

**FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH-OCCUPANCY TOLL AND
HIGH-OCCUPANCY TOLL HMS SIGN SUPPORTS
HIGHWAY 427 REHABILITATION
FROM FASKEN DRIVE TO FINCH AVENUE
TORONTO, ONTARIO
G.W.P. 202-95-00**

GEOCRES NO. 30M12-407

Submitted

to

SNC-Lavalin Inc.

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PART 1 FACTUAL INFORMATION

1.0 INTRODUCTION

This report presents relevant factual data from previous foundation investigations for the detailed design of High-Occupancy Toll (HOT) and High-Occupancy Toll HMS (HOT HMS) sign supports. The sign supports will be located at specific locations along Highway 427, from Fasken Drive to Finch Avenue in Toronto, Ontario. This project is a part of the overall project for the rehabilitation of Highway 427.

Thurber has been retained by SNC-Lavalin Inc. (SLI) to carry out this study under the Ministry of Transportation Ontario (MTO) Agreement No. 2014-E-0060-03.

The purpose of this investigation was to review available subsurface information near the proposed locations of the HOT and HOT HMS sign supports and, based on this data, to provide borehole location plans, records of boreholes, and a written description of the subsurface conditions.

For preparation of this report, reference has been made to previous reports listed as follows:

- Foundation Investigation Report, Highway 427 Widening From Fasken Drive To Steeles Avenue, High Mast Lighting Poles, Overhead Sign Supports, Toronto,

Ontario, G.W.P. 202-95-00, Geocres No. 30M12-291, File 19-92-70, dated March 12, 2010 (Reference 1).

- Engineering Materials Office, Foundation Design Section, report titled “High Mast Lighting, Hwy. 427 from Campus Rd./Fasken Dr. to Steeles Avenue”, W.P. 615-89-00, Dist. 6, Geocres No. 30M12-224, dated January 25, 1995 (Reference 2).
- Foundation Investigation Report titled “Highway 427 Overpass Widening at Fasken Drive/Campus Road”, W.P. 187-94-01/02 and 273-66, Site 37-0986, Central Region, Geocres No. 30M12-227, dated March 3, 1972 (Reference 3).
- F.T.M.S. – Overhead Signs, Highway 427 SB to Turning Roadway Over Highway 409, Engineering Materials Office, Foundation Design Section, W.P. 48-71-22, District 6, Toronto, Geocres 30M12-206. (Reference 4).
- Foundation Investigation Report for The Proposed Underpass Structure at the Crossing of Highway 427 and Rexdale Blvd. Borough of Etobicoke, County of York, District No. 6, Toronto”, W.O. 72-11024, W.P. 126-60, Site 37-982, Geocres No. 30M12-061. (Reference 5).

2.0 SITE DESCRIPTION

Eight (8) HOT sign supports and three (3) HOT HMS sign supports are to be located at the median of the northbound and southbound lanes, along the alignment of the proposed Highway 427 between Fasken Drive and Finch Avenue in Toronto, Ontario.

The land usage adjacent to this section of Highway 427 is generally a combination of commercial, industrial and residential.

The project area is located within the physiographic region known as the South Slope which is comprised predominantly of the Halton drift (till). The Halton till is an interbedded complex of clayey silt to silt till and sand. This till comprises a slightly hummocky till plain, into which the surface watercourses have eroded 10 to 15 m deep gullies. Relatively recent fluvial sediments have been deposited in the gullies. The Halton drift overlies bedrock at depths in the order of 100 m in the vicinity of the project area. The bedrock consists of grey shale with hard siltstone and limestone interlayers of the Georgian Bay Formation.

3.0 SITE INVESTIGATION AND FIELD TESTING

A site investigation was not carried out for the current project as per the direction from MTO. Instead, selected borehole information from previous investigations at the site has been used (References 1 to 5). Table 3.1 indicates the reference boreholes that were used to assess the subsurface conditions at the proposed HOT and HOT HMS sign support locations. These are generally the closest available boreholes to each sign support. Since the boreholes were drilled between 1972 and 1994, and there has been recent and ongoing reconstruction of the highway and its structures, it is possible that the current ground surface elevations may differ and the subsurface stratigraphy may include additional fill that is not shown on the reference borehole logs. The approximate locations of the proposed HOT and HOT HMS sign supports, and previously drilled boreholes in the vicinity are shown on the Borehole Location drawings in Appendix B.

Table 3.1 Proposed HOT and HOT HMS locations and Reference Boreholes

| HOT / HOT HMS Number | Station | Reference Borehole | Ground Surface Elevation (m) (Year of Investigation) | Reference Borehole Station/Location |
|-------------------------------------|----------------|--------------------------------|---|--|
| HMS01 | 20+209 (NB) | 1,3 (273-66) ¹ | 165.8 (1972) | 20+343 20+347 |
| TS01 | 20+913 | 2 (615-89-00) ² | 164.5 (1994) | 20+975 |
| TS02 | 21+637 | 4 (615-89-00) ² | 166.7 (1994) | 20+619 |
| TS03 | 22+158 | 4 (48-71-22) ³ | 173.0 (1988) | 22+233 |
| HMS02 | 22+697 (NB) | 6 (48-71-22) ³ | 171.1 (1988) | 22+707 |
| TS04 | 22+785 | 6 (48-71-22) ³ | 171.1 (1988) | 22+707 |
| TS05 | 23+279 | 7 (615-89-00) ² | 166.3 (1994) | 23+231 |
| TS06 | 23+821 | 1 (126-60) ⁴ | 168.4 (1972) | 23+857 |
| TS07 | 23+975 | 7 (126-60) ⁴ | 168.0 (1972) | 23+902 |
| TS08 | 24+475 | 11 (615-89-00) ² | 162.1 (1994) | 24+440 |
| HMS03 | 25+045 (SB) | 13 (615-89-00) ² | 162.5 (1994) | 25+096 |

(1) Reference 3

(2) Reference 2

(3) Reference 4

(4) Reference 5

4.0 SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy from previous investigations are presented on the Record of Borehole sheets in Appendix A. A general description of the

stratigraphy established at relevant boreholes near the proposed HOT and HOT HMS sign supports is presented in the following paragraphs. The factual data presented in the records of boreholes governs any interpretation of the site conditions. It should be noted that the subsurface conditions may vary between and beyond the borehole locations. It is also noted that the quoted depths are referenced to the original ground surface at the time of the investigations.

In general, the subsurface conditions encountered in most boreholes consist of clayey silt embankment fill with occasional layers of organics. Underlying the embankment fill or exposed at the original ground surface is an extensive deposit of native, stiff to hard clayey silt till containing typically compact to very dense sand and silt interlayers. Deposits of native clayey silt to silt were encountered surficially in some boreholes. It is noted that glacial tills inherently contain cobbles and boulders, and could be inferred by the refusal 'N' values recorded in some boreholes. Shale bedrock was contacted below the clayey silt till and clayey silt in four boreholes at depths ranging from 21.6 m to 26.4 m (Elevations 144.2 to 142.1), and at 7.1 m (Elevation 155.4) at one location.

4.1 Embankment Fill

Boreholes 2, 4, 7 (WP 615-89-00), and Boreholes 4, 6 (WP 48-71-22) drilled within the project area, along the Highway 427 median, encountered embankment fill consisting of brown to grey clayey silt containing some sand and trace gravel. Layers of organics were encountered in two boreholes (4 and 6 from WP 48-71-22).

The thickness of the embankment fill ranged from 2.1 m to 9.1 m. The depth to the base of the embankment fill ranged from 2.1 m to 9.1 m (Elevations 160.8 to 165.0).

SPT 'N' values recorded in the cohesive embankment fill varied from 10 to 40 (typically 12 to 23) blows per 0.3 m penetration indicating a stiff to hard consistency. Lower SPT 'N' values, ranging from 4 to 9 blows per 0.3 m of penetration, indicating firm to stiff consistency, were measured in Borehole 7 (WP 615-89-00). Moisture content measured in the embankment fill ranged from 18 percent to 22 percent.

4.2 Clayey Silt Till

A clayey silt till deposit with sand and trace to some gravel was encountered surficially in Boreholes 1, 3 (WP 273-66) and 1, 7 (WP 126-60), and below the fill or other soils in Boreholes 2, 4, 7, 11 (WP 615-89-00) and 4, 6 (WP 48-71-22) at depths generally ranging from 2.1 m to 9.1 m. In Borehole 11 (WP 615-89-00), the clayey silt till was contacted below the clayey silt to silt, at 4.4 m depth (Elevation 157.7). The thickness of the clayey silt till, where fully penetrated, typically ranged from 21.6 m to 26.4 m, and was 4.2 m in Borehole 11. The depth to the base of the clayey silt till varied from 21.6 m to 26.4 (Elevations 142.1 to 144.2), and at 8.6 m (Elevation 153.5) in Borehole 11.

Boreholes 2, 4, 7 (WP 615-89-00), and 4, 6 (WP 48-71-22) were terminated within the clayey silt till at depths ranging from 9.4 m to 12.6 m (Elevations 154.1 to 161.5). SPT 'N' values ranged from 11 blows per 0.3 m penetration to greater than 100 blows for less than 0.3 m of penetration, indicating a stiff to hard consistency. Glacial tills inherently contain cobbles and boulders. Moisture content measured in the clayey silt till ranged from 8 percent to 19 percent, and occasionally up to 28 percent.

4.3 Clayey Silt to Silt

Layers of clayey silt to silt were contacted surficially in Boreholes 11 and 13 (WP 615-89-00). The combined thickness of the clayey silt to silt layer ranged from 2.9 m to 6.4 m. The depth to the base of the clayey silt to silt was 4.0 m and 7.1 m (Elevations 158.1 and 155.4) in Boreholes 11 and 13, respectively.

SPT 'N' values of the clayey silt to silt ranged from 17 to greater than 100 blows per 0.3m of penetration indicating a very stiff to hard consistency. SPT 'N' values greater than 100 blows for less than 0.3 m of penetration in Borehole 13 inferred the presence of cobbles and/or boulders.

4.4 Silty Sand to Sandy Silt Interlayers

Interlayers of silty sand to sandy silt were encountered in Boreholes 1, 7, 11 and 13 (WP 126-00 and WP 615-89-00) at various depths ranging from 1.4 m to 15.2 m. The thickness of these interlayers ranged from 0.4 m to 9.1 m. The depths to the base of the

silty sand and sandy silt layers varied from 2.5 m to 22.1 m (Elevations 145.9 to 156.6). Borehole 11 was terminated within the layer of sandy silt, at 9.6 m (elevation 152.5).

SPT 'N' values measured in the cohesionless layers generally ranged from 13 to 58 blows per 0.3 m of penetration, indicating a compact to very dense state. An SPT 'N' value of 147 blows per 0.3 m of penetration, indicating a very dense condition, was measured at approximate Elevation 146.3 in Borehole 7 (WP 126-60), drilled near Station 23+902. A moisture content measured in a sandy silt to silty sand sample was 17%.

4.5 Shale Bedrock

Shale bedrock was encountered or inferred in five boreholes drilled in proximity to the proposed HOT and HOT HMS sign supports at the following depths and elevations:

Table 4.1 Bedrock depths and elevations

| HOT/HOT HMS Number and Station | Reference Borehole | Borehole Approx. Station | Bedrock depth (m) | Bedrock Elevation (m) |
|--------------------------------|--------------------------------|--------------------------|--------------------|-----------------------|
| HMS01 20+209 (NB) | 1,3 (273-66) ¹ | 20+343 20+347 | 21.6 to 22.3 | 144.2 to 144.0 |
| TS06 23+821 | 1 (126-60) ³ | 23+857 | 26.4 (inferred) | 142.1 (inferred) |
| TS07 23+975 | 7 (126-60) ³ | 23+902 | 25.5 | 142.5 |
| HMS03 25+045 (SB) | 13 (615-89-00) ² | 25+096 | 7.1 | 155.4 |

(1) Reference 3

(2) Reference 2

(3) Reference 5

4.6 Groundwater Conditions

The water levels measured in the open boreholes drilled during the previous investigations are summarized below.

Table 4.2 Water Level Measurements in Open Boreholes

| HOT/HOT HMS Number | Station | Reference Borehole | Date | Depth (m) | Elevation (m) | Comments |
|--------------------------|----------------|--------------------------------|------------------|------------|------------------|----------------------------------|
| HMS01 | 20+209 (NB) | 1,3 (273-66) ¹ | February 1972 | 0.5 to 0.9 | 165.3 | - |
| TS01 | 20+913 | 2 (615-89-00) ² | August 1994 | - | - | Borehole Caved-in at 2.4 m |
| TS02 | 21+637 | 4 (615-89-00) ² | July 1994 | 7.9 | 158.8 | - |
| TS03 | 22+158 | 4 (48-71-22) ³ | March 1988 | 9.5 | 163.5 | - |
| HMS02 | 22+697 (NB) | 6 (48-71-22) ³ | March 1988 | 6.2 | 164.9 | - |
| TS04 | 22+785 | 6 (48-71-22) ³ | March 1988 | 6.2 | 164.9 | - |
| TS05 | 23+279 | 7 (615-89-00) ² | August 1994 | 0.7 | 165.6 | - |
| TS06 | 23+821 | 1 (126-60) ⁴ | March 1972 | 0.3 | 168.1 | - |
| TS07 | 23+975 | 7 (126-60) ⁴ | March 1972 | 0.8 | 167.2 | - |
| TS08 | 24+475 | 11 (615-89-00) ² | August 1994 | 2.4 | 159.7 | - |
| HMS03 | 25+045 (SB) | 13 (615-89-00) ² | August 1994 | 2.0 | 160.5 | - |

(1) Reference 3

(2) Reference 2

(3) Reference 4

(4) Reference 5

Based on the observations in the open boreholes, the water level varies between 0.3 m and 9.8 m depth below the original ground surface (Elevations 158.8 to 168.1). It should be noted that these are very short term observations and groundwater levels are subject

to seasonal fluctuations, severe climatic events and site alterations resulting from construction activities.

5.0 MISCELLANEOUS

Interpretation of the subsurface data and preparation of this report were carried out by Ms. Rocio Palomeque Reyna.

The report was reviewed by Dr. Sydney Pang, P.Eng., and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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PART 2 ENGINEERING DISCUSSION AND RECOMMENDATIONS

6.0 GENERAL

This section of the report presents foundation recommendations for the design of the proposed High-Occupancy Toll (HOT) and High-Occupancy Toll HMS (HOT HMS) sign supports along Highway 427 from Fasken Drive to Finch Avenue in Toronto, Ontario.

This project includes a total of eight (8) HOT and three (3) HOT HMS signs. The HOT sign will be of the cantilever type supported on one median caisson, while the HOT HMS sign will be supported on one median caisson and one outside caisson.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of the Ministry of Transportation, and shall not be used or relied upon for any other purposes or by any other parties including the construction contractor. The contractor must make their own interpretation based on the factual data in Part 1 of the report. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Contractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

Information on the proposed locations of the signs was provided to Thurber by SLI. Based on the proposed design layout, selected boreholes drilled during previous

investigations and in proximity to each proposed sign location were used to evaluate the soil and groundwater conditions for foundation design. The Record of Borehole sheets for these boreholes are presented in Appendix A. Table 1 immediately following the text of this report presents the relevant boreholes that are used for the design of the HOT and HOT HMS sign supports, and the foundation design parameters recommended for each location.

It is noted that since these previous boreholes were drilled between 1972 and 1994, and there has been recent and ongoing reconstruction of the highway and its structures, it is possible that the current ground surface elevations differ from those reported for the boreholes, and that the subsurface stratigraphy may include additional fill that is not shown on the reference borehole records.

6.1 FOUNDATION DESIGN PARAMETERS

Design of the sign support foundations should be carried out in accordance with the following document.

- Ministry of Transportation, Ontario (2015) "Sign Support Manual", Highway Standards Branch, Bridge Office (Reference 6).

Reference should also be made to the following documents.

- Ministry of Transportation, Ontario (2004) "Guidelines for the Design of High Mast Pole Foundations", Fourth Edition, BRO-009, Engineering Standards Branch, Bridge Office (Reference 7).
- Canadian Highway Bridge Design Code and Commentary (2010). CAN/CSA-S6-00 and S6.1-00 (Reference 8).

It is understood that a typical HOT sign support consists of a single conventional augered caisson (drilled shaft). A HOT HMS sign support is designed for two supports. Table 1 following the text of this report presents the recommended parameters for foundation design of such caissons.

It is recommended that MTO's standard designs in Reference 6 be used as a basis for the sign support foundations. The foundation design parameters in Table 1 may be

used in conjunction with References 6 and 7 to confirm that the standard designs are adequate.

In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson within the upper 1.2 m below final grade should be neglected in the foundation design. It is recommended that all topsoil and organics be neglected in determining lateral resistance.

The stabilized groundwater level may be higher.

Where downward sloping fill or native soil exists in front of a caisson, reduction of lateral passive resistance should be taken into consideration during design. For foundation design at the caissons, it should be assumed that full lateral resistance can only be mobilized where the width of the soil in front of or behind the caisson is equal to or greater than approximately four (4) times the diameter of the caissons. For sloping ground in front of a caisson, the magnitude of the mobilized passive resistance can be estimated by interpolating between zero passive resistance at the level where the slope face intersects the caisson, and full passive resistance at the level where the slope face is at a horizontal distance equal to or greater than four (4) times the diameter of the caisson.

Where an unconfined compressive strength, q_u , ($q_u = 2 \times C_u$, undrained shear strength) is provided for a cohesive soil (clayey silt fill, native clayey silt till and clayey silt), the ultimate lateral passive resistance should be calculated in conjunction with the total soil unit weight. When designing for portions of the caissons below the groundwater level in cohesionless sands and silts, the submerged soil unit weight, γ' , should be used. The required depth of the drilled shaft will be governed by lateral loads, including wind loads, acting on the sign. The length of the caisson should also be sufficient to counteract frost jacking (upward) forces.

An equivalent caisson width equal to two (2) times the caisson diameter may be assumed for lateral resistance calculations. Appropriate load and resistance factors should be applied for caisson design.

6.2 CAISSON INSTALLATION

Caisson installation should generally be carried out in accordance with OPSS.PROV 903 and OPSS.PROV 915.

The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for HOT and HOT HMS foundation supports at this site. Suggested wordings for this NSSP are provided in Appendix C.

Caisson installation equipment must be able to dislodge, handle, remove cobbles and boulders, to penetrate obstructions within the fill and to drill through hard or very dense layers, where encountered.

The very short term groundwater levels were observed during the original investigations at between 0.3 m and 9.8 m depths below the original ground surface (Elevations 158.9 to 168.1). The stabilized groundwater levels may be higher. Soil sloughing and water seepage may occur in unsupported holes especially in sands and silts below the groundwater level. Temporary liners must be available to support the caisson sidewalls and to provide seepage cut-off where required. Any accumulated water may have to be pumped out from the hole prior to placing concrete. Should it be considered impractical to remove the accumulated water inside the hole, it is recommended that the concrete be placed by the tremie method.

6.3 CONSTRUCTION CONCERNS

It is understood that a median sewer, ranging from 0.3 m to 1.1 m in diameter, has recently be installed at or near the Highway 427 centreline as part of the overall rehabilitation project. In order to maintain the integrity of the sewer, it is imperative that the as-constructed location of the sewer be confirmed prior to constructing the sign support caissons. Consideration can also be given to daylighting the sewer at the locations of the proposed sign support caissons prior to constructing the caissons. In case of potential conflicts, information from SLI indicates that the sign support caissons may be slightly offset from the design locations to provide clearance. Suggested wordings on an NSSP to address this issue is included in Appendix C.

SLI has also advised that the MTO is prepared to carry out a CCTV survey of the affected sections of sewer after the sign supports are constructed. It is understood that any adversely affected pipe sections will be replaced.

Other concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, or other obstructions in the fill and till, drilling through hard/very dense soils, soil sloughing and water seepage from caisson sidewalls, and basal instability. Recommendations on how to address these issues have been outlined in the previous section.

6.4 CONSTRUCTION INSPECTION AND TESTING

Caisson construction should be monitored by qualified geotechnical personnel (as per OPSS 903) to verify the soil conditions and to confirm that those conditions are consistent with the design assumptions in this report.

Thurber Engineering Ltd.



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Review Principal, Designated MTO Contact

TABLE 1
FOUNDATION DESIGN PARAMETERS
HOT AND HOT HMS SIGN SUPPORTS
HIGHWAY 427 REHABILITATION
FASKEN DRIVE TO FINCH AVENUE
G.W.P. 202-95-00

| HOT/HOT HMS Number | Stationing of HOT/HOT HMS Equipment | Reference Borehole | OGS Elevation (Year of Investigation) | Reference Simplified Subsurface Stratigraphy For Design | Depth Below Original Ground Surface (m) | Foundation Design Parameters | | | | | | |
|--------------------------|--|-------------------------------------|--|---|---|------------------------------|-------------------|-------------------------------|-------|----------------------------------|-----------------------------------|-------------------------------|
| | | | | | | q_u (kPa) | ϕ' (deg.) | n_h (MN/m ³) | K_P | γ (kN/m ³) | γ' (kN/m ³) | Ground- water Depth (m) |
| HMS01 | 20+209 (NB) | 1,3 (WP 273-66) ¹ | 1 165.8 | Clayey Silt Till | 0.0 – 10.0 | 180 | - | - | - | 19 | - | 0.5 Below OGS |
| | | | 3 166.2 (1972) | Clayey silt Till | 10.0 – 22.0 | 300 | - | - | - | 20 | - | |
| | | | | Weathered Shale | Below 22.0 | - | 40 | 10 | 4.6 | - | 13 | |
| TS01 | 20+913 | 2 (WP 615-89-00) ² | 164.5 (1994) | Clayey Silt Fill | 0.0 – 3.0 | 150 | - | - | - | 18 | - | 2 Below OGS |
| | | | | Clayey Silt Till | 3.0 – 5.0 | 150 | - | - | - | 18 | - | |
| | | | | Clayey Silt Till | 5.0 – 9.5 | 250 | - | - | - | 20 | - | |
| TS02 | 21+637 | 4 (WP 615-89-00) ² | 165.7 (1994) | Clayey Silt Fill | 0.0 – 6.0 | 125 | - | - | - | 18 | - | 5 Below OGS |
| | | | | Clayey Silt Till | 6.0 – 12.5 | 200 | - | - | - | 20 | - | |
| TS03 | 22+158 | 4 (WP 48-71-22) ³ | 173.0 (1988) | Clayey Silt Fill | 0.0 – 9.0 | 125 | - | - | - | 18 | - | 5 Below OGS |
| | | | | Clayey Silt Till | 9.0 – 12.5 | 200 | - | - | - | 20 | - | |
| HMS02 | 22+697 (NB) | 6 (WP 48-71-22) ³ | 171.1 (1988) | Clayey Silt Fill | 0.0 – 6.0 | 150 | - | - | - | 18 | - | 5 Below OGS |
| | | | | Clayey Silt Till | 6.0 – 9.5 | 200 | - | - | - | 19 | - | |

- Notes: 1. This table must be read in conjunction with the text of this report.
2. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.2 m below final grade should be neglected in the foundation design.
3. If new fill is placed, some caissons may be partially embedded within the new fill. Some existing fill may be considered loose.

| HOT/HOT HMS Number | Stationing of HOT/HOT HMS Equipment | Reference Borehole | OGS Elevation (Year of Investigation) | Reference Simplified Subsurface Stratigraphy For Design | Depth Below Original Ground Surface (m) | Foundation Design Parameters | | | | | | |
|--------------------------|--|--|--|---|---|------------------------------|-------------------|-------------------------------|-------|----------------------------------|-----------------------------------|-------------------------------|
| | | | | | | q_u (kPa) | ϕ' (deg.) | n_h (MN/m ³) | K_p | γ (kN/m ³) | γ' (kN/m ³) | Ground- water Depth (m) |
| TS04 | 22+785 | 6 (WP 48-71-22) ³ | 171.1 (1988) | Clayey Silt Fill | 0.0 – 6.0 | 150 | - | - | - | 18 | - | 5 Below OGS |
| | | | | Clayey Silt Till | 6.0 – 9.5 | 200 | - | - | - | 19 | - | |
| TS05 | 23+279 | 7 (WP 615-89- 00) ² | 166.3 (1994) | Clayey Silt Fill | 0.0 – 2.5 | 50 | - | - | - | 18 | - | 0.5 Below OGS |
| | | | | Clayey Silt to Silt Till | 2.5 – 9.5 | 150 | - | - | - | 19 | - | |
| TS06 | 23+821 | 1 (WP 126-60) ⁴ | 168.9 (1972) | Clayey Silt Till | 0 – 15.0 | 250 | - | - | - | 19 | - | At OGS |
| | | | | Silty Sand/ Sandy Silt | 15.0 – 21.0 | - | 32 | 4.0 | 3.2 | - | 11 | |
| | | | | Clayey Silt Till | 21.0 – 26.0 | 300 | - | - | - | 20 | - | |
| TS07 | 23+975 | 7 (WP 126-60) ⁴ | 168.0 (1972) | Clayey Silt Till | 0 – 13.0 | 250 | - | - | - | 20 | - | At OGS |
| | | | | Silty Sand/ Sandy Silt | 13.0 – 22.0 | - | 31 | 3.0 | 3.1 | - | 10 | |
| | | | | Clayey Silt Till | 22.0 – 25.0 | 300 | - | - | - | 20 | - | |
| TS08 | 24+475 | 11 (WP 615-89- 00) ² | 162.1 (1994) | Clayey Silt to Silt | 0 – 1.5 | 180 | - | - | - | 19 | - | 2 Below OGS |
| | | | | Silty Sand to Sand | 1.5 – 2.5 | - | 31 | 3.5 | 3.1 | - | 10 | |
| | | | | Clayey Silt to Silt | 2.5 – 4.5 | 250 | - | - | - | 20 | - | |
| | | | | Clayey Silt Till | 4.5 – 8.5 | 300 | - | - | - | 20 | - | |
| | | | | Sandy Silt | 8.5 – 9.5 | - | 31 | 3.5 | 3.1 | - | 10 | |

- Notes: 1. This table must be read in conjunction with the text of this report.
2. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.2 m below final grade should be neglected in the foundation design.
3. If new fill is placed, some caissons may be partially embedded within the new fill. Some existing fill may be considered loose.

| HOT/HOT HMS Number | Stationing of HOT/HOT HMS Equipment | Reference Borehole | OGS Elevation (Year of Investigation) | Reference Simplified Subsurface Stratigraphy For Design | Depth Below Original Ground Surface (m) | Foundation Design Parameters | | | | | | |
|--------------------------|--|--|--|---|--|------------------------------|--------------|---|----------------|---------------------------|----------------------------|---------------------------------|
| | | | | | | q _u (kPa) | ϕ' (deg.) | n _h (MN/m ³) | K _p | γ (kN/m ³) | γ' (kN/m ³) | Groundw ater Depth (m) |
| HMS03 | 25+045 (SB) | 13 (WP 615-89- 00) ² | 162.5 (1994) | Clayey Silt to Silt | 0 – 2.0 | 200 | - | - | - | 19 | - | 2 Below OGS |
| | | | | Clayey Silt to Silt | 2.0 – 7.0 | 300 | - | - | - | 20 | - | |
| | | | | Weathered Shale | Below 7.0 | - | 40 | 10 | 4.6 | - | 13 | |
| | | - | - | New Fill – SSM (see Note 3) | Variable height above ground surface | - | 30 | 3.0 | 3.0 | 20 | - | Below base of new fill |
| | | | | Existing Fill – loose sand (see Note 3) | | - | 28 | 2.0 | 2.8 | 18 | 8 | |

- (1) Reference 3 indicated in the report
 (2) Reference 2 indicated in the report
 (3) Reference 4 indicated in the report
 (4) Reference 5 indicated in the report
 OGS Original Ground Surface

LEGEND

- q_u = Unconfined Compressive Strength (= 2 x C_u , undrained shear strength) (kPa)
 ϕ' = Angle of Internal Friction (degrees)
 n_h = Coefficient of Horizontal Subgrade Reaction (MN/m³ or X 10³ kN/m³)
 K_p = Coefficient of Passive Earth Pressure
 γ = Soil Unit Weight (kN/m³)
 γ' = Submerged Soil Unit Weight (kN/m³) – to be used only for cohesionless soils below the groundwater table.

- Notes: 1. This table must be read in conjunction with the text of this report.
 2. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.2 m below final grade should be neglected in the foundation design.
 3. If new fill is placed, some caissons may be partially embedded within the new fill. Some existing fill may be considered loose.



Appendix A

Record of Boreholes

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

| c_u (kPa) | 0 - 12 | 12 - 25 | 25 - 50 | 50 - 100 | 100 - 200 | > 200 |
|-------------|-----------|---------|---------|----------|------------|-------|
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

| N (BLOWS/0.3m) | 0 - 5 | 5 - 10 | 10 - 30 | 30 - 50 | > 50 |
|----------------|------------|--------|---------|---------|------------|
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

| RQD (%) | 0 - 25 | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100 |
|---------|-----------|---------|---------|---------|-----------|
| | VERY POOR | POOR | FAIR | GOOD | EXCELLENT |

JOINTING AND BEDDING:

| SPACING | 50mm | 50 - 300mm | 0.3m - 1m | 1m - 3m | > 3m |
|----------|------------|------------|------------|---------|------------|
| JOINTING | VERY CLOSE | CLOSE | MOD. CLOSE | WIDE | VERY WIDE |
| BEDDING | VERY THIN | THIN | MEDIUM | THICK | VERY THICK |

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

| | | | |
|-----|---------------------|-----|----------------------------|
| S S | SPLIT SPOON | T P | THINWALL PISTON |
| W S | WASH SAMPLE | O S | OSTERBERG SAMPLE |
| S T | SLOTTED TUBE SAMPLE | R C | ROCK CORE |
| B S | BLOCK SAMPLE | P H | T W ADVANCED HYDRAULICALLY |
| C S | CHUNK SAMPLE | P M | T W ADVANCED MANUALLY |
| T W | THINWALL OPEN | F S | FOIL SAMPLE |

STRESS AND STRAIN

| | | |
|--------------------------------------|-----|-------------------------------|
| u_w | kPa | PORE WATER PRESSURE |
| r_u | 1 | PORE PRESSURE RATIO |
| σ | kPa | TOTAL NORMAL STRESS |
| σ' | kPa | EFFECTIVE NORMAL STRESS |
| τ | kPa | SHEAR STRESS |
| $\sigma_1, \sigma_2, \sigma_3$ | kPa | PRINCIPAL STRESSES |
| ϵ | % | LINEAR STRAIN |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | % | PRINCIPAL STRAINS |
| E | kPa | MODULUS OF LINEAR DEFORMATION |
| G | kPa | MODULUS OF SHEAR DEFORMATION |
| μ | 1 | COEFFICIENT OF FRICTION |

MECHANICAL PROPERTIES OF SOIL

| | | |
|----------------|-------------------|---|
| m_v | kPa ⁻¹ | COEFFICIENT OF VOLUME CHANGE |
| C_c | 1 | COMPRESSION INDEX |
| C_s | 1 | SWELLING INDEX |
| C_α | 1 | RATE OF SECONDARY CONSOLIDATION |
| c_v | m ² /s | COEFFICIENT OF CONSOLIDATION |
| H | m | DRAINAGE PATH |
| T_v | 1 | TIME FACTOR |
| U | % | DEGREE OF CONSOLIDATION |
| σ'_{v0} | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| σ'_p | kPa | PRECONSOLIDATION PRESSURE |
| τ_f | kPa | SHEAR STRENGTH |
| c' | kPa | EFFECTIVE COHESION INTERCEPT |
| ϕ' | -° | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| c_u | kPa | APPARENT COHESION INTERCEPT |
| ϕ_u | -° | APPARENT ANGLE OF INTERNAL FRICTION |
| τ_R | kPa | RESIDUAL SHEAR STRENGTH |
| τ_r | kPa | REMOULDED SHEAR STRENGTH |
| S_t | 1 | SENSITIVITY $\times \frac{c_u}{\tau_r}$ |

PHYSICAL PROPERTIES OF SOIL

| | | | | | | | | |
|----------------|-------------------|--------------------------------|-----------|------|---|-----------|-------------------|---|
| ρ_s | kg/m ³ | DENSITY OF SOLID PARTICLES | e | 1, % | VOID RATIO | e_{min} | 1, % | VOID RATIO IN DENSEST STATE |
| γ_s | kN/m ³ | UNIT WEIGHT OF SOLID PARTICLES | n | 1, % | POROSITY | I_D | 1 | DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$ |
| ρ_w | kg/m ³ | DENSITY OF WATER | w | 1, % | WATER CONTENT | D | mm | GRAIN DIAMETER |
| γ_w | kN/m ³ | UNIT WEIGHT OF WATER | S_r | % | DEGREE OF SATURATION | D_n | mm | n PERCENT - DIAMETER |
| ρ | kg/m ³ | DENSITY OF SOIL | w_L | % | LIQUID LIMIT | C_u | 1 | UNIFORMITY COEFFICIENT |
| γ | kN/m ³ | UNIT WEIGHT OF SOIL | w_p | % | PLASTIC LIMIT | h | m | HYDRAULIC HEAD OR POTENTIAL |
| ρ_d | kg/m ³ | DENSITY OF DRY SOIL | w_s | % | SHRINKAGE LIMIT | q | m ² /s | RATE OF DISCHARGE |
| γ_d | kN/m ³ | UNIT WEIGHT OF DRY SOIL | I_p | % | PLASTICITY INDEX $= w_L - w_p$ | v | m/s | DISCHARGE VELOCITY |
| ρ_{sat} | kg/m ³ | DENSITY OF SATURATED SOIL | I_L | 1 | LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$ | i | 1 | HYDRAULIC GRADIENT |
| γ_{sat} | kN/m ³ | UNIT WEIGHT OF SATURATED SOIL | I_C | 1 | CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$ | k | m/s | HYDRAULIC CONDUCTIVITY |
| ρ' | kg/m ³ | DENSITY OF SUBMERGED SOIL | e_{max} | 1, % | VOID RATIO IN LOOSEST STATE | j | kN/m ² | SEEPAGE FORCE |
| γ' | kN/m ³ | UNIT WEIGHT OF SUBMERGED SOIL | | | | | | |

30 M 12-227

25

WP 107-94-01/02

| DEPARTMENT OF HIGHWAYS - ONTARIO | | | | RECORD OF BOREHOLE No. 1 | | | | FOUNDATION SECTION | | | | | | | | |
|----------------------------------|---|--------------------|------|--|---------------|--|----|-------------------------|----|--|----|----|----|---------------------|---------|--|
| MATERIALS & TESTING OFFICE | | | | Co-ordinates 4858 602.1; E 296 518.6 | | | | LOCATION | | | | | | | | |
| JCR 72-11005 | | | | Co-ords. 15,874,679 E; 972,830 N. | | | | ORIGINATED BY <u>TK</u> | | | | | | | | |
| W.P. 27-66 | | | | ROBING DATE Jan. 3 & 4, 1972 | | | | COMPILED BY <u>TS</u> | | | | | | | | |
| DATUM Geodetic | | | | BOREHOLE TYPE Penn Drill and Diamond Drill | | | | CHECKED BY <u>RL</u> | | | | | | | | |
| ELEV DEPTH | SOIL PROFILE DESCRIPTION | SAMPLING NUMBER | TYPE | MOVS/FOOT | ELEV SCALE | DYNAMIC PENETRATION RESISTANCE Blows / Foot | | | | LIQUID LIMIT PLASTIC LIMIT WATER CONTENT | | | | SUN Y DENSITY | REMARKS | |
| | | | | | | 20 | 40 | 60 | 80 | 100 | 10 | 20 | 30 | | | |
| Sub. 1 | Ground Level | | | | | | | | | | | | | | | |
| | 0.0 Met. mix. of clayey silt sand & gravel, ooo. clayey silt seam | 1 | SS | 21 | | | | | | | | | | | | |
| | Very Stiff to Hard | 2 | SS | 15 | | | | | | | | | | | | |
| | | 3 | SS | 17 | | | | | | | | | | | | |
| | | 4 | SS | 16 | | | | | | | | | | | | |
| | Brown Grey | 5 | SS | 14 | | | | | | | | | | | | |
| | | 6 | SS | 12 | | | | | | | | | | | | |
| | Clayey Till | 7 | SS | 14 | | | | | | | | | | | | |
| | | 8 | SS | 11 | | | | | | | | | | | | |
| | | 9 | SS | 11 | | | | | | | | | | | | |
| | | 10 | SS | 14 | | | | | | | | | | | | |
| | | 11 | SS | 100 | | | | | | | | | | | | |
| | | 12 | SS | 100 | | | | | | | | | | | | |
| | | 13 | SS | 189 | | | | | | | | | | | | |
| | | 14 | SS | 21 | | | | | | | | | | | | |
| 473.1 | | 15 | SS | 100 | | | | | | | | | | | | |
| 71.0 | Shale Bedrock | | | | | | | | | | | | | | | |
| | Weathered Sound | 16 | SI | 100 | | | | | | | | | | | | |
| 161.1 | | | | | | | | | | | | | | | | |
| 83.0 | End of Borehole | | | | | | | | | | | | | | | |

20
15-17 % STRAIN AT FAILURE
10

WP 187-94-01/02

| DEPARTMENT OF HIGHWAYS - ONTARIO | | | RECORD OF BOREHOLE No. 3 | | | FOUNDATION SECTION | | | |
|----------------------------------|---|------------|--|--------------------------------|------------|--|-----------------|--------------|---------|
| MATERIALS & TESTING OFFICE | | | Co-ords: N 4838 558.01 E 296 497.9 | | | | | | |
| JOB 72-11006 | | | LOCATION | | | ORIGINATED BY VK | | | |
| W.P. 773-66 | | | BORING DATE Jan. 5, 1972 | | | COMPAED BY TT | | | |
| DATUM Quebec | | | BOREHOLE TYPE Penn Drill and Diamond Drill | | | CHECKED BY | | | |
| SOIL PROFILE | | SAMPLES | | DYNAMIC PENETRATION RESISTANCE | | LIQUID LIMIT PLASTIC LIMIT WATER CONTENT | | BULK DENSITY | REMARKS |
| ELEV. DEPTH | DESCRIPTION | SIRAT PLOT | NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE | WATER CONTENT % | | |
| 545.3 | Ground Level | | | | | | | | |
| 0.0 | Red. mix. of clayey silt, sand & gravel | | | | | | | | |
| | Glacial Till | | | | | | | | |
| | eco. clayey silt some | | | | | | | | |
| | Very Stiff to Hard | | | | | | | | |
| | Brown | | | | | | | | |
| | Grey | | | | | | | | |
| | | | 1 | SS | 10 | | | | |
| | | | 2 | SS | 20 | | | | |
| | | | 3 | SS | 30 | | | | |
| | | | 4 | SS | 40 | | | | |
| | | | 5 | SS | 50 | | | | |
| | | | 6 | SS | 60 | | | | |
| | | | 7 | SS | 70 | | | | |
| | | | 8 | SS | 80 | | | | |
| | | | 9 | SS | 90 | | | | |
| | | | 10 | SS | 100 | | | | |
| | | | 11 | SS | 110 | | | | |
| | | | 12 | SS | 120 | | | | |
| | | | 13 | SS | 130 | | | | |
| | | | 14 | SS | 140 | | | | |
| | | | 15 | SS | 150 | | | | |
| | | | 16 | SS | 160 | | | | |
| | | | 17 | SS | 170 | | | | |
| | | | 18 | SS | 180 | | | | |
| | | | 19 | SS | 190 | | | | |
| | | | 20 | SS | 200 | | | | |
| | | | 21 | SS | 210 | | | | |
| | | | 22 | SS | 220 | | | | |
| | | | 23 | SS | 230 | | | | |
| | | | 24 | SS | 240 | | | | |
| | | | 25 | SS | 250 | | | | |
| | | | 26 | SS | 260 | | | | |
| | | | 27 | SS | 270 | | | | |
| | | | 28 | SS | 280 | | | | |
| | | | 29 | SS | 290 | | | | |
| | | | 30 | SS | 300 | | | | |
| | | | 31 | SS | 310 | | | | |
| | | | 32 | SS | 320 | | | | |
| | | | 33 | SS | 330 | | | | |
| | | | 34 | SS | 340 | | | | |
| | | | 35 | SS | 350 | | | | |
| | | | 36 | SS | 360 | | | | |
| | | | 37 | SS | 370 | | | | |
| | | | 38 | SS | 380 | | | | |
| | | | 39 | SS | 390 | | | | |
| | | | 40 | SS | 400 | | | | |
| | | | 41 | SS | 410 | | | | |
| | | | 42 | SS | 420 | | | | |
| | | | 43 | SS | 430 | | | | |
| | | | 44 | SS | 440 | | | | |
| | | | 45 | SS | 450 | | | | |
| | | | 46 | SS | 460 | | | | |
| | | | 47 | SS | 470 | | | | |
| | | | 48 | SS | 480 | | | | |
| | | | 49 | SS | 490 | | | | |
| | | | 50 | SS | 500 | | | | |
| | | | 51 | SS | 510 | | | | |
| | | | 52 | SS | 520 | | | | |
| | | | 53 | SS | 530 | | | | |
| | | | 54 | SS | 540 | | | | |
| | | | 55 | SS | 550 | | | | |
| | | | 56 | SS | 560 | | | | |
| | | | 57 | SS | 570 | | | | |
| | | | 58 | SS | 580 | | | | |
| | | | 59 | SS | 590 | | | | |
| | | | 60 | SS | 600 | | | | |
| | | | 61 | SS | 610 | | | | |
| | | | 62 | SS | 620 | | | | |
| | | | 63 | SS | 630 | | | | |
| | | | 64 | SS | 640 | | | | |
| | | | 65 | SS | 650 | | | | |
| | | | 66 | SS | 660 | | | | |
| | | | 67 | SS | 670 | | | | |
| | | | 68 | SS | 680 | | | | |
| | | | 69 | SS | 690 | | | | |
| | | | 70 | SS | 700 | | | | |
| | | | 71 | SS | 710 | | | | |
| | | | 72 | SS | 720 | | | | |
| | | | 73 | SS | 730 | | | | |
| | | | 74 | SS | 740 | | | | |
| | | | 75 | SS | 750 | | | | |
| | | | 76 | SS | 760 | | | | |
| | | | 77 | SS | 770 | | | | |
| | | | 78 | SS | 780 | | | | |
| | | | 79 | SS | 790 | | | | |
| | | | 80 | SS | 800 | | | | |
| | | | 81 | SS | 810 | | | | |
| | | | 82 | SS | 820 | | | | |
| | | | 83 | SS | 830 | | | | |
| | | | 84 | SS | 840 | | | | |
| | | | 85 | SS | 850 | | | | |
| | | | 86 | SS | 860 | | | | |
| | | | 87 | SS | 870 | | | | |
| | | | 88 | SS | 880 | | | | |
| | | | 89 | SS | 890 | | | | |
| | | | 90 | SS | 900 | | | | |
| | | | 91 | SS | 910 | | | | |
| | | | 92 | SS | 920 | | | | |
| | | | 93 | SS | 930 | | | | |
| | | | 94 | SS | 940 | | | | |
| | | | 95 | SS | 950 | | | | |
| | | | 96 | SS | 960 | | | | |
| | | | 97 | SS | 970 | | | | |
| | | | 98 | SS | 980 | | | | |
| | | | 99 | SS | 990 | | | | |
| | | | 100 | SS | 1000 | | | | |
| | | | 101 | SS | 1010 | | | | |
| | | | 102 | SS | 1020 | | | | |
| | | | 103 | SS | 1030 | | | | |
| | | | 104 | SS | 1040 | | | | |
| | | | 105 | SS | 1050 | | | | |
| | | | 106 | SS | 1060 | | | | |
| | | | 107 | SS | 1070 | | | | |
| | | | 108 | SS | 1080 | | | | |
| | | | 109 | SS | 1090 | | | | |
| | | | 110 | SS | 1100 | | | | |
| | | | 111 | SS | 1110 | | | | |
| | | | 112 | SS | 1120 | | | | |
| | | | 113 | SS | 1130 | | | | |
| | | | 114 | SS | 1140 | | | | |
| | | | 115 | SS | 1150 | | | | |
| | | | 116 | SS | 1160 | | | | |
| | | | 117 | SS | 1170 | | | | |
| | | | 118 | SS | 1180 | | | | |
| | | | 119 | SS | 1190 | | | | |
| | | | 120 | SS | 1200 | | | | |
| | | | 121 | SS | 1210 | | | | |
| | | | 122 | SS | 1220 | | | | |
| | | | 123 | SS | 1230 | | | | |
| | | | 124 | SS | 1240 | | | | |
| | | | 125 | SS | 1250 | | | | |
| | | | 126 | SS | 1260 | | | | |
| | | | 127 | SS | 1270 | | | | |
| | | | 128 | SS | 1280 | | | | |
| | | | 129 | SS | 1290 | | | | |
| | | | 130 | SS | 1300 | | | | |
| | | | 131 | SS | 1310 | | | | |
| | | | 132 | SS | 1320 | | | | |
| | | | 133 | SS | 1330 | | | | |
| | | | 134 | SS | 1340 | | | | |
| | | | 135 | SS | 1350 | | | | |
| | | | 136 | SS | 1360 | | | | |
| | | | 137 | SS | 1370 | | | | |
| | | | 138 | SS | 1380 | | | | |
| | | | 139 | SS | 1390 | | | | |
| | | | 140 | SS | 1400 | | | | |
| | | | 141 | SS | 1410 | | | | |
| | | | 142 | SS | 1420 | | | | |
| | | | 143 | SS | 1430 | | | | |
| | | | 144 | SS | 1440 | | | | |
| | | | 145 | SS | 1450 | | | | |
| | | | 146 | SS | 1460 | | | | |
| | | | 147 | SS | 1470 | | | | |
| | | | 148 | SS | 1480 | | | | |
| | | | 149 | SS | 1490 | | | | |
| | | | 150 | SS | 1500 | | | | |
| | | | 151 | SS | 1510 | | | | |
| | | | 152 | SS | 1520 | | | | |
| | | | 153 | SS | 1530 | | | | |
| | | | 154 | SS | 1540 | | | | |
| | | | 155 | SS | 1550 | | | | |
| | | | 156 | SS | 1560 | | | | |
| | | | 157 | SS | 1570 | | | | |
| | | | 158 | SS | 1580 | | | | |
| | | | 159 | SS | 1590 | | | | |
| | | | 160 | SS | 1600 | | | | |
| | | | 161 | SS | 1610 | | | | |
| | | | 162 | SS | 1620 | | | | |
| | | | 163 | SS | 1630 | | | | |
| | | | 164 | SS | 1640 | | | | |
| | | | 165 | SS | 1650 | | | | |
| | | | 166 | SS | 1660 | | | | |
| | | | 167 | SS | 1670 | | | | |
| | | | 168 | SS | 1680 | | | | |
| | | | 169 | SS | 1690 | | | | |
| | | | 170 | SS | 1700 | | | | |
| | | | | | | | | | |

RECORD OF BOREHOLE No 2

1 OF 1 METRIC

W.P. 615-89-00 LOCATION Coords.: N 4 839 195 E 296 285
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger
 DATUM Goodells DATE 1994 05 09
 ORIGINATED BY LO
 COMPILED BY LO
 CHECKED BY BB

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|--------|------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 164.5 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | CLAYEY SILT Traces of Gravel Some Sand Suff to Very Suff | | 1 | SS | 23 | | | | | | | | | | | |
| | Sand | | 2 | SS | 15 | | | | | | | | | | | |
| | | | 3 | SS | 18 | | | | | | | | | | | |
| 161.6 | (FILL MATERIAL) | | | | | | | | | | | | | | | |
| 2.9 | Trace Organics | | 4 | SS | 17 | | | | | | | | | | | |
| | | | 5 | SS | 14 | | | | | | | | | | | |
| | | | 6 | SS | 28 | | | | | | | | | | | |
| | CLAYEY SILT Traces to Some Gravel Some Sand Suff to Hard | | 7 | SS | 50 | | | | | | | | | | | |
| | (GLACIAL TILL) | | 8 | SS | 63 | | | | | | | | | | | |
| | Brown | | | | | | | | | | | | | | | |
| | Grey | | 9 | SS | 21 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 155.1 | | | 10 | SS | 75 | /15cm | | | | | | | | | | |
| 9.4 | End of Borehole | | | | | | | | | | | | | | | |
| | • WATER LEVEL NOT ESTABLISHED DUE TO THE WALLS CAVING AT 8 FEET. | | | | | | | | | | | | | | | |

+3, x5 : Numbers refer to
Sensitivity 20
15-25 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 615-89-00

LOCATION Coords.: N 4 839 786 E 295 897

ORIGINATED BY LQ

DIST 8 HWY 427

BOREHOLE TYPE Hollow Stem Auger

COMPILED BY LQ

DATUM Geodetic

DATE 1994 08 10

CHECKED BY BB

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC NATURAL LIQUID LIMIT | | | UNIT WEIGHT | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|--|------------|--------|------|-------------------------|---|--|--------------------|----|-----|-------------------|------------------------------|----------------|---|-------------|---------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | 'N' VALUES | SHEAR STRENGTH kPa | | | | | W _p | W | | |
| | | | | | | 20 | 40 | 60 | 80 | 100 | WATER CONTENT (%) | | | | | |
| | | | | | | UNCONFINED + FIELD VANE QUICK TRIAXIAL LAB VANE 20 40 60 80 100 | | | | | 10 | 20 | 30 | | | |
| 188.7 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | | | | |
| | CLAYEY SILT Trace to some Gravel Some Sand Stiff | | 1 | SS | 13 | | | | | | | | | | | |
| | | | 2 | SS | 13 | | | | | | | | | | | |
| | | | 3 | SS | 12 | | | | | | | | | | | |
| | | | 4 | SS | 17 | | | | | | | | | | | |
| | | | 5 | SS | 14 | | | | | | | | | | | |
| | | | 6 | SS | 18 | | | | | | | | | | | |
| | | | 7 | SS | 19 | | | | | | | | | | | |
| 160.5 | (FILL MATERIAL) | | 8 | SS | 28 | | | | | | | | | | | |
| 5.9 | | | 9 | SS | 30 | | | | | | | | | | | |
| | Trace Organics | | | | | | | | | | | | | | | |
| | CLAYEY SILT Trace to some Gravel Some Sand Very Stiff to Hard (GLACIAL TILL) | | 10 | SS | 30 | | | | | | | | | | | |
| | Brown | | | | | | | | | | | | | | | |
| | Grey | | 11 | SS | 45 | | | | | | | | | | | |
| 154.1 | | | 12 | SS | 19 | | | | | | | | | | | |
| 12.6 | End of Borehole | | | | | | | | | | | | | | | |

+3, x⁵ Numbers refer to Sensitivity 20 15-25 (%) STRAIN AT FAILURE 10

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 1/2" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDAINED SHEAR STRENGTH AS FOLLOWS:

| S_u (FSF) | 0 - 250 | 250 - 500 | 500 - 1000 | 1000 - 2000 | 2000 - 4000 | > 4000 |
|-------------|-----------|-----------|------------|-------------|-------------|--------|
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

| 'N' (BLOW/FT) | 0 - 5 | 5 - 10 | 10 - 30 | 30 - 50 | > 50 |
|---------------|------------|--------|---------|---------|------------|
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

ROCK QUALITY: ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

| RQD (%) | 0 - 25 | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100 |
|---------|-----------|---------|---------|---------|-----------|
| | VERY POOR | POOR | FAIR | GOOD | EXCELLENT |

JOINTING AND BEDDING:

| SPACING | 2" | 2" - 12" | 1' - 3' | 3' - 10' | > 10' |
|----------|------------|----------|------------|----------|------------|
| JOINTING | VERY CLOSE | CLOSE | MOD. CLOSE | WIDE | VERY WIDE |
| BEDDING | VERY THIN | THIN | MEDIUM | THICK | VERY THICK |

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. CUU = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

S S SPLIT SPOON
W S WASH SAMPLE
S T SLOTTED TUBE SAMPLE
B S BLOCK SAMPLE
C S CRUSH SAMPLE
T W THINWALL OPEN
T P THINWALL PISTON
O S OSTERBERG SAMPLE
F S FOIL SAMPLE
R C ROCK CORE
P H T.W. ADVANCED HYDRAULICALLY
P M T.W. ADVANCED MANUALLY

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_a COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_p COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 α SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_1, N_2, N_3 BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w - w_p$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{w_L - w_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w_p}{w_L - w_s}$
 A_c ACTIVITY = $\frac{I_p}{w_L - w_p}$ Soil Fraction
 O_m ORGANIC MATTER CONTENT

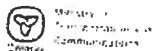
STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_a EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 σ_{1a}, σ_{2a} STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY THE USE OF APOSTROPHE ABOVE THE SYMBOL.

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 Q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 α_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION



RECORD OF BOREHOLE No 4

METRIC

W P 48-71-22 LOCATION Sta. 406 + 50; o/s 26.0' Lt. (Imperial Chainage)
DIST 6 HWY 427/409 BOREHOLE TYPE Cone Test, Solid Stem Auger
DATUM Geodetic DATE 88 03 29

ORIGINATED BY TS

COMPILED BY TS

CHECKED BY

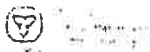
OFFICE REPORT ON SOIL EXPLORATION

CHECKED BY

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | | | | | | | | |
|--------------|-----------|--|------------|--------|-------------------------|-----------------|--|--------|---|----|----|------------------|---------------------------------------|----|-----|----------------|---|----------------|----|----|----|-------------------|----|
| ELEV (feet) | DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | | | TYPE | VALUES | 20 | 40 | 60 | | | 80 | 100 | W _p | W | W _L | 10 | 20 | 30 | KN/m ³ | GR |
| 567.6 | 0.0 | Ground Surface | | | | | | | | | | | | | | | | | | | | | |
| 0.0 | 0.0 | Irregular Mixture of Clayey Silt, Some Sand, Trace Gravel (Fill) | | 1 | SS | 40 | | | | | | | | | | | | | | | | | |
| | | Some Organics | | 2 | SS | 12 | | | | | | | | | | | | | | | | | |
| | | | | 3 | SS | 10 | | | | | | | | | | | | | | | | | |
| | | | | 4 | SS | 22 | | | | | | | | | | | | | | | | | |
| | | Brown/Grey Stiff to Very Stiff | | 5 | SS | 20 | | | | | | | | | | | | | | | | | |
| 537.6 | 163.9 | Ret. Mixture of Clayey Silt, Sand and Gravel (Glacial Till) | | 6 | SS | 37 | | | | | | | | | | | | | | | | | |
| 30.0 | 9.1 | | | 7 | SS | 71 | | | | | | | | | | | | | | | | | |
| | | Brown Grey | | 8 | SS | 31 | | | | | | | | | | | | | | | | | |
| 526.1 | 160.4 | End of Borehole | | | | | | | | | | | | | | | | | | | | | |
| 41.5 | 12.6 | | | | | | | | | | | | | | | | | | | | | | |

*3, *5: Numbers refer to Sensitivity
20
15
10

(%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 6

METRIC

W P 6d-71-22 LOCATION Co-ords: N 4 840 755, E 245556 ORIGINATED BY TS
DIST 6 HWY 427/409 BOREHOLE TYPE Cone Test, Solid Stem Auger COMPILED BY TS
DATUM Geodetic DATE 88 03 30 CHECKED BY

| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|-----------|---|------------|-------------------------|-----------------|--|-----------------|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| ELEV (feet) | DEPTH (m) | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | 20 40 60 80 100 | | | | | |
| 561.4 | 171.1 | Ground Surface | | | | | | | | | | |
| 0.0 | 0.0 | Irregular Mixture of Clayey Silt Sand and Gravel (Fill) | | 1 | SS | 16 | | | | | | |
| | | Brown/Grey | | 2 | SS | 16 | | | | | 20.6 | 4 24 37 35 |
| | | Stiff to Very Stiff | | 3 | SS | 18 | | | | | | |
| | | Organic Inclusions | | 4 | SS | 23 | | | | | | |
| | | | | 5 | SS | 30 | | | | | | |
| 341.4 | 165.0 | Het. Mix. of Clayey Silt, Sand and Gravel | | 6 | SS | 20 | | | | | | |
| 20.0 | 6.8 | Brown Grey (Glacial Till) | | 7 | SS | 41 | | | | | | 1 17 58 24 |
| 529.9 | 161.5 | V. Stiff to Hard | | 8 | SS | 20 | | | | | | |
| 31.5 | 9.6 | End of Borehole | | | | | | | | | | |

3, 4, 5: Numbers refer to Sensitivity
20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 815-89-00

LOCATION Coords.: N 4 841 287, E 295 339

ORIGINATED BY LO

DIST 8 HWY 427

BOREHOLE TYPE Solid Stem Auger

COMPILED BY LO

DATUM Geodetic

DATE 1994 09 11

CHECKED BY BB

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT 7 KN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|--------|------|----------------------------|-----------------|---|----|----|----|-----|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | | |
| 166.3 | Ground Surface | | | | | | | | | | | | |
| 0.0 | CLAYEY SILT Trace Gravel Some Sand Firm to Stiff | | 1 | SS | 4 | | | | | | | | |
| 164.2 | (FILL MATERIAL) | | 2 | SS | 9 | | | | | | | | |
| 2.1 | | | 3 | SS | 29 | | | | | | | | |
| | Brown | | 4 | SS | 30 | | | | | | | | |
| | Grey | | 5 | SS | 16 | | | | | | | | |
| | CLAYEY SILT TO SILT Trace Gravel; Trace to some Sand Stiff to Hard (GLACIAL TILL) | | 6 | SS | 14 | | | | | | | | |
| | Silty Sand Seams | | 7 | SS | 13 | | | | | | | | |
| | | | 8 | SS | 16 | | | | | | | | |
| | | | 9 | SS | 34 | | | | | | | | |
| 158.7 | | | 10 | SS | 34 | | | | | | | | |
| 9.6 | End of Borehole | | | | | | | | | | | | |

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1

Co-ords: N 4841 828, E 295 134

JOB 72-11024

LOCATION: 5,885,263 N; 968,288 E.

W.P. 126-60

BORING DATE March 8, 1972

ORIGINATED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger & sample with C.H.E.

COMPILED BY VK

CHECKED BY

METRIC UNITS

| SOIL PROFILE | | SAMPLES | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT | | | | | LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w | | | BULK DENSITY γ P.C.F. | REMARKS | | |
|----------------|-------------|--|--------|-------------|--|--|--|--|--|--|--|--|------------------------------------|------------------|--|--|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLT | NUMBER | TYPE | BLOWS/FOOT | | | | | SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB. VANE | WATER CONTENT % w_p — w — w_L 15 30 45 | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 148.9 | 552.6 | Ground Level | | | | | | | | | | | | | | |
| 0.0 | 0.0 | Met. mix. of clayey silt, sand & gravel | 1 | SS | 14 | | | | | | | | | 551.6 =168.1m | | |
| | | | 2 | SS | 76 | | | | | | | | | 2 19 69 10 | | |
| | | | 3 | SS | 78 | | | | | | | | | | | |
| | | Brown Grey | 4 | SS | 21 | | | | | | | | | | | |
| | | Glacial Till | 5 | SS | 22 | | | | | | | | | 0 10 33 57 | | |
| | | Stiff to Hard | 6 | SS | 21 | | | | | | | | | | | |
| | | | 7 | SS | 13 | | | | | | | | | | | |
| 140.0 | 525.0 | | 8 | SS | 20 | | | | | | | | | 0 18 51 31 | | |
| 8.4 | 27.6 | Silty sand with some gravel. | 9 | SS | 18 | | | | | | | | | 13 83 (4) | | |
| 157.8 | 517.6 | Compact | 10 | SS | 95 | | | | | | | | | | | |
| 10.7 | 35.0 | | 11 | SS | 13 | | | | | | | | | | | |
| | | | 12 | SS | 55 | | | | | | | | | | | |
| 153.2 | 502.6 | | 13 | SS | 28 | | | | | | | | | 0 42 48 10 | | |
| 15.2 | 50.0 | Silty sand to sandy silt, with trace of clay and gravel. | 14 | SS | 43 | | | | | | | | | | | |
| | | Compact to Dense | | | | | | | | | | | | | | |
| 147.2 | 483.1 | Met. mix. of clayey silt, sand & gravel. (Glacial Till) | 15 | SS | 140 | | | | | | | | | | | |
| 21.2 | 69.5 | Hard | | | | | | | | | | | | | | |
| | | Fragments of Shale | 16 | SS | 100/3" | | | | | | | | | | | |
| 142.1 | 466.1 | | | | | | | | | | | | | | | |
| 26.4 | 86.5 | End of Borehole Probable Bedrock | | | | | | | | | | | | | | |

20
15 \diamond 5 % STRAIN AT FAILURE
10

FOUNDATIONS OFFICE

LOCATION

Co-ORDS: N 4 841 846, E 295 053

Co-ords. 5,885,320 N; 968,022 E.

W.P. 126-60

BORING DATE March 13, 1972

ORIGINATED BY VK

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger & sample with C.M.E.

CHECKED BY

15 $\frac{20}{10}$ 5 % STRAIN AT FAILURE

RECORD OF BOREHOLE No 11

1 OF 1

METRIC

W.P. 615-89-00

LOCATION Coords.: N 4 842 341, E 294 896

ORIGINATED BY T.G.

DIST 8 HWY 427

BOREHOLE TYPE Solid Stem Auger

COMPILED BY L.O.

DATUM Geodetic

DATE 1994 08 15

CHECKED BY B.B.

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC NATURAL LIQUID UNIT MOISTURE UNIT UNIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|--------|------|----------------------------|-----------------|---|----|----|----|-----|---|---|----------------|---|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | W _P | W | W _L | | |
| 162.1 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | CLAYEY SILT TO SILT Traces of Sand Very Stiff | | 1 | SS | 23 | | | | | | | | | | | |
| 160.7 | | | 2 | SS | 37 | | | | | | | | | | | |
| 1.4 | SILTY SAND TO SAND Traces of fines Dense to Very Dense | | 3 | SS | 52 | | | | | | | | | | | |
| 159.8 | | | 4 | SS | 43 | | | | | | | | | | | |
| 2.5 | CLAYEY SILT TO SILT Traces of Sand Hard | | 5 | SS | 61 | | | | | | | | | | | |
| 158.1 | | | 6 | SS | 30 | | | | | | | | | | | |
| 4.0 | SAND - Poorly Graded, Traces of Fines, Very Dense | | 7 | SS | 89 | | | | | | | | | | | |
| 157.7 | | | 8 | SS | 67 | | | | | | | | | | | |
| 4.4 | CLAYEY SILT Trace of Gravel Some Sand Hard to Very Stiff (GLACIAL TILL) | | 9 | SS | 29 | | | | | | | | | | | |
| 153.5 | | | 10 | SS | 45 | | | | | | | | | | | |
| 6.6 | SANDY SILT Trace Gravel Trace Sand Occasional Seams of Sand Dense | | | | | | | | | | | | | | | |
| 152.5 | | | | | | | | | | | | | | | | |
| 9.8 | End of Borehole | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 13

1 OF 1

METRIC

W.P. 515-59-00

LOCATION Coords.: N 4 842 931, E 294 659

ORIGINATED BY T.G.

DIST 6 HWY 427

BOREHOLE TYPE Solid Stem Auger

COMPILED BY L.O.

DATUM Geodetic

DATE 1994 08 15

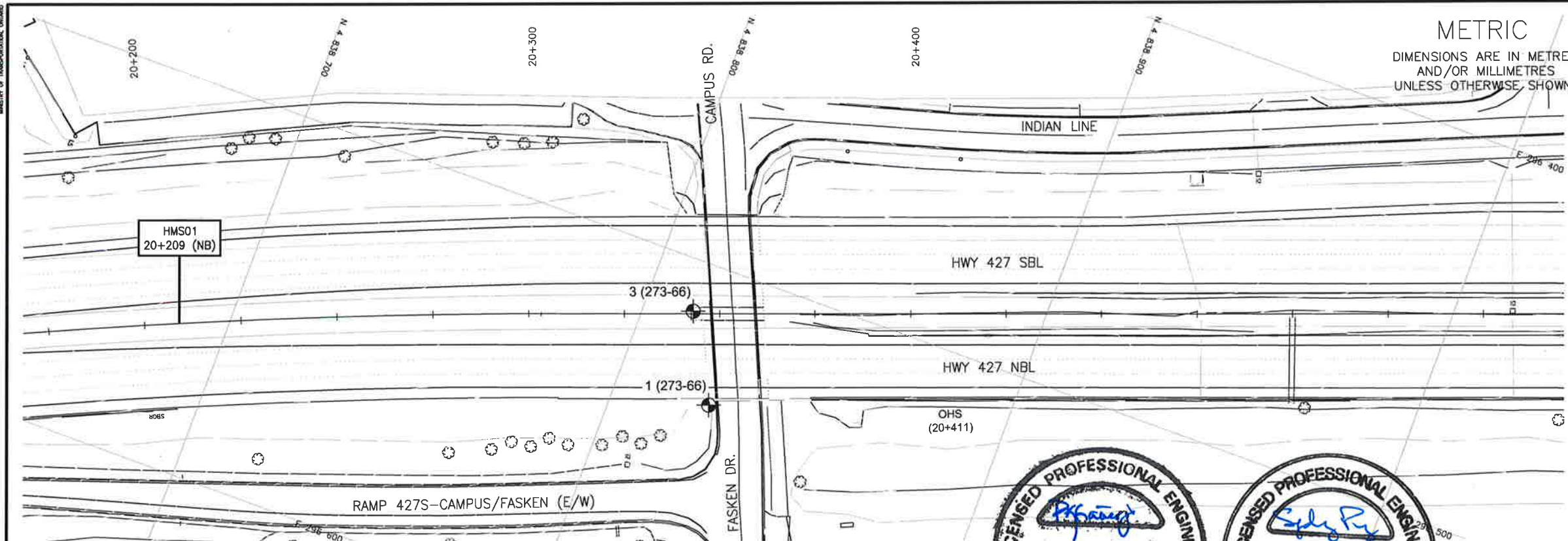
CHECKED BY B.B.

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---|------------|--------|------|----------------------------|-----------------|---|----|----|----|-----|---|---|----------------|-------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | W _p | W | W _L | | |
| 162.5 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | CLAYEY SILT TO SILT Trace Gravel Trace to some Sand Very Stiff to Hard | | 1 | SS | 58 | | | | | | | | | | | |
| | | | 2 | SS | 17 | | | | | | | | | | | |
| | | | 3 | SS | 122 | | | | | | | | | | | |
| | | | 4 | SS | 125 | | | | | | | | | | | |
| | | | 5 | SS | 149 | /23cm | | | | | | | | | | |
| 157.3 | | | 6 | SS | 150 | /28cm | | | | | | | | | | |
| 5.2 | SILTY SAND Some Gravel Some Fines Dense | | 7 | SS | 32 | | | | | | | | | | | |
| 155.8 | | | 8 | SS | 150 | | | | | | | | | | | |
| 5.9 | CLAYEY SILT Traces of Gravel Some Sand Hard | | 9 | SS | 112 | /8cm | | | | | | | | | | |
| 155.4 | | | 10 | SS | 100 | /8cm | | | | | | | | | | |
| 7.1 | BEDROCK Weathered Gray Shale Hard | | | | | | | | | | | | | | | |
| 152.9 | | | | | | | | | | | | | | | | |
| 9.6 | End of Borehole | | | | | | | | | | | | | | | |



Appendix B

Borehole Locations Drawings



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT NO 2014-2016
GWP No 202-95-00



HIGHWAY 427 WIDENING
HOT TOLL & HOT HMS
SIGN SUPPORT
BOREHOLE LOCATIONS PLAN

SHEET
251-1








THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole |
|  | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

| NO | ELEVATION | NORTHING | EASTING |
|---------------|-----------|-------------|-----------|
| 1 (273-66) | 165.8 | 4 838 825.1 | 296 534.9 |
| 3 (273-66) | 166.2 | 4 838 812.8 | 296 513.2 |
| 2 (615-89-00) | 164.5 | 4 839 403.4 | 296 288.5 |

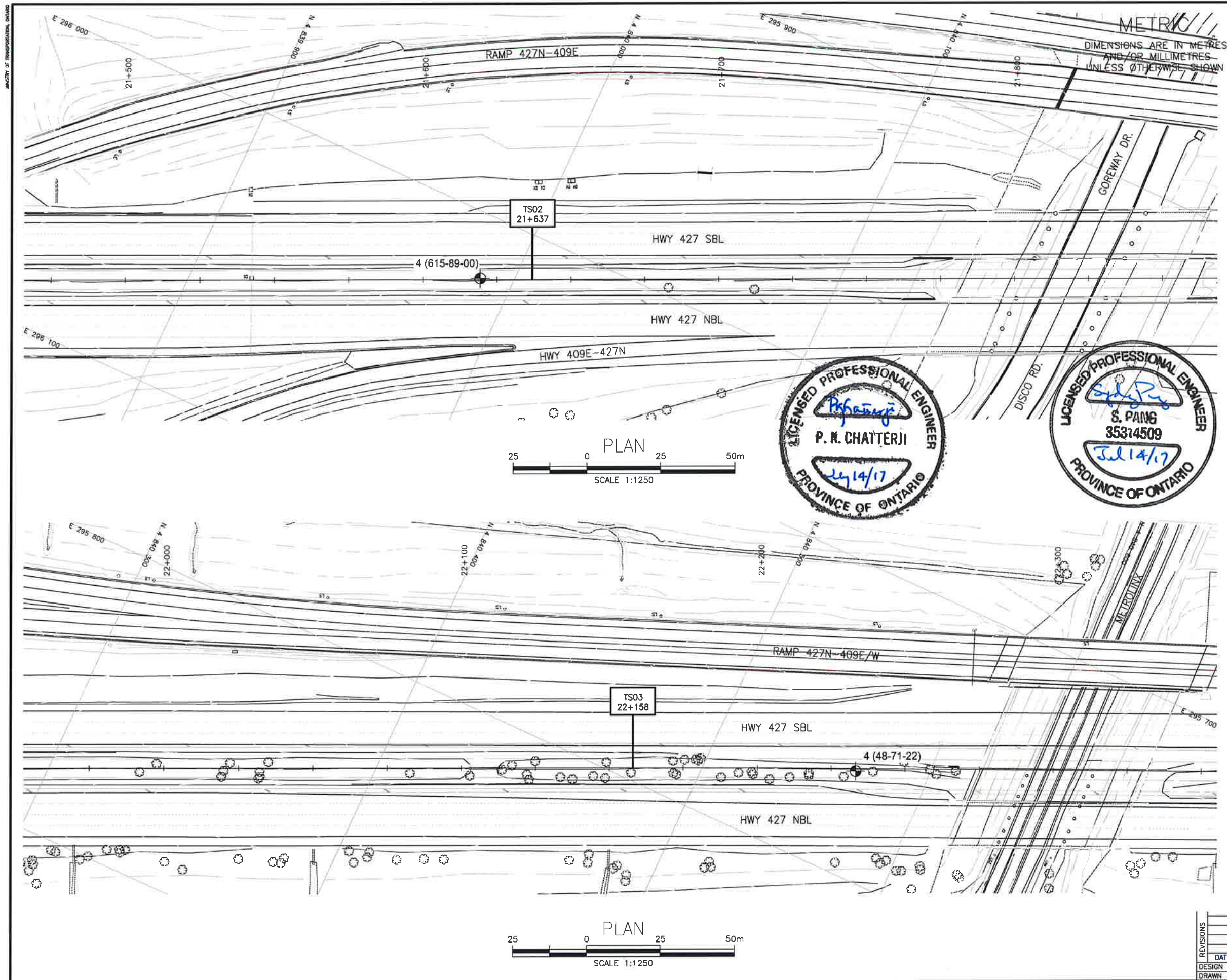
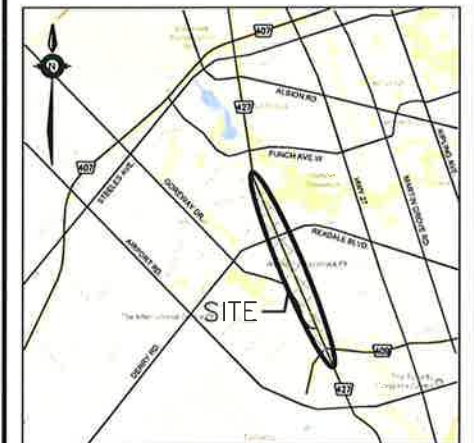
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 30M12-407

[illegible]

FILENAME: H:\Drafting\11000\11294\TED-11294-BHPL.dwg
PLOTDATE: 7/7/2017 1:34 PM

CONT NO 2014-2016
GWP No 202-95-00HIGHWAY 427 WIDENING
HOT TOLL & HOT HMS
SIGN SUPPORT
BOREHOLE LOCATIONS PLANSHEET
251-2

KEYPLAN

LEGEND

| | |
|------|---------------------------------------|
| | Borehole |
| | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60' Cone, 475J/blow) |
| PH | Pressure, Hydraulic |
| | Water Level |
| | Head Artesian Water |
| | Piezometer |
| 90% | Rock Quality Designation (RQD) |
| A/R | Auger Refusal |

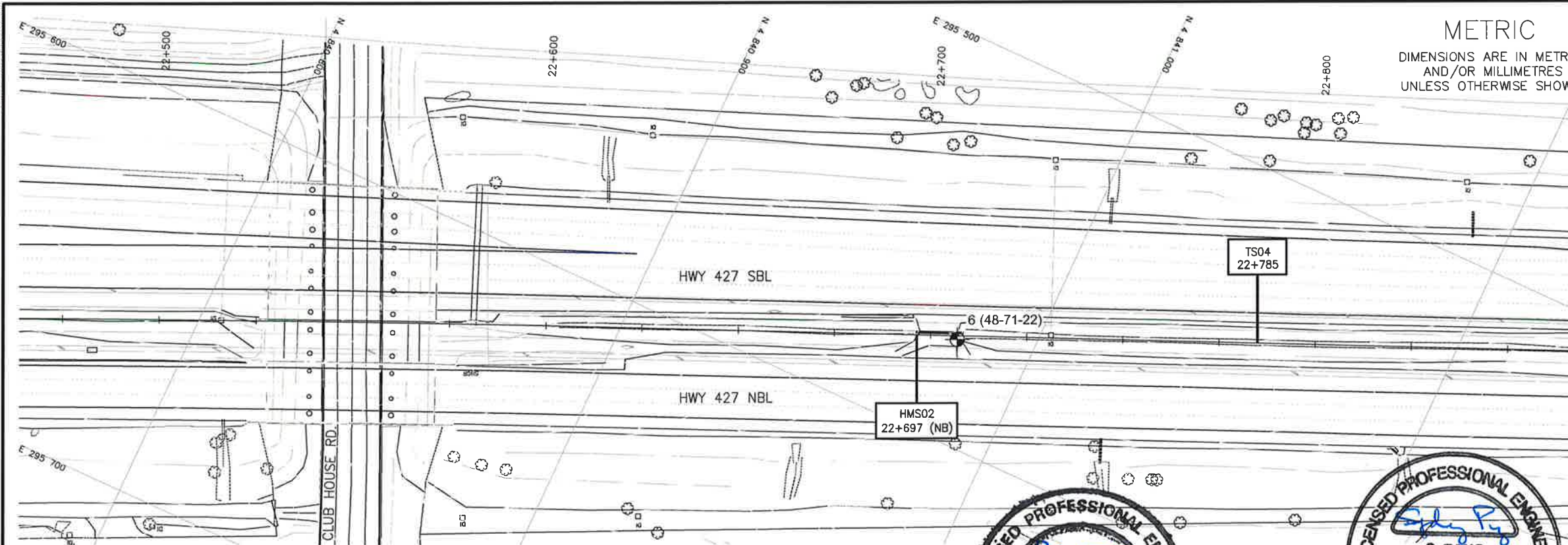
| NO | ELEVATION | NORTHING | EASTING |
|---------------|-----------|-------------|-----------|
| 4 (48-71-22) | 173.0 | 4 840 547.7 | 295 765.4 |
| 4 (615-89-00) | 166.7 | 4 839 989.4 | 296 020.9 |

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCREs No. 30M12-407

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METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT NO 2014-2016
GWP No 202-95-00



HIGHWAY 427 WIDENING
HOT TOLL & HOT HMS
SIGN SUPPORT
BOREHOLE LOCATIONS PLAN

SHEET
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THURBER ENGINEERING LTD.



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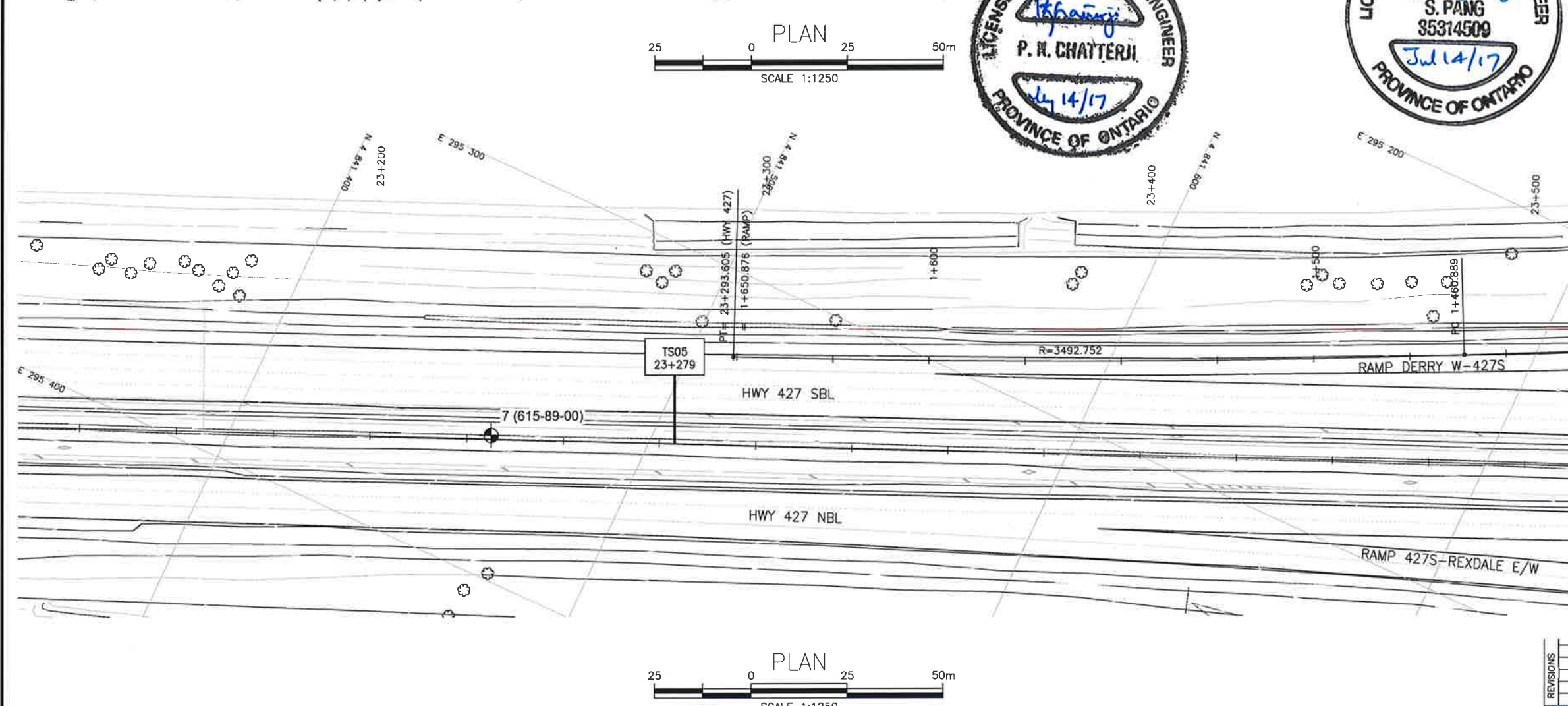
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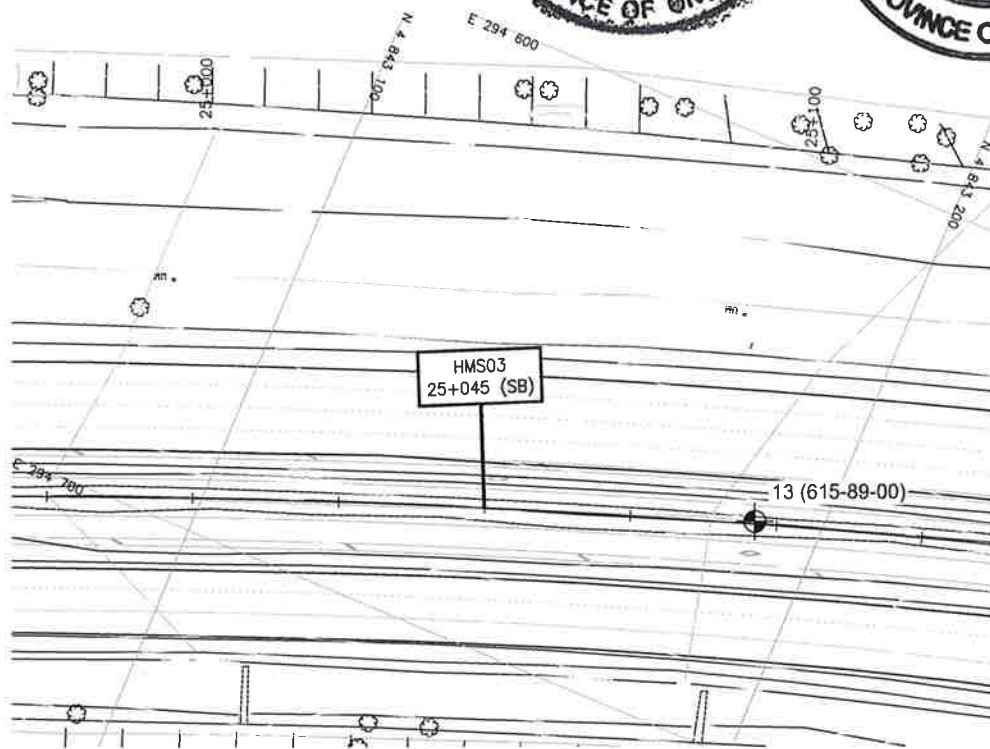
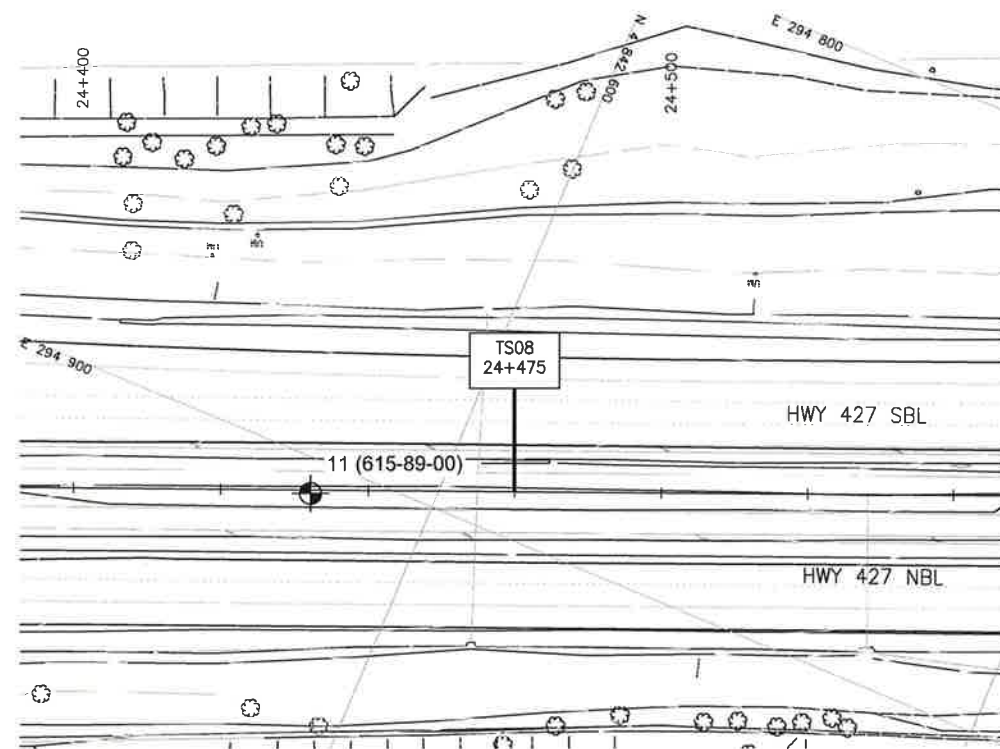
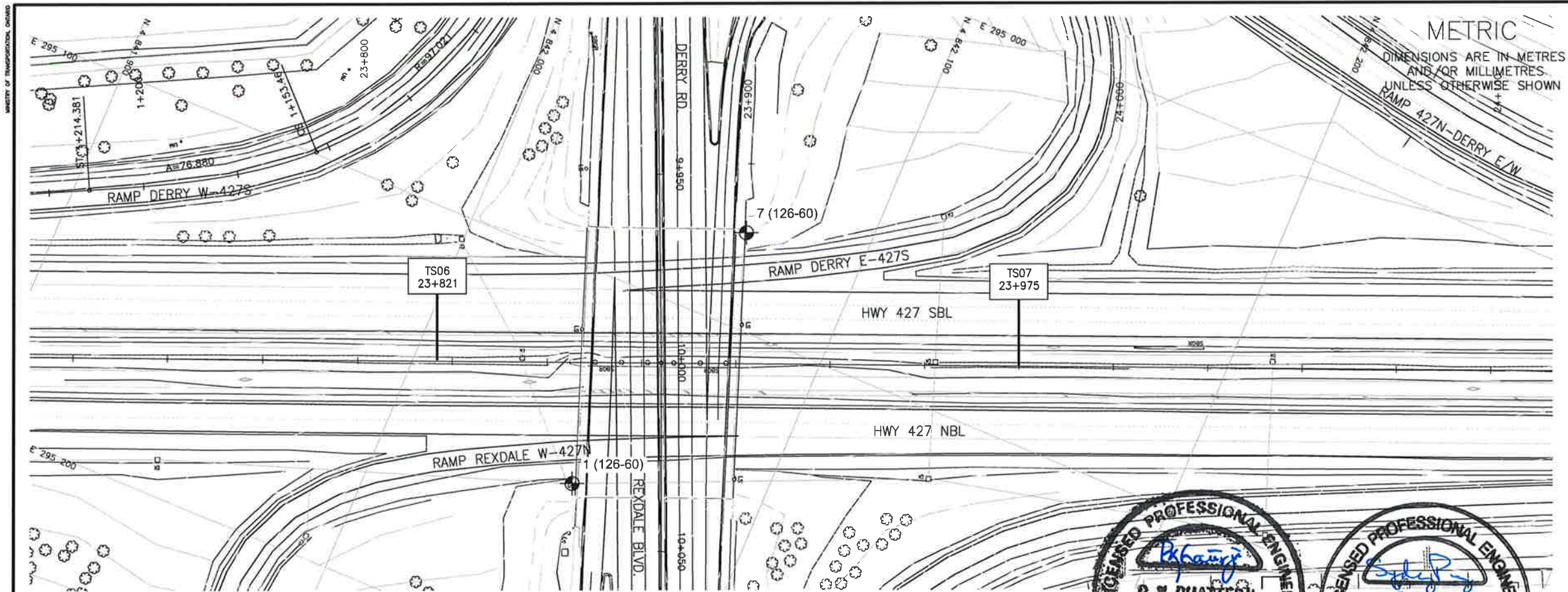
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|---------------|-----------|-------------|-----------|
| 6 (48-71-22) | 171.1 | 4 840 980.9 | 295 573.9 |
| 7 (615-89-00) | 166.3 | 4 841 462.0 | 295 365.4 |

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 30M12-407

[illegible]



CONT NO 2014-2016
GWP No 220-95-00

HIGHWAY 427 WIDENING
HOT TOLL & HOT HMS
SIGN SUPPORT
BOREHOLE LOCATIONS PLAN



THURBER ENGINEERING LTD.



KEYPLAN LEGEND

| | |
|--|---------------------------------------|
| | Borehole |
| | Borehole and Cone |
| | Blows /0.3m (Std Pen Test, 475J/blow) |
| | Blows /0.3m (60' Cone, 475J/blow) |
| | Pressure, Hydraulic |
| | Water Level |
| | Head Artesian Water |
| | Piezometer |
| | Rock Quality Designation (RQD) |
| | Auger Refusal |

| NO | ELEVATION | NORTHING | EASTING |
|----------------|-----------|-------------|-----------|
| 1 (126-60) | 168.4 | 4 842 051.6 | 295 154.5 |
| 7 (126-60) | 168.0 | 4 842 068.6 | 295 075.5 |
| 11 (615-89-00) | 162.1 | 4 842 580.1 | 294 905.8 |
| 13 (615-89-00) | 162.5 | 4 843 188.8 | 294 661.3 |

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCREs No. 30M12-407

| REVISIONS | DATE | BY | DESCRIPTION |
|-----------|------|----------|-------------|
| DESIGN | RPR | CHK SKP | CODE |
| DRAWN | AN | CHK RPR | SITE |
| LOAD | DATE | JUL 2017 | |
| STRUCT | DWG | 4 | |

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Appendix C

List of Special Provisions and Suggested Text for NSSP

List of Special Provisions Referenced in this Report

OPSS.PROV 903

OPSS.PROV 915

Suggested Text for NSSP on:

“Augered Caisson Construction for HOT and HOT HMS Support Foundations”

The Contractor is advised that variable types of subsurface materials may be encountered at the locations of the HOT and HOT HMS foundations. For additional information regarding subsurface conditions, the Contractor is referred to the Foundation Investigation Report.

1. The subsurface conditions at an augered caisson location shall be assumed to be the same as those encountered in the borehole closest to the subject caisson location.
2. Cobbles, boulders and rock fragments may be encountered within the glacial till deposits. Obstructions including rubble, cobbles and boulders may also be present within the embankment fills. The soil matrix is anticipated to become harder or denser with depth. Caisson installation equipment must be able to dislodge, handle, remove or otherwise penetrate these obstructions and hard/very dense layers.
3. Water seepage and/or soil sloughing into the caisson hole will occur from existing fill and cohesionless soils. The cohesionless soils would be susceptible to disturbance under conditions of unbalanced hydrostatic head. Temporary liners shall be available on site, or be made available on very short notice, to support the caisson sidewalls and provide seepage cut-off where required. All concrete shall be placed in the dry. Should it be impractical to remove accumulated water in the caisson hole, tremie techniques should be used to place the concrete.

The Contractor is responsible for constructing the HOT and HOT HMS foundations without disturbing the material at the sides or bases of the foundations.

Suggested Text for NSSP on:

“Potential Conflicts with Median Sewer”

A median sewer, ranging from 0.3 m to 1.1 m in diameter, has recently been installed at or near the Highway 427 centreline as part of the overall rehabilitation project. In order to maintain the integrity of the sewer, it is imperative that the as-constructed location of the sewer be confirmed prior to constructing the sign support caissons. Should there be any doubt about the actual installed location of the sewer relative to the sign support caissons, the sewer should be daylighted and clearance confirmed prior to constructing the caissons. In case of potential conflicts, the CA and the project designers shall be advised. Remedial measures may include slightly offsetting the caisson locations to provide clearance.