

# CORRESPONDENCE/MEMORANDUM

STATE OF WISCONSIN

Date: June 11, 1985

File Ref:

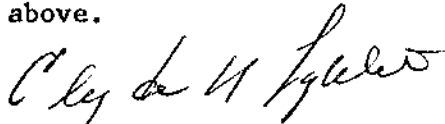
To: Mr. Thomas R. Clark, District Director

Attention: Mr. Louie Schmidt, District Chief Construction & Materials Engineer

From: Mr. G. H. Zuehlke, Chief Materials Engineer

Subject: MATERIALS  
SOILS  
SITE INVESTIGATION REPORT  
Project ID 8070-01-00  
USH 63 over Soo Line Railroad  
Structure B-55-103  
St. Croix County

We are attaching copies of a Site Investigation Report for the project noted above.



CNL:lcr

cc: District 6 (Original + 3)  
Bridge  
GHZ  
DLS  
MOF  
Soils File

SITE INVESTIGATION REPORT  
Project ID 8070-01-00  
USH 63 over Soo Line Railroad  
Structure B-55-103  
St. Croix County

1. General

Three borings have been made for the proposed structure carrying USH 63, Station 770 + 87, over the Soo Line Railroad. The data from the borings with our analyses of the data for foundation design is reported here.

The site is about  $\frac{1}{2}$  mile south of the intersection of USH 63 and STH 64 some 11 miles north of Baldwin. A new three-span bridge is planned to replace the existing three-span concrete structure. The approach fills are about 25 feet high and are in good condition. The general area is rolling farmland with surface soils of sands and gravel.

2. Subsurface Conditions

Standard Penetration Tests, AASHTO T-206, were made to estimate relative soil density, fix allowable bearing capacity, determine factors to guide in selection of pile type and assignment of pile support values, and lift specimens for soil textural identification and classification. Soil textures noted are driller's field identification.

The three borings were made from the existing roadway. A fourth boring for pier 2 was omitted since the soil and rock conditions were rather uniform and knowledge of local geology/soils indicated nothing would be gained from further interference with traffic on the existing structure.

For the abutments, borings 1 and 3 logged some 6 to 12 inches of asphalt surfacing at the roadway surface, elevation 1069±. Below this, loose to firm sand or silty sand fill material was logged down to elevation 1041±. Immediately beneath the fill, a zone of more silty soil was noted, but by elevation 1034± the soil is again very sandy with some gravel, largely of firm density. This firm sandy soil was logged down to elevation 1016± in Boring 1 and to 1012± in Boring 3. Below this either dense sands or highly weathered limestone was logged to elevation 1000± where hard dense limestone was noted.

Boring 2 was made through the existing bridge deck, logs 19 feet of air to elevation 1051±. Below this the soil was somewhat similar to the other two with very loose to dense sands above weathered limestone at elevation 1005±. The weathered zone extended down to elevation 995± where a harder, more dense rock was drilled. A 4-foot NQ core was cut from elevation 1086± to 1082± with 62.5% recovery. The weathered limestone was rather complex in its stratification with hard zones and zones of looser clayey or silty material.

At the time of drilling, no definitive water level readings were made. There were indications of both perched water with water ponding in ditches and also of very wet soil (water possibly) near elevation 1026±.

### 3. Bearing Capacity

The fill soils at abutments and soils at workable depths for footings at the piers are incompetent for bridge loads. This opinion is based on a cursory inspection only of the data.

### 4. Piles

The table below can be utilized in pile length computations:

<u>Elevation</u>	<u>File Skin Friction</u>		<u>End Bearing, psf</u>	
	(psf)	(SF=2)	(Displ. Piles)	(H-Piles)
Abutments:				
Surface to 1020±	200*		24,000	10,000
1020± to 1008±	250*		68,000	44,000
1008± to 995±	200		52,000	32,000
Below 995±		Erratic Refusal		
Pier:				
Surface to 1020±	200*		20,000	9,000
1020± to 1008±	250*		40,000	28,000
1008± to 995±	200		36,000	20,000
Below 995±		Erratic Refusal		

\*Increase 20% for treated timber.

### 5. Alternate Foundation Types

The silty sands to sands logged here can be improved by either vibratory methods such as Vibroflotation or by dynamic compaction to a capacity of 3 tsf. Two things detract from usage here. The first is both methods mentioned above are not suited to abutment fills near side or spill slopes. The second is that the amount of work is probably insufficient to recoup more in expense.

Drilled caissons in deep loose sands with erratic rock requiring hands-on inspection is not an attractive foundation type of this work.

### 6. Lateral Earth Pressures

The readily available sands or silty sands will exert an active earth pressure (equivalent fluid) of 30-35 psf on backwalls or other earth retention devices. This presumes adequate compaction (90% of AASHTO T-99 maximum density) and thorough drainage. A silt soil placed in a similar state will give 52-55 psf and a heavy clay will produce 80-85 psf.

If sheeting or bracing for pier excavation near the tracks is needed, a value of 6 or 7 times active pressure can be used for passive pressure.

## 7. Construction Problems

With the degree and irregularities of weathering evident in the limestone surface, twisting and drifting of piles can be expected along with erratic pile penetration for piles driven to rock. The usual clearance, notifications, and similar railroad structure problems will exist, of course.

## 8. Recommendations

Piles are the evident foundation units required for this structure. In the loose to firm sands, there is a good possibility that a pile will drive to a length of 20-25 diameters with increasing bearing with penetration for this length, then reach a nominal level of 20-30 tons, and exhibit no further increase until a harder dense stratum is reached. This possibility then makes a strong case for either treated timber piles driven to 25 tons/pile or steel H-piles driven to 10,000 psi in the steel section reaching the rock. The choice between these two types is one of economics and bridge loads or other structural considerations.

If treated timber is selected, a test pile should be driven at each unit before the piles are ordered down for the work. The plans should require these test piles to be 10 feet longer than the estimated lengths.

If no major grade changes are contemplated, the existing fill should be stable with no in-fill or foundation settlement. A zone of old topsoil was logged in Boring 1, but no problems are foreseen because of the long period of loading from the in-place fill.

FIELD BORING LOG

E-L-3(S)-8-76

State of Wisconsin/Department of Transportation

Boring No. 1 Structure Soap Line R.R. Over Pass County St. Croix Sheet 1 of 2

Project 8070-01-00 Road USH. "63"

Station 771 + 65 Offset 7' Lt E Surface Elevation 1008.9

GROUND WATER OBSERVATIONS

While drilling Time after drilling

Before casing removal Depth to water

After Boring Completed Depth to cave-in

Cave In Water Notes

MOISTURE  
D = Damp  
M = Moist  
W = Wet

WA = Washhead  
FT = Fish tail  
RB = Rock bit

ST = Shelby tube  
SS = Split spoon  
DM = Drilling mud

A = Auger  
C = Coring  
W = Wash

E = Easy  
M = Medium  
H = Hard

Start 4/17/85 Unit II

Finish Chief Meyers

Sample No.	Moisture	Blows on Sampler		Sample and Recovery	VISUAL FIELD CLASSIFICATION AND REMARKS	Unconfined Strength	Boulders	Blows on		Drilling Method
		0/6	6/12					Casing Size	Probe Size	
					6" Asphalt					
					Loose Br Med. SAND - Tr. Gravel. Tr. silt.					A
1	M	4	4					18		
		5						27		
								29		
					Firm Br Silty SAND - Tr. Fine Gravel. Tr. Clay.			35		
								42		
2	M	4	3					26		R.B. Should Report
		11								
3	M	17	30		5" Recovery Drove Rock.					
					Firm Br Med. SAND - Tr. silt.					
4	M	8	6							
		9								
					Loose Br. Silty SAND - Tr. Fine Gravel.					
5	M	3	2							
		5								
					Loose Gray SILT - Tr. <del>fine</del> Fine Sand. old. Topsail					
6	M	4	2							
		4								
					Firm Br. Silty SAND - Little Gravel.					
7	M	14	12							
		13								
8	M	6	5							
		8								

FIELD BORING LOG

E-L-3(S)- 8-76

State of Wisconsin/Department of Transportation

Boring No. 1 Structure Soo Line R.R. Overpass County St. Croix Sheet 2 of 2

Project 8070-01-00 Road USH. 63

Station 771+65 Offset 7' Lt E Surface Elevation 1068.9

GROUND WATER OBSERVATIONS

While drilling Time after drilling

Before casing removal Depth to water

After Boring Completed Depth to cave-in

Cave In Water Notes

MOISTURE  
D = Damp  
M = Moist  
W = Wet

WA = Washhead  
FT = Fish tail  
RB = Rock bit

ST = Shelby tube  
SS = Split spoon  
DM = Drilling mud

A = Auger  
C = Coring  
W = Wash

E = Easy  
M = Medium  
H = Hard

Start 4/17/85 Unit JT

Finish 4/17/85 Chief Mayals

Sample No.	Moisture	Blows on Sampler		Sample and Recovery	VISUAL FIELD CLASSIFICATION AND REMARKS	Unconfined Strength	Boulders	Blows on		Drilling Method
		0/6	6/12					Casing Size	Probe Size	
8	M	6	8	40'	Firm Br Silty SAND - Little Gravel	40				RA Biscuit Recess
9	M	10	5	45'		45				
10	M	10	5	50'		50				
11	M	24	17	55'	U. Dense Br Fine to Med SAND	55				
12	M	16	14	60'		60				
13	M	3	2	65'	Soft to Dense weathered Limestone like silty CLAY	65				
14	M	21	14	70'	Hard Layer	70				
				75'	ss. material	75				
				80'	End of Run	80				

Checked by Final Boring No.

## State of Wisconsin/Department of Transportation

Checked by	Final	Boring No.
		2

FIELD BORING LOG

E-L-3(S)-8-76

State of Wisconsin/Department of Transportation

Boring No. 2 Structure Soo Line R.R. Overpass County St. Croix Sheet 2 of 2

Project 8070-01-00 Road USH 63

Station 770+60 Offset 9' Nt E Surface Elevation 1069.3

GROUND WATER OBSERVATIONS

While drilling Time after drilling

Before casing removal Depth to water

After Boring Completed Depth to cave-in

Cave In Water Notes

MOISTURE D = Damp M = Moist W = Wet WA = Washhead FT = Fish tail RB = Rock bit DRILLING METHOD ST = Shelby tube SS = Split spoon DM = Drilling mud A = Auger C = Coring W = Wash E = Easy M = Medium H = Hard Start 4/18/85 Unit II Chief Mayers Finish

Sample No.	Moisture	Blows on Sampler		Sample and Recovery	VISUAL FIELD CLASSIFICATION AND REMARKS	Unconfined Strength	Boulders	Blows on		Drilling Method
		0/6	6/12					Casing Size	Probe Size	
4	M	8	9	40'	Firm Br. Alternating layers of SAND and Clayey SILT			2		R.B.
								4		Revert.
								5		
								4		
5	M	13	16	45'				7		
								12		
								18		
					Dense Br. Alternating layers of SAND and Clayey SILT			18		
								19		
6	M	23	26	50'				24		
								23		
								20		
								31		
								36		
7	M	26	29	55'	Dense white SAND			36		
								43		
								39		
								34		
								30		
8	M	16	16	60'	Dense			30		
								28		
								25		
								25		
9	W	5	3	65'	Soft Yellow Br. CLAY and SILT looks like weathered Limestone			22		
								20		
								21		
								23		
								23		
								26		
10	W	2	4	70'				25		
								28		
								30		
								33		
								39		
11	W	12	9	75'	Firm			22/14		R.B.
								36		Revert.
								52		
								69		
								53		
12	W	21	16	80'	Dense Yellow and Br. weathered Limestone			58		
								92		

Checked by Final Boring No. 2



FIELD BORING LOG

E-L-3(S)- 8-76

State of Wisconsin/Department of Transportation

Boring No. 2 Structure Soo Line RR. Overpass County St. Croix Sheet 3 of 3

Project 8070-01-00 Road US 63

Station 770+60 Offset 9' RT E Surface Elevation 6069.3

GROUND WATER OBSERVATIONS

While drilling \_\_\_\_\_ Time after drilling \_\_\_\_\_  
Before casing removal \_\_\_\_\_ Depth to water \_\_\_\_\_  
After Boring Completed \_\_\_\_\_ Depth to cave-in \_\_\_\_\_  
Cave In \_\_\_\_\_ Water Notes \_\_\_\_\_

MOISTURE

D = Damp  
M = Moist  
W = Wet

WA = Washhead  
FT = Fish tail  
RB = Rock bit

DRILLING METHOD

ST = Shelby tube  
SS = Split spoon  
DM = Drilling mud

A = Auger  
C = Coring  
W = Wash

E = Easy  
M = Medium  
H = Hard

Start 4/18/85 Unit 4H

Finish 4/24/85 Chief Meyers

Sample No.	Moisture	Blows on Sampler		Sample and Recovery	VISUAL FIELD CLASSIFICATION AND REMARKS	Unconfined Strength	Boulders	Blows on			Drilling Method
		0/6	6/12					Casing Size	Probe Size		
12	W	21	16	80'	Dense Yellow and Br weathered Limestone. lost all Revert. Cored 4' 62.5% Recovery. Limestone Roller Bit Drilled V. Hard	80'		150			RR. Blund. Rough.
				85							
				90							
				95							
				100							
				25							
				30							
				35							
				40							

Checked by

Final

Boring No.

2

Boring No. 3      Structure So Line RR. Overpass      County St. Croix      Sheet 1 of 2

Project 8070-01-00      Road USH. 63

Station 770 +12      Offset 7' Lt E      Surface Elevation 1069.1

GROUND WATER OBSERVATIONS

While drilling \_\_\_\_\_ Time after drilling \_\_\_\_\_

Before casing removal Used Revert Depth to water \_\_\_\_\_

After Boring Completed Couldnt tell Depth to cave-in \_\_\_\_\_

Cave In \_\_\_\_\_ Water Notes \_\_\_\_\_

MOISTURE      DRILLING METHOD      Start 4/25/85      Unit II

D = Damp      WA = Washhead      ST = Shelby tube      A = Auger      E = Easy

M = Moist      FT = Fish tail      SS = Split spoon      C = Coring      M = Medium

W = Wet      RB = Rock bit      DM = Drilling mud      W = Wash      H = Hard

Finish \_\_\_\_\_ Chief Meyers

Sample No.	Moisture	Blows on Sampler		Sample and Recovery	VISUAL FIELD CLASSIFICATION AND REMARKS	Unconfined Strength	Boulders	Blows on		Drilling Method
		0/6	5/12					3" Casing Size	Probe Size	
					Asphalt					A
					Loose Br Med to Coarse SAND -					
					Tr <del>Gravel</del>					
1	M		3	5	Silt	5		4		
		4	5					6		
								11		
								14		
								14		
								17		
2	M		4	10		10		9		R.B.
		4	5		Tr Gravel					Ahead Revert.
3	M		4			15				
		5	5							
4	M		1	20	Firm	20				
		5	9							
5	M		4	25		25				
		5	7							
					Loose Br. Silty SAND - Tr Firm Gravel					
6	M		3	30		30				
		4	4							
7	M		3	35		35				
		4	15							
					Firm Br alternating layers of SAND and SILT					
8	M		4	40		40				
		5	8							

# FIELD BORING LOG

E-L-3(S)-8-76

State of Wisconsin/Department of Transportation

Boring No. 3 Structure Soa Line RR Overpass County St. Croix Sheet 2 of 2

Project 8070-01-00 Road USH 63

Station 770 +12 Offset 7' Lt E Surface Elevation 1069.1

## GROUND WATER OBSERVATIONS

While drilling \_\_\_\_\_ Time after drilling \_\_\_\_\_  
Before casing removal \_\_\_\_\_ Depth to water \_\_\_\_\_  
After Boring Completed \_\_\_\_\_ Depth to cave-in \_\_\_\_\_  
Cave In \_\_\_\_\_ Water Notes \_\_\_\_\_

### MOISTURE

D = Damp  
M = Moist  
W = Wet

WA = Washahead  
FT = Fish tail  
RB = Rock bit

### DRILLING METHOD

ST = Shelby tube  
SS = Split spoon  
DM = Drilling mud

A = Auger  
C = Coring  
W = Wash

E = Easy  
M = Medium  
H = Hard

Start 4/25/85 Unit FT

Finish \_\_\_\_\_ Chief Mayers

Sample No.	Moisture	Blows on Sampler		Sample and Recovery	VISUAL FIELD CLASSIFICATION AND REMARKS	Unconfined Strength	Boulders	Blows on			Drilling Method
		0/6	6/12					Casing Size	Probe Size		
8	W	5	8	40'	Firm Br Alternating Layers of SAND and SILT						RB. Should Revert.
9	W	10	11	45'							
10	W	7	8	50'	Firm br. Med SAND - Tr Silt.						
11	W	6	8	55'							
12	W	8	11	60'	Firm to Dense Br and Yellow weathered Limestone						
13	W	3	5	65'	Loose Br. Sandy SILT - Tr Clay weathered Limestone						
14	W	2	4	70'	Hard Rock						
		50/1/2"		75'	No Recovery. Hard Rock						
				80'	End of Bore						

Checked by \_\_\_\_\_ Final \_\_\_\_\_ Boring No. 3