SOIL MECHANICS REPORT

PLUM CREEK FRS NO. 10
BUDA, TEXAS

M & E Consultants
Heidenheimer, Texas

Balcones Geotechnical

Balcones Geotechnical 5926 Balcones Drive, Suite 230 Austin, Texas 78731 Phone: 512-380-9969
TBPE Firm Registration F-15624

Mr. Trent Street, P.E.
M & E Consultants
P.O. Box 9
Heidenheimer, TX 76533

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Soil Mechanics Report
Plum Creek FRS 10
Buda, Texas

Submitted herewith are the results of the geotechnical investigation and engineering analyses to support the proposed modifications to the existing Plum Creek Dam 10 in Buda, Texas. Our services included a field reconnaissance and geotechnical investigation, laboratory testing, engineering analyses, and preparation of this report.

Balcones Geotechnical, LLC (Balcones) appreciates the opportunity to provide these geotechnical engineering services to M & E Consultants and looks forward to our continued association. Please do not hesitate to contact us with any questions or comments about this report, or if we can be of further service.

Sincerely,

BALCONES GEOTECHNICAL, LLC
TBPE Firm Registration No. F-15624

STATE OF TEXAS
REBECCA A. RUSSO
91271
LICENSED
PROFESSIONAL ENGINEER

Rebecca

Rebecca A. Russo, P.E.
Senior Geotechnical Engineer

John A. Wooley

John A. Wooley, P.E.
Principal

Attachments
Distribution:
Addressee
File (1)

CONTENTS

LIST OF TABLES

PLATES

APPENDICES

INTRODUCTION

The project will consist of improvements to the existing Plum Creek FRS No. 10 embankment dam including wave protection on the upstream slope; flattening the downstream slope and installation of toe drains; installation of a new principal spillway riser, horizontal conduit pipe, and discharge basin; and modifications to the auxiliary spillway. The dam site is located at the northeast quadrant of the intersection of FM 2001 and Satterwhite Road, as shown on the Vicinity Map, Plate 1.

The dam is owned and operated by the Natural Resource Conservation Service (NRCS) and Hays County. The proposed improvements are being designed by M & E Consultants (M&E). Balcones Geotechnical, LLC (Balcones) was retained by M&E to provide geotechnical engineering services and this Soil Mechanics Report (SMR).

The following sections of this report include a discussion of authorization and scope; project description; field and laboratory investigation procedures; site and subsurface conditions; geotechnical evaluations and results; and recommendations for construction.

AUTHORIZATION AND SCOPE

The investigation was authorized by approval of our proposal dated January 2, 2018 and authorized by Mr. Trent Street, P.E. of M&E. The proposal outlines the requested and agreed upon scope of services.

The scope of the investigation included 1) drilling of 15 borings to determine subsurface conditions within the dam footprint and borrow areas for obtaining representative samples for laboratory testing; 2) laboratory testing to determine classification and strength properties of embankment materials and borrow, 3) geotechnical engineering characterization and stability analyses for proposed improvements, and 4) preparation of this report including geotechnical design and construction recommendations.

A Geologic Investigation (GI) report is being submitted under separate cover, and is being authored by the NRCS. The Soil Mechanics Report (SMR) presented herein contains data collected for this investigation as well as as-built information and site observations. This SMR is intended to supplement the GI report with specific findings and recommendations based on geotechnical analyses.

Field sampling and laboratory testing were in general accordance with methods, procedures, and practices set forth by the American Society for Testing and Materials, latest version of Annual Book of ASTM Standards, where applicable.

PROJECT DESCRIPTION

The project will consist of modifications to an existing earthen embankment flood control dam in Buda, Texas. According to the USACE National Inventory of Dams, the dam (TX01577) was built in 1963, has a reported dam length of 1,788 LF and dam height of 36 feet. As-built drawings, dated 1962, were provided to us by M&E and are included in Appendix A. The as-built drawings report a dam height of 31 ft and a dam length of 1,654 LF.

Proposed improvements will include reconstructing the upstream slope with addition of wave protection; flattening of the downstream slope and construction of toe drains; installation of a new principal spillway including a new inlet riser, discharge basin, and horizontal conduit pipe; and modifications to the auxiliary spillway including a 30-ft widening and 2 ft lowering of the control elevation. The modifications are planned to bring the dam into compliance with TCEQ Dam Safety requirements for a high hazard dam.

FIELD INVESTIGATION

Site Reconnaissance. On January 18, 2018, Balcones personnel, Rebecca Russo, P.E., and David Mason, P.G., visited the subject site to observe site conditions and establish boring locations. At the site were representatives with NRCS, Hays County, and M&E. A photographic log of the site observations during this field visit are included in Appendix B.

In general, the dam was observed to be in good condition with noted wave erosion and small surface sloughing along the upstream slope. A wastewater utility line was noted in the proposed borrow area to the east of the lake impoundment, as evidenced by marked manholes.

Drilling. On January 23 through 25, eighteen (18) borings were drilled along the dam crest, dam toe, and in proposed borrow areas. Approximate boring locations are shown on the attached Boring Location Plan, Plate 2. A summary of boring information is given in the following table.

Table 1. Boring Summary Information					
Boring	Drill Date	Drilled Depth	GPS Coordinates		Location
B-301	1/24/2018	55	-97.800261457399	30.0631360773346	Dam Crest
B-601	1/23/2018	20	-97.798736315394	30.0634351884296	Dam Toe
B-602	1/23/2018	20	-97.799149575767	30.063302385941	Dam Toe
B-603	1/23/2018	30	-97.799743011732	30.0630894014034	Dam Toe
B-604	1/24/2018	40	-97.800295944141	30.0628879172365	Dam Toe
B-605	1/23/2018	20	-97.800927111885	30.0626931575656	Dam Toe
B-606	1/24/2018	25	-97.801507928588	30.0624922628081	Dam Toe
B-607	1/24/2018	20	-97.802107509847	30.0623418685759	Dam Toe
B-150	1/25/2018	10	-97.798559392376	30.0650744378205	East Borrow
B-151	1/25/2018	10	-97.799347584174	30.0648056557227	East Borrow
B-152	1/25/2018	10	-97.799715962831	30.0653272909095	East Borrow
B-153	1/25/2018	10	-97.800076748797	30.0657905173372	East Borrow
B-154	1/25/2018	10	-97.799282679301	30.0658053787738	East Borrow
B-155	1/25/2018	10	-97.802422952588	30.0632361901515	West Borrow
B-156	1/25/2018	10	-97.802874018834	30.064093928968	West Borrow

Boring Designation Nomenclature (NRCS):
B-300 – Borings along Dam Crest
B-600 – Borings along Dam Toe
B-150 – Borrow Borings

Detailed descriptions of subsurface materials encountered at the boring locations are presented on the Logs of Borings, included in Appendix C. Keys to Terms and Symbols used on the logs are set forth in Appendix C, following the boring logs.

Photographs of the soil and shale samples obtained from the borings are presented on the attached Plates 5 and 6. Photographs of bulk soil samples obtained from the borrow borings are presented on Plate 7. A Generalized Subsurface Profile through the dam centerline along the proposed principal spillway is presented on Plate 8.

Pocket penetrometer values, in tons per square foot, and Standard Penetration Test N-values, in blows per foot, are also shown on the logs of borings at the respective test depth. Groundwater and/or drilling fluid observations made during drilling are presented on the boring logs. Borings were backfilled with a mixture of bentonite and grout upon completion of drilling.

Latitude and longitude GPS coordinates obtained at boring locations using a hand-held GPS device accurate to about 3 horizontal meters, are shown at the top of the boring logs and should be considered approximate. Boring elevations shown on the boring logs were interpolated from the provided 1-ft contour plan and should be considered approximate.

The borings were drilled using a track-mounted geoprobe equipped with 1) continuous flight augers for advancing the holes dry and recovering disturbed samples (ASTM D1452), 2) seamless push tubes for obtaining relatively undisturbed soil samples of cohesive strata (ASTM D1587), and 3) split-barrel samplers and drive weight assembly for obtaining representative samples and measuring the penetration resistance (N values) of non-cohesive soil strata (ASTM D1586). The dam crest boring was drilled using a truck-mounted CME drilling rig that also included a double-tube wireline core barrel with diamond bits for obtaining 2-inch diameter rock cores (ASTM D2113). Selected photographs of site drilling are included in Appendix B.

LABORATORY INVESTIGATION

The laboratory testing program included identification and classification testing of strata encountered in the subsurface. Soil classification tests, including Atterberg limit determinations (ASTM D4318), and partial grain-size analyses (ASTM D422), were conducted on representative samples of the soil strata. Unconsolidated undrained triaxial compression tests (ASTM D2850) were conducted on testable clay soil samples obtained from the borings. The classification and compressive strength tests included natural water content determinations (ASTM D2216). The compressive strength tests also included unit dry weight determinations.

The results of the tests are tabulated on the boring logs at the sample recovery depths. Grainsize data in graphical form and summary lab data is presented in Appendix D. Advanced laboratory testing and borrow sample test results are presented in the following sections.

Consolidated Undrained Triaxial Compression

In addition to classification and compression testing, advanced laboratory testing consisting of one triaxial test on a representative, testable clay sample from boring B-301 at the 18 to 19 ft depth. Advanced lab testing was conducted by TRI Environmental in Austin, Texas, and results are included in Appendix D.

The triaxial testing consisted of consolidated-undrained (CU) triaxial compression (ASTM D4767) with pore pressure measurements. In this test, the clay sample is trimmed and loaded into a triaxial test chamber, backpressure saturated, consolidated and sheared at varying confining pressures. From the resulting stress vs. strain and pore water pressure measurements at three different confining pressures, the following strength parameters can be deduced: total stress friction angle (ϕ), effective stress friction angle (ϕ'), total stress cohesion intercept (c), and effective stress cohesion intercept (c'). The results are summarized in the following table.

Table 2. CU Triaxial Test Results

Boring Depth	Data Reduction Method	Total Stress Parameters		Effective Stress Parameters	
		Cohesion, c (psf)	Friction Angle, ϕ	Cohesion, c' (psf)	Friction Angle, ϕ'
B-301 18 – 19 ft	Max stress ratio	363	15.9	392	22.5
	Max stress difference	881	10.8	616	17.5

As indicated in Table 2, two data reduction techniques were applied to the lab data to determine peak strength: maximum principal stress *ratio* and maximum principal stress *difference*. It can be seen that the data reduction technique resulted in variable strength values. For this analysis, we used the more conservative friction angle and applied a reduction factor to the cohesion from max stress difference method. In general, the strength envelope of clay is oftentimes curved (non-linear), lending to a lower cohesion intercept than that estimated with a linear failure envelope.

Borrow Samples

Soil pH and PI lime series tests were conducted on composite samples obtained from the borrow borings. The samples were combined based on the visual classification of similar conditions. A summary of composite samples and resulting pH and PI tests for varying percent lime is presented in the following table.

Table 3. Borrow Boring Lab Data Summary				
Composite Sample Designation	Samples Included	% Lime Added (by dry weight)	PI	pH
CS1 (Dark brown CH)	B-150 (0-3 ft) B-151 (0-3 ft) B-152 (0-3.5 ft) B-153 (0-3 ft) B-154 (0-3 ft)	0	51	8.2
		4	15	12.5
		5	14	12.6
		6	14	12.6
CS2 (Tan CH)	B-150 (7-10 ft) B-151 (3-10 ft) B-152 (5-10 ft) B-153 (5-10 ft) B-154 (5-10 ft)	0	36	8.6
		4	17	12.6
		5	17	12.7
		6	17	12.7
S3 (Dark grayish brn CH)	B-155 (0-4 ft)	0	64	---
S4 (Tan, calcareous CH)	B-156 (2.5-5 ft)	0	36	---

PI – Plasticity Index
CH – Fat Clay
"---" Test not performed

Based on laboratory test results on composite borrow samples, a minimum of 4% lime is recommended to cause the optimal pozzolanic reaction (to achieve a pH of at least 12.4), and to sufficiently reduce the PI.

Crumb Dispersion Test

To evaluate the dispersive characteristics of proposed embankment soils, crumb dispersion tests were performed on soil fragments from bulk samples obtained from borrow borings and combined samples.

The test is performed by immersing a small fragment (crumb) of soil, at the natural moisture content, into about 150 ml of distilled water. After about 5 to 10 minutes, the sample is viewed and graded based on the colloidal suspension. The test results including boring number, depth, soil description and "grade reaction" are summarized the table below. The test results ranged from non-dispersive to slightly dispersive with one sample having a moderate reaction.

Table 4. Borrow Boring Lab Data Summary			
Boring / Sample Designation	**Depth**	**Sample Description**	**Grade Reaction (after 1 hr / after 6 hrs)**
CS1	S1	Dark brown CH	1 / 1
CS1	S2	Dark brown CH	3 / 3
CS2	S1	Tan CH	2 / 2
CS2	S2	Tan CH	1 / 1
B-150	0-3 ft	Dark brown CH	1 / 1
B-151	3-10 ft	Tan and gray CH	1 / 1
B-153	0-3 ft	Dark brown CH	1 / 1
B-154	0-3 ft	Dark brown CH	1 / 1
B-155	6.5-10 ft	Grayish brown CH, calcareous	2 / 2

Grade 1: No Reaction: Crumb may slake and run out on bottom of the beaker in flat pile but no sign of cloudy water caused by colloids in suspension.
Grade 2: Slight Reaction: Bare hint of could in water at the surface of crumb. (If the cloud is easily visible, use Group 3).
Grade 3: Moderate Reaction: Easily recognizable could of colloids in suspension. Usually spreading out in thin streaks on bottom of beaker.
Grade 4: Strong Reaction: Colloidal cloud covers nearly who bottom of beaker, usually in a very thin skin. In extreme cases all the water in the beaker becomes cloudy.

Soluble Sulfate Content Tests

Nine soluble sulfate content tests were conducted on bulk soil samples obtained from the borrow borings and composite samples.

The tests were performed in accordance with TxDOT Test Methods Tex-619-J and Tex-620-J to evaluate soils with regard to the phenomenon known as “sulfate induced heave.” The results of the soluble sulfate content tests are presented in the following table.

Table 5. Soluble Sulfate Content Test Results		
Boring	**Sample Depth**	**Soluble Sulfate Content**
CS1	S1	3,000 mg/kg
CS1	S2	3,620 mg/kg
CS2	S1	320 mg/kg
CS2	S2	140 mg/kg

Table 5. Soluble Sulfate Content Test Results		
Boring	**Sample Depth**	**Soluble Sulfate Content**
B-150	0-3 ft	100 mg/kg
B-151	3-10 ft	120 mg/kg
B-153	0-3 ft	120 mg/kg
B-154	0-3 ft	120 mg/kg
B-155	6.5-10 ft	140 mg/kg

The following table presents some general guidelines concerning the soluble sulfate content in soils and the associated level of risk with regard to causing sulfate induced heave when lime stabilizing subgrade soils. These general guidelines were presented in a Technical Memorandum titled “Guidelines for Stabilization of Soils Containing Sulfates” presented at a Soil Stabilization Seminar that was sponsored by the Lime Association of Texas.

Table 6. Guidelines for Stabilization of Soils Containing Sulfates	
Soluble Sulfate Content (mg/kg or ppm)	**Level of Risk***
< 3,000	Low
3,000 to 5,000	Moderate
5,000 to 8,000	Moderate to High
> 8,000	High to Unacceptable
* Level of risk associated with routine lime stabilization procedures.	

The measured sulfate contents ranged from 100 to 3,620 mg/kg but were generally less than 3,000 mg/kg (ppm) which is in the low level of risk category associated with lime stabilization procedures.

Strata Descriptions

Descriptions of strata made in the field at the time the borings were drilled were modified in accordance with results of laboratory tests and visual examination. All recovered soil samples were classified in general accordance with ASTM D2487 and described as recommended in ASTM D2488. Classifications of the soils and finalized descriptions of soil strata are shown on the boring logs.

SITE AND SUBSURFACE CONDITIONS

Physiography

The project site is located in the northeast quadrant of the intersection of FM 2001 and Satterwhite Road, about 2 miles east of IH-35 in Buda, Texas. The dam site is accessed from a gated entry at Satterwhite Road. A wastewater treatment plant is located adjoining the site at the southeast corner of the dam footprint and auxiliary spillway. One wastewater utility was observed at the project site, east borrow area, where manholes were observed. It is understood that the utility mainly extends along the eastern side of the impoundment area and to the north.

The USGS Topographic Map is presented on Plate 3. The dam is situated on Brushy Creek, within the Plum Creek Watershed district. According to the topographic map, ground surface elevations generally range from El. 650 ft near Brushy Creek, to about El. 680 to 685 ft at the dam abutments.

The drainage area for Dam 10 is reported as 1,210 acres, and the normal pool reservoir is on the order of 42 acres in size, at the time of this study. An offsite pipeline (presumably gas) extends northeast-southwest, about 600 ft south and east of the auxiliary spillway flood elevation.

Geology

According to the Geologic Atlas of Texas, Austin Sheet[1], the dam site is mapped as being underlain by clay and shale of the Pecan Gap formation of the Taylor Group. A Geologic Map is presented on Plate 4.

The Pecan Gap formation of the Taylor Group generally consists of highly plastic, calcareous clay and clayshale with some limestone. The Pecan Gap was deposited in the Upper Cretaceous age as calcareous clay. With weathering, near-surface Pecan Gap becomes fat clay with high shrink/swell potential when subjected to moisture changes.

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1 Barnes, V.E. (1974), "Geologic Atlas of Texas, Austin Sheet," Second Printing 1995, Bureau of Economic Geology, The University of Texas at Austin, map and explanatory bulletin.

Stratigraphy and Engineering Properties

Subsurface conditions can best be understood by a thorough review of the Boring Logs included in Appendix C. In general, the borings encountered embankment fill, dark brown fat clay, tan and gray fat clay, and weathered shale to the boring termination depths. A brief description of the subsurface conditions and engineering properties for the dam crest, dam toe, and borrow borings is provided in the following sections.

Dam Crest. Boring B-301 was drilled to the 55 ft depth within the dam crest, approximately where the new principal spillway is planned. The boring encountered 38.5 ft of embankment fill material, further underlain by very stiff to hard tan clay and less weathered gray clayshale of the Pecan Gap formation.

The embankment fill material is described as brown, tan and gray fat clay with measured plasticity indices of 33 and 45. Percent fines (material passing the No. 200 sieve) were 84 and 86 percent. Insitu soil moisture contents ranged from 17 to 23 percent in the upper 20 ft of embankment, and generally 25 to 35 percent in the lower depths of the embankment, above the less pervious Pecan Gap clay. Unconfined compressive strengths of testable clay samples were 6.5 and 3.4 tsf.

Tan and gray fat clay of the Pecan Gap formation was encountered from the 38.5 to 42 ft depth (approximate El. 646.5 to 643 ft), further underlain by less weathered gray clayshale to the boring termination depth of 55 feet. Standard Penetration Test (SPT) blow counts were generally above 100 blows per foot (bpf) in the clayshale stratum.

Dam Toe. Borings B-601 through B-607 were drilled to depths of 20 to 40 feet below existing grade. The borings encountered embankment fill material, further underlain by very stiff to hard tan clay and less weathered gray clayshale of the Pecan Gap formation.

The embankment fill material is described as brown, tan and gray fat clay with measured plasticity indices ranging from 31 to 50 with an average of 41. Percent fines (material passing the No. 200 sieve) ranged from 54 to 84 with an average of 76 percent. Insitu soil moisture contents ranged from 16 to 39 with an average of 25 percent. Unconfined compressive strengths of testable clay samples ranged from 1.2 to 3.8 with an average of 2.5 tsf.

Tan and gray fat clay of the Pecan Gap formation was encountered at depths of 9 to 11.5 feet below existing grade. The measured plasticity index in the tan and gray stratum was 39, and unconfined compressive strengths were 7.3 and 3.0 tsf. Relatively less weathered gray clayshale was encountered beneath the tan and gray clay in 5 of the 7 borings. Standard

Penetration Test (SPT) blow counts ranged from 60 to over 100 blows per foot (bpf) in the clayshale stratum.

Borrow. Borings B-150 through B-156 were drilled to the 10 ft depth within two proposed borrow areas. Borings B-150 through B-154 were drilled along the east impoundment area and encountered dark brown fat clay over tan and gray fat clay to the boring termination depths. The measured plasticity index of the upper dark brown soil material was 51 with 95 percent fines, and the measured plasticity index of the lower tan and gray fat clay was 36 with 87 percent fines.

Borings B-155 and B-156 were drilled to the 10-ft depth along the west impoundment area and encountered dark gray fat clay, calcareous dark gray fat clay, and tan and gray fat clay. Measured plasticity indices were 64 and 36 where the lower PI material was the calcareous clay. Percent fines were 96 and 94. It is suspected that this area may have been previously excavated.

Groundwater

Groundwater was not encountered in the borings at the time of drilling. The toe borings (B-601 through B-607) were allowed to remain open for at least 24 hours, and stabilized groundwater was encountered in 4 of the 7 borings at depths of 0.5 to 18.5 feet below existing grade. A summary of stabilized groundwater measurements is presented in the table below.

Table 7. Summary of Stabilized Groundwater Measurements

Boring	Estimated Boring Elev.	24-hour Groundwater Depth	24-Hour Groundwater Elev.
B-601	674	10.5	663.5
B-602	668	0.5	667.5
B-603	664	21	643
B-605	658	18.5	639.5
The normal pool (riser) elevation is estimated to be El. 671 ft at the time of drilling.			

GEOTECHNICAL EVALUATION

The project will include wave erosion improvements to the upstream slope, flattening of the downstream slope, installation of a new principal spillway riser, conduit pipe, and discharge basin, and modifications to the auxiliary spillway. For this analysis, a typical cross section at boring B-301 (approximate STA 12+00) was used for seepage and slope stability modeling. This section roughly corresponds to the maximum dam height section, and the location of the principal spillway. A schematic from the model is below.

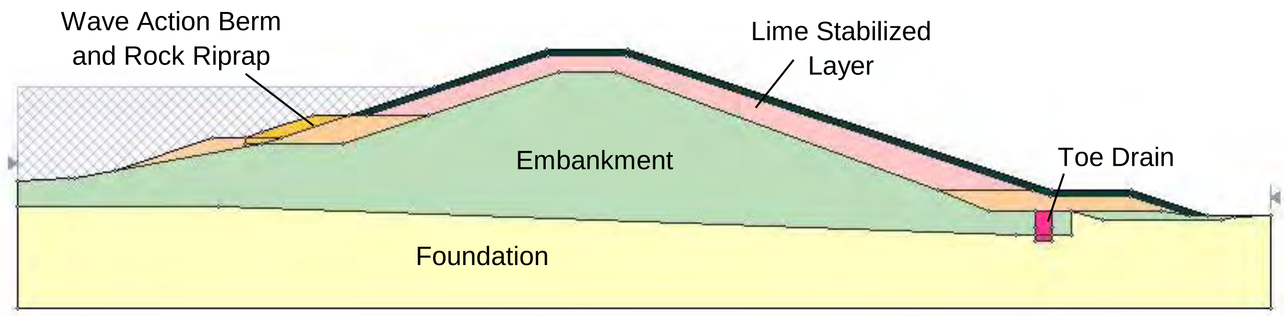


Figure 1. Proposed Dam Configuration Used in Model

Methodology

The computer program SLIDE V6 by RocScience was utilized to analyze seepage and slope stability of the proposed dam configuration. For seepage analyses, the software generates a finite element mesh for the defined geometry, material properties and boundary conditions. The analyses can be nested to retain seepage and phreatic conditions, then imported to evaluate slope stability.

Analyses and stability criteria for this rehabilitation project will be based on strength definitions and minimum factors of safety as outlined in TR-60, Earth Dams and Reservoirs, NRCS, July 2005, and engineering judgment. For items not specifically addressed in TR-60, the geotechnical analyses will be in accordance with TCEQ, Design and Construction Guidelines for Dams in Texas, August 2009.

Seepage

Seepage evaluations were performed using the SLIDE finite element module (RocScience). Reservoir level (left-side) boundary conditions consist of specified head equal to the normal pool. Normal pool boundary conditions were applied to the reservoir side ground surface and along the vertical, left side of the model. Tailwater (right-side) boundary condition consisted of specified heads equal to the ground surface along the right-side model vertical edge. Seepage face boundary conditions were applied along the downstream slope and ground surface to the right side of the model edge, and include the proposed toe drains.

Performance Criteria. There are no specific criteria regarding seepage published in TR-60 (NRCS, 2005) or TCEQ (2009). Seepage performance was evaluated in terms of the following:

- Computed pore pressures were used for pertinent slope stability evaluations, including long-term steady seepage and short-term undrained loading during rapid draw down.
- Downstream toe drains were evaluated in terms of how they would control the phreatic surface at the downstream toe of the dam, and construction considerations.
- Computed hydraulic gradient variations were reviewed to assess their impact on potential erosion and piping and the need for filter control.

Material Properties. Hydraulic conductivities were estimated from laboratory test data, published correlations, published values, and experience with similar materials. A seepage analysis calculation packet is included in Appendix B which presents: 1) a summary of referenced correlations and published values, 2) presentation of laboratory test data and detailed evaluation of materials properties for each strata, and 3) a rationale for the hydraulic conductivity parameters selected for design. Based on our evaluation presented in Appendix B, the following hydraulic conductivity parameters were selected for use in developing the phreatic surface.

Table 8. Hydraulic Conductivities Estimated for Seepage Model

Material	Ks (ft/min)	K_2/K_1
Embankment	1×10^{-7}	0.25
Foundation (Natural Soil)	1×10^{-7}	0.25
Lime Treated Embankment	1×10^{-6}	0.25
Compacted Embankment	1×10^{-7}	0.25
Rock Riprap	1×10^{-3}	0.25
Toe Drain	1×10^{-4}	0.25

Results. The seepage analysis was performed to determine the shape of the phreatic surface for use in the steady state and rapid draw down stability analyses presented in the following section of this report. The boundary conditions included modeling of a normal pool elevation of 679.0 ft which is the proposed auxiliary spillway crest elevation, and the presence of toe drains. Exit gradients were found to be at acceptable levels. Graphical presentation and summary of results are presented in Appendix E.

Slope Stability

Slope stability analyses were performed to evaluate the steady-state seepage and rapid-drawdown conditions using the proposed dam configuration cross section presented previously in Figure 1 which represents the maximum dam height.

Slope stability evaluations were performed using SLIDE V6 (RocScience) which uses limit equilibrium procedures applied to discretized slices representing a potential slide mass to evaluate factors of safety with respect to slope stability. The Spencer method was selected for this limit equilibrium analysis.

Performance Criteria. The slope stability analysis was considered for the steady state seepage condition and the rapid drawdown condition. Due to minimal grading required as part of this dam rehabilitation project (i.e. no additional earth load planned), we anticipate that the dam is currently in the steady state seepage (effective stress) condition and will not achieve a total stress condition, as modeled in the end of construction analysis. Therefore, we have not included a total stress, end of construction condition in this stability analysis. Additionally, the seismic condition was also neglected due to the general lack of seismic potential in central Texas.

For conditions of steady state seepage, the phreatic surface was developed as part of the Seepage Analysis, described previously. For this case, the NRCS requires applying uplift forces to saturated soil zones. The uplift is modeled as a piezometric surface which begins at the auxiliary spillway crest on the upstream side of the embankment.

As required by TR-60 the following conditions of stability were investigated in this analysis. The recommended minimum factors of safety (FS) are also listed for both NRCS and TECEQ 2009, which are the same.

Table 9. Slope Stability Design Criteria			
Design Condition	NRCS Design Shear Strengths	NRCS Minimum FS	TCEQ Minimum FS
Steady Seepage - D/S slope	Lowest shear strength from a composite envelope of CD and (CU+CD)/2 envelopes	1.5	1.5
Rapid Drawdown – U/S slope	3-stage Analysis: Consolidated Drained (CD) envelope before drawdown, lowest	1.2	1.2

Material Properties. Material properties for the embankment and foundation materials are based on laboratory test results presented herein, and developing the NRCS-specified strength envelopes for the embankment material. Shear function calculations developed for this analysis are included in Appendix E.

For soil materials without advanced laboratory testing, material properties were estimated using engineering judgment and experience with similar materials. A summary of the material strength properties is presented in the following table.

Table 10. Summary of Estimated Material Properties						
Material Layer	Drained Effective Stress (Steady State)		Drained (CU') Effective Stress (Rapid Drawdown)		Undrained (CU) Total Stress (Rapid Drawdown)	
	c' (psf)	ϕ' (deg)	c' (psf)	ϕ' (deg)	c (psf)	ϕ (deg)
Embankment	Composite shear function		200	17.5	400	10.8
Foundation Subgrade	200	26	200	26	---	---
Lime Treated Embankment	150	24	50	17.5	100	10.8
Compacted Embankment	150	20	100	17.5	150	10.8
Rock Riprap	0	40	0	40	---	---
Toe Drain	0	32	0	32	---	---
Topsoil	150	28	0	28	---	---
"---" modeled as drained (CU') strength.						

Results. The SLIDE V6 computer program utilizing Spencer's method of slices and side force determination employed search routines to find the theoretically critical shear surface for steady state and rapid drawdown loading conditions. Results are presented in Appendix E and summarized in the following table. Results indicated minimum required factors of safety satisfy NRCS and TCEQ design criteria for slope stability.

Table 11. Results of Slope Stability Analysis

Loading Condition	Shear Envelope	Minimum FS Required	Results		
			Slope	Boundary Condition	Minimum Calculated FS
Steady Seepage	Composite: Lowest of CD and (CD+CU)/2	1.5	D/S	Normal Pool at 679.0	1.60
Rapid Drawdown	Composite: Lowest of CD and CU	1.2	U/S	Normal Pool at 679.0 to drained lake	1.21

Settlement

The proposed modifications to the existing embankment will generally consist of removal of up to 4 feet of existing embankment material, addition of at least 4% lime in most areas, and earthwork replacement of existing slopes and berms. A slight flattening of the downstream slope (from 2.5H:1V to 3.0H:1V) is planned which will add perhaps 1 ft of embankment earth load on the downstream slope.

Accordingly, the resulting configuration will be sufficiently similar to the existing, and no additional settlement is anticipated. It is noted that assessment of the current settlement condition of the embankment is beyond the scope of this investigation; however, no appreciable surface depressions or low areas were noted along the dam crest at the time of our site visit (see photos in Appendix B).

GEOTECHNICAL RECOMMENDATIONS

Proposed embankment dam modifications will include: improvements to upstream slope, flattening of downstream slope and installation of toe drains, installation of a new principal spillway, and modifications to the auxiliary spillway. The following sections provide geotechnical design and construction recommendations for each of the proposed improvements.

Upstream Slope Modifications

According to the as-built drawings, the upstream slope was designed as 2.5H:1V with a wave berm at the principal spillway elevation of 671.90 feet. Currently, the slope face has eroded due to wave action, with shallow surface sloughs.

Proposed modifications to the upstream slope will include regrading to a 3.0H:1V slope configuration, construction of a new wave action berm at elevation 670.0 ft, and construction of a rock riprap berm. The new embankment behind the riprap berm will be constructed of compacted earth. Above the riprap berm, the slope face will be constructed at 3H:1V with the upper 4 feet of earth being lime treated. Based on laboratory testing results presented herein, a 4% lime addition is required to sufficiently reduce the plasticity index (PI) generally below 20. Recommendations for earthwork are provided in the Construction Recommendations section to follow.

Downstream Slope Flattening and Toe Drain Installation

The as-built drawings included in Appendix A show the downstream slope configuration as 2.5H:1V with a toe berm at elevation 660.0 feet. Proposed modifications will include flattening of the downstream slope to 3H:1V, and installation of toe drains. A compacted earth toe berm is planned along a portion of the dam at elevation 660.8 feet.

With reshaping and flattening of the downstream slope, the upper 4 feet of embankment will be lime treated with at least 4% lime by dry weight. The purpose of the lime treatment is to lower the PI of the high PI site soils so that a 3H:1V slope configuration can be maintained long term. Recommendations for compacted earth and lime treated embankment are provided in the Construction Recommendations section of this report to follow.

New Principal Spillway

A new principal spillway is planned, consisting of a new riser structure, horizontal conduit pipe, and discharge basin. The new principal spillway riser will have a crest elevation of 671.0 ft and invert elevation of approximately 659.0 feet. Borings were not performed within the proposed riser footprint due to the lake impoundment.

Riser Structure. According to provided preliminary 30% plans, the riser structure will be situated near dam center line STA 11+72 and will be founded approximately 5 to 8 feet below existing grade. According to nearby boring data, subsurface conditions at the riser foundation will likely consist of tan and gray fat clay (CH) with sand and gravel. Groundwater may be present.

The Geotechnical Engineer of Record should observe the foundation subgrade prior to reinforcing steel placement, to confirm a dry excavation with suitable bearing. Specifically, the following is recommended regarding the riser structure foundation:

1. Within the riser structure footprint and at least 5 ft outside the footprint, remove and dispose of all vegetation and/or muck, any deleterious materials, and any additional depth required to bear below low consistency soils.
2. Scarify the excavated subgrade at least 8 inches and recompact to at least of 95% of the maximum dry density as determined using ASTM D698. Hold water contents within optimum to +3 of optimum.
3. Consideration should be given to placing a seal slab on the moisture conditioned subgrade and prior to foundation construction. The seal slab will provide a working surface for the construction and reduce the potential for moisture change of the underlying fat clay soils. The geotechnical engineer should observe the overexcavated subgrade prior to seal slab preparation to confirm suitable bearing conditions and sufficient excavation depths.
4. If needed to bring the foundation subgrade to grade, use a soil material having a PI less than 30, not open-graded, and containing more than 50% fines (percent passing the No. 200 sieve).
5. Compact the structural fill to at least 95% of the maximum dry density as determined using ASTM D698. Hold water contents within optimum to +4 percent of optimum, and maintain compacted lift thicknesses to 6 inches or less.
6. Foundations bearing at least 12 inches below grade may be sized using an allowable bearing pressure of 1,500 psf on the compacted, approved subgrade.

7. The perimeter foundation slab should be thickened to support the riser side walls, and bear at least 12 inches below grade for an allowable bearing pressure of 1500 psf. Higher bearing capacity is available for deeper embedment.
8. If the slab design requires a modulus of subgrade reaction, use 75 pci.
9. For concrete foundations poured in good contact with the prepared subgrade or atop a seal slab, an allowable coefficient of friction of 0.35 may be used for sliding resistance.
10. These recommendations do not consider scour.

Impact Basin. The proposed impact basin and concrete cradle may be designed for shallow foundation support atop a prepared subgrade. Based on preliminary plans, subgrade conditions will likely consist of tan and gray, moist high plasticity clay. Groundwater may be present.

The Geotechnical Engineer of Record should observe the foundation subgrade prior to reinforcing steel placement, to confirm a dry excavation with suitable bearing. Specifically, the following is recommended regarding the basin structure foundation and retaining wall design:

1. Excavate to the concrete cradle and impact basin subgrade elevation, and extend laterally as specified on the design plans.
2. The geotechnical engineer should observe the excavated subgrade to verify potentially unsuitable soils are not present. At that time, the geotechnical engineer will determine the presence of loose, soft or compressible material and recommend undercut depths, if necessary.
3. If the over-excavated subgrade needs to be brought to grade, use a soil material having a PI less than 30, not open-graded, and containing more than 50% fines (percent passing the No. 200 sieve).
4. Compact the structural fill to at least 95% of the maximum dry density as determined using ASTM D698. Hold water contents within optimum to +4 percent of optimum, and maintain compacted lift thicknesses to 6 inches or less.
5. Groundwater will likely be present in the basin and cradle excavation. The contractor should be prepared to maintain a dry excavation.
6. Foundations bearing at least 12 inches below grade may be sized using an allowable bearing pressure of 1,500 psf on the compacted, approved subgrade.

7. The perimeter foundation slab should be thickened to support the riser side walls, and bear at least 12 inches below grade for an allowable bearing pressure of 1500 psf. Higher bearing capacity is available for deeper embedment.
8. If the slab design requires a modulus of subgrade reaction, use 75 pci.
9. For concrete foundations poured in good contact with the prepared subgrade or atop a seal slab, an allowable coefficient of friction of 0.35 may be used for sliding resistance.
10. These recommendations do not consider scour.
11. Any loose or disturbed materials encountered at the bottom of the foundation excavation should be removed. There should also not be any free water standing in the excavation. The exposed subgrade should be observed by the geotechnical engineer prior to reinforcing steel and concrete placement to confirm suitable bearing.
12. Assuming similar soils are used to backfill behind below grade walls, a dry density of γ_d = 110 pcf and moist unit weight of γ_{moist} = 120 pcf may be used for design of below grade structures.
13. Below grade walls may be designed in accordance with the following.
    a. Walls free to rotate, with a horizontal backfill, use an “active” equivalent fluid pressure of 95 pcf for walls that do not drain, and 60 pcf for drained conditions.
    b. For walls restrained from rotation, with a horizontal backfill, use an “at rest” equivalent fluid pressure of 105 pcf for walls that do not drain, and 80 for drained condition.
    c. If drainage is provided behind the walls, it should consist of a minimum of 12 inches of clean, free-draining crushed stone with a maximum particle size between ¼ and ½ inches, and less than 5 percent fines (material passing the No. 200 sieve). ASTM C33 Grade 67 stone is a suitable gradation. A perforated pipe should be provided in the bottom of the gravel drainage material just beyond the walls that is connected to an outlet pipe or weep holes.
    d. During construction, heavy compaction rollers should operate no closer than 3 feet from the wall. Hand operated compaction equipment, such as vibratory plates, should be used directly behind the wall.

Auxiliary Spillway Modifications

The preliminary design plans show the auxiliary spillway modifications to include lowering of the spillway crest from 681.0 to 679.0, widening by 35-feet into the dam footprint, and reconstruction of spillway berms associated with spillway widening. Borings were not drilled along the auxiliary spillway. However, we anticipate subsurface conditions to consist high plasticity brown, tan and gray fat clay. Proposed construction of earthen berms should be selected and performed as recommended in the following Construction Recommendations section of the report.

CONSTRUCTION RECOMMENDATIONS

Earthwork

Proposed earthwork should be performed in accordance with the following recommendations.

Compacted Earth – Zone 1

- Classify as CL or CH in accordance with the Unified Soil Classification System;
- Non-dispersive; free of organic material (trees, stumps and roots), debris, or other deleterious matter.
- Plasticity index less than 40.
- Maximum particle size of 2 inches.

The following is recommended for Zone 1 soil placement and compaction:

1. The soil should be processed before placement so that it is reasonably uniform in composition and moisture content. Materials should be well blended to create a uniform material type and consistency.
2. Construct in lifts such that all lifts are bonded together and free of hydraulic defects, specified densities are met throughout each lift, the moisture content is uniform throughout the fill, and clods are broken down and bonded into the rest of the lift without nesting and voids.
3. Compact to at least 95 percent of the maximum dry density as determined by the standard Proctor compaction test (ASTM D 698). Maintain moisture contents between optimum and 4 percent of optimum moisture content as determined by the standard Proctor.

4. Compacted lift thicknesses should not exceed 8 inches.
5. Borrow soils more than 3 percent dry of optimum should be prewetted in the borrow area, and should not be placed on the fill until their moisture contents have equilibrated.
6. Compacted soils outside the range of optimum to +4 percent of optimum should be removed and reworked off the dam.
7. Kneading-type compaction equipment, such as cleat-type rollers, should be used so that individual lifts are integrated and that preferential planes of hydraulic conductivity are not created in the embankment.
8. Compaction of embankment material against structures should be done with heavy rubber tired equipment with high tire pressures wherever practical. Thorough compaction in these areas is critical and should be monitored carefully in the field. Soil moisture contents for this application should be between optimum and 4 percent above standard Proctor optimum.
9. Hand compaction equipment should be permitted only where machinery cannot be operated. Core material compacted by hand or by small equipment should be compacted at the same moisture range and to the same density as specified in item 3 above, and in loose lifts no thicker than 4 inches. Care should be taken to prevent displacement of structures and damage to prepared rock surfaces.

Lime Treated Earth – Zone 2

- Classify as CL or CH in accordance with the Unified Soil Classification System, before lime treatment.
- Non-dispersive; free of organic material (trees, stumps and roots), debris, or other deleterious matter.
- Plasticity index less than 20.
- Maximum particle size of 2 inches.

The following is recommended for Zone 2 placement and compaction:

1. Lime Stabilize the soils in place, in horizontal lifts, in accordance with project Construction Specifications.
2. Use hydrated lime, at a rate of 4% lime by dry weight.

3. Mix the soil-lime with a rotary mixer. During initial mixing, maintain a maximum layer thickness of 9 inches before compaction, and achieve a maximum particle size of 3 inches. Compact or seal off the surface in order to maintain moisture during curing.
4. Cure the mixture at least 72 hours. Maintain the water content of the mixture at or above standard optimum water content during the curing period.
5. After curing, the treated material shall be thoroughly remixed to meet the following gradation (exclusive of non-slaking rock fragments):
   . Minimum passing 2-inch sieve = 100 percent
   i. Minimum passing no. 4 sieve = 60 percent
6. Compact to at least 95 of the maximum dry density as determined by the standard Proctor compaction test (ASTM D 698), at moisture contents between 0 to +4 percent of optimum.
7. Compacted lift thicknesses should not exceed 8 inches.
8. A minimum density testing frequency should include one test per lift and per 10,000 SF of fill placed.
9. In addition to field density testing, pH testing is recommended every lift and every 20,000 SF of lime stabilized earth fill to confirm sufficient lime treatment and effective pH increase to at least 12.3. A minimum of 3 tests per lift is recommended. Areas that do not achieve a pH of at least 12.3 should be removed from dam, reprocessed, and replaced with lime stabilized earth that meets this requirement.
10. Borrow soils more than 3 percent dry of optimum should be prewetted in the borrow area, and should not be placed on the fill until their moisture contents have equilibrated to within the required moisture content range.
11. Maintain the specified moisture until the lift is covered with successive lifts. Compacted soils outside the range of 0 to +4 percent of optimum must be reworked and recompacted.
12. Kneading-type compaction equipment, such as sheep-foot rollers, should be used so that individual lifts are integrated and that preferential planes of hydraulic conductivity are not created in the embankment.
13. Compaction against structures should be done with heavy rubber tired equipment with high tire pressures wherever practical. Thorough compaction in these contact areas is critical and should be monitored carefully in the field. Soil moisture contents for this application should be between optimum and 4 percent above standard Proctor optimum.

14. Hand compaction equipment should be permitted only where machinery cannot be operated. Material compacted by hand or by small equipment should be compacted at the same moisture range and to the same density as specified in Item 6 above, and in loose lifts no thicker than 4 inches. Care should be taken to prevent displacement of structures and damage to prepared surfaces.

Fine Drainfill - Zone 3. Zone 3 will consist of filter sands for the filter drain and two-stage toe drains. Clean fine sand was not encountered at the site or in the proposed borrow areas, and will likely need to be imported. A fine aggregate sand meeting the gradation as specified in ASTM C 33 should be suitable for use.

The Zone 3 filter material should be placed in maximum 8 inch loose lifts and compacted with a minimum of four complete overlapping passes over the entire surface with a vibratory plate compactor until further passes will not result in greater densification and results in an unyielding surface. Care should be taken to prevent overcompaction and breakdown of the sand particles. The proposed compaction process should be observed and approved the geotechnical engineer or his representative.

Aggregate - Zone 4. Zone 4 will consist of bedding and rock riprap to protect the upstream face of the embankment from erosion by wave action. Aggregate durability tests should be provided or performed on bulk riprap samples obtained from nearby quarries

A bedding stone, such as ASTM C 33 No. 57 stone is recommended to provide protection of the relatively fined grained upstream shell. The bedding stone should be at least 1 ft in thickness, and the riprap should be at least 3 ft in thickness. Coarse drainfill aggregate may consist of ASTM C33 No. 89 stone.

Excavation in Borrow Areas

Excavation in proposed borrow areas consisting of dark brown fat clay, and tan and gray calcareous fat clay should proceed without difficultly. The contractor should be prepared and equipped to thoroughly mix and process hard, high plasticity clay and soft clayshale.

Depending on proposed dewatering and construction sequence, groundwater may be present during mass grading and processing of borrow materials for embankment construction. It is anticipated that the contractor will have work areas to process excavated soils, and accommodate management of soil moisture and lime application.

Stripping and Surface Preparation

The ground surface beneath areas to receive new fill should be prepared prior to the start of embankment construction. All trees, stumps, roots, and brush should be grubbed and removed from the embankment areas. Grasses and other vegetation should be stripped to a depth of at least 6 inches. The finished subgrade should then be proofrolled to identify any soft areas which should be over-excavated and replaced with compacted embankment material. After proofrolling, the subgrade should be scarified and compacted to at least 95% of the maximum dry density determined by the standard Proctor compaction test, (ASMT D 698) and at a soil moisture within optimum to +4% of optimum.

Construction Monitoring

It is recommended that the Geotechnical Engineer of record, or a qualified representative, be present on-site during construction to observe, monitor construction activities and perform quality control tests. Construction monitoring performed by qualified personnel independent of the Contractor is recommended because the performance of foundations and other structures constructed during this project will be directly related to the Contractor’s adherence to the recommendations presented in this report and to the specifications prepared by the Designer. Additionally, unanticipated soil and/or groundwater conditions may be encountered during construction. Qualified geotechnical personnel observing construction on-site can monitor construction activities and may aid in recognizing unanticipated subsurface conditions and assist in reconciling these conditions with design recommendations.

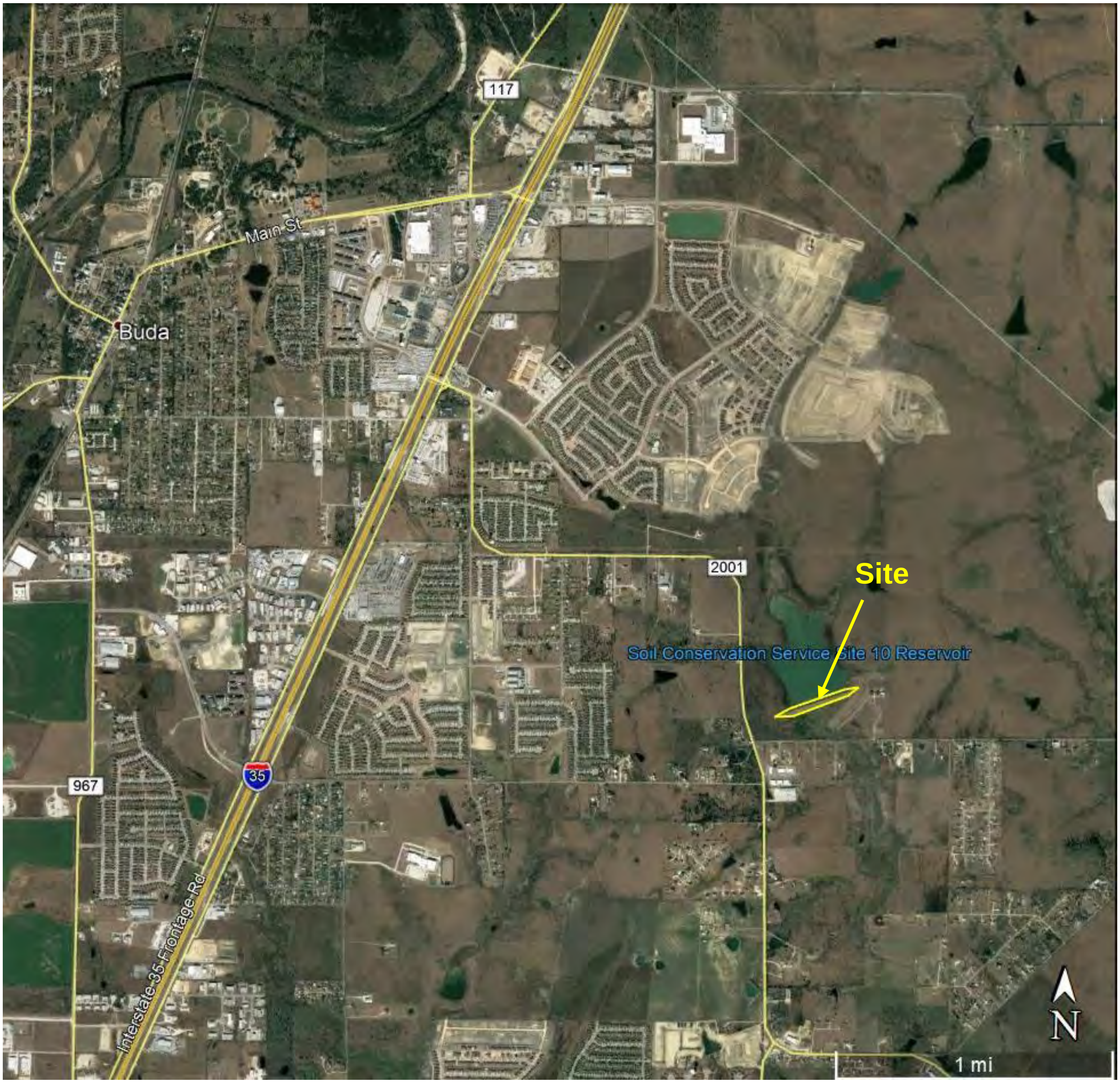
CONDITIONS

Since some variation was found in subsurface conditions at boring locations, all parties involved should take notice that even more variation may be encountered between boring locations. Statements in the report as to subsurface variation over given areas are intended only as estimations from the data obtained at specific boring locations.

The professional services that form the basis for this report have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in the same locality. No other warranty, expressed or implied, is made as the professional advice set forth. The results contained in this report are directed at, and intended to be utilized within, the scope of work contained in the agreement executed by Balcones Geotechnical, LLC and client. This report is not intended to be used for any other purposes.

* * *

PLATES



Source: Google Earth Professional

VICINITY MAP
Plum Creek FRS No. 10
Buda, Texas

Balcones
Geotechnical
Austin, TX 78731
512.380.9969

Source: Google Earth Professional, Imagery date 1/13/2018

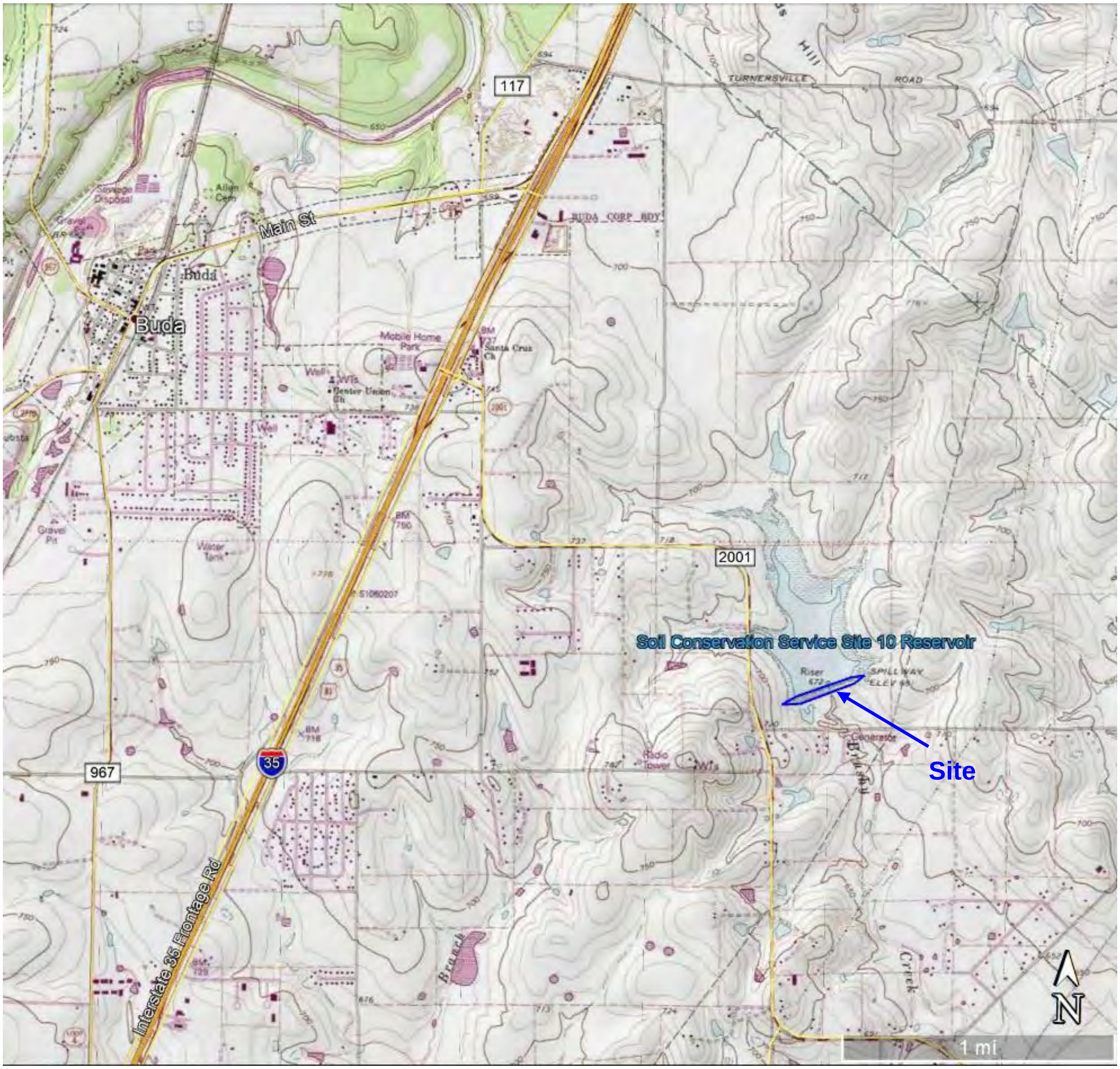
BORING LOCATION PLAN

Plum Creek FRS No. 10
Buda, Texas

Balcones Geotechnical
Austin, TX 78731
512.380.9969

Plate 2

BG Project No. 0118-002



Source: Google Earth Professional, Earth Point Topo Map

USGS TOPOGRAPHIC MAP

Plum Creek FRS No. 10

Buda, Texas

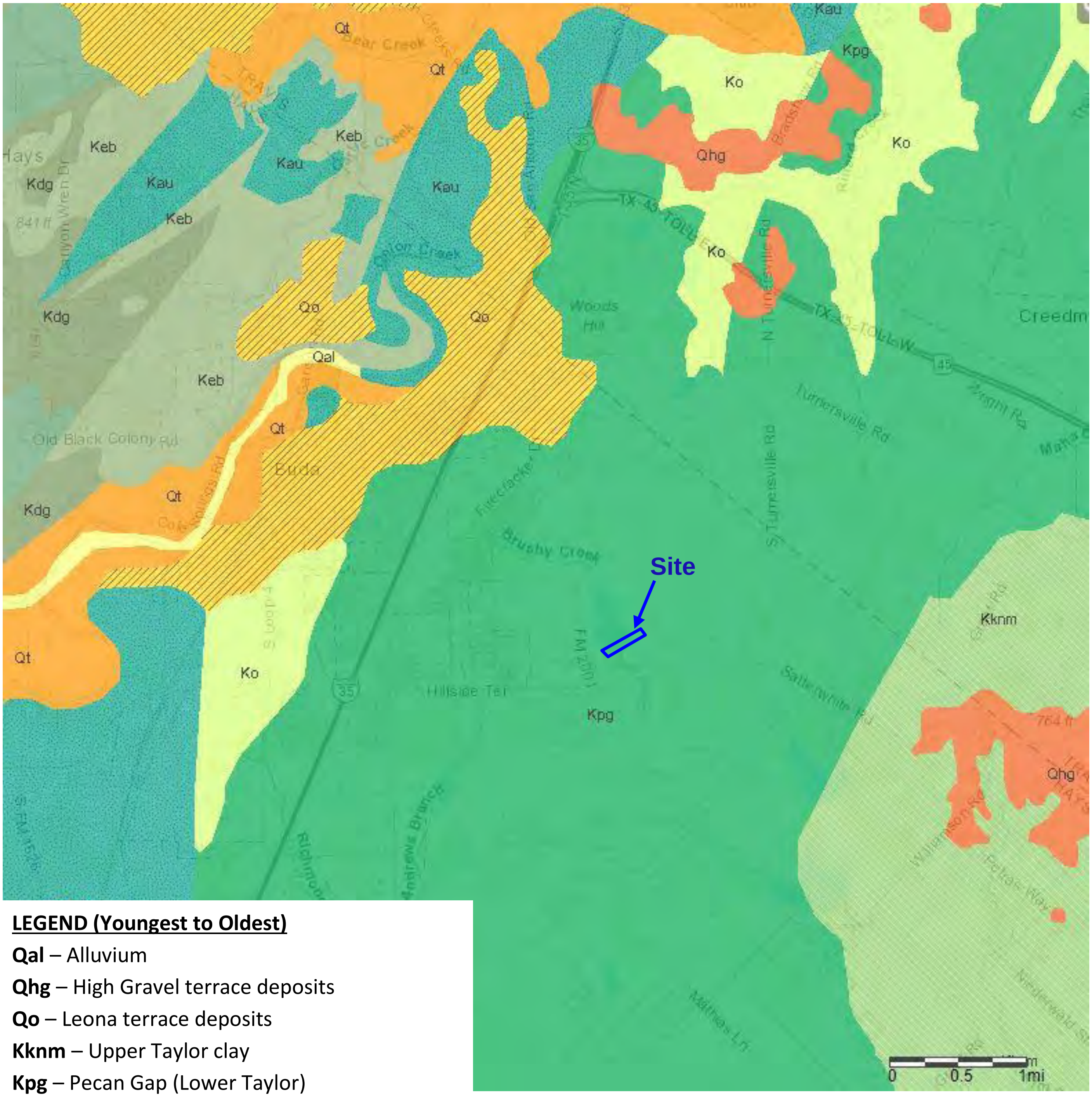
Balcones Geotechnical

Austin, TX 78731

512.380.9969

Plate 3

BG Project No. 0118-002



LEGEND (Youngest to Oldest)

Qal – Alluvium
Qhg – High Gravel terrace deposits
Qo – Leona terrace deposits
Kknm – Upper Taylor clay
Kpg – Pecan Gap (Lower Taylor)
Ko – Ozan Formation (lower Taylor)
Kau – Austin Group limestone
Kef – Eagle Ford shale
Kbu – Buda limestone
Kdg – Del Rio shale / Georgetown limestone

USGS Texas Geology Web Viewer (https://txpub.usgs.gov/dss/texasgeology/)

GEOLOGIC MAP
Plum Creek FRS No. 10
Buda, Texas

Balcones Geotechnical
Austin, TX 78731
512.380.9969

Plate 4

BORING B-301 SAMPLE PHOTOS

Plum Creek FRS No. 10
Buda, Texas

Balcones Geotechnical
Austin, TX 78731
512.380.9969

BG Project No. 0118-002

B-601

B-602

B-603

TOE BORING SAMPLE PHOTOS

Plum Creek FRS No. 10
Buda, Texas

Balcones Geotechnical
Austin, TX 78731
512.380.9969

Plate 6a

BG Project No. 0118-002

B-604

B-605

TOE BORING SAMPLE PHOTOS

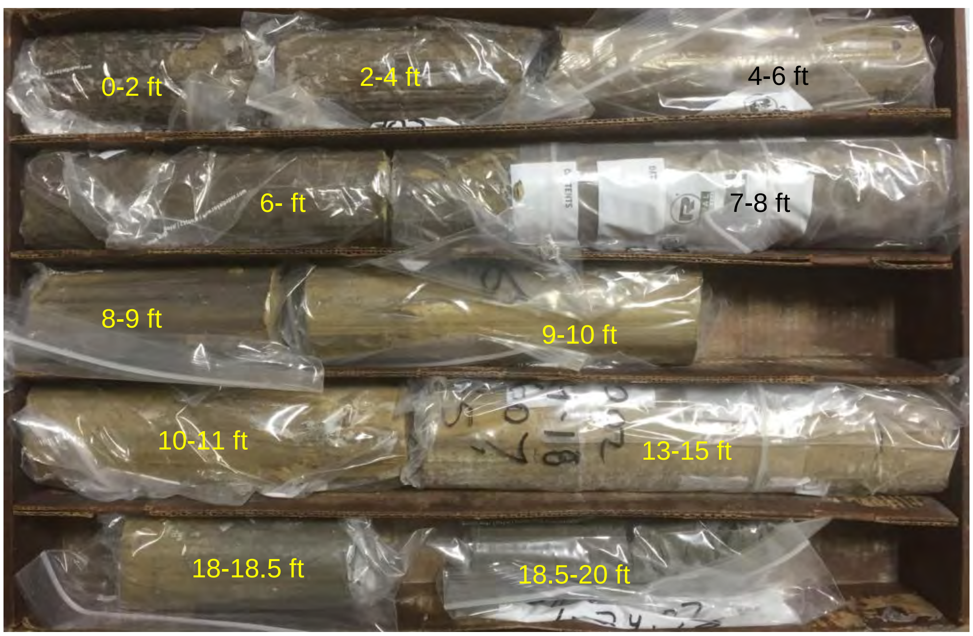
Plum Creek FRS No. 10

Buda, Texas

Balcones Geotechnical
Austin, TX 78731
512.380.9969

Plate 6b

B-606



B-607

TOE BORING SAMPLE PHOTOS

Plum Creek FRS No. 10
Buda, Texas

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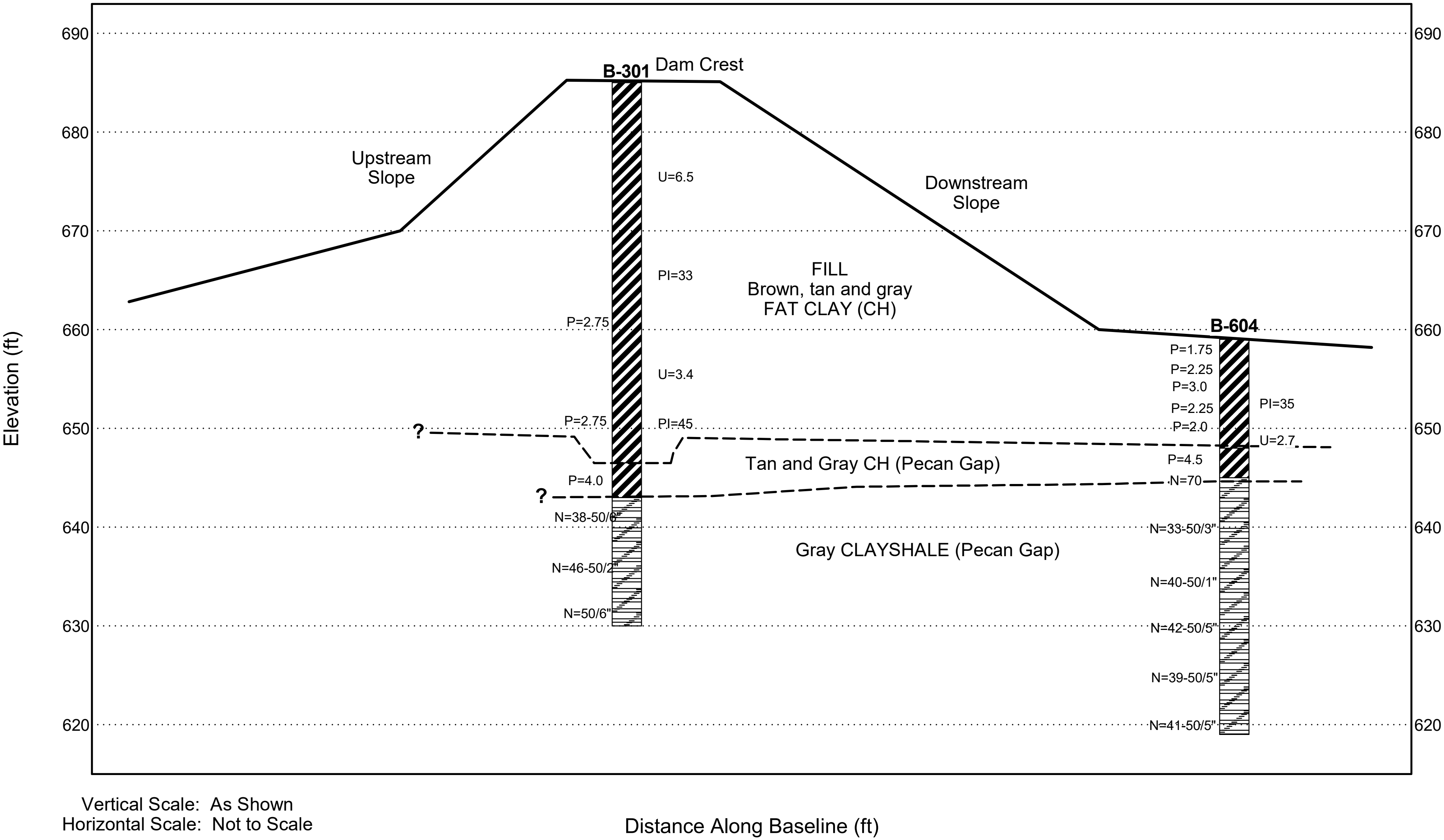
Plate 6c

BORROW BORING SAMPLE PHOTOS

Plum Creek FRS No. 10

Buda, Texas

Balcones Geotechnical
Austin, TX 78731
512.380.9969



SIMPLE FENCE - A SIZE (W/DATA) 0118-002 PLUM CREEK.GPJ FUGRO DALLAS DATA TEMPLATE.GDT 06/03/18 16:28

Balcones Geotechnical

Plum Creek FRS No. 10

GENERALIZED SUBSURFACE PROFILE

Buda, Texas

Project No. **0118-002**

Plate 8

APPENDIX A

Original Dam Drawings

PLUM CREEK WATERSHED PROJECT

FLOODWATER RETARDING DAM NO.10

DRAINAGE AREA	1210 ACRES
TOTAL STORAGE	779 AC. FT.
WATER SURFACE AREA	34 ACRES
HEIGHT OF DAM	31 FEET
VOLUME OF FILL	106,750 CU.YDS.

BUILT UNDER THE WATERSHED PROTECTION
AND FLOOD PREVENTION ACT

BY

HAYS-CALDWELL-TRAVIS SOIL CONSERVATION DISTRICT

AND

PLUM CREEK CONSERVATION DISTRICT

WITH THE ASSISTANCE OF

SOIL CONSERVATION SERVICE

OF THE

U. S. DEPARTMENT OF AGRICULTURE

1962

As Built Plans
Const. Comp. 5-14-63

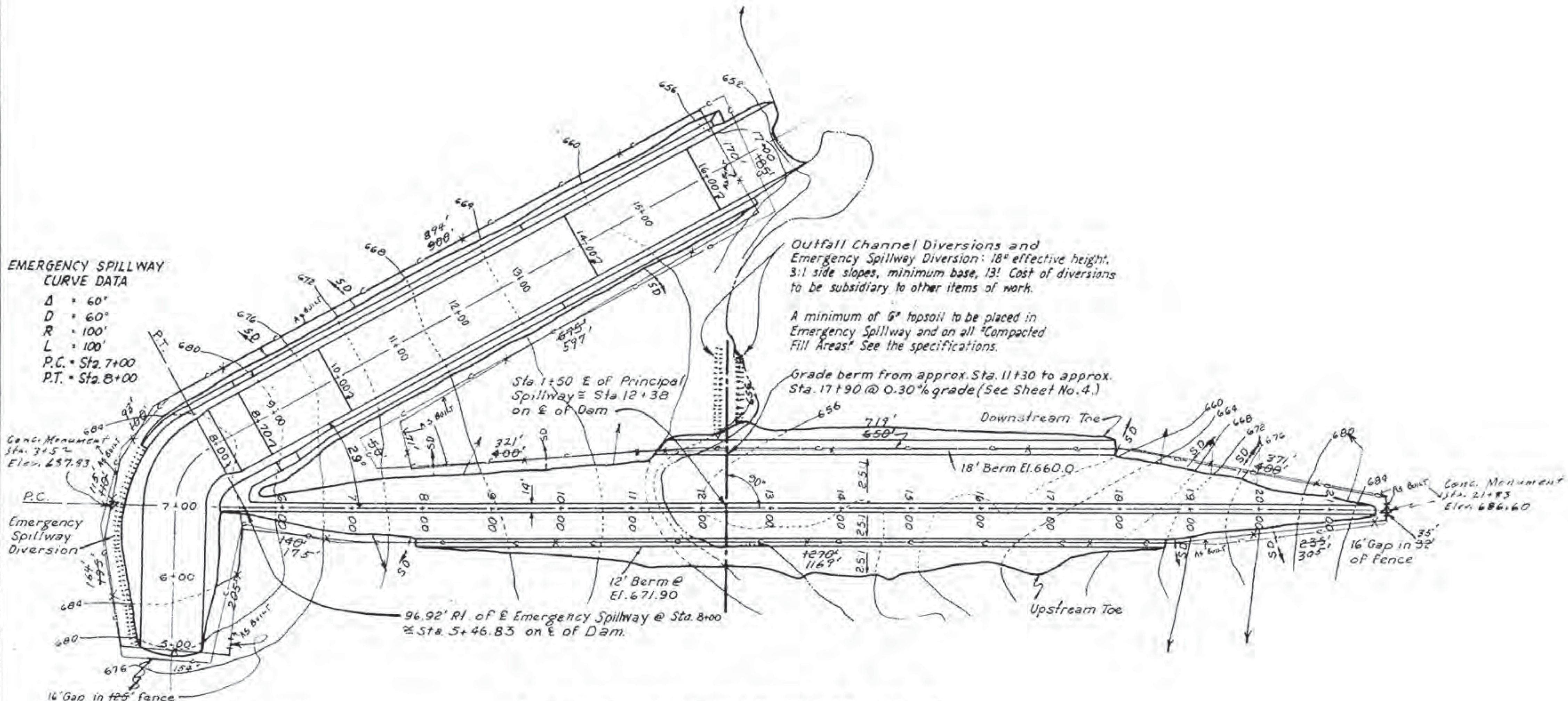
CONSTRUCTION DRAWINGS APPROVED

Howard Matson — 6/14/62
HEAD, ENGINEERING & WATERSHED PLANNING UNIT, FORT WORTH, TEXAS — Date

[signature] — 6/14/62
STATE CONSERVATION ENGINEER, S.C.S., TEMPLE, TEXAS — Date

Sheet	Drawing No.
No. 1 of 8	4-E-16,786

JUL 2 1962

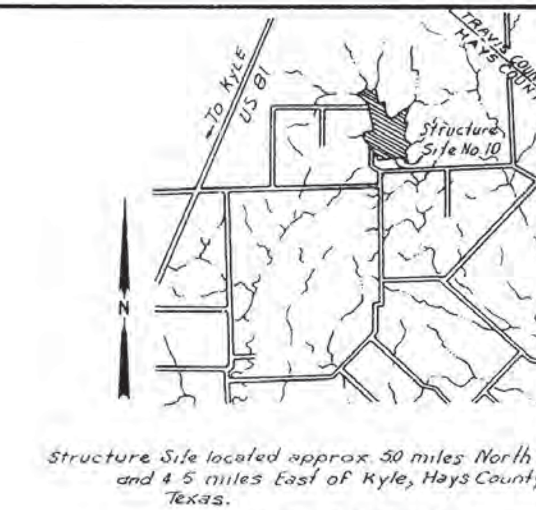


PLAN OF EMBANKMENT AND SPILLWAYS

SCALE IN FEET

FENCE LEGEND

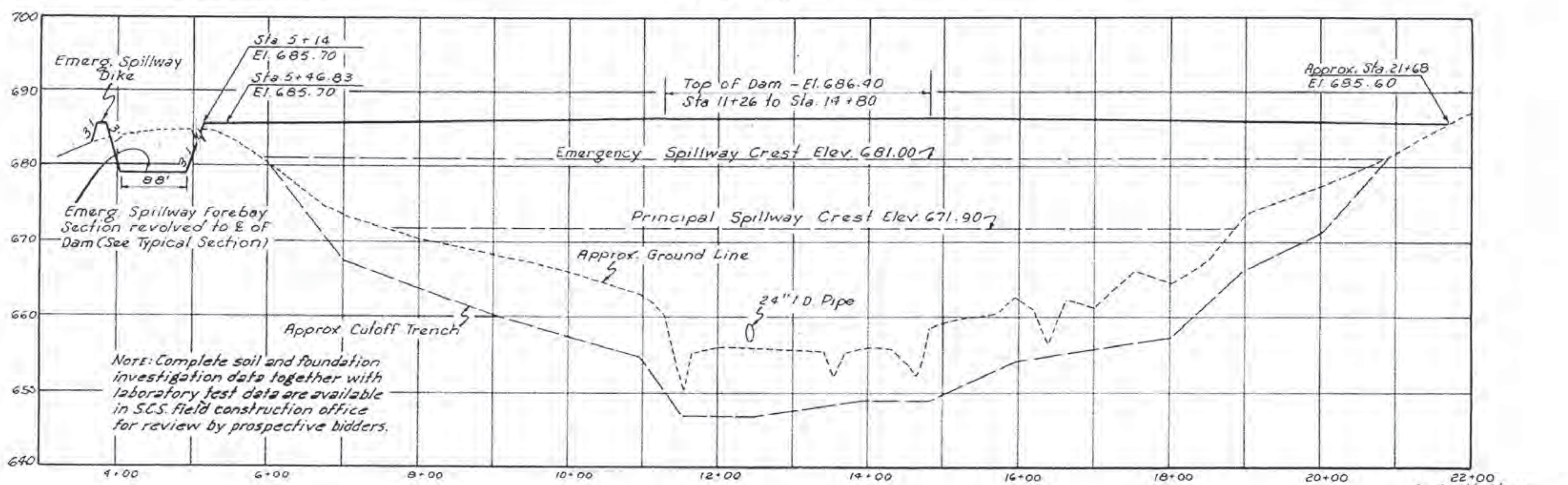
—c——c—— Fence to be constructed under this Contract



Structure Site located approx. 5.0 miles North and 4.5 miles East of Kyle, Hays County, Texas.

VICINITY MAP

SCALE IN MILES



PROFILE ON ℄ OF DAM

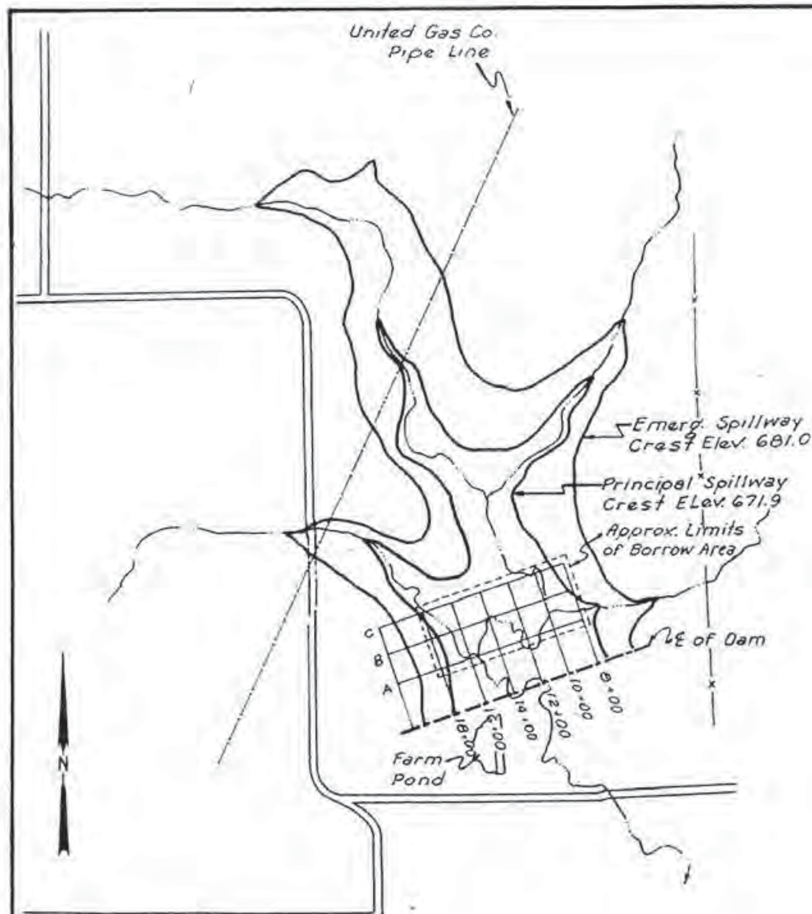
As Built Plans
Const. Comp. 5-14-63

EMBANKMENT PLAN AND PROFILE
FLOODWATER RETARDING STRUCTURE SITE No. 10
PLUM CREEK WATERSHED
IN
HAYS, CALDWELL AND TRAVIS COUNTIES, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

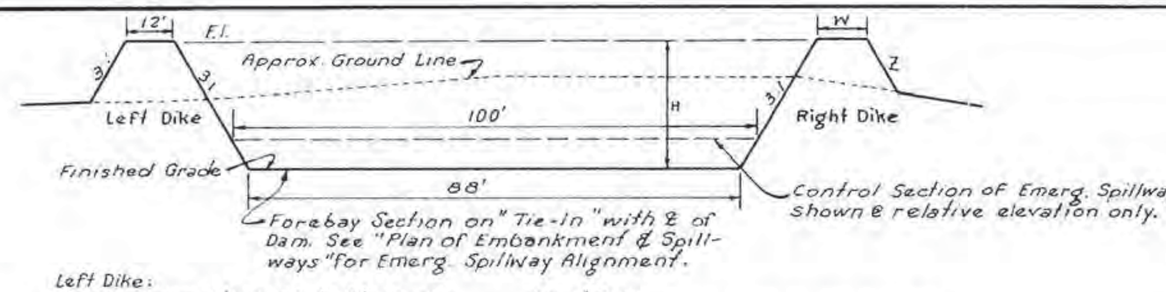
		Date	
Designed	G.J.M.	5-62	Approved by
Drawn	G.J.M. & O.L.S.	5-62	
Traced	O.L.S.	5-62	Sheet No. 2 of 8
Checked	G.J.M. & G.W.T.	6-62	Drawing No. 4-E-16,786

JUL 2 1962



GENERAL PLAN OF RESERVOIR

0 660 1320 1980 2640
SCALE IN FEET

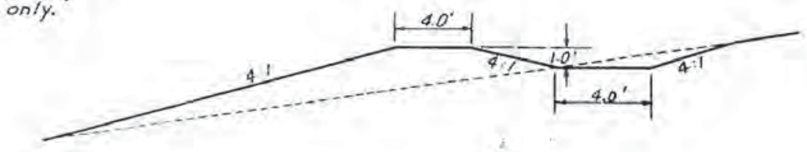


Left Dike:
From approx. Sta 7+50 to Sta. 8+70 @ El. 685.70.
Transition from Sta. 8+70 to Sta. 9+~~00~~58. From Sta 9+~~00~~58 to Sta. 13+40, H=3.0' above grade. Slope Dike Uniformly from Sta. 13+40 to Ground Line @ approximate Sta. 16+50, H=3'

Right Dike:
From approx. Sta. 7+50 to Sta. 8+70 @ El. 685.70, W=14'. Transition from Sta. 8+70 to Sta. 9+~~00~~58. From Sta. 9+~~00~~60 to Sta. 13+40; H=3.0' above grade, W=12', Z=3:1. Slope dike uniformly from Sta. 13+40 to Ground Line @ Approx. Sta. 16+50; H=3', W=12', Z=3:1

Material forming dikes to be placed and paid as "Compacted Fill."

TYPICAL SECTION - EMERGENCY SPILLWAY

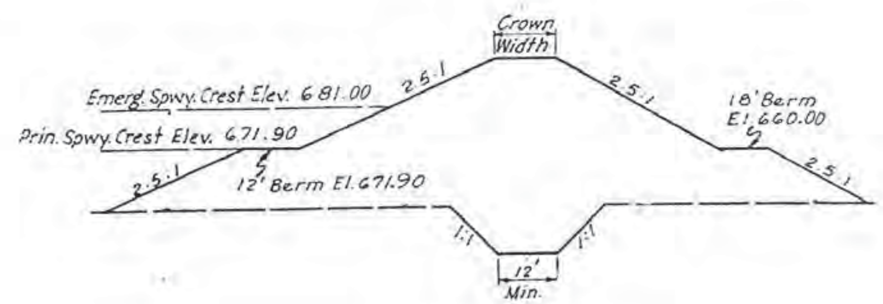


TYPICAL SECTION - STUB DIVERSIONS

MATERIAL PLACEMENT DATA								
SOURCE OF FILL MATERIAL			LAB. TEST		COMPACTION REQUIREMENTS			Lab. Curve
Location	Ave. Depth Feet		Modified		Min. Dry Density	Moisture Range		
			Max Dry Den.	Opt'm Moist	Lbs. Per Cu. Ft.	Percent		
	From	To				From	To	No.
Borrow-Comp. #2	0'	6'	116.0	14.5	98.5	14	Up	1
Borrow-Comp. #3	6'	13'	117.0	14.5	99.5	14	Up	2
Borrow-Comp. #1	0'	4'	(Like Curve No. 2)					
Emerg. Spwy.-Comp. #4	0'	2'	(Like Curve No. 2)					
" " " #5	2'	4'	(Like Curve No. 1)					
" " " #6	7'	10'	(Like Curve No. 2)					

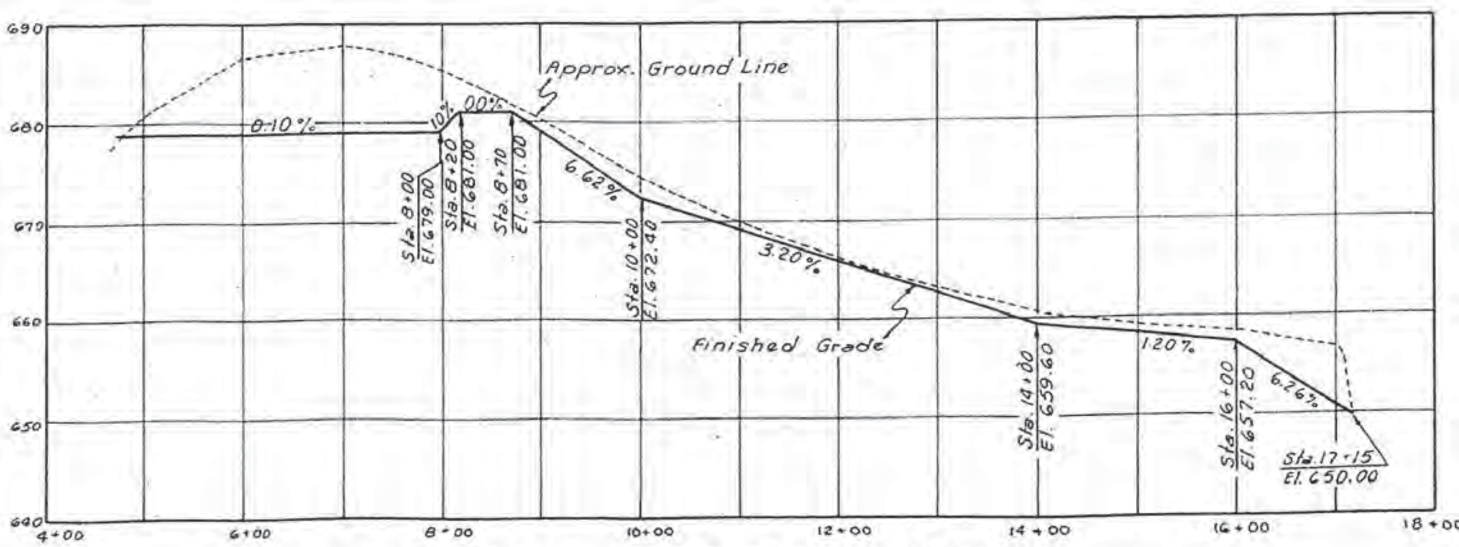
The Engineer will direct a selection and placement of all fill materials to produce a homogeneously placed Embankment.
No upward limits of placement moisture are established. Upward limits of placement moisture will be determined during construction by the engineer, based on the workability aspects of the materials being placed in the fill and the densities reached.

Maximum dry density, optimum moisture, minimum acceptable dry density and moisture range shown are for material particles passing the number 4 sieve. If the material being placed contains 1/4" or larger rock particles, the minimum acceptable dry density and moisture range will be corrected for the presence of rock.



TYPICAL SECTION

EMBANKMENT DATA



PROFILE ON ℄ OF EMERGENCY SPILLWAYS

ELEVATION	SURFACE ACRES	STORAGE	
		ACRE FEET	INCHES
656.0	0.0	0.0	0.00
660.0	3.8	7.6	0.07
664.0	8.6	32	0.32
668.0	17.3	84	0.83
671.9	33.5	183	1.82
672.0	33.9	187	1.85
676.0	63.1	381	3.78
680.0	89.4	686	6.80
681.0	96.1	779	7.73
684.0	116.2	1097	10.88
688.0	149.5	1628	16.15

Top of Dam (Effective) Elev.	685.6
Emergency Spillway Crest Elev.	681.0
Principal Spillway Crest Elev.	671.9
Sediment Pool Elev.	671.9
Drainage Area, Acres	1210
Sediment Storage, Acre Feet	201
Floodwater Storage, Acre Feet	578
Max. Emergency Spillway Cap., c.f.s.	2,478

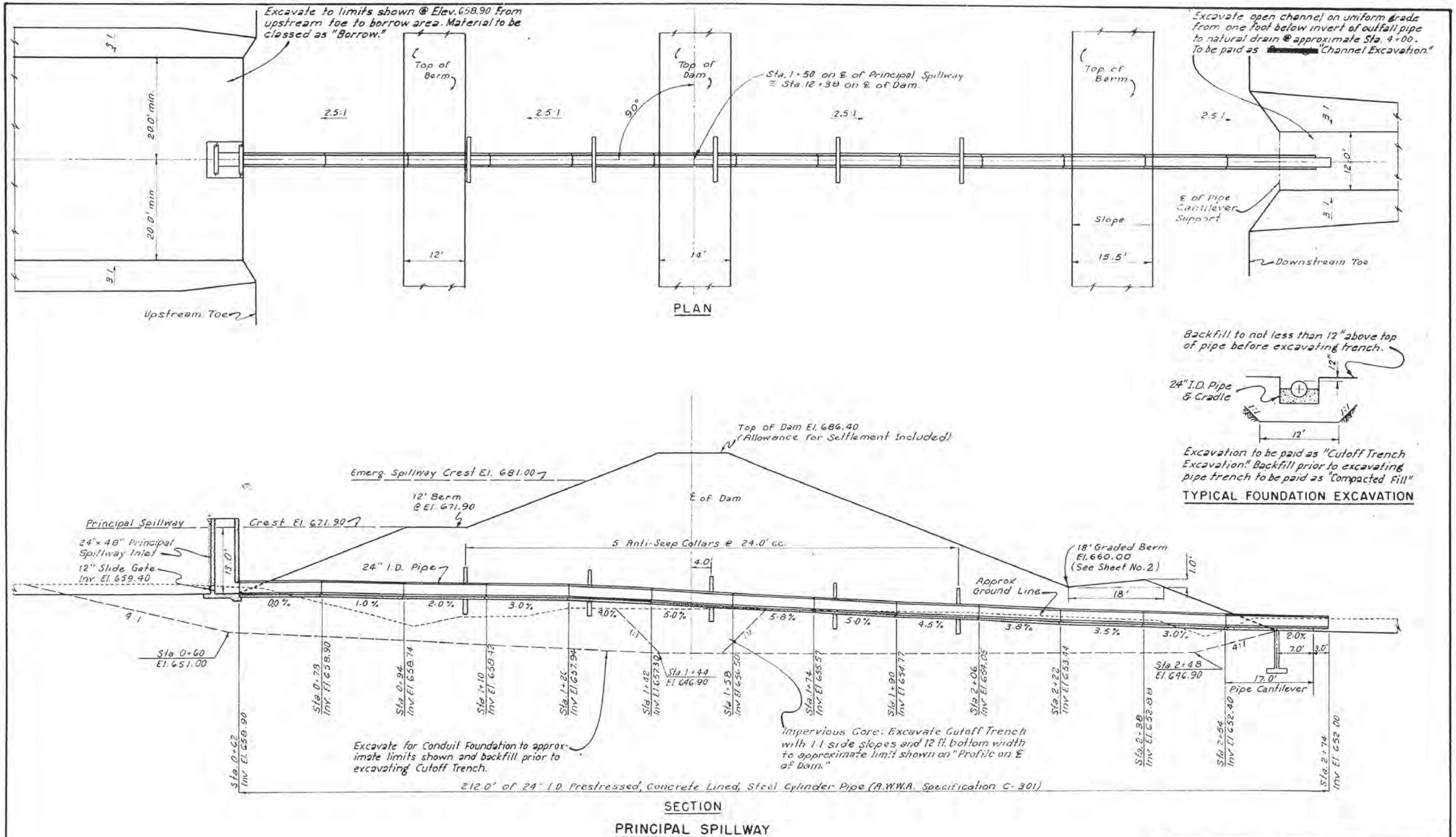
As Built Plans
Const. Comp. 5-14-63

GENERAL PLAN AND PROFILE
FLOODWATER RETARDING STRUCTURE SITE No. 10
PLUM CREEK WATERSHED
IN
HAYS, CALDWELL AND TRAVIS COUNTIES, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date		
Designed	G.J.M.	5-62	Approved by:	
Drawn	G.J.M. & O.L.S.	5-62	Fort Worth, Texas	
Traced	O.L.S.	5-62	Temple, Texas	
Checked	G.J.M. & G.W.T.	6-62	Sheet No. 3 of 8	Drawing No. 4-E-16,786

JUL 2 1962

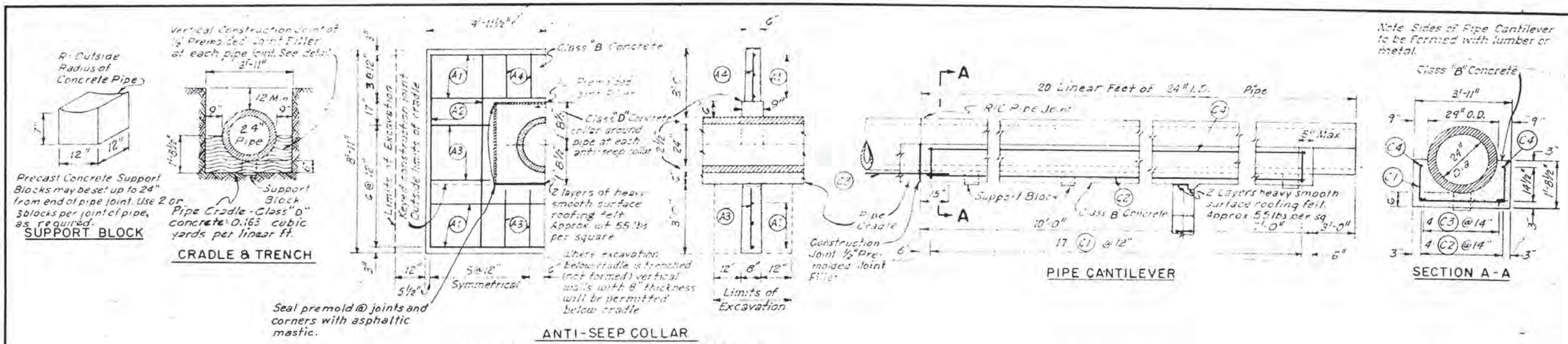


As Built Plans
Const. Comp. 5-14-63
No Change in Const.

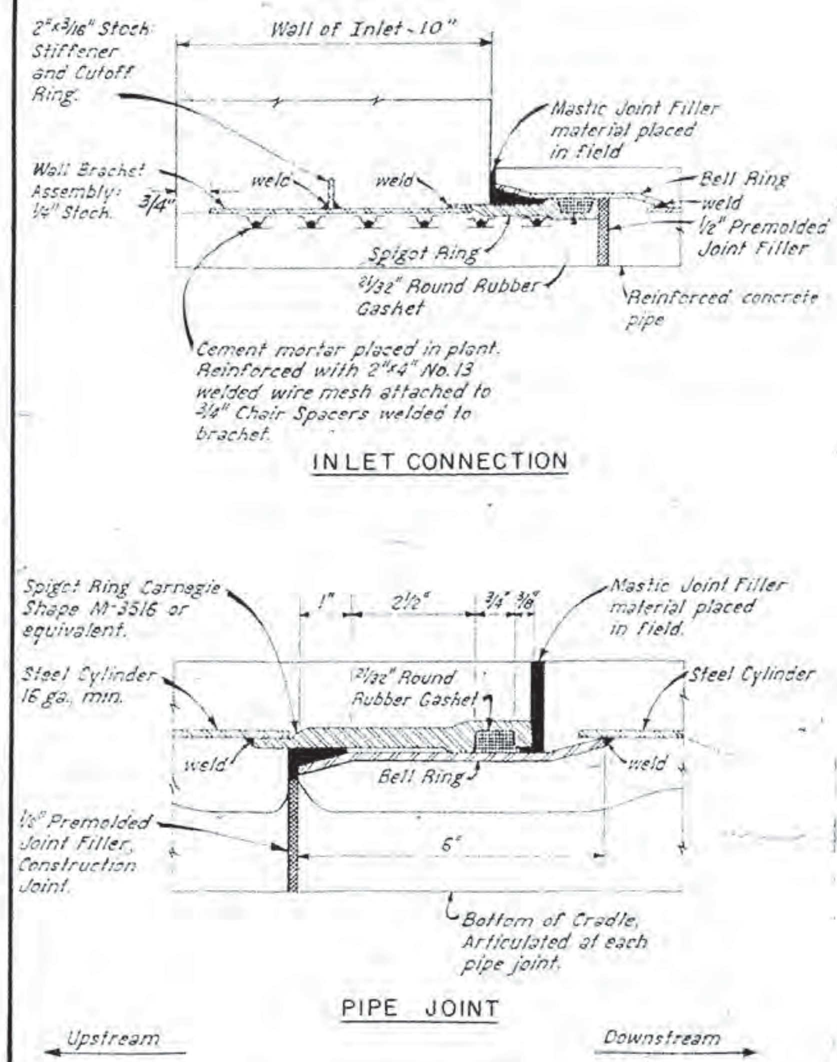
PRINCIPAL SPILLWAY—PLAN AND SECTION
FLOODWATER RETARDING STRUCTURE SITE No. 10
PLUM CREEK WATERSHED
IN
HAYS, CALDWELL AND TRAVIS COUNTIES, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

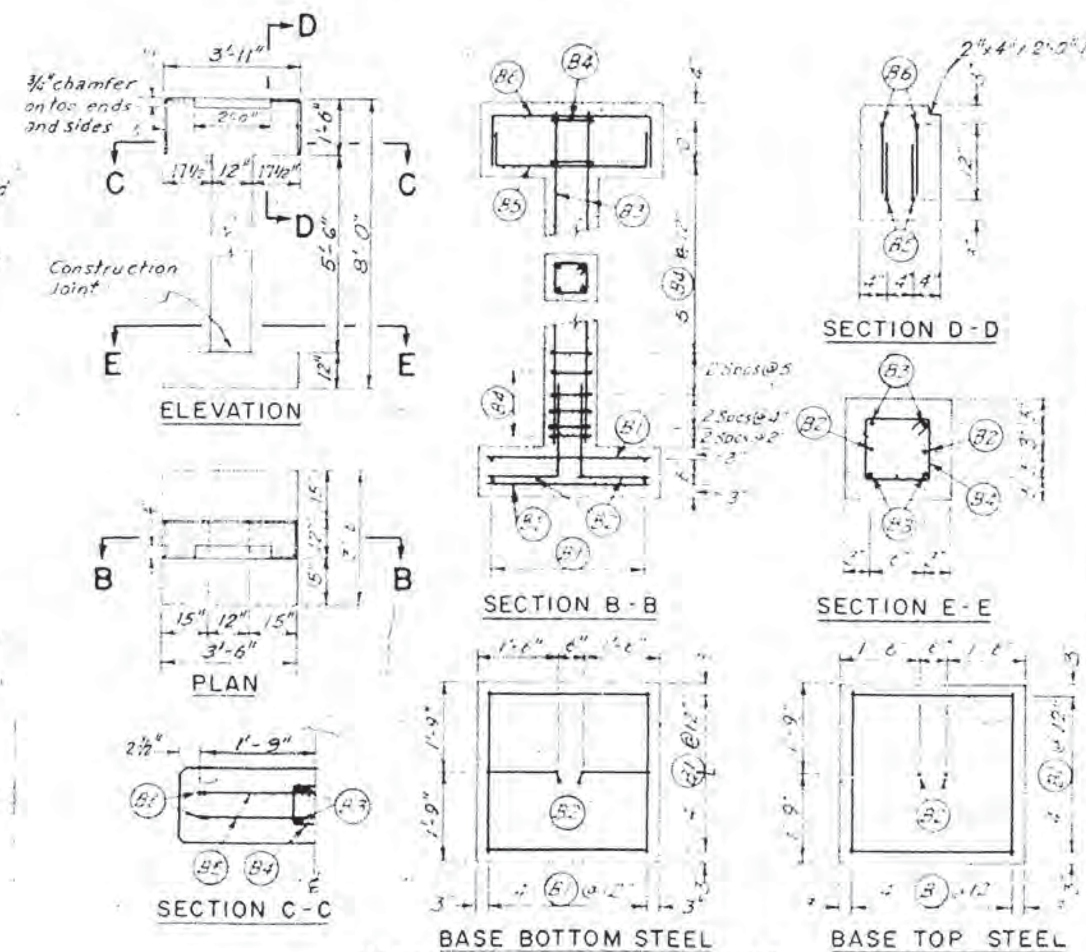
		Date	
Designed	G.J.M.	5-62	Approved by: HEAD ENGINEERING & WATERSHED PLANNING UNIT, FORT WORTH, TEXAS
Drawn	G.J.M. & O.L.S.	5-62	STATE CONSERVATION ENGINEER, S.C.S., TEMPLE, TEXAS
Traced	O.L.S.	5-62	Sheet No. 4 of 8
Checked	G.J.M. & G.W.T.	6-62	Drawing No. 4-E-16,786



CONCRETE PIPE PLACEMENT DETAILS



PIPE JOINT DETAILS



PIPE CANTILEVER SUPPORT

Note:
Premolded Joint Filler in principal spillway shall conform to either ASTM Spec. D1752-60T, Type I, II or III or ASTM Spec. D994, except that joint filler material conforming to ASTM Spec. D1751-60T, may be used to form the construction joints in the concrete cradle under the principal spillway conduit.

Note:
Pipe supplied will be manufactured in accordance with AWWA Specification C-301 and be prestressed concrete lined steel cylinder pipe, having a D-load capacity of not less than 3000 lbs. per linear foot at the 0.001" crack and an internal pressure head capacity equal to or greater than 50 feet.

As Built Plans
Const. Comp. 5-16-62
No Change in Const.

FOR TYPICAL BAR TYPES REFER TO ACI STANDARD 315-48

Bar No.	Location	Qty.	Lgth.	Total Length	Size	Type	A	B	C	D	E	F	G	H	J	O
A1	Anti-Seep Collar	6	9-3	55-6	4	Str										
A2		6	8-6	51-0	4											
A3		10	2-8	26-3	4											
A4		4	2-3	9-0	4											

Total Steel in One Anti-Seep Collar (Size 4) - 142'-2" = 94.97 lbs.
Total Class "B" Concrete in One Anti-Seep Collar = 1.62 cu yds

Bar No.	Location	Qty.	Lgth.	Total Length	Size	Type	A	B	C	D	E	F	G	H	J	O
B1	Cantilever Support	16	3-0	48-0	4	Str										
B2	" "	2	3-9	7-6	6	2	2-6	1-3								
B3	" "	4	6-9	27-0	6	Str										
B4	" "	11	3-2	34-10	3	T1	0-4	0-7½	0-7½	0-7½	0-7½		0-4			
B5	" "	2	4-11	9-10	4	2	0-9	3-5					0-9			
B6	" "	2	5-7	11-2	6	2	1-0	3-7					1-0			

Total Steel in Pipe Cantilever Support (Size # 3) = 34'-10" = 13.10 lbs.
Total Steel in Pipe Cantilever Support (Size # 4) = 57'-10" = 38.63 lbs.
Total Steel in Pipe Cantilever Support (Size # 6) = 45'-8" = 68.59 lbs.
Total Steel = 120.32 lbs.
Total Class "B" Concrete in Pipe Cantilever Support = 0.88 cu. yds.

Bar No.	Location	Qty.	Lgth.	Total Length	Size	Type	A	B	C	D	E	F	G	H	J	O
C1	Pipe Cantilever	17	5-11	100-7	4	S10		1-3	3-5	1-3						
C2		4	16-6	66-0	4	Str										
C3		4	5-0	20-0	4	Str										
C4		2	16-6	33-0	9	Str										

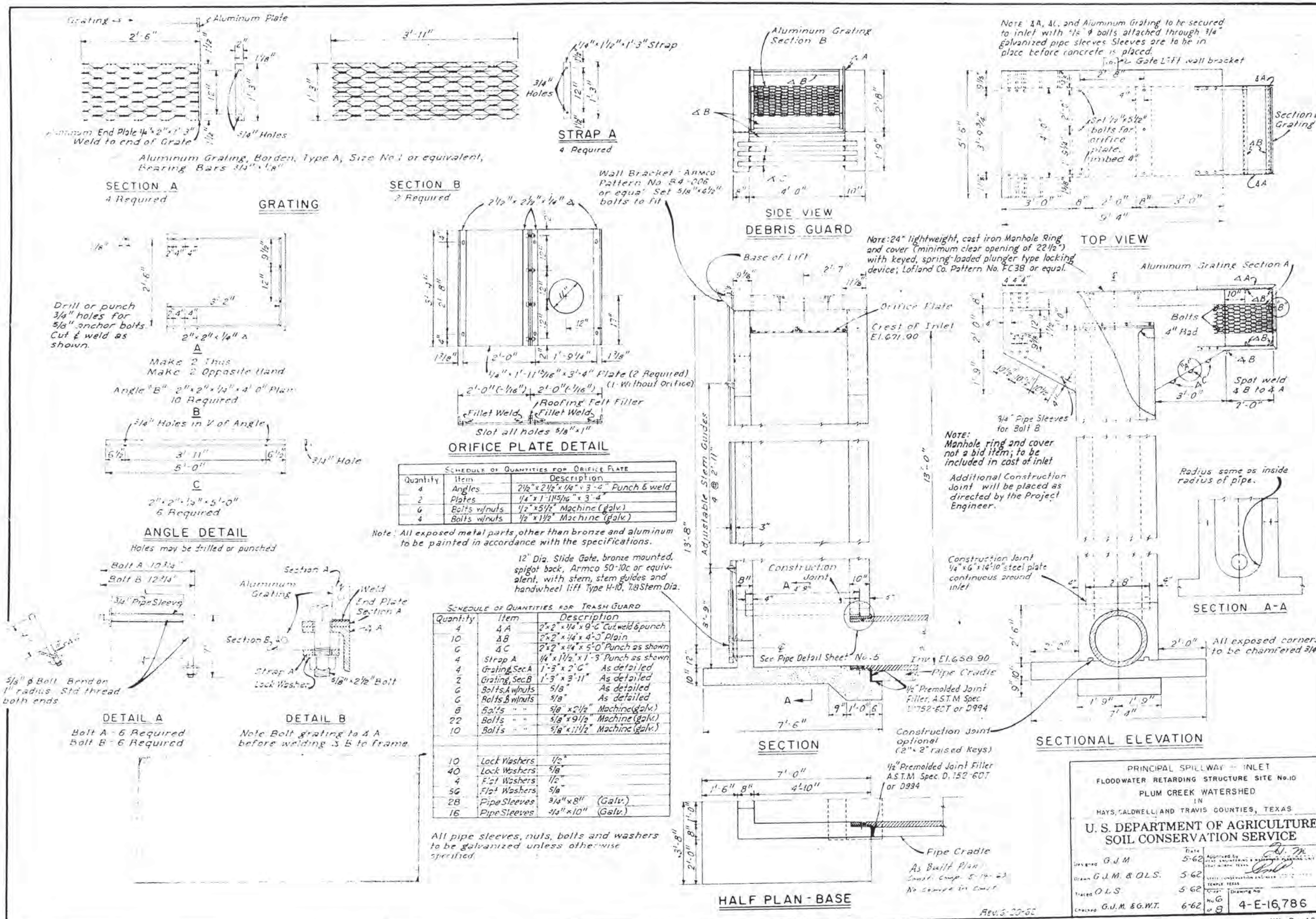
Total Steel in Pipe Cantilever Size # 4 - 186'-7" = 124.64 lbs.
Total Steel in Pipe Cantilever Size # 9 - 33'-0" = 112.20 lbs.
Total Steel = 236.84 lbs.
Total Class B Concrete in Pipe Cantilever = 2.77 cu yds.

Class "D" Concrete in Pipe Cradle = 31.30 Cu. Yds.
Class "D" Concrete in Anti-Seep Collars = 0.60 " "
Total Class "D" = 31.90 Cu. yds.

PIPE DETAILS
FLOODWATER RETARDING STRUCTURE SITE No. 10
PLUM CREEK WATERSHED
IN
HAYS, CALDWELL AND TRAVIS COUNTIES, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G.J.M.	Date 5-62	Approved by ________ Head, Engineering & Watershed Planning Unit, Fort Worth, Texas
Drawn G.J.M. & O.L.S.	5-62	State Conservation Engineer, S.C.S., Temple, Texas
Traced O.L.S.	5-62	Sheet No. 5 of 8
Checked G.J.M. & G.W.T.	6-62	Drawing No. 4-E-16,786



SCHEDULE OF QUANTITIES FOR ORIFICE PLATE

Quantity	Item	Description
4	Angles	2 1/2" × 2 1/2" × 1/4" × 3'-4" Punch & weld
2	Plates	1/4" × 1'-11 5/16" × 3'-4"
6	Bolts w/nuts	1/2" × 5 1/2" Machine (galv.)
4	Bolts w/nuts	1/2" × 1 1/2" Machine (galv.)

Note: All exposed metal parts, other than bronze and aluminum to be painted in accordance with the specifications.

SCHEDULE OF QUANTITIES FOR TRASH GUARD

Quantity	Item	Description
4	∠A	2"×2"×1/4"×9'-6" Cut, weld & punch
10	∠B	2"×2"×1/4"×4'-3" Plain
6	∠C	2"×2"×1/4"×5'-0" Punch as shown
4	Strap A	1/4"×1 1/2"×1'-3" Punch as shown
4	Grating Sec. A	1'-3"×2'-6" As detailed
2	Grating, Sec. B	1'-3"×3'-11" As detailed
6	Bolts A w/nuts	5/8" As detailed
6	Bolts B w/nuts	5/8" As detailed
8	Bolts " "	5/8"×2 1/2" Machine (galv.)
22	Bolts " "	5/8"×9 1/2" Machine (galv.)
10	Bolts " "	5/8"×11 1/2" Machine (galv.)
10	Lock Washers	1/2"
40	Lock Washers	5/8"
4	Flat Washers	1/2"
56	Flat Washers	5/8"
28	Pipe Sleeves	3/4"×8" (Galv.)
16	Pipe Sleeves	3/4"×10" (Galv.)

All pipe sleeves, nuts, bolts and washers to be galvanized unless otherwise specified.

PRINCIPAL SPILLWAY — INLET
FLOODWATER RETARDING STRUCTURE SITE No.10
PLUM CREEK WATERSHED
IN
HAYS, CALDWELL AND TRAVIS COUNTIES, TEXAS

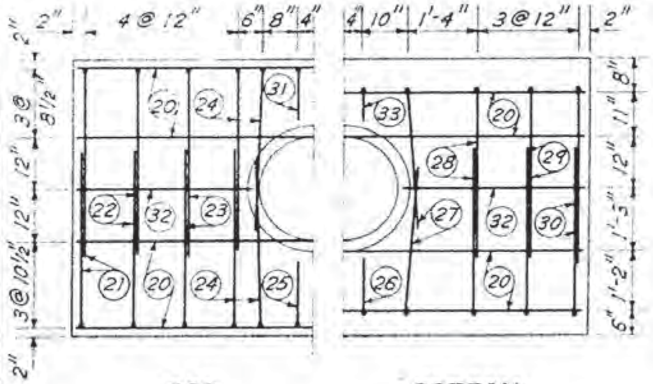
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	G.J.M.	5-62
Drawn	G.J.M. & O.L.S.	5-62
Traced	O.L.S.	5-62
Checked	G.J.M. & G.W.T.	6-62

Approved by: Head, Engineering & Watershed Planning Unit, Fort Worth, Texas
State Conservation Engineer, Temple, Texas

Sheet No. 6 of 8
Drawing No. 4-E-16,786

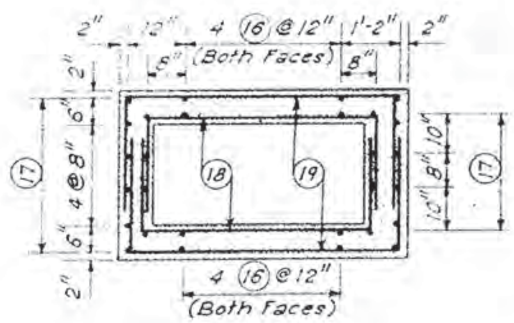
JUL 2 1962



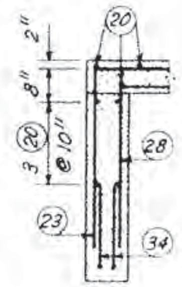
TOP BOTTOM

PLAN

ANTI-VORTEX DECK



SECTION A-A

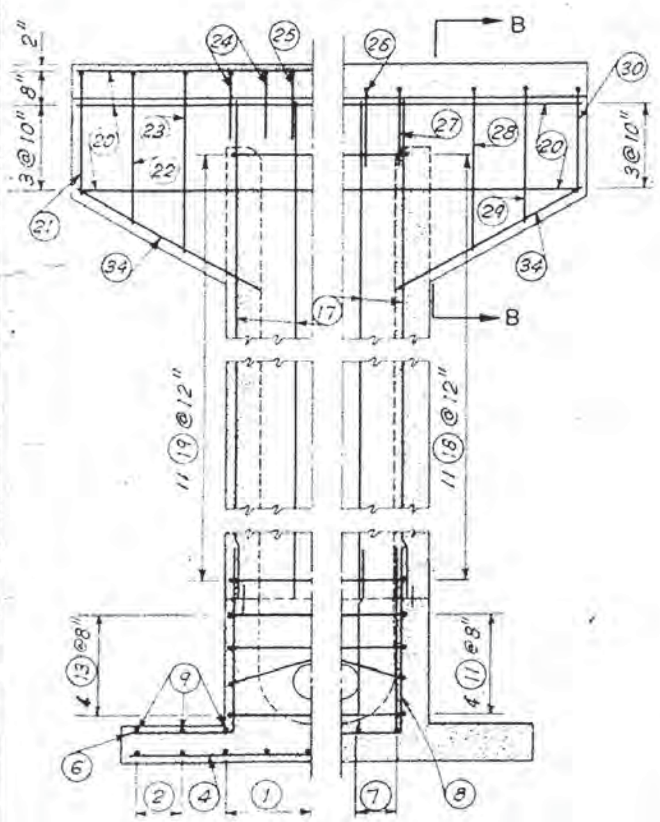


SECTION B-B

FOR TYPICAL BAR TYPES REFER TO A.C.I STANDARDS 315-48

No.	Qty	Lgth.	Total Lgth.	Size	Type	A	B	C	D	G	J	O
1	5	5-0	25-0	5	See Detail							
2	9	6-10	61-6	5	Str.							
3	2	3-2	6-4	5	Str.							
4	9	7-0	63-0	5	Str.							
5	6	5-6	33-0	5	2	1-6	4-0					
6	14	6-0	84-0	5	2	2-0	4-0					
7	4	8-9	35-0	5	2	4-9	4-0					
8	10	6-0	60-0	5	2	2-0	4-0					
9	6	6-10	41-0	5	Str.							
10	2	7-0	14-0	5	Str.							
11	8	5-9	54-0	5	2	2-0	4-9					
13	8	7-6	60-0	5	2	2-4	5-2					
16	16	10-4	165-4	4	Str.							
17	20	11-4	226-8	4	Str.							
18	22	8-1	177-10	4	2	1-10	4-5			1-10		
19	22	9-6	209-0	4	2	2-2	5-2			2-2		
20	22	9-0	198-0	4	Str.							
21	4	5-7	22-4	4	2	2-4	3-3					
22	4	6-3	25-0	4	2	3-0	3-3					
23	4	6-10	27-4	4	2	3-7	3-3					
24	8	4-5	35-4	4	2	1-2	3-3					
25	2	2-11	5-10	4	2	1-2	1-9					
26	2	2-7	5-2	4	2	1-2	1-5					
27	4	4-0	16-0	4	2	1-2	2-10					
28	4	6-1	24-4	4	2	3-3	2-10					
29	4	5-6	22-0	4	2	2-8	2-10					
30	4	4-10	19-4	4	2	2-0	2-10					
31	2	2-7	5-2	4	2	1-2	1-5					
32	4	3-6	14-0	4	Str.							
33	2	2-2	4-4	4	2	1-2	1-0					
34	8	4-0	32-0	4	Str.							

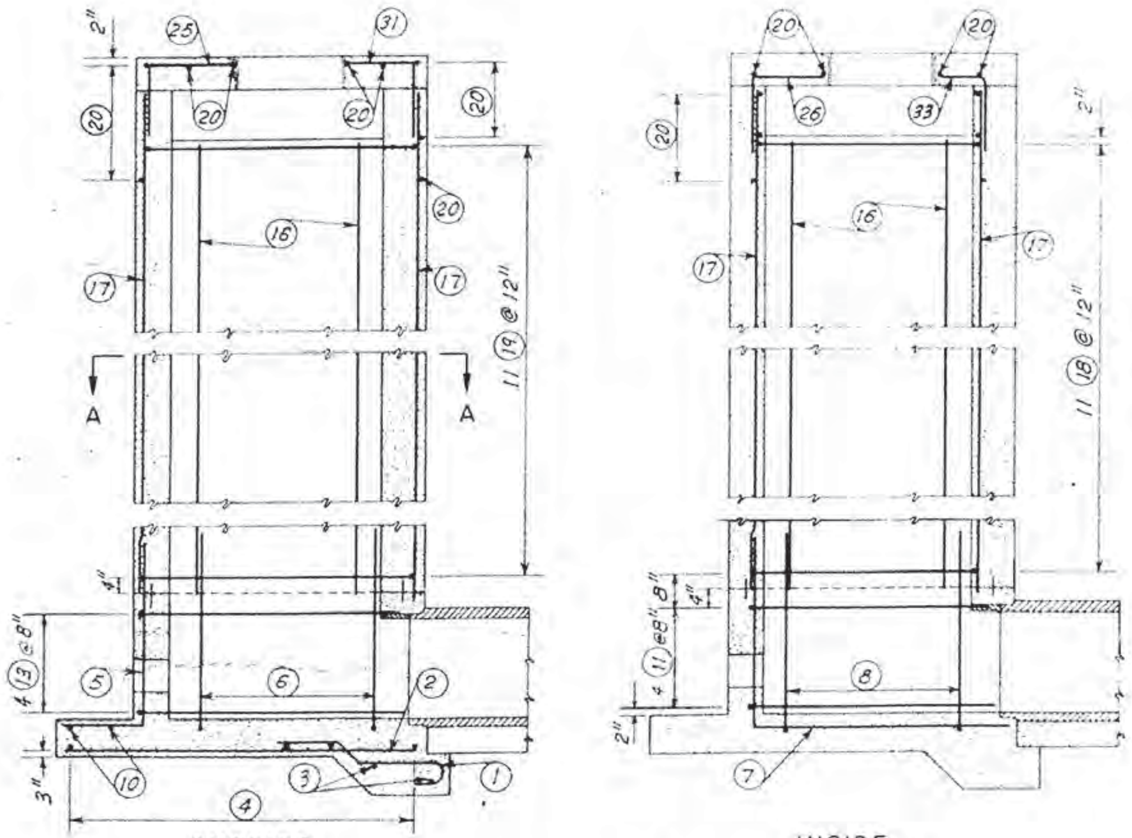
Total Size 4 Steel in Prin Spwy Inlet =1235'-0"=824.98 lbs.
Total Size 5 Steel " " " " =536'-10"=559.92 lbs.
Total Steel in Prin. Spwy. Inlet = 1384.90 lbs.
Total Class "B" Conc. in Prin. Spwy. Inlet = 8.99 cu.yds.



OUTSIDE INSIDE

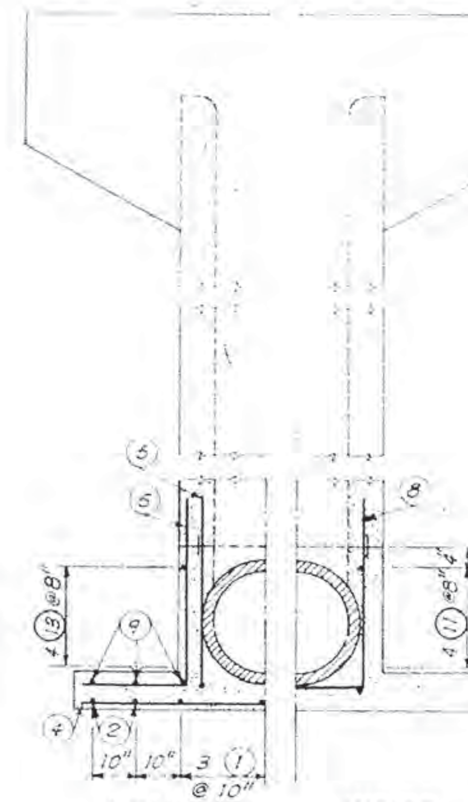
HALF SECTIONS

(UPSTREAM)



OUTSIDE INSIDE

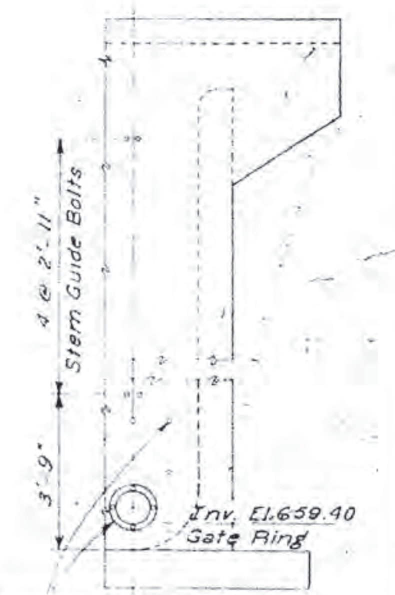
SECTION ALONG ℄



OUTSIDE INSIDE

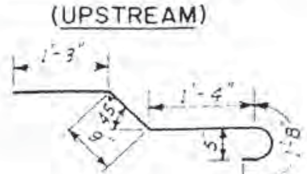
HALF SECTIONS

(DOWNSTREAM)

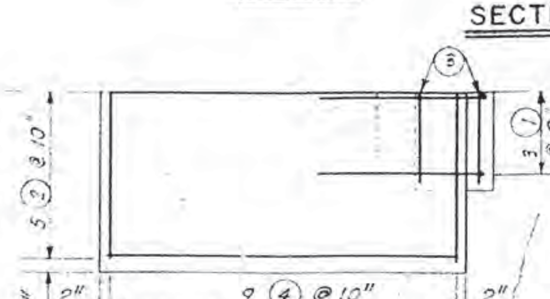


Set anchor bolts to fit gate and ring for Armco bronze mounted, spigot back, slide gate No. 50-10.c or equivalent.

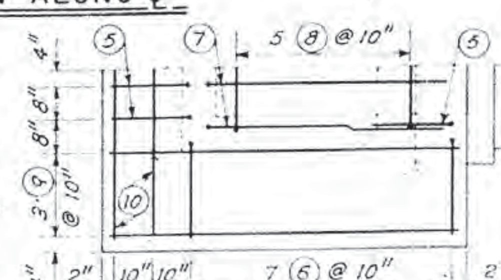
SLIDE GATE



DETAIL BAR NO. 1



BOTTOM



TOP

FOUNDATION SLAB

Note: All steel to have a minimum of 2" cover from exposed surfaces, unless otherwise specified.

As Built Plans
Const. Comp. 5-14-62
No Change in Const.

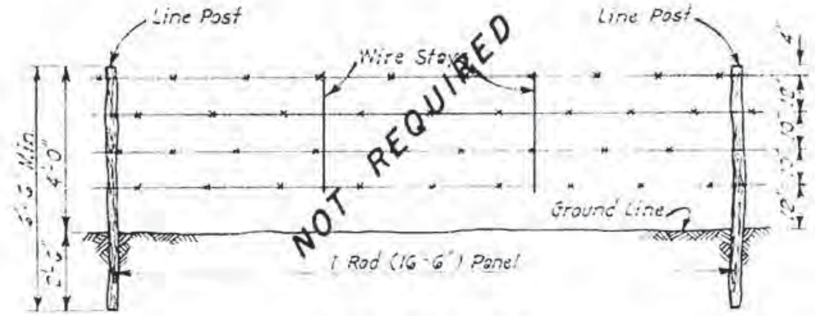
STEEL PLACEMENT - PRINCIPAL SPILLWAY INLET
FLOODWATER RETARDING STRUCTURE SITE No. 10
PLUM CREEK WATERSHED
IN
HAYS, CALDWELL AND TRAVIS COUNTIES, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G.J.M.	Date 5-62	Approved by [signature] HEAD, ENGINEERING & WATERSHED PLANNING UNIT, FORT WORTH, TEXAS
Drawn G.J.M. & O.L.S.	5-62	[signature] STATE CONSERVATION ENGINEER S.C.S., TEMPLE, TEXAS
Traced O.L.S.	5-62	Sheet No. 7 of 8
Checked G.J.M. & G.W.T.	6-62	Drawing No. 4-E-16,786

JUL 2 1962

Note: Wire stays to be 10 ga. (min. size), galv. two strand spiral, twist-on type. Length to extend from top fence strand to 3" below bottom fence strand for barbed wire fences and from top strand to 3" below the second strand of the woven wire for woven wire fences. Wire stays to be spaced equally, two stays per line post panel. Stays to be twisted firmly against top strand.

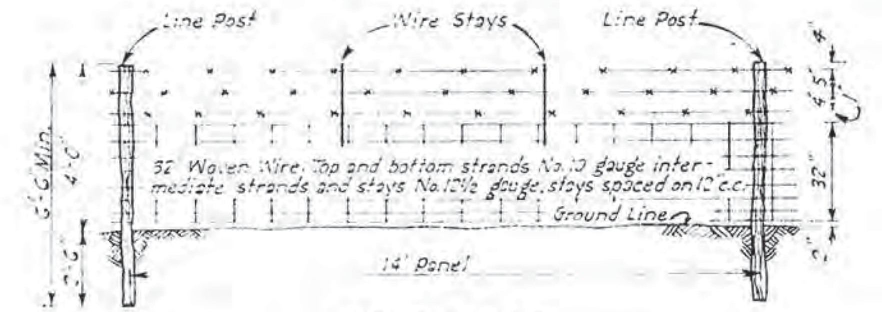


BARBED WIRE

Barbed wire to be 12½ ga. galv., double strand barbed wire with 14 ga. 2 point barbs at 4" o.c. Staples to be 9 ga. galv., 1½" minimum length for treated pine and cedar posts and 1" minimum length for bois d'arc.

Note:
For Barbed Wire, Galvanizing shall conform to A.S.T.M. Specification A-121 Class I coating.

For Woven Wire, Galvanizing shall conform to A.S.T.M. Specification A-116, Class I coating.

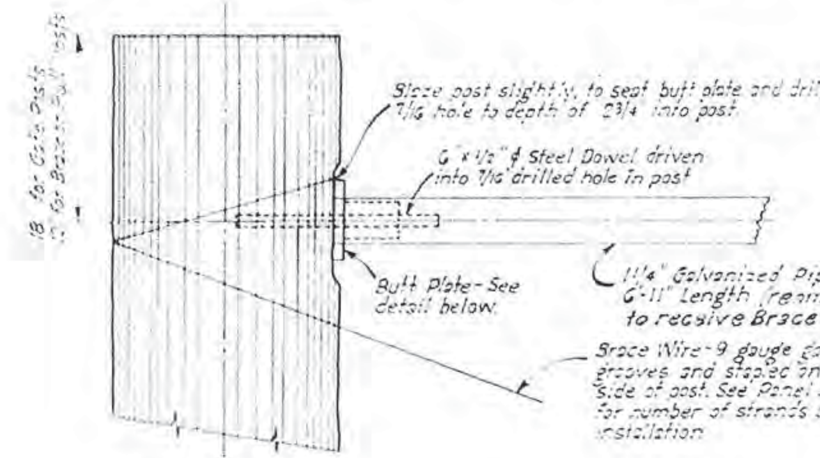


WOVEN WIRE

Minimum Post Size	
Corner & Brace	Cedar, 8" dia. Treated Pine, 6" dia. Bois d'arc, 6" dia.
Line Posts	Cedar, 4" dia. Treated Pine, 3" dia. Bois d'arc, 3" dia. Other, see specifications
Gate Posts	Treated Pine, 5" dia.

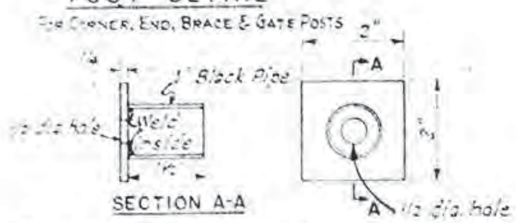
Note: Ash Juniper is considered as meeting the requirements of the specifications for cedar posts. Creosote-Coal Tar Solution will be used for treatment of pine posts. **Steel posts not acceptable.**

Note: Woven wire fencing shall be as shown above, excepting through the reach along the upstream berm. Through this reach, one of the upper barbed wire strands shall be deleted from the top and located below the woven wire panel as directed by the Engineer. A pull panel at the terminal ends of the berm will be required.



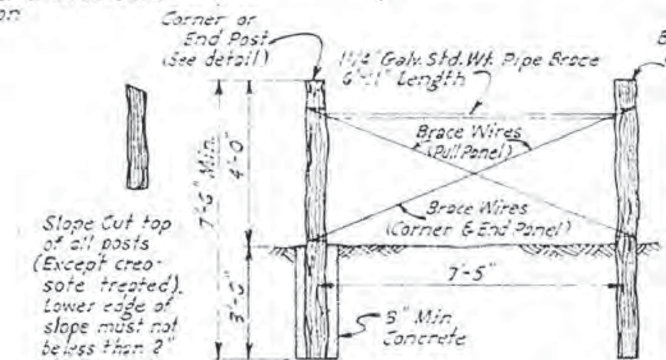
POST DETAIL

For Corner, End, Brace & Gate Posts



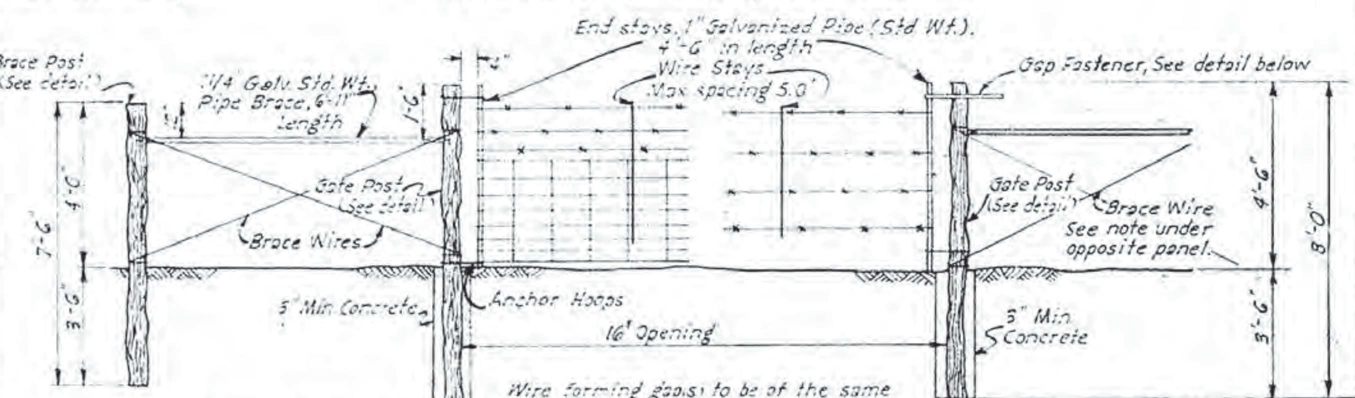
Brace Butt Plate of plate steel 2 x 2 x ¼"; ½" dia. hole drilled in center, with thimble of 1" dia. black steel pipe, 1½" long, welded to plate; weld to be inside of pipe with pipe concentrically centered with the ½" drilled hole in the plate.

BRACE BUTT PLATE



CORNER, END, OR PULL PANEL

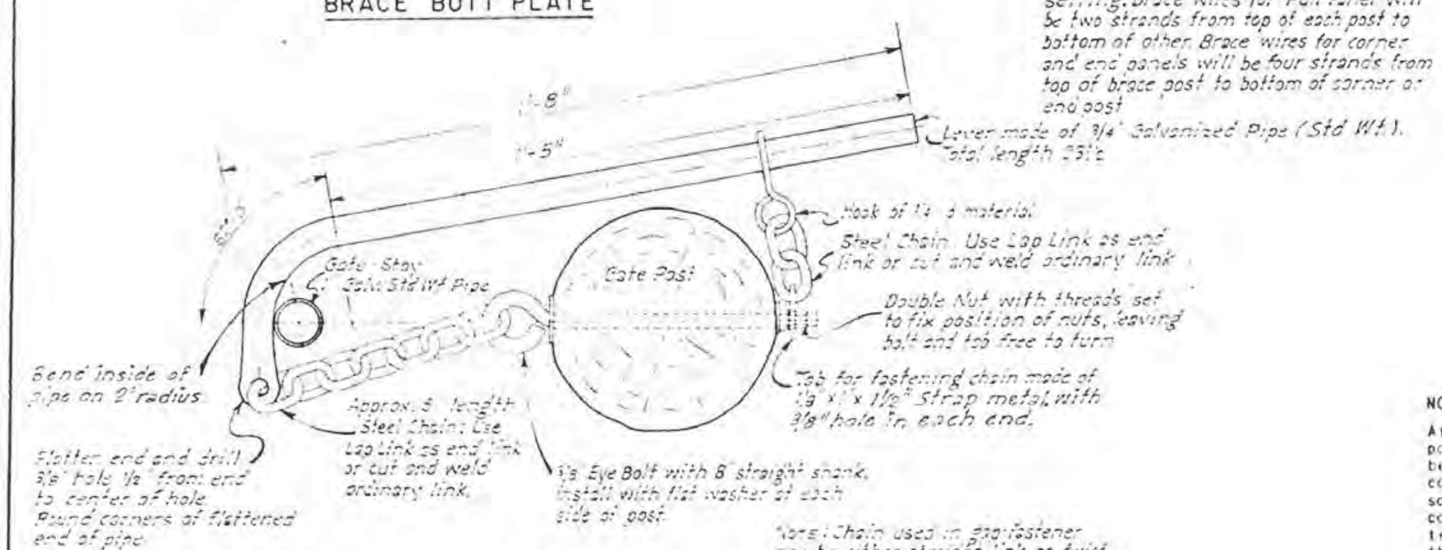
Pull panel does not require concrete setting. Brace wires for Pull Panel will be two strands from top of each post to bottom of other. Brace wires for corner and end panels will be four strands from top of brace post to bottom of corner or end post.



Where fence extends in line left or right of Gate Panel, Brace Wires for Gate Panel will be four strands from top of Brace Post to bottom of Gate Post. Where there is no pull of line fence (that is, the Gate Panel is at a corner), Brace Wires for the Gate Panel will be two strands from top of each post to bottom of other.

Wire forming gap(s) to be of the same type and spacing as the regular fence. Wire to be double wrapped around end stays and secured in place by drilling 1/4" holes at bottom and top strands of woven wire and at each strand of barbed wire, tying these strands with 14 gauge galvanized wire through the holes. Anchor hoops to be two strands of 9 gauge wire stapled at the back side of the gate post.
2 Gap(s) required.

WIRE GAP PANEL



WIRE GAP FASTENER DETAIL

Note: Chain used in gap fastener may be either straight link or twist link chain; material size from 1/8 to 3/16; links per foot from 10 to 18; wt. per foot from 0.1 to 0.5 lbs. Weldless wire-twist chain will not be permitted.

FENCE DETAILS

NOTE:

At changes in vertical alignment, such as crossings of stub diversions, line posts or pull-panel posts that restrain upward pull of the fence strands shall be anchored by setting such posts in concrete, with a minimum 3" thickness of concrete at the ground surface and a minimum 6" at the bottom of the post hole, so as to provide a minimum 3-inch taper to the outside surface of the embedding concrete. The engineer will designate the post locations where this anchorage treatment is required. In addition, anchorage of fence wires to posts where there is change in vertical alignment that produces upward or downward pull, shall be accomplished with a special tie-wire, in addition to stapling. A tie-wire of a strand of No. 9 smooth galvanized wire shall be secured to the post with two wraps and tie 3" above the top fence wire (where the pull is downward) or 6" below the bottom fence wire (where the pull is upward) and shall be extended to each successive fence wire, securing each in position by two close drawn wraps. The engineer will designate the posts where this special fastening of the fence wires is required.

As Built Plans
Const. Comp. 5-14-63
No Change in Const.

FENCE DETAILS

FLOODWATER RETARDING STRUCTURE SITE No. 10

PLUM CREEK WATERSHED
IN
HAYS, CALDWELL AND TRAVIS COUNTIES, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	G.J.M.	5-62	Approved by: Head, Engineering & Watershed Planning Unit, Fort Worth, Texas
Drawn	G.J.M. & O.L.S.	5-62	State Conservation Engineer S.C.S., Temple, Texas
Traced	O.L.S.	5-62	
Checked	G.J.M. & G.W.T.	6-62	Sheet No. 8 of 8 — Drawing No. 4-E-16,786

JUL 2 1962

APPENDIX B

Site Photographs

	
PHOTO NO. 1	**DESCRIPTION:** View of dam crest, facing east 1/18/2018
	
PHOTO NO. 2	**DESCRIPTION:** View of downstream slope from left abutment/emergency spillway, facing east 1/18/2018

Photo No.	**Description:**
3	View of upstream slope, from east impoundment (borrow) area, facing south. 1/18/2018

Photo No.	**Description:**
4	Dam crest from right abutment, facing west. 1/18/2018

PHOTO NO. 5	**DESCRIPTION:** Drilling B-603, facing west. 1/23/2018

PHOTO NO. 6	**DESCRIPTION:** Drill crew for B-301, as viewed from B-604. 1/24/2018

PHOTO NO. 7	**DESCRIPTION:** Drilling B-151, facing north 1/25/2018

PHOTO NO. 8	**DESCRIPTION:** Drilling borrowing boring B-152, facing southeast. 1/25/2018

APPENDIX C

Boring Logs

LOG OF BORING NO. B-301

LATTITUDE: 30.063136
LONGITUDE: -97.800261

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	POCKET PEN, tsf / Blows/ft. / REC./RQD, %	STRATUM DESCRIPTION (SURF. ELEVATION: 685±)	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
0-1	P=4.5+	Brown, tan and gray FAT CLAY with Sand, very stiff, w/scattered gravel. CH (Fill)		23						
2-3	P=3.25			22						
4-5	P=4.5+			17						
6-7	P=4.5+			17						
9-10	P=4.5+			19					110	6.5(U)
10-11	P=4.5+			17						
13-14	P=4.5+			20						
19-20	P=4.0			23	57	24	33	84		
23-24	P=2.75			25						
29-30	P=2.75			29					97	3.4(U)
33-34	P=2.75			24						
34-35				25	69	24	45	86		
35-38		- moist from 35 to 38 ft								
38-39			646.5 / 38.5	35						
39-40	P=3.5			19						

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COMPLETION DEPTH: 55.0
DATE DRILLED: 1-24-18
WATER LEVEL / SEEPAGE:
UPON COMPLETION:

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 1a

LOG OF BORING NO. B-301

LATTITUDE: 30.063136
LONGITUDE: -97.800261

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	SYMBOL	SAMPLES	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
				SURF. ELEVATION: 685±								
				Tan and gray FAT CLAY, very stiff, moist, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap) *(continued)*	643.0 42.0							
45			N=38-50/6"	Gray CLAYSHALE, soft, fissile, w/silt and sand partings. (Pecan Gap) *- moist at 44 ft*		14						
50			N=46-50/2"			13						
55			N=50/6"		630.0 55.0	13						
60												
65												
70												
75												

NOTES:
1. Boring was drilled dry to the 55 ft depth, and groundwater was not encountered. Moist soil conditions are noted at the 35 ft depth.
2. The boring was advanced using a truck mounted CME 75.
3. The boring was backfilled with a mixture of soil cuttings and bentonite.

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COMPLETION DEPTH: 55.0
DATE DRILLED: 1-24-18
WATER LEVEL / SEEPAGE:
UPON COMPLETION:

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

LOG OF BORING NO. B-601

LATTITUDE: 30.063435
LONGITUDE: -97.798736

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

SURF. ELEVATION: 674±

DEPTH, FT	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
0–11	P=1.5, P=0.75, P=0.75, P=3.25, P=3.25	Brown, tan and gray FAT CLAY with Sand, firm to very stiff, w/calcarous particles and scattered gravel. CH (Fill)	663.0 / 11.0							
~6				26	61	20	41	54		
~9				22					105	3.8(U)
11–20	P=0.75, P=4.5+, P=4.5+	Tan and gray FAT CLAY, firm to hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)	654.0 / 20.0							

NOTES:
1. Boring was advanced dry to the 20-ft depth, and the borehole was dry upon completion.
2. After 24 hrs, groundwater was measured at the 10.5 ft depth, and the borehole caved at the 13.5 ft depth.
3. Soil samples were obtained using direct-push geoprobe and auger cuttings.

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COMPLETION DEPTH: 20.0
DATE DRILLED: 1-23-18
WATER LEVEL / SEEPAGE:
UPON COMPLETION:

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 2

LOG OF BORING NO. B-602

LATTITUDE: 30.063302
LONGITUDE: -97.799150

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

SURF. ELEVATION: 668±

DEPTH, FT	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
0–9	P=0.75	Brown, tan and gray FAT CLAY with Sand, firm to very stiff, w/calcarous particles and scattered gravel. CH (Fill)								
				39	77	27	50	79		
	P=0.5									
5	P=1.0									
				29					98	1.2(U)
	P=2.5									
		- calcareous, w/gravel from 8 to 9 ft	659.0 / 9.0							
9–20	N=12	Tan and gray FAT CLAY, very stiff to hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)								
				22					106	3(U)
	P=4.5+									
	P=4.5+		648.0 / 20.0							

NOTES:
1. Boring was advanced dry to the 20-ft depth, and the borehole was dry upon completion.
2. After 24 hrs, groundwater was measured at the 0.5 ft depth, and the borehole caved at the 10-ft depth.
3. Soil samples were obtained using direct-push geoprobe and auger cuttings.

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COMPLETION DEPTH: 20.0
DATE DRILLED: 1-23-18
WATER LEVEL / SEEPAGE:
UPON COMPLETION:

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

LOG OF BORING NO. B-603

LATTITUDE: 30.063089
LONGITUDE: -97.799743

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

SURF. ELEVATION: 664±

DEPTH, FT	POCKET PEN, tsf / Blows/ft. / REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
0–9	P=1.0	Brown, tan and gray FAT CLAY with Sand, stiff to very stiff, w/calcarous particles and scattered gravel. CH (Fill)								
	P=1.25			30					91	1.3(U)
5	P=2.0									
	P=3.75	*- calcareous, w/gravel from 7 to 8.5 ft*								
			655.0 / 9.0	16	50	15	35	73		
9–20	P=3.25	Tan and gray FAT CLAY, very stiff to hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)								
10	P=4.5+			22	60	21	39	85		
	P=4.5+			18					114	7.3(U)
15										
	N=43		644.0 / 20.0							
20–30		Gray CLAYSHALE, soft, fissile, calcareous, w/silt and sand partings. (Pecan Gap)								
25	N=35-50/5"									
	N=35-50/5"		634.0 / 30.0							
30										
35										

NOTES:
1. Boring was advanced dry to the 30-ft depth, and the borehole was dry upon completion.
2. After 24 hrs, groundwater was measured at the 21-ft depth, and the borehole caved at 25 ft
3. Soil samples were obtained using direct-push geoprobe and auger cuttings.

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COMPLETION DEPTH: 30.0
DATE DRILLED: 1-23-18
WATER LEVEL / SEEPAGE:
UPON COMPLETION:

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 4

LOG OF BORING NO. B-604

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

LATTITUDE: 30.062888
LONGITUDE: -97.800296

SURF. ELEVATION: 659±

STRATUM DESCRIPTION	LAYER ELEV./ DEPTH
Brown, tan and gray FAT CLAY with Sand, stiff to very stiff, w/calcarous particles and scattered gravel. CH (Fill) *- calcareous, w/gravel from 8.5 to 10 ft*	648.0 11.0
Tan and gray FAT CLAY, hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)	645.0 14.0
Gray CLAYSHALE, soft, fissile, calcareous, w/silt and sand partings. (Pecan Gap)	619.0

POCKET PEN, tsf / Blows/ft. / REC./RQD, %	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
P=1.75							
P=2.25							
P=3.0							
P=3.0							
P=4.0							
P=3.0							
P=2.25	20	53	18	35	73		
P=2.0							
P=4.5	21					106	2.7(U)
N=70							
N=33-50/3"							
N=40-50/1"							
N=42-50/5"							
N=39-50/5"							
N=41-50/5"							

DEPTH, FT: 5, 10, 15, 20, 25, 30, 35

NOTES:
1. Boring was advanced dry to the 40-ft depth, and the borehole was dry upon completion.
2. After 24 hrs, the borehole was dry, and caved at the 31 ft depth.
3. Soil samples were obtained using direct-push geoprobe and auger cuttings.

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COMPLETION DEPTH: 40.0
DATE DRILLED: 1-24-18
WATER LEVEL / SEEPAGE:
UPON COMPLETION:

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 5a

LOG OF BORING NO. B-605

LATTITUDE: 30.062693
LONGITUDE: -97.800927

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	SYMBOL	SAMPLES	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION (SURF. ELEVATION: 658±)	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
			P=1.5	Brown, tan and gray FAT CLAY with Sand, stiff to very stiff, w/calcarous particles and scattered gravel. CH (Fill)								
						24	66	25	41	80		
			P=2.0									
5			P=3.5									
			P=2.75									
			P=2.75	*- calcareous, w/gravel from 8.5 to 10 ft*		29	74	25	49	78		
10					647.0	21					105	3.1(U)
			P=3.25	Tan and gray FAT CLAY, hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)	11.0							
			P=4.5+									
15					642.0							
				Gray CLAYSHALE, soft, fissile, calcareous, w/silt and sand partings. (Pecan Gap)	16.0							
			N=35-50/6"		638.0							
20					20.0							
25												
30												
35												

NOTES:
1. Boring was advanced dry to the 20-ft depth, and the borehole was dry upon completion.
2. After 24 hrs, groundwater was measured at the 18.5 ft depth, and the borehole cased at the 19-ft depth.
3. Soil samples were obtained using direct-push geoprobe and auger cuttings.

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COMPLETION DEPTH: 20.0
DATE DRILLED: 1-23-18
WATER LEVEL / SEEPAGE:
UPON COMPLETION:

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

LOG OF BORING NO. B-606

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

LATTITUDE: 30.062492
LONGITUDE: -97.801508

SURF. ELEVATION: 658±

DEPTH, FT	POCKET PEN, tsf / Blows/ft. / REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
0	P=2.25	Brown, tan and gray FAT CLAY with Sand, very stiff, w/calcarous particles and scattered gravel. CH (Fill)		28	72	24	48	84		
	P=3.0									
5	P=4.5									
	P=2.5									
		- w/gravel and organics from 8 to 9 ft		25					98	2(U)
10	P=2.5			24	50	19	31	79		
	P=1.25		646.5 / 11.5							
	P=4.5+	Tan and gray FAT CLAY, hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)								
15			641.5 / 16.5							
	N=33-50/6"	Gray CLAYSHALE, soft, fissile, calcareous, w/silt and sand partings. (Pecan Gap)								
20										
	N=36-50/4"		633.0 / 25.0							
25										
30										
35										

NOTES:
1. Boring was advanced dry to the 25-ft depth, and the borehole was dry upon completion.
2. After 24 hrs, the borehole was dry, and caved at 23 feet.
3. Soil samples were obtained using direct-push geoprobe and auger cuttings.

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COMPLETION DEPTH: 25.0
DATE DRILLED: 1-24-18
WATER LEVEL / SEEPAGE:
UPON COMPLETION:

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 7

LOG OF BORING NO. B-607

LATTITUDE: 30.062342
LONGITUDE: -97.802108

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

SURF. ELEVATION: 658±

DEPTH, FT	POCKET PEN, tsf / Blows/ft. / REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
0–11	P=1.25, P=1.5, P=2.25, P=2.5, P=1.75	Brown, tan and gray FAT CLAY with Sand, stiff to very stiff, w/calcarous particles and scattered gravel. CH (Fill)	647.0 / 11.0	29	66	24	42	82		
10				21					106	3.5(U)
11–18	P=2.5, P=4.5+	Tan and gray FAT CLAY, hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)	640.0 / 18.0							
18–20	N=60	Gray CLAYSHALE, soft, fissile, w/silt and sand partings. (Pecan Gap)	638.0 / 20.0							

NOTES:
1. Boring was advanced dry to the 20-ft depth, and the borehole was dry upon completion.
2. After 24 hrs, the borehole was dry, and caved at 18.5 feet.
3. Soil samples were obtained using direct-push geoprobe and auger cuttings.

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COMPLETION DEPTH: 20.0
DATE DRILLED: 1-24-18
WATER LEVEL / SEEPAGE:
UPON COMPLETION:

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

LOG OF BORING NO. B-150

LATTITUDE: 30.065074
LONGITUDE: -97.798559

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	SYMBOL	SAMPLES	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION (SURF. ELEVATION: 678±)	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO.4 SIEVE, %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
			P=1.75, P=2.75, P=3.0	Dark grayish brown FAT CLAY, stiff to very stiff, w/calcareous nodules, sand, scattered organics, and trace gravel. CH	675.0 3.0							
5			P=3.5, P=3.0, P=2.5, P=2.5, P=3.25, P=4.25, P=4.5+	Tan and gray FAT CLAY, very stiff to hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)	668.0 10.0							
10												
15												
20												

NOTES:
1. Boring was advanced dry to the 10-ft depth, and no groundwater was encountered.
2. Soil samples were obtained using direct-push geoprobe and auger cuttings.
3. Bulk samples from auger cuttings were obtained from 0-3 ft, 3-7.5 ft, and 7.5-10 ft.

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COMPLETION DEPTH: 10.0
DATE DRILLED: 1-25-18
WATER LEVEL / SEEPAGE: Not Observed
UPON COMPLETION: Not Observed
0

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

LOG OF BORING NO. B-151

LATTITUDE: 30.064806
LONGITUDE: -97.799348

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	SYMBOL	SAMPLES	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO.4 SIEVE, %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
				SURF. ELEVATION: 672±								
			P=0.25 P=0.25	Dark grayish brown FAT CLAY, soft, w/calcareous nodules, sand, scattered organics, and trace gravel. CH	669.5 2.5							
5			P=1.25 P=2.5 P=3.5 P=1.25 P=2.25 P=2.75 P=4.0 P=4.5+	Tan and gray FAT CLAY, stiff to very stiff, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap) *- hard below 9 ft*	662.0 10.0							
10 15 20				NOTES: 1. Boring was advanced dry to the 10-ft depth, and no groundwater was encountered. 2. Soil samples were obtained using direct-push geoprobe and auger cuttings. 3. Bulk samples from auger cuttings were obtained from 0-3 ft and 3-10 ft.								

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COMPLETION DEPTH: 10.0
DATE DRILLED: 1-25-18
WATER LEVEL / SEEPAGE: Not Observed
UPON COMPLETION: Not Observed
0

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 10

LOG OF BORING NO. B-152

LATTITUDE: 30.065327
LONGITUDE: -97.799716

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	SYMBOL	SAMPLES	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO.4 SIEVE, %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
				SURF. ELEVATION: 671±								
			P=0.75, P=1.5, P=1.25	Dark grayish brown FAT CLAY, firm to stiff, w/calcareous nodules, sand, scattered organics, and trace gravel. CH	667.5 / 3.5							
5			P=1.0, P=1.25, P=2.75, P=4.0, P=4.5, P=3.25, P=3.25	Tan and gray FAT CLAY, stiff to hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap) *- gravel layer at 7 ft*	661.0 / 10.0							
10												
15												
20												

NOTES:
1. Boring was advanced dry to the 10-ft depth, and no groundwater was encountered.
2. Soil samples were obtained using direct-push geoprobe and auger cuttings.
3. Bulk samples from auger cuttings were obtained from 0-3.5 ft and 3.5-10 ft.

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COMPLETION DEPTH: 10.0
DATE DRILLED: 1-25-18
WATER LEVEL / SEEPAGE: Not Observed
UPON COMPLETION: Not Observed
0

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 11

LOG OF BORING NO. B-153

LATTITUDE: 30.065791
LONGITUDE: -97.800077

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	SYMBOL	SAMPLES	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO.4 SIEVE, %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
				SURF. ELEVATION: 672±								
			P=1.25 P=1.25 P=1.0	Dark grayish brown FAT CLAY, stiff, w/calcareous nodules, sand, scattered organics, and trace gravel. CH	669.0 3.0							
5			P=1.25 P=1.25 P=3.0 P=4.5 P=4.5+ P=4.0 P=4.0	Tan and gray FAT CLAY, stiff to hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap) *- gravel from 6 to 7 ft*	662.0 10.0							
10												
15				NOTES: 1. Boring was advanced dry to the 10-ft depth, and no groundwater was encountered. 2. Soil samples were obtained using direct-push geoprobe and auger cuttings. 3. Bulk samples from auger cuttings were obtained from 0-3 ft, 3-5 ft, and 5-10 ft.								
20												

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512.380.9969

COMPLETION DEPTH: 10.0
DATE DRILLED: 1-25-18
WATER LEVEL / SEEPAGE: Not Observed
UPON COMPLETION: Not Observed
0

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 12

BALCONES_STD_25FT 0118-002 PLUM CREEK.GPJ 0118-002 PLUM CREEK.GPJ 06/05/18 11:46

LOG OF BORING NO. B-154

LATTITUDE: 30.065805
LONGITUDE: -97.799283

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	SYMBOL	SAMPLES	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION (SURF. ELEVATION: 677±)	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO.4 SIEVE, %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
			P=0.75	Dark grayish brown FAT CLAY, firm to very stiff, w/calcareous nodules, sand, scattered organics, and trace gravel. CH								
			P=2.75									
			P=3.0		673.5							
			P=3.5	Tan and gray FAT CLAY, very stiff to hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)	3.5							
5			P=3.0									
			P=4.5+									
			P=4.5+	*- gravel layer at 7 ft*								
			P=4.5+									
			P=4.5+									
			P=4.5+		667.0							
10					10.0							
15												
20												

NOTES:
1. Boring was advanced dry to the 10-ft depth, and no groundwater was encountered.
2. Soil samples were obtained using direct-push geoprobe and auger cuttings.
3. Bulk samples from auger cuttings were obtained from 0-3 ft and 5-10 ft.

Balcones Geotechnical
Austin, TX 78731
512.380.9969

COMPLETION DEPTH: 10.0
DATE DRILLED: 1-25-18
WATER LEVEL / SEEPAGE: Not Observed
UPON COMPLETION: Not Observed
0

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 13

LOG OF BORING NO. B-155

LATTITUDE: 30.063236
LONGITUDE: -97.802423

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	SYMBOL	SAMPLES	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO.4 SIEVE, %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
				SURF. ELEVATION: 672±								
			P=0.75 P=0.25 P=1.0 P=1.0	Dark grayish brown FAT CLAY, soft to firm, w/calcareous nodules, sand, scattered organics, and trace gravel. CH	667.5 4.5							
5			P=1.25 P=1.25	Brownish gray FAT CLAY, stiff, w/calcareous nodules, sand, gravel, and ferrous staining. CH *- gravel at 6 ft*	665.5 6.5							
			P=2.75 P=1.5 P=3.5 P=4.5+	Tan and gray FAT CLAY, stiff to hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap)	662.0 10.0							
10												
15												
20												

NOTES:
1. Boring was advanced dry to the 10-ft depth, and no groundwater was encountered.
2. Soil samples were obtained using direct-push geoprobe and auger cuttings.
3. Bulk samples from auger cuttings were obtained from 0-4 ft, 4-6.5 ft, and 6.5-10 ft.

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Austin, TX 78731
512.380.9969

COMPLETION DEPTH: 10.0
DATE DRILLED: 1-25-18
WATER LEVEL / SEEPAGE: Not Observed
UPON COMPLETION: Not Observed
0

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 14

LOG OF BORING NO. B-156

LATTITUDE: 30.064094
LONGITUDE: -97.802874

Plum Creek FRS No. 10
Buda, Texas
PROJECT NO. 0118-002

DEPTH, FT	SYMBOL	SAMPLES	POCKET PEN, tsf Blows/ft. REC./RQD, %	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX (PI), %	PASSING NO.4 SIEVE, %	PASSING NO. 200 SIEVE, %	UNIT DRY WEIGHT, PCF	UNCONFINED STRENGTH TSF
				SURF. ELEVATION: 672±								
			P=1.5 P=4.5+	Dark grayish brown FAT CLAY, stiff to hard, w/calcareous nodules, sand, scattered organics, and trace gravel. CH	669.5 2.5							
5			P=4.5+ P=4.5+ P=4.5+ P=3.25 P=3.25 P=4.5 P=4.5+ P=4.5+	Tan and gray FAT CLAY, very stiff to hard, slightly blocky, calcareous, w/calcareous nodules, sand and silt seams and partings, scattered gravel, and ferrous staining. CH (Pecan Gap) *- gravel at 4 ft*	662.0 10.0							
10 15 20				NOTES: 1. Boring was advanced dry to the 10-ft depth, and no groundwater was encountered. 2. Soil samples were obtained using direct-push geoprobe and auger cuttings. 3. Bulk samples from auger cuttings were obtained from 2.5-5 ft and 5-10 ft.								

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512.380.9969

COMPLETION DEPTH: 10.0
DATE DRILLED: 1-25-18
WATER LEVEL / SEEPAGE: Not Observed
UPON COMPLETION: Not Observed
0

KEY:
P = Pocket Penetrometer
N = Standard Penetration Test (bpf)
U = Unconfined Compression (tsf)

Plate 15

TERMS AND SYMBOLS USED ON BORING LOGS FOR SOIL

SOIL TYPES

CLAY (CH)	**SHALY CLAY (CH)**	**CLAY (CL)**	**SANDY CLAY (CL)**
Well-Graded **SAND (SW)**	Poorly-Graded **SAND (SP)**	**SILTY SAND (SM)**	**CLAYEY SAND (SC)**
Well-Graded **GRAVEL (GW)**	Poorly-Graded **GRAVEL (GP)**	**SILTY GRAVEL (GM)**	**FILL** Material

SOIL GRAIN SIZE

U.S.STANDARD SIEVE

12"	3"	3/4"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
304	76.2	19.1	4.76	2.00	0.420	0.074	0.002	

SOIL GRAIN SIZE IN MILIMETERS

STRENGTH OF COHESIVE SOILS (2)

CONSISTENCY	UNDRAINED COMPRESSIVE STRENGTH Tons Per Sq. Ft.
Very Soft	Less Than 0.25
Soft	0.25 to 0.50
Firm	0.5 to 1.00
Stiff	1.00 to 2.00
Very Stiff	2.00 to 4.00
Hard	greater than 4.00

DENSITY OF GRANULAR SOILS (2)

NUMBER OF BLOWS PER FT., N	RELATIVE DENSITY
0-4	Very Loose
4-10	Loose
10-30	Medium
30-50	Dense
Over 50	Very Dense

DESCRIPTIVE TERMS FOR SOIL (1)

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick.
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusions of small pockets of different soils.

MOISTURE

Dry	No water evident in sample; fines less than plastic limit.
Moist	Sample feels damp; fines near the plastic limit
Very Moist	Water visible on sample; fines greater plastic limit and less than liquid limit
Wet	Sample bears free water; fines greater than liquid limit.

INCLUSIONS (1)

Parting	Inclusion <1/8" thick extending through sample
Seam	Inclusion 1/8" to 3" thick extending through sample.
Layer	Inclusion >3" thick extending through sample.
Trace	<5% of sample.
Few	5% to 10% of sample.
Little	15 to 25% of sample.
With	15% to 29% of sample.

Balcones Geotechnical
Austin, TX 78731
512.451.8600

NOTE: Information on each boring log is a compilation of subsurface conditions and soil and rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted from commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the times and places indicated, and may vary with time, geologic condition or construction activity.

REFERENCES: 1) ASTM D 2488 2) Peck, Hanson and Thornburn, (1974), Foundation Engineering.

TERMS AND SYMBOLS USED ON BORING LOGS FOR ROCK

ROCK TYPES

LIMESTONE	SHALE	SANDSTONE
WEATHERED LIMESTONE	WEATHERED SHALE	WEATHERED SANDSTONE
HIGHLY WEATHERED LIMESTONE	ARGILLACEOUS LIMESTONE	MARL

SAMPLER TYPES

Thin-walled Tube	Rock Core
Standard Penetration Test	Auger Sample
THD Cone Penetration Test	Bag Sample

SOLUTION & VOID CONDITIONS

Void	Interstice; a general term for pore space or other openings in rock.
Cavities	Small solutional concavities.
Vuggy	Containing small cavities, usually lined with a mineral of different composition from that of the surrounding rock.
Vesicular	Containing numerous small, unlined cavities, formed by expansion of gas bubbles or steam during solidification of the rock.
Porous	Containing pore, interstices, or other openings which may or may not interconnect.
Cavernous	Containing cavities or caverns, sometimes quite large. Most frequent in limestones and dolomites.

WEATHERING GRADES OF ROCKMASS[1]

Slightly	Discoloration indicates weathering of rock material and discontinuity surfaces.
Moderately	Less than half of the rock material is decomposed or disintegrated to a soil.
Highly	More than half of the rock material is decomposed or disintegrated to a soil.
Completely	All rock material is decomposed and/or disintegrated to soil.The original mass structure is still largely intact.
Residual Soil	All rock material is converted to soil.The mass structure and material fabric are destroyed.

HARDNESS

Friable	Crumbles under hand pressure
Low Hardness	Can be carved with a knife
Moderately Hard	Can be scratched easily with a knife
Very Hard	Cannot be scratched with a knife

BEDDING THICKNESS[2]

Very Thick	>4'
Thick	2'-4'
Thin	2"-2'
Very Thin	1/2"-2"
Laminated	0.08"-1/2"
Thinly-Laminated	<0.08"

JOINT DESCRIPTION

SPACING

Very Close	<2"
Close	2"-12"
Medium Close	12"-3'
Wide	>3'

INCLINATION

Horizontal	0-5
Shallow	5-35
Moderate	35-65
Steep	65-85
Vertical	85-90

SURFACES

Slickensided	Polished, grooved
Smooth	Planar
Irregular	Undulating or granular
Rough	Jagged or pitted

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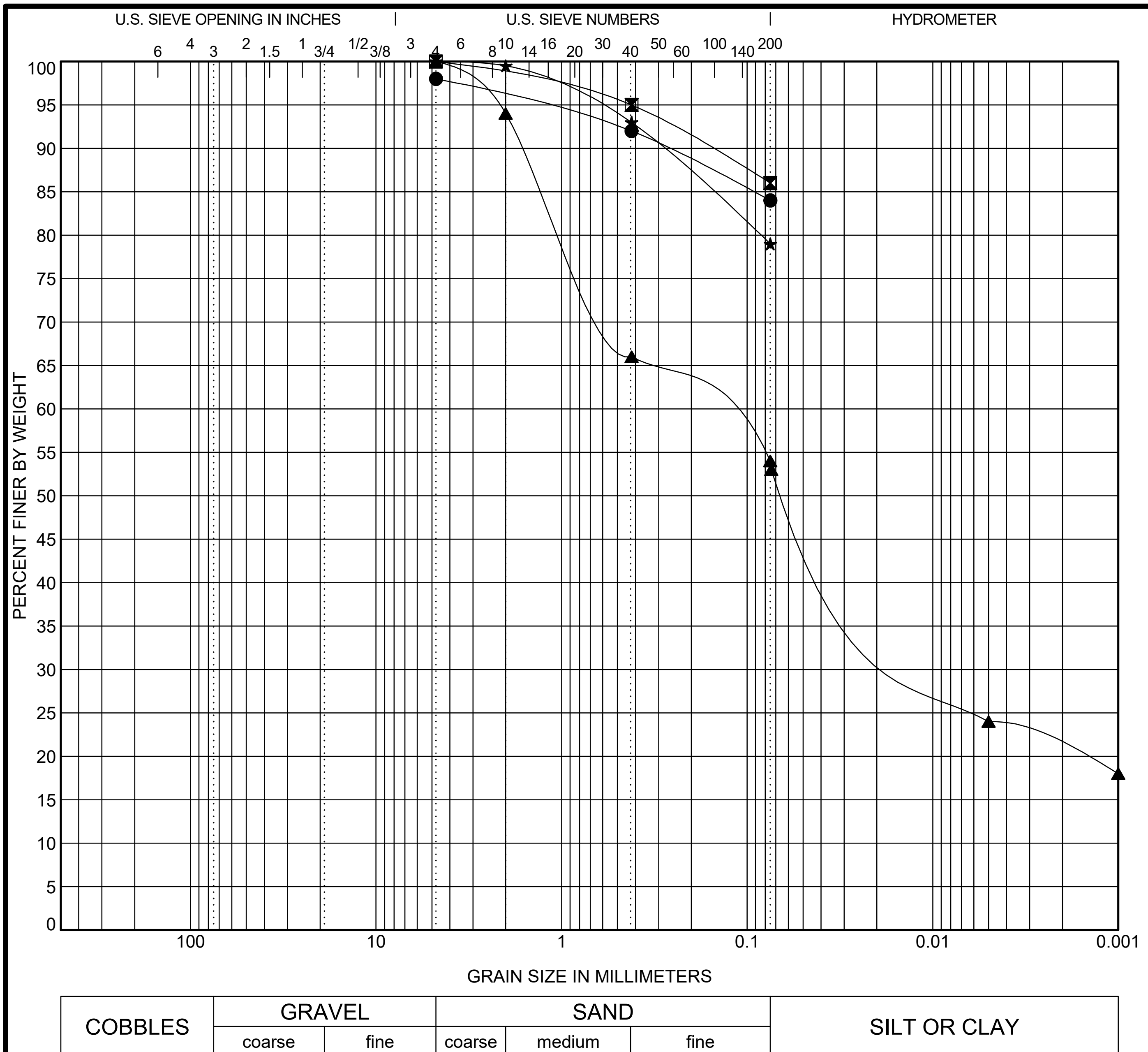
512.451.8600

NOTE: Information on each boring log is a compilation of subsurface conditions and soil and rock classificaitons obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the times and places indicated, and may vary with time, geologic condition or construction activity.

REFERENCES: 1) British Standard(1981) Code of Practice for Site Investigation BS 5930.
2) The Bridge Division, Texas Highway Dept. Foundation Exploration & Design Manual, 2nd Edition,revised June,1974.

APPENDIX D

Laboratory Testing



	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**B-301**		**19.0**	**FAT CLAY with SAND (CH)**	**57**	**24**	**33**		
⧗	**B-301**		**34.0**	**FAT CLAY (CH)**	**69**	**24**	**45**		
▲	**B-601**		**6.0**	**SANDY FAT CLAY (CH)**	**61**	**20**	**41**		
★	**B-602**		**2.0**	**FAT CLAY with SAND (CH)**	**77**	**27**	**50**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-301**	**19.0**	**4.75**					**14.0**	**84.0**	
⧗	**B-301**	**34.0**	**4.75**				**0.0**	**14.0**	**86.0**	
▲	**B-601**	**6.0**	**4.75**	**0.177**	**0.009**		**0.0**	**46.0**	**33.4**	**20.6**
★	**B-602**	**2.0**	**4.75**				**0.0**	**21.0**	**79.0**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

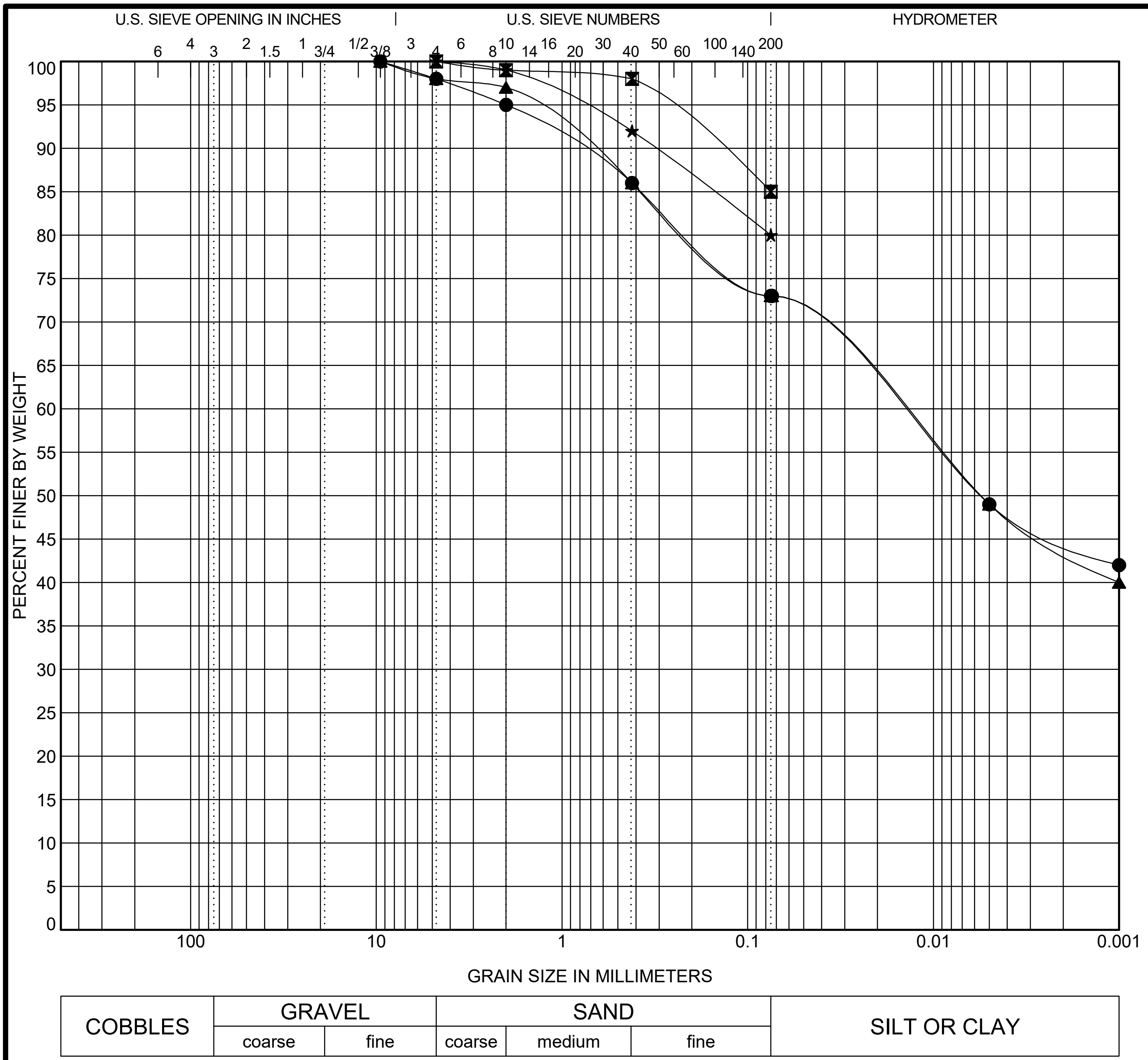
Balcones Geotechnical
Austin, TX 78731
512.380.9969

GRAIN SIZE DISTRIBUTION

Project: Plum Creek FRS No. 10

Location: Buda, TX

Job No.: 0118-002



	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**B-603**		**8.0**	**FAT CLAY with SAND (CH)**	**50**	**15**	**35**		
⧗	**B-603**		**11.0**	**FAT CLAY with SAND (CH)**	**60**	**21**	**39**		
▲	**B-604**		**6.0**	**FAT CLAY with SAND (CH)**	**53**	**18**	**35**		
★	**B-605**		**2.0**	**FAT CLAY with SAND (CH)**	**66**	**25**	**41**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-603**	**8.0**	**9.51**	**0.017**			**2.0**	**25.0**	**28.0**	**45.0**
⧗	**B-603**	**11.0**	**4.75**				**0.0**	**15.0**	**85.0**	
▲	**B-604**	**6.0**	**9.51**	**0.017**			**2.0**	**25.0**	**29.1**	**43.9**
★	**B-605**	**2.0**	**4.75**				**0.0**	**20.0**	**80.0**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

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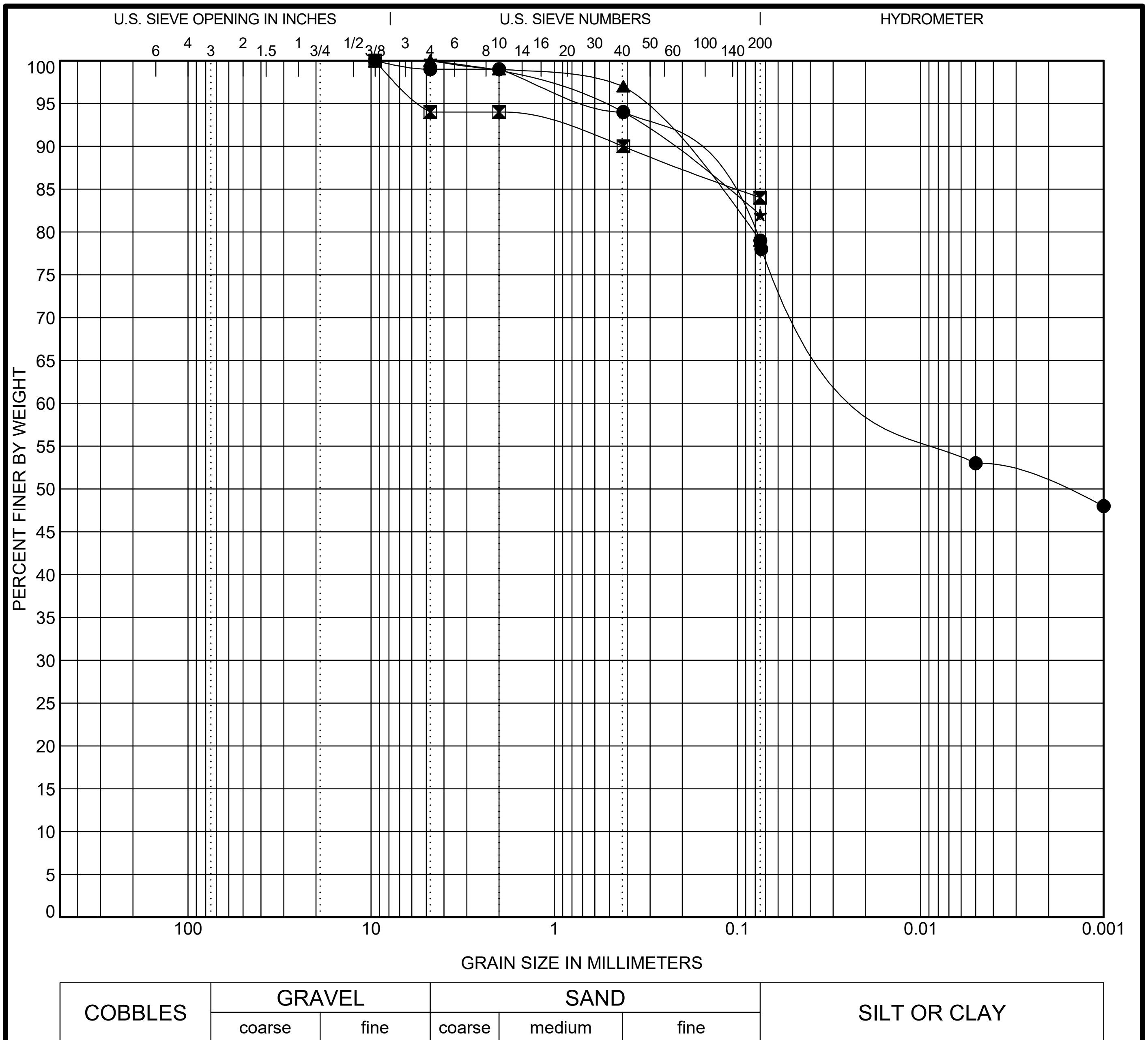
512.380.9969

GRAIN SIZE DISTRIBUTION

Project: Plum Creek FRS No. 10

Location: Buda, TX

Job No.: 0118-002



	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**B-605**		**10.0**	**FAT CLAY with SAND (CH)**	**74**	**25**	**49**		
⧗	**B-606**		**2.0**	**FAT CLAY with SAND (CH)**	**72**	**24**	**48**		
▲	**B-606**		**10.0**	**FAT CLAY with SAND (CH)**	**50**	**19**	**31**		
★	**B-607**		**2.0**	**FAT CLAY with SAND (CH)**	**66**	**24**	**42**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-605**	**10.0**	**9.51**	**0.011**			**1.0**	**20.0**	**28.8**	**50.2**
⧗	**B-606**	**2.0**	**9.51**				**6.0**	**10.0**	**84.0**	
▲	**B-606**	**10.0**	**4.75**				**0.0**	**21.0**	**79.0**	
★	**B-607**	**2.0**	**4.75**				**0.0**	**18.0**	**82.0**	

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

GRAIN SIZE DISTRIBUTION

Project: Plum Creek FRS No. 10

Location: Buda, TX

Job No.: 0118-002

Balcones Geotechnical
Austin, TX 78731
512.380.9969

GRAINSIZE.GPJ 4/27/18 (GRAIN SIZE BG,US_LAB.GDT,LIBRARY2013-01.GLB)

LABORATORY TEST REPORT

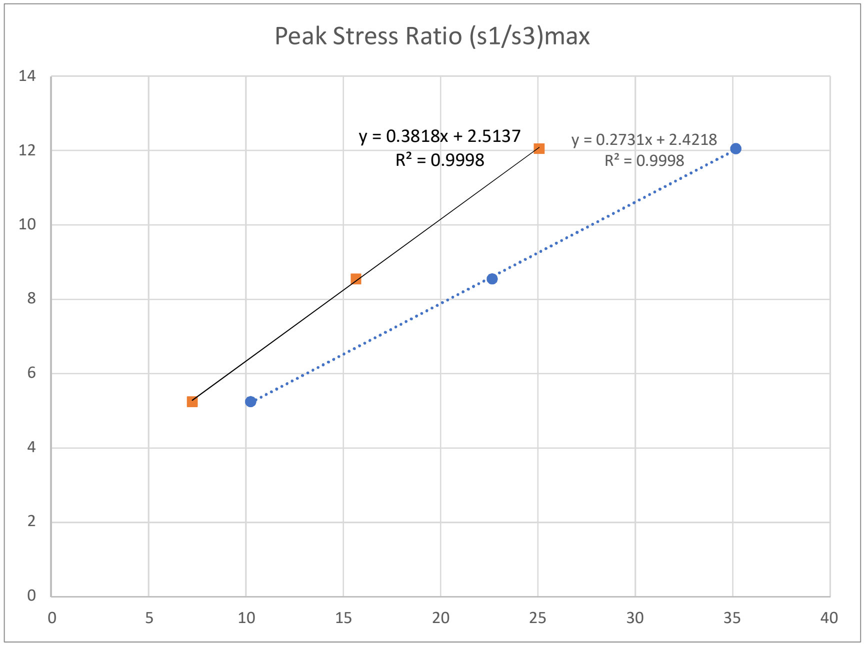
FUGRO
Fugro USA Land, Inc.
8613 Cross Park Drive
Austin, Texas 78754
Phone (512) 977-1800

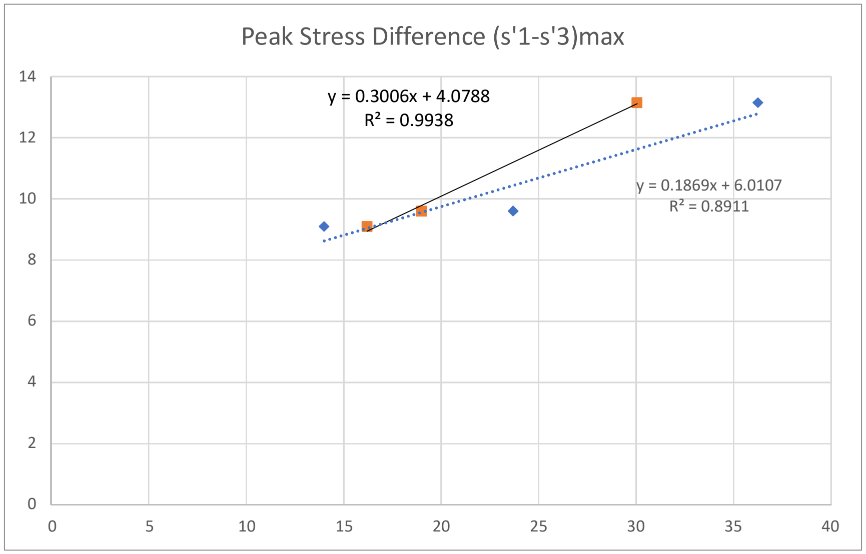
Project: Balcones Geotechnical	**Date Assigned**: 2/21/18	**Assigned By**: R.Russo
Project Number: 04.30182002	**Client Project & No.**: Plum Creek 0118-002	**Report Date**:03/21/2018

Boring	Depth (Feet)	Moisture in %	Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing (3/8)	Percent Passing (#4)	Percent Passing (#10)	Percent Passing (#40)	Percent Passing (-200)	Percent Passing 0.074	Percent Passing 0.005	Percent Passing 0.001	TEX-121 and Tex-128		
B601	6-8	25.71	61	20	41	100.0	100.0	94.4	66.0	53.6	53.5	24.4	17.7			
B602	2-4	38.79	77	50	27	100.0	100.0	99.6	92.8	79.4						
B603	8-9	15.82	50	15	35	100.0	98.2	95.0	85.6	73.3	73.2	48.8	41.7			
B603	11-12	22.31	60	21	39	100.0	100.0	99.8	98.2	84.6						
B604	6-8	19.69	53	18	35	100.0	98.3	96.8	85.8	73.0	72.9	49.1	39.8			
B605	2-4	23.96	66	25	41	100.0	100.0	99.6	92.4	80.1						
B605	10-11	29.05	74	25	49	100.0	99.5	99.5	94.1	78.1	78.8	53.1	48.1			
B606	2-4	27.59	72	24	48	100.0	94.1	94.1	90.0	83.6						
B606	10-12	23.93	47	19	28	100.0	100.0	99.8	97.2	78.9						
B607	2-4	28.55	66	24	42		99.0		93.9	81.6						
B301	19-20	22.66	57	24	33		98.4		91.7	83.7						
B301	34-35	24.76	69	24	45		100.0		95.1	85.5						
CS1	No Lime		81	30	51		99.7		97.9	95.4				8.2		
CS1	4% Lime		68	53	15									12.5		
CS1	5% Lime		70	56	14									12.6		
CS1	6% Lime		69	55	14									12.6		
CS2	No Lime		55	19	36		96.1		92.4	86.7				8.6		
CS2	4% Lime		52	35	17									12.6		
CS2	5% Lime		53	36	17									12.7		
CS2	6% Lime		55	38	17									12.7		
S3	--	20.54	85	21	64		99.9		98.5	96.3						
S4	--	11.02	58	22	36		98.9		97.6	93.7						

peak stress ratio (from TRI lab datasheet)					
Minor Effective Stress	$\sigma_3'{}_f$	psi	2	7.1	13
Principal Stress Difference	$(\sigma_1 - \sigma_3)_f$	psi	10.5	17.1	24.1
Pore Water Pressure	Δu_f	psi	3	7	10.1
Major Effective Stress	$\sigma_1'{}_f$	psi	12.5	24.2	37.1
p' at failure where $p' = (\sigma_1'{}_f + \sigma_3'{}_f) / 2$	p'_f	psi	7.25	15.65	25.05
p at failure where $p = (\sigma_{1f} + \sigma_{3f}) / 2$	p_f	psi	10.25	22.65	35.15
q at failure where $q = (\sigma_{1f} - \sigma_{3f}) / 2$	q_f	psi	5.25	8.55	12.05
Effective Stress Cohesion (CD Conditions)	**c'**	**psi**	**2.720**		
Effective Stress Friction Angle (CD Conditions)	**ϕ'**	**degrees**	**22.447**		
Total Stress Cohesion (CU Conditions)	**c**	**psi**	**2.518**		
Total Stress Friction Angle (CU Conditions)	**ϕ**	**degrees**	**15.849**		

peak stress difference (from TRI lab datasheet)					
Minor Effective Stress	$\sigma_3'{}_f$	psi	7.1	9.4	16.9
Principal Stress Difference	$(\sigma_1 - \sigma_3)_f$	psi	18.2	19.2	26.3
Pore Water Pressure	Δu_f	psi	-2.2	4.7	6.2
Major Effective Stress	$\sigma_1'{}_f$	psi	25.3	28.6	43.2
p' at failure where $p' = (\sigma_1'{}_f + \sigma_3'{}_f) / 2$	p'_f	psi	16.2	19	30.05
p at failure where $p = (\sigma_{1f} + \sigma_{3f}) / 2$	p_f	psi	14	23.7	36.25
q at failure where $q = (\sigma_{1f} - \sigma_{3f}) / 2$	q_f	psi	9.1	9.6	13.15
Effective Stress Cohesion (CD Conditions)	**c'**	**psi**	**4.277**		
Effective Stress Friction Angle (CD Conditions)	**ϕ'**	**degrees**	**17.493**		
Total Stress Cohesion (CU Conditions)	**c**	**psi**	**6.118**		
Total Stress Friction Angle (CU Conditions)	**ϕ**	**degrees**	**10.769**		





Consolidated-Undrained Triaxial Compression

Client: Balcones Geotechnical
Project: Plum Creek
Sample: 30.18 (18 - 19)

TRI Log #: 35589
Test Method: ASTM D4767

Specimens			
Identification	-	-	-
Depth/Elev. (ft)	-	-	-
Eff. Consol. Stress (psi)	5.0	15.0	25.0
Initial Specimen Properties			
Avg. Diameter (in)	1.42	1.41	1.41
Avg. Height (in)	3.14	3.00	3.28
Avg. Water Content (%)	25.5	23.9	25.9
Bulk Density (pcf)	116.6	114.7	119.5
Dry Density (pcf)	93.0	92.6	94.9
Saturation (%)	84.5	78.6	90.2
Void Ratio, n	0.81	0.82	0.78
Specific Gravity (Assumed)	2.70	2.70	2.70
Total Back-Pressure (psi)	54.3	55.1	56.0
B-Value, End of Saturation	0.95	1.00	1.00

Test Setup	
Specimen Condition	Undisturbed / Intact
Specimen Preparation	Trimmed
Mounting Method	Wet
Consolidation	Isotropic

Post-Consolidation / Pre-Shear			
Void Ratio	0.81	0.78	0.74
Area (in^2)	1.57	1.55	1.53

Shear / Post-Shear			
Avg. Water Content (%)	28.0	29.3	25.3
Rate of Strain (%/hr)	0.50	0.50	5.00

At Failure						
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$			Ratio, $(\sigma_1'/\sigma_3')_{max}$		
Axial Strain at Failure (%), $\varepsilon_{a,f}$	15.0	15.0	15.0	1.1	3.8	5.7
Minor Effective Stress (psi), $\sigma_3'{}_f$	7.1	9.4	16.9	2.0	7.1	13.0
Principal Stress Difference (psi), $(\sigma_1-\sigma_3)_f$	18.2	19.2	26.3	10.5	17.1	24.1
Pore Water Pressure, Δu_f (psi)	-2.2	4.7	6.2	3.0	7.0	10.1
Major Effective Stress (psi), $\sigma_1'{}_f$	25.3	28.6	43.2	12.4	24.2	37.2
Secant Friction Angle (degrees)	34.1	30.4	25.9	46.7	33.2	28.7
Effective Friction Angle (degrees)	17.5			22.4		
Effective Cohesion (psi)	4.3			2.7		

Please note that the presented M-C parameters are based on a linear regression in modified stress space, across all assigned effective consolidation stresses. This fit does not purported to capture typical curvature of envelopes that may, in particular, be observed across broader range in effective stresses. Please note that the stresses associated with peak principal stress ratio and peak principal stress difference are presented in tabular form on the first page of the report. There are alternate interpretations to theses two failure criterion including but not limited to strain compatibility and post-peak.

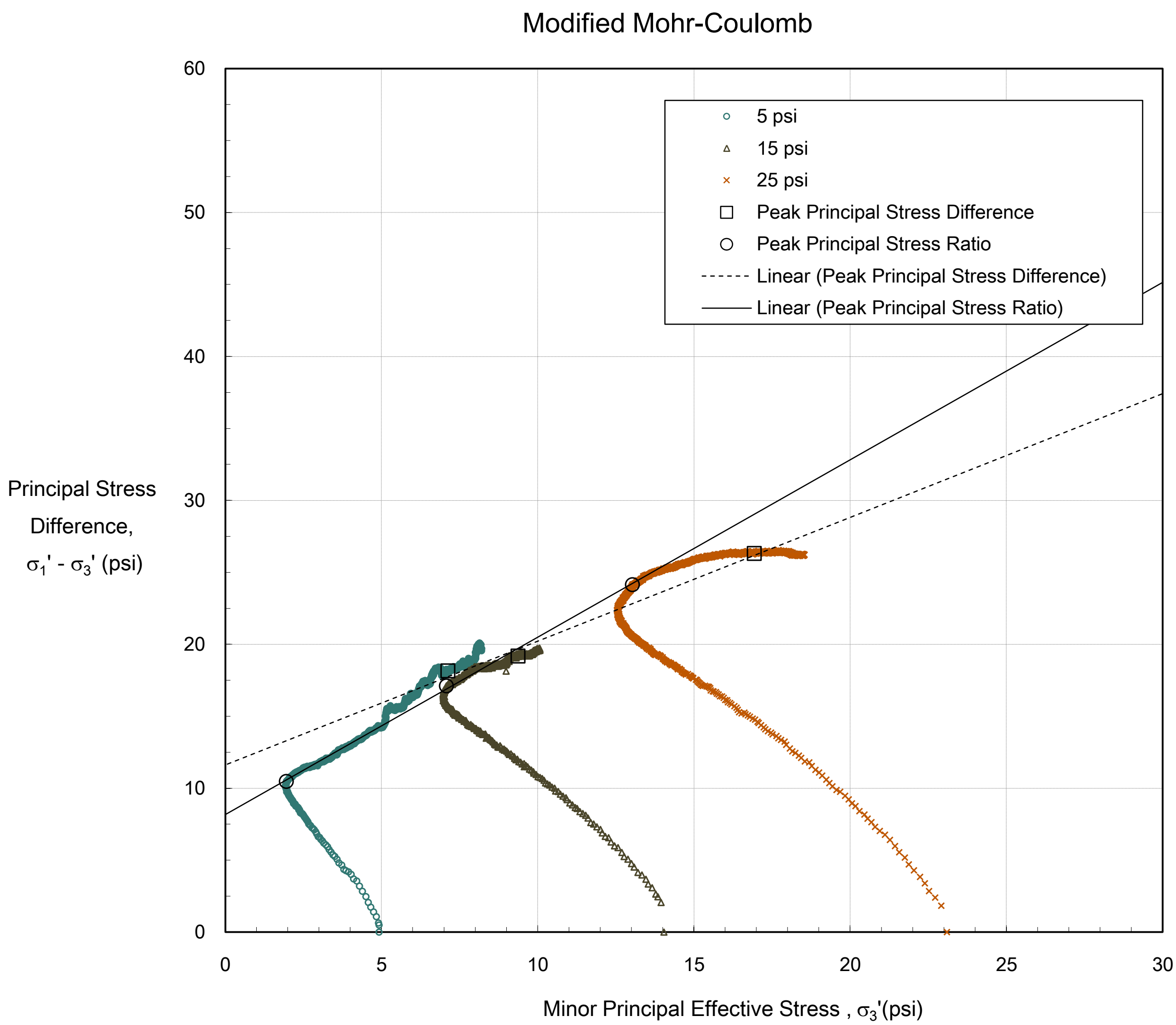
Jeffrey A. Kuhn , Ph.D., P.E., 3/19/2018
Analysis & Quality Review/Date

TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

Consolidated-Undrained Triaxial Compression

Client: Balcones Geotechnical
Project: Plum Creek
Sample: 30.18 (18 - 19)

TRI Log #: 35589
Test Method: ASTM D4767



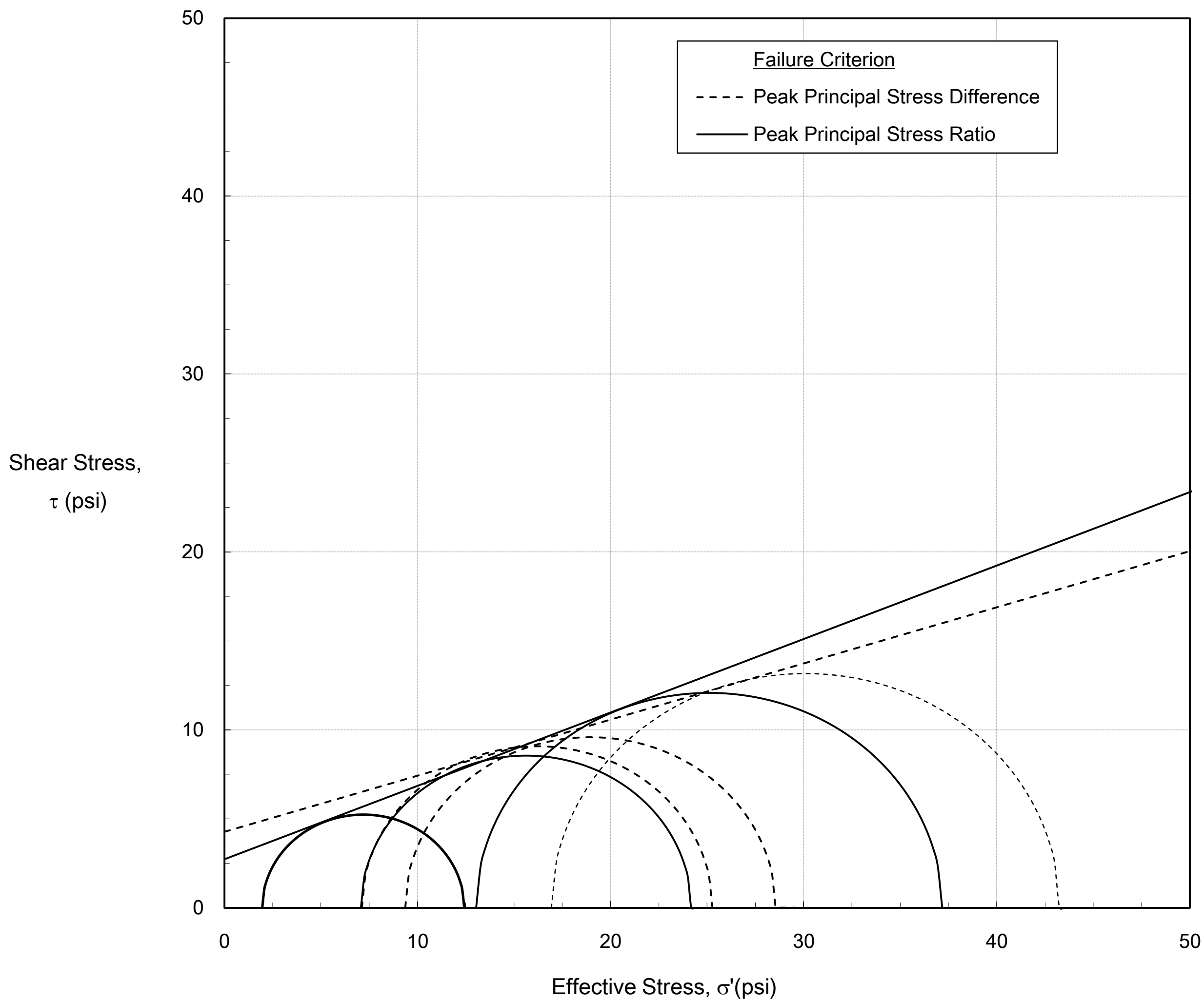
Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	17.5	22.4
Effective Cohesion (psi)	4.3	2.7

Consolidated-Undrained Triaxial Compression

Client: Balcones Geotechnical
Project: Plum Creek
Sample: 30.18 (18 - 19)

TRI Log #: 35589
Test Method: ASTM D4767

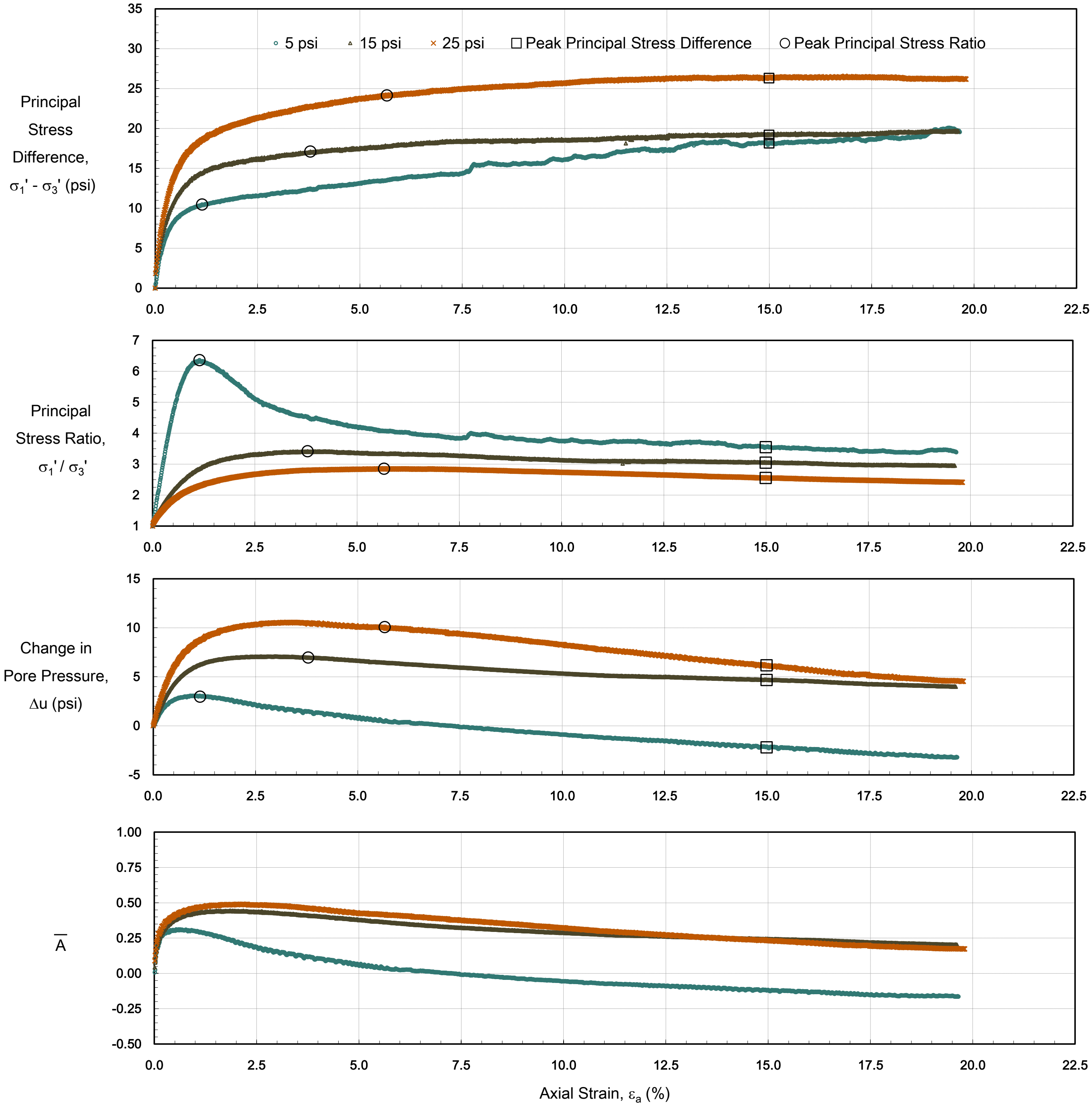
Mohr-Coulomb



Failure Criterion: Peak Principal Stress	Difference, $(\sigma_1'-\sigma_3')_{max}$	Ratio, $(\sigma_1'/\sigma_3')_{max}$
Effective Friction Angle (deg)	17.5	22.4
Effective Cohesion (psi)	4.3	2.7

Consolidated-Undrained Triaxial Compression

Client:	Balcones Geotechnical	TRI Log #:	35589
Project:	Plum Creek	Test Method:	ASTM D4767
Sample:	30.18 (18 - 19)		



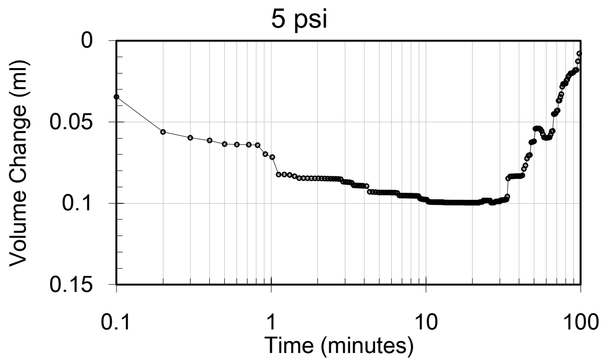
TRI ENVIRONMENTAL, INC.
9063 BEE CAVES RD. – AUSTIN, TX 78733 – USA | PH: 800.880.TEST OR 512.263.2101

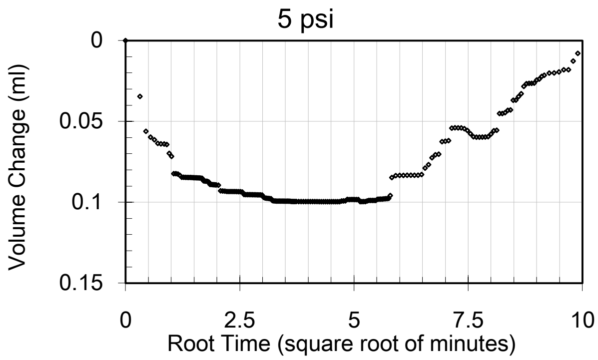
Consolidated-Undrained Triaxial Compression

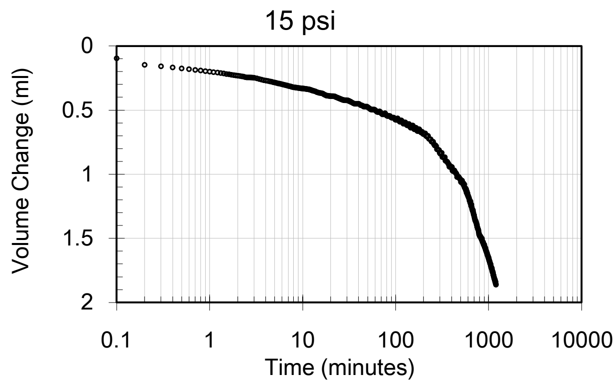
Client: Balcones Geotechnical
Project: Plum Creek
Sample: 30.18 (18 - 19)

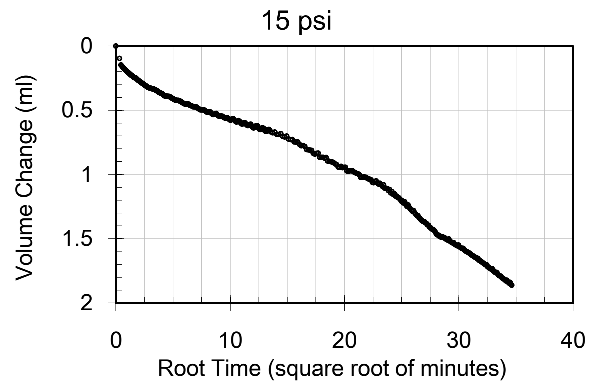
TRI Log #: 35589
Test Method: ASTM D4767

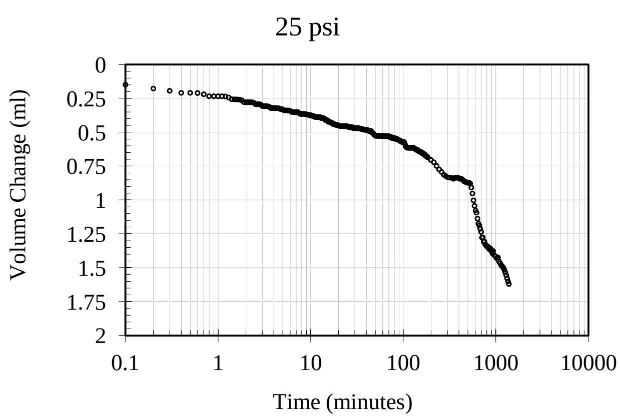
Consolidation

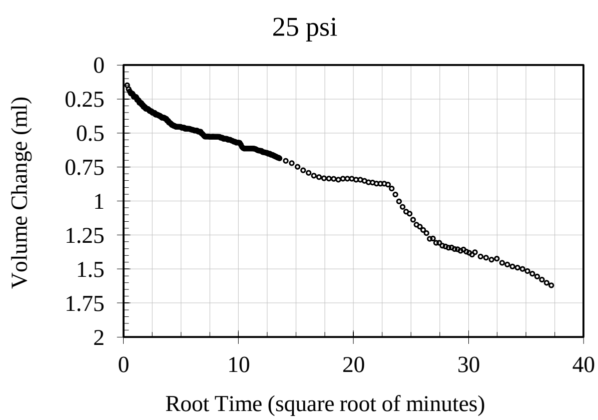












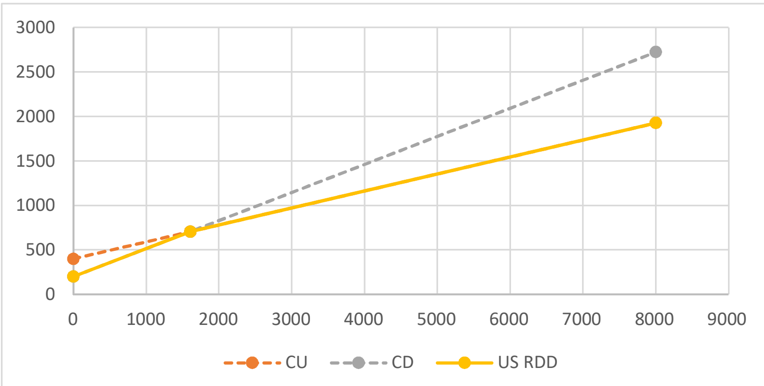
APPENDIX E

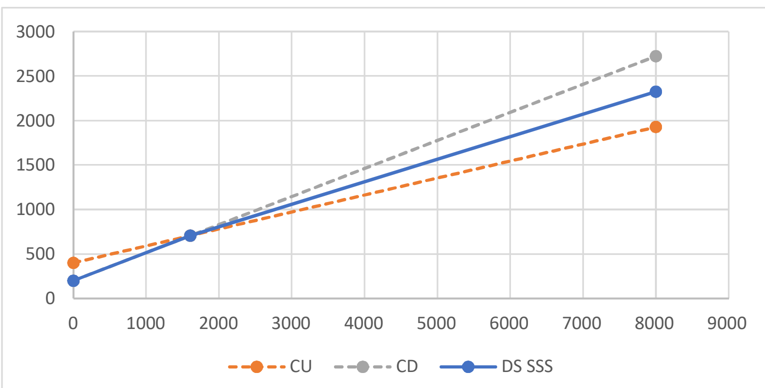
SLIDE Slope Stability Computer Output

CU and CD Strength Envelopes			
CU		CD	
c	phi	c'	phi'
400	10.8	200	17.5

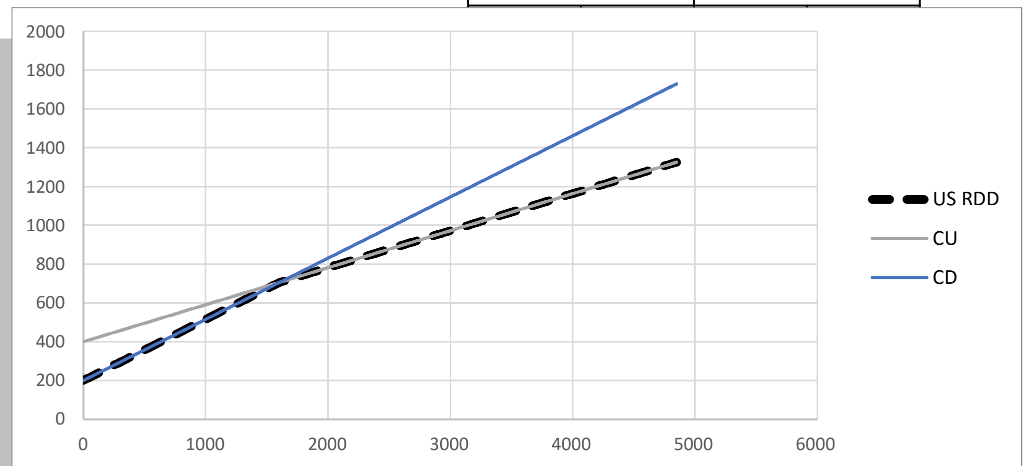
Simple 3-Point Envelope

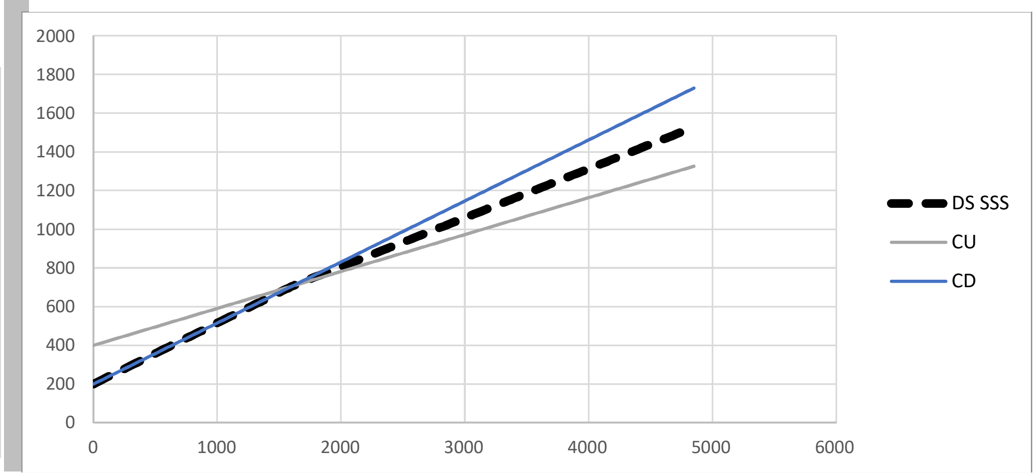
Normal	CU	CD	Normal	US RDD	Normal	DS SSS
0	400	200	0	200	0	200
1606	706	706	1606	706	1606	706
8000	1926	2722	8000	1926	8000	2324





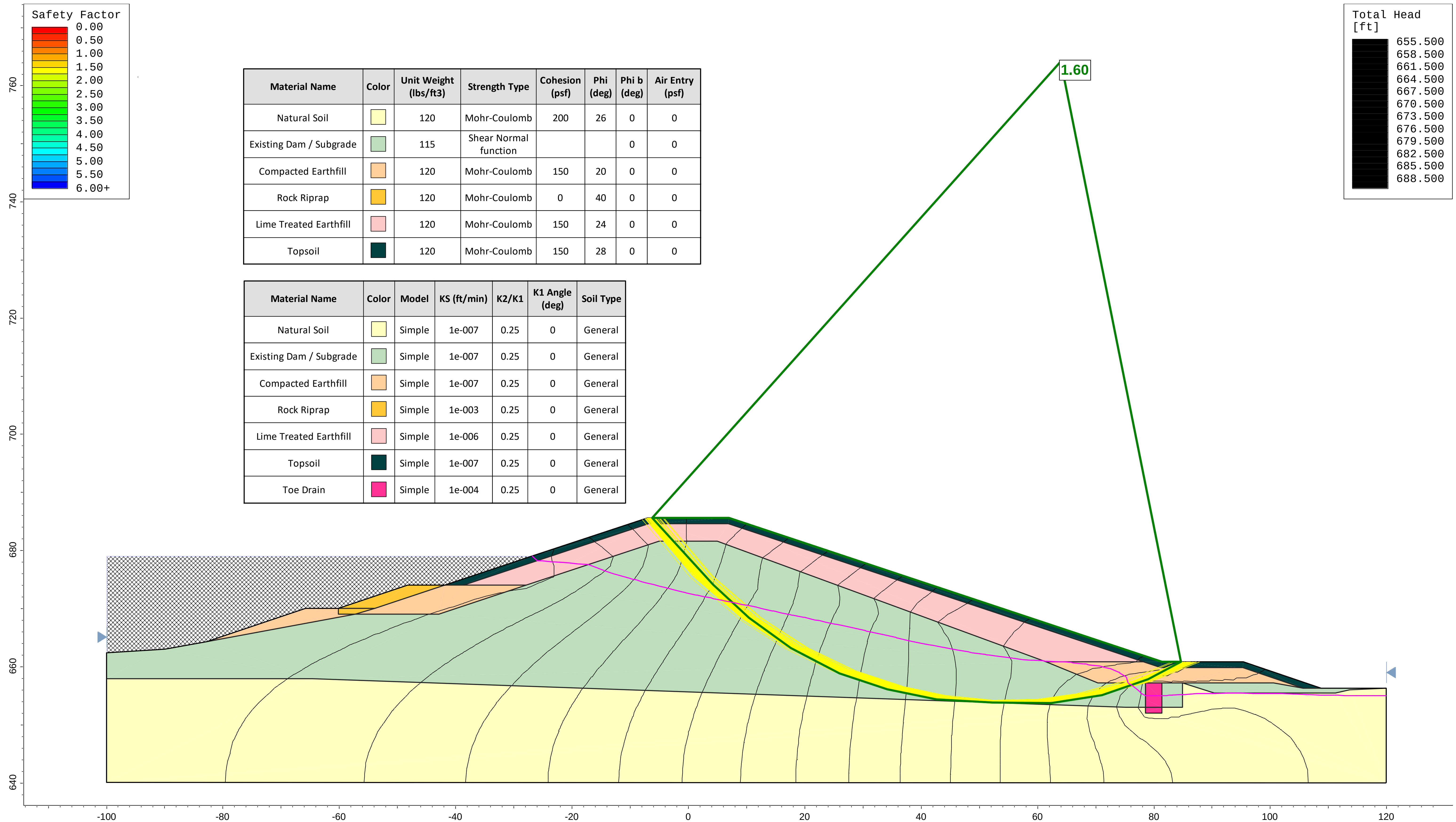
Shear vs Normal in 25psf Increments	
US RDD	*DS SSS*

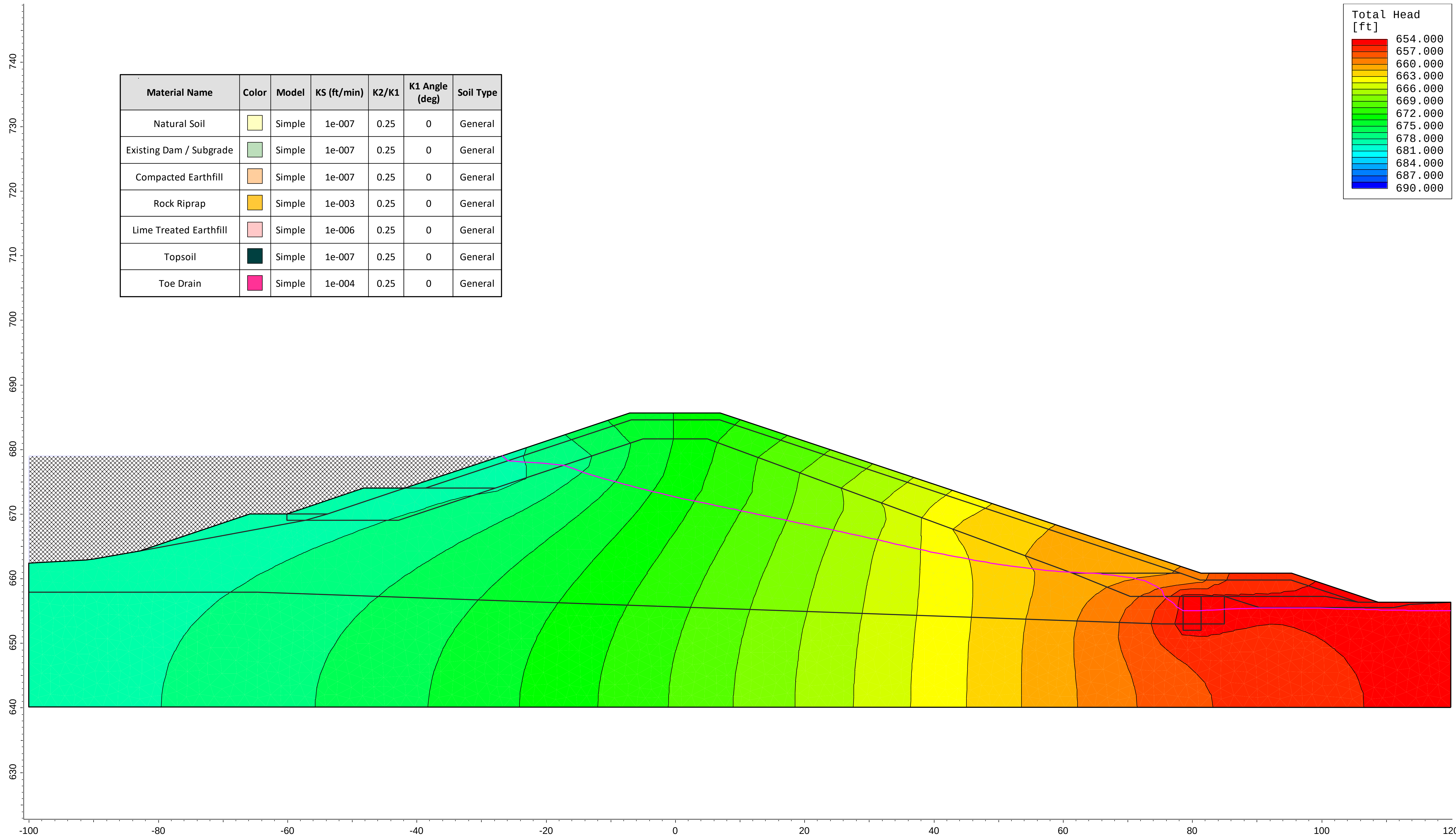




Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Phi b (deg)	Air Entry (psf)
Natural Soil		120	Mohr-Coulomb	200	26	0	0
Existing Dam / Subgrade		115	Shear Normal function			0	0
Compacted Earthfill		120	Mohr-Coulomb	150	20	0	0
Rock Riprap		120	Mohr-Coulomb	0	40	0	0
Lime Treated Earthfill		120	Mohr-Coulomb	150	24	0	0
Topsoil		120	Mohr-Coulomb	150	28	0	0

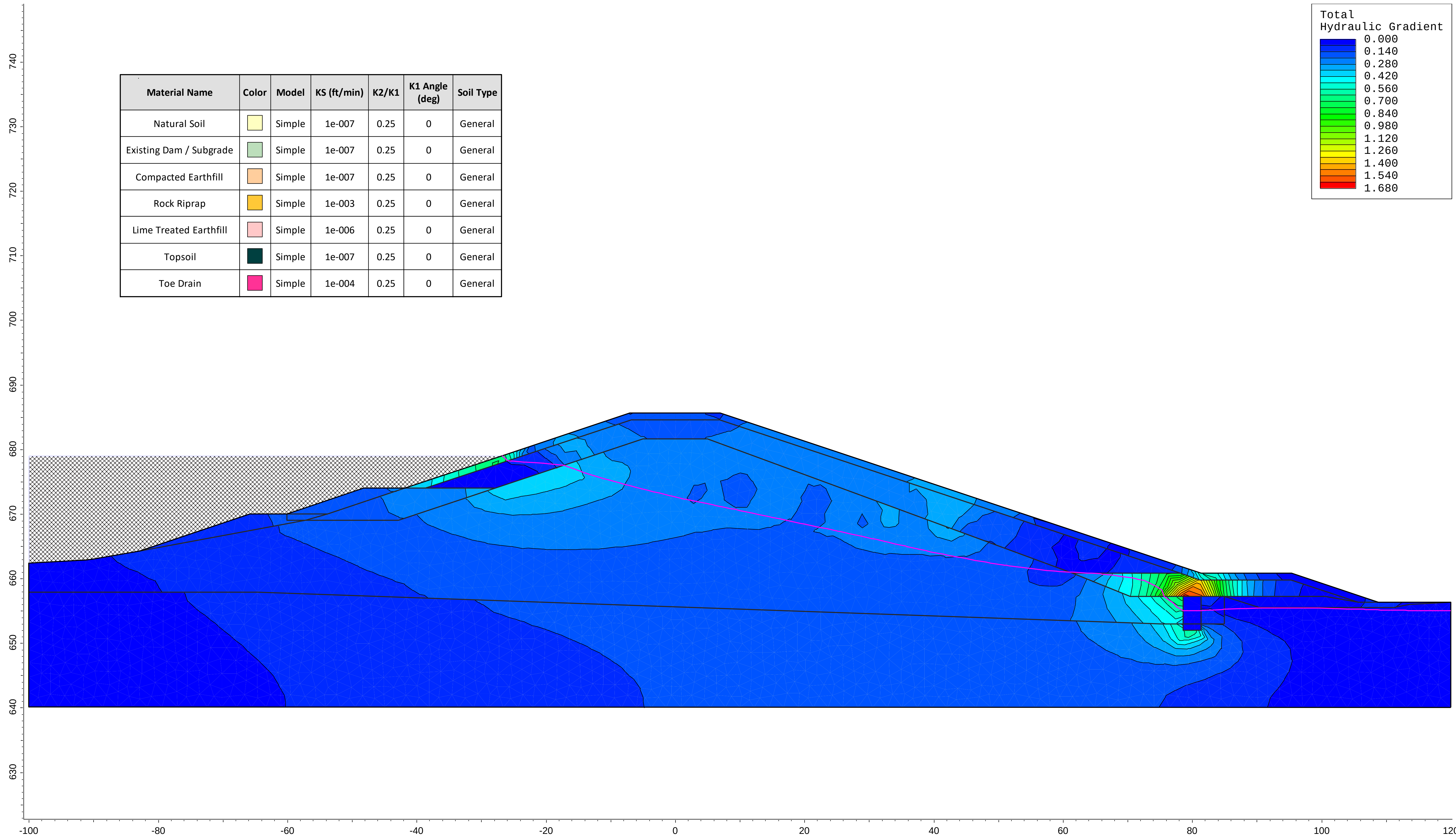
Material Name	Color	Model	KS (ft/min)	K2/K1	K1 Angle (deg)	Soil Type
Natural Soil		Simple	1e-007	0.25	0	General
Existing Dam / Subgrade		Simple	1e-007	0.25	0	General
Compacted Earthfill		Simple	1e-007	0.25	0	General
Rock Riprap		Simple	1e-003	0.25	0	General
Lime Treated Earthfill		Simple	1e-006	0.25	0	General
Topsoil		Simple	1e-007	0.25	0	General
Toe Drain		Simple	1e-004	0.25	0	General

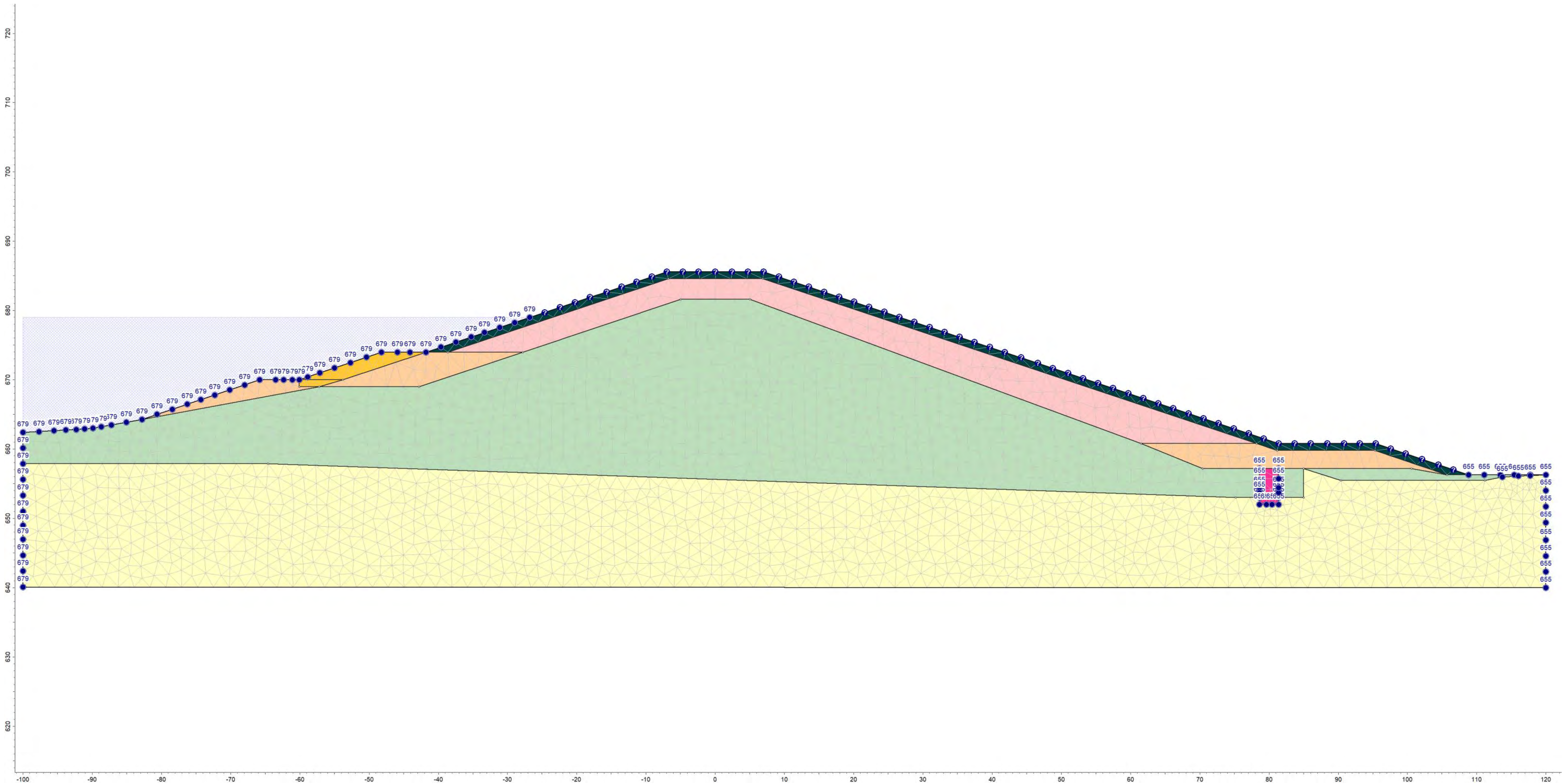




Material Name	Color	Model	KS (ft/min)	K2/K1	K1 Angle (deg)	Soil Type
Natural Soil		Simple	1e-007	0.25	0	General
Existing Dam / Subgrade		Simple	1e-007	0.25	0	General
Compacted Earthfill		Simple	1e-007	0.25	0	General
Rock Riprap		Simple	1e-003	0.25	0	General
Lime Treated Earthfill		Simple	1e-006	0.25	0	General
Topsoil		Simple	1e-007	0.25	0	General
Toe Drain		Simple	1e-004	0.25	0	General

Material Name	Color	Model	KS (ft/min)	K2/K1	K1 Angle (deg)	Soil Type
Natural Soil		Simple	1e-007	0.25	0	General
Existing Dam / Subgrade		Simple	1e-007	0.25	0	General
Compacted Earthfill		Simple	1e-007	0.25	0	General
Rock Riprap		Simple	1e-003	0.25	0	General
Lime Treated Earthfill		Simple	1e-006	0.25	0	General
Topsoil		Simple	1e-007	0.25	0	General
Toe Drain		Simple	1e-004	0.25	0	General





720
710
700
690
680
670
660
650
640
630
620
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
679
655

Slide Analysis Information
SLIDE - An Interactive Slope Stability Program

Project Summary

- File Name: Section Station 12
- Slide Modeler Version: 6.039
- Project Title: SLIDE - An Interactive Slope Stability Program
- Date Created: 3/29/2018, 4:22:35 PM

General Settings

- Units of Measurement: Imperial Units
- Time Units: days
- Permeability Units: feet/minute
- Failure Direction: Left to Right
- Data Output: Standard
- Maximum Material Properties: 20
- Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

  - Spencer
- Number of slices: 25
- Tolerance: 0.005
- Maximum number of iterations: 50
- Check malpha < 0.2: Yes
- Initial trial value of FS: 1
- Steffensen Iteration: Yes

Groundwater Analysis

- Groundwater Method: Steady State FEA
- Pore Fluid Unit Weight: 62.4 lbs/ft3
- Tolerance: 1e-006
- Maximum number of iterations: 500
- Advanced Groundwater Method: None
- Mesh Element Type: 3 noded triangles
- Number of Elements: 4233
- Number of Nodes: 2226

Random Numbers

- Pseudo-random Seed: 10116
- Random Number Generation Method: Park and Miller v.3

Surface Options

- Search Method: Auto Refine Search
- Divisions along slope: 15
- Circles per division: 15
- Number of iterations: 10

- Divisions to use in next iteration: 50%
- Number of vertices per surface: 12
- Minimum Elevation: Not Defined
- Minimum Depth: Not Defined

Material Properties

Property	Natural Soil	Existing Dam / Subgrade	Compacted Earthfill	Rock Riprap	Lime Treated Earthfill	Topsoil	Toe Drain
Color							
Strength Type	Mohr-Coulomb	Shear Normal function	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	115	120	120	120	120	120
Cohesion [psf]	200		150	0	150	150	0
Friction Angle [deg]	26		20	40	24	28	32
Unsaturated Shear Strength Angle [deg]	0	0	0	0	0	0	0
Air Entry Value [psf]	0	0	0	0	0	0	0
Ks [feet/minute]	1e-007	1e-007	1e-007	1e-003	1e-006	1e-007	1e-004
K2/K1	0.25	0.25	0.25	0.25	0.25	0.25	0.25
K Angle [deg]	0	0	0	0	0	0	0
Groundwater Model	Simple	Simple	Simple	Simple	Simple	Simple	Simple
GW Model Properties	Soil Type: General	Soil Type: General	Soil Type: General	Soil Type: General	Soil Type: General	Soil Type: General	Soil Type: General

Shear Normal Functions

- Name: DS SSS

Normal (psf)	Shear (psf)
0	200
1606	706
8000	2324

Global Minimums

Method: spencer

- FS: 1.598920
- Axis Location: 64.014, 764.061
- Left Slip Surface Endpoint: -6.216, 685.600
- Right Slip Surface Endpoint: 84.645, 660.800
- Resisting Moment=6.3842e+006 lb-ft
- Driving Moment=3.99281e+006 lb-ft
- Resisting Horizontal Force=52940.3 lb
- Driving Horizontal Force=33109.9 lb
- Total Slice Area=1256.9 ft2

Global Minimum Coordinates

Method: spencer

X	Y
-6.21605	685.6
4.28487	674.123

10.4227	668.363
17.6719	663.198
25.9869	658.867
34.2461	656.059
42.6887	654.39
52.3516	653.8
62.3555	653.709
71.0976	655.064
79.0197	657.821
84.6449	660.8

Valid / Invalid Surfaces

Method: spencer

- Number of Valid Surfaces: 6701
- Number of Invalid Surfaces: 9050

Error Codes:

- Error Code -105 reported for 2695 surfaces
- Error Code -106 reported for 2535 surfaces
- Error Code -108 reported for 3810 surfaces
- Error Code -1000 reported for 10 surfaces

Error Codes

The following errors were encountered during the computation:

- -105 = More than two surface / slope intersections with no valid slip surface.
- -106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
- -108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
- -1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

- **Global Minimum Query (spencer) - Safety Factor: 1.59892**

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	0.914921	54.8953	Topsoil	150	28	88.9719	142.259	-14.5588	-670.199	-14.5588
2	2.74476	823.429	Lime Treated Earthfill	150	24	134.768	215.484	147.079	-557.858	147.079
3	3.42062	2377.25	Existing Dam / Subgrade	200	17.488	206.932	330.868	415.363	-387.802	415.363
4	3.42062	3847.94	Existing Dam / Subgrade	200	17.488	267.054	426.998	720.474	-220.39	720.474
5	3.06893	4622.86	Existing Dam / Subgrade	200	17.488	332.498	531.637	1052.59	-71.4021	1052.59
6	3.06893	5426.84	Existing Dam / Subgrade	200	17.488	361.399	577.848	1253.01	53.7537	1199.26
7	3.62459	7084.97	Existing Dam / Subgrade	200	17.488	392.467	627.523	1524.96	168.042	1356.92

8	3.62459	7660.05	Existing Dam / Subgrade	200	17.488	398.288	636.83	1659.94	273.476	1386.46
9	4.15751	9304.05	Existing Dam / Subgrade	200	17.488	426.235	681.515	1894.59	366.301	1528.29
10	4.15751	9679.9	Existing Dam / Subgrade	200	17.488	426.519	681.969	1975.76	446.031	1529.73
11	4.12958	9809.46	Existing Dam / Subgrade	299.602	14.2006	449.392	718.542	2160.99	505.423	1655.56
12	4.12958	9825.32	Existing Dam / Subgrade	299.602	14.2006	444.04	709.985	2165.18	543.432	1621.75
13	4.22131	9914.3	Existing Dam / Subgrade	299.602	14.2006	455.713	728.648	2260.4	564.902	1695.5
14	4.22131	9639.55	Existing Dam / Subgrade	299.602	14.2006	445.121	711.713	2197.8	569.221	1628.58
15	4.83143	10512.1	Existing Dam / Subgrade	299.602	14.2006	450.464	720.256	2216.44	554.111	1662.33
16	4.83143	9785.24	Existing Dam / Subgrade	200	17.488	429.621	686.93	2064.77	519.296	1545.47
17	3.33465	6296.56	Existing Dam / Subgrade	200	17.488	418.062	668.448	1971	484.188	1486.82
18	3.33465	5883.81	Existing Dam / Subgrade	200	17.488	399.996	639.561	1843.73	448.605	1395.13
19	3.33465	5471.13	Existing Dam / Subgrade	200	17.488	382.328	611.312	1716.56	411.096	1305.47
20	4.37105	6368.55	Existing Dam / Subgrade	200	17.488	383.354	612.952	1654.79	344.114	1310.68
21	4.37105	5301.92	Existing Dam / Subgrade	200	17.488	350.911	561.079	1389.84	243.81	1146.03
22	6.13786	5181.25	Existing Dam / Subgrade	200	17.488	328.854	525.811	1113.52	79.4226	1034.1
23	1.78417	937.841	Compacted Earthfill	150	20	259.213	414.461	726.601	-102.949	726.601
24	3.73704	1005.54	Compacted Earthfill	150	20	201.658	322.435	473.761	-81.324	473.761
25	1.88819	113.292	Topsoil	150	28	161.624	258.424	203.915	-163.113	203.915

Interslice Data

- **Global Minimum Query (spencer) - Safety Factor: 1.59892**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-6.21605	685.6	0	0	0
2	-5.30113	684.6	-95.9609	-20.7563	12.205
3	-2.55637	681.6	-24.6306	-5.3276	12.2051
4	0.86425	677.861	820.454	177.464	12.205
5	4.28487	674.123	2600.6	562.509	12.205
6	7.3538	671.243	4611.59	997.485	12.205
7	10.4227	668.363	7111.09	1538.13	12.2051
8	14.0473	665.78	9626.58	2082.23	12.2051
9	17.6719	663.198	12469.5	2697.15	12.205

10	21.8294	661.032	14800.5	3201.34	12.205
11	25.9869	658.867	17306.1	3743.3	12.205
12	30.1165	657.463	18483.6	3998	12.205
13	34.2461	656.059	19689.1	4258.75	12.205
14	38.4674	655.225	19652.3	4250.78	12.205
15	42.6887	654.39	19607.9	4241.18	12.205
16	47.5202	654.095	18085.2	3911.83	12.2051
17	52.3516	653.8	16618.5	3594.58	12.205
18	55.6862	653.77	15284	3305.92	12.205
19	59.0209	653.74	14005.8	3029.45	12.205
20	62.3555	653.709	12782.7	2764.89	12.205
21	66.7266	654.387	9986.01	2159.97	12.205
22	71.0976	655.064	7510.63	1624.55	12.2051
23	77.2355	657.2	3113.93	673.541	12.205
24	79.0197	657.821	2200.35	475.934	12.205
25	82.7567	659.8	509.092	110.116	12.205
26	84.6449	660.8	0	0	0

List Of Coordinates

External Boundary

X	Y
120	640
120	656.3
108.8	656.3
95.4	660.8
81.4	660.8
7	685.6
-7	685.6
-26.8014	679
-41.8	674
-48.2	674
-57.1261	671
-60.1	670
-65.8	670
-82.8	664.3
-89.9	663
-91.1	662.9
-100	662.4
-100	657.9
-100	640.1

Material Boundary

X	Y
-82.8	664.3
-57.2	669
-53.8	670
-41.8	674
-38.6	674

-6.8	684.6
6.9	684.6
78.204	660.8
81.2	659.8
95.3	659.8
105.7	656.3
108.8	656.3

Material Boundary

X	Y
-57.2	669
-42.8	669
-27.8	674
-5	681.6
5	681.6
61.5	660.8
70.4	657.2
78.6	657.2
81.4	657.2
85	657.2
100.6	657.2
105.7	656.3

Material Boundary

X	Y
-60.1	670
-53.8	670

Material Boundary

X	Y
-60.1	670
-60.1	669
-57.2	669

Material Boundary

X	Y
-100	657.9
-64.6	657.9
75.2	653
78.6	653
81.4	653
85	653
85	657.2
90.4	655.5
111.2	655.5
113.7	656
120	656.3

Material Boundary

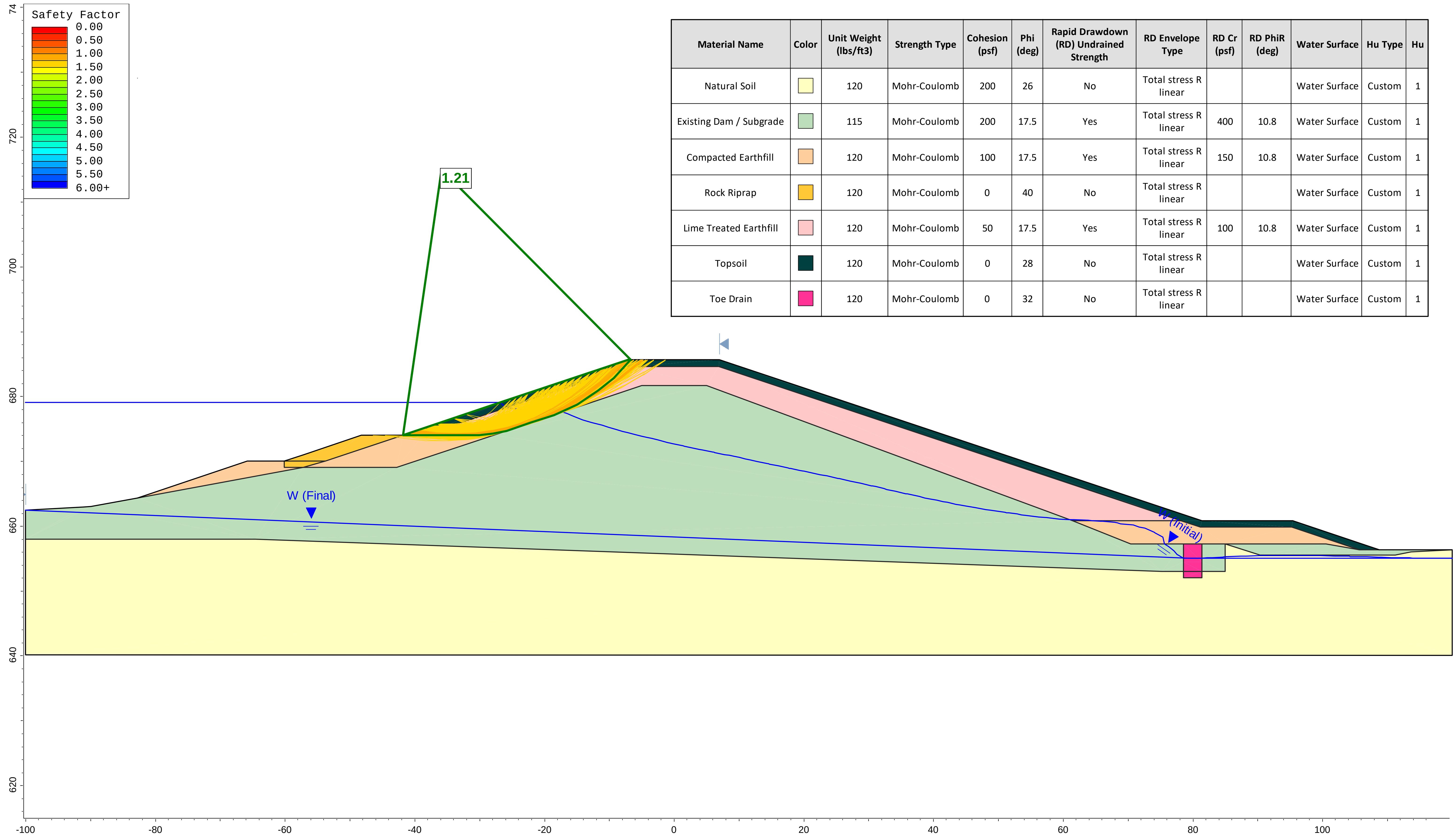
X	Y
61.5	660.8
78.204	660.8

Material Boundary

X	Y
-38.6	674
-27.8	674

Material Boundary

X	Y
78.6	657.2
78.6	654.41
78.6	653
78.6	652
81.4	652
81.4	653
81.4	654.41
81.4	657.2



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Rapid Drawdown (RD) Undrained Strength	RD Envelope Type	RD Cr (psf)	RD PhiR (deg)	Water Surface	Hu Type	Hu
Natural Soil		120	Mohr-Coulomb	200	26	No	Total stress R linear			Water Surface	Custom	1
Existing Dam / Subgrade		115	Mohr-Coulomb	200	17.5	Yes	Total stress R linear	400	10.8	Water Surface	Custom	1
Compacted Earthfill		120	Mohr-Coulomb	100	17.5	Yes	Total stress R linear	150	10.8	Water Surface	Custom	1
Rock Riprap		120	Mohr-Coulomb	0	40	No	Total stress R linear			Water Surface	Custom	1
Lime Treated Earthfill		120	Mohr-Coulomb	50	17.5	Yes	Total stress R linear	100	10.8	Water Surface	Custom	1
Topsoil		120	Mohr-Coulomb	0	28	No	Total stress R linear			Water Surface	Custom	1
Toe Drain		120	Mohr-Coulomb	0	32	No	Total stress R linear			Water Surface	Custom	1

Slide Analysis Information
SLIDE - An Interactive Slope Stability Program

Project Summary

- File Name: Section Station 12 - RDD
- Slide Modeler Version: 6.039
- Project Title: SLIDE - An Interactive Slope Stability Program
- Date Created: 3/29/2018, 4:22:35 PM

General Settings

- Units of Measurement: Imperial Units
- Time Units: days
- Permeability Units: feet/minute
- Failure Direction: Right to Left
- Data Output: Standard
- Maximum Material Properties: 20
- Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

  - Spencer
- Number of slices: 25
- Tolerance: 0.005
- Maximum number of iterations: 50
- Check malpha < 0.2: Yes
- Initial trial value of FS: 1
- Steffensen Iteration: Yes

Groundwater Analysis

- Groundwater Method: Water Surfaces
- Pore Fluid Unit Weight: 62.4 lbs/ft3
- Advanced Groundwater Method: Rapid Drawdown
- Rapid Drawdown Method: Army Corp. Eng. 2 Stage (1970)

Random Numbers

- Pseudo-random Seed: 10116
- Random Number Generation Method: Park and Miller v.3

Surface Options

- Search Method: Auto Refine Search
- Divisions along slope: 15
- Circles per division: 15
- Number of iterations: 10
- Divisions to use in next iteration: 50%
- Number of vertices per surface: 12
- Minimum Elevation: Not Defined
- Minimum Depth: Not Defined

Material Properties

Property	Natural Soil	Existing Dam / Subgrade	Compacted Earthfill	Rock Riprap	Lime Treated Earthfill	Topsoil	Toe Drain
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	115	120	120	120	120	120
Cohesion [psf]	200	200	100	0	50	0	0
Friction Angle [deg]	26	17.5	17.5	40	17.5	28	32
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1
Rapid Drawdown Undrained Behaviour		Yes	Yes		Yes		
RD Shear Strength Envelope Properties		CR: 400 PhiR: 10.8	CR: 150 PhiR: 10.8		CR: 100 PhiR: 10.8		

Global Minimums

Method: spencer

- FS: 1.210310
- Axis Location: -35.841, 714.918
- Left Slip Surface Endpoint: -41.800, 674.000
- Right Slip Surface Endpoint: -6.682, 685.600
- Resisting Moment=197719 lb-ft
- Driving Moment=163363 lb-ft
- Resisting Horizontal Force=4387.89 lb
- Driving Horizontal Force=3625.44 lb
- Total Slice Area=149.907 ft2

Global Minimum Coordinates

Method: spencer

X	Y
-41.8	674
-34.9006	674
-33.6712	674
-30.0991	674
-27.949	674.216
-25.7989	674.667
-22.0997	675.9
-18.5277	677.091
-14.9556	678.721
-11.6417	680.893
-9.29162	682.809
-6.68249	685.6

Valid / Invalid Surfaces

Method: spencer

- Number of Valid Surfaces: 12669
- Number of Invalid Surfaces: 3082

Error Codes:

- Error Code -105 reported for 269 surfaces
- Error Code -106 reported for 2265 surfaces
- Error Code -108 reported for 500 surfaces
- Error Code -111 reported for 1 surface
- Error Code -122 reported for 42 surfaces
- Error Code -1000 reported for 5 surfaces

Error Codes

The following errors were encountered during the computation:

- -105 = More than two surface / slope intersections with no valid slip surface.
- -106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
- -108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
- -111 = safety factor equation did not converge
- -122 = Unable to compute undrained shear strength in drawdown stage. Most likely due to negative base effective stresses.
- -1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

- **Global Minimum Query (spencer) - Safety Factor: 1.21031**

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.60008	51.2025	Topsoil	0	28	15.9875	19.3498	36.3917	0	36.3917
2	1.60008	153.608	Topsoil	0	28	47.9625	58.0495	109.175	0	109.175
3	1.8496	305.167	Lime Treated Earthfill	83.3854	0	68.8959	83.3854	183.916	0	183.916
4	1.8496	442.002	Lime Treated Earthfill	94.23	0	77.8561	94.23	260.357	0	260.357
5	1.22946	369.514	Lime Treated Earthfill	103.258	0	85.3153	103.258	323.99	0	323.99
6	1.78603	644.513	Lime Treated Earthfill	112.1	0	92.6209	112.1	386.31	0	386.31
7	1.78603	772.115	Lime Treated Earthfill	122.572	0	101.273	122.572	460.132	0	460.132
8	1.07504	519.299	Lime Treated Earthfill	123.542	0	102.075	123.542	487.399	0	487.399
9	1.07504	551.6	Lime Treated Earthfill	127.662	0	105.479	127.662	517.217	0	517.217
10	2.1501	1169.78	Lime Treated Earthfill	126.733	0	104.711	126.733	520.829	0	520.829
11	1.23307	690.508	Lime Treated Earthfill	146.619	0	121.142	146.619	506.508	0	506.508
12	1.23307	690.509	Lime Treated Earthfill	156.742	0	129.506	156.742	506.06	0	506.06
13	1.23307	690.51	Lime Treated Earthfill	166.403	0	137.488	166.403	505.632	0	505.632

14	1.19069	666.777	Lime Treated Earthfill	175.637	0	145.117	175.637	505.22	0	505.22
15	1.19069	666.776	Lime Treated Earthfill	181.527	0	149.984	181.527	504.959	0	504.959
16	1.19069	666.776	Lime Treated Earthfill	187.297	0	154.751	187.297	504.702	0	504.702
17	1.19068	656.302	Lime Treated Earthfill	187.607	0	155.007	187.607	464.761	0	464.761
18	1.19068	635.363	Lime Treated Earthfill	187.36	0	154.803	187.36	449.168	0	449.168
19	1.19068	614.425	Lime Treated Earthfill	184.435	0	152.387	184.435	433.933	0	433.933
20	1.65693	787.417	Lime Treated Earthfill	167.986	0	138.796	167.986	357.959	0	357.959
21	1.65693	681.342	Lime Treated Earthfill	151.564	0	125.227	151.564	308.083	0	308.083
22	1.17506	405.641	Lime Treated Earthfill	128.974	0	106.563	128.974	234.957	0	234.957
23	1.17506	325.763	Lime Treated Earthfill	112.432	0	92.8952	112.432	185.458	0	185.458
24	1.30425	242.096	Lime Treated Earthfill	85.1828	0	70.381	85.1828	100.221	0	100.221
25	1.30489	89.7828	Topsoil	0	28	18.3965	22.2655	41.8753	0	41.8753

Interslice Data

- **Global Minimum Query (spencer) - Safety Factor: 1.21031**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-41.8	674	0	0	0
2	-40.1999	674	25.5804	7.02752	15.3615
3	-38.5998	674	102.322	28.1101	15.3614
4	-36.7502	674	229.747	63.1167	15.3615
5	-34.9006	674	373.742	102.676	15.3616
6	-33.6712	674	478.637	131.493	15.3615
7	-31.8851	674	644.071	176.941	15.3615
8	-30.0991	674	824.96	226.636	15.3615
9	-29.0241	674.108	882.079	242.328	15.3615
10	-27.949	674.216	939.638	258.14	15.3615
11	-25.7989	674.667	929.809	255.44	15.3615
12	-24.5659	675.078	871.002	239.284	15.3615
13	-23.3328	675.489	822.693	226.013	15.3615
14	-22.0997	675.9	784.403	215.494	15.3615
15	-20.909	676.297	756.671	207.875	15.3615
16	-19.7183	676.694	734.838	201.877	15.3615
17	-18.5277	677.091	718.782	197.466	15.3615
18	-17.337	677.634	650.779	178.784	15.3615
19	-16.1463	678.178	591.008	162.364	15.3615
20	-14.9556	678.721	536.637	147.427	15.3615
21	-13.2987	679.807	377.941	103.829	15.3615

22	-11.6417	680.893	250.919	68.9332	15.3615
23	-10.4667	681.851	151.01	41.4859	15.3615
24	-9.29162	682.809	82.4686	22.656	15.3615
25	-7.98738	684.204	34.4437	9.46249	15.3615
26	-6.68249	685.6	0	0	0

List Of Coordinates

Water Table

X	Y
-100	679
-26.8006	679
-26.7973	678.997
-25.9374	678.221
-25.5094	678.2
-25.0573	678.164
-23.4411	678.008
-23.1506	677.992
-21.6622	677.897
-20.4438	677.817
-19.7508	677.77
-18.9137	677.687
-17.2003	677.533
-16.4986	677.283
-15.7684	677.031
-14.0734	676.357
-12.7592	675.969
-12.4015	675.858
-11.1237	675.513
-10.1387	675.217
-9.56595	675.061
-8.95385	674.895
-7.87784	674.563
-7.14957	674.378
-5.93693	674.089
-4.95801	673.853
-4.21625	673.667
-3.42137	673.468
-2.49677	673.232
-1.00234	672.88
-0.585473	672.767
-0.251348	672.676
1.35723	672.325
1.57304	672.282
2.7639	672.03
3.90601	671.802
4.40351	671.7
5.9815	671.379
6.19501	671.336

6.2583	671.322
7.83205	670.983
8.51357	670.848
9.25398	670.695
10.0752	670.524
10.9743	670.339
11.8063	670.161
12.8566	669.942
14.4952	669.578
14.5801	669.56
14.7331	669.528
16.1366	669.228
17.5821	668.924
17.856	668.867
17.9669	668.844
19.416	668.551
19.9638	668.44
20.0128	668.431
21.7824	668.064
22.5783	667.891
23.5745	667.684
25.2793	667.319
25.3942	667.295
25.4523	667.282
27.1966	666.91
28.0351	666.727
28.8432	666.554
30.469	666.181
30.6085	666.151
31.0766	666.042
32.3886	665.745
32.8174	665.632
34.0861	665.348
35.7629	664.973
35.8823	664.945
35.9618	664.927
37.856	664.512
38.6861	664.324
39.57	664.136
40.5053	663.951
41.5077	663.738
42.1369	663.611
43.486	663.351
44.0373	663.246
44.9215	663.079
46.3985	662.821
46.4023	662.821
48.1225	662.525
48.771	662.418

51.0166	662.077
51.2653	662.039
51.5806	661.995
52.8912	661.805
53.5862	661.713
54.2874	661.617
55.6241	661.452
56.2827	661.39
57.4727	661.243
58.8161	661.138
59.4365	661.063
61.0107	660.98
61.3853	660.962
61.4944	660.956
61.5963	660.95
63.7819	660.841
63.8249	660.838
64.4853	660.8
65.8188	660.706
66.0774	660.675
67.9879	660.509
68.3663	660.437
68.8791	660.324
70.7995	660.114
71.7145	659.818
72.621	659.681
74.069	658.98
74.1053	658.972
74.1646	658.928
75.3593	658.222
75.6218	657.2
76.276	656.767
77.0931	656.14
77.6361	655.605
77.7892	655.509
78.6	655
78.7852	655
79.393	655
80.8581	655
81.4	655
82.2073	655.055
82.655	655.088
83.0348	655.116
84.5851	655.195
85	655.221
85.2802	655.23
87.4151	655.336
88.2834	655.361
90.3063	655.4

90.4154	655.402
90.514	655.403
92.6465	655.425
92.7426	655.425
94.9385	655.428
95.0286	655.428
97.1791	655.415
97.2674	655.415
97.3499	655.414
99.535	655.388
99.687	655.385
101.926	655.346
102.133	655.342
104.111	655.293
104.296	655.289
104.481	655.284
106.4	655.22
106.797	655.21
108.665	655.139
109.135	655.129
110.672	655.1
111.091	655.091
111.545	655.085
112.906	655.058
113.468	655.049
113.956	655.041
114.955	655.039
114.995	655.039
115.908	655.031
116.4	655.03
116.692	655.027
117.084	655.024
117.294	655.022
117.607	655.02
117.652	655.019
117.707	655.019
118.024	655.016
118.203	655.015
118.68	655.011
118.949	655.009
119.455	655.006
120	655

Drawdown Line

X	Y
-100	662.4
79.393	655
120	655

External Boundary

X	Y
120	640
120	656.3
108.8	656.3
95.4	660.8
81.4	660.8
7	685.6
-7	685.6
-26.8014	679
-41.8	674
-48.2	674
-57.1261	671
-60.1	670
-65.8	670
-82.8	664.3
-89.9	663
-91.1	662.9
-100	662.4
-100	657.9
-100	640.1

Material Boundary

X	Y
-82.8	664.3
-57.2	669
-53.8	670
-41.8	674
-38.6	674
-6.8	684.6
6.9	684.6
78.204	660.8
81.2	659.8
95.3	659.8
105.7	656.3
108.8	656.3

Material Boundary

X	Y
-57.2	669
-42.8	669
-27.8	674
-5	681.6
5	681.6
61.5	660.8
70.4	657.2
78.6	657.2
81.4	657.2
85	657.2

100.6	657.2
105.7	656.3

Material Boundary

X	Y
-60.1	670
-53.8	670

Material Boundary

X	Y
-60.1	670
-60.1	669
-57.2	669

Material Boundary

X	Y
-100	657.9
-64.6	657.9
75.2	653
78.6	653
81.4	653
85	653
85	657.2
90.4	655.5
111.2	655.5
113.7	656
120	656.3

Material Boundary

X	Y
61.5	660.8
78.204	660.8

Material Boundary

X	Y
-38.6	674
-27.8	674

Material Boundary

X	Y
78.6	657.2
78.6	654.41
78.6	653
78.6	652
81.4	652
81.4	653
81.4	654.41
81.4	657.2