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

October 19, 2023

Tech Contractors
3575 Kenyon Street, Suite 200
San Diego, California 92110

Attn: Raul Guzman

Re: Pavement Recommendations
The Sanctuary at Meridian Ranch – Filing No. 1, Phase No. 2
El Paso County, Colorado
Entech Job No. 230523

Dear Mr. Guzman:

As requested, Entech Engineering, Inc. (Entech) obtained samples of the pavement subgrade soils from the roadways in The Sanctuary at Meridian Ranch Subdivision, Filing No. 1, Phase No. 2 in El Paso County, Colorado. This letter presents the results of the subsurface soil investigation and laboratory testing and provides pavement recommendations for the roadway sections within Phase 2 of the filing.

Project Description

The roadways for this project consist of sections of Arriba Drive and Nederland Drive, within Filing No. 1. The roadways are located within a proposed residential neighborhood.

Subsurface Explorations and Laboratory Testing

Subsurface conditions at the project site were explored by 5 test borings, designated, TB-101 through TB-105, on October 4, 2023. The locations of the test borings are shown on the Test Boring Location Map (Figure 1). The borings were drilled to depths of 5 and 10 feet below the existing ground surface (bgs). The drilling was performed using a truck-mounted, continuous flight auger drill rig supplied and operated by Entech. Descriptive boring logs of the subsurface conditions encountered during drilling are presented in Appendix A. Groundwater levels were measured in each of the open boreholes at the conclusion of drilling.

Soil samples were obtained from the borings utilizing the Standard Penetration Test (ASTM D1586) using a split-barrel California sampler. Results of the Standard Penetration Test (SPT) are included on the boring logs in terms of N-values expressed in blows per foot (bpf). Soil samples recovered from the borings were visually classified and recorded on the boring logs. The soil classifications were later verified utilizing laboratory testing and grouped by soil type. The soil type numbers are included on the boring logs. It should be understood that the soil descriptions shown on the boring logs may vary between boring location and sample depths. It should also be noted that the lines of stratigraphic separation shown on the boring logs represent approximate boundaries between soil types and the actual stratigraphic transitions may be more gradual or variable with location.

Water content testing (ASTM D2216) was performed on the samples recovered from the borings, and the results are shown on the boring logs. Grain-Size Analysis (ASTM D422) and Atterberg Limits testing (ASTM D4318) were performed on selected samples to assist in classifying the materials encountered in the borings. Swell/Consolidation testing (ASTM D4546) was performed to evaluate the expansive/compressive characteristics of the roadway subgrade. Soluble sulfate testing was performed on select soil samples to evaluate the potential for below grade degradation of concrete due to sulfate attack. The laboratory testing results are

summarized on Table B-1 and are presented in Appendix B. Select laboratory test results from the Phase 1 subsurface soil investigation including the Soil Type 1 CBR results and a summary table of all previously completed tests are provided in Appendix D.

Subgrade Conditions

Subsurface conditions along the proposed roadways consisted of silty to clayey sand fill (Soil Type 1) and sandstone bedrock (Soil Type 5), which was generally located below the zone of subgrade influence. Soil types and corresponding AASHTO soil classification are listed below:

- Soil Type 1: A-1-b and A-2-6
- Soil Type 5: A-6

Groundwater was not encountered in the test borings.

Water soluble sulfate tests results indicated that the soils exhibit a negligible potential for sulfate attack.

Based on the soil classifications and swell test results, swell mitigation is not required for the site. All A-6 materials were encountered below the zone of influence for pavements.

The soil classifications for Soil Type 1 encountered in Phase 1 and Phase 2 both classify as A-1-b and A-2-6 soils. Based on the similarities in subgrade conditions encountered during the Phase 1 and Phase 2 explorations, the design subgrade California Bearing Ratio (CBR) testing completed for Phase 1 are applicable for Phase 2. Refer to the Pavement Recommendations Report for The Sanctuary at Meridian Ranch – Filing No. 1, Phase No. 1, dated April 27, 2023, Entech Job No. 230532 and Appendix D.

CBR testing was performed on a representative sample of Soil Type 1 from TB-6 in the Phase 1 Subsurface Soil Investigation and was used to determine the support characteristic of the subgrade soils for the roadway sections. The results of the CBR testing, are presented in Appendix B, D and summarized as follows:

Exhibit 1: Subsurface Laboratory Testing Summary

Design Parameter	Value
Soil Type	1 – Clayey Sand
CBR at 95%	10.33
Design CBR	10
Liquid Limit	26
Plasticity Index	11
Percent Passing 200	32.0
AASHTO Classification	A-2-6
Group Index	0
Unified Soils Classification	SC

Pavement Design

The CBR testing was used to determine the design subgrade modulus for the roadway. The pavement sections were determined utilizing the El Paso County “Pavement Design Criteria Manual”. ESAL values were obtained from the Traffic Impact Study performed by LSC Transportation Consultants, LLC dated May 5, 2023, LSC Job No. S224190. The recommended street classifications are also shown in Figure No. 1. Nederland Drive and Arriba Drive classify as urban local roads, which uses an 18K ESAL value of 292,000 for design.

Alternative pavement sections for asphalt supported on aggregate base course (ABC) or recycled concrete, and asphalt supported on cement stabilized subgrade (CTS) are provided. Design parameters used in the pavement analysis are presented in Exhibit 2.

Exhibit 2: Pavement Design Parameters

Design Parameter	Value
Reliability (Urban Local)	80%
Standard Deviation	0.45
Serviceability Loss (Δ psi)	2.0
Design CBR	10
Resilient Modulus - Soil Type 1	15,000 psi
Structural Coefficients	
HMA	0.44
ABC	0.11
CTS	0.11

The pavement design calculations are presented in Appendix C. 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 recommended for this phase of the filing are summarized in Exhibit 3.

Exhibit 3: Recommended Pavement Sections

Pavement Area	Design ESAL	Alternative
Arriba Dr. and Nederland Dr.	292,000	1. 4.0 inches HMA over 8.0 inches ABC
		2. 4.0 inches HMA over 10.0 inches of CTS

ABC = Aggregate Base Course; ESAL = equivalent single axle loads; HMA = Hot Mix Asphalt; CTS = Cement Treated Subgrade

Notes:
1. All pavement alternatives represent the minimum sections required per El Paso County Pavement Design Criteria Manual.
2. Full depth sections are not recommended by El Paso County.

Swelling Soils Mitigation

El Paso County criteria requires mitigation of expansive soils for roadway subgrade that have a swell of 2% or greater with a 150 pound per square foot surcharge. Swell testing on Soil Type 5 from TB-103 indicated a swell of 0.9% and is below the zone of influence for pavements.

If encountered, areas with high clay contents (AASHTO A-6 material) will require removal and replacement with granular fill to a depth of 18 inches. The extents of any cohesive material overexcavation should be field determined.

Roadway Construction –Aggregate Base Course Alternatives

If pavement section alternatives are selected utilizing ABC, the final subgrade surface should be scarified to a depth of 12 inches, moisture conditioned within 0% to 3% over the optimum water content, and recompacted to 95% of its maximum Modified Proctor dry density, ASTM D1557. Any A-6 material identified during scarification should be removed and replaced as discussed in the Swelling Soils Mitigation Section.

The compacted surface below pavements should be proof-rolled with a fully loaded, tandem-axle, 10-yard dump truck or equivalent. Any areas that are delineated to be soft, loose, or yielding during proof-rolling should be removed and reconditioned or replaced.

ABC materials shall conform to the Table D-6 from the El Paso County Pavement Design Criteria and Report. ABC materials should be compacted to a minimum of 95% of its maximum Modified Proctor Dry Density (ASTM D1557) at +/-2% of optimum moisture content.

Roadway Construction – Stabilized Subgrade Alternative

Prior to placement of the asphalt, the subgrade shall be stabilized by the addition of cement to a depth of at least 10 inches if CTS alternatives are selected. The amount of cement applied shall be a minimum of 2% (by weight) of the subgrade's maximum dry density as determined by the Modified Proctor Test (ASTM D1557) or by the Standard Proctor Test (ASTM D698). Local practice typically recommends that the design mix be increased by 1% in the field to account for waste and construction variability. The cement should be spread evenly on the subgrade surface and be thoroughly mixed into the subgrade over a 10-inch depth, as specified, 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% more than the optimum water content as necessary to provide compactable soil conditions. Densification of the cement-stabilized subgrade should be completed to obtain a compaction of at least 95% of the subgrade maximum dry density as determined by the Modified Proctor Test (ASTM D1557) or by the Standard Proctor Test (ASTM D698). Satisfactory compaction of the subgrade shall occur within 90 minutes from the time of mixing the cement into the subgrade. Structural coefficients used for pavement design assume a minimum 7 day strength of 125 psi.

Strength testing was performed on a soil/cement composite sample. Testing was performed on soil samples prepared with 2% and 4% Portland Cement Type 1/2. The 5-day average strength values of the 2% mix was 210 psi. The 5-day average strength values of the 4% mix was 222 psi. A 2% mix is recommended based on the laboratory test results. A summary of the testing results is attached in Appendix D, Table D-2.

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^{o} F. Cement treated subgrades should be maintained at a temperature of 40^{o} 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.

- Pending the results of the field density testing, microfracturing of the stabilized subgrade may be required. Soil strengths in excess of 275 psi require microfracturing.

In addition to the above guidance, the asphalt, cement, subgrade conditions, compaction of materials, and roadway construction methods shall meet the El Paso County Pavement Design Criteria and the Pikes Peak Region Asphalt Paving Specifications.

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

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Daniel P. Stegman
Geotechnical Engineering Staff

Reviewed by:

COLORADO LICENSED
JOSEPH C GOODE III
52381
PROFESSIONAL ENGINEER

Digitally signed by Joseph C Goode III
Date: 2023.10.19 15:38:14 -06'00'

Joseph C. Goode III, P.E.
Sr. Engineer

Encl.

SW:JCG/jcg
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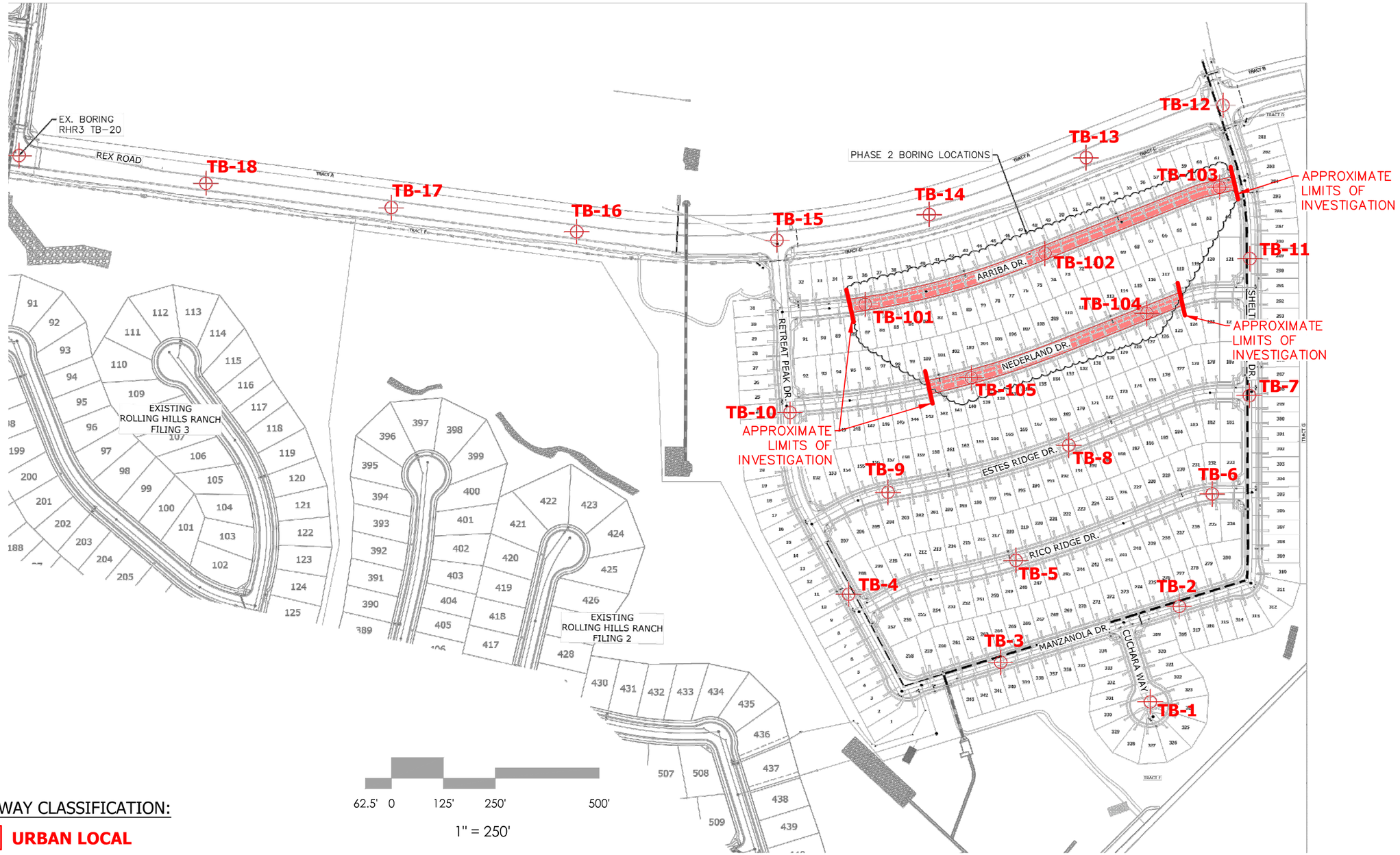

ROADWAY CLASSIFICATION:

URBAN LOCAL

TB-1 - TB-18 APPROXIMATE TEST BORING LOCATION AND NUMBER (DRILLED APRIL 6, 2023)

TB-101 - TB-105 APPROXIMATE TEST BORING LOCATION AND NUMBER (DRILLED OCTOBER 4, 2023)

REVISION	BY

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
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TEST BORING LOCATION MAP
THE SANCTUARY AT MERIDIAN RANCH,
FILING 1, PHASE 2
EL PASO COUNTY, COLORADO
FOR: TECH CONTRACTORS

DRAWN	JAC
CHECKED	DPS
DATE	10/16/23
SCALE	1"=250'
JOB NO.	230532
FIGURE No.	1

APPENDIX A: Test Boring Logs

TEST BORING 101
DATE DRILLED 10/4/2023

REMARKS

DRY TO 5', 10/4/23

FILL 0-5', SAND, CLAYEY, OLIVE, LOOSE to MEDIUM DENSE,

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			8	5.2	1
5			16	8.8	1
10					
15					
20					

TEST BORING 102
DATE DRILLED 10/4/2023

REMARKS

DRY TO 5', 10/4/23

FILL 0-5', SAND, CLAYEY, BROWN to OLIVE, MEDIUM DENSE to LOOSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			13	8.6	
5			9	5.0	
10					
15					
20					

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TEST BORING LOGS

SANCTUARY AT MERIDIAN RANCH
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FIG. A-1

TEST BORING 103
DATE DRILLED 10/4/2023

REMARKS

DRY TO 10', 10/4/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-4', SAND, CLAYEY, BROWN, LOOSE, MOIST			5	9.2	1
SANDSTONE, WEAK, OLIVE, MODERATELY WEATHERED (SAND, CLAYEY, VERY DENSE, MOIST)			50/10"	7.3	5
			50/5"	10.0	5

TEST BORING 104
DATE DRILLED 10/4/2023

REMARKS

DRY TO 5', 10/4/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-5', SAND, SILTY, BROWN, MEDIUM DENSE to LOOSE,			15	8.3	1
			8	4.4	1

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TEST BORING LOGS

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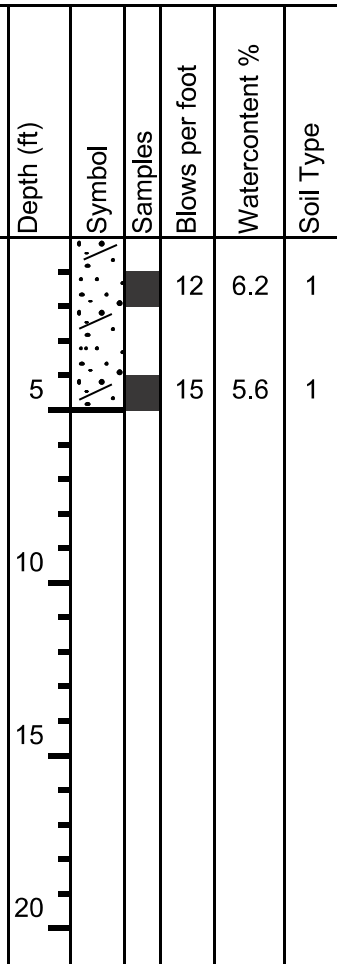
FIG. A-2

TEST BORING 105
DATE DRILLED 10/4/2023

REMARKS

DRY TO 5', 10/4/23



FILL 0-5', SAND, CLAYEY, DARK BROWN to TAN, MEDIUM DENSE, MOIST	12	6.2	1
	15	5.6	1

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TEST BORING LOGS

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TECH CONTRACTORS

JOB NO. 230532

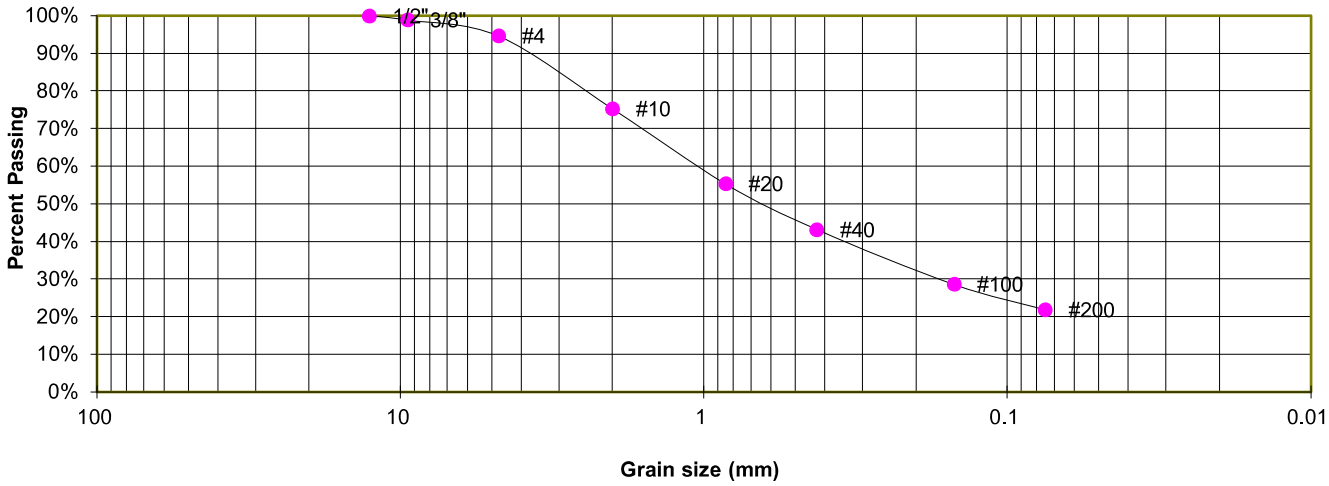
FIG. A-3

APPENDIX B: Laboratory Test Results

TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SULFATE (WT %)	SWELL/ CONSOL (%)	AASHTO CLASS.	USCS	SOIL DESCRIPTION
1	104	0-3			21.9	NV	NP	NP			A-1-b	SM	FILL, SAND, SILTY
1	102	1-2			28.6	35	17	18	<0.01		A-2-6	SC	FILL, SAND, CLAYEY
1	104	1-2			19.1	NV	NP	NP	<0.01		A-1-b	SM	FILL, SAND, SILTY
1	105	1-2			20.3	NV	NP	NP			A-1-b	SM	FILL, SAND, SILTY
1	101	1-2			23.5	27	20	7			A-2-4	SC	FILL, SAND, CLAYEY
1	103	1-2			21.7	27	14	13			A-2-6	SC	FILL, SAND, CLAYEY
5	103	10	7.9	122.5	45.4	29	16	13	<0.01	0.9	A-6	SC	SANDSTONE (SAND, CLAYEY)
1, CBR #1	6	0-3			32.0	26	11	15			A-2-6	SC	FILL, SAND, CLAYEY

TEST BORING 104	SOIL DESCRIPTION FILL, SAND, SILTY
DEPTH (FT) 0-3	SOIL TYPE 1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.9%
4	94.6%
10	75.3%
20	55.3%
40	43.2%
100	28.6%
200	21.9%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SM
AASHTO CLASSIFICATION:	A-1-b
AASHTO GROUP INDEX:	0

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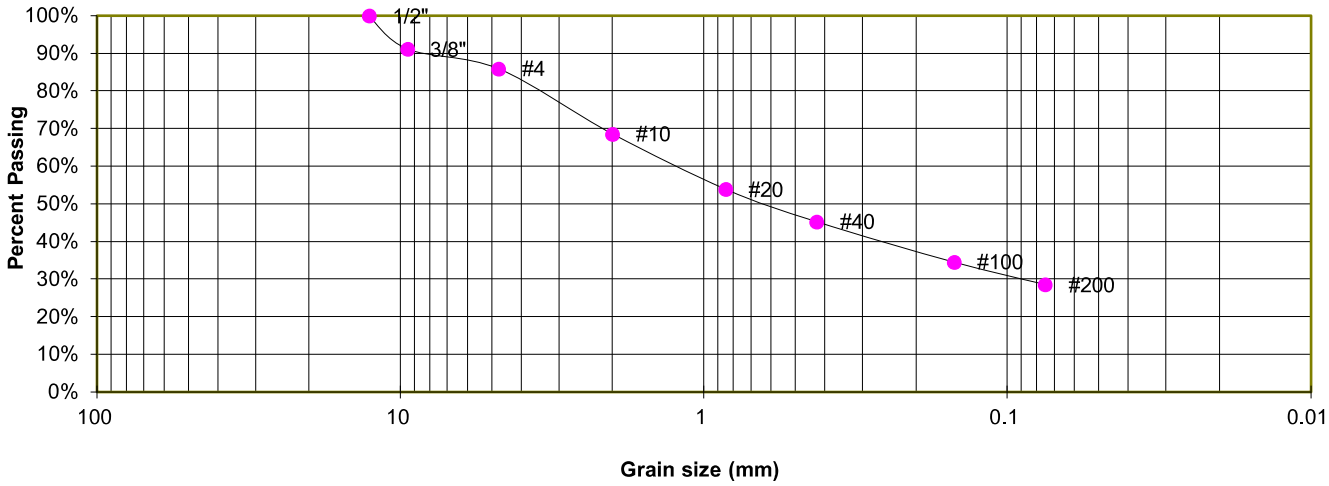
LABORATORY TEST RESULTS

SANCTUARY AT MERIDIAN RANCH
TECH CONTRACTORS

JOB NO. 230532

FIG. B-1

TEST BORING	102	SOIL DESCRIPTION	FILL, SAND, CLAYEY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	91.2%
4	85.9%
10	68.6%
20	53.9%
40	45.3%
100	34.6%
200	28.6%

ATTERBERG LIMITS

Plastic Limit	17
Liquid Limit	35
Plastic Index	18

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SC
AASHTO CLASSIFICATION:	A-2-6
AASHTO GROUP INDEX:	1

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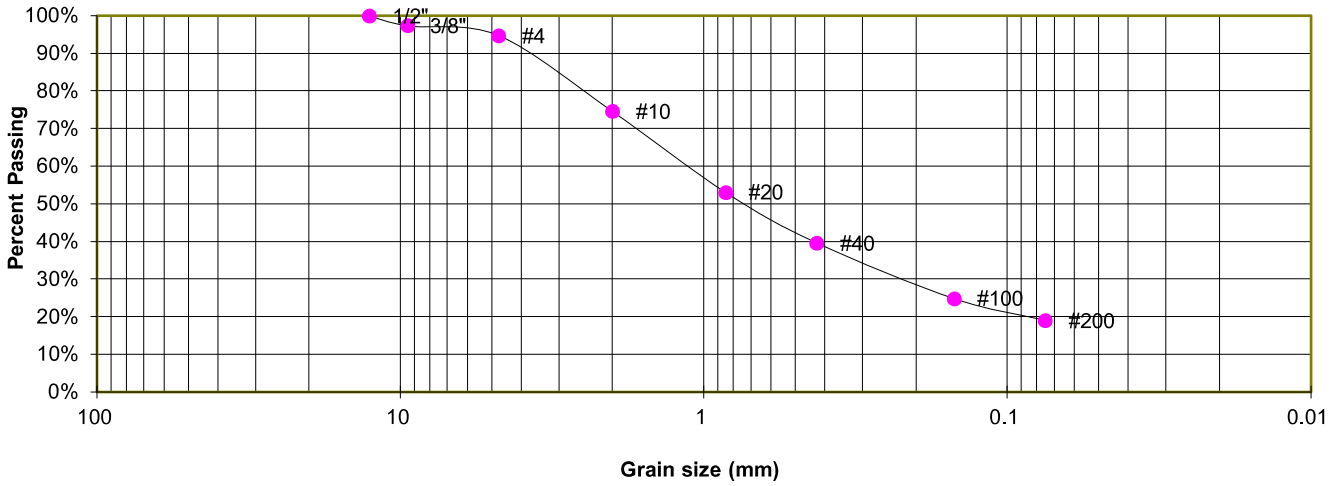
LABORATORY TEST RESULTS

SANCTUARY AT MERIDIAN RANCH
TECH CONTRACTORS

JOB NO. 230532

FIG. B-2

TEST BORING	104	SOIL DESCRIPTION	FILL, SAND, SILTY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.4%
4	94.7%
10	74.6%
20	53.1%
40	39.6%
100	24.9%
200	19.1%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SM
AASHTO CLASSIFICATION:	A-1-b
AASHTO GROUP INDEX:	0

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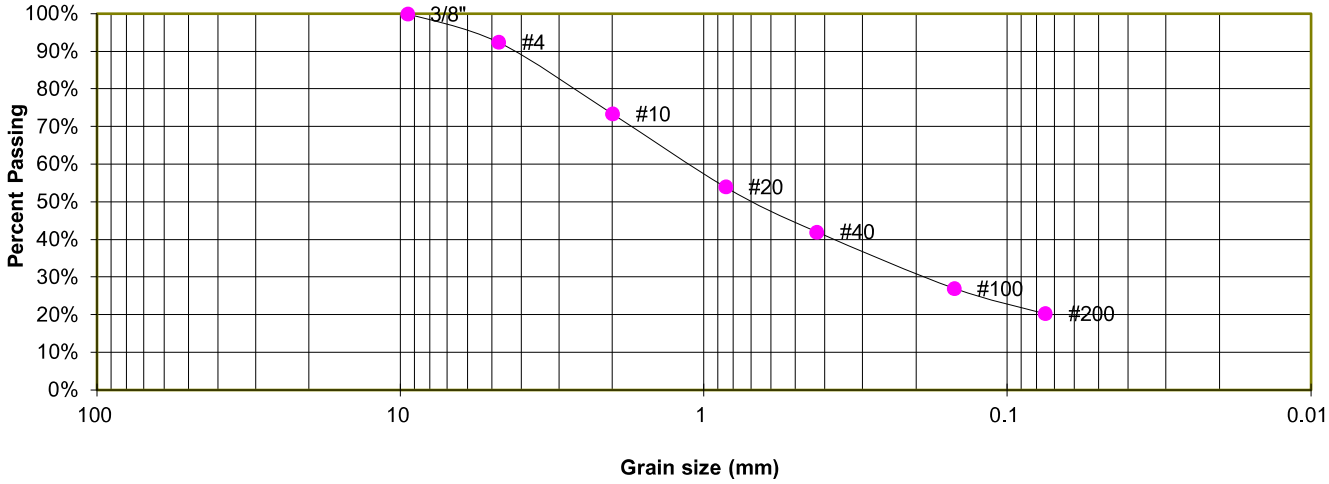
LABORATORY TEST RESULTS

SANCTUARY AT MERIDIAN RANCH
TECH CONTRACTORS

JOB NO. 230532

FIG. B-3

TEST BORING	105	SOIL DESCRIPTION	FILL, SAND, SILTY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	92.5%
10	73.4%
20	54.0%
40	42.1%
100	27.1%
200	20.3%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SM
AASHTO CLASSIFICATION:	A-1-b
AASHTO GROUP INDEX:	0

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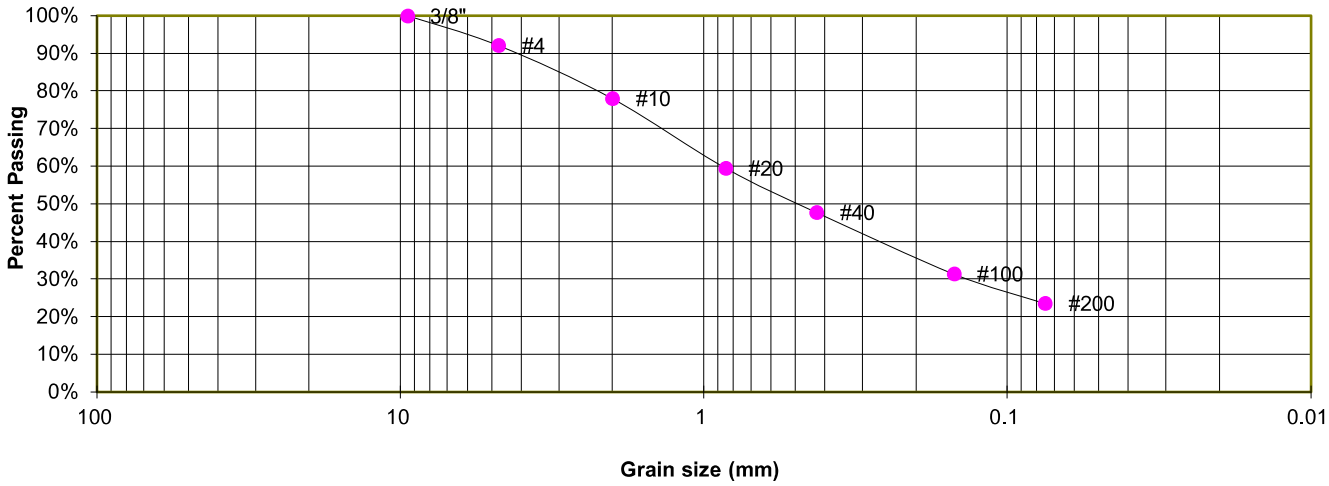
LABORATORY TEST RESULTS

SANCTUARY AT MERIDIAN RANCH
TECH CONTRACTORS

JOB NO. 230532

FIG. B-4

TEST BORING	101	SOIL DESCRIPTION	FILL, SAND, CLAYEY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	92.1%
10	78.0%
20	59.5%
40	47.7%
100	31.4%
200	23.5%

ATTERBERG LIMITS

Plastic Limit	20
Liquid Limit	27
Plastic Index	7

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SC
AASHTO CLASSIFICATION:	A-2-4
AASHTO GROUP INDEX:	0

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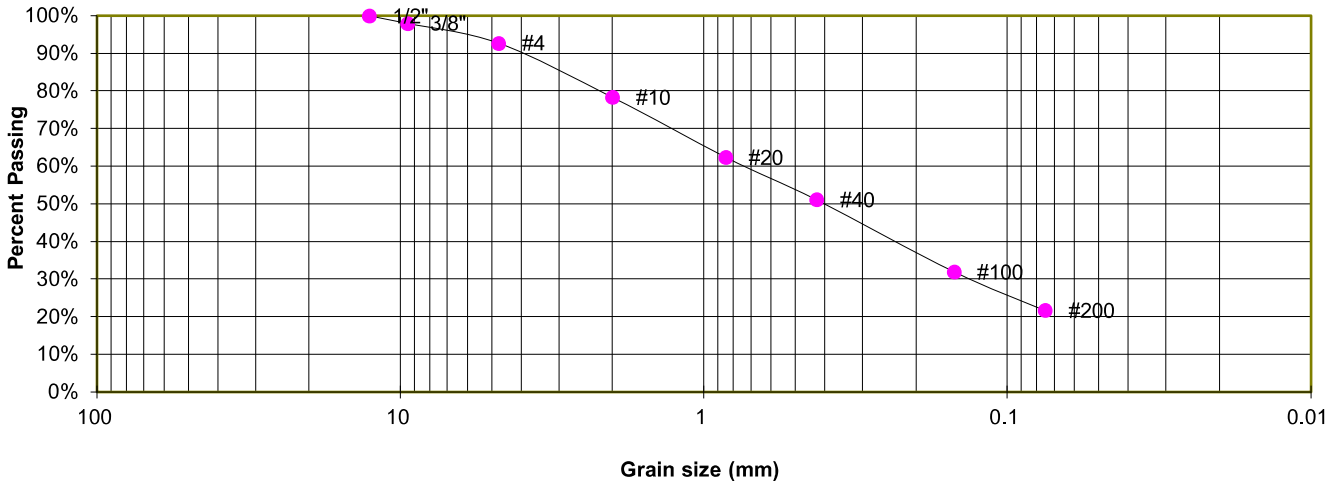
LABORATORY TEST RESULTS

SANCTUARY AT MERIDIAN RANCH
TECH CONTRACTORS

JOB NO. 230532

FIG. B-5

TEST BORING	103	SOIL DESCRIPTION	FILL, SAND, CLAYEY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.0%
4	92.7%
10	78.3%
20	62.4%
40	51.1%
100	32.0%
200	21.7%

ATTERBERG LIMITS

Plastic Limit	14
Liquid Limit	27
Plastic Index	13

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SC
AASHTO CLASSIFICATION:	A-2-6
AASHTO GROUP INDEX:	0

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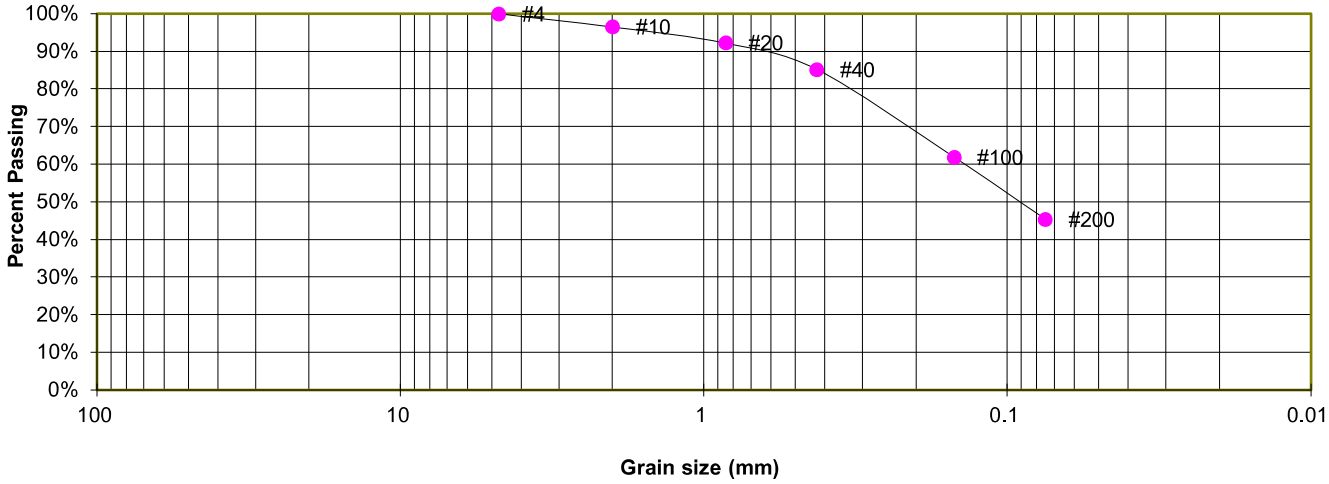
LABORATORY TEST RESULTS

SANCTUARY AT MERIDIAN RANCH
TECH CONTRACTORS

JOB NO. 230532

FIG. B-6

TEST BORING	103	SOIL DESCRIPTION	SANDSTONE (SAND, CLAYEY)
DEPTH (FT)	10	SOIL TYPE	5



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	96.5%
20	92.3%
40	85.2%
100	61.9%
200	45.4%

ATTERBERG LIMITS

Plastic Limit	16
Liquid Limit	29
Plastic Index	13

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SC
AASHTO CLASSIFICATION:	A-6
AASHTO GROUP INDEX:	2

ENTECH ENGINEERING, INC.

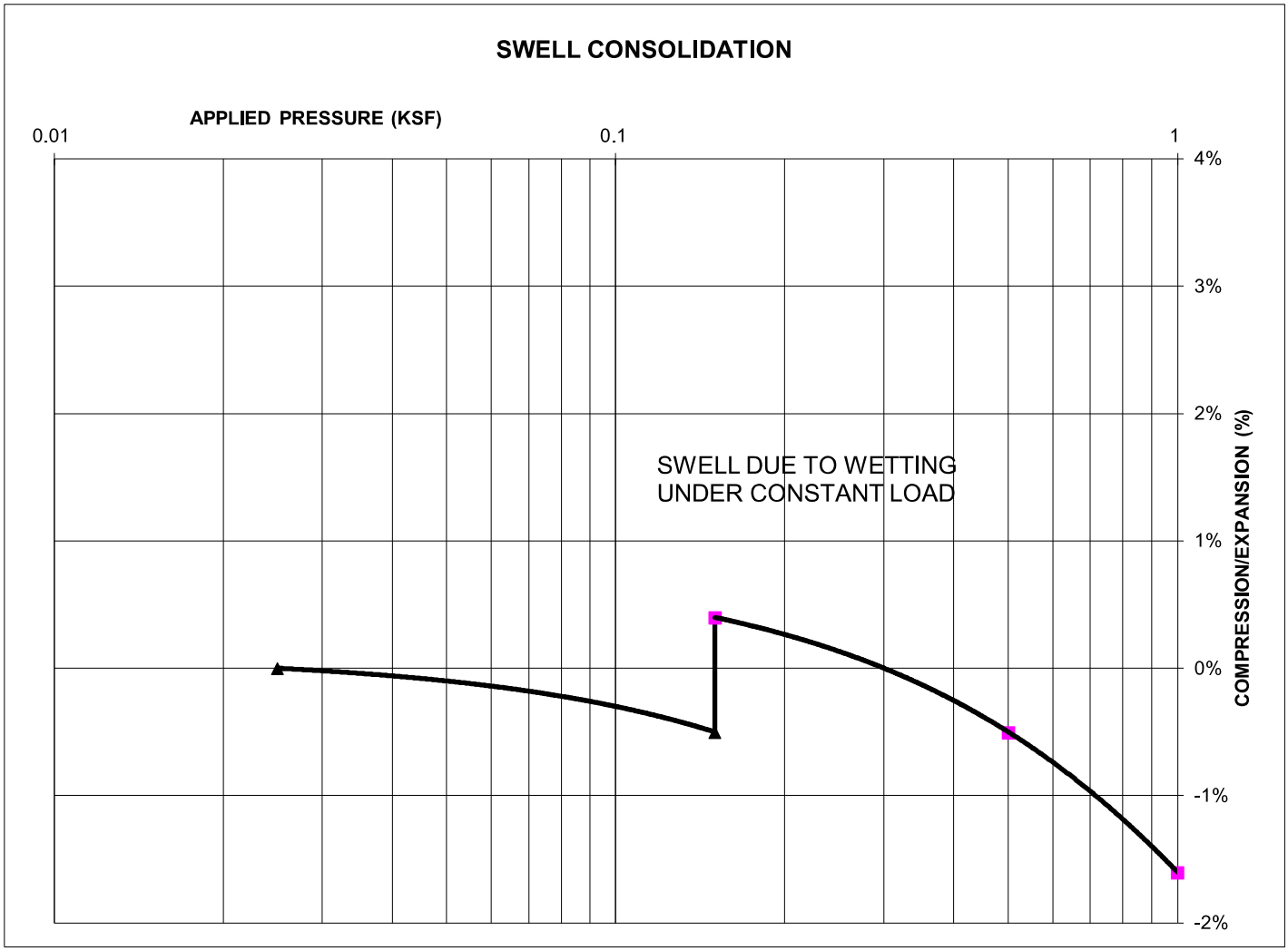
LABORATORY TEST RESULTS

SANCTUARY AT MERIDIAN RANCH
TECH CONTRACTORS

JOB NO. 230532

FIG. B-7

TEST BORING	103	SOIL DESCRIPTION	SANDSTONE (SAND, CLAYEY)
DEPTH (FT)	10	SOIL TYPE	5



SWELL/CONSOLIDATION TEST RESULTS

NATURAL UNIT DRY WEIGHT (PCF):	123
NATURAL MOISTURE CONTENT:	7.9%
SWELL/CONSOLIDATION (%):	0.9%

ENTECH ENGINEERING, INC.

SWELL/CONSOLIDATION TEST RESULTS

SANCTUARY AT MERIDIAN RANCH
TECH CONTRACTORS

JOB NO. 230532

FIG. B-8

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

PROJECT DATA

Project Location The Sanctuary at Meridian Ranch

Job Number: 230532

DESIGN DATA

Equivalent (18-kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	292,000
Design CBR	CBR =	10
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	15,000 psi

Required Structural Number (SN): → SN = 1.99

DESIGN EQUATIONS

Resilient Modulus

If using CBR: $M_R = (CBR) \times 1{,}500$

If using R-Value: $M_R = 10^{[(S_i + 18.72) / 6.24]}$ where: $S_i = [(\text{R-value} - 5) / 11.29] + 3$

Required Structural Number

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

Pavement Section Thickness

$SN^* = C_1D_1 + C_2D_2$ where:

C_1 = Strength Coefficient - HMA

C_2 = Strength Coefficient - ABC

D_1 = Depth of HMA (inches)

D_2 = Depth of ABC (inches)

RECOMMENED THICKNESSES

Layer	Material	Structural Layer	Thickness (D^*_i)	SN^*_i	SN
1	HMA	C_1 = 0.44	4.0 inches	1.760	-
2	ABC	C_2 = 0.11	8.0 inches	0.880	
			SN* = 2.640		1.99

Pavement SN > Required SN, Design is Acceptable

FIG. C-1

FLEXIBLE PAVEMENT DESIGN

PROJECT DATA

Project Location The Sanctuary at Meridian Ranch

Job Number: 230532

DESIGN DATA

Equivalent (18-kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	292,000
Design CBR	CBR =	10
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	15,000 psi

Required Structural Number (SN): → SN = 1.99

DESIGN EQUATIONS

Resilient Modulus

If using CBR: $M_R = (CBR) \times 1{,}500$

If using R-Value: $M_R = 10^{[(S_i + 18.72) / 6.24]}$ where: $S_i = [(\text{R-value} - 5) / 11.29] + 3$

Required Structural Number

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

Pavement Section Thickness

$SN^* = C_1D_1 + C_2D_2$ where:

C_1 = Strength Coefficient - HMA

C_2 = Strength Coefficient - CTS

D_1 = Depth of HMA (inches)

D_2 = Depth of CTS (inches)

RECOMMENED THICKNESSES

Layer	Material	Structural Layer	Thickness (D^*_i)	SN^*_i	SN
1	HMA	C_1 = 0.44	4.0 inches	1.760	-
2	CTS	C_2 = 0.11	10.0 inches	1.100	
			SN* = 2.860		1.99

Pavement SN > Required SN, Design is Acceptable

FIG. C-2

APPENDIX D: Phase 1 Laboratory Test Results

ENTECH ENGINEERING, INC.

TABLE D-1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT TECH CONTRACTORS
PROJECT SANC. AT MERIDIAN RANCH, F-1
JOB NO. 230532

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	AASHTO CLASS.	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1, CBR #1	6	0-3			32.0	26	11		A-2-6		SC	FILL, SAND, CLAYEY
1	1	1-2			13.3	NV	NP	<0.01	A-1-b		SM	FILL, SAND, SILTY
1	2	1-2			19.0	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	3	1-2			13.5	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	4	1-2			15.3	NV	NP	<0.01	A-1-b		SM	FILL, SAND, SILTY
1	5	1-2			19.0	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	7	1-2			29.0	27	10		A-2-4		SC	FILL, SAND, CLAYEY
1	8	1-2	8.6	115.0	27.8	27	12		A-2-6	-0.2	SC	FILL, SAND, CLAYEY
1	9	1-2	6.8	111.4	27.8	30	15		A-2-6	0.1	SC	FILL, SAND, CLAYEY
1	10	1-2			19.1	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	15	1-2			13.3	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	3	0-3			27.5						SM	FILL, SAND, SILTY
1	9	0-3			20.5						SM	FILL, SAND, SILTY
1	12	0-3			30.8						SM	FILL, SAND, SILTY
2, CBR #2	18	0-3			46.3	27	14		A-6		SC	FILL, SAND, VERY CLAYEY
2	6	1-2	11.5	114.6	45.2	34	18		A-6	1.2	SC	FILL, SAND, VERY CLAYEY
2	14	1-2			82.8	33	19		A-6		CL	FILL, CLAY, SANDY
2	15	0-3			45.5						SC	FILL, SAND, VERY CLAYEY
3	6	10			20.4	NV	NP	<0.01	A-2-4		SM	SAND, SILTY
3	17	1-2			14.9	NV	NP		A-1-b		SM	SAND, SILTY
3	18	1-2			11.0	NV	NP		A-1-b		SM-SW	SAND, SLIGHTLY SILTY,
4	3	5	13.7	119.3	35.4	29	15	<0.01	A-6	1.0	SC	SAND, VERY CLAYEY
5	11	1-2			14.2	NV	NP		A-1-b		SM	SANDSTONE, SILTY
5	12	1-2			15.0	NV	NP		A-1-b		SM	SANDSTONE, SILTY
5	13	1-2			16.4	NV	NP		A-1-b		SM	SANDSTONE, SILTY
5	16	1-2			16.1	NV	NP		A-2-4		SM	SANDSTONE, SILTY
5	3	10			29.7	21	8	<0.01	A-2-4		SC	SANDSTONE, CLAYEY
5	9	10			23.3	30	15		A-2-6		SC	SANDSTONE, CLAYEY
6	9	5	15.7	115.7	86.0	41	21	<0.01	A-7-6	4.3	CL	CLAYSTONE, SANDY

ENTECH ENGINEERING, INC

TABLE D-2 SUMMARY OF CTS TEST RESULTS

LAB TESTING

CLIENT	TECH CONTRACTORS	JOB NO	230532
PROJECT	SANC. AT MERIDIAN RANCH, F-1	DATE	5/1/23
FIELD SAMPLE ID	TB-6 @ 0-3	BY	BL
SOIL ADDITIVE	TYPE I/II CEMENT		

ADDITIVE %	*WATER %*	*DENSITY (dry)*	*AGE (days)*	*STRENGTH (psi)*
2	9.0	116.8	5	214
2	9.0	117.0	5	217
2	9.0	116.0	5	199
			AVERAGE:	**210**
4	9.0	117.1	5	224
4	9.0	117.3	5	234
4	9.0	116.8	5	208
			AVERAGE:	**222**

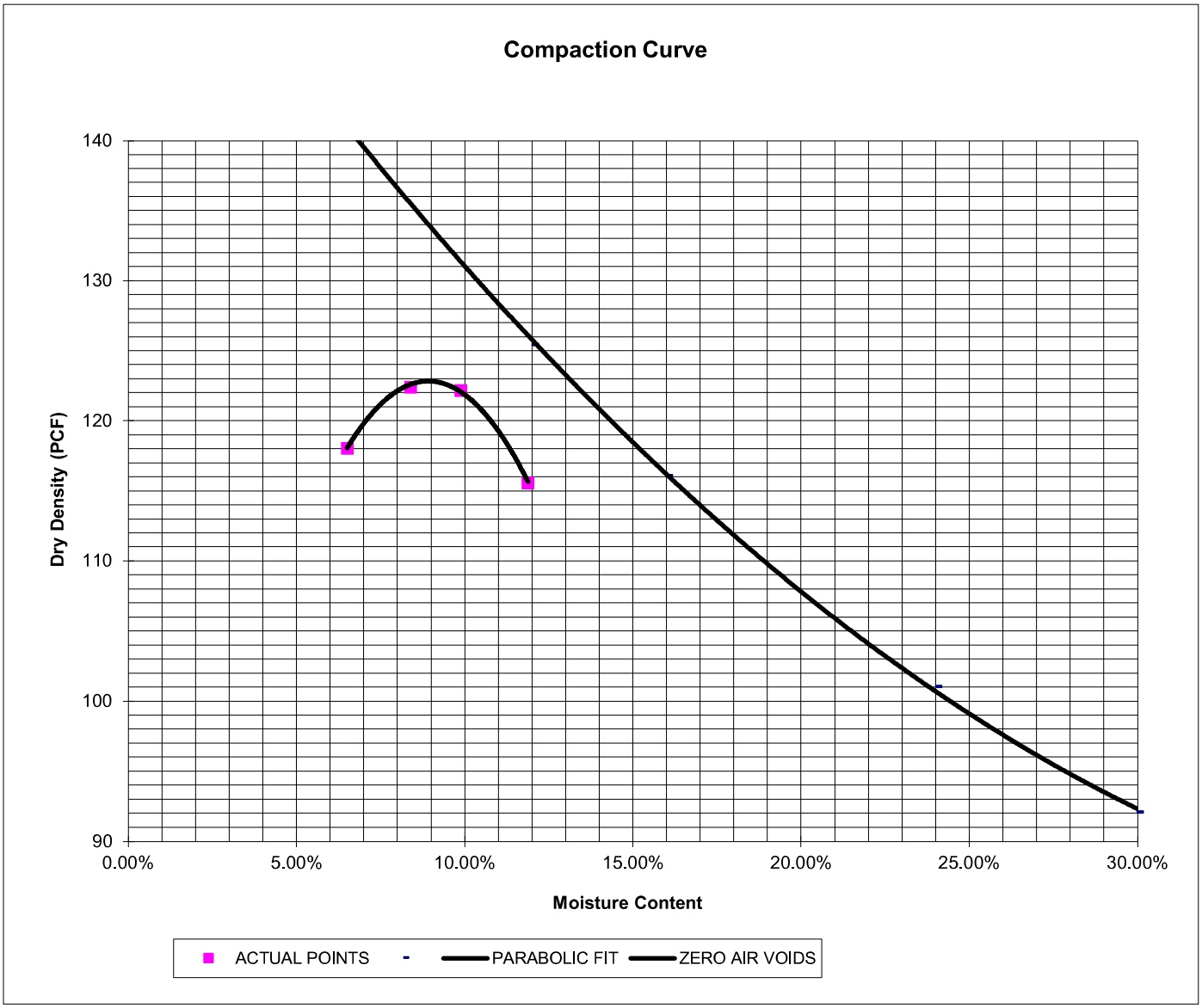
CURING METHOD

100° HUMIDIFIED OVEN

SAMPLE LOCATION TB-6 @ 0-3'	SOIL DESCRIPTION FILL, SAND, CLAYEY, BROWN SOIL TYPE 1

PROCTOR DATA

IDENTIFICATION:	SC
PROCTOR TEST #:	1
TEST BY:	AL
TEST DESIGNATION:	ASTM-1557-A
MAXIMUM DRY DENSITY (PCF):	122.9
OPTIMUM MOISTURE:	9



ENTECH ENGINEERING, INC.

LABORATORY TEST RESULTS

SANC. AT MERIDIAN RANCH, F-1
TECH CONTRACTORS

JOB NO.
230532

FIG. D-1

SAMPLE LOCATION TB-6 @ 0-3'	SOIL DESCRIPTION FILL, SAND, CLAYEY, BROWN
DEPTH (FT) 0	SOIL TYPE 1

CBR TEST LOAD DATA

Piston Diameter (cm): 4.958
Piston Area (in^2): 2.993

Penetration Depth (inches)	*10 BLOWS* Mold # 1 Load (lbs)	Stress (psi)	*25 BLOWS* Mold # 2 Load (lbs)	Stress (psi)	*56 BLOWS* Mold # 3 Load (lbs)	Stress (psi)
0.000	0	0.00	0	0.00	0	0.00
0.025	73	24.39	146	48.79	177	59.15
0.050	121	40.43	241	80.53	305	101.92
0.075	166	55.47	331	110.61	375	125.31
0.100	199	66.50	399	133.33	457	152.71
0.125	234	78.20	467	156.06	558	186.47
0.150	271	90.56	542	181.12	676	225.90
0.175	308	102.92	616	205.85	774	258.65
0.200	331	110.61	661	220.88	920	307.43
0.300	455	152.05	909	303.76	1342	448.45
0.400	514	171.76	1097	366.58	1706	570.09
0.500	623	208.19	1288	430.41	2073	692.73

MOISTURE AND DENSITY DATA

	Mold # 1	Mold # 2	Mold # 3
Can #	357	354	399
Wt. Can	8.14	7.96	8.24
Wt. Can+Wet	202.18	211.1	215.24
Wt. Can+Dry	188.74	190.43	195.02
Wt. H20	13.44	20.67	20.22
Wt. Dry Soil	180.6	182.47	186.78
Moisture Content	7.44%	11.33%	10.83%
Wet Density (PCF)	128.4	136.1	139.6
Dry Density (PCF)	117.8	124.9	128.1
% Compaction	96%	102%	104%
CBR	6.65	13.33	15.27

PROCTOR DATA

Maximum Dry Density (pcf)	122.9
Optimum Moisture	9
90% of Max. Dry Density (pcf)	110.6
95% of Max. Dry Density (pcf)	116.8

CBR at 90% of Max. Density = 4.28	~ R VALUE 10
CBR at 95% of Max. Density = 10.33	~ R VALUE 30

ENTECH ENGINEERING, INC.

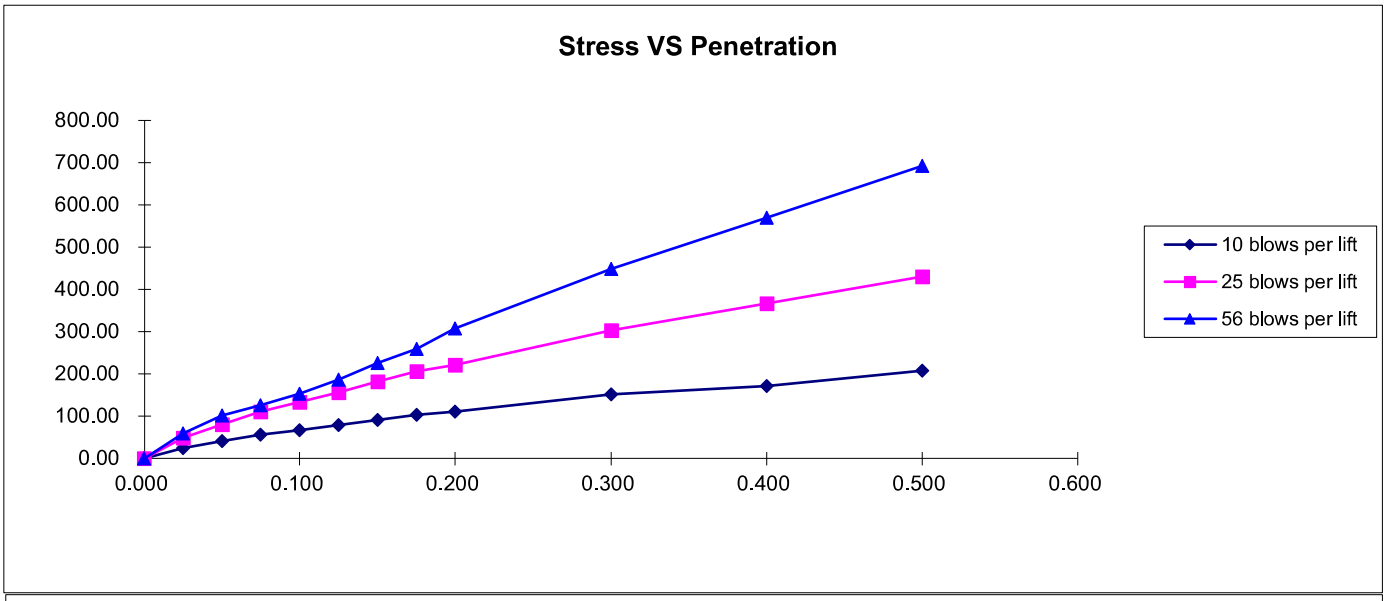
LABORATORY TEST RESULTS

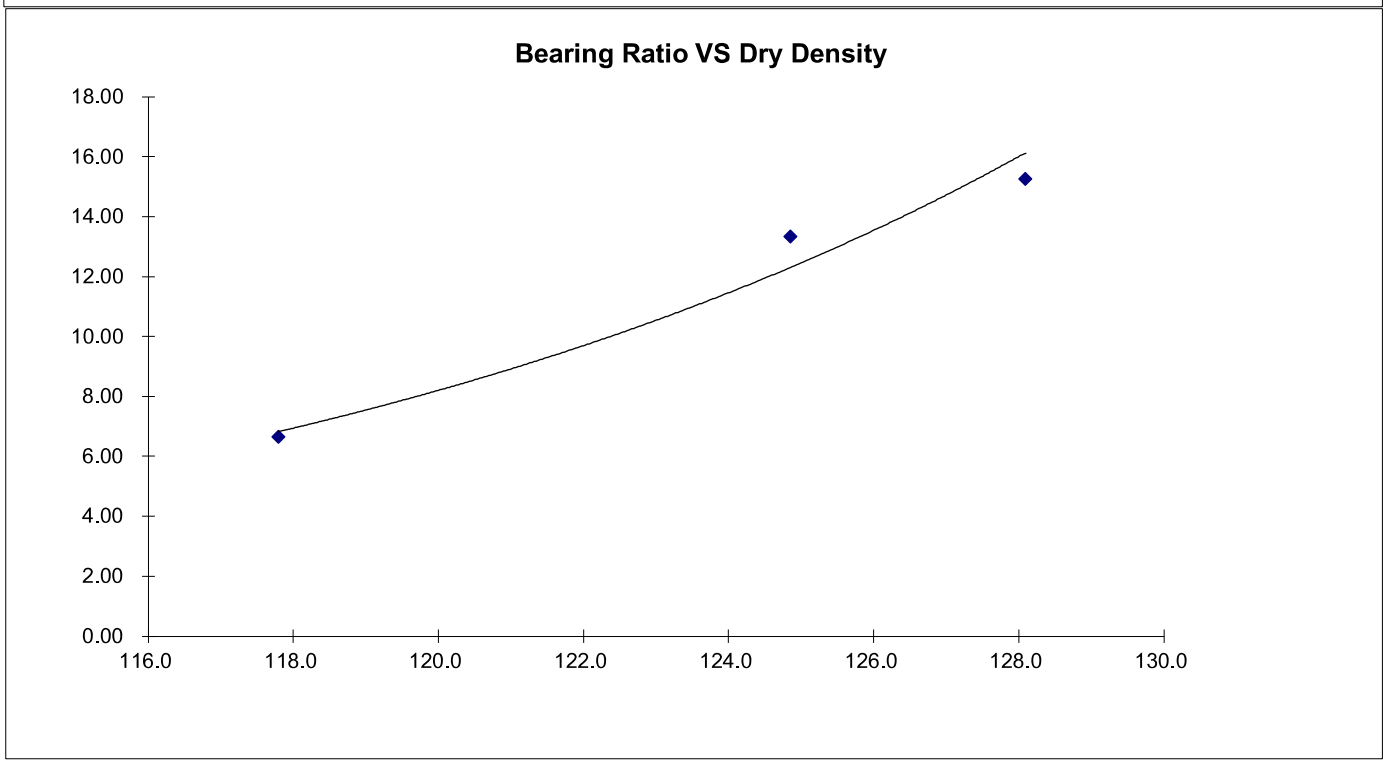
SANC. AT MERIDIAN RANCH, F-1
TECH CONTRACTORS

JOB NO. 230532

FIG. D-2

SAMPLE LOCATION TB-6 @ 0-3'	SOIL DESCRIPTION FILL, SAND, CLAYEY, BROWN
DEPTH (FT) 0	SOIL TYPE 0





ENTECH ENGINEERING, INC.

LABORATORY TEST RESULTS

SANC. AT MERIDIAN RANCH, F-1
TECH CONTRACTORS

JOB NO. 230532

FIG. D-3