

Final Geotechnical Report



**John Hayes Street/Berryville Road Extension
El Paso, El Paso County, Texas**

Project # 2037192009

Prepared for:

CEA Group, Inc.

Engineers · Architects · Planners

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April 5, 2021



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Attn.: Mr. Ruben Chavez, P.E.

**RE: Final Geotechnical Study
John Hayes Street/Berryville Road Widening
El Paso County, Texas**

Dear Mr. Chavez:

Wood Environment & Infrastructure Solutions, Inc. (Wood) submits this Geotechnical Report for the John Hayes Street/Berryville Road Widening in east El Paso, Texas. The report includes identified soil and geological conditions along the alignment and presents pavement design sections for the project.

We truly appreciate being part of the CEA Group team for this project and look forward to assisting CEA Group on this and future projects. Should any questions arise concerning this report, we would be pleased to discuss them with you.

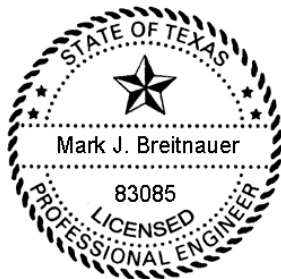
Respectfully submitted,

Wood Environment & Infrastructure Solutions, Inc.

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1.0 INTRODUCTION

This report is submitted pursuant to a geotechnical study completed by Wood Environment & Infrastructure Solutions, Inc. (Wood) for the proposed John Hayes Street/Berryville Road Widening project planned for construction in east El Paso, Texas. The objective of this study was to evaluate the physical properties of the soils underlying the site to provide recommendations for pavement design and related earthwork.

2.0 PROPOSED CONSTRUCTION

It is our understanding that the project will consist of the redevelopment and widening of John Hayes Street (Berryville Road) from Montwood Drive to Pellicano Drive in east El Paso, Texas. The proposed 3.0-mile alignment will consist of a roadway extension of John Hayes Street, creating a 6-lane divided facility, hike and bike trail, illumination, safety appurtenances, drainage, and landscaping.

Traffic along the proposed roadway is anticipated to be primarily automobiles with some commercial traffic. Although no traffic volume data is available at this time, we understand that the street will be classified as an arterial roadway.

The proposed construction will also include drainage improvements, including the construction of three ponding areas. At the time of this report, the proposed ponding area locations have not been defined and therefore no evaluation has been conducted.

Earthwork requirements for the roadway are anticipated to consist of minor cuts and some fill placement, especially along the undeveloped section of the roadway. In addition, improvements along the existing John Hayes Street (Berryville Street) are anticipated to be constructed near or at existing grades.

3.0 SOIL STUDY

3.1 SUBSURFACE EXPLORATION

A total of eleven (11) test borings were drilled along the project alignment to a depth of 15 feet below existing grades. The scope of work was reduced by one boring location in order to place asphalt cores to determine the existing pavement thickness.

The test borings were completed using a CME 75 truck-mounted drill rig equipped with 3¼ inch I.D. hollow stem augers. Standard penetration testing using an automatic hammer was performed at 2.5-foot intervals in the top 10 feet and at 5-foot intervals after 10 feet to the boring depth of 15 feet. During the field study, the soils encountered were examined, visually classified, and logged. Results of the field study are presented in **Appendix A**, which includes a brief description of drilling and sampling equipment and procedures, site plans showing the boring locations, and logs of the test borings.

The boring logs and related information included in this report are indicators of subsurface conditions only at the specific locations and times noted. Subsurface conditions, including groundwater levels at other locations of the subject sites, may differ from conditions that were encountered at the locations sampled.

3.2 GEOTECHNICAL LABORATORY TESTING

To aid in soil classification and evaluation of the engineering properties of the soils, laboratory testing of selected samples was performed. Tests included moisture content (ASTM D 2216), particle size distribution (ASTM D 6913), Atterberg limits (ASTM D 4318), moisture-density relationships (ASTM D 1557) and CBR tests (ASTM D 1883). The results of the moisture testing are shown on the boring logs presented in **Appendix A**. Remaining laboratory test results are presented in **Appendix B**.

The soils encountered during the field study were classified in general accordance with the Unified Soil Classification System. The soil classification symbols appear on the boring logs and are briefly described in **Appendix A**.

4.0 SITE CONDITIONS, GEOLOGY AND GEOTECHNICAL PROFILE

4.1 SITE CONDITIONS

John Hayes Street (Berryville Road) from Montwood Drive to about 0.5 miles south of Montwood Drive consists of a narrow, paved roadway that terminates at an existing private road. The roadway consists of an asphalt paved roadway constructed with a slight crown and gravel shoulders. The roadway is currently in poor to fair condition with potholes, alligator, transverse and longitudinal cracking, and rutting along the wheel paths. The majority of the distress conditions appears to be due to poor drainage conditions and thin pavement section.

From the private road heading south to Pellicano Drive, the roadway transitions to a one-lane dirt road. We understand that two underground pipelines cross the roadway right-of-way near borings B-9 and B-10.

4.2 SITE GEOLOGY

Soils noted in the field include windblown sands overlying calcium carbonate indurated silts, clays, and sands (caliche). Silty sands, sands, and some gravels occur at depth in the basin filling Quaternary sediments beneath the site. Quaternary/Late Tertiary basin filling materials (clay, sand, silt, gravel) underlie the site to depths of several hundred feet or more.

4.3 GEOTECHNICAL PROFILE

The general subsurface conditions encountered during the field exploration conducted on February 27, 2020, are shown on the soil boring logs, which are included hereafter. The lines of stratification shown on the logs are based upon examination of the recovered soil samples and interpretation of the field boring logs and represent the approximate boundaries between the soil types; the actual transitions may be gradual.

Soils encountered along the project alignment generally consist of silty and poorly graded sand with silt with interbedded clayey sand and clay layers. A slight to moderate calcareous cementation is also present within the soil profile. Based on standard penetration tests, the silty and poorly graded sands are generally loose to dense with occasional very loose zones. The clayey sand layers were generally observed at varying depths along the alignment including 2.5, 5, and 10 feet. Laboratory testing indicates liquid limits varying from 21 to 35 with corresponding plasticity indices ranging from 3 to 15 for the clayey soils.

Although not encountered at any of the boring locations, it is recommended that earthwork activities be monitored for the presence of construction debris and other deleterious materials that may be present. If encountered, these materials should be excavated and removed in their entirety and replaced with structural fill placed in compacted lifts to final grade.

The soil classification symbols shown above and elsewhere herein are derived from ASTM D2487, *Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)* and D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. The descriptives for relative density and firmness are based on grain size and standard penetration tests as detailed in "Terminology Used to Describe the Relative Density, Consistency or Firmness of Soil" in **Appendix A** of this report.

4.4 SOIL MOISTURE AND GROUNDWATER CONDITIONS

At the time of our field studies, no free groundwater was encountered in any of the test borings within the depths explored. Soil moisture contents of the soil were observed to be dry to moist, varying from 1.5 to 15.1 percent. Higher moisture contents were generally observed within the clay soils.

5.0 DISCUSSION & RECOMMENDATIONS

5.1 SUBGRADE PROPERTIES

The upper soils encountered along the project alignment generally consist of silty and poorly graded sand with silt. Wood obtained four bulk samples along the project alignment for California Bearing Ratio (CBR) tests. A summary of the test results is presented in the table below.

Sample Location	Standard Proctor Value (pcf)	Optimum Moisture Content (%)	CBR Value
CBR-1 / B-11	107.6	12.4	9.9
CBR-2 / B-8	113.3	8.4	11.9
CBR-3 / B-5	110.6	11.7	13.0
CBR-4 / B-2	114.8	10.1	18.3

5.2 FLEXIBLE PAVEMENT – JOHN HAYES STREET

We understand that the proposed roadway will be classified as an arterial roadway. Based on the City of El Paso Subdivision Improvement Design Standards, for this classification, average daily traffic of 26,000 vehicles and total ESALs of 3,100,000 is anticipated.

We understand that John Hayes Drive is classified as an arterial roadway and will be subjected to heavy truck traffic during its design life. Traffic data was provided to Wood for a 20-year design period from 2025 through 2045. According to the traffic information provided to Wood, average daily traffic of 7900 vehicles, 2.2 percent trucks, and an ESAL of 3,100,000 is anticipated for the design period.

The pavement design software FPS-21 provides a variety of possible pavement sections that are available for the traffic data specified. Wood analyzed two typical pavement sections that appear to be the most appropriate

considering the traffic conditions expected for John Hayes. For each case provided below, a minimum of 8-inches of prepared subgrade will be required.

Pavement Section 1

Layer	Option 1
Asphalt: Type D, Item 341, PG 64-22	1.5 inches
Asphalt: Type C, Item 341, PG 64-22	4 inches
Aggregate Base Course: Item 247, Type A, Grade 1 or 2	6 inches
Compacted Subgrade	8 inches

Pavement Section 2

Layer	Option 1
Asphalt: Type D, Item 341, PG 64-22	1.5 inches
Asphalt: Type C, Item 341, PG 64-22	4 inches
Cement Treated Base, Item 275, Class L (300 psi compressive strength)	6 inches
Compacted Subgrade	8 inches

Recommendations for a pavement section with a cement-treated base course are provided above as an alternative pavement section. Placement of the cement-treated base (CTB) course requires construction oversight to minimize the potential for construction difficulties. Wood recommends that the contractor develop a CTB placement plan that includes procedures to ensure uniform application of cement during dry placement to meet the required percentages and to ensure proper compaction is achieved within 2 hours following the addition of moisture. Lift thickness and length of placement are also critical items that should be included in any plan.

Prior to the construction of the pavement section, the recommended subgrade preparation in cut areas and prior to the placement of any fill consists of scarifying the native soils to a depth of 8 inches. The scarified soils should then be moisture conditioned as needed to within plus or minus 3 percent of the optimum moisture content and compacted. Structural fill should then be placed, as required, in compacted lifts to final grade. Compaction of the soil should be accomplished by mechanical means to obtain a minimum density of 95 percent of maximum dry density. Optimum moisture content and maximum dry density should be determined in accordance with ASTM D 1557. Structural fill should be non-expansive and meet the gradation requirements presented in this report. Based on the soil types encountered along the project alignment, a shrinkage factor of 20 percent is generally anticipated.

Additional processing and careful moisture control may be required in order to achieve compaction and calcareous indurated soils. Subgrade soils and structural fill should be tested for compaction verification at the required frequencies along the project alignment. Those areas not meeting the minimum compaction requirements should be reworked and recompacted as required in the project specifications. In addition, any weak or compressible soil zones identified during earthwork activities should be removed and replaced with structural fill placed in compacted lifts.

It is critical during construction that the project area be shaped to provide drainage of surface water in order to avoid the ponding of water. Collected surface water should be pumped immediately from the construction area after each rain and a firm subgrade maintained. The moisture content and density within the completed subgrade must be maintained until construction is complete.

Adequate drainage is critical to the satisfactory performance of pavement areas. It is recommended that the pavement be constructed to allow rapid drainage of surface runoff away from the soil directly underlying the pavement section. In addition, in order to minimize surface water infiltration through the pavement surface, and thereby minimizing the potential for water infiltration into the subgrade, all cracks and joints in the pavement should be sealed on a routine basis after construction.

5.3 RIGID PAVEMENT

As an option, a rigid pavement section may be considered for the project based on the traffic volumes anticipated. At a minimum, a rigid pavement section is recommended at major intersections along the project alignment due to anticipated stop/start and turning actions from truck traffic.

The recommended subgrade preparation consists of scarifying the native soils to a depth of 8 inches. The scarified soils should then be moisture conditioned as needed to within plus or minus 3 percent of the optimum moisture content and compacted. Structural fill should then be placed, as needed, in compacted lifts to final grade. Compaction of the soil should be accomplished by mechanical means to obtain a density of not less than 95 percent of maximum dry density. Optimum moisture content and maximum dry density should be determined in accordance with ASTM D 1557.

The concrete to be used in construction was assumed to have an elastic modulus of 3.8×10^6 psi and a mean modulus of rupture of 650 psi. This would generally correspond to a 28-day cylinder strength of 4,400 psi as determined in accordance with ASTM C 39. A working stress of 60,000 psi (corresponding to Grade 60) was assumed for the reinforcing steel.

The concrete pavement should be continuously reinforced using a minimum #6 reinforcing bar in the longitudinal direction and #5 reinforcing bars in the transverse direction. Spacing for longitudinal and transverse reinforcement is presented in the tables below to meet the minimum Texas Department of Transportation Standards.

Longitudinal Reinforcing Steel Spacing		
Spacing (in)	First Spacing at Edge or Joint (in)	Additional Steel Bars at Transverse Construction Joint (in)
8	3 to 4	16

Transverse Reinforcing Steel Spacing		
Spacing (in)	Tie Bars at Longitudinal Contraction Joint (in)	Tie Bars at Longitudinal Construction Joint (in)
48	48	24

All materials and methodologies used in construction should conform with guidelines presented in "Item 360-Concrete Pavement" section of the current edition of the Texas Department for Construction of Highways, Streets and Bridges.

Recommendations for a rigid pavement section are based on the anticipated traffic volumes, a design period of 30 years, the above design parameters, and guidelines provided by AASHTO (1993) and are presented in the table below.

Material	Minimum Thickness (in)
Continuously Reinforced Portland Cement Concrete Pavement, TxDOT Item 360	8
Bond Breaker Layer, HMAC, TxDOT Item 341 Type D	2
Aggregate Base Course, Item 247, Type A, Grade 1 or 2 of Item 247	6
Compacted Subgrade	8

Adequate drainage is critical to the satisfactory performance of pavement areas. It is recommended that the pavement be constructed to allow rapid drainage of surface runoff away from the soil directly underlying the pavement section. In addition, in order to minimize surface water infiltration through the pavement surface, and thereby minimizing the potential for water infiltration into the subgrade, all cracks and joints in the pavement should be sealed on a routine basis after construction.

5.4 ASPHALT PAVEMENT THICKNESS EVALUATION – JOHN HAYES STREET

Two core specimens were obtained along the paved section of John Hayes to evaluate the pavement thickness. A summary of the asphalt and base course thicknesses measured at the two locations is presented in the table below.

Approximate Asphalt Thickness Measurements

Approximate Location	Approximate Asphalt Thickness (inches)	Base Course Thickness (inches)	Subgrade Material
C1	2.25	8	Brown fine SAND, little silt, nonplastic fines, damp.
C2	2.25	0	Brown fine SAND, little silt, nonplastic fines, damp.

Based on measured pavement thickness, it is our opinion that the existing pavement section will not support the anticipated increased traffic conditions projected for the project.

5.5 LIFE CYCLE ANALYSIS

Several options were reviewed for the reconstruction of the pavement sections along the project alignment. Both flexible and rigid pavement options were considered during this evaluation.

Flexible Pavement Options

A series of different base types were considered in developing the pavement sections. The pavement section based on a granular base is as follows:

Asphalt: Type D, Item 341, PG 64-22 - 1.5 inches
Asphalt: Type C, Item 341, PG 64-22 - 4.0 inches
Aggregate Base Course: Item 247, Type A, Grade 1 or 2 – 6.0 inches
Compacted Subgrade – 8 inches

The pavement section based on a cement-treated base (CTB) is as follows:

Asphalt: Type D, Item 341, PG 64-22 – 1.5 inches
Asphalt: Type C, Item 341, PG 64-22 - 4.0 inches
Cement Treated Base, Item 275, Class L (300 psi compressive strength) – 6 inches
Compacted Subgrade – 8 inches

Inputs

Table 1 provides the construction costs of placing each of the materials for each of the options identified. Based on these costs, the HMA on aggregate base course and CRCP with a modulus of rupture of 650 psi on the aggregate base course was used for comparison in the life-cycle cost analysis. These two sections were the cheapest to construct for the respective surface types. This approach simplifies the analysis and review but still allows for a direct comparison of costs given the different design lives. The full list of inputs for the analysis is provided in **Appendix A**. The inputs include inputs for user costs, but these values have largely been ignored in the analysis of the results as these inputs are uncertain at best.

6.0 ILLUMINATION STRUCTURES - DEEP FOUNDATION SYSTEM

Recommendations for foundation support for proposed illumination structures are presented below.

Straight, drilled, cast-in-place concrete piers may be used to support the proposed light structures. The pier foundation should be founded at a minimum depth of 8 feet below existing grade using an allowable end bearing capacity of 6,000 pounds per square foot. An allowable skin friction component of 500 pounds per square foot of pier shaft area may be used for that portion of the pier extending below a depth of 5 feet. The minimum shaft diameter of piers is 18-inches. The safe upward capacity of the piers can be considered as being 80 percent of the safe downward capacity.

The allowable capacities apply to full dead plus realistic live loads. Capacities apply to the allowable soil supporting capacity and do not consider the structural strength of the piers. Pier capacities were developed using a safety factor of 2.5.

6.1 LATERAL LOADS

Piers can be drilled vertically and designed to resist lateral loads. For lateral load and overturning design, a passive soil pressure of 500 pounds per square foot per foot of depth may be used below a depth of 1 foot. For calculation of lateral deflection, a coefficient of lateral subgrade reaction (K_n) of 90 pounds per cubic inch may be used for the analysis below a depth of 1 foot.

Lateral load design parameters are valid within the elastic range of the soil. The passive pressure and coefficient of subgrade reaction are ultimate values; therefore, appropriate factors of safety should be applied in the shaft design.

Based on Brom's method of analysis, a maximum allowable working load of 3,000 pounds may be used for a single pier for less than 0.5 inches of lateral deflection at the ground surface. The working load is based on a safety factor of 2.5. If additional support is required, a concrete collar may be installed.

6.2 ESTIMATED FOUNDATION MOVEMENTS

Upward and downward movements of a drilled pier foundation system are expected to be less than about $\frac{3}{4}$ of an inch. Movement at the ground surface of drilled piers subject to lateral loads is estimated not to exceed 0.5 inches below a depth of 5 feet.

6.3 CONSTRUCTION CONSIDERATIONS

6.3.1 GEOTECHNICAL CONDITIONS

Drilling conditions for pier installation are not anticipated to be difficult. Some caving and sloughing of the pier excavation, especially within the sand stratum, may be encountered. Alternate methods may be required such as temporary casing or drilling with mud should caving and sloughing become excessive.

6.3.2 POSITIONAL TOLERANCES

Drilled piers should be installed so that the centerline of the top of the pier is within 3 inches of the plan location. A vertical pier with a diameter of 3 feet or more should not deviate from plumb more than 2 percent of the pier length or as determined by the structural engineer based on the structural properties of the shaft and lateral restraint properties of the soils penetrated.

6.3.3 CLEANING OF PIER EXCAVATIONS

After the shaft has been advanced to its planned depth, the bottom of the excavation should be cleaned of slough and loose material in a manner acceptable to the geotechnical engineer. The cleaning should ultimately result in the bottom of the excavation having an average of no more than 4 inches of disturbed material prior to placement of concrete.

Various techniques may be used at the contractor's option to accomplish the cleaning. Options include vacuum cleaning or careful machine-cleaning with rig-mounted tools. If rig-mounted tools are used, they should be approved by the geotechnical engineer.

6.3.4 PLACEMENT OF CONCRETE

Before any concrete is placed, the pier hole should be inspected by a representative of the geotechnical engineer. The drilled hole should be dry, free of loose or softened soil, and should be cleaned at its base. If the base of the hole is wet, a layer of dry concrete should first be placed and well compacted. The geotechnical engineering should be notified if excessive moisture is encountered or the presence of groundwater in the excavations.

Concrete should be placed in one continuous operation through a hopper, tremmie, drop chute, or other device approved by the geotechnical engineer so that it is channeled in such a manner to free fall and clear the walls of the excavation and reinforcing steel until it strikes the bottom. Adequate compaction will be achieved by free fall of the concrete up to the top 5 feet. The top 5 feet should be vibrated to achieve proper compaction. Concrete should

be placed at a slump of between 5 and 7 inches and should be designed to achieve the required compressive strength at that slump.

6.3.5 CONSTRUCTION QUALITY ASSURANCE

Continuous observations of the construction of the drilled pier foundations should be performed by a qualified engineering technician working under the direction of a geotechnical engineer. The technician should verify the proper diameter of the shaft, depth, cleaning, and also confirm the nature of materials encountered in the pier excavation. Concrete placement should be continuously observed to ensure that it meets requirements. A quality assurance report should be submitted on the pier stating all details have been observed and affirming that the pier meets construction requirements.

7.0 LATERAL LOADS – RETAINING WALLS

The pressure exerted on the walls will depend on their degree of restraint. Rigid, restrained walls with horizontal backfill meeting structural fill requirements as presented in **Appendix C** of the geotechnical report should be designed using an "at rest" equivalent fluid pressure of 60 pounds per cubic foot (pcf). Walls allowed to rotate about their bases a distance of 0.001 times their height or more, at the top, should be designed using an "active" equivalent fluid pressure of 40 pcf.

The passive soil resistance against the edges of footings, stem walls, etc. with properly compacted backfill, should be considered as being equal to forces exerted by a fluid of 350 pounds per cubic foot unit weight. A coefficient of friction of 0.35 is recommended for computing lateral resistance between the bases of the footings and the soil in analyzing lateral loads.

Based on the soil conditions encountered, recommended design parameters include an internal friction angle of 32 degrees and a bulk soil unit weight of 115 pounds per cubic foot.

The equivalent fluid pressures do not include any lateral component due to either hydrostatic or surcharge loads. The retaining walls at this site should be designed with a drainage system to prevent the build-up of hydrostatic forces behind the wall. If a drain system is not provided, then an additional 62.4 pcf must be added to the lateral forces acting on the wall. Special care should be taken not to over compact the backfill material to reduce the potential for the build-up of residual compaction pressures against the retaining walls.

The equivalent fluid pressures provided above do not include a factor of safety, however, we recommend that a minimum factor of safety of 1.5 be used for the design of retaining walls. Surcharge loads, such as vehicular wheel loads, to the area adjacent to the retaining wall, can add additional horizontal components of lateral earth pressures to this wall. The magnitude of these components will depend on the loads and locations of these loads relative to the retaining wall.

8.0 STORM SEWER PIPE

8.1 FOUNDATIONS

Based on the results of the subsurface exploration, the soils underlying the project site will provide reliable support for foundation elements related to the proposed storm sewer installation following some minor soil improvements. Pipeline anchor blocks and inlet structures can be supported on spread footings, bearing on improved native soils,

provided guidelines concerning site preparation, pipeline installation, and backfill requirements presented in this report are followed.

As discussed previously, earthwork operations should be monitored for the presence of construction debris and other deleterious materials. If encountered, these materials should be removed and replaced with structural fill placed in compacted lifts.

It is recommended the existing soils below all foundations be scarified to a depth of 8 inches, brought to within plus or minus 3 percent of optimum moisture content, and compacted. Compaction of the soil should be accomplished by mechanical means to obtain a density of not less than 95 percent of maximum dry density. Optimum moisture content and maximum dry density should be determined in accordance with ASTM D 1557.

A net allowable soil bearing pressure of 2,000 pounds per square foot may be used for the design of foundations bearing on improved native soils.

It is estimated that vertical movements of footings designed as recommended above will not exceed $\frac{3}{4}$ of an inch for moisture contents of the native soils encountered during test drilling or compaction moisture contents introduced during construction. Differential movements are expected to be less than 75 percent of the total movement. Significant moisture increases above these values in the soils could result in additional movements.

8.2 PIPE INSTALLATION

The soils encountered along the proposed alignment should provide adequate support for the pipe. Differential settlement in the pipe should not exceed $\frac{1}{2}$ inch for 20-foot pipe sections if the recommended site preparation and backfill requirements outlined are followed. Settlement of the pipe will primarily result from elastic movement of the soil mass during backfill and compaction operations.

Pipes should be installed using typical industry standards. Bedding materials should surround the pipe for support. The pipe and backfill should be designed utilizing a bedding condition in which fill is shaped to fit the pipe. A minimum of 12 inches of granular bedding material should be placed and compacted along the top and sides of the pipe. A minimum of 6 inches of bedding material should also be placed beneath the pipe. The granular bedding material should be compacted to achieve a density of not less than 90 percent of the maximum dry density as determined by ASTM D 1557. Granular bedding should satisfy the requirements provided in **Appendix C**, Section 5.B. (2).

8.3 TRENCH BACKFILL

Trench backfill should consist of native or imported soil free from debris or deleterious materials. The backfill should be nonplastic and should satisfy the requirements for trench backfill provided in **Appendix C**, Section 5.B.(3). It is anticipated that most of the soils encountered along the alignment will satisfy the requirements for backfill. However, the occasional interbedded clay soils encountered along the project alignment should not be used as a backfill material.

Backfill should be placed in trenches and compacted in lifts no greater than 8 inches in compacted thickness. Backfill in areas greater than 10 feet from existing or proposed paved streets or structures (nonstructural areas) should be compacted to a density of not less than 85 percent from the top of pipe bedding to the ground surface. Backfill in areas less than 10 feet from existing or proposed paved streets or structures (structural areas) should be compacted

to a density of not less than 90 percent from the top of pipe bedding to 3 feet below finished grade. The upper three feet of backfill should be compacted to a density of not less than 95 percent. Final dimensions may be adjusted due to pavement thickness and should be verified in the field.

The moisture content at the time of compaction should be within 3 percent of optimum moisture content. Optimum moisture content and dry density for each soil type used should be determined in accordance with ASTM D 1557.

8.4 EXCAVATION CONDITIONS

Based on the results of the field study, excavations along the project alignment are not anticipated to be difficult using conventional earthwork equipment. However, earthwork contractors should verify the suitability of their equipment for use for the varied soil types and conditions observed along the project alignment.

Based upon the results of our study, the soils encountered along the majority of the alignment classify as OSHA Type C soils and side slopes of the trench excavations should be no steeper than 1.5 to 1 (horizontal to vertical). Should the excavations remain open for periods longer than 72 hours, maximum slopes should not exceed 2H:1V, and the proper use of barricades and fencing will be required. Shoring or other bracing methods may be used for excavations up to 20 feet deep. Trench excavations greater than 20 feet in depth will require a special design or approval from a registered engineer.

Based on the soil conditions encountered along the pipe alignment, some caving and sloughing are anticipated during excavations. These conditions can reduce the overall stability of the excavations leading to a slope failure. The contractor should be prepared to bench excavations beyond the 1.5:1 slope or provide alternate methods of soil support such as trench shields or shoring systems should unstable conditions exist.

It is anticipated that a shoring system will be required at several areas of the proposed alignment due to the limited space available. Although trench shields will probably be the preferred method of trench stabilization, sheet piles or other methods (such as pneumatic or hydraulic systems) approved by the geotechnical engineer could be used. All shoring, including trench shields, should be designed using lateral loads described in Section 8.0.

It is recommended that a representative of the geotechnical engineer periodically observe temporary cut slopes at the time of excavation to assess their stability. All excavations should be provided with berms or other installations to prevent surface runoff from entering the excavation or impacting the excavation slopes. Construction equipment and materials, including soil stockpiles, should not be placed within 5 feet or $\frac{1}{2}$ of the total excavation depth, whichever is greater, from the crest of open excavations. The exception to this recommendation is the presence of small soil berms constructed for temporary drainage purposes.

The above recommendations for temporary excavation slopes are based on geotechnical considerations only. These recommendations do not consider requirements that might be imposed by OSHA, the State of Texas, or other governmental agencies. For all open excavations and trenches, OSHA and other governing entities' regulations should be followed in the process of planning.

8.5 PONDING AREAS

The proposed construction will include drainage improvements, including the construction of up to three ponding areas along the project alignment.

Retention basin boring PB-1 will be located at the south end of the Eastlake Sports Complex retention pond, approximately 20 feet west of Station 138+80 on the proposed John Hayes Street. The second retention basin boring PB-2 is located about 40 feet west of Station 130+00 on John Hayes Street and Retention Basin 3 (PB-3) is located near Station 14+00 on the proposed John Hayes Street within the Jobe Materials, LP property, north of the EPE substation. The proposed depths for the three retention basins are about 20 feet below the existing ground surface.

To evaluate soil conditions at each ponding area, one boring was drilled to a depth of about 30 feet below existing grades at each basin location. Percolation tests were also completed to evaluate the infiltration characteristics of the soils at the bottom of pond elevation, about 20 feet below the existing ground surface.

Pond Boring PB-1

The soils at Boring PB-1 consist of silty sand (SM) that extends from the ground surface to a depth of about 17.5 feet. Standard penetration testing indicates a relative density of dense at the surface and medium dense to 12.5 feet and very dense to about 17.5 feet below the ground surface.

The next soil stratum consists of nonplastic sands with varying amounts of gravel and sandy gravels (SP, SP-SM) that extend to the total depth explored (31.5 feet). Standard penetration testing indicates a relative density of dense to very dense.

Pond Boring PB-2

The soils at Boring PB-2 consist of silty sand (SM) that extends from the ground surface to a depth of about 10 feet. Standard penetration testing indicates a relative density of medium dense to 5 feet and dense to very dense to 10 feet below the ground surface.

The next soil stratum consists of sandy clays (CL) extending to a depth of about 12.5 feet below the ground surface. Laboratory testing indicates liquid limits of 30 with a plasticity index of 8. Standard penetration testing indicates a relative consistency of hard.

The final stratum consists of nonplastic sands (SP, SP-SM) with varying amounts of gravel that extend to the total depth explored (31.5 feet). Standard penetration testing indicates a relative density of medium dense to very dense.

Pond Boring PB-3 (Proposed Retention Basin 1)

The soils at Boring PB-3 consist of nonplastic silty sand (SM) that extends from the ground surface to a depth of about 2.5 feet. Standard penetration testing indicates a relative density of dense. The silty sand overlies interbedded layers of clayey sands and silty sands (SM) to a depth of about 7.5 feet below the existing grade. Standard penetration testing indicates a relatively very dense for the clayey sands and medium dense for the silty sands.

The next soil stratum consists of sandy clays (CL) that extend to a depth of about 12.5 feet. Laboratory testing indicates liquid limits of 45 to 46 with plasticity indices of 24 to 29 for the clay soil. Standard penetration testing indicates a relative consistency of hard.

The final stratum consists of nonplastic sands (SP, SP-SM) with varying amounts of gravel that extend to the total depth explored (31.5 feet). Standard penetration testing indicates a relative density of dense to very dense.

At the time of our field study, groundwater was not encountered nor should it be expected to occur naturally at this locale at an elevation that would impact the planned construction. Soil moisture contents were generally dry to

damp with values ranging from 1 to 18.2 percent. Higher moisture contents were generally observed within the clay soils.

Based on the results of the field study, excavations are not anticipated to be difficult using conventional earthwork equipment. However, earthwork contractors should verify the suitability of their equipment for use for the varied soil types and conditions observed at the proposed basin locations.

Retention Basin at PB-1 encountered dense to very dense sands at a depth of 17.5 feet below existing ground surface overlying sands with some gravel.

Retention Basin at PB-2 encountered a sandy clay (CL) layer from about 10 to about 12.5 feet below the ground surface. The depth of the clay layer should be kept in mind during project planning and should be penetrated in order to improve the infiltration characteristics of the proposed ponding area.

Retention Basin 1 at PB-3 encountered interbedded silty and clayey sand extending to a depth of approximately 7.5 feet below the existing grade. A second clay layer was observed from about 7.5 to approximately 12.5 feet below the ground surface. The depth of the clay layer should be kept in mind during project planning and should be penetrated in order to improve the infiltration characteristics of the proposed ponding area.

Based on the soil conditions encountered for the project, ponding area slopes should be designed and constructed to be no steeper than 3H:1V (horizontal to vertical). It is recommended that the interior side slopes be compacted to at least 90 percent of the maximum dry density within plus or minus 2 percent of the optimum moisture content as determined by ASTM D 1557 during the excavation and construction of the proposed ponding areas.

The silty and poorly graded sands encountered at the project site are considered to be highly erodable. As a result, protection of the slope face, especially at any spillway, inlet structure, or at natural drainage features should be provided consisting of rock rip rap, vegetation, geosynthetic materials, or other approved methods. If used, a rock rip rap should have a minimum thickness of 12 inches. A shallow berm should be considered to be placed along the top of the pond to direct surface water toward a spillway in order to minimize erosion at other areas of the pond. It is also recommended that inspection and repair of the stormwater retention ponds should be implemented as part of the facility's annual maintenance schedule.

8.5.1 PERCOLATION TESTS

Percolation tests were completed to evaluate the infiltration characteristics of the soils for the three proposed retention basins. General procedures for performing the percolation test consist of excavating the test location to the appropriate depth and the excavation is pre-soaked for a 3 to 4-hour period. Following the saturation period, the excavation is filled with water and the drop in water level is measured over an approximately 10-minute period for one hour for granular soils. Wood typically performs two 30-minute tests per location to ensure consistent results are achieved.

The percolation tests were conducted about 20 feet below the ground surface at the proposed base of the ponds. The results of the percolation test indicate an infiltration rate are as follows:

Location	Infiltration Rate, min/inch
Retention Basin at PB-1	5
Retention Basin at PB-2	10
Retention Basin at PB-3	5

It is important to note that percolation rates may vary at other locations across the site due to changes in soil conditions and clay content. In all cases, the clayey soils, if encountered, should be penetrated in order to improve the infiltration characteristics of the proposed ponding areas.

9.0 CONSTRUCTION OBSERVATION AND TESTING

Recommendations presented in previous sections of this report are predicated on the fact that there will be continuous observation and testing by the geotechnical engineer during earthwork operations. Verification of recommended excavations, moisture increases, and required degree of compaction should be performed in accordance with "Guide Specifications for Earthwork," **Appendix C**.

The recommendations presented in this report are based upon a limited number of subsurface samples obtained from eleven sampling locations. The samples may not fully indicate the nature and extent of the variations that exist beyond the sampling locations. For that reason, among others, Wood recommends that Wood be retained to observe earthwork construction. It should be noted if variations or other latent conditions become evident during earthwork construction, it will be necessary for Wood to review these conditions and modify its recommendations.

APPENDIX A

TEST DRILLING EQUIPMENT & PROCEDURES

SAMPLING PROCEDURES - Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D-1586 procedures. In most cases, 2" O.D. samplers are used to obtain the standard penetration resistance. Undisturbed samples of firmer soil are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140 pound, 30-inch free fall drop hammer required to advance the samplers in 6-inch increments. However, in stratified soil, driving resistance is sometimes recorded in 2 or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per foot on the logs. Undisturbed sampling of softer soil is sometimes performed with thin walled Shelby tubes (ASTM D-1587). Where samples of rock are required, they are obtained in NX diamond core drilling (ASTM D-2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings.

CONTINUOUS PENETRATION TESTS - Continuous penetration tests are performed by driving a 2" O.D. blunt nosed penetrometer adjacent to or in the bottom of borings. The penetrometer is attached to 1-inch O.D. drill rods to provide clearance to minimize side friction so that penetration values are recorded as the number of blows of a 140 pound, 30-inch free fall drop hammer required to advance the penetrometer in one foot increments or less.

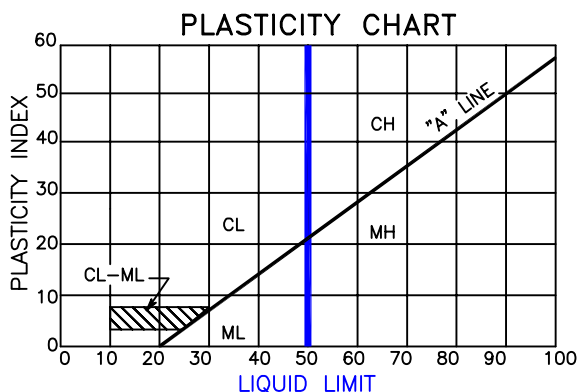
BORING RECORDS - Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares boring logs. Soil is visually classified in accordance with the Unified Soil Classification System (ASTM D-2487), with appropriate group symbols being shown on the logs.

UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the Unified Soil Classification System on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System", Corp of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-93T.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
					GP	Poorly graded gravels, gravel-sand mixtures or sand-gravel-cobble mixtures
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line or hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)			SW	Well graded sands, gravelly sands
					SP	Poorly graded sands, gravelly sands
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line or hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS Limits plot below "A" line or hatched zone on plasticity chart	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50%)			ML	Inorganic silts, clayey silts with slight plasticity
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50%)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
	CLAYS Limits plot above "A" line & hatched zone on plasticity chart	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50%)			CL	Inorganic clays of low to medium plasticity; gravelly clays, sandy clays, silty clays, lean clays
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50%)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
COBBLES	Above 3 inches
GRAVEL	3 inches to No. 4 sieve
Coarse Gravel	3 inches to 3/4 inch
Fine Gravel	3/4 inch to No. 4 sieve
SAND	No. 4 sieve to No. 200
Coarse	No. 4 sieve to No. 10
Medium	No. 10 sieve to No. 40
Fine	No. 40 sieve to No. 200
FINES (SILT or CLAY)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY CONSISTENCY, OR FIRMNESS OF SOIL

The terminology used on the boring logs to describe the relative density, consistency or firmness of soil relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blow per foot is obtained by ASTM D-1586 procedure using 2" O.D., 1-inch I.D. samplers.

RELATIVE DENSITY: Terms for description of relative density of cohesionless, uncemented sand and sand-gravel mixtures, and

RELATIVE CONSISTENCY: Terms for the description of fine-grained soils. Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance.

<i>Granular Materials</i>		
Relative Density	Safety Hammer SPT N-Value (Blows /Foot)	Automatic Hammer SPT N-value (Blows/Foot)
Very Loose	Less than 4	Less than 3
Loose	4 – 10	3 – 8
Medium Dense	10 – 30	8 – 24
Dense	30 – 50	24 – 40
Very Dense	Greater than 50	Greater than 40
<i>Silts and Clays</i>		
Consistency	Safety Hammer SPT N-Value (Blows /Foot)	Automatic Hammer SPT N-value (Blows/Foot)
Very Soft	Less than 2	Less than 1
Soft	2 – 4	1 – 3
Firm	4 – 8	3 – 6
Stiff	8 – 15	6 – 12
Very Stiff	15 – 30	12 – 24
Hard	Greater than 30	Greater than 24

If SPT data is not available, consistency can be estimated in the field based on visual-manual examination of the material. Refer to ASTM D 2488 for consistency criteria.

The pocket penetrometer and torvane devices may be used in the field as an index of the remolded undrained shear strength of clay samples.

RELATIVE FIRMNESS: Terms for the descriptions of partially saturated and/or cemented soil which commonly occurs in the Southwest including clay, cemented granular materials, silt and silty and clayey granular soil:

<u>N</u>	<u>RELATIVE FIRMNESS</u>
0-4	Very Soft
5-8	Soft
9-15	Moderately Firm
16-30	Firm
31-50	Very Firm
50+	Hard

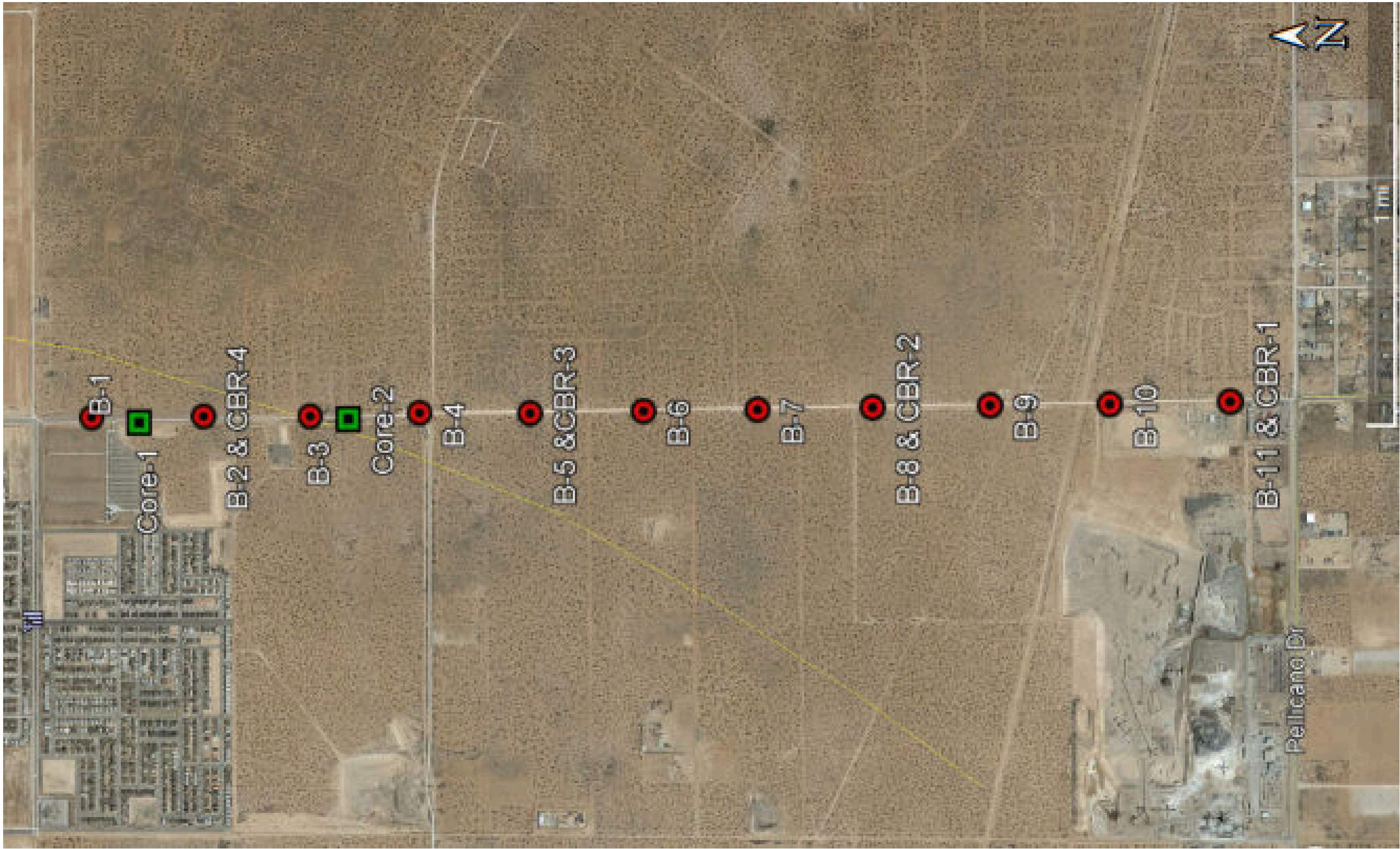


SOIL MOISTURE CLASSIFICATION

MOISTURE CONDITION	FIELD IDENTIFICATION	ESTIMATED RANGE OF MOISTURE	
		Group A (%)	Group B (%)
Dry	Absence of moisture, dusty. Dry to the touch.	0-4	0-8
Damp	Grains appear slightly darkened, but no visible water. Silt/clay may clump. Sand will not bulk. Soils are below plastic limits.	4-8	8-16
Moist	Grains appear darkened, but no visible water. Silt/clay will clump. Sand will bulk. Soils are often at or near plastic limits.	8-16	16-30
Wet	Visible water on larger grain surfaces. Sand and cohesionless silt exhibit dilatancy. Cohesive silt/clay can be readily remolded. "Wet" indicates that the soil is much wetter than the optimum moisture content and above the plastic limit (APL).	>16	>30
Water Bearing	A water-producing formation.	N/A	N/A

Group A - Coarse Grained Soils, nonplastic to plasticity index <7.
Includes: SM, SP-SM, SP, SW, GM, GP, and GW.

Group B - Fine Grained Soils to clayey sands & gravels with a plasticity index >7.
Includes: GC, SC, ML, MH, CL, and CH.



CLIENT: CEA Group Engineers · Architects · Planners 4712 Transmountain Rd., Ste. F El Paso, Texas 79924	LEGEND: <div><div></div> Boring Approximate Location</div>	DRAWN BY: MJB	PROJECT: John Hayes Street Extension Project Darrington Road to Berryville Street El Paso County, Texas	REV NO. 0
		CHK'D BY: DAV		DATE 3/25/2020
		PROJECTION:		PROJECT NO. 2037192009
		<div><div>wood.</div><div>E & I S, INC. 125 MONTOYA ROAD EL PASO, TX 39932</div></div>	SCALE: AS SHOWN	BORING LOCATION PLAN

PROJECT John Hayes Street Extension
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



Technical Consulting Solutions, Inc.
125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 **DATE** 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	5-5-4	9	8.0	21					SM	Medium Dense	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, trace gravel (cemented sands, caliche), damp.
			X	S	6-3-3	6								Loose PP=2.0 tsf	
5			X	S	2-2-3	5	6.1						SM	Loose	Silty Sand - Light reddish brown mostly fine SAND, little silt, nonplastic fines, damp.
			X	S	4-7-15	22	12.5	15					SM	Medium Dense	Silty Sand with Gravel - Light reddish brown medium and fine SAND, little silt, nonplastic fines, little gravel (cemented sands, caliche), moist.
10			X	S	10-16-17	33							SM	Dense	Silty Sand with Gravel - Reddish brown medium and fine SAND, little silt, nonplastic fines, little gravel (cemented sands, caliche), damp.
													SP-SM		Poorly Graded Sand with Silt - Grayish brown medium and fine SAND, few silt, nonplastic fines, damp.
15			X	S	4-10-16	26								Medium Dense	
20															Auger terminated at 15 feet. Sampler terminated at 16.5 feet.
25															NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
SH - 3" O.D. Shelby Tube Sample
MC - Modified California Sampler

LOG OF TEST BORING NO. B- 1

PROJECT John Hayes Street Extension
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



Technical Consulting Solutions, Inc.
125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 **DATE** 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	3-5-5	10							SM	Loose	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, damp.
			X	S	2-3-4	7	7.1	22					SM	Loose PP=2.0 tsf	Silty Sand - Light reddish brown mostly fine SAND, little silt, nonplastic fines, damp.
5			X	S	4-6-9	15	12.8	25	26	26	NP		SM	Medium Dense PP=3.25 tsf	Silty Sand - Light reddish brown medium and fine SAND, little silt, low plastic fines, moist.
			X	S	2-4-3	7							SM	Loose	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, trace gravel, subrounded to subangular, moist.
10			X	S	2-4-4	8	9.2	16						Loose	
													SP-SM		Poorly Graded Sand with Silt -Grayish brown medium and fine SAND, few silt, nonplastic fines, damp.
15			X	S	4-8-12	20								Medium Dense	
20															Auger terminated at 15 feet. Sampler terminated at 16.5 feet. NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
25															
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
 A - Drill cuttings
 S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
 U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
 SH - 3" O.D. Shelby Tube Sample
 MC - Modified California Sampler

LOG OF TEST BORING NO. B- 2

PROJECT **John Hayes Street Extension**
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



Technical Consulting Solutions, Inc.
125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 DATE 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	4-6-6	12	4.0						SM	Medium dense	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, damp.
			X	S	13-14-10	24	7.0	24	21	18	3		SM	Medium Dense	Silty Sand - Pale brown medium and fine SAND, little silt, low plastic fines, trace gravel (cemented sands, caliche), damp.
5			X	S	4-6-9	15							SM	Medium Dense	Silty Sand - Light brown mostly fine SAND, little silt, nonplastic fines, few gravel (cemented sands, caliche), dry.
			X	S	16-42-50/5"		10.1	19	NV	--	NP		SM	Very Dense	Silty Sand with Gravel - Reddish brown coarse to fine SAND, little silt, nonplastic fines, little gravel, subangular, damp.
10			X	S	11-31-46	77								Very Dense	
													SP-SM		Poorly Graded Sand with Silt - Reddish brown medium and fine SAND, few silt, nonplastic fines, few gravel, subangular to subrounded, dry.
15			X	S	6-15-20	35								Dense	
20															Auger terminated at 15 feet. Sampler terminated at 16.5 feet. NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
25															
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
SH - 3" O.D. Shelby Tube Sample
MC - Modified California Sampler

LOG OF TEST BORING NO. B- 3

PROJECT John Hayes Street Extension
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



Technical Consulting Solutions, Inc.
125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 **DATE** 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	2-3-5	8							SM	Loose PP=1.75 tsf	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, moist/damp.
			X	S	4-37-20	57							SM	Very Dense	Silty Sand - Light reddish brown medium and fine SAND, little silt, low plastic fines, few gravel (cemented sands, caliche), dry.
5			X	S	1-14-17	31	15.1	13					SM	Dense	Silty Sand with Gravel - Light reddish brown medium and fine SAND, little silt, nonplastic fines, little gravel (cemented sands, caliche), dry.
			X	S	2-4-4	8	5.6						SM	Loose	Silty Sand - Reddish brown fine SAND, some silt, nonplastic fines, damp.
10			X	S	3-18-31	49							SM	Dense	Silty Sand - Light reddish brown medium and fine SAND, little silt, nonplastic fines, few gravel (cemented sands, caliche), dry.
15			X	S	4-14-14	28							SC	Medium Dense	Clayey Sand - Reddish brown medium and fine SAND, little clay, medium plastic fines, dry.
															Auger terminated at 15 feet. Sampler terminated at 16.5 feet.
20															NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
25															
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
SH - 3" O.D. Shelby Tube Sample
MC - Modified California Sampler

LOG OF TEST BORING NO. B- 4

PROJECT John Hayes Street Extension
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



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125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 **DATE** 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	5-6-5	11							SM	Medium Dense PP=1.25 tsf	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, damp. Root fragments.
			X	S	4-21-47	68							SC-SM	Very Dense PP=2.25 tsf	Silty Clayey Sand - Pale brown medium and fine SAND, little silty clay, low plastic fines, few gravel (cemented sands, caliche), dry.
5			X	S	23-37-27	64								Very Dense	
			X	S	9-33-48	81	7.6	12					SP-SM	Very Dense	Poorly Graded Sand with Silt and Gravel - Reddish brown coarse to fine SAND, few silt, nonplastic fines, little gravel (cemented sands, caliche), damp.
10			X	S	14-30-34	64								Very Dense	
15			X	S	12-26-45	71	9.8	44	30	13	17		SC	Very Dense	Clayey Sand - Dark reddish brown medium and fine SAND, some clay, medium plastic fines, damp. Iron staining.
20															Auger terminated at 15 feet. Sampler terminated at 16.5 feet. NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
25															
30															

DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
SH - 3" O.D. Shelby Tube Sample
MC - Modified California Sampler

LOG OF TEST BORING NO. B- 5

PROJECT John Hayes Street Extension
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



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El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 **DATE** 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	8-13-12	25							SM	Medium Dense	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, dry.
			X	S	4-9-9	18								Medium Dense	
5			X	S	3-8-8	16	1.8	11					SP-SM	Medium Dense	Poorly Graded Sand with Silt - Brown fine SAND, few silt, nonplastic fines, dry.
			X	S	12-18-19	37							SM	Dense	Silty Sand - Light brown coarse to fine SAND, little silt, nonplastic fines, few gravel (cemented sands, caliche), moist.
10			X	S	10-21-20	41	9.0	15						Dense	
													SM		Silty Sand - Light reddish brown medium and fine SAND, little silt, nonplastic fines, trace gravel (cemented sands, caliche), dry.
15			X	S	19-50-50/1"									Very Dense	
20															Auger terminated at 15 feet. Sampler terminated at 16.5 feet.
25															NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
 A - Drill cuttings
 S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
 U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
 SH - 3" O.D. Shelby Tube Sample
 MC - Modified California Sampler

LOG OF TEST BORING NO. B- 6

PROJECT John Hayes Street Extension
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



Technical Consulting Solutions, Inc.
125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 **DATE** 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	3-3-4	7							SM	Loose	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, moist.
			X	S	2-3-3	6								Loose	
5			X	S	2-4-4	8	3.6	12					SP-SM	Loose	Silty Sand - Strong brown medium and fine SAND, few silt, nonplastic fines, dry.
			X	S	3-7-50/3"		2.1	10					SP-SM	Very Dense	Poorly Graded Sand with Silt - Light brown mostly fine SAND, few silt, nonplastic fines, dry.
10			X	S	50-50-50	100	8.0	46	34	27	7		SC-SM	Very Dense	Silty Clayey Sand - Pale brown medium and fine SAND, little silty clay, low plastic fines, damp.
													SC		Clayey Sand - Reddish brown medium and fine SAND, little silt, medium plastic fines, trace gravel (cemented sands, caliche), dry.
15			X	S	15-35-46	81								Very Dense PP>4.5 tsf	
20															Auger terminated at 15 feet. Sampler terminated at 16.5 feet.
25															NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
 A - Drill cuttings
 S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
 U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
 SH - 3" O.D. Shelby Tube Sample
 MC - Modified California Sampler

LOG OF TEST BORING NO. B- 7

PROJECT **John Hayes Street Extension**
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



Technical Consulting Solutions, Inc.
125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 DATE 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	3-10-9	19							SM	Medium Dense PP=2.5 tsf	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, damp. Clay nodules observed in sample.
			X	S	3-6-7	13	3.3	17	NV	--	NP		SM	Medium Dense	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, dry.
5			X	S	2-6-8	14							SM	Medium Dense	Silty Sand - Strong brown medium and fine SAND, little silt, nonplastic fines, dry.
			X	S	2-2-50/4"		2.1	16						Very Dense	
10			X	S	18-50-50	100	5.6	20					SM	Very Dense	Silty Sand - Pale brown medium and fine SAND, little silt, nonplastic fines, damp.
													SM		Silty Sand - Light reddish brown medium and fine SAND, little silt, nonplastic fines, moist.
15			X	S	9-28-31	59	8.9	25						Very Dense	
20															Auger terminated at 15 feet. Sampler terminated at 16.5 feet. NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
25															
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
SH - 3" O.D. Shelby Tube Sample
MC - Modified California Sampler

LOG OF TEST BORING NO. B- 8

PROJECT **John Hayes Street Extension**
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



Technical Consulting Solutions, Inc.
125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. **2037192009** DATE **2/27/20**

LOCATION **See Boring Location Plan**
LOGGED BY **J. Cardenas**
RIG TYPE **Tierra Drilling - CME 75**
BORING TYPE **Hollow Stem Auger Method**
SURFACE ELEV. **Existing Ground Surface**
DATUM **Existing Ground Surface**

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	6-10-12	22	3.3	22					SM	Medium Dense	Silty Sand - Reddish brown mostly fine SAND, little silt, nonplastic fines, damp. Clay nodules observed in sample.
			X	S	13-16-17	33	7.2	22					SC	Dense PP>4.5 tsf	Clayey Sand - Very pale brown medium and fine SAND, little clay, low plastic fines, damp.
5			X	S	8-12-20	32								Dense	
			X	S	8-13-19	32								Dense	
10			X	S	8-16-22	38	10.6	23	35	20	15		SC	Dense	Clayey Sand - Pale brown medium and fine SAND, little clay, medium plastic fines, damp.
													SM		Silty Sand - Light brown mostly fine SAND, little silt, medium plastic fines, trace gravel (cemented sands, caliche), dry.
15			X	S	6-9-11	20								Medium Dense	
20															Auger terminated at 15 feet. Sampler terminated at 16.5 feet. NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
25															
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
SH - 3" O.D. Shelby Tube Sample
MC - Modified California Sampler

LOG OF TEST BORING NO. **B- 9**

PROJECT John Hayes Street Extension
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



Technical Consulting Solutions, Inc.
125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 **DATE** 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	4-9-15	24							SM	Medium Dense PP=2.25 tsf	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, damp. Clay nodules observed in sample.
			X	S	18-44-50/4"			7.6	26	31	23	8	SC	Very Dense	Clayey Sand - Reddish brown medium and fine SAND, little clay, low plastic fines, dry.
5			X	S	8-14-11	25							SM	Medium Dense	Silty Sand with Gravel - Pale brown medium and fine SAND, little silt, nonplastic fines, little gravel (cemented sands, caliche), damp.
			X	S	7-11-12	23		7.2	14					Medium Dense	
10			X	S	5-10-11	21		6.2	19	24	17	7	SC-SM	Medium Dense	Silty Clayey Sand - Reddish brown medium and fine SAND, little silty clay, low plastic fines, damp.
													SP-SM		Poorly Graded Sand with Silt - Brown medium and fine SAND, few silt, medium plastic fines, dry.
15			X	S	4-10-12	22		1.5	5.0					Medium Dense	
20															Auger terminated at 15 feet. Sampler terminated at 16.5 feet.
25															NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
 A - Drill cuttings
 S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
 U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
 SH - 3" O.D. Shelby Tube Sample
 MC - Modified California Sampler

LOG OF TEST BORING NO. B-10

PROJECT **John Hayes Street Extension**
Darrington Road to Berryville Street
El Paso, El Paso County, Texas



Technical Consulting Solutions, Inc.
125 Montoya Road
El Paso, Texas 79932
Telephone: 915-585-2472

JOB NO. 2037192009 DATE 2/27/20

LOCATION See Boring Location Plan
LOGGED BY J. Cardenas
RIG TYPE Tierra Drilling - CME 75
BORING TYPE Hollow Stem Auger Method
SURFACE ELEV. Existing Ground Surface
DATUM Existing Ground Surface

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Sample Number	Blows Per Six Inches	SPT N-Value	Moisture Content Percent of Dry Weight	Percent Fines	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification or Rock Unit	REMARKS	VISUAL CLASSIFICATION
0			X	S	3-4-4	8							SM	Loose	Silty Sand - Reddish brown medium and fine SAND, little silt, nonplastic fines, damp. Clay nodules observed in sample.
			X	S	5-11-12	23	13.8	28					SC	Medium Dense	Clayey Sand - Pale brown medium and fine SAND, little clay, low plastic fines, damp.
5			X	S	3-5-6	11	12.9	21					SM	Medium Dense	Silty Sand - Light brown medium and fine SAND, little silt, nonplastic fines, few gravel (cemented sands, caliche), damp.
			X	S	5-6-9	15							SM	Medium Dense	Silty Sand - Brown medium and fine SAND, little clay, low plastic fines, trace gravel (cemented sands, caliche), damp.
10			X	S	6-19-23	42	13.5	16	26	16	10		SC	Dense	Clayey Sand - Reddish brown coarse to fine SAND, little clay, low plastic fines, few gravel (cemented sands, caliche), damp.
													SP-SM		Poorly Graded Sand with Silt - Brown medium and fine SAND, few silt, medium plastic fines, trace gravel, subrounded to subangular, dry.
15			X	S	7-16-19	35								Dense	
															Auger terminated at 15 feet. Sampler terminated at 16.5 feet. NE - Not Encountered PP - Pocket Penetrometer tsf - tons per square foot
20															
25															
30															

GROUNDWATER		
DEPTH(ft)	HOUR	DATE
NE	0	2/27/2020

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.375" I.D. Split-Barrel Sampler
U - 3" O.D. 2.375" I.D. Split-Barrel Sampler
SH - 3" O.D. Shelby Tube Sample
MC - Modified California Sampler

LOG OF TEST BORING NO. B-11

APPENDIX B

TABULATION OF TEST RESULTS

DATE: March 2020
 PROJECT: John Hayes Street Extension
Montwood Drive to Pellicano Drive
El Paso County, Texas

Wood Project No.: 2037192009

BORING NO.	DEPTH	UNIFIED CLASS.	LL	PL	PI	SIEVE ANALYSIS - ACCUM. % PASSING														MOISTURE %
						No.200	No.140	No.100	No.60	No.40	No.20	No.10	No.4	3/8"	3/4"	1"	1 1/2"	2"	3"	
B-1	0'-1 1/2'	SM				21	33	48	73	89	93	95	98	100						8.0
B-1	5'-6 1/2'																			6.1
B-1	7 1/2'-9'	SM				15	23	35	51	63	69	76	85	95	100					12.5
B-2	2 1/2'-4'	SM				22	34	50	74	92	98	99	100							7.1
B-2	5'-6 1/2'	SM	26	26	0	25	35	48	69	85	93	97	99	100						12.8
B-2	10'-11 1/2'	SM				16	25	39	64	86	95	98	100	100						9.2
B-3	0'-1 1/2'																			4.0
B-3	2 1/2'-4'	SM	21	18	3	24	33	45	65	80	86	91	95	98	100					7.0
B-3	7 1/2'-9'	SM	NV	--	NP	19	24	33	45	56	65	76	88	95	100					10.1
B-4	5'-6 1/2'	SM				13	20	28	42	52	58	66	86	99	100					15.1
B-4	7 1/2'-9'																			5.6
B-5	7 1/2'-9'	SP-SM				12	20	31	45	58	67	79	92	100						7.6
B-5	15'-16 1/2'	SC	30	13	17	44	50	57	70	85	95	98	99	100						9.8
B-6	5'-6 1/2'	SP-SM				11	15	23	64	91	98	99	100	100						1.8
B-6	10'-11 1/2'	SM				15	23	33	50	64	70	77	88	100						9.0
B-7	5'-6 1/2'	SM				12	20	34	70	94	100	100								3.6
B-7	7 1/2'-9'	SP-SM				10	16	27	64	91	99	100	100	100						2.1
B-7	10'-11 1/2'	SC-SM	34	27	7	46	53	61	76	87	94	100								8.0
B-8	2 1/2'-4'	SM	NV	--	NP	17	26	39	69	90	99	100								3.3
B-8	7 1/2'-9'	SM				16	24	38	68	90	99	100								2.1
B-8	10'-11 1/2'	SM				20	27	38	58	74	86	98	100							5.6
B-8	15'-16 1/2'	SM				25	35	47	66	80	93	100	100							8.9
B-9	0'-1 1/2'	SM				22	31	46	74	92	97	99	100	100						3.3
B-9	2 1/2'-4'	SC				22	30	46	71	88	96	100	100	100						7.2

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BEARING RATIO OF LABORATORY COMPACTED SOILS

City of El Paso Specifications

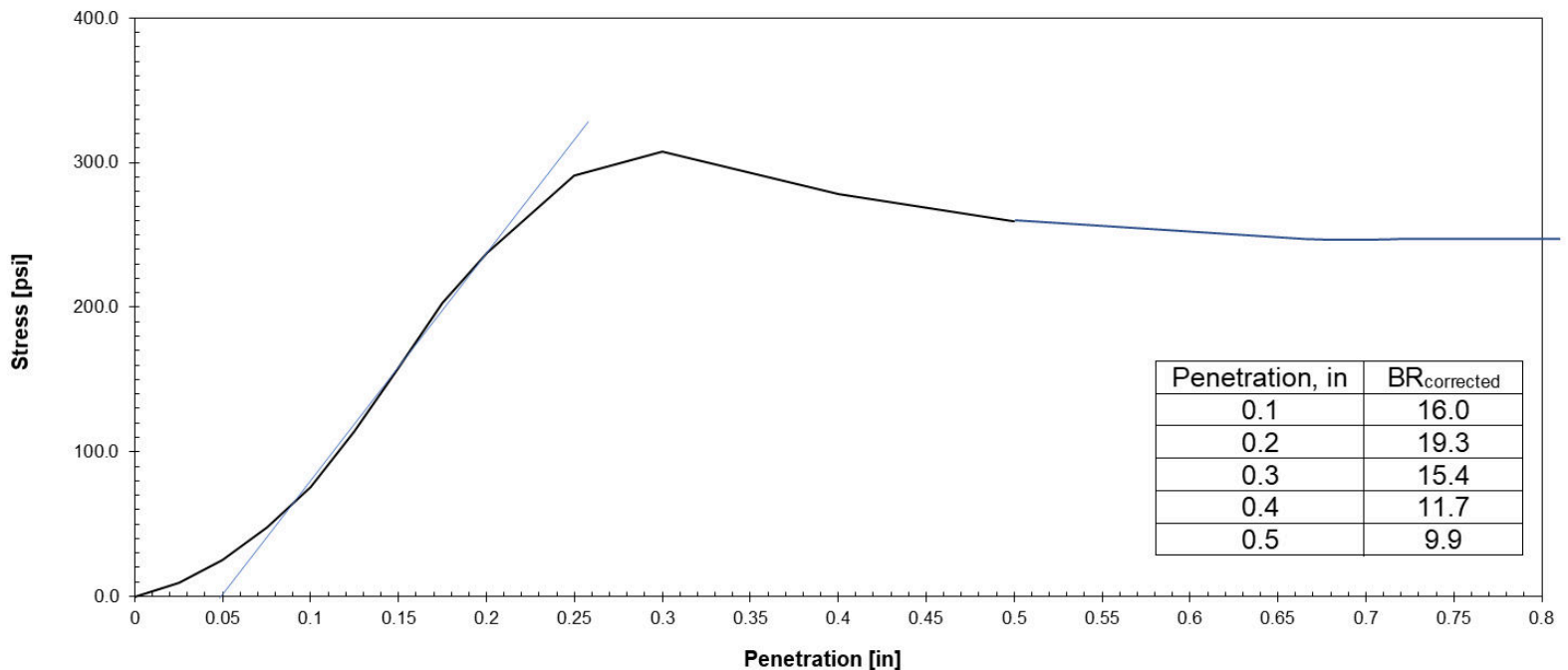
Client:	CEA Group, Inc..
Project No.:	2037192009
Project Name:	John Hayes Street Extension
Project Location:	Montwood Drive to Pellicano Drive, El Paso, El Paso County, Texas

Specimen No.:	CBR - 1
Material Source/Location:	Existing Material / Sta. 7+30 on John Hayes Street (Berryville Street)
Material Description:	A-2-4; Brown fine SAND, few silt, nonplastic fines.
Material Use:	Roadway Subgrade

Preparation Method:	Optimum moisture as determined by AASHTO T-99; BR compaction effort: 10 lb rammer, 18" drop, 10 blows per layer, 5 layers.
Condition of Sample:	Soaked
Dry Density Before Soaking:	107.6 pcf
Moisture Content Before Soaking:	12.4%
Dry Density After Soaking:	107.7 pcf
Moisture Content After Soaking (avg):	16.3%
Moisture Content in Top 1" After Soaking:	18.0%
Percent Retained on the 3/4" Sieve* (if replaced):	0%
Surcharge weights and plate (lbs):	17.5
Swell (+)/Consolidation (-) After Soaking:	0.04%
Soaking Period:	96 Hours

* Replaced material retained on the 3/4" sieve with material passing the 3/4" sieve and retained on the U.S. No. 4 sieve.

Design Bearing Ratio of Soaked Sample, percent: 9.9



BEARING RATIO OF LABORATORY COMPACTED SOILS

City of El Paso Specifications

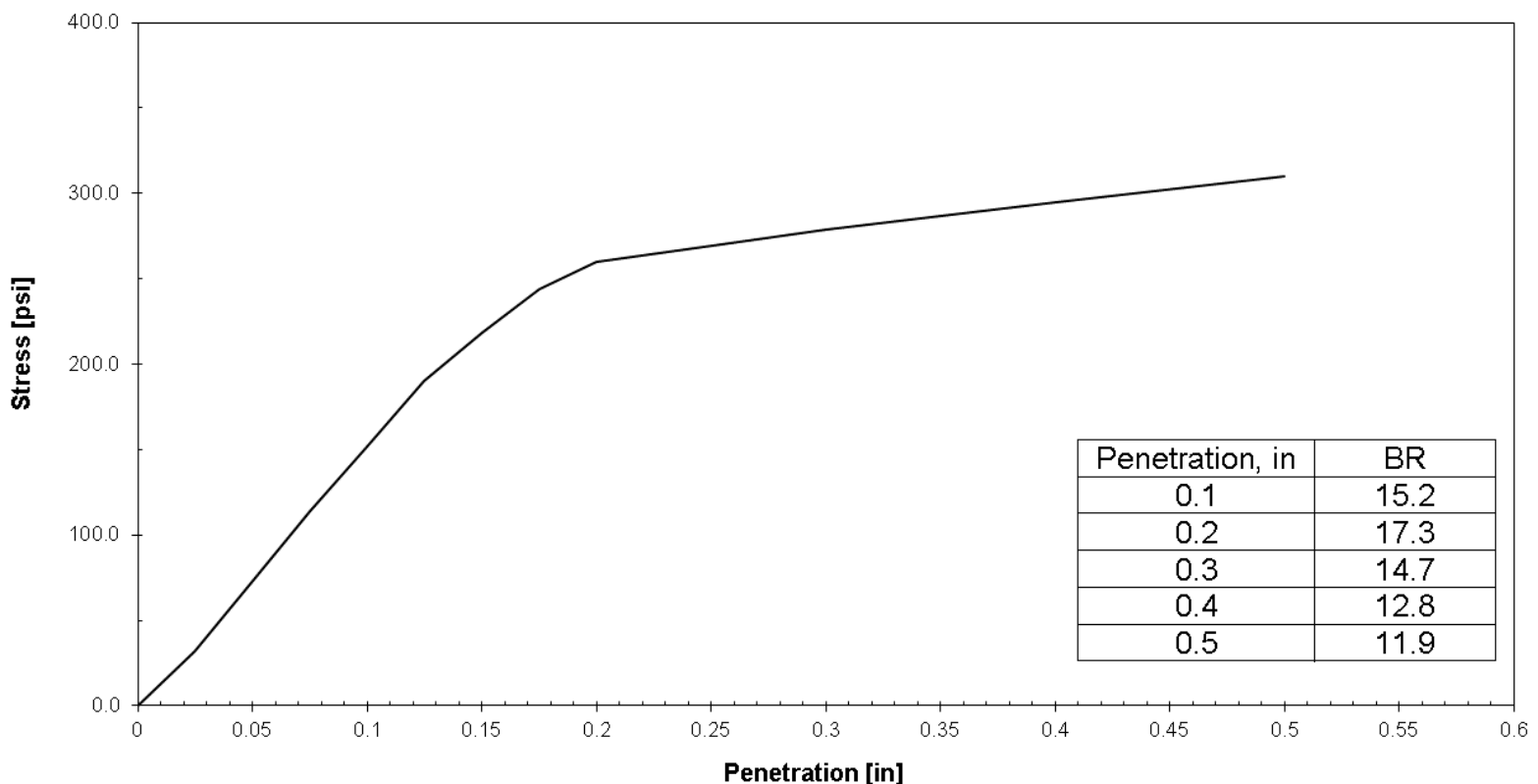
Client:	CEA Group, Inc..
Project No.:	2037192009
Project Name:	John Hayes Street Extension
Project Location:	Montwood Drive to Pellicano Drive, El Paso, El Paso County, Texas

Specimen No.:	CBR - 2
Material Source/Location:	Existing Material / Sta. 50+00 on John Hayes Street (Berryville Street)
Material Description:	A-2-4; Brown medium and fine SAND, little silt, nonplastic fines.
Material Use:	Roadway Subgrade

Preparation Method:	Optimum moisture as determined by AASHTO T-99; BR compaction effort: 10 lb rammer, 18" drop, 10 blows per layer, 5 layers.
Condition of Sample:	Soaked
Dry Density Before Soaking:	109.7 pcf
Moisture Content Before Soaking:	8.5%
Dry Density After Soaking:	110.5 pcf
Moisture Content After Soaking (avg):	15.3%
Moisture Content in Top 1" After Soaking:	16.4%
Percent Retained on the 3/4" Sieve* (if replaced):	0%
Surcharge weights and plate (lbs):	17.5
Swell (+)/Consolidation (-) After Soaking:	0.04%
Soaking Period:	96 Hours

* Replaced material retained on the 3/4" sieve with material passing the 3/4" sieve and retained on the U.S. No. 4 sieve.

Design Bearing Ratio of Soaked Sample, percent: 11.9



BEARING RATIO OF LABORATORY COMPACTED SOILS

City of El Paso Specifications

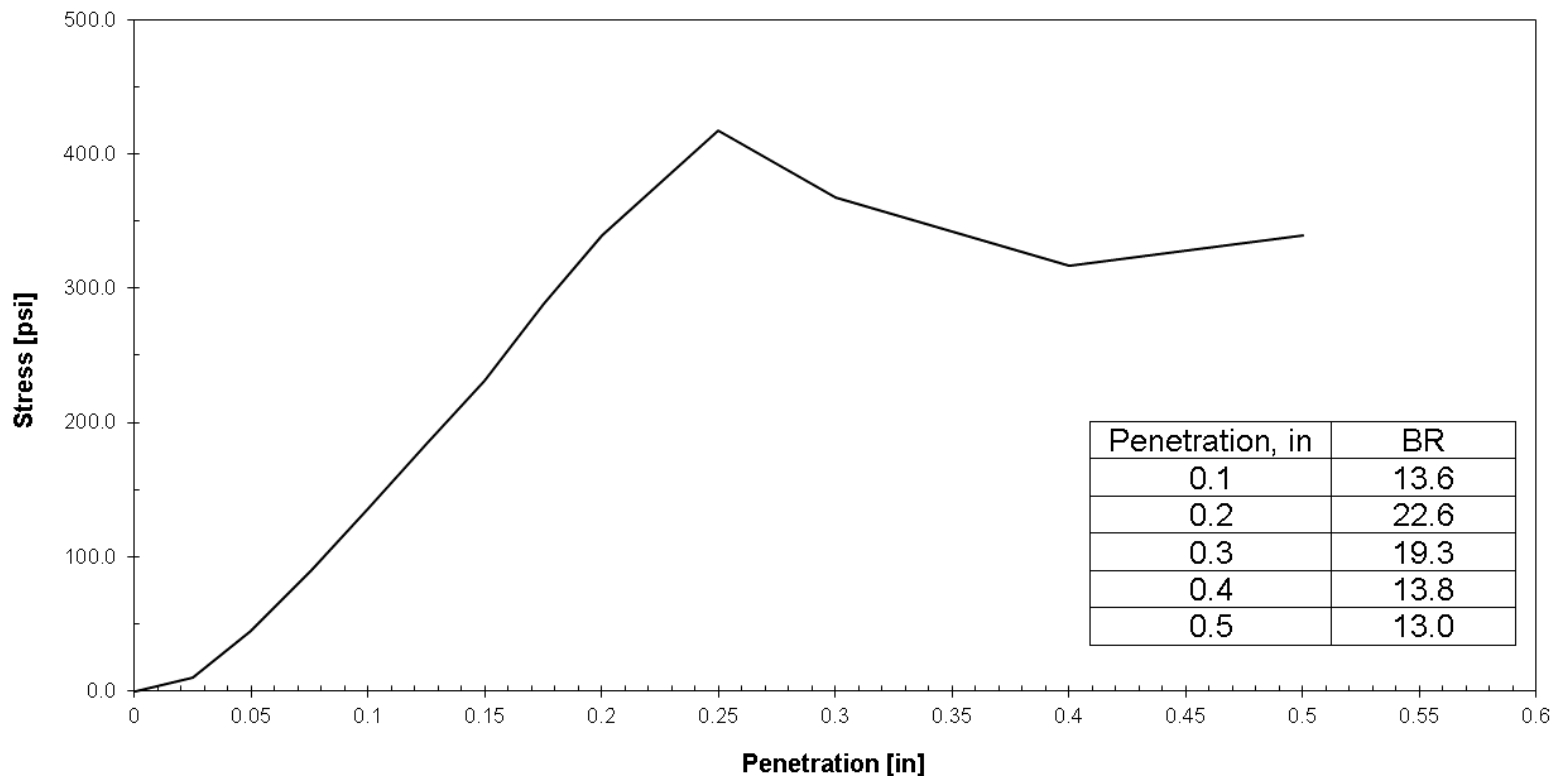
Client:	CEA Group, Inc..
Project No.:	2037192009
Project Name:	John Hayes Street Extension
Project Location:	Montwood Drive to Pellicano Drive, El Paso, El Paso County, Texas

Specimen No.:	CBR - 3
Material Source/Location:	Existing Material / Sta. 92+55 on John Hayes Street (Berryville Street)
Material Description:	A-2-4; Brown fine SAND, little silt, nonplastic fines.
Material Use:	Roadway Subgrade

Preparation Method:	Optimum moisture as determined by AASHTO T-99; BR compaction effort: 10 lb rammer, 18" drop, 10 blows per layer, 5 layers.
Condition of Sample:	Soaked
Dry Density Before Soaking:	109.6 pcf
Moisture Content Before Soaking:	12.0%
Dry Density After Soaking:	110.4 pcf
Moisture Content After Soaking (avg):	14.8%
Moisture Content in Top 1" After Soaking:	14.9%
Percent Retained on the 3/4" Sieve* (if replaced):	0%
Surcharge weights and plate (lbs):	17.5
Swell (+)/Consolidation (-) After Soaking:	-0.04%
Soaking Period:	96 Hours

* Replaced material retained on the 3/4" sieve with material passing the 3/4" sieve and retained on the U.S. No. 4 sieve.

Design Bearing Ratio of Soaked Sample, percent: 13.0



BEARING RATIO OF LABORATORY COMPACTED SOILS

City of El Paso Specifications

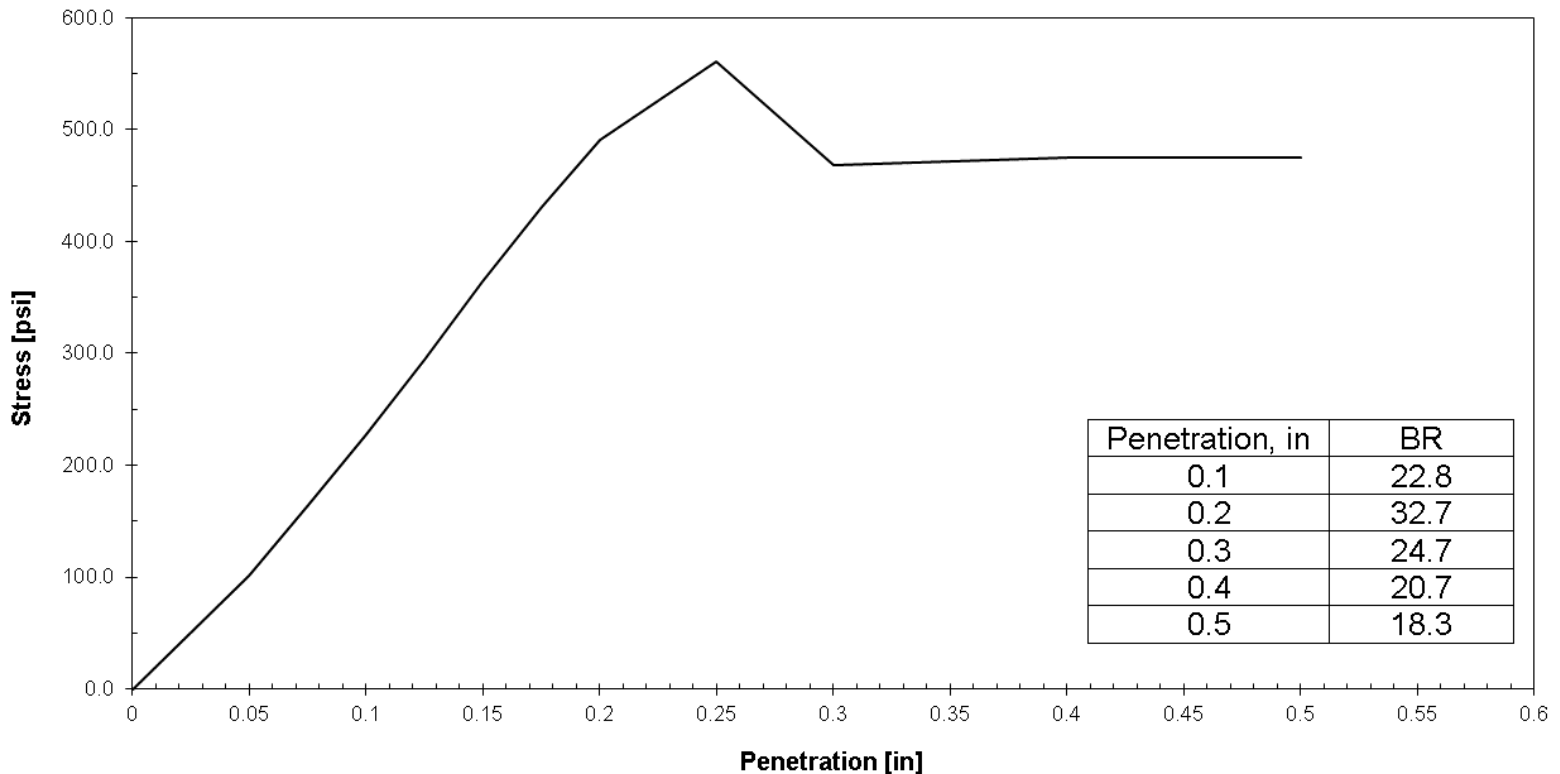
Client:	CEA Group, Inc..
Project No.:	2037192009
Project Name:	John Hayes Street Extension
Project Location:	Montwood Drive to Pellicano Drive, El Paso, El Paso County, Texas

Specimen No.:	CBR - 3
Material Source/Location:	Existing Material / Sta. 135+00 on John Hayes Street (Berryville Street)
Material Description:	A-2-4; Brown medium and fine SAND, little silt, nonplastic fines.
Material Use:	Roadway Subgrade

Preparation Method:	Optimum moisture as determined by AASHTO T-99; BR compaction effort: 10 lb rammer, 18" drop, 10 blows per layer, 5 layers.
Condition of Sample:	Soaked
Dry Density Before Soaking:	112.9 pcf
Moisture Content Before Soaking:	10.2%
Dry Density After Soaking:	113.9 pcf
Moisture Content After Soaking (avg):	13.0%
Moisture Content in Top 1" After Soaking:	13.4%
Percent Retained on the 3/4" Sieve* (if replaced):	0%
Surcharge weights and plate (lbs):	17.5
Swell (+)/Consolidation (-) After Soaking:	-0.04%
Soaking Period:	96 Hours

* Replaced material retained on the 3/4" sieve with material passing the 3/4" sieve and retained on the U.S. No. 4 sieve.

Design Bearing Ratio of Soaked Sample, percent: 18.3



APPENDIX C

GUIDE SPECIFICATIONS FOR EARTHWORK

1. SCOPE

Includes all clearing and grubbing, removal of obstructions, general excavating, grading and filling and any related items necessary to complete the grading for the entire project in accordance with these specifications.

2. SUBSURFACE SOIL DATA

Subsurface soil studies have been made, and the results are available for examination by the contractor. The contractor is expected to examine the site and determine for himself the character of materials to be encountered.

No additional allowance will be made for rock removal, site clearing and grading, filling, compaction, excess excavation due to loose materials or shallow groundwater conditions, disposal or removal of any unclassified materials.

3. CLEARING AND GRUBBING

- A. General:** Clearing and grubbing will be required for all areas shown on the plans to be excavated or on which fill is to be constructed.
- B. Clearing:** Clearing shall consist of removal and disposal of the existing asphalt and base course materials located within the project corridor. Clearing shall also consist of removal and disposal of vegetation observed during field activities.
- C. Grubbing:** Stumps, matted roots and roots larger than 3 inches in diameter shall be removed from fill soils used as pipe trench backfill. Materials as described above shall not be used or allowed to remain within 18 inches of finished subgrade in either cut or fill sections and shall be removed. Areas disturbed by grubbing will be filled as specified hereinafter for STRUCTURAL FILL.

4. EARTH EXCAVATION

- A.** Earth excavation shall consist of the excavation and removal of suitable soil for use as backfill or embankment, as well as, the satisfactory disposal of all vegetation, debris and deleterious materials encountered within the area to be graded and/or in a borrow area.
- B.** Excavated areas shall be continuously maintained such that the surface shall be smooth and have sufficient slope to allow water to drain from the surface.

5. STRUCTURAL FILL

- A. General:** Structural fill shall consist of controlled fill constructed in areas indicated on the grading plans.

B. Materials:

(1) Physical Characteristics: Structural fill material shall consist of soil that conforms to the following physical characteristics:

Sieve Size (Square Openings)	Percent Passing by Weight
3 inch	100
3/4 inch	70 - 100
No. 4	40 - 100
No. 200	5 - 35

The plasticity index of the material, as determined in accordance with ASTM D 4318, shall not exceed 12. The structural fill material shall be free from roots, grass, other vegetable matter, clay lumps, rocks larger than 3 inches in any dimension, or other deleterious materials.

(2) Granular Pipe Bedding: Material shall consist of soil that conforms to the following physical characteristics:

Sieve Size (Square Openings)	Percent Passing by Weight
3/8 inch	100
No. 200	0 - 12

The granular bedding material shall be nonplastic as determined in accordance with ASTM D 4318. The material shall be free from roots, grass or other vegetable matter, clay lumps or other deleterious materials.

(3) Trench Backfill: Material shall consist of soil that conforms to the following physical characteristics:

Sieve Size (Square Openings)	Percent Passing by Weight
3 inch	100
3/4 inch	70 - 100
No. 4	40 - 100
No. 200	5 - 40

The plasticity index of the material, as determined in accordance with ASTM D4318, shall not exceed 15. The trench backfill material shall be free from roots, grass or other vegetable matter, clay lumps or other deleterious materials.

(2) Site Soil: Site soil from cuts may be used for structural fill, bedding and trench backfill provided they meet the requirements in paragraph 5.B.1, 2 and 3, respectively. The results of this soil study indicate that the majority of the soils encountered along the project alignment will meet the requirements for structural fill and trench backfill. Imported materials will be required for bedding. In addition, the clay soils encountered along the project alignment will NOT meet the structural fill, bedding or backfill requirements.

(3) Borrow: When the quantity of suitable material required for backfill or embankments are not available within the limits of the job site, the contractor shall provide sufficient materials to construct the fills and embankments to the lines, elevations and cross sections as shown on the drawings from borrow areas. The contractor shall obtain from owners of said borrow areas, the right to excavate material, shall pay all royalties and other charges involved, and shall pay all expenses in developing the source including the cost of right-of-way required for hauling the material.

C. Construction:

(1) Subgrade Treatment: Prior to the construction of a pavement section, the existing subgrade shall be scarified to a depth of 8 inches. The scarified soils shall be moisture conditioned as needed to bring the soil to within plus or minus 2 percent of the optimum moisture content. The roadway areas shall then be brought to final subgrade elevation with properly compacted structural fill as determined by drainage considerations and pavement thickness.

During construction, the project area shall be shaped to provide drainage of surface water in order to avoid the ponding of water. Surface water shall be pumped immediately from the construction area after each rain and a firm subgrade maintained. In addition, the moisture content and density within the completed subgrade must be maintained until construction is complete.

(2) Foundations – Illumination Structures: Continuous observation of the construction of deep foundations shall be conducted by a representative of the geotechnical engineer. Checks shall be made to verify the proper diameter of the shaft, depth, cleaning and also confirm the nature of materials encountered in the excavations.

(3) Storm Sewer Pipe Bedding Treatment: Site preparation for the installation of the pipeline shall consist of scarifying the native soil to a depth of 8 inches, watering as necessary to bring to within plus or minus 2 percent of optimum moisture content and compacting. A minimum of 12 inches of granular bedding material shall be placed and compacted along the top and sides of the pipes. A minimum of 6 inches of granular bedding material shall be placed and compacted below the pipes. The granular bedding material shall be compacted to a density of not less than 90 percent of the maximum dry density. Moisture content at the time of compaction shall be within 2 percent of optimum as determined by ASTM D 1557.

(4) Compaction: All fill required beneath paved areas or fills required to support structural loadings shall be spread in layers not exceeding 8 inches, watered as necessary and compacted. Moisture content at the time of compaction shall be within plus or minus 2 percent of optimum moisture content. Compaction of the fill shall be accomplished by mechanical means only to obtain a density of not less than 95 percent of maximum dry density. Fill required outside of paved areas or fills not required to support structural loadings shall be compacted to 90 percent of maximum dry density. Optimum moisture content and maximum dry density for each soil type used shall be determined in accordance with ASTM D 1557. Where vibratory compaction equipment is used, it shall be the contractor's responsibility to insure that the vibrations do not damage nearby buildings or other adjacent property.

(5) Weather Limitations: Controlled fill shall not be constructed when the atmospheric temperature is below 35 degrees F. When the temperature falls below 35 degrees, it shall be the responsibility of

the contractor to protect all areas of completed surface against any detrimental effects of ground freezing by methods approved by the geotechnical engineer. Any areas that are damaged by freezing shall be reconditioned, reshaped and compacted by the contractor in conformance with the requirements of this specification without additional cost to the owner.

- D. Slope Protection & Drainage:** The edges of the controlled fill embankments shall be graded to the contours shown on the drawings and compacted to the density required in paragraph 5.C.(4). Embankment slopes steeper than 1 vertical to 3 horizontal shall be protected from erosion.

6. INSPECTION & TESTS

- A. Field Inspection & Testing:** The owner shall employ the services of a registered, licensed geotechnical engineer for consultation during all controlled earthwork operations. The geotechnical engineer shall provide continuous on-site observation and testing by experienced personnel during construction of controlled earthwork. The contractor shall notify the engineer at least two working days in advance of any field operations of the controlled earthwork, or of any resumption of operations after stoppages. Tests of fill materials and embankments will be made at the following suggested minimum rates:

(1) One field density test for each 250 lineal feet of roadway per 8 inch lift.

(2) One field density test for each 500 lineal feet of roadway per 8 inch lift in nonstructural areas for storm water pipe placement. In structural areas, one field density test for each 250 lineal feet of roadway per 8 inch lift for storm water pipe placement.

(3) One moisture-density curve for each type of material used, as indicated by sieve analysis and plasticity index.

- B. Report of Field Density Tests:** The geotechnical engineer shall submit, daily, the results of field density tests required by these specifications.
- C. Costs of Tests & Inspection:** The costs of tests, inspection and engineering, as specified in this section of the specifications, shall be borne by the owner.