LIMITED GEOTECHNICAL GENERAL SUBSURFACE SOIL EVALUATION REPORT

FOR

EL PASO WATER
GRISSOM LANE STORM SEWER IMPROVEMENTS PROJECT
EL PASO, EL PASO COUNTY, TEXAS
CQC PROJECT NO. AGCQC17-046

PREPARED FOR

CEA GROUP
4712 WOODROW BEAN, SUITE F
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- Construction Material Testing
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November 30, 2017 (Final Issued Report Date: January 15, 2018)

CEA Group
4712 Woodrow Bean, Ste. F
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Attn.: Mr. Abel Garcia, P.E.
Project Manager

Re: Limited General Subsurface Soils Evaluation Report
El Paso Water (EPW) – Grissom Lane Storm Sewer Improvements Project
El Paso, El Paso County, Texas
CEA Project No. 1040-026
CQC Project No.: AGCQC17-046

Dear Mr. Garcia,

In accordance with our agreement and scope of services under proposal PGCQC17-020, dated April 27, 2017 (Revised), CQC Testing and Engineering, L.L.C. (CQC) is pleased to provide **CEA Group (Client)** with this Limited General Subsurface Soils Evaluation Report for the above referenced El Paso Water (EPW, Owner) project. The preliminary results of our limited subsurface exploration borings was provided to our Client on September 13, 2017.

This report presents the results of our exploration borings, boring logs, laboratory engineering soil classification test results, soil bearing capacity values, and guidance information with respect to site preparation, storm sewer pipeline embedment, soil backfilling and trench safety considerations. Please note that at the time this report was completed, final plans and specifications for the complete design of the new drainage pipeline were not available for our review and consideration in the preparation of this report. It is recommended that once plans become available, be provided to CQC for review and/or modify our recommendations submitted in this report, if necessary. Modifications to our recommendations within this report shall be provided through a written supplemental technical-letter.

We look forward to working with the design team on the construction phase of the project. Thank you for selecting our firm for geotechnical consulting services, please feel free to contact us if you have any questions.

Respectfully Submitted,
CQC Testing and Engineering, L.L.C.
TBPE Firm Registration No. F-10632

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Section 1.0 – General Project Information

This limited general subsurface soils evaluation report has been prepared for CEA Group (Client) for the El Paso Water (EPW) – Grissom Lane Storm Sewer Improvements Project. Based on general information provided by our Client, the proposed project consists of the design and replacement of approximately 400 linear feet of a gravity storm sewer pipeline. The proposed pipeline is planned to start at the southwest area of Grissom Lane, transverse private residential properties towards the southwest to the intersection of Hunt Circle and McAffee Place in east El Paso, El Paso County, Texas.

We understand that open-cut methods shall be used to install the proposed pipeline, and that pipeline invert depths shall range between 5 feet and 10 feet below the existing surface elevation. It is our understanding that the installation of the storm sewer line shall require the removal of existing structures and excavations adjacent to existing residential buildings. Our original proposed scope of work included performing a limited observation of the existing structure conditions along the proposed storm sewer pipeline alignment and performing manual exploratory borings within the residential properties, however this scope of work was not approved by the owner. As a result, the geotechnical information presented within this report is limited to our observation and soil test results of the encountered soils within our subsurface exploration borings performed. This report does not include an observation and/or structural evaluation of the existing property, sitework structures and residential building conditions along the proposed storm sewer pipeline alignment.

Our specific limited scope of services for this project consisted of generally evaluating the subsurface soil conditions by collecting subsurface soils information at the initial and terminus limits of the pipeline, conducting Standard Penetration Tests (SPT's), and preparing soil related information with respect to the suitability of the on-site soils, engineering soil classification, bearing resistance, and potential construction use for pipeline backfilling.

The following sections of this report present our field evaluation methods, site soil-related considerations, estimated soil allowable bearing capacity values, and guidance information with respect to site preparation, structure embedment, soil backfilling, and trench safety considerations. Please note that the entire report should be read for a thorough understanding of our evaluation, findings, and guideline recommendations. CQC Testing and Engineering, L.L.C. (CQC) should be contacted through a written statement if our stated understanding of the project is not correct and/or if the owner changes the new storm sewer pipeline route for this project.

1.1 - Site Geologic Considerations

The Geologic Atlas of Texas (Van Horn-El Paso Sheet, Revised 1983) published by the Bureau of

Economic Geology at the University of Texas at Austin indicates that that the project site is located in an area of Bolson deposits (QTb) from the late Pleistocene era. These formations typically consist of areas of clay, silty, poorly graded sands, and gravel with interbedded layers of calcareous and gypsum material, and includes Gatuna formation of the Kent area. Calcareous gypsum soil formations shall be susceptible to collapse when saturated with moisture. The geologic map also indicates that the closest fault zone is located about three miles west the project site.

It has been reported that no significant ground movement caused by the existing faults has been recorded for the past 50 years in the El Paso area. Although the local seismic observatory at the University of Texas at El Paso (UTEP) has indicated that the frequency of recordable ground movements has increased within the last few years.

Please note that our scope of work did not include the specific delineation of faults within the project construction limits and/or the development of specific design recommendations over faults zones. However, these services may be provided as an additional scope of work and service to our Client, if required.

1.2 – Existing Site Conditions

As requested, our limited exploration vertical borings were performed at the initial and terminus of the proposed gravity storm sewer pipeline as shown in our Limited General Surface Exploration Boring Location Aerial Plan, Sheet A1 in Appendix A of this report. Our borings were located within sections of active streets paved with approximately three inches of asphaltic-concrete underlie by about two inches of base course material based on the observed pavement section materials within our borings. Based on our general review of satellite aerial imagery, the topography along the pipeline slopes from north to south approximately 15 to 20 feet in vertical difference. The residential subdivision development within the project area is over 40 years old.

CQC was not provided any historical or current topographic survey plans, design plans, construction reports or environmental reports for review from our Client. Therefore, CQC has no knowledge of the existing conditions along the pipeline alignment.

1.3 – Seismic Considerations

Based on our review of the current International Building Code and Site Classification for Seismic Design Definitions in conjunction with our review of the geologic conditions in the area, it is our professional opinion that a Site Class D may be used for this site. Please note that a geologic atlas of the area was used to supplement our analysis since our soil borings were performed to a maximum

depth of 10 feet below the existing ground surface elevations and the building code considers the average soil properties in the top 100 feet of the subject site. In the event that the owner and/or design representative is interested in determining the building code Site Class with a higher degree of accuracy, additional tests beyond our original requested scope of work shall be required.

Based on a Soil Site Class D, seismic ground motion values were determined based on a site latitude coordinate of 31.7852º and longitude coordinate of -106.4219º are defined in the table below. The seismic coefficients were generated through the USGS Seismic Hazard Curves & Uniform Hazard Response Spectra website. The values should be verified by the project civil engineer prior to use in structural analysis. CQC should be informed if the reported values vary significantly.

Table 1 – Seismic Ground Motion Values

Period (Seconds)	Spectral Accelerations (g)	Site Coefficient, F_a	Site Coefficient, F_v
0.2 (S_s)	0.365	1.508	-
1.0 (S_1)	0.111	-	2.355

Section 2.0 – Limited General Subsurface Soils Evaluation

As requested by our Client, the subsurface soils along the proposed storm sewer pipeline alignment were evaluated by completing a total of two (2) limited subsurface exploration vertical borings performed at the approximate locations shown in the Limited General Subsurface Exploration Boring Location Aerial Plan, Sheet A1.

The borings were drilled with a rotary drilling rig (CME-75) and hollow stem auger drilling techniques and were logged during our field operations by a trained member of our geotechnical engineering technical staff. Our boring logs are presented in Appendix A, Sheets A2 and A3. In general, the borings were drilled to a maximum depth of 10 feet each, below the existing pavement surface elevation.

During our drilling operations Standard Penetration Tests (SPT's) were performed in general conformance with ASTM D 1586. Soil samples were collected within a split-spoon sampler at discrete depth intervals and were containerized and transported to our laboratory for further observation and selection of samples for engineering soilclassification testing. Our laboratory engineering soil classification tests (i.e., moisture contents, sieve analysis, and Atterberg Limit Tests) were performed in accordance with accepted ASTM test procedures D 2216, D 1140, D 2217, D6913, and D 4318, respectively. In general, the results of our tests and estimated "N-Values" are presented in our boring logs and Summary of Field and Laboratory Engineering Soil Classification Test Results in Appendix A,

Sheet A8. At the completion of our subsurface exploration activities, the borings were backfilled with soil cuttings, firmly compacted at the ground surface, and patched with concrete.

The following table summarizes the completion depth of our borings, type of samples collected, and number of collected samples at the time of our subsurface exploration activities.

Table 2 – Summary of Field Evaluation – Boring Depths & Samples Collected

Summary of Subsurface Exploration Evaluation				
Borehole No.	**Approximate Termination Depth (ft.)**	**No. Split-Spoon Samples**	**No. Grab Samples**	**Observed Groundwater Depth (ft.)**
B-1	11½	5	--	NE
B-2	11½	5	--	NE

NE- Not encountered at the time of our drilling activities.

Contractors interested in bidding the project shall perform their own tests to verify the types of materials or review historical plans of the project area to evaluate the excavation requirements prior to bidding the project. The owner shall not incur additional costs for additional excavations or removal of encountered variable unclassified soils, heavy equipment required to penetrate the encountered subsurface soil formations, buried materials or utilities.

Please note that the collected soil samples from our soils evaluation shall be stored for a period of up to 60 days after the submittal of this report, if a longer period of storage is required by our client, CQC should be informed in writing.

2.1 - Laboratory Engineering Soil Classification Testing

In the laboratory, selected soil samples were evaluated and visually classified by our geotechnical engineering staff in general accordance with the Unified Soil Classification System (USCS). The geotechnical engineering properties of the selected samples were evaluated by the following tests.

Table 3 – Summary of Performed Laboratory Engineering Classification Tests

Type of Test	Total Number Conducted
Soil Moisture Contents	6
Atterberg Limit Tests	2
Particle Size Analysis Tests	4
Soil Moisture-Density Relationship Tests	2

Our selected sieve analysis test curves are reported in Appendix A, Sheets A4 through A7 in this report. A summary of our field and soil classification tests is reported in Appendix A, Sheet A8 for ease of reference.

2.2 – Soil Moisture-Density Relationship Test Results

At the time of our drilling activities, two (2) bulk subgrade soil samples were obtained from boring locations B-1 and B-2 for soil moisture density-relationship testing. The samples were collected from approximate depths ranging from below the pavement structure to about 5 feet below the existing ground surface elevation. The results of our soil moisture density relationship tests (i.e., proctor) conducted on the collected soil samples are presented in Appendix A, Sheets A9 and A10. The proctors were prepared in accordance with compaction test procedure ASTM D 1557, Method "B". The optimum dry density and moisture content values are presented in the table below.

Table 6 – Summary of Moisture-Density Relationship Test Results

Borehole No.	Sample Depth (ft)	Soil Classification	Opt. Dry Density (pcf)	Opt. Moisture (%)
B-1	½ - 5	SM	130.9	6.0
B-2	½ - 5	SM	127.8	5.9

Section 3.0 – Encountered Subsurface Soil Conditions

In general, the subsurface soils encountered at the pipeline initial and terminus locations may be described by two (2) generalized soil stratums. The logged depths of the reported soil formation types are approximately delineated in our subsurface exploration boring logs. The proposed gravity storm water pipeline embedment and backfill recommendations in Section 7.0 and Section 9.0 of this report should be reviewed and considered in the design and development of specifications for this pipeline replacement project. Our boring logs are presented in Appendix A of this report. It is possible for variations in the types and depths of the soil formations to occur than those reported in our borings logs. This is specifically true for this pipeline alignment since borings were not performed within the residential areas where the pipeline shall traverse.

Stratum I consists of non-plastic, fine to coarse grained, light brown to multicolored, silty sands and poorly graded sands with various amounts of silt. These soils were encountered in our borings at the approximate depths delineated in our boring logs. Based on our SPTs conducted in our borings, these soils were encountered at a very loose to medium dense relative density with SPT N-values ranging from 2 to 30 blows per foot of penetration. Measured moisture contents ranged from 3 and 7 percent. Based on our soil particle size analysis tests, these soils contain fines ranging from 9 to 24 percent. The encountered soils may be classified as SM or SP-SM in general accordance with the USCS. In general, these soils are anticipated to be Class II and III backfill soil materials.

Stratum II consisted of moderately plastic, brown, sandy lean clays. These soils were encountered at a stiff consistency and only in Boring B-1 at an approximate depth of 7½ feet. A measured moisture content was 15 percent, and a single Atterberg Limit test indicated that the clay soils exhibited a liquid limit of 27 and a plasticity index of 12. Our particle size analysis test indicated that these soils contained fines of about 50 percent. Stratum II clay soils may be classified as CL in general accordance with the USCS and Class IV materials in accordance with ASTM. These soils are not considered suitable for use as Select Fill and backfill soil materials for the project pipeline excavations. It should be anticipated that these soils shall have to be replaced or blended with suitable native sand soils or imported Select Fill as classified in Section 9.0 of this report.

Bidding contractors shall anticipate that import of suitable backfill soil materials shall be required to meet the specified backfill soil requirements for the pipe embedment zone and pipe zone.

3.1 - Groundwater Depth Considerations

At the time of our drilling operations groundwater and/or water seepage was not observed or encountered in our boring logs. Based on our geotechnical field experience in this area, the static groundwater elevation is well below the anticipated maximum excavation depth of 11½ feet for this project. However, it is possible to encounter shallower perched water zones and flowing water zones where relatively high permeability soils overlay low permeability soils or after periods of significant precipitation. If encountered, flowing water seepage may be associated with the irrigation of the residential property landscaping. If water seepage is encountered provisions may include the excavation of a temporary diversion pit to collect water seepage away from the pipeline alignment to allow construction to proceed. Collected water within the excavation pit may be appropriately pumped out and re-directed as approved by EPW or design engineer. The portion of the pipeline exposed to water seepage may be installed in accordance with standard pipeline installation below groundwater conditions. Other methods to bridge-over water seepage may also include the installation of suitable Controlled Low Strength Materials (CLSM) or approved gravel rock. The proposed CLSM or gravel rock should be approved by the engineer of record through a submittal process. In any event, CQC should be immediately contacted to perform site observation of the noted conditions to develop additional recommendations, if necessary. Workers shall be prohibited from working in excavations where water has accumulated or is accumulating.

3.2 - Subsurface Soil Considerations and Preparation

The following section presents specific conditions that we have observed during our evaluation that should be considered by the owner, owner's design team and contractors interested in bidding the project with respect to earthwork estimates and operations.

Special Considerations

- Site work and backfilling should be performed in accordance with the following sections of this report or as required by the project specifications and plans, whichever is more stringent.

- When placing backfill within utility line trenches or during the installation of the new pipelines, backfill materials should be appropriately placed and compacted to mitigate potential settlements caused by uncontrolled backfill during construction. The contractor should adequately overexcavate areas and backfill pipeline trenches with approved Select backfill soils, or as required by the project plans and specifications. Select Fill material specifications are presented in Section 9.0 of this report.

- Bidding general contractors shall be responsible for conducting their own tests to verify the actual depths of the soil formations and types within the project limits to perform earthwork. This is specifically true for this project, since borings were limited to areas outside of the residential properties. The owner shall not incur additional costs for variations in the soil formations within the project limits and/or additional excavation requirements by the contractor. The boring logs in this report are intended for engineering design purposes. Bidding contractors may consider the information presented in this report at their own risk. If deemed necessary, bidding contractors shall perform additional borings and/or test pits for use and/or interpretation for earthwork estimates that comply with the project specifications prior to bidding.

- Based on our soil boring logs and soil classification tests, the soils encountered within the proposed storn sewer pipeline alignment should be considered Type "C" soils under current Occupational Safety and Health Administration (OSHA) regulations (Standard – 29 CFR-Part 1926.650, Subpart P-Excavations) pertaining to excavations. In excavations penetrating these soils, the non-permanent sloping and benching schemes specified for Type "C" soils under the OSHA regulations require that the excavation sidewalls be sloped no steeper than 1½:1 (horizontal: vertical) for Type "C" soils. Trenches or excavations 4 feet and deeper shall require the development of a trench safety plan to protect employees and the general public. Please note that it is the contractor's responsibility to assign a "competent" person to perform daily inspections and required documentation in accordance with OSHA regulations. In addition, OSHA limits excavations to 20 feet when excavations utilize soil benching and sloping methods and braced/shored trench box (i.e., rated) shielded systems designed by a licensed professional engineer. Trench excavations utilizing sheet piling systems or un-braced temporary shielded systems per OSHA regulations shall be designed by a licensed professional engineer for any excavation depth in consideration to protect the health and safety of all workers and the public.

- Based on our observations of the pipeline alignment locations and access considerations within the residential properties, we anticipate that the contractor may be required to use rated braced trench box systems to install the pipeline. As a result, the contractor shall be responsible for preparing a trench safety plan prior to construction with applicable manufacturer's trench box system specifications for submittal to the engineer for compliance with the project specifications.

The trench safety plan shall be performed by a licensed professional engineer. In the event that braced sheet piling is utilized, the sheet piling design and specified depths shall be determined by a licensed professional engineer and submitted to the engineer for review and documentation for any depth in consideration. This report provides general trench safety considerations for the project under report sections below.

Site Preparation

- The existing soils at this site that will support approved compacted Select Backfill materials and the new pipeline should be cleared of all vegetation, organic matter, topsoil, construction debris and/or any foreign matter. The cleared subgrade should be thoroughly compacted in order to densify any weak and compressible zones. The finished subgrade should be compacted to a minimum of 90 percent of maximum dry density per ASTM D-1557 and maintained within ±3 percent of optimum moisture and/or as required by the project specifications, whichever is more stringent. Weak or compressible soil zones identified during fill operations should be reprocessed or over excavated, removed and replaced with specified compacted "Select Fill" to a minimum depth of 8 inches or as required to appropriately bridge over these soils, whichever is deeper. Subgrade preparation operations should be observed by a representative of CQC.

- Suitable fill or backfill materials should be appropriately tested at standard frequencies as recommended in this report and/or as required by the project specifications, whichever is more stringent.

3.3 - Drainage Considerations

Drainage is an important key to the successful performance of any excavation and soil supported structure. Positive surface drainage should be established prior to and be maintained during and after construction to prevent water from ponding within or adjacent to the pipeline trenches. It is also possible for sinkholes to be created if pipeline trenches are left open during periods of significant rainfall events especially in sites that have significant vertical changes in elevation.

Section 4.0 – Soil Bearing Capacity and Design Considerations

4.1 – Pipeline Design Considerations

The encountered subsurface soils at the anticipated water line invert elevations shall provide relatively low to moderate allowable bearing capacity values. Based on our SPT data, the encountered subsurface soils shall provide allowable bearing capacities ranging from 850 to 1,500 pounds per square foot (psf), anticipating that the pipeline shall be at least 5 to 10 feet below existing ground. The recommendations in the following sections of this report should be considered in the design of the pipeline associated structures, pipeline embedment and backfilling.

4.2 - Earth Loads

The pipe analysis and design should consider the earth loads, fluid pressure, pipe laying methods, internal pressure, bending stresses, and estimated pipe deflections. The following soil related design parameters may be considered in the pipe design analysis. The design criteria equations in the current specifications of the American Water Work Association (AWWA) should be considered for design analysis. CQC should be contacted if additional soil related information is required to supplement pipeline design and analysis.

- **Soil Related Design Parameters**

  γ_s = Design Soil Total unit weight, lb/ft^3 – no less than 135 lb/ft

  E' = Modulus of Soil Reaction, psi - 500 for Type 4 laying conditions per AWWA specs.

  D = Soil Group – Fine Grained Soils, medium to no plasticity, LL less than 50%

4.3 – Thrust Blocks

We anticipate that thrust blocks shall be specified at curves and turns of the proposed pipeline, a passive earth resistance of 85 to 150 pounds per cubic foot may be used for design purposes. Thrust blocks should bear solidly against undisturbed trench walls in all directions.

Section 5.0 – Below Grade Lateral Earth Pressures

The tables below present at-rest (K_o) and active (K_a) pressure coefficients for select backfill soils. The K_o pressures are recommended for cases where the structure will experience little yield. Select backfill soils should meet the requirements of Select Fill as included in Sections below or as required by the project specifications, whichever is more stringent.

Table 7 – Lateral Earth Pressure Coefficients

Earth Pressure Coefficients (Cont.)						
Soil Type	**Estimated Total Unit Weight (pcf)**	**Presumptive Soil Angle of Internal Friction (deg)**	**Lateral Earth Pressure Coefficients**	**Lateral Earth Pressure Coefficients**	**Equivalent Fluid Weight (pcf)**	**Equivalent Fluid Weight (pcf)**
			At-Rest (K_o)	**Active (K_a)**	**At-Rest (K_o)**	**Active (K_a)**
Structural Fill – Aggregate Base Course	145 – 148	39 - 42	0.37 - 0.33	0.22 - 0.20	54 – 48	32 - 30
Select Fill Soils (PI<12)	120 - 127	29 - 32	0.51 - 0.47	0.34 - 0.31	61- 60	41 - 39
Clayey or Silty Sands	117 – 122	27 – 31	0.55 - 0.48	0.37 - 0.32	64 – 59	43 - 39
Poorly Graded Sands	115 - 125	25 – 30	0.57 - 0.50	0.41 - 0.33	65 – 62	47 - 41

The lateral pressure with depth may be estimated with the following equation;

$$P_s = K_o \gamma_s (H-H_w) + K_o(\gamma_s - \gamma_w) Hw + \gamma_w H_w + q K_o$$

Where; P = lateral earth pressure at calculated depth, psf
K_o = At-rest lateral earth pressure coefficient (typically used for long-term cases)
γ_s = Total wet unit weight of soil, pcf
H = Depth of structure from ground surface to calculated depth, ft
H_w = Positive vertical downward depth of water from reported highest depth.
Note: When calculation depth is above reported water depth, then $H_w = 0$

γ_w = Unit weight of water, pcf
q = Surcharge pressure, psf (typically only considered to 20 feet)
light loads (i.e., pedestrians and soil stockpiles) – 50 psf,
moderate (i.e., light equipment) – 150 psf,
heavy (i.e., heavy duty equipment) – 250 psf or more

Section 6.0 – General Trench Safety Considerations

The following report sections present general trench safety excavation considerations.

6.1 – Trench Safety Considerations

Trench excavations of more than 4 feet in depth and extending to a maximum depth of 20 feet may be supported with shielded systems in accordance with OSHA regulations. Shielded systems, such as trench boxes, should not be subjected to loads exceeding those which the system was designed to withstand. Shields may be stacked, provided that they are installed in a manner to resist lateral displacements or other hazardous movements of the shield in the event of sudden changes in lateral loads, such as sidewall collapse, or impact from excavation equipment or any other potential force. Braced Trench Box Systems may also be utilized for excavations extending to a maximum depth of 20

feet, provided that they are designed and rated for the specific excavation depths and soil materials.

Employees shall not be allowed in shielded trenches when shields are being installed, removed, or moved vertically or horizontally. Employees should not be permitted in trenches that show possible loss of soil from behind or below the bottom of the shield. Hard hats and warning vests or other highly visible Personal Protection Equipment (PPE) should be worn by all employees.

Surface encumbrances, such as boulders and vegetation, located so as to create a hazard to employees involved in excavation work or in the vicinity thereof at any time during operations, shall be removed, properly supported or made safe before excavation begins. Existing underground utility lines shall be located prior to performing excavations and protected during excavation construction. Excavations should not undermine existing structures and should be at least 10 feet from the toe of any structure.

When mobile equipment is operated adjacent to an excavation, a warning system should be utilized such as barricades, hand or mechanical signals, or stop logs.

Properly designed means of access and egress from excavations should be provided for employees. Structural members used as ramps and/or runways over excavations 6 feet or more in depth should be equipped with guardrails and should be uniform in thickness and supported properly to prevent displacements. Stairways, ladders, ramps, or other safe means of egress shall be located in trench excavations that are 4 feet in depth or more in depth so as to require no more than 25 feet of lateral travel for employees.

A “competent person” shall inspect and document the excavation conditions trench systems and equipment daily and notify the contractor's superintendent of any conditions which may adversely affect the reliability and safety of the excavation. The excavations shall also be inspected after each rainstorm or when any changes in conditions occur that can increase the possibility of a cave-in or slide. If evidence of possible cave-ins or slides is apparent, all work in the excavation shall cease until the necessary precautions for sloping or bracing have been taken to safeguard the employees and trench. Any loose soil shall be scaled from the slope and removed from the excavation to protect workers against falling soil.

As applicable, the atmosphere within a trench deeper than 4 feet shall be tested when there is a possibility of oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or build-up of hazardous gases. Ventilation should be provided to prevent flammable gas build-up to 20 percent of lower explosive limit of the gas. In addition, testing should be conducted as often as necessary to ensure that the atmosphere remains safe. Emergency rescue procedures and equipment should be readily available at all times, especially where hazardous atmospheric conditions could exist or develop during

work in an excavation. Employees entering deep confined excavations should wear a safety harness with a lifeline securely attached to the harness.

A health and safety plan and emergency rescue plan should be established and maintained by the general contractor at all times during the project. In the event of an injury or emergency situation, it is imperative to follow all guidelines as detailed in the most recent OSHA Standards for the Construction Industry Manual, including completion of all necessary forms, accident procedures, and report documentation. After rescue operations are implemented the accident area should be closed off and made safe until an OSHA inspector visits the site and documents conditions after immediate notification. This emergency contact information should be posted on the site at all times during excavation activities.

Excavations of earth material to a level not greater than 2 feet below the bottom of a shield may be permitted, provided that the soil sidewalls are stable. Shields should extend to a minimum of 18 inches above the top of the vertical side or crest of the excavation.

The trench box system should be used in accordance with the Manufacturer's recommendations in accordance with the requirements of a trench safety plan and current OSHA regulations. Excavation safety systems for trenches shall be designed by a licensed professional engineer for all anticipated depths for this project.

It shall be the contractor's responsibility to document and record all daily excavation activities in accordance with OSHA regulations. CQC and our Client shall have no liability for the selected means and methods utilized by the contractor to perform excavations. This is especially true for this project, since excavations shall be performed adjacent to existing residential structures.

Section 7.0 – Pipe Backfill Considerations

As indicated above, the following recommendations should be considered in the design of the pipeline embedment and backfilling specifications.

Bidding contractors shall anticipate that import of suitable backfill soil materials shall be required to meet the specified backfill soil requirements for the pipe embedment zone and pipe zone depending on the selected type of pipe and manufacturer. The backfill materials should be moisture conditioned to ±3 percent of optimum moisture content and compacted to a minimum of 90 percent of maximum density as determined by ASTM D-1557 laboratory compaction procedures. The trench backfill materials should be placed to 24 inches below the finished subgrade elevation. The suitable fill materials below 24 inches of the finished grade elevations should achieve a minimum compaction of 95 percent as per ASTM D-1557 or as required by the project specifications. The use of vibratory equipment to east compaction shall be strictly limited for this project due to existing residential structures.

Section 8.0 – Additional Design and Construction Considerations

In excavations adjacent to existing structures, precautions should be taken not to undermine or damage existing structures, footings, and/or utility lines. Precautions should be taken to prevent distresses to nearby existing structures. This is specifically true for this proposed pipeline alignment.

As typically expected with construction activities and pipeline excavation projects, a degree of vibratory impacts should be expected. Our scope of work did not include an assessment of the condition of residential structures or facilities adjacent to the pipeline project limits nor opinions or statements of potential impacts. In accordance with the typical provisions of construction contracts the general contractor shall be responsible for monitoring of existing structures. As required the general contractor shall develop a vibration and ground settlement monitoring plan before, during the course of construction and after all construction activities have been completed at the project site. The plan may include the set-up of an array of monitoring points near the pipeline alignment and at radial distances from construction activities to monitor potential ground movements. It is recommended that the general contractor retain the services of a licensed professional engineer or geologist to develop a monitoring plan and provide site monitoring services as needed. It may be necessary for the contractor to establish a contingency plan for observed movements of adjacent structures. The development of a settlement monitoring program was beyond our scope of work; however, we may meet with our Client and owner to further discuss this issue, as required. The US Bureau of Mines, FHWA – "Geotechnical Instrumentation for Monitoring Field Performance" manual and ASCE publications may be referenced to establish a monitoring plan and set maximum vibration peak particle velocity and frequency thresholds to ensure that vibrations are maintained below these limits during construction.

Section 9.0 – Project Specification Information

9.1 - Fill Materials

Select Fill soils shall consist of granular clayey, silty sands or sandy clayey, silty gravel mixtures, free of clay lumps, deleterious materials, organic material, vegetation, cobbles or boulders over 3 inches in nominal size. The Select Fill shall have a liquid limit less than 35 and a plasticity index of 12 or less. The Select Fill shall also exhibit an optimum dry density of at least 120 pcf determined per ASTM D 1557. Select Fill soils shall also meet the gradation requirements below.

Table 8 – Select Fill Gradation Requirements

Sieve Size (square opening)	% Passing by Weight
3-inch	100
3/4-inch	75 – 100
No. 4	40 – 100
No. 200	5 – 40, +5%

Select Fill soils should classify as SP-SM, SM, SC, SC-SM, GM, GC, GC-GM, GP-GM, and GP-GC in accordance with the USCS. It is not recommended that Select Fill consist of recycled concrete base material or slag unless approved by the engineer of record.

Native Fill Soil shall consist of granular clayey, silty sands or sandy gravel mixtures, free of clay lumps, deleterious materials, vegetation, organic material, cobbles or boulders over 3 inches in nominal size. The Native Fill soils shall have a liquid limit less than 35 and a plasticity index less than 15. Native Fill soils shall meet the gradation requirements below.

Table 9 – Native Fill Soil Gradation Requirements

Sieve Size (square opening)	% Passing by Weight
3-inch	100
3/4-inch	70 – 100
No. 4	45 – 100
No. 200	3 – 45

Native Fill soils classified in the following list according to the USCS may be considered satisfactory for use: SM, SW, SC, SP-SM, SP-SC, SC-SM, GW, GP, GM, GC, GP-GM and GP-GC, provided that these soils also meet the requirements above.

It is recommended that on-site soils classified as SP be blended with low-plasticity clayey sands or as appropriate to mitigate potential soil sloughing during excavations in these types of soils and to create a relatively stable blended soil material that exhibits adequate bearing capacity. The blended soils should meet the requirements of Native Fill above.

Soils classified as CH, CL, MH, ML, OH, OL and PT or a combinations of these under the USCS classification and soils that exhibit a plasticity index greater than 15 are not considered suitable for use as Native Fill and Select Fill soil materials.

The following soil backfill classifications are typically designated for pipeline backfill soil materials. **It is not recommended that slag be utilized for the backfill material unless approved by the**

engineer of record. Class I, Class II, Class III, and Class IV materials may be defined as follows:

- **CLASS I** material may be manufactured angular, well-graded, crushed stone per ASTM D-2321 with a maximum particle size of 1½ inches. The following materials shall be acceptable under this class designation: ASTM D-448 – Stone Sizes 4, 46, 5, 56, 57, and 6. Pea Gravel and other uniformly graded material are not acceptable under this class. A gradation of Class I material shall be submitted by the Contractor to the Engineer for approval prior to use.
- **CLASS II** material may be coarse sands and gravels per ASTM D-2487 with maximum particle size of 1½ inches, including variously graded sands and gravels, containing less than 12 percent fines (material passing the #200 sieve) generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class. (i.e., typically required within pipe zone). Proposed Class II material shall be submitted by the Contractor to the Engineer for evaluation and approval prior to use.
- **CLASS III** material may be fine sands, clayey sand mixtures, clayey gravel and sand mixtures, suitable clean native sands and gravels. Class III materials shall also be free of clay lumps, deleterious materials, cobbles or boulders over 3-inches in nominal size. Class III materials should have a liquid limit less than 35 and a plasticity index less than or equal to 12 and exhibit an optimum dry density of at least 115 pcf. Soils classified in the following list according to the USCS and ASTM may be considered satisfactory for use as Class III backfill soil materials above the pipe zone as approved by the project engineer of record: SM, SW, SC, SP-SM, SP-SC, SC-SM, GW, GP, GM, GC, GP-GM and GP-GC. Proposed Class III material shall be submitted by the Contractor to the Engineer for evaluation and approval prior to use.
- **CLASS IV and V** material may be classified as CH, CL, MH, ML, OH, OL and PT under the USCS. These soils shall not be used as backfill materials, unless approved by the engineer of record.

9.2 - Construction Materials Testing

We recommend that construction materials inspection and testing of site work, fill placement, excavations, concrete placement, and all other applicable materials and structures be performed by CQC. The contractor shall perform testing in accordance with the guidelines presented above and/or as required by the project specifications, whichever is more stringent. The specification testing program should include the following testing frequencies as a minimum:

1. At least one (1) Laboratory Compaction Characteristics of Soil using Modified or Standard Effort (Proctor) for each type of material encountered or imported material to be used, according to

ASTM D-1557 or as required by the project specifications. Additional soil samples for testing shall be requested by the G.C. during the course of earthwork operations to ensure that the fill materials are maintained consistently within the specified requirements.

2. At least one (1) Soil Classification (Sieve Analysis and Atterberg Limits Test) for each type of material encountered or import material used, according to ASTM D 6913 and D-4318. Additional soil samples for testing shall be requested by the G.C. during the course of earthwork operations to ensure that the fill materials are maintained consistently within the specified requirements.

3. A minimum of one (1) density test per 8-inch lift at 150 lineal feet spacings for pipe bedding and soil backfilling operations, according to ASTM D 6938 or D-1556.

4. Sampling and testing for quality assurance of placed **concrete** or **2-Sack** materials should be performed for the project. Concrete field testing shall include testing for temperature, slump and air content (if required). The design strength of the concrete mix shall be evaluated by collecting cylindrical concrete compression test specimens for lab curing and testing in accordance with applicable ASTM procedures. At least one set of four (4) 6-inch x 12-inch or 4-inch x 8-inch concrete cylinders should be collected for every 50 cubic yards or less of placed concrete or as directed by the project engineer. The concrete specimens should be tested at 7 days (1 cylinder) and 28 days (3 cylinders) for verification of the specified design compressive strength or as directed by the project specifications. The ACI guidelines for hot weather and cold weather concreting should be followed to mitigate the potential poor performance of the concrete materials during significant periods of high (above 95° F) and low (below 35° F) temperatures.

Section 10.0 – Soils Evaluation Considerations and Limitations

The analysis and recommendations in this report are based on the data obtained from a total of two (2) soil boring logs performed at the approximate locations indicated on the attached General Exploration Boring Location Aerial Plan, Sheets A1. This report may not reflect all the subsurface soil variations that may occur near and/or between the soil boring logs. The nature and extent of the variations may not become evident until during the course of construction. If variations appear during construction, CQC should be contacted immediately, it may be necessary to re-evaluate our information and/or recommendations provided within this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations. No other information relevant to the project site history or known conditions of concern were discussed or disclosed to CQC by our Client or Owner.

The scope of our soil evaluation did not include surveying services, ground water study, slope stability analysis, landslide analysis, preparation of engineering plans, specifications, cost estimates, an environmental assessment of the property's air, soil, water, site fault delineation and evaluation, preparation of a dewatering plan, trench safety and/or shoring plan, delineation of subsurface flowing water or rock conditions either on or adjacent to the pipeline limits, therefore no opinions and/or conclusions are presented in this report. Our geotechnical scope of work for this site did not include an

environmental assessment or chemical testing and analysis of the subsurface soils.

Section 11.0 – General List of Technical References

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2.) Coduto, Donald P. (1994). *Foundation Design: Principles and Practices.* Englewood, NJ: Prentice-Hall, Inc.

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4.) Holtz, Robert D., Kovacs, William D. (1981). *An Introduction to Geotechnical Engineering.* Englewood Cliffs, NJ: Prentice-Hall, Inc.

5.) Bowles, Joseph E. (1996). *Foundation Analysis and Design.* 5th edition. New York: The McGraw-Hill Companies, Inc.

6.) International Code Council, Inc. *International Building Code.* Country Club, IL: International Code Council, Inc.

7.) U.S. Department of Labor-Occupational Safety and Health Administration (OSHA). *Part 1926 – Safety and Health Regulations for Construction.* Washington, DC.

8.) American Concrete Institute. *ACI Manual of Concrete Practice Part 2: Construction Practices and Inspection Pavements.* Farmington Hills, MI: American Concrete Institute

9.) American Society for Testing and Materials Standard D 6151. *Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling.* Volume 04.09. West Conshohocken, PA: ASTM International

10.) American Society for Testing and Materials Standard D 2113. *Standard Practice for Rock Core Drilling and Sampling of Rock for Site Evaluation.* Volume 04.08. West Conshohocken, PA: ASTM International

11.) American Society for Testing and Materials Standard D 6914. *Standard Practice for Sonic Drilling for Site Characterization and the Installation of Subsurface Monitoring Devices.* Volume 04.09. West Conshohocken, PA: ASTM International

12.) American Society for Testing and Materials Standard D 5434. *Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock.* Volume 04.08. West Conshohocken, PA: ASTM International

13.) American Society for Testing and Materials Standard D 1586. *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.* Volume 04.08. West Conshohocken, PA: ASTM International

14.) American Society for Testing and Materials Standard D 422. *Standard Test Method for Particle-Size Analysis of Soil.* Volume 04.08. West Conshohocken, PA: ASTM International

15.) American Society for Testing and Materials Standard D 698. *Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3).* Volume 04.08. West Conshohocken, PA: ASTM International

16.) American Society for Testing and Materials Standard D 1140. *Standard Test Method for Amount of Material in Soils Finer than No. 200 (75µm) Sieve.* Volume 04.08. West Conshohocken, PA: ASTM International

17.) American Society for Testing and Materials Standard D 1556. *Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone.* Volume 04.08. West Conshohocken, PA: ASTM International

18.) American Society for Testing and Materials Standard D 1557. *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3).* Volume 04.08. West Conshohocken, PA: ASTM International

19.) American Society for Testing and Materials Standard D 2216. *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.* Volume 04.08. West Conshohocken, PA: ASTM International

20.) American Society for Testing and Materials Standard D 4318. *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.* Volume 04.08. West Conshohocken, PA: ASTM International

21.) American Society for Testing and Materials Standard D 6913. *Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.* Volume 04.08. West Conshohocken, PA: ASTM International

22.) American Society for Testing and Materials Standard D 6938. *Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).* Volume 04.08. West Conshohocken, PA: ASTM International

23.) American Society for Testing and Materials Standard C136. *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.* Volume 04.02. West Conshohocken, PA: ASTM International

24.) American Society for Testing and Materials Standard C131. *Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.* Volume 04.02. West Conshohocken, PA: ASTM International

25.) American Society for Testing and Materials Standard C117. *Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.* Volume 04.02. West Conshohocken, PA: ASTM International

26.) American Society for Testing and Materials Standard D2950. *Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.* Volume 04.03. West Conshohocken, PA: ASTM International

27.) American Society for Testing and Materials Standard D6307. *Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method.* Volume 04.03. West Conshohocken, PA: ASTM International

28.) American Society for Testing and Materials Standard D5444. *Standard Test Method for Mechanical Size Analysis of Extracted Aggregate.* Volume 04.03. West Conshohocken, PA: ASTM International

29.) American Society for Testing and Materials Standard D2041. *Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.* Volume 04.03. West Conshohocken, PA: ASTM International

30.) American Society for Testing and Materials Standard D2726. *Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.* Volume 04.03. West Conshohocken, PA: ASTM International

31.) American Society for Testing and Materials Standard D6927. *Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures.* Volume 04.03. West Conshohocken, PA: ASTM International

32.) American Society for Testing and Materials Standard D6307. *Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.* Volume 04.03. West Conshohocken, PA: ASTM International

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34.) American Association of State Highway and Transportation Officials. *Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Part 2B: Tests.* 30th Edition. Washington, DC: American Association of State Highway and Transportation Officials

35.) Texas Department of Transportation. (November 2014). *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.* Austin, TX: Texas Department of Transportation

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D:\Dropbox\CQC Files\CQC Working Files\GEO\Reports\2017\17-046 EPW-Grissom and Hunt Storm Sewer Imp (CEA Group)\07-Final Report Docs\17-046-Final Report 1 15 18.docx

APPENDIX A

construction quality control
testing and engineering

Limited General Subsurface Exploration
Boring Location Aerial Plan

El Paso Water (EPW) –
Grissom Lane Storm Sewer Improvements Project
El Paso, El Paso County, Texas

Client: CEA Group	
CQC Project No. AGCQC17-046	
Scale: NTS	Check by: ME
Date: 11/30/17	Sheet A1

CQC Testing and Engineering LLC-TBPE Firm No. F-10632
4606 Titanic Avenue
El Paso, Texas 79904
Ph: (915) 771-7766
Fx: (915) 771-7786

BORING NUMBER B-1

CLIENT CEA Group
PROJECT NAME EPW - Grissom Storm Sewer Improvements Project
PROJECT NUMBER AGCQC17-046
PROJECT LOCATION Grissom Lane and Hunt Court, El Paso, Texas
DATE STARTED 8/30/17 **COMPLETED** 8/30/17
GROUND ELEVATION Ext. Grade **HOLE SIZE** 6 inches
DRILLING CONTRACTOR T.D.
GROUND WATER LEVELS:
DRILLING METHOD CME-75 w/3-1/4" ID HSA
AT TIME OF DRILLING None Encountered
LOGGED BY JA **CHECKED BY** CS
AT END OF DRILLING ---
NOTES Boring Location: See Attached Boring Location Plan, Sheet A1
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -4	% -200	% Moisture Content	PI (LL-PL)	USCS
0.0			Asphaltic-Concrete Pavement - Approx. 3 in. thick Apparent Base Course Mat. - Approx. 2 in. thick						
	SS 1		SAND, Fine to Coarse Grained, Silty, Brown to Multicolored, Medium Dense to Very Loose, Moist with silt.	5-10-10 (20)			7		
2.5	SS 2		- Loose soils from approximately 2-1/2 feet to 7-1/2 feet shall be susceptible to soil sloughing and elastic settlement.	2-2-2 (4)					
5.0	SS 3			1-1-1 (2)	99	12	7	NP	SM
7.5	SS 4		CLAY, Lean, Sandy, Brown, Stiff, Moist. SAND, Fine to Coarse Grained, Poorly Graded, Brown to Multicolored, Medium Dense, Moist with silt.	6-5-8 (13)	91	50	15	12	CL
10.0	SS 5		NOTE: SS - Split Spoon Sample	3-9-9 (18)					
			Bottom of hole at 11.5 feet.						

SPT N VALUE
10 20 30 40
PL MC LL
20 40 60 80
% - 200
20 40 60 80

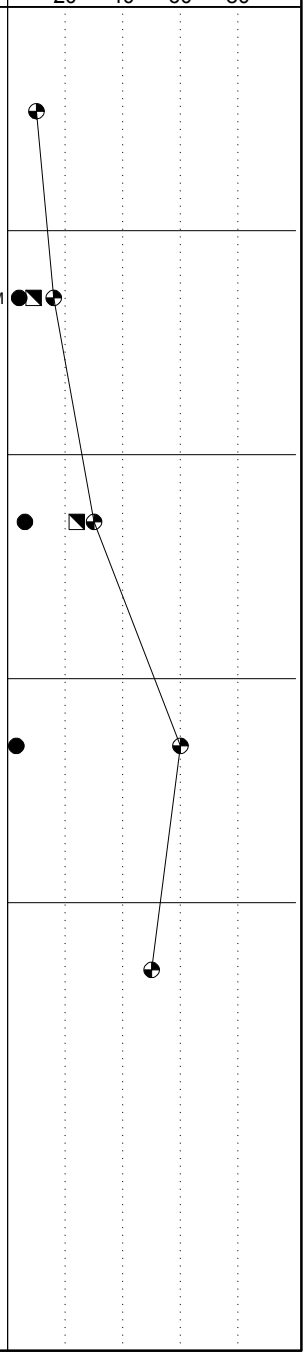
CQC Testing and Engineering LLC-TBPE Firm No. F-10632
4606 Titanic Avenue
El Paso, Texas 79904
Ph: (915) 771-7766
Fx: (915) 771-7786

BORING NUMBER B-2

CLIENT CEA Group
PROJECT NAME EPW - Grissom Storm Sewer Improvements Project
PROJECT NUMBER AGCQC17-046
PROJECT LOCATION Grissom Lane and Hunt Court, El Paso, Texas
DATE STARTED 8/30/17 **COMPLETED** 8/30/17
GROUND ELEVATION Ext. Grade **HOLE SIZE** 6 inches
DRILLING CONTRACTOR T.D.
GROUND WATER LEVELS:
DRILLING METHOD CME-75 w/3-1/4" ID HSA
AT TIME OF DRILLING None Encountered
LOGGED BY JA **CHECKED BY** CS
AT END OF DRILLING ---
NOTES Boring Location: See Attached Boring Location Plan, Sheet A1
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -4	% -200	% Moisture Content	PI (LL-PL)	USCS
0.0			Asphaltic-Concrete Pavement - Approx. 3 in. thick Apparent Base Course Mat. - Approx. 2 in. thick						
	SS 1		SAND, Fine to Coarse Grained, Poorly Graded, Brown to Multicolored, Loose, Slightly Moist with silt. - These sands shall be susceptible to soil sloughing and elastic settlement.	4-3-2 (5)					
2.5									
	SS 2			3-4-4 (8)	92	9	4	NP	SP-SM
5.0									
	SS 3		SAND, Fine to Coarse Grained, Silty, Brown, Medium Dense, Slightly Moist.	5-7-8 (15)	96	24	6	NP	SM
7.5									
	SS 4		SAND, Fine to Coarse Grained, Poorly Graded, Brown to Multicolored, Medium Dense, Slightly Moist with silt.	6-14-16 (30)			3		
10.0									
	SS 5			4-10-15 (25)					
			NOTE: SS - Split Spoon Sample						
			Bottom of hole at 11.5 feet.						

SPT N VALUE
10 20 30 40
PL MC LL
20 40 60 80
% - 200
20 40 60 80



THE BORING LOGS PRESENTED SHOULD NOT BE SEPARATED FROM THE REPORT

CQC STANDARD LOG 17-046-LOGS.GPJ CQC2014.GDT

SOIL SAMPLE PARTICLE SIZE ANALYSIS TEST REPORT

PROJECT NO.: AGCQC17-046

PROJECT NAME: Limited General Subsurface Soils Evaluation
EPW - Grissom Lane Storm Sewer Improvements Project
Grissom Lane and Hunt Court
El Paso, El Paso County, Texas

SAMPLE INFORMATION

SAMPLE DATE: 8/30/2017 **SAMPLE NO.:** S-3

BORING NO.: B-1 **SAMPLE DEPTH:** 5' - 6½'

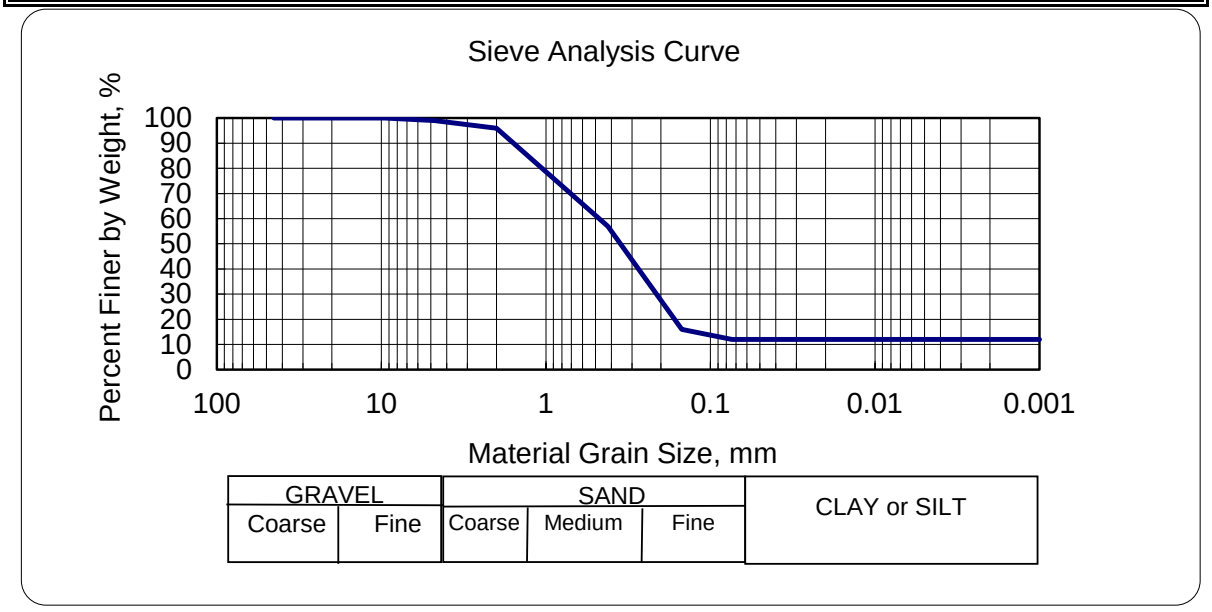
SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils / SAND, Fine to Coarse Grained, Silty, Sand, Brown to Multicolored with silt

ANALYSIS TEST RESULTS

Sieve Analysis Test:

Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
1-3/4 inches	0	100
1-1/2 inches	0	100
1 inch	0	100
3/4 inch	0	100
1/2 inch	0	100
3/8 inch	0	100
No. 4	1	99
No. 10	4	96
No. 40	43	57
No. 100	84	16
No. 200	88	12
0.005 mm	-	-
0.001 mm	-	-



SOIL SAMPLE PARTICLE SIZE ANALYSIS TEST REPORT

PROJECT NO.: AGCQC17-046

PROJECT NAME: Limited General Subsurface Soils Evaluation
EPW - Grissom Lane Storm Sewer Improvements Project
Grissom Lane and Hunt Court
El Paso, El Paso County, Texas

SAMPLE INFORMATION

SAMPLE DATE: 8/30/2017 **SAMPLE NO.:** S-4

BORING NO.: B-1 **SAMPLE DEPTH:** 7½' - 9'

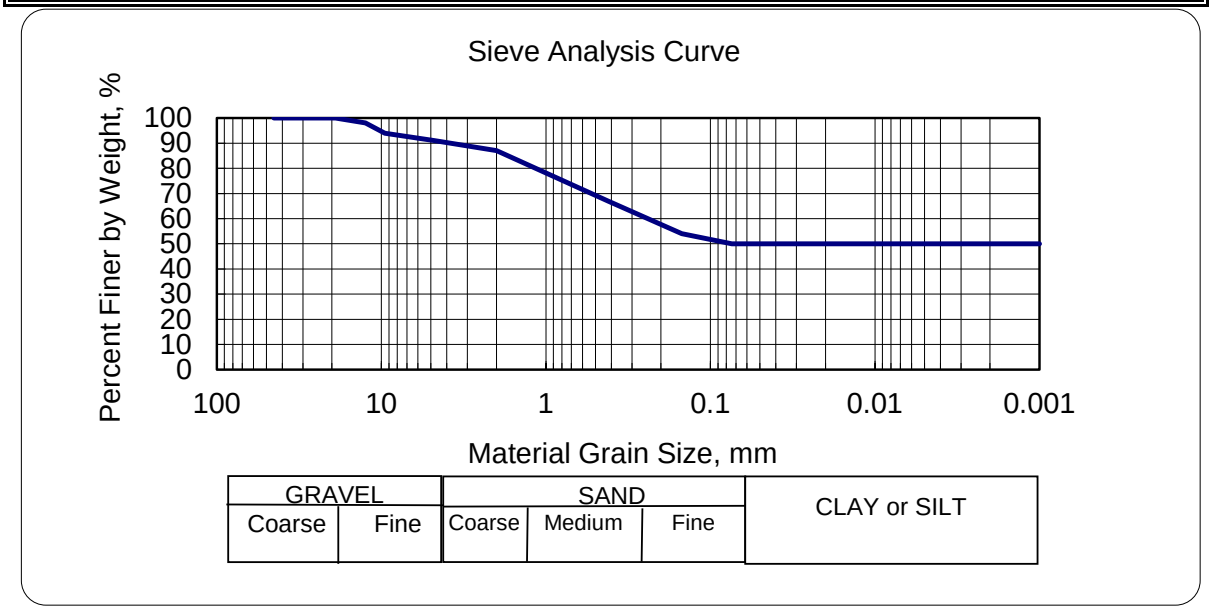
SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils / CLAY, Lean, Sandy, Brown with some gravel

ANALYSIS TEST RESULTS

Sieve Analysis Test:

Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
1-3/4 inches	0	100
1-1/2 inches	0	100
1 inch	0	100
3/4 inch	0	100
1/2 inch	2	98
3/8 inch	6	94
No. 4	9	91
No. 10	13	87
No. 40	33	67
No. 100	46	54
No. 200	50	50
0.005 mm	-	-
0.001 mm	-	-



SOIL SAMPLE PARTICLE SIZE ANALYSIS TEST REPORT

PROJECT NO.: AGCQC17-046

PROJECT NAME: Limited General Subsurface Soils Evaluation
EPW - Grissom Lane Storm Sewer Improvements Project
Grissom Lane and Hunt Court
El Paso, El Paso County, Texas

SAMPLE INFORMATION

SAMPLE DATE: 8/30/2017 **SAMPLE NO.:** S-2

BORING NO.: B-2 **SAMPLE DEPTH:** 2½' - 4'

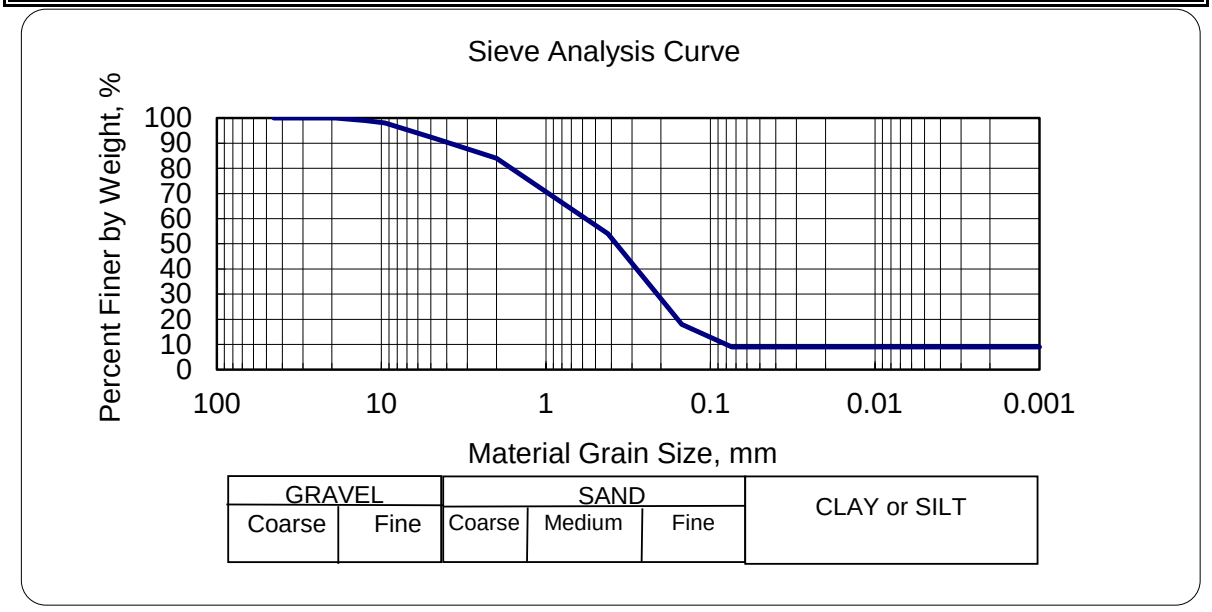
SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils / SAND, Fine to Coarse Grained, Poorly Graded, Brown to Multicolored with silt

ANALYSIS TEST RESULTS

Sieve Analysis Test:

Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
1-3/4 inches	0	100
1-1/2 inches	0	100
1 inch	0	100
3/4 inch	0	100
1/2 inch	1	99
3/8 inch	2	98
No. 4	8	92
No. 10	16	84
No. 40	46	54
No. 100	82	18
No. 200	91	9
0.005 mm	-	-
0.001 mm	-	-



SOIL SAMPLE PARTICLE SIZE ANALYSIS TEST REPORT

PROJECT NO.: AGCQC17-046

PROJECT NAME: Limited General Subsurface Soils Evaluation
EPW - Grissom Lane Storm Sewer Improvements Project
Grissom Lane and Hunt Court
El Paso, El Paso County, Texas

SAMPLE INFORMATION

SAMPLE DATE: 8/30/2017 **SAMPLE NO.:** S-3

BORING NO.: B-2 **SAMPLE DEPTH:** 5' - 6½'

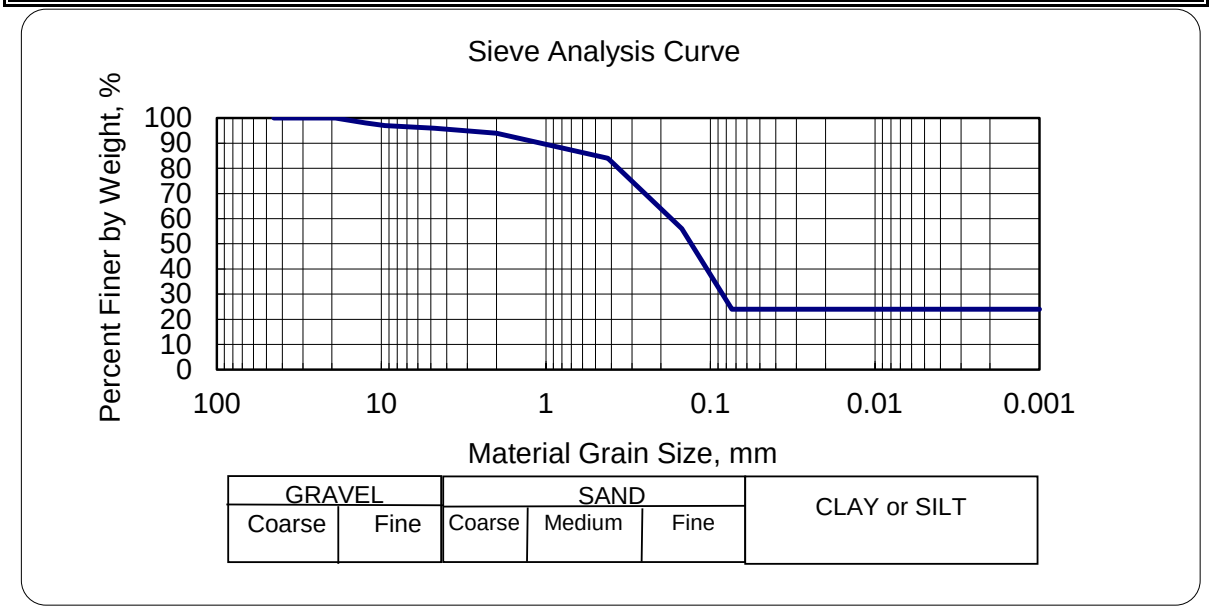
SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils / SAND, Fine to Medium Grained, Silty, Brown to Multicolored with silt

ANALYSIS TEST RESULTS

Sieve Analysis Test:

Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
1-3/4 inches	0	100
1-1/2 inches	0	100
1 inch	0	100
3/4 inch	0	100
1/2 inch	2	98
3/8 inch	3	97
No. 4	4	96
No. 10	6	94
No. 40	16	84
No. 100	44	56
No. 200	76	24
0.005 mm	-	-
0.001 mm	-	-



SUMMARY OF FIELD AND LABORATORY ENGINEERING SOIL CLASSIFICATION TEST RESULTS

PROJECT NAME: Limited General Subsurface Soils Evaluation
EPW – Grissom Lane Storm Sewer Improvements Project
Grissom Lane and Hunt Court
El Paso, El Paso County, Texas

PROJECT NO.: AGCQC17-046

Boring No.	Sample No.	Sample Type	Approx. Sample Depth (ft.)	N-Value	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 4 Sieve	% Passing No. 200 Sieve	USCS
B-1	1	SS	0' - 1 ½"	20	7						
	2	SS	2 ½' – 4'	4							
	3	SS	5' – 6 ½'	2	7				99	12	SM
	4	SS	7 ½' – 9'	13	15	27	15	12	91	50	CL
	5	SS	10' – 11 ½'	18							
B-2	1	SS	0' - 1 ½"	5							
	2	SS	2 ½' – 4'	8	4	-	-	NP	92	9	SP-SM
	3	SS	5' – 6 ½'	15	6				96	24	SM
	4	SS	7 ½' – 9'	30	3						
	6	SS	10' – 11 ½'	25							

Note: SS – Split-Spoon Sample
NP – Non-Plastic by Test

Construction Materials Testing
Geotechnical Engineering
Environmental Site Assessments
Forensic Analysis/Testing

SOIL MOISTURE - DENSITY RELATIONSHIP TEST RESULTS

PROJECT NO.: AGCQC17-046

PROJECT NAME: Limited General Subsurface Soils Evaluation
EPW - Grissom Lane Storm Sewer Improvements Project
Grissom Lane and Hunt Court
El Paso, El Paso County, Texas

SAMPLE INFORMATION

PROCTOR NO.: 1 **SAMPLED BY:** JA

SOIL SAMPLE LOCATION: B-1 **SAMPLE DATE:** 8/30/2017

SOIL SAMPLE APPROX. DEPTH: 1/2'-5'

SOIL TYPE/DESCRIPTION: On Site Subsurface Soils / SAND, Fine to Coarse Grained, Silty, Brown with fine gravel

SAMPLE TEST RESULTS

Sieve Analysis Test
Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
3"	0	100
2-1/2"	0	100
1-1/2"	0	100
1"	0	100
3/4"	2	98
1/2"	6	94
3/8"	8	92
No. 4	12	88
No. 10	18	82
No. 40	46	54
No. 100	79	21
No. 200	84	16

NS- Not Specified

Atterberg Limits Test
Test Method: ASTM D 4318

Limit Test	Index Test Result
LL	--
PL	--
PI	NP

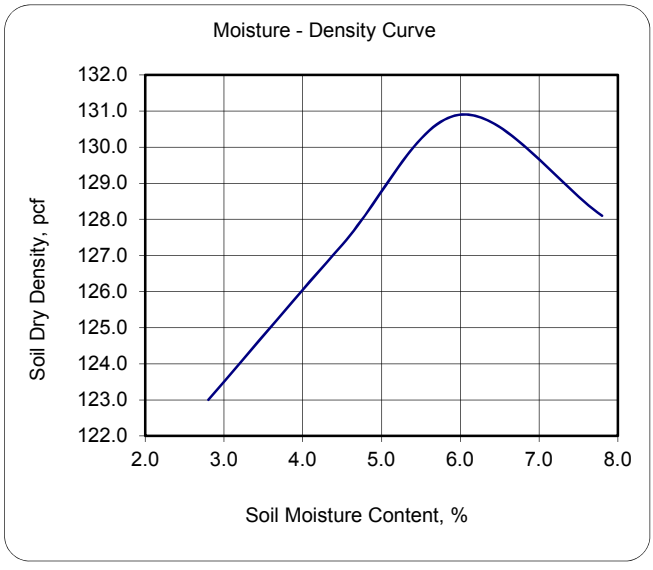
NP-Non Plastic

Soil Classification: **SM**
Test Method: ASTM D 2487

Moisture-Density Relationship Test
Test Method: ASTM D 1557, Method "B"

Test Sample No.	Moisture Content (%)	Sample Dry Density (pcf)
1	2.8	123.0
2	4.5	127.3
3	6.0	130.9
4	7.8	128.1

Maximum Dry Density, pcf: **130.9**
Optimum Moisture Content, %: **6.0**



Construction Materials Testing
Geotechnical Engineering
Environmental Site Assessments
Forensic Analysis/Testing

SOIL MOISTURE - DENSITY RELATIONSHIP TEST RESULTS

PROJECT NO.: AGCQC17-046

PROJECT NAME: Limited General Subsurface Soils Evaluation
EPW - Grissom Lane Storm Sewer Improvements Project
Grissom Lane and Hunt Court
El Paso, El Paso County, Texas

SAMPLE INFORMATION

PROCTOR NO.: 2 **SAMPLED BY:** JA

SOIL SAMPLE LOCATION: B-2 **SAMPLE DATE:** 8/30/2017

SOIL SAMPLE APPROX. DEPTH: 1/2'-5'

SOIL TYPE/DESCRIPTION: On Site Subsurface Soils / SAND, Fine to Coarse Grained, Silty, Brown with some fine gravel

SAMPLE TEST RESULTS

Sieve Analysis Test
Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
3"	0	100
2-1/2"	0	100
1-1/2"	0	100
1"	0	100
3/4"	0	100
1/2"	2	98
3/8"	3	97
No. 4	7	93
No. 10	15	85
No. 40	43	57
No. 100	74	26
No. 200	84	16

NS- Not Specified

Atterberg Limits Test
Test Method: ASTM D 4318

Limit Test	Index Test Result
LL	--
PL	--
PI	NP

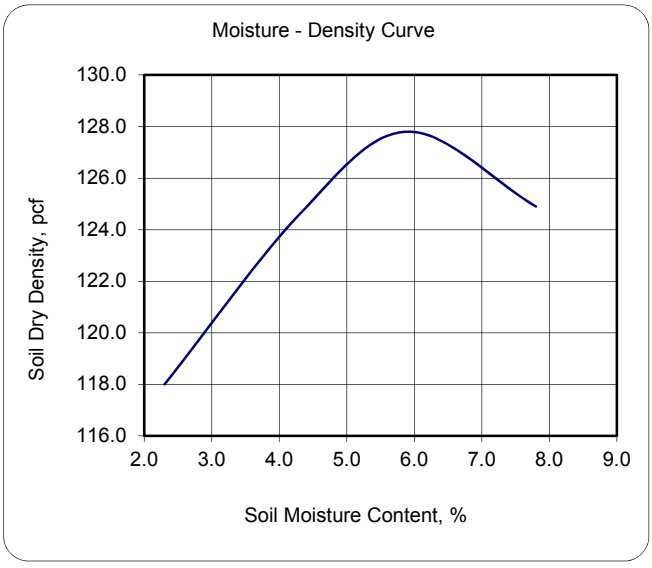
NP-Non Plastic

Soil Classification: **SM**
Test Method: ASTM D 2487

Moisture-Density Relationship Test
Test Method: ASTM D 1557, Method "B"

Test Sample No.	Moisture Content (%)	Sample Dry Density (pcf)
1	2.3	118.0
2	4.3	124.6
3	5.9	127.8
4	7.8	124.9

Maximum Dry Density, pcf: **127.8**
Optimum Moisture Content, %: **5.9**



APPENDIX B

GEOTECHNICAL REPORT
TECHNICAL REFERENCE INFORMATION

DEFINITION OF DESCRIPTIVE TERMS

DENSITY OF GRANULAR SOILS

SPT N Value	Relative Density
< 4	Very Loose
4 – 10	Loose
11 – 30	Med. Dense
31 – 50	Dense
50 – 80	Very Dense
> 80	Hard

CONSISTENCY OF COHESIVE SOILS

SPT N Value	Consistency
< 2	Very Soft
2 – 4	Soft
5 – 8	Medium Stiff
9 – 15	Stiff
16 – 50	Very Stiff
> 80	Very Hard

DEGREE OF PLASTICITY

Nonplastic –	Has no cohesion; will not roll into a thread.
Trace of Plasticity –	Barely hold its shape when rolled into a thread.
Low Plasticity –	Has sufficient cohesion to form a thread but will quickly rupture when deformed.
Med. Plasticity –	Has considerable cohesion. Can be molded into a thread and will withstand considerable deformation without rupture.
High Plasticity –	Can be kneaded like dough without trace of rupture.

MOISTURE DESCRIPTIONS

	GRANULAR SOILS	COHESIVE SOILS
Dry	No Apparent Moisture	No Apparent Moisture
Slightly Moist	< Than 3% by Weight	< Less Than Plastic Limit
Moist	3% to 9% by Weight	Approximately Plastic Limit
Very Moist	> 9% by Weight	> than PL but < than LL
Wet	Submerged or Saturated	Submerged or Saturated

PLASTICITY

Cohesion TSF	Plasticity Index	Degree of Plasticity
0-0.125	0-5	None
0.125-0.25	5-10	Low
0.25-0.5	10-20	Moderate
0.5-1.0	20-40	Plastic
1.0-2.0	> 40	Highly Plastic
> 2.0		

ABBREVIATIONS

V. – Very	Fl. – Fairly	Sl. – Slightly	Med. – Medium
Tr. – Trace	< - Less Than	> - Greater Than	PL – Plastic Limit
Mod. – Moderately			

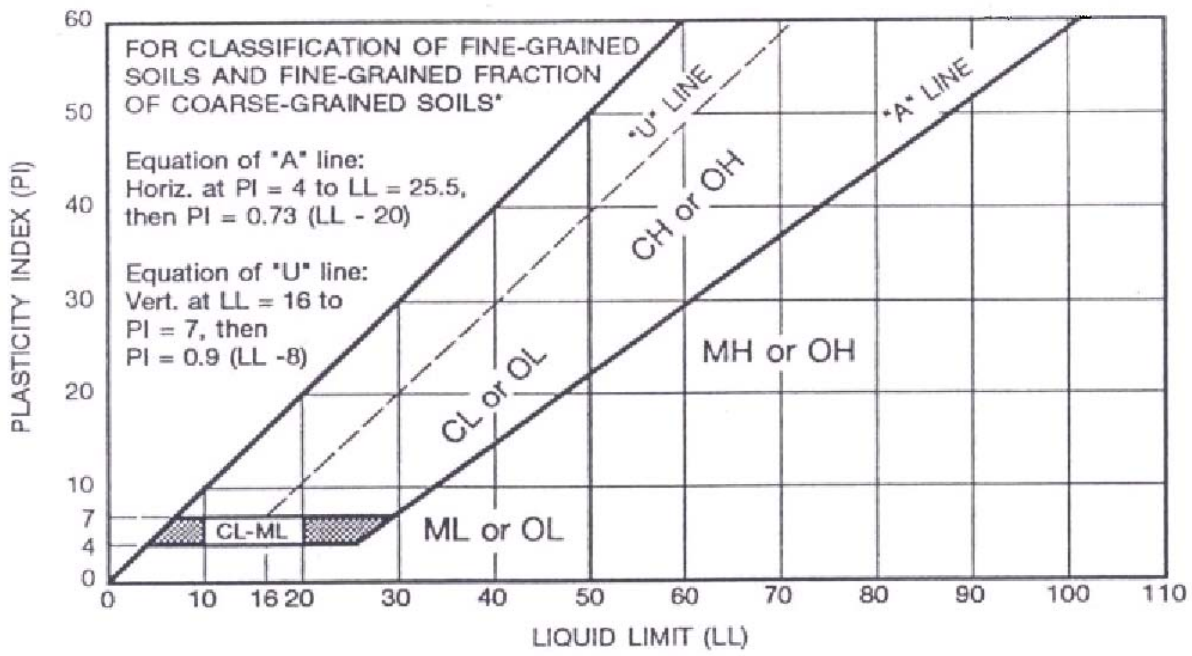
SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

GEOTECHNICAL REPORT
SOIL CLASSIFICATION REFERENCE INFORMATION

Cohesive Soil Classification Chart



U.S. STANDARD SIEVE

	12"	3"	¾"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND				SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE			
152	76.2	19.1	4.76	2.00	0.420	0.074	0.002		

SOIL GRAIN SIZE IN MILLIMETERS

Laboratory Test Methods:

Moisture Content Tests:

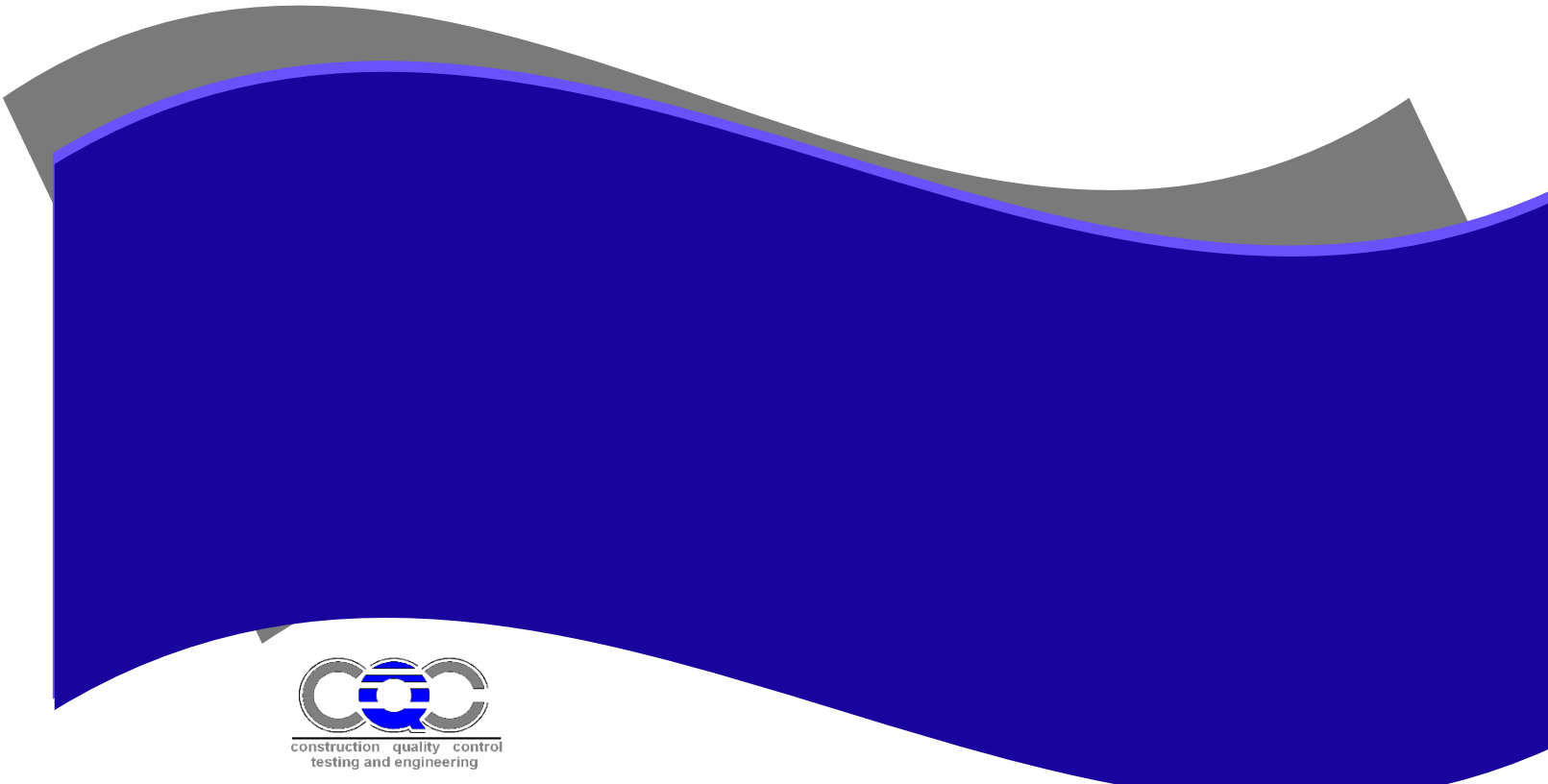
Moisture Contents are determined from representative portions of a soil sample. The samples initial weight is recorded and it is then dried to a constant weight. From this data the moisture content is calculated.

Atterberg Limit Tests:

Liquid Limit (LL), Plastic Limit (PL) and Shrinkage Limit (SL) tests are performed to aid in the classification of soils and to determine the plasticity and volume change characteristics of the materials. The Liquid Limit is the minimum moisture content at which a soil will flow as a heavy viscous fluid. The Plastic Limit is the minimum moisture content at which the soil behaves as a plastic material. The Shrinkage Limit is the moisture content below which no further volume change will take place with continued drying. The Plasticity Index (PI) is the numeric difference between the Liquid Limit and the Plastic Limit and indicates the range of moisture content over which a soil remains plastic.

Grain Size Distribution Test (Particle Size Analysis, Sieve Analysis):

The distribution of soils finer than the No. 200 sieve is determined by passing a representative soil sample through a standard set of nested sieves. The weight of material retained on each sieve is determined and the percentage passing (or retained) is calculated. For determination of the percentage of material finer than the No. 200 sieve, the specimen is first washed through the sieve. The distribution of the materials finer than the No. 200 is determined by use of the different size particles while suspended in water.



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