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

February 7, 2023
Revised – June 14, 2023

Cola, LLC
555 Middle Creek Parkway, Suite 500
Colorado Springs, CO 80921

Attn: Richard VanSeenus

Re: Pavement Recommendations - Revised
Trails at Aspen Ridge Filing No. 3, Phase I
El Paso County, Colorado
Entech Job No. 230007

Approved
by Jeff Rice
El Paso County Department of Public Works
on behalf of Elizabeth Nijkamp, Deputy County Engineer
06/14/2023 1:59:39 PM

*If option 2 is selected, a three year total warranty will be required (one additional year). The developer will also be required to work with County staff to develop a monitoring program to assess the condition of the pavement.

Dear Mr. VanSeenus:

As requested, Entech Engineering, Inc. has obtained samples of the subgrade soils from sections of the roadways at the Trails at Aspen Ridge Filing No. 3, Phase I 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 Sidewinder Drive, Natural Bridge Trail and sections of Falling Rock Drive and Moose Meadow Street. The site layout and the locations of the test borings are shown on the Test Boring Location Map, Figure 1.

Subgrade Conditions

Eight exploratory test borings were drilled in the roadways to depths of approximately 5 to 10 feet. The borings were spaced at the required intervals within the limits set forth in the El Paso County Criteria ECM Section D.2.1. The subgrade soils consisted of sandy clay fill (Soil Type 1). The Boring Logs are presented in Appendix A.

Sieve Analyses and Atterberg Limit testing were performed on the majority of the subgrade soil samples obtained from the test borings for the purpose of classification. Sieve analyses indicated the percent passing the No. 200 sieve ranged from approximately 60 to 93 percent. Atterberg Limit Tests resulted in Liquid Limits ranging from 27 to 44 and Plastic Indexes of 12 to 28 percent.

Swell/Consolidation Testing was required due to the plastic index values of the subgrade soils. Swell/Consolidation Tests performed on in-situ subgrade soil samples showed volume changes ranging from 1.3 to 10.8 percent, and testing on remolded Type 1 soil, moisture-conditioned to 4 percent over optimum, showed volume changes of 1.6 to 1.9 percent.

Based on the results of the laboratory testing, one pavement subgrade soil type was determined. The subgrade soils classify as A-6 and A-7-6 soils using the AASHTO Classification System, which typically have poor pavement support characteristics. The laboratory testing results are presented in Appendix B and are summarized in Table 1.

Sulfate testing indicated that the clay soils exhibit moderate to severe potential for sulfate attack. Due to the variability of the moderate to severe sulfate soils, Type 1L or V cement is recommended for any cement on the site soils. Type 1L or V cement or equivalent sulfate resistant materials should be used for all concrete associated with the roadways on this site. If Type 1L or V cement is not readily available, the cement supplier shall provide a cement which is highly resistant to sulfate degradation.

California Bearing Ratio (CBR) testing was conducted on a representative subgrade sample for the roadways in this filing. The CBR and laboratory test results are summarized in Table 1 and included in Appendix B. The laboratory classification testing results are included in the following table.

Soil Type 1 – Sandy Clay Fill

R @ 90% = 1.0
R @ 95% = 6.0
Use R = 6.0 for design

Classification Testing

Liquid Limit	38
Plasticity Index	27
Percent Passing 200	83.4
AASHTO Classification	A-6
Group Index	20
Unified Soils Classification	CL
M_R	3,126 psi

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" and using the recommended street classifications in the Traffic Impact Study by LSC Transportation Consultants The roadways all classify as urban local roads, which used an 18k ESAL value of 292,000 to determine the pavement sections. Pavement sections for asphalt over aggregate basecourse, and grid reinforced basecourse sections are provided. Design parameters used in the pavement analysis are as follows:

Serviceability Index:	
Urban Local	2.0
Reliability:	
Urban Local	80%
"R" Value Subgrade	6.0
Resilient Modulus	3,126 psi
Structural Coefficients:	
Hot Bituminous Pavement	0.440
Basecourse	0.110
Basecourse with Tensar NX750 Grid – Urban Local	0.236*

*Structural number is based on a 6-inch base layer. (8-inches will be used for section)

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

Pavement Sections – Urban Local (ESAL = 292,000)

Alternative	Asphalt (in)	Basecourse (in)	Basecourse reinforced with Tensar NX750 Grid (in)
1. Asphalt over Basecourse	5.0	12.5	--
2. Asphalt over Reinforced Basecourse	5.0	--	8.0

*Full depth asphalt is not allowed in unincorporated El Paso County.

*The Tensar NX750 grid should be overlapped and installed per the manufacturer's specifications.

Recycled concrete basecourse materials that meet the Class 6 gradation requirements may be an acceptable basecourse alternative on this site. County approval is required for this option.

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. Several samples exceeded this threshold. Remolded swell tests moisture conditioned to 4 percent over optimum exhibited swells of 1.6 to 1.9 percent. These swell levels are below the threshold for mitigation. The roadway subgrade soils were initially moisture conditioned and processed during utility installation. The subgrade was conditioned and compacted to specified requirements during the utility installations. Prior to paving, the subgrade should be evaluated for proper moisture conditions. In areas that need additional moisture-conditioning, we recommend that the top 12-inches of the subgrade be scarified and moisture-conditioned to 0 to 4 percent over optimum moisture content and be recompacted. Specific areas requiring mitigation should be field determined. The subgrade soils should be observed and tested by Entech personnel prior to paving.

Cola, LLC
Pavement Recommendations – Revised
Trails at Aspen Ridge Filing No. 3, Phase I
El Paso County, Colorado
Entech Job No. 230007

Roadway Construction

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 4 percent over optimum moisture content. Any 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. Full-depth asphalt sections are currently not allowed by El Paso County.

Based on the soils encountered, subgrade soil problem areas, if any, will be identified during proof roll observations. 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.

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.

Reviewed by:

Daniel P. Stegman

Austin M. Nossokoff, P.E.

DPS/dps

Encl.

Entech Job No. 230007
AAprojects/2023/230007 pr-Rev3

EPC Project No SF-2122

TABLE

TABLE 1

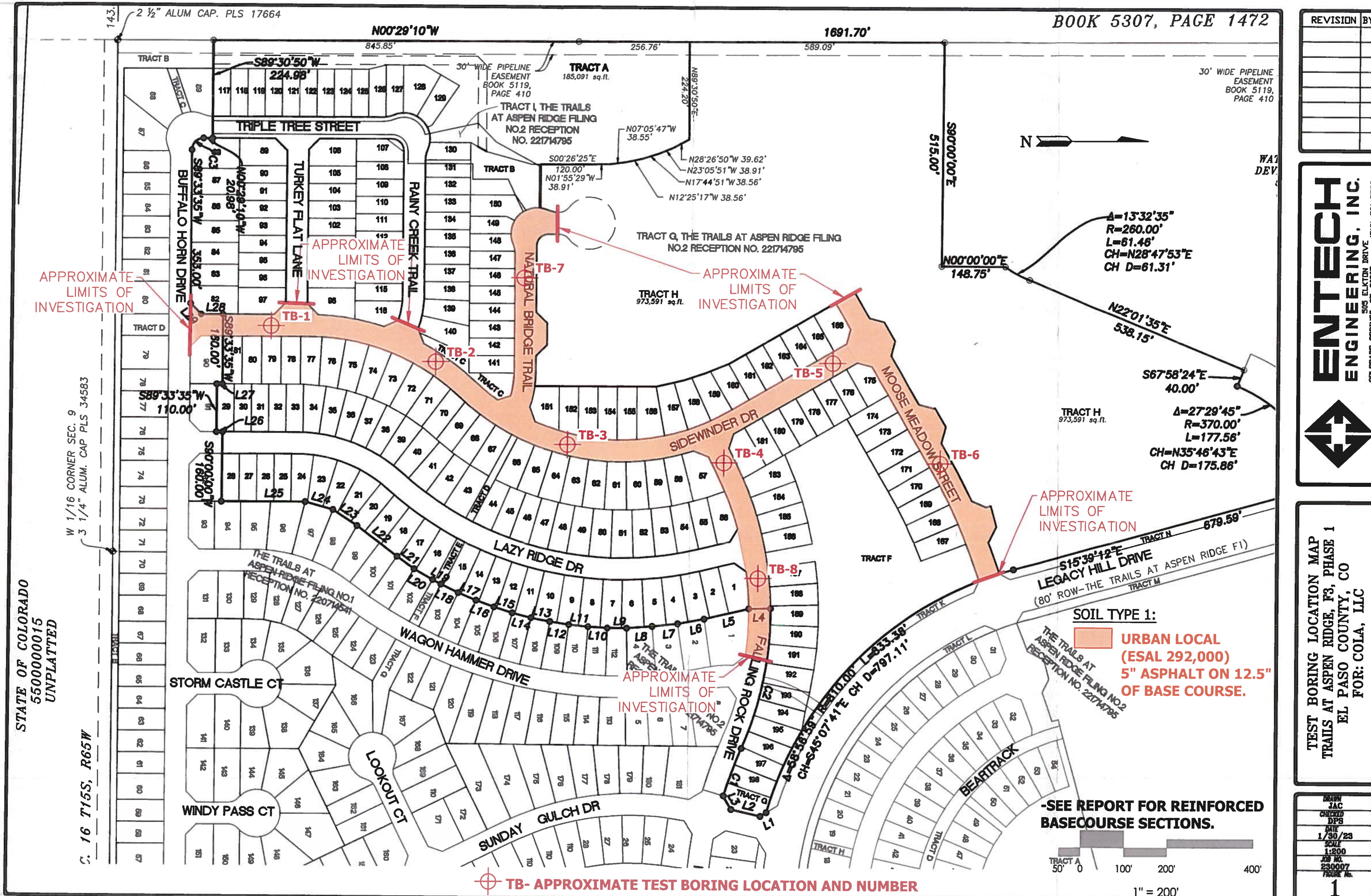
SUMMARY OF LABORATORY TEST RESULTS

CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3
JOB NO. 230007

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			83.4	38	27		A-6		CL	FILL, CLAY, SANDY
1	1	1-2	12.0	116.1	78.3	37	21		A-6	8.7	CL	FILL, CLAY, SANDY
1	1	1-2	17.8	108.4						1.6*	CL	CLAY, SANDY
1	2	1-2	14.1	116.6	85.2	38	21		A-6	1.3	CL	FILL, CLAY, SANDY
1	3	1-2	14.3	114.7	80.5	41	23	0.27	A-7-6	2.8	CL	FILL, CLAY, SANDY
1	4	1-2	12.6	118.5	74.2	39	23		A-6	8.3	CL	FILL, CLAY, SANDY
1	4	1-2	17.9	111.1						1.8*	CL	CLAY, SANDY
1	5	1-2	11.0	114.2	59.5	27	12	0.15	A-6	1.9	CL	FILL, CLAY, VERY SANDY
1	6	1-2	9.5	110.5	82.8	44	28		A-7-6	5.4	CL	FILL, CLAY, SANDY
1	6	1-2	14.9	113.0						1.8*	CL	CLAY, SANDY
1	7	1-2	13.8	116.7	86.1	43	24		A-7-6	10.8	CL	FILL, CLAY, SANDY
1	7	1-2	18.1	110.2						1.9*	CL	CLAY, SANDY
1	8	1-2	14.5	113.7	92.5	43	26		A-7-6	6.2	CL	FILL, CLAY, SANDY
1	3	0-3			82.9						CL	FILL, CLAY, SANDY

* - REMOLDED SAMPLES

FIGURE



BOOK 5307, PAGE 1472
REVISION BY
ENTECH ENGINEERING, INC.
505 ELKTON DRIVE COLORADO SPRINGS, CO 80907 (719) 531-5599
TEST BORING LOCATION MAP
TRAILS AT ASPEN RIDGE, F3, PHASE 1
EL PASO COUNTY, CO
FOR: COLA, LLC
DRAWN JAC
CHECKED DPS
DATE 1/30/23
SCALE 1:200
JOB NO. 230007
FIGURE No. 1
TRIPLE TREE STREET
TURKEY FLAT LANE
RAINY CREEK TRAIL
BUFFALO HORN DRIVE
NATURAL BRIDGE TRAIL
SIDEWINDER DR
MOOSE MEADOW STREET
LAZY RIDGE DR
WAGON HAMMER DRIVE
FALLING ROCK DRIVE
LEGACY HILL DRIVE
(80' ROW-THE TRAILS AT ASPEN RIDGE F1)
STORM CASTLE CT
WINDY PASS CT
LOOKOUT CT
SUNDAY GULCH DR
BEARTRACK
TRACT A 185,091 sq.ft.
TRACT H 973,591 sq.ft.
TRACT I, THE TRAILS AT ASPEN RIDGE FILING NO.2 RECEPTION NO. 221714795
TRACT G, THE TRAILS AT ASPEN RIDGE FILING NO.2 RECEPTION NO. 221714795
THE TRAILS AT ASPEN RIDGE FILING NO.1 RECEPTION NO. 220714541
THE TRAILS AT ASPEN RIDGE FILING NO.2 RECEPTION NO. 221714795
30' WIDE PIPELINE EASEMENT BOOK 5119, PAGE 410
2 1/2" ALUM CAP. PLS 17664
W 1/16 CORNER SEC. 9 3 1/4" ALUM. CAP PLS 34583
STATE OF COLORADO 550000015 UNPLATTED
N00°29'10"W 845.85'
1691.70'
S89°30'50"W 224.98'
APPROXIMATE LIMITS OF INVESTIGATION
TB-1
TB-2
TB-3
TB-4
TB-5
TB-6
TB-7
TB-8
SOIL TYPE 1:
URBAN LOCAL (ESAL 292,000) 5" ASPHALT ON 12.5" OF BASE COURSE.
-SEE REPORT FOR REINFORCED BASECOURSE SECTIONS.
TB- APPROXIMATE TEST BORING LOCATION AND NUMBER
1" = 200'

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 1/5/2023
Job # 230007

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 1/5/23						
FILL 0-5', CLAY, SANDY, BROWN, FIRM TO STIFF, MOIST				14	12.2	1
	5			20	12.2	1
	10					
	15					
	20					

TEST BORING NO. 2
DATE DRILLED 1/5/2023
CLIENT COLA, LLC
LOCATION ASPEN RIDGE, F-3

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 1/5/23						
FILL 0-5', CLAY, SANDY, BROWN, VERY STIFF TO STIFF, MOIST				31	14.6	1
	5			20	13.7	1
	10					
	15					
	20					

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: A- 1

TEST BORING NO. 3
DATE DRILLED 1/5/2023
Job # 230007

REMARKS

DRY TO 10', 1/5/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-10', CLAY, SANDY, BROWN, STIFF TO FIRM, MOIST			24	13.6	1
5			9	16.9	1
10			9	15.8	1
15					
20					

TEST BORING NO. 4
DATE DRILLED 1/5/2023
CLIENT COLA, LLC
LOCATION ASPEN RIDGE, F-3

REMARKS

DRY TO 5', 1/5/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-5', CLAY, SANDY, BROWN, VERY STIFF TO STIFF, MOIST			34	8.4	1
5			18	13.0	1
10					
15					
20					

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TEST BORING LOG

DRAWN:	DATE:	CHECKED: SW	DATE: 1-27-23

JOB NO.: 230007
FIG NO.: A- 2

TEST BORING NO. 5
DATE DRILLED 1/5/2023
Job # 230007

REMARKS

DRY TO 5', 1/5/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-5', CLAY, VERY SANDY, BROWN, STIFF, MOIST			20	14.6	1
			16	13.3	1
5					
10					
15					
20					

TEST BORING NO. 6
DATE DRILLED 1/5/2023
CLIENT COLA, LLC
LOCATION ASPEN RIDGE, F-3

REMARKS

DRY TO 10', 1/5/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-5', CLAY, SANDY, BROWN, STIFF, MOIST			25	7.2	1
			16	13.5	1
5					
10			26	13.4	1
15					
20					

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: A- 3

TEST BORING NO. 7
DATE DRILLED 1/12/2023
Job # 230007

REMARKS

DRY TO 5', 1/12/23

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

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			31	11.1	1
5			27	13.1	1
10					
15					
20					

TEST BORING NO. 8
DATE DRILLED 1/12/2023
CLIENT COLA, LLC
LOCATION ASPEN RIDGE, F-3

REMARKS

DRY TO 5', 1/12/23

FILL 0-5', CLAY, SANDY, BROWN, STIFF, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			25	16.5	1
5			27	15.2	1
10					
15					
20					

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TEST BORING LOG

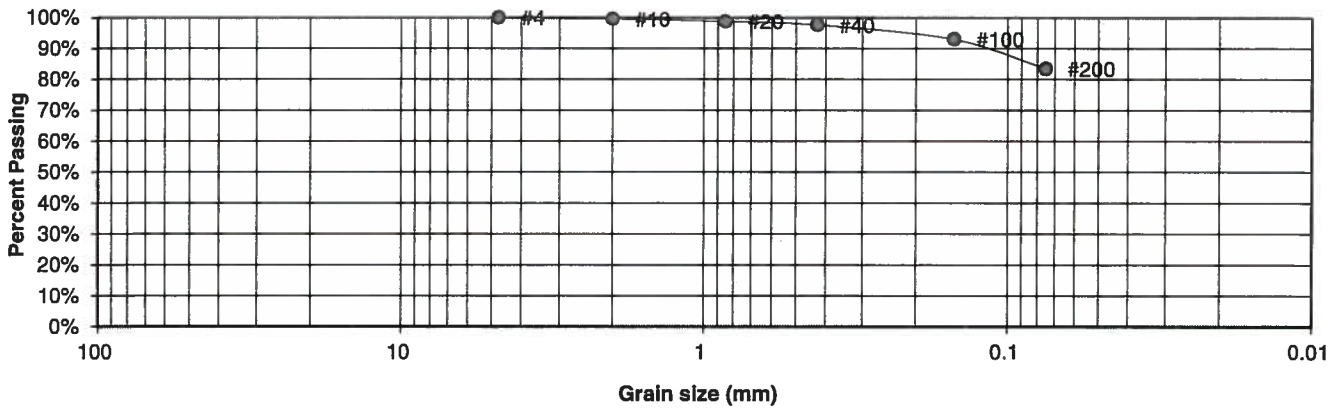
DRAWN:	DATE:	CHECKED: SW	DATE: 1-27-23

JOB NO.: 230007
FIG NO.: A- 4

APPENDIX B: Laboratory Test Results

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1, CBR	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	6	JOB NO.	230007
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	20

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.6%
20	98.8%
40	97.6%
100	92.9%
200	83.4%

Atterberg Limits	
Plastic Limit	11
Liquid Limit	38
Plastic Index	27

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

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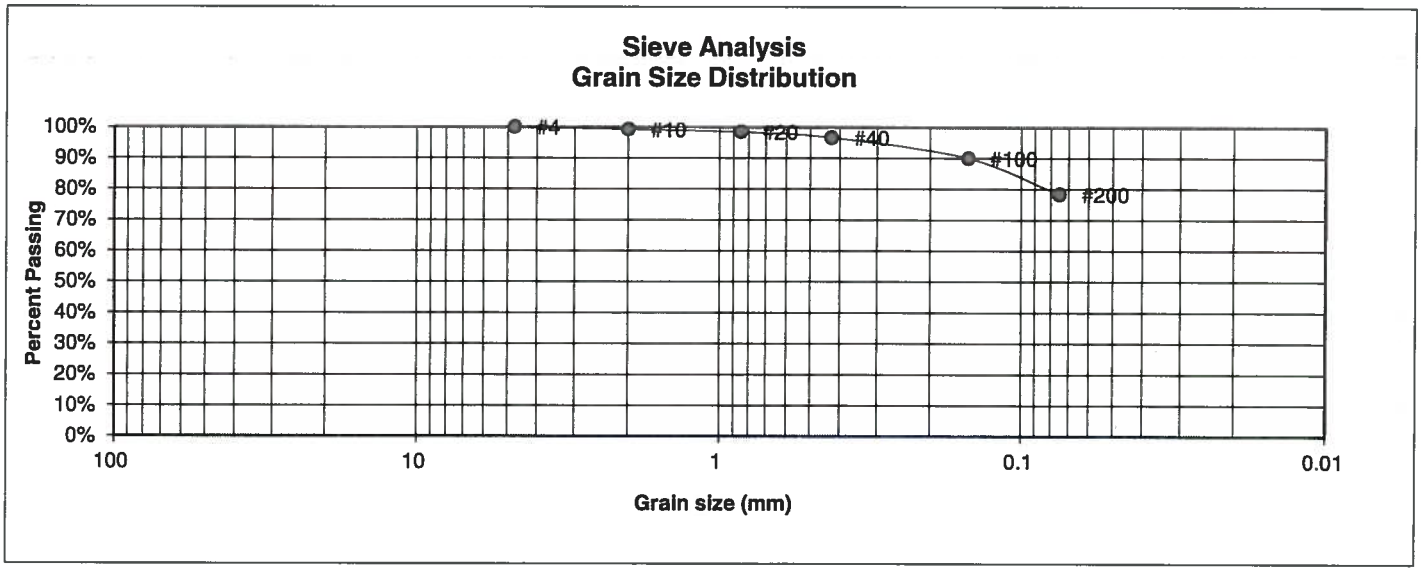
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-1

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	1	JOB NO.	230007
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	15



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.2%
20	98.4%
40	96.6%
100	90.0%
200	78.3%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	37
Plastic Index	21

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

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COLORADO SPRINGS, COLORADO 80907

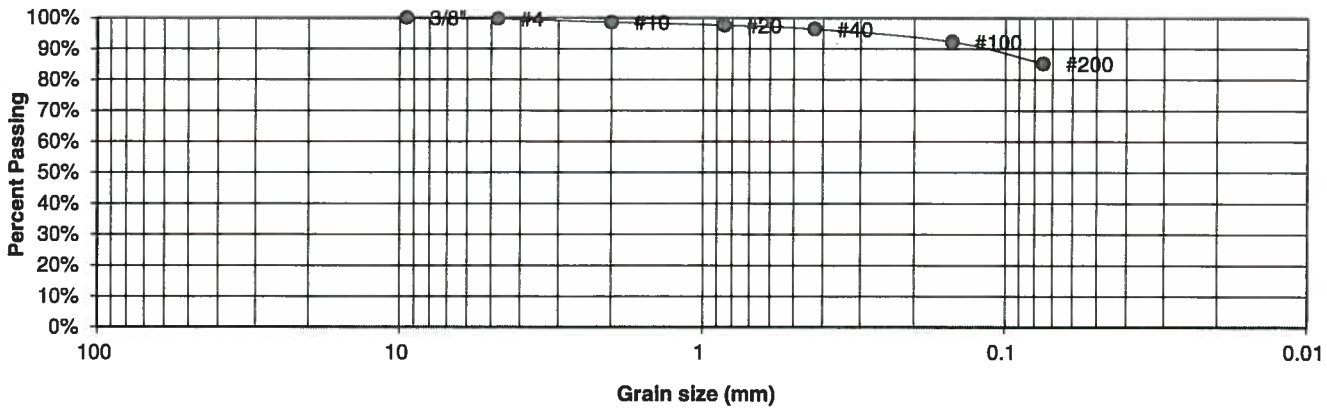
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: SW	DATE: 1-27-23

JOB NO.: 230007
FIG NO.: B-2

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	2	JOB NO.	230007
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	18

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.7%
10	98.5%
20	97.5%
40	96.3%
100	92.3%
200	85.2%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	38
Plastic Index	21

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

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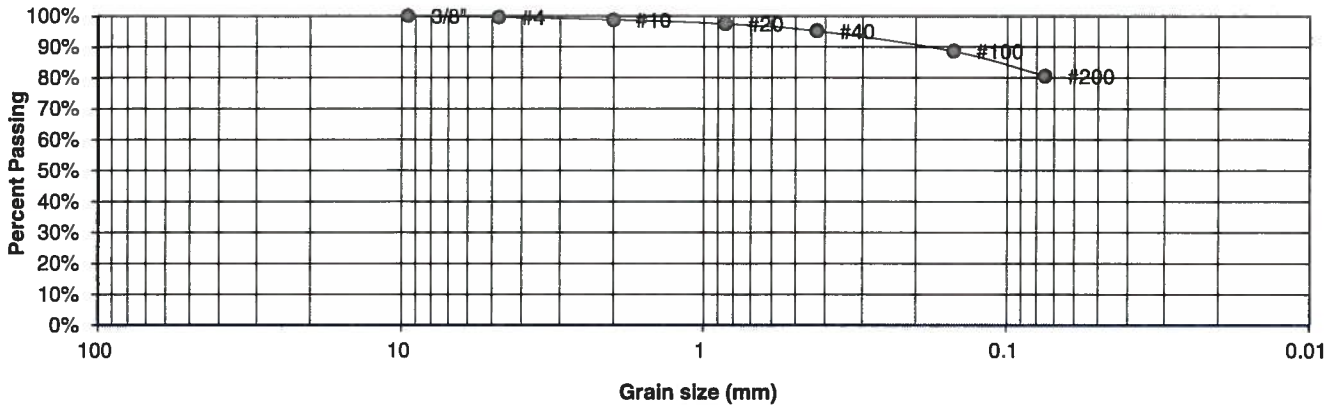
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-3

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	3	JOB NO.	230007
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-7-6	GROUP INDEX	18

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.6%
10	98.7%
20	97.4%
40	95.1%
100	88.6%
200	80.5%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	41
Plastic Index	23

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

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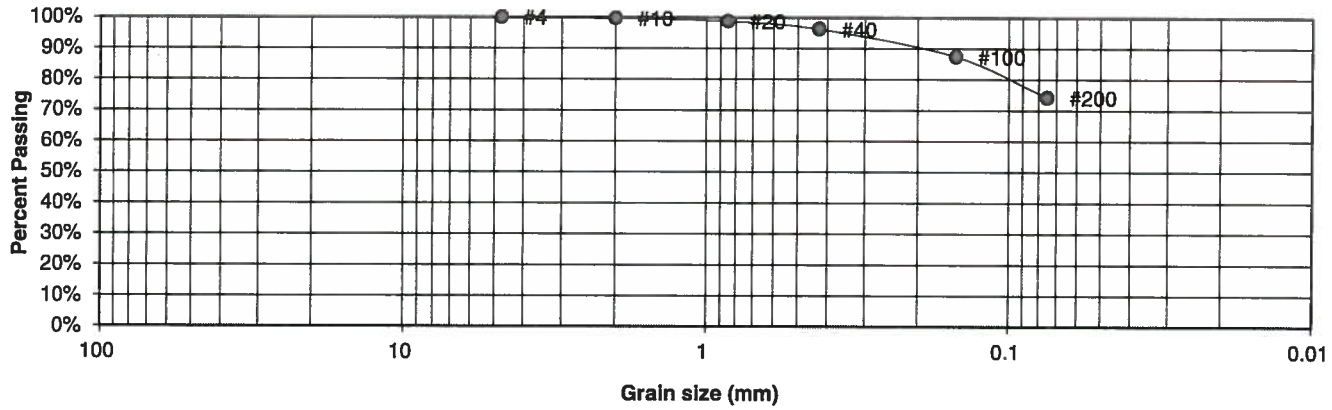
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-4

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	4	JOB NO.	230007
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	16

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.7%
20	98.7%
40	96.2%
100	87.4%
200	74.2%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	39
Plastic Index	23

Swell	
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

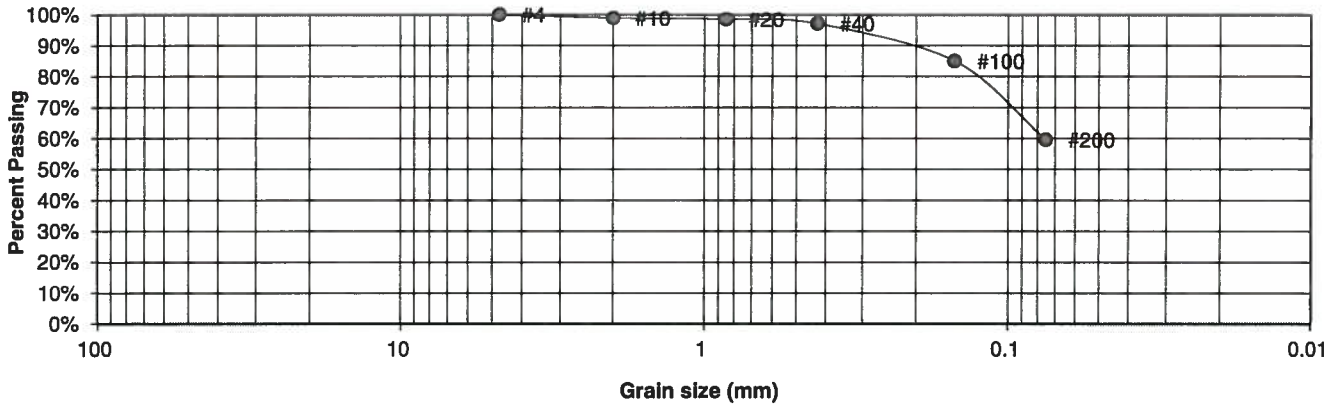
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: SW	DATE: 1-27-23

JOB NO.: 230007
FIG NO.: B-5

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	5	JOB NO.	230007
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	4

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	98.9%
20	98.5%
40	97.1%
100	85.0%
200	59.5%

Atterberg Limits	
Plastic Limit	15
Liquid Limit	27
Plastic Index	12

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

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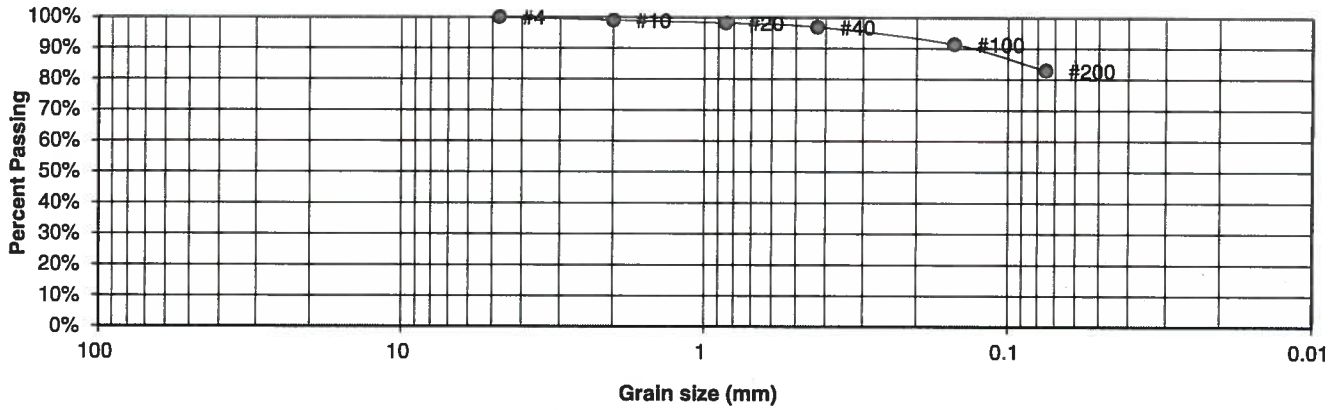
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-6

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	6	JOB NO.	230007
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-7-6	GROUP INDEX	20

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	99.0%
20	98.1%
40	96.8%
100	91.3%
200	82.8%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	44
Plastic Index	28

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

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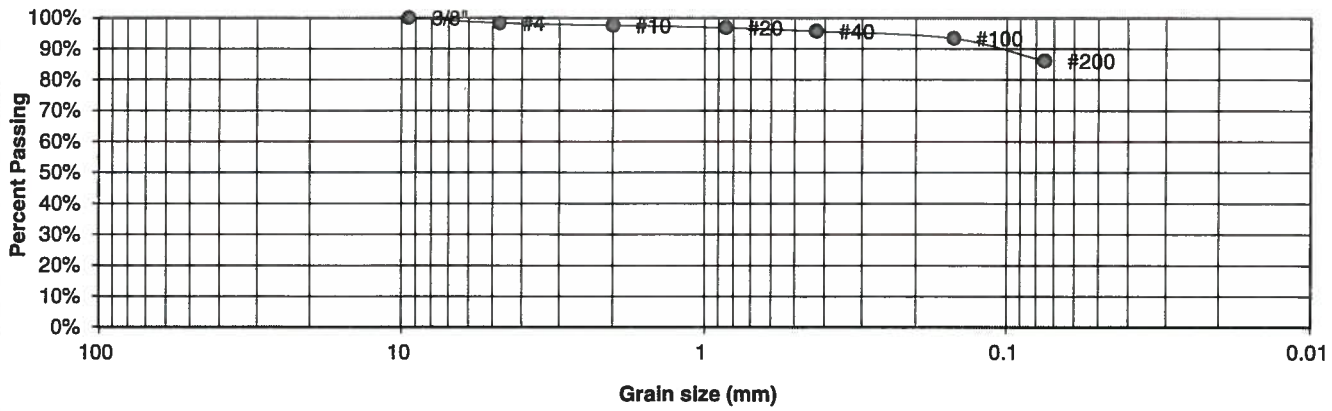
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-7

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	7	JOB NO.	230007
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-7-6	GROUP INDEX	20

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.3%
10	97.6%
20	96.8%
40	95.6%
100	93.4%
200	86.1%

Atterberg Limits	
Plastic Limit	18
Liquid Limit	43
Plastic Index	24

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

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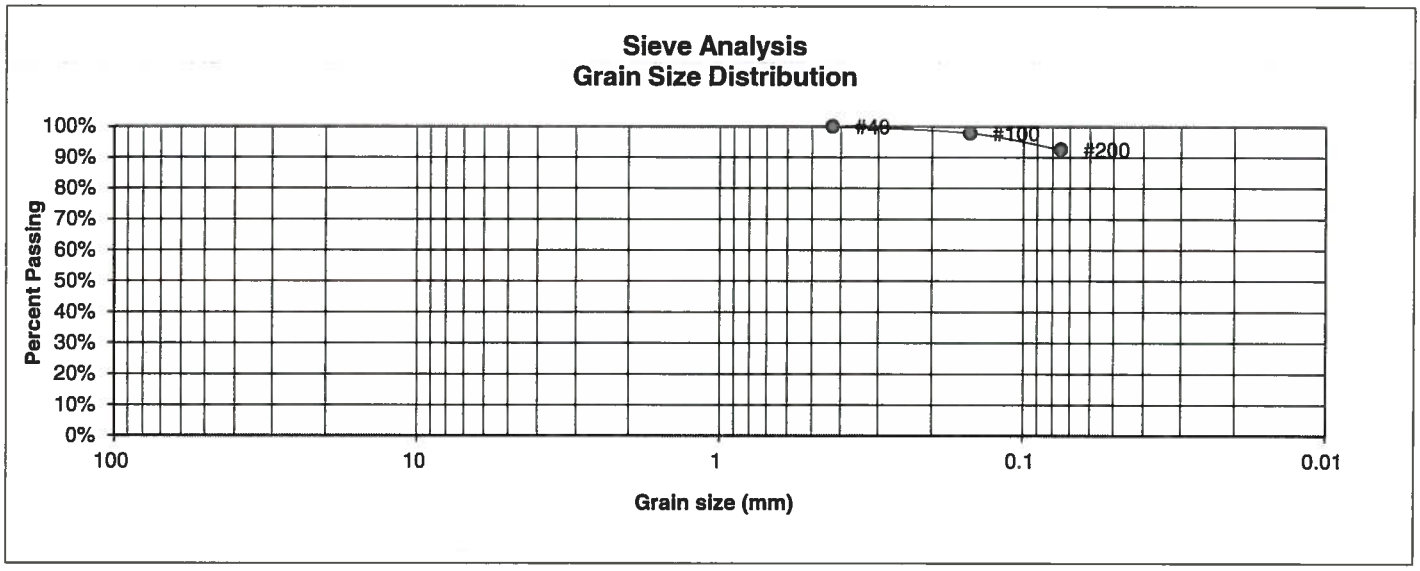
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: SW	DATE: 1-27-23

JOB NO.: 230007
FIG NO.: B-8

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	8	JOB NO.	230007
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-7-6	GROUP INDEX	20



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	
40	100.0%
100	97.8%
200	92.5%

Atterberg Limits	
Plastic Limit	18
Liquid Limit	43
Plastic Index	26

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

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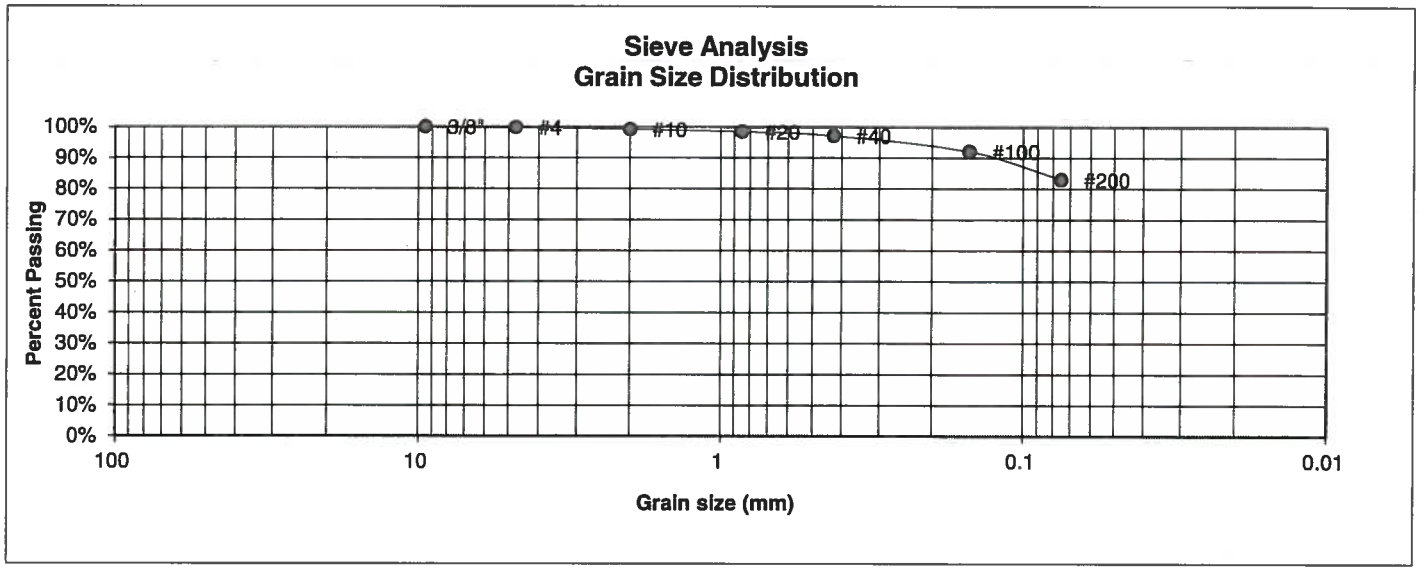
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: SW	DATE: 1-27-23

JOB NO.: 230007
FIG NO.: B-9

UNIFIED CLASSIFICATION	CL	CLIENT	COLA, LLC
SOIL TYPE #	1	PROJECT	ASPEN RIDGE, F-3
TEST BORING #	3	JOB NO.	230007
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION		GROUP INDEX	#VALUE!



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.8%
10	99.2%
20	98.4%
40	97.1%
100	92.0%
200	82.9%

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

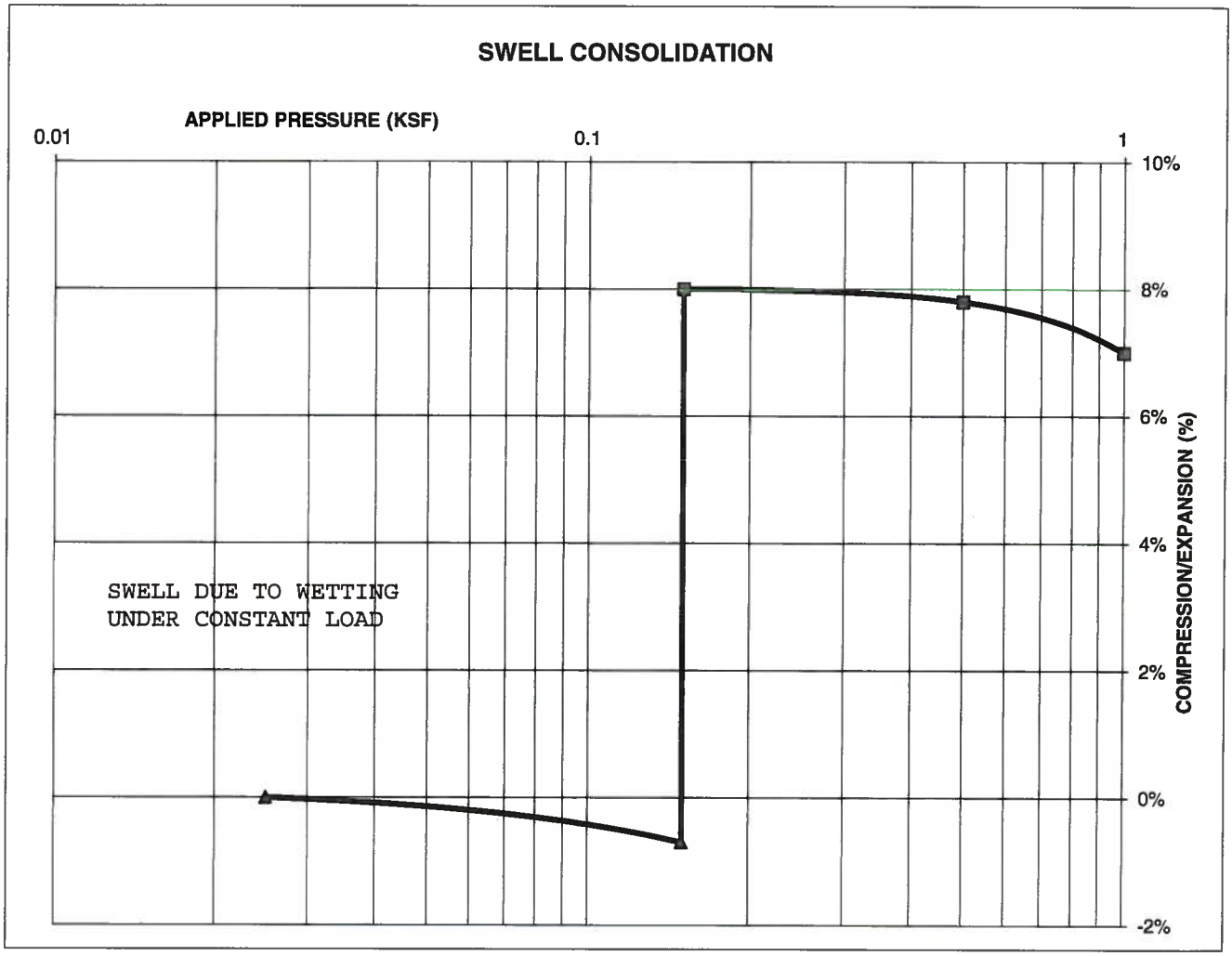
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-10

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			116
NATURAL MOISTURE CONTENT			12.0%
SWELL/CONSOLIDATION (%)			8.7%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

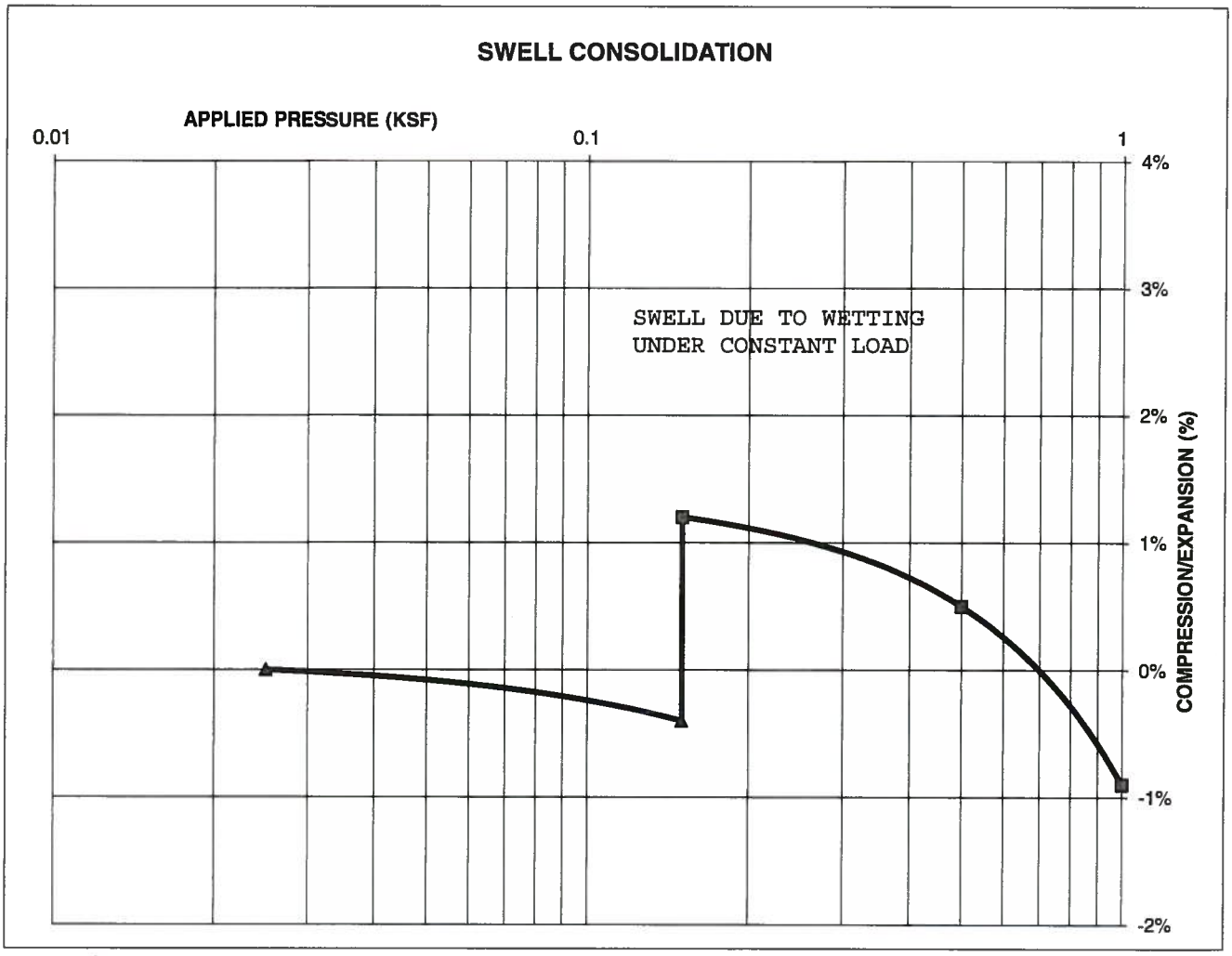
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-11

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			108
NATURAL MOISTURE CONTENT			17.8%
SWELL/CONSOLIDATION (%)			1.6%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

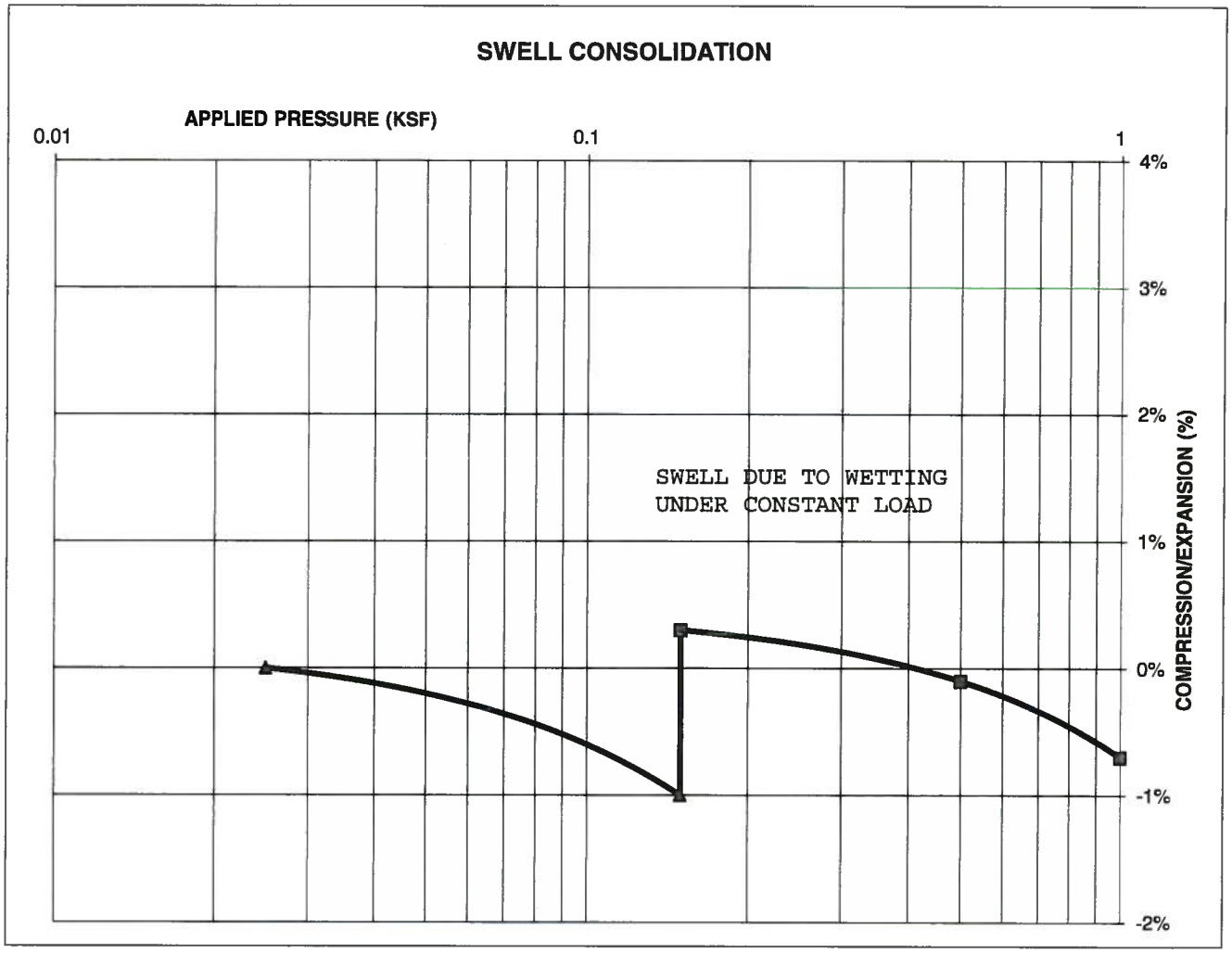
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-12

CONSOLIDATION TEST RESULTS

TEST BORING #	2	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			117
NATURAL MOISTURE CONTENT			14.1%
SWELL/CONSOLIDATION (%)			1.3%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

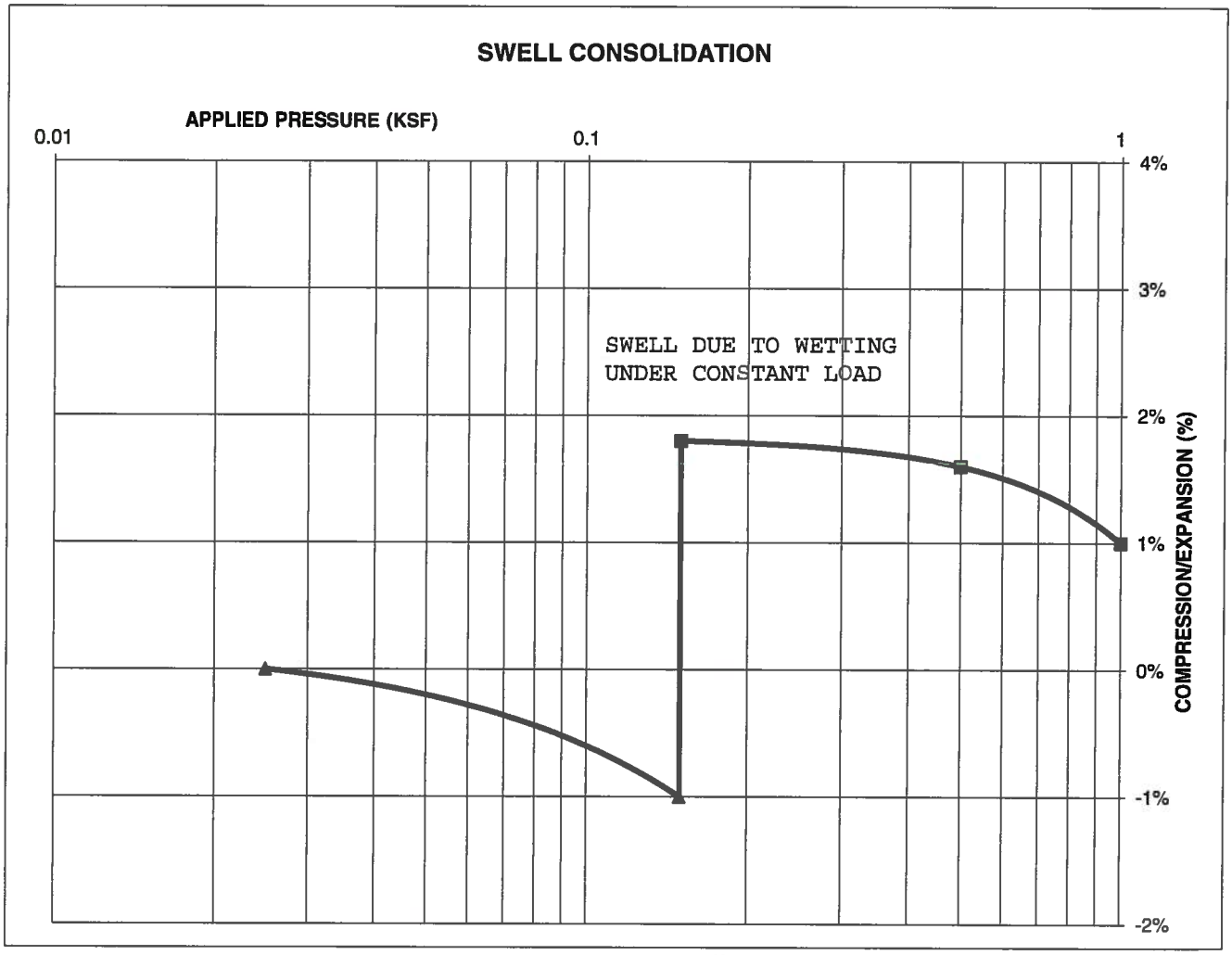
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-13

CONSOLIDATION TEST RESULTS

TEST BORING #	3	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			115
NATURAL MOISTURE CONTENT			14.3%
SWELL/CONSOLIDATION (%)			2.8%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

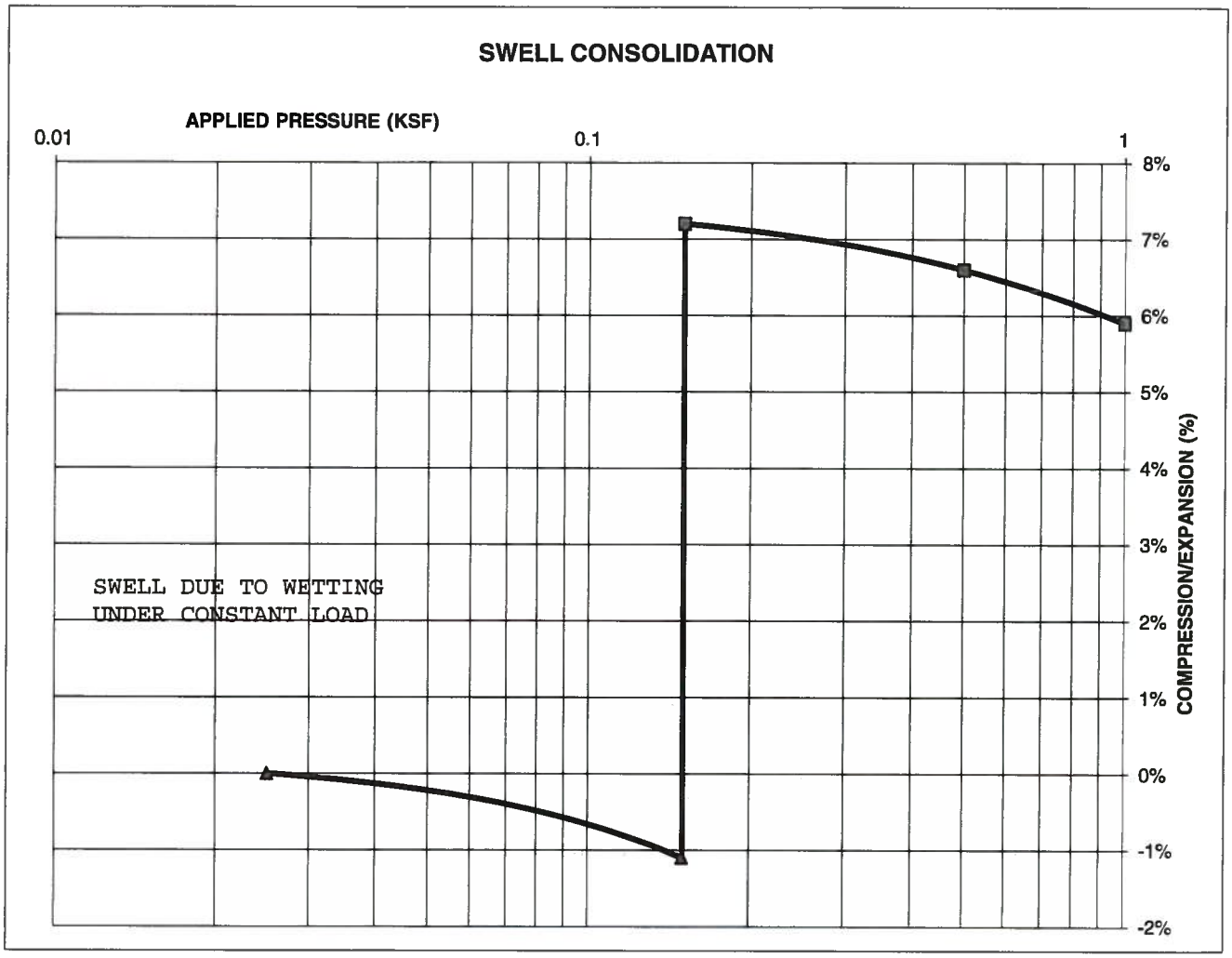
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-14

CONSOLIDATION TEST RESULTS

TEST BORING #	4	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			118
NATURAL MOISTURE CONTENT			12.6%
SWELL/CONSOLIDATION (%)			8.3%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

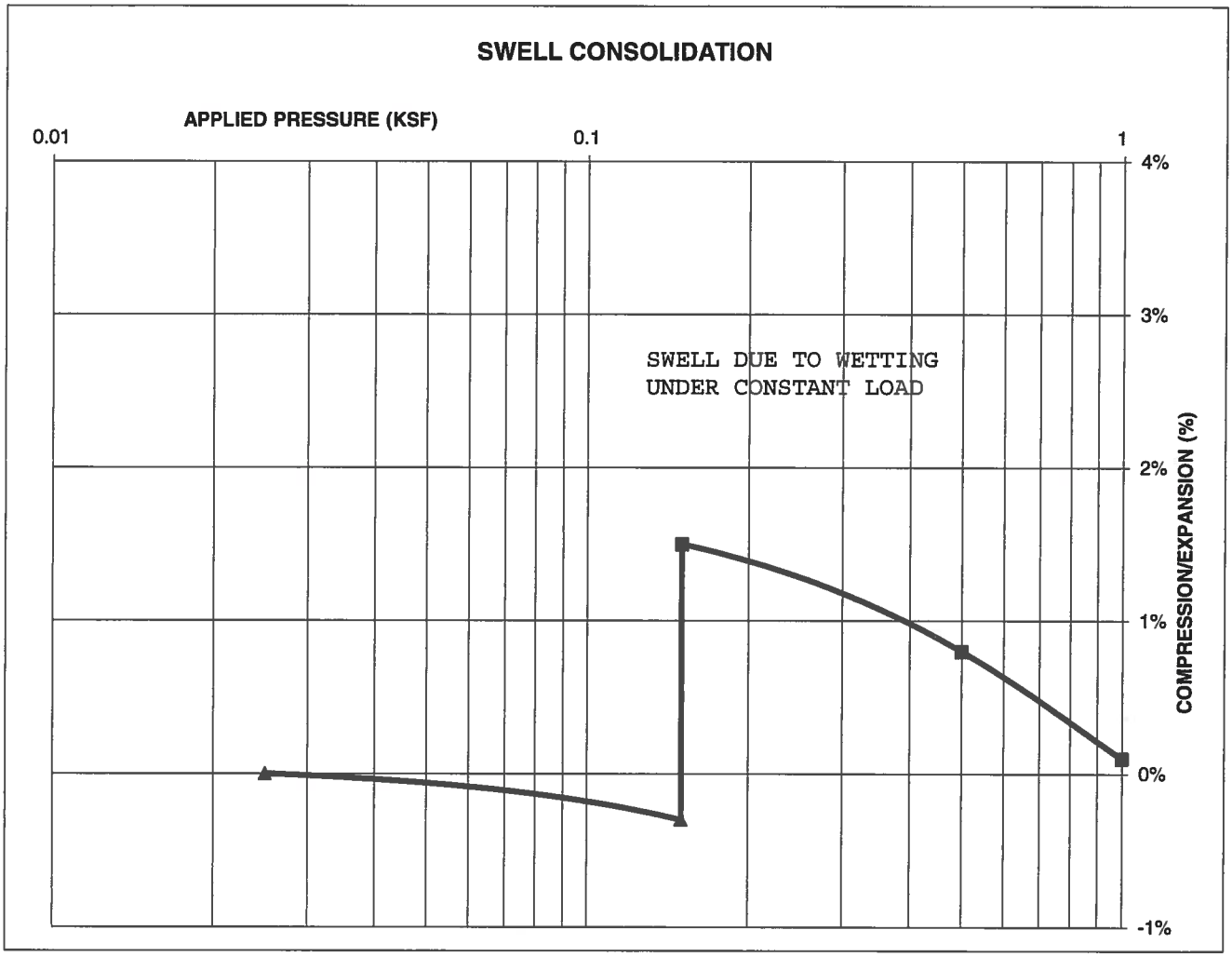
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-15

CONSOLIDATION TEST RESULTS

TEST BORING #	4	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			111
NATURAL MOISTURE CONTENT			17.9%
SWELL/CONSOLIDATION (%)			1.8%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

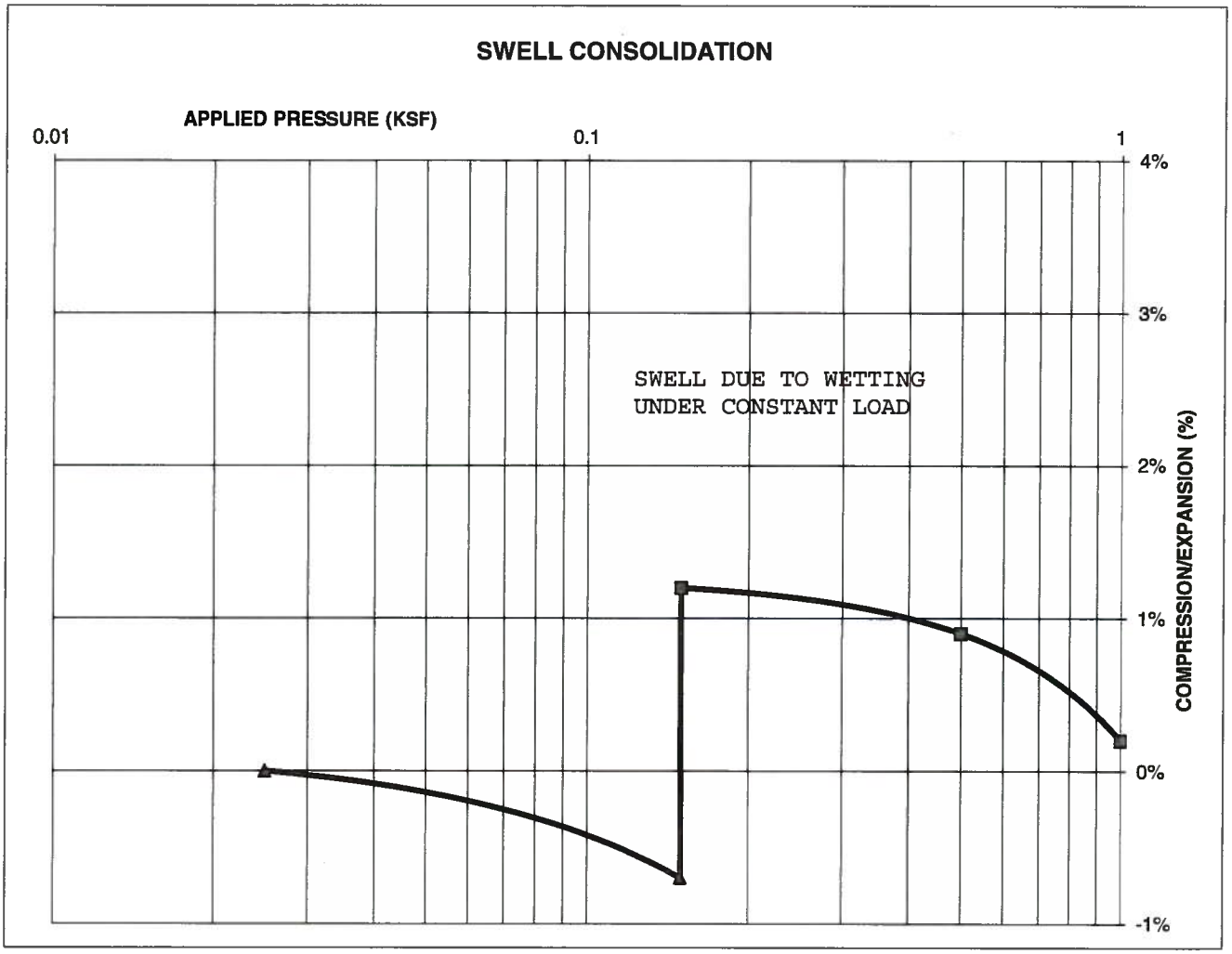
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-16

CONSOLIDATION TEST RESULTS

TEST BORING #	5	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			114
NATURAL MOISTURE CONTENT			11.0%
SWELL/CONSOLIDATION (%)			1.9%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

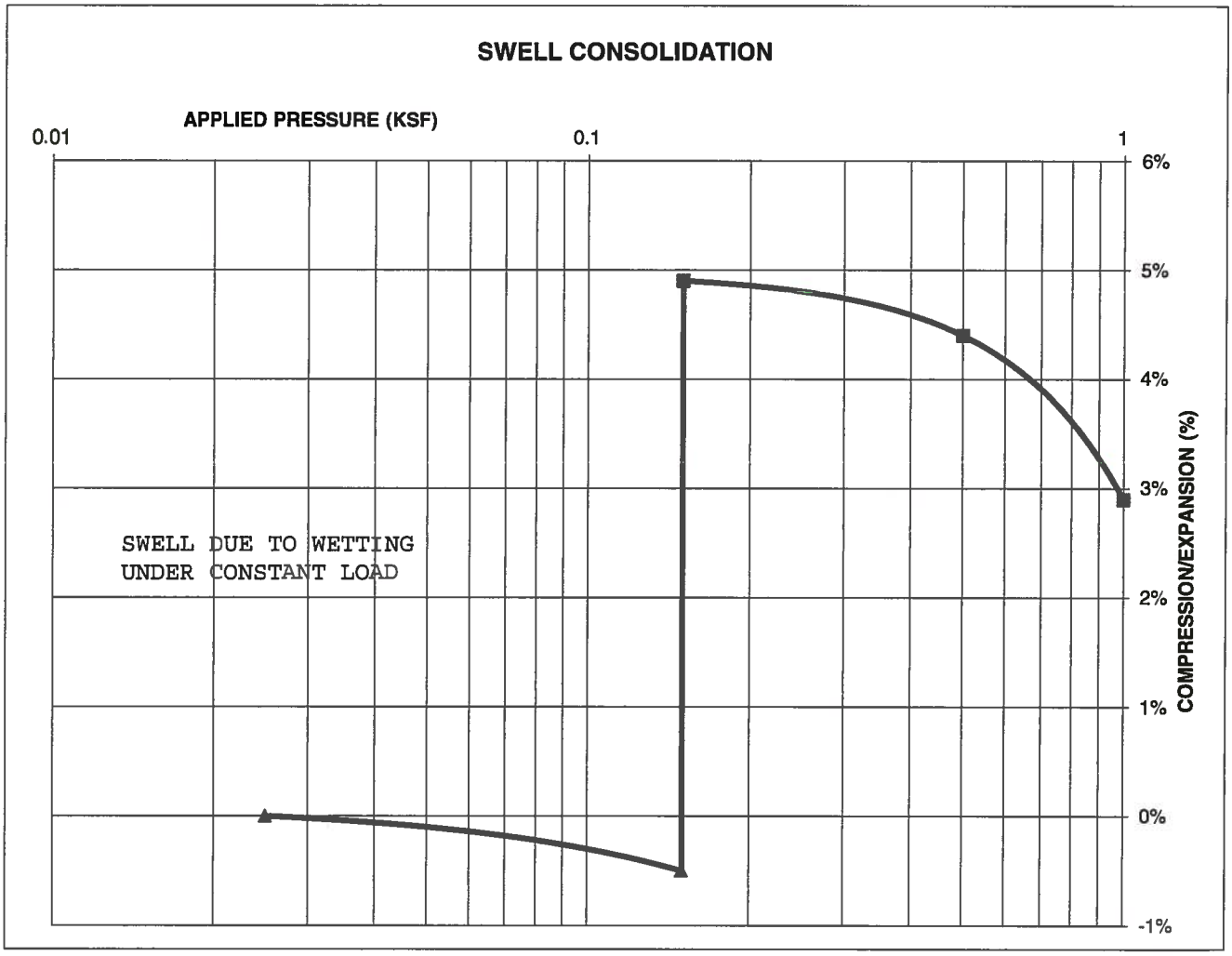
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-17

CONSOLIDATION TEST RESULTS

TEST BORING #	6	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			111
NATURAL MOISTURE CONTENT			9.5%
SWELL/CONSOLIDATION (%)			5.4%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

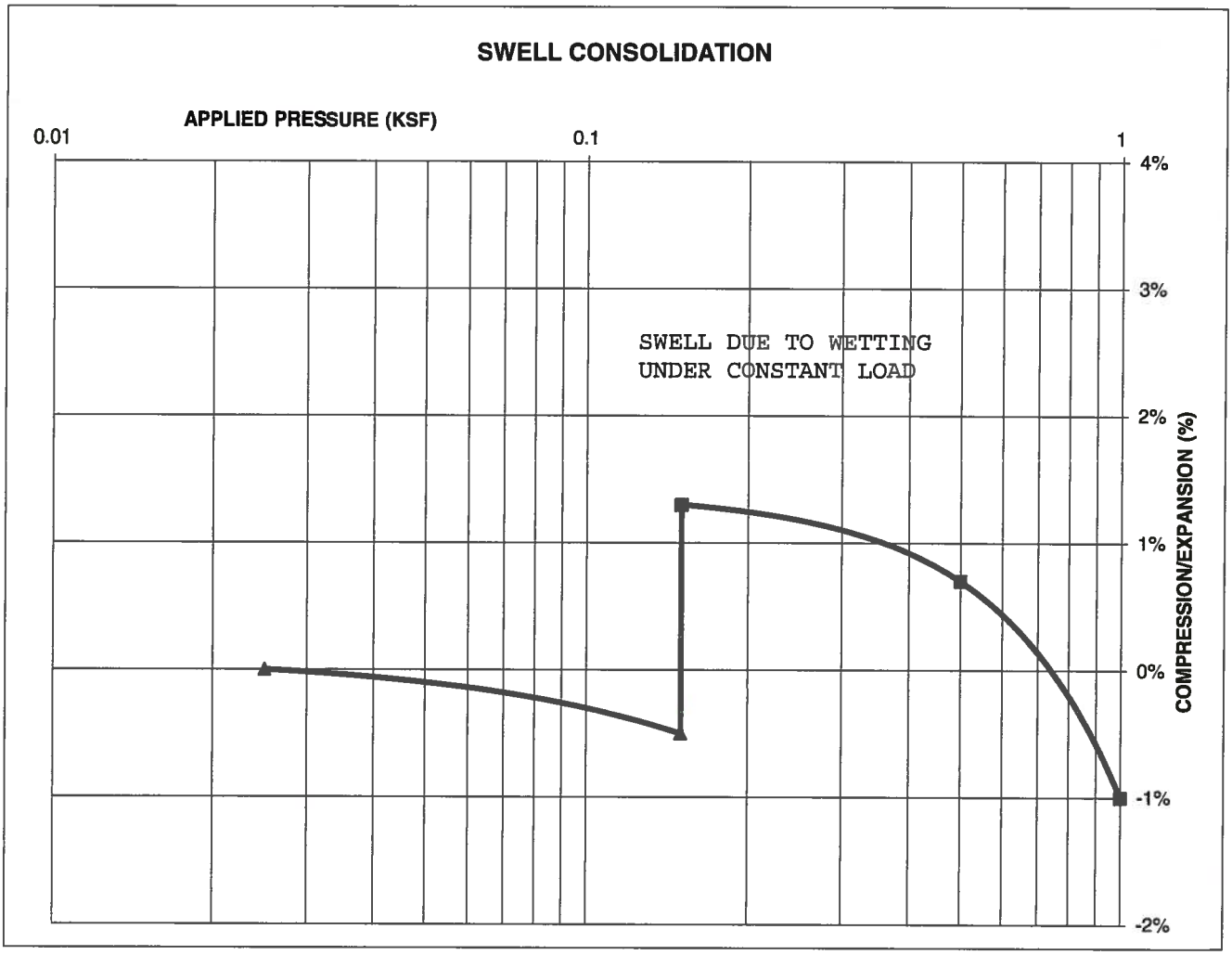
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-18

CONSOLIDATION TEST RESULTS

TEST BORING #	6	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			113
NATURAL MOISTURE CONTENT			14.9%
SWELL/CONSOLIDATION (%)			1.8%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

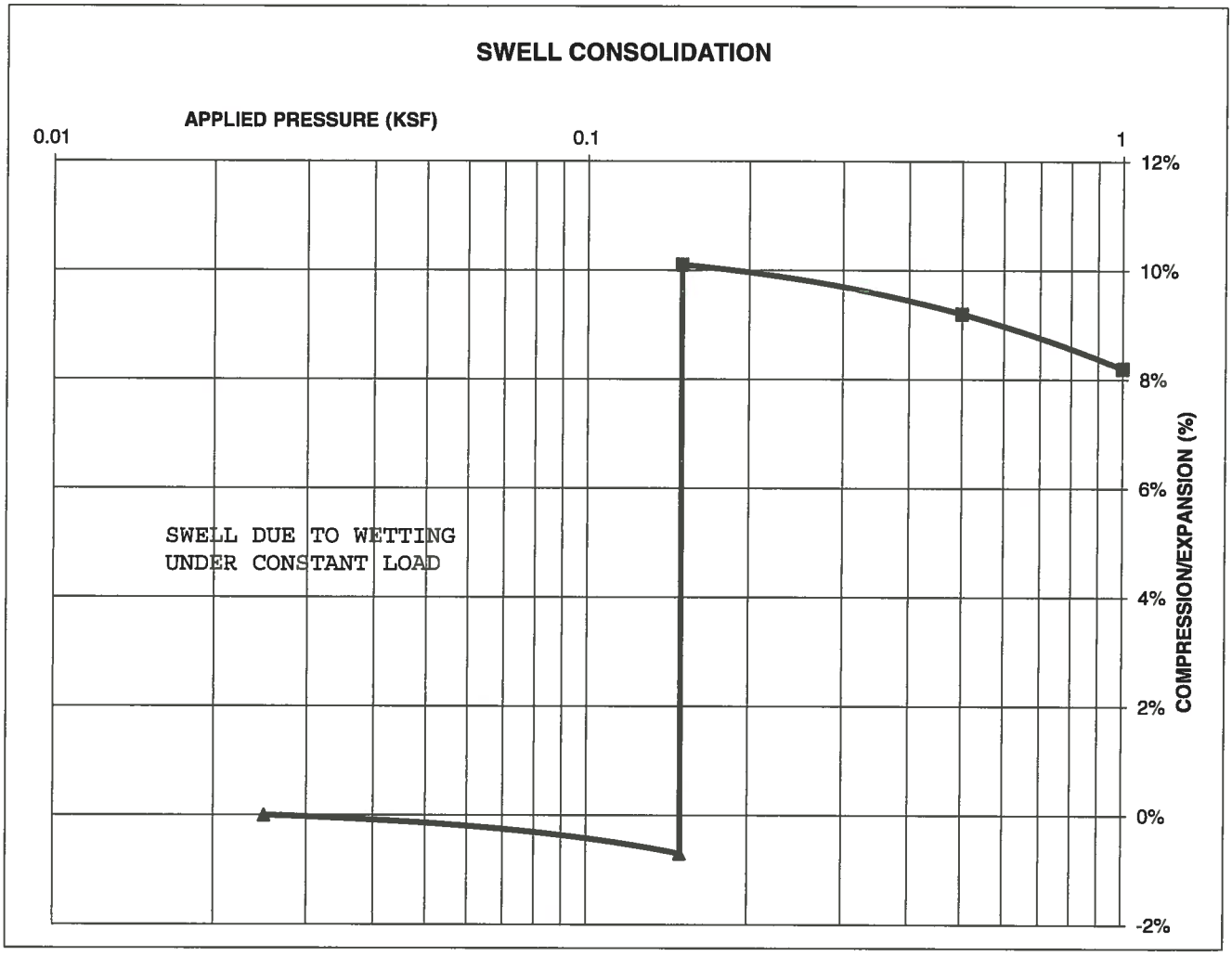
DRAWN:	DATE:	CHECKED: SW	DATE: 1-27-23

JOB NO.: 230007
FIG NO.: B-19

CONSOLIDATION TEST RESULTS

TEST BORING #	7	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			117
NATURAL MOISTURE CONTENT			13.8%
SWELL/CONSOLIDATION (%)			10.8%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

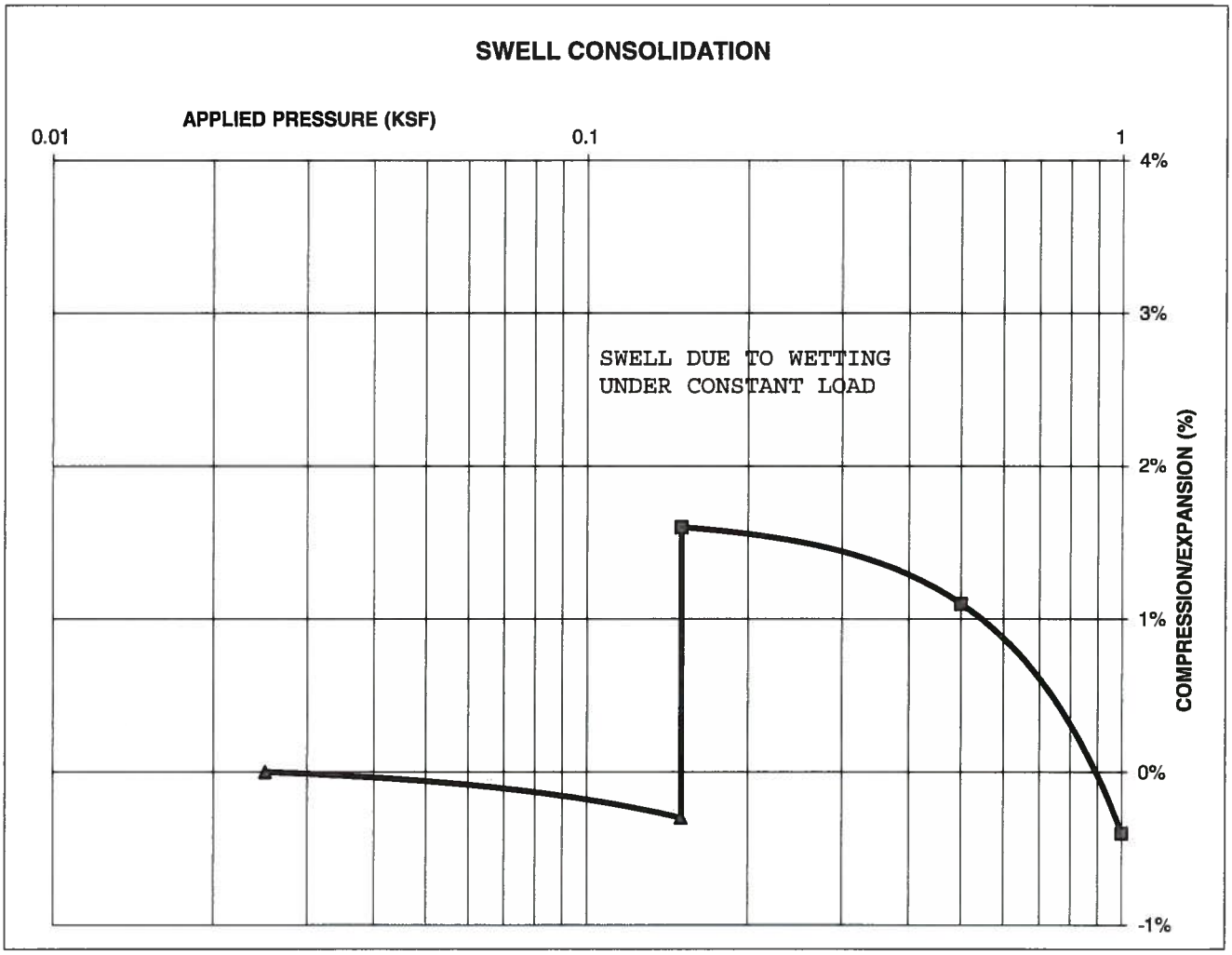
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-20

CONSOLIDATION TEST RESULTS

TEST BORING #	7	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			110
NATURAL MOISTURE CONTENT			18.1%
SWELL/CONSOLIDATION (%)			1.9%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

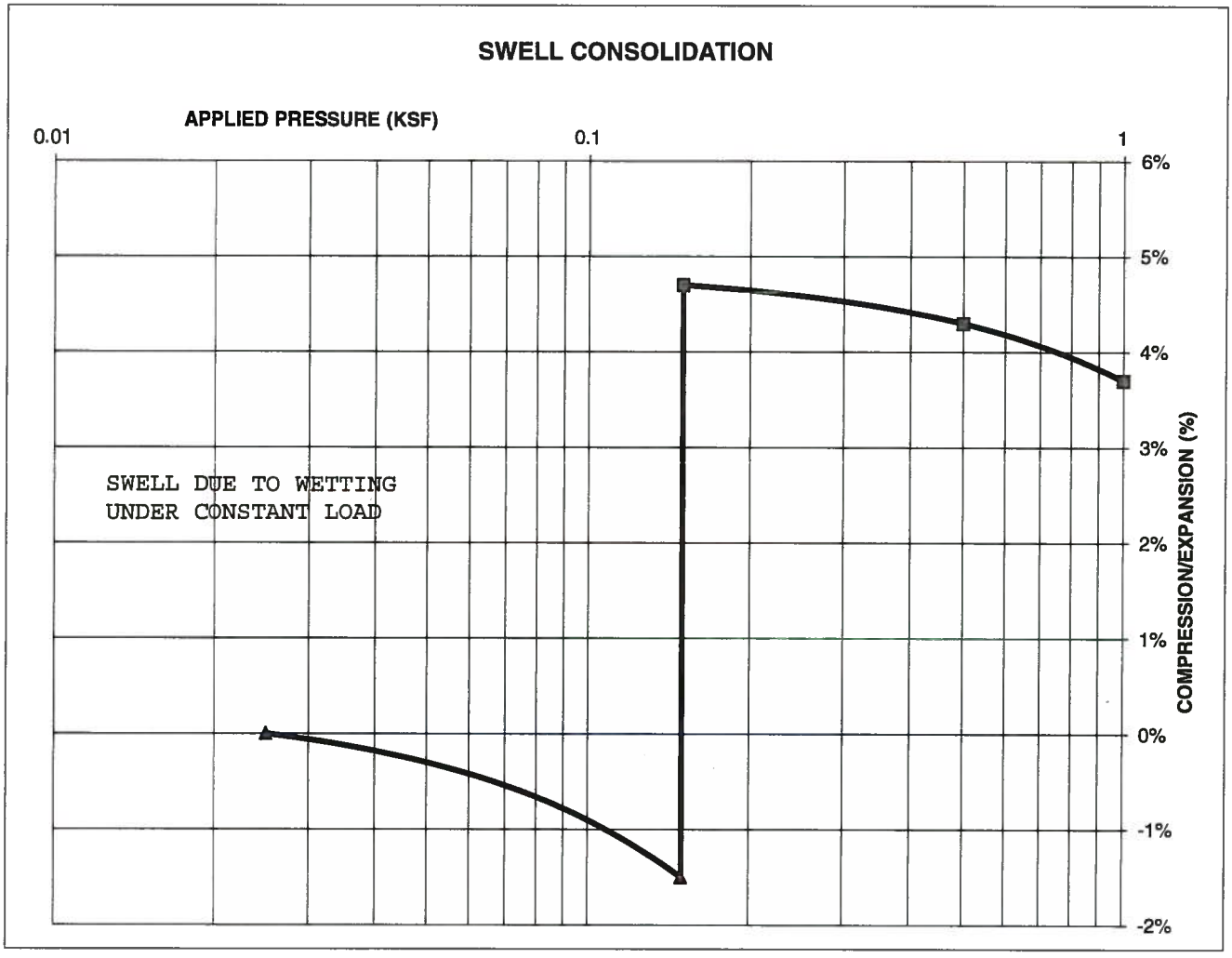
DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-21

CONSOLIDATION TEST RESULTS

TEST BORING #	8	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			114
NATURAL MOISTURE CONTENT			14.5%
SWELL/CONSOLIDATION (%)			6.2%

JOB NO. 230007
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3



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SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-22

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

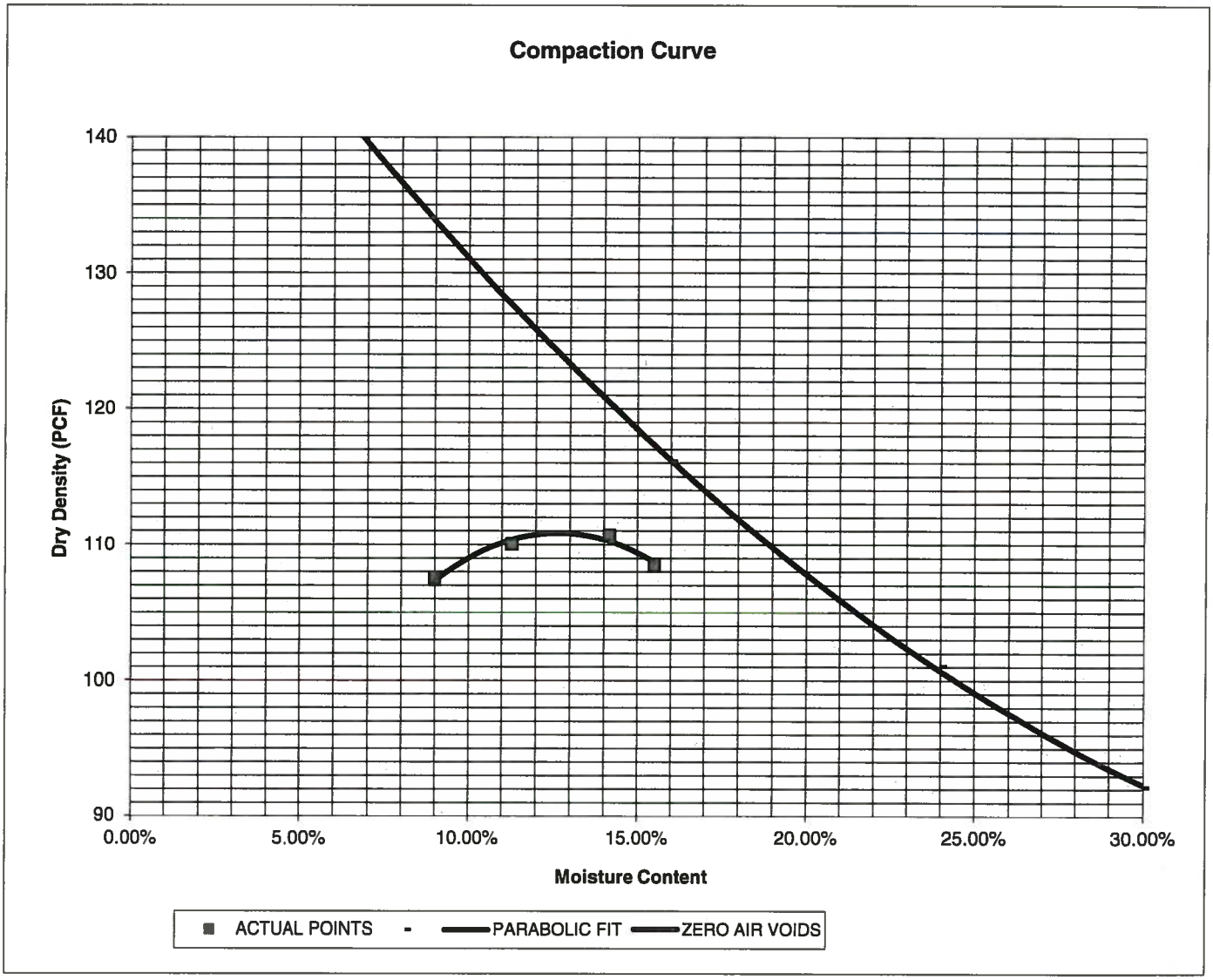
CLIENT COLA, LLC
PROJECT ASPEN RIDGE, F-3
JOB NO. 230007

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			83.4	38	27		A-6		CL	FILL, CLAY, SANDY
1	1	1-2	12.0	116.1	78.3	37	21		A-6	8.7	CL	FILL, CLAY, SANDY
1	1	1-2	17.8	108.4						1.6*	CL	CLAY, SANDY
1	2	1-2	14.1	116.6	85.2	38	21		A-6	1.3	CL	FILL, CLAY, SANDY
1	3	1-2	14.3	114.7	80.5	41	23	0.27	A-7-6	2.8	CL	FILL, CLAY, SANDY
1	4	1-2	12.6	118.5	74.2	39	23		A-6	8.3	CL	FILL, CLAY, SANDY
1	4	1-2	17.9	111.1						1.8*	CL	CLAY, SANDY
1	5	1-2	11.0	114.2	59.5	27	12	0.15	A-6	1.9	CL	FILL, CLAY, VERY SANDY
1	6	1-2	9.5	110.5	82.8	44	28		A-7-6	5.4	CL	FILL, CLAY, SANDY
1	6	1-2	14.9	113.0						1.8*	CL	CLAY, SANDY
1	7	1-2	13.8	116.7	86.1	43	24		A-7-6	10.8	CL	FILL, CLAY, SANDY
1	7	1-2	18.1	110.2						1.9*	CL	CLAY, SANDY
1	8	1-2	14.5	113.7	92.5	43	26		A-7-6	6.2	CL	FILL, CLAY, SANDY
1	3	0-3			82.9						CL	FILL, CLAY, SANDY

* - REMOLDED SAMPLES

PROJECT	ASPEN RIDGE, F-3	CLIENT	COLA, LLC
SAMPLE LOCATION	TB-6 @ 0-3'	JOB NO.	230007
SOIL DESCRIPTION	FILL, CLAY, SANDY, BROWN	DATE	01/12/23

IDENTIFICATION	CL	COMPACTION TEST #	1
TEST DESIGNATION / METHOD	ASTM D-698-A	TEST BY	BL
MAXIMUM DRY DENSITY (PCF)	110.9	OPTIMUM MOISTURE	12.8%



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MOISTURE DENSITY RELATION

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-23

CBR TEST LOAD DATA

JOB NO: 230007
CLIENT: COLA, LLC
PROJECT: ASPEN RIDGE, F-3
SOIL TYPE: 1

PISTON DIAMETER (cm)	PISTON AREA (in^2)
4.958	2.993

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	20	6.68	30	10.03	63	21.05
0.050	20	6.68	30	10.03	76	25.40
0.075	20	6.68	35	11.70	81	27.07
0.100	18	6.02	40	13.37	81	27.07
0.125	18	6.02	38	12.70	86	28.74
0.150	20	6.68	36	12.03	96	32.08
0.175	20	6.68	36	12.03	103	34.42
0.200	20	6.68	38	12.70	109	36.42
0.300	23	7.69	41	13.70	128	42.77
0.400	23	7.69	46	15.37	148	49.46
0.500	25	8.35	48	16.04	166	55.47

FINAL MOISTURE CONTENT

	MOLD # 1	MOLD # 2	MOLD # 3
CAN #			
WT. CAN			
WT. CAN+WET			
WT. CAN+DRY			
WT. H20	#VALUE!	#VALUE!	#VALUE!
WT. DRY SOIL	#VALUE!	#VALUE!	#VALUE!
MOISTURE CONTENT	#VALUE!	#VALUE!	#VALUE!

WET DENSITY (PCF)		110.5	115.8	120.4
DRY DENSITY (PCF)		97.9	102.6	106.7
BEARING RATIO		0.60	1.34	2.71
90% OF DRY DENSITY	99.8			
95% OF DRY DENSITY	105.4			

BEARING RATIO AT 90% OF MAX	0.89	~ R VALUE	1
BEARING RATIO AT 95% OF MAX	2.24	~ R VALUE	6

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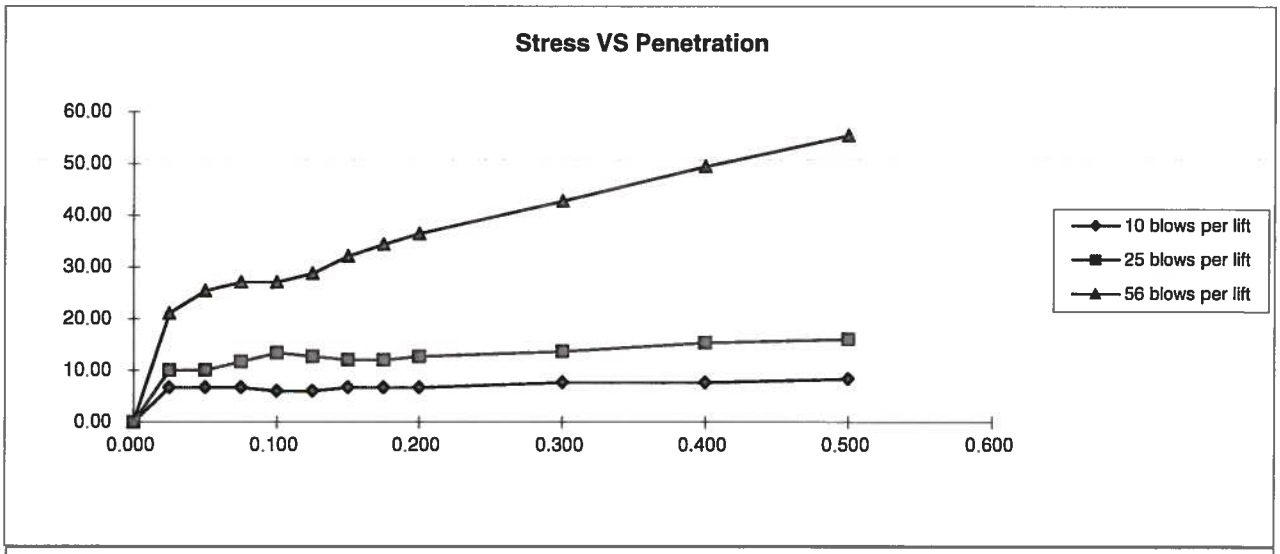
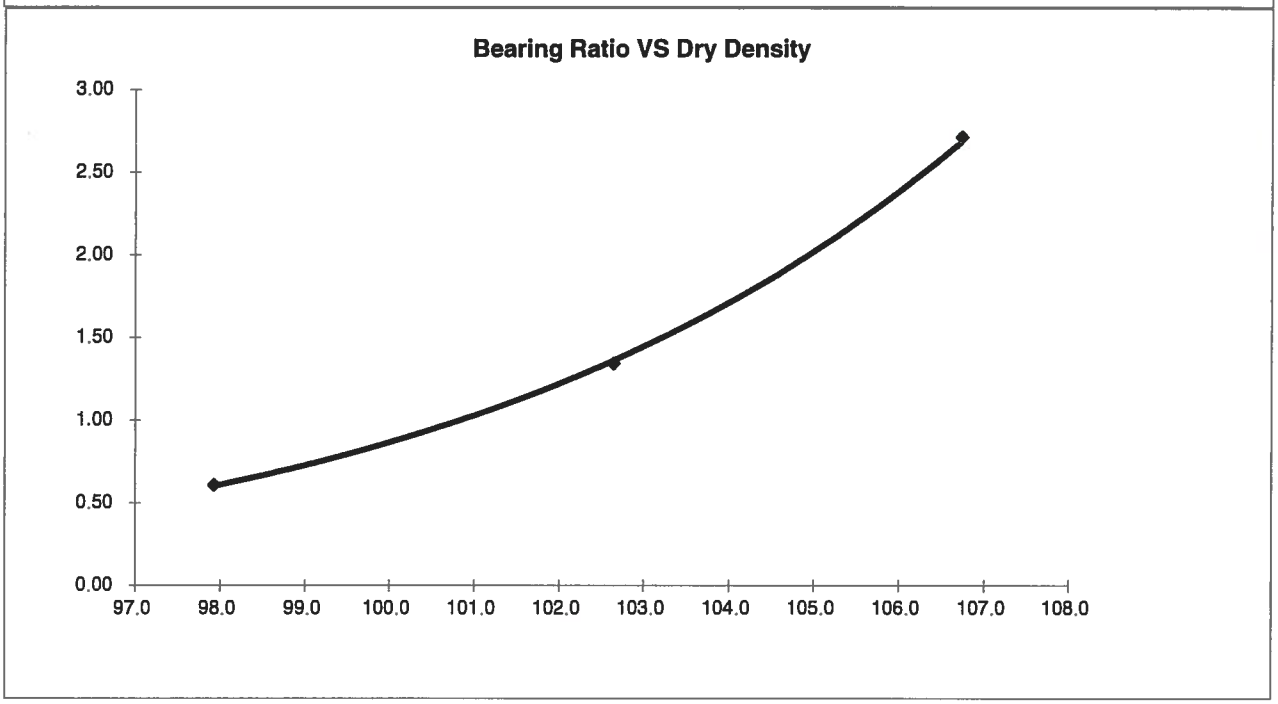
COLORADO SPRINGS, COLORADO 80907

CBR TEST DATA

DRAWN:	DATE:	CHECKED:	DATE:
		SW	1-27-23

JOB NO.: 230007
FIG NO.: B-24





BEARING RATIO AT 90% OF MAX	0.89	~ R VALUE	1.00
BEARING RATIO AT 95% OF MAX	2.24	~ R VALUE	6.00

JOB NO: 230007
SOIL TYPE: 1

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COLORADO SPRINGS, COLORADO 80907

CALIFORNIA BEARING RATIO

DRAWN:	DATE:	CHECKED: SW	DATE: 1-27-23

JOB NO.: 230007
FIG NO.: B-25

APPENDIX C: Pavement Design Calculations

DESIGN CALCULATIONS

DESIGN DATA

COLA,LLC TRAILS AT
ASPEN RIDGE FILING
NO. 3 PHASE 1
URBAN LOCAL SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	292,000
Hveem Stabilometer (R Value) Results:	R =	6
Weighted Structural Number (WSN):	WSN =	3.56

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)

$D_1 = (WSN)/C_1$ = 8.1 inches of Full Depth Asphalt
Use 8.5 inches Full Depth

FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = [5] inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 12.3 inches of Aggregate
Base Course, use 12.5 inches

RECOMMENDED ALTERNATIVES

1. 5.0 inches of Asphalt + 12.5 inches of Aggregate Base Course, or
2. 8.5 inches of Full-Depth Asphalt

Job No. 230007
Fig. No. C-1

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA — COLA,LLC TRAILS AT ASPEN RIDGE FILING NO. 3 PHASE 1
URBAN LOCAL SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	292,000
Hveem Stabilometer (R Value) Results:	R =	6
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.841
Soil Resilient Modulus	M_R =	3126

Weighted Structural Number (WSN): → WSN = 3.56

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

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

Left	Right	Difference
5.47	5.47	0.0

Job No.230007
Fig. No. C-2

Tensar

Asphalt Pavement
Design Analysis

Tensar

Design		**Reference**	URBAN LOCAL
Project	Trails at Aspen Ridge	**Location**	El Paso County, CO, USA
Customer		**Designer**	Tamera Flowers
Company	Tensar	**Date**	February 24, 2023

Results

Stabilized
325,200 ESALs

	Thickness	Coeff.	SN
HMA layer 1	5 in	0.440	2.200
Aggregate base	6 in	0.236	1.416 *
Structural number (SN)			3.616

Unstabilized
301,800 ESALs

	Thickness	Coeff.	SN
HMA layer 1	5 in	0.440	2.200
Aggregate base	12.5 in	0.110	1.375
Structural number (SN)			3.575

Parameters

Project Information

Target ESALs	Subgrade resilient modulus	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
292,000	3,126 psi	80%	0.45	4.5	2.5

* BASE SECTION USED 6-INCH LAYER. DESIGN SECTIONS WITH UTILIZE 8" OF BASE.

JOB. NO. 230007
FIG NO. C-3