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Chosen Valley Testing

Factual Geotechnical Report:

Proposed Wetland
Highway 18
Floyd County, Iowa

Prepared for:

Mr. Nathan Anderson
WHKS & Co.

November 25, 2014
7066.14.IAM

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Chosen Valley Testing, Inc.

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Mr. Nathan Anderson, PE
WHKS & Co
2905 South Broadway
Rochester, MN 55904
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November 25, 2014

Re: Factual Geotechnical Report
Proposed Wetland
Highway 18
Floyd County, Iowa
CVT Project Number: 7066.14.IAM

Dear Mr. Anderson:

This factual report was prepared to assist planning for the proposed earthen-constructed wetland near Nora Springs, Iowa. Our services were authorized by Mr. Nathan Anderson of WHKS, on behalf of Floyd County. This report includes our original findings from November 2013, under the project number 5848.13.IAM.

A. Introduction

The intent of this report is to present our results to the client in the same logical sequence that led us to arrive at the opinions and recommendations expressed. Since our services must often be completed before the design, assumptions are sometimes needed to prepare a proper evaluation and to analyze the data. A complete and thorough review of this entire document, including the assumptions and the appendices, should be undertaken immediately upon receipt.

A.1. Purpose

This report was prepared to assist planning for the proposed earthen-constructed wetland near Nora Springs, Iowa. Our services were authorized by Mr. Nathan Anderson of WHKS, on behalf of Floyd County.

A.2. Scope

To obtain data for analysis, our initial services included a total of 5 penetration test borings drilled to their planned depths of 10 feet or to auger refusal. Our supplemental service included a total of 1 penetration test boring drilled to its planned depth of 20 feet. Our engineering scope consisted of providing a factual discussion of the soils and materials encountered during our exploration.

A.3. Boring Locations and Elevation

The desired borings locations were indicated to Chosen Valley Testing on site plans provided by the client. The Boring Location Sketch in the Appendix shows the approximate locations drilled. Elevations were not measured.

A.4. Geologic Background

A geotechnical report is based on subsurface data collected for the specific structure or problem. Available geologic data from the region can help interpretation of the data and is briefly summarized in this section.

Area geologic maps indicate that the natural upper soils are primarily glacial clay deposits overlying residual soils (bedrock derived). Bedrock is expected to be less than 50 feet below the surface and consist of dolostone, limestone, or shale from the Cedar Valley Group.

B. Subsurface Data

Methods: All of the borings were performed using penetration test procedures (Method of Test D1586 of the American Society for Testing and Materials). This procedure allows for the extraction of intact soil specimen from deep in the ground. With this method, a hollow-stem auger is drilled to the desired sampling depth. A 2-inch OD sampling tube is then screwed onto the end of a sampling rod, inserted through the hole in the auger's tip, and then driven into the soil with a 140-pound hammer dropped repeatedly from a height of 30 inches above the sampling rod. The sampler is driven 18-inches into the soil, unless the material is too hard. The samples are generally taken at 2½ to 5-foot intervals. The core of soil obtained is classified and logged by the driller and a representative portion is then sealed in a jar and delivered to the soils engineer for review.

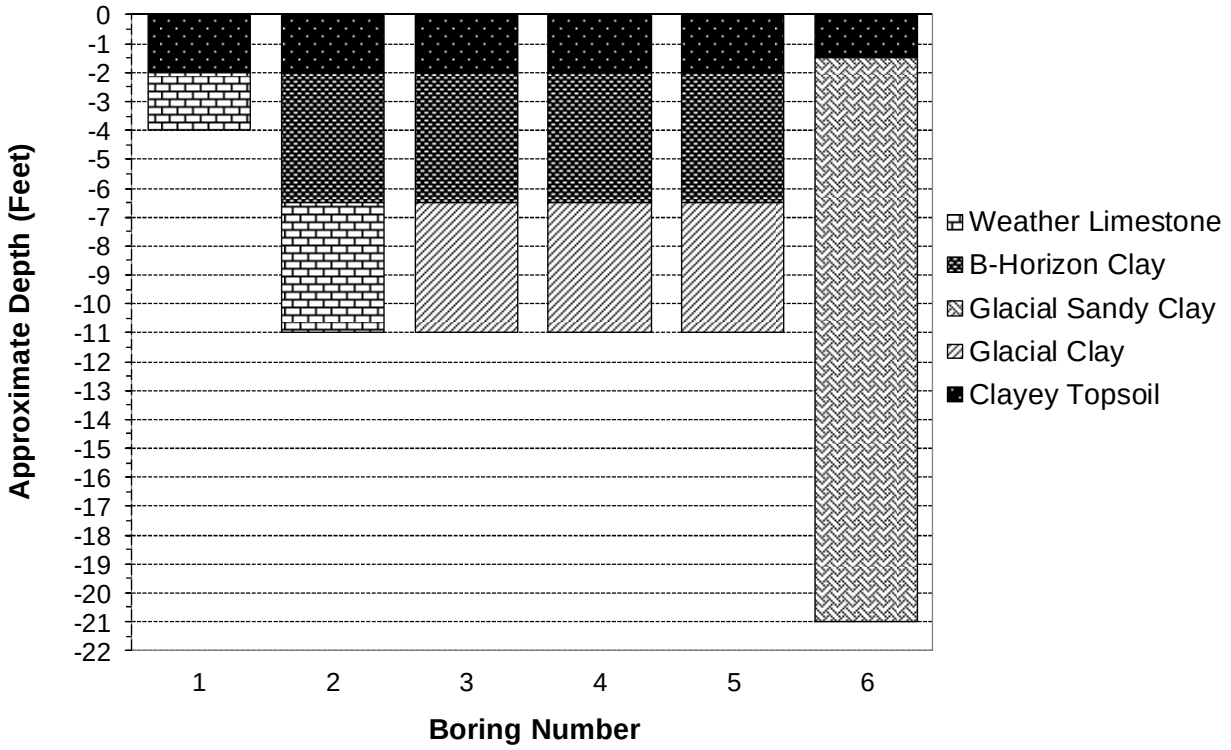
B.1. Stratification

At the surface, the borings encountered about 1½ to 2 feet of slightly organic clayey topsoil. In all borings except Borings B-1 and B-6, this was followed by dark, non-slightly organic clays (B-Horizon soils) to depths of about 4 to 6½ feet.

The southwestern borings (Borings B-1) encountered materials derived from limestone at a depth of 2 feet and met auger refusal at 4 feet. Nearby Boring B-2 met similar but more weathered material derived from limestone at 6½ feet and terminated in this material at the planned termination depth of 11 feet.

The remaining borings encountered glacial sandy clays below the topsoil and B-Horizon clays to their termination depths of about 11 to 21 feet below the surface.

The following simplified cross-section summarizes the boring data. For more detailed information, please refer to the Log of Boring sheets in the Appendix.



B.2. Penetration Test Results

The number of blows needed for the hammer to advance the penetration test sampler is an indicator of soil characteristics. The number of blows to advance the sampler 1 foot is called the penetration resistance or "N"-value. The results tend to be more meaningful for natural mineral soils, than for fill soils. In fill soils, compaction tests are more meaningful.

Penetration resistance values (N-values) of 14 to 26 Blows per Foot (BPF) were recorded in the clays, indicating they were stiff to very stiff. The materials derived from limestone returned values of 12 to 50 blows for 6 inches of sampler advancement, indicating they were rather stiff to hard.

A key to the descriptors used to qualify the relative density of soil (such as *soft*, *stiff*, *loose*, and *dense*) can be found on the Legend to Soil Description in the Appendix.

A pocket penetrometer was used to provide additional data on the compressive strength of the cohesive soils. The clays returned values of ¾ to 4¼ tons per square foot (tsf).

B.3. Groundwater Data

During the drilling operation, the drillers may note the presence of moisture on the sampling instrument, in the cuttings, or within the borehole. These observations are recorded on the boring logs. The water level may vary with weather; time of year and other factors and the presence or absence of water during the drilling is

subject to interpretation and is not always conclusive.

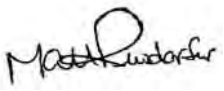
Water was encountered around 8 feet in the south-central area of the watershed (Boring B-2). Based on the moisture contents of the samples retrieved, the static water level in the other four locations appears to be below the depths explored by the borings. Groundwater levels at the site are expected to fluctuate seasonally with nearby creeks and rivers, as well as with local weather patterns.

C. Level of Care

The services provided for this project have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area, under similar budget and time constraints. This is our professional responsibility. No other warranty, expressed or implied, is made.

D. Certification

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly licensed engineer under the laws of the State of Iowa.



Matthew J. Reisdorfer, PE
Registration Number 22234
November 25, 2014

Appendix

Soil Boring Location Sketch

Log of Boring #5848.13.IAM: B1 – B5

Log of Boring #7066.14.IAM: B6

Legend to Soil Description

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Soil Boring Location Sketch

Proposed Wetland
US Highway 18 and Echo Ave
Rock Grove Twp, Floyd Co, Iowa
7066.14.IAM

Legend
- Boring Locations
- Benchmark

N

LOG OF BORING

CHOSEN VALLEY TESTING CVT

PROJECT: 5848.13.IAM Design Phase Geotechnical Evaluation Floyd County Watershed Highway 27 and Echo Avenue Nora Springs, Iowa	BORING: **B-1** LOCATION: See attached sketch. DATE: 11/15/2013 SCALE: 1" = 2'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
	0.0	CL OL	**Slightly Organic LEAN CLAY** trace pin roots, black. (Topsoil)			
	2.0		**WEATHERED LIMESTONE**	*		PP = 2.25 tsf MC = 13.6% * 50 = 6" (Set) Stratum inferred. No sample returned.
	4.0		End of boring. Boring sealed upon completion.			Auger refusal at 4 feet.

CVT STANDARD 5848.13.IAM (FLOYD COUNTY WATERSHED).GPJ LOG A GNNN06.GDT 1/13/14

LOG OF BORING

CHOSEN VALLEY TESTING CVT

PROJECT: 5848.13.IAM Design Phase Geotechnical Evaluation Floyd County Watershed Highway 27 and Echo Avenue Nora Springs, Iowa	BORING: **B-2** LOCATION: See attached sketch. DATE: 11/15/2013 SCALE: 1" = 2'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
	0.0	CL OL	**Slightly Organic LEAN CLAY** trace pin roots, black. (Topsoil)			
	2.0	CL OL	**LEAN CLAY** non-to-slightly Organic, with a trace of roots, dark brown to black, moist, rather stiff to stiff. (B-Horizon)	14		PP = 4.25 tsf MC = 16.4%
				12		PP = 2.5 tsf MC = 21.4%
	6.5		**SILTY LEAN CLAY with WEATHERED LIMESTONE** yellowish brown, wet, hard. (Residual Limestone)	38	▽	PP = 1.5 tsf MC = 16.9% Water was encountered around 8 feet during drilling.
				78		PP = 4.0 tsf MC = 18.3%
	11.0		End of boring. Boring sealed upon completion.			

CVT STANDARD 5848.13.IAM (FLOYD COUNTY WATERSHED).GPJ LOG A GNNN06.GDT 1/13/14

LOG OF BORING

CHOSEN VALLEY TESTING CVT

PROJECT: 5848.13.IAM Design Phase Geotechnical Evaluation Floyd County Watershed Highway 27 and Echo Avenue Nora Springs, Iowa	BORING: **B-3** LOCATION: See attached sketch. DATE: 11/15/2013 SCALE: 1" = 2'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
	0.0	CL OL	**Slightly Organic LEAN CLAY** trace pin roots, black. (Topsoil)			
	2.0	CL OL	**LEAN CLAY** trace gravel, trace pin roots, black, moist. (B-Horizon)			PP = 1.5 tsf MC = 20.0%
	4.0	CL	**LEAN CLAY** dark brown to black, moist. (Glacial Till)			PP = 1.0 tsf
			Greenish brown to dark gray below 7 feet.			PP = 1.25 tsf MC = 18.5%
	11.0					PP = 1.0 tsf
			End of boring. Boring sealed upon completion.			

CVT STANDARD 5848.13.IAM (FLOYD COUNTY WATERSHED).GPJ LOG A GNNN06.GDT 1/13/14

LOG OF BORING

CHOSEN VALLEY TESTING CVT

PROJECT: 5848.13.IAM Design Phase Geotechnical Evaluation Floyd County Watershed Highway 27 and Echo Avenue Nora Springs, Iowa	BORING: **B-4** LOCATION: See attached sketch. DATE: 11/15/2013 SCALE: 1" = 2'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
	0.0	CL OL	**Slightly Organic LEAN CLAY** trace pin roots, black. (Topsoil)			
	2.0	CL	**LEAN CLAY** dark brown, moist. (B-Horizon)			PP = 1.75 tsf MC = 13.7% PP = 1.0 tsf
	6.5	CL	**LEAN CLAY** greenish brown to dark brown, moist. (Alluvium)			PP = 1.0 tsf MC = 16.2% PP = 1.25 tsf
	11.0		End of boring. Boring sealed upon completion.			

LOG OF BORING

CHOSEN VALLEY TESTING CVT

PROJECT: 5848.13.IAM Design Phase Geotechnical Evaluation Floyd County Watershed Highway 27 and Echo Avenue Nora Springs, Iowa	BORING: **B-5** LOCATION: See attached sketch. DATE: 11/15/2013 SCALE: 1" = 2'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
	0.0	CL OL	**Slightly Organic LEAN CLAY** trace pin roots, black. (Topsoil)			
	2.0	CL	**LEAN CLAY** dark brown, wet, very stiff. (B-Horizon)	19		PP = 3.0 tsf
	6.5	CL	**LEAN CLAY** trace gravel, yellowish brown to dark brown, slightly mottled, moist, very stiff. (Alluvium) Trace seam of sand at 7.5 feet.	21		PP = 2.25 tsf MC = 18.3%
	9.0	CL	**LEAN CLAY** greenish brown to dark gray, moist, very stiff. (Alluvium)	26		PP = 2.75 tsf MC = 14.7%
	11.0		End of boring. Boring sealed upon completion.	24		PP = 3.25 tsf MC = 17.2%

CVT STANDARD 5848.13.IAM (FLOYD COUNTY WATERSHED).GPJ LOG A GNNN06.GDT 1/13/14

UNIFIED SOIL CLASSIFICATION (ASTM D-2487/2488)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	Cu>4 AND 1<Cc<3	GW	WELL-GRADED GRAVEL
			Cu>4 AND 1>Cc>3	GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	Cu>6 AND 1<Cc<3	SW	WELL-GRADED SAND
			Cu>6 AND 1>Cc>3	SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR CL	SM	SILTY SAND
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY
			PI>4 AND PLOTS<"A" LINE	ML	SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY
			PI PLOTS <"A" LINE	MH	ELASTIC SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT

Relative Proportions of Sand and Gravel

TERM	PERCENT
Trace	< 15
With	15 - 29
Modifier	> 30

Relative Proportions of Fines

TERM	PERCENT
Trace	< 5
With	5 - 12
Modifier	> 12

Grain Size Terminology

TERM	SIZE
Boulder	< 12 in.
Cobble	3 in. - 12 in.
Gravel	#4 sieve to 3 in.
Sand	#200 sieve to #4 sieve
Silt or Clay	Passing #200 sieve

SAMPLE TYPES

Hollow Stem

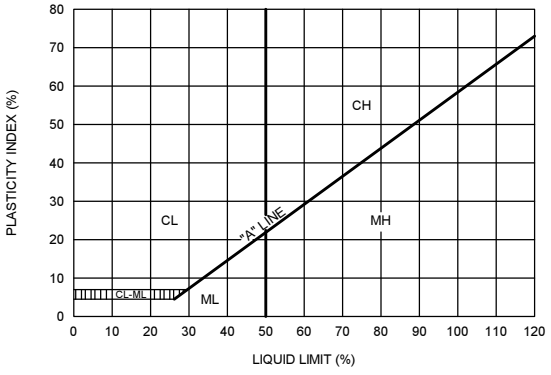
Standard Penetration Test

TEST SYMBOLS

MC	-	MOISTURE CONTENT	LL	-	LIQUID LIMIT
OC	-	ORGANIC CONTENT	PI	-	PLASTISITY INDEX
CN	-	CONSOLIDATION	SW	-	SWELL TEST
DD	-	DRY DENSITY	UU		Unconsolidated Undrained triaxial
PP	-	POCKET PENETROMETER			
RV	-	R-VALUE			
SA	-	SIEVE ANALYSIS			
P200	-	% PASSING #200 SIEVE			

- WATER LEVEL (WITH TIME OF) MEASUREMENT

PLASTICITY CHART



PENETRATION RESISTANCE
(RECORDED AS BLOWS / 0.5 FT)

SAND & GRAVEL		SILT & CLAY		
RELATIVE DENSITY	BLOWS/FOOT*	CONSISTENCY	BLOWS/FOOT*	COMPRESSIVE STRENGTH (TSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 1	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 3	0.25 - 0.50
MEDIUM DENSE	10 - 30	RATHER SOFT	4 - 5	0.50 - 1.0
DENSE	30 - 50	MEDIUM	6 - 8	
VERY DENSE	OVER 50	RATHER STIFF	9 - 12	1.0 - 2.0
		STIFF	13 - 16	
		VERY STIFF	17 - 30	2.0 - 4.0
		HARD	OVER 30	OVER 4.0

* NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

Chosen Valley Testing, Inc.

Job No. 5848.13.IAM

LEGEND TO SOIL DESCRIPTIONS

CVT

CVT 5848.13.IAM (FLOYD COUNTY WATERSHED).GPJ 1/13/14

LOG OF BORING

CHOSEN VALLEY TESTING CVT

PROJECT: 7066.14.IAM Design Phase Geotechnical Evaluation Floyd County Watershed Highway 27 and Echo Avenue Nora Springs, Iowa	BORING: **B-6** LOCATION: See attached sketch. DATE: 11/18/2014 SCALE: 1" = 3'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
	0.0	CL OL	**Slightly Organic LEAN CLAY** trace pin roots, black. (Topsoil)			
	1.5	CL	**SANDY LEAN CLAY** trace of gravel, slightly mottled, brown and gray, wet, rather stiff. (Glacial Till)	9		PP = .75 tsf
				9		PP = 1.0 tsf
	6.5	CL	**SANDY LEAN CLAY** trace of gravel, gray, wet, rather stiff to stiff. (Glacial Till)	15		PP = 2.75 tsf
				16		PP = 2.0 tsf
				11		PP = 2.5 tsf
				11		PP = 2.5 tsf
				13		PP = 1.0 tsf
	21.0		End of boring. Boring sealed upon completion.			

CVT STANDARD 5848.13.IAM (FLOYD COUNTY WATERSHED).GPJ LOG A GNNN06.GDT 11/25/14