

February 5, 2019



ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
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Jerome Hannigan and Associates, Inc.
19360 Spring Valley Road
Colorado Springs, Colorado

Attn: Jerry Hannigan

Re: Embankment Recommendations
Settlers View Subdivision
Colorado Springs, Colorado

Ref: Entech Engineering, Inc., Dated February 2, 2017. *Soils, Geology, Geologic Hazard, and Wastewater Study*, El Paso County, Colorado. Entech Job No. 162442.

Dear Mr. Hannigan:

Entech Engineering, Inc. previously performed a Soils, Geology, Geologic Hazard, and Wastewater Study at the above referenced site. Information from this report was used for preparing this letter. The proposed dam embankment will be located on Lot 11 of Settlers View Subdivision. The site is indicated on the Engineering Geology Map, Figure 1. The project is to consist of construction of a dam embankment for the proposed development. This letter provides recommendations for the embankment based on the site conditions and above referenced report.

SITE CONDITIONS:

The site is currently vacant. Adjacent properties consist of undeveloped land and future rural residential development. Topography of the site is gradually sloping to the west southwest. The proposed embankment site encompasses an existing drainage area. Vegetation consists of field grasses and weeds.

PROJECT DESCRIPTION:

The project is to consist the construction of a detention pond/earthen embankment. At this time specific plans for the embankment are not available.

FIELD INVESTIGATION AND LABORATORY TESTING:

The subsurface conditions on this property were previously investigated by drilling three (3) exploratory test borings and excavating three (3) test pits across the proposed subdivision. Profile Hole No. 3 was located on Lot 11 south of the proposed earthen embankment location. The approximate locations of the test borings are indicated on the Engineering Geology Map, Figure 1.

The test borings were advanced with a power-driven continuous flight auger drilling rig to depths of 15 feet below the existing ground surface. Samples were obtained during drilling using the Standard Penetration Test, ASTM D-1586, utilizing a 2.0-inch O.D. split-barrel sampler and California sampler. Results of the Standard Penetration Tests are shown on the Test Boring Logs. The Test Boring Logs and Laboratory test results are summarized in Table 1 are included with this letter.

Embankment Recommendations
Settlers View Subdivision
El Paso County, Colorado
Job No. 162442

SOIL AND GROUNDWATER CONDITIONS:

The soils encountered in the test borings generally consisted of silty to clayey sand and sandy clay overlying silty sandstone. The soils were classified into three (3) general soil types using the Unified Soil Classification System (USCS).

The soils encountered in Profile Hole No. 3 on Lot 11 consisted of silty to clayey sand. The profile hole was drilled to 15 feet deep. Standard Penetration Testing on the sand resulted in a SPT N-values of 10 to 28 blows per foot, indicating medium dense to dense states. Groundwater was not encountered in the profile hole. It should be noted that the area of the proposed dam embankment is mapped in an area of seasonal shallow groundwater (Figure 1). Groundwater conditions may vary due to the depths of the proposed cuts, variations in rainfall, drainage and other factors not readily apparent at this time. Unstable soil conditions should be expected where excavations approach the groundwater level. Stabilization utilizing shot rock or geogrids may be necessary. Development of the property, adjacent properties and associated changes in runoff may affect the groundwater surface elevations in the drainage basin.

DEVELOPMENT CONSIDERATIONS AND RECOMMENDATIONS:

In general, the site soils are suitable for the proposed dam embankment. Groundwater should be expected to be encountered in any cuts made in the area mapped as seasonal shallow groundwater. Dewatering of the area may be required during site grading and embankment construction. Saturated unstable soil conditions may be encountered during construction of the basin and embankment. Excavation of saturated soils will be difficult with rubber-tired equipment. Stabilization using shot rock or geogrids may be necessary.

Any areas to receive fill should have all topsoil, organic material or debris removed. Fill must be properly benched and compacted to minimize potentially unstable conditions in slope areas. Fill slopes should be 3:1 or flatter on the upstream faces or 2.5:1 or flatter on the downstream face. The subgrade should be scarified and moisture conditioned to within 2% of optimum moisture content and compacted to a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557, prior to placing new fill. Areas receiving fill may require stabilization with rock or fabric if water is encountered.

New fill should be placed in thin lifts not to exceed 6 inches after compaction while maintaining at least 95% of its maximum Modified Proctor Dry Density, ASTM D-1557. These materials should be placed at a moisture content conducive to compaction, usually 0 to $\pm 2\%$ of Proctor optimum moisture content. The placement and compaction of fill should be observed and tested by Entech during construction. Entech should approve any import materials prior to placing or hauling them to the site.

CONCRETE:

Type II cement may be used for all concrete on this 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 excavations prior to the placement of concrete. If standing water is present in the foundation excavations, 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.

Embankment Recommendations
Settlers View Subdivision
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CLOSURE

The subsurface investigation, geotechnical evaluation and recommendations presented in this report are intended for use by Jerome Hannigan and Associates with application to the planned Embankment on Lot 11 of Settlers View Subdivision. 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 same locality and under similar conditions. No other warranty, expressed or implied is made. Final embankment /pond plans should be reviewed to determine where additional investigation is recommended. During final design and/or construction, if conditions are encountered which appear different from those described in this report, Entech Engineering, Inc. requests that it 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.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Reviewed by:



Logan L. Langford, P.G.
Geologist

LLL/nc

Entech Job No. 162442
AAProjects/2016/162442 Embankment Recommendations



Joseph C. Goode, P.E.
President



Professional Engineer Seal: JOSEPH COLLIN GOODE, LICENSE NO. 23725, COLORADO, PROFESSIONAL ENGINEER

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

CLIENT: JEROME HANNIGAN & ASSOC.
 PROJECT: SILVER NELL & SETTLERS VIEW
 JOB NO.: 162442

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	USDA SOIL TYPE	FHA SWELL (PSF)	SWELL/CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	PH-3	2-3			13.7						SM	SAND, SILTY
1	PH-2	5			19.5						SM	SAND, SILTY
1	TP-1	7-8			5.5			1			SM-SW	SAND, SLIGHTLY SILTY
1	TP-2	2-3			21.2			2A			SC	SAND, CLAYEY
1	TP-3	2-3			49.4			3A			SC	SAND, VERY CLAYEY
2	PH-1	10	15.2	122.4	60.1					0.0	CL	CLAY, VERY SANDY
3	PH-1	15			15.4						SM	SANDSTONE, SILTY

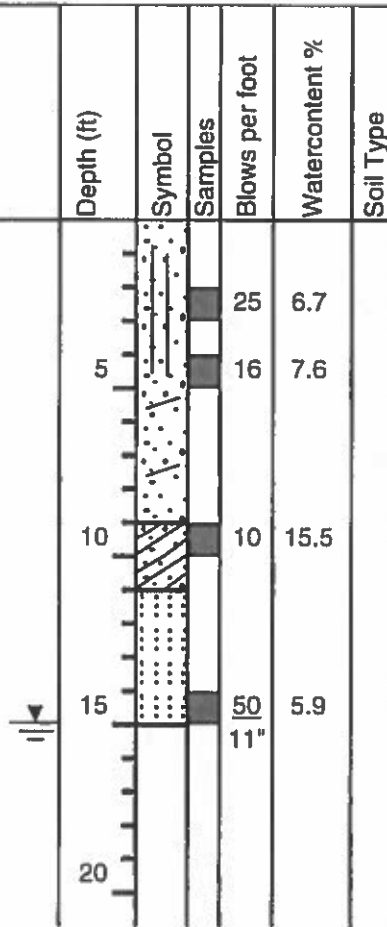
PROFILE HOLE NO. 1
 DATE DRILLED 1/11/2017
 Job # 162442

PROFILE HOLE NO. 2
 DATE DRILLED 1/11/2017
 CLIENT JEROME HANNIGAN & ASSOC.
 LOCATION SILVER NELL & SETTLERS VIEW

REMARKS

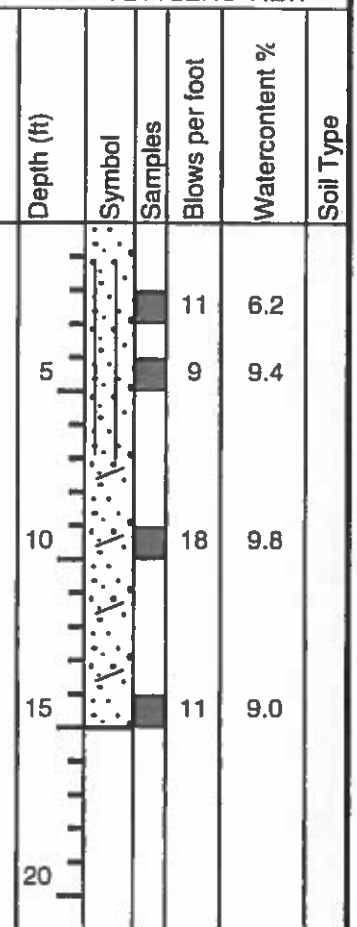
WATER @ 15', 1/12/17
 SAND, SILTY TO CLAYEY, FINE
 TO COARSE GRAINED, GRAY
 BROWN, MEDIUM DENSE, MOIST

CLAY, VERY SANDY, BROWN,
 FIRM, MOIST
 SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, TAN, VERY
 DENSE, MOIST



REMARKS

DRY TO 15', 1/12/17
 SAND, SILTY TO CLAYEY, FINE
 TO COARSE GRAINED, GRAY
 BROWN, MEDIUM DENSE TO
 LOOSE, MOIST



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PROFILE HOLE LOG

DRAWN:	DATE:	CHECKED:	DATE:
		<i>hm</i>	1/17/17

JOB NO.:
 162442
 FIG NO.:
 B-1

PROFILE HOLE NO. 3
 DATE DRILLED 1/11/2017
 Job # 162442

PROFILE HOLE NO.
 DATE DRILLED
 CLIENT JEROME HANNIGAN & ASSOC.
 LOCATION SILVER NELL & SETTLERS VIEW

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 15', 1/12/17 SAND, SILTY TO CLAYEY, FINE TO COARSE GRAINED, GRAY BROWN, MEDIUM DENSE, MOIST				16	4.0								
	5			10	6.8			5					
	10			12	14.5			10					
	15			28	8.6			15					
	20							20					



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PROFILE HOLE LOG

DRAWN:	DATE:	CHECKED:	DATE:
		A	1/17/17

JOB NO.:
 162442
 FIG NO.:
 B-2

TEST PIT NO. 1
 DATE EXCAVATED 12/15/2016
 Job # 162442

TEST PIT NO. 2
 DATE EXCAVATED 12/15/2016
 CLIENT JEROME HANIGAN & ASSOCIATES
 LOCATION SETTLERS VIEW SUBDIVISION

REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type
topsoil, sandy loam, dark brown	1	⌘		gr	w	2A	topsoil, sandy loam, dark brown	1	⌘		gr	w	2A
sandy loam, fine to coarse grained, reddish brown	2			gr	w	2A	sandy loam, fine to coarse grained, reddish brown	2			gr	w	2A
	3							3					
	4							4					
	5							5					
	6							6					
gravelly sand, medium to coarse grained, tan	7			sg		1	gravelly sand, medium to coarse grained, tan	7			sg		1
	8							8					
	9							9					
	10							10					

Soil Structure Shape
 granular - gr
 platy - pl
 blocky - bl
 prismatic - pr
 single grain - sg
 massive - ma

Soil Structure Grade
 weak - w
 moderate - m
 strong - s
 loose - l



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TEST PIT LOG

DRAWN:

DATE:

CHECKED:

DATE:

LLL

1/17/17

JOB NO.:

162442

FIG NO.:

B-3

TEST PIT NO. 3
 DATE EXCAVATED 12/15/2016
 Job # 162442

CLIENT LOCATION
 JEROME HANIGAN & ASSOCIATES
 SETTLERS VIEW SUBDIVISION

REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type	REMARKS	Depth (ft)	Symbol	Samples	Soil Structure Shape	Soil Structure Grade	USDA Soil Type
topsoil, sandy loam, dark brown	1	*		gr	w	2A		1					
gravelly sandy clay loam, fine to coarse grained, reddish tan	2			gr	w	3A		2					
	3							3					
	4							4					
silty sandstone, fine to coarse grained, tan	5			ma		3A		5					
	6							6					
	7							7					
	8							8					
	9							9					
	10							10					

Soil Structure Shape
 granular - gr
 platy - pl
 blocky - bl
 prismatic - pr
 single grain - sg
 massive - ma

Soil Structure Grade
 weak - w
 moderate - m
 strong - s
 loose - l



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TEST PIT LOG

DRAWN:

DATE:

CHECKED:
 LLL

DATE:
 1/17/17

JOB NO.:

162442

FIG NO.:

B-4