March 31, 2020

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
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John Jennings
c/o OWA
1046 Elkton Drive
Colorado Springs, CO 80907

Attn: Roland Obering

Approved
By: Elizabeth Nijkamp
Date:04/22/2020
El Paso County Planning & Community Development

Re: Pavement Recommendations
Judge Orr Ranchettes
Linder Drive, Jae Lynn Drive, and Bailiff Drive
El Paso County, Colorado

Dear Mr. Obering:

As requested, Entech Engineering, Inc. has obtained samples of the subgrade soils from sections of the roadways in the Judge Orr Ranchettes subdivision in El Paso County, Colorado. Laboratory testing to determine the pavement support characteristics of the soils was performed. This letter presents the results of the laboratory testing and pavement recommendations for the roadways.

Project Description

The roadways in this project consist of Jae Lynn Drive and Bailiff Drive, and a section of Linder Drive. The site layout and the locations of the test borings, drilled at approximate 500-foot intervals, are shown on the Test Boring Location Plan, Figure 1.

Subgrade Conditions

Seven exploratory test borings were drilled in the roadways to depths of approximately 5 to 10 feet. The Boring Logs are presented in Appendix A. Sieve Analysis and Atterberg Limit testing were performed on soil samples obtained from the test borings for the purpose of classification. Sieve analyses performed indicated the percent passing the No. 200 sieve for the roadway subgrade soils ranged from approximately 6 to 23 percent. Atterberg Limit Tests performed on the samples resulted in Liquid Limits ranging from 22 to no value and Plastic Indexes of 6 to non-plastic. One general subgrade soil type was encountered (Soil Type 1). Soil Type 1 consisted of silty to clayey sand which classified as A-2-4 and A-1-b soils based on the AASHTO classification system. The Type 1 soils have good pavement support characteristics. The Type 2 very clayey sand soils were encountered at depths located beneath the subgrade influence zone. Sulfate testing of the subgrade indicated that the soils exhibit a negligible potential for sulfate attack. Groundwater was encountered in the two of the test borings at depths of 5 and 9 feet. The groundwater will not affect the pavement subgrade.

Swell testing was performed on the Soil Type 1 and Type 2 soils. Swells of zero and 0.3 were measured. Based on the swells and the soils AASHTO classifications, mitigation is not required. Laboratory test results are presented in Appendix B and are summarized on Table 1.

California Bearing Ratio (CBR) testing was performed on a sample of Soil Type 1 to determine the support characteristic of the subgrade soils for the roadway sections. The results of the CBR testing, are presented in Appendix B and summarized as follows:

Soil Type1 – Silty Sand

R @ 90% = 65.0
R @ 95% = 71.0
Use R = 50.0 for design*

Classification Testing

Liquid Limit	NV
Plasticity Index	NP
Percent Passing 200	15.6
AASHTO Classification	A-1-b
Group Index	0
Unified Soils Classification	SM

* An R Value of 50 is used for design calculations due to slight variability of the soils between borings and it results in minimum sections for the roadways.

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". The following classifications and ESAL values were used for this the filing. All of the roadways classify as rural local roads which uses an 18K ESAL value of 36,500 for design. Pavement alternatives for asphalt over aggregate basecourse sections are provided. Design parameters used in the pavement analysis are as follows:

Reliability (Local Roads)	80%
Serviceability Index Urban Local	2.2
Resilient Modulus	13,168 psi
"R" Value Subgrade – ST 1	50.0
Structural Coefficients:	
Hot Bituminous Pavement	0.44
Aggregate Base Course	0.11

Pavement calculations are attached in Appendix C. Pavement sections recommended for this phase of the filing are summarized as follows:

Pavement Sections – Soil Type 1

Rural Local – ESAL = 36,500 – All Roadways

Alternative	Asphalt (in)	Base Course (in)
1. Asphalt Over Base Course	3.0*	4.0*

* Minimum sections required by the El Paso County Pavement Design Criteria and Report.

Mitigation

El Paso County criteria requires mitigation of expansive soils for roadway subgrade that have a swell of 2 percent or greater with a 150 pound per square foot surcharge. Due to the AASHTO classifications, mitigation for expansive soils will not be required.

Roadway Construction - Full Depth Asphalt and Asphalt on Aggregate Base Course 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 or 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 at ±2 percent of optimum moisture content. Any loose or soft areas should be removed and replaced with suitable materials. Base course 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,

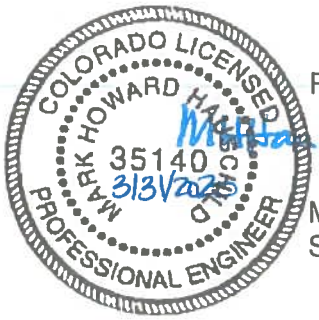
ENTECH ENGINEERING, INC.

Daniel P. Stegman

DPS/ao

Encl.

Entech Job No. 191776
AAprojects/2019/191776/191776 pr



Reviewed by:

Mark H. Hauschild, P.E.
Senior Engineer

TABLE

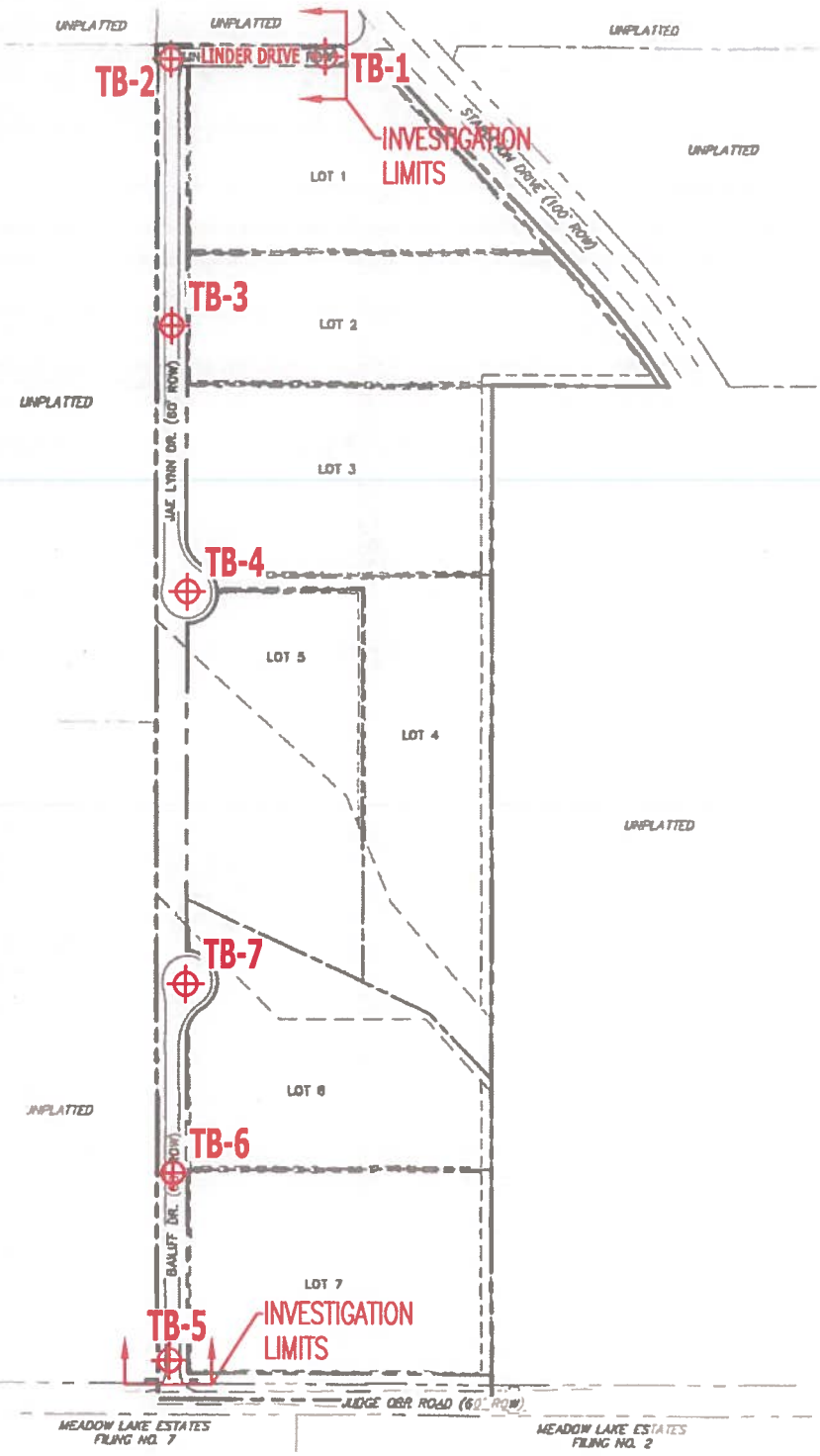
TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT JOHN JENNINGS
PROJECT JUDGE ORR RANCHETTTES
JOB NO. 191776

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, CBR	2	0-3			15.6	NV	NP		A-1-b		SM	SAND, SILTY
1	1	1-2			23.1	22	6		A-2-4		SC-SM	SAND, CLAYEY, SILTY
1	2	1-2			6.6	NV	NP		A-1-b		SM-SW	SAND, SLIGHTLY SILTY
1	3	1-2			19.7	NV	NP	<0.01	A-2-4		SM	SAND, SILTY
1	4	1-2			10.4	NV	NP		A-1-b		SM-SW	SAND, SLIGHTLY SILTY
1	5	1-2			6.2	NV	NP		A-1-b		SM-SW	SAND, SLIGHTLY SILTY
1	6	1-2			5.9	NV	NP		A-1-b		SM-SW	SAND, SLIGHTLY SILTY
1	7	1-2			18.7	NV	NP	<0.01	A-1-b		SM	SAND, SILTY
1	4	10	14.0	116.8	32.2	28	10	<0.01	A-2-4	0.0	SC	SAND, CLAYEY
1	7	10	10.5	122.4	29.1	31	9		A-2-4	0.0	SC	SAND, CLAYEY
2	2	10	22.0	98.6	49.8	34	13		A-6	0.3	SC	SAND, VERY CLAYEY

FIGURE



NOTES:

RURAL LOCAL : (ESAL = 36,500) – 3.0" ASPHALT OVER 4.0" BASECOURSE

⊕ TB-2- APPROXIMATE TEST BORING LOCATION AND NUMBER

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TEST BORING LOCATION PLAN
JUDGE ORR RANCHETTES
EL PASO COUNTY, CO
FOR: JOHN JENNINGS

DRAWN BY:	DATE DRAWN:	DESIGNED BY:	CHECKED:
JAC	03/16/20	KAH	DS

JOB NO.: 191776

FIG. NO.: 1

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 2/13/2020
Job # 191776

REMARKS

DRY TO 5', 2/13/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			12	2.6	1	6" TOPSOIL, SAND, CLAYEY, SILTY, FINE TO COARSE GRAINED, DARK BROWN TO BROWN, MEDIUM DENSE, DRY
5			10	0.2	1	
10						
15						
20						

TEST BORING NO. 2
DATE DRILLED 2/13/2020
CLIENT JOHN JENNINGS
LOCATION JUDGE ORR RANCHETTTES

REMARKS

WATER @ 9', 2/13/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			12	1.1	1	6" TOPSOIL, SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, DRY TO MOIST
5			17	3.5	1	
10			6	22.1	2	SAND, VERY CLAYEY, FINE GRAINED, BROWN, LOOSE, MOIST
15						
20						

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		DS	3/31/20

JOB NO.: 191776
FIG NO.: A-1

TEST BORING NO. 3
DATE DRILLED 2/13/2020
Job # 191776

REMARKS

DRY TO 5', 2/13/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	SAND, SILTY, FINE TO COARSE GRAINED, BROWN, LOOSE, DRY		4	2.4	1
5			6	3.0	1
10					
15					
20					

TEST BORING NO. 4
DATE DRILLED 2/13/2020
CLIENT JOHN JENNINGS
LOCATION JUDGE ORR RANCHETTTES

REMARKS

WATER @ 5', 2/13/20

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	6" TOPSOIL, SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, BROWN, LOOSE TO		8	1.8	1
5	MEDIUM DENSE, DRY TO MOIST ▼		25	3.2	1
10	SAND, CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST		28	14.7	1
15					
20					

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		DS	3/31/20

JOB NO.: 191776
FIG NO.: A-2

TEST BORING NO. 5
DATE DRILLED 2/13/2020
Job # 191776

REMARKS

DRY TO 5', 2/13/20

SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, LOOSE, MOIST

SAND, CLAYEY, FINE TO MEDIUM GRAINED, GRAY BROWN, MEDIUM DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			6	2.8	1
5			13	14.9	1
10					
15					
20					

TEST BORING NO. 6
DATE DRILLED 2/13/2020
CLIENT JOHN JENNINGS
LOCATION JUDGE ORR RANCHETTTES

REMARKS

DRY TO 5', 2/13/20

6" TOPSOIL, SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, DRY TO MOIST
SLIGHTLY CLAYEY LENSES

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			19	1.6	1
5			21	7.1	1
10					
15					
20					

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		DS	3/31/20

JOB NO.: 191776
FIG NO.: A-3

TEST BORING NO. 7
DATE DRILLED 2/13/2020
Job # 191776

TEST BORING NO.
DATE DRILLED
CLIENT JOHN JENNINGS
LOCATION JUDGE ORR RANCHETTTES

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 2/13/20						
6" TOPSOIL, SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, DRY TO MOIST				10	2.5	1
	5			23	4.1	1
SAND, CLAYEY, FINE GRAINED, GRAY BROWN, DENSE, MOIST	10			32	13.8	1
	15					
	20					

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	5					
	10					
	15					
	20					

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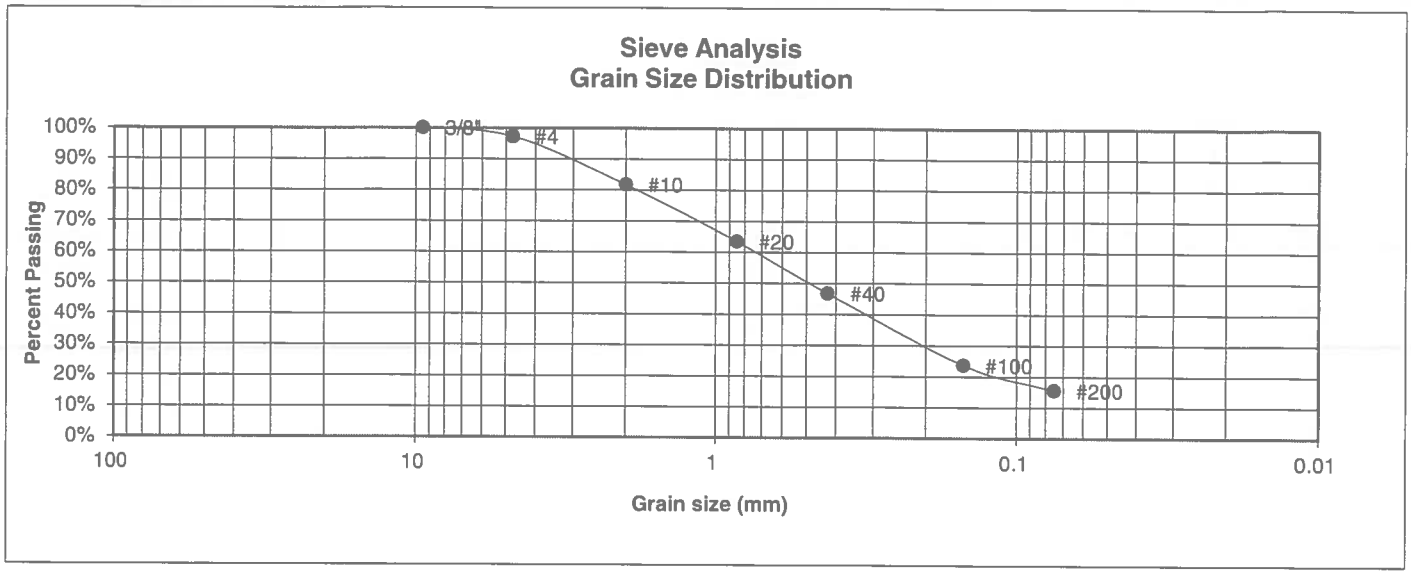
TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		DS	3/27/20

JOB NO.: 191776
FIG NO.: A-4

APPENDIX B: Laboratory Test Results

UNIFIED CLASSIFICATION	SM	CLIENT	JOHN JENNINGS
SOIL TYPE #	1, CBR	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	2	JOB NO.	191776
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION	A-1-b	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.2%
10	81.7%
20	63.5%
40	46.8%
100	23.6%
200	15.6%

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)

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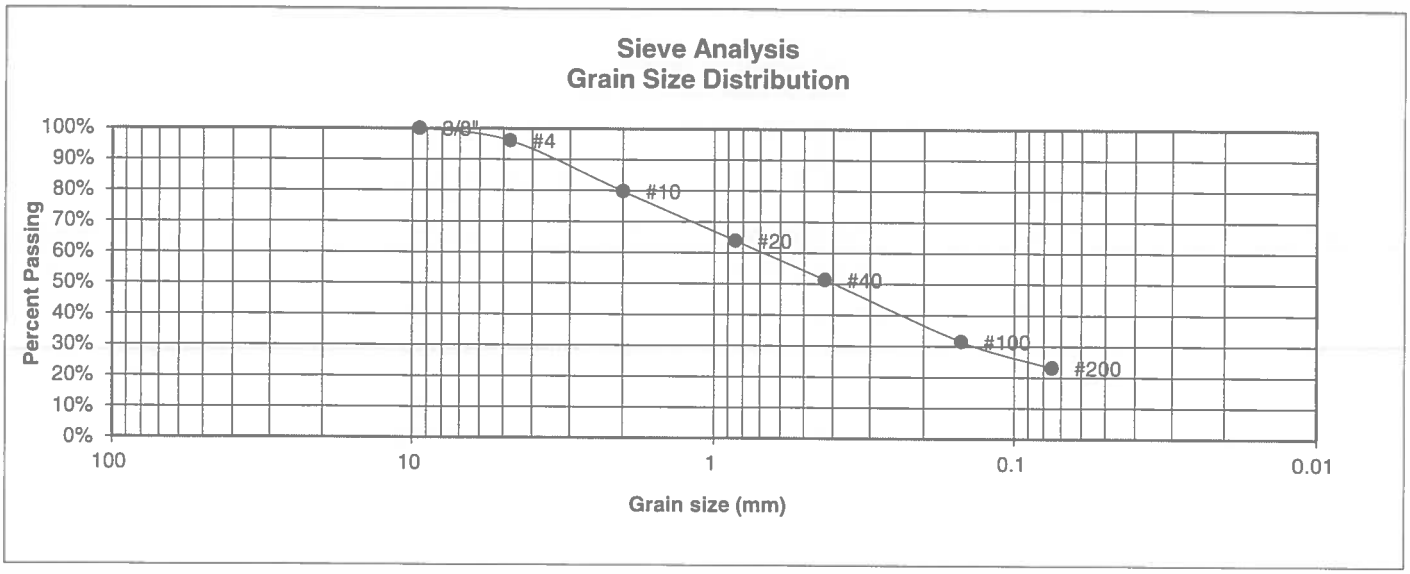
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 3/9/20

JOB NO.: 191776
FIG NO.: B-1

UNIFIED CLASSIFICATION	SC-SM	CLIENT	JOHN JENNINGS
SOIL TYPE #	1	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	1	JOB NO.	191776
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.1%
10	79.8%
20	63.9%
40	51.4%
100	31.5%
200	23.1%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	22
Plastic Index	6

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

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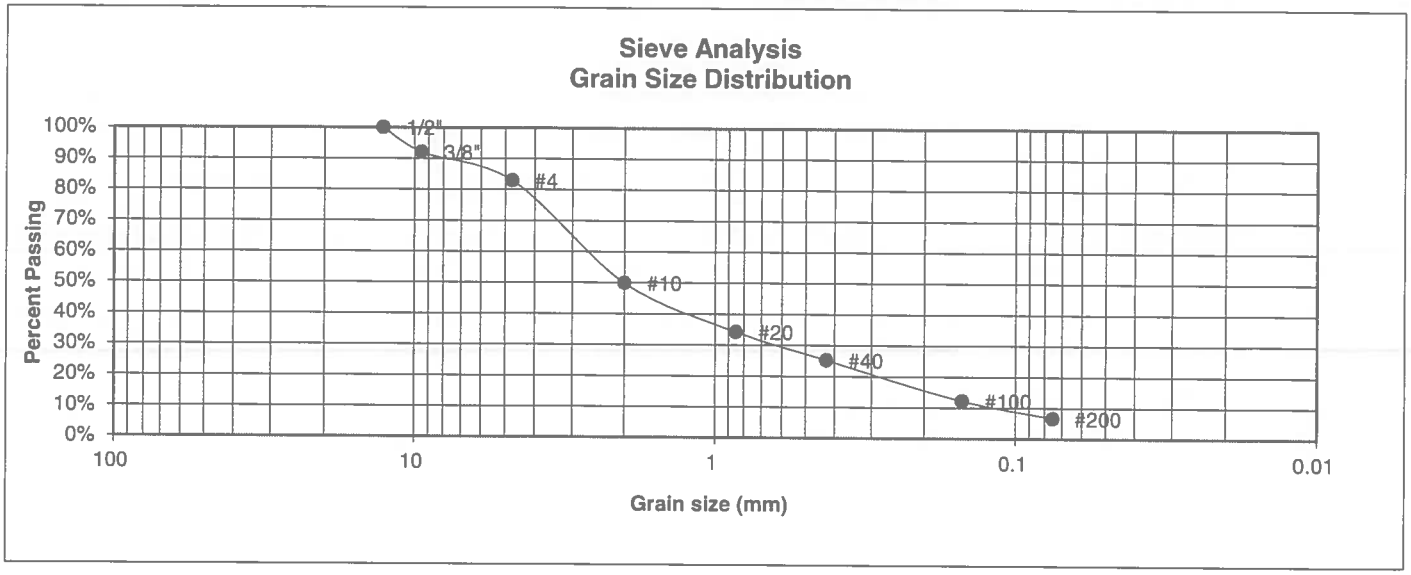
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			3/9/20

JOB NO.: 191776
FIG NO.: B-2

UNIFIED CLASSIFICATION	SM-SW	CLIENT	JOHN JENNINGS
SOIL TYPE #	1	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	2	JOB NO.	191776
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-1-b	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	92.1%
4	82.9%
10	49.9%
20	34.2%
40	25.2%
100	12.2%
200	6.6%

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)

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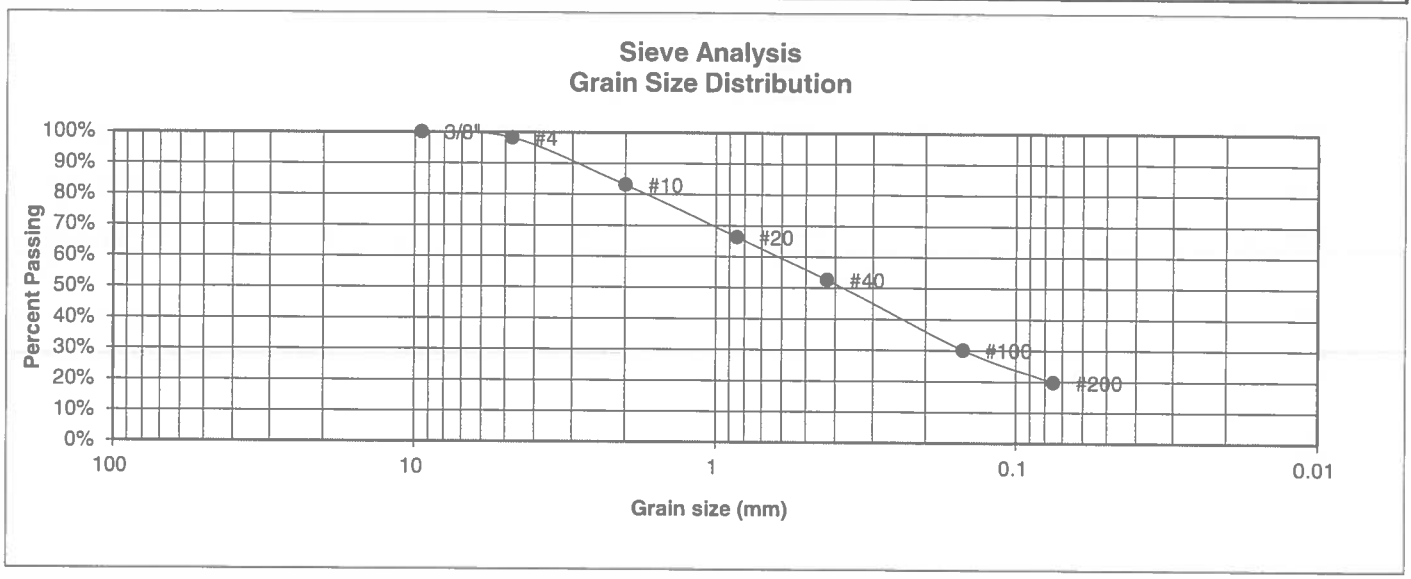
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			3/9/20

JOB NO.: 191776
FIG NO.: B-3

UNIFIED CLASSIFICATION	SM	CLIENT	JOHN JENNINGS
SOIL TYPE #	1	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	3	JOB NO.	191776
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.2%
10	83.1%
20	66.3%
40	52.6%
100	30.1%
200	19.7%

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)

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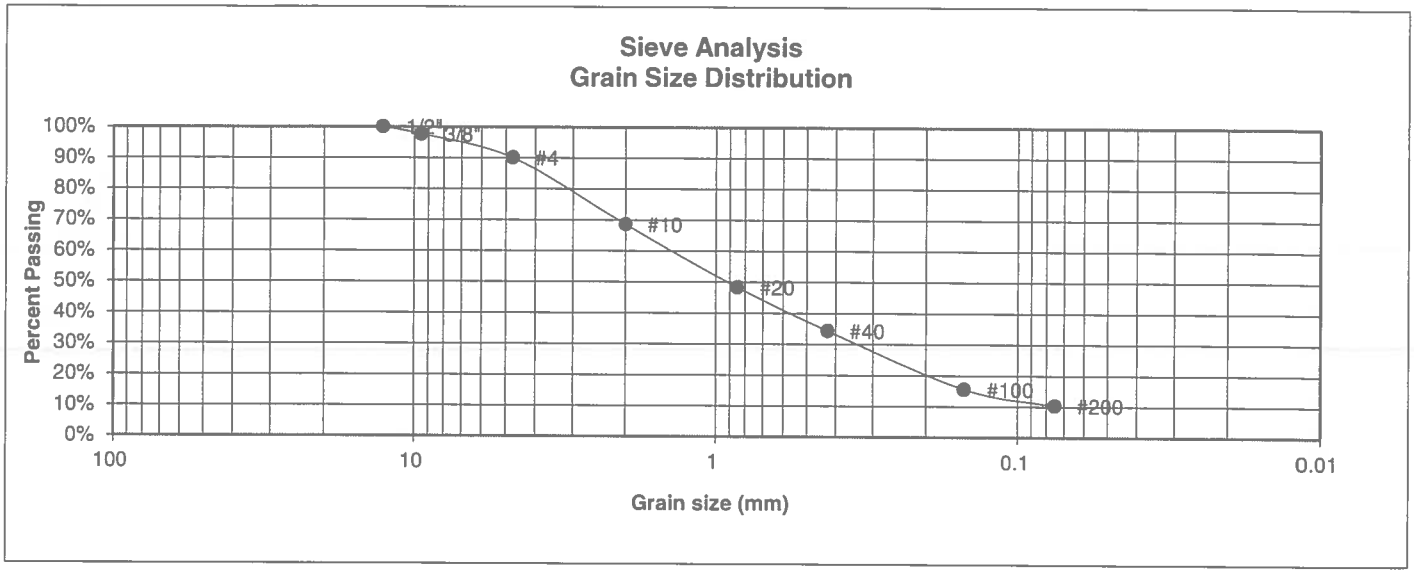
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 3/9/20

JOB NO.: 191776
FIG NO.: B-4

UNIFIED CLASSIFICATION	SM-SW	CLIENT	JOHN JENNINGS
SOIL TYPE #	1	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	4	JOB NO.	191776
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-1-b	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.7%
4	90.0%
10	68.6%
20	48.4%
40	34.3%
100	15.6%
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)

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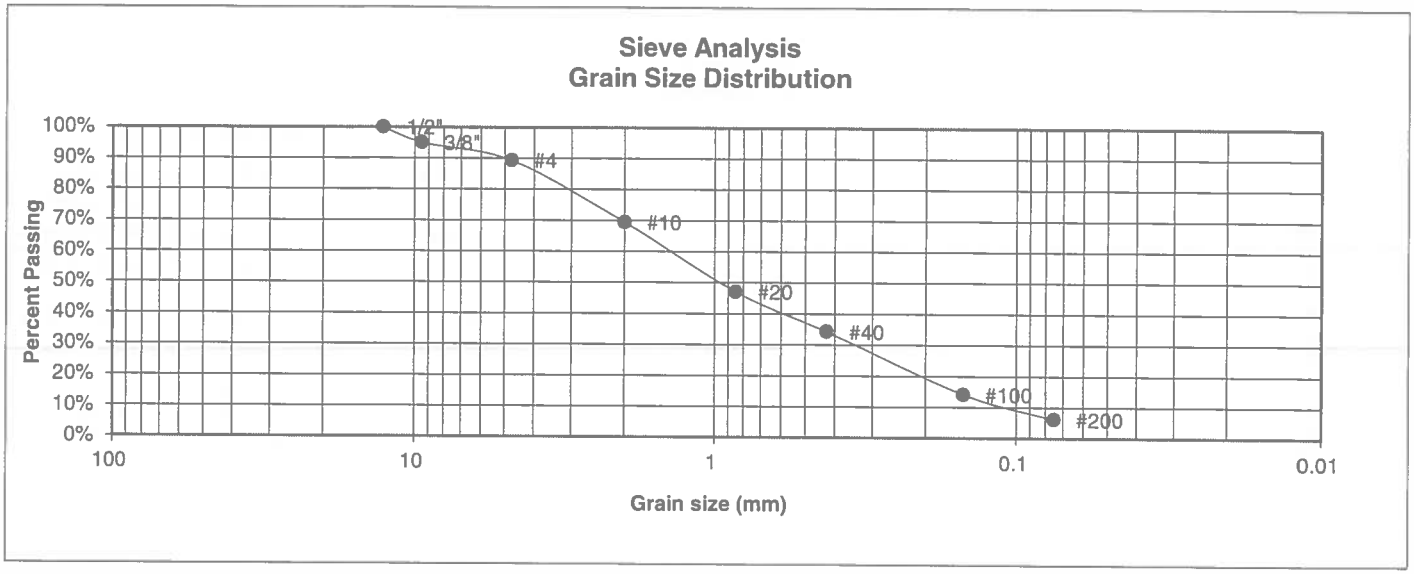
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 3/9/20

JOB NO.: 191776
FIG NO.: B-5

UNIFIED CLASSIFICATION	SM-SW	CLIENT	JOHN JENNINGS
SOIL TYPE #	1	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	5	JOB NO.	191776
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-1-b	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	95.0%
4	89.3%
10	69.4%
20	47.1%
40	34.3%
100	14.1%
200	6.2%

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)	

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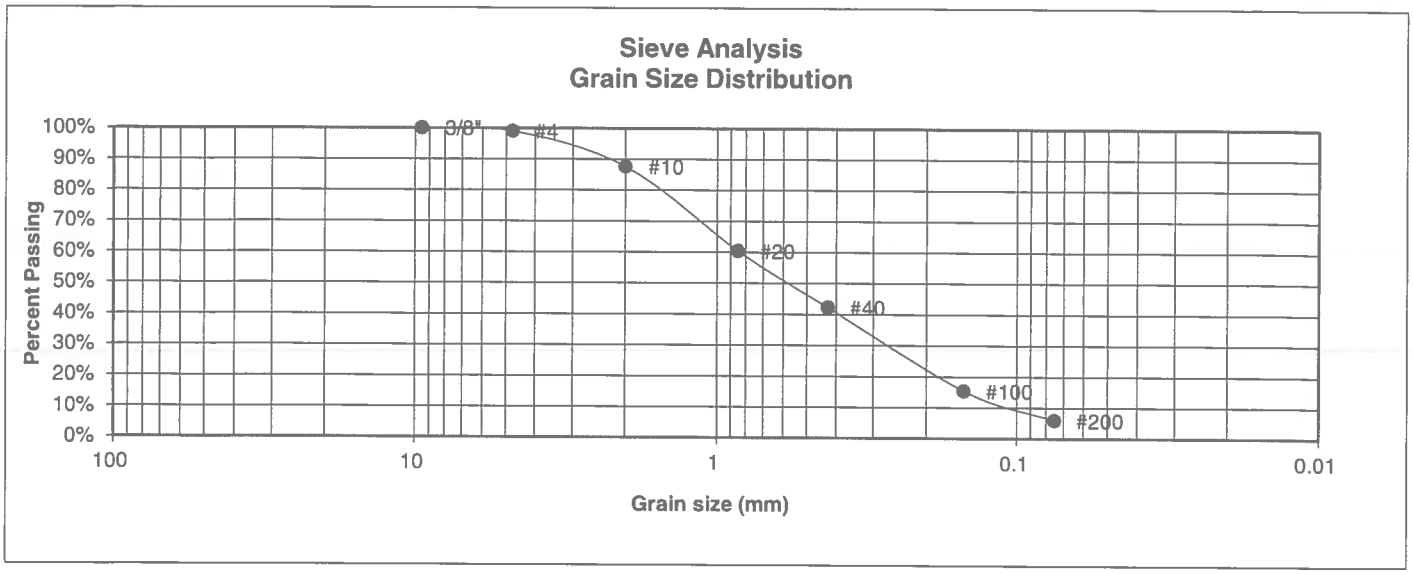
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			2/9/20

JOB NO.: 191776
FIG NO.: B-6

UNIFIED CLASSIFICATION	SM-SW	CLIENT	JOHN JENNINGS
SOIL TYPE #	1	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	6	JOB NO.	191776
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-1-b	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.0%
10	87.6%
20	60.4%
40	42.3%
100	15.4%
200	5.9%

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)

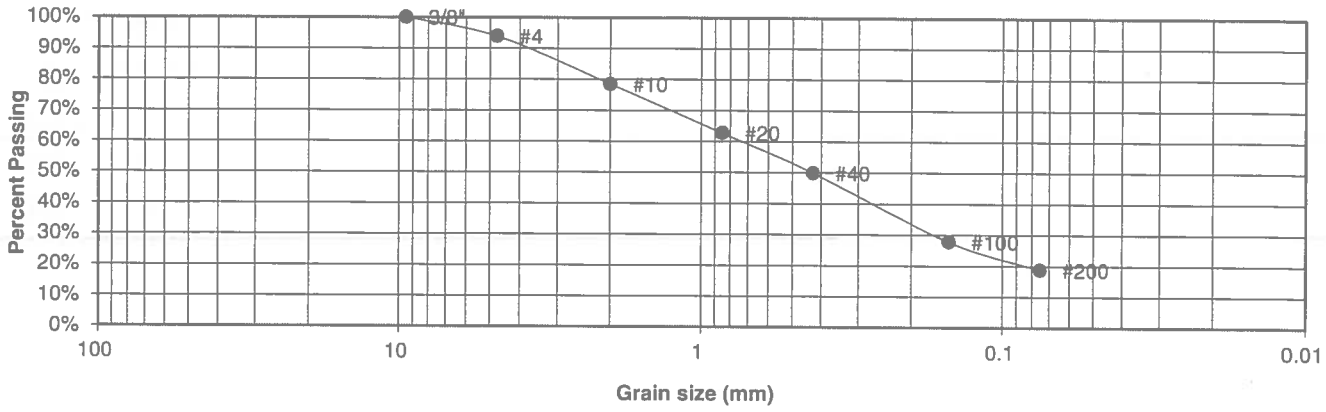
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			3/9/20

JOB NO.: 191776
FIG NO.: B-7

UNIFIED CLASSIFICATION	SM	CLIENT	JOHN JENNINGS
SOIL TYPE #	1	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	7	JOB NO.	191776
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-1-b	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	93.9%
10	78.4%
20	62.8%
40	49.9%
100	27.8%
200	18.7%

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)

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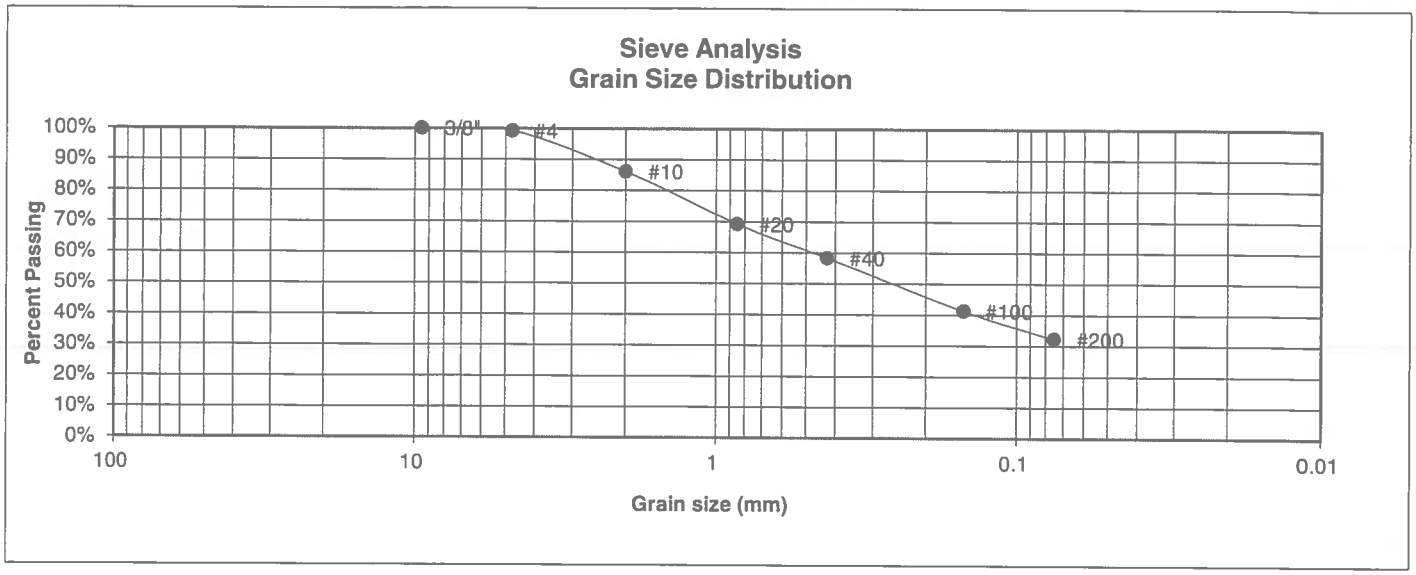
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			3/31/20

JOB NO.: 191776
FIG NO.: B-8

UNIFIED CLASSIFICATION	SC	CLIENT	JOHN JENNINGS
SOIL TYPE #	1	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	4	JOB NO.	191776
DEPTH (FT)	10	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.2%
10	86.1%
20	69.2%
40	58.3%
100	41.3%
200	32.2%

Atterberg Limits	
Plastic Limit	18
Liquid Limit	28
Plastic Index	10

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

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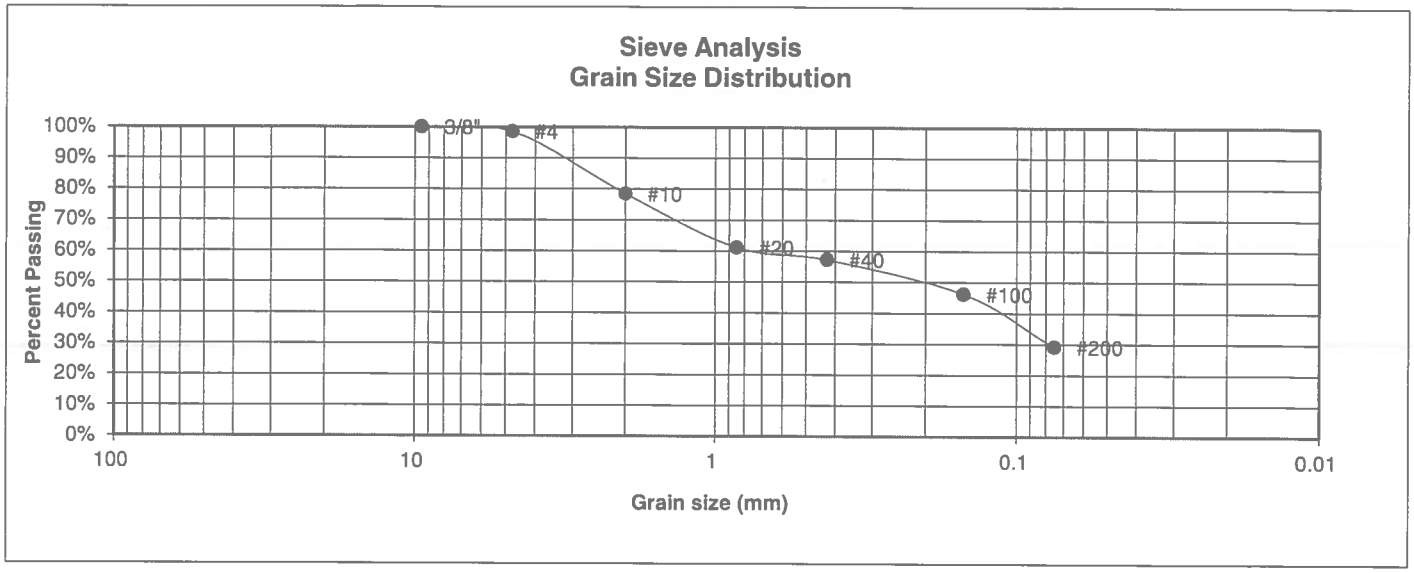
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 3/9/20

JOB NO.: 191776
FIG NO.: B-9

UNIFIED CLASSIFICATION	SC	CLIENT	JOHN JENNINGS
SOIL TYPE #	1	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	7	JOB NO.	191776
DEPTH (FT)	10	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	GROUP INDEX	-1



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.5%
10	78.5%
20	61.1%
40	57.2%
100	46.2%
200	29.1%

Atterberg Limits	
Plastic Limit	22
Liquid Limit	31
Plastic Index	9

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

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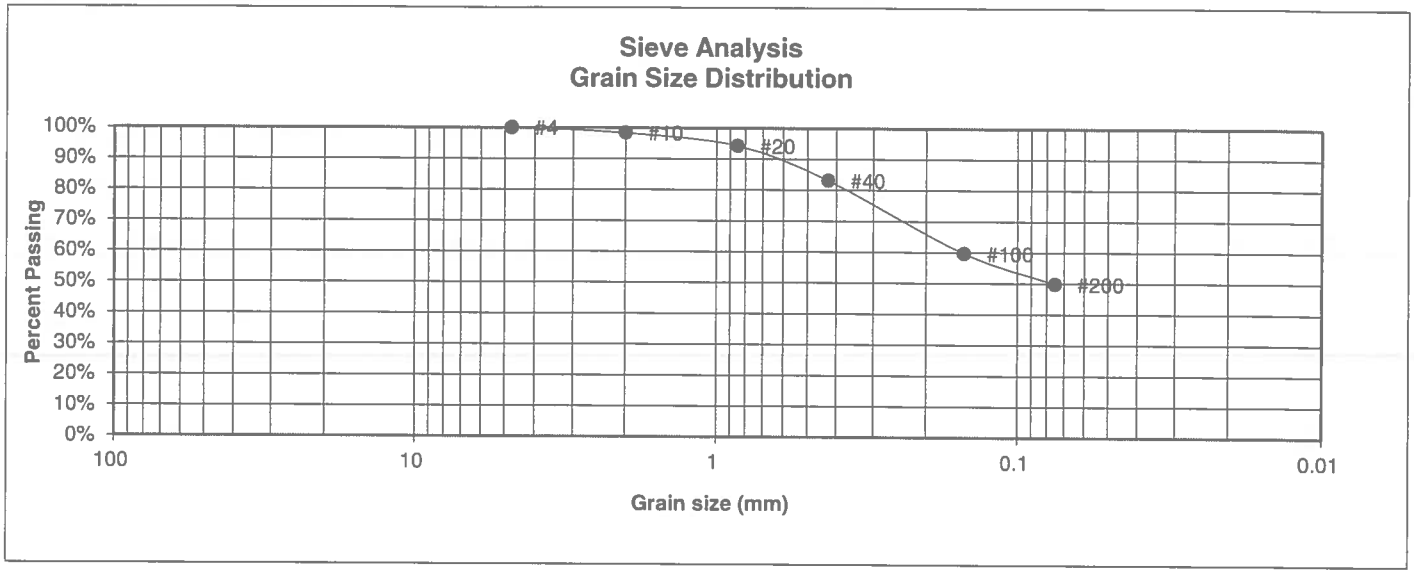
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 3/9/20

JOB NO.: 191776
FIG NO.: B-10

UNIFIED CLASSIFICATION	SC	CLIENT	JOHN JENNINGS
SOIL TYPE #	2	PROJECT	JUDGE ORR RANCHETTTES
TEST BORING #	2	JOB NO.	191776
DEPTH (FT)	10	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	3



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	98.3%
20	94.2%
40	83.1%
100	59.7%
200	49.8%

Atterberg Limits	
Plastic Limit	22
Liquid Limit	34
Plastic Index	13

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

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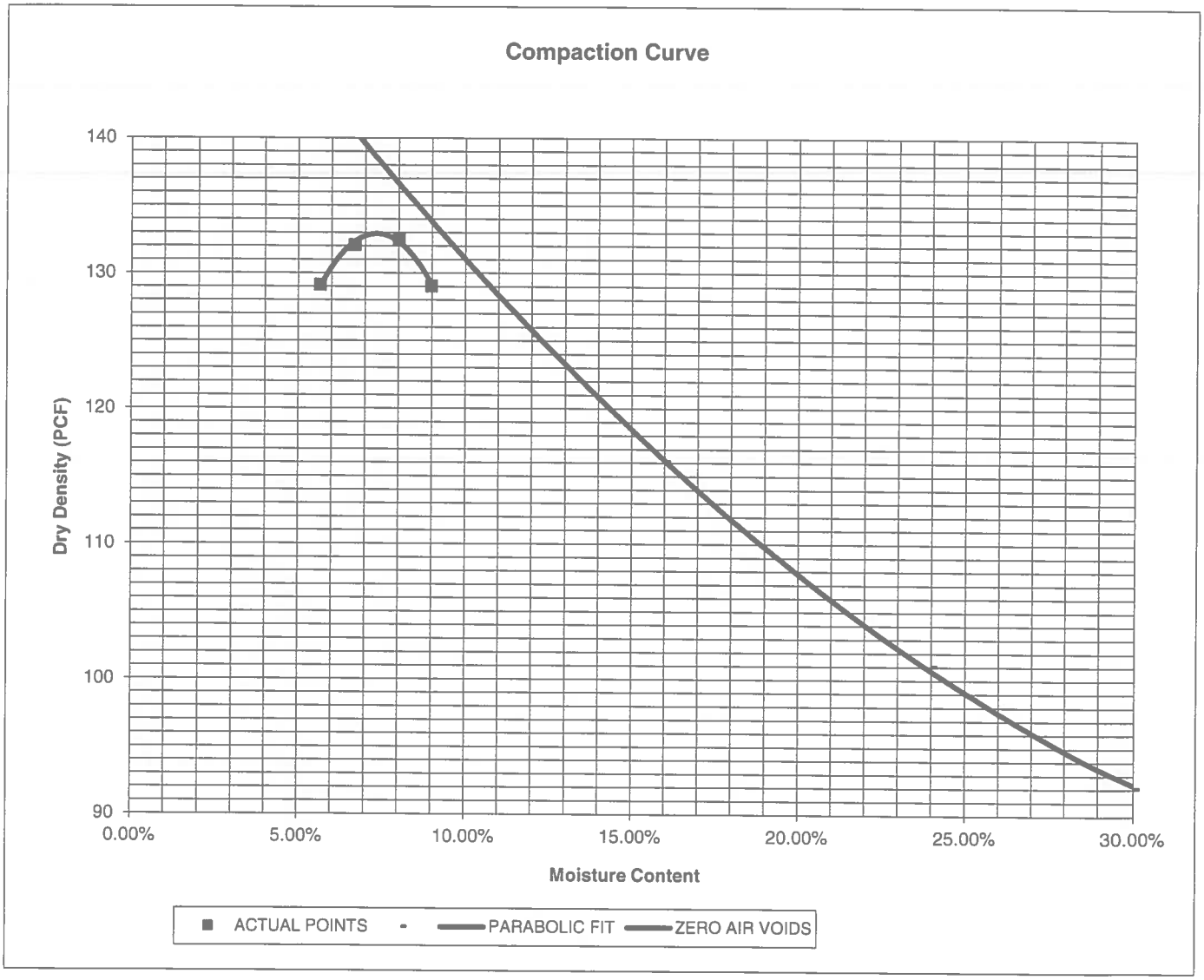
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 2/9/20

JOB NO.: 191776
FIG NO.: B-11

PROJECT	JUDGE ORR RANCHETTTES	CLIENT	JOHN JENNINGS
SAMPLE LOCATION	TB-2 @ 0-3'	JOB NO.	191776
SOIL DESCRIPTION	SAND, SILTY, BROWN	DATE	02/17/20

IDENTIFICATION	SM	COMPACTION TEST #	1
TEST DESIGNATION / METHOD	ASTM D-1557-A	TEST BY	KW
MAXIMUM DRY DENSITY (PCF)	132.9	OPTIMUM MOISTURE	7.3%



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MOISTURE DENSITY RELATION

DRAWN:	DATE:	CHECKED:	DATE:
			3/9/20

JOB NO.: 191776
FIG NO.: B-12

CBR TEST LOAD DATA

JOB NO: 191776
CLIENT: JOHN JENNINGS
PROJECT: JUDGE ORR RANCHETTTES
SOIL TYPE: 1

PISTON DIAMETER (cm)	PISTON AREA (in^2)
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	91	30.41	157	52.46	177	59.15
0.050	219	73.18	330	110.28	418	139.68
0.075	484	161.74	506	169.09	757	252.96
0.100	576	192.48	680	227.23	1086	362.91
0.125	800	267.33	970	324.14	1531	511.61
0.150	923	308.44	1393	465.50	1966	656.97
0.175	1083	361.90	1656	553.38	2289	764.91
0.200	1196	399.66	2096	700.42	2718	908.27
0.300	1659	554.38	3901	1303.59	4493	1501.42
0.400	1820	608.19	4751	1587.63	5978	1997.65
0.500	2122	709.10	5501	1838.26	6000	2005.01

FINAL MOISTURE CONTENT

	MOLD # 1	MOLD # 2	MOLD # 3
CAN #	345	357	106
WT. CAN	6.8	6.7	9.34
WT. CAN+WET	170.43	197.03	176.21
WT. CAN+DRY	148.42	175.42	160.62
WT. H20	22.01	21.61	15.59
WT. DRY SOIL	141.62	168.72	151.28
MOISTURE CONTENT	15.54%	12.81%	10.31%
WET DENSITY (PCF)	130.2	135.8	141.8
DRY DENSITY (PCF)	121.4	126.5	132.1
BEARING RATIO	19.25	22.72	36.29

90% OF DRY DENSITY	119.6
95% OF DRY DENSITY	126.3

BEARING RATIO AT 90% OF MAX	18.05	~ R VALUE	65
BEARING RATIO AT 95% OF MAX	22.53	~ R VALUE	71

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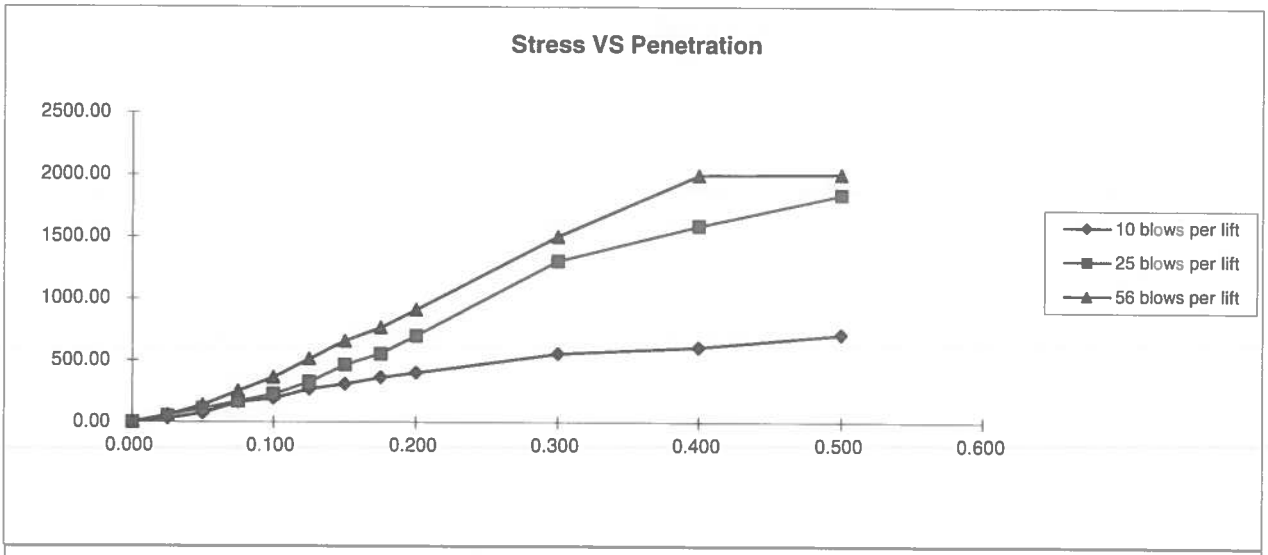
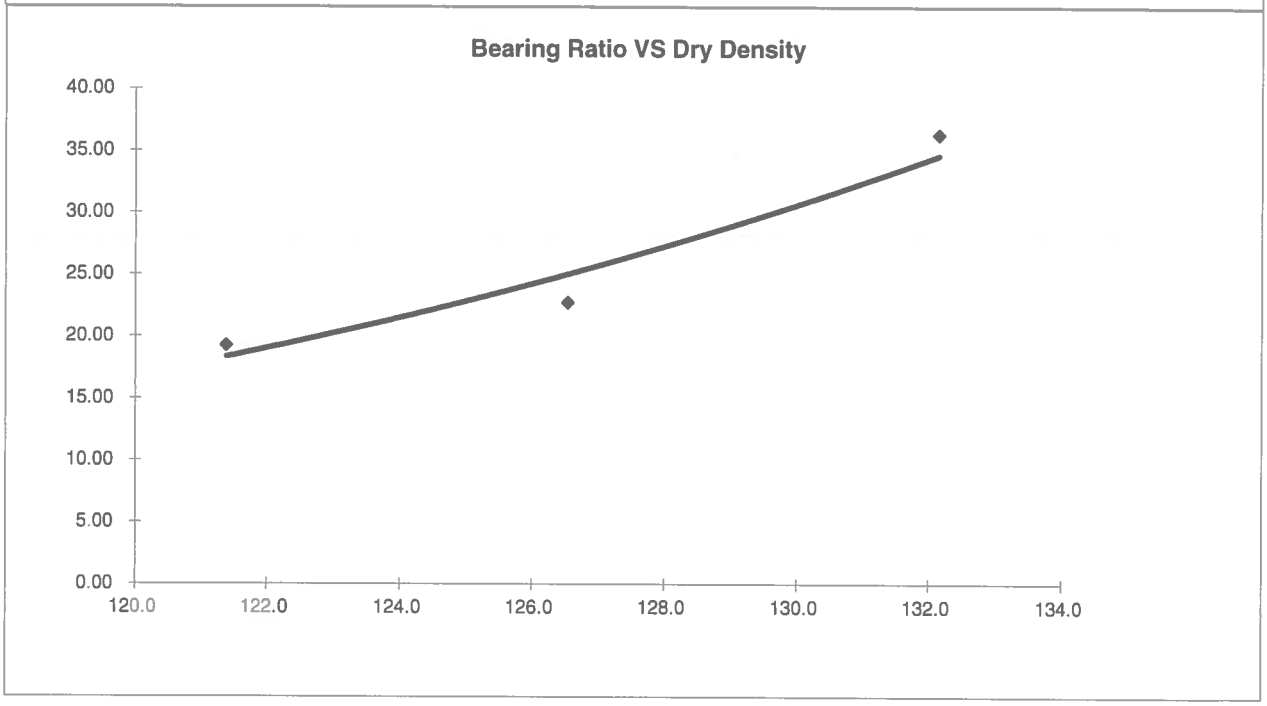
CBR TEST DATA

DRAWN:	DATE:	CHECKED:	DATE:
		DS	3/22/21

JOB NO.: 191776
FIG NO.: B-13





BEARING RATIO AT 90% OF MAX	18.05	~ R VALUE	65.00
BEARING RATIO AT 95% OF MAX	22.53	~ R VALUE	71.00

JOB NO: 191776
SOIL TYPE: 1

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CALIFORNIA BEARING RATIO

DRAWN:	DATE:	CHECKED:	DATE:
		DS	5/22/20

JOB NO.: 191776
FIG NO.: B-4

CLIENT	JOHN JENNINGS	JOB NO.	191776
PROJECT	JUDGE ORR RANCHETTTES	DATE	3/3/2020
LOCATION	JUDGE ORR RANCHETTTES	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-3	1-2	1	SM	<0.01
TB-4	10	1	SC	<0.01
TB-7	1-2	1	SM	<0.01

QC BLANK PASS

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LABORATORY TEST
SULFATE RESULTS

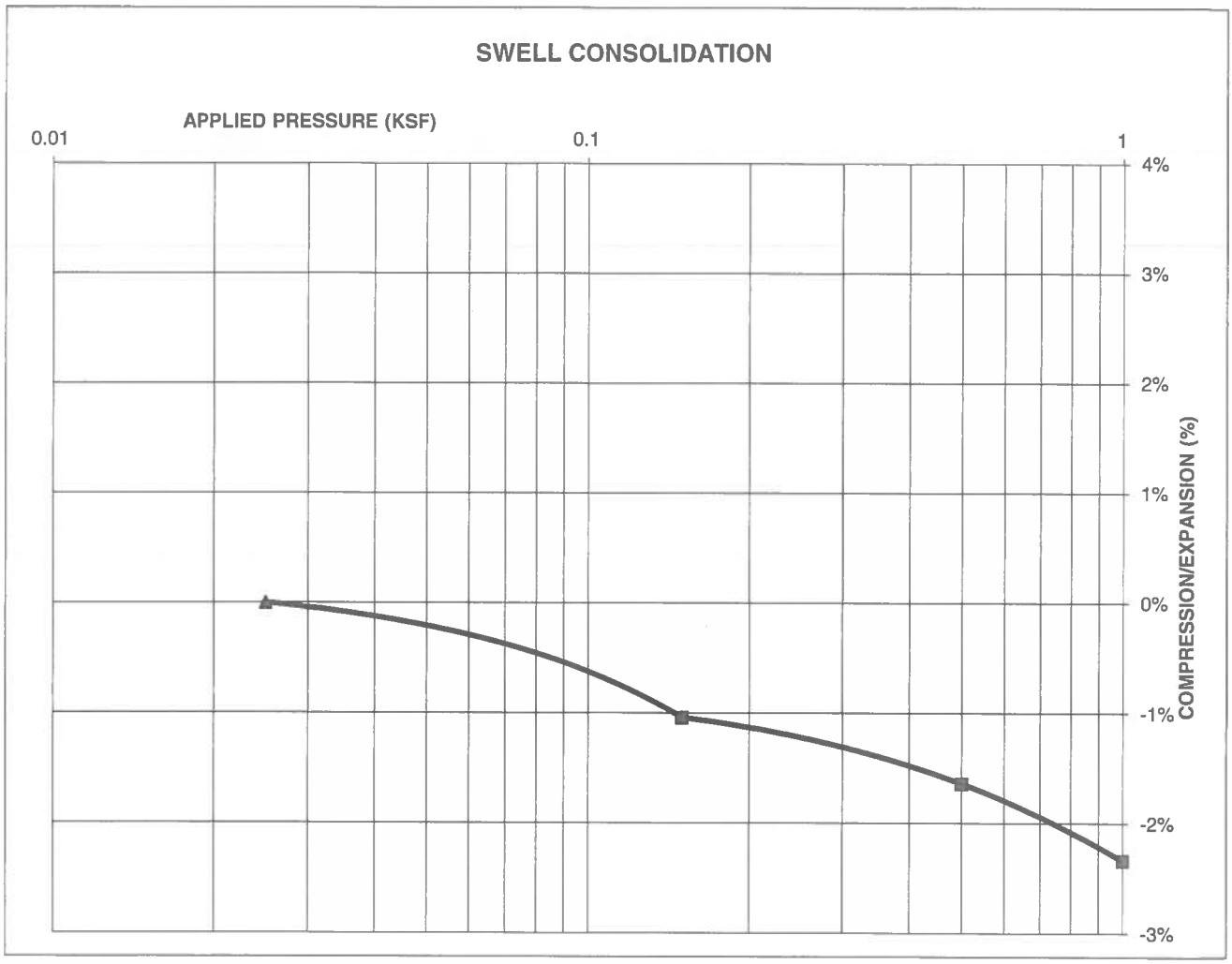
DRAWN:	DATE:	CHECKED:	DATE: 3/9/20

JOB NO.: 191776
FIG NO.: B-15

CONSOLIDATION TEST RESULTS

TEST BORING #	7	DEPTH(ft)	10
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			122
NATURAL MOISTURE CONTENT			10.5%
SWELL/CONSOLIDATION (%)			0.0%

JOB NO. 191776
CLIENT JOHN JENNINGS
PROJECT JUDGE ORR RANCHETTTES



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SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	3/31/20

JOB NO.: 191776
FIG NO.: 1

CONSOLIDATION TEST RESULTS

TEST BORING #	4	DEPTH(ft)	10
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			117
NATURAL MOISTURE CONTENT			14.0%
SWELL/CONSOLIDATION (%)			0.0%

JOB NO. 191776
CLIENT JOHN JENNINGS
PROJECT JUDGE ORR RANCHETTTES

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SWELL CONSOLIDATION
TEST RESULTS

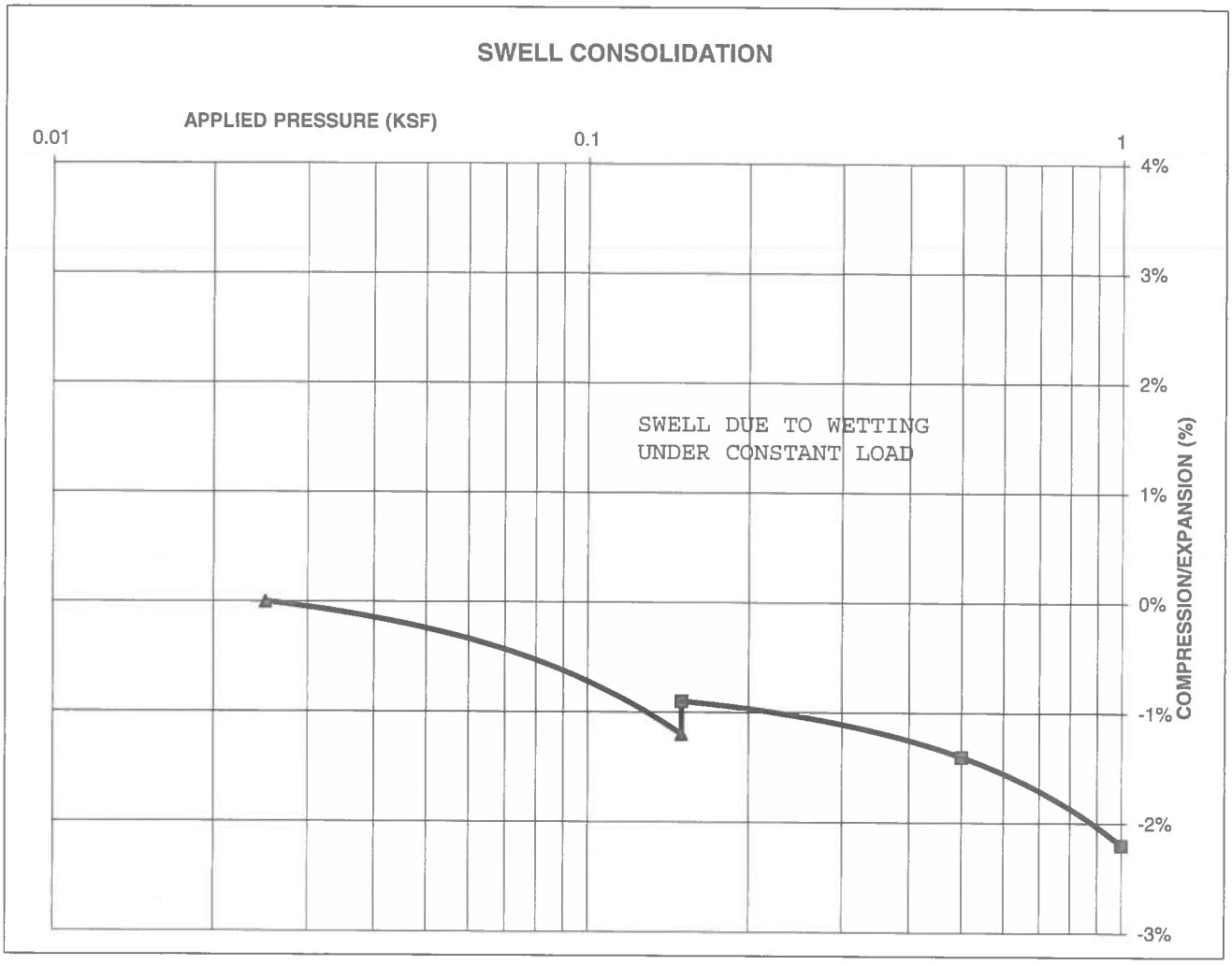
DRAWN:	DATE:	CHECKED:	DATE:
		DS	3/31/21

JOB NO.: 191776
FIG NO.: 6-17

CONSOLIDATION TEST RESULTS

TEST BORING #	2	DEPTH(ft)	10
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			99
NATURAL MOISTURE CONTENT			22.0%
SWELL/CONSOLIDATION (%)			0.3%

JOB NO. 191776
CLIENT JOHN JENNINGS
PROJECT JUDGE ORR RANCHETTTES



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SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	3/12/20

JOB NO.: 191776
FIG NO.: B-18

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA JUDGE ORR RANCHETTES - RURAL LOCAL - ESAL = 36,500

SOIL TYPE 1, CBR # 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	36,500
Hveem Stabilometer (R Value) Results:	R =	50
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 =	13168

Weighted Structural Number (WSN): → WSN = 1.50

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)
80	-0.84
85	-1.04
90	-1.28
93	-1.48
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	4.63	-0.1

Job No. 191776
Fig. No. C-1

DESIGN CALCULATIONS

DESIGN DATA JUDGE ORR RANCHETTES - RURAL LOCAL - ESAL = 36,500

SOIL TYPE 1, CBR # 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	36,500
Hveem Stabilometer (R Value) Results:	R =	50
Weighted Structural Number (WSN):	WSN =	1.50

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 Base Course

D_1 = Depth of Asphalt (inches)
D_2 = Depth of Base Course (inches)

FOR FULL DEPTH ASPHALT SECTION (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1$ = 3.4 inches of Full Depth Asphalt
Use 4.0 inches Full Depth

FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = [3] inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 1.7 inches of Aggregate
Base Course, use 4.0 inches

RECOMMENDED ALTERNATIVES

1. 3.0 inches of Asphalt + 4.0 inches of Aggregate Base Course, or
2. 4.0 inches of Full Depth Asphalt

Job No. 191776
Fig. No. C-2