April 28, 2020

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

Delanco, LLC
P.O. Box 1488
Monument, CO 80132

Attn: Mark Davis

Re: Pavement Recommendations
Settlers Ranch, Filing 2C SF 18-018
El Paso County, Colorado

Approved
By: Elizabeth Nijkamp
Date:06/11/2020
El Paso County Planning & Community Development

Dear Mr. Davis:

As requested, Entech Engineering, Inc. obtained samples of the pavement subgrade soil from the proposed roadway section within the above referenced subdivision. Laboratory testing was performed in order to determine the pavement support characteristics of the soil at proposed subgrade. This letter presents the results of the laboratory testing and pavement recommendations for the rural local residential roadways.

Project Description

The project will consist of the paving of a portion of Settlers Ranch Road in the Settlers Ranch Subdivision, Filing 2C. Subsurface Soil Investigation and laboratory testing was performed to determine the pavement support characteristics on the soil. The general location is shown in the Vicinity Location Map, Figure 1. The general layout of the site is presented in the Test Boring Location Map, Figure 2.

Subgrade Conditions

Four test borings were drilled in the proposed roadways. The test boring locations are shown in Figure No. 2. The Test Boring Logs are presented in Appendix A. Representative bulk samples of the subgrade soils were obtained from the test borings at the anticipated subgrade elevation. Soils encountered in the test borings within the subgrade influence zone consisted of silty to clayey sand fill and very clayey sand fill. The surficial soils were classified into two soil types. The silty to clayey sand fill was grouped into Type 1 soil; the very clayey sand fill was grouped into Type 2 soil. The Type 3 through 6 were encountered at depths beneath the subgrade influence zone.

Sieve Analyses was performed on the subgrade soils for the purpose of classification. The Sieve Analyses on the Type 1 subgrade soils indicated that approximately 29 percent of the soil particles passed the No. 200 sieve. The Type 2 subgrade soils indicated approximately 39 to 45 percent of the soil particles passed the No. 200 sieve. The Type 1 soils classify as A-2-4 and the Type 2 soils classified as A-4 and A-6 soils, using the AASHTO classification. Soil Type 1 soils typically provide good pavement support characteristics and the Type 2 soils typically provide poor pavement support characteristics. Groundwater was not encountered in the test borings during or subsequent to drilling. The results of laboratory testing are presented Appendix B. Swell/Consolidation testing was performed on the Soil Type 2 and 3 samples collected. The Swell/Consolidation tests resulted in volume changes of 0.3 to 1.6 percent, indicating a low expansion potential. Mitigation for expansive soils will not be required.

Delanco, LLC
Pavement Recommendations
Settlers Ranch Subdivision, Filing 2C
El Paso County, Colorado

California Bearing Ratio (CBR) testing was performed on a sample of the Soil Type 2 subgrade soils obtained from Test Boring No. 1. Soil Type 2 was the predominant soil type encountered at subgrade depths. The results of the CBR and classification testing are summarized in Table 1 and presented in the following tables, and in Appendix B, attached.

Soil Type 2 – Very Clayey Sand Fill

R @ 90% = 6.0
R @ 95% = 10.0
Use R = 10.0 for design

Classification Testing

Liquid Limit	26
Plasticity Index	9
Percent Passing 200	39.0
AASHTO Classification	A-4
Group Index	0
Unified Soils Classification	SC

Pavement Design

The CBR testing was used to determine pavement sections for this site. The pavement sections were determined utilizing the El Paso County "Pavement Design Criteria and Report". All of the roadways classify as rural local residential roadways which used an 18K ESAL value of 36,500 for design. Pavement alternatives for asphalt over aggregate basecourse and full depth asphalt are provided. Design parameters used in the pavement analysis are as follows:

Reliability (Rural Local Roads)	80%
Serviceability Index Local Low Volume, Local Roads	2.2
"R" Value Subgrade	10.0
Resilient Modulus	3,562 psi
Structural Coefficients:	
Hot Bituminous Pavement	0.44
Aggregate Basecourse	0.11

Pavement calculations are attached in Appendix C. Pavement sections recommended for the site are summarized as follows:

Delanco, LLC
Pavement Recommendations
Settlers Ranch Subdivision, Filing 2C
El Paso County, Colorado

Pavement Sections

Rural Local – ESAL = 36,500 – Settlers Ranch Road, Filing 2C

Alternative	Asphalt (in)	Basecourse (in)
1. Asphalt Over Basecourse	4.0	6.5

Roadway Construction - ~~Full Depth Asphalt and~~ Asphalt on Aggregate Basecourse Alternatives

Prior to placement of the asphalt, the subgrade should be proofrolled and compacted to a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 at ±2 percent of optimum moisture content. Any loose areas should be removed and replaced with suitable materials. Basecourse materials should be compacted to a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 at ±2 percent of optimum moisture content. Special attention should be given to areas adjacent to manholes, inlet structures and valves.

If significant grading is performed, the soils at subgrade may change. Modification to the pavement sections should be evaluated after site grading is completed. In addition to the above guidance, the asphalt, subgrade conditions, compaction of materials and roadway construction methods shall meet the El Paso County specifications.

We trust that this has provided you with the information you required. If you have any questions or need additional information, please do not hesitate to contact us.

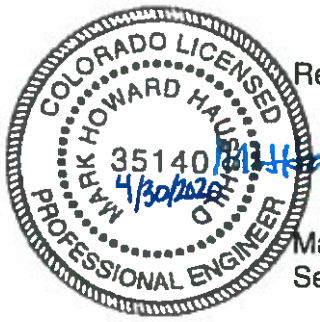
Respectfully Submitted,

ENTECH ENGINEERING, INC.

Daniel P. Stegman

DPS/ag

Entech Job No. 191457
AAprojects/2019/191457 pr



Reviewed by:

Mark H. Hauschild, P. E.
Senior Engineer

TABLE

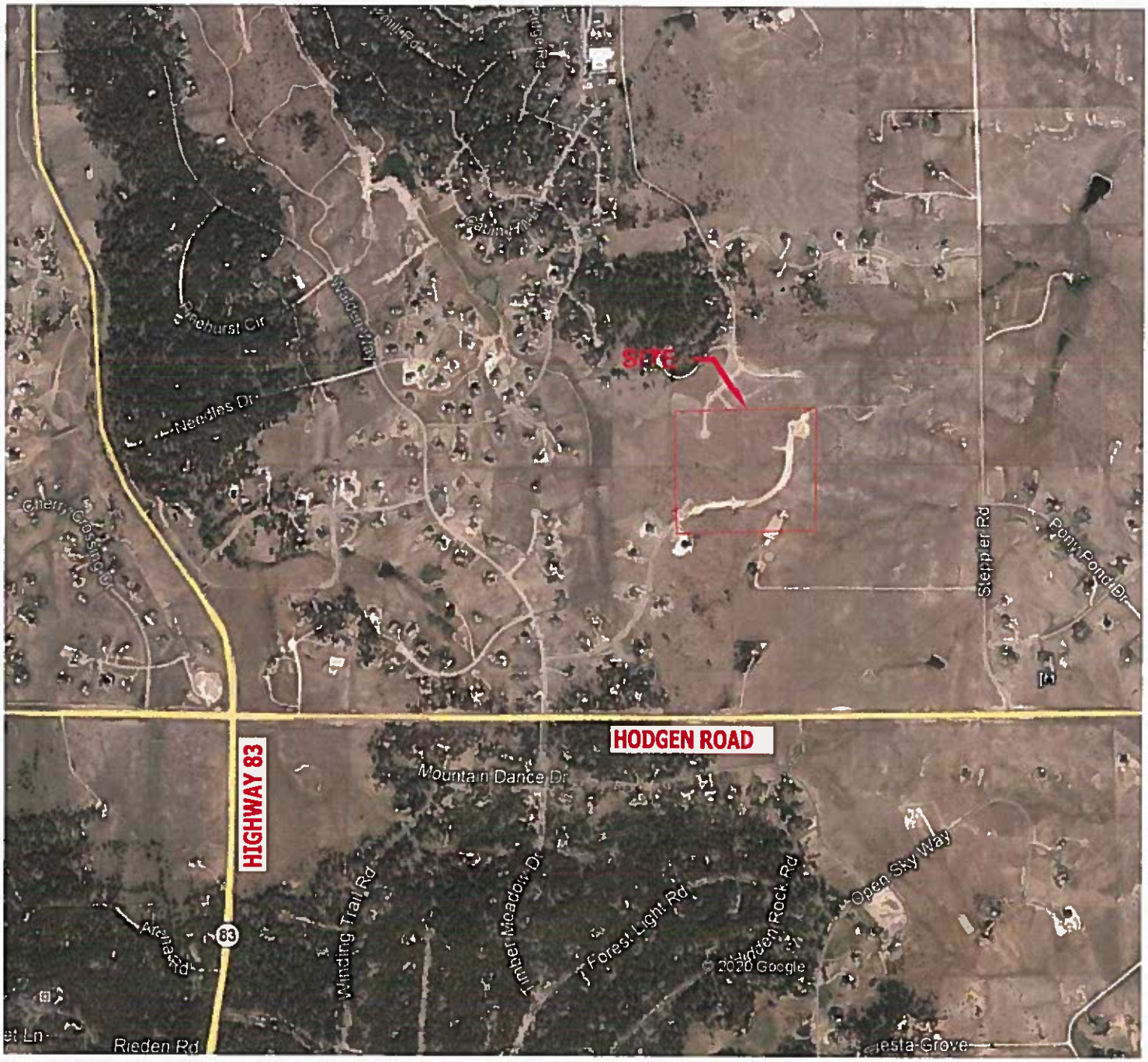
TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT DELANCO, LLC
PROJECT SETTLERS RANCH
JOB NO. 191457

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	AASHTO CLASS.	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	2	1-2			29.2	25	6	<0.01	A-2-4		SC-SM	FILL, SAND, CLAYEY, SILTY
2, CBR	1	0-3	11.4	120.6	39.0	26	9		A-4	1.1	SC	FILL, SAND, VERY CLAYEY
2	1	1-2	12.6	122.3	44.7	27	12		A-6	0.5	SC	FILL, SAND, VERY CLAYEY
2	3	1-2	14.5	114.7	43.2	26	9		A-4	0.3	SC	FILL, SAND, VERY CLAYEY
2	4	1-2	15.9	114.3	44.1	34	18	0.03	A-6	1.6	SC	FILL, SAND, VERY CLAYEY
3	1	10	14.7	115.0	22.2	32	14	<0.01	A-2-6	1.4	SC	SAND, CLAYEY
4	2	10			65.5	22	8	0.02	A-4		CL	CLAY, SANDY
5	4	5			10.4	NV	NP		A-1-b		SM-SW	SANDSTONE, SLIGHTLY SILTY
6	3	10			54.6	26	2	0.01	A-4		ML	SILTSTONE, VERY SANDY

FIGURES

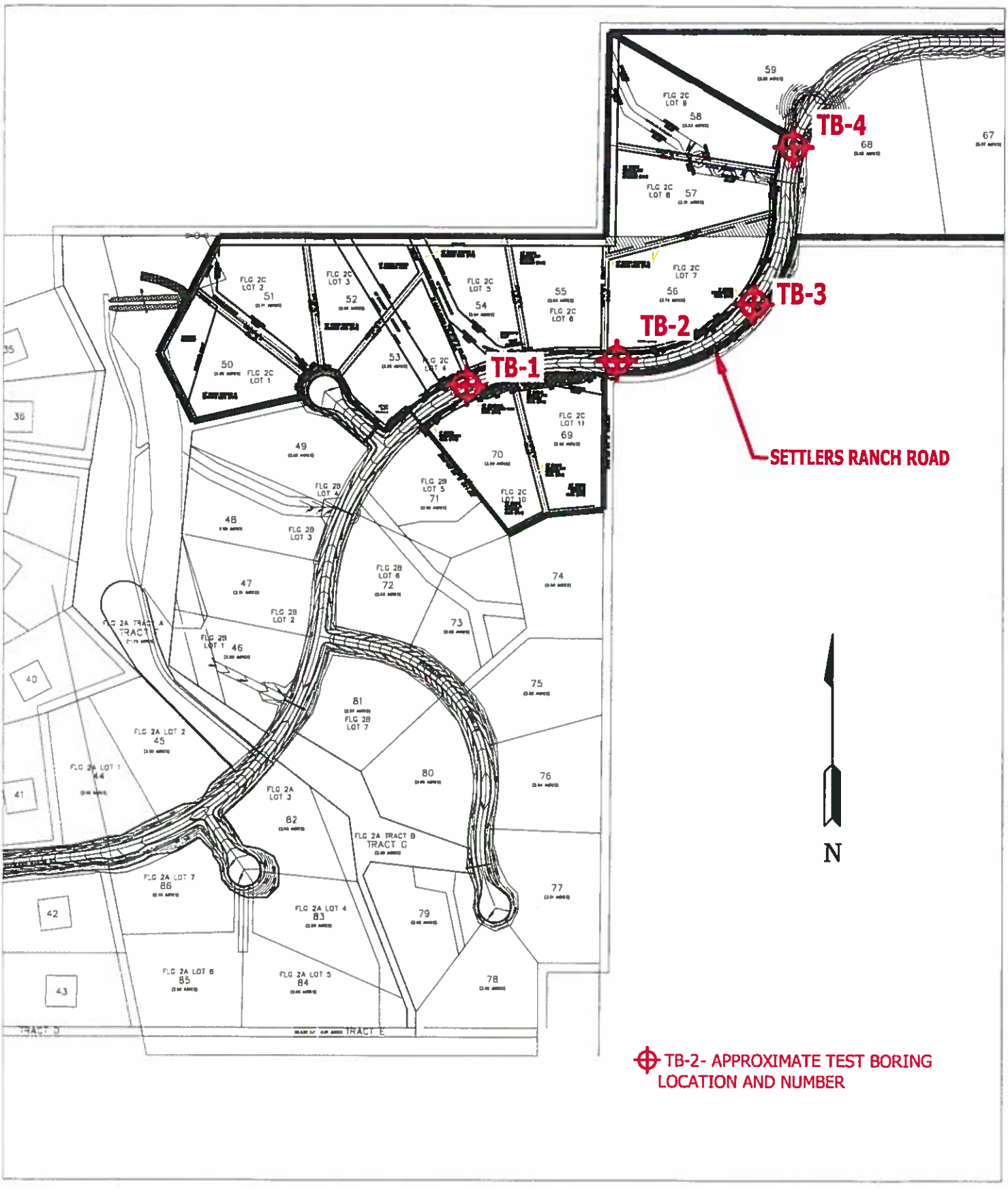


ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

VICINITY LOCATION MAP
SETTLERS RANCH ROAD
COLORADO SPRINGS, COLORADO
FOR: DELANCO, LLC

DRAWN BY:	DATE DRAWN:	DESIGNED BY:	CHECKED:
RPJ	04/20/20	RPJ	DPS

JOB NO.: 191457
FIG. NO.: 1



ENTECH ENGINEERING, INC.
305 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

TEST BORING LOCATION MAP
SETTLERS RANCH ROAD
COLORADO SPRINGS, COLORADO
FOR: DELANCO, LLC

DRAWN BY:	DATE DRAWN:	DESIGNED BY:	CHECKED:
RPJ	04/20/20	RPJ	DPS

JOB NO.: 191457
FIG. NO.: 2

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 4/2/2020
Job # 191457

REMARKS

DRY TO 10', 4/2/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			19	8.0	2
5			29	5.2	2
10			33	7.3	3
15					
20					

FILL 0-5', SAND, VERY CLAYEY TO SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST

SAND, CLAYEY, FINE TO COARSE GRAINED, TAN, DENSE, MOIST

TEST BORING NO. 2
DATE DRILLED 4/2/2020
CLIENT DELANCO, LLC
LOCATION SETTLERS RANCH

REMARKS

DRY TO 10', 4/2/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			23	6.1	1
5			30	5.5	3
10			15	10.7	4
15					
20					

FILL 0-4', SAND, CLAYEY, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST

SAND, SILTY, FINE TO COARSE GRAINED, TAN, DENSE, MOIST

CLAY, SANDY, TAN, STIFF, MOIST

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE: 4/28/20

JOB NO: 191457
FIG NO: A-1

TEST BORING NO. 3
DATE DRILLED 4/2/2020
Job # 191457

REMARKS

DRY TO 10', 4/2/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-9', SAND, VERY CLAYEY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST			17	6.6	2
5			29	7.9	2
SILTSTONE, VERY SANDY, TAN, HARD, MOIST 10			50	17.7	6
15					
20					

TEST BORING NO. 4
DATE DRILLED 4/2/2020
CLIENT DELANCO, LLC
LOCATION SETTLERS RANCH

REMARKS

DRY TO 10', 4/2/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-4', SAND, VERY CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST			22	9.4	2
5 SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST			50/11"	5.5	5
10			50/9"	6.5	5
15					
20					

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

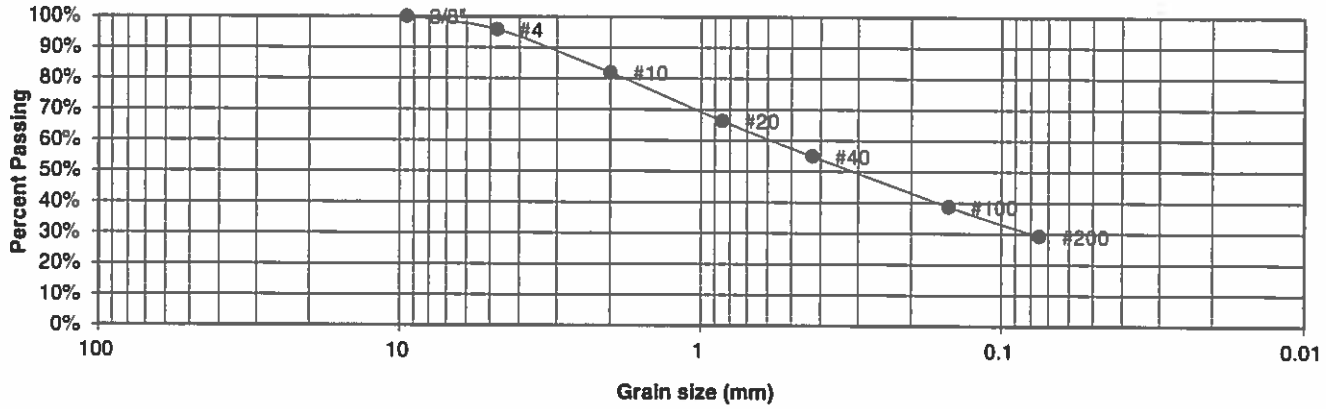
DRAWN:	DATE:	CHECKED:	DATE: 4/20/20

JOB NO.: 191457
FIG NO.: A-2

APPENDIX B: Laboratory Testing Results

UNIFIED CLASSIFICATION	SC-SM	CLIENT	DELANCO, LLC
SOIL TYPE #	1	PROJECT	SETTLERS RANCH
TEST BORING #	2	JOB NO.	191457
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	GROUP INDEX	0

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.8%
10	81.9%
20	66.3%
40	54.9%
100	38.7%
200	29.2%

Atterberg Limits

Plastic Limit	19
Liquid Limit	25
Plastic Index	6

Swell

Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

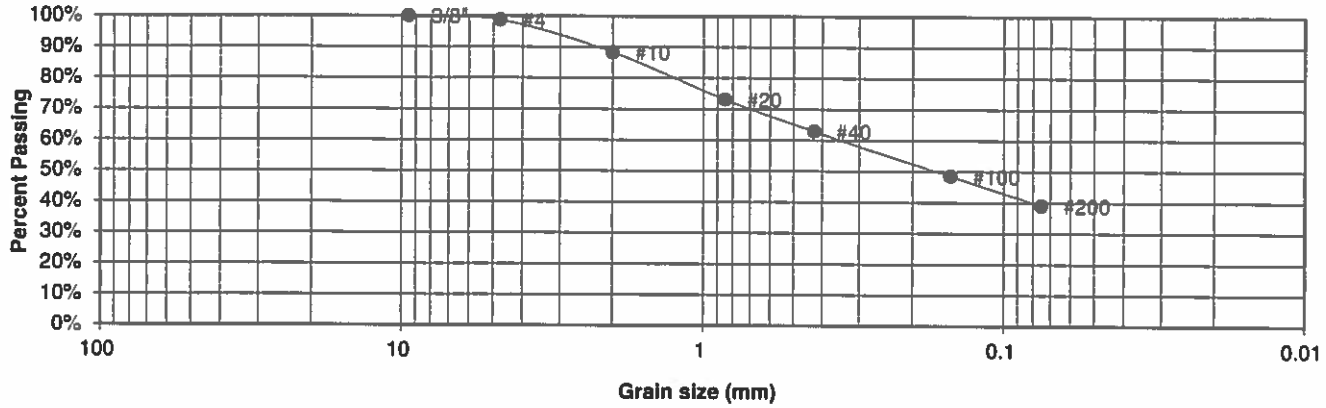
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			4/20/20

JOB NO.: 191457
FIG NO.: B-1

UNIFIED CLASSIFICATION	SC	CLIENT	DELANCO, LLC
SOIL TYPE #	2, CBR	PROJECT	SETTLERS RANCH
TEST BORING #	1	JOB NO.	191457
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION	A-4	GROUP INDEX	0

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.7%
10	88.3%
20	73.1%
40	62.9%
100	48.5%
200	39.0%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	26
Plastic Index	9

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

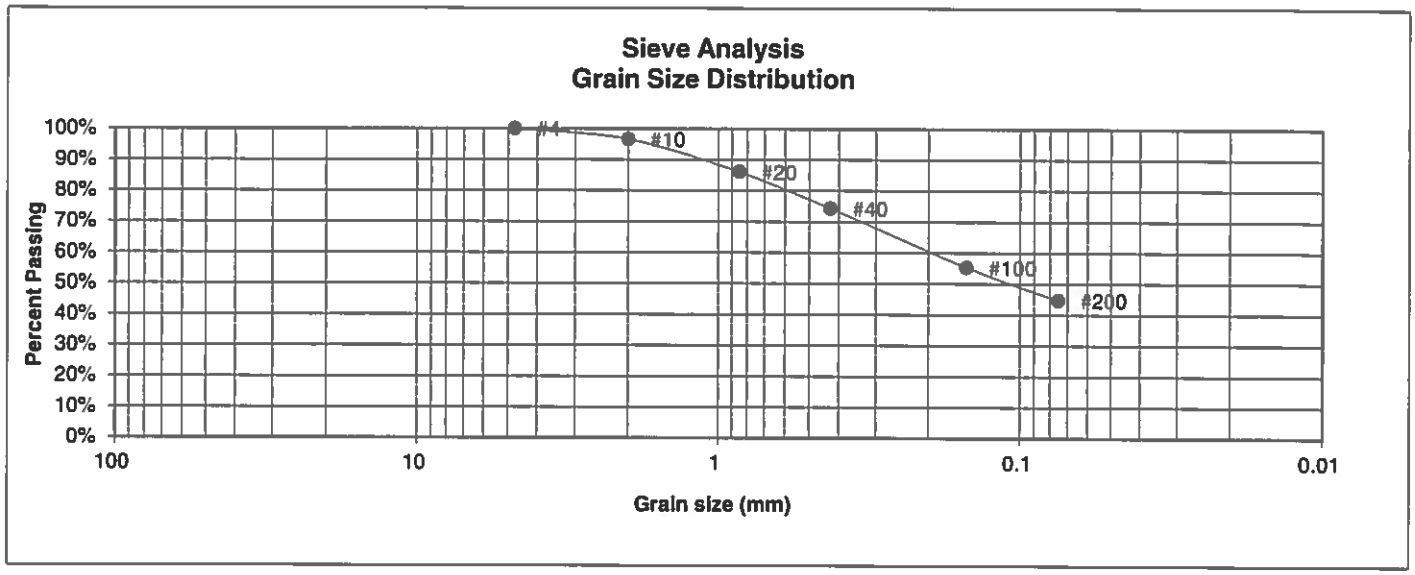
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 4/28/20

JOB NO.: 191457
FIG NO.: B-2

UNIFIED CLASSIFICATION	SC	CLIENT	DELANCO, LLC
SOIL TYPE #	2	PROJECT	SETTLERS RANCH
TEST BORING #	1	JOB NO.	191457
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	2



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	96.6%
20	86.1%
40	74.3%
100	55.3%
200	44.7%

Atterberg Limits	
Plastic Limit	15
Liquid Limit	27
Plastic Index	12

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

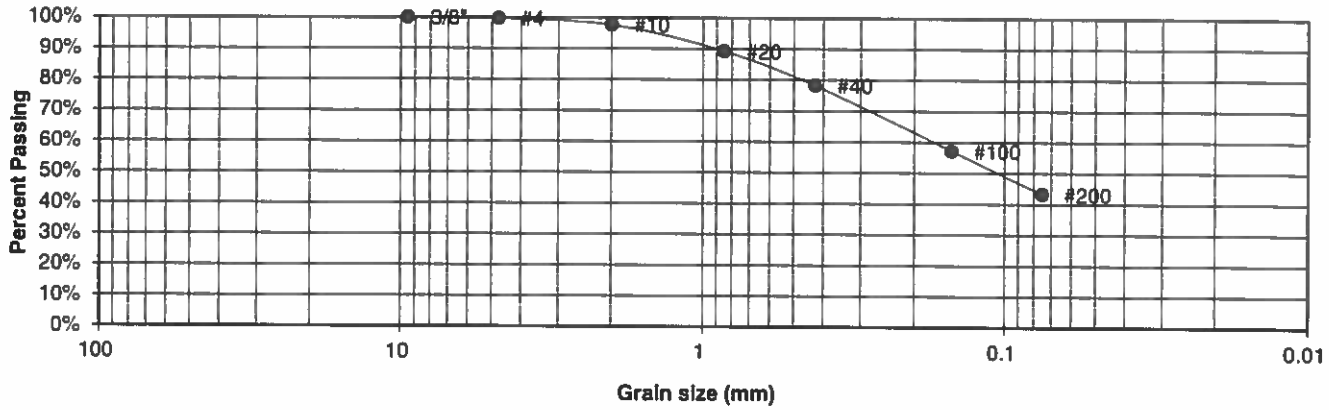
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 4/20/20

JOB NO.: 191457
FIG NO.: B-3

UNIFIED CLASSIFICATION	SC	CLIENT	DELANCO, LLC
SOIL TYPE #	2	PROJECT	SETTLERS RANCH
TEST BORING #	3	JOB NO.	191457
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-4	GROUP INDEX	1

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.7%
10	97.7%
20	89.2%
40	78.2%
100	57.2%
200	43.2%

Atterberg Limits

Plastic Limit	17
Liquid Limit	26
Plastic Index	9

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

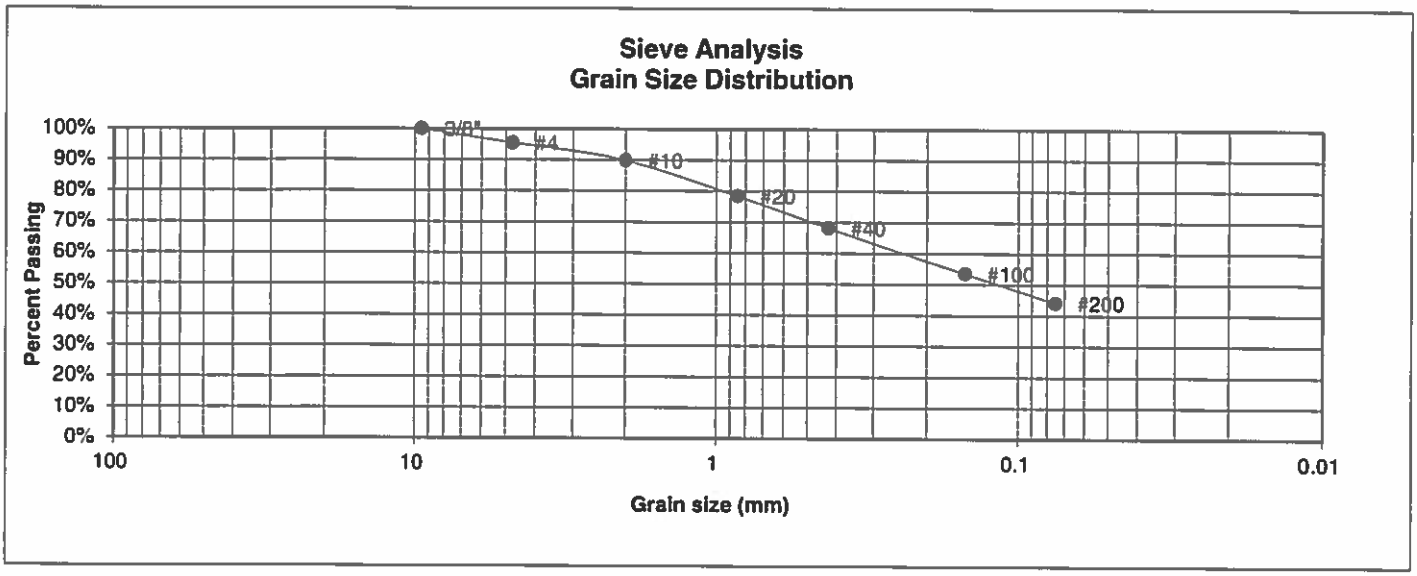
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 9/20/20

JOB NO.: 191457
FIG NO.: B-4

UNIFIED CLASSIFICATION	SC	CLIENT	DELANCO, LLC
SOIL TYPE #	2	PROJECT	SETTLERS RANCH
TEST BORING #	4	JOB NO.	191457
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	4



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.5%
10	89.8%
20	78.4%
40	68.1%
100	53.5%
200	44.1%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	34
Plastic Index	18

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

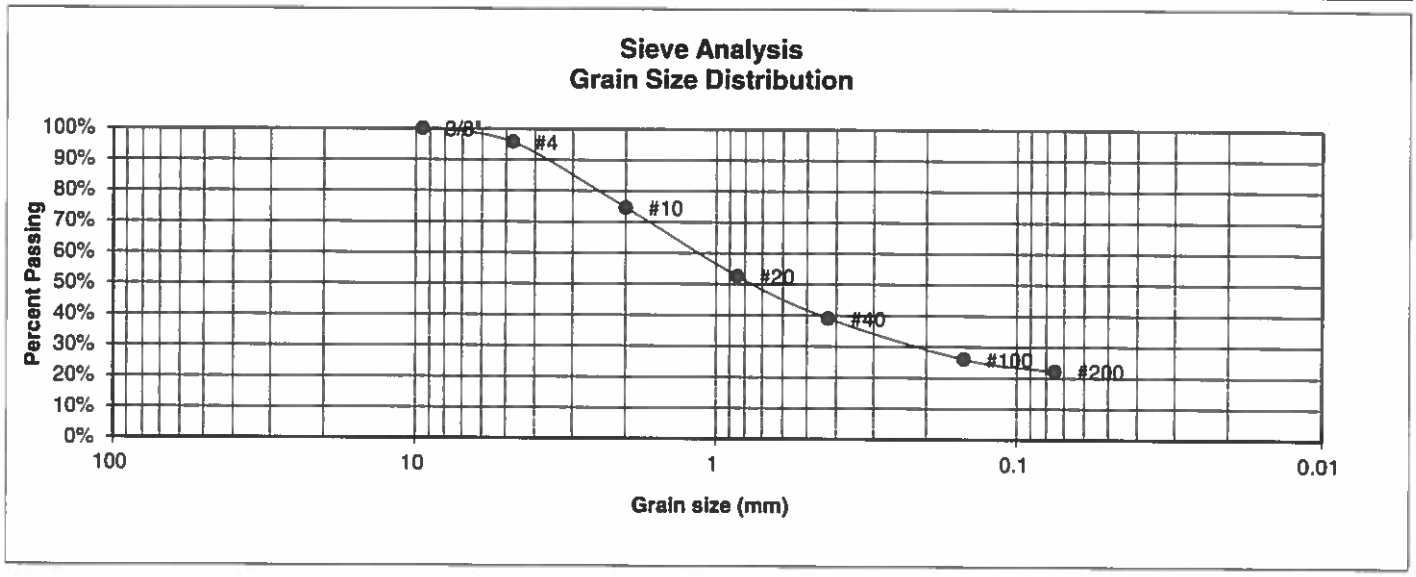
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 4/20/20

JOB NO. 191457
FIG NO. B-5

UNIFIED CLASSIFICATION	SC	CLIENT	DELANCO, LLC
SOIL TYPE #	3	PROJECT	SETTLERS RANCH
TEST BORING #	1	JOB NO.	191457
DEPTH (FT)	10	TEST BY	BL
AASHTO CLASSIFICATION	A-2-6	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.7%
10	74.6%
20	52.6%
40	39.0%
100	26.0%
200	22.2%

Atterberg Limits

Plastic Limit	18
Liquid Limit	32
Plastic Index	14

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

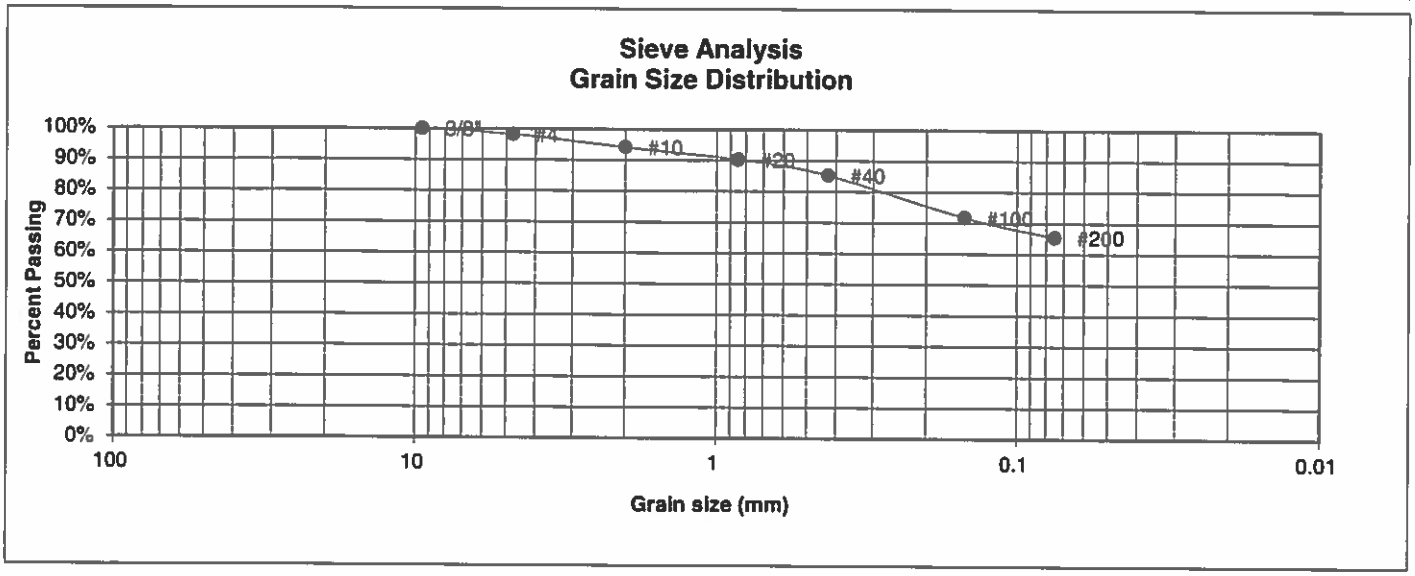
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
			9/20/20

JOB NO.: 191457
FIG NO.: B-6

UNIFIED CLASSIFICATION	CL	CLIENT	DELANCO, LLC
SOIL TYPE #	4	PROJECT	SETTLERS RANCH
TEST BORING #	2	JOB NO.	191457
DEPTH (FT)	10	TEST BY	BL
AASHTO CLASSIFICATION	A-4	GROUP INDEX	2



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.2%
10	94.2%
20	90.3%
40	85.3%
100	71.7%
200	65.5%

Atterberg Limits	
Plastic Limit	14
Liquid Limit	22
Plastic Index	8

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

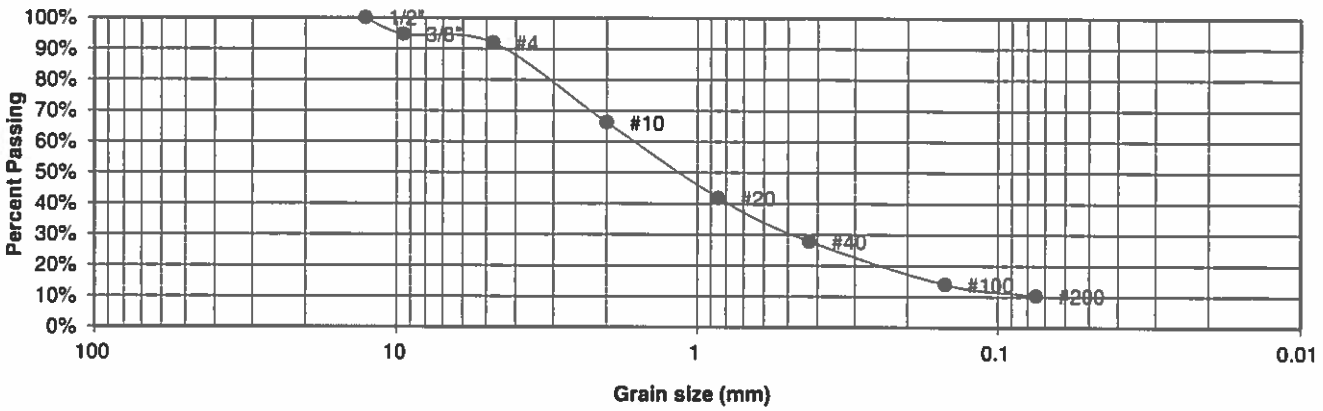
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			4/20/20

JOB NO.: 191457
FIG NO.: B-7

UNIFIED CLASSIFICATION	SM-SW	CLIENT	DELANCO, LLC
SOIL TYPE #	5	PROJECT	SETTLERS RANCH
TEST BORING #	4	JOB NO.	191457
DEPTH (FT)	5	TEST BY	BL
AASHTO CLASSIFICATION	A-1-b	GROUP INDEX	0

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	94.7%
4	92.0%
10	66.3%
20	41.8%
40	27.8%
100	14.0%
200	10.4%

Atterberg Limits

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell

Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

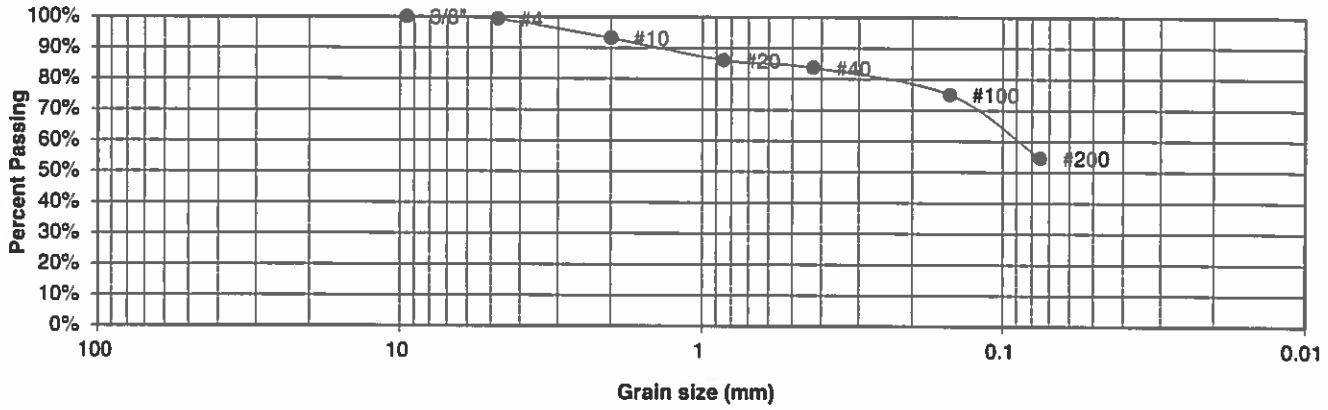
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 4/20/20

JOB NO.: 191457
FIG NO.: B-8

UNIFIED CLASSIFICATION	ML	CLIENT	DELANCO, LLC
SOIL TYPE #	6	PROJECT	SETTLERS RANCH
TEST BORING #	3	JOB NO.	191457
DEPTH (FT)	10	TEST BY	BL
AASHTO CLASSIFICATION	A-4	GROUP INDEX	0

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.3%
10	93.1%
20	86.0%
40	83.7%
100	75.0%
200	54.6%

Atterberg Limits	
Plastic Limit	24
Liquid Limit	26
Plastic Index	2

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

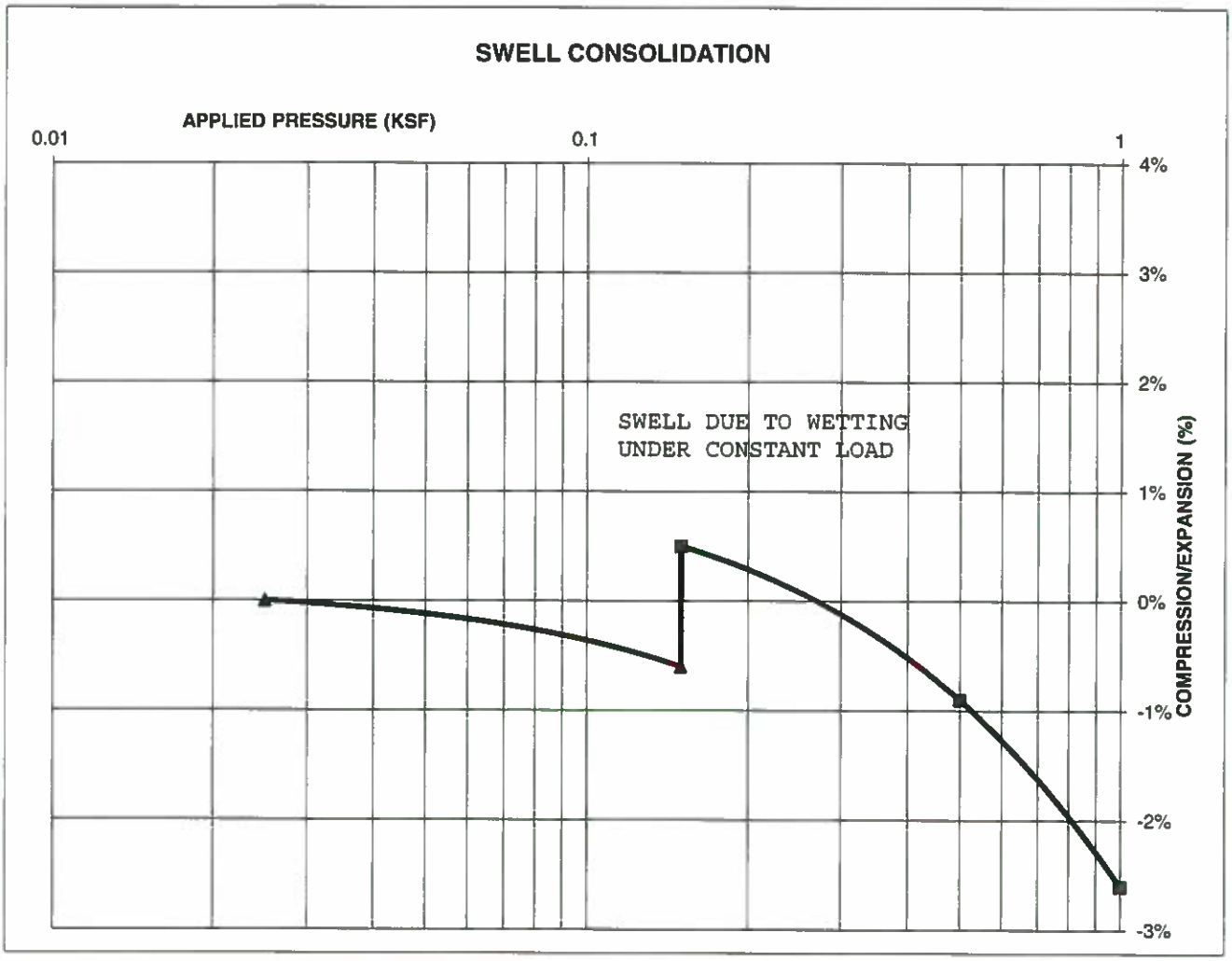
DRAWN	DATE	CHECKED	DATE
			4/20/20

JOB NO.: 191457
FIG NO.: B-9

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	0-3
DESCRIPTION	SC	SOIL TYPE	2, CBR
NATURAL UNIT DRY WEIGHT (PCF)			121
NATURAL MOISTURE CONTENT			11.4%
SWELL/CONSOLIDATION (%)			1.1%

JOB NO. 191457
CLIENT DELANCO, LLC
PROJECT SETTLERS RANCH



ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

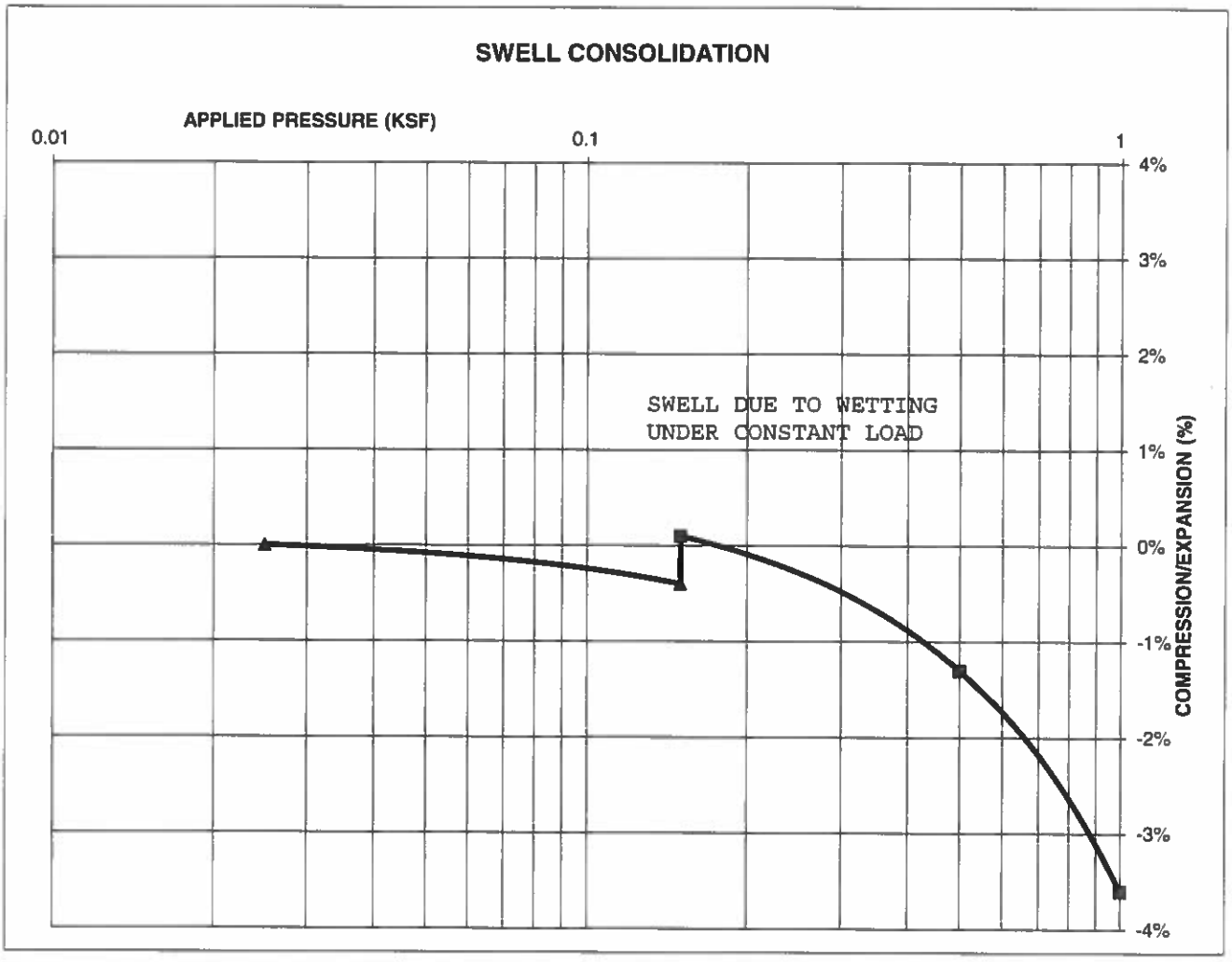
DRAWN:	DATE:	CHECKED:	DATE:
		DS	4/22/20

JOB NO.: 191457
FIG NO.: D-10

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			122
NATURAL MOISTURE CONTENT			12.6%
SWELL/CONSOLIDATION (%)			0.5%

JOB NO. 191457
CLIENT DELANCO, LLC
PROJECT SETTLERS RANCH



ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

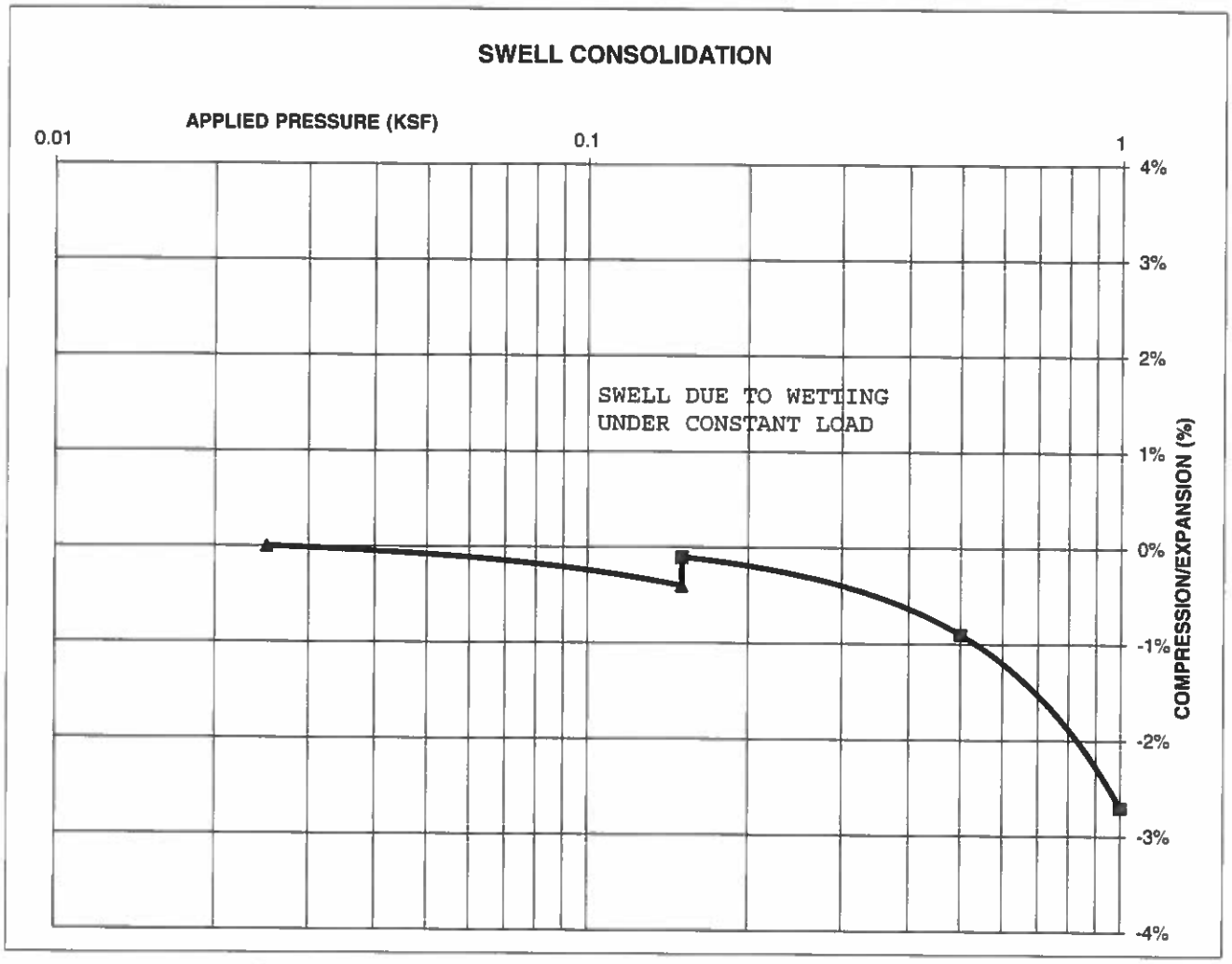
DRAWN:	DATE:	CHECKED:	DATE:
		DS	4/12/20

JOB NO.: 191457
FIG NO.: B-11

CONSOLIDATION TEST RESULTS

TEST BORING #	3	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			115
NATURAL MOISTURE CONTENT			14.5%
SWELL/CONSOLIDATION (%)			0.3%

JOB NO. 191457
CLIENT DELANCO, LLC
PROJECT SETTLERS RANCH



ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

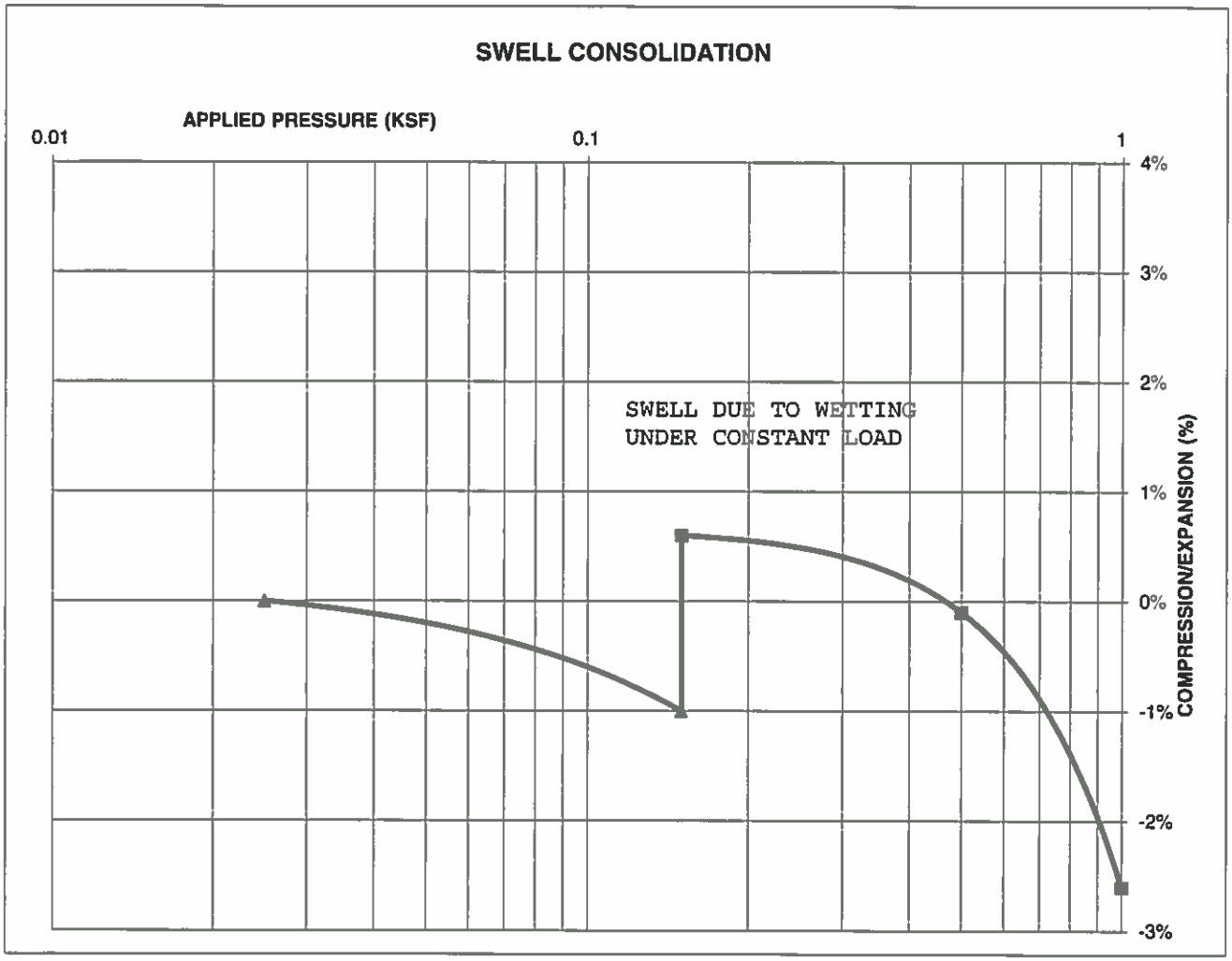
DRAWN:	DATE:	CHECKED:	DATE:
		DS	4/22/20

JOB NO.: 191457
FIG NO.: B-12

CONSOLIDATION TEST RESULTS

TEST BORING #	4	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			114
NATURAL MOISTURE CONTENT			15.9%
SWELL/CONSOLIDATION (%)			1.6%

JOB NO. 191457
CLIENT DELANCO, LLC
PROJECT SETTLERS RANCH



ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

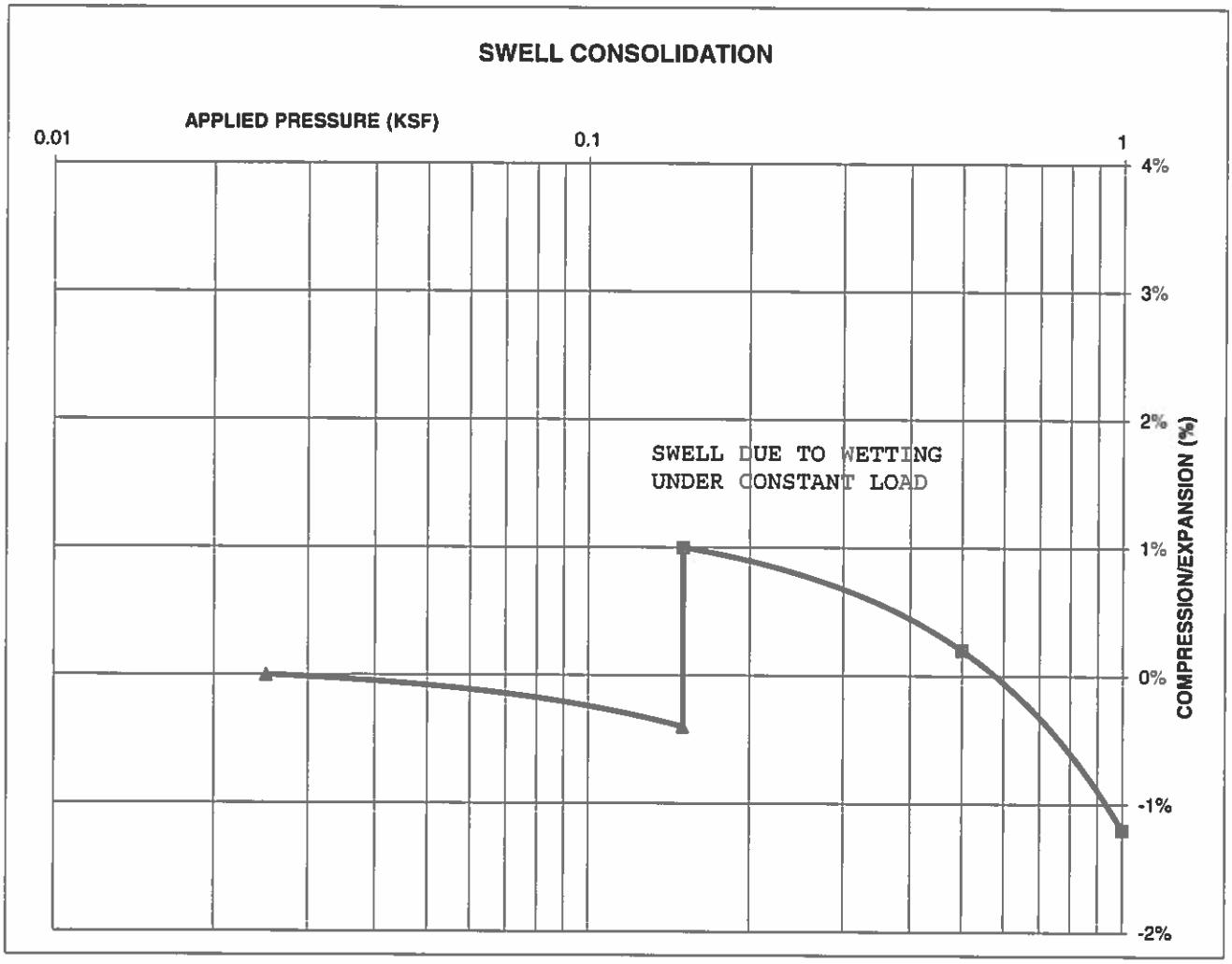
DRAWN:	DATE:	CHECKED:	DATE:
		DS	4/22/20

JOB NO.: 191457
FIG NO.: B-13

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	10
DESCRIPTION	SC	SOIL TYPE	3
NATURAL UNIT DRY WEIGHT (PCF)			115
NATURAL MOISTURE CONTENT			14.7%
SWELL/CONSOLIDATION (%)			1.4%

JOB NO. 191457
CLIENT DELANCO, LLC
PROJECT SETTLERS RANCH



ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	4/22/21

JOB NO.: 191457
FIG NO.: B-14

CLIENT	DELANCO, LLC	JOB NO.	191457
PROJECT	SETTLERS RANCH	DATE	4/15/2020
LOCATION	SETTLERS RANCH	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-2	1-2	1	SC-SM	<0.01
TB-4	1-2	2	SC-SM	0.03
TB-1	10	3	SC-SM	<0.01
TB-2	10	4	CL	0.02
TB-3	10	6	ML	0.01

QC BLANK PASS

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

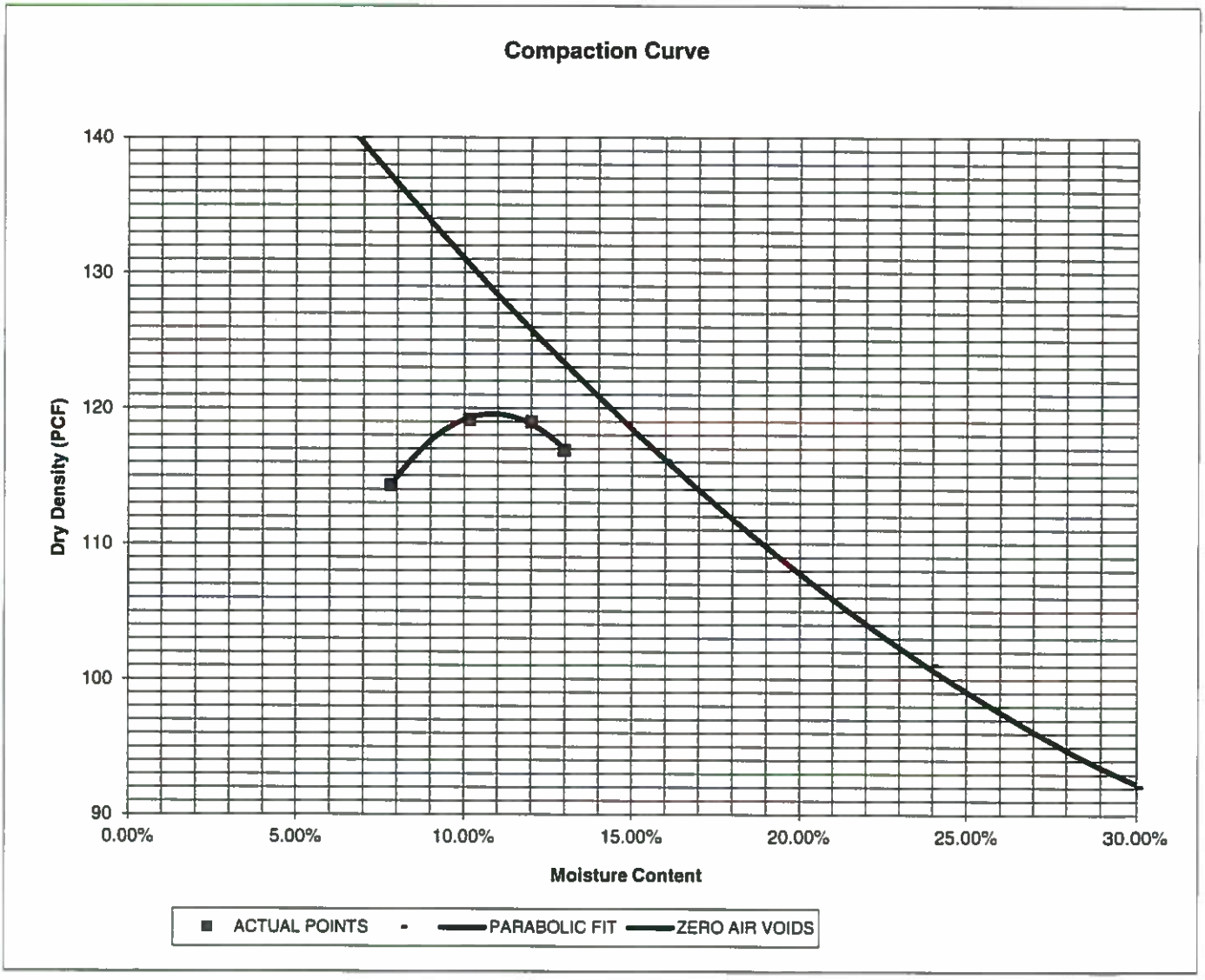
LABORATORY TEST SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			4/20/20

JOB NO.: 191457
FIG NO.: B-15

PROJECT	SETTLERS RANCH	CLIENT	DELANCO, LLC
SAMPLE LOCATION	TB-1 @ 0-3'	JOB NO.	191457
SOIL DESCRIPTION	FILL, SAND, V. CLAYEY, BROWN	DATE	04/06/20

IDENTIFICATION	SC	COMPACTION TEST #	1
TEST DESIGNATION / METHOD	ASTM D-698-A	TEST BY	KW
MAXIMUM DRY DENSITY (PCF)	119.6	OPTIMUM MOISTURE	10.9%



ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

MOISTURE DENSITY RELATION

DRAWN:	DATE:	CHECKED:	DATE
			4/20/20

JOB NO.: 191457

FIG NO.: B-16

CBR TEST LOAD DATA

JOB NO: 191457
CLIENT: DELANCO, LLC
PROJECT: SETTLERS RANCH
SOIL TYPE: 2

PISTON DIAMETER (cm)	PISTON AREA (in²)
4.958	2.99250919

PENETRATION DEPTH (INCHES)	*10 BLOWS* MOLD # 1 LOAD(LBS) (LBS)	STRESS (PSI)	*25 BLOWS* MOLD # 2 LOAD(LBS) (LBS)	STRESS (PSI)	*56 BLOWS* MOLD # 3 LOAD(LBS) (LBS)	STRESS (PSI)
0.000	0	0.00	0	0.00	0	0.00
0.025	25	8.35	51	17.04	93	31.08
0.050	33	11.03	76	25.40	134	44.78
0.075	36	12.03	91	30.41	166	55.47
0.100	38	12.70	97	32.41	188	62.82
0.125	40	13.37	106	35.42	218	72.85
0.150	40	13.37	115	38.43	237	79.20
0.175	42	14.04	121	40.43	254	84.88
0.200	42	14.04	131	43.78	278	92.90
0.300	45	15.04	153	51.13	336	112.28
0.400	48	16.04	171	57.14	372	124.31
0.500	52	17.38	189	63.16	404	135.00

FINAL MOISTURE CONTENT

	MOLD # 1	MOLD # 2	MOLD # 3
CAN #	105	118	120
WT. CAN	9.23	9.17	9.27
WT. CAN+WET	249.68	277.44	279.01
WT. CAN+DRY	207.39	237.06	243.59
WT. H20	42.29	40.38	35.42
WT. DRY SOIL	198.16	227.89	234.32
MOISTURE CONTENT	21.34%	17.72%	15.12%
WET DENSITY (PCF)	109.1	121.2	129.7
DRY DENSITY (PCF)	98.4	109.3	117.0
BEARING RATIO	1.27	3.24	6.28

90% OF DRY DENSITY	107.6
95% OF DRY DENSITY	113.6

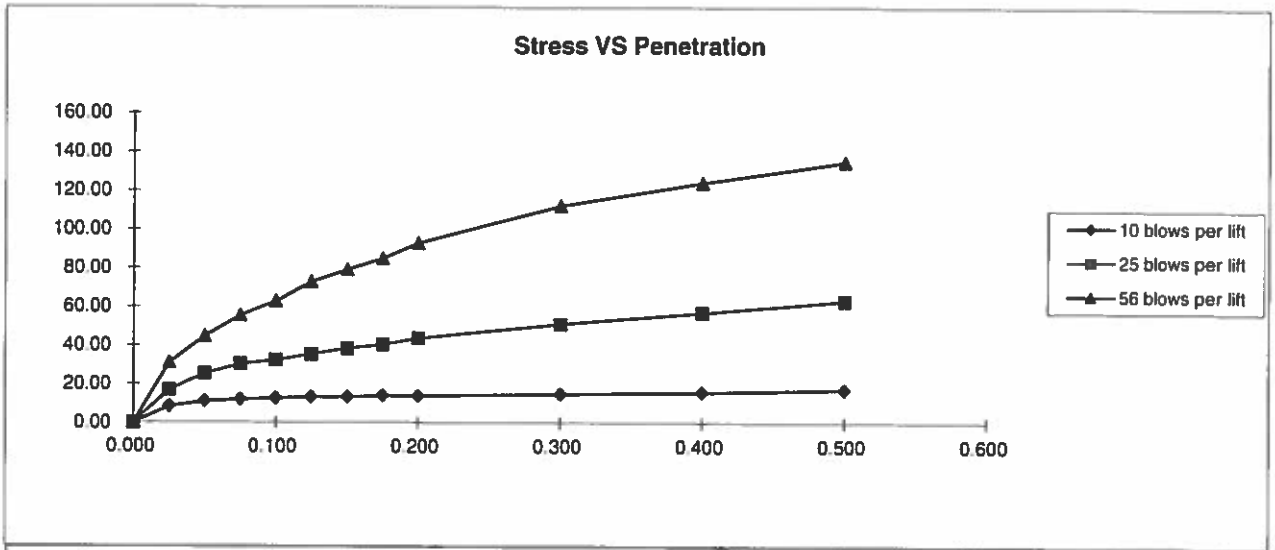
BEARING RATIO AT 90% OF MAX	2.95	~ R VALUE	6
BEARING RATIO AT 95% OF MAX	4.96	~ R VALUE	10

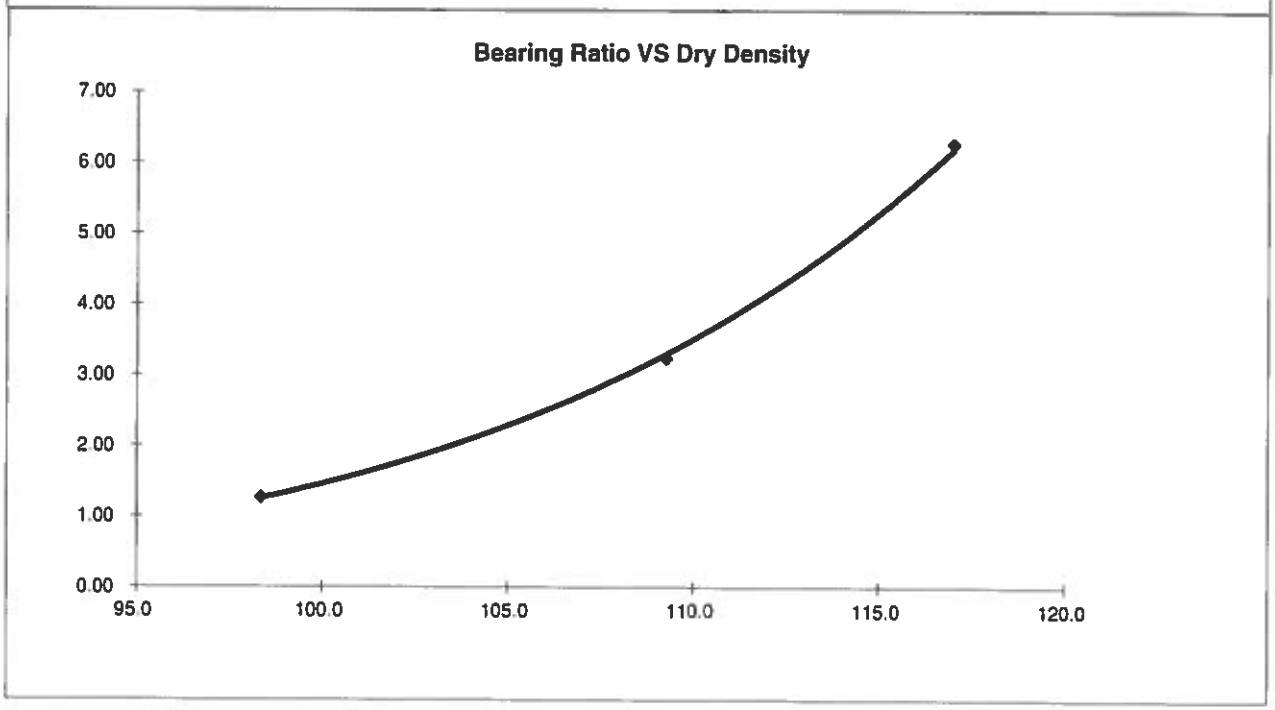
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

CBR TEST DATA

DRAWN:	DATE:	CHECKED:	DATE:
			4/20/20

JOB NO.: 191457
FIG NO.: B-17





BEARING RATIO AT 90% OF MAX	2.95	~ R VALUE	6.00
BEARING RATIO AT 95% OF MAX	4.96	~ R VALUE	10.00

JOB NO: 191457
SOIL TYPE: 2

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

CALIFORNIA BEARING RATIO

DRAWN:	DATE:	CHECKED:	DATE: 4/20/20

JOB NO: 191457
FIG NO: B-18

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA — DELANCO, LLC - SETTLERS RANCH SUBDIVISION, FILING 2C
RURAL LOCAL ROADS - SOIL TYPE 2
SETTLER RANCH ROAD

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	36,500
Hveem Stabilometer (R Value) Results:	R =	10
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.2
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	3562

Weighted Structural Number (WSN): → WSN = 2.43

DESIGN TABLES AND EQUATIONS

$S_1 = [(R - 5) / 11.29] + 3$

$M_R = 10^{[(S_1 + 18.72) / 6.24]}$

$k = M_R / 19.4$

Where:

M_R = resilient modulus (psi)

S_1 = the soil support value

R = R-value obtained from the Hveem stabilometer

CBR = California Bearing Ratio

Reliability (%)	Z_R (z-statistic)
75	-0.67
80	-0.84
85	-1.04
90	-1.28
94	-1.56
95	-1.65
96	-1.75
97	-1.88
98	-2.05
99	-2.33
99.9	-3.09
99.99	-3.75

$$\log_{10}W_{18} = Z_R * S_O + 9.36 * \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2 - 1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 * \log_{10}M_R - 8.07$$

Left	Right	Difference
4.56	4.56	0.0

Job No. 191457
Fig. No. C-1

DESIGN CALCULATIONS

DESIGN DATA DELANCO, LLC - SETTLERS RANCH SUBDIVISION, FILING 2C
RURAL LOCAL ROADS - SOIL TYPE 2
SETTLER RANCH ROAD

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	36,500
Hveem Stabilometer (R Value) Results:	R =	10
Weighted Structural Number (WSN):	WSN =	2.43

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

C_1 = 0.44 Strength Coefficient - Hot Bituminous Asphalt
C_2 = 0.11 Strength Coefficient - Aggregate Basecourse

D_1 = Depth of Asphalt (inches)
D_2 = Depth of Basecourse (inches)

FOR FULL DEPTH ASPHALT SECTION (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1$ = 5.5 inches of Full Depth Asphalt
Use 5.5 inches Full Depth

FOR ASPHALT + AGGREGATE BASECOURSE SECTION

Asphalt Thickness (t) = [4] inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 6.1 inches of Aggregate
Basecourse, use 6.5 inches

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 6.5 inches of Aggregate Basecourse, or
2. 5.5 inches of Full-Depth Asphalt

Job No. 191457
Fig. No. C-2