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TECHNICAL MEMORANDUM

To: David Skaleski, P.E.

From: Rachel Miller, P.E.

Dawn Edgell, P.E.

Date: September 9, 2024

Subject: **IDOT PTB 198-003**
Geotechnical Recommendations
I-80 Temporary Soil Retention System

This design memorandum presents recommendations for the proposed temporary soil retention system along I-80 near the Wheeler Avenue bridge in Joliet, Illinois. The purpose of this memorandum is to provide design recommendations to design the retaining system. GSG has completed soil borings at this proposed location as part of the I-80 over Des Plaines River Bridge project: IDOT PTB 198-003.

1. INTRODUCTION

Based on information provided by WSP, a TSRS (temporary soil retention system) is required along westbound I-80 near the Wheeler Avenue bridge. The dimensions of the temporary retaining wall are currently unknown.

Table 1 provides a list of the five (5) soil borings completed in this area that are being used for design of the temporary structure. The borings were completed within the I-80 median separating the eastbound and westbound lanes.

Table 1 – Boring Information

Boring	Northing	Easting	Ground Surface Elevation (ft)	Depth (ft)
TSRS-B-1	1764809.064	1047011.349	616.33	20.8*
TSRS-B-2	1764805.990	1046942.417	615.46	28.5**
TSRS-B-3	1764801.414	1046860.765	614.67	19.0*
TSRS-B-4	1764792.706	1046669.011	612.08	30.5**
TSRS-B-5	1764792.253	1046590.487	611.92	20.0*

*borings were terminated upon reaching auger refusal on bedrock

**includes a rock core

Copies of the soil boring logs are attached.

2. RECOMMENDATIONS

The surficial materials at each of the borings consisted of 2 inches of topsoil. The subsurface soil typically consisted of silty clay/silty clay loam fill materials to depths of about 2 to 3 feet (El. 613.3 to 609.1 feet). Below the fill, the borings encountered native, stiff to hard, brown and gray to gray silty clay to depths of 10.5 to 15.5 feet (El. 601.4 to 599.2 feet). The unconfined compressive strength of the native clay soils ranged from 1.5 to 5.0 tons per square foot (tsf). The silty clay soils were underlain by layers of medium dense to extremely dense sand, silt, and gravel to auger refusal on limestone bedrock at depths of 18 to 20.8 feet (El. 597.0 to 591.9 feet). The granular soils exhibited SPT N-values of 16 blows per foot (bpf) to 50 blows to drive the split spoon 3 inches.

Rock core samples were collected at two (2) of the soil boring locations. The bedrock cores generally consisted of brown and gray limestone, with slight to moderate weathering and high levels of fracturing. Photographs of the cores recovered and RQD values are included with each boring log in **Attachment 2**.

Water levels were checked in each boring to determine the general groundwater conditions present at the site and were measured while drilling and after each boring was completed. Groundwater was not encountered in the borings while drilling or immediately after drilling. It is assumed that the long-term groundwater is near or below the bedrock interface at depths of 18 to 20.8 feet (El. 597.0 to 591.9 feet). Water level readings were made in the boreholes at times and under conditions shown on the boring logs and stated in the text of this report. Long term observations in cased borings or piezometers would be necessary to more accurately evaluate the long-term groundwater conditions at the site. However, it should be noted that fluctuations in groundwater level may occur due to variations in rainfall, other climatic conditions, or other factors not evident at the time measurements were made and reported herein.

GSG determined the geotechnical parameters to be used for the project design based on the results of field and laboratory test data on individual boring logs as well as our experience. Unit weights, friction angles and shear strength parameters were estimated using standard penetration test (SPT) results for the cohesionless soils and in-situ and laboratory test results for cohesive soils. The SPT values were corrected for hammer efficiency and overburden pressure. Based on the field investigation data collected, generalized soil parameters for the soils for use in design are presented in **Tables 2a and 2b – Attachment 3.**

A. Surcharge Load

Traffic and other surcharge loads should be included in the retaining design as necessary. A live load surcharge shall be applied where vehicular load is expected to act on the surface of the backfill within a distance equal to one-half the wall height behind the back face of the wall in accordance with AASHTO 3.11.6.4. The live load surcharge may be estimated as a uniform horizontal earth pressure due to an equivalent height (H_{eq}) of soil. **Table 3** provides the equivalent heights of soils for vehicular loadings on retaining walls.

Table 3 - Equivalent Height of Soil for Vehicular Loading on Retaining Walls Parallel to Traffic

Retaining Wall Height (ft)	H_{eq} Distance from Wall Back face to Edge of Traffic	
	0 feet	**1.0 feet or Further**
5	5.0 feet	2.0 feet
10	3.5 feet	2.0 feet
≥20	2.0 feet	2.0 feet

Reference: AASHTO LRFD Table 3.11.6.4-2

B. Drainage Recommendations

GSG does not anticipate significant groundwater related issues during construction activity; however, water may become perched in the fill soils or within confined granular layers. If rainwater run-off or perched water is accumulated at the base of excavation, the contractor should remove accumulated water using conventional sump pit and pump procedures and maintain a dry and stable excavation. The location of the sump should be determined by the contractor based on field conditions. During earthmoving activities at the site, grading should be performed to ensure that drainage is maintained throughout the construction period. Water should not be allowed to accumulate in the foundation area either during or after construction. Undercut and excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater or surface run-off. Grades should be sloped away from the excavations to minimize runoff from entering.

C. Construction Requirements

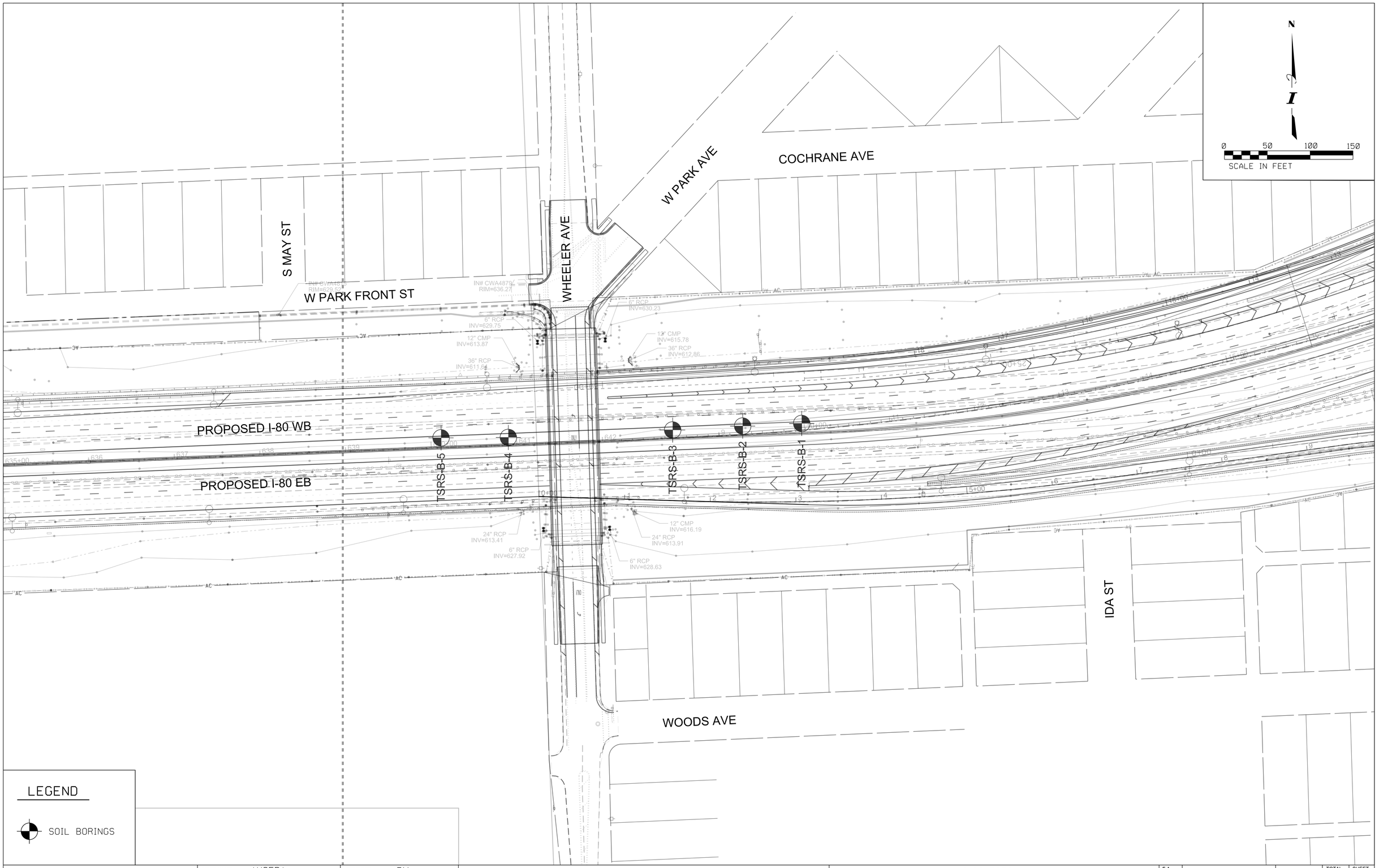
The temporary soil retention system should be designed in accordance with the IDOT Bridge Design Manual, Section 3.13.1, *Temporary Sheet Piling Design and Temporary Soil Retention Systems* and the IDOT Design Guide, Section 3.13.1, *Temporary Sheet Piling Design.* The design of the temporary soil retention system (TSRS) is the responsibility of the contractor. The contractor should submit the TSRS plans to the structural design team for review prior to commencing construction of the TSRS.

Attachments:

1. Soil Boring Location Plan
2. Soil Boring Logs
3. Tables 2a, 2b – Summary of Soil Parameters

ATTACHMENT 1

SOIL BORING LOCATION PLAN



LEGEND

SOIL BORINGS

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TIME = $TIME$
SHEET SIZE = $SHEETSIZE$
PLOT SCALE = $SCALE$
USER NAME = $USER$

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USER NAME	= $USER$	DESIGNED -	RM
SHEET SIZE	= $SHEETSIZE$	DRAWN -	NN
PLOT SCALE	= $SCALE$	CHECKED -	DE
PLOT DATE	= $DATE$	DATE -	08/19/2024

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

I-80 TSRS
SOIL BORING LOCATION PLAN
JOLIET, ILLINOIS

SCALE: 1:50 | SHEET 1 OF 1 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		WILL	1	1
		CONTRACT NO. PTB-198-003		
	ILLINOIS	FED. AID PROJECT		

ATTACHMENT 2

SOIL BORING LOGS

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 7/31/24

ROUTE I-80 **DESCRIPTION** TSRS **LOGGED BY** DV

SECTION C-91-109-22 **LOCATION** , **SEC.** 17, **TWP.** 35 N, **RNG.** 10 E,
Latitude , **Longitude**

COUNTY Will **DRILLING RIG** Diedrich D-70 ATV **HAMMER TYPE** Auto
DRILLING METHOD HSA **HAMMER EFF (%)** 93

STRUCT. NO.
Station

BORING NO. TSRS-B-1
Station
Offset
Ground Surface Elev. 616.33 **ft**

Surface Water Elev. N/A **ft**
Stream Bed Elev. N/A **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion N/A **ft**
After Hrs. N/A **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
2 inches of Topsoil 616.16							
Dark Brown, Moist FILL: SILTY CLAY, trace sand, trace gravel	5						
	5 5	1.5 P	18				
613.33							
Very Stiff Brown and Gray, Moist SILTY CLAY, trace gravel (CL/ML)	4						
	3 4	2.1 B	20	-25			
610.83							
Stiff to Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML)	3						
	3 4	1.9 B	22				
	3						
	3 5	2.1 B	15	-30			
-10							
	4						
	4 7	4.0 B	19				
	3						
	4 8	3.3 B	19	-35			
-15							
600.83							
Medium Dense Gray, Moist SILT, trace gravel, trace sand (ML)	5						
	8 8		18				
598.33							
Dense Brown, Dry SAND, medium to coarse grained, with gravel (SP)	3						
	14 31		4				
596.33 -20				-40			

Auger Refusal on Limestone
Bedrock at 20.75 feet
End of Boring

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 7/31/24

ROUTE I-80 **DESCRIPTION** TSRS **LOGGED BY** DV

SECTION C-91-109-22 **LOCATION** , **SEC.** 17, **TWP.** 35 N, **RNG.** 10 E,
Latitude , **Longitude**

COUNTY Will **DRILLING RIG** Diedrich D-70 ATV **HAMMER TYPE** Auto
DRILLING METHOD HSA **HAMMER EFF (%)** 93

STRUCT. NO.
Station

BORING NO. TSRS-B-2
Station
Offset
Ground Surface Elev. 615.46 **ft**

Surface Water Elev. N/A **ft**
Stream Bed Elev. N/A **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion N/A **ft**
After Hrs. N/A **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
0				2 inches of Topsoil 615.30
	6			Dark Brown, Moist FILL: SILTY CLAY LOAM, with sand, trace gravel
	5 6		16	
				612.46
	3			Stiff to Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML)
-5	3 4	1.9 B	22	
	4			
	4 4	2.7 B	14	
	3			
	5	2.8	17	
-10	4	P		
	4			
	4 6	3.1 B	21	
	3			
	4	3.8	20	
-15	6	B		
				599.96
	7			Very Dense Brown, Dry SAND, with gravel (SP)
	23 32		4	
				Auger Refusal on Limestone Bedrock at 18.5 feet 596.96
	50/4			
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Brown and Gray LIMESTONE, slightly weathered, highly fractured, trace clay at 19.5, 22.5, and 26 feet, some vugs
				Run 1: 18.5' - 28.5' Recovery: 83.8% RQD: 6.7% (Very Poor) *(continued)*
-25				
				586.96
				End of Boring
-30				
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

I-80 TSRS
Boring Number: TSRS-B-2
Will County, IL

Boring No.	Run	Depth (ft)	Recovery (%)	RQD (%)	RQD Classification	Description
TSRS-B-2	1	18.5'-28.5'	83.8	6.7	Very Poor	Brown and Gray Limestone Slightly Weathered, Highly Fractured, Trace Clay at 19.5, 22.5, and 26 feet, Some Vugs

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SOIL BORING LOG

Date 7/31/24

ROUTE I-80 **DESCRIPTION** TSRS **LOGGED BY** DV

SECTION C-91-109-22 **LOCATION** , **SEC.** 17, **TWP.** 35 N, **RNG.** 10 E,
Latitude , **Longitude**

COUNTY Will **DRILLING RIG** Diedrich D-70 ATV **HAMMER TYPE** Auto
DRILLING METHOD HSA **HAMMER EFF (%)** 93

STRUCT. NO.
Station

BORING NO. TSRS-B-3
Station
Offset
Ground Surface Elev. 614.67 **ft**

Surface Water Elev. N/A **ft**
Stream Bed Elev. N/A **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion N/A **ft**
After ____ **Hrs.** N/A **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
614.50				2 inches of Topsoil
	6			Dark Brown, Moist FILL: SILTY CLAY, trace sand, trace gravel
612.67	6 4	1.7 B	19	Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML)
	4			
-5	3 4	1.7 B	20	
609.17				Very Stiff to Hard Gray, Moist SILTY CLAY, trace gravel (CL/ML)
	3			
	6 7	5.0 B	17	
	4			
-10	5 7	3.8 B	20	
	4			
	6 8	4.0 B	19	
	3			
-15	5 6	4.2 B	20	
599.17				Extremely Dense Brown, Dry SAND, with gravel (SP)
	10			
	37 50/5		4	
596.67				Extremely Dense Gray, Dry GRAVEL, with sand (GP)
595.67	18			
	50/3		4	Auger Refusal on Limestone
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Bedrock at 19 feet End of Boring
-25				
-30				
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 8/1/24

ROUTE I-80 **DESCRIPTION** TSRS **LOGGED BY** DV

SECTION C-91-109-22 **LOCATION** , **SEC.** 17, **TWP.** 35 N, **RNG.** 10 E,
Latitude , **Longitude**

COUNTY Will **DRILLING RIG** Diedrich D-70 ATV **HAMMER TYPE** Auto
DRILLING METHOD HSA **HAMMER EFF (%)** 93

STRUCT. NO.
Station

BORING NO. TSRS-B-4
Station
Offset
Ground Surface Elev. 612.08 **ft**

Surface Water Elev. N/A **ft**
Stream Bed Elev. N/A **ft**

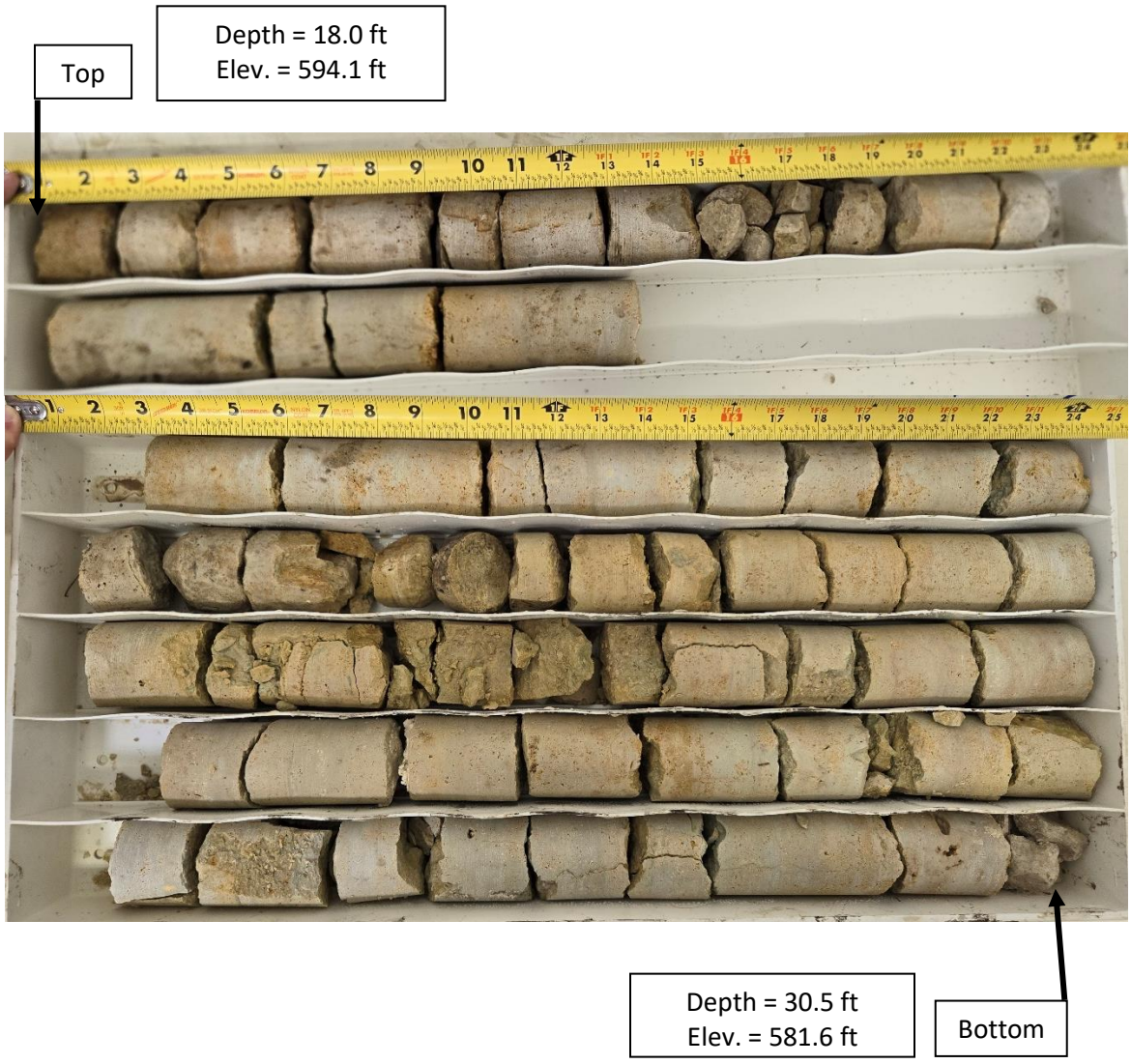
Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion N/A **ft**
After ____ **Hrs.** N/A **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
611.92				2 inches of Topsoil
	9			Dark Brown, Moist FILL: SILTY CLAY, with sand, trace gravel
	6 6		18	
609.08				
	3			Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML)
-5	3 4	3.1 B	19	
	2			
	5 5	2.9 B	21	
	2			
-10	4 5	2.9 B	22	
600.58	3			
	7 7		18	Medium Dense Gray, Moist SILT, trace gravel, trace sand (ML)
599.08				
	5			Dense to Extremely Dense Brown, Moist SAND, with gravel (SP)
-15	17 28		5	
	12			
	46 50/1		8	
594.08				Auger Refusal on Limestone Bedrock at 18 feet
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Brown and Gray LIMESTONE, slightly to moderately weathered, highly fractured, vertical fractures at 24 and 30 feet, trace clay at 19.5 feet, trace vugs
				Run 1: 18.0' - 30.5' Recovery: 100% RQD: 11.0 % (Very Poor) *(continued)*
-25				
-30				
581.58				End of Boring
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

I-80 TSRS
Boring Number: TSRS-B-4
Will County, IL



Boring No.	Run	Depth (ft)	Recovery (%)	RQD (%)	RQD Classification	Description
TSRS-B-4	1	18.0'-30.5'	100	11.0	Very Poor	Brown and Gray Limestone Slightly to Moderately Weathered, Highly Fractured, Vertical Fractures at 24 and 30 feet, Trace Clay at 19.5 feet, Trace Vugs

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 8/1/24

ROUTE I-80 **DESCRIPTION** TSRS **LOGGED BY** DV

SECTION C-91-109-22 **LOCATION** , **SEC.** 17, **TWP.** 35 N, **RNG.** 10 E,
Latitude , **Longitude**

COUNTY Will **DRILLING RIG** Diedrich D-70 ATV **HAMMER TYPE** Auto
DRILLING METHOD HSA **HAMMER EFF (%)** 93

STRUCT. NO.
Station

BORING NO. TSRS-B-5
Station
Offset
Ground Surface Elev. 611.92 **ft**

Surface Water Elev. N/A **ft**
Stream Bed Elev. N/A **ft**

Groundwater Elev.:
First Encounter Dry **ft**
Upon Completion N/A **ft**
After Hrs. N/A **ft**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
611.75				2 inches of Topsoil
	4			Stiff to Very Stiff Gray, Moist SILTY CLAY, trace gravel (CL/ML)
	4 4	2.3 B	18	
	3			
-5	3 5	1.5 B	19	
	3			
	4 5	2.3 B	21	
	2			
-10	4 7	2.1 B	19	
601.42				
	4			Medium Dense Gray, Moist SILT, with clay, trace gravel, trace sand (ML)
	8 7		20	
598.42				
	4			Very Dense to Extremely Dense Brown, Moist to Wet SAND, with gravel (SP)
	22 34		18	
-15				
	25			
	50/3		5	
593.92				
	19			Stiff Brown and Gray, Moist SILTY CLAY, with sand, little gravel (CL/ML)
	16 50/3	1.8 P	15	
591.92 -20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Auger Refusal on Limestone Bedrock at 20 feet End of Boring
-25				
-30				
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

ATTACHMENT 3

SUMMARY OF SOIL PARAMETERS

Table 2a: Summary of Soil Parameters – TSRS East (TSRS-B-1 through TSRS-B-3)

Depth ft (Elevation)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained		Lateral Earth Pressure Long-term/Drained			Parameters for p-y Curve Method		
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)	Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At Rest Earth Pressure Coefficient (K_o)	p-y Curve Type in LPile	Coefficient of Lateral Subgrade Modulus* (kpy, pci)	Horizontal Strain Factor (ε_{50})
0-2.5 (615.5-613)	Fill Dark Brown Silty Clay	136	1,600	0	160	25	0.41	2.46	0.58	Stiff Clay w/o Free Water	500	0.007
2.5-16.5 (613-599)	Brown and Gray to Gray Stiff to Hard Silty Clay	135	3,000	0	300	28	0.36	2.77	0.53	Stiff Clay w/o Free Water	1,000	0.005
16.5-19 (599-596.5)	Brown Dense to Very Dense Sand	142	0	42	0	42	0.20	5.04	0.33	Sand (Reese)	125	N/A
14.5-17 (601-598.5) **TSRS-B-1 only**	Gray Medium Dense Silt	128	0	34	0	34	0.28	3.53	0.44	Silt	90	N/A

*The initial p-y modulus, E_{py} , varies linearly with depth. To obtain E_{py} use the equation $E_{py} = k_{py} * z$, where k_{py} is the subgrade modulus given in the table and z is the distance from the surface to the center point of the layer in inches.

Table 2b: Summary of Soil Parameters – TSRS West (TSRS-B-4, TSRS-B-5)

Depth ft (Elevation)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained		Lateral Earth Pressure Long-term/Drained			Parameters for p-y Curve Method		
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)	Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At Rest Earth Pressure Coefficient (K_o)	p-y Curve Type in LPile	Coefficient of Lateral Subgrade Modulus* (kpy, pci)	Horizontal Strain Factor (ε_{50})
0-11 (612-601)	Gray Stiff to Very Stiff Silty Clay	132	2,400	0	240	28	0.36	2.77	0.53	Stiff Clay w/o Free Water	1,000	0.005
11-13 (601-599)	Gray Medium Dense Silt	129	0	34	0	34	0.28	3.53	0.44	Silt	90	N/A
13-18 (599-594)	Brown Dense to Extremely Dense Sand	143	0	45	0	45	0.17	5.82	0.29	Sand (Reese)	225	N/A
0-3 (612-609) **TSRS-B-4 only**	Fill Dark Brown Silty Clay	130	1,000	0	100	25	0.41	2.46	0.58	Stiff Clay w/o Free Water	500	0.007
18-20 (594-592) **TSRS-B-5 only**	Brown and Gray Stiff Silty Clay	137	1,800	0	180	28	0.36	2.77	0.53	Stiff Clay w/o Free Water	500	0.007