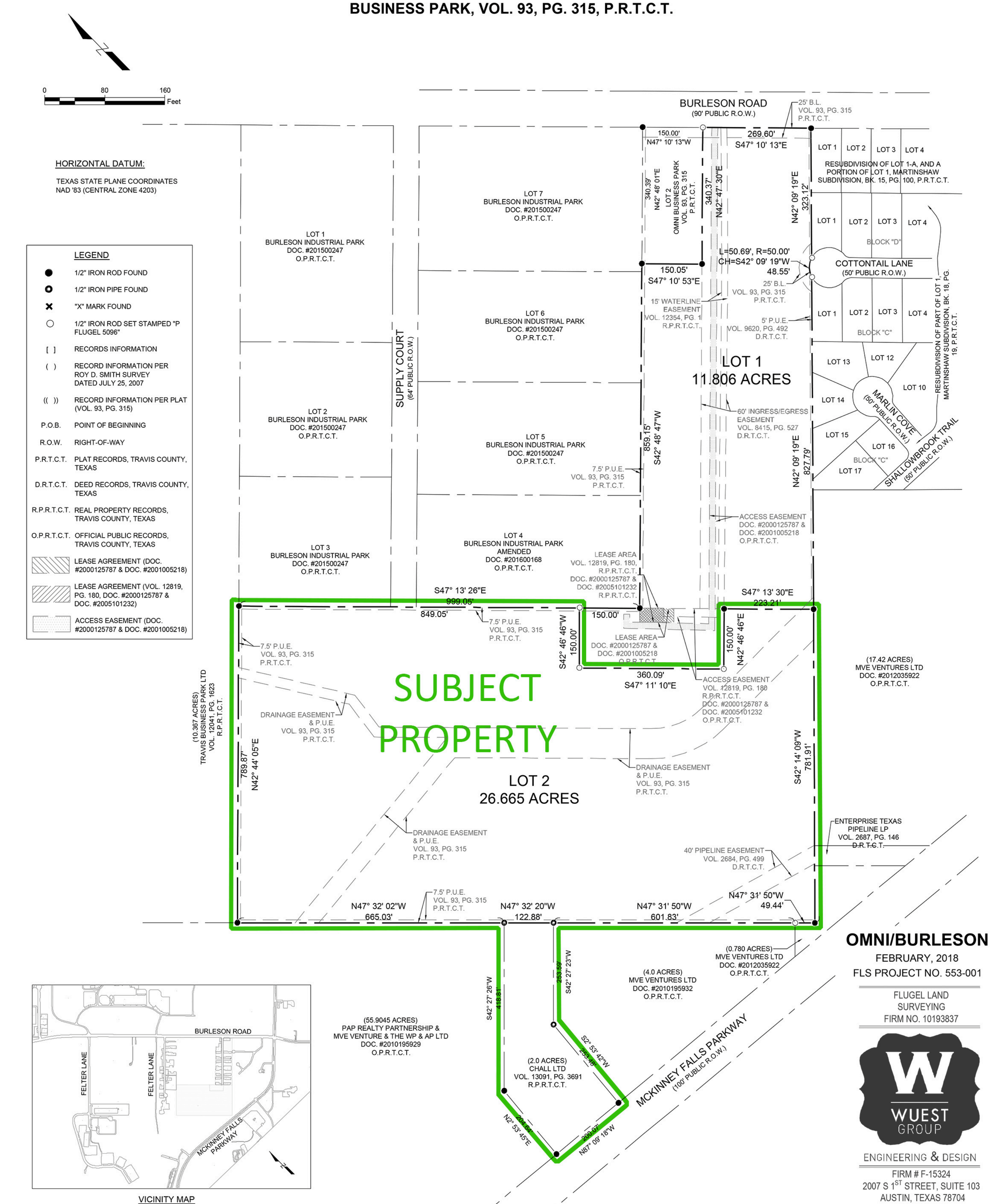
OMNI/BURLESON

AMENDED PLAT OF LOTS 1 AND 3, OMNI BUSINESS PARK, VOL. 93, PG. 315, P.R.T.C.T.



OMNI/BURLESON
FEBRUARY, 2018
FLS PROJECT NO. 553-001

FLUGEL LAND SURVEYING
FIRM NO. 10193837

WUEST GROUP
ENGINEERING & DESIGN
FIRM # F-15324
2007 S 1ST STREET, SUITE 103
AUSTIN, TEXAS 78704
(512)394-1900

SHEET 1 OF 2

Drawing: G:_Flugel Land Survey\553 Mylo Obstacles Fitness\001 Omni Business Park\CAD\Omni-Burleson.plat.dwg Last Plotted: Mon Feb 26, 2018 – 12:09pm By: bdaniel

OMNI/BURLESON

AMENDED PLAT OF LOTS 1 AND 3, OMNI BUSINESS PARK, VOL. 93, PG. 315, P.R.T.C.T.

GENERAL NOTES:

1. BY APPROVING THIS PLAT, THE CITY OF AUSTIN ASSUMES NO OBLIGATION TO CONSTRUCT ANY INFRASTRUCTURE IN CONNECTION WITH THIS SUBDIVISION. ANY SUBDIVISION INFRASTRUCTURE REQUIRED FOR THE DEVELOPMENT OF THE LOTS IN THIS SUBDIVISION IS THE RESPONSIBILITY OF THE DEVELOPER AND/OR THE OWNERS OF THE LOTS. FAILURE TO CONSTRUCT ANY REQUIRED INFRASTRUCTURE TO CITY STANDARDS MAY BE JUST CAUSE FOR THE CITY TO DENY APPLICATIONS FOR CERTAIN DEVELOPMENT PERMITS INCLUDING BUILDING PERMITS, SITE PLAN APPROVALS, AND/OR CERTIFICATES OF OCCUPANCY.

2. THE OWNER OF THIS SUBDIVISION AND HIS OR HER SUCCESSORS AND ASSIGNS, ASSUMES RESPONSIBILITIES FOR PLANS FOR CONSTRUCTION OF SUBDIVISION IMPROVEMENTS WHICH COMPLY WITH APPLICABLE CODES AND REQUIREMENTS OF THE CITY OF AUSTIN. THE OWNER UNDERSTANDS AND ACKNOWLEDGES THAT PLAT VACATION OR REPLATTING MAY BE REQUIRED, AT THE OWNERS SOLE EXPENSE IF PLANS TO CONSTRUCT THIS SUBDIVISION DO NOT COMPLY WITH SUCH CODES AND REQUIREMENTS.

3. ALL RESTRICTIONS AND NOTES FORM THE PREVIOUS EXISTING SUBDIVISION, OMNI BUSINESS PARK, VOLUME 93, PAGE 315, OF THE TRAVIS COUNTY PLAT RECORDS, SHALL APPLY TO THIS AMENDED PLAT.

4. NO LOTS IN THIS SUBDIVISION SHALL BE OCCUPIED UNTIL CONNECTED TO THE CITY OF AUSTIN WATER AND WASTEWATER UTILITIES.

5. THE WATER AND WASTEWATER UTILITY SYSTEM SERVING THIS SUBDIVISION MUST BE IN ACCORDANCE WITH THE CITY AUSTIN UTILITY DESIGN CRITERIA. THE WATER AND WASTEWATER UTILITY PLAN MUST BE REVIEWED AND APPROVED BY THE AUSTIN WATER UTILITY. ALL WATER AND WASTEWATER CONSTRUCTION MUST BE INSPECTED BY THE CITY OF AUSTIN. THE LANDOWNER MUST PAY THE CITY INSPECTION FEE WITH THE UTILITY CONSTRUCTION. FYI: THE LANDOWNER MUST PAY THE TAP AND IMPACT FEE ONCE THE LANDOWNER MAKES AN APPLICATION FOR A CITY OF AUSTIN WATER AND WASTEWATER UTILITY TAP PERMIT.

6. EROSION CONTROLS ARE REQUIRED FOR ALL CONSTRUCTION ON INDIVIDUAL LOTS, INCLUDING DETACHED SINGLE FAMILY AND DUPLEX CONSTRUCTION, IN ACCORDANCE WITH THE CITY OF AUSTIN ENVIRONMENTAL CRITERIA MANUAL AND SECTION 25-8-181 OF THE LAND DEVELOPMENT CODE.

7. PRIOR TO CONSTRUCTION, EXCEPT DETACHED SINGLE FAMILY ON ANY LOT IN THIS SUBDIVISION, A SITE DEVELOPMENT PERMIT MUST BE OBTAINED FROM THE CITY OF AUSTIN.

8. BUILDING SETBACK LINES SHALL BE IN ACCORDANCE WITH THE CITY OF AUSTIN ZONING ORDINANCE REQUIREMENTS.

9. AUSTIN ENERGY HAS THE RIGHT TO PRUNE AND/OR REMOVE TREES, SHRUBBERY AND OTHER OBSTRUCTIONS TO THE EXTENT NECESSARY TO KEEP THE EASEMENTS CLEAR. AUSTIN ENERGY WILL PERFORM ALL TREE WORK IN COMPLIANCE WITH CHAPTER 25-8, SUBCHAPTER 8 OF THE CITY OF AUSTIN LAND DEVELOPMENT CODE.

10. THE OWNER/DEVELOPER OF THIS SUBDIVISION/LOT SHALL PROVIDE THE CITY OF AUSTIN ELECTRIC UTILITY DEPARTMENT WITH ANY EASEMENT AND/OR ACCESS REQUIRED TO PROVIDE SERVICE TO THIS SUBDIVISION, IN ADDITION TO THOSE INDICATED, FOR THE INSTALLATION AND ONGOING MAINTENANCE OF OVERHEAD AND UNDERGROUND ELECTRIC FACILITIES. THESE EASEMENTS AND/OR ACCESS ARE REQUIRED TO PROVED ELECTRIC SERVICE TO THE BUILDING, AND WILL NOT BE LOCATED SO AS TO CAUSE THE SITE TO BE OUT OF COMPLIANCE WITH CHAPTER 25-8 OF THE CITY OF AUSTIN LAND DEVELOPMENT CODE.

11. ANY RELOCATION OF ELECTRIC FACILITIES SHALL BE AT OWNERS EXPENSE.

12. THE OWNER SHALL BE RESPONSIBLE FOR INSTALLATION OF TEMPORARY EROSION CONTROL, REVEGETATION AND TREE PROTECTION. IN ADDITION, THE OWNER SHALL BE RESPONSIBLE FOR ANY INITIAL TREE REMOVAL THAT IS WITHIN 10 FEET OF THE CENTER LINE OF THE PROPOSED OVERHEAD ELECTRICAL FACILITIES DESIGNED TO PROVIDE ELECTRIC SERVICE TO THIS PROJECT. THE OWNER SHALL INCLUDE AUSTIN ENERGY'S WORK WITHIN THE LIMITS OF CONSTRUCTION FOR THIS PROJECT.

13. THERE ARE NO SLOPES GREATER THAN 15% WITHIN THIS SUBDIVISION.

14. THE OWNER OF THE PROPERTY IS RESPONSIBLE FOR MAINTAINING CLEARANCES REQUIRED BY THE NATIONAL ELECTRIC SAFETY CODE, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) REGULATIONS, CITY OF AUSTIN RULES AND REGULATIONS AND TEXAS STATE LAWS PERTAINING TO CLEARANCES WHEN WORKING IN CLOSE PROXIMITY TO OVERHEAD POWER LINES AND EQUIPMENT. AUSTIN ENERGY WILL NOT RENDER ELECTRIC SERVICE UNLESS REQUIRED CLEARANCES ARE MAINTAINED. ALL COSTS INCURRED BECAUSE OF FAILURE TO COMPLY WITH THE REQUIRED. CLEARANCES WILL BE CHARGED TO THE OWNER.

THE STATE OF TEXAS
THE COUNTY OF TRAVIS

I, Dana DeBeauvoir, Clerk of Travis County, Texas, do hereby certify that the foregoing instrument of writing and its Certificate of Authentication was filed for record in my office on the ______ day of ___________, 2018, A.D., at ______ o'clock ____M., and duly recorded on the ______ day of ___________, 2018, A.D., at ______ o'clock ____M., Plat Records of said County and State in Document No. ___________.
Official Public Records of Travis County, Texas.

WITNESS MY HAND AND SEAL OF OFFICE OF THE COUNTY CLERK OF SAID COUNTY this the ______ day of ___________, 2018, A.D.

DANA DEBEAUVOIR, COUNTY CLERK TRAVIS COUNTY, TEXAS

BY:_______________________
Deputy

THE STATE OF TEXAS
THE COUNTY OF TRAVIS

This subdivision is located within the Full Purpose Jurisdiction of the City of the City of Austin on this the ______ day of ___________, 2018.

APPROVED, ACCEPTED AND AUTHORIZED FOR RECORD BY THE DIRECTOR, DEVELOPMENT SERVICES DEPARTMENT, CITY OF AUSTIN, COUNTY OF TRAVIS, THIS THE ____ DAY OF ___________, 2018, AD.

____
J. Rodney Gonzales, Director
Development Services Department

STATE OF TEXAS
COUNTY OF TRAVIS

KNOWN ALL MEN BY THESE PRESENT: That Chall LTD, being owners of 39.643 acres of land comprised of Lot 1 and Lot 3, Omni Business Park, a subdivision in Travis County recorded in Volume 93, Page 315, Plat Records, Travis County, Texas, Lot 1 and Lot 3 having been conveyed in Volume 11903, Page 2435, Real Property Records, Travis County, Texas, do hereby amend said subdivision pursuant to Chapter 212.016, of the Local Government Code, said subdivision to be known as:

"OMNI/BURLESON"
AMENDED PLAT OF LOTS 1 AND 3,
OMNI BUSINESS PARK,
VOL. 93, PG. 315
P.R.T.C.T.

And do hereby dedicate to the public any streets and/or easements shown hereon. Additionally, there are no lien holders for this property.

BY: _______________________________
agent, Chall LTD

THE STATE OF TEXAS
THE COUNTY OF TRAVIS

I, the undersigned authority, on this the ______ day of ___________, A.D., 2018, did personally appear ______________, agent, Chall LTD, known to me to be the person whose name is subscribed to the foregoing instrument of writing, and he acknowledged before me that he executed the same for the purposes and considerations therein expressed.

NOTARY PUBLIC ______________________

Printed name ______________________

Commision Expires ______________________

THE STATE OF TEXAS
THE COUNTY OF TRAVIS

I, Paul J. Flugel, am authorized under the laws of the State of Texas to practice the profession of surveying and hereby certify that this plat complies with Title 25 of the Austin City Code, and is true and correct and was prepared from an actual survey of the property made by me or under my supervision on the ground.

Paul J. Flugel - RPLS #5096
Flugel Land Surveying
Firm No. 10193837
(512)633-3996

02/26/2018
Date

STATE OF TEXAS
REGISTERED
PAUL J. FLUGEL
5096
PROFESSIONAL
LAND SURVEYOR

THE STATE OF TEXAS
THE COUNTY OF TRAVIS

This is to certify that I am authorized to practice the profession of engineering in the State of Texas, that I participated in the preparation of the plan submitted herewith, and that all information shown thereon is accurate and correct to the best of my knowledge as related to the engineering portions thereof, and that to the best of my knowledge said plat complies with Chapter 25 of the Austin City Code of 1999, as amended, and all other applicable codes and ordinances.

No Portion of this subdivision is within the boundaries of the 100-year flood plain of any waterway that is within the limits of study of the Federal Flood Administration FIRM panel 48453C0605J, dated January 6, 2016.

Scott M. Wuest, P.E. #98412
WUEST GROUP
Firm F-15324
(512)328-0002

02/26/2018
Date

STATE OF TEXAS
SCOTT M. WUEST
98412
LICENSED
PROFESSIONAL ENGINEER

OMNI/BURLESON
FEBRUARY, 2018
FLS PROJECT NO. 553-001

FLUGEL LAND SURVEYING
FIRM NO. 10193837

WUEST GROUP
ENGINEERING & DESIGN
FIRM # F-15324
2007 S 1ST STREET, SUITE 103
AUSTIN, TEXAS 78704
(512)394-1900

SHEET
2 OF 2

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

Proposed Burleson Development
McKinney Falls Parkway near
Shaw Lane, Austin, Texas

PSI Project No. 0303926

PREPARED FOR:

LH Layne Company
404 W Powell Lane, Suite 202
Austin, Texas 78753

October 28, 2016

BY:

PROFESSIONAL SERVICE
INDUSTRIES, INC.
2600 McHale Court, Suite 125
Austin, Texas 78758
Phone: (512) 491–0200
Fax: (512) 491–0220

October 28, 2016

LH Layne Company
404 W Powell Lane, Suite 202
Austin, Texas 78753

Attn: Mr. Eric Layne

RE: PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
PROPOSED BURLESON DEVELOPMENT
MCKINNEY FALLS PARKWAY NEAR SHAW LANE
AUSTIN, TEXAS
PSI Project No. 0303926

Dear Mr. Layne:

Professional Service Industries, Inc. (PSI) is pleased to submit this Preliminary Geotechnical Engineering Report for the referenced project. This report includes the results of field and laboratory testing along with preliminary recommendations as a part of the due diligence study to estimate budgetary project costs.

PSI appreciates the opportunity to perform this Preliminary Geotechnical Engineering Report and looks forward to continuing participation during the design and construction phases of this project. If there are any questions pertaining to this report, or if PSI may be of further service, please contact the PSI office.

PSI also has great interest in providing materials testing and inspection services during the construction of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Texas Board of Professional Engineers Certificate of Registration # F003307

Andrew J. Domke, P.E.
Geotechnical Department Manager

Dexter Bacon, P.E.
Chief Engineer

Pegah Rajaei
Graduate Engineer

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1.0 PROJECT INFORMATION

1.1 PROJECT AUTHORIZATION

Professional Service Industries, Inc., (PSI) has completed a field exploration and geotechnical evaluation for the proposed Burleson Development project to be constructed at McKinney Falls Parkway near Shaw Lane in Austin, Texas. Mr. Eric Layne , representing LH Layne Company, authorized PSI's services on October 20, 2016 by signing PSI Proposal No. 192275 dated October 19, 2016. PSI's proposal contained a proposed scope of work, lump sum fee, and PSI's General Conditions.

1.2 GEOTECHNICAL STUDY SYNOPSIS

Table 1.1 – Preliminary Geotechnical Design Summary

General Subsurface Conditions	Fat Clay over Lean Clay (Section 2.5)
Groundwater Observations	Water Encountered at 4 & 6 feet (Section 2.6)
Estimated Shrink Swell Movements	4 ½ inches (Section 3.2.1)
Tolerable Floor/Foundation Movements	Total: On the order of 1 inch Differential: On the order of ½ inch
Slab-on-Grade Earthwork Recommendation	Section 3.3.1
Foundation Design Recommendations	Monolithic Stiffened Beam or Drilled Pier with Slab-on-Grade (Section 3.5)
Allowable Bearing Pressure	2,000 psf (Section 3.5)
Drilled Pier Resistance Parameters	Section 3.5.2
Site Seismic Class	Class D (Section 3.6)
Pavement Type	Rigid or Flexible (Section 4.2)

1.3 PROJECT DESCRIPTION

Based on information provided, a summary of the proposed project and geotechnical recommendations are presented in the following tables.

Table 1.2 – General Project Description

Structural Design Element(s)	Not Provided
Structural Foot Print	Not Provided
Building Construction Type	Not Provided
Existing Grade Change within Building Pad	Not Provided
Existing Grade Change within Project Site	± 30 Feet Estimate
Finished Floor Elevation	Not Provided
Requested Foundation Type	None
Maximum Column Loading	Not Provided
Maximum Wall Loading	Not Provided

The geotechnical recommendations presented in this report are based on the available project information, structure locations, and the subsurface materials described in this report. If any of the noted information or assumptions made are incorrect, please inform Intertek-PSI so that the recommendations presented in this report can be amended as necessary. Intertek-PSI will not be responsible for the implementation of provided recommendations if not notified of changes in the project.

It should be noted that preliminary geotechnical recommendations are part of the due diligence study to estimate budgetary project costs and the current scope of work is not intended for design or construction purposes and a detailed geotechnical investigation should be performed for design and construction recommendations.

1.4 PURPOSE AND SCOPE OF SERVICES

The purpose of this study is to evaluate the subsurface conditions at the site and develop geotechnical engineering recommendations and guidelines as a part of the due diligence study to estimate budgetary project costs. The scope of services included drilling borings, performing laboratory testing, and preparing this preliminary geotechnical engineering report.

This report briefly outlines the available project information, describes the site and subsurface conditions, and presents preliminary recommendations regarding the following:

- General site development and subgrade preparation,
- Estimated potential soil movements associated with shrinking and swelling soils and methods to reduce these movements to acceptable levels;
- Recommendations for site excavation, fill compaction, use of on-site and imported fill material in the area of the structures and under pavements;
- Recommendations for building pad preparation for ground supported slabs having a maximum movement potential, due to heave or settlement, of 1-inch;
- Recommendations for design of foundations to be used for support of the proposed structure, including Wire Reinforcing Institute (WRI) and Post-Tensioning Institute (PTI) design criteria for slab-on-grade foundations designed for a 1” potential vertical movement;
- For drilled pier supported structures, drilled shaft/pier design will include end bearing and skin friction values, as well as LPILE design values for lateral load analysis;
- Seismic design site classification per the International Building Code;
- Recommendations for the design of flexible asphaltic and rigid concrete pavement systems for the proposed parking and drive areas.

The scope of services for this preliminary geotechnical exploration did not include an environmental, mold nor detailed seismic/fault assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 Site Description

The following table provide generalized descriptions of the existing site conditions based on visual observations during the field activities, as well as other available information.

Table 2.1 – Site Description

Site Location Description	McKinney Falls Parkway near Shaw Lane
Existing Site Conditions	Small creeks running through the property
Existing Grad/Elevation Changes	Upward slope from the east, west, and south to peak in the north section of the site with approximately 30 feet of change in elevation
Existing Site Ground Cover	Grass and trees
Ground Surface Soil Support Capability	Site was very wet and soft during initial field investigation. Only 3 of 5 borings were accessible due to soft conditions.
Site Boundaries	Bounded by existing commercial properties to the northeast and north and undeveloped properties to the south and southeast and northeast.

Figure 2.1 – Project Location

Figure 2.2 – Viewing North

Figure 2.3 – Viewing Southeast

Figure 2.4 – Viewing South

Figure 2.5 – Viewing West

2.2 FIELD EXPLORATION

Field exploration for the project consisted of drilling a total of 3 borings. The boring design element, boring labels, and approximate depths are provided in the following table.

Table 2.2 – Field Exploration Summary

Design Element	Boring Label	Approx. Depth of Boring
----	B-1, B-2	30 feet
----	B-3	10 feet

The boring locations were selected by PSI personnel and were located in the field using available natural landmarks and GPS coordinates. Elevations of the ground surface at the boring locations were not provided to PSI. Therefore, the references to elevations of various subsurface strata are based on depths below existing grade at the time of drilling. The approximate boring locations are depicted on the Boring Location Plan provided in the Appendix.

Table 2.3 – Field Exploration Description

Drilling Equipment	Truck mounted drilling equipment
Drilling Method	Continuous flight auguring, hollow-stem augers, wet rotary, air rotary
Drilling Procedure	Applicable ASTM and PSI Safety Manual
Sampling Procedure	Cohesive Soils – ASTM D1587 Cohesionless Soils – ASTM D1587/1586 Granular Soils – ASTM D1586
Field Testing Procedures	Hand Penetrometers Split Spoon Testing (ASTM D1586)
Frequency of Groundwater Level Measurements	During Drilling
Boring Backfill Procedures	Soil Cuttings
Sample Preservation and Transportation Procedure	General accordance with ASTM D4220

During the field activities, the encountered subsurface conditions were observed, logged, and visually classified (in accordance with ASTM D2487). Field notes were maintained to summarize soil types and descriptions, water levels, changes in subsurface conditions, and drilling conditions.

2.3 LABORATORY TESTING PROGRAM

PSI supplemented the field exploration with a laboratory testing program to determine additional engineering characteristics of the subsurface soils encountered. The laboratory testing program included:

- Visual Classification (ASTM D2488),
- Moisture Content Tests (ASTM D2216),
- Atterberg Limits (ASTM D4318),
- Material Finer than No. 200 (ASTM D1140),

- Unconfined Compression Strength Test (ASTM D2166).

The laboratory testing program was conducted in general accordance with applicable ASTM Specifications. The results of the laboratory tests are provided in the Appendix on the Logs of Boring. Portions of any samples that are not altered or consumed by laboratory testing will be retained for 30 days from the date shown this report and will then be discarded.

2.4 SITE GEOLOGY

As shown on the Geologic Map of the Waco Area, Texas, reprinted in 1979, the site is located in an area where the **Ozan Formation (Ko)** is present at or near the ground surface. The Ozan Formation consists of clay/marly clay with calcareous content, light brown to gray in color and develops poor fissility. The thickness of the Ozan Formation ranges from 500-775 feet.

It should be noted that this site located near the area where the **High Gravel Deposits (Qhg)** formation is present at or near the ground surface, and underlain by the **Fredericksburg Group (Kfr)**. The High Gravel Deposits (Qhg) formation is generally composed of an upper silty clay unit good for crop production and a lower coarse unit that yields some water. The Fredericksburg Group (Kfr) consists of Edwards Limestone, Comanche Peak Limestone, Keys Valley Marl, Cedar Park Limestone, and Bee Cave Marl. **Therefore, PSI recommends that the geological investigation be conducted on the site prior to the construction.**

2.5 SUBSURFACE CONDITIONS

The results of the field and laboratory testing indicates that the site generally contains fat clay over lean clay followed by another fat clay layer to each boring termination depth. Generally, fat clay or fat clay with gravel is present in the upper 3.5 to 5 feet. The Atterberg limits test indicates that the clay in this upper layer indicate a plasticity index (PI) range of 47 to 53 and the material has a percent passing the No. 200 sieve ranges from 71 to 90%. In these borings, the upper fat clay layer is followed by a layer of lean clay to a depth of 8 to 10 feet. Based on the Atterberg limits tests, the clay in this layer has a PI of 15 to 30 and the material has a percent passing the No. 200 sieve of 57 to 84%. The lean clay layer is followed by another fat clay layer Based on the Atterberg limits tests, the clay in this layer has a PI of 35 to 41 and the material has a percent passing the No. 200 sieve of 92 to 94%. The generalized subsurface profile at this site is shown in the following image.

The boring logs included in the Appendix should be reviewed for specific information at individual boring locations. The boring logs include soil descriptions, stratifications, locations of the samples, and field and laboratory test data. The stratifications shown on the boring logs only represent the conditions at that actual boring location and represent the approximate boundaries between subsurface materials. The actual transitions between strata may be more gradual or more distinct. Variations will occur and should be expected across the site. The stratification shown on the borings logs represents the approximate boundary between subsurface materials and the actual transition may be gradual.

Figure 2.6 – Generalized Subsurface Profile

2.6 GROUNDWATER INFORMATION

Water level measurements were performed during drilling the drilling. Specific information concerning groundwater is noted on each boring log presented in the Appendix of this report. The groundwater measurements are summarized in the following table.

Table 2.4 – Groundwater Levels (Depths)

Boring Designation	Boring Depth (feet)	During Drilling (feet)	After Drilling (feet)	Delayed (feet)
B-1	30	6	Note 1	Note 1
B-2	30	dry	Note 1	Note 1
B-3	10	4	Note 1	Note 1

(1) Not recorded during field activities

Groundwater levels fluctuate seasonally as a function of rainfall, proximity to creeks, rivers and lakes, the infiltration rate of the soil, seasonal and climatic variations and land usage. In relatively pervious soils, such as sandy soils, the indicated depths are considered to be a relatively reliable indicator of groundwater levels. In relatively impervious soils, however, water levels observed in the borings even after several days may not provide reliable indications of groundwater table elevations. If more detailed water level information is required, observation wells or piezometers could be installed at the site, and water levels could be monitored.

The groundwater levels presented in this report are the levels that were measured at the time of our field activities. It is recommended that the contractor determine the actual groundwater levels at the site at the time of the construction activities to determine the impact, if any, on the construction procedures.

The shallow groundwater noted in the borings is typically “perched” groundwater due to recent rains and is typically controlled using conventional sump and pump methods.

3.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

3.1 GEOTECHNICAL DISCUSSION

Based upon the information gathered from the soil borings and laboratory testing, the clay soils encountered at this site within the seasonally active zone have a high potential for expansion. The expansive potential (i.e. "Potential Vertical Movement" or PVM) of these soils must be addressed in the design and construction of this project in order to reduce the potential for foundation movements and foundation distress to an acceptable magnitude.

PSI understands that the future project might be supported on deep drilled piers due to its relatively heavy structural loading in order to reduce the potential for detrimental settlement. A shallow soil supported stiffened beam and slab-on-grade type foundation (Waffle Slab) is recommended for support of ancillary structures.

A foundation pad under the soil supported floor slab should be constructed to a depth of four feet below the final elevation grade of the slab. Several methods are available to improve the foundation soil beneath the grade supported foundation or floor slab. PSI recommends over-excavating and replacing the upper 4 feet or all dark brown fat clay, whichever is deeper, with density and moisture controlled select fill materials *(Undercut and Replace Method)*

The most cost effective method for a given site is typically a function of site-specific conditions and climate conditions anticipated at the time of construction.

3.2 ESTIMATED MOVEMENT OF EXPANSIVE SOILS

The soils encountered at the soil boring locations exhibit high potential for volumetric changes as a result of fluctuations in soil moisture content. For this reason, PSI has conducted tests to estimate the potential vertical movement within the proposed construction area.

3.2.1 Shrink/Swell Movement Estimate for Existing Conditions

Based on laboratory testing results and the Texas Department of Transportation (TxDOT) method TEX-124-E, the potential vertical movement for existing conditions within the proposed project area was estimated to be approximately in the range of **3 ½ inches** to **4 ½ inches**.

It is not possible to quantify actual soil moisture regime changes and resulting shrink/swell movements. Extreme soil moisture variations could occur due to unusual drought severity, leaking water or sewer lines, poor drainage (possibly due to landscape changes after construction), irrigation line breaks, perched groundwater infiltration, springs, large trees located adjacent to the building or previously underneath the building, downspouts directing roof discharge under the foundation, etc. Therefore, because of these factors, the shrink/swell potential of soils in the Central Texas area can often be significantly underestimated using the TxDOT, PTI or swell test methods.

These conditions cannot be determined at the time of the geotechnical study. Therefore, estimated shrink/swell movements are calculated in consideration of historical climate data related to soil moisture variations. Movements in excess of these assumed variations should be anticipated and adequate maintenance should be provided to address these issues throughout the life of the structure.

3.2.2 Acceptable PVM Tolerance and Recommendations

Any grade supported floor slabs and foundations should be expected to undergo some vertical movements, including differential, as a result of the action of expansive soils. In this general area, most owners, architects, structural and geotechnical engineers consider a value of one (1) inch or less to be within acceptable movement tolerances for grade supported floor slabs or foundations. This generally accepted tolerance for movement has been used by PSI in developing the recommendations for preparing the foundation pad for this project.

The amount of movement associated with a PVM magnitude of one (1) inch may not take into consideration the movement tolerance understood by the facility owner or occupants. These "operational" or "aesthetic" performance criteria require a lower magnitude of allowable movement than the "structural" criteria or tolerances associated with a one (1) inch PVM. The fact that cracking in the foundation and walls will likely occur due to expansive soil movement requiring periodic maintenance with a 1 inch PVM should be understood by the Owner and Design Team during the design phase.

Therefore, PSI recommends that the owner discuss allowable movement tolerances with the structural engineer, the architect, and other appropriate members of the Design Team prior to commencement of the final design to make certain that appropriate movement tolerances for grade supported floor slabs/foundations are developed and used for this project. If design PVM values other than one (1) inch are desired, PSI should be contacted to review and revise the recommendations presented in this report as necessary to meet the project requirements.

If the risk of grade-supported foundation and floor slab movements is not acceptable, or if the required foundation pad preparation costs for a soil supported foundation are determined to be excessive, a drilled pier foundation with a structurally suspended floor slab should be used.

3.2.3 Construction Phase Recommendations

Foundation pad preparation requirements on expansive clay sites depend on the soil moisture climatic condition at the time of construction as well as the expansive properties of the clay. It is recommended that the foundation pad recommendations presented in this report be confirmed immediately prior to construction by the Geotechnical Engineer.

Having the Geotechnical Engineer retained to review the earthwork recommendations in the Contract Documents and be an active participant in team meetings near the time of construction can often result in project cost savings. **The geotechnical engineer can assess soil moisture conditions at the time of construction more accurately by knowing the location of the building, surrounding flatwork, pavements, planned landscaping, and drainage features often resulting in less risk and project cost savings.**

3.3 FOUNDATION DISCUSSION

Based on information provided to PSI, information obtained during the field operations, results of the laboratory testing, and PSI's experience with similar projects, recommendations for a slab-on-ground, spread footing and drilled pier type foundation are presented in this report. Should it be determined that a different foundation type is desired, please inform PSI as soon as possible so that a supplement to this report for the desired foundation type can be provided.

A potential for vertical movement greater than 1 inch is above the value considered acceptable by most structural and geotechnical engineers in this area. Therefore, foundation improvement is recommended to reduce the PVM to an acceptable value for any grade supported floor slabs.

3.3.1 Slab-on-Grade Earthwork Recommendations

Foundation pad improvement should consist of removing the upper soils to the specified minimum over-excavation depth, compacting the exposed subgrade, placement and compaction of moisture conditioned general fill in any areas between the top of the compacted subgrade up to the bottom of the select fill, and finally compaction of the select fill to finish floor grade. This procedure is outlined in the following sections.

3.3.1.1 *Undercut and Replace Method*

PSI recommends that the building foundation be improved using the Undercut and Replace Method. The following illustrations and tables provide general requirements for the installation of a foundation pad utilizing the *Undercut and Replace* Method that should provide a reduced potential for vertical movement and a structurally improved foundation system.

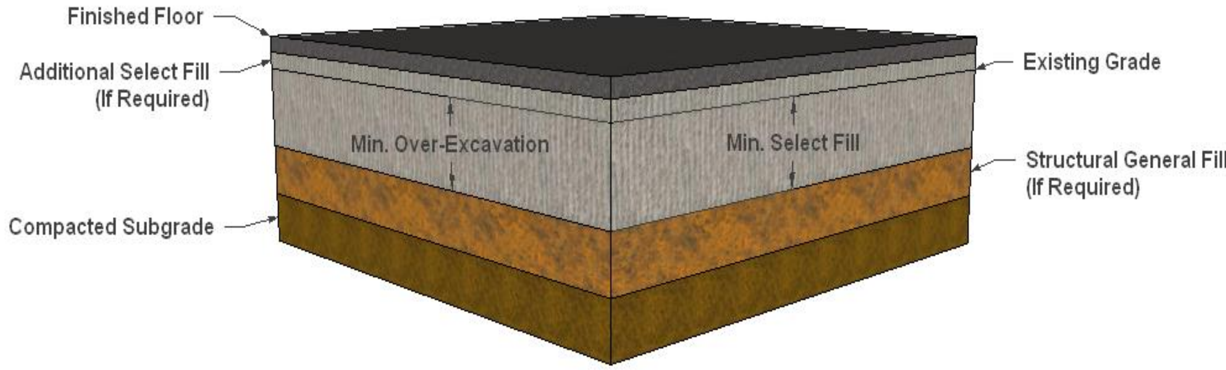


Figure 3.1 – Select Fill Foundation Pad Improvement

Table 3.1 – Undercut and Replacement Recommendations

Application	Soil Supported Floor Slab
Site Stripping Removal	Upper 6 inches of organics and deleterious material including debris to expose clean subgrade
Foundation Improvement Method	Remove and replace existing soils with select fill
Improved Site Condition PVM	Less than 1 inch
Minimum Over-Excavation	4 feet
Horizontal Undercut Extent	Below all slab areas and at least 5 feet beyond the slab perimeter and **extending the full width of flatwork that may be sensitive to movement**
Proof-Rolling Requirements	The exposed subgrade should be proof-rolled with construction equipment weighing at least 20 tons. Soils that are observed to rut or deflect excessively under the moving load should be removed and replaced with properly compacted select fill materials.

Exposed Subgrade Treatment	Proof-roll then scarify, moisture condition, and compact 9 inches natural subgrade
Select Fill Thickness	**At least 4 feet minimum at top of pad**
Select Fill Material	TxDOT Item 247 (Crushed Limestone Material) Type A or B Grade 1, 2, or 3
Select Fill Material Alternative	Pit Run (On-Site or Imported) Free of organics, trash, or other deleterious material Liquid Limit <40% Plasticity Index 7 to 20 Max Particle Size < 3”
Structural General Fill Requirements	Clean on site materials having: Allowable PI from 12 to 35 Percent Passing No. 200 Sieve > 50% Max Particle Size < 3”
Vapor Retarder Material	Minimum 10-mil conforming to ASTM E1745, Class C or better and with a maximum water vapor permeance of 0.044 perms (ASTM E96) such as a 10 mil Stego Wrap by Stego Industries LLC or other similar product
Maximum Loose Lift Thickness	8 inches
Time Between Subgrade Prep. and Select Fill Placement	Less than 48 hours

**Note that the material between the 4 and 9 foot depths is generally a lean clay meeting the Structural General Fill requirements and could be stockpiled separately and used in the building area.*

3.3.2 Compaction and Testing Requirements for Foundation Pad Areas

The following table outlines foundation pad compaction requirements in consideration of appropriate vertical movement reduction method.

Table 3.2 – Compaction Requirements for Undercut and Replace Method

Location	Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Requirement
Foundation Pad Areas	Subgrade Soil (Base of excavation)	ASTM D 698	94% to 98%	0 to +4%	1 per 5,000 SF
	Structural General Fill (Onsite Material)	ASTM D 698	94% to 98%	0 to +4%	1 per 5,000 SF; min. 3 per lift
	Select Fill (Item 247 or Pit Run)	ASTM D 698	≥ 98%	–1 to +3%	1 per 5,000 SF; min. 3 per lift

3.4 DESIGN MEASURES TO REDUCE CHANGES IN SOIL MOISTURE

The following recommended measures can reduce possible moisture fluctuations of the soils under the floor slab. Movements of the foundation soil can be effectively reduced by providing horizontal and/or vertical moisture barriers around the edge of the slab. Typically, the moisture barriers would consist of concrete flatwork or asphalt or concrete pavement placed adjacent to the edge of the building, a clay cap over poly, and/or a deepened perimeter grade beam or vertical poly trench filled with flowable fill.

Although subgrade modification through excavation and replacement is recommended to reduce potential soil-related foundation movements, the design and construction of a grade-supported foundation should also include the following elements:

- *Roof drainage should be controlled by gutters and carried well away from the structure. The ground surface adjacent to the building perimeter should be sloped and maintained a minimum of 5% grade away from the building for 10 feet to result in positive surface flow or drainage away from the building perimeter. In areas adjacent to the building controlled by ADA, concrete flatwork slopes should not be less than 2% within 10 feet of the building.*

- *Hose bibs, sprinkler heads, and other external water connections should be placed well away from the foundation perimeter such that surface leakage cannot readily infiltrate into the subsurface or compacted fills placed under the proposed foundations and slabs.*

- *No trees or other vegetation over 6 feet in height shall be planted within 15 feet of the structure unless specifically accounted for in the foundation design.*

- *Utility bedding should not include gravel near the perimeter of the foundation. Compacted clay or flowable fill trench backfill should be used in lieu of permeable bedding materials between 2 feet inside the building to a distance of 4 feet beyond the exterior of the building edge to reduce the potential for water to infiltrate within utility bedding and backfill material.*

- *Paved areas around the structure are helpful in maintaining soil moisture equilibrium. It will be very beneficial to have pavement, sidewalks or other flatwork located immediately adjacent to the building to both reduce intrusion of surface water into the more permeable select fill and to reduce soil moisture changes along the exterior portion of the floor due to soil moisture changes from drought, excessive rainfall or irrigation, etc. The use of a clay cap over poly sheeting (horizontal barrier) or impervious geosynthetic liner or concrete (vertical barrier) is recommended in those areas not covered with asphalt or concrete pavement or flatwork. For this project, the minimum recommended horizontal distance of relatively impervious cover from pavement, flatwork or geosynthetic liner is 8 feet. For a deepened concrete beam or other type of impervious vertical barrier, a minimum depth of 6 feet is recommended*

- *Flower beds and planter boxes should be piped or water tight to prevent water infiltration under the building. Experience indicates that landscape irrigation is a common source of foundation movement problems and pavement distress.*

- *Experience indicates that landscape irrigation is a common source of foundation movement problems and pavement distress. Repairing irrigation lines as soon as possible after leakage commences will benefit foundation performance greatly.*

- *Foundation pad and pavement subgrade should be protected and covered within 48 hours to reduce changes in the natural moisture regime from rainfall events or excessive drying from heat and wind.*

3.5 FOUNDATION DESIGN RECOMMENDATIONS

A stiffened beam and slab foundation would typically be utilized for any smaller ancillary structures. The heavier warehouse buildings would typically be supported on a drilled pier type foundation with a soil supported floor slab.

3.5.1 Stiffened Beam and Slab-on-Ground Foundation Recommendations

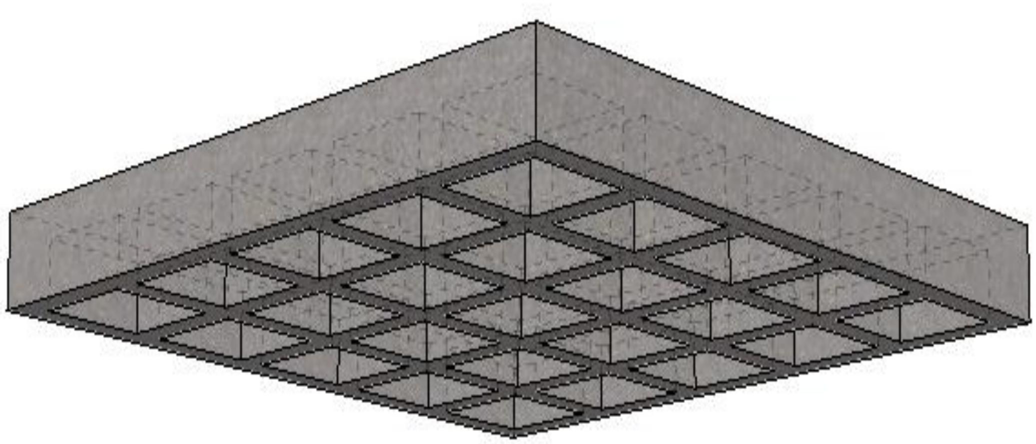


Figure 3.2 – Typical Waffle Slab

A waffle slab type foundation is generally used to support relatively light structures where soil conditions are relatively uniform and where uplift and settlement can be tolerated. The intent of a stiffened beam and slab-on-grade foundation is to allow the structure and foundation to move with soil movements while providing sufficient stiffness to limit differential movements within the superstructure to an acceptable magnitude. The foundation may be designed using the Design of Slab-On-Ground Foundations published by the Wire Reinforcement Institute, Inc. (August 1981, updated March 1996). Alternately, the foundation may be designed using the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground published by the Post-Tensioning Institute (PTI DC10.1-08). The following table is applicable for a conventionally reinforced "Waffle Slab" with subgrade prepared in accordance with Section 3.3, which details foundation pad preparation and construction recommendations.

Table 3.3 – Waffle Slab Design Parameters

Waffle Slab Design Method	Wire Reinforcement Institute (WRI)
Effective Plasticity Index	25.0
Soil/Climatic Rating Factor (1–C)	0.11
Allowable Bearing Pressure for Grade Beams	2,000 psf
Bearing Stratum at Bottom of Grade Beams	Compacted Lean Clay or Select Fill
Penetration of Perimeter Beams Below Final Exterior Grade	At least 24 inches

PSI is providing PTI design values for the Structural Engineer's consideration and possible use. These design values are estimated from the "Volflo" computer program in consideration of the soil conditions in the building area, an improved foundation pad for a 1 inch PVM and local experience. The following table is applicable for a conventionally reinforced or post-tensioned slab-on-grade with subgrade prepared in accordance with Section 3.3, which details foundation pad preparation and construction recommendations.

Table 3.4 – PTI Design Parameters

Waffle Slab Design Method	Post Tension Institute (PTI)
Edge Moisture Variation Distance Center Lift, e_m Edge Lift, e_m	 9.0 feet 4.9 feet
Differential Soil Movement Center Lift, y_m Edge Lift, y_m	 -0.86 inches 1.22 inches
Allowable Bearing Pressure for Grade Beams	2,000 psf
Bearing Stratum at Bottom of Grade Beams	Compacted Lean Clay or Select Fill
Penetration of Perimeter Beams	At least 24 inches

Utilities that project through slab and grade beam foundations should be designed either with some degree of flexibility or with sleeves in order to prevent any damage to these lines as a result of vertical movement. Contraction, control or expansion joints should be designed and placed in various portions of the structure to minimize and control wall cracking as a result of foundation movements. Properly planned placement of these joints will assist in controlling the degree and location of material cracking which normally occurs due to material shrinkage, thermal affects, soil movements and other related structural conditions.

3.5.2 Drilled Pier Recommendations

3.5.2.1 *Straight Drilled Pier*

PSI recommends that the heavy loaded buildings be supported on deep straight shaft drilled piers to minimize the potential for undesirable settlement. The following illustrations and tables outline the requirements for drilled shaft design and construction considerations for support of these structures.

Table 3.5 – Parameters for Axial Design

Depth Interval, feet	Material	Allowable Skin Friction, Qf, psf (includes F.S. = 2)	Allowable End Bearing, Qeb, psf (includes F.S. = 3)	Uplift Force of Soil in Active Zone, kips
0 to 10	Clay	—	—	35d (d in feet)
10 to 18	Clay	400	--	
18 to 30	Clay	1,000	12,000	

Table 3.6 – Constraints for Straight Shaft Design

Estimated Depth to Neglect Skin Friction	10 feet
Minimum Embedment Depth below Original Grade	22 feet
Minimum Shaft Diameter, d	18 inches
Thickness to Neglect Skin Friction at Base of Shaft	1 Shaft Diameter
Uplift Resistance	Pier Weight + Dead Load + Allowable Skin Friction Below Active Zone
Minimum Shaft Spacing (center to center)	3 Shaft Diameters (3·d)
Possible Group Effect	Spacing less than 3d consult Geotechnical Engineer
Minimum Pier Vertical Reinforcing Steel	1% of gross cross-sectional area; As needed to resist uplift forces
Pier Tensile Reinforcing Steel	As Per ACI Code
Estimated Settlement Total Settlement Differential Settlement	 Less than 1 inch Less than 0.5 inch

*Detailed Settlement Analysis is outside project scope

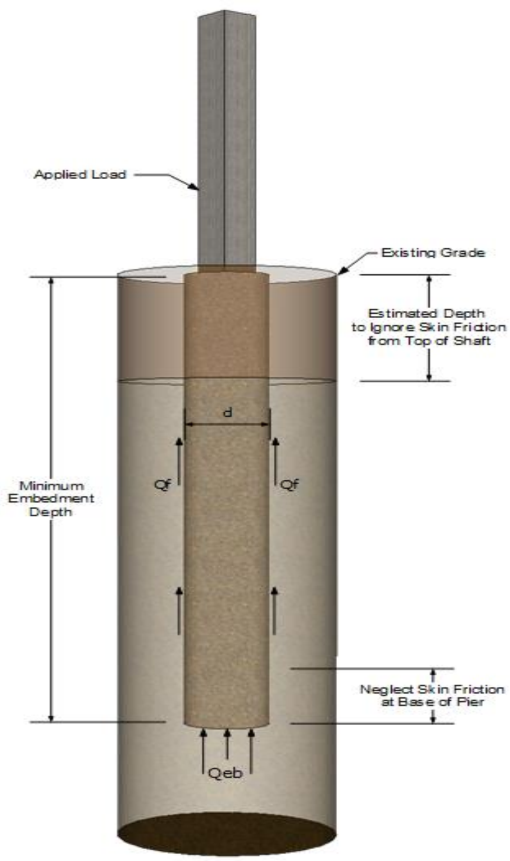


Figure 3.3 – Straight Drilled Pier

The minimum embedment depth was selected to locate the pier base below the depth of seasonal moisture change and within a specified desired stratum. Actual pier depths may need to be deeper depending upon the actual compressive loads on the pier.

3.5.2.2 *Underreamed Drilled Pier*

PSI recommends that the proposed building be supported on deep drilled piers to minimize the potential for undesirable movement. The following illustrations and tables outline the requirements for the belled pier design and construction considerations.

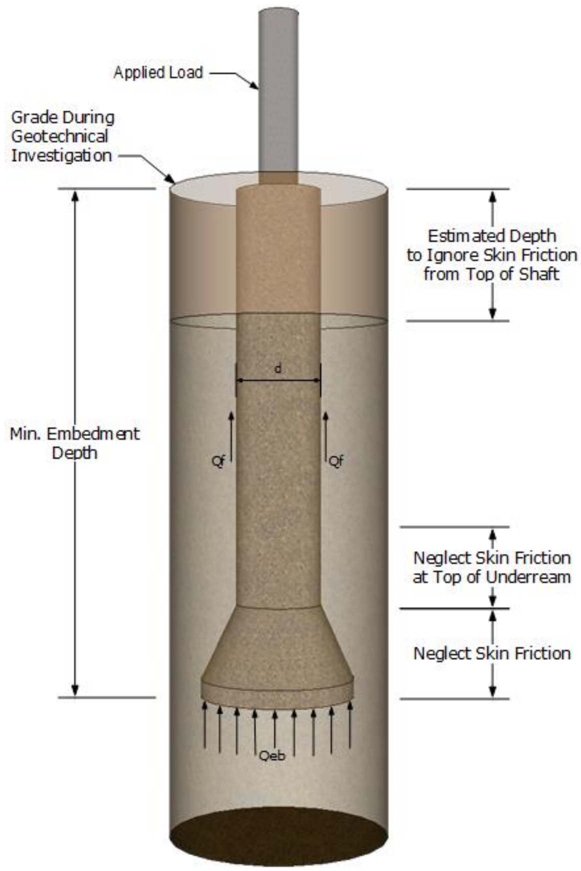


Figure 3.4 – Underreamed Drilled Pier

Table 3.7 – Parameters for Axial Design

Depth Interval, feet	Material	Allowable Skin Friction, Qf, psf (F.S. = 2)	Allowable End Bearing, Qeb, psf (F.S. = 3)	Uplift Force of Soil in Active Zone, kips
0 to 10	Clay	—	—	25d (d in feet)
10 to 18	Clay	400	--	
18 to 30	Clay	1,000	12,000	

If the undercut and replacement or chemical injection option is not used for this project, the uplift force should be increased to 90d.

Table 3.8 – Constraints for Underream Pier Design

Estimated Depth to Neglect Skin Friction from Top of Shaft	10 feet
Minimum Embedment Depth below Original Grade	18 feet
Minimum Shaft Diameter, d	18 inches
Maximum Bell to Shaft Ratio	2.5
Minimum Thickness to Neglect Skin Friction from Base of Pier	Belled Portion and 1 Pier Diameter
Uplift Resistance	8 x (B^2 – D^2) *Where: B is base diameter in feet* *D is shaft diameter in feet*
Minimum Shaft Spacing (center to center)	3 Shaft Diameters (3·d)
Possible Group Effect	If spacing is less than 3d consult Geotechnical Engineer
Min. Pier Vertical Reinforcing Steel	1% of gross cross-sectional area and as needed to resist uplift forces
Pier Tensile Reinforcing Steel	Per ACI Code
Estimated Settlement* Total Settlement Differential Settlement	 Less than 1 inch Less than 0.5 inch

*Detailed Settlement Analysis is outside project scope

3.5.2.3 *LPILE Design Criteria*

Piers having lateral loads should be designed utilizing the following LPILE input parameters for this project:

Table 3.9 – Parameters for Lateral Design using LPILE

Depth Interval, feet	Material	Effective soil unit weight, pci γ_e	Undrained soil shear strength, psi C_u	Undrained angle of internal friction, degrees ϕ	Modulus of Subgrade Reaction, pci K (cyclic loading)	50% strain value e_{50}
0 to 5	Fat Clay	.072	6.9	0	100	0.010
5 to 18	Lean Clay (Saturated	.072	10.4	0	200	0.007
18 to 30	Fat Clay (Saturated	.072	31.2	0	400	0.005

3.5.2.4 *General Pier Construction Recommendations*

Table 3.10 – Drilled Pier Installation Considerations

Recommended Installation Procedure	FHWA-NHI-10-016, May 2010
High-Torque Drilling Equipment Anticipated	Possible
Groundwater Anticipated	Yes

Verification of Groundwater before Installation	Yes
Temporary Casing Anticipated	Possible
Concrete Placement after Drilling	Same Day as drilling. If concrete cannot be poured the same day as excavation, temporary casing or slurry may be needed to maintain an open excavation. Concrete should not be allowed to ricochet off the pier reinforcing steel nor off the side walls of excavation.
Concrete Slump	7 inches ± 1 inch
Permissible Water Accumulation in Excavation	Less than 2 inches
Concrete Installation Method for Water Infiltration	Tremie or pump to displace water
Reinforcing and Excavation to Cage Separation	3 times maximum size of coarse aggregate
Centralizers Recommended for Reinforcement	Yes
Cross Bracing within Reinforcement Cage	Not Recommended
Quality Assurance Monitoring by Geotechnical Engineer or Representative	Observe drilling of all piers During drilling, record tip of shaft depth Observe base material and cleanliness of base Observe placement of reinforcement

3.6 SITE SEISMIC DESIGN RECOMMENDATIONS

For the purposes of seismic design, based on the encountered site conditions and local geology, PSI interpreted the subsurface conditions to satisfy the **Site Class D** criteria for use at this site as defined by the International Building Code (IBC). The site class is based on the subsurface conditions encountered at the soil borings, the results of field and laboratory testing, experience with similar projects in this area, and considering the site prepared as recommended herein. The table below provides recommended seismic parameters for the project based on the 2012 edition of the IBC.

Table 3.11 – Recommended Design Seismic Parameters

Seismic Parameter	IBC 2012
0.2 sec (S_S)	0.064g
1.0 sec (S_1)	0.033g
Site Coefficient 0.2sec, F_a	1.6
Site Coefficient 1.0 sec, F_v	2.4
0.2 sec (S_{DS})	0.069g
1.0 sec (S_{D1})	0.052g

4.0 PAVEMENT DESIGN RECOMMENDATIONS

4.1 PAVEMENT DESIGN PARAMETERS

PSI understands that flexible and rigid pavements will be considered for this project. Therefore, pavement design recommendations for several levels of traffic loading were developed based on assumptions of potential trafficking, drive paths or patterns and anticipated soil support characteristics of pavement subgrades. PSI utilized the "AASHTO Guide for Design of Pavement Structures" published by the American Association of State Highway and Transportation Officials to evaluate the pavement thickness recommendations in this report. This method of design considers pavement performance, traffic, roadbed soil, pavement materials, environment, drainage and reliability. Each of these items is incorporated into the design methodology. *PSI is available to provide laboratory testing and engineering evaluation to refine the site specific design parameters and sections, upon request.*

Specific design traffic types and volumes for this project were not available to PSI at the issuance of this report. This traffic information is typically used to determine the number of 18-kip Equivalent Single Axle Loads (ESAL) that is applied to the pavement over its design life. Furthermore, the scope of services for this project did not include California Bearing Ratio (CBR) testing. In lieu of project specific design parameters, general trafficking and subgrade parameter assumptions were used for this design. Based on this information, PSI has provided recommended pavement sections for "light duty", and "heavy duty" pavements constructed on stable and properly prepared/compacted subgrades. Flexible pavement options with and without geogrid options are also provided for consideration. Details regarding the basis for this design are presented in the table below.

Table 4.1 – Pavement Design Parameters and Assumptions (Rigid and Flexible)

Reliability, percent	75
Initial Serviceability Index, Flexible Pavement	4.2
Initial Serviceability Index, Rigid Pavement	4.5
Terminal Serviceability Index	2.0
Traffic Load for Light Duty Pavement	15,000 equivalent single axle loads (ESALs)
Traffic Load for Heavy Duty Pavement	150,000 equivalent single axle loads (ESALs)
Standard Deviation, Flexible Pavement	0.45
Standard Deviation, Rigid Pavement	0.35
Concrete Compressive Strength	4,000 psi
Subgrade California Bearing Ratio (CBR)	2.0 for high plasticity clay subgrade
Subgrade Modulus of Subgrade Reaction, k in pci	75 for high plasticity clay subgrade

Asphaltic concrete pavements founded on top of expansive soils will be subjected to PVM soil movements estimated and presented in this report (*i.e.,* 3 ½ inches to 4 ½ inches). These potential soil movements are typically activated to some degree during the life of the pavement. Consequently, pavements can be expected to crack and require periodic maintenance to reduce damage to the pavement structure.

Light duty areas include parking and drive lanes that are subjected to passenger vehicle traffic only and exclude entrance aprons and general and single access roadway drives to the parking lot area. Heavy duty areas include areas subjected to 18-wheel tractor trailers, including loading and unloading areas, and areas where truck turning and maneuvering may occur.

During the paving life, maintenance to seal surface cracks within concrete or asphalt paving and to reseal joints within concrete pavement should be undertaken to achieve the desired paving life. Perimeter drainage should be controlled to prevent or retard influx of surface water from areas surrounding the paving. Water penetration leads to paving degradation. Water penetration into base or subgrade materials, sometimes due to irrigation or surface water infiltration leads to pre-mature paving degradation. Curbs should be used in conjunction with asphalt paving to reduce potential for infiltration of moisture into the base course. Curbs should extend the full depth of the base course and should extend at least 3 inches into the underlying clayey subgrade. The base layer should be tied into the area inlets to drain water that may collect in the base.

Material specifications, construction considerations, and section requirements are presented in following sections.

The presented recommended pavement sections are based on the field and laboratory test results for the project, local pavement design practice, design assumptions presented herein and previous experience with similar projects. The project Civil Engineer should verify that the ESAL and other design values are appropriate for the expected traffic and design life of the project. PSI should be notified in writing if the assumptions or design parameters are incorrect or require modification.

4.2 PAVEMENT SECTION RECOMMENDATIONS

PSI anticipated that the roadways and parking areas will be used primarily by passenger vehicles and delivery vehicles. PSI is providing parking and drive area sections based on experience with similar facilities constructed on similar soil conditions for the design traffic loading anticipated.

4.2.1 Flexible Pavement

The proposed roadways and parking areas for this project may be constructed with flexible asphaltic concrete pavement. Recommendations for flexible asphaltic concrete pavement for roadways and parking areas are shown below.

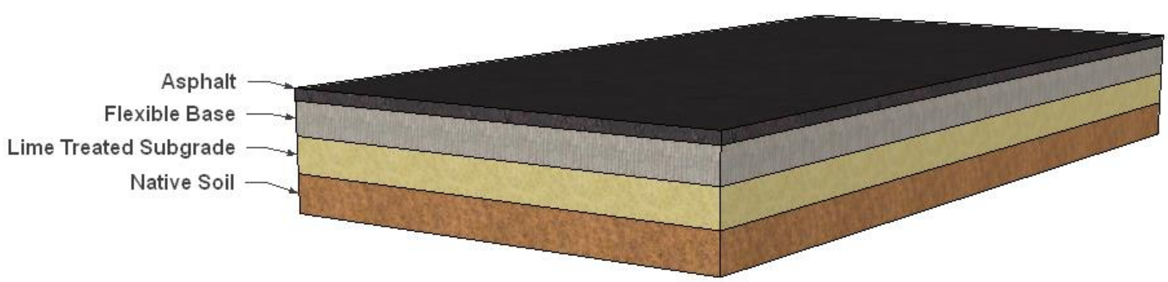


Figure 4.1 – Option 1 Flexible Pavement Typical Section

Figure 4.2 – Option 2 Flexible Pavement Typical Section

Table 4.2 – Flexible Pavement Roadway and Parking Area Section Options

Material	Option 1		Option 2	
Traffic Type	Light	Heavy	Light	Heavy
Hot Mix Asphaltic Concrete	2”	3”	2”	3”
Import Flexible Base	7”	10”	7”	10”
Lime Stabilized Subgrade	8”		No	
Geogrid	No		Yes	
Compacted Subgrade	—		8”	

4.2.2 Rigid Pavement

The proposed roadways and parking areas for this project may be constructed with rigid concrete pavement. Recommendations for rigid concrete pavement for roadways and parking areas are shown below.

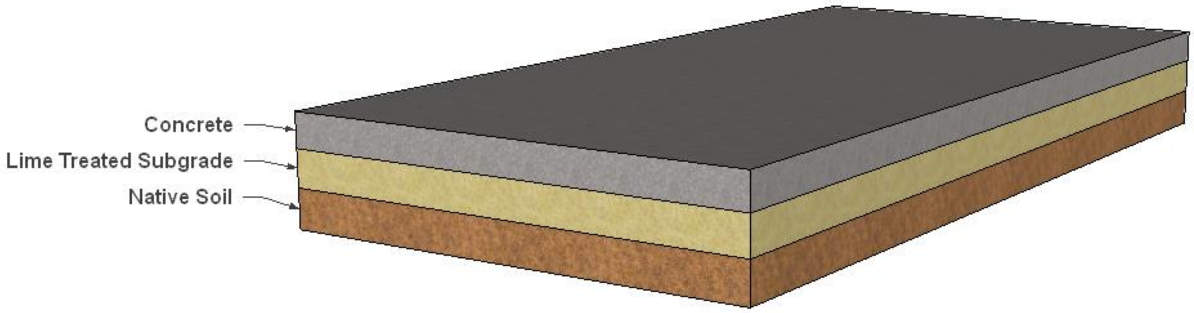


Figure 4.3 – Option 1 Rigid Pavement Typical Section

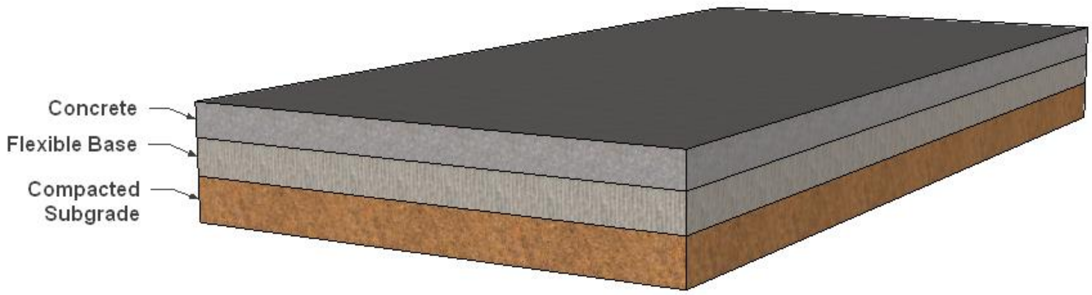


Figure 4.4 – Option 2 Rigid Pavement Typical Section

Table 4.3 – Rigid Pavement Roadway and Parking Area Section Options

Material	Option 1		Option 2	
Traffic Type	Light	Heavy	Light	Heavy
Portland Cement Concrete	5”	7”	5”	7”
Import Flexible Base	—	—	6”	6”
Lime Stabilized Subgrade	8”		No	
Compacted Subgrade	—		8”	

4.2.3 General Pavement Design and Construction Recommendations

Table 4.4 – Pavement Design and Construction Requirements

Minimum Undercut Depth	4 inches or as needed to remove roots
Reuse Excavated Soils	Must be free of roots and debris and meet material requirements of intended use
Undercut Extent	2 feet beyond the paving limits
Exposed Subgrade Treatment	Poof-roll with rubber tired vehicle weighing at least 20 tons. A representative of the Geotechnical Engineer should be present during proof-roll.
Proof-Rolled Pumping and Rutting Areas	Excavate to firmer materials and replace with compacted general or select fill under direction of a representative of the Geotechnical Engineer
General Fill Requirements	Materials free of roots, debris, and other deleterious materials with a maximum rock size of 4 inches with a CBR greater than 3
Minimum General Fill Thickness	As required to achieve grade
Maximum General Fill Loose Lift Thickness	9 Inches
Lime Stabilization	Performed in general accordance with TxDOT Item 260. Upper 8 inches of subgrade stabilized with lime to achieve pH of 12.4 or greater. Sulfate testing should be conducted before placement of lime.
Geogrid	Geogrid must meet TxDOT Item DMS - 6240. Subgrade should be leveled and smoothed prior to geogrid placement on compacted subgrade.
Imported Flexible Base Requirements	TxDOT Item 247, Type A, Grade 1 or 2
Maximum Flexible Base Loose Lift Thickness	9 Inches
Hot Mix Asphaltic Concrete	TxDOT Item 340, Type D
Concrete Minimum Recommended Strength	4,000 psi (avg. 28-day comp. strength)
Concrete Min. Recommended Reinforcement to Reduce Cracking	No. 4 bars at 18-inch on center each way Located in top half of concrete section Minimum 2 inch cover 14-inch long dowels spaced at 12 inch on center at construction joints

Table 4.5 – Compaction and Testing Requirements for Pavement Areas

Location	Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Requirement
Pavement Areas	Scarified On-site Soil (Subgrade)	ASTM D 698	94% to 98%	0 to +4%	1 per 7,500 SF; min. 3 tests
	General Fill (Onsite Material)	ASTM D 698	94% to 98%	0 to +4%	1 per 10,000 SF; min. 3 per lift
	Base Material	ASTM D 1557 TEX-113-E	≥ 95% ≥ 100%	±3% ±2%	1 per 5,000 SF; min. 3 per lift

5.0 POND LINER RECOMMENDATIONS

Impermeable layers such as roadways, parking areas, and roof tops can lead to excessive water runoff during storm events. The water runoff may be too large for the local stormwater system to control or a certain amount of the runoff may need to be treated due to contamination. A retention, detention, or water quality pond may be required to provide site sufficient drainage and treatment control. The following tables provide a summary of recommendations for wet ponds constructed with clay or geomembrane liners. For further information about requirement and installation, City of Austin Environmental Criteria Manual Section 1.6.0 Design Guidelines for Water Quality Controls.

Table 5.1 – Impermeable Basin/Pond Liner Requirements

Allowable Types of Liner	Concrete, Geosynthetic Clay Liner (GCL), Geomembrane, Clay Liner, or other upon approval
Allowable Pond Side Slope	4H:1V or less upon approval
Liner Location	Below Sedimentation/Filtration Basin and Gabions
Liner Subgrade	Suitable smooth compacted material
Geomembrane Liner Requirements	Minimum thickness of thirty (30) mils Ultraviolet resistant Geotextile protection above and below Rock installation requires additional protective material
Geotextile Protection Minimum Requirements	Unit weight of 8 oz/yd^2 Puncture strength of 125 lbs Mullen burst strength of 400 psi
Clay Liner Requirements	Minimum thickness of twelve (12) inches Coefficient of permeability of 1x10-7 cm/sec or Less Plasticity index equal to or greater than 15 Liquid limit equal to or greater than 30% Percent passing no. 200 sieve greater than 30% Maximum particle size of 1 inch
Liner Protection (Includes 6" Topsoil)	Clay Liner – 12" protective soil layer Geomembrane or CGL – 24" soil layer Upon approval 24" soil layer can be reduced to 12"
Additional Clay Liner Protection	If overlain by a drainage layer, geotextile protection
Additional Liner Protection (Includes 6" Topsoil)	Clay Liner – 12" protective soil layer Geomembrane or CGL – 24" soil layer Upon approval 24" soil layer can be reduced to 12"

Table 5.2 – Impermeable Basin/Pond Liner Construction Items

Liner Subgrade	Proof-roll subgrade and evaluate for voids. Weak areas should be removed and replaced with suitable fill material. The subgrade should be smooth and contain no particles with a diameter greater than 0.375 inches.
Geomembrane Liner	The designer must demonstrate liner's impermeability, the method of liner protection to be used during maintenance and sediment removal operations. Individuals installing geomembrane liners must be trained and/or certified by the liner manufacturer.
Clay Liner Requirements	Soil sampling and testing must be conducted on the borrow source and installed liner samples as applicable. In-situ materials may be used if liner

	parameters are met. Liner material should be processed and compacted with footed rollers. Lifts should not exceed 6 inches compacted.
Rock Subgrade Requirements	If a geomembrane or GCL liner is placed over excavated rock a protection material must be installed to prevent liner damage.
Liner Installation Quality Assurance and Control	A Soils and Liner Evaluation Report (SLER), Geosynthetic Clay Liner Evaluation Report (GCLER), or a Geomembrane Liner Evaluation Report (GLER) should be prepared by an independent licensed engineer with experience in geotechnical engineering.

Table 5.3 – Compaction and Testing Requirements for Clay Liner

Location	Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Requirement
Basin/Pond Liner	Clay Liner Material	ASTM D 698	≥ 95%	0 to +4%	1 per 5,000 SF; min. 3 tests
		ASTM D 1557	≥ 90%	-1 to +3%	

6.0 CONSTRUCTION CONSIDERATIONS

PSI should be retained to provide observation and testing of construction activities involved in the foundations, earthwork, pavements and related activities of this project. PSI cannot accept any responsibility for any conditions which deviate from those described in this report, nor for the performance of the foundations or pavements if not engaged to also provide construction observation and testing for this project.

6.1 INITIAL SITE PREPARATION CONSIDERATIONS

The following table outlines construction considerations in consideration of demolition of existing structures, demolition of existing paving, procedures for abandoning old utility lines and removing trees.

Table 6.1 – Considerations for Demolition

Existing Structures	
Foundations of former structure(s) located below new structure	Impact of foundation of former structures should be evaluated on a case by case basis
Foundations for former structure(s) located below new paving	Cut off at least 3 feet below finished paving grade
Existing Pavement	
Former paving located within footing of proposed structure(s)	Remove concrete and/or HMAC surface course and base entirely or review impact on case by case basis
Former paving located within footprint of proposed new paving	Remove concrete and/or HMAC surface course and evaluate if base can be reused
Abandoned Utilities	
Utilities of former structure(s) located within new foundation pad/footprint of proposed structure	Remove pipe, bedding and backfill and then replace with select fill placed using controlled compaction
Utilities of former structure(s) located outside of foundation pad footprint	Abandon in place using a grout plug
Tree Removal	
Trees located within proposed building footprint; roadways, parking, and sidewalk areas; and 5 feet of building area	Remove root system for full vertical and lateral extent and extend removal for at least 3 feet beyond presence of any root fragment and replace void with compacted general fill or flowable fill

6.2 MOISTURE SENSITIVE SOILS/WEATHER RELATED CONCERNS

Soils are sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils which become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork, foundation, and construction activities during dry weather. A relatively all-weather compacted crushed limestone cap having a thickness of at least 6 inches should be provided as a working surface.

6.3 BUILDING FOUNDATION EXCAVATION OBSERVATIONS

At time of final construction, foundation excavations should be observed by a representative of PSI prior to reinforcing steel or concrete placement to assess the foundation materials. This is especially important to identify the condition and acceptability of the exposed subgrades under the foundation. Soft or loose soil zones should be removed to the level of competent soils as directed by the Geotechnical Engineer. Cavities formed as a result of excavation of soft or loose soil zones should be backfilled with compacted select fill or lean concrete.

After opening, excavations should be observed and concrete placed as quickly as possible to avoid exposure to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. If excavations must be left open an extended period, they should be protected to reduce evaporation or entry of moisture.

6.4 DRAINAGE CONSIDERATIONS

Water should not be allowed to collect in foundation excavations, on foundation surfaces, or on prepared subgrades within the construction area either during or after construction. Proper drainage around grade supported sidewalks and flatwork is also important to reduce potential movements. Excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater, or surface runoff. Providing rapid, positive drainage away from the building will reduce moisture variations within the underlying soils and will therefore provide a valuable benefit in reducing the magnitude of potential movements.

6.5 EXCAVATIONS AND TRENCHES

It should be noted that excavation equipment capabilities and field conditions may vary. Geologic processes are erratic and large variations can occur in small vertical and/or lateral distances. Details regarding “means and methods” to accomplish the work (such as excavation equipment and technique selection) are the sole responsibility of the project contractor. The comments contained in this report are based on small diameter borehole observations. The performance of large excavations may differ as a result of the differences in excavation sizes.

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926, Revised October 1989), require that excavations be constructed in accordance with the current OSHA guidelines. Furthermore, the State of Texas requires that detailed plans and specifications meeting OSHA standards be prepared for trench and excavation retention systems used during construction. PSI understands that these regulations are being strictly enforced, and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and Federal safety regulations.

PSI is providing this information solely as a service to the client. PSI does not assume responsibility for construction site safety or the contractor's or other parties’ compliance with local, state, and Federal safety or other regulations.

7.0 SUBGRADE PREPARATION for SITE WORK (NON-STRUCTURAL - GENERAL FILL)

Grade adjustments outside of the foundation pad and pavement areas can be made using select or general fill materials. The clean excavated onsite soils may also be reused in areas not sensitive to movement.

Table 7.1 – Subgrade Preparation for Non-Structural - General Fill

Minimum Undercut Depth	4 inches or as needed to remove roots, organic and/or deleterious materials
Exposed Subgrade Treatment	Proof-roll with rubber tired vehicle weighing at least 2 tons. A representative of the Geotechnical Engineer should be present during proof-roll.
Proof-Rolled Pumping and Rutting Areas	Excavate to firmer materials and replace with compacted general or select fill under direction of a representative of the Geotechnical Engineer
General Fill Type	Any clean material free of roots, debris and other deleterious material with a maximum particle size of 4 inches
Maximum General Fill Loose Lift Thickness	8 inches

Table 7.2 – Fill Compaction Requirements Outside of Building and Pavement Areas

Location	Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Requirement
Outside of Structure or Pavement Areas	General Fill	ASTM D 698	≥ 95%	0 to +4%	1 per 10,000 SF; min. 3 per lift

8.0 REPORT LIMITATIONS

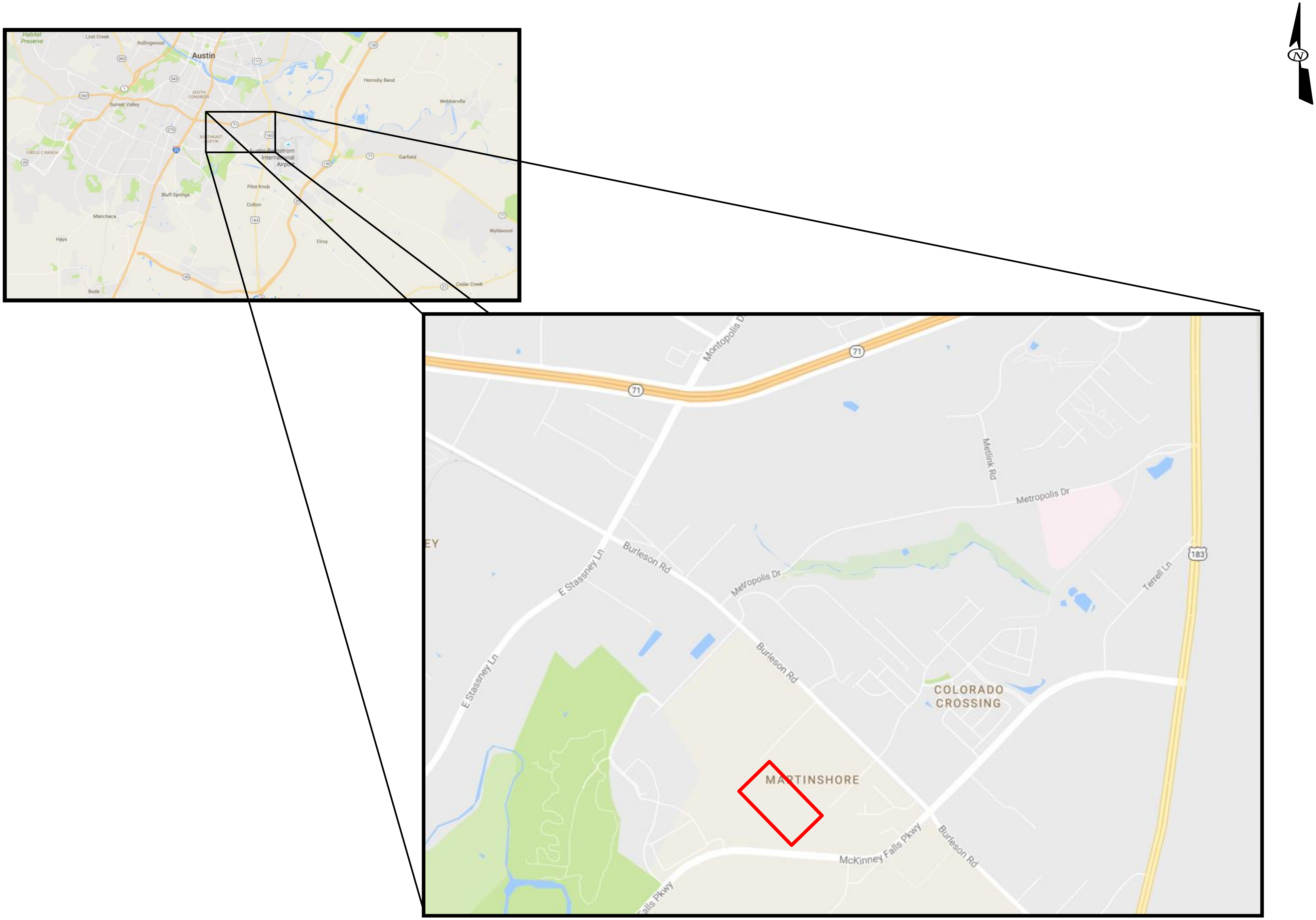
The recommendations submitted in this preliminary report are based on the available subsurface information obtained by PSI and design details furnished by the client for the proposed project. If there are any revisions to project site, or if deviations from the anticipated subsurface conditions, PSI should be notified immediately to determine if changes to the recommendations are required. If PSI is not notified of such changes, PSI will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional Geotechnical Engineering practices in the local area. No other warranties are implied or expressed. This report may not be copied without the expressed written permission of PSI.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to provide final geotechnical recommendations based on a more thorough investigation.

This report has been prepared for the exclusive use of LH Layne Company for specific application to the proposed Burleson Development to be constructed at McKinney Falls Parkway near Shaw Lane in Austin, Texas.

APPENDIX



Intertek psi

2600 McHale Ct. #125 - Austin, Texas 78758
(512) 491-0200 - FAX (512) 491-0221

Site Vicinity Map
PSI Project No. 0303926

Proposed Burleson Development
McKinney Falls Parkway near Shaw Lane
Austin, Texas

Intertek psi

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(512) 491-0200 - FAX (512) 491-0221

Boring Location Plan
PSI Project No. 0303926

Proposed Burleson Development
McKinney Falls Parkway near Shaw Lane
Austin, Texas

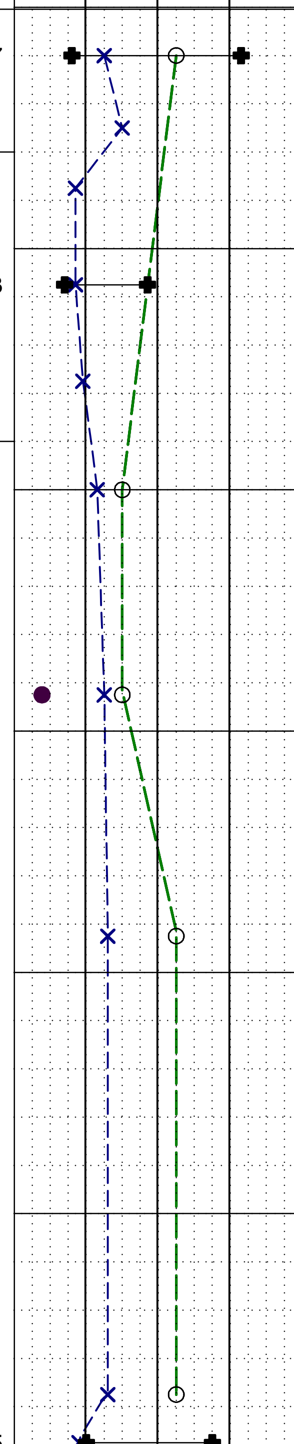
Burleson Development
McKinney Falls Parkway near Shaw Lane
Project No. 0303926

BORING B-1

LOCATION: 30.191904°, -97.705177°

Elevation:

Depth, ft.	Soil Description	Moisture Content	% Retained #4	% Passing #200	SPT (N) & TCP (T) Values	% REC	%RQD	Liquid Limit	Plastic Limit	Plasticity Index	Unconf. Comp. (TSF)	Unit Dry Wt. (LB/CU FT)
	FAT CLAY (CH), hard to stiff, dark brown, moist with trace gravel	25	5	90				63	16	47		
		30										
	LEAN CLAY (CL) with GRAVEL, grayish light brown, stiff to hard, moist, calcareous nodules	17			14							
5		17	12	84	14			37	14	23		
		19			12							
10	FAT CLAY (CH), hard, dark gray, dry	23										
15		25									0.77	103
20		26										
25	Attempt SS and ST with no recovery											
		26										
30	Boring terminated at a depth of approximately 30 feet.	18	2	94	62			55	20	35		



COMPLETION DEPTH: 30.0 Feet

DATE: 3/1/16-3/1/16

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DEPTH TO GROUND WATER

SEEPAGE (ft.): 6'

END OF DRILLING (ft.): None Observed

DELAYED WATER LEVEL (FT): N/A

GEO TESTS 00 - SAN ANTONIO RBENNETT GW.GDT 10/28/16

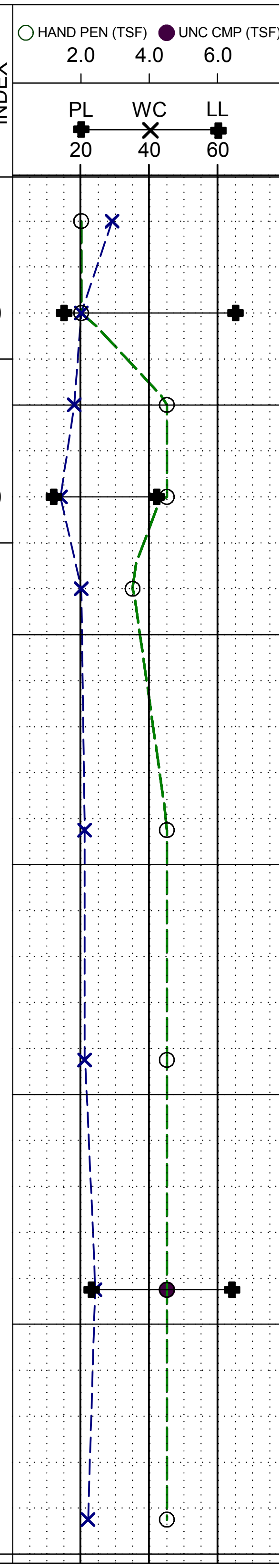
Burleson Development
McKinney Falls Parkway near Shaw Lane
Project No. 0303926

BORING B-2

LOCATION: 30.191249°, -97.705754°

Elevation:

DEPTH, FT.	SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
0–4	FAT CLAY (CH) with GRAVEL, stiff to hard, dark brown, moist	29										
		20	11	79				65	15	50		
4–8	CLAYEY GRAVEL (GC) with SAND, hard, grayish light brown, moist	18										
		14	49	36				42	12	30		
8–30	FAT CLAY (CH), hard, grayish light brown, moist	20										
		21										
		21										
		24	0	92				64	23	41	4.5	105
30	Boring terminated at a depth of approximately 30 feet.	22										



COMPLETION DEPTH: 30.0 Feet
DATE: 3/1/16-3/1/16

DEPTH TO GROUND WATER
SEEPAGE (ft.): NONE ENCOUNTERED
END OF DRILLING (ft.): None Observed
DELAYED WATER LEVEL (FT): N/A

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GEO TESTS 00 - SAN ANTONIO RBENNETT GW.GDT 10/28/16

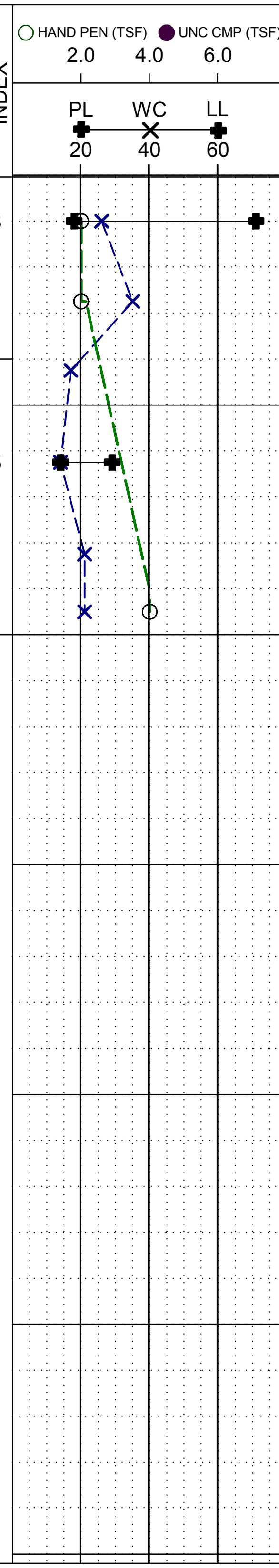
Burleson Development
McKinney Falls Parkway near Shaw Lane
Project No. 0303926

BORING B-3

LOCATION: 30.192215°, -97.706193°

Elevation:

SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
FAT CLAY (CH) with GRAVEL, stiff, dark brown, moist with little gravel	26	20	71				71	18	53
	35								
GRAVELY LEAN CLAY with SAND, stiff to hard, grayish light brown, moist, calcareous nodules	17			30					
	14	25	57	16			29	14	15
Less than 4" cavity encountered during drilling	21			10					
Boring terminated at a depth of approximately 10 feet.	21								



COMPLETION DEPTH: 10.0 Feet
DATE: 3/1/16-3/1/16

Information To Build On
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DEPTH TO GROUND WATER
SEEPAGE (ft.): 4'
END OF DRILLING (ft.): None Observed
DELAYED WATER LEVEL (FT): N/A

KEY TO TERMS AND SYMBOLS USED ON LOGS

ROCK CLASSIFICATION

RECOVERY

DESCRIPTION OF RECOVERY	% CORE RECOVERY
Incompetent	< 40
Competent	40 TO 70
Fairly Continuous	70 TO 90
Continuous	90 TO 100

ROCK QUALITY DESIGNATION (RQD)

DESCRIPTION OF ROCK QUALITY	RQD
Very Poor (VPo)	0 TO 25
Poor (Po)	25 TO 50
Fair (F)	50 TO 75
Good (Gd)	75 TO 90
Excellent (ExInt)	90 TO 100

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	N-VALUE (Blows/Foot)	SHEAR STRENGTH (tsf)	HAND PEN VALUE (tsf)
Very Soft	0 TO 2	0 TO 0.125	0 TO 0.25
Soft	2 TO 4	0.125 TO 0.25	0.25 TO 0.5
Firm	4 TO 8	0.25 TO 0.5	0.5 TO 1.0
Stiff	8 TO 15	0.5 TO 1.0	1.0 TO 2.0
Very Stiff	15 TO 30	1.0 TO 2.0	2.0 TO 4.0
Hard	>30	>2.0 OR 2.0+	>4.0 OR 4.0+

SOIL DENSITY OR CONSISTENCY

DENSITY (GRANULAR)	CONSISTENCY (COHESIVE)	THD (BLOWS/FT)	FIELD IDENTIFICATION
Very Loose (VLo)	Very Soft (VSo)	0 TO 8	Core (height twice diameter) sags under own weight
Loose (Lo)	Soft (So)	8 TO 20	Core can be pinched or imprinted easily with finger
Slightly Compact (SICmpt)	Stiff (St)	20 TO 40	Core can be imprinted with considerable pressure
Compact (Cmpt)	Very Stiff (VSt)	40 TO 80	Core can only be imprinted slightly with fingers
Dense (De)	Hard (H)	80 TO 5"/100	Core cannot be imprinted with fingers but can be penetrated with pencil
Very Dense (VDe)	Very Hard (VH)	5"/100 to 0"/100	Core cannot be penetrated with pencil

DEGREE OF PLASTICITY OF COHESIVE SOILS

DEGREE OF PLASTICITY	PLASTICITY INDEX (PI)	SWELL POTENTIAL
None or Slight	0 to 4	None
Low	4 to 20	Low
Medium	20 to 30	Medium
High	30 to 40	High
Very High	>40	Very High

BEDROCK HARDNESS

MORHS' SCALE	CHARACTERISTICS	EXAMPLES	APPROXIMATE THD PEN TEST	
5.5 to 10	Rock will scratch knife	Sandstone, Chert, Schist, Granite, Gneiss, some Limestone	Very Hard (VH)	0" to 2"/100
3 to 5.5	Rock can be scratched with knife blade	Siltstone, Shale, Iron Deposits, most Limestone	Hard (H)	1" to 5"/100
1 to 3	Rock can be scratched with fingernail	Gypsum, Calcite, Evaporites, Chalk, some Shale	Soft (So)	4" to 6"/100

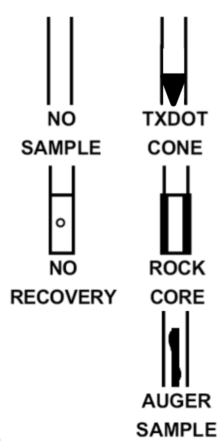
MOISTURE CONDITION OF COHESIVE SOILS

DESCRIPTION	CONDITION
Absence of moisture, dusty, dry to touch	DRY
Damp but no visible water	MOIST
Visible free water	WET

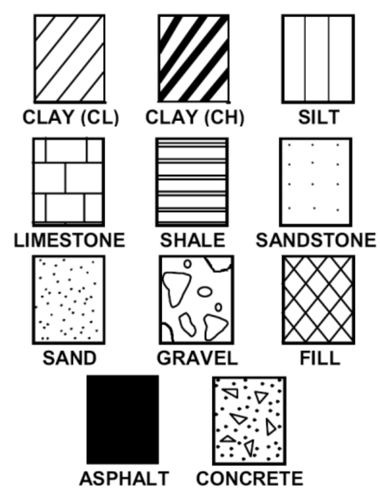
RELATIVE DENSITY FOR GRANULAR SOILS

APPARENT DESNITY	SPT (BLOWS/FT)	CALIFORNIA SAMPLER (BLOWS/FT)	MODIFIED CA. SMAPLER (BLOWS/FT)	RELATIVE DENSITY (%)
Very Loose	0 to 4	0 to 5	0 to 4	0 to 15
Loose	4 to 10	5 to 15	5 to 12	15 to 35
Medium Dense	10 to 30	15 to 40	12 to 35	35 to 65
Dense	30 to 50	40 to 70	35 to 60	65 to 85
Very Dense	>50	>70	>60	85 to 100

SAMPLER TYPES



SOIL TYPES



ABBREVIATIONS

PL – Plastic Limit
LL – Liquid Limit
WC – Percent Moisture

Q_P – Hand Penetrometer
Q_U – Unconfined Compression Test
UU – Unconsolidated Undrained Triaxial

Note: Plot Indicates Shear Strength as Obtained By Above Tests

WATER SEEPAGE

WATER LEVEL AT END OF DRILLING

CLASSIFICATION OF GRANULAR SOILS

U.S. STANDARD SIEVE SIZE(S): 6", 3", 3/4", 4, 10, 40, 200

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

GRAIN SIZE IN MM: 152, 76.2, 19.1, 4.76, 2.0, 0.42, 0.074, 0.002