



ENTECH ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
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October 17, 2022
Revised October 21, 2022

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

APPROVED
Engineering Review

10/27/2022 10:16:20 AM


dsdrice
JeffRice@elpasoco.com
(719) 520-7877

Attn: Adam Doyle

Re: Pavement Recommendations - Revised
Owl Perch Loop, Elk Antler Lane and Bison Valley Trail
Retreat at TimberRidge, Filing No. 2
El Paso County, Colorado
Entech Job No. 221486

EPC Planning & Community
Development Department

Dear Mr. Doyle:

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

Project Description

The project will consist of paving of the proposed Owl Perch Loop and portions of Elk Antler Lane and Bison Valley Trail in the Retreat at TimberRidge, Filing No. 2 subdivision in El Paso County, Colorado. A Subsurface Soil Investigation and laboratory testing were performed to determine the pavement support characteristics on the soils. The general layout of the site is presented in the Test Boring Location Map in Figure 1.

Subgrade Conditions

A total of seven test borings were drilled along the roadways to depths of approximately 5 and 10 feet below the existing subgrade surface at the required sample frequency. The boring locations are shown from Figure No. 1.

The soils at the roadway subgrade depth consisted of clayey to silty sand fill (Soil Type 1) and slightly silty to silty sandstone (Soil Type 2). The Test Boring Logs are presented in Appendix A. Soil Type 2 was encountered beneath the subgrade influence zone at a depth of 4 to 9 feet and is not expected to affect the asphalt performance. The pavement sections were determined using the Type 1 soil data. Sieve Analyses and Atterberg Limit testing were performed on subgrade soil samples obtained from the test borings for the purpose of classification. The percent passing the No. 200 sieve ranged from approximately 12 to 29 percent.

The Type 1 soil classified as A-2-6, A-1-b soils and A-2-4 soils which commonly exhibits good pavement support characteristics. Groundwater was not encountered in the test borings. Sulfate testing resulted in less than 0.01 to 0.02 percent soluble sulfate by weight, indicating a negligible potential for below grade concrete degradation due to sulfate attack. Two samples of the Type 1 soils had Plastic Indexes of over 10 percent. Swell/Consolidation testing on the two

PCD File No. SF-2121

samples resulted in volume changes of 0.6 and 1.0 percent, which are below the levels in which mitigation is required. Mitigation for expansive soils is not required on this site.

California Bearing Ratio (CBR) testing was performed on a representative subgrade sample of the Type 1 materials from Test Boring No. 6 to determine the support characteristics of the subgrade soils for the roadway sections. The results of the CBR testing, are presented in Appendix B and summarized as follows:

Soil Type 1 – Clayey Sand
R @ 90% = 17.0
R @ 95% = 65.0
Use R = 50.0 for design

<u>Classification Testing</u>	
Liquid Limit	27
Plasticity Index	11
Percent Passing 200	29.2
AASHTO Classification	A-2-6
Group Index	0
Unified Soils Classification	SC

Pavement Design

CBR testing was used to determine pavement sections for the roadways. Pavement sections were determined utilizing El Paso County Engineering Criteria Manual. Owl Perch Loop, Elk Antler Lane, and Bison Valley Trail classify as Urban Local Roads, which use an 18K ESAL value of 292,000 for design purposes. Pavement sections were determined for asphalt on basecourse or asphalt on cement stabilized subgrade.

Design parameters used in the pavement analysis for the roadways are as follows:

Reliability	80%
Δpsi	2.0
“R” Value Subgrade (Soil Type 1)	50.0
Resilient Modulus (Soil Type 1)	13,168 psi
Structural Coefficients	
Hot Bituminous Pavement	0.44
Aggregate Basecourse	0.11
Cement Stabilized Subgrade	0.11

The pavement design calculations are presented in Appendix C. Pavement section alternatives for the roadway sections are presented below. Any additional grading may result in subgrade soils with different support characteristics. The following pavement sections should be re-evaluated if additional grading is performed.

Pavement Sections – Local Urban Roads

ESAL = 292,000

Soil Type 1

<u>Alternative</u>	<u>Asphalt (in)</u>	<u>Basecourse (in)</u>	<u>Cement Stabilized Subgrade (in)</u>
1. Asphalt Over Basecourse	3.0*	8.0*	-
2. Asphalt Over Cement Stabilized Subgrade	3.0*	-	8.0

* Minimum sections required per El Paso County Criteria.

The calculations have full-depth sections provided. Full depth sections are currently not allowed by El Paso County.

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 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.

Roadway Construction – Cement Stabilized Subgrade

Prior to placement of the asphalt, the subgrade may be stabilized by addition of cement to a depth of at least 8 inches. The amount of cement applied shall be 2.0 percent (by weight) of the subgrade’s maximum dry density as determined by the Modified Proctor Test (ASTM D-1557) and based on laboratory cement stabilization testing. The cement should be spread evenly on the subgrade surface and be thoroughly mixed into the subgrade over an 8-inch depth such that a uniform blend of soil and cement is achieved. Prior to application or mixing of the cement, the upper 8 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 Modified Proctor Test (ASTM D-1557). 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.

Based on the soils encountered, subgrade soil problem areas, if any, will be identified at proof roll. We do not anticipate issues with the subgrade in regards to shallow water, frost susceptible soils, groundwater or drainage conditions, soluble sulfates, or cold weather construction.

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.

We trust that this has provided you with the information you required. The pavement sections provided are based on general site soil types. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

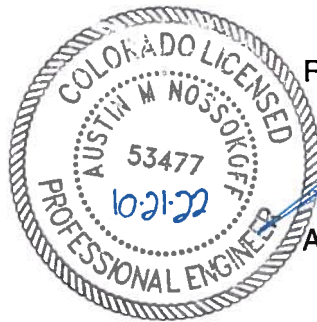


Stuart Wood
Geologist

SW/rs

Encl.

AAprojects/2022/221486 - pr rev 6



Reviewed by:



Austin M. Nossokoff, P.E.

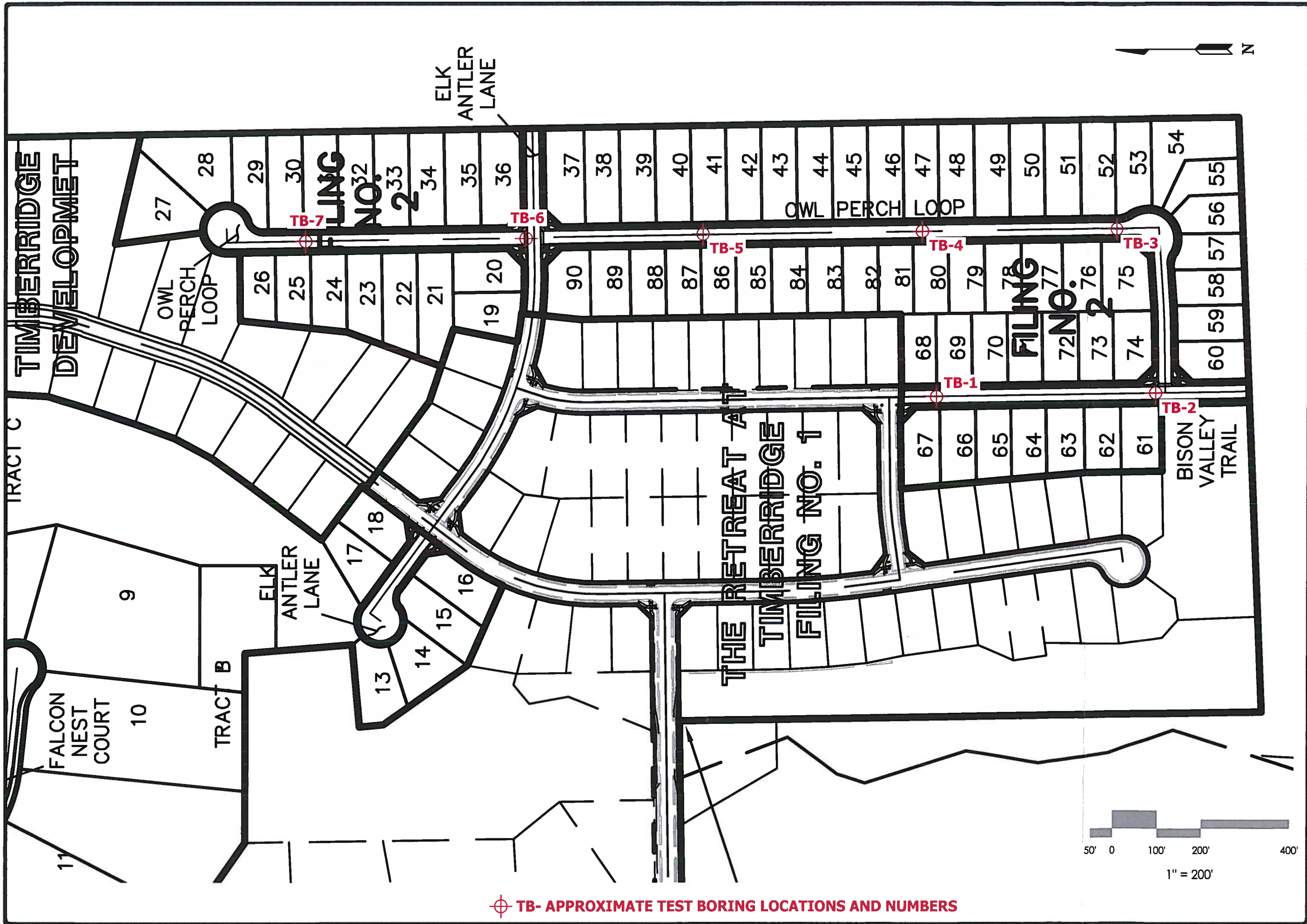
TABLE

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

CLIENT CLASSIC COMMUNITIES
PROJECT TIMBERRIDGE, FILING 2
JOB NO. 221486

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	6	0-3	12.4	107.2	29.2	27	11		A-2-6	0.6	SC	FILL, SAND, CLAYEY
1	1	1-2			13.7	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	2	1-2			12.3	NV	NP	0.02	A-1-b		SM	FILL, SAND, SILTY
1	3	1-2			20.7	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	4	1-2			22.8	28	9		A-2-4		SC	FILL, SAND, CLAYEY
1	5	1-2			20.4	NV	NP	0.00	A-1-b		SM	FILL, SAND, SILTY
1	6	1-2	12.7	109.2	23.9	30	11		A-2-6	1.0	SC	FILL, SAND, CLAYEY
1	3	0-3			26.5				A-2-4		SM	FILL, SAND, SILTY
1	7	1-2			8.9	NV	NP		A-1-b		SM-SW	FILL, SAND, SLIGHTLY SILTY
2	7	5			20.3	NV	NP		A-1-b		SM	SANDSTONE, SILTY
2	3	10			9.9	NV	NP	<0.01	A-1-b		SM-SW	SANDSTONE, SLIGHTLY SILTY
2	6	10			18.4	NV	NP		A-1-b		SM	SANDSTONE, SILTY

FIGURE



⊕ TB- APPROXIMATE TEST BORING LOCATIONS AND NUMBERS

REVISION	BY

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505 ELKTON DRIVE 719 531-3599
COLORADO SPRINGS, CO. 80907

TEST BORING LOCATION MAP
RETREAT AT TIMBER RIDGE, F2
EL PASO COUNTY, CO
FOR: CLASSIC COMMUNITIES

DRAWN BY: JAC
 CHECKED BY: DFB
 DATE: 10/10/22
 SCALE: 1" = 200'
 JOB NO: 231486
 DRAWING NO: 1

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
 DATE DRILLED 9/16/2022
 Job # 221486

TEST BORING NO. 2
 DATE DRILLED 9/16/2022
 CLIENT CLASSIC COMMUNITIES
 LOCATION TIMBERRIDGE, FILING 2

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 9/16/22							DRY TO 5', 9/16/22						
FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, TAN, LOOSE TO MEDIUM DENSE, MOIST	5	[Symbol]		9	7.4	1	FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, TAN, LOOSE TO MEDIUM DENSE, MOIST	5	[Symbol]		7	7.7	1
	5	[Symbol]		13	8.7	1		5	[Symbol]		27	8.7	1
	10							10					
	15							15					
	20							20					



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *SW*

DATE: *10-3-22*

JOB NO.:
 221486

FIG NO.:
 A-1

TEST BORING NO. 3
 DATE DRILLED 9/16/2022
 Job # 221486

TEST BORING NO. 4
 DATE DRILLED 9/16/2022
 CLIENT CLASSIC COMMUNITIES
 LOCATION TIMBERRIDGE, FILING 2

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 10', 9/16/22							DRY TO 5', 9/16/22						
FILL 0-4', SAND, SILTY, FINE TO COARSE GRAINED, TAN, LOOSE TO MEDIUM DENSE, MOIST				15	13.1	1	FILL 0-5', SAND, CLAYEY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE TO DENSE, MOIST				26	7.2	1
SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	5			50 10"	5.8	2		5			30	7.9	1
	10			50 6"	7.1	2		10					
	15							15					
	20							20					



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *SW*

DATE: *10-3-22*

JOB NO.:
 221486

FIG NO.:
 A- 2

TEST BORING NO. 5
 DATE DRILLED 9/16/2022
 Job # 221486

TEST BORING NO. 6
 DATE DRILLED 9/16/2022
 CLIENT CLASSIC COMMUNITIES
 LOCATION TIMBERRIDGE, FILING 2

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 9/16/22							DRY TO 10', 9/16/22						
FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST	5	[Symbol]		24	6.5	1	FILL 0-9', SAND, CLAYEY, FINE TO COARSE GRAINED, DARK BROWN TO TAN, DENSE TO MEDIUM DENSE, MOIST	5	[Symbol]		33	7.9	1
	5	[Symbol]		24	9.5	1		5	[Symbol]		17	9.3	1
	10	[Symbol]					SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	10	[Symbol]		50 9"	6.5	2
	15	[Symbol]						15	[Symbol]				
	20	[Symbol]						20	[Symbol]				



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TEST BORING LOG

DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>10-3-22</i>
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JOB NO.:
221486

FIG NO.:
A- 3

TEST BORING NO. 7
 DATE DRILLED 10/3/2022
 Job # 221486

TEST BORING NO.
 DATE DRILLED
 CLIENT CLASSIC COMMUNITIES
 LOCATION TIMBERRIDGE, FILING 2

REMARKS

REMARKS

DRY TO 5', 10/3/22

FILL 0-3', SAND, SLIGHTLY SILTY,
 FINE TO COARSE GRAINED, TAN,
 DENSE, DRY

SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, TAN, VERY
 DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0-3	(Symbol)		37	1.4	1	0-3	(Symbol)				
3-5	(Symbol)		50	4.3	2	3-5	(Symbol)				
5-5"	(Symbol)		5"			5-5"	(Symbol)				
5-10						5-10					
10-15						10-15					
15-20						15-20					
20-25						20-25					



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TEST BORING LOG

DRAWN: DATE: CHECKED: DATE: *DS* *10/12/22*

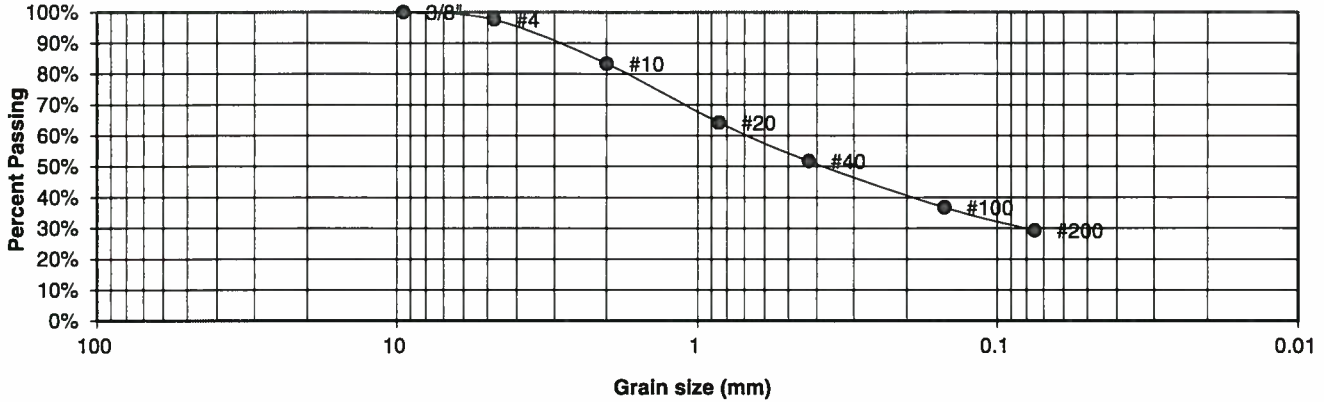
JOB NO.:
 221486

FIG NO.:
 A- 4

APPENDIX B: Laboratory Test Results

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1, CBR	PROJECT	TIMBERRIDGE, FILING 2
TEST BORING #	6	JOB NO.	221486
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION	A-2-6	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	97.6%
10	83.3%
20	64.2%
40	51.7%
100	36.7%
200	29.2%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	27
Plastic Index	11

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: <i>SW</i>	DATE: <i>10-3-22</i>
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JOB NO.:

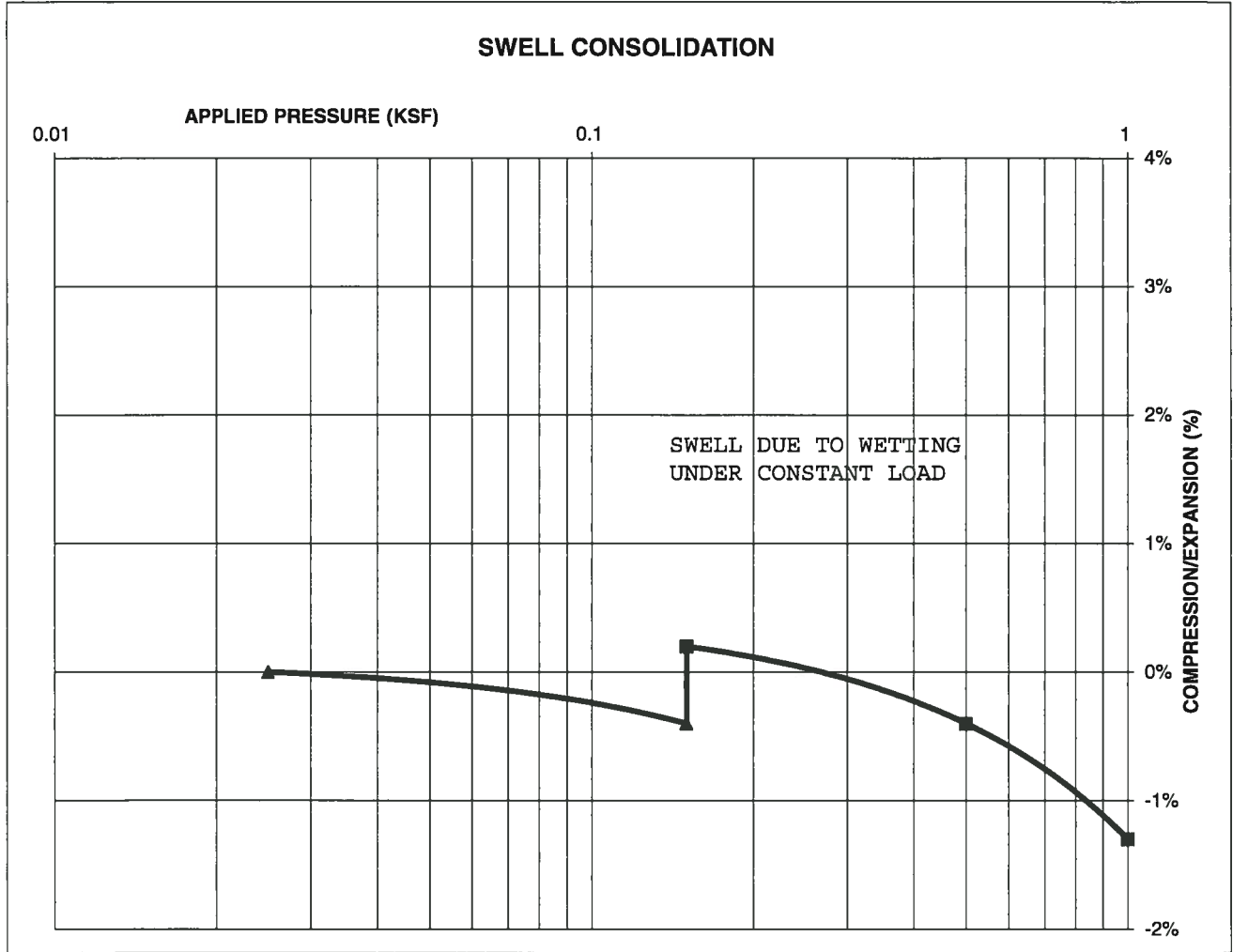
221486
FIG NO.:

B-1

CONSOLIDATION TEST RESULTS

TEST BORING #	6	DEPTH(ft)	0-3
DESCRIPTION	SC	SOIL TYPE	1, CBR
NATURAL UNIT DRY WEIGHT (PCF)	107		
NATURAL MOISTURE CONTENT	12.4%		
SWELL/CONSOLIDATION (%)	0.6%		

JOB NO. 221486
 CLIENT CLASSIC COMMUNITIES
 PROJECT TIMBERRIDGE, FILING 2



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**SWELL CONSOLIDATION
 TEST RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

DS

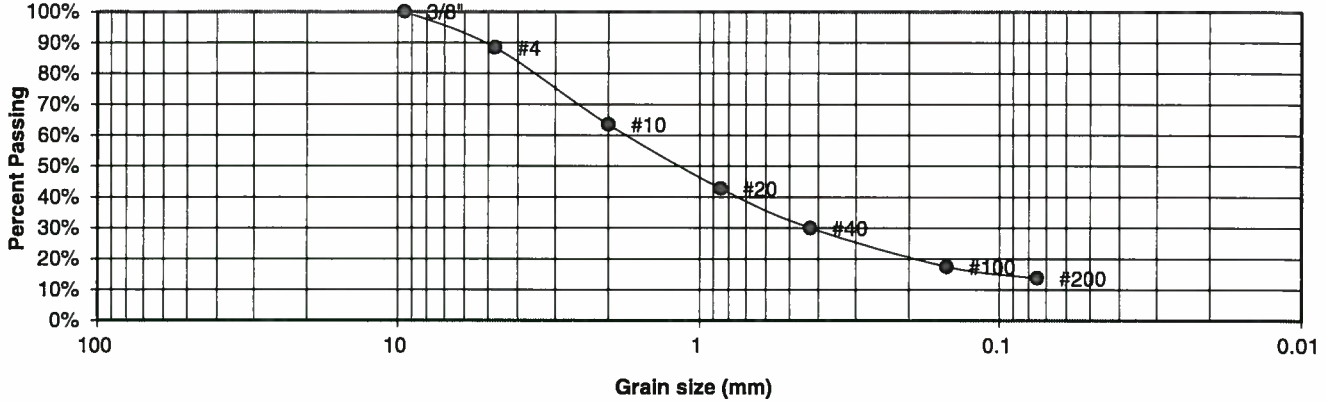
10/29/22

JOB NO.:
 221486

FIG NO.:
 B-1A

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	CLASSIC COMMUNITIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	TIMBERRIDGE, FILING 2
<u>TEST BORING #</u>	1	<u>JOB NO.</u>	221486
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	88.3%
10	63.5%
20	42.7%
40	30.0%
100	17.5%
200	13.7%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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**LABORATORY TEST
RESULTS**

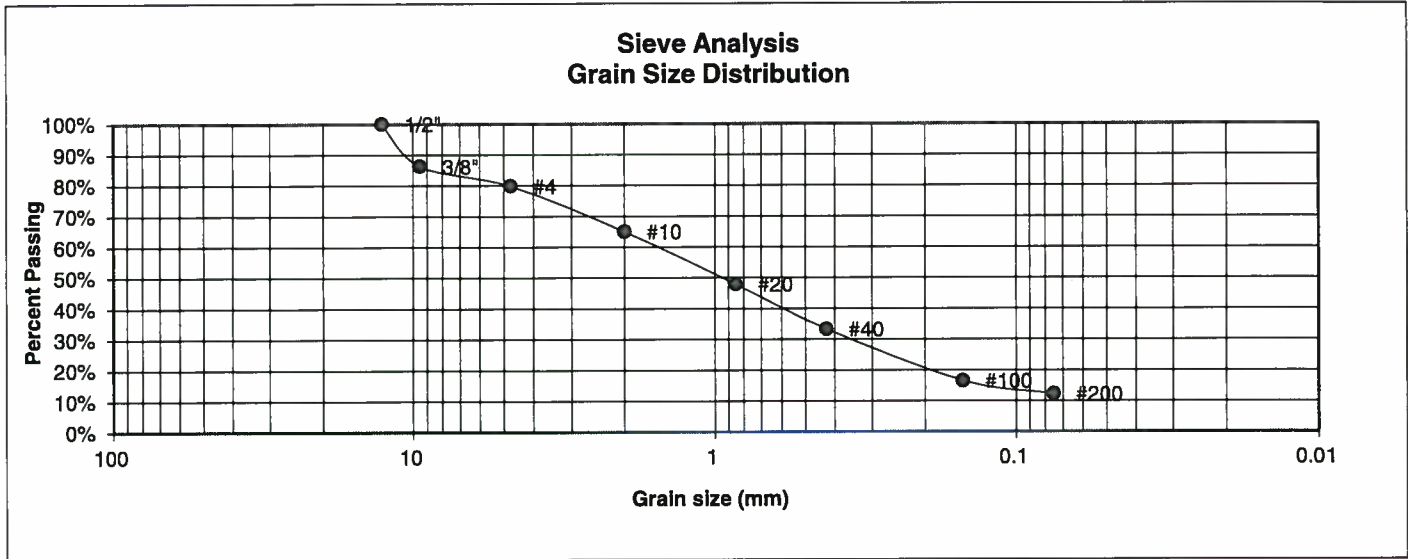
<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> SW	<u>DATE:</u> 10-3-22
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JOB NO.:

221486
FIG NO.:

B-2

UNIFIED CLASSIFICATION	SM	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	TIMBERRIDGE, FILING 2
TEST BORING #	2	JOB NO.	221486
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"	86.3%
4	79.8%
10	65.0%
20	47.9%
40	33.3%
100	16.5%
200	12.3%

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: <i>SW</i>	DATE: <i>10-3-22</i>
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JOB NO.:

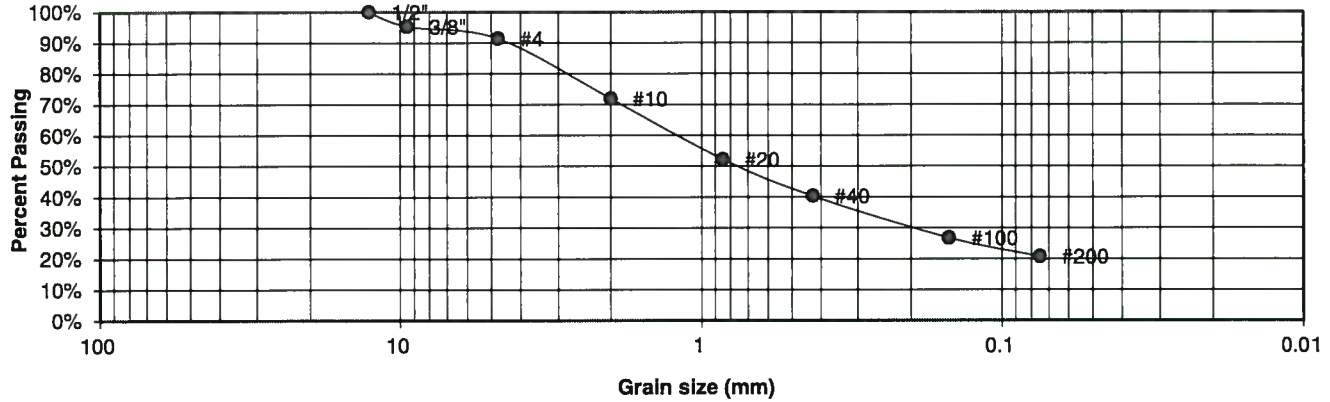
221486

FIG NO.:

B-3

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	CLASSIC COMMUNITIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	TIMBERRIDGE, FILING 2
<u>TEST BORING #</u>	3	<u>JOB NO.</u>	221486
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	95.3%
4	91.4%
10	71.9%
20	52.2%
40	40.3%
100	26.7%
200	20.7%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>	
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:
		SW	10-3-22

JOB NO.:

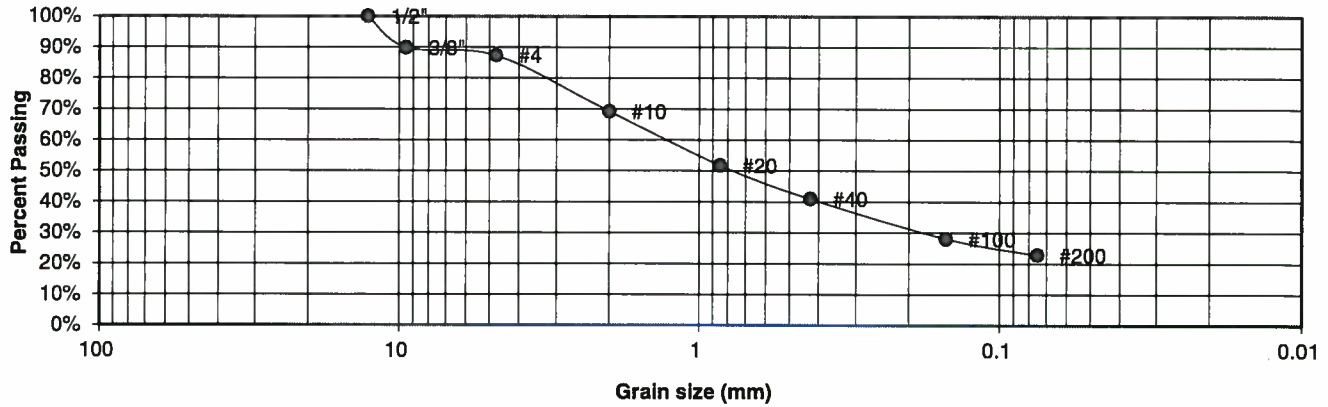
221486

FIG NO.:

B-4

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	CLASSIC COMMUNITIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	TIMBERRIDGE, FILING 2
<u>TEST BORING #</u>	4	<u>JOB NO.</u>	221486
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-4	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	89.8%
4	87.3%
10	69.2%
20	51.7%
40	40.9%
100	28.0%
200	22.8%

<u>Atterberg Limits</u>	
Plastic Limit	19
Liquid Limit	28
Plastic Index	9

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>10-3-22</i>
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JOB NO.:

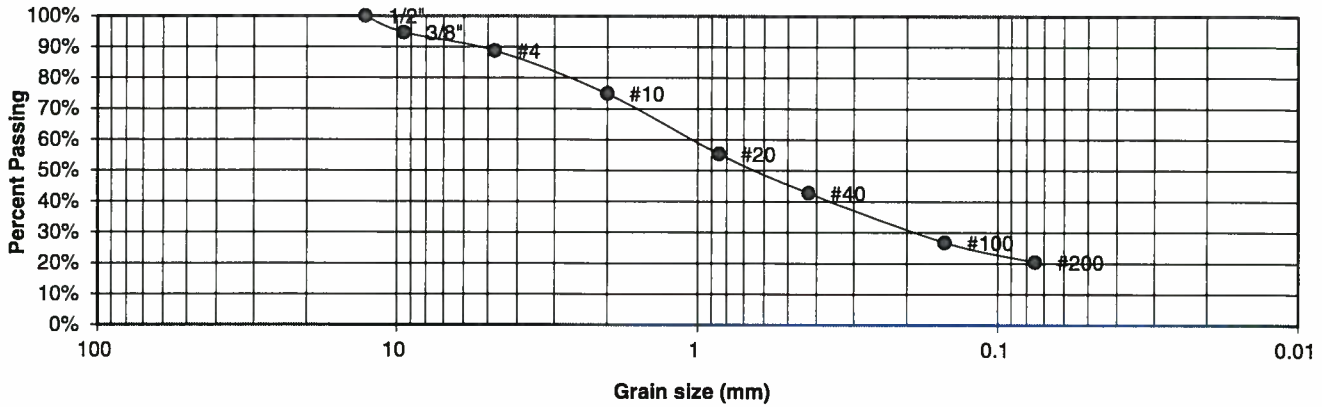
221486

FIG NO.:

B-5

UNIFIED CLASSIFICATION	SM	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	TIMBERRIDGE, FILING 2
TEST BORING #	5	JOB NO.	221486
DEPTH (FT)	1-2	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"	94.6%
4	88.7%
10	74.9%
20	55.4%
40	42.7%
100	26.8%
200	20.4%

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: <i>SW</i>	DATE: <i>10-3-22</i>
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JOB NO.:

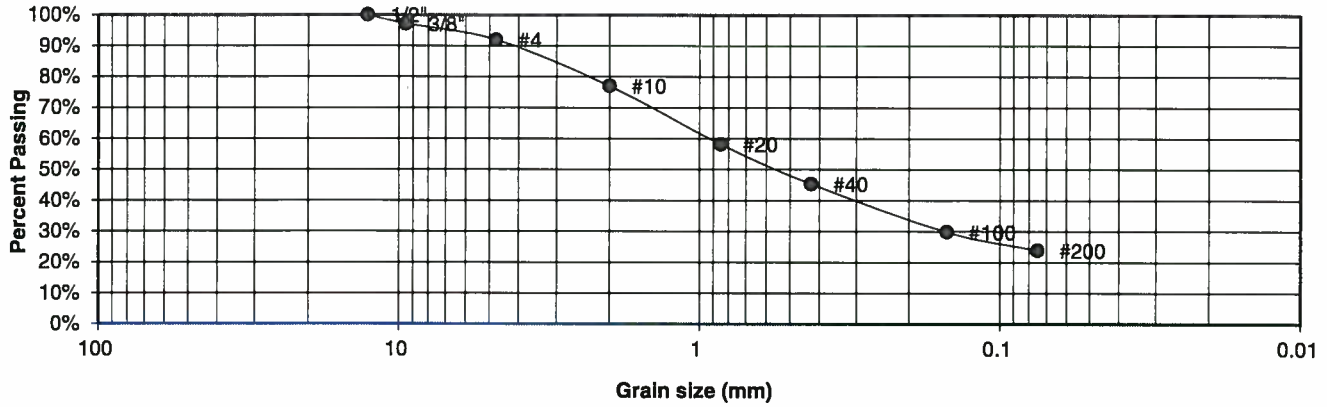
221486

FIG NO.:

B-6

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	CLASSIC COMMUNITIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	TIMBERRIDGE, FILING 2
<u>TEST BORING #</u>	6	<u>JOB NO.</u>	221486
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-6	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.1%
4	91.9%
10	77.0%
20	58.2%
40	45.3%
100	29.8%
200	23.9%

<u>Atterberg Limits</u>	
Plastic Limit	19
Liquid Limit	30
Plastic Index	11

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED: *SW*

DATE:

10-3-22

JOB NO.:

221486

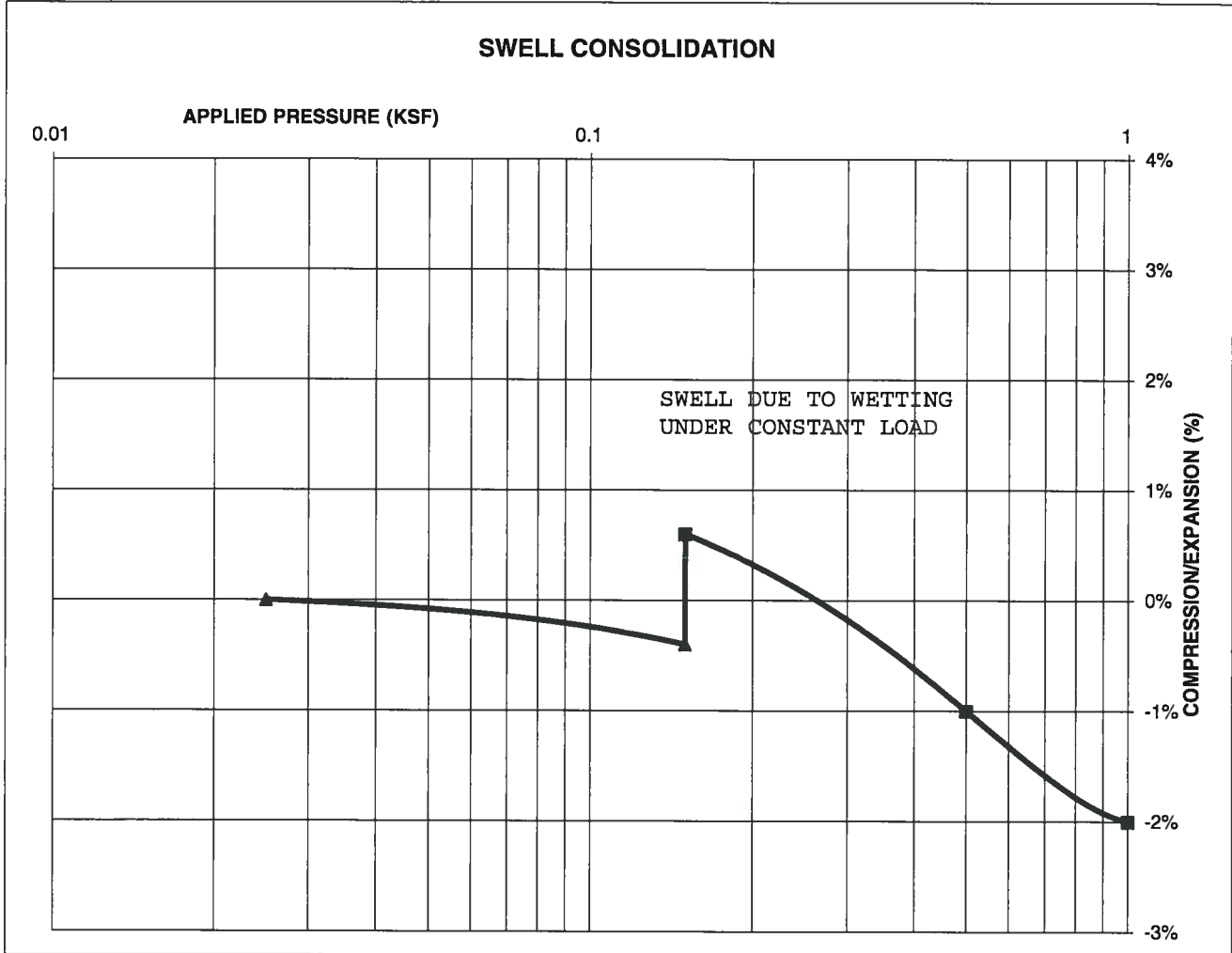
FIG NO.:

B-7

CONSOLIDATION TEST RESULTS

TEST BORING #	6	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			109
NATURAL MOISTURE CONTENT			12.7%
SWELL/CONSOLIDATION (%)			1.0%

JOB NO. 221486
 CLIENT CLASSIC COMMUNITIES
 PROJECT TIMBERRIDGE, FILING 2



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 COLORADO SPRINGS, COLORADO 80907

**SWELL CONSOLIDATION
TEST RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

TSS

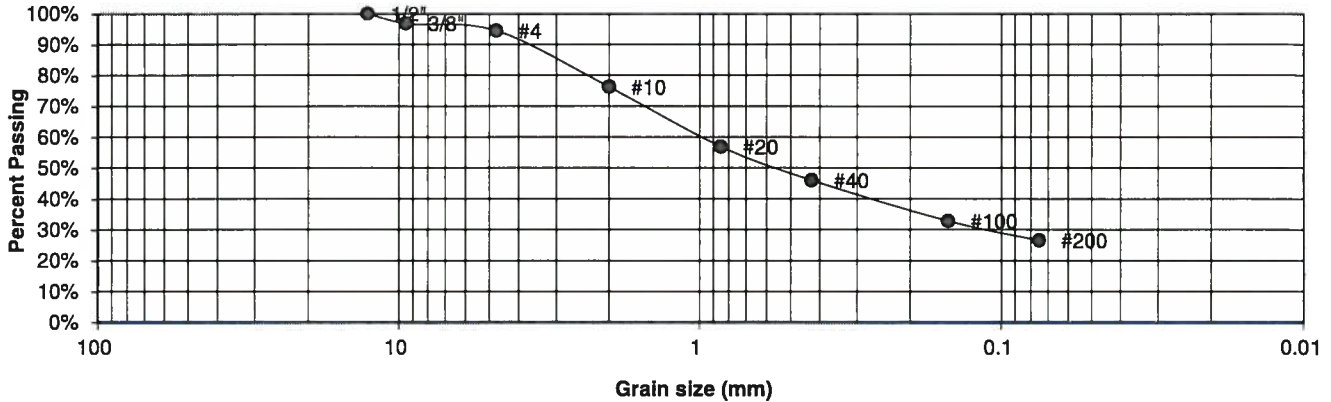
10/20/22

JOB NO.:
221486

FIG NO.:
B-TA

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	CLASSIC COMMUNITIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	TIMBERRIDGE, FILING 2
<u>TEST BORING #</u>	3	<u>JOB NO.</u>	221486
<u>DEPTH (FT)</u>	0-3	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-4	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	96.8%
4	94.4%
10	76.2%
20	56.9%
40	46.0%
100	32.8%
200	26.5%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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: *SW*

DATE: *10-3-22*

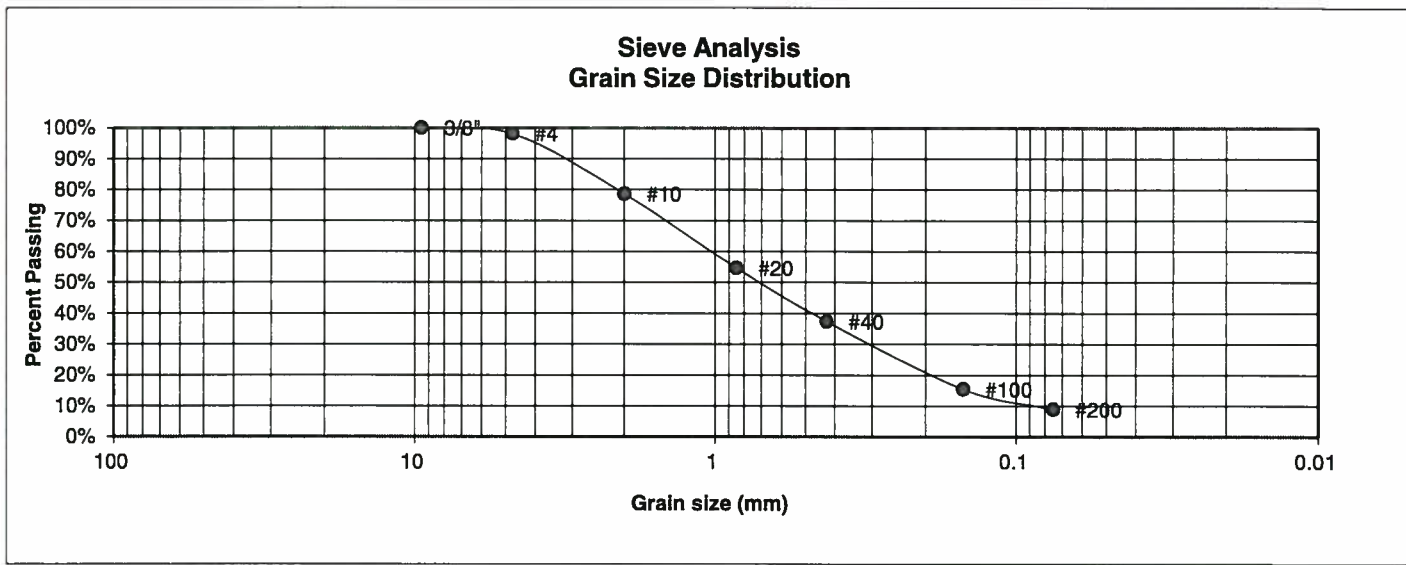
JOB NO.:

221486

FIG NO.:

B-8

UNIFIED CLASSIFICATION	SM-SW	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	TIMBERRIDGE, FILING 2
TEST BORING #	7	JOB NO.	221486
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	98.1%
10	78.6%
20	54.7%
40	37.4%
100	15.4%
200	8.9%

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)	



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**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED:	DATE:
		DS	10/12/12

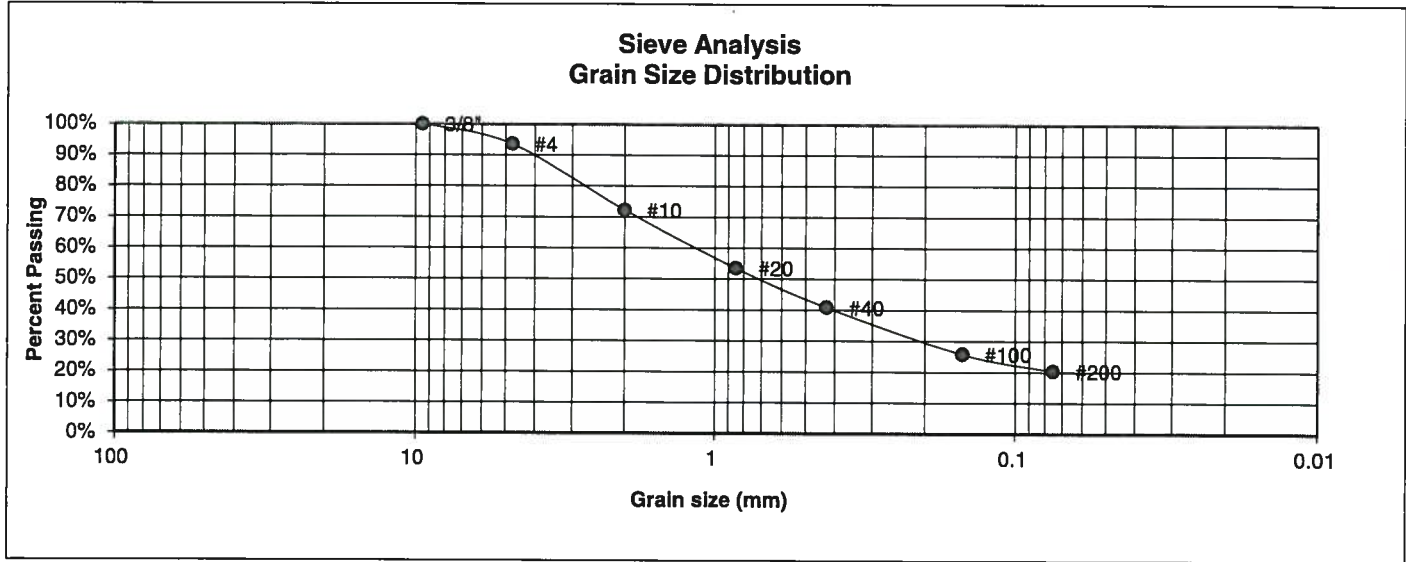
JOB NO.:

221486

FIG NO.:

B-9

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	CLASSIC COMMUNITIES
<u>SOIL TYPE #</u>	2	<u>PROJECT</u>	TIMBERRIDGE, FILING 2
<u>TEST BORING #</u>	7	<u>JOB NO.</u>	221486
<u>DEPTH (FT)</u>	5	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	93.5%
10	72.2%
20	53.5%
40	40.8%
100	25.8%
200	20.3%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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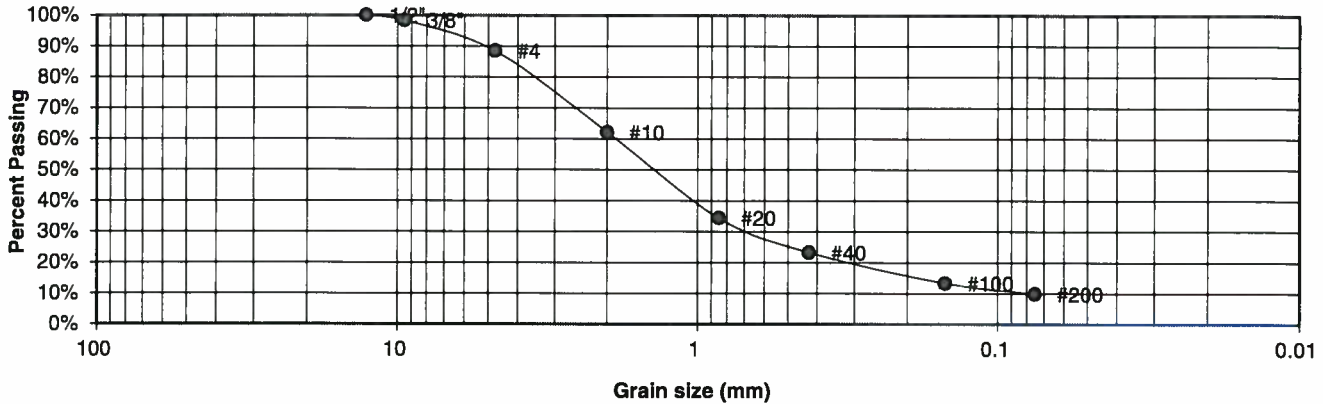
**LABORATORY TEST
RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u>	<u>DATE:</u>
		DS	10/12/22

JOB NO.:
221486
FIG NO.:
B-10

UNIFIED CLASSIFICATION	SM-SW	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	2	PROJECT	TIMBERRIDGE, FILING 2
TEST BORING #	3	JOB NO.	221486
DEPTH (FT)	10	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"	98.3%
4	88.5%
10	62.2%
20	34.4%
40	23.2%
100	13.3%
200	9.9%

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)	



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**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>10-3-22</i>
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JOB NO.:

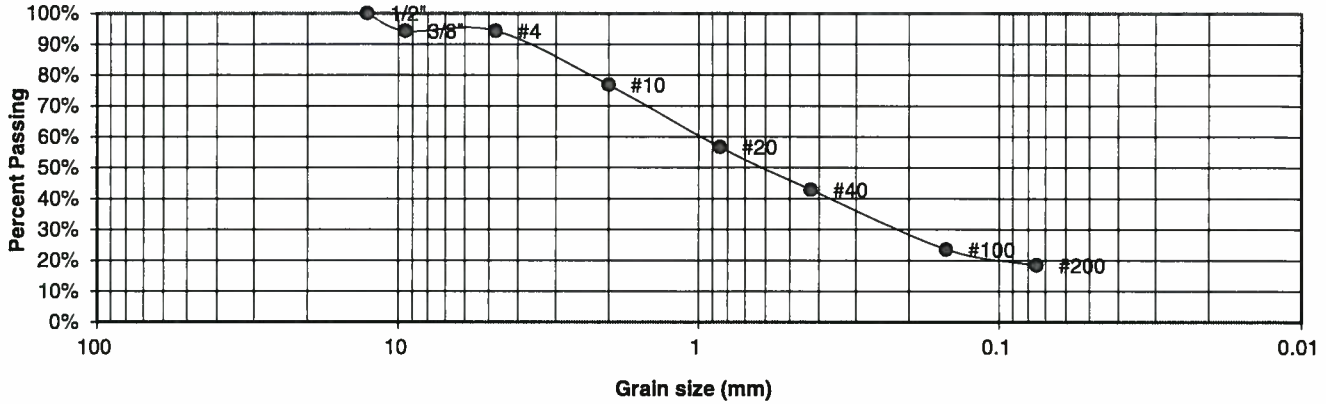
221486

FIG NO.:

8-11

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	CLASSIC COMMUNITIES
<u>SOIL TYPE #</u>	2	<u>PROJECT</u>	TIMBERRIDGE, FILING 2
<u>TEST BORING #</u>	6	<u>JOB NO.</u>	221486
<u>DEPTH (FT)</u>	10	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	94.3%
4	94.3%
10	76.8%
20	56.7%
40	42.9%
100	23.6%
200	18.4%

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: <i>SW</i>	DATE: <i>10-3-22</i>
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JOB NO.:

221486

FIG NO.:

B-12

CLIENT	CLASSIC COMMUNITIES	JOB NO.	221486
PROJECT	TIMBERRIDGE, FILING 2	DATE	9/28/2022
LOCATION	TIMBERRIDGE, FILING 2	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-2	1-2	1	SM	0.02
TB-3	10	2	SM-SW	<0.01
TB-5	1-2	1	SM	0.00

QC BLANK PASS



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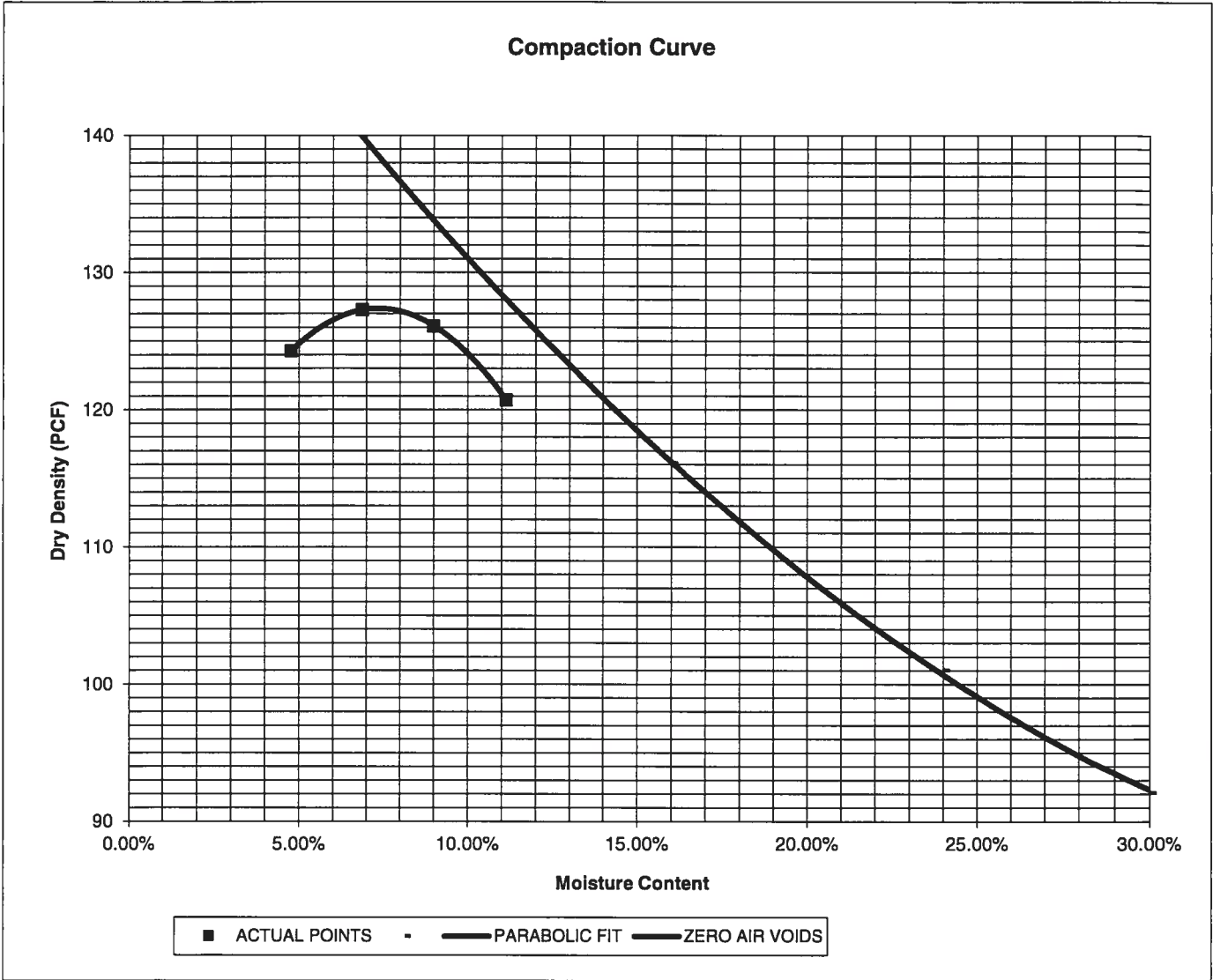
**LABORATORY TEST
SULFATE RESULTS**

DRAWN:	DATE:	CHECKED: SW	DATE: 10-3-22
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JOB NO.:
221486
FIG NO.:
B-13

<u>PROJECT</u>	TIMBERRIDGE, FILING 2	<u>CLIENT</u>	CLASSIC COMMUNITIES
<u>SAMPLE LOCATION</u>	TB-6 @ 0-3'	<u>JOB NO.</u>	221486
<u>SOIL DESCRIPTION</u>	SAND, CLAYEY, BROWN	<u>DATE</u>	09/28/22

<u>IDENTIFICATION</u>	SC	<u>COMPACTION TEST #</u>	1, SOIL TYPE #1
<u>TEST DESIGNATION / METHOD</u>	ASTM D-1557-A	<u>TEST BY</u>	AL
<u>MAXIMUM DRY DENSITY (PCF)</u>	127.3	<u>OPTIMUM MOISTURE</u>	7.5%




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MOISTURE DENSITY RELATION

DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>10-3-22</i>
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JOB NO.:
221486
FIG NO.:
B-14

CBR TEST LOAD DATA

JOB NO: 221486
 CLIENT: CLASSIC COMMUNITIES
 PROJECT: TIMBERRIDGE, FILING 2
 SOIL TYPE: 1, CBR #1

PISTON		PISTON		10 BLOWS		25 BLOWS		56 BLOWS	
DIAMETER (cm)		AREA (in ²)		MOLD # 1		MOLD # 2		MOLD # 3	
4.958		2.993		LOAD(LBS)	STRESS (PSI)	LOAD(LBS)	STRESS (PSI)	LOAD(LBS)	STRESS (PSI)
PENETRATION DEPTH (INCHES)		(LBS)	(PSI)	(LBS)	(PSI)	(LBS)	(PSI)	(LBS)	(PSI)
0.000		0	0.00	0	0.00	0	0.00	0	0.00
0.025		153	51.13	235	78.53	345	115.29		
0.050		229	76.52	351	117.29	523	174.77		
0.075		286	95.57	440	147.03	598	199.83		
0.100		374	124.98	558	186.47	706	235.92		
0.125		481	160.73	740	247.28	800	267.33		
0.150		521	174.10	801	267.67	881	294.40		
0.175		585	195.49	900	300.75	962	321.47		
0.200		634	211.86	975	325.81	1050	350.88		
0.300		769	256.97	1183	395.32	1341	448.12		
0.400		814	272.01	1251	418.04	1593	532.33		
0.500		1024	342.19	1575	526.31	1880	628.24		

FINAL MOISTURE CONTENT

	MOLD # 1	MOLD # 2	MOLD # 3
CAN #	318	347	341
WT. CAN	8.36	8.53	8.57
WT. CAN+WET	176.39	173.7	133.75
WT. CAN+DRY	162.44	157.89	118.23
WT. H2O	13.95	15.81	15.52
WT. DRY SOIL	154.08	149.36	109.66
MOISTURE CONTENT	9.05%	10.59%	14.15%

WET DENSITY (PCF)	126.5	130.3	134.0
DRY DENSITY (PCF)	117.6	121.2	124.6

BEARING RATIO 12.50 18.65 23.59

90% OF DRY DENSITY 114.6

95% OF DRY DENSITY 120.9

BEARING RATIO AT 90% OF MAX	7.20 ~ R VALUE	17
BEARING RATIO AT 95% OF MAX	18.21 ~ R VALUE	65



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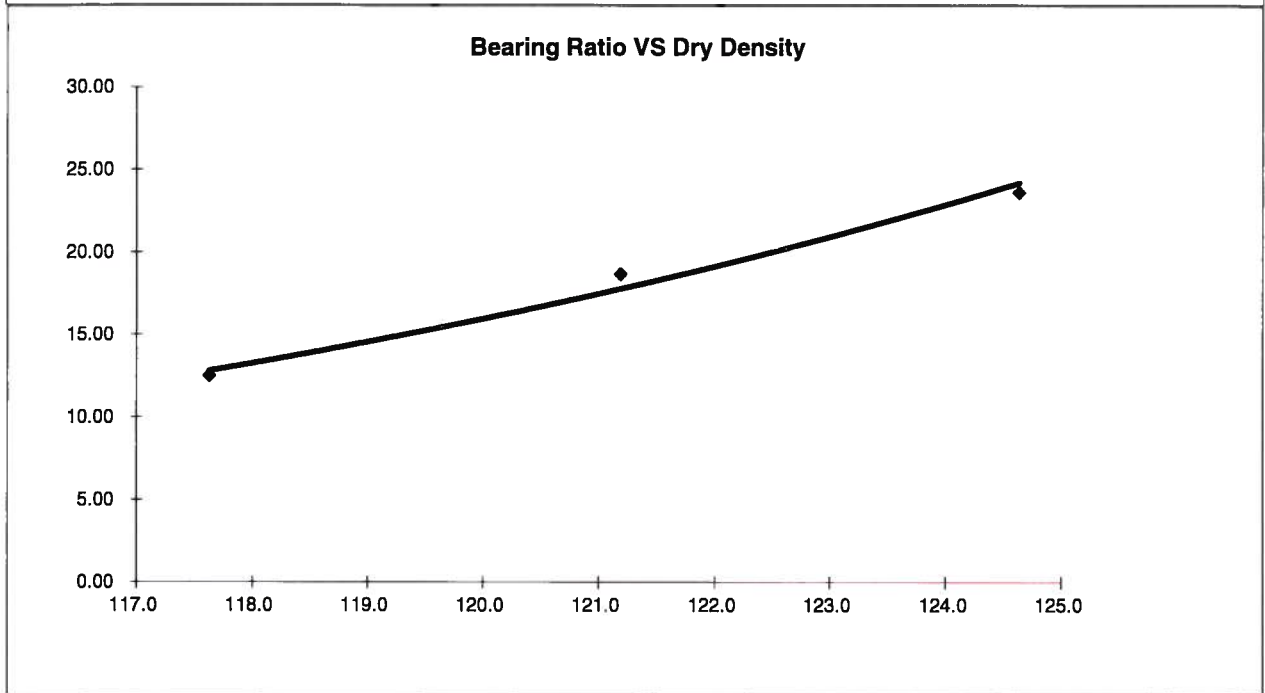
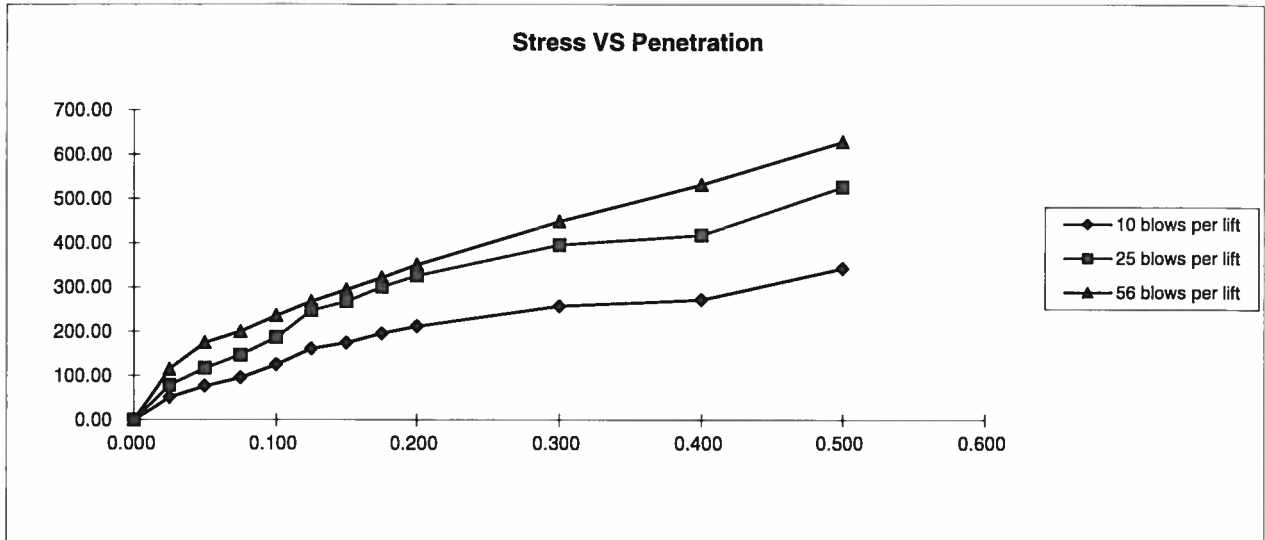
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CBR TEST DATA

DRAWN:	DATE:	CHECKED: SW	DATE: 10-3-22
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JOB NO:
 221486

FIG NO:
 B-15



BEARING RATIO AT 90% OF MAX	7.20 ~ R VALUE	17.00
BEARING RATIO AT 95% OF MAX	18.21 ~ R VALUE	65.00

JOB NO: 221486
 SOIL TYPE: 1, CBR #1



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 COLORADO SPRINGS, COLORADO 80907

CALIFORNIA BEARING RATIO

DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>10-3-22</i>
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JOB NO: 221486
 FIG NO: *B-16*

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA

Classic Communitites

Retreat at TimberRidge, Filing No. 2 - Urban Local - Soil Type 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	292,000
Hveem Stabilometer (R Value) Results:	R =	50
Standard Deviation	S_o =	0.45
Loss in Serviceability	$\Delta\psi$ =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.841
Soil Resilient Modulus	M_R =	13168

Weighted Structural Number (WSN): ➔ WSN = 2.10

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)

50	0
60	-0.253
70	-0.524
75	-0.674
80	-0.841
90	-1.282
95	-1.65
97	-1.88
98	-2.05
99	-2.33
99.9	-3.09
99.99	-3.75

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

Left	Right	Difference
5.47	5.47	0.0

Job No. 221486

Fig. No. C-1

DESIGN CALCULATIONS

CEMENT TREATED SECTIONS

DESIGN DATA

Classic Communities

Retreat at TimberRidge, Filing No. 2 - Urban Local - Soil Type 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL = 292,000
Hveem Stabilometer (R Value) Results:	R = 50
Weighted Structural Number (WSN):	WSN = 2.10

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

$C_1 = 0.44$ Strength Coefficient - Hot Bituminous Asphalt

$C_2 = 0.11$ Strength Coefficient - Cement Stabilized Subgrade

$D_1 =$ Depth of Asphalt (inches)

$D_2 =$ Depth of Cement Stabilized Subgrade(inches)

FOR FULL DEPTH ASPHALT SECTION(CURRENTLY NOT ALLOWED)

$$D_1 = (WSN)/C_1 = 4.8 \text{ inches of Full Depth Asphalt}$$

Use 5.0 inches Full Depth

FOR ASPHALT + CEMENT STABILIZED SUBGRADE SECTION

$$\text{Asphalt Thickness (t)} = \boxed{3} \text{ inches}$$

$$D_2 = ((WSN) - (t)(C_1))/C_2 = 7.1 \text{ inches of Cement Stabilized Subgrade,}$$

use 8.0 inches

RECOMMENDED ALTERNATIVES

1. 3.0 inches of Asphalt + 8.0 inches of Cement Stabilized Subgrade, or
2. 5.0 inches of Full-Depth Asphalt

Job No. 221486

Fig. No. C-2

DESIGN CALCULATIONS

CEMENT TREATED SECTIONS

DESIGN DATA

Classic Communities

Retreat at TimberRidge, Filing No. 2 - Urban Local - Soil Type 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	292,000
Hveem Stabilometer (R Value) Results:	R =	50
Weighted Structural Number (WSN):	WSN =	2.10

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

$C_1 = 0.44$ Strength Coefficient - Hot Bituminous Asphalt

$C_2 = 0.11$ Strength Coefficient - Cement Stabilized Subgrade

$D_1 =$ Depth of Asphalt (inches)

$D_2 =$ Depth of Cement Stabilized Subgrade(inches)

FOR FULL DEPTH ASPHALT SECTION(CURRENTLY NOT ALLOWED)

$$D_1 = (WSN)/C_1 = 4.8 \text{ inches of Full Depth Asphalt}$$

Use 5.0 inches Full Depth

FOR ASPHALT + CEMENT STABILIZED SUBGRADE SECTION

$$\text{Asphalt Thickness (t)} = \boxed{3} \text{ inches}$$

$$D_2 = ((WSN) - (t)(C_1))/C_2 = 7.1 \text{ inches of Cement Stabilized Subgrade,}$$

use 8.0 inches

RECOMMENDED ALTERNATIVES

1. 3.0 inches of Asphalt + 8.0 inches of Cement Stabilized Subgrade, or
2. 5.0 inches of Full-Depth Asphalt

Job No. 221486

Fig. No. C-3