BUCKHORN GEOTECH

Civil, Structural & Geotechnical Engineers

222 South Park Ave. • Montrose, CO 81401
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July 28, 2014

Town of Crested Butte, Parks and Recreation Department
Attn: Janna Hansen, Rodney Due
507 Maroon Avenue
P.O. Box 39
Crested Butte, CO 81224

Transmitted by email: *jhansen@crestedbutte-co.gov, rdue@crestedbutte-co.gov*

RE: CRESTED BUTTE TENNIS COURT REPLACEMENT PROJECT
GEOTECHNICAL RECOMENDATIONS

Dear Ms. Hansen and Mr. Due:

At your request, Buckhorn Geotech, Inc. conducted a site visit to evaluate shallow subsurface conditions at the tennis court site. We visited the site on Monday, July 21 and our evaluation consisted of a general site reconnaissance, verbal review of the proposed tennis court improvement plans with Mr. Due, excavation of four subgrade exploratory test pits, logging the test pit profiles, sampling representative soils, and selected laboratory testing. This letter presents our findings and our geotechnical recommendations related to the currently proposed tennis court replacement project.

Proposed Construction

Also refer to the Request for Proposal issued for this project by the Town of Crested Butte, dated July 10, 2014. We understand the new court surface will be a post tensioned slab design, which will overlay the existing asphalt court surface. However, the size of the new court is approximately 22 feet wider than the existing asphalt surfaced court. Based on the location of the town storm sewer line, which was located during the excavation of our test pits, we understand the new court will be extended approximately 6 feet to the west of the existing court surface and approximately 16 feet to the east of the existing court surface. The storm sewer was located approximately 2.5 feet below the existing ground surface, and roughly 9 feet west of the northwest corner of the existing court and roughly 6 feet west of the southwest corner of the existing court.

Site, Subsurface, and Laboratory Evaluations

Four test pits were excavated at the site. One located at approximately each corner of the existing court, to both the east and west sides. Our test pits revealed generally damp to moist sandy subrounded to subangular gravel and cobbles, with some silt and a trace of clay. This material was rocky and moderately dense throughout the depth of the test pits. The test pits ranged in depth from 2.5. to 5.0 feet in depth. The two test pits on the east side had

approximately 6 inches of grass roots and topsoil, while the two test pits on the west side had little to no topsoil present. No groundwater or bedrock was observed in the four test pits.

We obtained a sample of the material from the test pit near the southwest corner of the court from a depth of 0 to 2.5 feet. This sample was tested to evaluate the plasticity and particle size characteristics (see attached Sieve Analysis and Atterberg Limits laboratory results for sample BS2). The sample had a liquid limit (LL) of 33, a plastic limit (PL) of 22, and a plasticity index (PI) of 11. A soil with a PI of less than 15 is considered to have low potential for swelling or shrinking.

A gradation analysis performed on this sample indicates that the sample is composed of 24% fines (silt and clay), 37% sand, and 39% gravel (sample BS2). Based on these laboratory test results, this soil classifies as a clayey gravel with sand (GC) according to the Unified Soil Classification System (USCS). Natural moisture content of the bulk sample was measured to be 5.6%.

A Modified Proctor (ASTM D 1557) test was also performed on sample BS2 and the results indicate the fine fraction of the sample has a maximum dry density of 123.9 pcf at an optimum moisture content of 10.3%. The corrected maximum dry density (corrected for 21.6% rock greater than ¾") is 131.0 pcf at a corrected optimum moisture content of 8.4%.

RECOMMENDATIONS

Site Preparation and Grading

1. Drainage plans should ensure that precipitation, snowmelt, and runoff are conveyed off of and away from the finished tennis court surface.

2. Areas below the proposed post tension slab requiring fill to match the existing tennis court surface elevation should be stripped of any topsoil and/or organics, the native sandy gravel and cobbles exposed should be moisture conditioned as necessary and compacted in order to obtain a minimum of 95% of the optimum dry density determined by Modified Proctor test, prior to placing additional structural fill.

3. Structural fill should be used in areas requiring fill below the new post tension slab. Structural fill used at this site should meet the gradational and compaction requirements listed in Tables 1 and 2 below. Structural fill should be placed and compacted in **maximum 6-inch lifts.** Structural fill should not be placed on frozen or wet existing soil or fill material.

Table 1. Gradation Requirements for Structural Fill Material

Type	Sieve	% Passing, by weight
Structural Fill (CDOT Class 6 roadbase)	3/4" (19.0 mm)	100
	#4 (4.75 mm)	30-65
	#8 (2.36 mm)	25-55
	#200 (0.075 mm)	3-12
Structural Fill (CDOT Class 1)	2.5" (63.5 mm)	100
	2" (50 mm)	95-100
	#4 (4.75 mm)	30-65
	#200 (0.075 mm)	3-15

Note: The Plasticity Index for all imported structural fill soils should be less than 6.

Table 2. Compaction Requirements for Fill Material

Application	Compaction Requirement	Proctor	Moisture
Under post tension slabs	95% max. dry density	Modified	±2% of optimum
Under exterior flatwork	90% max. dry density	Modified	±2% of optimum

4. A representative of Buckhorn Geotech should be called out to the site to observe placement of structural fill and verify the compacted density of both the native site soils and imported structural fill.

Concrete

Because of the potential sulfates in the soil and their corrosive qualities, Type II sulfate-resistant cement with type 'F' fly ash should be used for all concrete in contact with native soils at this site.

Closing

Thank you for the opportunity to perform this geotechnical evaluation for you. If you require any additional services or have any questions regarding this report, please contact us.

The owner or contractor should contact Buckhorn Geotech in advance of the construction phase to discuss the specific testing requirements, budget, and scheduling needed for these services.

Respectfully Submitted
ELECTRONICALLY,

Buckhorn Geotech, Inc.

Kari Roberts. E.I.
Project Manager

Reviewed by:

Wayne Pandorf, P.E.
Professional Engineer

Attachments: Sieve Analysis and Atterberg Limits results, Sample BS2
Modified Proctor results, Sample BS2

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Sieve Analysis and Atterberg Limits

Project Name	Crested Butte Tennis Courts	Date	7/22/2014
Project Location	Crested Butte, CO	Project #	14-195-GRP
Client	Town of Crested Butte	Sample by	KR
Test Location	TP#3 @0-2.5'	Tested by	LC/BK
Sample #	BS2		

Sieve Analysis

ASTM C136 / C117

Sieve	Opening (mm)	% Passing
3"	76.2	100.0
3/4"	19.0	78.1
3/8"	9.5	69.2
#4	4.750	61.3
#10	2.000	52.3
#40	0.425	40.6
#200	0.075	24.0

Atterberg Limits

ASTM D4318

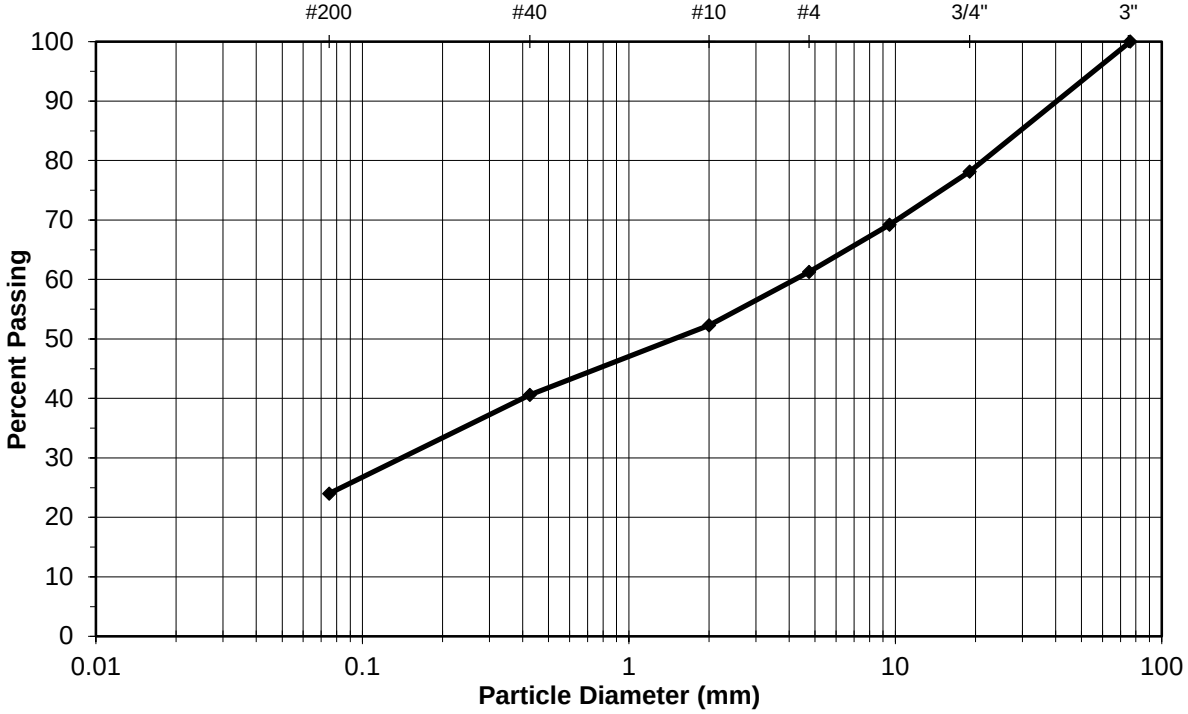
Liquid Limit (LL)	33
Plastic Limit (PL)	22
Plasticity Index (PI)	11

CL = Clay

Natural Moisture Content (%) = 5.6%

Soil Description: dark reddish brown clayey GRAVEL with sand

USCS Classification: GC



Clay/Silt	Fine	Medium	Coarse	Fine	Coarse
FINES	**SAND**			**GRAVEL**	

% Fines = 24.0 % Sand = 37.3 % Gravel = 38.7

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MODIFIED PROCTOR ASTM D 1557. ASTM D 4718
METHOD C

Project Name	Crested Butte Tennis Courts	Date	7/22/2014
Project Location	Crested Butte, CO	Project #	14-195-GRP
Client	Town of Crested Butte	Sample by	KR
Sample Location	TP#3 @0-2.5'	Test by	LC
Sample ID	BS2		
Soil Description	dark reddish brown clayey GRAVEL with sand	USCS Classification	GC

Oversize Particles Determined by Sieve:	3/4"	Max. Dry Density (fine fraction) (pcf):	123.9
Percentage Oversize Particles (by weight):	21.6	Optimum Moisture Content (fine fraction)(%):	10.3
Bulk Specific Gravity (G_M):	2.67	Corrected Max. Dry Density (pcf):	131.0
		Corrected Optimum Moisture Content (%):	8.4