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

May 6, 2021

Classic Communities
2138 Flying Horse Club Drive
Colorado Springs, Colorado 80921

Attn: Adam Doyle

Re: Pavement Recommendations
Midtown at Hannah Ridge, Filing No. 1, Phases 1 and 2
El Paso County, Colorado

Phase 2 only.

Dear Mr. Doyle:

As requested, Entech Engineering, Inc. obtained samples of the pavement subgrade soil from the proposed roadways within the above referenced filing. 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 local residential roadways within the filing.

Project Description

The project will consist of the paving of sections of Horsemanship Court, Grand Prix Court, Rosa Belle Heights, and Cracker Jack Heights in the Midtown at Hannah Ridge, Filing No. 1 Subdivision, Phase 1 and 2. Subsurface Soil Investigation and laboratory testing was performed to determine the pavement support characteristics on the soil. The general layout of the site is presented in the Test Boring Location Map, Figure 1.

Subgrade Conditions

Eight test borings were drilled in the roadways in this filing, not exceeding 500 feet between each test boring. The test boring locations are shown in Figure No. 1. The Test Boring Logs are presented in Appendix A. A representative bulk sample of the subgrade soils was obtained from Test Boring No. 1 at the anticipated subgrade elevation. Soils encountered in the test borings consisted of clayey to very clayey sand fill and sandy clay fill. The surficial soils were classified into two soil type (Soil Types 1 and 2). Due to the similarity of the soils, design was performed on a sample of the Type 1 soil. The Type 3 and 4 soils were located at depths beneath the subgrade influence zone.

Sieve Analyses were performed on the subgrade soils for the purpose of classification. The Sieve Analyses on the Type 1 soils indicated that approximately 41 to 57 percent of the soil particles passed the No. 200 sieve. The Type 1 soils classify as A-6 and soils using the AASHTO classification system. The Type 1 soils typically provide fair pavement support characteristics. Water soluble sulfate tests indicated that the soils exhibited a negligible potential for below grade sulfate attack. 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 on the Type 1 and 2 soils was required due to their plastic indexes. The testing resulted in swells of 0.2 to 1.9 percent. Based on these results, mitigation for expansive soils is not required in this filing.

California Bearing Ratio (CBR) testing was performed on a sample of the Type 1 subgrade soils. 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 1 – Very Clayey Sand Fill

R @ 90% = 14.0
R @ 95% = 30.0
Use R = 30.0 for design

Classification Testing

Liquid Limit	36
Plasticity Index	16
Percent Passing 200	43.2
AASHTO Classification	A-6
Group Index	3
Unified Soils Classification	SC

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 local roadways which used an 18K ESAL value of 292,000 for design. Pavement alternatives for asphalt over aggregate basecourse and cement stabilized subgrade sections are provided. Design parameters used in the pavement analysis are as follows:

Reliability (Local Roads)	80%
Serviceability Index (Local Roads)	2.0
"R" Value Subgrade - Soil Type 1	30.0
Resilient Modulus - Soil Type 1	6,849 psi
Structural Coefficients:	
Hot Bituminous Pavement	0.44
Aggregate Basecourse	0.11
Cement Stabilized Subgrade	0.12

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

Pavement Sections – Soil Type 1

Urban Local – ESAL = 292,000

Alternative	Asphalt (in)	Basecourse (in)	Cement Stabilized Subgrade (in.)
1. Asphalt Over Basecourse	4.0	9.0	--
2. Cement Stabilized Subgrade	4.0*	--	10.0

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

Roadway Construction - 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 Standard Proctor Dry Density, ASTM D-698 at 0 to +3 percent of optimum moisture content. Any loose or soft 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.

Roadway Construction – Cement Stabilized Subgrade Alternative

Prior to placement of the asphalt, the subgrade shall be stabilized by addition of cement to a depth of at least 10 inches. The amount of cement applied shall be 2.0 percent (by weight) of the subgrade's maximum dry density as determined by the Standard Proctor Test (ASTM D-698) based on laboratory cement stabilization testing. The cement should be spread evenly on the subgrade surface and be thoroughly mixed into the subgrade over a 10-inch depth such that a uniform blend of soil and cement is achieved. Prior to application or mixing of the cement, the upper 10-inches of subgrade should be thoroughly moisture conditioned to the soil's optimum water content or as much as 2 percent more than the optimum water content as necessary to provide a compactable soil condition. Densification of the cement-stabilized subgrade should be completed to obtain a compaction of at least 95 percent of the subgrade maximum dry density as determined by the Standard Proctor Test (ASTM D-698). Satisfactory compaction of the subgrade shall occur within 90 minutes from the time of mixing the cement into the subgrade.

The following conditions shall be observed as part of the subgrade stabilization:

- Type I/II cement as supplied; a local supplier shall be used. All cement used for stabilization should come from the same source. If cement sources are changed a new laboratory mix design should be completed.

- Moisture conditioning of the subgrade and/or mixing of the cement into the subgrade shall not occur when soil temperatures are below 40° F. Cement treated subgrades should be maintained at a temperature of 40° F or greater until the subgrade has been compacted as required.

- Cement placement, cement mixing and compaction of the cement treated subgrade should be observed by a Soils Engineer. The Soils Engineer should complete in situ compaction tests and construct representative compacted specimens of the treated subgrade material for subsequent laboratory quality assurance testing.

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, cement, subgrade conditions, compaction of materials and roadway construction methods shall meet the El Paso County specifications.

Classic Communities
Pavement Recommendations
Midtown at Hannah Ridge, Filing No. 1, Phases 1 and 2
El Paso County, Colorado

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/bs

Encl.

Entech Job No. 200511
AAprojects/2020/200511 pr 2

COLORADO LICENSED
MARK HOWARD HAUSCHILD
35140
5-19-2021
PROFESSIONAL ENGINEER

Reviewed by:

Mark H. Hauschild, P.E.
Senior Engineer

TABLE

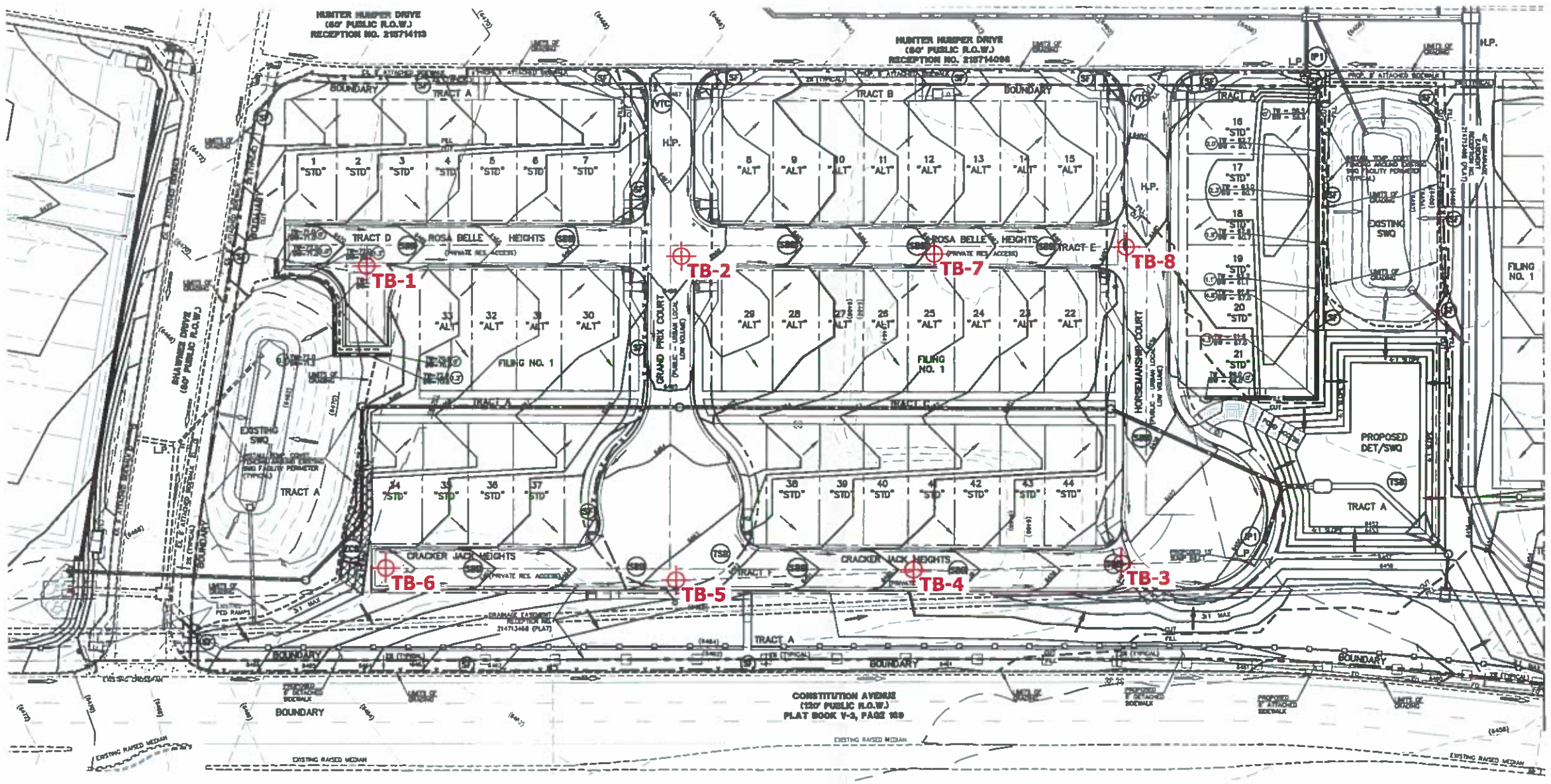
TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1
JOB NO. 200511

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	1	0-3	13.0	112.4	43.2	36	16		A-6	0.5	SC	FILL, SAND, VERY CLAYEY
1	1	1-2	15.8	110.2	40.8	33	16	<0.01	A-6	0.2	SC	FILL, SAND, VERY CLAYEY
1	3	1-2	9.0	90.3	43.4	36	17		A-6	0.3	SC	FILL, SAND, VERY CLAYEY
1	4	1-2	15.8	104.8	44.1	34	12		A-6	0.3	SC	FILL, SAND, VERY CLAYEY
1	6	1-2	11.7	114.8	47.9	37	16	0.06	A-6	0.2	SC	FILL, SAND, VERY CLAYEY
1	7	1-2	13.3	85.1	56.8	34	17		A-6	0.6	CL	FILL, CLAY, VERY SANDY
1	8	1-2	12.9	94.4	50.2	35	17		A-6	1.9	SC-CL	FILL, SAND-CLAY
2	2	1-2	13.7	112.5	24.7	36	17		A-2-6	0.3	SC	FILL, SAND, CLAYEY
2	5	1-2	16.7	108.5	30.9	35	13	<0.01	A-2-6	0.6	SC	FILL, SAND, CLAYEY
3	1	10			22.0	NV	NP		A-2-4		SM	SAND, SILTY
4	5	10			39.7	30	14	<0.01	A-6		SC	SAND, VERY CLAYEY

FIGURE



N

50' 0 100' 200' 400'

1" = 200'

TB- APPROXIMATE TEST BORING LOCATIONS AND NUMBERS

REVISION	BY

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TEST BORING LOCATION MAP
MIDTOWN AT HANNAH RIDGE F# 1&2
COLORADO SPRINGS, CO
FOR: CLASSIC COMMUNITIES

DRAWN	JAC
CHECKED	DPS
DATE	04/23/21
SCALE	1"=200'
JOB NO.	200511
FIGURE No.	1

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 3/24/2021
Job # 200511

REMARKS

DRY TO 10', 3/24/21

FILL 0-5', SAND, VERY CLAYEY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE, MOIST

SAND, SILTY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			17	8.2	1
5			18	8.3	1
10			12	7.4	3
15					
20					

TEST BORING NO. 2
DATE DRILLED 3/24/2021
CLIENT CLASSIC COMMUNITIES
LOCATION MIDTOWN, HANNAH RIDGE, F1

REMARKS

DRY TO 5', 3/24/21

FILL 0-5', SAND, CLAYEY, FINE TO MEDIUM GRAINED, BROWN, DENSE TO MEDIUM DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			30	13.2	2
5			15	17.1	2
10					
15					
20					

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TEST BORING LOG

DRAWN	DATE	CHECKED:	DATE:
		h	4/6/21

JOB NO 200511
FIG NO. A-1

TEST BORING NO. 3
DATE DRILLED 3/24/2021
Job # 200511

REMARKS

DRY TO 5', 3/24/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	FILL 0-5', SAND, VERY CLAYEY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE, MOIST		18	9.4	1
5			15	11.8	1
10					
15					
20					

TEST BORING NO. 4
DATE DRILLED 3/24/2021
CLIENT CLASSIC COMMUNITIES
LOCATION MIDTOWN, HANNAH RIDGE, F1

REMARKS

DRY TO 5', 3/24/21

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	FILL 0-5', SAND, VERY CLAYEY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE TO DENSE, MOIST		12	11.8	1
5			33	10.5	1
10					
15					
20					

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TEST BORING LOG

DRAWN:	DATE	CHECKED:	4/30/21

JOB NO. 200511
FIG NO. A-2

TEST BORING NO. 5
DATE DRILLED 3/24/2021
Job # 200511

REMARKS

DRY TO 10', 3/24/21

FILL 0-5', SAND, CLAYEY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE, MOIST

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

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			23	12.7	2
5			15	14.4	2
10			10	13.2	4
15					
20					

TEST BORING NO. 6
DATE DRILLED 3/24/2021
CLIENT CLASSIC COMMUNITIES
LOCATION MIDTOWN, HANNAH RIDGE, F1

REMARKS

DRY TO 5', 3/24/21

FILL 0-5', SAND, VERY CLAYEY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			19	17.1	1
5			15	13.2	1
10					
15					
20					

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TEST BORING LOG

DRAWN	DATE	CHECKED L	DATE 4/8/21

JOB NO 200511
FIG NO A-3

TEST BORING NO. 7
DATE DRILLED 3/24/2021
Job # 200511

REMARKS

DRY TO 5', 3/24/21

FILL 0-5', CLAY, VERY SANDY, BROWN, STIFF TO FIRM, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			17	12.0	1
5			9	14.4	1
10					
15					
20					

TEST BORING NO. 8
DATE DRILLED 3/24/2021
CLIENT CLASSIC COMMUNITIES
LOCATION MIDTOWN, HANNAH RIDGE, F1

REMARKS

DRY TO 5', 3/24/21

FILL 0-5', SAND-CLAY, FINE TO MEDIUM GRAINED, BROWN, LOOSE TO MEDIUM DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			8	15.2	1
5			11	14.3	1
10					
15					
20					

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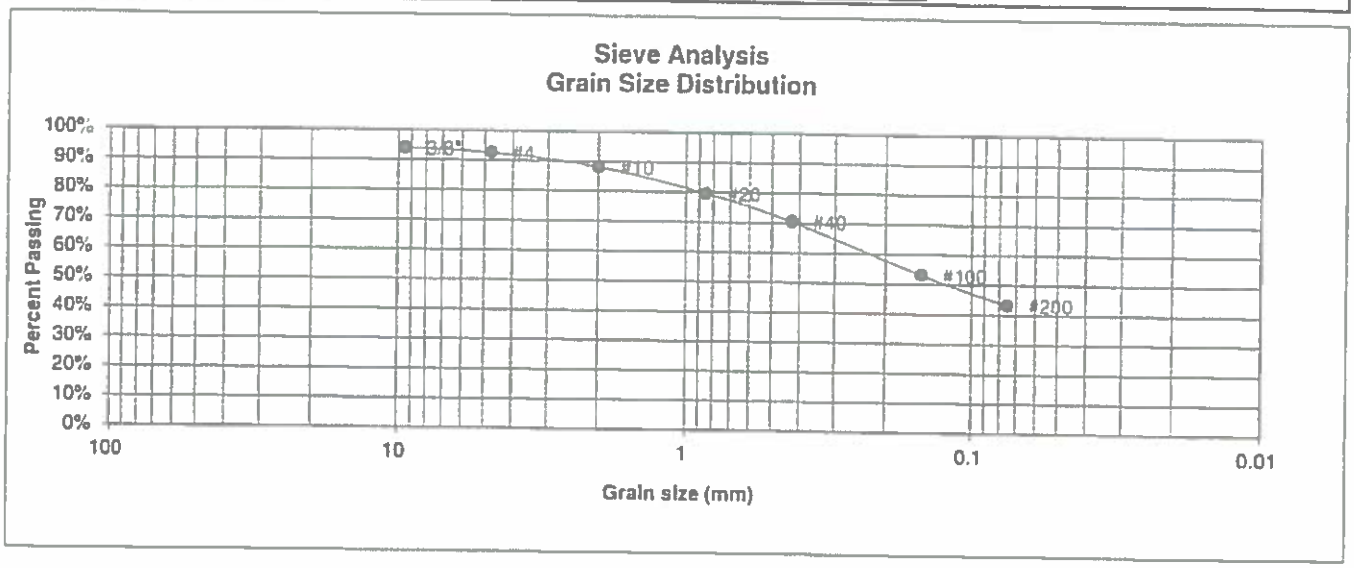
TEST BORING LOG

DRAWN:	DATE	CHECKED:	DATE: 4/8/21

JOB NO 200511
FIG NO A-4

APPENDIX B: Laboratory Test Results

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1, CBR	PROJECT	MIDTOWN, HANNAH RIDGE, F1
TEST BORING #	1	JOB NO.	200511
DEPTH (FT)	0-3	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"	94.0%
4	92.6%
10	88.1%
20	79.6%
40	70.5%
100	53.1%
200	43.2%

Atterberg Limits	
Plastic Limit	20
Liquid Limit	36
Plastic Index	16

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

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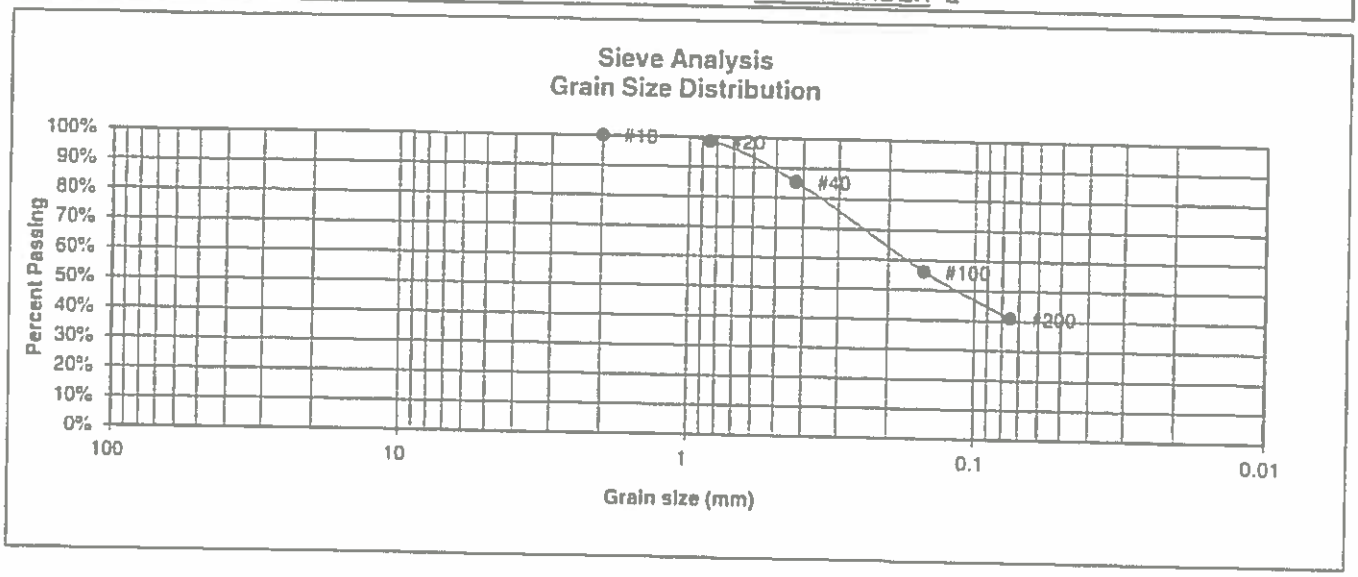
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
		A	4/8/21

JOB NO 200511

FIG NO B-1

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, FI
TEST BORING #	1	JOB NO.	200511
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	
10	100.0%
20	98.6%
40	85.4%
100	56.2%
200	40.8%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	33
Plastic Index	16

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

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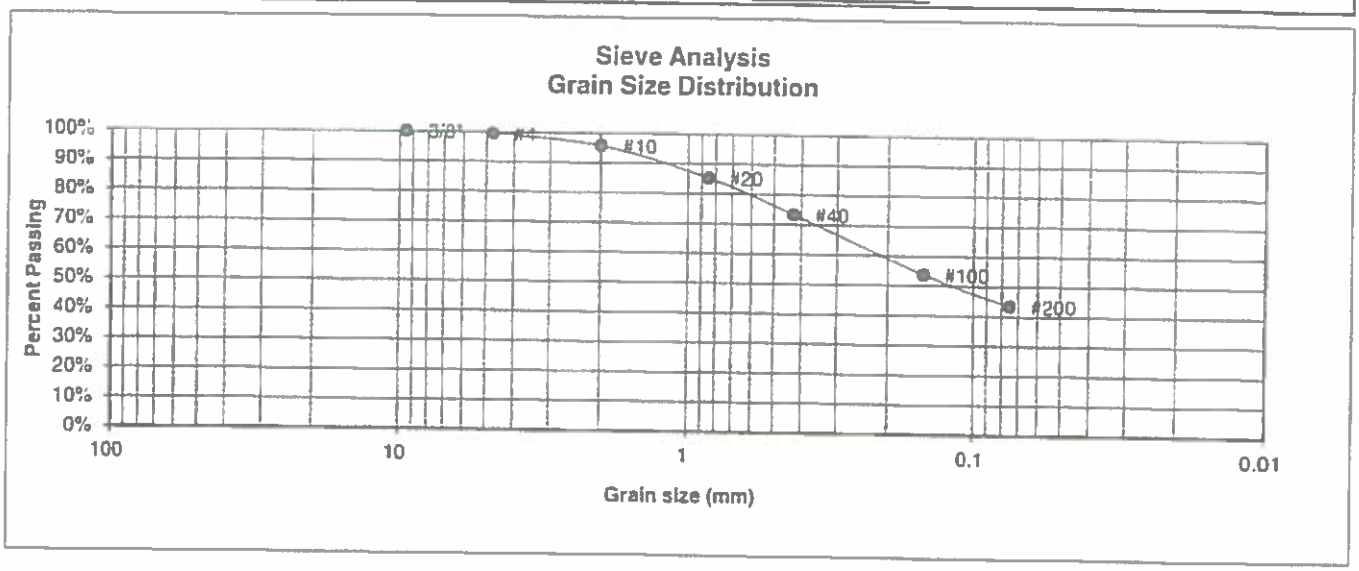
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED:	DATE
		h	4/8/21

JOB NO. 200511
FIG NO. B-2

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, FI
TEST BORING #	3	JOB NO.	200511
DEPTH (FT)	1-2	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"	100.0%
4	99.4%
10	95.7%
20	85.3%
40	73.3%
100	53.8%
200	43.4%

Atterberg Limits	
Plastic Limit	19
Liquid Limit	36
Plastic Index	17

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

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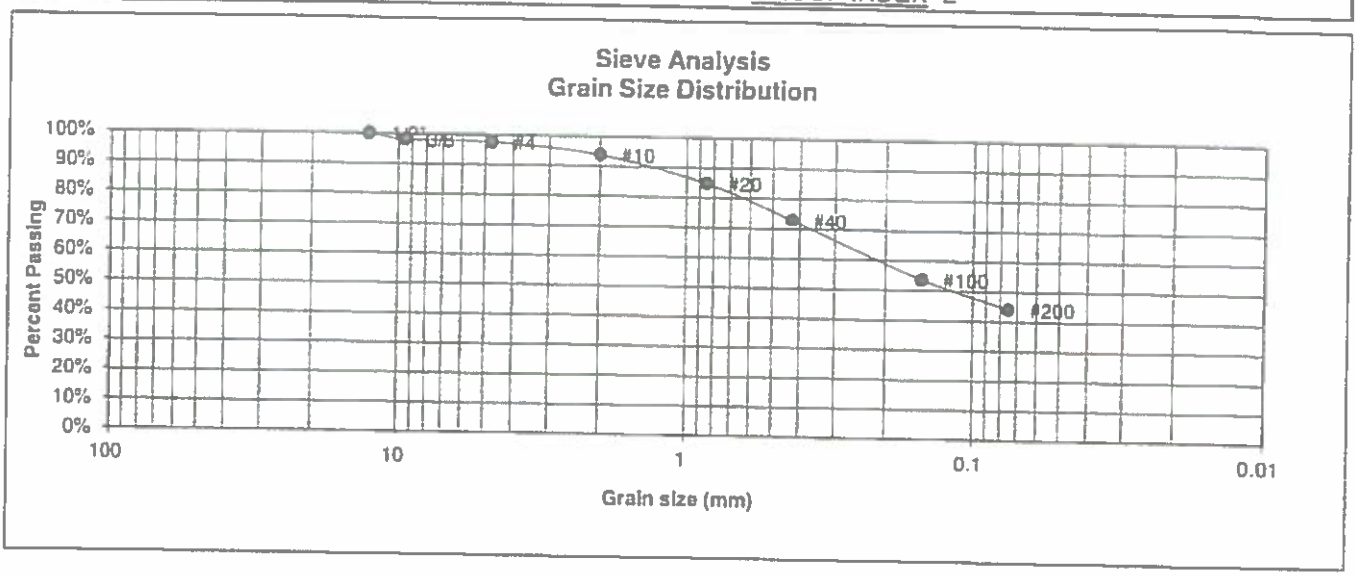
LABORATORY TEST RESULTS

DRAWN:	DATE	CHECKED:	DATE:
			4/8/21

JOB NO 200511
FIG NO B-3

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, FI
TEST BORING #	4	JOB NO.	200511
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"	100.0%
3/8"	98.1%
4	97.5%
10	93.8%
20	84.7%
40	72.8%
100	53.7%
200	44.1%

Atterberg Limits	
Plastic Limit	23
Liquid Limit	34
Plastic Index	12

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

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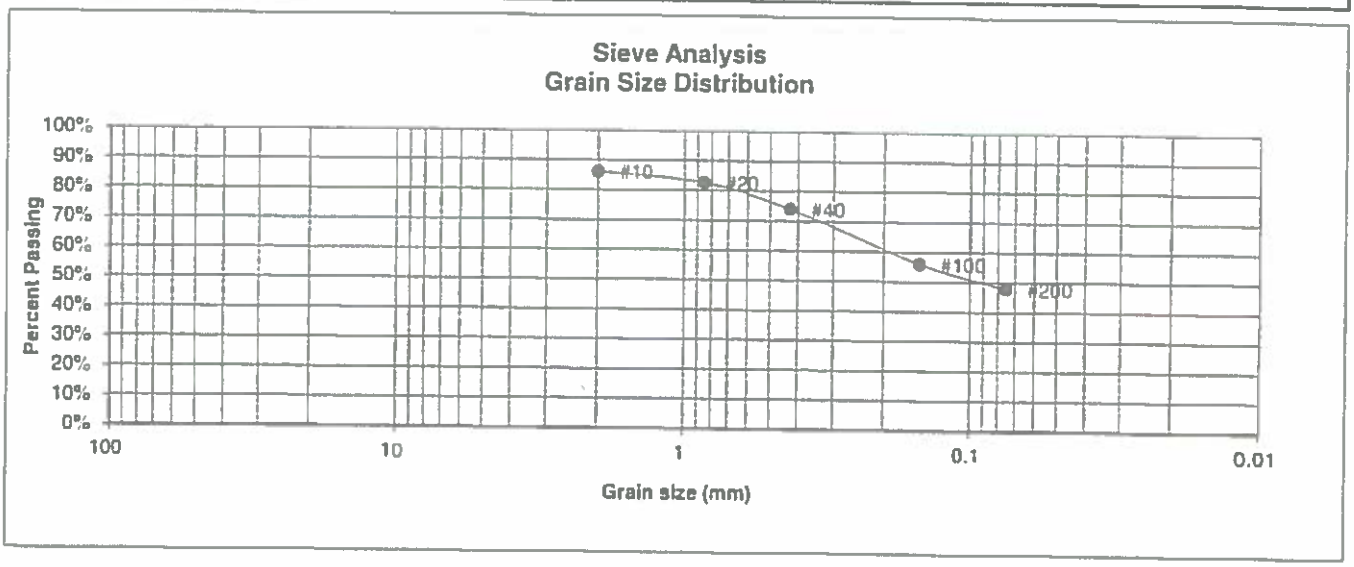
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
			4/8/21

JOB NO. 200511
FIG NO B-4

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, FI
TEST BORING #	6	JOB NO.	200511
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"	
4	
10	86.1%
20	82.6%
40	74.0%
100	55.9%
200	47.9%

Atterberg Limits	
Plastic Limit	21
Liquid Limit	37
Plastic Index	16

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

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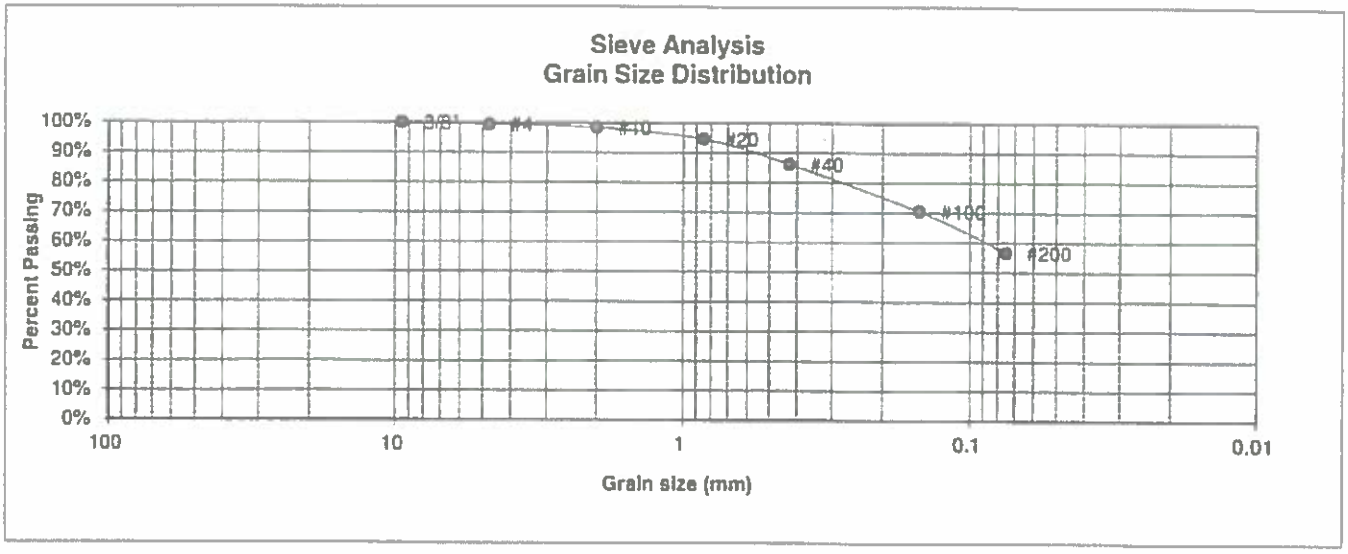
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
		DS	4/16/2

JOB NO 200511
FIG NO B-5

UNIFIED CLASSIFICATION	CL	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, FI
TEST BORING #	7	JOB NO.	200511
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	6



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.3%
10	98.4%
20	94.6%
40	86.2%
100	70.5%
200	56.8%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	34
Plastic Index	17

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

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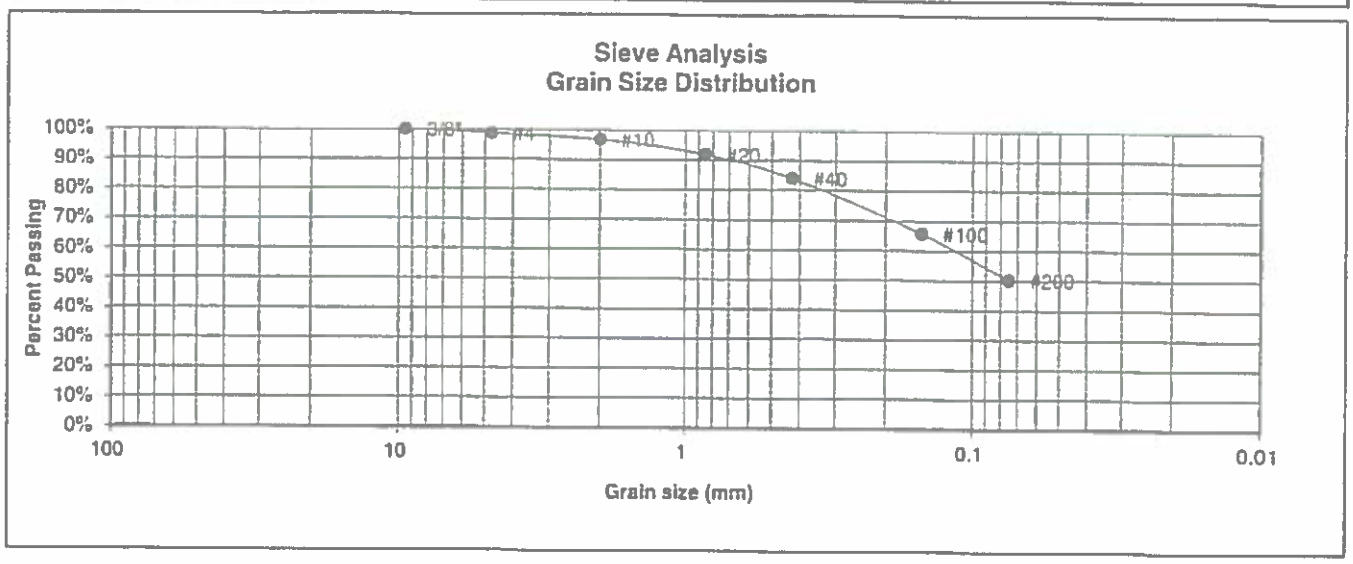
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
			4/8/21

JOB NO 200511
FIG NO

UNIFIED CLASSIFICATION	SC-CL	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, FI
TEST BORING #	8	JOB NO.	200511
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	5



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.7%
10	96.8%
20	91.9%
40	84.0%
100	65.7%
200	50.2%

Atterberg Limits	
Plastic Limit	18
Liquid Limit	35
Plastic Index	17

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

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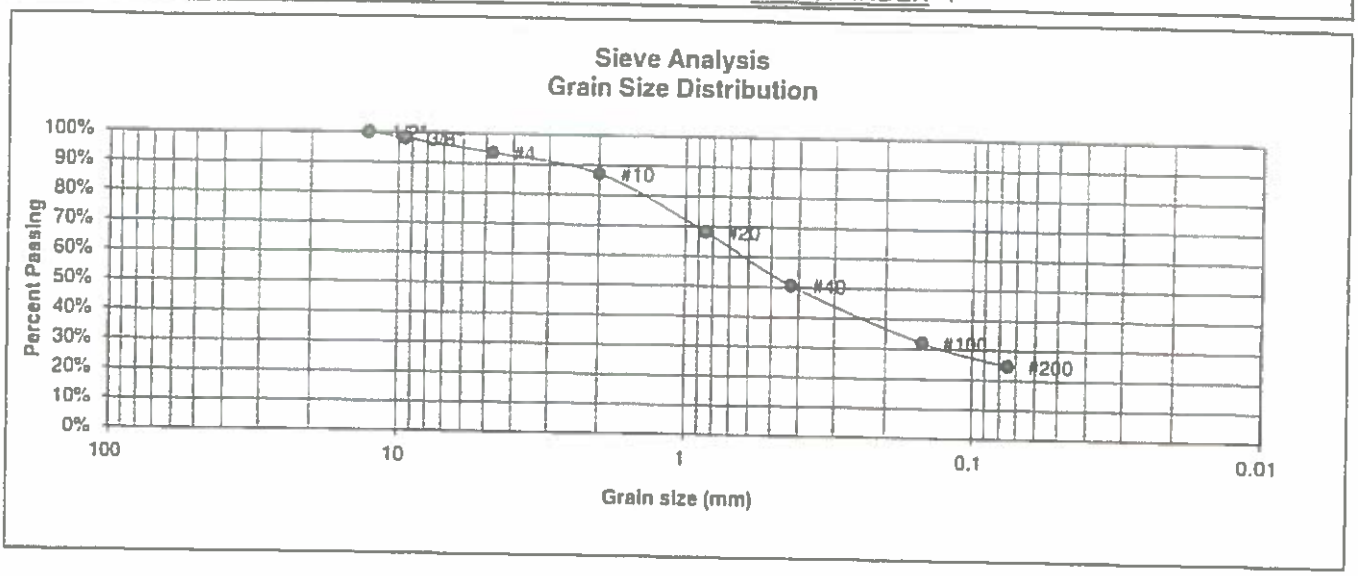
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
			4/8/21

JOB NO 200511
FIG NO B-7

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	2	PROJECT	MIDTOWN, HANNAH RIDGE, FI
TEST BORING #	2	JOB NO.	200511
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-6	GROUP INDEX	1



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.1%
4	93.6%
10	87.2%
20	68.2%
40	50.6%
100	32.1%
200	24.7%

Atterberg Limits	
Plastic Limit	19
Liquid Limit	36
Plastic Index	17

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

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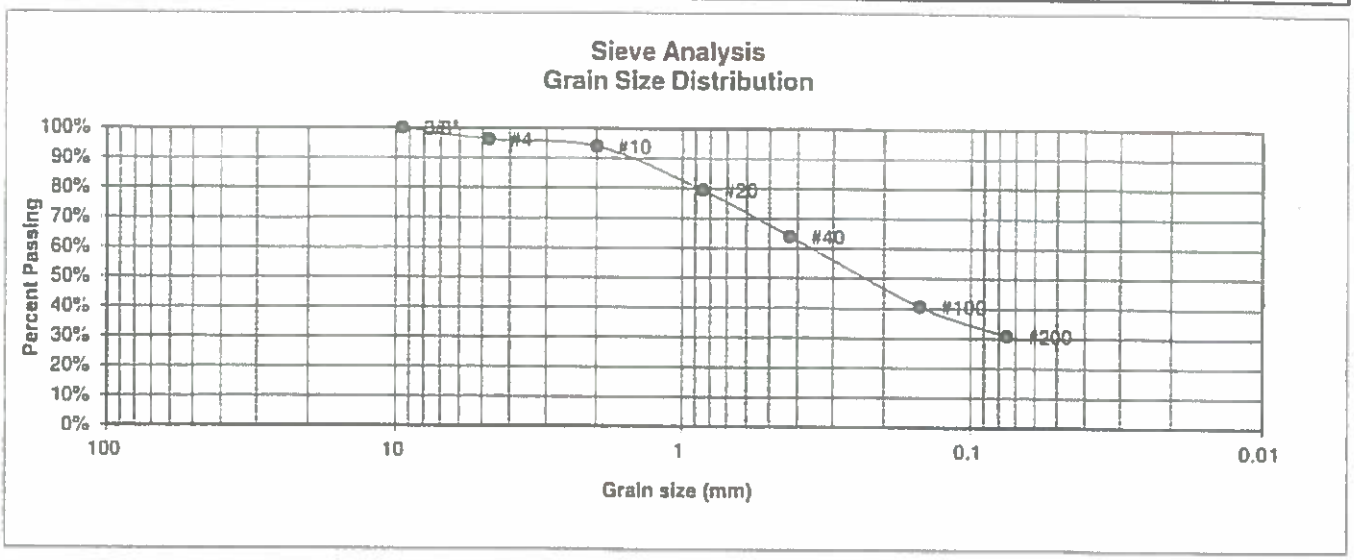
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
			4/8/21

JOB NO. 200511
FIG NO. B-8

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	2	PROJECT	MIDTOWN, HANNAH RIDGE, Fl
TEST BORING #	5	JOB NO.	200511
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-6	GROUP INDEX	1



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.3%
10	94.1%
20	79.4%
40	64.0%
100	40.6%
200	30.9%

Atterberg Limits	
Plastic Limit	22
Liquid Limit	35
Plastic Index	13

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

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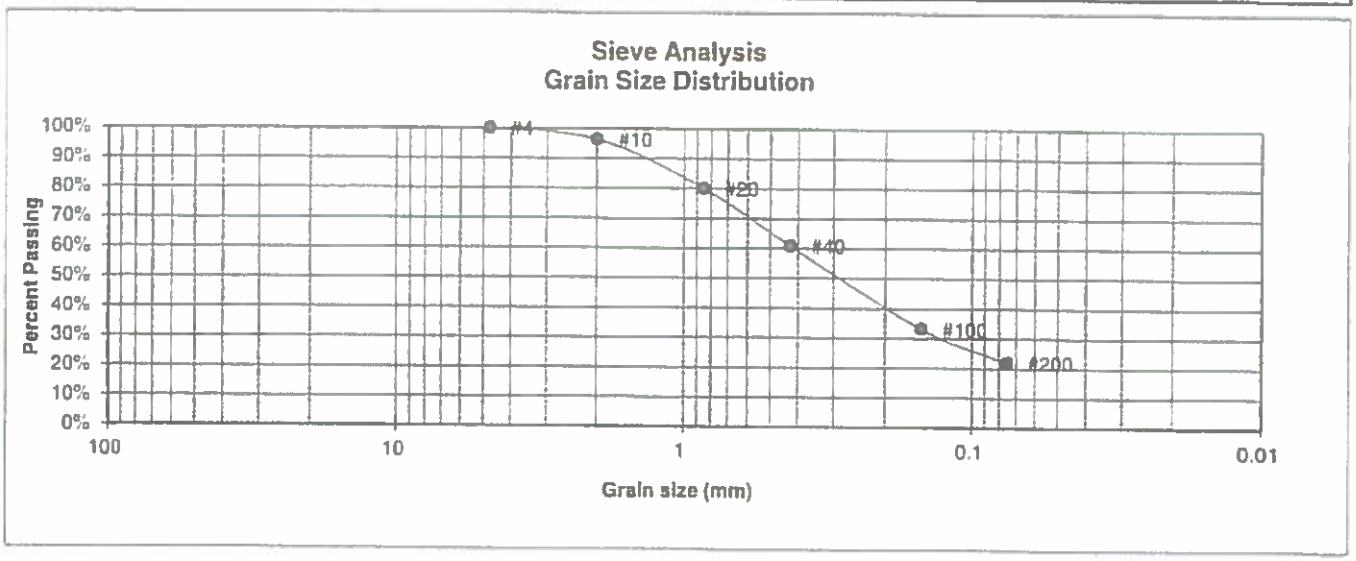
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
			1/8/21

JOB NO 200511
FIG NO B-9

UNIFIED CLASSIFICATION	SM	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	3	PROJECT	MIDTOWN, HANNAH RIDGE, FI
TEST BORING #	1	JOB NO.	200511
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"	
4	100.0%
10	96.4%
20	80.0%
40	60.9%
100	33.1%
200	22.0%

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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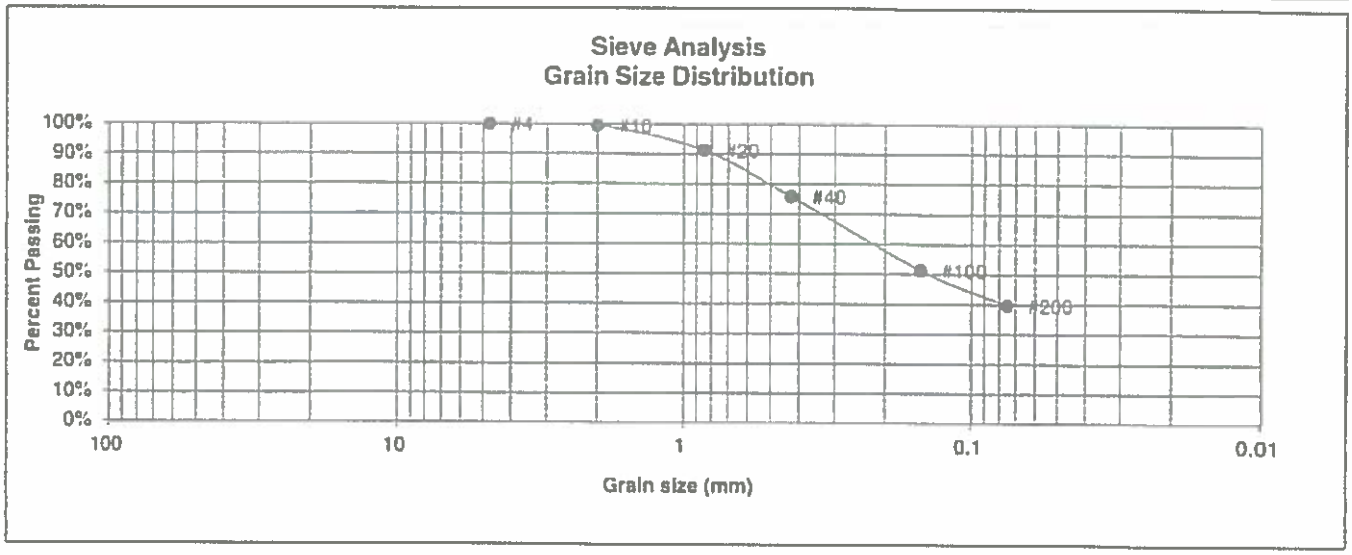
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED:	DATE
			4/9/21

JOB NO. 200511
FIG NO B-10

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	4	PROJECT	MIDTOWN, HANNAH RIDGE, FI
TEST BORING #	5	JOB NO.	200511
DEPTH (FT)	10	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	99.4%
20	91.2%
40	75.8%
100	51.3%
200	39.7%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	30
Plastic Index	14

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

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LABORATORY TEST RESULTS

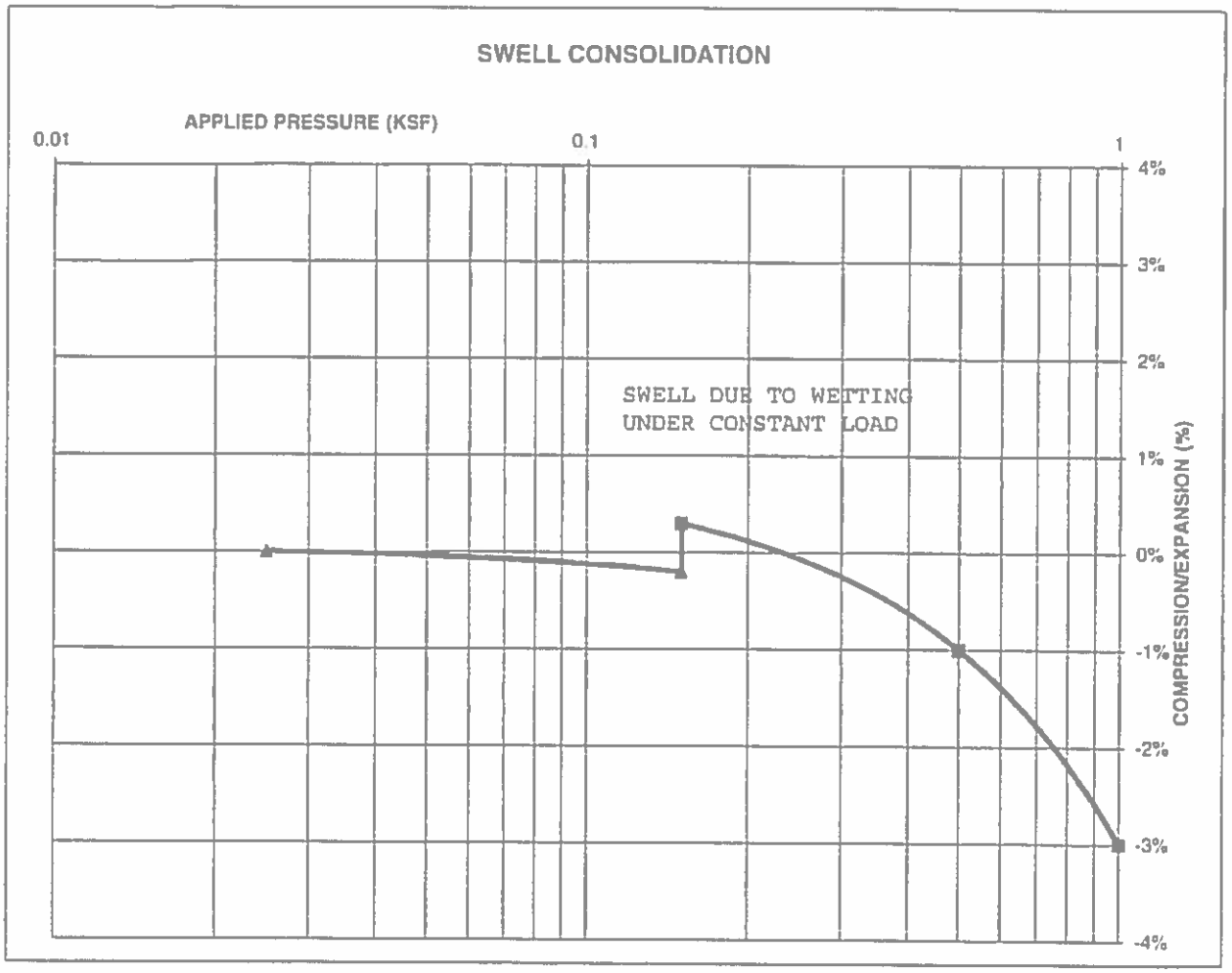
DRAWN:	DATE.	CHECKED	DATE.
		h	4/8/21

JOB NO 200511
FIG NO B-11

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	0-3
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			112
NATURAL MOISTURE CONTENT			13.0%
SWELL/CONSOLIDATION (%)			0.5%

JOB NO. 200511
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1



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SWELL CONSOLIDATION
TEST RESULTS

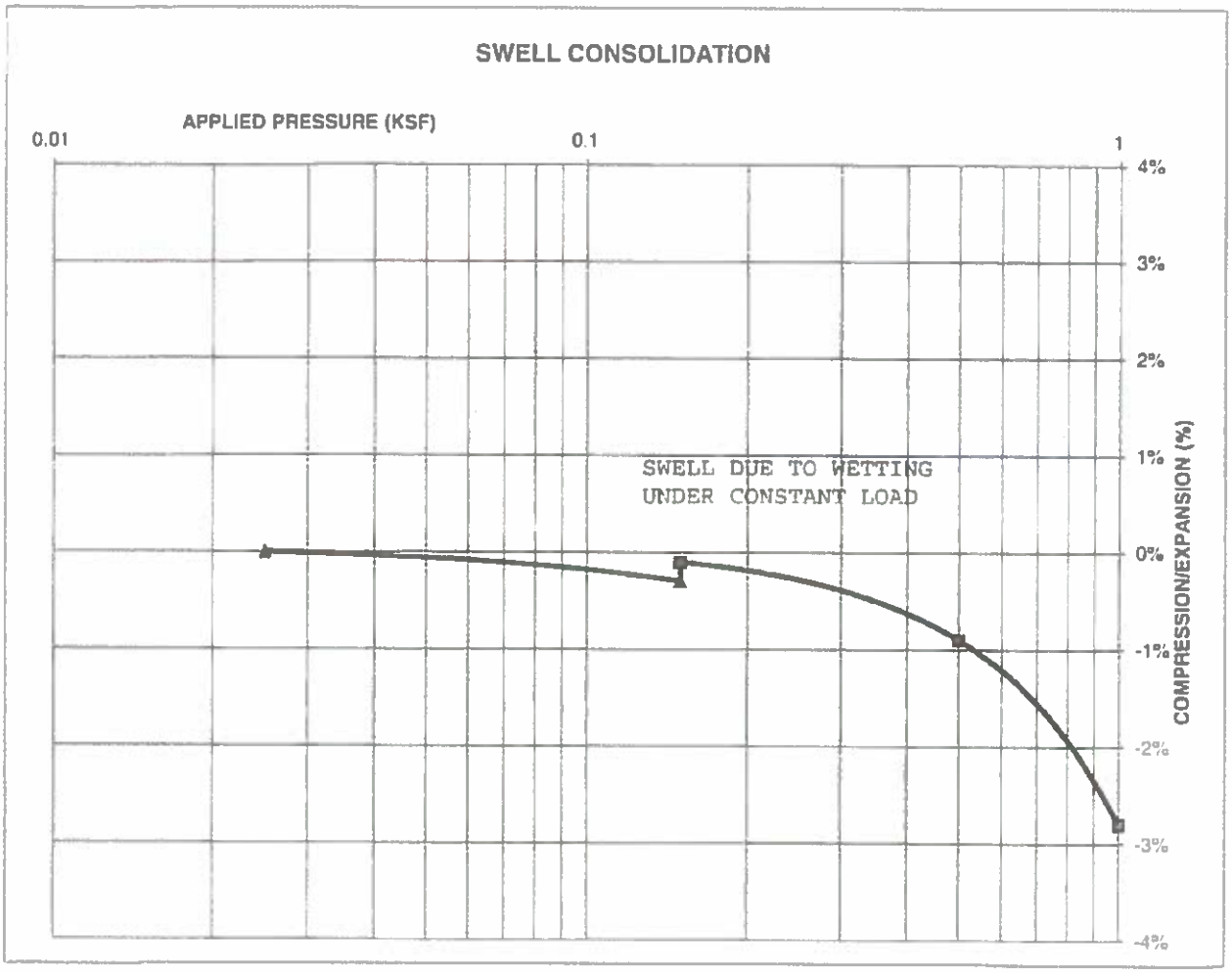
DRAWN	DATE	CHECKED	DATE
		DS	5/6/21

JOB NO 200511
FIG NO B-12

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			110
NATURAL MOISTURE CONTENT			15.8%
SWELL/CONSOLIDATION (%)			0.2%

JOB NO. 200511
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1



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SWELL CONSOLIDATION
TEST RESULTS

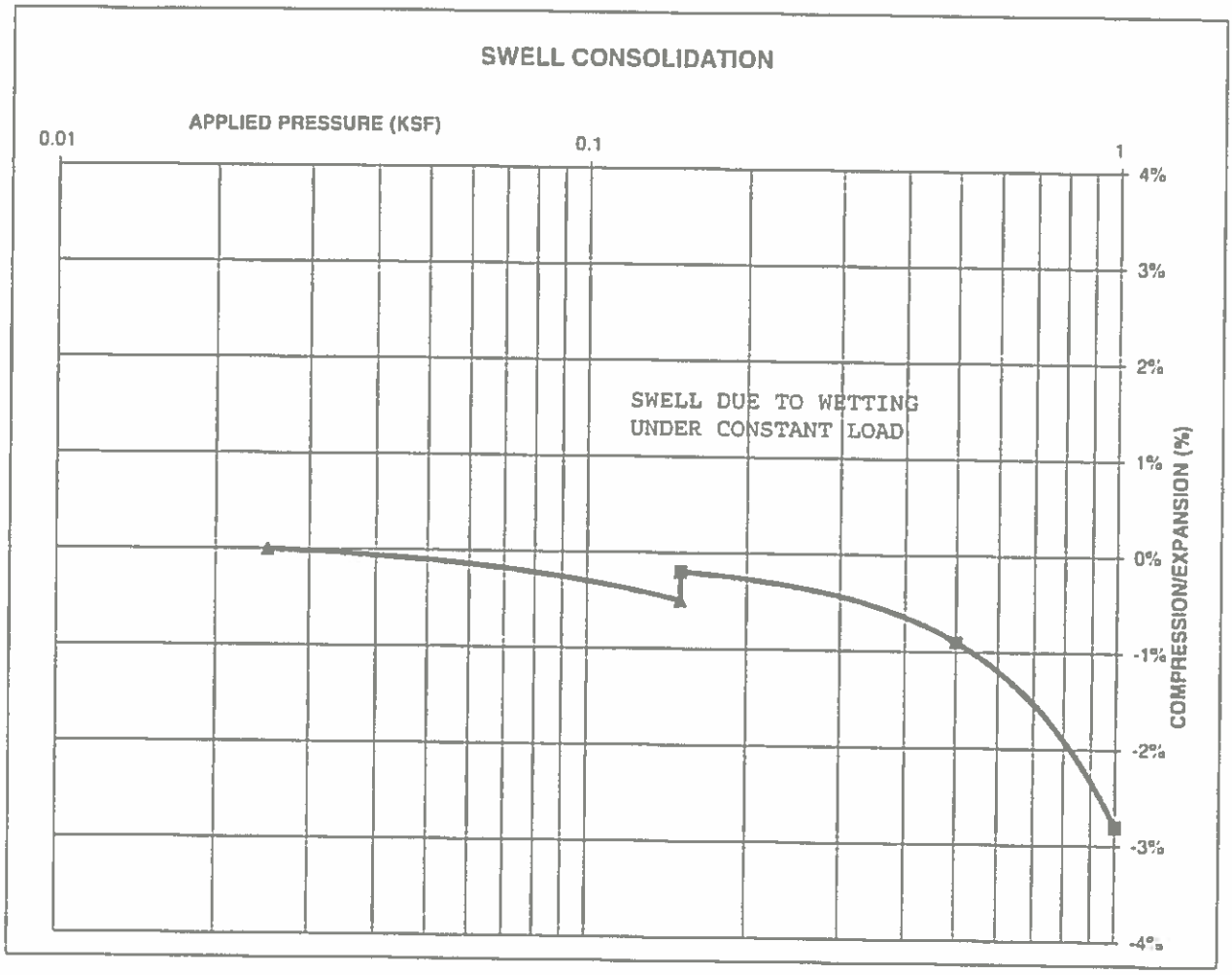
DRAWN	DATE	CHECKED	DATE
		DS	5/6/21

JOB NO 200511
FIG NO B-13

CONSOLIDATION TEST RESULTS

TEST BORING #	3	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			90
NATURAL MOISTURE CONTENT			9.0%
SWELL/CONSOLIDATION (%)			0.3%

JOB NO. 200511
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1



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SWELL CONSOLIDATION
TEST RESULTS

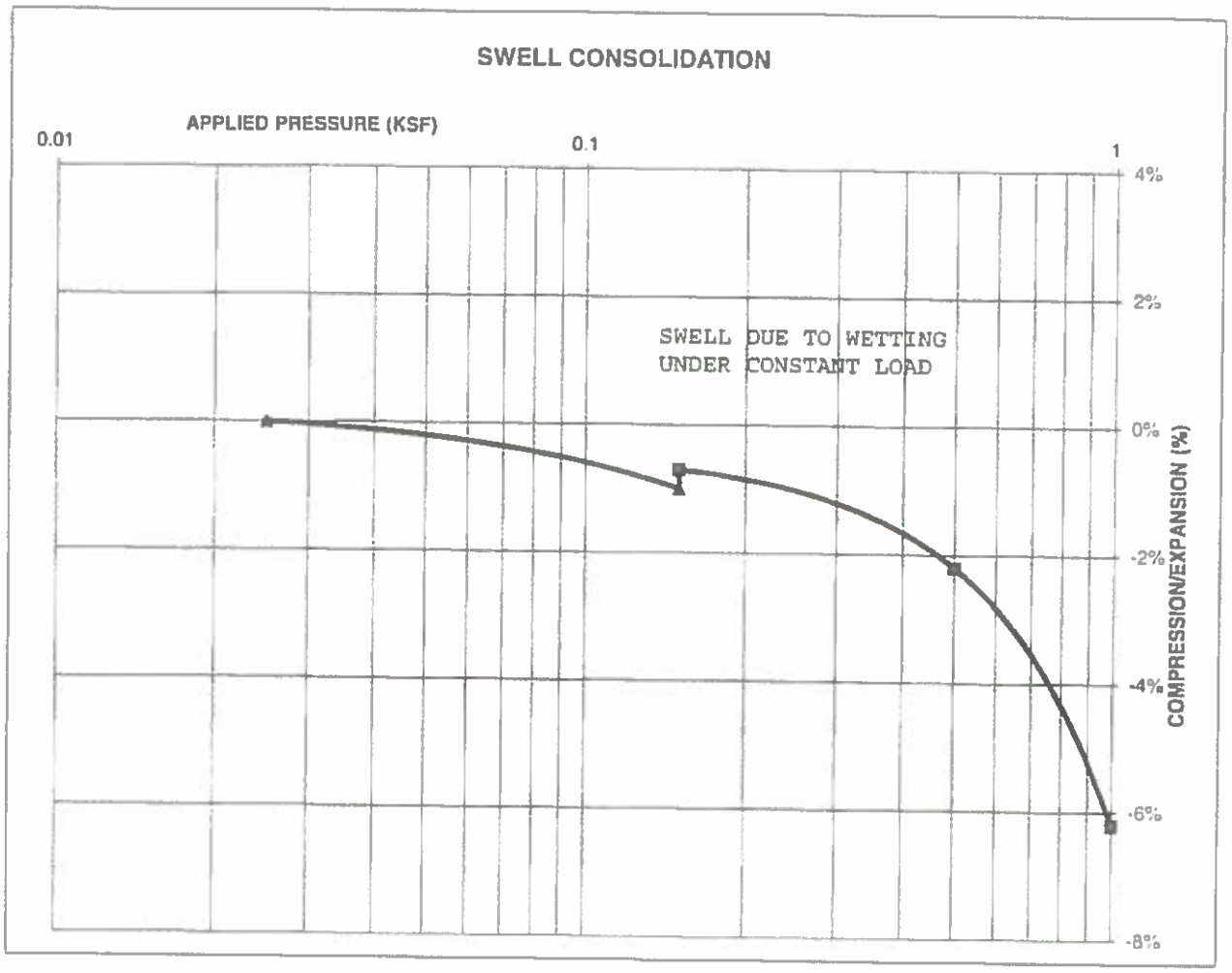
DRAWN	DATE	CHECKED	DATE
		DS	5/6/21

JOB NO 200511
FIG NO B-14

CONSOLIDATION TEST RESULTS

TEST BORING #	4	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			105
NATURAL MOISTURE CONTENT			15.8%
SWELL/CONSOLIDATION (%)			0.3%

JOB NO. 200511
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1



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SWELL CONSOLIDATION
TEST RESULTS

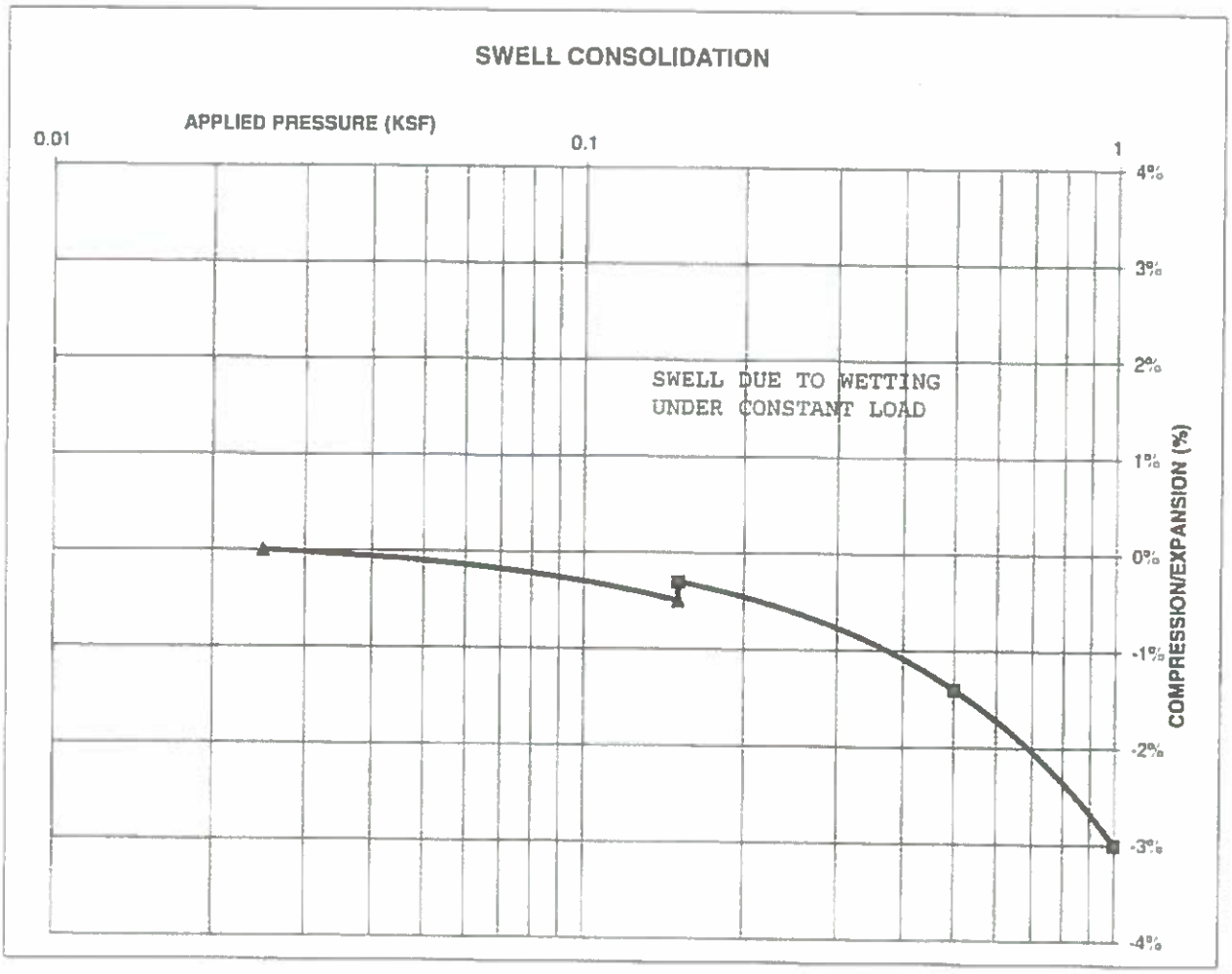
DRAWN	DATE	CHECKED	DATE
		DS	5/6/04

JOB NO 200511
FIG NO B-15

CONSOLIDATION TEST RESULTS

TEST BORING #	6	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			115
NATURAL MOISTURE CONTENT			11.7%
SWELL/CONSOLIDATION (%)			0.2%

JOB NO. 200511
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1



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SWELL CONSOLIDATION
TEST RESULTS

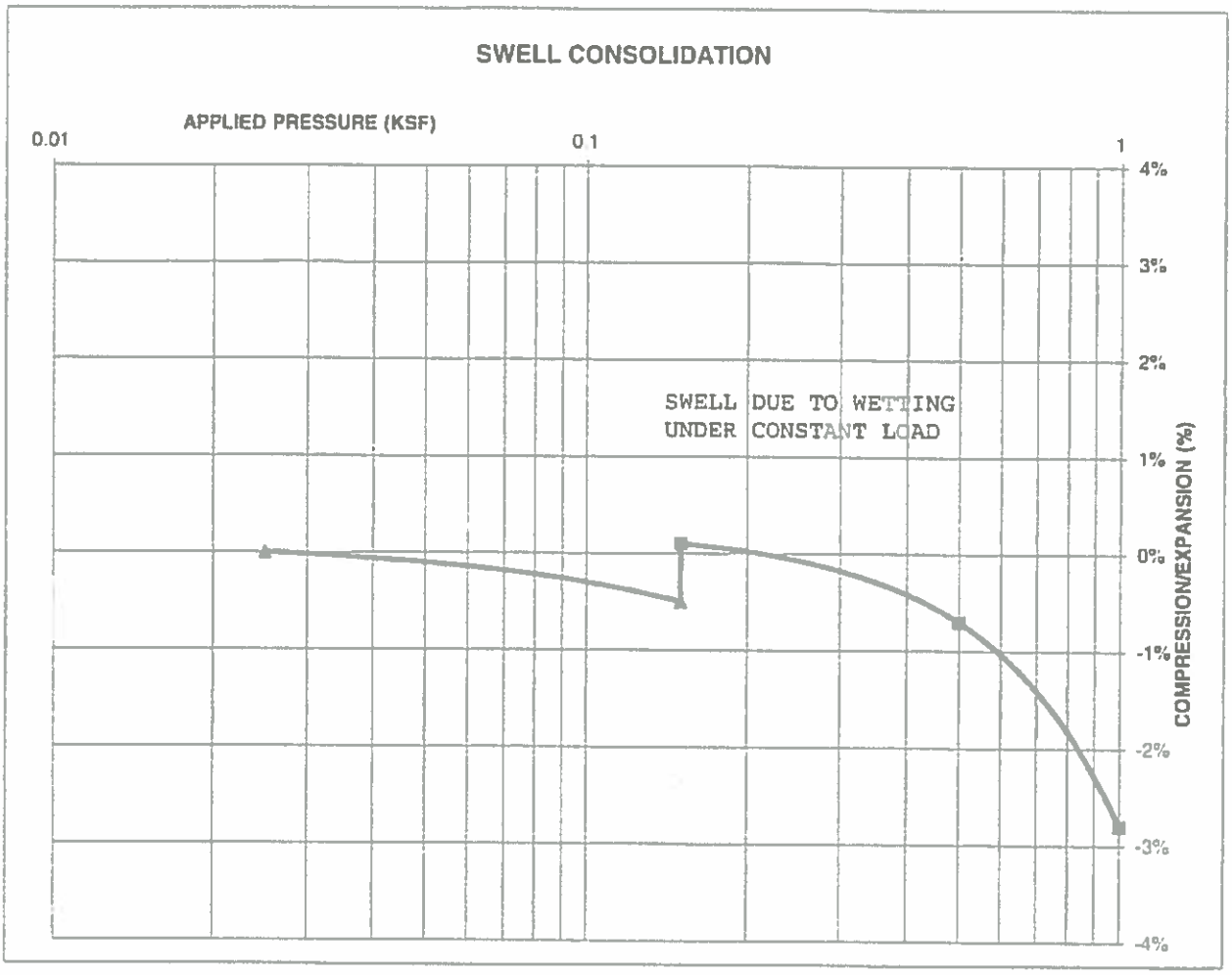
DRAWN	DATE	CHECKED:	DATE
		DS	5/6/21

JOB NO 200511
F G NO B-1L

CONSOLIDATION TEST RESULTS

TEST BORING #	7	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			85
NATURAL MOISTURE CONTENT			13.3%
SWELL/CONSOLIDATION (%)			0.6%

JOB NO. 200511
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1



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SWELL CONSOLIDATION
TEST RESULTS

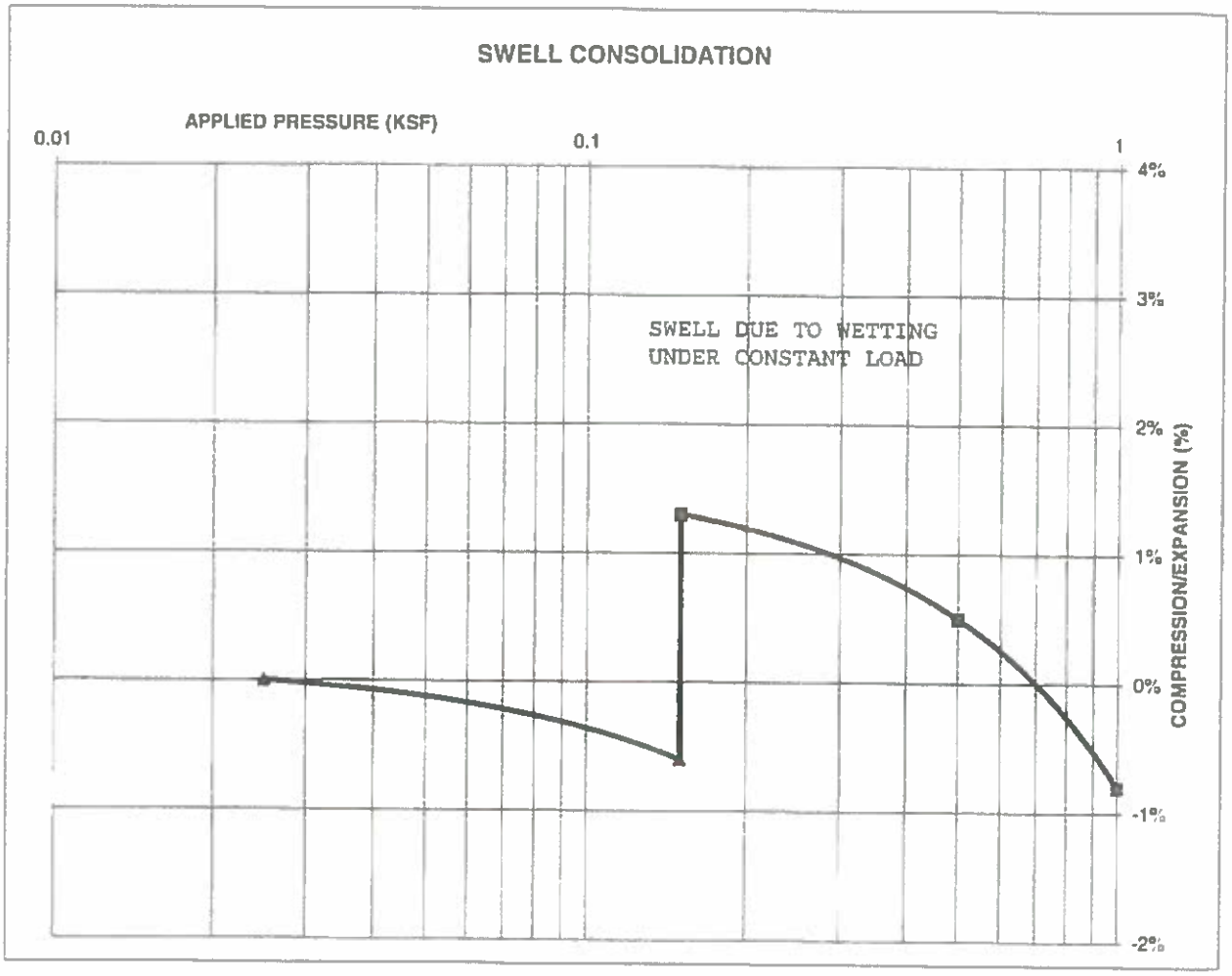
DRAWN	DATE	CHECKED	DATE
		DS	5/6/24

JOB NO. 200511
FIG NO. B-17

CONSOLIDATION TEST RESULTS

TEST BORING #	8	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			94
NATURAL MOISTURE CONTENT			12.9%
SWELL/CONSOLIDATION (%)			1.9%

JOB NO. 200511
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1



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SWELL CONSOLIDATION
TEST RESULTS

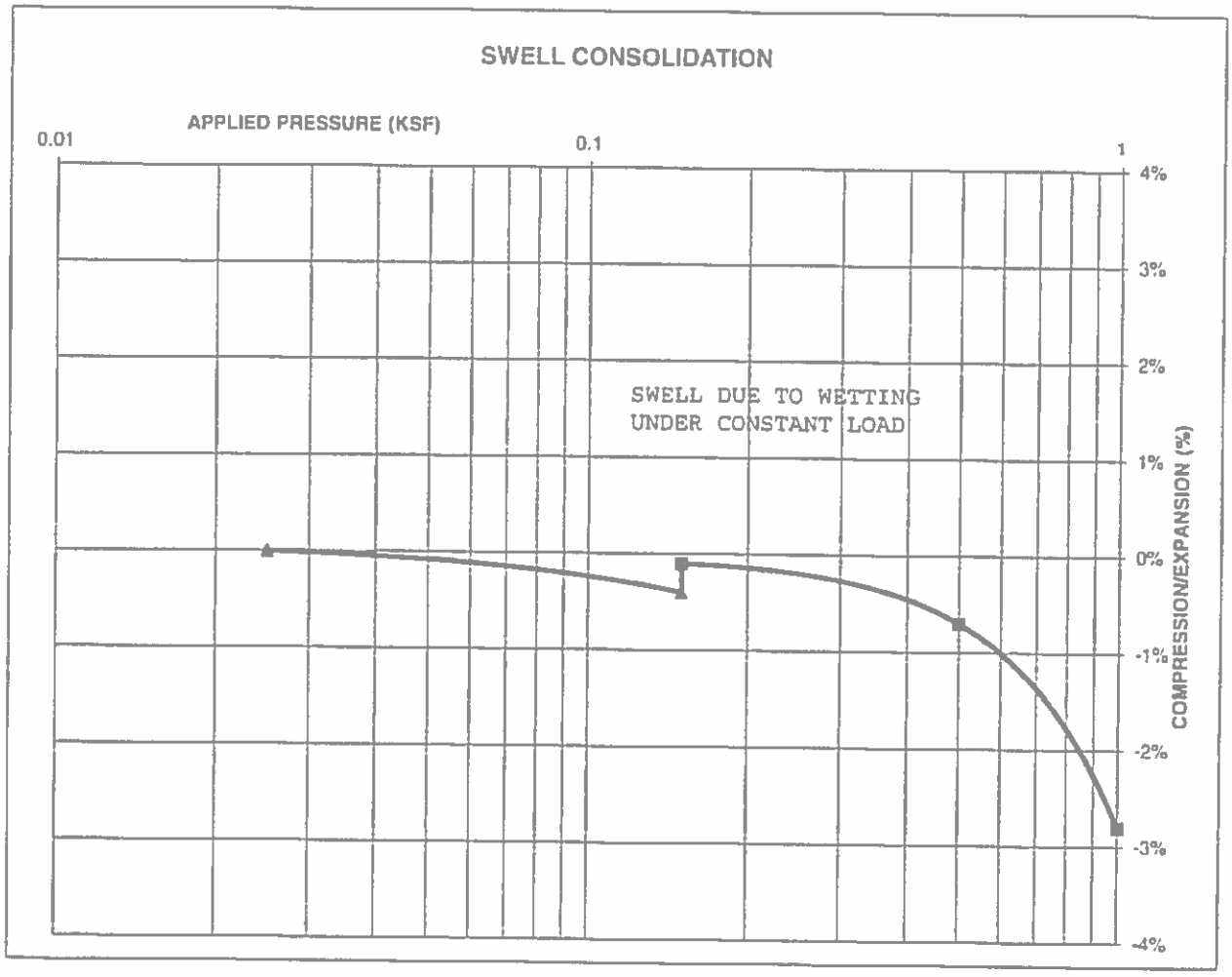
DRAWN	DATE	CHECKED	DATE
		DS	5/6/21

JOB NO 200511
FIG NO B-18

CONSOLIDATION TEST RESULTS

TEST BORING #	2	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			112
NATURAL MOISTURE CONTENT			13.7%
SWELL/CONSOLIDATION (%)			0.3%

JOB NO. 200511
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1



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SWELL CONSOLIDATION
TEST RESULTS

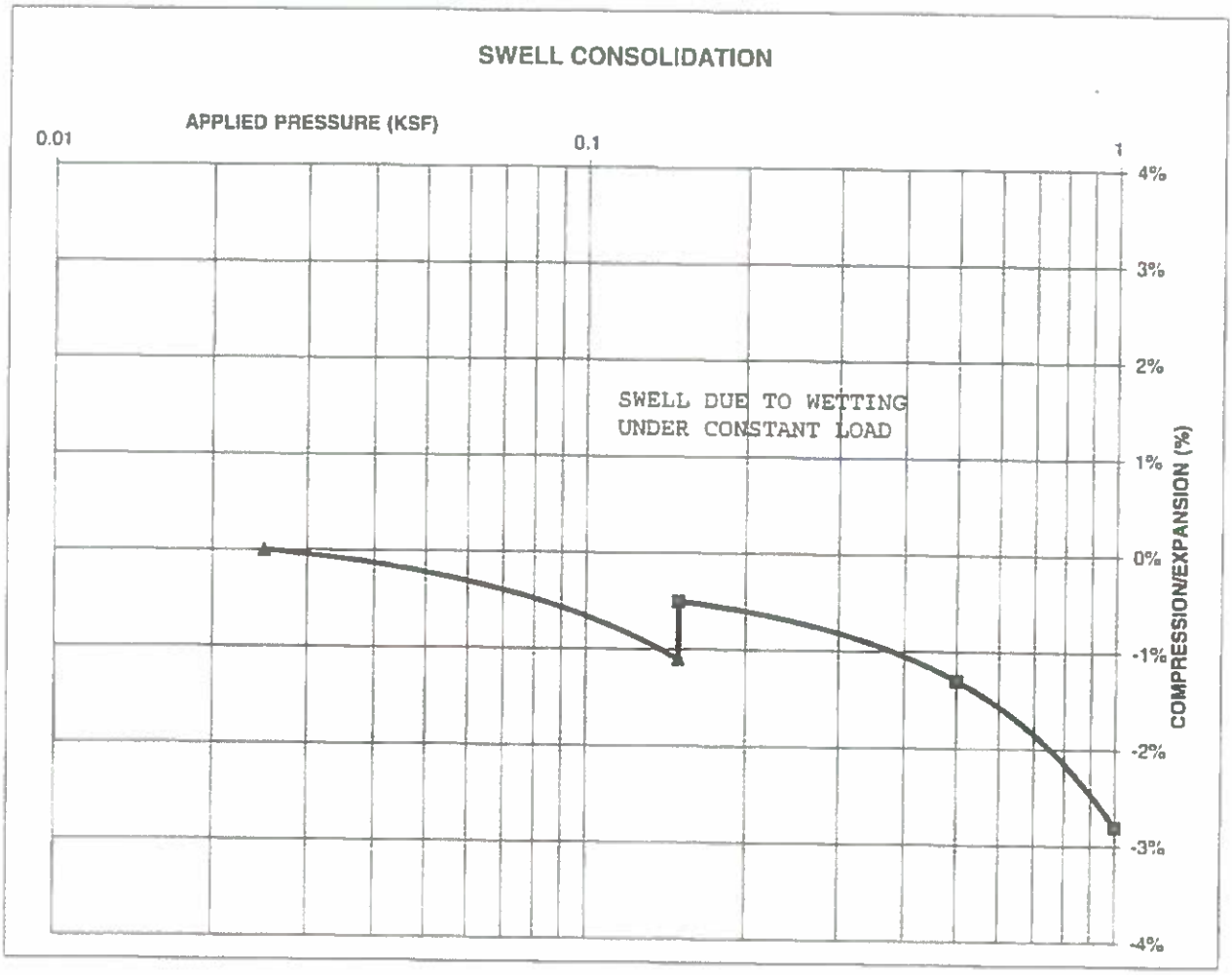
DRAWN	DATE	CHECKED	DATE
		DJ	5/6/04

JOB NO 200511
FIG NO B-19

CONSOLIDATION TEST RESULTS

TEST BORING #	5	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			108
NATURAL MOISTURE CONTENT			16.7%
SWELL/CONSOLIDATION (%)			0.6%

JOB NO. 200511
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1



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SWELL CONSOLIDATION
TEST RESULTS

DRAWN	DATE	CHECKED	DATE
		DJ	5/6/21

JOB NO. 200511
FIG NO B-26

CLIENT	CLASSIC COMMUNITIES	JOB NO.	200511
PROJECT	MIDTOWN, HANNAH RIDGE, F1	DATE	4/7/2021
LOCATION	MIDTOWN, HANNAH RIDGE, F1	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-1	1-2	0	SM	<0.01
TB-5	1-2	0	SC	<0.01
TB-5	10	0	SC	<0.01
TB-6	1-2	0	SC	0.06

QC BLANK PASS

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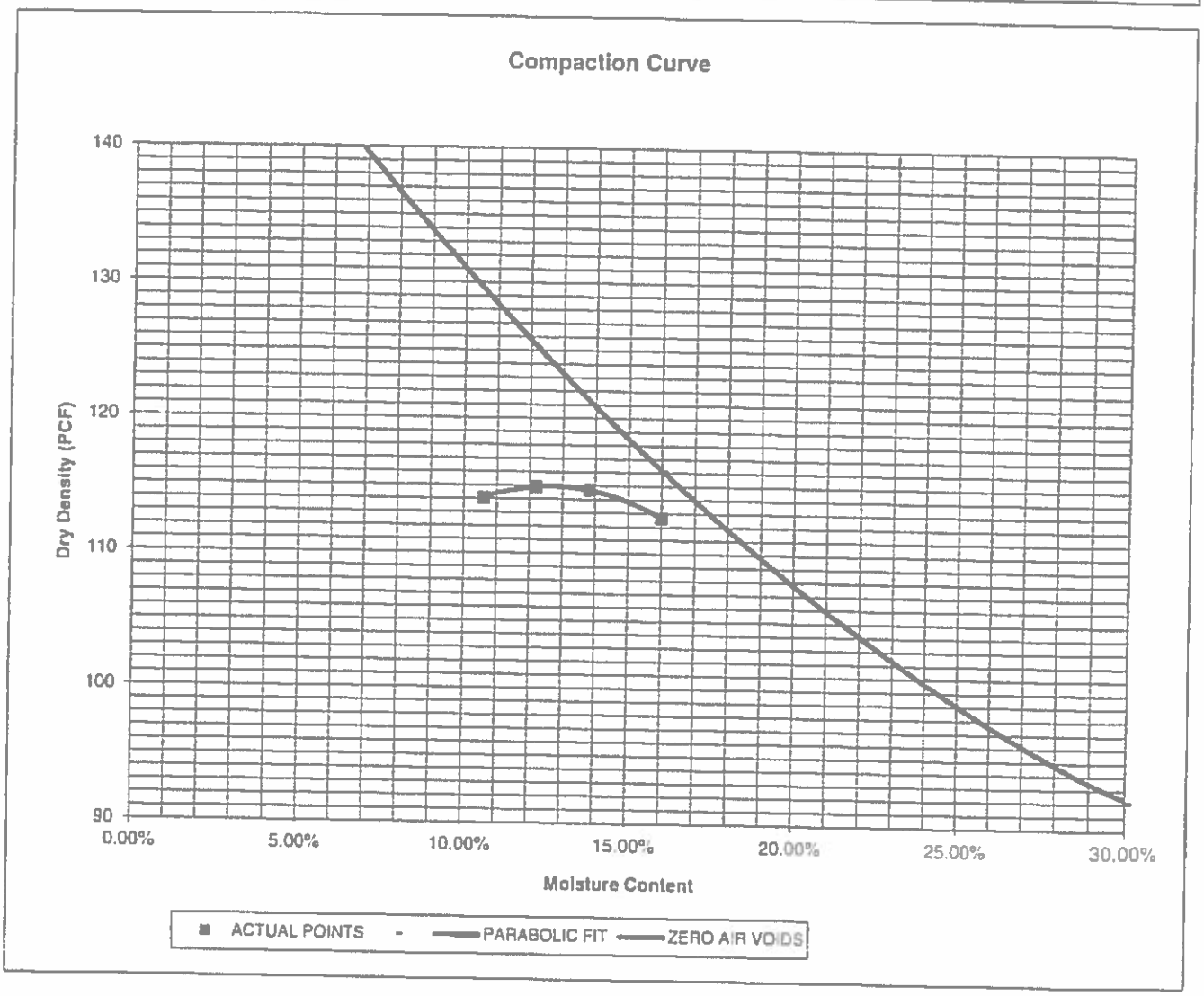
LABORATORY TEST
SULFATE RESULTS

DRAWN	DATE	CHECKED:	DATE:
			4/8/21

JOB NO 200511
FIG NO B-21

PROJECT	MIDTOWN, HANNAH RIDGE, F1	CLIENT	CLASSIC COMMUNITIES
SAMPLE LOCATION	TB-1 @ 0-3'	JOB NO.	200511
SOIL DESCRIPTION	FILL, SAND, V. CLAYEY, BROWN	DATE	04/01/21

IDENTIFICATION	SC	COMPACTION TEST #	1
TEST DESIGNATION / METHOD	ASTM D-698-A	TEST BY	BL
MAXIMUM DRY DENSITY (PCF)	115	OPTIMUM MOISTURE	13.0%



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MOISTURE DENSITY RELATION

DRAWN	DATE	CHECKED:	DATE
			4/8/21

JOB NO 200511

FIG NO B-22

CBR TEST LOAD DATA

JOB NO: 200511
CLIENT: CLASSIC COMMUNITIES
PROJECT: MIDTOWN, HANNAH RIDGE, FI
SOIL TYPE: 1

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 # 3 LOAD(LBS) (LBS)	STRESS (PSI)	56 BLOWS MOLD # 5 LOAD(LBS) (LBS)	STRESS (PSI)
0.000	0	0.00	0	0.00	0	0.00
0.025	46	15.37	72	24.06	94	31.41
0.050	76	25.40	123	41.10	245	81.87
0.075	98	32.75	167	55.81	335	111.95
0.100	149	49.79	237	79.20	398	133.00
0.125	189	63.16	278	92.90	459	153.38
0.150	216	72.18	333	111.28	566	189.14
0.175	240	80.20	380	126.98	660	220.55
0.200	270	90.23	440	147.03	780	260.65
0.300	369	123.31	539	180.12	878	293.40
0.400	446	149.04	693	231.58	997	333.17
0.500	503	168.09	723	241.60	1141	381.29

FINAL MOISTURE CONTENT

	MOLD #	1	MOLD #	3	MOLD #	5
CAN #		350		349		106
WT. CAN		6.79		6.85		9.37
WT. CAN+WET		227.77		233.21		232.73
WT. CAN+DRY		205.28		212.22		214.5
WT. H20		22.49		20.99		18.23
WT. DRY SOIL		198.49		205.37		205.13
MOISTURE CONTENT		11.33%		10.22%		8.89%
WET DENSITY (PCF)		114.0		120.9		127.1
DRY DENSITY (PCF)		100.9		107.0		112.5
BEARING RATIO		4.98		7.92		13.30
90% OF DRY DENSITY	103.5					
95% OF DRY DENSITY	109.3					

BEARING RATIO AT 90% OF MAX	6.24	- R VALUE	14
BEARING RATIO AT 95% OF MAX	10.14	- R VALUE	30

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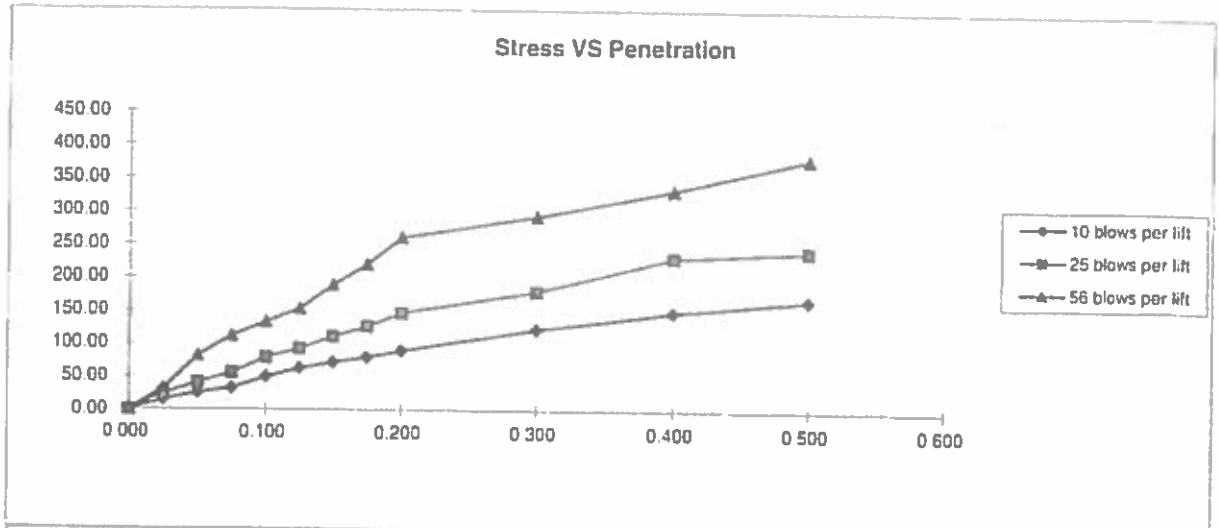
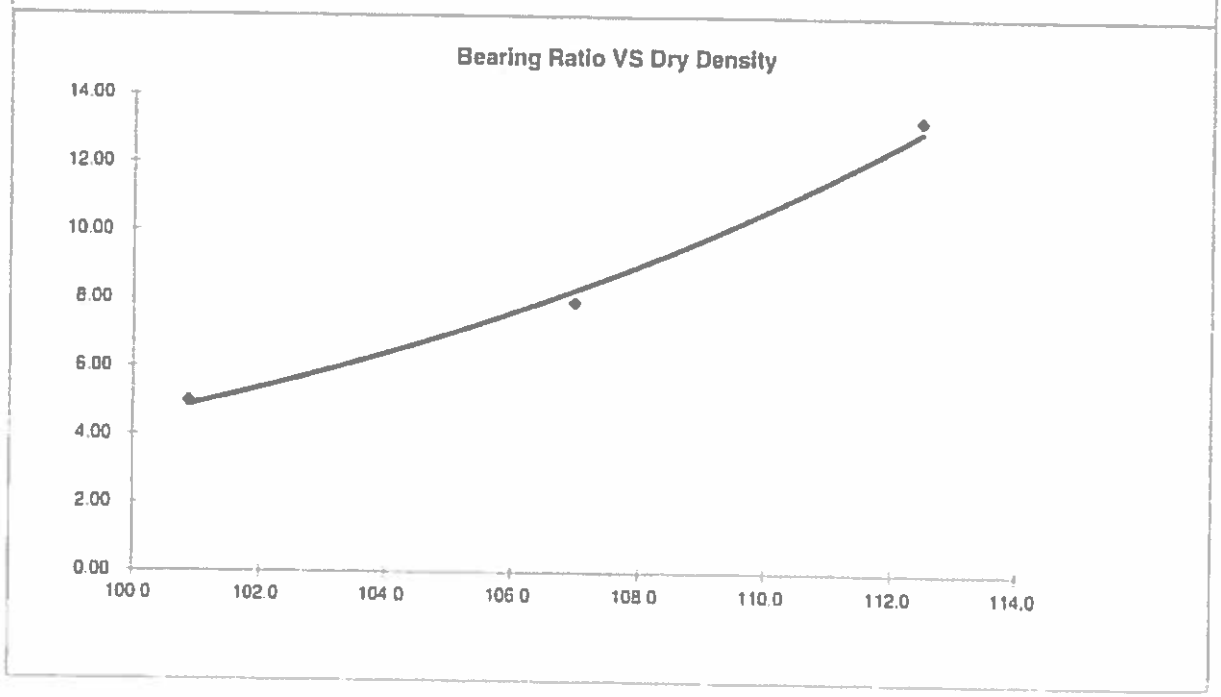
CBR TEST DATA

DRAWN:	DATE	CHECKED:	DATE
		h	4/8/21

JOB NO 200511
FIG NO B-23





BEARING RATIO AT 90% OF MAX	6.24	~ R VALUE	14.00
BEARING RATIO AT 95% OF MAX	10.14	~ R VALUE	30.00

JOB NO: 200511
SOIL TYPE: 1

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CALIFORNIA BEARING RATIO

DRAWN:	DATE	CHECKED:	DATE:
			4/8/21

JOB NO. 200511
FIG NO 3-24

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA — CLASSIC COMM - MIDTOWN @ HANNAH RIDGE FILINING 1, PHASES 1 &2
LOCAL ROADS - SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	292,000
Hveem Stabilometer (R Value) Results:	R =	30
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	6849

Weighted Structural Number (WSN): → WSN = 2.68

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
5.47	5.47	0.0

Job No. 200511
Fig. No. C-1

DESIGN CALCULATIONS

DESIGN DATA CLASSIC COMM - MIDTOWN @ HANNAH RIDGE FILINING 1, PHASES 1 &2
LOCAL ROADS - SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	292,000
Hveem Stabilometer (R Value) Results:	R =	30
Weighted Structural Number (WSN):	WSN =	2.68

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)

$D_1 = (WSN)/C_1 =$ 6.1 inches of Full Depth Asphalt
Use 6.5 inches Full Depth

FOR ASPHALT + AGGREGATE BASECOURSE SECTION 4

Asphalt Thickness (t) = [4] inches
$D_2 = ((WSN) - (t)(C_1))/C_2 =$ 8.3 inches of Aggregate
Basecourse, use 9.0 inches

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 9.0 inches of Aggregate Basecourse, or
2. 6.5 inches of Asphalt

Job No. 200511
Fig. No. C-2

DESIGN CALCULATIONS

CEMENT TREATED SECTIONS - SOIL TYPE 1

DESIGN DATA: CLASSIC COMM - MIDTOWN AT HANNAH RIDGE - FILING NO. 1 PH 1 & 2

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	292,000
Hveem Stabilometer (R Value) Results:	R =	30
Weighted Structural Number (WSN):	WSN =	2.68

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

C_1 = 0.44 Strength Coefficient - Hot Bituminous Asphalt
C_2 = 0.12 Strength Coefficient - Cement Treated Subgrade

D_1 = Depth of Asphalt (inches)
D_2 = Depth of Cement Treated Subgrade (inches)

FOR FULL DEPTH ASPHALT SECTION - (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1$ = 6.1 inches of Full Depth Asphalt
Use 6.5 inches Full Depth

FOR ASPHALT + CEMENT TREATED SUBGRADE SECTION

Asphalt Thickness (t) = 4 inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 7.7 inches
Use 10.0 inches of Cement Treated Subgrade

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 10 inches of Cement Treated Subgrade
2. 6.5 inches of Full Depth Asphalt

Job No. 200511
Fig. No. C-3

ENTECH
ENGINEERING, INC.

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

May 6, 2021

Classic Communities
6385 Corporate Drive, Suite 200
Colorado Springs, CO 80919

Attn: Adam Doyle

Re: Cement Stabilized Subgrade Results - Laboratory Testing
Midtown at Hannah Ridge, Filing No. 1, Phase 1 and 2
El Paso County, Colorado

Ref: Pavement Recommendations Report by Entech Engineering, Inc., dated May 6, 2021, Entech Job No. 200511.

Dear Mr. Doyle:

As requested, personnel of Entech Engineering, Inc. have performed strength testing on two sets of three soil/cement composite samples of Soil Type 1 for the above reference project. Testing was performed on soil samples prepared with 2% and 4% Portland Cement Type 1/2, from Martin Marietta, near Pueblo, Colorado.

A compression strength of 160 psi is recommended for cement stabilized subgrade. The 5-day average strength value of the 2% mix was 186 psi. The 5-day average strength value of the 4% mix was 211 psi. A 2% mix is recommended based on the laboratory test results. A summary of the testing results is attached.

Pending the results of the field density testing, microfracturing of the stabilized subgrade may be required. Soil strengths in excess of 200 psi require microfracturing.

We trust 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/bs

COLORADO LICENSED
MARK HOWARD HAUSCHILD
35140
5-7-2021
PROFESSIONAL ENGINEER

Reviewed by:

Mark H. Hauschild, P.E.
Senior Engineer

Encl.
Entech Job No. 200511
AAprojects/2020/200511 cssr – lab Par1&2

SUMMARY OF CTS TEST RESULTS

LAB TESTING

CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F1
FIELD SAMPLE ID TB-1 @ 0-3'
SOIL ADDITIVE TYPE I/II CEMENT

JOB NO 200511
DATE 4/29/21
BY BL

ADDITIVE %	*WATER %*	*DENSITY (dry)*	*AGE (days)*	*STRENGTH (psi)*
2	13.0	109.1	5	197
2	13.0	109.1	5	177
2	13.0	109.2	5	186
			AVERAGE:	**186**
4	13.0	109.2	5	208
4	13.0	109.2	5	210
4	13.0	109.1	5	216
			AVERAGE:	**211**

CURING METHOD

100° HUMIDIFIED OVEN