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PAVEMENT DESIGN REPORT

Paint Brush Hills Filing No. 13E
El Paso County, Colorado

PCD Project No. SF-189

PREPARED FOR:

Landhuis Company
212 N. Wahsatch Ave. Ste 301
Colorado Springs, CO

JOB NO. 165451

November 16, 2018

Respectfully Submitted,

RMG – Rocky Mountain Group

Kelli Zigler, P. G.
Project Geologist

Reviewed by,

RMG – Rocky Mountain Group

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Sr. Geotechnical Project Manager

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PROFESSIONAL ENGINEER

Approved
By: Elizabeth NijKamp
Date:11/29/2018
El Paso County Planning & Community Development

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GENERAL SITE AND PROJECT DESCRIPTION

Location

Paint Brush Hills, Filing No. 13E is located northwest of the intersection of Towner Avenue and Londonderry Drive in El Paso County, Colorado. The location of the site is shown on the Site Vicinity Map, Figure 1

Existing Conditions

At the time of our field investigation the eastern portion of Filing 13E was ready for evaluation. The proposed streets were close to grade and utility mains and services had been installed. Curb and gutter had not been installed. The western portion of the Filing was not ready for investigation.

Project Description

This Pavement Design Report was performed to determine the subsurface conditions present along the roadway alignments and to develop recommendations for the design and construction of the proposed flexible pavements.

The proposed streets included in this investigation are shown on Figure 2. The streets considered below are classified as Urban Local. Beckham Street, Bracknell Place and Triborough Trail have 50-foot Right-of-Ways with 15-foot travel lanes.

FIELD INVESTIGATION AND SUBSURFACE CONDITIONS

Drilling

The subsurface conditions on the site were investigated by drilling twelve (12) exploratory test borings at maximum 500-foot spacing. The approximate locations of the test borings are presented in the Test Boring Location Plan, Figure 2.

The test borings were advanced with a power-driven, continuous-flight auger drill rig to depths of about 5 to 10 feet below the existing ground surface. Samples were obtained in general accordance with ASTM D-3550 utilizing a 2½-inch OD modified California sampler. Representative bulk samples of subsurface materials were obtained from each boring at a depth of approximately 0 to 2 feet below the existing ground surface. An Explanation of Test Boring Logs is presented in Figure 3. The Test Boring Logs are presented in Figures 4 through 9.

Subsurface Materials

The subsurface materials encountered in the test borings consisted of fairly well-graded silty and clayey sand. Combined bulk samples of the material classified as SM-SC according to the Unified Classification System. For pavement design purposes the combined bulk soil samples classified as A-1-b

and A-2-6 in accordance with the American Association of State Highway and Transportation Officials (ASSHTO) classification system. This soil classification is considered "excellent to good" as subgrade material.

Groundwater

Groundwater was not encountered in the test borings at the time of drilling. Groundwater is not expected to affect the construction of the pavements. Fluctuations in groundwater and subsurface moisture conditions may occur due to variations in precipitation and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

LABORATORY TESTING

Laboratory Testing

The moisture content for the recovered samples was obtained in the laboratory. Grain-size analysis and Atterberg Limits tests were performed on selected samples for purposes of classification and to develop pertinent engineering properties. A Summary of Laboratory Test Results is presented in Figure 10. Soil Classification Data are presented in Figures 11 through 13. Swell/consolidation test results are presented in Figure 14.

A bulk sample of A-1-b soil was tested to determine the optimum moisture-density relationship in accordance with ASTM D1557 (Modified Proctor compaction test). A bulk sample of the A-2-6 soils was tested to determine the optimum moisture-density relationship in accordance with ASTM D698 (Standard Proctor Test). For each soil type California Bearing Ratio CBR tests were performed at varying densities with moisture content near optimum. The Moisture-Density Relation Curves are presented in Figure 15 and 16. CBR Test Results are presented in Figures 17 through 20.

The CBR of each soil type at 95 percent of the maximum Proctor density is as follows:

Soil Type	CBR (Modified Proctor)	CBR (Standard Proctor)
A-1-b	16	
A-2-6		9.2

The developer intends to install a composite roadway section consisting of Hot Mix Asphalt over Cement-Treated Subgrade (CTS).

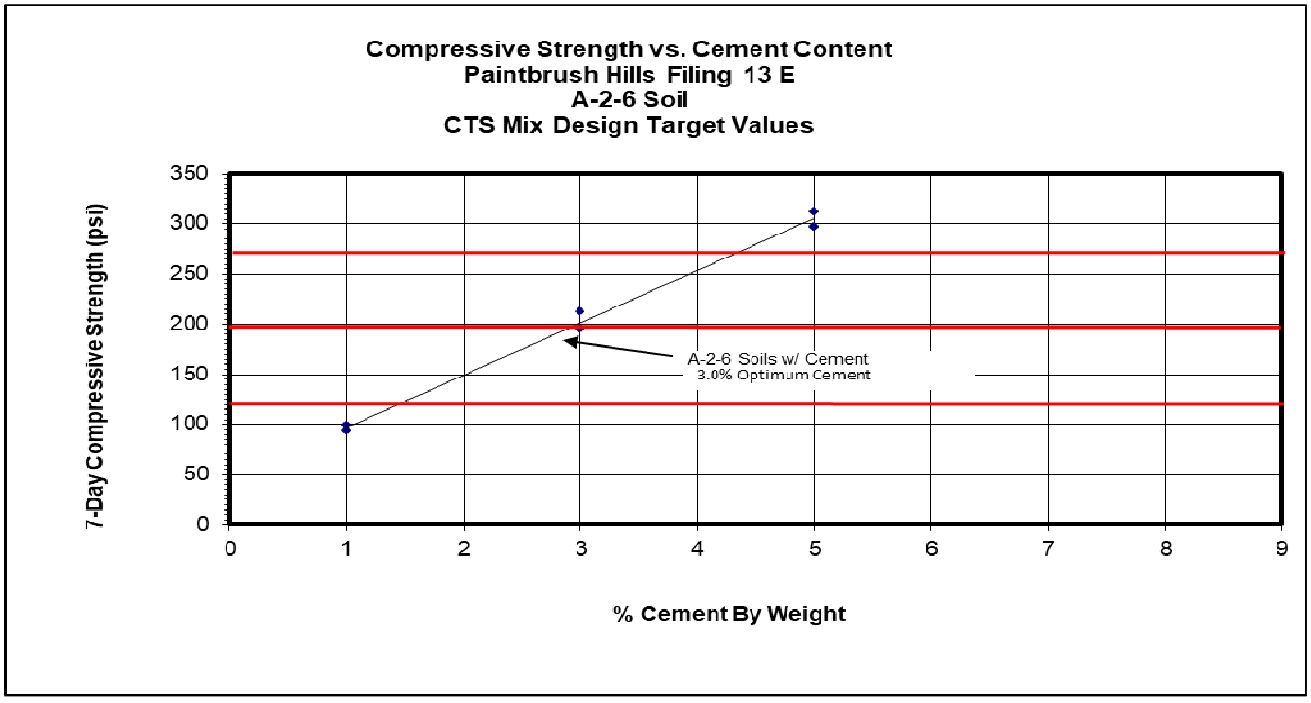
A-1-b and A-2-6 soils are interspersed throughout Filing 13E. As A-2-6 soil is the lessor quality subgrade material this soil was selected for use in the pavement design. Specimens of A-2-6 soil and Portland cement were prepared by varying the "percent cement by weight" at target values of 1, 3, and 5 percent cement. Two specimens (pucks) were prepared for each target cement value, compacted to 95% of the maximum Modified Proctor density and cured in a saturated condition for 7-days. The

compressive strength of each specimen was then determined upon completion of the 7-day curing process. The compressive strengths are presented in the table below:

Compressive Strength Calculations A-2-6 Soil

CTS Puck	Age/Day	Cap & Plate	Area of Sample	Dial Reading	Load LBF	Total Load	PSI
1A	7	2.82	12.566	116	1173.6	1176.4	94
1B	7	2.82	12.566	123	1244.4	1247.2	99
3A	7	2.82	12.566	242	2448.3	2451.1	195
3B	7	2.82	12.566	264	2670.9	2673.7	213
5A	7	2.82	12.566	369	3733.2	3736.0	297
5B	7	2.82	12.566	387	3915.3	3918.1	312

The data values were then plotted as a function of "7-day Compressive Strength versus Percent Cement by Weight". In accordance with the El Paso County Engineering Criteria Manual, the target "percent cement by weight" was selected to obtain strengths in the lower Strength Coefficient (SC) categories (SC = 0.11, 125-200 psi; SC = 0.12, 200-275 psi). A target SC = 0.11 is used for CTS soil in the pavement design procedure presented below. Based upon an evaluation of the test data, a target range of 3.0 percent cement is recommended to maintain strengths below the 275 psi threshold stipulated in the Engineering Criteria Manual. Graphical representations of the results are presented below:



PAVEMENT DESIGN

The discussion presented below is based on the subsurface conditions encountered in the test borings, laboratory test results and the project characteristics previously described. If the subsurface conditions are different from those described in this report or the project characteristics change, RMG should be retained to review our recommendations and modify them, if necessary. The conclusions and recommendations presented in this report should be verified by RMG during construction.

The pavement design was performed using the El Paso County Engineering Criteria Manual, Appendix D. The pavement design parameters and design calculations are presented below.

Street Classification – Urban Local

1) Beckham Street, Bracknell Place and Triborough Trail
   ESAL = 292,000 (Table D-2)
   Serviceability Index = 2.0 (Table D-1)

2) Strength coefficients (Table D-3)
   Asphalt (HMA): $a_1 = 0.44$
   Cement Stabilized Subgrade: $a_2 = 0.11$

3) Subgrade
   M_r = CBR x 1500 = 9.2 x 1500 = 13,800 psi

4) Structural number (SN) = 2.1 (per 1993 AASHTO Empirical Equation for Flexible Pavements, presented in Appendix A)

5) Composite asphalt/base course section
   Minimum HMA thickness = D_1 = 3 inches (Table D-2)
   CTS thickness = $D_2 = \{SN – (D_1 \times a_1)\} / a_2 = \{2.1 – (3 \times 0.44)\} / 0.11 = 7.1$ inches
   Minimum CTS thickness = 8 inches (Table D-2)
   SN = (3 x 0.44) + (8 x 0.11) = 2.20 > 2.10 (Min. SN required)
   Use minimum HMA thickness = 3.5 inches (Paragraph D.4.1-F: base course thickness cannot exceed 2.5 times the HMA thickness)

   SN = (3.5 x 0.44) + (8 x 0.11) = 2.42 > 2.10 (Min. SN required)

Pavement Thickness

The recommended pavement section is presented below and on Figure 2.1.

Recommended Pavement Section

Beckham Street, Bracknell Place and Triborough Trail	3.5” HMA	8" CTS
Optimal CTS Percent Cement by Weight = 3%		

Pavement Materials

Pavement materials should be selected, prepared, and placed in accordance with El Paso County specifications and the *Pikes Peak Region Asphalt Paving Specifications*. Tests should be performed in accordance with the applicable procedures presented in the specifications.

Soil Mitigation

The PDCM notes that mitigation measures may be required for expansive soils, shallow ground water, subgrade instability, etc. Based on the AASHTO classification of for the soils in the subdivision, the subgrade soils evaluated for this pavement design can be expected to be nonexpansive. Groundwater or wet and unstable soils were not encountered in the borings. Therefore, special mitigation measures do not appear to be necessary for subgrade preparation.

Subgrade Preparation

Subgrade for Filing 13E shall be Cement Treated Subgrade (CTS) composed of a mixture of local soil, water, and Portland cement compacted at optimum moisture. Prior to CTS construction the existing soil should be proof-rolled to a firm and unyielding condition. Areas which deform under wheel loads should be removed and replaced. The soil should then be scarified, pulverized, mixed with cement and water, compacted, finished and cured in lengths that allow the full roadway width to be completed in not more than 4 hours from the time that cement is exposed to water.

The quantity of cement shall be by weight as a percentage of the dry weight of the soil as specified herein (3% optimum), and should be applied uniformly on the soil to create a cement and water mixture for the full design width and depth. Mixing should be continuous until the mixture is at optimum moisture and ready for compacting and finishing. Compaction should begin within 30 minutes of mixing. CTS should be maintained in a moist condition during the curing process, and all traffic except for necessary construction equipment should be kept off the CTS for a minimum of 7 days or until the final pavement structure layers are placed.

CTS testing shall be in accordance with the El Paso County Engineering Criteria Manual. CTS compressive strength test results shall be submitted to the County prior to the placement of the asphalt,

in part to confirm the requirement for micro fracturing (MF). Micro fracturing of the CTS shall be performed when 7-day compressive strength test results indicate CTS strength in excess of 275 psi. The subgrade should be kept in a moist cured condition for 48 to 72 hours before any micro fracturing is performed by a heavy (12-ton) steel drum vibratory roller operating at maximum amplitude. After satisfactory completion of micro fracturing the subgrade should continue to be moist cured by sprinkling or other means.

Surface Drainage

Surface drainage is important for the satisfactory performance of pavement. Wetting of the subgrade soils or base course will cause a loss of strength which can result in pavement distress. Surface drainage should provide for efficient removal of storm-water runoff. Water should not pond on the pavement or at the edges of the pavement.

Subgrade Observations and Testing

The pavement thicknesses presented above assume pavement construction is completed in accordance with El Paso County specifications and the *Pikes Peak Region Asphalt Paving Specifications*. RMG should be present at the site during subgrade preparation, placement of fill, and construction of pavements to perform site observations and testing.

CLOSING

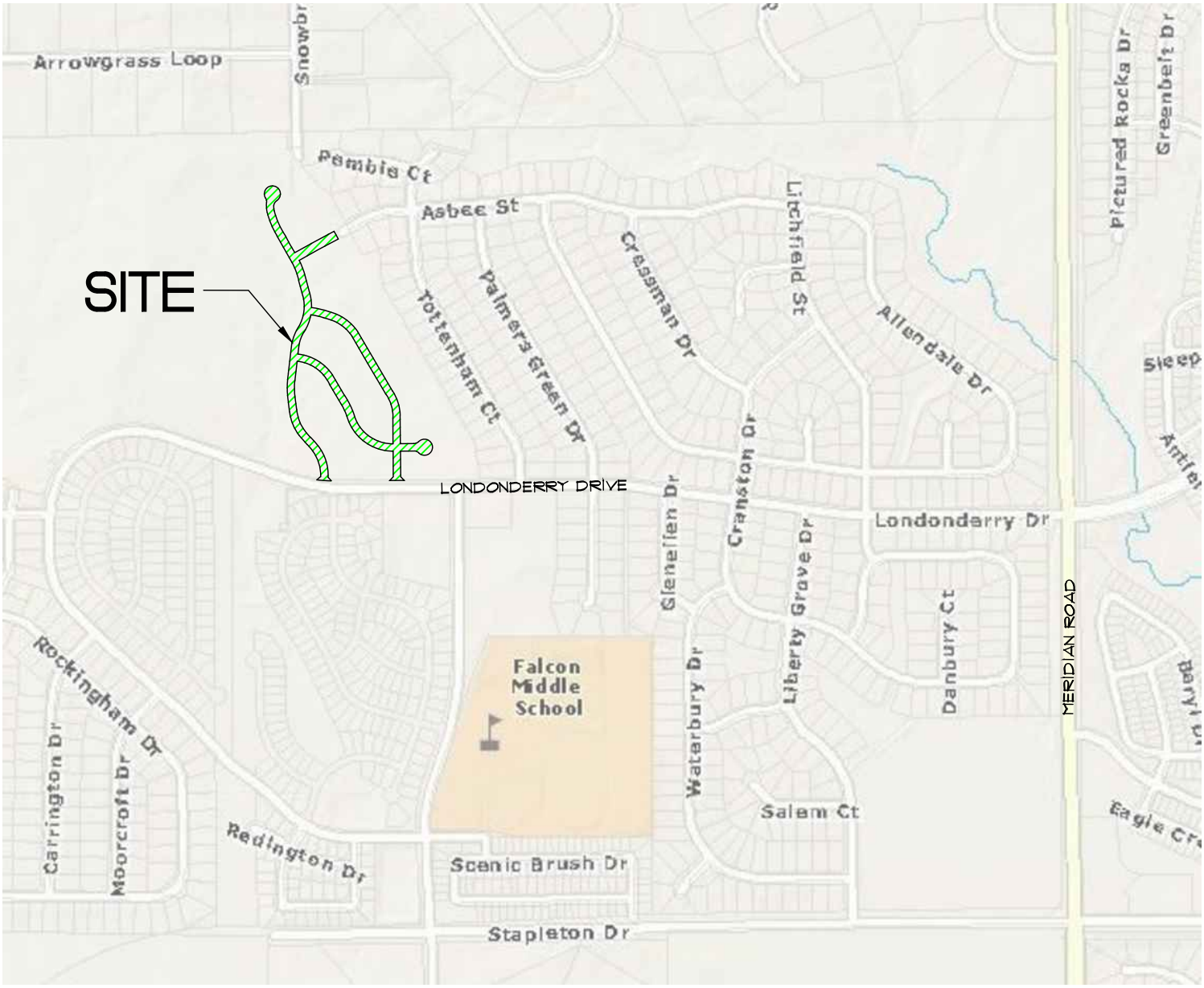
Our field exploration was conducted to provide geotechnical information for pavement thickness design. Variations in subsurface conditions not indicated by the borings may be encountered. This report has been prepared for **Landhuis Company** for application as an aid in the design of the proposed development in accordance with generally accepted geotechnical engineering practices. The analyses and recommendations in this report are based in part upon data obtained from exploratory borings and test pits, site observations and the information presented in referenced reports. The nature and extent of variations may not become evident until construction. If variations then become evident, RMG should be retained to re-evaluate the recommendations of this report, if necessary.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers practicing in this or similar localities. RMG Engineers does not warrant the work of regulatory agencies or other third parties supplying information which may have been used during the preparation of this report. No warranty, express or implied is made. Any contractor reviewing this report for bidding purposes must draw his own conclusions regarding site conditions and specific construction techniques to be used on this project.

This report is for the exclusive purpose of providing geotechnical information and pavement thickness design recommendations. The scope of services for this project does not include, either specifically or by implication, environmental assessment of the site or identification of contaminated or hazardous materials or conditions. Development of recommendations for the mitigation of environmentally related conditions, including but not limited to biological or toxicological issues, are beyond the scope of this report. If the Client desires investigation into the potential for such contamination or conditions, other studies should be undertaken.

If we can be of further assistance in discussing the contents of this report or analysis of the proposed development, from a geotechnical engineering point-of-view, please feel free to contact us.

FIGURES



REFERENCE
NOT TO SCALE

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Northern Office:
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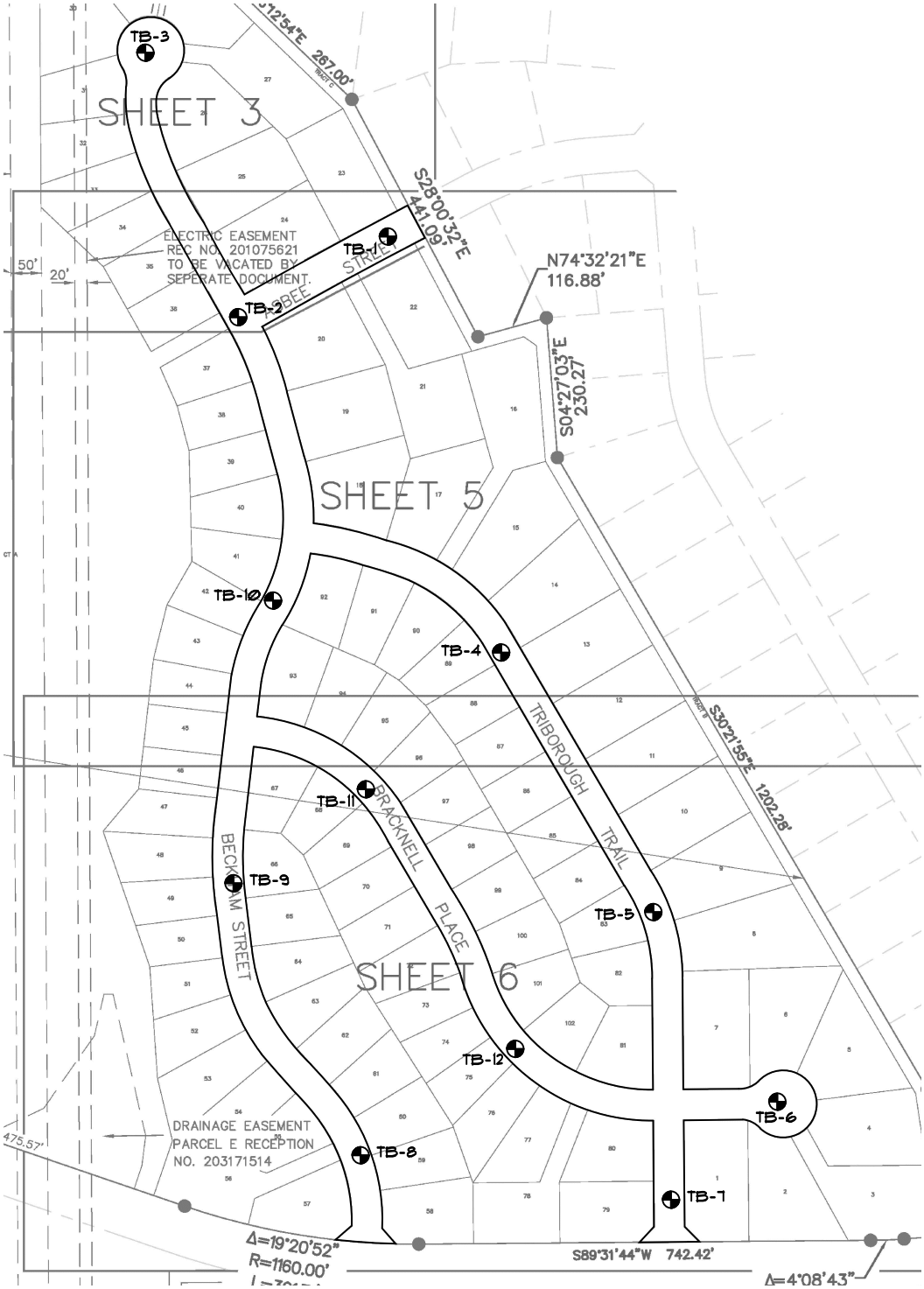
SITE VICINITY MAP

PAINT BRUSH HILLS
FILING NO. 13E, EAST PHASE
EL PASO COUNTY, CO
LANDHUIS COMPANY

JOB No. 165451

FIG No. 1

DATE 11-16-2018



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0 500 FT

@ 10 SCALE

DENOTES APPROXIMATE
LOCATION OF TEST BORINGS

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TEST BORING LOCATION PLAN

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FIG No. 2

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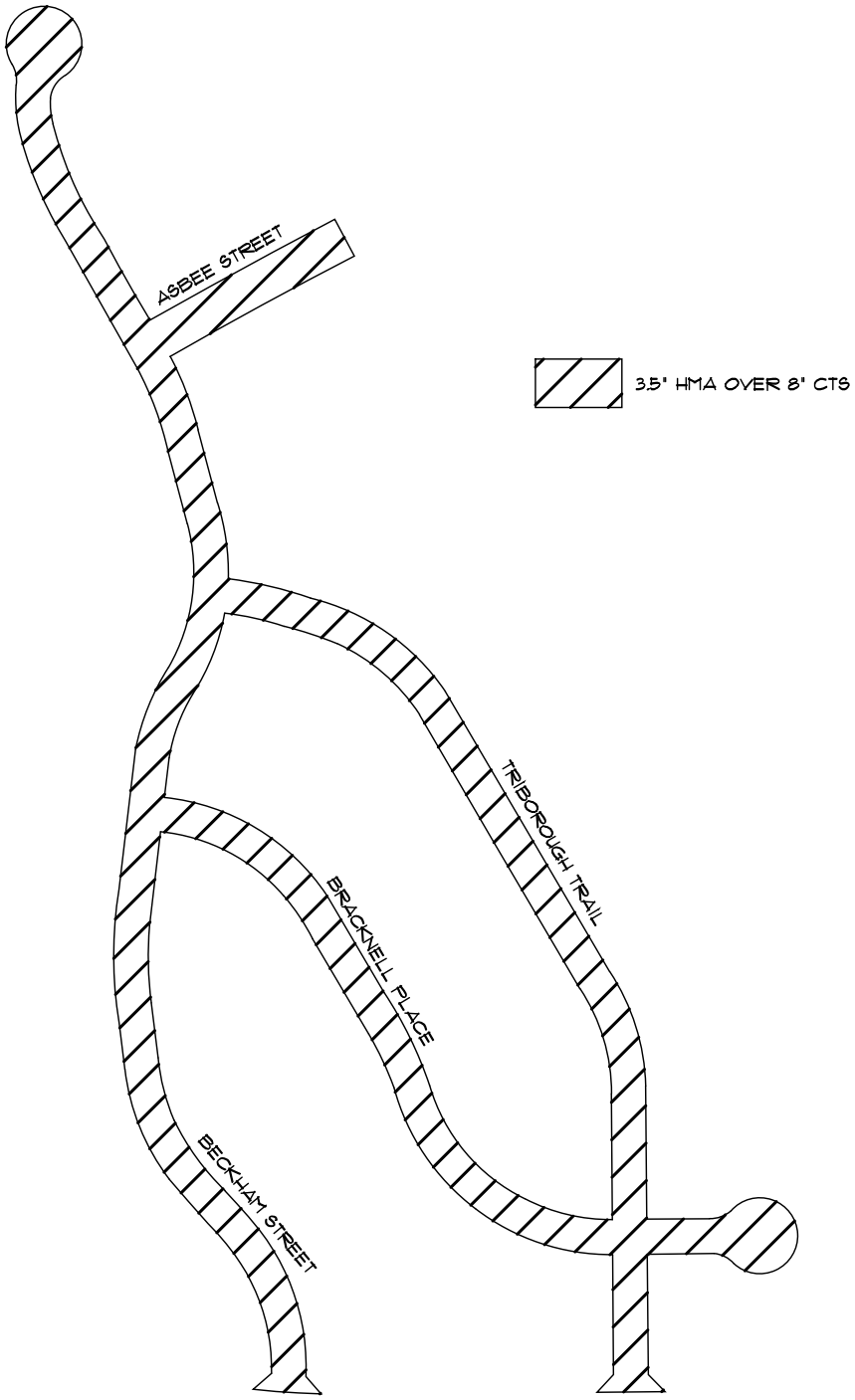

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FIG No. 2.1

DATE 11-16-2018

SOILS DESCRIPTION


CLAYEY SAND


FILL: SAND, SILTY TO CLAYEY


FILL: CLAY, SANDY


SANDSTONE


SANDY CLAY


SILTY SAND

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
RMG - ROCKY MOUNTAIN GROUP
2910 AUSTIN BLUFFS PARKWAY
COLORADO SPRINGS, COLORADO

SYMBOLS AND NOTES


XX — STANDARD PENETRATION TEST - MADE BY DRIVING A SPLIT-BARREL SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-1586. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).


XX — UNDISTURBED CALIFORNIA SAMPLE - MADE BY DRIVING A RING-LINED SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-3550. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).


FREE WATER TABLE


DEPTH AT WHICH BORING CAVED


BULK — DISTURBED BULK SAMPLE


AUG — AUGER "CUTTINGS"

4.5 — WATER CONTENT (%)

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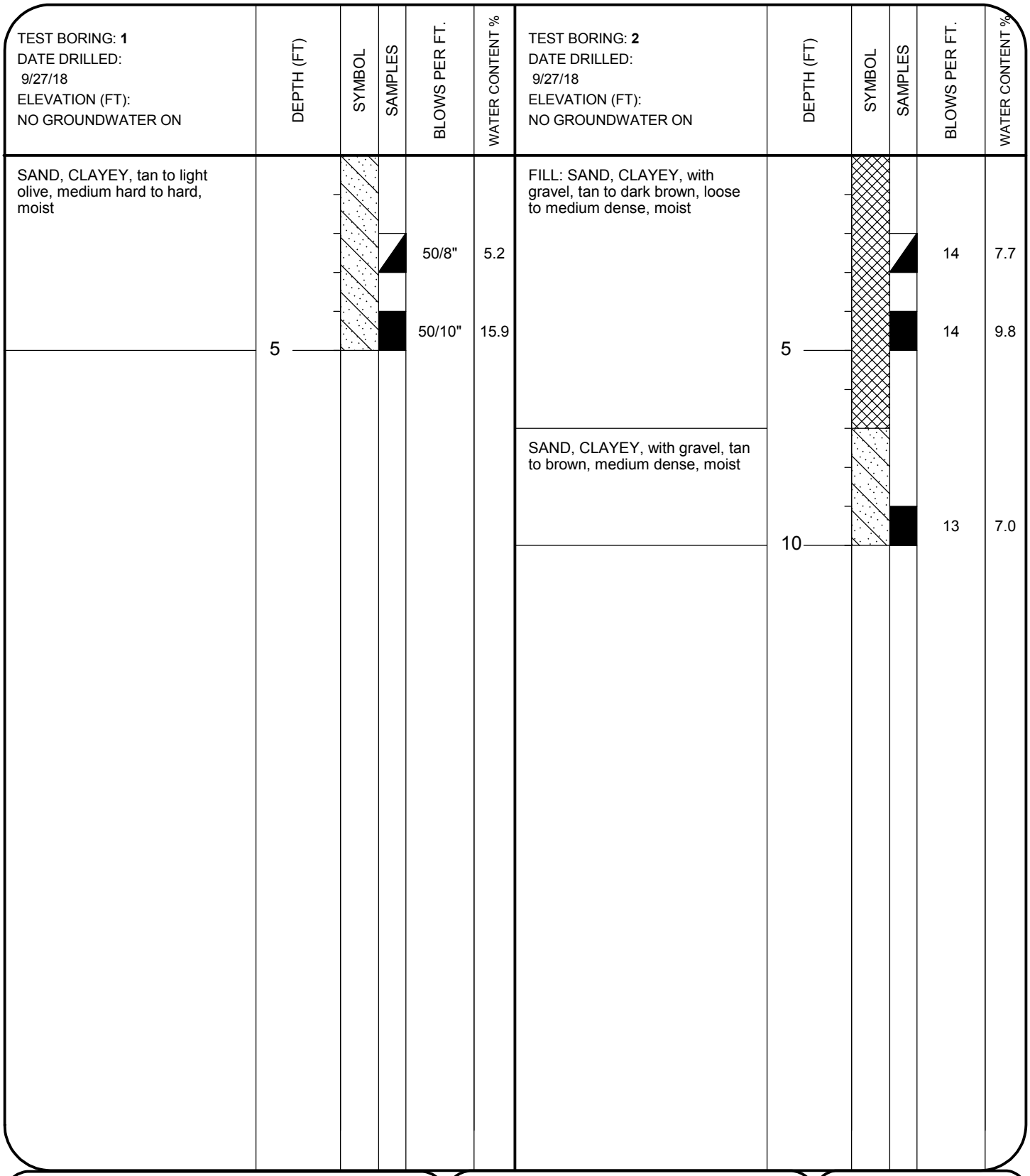
EXPLANATION OF TEST BORING LOGS

JOB No. 165451

FIGURE No. 3

DATE 11/16/18



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TEST BORING LOG

JOB No. 165451

FIGURE No. 4

DATE 11/16/18

TEST BORING: **3** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, CLAYEY, with gravel, brown to olive, medium dense, moist				21	4.9
				13	6.9
	5				

TEST BORING: **4** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, CLAYEY, with gravel, tan to brown and olive, loose to medium dense, moist				18	5.4
				13	8.3
	5				

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TEST BORING LOG

JOB No. 165451

FIGURE No. 5

DATE 11/16/18

TEST BORING: **5** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, CLAYEY, with gravel, tan to reddish brown and olive, loose, moist				15	8.7
				6	12.8
	5				

TEST BORING: **6** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: CLAY, SANDY, reddish brown to olive, hard, moist				43	14.0
CLAY, SANDY, olive, hard, moist				36	12.2
	5				

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TEST BORING LOG

JOB No. 165451

FIGURE No. 6

DATE 11/16/18

TEST BORING: **7** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, CLAYEY, with gravel, dark brown, moist					
SAND, CLAYEY, with gravel, tan to dark brown, loose to medium dense, moist				19	7.6
				9	9.1
	5				

TEST BORING: **8** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SAND, CLAYEY, brown to olive, loose, moist					
				11	7.0
				9	10.6
	5				

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TEST BORING LOG

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FIGURE No. 7

DATE 11/16/18

TEST BORING: **9** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SANDSTONE, SILTY TO CLAYEY, tan to olive, medium hard to hard, moist					
				50/8"	3.7
				50/10"	8.2
	5				

TEST BORING: **10** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SANDSTONE, CLAYEY, with gravel, tan to olive, medium hard to hard, moist					
				50/9"	4.6
				50/11"	9.6
	5				

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TEST BORING LOG

JOB No. 165451

FIGURE No. 8

DATE 11/16/18

TEST BORING: **11** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, CLAYEY, with organics, brown to olive, medium dense, moist				40	4.2
SANDSTONE, CLAYEY, with gravel, brown to gray, medium hard, moist				48	4.8
	5				

TEST BORING: **12** DATE DRILLED: 9/27/18 ELEVATION (FT): NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, CLAYEY, with organics, brown, loose, moist				12	3.2
SAND, SILTY, with gravel, tan to brown, loose to medium dense, moist				12	2.3
	5				
SANDSTONE, CLAYEY, with gravel, tan to gray, hard, moist				50	6.0
	10				

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TEST BORING LOG

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FIGURE No. 9

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Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.4 Sieve	% Passing No. 200 Sieve	FHA Expansion Pressure (psf)	% Swell/ Collapse	USCS Classification
1	2.0	5.2		NP	NP	0.9	37.2			SM
1	4.0	15.9								
2	2.0	7.7		37	17	6.8	27.9			SC
2	4.0	9.8								
2	9.0	7.0								
3	2.0	4.9		NP	NP	10.2	20.0			SM
3	4.0	6.9								
4	2.0	5.4		39	19	6.8	26.0			SC
4	4.0	8.3								
5	2.0	8.7		35	17	5.0	29.0			SC
5	4.0	12.8								
6	2.0	14.0		40	14	0.8	29.7			SM
6	4.0	12.2								
7	2.0	7.6	106.3	38	20	5.9	26.6		- 2.3	SC
7	4.0	9.1								
8	2.0	7.0		34	17	9.1	23.3			SC
8	4.0	10.6								
9	2.0	3.7		NP	NP	7.7	15.7			SM
9	4.0	8.2								
10	2.0	4.6		NP	NP	7.1	18.7			SM
10	4.0	9.6								
11	2.0	4.2		NP	NP	11.0	18.3			SM
11	4.0	4.8								
12	2.0	3.2		NP	NP	12.3	18.4			SM
12	4.0	2.3								
12	9.0	6.0								

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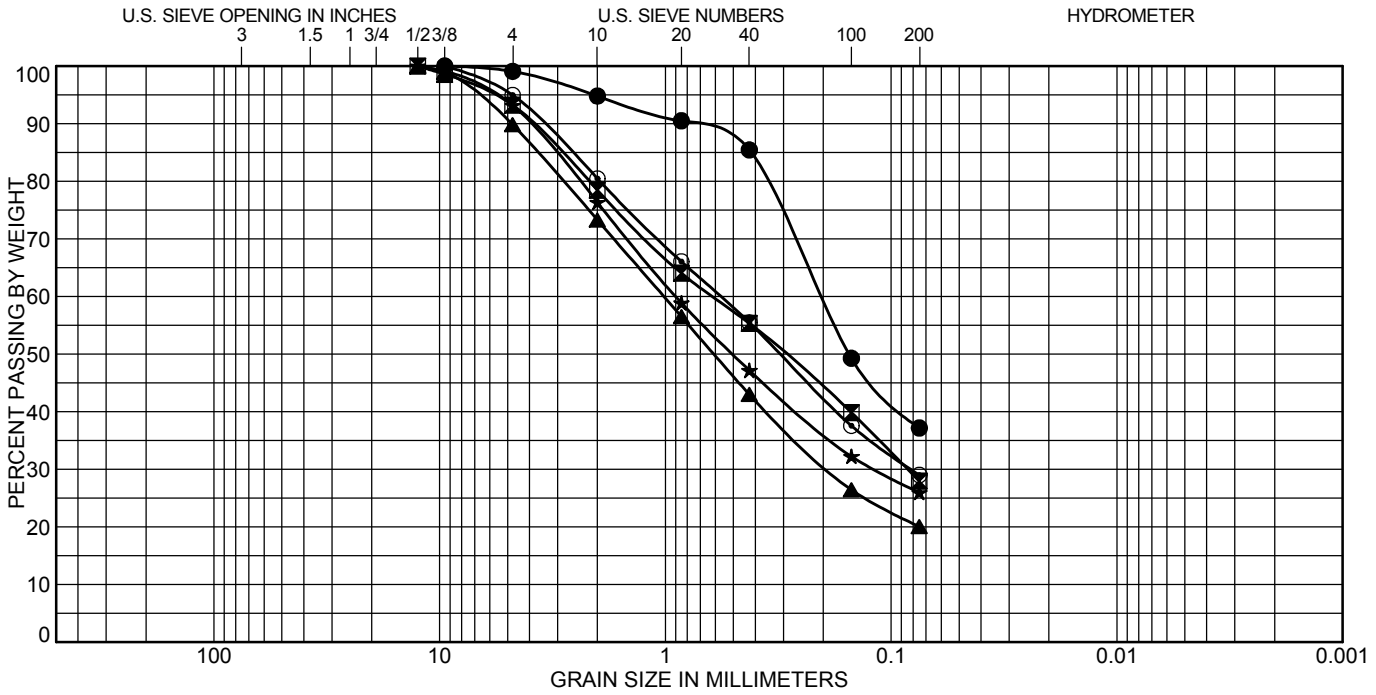
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 165451
FIGURE No. 10
PAGE 1 OF 1
DATE 11/16/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	1	2.0	A-4 (0)	NP	NP	NP		
⊠	2	2.0	A-2-6 (1)	37	20	17		
▲	3	2.0	A-1-b (0)	NP	NP	NP		
★	4	2.0	A-2-6 (1)	39	20	19		
⊙	5	2.0	A-2-6 (1)	35	18	17		

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	2.0	0.9	61.9	37.2	
⊠	2	2.0	6.8	65.3	27.9	
▲	3	2.0	10.2	69.8	20.0	
★	4	2.0	6.8	67.2	26.0	
⊙	5	2.0	5.0	66.0	29.0	

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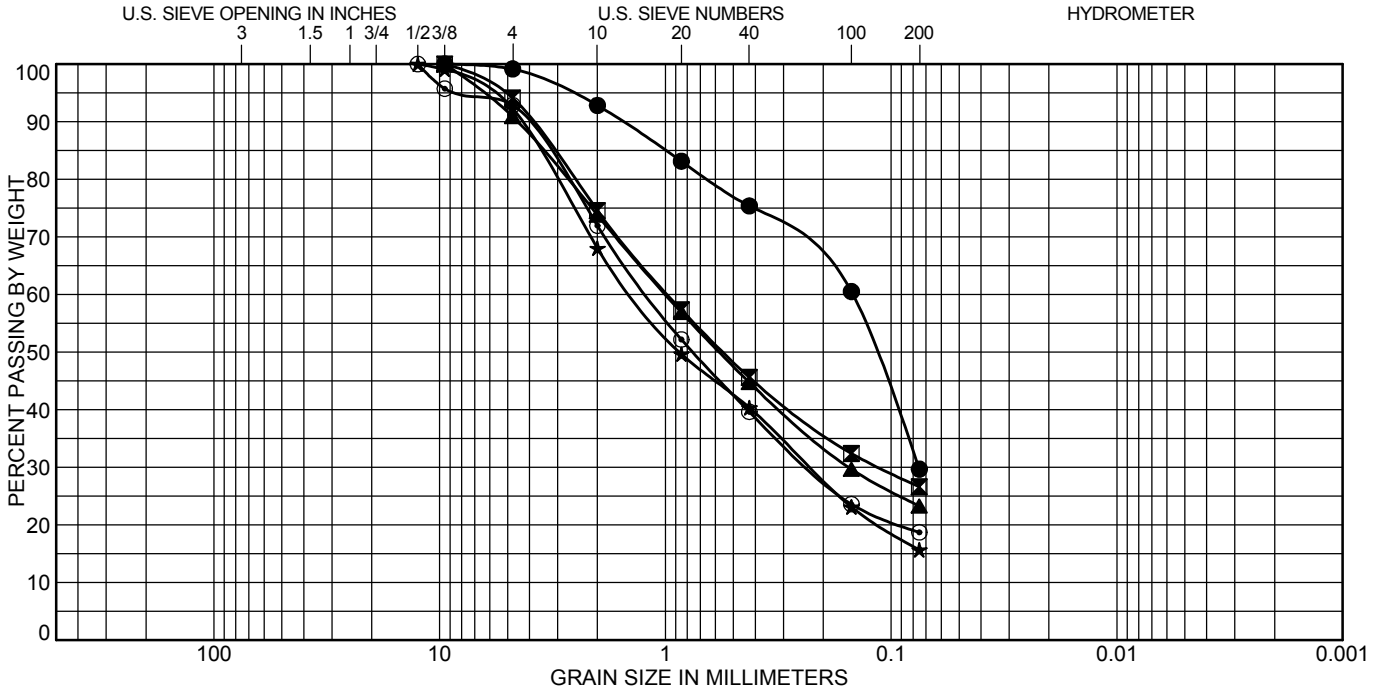
SOIL CLASSIFICATION DATA

JOB No. 165451

FIGURE No. 11

DATE 11/16/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	6	2.0	A-2-6 (1)	40	26	14		
⊠	7	2.0	A-2-6 (1)	38	18	20		
▲	8	2.0	A-2-6 (1)	34	17	17		
★	9	2.0	A-1-b (0)	NP	NP	NP		
⊙	10	2.0	A-1-b (0)	NP	NP	NP		

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	6	2.0	0.8	69.5	29.7	
⊠	7	2.0	5.9	67.5	26.6	
▲	8	2.0	9.1	67.6	23.3	
★	9	2.0	7.7	76.6	15.7	
⊙	10	2.0	7.1	74.2	18.7	

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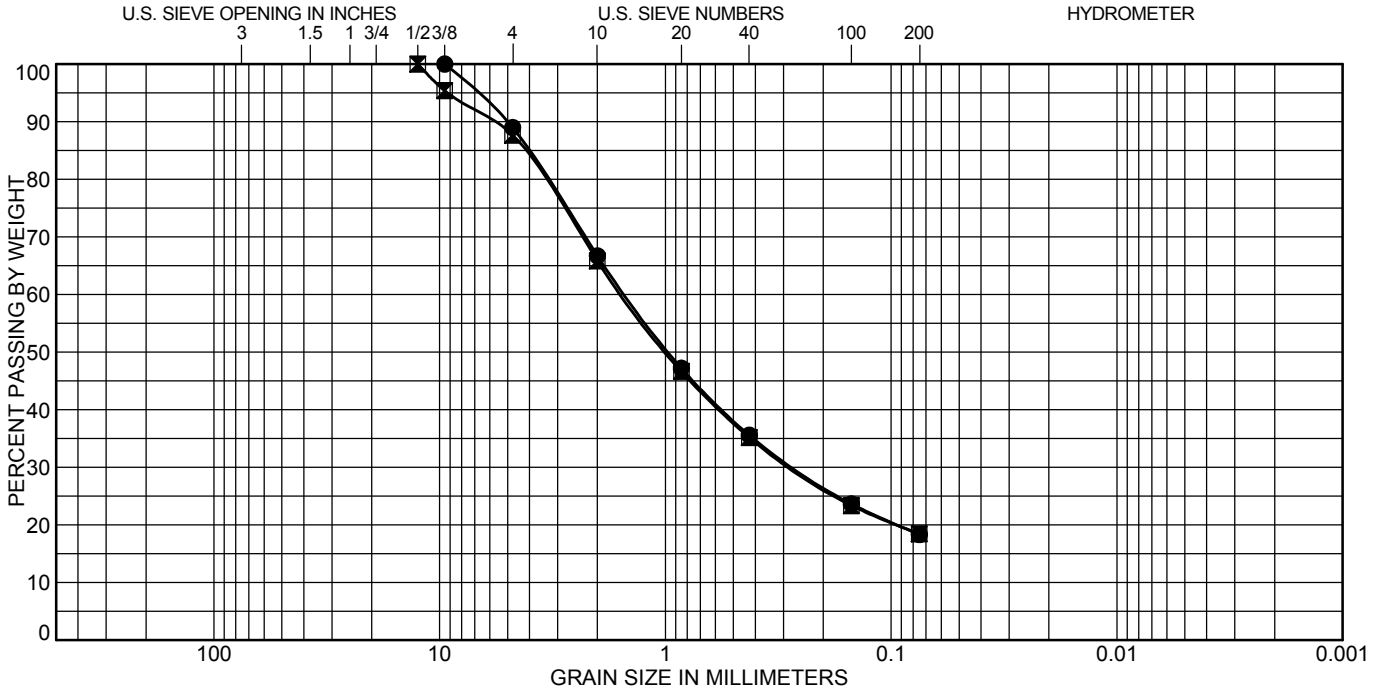
SOIL CLASSIFICATION DATA

JOB No. 165451

FIGURE No. 12

DATE 11/16/18



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	**11**	**2.0**	**A-1-b (0)**	**NP**	**NP**	**NP**		
⧓	**12**	**2.0**	**A-1-b (0)**	**NP**	**NP**	**NP**		

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	**11**	**2.0**	**11.0**	**70.7**	**18.3**	
⧓	**12**	**2.0**	**12.3**	**69.3**	**18.4**	

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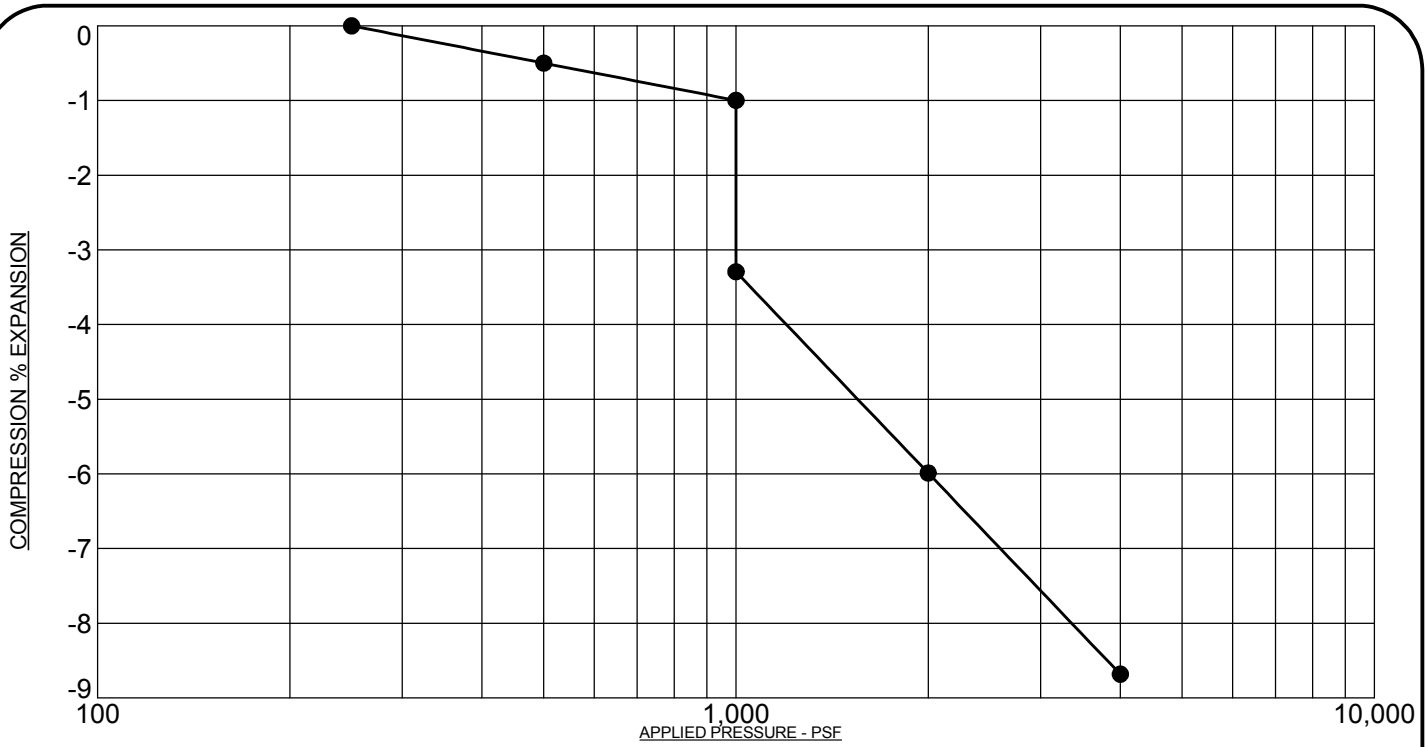
SOIL CLASSIFICATION DATA

JOB No. 165451

FIGURE No. 13

DATE 11/16/18



PROJECT: **Paint Brush Hills, Filing No. 13E (East side), El Paso County, Colorado**
RMG SOIL TYPE:
SAMPLE DESCRIPTION: **SAND, CLAYEY**
NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: **7 @ 2 FT**
NATURAL DRY UNIT WEIGHT: **106.3 PCF**
NATURAL MOISTURE CONTENT: **7.6%**
PERCENT SWELL/COMPRESSION: **- 2.3**

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SWELL/CONSOLIDATION TEST RESULTS

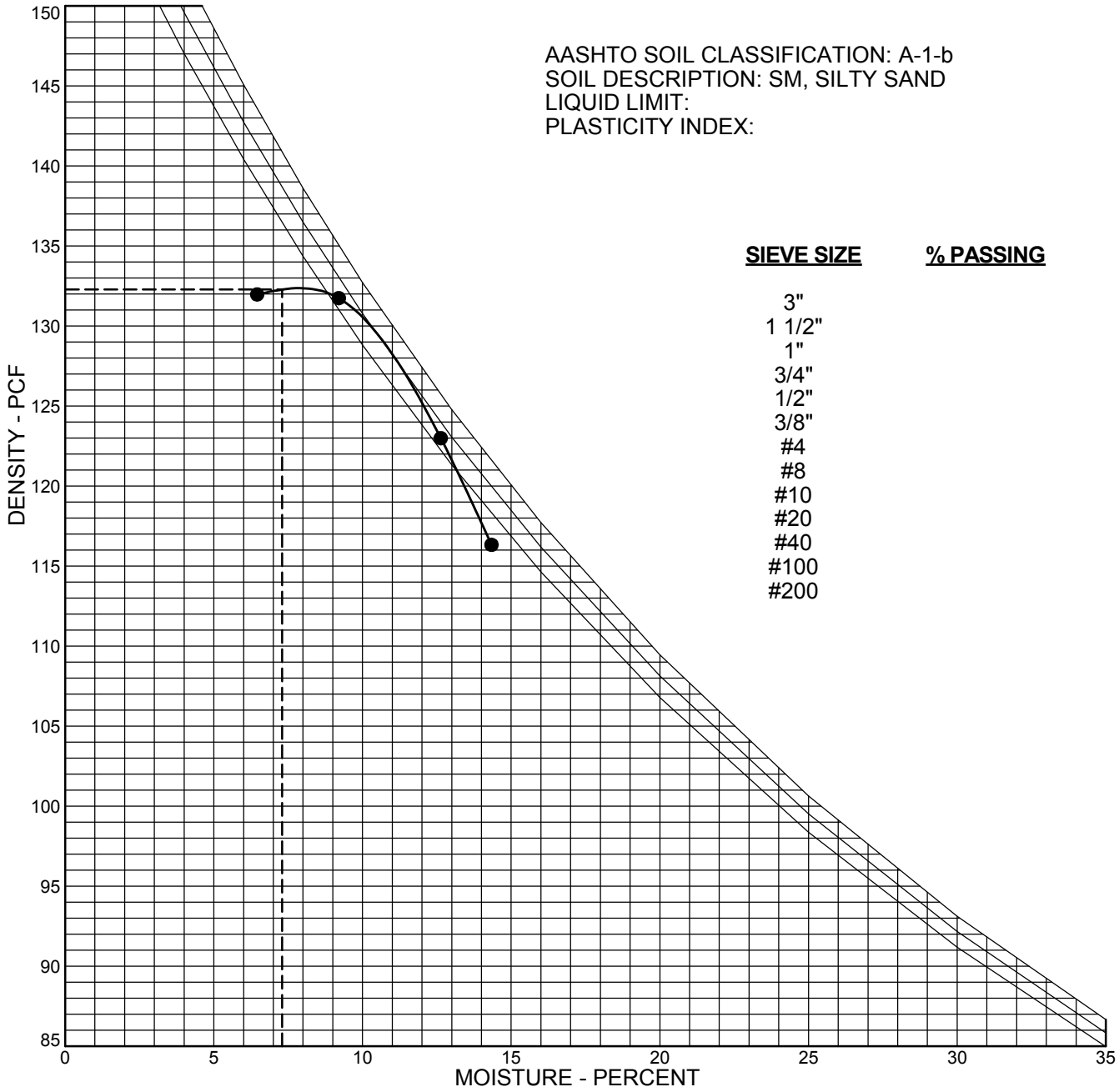
JOB No. 165451

FIGURE No. 14

DATE 11/16/18

CLIENT: **Landhuis Company** SAMPLE NUMBER: **PROCTOR 3**

PROJECT: Paint Brush Hills, Filing No. 13E, El Paso County, Colorado



AASHTO SOIL CLASSIFICATION: A-1-b
SOIL DESCRIPTION: SM, SILTY SAND
LIQUID LIMIT:
PLASTICITY INDEX:

SIEVE SIZE	% PASSING
3"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
#4	
#8	
#10	
#20	
#40	
#100	
#200	

DESIGNATION **AASHTO 1557B**
MAX. DRY DENSITY **132.05 pcf**
OPTIMUM MOISTURE **7.3 %**
FRACTION USED **5**
MOLD VOLUME **0.0326 cu.ft.**

NOTE:
ZERO AIR VOIDS CURVES PLOTTED FOR:
Gs = 2.60
Gs = 2.65
Gs = 2.70

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MOISTURE-DENSITY RELATION CURVE

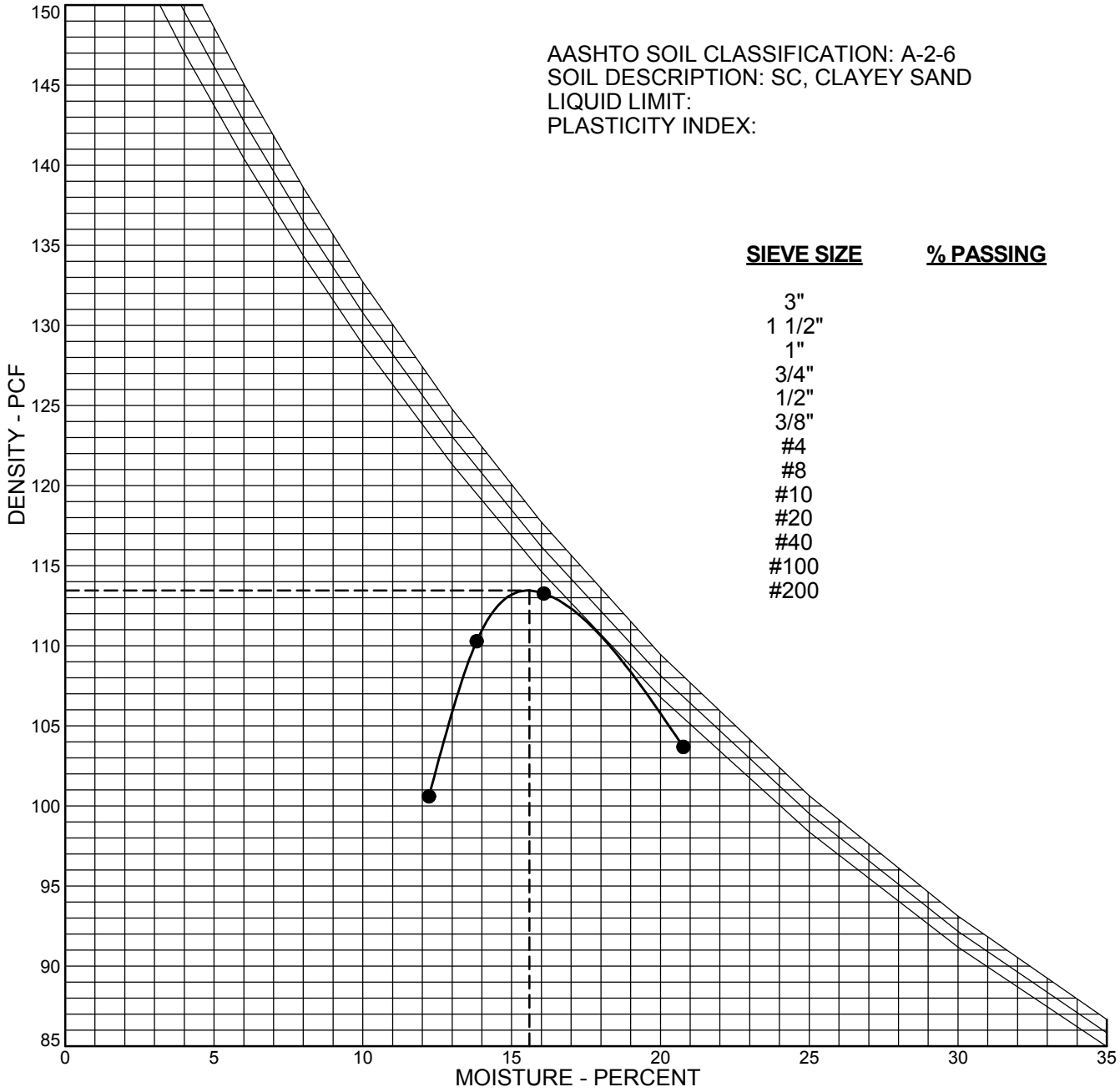
JOB No. 165451

FIGURE No. 15

DATE 11/16/18

CLIENT: **Landhuis Company** SAMPLE NUMBER: **PROCTOR 2**

PROJECT: Paint Brush Hills, Filing No. 13E, El Paso County, Colorado



AASHTO SOIL CLASSIFICATION: A-2-6
SOIL DESCRIPTION: SC, CLAYEY SAND
LIQUID LIMIT:
PLASTICITY INDEX:

SIEVE SIZE	% PASSING
3"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
#4	
#8	
#10	
#20	
#40	
#100	
#200	

DESIGNATION **AASHTO 698B**
MAX. DRY DENSITY **113.4 pcf**
OPTIMUM MOISTURE **15.6 %**
FRACTION USED **3**
MOLD VOLUME **0.0326 cu.ft.**

NOTE:
ZERO AIR VOIDS CURVES PLOTTED FOR:
Gs = 2.60
Gs = 2.65
Gs = 2.70

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MOISTURE-DENSITY RELATION CURVE

JOB No. 165451

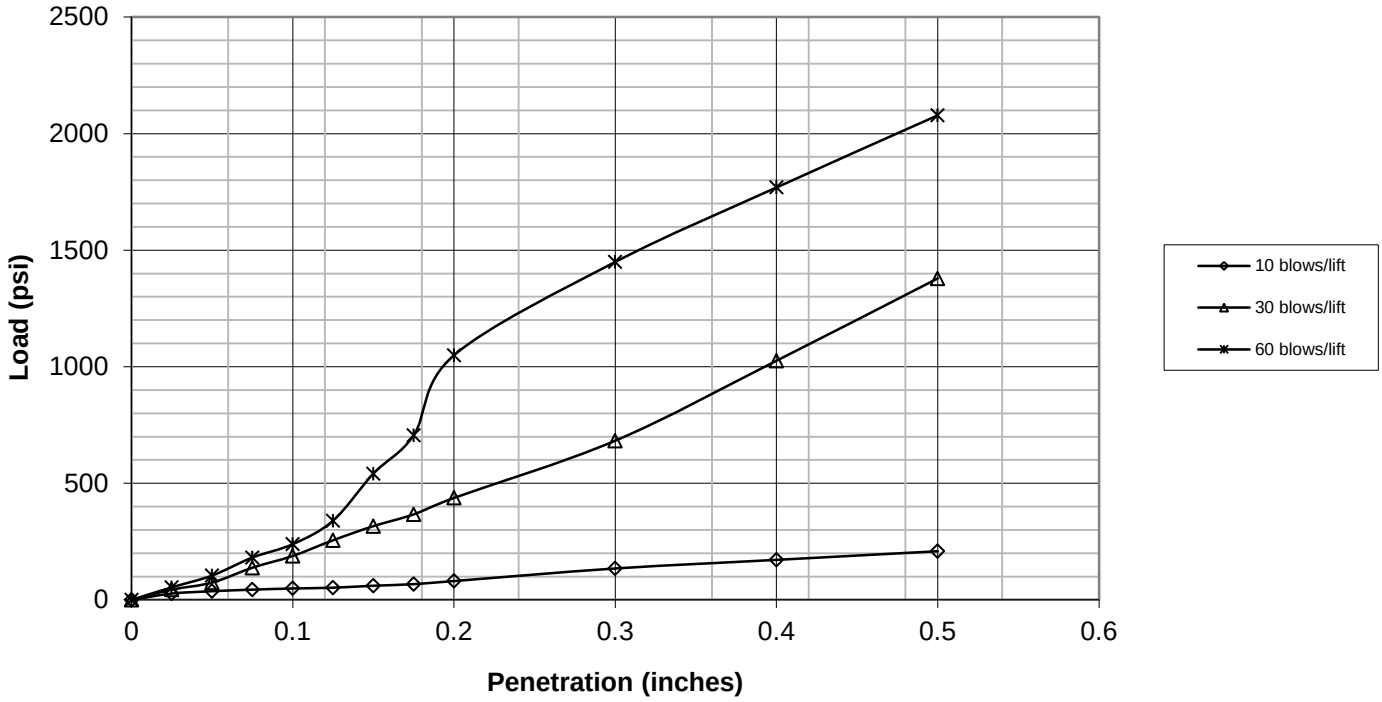
FIGURE No. 16

DATE 11/16/18

CALIFORNIA BEARING RATIO TEST RESULTS

PROJECT: Paintbrush Hills Filing 13 E
JOB NUMBER: 165451 TEST DATE: 10/19/2018
AASHTO A-1-b
SAMPLE NUMBER: CBR
SAMPLE LOCATION: Combination bulk sample from A-1-b Test Borings
SOIL DESCRIPTION: Silty Sand (SM)

	10 blows/lift	30 blows/lift	60 blows/lift
Penetration (in)	Load (psi)	Load (psi)	Load (psi)
0.000	0.0	0.0	0.0
0.025	26.9	43.7	53.8
0.050	37.0	74.0	104.3
0.075	43.7	137.9	181.6
0.100	48.8	188.3	238.8
0.125	52.1	255.6	339.7
0.150	60.5	316.1	541.4
0.175	67.3	366.6	706.2
0.200	80.7	437.2	1049.3
0.300	134.5	682.7	1449.5
0.400	171.5	1025.7	1768.9
0.500	208.5	1378.8	2078.3



	10 blows/lift	30 blows/lift	60 blows/lift
Corrected Penetration (in)	Corrected Load (psi)	Corrected Load (psi)	Corrected Load (psi)
0.1	4.9	18.8	23.9
0.2	5.4	29.1	70.0

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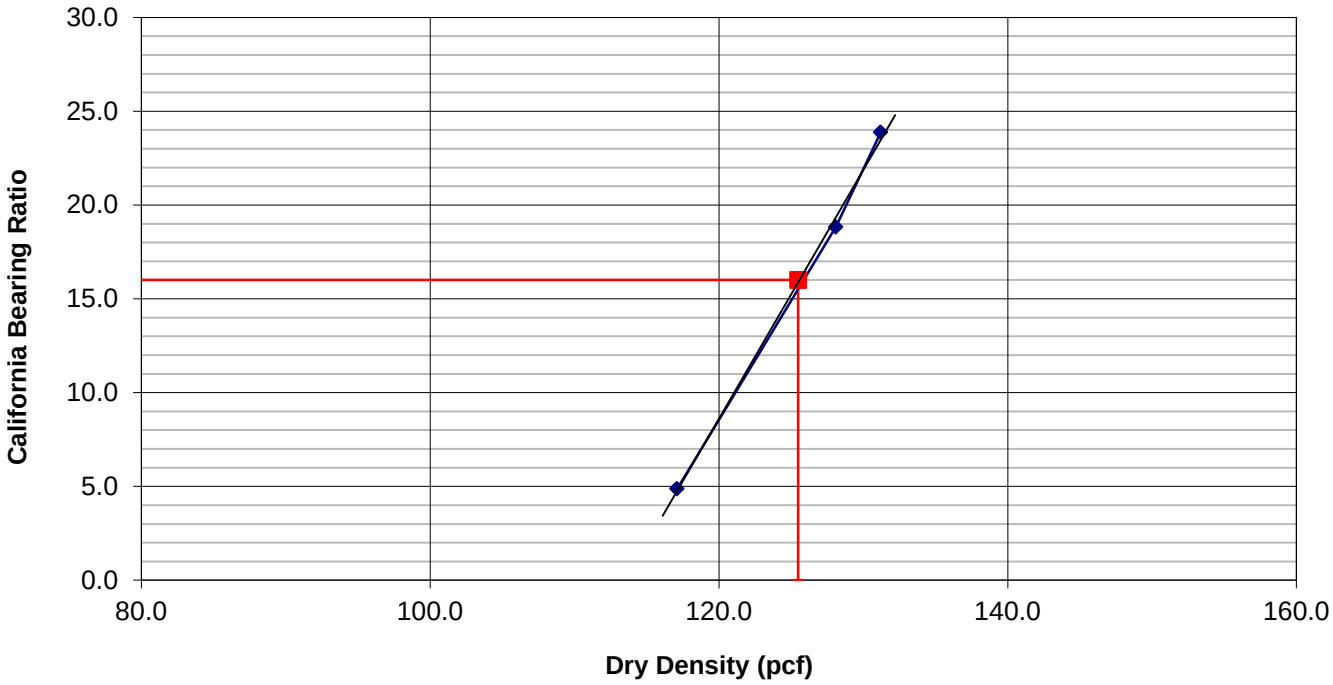
Figure No. 17

CALIFORNIA BEARING RATIO TEST RESULTS

PROJECT:	Paintbrush Hills Filing 13 E
JOB NUMBER:	165451
TEST DATE:	10/19/2018
AASHTO CLASSIFICATION:	A-1-b
SAMPLE NUMBER:	CBR
SAMPLE LOCATION:	Combination bulk sample from A-1-b Test Borings
SOIL DESCRIPTION:	Silty Sand (SM)

	10 blows/lift	30 blows/lift	60 blows/lift
Corrected California Bearing Ratio	4.9	18.8	23.9
Dry Density (pcf)	117.1	128.1	131.2
Percent Compaction	89	97	99
Percent Moisture After Soaking	11.1	12.6	9.7
Percent Expansion/Compression	0.0	0.0	0.0
Surcharge Weight (lbs)	12.50	12.50	12.50



California Bearing Ratio	**16.0**
Dry Density (pcf)	132.1
Percent Compaction	95.00%
Target Dry Density	125.5
Compaction Test Method	ASTM D-1557
Condition of sample	Soaked

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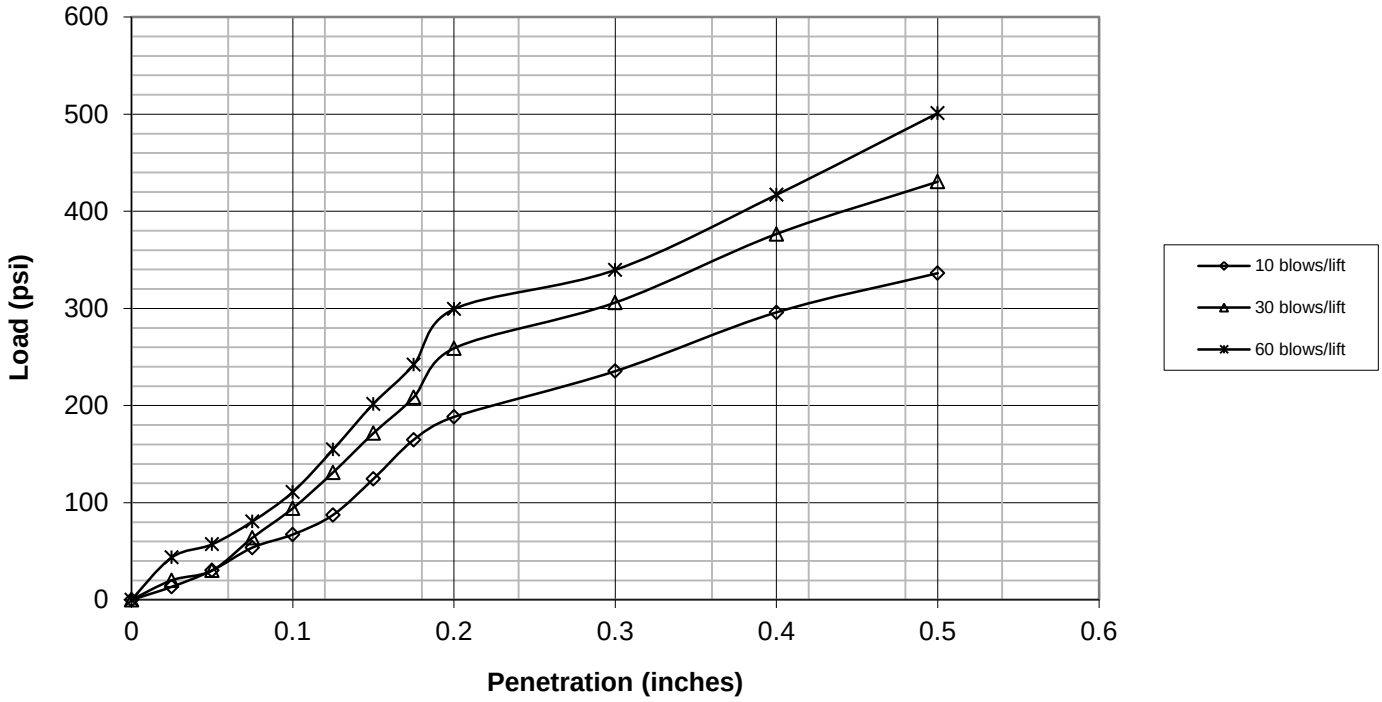
Figure No. 18

CALIFORNIA BEARING RATIO TEST RESULTS

PROJECT: Paint Brush Hills, Filing No. 13E
JOB NUMBER: 165451 TEST DATE: 9/14/2018
AASHTO A-2-6
SAMPLE NUMBER: CBR
SAMPLE LOCATION: Combination bulk sample from A-2-6 Test Borings
SOIL DESCRIPTION: Silty Sand (SM)

	10 blows/lift	30 blows/lift	60 blows/lift
Penetration (in)	Load (psi)	Load (psi)	Load (psi)
0.000	0.0	0.0	0.0
0.025	13.5	20.2	43.7
0.050	30.3	30.3	57.2
0.075	53.8	63.9	80.7
0.100	67.3	94.2	111.0
0.125	87.4	131.2	154.7
0.150	124.4	171.5	201.8
0.175	164.8	208.5	242.1
0.200	188.3	259.0	299.3
0.300	235.4	306.0	339.7
0.400	295.9	376.7	417.0
0.500	336.3	430.5	501.1



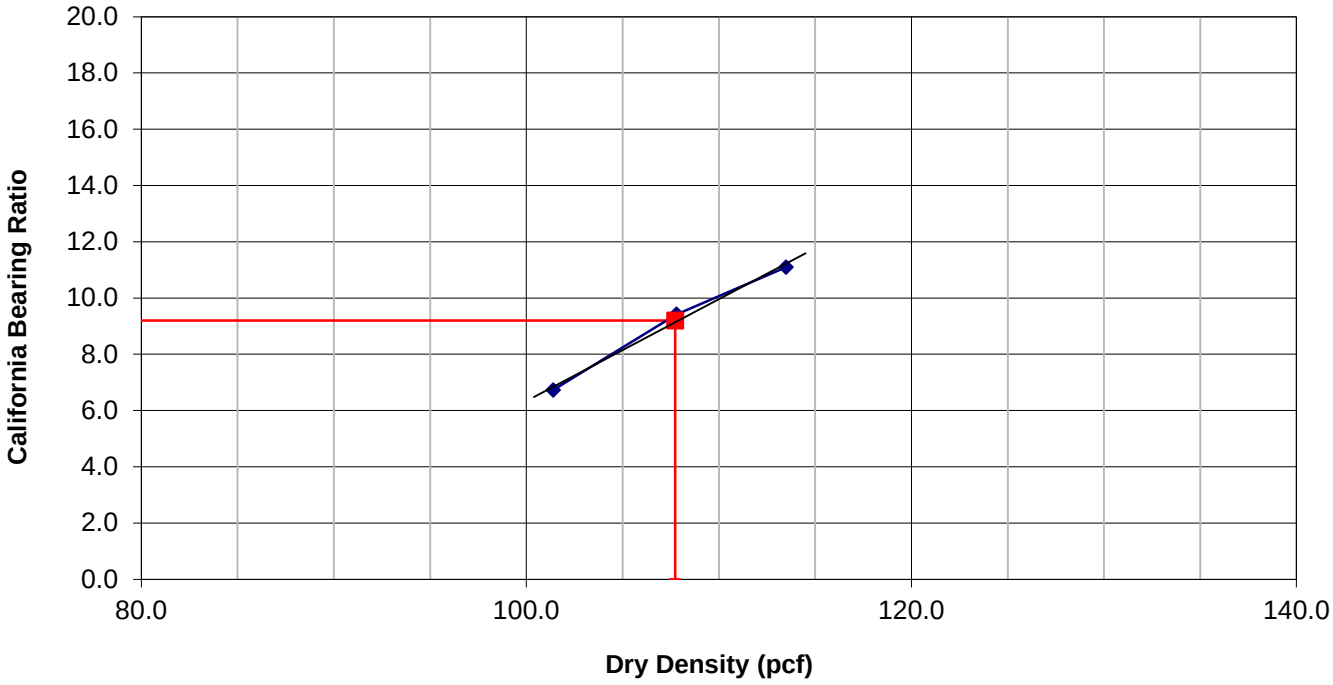
	10 blows/lift	30 blows/lift	60 blows/lift
Corrected Penetration (in)	Corrected Load (psi)	Corrected Load (psi)	Corrected Load (psi)
0.1	6.7	9.4	11.1
0.2	12.6	17.3	20.0

Figure No. 19

CALIFORNIA BEARING RATIO TEST RESULTS

PROJECT:	Paint Brush Hills, Filing No. 13E
JOB NUMBER:	165451 TEST DATE: 9/14/2018
AASHTO CLASSIFICATION:	A-2-6
SAMPLE NUMBER:	CBR
SAMPLE LOCATION:	Combination bulk sample from A-2-6 Test Borings
SOIL DESCRIPTION:	Silty Sand (SM)

	10 blows/lift	30 blows/lift	60 blows/lift
Corrected California Bearing Ratio	6.7	9.4	11.1
Dry Density (pcf)	101.4	107.8	113.5
Percent Compaction	89	95	100
Percent Moisture After Soaking	15.7	15.6	15.9
Percent Expansion/Compression	0.0	0.0	0.0
Surcharge Weight (lbs)	12.60	12.60	12.60



California Bearing Ratio	**9.2**
Dry Density (pcf)	113.4
Percent Compaction	95.00%
Target Dry Density	107.7
Compaction Test Method	ASTM D-698
Condition of sample	Soaked

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Figure No. 20

APPENDIX A

1993 AASHTO Empirical Equation for Flexible Pavements

Equation Solver | Variable Descriptions and Typical Values | Precautions

Type in data in the grey boxes and click the calculate button to see the output. To make additional calculations, change the desired input data and click the calculate button again. Click on the text descriptions of the input or output variables for more information.

INPUT

1. Loading

Total Design ESALs (W_{18}): 292000

2. Reliability

Reliability Level in percent (R): 80

Combined Standard Error (S_0): 0.44

3. Serviceability

Initial Serviceability Index (p_i): 4.5

Terminal Serviceability Index (p_t): 2

4. Layer Parameters

Number of Base Layers: 0

	a	m	M_R	Min. Depth
Surface	0.44	1.0	N/A	0
Subgrade	N/A	N/A	13800	N/A

OUTPUT

1. Calculation Parameters

Standard Normal Deviate (z_R): -0.841

ΔPSI: 2.5

Design Structural Number (SN): 2.095

2. Layer Depths (to the nearest 1/2 inch)

Surface: 5

Total SN based on layer depths: 2.2

See Solution Details

Comments

Calculate