was calculated by dividing the ultimate bearing capacity by the factor of safety. All recommendations reflect the maximum allowable bearing capacity in pounds per square foot.

Bearing Capacity of Soils (Foundation Pads, Slabs on Grade, Shallow Footings)

The maximum allowable bearing capacity in the area of Boring B-01 is **1,700 pounds per square foot**. This value was calculated using square foundation geometry and a factor of safety equal to 3 (FOS = 3).

The maximum allowable bearing capacity in the area of Boring B-02 is **1,000 pounds per square foot**. This value was calculated using square foundation geometry and a factor of safety equal to 3 (FOS = 3).

The maximum allowable bearing capacity in the area of Boring B-03 is **1,500 pounds per square foot**. This value was calculated using square foundation geometry and a factor of safety equal to 3 (FOS = 3).

Potential Vertical Rise (Slab on Grade)

The soils at this site consisted primarily of moderate to high plasticity clays (becoming more plastic with depth), which have a medium to high potential for exhibiting appreciable differential movements or swell/shrink capabilities with moisture changes. The Potential Vertical Rise (PVR) calculations for the general soil profile were performed using the Texas Department of Transportation's (TxDOT) TEX 124-E method. Based on review of the soil log (sandy lean clays in upper 5 feet and fat clays with various sand content below that depth), water table observation (water strike encountered typically 13 feet below natural ground, 24 hours water levels at 7 to 12 feet below natural ground), geometric configuration of the area, and typical climatic conditions of the area (generally very hot humid climate).

The calculated **PVR** value for the existing soil profile, based on the strata found at each boring location and the existing conditions, ranged from approximately **2.0 to 3.1 inches**. This value represents total vertical in-situ movements and does not consider differential swell between any two points on the ground; nor does it take into account movements caused by uncontrolled water sources such as poor drainage, migration of subsurface water from off-site locations, and utility line leaks. Typically, **PVR** values of around **1.0 inch** are considered acceptable for most at grade or shallow foundation designs. Based on the results of the calculations as noted, the project site soil conditions will require earthwork (removal and replacement of surficial soils with lower swelling structural fill materials) to counteract potential shrink/swell capabilities. The following table provides guidelines on the amount of surficial soil removal versus the calculated heave potential (Table 2). Final movement tolerances for the project facilities shall be selected by the Designer (and agreed upon by the Owner).

Boring: B-1	
Exist. PVR = 2.8 in	
*Removal & Replacement (ft)	Est. Heave (PVR) (in)
0	1.8
1	1.7
2	1.5
3	1.3
4	1.2
5	1.0
6	0.8

Boring: B-2	
Exist. PVR = 3.1 in	
*Removal & Replacement (ft)	Est. Heave (PVR) (in)
0	2.2
1	2.1
2	2.1
3	2.0
4	1.8
5	1.6
6	1.2

Boring: B-3	
Exist. PVR = 2.0 in	
*Removal & Replacement (ft)	Est. Heave (PVR) (in)
0	1.2
1	1.1
2	1.0
3	0.9
4	0.8
5	0.8
6	0.7

Table 2 – Summary of Removal/Replacement vs. Est. Heave (PVR)

**all depths are referenced from existing natural ground*

Post-Tensioning Institute (PTI) Slab Design Parameters

The recommendations for foundation design criteria in this section have been calculated using the method described by the Post-Tensioning Institute manual, "Design of Post-Tensioned Slabs-on-Ground" Third Edition; also known as the PTI method. This method gives soil parameters for ribbed or uniform thickness (monolithic) foundations that can be used in the design of post-tensioned or traditionally reinforced foundations. The PTI method does not allow for the development of design parameters for collapsing soils or other highly unusual conditions. It must be emphasized that the determination of these parameters is based upon normal climate-moisture variance from season to season in the local area and are invalid when influenced to any significant degree by other conditions, including but not limited to those mentioned in the previous sections.

The edge moisture variation distances (e_m) for the center and edge lift conditions were derived based on a Thornthwaite index of -32 for the project site. The Thornthwaite index is based on the average rainfall over a significant period of time (e.g. 20 or 30 years) in excess or deficit of the average evapotranspiration rates of the area. Other parameters and influencing variables were derived using information collected from the laboratory tests performed on the recovered soil samples as stated in the PTI guidelines for geotechnical exploration and laboratory testing schedule. Table 3 lists the PTI design parameters for a slab-on-grade foundation supported in the shallow surface soils.

	Center Lift Conditions		**Edge Lift Conditions**	
Equilibrium Soil Suction (pF)	Center Moisture Variation Distance e_m (ft)	Est. Differential Movement y_m (in)	Edge Moisture Variation Distance e_m (ft)	Est. Differential Movement y_m (in)
4.04	8.90	1.33	4.50	0.93

Table 3 - Recommended PTI Slab Design Parameters

Wire Reinforcement Institute (WRI) Slab Design Parameters

The Wire Reinforcement Institute (WRI) method is an empirically derived foundation design method that was developed by observing slab performance over time and creating and modifying equations to give results which approximate foundation designs that exhibit the best results. While the WRI method deals only with foundations reinforced with reinforcing bars or welded wire reinforcement, the procedure has been developed to be independent of the type of reinforcement used.

The climatic rating reflects the stability of the moisture content which may be expected in the soil due to the climatic conditions which may vary from year to year. The effective design Plasticity Index was obtained by weighting the test values in each boring as described in the WRI procedures. The slope correction factor is based on the average slope of the tract of land. Since the slope is relatively small (as shown on Figure 4 in Appendix A) the adjustment factor was negligible. Table 4 lists these WRI design parameters for a slab-on-grade foundation supported in the shallow surface soils.

Effective PI	Climatic Rating	Slope Coefficient	Soil Support Index, C
30	15	1	0.83

Table 4 - Recommended WRI Slab Design Parameters

Earthwork Recommendations (Preparation of the Foundation Pads)

L&G recommends the following earthwork recommendations within the foundation footprint areas:

- Clear and grub all vegetation, organic topsoil, and other miscellaneous debris up to a minimum of 2 feet beyond all proposed foundation pad areas.
- Excavate the surficial soils to the depth selected (as per the Designer and Owner's desired performance level based on Table 2 in the "Foundation Recommendations – Potential Vertical Rise (Slab on Grade)" section of this report.
- The exposed subgrade below the excavation to minimum depth of 12 inches shall be scarified, moisture conditioned and re-compacted to a minimum 95% of the maximum dry density, as determined by ASTM D-698 at a moisture content ranging from 0 to +3 percent of the optimum moisture content.
- The foundation shall be brought to grade (excavated area should then be filled) with 'Structural Fill' that meets the requirements of the "General Construction Considerations – Select Fill and Structural Fill Recommendations" section of this report.
- An additional 12 inches of 'Structural Fill' shall be installed to raise the foundation areas above natural ground (grade) and provide positive storm water drainage away from the foundation.

PAVEMENT RECOMMENDATIONS

Background Information

The pavement recommendations contained in this report were limited to the data recovered from the field and laboratory testing performed for the borings. No traffic loading data was presented for the future proposed parking lot and drives.

Our recommendations are based on design procedures found in the Army Corps of Engineers Manuals EM 1110-3-131 (Flexible Pavement Design), EM 110-3-132 (Rigid Pavement Design), and our experience with similar soils and site conditions. The traffic composition used in our analysis was grouped under 'Category I', which is comprised of traffic essentially free of trucks (not more than 1% two-axle trucks). The road type selected was 'Class D', with a flat slope and low volume (under 1,000 average daily vehicles).

Subgrade Analysis

The existing subgrade index properties (plasticity index and grain size) were used to correlate the Modulus of Soil Reaction (k) and the California Bearing Ratio (CBR) values of the subgrade. These values were then applied to the corresponding design procedures, according to the applicable Army Corps of Engineers manuals to determine the recommended minimum pavement thickness for flexible pavement designs. A subgrade k value of **200 pci** and a CBR value of **10** were utilized in the pavement designs.

Pavement Section Recommendations

After completing the pavement designs and analyzing several options for construction, **L&G** has provided the following recommendations within Tables 5 & 6 for pavement thickness:

Materials	Flexible Pavement Design Recommendation
Asphalt Pavement (ACP)	**1.5 in.**
Flexible Base Material (Crushed Limestone or Treated Caliche)	**6.0 in.**
Moisture Conditioned Compacted Subgrade	**12.0 in.**

Table 5 – Flexible Pavement Recommendation (Parking Lot)

Materials	Flexible Pavement Design Recommendation
Reinforced Concrete Pavement (RCP)	**4.0 in.**
Moisture Conditioned Compacted Subgrade	**12.0 in.**

Table 6 – Rigid Pavement Recommendation (Turnouts, Driveways, etc.)

Pavement Material Specification Recommendations

Asphaltic Concrete Pavement (ACP)

The asphalt concrete pavement (ACP) surface shall meet the requirements of the current TxDOT 2014 Specification Item 340 for Type D Hot Mix Asphaltic Concrete. The grade of the asphalt cement should contain a minimum PG 64-22 asphalt binder. It is recommended that the testing required by this specification be performed during production and placement by a representative of **L&G**.

Reinforced Concrete Pavement (RCP)

The concrete used for pavement shall meet the requirements of TxDOT Specifications Item 360 (Concrete Pavement) and Item 421 Hydraulic Cement Class P concrete, designed with a minimum average flexural strength of 570 psi or a minimum average compressive strength of 4,000 psi at 28 days (or as otherwise noted in the pertinent item). The hydraulic cement concrete properties shall be in accordance with the specification items previously outlined for the given class of concrete (temperature, slump, air content, etc.) The reinforcement shall consist of Grade 60 steel or better rebar distributions with a recommended minimum of 0.1% longitudinal and transverse steel in the cross-sectional area. This is equivalent to a reinforcing scheme of #3 rebar at 18 inch center to center spacing in both the transverse and longitudinal directions for a 6 inch slab. It is recommended that transverse and longitudinal contraction joints be spaced at a maximum 15 feet, saw cut to a depth of two (2) inches. We further recommend that all joints be sealed. It is very important the reinforcing steel is positioned correctly and properly supported with adequate materials to maintain the integrity of the reinforcement during the paving process.

Flexible Base Material (Crushed Limestone)

The crushed limestone material shall meet the requirements of TxDOT 2014 Specification Item 247 Type A, Grade 1 as noted in the "General Construction Considerations – Select Fill & Structural Fill Recommendations" section of this report.

Flexible Base Material (Caliche)

The caliche base material shall meet the requirements of TxDOT 2014 Specification Item 247 Type E, Grade 4 as approved by the engineer. Caliche base shall conform to the gradation and properties requirements noted in the "General Construction Considerations – Select Fill & Structural Fill Recommendations" section of this report before lime or admixtures are added. Treated caliche base material shall meet all the previous requirements and contain a minimum of two (2) percent lime or Portland Cement by weight. Lime and cement treatments shall be in compliance with all applicable sections of TxDOT Item 260 and 275 specifications.

Moisture Conditioned Compacted Subgrade

The existing subgrade layer beneath the subbase (caliche/limestone) shall be compacted and moisture conditioned to a minimum 95 percent of the maximum dry density (ASTM D698 or Tex-114-E) at moisture contents ranging from plus 1 (+1) to plus three (+3) percentage points of the optimum moisture content. **L&G** recommends compacted subgrade be treated through incorporation of a minimum three (3) percent lime by weight. Lime treatment shall be in compliance with all applicable sections of TxDOT Item 260 specifications.

GENERAL CONSTRUCTION CONSIDERATIONS

Site Grading Recommendations

Site grading plans can result in changes in almost all aspects of foundation recommendations. We have prepared the foundation recommendations based on the existing ground surface and the stratigraphic conditions encountered at the time of our study. We recommend gradual slopes away from foundations at structure locations to assist with site drainage, ponding, and any potential shrink/swell issues. Based on the upper site soils, erosion and slope sloughing, causing for periodic maintenance are limitations when utilizing 2:1 slopes or steeper. We recommend the use of 3:1 slopes (or flatter) for general site grading.

Site Drainage Recommendations

Drainage is one of the most important aspects to be addressed to ensure the successful performance of any foundation. Positive surface drainage should be implemented prior to, during and maintained after construction to prevent water ponding at or adjacent to the proposed facilities. We advise that construction drainage programs be implemented to assist with standing waters from precipitation, general surface runoff or other moisture intrusion. It is recommended that the site design include site drainage features to channel runoff away from the proposed site location and most importantly away from all shallow foundations.

Site Preparation Recommendations

The proposed site areas and all areas used to support foundation construction should be cleared and grubbed of all vegetation, organic topsoil and other miscellaneous debris up to a minimum of two (2) feet beyond the proposed site perimeters. This shall include the removal of all trees, brush, roots, weeds, or other organic debris that will interfere with construction. After clearing, the contractor should follow the earthwork procedures outlined in the 'Foundation Recommendations' section of this report. Any soft and/or compressible soft spots noted during compaction activities shall be over-excavated and replaced with Select Fill. All placements of Select Fill and Structural Fill shall be in accordance with the "General Construction Considerations – Select Fill & Structural Fill Recommendations" section of this report. Any excavation/backfill activities should be observed by **L&G** representatives to document subgrade preparation.

Select Fill & Structural Fill Recommendations

Materials used for **Select Fill** (General Site Grading) shall meet the following requirements:

1. Soils classified according to the Unified Soils Classification System as SM, SC, GM, GC, CL, ML and combinations of these soils. These soils shall be free of organic material, topsoil, debris, or other deleterious material that cannot be properly compacted. In addition to the USCS classification, select materials shall have a **liquid limit of less than 40 and a plasticity index between 8 and 20**.

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

3. **L&G** recommends additional quality control of all 'General Site Fill' materials as they are placed and compacted to ensure that they meet the requirements specified.

Select Fill shall be placed in lifts not to exceed 8 inches loose (6 inches compacted) and compacted to a minimum 95 percent of the maximum dry density as determined in accordance with ASTM D698. The water content of the fill shall be maintained within the range of optimum moisture to three (3) percentage points above the optimum moisture content until the fill is permanently covered. The fill should be properly compacted in accordance with these recommendations and tested for compaction as specified.

Materials used for **Structural Fill** shall meet the following requirements:

1. Soils classified as Base Material meeting the requirements of TxDOT 2014 Specification Item 247 Type E, Grade 4 - Caliche (see Table 7 for specifications and requirements) or Item 247 Type A, Grade 1 - Limestone (see Table 8 for specifications and requirements).

2. **L&G** recommends additional quality control of all Structural Fill materials as they are placed and compacted to ensure that they meet the requirements specified.

Structural Fill shall be compacted to a minimum 98 percent of the maximum dry density as determined by the ASTM D698 at moisture contents ranging between minus two (-2) and plus two (+2) percentage points of the optimum moisture content. Structural Fill shall be placed in loose lifts not to exceed 8 inches (6 inches compacted). The fill should be properly compacted in accordance with these recommendations and tested for compaction as specified.

Retained on Square Sieve	Percent Retained
2"	0
$^1/_2$"	20-60
No. 4	40-75
No. 40	70-90
Plasticity Index, max	15
Wet Ball PI, max	15
Wet Ball Mill, % max	50

Table 7 – Structural Fill - Type E Grade 4 Specifications

Retained on Square Sieve	Percent Retained
2–½”	0
1–¾”	0-10
$^{7}/_{8}$”	10-35
$^{3}/_{8}$”	30-65
No. 4	45-75
No. 40	65-90
Liquid Limit, % max	40
Plasticity Index, % max	10
Wet Ball Mill, % max	40

Table 8 – Structural Fill - Type A Grade 1 Specifications

Excavation, Sloping, Benching and Utility Considerations

If trenches are to extend to or below a depth of five (5) ft, the contractor or persons doing the trenching should adhere to the current Occupational Health and Safety Administration (OSHA) guidelines on trench excavation safety and protection measures or other applicable industry standards. The collection of specific geotechnical data and development of a plan for trench safety, sloping, benching or various types of temporary shoring, is beyond the scope of the this study. Utilities that protrude through the slab-on-grade should be designed with some degree of flexibility or with sleeves. Such features will help reduce the risk of damage to utility facilities from soil movements related to shrinkage and expansion. Furthermore, when trenching for utility installation, we recommend that the backfill used to protect these utilities conform to the recommendations presented in the ‘Select Fill Recommendations’ section of this report.

Miscellaneous Pavement Recommendations

Adequate perimeter drainage is essential for long-term performance of any pavement structure. Infiltration of surface water from unpaved areas surrounding the pavement should be minimized. Base materials under curb and gutters should be compacted to the same requirements as other areas. It is recommended that these curb and gutters be extended through the base and a minimum of three (3) inches into the subgrade. This will reduce the potential of intrusion of moisture from adjacent areas. An adequate seal should be provided at all base-asphalt interfaces.

A maintenance plan is recommended for the long-term performance of paved areas. Asphaltic pavements have a tendency to strip and become oxidized with exposure to the elements. Thus cracks may become present in the pavement. It is recommended that a maintenance schedule of biannual crack sealing, fog seals and overlays every five to ten years be used over the life of the pavement.

REFERENCES

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6. American Society of Testing Materials, D6433 (Up to Date).

7. TxDOT, 2000, 2006, 2012 “Geotechnical Manual”, Austin, TX.

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9. TxDOT Construction Division, 2005, “Guidelines for Treatment of Sulfate-Rich Soils and Bases in Pavement Structures”, Austin, TX.

10. TxDOT Pharr District, 2014, “TxDOT Pharr District Master General Notes” (Updated 9-22-2015), Pharr, TX

11. United Stated Army Corps of Engineers, “Bearing Capacity of Soils”, EM 1110-1-1905

12. United Facilities Criteria (UFC), “Soils & Geology Procedures for Foundation Design of Building and Other Structures”, UFC 3-220-03FA, (January 2004).

13. United Stated Army Corps of Engineers, “Flexible Pavements for Roads, Streets, Walks and Open Storage Areas”, EM 1110-3-131

14. Post-Tensioning Institute, 2004, “Design of Post-Tensioned Slabs on Ground”, Phoenix, AZ.

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APPENDIX A – FIGURES

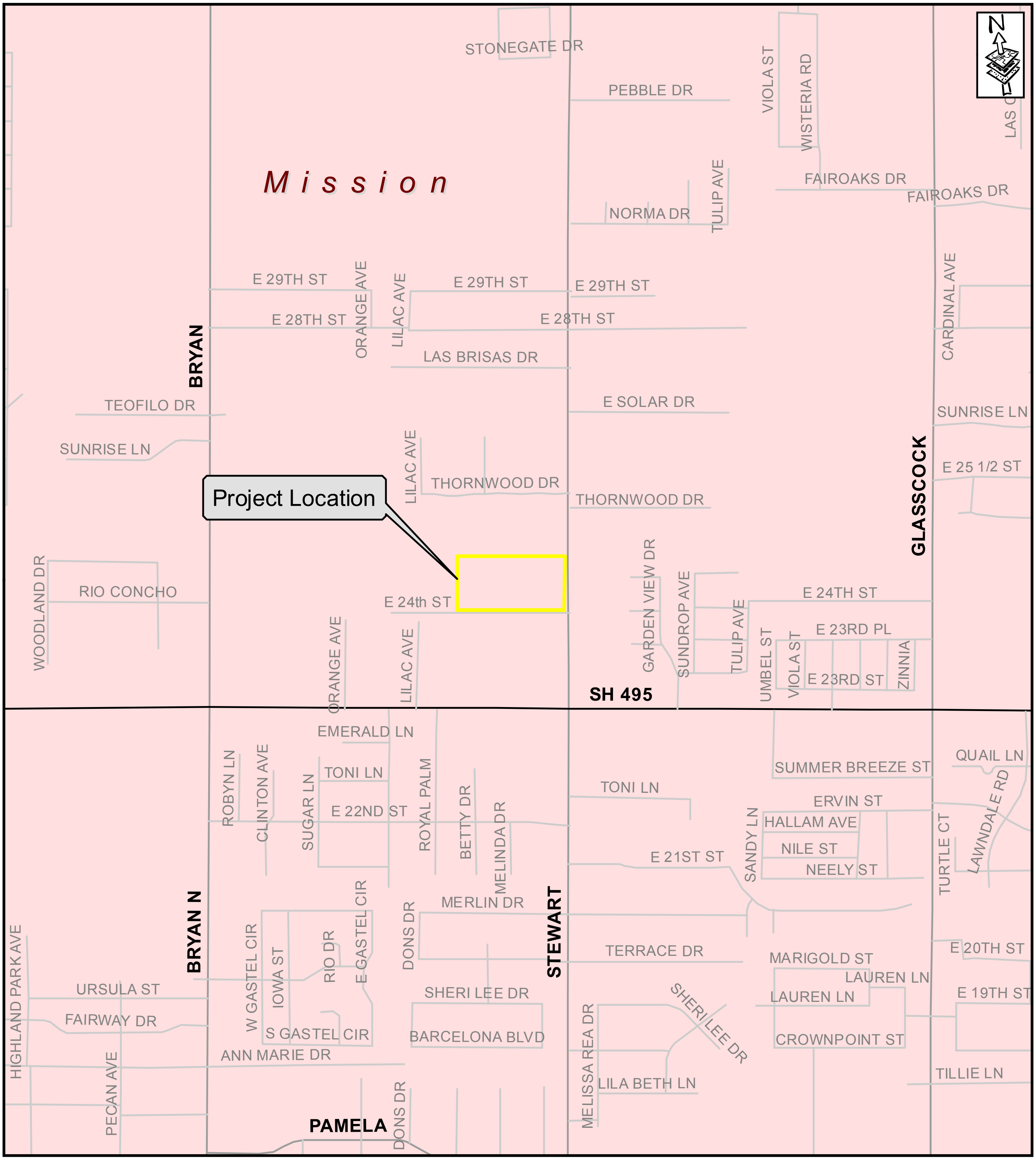


Figure 1

City of Mission
Tennis Center at Birdwell Park

Location Map

Legend

Project Location

Roadway Designation

Local Street

State Highway

FC Street

1,000 Feet

1 inch = 1,000 feet

L&G Engineering
Firm No. F-1'05

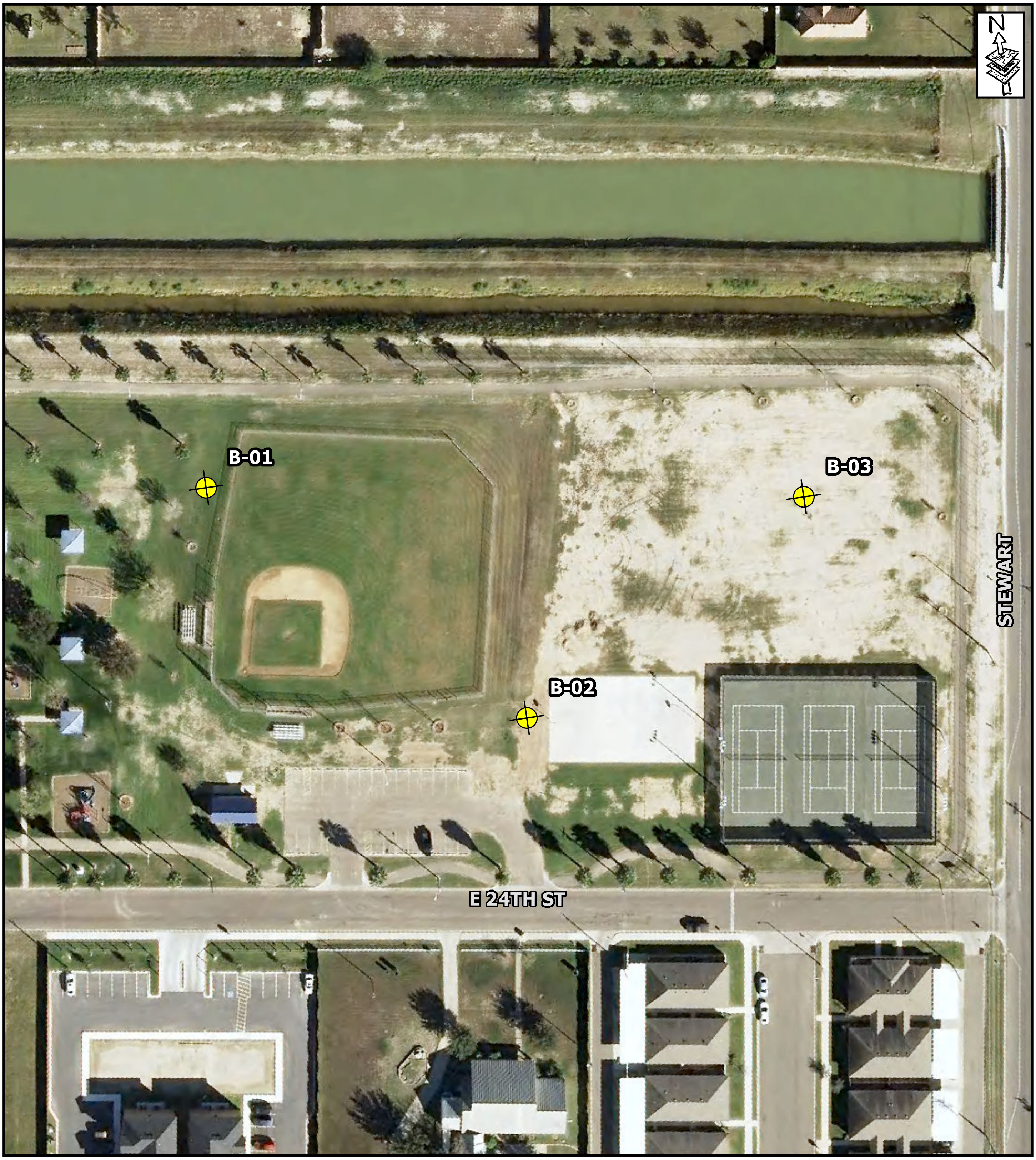


Figure 2

City of Mission
Tennis Center at Birdwell Park

Boring Location Map

Legend

Boring Locate

100
Feet
1 inch = 100 feet

L&G Engineering
Firm No. F-4105

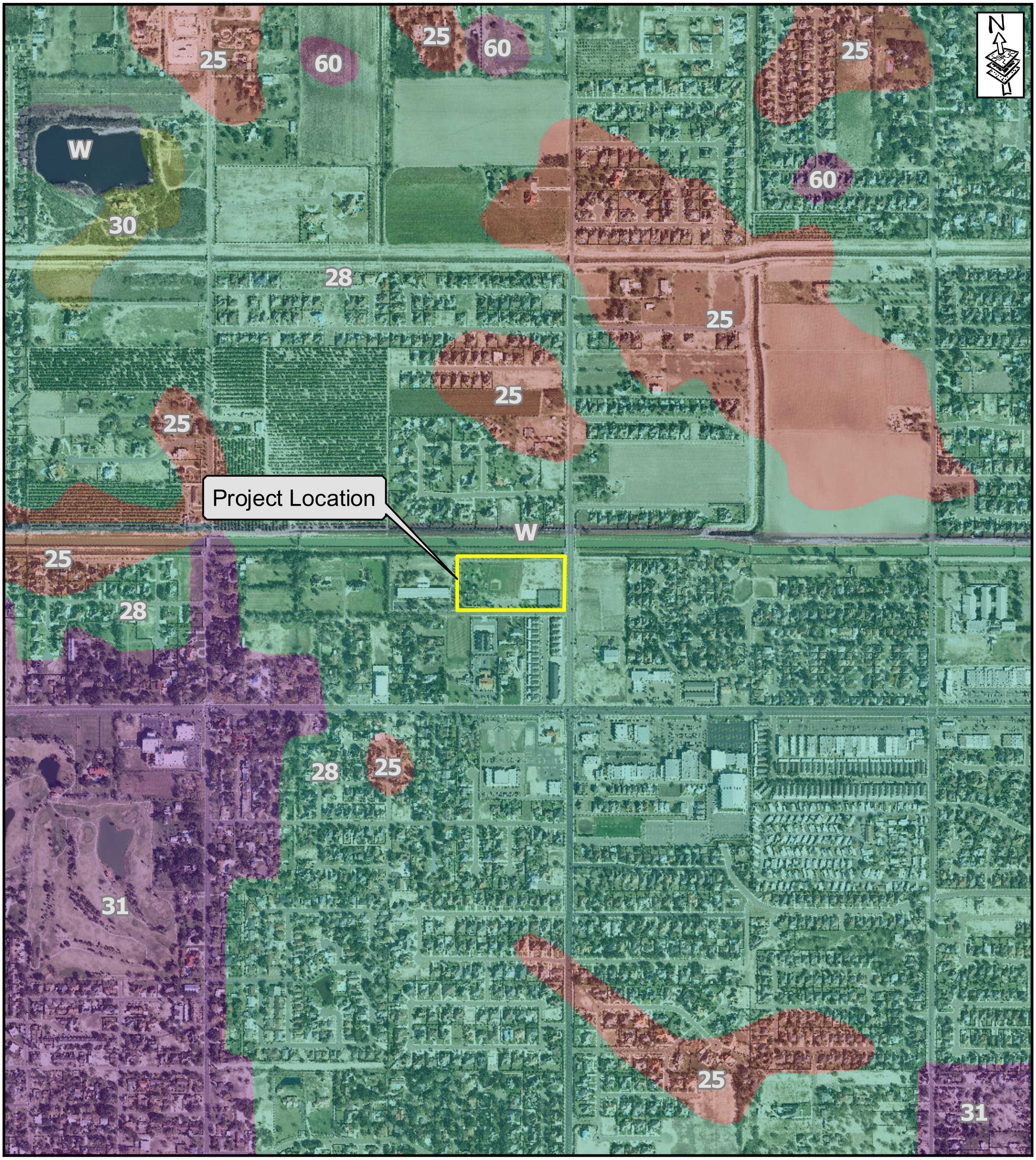


Figure 3

City of Mission
Tennis Center at Birdwell Park

Soil Classification Map
USDA SOIL CONSERVATION SERVICE

Legend

Project Location
28 Hidalgo Sandy Clay Loam (0-1% Slopes)

1,000
Feet
1 inch = 1,000 feet

L&G Engineering
Firm No. F-1105

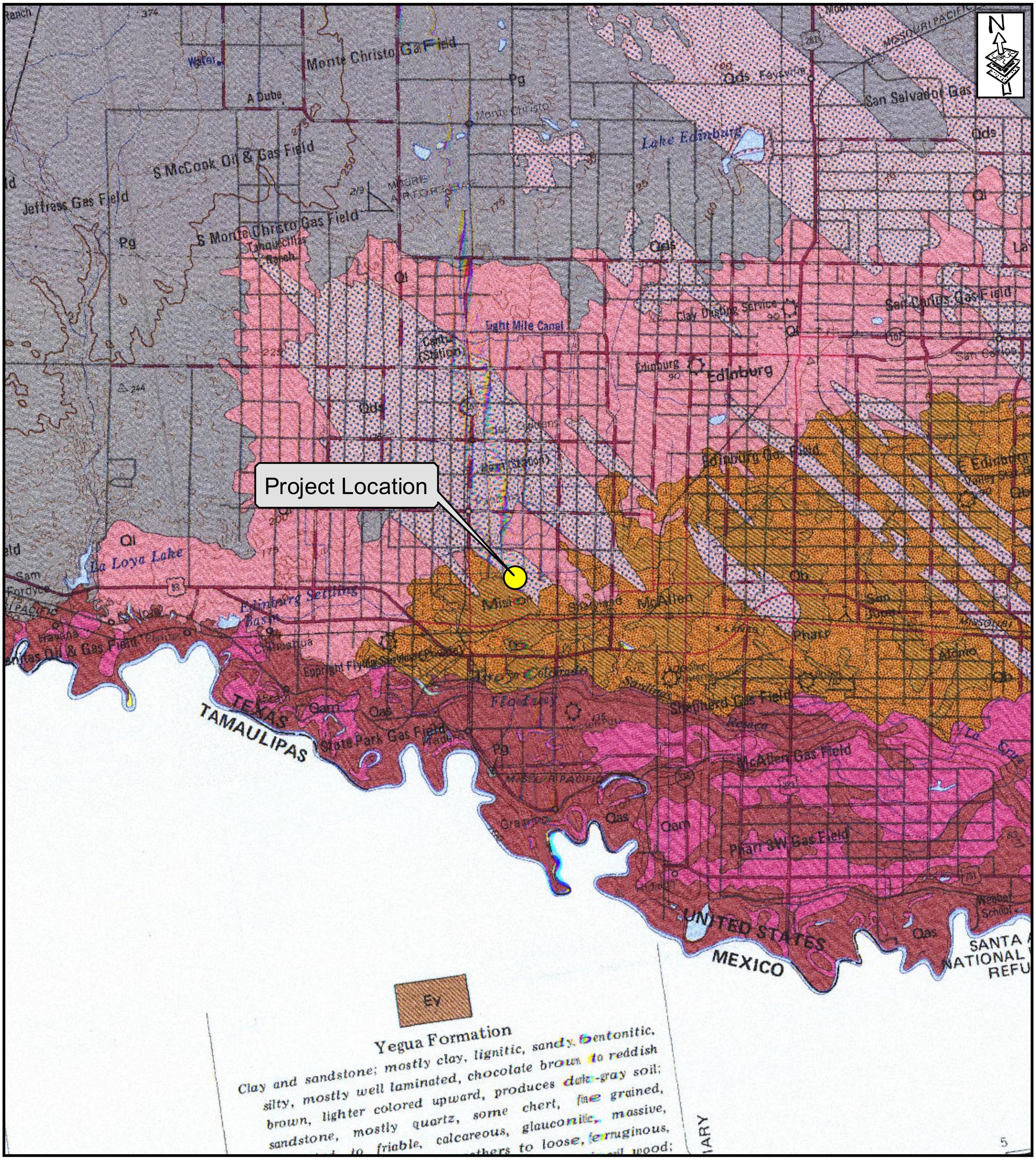


Figure 4

City of Mission
Tennis Center at Birdwell Park

Geologic Atlas of Texas

Legend

Project Location

Windblown Deposits - Stabilized Sand Dune Deposits

20,000 Feet

1 inch = 20,000 feet

L&G Engineering

APPENDIX B – BORING LOGS & GRADATION CURVES

L & G Engineering Laboratory
Construction Material Testing
Geotechnical Engineering

L&G Engineering Laboratory LLC
2100 W. Expressway 83
Mercedes TX 78570
Telephone: 956-565-0760

KEY TO SYMBOLS

CLIENT City of Mission
PROJECT NAME Mission Tennis Center at Birdwell Park
PROJECT NUMBER G17004
PROJECT LOCATION Hidalgo County

LITHOLOGIC SYMBOLS (Unified Soil Classification System)

CH: USCS High Plasticity Clay

CL: USCS Low Plasticity Clay

SAMPLER SYMBOLS

Standard Penetration Test

WELL CONSTRUCTION SYMBOLS

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)

TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION

Water Level at Time Drilling, or as Shown
Water Level at End of Drilling, or as Shown
Water Level After 24 Hours, or as Shown

L&G Engineering Laboratory
Construction Material Testing
Geotechnical Engineering

L&G Engineering Laboratory LLC
2100 W. Expressway 83
Mercedes TX 78570
Telephone: 956-565-0760

BORING NUMBER B-01

CLIENT City of Mission
PROJECT NAME Mission Tennis Center at Birdwell Park
PROJECT NUMBER G17004
PROJECT LOCATION Hidalgo County
DATE STARTED 4/26/17 **COMPLETED** 4/26/17
GROUND ELEVATION 135 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR L&G Consulting Engineers, Inc (Lab Division)
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING 13.00 ft / Elev 122.00 ft
LOGGED BY J. Sinclair **CHECKED BY** David A. Saenz, P.E.
AT END OF DRILLING ---
NOTES GPS 26°13'45.72" N, 98°18'03.18" W (Approx. Elev.)
24hrs AFTER DRILLING 10.33 ft / Elev 124.67 ft Cave-In Depth = 11.67 ft

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0	(CL) Sandy Lean Clay, Dark Brown, Soft to Medium Stiff, Dry										
		SPT 1		4-4-3 (7)			11				
		SPT 2		1-2-2 (4)			13	40	14	26	
5	(CH) Fat Clay w/ Sand, Brown, w/ Calcareous Nodules, Medium Stiff to Very Stiff, Dry to Wet	SPT 3		2-2-3 (5)			15				72
		SPT 4		3-6-10 (16)			16				
		SPT 5		4-7-12 (19)			16	56	18	38	84
10											
	(CH) Sandy Fat Clay, Brown, Stiff, Wet	SPT 6		3-5-6 (11)			16	54	18	36	65
15											
	(CH) Fat Clay w/ Sand, Brown, Stiff, Wet	SPT 7		3-6-6 (12)			16	55	20	35	72
20											

Bottom of borehole at 20.0 feet.

BORING NUMBER B-02

L & G Engineering Laboratory
Construction Material Testing
Geotechnical Engineering

L&G Engineering Laboratory LLC
2100 W. Expressway 83
Mercedes TX 78570
Telephone: 956-565-0760

CLIENT City of Mission
PROJECT NAME Mission Tennis Center at Birdwell Park
PROJECT NUMBER G17004
PROJECT LOCATION Hidalgo County
DATE STARTED 4/26/17 **COMPLETED** 4/26/17
GROUND ELEVATION 129.5 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR L&G Consulting Engineers, Inc (Lab Division)
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 18.00 ft / Elev 111.50 ft
LOGGED BY J. Sinclair **CHECKED BY** David A. Saenz, P.E.
AT END OF DRILLING ---
NOTES GPS 26°13'43.73" N, 98°18'00.91" W (Approx. Elev.)
▼ **24hrs AFTER DRILLING** 7.25 ft / Elev 122.25 ft Cave-In Depth = 10.50 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(CL) Sandy Lean Clay, Dark Brown, Very Soft to Soft, Dry										
			SPT 1		2-2-2 (4)			17	32	15	17	
			SPT 2		1-1-1 (2)			21				69
5		(CH) Fat Clay w/ Sand, Brown, w/ Calcareous Nodules (Noted From 8.5 to 10 ft), Medium Stiff to Very Stiff, Dry to Wet	SPT 3		1-2-3 (5)			22				
	▼		SPT 4		2-3-5 (8)			18	65	19	46	
10			SPT 5		7-10-14 (24)			18				77
15			SPT 6		5-11-12 (23)			16	67	23	44	76
	▽											
20			SPT 7		6-9-13 (22)			23	77	26	51	83

Bottom of borehole at 20.0 feet.

L&G Engineering Laboratory
Construction Material Testing
Geotechnical Engineering

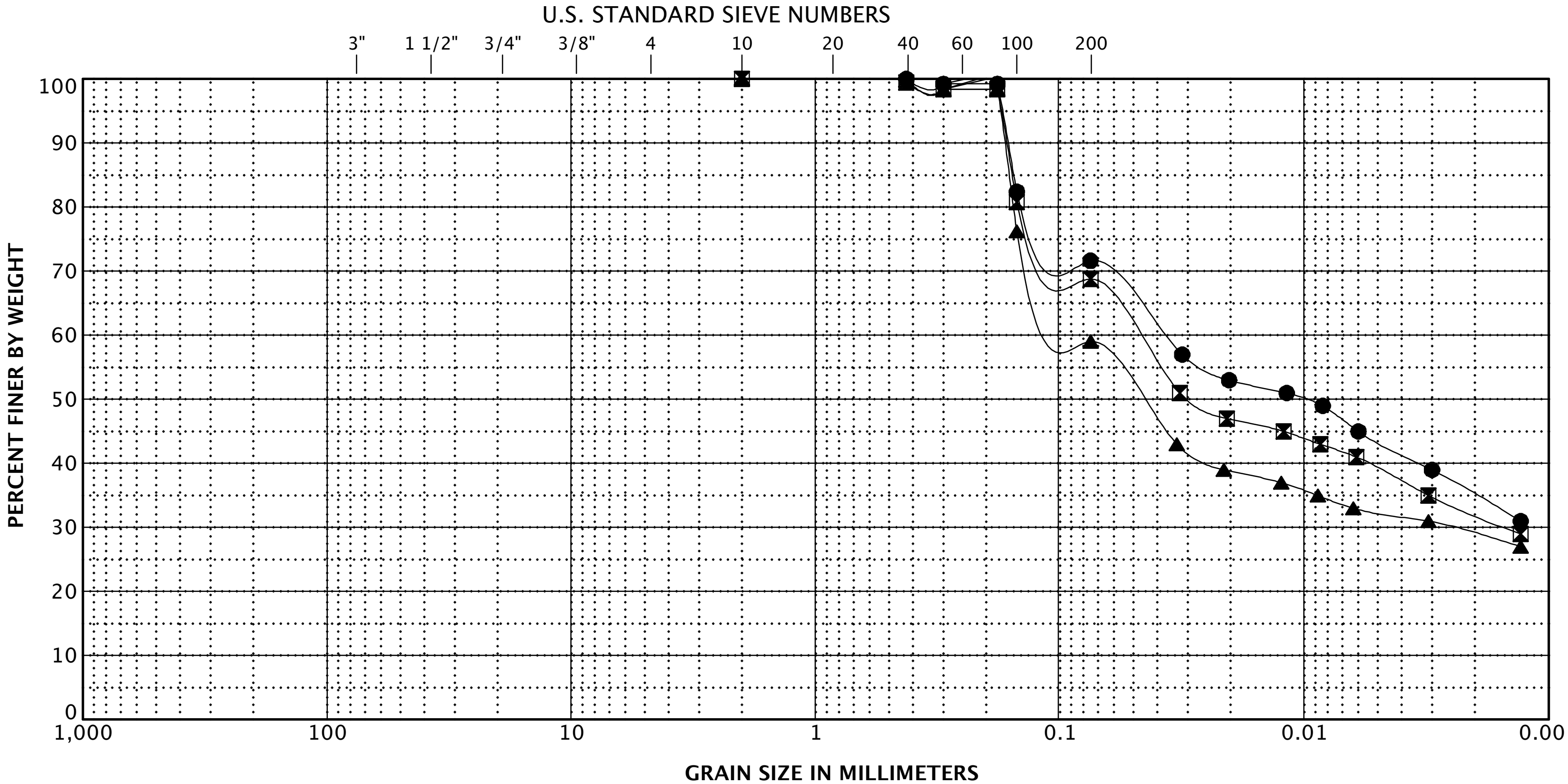
L&G Engineering Laboratory LLC
2100 W. Expressway 83
Mercedes TX 78570
Telephone: 956-565-0760

BORING NUMBER B-03

CLIENT City of Mission
PROJECT NAME Mission Tennis Center at Birdwell Park
PROJECT NUMBER G17004
PROJECT LOCATION Hidalgo County
DATE STARTED 4/26/17 **COMPLETED** 4/26/17
GROUND ELEVATION 129.5 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR L&G Consulting Engineers, Inc (Lab Division)
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING --- No Water Strike Encountered
LOGGED BY J. Sinclair **CHECKED BY** David A. Saenz, P.E.
AT END OF DRILLING ---
NOTES GPS 26°13'45.02" N, 98°17'58.45" W (Approx. Elev.)
24hrs AFTER DRILLING 11.25 ft / Elev 118.25 ft Cave-in Depth = 14.33 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(CL) Sandy Lean Clay, Dark Brown, Medium Stiff to Stiff, Dry	SPT 1		3-4-6 (10)			8				59
			SPT 2		2-2-3 (5)			13	37	15	22	
5			SPT 3		2-2-3 (5)			16				
		(CL) Lean Clay w/ Sand, Brown, w/ Calcareous Nodules, Medium Stiff to Stiff, Dry	SPT 4		2-3-4 (7)			13				71
10			SPT 5		3-4-7 (11)			15	47	17	30	
15		(CH) Fat Clay w/ Sand, Brown, w/ Calcareous Nodules, Very Stiff, Dry	SPT 6		5-12-14 (26)			17	65	23	42	79
20		(CH) Fat Clay, Brown, w/ Black Mottles, Hard, Dry	SPT 7		7-14-17 (31)			19	79	25	54	91

Bottom of borehole at 20.0 feet.



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	D90	D60	D50	D30	D10	GRAVEL (PERCENT)	SAND (PERCENT)	SILT (PERCENT)	CLAY (PERCENT)
●	B-1	4.5		0.16	0.04	0.010			0	28	28	43
⧗	B-2	2.5		0.16	0.05	0.029	0.002		0	31	30	39
▲	B-3	0.5		0.17	0.08	0.047	0.003		0	41	27	32

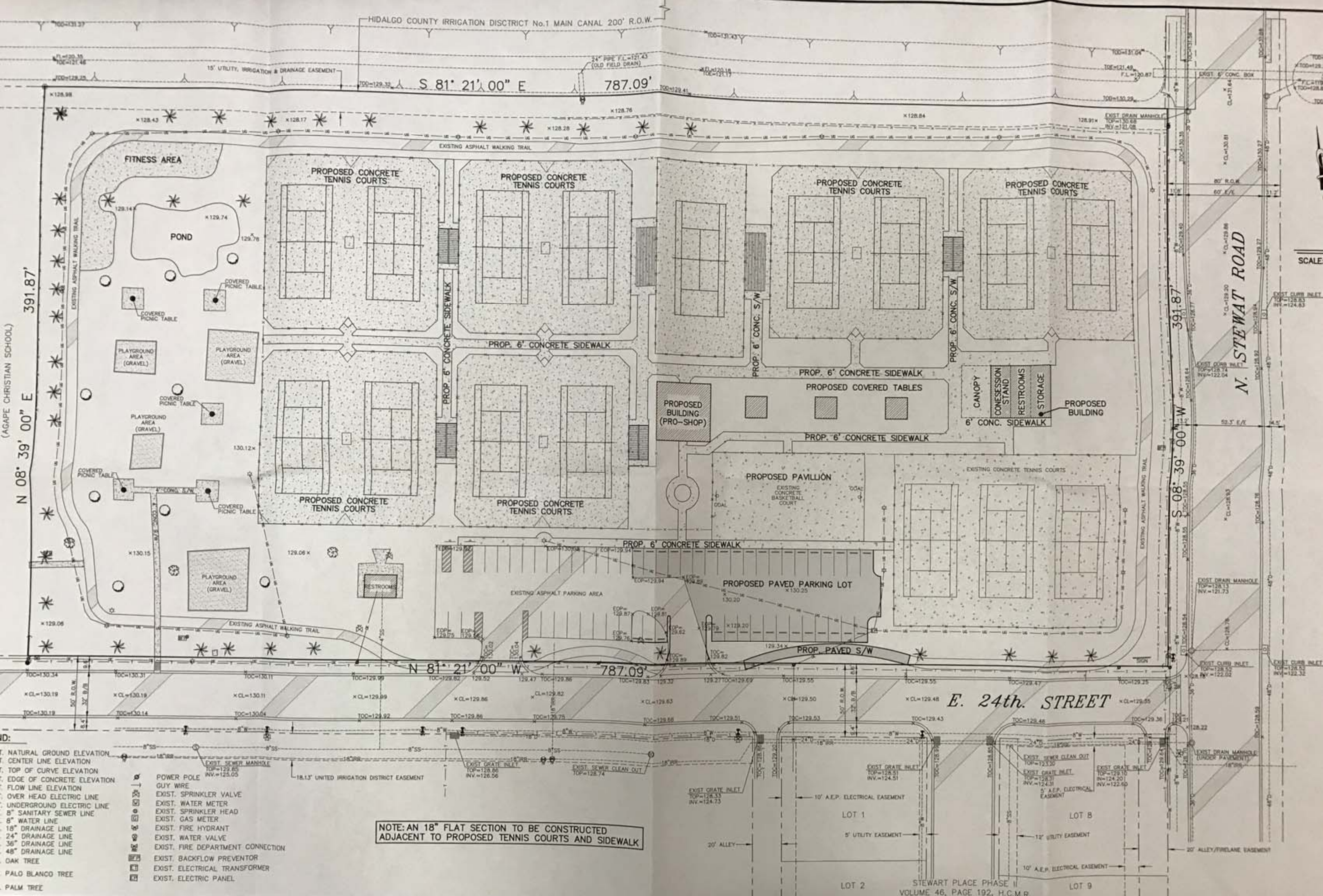
L & G Engineering Laboratory
Construction Material Testing
Geotechnical Engineering

GRAIN-SIZE TEST RESULTS

MISSION TENNIS CENTER AT BIRDWELL PARK
HIDALGO COUNTY

FIGURE

APPENDIX C – PLANS & SPECS (PROVIDED BY CLIENT)



SIONS

PROJECT No.	170203
DATE:	MARCH, 2017
DRAWN BY	P.GONZALEZ
CHK. BY	J.H.

JEH

JAVIER HINOJOSA ENGINEERING
CONSULTING ENGINEERS
416 E. DOVE AVENUE McALLEN, TEXAS 78504
PHONE (956) 668-1588
javhin@rgv.rr.com
TBPE FIRM No. F-1295

PROPOSED SITE PLAN
MISSION TENNIS CENTER AT BIRDWELL PARK
(LOT 2 W. RUSSELL AND NORMA BARNES BIRDWELL SUBDIVISION)
MISSION, TEXAS

SHEET
OF 3