SUBGRADE EXPLORATION

CUY-CR57-04.79 (WALLINGS ROAD), PID 106239
BROADVIEW, OHIO

SME Project Number: 078832.01
November 12, 2021

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Kirtland, OH 44094-8501

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November 12, 2021

Shelley M. Kiwala, PE
Osborn Engineering
1100 Superior Avenue - Suite 300
Cleveland, OH 44114-2530

Via Email: skiwala@osborn-eng.com (PDF file)

RE: ODOT LPA: CUY-CR57-04.79
Wallings Road Bridge Widening
Revised Subgrade Exploration Report
Broadview Heights, Ohio
SME Project No. 078832.00

Dear Ms. Kiwala:

We have completed the subgrade exploration report for the planned widening of Wallings Road in Broadview Heights, Ohio. The attached revised report presents the results of our subsurface investigation and our recommendations for subgrade preparation and is a supplement to our Structure Foundation Exploration Report, also dated November 12, 2021.

We appreciate the opportunity to work with you on this project. If you have questions, please call.

Sincerely,

SME

Alan J. Esser, PE
Chief Consultant

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1.0 EXECUTIVE SUMMARY

This report presents the results of our subgrade exploration and soil analysis for the Wallings Road (CR 57) widening project from Skyline Drive to Mill Road in Broadview Heights, Ohio. SME performed this work in accordance with our proposal dated October 17, 2018, which was authorized on October 15, 2019. This is a supplement to our Structure Foundation Exploration Report, dated March 30, 2020. This phase of the project consists of widening Wallings Road from Skyline Drive to just east of the I-77 northbound entrance ramp, improvements at the intersection of Skyline Drive and Wallings Road, and widening a portion of Mill Road and the I-77 southbound off-ramp, designated Ramp D4. A short retaining wall was originally planned along the west side of Skyline Drive at the intersection. The retaining wall is not being considered anymore. This exploration pand analysis were conducted in general accordance with the latest versions of ODOT's Specifications for Geotechnical Engineering (SGE), and Geotechnical Bulletin 1 (GB1).

The pavement section within the limits of this project generally consisted of asphalt or asphalt over concrete. Total pavement thicknesses range from about 9 to 14 inches. Borings drilled off the road encountered 3 inches of topsoil or fill at the surface. Fill and soils classified as possible fill were encountered at four borings to depths ranging from 1½ to 3 feet below the existing ground surface. The fill consists of silt and clay (A-6a) and coarse and fine sand (A-3a). Below the surficial material and fill, we encountered clay soils at most borings, consisting of A-6a, A-6b, and A-7-6 soils. At B-008-0-20 and B-009-0-20, we encountered sand (A-3a and A-3, respectively) below the pavement. At B-008-0-20, we encountered sandstone bedrock below the sand at a depth of about 2 feet.

The ODOT GB1 spreadsheet analysis indicates to use a design CBR of 7. The average N_{60L} for the project is 16 blows/foot. The average PI for the project is 13. The spreadsheet indicates that about 38% of the project area has unstable soil that requires stabilization. Very dense sand (residual rock) over intact sandstone was encountered at B-008-0-10 along Skyline Drive. Contractors should anticipate encountering cobbles and boulders during subgrade preparation in this area.

The majority of borings encountered soils with moisture contents above their optimum moisture content, per GB1 Figure A. Therefore, we recommend installing underdrains throughout the project site as early in the construction process as possible to reduce the time that the subgrade may remain saturated during wet periods and to reduce the potential for higher groundwater levels that may exist during wet weather. The subgrade should then be compacted and proofrolled in accordance with ODOT Item 204. Unstable zones identified during proofrolling should be mechanically improved (compacted in-place), if feasible, or removed and replaced with engineered fill. Based on the results of the GB1 analysis, anticipate that undercuts could extend 12 to 36 inches below the top of subgrade. Positive drainage should be provided to all undercuts.

The location, length, and dimensions of the retaining wall at Skyline Drive were unknown at the time of this report. Based on the findings at B-008-0-20 and B-009-0-20, we anticipate the wall will bear on sandstone bedrock and may transition to bear on silty clay at the south end. If this transition in bearing conditions is encountered, expansion joints should be used to reduce the potential for cracking due to the differing bearing conditions.

The summary presented above includes selected elements of our findings and recommendations and is provided solely for purposes of overview. It does not present details needed for the proper application of our findings and recommendations.

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2.0 INTRODUCTION

This report presents the results of our subsurface exploration for the Wallings Road widening in Broadview Heights, Ohio. This is a supplement to our Structure Foundation Exploration Report, dated March 30, 2020. This revised report supersedes our original Geotechnical Report dated September 11, 2020, which should no longer be considered valid. This phase of the project consists of widening Wallings Road from Skyline Drive to Mill Road, improvements at the intersection of Skyline Drive and Wallings Road and widening a portion of Mill Road and the I-77 southbound off-ramp designated Ramp D4. A short retaining wall was originally planned along the west side of Skyline Drive at the intersection. The retaining wall is not being considered anymore. We completed this exploration in accordance with our proposal dated October 17, 2018. Shelley Kiwala of Osborn Engineering authorized SME to provide these services on October 15, 2019.

3.0 EXPLORATION

Subgrade conditions were identified by a field exploration program consisting of eight Standard Penetration Test (SPT) borings, designated B-006-0-20 through B-013-0-20. Borings extended to 6-foot depths below the pavement or topsoil except at B-008-0-20 and B-010-0- 20 which were deepened for the originally planned retaining wall and because of the depth of surface fill, respectively. The boring locations were selected by Osborn Engineering. SME staked the borings in the field. Some were moved slightly due to buried or overhead utilities. Survey information, including surface elevations at the boring locations, was provided by OHM Advisors. The approximate boring locations are shown on the attached *Boring Location Plan*.

Drilling equipment consisted of a CME-55 truck mounted rig equipped with 4-inch solid-stem augers and a CME auto hammer having an energy transfer ratio of 81.3 percent based on our current calibrations. We observed the boreholes for the presence of groundwater during and immediately after drilling. The boreholes were backfilled with a blend of auger cuttings and bentonite chips.

Samples were taken to our laboratory where they were classified in accordance with the ODOT-modified AASHTO procedure. Laboratory testing included water contents on all SPT samples, mechanical classification (hydrometer, gradation analysis, and Atterberg limits) on sixteen soil samples (two per boring), and eight sulfate content tests (one per boring).

4.0 FINDINGS

4.1 SUBSURFACE CONDITIONS

Surficial material at the borings varied from 3 inches of topsoil, 9 to 14 inches of pavement, and 18 inches of sand with cinders. Fill and possible fill were encountered at four borings to depths ranging from 1½ to 3 feet below the existing ground surface. At B-007-0-20, B-011-0-20, and B-013-0-20, the fill consists of silt and clay (A-6a). At B-010-0-20, the fill consists of coarse and fine sand (A-3a).

Below the surficial material and fill, we encountered clay soils at most borings, consisting of A-6a, A-6b, and A-7-6 soils. At B-008-0-20 and B-009-0-20, we encountered sand (A-3a and A-3, respectively) below the pavement. At B-008-0-20, we encountered sandstone bedrock below the sand at a depth of about 2 feet.

Unsuitable soils encountered in the borings consisted of clay (A-7-6), and silt and clay (A-6a) to depths of 1.8 and 1.5 feet at B-006-0-20 and at B-007-0-20, respectively. Very dense sand (A-3a) to a depth of about 1.5 feet over shallow sandstone was encountered at B-008-0-20. Silty clay soil (A-6b) with HP=1.5 was encountered from 2.5 to 4 feet below the ground surface at B-009-0-20.

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4.2 SULFATE TEST RESULTS

Sulfate contents in the subgrade samples ranged from 71 to 726 parts per million (ppm). Gypsum was not visually evident in any of the subgrade samples. The risk of sulfate-induced heave becomes significant above 3,000 ppm when calcium-based stabilizers are used. GB1 indicates that chemical stabilization should not be considered if any samples have a sulfate concentration above 5,000 ppm. Since our tests indicate sulfate contents well below these limits, chemical stabilization may be considered.

5.0 ANALYSIS AND RECOMMENDATIONS

PAVEMENT WIDENING

The ODOT GB1 spreadsheet analysis indicates to use a design CBR of 7. The average N_{60L} for the project is 16 blows/foot. The average PI for the project is 13. After removing unsuitable soils and cutting to design subgrade elevation, but prior to placing fill, the subgrade should be compacted and evaluated with a proofroll in accordance with ODOT Item 204. The spreadsheet indicates that about 44% of the project area has unstable soil that requires stabilization. Due to the limited project size, chemical stabilization is not an economical option. Therefore, unstable soils identified by a proofroll should either be scarified, dried, and re-compacted or excavated and replaced with geotextile at the bottom of the undercut followed by engineered fill (Item 204). The results of our field and laboratory testing suggest the following areas may require subgrade improvement; however, the actual extent of subgrade improvement should be determined in the field in accordance with ODOT Item 204.

- Subgrade for Wallings Road from Station 76+50 to 84+60 could require 12 inches of undercut and replacement if a proofroll indicates unstable subgrade, which cannot be stabilized in place.
- Subgrade for Mill Road from Station 24+45 to 29+57 could require 12 inches of undercut and replacement if a proofroll indicates unstable subgrade, which cannot be stabilized in place.
- Subgrade for Ramp D4 from Station 53+60 to 58+00 (Ramp D4) could require 12 inches of undercut and replacement if a proofroll indicates unstable subgrade, which cannot be stabilized in place.
- Subgrade for Skyline Drive from Station 0+00 to 3+30 could require 24 inches of undercut and replacement if rock is encountered.

Unsuitable soils consisting of silt (A-4b) were encountered at B-010-0-20; however, based on the plan and profile sheets provided by Osborn Engineering, we understand the subgrade in this area will be raised by more than 6 inches. Therefore, the unsuitable soils should be more than 3 feet below the top of subgrade and will not require removal.

Very dense sand (residual rock) over shallow sandstone was encountered at B-008-0-10 along Skyline Drive. Contractors should anticipate encountering cobbles and boulders during subgrade preparation in this area. If sandstone bedrock is encountered shallower than 1 foot below top of subgrade, SME and ODOT OGE should be contacted for instructions on how to proceed.

The majority of borings encountered soils with moisture contents above their optimum moisture content, per GB1 Figure A – “Optimum Moisture Content”. Therefore, we recommend installing underdrains throughout the project as early in the construction process as possible to reduce the time that the subgrade may remain saturated during wet periods and to reduce the potential for higher groundwater levels that may exist during wet weather. The subgrade should then be compacted and evaluated in accordance with ODOT Item 204 through the entire project area. Unstable zones identified should be mechanically improved (compacted in-place), if feasible, or removed and replaced with geotextile and engineered fill. Based on the results of the GB1 analysis, anticipate that undercuts could extend 12 to 36 inches below the top of subgrade. Positive drainage should be provided to all undercuts.

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6.0 SIGNATURES

Report Prepared by:

Brendan P. Lieske, PE
Project Engineer

Report Reviewed by:

Alan J. Esser, PE, D.GE.
Chief Consultant

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APPENDIX A

ODOT GB1 SPREADSHEET
BORING LOCATION PLAN
BORING LOG TERMINOLOGY
BORING LOGS
SULFATE TEST RESULTS

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OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

CUY-CR57-04.43
106239

Roadway widening along Wallings Road (CR 57) from Skyline Drive to Mill Road

SME

Prepared By: Alan J. Esser, PE, D.GE
Date prepared: Monday, March 16, 2020

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NO. OF BORINGS: 8

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-006-0-20	CL CONST. MILL RD	26+91	21	Lt	293-CME55-TRK	81	1073.0	1073.0	0.0
2	B-007-0-20	BL RAMP D4	56+43	16	Lt	293-CME55-TRK	81	1080.7	1080.7	0.0
3	B-008-0-20	CL SKYLINE DRIVE	01+12	7	Lt	293-CME55-TRK	81	1168.4	1166.7	1.7 C
4	B-009-0-20	. CONST. WALLINGS R	80+56	8	Rt	293-CME55-TRK	81	1160.1	1158.6	1.5 C
5	B-010-0-20	. CONST. WALLINGS R	83+97	9	Lt	293-CME55-TRK	81	1136.6	1137.3	0.7 F
6	B-011-0-20	. CONST. WALLINGS R	87+71	16	Lt	293-CME55-TRK	81	1120.9	1121.3	0.3 F
7	B-012-0-20	. CONST. WALLINGS R	90+21	23	Rt	293-CME55-TRK	81	1106.4	1106.7	0.3 F
8	B-013-0-20	. CONST. WALLINGS R	99+82	23	Lt	293-CME55-TRK	81	1063.8	1064.0	0.2 F

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SB1	0.3	1.8	0.3	1.8	9		2.25							26	18	A-7-6	16			N_{60} & Mc		12"	12"
	006-0	SB2	1.8	3.3	1.8	3.3	15		4.5	44	25	19	48	46	94	21	22	A-7-6	12	350					204 Geotextile
	20	SB3	3.3	4.8	3.3	4.8	23		4.5	38	23	15	46	53	99	15	18	A-6a	10						
		SB4	4.8	6.3	4.8	6.3	46	9	4.5							19	14	A-6a	10						
2	B	SB1	0.0	1.5	0.0	1.5	11		2.5	35	23	12	27	28	55	18	18	A-6a	5			N_{60}		12"	12"
	007-0	SB2	1.5	3.0	1.5	3.0	19		4.5	31	20	11	32	35	67	15	15	A-6a	7	371					204 Geotextile
	20	SB3	3.0	4.5	3.0	4.5	37		4.5							15	14	A-6a	10						
		SB4	4.5	6.0	4.5	6.0	49	11	4.5							15	14	A-6a	10						
3	B	SB1	0.8	2.3	-1.0	0.6	75						7	4	11	5	8	A-3a	0	71					
	008-0	SB2	2.3	2.8	0.6	1.1	50						9	3	12	12	0	Rock	0		Rock	Mc	13"		
	20	SB3	3.8	4.3	2.1	2.6	50									9	0	Rock	0			Mc			
		SB4	5.3	5.3	3.6	3.6	50	30								17	0	Rock	0						
4	B	SB1	1.0	2.5	-0.5	1.0	41						6	4	10	8	8	A-3	0	390					
	009-0	SB2	2.5	4.0	1.0	2.5	22		1.5	39	21	18	30	41	71	16	16	A-6b	10			HP		12"	204 Geotextile
	20	SB3	4.0	5.5	2.5	4.0	27		4.5							17	16	A-6b	16						
		SB4	5.5	7.0	4.0	5.5	62	22	4.5							14	14	A-6a	10						
5	B	SB1	1.0	2.5	1.7	3.2	23						10	7	17	7	8	A-3a	0	550					
	010-0	SB2	2.5	4.0	3.2	4.7	12									13	10	A-4b	8						
	20	SB3	4.0	5.5	4.7	6.2	8		0.5	29	23	6	68	25	93	35	18	A-4b	8						
		SB4	5.5	7.0	6.2	7.7	8	8	0.75							34	14	A-6a							
6	B	SB1	0.0	1.5	0.3	1.9	18									19	8	A-3a	0						
	011-0	SB2	1.5	3.0	1.9	3.4	15		3	33	20	13	29	34	63	22	15	A-6a	7	726		Mc			
	20	SB3	3.0	4.5	3.4	4.9	27		4.5	31	19	12	27	29	56	15	14	A-6a	5						
		SB4	4.5	6.0	4.9	6.4	41	15	4.5							14	14	A-6a	10						
7	B	SB1	1.2	2.7	1.5	3.0	19		4	25	19	6	38	36	74	17	14	A-4a	8	570		Mc			
	012-0	SB2	2.7	4.2	3.0	4.5	20		3.5							11	10	A-4a	8						
	20	SB3	4.2	5.7	4.5	6.0	24		4.5	27	18	9	35	32	67	15	13	A-4a	6						
		SB4	5.7	7.2	6.0	7.5	30	19	4.5							16	10	A-4a							
8	B	SB1	0.3	1.8	0.5	2.0	20		1.75	36	23	13	36	31	67	17	18	A-6a	8	330					
	013-0	SB2	1.8	3.3	2.0	3.5	12		3.75	38	21	17	33	44	77	15	16	A-6b	11						
	20	SB3	3.3	4.8	3.5	5.0	12		4.5							16	16	A-6b	16						
		SB4	4.8	6.3	5.0	6.5	24	12	4.5							17	16	A-6b	16						

PID: 106239

County-Route-Section: CUY-CR57-04.43
No. of Borings: 8

Geotechnical Consultant: SME
Prepared By: Alan J. Esser, PE, D.GE
Date prepared: 3/16/2020

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	12''

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L): Average(HP):	12'' 0''
Global Geogrid Average(N60L): Average(HP):	0'' 0''

Design CBR	7

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	3%
$N_{60} < 12$	10%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	10%	1 < HP ≤ 2	6%
$N_{60} \geq 20$	65%	HP > 2	65%
M+	16%		
Rock	13%		
Unsuitable	16%		

Excavate and Replace at Surface	
Average	2''
Maximum	12''
Minimum	0''

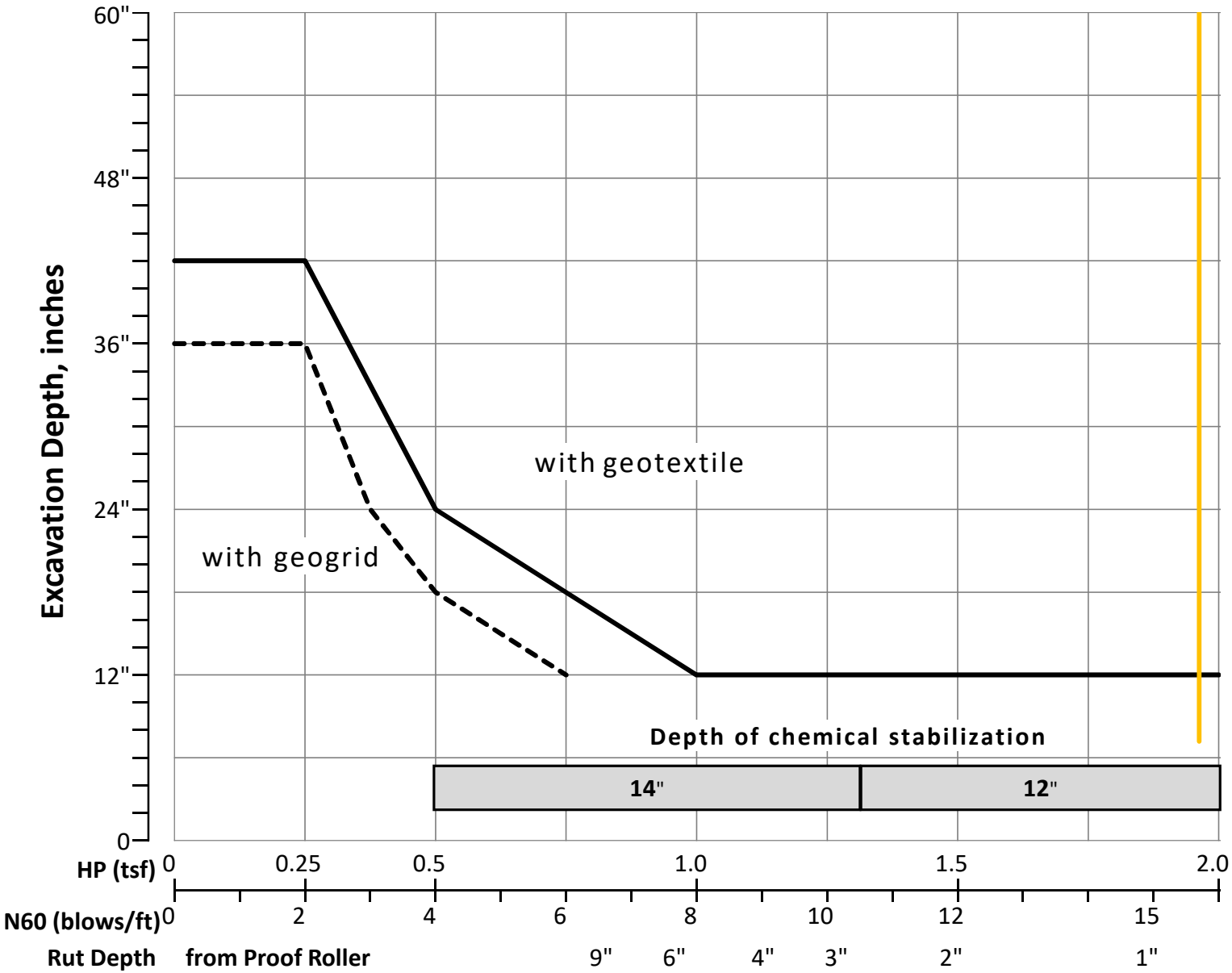
% Proposed Subgrade Surface	
Unstable & Unsuitable	50%
Unstable	44%
Unsuitable	6%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	28	16	3.60	34	21	13	30	28	58	16	13	8
Maximum	75	30	4.50	44	25	19	68	53	99	35	22	16
Minimum	8	8	0.50	25	18	6	6	3	10	5	0	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	3	0	0	0	0	0	0	1	3	4	2	0	12	5	0	2	0	0	32
Percent	9%	0%	0%	0%	0%	0%	0%	3%	9%	13%	6%	0%	38%	16%	0%	6%	0%	0%	100%
% Rock|Granular|Cohesive	9%	25%									66%								100%
Surface Class Count	2	0	0	0	0	0	0	1	3	1	0	0	4	3	0	2	0	0	16
Surface Class Percent	13%	0%	0%	0%	0%	0%	0%	6%	19%	6%	0%	0%	25%	19%	0%	13%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
3.60	0.50	☐ HP
15.75	6.00	☐ N60L

Average HP
Average N_{60L}

LEGEND

APPROXIMATE BORING LOCATION

NOTES:

DRAWING INFORMATION TAKEN FROM GOOGLE EARTH

No.	Revision Date		
1	09/09/2020	Date	3/30/2020
		Drawn By	JF
		Checked By	BPL
		Scale	NTS
		Project	078832.01

ODOT LPA: CUY-CR57-4.43
PID 106239
EAST WALLINGS ROAD
CLEVELAND, OH

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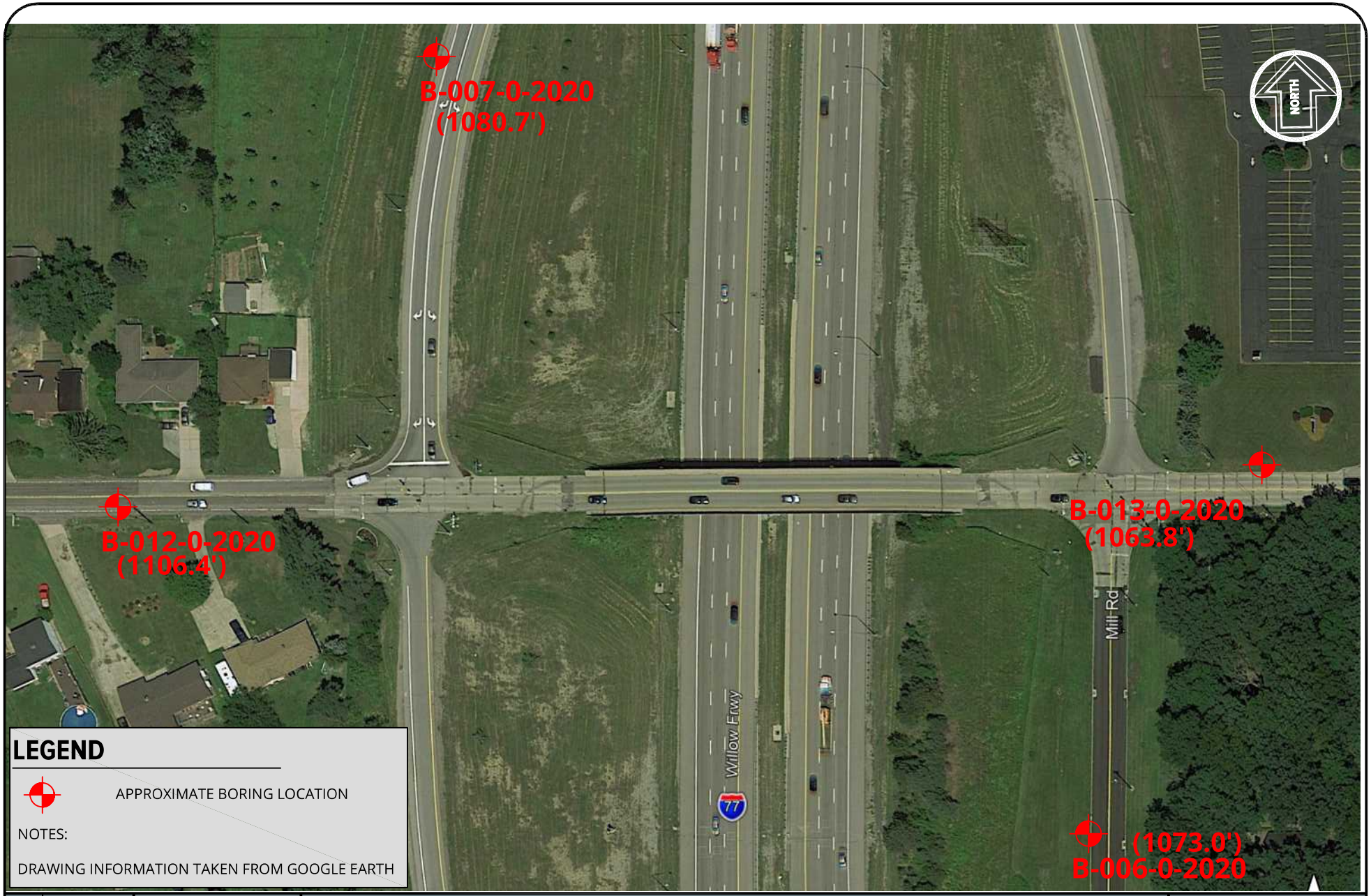
Figure No. 1



LEGEND

APPROXIMATE BORING LOCATION

NOTES:

DRAWING INFORMATION TAKEN FROM GOOGLE EARTH

No.	Revision Date		
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PID 106239
EAST WALLINGS ROAD
CLEVELAND, OH

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Figure No. 2

1) STRENGTH OF SOIL:

Non-Cohesive (granular) Soils - Compactness	
Description	**Blows Per Ft.**
Very Loose	≤ 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

2) COLOR :

If a color is a uniform color throughout, the term is single, modified by an adjective such as light or dark. If the predominate color is shaded by a secondary color, the secondary color procedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled"

3) PRIMARY COMPONENT

Use **DESCRIPTION** from ODOT Soil Classification Chart on Back

Cohesive (fine grained) Soils - Consistency

Description	Qu (TSF)	Blows Per Ft.	Hand Manipulation
Very Soft	<0.25	<2	Easily penetrates 2" by fist
Soft	0.25-0.5	2 - 4	Easily penetrates 2" by thumb
Medium Stiff	0.5-1.0	5 - 8	Penetrates by thumb with moderate effort
Stiff	1.0-2.0	9 - 15	Readily indents by thumb, but not penetrate
Very Stiff	2.0-4.0	16 - 30	Readily indents by thumbnail
Hard	>4.0	>30	Indent with difficulty by thumbnail

4) COMPONENT MODIFIERS:

Description	Percentage By Weight
Trace	0% - 10%
Little	10% - 20%
Some	20% - 35%
"And"	35% -50%

5) Soil Organic Content

Description	% by Weight
Slightly Organic	2% - 4%
Moderately Organic	4% - 10%
Highly Organic	> 10%

6) Relative Visual Moisture

Description	Criteria	
	Cohesive Soil	**Non-cohesive Soils**
Dry	Powdery; Cannot be rolled; Water content well below the plastic limit	No moisture present
Damp	Leaves very little moisture when pressed between fingers; Crumbles at or before rolled to $^1/_8$"; Water content below plastic limit	Internal moisture, but no to little surface moisture
Moist	Leaves small amounts of moisture when pressed between fingers; Rolled to $^1/_8$" or smaller before crumbling; Water content above plastic limit to -3% of the liquid limit	Free water on surface, moist (shiny) appearance
Wet	Very mushy; Rolled multiple times to $^1/_8$" or smaller before crumbles; Near or above the liquid limit	Voids filled with free water, can be poured from split spoon.

CLASSIFICATION OF SOILS

Ohio Department of Transportation

(The classification of a soil is found by proceeding from top to bottom of the chart.
The first classification that the test data fits is the correct classification.)

SYMBOL	DESCRIPTION	Classifcation AASHTO	Classifcation OHIO	LL_O/LL x 100*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
	Gravel and/or Stone Fragments	A-1-a			30 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
F.S.	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4				35 Max.	40 Max.	10 Max.	0	
		A-2-5					41 Min.			
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6				35 Max.	40 Max.	11 Min.	4	
		A-2-7					41 Min.			
	Sandy Silt	A-4	A-4a	76 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	76 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		76 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	76 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		76 Min.		36 Min.	41 Min.	≤LL-30	20	
	Clay	A-7-6		76 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8a	75 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-5, A-6a, A-6b, A-7-5 or A-7-6

MATERIAL CLASSIFIED BY VISUAL INSPECTION

Sod and Topsoil

Pavement or Base

Uncontrolled Fill (Describe)

Bouldery Zone

P Peat

* Only perform the oven-dried liquid limit test and this calculation if organic material is present in the sample.

PROJECT: CUY-77-04.79	DRILLING FIRM / OPERATOR: SME / RH/RM	DRILL RIG: 293-CME55-TRK	STATION / OFFSET: 26+91, 21' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: SME / JF	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. MILL RD
PID: 106239 SFN:	DRILLING METHOD: 4" SSA	CALIBRATION DATE: 4/5/17	ELEVATION: 1073.0 (NAVD88) EOB: 6.25 ft.
START: 2/21/20 END: 2/21/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 41.344021, -81.648931

EXPLORATION ID B-006-0-20

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1073.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	ABAN-DONED
3" TOPSOIL (DRILLERS DESCRIPTION)	1072.8																		
VERY STIFF TO HARD, BROWN AND GRAY, **CLAY**, "AND" SILT, TRACE SAND, TRACE GRAVEL, MOIST TO DAMP	1069.8	1	3 3 4	9	100	SS-1	2.25	-	-	-	-	-	-	-	-	26	A-7-6 (V)	-	
		2	3 5 6	15	100	SS-2	4.50	2	1	3	48	46	44	25	19	21	A-7-6 (12)	350	
HARD, BROWN AND GRAY, **SILT AND CLAY**, TRACE SAND, DAMP		3																	
		4	5 7 10	23	100	SS-3	4.50	0	0	1	46	53	38	23	15	15	A-6a (10)	-	
		5	12 14 20	46	100	SS-4	4.50	-	-	-	-	-	-	-	-	19	A-6a (V)	-	
@5.5'; LITTLE GRAVEL AND STONE FRAGMENTS	1066.8	6 EOB																	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 11/9/21 09:01 - \\SME-INC\PZ\WIP\078832.01\PROJECT DATA\GINT\078832.01_CUY-CR57-4.43.GPJ

PROJECT: CUY-77-04.79	DRILLING FIRM / OPERATOR: SME / RH/RM	DRILL RIG: 293-CME55-TRK	STATION / OFFSET: 56+43, 16' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: SME / JF	HAMMER: CME AUTOMATIC	ALIGNMENT: BL RAMP D4
PID: 106239 SFN:	DRILLING METHOD: 4" SSA	CALIBRATION DATE: 4/5/17	ELEVATION: 1080.7 (NAVD88) EOB: 6.0 ft.
START: 2/21/20 END: 2/21/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 41.345814, -81.650907

EXPLORATION ID B-007-0-20

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1080.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	ABAN-DONED
VERY STIFF, BROWN, **SILT AND CLAY**, SOME GRAVEL AND STONE FRAGMENTS, LITTLE SAND, **FILL**, DAMP	1079.2	1	3 3 5	11	100	SS-1	2.50	27	8	10	27	28	35	23	12	18	A-6a (5)	-	
HARD, BROWN, **SILT AND CLAY**, LITTLE GRAVEL AND STONE FRAGMENTS, LITTLE SAND, DAMP		2	7 7 7	19	100	SS-2	4.50	19	6	8	32	35	31	20	11	15	A-6a (7)	370	
		3	8 11 16	37	100	SS-3	4.50	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
	1074.7	4 5 EOB 6	11 15 21	49	100	SS-4	4.50	-	-	-	-	-	-	-	-	15	A-6a (V)	-	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 11/9/21 09:01 - \\SME-INC\PZ\WIP\078832.01\PROJECT DATA\GINT\078832.01_CUY-CR57-4.43.GPJ

PROJECT: CUY-77-04.79	DRILLING FIRM / OPERATOR: SME / RH/RM	DRILL RIG: 293-CME55-TRK	STATION / OFFSET: 1+12, 7' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: SME / JF	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SKYLINE DRIVE
PID: 106239 SFN:	DRILLING METHOD: 4" SSA	CALIBRATION DATE: 4/5/17	ELEVATION: 1168.4 (NAVD88) EOB: 7.8 ft.
START: 2/21/20 END: 2/21/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 41.345127, -81.655603

EXPLORATION ID B-008-0-20

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	ABAN-DONED
	1168.4																		
3" ASPHALT AND 6" CONCRETE (DRILLERS DESCRIPTION)	1167.7																		
VERY DENSE, LIGHT BROWN, **COARSE AND FINE SAND**, TRACE SILT, TRACE GRAVEL, TRACE CLAY, DAMP	1166.2	TR	19 36 19	75	83	SS-1	-	4	14	71	7	4	NP	NP	NP	5	A-3a (0)	<100	
			50/6"	-	100	SS-2	-	-	-	-	-	-	-	-	-	12	Rock (V)	-	
SANDSTONE, BROWN, MODERATELY WEATHERED, TRACE CLAY SEAMS			50/6"	-	100	SS-3	-	-	-	-	-	-	-	-	-	9	Rock (V)	-	
			50/1"	-	100	SS-4	-	-	-	-	-	-	-	-	-	17	Rock (V)	-	
	1160.6	EOB	50/0"	-		SS-5	-	-	-	-	-	-	-	-	-	-	Rock (V)	-	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 11/9/21 09:01 - \\SME-INC\PZ\WIP\078832.01\PROJECT DATA\GINT\078832.01_CUY-CR57-4.43.GPJ

PROJECT: CUY-77-04.79	DRILLING FIRM / OPERATOR: SME / RH/RM	DRILL RIG: 293-CME55-TRK	STATION / OFFSET: 80+56, 8' RT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: SME / JF	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. WALLINGS RD.
PID: 106239 SFN:	DRILLING METHOD: 4" SSA	CALIBRATION DATE: 4/5/17	ELEVATION: 1160.1 (NAVD88) EOB: 7.0 ft.
START: 2/21/20 END: 2/21/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 41.344799, -81.655346

EXPLORATION ID B-009-0-20

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1160.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	ABAN-DONED
12" ASPHALT (DRILLERS DESCRIPTION)	1159.1																		
DENSE, BROWN, **FINE SAND**, SOME GRAVEL AND STONE FRAGMENTS, TRACE SILT, TRACE CLAY, DAMP	1157.6	1	17 18 12	41	83	SS-1	-	29	5	56	6	4	NP	NP	NP	8	A-3 (0)	390	
STIFF TO HARD, BROWN AND GRAY, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, DAMP	1154.6	2 3 4 5	5 7 9	22	100	SS-2	1.50	8	2	19	30	41	39	21	18	16	A-6b (10)	-	
			7 9 11	27	100	SS-3	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	-	
HARD, BROWN, **SILT AND CLAY**, SOME GRAVEL AND STONE FRAGMENTS, TRACE SAND, DAMP	1153.1	6	7 17 29	62	100	SS-4	4.50	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		EOB 7																	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 11/9/21 09:01 - \\SME-INC\PZ\WIP\078832.01\PROJECT DATA\GINT\078832.01_CUY-CR57-4.43.GPJ

PROJECT: CUY-77-04.79	DRILLING FIRM / OPERATOR: SME / RH/RM	DRILL RIG: 293-CME55-TRK	STATION / OFFSET: 83+97, 9' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: SME / JF	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. WALLINGS RD.
PID: 106239 SFN:	DRILLING METHOD: 4" SSA	CALIBRATION DATE: 4/5/17	ELEVATION: 1136.6 (NAVD88) EOB: 8.5 ft.
START: 2/21/20 END: 2/21/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 41.344852, -81.654106

EXPLORATION ID B-010-0-20

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1136.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	ABAN-DONED
12" ASPHALT (DRILLERS DESCRIPTION)	1135.6																		
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE TO SOME GRAVEL AND STONE FRAGMENTS, TRACE TO LITTLE SILT, TRACE CLAY, **POSSIBLE FILL**, DAMP	1133.6	1	8 10 7	23	100	SS-1	-	20	7	56	10	7	NP	NP	NP	7	A-3a (0)	550	
		2				SS-2A	-	-	-	-	-	-	-	-	-	-	A-3a (V)	-	
		3	6 5 4	12	100	SS-2B	-	-	-	-	-	-	-	-	-	13	A-4b (V)	-	
SOFT, BROWN TO GRAY, **SILT**, SOME CLAY, TRACE SAND, TRACE GRAVEL, DRY TO WET	1131.1	4	2 3 3	8	100	SS-3	0.50	1	1	5	68	25	29	23	6	35	A-4b (8)	-	
MEDIUM STIFF TO VERY STIFF, GRAY AND BROWN, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, LITTLE TO SOME ORGANICS, WET TO MOIST		5	2 3 3	8	100	SS-4	0.75	-	-	-	-	-	-	-	-	34	A-6a (V)	-	
	1128.1	6	5 8 10	24	100	SS-5	2.50	-	-	-	-	-	-	-	-	21	A-6a (V)	-	
		7																	
		8																	
		EOB																	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 11/9/21 09:02 - \\SME-INC\PZ\WIP\078832.01\PROJECT DATA\GINT\078832.01_CUY-CR57-4.43.GPJ

PROJECT: CUY-77-04.79	DRILLING FIRM / OPERATOR: SME / RH/RM	DRILL RIG: 293-CME55-TRK	STATION / OFFSET: 87+71, 16' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: SME / JF	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. WALLINGS RD.
PID: 106239 SFN:	DRILLING METHOD: 4" SSA	CALIBRATION DATE: 4/5/17	ELEVATION: 1120.9 (NAVD88) EOB: 6.0 ft.
START: 2/21/20 END: 2/21/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 41.344875, -81.652743

EXPLORATION ID B-011-0-20

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1120.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	ABAN-DONED
SAND with CINDERS, SOME SILT, BLACK, MOIST, **FILL**	1119.4	1	5 5 8	18	100	SS-1	-	-	-	-	-	-	-	-	-	19	UCF (V)	-	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, **POSSIBLE FILL**, MOIST	1117.9	2 3	4 5 6	15	100	SS-2	3.00	15	12	10	29	34	33	20	13	22	A-6a (7)	730	
HARD, BROWN, **SILT AND CLAY**, SOME GRAVEL, LITTLE SAND, DAMP	1114.9	4 5	5 7 13	27	67	SS-3	4.50	28	8	8	27	29	31	19	12	15	A-6a (5)	-	
		EOB 6	8 13 17	41	100	SS-4	4.50	-	-	-	-	-	-	-	-	14	A-6a (V)	-	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 11/9/21 09:02 - \\SME-INC\PZ\WIP\078832.01\PROJECT DATA\GINT\078832.01_CUY-CR57-4.43.GPJ

PROJECT: CUY-77-04.79	DRILLING FIRM / OPERATOR: SME / RH/RM	DRILL RIG: 293-CME55-TRK	STATION / OFFSET: 90+21, 23' RT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: SME / JF	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. WALLINGS RD.
PID: 106239 SFN:	DRILLING METHOD: 4" SSA	CALIBRATION DATE: 4/5/17	ELEVATION: 1106.4 (NAVD88) EOB: 7.17 ft.
START: 2/21/20 END: 2/21/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 41.344773, -81.651832

EXPLORATION ID B-012-0-20

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1106.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	ABAN-DONED
14" ASPHALT (DRILLERS DESCRIPTION)	1105.2																		
VERY STIFF TO HARD, BROWN, **SANDY SILT**, SOME TO "AND" CLAY, TRACE TO LITTLE GRAVEL, DAMP		1	8 6 8	19	100	SS-1	4.00	7	9	10	38	36	25	19	6	17	A-4a (8)	570	
		2	5 7 8	20	100	SS-2	3.50	-	-	-	-	-	-	-	-	11	A-4a (V)	-	
		3	7 8 10	24	100	SS-3	4.50	15	7	11	35	32	27	18	9	15	A-4a (6)	-	
		4	7 9 13	30	100	SS-4	4.50	-	-	-	-	-	-	-	-	16	A-4a (V)	-	
	1099.2	5																	
		6																	
		7 EOB																	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 11/9/21 09:02 - \\SME-INC\PZ\WIP\078832.01\PROJECT DATA\GINT\078832.01_CUY-CR57-4.43.GPJ

PROJECT: CUY-77-04.79	DRILLING FIRM / OPERATOR: SME / RH/RM	DRILL RIG: 293-CME55-TRK	STATION / OFFSET: 99+82, 23' LT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: SME / JF	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. WALLINGS RD.
PID: 106239 SFN:	DRILLING METHOD: 4" SSA	CALIBRATION DATE: 4/5/17	ELEVATION: 1063.8 (NAVD88) EOB: 6.25 ft.
START: 2/21/20 END: 2/21/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.3	LAT / LONG: 41.344911, -81.648333

EXPLORATION ID B-013-0-20

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 1063.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	ABAN-DONED
3" TOPSOIL	1063.6																		
STIFF, GRAY, **SILT AND CLAY**, LITTLE GRAVEL, LITTLE SAND, TRACE ORGANICS, **FILL**, DAMP	1061.6	1	2 9 6	20	44	SS-1	1.75	18	6	9	36	31	36	23	13	17	A-6a (8)	330	
VERY STIFF TO HARD, BROWN, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL, DAMP	1059.1	2	3 4 5	12	100	SS-2A	-	-	-	-	-	-	-	-	-	-	A-6a (V)	-	
		3				SS-2B	3.75	11	4	8	33	44	38	21	17	15	A-6b (11)	-	
		4	4 4 5	12	100	SS-3	4.50	-	-	-	-	-	-	-	-	16	A-6b (V)	-	
HARD, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	1057.6	5	5 8 10	24	100	SS-4	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	-	
		6 EOB																	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 11/9/21 09:02 - \\SME-INC\PZ\WIP\078832.01\PROJECT DATA\GINT\078832.01_CUY-CR57-4.43.GPJ

DETERMINING SULFATE CONTENT IN SOILS - COLORIMETRIC METHOD ODOT SUPPLEMENT 1122

PROJECT	CUY-CR57-4.43 (PID 106239)	*PROJECT NO.*	078832.01
LOCATION	Wallings Road	*DATE*	March 11, 2020

SAMPLE NO.	LOCATION	WEIGHT OF SOIL, g	AMOUNT OF WATER ADDED, mL	INITIAL DILUTION RATIO	FINAL DILUTION RATIO	AVERAGE COLORIMETER READING*	AVERAGE SULFATE CONCENTRATION, ppm
SB	B-006-0-20 ; 1.75'-3.25'	20.00	400.0	20.0	20.0	18.90	350
		20.00	400.0	20.0	20.0	16.45	
		20.00	400.0	20.0	20.0	17.21	
SB	B-007-0-20 ; 1.5'-3.0'	20.00	400.0	20.0	20.0	19.71	371
		20.00	400.0	20.0	20.0	18.77	
		20.00	400.0	20.0	20.0	17.16	
SB	B-008-0-20 ; 0.75'-2.25'	20.00	400.0	20.0	20.0	3.00	71
		20.00	400.0	20.0	20.0	3.59	
		20.00	400.0	20.0	20.0	4.01	
SB	B-009-0-20 ; 1.0'-2.5'	20.00	400.0	20.0	20.0	18.21	393
		20.00	400.0	20.0	20.0	21.12	
		20.00	400.0	20.0	20.0	19.57	
SB	B-010-0-20 ; 1.0'-2.5'	20.00	400.0	20.0	20.0	26.31	551
		20.00	400.0	20.0	20.0	29.23	
		20.00	400.0	20.0	20.0	27.18	
SB	B-011-0-20 ; 1.5'-3.0'	20.00	400.0	20.0	20.0	37.83	726
		20.00	400.0	20.0	20.0	34.21	
		20.00	400.0	20.0	20.0	36.80	
SB	B-012-0-20 ; 1.17'-2.67'	20.00	400.0	20.0	20.0	27.50	570
		20.00	400.0	20.0	20.0	29.39	
		20.00	400.0	20.0	20.0	28.61	
SB	B-013-0-20 ; 0.25'-1.75'	20.00	400.0	20.0	20.0	15.40	331
		20.00	400.0	20.0	20.0	16.33	
		20.00	400.0	20.0	20.0	17.98	

REMARKS.
*AVERAGE COLORIMETER READING: reading is corrected with initial filtrate reading ("zero" reading)

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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