April 20, 2023

Proterra Properties 1864 Woodmoor Drive, Suite 100 Monument, Colorado 80132

Attn: Joe Desjardin

Re: Pavement Recommendations (Revised) Cloverleaf, Filing 2 El Paso County, Colorado Entech Job No. 212757 Full-depth asphalt paving is not allowed in unincorporated El Paso County.



Dear Mr. Desjardin:

As requested, Entech Engineering, Inc. has obtained samples of the pavement subgrade soils from the roadways in the Cloverleaf, Filing 2 subdivision. This letter presents the results of the laboratory testing and pavement recommendations for the roadway sections within the filing.

Project Description

The roadways for this project consist of Crimson Clover Drive, Alsike Clover Court, and White Clover Drive in Monument, Colorado. Subsurface Soil Investigation and laboratory testing were performed in order to determine the pavement support characteristics of the soils. The approximate locations of the test borings are presented on the Test Boring Location Map, Figure 1.

Subgrade Conditions

Seventeen test borings were drilled along the roadway to depths of approximately 5 and 10 feet below the existing subgrade surface. The soils at the roadway subgrade depth consisted of silty to slightly silty to clayey sand fill (Soil Type 1).

One general soil type was encountered in the test borings at subgrade level and was used in this design, Soil Type 1. The Test Boring Logs are presented in Appendix A. Sieve Analyses and Atterberg Limit testing were performed on the subgrade soil samples obtained from the test borings for the purpose of classification. The percent passing the No. 200 sieve for the Type 1 soils ranged from approximately 4 to 24 percent. (Soil Type 2) native silty to slightly silty sand, and (Soil Type 3) very clayey sand was encountered below the zone of pavement influence and was not used in this design. Based on the grain size analysis, the Type 1 subgrade soils classify as A-2-4 and A-1-b soils using the AASHTO classification system. These soils typically provide good pavement support characteristics. Groundwater was not encountered in the test borings. Water soluble sulfate tests results indicated that the soils exhibit a negligible potential for sulfate attack.

Atterberg Limits Testing on samples of the Type 1 soil taken from the test borings resulted in Liquid Limits of no value to 25 percent and Plastic Indexes of non-plastic to 7 percent. Based on the soils classification, mitigation of expansive soils is not required on this site. Laboratory test results are presented in Appendix B and are summarized in Table 1.

PCD File No. SF-2123





505 ELKTON DRIVE COLORADO SPRINGS, CO 80907 PHONE (719) 531-5599 FAX (719) 531-5238 Proterra Properties Pavement Recommendations Cloverleaf, Filing No. 2 Monument, Colorado Entech Job No. 212757

California Bearing Ratio (CBR) testing was performed on a representative sample of Soil Type 1 from Test Boring No. 9 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:

<u>Soil Type 1 – Silty Sand Fill</u> R @ 90% = 35.0 R @ 95% = 71.0 Use R = 50.0 for design

Classification Testing

Liquid Limit	NV
Plasticity Index	NP
Percent Passing 200	24.1
AASHTO Classification	A-2-4
Group Index	0
Unified Soils Classification	SM

Pavement Design

CBR testing was used to determine pavement sections for the roadways. Pavement sections were determined utilizing the El Paso County Pavement Design Criteria Manual. The roadways in the filing classify as urban local roads, which used an 18K ESAL value of 292,000 for design purposes. Pavement sections were determined for asphalt supported on aggregate basecourse.

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

Reliability (Local Roads)	80%
Standard Deviation	0.45
Design R-Value Subgrade	50
Resilient Modulus	13,168 psi
Loss in Serviceability (Δ psi)	2.0
Structural Coefficients	
Hot Bituminous Pavement	0.44
Aggregate Basecourse	0.11

The pavement design calculations are presented in Appendix C. Pavement sections 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.

Proterra Properties Pavement Recommendations Cloverleaf, Filing No. 2 Monument, Colorado Entech Job No. 212757

Roadway Classification	Design ESAL	Alternatives
Lishan Lagal	202.000	1. 3.0 inches asphalt over 8.0 inches aggregate basecourse
Urban Local	292,000	2. 4.0 inches asphalt over 6.0 inches aggregate basecourse

Exhibit 1: Pavement Sections – Soil Type 1

Notes:

1. Alternative 1 meets the minimum asphalt and basecourse thicknesses required per El Paso County Pavement Design Criteria Manual for Urban Local Roadways.

2. Alternative 2 requires a deviation form submittal for acceptance by El Paso County.

Roadway Construction – Asphalt on Aggregate Basecourse

Prior to placement of the asphalt, subgrade should be compacted to a minimum of 95 percent of the soils maximum Modified Proctor Dry Density, ASTM D-1557 at \pm 2 percent of optimum moisture content and proof rolled. Any soft or loose subgrade 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 \pm 2 percent of optimum moisture content. Special attention should be given to areas adjacent to manholes, inlet structures and valves.

In addition to the above guidance, the asphalt, cement, subgrade conditions, compaction of materials and roadway construction methods shall meet the El Paso County Engineering Criteria Manual.

We trust that this report contains the information you require. If you have questions or needed additional information, please contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

SW/rs

Encl. F:\AA projects\2022\221977 Pavement Design\221977 pr.docx Reviewed by:

Joseph C. Goode III, P.E.

TABLE

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENTPROTERRA PROPERTIESPROJECTCLOVERLEAF & HIGBYJOB NO.212757

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	9	0-3			24.1	NV	NP		A-2-4		SM	FILL, SAND, SILTY
1	1	1-2			6.9	NV	NP		A-1-b		SM-SW	FILL, SAND, SLIGHTLY SILTY
1	2	1-2			18.6	NV	NP	0.01	A-2-4		SM	FILL, SAND, SILTY
1	3	1-3	_		12.9	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	4	1-2			13.5	NV	_ NP		A-1-b		SM	FILL, SAND, SILTY
1	5	1-2			17.2	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	6	1-2			13.1	NV	NP		A-1-b	<u> </u>	SM	FILL, SAND, SILTY
. 1	7	1-2			17.8	NV	NP	0.01	A-2-4		SM	FILL, SAND, SILTY
1	8	1-2			22.2	25	7		A-2-4		SC-SM	FILL, SAND, SILTY, CLAYEY
1	9	1-2			18.6	NV	NP		A-2-4		SM	FILL, SAND, SILTY
1	10	1-2			9.6	NV	NP		A-1-b		SM-SW	FILL, SAND, SLIGHTLY SILTY
1	11	1-2			11.0	NV	. NP	<0.01	A-1-b	1	SM-SW	FILL, SAND, SLIGHTLY SILTY
1	12	1-2			7.3	NV	NP		A-1-b		SM-SW	FILL, SAND, SLIGHTLY SILTY
1	13	1-2			4.4	NV	NP		A-1-b		SW	FILL, SAND
1	14	1-2			13.3	NV	NP		A-2-4		SM	FILL, SAND, SILTY
1	15	1-2			17.0	NV	NP		A-2-4		SM	FILL, SAND, SILTY
1	16	1-2			9.0	NV	NP	<0.01	A-1-b		SM-SW	FILL, SAND, SLIGHTLY SILTY
1	17	1-2			4.9	NV	NP		A-2-4		SW	FILL, SAND
1	17	0-3			8.7						SM-SW	FILL, SAND, SLIGHTLY SILTY
1	4	0-3			18.2						SM	FILL, SAND, SILTY
2	4	10			13.8	NV	NP	<0.01	A-2-4		SM	SAND, SILTY
2	7	10			7.3	NV	NP	<0.01	A-2-4		SM-SW	SAND, SLIGHTLY SILTY
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APPENDIX A: Test Boring Logs

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FILL 0-3', SAND, SLIGHTI FINE TO COARSE GRAIN MEDIUM DENSE, MOIS	LY SILTY, IED, TAN, T				11	4.5	1	FILL 0-5', SAND, SILTY, F COARSE GRAINED, TAN DENSE, MOIST	INE TO				21	5.9	1
GRAINED, GRAY BROWN DENSE TO DENSE, MOIS	NE N, MEDIUM ST	5	<u>/ / / /</u>		15	10.8	3			5			19	5.0	1
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FILL 0-S', SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST	-			13	5.2	1	FILL 0-8', SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUN DENSE TO LOOSE, MOIST	1			24	5.7	1	
	5			24	5.8	1		5		2	8	5.2	1	
	10						SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST	10			18	4.4	2	
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LL 0-5', SAND, SILTY, FINE TO DARSE GRAINED, TAN, LOOSE D MEDIUM DENSE, MOIST				6	7.1	1	FILL 0-5', SAND, SILTY, F COARSE GRAINED, TAN, MOIST	INE TO , LOOSE,				7	7.6	1
	5			23	5.2	1			5			6	7.9	1
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FILL 0-8', SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE TO LOOSE, MOIST	5			12 21	6.1 2.5	1	FILL 0-5', SAND, SILTY, C FINE GRAINED, BROWN DENSE, MOIST	LÂYEY, , MEDIUM	5			11 18	8.1 7.4	1	
SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST	10			23	3.4	2			10 -						
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DRY TO 10', 3/13/23	Depth (ft) Symbol	Samples	Blows per foot	Watercontent %	Soil Type	Depth (ft) Symbol Soil Type Soil Type
FILL 0-10', SAND, CLEAN TO SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE TO DENSE, MOIST	5		20 26	3.6 3.8	1	FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST 5 16 5 16 5 16 5 16 5 1 1 16 5 1
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REMARKS DRY TO 5', 3/13/23	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	REMARKS DRY TO 5', 3/13/23		Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST	5			25 22	7.2 5.2	1	FILL 0-5', SAND, SLIGHTLY SILT FINE TO COARSE GRAINED, TA LOOSE, DRY TO MOIST	Y, N,	5			4	2.9 5.9	1
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APPENDIX B: Laboratory Test Results

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U.S. <u>Sieve #</u> 3*	Percent <u>Finer</u>	Atterberg <u>Limits</u> Plastic Limit NP
1 1/2" פ/איי		Liquid Limit NV Plastic Index NP
1/2" 3/8"	100.0% 98.7%	riddic maex int
4	95.4%	Swell
10	77.0%	Moisture at start
20 40	57.0% 46.3%	Moisture at finish Moisture increase
100 200	31.4% 24.1%	Initial dry density (pcf) Swell (psf)

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U.S.	Percent	Atterberg
Sieve #	Finer	<u>Limits</u>
3"		Plastic Limit NP
1 1/2"		Liquid Limit NV
3/4"		Plastic Index NP
1/2"		
3/8"	100.0%	
4	96.4%	Swell
10	74.5%	Moisture at start
20	46.5%	Moisture at finish
40	28.8%	Moisture increase
100	11.0%	Initial dry density (pcf)
200	6.9%	Swell (psf)

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ENTECH ENGINEERING, INC.		JOB NO.: 212757 FIG NO.:			
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18.6%

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

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3/4"		
1/2"	100.0%	
3/8"	93.1%	Swall
4	91.5%	<u>Swell</u>
10	67.6%	Moisture at start
20	45.1%	Moisture at finish
40	34.7%	Moisture increase
100	18.9%	Initial dry density (pcr)
200	12.9%	Swell (pst)

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3/4"		Flastic mack 14
1/2"		
3/8"	100.0%	- "
4	96.7%	Swell
10	74.7%	Moisture at start
20	54.6%	Moisture at finish
40	42.7%	Moisture increase
100	25.3%	Initial dry density (pcf)
200	17.2%	Swell (psf)

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	LABORATORY TEST RESULTS					
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Plastic Limit

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Plastic Index

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

Swell (psf)

Swell

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<u>Sieve #</u> 3"	<u>Finer</u>
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	96.3%
4	91.3%
10	66.5%
20	45.9%
40	33.8%
100	18.7%
200	13.1%

ENTECH ENGINEERING, INC.		JOB NO.: 212757 EIG NO 1			
505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: SW	DATE: 3-28-23	B-7



U.S. <u>Sieve #</u> 3" 1 1/2" 3/4"	Percent <u>Finer</u>	Atterberg <u>Limits</u> Plastic Limit NP Liquid Limit NV Plastic Index NP
1/2" 3/8" 4 10 20	100.0% 95.2% 75.6% 55.0%	<u>Swell</u> Moisture at start Moisture at finish
40 100 200	41.8% 24.5% 17.8%	Moisture increase Initial dry density (pcf) Swell (psf)

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	LABORATORY TEST RESULTS				
505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: 5W	DATE: 3-28-23	B-

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Q.Q.	I Olochi	7	
<u>Sieve #</u>	<u>Finer</u>	<u>Limits</u>	
3"		Plastic Limit 18	
1 1/2"		Liquid Limit 25	
3/4"		Plastic Index 7	
1/2"	100.0%		
3/8"	97.7%		
4	94.7%	Swell	
10	74.7%	Moisture at start	
20	56.2%	Moisture at finish	
40	44.6%	Moisture increase	
100	28.9%	Initial dry density (pcf)	
200	22,2%	Swell (psf)	

$\mathbf{\bullet}$	ENTECH ENGINEERING, INC.		JOB NO.: 212757 EIS NO			
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED:	DATE: 3+28-23	B-9

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U.S. <u>Sieve #</u> 3" 1 1/2" 3/4" 1/2" 2/8"	Percent <u>Finer</u>	Atterberg <u>Limits</u> Plastic Limit NP Liquid Limit NV Plastic Index NP
3/0	08.50%	Swell
4 10	78.2%	Moisture at start
20	55.4%	Moisture at finish
40	42.0%	Moisture increase
100 200	24.7% 18.6%	Initial dry density (pcf) Swell (psf)

ENTECH ENGINEERING, INC.		LABOF RESUL	RATORY TEST		JOB NO.: 212757 FIG NO.:
505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: SW	DATE: 3-28-23	B-10

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U.S.	Percent	Atterberg
<u>Sieve #</u>	<u>Finer</u>	Limits
3"		Plastic Limit NP
1 1/2"		Liquid Limit NV
3/4"		Plastic Index NP
1/2"		
3/8"	100.0%	
4	99.3%	Swell
10	69.0%	Moisture at start
20	42.0%	Moisture at finish
40	32.3%	Moisture increase
100	15.6%	Initial dry density (pcf)
200	9.6%	Swell (psf)

			JOB NO.: 212757			
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: SW	DATE: 3-28-23	B-11

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U.S. Sieve #	Fercent	Limite
<u>3"</u>		Plastic Limit NP
1 1/2"		Liquid Limit NV
3/4"		Plastic Index NP
1/2"		
3/8"		
4	100.0%	<u>Sweli</u>
10	69.2%	Moisture at start
20	44.2%	Moisture at finish
40	34.6%	Moisture increase
100	17.5%	Initial dry density (pcf)
200	11.0%	Swell (psf)

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ENTECH ENGINEERING, INC.		LABOF RESUL	ATORY TEST		JOB NO.: 212757 EIG NO.:
505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: SW	DATE: 3-28-23	8-12

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U.S.	Percent	Atterberg
Sieve #	<u>Finer</u>	<u>Limits</u>
3"		Plastic Limit NP
1 1/2"		Liquid Limit NV
3/4"		Plastic Index NP
1/2"		
3/8"	100.0%	
4	99.0%	<u>Swell</u>
10	74 .9%	Moisture at start
20	43.7%	Moisture at finish
40	33.2%	Moisture increase
100	14.4%	Initial dry density (pcf)
200	7.3%	Swell (psf)

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ENTECH ENGINEERING, INC.	[LABOR RESUL	ATORY TEST		JOB NO.: 212757 EIG NO
505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED:	DATE: 3-28-23	B-13



U.S.	Percent	Atterberg
Sieve #	<u>Finer</u>	Limits
3"		Plastic Limit NP
1 1/2"		Liquid Limit NV
3/4"		Plastic Index NP
1/2"		
3/8"		
4	100.0%	<u>Swell</u>
10	73.0%	Moisture at start
20	26.0%	Moisture at finish
40	19.1%	Moisture increase
100	8.8%	Initial dry density (pcf)
200	4.4%	Swell (psf)

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		JOB NO.: 212757				
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: 5W	DATE: 3-28-23	B-14

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U.S.	Percent	Atterberg
Sieve #	Finer	Limits
3"		Plastic Limit NP
1 1/2"		Liquid Limit NV
3/4°		Plastic Index NP
1/2"		
3/8"		
4	100.0%	<u>Swell</u>
10	80.0%	Moisture at start
20	52.6%	Moisture at finish
40	41.3%	Moisture increase
100	20.3%	Initial dry density (pcf)
200	13.3%	Swell (psf)

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\mathbf{O}	ENTECH ENGINEERING, INC.	\square	LABOR RESUL	ATORY TEST		JOB NO.: 212757
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: SW	DATE: 3-28-23	B-15

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U.S. <u>Sieve #</u> 3" 1 1/2" 3/4" 1/2"	Percent <u>Finer</u>	Atterberg <u>Limits</u> Plastic Limit NP Liquid Limit NV Plastic Index NP
3/8"	100.0%	
4	97.8%	Swell
10	76.6%	Moisture at start
20	53.1%	Moisture at finish
40	42.0%	Moisture increase
100 200	24.4% 17.0%	Initial dry density (pcf) Swell (psf)

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\mathbf{O}	ENTECH ENGINEERING, INC.		JOB NO.: 212757 EIG NO.:			
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED:	DATE: 3-28-23	B-16



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U.S.	Percent	Atterberg
Sieve #	<u>Finer</u>	<u>Limits</u>
3"		Plastic Limit NP
1 1/2"		Liquid Limit NV
3/4"		Plastic Index NP
1/2"		
3/8"	100.0%	
4	99.5 <i>%</i>	<u>Swell</u>
10	64.5%	Moisture at start
20	38.2%	Moisture at finish
40	29.9%	Moisture increase
100	14.9%	Initial dry density (pcf)
200	9.0%	Swell (pst)

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			JOB NO.: 212757 EIG NO.:			
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:		DATE: 3-28-23	B-17



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U.S. <u>Sieve #</u> 3" 1 1/2" 3/4" 1/2" 3/8"	Percent <u>Finer</u>	Atterberg <u>Limits</u> Plastic Limit NP Liquid Limit NV Plastic Index NP
4	100.0%	Swell
10	69.9%	Moisture at start
20	42.8%	Moisture at finish
40	33.1%	Moisture increase
100 200	11.5% 4.9%	Initial dry density (pcf) Swell (psf)

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ENTECH ENGINEERING, INC.		LABOF RESUL	RATORY TEST		JOB NO.: 212757
505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED	DATE: 3-28-23	B-18

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U.S.	Percent	Atterberg
<u>Sieve #</u>	<u>Finer</u>	Limits
3"		Plastic Limit
1 1/2"		Liquid Limit
3/4"		Plastic Index
1/2"		
3/8"	100.0%	
4	99.1%	<u>Swell</u>
10	69.5%	Moisture at start
20	39.9%	Moisture at finish
40	31.6%	Moisture increase
100	15.7%	Initial dry density (pcf)
200	8.7%	Swell (psf)

\diamond	ENTECH ENGINEERING, INC.	[JOB ND.: 212757			
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: SW	DATE: 3-28-23	6-19



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U.S.	Percent	Atterberg
Sieve #	<u>Finer</u>	Limits
3"		Plastic Limit
1 1/2"		Liquid Limit
3/4"		Plastic Index
1/2"		
3/8"	100.0%	
4	99.7%	Swell
10	75.8%	Moisture at start
20	51.7%	Moisture at finish
40	41.0%	Moisture increase
100	25.6%	Initial dry density (pcf)
200	18.2%	Swell (psf)

\mathbf{O}	ENTECH ENGINEERING, INC.		JOB NO.: 212757			
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: SW	DATE: 2-78-73	B-20



1/2"		
3/8"	100.0%	
4	95.0%	Swell
10	71.5%	Moisture at start
20	46.1%	Moisture at finish
40	32.4%	Moisture increase
100	18.3%	Initial dry density (pcf)
200	13.8%	Swell (psf)

$ \diamond $	ENTECH ENGINEERING, INC.		LABOF RESUL	ATORY TEST		JOB NO.: 212757 E/0 NO :
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED SW	DATE: 3-28-23	8-21

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U.S.	Percent	Atterberg
<u>Sieve #</u>	<u>Finer</u>	Limits
3"		Plastic Limit NP
1 1/2"		Liquid Limit NV
3/4"		Plastic Index NP
1/2"		
3/8"	100.0%	
4	97.4%	Swell
10	87.9%	Moisture at start
20	60.8%	Moisture at finish
40	33.6%	Moisture increase
100	11.7%	Initial dry density (pcf)
200	7.3%	Swell (psf)

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	\square	JOB NO.: 212757 E/3 NO :				
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED:	DATE: 3-28-23	B-22



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4	90.8%	Sweil
10	80.3%	Moisture at start
20	65.7%	Moisture at finish
40	56.3%	Moisture increase
100	43.9%	Initial dry density (pcf)
200	38.2%	Swell (psf)

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\Leftrightarrow	ENTECH ENGINEERING, INC.		LABOF RESUL	ATORY TEST		JOB NO.: 212757
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED:	DATE: 3-29-23	B-23

CLIENTPROTERRA PROPERTIESJOB NO.212757PROJECTCLOVERLEAF & HIGBYDATE3/20/2023LOCATIONCLOVERLEAF & HIGBYTEST BYBL

A. A.

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-2	1-2	1	SM	0.01
TB-4	10	2	SM	<0.01
TB-7	1-2	1	SM	0.01
TB-7	10	2	SM-SW	<0.01
TB-11	1-2	1 -	SM-SW	<0.01
TB-16	1-2	1 📼	SMSW	<0.01

QC BLANK PASS



19-15-19-18 1-18-18-19-18

1 Stand Bridge State

	LABO SULF/	RATORY TEST ATE RESULTS		JOB NO.: 212757 FIG NO.:
DRAWN:	DATE:	CHECKED:	3-28-23	B-24

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505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907 DRAWN: DATE: CHECKED: DATE: 3-28-23

JOB NO: 212757

CBR TEST LOAD DATA

		_	CLIENT:	PROTERRA	PROPERTIES	
PISTON	PISTON	1	PROJECT:	CLOVERLE/	AF & HIGBY	
DIAMETER (cm)	AREA (in ²)	1	SOIL TYPE:	1, SOIL TYP	E #1	
4.958	2.993	l				
	10 BLOWS		25 BLOWS		56 BLOWS	
PENETRATION	MOLD #	1	MOLD #	2	MOLD #	3
DEPTH	LOAD(LBS)	STRESS	LOAD(LBS)	STRESS	LOAD(LBS)	STRESS
(INCHES)	(LBS)	(PSI)	(LBS)	(PSI)	(LBS)	(PSI)
0.000	0	0.00	0	0.00	0	0.00
0.025	128	42.77	256	85.55	497	166.08
0.050	248	82.87	495	165.41	834	278.70
0.075	343	114.62	685	228.90	1229	410.69
0.100	448	149.71	896	299.41	1404	469.17
0.125	662	221.22	1324	442,44	1794	599.50
0.150	821	274.35	1641	548.37	2263	756.22
0.175	991	331.16	1981	661.99	2397	801.00
0.200	1168	390.31	2335	780.28	2707	904.59
0.300	1998	667.67	3396	1134.83	3809	1272.84
0.400	2155	720.13	4305	1438.59	4807	1606.34
0.500	2985	997.49	5061	1691.22	5781	1931.82

FINAL MOISTURE CONTENT

	MOLD #	1	MOLD #	2	MOLD #	3
CAN #	-	303		357		352
WT. CAN		8.26		7.97		8.03
WT. CAN+WET		147.47		197.94		216.03
WT. CAN+DRY		132.22		181.2		198.56
<u>WT. H20</u>		15.25		16.74		17.47
W.T. DRY SOIL		123.96		173.23		190.53
MOISTURE CONTENT		12.30%		9.66%		9.17%
WET DENSITY (PCF)		125.2	-	134.3		143.9
DRY DENSITY (PCF)		116.8		125.3		134.2
BEARING RATIO		14.97		29,94		46.92
90% OF DRY DENSITY	115.0					
95% OF DRY DENSITY	121.4					
BEARING RATIO AT 90% OF MAX		11.81	~ R VALUE	35		
BEARING RATIO AT 95% OF MAX		23.10	~ R VALUE	71		

Θ	ENTECH ENGINEERING, INC.		CI	BR TEST DATA		JCB NO.: 212757 FIG NO.:
	505 ELKTON DRIVE COLORADO SPRINGS, COLORADO 80907	DRAWN:	DATE:	CHECKED: SW	DATE: 3-28-23	B-26

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APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN



	$\log_{10} \left[\frac{\Delta PSI}{4.2 - 1.5} \right]$	
$\log_{10}W_{18} = Z_R^* S_0 + 9.36^* \log_{10}(SN+1) - 0.20 + -$	$0.40 + \frac{1094}{(SN+1)^{5.19}}$	— + 2.32*log ₁₀ M _R - 8.07 -

Left	Right	Difference
5.47	5.47	0.0

Job No. 212757 Fig. No. C-1

DESIGN CALCULATIONS

DESIGN DATA PROTERRA PROPERTIES CLOVERLEAF, FILING NO. 2 URBAN LOCAL ROADWAYS 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 - Aggregate Basecourse

D₁ = Depth of Asphalt (inches) D₂ = Depth of Basecourse (inches)

FOR ASPHALT + AGGREGATE BASECOURSE SECTION

Asphalt Thickness (t) = 3 inches $D_2 = ((WSN) - (t)(C_1))/C_2 = 7.1$ inches of Aggregate Basecourse, use 8.0 inches

RECOMMENDED ALTERNATIVES

1. 3.0 inches of Asphalt + 8.0 inches of Aggregate Basecourse

Job No. 212757 Fig. No. C-2

DESIGN CALCULATIONS

DESIGN DATA PROTERRA PROPERTIES CLOVERLEAF, FILING NO. 2 URBAN LOCAL ROADWAYS 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 - Aggregate Basecourse

D₁ = Depth of Asphalt (inches) D₂ = Depth of Basecourse (inches)

FOR ASPHALT + AGGREGATE BASECOURSE SECTION

Asphalt Thickness (t) = 4 inches $D_2 = ((WSN) - (t)(C_1))/C_2 = 3.1$ inches of Aggregate Basecourse, use 6.0 inches

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 6.0 inches of Aggregate Basecourse

Job No. 212757 Fig. No. C-3