



## Minnesota Department of Transportation

### MEMO

Office of Materials  
Mailstop 645  
1400 Gervais Avenue  
Maplewood, MN 55109

**DATE:** June 18, 2009

**TO:** Peter Her, Final Design Project Manager  
Metro – Waters Edge

**FROM:** Gary Person, Foundations Engineer  
Geotechnical Section  
Foundations Unit

**PHONE:** 651-366-5598

**CONCUR:** Rich Lamb, Assistant Foundations Engineer  
Office of Materials

**SUBJECT:** S.P.6285-140  
3-Cable Guardrail for the Median of Interstate 694  
Located from I35W in Arden Hills to Rice Street in Shoreview  
Subsurface Investigation & Foundation Analysis

### **Project Description**

This report provides a summary of the subsurface investigation and foundation analysis to describe the soils that may be encountered when installing the proposed 3-cable guardrail system.

### **Field Investigation and Foundation Conditions**

Twenty-one cone penetration tests (CPT) were taken in April of 2009 by Mn/DOT's Foundation unit. CPT soundings were taken at designated termination points of the guardrail section. The attached map shows the location of the CPT soundings. A copy of the CPT soundings is included with this report.

Three SPT borings that were taken in July 1961, October 1985, and September 2001 are included. Their approximate location is shown on the attached map, but due to the method of locating borings historically, the plotted locations may be off by as much as 400'. The station offset shown on the logs, however, is typically accurate to the nearest foot. The information provided in these older borings should be used with the appropriate engineering judgment.

### **Foundation Analysis**

The CPT soundings were interpreted for a general soil behavior type and blow count. They were broken into significant soil layers by depth. No soil samples were taken, so the soil behavior type may not match exactly what soil is present,

but should indicate how it behaves if compared to standard soils. Undefined under interpreted soil behavior type simply means that the CPT programming was unable to determine a soil behavior type based on the available parameters.

ID	Location (I-94)	Depth (ft)	Interpreted Soil Behavior Type	Interpreted Blow Count (N <sub>60</sub> ) Range
72121 (c01)	0.17 miles north west of Rice Street on I-694	0-4	Undefined	10-40
		4-6	Gravelly Sand	40
		6-22	Sands	30-40
72122 (c02)	0.28 miles north west of Rice Street on I-694	0-7	Undefined	10-40
		7-22	Sands	20-40
72123 (c03)	0.3 miles north west of Rice Street on I-694	0-3	Undefined	10-40
		3-20	Sands	30-40
72124 (c04)	0.5 miles north west of Rice Street on I-694	0-4	Undefined	10-40
		4-11	Gravelly Sand	30-40
		11-14	Sands	10-30
		14-17	Gravelly Sand	10-40
72125 (c05)	0.6 miles north west of Rice Street on I-694	17-20	Sands	40
		0-4	Undefined	10-40
		4-7	Gravelly Sand	30-40
72126 (c06)	0.55 miles east of Victoria Street on I-694	7-20	Sands	30-40
		0-3	Undefined	10-40
		3-10	Very Stiff Sandy	20-40
		10-12	Sands	40
		12-17	Silt Mix	10-40
		17-18	Very Stiff Sandy	40
72127 (c07)	0.5 miles east of Victoria Street on I-694	18-20	Sands	40
		0-4	Undefined	10-40
		4-8	Gravelly Sand	30-40
		8-21	Gravelly Sand	20-40

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 Subsurface Investigation & Foundation Analysis  
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72128 (c08)	0.03 miles east of Victoria Street on I-694	0-5	Undefined	10-40
		5-8	Very Stiff Fine Gravel	20-40
		8-9	Clays	10
		9-21	Silt Mix	10-30
72129 (c09)	0.04 miles west of Victoria Street on I-694	0-3	Undefined	10-40
		3-5	Sands	40
		5-8	Very Stiff Fine Gravel	20-40
		8-13	Very Stiff Sandy	20-30
		13-16	Sands	40
		16-20	Very Stiff Sandy	20-40
72130 (c10)	0.1 miles west of Victoria Street on I-694	0-1	Undefined	0-40
		1-2	Very Stiff Sandy	20-30
		2-3	Undefined	10-40
72131 (c10a)	0.1 miles west of Victoria Street on I-694	0-1	Undefined	10
		1-3	Very Stiff Fine Gravel	10
		3-4	Sand Mix	10
		4-6	Very Stiff Fine Gravel	10-30
		6-15	Sand Mix	20-30
		15-21	Silt Mix	10-30
72132 (c10b)	0.1 miles west of Victoria Street on I-694	0-2	Undefined	10-40
		2-6	Very Stiff Fine Gravel	20-40
		6-7	Sands	20-30
		7-15	Sand Mix	10-30
		15-16	Very Stiff Fine Gravel	20-40
		16-21	Silt Mix	10-30
72133 (c11)	0.2 miles west of Victoria Street on I-694	0-1	Undefined	10-20
		1-5	Very Stiff sandy	20
		5-6	Very Stiff Fine Gravel	20
		6-7	Sands	10-20
		7-8	Very Stiff Fine Gravel	30
		8-12	Silt Mix	10-20
		12-21	Sand Mix	10-20
72134 (c12)	0.025 miles east of Lexington Avenue on I-694	0-4	Undefined	10-40
		4-6	Very Stiff Sandy	10-20
		6-21	Sand Mix	10-20

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72135 (c13)	0.03 miles west of Lexington Avenue on I-694	0-3	Undefined	10-40
		3-4	Very Stiff Sandy	30-40
		4-6	Undefined	40
		6-18	Sand Mix	10-20
		18-20	Silt Mix	10
72136 (c14)	0.2 miles east of Hamline Avenue on I-694	0-1	Undefined	10-20
		1-2	Very Stiff Sandy	20
		2-11	Very Stiff Fine Gravel	10-40
		11-18	Silt Mix	20-30
		18-21	Sand Mix	20-40
72138 (c15c)	0.27 miles east of I-35W on I-694	0-1	Undefined	10-30
		1-4	Very Stiff Sandy	30-40
		4-11	Very Stiff Fine Gravel	20-40
		11-13	Gravelly sand	30-40
		13-14	Sand Mix	20-40
		14-16	Very Stiff Fine Gravel	20-40
		16-18	Gravelly Sand	40
72139 (c16a)	0.25 miles east of I-35W on I-694	0-3	Undefined	10-40
		3-14	Very Stiff Fine Gravel	20-40
		14-15	Sands	30-40
		15-17	Gravelly Sand	40
		17-20	Silt Mix	10-40
		20-21	Clays	10-20
72140 (c17a)	0.07 miles east of I-35W on I-694	0-3	Undefined	40
		3-4	Very Stiff Sandy	30-40
		4-20	Very Stiff Fine Gravel	30-40
72141 (c18)	0.2 miles west of US Hwy 10 on I-694	0-1	Undefined	10-20
		1-2	Very Stiff Sandy	20
		2-10	Very Stiff Fine Gravel	20-40
		10-12	Sands	20-40
		12-16	Clays	20-40

72142 (c18a)	0.2 miles west of US Hwy 10 on I-694	0-1	Undefined	10-30
		1-2	Very Stiff Sandy	20-30
		2-11	Very Stiff Fine Gravel	20-40
		11-12	Sands	40
		12-15	Very Stiff Fine Gravel	10-40
		15-16	Sand Mix	20-40
		16-18	Gravelly Sand	40
		18-20	Very Stiff Fine Gravel	30-40
		20-21	Clays	10-30

Attachments:

Map of CPT Sounding and SPT Boring Locations  
CPT Soundings Logs Unique # 72157 to 72185  
SPT Boring Logs Unique # 3261, 53092, and 58979

cc: Glenn Engstrom  
Dave VanDeusen  
File

# SP# 6285-140 Guardrail



# SP# 6285-140 Guardrail

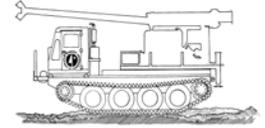


# SP# 6285-140 Guardrail



# SP# 6285-140 Guardrail





**USER NOTES, ABBREVIATIONS AND DEFINITIONS - Additional information available in Geotechnical Manual.**

This boring was made by ordinary and conventional methods and with care deemed adequate for the Department's design purposes. Since this boring was not taken to gather information relating to the construction of the project, the data noted in the field and recorded may not necessarily be the same as that which a contractor would desire. While the Department believes that the information as to the conditions and materials reported is accurate, it does not warrant that the information is necessarily complete. This information has been edited or abridged and may not reveal all the information which might be useful or of interest to the contractor. Consequently, the Department will make available at its offices, the field logs relating to this boring.

Since subsurface conditions outside each borehole are unknown, and soil, rock and water conditions cannot be relied upon to be consistent or uniform, no warrant is made that conditions adjacent to this boring will necessarily be the same as or similar to those shown on this log. Furthermore, the Department will not be responsible for any interpretations, assumptions, projections or interpolations made by contractors, or other users of this log.

Water levels recorded on this log should be used with discretion since the use of drilling fluids in borings may seriously distort the true field conditions. Also, water levels in cohesive soils often take extended periods of time to reach equilibrium and thus reflect their true field level. Water levels can be expected to vary both seasonally and yearly. The absence of notations on this log regarding water does not necessarily mean that this boring was dry or that the contractor will not encounter subsurface water during the course of construction.

- WH** ..... Weight of Hammer
- WR** ..... Weight of Rod
- Mud** ..... Drilling Fluids in Sample
- CS** ..... Continuous Sample

**SOIL/CORE TESTS**

- SPT N<sub>60</sub>** ..... ASTM D1586 Modified Blows per foot with 140 lb. hammer and a standard energy of 210 ft-lbs. This energy represents 60% of the potential energy of the system and is the average energy provided by a Rope & Cathead system.
- MC** ..... Moisture Content
- COH** ..... Cohesion
- γ** ..... Sample Density
- LL** ..... Liquid Limit
- PI** ..... Plasticity Index
- Φ** ..... Phi Angle
- REC** ..... Percent Core Recovered
- RQD** ..... Rock Quality Description (Percent of total core interval consisting of unbroken pieces 4 inches or longer)
- ACL** ..... Average Core Length (Average length of core that is greater than 4 inches long)
- Core Breaks** .... Number of natural core breaks per 2-foot interval.

- very loose ..... 0-4
- loose ..... 5-10
- medium dense ..... 11-24
- dense ..... 25-50
- very dense ..... >50

**Consistency - Cohesive Soils BPF**

- very soft ..... 0-1
- soft ..... 2-4
- firm ..... 5-8
- stiff ..... 9-15
- very stiff ..... 16-30
- hard ..... 31-60
- very hard ..... > 60

**COLOR**

- blk** ..... Black
- grn** ..... Green
- org** ..... Orange
- dk** ..... Dark
- IOS** ..... Iron Oxide Stained
- wht** ..... White
- brn** ..... Brown
- yel** ..... Yellow
- lt** ..... Light

**GRAIN SIZE /PLASTICITY**

- VF** ..... Very Fine
- F** ..... Fine
- Cr** ..... Coarse
- pl** ..... Plastic
- slpl** ..... Slightly Plastic

**SOIL/ROCK TERMS**

- C** ..... Clay
- L** ..... Loam
- S** ..... Sand
- Si** ..... Silt
- G** ..... Gravel (No. 10 Sieve to 3 inches)
- Bldr** ..... Boulder (over 3 inches)
- T** ..... till (unsorted, nonstratified glacial deposits)
- Lmst** ..... Limestone
- Sst** ..... Sandstone
- Dolo** ..... Dolostone
- wx** ..... weathered

**DISCONTINUITY SPACING**

- | Fractures  | Distance     | Bedding   |
|------------|--------------|-----------|
| Very Close | <2 inches    | Very Thin |
| Close      | 2-12 inches  | Thin      |
| Mod. Close | 12-36 inches | Medium    |
| Wide       | >36 inches   | Thick     |

**DRILLING SYMBOLS**

**WATER MEASUREMENT**

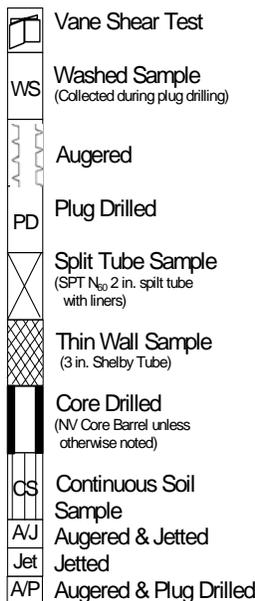
- AB** ..... After Bailing
- AC** ..... After Completion
- AF** ..... After Flushing
- w/C** ..... with Casing
- w/M** ..... with Mud
- WSD** ..... While Sampling/Drilling
- w/AUG** ..... with Hollow Stem Auger

**MISCELLANEOUS**

- NA** ..... Not Applicable
- w/** ..... with
- w/o** ..... with out
- sat** ..... saturated

**DRILLING OPERATIONS**

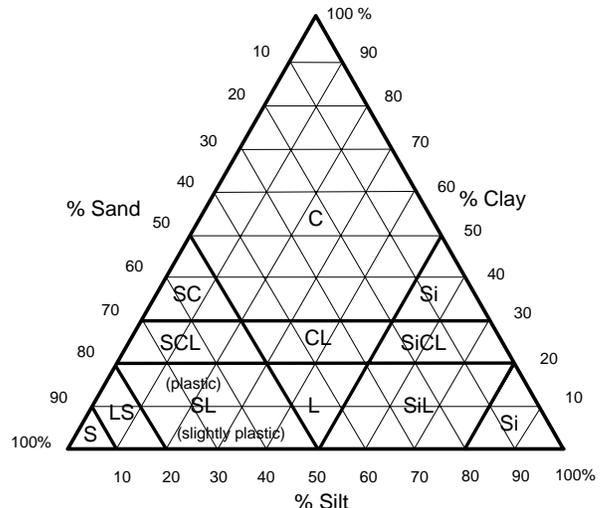
- AUG** ..... Augered
- CD** ..... Core Drilled
- DBD** ..... Disturbed by Drilling
- DBJ** ..... Disturbed by Jetting
- PD** ..... Plug Drilled
- ST** ..... Split Tube (SPT test)
- TW** ..... Thinwall (Shelby Tube)
- WS** ..... Wash Sample
- NSR** ..... No Sample Retrieved
- CS** ..... Continuous Soil Sample
- A/J** ..... Augered & Jetted
- Jet** ..... Jetted
- APV** ..... Augered & Plug Drilled



**RELATIVE DENSITY**

Compactness - Granular Soils BPF

**Mn/DOT Triangular Textural Soil Classification System**



MINNESOTA HIGHWAY DEPARTMENT  
 MATERIALS AND RESEARCH SECTION  
 LOG OF TEST BORINGS

Project: SP 6585-02 (T.H. 694)  
 Valentine Lake

Laboratory No.: FS 61548-8999

Vertical Scale: 1" = 5'

Machine : Soil Sampler  
 Supervisor: D. Nyquist  
 Operator : C. Hilgert

Resistance Sounding { Hammer 140 lbs.  
 Drop 30 in.  
 Blows per Foot Sampler 2 in O.D.

Boring No.: T-2 Date: 7-18-61  
 Location: STA 678+93, 435' LT of EB TH 694  
 Surface Elev.: 839.5

Boring No.: T-2 (Cont.) Date:  
 Location:  
 Surface Elev.:

Depth	Description	BPF
0		
	SANDY LOAM, slightly plastic, brown, moist and hard.	10
		6
		1
14.4	WATER TABLE	
		4
21		
	SAND, heavy and wet	2
		7
		10
35	Cont. Next Column	

Depth	Description	BPF
35	CLAY LOAM, red brown	
37		8
	Fine SAND, light brown	8
		10
53	SILTY CLAY LOAM, brown	16
54.5	Medium SAND, brown, Peat Layers	
56	PEAT, fib, dark brown, moist and soft	6
		8
64.5		
	pl. SANDY LOAM, grey	21
71.5	bottomed at elev. 818.0 in SANDY LOAM	

MINNESOTA TRANSPORTATION DEPARTMENT - OFFICE OF MATERIALS  
LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATIONUNIQUE NUMBER 53092

S.P. 6285	Bridge No. or Job Desc. 62824	T.H. 694	Boring No. T-1	Gnd. Elev. 954.2 ±
Location STA. <u>247+33.5, 37.0' W. of Lexington Ave (Inplace)</u>				LAB No. FS <u>4380</u> thru <u>4402</u>
Crossing <u>Lexington Ave / I-694 in Arden Hills, Shoreview</u>				
Drilling Completion 10/29/85	Test 140 lb. HAMMER w/ 30 inch DROP & 2 inch S.T.			3" TW
Supervisor J. Risteay	Operator K. Lundgren	Machine No. FORD CME 69793		

## Notes to Users of Laboratory Logs:

This boring was made by ordinary and conventional methods and with care deemed adequate for the State's design purposes. However, since this boring was not taken to gather information relating to the construction of the project, the data noted in the field and recorded may not necessarily be the same as that which a contractor would desire. Therefore, while the State believes that the information as to the conditions and material reported is accurate, it does not warrant that the information is necessarily complete. This log has been edited or abridged and may not reveal all information which might be useful or of interest to the contractor. (Field notes are available on request.) Since subsurface conditions outside of each individual test hole are unknown to the State and soil, rock and water conditions cannot be relied upon to be consistent or uniform, no warrant is made that conditions adjacent to this boring will necessarily be the same as shown on this log. Furthermore, the contractor shall accept complete responsibility for any interpretations, assumptions, projections or interpolations made by his organization, in using this boring log.

A notation regarding water has been made on this log. Individual water levels and levels of great divergence between logs should be used with discretion as the use of drilling fluids and drilling muds may seriously distort the true conditions. Also, it can be expected that water levels will vary from season to season and year to year.

Cohesion values followed by an asterisk were obtained from samples recovered with a thin-wall type sampler. All others are split-tube samples. Before these cohesion values are averaged or used in any computations, the original laboratory data sheets should be checked for any unusual factors which might have a bearing on the cohesion values; such as, high moisture content, high densities, cracks or stones in the original sample, etc. Data sheets are available in the Foundations Laboratory, Office of Materials. "Cohesions" are assumed to be 1/2 of the unconfined compressive strength.

SOIL TYPE		GRAIN SIZE		MISCELLANEOUS	
C	Clay	VF	Very Fine	Gnd	Ground
L	Loam	F	Fine	N/A	Not Applicable
org	Organic	M	Medium	w/	with
S	Sand	Cr	Coarse	w/o	without
SI	Silt			sat	Saturated
G	Gravel (No 10 sieve to 3")	<b>WATER MEASUREMENT</b>		<b>RELATIVE DENSITY</b>	
Bldr	Boulder (over 3")	AB	After Bailing	<b>GRANULAR SOIL:</b>	
or combination of the above such as S1CL		AC	After Completion	BPF	Compactness
<b>TESTS</b>		AF	After Flushing	0 - 4	V. Loose
BPF	Blows per Foot	WC	with Casing	5 - 10	Loose
MC	Moisture Content	WM	with Mud	11 - 24	M. Dense
COH	Cohesion, psf	WSD	While Sampling or Drilling	25 - 50	Dense
X <sub>d</sub>	Dry Density, pcf	or combination of the above such as WSD-WC		51 or more	V. Dense
Y	Wet Density pcf	<b>PLASTICITY</b>		<b>COHESIVE SOIL:</b>	
LL	Liquid Limit	pl	Plastic	BPF	Consistency
PI	Plastic Index	sipl	Slightly Plastic	0 - 1	V. Soft
PL	Plastic Limit	non-pl	Nonplastic	2 - 4	Soft
ORG	Organic Content	<b>OPERATION</b>		5 - 8	Firm
Hydro	Hydrometer Analysis	AUG	Augered	9 - 15	Stiff
DS	Direct Shear	CD	Core Drilled	16 - 30	V. Stiff
TriAx	Triaxial Compression	DBD	Disturbed by Drilling	31 - 60	Hard
<b>COLOR</b>		DBJ	Disturbed by Jetting	61 or more	V. Hard
blk	Black	PD	Plug Drilled	<b>GEOLOGICAL TERMS</b>	
bwn	Brown	ST	Split Tube	wx	Weathered
gr	Gray	TW	Thin Wall	Lmst	Limestone
grn	Green	WS	Wash Sample	Dolo	Dolomite
wht	White	NSR	No Sample Retrieved	Sst	Sandstone
yel	Yellow	WH	Weight of Hammer	RQD	Percent of total cored interval consisting of unbroken pieces 4 inches or longer. Unnatural breaks caused by drilling are disregarded.
los	Iron Oxide Stains	WR	Weight of Rod	<b>OTHER (EXPLAIN)</b>	
lt	Light	DM	Drilling Mud	T Till; This is ONLY a textural classification and DOES NOT NECESSARILY indicate an unsorted, nonstratified glacially deposited material.	
dk	Dark	(Other colors are not abbreviated)			

Mn/DOT TP24595 (1-80)

DEPTH (1"=2.5')

NOTE: This log is not complete if heading sheet is not attached.

Depth	SOIL CLASSIFICATION	Color	Moisture Condition	BPF	MC (%)	COH (psf)	DENSITY		LL PI	Si C	OTHER TESTS
							R	R			
0	LS			7	NSR						
5	sl. pl. FSL	bwn.		8	32						
5.5											
10	CLT w/sl. pl. SiL seams @ 7.5' & 10.0'	bwn. w/ red- bwn.	Moist	18	18						
9				9	NSR						
15				9	18						
16	Mixed C & ashes?	gr. & blk.									
17	sl. pl. SiL	lt. bwn w/ dk. bwn.		15	30						
18.5											
20	CLT	gr. w/bwn.		18	18						
25		I.O.S. from 21.5' to 25.5'	Damp	25	16						
25	CONT'D ON NEXT SHEET			28	17						

Mn/DOT TP24595 (1-80)

DEPTH (1"=2.5')

NOTE: This log is not complete if heading sheet is not attached.

Depth	SOIL CLASSIFICATION	Color	Moisture Condition	BPF	MC (%)	COH (psf)	DENSITY		LL PI	Si C	OTHER TESTS
							$\rho_r$	$\rho$			
25	CLT	gr. w/ bwn.	Damp								
26				26	19						
27				21	17						
28				20	17						
34.6		red-bwn.									
35	Refusal @ 35.5' FS	gr-bwn.	Sat.	15	19						
37.8	Water measurement @ 38.6' AC w/AUG.										
40	CLT			25	17						
41				34	16						
42			gr. Moist	30	17						
43				34	15						
49.4	sl. pl. SLT	red-bwn.		50	9						

Mn/DOI IP24595 (1-8U)

DEPTH (1"=2.5')

NOTE: This log is not complete if heading sheet is not attached.

Depth	SOIL CLASSIFICATION	Color	Moisture Condition	BPF	MC (%)	COH (psf)	DENSITY		LL PI	Si C	OTHER TESTS
							$\rho_r$	$\rho$			
50											
55	sl. pl. SLT	red-bwn.	Moist	36	10						
60				70	10						
62.5											
65	LFS	bwn.		75/6	7						
67											
70	sl. pl. FSLT	Dk. bwn.		36	10						
74	S+G	bwn.	Damp								
75	CONT'D ON NEXT SHEET			60	3						

MINNESOTA DEPARTMENT OF TRANSPORTATION - OFFICE OF MATERIALS  
LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

By: DB RR  
Lab Desc. Graphic Log Rock Desc.

Sheet 5 of 5

S.P. 6285 Bridge No. 62824 T.H. 694 Boring No. T-1 Gnd. Elev. 954.2 ±

Depth	SOIL CLASSIFICATION	Color	Moisture Condition	BPF	MC (%)	COH (psf)	DENSITY		LL	SI	OTHER TESTS
							$\gamma_d$	$\gamma$			
75	S 4 G End boring @ 75.5' Elev. 878.7 ±	bwn.	Damp								
80											
85											
90											
95											
100											

Mn/DOT 1P24595 (1-80)

DEPTH (1"=2.5')

NOTE: This log is not complete if heading sheet is not attached.

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION  
 LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

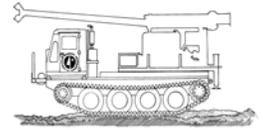


**UNIQUE NUMBER 58979**  
 U.S. Customary Units

State Project <b>6285-125</b>		Bridge No. or Job Desc. <b>Piezo</b>		Trunk Highway/Location <b>Interstate Highway 694</b>		Boring No. <b>T1P</b>		Ground Elevation <b>908.0 (Surveyed)</b>		
Location <b>SW quad. of Rice St. and 694</b>						Drill Machine <b>92730 Failing 1500 4x4</b>		SHEET 1 of 1		
Ramsey Co. Coordinate: X=571277 Y=192827 (ft.)						Hammer <b>Mobile Auto Calibrated</b>		Drilling Completed <b>9/18/01</b>		
Latitude (North)=45°02'43.32" Longitude (West)=93°06'27.32"										
DEPTH	Depth	Lithology	Classification	Drilling Operation	SPT	MC	COH	γ	Soil	Other Tests
	Elev.				N <sub>60</sub>	(%)	(psf)	(pcf)		Or Remarks
					REC	RQD	ACL	Core	Rock	Formation
					(%)	(%)	(ft)	Breaks		or Member
	2.0 906.0	LS, dk bm & damp				4				
5		FS & S, lt gray-brn & damp			12	3				
					10	3				
10					13	4				
					13	4				
15	15.5 892.5	S, brn & moist			16	4				
		S w/ trace slpl FSL, trace slorg slpl SL; brn w/ blk; sat			24	6				
19.0	889.0				22	19				
20					20	20				
25	25.0 883.0				9	21				
Bottom of Hole - 25.0' Water measured at 19.0' with auger										



# Minnesota Department of Transportation Geotechnical Section Cone Penetration Test Index Sheet 1.0 (CPT 1.0)



## USER NOTES, ABBREVIATIONS AND DEFINITIONS

This Index sheet accompanies Cone Penetration Test Data. Please refer to the Boring Log Descriptive Terminology Sheet for information relevant to conventional boring logs.

This Cone Penetration Test (CPT) Sounding follows ASTM D 5778 and was made by ordinary and conventional methods and with care deemed adequate for the Department's design purposes. Since this sounding was not taken to gather information relating to the construction of the project, the data noted in the field and recorded may not necessarily be the same as that which a contractor would desire. While the Department believes that the information as to the conditions and materials reported is accurate, it does not warrant that the information is necessarily complete. This information has been edited or abridged and may not reveal all the information which might be useful or of interest to the contractor. Consequently, the Department will make available at its offices, the field logs relating to this sounding.

Since subsurface conditions outside each CPT Sounding are unknown, and soil, rock and water conditions cannot be relied upon to be consistent or uniform, no warrant is made that conditions adjacent to this sounding will necessarily be the same as or similar to those shown on this log. Furthermore, the Department will not be responsible for any interpretations, assumptions, projections or interpolations made by contractors, or other users of this log.

Water pressure measurements and subsequent interpreted water levels shown on this log should be used with discretion since they represent dynamic conditions. Dynamic Pore water pressure measurements may deviate substantially from hydrostatic conditions, especially in cohesive soils. In cohesive soils, water pressures often take extended periods of time to reach equilibrium and thus reflect their true field level. Water levels can be expected to vary both seasonally and yearly. The absence of notations on this log regarding water does not necessarily mean that this boring was dry or that the contractor will not encounter subsurface water during the course of construction.

### CPT Terminology

CPT ..... Cone Penetration Test  
 CPTU ..... Cone Penetration Test with Pore Pressure measurements  
 SCPTU ..... Cone Penetration Test with Pore Pressure and Seismic measurements  
 Piezocone... Common name for CPTU test

(Note: This test is not related to the Dynamic Cone Penetrometer DCP)

### q<sub>t</sub> TIP RESISTANCE

The resistance at the cone corrected for water pressure. Data is from cone with 60 degree apex angle and a 10 cm<sup>2</sup> end area.

### f<sub>s</sub> SLEEVE FRICTION RESISTANCE

The resistance along the sleeve of the penetrometer.

### FR Friction Ratio

Ratio of sleeve friction over corrected tip resistance.

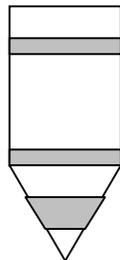
$$FR = f_s/q_t$$

### V<sub>s</sub> Shear Wave Velocity

A measure of the speed at which a seismic wave travels through soil/rock.

### PORE WATER MEASUREMENTS

Pore water measurements reported on CPT Log are representative of water pressures measured at the U2 location, just behind the cone tip, prior to the sleeve, as shown in the figure below. These measurements are considered to be dynamic water pressures due to the local disturbance caused by the cone tip. Dynamic water pressure decay and Static water pressure measurements are reported on a Pore Water Pressure Dissipation Graph.



U2

### SBT SOIL BEHAVIOR TYPE

Soil Classification methods for the Cone Penetration Test are based on correlation charts developed from observations of CPT data and conventional borings. Please note that these classification charts are meant to provide a guide to Soil Behavior Type and should not be used to infer a soil classification based on grain size distribution.

The numbers corresponding to different regions on the charts represent the following soil behavior types:

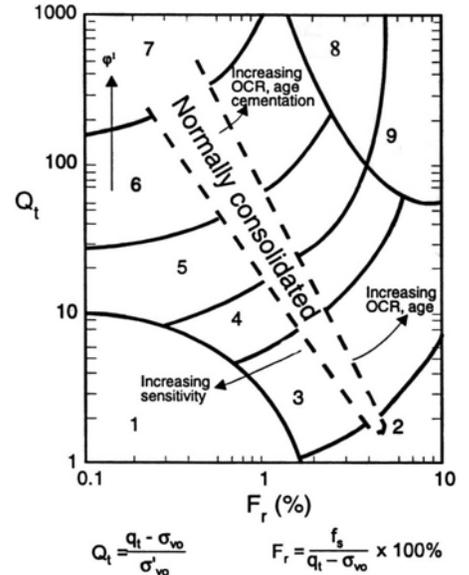
1. Sensitive, Fine Grained
2. Organic Soils - Peats
3. Clays - Clay to Silty Clay
4. Silt Mixtures - Clayey Silt to Silty Clay
5. Sand Mixtures - Silty Sand to Sandy Silt
6. Sands - Clean Sand to Silty Sand
7. Gravelly Sand to Sand
8. Very Stiff Sand to Clayey Sand
9. Very Stiff, Fine Grained

Note that engineering judgment, and comparison with conventional borings is especially important in the proper interpretation of CPT data in certain geo-materials.

The following charts are used to provide a Soil Behavior Type for the CPT Data.

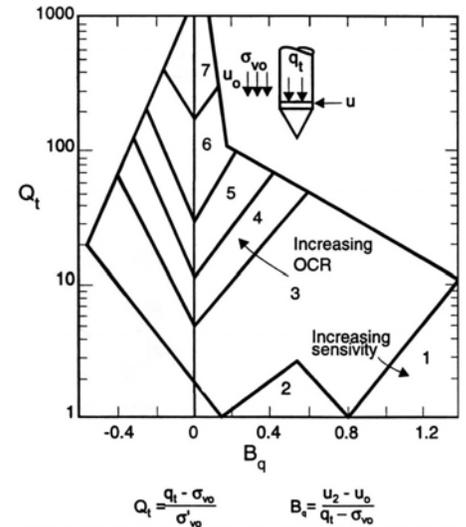
### Robertson CPT 1990

Soil Behavior type based on friction ratio



### Robertson CPTU 1990

Soil Behavior type based on pore pressure



where ...

- QT ..... normalized cone resistance
- Bq ..... pore pressure ratio
- Fr ..... Normalized friction ratio
- σ<sub>vo</sub> ..... overburden pressure
- σ' <sub>vo</sub> ..... effective over burden pressure
- u<sub>2</sub> ..... measured pore pressure
- u<sub>0</sub> ..... equilibrium pore pressure

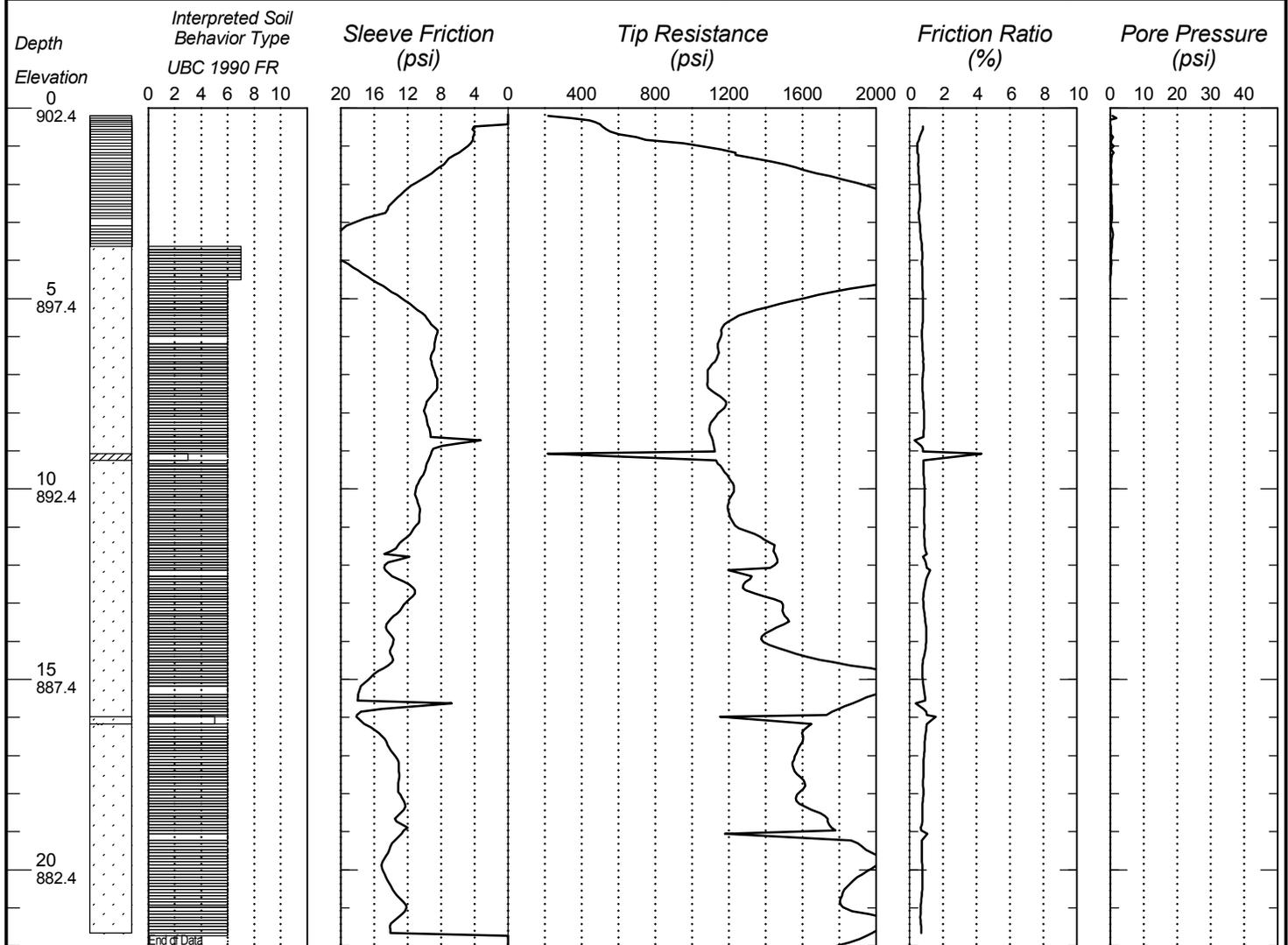
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72121**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c01</b>	Ground Elevation <b>902.4 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=570899 Y=193257</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°02'47.58" Longitude (West)=93°06'32.57"			CPT Operator <b>Iueck</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/2/09</b>



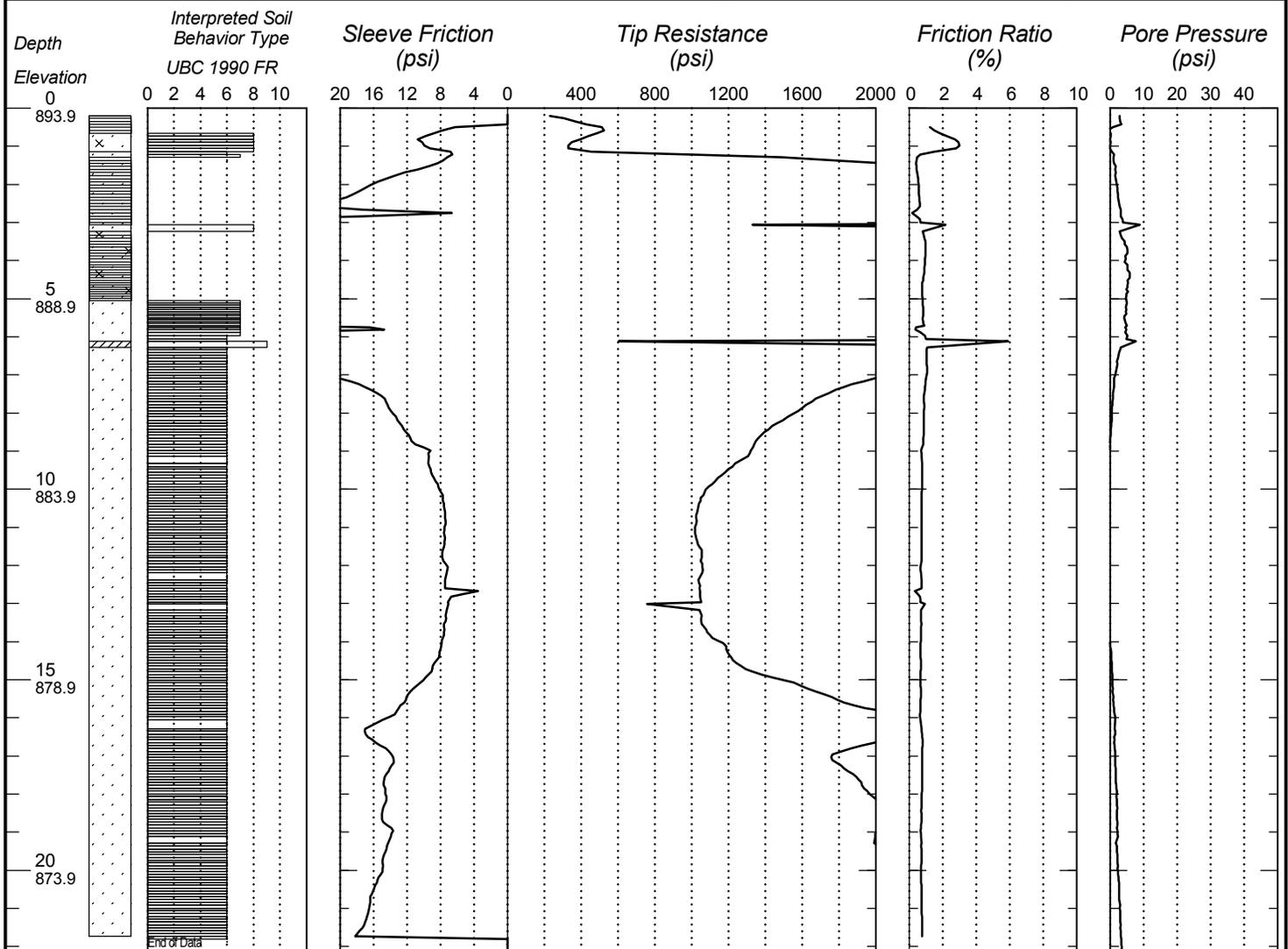
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

CONE PENETRATION TEST RESULTS  
**UNIQUE NUMBER 72122**

U.S. Customary Units



State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c02</b>	Ground Elevation <b>893.9 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=570441 Y=193635</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°02'51.33" Longitude (West)=93°06'38.93"			CPT Operator <b>Iueck</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/2/09</b>



Bottom of Hole 22.17

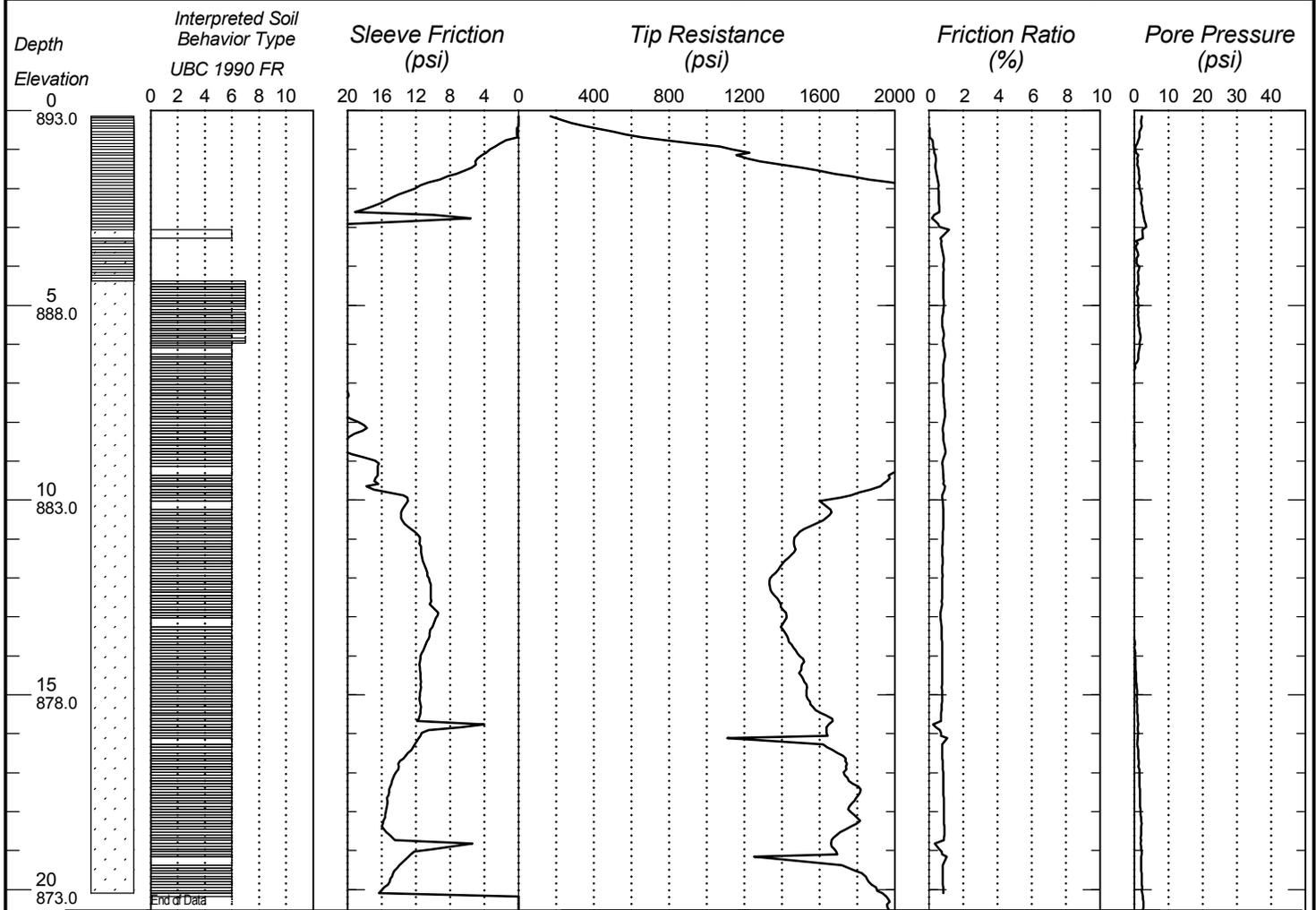
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72123**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c03</b>	Ground Elevation <b>893.0 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=570279 Y=193766 (ft.)</b>		CPT Machine		<b>SHEET 1 of 1</b>
Latitude (North)=45°02'52.63" Longitude (West)=93°06'41.17"		CPT Operator <b>Iueck</b>		Date Completed
No Station-Offset Information Available		Hole Type <b>CPT-STD</b>		<b>4/2/09</b>



Bottom of Hole 20.53

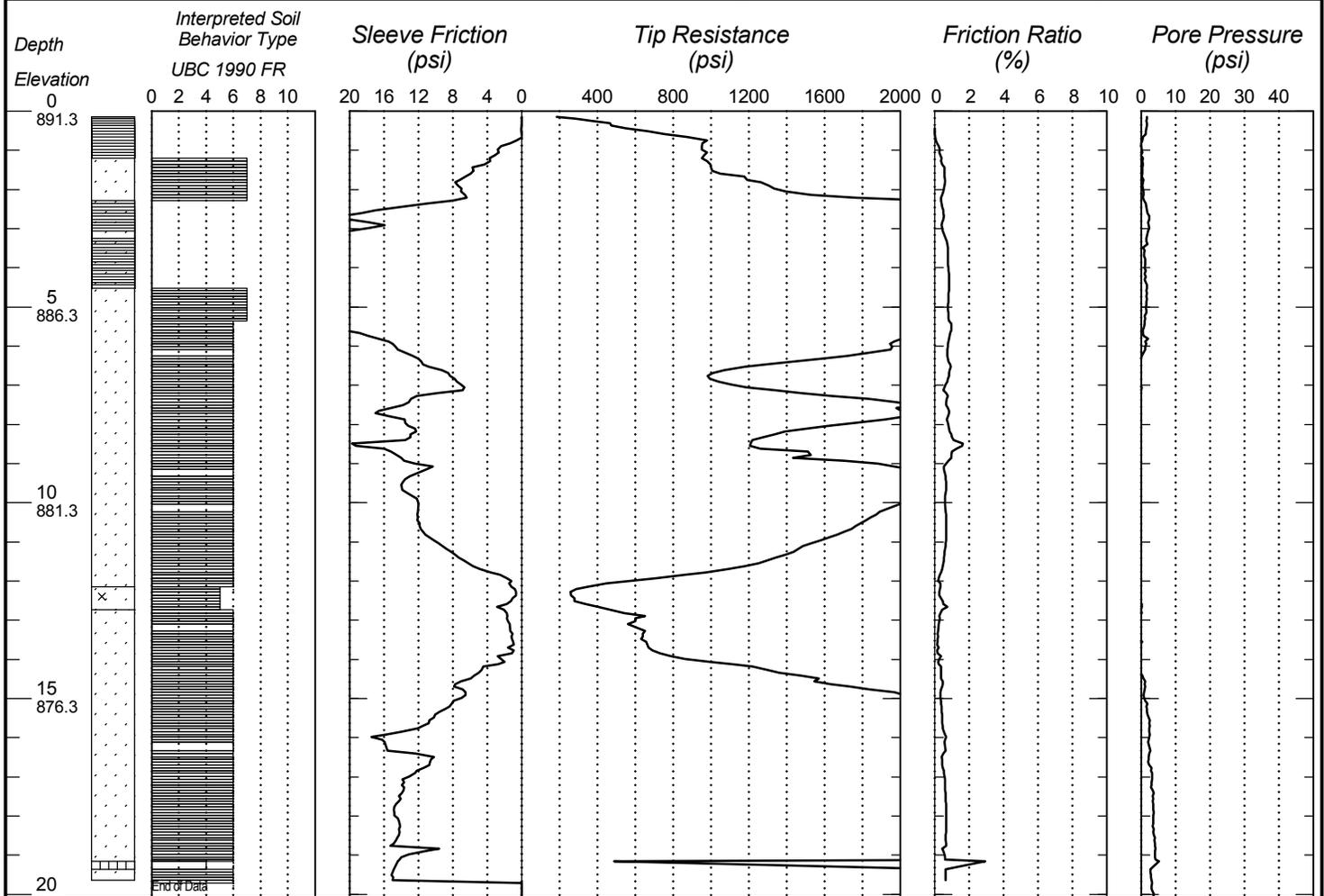
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72124**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c04</b>	Ground Elevation <b>891.3 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=569507 Y=194457 (ft.)</b>		CPT Machine		<b>SHEET 1 of 1</b>
Latitude (North)=45°02'59.47" Longitude (West)=93°06'51.90"		CPT Operator <b>Iueck</b>		Date Completed
No Station-Offset Information Available		Hole Type <b>CPT-STD</b>		<b>4/2/09</b>



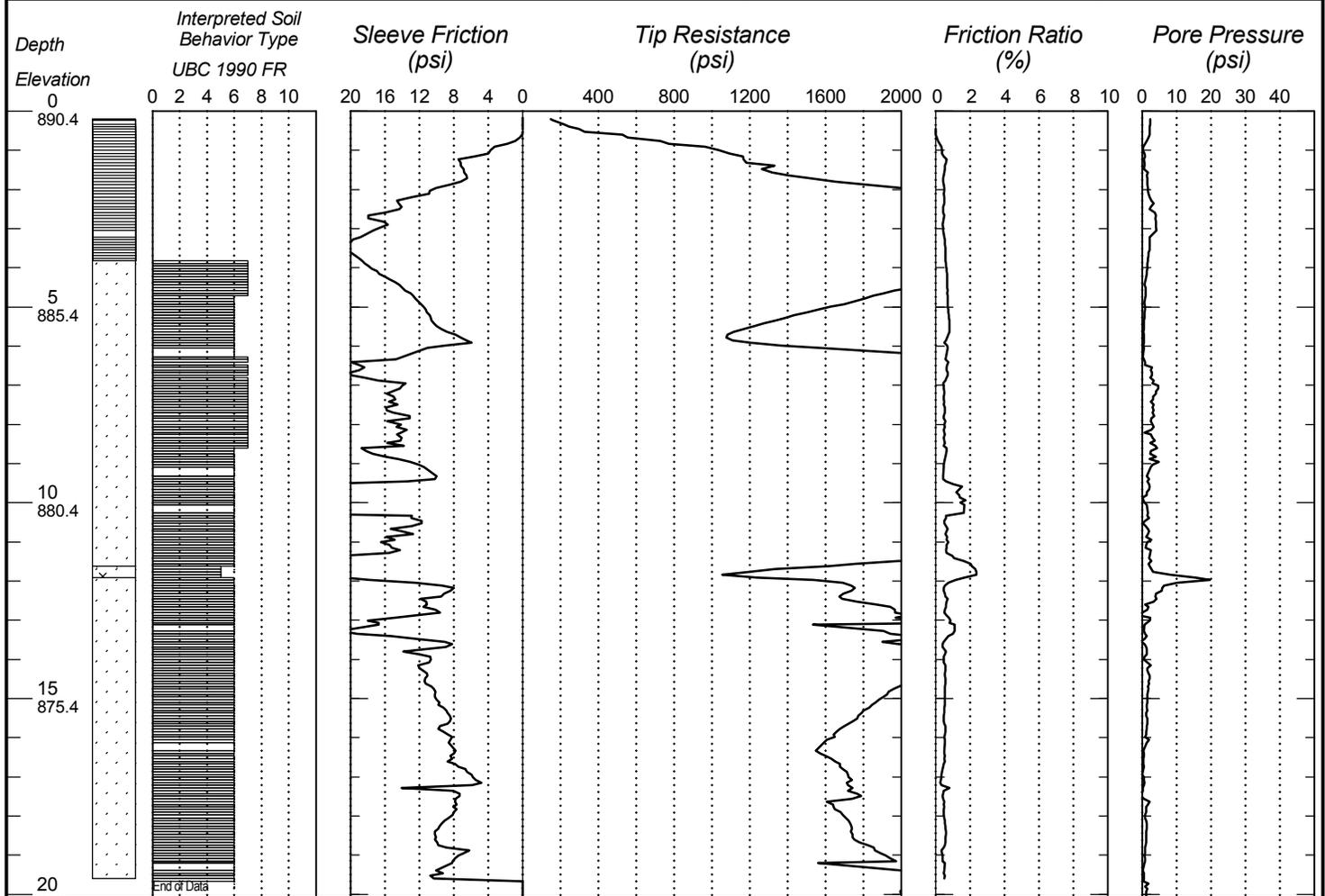
Bottom of Hole 20.07



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72125**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c05</b>	Ground Elevation <b>890.4 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=569138 Y=194816</b> (ft.)		CPT Machine		<b>SHEET 1 of 1</b>
Latitude (North)=45°03'03.03" Longitude (West)=93°06'57.02"		CPT Operator <b>Iueck</b>		Date Completed
No Station-Offset Information Available		Hole Type <b>CPT-STD</b>		<b>4/2/09</b>



Bottom of Hole 20.07

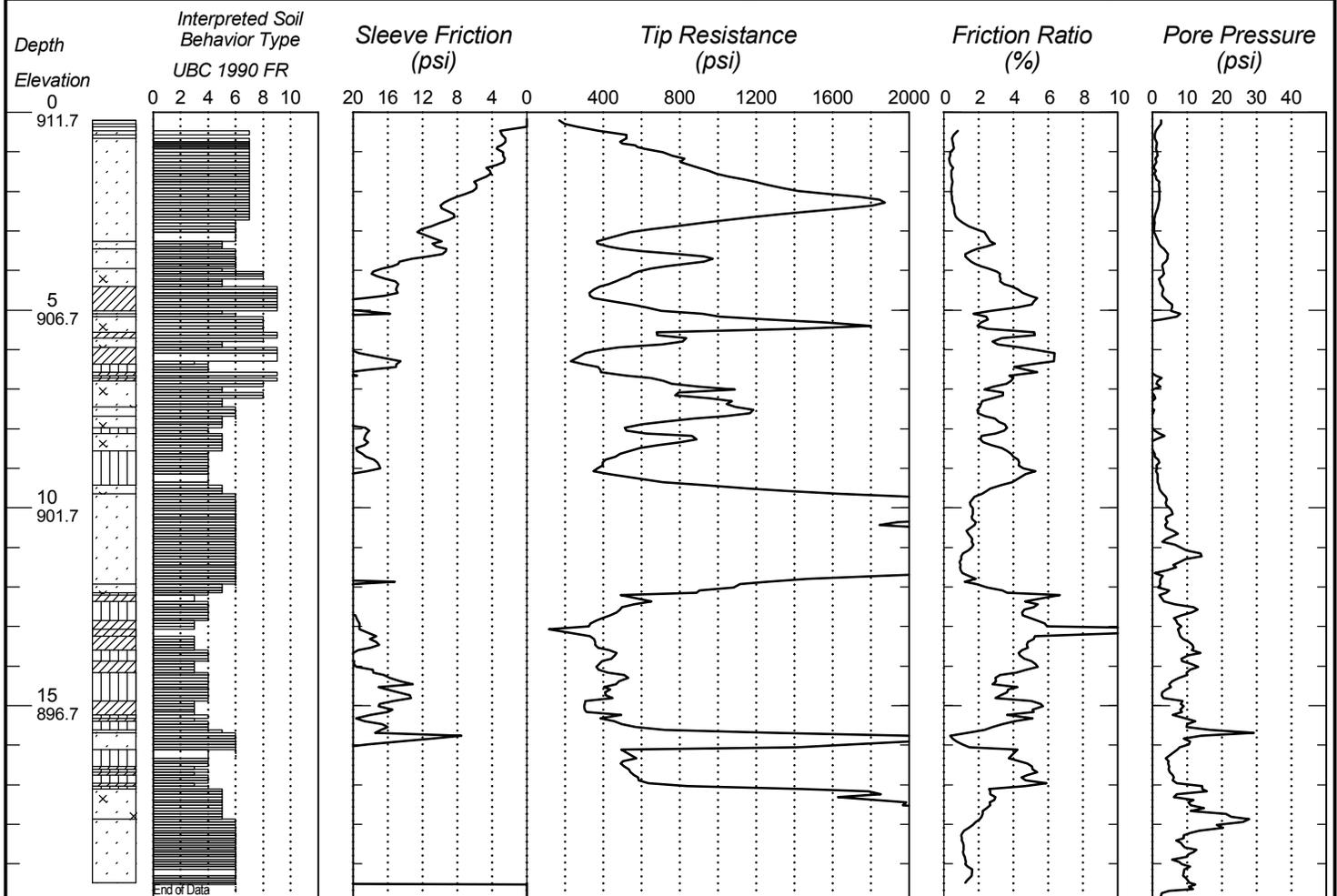
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72126**

U.S. Customary Units



State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c06</b>	Ground Elevation <b>911.7 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=567871 Y=195777</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°03'12.56" Longitude (West)=93°07'14.62"			CPT Operator <b>Iueck</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/2/09</b>



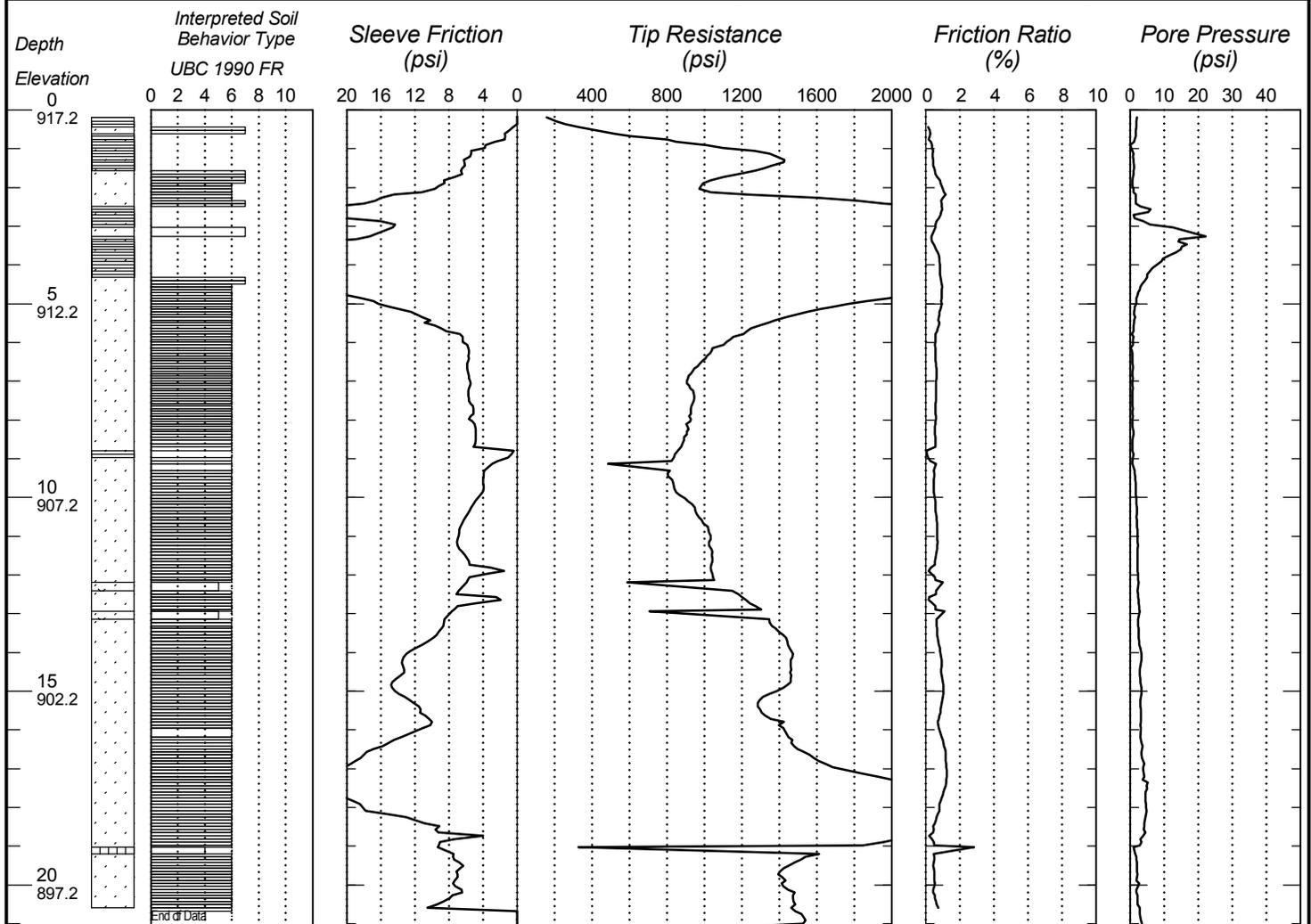
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72127**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c07</b>	Ground Elevation <b>917.2 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=567709 Y=195865 (ft.)</b>		CPT Machine		<b>SHEET 1 of 1</b>
<b>Latitude (North)=45°03'13.43" Longitude (West)=93°07'16.88"</b>		CPT Operator <b>Iueck</b>		Date Completed
No Station-Offset Information Available		Hole Type <b>CPT-STD</b>		<b>4/2/09</b>



Bottom of Hole 21.05

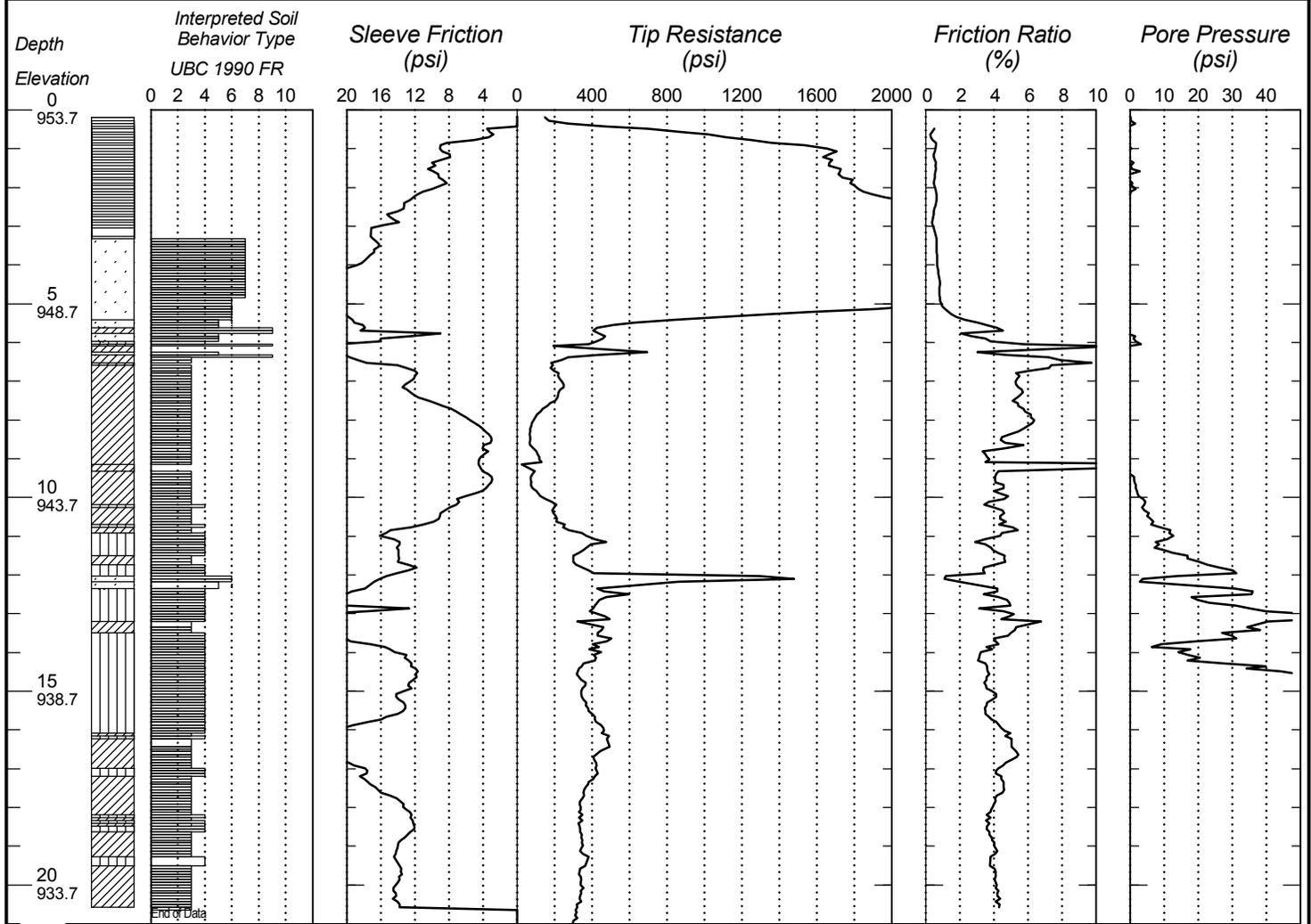
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72128**

U.S. Customary Units



State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c08</b>	Ground Elevation <b>953.7 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=565272 Y=196712</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°03'21.87" Longitude (West)=93°07'50.79"			CPT Operator <b>Iueck</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/2/09</b>



Bottom of Hole 21

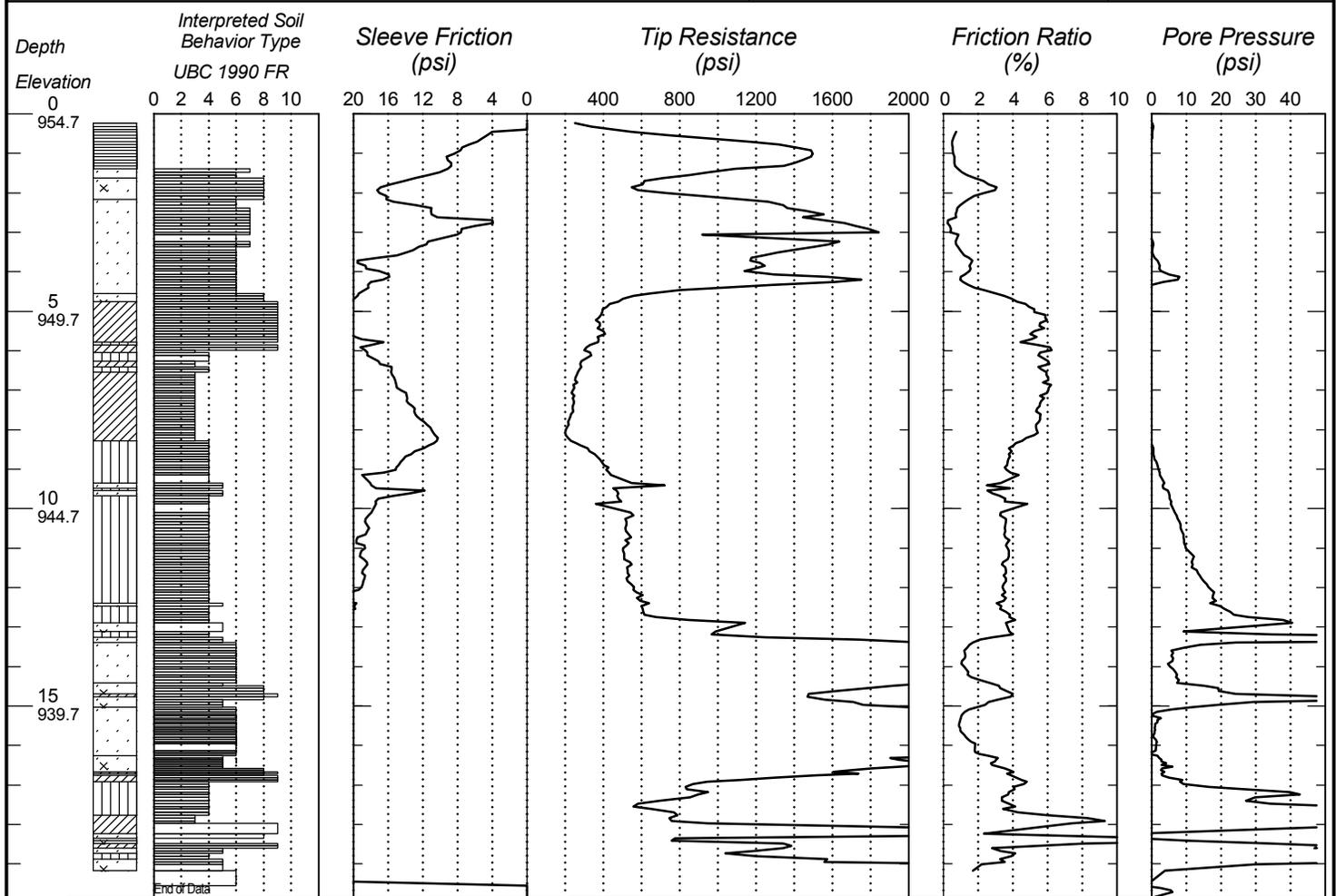
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72129**

U.S. Customary Units



State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c09</b>	Ground Elevation <b>954.7 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=564924 Y=196820</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°03'22.95" Longitude (West)=93°07'55.63"			CPT Operator <b>P Faschingbauer</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/7/09</b>



Bottom of Hole :19.88

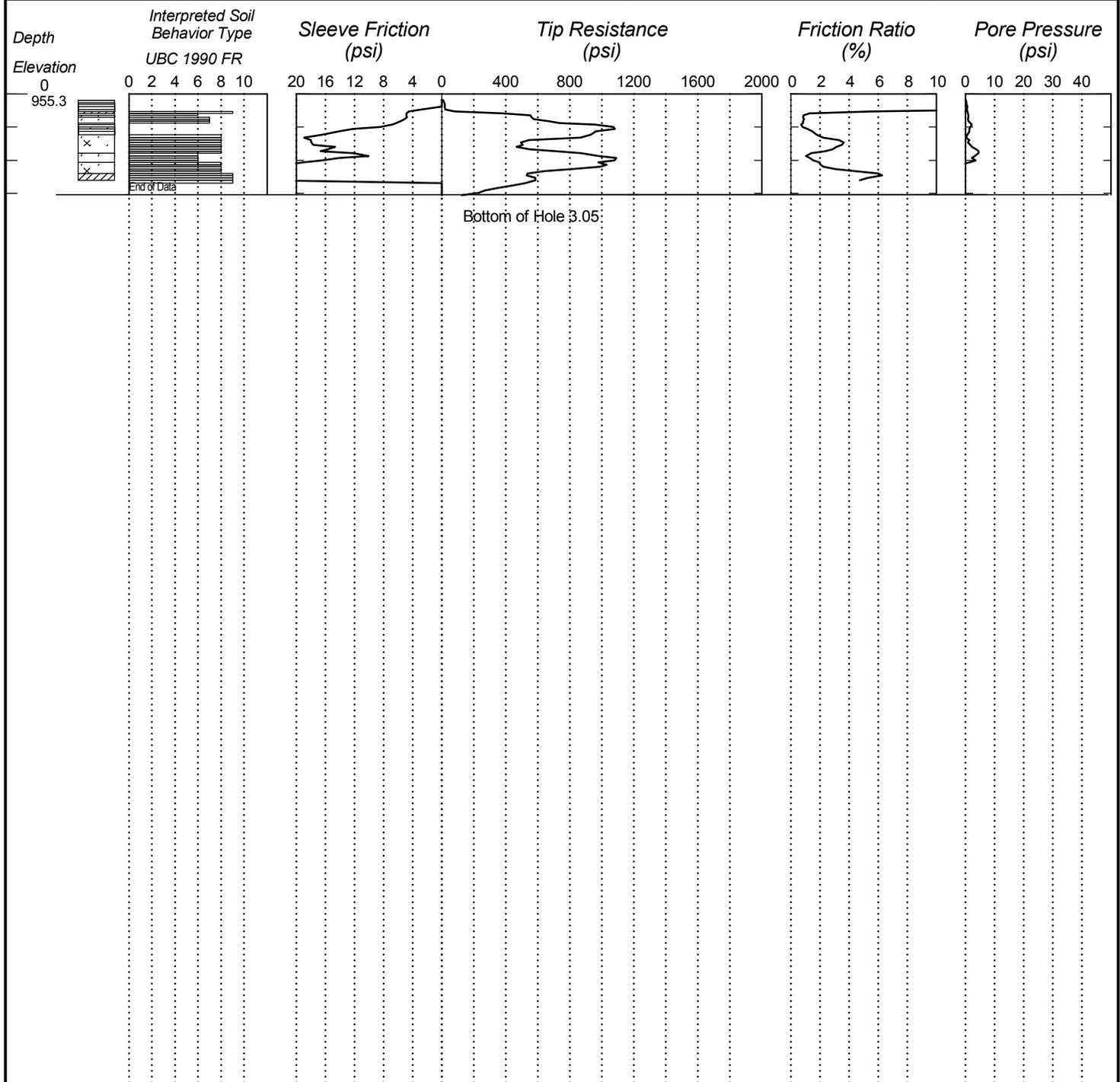
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72130**

U.S. Customary Units



State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c10</b>	Ground Elevation <b>955.3 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=564506 Y=196946 (ft.)</b>		CPT Machine		<b>SHEET 1 of 1</b>
Latitude (North)=45°03'24.21" Longitude (West)=93°08'01.44"		CPT Operator <b>P Faschingbauer</b>		Date Completed
No Station-Offset Information Available		Hole Type <b>CPT-STD</b>		<b>4/7/09</b>



Index Sheet Code

L:\6285-140\Cone\E07A0902C.DASoil Class: Rock Class: Edit: Date: 6/18/09  
 G:\GINT\PROJECTS-ACTIVE\6285-140\_NAME-REPAIR.GPJ

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

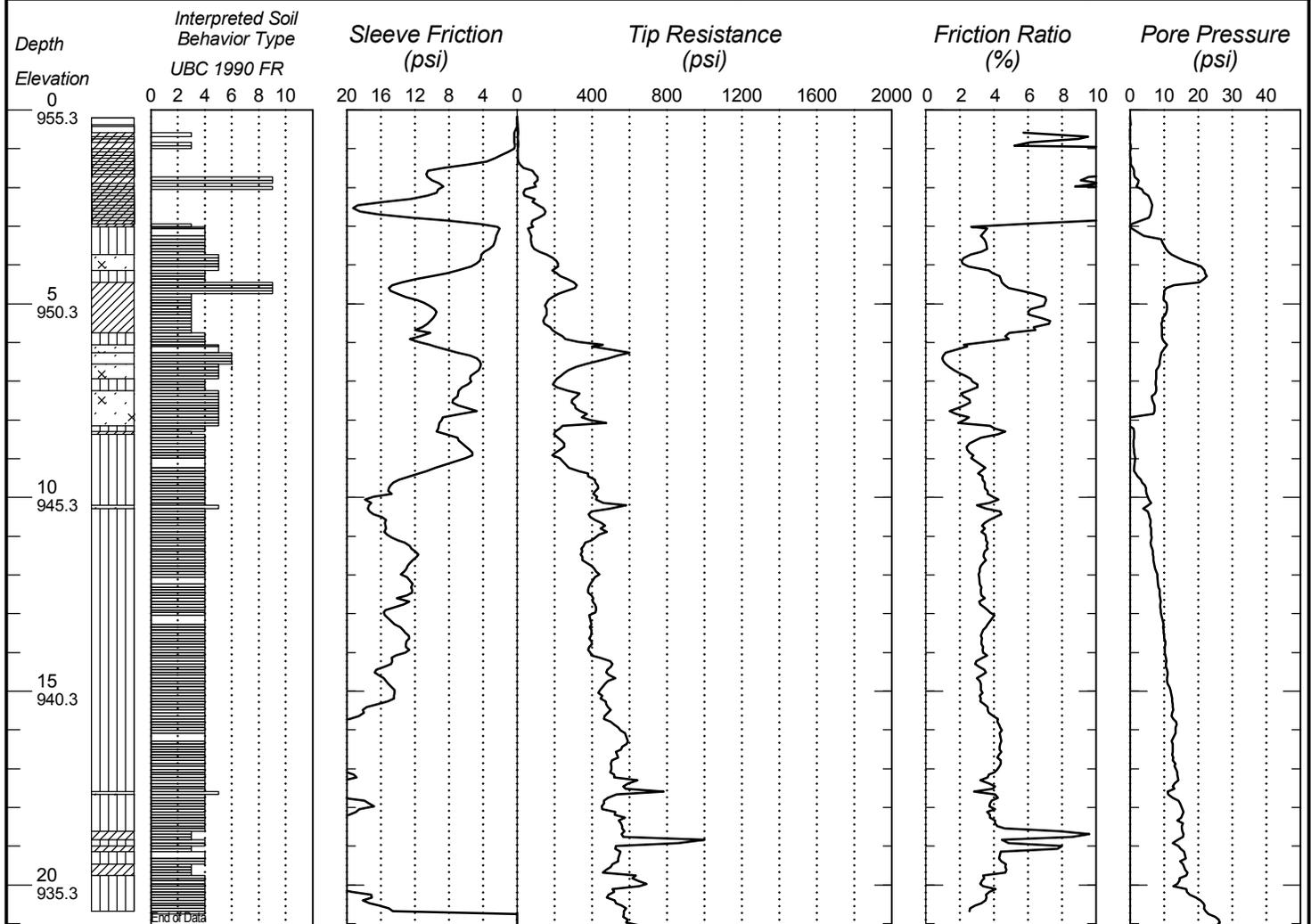
CONE PENETRATION TEST RESULTS

UNIQUE NUMBER 72131

U.S. Customary Units



State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c10a</b>	Ground Elevation <b>955.3 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=564506 Y=196946</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°03'24.21" Longitude (West)=93°08'01.44"			CPT Operator <b>P Faschingbauer</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/7/09</b>



Bottom of Hole 21.11

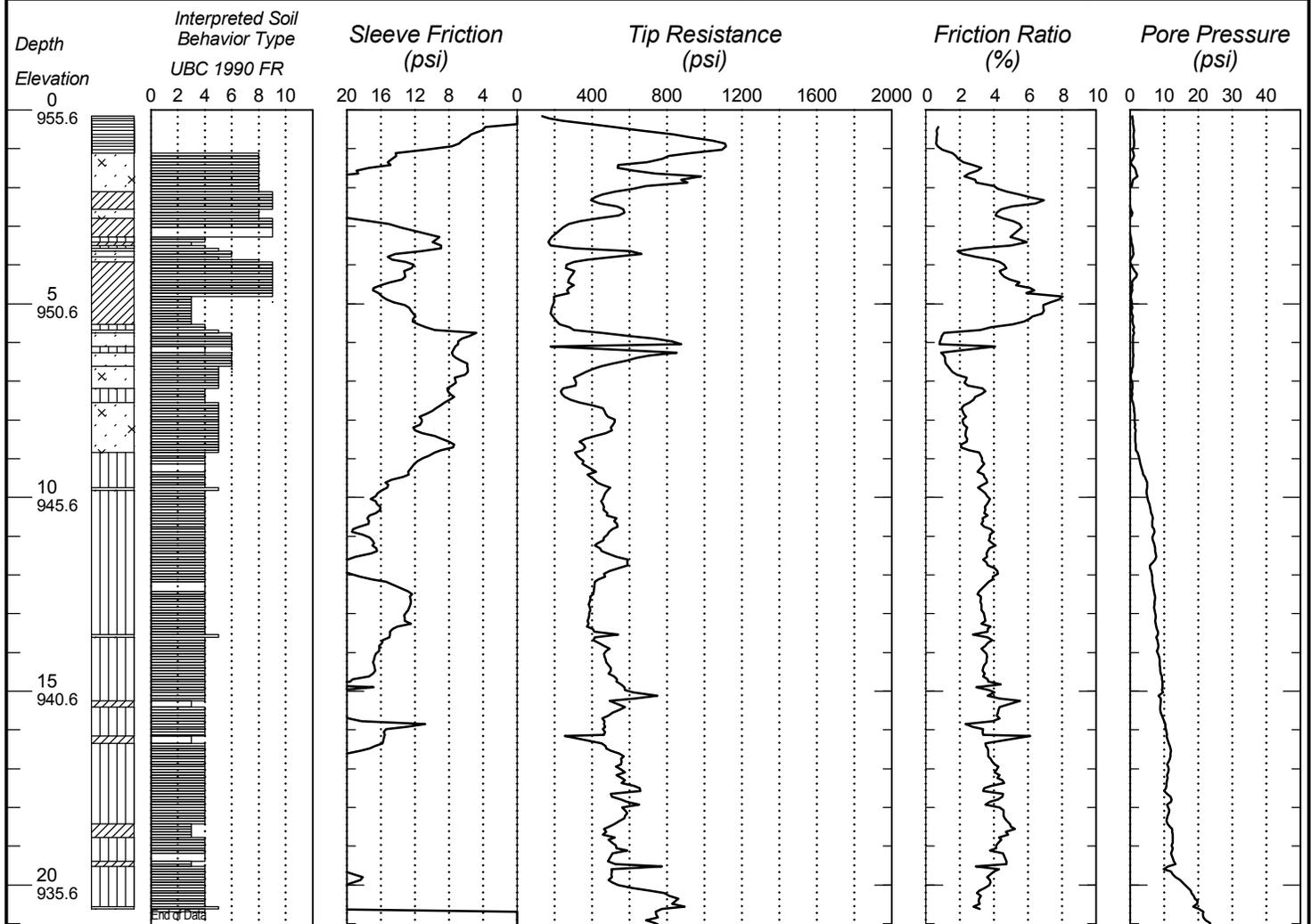
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72132**

U.S. Customary Units



State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c10b</b>	Ground Elevation <b>955.6 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=564503 Y=196953</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°03'24.27" Longitude (West)=93°08'01.49"			CPT Operator <b>P Faschingbauer</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/7/09</b>



Bottom of Hole 21.05

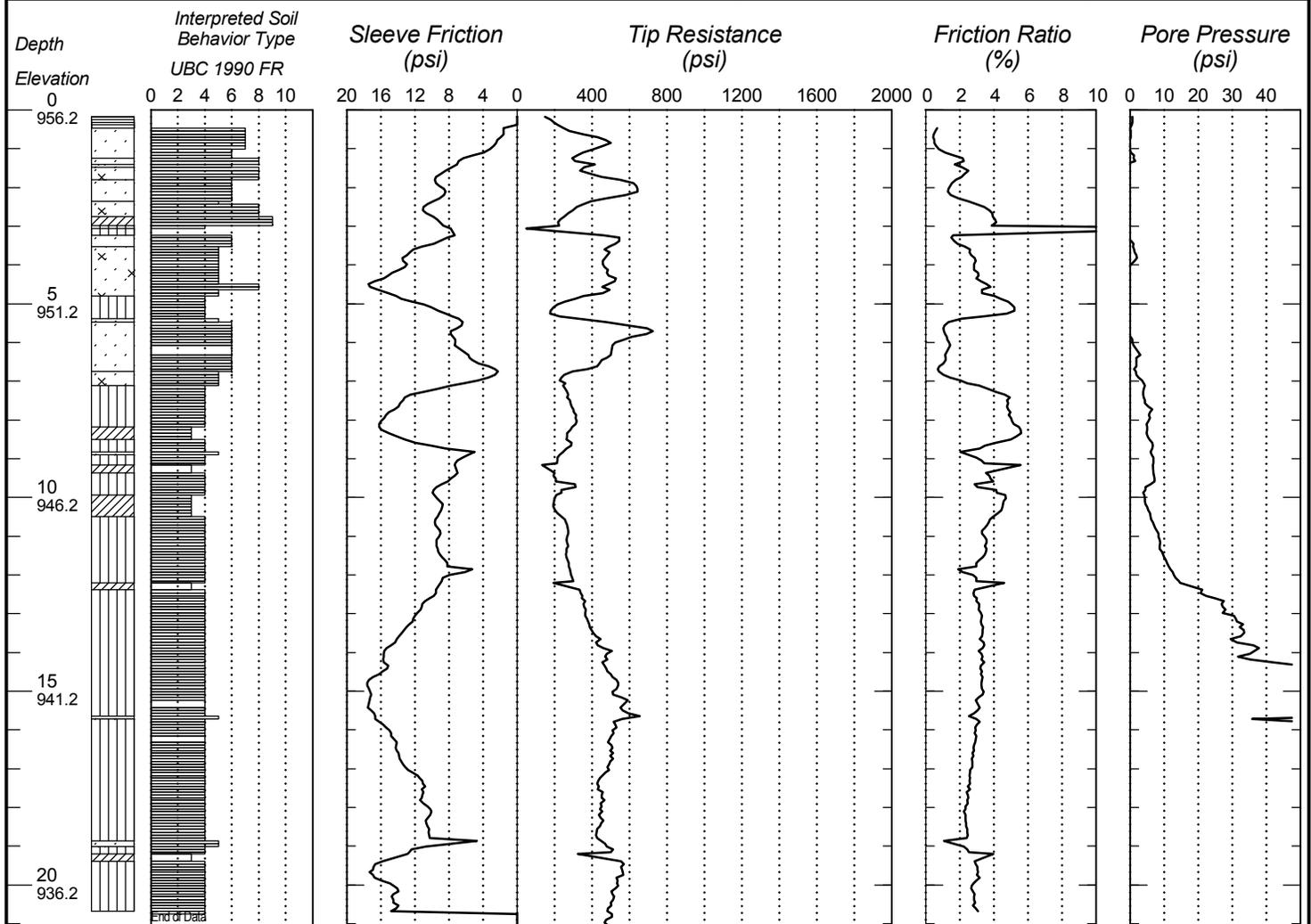
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72133**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c11</b>	Ground Elevation <b>956.2 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=564111 Y=197071</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°03'25.45" Longitude (West)=93°08'06.94"			CPT Operator <b>P Faschingbauer</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/7/09</b>



Bottom of Hole 21.08

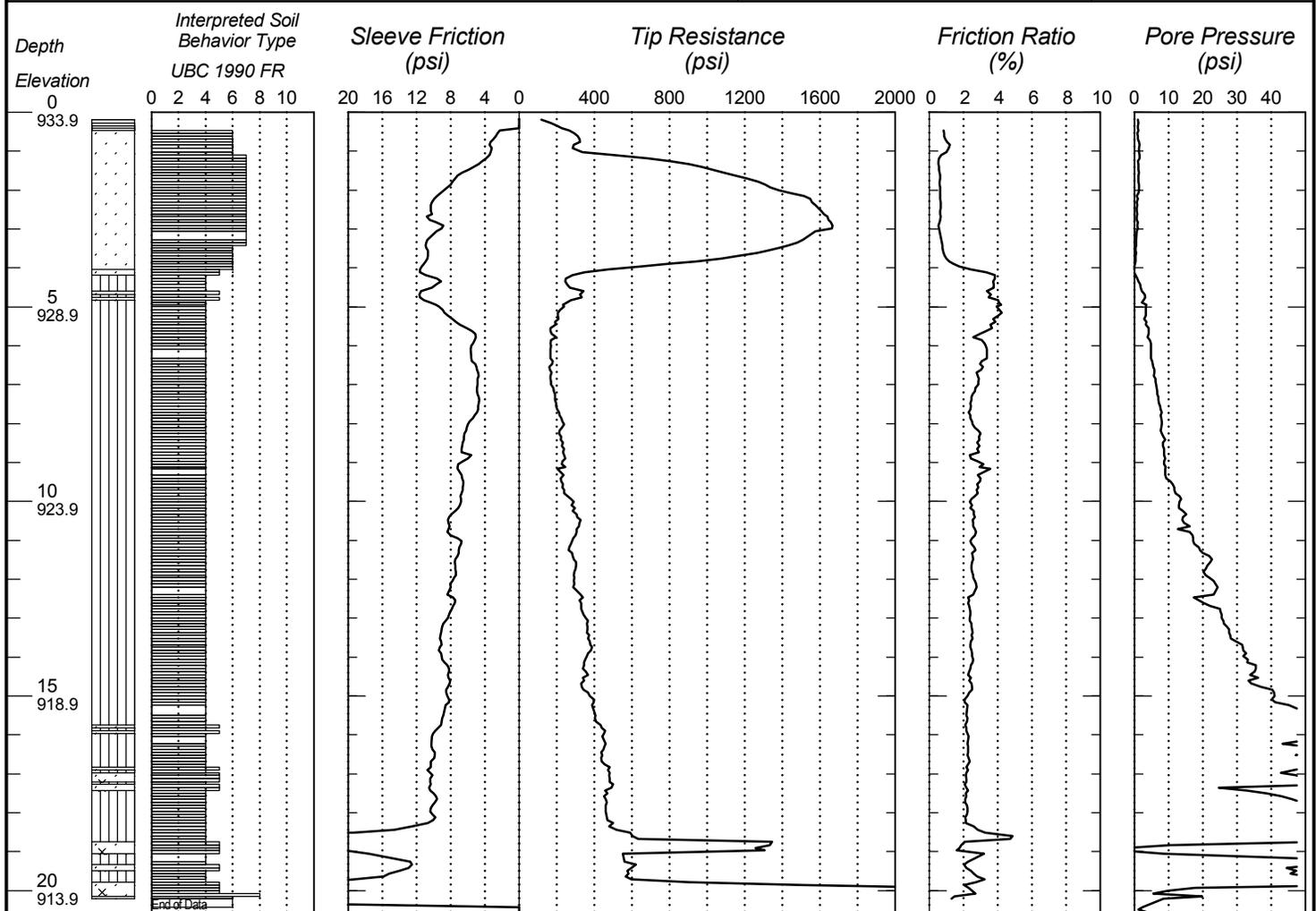
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72134**

U.S. Customary Units



State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c12</b>	Ground Elevation <b>933.9 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=561170 Y=197980 (ft.)</b>		CPT Machine		<b>SHEET 1 of 1</b>
Latitude (North)=45°03'34.51" Longitude (West)=93°08'47.87"		CPT Operator <b>P Faschingbauer</b>		Date Completed
No Station-Offset Information Available		Hole Type <b>CPT-STD</b>		<b>4/7/09</b>



Bottom of Hole 20.63

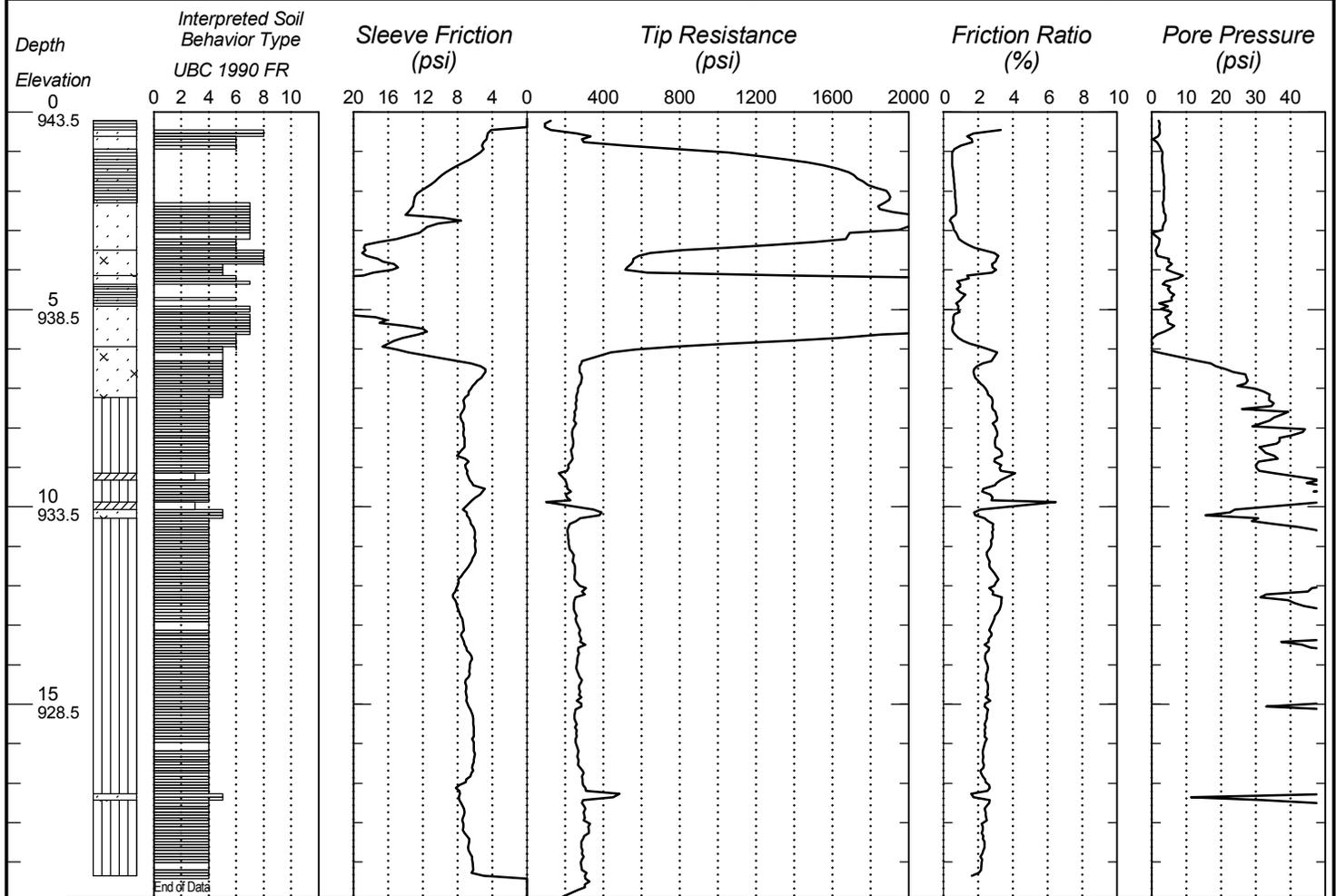
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72135**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c13</b>	Ground Elevation <b>943.5 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=560904 Y=198059</b> (ft.)		CPT Machine		<b>SHEET 1 of 1</b>
Latitude (North)=45°03'35.30" Longitude (West)=93°08'51.57"		CPT Operator <b>P Faschingbauer</b>		Date Completed
No Station-Offset Information Available		Hole Type <b>CPT-STD</b>		<b>4/7/09</b>



Bottom of Hole :19.91

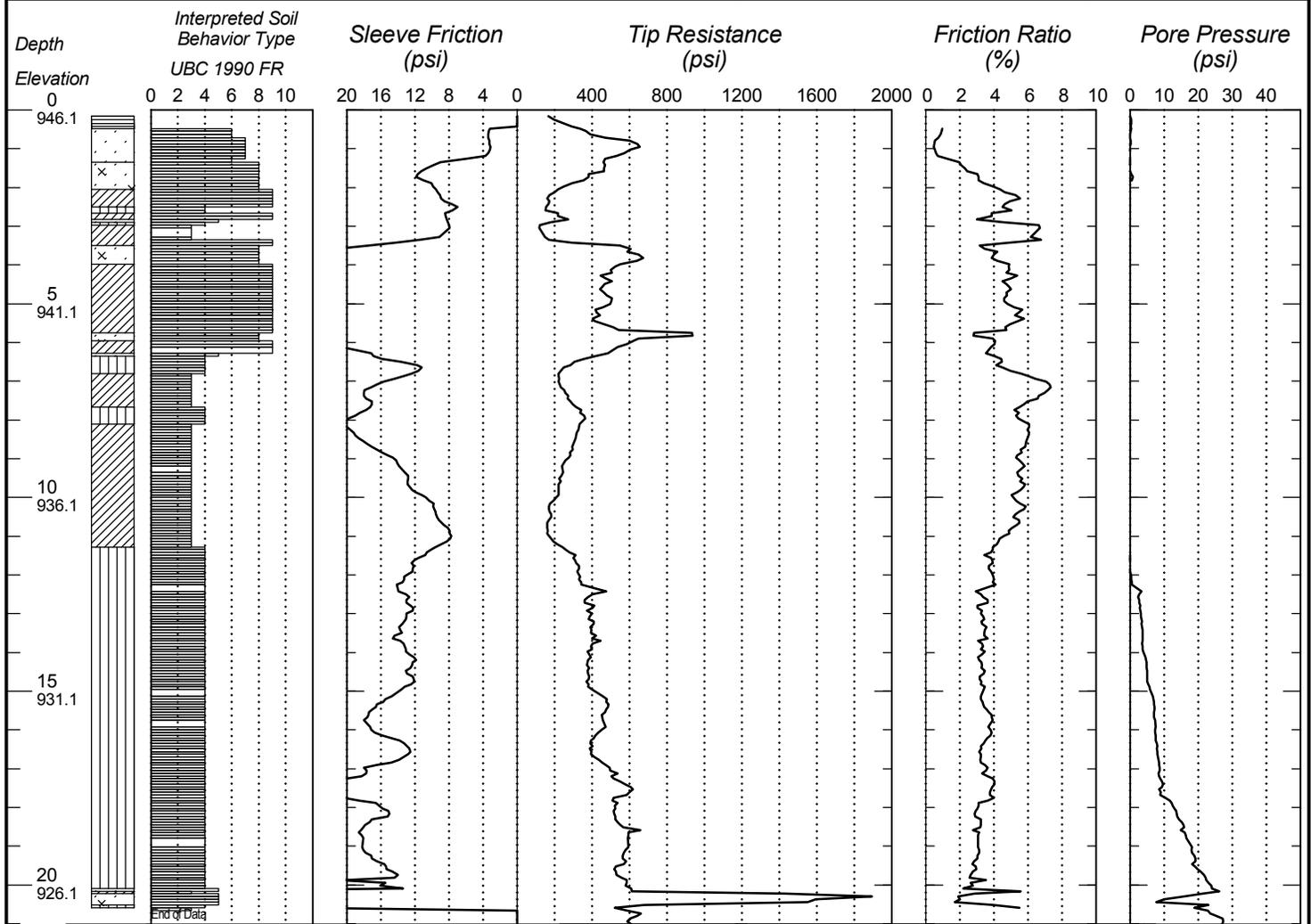
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72136**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c14</b>	Ground Elevation <b>946.1 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=559644 Y=198459 (ft.)</b>		CPT Machine		<b>SHEET 1 of 1</b>
Latitude (North)=45°03'39.29" Longitude (West)=93°09'09.11"		CPT Operator <b>P Faschingbauer</b>		Date Completed
No Station-Offset Information Available		Hole Type <b>CPT-STD</b>		<b>4/8/09</b>



Bottom of Hole 21.01

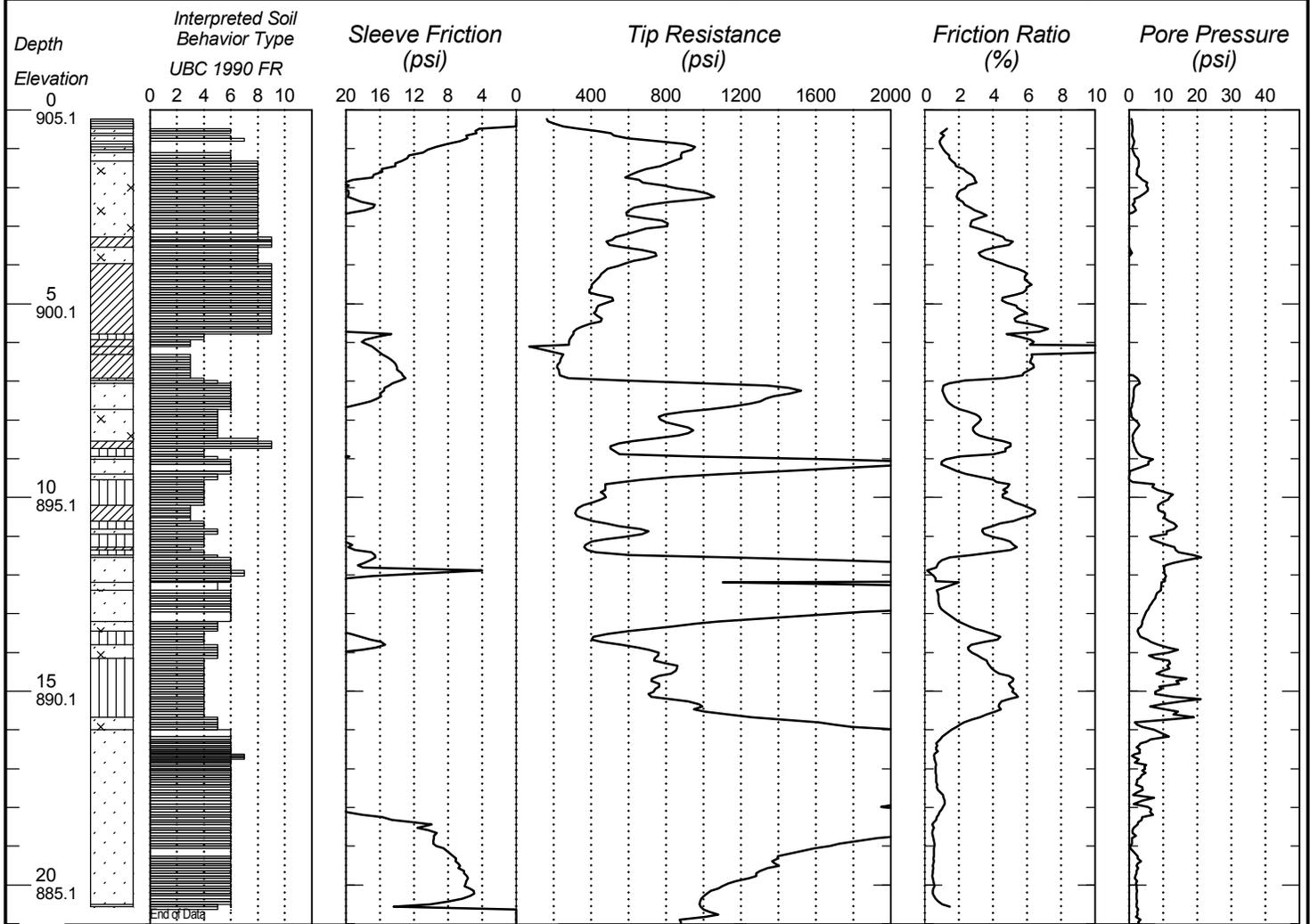
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72138**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c15c</b>	Ground Elevation <b>905.1 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=552429 Y=200686</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°04'01.47" Longitude (West)=93°10'49.54"			CPT Operator <b>P Faschingbauer</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/8/09</b>



Bottom of Hole 21.01

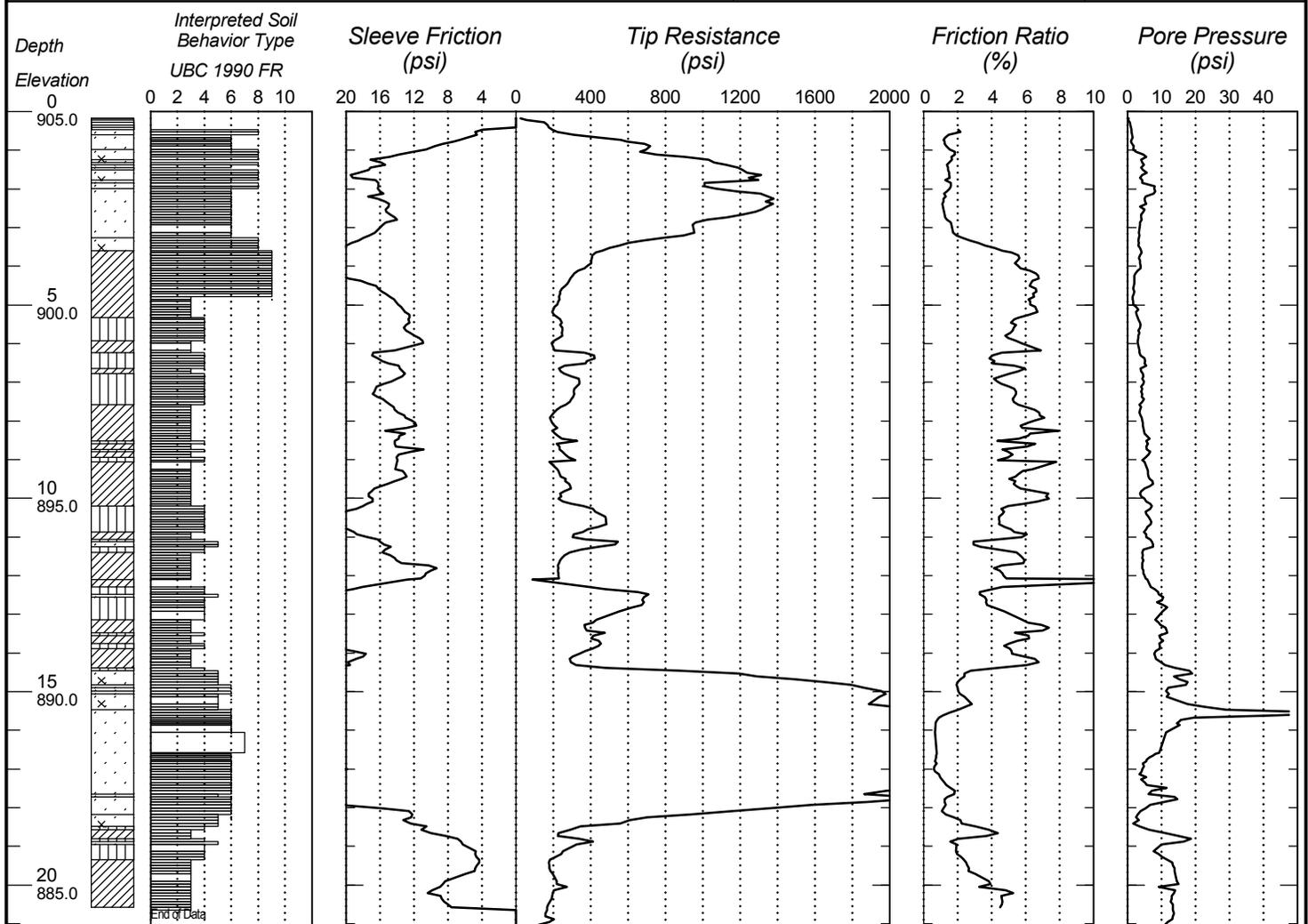
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72139**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c16a</b>	Ground Elevation <b>905.0 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=552280 Y=200705</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°04'01.66" Longitude (West)=93°10'51.62"			CPT Operator <b>P Faschingbauer</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/8/09</b>



Bottom of Hole 21.04

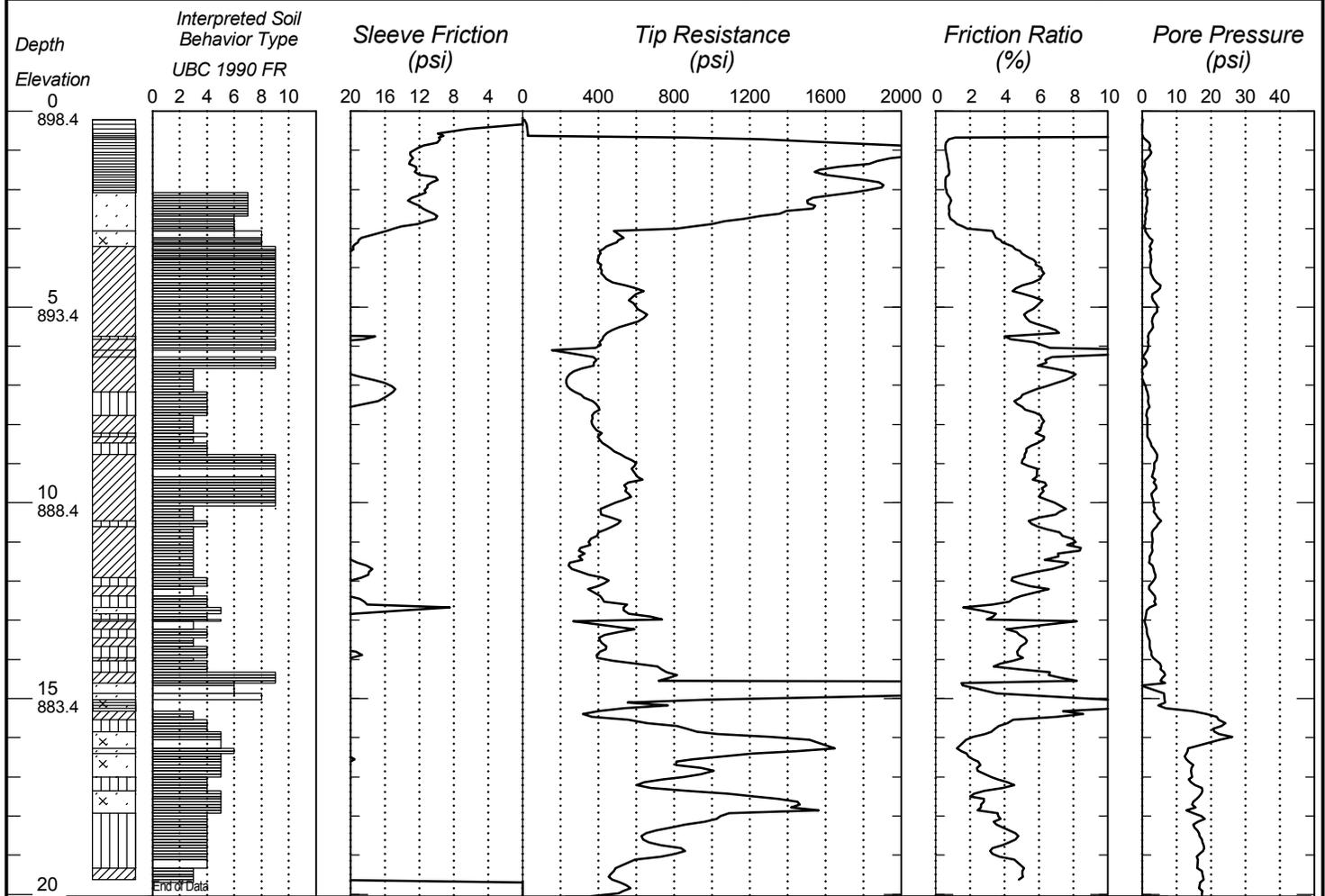
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72140**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c17a</b>	Ground Elevation <b>898.4 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=551335 Y=200721</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°04'01.83" Longitude (West)=93°11'04.78"			CPT Operator <b>P Faschingbauer</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/8/09</b>



Bottom of Hole 20.05

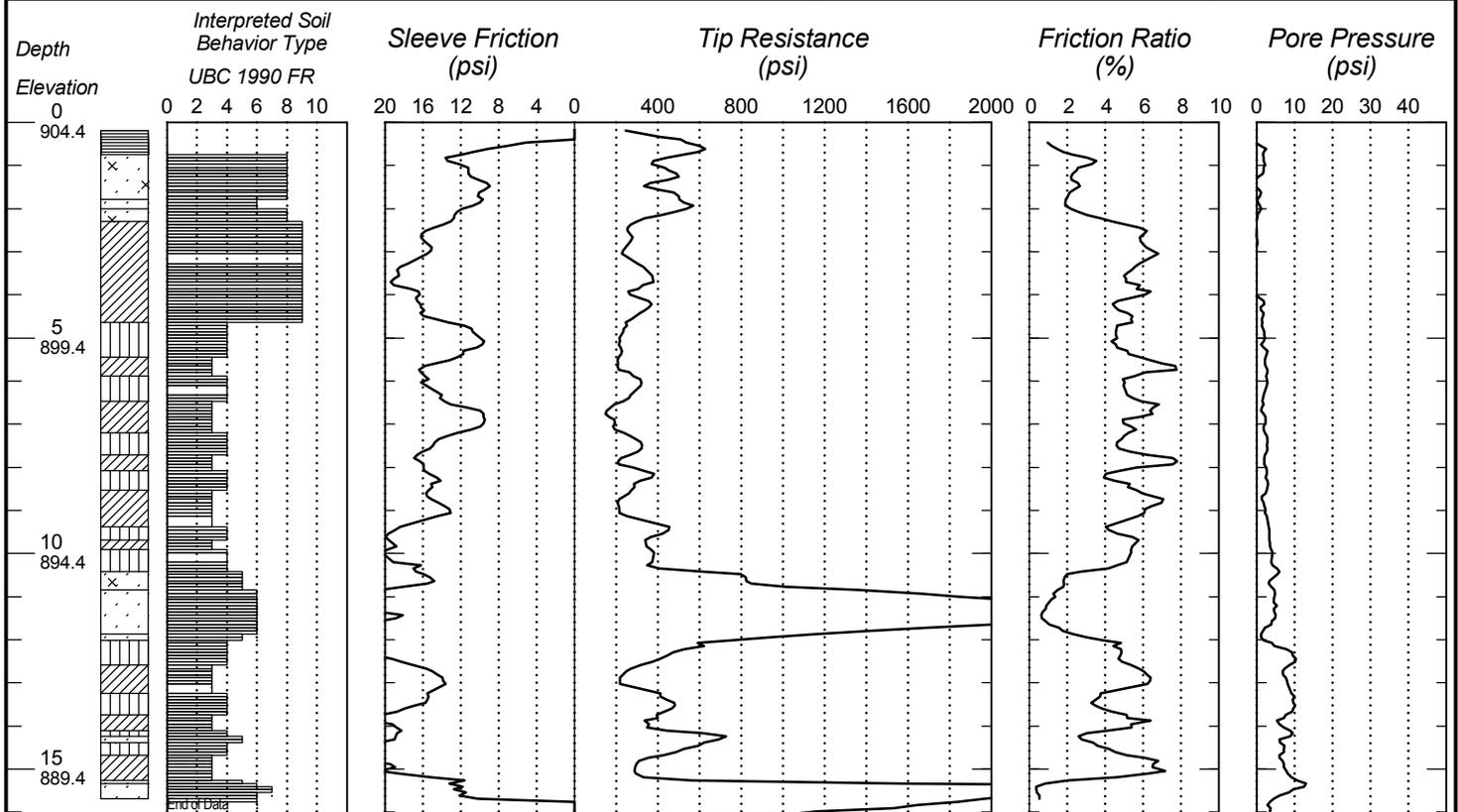
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION



**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72141**

U.S. Customary Units

State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c18</b>	Ground Elevation <b>904.4 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=554976 Y=200543</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°03'59.99" Longitude (West)=93°10'14.07"			CPT Operator <b>P Faschingbauer</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/8/09</b>



Bottom of Hole 16.09

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

**CONE PENETRATION TEST RESULTS**  
**UNIQUE NUMBER 72142**

U.S. Customary Units



State Project <b>6285-140</b>	Bridge No. or Job Desc. <b>guardrail</b>	Trunk Highway/Location <b>I694</b>	Sounding No. <b>c18a</b>	Ground Elevation <b>904.4 (DTM)</b>
Location <b>Ramsey Co. Coordinate: X=554976 Y=200543</b> (ft.)			CPT Machine	<b>SHEET 1 of 1</b>
Latitude (North)=45°03'59.99" Longitude (West)=93°10'14.07"			CPT Operator <b>P Faschingbauer</b>	Date Completed
No Station-Offset Information Available			Hole Type <b>CPT-STD</b>	<b>4/8/09</b>

