



ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
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May 25, 2022
Revised June 8, 2022

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

APPROVED
Engineering Department

06/08/2022 1:35:12 PM
dsdnijkamp

EPC Planning & Community
Development Department

Attn: Mark Sherwood

Re: Pavement Recommendations - Revised
Forest Lakes Filing No. 6, Phase No. 2
El Paso County, Colorado

Dear Mr. Sherwood:

As requested, Entech Engineering, Inc. has obtained samples of the pavement subgrade soils from the roadways in the Forest Lakes, Filing No. 6 subdivision in El Paso County, Colorado. This letter presents the results of the laboratory testing and pavement recommendations for the roadways.

Project Description

The roadway for this project consists of a section of Mesa Top Drive North. A Subsurface Soil Investigation and laboratory testing was performed in order to determine the pavement support characteristics of the soils. The general layout of the site is presented in the Test Boring Location Map in Figure 1.

Subgrade Conditions

Nine 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 and clayey sand with gravel (Soil Type 1). The Type 1 soils were encountered in all of the borings to depths drilled 5 to 10 feet. Groundwater was not encountered in the test borings. The Test Boring Logs are presented in Appendix A. Sieve Analyses and Atterberg Limit testing were performed on soil samples obtained from the test borings for the purpose of classification. The Type 1 soils passing the No. 200 sieve ranged from approximately 21 to 31 percent and classified as A-2-4 and A-1-b soils, using the AASHTO classification system. Atterberg Limits Testing resulted in liquid limits of no-value to 21 to 24 percent and plastic indexes of 4 to 10 percent to non-plastic. One general subgrade soil type was determined for pavement evaluation based on the laboratory testing (Type 1). Water-soluble sulfate tests results indicated that the soils exhibit a negligible potential for sulfate attack.

Swell/Consolidation Testing was not required on the site soils due to their classifications and plastic indexes. Mitigation of expansive soils on this site is not required. Laboratory test results are presented in Appendix B and are summarized on Table 1.

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

Soil Type 1 – Clayey Sand and Gravel

CBR 1

R @ 90% = 10.0

R @ 95% = 30.0

Use R = 30.0 for design

Classification Testing

Liquid Limit	23
Plasticity Index	9
Percent Passing 200	29.8
AASHTO Classification	A-2-4
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. Mesa Top Drive North classifies as an urban local residential roadway, which used an 18k ESAL value of 292,000 for design purposes. Alternative pavement sections were determined for asphalt supported on aggregate basecourse, and asphalt on cement stabilized subgrade.

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

Reliability	
Urban Residential Collector	80%
Standard Deviation	0.45
Δpsi	2.0
“R” Value Subgrade	30.0
Resilient Modulus	6,849 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 as follows. 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 – Soil Type 1

Urban Local Residential – ESAL = 292,000

<u>Alternative</u>	<u>Asphalt (in)</u>	<u>Basecourse (in)</u>	<u>Cement Stabilized Subgrade (in.)</u>
1. Asphalt Over Basecourse	4.0	8.0*	--
2. Cement Stabilized Subgrade	4.0	--	10.0

* Minimum sections required in accordance with the El Paso County Pavement Design Criteria Manual.

Roadway Construction - Asphalt on Aggregate Basecourse Alternative

Prior to placement of the asphalt, the subgrade should be proofrolled and compacted to a minimum of 95 percent of the soils maximum Modified Proctor Dry Density, ASTM D-1557 at ± 2 percent of optimum moisture content. Any loose areas should be removed and replaced with suitable materials. Basecourse materials should be compacted to a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 at ± 2 percent of optimum moisture content. Special attention should be given to areas adjacent to manholes, inlet structures and valves.

Roadway Construction – Cement Stabilized Subgrade Alternative

Prior to placement of the asphalt, the subgrade shall be stabilized by addition of cement to a depth of at least 10 inches. The amount of cement applied shall be 2.0 percent (by weight) of the subgrade’s maximum dry density as determined by the Modified Proctor Test (ASTM D-1557) based on laboratory cement stabilization testing. The cement should be spread evenly on the subgrade surface and be thoroughly mixed into the subgrade over a 10 inches depth such that a uniform blend of soil and cement is achieved. Prior to application or mixing of the cement, the upper 10 inches of subgrade should be thoroughly moisture conditioned to the soil’s optimum water content or as much as 2 percent more than the optimum water content as necessary to provide a compactable soil condition. Densification of the cement-stabilized subgrade should be completed to obtain a compaction of at least 95 percent of the subgrade maximum dry density as determined by the 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.

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Pavement Recommendations - Revised
Forest Lakes Filing No. 6, Phase No. 2
El Paso County, Colorado

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

- Type I/II cement as supplied, a local supplier shall be used. All cement used for stabilization should come from the same source. If cement sources are changed a new laboratory mix design should be completed.
- Moisture conditioning of the subgrade and/or mixing of the cement into the subgrade shall not occur when soil temperatures are below 40 °F. Cement treated subgrades should be maintained at a temperature of 40 °F or greater until the subgrade has been compacted as required.
- Cement placement, cement mixing and compaction of the cement treated subgrade should be observed by a Soils Engineer. The Soils Engineer should complete in situ compaction tests and construct representative compacted specimens of the treated subgrade material for subsequent laboratory quality assurance testing.

If significant grading is performed, the soils at subgrade may change. Modification to the pavement sections should be evaluated after site grading is completed.

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

We trust that this has provided you with the information you required. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.



Daniel P. Stegman

DPS/el

Entech Job No. 220742
AAprojects/2022/220742 – pr-Rev2

Reviewed by:



Austin M. Nossokoff, P.E.

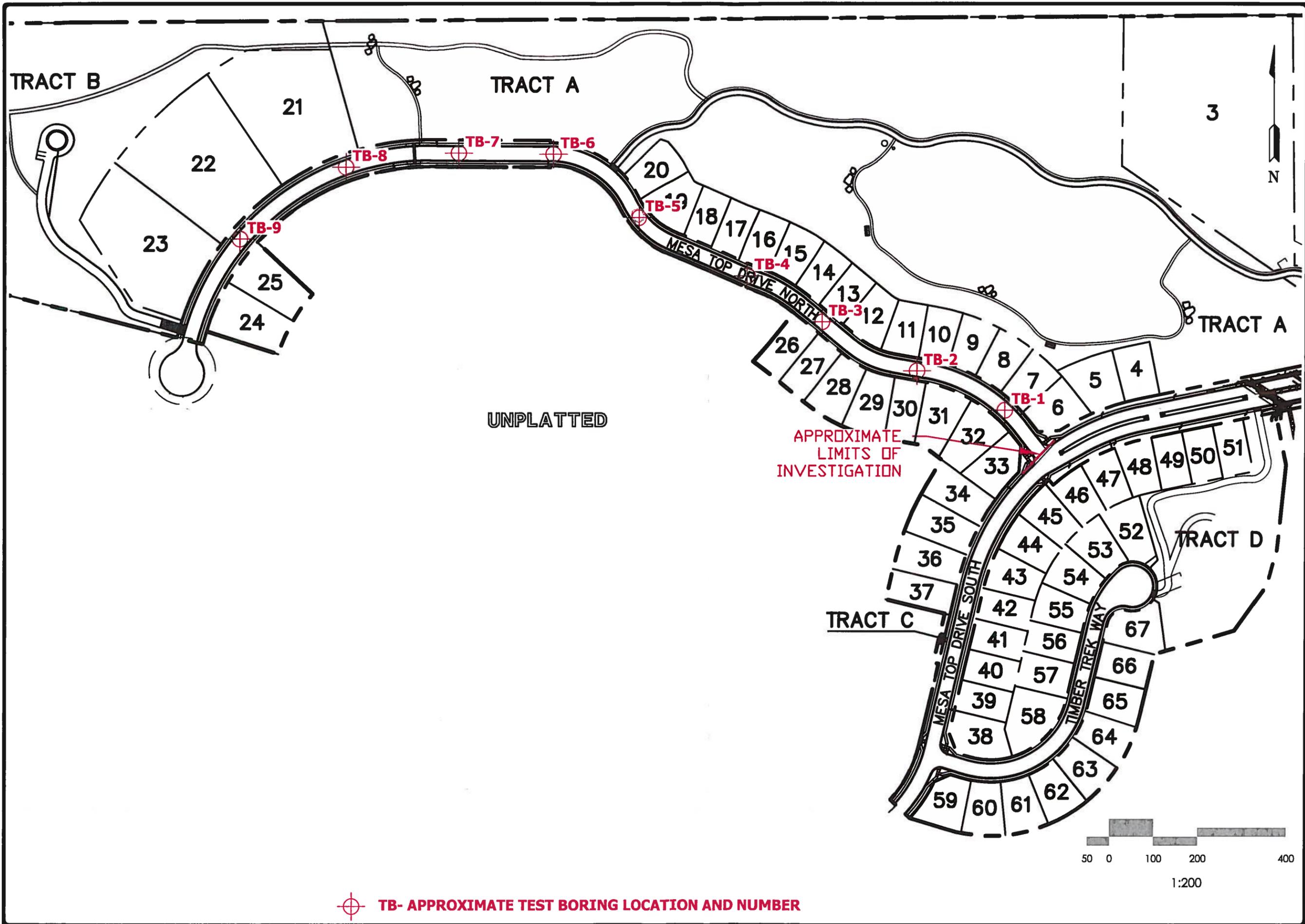
TABLE

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

CLIENT ELITE PROPERTIES
PROJECT FOREST LAKES, FILING 6
JOB NO. 220742

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	4	0-3			29.8	23	9		A-2-4		SC	SAND, CLAYEY
1	1	1-2			21.1	NV	NP	0.01	A-1-b		SM	SAND, SILTY
1	2	1-2			21.6	24	7		A-2-4		SC	SAND, CLAYEY
1	3	1-2			24.1	24	10		A-2-4		SC	SAND, CLAYEY
1	4	1-2			22.8	21	4		A-2-4		SC-SM	SAND, CLAYEY, SILTY
1	5	1-2			27.3	23	7		A-2-4		SC	SAND, CLAYEY
1	6	1-2			27.5	24	9	<0.01	A-2-4		SC	SAND, CLAYEY
1	7	1-2			31.2	23	7		A-2-4		SC-SM	SAND, CLAYEY, SILTY
1	8	1-2			29.3	NV	NP		A-2-4		SM	SAND, SILTY
1	9	1-2			24.4	23	9		A-2-4		SC	SAND, CLAYEY

FIGURE



TB- APPROXIMATE TEST BORING LOCATION AND NUMBER

REVISION	BY

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TEST BORING LOCATION MAP
FOREST LAKES, FILING 6, PHASE 2
MONUMENT, CO.
FOR: CLASSIC COMMUNITIES

DRAWN	JAC
CHECKED	DPS
DATE	5/11/22
SCALE	1:200
JOB NO.	220742
FIGURE NO.	1

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
 DATE DRILLED 5/6/2022
 Job # 220742

TEST BORING NO. 2
 DATE DRILLED 5/6/2022
 CLIENT ELITE PROPERTIES
 LOCATION FOREST LAKES, FILING 6

REMARKS

DRY TO 10', 5/6/22

SAND, SILTY, GRAVELLY, FINE TO COARSE GRAINED, RED BROWN, MEDIUM DENSE TO VERY DENSE, MOIST

* - HIGH BLOW COUNTS DUE TO GRAVEL

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			45	4.2	1
5			25	7.0	1
10			50*	6.6	1
			8"		

REMARKS

DRY TO 5', 5/6/22

SAND, GRAVELLY, CLAYEY, FINE TO COARSE GRAINED, RED BROWN, DENSE TO MEDIUM DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			40	6.5	1
5			18	7.4	1



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *SW*

DATE: *5-19-22*

JOB NO.:
 220742

FIG NO.:
 A-1

TEST BORING NO. 3
 DATE DRILLED 5/6/2022
 Job # 220742

TEST BORING NO. 4
 DATE DRILLED 5/6/2022
 CLIENT ELITE PROPERTIES
 LOCATION FOREST LAKES, FILING 6

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', 5/6/22 SAND, GRAVELLY, CLAYEY, FINE TO COARSE GRAINED, RED BROWN, MEDIUM DENSE, MOIST	5	[Symbol]	14	29	9.8	1	DRY TO 10', 5/6/22 SAND, GRAVELLY, CLAYEY, SILTY, FINE TO COARSE GRAINED, RED BROWN, MEDIUM DENSE TO DENSE, MOIST TO DRY	5	[Symbol]	20	7.7	1	
								5	[Symbol]	22	3.6	1	
	10							10	[Symbol]	37	2.0	1	
	15							15					
	20							20					



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *SW*

DATE:

5-19-22

JOB NO.:
 220742

FIG NO.:
 A- 2

TEST BORING NO. 5
 DATE DRILLED 5/6/2022
 Job # 220742

TEST BORING NO. 6
 DATE DRILLED 5/6/2022
 CLIENT ELITE PROPERTIES
 LOCATION FOREST LAKES, FILING 6

REMARKS

DRY TO 5', 5/6/22

SAND, GRAVELLY, CLAYEY, FINE
 TO COARSE GRAINED, RED
 BROWN, MEDIUM DENSE TO
 LOOSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			19	4.4	1
5			6	5.5	1
10					
15					
20					

REMARKS

DRY TO 5', 5/6/22

SAND, GRAVELLY, CLAYEY, FINE
 TO COARSE GRAINED, RED
 BROWN, MEDIUM DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			23	7.0	1
5			10	9.2	1
10					
15					
20					



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *SW*

DATE:

5-19-22

JOB NO.:
 220742

FIG NO.:
 A-3

TEST BORING NO. 7
 DATE DRILLED 5/6/2022
 Job # 220742

TEST BORING NO. 8
 DATE DRILLED 5/6/2022
 CLIENT ELITE PROPERTIES
 LOCATION FOREST LAKES, FILING 6

REMARKS

DRY TO 10', 5/6/22

SAND, GRAVELLY, CLAYEY,
 SILTY, FINE TO COARSE GRAINED,
 RED BROWN, MEDIUM DENSE TO
 DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			25	7.5	1
5			14	5.1	1
10			34	3.3	1
15					
20					

REMARKS

DRY TO 5', 5/6/22

SAND, GRAVELLY, SILTY, FINE
 TO COARSE GRAINED, RED BROWN,
 MEDIUM DENSE TO LOOSE,
 MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			15	5.6	1
5			8	5.5	1
10					
15					
20					



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *SVU*

DATE: *5-19-22*

JOB NO.:
 220742

FIG NO.:
 A- 4

TEST BORING NO. 9
 DATE DRILLED 5/6/2022
 Job # 220742

TEST BORING NO.
 DATE DRILLED
 CLIENT ELITE PROPERTIES
 LOCATION FOREST LAKES, FILING 6

REMARKS

REMARKS

DRY TO 5', 5/6/22
 SAND, GRAVELLY, CLAYEY, FINE
 TO COARSE GRAINED, RED
 BROWN, MEDIUM DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			16	7.4	1	5					
5			14	5.7	1	5					
10						10					
15						15					
20						20					



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *SW*

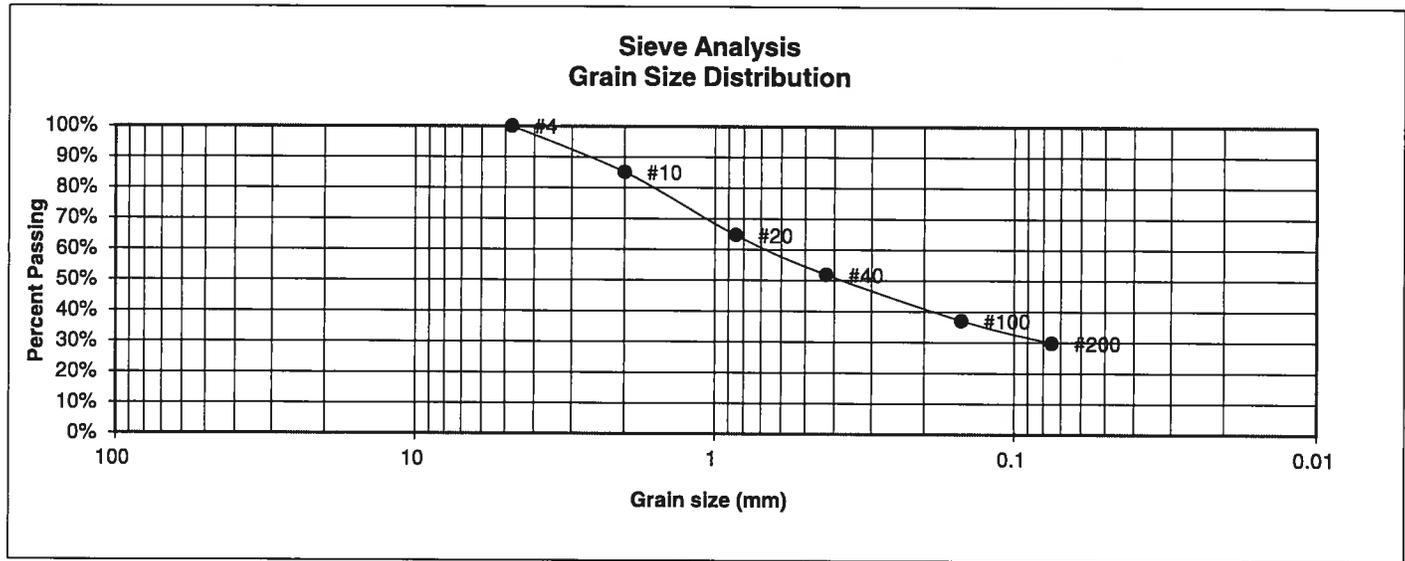
DATE: *5-19-22*

JOB NO.:
 220742

FIG NO.:
 A- 5

APPENDIX B: Laboratory Test Results

UNIFIED CLASSIFICATION	SC	CLIENT	ELITE PROPERTIES
SOIL TYPE #	1, CBR	PROJECT	FOREST LAKES, FILING 6
TEST BORING #	4	JOB NO.	220742
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	85.1%
20	64.7%
40	51.9%
100	37.0%
200	29.8%

Atterberg Limits	
Plastic Limit	14
Liquid Limit	23
Plastic Index	9

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



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**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED: *SW*

DATE:

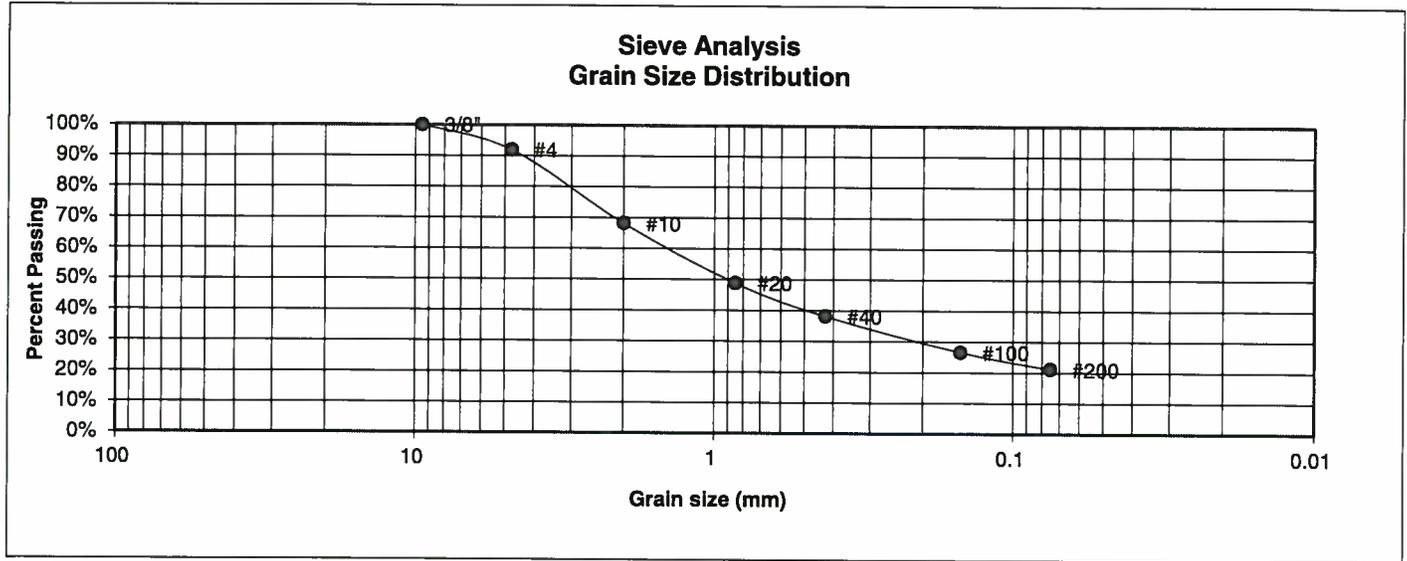
5-21-22

JOB NO.:

220742
FIG NO.:

B-1

UNIFIED CLASSIFICATION	SM	CLIENT	ELITE PROPERTIES
SOIL TYPE #	1	PROJECT	FOREST LAKES, FILING 6
TEST BORING #	1	JOB NO.	220742
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	91.9%
10	68.1%
20	48.8%
40	38.1%
100	26.6%
200	21.1%

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**

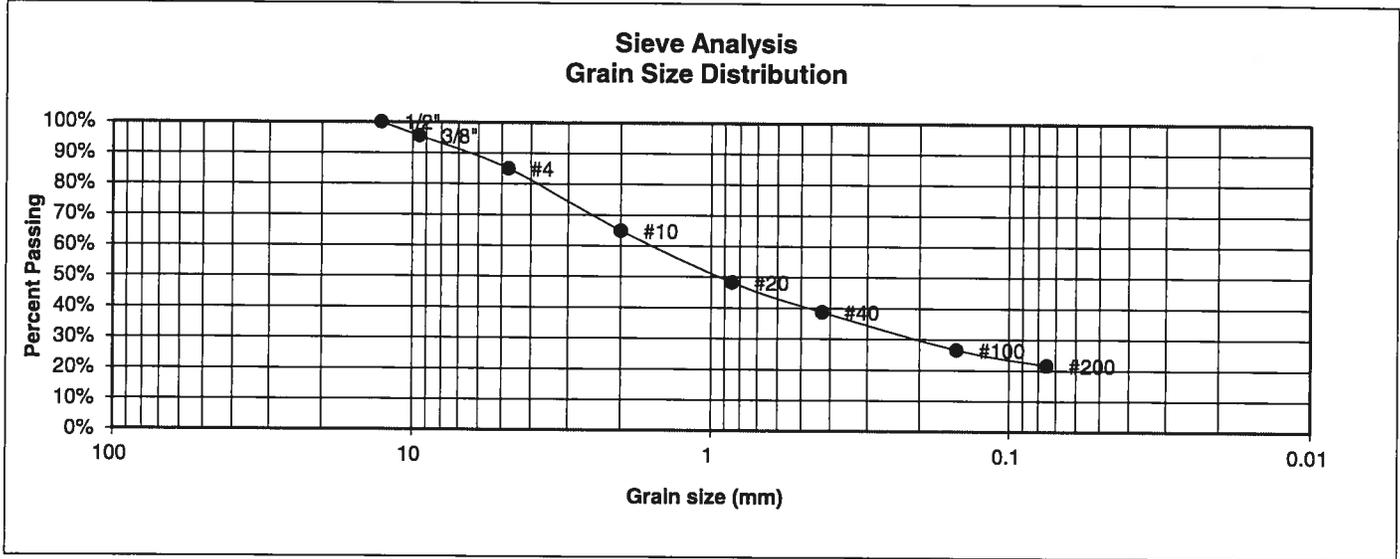
DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>5-21-22</i>
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JOB NO.:

220742
FIG NO.:

B-2

UNIFIED CLASSIFICATION	SC	CLIENT	ELITE PROPERTIES
SOIL TYPE #	1	PROJECT	FOREST LAKES, FILING 6
TEST BORING #	2	JOB NO.	220742
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	95.5%
4	85.0%
10	64.9%
20	48.2%
40	38.7%
100	26.6%
200	21.6%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	24
Plastic Index	7

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: *5-21-22*

JOB NO.:

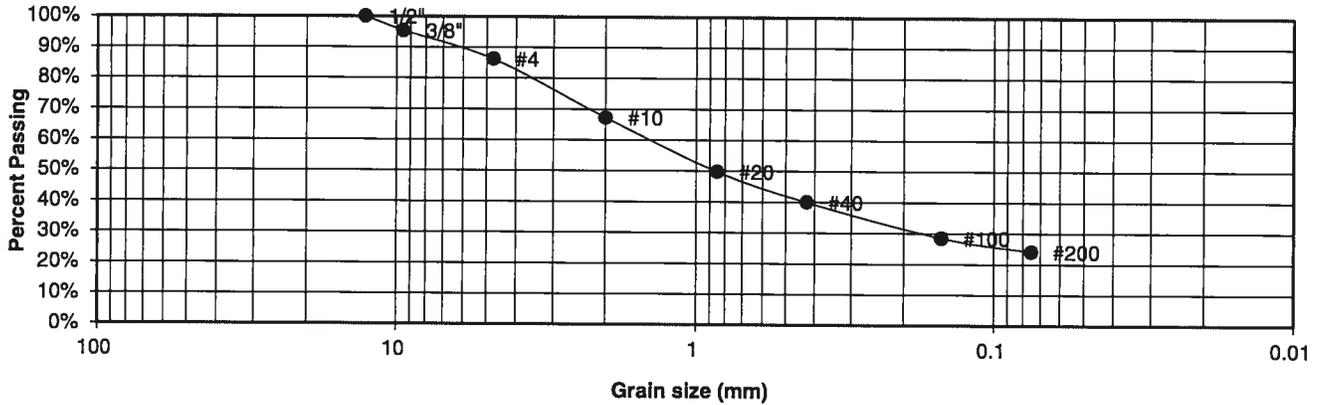
220742

FIG NO.:

B-3

UNIFIED CLASSIFICATION	SC	CLIENT	ELITE PROPERTIES
SOIL TYPE #	1	PROJECT	FOREST LAKES, FILING 6
TEST BORING #	3	JOB NO.	220742
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	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"	95.3%
4	86.2%
10	67.3%
20	49.8%
40	40.0%
100	28.5%
200	24.1%

Atterberg Limits	
Plastic Limit	14
Liquid Limit	24
Plastic Index	10

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



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**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>5-21-22</i>
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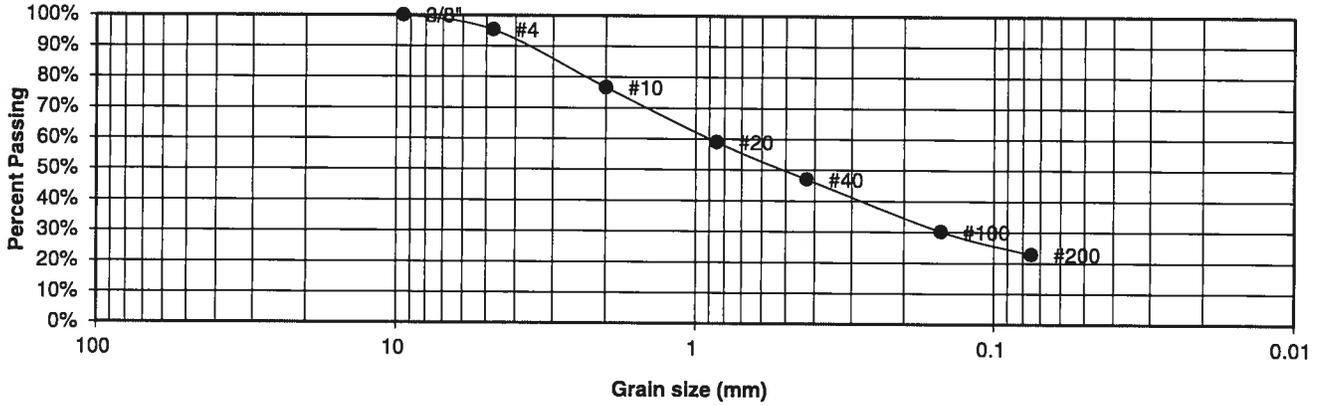
JOB NO.:

220742
FIG NO.:

B-4

UNIFIED CLASSIFICATION	SC-SM	CLIENT	ELITE PROPERTIES
SOIL TYPE #	1	PROJECT	FOREST LAKES, FILING 6
TEST BORING #	4	JOB NO.	220742
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	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	95.3%
10	76.6%
20	59.0%
40	47.0%
100	30.1%
200	22.8%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	21
Plastic Index	4

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: 5-21-22
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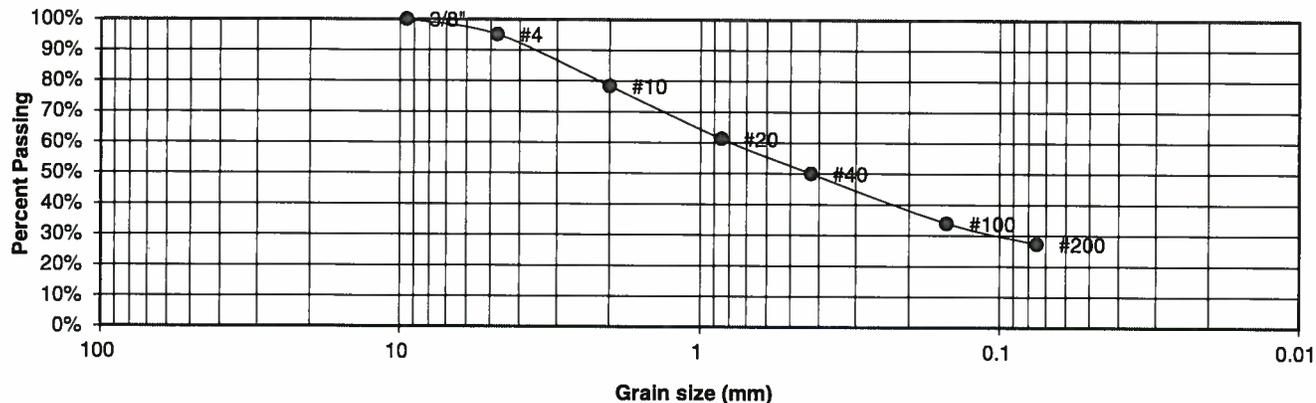
JOB NO.:

220742
FIG NO.:

B-5

UNIFIED CLASSIFICATION	SC	CLIENT	ELITE PROPERTIES
SOIL TYPE #	1	PROJECT	FOREST LAKES, FILING 6
TEST BORING #	5	JOB NO.	220742
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	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	95.0%
10	78.3%
20	61.3%
40	50.0%
100	34.0%
200	27.3%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	23
Plastic Index	7

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



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**LABORATORY TEST
RESULTS**

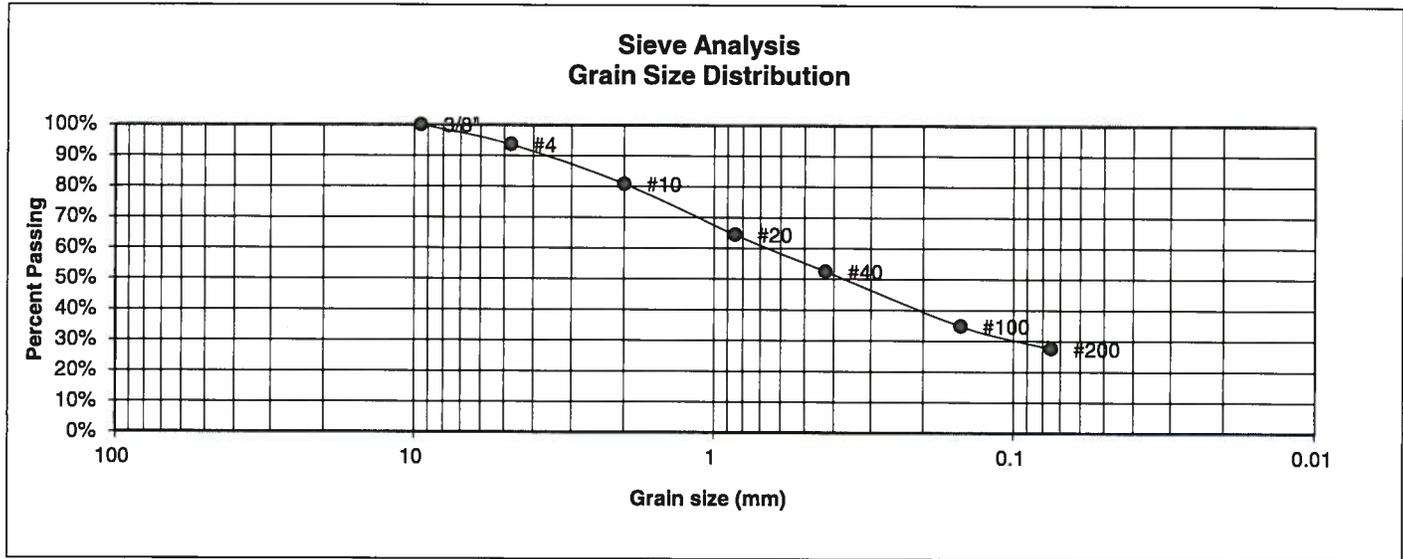
DRAWN:	DATE:	CHECKED: SW	DATE: 5-21-22
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JOB NO.:

220742
FIG NO.:

B-6

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	ELITE PROPERTIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	FOREST LAKES, FILING 6
<u>TEST BORING #</u>	6	<u>JOB NO.</u>	220742
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-4	<u>GROUP INDEX</u>	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	93.6%
10	80.9%
20	64.4%
40	52.5%
100	34.8%
200	27.5%

Atterberg Limits	
Plastic Limit	15
Liquid Limit	24
Plastic Index	9

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



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**LABORATORY TEST
RESULTS**

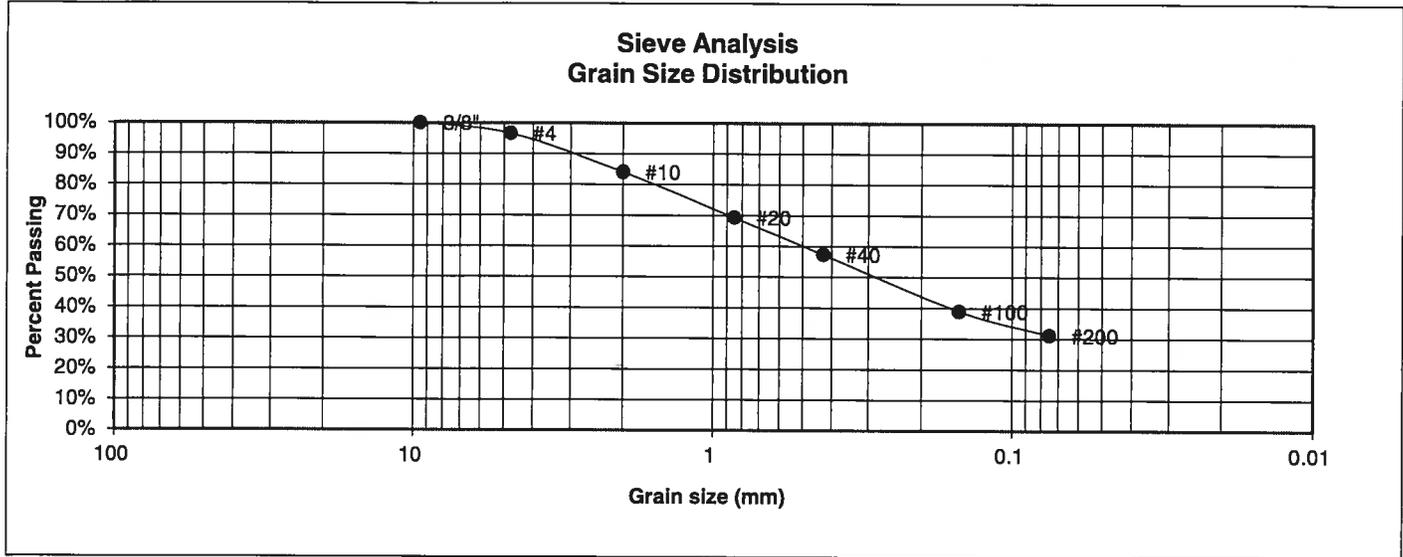
DRAWN:	DATE:	CHECKED: SW	DATE: 5-21-22
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JOB NO.:

220742
FIG NO.:

B-7

<u>UNIFIED CLASSIFICATION</u>	SC-SM	<u>CLIENT</u>	ELITE PROPERTIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	FOREST LAKES, FILING 6
<u>TEST BORING #</u>	7	<u>JOB NO.</u>	220742
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-4	<u>GROUP INDEX</u>	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.6%
10	84.0%
20	69.3%
40	57.3%
100	38.9%
200	31.2%

<u>Atterberg Limits</u>	
Plastic Limit	16
Liquid Limit	23
Plastic Index	7

<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**

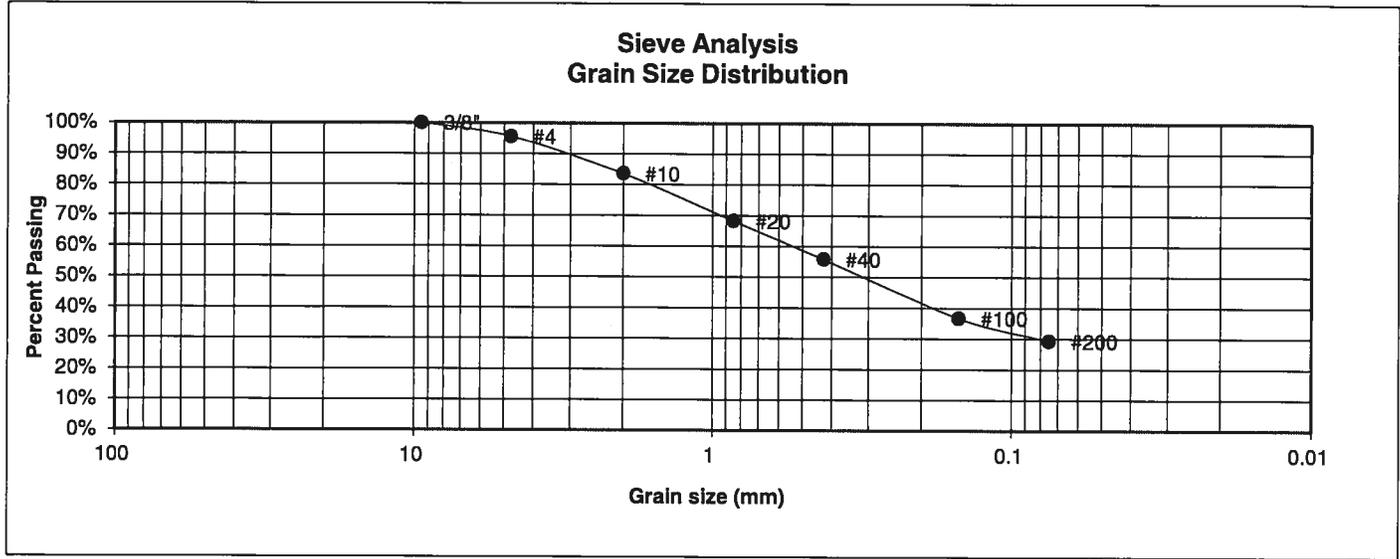
DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>5-21-22</i>
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JOB NO.:

220742
FIG NO.:

B-8

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	ELITE PROPERTIES
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	FOREST LAKES, FILING 6
<u>TEST BORING #</u>	8	<u>JOB NO.</u>	220742
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-4	<u>GROUP INDEX</u>	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.6%
10	83.6%
20	68.2%
40	55.8%
100	36.7%
200	29.3%

<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**

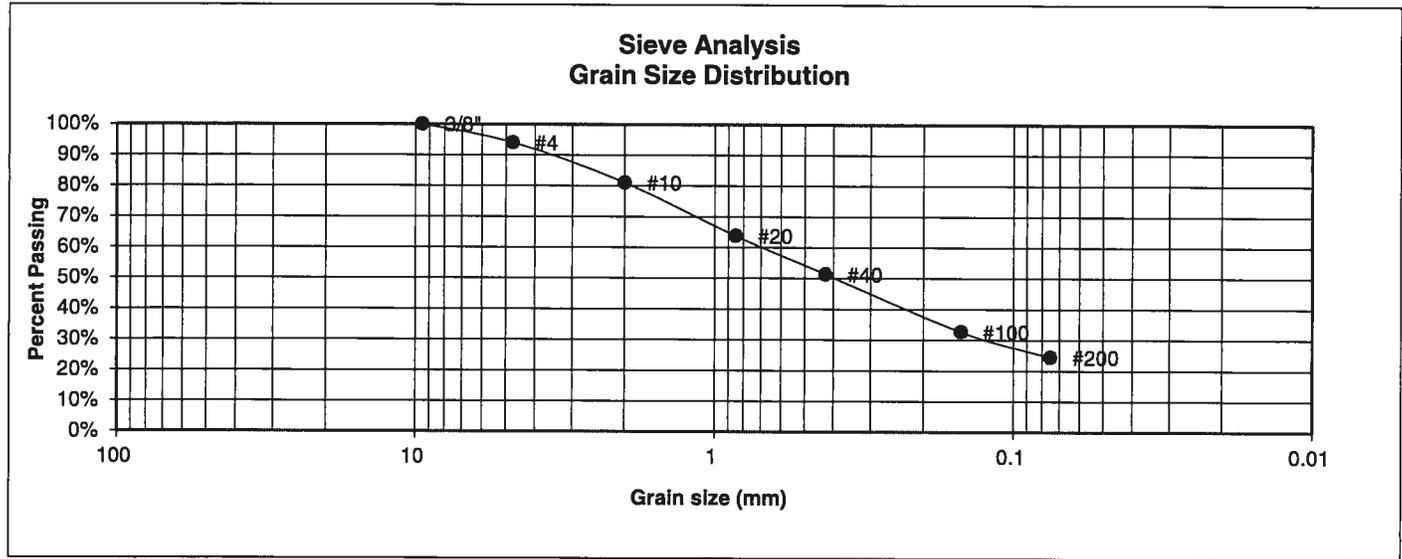
DRAWN:	DATE:	CHECKED:	DATE:
		SW	5-2-22

JOB NO.:

220742
FIG NO.:

B-9

UNIFIED CLASSIFICATION	SC	CLIENT	ELITE PROPERTIES
SOIL TYPE #	1	PROJECT	FOREST LAKES, FILING 6
TEST BORING #	9	JOB NO.	220742
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.0%
10	81.1%
20	63.8%
40	51.4%
100	32.6%
200	24.4%

Atterberg Limits	
Plastic Limit	14
Liquid Limit	23
Plastic Index	9

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



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**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: SW	DATE: 5-21-22
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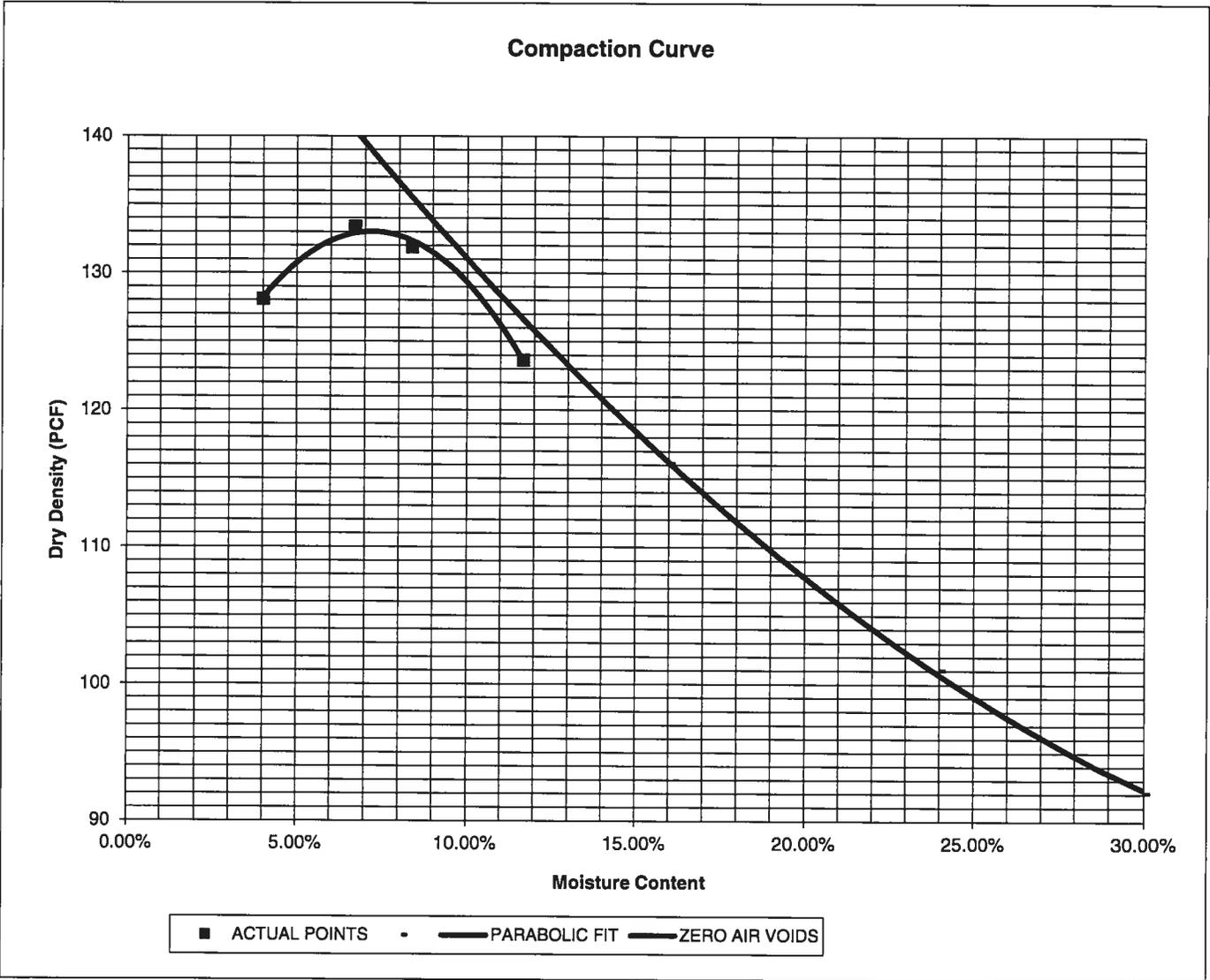
JOB NO.:

220742
FIG NO.:

B-10

PROJECT	FOREST LAKES, FILING 6	CLIENT	ELITE PROPERTIES
SAMPLE LOCATION	TB-4 @ 0-3'	JOB NO.	220742
SOIL DESCRIPTION	SAND, CLAYEY, RED BROWN	DATE	05/06/22

IDENTIFICATION	SC	COMPACTION TEST #	1
TEST DESIGNATION / METHOD	ASTM D-1557-A	TEST BY	BC
MAXIMUM DRY DENSITY (PCF)	133.2	OPTIMUM MOISTURE	7.2%



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MOISTURE DENSITY RELATION

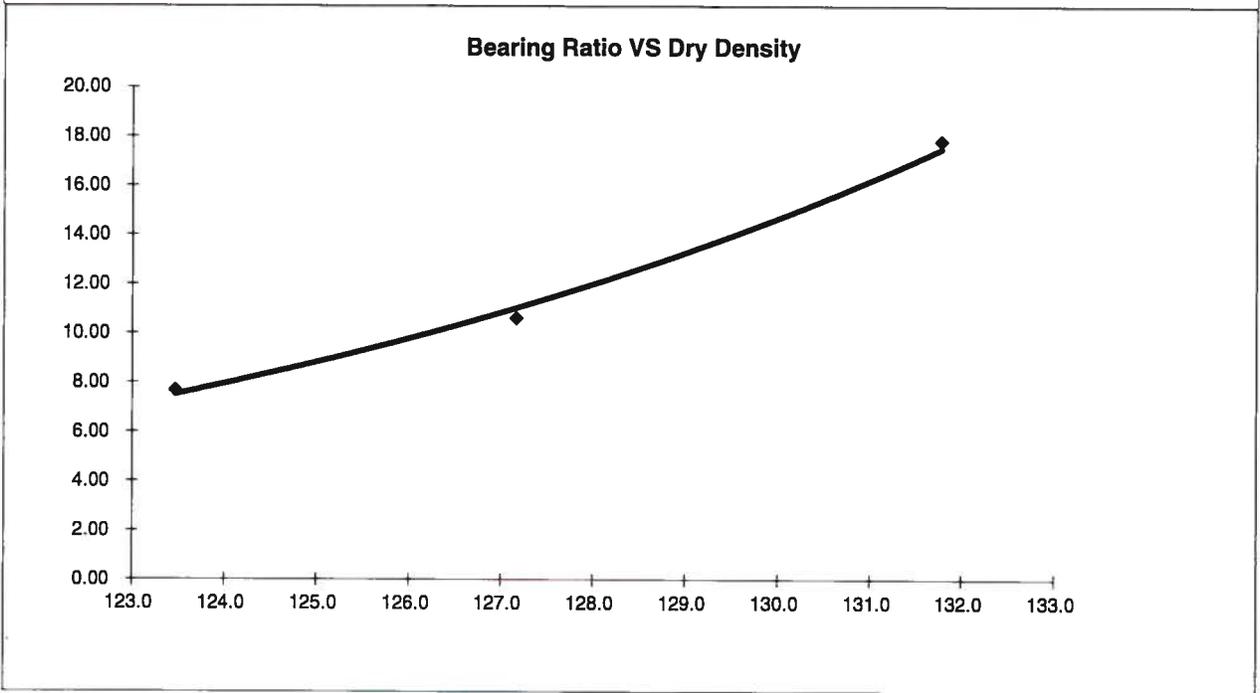
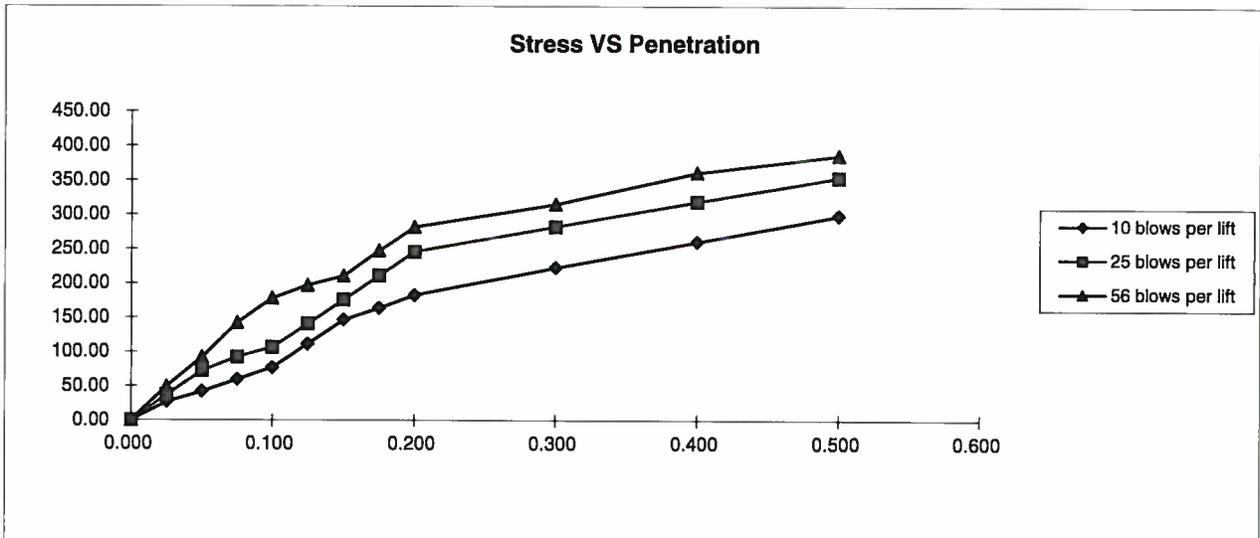
DRAWN:	DATE:	CHECKED:	DATE:
		SW	5-21-22

JOB NO.:

220742

FIG NO.:

B-12



BEARING RATIO AT 90% OF MAX	4.83 ~ R VALUE	10.00
BEARING RATIO AT 95% OF MAX	10.12 ~ R VALUE	30.00

JOB NO: 220742
 SOIL TYPE: 1



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CALIFORNIA BEARING RATIO

DRAWN:

DATE:

CHECKED: *SW*

DATE: *5-21-22*

JOB NO:
 220742

FIG NO:
B-14

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA

CLASSIC COMMUNITIES - FOREST LAKES # 6 - PHASE # 2
SOIL TYPE 1 - MESA TOP DRIVE NORTH

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

Weighted Structural Number (WSN): ➔ WSN = 2.68

DESIGN TABLES AND EQUATIONS

$$S_1 = [(R - 5) / 11.29] + 3$$

$$M_R = 10^{[(S_1 + 18.72) / 6.24]}$$

$$k = M_R / 19.4$$

Where:

M_R = resilient modulus (psi)

S_1 = the soil support value

R = R-value obtained from the Hveem stabilometer

CBR = California Bearing Ratio

Reliability (%) Z_R (z-statistic)

80	-0.84
85	-1.04
90	-1.28
93	-1.48
94	-1.56
95	-1.65
96	-1.75
97	-1.88
98	-2.05
99	-2.33
99.9	-3.09
99.99	-3.75

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

Left	Right	Difference
5.47	5.46	0.0

Job No. 220742
Fig. No. C-1

DESIGN CALCULATIONS

AGGREGATE BASECOURSE SECTIONS

DESIGN DATA CLASSIC COMMUNITIES - FOREST LAKES # 6- PHASE # 2
SOIL TYPE 1 - MESA TOP DRIVE NORTH

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

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

$C_1 = 0.44$ Strength Coefficient - Hot Bituminous Asphalt

$C_2 = 0.11$ Strength Coefficient - Aggregate Base Course

$D_1 =$ Depth of Asphalt (inches)

$D_2 =$ Depth of Base Course (inches)

FOR FULL DEPTH ASPHALT SECTION (CURRENTLY NOT ALLOWED)

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

FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = inches

$D_2 = ((WSN) - (t)(C_1))/C_2 = 8.0$ inches of Aggregate
Base Course, use 8.0 inches

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 8.0 inches of Aggregate Base Course, or
2. 6.5 inches of Full Depth Asphalt

Job No. 220742

Fig. No. C-2

DESIGN CALCULATIONS

CEMENT TREATED SECTIONS

DESIGN DATA: CLASSIC COMMUNITIES - FOREST LAKES # 6- PHASE # 2
SOIL TYPE 1 - MESA TOP DRIVE NORTH

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

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

$C_1 = 0.44$ Strength Coefficient - Hot Bituminous Asphalt
 $C_2 = 0.11$ Strength Coefficient - Cement Treated Subgrade.

$D_1 =$ Depth of Asphalt (inches)

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

FOR FULL DEPTH ASPHALT SECTION - (CURRENTLY NOT ALLOWED)

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

FOR ASPHALT + CEMENT TREATED SUBGRADE SECTION

Asphalt Thickness (t) = 4 inches

$D_2 = ((WSN) - (t)(C_1))/C_2 = 8.4$ inches

Use 10.0 inches of Cement Treated Subgrade.

RECOMMENDED ALTERNATIVES

1. 5.0 inches of Asphalt + 10 inches of Cement Treated Subgrade.
2. 6.5 inches of Full Depth Asphalt

Job No. 220742

Fig. No. C-3