Report of
Geotechnical Engineering Services

Pico Norte Pond Slopes
El Paso, Texas

Prepared for
Mr. Mark Medina
Moreno Cardenas Inc.
2505 E. Missouri Ave
El Paso, Texas 79903

Prepared by
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4601 Ripley Drive
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November 5, 2013

PSI Project 0625649
November 5, 2013

Mr. Mark Medina, P.E., CFM, CNU-A
Moreno Cardenas Inc.
2505 E. Missouri Avenue
El Paso, Texas 79903

Subject: Geotechnical Engineering Services Report
Pico Norte Ponds
El Paso, Texas
PSI Project No.: 0625649

Dear Mr. Medina:

Professional Service Industries, Inc. (PSI) performed the geotechnical engineering services that you requested. PSI provided its services in general accordance with PSI Proposal No. 0625-101944 dated August 1, 2013. PSI transmits two originals and one electronic copy with this letter.

PSI thanks you for choosing us as your consultant for this project. Please contact us at 915-584-1317 if you have any questions or we may be of further service.

Respectfully Submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Texas Firm Registration No. F-03305

Danny R. Anderson, P.E.
Senior Engineer

Reviewed By: Shailendra Endley, Ph.D., P.E.
Chief Engineer

William H. Kingsley
Senior Consultant
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1 PROJECT INFORMATION

1.1 PROJECT AUTHORIZATION

Professional Service Industries, Inc. (PSI) has completed a geotechnical exploration for the Pico Norte Pond Slopes. The site is adjacent to the intersection of Bywood Dr. and Escarpa Dr., El Paso, Texas. Our services were authorized by Mr. Mark Medina with Moreno Cardenas, Inc. by an email sent to Mr. Danny Anderson with PSI, dated July 31, 2013. This exploration was accomplished in general accordance with PSI Proposal No. 0625-101944.

1.2 PROJECT DESCRIPTION

The subject property is located adjacent to the intersection of Bywood Dr. and Escarpa Dr. in El Paso, Texas. It is the site of a storm water retention pond excavated below the natural ground surface. The soils forming the slopes at the site are typically fine sands with a minor non-plastic or very weakly plastic silt component. The pond does not have an artificial drain system to release water. The only drainage occurs as a result of water infiltration into the native soils.

The existing side slopes of the ponding area range between slope angles having a horizontal to vertical ratio of 1:1 to approximately 1.5:1. The height of the slopes currently ranges from twenty five (25) feet to thirty five (35) feet in height. It is our understanding that the final slope height will be on the order of thirty five (35) feet in height.

The existing side slopes are showing signs of moderate to severe distress attributable to being moderately to deeply incised by erosional channels developed as a result of water running over the crest of the slopes and down the cut face. Additional, erosion of the faces was identified as a result of sheet flow down the faces which carry the slope materials down the face where it is deposited as aprons at the toe of the slopes. Some sloughing of the slope faces was also observed during the site review, apparently caused by lack of confinement of the sandy material comprising the cut faces. Some cracking and settlement was observed behind the slopes crests; suggesting deep seated instability may exist in some areas.

PSI is to provide recommended side slope angles for the pond and slope face erosion protection recommendations.

The geotechnical recommendations presented in this report are based on the available information from previous work at the site as well as data obtained during the course of this investigation. If any of the noted information is incorrect, please inform PSI in writing so that we may amend the recommendations presented in this report as appropriate. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.
1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to explore the subsurface conditions and make the pertinent slope recommendations at the subject site. The subsurface information was obtained from auger boring, Standard Penetration testing and sampling as well as laboratory testing. To evaluate the subsurface conditions one (1) boring was advanced to a depth of approximately twenty one and one half (21½) feet. The approximate boring location is shown on the Boring Plan (Figure 2) in the appendix of this report.

Soil samples were generally obtained beginning at the ½-foot depth followed by the 2½ foot depth and then at 2-½ intervals to a depth of approximately ten (10) feet below the existing ground surface. Below a depth of approximately ten (10) feet, soil samples were obtained at approximately five (5) foot intervals to the total explored depth. The samples were sealed in plastic bags at the site to prevent loss of moisture during shipment to our laboratory.

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

- Subsurface soil conditions, including depth and consistency of soil strata. Recommendations for side slopes for the existing pond with no stabilization erosion measure provided;
- Recommendations for side slopes for the pond with stabilization measures;
- Type of stabilization erosion measure or measures; and,
- Specifications for the installation of the recommended stabilization erosion measure. Recommendations for engineered structural fill where needed;

Our scope of services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, ground water, or air on or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2 SITE AND SURFACE CONDITIONS

2.1 SITE AND LOCATION DESCRIPTION

The subject property is located adjacent to intersection of Bywood Dr. and Escarpa Dr. in El Paso, Texas. The site area has been developed as a retention pond. The ground surface in the slope area typically is bare soil with a few scattered native bushes. At the time of the site exploration some erosion had occurred in most side slopes of the pond and some surface sloughing of the slope faces has occurred.
2.2 SUBSURFACE CONDITIONS

The site subsurface conditions were explored with one boring advanced to a depth of approximately twenty one and one half (21½) feet below the existing surface and a review of boring logs from previous investigations at the site that were advanced to depths as deep as one hundred feet below the ground surface.

Generally, the site soils are comprised of fine sands with minor amounts of silt. Some thin clay stringers of sandy clay were identified in the upper four (4) feet. Based on field observation the sandy clay stringers are discontinuous and absent at most locations around the site. Also the clays are very low plasticity and, based on field observation, do not appear to significantly impact the stability of the slopes. Below the four foot depth to the total depth of the boring the soils are typically comprised of fine sands with silt. The soil moisture at the time of the investigation ranged from approximately 4% to 7%. This stratigraphy is also typical of the logs from previous investigations.

Select soil samples were tested in the laboratory to determine material properties for our evaluation. Laboratory testing was generally accomplished in accordance with ASTM procedures.

Groundwater observations were made while drilling and immediately following drilling. Groundwater was not encountered during the investigation. The boreholes were backfilled with soil cuttings at the completion of drilling and groundwater observations.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring log included in the Appendix should be reviewed for specific information at the boring location. These records include soil descriptions, stratifications, penetration resistances, locations of the samples and laboratory test data. The stratifications shown on the boring log represent the conditions only at the actual boring location. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. The samples that were not altered by laboratory testing will be retained for 60 days from the date of this report and then discarded.

3 EVALUATION AND RECOMMENDATIONS

3.1 GEOTECHNICAL DISCUSSION

The following recommendations have been developed based on the previously described project characteristics and subsurface conditions encountered. Once final design plans and specifications are available, a general review by PSI is recommended as a means to check that the conditions idealized in the project description are correct.
and that the earthwork and foundation recommendations are properly interpreted and implemented.

3.2 SLOPE STABILITY ANALYSIS

Although the soil materials to be used for construction of the slope are not yet known, we performed a direct shear test on a representative sample of the near-surface soils from the site. The direct shear test was performed on a sample remolded to the approximate unit weight typical of the natural soil found at the site. The soil strength parameters obtained from that test were utilized in our slope stability analysis. The results of the direct shear test are present in Appendix B.

To evaluate the stability of the soil, slope angles having horizontal to vertical ratios of 1H:1V, 2H:1V, 3H:1V, and 4H:1V were analyzed and a factor of safety against shear failure was determined for each case. Global slope stability analyses were performed considering the interpreted stratigraphy at the explored boring location and based on visual observations of the existing slopes. The material qualities of the necessary imported fill for this project was estimated from our previous explorations at the site and from published strength correlations based on engineered structural fill material type as outlined in Section 3.4, Site Preparation. Strength parameters for the in-situ soils were estimated based on the results of the direct shear test. The computer program 2012 SLOPE/W was used to perform the stability analyses. The SLOPE/W program incorporates a search for the minimum factor of safety and incorporates a limit equilibrium approach. The slope angles and associated factors of safety were plotted. Using the plot an approximate slope angle for a desired factor of safety can be determined (Figure 8). Figures 4 through 7 and figure 9 show the critical failure surfaces and factors of safety for each analyzed slope angle.

The analysis indicated that the critical failure surfaces are relatively shallow. Many of the slopes are currently at an angle having a horizontal to vertical ratio between 1.5H:1V and 1H:1V with associated factors of safety of between approximately 1.0 and 0.6 respectively. As a result the slopes are raveling, sloughing and are being deeply incised by water erosion. In our opinion, the slightly moist condition of the soil is adding somewhat to the stability because of weak bonding between the water and the soil particles in the unsaturated state. Should the soil become saturated, significant failure could occur. This is illustrated near the toe of the slopes where the slope angle is flatter most likely as a result of saturation during filling of the pond.

Based on our analyses, PSI recommends the slopes not exceed an angle having a horizontal to vertical ratio of 3H:1V which produces a static factor of safety of approximately 1.9, and a static factor of safety of approximately 1.6 during drawdown. The typical required minimum factor of safety is 1.5. During drawdown the critical failure surface is deep seated when the surface is protected (Figure 9). If left unprotected, severe surface sloughing could occur. To minimize surface sloughing the slope should be protected using a high density non-erosive material such as rock
plating. In our opinion, if no surface erosion measures are taken, the allowable slope angle should be flattened to 4H:1V and periodic maintenance and repair of surface erosion gullies should be planned. PSI recommends that once the final slope height and soil to be used for construction of the slope are known, direct shear testing should be performed on representative import material to confirm that the resulting stability of the proposed slope is acceptable.

Placement of the new fill on the existing slope will require preparation of the native slope to properly support the new material. It is imperative that the new fill material be properly keyed into the existing native material so that a plane of weakness is not constructed between the existing slope and the new fill material. It is recommended that the new fill be placed such that it is keyed as well as practical into relatively horizontal benches cut into the existing slope.

When keying into the existing slope, the back face of the bench may be near-vertical to allow for more efficient compaction of fill against the back slope of the key. It is recommended that each bench not exceed an elevation change of greater than four feet per step. Some sloughing of the benches will occur in the clean sands. Removal of the sloughed materials is required prior to placing the engineered structural fill. Minimum bench widths of 8 to 10 feet to the face of the slope are recommended to allow for proper compaction by earthwork equipment. After bench construction the fill material should be placed and compacted to the top of the bench cut before daily work stoppage. Newly cut benches should not be left exposed for extended periods of time such as during overnight work stoppage.

The bottom of the cut bench should be scarified eight (8) inches, processed to bring the material uniformly as close as practical (as described below) to optimum moisture content and compacted. Figure 3 illustrates the concept of keying into the slope. During construction of the slopes, it is recommended that the slope faces be back-rolled at height intervals not exceeding 4 feet with a vibratory roller or other appropriate compaction equipment to obtain a compacted surface on the slope face. Alternatively, the slope can be over-built by at least 3 feet and then cut back to the final grade so that a compacted face is exposed.

When the above information is followed the slopes are anticipated to be stable with respect to deep-seated failures. The face of the slope, however, may be subject to erosion and/or surficial failures if water is allowed to flow across the slope face from the developed area. It is recommended that water not be allowed to run across the face of the slopes. It is recommended that water from above be collected and diverted into lined channels or drop structures and discharged at the toe of the slope in the ponding area.

The only water that should be allowed to cross the face of the slopes is precipitation waters that fall directly on the face. In higher precipitation events, even this water flowing on the slope face will likely cause erosion. It is recommended that the slope
faces be plated with erosion resistant materials as deemed appropriate by the landscape consultant. Other methods may be used to retard the erosion of the face such as seeding, sheet flow baffles or other similar devices.

### 3.3 SLOPE FACE TREATMENT

Slope faces should be anticipated to erode during precipitation events and, potentially, during drawdown of ponded water. Erosion may be controlled by reducing the velocity of flowing water on the slope face, by reducing the volume of the water that may flow across the slope face, confining the sandy surface and dissipating wave action. PSI recommends that measures be taken to limit the amount of water crossing the slope face.

PSI recommends that behind the top of the slope the surface should be graded so that water is collected before it can cross the slope face and be directed to lined channels or drop structures where it can be discharged in the ponding area. Discharge of the flowing water should be a minimum of 20 feet from the toe of the slope.

To aid in confinement of the slope surface and to assist in dissipating water flow energy PSI recommends the slope be plated with angular rock. The rock should be graded such that the nominal diameters of the individual rock is between three (3) and six (6) inches. PSI recommends that a minimum of twelve (12) inches of rock plating be placed on the surface of the slope. The rock plating should extend a minimum of twenty (20) feet beyond the toe of the slope and extend behind the crest of the slope a minimum of five (5) feet.

### 3.4 SITE PREPARATION

Owing to the presence of near surface loose soils, especially in the bottom of the pond basin near the toe of the slopes, PSI recommends that the soils below the new slope fill and extending a minimum distance of twenty (20) feet beyond the toe of the slope be over-excavated to a depth of at least 2 feet below the finished grade. The exposed subgrade should be scarified to a depth of approximately 12 inches, be moisture conditioned to near optimum moisture content and then be compacted to at least 95 percent of the soil’s maximum dry density, per ASTM D-1557. The compacted subgrade should then be proof-rolled with a loaded tandem axle dump truck, water truck or equivalent. Soils which are observed to rut or deflect excessively (greater than 1 inch) under the moving load should be undercut and replaced with properly compacted fill. The proof-rolling activities should be witnessed by a representative of the Geotechnical Engineer and should be performed during a period of dry weather.

Following the subgrade preparation, engineered structural fill placement may begin. The first layer of engineered structural fill should be placed in a relatively uniform horizontal lift and be adequately keyed into the stripped and scarified subgrade soils as previously discussed. Fill materials for engineered structural fill should be free of
organic or other deleterious materials and should have a maximum particle less than 3 inches. Soils proposed to be used as engineered structural fill materials should be classified in accordance with procedures stated in ASTM D 2487. The on-site soils meeting the following criteria could be reused as engineered structural fill. Soils will be considered satisfactory for engineered structural fill when classified as follows:

GW, GP, GC, GM, GC-GM, GP-GM, GP-GC

SW, SP, SC, SM, SC-SM, SP-SM, SP-SC

Soils will be considered unsatisfactory for engineered structural fill materials when classified as follows:

PT, OL, OH, MH, ML, CL-ML, CL and CH or

where the plasticity index exceeds 15.

The resulting engineered structural fill must produce a stable, uniform and consistent compacted fill body. Fill material should be placed in maximum lifts of 8 inches of loose material and should be compacted within the range of 2 percentage points below to 2 percentage points above the optimum moisture content value (-2% to +2% of OMC) for cohesionless soils and at optimum to 3 percentage points above optimum (0 to +3% of OMC) for cohesive soils, as determined by the Modified Proctor Maximum Dry Density Test (ASTM D 1557).

Compaction of the fill material should be performed with appropriate types of power, pneumatic or tamping equipment. Each lift of fill should be compacted to a density which is not less than 95 percent of maximum dry density for cohesionless materials and 90 percent of maximum density for cohesive materials. Maximum dry density should be determined in accordance with ASTM D 1557. Monitoring of the backfilling should include sufficient compaction testing by the Geotechnical Engineering representative to document that each lift of fill has been compacted to the required density. Should any lift or portion of a lift not conform to the density requirements, the lift should be scarified and recompacted until the required density is obtained. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by diskimg or scarifying. Each lift of compacted engineered fill should be tested by a representative of the Geotechnical Engineer prior to placement of subsequent lifts. Care should be taken to apply compactive effort throughout the fill and fill slope areas. The moisture content and the degree of compaction of the structural fill soils should be maintained until the construction of the structures within the area.

4 CONSTRUCTION CONSIDERATIONS

PSI should be retained to provide observation and testing of the construction activities involved in the reconstruction and regrading operations including foundations, slabs, earthwork, paving and related activities of this project. PSI cannot accept any
responsibility for any conditions which deviated from those described in this report, nor for the performance of the foundations if not engaged to provide construction observation and testing for this project.

4.1 DRAINAGE AND WATER CONCERNS

Water should not be allowed to collect in the excavations, on slab areas, or on prepared subgrade of the construction site during construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, or other surface runoff. Positive site surface drainage should be provided to reduce infiltration of surface water in the work area.

Any water accumulation should be removed from excavations by pumping. Should excessive and uncontrolled amounts of seepage occur, the Geotechnical Engineer should be consulted.

4.2 EXCAVATIONS

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed the owner and the contractor could be liable for substantial penalties.

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

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

4.3 RECOMMENDED MINIMUM SAMPLING AND TESTING FREQUENCIES

It is recommended that PSI be retained to provide observation and testing of construction activities involved in the foundations, earthwork, and related activities of
this project. PSI cannot accept responsibility for any conditions that deviate from those described in this report, nor for the performance of the foundations if not engaged to also provide construction observation and testing for this project. The following are recommended minimum sampling and testing frequencies.

Earthwork:

- At least one (1) moisture-density (Proctor) test, Atterberg limits test and percent finer than #200 sieve test should be performed per soil type for subgrade, backfill, fill and base materials.

- In paved rundown areas and other flatwork and pavement areas, at least one (1) density and moisture content test per 2,500 square feet of surface area, or portion thereof, should be performed on the subgrade soils for each compacted 6-inch thickness of fill. Testing of backfilled trenches should be at least one (1) density and moisture content test per 100 linear feet of trench per 8-inch compacted fill thickness.

Concrete:

- At least one (1) slump, air content and temperature test should be performed per 30 cubic yards, or portion thereof, of each type of concrete placed each day including when the concrete test cylinders are molded.

- At least one (1) set of four (4) concrete test cylinders should be molded for each type of concrete per 100 cubic yards or fraction thereof placed in a day.

- Each set of cylinders should be tested for compressive strength with two (2) of the cylinders tested at seven (7) days and two (2) of the cylinders tested at 28 days.

- Reinforcing steel should be checked for size and placement prior to concrete placement.

4.4 REPORT LIMITATIONS

The recommendations submitted, in this report, are based on the available subsurface information obtained by PSI. PSI should be notified immediately if changes in conditions at the site occur prior to or during construction to determine if changes in the foundation recommendations are required. If PSI is not notified of such changes, PSI will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally
accepted professional Geotechnical Engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

This report was prepared for the specific use of Moreno Cardenas Inc.
FIGURES
Pico Norte Ponds
PSI Project No. 0625649

Name: Sand    Unit Weight: 120 pcf    Cohesion': 0 psf    Phi': 32 °

Slope Stability Analysis
Short Term Condition
Method: Spencer
Slip Surface: Entry and Exit
Factor of Safety: 2.50

Figure 4 - 4H:1V Slope Analysis
Pico Norte Ponds
PSI Project No. 0625649

Slope Stability Analysis
Short Term Condition
Method: Spencer
Slip Surface: Entry and Exit
Factor of Safety: 1.88

Name: Sand  
Unit Weight: 120 pcf  
Cohesion': 0 psf  
Phi': 32 °

Figure 5 - 3H:1V Slope Analysis
Pico Norte Ponds
PSI Project No. 0625649

Slope Stability Analysis
Short Term Condition
Method: Spencer
Slip Surface: Entry and Exit
Factor of Safety: 1.25

Name: Sand  Unit Weight: 120 pcf  Cohesion: 0 psf  Phi: 32°

Figure 6 - 2H:1V Slope Analysis
Figure 7 - 1H:1V Slope Analysis

Slope Stability Analysis
Short Term Condition
Method: Spencer
Slip Surface: Entry and Exit
Factor of Safety: 0.67

Name: Sand  Unit Weight: 120 pcf  Cohesion': 0 psf  Phi': 32 °
Figure 8  Min. Factor of Safety VS Slope Angle
Pico Norte Ponds
PSI Project No. 0625649

Slope Stability Analysis
Short Term Condition
Method: Spencer
Slip Surface: Entry and Exit
Factor of Safety: 1.60

Name: Sand      Unit Weight: 120 pcf    Cohesion': 0 psf    Phi': 32 °
Name: Rock Blanket      Unit Weight: 140 pcf    Cohesion': 0 psf    Phi': 40 °

Figure 9 - 3H:1V Drawdown Slope Analysis
**BOARING B1**

- **DATE STARTED:** 9/3/13
- **DATE COMPLETED:** 9/3/13
- **COMPLETION DEPTH:** 61.5 ft
- **BENCHMARK:** N/A
- **ELEVATION:** N/A
- **LATITUDE:** 31.77724°
- **LONGITUDE:** -106.33248°
- **STATION:** N/A
- **OFFSET:** N/A
- **REMARKS:** None
- **DRILL COMPANY:** PSI, Inc.
- **DRILLER:** AB
- **LOGGED BY:** AR/LD
- **DRILL RIG:** BK81-HD
- **DRILLING METHOD:** Hollow Stem Auger
- **SAMPLING METHOD:** SS
- **HAMMER TYPE:** Automatic
- **EFFICIENCY:** N/A
- **REVIEWED BY:** Danny R. Anderson, PE

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### MATERIAL DESCRIPTION

**SS1** 15
- **Depth:** 0 ft
- **Material:** Silty Clayey Sand - brown, dense, moist, with thin sandy clay lenses
- **USCS Classification:** SC
- **SPT Blow per 6-inch (SS):** 3-10-23 N=33

**SS2** 16
- **Depth:** 5 ft
- **Material:** Silty Sand - brown, medium dense, moist
- **USCS Classification:** SM
- **SPT Blow per 6-inch (SS):** 8-30-27 N=57

**SS3** 17
- **Depth:** 10 ft
- **Material:** Medium dense

**SS4** 18
- **Depth:** 15 ft
- **Material:** POORLY GRADED SAND - brown, medium dense, moist
- **USCS Classification:** SP
- **SPT Blow per 6-inch (SS):** 6-8-9 N=17

**SS5** 18
- **Depth:** 20 ft
- **Material:** Dense

**SS6** 17
- **Depth:** 25 ft
- **Material:** Boring terminated at 21.5 feet below grade

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### STANDARD PENETRATION TEST DATA

- **N in blows/ft:**
  - 0
  - 25
  - 50
- **Moisture:**
  - PL
  - LL
- **STRENGTH, t/sf:**
  - Qu
  - Qp

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**PROJECT NO.:** 0625649
**PROJECT:** Pico Norte Ponds
**LOCATION:** El Paso, TX

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The stratification lines represent approximate boundaries. The transition may be gradual.
APPENDIX B – DIRECT SHEAR TEST RESULTS
Direct Shear Test Results

Soil Type: Fine Sand with Silt
Boring No.: 1
Depth: 10'
Test Type: CD
Moisture Condition: Sat
Performed By: WHK/LD
Date: 10/23/13
Project No.: 0625649
Project: Pico Norte Slopes

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<th>Test Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tr>
<td>Moisture Content (%)</td>
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<td>6.0</td>
<td>6.0</td>
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<tr>
<td>Dry Unit Weight (pcf)</td>
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<td>104.9</td>
<td>104.9</td>
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<tr>
<td>Normal Stress (psi)</td>
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<td>5.0</td>
<td>10.0</td>
<td></td>
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<tr>
<td>Maximum Shear Stress (psi)</td>
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<td>3.3</td>
<td>6.4</td>
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<tr>
<td>Strain Rate (in/min)</td>
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<td>Initial Sample Area (Sq. In.)</td>
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<td>4.0</td>
<td>4.0</td>
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Cohesion = 0.2 psi

\[ \phi = 32 \text{ deg} \]
APPENDIX C – KEY TO TERMS USED ON LOGS
TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on #200 sieve)
Includes (1) clean gravels and sands described as fine, medium or coarse, depending on distribution of grain sizes and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests or estimated from resistance to sampler.

<table>
<thead>
<tr>
<th>PENETRATION RESISTANCE</th>
<th>DESCRPTIVE TERM</th>
<th>RELATIVE DENSITY**</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLOWS / FOOT*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – 10</td>
<td>Loose</td>
<td>0 – 40 %</td>
</tr>
<tr>
<td>11 – 30</td>
<td>Medium dense</td>
<td>40 – 70 %</td>
</tr>
<tr>
<td>31 – 50</td>
<td>Dense</td>
<td>70 – 90 %</td>
</tr>
<tr>
<td>Over 50</td>
<td>Very dense</td>
<td>90 – 100 %</td>
</tr>
</tbody>
</table>

* 140 pound hammer, 30 inch drop.
** From tests on undisturbed sand sample.

FINE GRAINED SOILS (major portion passing #200 sieve)
Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

<table>
<thead>
<tr>
<th>DESCRIPTIVE TERM</th>
<th>COMPRESSIVE STRENGTH tons/sq. ft.</th>
<th>DESCRIPTIVE TERM</th>
<th>COMPRESSIVE STRENGTH tons/sq. ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Soft</td>
<td>Less than 0.25</td>
<td>Stiff</td>
<td>1.00 to 2.00</td>
</tr>
<tr>
<td>Soft</td>
<td>0.25 to 0.50</td>
<td>Very Stiff</td>
<td>2.00 to 4.00</td>
</tr>
<tr>
<td>Firm</td>
<td>0.50 to 1.00</td>
<td>Hard</td>
<td>4.00 &amp; higher</td>
</tr>
</tbody>
</table>

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or shrinkage cracks in the soil. The consistency ratings of such soils are bade on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided – having inclined planes of weakness that are slick and glassy in appearance.
Fissured – containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Sensitive – pertaining to cohesive soils that are subject to appreciable loss of strength when remolded.
Laminated – composed of thin layers of varying colors and texture.
Interbedded – composed of alternate layers of different soil types.
Calcareous – containing appreciable quantities of calcium carbonate.
Well Graded – having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
Poorly Graded – predominantly of one grain size, or having a range of sizes with some intermediate size missing.