SKG ENGINEERING, LLC

Geotechnical Report

Proposed Detention Basin

San Angelo, Texas

7/5/18
SKG Engineering, LLC
F-7608

PREPARED FOR:
Mr. Kevin Morris
Freese and Nichols Inc.
2732 82nd Street
Lubbock, Texas 79424

July 2018

18-E-0721

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July 5, 2018 18-E-0721

Mr. Kevin Morris
Freese and Nichols, Inc.
2732 82nd Street
Lubbock, Texas 79424

Subject: Geotechnical Report, Proposed Detention Basin,
San Angelo, Texas

Dear Mr. Morris,

In accordance with your authorization, SKG Engineering has completed its geotechnical investigation at the referenced site. The work was done in accordance with the proposal dated the 23th day of February 2018. The data and results are included in the attached report.

If you have any questions or comments, or if we can be of any more service to you, please do not hesitate to contact us at (806)-368-7638.

Sincerely,
SKG Engineering, LLC

Travis Barnett, P.E., C.F.M.

SKG Engineering, LLC
F-7608

Attachments - Geotechnical Report

CC: File

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Table of Contents

1.0 Project Information **1**

2.0 Field Explorations **1**

2.1 Means and Methods 1
2.2 Considerations 1

3.0 Laboratory Testing **2**

4.0 Subsurface Materials and Conditions **2**

5.0 Groundwater **2**

6.0 Foundation Design Recommendations **2**

6.1 Considerations 2
6.2 Shrink/Swell Considerations 3
6.3 Foundation System and Recommendations 3
6.3.1 Grade Supported Foundation 3
6.3.2 Drilled Piers 4
6.3.3 Uplift Loads 4
6.4 Seismic Design Criteria 4
6.5 Lateral Design Criteria 5
6.6 Retaining Wall Backfill Material and Compaction 5
6.7 Drainage 5

7.0 Embankment Design Recommendations **6**

7.1 Typically Embankment Section 6
7.2 Stability Analysis 6
7.3 Embankment Settlements 6
7.4 Slope Protection 6

8.0 Construction Considerations **7**

8.1 Stripping and Existing Grade Preparations 7
8.2 Placement and Compaction of Embankment Fill 7
8.3 Construction Observation 7

9.0 Underground Utilities **7**

9.1 Trenching and Excavation Requirements 7

10.0 Site Preparation **8**

10.1 Subgrade 8
10.2 Engineered Fill 8
10.3 Flexible Base Material 8
10.4 Testing 8

11.0 Limitations **9**

Attachments

A – Borehole Location Map
B – Proposed Pond Limits Exhibit
C – Logs of Boreholes
D – Laboratory Results

E – Typical Embankment Sections (Provided by Freese and Nichols Inc.)
F – Slope Stability Analysis – Section B-B’
G – Slope Stability Analysis – Section C-C’

1.0 Project Information

The subject property is located west of the intersection of La Cruz Street and Avenue P in San Angelo, Texas. Existing developed and undeveloped areas will be excavated in order to accommodate the proposed detention pond. A concrete drainage channel currently exists in the area of the proposed detention pond bottom. There are two drainage culverts that discharge into this channel at separate locations. An exhibit showing the proposed detention pond location and limits is attached to this report in Appendix B.

The top of berm is planned at elevation 1851.0 with a normal water level of 1849.0. The proposed bottom elevation of the detention pond is 1842.60, resulting in a maximum height of about 8.4 feet. An outfall structure is planned for the pond, and will be designed by Freese and Nichols, Inc.

2.0 Field Explorations

2.1 Means and Methods

The subsurface explorations were conducted on this site in June 2018. The boreholes were drilled to a maximum depth of 40', and the logs of these boreholes are included in this report. The drilling was performed with a truck mounted air rotary drill rig. The drilling activities were performed in accordance with accepted methods and procedures. A location map showing the approximate borehole locations is included in Attachment A.

Material samples were recovered at various depths for testing. The primary means of extracting subsurface soil samples was by the use of a 3" Shelby-tube and/or a 2" O.D. split barrel sampler. The samples were extruded or removed in the field and placed in moisture tight bags and labeled. The samples were then transported to the laboratory for testing and visual evaluation by geotechnical personnel. Refer to the logs of borings located in Attachment C for lithology, sample locations and quantities.

Due to site access constraints, boreholes 7, 8, 9, and 10 were drilled at the top of the existing channel embankment to the west of the proposed site. Borehole 9 was advanced to 40-ft to offset the embankment height and obtain soil data below the bottom of proposed excavation along the western slope.

Bulk samples of potential borrow soils were obtained from drilling cuttings. The two samples obtained are representative of proposed cut and fill soils. Proposed borrow material was obtained in Boreholes 9 and 10. Refer to Attachment A for borehole locations.

2.2 Considerations

A strong hydrocarbon odor was detected by field staff during drilling of Boreholes 1 and 2. Prior to any excavation at the site, it is recommended that the project owner perform all environmental due diligence to determine the nature and concentration of any hydrocarbon soil contamination in the proposed areas of excavation. This report is not an environmental study and does not meet any environmental due diligence criteria.

Field observation by SKG staff of hydrocarbon odors in the areas of Boreholes 1 and 2 does not necessarily mean that hydrocarbon contamination levels present are above acceptable thresholds in this area, nor does it imply that hydrocarbon contamination is absent in other areas of the project.

3.0 Laboratory Testing

Tests were performed to determine engineering characteristics of the subsurface materials encountered including, but not limited to, soil moisture content, Atterberg Limits and sieve analysis. The test results can be found in Attachment D. Samples not tested in the laboratory will be retained for a maximum of 60 days and then discarded unless otherwise notified in writing prior to disposal of the samples.

Standard Proctor tests (ASTM D-698) were performed on two bulk samples obtained during drilling to evaluate the proposed slope stability of both cut and fill embankment sections. The results of these tests are presented in Attachments D.

4.0 Subsurface Materials and Conditions

The specific subsurface stratum encountered in each borehole is described in the logs of boreholes included in Attachment C. The strata encountered at the site can be divided into two major strata. The first stratum is a surface layer of clayey sand that extends from a depth of 0' to 3'. The second soil stratum consists of clay that extends from a depth of 3' to the depth of the boreholes.

The subsurface stratum varies from those stated above as follows:

B1 – Clayey sand encountered from a depth of 0 feet to 5 feet;
B4 – Clay encountered from the surface to the depth of the borehole;
B5 – Clay encountered from the surface to the depth of the borehole;
B6 - Clay encountered from the surface to the depth of the borehole;
B7 – Clay encountered from the surface to the depth of the borehole;
B8 – Clay encountered from the surface to the depth of the borehole;
B9 – Clay encountered from the surface to the depth of the borehole;
B10 – Clay encountered from the surface to the depth of the borehole.

5.0 Groundwater

There was groundwater noted in boreholes 7 & 9 at the time of the investigation. Refer to the logs of borings located in Attachment C for specific water levels. The groundwater noted in the boreholes does not express or imply a groundwater study was performed, which is beyond the scope of this report. It should be noted that groundwater levels are subject to change based on seasonal and climatic conditions. Groundwater encountered could impact embankment cut along the western slope of the detention pond. Project owners and contractors should perform any due diligence work prior to mobilizing equipment to the site.

6.0 Foundation Design Recommendations

6.1 Considerations

The properties of in-situ soils, site characteristics, and the level of tolerable deflection should be carefully considered during the design phase. A foundation should economically meet the functional requirements of the structure and minimize differential movement of the structure that could cause damage.

There is existing grass and organic material at the site. Any grass, tree roots, or other organics in the footprint of proposed foundations should be removed entirely, and site soils should be used to fill the excavated areas. The fill should be placed and compacted in accordance with the Site Preparation section of this report.

Routing of drainage should be addressed in the design phase of the project to ensure drainage is routed away from and around proposed foundation systems and erosive conditions are avoided.

6.2 Shrink/Swell Considerations

Shrink/swell movements of the in-situ soils with changes in the soil moisture content are anticipated to be moderate at the site. The Potential Vertical Rise (PVR) at the existing ground surface was calculated to be on the order of 0.75-in. using the McDowell PVR Method. The PVR was approximated using the McDowell's initial dry soil condition and a potential active zone to fifteen feet below grade.

The PVR can be reduced to be on the order of 0.5-in. by providing a 3-ft. layer of engineered fill below and 2-ft. beyond any foundation systems. When engineered fill is utilized to reduce the PVR, all footings should bear to the engineered fill depth, or engineered fill shall be provided below the footing depth as required for PVR mitigation. Refer to the Engineered Fill section for placement and specifications.

The estimated depth of footings provided by Freese and Nichols, Inc. at the site is roughly 5-ft. below natural ground. Footings bearing deeper than 3-ft. below natural ground would experience a PVR of approximately 0.5-in.

The PVR, and moreover foundation movement is affected by many factors that influence its magnitude and rate of change. Factors include: seasonal variations in the moisture content between the interior and perimeter of the foundation, topographic relief, vegetative cover, confining pressures, fluctuating and shallow water tables, and the composition of underlying soils. In-situ clays can expand with the introduction of moisture and shrink with decreases in moisture.

6.3 Foundation System and Recommendations

We recommend an adequately reinforced concrete slab foundation system with grade beams placed as determined by the structural engineer. Spread footings should be used to support concentrated point loads and provide lateral stability where necessary. Pier parameters are provided herein, if the structural engineer chooses to utilize a foundation supported by piers.

6.3.1 Grade Supported Foundation

We recommend an 8" thick layer of granular base below the bottom of slab to serve as a capillary break. Subgrade below the granular base should be scarified and compacted in accordance with the Site Preparation section of this report.

A frost depth of 12" shall be utilized for this site. Footings shall bear to a minimum depth of 1-ft. below existing grade. We recommend grade beams not supported by piers to be a minimum of 12" wide. The dimensions of spread footings should be calculated by the structural engineer, and all footings properly reinforced for the anticipated design loads to minimize the possibility of a local bearing capacity failure.

The allowable bearing pressure exerted by the grade beams or spread footings on the in-situ soils from a depth of 1.5-ft. to 2-ft is 2,000 psf and from a depth of 2-ft to 4-ft. is 3,000 psf. At a depth of 5-ft, the allowable bearing pressure is 4,400 psf. The value of 125 pci for subgrade modulus may be used for design purposes. The value of 28 degrees may be utilized for the internal friction angle of the clayey soils for design purposes. The value of 0.35 for the ultimate lateral sliding resistance coefficient may be utilized for design in regard to the foundation on an engineered fill.

The allowable bearing pressure exerted by grade beams bearing into an engineered fill, placed in accordance with the specifications in Site Preparation of this report, is 3,500 psf for foundation members at a depth of 2-ft. to 4-ft.

6.3.2 Drilled Piers

Straight shaft or belled piers can be used for foundation support where loads are less than 50 kips. The piers should bear a minimum of 18' up to 25' below existing grade, bearing into the firm clay. The piers should be located below the active zone and founded on a firm, stable stratum. We recommend foregoing utilizing side shear resistance for the allowable bearing capacity of the piers between 0 and 15 feet of depth. The piers can be designed with an allowable side shear resistance of 450 psf for the portion of shaft extending from a depth of 15' to the depth of the borehole, in addition to the allowable end bearing pressure stated below. An allowable side shear resistance of 350 psf for the portion of shaft extending from a depth of 15' to the depth of the borehole may be utilized for uplift resistance. The allowable lateral bearing of the piers on the clayey soils may be taken as 150 psf/f. Field adjustments to some shaft depths may be required due to the variation in the site elevations and varied soils encountered. The allowable end bearing pressure exerted by the piers on the soils 18' to 25' below existing grade is 12,000 psf.

We recommend a minimum and maximum shaft diameter of 24" and 42", respectively for piers. The bell to shaft diameter ratio should not exceed 3.0. It should also be noted that bells in excess of 60" in diameter may become more difficult to construct due to the potential of caving or sloughing. The maximum slope angle of the underreamed bell should not exceed 45 degrees. Adjacent piers should maintain a minimum center to center spacing of 3 times the end bearing diameter. Piers spaced as specified do not require a reduction in the load carrying capacity of the individual piers due to group action.

Settlement of properly constructed piers are estimated to be less than ½" for loads of 50 kips or less. Additional settlement may occur if the load exceeds 50 kips.

Piers should be inspected for proper size, depth and reinforcement placement prior to the placement of any concrete. It is essential that the bearing stratum of the piers be identified by the engineer or his representative. A representative from SKG Engineering should be present during drilling activities to approve the bearing strata. Each pier excavation should be completed and concrete placed within one

day. In no instance should any pier excavation be left open overnight. We recommend alternating the drilling and placement of concrete for shafts in groups. Foundation concrete should be placed in clean, dry holes. Bottoms of pier excavation should be cleared of loose debris prior to the placement of concrete.

We do not anticipate the need for temporary pier casing to prevent caving or sloughing of the hole during pier drilling operations, due to the subsurface stratum. However, should field conditions warrant the use of pier casings, they should be utilized.

6.3.3 Uplift Loads

The piers could experience tensile loads as a result of post construction heave of the clay soils. The shafts must contain sufficient reinforcing steel for the length of the shaft to accommodate the net tensile loads. There are several factors affecting the magnitude of the loads, such as; shaft diameter, soil parameters and in-situ moisture levels during and after construction. However, due to subsurface conditions, any soil induced uplift pressures will be offset by the dead load of the pier itself; therefore, vertical tension reinforcement steel is not required.

6.4 Seismic Design Criteria

We have provided the seismic criteria for use in the structural design phase of the project. The seismic criteria is based on the 2015 International Building Code. The stratum referenced in this section refer to

those described in the section Subsurface Materials and Conditions of this report. Please refer to the following table for seismic design parameters.

Mapped Spectral Response Acceleration					
Description	Site Class	Short Periods (S_s)	1 Second Period (S_1)	Site Coefficients	
				F_a	F_v
Stratum I	D	0.09g	0.04g	1.6	2.4
Stratum II	C	0.09g	0.04g	1.2	1.7

The International Building Code (IBC) requires a site soil profile determination extending a depth of 100 feet for seismic site classification. The scope of our geotechnical services requested does not include the 100-foot soil profile determination. Additional services can be performed if requested or required, since our scope terminated the boreholes at a depth of 40 feet. We would recommend utilizing a Seismic Site Classification of C for this site, based on the soil conditions to a depth of 40 feet.

6.5 Lateral Design Criteria

Retaining walls that are sensitive to movements on the order of 0.75-in. should be supported by piers bearing a minimum of 18' below existing grade in a firm stable stratum. We recommend that wall footings bear a minimum of 2' below finished grade and be designed to withstand the lateral forces applied by earth pressures described below. The footings should not exceed the allowable bearing capacity of the soil on which it bears. The allowable passive earth pressure is 298 psf/ft of the depth, to a maximum of 1,500 psf.

Lateral earth pressures acting on the retaining walls will depend on several parameters such as; backfill used, drainage conditions and loads of adjacent structures. Recommended lateral earth pressures expressed as equivalent fluid pressures are presented below. The pressures below are assuming positive drainage is provided to prevent hydrostatic pressures.

Equivalent Fluid Pressures		
Material	At Rest (psf/ft)	Active (psf/ft)
Stratum I & II	100	60
Engineered Fill	55	35

6.6 Retaining Wall Backfill Material and Compaction

Retaining walls should be backfilled with a 12" width of pea gravel for the height of the wall. Backfill behind the pea gravel should be a non-expansive fill material with a maximum particle size of 4" nominal diameter three quarters of the wall height and a clay cap on the top quarter of the wall height. We recommend providing weep holes along the bottom of the retaining wall height at 10' on center maximum spacing for the length of the wall. We recommend placing fill in maximum 8" loose lifts and compacted to between 93% to 97% of the Standard Proctor Density. Compaction tests should be performed on each lift.

6.7 Drainage

Positive drainage away from the foundation must be provided and maintained to reduce subsurface moisture variations. Due to the presence of in-situ clays, we recommend through the design and construction phase an emphasis on maintaining a stable moisture content in the soils beneath and adjacent to the foundation be a major priority. Temporary and permanent control measures should be properly designed and installed to ensure positive drainage away from the foundation to maintain a quasi-stable soil moisture content.

7.0 Embankment Design Recommendations

7.1 Typically Embankment Section

Two typical embankment sections are presented in Attachment E. The two embankment sections represent a proposed cut and proposed fill embankment section, respectively. The two proposed sections were provided by Freese and Nichols, Inc. for slope stability analysis.

The slope stability analyses performed for this study found that the proposed side slopes have an adequate factor of safety with respect to deep-seated shearing movements. The slope stability analyses are discussed in a later section of the report. There is a risk of shallow "skin slides". These shallow slides typically occur in high PI earthen slopes. Using downstream slopes with a maximum 4H:1V serves to reduce the risk of shallow slides.

7.2 Stability Analysis

The top of the embankment for section B-B' is planned at elevation 1851.0 with a normal water level of 1849.0. Proposed bottom-of-detention grade is 1842.6, which results in a maximum slope of 8.4 vertical feet. For section C-C' a maximum height was not specified. The section will match existing grade at the property line. For modeling purposes, this section was assumed to have a top-of-embankment grade of 1856.0. The bottom-of-detention grade for section C-C' is 1842.6, which results in a maximum slope of 13.4 vertical feet modeled for section C-C'.

Freese and Nichols, Inc. indicated that section C-C' may be constructed with 3H:1V slopes or 4H:1V slopes. 3H:1V slopes were used to model all scenarios for section C-C'.

The two cross sections provided by Freese and Nichols, Inc. were analyzed for three conditions: end of construction condition, pond-full condition, and rapid drawdown condition. Seismic risk in the area is minimal and was not modeled.

Shear strength parameters used in the analysis were selected based on soil classifications and laboratory tests. The soil parameters, phreatic surface, and geometry used in the analysis are presented on Attachments F and G. The stability analyses were performed using the computer program SLIDE 6.0 for deep seated shearing failures.

The results of the analysis are presented on Attachments F and G. The minimum computed factor of safety for all three analyzed conditions was 3.509 for section B-B', and 3.564 for section C-C'. Accepted engineering practice generally requires a safety factor greater than 1.5 with respect to deep seated shearing failures for the conditions analyzed. The planned sections satisfiy this criterion.

7.3 Embankment Settlements

Differential settlements will occur along the axis of the fill sections of the embankment because of variations in the depth of overburden soils and embankment height. This settlement is expected to be less than 2% of the embankment height. In areas with minimal overburden, foundation settlements will be negligible. For the maximum-height fill section, 2% settlement would result in approximately +/- 2 inches of settlement at the maximum height of 8.4 feet. About 50 percent of this settlement should occur during construction. This results in total post construction settlements of about +/- 1 inch at the maximum-height fill section.

7.4 Slope Protection

The upstream face of the slope will be subject to wave action when the detention pond is full. Over time, this wave erosion will cut a beach into the slope face. Covering the slope with grass will help reduce the

rate of erosion. The slope face above the maximum water surface elevation and the downstream slope should also be planted with grass to reduce erosion gulling. The grass slopes should be maintained.

8.0 Construction Considerations

8.1 Stripping and Existing Grade Preparations

The areas to receive fill should be stripped and grubbed to remove all vegetation, major root systems and any loose surficial soils or rock. Tree root balls should be removed.

Stripped surfaces should be scarified and compacted prior to the placement of the fills to provide a good integrated contact between the existing soils and fills. Benching of existing slopes steeper than about 6-horizontal to 1-vertical will be necessary so that relatively horizontal lifts can be placed, and good contact is made between the natural soils and fills.

8.2 Placement and Compaction of Embankment Fill

The imported embankment fills should be placed in loose, relatively horizontal lifts, up to a maximum of 10 inches thick, and compacted to a minimum of 95 percent of Standard Proctor maximum dry density. The fill should be compacted with a tamping roller or a sheep-foot roller. A smooth drum roller should not be allowed. The fill should be thoroughly mixed with water to eliminate hard dry clods. The fill should be processed to allow each lift to be placed at moisture contents at or above the optimum moisture content as determined by ASTM D-698. Care should be taken that fill placed in any confined areas is also uniformly compacted at the proper moisture content. This may require thinner lifts and hand operated equipment. Any lift which becomes desiccated or rutted should be reworked prior to placing a subsequent lift. Surfaces to receive the fills should be roughened to assure bond between each layer of compacted soil.

8.3 Construction Observation

A representative from SKG Engineering should be present during construction to inspect construction activities. Specifically, SKG personnel would examine subsurface excavations, monitor compliance with the design concept, specifications and recommendations. SKG Engineering should provide in-place density tests as specified in the project plan set.

9.0 Underground Utilities

The backfill material used for underground utility trenches should be on-site materials or imported clayey materials. We recommend not using a granular material to avoid the possibility of water migration through the trenches and possibly under foundation systems at the site.

9.1 Trenching and Excavation Requirements

The guidelines specified by Occupational Safety and Health Administration (OSHA) should be followed for all excavation activities. The OSHA Standards (29 CFR Part 1926 revised, 2017) require all trenches that exceed 5' in depth to be shored or benched appropriately unless the soil stratum is “solid” rock.

The OSHA standards should be strictly adhered to for all excavation activities. The classification of the soils encountered at the site are Type A soils. The soil classifications are based on soils encountered in the boreholes conducted at the site. Refer to the following OSHA Table B-1 for slope requirements for excavations that are less than 20 feet in depth. Trenches in excess of 20 feet in depth should be designed by a registered professional engineer.

Maximum Allowable Slopes		
Stratum	Horizontal	Vertical
Stable Rock	Vertical	1
Type A	3/4	1
Type B	1	1
Type C	1-1/2	1

The above information is provided for temporary excavations. We recommend that any permanent trenches proposed for the site should have a minimum of 4:1 side slopes. Any permanent trenches or channels should be lined with erosion control measures.

10.0 Site Preparation

10.1 Subgrade

Remove the top 6" of surface soils, any deleterious material, and in-situ soils as necessary to bring the foundation system to design grade. The top 6" of material should then be scarified, moisture conditioned, and compacted to at least 95% of the Standard Proctor Density within 2% points of the optimum moisture content. Any soft or pumping areas are to be excavated and an engineered fill shall be used as backfill. Where existing slopes exceed ten horizontal to one vertical, the cross slope should be benched to provide a minimum of 6' bench width.

10.2 Engineered Fill

An approved select fill shall be used to bring the foundation system to grade. It shall be a non-granular, cohesive soil, free of deleterious material, have a liquid limit of less than 40, and a plasticity index between 6 and 14. The select fill shall meet the following percent retained on sieve requirements: 2-1/2": 0-5%, No. 4: 40-80%, and No. 40: 50-85% or obtain approval from the geotechnical engineer. The fill

should be installed in maximum eight-inch loose lifts and compacted to at least 95% of the Standard Proctor Density within 3% points of the optimum moisture content. Base consisting of TxDOT Type A, Grade 2 limestone will be accepted as engineered fill. Blended materials utilized for engineered fill will have to meet the specifications herein and be approved by the geotechnical engineer. If a blended material is approved, the contractor shall blend the material and have one stockpile for the entire project. Continuous blending of material throughout the duration of the project is not acceptable.

10.3 Flexible Base Material

Provide compacted base consisting of Type A, Grade 2, limestone material below the foundation. Compact to 96% of the Standard Proctor Density within 2% points of the optimum moisture content. Material shall be placed in lifts not to exceed 8". Alternative flexible base materials provided by local suppliers which do not meet theses specifications shall be approved by the Engineer of record.

10.4 Testing

Test results of the engineered fill shall be submitted to the engineer of record for approval prior to incorporating into the work. Arrange for a testing agency to verify flexible base, engineered fill, and subgrade compaction and moisture content. To confirm the compaction of the subgrade, engineered fill, and base beneath foundation systems we recommend the more stringent of three density test for each lift placed or one density test for every 2,000 square feet of foundation area for each lift placed. The Standard Proctor Density shall be determined in accordance with ASTM D698.

11.0 Limitations

The recommendations presented in this report are based upon the information obtained from the borings performed at the site and from other information discussed in this report. This report is based upon the findings from the borings made and may not identify all subsurface variations which exist across the site. The nature and extent of such variations may not become evident until construction. If significant variations appear, contact SKG Engineering to further access the design criteria and the recommendations contained within this report.

The scope of services for this project does not include either specifically or by implication any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such conditions, the appropriate investigations should be performed.

No warranties, either expressed or implied, are intended or made. In the event that changes in the nature, design, or location of the project as outlined in this report are made, the recommendations contained in this report shall not be considered valid unless SKG Engineering reviews the changes and either verifies or modifies the conclusions of this report in writing.

Attachment A

Borehole Location Map

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PROPOSED DETENTION BASIN
SAN ANGELO, TEXAS

BOREHOLE LOCATION MAP

DWG BY:	DWG. DATE:
SKG	05.17.2018
JOB NO.	SHEET NO.
18-E-0721	BH1
SCALE:	
1"=150'	

Attachment B

Proposed Pond Limits Exhibit


PROPOSED SITE OF DETENTION FACILITY
AVENUE N
OUTFALL STRUCTURE AT AVENUE P
AVENUE Q
BRYANT BLVD

Attachment C

Logs of Boreholes

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COURSE 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 OR 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–SILT MIXTURES.
	SILTS AND CLAYS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
				SP	POORLY GRADED SANDS OR GRAVELLY SANDS, 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, FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS AND 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, FAT CLAYS.
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS.

SAMPLER TYPE

WATER LEVEL AT END OF DRILLING

WATER TABLE AT TIME OF DRILLING

SOIL TERMS	DESCRIPTION
BLOCKY	CONTAINS CRACKS OR FAILURE PLANES RESULTING IN ROUGH CUBES OF MATERIAL.
CALCAREOUS	CONTAINS APPRECIABLE QUANTITIES OF CALCIUM CARBONATE.
FISSURED	CONTAINS SHRINKAGE CRACKS, WHICH ARE FREQUENTLY FILLED WITH FINE SAND OR SILT. THE FISSURES ARE USUALLY NEAR VERTICAL IN ORIENTATION.
INTERBEDDED	COMPOSED OF ALTERNATING LAYERS OF DIFFERENT SOIL TYPES.
LAMINATED	COMPOSED OF THIN LAYERS OF VARYING COLOR AND TEXTURE.
NODULES	SECONDARY INCLUSIONS THAT APPEAR AS SMALL LUMPS ABOUT 0.1 TO 0.3 INCH IN DIAMETER.
PARTINGS	INCLUSION OF DIFFERENT MATERIAL LESS THAN ⅛ INCH THICK EXTENDING THROUGH THE SAMPLE.
POCKETS	INCLUSION OF DIFFERENT MATERIAL THAT IS SMALLER THAN THE DIAMETER OF THE SAMPLE.
SEAMS	INCLUSION OF DIFFERENT MATERIAL BETWEEN ⅛ AND 3 INCHES THICK, AND EXTENDS THROUGH THE SAMPLE.
SLICKENSIDED	HAS INCLINED PLANES OF WEAKNESS THAT ARE SLICK AND GLOSSY IN APPEARANCE. SLICKENSIDES ARE COMMONLY THOUGHT TO BE RANDOMLY ORIENTED.
STREAKS OR STAINS	STAINS OF LIMITED EXTENT THAT APPEAR AS SHORT STRIPES, SPOTS OR BLOTCHES.

ROCK TERMS	
BEDDING PLANE	A SURFACE PARALLEL TO THE SURFACE OF DEPOSITION, GENERALLY MARKED BY CHANGES IN COLOR OR GRAIN SIZE.
FRACTURE	A NATURAL BREAK IN ROCK ALONG WHICH NO DISPLACEMENT HAS OCCURED.
JOINT	A NATURAL BREAK ALONG WHICH NO DISPLACEMENT HAS OCCURED, WHICH GENERALLY INTERSECTS PRIMARY SURFACES.
% RECOVERY	THE RATIO OF TOTAL LENGTH OF RECOVERY TO THE TOTAL LENGTH OF CORE RUN, EXPRESSED AS A PERCENTAGE.
RQD - ROCK QUALITY DESIGNATION	THE RATIO OF TOTAL RECOVERED LENGTH OF FRAGMENTS LONGER THAN 4 INCHES TO THE TOTAL RUN LENGTH, EXPRESSED AS A PERCENTAGE.
WEATHERING	THE PROCESS BY WHICH ROCK IS BROKEN DOWN AND DECOMPOSED.

MOISTURE CONTENT

DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH.
DAMP	SOME PERCEPTIBLE MOISTURE; BELOW OPTIMUM.
MOIST	NO VISIBLE WATER; NEAR OPTIMUM MOISTURE CONTENT.
WET	VISIBLE FREE WATER, USUALLY SOIL IS BELOW WATER TABLE.

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	POCKET PENETROMETER READING IN TONS/FT2	N-VALUE (BLOWS/FOOT)
VERY SOFT	0 TO 0.25	<2
SOFT	0.25 TO 0.5	2 TO 4
FIRM	0.5 TO 1.0	4 TO 8
STIFF	1.0 TO 2.0	8 TO 15
VERY STIFF	2.0 TO 4.0	15 TO 30
HARD	>4.0 OR 4.5+	>30

CLAY	SILT	SAND			GRAVEL		COBBLES	BOULDERS
		FINE	MEDIUM	COARSE	FINE	COARSE		
0.005mm	No.200	No.40	No.10	No.4	¾"	3"	12"	

U.S. STANDARD SIEVE SIZE

RELATIVE DENSITY-GRANULAR SOILS

CONSISTENCY	N-VALUE (BLOWS/FOOT)
VERY LOOSE	0 TO 4
LOOSE	5 TO 10
MEDIUM DENSE	11 TO 30
DENSE	31 TO 50
VERY DENSE	>50 OR 50+

REFERENCE: THE UNIFIED SOIL CLASSIFICATION SYSTEM, CORPS OF ENGINEERS, U.S. ARMY TECHNICAL MEMORANDUM NO. 3–357, VOL. 1 MARCH, 1953 (REVISED APRIL, 1960)

KEY
TO SYMBOLS AND TERMS

SKG
ENGINEERING

Project:	B-1
Proposed Detention Basin San Angelo, Texas	

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | Date Finished: June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | Drop: 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lith-ology	Material Description	Samples				Laboratory	
			Number	Type	SPT	PEN (tsf)	W%	PI
		Surface Elevation:						
0		clayey SAND (SC): tan			50-3"		6.5	16
		clayey SAND (SC): tan with gravel			50-6"			
5		GWT not encountered			50-3"		5.8	14
		lean CLAY (CL); brown with gravel						
10					8/8/6			
15					50-0"			
		Boring completed at depth of 15'. Groundwater was not present at the time of drilling activites.						
20								
25								
30								
35								

Project:		B-2
Proposed Detention Basin San Angelo, Texas		

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | Date Finished: June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | Drop: 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lithology	Material Description	Samples: Number	Samples: Type	Samples: SPT	Samples: PEN (tsf)	Laboratory: W%	Laboratory: PI
		Surface Elevation:						
0		clayey SAND (SC); tan with gravel			17/21/21			
					12/13/20		11.4	18
		lean CLAY (CL); tan						
5					50-3"			
10					50-3"			
15					50-6"			
		clayey SAND (SC); tan						
20					50-3"		6.7	13
25					50-2"			
		lean CLAY (CL); red with gravel						
30					50-1"		13.3	17
		Boring completed at depth of 30'. Groundwater was not present at the time of drilling activites.						
35								

SKG ENGINEERING, LLC | 18-E-0721 | Plate A- 2

Project:		B-3
Proposed Detention Basin San Angelo, Texas		

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | **Date Finished:** June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | **Drop:** 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lith-ology	Material Description	Samples				Laboratory	
			Number	Type	SPT	PEN (tsf)	W%	PI
		Surface Elevation:						
0		clayey SAND (SC); brown			10/13/19			
					8/7/5			
		lean CLAY (CL); tan with sand						
5		GWT not encountered			9/15/17		15.3	18
10					8/9/9		15.2	19
15					10/9/13			
		Boring completed at depth of 15'. Groundwater was not present at the time of drilling activites.						
20								
25								
30								
35								

Project:	B-4
Proposed Detention Basin San Angelo, Texas	

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | Date Finished: June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | Drop: 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lith-ology	Material Description	Samples				Laboratory	
			Number	Type	SPT	PEN (tsf)	W%	PI
		Surface Elevation:						
0		sandy lean CLAY (CL); brown			2/2/3			
					3/6/8			
		lean CLAY (CL); brown with sand			8/12/15		16.9	15
5								
					4/7/11			
10								
		sandy lean CLAY (CL); green			5/11/15		16.9	16
15								
		lean CLAY (CL); red with sand			50-5"			
20								
					50-1"		12.4	20
25								
					50-1"			
30		Boring completed at depth of 30'. Groundwater was not present at the time of drilling activites.						
35								

GWT not encountered

Project:		B-5
Proposed Detention Basin San Angelo, Texas		

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | Date Finished: June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | Drop: 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lith-ology	Material Description	Samples				Laboratory	
			Number	Type	SPT	PEN (tsf)	W%	PI
		Surface Elevation:						
0		sandy lean CLAY (CL); brown			8/7/6			
					4/7/9			
		lean CLAY (CL); brown with sand			6/13/15			
5								
10					6/8/10		19.7	19
		sandy lean CLAY (CL); green						
15					8/8/18		9.7	13
		Boring completed at depth of 15'. Groundwater was not present at the time of drilling activites.						
20								
25								
30								
35								

GWT not encountered

Project:	B-6
Proposed Detention Basin San Angelo, Texas	

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | Date Finished: June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | Drop: 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lith-ology	Material Description	Samples				Laboratory	
			Number	Type	SPT	PEN (tsf)	W%	PI
		Surface Elevation:						
0		sandy lean CLAY (CL); brown			3/2/3			
					4/3/5		16.4	17
		lean CLAY (CL); tan with sand			4/5/7			
5								
					5/11/12		16.8	18
10								
		sandy lean CLAY (CL); tan			4/10/13			
15		Boring completed at depth of 15'. Groundwater was not present at the time of drilling activites.						
20								
25								
30								
35								

GWT not encountered

SKG ENGINEERING, LLC | 18-E-0721 | Plate A- 6

Project: **Proposed Detention Basin**
San Angelo, Texas

B-7

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | Date Finished: June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | Drop: 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lith-ology	Material Description	Samples				Laboratory	
			Number	Type	SPT	PEN (tsf)	W%	PI
		Surface Elevation:						
0		sandy lean CLAY (CL); brown with gravel			3/4/8			
					7/5/6			
		lean CLAY (CL); tan with sand			4/4/4			
5								
10					3/4/5		13.9	13
15					5/10/13			
20					7/7/11			
		sandy lean CLAY (CL); tan with gravel			50-6"		23.6	15
25								
		clayey SAND (SC); red with gravel			50-4"			
30		Boring completed at depth of 30'. Groundwater was present at the time of drilling activites.						
35								

SKG ENGINEERING, LLC

18-E-0721

Plate A- 7

Project:	B-8
Proposed Detention Basin San Angelo, Texas	

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | Date Finished: June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | Drop: 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lith-ology	Material Description	Samples				Laboratory	
			Number	Type	SPT	PEN (tsf)	W%	PI
		Surface Elevation:						
0		sandy lean CLAY (CL); brown with gravel			4/9/8			
					6/10/11			
		lean CLAY (CL); tan with sand			9/13/12			
5								
					3/3/5		13.1	14
10								
					4/7/9		16.5	18
15		Boring completed at depth of 15'. Groundwater was not present at the time of drilling activites.						
20								
25								
30								
35								

GWT not encountered

SKG ENGINEERING, LLC | 18-E-0721 | Plate A- *8*

Project:		B-9
Proposed Detention Basin San Angelo, Texas		

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | Date Finished: June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | Drop: 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lith-ology	Material Description	Samples				Laboratory	
			Number	Type	SPT	PEN (tsf)	W%	PI
		Surface Elevation:						
0		sandy lean CLAY (CL); brown			6/10/7			
					6/6/8		10.9	18
					8/7/8			
10					4/4/6			
		lean CLAY (CL); tan with sand			4/8/7			
20						4.5	16.8	15
		sandy lean CLAY (CL); tan with gravel			8/15/25			
30		clayey SAND (SC); green with gravel			50-4"		23.5	11
40					50-6"			
		Boring completed at depth of 40'. Groundwater was present at the time of drilling activites.						
50								
60								
70								

SKG ENGINEERING, LLC | 18-E-0721 | Plate A- 9

Project:		B-10
Proposed Detention Basin San Angelo, Texas		

Boring Location: Refer to the borehole location map

Date Started: June 13, 2018 | Date Finished: June 13, 2018

Drilling Method: Air rotary

Hammer Weight: 140 lbs | Drop: 30 inches

Sampler: Shelby tube/2" split barrel sampler

Depth (feet)	Lith-ology	Material Description	Samples				Laboratory	
			Number	Type	SPT	PEN (tsf)	W%	PI
		Surface Elevation:						
0		sandy lean CLAY (CL); brown with gravel			4/10/12			
					14/15/12		6.2	16
5					6/10/6			
		lean clay (CL); tan with sand						
10					4/4/5			
		sandy lean CLAY (CL); tan						
15					15/22/18		12.0	17
		Boring completed at depth of 15'. Groundwater was not present at the time of drilling activites.						
20								
25								
30								
35								

GWT not encountered

SKG ENGINEERING, LLC | 18-E-0721 | Plate A- *10*

Attachment D

Laboratory Analysis

SKG
ENGINEERING, LLC
SURVEYING ♦ ENVIRONMENTAL ♦ LAB/CMT
706 SOUTH ABE STREET
SAN ANGELO, TEXAS 76903
PHONE: 325.655.1288
FAX: 325.657.8189

ANALYSIS RESULTS

CLIENT:	Freese and Nichols
PROJECT:	Proposed Detention Basin
PROJECT #:	18-E-0721
DATE:	6/25/2018

Lab No.	Description	Plastic Limit (%) *	Liquid Limit (%)*	Plasticity Index *	Moisture (%) *	Pass # 4 Sieve (%)*	Pass # 40 Sieve (%)*	Pass # 200 Sieve (%)*
0610	B1 0' 1.5'	21	37	16	6.5	85.6	52.9	49.7
0611	B1 3.5' 5'	19	33	14	5.8	58.2	31.2	28.1
0612	B2 1.5' 3'	21	39	18	11.4	82.6	47.3	42.6
0613	B2 18.5' 20'	13	26	13	6.7	88.1	49.4	47.4
0614	B2 28.5' 30'	18	35	17	13.3	81.3	76.9	70.8
0615	B3 3.5' 5'	17	35	18	15.3	94.5	88.9	72.9
0616	B3 8.5' 10'	19	38	19	15.2	98.7	97.0	83.4

Average PL	18
Average LL	35
Average PI	16
Average % Clay	56.4

Stephanie Cheatheam

Stephanie Cheatheam
Lab/CMT Manager

SKG
ENGINEERING, LLC
SURVEYING ♦ ENVIRONMENTAL ♦ LAB/CMT
706 SOUTH ABE STREET
SAN ANGELO, TEXAS 76903
PHONE: 325.655.1288
FAX: 325.657.8189

ANALYSIS RESULTS

CLIENT:	Freese and Nichols
PROJECT:	Proposed Detention Basin
PROJECT #:	18-E-0721
DATE:	6/19/2018

Lab No.	Description			Plastic Limit (%) *	Liquid Limit (%)*	Plasticity Index *	Moisture (%) *	Pass # 4 Sieve (%)*	Pass # 40 Sieve (%)*	Pass # 200 Sieve (%)*
18-0566	B4	3.5'	5'	16	31	15	16.9	99.4	97.5	70.2
18-0567	B4	13.5'	15'	17	33	16	16.9	94.1	89.2	60.7
18-0568	B4	23.5'	25'	17	37	20	12.4	97.6	86.3	82.9
18-0569	B5	5.8'	10'	17	36	19	19.7	97.3	95.6	84.1
18-0570	B5	13.5'	15'	14	27	13	9.7	90.1	82.7	59.6
18-0571	B6	1.5'	3	18	35	17	16.4	96.1	87.9	68.5
18-0572	B6	8.5'	10'	20	38	18	16.8	100	98.8	83
18-0573	B7	8.5'	10'	14	27	13	13.9	94.8	89.3	73.2
18-0574	B7	23.5'	25'	14	29	15	23.6	91.4	83.2	64.9
18-0575	B8	8.5'	10'	13	27	14	13.1	98.1	95.8	78.6
18-0576	B8	13.5'	15'	20	38	18	16.5	99.5	98.6	75
18-0577	B9	1.5'	3'	18	36	18	10.9	89.9	74.7	56.8
18-0578	B9	18.5'	20'	20	35	15	16.8	99.6	98.6	80.9
18-0579	B9	28.5'	30'	12	23	11	23.5	76.7	61.6	40.7
18-0580	B10	1.5'	3'	18	34	16	6.2	94.6	82.3	64.2
18-0581	B10	13.5'	15'	16	33	17	12	86.5	80.1	68.9

Average PL	17
Average LL	32
Average PI	16
Average % Clay	69.5

Stephanie Cheatheam

Stephanie Cheatheam
Lab/CMT Manager

SKG
ENGINEERING, LLC
FIRM REGISTRATION NUMBER F-7608
SURVEYING ♦ ENVIRONMENTAL ♦ LAB/CMT

706 SOUTH ABE STREET
SAN ANGELO, TEXAS 76903

PHONE: 325.655.1288
FAX: 325.657.8189

REPORT OF MOISTURE-DENSITY RELATIONSHIP

Client:	Freese and Nichols 2732 82nd Street Lubbock, Texas	**Date:**	**June 22, 2018**
		Technician:	**J. Medina**
Project:	Proposed Detention Basin San Angelo, Texas	**Project No.:**	**18E0721**
		Report No.:	**1**

Sample Information

Sampled By:	L. Cauley
Date:	6/18/2018
Number:	18-0619
Location:	On Site
Description:	B9 10'-15'
Test Method(s):	**ASTM D 698** **ASTM C 136**

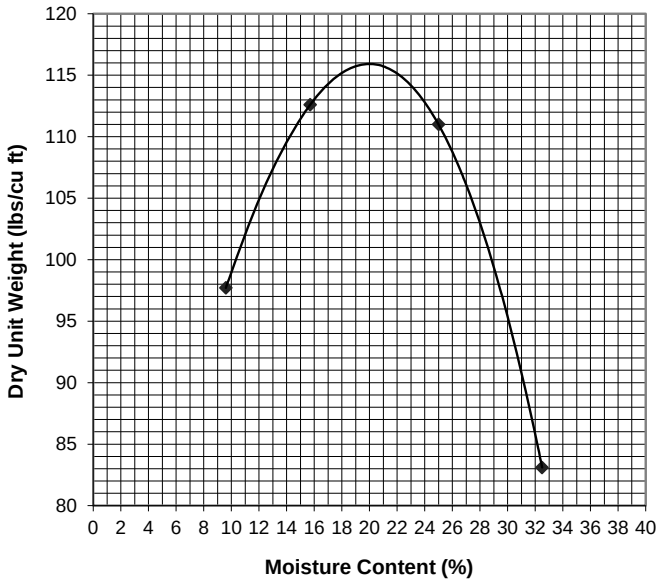
Atterberg Limits

Liquid Limit:	-
Plastic Limit:	-
Plasticity Index:	-

Sieve Analysis

Retained	(%)
3/4"	0.0
3/8"	0.0
#4	0.0

Moisture-Density Relationship



Test Results

Maximum Dry Unit Weight (pcf):	116.0
Optimum Moisture Content (%):	20.0

Copies: Client

SKG Engineering

Stephanie Cheatham

The information shown hereon represent results only from the samples tested for the use of the client.
Where no values are shown indicates that a particular test was not run.

SKG
ENGINEERING, LLC
FIRM REGISTRATION NUMBER F-7608
SURVEYING ♦ ENVIRONMENTAL ♦ LAB/CMT

706 SOUTH ABE STREET
SAN ANGELO, TEXAS 76903

PHONE: 325.655.1288
FAX: 325.657.8189

REPORT OF MOISTURE-DENSITY RELATIONSHIP

Client:	Freese and Nichols 2732 82nd Street Lubbock, Texas	**Date:**	**June 22, 2018**
		Technician:	**J. Medina**
Project:	Proposed Detention Basin San Angelo, Texas	**Project No.:**	**18E0721**
		Report No.:	**2**

Sample Information

Sampled By:	L. Cauley
Date:	6/18/2018
Number:	18-0620
Location:	On Site
Description:	B10 10'-15'
Test Method(s):	**ASTM D 698** **ASTM C 136**

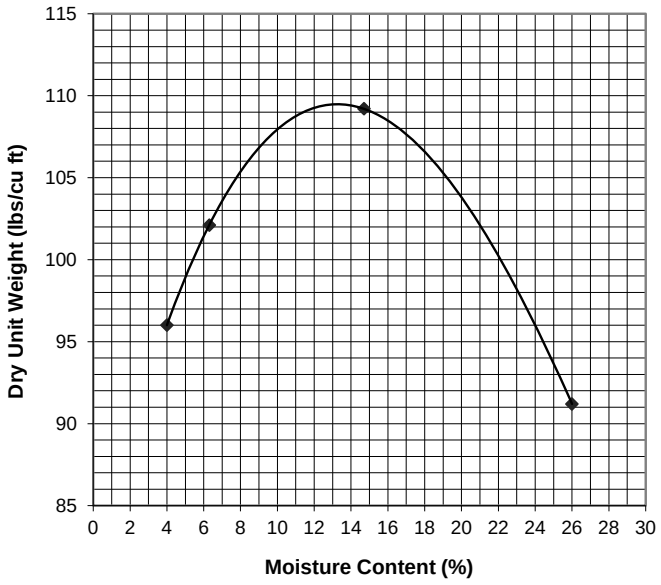
Atterberg Limits

Liquid Limit:	-
Plastic Limit:	-
Plasticity Index:	-

Sieve Analysis

Retained	(%)
3/4"	0.0
3/8"	4.3
#4	43.1

Moisture-Density Relationship



Test Results

Maximum Dry Unit Weight (pcf):	109.5
Optimum Moisture Content (%):	13.2

Copies: Client

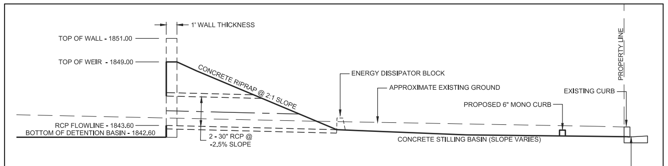
SKG Engineering

Stephanie Cheatham

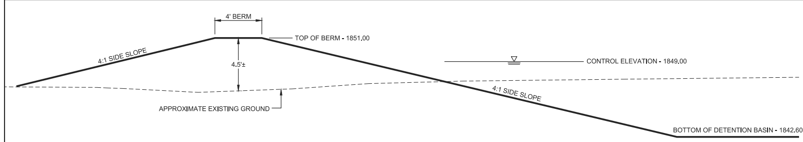
The information shown hereon represent results only from the samples tested for the use of the client.
Where no values are shown indicates that a particular test was not run.

Attachment E

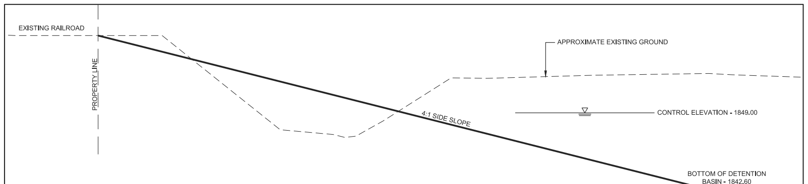
Typical Embankment Sections
(Provided by Freese and Nichols, Inc.)



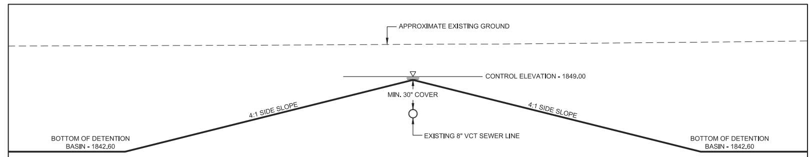
SECTION A-A



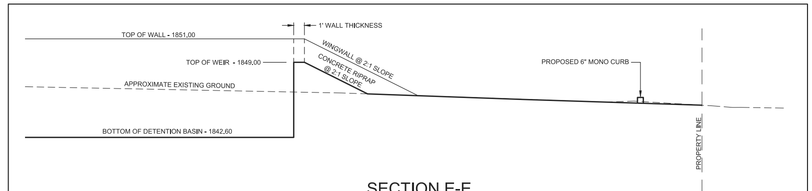
SECTION B-B



SECTION C-C



SECTION D-D



SECTION E-E

0 2.5' 5' 10'
SCALE IN FEET

Freese and Nichols, Inc.
Texas Registered Engineering Firm F-2144

FREESE AND NICHOLS
2732 82nd Street, Suite A
Lubbock, Texas 79423
Phone - (806) 686-2700
Web - www.freese.com

CITY OF SAN ANGELO
AVENUE P STORMWATER DETENTION BASIN
BASIN SECTION EXHIBIT

F&N JOB NO.	HAF18286
DATE	05/11/18
DESIGNED	
DRAWN	
REVISED	
CHECKED	
FILE NAME	CV-BASE05.dwg

NO.	ISSUE	BY	DATE

VERIFY SCALE
0 1
Bar is one inch on original drawing. If not one inch on this sheet, adjust scale.

SHEET

SEQ.

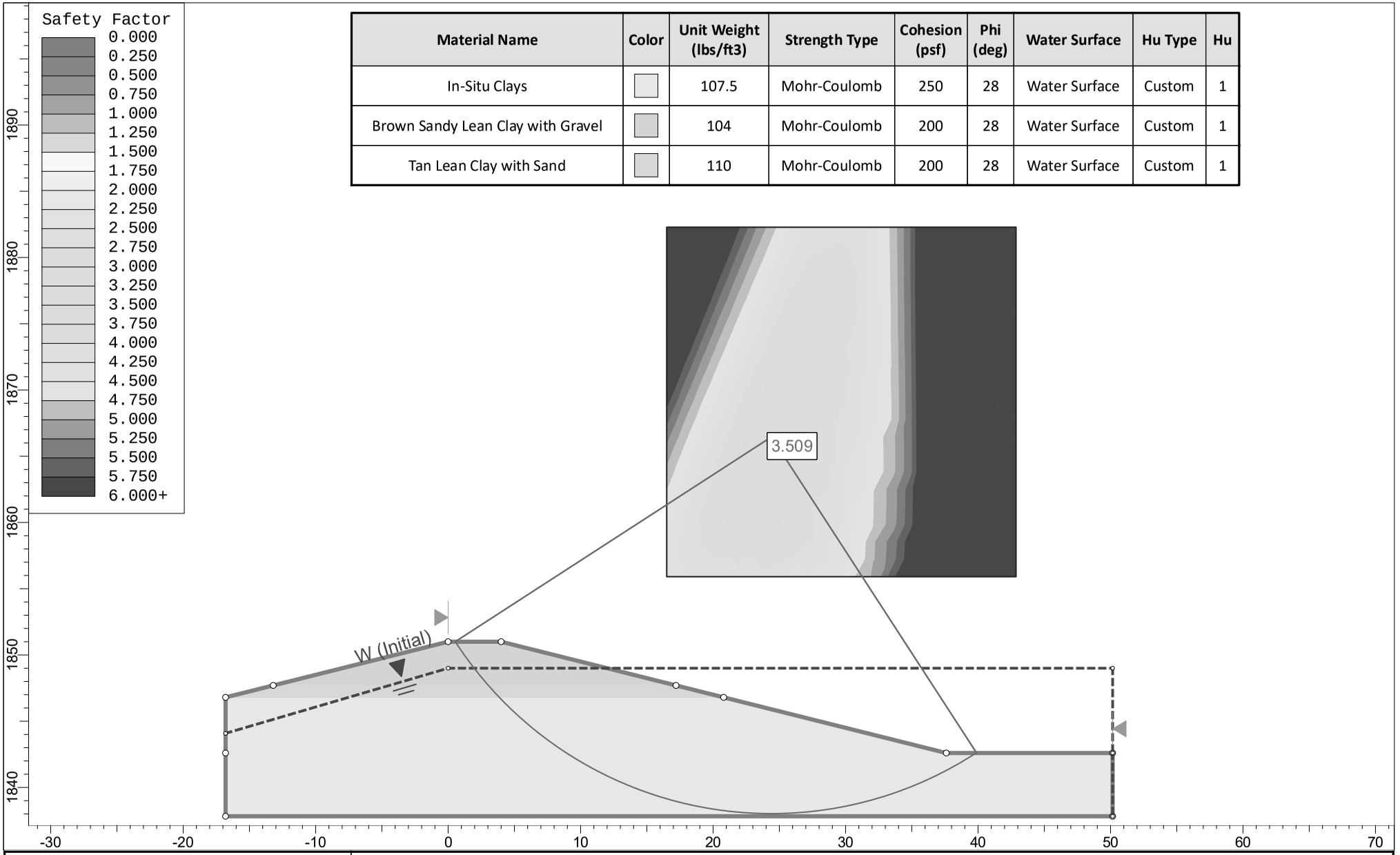
Plot Date: 5/11/2018 4:06 PM Plot By: 02861 Filename: N:\ENG\CV-BASE05.dwg

ACAD Rel: 21.0s (LMS Tech)
Filename: N:\ENG\CV-BASE05.dwg
Last Saved: 5/11/2018 5:46 PM Saved By: 02861

Attachment F

Slope Stability Analysis – Section B-B’

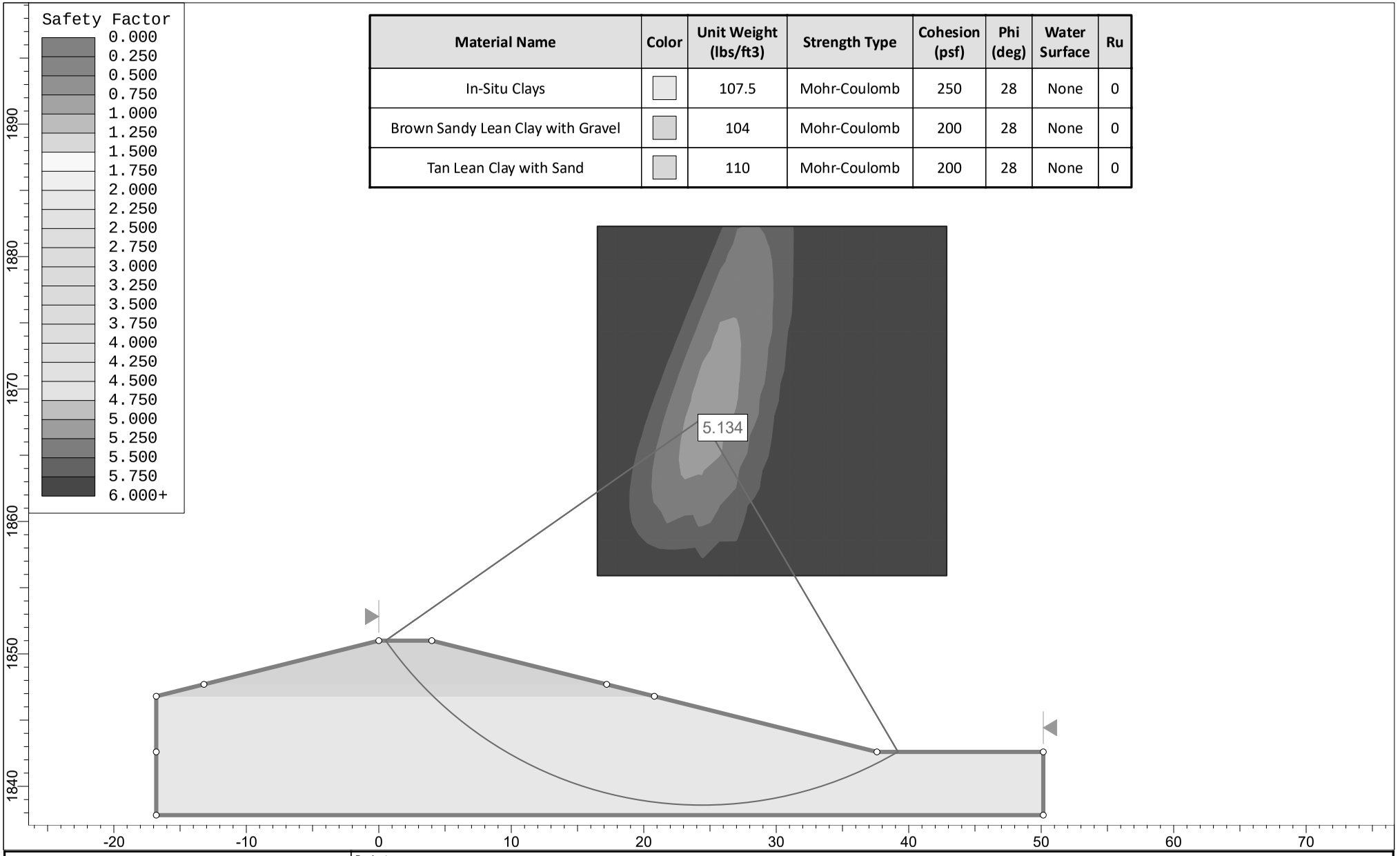
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
In-Situ Clays		107.5	Mohr-Coulomb	250	28	Water Surface	Custom	1
Brown Sandy Lean Clay with Gravel		104	Mohr-Coulomb	200	28	Water Surface	Custom	1
Tan Lean Clay with Sand		110	Mohr-Coulomb	200	28	Water Surface	Custom	1



Project	City of San Angelo Detention Pond			
Analysis Description	Section B-B'			
Drawn By	TSB	Scale	1:120	Company: SKG Engineering, LLC
Date	6/28/18			File Name: B-B Drawdown.slim

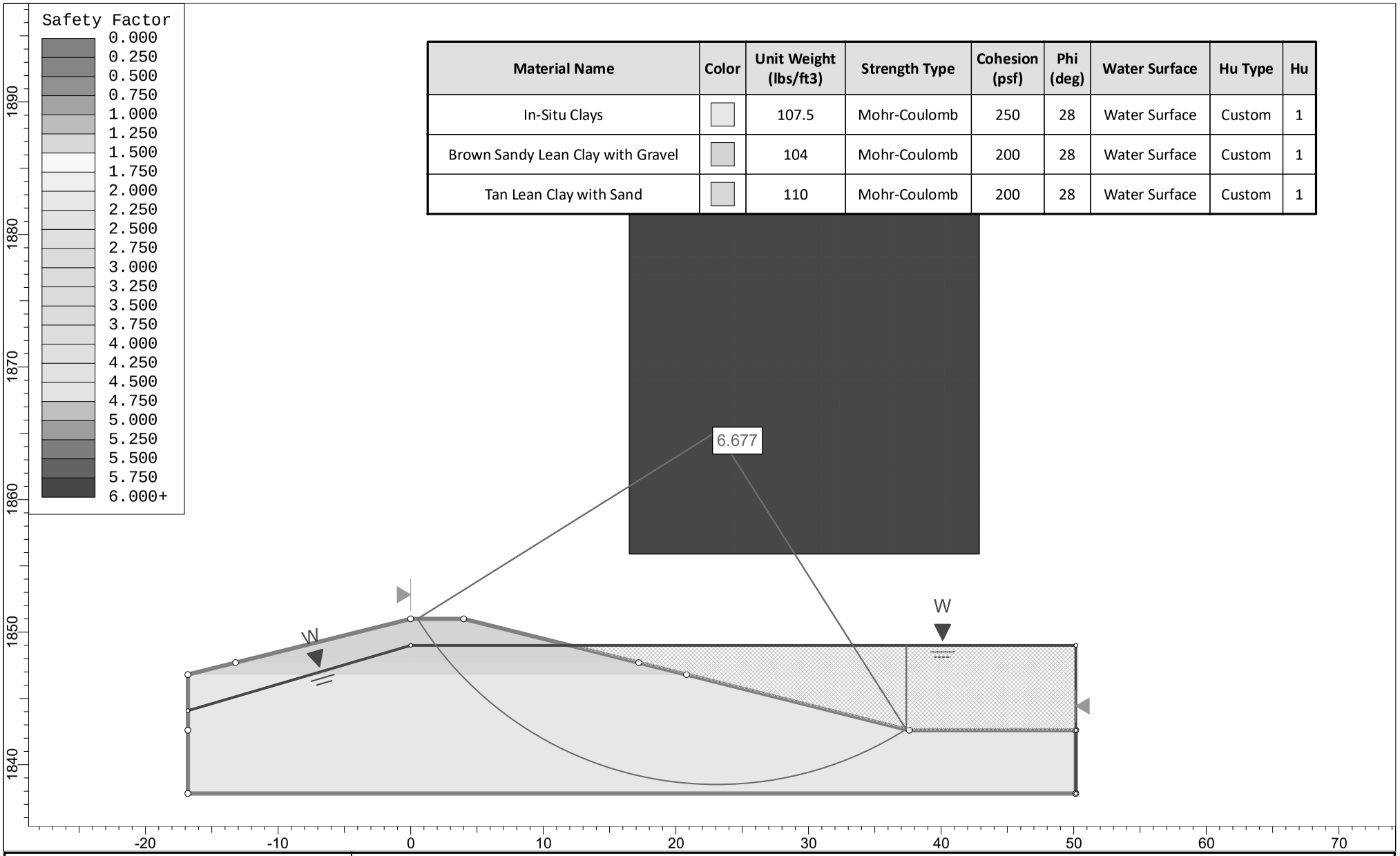
SLIDEINTERPRET 6.039

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In-Situ Clays		107.5	Mohr-Coulomb	250	28	None	0
Brown Sandy Lean Clay with Gravel		104	Mohr-Coulomb	200	28	None	0
Tan Lean Clay with Sand		110	Mohr-Coulomb	200	28	None	0



Project	City of San Angelo Detention Pond		
Analysis Description	Section B-B'		
Drawn By	TSB	Scale 1:120	Company SKG Engineering, LLC
Date	6/27/18		File Name B-B End of Construction.slim

SLIDEINTERPRET 6.039



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
In-Situ Clays		107.5	Mohr-Coulomb	250	28	Water Surface	Custom	1
Brown Sandy Lean Clay with Gravel		104	Mohr-Coulomb	200	28	Water Surface	Custom	1
Tan Lean Clay with Sand		110	Mohr-Coulomb	200	28	Water Surface	Custom	1

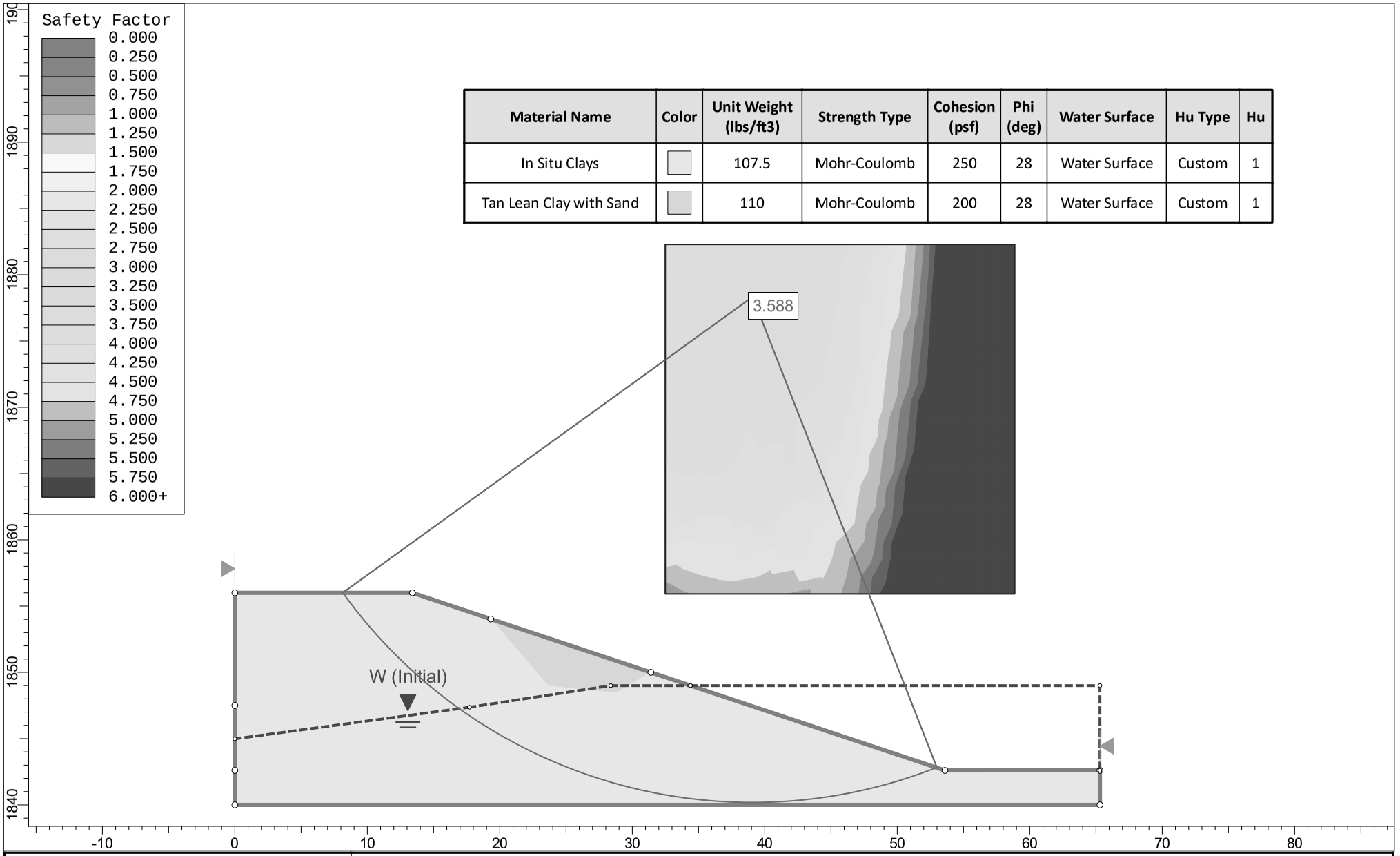
rocscience

SLIDEINTERPRET 6.039

Project	City of San Angelo Detention Pond		
Analysis Description	Section B-B'		
Drawn By	TSB	Scale 1:120	Company SKG Engineering, LLC
Date	6/28/18		File Name B-B Water Table.slim

Attachment G

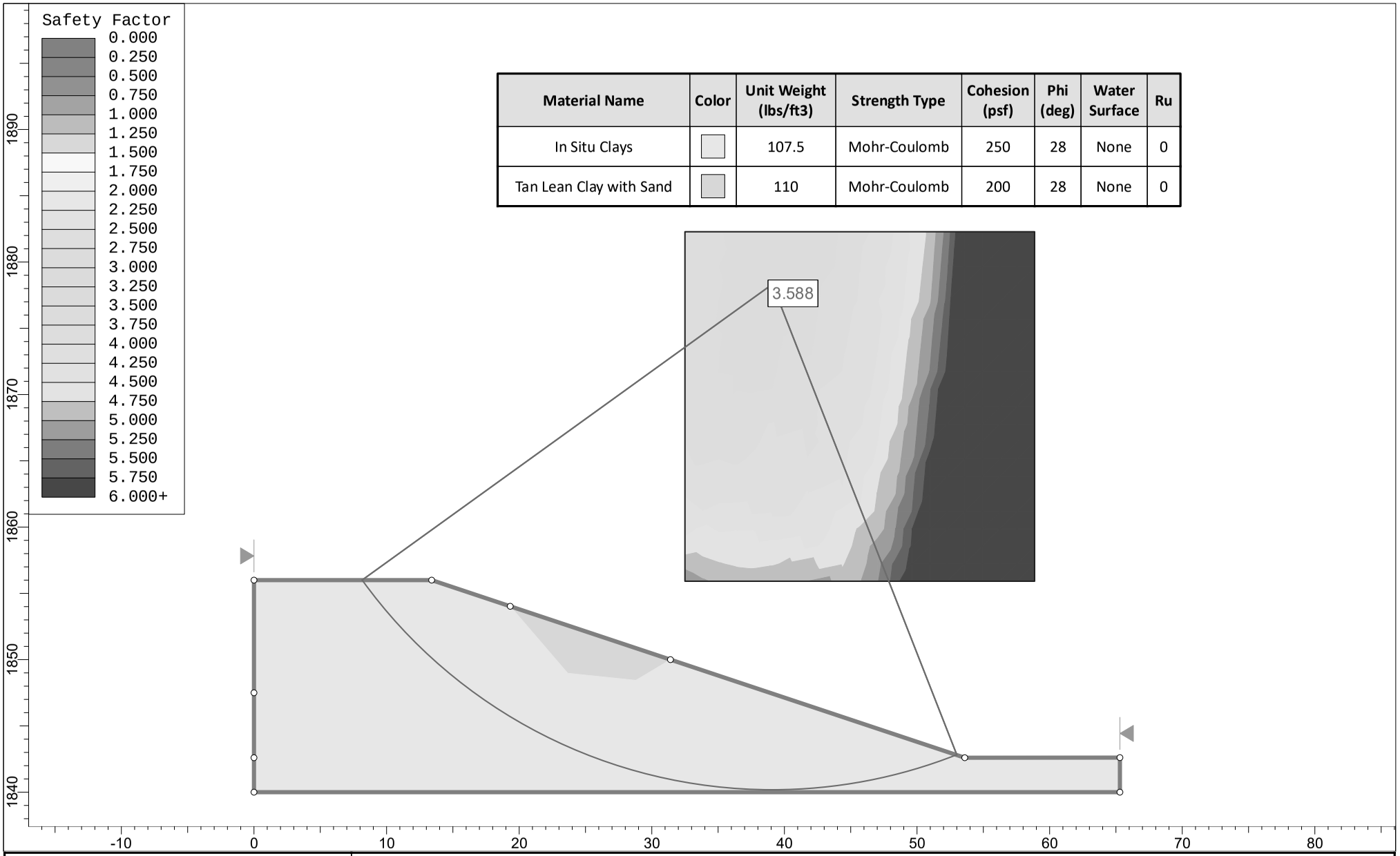
Slope Stability Analysis – Section C-C’



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
In Situ Clays		107.5	Mohr-Coulomb	250	28	Water Surface	Custom	1
Tan Lean Clay with Sand		110	Mohr-Coulomb	200	28	Water Surface	Custom	1

rocscience	Project	City of San Angelo Detention Pond		
	Analysis Description	C-C'		
	Drawn By	TSB	Scale 1:120	Company SKG Engineering, LLC
	Date	7/2/18		File Name C-C Drawdown.slim

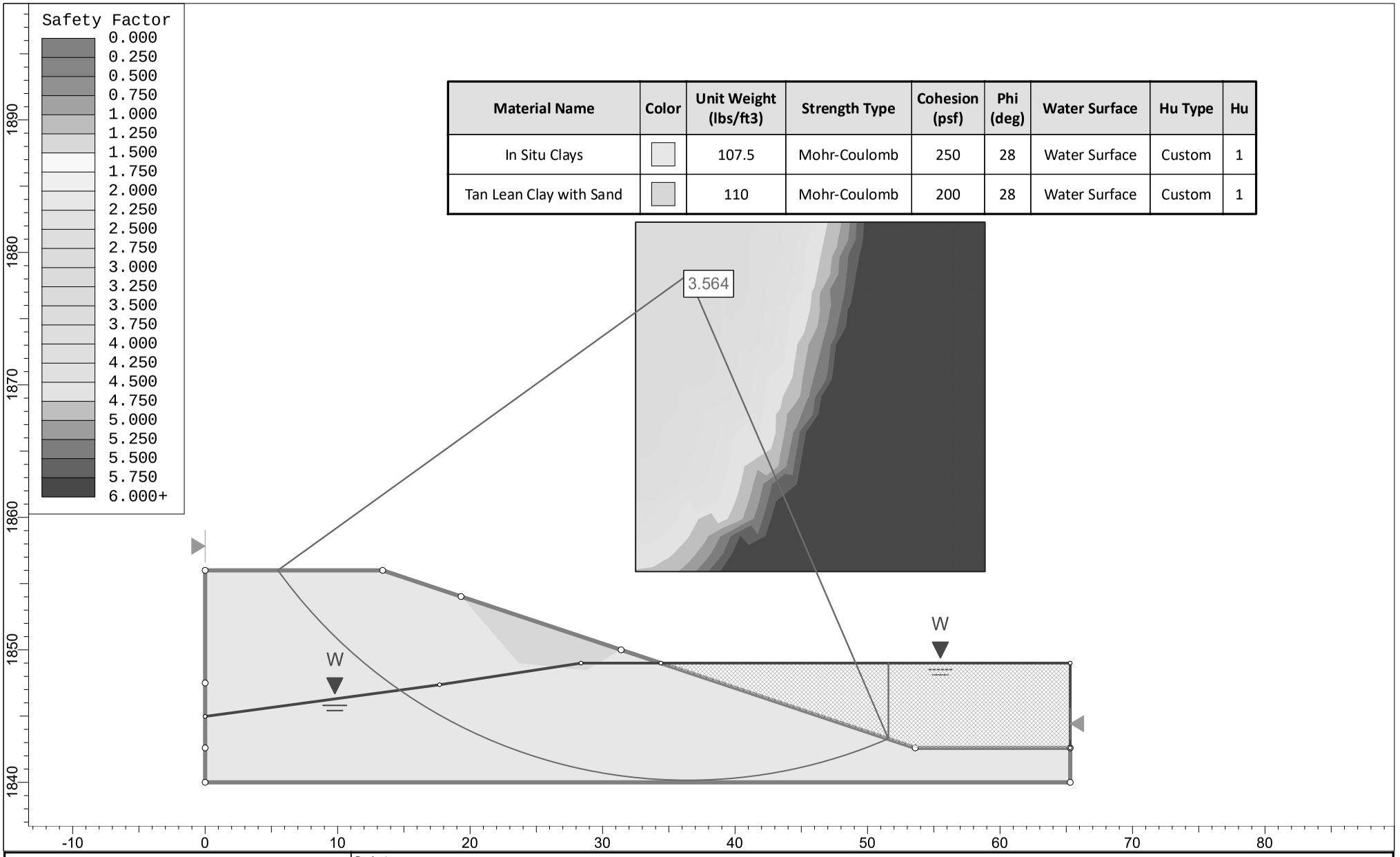
SLIDEINTERPRET 6.039



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
In Situ Clays		107.5	Mohr-Coulomb	250	28	None	0
Tan Lean Clay with Sand		110	Mohr-Coulomb	200	28	None	0

Project	City of San Angelo Detention Pond		
Analysis Description	C-C'		
Drawn By: TSB	Scale: 1:120	Company: SKG Engineering, LLC	
Date: 7/2/18		File Name: C-C End of Construction.slim	

SLIDEINTERPRET 6.039



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
In Situ Clays		107.5	Mohr-Coulomb	250	28	Water Surface	Custom	1
Tan Lean Clay with Sand		110	Mohr-Coulomb	200	28	Water Surface	Custom	1

Project	City of San Angelo Detention Pond		
Analysis Description	C-C'		
Drawn By: TSB	Scale: 1:120	Company: SKG Engineering, LLC	
Date: 7/2/18		File Name: C-C Water Table.slim	

SLIDEINTERPRET 6.039