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& CONSULTING, INC.

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Structural Engineering & Consulting
Geotechnical Engineering
On-Site Wastewater Treatment Design
Inspections & Technical Reports

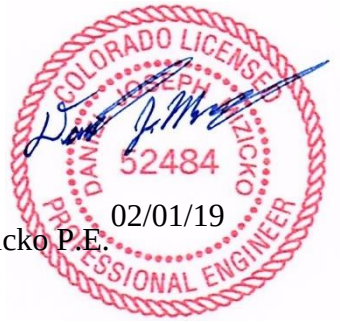
February 1, 2019 JN 19.030

Project: **Subsurface Soil Investigation**
2290 Old Ranch Road,
Colorado Springs, Colorado 80908

Attached is a formal soils report for the project referenced above. Included in this report is a review of the soils investigation and analysis for this location. The purpose of our investigation was to evaluate the conditions of the subsurface soil in order to establish design and construction criteria for the proposed structure(s). A discussion of the results of our investigation with construction recommendations is also included. If revisions to the design of the proposed structure take place, it is advised that our firm be contacted immediately to review the changes and to determine if the revised plans are acceptable.

If you have any questions concerning this report, please feel free to contact our office at 719-494-0404.

Sincerely,



Daniel J. Mizicko P.E.

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Purpose and Scope of Study

This report presents the results of a subsurface exploration program to provide foundation recommendations for the proposed structure to be located on the parcel of land referenced above.

The exploration program was conducted in order to obtain information regarding the subsurface conditions. Soil samples were retrieved from a soil boring(s) and analyzed to provide data on the classification and engineering characteristics of the on-site soils. The results of the field and laboratory investigation are presented herein.

This report has been prepared to summarize the data obtained and to present our conclusion and recommendations based on the proposed construction and the subsurface conditions encountered. Design criteria and a discussion of the geotechnical engineering considerations related to the construction of the proposed structure are included.

***<u>The information presented in this report is NOT intended to be used as a design</u>. The foundation design requirements and all inspections associated with the foundation design is the responsibility of the Structural Engineer of Record.**

Proposed Construction

Based on the information provided, the proposed construction will consist of a 30'x40' commercial structure, supported on a reinforced concrete foundation system. We anticipate maximum structural loadings of 3000 pounds per lineal foot for distributive wall loads and 15 kips for concentrated column loads.

If the project features or loadings differ significantly from those above, our firm should be contacted to reevaluate the recommendations contained herein.

Field Investigation

The field investigation for this project was conducted on January 24, 2019.

A 4" diameter exploratory boring was drilled to approximately 18 feet below grade in the area of the proposed construction. Standard penetration testing (SPT) was conducted during the drilling process.

The SPT measures resistance to penetration of a standard split-spoon sampler that is driven by a 140 lbm hammer dropped from a height of 30 in. The number of blows required to drive the sampler a distance of 12 in. after an initial penetration of 6 in. is referred to as the N-value or standard penetration resistance in blows per foot.

The representative samples obtained from the SPT split-spoon sampler are saved for subsequent laboratory examination and testing.

Laboratory Investigation

The field samples obtained were analyzed and classified in the laboratory. Laboratory testing included standard property tests, natural water content, Atterberg limits and Expansion Index tests.
The laboratory testing was conducted in general accordance with ASTM specifications.

Subsurface Conditions

The following tables summarize information obtained about the subsurface conditions encountered:

Soil Classification	Sample Depth	Gravel	Sand	Fines	LL[1]	PI[2]	EI[3]	Expansive Potential
Clayey Sand (SC)	5 ft.	2.9%	51.9%	45.2%	33	16	**146**	**Very High**

LL – Liquid Limit [1] PI – Plasticity Index [2] EI – Expansion Index [3]

Soil Classification	Sample Depth	SPT N-Value	Relative Density	Moisture Content	Clay Content	Expansive Index	Expansion Potential
Clayey Sand (SC)	5 ft.	5/16	Medium Dense	13.9%	**High**	**146**	**Very High**
Silty Clayey Sand (SC-SM)	10 ft.	6/20	Medium Dense	3.2%	Low	N/A	**Low**
Silty Clayey Sand (SC-SM)	15 ft.	N/A	Medium Dense	4.2%	Low	N/A	**Low**
Silty Clayey Sand (SC-SM)	18 ft.	N/A	Medium Dense	14.5%	Low	N/A	**Low**

Ground water was not encountered during the time of our investigation. This may be due to lack of moisture received in the area and subsequently may rise due to seasonal changes, degree of irrigation and/or other factors.

Foundation Recommendations

The laboratory data indicates subsurface conditions consisting of soil with a very high potential for expansion at depths at and below the proposed bearing depth. Given the nature of the native soil conditions, the following foundation recommendations have been provided to minimize and/or eliminate the potential for foundation movement.

Option 1: Overexcavation & Compacted Fill

The native expansive soil shall be over excavated and replaced with properly compacted, offsite structural fill material to a depth of 4 feet minimum below the foundation elements. The fill material shall be compacted to minimum 95% Modified Proctor density. All foundation elements bearing directly on structural fill material shall be designed for a maximum allowable bearing pressure of 1500 psf. **It should be emphasized that foundation movement remains a possibility if significant moisture changes occur in the native soil below the fill material. The owner/owners representative accepts**

all risks associated with foundation movement if this option is selected. Otherwise, option 2 should be considered.

Option 2: Drilled Caissons

The foundation design shall consist of a reinforced concrete grade beam system with the installation of drilled, straight shaft piers (caissons) embedded into competent bedrock formation.

- All piers shall be 10" diameter minimum and shall have a minimum 25 foot shaft length.
- All piers shall be anchored a minimum of 7 feet into competent bedrock with a minimum of 3 shear rings (minimum 4"wide x 3" deep) @ 24" o.c. max. along the bottom of the pier and embedded into competent rock formation.
- All piers shall be designed for a maximum end bearing pressure of 30,000 psf, a side shear of 3,000 psf and a minimum dead load end bearing pressure of 15,000 psf. A design anchor value of 2000 psf times the surface area may be used for the portion of pier penetration into bedrock.
- Concrete shall be sulfate resistant Type II cement for all elements within 6 inches of soil
- Concrete should be placed immediately after drilling, cleaning and observing each pier hole. A representative of Parr Engineering & Consulting, Inc. should be contacted to observe drilling operations.
- All piers to be reinforced for their full length with a minimum of three No. 5 bars which shall extend into the grade beams or foundation walls a minimum of 24".
- A minimum 6-inch continuous void space below grade beam is recommended between piers.

Structural Fill Gradation & Compaction

Structural Fill shall consist of a well graded mixture of sound mineral aggregate particles void of debris containing sufficient proper quality binding materials to secure a firm, stable foundation when placed and compacted. When tested with laboratory sieves, the material shall meet the following gradation requirements:

Standard Sieve Size	% Passing (by Weight)
2 inch	100
No. 4	30-100
No. 50	10-60
No. 200	5-20

Colorado Department of Transportation approved class 4, 5, or 6 base course materials typically meet the above specifications. A report showing the gradation analysis and test results for the materials proposed for structural fill shall be provided to Parr Engineering for review and approval prior to placement.

Imported structural fill shall be placed in 8" maximum uniform lifts and compacted to a minimum 95% Modified Proctor Density (ASTM D-1557) near optimum moisture content.

Compaction testing and confirmation is required at 24" intervals max. Results of the testing must be provided to Parr Engineering & Consulting when complete.

Foundation Walls

Foundation walls may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 55 pcf for imported fill material.

All foundation walls should be designed for appropriate hydrostatic and surcharge pressures such as adjacent buildings, traffic and construction materials and equipment. The pressures recommended above assume a relatively horizontal backfill surface.

Backfill shall be carefully placed in uniform lifts and properly compacted near optimum moisture content. Care should be taken not to overcompact the backfill since this could cause excessive lateral pressure on the walls. Some settlement of deep foundation wall backfill will occur even if the material is placed correctly.

Medium plasticity, clayey material encountered during excavation should not be used as foundation wall backfill.

Open Excavation/Caisson Installation Observation

It is assumed that the results in this report are representative of the subsurface conditions throughout the site. However, variations across the site are a possibility and will not become evident until the foundation excavation and caisson drilling operations take place.

A representative of Parr Engineering & Consulting must be contacted to inspect the completed foundation excavation. Furthermore, continuous inspection and observation by a representative of Parr Engineering & Consulting is required during fill placement/compaction activities and caisson drilling and installation operations. Please contact our office a minimum of 24 hours prior to the above activities. This report may be rendered null and void if the above inspections/observations are not completed.

***The Open Excavation/Caisson Install Observation Report will be billed additionally at the time services are complete and prior to the release of any documentation (either electronically or hard copy).**

Interior Structural Floors

Given the nature of the potentially expansive soil conditions, interior slabs supported directly on the native soil can be expected to move and crack when exposed to moisture and should be avoided if possible. If floor movement and cracking cannot be tolerated, interior floor slabs (i.e., basement floors) shall be elevated over a crawl space and designed as structural systems supported independently of the underlying soil.

Garage Slabs-On-Grade

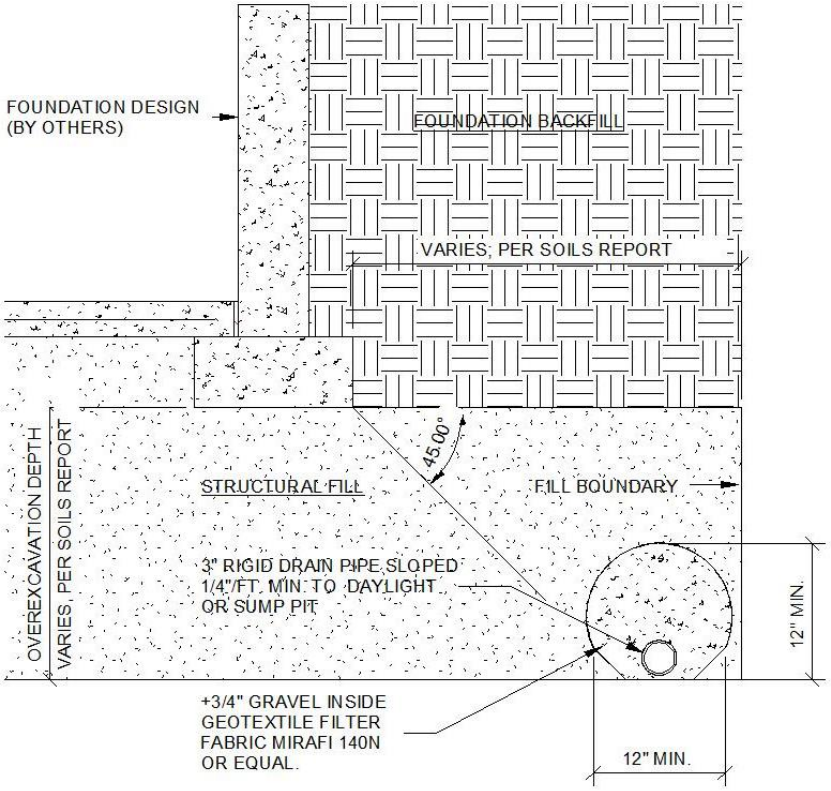
It is recommended that all garage slabs be supported on a minimum of 3 feet of imported structural fill. Slabs shall be reinforced with #3 bars @ 18" o.c. each way or 4x4-W2.9xW2.9 W.W.F. (centered).

Slabs should be provided with control joints to reduce damage that may occur as a result of shrinkage cracking. We suggest the spacing of the joints to be no more than 15 feet centers. The actual joint spacing should be based on the slab reinforcing design.

All non-load bearing partitions resting on slabs-on-grade shall be constructed with a minimum 1 ½" void space to allow for freedom of movement without affecting the roof and floor structure above.

Overexcavation Drainage

A subsurface underdrain is required around the perimeter of the overexcavation/structural fill zone, located 48" below the bottom of the foundation elements.

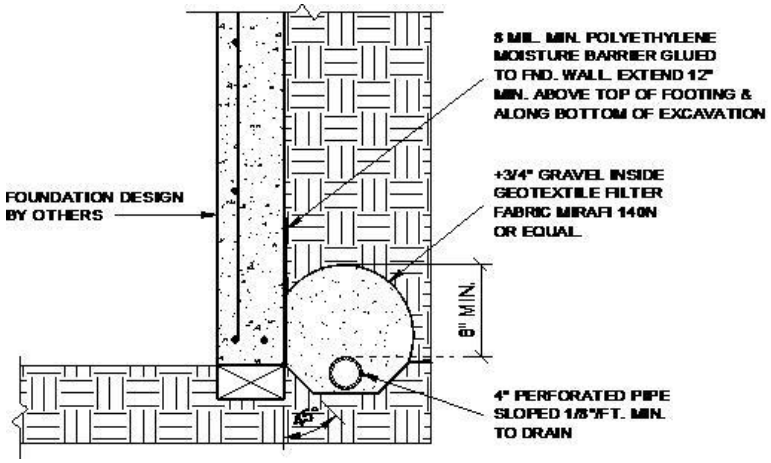


Foundation Drainage

A subsurface foundation drain or equivalent protection measure is required around the perimeter of all habitable or storage spaces located below grade (including crawlspace areas).

A subsurface drain is designed to redirect moisture around and away from the foundation system. However, it should be noted that a properly functioning drain does not completely eliminate the potential for foundation movement if exposed to subsurface moisture.

Foundation Drainage (continued)



Surface Drainage

The following drainage precautions should be observed during the construction and maintained at all times after the residence has been completed.

1) Excessive wetting and drying of the foundation excavations and underslab areas should be avoided during construction.
2) The ground surface surrounding the exterior of the building should be sloped to drain away from the foundation in all directions. We recommend a minimum slope of 12 inches in the first 10 feet.
3) Roof downspouts and drains should discharge well beyond the limits of the backfill.
4) Landscaping which requires excessive watering should be located at least 10 feet from the house.
5) Plastic membranes should not be used to cover the ground surface adjacent to the foundation walls.

Limitations

This report has been prepared with generally accepted soil and foundation engineering practices in this area for use by the client for design purposes. The conclusions and recommendations presented are based on data obtained from the exploratory boring(s). The nature and extent of variation from the exploratory boring may not become evident until excavation is performed. If during construction, soil, rock and groundwater conditions appear to be different from those described herein, our office should be advised immediately so that reevaluation of the recommendations may be made.

Although all laboratory procedures were performed under optimal conditions, it should be noted that precautions should be taken to accommodate for certain sources of failure such as inconsistencies in the properties/characteristics of the on-site soil, variations in groundwater levels due to seasonal changes, etc.

This report DOES NOT address the potential for geologic hazards or constraints (i.e., slope stability, landslides). It must be emphasized that such hazards and constraints are outside the scope of this investigation and must be investigated independently.

Site Map


TB #1
2290 Old Ranch Road, 80908
Old Ranch Rd
© 2018 Google
Google Earth

Laboratory Analysis – Sieve Analysis

SOIL CLASSIFICATION

Location of Site	2290 Old Ranch Road, 80908	Tested By:	R.Jaquet
		Date Tested	01/28/19
Legal Description	N/A		
		Collected By	D.Mizicko
Job Number	19.030	Date Collected	01/24/19

SITE INVESTIGATION

Test Hole Depth	18'-0"	Groundwater Table	N/A
Surface Layer Thickness	-	Volume of Soil Sample	1/2 cu.ft.
Soil System	Varies	Visual Moisture Observation	Moist

Layer	Soil Type/Depth
Surface	-
No. 1	SC/0 - 7'-0"
No. 2	SC-SM/7'-0" - 18'-0"
No. 3	-

Critical Layer	No. 1
Coloration	Grey
Gravel	Trace
Organic Content	Little-None

SIEVE ANALYSIS

Test Bore #:	TB #1	Bulk	Wet Weight of Soil (g)	457.3
Layer	No. 1		Dry Weight of Soil (g)	401.5
Depth of Sample	5'-0"		Natural Moisture Content	13.9%

Sieve #	Thickness (mm)	Mass Ret. (g)	% Ret.	%Pass	
4	4.750	11.8	2.9%	97.1%	Gravel
10	2.000	29.2	7.3%	89.8%	
40	0.425	73.3	18.3%	71.5%	
60	0.250	30.8	7.7%	63.9%	Sand
100	0.150	52.9	13.2%	50.7%	
200	0.075	22.0	5.5%	45.2%	
Pan	0.000	181.4	45.2%	0.0%	Fines
Pan	0.000		0.0%	0.0%	Organic
Totals		401.4	100.0%		

% Gravel	2.9%	Retained on #200	$C_u = D_{60}/D_{10}$ = N/A
% Sand	51.9%		
% Fines	45.2%	Passes #200	$C_c = D_{30}^2/(D_{10})(D_{60})$ = N/A
% Organic	0.0%		
Check	100.0%		

Laboratory Analysis – Atterberg Limits

ATTERBERG LIMITS

LIQUID LIMIT - LL

	Tin Mass(g)						
Cup #	Empty	Wet Soil	Dry Soil	# Drops	Water Mass (g)	Solids Mass (g)	Water Content
1	13.6	56.7	44.8	6	11.9	31.2	0.38
2	13.5	52.5	42.9	29	9.6	29.4	0.33
3	13.6	52.1	42.2	17	9.9	28.6	0.35

Liquid Limit (from plot)	0.33

PLASTIC LIMIT - PL

	Tin Mass(g)					
Cup #	Empty	Wet Soil	Dry Soil	Water Mass (g)	Solids Mass (g)	Plastic Limit (PL)
1	13.5	17.3	16.8	0.55	3.26	0.17
2	13.5	19.0	18.2	0.83	4.71	0.18
					Average	0.17

Plastic Limit	0.17

Note: Liquid Limit, Plastic Limit and Plasticity Index values have been rounded to nearest whole number when expressing as a percentage.

PLASTICITY INDEX - PI

Plasticity Index = Liquid Limit - Plastic Limit

Plasticity Index	0.16

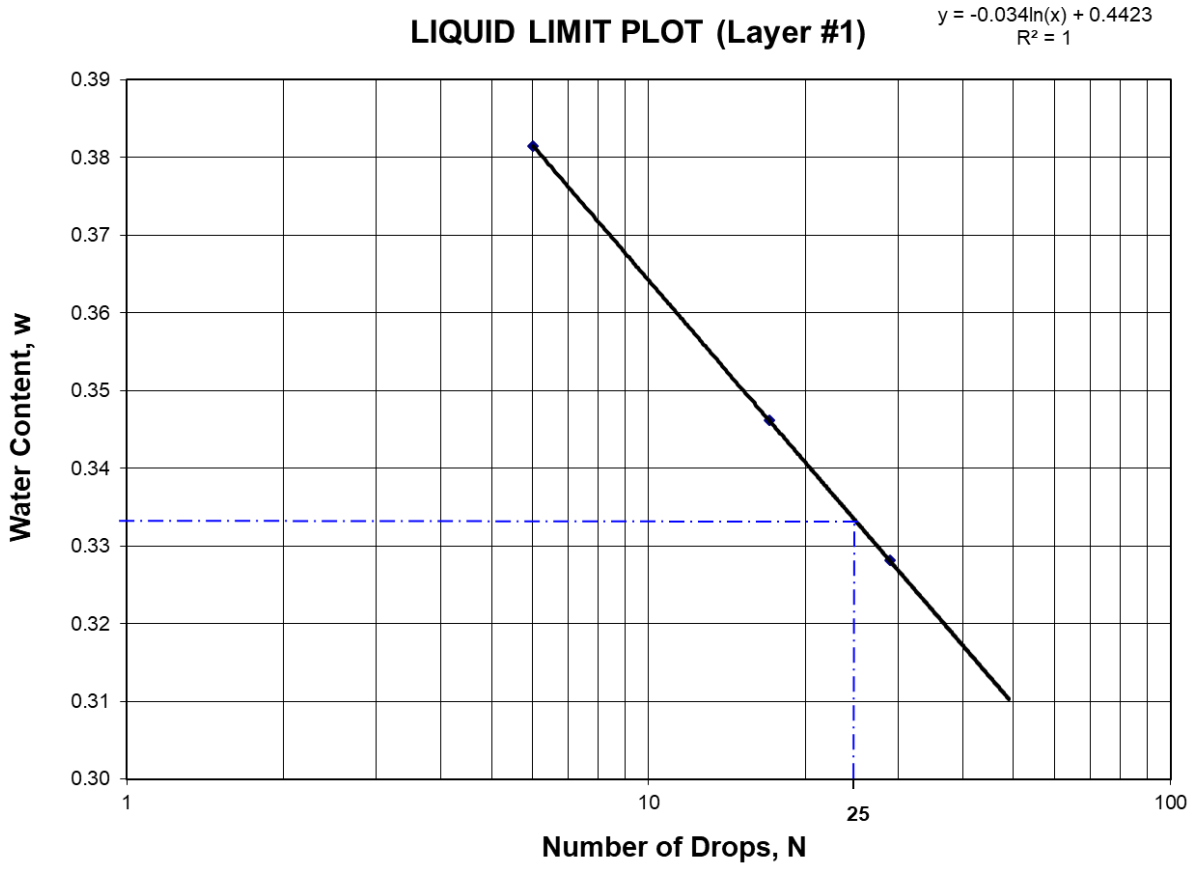
MOISTURE CONTENT

	Tin Mass(g)					
Depth	Empty	Wet Soil	Dry Soil	Water Mass (g)	Solids Mass (g)	Water Content
10'-0"	13.5	70.5	68.7	1.8	55.2	3.2%
15'-0"	13.7	77.2	74.6	2.5	61.0	4.2%
18'-0"	13.4	75.3	67.5	7.8	54.1	14.5%

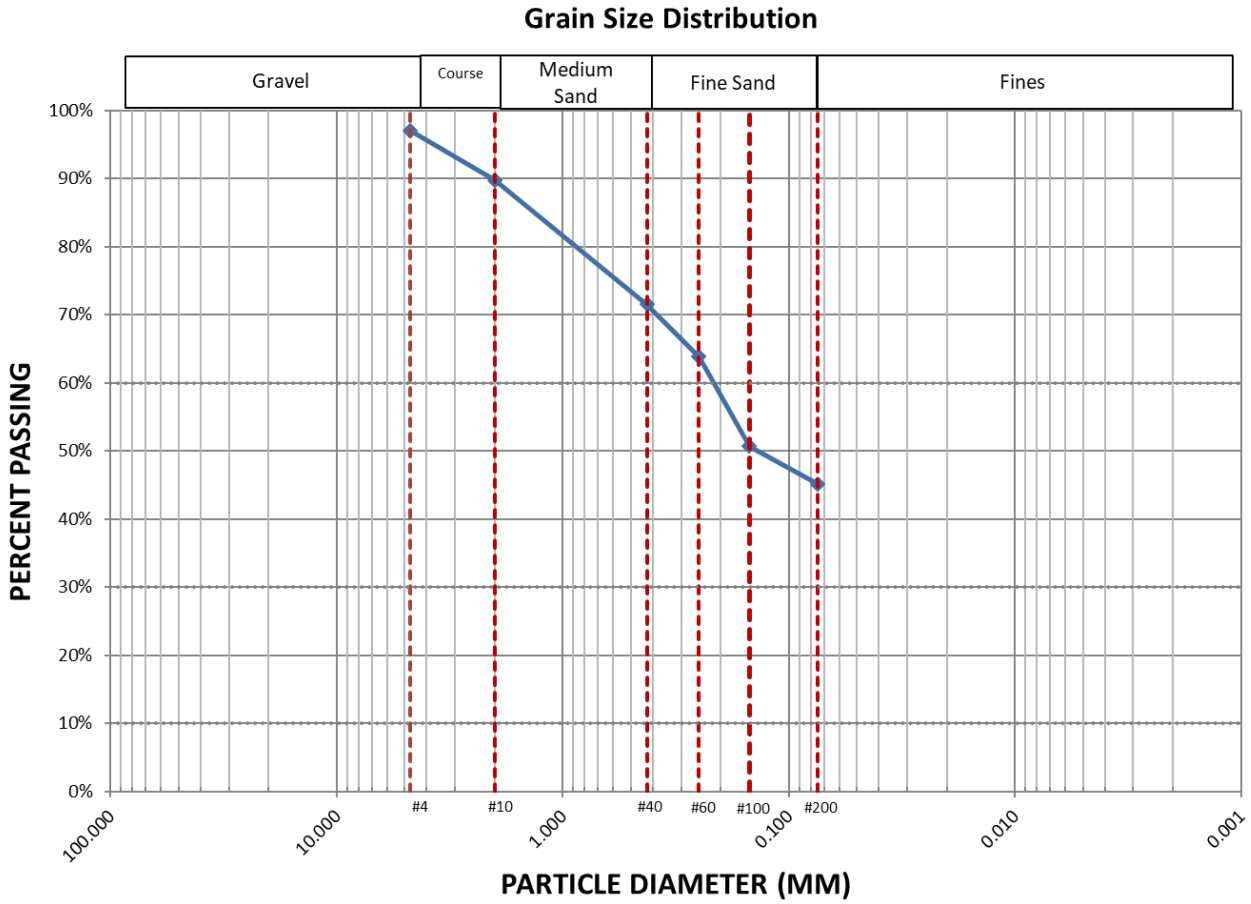
CLASSIFICATION

Plasticity	Medium Plasticity
Group Symbol	SC
Group Name	Clayey Sand

Laboratory Analysis – Liquid Limit Plot



Laboratory Analysis – Grain Size Distribution



Drill Log – Test Bore #1

Parr Engineering & Consulting, Inc. 11590 Black Forest Road, Suite 10 Colorado Springs, Colorado 80908 Phone: 719-494-0404	BORING LOG	
	Job Number:	19.030
	Date Drilled:	01/24/19
	Boring #:	TB #1

Driller:	D.Mizicko	Total Depth:	18'-0"
Logged By:	D.Mizicko	Groundwater Elevation:	N/A
Method:	Boring	Latitude:	38°58'53.07"N
Auger & Size:	4" Solid Stem	Longitude:	104°47'6.20"W

Depth (ft.)	Sample Interval	SPT Blows/12"	2290 Old Ranch Road, 80908	Additional Notes
			Sand, Coarse-Grained, Clay, Low Plasticity, Trace Gravel, Loose, Brown, Moist, (SC)	
5		5/16	Sand, Clay, Medium Plasticity, Trace Gravel, Medium Dense, Grey, Moist, (SC)	
			Sand, Coarse-Grained, Silt, Clay, Trace Gravel, Medium Plasticity, Medium Dense, Brown, Moist, (SC-SM)	
10		6/20		
15		Grab		
			Sand, Coarse-Grained, Silt, Clay, Trace Gravel, Medium Plasticity,	
		Grab	Medium Dense, Grey, Moist, (SC-SM)	
			Total Depth= 18'-0"	
20				
25				