


**TEST BORINGS & LABORATORY TESTS
PROPOSED TREATED WATER PIPELINE
IOWA SEGMENTS 4 & 5
LEWIS & CLARK REGIONAL WATER SYSTEM
HULL TO SHELDON, IOWA
GEOTEK #20-K94**

	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <p><i>D. R. Hanson</i></p> <hr/> <p>Daniel R. Hanson</p> <p>License number <u>11557</u></p> <p>My license renewal date is December 31, 2020.</p> <p>Pages or sheets covered by this seal: <u>1-6 PLUS ATTACHMENTS</u></p> <hr/> <hr/>
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**GEOTEK ENGINEERING
& TESTING SERVICES, INC.**
909 East 50th Street North
Sioux Falls, South Dakota 57104
Phone 605-335-5512 Fax 605-335-0773

December 28, 2020

Banner Associates, Inc.
2307 W. 57th Street, Suite 102
Sioux Falls, South Dakota 57108

Attn: Scott Vander Meulen, PE, LS

Subj: Test Borings & Laboratory Tests
Proposed Treated Water Pipeline
Iowa Segments 4 & 5
Lewis & Clark Regional Water System
Hull to Sheldon, Iowa
GeoTek #20-K94

Introduction

This correspondence presents our reporting of the recent test borings and laboratory tests for the referenced project. Our work was performed in accordance with your authorization.

Project Information

We understand that the project will consist of installing a treated water pipeline (Iowa Segments 4 and 5). The project begins just south of Hull, Iowa and extends to Sheldon, Iowa.

Test Borings

We performed 19 test borings on December 8, December 9 and December 10, 2020. Table 1 shows the Northings, Eastings and ground surface elevations at the test boring locations (provided by Banner Associates, Inc.). Four (4) test boring location maps (Figures 1 through 4) are also attached showing the relative location of the test borings.

Table 1. Northings, Eastings & Ground Surface Elevations

Test Boring	Northing	Easting	Ground Surface Elevation, ft
4-1	3900933.172	4217773.468	1,467.2
4-2	3900524.954	4229200.253	1,377.7
4-3	3905720.995	4233467.888	1,409.5
4-4	3905860.654	4233431.011	1,412.6
4-5	3911142.777	4235023.665	1,412.6

Table 1 (Continued). Northings, Eastings & Ground Surface Elevations

Test Boring	Northing	Easting	Ground Surface Elevation, ft
4-6	3910722.701	4246678.811	1,422.6
4-7	3910577.455	4249125.873	1,406.7
4-8	3910458.395	4251836.437	1,433.6
4-9	3910619.574	4251985.176	1,440.7
4-10	3910436.728	4254300.797	1,420.5
5-1	3910151.919	4265109.331	1,422.8
5-2	3909792.777	4275461.925	1,438.5
5-3	3909688.374	4277632.510	1,477.6
5-4	3909224.215	4291391.134	1,389.2
5-5	3907055.570	4291953.092	1,375.8
5-6	3907015.779	4292383.221	1,377.3
5-7	3906940.610	4293216.496	1,384.9
5-8	3906860.998	4294172.680	1,382.0
5-9	3906757.971	4294555.031	1,390.9

Subsurface Conditions

The subsurface profile at the test boring locations consisted of the following soil types: topsoil materials, existing fill materials, loess soils, fine alluvium soils, mixed alluvium soils, coarse alluvium soils, glacial outwash soils and glacial till soils.

The topsoil materials were encountered at the majority of the test borings (15 out of 19) and extended to depths varying from 1 ½ feet to 5 feet. The existing fill materials were only encountered at test borings 4-4, 4-6, 5-2 and 5-7. The existing fill materials extended to depths varying from 1 foot to 4 ½ feet. The loess soils were encountered at about half of the test borings (9 out of 19). The fine alluvium soils were also encountered at about half of the test borings (8 out of 19). The mixed alluvium soils were only encountered at test boring 5-4, 5-5, 5-6 and 5-8. The coarse alluvium soils were only encountered at test borings 5-4, 5-8 and 5-9. The glacial outwash soils were only encountered at test boring 5-7. The glacial till soils were encountered at the majority of the test borings (16 out of 19).

The topsoil materials consisted of lean clay (CL). The existing fill materials consisted of lean clay (CL) and lean clay with sand (CL). The loess soils consisted of lean clay (CL) and fat clay (CH). The fine alluvium soils consisted of lean clay (CL), fat clay (CH) and lean clay with sand (CL). The mixed alluvium soils consisted of sandy lean clay (CL) and clayey sand (SC). The coarse alluvium soils consisted of sand with silt (SP-SM) and sand (SP). The glacial outwash soils consisted of sand with silt (SP-SM). The glacial till soils consisted of lean clay (CL), lean clay with sand (CL), fat clay with sand (CH) and sandy lean clay (CL).

The consistency/relative density of the soils is indicated by the standard penetration resistance (“N”) values as shown on the boring logs. A description of the soil consistency/relative density based on the “N” values can be found on the attached Soil Boring Symbols and Descriptive Terminology data sheet.

We wish to point out that the subsurface conditions at other times and locations along the length of the project may differ from those found at our test boring locations.

Water Levels

Measurements to record the groundwater levels were made at the test boring locations. Delayed groundwater readings were made at all of the test borings except for test boring 4-6 (located within a road). The time and level of the groundwater readings are recorded on the boring logs. Also, a summary of the groundwater levels is shown in Table 2.

Table 2. Groundwater Levels

Test Boring	Ground Surface Elevation, ft	Groundwater Level, ft	Elevation of Groundwater, ft
4-1	1,467.2	14	1,453.2
4-2	1,377.7	4	1,373.7
4-3	1,409.5	13	1,396.5
4-4	1,412.6	14	1,398.6
4-5	1,412.6	7	1,405.6
4-6	1,422.6	Dry to the Termination Depth	N/A
4-7	1,406.7	7	1,399.7
4-8	1,433.6	Dry to the Termination Depth	N/A
4-9	1,440.7	Dry to the Termination Depth	N/A
4-10	1,420.5	10	1,410.5
5-1	1,422.8	11	1,411.8
5-2	1,438.5	Dry to the Termination Depth	N/A
5-3	1,477.6	Dry to the Termination Depth	N/A
5-4	1,389.2	10 ½	1,378.7
5-5	1,375.8	5	1,370.8
5-6	1,377.3	6	1,371.3
5-7	1,384.9	12	1,372.9
5-8	1,382.0	9	1,373.0
5-9	1,390.9	8	1,382.9

Note: A delayed groundwater reading was not made at test boring 4-6 (located within a road).

The water levels may or may not be an accurate indication of the depth or lack of subsurface groundwater. The limited length of observation restricts the accuracy of the measurements. Long term groundwater monitoring was not included in our scope of work.

Resistivity, pH, Chloride Content & Sulfate Content Results

Twenty (20) soil samples were collected from test borings (2 samples from test boring 5-2) and were submitted for resistivity, pH, chloride content and sulfate content testing. The results of the laboratory tests are shown in Table 3.

Table 3. Laboratory Test Results

Test Boring	Depth (ft)	Soil Type	Resistivity (ohm-cm) (as-received)	Resistivity (ohm-cm) (saturated)	pH	Chloride (mg/kg)	Sulfate (mg/kg)
4-1	7 – 8 ½	Lean Clay w/ Sand (GT)	1,675	1,608	8.5	3	7
4-2	7 – 8 ½	Lean Clay (FA)	1,474	1,474	8.0	4	29
4-3	7 – 8 ½	Lean Clay w/ Sand (GT)	1,139	1,072	8.5	18	31
4-4	12 – 13 ½	Lean Clay w/ Sand (GT)	1,206	1,206	8.4	8	13
4-5	7 – 8 ½	Sandy Lean Clay (GT)	>737,000	3,685	8.5	6	32
4-6	7 – 8 ½	Lean Clay (FA)	1,340	1,340	8.4	8	46
4-7	9 ½ – 11	Lean Clay (FA)	1,608	1,273	8.1	3	24
4-8	9 ½ – 11	Lean Clay w/ Sand (GT)	1,675	1,608	8.5	8	13
4-9	9 ½ – 11	Lean Clay w/ Sand (GT)	1,809	1,675	8.6	12	29
4-10	9 ½ – 11	Lean Clay w/ Sand (GT)	2,010	2,010	8.7	10	20
5-1	9 ½ – 11	Lean Clay w/ Sand (GT)	1,809	1,675	8.5	10	21
5-2	7 – 8 ½	Lean Clay (L)	1,675	1,675	8.2	7	11
5-2	9 ½ – 11	Lean Clay w/ Sand (GT)	1,608	1,541	8.4	4	15
5-3	7 – 8 ½	Lean Clay w/ Sand (GT)	1,541	1,474	8.5	11	12
5-4	9 ½ – 11	Sandy Lean Clay (MA)	5,762	4,690	8.5	4	14
5-5	12 – 13 ½	Lean Clay w/ Sand (GT)	1,139	1,072	8.5	6	251
5-6	14 ½ – 16	Lean Clay w/ Sand (GT)	1,072	1,005	8.5	5	398
5-7	9 ½ – 11	Lean Clay w/ Sand (GT)	1,474	1,407	8.6	10	27
5-8	7 – 8 ½	Lean Clay w/ Sand (FA)	1,675	1,675	8.7	8	22
5-9	9 ½ – 11	Lean Clay w/ Sand (GT)	1,541	1,474	8.6	7	21

Note: L – loess soils, FA – fine alluvium soils, MA – mixed alluvium soils and GT – glacial till soils.

Discussion

The subgrade soils anticipated at the invert depths for the pipeline will consist of mostly clay soils and some sand soils (sand soils were only encountered near Sheldon). Where soils having moderate moisture and density values are encountered at the bottom of the trench excavations, it is our opinion that the soils are considered suitable for support of the pipeline, provided they are adequately dewatered, and are not disturbed by construction traffic. Localized areas of wet or soft soils may be encountered at the bottom of the trench excavations. These areas will require subexcavation and trench stabilization methods and materials. Appropriate bedding materials

should be used for the pipeline. Some subexcavation and trench stabilization methods and materials may be needed at and around test borings 4-7 and 5-8 (areas where soft or wet soils are near the invert depths of the pipeline).

Water may enter the trench excavations as a result of subsurface water, precipitation or surface run off. Dewatering procedures may be required in order to control and remove water during the excavation for the pipeline. Where clay soils are encountered, it may be possible to remove and control water entering the trench excavations using normal sump pumping techniques. However, where waterbearing sand soils are encountered, extensive dewatering techniques will likely be required due to the potentially large volumes of water. The contractor should provide appropriate dewatering methods and equipment. It should be noted that groundwater was encountered at the majority of the test borings (see Table 2). Also, wet or waterbearing sand soils were generally encountered near Sheldon. Any water that accumulates at the bottom of the trench excavations should be immediately removed and surface drainage away from the trench excavations should be provided during construction.

A portion of the soils encountered in the trench excavations may not be suitable or ideal for use as trench backfill. The unsuitable soils would consist of organic soils as well as soils having high moisture content levels such that the specified compaction level cannot be reasonably achieved. The organic soils should be replaced with suitable material available at the site or with suitable off-site borrow soils. The wet soils will require significant drying in order to adjust the moisture content of the soils to a level that will facilitate the specified compaction requirement. Alternatively, the wet soils could be replaced with suitable material available at the site or with suitable off-site borrow soils. Based on the moisture content levels, the majority of the loess soils and fine alluvium soils will require significant drying. Some drying may be needed with the existing fill materials, mixed alluvium soils and glacial till soils. Minimal drying should be expected with the coarse alluvium soils.

Pipe jacking will be performed near test borings 4-3, 4-4, 4-8, 4-9, 4-10, 5-2, 5-8 and 5-9. It is our opinion that the loess soils and fine alluvium soils encountered at these test borings have low strength levels. We estimate that the loess soils and fine alluvium soils have unconfined compressive strength values between 0.25 to 0.5 tons per square foot (tsf). Regarding the glacial till soils at these test borings, it is our opinion that the glacial till soils have moderate to moderately high strength levels. We estimate that the glacial till soils have unconfined compressive strength values between 1.5 to 2.5 tsf. Boulders and cobbles may be encountered within the coarse alluvium soils and glacial till soils. The contractor may experience difficulties if boulders or cobbles are encountered during installation.

All excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches". This document states that the excavation safety is the responsibility of the contractor. Reference to this OSHA requirement should be included in the project specifications.

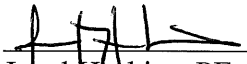
Standard of Care


The recommendations submitted in this report represent our professional opinions. Our services for your project were performed in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering profession currently practicing at this time and area.

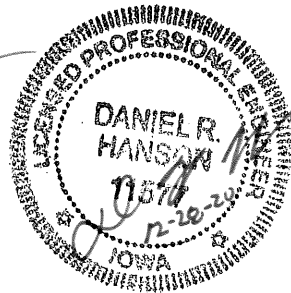
Remarks

We trust this report provides you with the necessary information for the project. If you have any questions or require additional information, please contact our office.

This report was prepared by:
GeoTek Engineering & Testing Services, Inc.


Jared Haskins, PE (SD)
Geotechnical Manager


Daniel Hanson, PE (IA)
General Manager



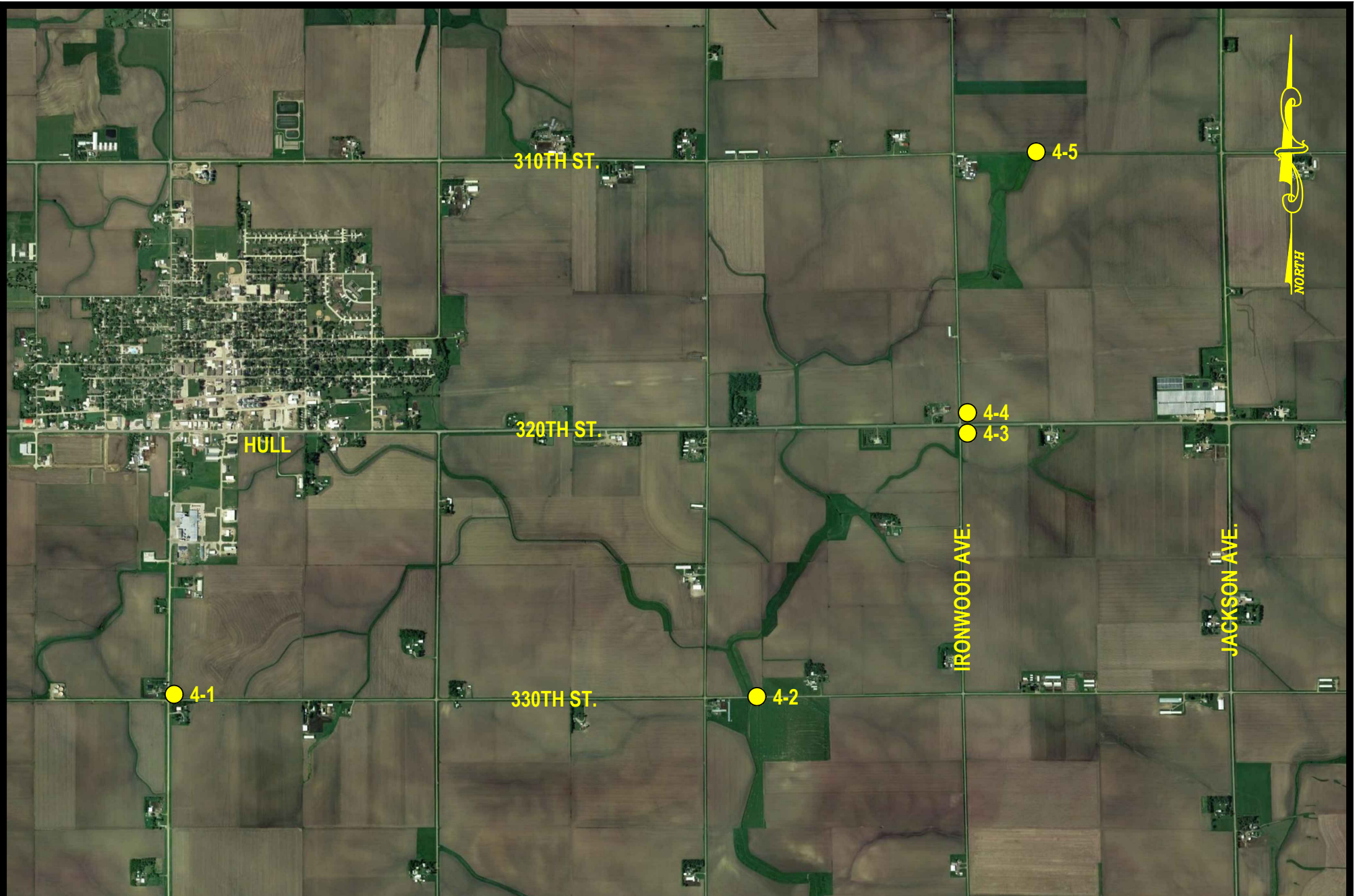


FIGURE 1
 TEST BORING LOCATION MAP (4-1 TO 4-5)
 PROPOSED TREATED WATER PIPELINE
 IOWA SEGMENTS 4 & 5
 LEWIS & CLARK REGIONAL WATER SYTEM
 HULL TO SEHORN, IA

ACAD/GEOTEK/JARED/20-594

PROJECT#: 20-K94

DRAWN BY: DHP



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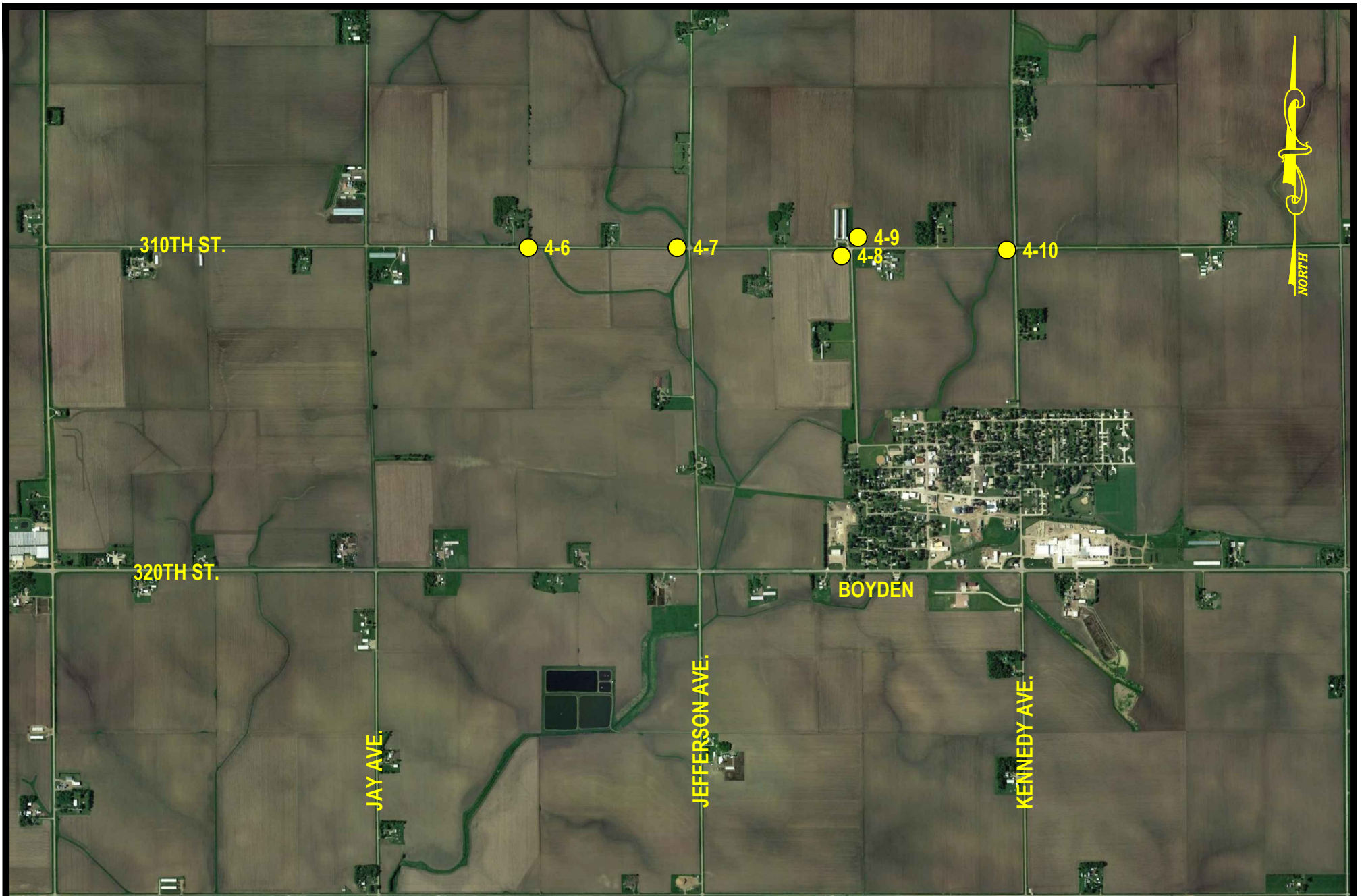


FIGURE 2
 TEST BORING LOCATION MAP (4-6 TO 4-10)
 PROPOSED TREATED WATER PIPELINE
 IOWA SEGMENTS 4 & 5
 LEWIS & CLARK REGIONAL WATER SYTEM
 HULL TO SEHORN, IA ACAD/GEOTEK/JARED/20-594

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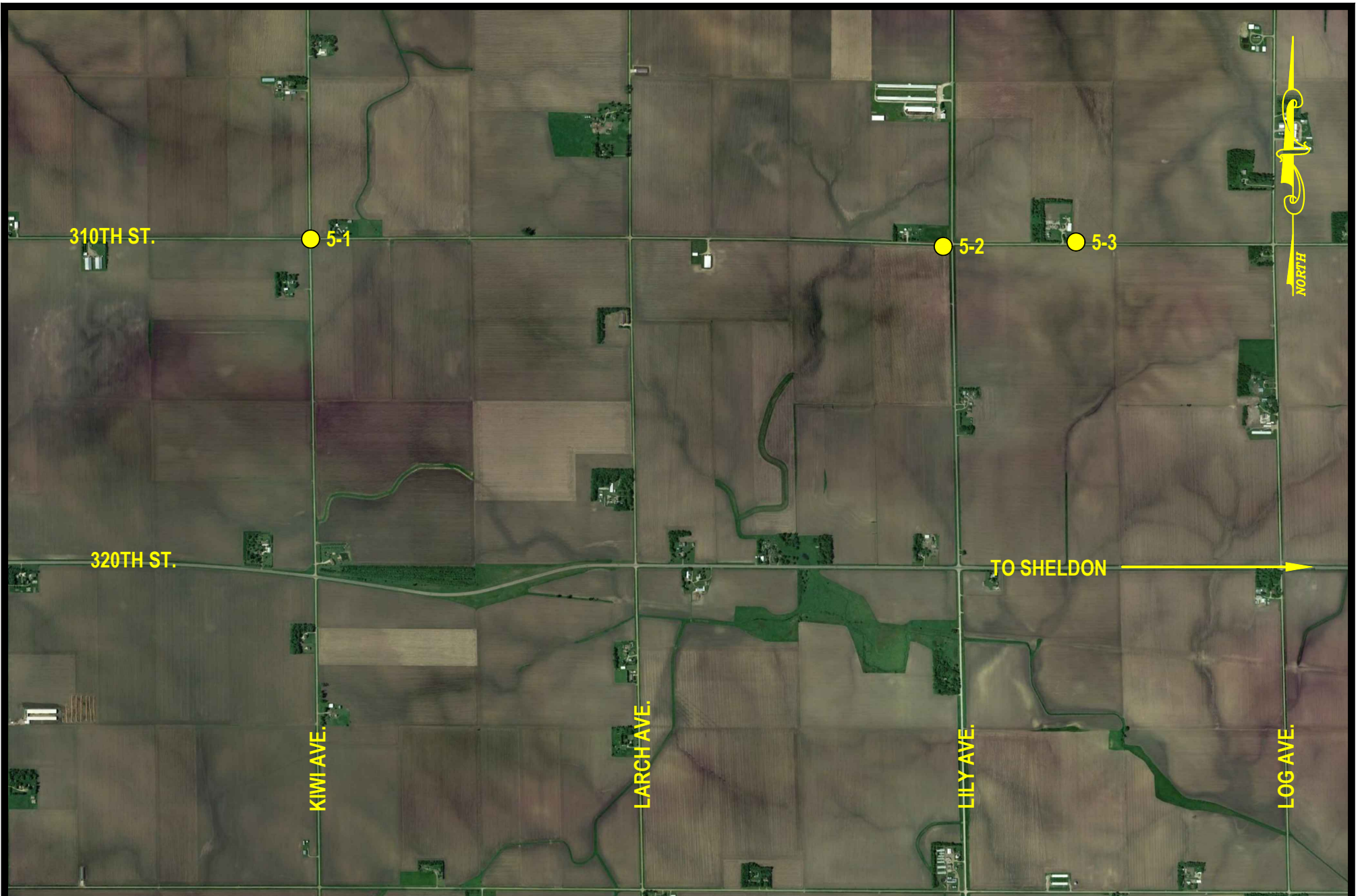


FIGURE 3
 TEST BORING LOCATION MAP (5-1 TO 5-3)
 PROPOSED TREATED WATER PIPELINE
 IOWA SEGMENTS 4 & 5
 LEWIS & CLARK REGIONAL WATER SYTEM
 HULL TO SEHORN, IA

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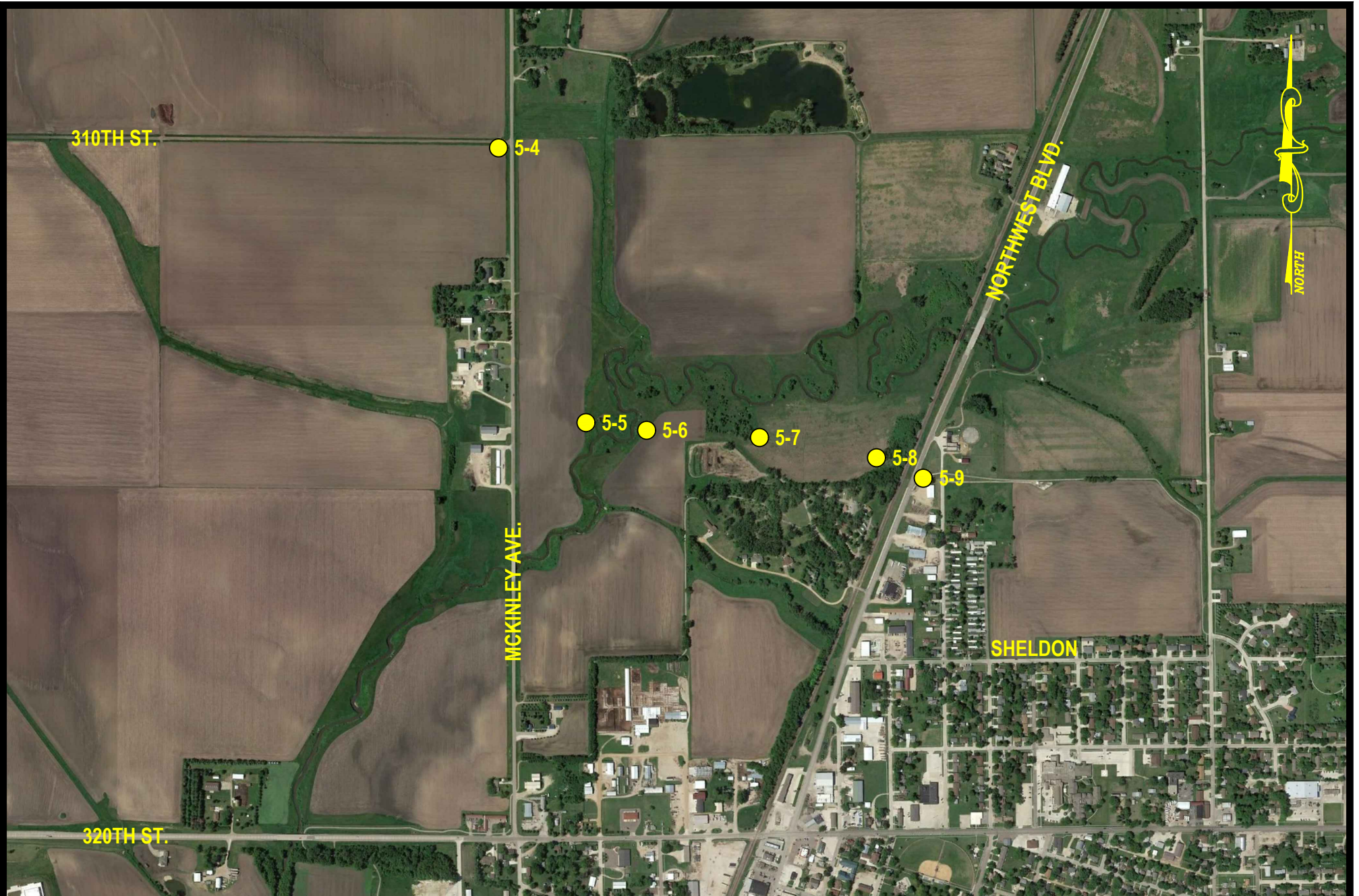


FIGURE 4
 TEST BORING LOCATION MAP (5-4 TO 5-9)
 PROPOSED TREATED WATER PIPELINE
 IOWA SEGMENTS 4 & 5
 LEWIS & CLARK REGIONAL WATER SYTEM
 HULL TO SEHORN, IA

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GEOTECHNICAL TEST BORING LOG

GEOTEK # <u>20-K94</u>						BORING NO. <u>4-1 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>1467.2 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
									NO.	TYPE	WC	D	LL	PL	QU		
2	LEAN CLAY: dark brown to very dark brown, moist, (CL)					TOPSOIL			1	HSA							
2	LEAN CLAY: brown and gray, moist, firm to stiff, (CL)					LOESS	9		2	SPT	24	98					
5							5		3	SPT	25	96					
7	LEAN CLAY WITH SAND: a little gravel, brown, moist to wet, stiff to very stiff, a few lenses of sand at 15' (CL)					GLACIAL TILL	9		4	SPT	16	116					
							11		5	SPT							
							16		6	SPT							
							14		7	SPT							
16	Bottom of borehole at 16 feet.																
WATER LEVEL MEASUREMENTS						START <u>12-8-20</u> COMPLETE <u>12-8-20 9:31 am</u>											
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD <u>3.25" ID Hollow Stem Auger</u>											
12-9-20	7:23 am	16	--	14	▼ 14												
12-12-20	1:33 pm	16	--	14	▼ 14												
--	--	--	--	--	--												
--	--	--	--	--	--	CREW CHIEF <u>Mike Wagner</u>											

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # 20-K94 BORING NO. 4-2 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1377.7 ft</u>														
	LEAN CLAY: black, moist, firm, (CL)	TOPSOIL				1	HSA								
5			7			2	SPT	34	86						
	LEAN CLAY: very dark brown to black, moist to wet, soft to firm, (CL)	FINE ALLUVIUM	3			3	SPT	41	79						
8½			5			4	SPT	35	86						
	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff, (CL)	GLACIAL TILL	12			5	SPT	19	110						
14½			11			6	SPT								
	LEAN CLAY: a trace of gravel, gray, moist, stiff, (CL)	GLACIAL TILL	11			7	SPT								
19½															
21	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff, (CL)	GLACIAL TILL	13			8	SPT								
	Bottom of borehole at 21 feet.														

WATER LEVEL MEASUREMENTS START 12-8-20 COMPLETE 12-8-20 10:28 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-8-20	10:29 am	21	--	19	14	3.25" ID Hollow Stem Auger
12-9-20	7:30 am	21	--	12	4	
12-12-20	1:38 pm	21	--	10	4	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # <u>20-K94</u>						BORING NO. <u>4-3 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>1409.5 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
									NO.	TYPE	WC	D	LL	PL	QU		
1 1/2	LEAN CLAY: very dark brown to black, moist, (CL)					TOPSOIL			1	HSA							
	LEAN CLAY: brown and gray, moist, firm, (CL)					LOESS	6		2	SPT	17	99					
							8		3	SPT	22	100					
7	LEAN CLAY WITH SAND: a little gravel, brown, moist, stiff, (CL)					GLACIAL TILL	12		4	SPT	20	109					
							13		5	SPT	22	104					
12	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff, (CL)					GLACIAL TILL	11	▼	6	SPT							
							14		7	SPT							
16	Bottom of borehole at 16 feet.																
WATER LEVEL MEASUREMENTS							START	<u>12-8-20</u>	COMPLETE	<u>12-8-20 11:18 am</u>							
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD											
12-8-20	11:18 am	16	--	14	none	3.25" ID Hollow Stem Auger											
12-9-20	7:35 am	16	--	13	▼ 13												
12-12-20	1:43 pm	16	--	13	▼ 13												
--	--	--	--	--	--	CREW CHIEF Mike Wagner											

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # <u>20-K94</u>						BORING NO. <u>4-4 (1 of 1)</u>										
PROJECT <u>Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA</u>																
DEPTH in FEET	DESCRIPTION OF MATERIAL				GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
								NO.	TYPE	WC	D	LL	PL	QU		
	SURFACE ELEVATION <u>1412.6 ft</u>															
	FILL, MOSTLY LEAN CLAY: a trace of gravel, brown and dark brown, moist				FILL			1	HSA							
4½	LEAN CLAY: brown and gray, moist to wet, firm, (CL)				LOESS	9		2	SPT							
7	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff to very stiff, (CL)				GLACIAL TILL	6		3	SPT	28	92					
						10		4	SPT	15	114					
						11		5	SPT	22	106					
						14		6	SPT	23	103					5300
16	Bottom of borehole at 16 feet.					17		7	SPT							
WATER LEVEL MEASUREMENTS						START <u>12-10-20</u> COMPLETE <u>12-10-20 2:49 pm</u>										
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD										
12-10-20	2:49 pm	16	--	14	none	3.25" ID Hollow Stem Auger										
12-12-20	1:46 pm	16	--	14	▼ 14											
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--	--	--	--	--	--	CREW CHIEF Mike Wagner										

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

DEPTH in FEET		DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
SURFACE ELEVATION 1412.6 ft						NO.	TYPE	WC	D	LL	PL	QU
		LEAN CLAY: very dark brown to black, moist, stiff, (CL)	TOPSOIL			1	HSA					
5		LEAN CLAY: grayish brown and dark gray, moist, stiff, (CL)	FINE ALLUVIUM	10		2	SPT	31				
7		SANDY LEAN CLAY: a little gravel, brown and gray, moist, stiff, with lenses of sand (CL)	GLACIAL TILL	11		3	SPT	23	103			
				10		4	SPT	14	124			
				14		5	SPT	16				
12		LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff, (CL)	GLACIAL TILL	15		6	SPT					
16		Bottom of borehole at 16 feet.		14		7	SPT					
WATER LEVEL MEASUREMENTS					START	12-8-20		COMPLETE	12-8-20 12:10 pm			
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD						
12-8-20	12:40 pm	16	--	15	12	3.25" ID Hollow Stem Auger						
12-9-20	7:39 am	16	--	9	7							
12-12-20	1:52 pm	16	--	8	7							
--	--	--	--	--	--	CREW CHIEF Mike Wagner						

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # <u>20-K94</u>						BORING NO. <u>4-6 (1 of 1)</u>										
PROJECT <u>Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA</u>																
DEPTH in FEET	DESCRIPTION OF MATERIAL				GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
								NO.	TYPE	WC	D	LL	PL	QU		
	SURFACE ELEVATION <u>1422.6 ft</u>															
	FILL, MOSTLY LEAN CLAY: a trace of gravel, very dark brown and black, moist				FILL			1	HSA							
2½	LEAN CLAY: black, moist, stiff, (CL)				TOPSOIL	9		2	SPT	32	87					
4½	LEAN CLAY: brown and gray, moist, stiff, (CL)				FINE ALLUVIUM	9		3	SPT	27	94					
7	LEAN CLAY: grayish brown, moist, firm, (CL)				FINE ALLUVIUM	5		4	SPT	27	97					
9½	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff, with several lenses of sand (CL)				GLACIAL TILL	10		5	SPT	19						
						12		6	SPT							
						14		7	SPT							
16	Bottom of borehole at 16 feet.															
WATER LEVEL MEASUREMENTS						START <u>12-10-20</u> COMPLETE <u>12-10-20 12:50 pm</u>										
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD										
12-10-20	12:50 pm	16	--	14	none	3.25" ID Hollow Stem Auger										
--	--	--	--	--	--											
--	--	--	--	--	--											
--	--	--	--	--	--	CREW CHIEF Mike Wagner										

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # <u>20-K94</u>						BORING NO. <u>4-7 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>1406.7 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
									NO.	TYPE	WC	D	LL	PL	QU		
2	LEAN CLAY: very dark brown to black, moist, (CL)					TOPSOIL			1	HSA							
2	LEAN CLAY: brown and gray, moist to wet, stiff, (CL)					FINE ALLUVIUM	9		2	SPT	25	96					
7	LEAN CLAY: grayish brown, moist to wet, firm to stiff, (CL)					FINE ALLUVIUM	10		3	SPT	28	96					
7	LEAN CLAY: grayish brown, moist to wet, firm to stiff, (CL)					FINE ALLUVIUM	6	▼	4	SPT	30	93					
12	LEAN CLAY: dark brown, moist to wet, firm to stiff, (CL)					FINE ALLUVIUM	10		5	SPT	28	96					
12	LEAN CLAY: dark brown, moist to wet, firm to stiff, (CL)					FINE ALLUVIUM	7		6	SPT	42	81					
	LEAN CLAY: dark brown, moist to wet, firm to stiff, (CL)					FINE ALLUVIUM	8		7	SPT							
21	LEAN CLAY: dark brown, moist to wet, firm to stiff, (CL)					FINE ALLUVIUM	12		8	SPT							
21	Bottom of borehole at 21 feet.																
WATER LEVEL MEASUREMENTS						START <u>12-8-20</u> COMPLETE <u>12-8-20 2:01 pm</u>											
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD 3.25" ID Hollow Stem Auger											
12-8-20	2:06 pm	21	--	13	12												
12-9-20	7:47 am	21	--	12	▼ 7												
12-12-20	1:59 pm	21	--	11	▼ 7												
--	--	--	--	--	--	CREW CHIEF Mike Wagner											

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # <u>20-K94</u>						BORING NO. <u>4-8 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>1433.6 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
									NO.	TYPE	WC	D	LL	PL	QU		
2	LEAN CLAY: very dark brown, dry, (CL)					TOPSOIL			1	HSA							
4 1/2	LEAN CLAY: dark brown, moist, firm, (CL)					LOESS	6		2	SPT	23	98					
7	LEAN CLAY: brown and gray, moist to wet, stiff, (CL)					LOESS	10		3	SPT	28	95					
7	LEAN CLAY WITH SAND: a little gravel, brown, moist, stiff, (CL)					GLACIAL TILL	11		4	SPT	15	117					
							9		5	SPT	17	116					3300
							12		6	SPT							
16							12		7	SPT							
Bottom of borehole at 16 feet.																	
WATER LEVEL MEASUREMENTS						START <u>12-8-20</u>		COMPLETE <u>12-8-20 2:57 pm</u>									
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD											
12-9-20	7:51 am	16	--	14	none	3.25" ID Hollow Stem Auger											
12-12-20	2:06 pm	16	--	12	none												
--	--	--	--	--	--												
--	--	--	--	--	--	CREW CHIEF <u>Mike Wagner</u>											

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # 20-K94

BORING NO. 4-9 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1440.7 ft</u>														
2	LEAN CLAY: very dark brown to black, dry, (CL)	TOPSOIL			1	HSA									
4 1/2	LEAN CLAY: brown, moist, stiff, (CL)	LOESS	9		2	SPT	20	99							
7	LEAN CLAY: brown and gray, moist, stiff, (CL)	LOESS	9		3	SPT	26								
	LEAN CLAY WITH SAND: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	10		4	SPT	14	119							
			13		5	SPT	15	119							
			12		6	SPT	17	117							
16			14		7	SPT									
	Bottom of borehole at 16 feet.														

WATER LEVEL MEASUREMENTS

START 12-8-20 COMPLETE 12-8-20 3:39 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-8-20	3:39 pm	16	--	14	none	3.25" ID Hollow Stem Auger
12-9-20	7:54 am	16	--	14	none	
12-12-20	2:09 pm	16	--	13	none	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # <u>20-K94</u>						BORING NO. <u>4-10 (1 of 1)</u>												
PROJECT <u>Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA</u>																		
DEPTH in FEET	DESCRIPTION OF MATERIAL				GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
								NO.	TYPE	WC	D	LL	PL	QU				
	SURFACE ELEVATION <u>1420.5 ft</u>																	
	LEAN CLAY: black, moist, (CL)				TOPSOIL			1	HSA									
2½	FAT CLAY: dark grayish brown, moist, stiff, (CH)				FINE ALLUVIUM	9		2	SPT	19								
4½	LEAN CLAY: grayish brown, moist, stiff, (CL)				FINE ALLUVIUM	12		3	SPT	25	98							
7	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff to very stiff, (CL)				GLACIAL TILL	12		4	SPT	17	118							
						12	▼	5	SPT	16	118							
						15		6	SPT	17	115							5400
						17		7	SPT									
21	Bottom of borehole at 21 feet.					16		8	SPT									
WATER LEVEL MEASUREMENTS						START	<u>12-8-20</u>		COMPLETE	<u>12-8-20 4:28 pm</u>								
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD												
12-8-20	4:29 pm	21	--	19	none	3.25" ID Hollow Stem Auger												
12-9-20	7:57 am	21	--	19	none													
12-12-20	2:14 pm	21	--	11	▼ 10													
--	--	--	--	--	--	CREW CHIEF Mike Wagner												

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # **20-K94**

BORING NO. **5-1 (1 of 1)**

PROJECT **Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1422.8 ft</u>														
2	LEAN CLAY: very dark brown to black, moist, (CL)	TOPSOIL			1	HSA									
4 1/2	FAT CLAY: brown and dark gray, moist, stiff, (CH)	LOESS	12		2	SPT	20	102							
8 1/2	LEAN CLAY: brown and gray, moist to wet, firm, (CL)	LOESS	5		3	SPT	32	89							
			5		4	SPT	28	96							
	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff, (CL)	GLACIAL TILL	11		5	SPT	17	118							
			15		6	SPT									
			15		7	SPT									
21	Bottom of borehole at 21 feet.		14		8	SPT									

WATER LEVEL MEASUREMENTS

START 12-9-20 COMPLETE 12-9-20 9:39 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-9-20	9:38 am	21	--	19	none	3.25" ID Hollow Stem Auger
12-12-20	2:20 pm	21	--	14	11	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # **20-K94**

BORING NO. **5-2 (1 of 1)**

PROJECT **Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1438.5 ft</u>														
4½	FILL, MOSTLY LEAN CLAY WITH SAND: brown and dark brown, moist	FILL	9		1	HSA									
					2	SPT	17	110							
9½	LEAN CLAY: brown and gray, moist to wet, soft to stiff, (CL)	LOESS	12		3	SPT	25	97							
			4		4	SPT	29	94							
16	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff, (CL)	GLACIAL TILL	14		5	SPT	17	117							
			15		6	SPT									
			15		7	SPT									
	Bottom of borehole at 16 feet.														

WATER LEVEL MEASUREMENTS

START 12-10-20 COMPLETE 12-10-20 11:43 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-10-20	11:43 am	16	--	14	none	3.25" ID Hollow Stem Auger
12-12-20	2:27 pm	16	--	14	none	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # **20-K94**

BORING NO. **5-3 (1 of 1)**

PROJECT **Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1477.6 ft</u>														
1½	LEAN CLAY: very dark brown to black, dry to moist, (CL)	TOPSOIL			1	HSA									
	LEAN CLAY: brown and gray, dry, firm, (CL)	LOESS	7		2	SPT	13	93							
4½	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff, (CL)	GLACIAL TILL	10		3	SPT	17	111							
			11		4	SPT	18	114							
9½	LEAN CLAY WITH SAND: a little gravel, brown and grayish brown, moist, stiff, (CL)	GLACIAL TILL	10		5	SPT									
			12		6	SPT									
			13		7	SPT									
16	Bottom of borehole at 16 feet.														

WATER LEVEL MEASUREMENTS

START 12-9-20 COMPLETE 12-9-20 10:29 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-9-20	10:29 am	16	--	14	none	3.25" ID Hollow Stem Auger
12-12-20	2:31 pm	16	--	14	none	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # **20-K94**

BORING NO. **5-4 (1 of 1)**

PROJECT **Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1389.2 ft</u>														
2	LEAN CLAY: very dark brown to black, dry to moist, (CL)	TOPSOIL			1	HSA									
4 1/2	LEAN CLAY: brown and gray, moist, stiff, (CL)	LOESS	9		2	SPT	15	95							
7	LEAN CLAY: brown, moist, stiff, (CL)	LOESS	12		3	SPT	13	114							
12	SANDY LEAN CLAY: a little gravel, brown, moist, stiff, (CL)	MIXED ALLUVIUM	14		4	SPT	8								
13 1/2	LEAN CLAY: brown, wet, stiff, (CL)	FINE ALLUVIUM	11	▼	5	SPT	17								
16	SAND WITH SILT: fine to medium grained, brown, waterbearing, loose, (SP-SM)	COARSE ALLUVIUM	9		6	SPT	24	108							
16	Bottom of borehole at 16 feet.		8		7	SPT									

WATER LEVEL MEASUREMENTS

START 12-9-20 COMPLETE 12-9-20 11:20 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-9-20	11:22 am	16	--	11	▼ 10.5	3.25" ID Hollow Stem Auger
12-12-20	2:36 pm	16	--	11	▼ 10.5	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



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GEOTECHNICAL TEST BORING LOG

GEOTEK # **20-K94**

BORING NO. **5-5 (1 of 1)**

PROJECT **Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS										
					NO.	TYPE	WC	D	LL	PL	QU						
	↓ SURFACE ELEVATION <u>1375.8 ft</u>																
	LEAN CLAY: very dark brown to black, moist, firm, (CL)	TOPSOIL			1	HSA											
4½			8		2	SPT	22	78									
	CLAYEY SAND: fine grained, very dark brown to black, wet, very loose, (SC)	MIXED ALLUVIUM	3	▼	3	SPT	20										
7			6		4	SPT	20	111									
	LEAN CLAY WITH SAND: gray, moist, firm, (CL)	FINE ALLUVIUM															
9½			11		5	SPT	18	114									
	LEAN CLAY WITH SAND: a little gravel, dark grayish brown, moist, stiff, (CL)	GLACIAL TILL															
14½			10		6	SPT	19	114									
	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, very stiff, (CL)	GLACIAL TILL	16		7	SPT	20	108									
19½			26		8	SPT	16	117									3600
	FAT CLAY WITH SAND: a little gravel, brown and gray, moist, very stiff, (CH)	GLACIAL TILL															
26			23		9	SPT											
	Bottom of borehole at 26 feet.																

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20

WATER LEVEL MEASUREMENTS

START 12-9-20 COMPLETE 12-9-20 1:23 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-9-20	1:23 pm	26	--	12	8	3.25" ID Hollow Stem Auger
12-12-20	2:43 pm	26	--	9	▼ 5	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner



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GEOTECHNICAL TEST BORING LOG

GEOTEK # 20-K94

BORING NO. 5-6 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1377.3 ft</u>														
	LEAN CLAY: very dark brown to black, moist, firm, (CL)	TOPSOIL				1	HSA								
4½			6			2	SPT	20	106						
	SANDY LEAN CLAY: very dark brown, wet, soft, (SC)	MIXED ALLUVIUM	2			3	SPT	15							
7			9			4	SPT	12							
	CLAYEY SAND: a trace of gravel, fine to medium grained, dark gray, wet, medium dense, (SC)	MIXED ALLUVIUM													
9½			13			5	SPT	17	116						
	LEAN CLAY WITH SAND: a little gravel, dark grayish brown, moist, firm to stiff, a few lenses of sand at 13' (CL)	GLACIAL TILL	8			6	SPT	18	114						
			12			7	SPT	19	112						
19½			24			8	SPT	16	120						
	LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, very stiff, (CL)	GLACIAL TILL	24			9	SPT								
			24												
31			21			10	SPT								
	Bottom of borehole at 31 feet.														

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20

WATER LEVEL MEASUREMENTS

START 12-9-20 COMPLETE 12-9-20 3:07 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-9-20	3:07 pm	31	--	15	10	3.25" ID Hollow Stem Auger
12-12-20	2:56 pm	31	--	14	6	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner



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GEOTECHNICAL TEST BORING LOG

GEOTEK # 20-K94

BORING NO. 5-7 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
					NO.	TYPE	WC	D	LL	PL	QU			
	SURFACE ELEVATION <u>1384.9 ft</u> 1 FILL, MOSTLY CLAYEY SAND: medium grained, dark brown, dry LEAN CLAY WITH SAND: a little gravel, brown and gray, moist, stiff, (CL)	FILL GLACIAL TILL				1	HSA							
			9			2	SPT	14	122					
			14			3	SPT	16	117					
			12			4	SPT	16	119					
			14			5	SPT	17	118					
12	SAND WITH SILT: a little gravel, fine to medium grained, brown, wet, medium dense, (SP-SM)	GLACIAL OUTWASH	11			6	SPT							
14½	LEAN CLAY WITH SAND: a little gravel, brown and dark gray, moist, stiff, (CL)	GLACIAL TILL	14			7	SPT							
16	Bottom of borehole at 16 feet.													

WATER LEVEL MEASUREMENTS

START 12-10-20 COMPLETE 12-10-20 8:12 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-10-20	8:15 am	16	--	13	none	3.25" ID Hollow Stem Auger
12-12-20	3:02 pm	16	--	12	▼ 12	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20



GEOTEK ENGINEERING & TESTING SERVICES, INC.
 909 E 50th St N
 Sioux Falls, South Dakota, 57104
 605-335-5512 Fax
 jhaskins@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **20-K94**

BORING NO. **5-8 (1 of 1)**

PROJECT **Proposed Treated Water Pipeline, Iowa Segments 4 & 5, Lewis & Clark Regional Water System, Hull to Sheldon, IA**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS									
					NO.	TYPE	WC	D	LL	PL	QU					
	↓ SURFACE ELEVATION <u>1382.0 ft</u>															
	LEAN CLAY: very dark brown to black, moist, stiff, (CL)	TOPSOIL			1	HSA										
4½			11		2	SPT	20	91								
	FAT CLAY: very dark brown, moist, stiff, (CH)	FINE ALLUVIUM	10		3	SPT	26	98								
7					4	SPT	28	98								
	LEAN CLAY WITH SAND: a trace of gravel, dark grayish brown, moist to wet, soft, (CL)	FINE ALLUVIUM	3													
9½					5	SPT	28									
	CLAYEY SAND: fine to medium grained, dark gray, wet, loose, (SC)	MIXED ALLUVIUM	8													
11					6	SPT										
	SAND: medium to coarse grained, brown, waterbearing, medium dense to dense, (SP)	COARSE ALLUVIUM	12													
16			18		7	SPT										
	Bottom of borehole at 16 feet.															

WATER LEVEL MEASUREMENTS

START 12-10-20 COMPLETE 12-10-20 9:52 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
12-10-20	10:04 am	16	--	13	11	3.25" ID Hollow Stem Auger
12-12-20	3:06 pm	16	--	10	9	
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GEOTECHNICAL TEST BORING LOG

DEPTH in FEET		DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS					
SURFACE ELEVATION <u>1390.9 ft</u>						NO.	TYPE	WC	D	LL	PL	QU	
9 1/2		SAND WITH SILT: a little gravel, medium to coarse grained, brown, dry to moist, medium dense, (SP-SM)	COARSE ALLUVIUM			1	HSA						
				13	2	SPT	8						
				14	3	SPT	5						
				12	4	SPT	8						
		9 1/2	LEAN CLAY WITH SAND: a little gravel, brown and dark gray, moist, stiff to very stiff, (CL)	GLACIAL TILL			5	SPT	15	121			
		17			6	SPT							
		17			7	SPT							
16		Bottom of borehole at 16 feet.											
WATER LEVEL MEASUREMENTS					START	<u>12-10-20</u>		COMPLETE	<u>12-10-20 10:45 am</u>				
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD							
12-10-20	10:48 am	16	--	11	8.5	3.25" ID Hollow Stem Auger							
12-12-20	3:13 pm	16	--	10	8								
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GEOTECHNICAL TEST BORING 20-K94.GPJ GEOTEKENG.GDT 12/16/20

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
<p>COARSE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE</p>	<p>GRAVEL AND GRAVELLY SOILS</p>	<p>CLEAN GRAVELS</p> <p>(LITTLE OR NO FINES)</p>		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	<p>SAND AND SANDY SOILS</p>	<p>CLEAN SANDS</p> <p>(LITTLE OR NO FINES)</p>		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
	<p>FINE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE</p>	<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT LESS THAN 50</p>		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT GREATER THAN 50</p>			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY	
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
<p>HIGHLY ORGANIC SOILS</p>				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BORING LOG SYMBOLS AND DESCRIPTIVE TERMINOLOGY

SYMBOLS FOR DRILLING AND SAMPLING

<u>Symbol</u>	<u>Definition</u>
Bag	Bag sample
CS	Continuous split-spoon sampling
DM	Drilling mud
FA	Flight auger; number indicates outside diameter in inches
HA	Hand auger; number indicates outside diameter in inches
HSA	Hollow stem auger; number indicates inside diameter in inches
LS	Liner sample; number indicates outside diameter of liner sample
N	Standard penetration resistance (N-value) in blows per foot
NMR	No water level measurement recorded, primarily due to presence of drilling fluid
NSR	No sample retrieved; classification is based on action of drilling equipment and/or material noted in drilling fluid or on sampling bit
SH	Shelby tube sample; 3-inch outside diameter
SPT	Standard penetration test (N-value) using standard split-spoon sampler
SS	Split-spoon sample; 2-inch outside diameter unless otherwise noted
WL	Water level directly measured in boring
▼	Water level symbol

SYMBOLS FOR LABORATORY TESTS

<u>Symbol</u>	<u>Definition</u>
WC	Water content, percent of dry weight; ASTM:D2216
D	Dry density, pounds per cubic foot
LL	Liquid limit; ASTM:D4318
PL	Plastic limit; ASTM:D4318
QU	Unconfined compressive strength, pounds per square foot; ASTM:D2166

DENSITY/CONSISTENCY TERMINOLOGY

<u>Density</u>	<u>Consistency</u>	
<u>Term</u>	<u>N-Value</u>	<u>Term</u>
Very Loose	0-4	Soft
Loose	5-8	Firm
Medium Dense	9-15	Stiff
Dense	16-30	Very Stiff
Very Dense	Over 30	Hard

PARTICLE SIZES

<u>Term</u>	<u>Particle Size</u>
Boulder	Over 12"
Cobble	3" – 12"
Gravel	#4 – 3"
Coarse Sand	#10 – #4
Medium Sand	#40 – #10
Fine Sand	#200 – #40
Silt and Clay	passes #200 sieve

DESCRIPTIVE TERMINOLOGY

<u>Term</u>	<u>Definition</u>
Dry	Absence of moisture, powdery
Frozen	Frozen soil
Moist	Damp, below saturation
Waterbearing	Pervious soil below water
Wet	Saturated, above liquid limit
Lamination	Up to ½" thick stratum
Layer	½" to 6" thick stratum
Lens	½" to 6" discontinuous stratum

GRAVEL PERCENTAGES

<u>Term</u>	<u>Range</u>
A trace of gravel	2-4%
A little gravel	5-15%
With gravel	16-50%