Minnesota Department of Transportation
Office of Materials & Road Research
1400 Gervais Avenue, Maplewood, MN 55109

Memo

Date: June 14th, 2017

To: Josie Tayse, Project Manager
Metro Traffic

From: Hossana Teklyes, Asist. Foundation Engineer
Office of Materials and Road Research

Concur: Rich Lamb, Foundations Engineer
Office of Materials and Road Research

Subject: SP 8825-562, (Metro District)
Four Overhead Signs located at TH35 NB, TH94 WB & TH10EB)
Foundations Investigation and Recommendations

1.0 Project Description

This report provides a Foundations Investigation and Recommendations for four overhead signs (Simple Span). The overhead sign will be placed along TH 35 NB, TH94 WB, and TH10 EB.

Sign #	Structure Type	Borings(Soundings)	TH	Stationing
OH I35-217	Simple Span	T05	TH 35 NB	1683+00
OH I35-218	Simple Span	(C07)	TH35 NB	1717+15
OH I94 - 687	Simple Span	T01 & T02	TH94 WB	70+20
OH US10-112	Simple Span	T03 & T04	TH10 EB	747+00

Table 1: Overhead Sign Type & Locations

2.0 Field Investigation and Foundation Conditions

Six Standard Penetration Tests (SPT) and One Cone Penetration Test (CPT) were advanced in May and June of 2017 by MnDOT close to the locations of overhead sign posts. Copies of the SPT Borings and CPT Sounding logs are included with this report.

The foundation soils at the proposed overhead sign posts locations can generally be categorized as

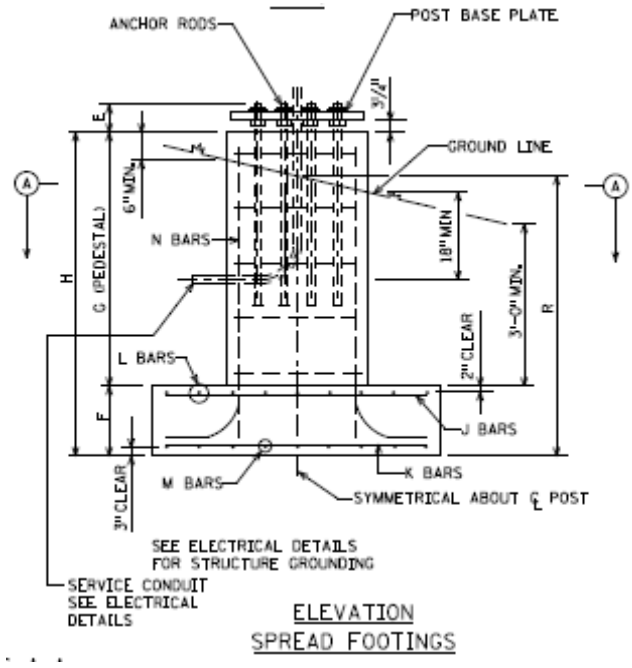
medium dense to dense Sandy soils.
Water was encountered in borings T03 and T04 (TH10 EB) at 9-11 ft. below existing ground (approximate ground elevation ranging from 894 – 895 ft.).

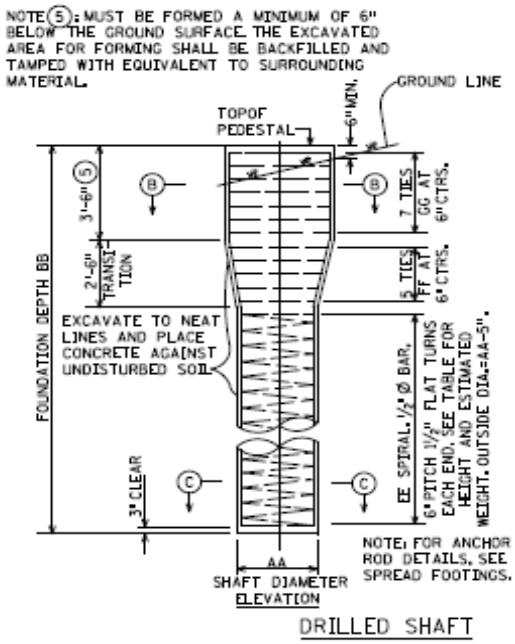
3.0 Foundation Analysis

The overhead sign locations were determined from plans provided by Metro District. The sign location is shown on the attached boring plan. As part of the overhead sign standard drawings (developed in the 1970's), standard foundations were developed to support the signs. These standard foundations consist of two spread footing and two drilled shaft designs to be used on different sign pole sizes (see Drawing ST-3, Standard Overhead Sign Supports Interim Design B).

- **Drilled shafts:** **3 ft. diameter & 23 ft. deep**
  4 ft. diameter & 29 ft. deep

- **Spread Footings:** **9 ft. x 14 ft.**
  12.5 ft. x 18 ft.





In addition, the standard foundation notes state the following requirements:

- All spread footings have an allowable design bearing pressure of 1 ¼ tons per square foot
- The drilled shafts have an allowable design lateral bearing pressure of 250 lbs. per square foot per foot of depth

Based on the soils at the proposed sign locations, the overhead signs can be supported **on Spread Footing or Drilled shaft.**

4.0 Foundation Recommendations

Based on the existing conditions along with an analysis of the project soils, we recommend the following:

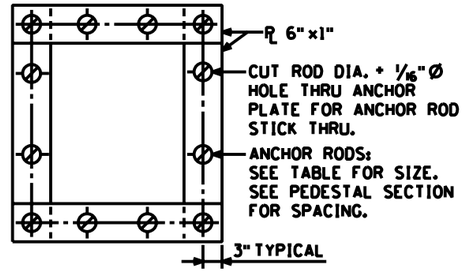
1. Topsoil and other organic material be removed from areas where new fill is to be placed.

2. Based on the soils at the overhead sign bases location, the overhead signs can be supported on **Spread Footings or Drilled Shafts.** The standard sign design supports are shown in drawing **ST-3**. A copy of Drawing ST-3 is included with this report.

Attachments: Drawing ST-3
Boring/Sounding Overhead Sign Plan
SPT/CPT Index Sheet
SPT Logs (T01- T05) Unique Numbers (82375, 82040, 82034, 82041 & 82035)
CPT Log (C07) Unique Number (82536)

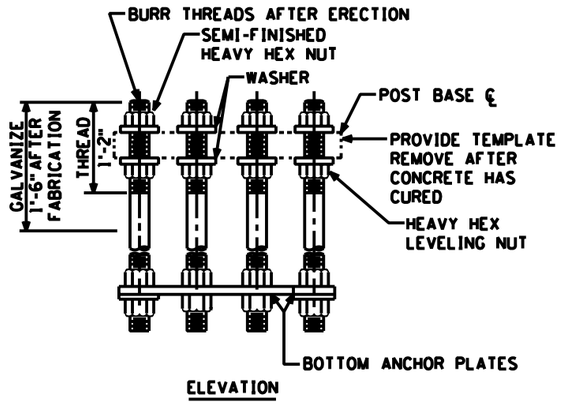
cc: B. Skow
E. Peterson
T. Clyne

File

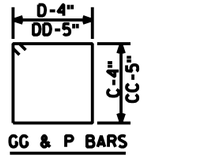


NOTE: ANCHOR PLATES SHOWN TYPICAL FOR ALL ANCHOR ROD SPACING.

ANCHOR PLATE PLAN



ELEVATION



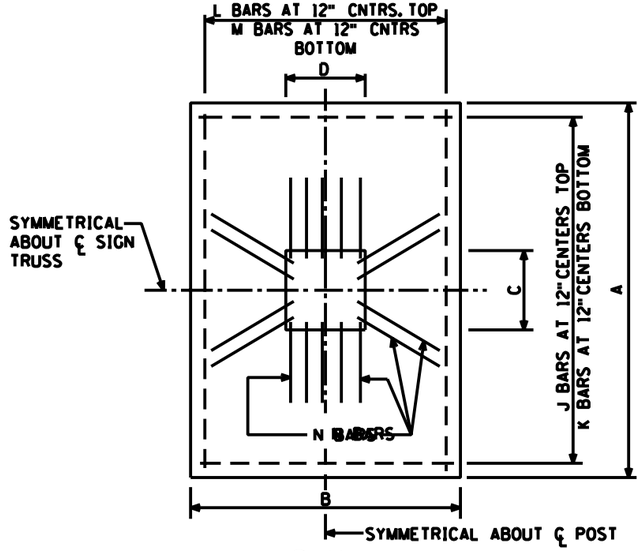
GG & P BARS

R=	
1'-1"	#8 BAR
1'-3"	#9 BAR
1'-4"	#10BAR
1'-6"	#11 BAR

2'-0"	#8 BAR
2'-3"	#9 BAR
2'-6"	#10 BAR
2'-9"	#11 BAR

N BARS

J, K, L, M, FF AND HH ARE STRAIGHT BARS
BAR BENDING DIAGRAMS



PLAN

SPECIFIC NOTES:

1. G IS IN FEET. ROUND UP TO WHOLE NUMBER. E.G. G=4.10/2G=8.2 NO. REQ'D=9.
2. G AND R ARE IN FEET.
3. BEND AS REQUIRED TO FORM A CLOSED LOOP.
4. FOR STRUCTURE STEEL SEE SPREAD FOOTING.
5. MUST BE FORMED A MIN. OF 6" BELOW THE GROUND SURFACE. THE SOIL EXCAVATED FOR FORMING SHALL BE BACKFILLED AND TAMPED TO EQUIVALENT COMPACTION AS SURROUNDING MATERAL.
6. SPECIAL LARGE RADIUS BENDS ARE REQUIRED. SEE "BAR BENDING DIAGRAMS" FOR SIZES OF RADII.

GENERAL NOTES:

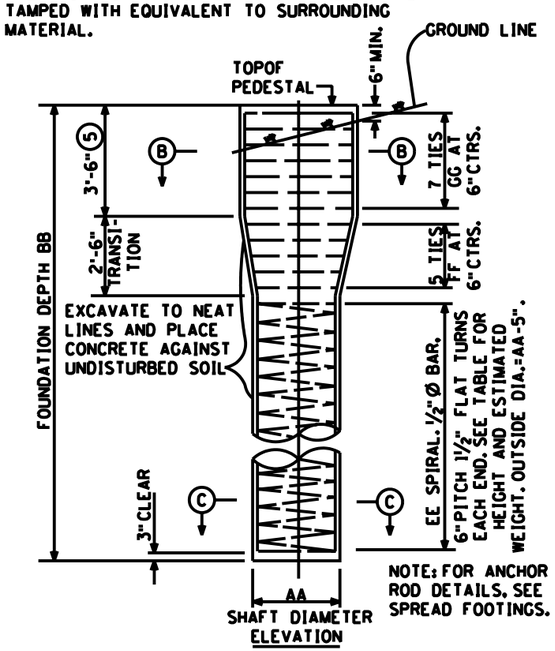
1. SEE THE FORMAT SHEET FOR FOOTING LOCATIONS, POST DESIGNATIONS, TOP OF PEDESTAL ELEVATIONS AND BOTTOM OF FOOTING ELEVATIONS.
2. ALL CONCRETE SHALL CONFORM TO CONCRETE MIX 3Y43 (MN/DOT 2461).
3. ALL BAR DIMENSIONS ARE OUT TO OUT OF BARS.
4. ALL SPREAD FOOTINGS HAVE AN ALLOWABLE DESIGN BEARING PRESSURE OF 1 1/4 T PER SQUARE FOOT.
5. DRILLED SHAFTS SHALL BE USED ONLY WHEN SPECIFIED IN THE CONTRACT PLANS.
6. THE DRILLED SHAFTS HAVE AN ALLOWABLE DESIGN LATERAL BEARING PRESSURE OF 250 LBS. PER SQ. FT. PER FOOT OF DEPTH.
7. UNLESS OTHERWISE NOTED, ALL REINFORCEMENT BARS SHALL BE EPOXY COATED IN ACCORDANCE WITH MN/DOT 3301. SPIRAL BARS AND J, K, L, & M BARS NEED NOT BE EPOXY COATED.
8. THE FOLLOWING TORQUE VALUES SHALL BE USED WHEN INSTALLING ALL ANCHOR NUTS FOR OVERHEAD SIGN STRUCTURES:

ANCHOR BOLT DIAMETER	TORQUE (FT./LBS.)
2 1/4"	375
2 1/2"	450

THE CONTRACTOR SHALL BURR THE THREADS OF THE ANCHOR BOLTS IN ACCORDANCE WITH MN/DOT 2402.3H AFTER TORQUEING NUTS.

ANCHOR ROD DETAILS

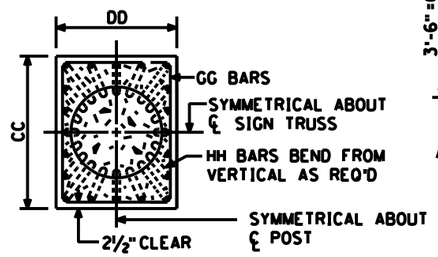
NOTE (5): MUST BE FORMED A MINIMUM OF 6" BELOW THE GROUND SURFACE. THE EXCAVATED AREA FOR FORMING SHALL BE BACKFILLED AND TAMPED WITH EQUIVALENT TO SURROUNDING MATERIAL.



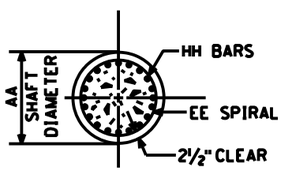
ELEVATION

NOTE: FOR ANCHOR ROD DETAILS, SEE SPREAD FOOTINGS.

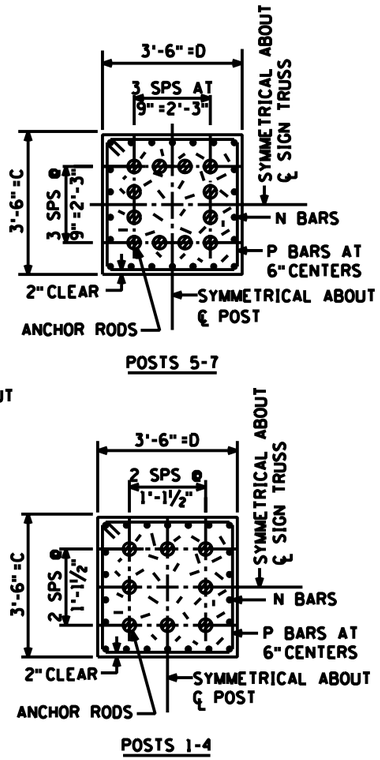
DRILLED SHAFT



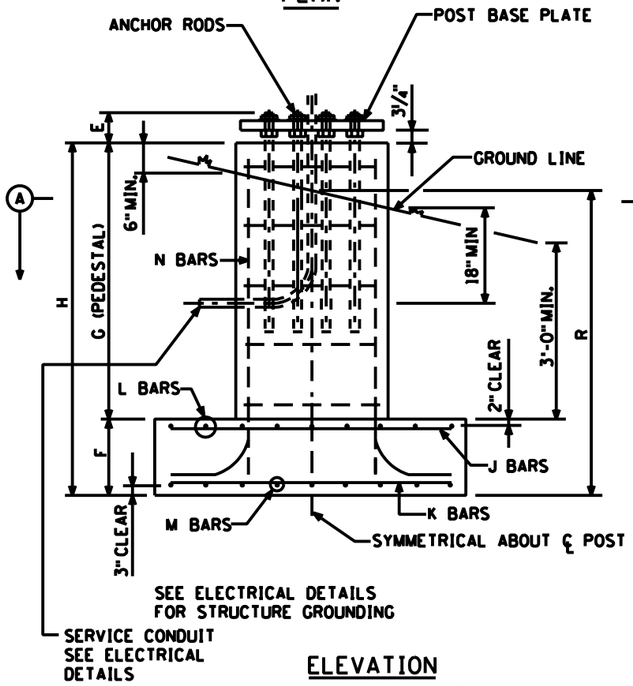
SECTION B-B



SECTION C-C



PEDESTAL CROSS SECTIONS A-A



ELEVATION
SPREAD FOOTINGS

POST NO.	DRILLED SHAFT DIMENSIONS AA	BB	CC	DD	REINFORCING BARS EE	FF (3)	GG	HH	ESTIMATED QUANTITIES (4) CONCRETE CY	REIN STEEL LBS.	SPREAD FOOTINGS SUMMARY OF ESTIMATED QUANTITIES CONCRETE CY (2)	REIN. STEEL LBS. (2)	ANCH. ASSM. LBS	ST. EXC. C.Y. (2)
1-4	3'-0"Ø	23'-0"	3'-6"	3'-6"	16'-6" x 197 LBS.	5 #5 x 14'-1"	7 #5 x 14'-1"	20 #9 x 22'-7"	6.9	1910	9.3 + 0.46 G	945 + 98G	781	7.4 R
5-7	4'-0"Ø	29'-0"	4'-0"	4'-0"	22'-6" x 362 LBS.	5 #5 x 16'-1"	7 #5 x 16'-1"	24 #10x 28'-7"	14.1	3490	16.7 + 0.46 G	2333 + 133G	1320	12.1 R

POST NO.	SPREAD FOOTINGS A	B	C	D	E	F	ANCHOR RODS NO. REQ'D	DIA.	LENGTH	J REIN. BARS NO. REQ'D	SIZE	LENGTH	K REIN. BARS NO. REQ'D	SIZE	LENGTH	L REIN. BARS NO. REQ'D	SIZE	LENGTH	M REIN. BARS NO. REQ'D	SIZE	LENGTH	(6) N REIN. BARS NO. REQ'D	SIZE	LENGTH	P REIN. BARS (1) NO. REQ'D	SIZE	LENGTH
1-4	14'-0"	9'-0"	3'-6"	3'-6"	8 1/2"	2'-0"	8	2 1/4"	3'-10 1/2"	14	#4	8'-6"	14	#6	8'-6"	10	#5	13'-6"	10	#7	13'-6"	20	#9	H + 2'-6"	26	#5	14'-3"
5-7	18'-0"	12'-6"	3'-6"	3'-6"	9"	2'-0"	12	2 1/2"	4'-0"	19	#4	12'-0"	19	#6	12'-0"	13	#6	17'-6"	13	#10	17'-6"	24	#10	H + 2'-9"	26	#5	14'-3"

STANDARD OVERHEAD SIGN SUPPORTS
INTERIM DESIGN B

FOUNDATIONS AND ANCHOR RODS

DRAWING ST-3

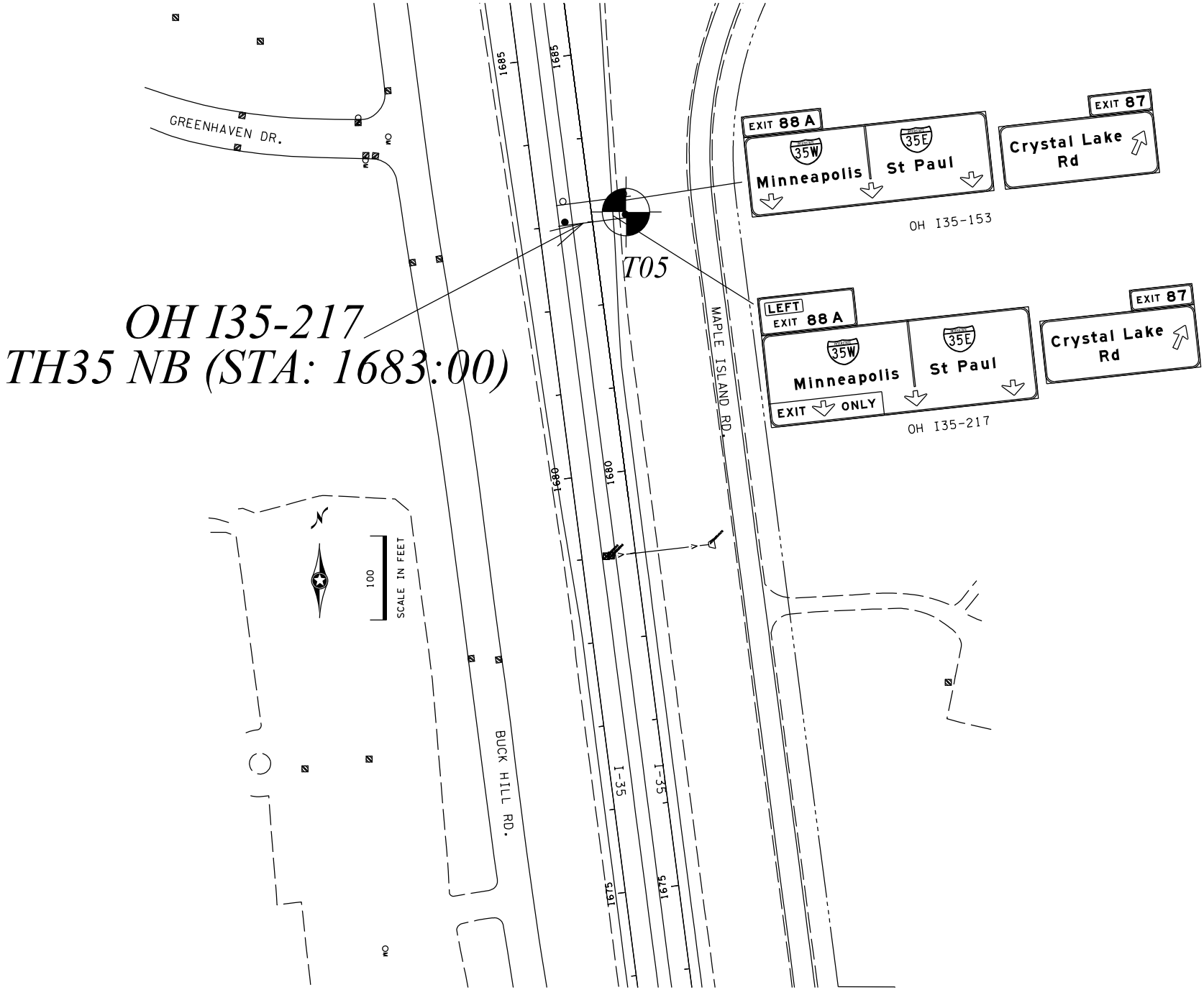
DGN S13 10-5-98

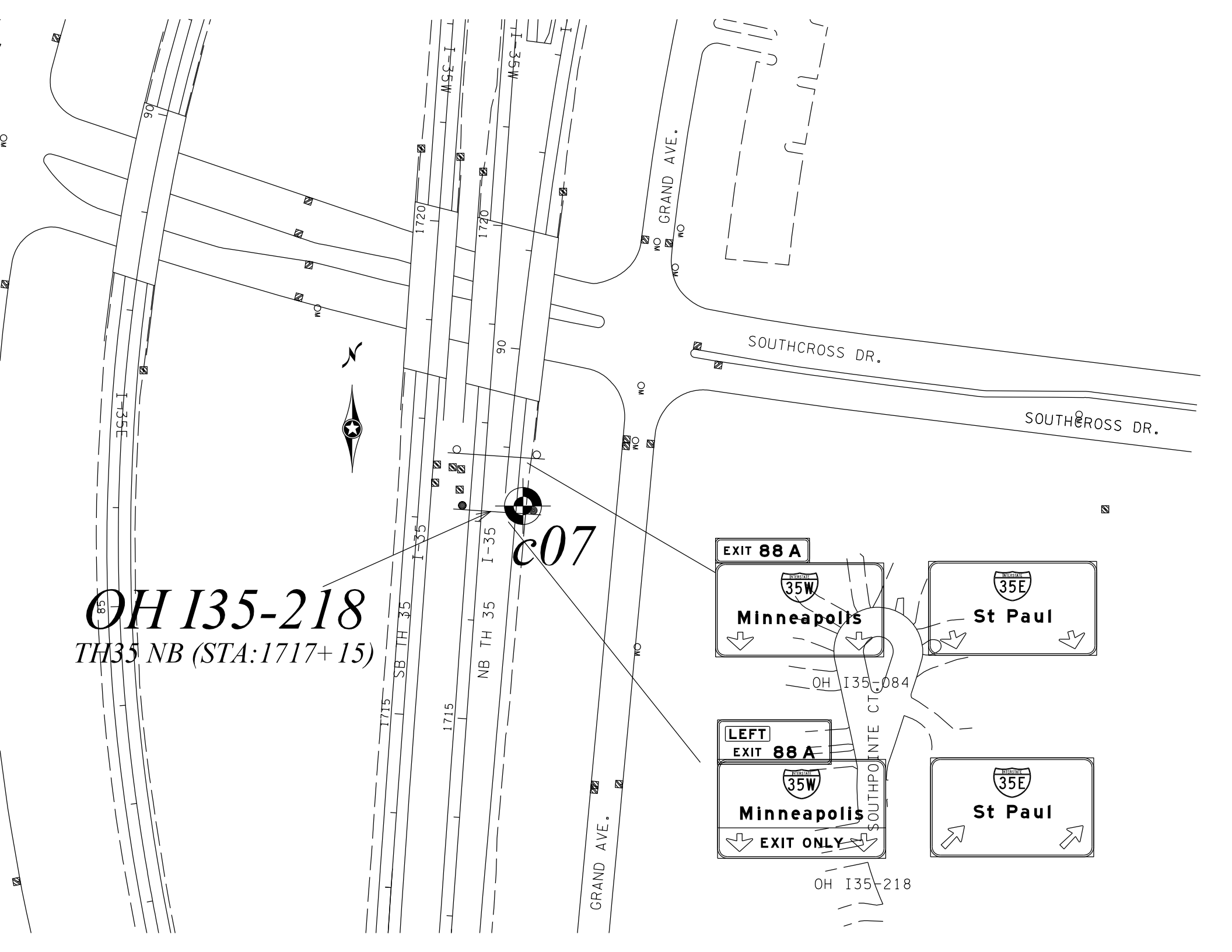
REVISED 10/5/98

ST-DRAWINGS[1].dgn 3/14/2006 10:35:46 AM

State Proj. No.

Sheet No. 86 of 99 Sheets

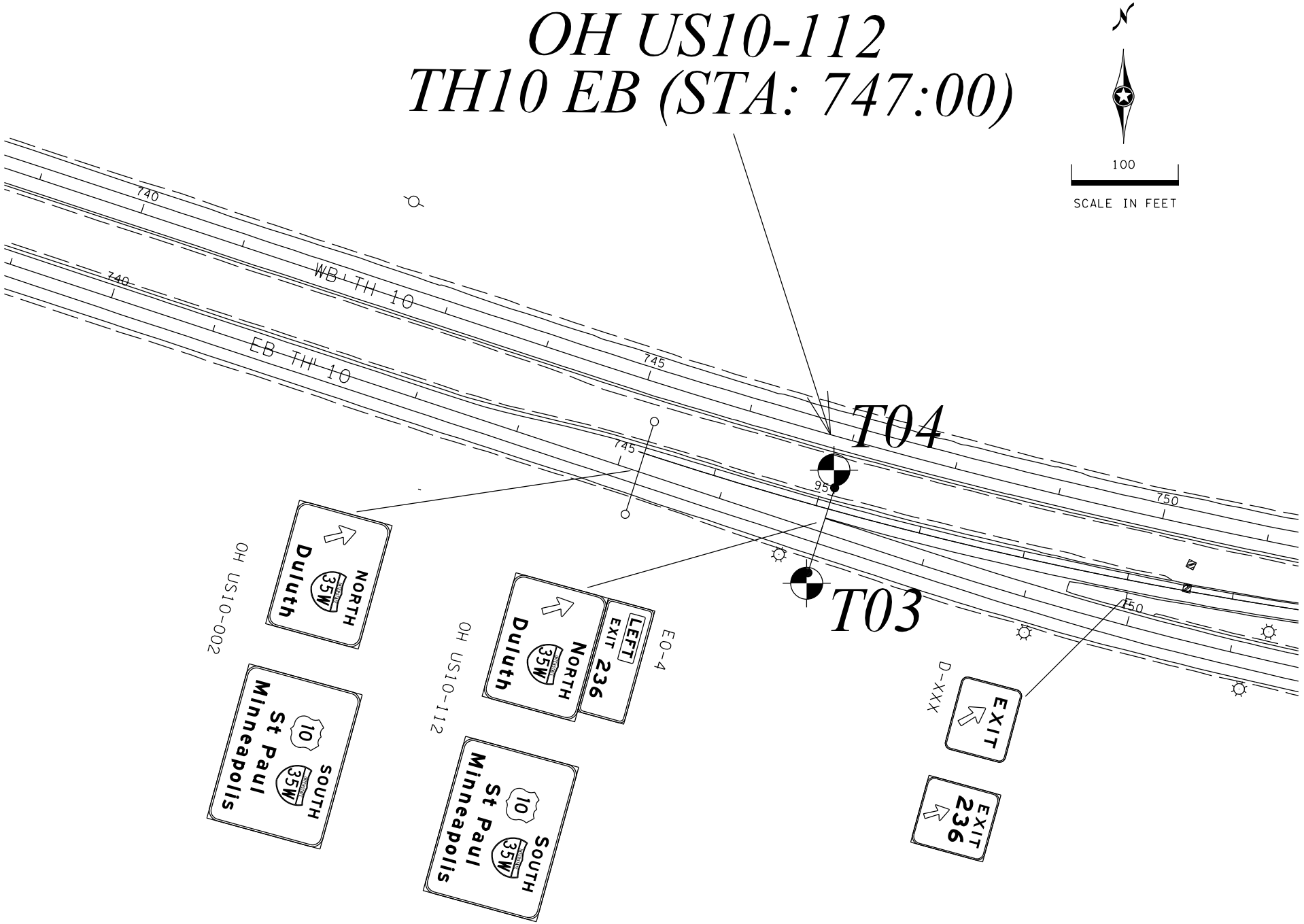

OH I35-217
TH35 NB (STA: 1683:00)
T05
GREENHAVEN DR.
MAPLE ISLAND RD.
BUCK HILL RD.
I-35
I-35
1685
1685
1680
1680
1675
1675
EXIT 88 A
35W
Minneapolis
35E
St Paul
EXIT 87
Crystal Lake Rd
OH I35-153
LEFT EXIT 88 A
35W
Minneapolis
35E
St Paul
EXIT ONLY
EXIT 87
Crystal Lake Rd
OH I35-217
N
100
SCALE IN FEET

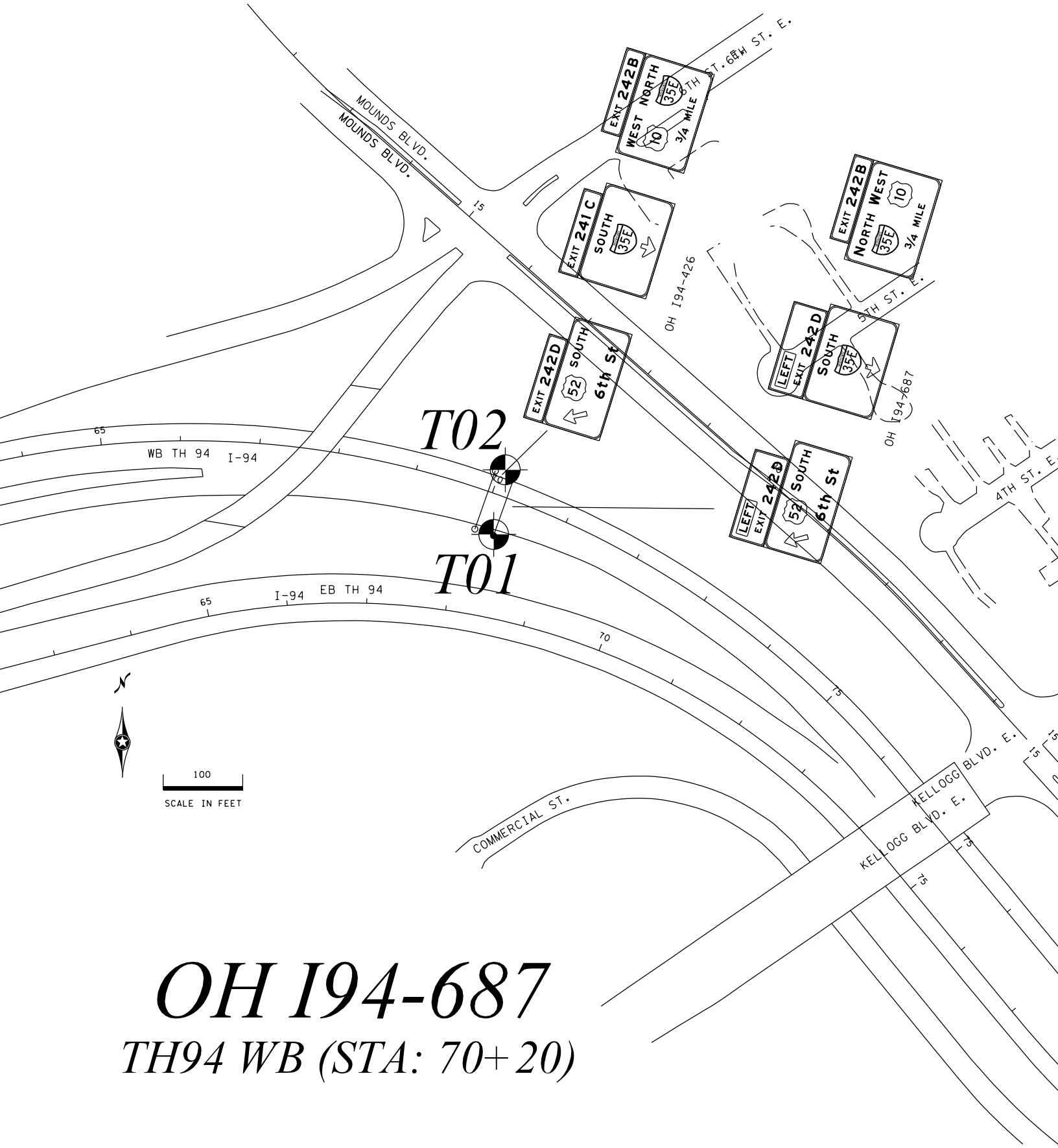


OH I35-218

TH35 NB (STA:1717+15)

OH US10-112
TH10 EB (STA: 747:00)



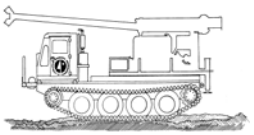


OH I94-687

TH94 WB (STA: 70+20)

Minnesota Department of Transportation Geotechnical Section

Boring Log Descriptive Terminology (English Units)



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_{60} ..... 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.

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

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
orng ..... 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

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

DRILLING SYMBOLS

Vane Shear Test

WS — Washed Sample (Collected during plug drilling)

Augered

PD — Plug Drilled

Split Tube Sample (SPT N_{60} 2 in. spilt tube with liners)

Thin Wall Sample (3 in. Shelby Tube)

Core Drilled (NV Core Barrel unless otherwise noted)

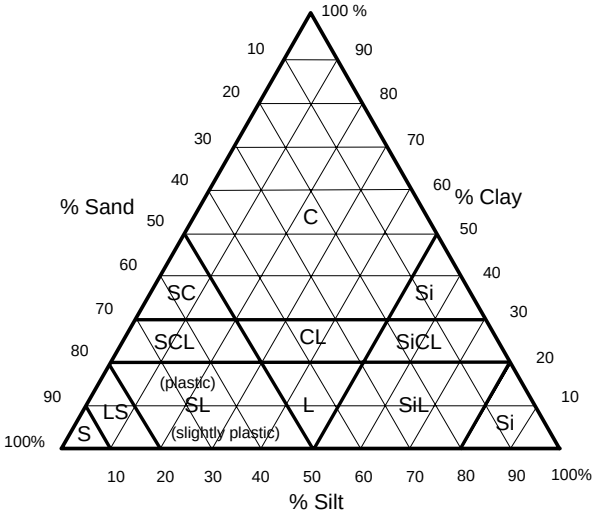
CS — Continuous Soil Sample

A/J — Augered & Jetted

Jet — Jetted

A/P — Augered & Plug Drilled

Mn/DOT Triangular Textural Soil Classification System



RELATIVE DENSITY

Compactness - Granular Soils	BPF
very loose	0-4
loose	5-10
medium dense	11-24
dense	25-50
very dense	>50

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

UNIQUE NUMBER 82375

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
8825-562	Overhead Sign	Interstate Highway TH 10 & 35 & 94	T01	766.2 (DTM)

Location: Ramsey Coord:X=579966 Y=159900 (ft.)
Latitude (North)=44°57'17.92" Longitude (West)=93°04'28.06"
No Station-Offset Information Available

Drill Machine: 211304 CME Fat Tire
Hammer: CME Automatic Calibrated

SHEET 1 of 1
Drilling Completed: 6/7/17

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
5	8.5 / 757.7		Loamy Fine Sand with plastic Sandy Loam seams at 3.0' and 5.0', dark-brown to brown, moist		19	8				
					14	10				
					9	20				
10					9	15				
			Loamy Very Fine Sand with a plastic Silt Loam seam at 15.0', brown, moist		8	17				
15					11	12				
	16.0 / 750.2		plastic Silt Loam, gray-brown, moist		7	40				
	17.5 / 748.7		plastic Sandy Loam with a Silty Clay seam, gray to brown, wet			25				
	19.0 / 747.2		Boulder		50/.4	7				sampled on a Boulder / rough drilling at 19.0'
20	20.0 / 746.2		Sand and Gravel with stone chips and pieces, browns, damp		10					
					27	5				
	23.5 / 742.7				50/.4					
					31	21				Hard drilling 24.0'-29.0'
25					50/.1					
			Loamy Sand and Gravel with stone chips and pieces, reddish-brown to light-brown, wet	PD						
					50/.3	N/A				
				PD						
	29.4 / 736.8				50/.4	16				

Bottom of Hole -29.4'
No water encountered or measured during drilling

Index Sheet Code 3.0

Soil Class:JAH Rock Class: Edit: Date: 6/14/17

G:\GINT\PROJECTS-ACTIVE\8825-562- OVERHEAD SIGN (TH 10 & 35W & 94).GPJ

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

UNIQUE NUMBER 82040

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
8825-562	**Overhead Sign**	**Interstate Highway TH 10 & 35 & 94**	**T02**	**768.9** (DTM)

Location: Ramsey Coord:X=579980 Y=159981 (ft.)
Latitude (North)=44°57'18.72" Longitude (West)=93°04'27.86"
No Station-Offset Information Available

Drill Machine: **209332 GeoProbe**
Hammer: **GeoProbe Automatic**

SHEET 1 of 1
Drilling Completed: **5/30/17**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
			Fine Sand with a little Gravel, brown, moist		31	11				Driller's Notes: Rough drilling 1.5'-2.5'
5	4.5 / 764.4		Loamy Sand and Gravel, brown and moist		10	9				
	7.0 / 761.9		Loamy Fine Sand, brown, moist to wet		12	14				Driller's Notes: Rough drilling 6.5'- 7.5'
10	9.5 / 759.4		Silt with a seam of slightly plastic Silt Loam, brown very moist		2	26				High very fine sand content
	12.0 / 756.9		Silty Clay Loam with few roots, browns, very moist		20	48 / 19				
15	13.5 / 755.4		Loamy Sand and Gravel with stone chips 13.5'-19.0', browns, moist to wet		35 / PD / 52	6 / 15				Driller's Notes: Rough drilling 13.5'- 29.0'
20					88 / PD / 15 50 50/.2	12 / 10				
	23.5 / 745.4		Medium-Grained Sand with a thin seam of slightly plastic Silt Loam at 25.0' and a little Gravel at 27.5'; stone chips at 29.5' browns, wet		PD / 63 / PD / 97 / PD / 17 50/.4	7 / 10 / 18				
25	29.9 / 739.0		Bottom of Hole -29.9"							

No water encountered or measured during drilling

Soil Class:JAH Rock Class: Edit: Date: 6/14/17

G:\GINT\PROJECTS-ACTIVE\8825-562- OVERHEAD SIGN (TH 10 & 35W & 94).GPJ

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

UNIQUE NUMBER 82034

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
8825-562	**Overhead Sign**	**Interstate Highway TH 10 & 35 & 94**	**T03**	**903.4** *(DTM)*

Location Anoka Coord:X=517835 Y=129634 (ft.)

Latitude (North)=45°06'59.5" *Longitude (West)=93°11'51.31"*

No Station-Offset Information Available

Drill Machine **209332 GeoProbe**

Hammer **GeoProbe Automatic**

SHEET 1 of 1

Drilling Completed **5/23/17**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} (%) REC	MC (%) RQD	COH (psf) ACL (ft)	γ (pcf) Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
	1.5 / 901.9		slightly organic slightly plastic Silt Loam, black, moist		3	17				
			Loamy Fine Sand with IOS, browns, moist		17	17				
5	5.5 / 897.9		Very Fine Sand, browns, saturated		8	28				
	8.5 / 894.9									
10			Silt, gray, saturated		9	29				
	11.0 / 892.4			PD	40	21				
				PD	42	21				
15				PD	43	20				
				PD	31	21				
20			Fine Sand with Very Fine Sand at 30.0', gray, saturated	PD	19	24				
				PD	22	24				
25				PD	6	27				
				PD	33	23				
30	30.5 / 872.9		Bottom of Hole -30.5'							

Water measured at 8.5' with auger

Index Sheet Code 3.0

Soil Class:JAH Rock Class: Edit: Date: 6/14/17

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MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

UNIQUE NUMBER 82041

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
8825-562	Overhead Sign	Interstate Highway TH 10 & 35 & 94	T04	905.2 (DTM)

Location: Anoka Coord:X=517860 Y=129740 (ft.)
Latitude (North)=45°07'00.55" Longitude (West)=93°11'50.95"
No Station-Offset Information Available

Drill Machine: 205120 CME(LC55) Track
Hammer: CME Automatic Calibrated

SHEET 1 of 1
Drilling Completed: 6/1/17

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N60 (%) / REC (%)	MC (%) / RQD (%)	COH (psf) / ACL (ft)	γ (pcf) / Core Breaks	Soil / Rock	Other Tests Or Remarks / Formation or Member
0										
5	6.0 / 899.2		Fine Sand, browns, moist		22 / 20 / 14 / 20	17 / 17 / 26 / 23				
10	11.0 / 894.2		Very Fine Sand, gray, moist to wet	PD	38 / 47 / 34 / 15 / 24 / 26 / 15 / 25	20 / 22 / 24 / 24 / 24 / 27 / 26 / 26				High Silt content
15				PD						
20			Fine Sand, gray, saturated	PD						
25				PD						
30	30.5 / 874.7		Bottom of Hole -30.5'	PD						

Water measured at 10.9' with auger

Index Sheet Code 3.0

Soil Class:JAH Rock Class: Edit: Date: 6/14/17

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MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

UNIQUE NUMBER 82035

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Boring No.	Ground Elevation
8825-562	**Overhead Sign**	**Interstate Highway TH 10 & 35 & 94**	**T05**	**1011.2** *(DTM)*

Location: Dakota Coord:X=508973 Y=193060 (ft.)

Latitude (North)=44°43'37.85" Longitude (West)=93°16'55.72"

No Station-Offset Information Available

Drill Machine: **209332 GeoProbe**

Hammer: **GeoProbe Automatic**

SHEET 1 of 1

Drilling Completed: **5/17/17**

DEPTH	Depth / Elev.	Lithology	Classification	Drilling Operation	SPT N_{60} (%)	MC (%)	COH (psf)	γ (pcf)	Soil / Rock	Other Tests Or Remarks / Formation or Member
	0.5 1010.7		Topsoil with roots, dark-brown, moist		15	33				
			Medium-Grained Sand, brown, damp		14	3				
5					8	4				
	7.0 1004.2				6	4				
10					10	9				
			Fine-Grained Sand, brown, damp		2	8				
15					12	9				
					14	7				
20					10	6				
	22.0 989.2									rough drilling 22.0'-27.0'
					12	5				
25			Medium-Grained Sand with some Gravel, brown, damp		7	4				
					9	3				
30										
	31.5 979.7				11	8				

Bottom of Hole -31.5'

No water encountered or measured during drilling

Index Sheet Code 3.0

Soil Class:JAH Rock Class: Edit: Date: 6/14/17

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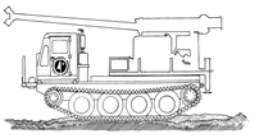
Minnesota Department of Transportation
Geotechnical Section
Cone Penetration Test Index Sheet 1.0 (CPT 1.0)



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)

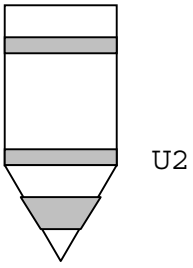
q_T TIP RESISTANCE
The resistance at the cone corrected for water pressure. Data is from cone with 60 degree apex angle and a 10 cm^2 end area.

f_s SLEEVE FRICTION RESISTANCE
The resistance along the sleeve of the penetrometer.

FR Friction Ratio
Ratio of sleeve friction over corrected tip resistance.
FR = fs/qt

V_s Shear Wave Velocity
A measure of the speed at which a siesmic 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.



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.

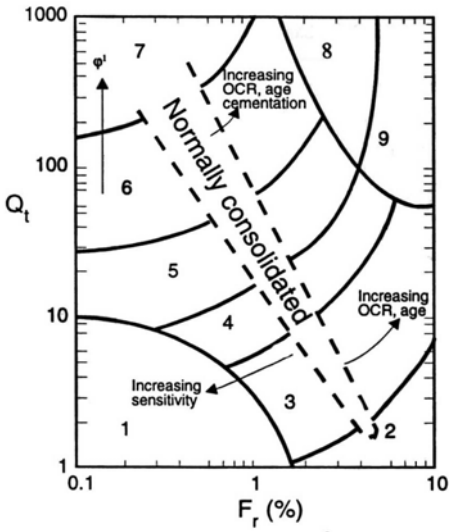
The numbers corresponding to different regions on the charts represent the following soil behavior types:

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

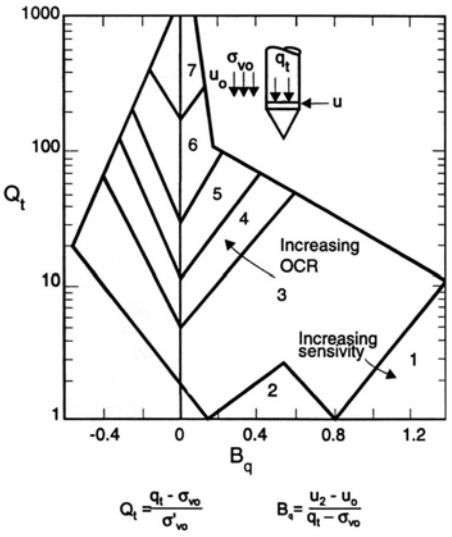
Note that engineering judgment, and comparison with conventional borings is especially important in the proper interpretation of CPT data in certain geo-materials.

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 ...
Q_T ..... normalized cone resistance
B_q ..... pore pressure ratio
F_r ..... Normalized friction ratio
σ_{vo} ..... overburden pressure
σ'_{vo} ..... effective over burden pressure
u_2 ..... measured pore pressure
u_0 ..... equilibrium pore pressure

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

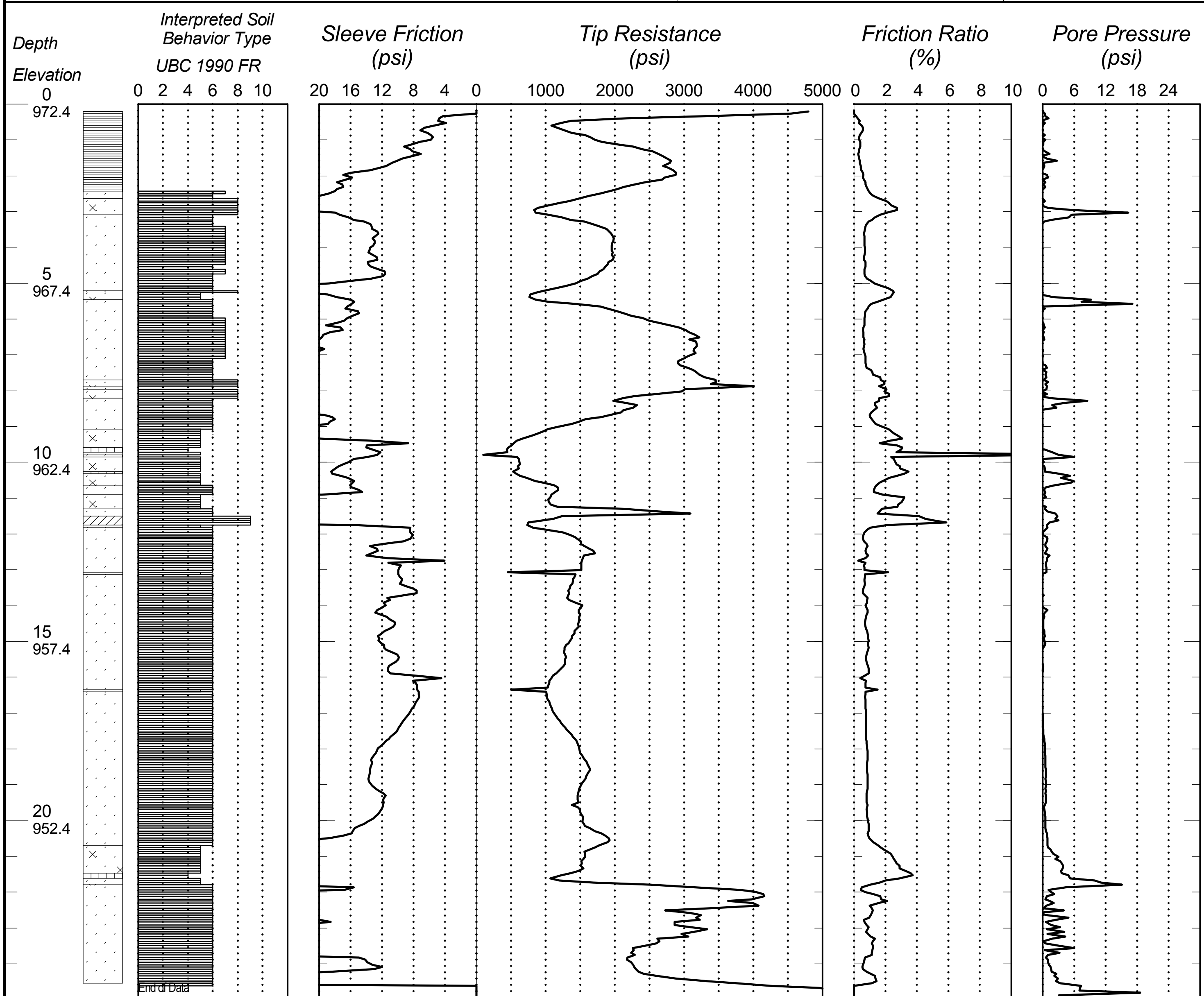
CONE PENETRATION TEST RESULTS

UNIQUE NUMBER 82536

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Sounding No.	Ground Elevation
8825-562	**Overhead Sign**	**TH 10 & 35 & 94**	**c07**	**972.4** (GeoXH(DC))

Location **Dakota Co. Coordinate: X=508728 Y=196508** (ft.)	CPT Machine **203094 CPT Truck**	SHEET 1 of 1
Latitude (North)=44°44'11.9" Longitude (West)=93°16'59.1"	CPT Operator **Buhl, Dylan**	Date Completed
No Station-Offset Information Available	Hole Type **CPT-STD**	**6/13/17**



Bottom of Hole 24.94
,Planned Depth

Index Sheet Code 3.0

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