REVISED GEOTECHNICAL ENGINEERING REPORT

Grace Gardens Units 1 and 2

South WW White Road
San Antonio ETJ, Bexar County, Texas

Prepared for:
Lennar
San Antonio, Texas

Prepared by:
TTL, Inc.
San Antonio, Texas

Project No. 00230902952.01
July 25, 2024

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July 25, 2024

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RE: Revised Pavement Design Report
Grace Gardens Units 1 and 2
South WW White Rd
San Antonio ETJ, Bexar County, Texas
TTL Project No.00230902952.01

Dear Mr. Mott:

TTL, Inc. (*TTL*) is pleased to submit this Revised Pavement Design Report for the above-referenced project. If you have any questions regarding our report, or if additional services are needed, please do not hesitate to contact us.

The enclosed report contains a brief description of the site conditions and our understanding of the project. The pavement section design recommendations contained within this report are based on our understanding of the proposed development, the results of our field exploration and laboratory tests, and our experience with similar projects.

We appreciate the opportunity to provide these Geotechnical Services for your project and look forward to continuing participation during the design and construction phases of this project.

Respectfully submitted,
TTL, Inc.

ANTHONY F. ADAMO
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Anthony F. Adamo

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1.0 PROJECT INFORMATION

1.1 Project Description

Item	Description
Project Location	The project site is located on South WW White Road, south of its intersection with Hildebrandt and Cacias Road in San Antonio ETJ, Bexar County, Texas. The Site Location Plan is provided in Appendix A.
Proposed Development	Based on the plat for the Subdivision, we understand that Units 1 and 2 of the subdivision will consist of approximately 75.9 acres of land. We understand this subdivision will involve the construction of single-family homes and associated streets.
Proposed Construction	This geotechnical engineering study will pertain to the design and construction of the streets within this subdivision. The streets are expected to consist of Local Type A, Local Type B, Collector, and Arterial streets designed as per Bexar County and City of San Antonio (COSA) design criteria.
Pavements	The pavements constructed as a part of this project will consist of flexible pavements only.

If the above information is not correct, please contact us so that we can make the necessary modifications to this document and our evaluation and recommendations, if needed.

1.2 Authorization

This Project was authorized on September 12, 2023, by Mr. Richard Mott with Lennar by acceptance of our Agreement for Services, No. P00230902952.00, dated September 12, 2023.

2.0 EXPLORATION FINDINGS

2.1 Site Conditions

Item	Description
Existing Conditions	Based on Google Earth aerial imagery, the site appears to be relatively undeveloped and used for agricultural purposes.
Existing Topography	Topographic information was not provided to TTL at the preparation of this report. Based on visual observations the property appears relatively flat and level.

2.2 Subsurface Stratigraphy

Subsurface conditions within the limits of the project were evaluated by drilling fifteen (15) exploratory borings at the approximate locations shown on the Boring Location Map included in Appendix A. Samples obtained during our field exploration were transported to our laboratory where they were reviewed by geotechnical engineering personnel. Representative samples were selected and tested to determine pertinent engineering properties and characteristics for use in our evaluation of the project site. Based on the information developed during our field exploration and laboratory testing, we have determined the stratigraphy of the site is generally as shown on the logs of boring as shown in Appendix A.

The boring logs presented in Appendix A represent our interpretation of the subsurface conditions at each individual boring location. Our interpretation is based on tests and observations performed during drilling operations, visual examination of the soil samples by a geotechnical engineer, and laboratory tests conducted on the retrieved soil samples. The USCS classifications shown on the boring logs represent classifications based on either visual examination, laboratory testing, or both. The lines designating the interfaces between various strata on the boring logs represent the approximate strata boundary. The transition between strata may be more gradual than shown, especially where indicated by a broken line. All data should only be considered accurate at the exact test boring location.

SANDY LEAN CLAY (CL), SANDY FAT CLAY (CH) AND SANDY FAT CLAY WITH GRAVEL (CH) materials were encountered below ground surface in all borings. Furthermore, these materials are preferential pathways for the transfer of subsurface water. Therefore, the contractor should check soil conditions before the commencement of excavation activities.

2.3 Subsurface Water Conditions

The soil borings were advanced using straight-flight auger drilling methods. Subsurface water was not detected either during or upon completion of our soil borings. Upon completion of subsurface water observations, the boreholes were backfilled with soil cuttings.

The presence or absence of subsurface water during a geotechnical exploration may not be indicative of long-term subsurface water conditions at the project site. Subsurface water may exist as ‘true” or permanent water sources or as temporary ‘perched’ sources. Furthermore, these water sources may or may not be contiguous across a given project site. Subsurface water may exist year-round or may appear intermittently. The presence or absence of subsurface water and the elevations at which it may be encountered can be influenced by a wide range of factors that often include seasonal and climatic changes, vegetation, surface runoff, and the proximity of the site to nearby water bodies.

As was mentioned above, SANDY LEAN CLAY (CL), SANDY FAT CLAY (CH) AND SANDY FAT CLAY WITH GRAVEL (CH) materials, were encountered throughout the site below ground surface. These materials will transmit water. It should be noted that subsurface water levels will fluctuate with the seasons and with variations in precipitation. Therefore, the contractor should be prepared to control subsurface water infiltration.

3.0 GEOTECHNICAL CONSIDERATIONS

The following geotechnical considerations have been prepared based on the information developed during this Project, our experience with similar projects, and our knowledge of sites with similar surface and subsurface conditions.

3.1 Expansive Soils

The expansive potential of a given soil profile may be characterized using the Potential Vertical Rise (PVR) methodology as described in the Texas Department of Transportation (TxDOT) Method TEX-124-E. This methodology is used to estimate how much a given point located on the ground surface may move due to volumetric changes in the soil resulting from fluctuations in soil moisture content. **Based on our laboratory test results, the estimated PVR of this site ranges from about one and a half (1½) inches to about two and a half (2½) inches in its present condition These estimated PVR values indicate the soils at this site are moderately to highly expansive.**

3.2 Corrosion Considerations

According to the 2021 IBC, concrete that is exposed to sulfate-containing solutions should be selected for sulfate resistance in accordance with ACI 318. To evaluate if sulfate exposure was a concern at this site, laboratory testing was conducted on soil samples recovered during the field exploration to assess the risk of sulfate attack at the site. The soil samples were submitted to an analytical lab to determine the sulfate content. The results of the laboratory tests are presented in the following table.

Summary of Laboratory Test Results

Boring No.	Sample Depth (ft.)	Sulfate (ppm)	% Sulfate by Mass	ACI 318-19 Exposure Class
B-01	2½ - 4	146	0.01	S0
B-02	4½ - 6	354	0.04	S0
B-04	8½ - 10	229	0.02	S0
B-05	8½ -10	208	0.02	S0
B-06	6½ - 8	292	0.03	S0
B-08	2½ - 4	250	0.03	S0
B-09	4½ - 6	146	0.01	S0
B-12	6½ - 8	229	0.02	S0
B-14	½ - 2	146	0.01	S0

The sulfate test results indicate that the sulfate exposure level is Class S0, which infers that sulfate exposure to concrete is not an issue. Therefore, Type I/II cement may be used. The sulfate test results indicate enough sulfate that it may require more lime to treat the subgrade.

4.0 EARTHWORK RECOMMENDATIONS

4.1 Subgrade Preparation and Stabilization

Please note that mass grading for the subdivision had not been performed before drilling of TTL'S exploratory borings at the site. The intended performance of earth supported elements such as foundations and utilities are contingent upon following the earthwork recommendations and guidelines outlined in this section. Earthwork activities on the project should be observed and evaluated by TTL personnel. The evaluation of earthwork should include observation and testing of all fill and backfill soils placed at the site, along with subgrade preparation beneath the residential structures, pavements, and other areas to receive fill materials.

If possible, site development should be performed during seasonably dry weather (typically May through October), and excavation and site preparation should not be performed during or immediately following periods of heavy precipitation or freezing temperatures. Positive surface drainage should be maintained during grading operations and construction to prevent water from ponding on the surface. Surface water run-off from off-site areas should be diverted around the site using berms or ditches. The surface can be rolled smooth to enhance drainage if precipitation is expected but should then be scarified prior to resuming fill placement operations. Subgrades damaged by construction equipment should be promptly repaired to avoid further degradation in adjacent areas and water ponding. Our geoprofessional should provide recommendations for treatment if the subgrade materials become wet, dry, or frozen. When work activities are interrupted by heavy rainfall, fill operations should not be resumed until the moisture content and density of the previously placed fill materials are as recommended in this report. The following earthwork recommendations must be performed prior to pavement and utility construction.

4.1.1 Stripping

Subgrade preparation should begin with stripping the existing vegetation and any otherwise unsuitable materials from planned construction areas.

- Stripping should extend at least three (3) feet (horizontal) beyond the construction limits or to the property lines, whichever is less. Due to the previous agricultural use at the site, the stripping depth may need to be at least 12 to 18 inches to completely grub and remove the roots.
- Organic-laden strippings including root masses and loose topsoil should be removed from the site or disposed of at designated on-site areas located outside the limits of current or future development.

4.1.2 Proof-rolling

After stripping and excavating to the design subgrade elevation, the stability of exposed subgrades in areas to receive fill should be evaluated by proof-rolling. The stability of subgrades exposed by cutting to final grades should also be evaluated by proof-rolling.

- Perform proof-rolling with a rubber-tired vehicle having a gross vehicle weight of at least 20 tons (such as a loaded tandem-axle dump truck, or similar size/weight construction equipment).
- Proof-rolling equipment should make multiple closely-spaced overlapping passes in perpendicular directions over the subgrade at a walking pace.

- The subgrade should be relatively smooth and free of wheel ruts, sheepsfoot roller dimples, loose clods of soil, or loose gravel, and the subgrade should not be desiccated, cracked, wet, or frozen.
- A TTL geotechnical engineer or their representative should observe the proof-rolling to identify, document, and mark areas of unstable subgrade response, such as pumping, rutting, or shoving, if any.

4.1.3 Subgrade Stabilization

Unstable subgrades should be stabilized as recommended below.

- Undercut soft, weak, and unstable soils by excavating below subgrade level to expose stable soils. The excavated soil can be used to restore the excavation subgrade, provided that the soils are relatively free and clean of deleterious material or materials exceeding three (3) inches in maximum dimension. The excavated soil, or imported fill soil, shall be placed in maximum 6-inch compacted lifts. Each lift of on-site soil fill shall be moisture conditioned between optimum and plus four (+4) percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with the Standard compaction effort (ASTM D 698). If undercutting deeper than about three (3) feet is needed, contact TTL.
- Soil subgrade areas requiring fill placement should be scarified to a depth of about eight (8) inches and moisture conditioned between optimum and plus four (+4) percentage points of the optimum moisture content. The moisture conditioned subgrade should then be compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698. The subgrade should be moisture conditioned just prior to fill placement so the subgrade maintains its compaction moisture levels and does not dry out.
- On-site soils (general fill), Select Fill or Granular Select Fill soil should be placed to achieve the desired elevation as described in Section 4.2 of this report.

4.2 Compacted Fill Materials

Compacted fill materials may consist of general or select fill depending upon its intended use. The general fill material may consist of onsite soils or select fill materials. General fill material should possess good compaction characteristics that will provide uniform support for pavements or other facilities not extremely sensitive to moments. Select fill materials are typically selected for specific engineering characteristics and performance criteria. These characteristics and criteria are typically dependent on the requirements of the structures or other facilities they are intended to support.

General and select fill materials should be clean and free of any vegetation, roots, organic materials, trash or garbage, construction debris, or other deleterious materials. These materials should contain stones no larger than three (3) inches in maximum dimension. The following table provides more specific requirements for general and select fill materials.

Material Type	Characteristics	Compaction Procedures	Compaction Control $^{1, 2}$
GENERAL FILL	Shall consist of CH, CL, SC, GC, SW, or GW as defined by ASTM D 2487. Plasticity Index: Not more than 35. Maximum allowable organic content: 3 percent by weight. **This fill material type shall not be used in areas where select fill materials area specified. It is not the intent of this material to control differential soil movements and it shall not be used in areas where control of soil movements is required.**	Maximum loose lift thickness: 8 inches. Compaction requirement: Compaction should be at least 95 percent of the standard Proctor (ASTM D 698) maximum dry density for fill bodies less than 5 feet in thickness. Compaction should be at least 95 percent of the modified Proctor (ASTM D 1557) maximum dry density for fill bodies 5 feet or greater in thickness. Moisture content at time of compaction: within plus to minus 3 percent of the material's optimum moisture content.	General Fill Areas: One field test for every 10,000 square feet per lift, with a minimum of two tests per lift. Utility Trenches (in areas where Select Fill is not required): One field density test per every 100 linear feet, per lift.
SELECT LEAN CLAY FILL (COMPACTED FILL)	Maximum particle size: 3 inches. Maximum gravel and oversize particle content: 15 percent retained on a ¾-inch sieve. At least 70 percent of total material (by weight) passing the No. 200 sieve Maximum allowable organic content: 3 percent by weight, but large roots are not allowed. Liquid Limit: Not more than 40. Plasticity Index: Between 8 and 15. Designation as a CL in accordance with the Unified Soil Classification System (USCS).	Maximum loose lift thickness: 8 inches with compacted thickness of about 6 inches. Compaction requirement: Compaction should be to at least 95 percent of the standard Proctor maximum (ASTM D 698) dry density for non-roadway areas and TEX-114-E for roadway areas. Moisture content at time of compaction: within minus 2 to plus 3 percent of the material's optimum moisture content.	Building Area: One field density test every 5,000 square feet per lift, with a minimum of two tests per lift. Pavement Areas and Slopes: One field density test every 10,000 square feet per lift, with a minimum of two tests per lift. Utility Trenches: One field density test per structure or one test per every 100 linear feet, per lift.
SELECT GRANULAR FILL (COMPACTED FILL)	Crushed stone (limestone) meeting Type A, Grades 1, 2, or 3; Crushed or uncrushed gravel meeting Type B, Grades 1, 2, or 3; Crushed concrete meeting Type D, Grades 1, 2, or 3; of the 2014 TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Designation as a GC or GM in accordance with the USCS Clayey gravel (may locally be referred to as "pit-run" material) or caliche having no particle sizes greater than 3 inches in any dimension, at least 50 percent of total material retained on the No. 200 sieve, a Liquid Limit (LL) no greater than 40, and a PI between 7 and 20. Designation as a GC in accordance with the USCS. Commercial Grade Base (may locally be referred to as "three-quarters to dust" material) that is produced by some local/regional quarries having nothing retained on the 2 inch sieve, at least 60 percent retained on the No. 40 sieve, at least 80 percent retained on the	Maximum loose lift thickness: 8 inches. Compaction requirement: Compaction should be to at least 98 percent of the TEX-113-E dry density. Moisture content at time of compaction: within minus 2 to plus 3 percent of the material's optimum moisture content.	Building Area: One field density test every 5,000 square feet per lift, with a minimum of two tests per lift. Pavement Areas and Slopes: One field density test every 10,000 square feet per lift, with a minimum of two tests per lift. Utility Trenches: One field density test per structure or one test per every 100 linear feet, per lift.

Material Type	Characteristics	Compaction Procedures	Compaction Control [1, 2]
	No. 200 sieve, an LL no greater than 30, and a PI of 7 or less. Designation as a GM in accordance with the USCS.		

[1] For preliminary planning only. Our technician/engineer should determine the actual test frequency.
[2] In addition, the fill must be stable under the influence of compaction equipment. Heavy construction traffic should not be allowed to travel on compacted fill areas, except on designated haul roads, to reduce the potential for damaging a previously compacted fill subgrade

If grading occurs during wet, cool weather, when drying soils is more difficult and time-consuming, the grading contractor may have difficulty achieving suitable moisture conditions for proper compaction of soil fill.

The surface of any filled area can experience settlement due to compression of the underlying soils, and sometimes additional settlement results from consolidation of thick soil fills due to their own self-weight. For this project, we expect settlements of fills will occur over the course of several years after completion of fill placement due to the nature of the on-site soils. If thicker fills are constructed, settlements could continue for longer periods of time after completion of fill placement, which could adversely affect utilities, structures, or pavements supported by the fill.

4.3 Excavation Conditions

4.3.1 Temporary Slopes and OSHA Soil Types

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926) require that excavations be constructed in accordance with the current OSHA guidelines. 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. To that end, the contractor's 'responsible person' as defined in 29 CFR Part 1926 should evaluate the required excavations and the soils exposed by those excavations and determine appropriate means as part of the contractor's safety procedures.

OSHA requires that excavations in excess of five (5) feet be shored or appropriately sloped. Currently available and practiced methods for achieving excavation stability include sloping, benching, shoring, and the use of trench shields. In excavations that are less than 20 feet deep, OSHA addresses maximum allowable slopes on Table as reproduced below.

Soil or Rock Type	Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 20 Feet Deep[2]	
Stable Rock	Vertical	90°
Type A[3]	¾:1	53°
Type B	1:1	45°
Type C	1½:1	34°

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.

2. Slopes or benching for excavations that exceed 20 feet shall be designed by a licensed professional engineer.
3. For Type A soils, a short-term maximum allowable slope of ½:1 (63°) is allowed in excavations that are 12 feet deep or less. For excavations deeper than 12 feet, the short-term allowable slope shown above applies. OSHA defines short-term as a period of 24 hours or less.

Based on the results of our field and laboratory testing, it is our opinion that the FAT CLAY (CH) and LEAN CLAY (CL) soils encountered in our soil borings may be considered as Type B soils. If those clay soils become saturated or submerged, they should be downgraded to Type C soils. We have provided this information solely as a service to our client. The actual OSHA regulations should be consulted prior to any excavations that would be subject to OSHA regulations. TTL does not assume responsibility for any construction site safety or the contractor’s or other parties’ compliance with local, state, and federal safety or other regulations.

4.3.2 Anticipated Excavation Conditions

The near-surface soils (i.e., upper five (5) feet) observed at the boring locations are generally FAT CLAY and LEAN CLAY soil materials with a firm to very stiff consistency. Generally, soils penetrated by geotechnical drilling equipment such as those encountered at this site can be removed with conventional earthmoving equipment.

4.3.3 Drainage During Construction

Water should not be allowed to collect in foundation or roadway excavations, on foundation surfaces, or on prepared subgrades within the construction area during construction. Excavated areas should be sloped toward designated drainage points to facilitate removal of any collected rainwater, subsurface water, or surface runoff. Positive surface drainage at the site should be provided to reduce infiltration of surface water into subgrades and fill bodies during construction and promote prompt removal of water from the project site.

Water should not be allowed to collect on completed pavement surfaces after construction. Excavated areas should be sloped to facilitate the removal of any collected water. Positive site surface drainage should be provided to reduce infiltration of surface water beneath the pavement surface. The grades should be sloped and surface drainage should be collected such that water is channeled to collection points and discharged away from the roadway or into storm sewers. In addition, curbs should be designed as full-depth curbs that extend through the base section and at least three (3) inches into the subgrade to help reduce the potential for water infiltration into the pavement section. Consideration may also be given to the installation of wick drains behind the curbs to intercept and remove water from the pavement perimeter before the water infiltrates the pavement section. All concrete/asphalt interfaces should be sealed using a sealant compatible with both materials.

4.4 Long-Term Drainage Considerations

Long-term drainage conditions can have a significant impact on the performance of structures, pavements, utilities, and other ancillary facilities on a project site. We recommend that site drainage be developed such that long-term ponding does not occur except in areas specifically designed for such purposes. When establishing final grades, the design team should be reminded that in expansive clay environments, it is common for ground surface movements to occur that could potentially cause reversal of site drainage patterns and unwanted ponding of surface water.

- Elevation of the ground surface adjacent to foundations should be at least six (6) inches below the Finished Foundation Elevation unless measures are taken to ensure long-term positive drainage away from the structure.
- The slope of the ground surface away from any structures (if not covered with pavement) should be a minimum of five (5) percent for a distance of at least 10 feet unless measures are taken to ensure long-term positive drainage away from the structures.
- Gutter downspouts should extend at least five (5) feet past the edge of the foundations.

We recommend that sufficient slope of the ground surface should be maintained around pavements and other ancillary facilities to ensure long-term positive drainage.

5.0 INFRASTRUCTURE RECOMMENDATIONS

5.1 Utilities

Various utilities will be installed across the development. The utilities will likely include sanitary sewer lines, electrical lines, and possibly telecommunication lines. Installation of these utilities should conform to the applicable specifications of the appropriate utility entities. At a minimum, all utilities should meet the following installation guidelines.

- The bottoms of the utility trench excavations should be clean of loose soils and debris prior to placement of the utility pipe or cable.
- Utility trenches may be backfilled with general or select fill in accordance with Section 4.2 of this report.
- As an alternate, utility trenches may be backfilled with flowable fill materials that terminate at a depth sufficient to allow for the construction of structure foundations or any pavements constructed as a part of this project. Flowable fill should have a minimum 28-day compressive strength of 100 psi. The flowable fill should not have an unreasonably high compressive strength to ensure that it remains excavatable should the need arise in the future. Flowable fill is defined as materials complying with Item 401 of the 2014 TxDOT Standard Specifications.

- Where granular bedding is used for pipe bedding, consideration should be given to the placement of filter fabric around the bedding materials within the trench to reduce the potential for piping fines through the bedding material. Piping of fines within utility trenches often results in pronounced subsidence of the ground surface over time that could affect foundations and pavements constructed over the utility trenches.

5.2 Landscape Considerations

TTL realizes landscaping is vital to the aesthetics of any project and is generally typical for residential construction. The owner and design team should be made aware that placing large bushes and trees adjacent to the structures and pavements may contribute to future distress. Vegetation placed in landscape beds adjacent to the structure should be limited to plants and shrubs that will not exceed a mature height of about three (3) to four (4) feet. Large bushes and trees that will generally exceed these heights should be planted at a reasonable distance away from structures and pavements so their canopy or “drip line” does not extend over the structure when the tree reaches maturity.

Watering of vegetation should be performed in a timely and controlled manner and in sufficient quantity to maintain healthy vegetative cover. Excessive watering should be avoided as excessive irrigation of landscaped areas adjacent to, near or up gradient from foundations and pavements can lead to water migration into building pads and base sections. This migration could cause moisture fluctuations in the underlying clay subgrade which could result in excessive soil movements and loss of subgrade strength.

5.3 Pavement Design Considerations

Based on the Bexar County and COSA design guidelines, the following design parameters were used for design of the pavement sections:

Acceptable Pavement Structural Sections

	Local Type A With Out Bus Traffic	Local Type B	Collector Street	Arterial Streets
Reliability, %	70	90	90	95
Initial Serviceability Index, po	4.2	4.2	4.2	4.2
Terminal Serviceability Index, pt	2.0	2.0	2.5	2.5
Standard Deviation, So	0.45	0.45	0.45	0.45
Design Life, years	20	20	20	20
18-kip ESALs	100,000	2,000,000	2,000,000	3,000,000
Minimum Structural Number	2.02	2.92	2.92	3.80
Maximum Structural Number	3.18	5.08	5.08	5.76

Soil bulk samples were collected to determine the California Bearing Ratio (CBR) value to be used for our pavement design recommendations. The locations at which the CBR bulk samples were taken are indicated on the Boring Location Plan in Appendix A. We performed CBR tests at three compaction levels (i.e., 90%, 95% and 100% for a total of three (3 CBR tests) on each sample location. Based on laboratory test results, CBR values of about 3.6 and 4.3 percent were obtained for the existing untreated subgrade compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698. TTL recommends that a CBR value of 3.0 percent be used to represent the pavement subgrade conditions at this site. There are a number of published correlations relating CBR to the Resilient Modulus (MR). In accordance with the COSA and Bexar County design guidelines, we used a Resilient Modulus (MR) = 1,500 times the CBR in psi, to convert CBR to MR.

The COSA pavement guidelines require lime treatment of clay subgrades with a PI greater than 20. CBR and the boring samples obtained from this subdivision indicates a PI value over 20. Therefore, the subgrade at this site shall be treated with hydrated lime in accordance with TxDOT Item 260. We anticipate that approximately eight (8) percent hydrated lime will be required (about 43 pounds per square yard). It is anticipated that even after the mass grading is completed that the soils will require lime treatment. Lime series testing was not performed for the geotechnical exploration. Lime series testing is usually performed at the start of construction. We do not have any laboratory data to include with this report.

However, it should be noted that, upon completion of the grading operations at the site, the index properties of the subgrade soils should be checked to determine whether or not lime treatment is required. This is because mass grading operations may have removed lower PI material to expose higher PI material or higher PI fill may have been placed over lower PI materials.

Even after subgrade lime treatment eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if other measures are used during construction.

5.3.1 Final Pavement Sections

Following are the recommended pavement sections for Local Type A, Local Type B, Collector, and Arterial.

Flexible Pavement System		
Component	Local Type A without Bus Traffic	
	Pavement Material Thickness, inches	
Hot Mixed Asphaltic Concrete – Type D	2 inches	2 inches
Prime Coat	Yes	Yes
Granular Base Course (Type A, Grade 1 or 2)	12 inches	8 inches
Tensar TX Type-3 Geogrid	----	Yes

Flexible Pavement System		
Component	Local Type A without Bus Traffic	
	Pavement Material Thickness, inches	
Lime Treated Subgrade[1]	6 inches	6 inches
Required Structural Number	2.49	2.49
Provided Structural Number[1]	2.52	2.50
Required 18-kip ESALs	100,000	100,000
Estimated Provided 18-kip ESALs	109,700	103,200

[1] Structural Number for Lime Treated Subgrade was not used in the Pavement Section Calculations.

Flexible Pavement System				
Component	Local Type B			
	Pavement Material Thickness, inches			
Hot Mixed Asphaltic Concrete – Type D	1 inch	2 inches	1½ inches	1½ inches
Hot Mixed Asphaltic Concrete – Type C	2 inches	3 inches	3 inches	2½ inches
Dense-Grade Hot-Mix Asphaltic Concrete Base Course (Type B, Item- 341)	6 inches	----	----	----
Prime Coat	Yes	Yes	Yes	Yes
Granular Base Course (Type A, Grade 1 or 2)	8 inches	12½ inches	17½ inches	16½ inches
Tensar TX Type-3 Geogrid	----	Yes	----	Yes
Lime Treated Subgrade[1]	6 inches	6 inches	6 inches	6 inches
Required Structural Number	4.37	4.37	4.37	4.37
Provided Structural Number[1]	4.72	4.38	4.43	4.40
Required 18-kip ESALs	2,000,000	2,000,000	2,000,000	2,000,000
Estimated Provided 18-kip ESALs	3,545,000	2,046,400	2,238,200	2,131,600

[1] Structural Number for Lime Treated Subgrade was not used in the Pavement Section Calculations.

Flexible Pavement System				
Component	Collector			
	Pavement Material Thickness, inches			
Hot Mixed Asphaltic Concrete – Type D	1 inch	1½ inches	2 inches	2½ inches
Hot Mixed Asphaltic Concrete – Type C	2 inches	3 inches	4 inches	2½ inches
Dense-Grade Hot-Mix Asphaltic Concrete Base Course (Type B, Item- 341)	6 inches	----	----	----

Flexible Pavement System				
Component	Collector			
	Pavement Material Thickness, inches			
Prime Coat	Yes	Yes	Yes	Yes
Granular Base Course (Type A, Grade 1 or 2)	8 inches	17 inches	14½ inches	15 inches
Tensar TX Type-3 Geogrid	----	Yes	----	Yes
Lime Treated Subgrade[1]	6 inches	6 inches	6 inches	6 inches
Required Structural Number	4.67	4.67	4.67	4.67
Provided Structural Number[1]	4.72	4.68	4.67	4.68
Required 18-kip ESALs	2,000,000	2,000,000	2,000,000	2,000,000
Estimated Provided 18-kip ESALs	2,175,900	2,062,500	2,024,000	2,038,800

[1] Structural Number for Lime Treated Subgrade was not used in the Pavement Section Calculations.

Flexible Pavement System				
Component	Arterial			
	Pavement Material Thickness, inches			
Hot Mixed Asphaltic Concrete – Type D	2 inches	2 inches	2 inches	1½ inches
Hot Mixed Asphaltic Concrete – Type C	3 inches	4 inches	4 inches	2½ inches
Dense-Grade Hot-Mix Asphaltic Concrete Base Course (Type B, Item- 341)	----	----	----	6 inches
Prime Coat	Yes	Yes	Yes	Yes
Granular Base Course (Type A, Grade 1 or 2)	13½ inches	15½ inches	12½ inches	8 inches
Tensar TX Type-3 Geogrid	Yes	----	Yes	----
Lime Treated Subgrade[1]	6 inches	6 inches	6 inches	6 inches
Required Structural Number	5.22	5.22	5.22	5.22
Provided Structural Number[1]	5.27	5.29	5.22	5.64
Required 18-kip ESALs	3,000,000	3,000,000	3,000,000	3,000,000
Estimated Provided 18-kip ESALs	3,745,100	3,044,200	3,263,100	4,911,800

[1] Structural Number for Lime Treated Subgrade was not used in the Pavement Section Calculations.

5.3.2 General Guidelines for Pavements

All pavement design and construction shall conform to the latest edition of Bexar County/ City of San Antonio Design and Construction guidelines. Pavement design methods are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support. **The support characteristics of the subgrade for pavement design do not account for shrink/swell movements of an expansive clayey subgrade. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade. It is, therefore, important to minimize moisture changes in the subgrade to reduce shrink/swell movements.**

On most projects, rough site grading is accomplished relatively early in the construction phase. However, as construction proceeds, excavations are made into these areas; dry weather may desiccate some areas; rainfall and surface water saturates some areas; heavy traffic from concrete and other delivery vehicles disturbs the subgrade; and many surface irregularities are filled in with loose soils to improve trafficability temporarily. As a result, the pavement subgrade should be carefully evaluated as the time for pavement construction approaches. This is particularly important in and around utility trench cuts.

Thorough proof-rolling of pavement areas using appropriate construction equipment weighing at least 20 tons should be performed no more than 24 hours prior to surface paving. Any problematic areas should be reworked and compacted at that time.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventive maintenance. The following recommendations should be considered at a minimum:

- Maintain and promote proper surface drainage away from pavement edges;
- Consider appropriate edge drainage systems;
- Install drainage in areas anticipated for frequent wetting (e.g., landscape beds, discharge area, collection areas, etc.).
- Place joint sealant and seal cracks immediately;
- Seal all landscaped areas in, or adjacent to pavements, to minimize or prevent moisture migration to subgrade soils;
- Placing compacted, low permeability backfill against the exterior side of curb and gutter; and,

Preventive maintenance should be planned and provided for through an on-going pavement management program. These activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. This consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance.

5.3.3 Drainage Adjacent to Pavements

The performance of the pavement system will not only be dependent upon the quality of construction but also upon the stability of the moisture content of the soils and base underlying the pavement surface. The moisture levels in the subgrade soils located near the edge of pavement structure are more susceptible to changes in moisture that occur due to natural seasonal moisture fluctuations. The edges will dry and shrink during drought conditions relative to the center of the pavement. During wet climate periods, the edges will swell relative to the center of the pavement. The shrinking and swelling of subgrade soils near the edge of pavements will result in longitudinal surface cracking that occurs parallel to the pavement. To help reduce the chances for moisture content variations of the subgrade soils, backfill behind the curbs should consist of compacted, low permeability clay. The use of landscape mulch or topsoil could provide an easy avenue for surface water to infiltrate behind and beneath curbs. This infiltration could adversely impact curb and pavement performance. Consideration should also be given to locating sidewalks immediately adjacent to the curbs as well.

Proper drainage along or adjacent to the pavement edge or curbs is ***very important*** and should be provided so infiltration of surface water from unpaved areas surrounding the pavement is minimized. **The infiltration of water into the base and subgrade materials comprising the pavement can result in a substantially reduced pavement service life.** The Project Civil Engineer should design final grades so that there is rapid, positive drainage away from the pavement/curb edge. Also, surface slopes for asphaltic concrete pavement areas should be no flatter than two (2) percent to reduce the potential for ponding of water on the asphaltic concrete surface. The importance of proper runoff and drainage cannot be overemphasized and should be thoroughly considered by the Project Civil Engineer.

5.3.4 Pavement Section Materials

All pavement materials shall conform to the latest edition of City of San Antonio/ Bexar County design and construction guidelines. Presented below are selection and preparation guidelines for various materials that may be used to construct the pavement sections. Submittals should be made for each pavement material. The submittals should be reviewed by TTL and any appropriate members of the Project Team. The submittals should provide test information necessary to verify full compliance with the recommended or specified material properties.

Hot Mix Asphaltic Concrete Surface - The paving mixture and construction methods shall conform to Item 340, “Hot Mix Asphaltic Concrete, Type C or D” of the Standard Specifications by TxDOT. The mix should be compacted between 91 and 95 percent of the maximum theoretical density as measured by TEX-227-F. The asphalt cement content by percent of total mixture weight should fall within a tolerance of ±0.3 percent asphalt cement from the specific mix. In addition, the mix should be designed so 75 to 85 percent of the voids in the mineral aggregate (VMA) are filled with asphalt cement. The asphalt cement grades should conform to the table shown below.

<table>
<tr><th colspan="4">Asphalt Cement Grades</th></tr>
<tr><th rowspan="2">Street Classifications</th><th colspan="3">Minimum PG Asphalt Cement Grade</th></tr>
<tr><th>Surface Courses</th><th>Binder and Level up courses</th><th>Base Courses</th></tr>
<tr><td>Arterials</td><td>PG 76-22</td><td rowspan="2">PG 70-22</td><td rowspan="4">PG 64-22</td></tr>
<tr><td rowspan="2">Collector and Local Type B Streets</td><td rowspan="2">PG 70-22</td></tr>
<tr><td rowspan="2">PG 64-22</td></tr>
<tr><td>Local Type A Street</td><td>PG 64-22</td></tr>
</table>

Aggregates known to be prone to stripping should not be used in the hot mix. If such aggregates are used measures should be taken to mitigate this concern. The mix should have at least 70 percent strength retention when tested in accordance with TEX-531-C.

Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method TEX-207-F. The nuclear-density gauge or other methods which correlate satisfactorily with results obtained from Project pavement specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required pavement specimens at their expense and in a manner and at locations selected by the Engineer.

<u>Hot Mix Asphaltic Concrete Base</u> – The paving mixture and construction methods shall conform to Item 340, “Hot Mix Asphaltic Concrete, Type B” of the standard specifications by TxDOT. The mix should be compacted between 95 and 98 percent of the maximum theoretical density as measured by Tex-227-F. The asphalt cement content by percent of total mixture weight should fall within a tolerance of ± 0.3 percent asphalt cement from the specific mix. In addition, the mix should be designed so 77 to 87 percent of the VMA are filled with asphalt cement.

<u>Prime Coat</u> - The prime coat should consist of sealing the base with an oil such as MC-30 or AE-P asphalt cement. The prime coat should be applied at a rate not to exceed 0.35 gallons per square yard with materials that meet TxDOT Item 300. The prime coat will help to minimize the penetration of rainfall and other moisture that penetrates the base.

<u>Granular Base Material</u> - Base material may be composed of crushed limestone base meeting all of the requirements of 2014 TxDOT Item 247, Type A, Grade 1 or 2; and should have no more than 15 percent of the material passing the No. 200 sieve. The base should be compacted to at least 95 percent of the maximum dry density determined in accordance with test method TEX-113-E at moisture contents ranging between -2 and +3 percentage points of the optimum moisture content.

Lime Treatment - Lime treatment shall be performed only on the dark brown clay subgrade. The subgrade shall be treated with hydrated lime in accordance with TxDOT Item 260. We anticipate that approximately six (6) percent hydrated lime will be required (approximately 35 pounds per square yard). The optimum hydrated lime content should result in a soil-lime mixture with a pH of at least 12.4 when tested in accordance with ASTM C 977, Appendix XI.

The hydrated lime should initially be blended with a mixing device such as a pulvermixer. After sufficient moisture conditioning, the treated soil mixture shall be compacted to at least 95 percent of the maximum dry density as determined in accordance with the Standard effort (ASTM D 698) at moisture contents from optimum to +4 percentage points of the optimum moisture content. If the in-place gradation requirements can be achieved during initial mixing, the remixing after the curing period can be eliminated.

Details regarding subgrade preparation are presented in Pavement Earthwork Section below.

5.3.5 Pavement Earthwork

The intended performance of roadway pavement is contingent upon following the earthwork recommendations and guidelines outlined in this section. Earthwork activities on the Project should be observed and evaluated by *TTL* personnel. The evaluation of earthwork should include observation and testing of all fill and backfill soils placed at the Site, and subgrade preparation beneath the streets.

The clay soils across the site have a moderate to high potential to undergo expansion and contraction with fluctuations in their moisture content. Expansion and contraction of the clay subgrade can lead to cracking and undulating/corrugation in the pavement and curbs. Remedial methods to address this issue include: removing the expansive soils and replacing them with non-expansive cohesive soil; chemical injection of the expansive soils; a combination of moisture conditioning, lime or cement treatment, and installation of a vertical moisture barrier; other subgrade preparation methods are also available.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and cracking in the pavements should be anticipated. The severity of cracking and other damage will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement other measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request*. If additional earthwork preparation methods will be used or evaluated, please contact us.*

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program.

Maintenance activities are intended to slow the rate of pavement deterioration and preserve the pavement investment.

The following earthwork recommendations must be performed prior to pavement construction.

- Strip vegetation, loose topsoil, vegetation, and any otherwise unsuitable materials from the pavement area. The pavement area is defined as the area that extends at least 3 feet (horizontal) beyond the perimeter of the proposed pavement and any adjacent flatwork (sidewalks).
- Perform cut and fill to accommodate the design pavement subgrade elevation (also referenced as the bottom of the base course). Onsite soils can be used for grade adjustments in fill areas. Refer to Section 4.0 of this report for requirements for the placement of onsite soils and select fill materials.
- After achieving the required excavation depth, and before placing any fill, the exposed excavation subgrade should be proof-rolled with at least a 20-ton roller, or equivalent equipment, to evidence any weak yielding zones. A technical representative of our firm should be present to observe the proof-rolling operations. If any weak yielding zones are present, they should be over-excavated, both vertically and horizontally, until competent soils are exposed. The excavated soil can be used to restore the excavation subgrade, provided that the soils are relatively free and clean of deleterious material or materials exceeding 3 inches in maximum dimension. The excavated soil or imported fill soil shall be placed in maximum of 6-inch compacted lifts. Each lift of soil shall be moisture conditioned and compacted as described in Section 4.0.
- After proof-rolling and replacing any weak yielding zones, the clay subgrade should be lime treated in accordance with TxDOT Item 260. The lime shall be in slurry form. It is anticipated that approximately six (6) percent hydrated lime will be required (approximately 35 pounds per square yard). The soil-lime mixture shall be placed between optimum and +4 percentage points of the optimum moisture content and shall be compacted to at least 95 percent of the maximum dry density determined in accordance with the Standard compaction effort (ASTM D 698).
- For pavement subgrades the earthwork described here should result in approximately six (6) inches of lime treated soil below the design pavement subgrade elevation.
- **For pavements located in natural drainage path areas, one of the following additional measures should be constructed beneath the soil subgrade level:**
    - Prepare the subgrade with 12 inches of moisture conditioned soils beneath 6 to 8 inches of lime treated soils, or
    - Prepare the subgrade with at least 12 inches of lime-treated soil.

6.0 LIMITATIONS

This geotechnical engineering report has been prepared for the exclusive use of our Client for specific application to this Project. This geotechnical engineering report has been prepared in accordance with generally accepted geotechnical engineering practices using that level of care and skill ordinarily exercised by licensed members of the engineering profession currently practicing under similar conditions in the same locale. No warranties, express or implied, are intended or made.

TTL understands that this geotechnical engineering report will be used by the Client and various individuals and firms’ designers and contractors involved with the preliminary design of the Project. TTL should be invited to attend Project meetings (in person or teleconferencing) or be contacted in writing to address applicable issues relating to the geotechnical engineering aspects of the Project. The information provided in this report is intended for planning purposes only for foundation design and should not be used for final design considerations.

This geotechnical engineering report is based upon the information provided to us by the Client and various other individuals and entities associated with the Project, along with the field exploration, laboratory testing, and engineering analyses and evaluations performed by TTL as described in this report. The Client and readers of this geotechnical engineering report should realize that subsurface variations and anomalies may exist across the site which may not be revealed by our field exploration. Furthermore, the Client and readers should realize that site conditions can change due to the modifying effects of seasonal and climatic conditions and conditions at times after our exploration may be different than reported herein.

The nature and extent of such site or subsurface variations may not become evident until construction commences or is in progress. If site and subsurface anomalies or variations exist or develop, TTL should be contacted immediately so that the situation can be properly evaluated and, if necessary, addressed with provide applicable recommendations.

Unless stated otherwise in this report or in the contract documents between TTL and Client, our scope of services for this Project did not include, either specifically or by implication, any environmental or biological assessment of the site or buildings, or any identification or prevention of pollutants, hazardous materials or conditions at the site or within buildings. If the Client is concerned about the potential for such contamination or pollution, TTL should be contacted to provide a scope of additional services to address the environmental concerns. In addition, TTL is not responsible for permitting, site safety, excavation support, and dewatering requirements.

Should the nature, design, or location of the Project, as outlined in this geotechnical engineering report be modified, the geotechnical engineering recommendations and guidelines provided in this document will not be considered valid unless TTL is authorized to review the changes and either verifies or modifies the applicable Project changes in writing.

Additional information about the use and limitations of a geotechnical report is provided within the Geoprofessional Business Association document included at the end of this report.

Important Information about This

Geotechnical-Engineering Report

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

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

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX A
ILLUSTRATIONS

Legend

SITE LOCATION MAP

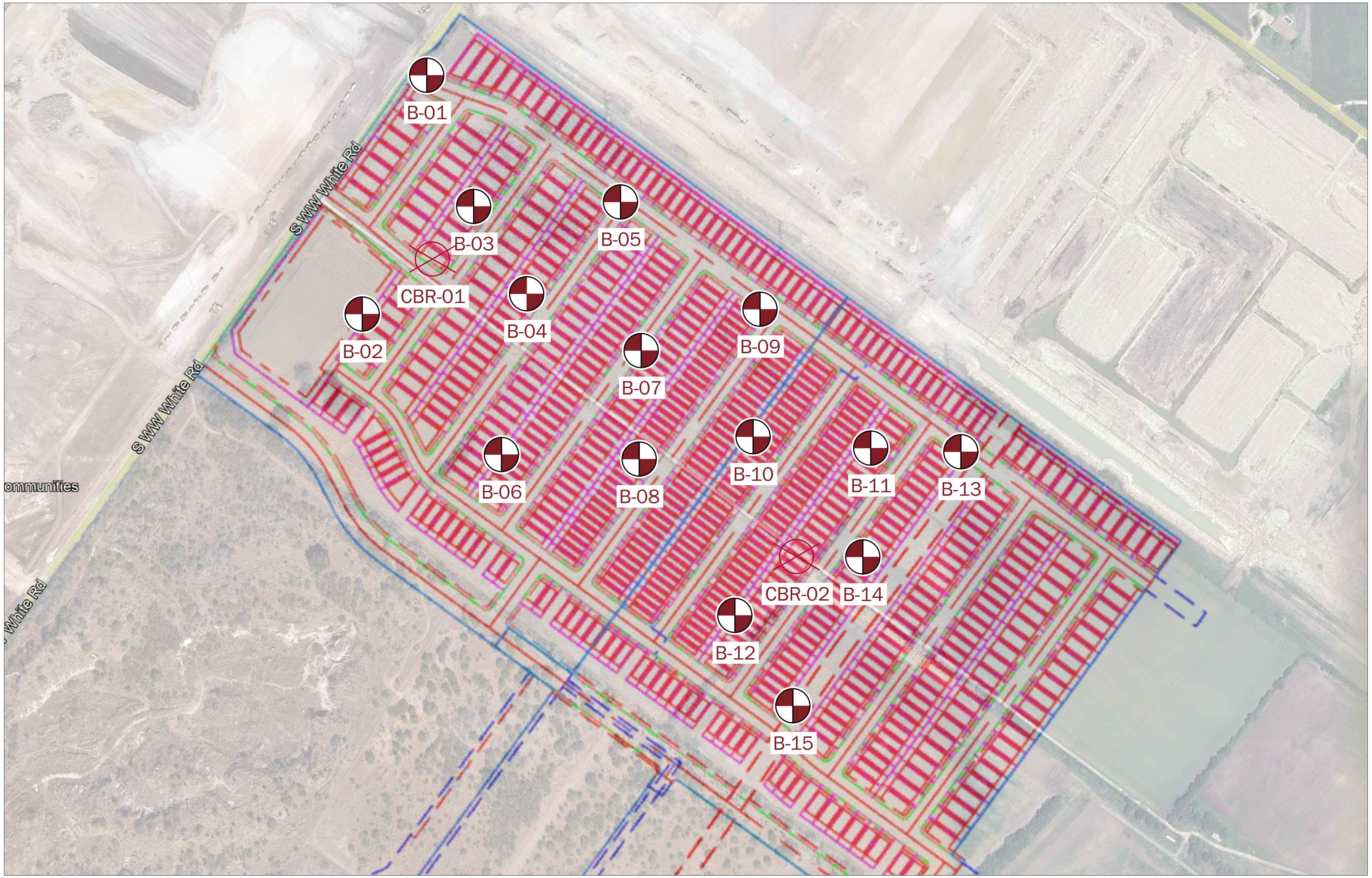
GRACE GARDENS UNITS 1 AND 2 - PAVEMENT DESIGN - REVISED LAYOUT

SOUTH WW WHITE RD
SAN ANTONIO ETJ, BEXAR COUNTY, TEXAS

Date:	04/04/2022
Drawn By:	RD
Checked By:	TA
Approved By:	TA
Project No.:	00230902952.01

Exhibit 1

TTL
17215 Jones Maltsberger Rd., Suite 101
San Antonio, TX 78247 210.888.6100
TBPELS Engineering: F-12622
TBPELS Surveying: 10194612
TBPG Firm: 50456



Legend

⊕ Boring Location and Identifier
B-X

⊗ California Bearing Ratio Sample Location and Identifier
CBR-X

BORING LOCATION MAP

GRACE GARDENS UNITS 1 AND 2 - PAVEMENT DESIGN - REVISED LAYOUT

SOUTH WW WHITE RD
SAN ANTONIO ETJ, BEXAR COUNTY, TEXAS

Date: 07/22/2024
Drawn By: RD
Checked By: TA
Approved By: TA
Project No.: 00230902952.01

Exhibit 2

TTL

17215 Jones Maltsberger Rd., Suite 101
San Antonio, TX 78247 210.888.6100
TBPELS Engineering: F-12622
TBPELS Surveying: 10194612
TBPG Firm: 50456

SOIL LEGEND

FINE- AND COARSE-GRAINED SOIL INFORMATION

FINE-GRAINED SOILS (SILTS AND CLAYS)

SPT N-Value	Consistency	Estimated Q_u (TSF)
0 - 1	Very Soft	0 - 0.25
2 - 4	Soft	0.25 - 0.5
5 - 8	Firm	0.5 - 1.0
9 - 15	Stiff	1.0 - 2.0
16 - 30	Very Stiff	2.0 - 4.0
31+	Hard	4.0+

Q_u = Unconfined Compression Strength

COARSE-GRAINED SOILS (SANDS AND GRAVELS)

SPT N-Value	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
51+	Very Dense

PARTICLE SIZE

Name	Size (US Std. Sieve)
Boulders	>300 mm (>12 in.)
Cobbles	75 mm to 300 mm (3 - 12 in.)
Coarse Gravel	19 mm to 75 mm (3/4 - 3 in.)
Fine Gravel	4.75 mm to 19 mm (#4 - 3/4 in.)
Coarse Sand	2 mm to 4.75 mm (#10 - #4)
Medium Sand	0.425 mm to 2 mm (#40 - #10)
Fine Sand	0.075 mm to 0.425 mm (#200 - #40)
Silts and Clays	< 0.075 mm (< #200)

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Terms	Percent of Dry Weight
"Trace"	< 15
"With"	15 - 30
Modifier	> 30

RELATIVE PROPORTIONS OF CLAYS AND SILTS

Descriptive Terms	Percent of Dry Weight
"Trace"	< 5
"With"	5 - 12
Modifier	> 12

CRITERIA FOR DESCRIBING MOISTURE CONDITION

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

CRITERIA FOR DESCRIBING CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

CRITERIA FOR DESCRIBING STRUCTURE

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note the thickness
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

ABBREVIATIONS AND ACRONYMS

WOH	Weight of Hammer	N-Value	Sum of the blows for last two 6-in increments of SPT
WOR	Weight of Rod		
Ref.	Refusal	NA	Not Applicable or Not Available
ATD	At Time of Drilling	OD	Outside Diameter
DCP	Dynamic Cone Penetrometer	PPV	Pocket Penetrometer Value
Elev.	Elevation	SFA	Solid Flight Auger
ft.	feet	SH	Shelby Tube Sampler
HSA	Hollow Stem Auger	SS	Split-Spoon Sampler
ID	Inside Diameter	SPT	Standard Penetration Test
in.	inches	USCS	Unified Soil Classification System
lbs	pounds		

SAMPLERS AND DRILLING METHODS

▌	AUGER CUTTINGS
◇	BAG/BULK SAMPLE
✋	GRAB SAMPLE
▤	CONTINUOUS SAMPLES
■	SHELBY TUBE SAMPLE
⧗	PITCHER SAMPLE
☒	STANDARD PENETRATION SPLIT-SPOON SAMPLE
○	SPLIT-SPOON SAMPLE WITH NO RECOVERY
▼	DYNAMIC CONE PENETROMETER
▮	ROCK CORE

WATER LEVEL SYMBOLS

▽	WATER LEVEL AT TIME OF DRILLING
≡	PERCHED WATER OBSERVED AT DRILLING
▼	DELAYED WATER LEVEL OBSERVATION
▨	CAVE-IN DEPTH
≈	OBSERVED SEEPAGE

TTL

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

COARSE GRAINED SOILS (>50% of the material is larger than the #200 sieve)	GRAVELS (>50% of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu > 4 Cc = 1-3	▨	GW	Well-graded gravels, gravel-sand mixtures with trace or no fines
			Cu ≤ 4 and/or Cc < 1 Cc > 3	▨	GP	Poorly-graded gravels, gravel-sand mixtures with trace or no fines
		GRAVEL WITH 5% TO 12% FINES	Cu > 4 Cc = 1-3	▨	GW-GM	Well-graded gravels, gravel-sand mixtures with silt fines
				▨	GW-GC	Well-graded gravels, gravel-sand mixtures with clay fines
			Cu ≤ 4 and/or Cc < 1 Cc > 3	▨	GP-GM	Poorly-graded gravels, gravel-sand mixtures with silt fines
				▨	GP-GC	Poorly-graded gravels, gravel-sand mixtures with clay fines
		GRAVEL WITH MORE THAN 12% FINES		▨	GM	Silty gravels, gravel-silt-sand mixtures
				▨	GC	Clayey gravels, gravel-sand-clay mixtures
				▨	GC-GM	Clayey gravels, gravel-sand-clay-silt mixtures
	SANDS (>50% of coarse fraction is smaller than the #4 sieve)	CLEAN SAND WITH <5% FINES	Cu > 6 Cc = 1-3	▨	SW	Well-graded sands, sand-gravel mixtures with trace or no fines
			Cu ≤ 6 and/or Cc < 1 Cc > 3	▨	SP	Poorly-graded sands, sand-gravel mixtures with trace or no fines
		SAND WITH 5% TO 12% FINES	Cu > 6 Cc = 1-3	▨	SW-SM	Well-graded sands, sand-gravel mixtures with silt fines
				▨	SW-SC	Well-graded sands, sand-gravel mixtures with clay fines
			Cu ≤ 6 and/or Cc < 1 Cc > 3	▨	SP-SM	Poorly-graded sands, sand-gravel mixtures with silt fines
				▨	SP-SC	Poorly-graded sands, sand-gravel mixtures with clay fines
		SAND WITH MORE THAN 12% FINES		▨	SM	Silty sands, sand-gravel-silt mixtures
				▨	SC	Clayey sands, sand-gravel-clay mixtures
				▨	SC-SM	Clayey sands, sand-gravel-clay-silt mixtures
FINE GRAINED SOILS (>50% of material is smaller than the #200 sieve)		SILTS & CLAYS (Liquid Limit less than 50)		▨	ML	Inorganic silts with low plasticity
				▨	CL	Inorganic clays of low plasticity, gravelly or sandy clays, silty clays, lean clays
				▨	CL-ML	Inorganic clay-silts of low plasticity, gravelly clays, sandy clays, silty clays, lean clays
				▨	OL	Organic silts and organic silty clays of low plasticity
		SILTS & CLAYS (Liquid Limit more than 50)		▨	MH	Inorganic silts of high plasticity, elastic silts
				▨	CH	Inorganic clays of high plasticity, fat clays
				▨	OH	Organic clays and organic silts of high plasticity

USCS - HIGHLY ORGANIC SOILS

Primarily organic matter, dark in color, organic odor

▨	PT	Peat, humus, swamp soils with high organic contents

OTHER MATERIALS

■	BITUMINOUS CONCRETE (ASPHALT)
▨	CONCRETE
▨	CRUSHED STONE/AGGREGATE BASE
▨	TOPSOIL
▨	FILL
▨	UNDIFFERENTIATED ALLUVIUM
▨	UNDIFFERENTIATED OVERBURDEN
▨	BOULDERS AND COBBLES

UNIFORMITY COEFFICIENT

$$C_u = D_{60}/D_{10}$$

COEFFICIENT OF CURVATURE

$$C_C = (D_{30})^2/(D_{60}xD_{10})$$

Where:

D_{60} = grain diameter at 60% passing
D_{30} = grain diameter at 30% passing
D_{10} = grain diameter at 10% passing

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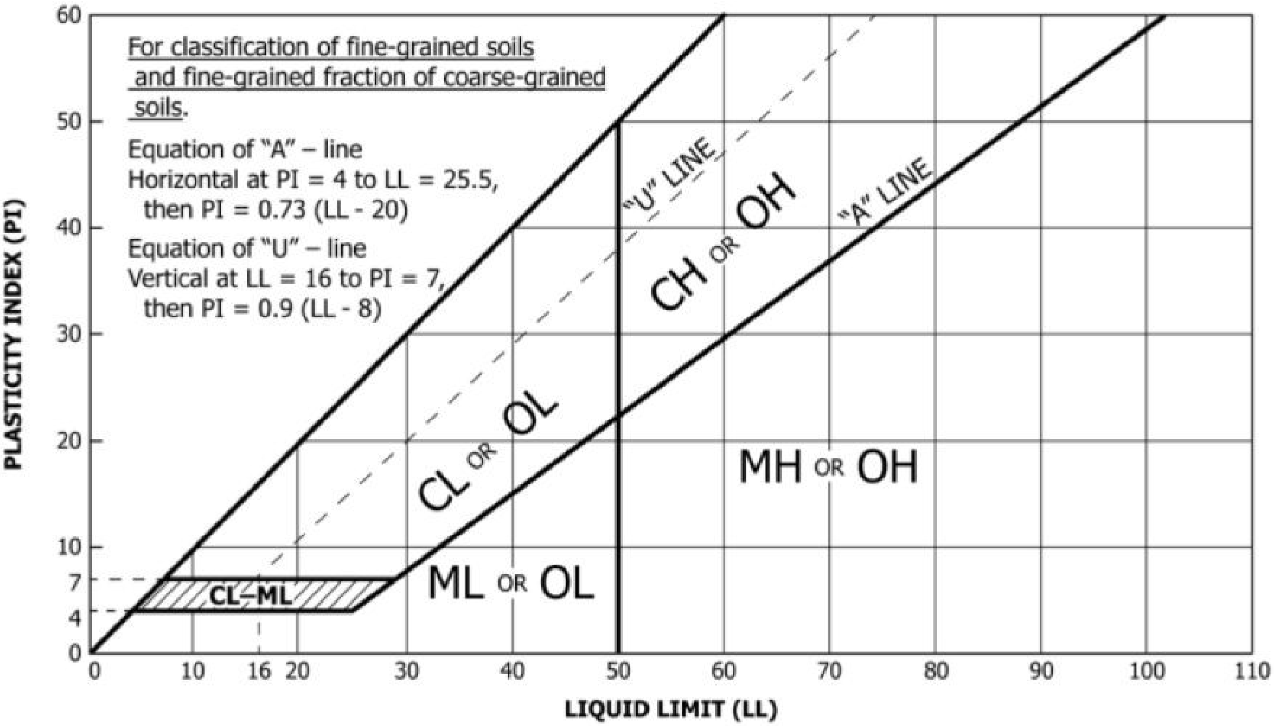
PLASTICITY CHART FOR USCS CLASSIFICATION OF FINE-GRAINED SOILS



IMPORTANT NOTES ON TEST BORING RECORDS

1) The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.

2) Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown. Solid lines are used to indicate a change in the material type, particularly a change in the USCS classification. Dashed lines are used to separate two materials that have the same material type, but that differ with respect to two or more other characteristics (e.g. color, consistency).

3) No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.

4) Logs represent general soil and rock conditions observed at the point of exploration on the date indicated.

5) In general, Unified Soil Classification System (USCS) designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.

6) Fine-grained soils that plot within the hatched area on the Plasticity Chart, and coarse-grained soils with between 5% and 12% passing the #200 sieve require dual USCS symbols as presented on the previous page.

7) If the sampler is not able to be driven at least 6 inches, then 50/X" indicates that the sampler advanced X inches when struck 50 times with a 140-pound hammer falling 30 inches.

8) If the sampler is driven at least 6 inches, but cannot be driven either of the subsequent two 6-inch increments, then either 50/X" or the sum of the second 6-inch increment plus 50/X" for the third 6-inch increment will be indicated.
Example 1: Recorded SPT blow counts are 16 - 50/4", the SPT N-value will be shown as N = 50/4"
Example 2: Recorded SPT blow counts are 18 - 25 - 50/2", the SPT N-value will be shown as N = 75/8"

TTL

Lennar
Grace Gardens Units 1 and 2
South WW White Rd

San Antonio ETJ, Bexar County, Texas

Log of B-01

Page 1 of 1

Drilling Co.: *Eagle Drilling*

Driller: *S. Drash*

Logged by: *D. Alfaro*

Equipment: *Mobile B-47*

Hammer Type: *Automatic*

Drilling Method: *Solid Flight Auger w/SPT Sampling*

TTL Project No.: *00230902952.01*

Date Drilled: *10/3/2023*

Boring Depth: *10 feet*

Boring Elevation: *Ground Surface*

Coordinates: *E: -98.3923 N: 29.3385*

▽ Water Level at Time of Drilling: *Not Encount.*

Cave-In at Time of Drilling: *N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	SAMPLE DATA												
				TYPE	BORE/CORE DATA 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
		▨	LEAN CLAY WITH SAND; very stiff, dark brown, calcareous (CL)													
	1	▨		☒	6 - 8 - 8 N = 16			10	48	16	32					
	2	▨	FAT CLAY; stiff to hard, dark brown to gray, calcareous to 6 feet (CH)													
	3	▨		☒	5 - 7 - 7 N = 14			15								
	4	▨														
	5	▨		☒	4 - 6 - 8 N = 14			17	56	19	37					
	6	▨														
	7	▨		☒	7 - 11 - 22 N = 33			16								90.1
	8	▨	LEAN CLAY WITH SAND; hard, gray (CL)													
	9	▨		☒	19 - 26 - 21 N = 47			7	22	13	9					
	10		Boring terminated at 10 feet.													
	11															
	12															
	13															
	14															

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Lennar
Grace Gardens Units 1 and 2
South WW White Rd
San Antonio ETJ, Bexar County, Texas

Log of B-02

Page 1 of 1

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/2/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*9.5 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.39307 N: 29.336*
Drilling Method:	*Solid Flight Auger w/SPT Sampling*		

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▽ Water Level at Time of Drilling: *Not Encount.*

Cave-In at Time of Drilling: *N/A*

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

SAMPLE DATA

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	TYPE	BORE/CORE DATA 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
	0	▨	FAT CLAY WITH SAND; stiff to very stiff, dark brown to gray, calcareous (CH)													
	1	▨		☒	3 - 5 - 5 N = 10			20								83.1
	2	▨														
	3	▨		☒	3 - 4 - 6 N = 10			14	66	25	41					
	4	▨														
	5	▨		☒	4 - 5 - 6 N = 11			23								
	6	▨														
	7	▨		☒	3 - 7 - 10 N = 17			13								81.6
	8	▨	LEAN CLAY WITH SAND; hard, gray, calcareous, cemented (CL)													
	9	▨		☒	15 - 50/6 N = 50/6"			7	23	13	10					
	10		Boring terminated at 9.5 feet.													
	11															
	12															
	13															
	14															

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San Antonio ETJ, Bexar County, Texas

Log of
B-03

Page 1 of 1

Drilling Co.: *Eagle Drilling*

Driller: *S. Drash*

Logged by: *D. Alfaro*

Equipment: *Mobile B-47*

Hammer Type: *Automatic*

Drilling Method: *Solid Flight Auger w/SPT Sampling*

TTL Project No.: *00230902952.01*

Date Drilled: *10/2/2023*

Boring Depth: *10 feet*

Boring Elevation: *Ground Surface*

Coordinates: *E: -98.3917 N: 29.3372*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▽ Water Level at Time of Drilling: *Not Encount.*

Cave-In at Time of Drilling: *N/A*

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

SAMPLE DATA

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	TYPE	BORE/CORE DATA: 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD / % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%): LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
	1 2	▨	LEAN CLAY WITH SAND; stiff, dark brown, calcareous (CL)	☒	2 - 4 - 5 N = 9			9								
	3 4	▨	FAT CLAY WITH SAND; stiff, dark brown, calcareous (CH)	☒	4 - 5 - 7 N = 12			14	62	20	42					
	5 6	▨	SANDY LEAN CLAY; very stiff to hard, reddish-brown to gray, calcareous (CL)	☒	6 - 8 - 11 N = 19			11								52.7
	7 8	▨		☒	6 - 7 - 9 N = 16			14	23	13	10					
	9 10	▨	- WITH SAND layer between 8½ and 10 feet	☒	10 - 13 - 21 N = 34			10								81.0
	11 12 13 14		Boring terminated at 10 feet.													

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Log of B-04

Page 1 of 1

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/2/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*10 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.3911 N: 29.3362*
Drilling Method:	*Solid Flight Auger w/SPT Sampling*	▽ Water Level at Time of Drilling:	*Not Encount.*
		Cave-In at Time of Drilling:	*N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

SAMPLE DATA

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	**MATERIALS DESCRIPTION**	TYPE	BORE/CORE DATA 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
	0	▨	SANDY FAT CLAY; stiff, dark brown, calcareous (CH)													
	1	▨		☒	5 - 5 - 8 N = 13			10								67.4
	3	▨		☒	4 - 4 - 5 N = 9			17	60	22	38					
	4½	▨	- WITH SAND layer between 4½ and 6 feet													
	5	▨		☒	4 - 5 - 7 N = 12			18								73.8
	6	▨	LEAN CLAY; very stiff, light brown, calcareous (CL)													
	7	▨		☒	5 - 7 - 12 N = 19			15	40	12	28					
	9	▨		☒	5 - 9 - 14 N = 23			13								91.1
	10		Boring terminated at 10 feet.													

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Log of B-05

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/2/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*9.5 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.39 N: 29.3372*
Drilling Method:	*Solid Flight Auger w/SPT Sampling*	▽ Water Level at Time of Drilling:	*Not Encount.*
		Cave-In at Time of Drilling:	*N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

SAMPLE DATA

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	TYPE	BORE/CORE DATA 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
		▨	FAT CLAY WITH SAND; stiff, dark brown, calcareous (CH)													
	1	▨		☒	4 - 5 - 7 N = 12			12	61	27	34					
	2	▨														
	3	▨		☒	4 - 6 - 7 N = 13			17								
	4	▨														
	5	▨		☒	4 - 7 - 8 N = 15			18								78.0
	6	▨	LEAN CLAY; hard, gray, calcareous (CL)													
	7	▨		☒	5 - 12 - 21 N = 33			10								88.4
	8	▨	- with interbedded cemented seams between 8½ and 10 feet													
	9	▨		☒	19 - 50/6 N = 50/6"			10	22	14	8					
	10		Boring terminated at 9.5 feet.													
	11															
	12															
	13															
	14															

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Grace Gardens Units 1 and 2
South WW White Rd
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Log of B-06

Page 1 of 1

Drilling Co.: *Eagle Drilling*

Driller: *S. Drash*

Logged by: *D. Alfaro*

Equipment: *Mobile B-47*

Hammer Type: *Automatic*

Drilling Method: *Solid Flight Auger w/SPT Sampling*

TTL Project No.: *00230902952.01*

Date Drilled: *10/2/2023*

Boring Depth: *10 feet*

Boring Elevation: *Ground Surface*

Coordinates: *E: -98.3914 N: 29.3346*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▽ Water Level at Time of Drilling: *Not Encount.*

Cave-In at Time of Drilling: *N/A*

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

SAMPLE DATA

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	**MATERIALS DESCRIPTION**	TYPE	BORE/CORE DATA N-VALUE BLOWS/FT (1st 6" 2nd 6" 3rd 6")	P: TONS/SQFT	RQD / % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
	0	▨	LEAN CLAY WITH SAND; firm, dark brown, calcareous (CL)	☒	1 - 4 - 2 N = 6			10								
	3	▨		☒	4 - 4 - 4 N = 8			11								
	4	▨	FAT CLAY WITH SAND; stiff, dark brown, calcareous (CH)	☒	1 - 5 - 7 N = 12			17	58	19	39					76.5
	6	▨	LEAN CLAY WITH SAND; very stiff, reddish-brown to light brown, calcareous (CL)	☒	6 - 10 - 14 N = 24			11	44	16	28					
	8.5	▨	- with trace of gravel between 8½ and 10 feet	☒	5 - 11 - 14 N = 25			12								83.9
	10		Boring terminated at 10 feet.													

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TTL	**Lennar** **Grace Gardens Units 1 and 2** **South WW White Rd** San Antonio ETJ, Bexar County, Texas	**Log of** **B-07** Page 1 of 1

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/3/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*10 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.3897 N: 29.3356*
Drilling Method:	*Solid Flight Auger w/SPT Sampling*	▽ Water Level at Time of Drilling:	*Not Encount.*
		Cave-In at Time of Drilling:	*N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	**MATERIALS DESCRIPTION**	TYPE	1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD / % REC	MOISTURE CONTENT (%)	LL (LIQUID LIMIT)	PL (PLASTIC LIMIT)	PI (PLASTICITY INDEX)	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
	0	▨	SANDY LEAN CLAY; firm, dark brown (CL)	☒	3 - 3 - 4 N = 7			8								64.1
	2	▨	FAT CLAY WITH SAND; stiff, dark brown to light brown, calcareous (CH)	☒	3 - 4 - 5 N = 9			13	59	21	38					
				☒	3 - 4 - 6 N = 10			20								
				☒	3 - 4 - 8 N = 12			19								81.7
	8	▨	LEAN CLAY WITH SAND; very stiff, light brown, calcareous (CL)	☒	6 - 9 - 12 N = 21			14	38	14	24					
	10		Boring terminated at 10 feet.													
	11															
	12															
	13															
	14															

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Lennar
Grace Gardens Units 1 and 2
South WW White Rd

San Antonio ETJ, Bexar County, Texas

Log of
B-08

Page 1 of 1

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/2/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*10 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.3898 N: 29.3345*
Drilling Method:	*Solid Flight Auger w/SPT Sampling*	∇ Water Level at Time of Drilling:	*Not Encount.*
		Cave-In at Time of Drilling:	*N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

SAMPLE DATA

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	TYPE	BORE/CORE DATA 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD / % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
		▨	FAT CLAY WITH SAND; firm to very stiff, dark brown, calcareous (CH)													
	1	▨		☒	2 - 3 - 4 N = 7			12	58	25	33					
	2	▨														
	3	▨		☒	4 - 5 - 7 N = 12			19								
	4	▨														
	5	▨	- with trace gravel between 4½ and 8 feet	☒	4 - 6 - 9 N = 15			19								72.2
	6	▨														
	7	▨		☒	5 - 8 - 9 N = 17			19								71.6
	8	▨	LEAN CLAY WITH SAND; very stiff, light brown, calcareous (CL)													
	9	▨		☒	4 - 5 - 11 N = 16			21	35	14	21					
	10		Boring terminated at 10 feet.													
	11															
	12															
	13															
	14															

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Grace Gardens Units 1 and 2
South WW White Rd
San Antonio ETJ, Bexar County, Texas

Log of
B-09

Page 1 of 1

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/2/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*10 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.3883 N: 29.3361*
Drilling Method:	*Solid Flight Auger w/SPT Sampling*	▽ Water Level at Time of Drilling:	*Not Encount.*
		Cave-In at Time of Drilling:	*N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	TYPE	BORE/CORE DATA 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
		▨	SANDY FAT CLAY; stiff, dark brown to light brown (CH)													
	1	▨		☒	2 - 5 - 5 N = 10			12	51	14	37					
	2	▨														
	3	▨		☒	4 - 5 - 7 N = 12			12								67.2
	4	▨	- calcareous between 4½ and 10 feet													
	5	▨		☒	5 - 5 - 7 N = 12			16	60	19	41					
	6	▨	- very stiff layer with trace gravel between 6½ and 8 feet													
	7	▨		☒	4 - 7 - 12 N = 19			18								68.2
	8	▨														
	9	▨		☒	7 - 5 - 9 N = 14			19								
	10		Boring terminated at 10 feet.													
	11															
	12															
	13															
	14															

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Lennar
Grace Gardens Units 1 and 2
South WW White Rd
San Antonio ETJ, Bexar County, Texas

Log of B-10
Page 1 of 1

Drilling Co.: *Eagle Drilling*
Driller: *S. Drash*
Logged by: *D. Alfaro*
Equipment: *Mobile B-47*
Hammer Type: *Automatic*
Drilling Method: *Solid Flight Auger w/SPT Sampling*

TTL Project No.: *00230902952.01*
Date Drilled: *10/3/2023*
Boring Depth: *10 feet*
Boring Elevation: *Ground Surface*
Coordinates: *E: -98.3884 N: 29.3347*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▽ Water Level at Time of Drilling: *Not Encount.*
Cave-In at Time of Drilling: *N/A*
▼ Delayed Water Level: *N/A*
Delayed Water Observation Date: *N/A*

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	SAMPLE DATA: TYPE	BORE/CORE DATA: 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD / % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%): LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
		▨	SANDY FAT CLAY; firm to stiff, dark brown to light brown (CH)													
	1	▨		☒	3 - 4 - 4 N = 8			9	54	14	40					
	2	▨	- calcareous between 2½ and 10 feet													
	3	▨		☒	3 - 4 - 6 N = 10			19								
	4	▨														
	5	▨		☒	4 - 4 - 5 N = 9			21	65	25	40					
	6	▨	- very stiff layer with trace gravel between 6½ and 8 feet													
	7	▨		☒	4 - 7 - 11 N = 18			21								69.8
	8	▨	- WITH GRAVEL between 8½ and 10 feet													
	9	▨		☒	5 - 5 - 5 N = 10			16								52.6
	10		Boring terminated at 10 feet.													
	11															
	12															
	13															
	14															

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X:\2023\09\23-09-02952.00 - LENNAR - GRACE GARDENS UNITS 1 AND 2\GEOTECHNICAL\DATA\00230902952.00 -- LENNAR - GRACE GARDENS UNITES 1 AND 2.GPJ 11/16/23 Report:AEP-GEOTECH LOG - LAT LONG

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Lennar
Grace Gardens Units 1 and 2
South WW White Rd

San Antonio ETJ, Bexar County, Texas

Log of B-11

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/2/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*10 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.387 N: 29.3346*
Drilling Method:	*Solid Flight Auger w/SPT Sampling*	▽ Water Level at Time of Drilling:	*Not Encount.*
		Cave-In at Time of Drilling:	*N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	TYPE	BORE/CORE DATA 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
	0	▨	SANDY FAT CLAY; firm to very stiff, dark brown to light brown, calcareous (CH)													
	1	▨		☒	2 - 2 - 3 N = 5			10								
	2	▨														
	3	▨		☒	5 - 7 - 5 N = 12			10								66.9
	4	▨	- WITH SAND between 4½ and 10 feet													
	5	▨		☒	3 - 3 - 5 N = 8			19	68	23	45					
	6	▨														
	7	▨		☒	4 - 7 - 8 N = 15			20	57	22	35					
	8	▨														
	9	▨		☒	4 - 7 - 10 N = 17			19								75.1
	10		Boring terminated at 10 feet.													
	11															
	12															
	13															
	14															

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Lennar
Grace Gardens Units 1 and 2
South WW White Rd
San Antonio ETJ, Bexar County, Texas

Log of
B-12

Page 1 of 1

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/2/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*10 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.3886 N: 29.3328*
Drilling Method:	*Solid Flight Auger w/SPT Sampling*	▽ Water Level at Time of Drilling:	*Not Encount.*
		Cave-In at Time of Drilling:	*N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

SAMPLE DATA

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	**MATERIALS DESCRIPTION**	TYPE	BORE/CORE DATA 1st 6" - 2nd 6" - 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD / % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
	0	▨	LEAN CLAY WITH SAND; firm to hard, dark brown to light brown, calcareous (CL)													
	1	▨		☒	3 - 3 - 5 N = 8			13	47	20	27					
	3	▨		☒	3 - 4 - 5 N = 9			16								
	5	▨		☒	3 - 5 - 7 N = 12			19								75.0
	7	▨		☒	4 - 5 - 10 N = 15			13	28	15	13					
	9	▨		☒	12 - 29 - 30 N = 59			11								74.1
	10		Boring terminated at 10 feet.													

Depth scale (ft): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

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Lennar
Grace Gardens Units 1 and 2
South WW White Rd
San Antonio ETJ, Bexar County, Texas

Log of
B-13
Page 1 of 1

Drilling Co.: *Eagle Drilling*

Driller: *S. Drash*

Logged by: *D. Alfaro*

Equipment: *Mobile B-47*

Hammer Type: *Automatic*

Drilling Method: *Solid Flight Auger w/SPT Sampling*

TTL Project No.: *00230902952.01*

Date Drilled: *10/2/2023*

Boring Depth: *10 feet*

Boring Elevation: *Ground Surface*

Coordinates: *E: -98.3859 N: 29.3346*

▽ Water Level at Time of Drilling: *Not Encount.*

Cave-In at Time of Drilling: *N/A*

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

				SAMPLE DATA												
					BORE/CORE DATA				ATTERBERG LIMITS (%)							
ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	TYPE	1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD % REC	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
		▨	LEAN CLAY WITH SAND; soft, dark brown, calcareous (CL)													
	1	▨		☒	2 - 1 - 2 N = 3			8								
	2	▨	FAT CLAY; firm to stiff, dark brown, calcareous (CH)													
	3	▨		☒	4 - 4 - 4 N = 8			16	58	23	35					
	4	▨														
	5	▨		☒	4 - 4 - 6 N = 10			16								99.2
	6	▨	SANDY LEAN CLAY; very stiff to stiff, light brown, calcareous (CL)													
	7	▨		☒	5 - 7 - 9 N = 16			17	49	20	29					
	8	▨														
	9	▨	- with trace gravel between 8½ and 10 feet	☒	4 - 4 - 7 N = 11			21								67.1
	10		Boring terminated at 10 feet.													
	11															
	12															
	13															
	14															

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Lennar
Grace Gardens Units 1 and 2
South WW White Rd
San Antonio ETJ, Bexar County, Texas

Log of B-14
Page 1 of 1

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/2/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*10 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.3871 N: 29.3335*
Drilling Method:	*Solid Flight Auger w/SPT Sampling*	▽ Water Level at Time of Drilling:	*Not Encount.*
		Cave-In at Time of Drilling:	*N/A*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

SAMPLE DATA

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIALS DESCRIPTION	TYPE	BORE/CORE DATA 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
		▨	LEAN CLAY WITH SAND; stiff to very stiff, dark brown to reddish-brown (CL)													
	1	▨		☒	4 - 5 - 7 N = 12			6								
	2	▨														
	3	▨	- calcareous between 2½ and 10 feet	☒	5 - 5 - 5 N = 10			14	47	12	35					
	4	▨														
	5	▨		☒	4 - 5 - 7 N = 12			19								
	6	▨														
	7	▨	- firm layer between 6½ and 8 feet	☒	4 - 4 - 4 N = 8			20	47	17	30					
	8	▨														
	9	▨	- with trace gravel between 8½ and 10 feet	☒	3 - 6 - 11 N = 17			22								78.1
	10		Boring terminated at 10 feet.													
	11															
	12															
	13															
	14															

Lennar
Grace Gardens Units 1 and 2
South WW White Rd
San Antonio ETJ, Bexar County, Texas

Log of
B-15

Page 1 of 1

Drilling Co.:	*Eagle Drilling*	**TTL** Project No.:	*00230902952.01*
Driller:	*S. Drash*	Date Drilled:	*10/2/2023*
Logged by:	*D. Alfaro*	Boring Depth:	*10 feet*
Equipment:	*Mobile B-47*	Boring Elevation:	*Ground Surface*
Hammer Type:	*Automatic*	Coordinates:	*E: -98.388 N: 29.3319*

Remarks:
Subsurface water was not enocuntered during drilling. The borehole was backfilled with soil cuttings after drilling activites were completed.

Drilling Method: *Solid Flight Auger w/SPT Sampling*

▽ Water Level at Time of Drilling: *Not Encount.*

Cave-In at Time of Drilling: *N/A*

▼ Delayed Water Level: *N/A*

Delayed Water Observation Date: *N/A*

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	**MATERIALS DESCRIPTION**	SAMPLE DATA TYPE	BORE/CORE DATA 1st 6" 2nd 6" 3rd 6" N-VALUE BLOWS/FT	P: TONS/SQFT	RQD / % REC	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY (psf)	SHEAR STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
		▨	FAT CLAY WITH SAND; stiff, dark brown, calcareous (CH)													
	1	▨		☒	4 - 5 - 8 N = 13			11								
	2	▨														
	3	▨		☒	4 - 5 - 7 N = 12			16	57	14	43					
	4	▨														
	5	▨		☒	4 - 7 - 7 N = 14			19								77.4
	6	▨	LEAN CLAY WITH SAND; very stiff to hard, light brown, calcareous (CL)													
	7	▨		☒	5 - 14 - 16 N = 30			13								
	8	▨														
	9	▨		☒	15 - 30 - 50/6 N = 80/12"			12	30	12	18					
	10		Boring terminated at 10 feet.													
	11															
	12															
	13															
	14															

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Boring	Depth	USCS	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Gravel	% Sand	Maximum Size (mm)	% Passing #200 % Silt % Clay (If hydrometer data available)	D50 (mm)
B-01	0.5 - 2	---	10	48	16	32	---	---	---	---	---
B-01	4.5 - 6	---	17	56	19	37	---	---	---	---	---
B-01	6.5 - 8	---	16	---	---	---	---	---	0.075	90.1	---
B-01	8.5 - 10	---	7	22	13	9	---	---	---	---	---
B-02	0.5 - 2	---	20	---	---	---	---	---	0.075	83.1	---
B-02	2.5 - 4	---	14	66	25	41	---	---	---	---	---
B-02	6.5 - 8	---	13	---	---	---	---	---	0.075	81.6	---
B-02	8.5 - 10	---	7	23	13	10	---	---	---	---	---
B-03	2.5 - 4	---	14	62	20	42	---	---	---	---	---
B-03	4.5 - 6	---	11	---	---	---	---	---	0.075	52.7	---
B-03	6.5 - 8	---	14	23	13	10	---	---	---	---	---
B-03	8.5 - 10	---	10	---	---	---	---	---	0.075	81.0	---
B-04	0.5 - 2	---	10	---	---	---	---	---	0.075	67.4	---
B-04	2.5 - 4	---	17	60	22	38	---	---	---	---	---
B-04	4.5 - 6	---	18	---	---	---	---	---	0.075	73.8	---
B-04	6.5 - 8	---	15	40	12	28	---	---	---	---	---
B-04	8.5 - 10	---	13	---	---	---	---	---	0.075	91.1	---
B-05	0.5 - 2	---	12	61	27	34	---	---	---	---	---
B-05	4.5 - 6	---	18	---	---	---	---	---	0.075	78.0	---
B-05	6.5 - 8	---	10	---	---	---	---	---	0.075	88.4	---
B-05	8.5 - 10	---	10	22	14	8	---	---	---	---	---
B-06	4.5 - 6	CH	17	58	19	39	---	---	0.075	76.5	---
B-06	6.5 - 8	---	11	44	16	28	---	---	---	---	---
B-06	8.5 - 10	---	12	---	---	---	---	---	4.75	83.9	---
B-07	0.5 - 2	---	8	---	---	---	---	---	0.075	64.1	---
B-07	2.5 - 4	---	13	59	21	38	---	---	---	---	---
B-07	6.5 - 8	---	19	---	---	---	---	---	0.075	81.7	---
B-07	8.5 - 10	---	14	38	14	24	---	---	---	---	---
B-08	0.5 - 2	---	12	58	25	33	---	---	---	---	---
B-08	4.5 - 6	---	19	---	---	---	---	---	38.1	72.2	---
B-08	6.5 - 8	---	19	---	---	---	---	---	0.075	71.6	---
B-08	8.5 - 10	---	21	35	14	21	---	---	---	---	---
B-09	0.5 - 2	---	12	51	14	37	---	---	---	---	---
B-09	2.5 - 4	---	12	---	---	---	---	---	0.075	67.2	---
B-09	4.5 - 6	---	16	60	19	41	---	---	---	---	---
B-09	6.5 - 8	---	18	---	---	---	---	---	4.75	68.2	---
B-10	0.5 - 2	---	9	54	14	40	---	---	---	---	---
B-10	4.5 - 6	---	21	65	25	40	---	---	---	---	---
B-10	6.5 - 8	---	21	---	---	---	---	---	38.1	69.8	---
B-10	8.5 - 10	---	16	---	---	---	---	---	38.1	52.6	---
B-11	2.5 - 4	---	10	---	---	---	---	---	0.075	66.9	---
B-11	4.5 - 6	---	19	68	23	45	---	---	---	---	---

TTL

Summary of Laboratory Test Results

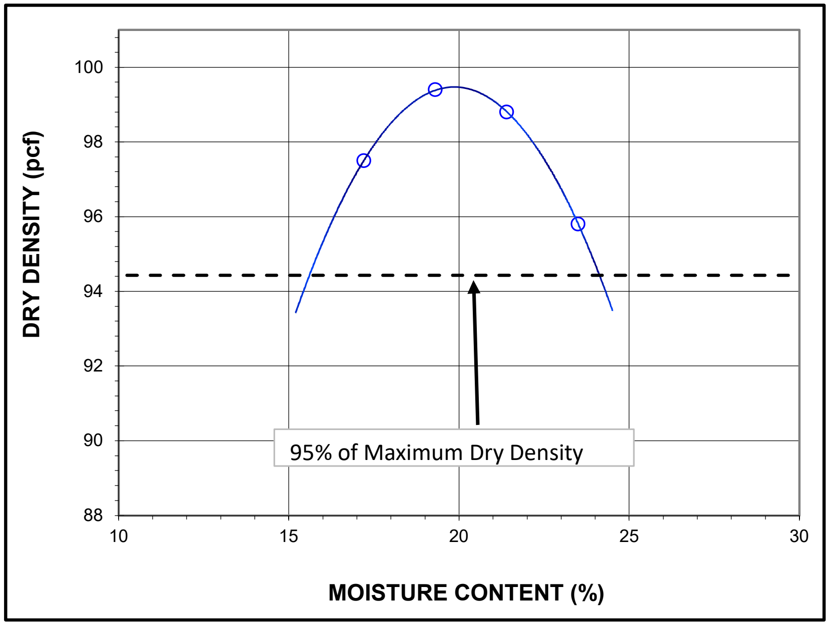
Client: Lennar
Project: Grace Gardens Units 1 and 2
Location: San Antonio ETJ, Bexar County, Texas
Project Number: 00230902952.01

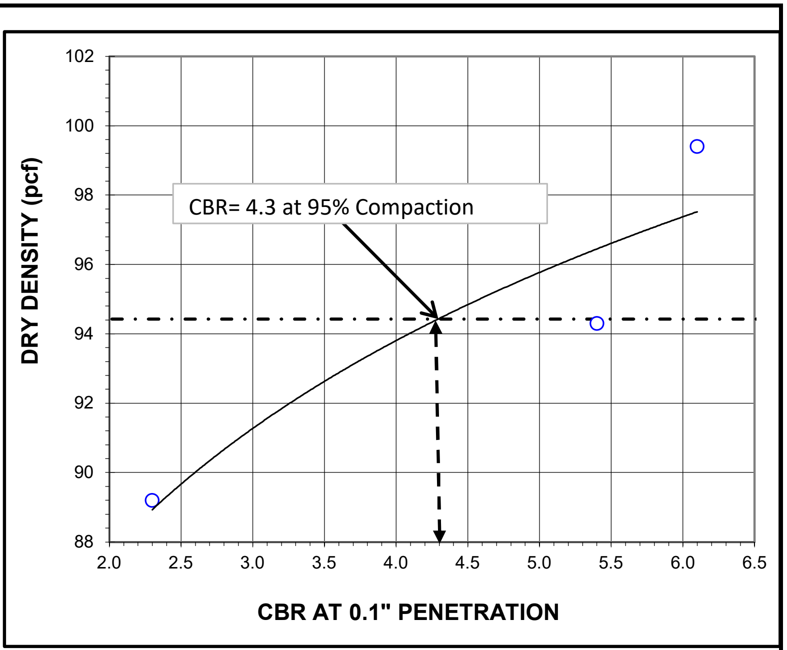
Boring	Depth	USCS	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Gravel	% Sand	Maximum Size (mm)	% Passing #200 % Silt % Clay (If hydrometer data available)	D50 (mm)
B-11	6.5 - 8	---	20	57	22	35	---	---	---	---	---
B-11	8.5 - 10	---	19	---	---	---	---	---	0.075	75.1	---
B-12	0.5 - 2	---	13	47	20	27	---	---	---	---	---
B-12	4.5 - 6	---	19	---	---	---	---	---	0.075	75.0	---
B-12	6.5 - 8	---	13	28	15	13	---	---	---	---	---
B-12	8.5 - 10	---	11	---	---	---	---	---	0.075	74.1	---
B-13	2.5 - 4	---	16	58	23	35	---	---	---	---	---
B-13	4.5 - 6	---	16	---	---	---	---	---	0.075	99.2	---
B-13	6.5 - 8	---	17	49	20	29	---	---	---	---	---
B-13	8.5 - 10	---	21	---	---	---	---	---	38.1	67.1	---
B-14	2.5 - 4	---	14	47	12	35	---	---	---	---	---
B-14	6.5 - 8	---	20	47	17	30	---	---	---	---	---
B-14	8.5 - 10	---	22	---	---	---	---	---	4.75	78.1	---
B-15	2.5 - 4	---	16	57	14	43	---	---	---	---	---
B-15	4.5 - 6	---	19	---	---	---	---	---	0.075	77.4	---
B-15	8.5 - 10	---	12	30	12	18	---	---	---	---	---

TTL

Summary of Laboratory Test Results

Client: Lennar
Project: Grace Gardens Units 1 and 2
Location: San Antonio ETJ, Bexar County, Texas
Project Number: 00230902952.01





CBR Sample Location: 29.336816°,-98.392106 °

Sample Depth: Between 0 and 5 feet below existing ground surface

Sample: **CBR Sample No. 1**

Proctor Test Method: Standard Proctor (ASTM D-698)

CBR Test Method: California Bearing Ratio (ASTM D-1883)

Material: DARK BROWN SANDY CLAY

Optimum Moisture Content: 20 %

Maximum Dry Unit Weight: 99.4 pcf

% Passing # 200 Sieve 68.5 %

Atterberg Limits: LL = 47 , PL = 19 , PI = 28

TTL

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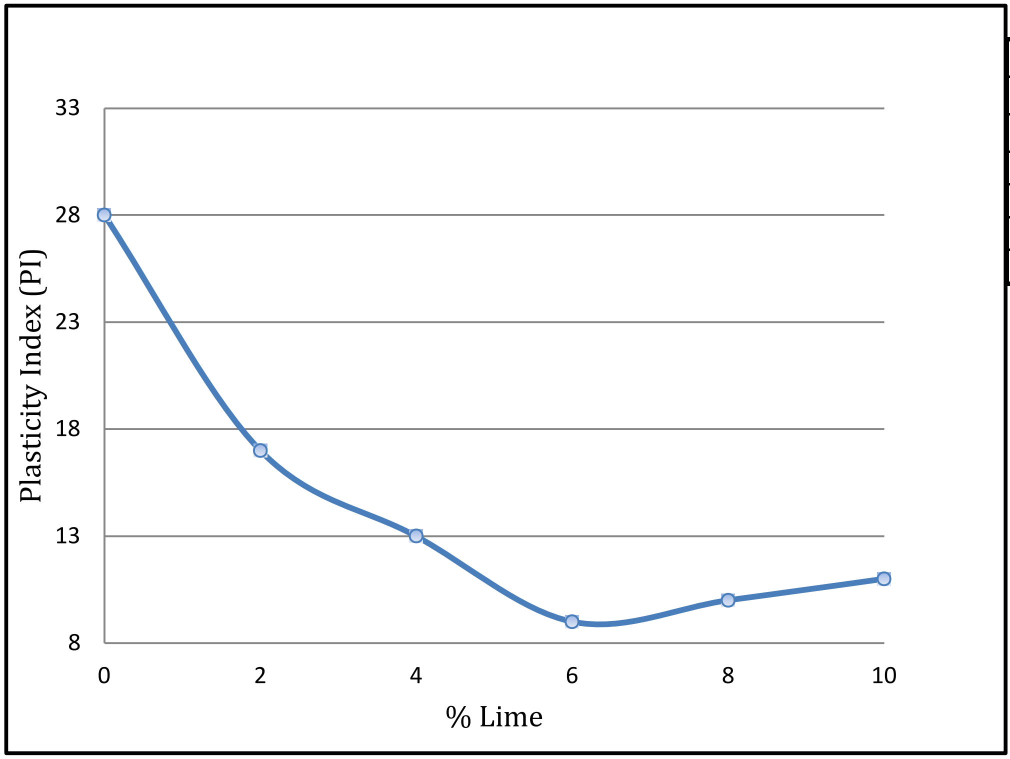
San Antonio, Texas 78247
T: 210-888-6100
WWW.TTLUSA.COM

GRACE GARDENS UNITS 1 AND 2 - LENNAR
SOUTH WW WHITE RD

SAN ANTONIO ETJ, BEXAR COUNTY, TEXAS

Drawn By: RD
Checked By: TA
Proj No:00230902952.01
File Name

CBR PLOT



% Lime	Plasticity	pH	LL	PL
0	28	8.50	47	19
2	17	11.73	45	28
4	13	12.15	45	32
6	9	12.39	45	36
8	10	12.44	45	35
10	11	12.51	45	34

Test Location:	**CBR Sample No. 1**
Material:	DARK BROWN SANDY CLAY
Test Method:	TxDOT Item 260, Lime Treatment
Test Method:	ASTM C 977, Appendix XI; pH:Lime Saturation Content
CBR Sample Location:	29.336816°,-98.392106 °

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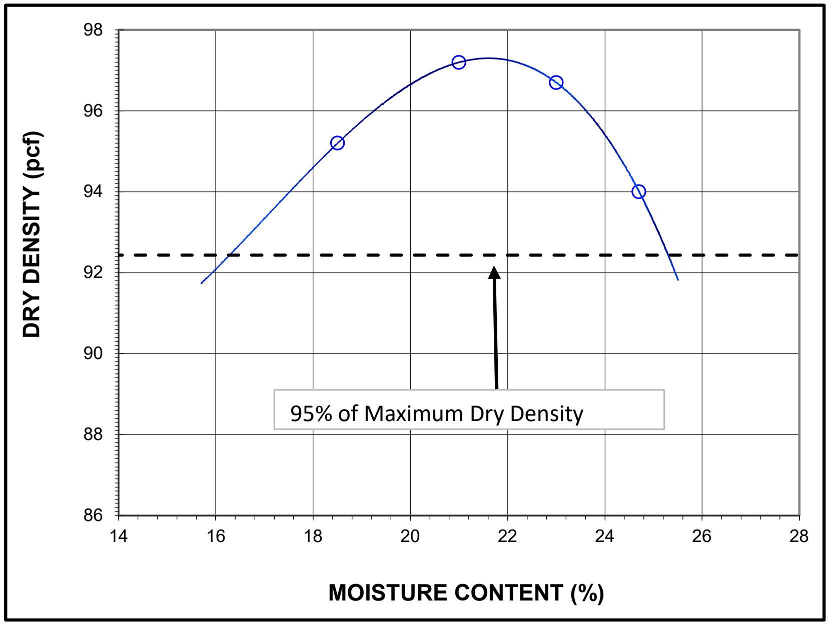
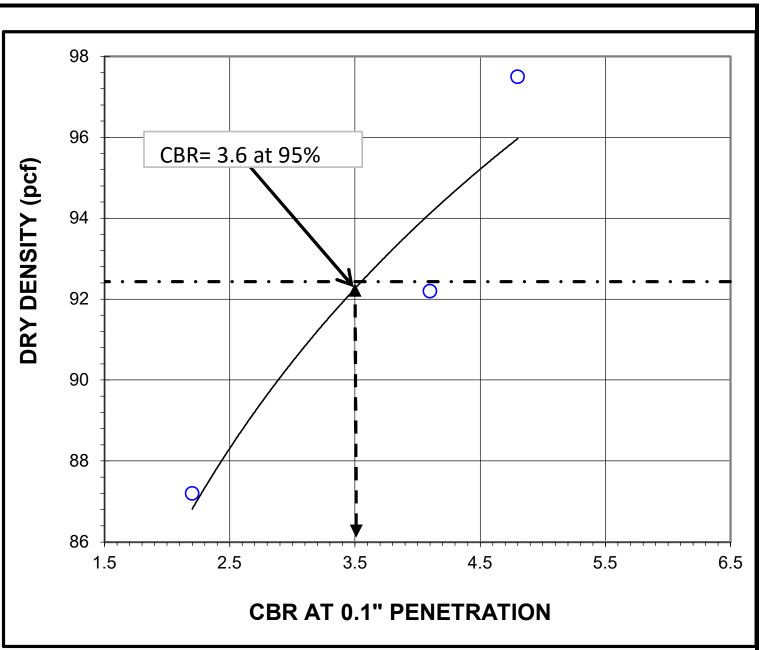
GRACE GARDENS UNITS 1 AND 2 - LENNAR
SOUTH WW WHITE RD

SAN ANTONIO ETJ, BEXAR COUNTY, TEXAS

Drawn By: RD
Checked By: TA
Proj No:00230902952.01
File Name

LIME SERIES





CBR Sample Location: 29.333787°,-98.387780 °
Sample Depth: Between 0 and 5 feet below existing ground surface
Optimum Moisture Content: 21.7 %
Maximum Dry Unit Weight: 97.3 pcf
% Passing # 200 Sieve 71.6 %
Atterberg Limits: LL = 49 ; PL = 20, PI = 29

Sample: **CBR Sample No. 2**
Proctor Test Method: Standard Proctor (ASTM D-698)
CBR Test Method: California Bearing Ratio (ASTM D-1883)
Material: DARK GRAY CLAY

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SAN ANTONIO ETJ, BEXAR COUNTY, TEXAS

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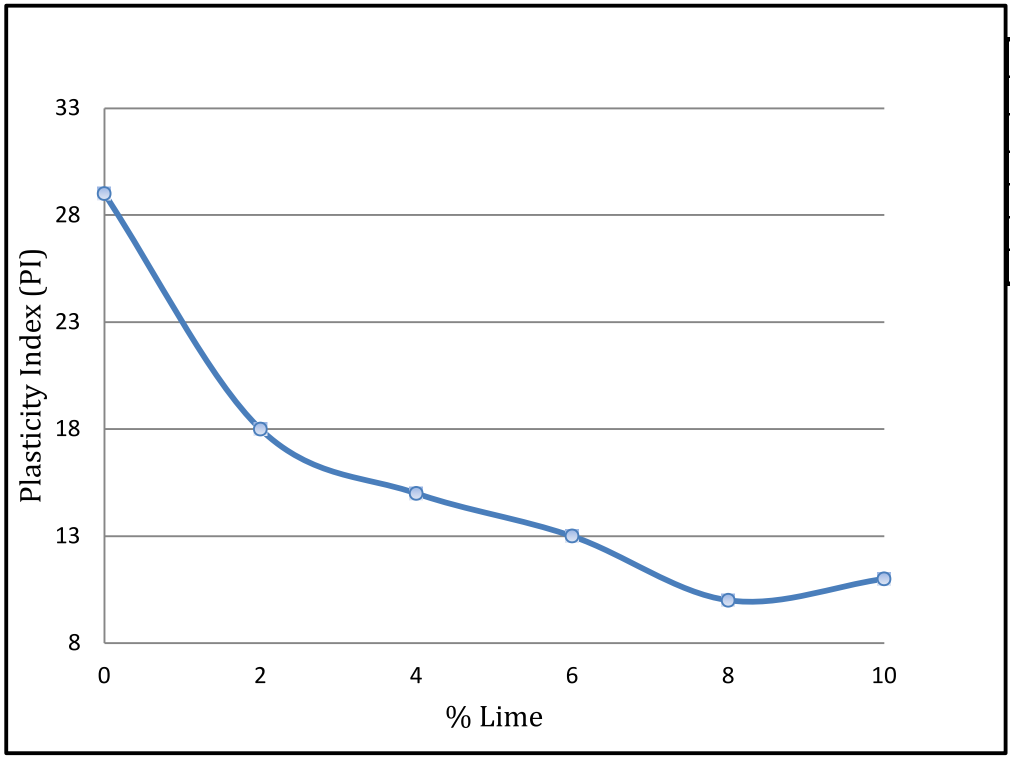
Checked By: TA
Proj No:00230902952.01
File Name

CBR PLOT



% Lime	Plasticity	pH	LL	PL
0	29	8.27	49	20
2	18	11.10	49	31
4	15	11.91	51	36
6	13	12.31	50	37
8	10	12.44	49	39
10	11	12.47	48	37

Test Location:	**CBR Sample No. 2**
Material:	DARK GRAY CLAY
Test Method:	TxDOT Item 260, Lime Treatment
Test Method:	ASTM C 977, Appendix XI; pH:Lime Saturation Content
CBR Sample Location:	29.333787°,-98.387780 °

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GRACE GARDENS UNITS 1 AND 2 - LENNAR
SOUTH WW WHITE RD

SAN ANTONIO ETJ, BEXAR COUNTY, TEXAS

Drawn By: RD
Checked By: TA
Proj No:00210900483.01
File Name

LIME SERIES

APPENDIX B
REFERENCE MATERIALS

EXPLORATION PROCEDURES

General

Various drill equipment and procedures are used to obtain soil or rock specimens during geotechnical engineering exploration activities. The drill equipment typically consists of fuel powered machinery that is mounted on a flat-bed truck or an all-terrain vehicle. The ground surface conditions at the site generally determine the type of vehicle to use.

Borings can be drilled either dry or wet. The drilling technique depends on the type of subsurface materials (clays, sands, silts, gravels, rock) encountered and whether or not subsurface water is present during the drilling operations. Sometimes a combination of both techniques is implemented.

The dry method can generally be employed when subsurface water or granular soils are not present. The dry method generally consists of advancing the augers without the use of water or drilling fluids. Air can be employed as necessary to remove cuttings from the borehole or cool the drilling bits during some drilling applications. The wet rotary process is generally used when subsurface water, rock or granular soils are present. The wet rotary process utilizes water or drilling fluids to advance the augers, remove cuttings from the borehole, and cool the drilling bits during drilling.

Sampling

Various sampling devices are available to recover soil or rock specimens during the geotechnical exploration program. The type of sampling apparatus to employ depends on the subsurface materials (clays, sands, silts, gravels, rock) encountered and on their consistency or strength. Most commonly used samplers are Shelby tubes, split-spoons or split-barrels, and NX core barrels. Depending on the subsurface conditions, sampling apparatus such as the Pitcher barrel, Osterberg sampler, Dennison barrel, or California sampler are sometimes used. The procedures for using and sampling subsurface materials with most of these samplers are described in detail by the American Society for Testing and Materials (ASTM). Sampling is generally performed on a two (2) foot continuous interval to a depth of about ten (10) feet, followed by five (5) foot intervals between the depths of about ten (10) to 50 feet, and on ten (10) foot intervals thereafter to the termination depth of the borings. However, sampling intervals may change depending on the project scope and actual subsurface conditions encountered.

If cohesive soils (clays and some silts) are present during drilling, samples are retrieved by using the Shelby tube sampler (ASTM D 1587) orthe split-barrel sampler (ASTM D 1586). The Shelby tube is used to recover "virtually" undisturbed soil specimens that can be returned to the laboratory for strength and compressibility testing. The Shelby tube is a three (3) inch nominal diameter, thin-walled tube that is advanced hydraulically into the soil by a single stroke of the drill equipment.

The split-barrel sampler is used when performing the Standard Penetration Test (SPT). There covered sample is considered to be a “disturbed” specimen due to the SPT procedure. The split-barrel is advanced into the soil by driving the sampler with blows from a 140-pound hammer free falling 30 inches. The SPT procedure is performed to evaluate the strength or competency of the material being sampled. This evaluation is based on the material sampled, depth of the sample, and the number of blows required to obtain full penetration of the split-barrel sampler. This blow count or penetration resistance is referred to as the “N” value.

The split-barrel is typically used when cohesionless soils (sands, silts, gravels) are encountered or when good quality cohesive soils cannot be recovered with the Shelby tube sampler. The SPT procedure can be employed when rock or cemented zones are encountered. However, the split-barrel may not penetrate the rock or cemented zone if the layer is extremely hard, thus resulting in no sample recovery.

When rock or cemented zones are present, and depending on the type of project and engineering testing required, rock coring may be implemented to recover specimens of the particular layer. Typically, an NX double tube core barrel (ASTM D 2113) is used.

Logging

During the drilling activities, one of our geologists or engineering technicians is present to make sure that the appropriate sampling techniques are employed and to extrude or remove all materials from the samplers. The samples are then visually classified by our field representative who records the information on a field boring log. Our field representative may perform pocket penetrometer, hand torvane, or field vane tests on the subsurface materials recovered from the Shelby tube samplers. If the SPT procedure is employed, our field representative will record the N values or blow counts that are germane to that particular field test. If rock coring is utilized, our field representative will calculate the percent recovery and Rock Quality Designation (RQD). The test data for all the field tests will be noted on the appropriate field boring log. Upon completion of the logging activities and field testing of the recovered soil or rock samples, representative portions of the specimens were placed in appropriately wrapped and sealed containers to preserve their natural moisture condition and to minimize disturbance during handling and transporting to our laboratory for additional testing.

When subsurface water is observed during the drilling and sampling operations, drilling will be temporarily delayed so the subsurface water level can be monitored for a period of at least 15 to 30 minutes. Depending on the rise of the subsurface water in the borehole and project requirements, subsurface water measurements may be monitored for periods of 24 hours or more. Generally, observation wells or piezometers are installed in the completed boreholes to monitor subsurface water levels for periods longer than 24 hours.

Following completion of drilling, sampling, and subsurface water monitoring, all boreholes are backfilled with soil cuttings from the completed borings unless the client requests or local ordinance requires special backfilling requirements. If there are not enough soil cuttings available, clean sand will be used to backfill the completed boreholes.

Details concerning the subsurface conditions are provided on each individual boring log presented in Appendix A. The terms and symbols used on each boring log are defined in the Legend Sheet which is also presented in Appendix A.

LABORATORY TESTING PROCEDURES

Classification and Index Testing

The recovered soil samples were classified in the laboratory by a geoprofessional using the USCS as a guide. Samples were tested for the following properties in general accordance with the applicable ASTM standards:

- Moisture content (ASTM D2216),
- Atterberg Limits (ASTM D4318),
- Percent material passing the No. 200 sieve (ASTM D1140),
- Grain Size Analysis (ASTM D6913 or D1140), and
- California Bearing Ratio test (ASTM D1883). With lime series (Tex-121-E) and pH
- Soluble Sulfates (ASTM C1580).

Results of tests for moisture content, Atterberg Limits, and percent material passing the No. 200 sieve are presented on individual boring logs in Appendix A. The results are also tabulated on the Summary of Laboratory Test Results sheet in Appendix A.