DATE: September 23, 2008

TO: Dan Dorgan, State Bridge Engineer  
Office of Bridges & Structures

FROM: Jeff Narr, Graduate Engineer-1  
Geotechnical Engineering Section

CONCUR: Rich Lamb, Foundations Project Engineer  
Geotechnical Engineering Section

CONCUR: Gary Person, Foundations Engineer  
Geotechnical Engineering Section

SUBJECT: S.P. 6241-51 Bridge 62049  
Larpenteur Ave. over railroad parallel to TH 280  
Replacing Bridge 6630  
Subsurface Investigation & Foundation Analysis

Project Description

This report provides a foundation analysis and recommendations for a new bridge (62049) replacing bridge (6630). The new single span bridge will use 14 inch prestressed concrete beams. The new bridge will be roughly 100 feet wide by 44 feet long. The substructures are to be supported on semi-integral abutments resting on either H piles or spread footings.

Field Investigation and Foundation Conditions

Braun Intertec advanced two foundation borings in May of 2008. Mn/DOT performed one seismic cone penetration test in September of 2008. Copies of the borings are included with this report.

West Abutment
The foundation soils encountered at the west abutment consist of 11 ft. of sandy loam (to an approximate elevation of 925 ft.) followed by 8 ft. of loamy sand. The last 57 ft. of boring is predominantly medium dense to very dense fine sand.

East Abutment
The foundation soils encountered at the East Abutment consist of 17 ft. of medium dense sandy loam (to an approximate elevation of 922 ft.) followed by 7 ft. of sand & gravel. The next 50 ft. is fine sand of varying densities. The final 11 ft. consisted of stiff clay loam or sandy loam.

Foundation Analysis
Approximate roadway elevations were determined from a Preliminary Bridge Plan provided by Mn/DOT’s Bridge Office. The bottom of footing elevation was assumed to be at 905 ft.
Shallow Foundation – Service Limit State
Two different models were used for the LRFD service limit state settlement calculations. The first model uses seismic CPT data (shear wave velocity) along with elasticity theory. The second model was based on SPT data and elasticity theory. The first model has shown more accurate settlement estimates in these soil types. Therefore, it was used to develop the settlement graphs for each abutment. Normally the 1 inch settlement criterion is used. However, if a greater nominal bearing capacity is required, 1.5 inch settlement is satisfactory. The settlement at the time of setting the beams may be less than predicted. This is due to some settlement occurring during the construction of the footing and stem.

Up to 22 ft. of fill will be placed at each abutment location. This fill should be placed and allowed to remain for three days before the abutment construction can begin. This will ensure that further settlements are due to bridge loading and not soil surcharges. To further minimize differential settlement, it is recommended that a 2 foot subcut be constructed, backfilled, and compacted with aggregate bedding beneath the footings.

Where spread footings are used for bridges: “[FHWA recommends] that the performance of the shallow foundation be monitored, so that actual settlements can be determined and the settlement analysis method can be calibrated for a specific geology or region of the country.” (FHWA NHI-01-023). Please contact our office if there is interest in monitoring foundation performance with respect to load or deflection.

Shallow Foundation – Strength Limit State
The strength limit state of the soil’s nominal bearing capacity was computed for varying footing widths. The strength limit is not the limiting case for this site; the service limit settlement state will control the design.

The following are the resistance factors for evaluation of the strength limit state performance limits based on the latest LRFD code.

- Bearing Resistance, using SPT = 0.45
- Sliding, Cast-in-Place Concrete on Sand = 0.80

Refer to the following figures in the appendix for the nominal bearing resistance and service limit state for the substructures on this project.

- Figure 1: West Abutment – 1 inch settlement
- Figure 2: West Abutment – 1.5 inch settlement
- Figure 3: East Abutment – 1 inch settlement
- Figure 4: East Abutment – 1.5 inch settlement
- Figure 5: East Abutment – Pile Capacity
- Figure 6: West Abutment – Pile Capacity

Pile Foundation
Driven H piles were also analyzed as an alternative foundation for the semi-integral abutments. A static pile capacity analysis was performed using the DRIVEN program. A HP 12x53 section was analyzed for the abutments. Bearing capacity graphs were generated for each abutment location. The graphs represent the LRFD Nominal Resistance of soil bearing capacity based on the pile bearing elevation. A set-up factor of 1.2 was used in modeling the granular soils, and 1.5 was used for cohesive soils. The capacities shown are at the strength limit and shall be reduced by a factor. This reduction factor ($\phi$) shall be based on the method used for construction control in accordance with applicable design codes (LRFD). The graphs are located in the appendix of this report.
Recommendations

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

1. Topsoil and other organic material should be removed from areas where fill is to be placed. These soils should be excavated and replaced with Granular Borrow (Mn/DOT spec. 3149.2B1) and compacted to maximum Standard Proctor density.

2. Place approach fills to full height and width and allow to remain in-place for 3 days before beginning construction of the abutments.

3. Embankment slopes are recommended to be constructed at 3H : 1V or shallower, for stability and to reduce erosion from overland flow. Vegetation should be established as quickly as possible after construction to minimize the potential for erosion.

4. Drainage shall be installed as appropriate at the footing locations to ensure that the bearing soils and soils behind the abutment are free draining. Drainage should be provided from the base of the footing subcut soils and from the rear of the abutment walls, similar to retaining wall drainage plans as used on recent projects.

5. The abutments may be placed on either spread footings or piling based on the attached graphs. For spread footing design use the seismic CPT settlement prediction. The SPT line is presented for comparison.

6. A 2 foot subcut is required beneath spread footings to further minimize differential settlement. Backfill subcut with Aggregate Bedding (Mn/DOT Spec. 3149.2G) and compact to maximum Standard Proctor density.

7. The footings should be buried a minimum of 4.5 feet below the final ground line for frost protection.

8. Further investigation utilizing wave equation analysis must be performed to determine the drivability of the pile. In addition, the wave equation analysis can determine the driving stresses and blow count based upon hammer size. Thus, the wall thickness and required hammer size can be determined to reach a desired ultimate capacity.

9. Please contact our office if there is interest in monitoring the loads and settlements for the foundations at this bridge during construction so improved correlations can be developed for the geotechnical prediction methods based on observed field behavior.

Attachments:
Spread Footing Bearing Resistance Graphs (Figures 1 to 4), Pile Capacity Graphs (Figures 5, 6)
Boring Plan, Bridge Profile, SPT index sheet, CPT index sheet
SPT Boring Logs STBR-4, STBR-6 (Unique # 70688, 70689)
CPT Siesmic Sounding CS52a (Unique # 70901)

cc: D. Dorgan, G. Engstrom
    T. Styrbicki, R. Evbayekha
    D. VanDeusen
    File
### Figure 1: West Abutment – 1 inch settlement

#### Effective Footing Width (ft.)

<table>
<thead>
<tr>
<th>Effective Footing Width (ft.)</th>
<th>Nominal Bearing Resistance, Service Limit State (ksf)</th>
<th>Nominal Bearing Resistance, Strength &amp; Extreme Limit State (ksf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>30.0</td>
<td>Service Limit State - Westergaard [SPT]</td>
</tr>
<tr>
<td>8</td>
<td>35.0</td>
<td>Service Limit State - Siesmic [CPT]</td>
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<td>10</td>
<td>40.0</td>
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</table>

- **LRFD (1.0 inch Settlement)**
- **SP 6241-51 BR 62049**
- **West Abutment - Boring (STBR-6, cs52a)**
Figure 2: West Abutment – 1.5 inch settlement

![Graph showing nominal bearing resistance and effective footing width](image-url)
Figure 3: East Abutment – 1 inch settlement
Figure 4: East Abutment – 1.5 inch settlement
Figure 5: East Abutment Pile Capacity

![Graph showing East Abutment Pile Capacity](image-url)
Figure 6: West Abutment Pile Capacity

Boring STBR-6(West Abutment)  HP 12x53
Bottom of Footing Elevation, ft: 905.0

- Static Capacity
- Time-of-Drive Capacity
- Set-up (estimated)
DECK GIRDER BRIDGE THAT IS 68.3' OF CONTRACT. BRIDGE NO. 6630 IS A 96.5' LONG, 3 SPAN, CONCRETE GIRDER BRIDGE THAT IS 68.3' WIDE AND WAS BUILT IN 1954.

GENERAL PLAN

WEST ABUTMENT

V.P.C. STA. 13+22.73

P.C. STA. 14+31.08

EAST ABUTMENT

P.C. STA. 14+84.32

LARPENTEUR AVE. E.B. (LARPE)
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 interlopations 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.

**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

**WATER MEASUREMENT**
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**DRILLING SYMBOLS**
- Vane Shear Test
- Washed Sample (Collected during plug drilling)
- Augered
- Plug Drilled
- Split Tube Sample (SPT No. 2 in. split tube with liner)
- Thin Wall Sample (3 in. Shelby Tube)
- Core Drilled (W/ Core Barrel unless otherwise noted)
- Continuous Soil Sample
- Augered & Jetted
- Jetted
- Augered & Plug Drilled

**Relative Density - Granular Soils**
- BPF (English Units)

**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

**SOIL/ROCK TERMS**
- C: Clay
- S: Sand
- L: Loam
- D: Dolostone
- Bldr: Bolder
- Scl: Silt
- Lmst: Limestone
- Sst: Siltstone
- Dso: Dolostone
- Si: Silt
- Grv: Gravel
- Bl: Boulder
- T: Till
- Lm: Limestone
- Sl: Silt
- Cl: Clay
- Gnt: Gneiss
- Sw: Shale
- Sr: Sandstone
- Sl: Silt
- Wd: Wood

**COLOR**
- blk: Black
- wht: White
- grn: Green
- brn: Brown
- orang: Orange
- yel: Yellow
- dk: Dark
- it: Light
- IOS: Iron Oxide Stained

**GRAIN SIZE (PLASTICITY)**
- VF: Very Fine
- F: Fine
- slpl: Slightly Plastic
- Cr: Coarse

**CONSISTENCY - COHESIVE SOILS**
- BPF (English Units)

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- BPF (English Units)

**CONSISTENCY - GRANULAR SOILS**
- BPF (English Units)
MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION
LABORATORY LOG & TEST RESULTS - SUBSURFACE EXPLORATION

UNIQUE NUMBER 70688
U.S. Customary Units

State Project 6241-51 Bridge No. or Job Desc. Trunk Highway/Location MN Trunk Highway 280 Boring No. STBR-4 Ground Elevation 939.7 (Surveyed)

Location, ft. LT Ramsey Co. Coordinate: X=545926 Y=173126 (ft.)
Latitude (North)=44°59'29.51" Longitude (West)=93°12'20.98"

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<th>Classification</th>
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<tr>
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<td>LOAMY F SAND, w/ trace of G, bm, moist, loose, fill</td>
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<td>5.0</td>
<td>pl SANDY LOAM, w/G and Gravelly layers, bm, moist, stiff, fill</td>
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<td>spl F SANDY LOAM, w/ trace of roots, bm, moist, Vloose to meddense</td>
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<td>SAND &amp; GRAVEL, bm, moist, meddense</td>
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Drill Machine: 7511 Hammer: CME Automatic Calibrated
Ground Elevation (Surveyed): 939.7

This boring was taken by Braun Intertec under a consultant contract for Mn/DOT

UNIQUE NUMBER 70688
U.S. Customary Units

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<td>spl F SANDY LOAM, w/ trace of roots, bm, moist, Vloose to meddense</td>
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<td>SAND &amp; GRAVEL, bm, moist, meddense</td>
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<td>F SAND, w/G, it bm, moist, loose to meddense to dense to Vdense</td>
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<th>COH</th>
<th>SPT Net</th>
<th>RQD Core</th>
<th>Soil Classification</th>
<th>Rock Classification</th>
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This boring was taken by Braun Intertec under a consultant contract for Mn/DOT.
**F SAND, w/G, lt brn, moist, loose to meddense to dense to Vdense (continued)**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Classification</th>
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<tbody>
<tr>
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<td>F SAND, w/G, lt brn, moist, loose to meddense to dense to Vdense</td>
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<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Ground Elevation (Surveyed)</th>
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<tbody>
<tr>
<td>69.0</td>
<td>939.7</td>
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<table>
<thead>
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<th>Depth (ft)</th>
<th>Soil Class: P. Martin Rock Class:</th>
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This boring was taken by Braun Intertec under a consultant contract for Mn/DOT.
<table>
<thead>
<tr>
<th>Depth (ft)</th>
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<th>SPT Nø</th>
<th>MC (%)</th>
<th>COH (psf)</th>
<th>γ (pcf)</th>
<th>Soil</th>
<th>Rock</th>
<th>Other Tests Or Remarks</th>
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<tr>
<td>856.7</td>
<td>spl SANDY LOAM, w/chunks of shale, brn, sat, meddense</td>
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<tr>
<td>853.7</td>
<td>Bottom of Hole - 86' Water measured at 70' while sampling and/or drilling Borehole then grouted with bentonite</td>
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Ground Elevation: 939.7 (Surveyed)

This boring was taken by Braun Intertec under a consultant contract for Mn/DOT.
### Soil Classification and Properties

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<tr>
<th>Depth (ft.)</th>
<th>Classification</th>
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<tbody>
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<td>pl SANDY LOAM w/ a little G, blk, moist, topsoil</td>
</tr>
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<td>5</td>
<td>pl SANDY LOAM w/ a little G, brn, moist, soft to Vstiff</td>
</tr>
<tr>
<td>10.5</td>
<td>LOAMY SAND, w/ G, brn, moist, meddense</td>
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<tr>
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<tr>
<td>19.0</td>
<td>F SAND, w/G, brn, moist, meddense</td>
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<tr>
<td>20</td>
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</table>

#### Drilling Details
- **Location**: Ramsey Co. Coordinate: X=545766 Y=173222 (ft.)
- **Gender**: 44°59'30.46" Longitude (West)=93°12'23.21"

#### Ground Elevation
- **Surveyed**: 935.6 ft.

#### Other Tests
- **SPT Nbr**: 7511
- **MC (%)**: 3
- **COH (psf)**: 13
- **γ (pcf)**: 23

#### Soil Classifications
- **Formation or Member**

#### Site Information
- **State Project No.**: 6241-51
- **Bridge No. or Job Desc.**: MN Trunk Highway 280
- **Trunk Highway/Location**: MN Trunk Highway 280
- **Boring No.**: STBR-6
- **Drill Machine**: CME Automatic Calibrated
- **Hammer**: 5/12/08
- **Completed**: 5/12/08
**Mn/DOT GEOTECHNICAL SECTION - LOG & TEST RESULTS**

**State Project** 6241-51  
**Bridge No. or Job Desc.**  
**Trunk Highway/Location** MN Trunk Highway 280  
**Boring No.** STBR-6  
**Ground Elevation** 935.6 (Surveyed)

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>29.0</td>
<td>F SAND, w/G, brn, moist, meddense (continued)</td>
</tr>
<tr>
<td>30.0</td>
<td>F SAND, w/G and some Bliders, lt brn, moist to 63' then sat, meddense to Vdense</td>
</tr>
</tbody>
</table>

**Notes:**
- Estimated footing depth
- This boring was taken by Braun Intertec under a consultant contract for Mn/DOT
- Soil Class: P, Martin Rock Class: Edit: Date: 8/5/08
- Ground Elevation: 935.6 (Surveyed)

**U.S. Customary Units**

<table>
<thead>
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**Ground Elevation (Surveyed)**

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<th>Classification</th>
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</thead>
<tbody>
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</tr>
<tr>
<td>30.0</td>
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</table>

**Notes:**
- Estimated footing depth
- This boring was taken by Braun Intertec under a consultant contract for Mn/DOT
- Soil Class: P, Martin Rock Class: Edit: Date: 8/5/08
- Ground Elevation: 935.6 (Surveyed)
F SAND w/G and some Bldrs, lt brn, moist to 63' then sat, meddense to Vdense (continued)

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Classification</th>
<th>Other Tests</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
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<td></td>
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<tr>
<td>75</td>
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</table>

(Continued Next Page)
This boring was taken by Braun Intertec under a consultant contract for Mn/DOT.

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>76.0</td>
<td>F SAND w/G and some Bldrs, lt brn, moist to 63' then sat, meddense to Vdense (continued)</td>
</tr>
<tr>
<td>859.6</td>
<td>Bottom of Hole - 76’</td>
</tr>
<tr>
<td></td>
<td>Water measured at 65’ while sampling and/or drilling</td>
</tr>
<tr>
<td></td>
<td>Borehole then grouted with bentonite</td>
</tr>
</tbody>
</table>

Ground Elevation (Surveyed): 935.6

**Formation**

**Drilling Operation**

**Other Tests Or Remarks**

**U.S. Customary Units**

**Laboratory Log & Test Results - Subsurface Exploration**

Mn/DOT Geotechnical Section - Log & Test Results Sheet 4 of 4

State Project 6241-51

Bridge No. or Job Desc.

Trunk Highway/Location MN Trunk Highway 280

Boring No. STBR-6

Ground Elevation 935.6 (Surveyed)

**Soil Class:** P. **Rock Class:** Edit: Date: 8/5/08

UNIQUE NUMBER 70689

**MN Trunk Highway 280**

**MN Trunk Highway/Location**

**Other Tests Or Remarks**

**Soil Class:** P. **Rock Class:** Edit: Date: 8/5/08
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 constant 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, pore waters 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
Pleasccone...Common name for CPTU test

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

**qt** TIP RESISTANCE

The resistance at the cone corrected for water pressure. Data is from cone with 60 degree apex angle and a 10 cm² end area.

**fₚ** SLEEVE FRICTION RESISTANCE

The resistance along the sleeve of the penetrometer.

**FR** Friction Ratio

\[ FR = \frac{q_t}{f_p} \]

**Vₙ** 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 measurements are considered to be dynamic and Statically 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 geomaterials.

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

### Robertson CPT 1990

Soil Behavior type based on pore pressure

\[ Q_u = \frac{u_0 - u_v}{\sigma_{vo}} \]

\[ B_r = \frac{B_0}{B_1} \]

where:

- \( Q_u \) ............normalized cone resistance
- \( B_r \) .............pore pressure ratio
- \( F_r \) ..............Normalized friction ratio
- \( \sigma_{vo} \) .........overburden pressure
- \( \sigma_{vo} \) .........effective overburden pressure
- \( u_2 \) ..............measured pore pressure
- \( u_0 \) ..............equilibrium pore pressure
## Cone Penetration Test Results

### Unique Number 70901

**U.S. Customary Units**

<table>
<thead>
<tr>
<th>State Project</th>
<th>Bridge No. or Job Desc.</th>
<th>Trunk Highway/Location</th>
<th>Sounding No.</th>
<th>Ground Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>6241-51</td>
<td>62048</td>
<td>280</td>
<td>cs52a</td>
<td>934.8 (from Plan*)</td>
</tr>
</tbody>
</table>

**Location**
- Ramsey Co. Coordinate: X=545757, Y=173226 (ft.)
- Latitude (North) = 44°59'30.50"
- Longitude (West) = 93°12'23.34"

**CPT Machine**
- 205146 CPT Truck (H)

**CPT Operator**
- J. Hasselquist

**Date Completed**
- 9/3/08

### Cone Penetration Test Details

<table>
<thead>
<tr>
<th>Depth (Elevation)</th>
<th>Interpreted Soil Behavior Type</th>
<th>UBC 1990 FR</th>
<th>Sleeve Friction (psi)</th>
<th>Tip Resistance (psi)</th>
<th>Friction Ratio (%)</th>
<th>Pore Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>0</td>
<td>1000</td>
<td>10</td>
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<td>5</td>
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<td>1800</td>
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<td>20</td>
<td>2700</td>
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<tr>
<td>934.8</td>
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<td></td>
<td>30</td>
<td>3600</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>

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**Index Sheet Code**: 3.0

**Location**: (ft.)

**CPT-SEISMIC**

**Soil Class**: Rock

**Edit**: Date: 9/22/08

**Unique Number**: 70901

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**G:\GINT\PROJECTS-ACTIVE\6241-51_TH280_LARPENTEUR.GPJ**

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(Continued Next Page)
### Cone Penetration Test Results

#### Mn/DOT Geotechnical Section - Cone Penetration Test Results

<table>
<thead>
<tr>
<th>Depth Elevation</th>
<th>Interpreted Soil Behavior Type</th>
<th>Waist Friction (psi)</th>
<th>Tip Resistance (psi)</th>
<th>Friction Ratio (%)</th>
<th>Pore Pressure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 ft (879.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 ft (874.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bottom of Hole 62.42

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**Ground Elevation: 934.8 (from Plan*)**

**State Project:** 6241-51  
**Bridge No. or Job Desc.:** 62048  
**Trunk Highway/Location:** 280  
**Sounding No.:** cs52a  
---

**U.S. Customary Units**

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**MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION**

**UNIQUE NUMBER 70901**

**Bridge No. or Job Desc.**

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**UBC 1990 FR**