construction quality control
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Construction Materials Testing
Geotechnical Engineering
Environmental Site Assessments
Forensic Analysis / Testing

September 7, 2006

CEA Engineering Group
1204 Montana Avenue
El Paso, Texas 79902

Attn.: Mr. Ulises Estrada, P.E.
Vice President

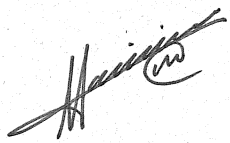
Re: Soils Investigation Report
Bosque Bonito Units 1 & 2
Wastewater Collection System
El Paso, El Paso County, Texas
CQC Project No. AGCQC06-052-00

Dear Mr. Estrada:

In accordance with our agreement and scope of services under proposal PGCQC06-072 dated August 16, 2006, CQC Testing and Engineering is pleased to provide CEA Engineering Group (Client) with this final Soils Investigation Report for the above referenced project. This report presents the results of our field tests, field boring logs, soil laboratory tests, soil classifications, soil bearing capacity, pavement section replacement and soil backfill and general trench safety recommendations in accordance with standards industry practices and the Occupational Safety and Health Administration (OSHA) regulations.

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

Respectfully Submitted,
CQC Testing & Engineering



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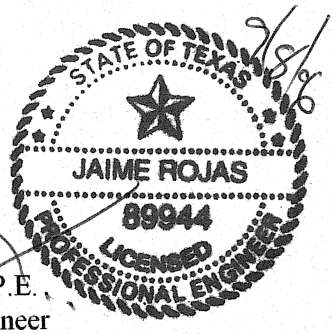

Jaime Rojas, P.E.
Principal Engineer
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Copies: (1.) Above Addressee - 4 – Original Report Copies (Hand Delivered)
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Report Table of Contents

Section 1.0 – General Project Information

This soil evaluation report has been prepared for CEA Engineering Group (Client) for the proposed Bosque Bonito Units 1 & 2 – Wastewater Collection System. Based on information provided by our Client, we understand that the project will consists of the installation of approximately 21,500 linear feet of 8-inch, 12-inch and/or 15-inch diameter sewer lines. The proposed project is located within an existing subdivision in San Elizario, El Paso County, Texas. The design information presented in this report is based on the data obtained from a total of seven (7) widely spaced borings drilled throughout the subdivision proposed sewer collection system locations to a maximum depth of 15 feet, each below the existing ground surface elevations at the time of our drilling activities (see attached Boring Location Plan, Sheet A1 and Boring Logs B-1 through B-7, Sheets A2 through A8).

Our objective and scope of services for this project consisted of generally evaluating the subsurface soil conditions by performing field borings, collecting soil samples, and conducting soil classification laboratory tests to provide information with respect to soil classifications, pipe embedment, soil backfilling, and general trench safety considerations.

The following sections of this report present our field investigation methods, site soil-related considerations, pipe embedment and backfill considerations, and general trench safety considerations. Please note that the entire report should be read for a thorough understanding of our evaluation findings and recommendations.

Section 2.0 – Subsurface Field Investigation

The subsurface soils were evaluated by completing a total of seven (7) borings at the approximate locations as shown in the General Boring Location Plan, Sheet A1, Appendix A of this report. In general, our borings were drilled to a maximum depth of 15 feet, each below the existing ground surface elevations at the time of our drilling activities. The borings were drilled with a CME-75 rotary drilling rigs and hollow stem auger drilling techniques. The borings were logged during our drilling operations by a certified and/or trained member of our staff. Our boring logs are presented in Appendix A, Sheets A2 through A8.

During the drilling operations Standard Penetration Tests (SPT) were performed in general conformance with ASTM D 1586. In accordance with the test procedure a standard 2-inch O.D. split-tube sampler (i.e., split-spoon) with a cutting shoe, is seated at the desired sampling elevation within the boring hole and dynamically driven 18 inches into the soil with a 140-pound hammer dropped from a height of 30 inches. The number of blows required to drive the sampler the latter 12 inches is the penetration resistance and regarded as the "N-Value". Soil samples collected within the split-spoon at discrete depth intervals were containerized and transported to our laboratory for further physical and classification testing. Our 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, and D 4318, respectively). The results of our tests and estimated "N-Values" are presented in our boring logs and Summary of Test Results in Appendix A, Sheet A9 in this report. At the completion of our drilling activities all the borings were backfilled with auger cuttings and compacted at the surface.

The following table below summarizes the completion depth of our borings and number of samples collected at the time of our drilling operations.

Summary of Field Investigation				
Borehole No.	**Approx. Termination Depth (ft.)**	**No. Split-Spoon Samples**	**No. Auger Samples**	**Observed Groundwater Approximate Depth (ft.)**
B-1	15	6	-	7
B-2	15	6	-	7
B-3	15	6	-	7
B-4	15	6	-	7
B-5	15	6	-	7
B-6	15	6	-	7
B-7	15	6	-	6

2.1 - Soil Laboratory 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.

Type of Test	Total Number Conducted
Natural Moisture Contents	20
Atterberg Limit Tests	3
Particle Size Analysis Tests	11

Section 3.0 – Subsurface Soil Conditions

As previously indicated, the subsurface soil conditions were evaluated based on our observations and field tests conducted in a total of seven (7) borings. In general, the subsurface soils encountered at the site may be described by two (2) major soil strata. The logged depth of the reported soil formation types are approximately delineated in our boring logs. Due to the geologic location of the site, it is possible for variations in the types and depths of the soil formations to occur over relatively short distances.

Stratum I consists of moderately plastic to plastic, brown, sandy clay. This stratum was encountered from the surface to approximate depths ranging from ½ to 2 feet below the existing ground surface elevation at the time of our drilling activities. This stratum was encountered at a medium stiff to stiff consistency with SPT N-values ranging from 8 to 17 blows per foot. Our Atterberg Limit Tests exhibited liquid limits ranging from 32 to 44 and plasticity indices ranging from 19 to 28. Based on our sieve analysis tests, these soils contained fines ranging from 63 to 66 percent. The encountered clays may be classified as CL in general accordance with the USCS. These sandy clays are not considered suitable for use as a Select Fill material. However, these clays may be blended with suitable non-plastic to low plasticity sands to achieve a modified soil that meets the minimum requirements of Select Fill and Select backfill soil materials. Please

note that soils with organic materials should not be blended and are not considered suitable soils.

Stratum II consists of non-plastic, fine to medium grained, light brown to multi-colored, silty sands with interbedded seams of poorly graded sands. This stratum was encountered below the Stratum I soils and extends to at least the boring termination depths of 15 feet. This stratum was encountered at a very loose to medium dense relative density with SPT N-values ranging from 2 to 22 blows per foot. Based on our sieve analysis tests, these soils contain fines ranging from 8 to 40 percent. These sandy soils may be classified as SM or SP-SM in general accordance with the USCS. These sands may be considered suitable for use as Select Fill materials, provided that they meet the requirements of this report. Please note that these soils are susceptible to erosion and should be appropriately maintained, shored and protected during excavations to mitigate potential soil sloughing.

3.1 - Groundwater Depth Considerations

Groundwater was encountered in all of our Borings (B-1 through B-7) at depths ranging from about 6 to 7 feet below the existing ground elevation at the time of our drilling operations. However, groundwater elevations may fluctuate at different times of the year and during periods of unusual rainfall events across the project site limits. Please note that it is possible for "perched" water zones to occur in soil formations where relatively permeable granular soils overlay relatively low permeability clayey soils, which may result in shallow water seepage or groundwater accumulation than encountered or reported.

Based on our understanding that portions of the proposed pipeline invert elevations may be below 6 feet from existing ground surface elevations, dewatering is anticipated to be required to lower the existing groundwater elevation to allow construction of the new pipe lines. Due to the potential groundwater level fluctuations in this area, we recommend that the contactor verify the groundwater depth prior to construction to develop an adequate dewatering design plan that will maintain construction excavations relatively dry and to mitigate potential construction

delays. The contractors dewatering plan should consider the potential of "heaving" sand effects during construction.

3.2 - Soil Related Movements

The results of our observations and soil classification tests were used to evaluate the Potential Vertical Rise (PVR) of the subsurface soils in accordance with a published empirical method. This method is used to estimate the potential vertical movements of cohesive soils (Stratum I soils) based on the plasticity index (PI) of the soil. The procedure allows the reduction of the initial estimated PVR for the existing soil conditions and/or dry soil profile through surcharge addition (i.e., fill soil pressure or load pressures) and replacement of the cohesive materials with non-plastic or low plasticity sandy soils.

Based on the encountered soil conditions and a surcharge pressure of at least 1 psi and an active depth of 15 feet, PVR values of less than ½-inch were estimated for the Stratum I clayey soils encountered in our borings.

3.3 - 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

- When placing backfill within utility line trenches, backfill materials should be appropriately placed and compacted to mitigate potential settlements caused by uncontrolled backfill during construction. Once removal or installation activities have been completed, the contractor should adequately overexcavate the excavated areas and backfill with Select Fill soils, or as required by the project plans and specifications. The backfilled soils should be placed in loose lifts not to exceed 8 inches in thickness. The backfilled soils should be compacted to at least 95 percent of maximum dry density as determined by ASTM D 1557 or as required by the project plans and specifications, whichever is more stringent.
- Contractors interested in bidding the project shall be responsible for conducting their own tests to verify the depth of the soil types within the project limits to prepare earthwork estimates. The owner shall not incur additional costs for variations in the soils

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 and not for the contractor's evaluation, use and/or interpretation for earthwork estimates.

- Based on our experience with similar soils in the area, the contractor should consider that it is possible for sloughing (i.e. erosion) of the sandy soils (Stratum II) to occur during excavations for this project. Sloughing of soils may hinder the installation of form work and cause excavations to be wider than expected. In general, the soils encountered in our borings may be considered as Type "C" soils under current Occupational Safety and Health Administration (OSHA) regulations pertaining to excavations. In excavations penetrating these soils, the sloping and benching schemes specified for Type "C" soils under the OSHA regulations require that non-permanent excavation sidewalls be sloped no steeper than 1½:1 (horizontal:vertical).

Site Preparation

- The existing soils at this site that will support compacted Select Fill materials should be cleared of all vegetation, organic matter, topsoil, pavement, construction debris and/or any foreign matter. The cleared subgrade should be thoroughly proofrolled in order to densify any weak and compressible zones. The finished subgrade should be compacted to a minimum of 95 percent of maximum dry density per ASTM D 1557 at ±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 overexcavated, removed and replaced with compacted "Select Fill" to a minimum depth of 8 inches or as required to the appropriately bridge over these soils, whichever is deeper. Subgrade preparation operations should be observed by a representative of CQC.

- As indicated in Section 3.0 in this report, the Stratum II sandy soils encountered in our borings are considered suitable for Select Fill and backfill materials, provided that they meet the requirements of Section 6.0 of this report and/or the project plans and specifications, whichever is more stringent. 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.

3.4 - Drainage Considerations

Drainage is an important key to the successful performance of any 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 wastewater collection system.

Section 4.0 – Design Soil Parameters

4.1 – Soil Bearing Capacity and Design Considerations

The native sandy soils below the wastewater line manhole depths are anticipated to be saturated and may provide relatively low allowable bearing capacity values and a potential for elastic soil settlements. In order to improve the bearing capacity of the supporting soils and to allow for an adequate concrete casting "bed" or soil bearing support, we recommend that the manhole be supported on a minimum of 24 inches of compacted Select Fill that meets the requirements of this report. The Select Fill that is placed and compacted in accordance with the recommendations in this report will provide an allowable bearing capacity of at least 1,500 psf. The Select Fill should extend a minimum 12 inches beyond the edges of the manhole base.

In the event that the relatively shallow groundwater conditions cause pumping or heaving during construction, as an alternative the contractor may backfill the trench area with flowable fill "Controlled Low Strength Material" (CLSM) to bridge over the pumping soils. The CLSM shall have maximum and minimum strengths of 1,200 psi and 150 psi, respectively, provided that it is approved by the engineer.

4.2 - Thrust Blocks

In the event that thrust blocks are required at curves and turns of the proposed wastewater lines, a passive earth resistance of 200 psf may be used for design purposes. Thrust blocks should bear solidly against undisturbed trench walls in all directions.

Section 5.0 – General Trench Safety Considerations

The proposed new sewer lines that will be installed for this project are located within residential streets that are anticipated to remain open for vehicle transit during construction. Therefore, due to the limited area of construction, the trenches are anticipated to be shielded and not sloped. Trench excavations more than 5 feet in depth and extending to a maximum depth of 20 feet may be supported with shielded systems. 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.

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, which show possible loss of soil from behind or below the bottom of the shield.

Excavations of earth material to a level not greater than 2 feet below the bottom of a shield shall be permitted. 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 relevant OSHA regulations. Excavation safety systems for trenches extending to a depth greater than 20 feet should be designed by a professional engineer.

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.

Properly designed means of access and egress from excavations should be provided for employees. Structural members used as ramps and/or runways 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 the excavations 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 bracing have been taken to safeguard the employees and trench.

During excavation, the materials encountered shall be evaluated daily. If material with different properties (e.g., fill soil, etc.) is encountered, the recommendations given in this report may not be adequate to assure safe excavations.

All excavations shall be protected from rain and groundwater by surface diversion ditches or dikes. Workers shall be prohibited from working in excavations where water has accumulated or is accumulating.

5.1 – De-watering Guidelines

All excavations should be protected from rain and groundwater by surface diversion ditches or dikes and appropriate de-watering systems. Ground water levels will fluctuate with seasons and may be encountered during construction. Perched water, if encountered, is to be removed from the excavation. Workers should be prohibited from working in excavations where water has accumulated or is accumulating.

Excavations performed for the pipeline alignment are anticipated to require de-watering. De-watering well points may be installed in this area to reduce the groundwater elevation to a minimum of 2 feet below the estimated excavation depths. Adequate time should be allowed for groundwater elevations to be reduced and to stabilize prior to proceeding with excavations.

Section 6.0 – Pipe Embedment and Backfill Considerations

Based on our observations the proposed new pipes may be supported by prepared and compacted on site sands (i.e., Stratum II soils), provided that they meet the requirements of the Select Fill section of this report and/or the project plans and specifications, whichever is more stringent. The exposed subgrade should be scarified just prior to pipe placement to a minimum depth of 8 inches and recompacted to a minimum of 90 percent of maximum dry density as determined by ASTM D 698. The moisture content of the subgrade should be maintained at or above optimum moisture content until permanently covered. Subgrade soils compacted to more

than 2 percent of the optimum moisture content may be accepted only after observation and approval by the project engineer.

Pipes (especially flexible pipes) should not be supported by soils classified as CH, CL, MH, ML, OH, OL and PT under the USCS.

6.1 - Pipe Zone Select Backfill Materials

The pipe zone backfill materials may consist of prepared and compacted soils that meet the requirements of Section 6.0 of this report. The suitable fill soils should be stripped of all vegetation, organic matter, clay lumps, topsoil, construction debris and/or any foreign matter. The backfill materials placement shall be in loose lift not to exceed 8 inches and recompacted to a minimum of 90 percent of maximum dry density as determined by ASTM D 698. The moisture content of the subgrade should be maintained at or above optimum moisture content until permanently covered. Subgrade soils compacted to more than 2 percent of the optimum moisture content may be accepted only after observation and approval by the project engineer.

Please note that the pipe zone is typically defined as the area extending from the bottom of the trench to 12 inches above the top of the pipe and extending to the undisturbed trench walls on both sides of the pipe.

6.2 – Pipe Installation Below Groundwater

Prior to pipe excavation the contractor should have an appropriate de-watering system. The method of de-watering shall maintain a phreatic water surface a minimum of 18 inches below pipeline grades. If over-excavation is necessary due to unsuitable foundation soil conditions, the ground water shall be additionally lowered as appropriate.

Pipes bedding materials, installed below existing or anticipated future ground water levels, should be enclosed with a layer of approved geotechnical filter fabric. The fabric shall be placed carefully along the bottom of the trench and up the side of the trench a sufficient distance above the pipe installation and wrapped around the bedding material and pipe. Backfill materials within the pipe zone should consist of angular, well-graded crushed stone with a maximum

particle size of 3/4-inches. The crushed stone may be a 56 or 57 stone size in accordance with ASTM D 448.

6.3 - Trench Backfill Materials (Above the Pipe Zone)

The backfill materials, above the pipe zone, should be placed in maximum 8-inch uniform thickness loose lifts and should meet the requirements of Select Fill of this report and/or the project plans and specifications, whichever is more stringent. The backfill materials should be moisture conditioned to plus or minus 2 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 18 inches below the finished subgrade elevation. The suitable fill materials below 18 inches of the finished grade elevations should achieve a minimum compaction of 95 percent per ASTM D 1557, especially below trenches that are within and/or traverse streets.

6.4 – Pavement Cuts and Replacement

We anticipate that portions of the wastewater collection lines may be constructed under existing roadways. Pavement removal, backfill, and pavement replacement should conform to the current requirements of the County of El Paso or relevant city ordinance and/or the project plans and specifications, whichever is more stringent. We recommend that the new pavement section consist of a minimum of 1-1/2-inches of hot-mixed asphaltic-concrete pavement (TXDOT, Type D) and a minimum of 5 to 6-inches of aggregate base course material (TXDOT Type A, Grade 3). The hot mixed asphaltic-concrete pavement should be placed at 95 to 98 percent of the laboratory Marshal value and the flexible base course should be placed in loose lifts not exceeding 8 inches in thickness and compacted to a minimum of 98 to 100 percent of the maximum dry density at a moisture content within ± 2 percentage points of the optimum moisture content as determined by ASTM D 1557. We recommend that the aggregate base course be supported by a minimum of 12-inches of compacted and moisture conditioned Select Fill or select backfill soil materials.

Section 7.0 – Project Specification Information

7.1 - Fill Classification

Select Fill and backfill materials should be granular and free of clay lumps, deleterious materials, cobbles or boulders over 3-inches in nominal size. Fill materials should meet requirements of this section and/or the project plans and specifications, whichever is more stringent. Select Fill materials should have a liquid limit less than 40 and a plasticity index less than or equal to 15. Soils classified in the following list according to the USCS can be considered satisfactory for use as Select Fill: 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.

Soils classified as CH, CL, MH, ML, OH, OL and PT under the USCS classification are **not** considered suitable for use as Select Fill and backfill materials.

Select Fill materials should be placed in accordance with this report and/or the project plans, whichever is more stringent. Select Fill should also meet the minimum gradation requirements tabulated below.

Sieve Size (square opening)	% Passing by Weight
3-inch	100
3/4-inch	70 – 100
No. 4	45 – 100
No. 200	5 – 40

In accordance with typical standard utility specifications, Class I, Class II and Class III 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 1-½ 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 1-½ inches, including various 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.

- CLASS III material may be fine sand and clayey (clay filled) gravels, per ASTM D-2487, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.

- CLASS IV and V material may be classified as CH, CL, MH, ML, OH, OL and PT under the USCS.

7.2 - 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, which ever is more stringent. The specification testing program should include the following testing frequencies as a minimum:

1. At least two (1) Laboratory Compaction Characteristics of Soil using Modified Effort or standard (Proctor) for each type of encountered or imported material to be used, according to ASTM D 1557 and/or ASTM D 698 as required by the project specifications.
2. At least two (1) Soil Classifications (Sieve Analysis and Atterberg Limits Test) for each type of encountered or imported material to be used, according to ASTM D 422 and D 4318.
3. Minimum of two (2) density tests for each lift (8-inch loose) for the subgrade and fill within the building pad, according to ASTM D 2922 or ASTM D 1556.
4. A minimum of one (1) density test per continuous footing excavation or 1 per each excavated wall footing, whichever gives rise to the greater number of tests, from the bottom of the footing excavation and each lift of fill, according to ASTM D 2922 or ASTM D 1556.
5. A minimum of one (1) density test per lift at 150 lineal feet spacing for pipe bedding and backfill operations, according to ASTM D 2922 or D 1556.
6. Sampling and testing for quality assurance of placed concrete 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 concrete cylinders should be collected for every 50 cubic yards or less of poured 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 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 90° F) and low (below 40° F) temperatures.

Section 8.0 – Soils Investigation Report Considerations and Limitations

The analysis and recommendations in this report are based on the data obtained from a total of seven (7) soil borings performed at the approximate locations indicated on the attached General Boring Location Plan, Sheet A1 in Appendix A. This report may not reflect all the variations that may occur through out the project sites. 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.

The scope of our soil evaluation study did not include an environmental assessment of the property's air, soil or water conditions either on or adjacent to the site, therefore no environmental opinions are presented in this report.

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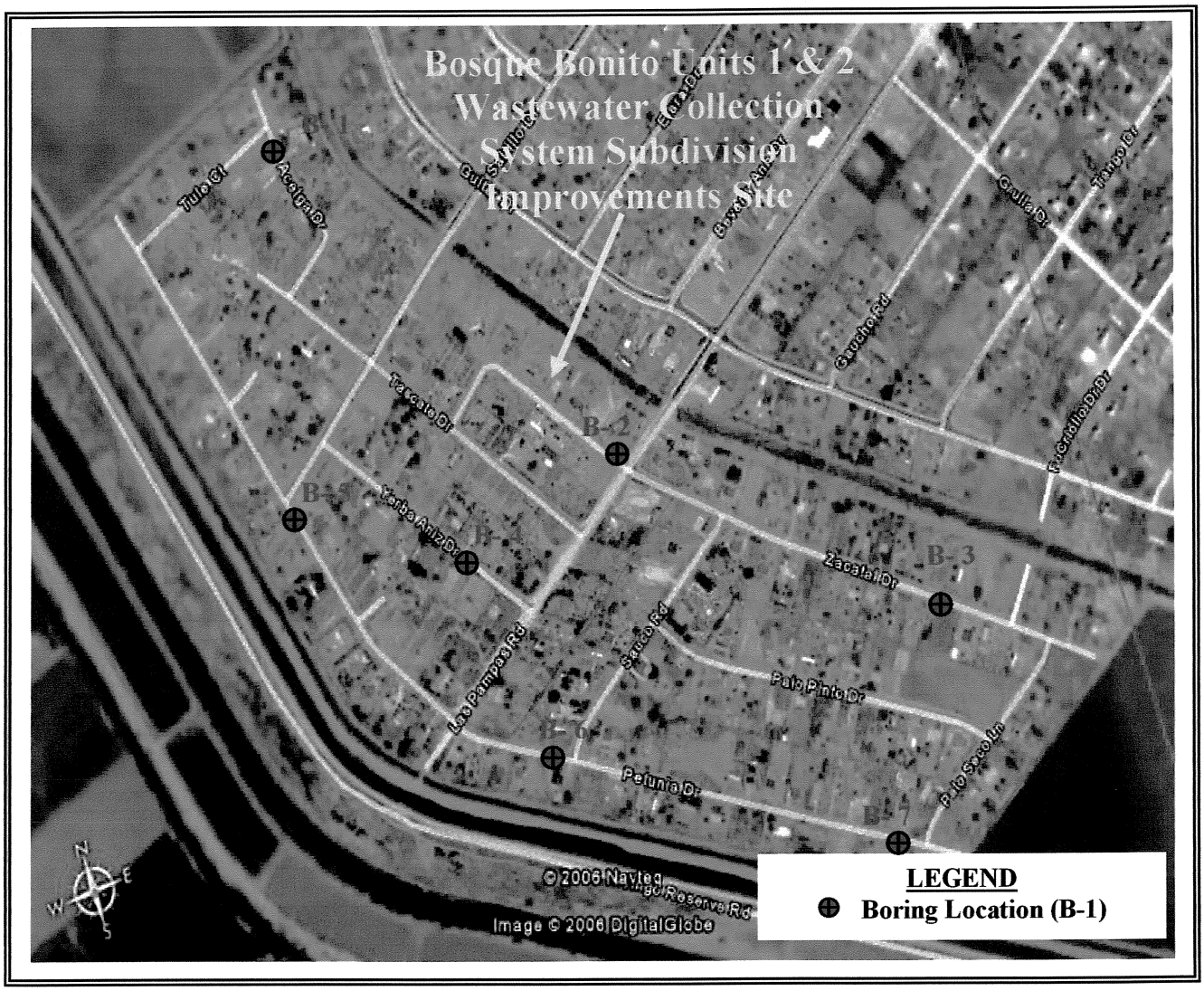

construction quality control testing and engineering	**General Boring Location Plan** Soils Investigation Proposed Bosque Bonito Wastewater Collection System San Elizario, El Paso County, Tx.	Client: CEA Engineering Group	
		Project No. AGCQC06-052	
		Scale: NTS	Check by: JR
		Date: 8/31/06	Sheet A1

CQC Testing and Engineering
6802 Commerce, Unit A
El Paso, Texas 79915
Telephone: (915) 771-7766
Fax: (915) 771-7786

BORING NUMBER B-1

CLIENT CEA Engineering Group
PROJECT NAME Bosque Bonito Units 1 & 2-Wastewater Collection System
PROJECT NUMBER AGCQC06-052
PROJECT LOCATION San Elizario, El Paso County, Texas
DATE STARTED 8/21/06 **COMPLETED** 8/21/06
GROUND ELEVATION Ext. Grade **HOLE SIZE** 6-inch diameter hole
DRILLING CONTRACTOR Tierra Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 75 w/3-1/4" ID HSA
▽ **AT TIME OF DRILLING** 7.0 ft
LOGGED BY ME **CHECKED BY** JR
AT END OF DRILLING -
NOTES See Boring Location Plan, Sheet A1
AFTER DRILLING -

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS
0	SS 1		CLAY, Sandy, Moderately Plastic, Brown, Stiff, Slightly Moist	6-6-8 (14)	63	19	CL
			SAND, Fine to Medium Grained, Silty, Light Brown to Multicolored, Medium Dense, Slightly Moist with interbedded seams of poorly graded sands				
	SS 2			4-4-6 (10)			
5	SS 3			4-5-9 (14)			
			▽ - wet below approximately 7 feet				
	SS 4			5-4-6 (10)	26		SM
10	SS 5			4-5-6 (11)			
15	SS 6			4-6-5 (11)			
			NOTE: SS - Split Spoon Sample Bottom of hole at 15.0 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 SEPERATED FROM THE REPORT

CQCLOG2 AGCQC06-052.GPJ GINT US.GDT

CQC Testing and Engineering
6802 Commerce, Unit A
El Paso, Texas 79915
Telephone: (915) 771-7766
Fax: (915) 771-7786

BORING NUMBER B-2

CLIENT CEA Engineering Group
PROJECT NAME Bosque Bonito Units 1 & 2-Wastewater Collection System
PROJECT NUMBER AGCQC06-052
PROJECT LOCATION San Elizario, El Paso County, Texas
DATE STARTED 8/21/06 **COMPLETED** 8/21/06
GROUND ELEVATION Ext. Grade **HOLE SIZE** 6-inch diameter hole
DRILLING CONTRACTOR Tierra Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 75 w/3-1/4" ID HSA
▽ **AT TIME OF DRILLING** 7.0 ft
LOGGED BY ME **CHECKED BY** JR
AT END OF DRILLING -
NOTES See Boring Location Plan, Sheet A1
AFTER DRILLING -

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS	SPT N VALUE / PL MC LL / % - 200
0	SS 1		CLAY, Sandy, Brown, Stiff, Slightly Moist	2-2-7 (9)				
			SAND, Fine to Medium Grained, Silty, Light Brown to Multicolored, Medium Dense, Slightly Moist with interbedded seams of poorly graded sand					
	SS 2			5-7-10 (17)				
5	SS 3			1-5-5 (10)	16		SM	
			▽ - wet below approximately 7 feet					
	SS 4			2-7-11 (18)				
10	SS 5			2-7-8 (15)				
	SS 6			3-4-7 (11)				
15			NOTE: SS - Split Spoon Sample Bottom of hole at 15.0 feet.					

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

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BORING NUMBER B-3

CLIENT CEA Engineering Group
PROJECT NAME Bosque Bonito Units 1 & 2-Wastewater Collection System
PROJECT NUMBER AGCQC06-052
PROJECT LOCATION San Elizario, El Paso County, Texas

DATE STARTED 8/21/06 **COMPLETED** 8/21/06
GROUND ELEVATION Ext. Grade **HOLE SIZE** 6-inch diameter hole
DRILLING CONTRACTOR Tierra Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 75 w/3-1/4" ID HSA
▽ **AT TIME OF DRILLING** 7.0 ft
LOGGED BY ME **CHECKED BY** JR
AT END OF DRILLING -
NOTES See Boring Location Plan, Sheet A1
AFTER DRILLING -

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS
0	SS 1		CLAY, Sandy, Moderately Plastic, Brown, Stiff, Slightly Moist	3-4-7 (11)	66	19	CL
			SAND, Fine to Medium Grained, Silty, Light Brown to Multicolored, Loose to Medium Dense, Slightly Moist with interbedded seams of poorly graded sands				
	SS 2			5-5-4 (9)	40		SM
5							
	SS 3		- with some clay seams between approximately 5 to 7 feet	3-6-9 (15)			
			▽ - wet below approximately 7 feet				
	SS 4			3-2-7 (9)	14		SM
10							
	SS 5			2-2-3 (5)			
	SS 6			2-2-3 (5)			
15			NOTE: SS - Split Spoon Sample Bottom of hole at 15.0 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 SEPERATED FROM THE REPORT

CQCLOG2 AGCQC06-052.GPJ GINT US.GDT

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BORING NUMBER B-4

CLIENT CEA Engineering Group
PROJECT NAME Bosque Bonito Units 1 & 2-Wastewater Collection System
PROJECT NUMBER AGCQC06-052
PROJECT LOCATION San Elizario, El Paso County, Texas
DATE STARTED 8/21/06 **COMPLETED** 8/21/06
GROUND ELEVATION Ext. Grade **HOLE SIZE** 6-inch diameter hole
DRILLING CONTRACTOR Tierra Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 75 w/3-1/4" ID HSA
▽ **AT TIME OF DRILLING** 7.0 ft
LOGGED BY ME **CHECKED BY** JR
AT END OF DRILLING -
NOTES See Boring Location Plan, Sheet A1
AFTER DRILLING -

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS
0	SS 1		CLAY, Sandy, Brown, Stiff, Slightly Moist	4-5-6 (11)			
			SAND, Fine to Medium Grained, Silty, Light Brown to Multicolored, Loose to Medium Dense, Slightly Moist with interbedded seams of poorly graded sands				
	SS 2			4-8-7 (15)			
5	SS 3			4-4-5 (9)	12		SM
			▽ - wet below approximately 7 feet				
	SS 4			3-3-3 (6)			
10	SS 5			1-2-1 (3)	8		SP-SM
	SS 6			6-6-5 (11)			
15			NOTE: SS - Split Spoon Sample Bottom of hole at 15.0 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 SEPERATED FROM THE REPORT

COCLOG2 AGCQC06-052.GPJ GINT US.GDT

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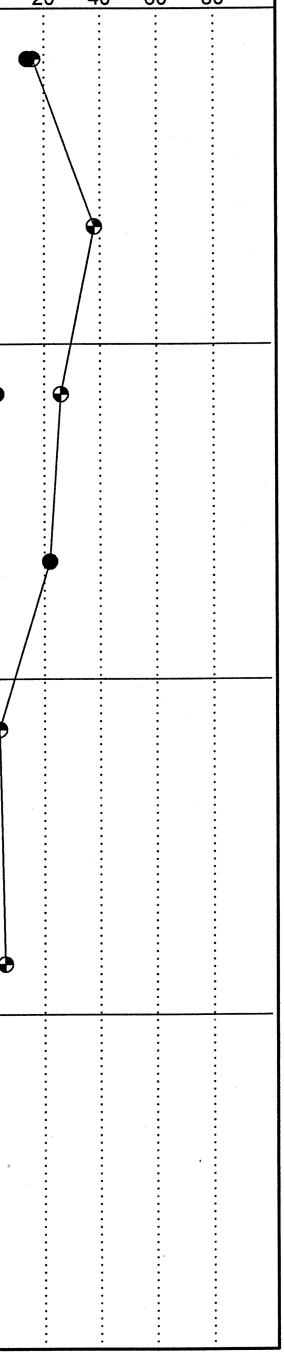
Fax: (915) 771-7786

BORING NUMBER B-5

CLIENT CEA Engineering Group
PROJECT NAME Bosque Bonito Units 1 & 2-Wastewater Collection System
PROJECT NUMBER AGCQC06-052
PROJECT LOCATION San Elizario, El Paso County, Texas
DATE STARTED 8/21/06 **COMPLETED** 8/21/06
GROUND ELEVATION Ext. Grade **HOLE SIZE** 6-inch diameter hole
DRILLING CONTRACTOR Tierra Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 75 w/3-1/4" ID HSA
▽ **AT TIME OF DRILLING** 7.0 ft
LOGGED BY ME **CHECKED BY** JR
AT END OF DRILLING -
NOTES See Boring Location Plan, Sheet A1
AFTER DRILLING -

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS
0	SS 1		CLAY, Sandy, Brown, Medium Stiff, Slightly Moist	5-5-3 (8)			
			SAND, Fine to Medium Grained, Poorly Graded, Light Brown to Multicolored, Very Loose to Medium Dense, Slightly Moist with interbedded seams of poorly graded sands				
	SS 2			3-7-12 (19)			
5	SS 3			1-5-8 (13)			
			▽ - wet below approximately 7 feet				
	SS 4			3-4-7 (11)			
10	SS 5		-heaving sands below approximately 10 feet	2-1-1 (2)			
	SS 6			2-2-1 (3)			
15			NOTE: SS - Split Spoon Sample Bottom of hole at 15.0 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 SEPERATED FROM THE REPORT

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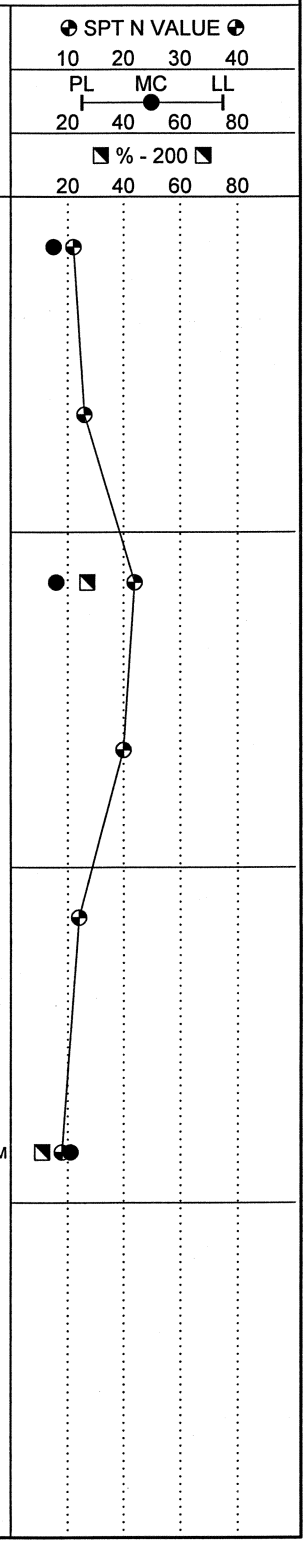
BORING NUMBER B-6

CLIENT CEA Engineering Group
PROJECT NAME Bosque Bonito Units 1 & 2-Wastewater Collection System
PROJECT NUMBER AGCQC06-052
PROJECT LOCATION San Elizario, El Paso County, Texas
DATE STARTED 8/21/06 **COMPLETED** 8/21/06
GROUND ELEVATION Ext. Grade **HOLE SIZE** 6-inch diameter hole
DRILLING CONTRACTOR Tierra Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 75 w/3-1/4" ID HSA
▽ **AT TIME OF DRILLING** 7.0 ft
LOGGED BY ME **CHECKED BY** JR
AT END OF DRILLING -
NOTES See Boring Location Plan, Sheet A1
AFTER DRILLING -

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS
0	SS 1		CLAY, Sandy, Brown, Stiff, Slightly Moist	4-4-7 (11)			
			SAND, Fine to Medium Grained, Silty, Light Brown to Multicolored, Loose to Medium Dense, Slightly Moist with interbedded seams of poorly graded sands				
	SS 2			4-5-8 (13)			
5							
	SS 3		- with some clay seams between approximately 5 to 7 feet	5-10-12 (22)	27		SM
			▽ - wet below approximately 7 feet				
	SS 4			5-9-11 (20)			
10							
	SS 5			6-5-7 (12)			
	SS 6			3-4-5 (9)	11		SP-SM
15			NOTE: SS - Split Spoon Sample Bottom of hole at 15.0 feet.				



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BORING NUMBER B-7

CLIENT CEA Engineering Group
PROJECT NAME Bosque Bonito Units 1 & 2-Wastewater Collection System
PROJECT NUMBER AGCQC06-052
PROJECT LOCATION San Elizario, El Paso County, Texas
DATE STARTED 8/21/06 **COMPLETED** 8/21/06
GROUND ELEVATION Ext. Grade **HOLE SIZE** 6-inch diameter hole
DRILLING CONTRACTOR Tierra Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME 75 w/3-1/4" ID HSA
▽ **AT TIME OF DRILLING** 6.0 ft
LOGGED BY ME **CHECKED BY** JR
AT END OF DRILLING -
NOTES See Boring Location Plan, Sheet A1
AFTER DRILLING -

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS
0	SS 1		CLAY, Sandy, Plastic, Brown, Stiff, Slightly Moist	4-6-11 (17)	65	28	CL
			SAND, Fine to Medium Grained, Silty, Light Brown to Multicolored, Loose to Medium Dense, Slightly Moist with interbedded seams of poorly graded sands				
	SS 2			2-7-8 (15)			
5							
	SS 3		▽ - wet below approximately 6 feet	4-8-8 (16)			
	SS 4			4-2-3 (5)			
10							
	SS 5			2-5-7 (12)			
	SS 6			1-5-7 (12)			
15			NOTE: SS - Split Spoon Sample Bottom of hole at 15.0 feet.				

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

SUMMARY OF TEST RESULTS

PROJECT NO.: AGCQC06-052 **DATE:** 09/07/06

PROJECT NAME: Bosque Bonito Units 1 & 2 – Wastewater Collection System
San Elizario, El Paso County, Texas

PROJECT NAME: CEA Engineering Group

Boring No.	Approx. Sample Depth (ft.)	N-Value (Blows/ft.)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Passing No. 4 Sieve (%)	Passing No. 200 Sieve (%)	USCS
B-1	0-1½	14	11.1	32	13	19	98	63	CL
	2½-4	10	3.6						
	5-6½	14							
	7½-9	10					100	26	SM
	10-11½	11							
	13½-15	11							
B-2	0-1½	9							
	2½-4	17							
	5-6½	10	6.0				96	16	SM
	7½-9	18							
	10-11½	15	21.1						
	13½-15	11							
B-3	0-1½	11	12.7	32	13	19	100	66	CL
	2½-4	9	3.5				100	40	SM
	5-6½	15							
	7½-9	9	20.6				100	14	SM
	10-11½	5							
	13½-15	5							
B-4	0-1½	11	12.9						
	2½-4	15							
	5-6½	9	2.6				100	12	SM
	7½-9	6					100	8	SP-SM
	10-11½	3	23.3						
	13½-15	11							
B-5	0-1½	8	14.2						
	2½-4	19							
	5-6½	13	3.4						
	7½-9	11	22.1						
	10-11½	2							
	13½-15	3							
B-6	0-1½	11	14.6						
	2½-4	13							
	5-6½	22	16.3				100	27	SM
	7½-9	20							
	10-11½	12							
	13½-15	9	21.2				100	11	SP-SM
B-7	0-1½	17	11.8	44	16	28	100	65	CL
	2½-4	15	3.2						
	5-6½	16	14.0						
	7½-9	5							
	10-11½	12	19.6						
	13½-15	12							

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			

construction quality control
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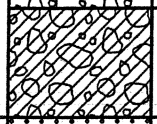
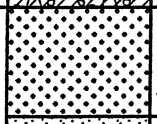
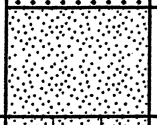
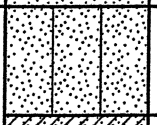
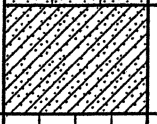
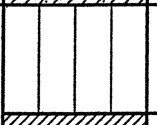
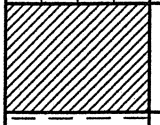
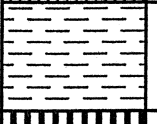
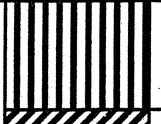
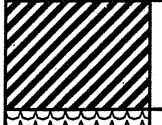
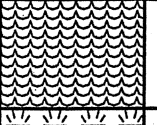
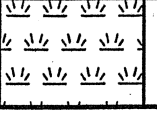
SOIL CLASSIFICATION CHART

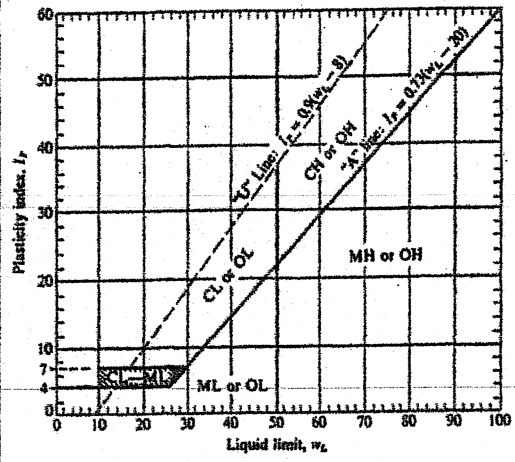
MAJOR DIVISIONS			SYMBOLS: GRAPH	SYMBOLS: LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		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

Fine-grained soils (More than half of material is smaller than No. 200 sieve)	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 sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
	Highly organic soils	Pt	Peat and other highly organic soils

For all soils plotting nearly on "A" line use dual symbols, i.e., $I_P = 29.5$, $w_L = 60$ gives CH-OH or CH-MH. When w_L is near 50 use CL/CH, ML/MH. Take "nearly on" as ±2 percent.



A-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.