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GEOTECHNICAL AND PAVEMENT DESIGN REPORT
BENT GRASS EAST, FILING No. 2, LOT 1
FALCON, COLORADO

Prepared for:
Carubia Properties, LLC
8035 Meridian Park Drive
Falcon, CO 80831

Attn: Lucas Carubia

November 25, 2024

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Lucas Morrison
Geotechnical Engineering Staff

Reviewed by:

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Date: 11/25/24

Joseph C. Goode III, P.E.
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LJM:JCG:AMN/ed

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1 Introduction

Entech Engineering Inc. (Entech) completed this geotechnical and pavement design report for a new commercial building and associated site improvements in Falcon, Colorado. This report describes the subsurface exploration program conducted for the planned commercial building and provides recommendations for foundation design, pavement sections, and construction considerations. Our services were completed for Carubia Properties, LLC in accordance with our geotechnical and pavement design service agreement dated October 21, 2024. The contents of this report, including the geotechnical evaluation and recommendations, are subject to the limitations and assumptions presented in Section 8.

2 Project and Site Description

The project will consist of the construction of a new commercial building and associated site improvements to be located west of Meridian Road, east of Meridian Park Drive, south of Bent Grass Meadows Drive in Falcon, Colorado. The location of the project site is shown on the Vicinity Map (Figure 1).

At the time of drilling, the property was a relatively flat vacant lot. Vegetation consisted of field grasses and weeds. Residential neighborhoods are located to the east and south and commercial property to the north and west of the proposed site. Building loads are expected to be light to moderate.

3 Subsurface Explorations and Laboratory Testing

3.1 Subsurface Exploration Program

Subsurface conditions at the project site were explored by five test borings, designated TB-1 through TB-5, drilled on October 30, 2024 at the approximate locations shown on the Site and Exploration Plan (Figure 2). Borings TB-1 through TB-3 were drilled in the proposed building footprint and borings TB-4 through TB-5 were drilled in the parking lot and drive lanes to provide pavement design recommendations. The borings drilled in the building footprint were drilled to depths of 20 feet below the ground surface (bgs), and the borings drilled in the parking and drive areas were drilled to depths of 10 feet bgs. The drilling was performed using a truck-mounted, continuous-flight auger drill rig supplied and operated by Entech. Descriptive boring logs providing the lithologies of the subsurface conditions encountered during drilling are presented in Appendix

A. Soil and bedrock 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 and bedrock samples recovered from the borings were visually classified and recorded on the boring logs. The soil and bedrock classifications were later verified utilizing laboratory testing and grouped by soil type. The soil and bedrock type numbers are included on the boring logs. It should be understood that soil and bedrock 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 and bedrock types, and the actual stratigraphic transitions may be more gradual or variable with location.

3.2 Laboratory Testing

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. One-dimensional swell/collapse testing (ASTM D4546) was performed to evaluate the expansive characteristics and collapse potential characteristics. Soluble sulfate testing was performed on select soil samples to evaluate the potential for below-grade degradation of concrete due to sulfate attack.

For pavement design, a Modified Proctor (ASTM D1557) and California Bearing Ratio (CBR) test (ASTM D1883) were completed on a bulk sample from the roadway subgrade. The Laboratory Testing Results are presented in Appendix B and summarized in Table B-1.

4 Subsurface Conditions

Three primary soil types and two bedrock types were encountered in the test borings drilled for the subsurface investigation. Each soil type was classified in accordance with the Unified Soil Classification System (USCS) and the American Association of State Highway and Transportation Officials (AASHTO) soil classification system using the laboratory testing results and the observations made during drilling.

4.1 Soil and Bedrock

Soil Type 1 classified as clayey sand, silty sand, and sand with silt fill (SM, SC, SW-SM). The medium dense fill was encountered in all borings to depths of 7 to 9 feet bgs. One-dimensional

swell or collapse testing on a sample of clayey sand resulted in a volume change of 0.0% indicating low swell and collapse potential.

Soil Type 2 classified as native clayey sand (SC). The medium dense native sand was encountered in TB-3 at a depth of 8 feet bgs and extended to a depth of 13 feet bgs. The native clayey sand is expected to have a low potential for expansion or collapse.

Soil Type 3 classified as native sandy clay (CL). The very stiff native clay was encountered in TB-1 and TB-2 at a depth of 13 and 9 feet bgs and extended to a depth of 17 and 12 feet bgs, respectively. One-dimensional swell or collapse testing on a sample of sandy clay resulted in a volume change of 0.1% indicating low collapse potential.

Soil Type 4 classified as moderately weathered sandstone bedrock of the Dawson formation, or very dense clayey sand, silty sand, and sand with clay when classified as a soil (SC). The sandstone bedrock was encountered in all test borings except TB-5 at depths ranging from 8 feet to 17 bgs and extended to the termination depth of each boring, 20 feet bgs. The sandstone is expected to have a low potential for expansion or collapse.

Soil Type 5 classified as claystone bedrock of the Dawson formation, or hard sandy clay when classified as a soil (CL). The claystone was encountered in TB-3 underlying the Soil Type 2 at 13 feet bgs and extended to 17 feet bgs. One-dimensional swell or collapse testing on a sample of sandy clay resulted in a volume change of 0.1% indicating low collapse potential.

Pavement subgrade soils generally consisted of Soil Type 1 sand fill classifying as AASHTO A-1-b, A-2-4, and A-6 soils.

4.2 Groundwater

Groundwater was encountered in boring TB-3 during our subsurface exploration program at a depth of 16 feet bgs within the proposed building pad. It should be noted that groundwater levels could change due to seasonal variations, changes in land runoff characteristics, and future development of nearby areas.

5 Geotechnical Evaluation and Recommendations

The following discussion is based on the subsurface conditions encountered in the borings drilled on the planned lot for construction. If subsurface conditions different from those described herein are encountered during construction, or if the project elements change from those described,

Entech should be notified so that the evaluation and recommendations presented can be reviewed and revised if necessary.

As discussed in Section 2, we understand that the site will be developed with a new commercial building and associated site improvements. The proposed structure is expected to be supported on a shallow foundation system. The existing fill is considered controlled and has been previously tested by Entech Engineering, Inc during placement. Anticipated subsurface conditions will consist of existing medium dense clayey sand fill.

5.1 Shallow Foundations

The proposed structure may be supported with shallow spread footing foundations placed on existing medium dense controlled fill. The subgrade should be prepared as discussed in Section 7.1.1. Refer to Exhibit 1 for the recommended allowable bearing capacity value. Shallow foundations shall not be placed on loose granular soil, cohesive soil, uncontrolled fill, expansive soils, or claystone bedrock. Actual bearing capacities and the need for overexcavation will be verified at the time of the open excavation observation (Section 7.9).

For design, continuous spread footings are recommended to have a minimum width of 16 inches, and individual column footings for main support beams should have minimum plan dimensions of 24 inches on each side in order to avoid punching failure into the supporting subgrade soils. Exterior footings should extend a minimum of 30 inches below the adjacent exterior site grade for frost protection.

The Dawson Formation bedrock commonly includes interbedded expansive claystone layers. Cohesive soils and interbedded claystone may be encountered during subgrade preparation and, if encountered, should be overexcavated and prepared as discussed in Section 7.1.1.

Foundation walls should be designed to resist lateral pressures generated by the soils used for wall backfill. Recommended active equivalent fluid density parameters for the on-site granular soils are provided in Exhibit 1. Clay/silt soils (more than 50% passing the No. 200 sieve) are not recommended for backfill against the walls. It should be noted that this value applies to level backfill conditions. If sloping backfill conditions exist, pressures will increase substantially depending on the conditions adjacent to the walls. Surcharge loading should also be considered in wall designs. Equivalent fluid pressures for sloping conditions should be determined on an individual basis. Exterior footings should extend a minimum of 30 inches below the adjacent exterior site grade for frost protection.

Exhibit 1: Foundation Design Parameters

Design Parameter	Value
Allowable Bearing Capacity [1, 2]	
Site Granular Grading Fill	2,400 psf
Lateral Earth Pressure Equivalent Fluid Density [3]	
Active Conditions - Granular Backfill	40 pcf

pcf = pounds per cubic foot; psf = pounds per square foot

Notes:

1. Assumes a minimum embedment of 30 inches for frost protection.
2. Up to 1 inch of total settlement and ½ inch of differential settlement is anticipated for the bearing capacity value provided, assuming subgrades are prepared in accordance with Section 7.
3. Assumes level backfill conditions.

5.2 On-Grade Floor Slabs

On-grade floor slabs for the planned structures should be supported on compacted site or imported granular soils prepared in accordance with Section 7.1.1, and any loose soils or uncontrolled fill encountered will require removal.

Grade-supported floor slabs should be separated from other building structural components and utility penetrations to allow for possible future vertical movement. Interior partition walls should be constructed in such a manner so as not to transfer slab movement into the overlying floor(s) and/or roof members, should slab movement occur. Control joints in grade-supported slabs are recommended at 10- to 15-foot perpendicular spacings to control cracking. If slab movement cannot be tolerated, a structural floor system should be used.

5.3 Seismic Site Classification

Based on the subsurface conditions encountered at the site, and in accordance with Section 1613 of the 2021 *International Building Code* (IBC), the site meets the conditions of a Site Class D.

5.4 Surface and Subsurface Drainage

Positive surface drainage is recommended around the building's perimeter to minimize infiltration of surface water into the supporting foundation soils. A minimum ground surface slope of 5% in the first 10 feet adjacent to exterior foundation walls is recommended for unpaved areas. For paved areas and other impervious surfaces, a minimum slope of 2% is adequate. All roof drains

and gutter downspouts should be extended to discharge well beyond the building's foundation backfill zone or be connected to a storm sewer system.

To help minimize infiltration of water into the foundation zone, vegetative plantings placed close to foundation walls should be limited to those species having low watering requirements, and irrigated grass should not be located within 5 feet of the foundation. Sprinklers are not recommended to discharge water within 5 feet of foundations. Irrigation near foundations should be limited to the minimum amount sufficient to maintain vegetation. The application of more irrigation water than necessary can increase the potential for slab and foundation movement.

Perimeter drains are recommended for usable space below grade (areas where the interior slab or bottom of the crawl space is below the exterior grade). A typical perimeter drain detail is shown in Figure 3. Additional drains, such as interceptor drains or a slab underdrain may be recommended if groundwater is encountered within 4 feet of the bottom of foundation components.

6 Pavement Design Recommendations

Pavement design recommendations were made in accordance with the *El Paso County Engineering Criteria Manual.*

6.1 Pavement Subgrade Conditions

Two test borings (TB-4 and TB-5) were drilled to depths of approximately 10 feet below the existing subgrade surface in the parking lot and drive lanes. The soils at the roadway subgrade depth consisted of clayey sand fill and silty sand to sand with silt fill. The native sands, classified as A-1-b and A-6 using the AASHTO classification system, were considered for pavement subgrades based on the laboratory testing.

California Bearing Ratio (CBR) testing was performed on a representative bulk sample of the silty sand (Soil Type 1) from TB-4 to determine the support characteristics of the subgrade soils for the pavement sections. The results of the CBR testing are presented in Appendix B and summarized in Exhibit 2.

Exhibit 2: Pavement Subgrade Laboratory Summary

Design Parameter	Value
Soil Type	1-Silty Sand
CBR at 95%	29.9
Design CBR	10
Liquid Limit	23
Plasticity Index	20
Percent Passing 200	21.8
AASHTO Classification	A-1-b
Group Index	0
Unified Soils Classification	SM

6.2 Swell Mitigation

El Paso County recommendations require swell mitigation of expansive soils criteria for roadway subgrade with swell testing results greater than 2% under a 150 pounds per square foot (psf) surcharge. Based on the classification of the soils, mitigation for expansive soils is not expected to be required on this site.

6.3 Traffic Loading

Traffic data is not available for the parking lot and access road. Based on the Colorado Asphalt Pavement Association (CAPA) *Guideline for the Design and Construction of Asphalt Parking Lots in Colorado* (2006), an 18-kip equivalent single axle loading (ESAL) of 100,000 is appropriate for moderate traffic level which includes passenger cars and light trucks.

6.4 Pavement Designs

The recommended flexible pavement sections were determined utilizing the *El Paso County Engineering Criteria Manual*, the CBR testing, and design ESAL value. Design parameters used in the pavement analysis are presented in Exhibit 3.

Exhibit 3: Pavement Design Parameters

Design Parameter	Value
Reliability	80%
Standard Deviation	0.45
Serviceability Loss (Δ psi)	2.0
Design CBR	10
Resilient Modulus	15,000 psi
Standard Deviation	0.44
Structural Coefficients	
Hot Bituminous Pavement	0.44
Aggregate Base Course	0.11
Recycled Concrete Base	0.11

Pavement sections are presented below in Exhibit 4. 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.

Exhibit 4: Recommended Pavement Sections

Pavement Area	Design ESAL	Alternative[1]
Parking Areas and Drive Lanes	100,000	1. 4.0 inches HMA over 4.0 inches ABC/RCB

ABC = Aggregate Base Course; ESAL = equivalent single axle loads; HMA = Hot Mix Asphalt; RCB = Recycled Concrete Base

Notes:

1. The pavement alternatives meet the minimum sections required per the *El Paso County Engineering Criteria Manual.*

7 Construction Recommendations

7.1 Earthwork Recommendations for Structures

7.1.1 Subgrade Preparation

If loose or expansive materials are encountered during subgrade preparation, they should be overexcavated to suitable, dense underlying soils and recompacted in place or replaced with granular fill (Section 7.1.2 and 7.1.3). All soil beneath the foundation and slabs should be free of organics, debris, and cobbles larger than 3 inches in diameter.

Prior to site earthwork, any ponded water should be drained and surface runoff should be directed away from earthwork areas. If water is allowed to sit, pond, or infiltrate into the foundation

subgrade, it will likely create unstable subgrade conditions. If shallow groundwater is encountered within 3 feet of the foundation elevation, stabilization will be required.

7.1.2 Granular Fill

Granular fill placed beneath foundation components and floor slabs shall consist of nonexpansive, granular soil free of organic matter, unsuitable materials, debris, and cobbles greater than 3 inches in diameter. On-site granular soils or properly processed sandstone may be used as granular fill. Entech should approve any imported granular or structural fill to be used within the foundation area prior to delivery to the site.

7.1.3 Fill Placement and Compaction

All granular fill placed within the foundation area should be compacted to a minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density at +/- 2% of optimum moisture content. Fill material should be placed in horizontal lifts such that each finished lift has a compacted thickness of 6 inches or less as determined by ASTM D1557. Mechanical methods can be used for placement and compaction of fill; however, heavy equipment should be kept at a distance from foundation walls and below slab infrastructure to avoid overstressing. No water flooding techniques of any type should be used for compaction or placement of foundation or floor slab fill material.

Fill placement and compaction beneath and around foundations should be observed and tested by Entech during construction. Density tests should be performed frequently to verify compaction with the first density test performed at the overexcavated subgrade elevation and with additional testing once each 12 to 18 inches of granular fill has been placed.

7.2 Pavements

Pavement design recommendations provided herein are contingent on good construction practices, and poor construction techniques may result in poor performance. Our analyses assumed that this project will be constructed according to the *El Paso County Engineering Criteria Manual* and the *Pike Peak Regional Asphalt Paving Specifications*.

7.2.1 Pavement Subgrade Preparation

Proper subgrade preparation is required for adequate pavement performance. Paving areas should be cleared of all deleterious materials including but not limited to: existing pavements,

utility poles, and fence poles. Surface vegetation should be removed by stripping, with the depth to be field determined.

The final subgrade surface should be scarified to a depth of 8 inches, a minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density at +/-2% of optimum moisture content. 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.

7.2.2 Aggregate Base Course and Recycled Concrete Base

ABC or RCB materials shall conform to the *El Paso County Standard Specifications Manual*, Section 300 Aggregate Base Course. ABC or RCB materials should be compacted to a minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density within +/-2% of optimum moisture content.

7.3 Excavation Potential

Excavation of the upper granular soils should be feasible with rubber-tired equipment.

7.4 Excavation Stability

Excavation sidewalls must be properly sloped, benched, and/or otherwise supported in order to maintain stable conditions. All excavation openings and work completed therein shall conform to OSHA Standards as put forward in CFR 29, Part 1926.650-652, (Subpart P).

7.5 Utility Trench Backfill

Trench backfill placement should be performed in accordance with El Paso County specifications. All excavation and excavation shoring/bracing should be performed in accordance with OSHA guidelines.

Fill placement and compaction in utility trenches should be observed and tested by Entech during construction. Fill should be placed in horizontal lifts having a compacted thickness of 6 inches or less and at a water content conducive to adequate compaction, within +/-2% of optimum water content. No water flooding techniques of any type should be used for compaction or placement of utility trench fill.

7.6 General Backfill

Any areas to receive general grading fill should have all topsoil, organic material, and debris removed. Fill must be properly benched into existing slopes in order to be adequately compacted. The fill-receiving surface should be scarified to a depth of 12 inches, a minimum of 95% of the Modified Proctor (ASTM D1557) maximum dry density at +/-2% of optimum moisture content or the Standard Proctor (ASTM D698) for cohesive soils before the addition of new fill. Fill should be placed in thin lifts not to exceed 6 inches in thickness. Fill material should be free of vegetation and other unsuitable material and should not contain cobbles or fragments larger than 3 inches. Topsoil and strippings should be segregated from all other fill sources on the site. Fill placement and compaction beneath and around foundations, in utility trenches, or beneath roadways or other structural features of the project should be observed and tested by Entech during construction.

7.7 Concrete Degradation Due to Sulfate Attack

Sulfate solubility testing was conducted on several samples recovered from the test borings to evaluate the potential for sulfate attack on concrete placed below surface grade. The test results indicated 0.01% and less than 0.01% soluble sulfate (by weight). The test results indicate the sulfate component of the in-place soils presents a negligible exposure threat to concrete placed below the site grade.

Type 1L or Type II cement is recommended for concrete on the site. To further avoid concrete degradation during construction it is recommended that concrete not be placed on frozen or wet ground. Care should be taken to prevent the accumulation or ponding of water in the foundation excavation prior to the placement of concrete. If standing water is present in the foundation excavation, it should be removed by ditching to sumps and pumping the water away from the foundation area prior to concrete placement. If concrete is placed during periods of cold temperatures, the concrete must be kept from freezing. This may require covering the concrete with insulated blankets and adding heat to prohibit freezing.

7.8 Winter Construction

In the event construction of the planned facility occurs during winter, foundations and subgrades should be protected from freezing conditions. Concrete should not be placed on frozen soil and once concrete has been placed, it should not be allowed to freeze. Similarly, once exposed, the foundation subgrade should not be allowed to freeze. During site grading and subgrade

preparation, care should be taken to eliminate the burial of snow, ice, or frozen material within the planned construction area.

7.9 Foundation Excavation and Construction Observation

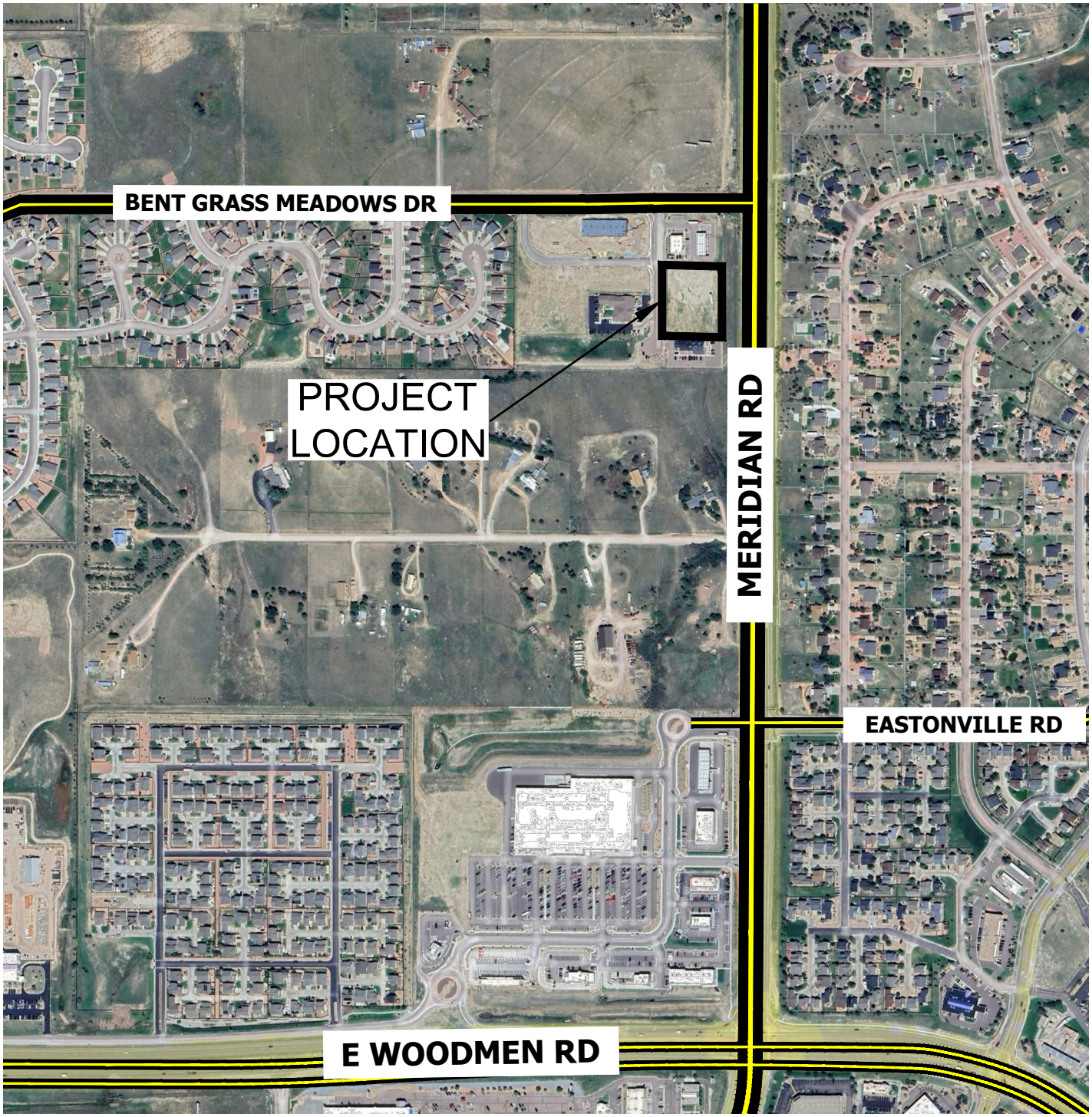
Subgrade preparation for building foundations should be observed by Entech prior to construction of the footings and floor slabs in order to verify that (1) no anomalies are present, (2) materials similar to those described in this report have been encountered or placed, and (3) no soft spots, expansive or organic soil, or debris are present in the foundation area prior to concrete placement or backfilling. Entech should make final recommendations for overexcavation, if required, and foundation drainage at the time of excavation observation, if necessary.

In addition, Entech should observe and document placement and compaction of utility bedding and trench backfill.

8 Closure

The subsurface investigation, geotechnical evaluation, and recommendations presented in this report are intended for use by Carubia Properties, LLC with application to the planned new construction of a commercial building located in Falcon, Colorado. In conducting the subsurface investigation, laboratory testing, engineering evaluation, and reporting, Entech Engineering, Inc. endeavored to work in accordance with generally accepted professional geotechnical and geologic practices and principles consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession currently practicing in the same locality and under similar conditions. No other warranty, expressed or implied, is made. During final design and/or construction, if conditions are encountered that appear different from those described in this report, Entech Engineering, Inc. requests to be notified so that the evaluation and recommendations presented herein can be reviewed and modified as appropriate.

If there are any questions regarding the information provided herein, or if Entech Engineering, Inc. can be of further assistance, please do not hesitate to contact us.



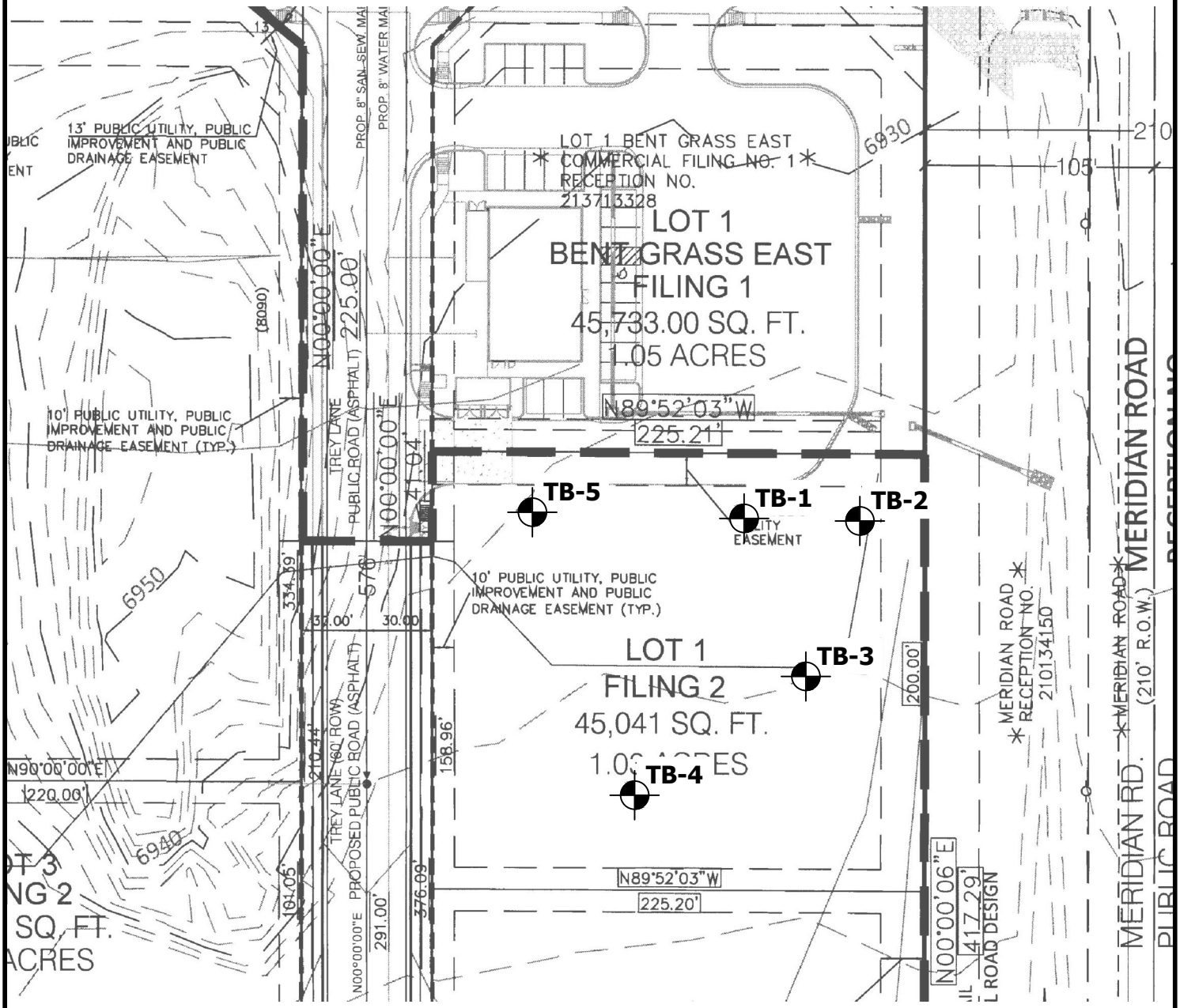
ENTECH ENGINEERING, INC.

VICINITY MAP

BENT GRASS EAST, FILING NO.2, LOT 1
CARUBIA PROPERTIES

JOB NO.
241844

FIG. 1



TB- APPROXIMATE TEST BORING LOCATION AND NUMBER

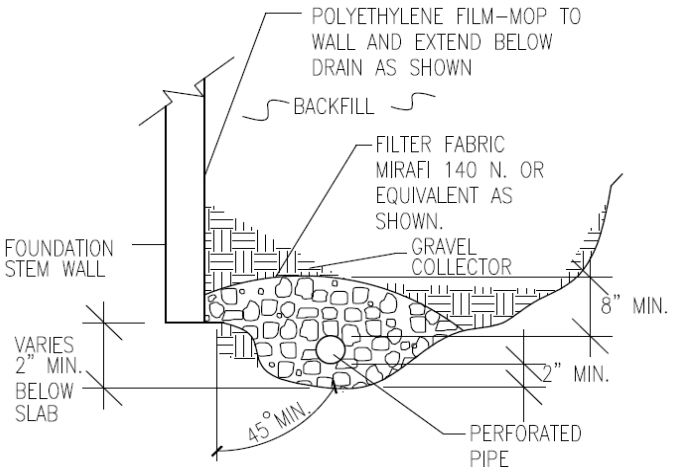
ENTECH ENGINEERING, INC.

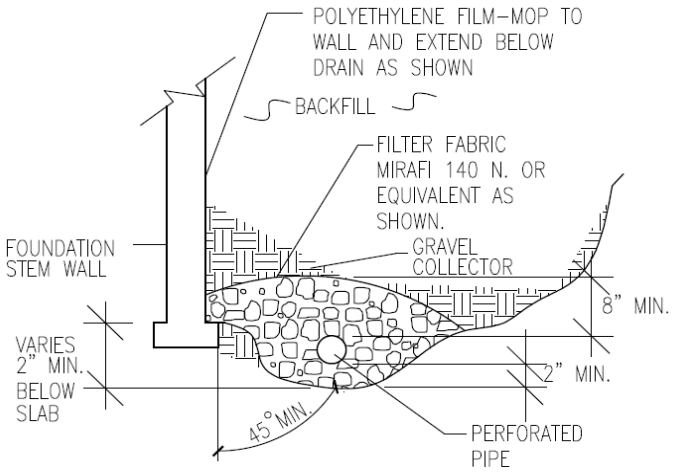
SITE AND EXPLORATION PLAN

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO.
241844

FIG. 2





NOTES:

–GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS–85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

–PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4–INCH DIAMETER IS MOST OFTEN USED.

–ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON–PERFORATED PIPE.

–FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

–MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

–DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP AND PUMP MAY BE USED IF GRAVITY OUT FALL IS NOT AVAILABLE.

ENTECH ENGINEERING, INC.

PERIMETER DRAIN DETAIL

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. 3

APPENDIX A: Test Boring Logs

TEST BORING 1
DATE DRILLED 10/30/2024

REMARKS

DRY TO 20', 10/30/24

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	FILL 0-7', SAND, CLAYEY, BROWN, MEDIUM DENSE, MOIST		21	4.2	1
5			17	5.7	1
	CLAY, SANDY, GRAY, HARD, MOIST				
10			35	12.2	3
	SANDSTONE, EXTREMELY WEAK, BROWN to GRAY, MODERATELY WEATHERED (SAND, SILTY, VERY DENSE, MOIST)				
15			50/7"	8.4	4
20			50/6"	7.4	4

TEST BORING 2
DATE DRILLED 10/30/2024

REMARKS

DRY TO 20', 10/30/24

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	FILL 0-7', SAND, CLAYEY, BROWN, MEDIUM DENSE, MOIST		18	7.0	1
5			21	7.6	1
	SAND, SILTY, TAN, DRY		*	2.5	2
10	CLAY, SANDY, GRAY, VERY STIFF, MOIST		17	10.5	3
	SANDSTONE, VERY WEAK, BROWN to GRAY, MODERATELY WEATHERED (SAND, SILTY, VERY DENSE, MOIST)				
15			50/8"	7.8	4
20			50/7"	14.9	4

* - BULK SAMPLE TAKEN

ENTECH ENGINEERING, INC.

TEST BORING LOGS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. A-1

TEST BORING 3
DATE DRILLED 10/30/2024

REMARKS

WATER @ 16', 10/30/24

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-7', SAND, CLAYEY, BROWN, MEDIUM DENSE, MOIST			16	4.8	1
5			18	3.7	1
SAND, CLAYEY, TAN, MEDIUM DENSE, MOIST					
10			27	11.6	2
CLAYSTONE, VERY WEAK, BROWN, HIGHLY WEATHERED (CLAY, SANDY, HARD, MOIST) ▼			50/11"	11.5	5
15					
SANDSTONE, VERY WEAK, BROWN, HIGHLY WEATHERED (SAND, CLAYEY, VERY DENSE, MOIST)			50/11"	10.5	4
20					

TEST BORING 4
DATE DRILLED 10/30/2024

REMARKS

DRY TO 10', 10/30/24

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-8', SAND, WITH SILT, BROWN, MEDIUM DENSE, MOIST			20	8.6	1
5			24	7.4	1
SANDSTONE, EXTREMELY WEAK, TAN, MODERATELY WEATHERED (SAND, SILTY, VERY DENSE, MOIST)			50/9"	11.5	4
10					
15					
20					

ENTECH ENGINEERING, INC.

TEST BORING LOGS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

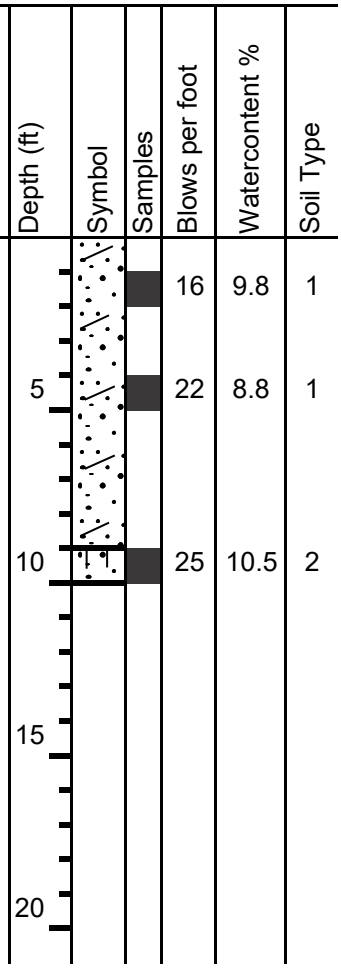
JOB NO. 241844

FIG. A-2

TEST BORING 5
DATE DRILLED 10/30/2024

REMARKS

DRY TO 10', 10/30/24



FILL 0-9', SAND, CLAYEY, TAN, MEDIUM DENSE, MOIST	16	9.8	1
	22	8.8	1
SAND, SILTY, TAN, MEDIUM DENSE, MOIST	25	10.5	2

ENTECH ENGINEERING, INC.

TEST BORING LOGS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. A-3

TABLE A-1

DEPTH TO BEDROCK

TEST BORING	DEPTH TO BEDROCK (ft.)
1	11
2	12
3	13
4	8
5	>10

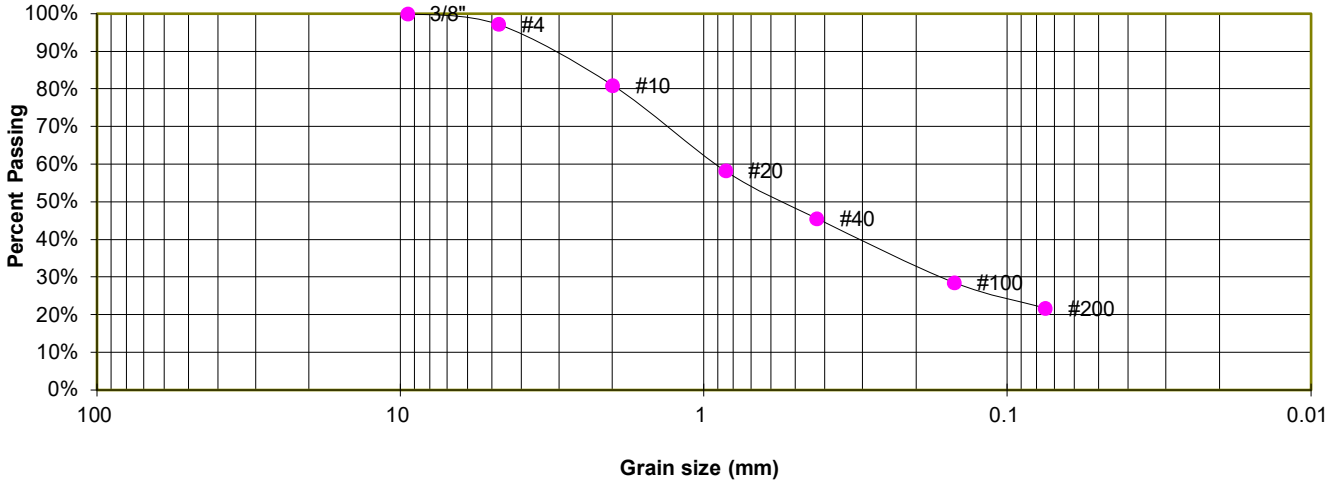
APPENDIX B: Laboratory Test Results

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/ COLLAPSE (%)	AASHTO CLASS. (GROUP INDEX)	USCS	SOIL DESCRIPTION
1, CBR	4	0-3	7.8		21.8	23	20	3			A-1-b (0)	SM	FILL, SAND, SILTY
1	1	2-3	4.2		23.0	23	14	9	0.01		A-2-4 (0)	SC	FILL, SAND, CLAYEY
1	4	1-2	8.6		10.4	NV	NP	NP			A-1-b (0)	SW-SM	FILL, SAND, WITH SILT
1	5	1-2	11.5	116.0	46.3	28	19	9		0.0	A-6 (1)	SC	FILL, SAND, CLAYEY
2	3	10	8.6		24.5	25	17	8			A-2-4 (0)	SC	SAND, CLAYEY
3	2	10	18.1	106.2	59.6	35	20	15	<0.01	0.1	A-6 (7)	CL	CLAY, SANDY
4	1	15	8.4		41.8	37	24	13	<0.01		A-6 (2)	SC	SANDSTONE (SAND, CLAYEY)
5	3	15	19.0	101.3	51.3	38	24	14	<0.01	0.1	A-6 (4)	CL	CLAYSTONE (CLAY, SANDY)

Project: Bent Grass East, Filing No. 1, Lot 2
Client: Carubia Properties
Job No: 241844

TEST BORING	4	SOIL DESCRIPTION	FILL, SAND, SILTY
DEPTH (FT)	0-3	SOIL TYPE	1, CBR



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.2%
10	81.0%
20	58.3%
40	45.6%
100	28.6%
200	21.8%

ATTERBERG LIMITS

Plastic Limit	20
Liquid Limit	23
Plastic Index	3

SOIL CLASSIFICATION

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

ENTECH ENGINEERING, INC.

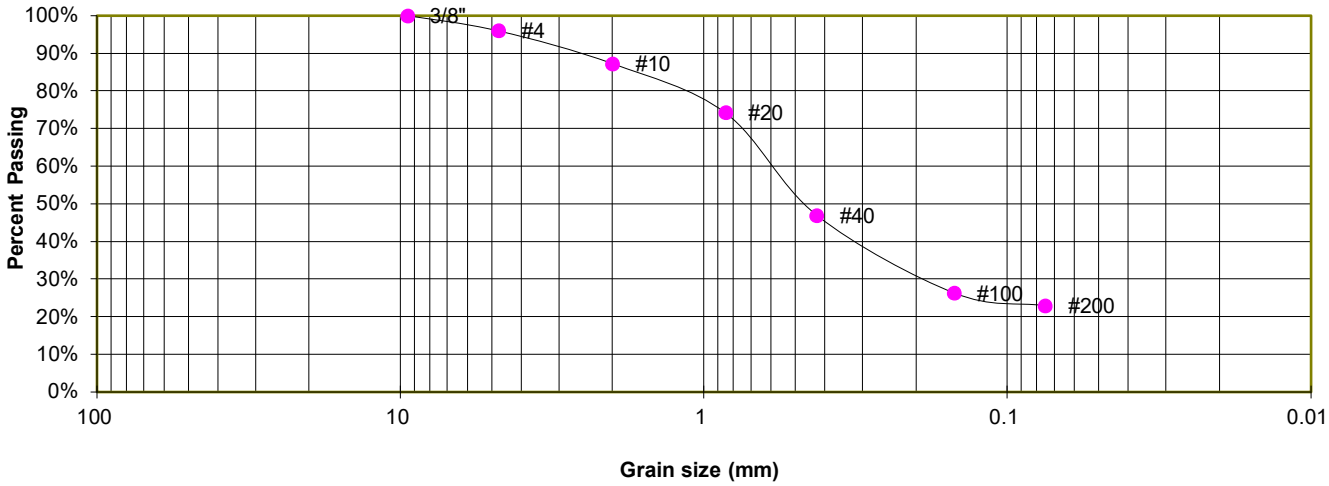
LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-1

TEST BORING	1	SOIL DESCRIPTION	FILL, SAND, CLAYEY
DEPTH (FT)	2-3	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.0%
10	87.3%
20	74.2%
40	47.0%
100	26.4%
200	23.0%

ATTERBERG LIMITS

Plastic Limit	14
Liquid Limit	23
Plastic Index	9

SOIL CLASSIFICATION

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

ENTECH ENGINEERING, INC.

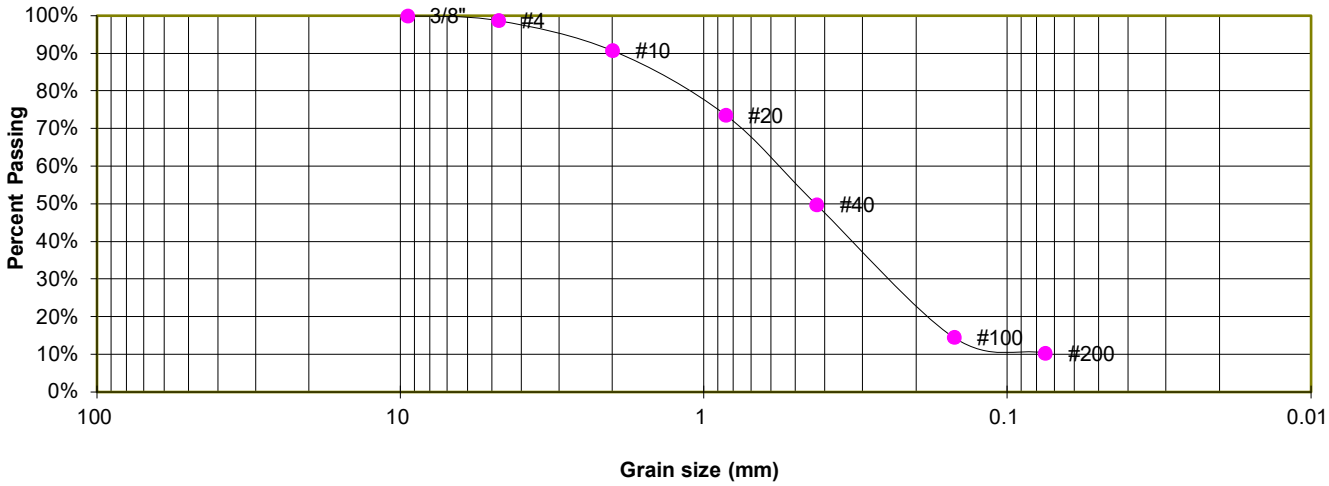
LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-2

TEST BORING	4	SOIL DESCRIPTION	FILL, SAND, WITH SILT
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	98.8%
10	90.8%
20	73.7%
40	49.8%
100	14.5%
200	10.4%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

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

ENTECH ENGINEERING, INC.

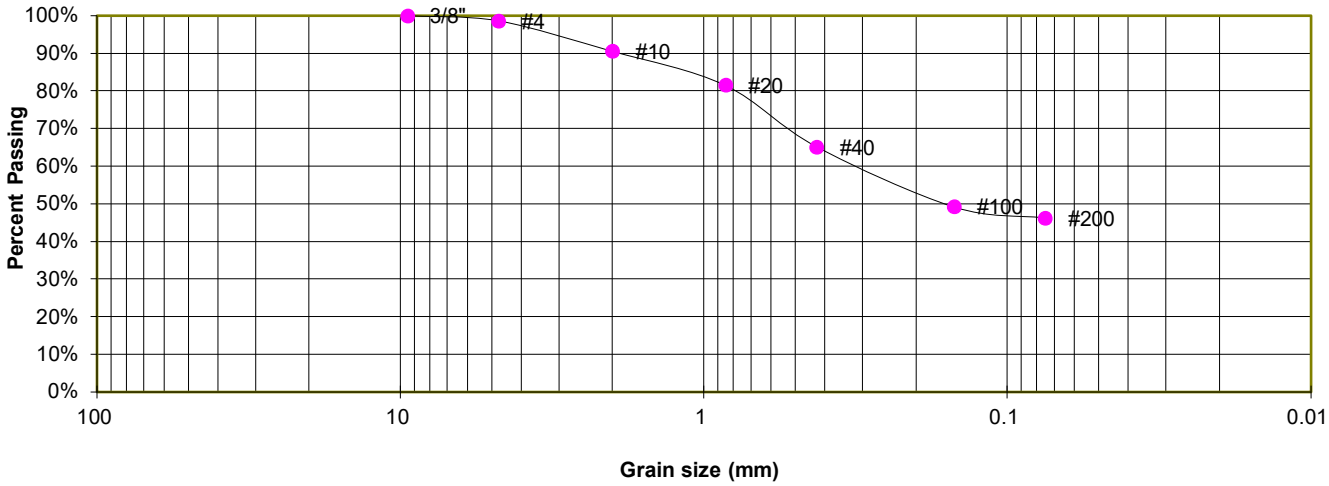
LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-3

TEST BORING	5	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	98.6%
10	90.6%
20	81.6%
40	65.1%
100	49.2%
200	46.3%

ATTERBERG LIMITS

Plastic Limit	19
Liquid Limit	28
Plastic Index	9

SOIL CLASSIFICATION

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

ENTECH ENGINEERING, INC.

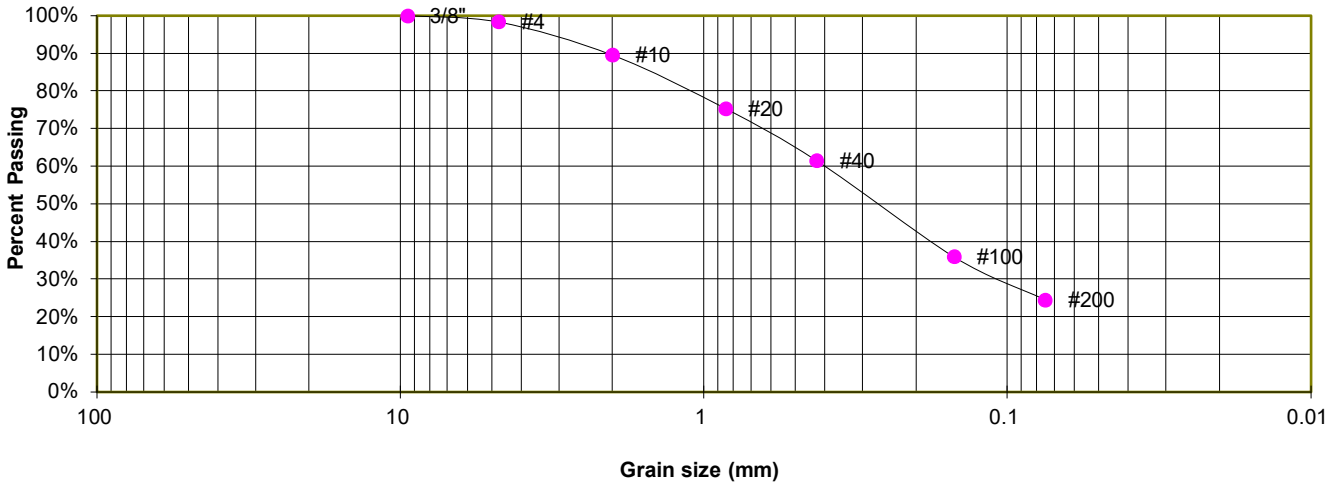
LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-4

TEST BORING	3	SOIL DESCRIPTION	SAND, CLAYEY
DEPTH (FT)	10	SOIL TYPE	2



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.4%
10	89.6%
20	75.4%
40	61.5%
100	36.0%
200	24.5%

ATTERBERG LIMITS

Plastic Limit	17
Liquid Limit	25
Plastic Index	8

SOIL CLASSIFICATION

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

ENTECH ENGINEERING, INC.

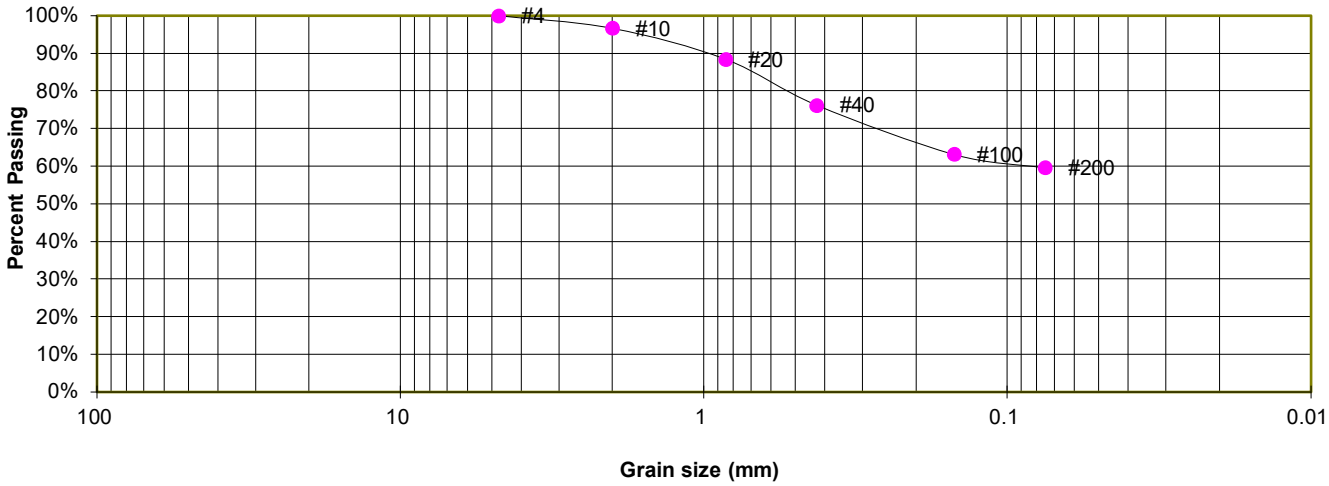
LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-5

TEST BORING	2	SOIL DESCRIPTION	CLAY, SANDY
DEPTH (FT)	10	SOIL TYPE	3



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	96.7%
20	88.4%
40	76.2%
100	63.2%
200	59.6%

ATTERBERG LIMITS

Plastic Limit	20
Liquid Limit	35
Plastic Index	15

SOIL CLASSIFICATION

USCS CLASSIFICATION:	CL
AASHTO CLASSIFICATION:	A-6
AASHTO GROUP INDEX:	7

ENTECH ENGINEERING, INC.

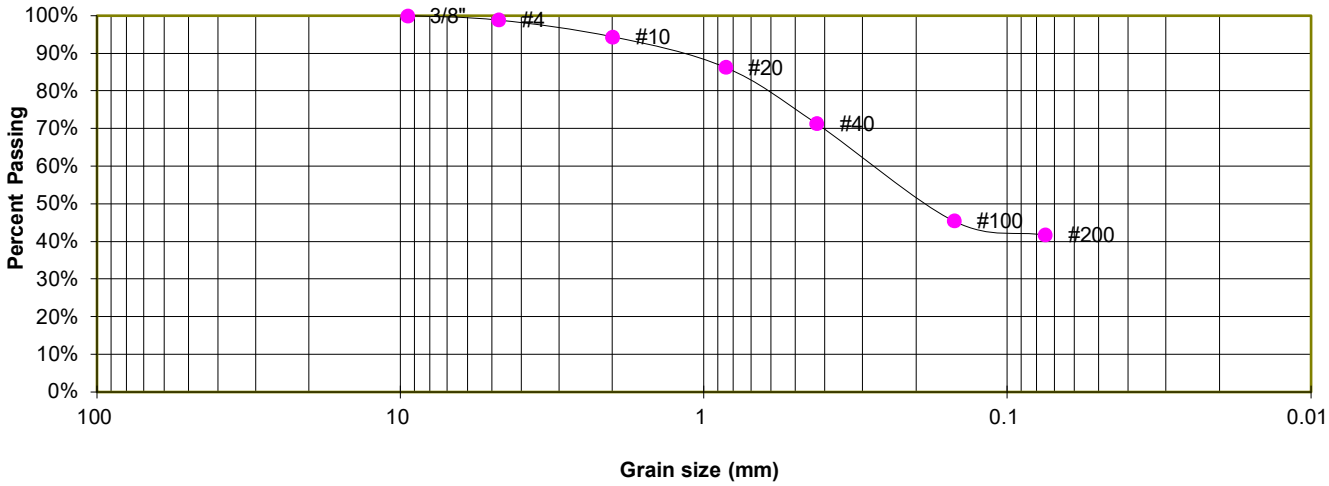
LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-6

TEST BORING	1	SOIL DESCRIPTION	SANDSTONE (SAND, CLAYEY)
DEPTH (FT)	15	SOIL TYPE	4



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.9%
10	94.4%
20	86.3%
40	71.4%
100	45.5%
200	41.8%

ATTERBERG LIMITS

Plastic Limit	24
Liquid Limit	37
Plastic Index	13

SOIL CLASSIFICATION

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

ENTECH ENGINEERING, INC.

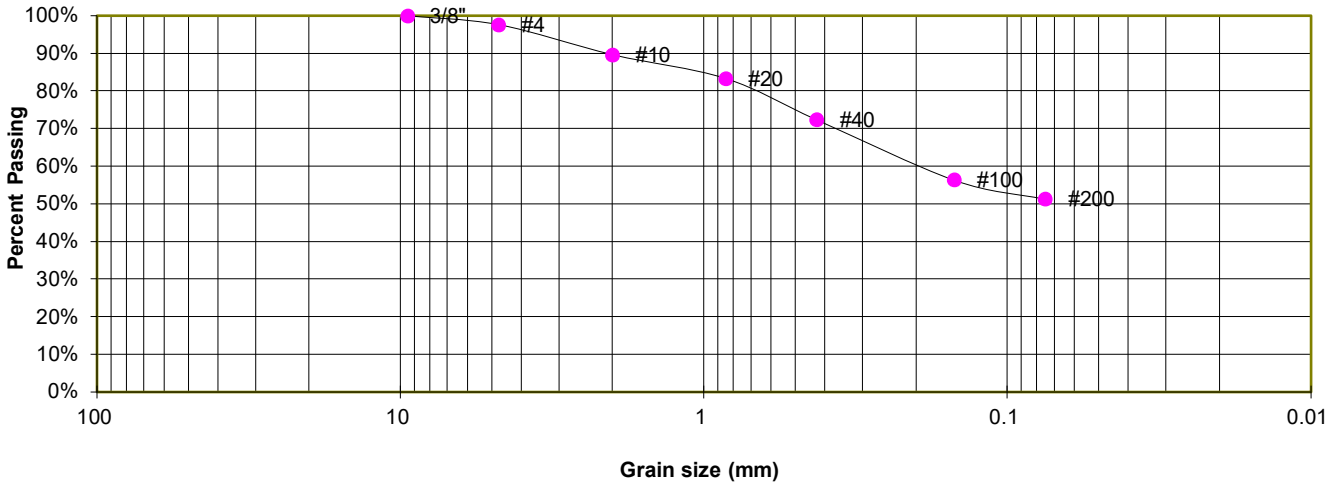
LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-7

TEST BORING	3	SOIL DESCRIPTION	CLAYSTONE (CLAY, SANDY)
DEPTH (FT)	15	SOIL TYPE	5



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.7%
10	89.7%
20	83.3%
40	72.4%
100	56.4%
200	51.3%

ATTERBERG LIMITS

Plastic Limit	24
Liquid Limit	38
Plastic Index	14

SOIL CLASSIFICATION

USCS CLASSIFICATION:	CL
AASHTO CLASSIFICATION:	A-6
AASHTO GROUP INDEX:	4

ENTECH ENGINEERING, INC.

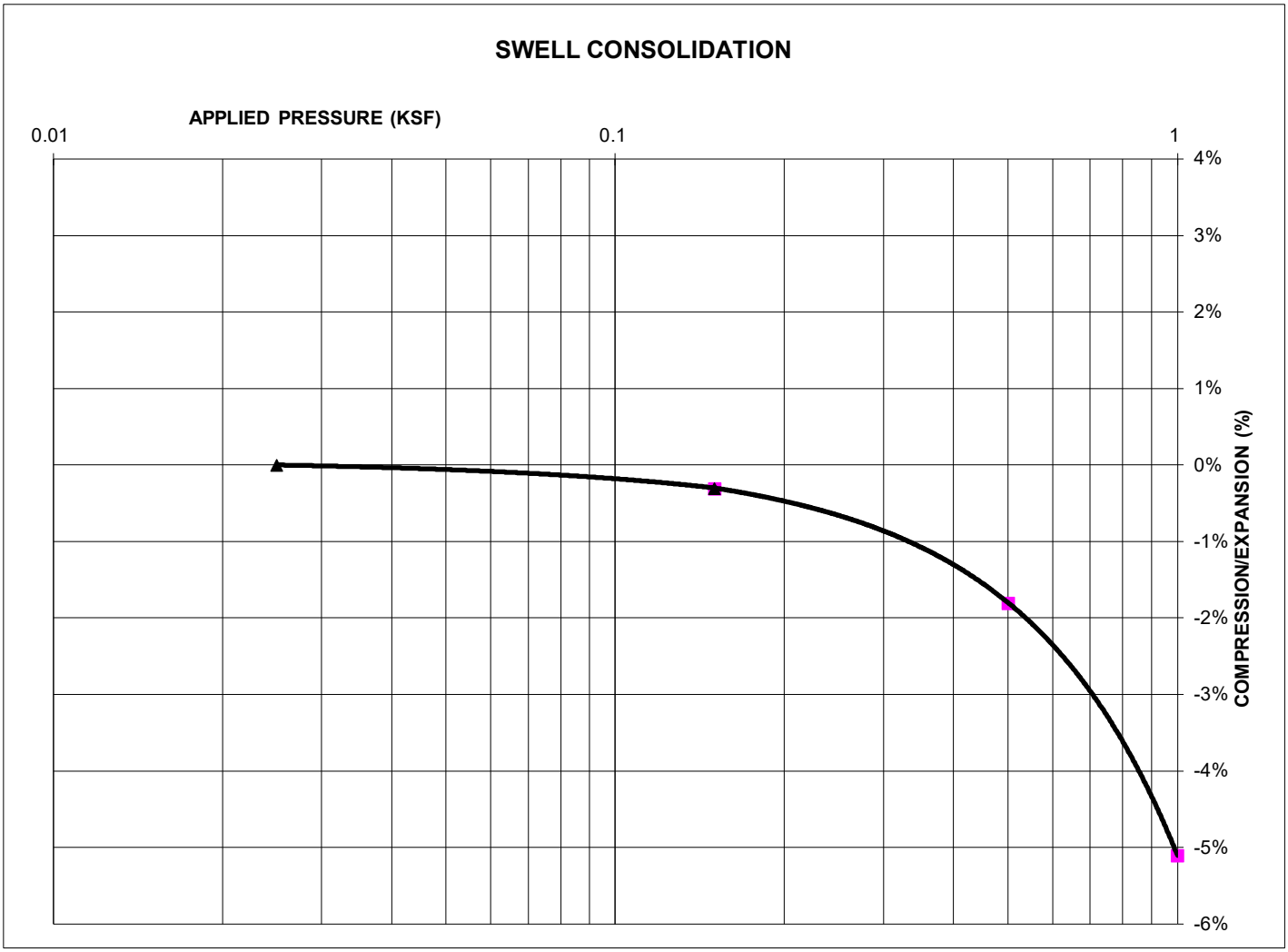
LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-8

TEST BORING	5	SOIL DESCRIPTION	FILL, SAND, CLAYEY
DEPTH (FT)	1-2	SOIL TYPE	1



SWELL/COLLAPSE TEST RESULTS

NATURAL UNIT DRY WEIGHT (PCF): 116
NATURAL MOISTURE CONTENT: 11.5%
SWELL/COLLAPSE (%): 0.0%

ENTECH ENGINEERING, INC.

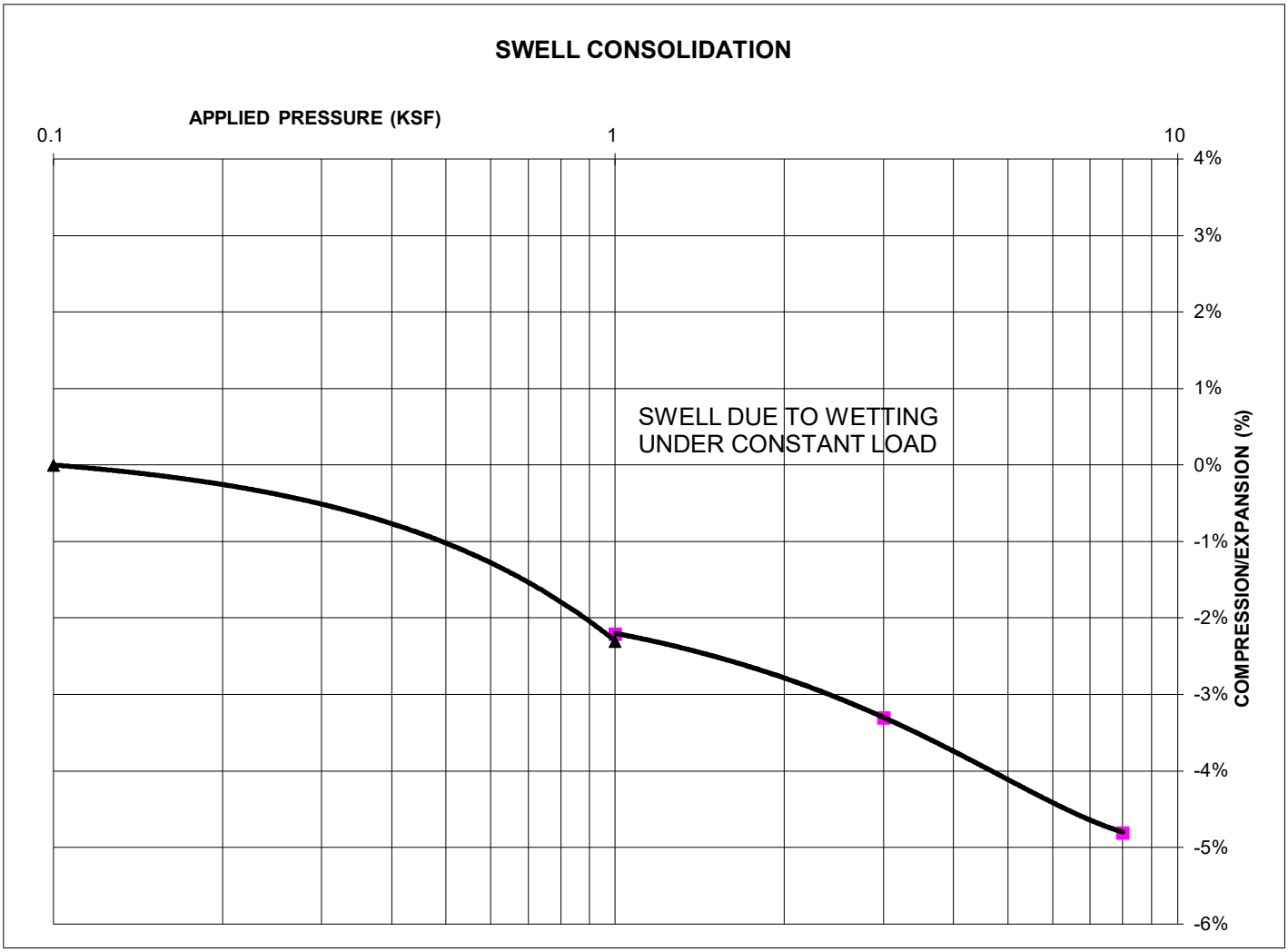
SWELL TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-9

TEST BORING	2	SOIL DESCRIPTION	CLAY, SANDY
DEPTH (FT)	10	SOIL TYPE	3



SWELL/COLLAPSE TEST RESULTS

NATURAL UNIT DRY WEIGHT (PCF): 106
NATURAL MOISTURE CONTENT: 18.1%
SWELL/COLLAPSE (%): 0.1%

ENTECH ENGINEERING, INC.

SWELL TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-10

TEST BORING	3	SOIL DESCRIPTION	CLAYSTONE (CLAY, SANDY)
DEPTH (FT)	15	SOIL TYPE	5

SWELL/COLLAPSE TEST RESULTS

NATURAL UNIT DRY WEIGHT (PCF): 101
NATURAL MOISTURE CONTENT: 19.0%
SWELL/COLLAPSE (%): 0.1%

ENTECH ENGINEERING, INC.

SWELL TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

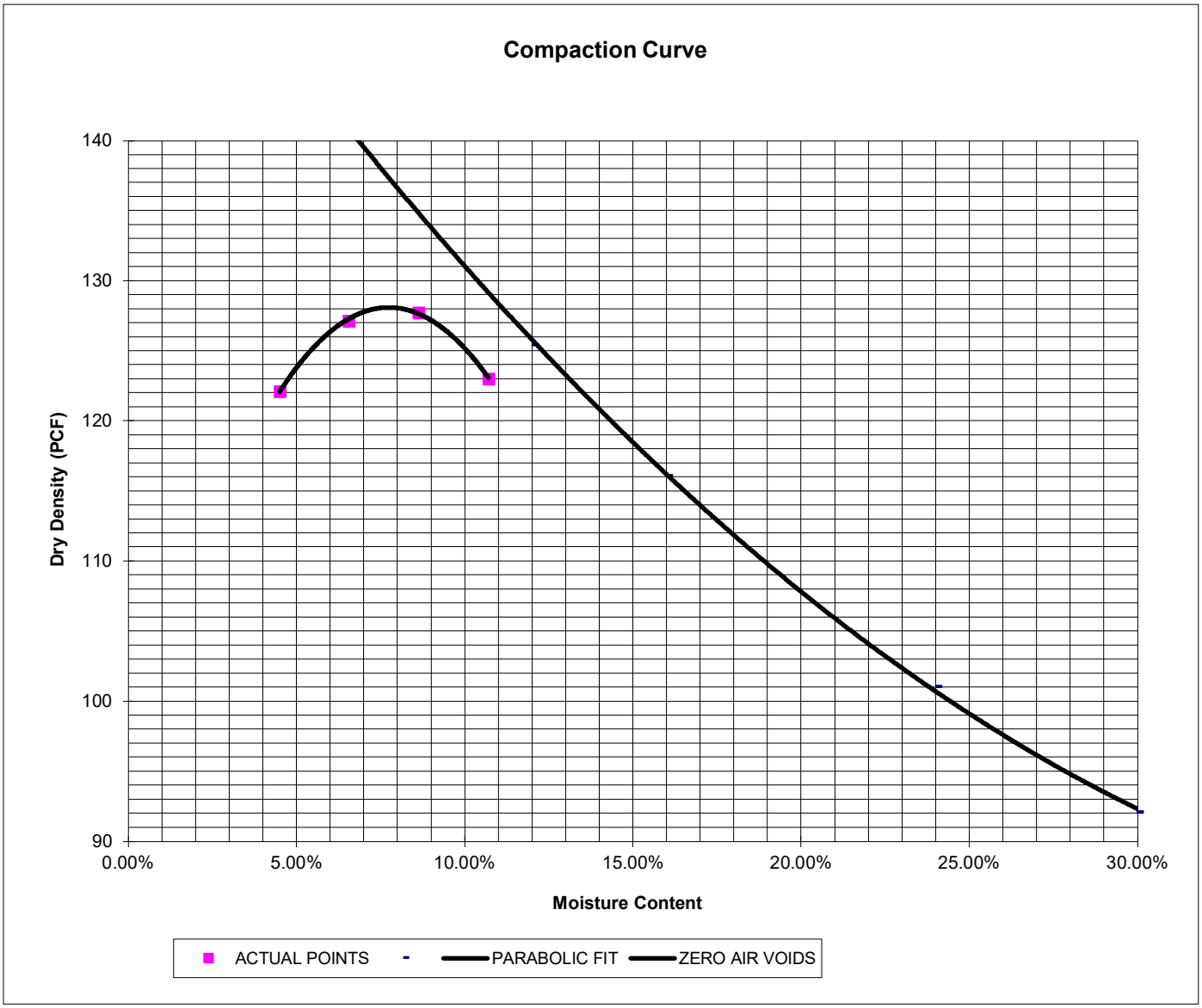
JOB NO. 241844

FIG. B-11

SAMPLE LOCATION TB-4 @ 0-3'	SOIL DESCRIPTION SAND, SILTY, BROWN
	SOIL TYPE 1

PROCTOR DATA

IDENTIFICATION:	SM
PROCTOR TEST #:	1
TEST BY:	PH
TEST DESIGNATION:	ASTM-1557-A
MAXIMUM DRY DENSITY (PCF):	128.1
OPTIMUM MOISTURE:	7.8



ENTECH ENGINEERING, INC.

LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-12

SAMPLE LOCATION TB-4 @ 0-3' | SOIL DESCRIPTION SAND, SILTY, BROWN
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	246	82.21	325	108.60	387	129.32
0.050	304	101.59	503	168.09	679	226.90
0.075	327	109.27	749	250.29	874	292.06
0.100	349	116.62	997	333.17	1250	417.71
0.125	367	122.64	1442	481.87	1694	566.08
0.150	394	131.66	1651	551.71	2123	709.44
0.175	423	141.35	1822	608.85	2538	848.12
0.200	447	149.37	1978	660.98	2959	988.80
0.300	553	184.79	2649	885.21	4558	1523.14
0.400	660	220.55	3004	1003.84	5674	1896.07
0.500	763	254.97	3374	1127.48	5800	1938.17

MOISTURE AND DENSITY DATA

	Mold # 1	Mold # 2	Mold # 3
Can #	343	349	117
Wt. Can	8.63	8.88	8.58
Wt. Can+Wet	168.34	124.38	111.54
Wt. Can+Dry	147.2	112.6	101.02
Wt. H20	21.14	11.78	10.52
Wt. Dry Soil	138.57	103.72	92.44
Moisture Content	15.26%	11.36%	11.38%
Wet Density (PCF)	125.8	132.2	137.4
Dry Density (PCF)	116.7	122.6	127.5
% Compaction	91%	96%	100%
CBR	11.66	33.32	41.77

PROCTOR DATA

Maximum Dry Density (pcf)	128.1
Optimum Moisture	7.8
90% of Max. Dry Density (pcf)	115.3
95% of Max. Dry Density (pcf)	121.7

CBR at 90% of Max. Density = 6.6 ~ R VALUE 14
CBR at 95% of Max. Density = 29.9 ~ R VALUE 73

ENTECH ENGINEERING, INC.

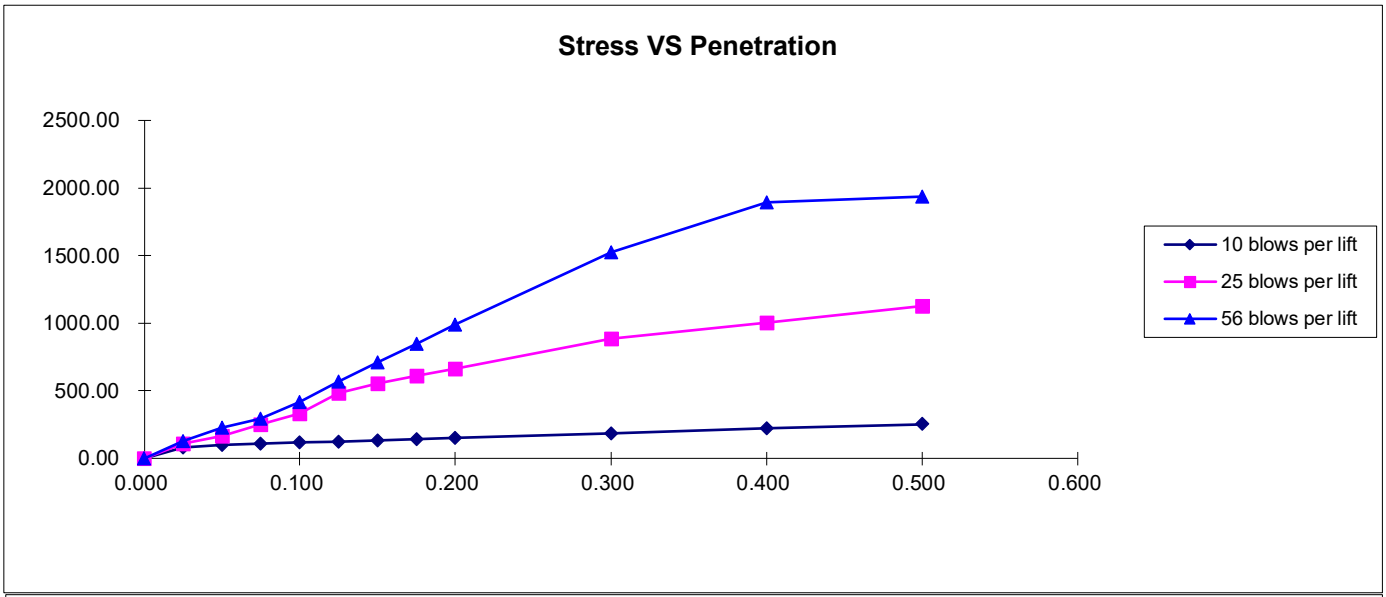
LABORATORY TEST RESULTS

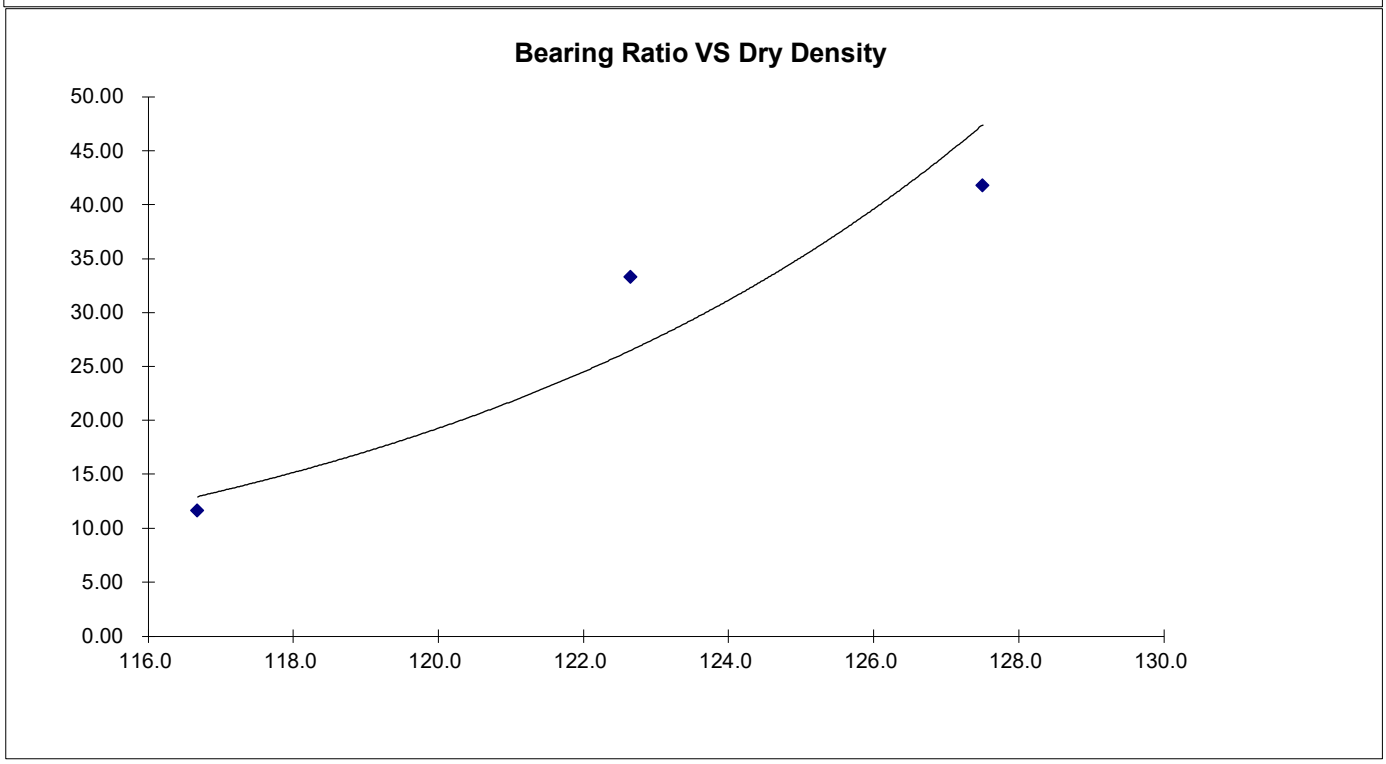
BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO. 241844

FIG. B-13

SAMPLE LOCATION TB-4 @ 0-3'	SOIL DESCRIPTION SAND, SILTY, BROWN SOIL TYPE 1





ENTECH ENGINEERING, INC.

LABORATORY TEST RESULTS

BENT GRASS EAST, FILING NO. 2, LOT 1
CARUBIA PROPERTIES

JOB NO.
241844

FIG. B-14

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

PROJECT DATA

Project Location: Bent Grass East, Filing No. 2, Lot 1

Job Number: 241844

DESIGN DATA

Equivalent (18-kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	100,000
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 = 1.66

DESIGN EQUATIONS

Resilient Modulus

If using CBR:

M_R = (CBR) x 1,500

If using R-Value:

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

D_1 = Depth of HMA (inches)

D_2 = Depth of ABC/RCB (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/RCB	C_2 = 0.11	4.0 inches	0.440	
			SN^* =	2.200	1.66

Pavement SN > Required SN, Design is Acceptable

FIG. C-1