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WP 326-88-01 DIST 6
HWY 407 STR SITE -

Feasibility Study for Hwy 407
From Whitby/Oshawa Boundary to Hwy 35/115

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FOUNDATION INVESTIGATION REPORT

For

Feasibility Study For Hwy 407

From Whitby/Oshawa Boundary to Hwy 35/115

W.P. 326-88-01, Central Region

INTRODUCTION

This report summarizes the results of a foundation investigation for the preliminary design study of the proposed Hwy 407 from Whitby/Oshawa boundary easterly to Hwy 35/115 in the City of Oshawa and Newcastle, Region of Durham. The investigation was carried out at the request of Central Region Structural Section.

Several routes were proposed for Hwy 407 between Whitby/Oshawa boundary and Hwy 35/115. All proposed routes were within the City of Oshawa and Town of Newcastle, except for one northerly route which extended into the Township of Manvers. However, the technically preferred route, where this foundation investigation took place, was the most southerly one, within the City of Oshawa and Town of Newcastle in the Region of Durham. The proposed technically preferred route originates at the intersection of Winchester Road and Whitby/Oshawa boundary. From that point it runs in a southeast direction, intersects Conlin Road just east of Oshawa and Newcastle boundary and then runs more or less parallel to Concession Road 6 in a zigzag manner towards the east, until it intersects Regional Road No. 42. The proposed route then runs in a northeast direction and connects to Hwy 35/115 intersection. The details of the proposed technically preferred route and structures are illustrated on Drawing No. 3268801-A.

This Foundation investigation was intended for initial assessment of the feasibility of the proposed alignment from a foundation point of view, with a general coverage of the area by limited number of boreholes.

Before initiating the Foundation investigation, a Preliminary Geotechnical Conditions report by Geocon Inc., dated July 10, 1990 was reviewed by this office (Geocon Report T11547/53425, Highway 407 Route Planning and Environmental Assessment Study, Hwy 48 to Hwy 35-115).

SITE DESCRIPTION

The site for the proposed Hwy 407 from Whitby/Oshawa boundary to Hwy 35/115 is located within the City of Oshawa and Town of Newcastle in the Region of Durham. Residential properties are primarily located along the major streets which the proposed highway would cross.

The existing ground elevation varies from 166.3m (BH P23) to 345.0m (east of BH P41, near Hwy 35/115 intersection). The proposed route is about 30.5 kilometre long (from station 9+500 to station 40+000). Between stations 31+000 and 40+000 the ground slopes down sharply from east to west at about 2.4 per cent slope (elevation drops from 345.0m to 163m). Further west of station 31+000 the ground surface is undulating, the slope ranges from 0.3 per cent to 2 per cent and the ground elevation varies from 155m and 225m.

Physiographically, the area is located in a region referred to as the "South Slope and Iroquois Plain" (Reference: Chapman and Putnam "The Physiography of Southern Ontario; 3rd Edition, 1984). This is the low land bordering Lake Ontario which was inundated in the Pleistocene time by Lake Iroquois. Subsoils in these areas generally are characterized by a mosaic of till plains, drumlins and areas of Glaciolacustrine deposits of silt, sand and clayey silt.

INVESTIGATION PROCEDURES

The field work for the investigation was carried out between 94 05 25 and 94 05 30. The investigation consisted of twenty one (21) sampled boreholes (BH P21 through P41). In general, at least one borehole was put down at each proposed major interchange. The boreholes were advanced to depths of 9.3 (BH P29) to 16.9 (BH P26).

The boreholes were advanced with three track mounted machines equipped with continuous flight augers. Conventional solid and hollow stem augers were used. The sampling program consisted of split spoon samples collected in the overburden. Soil samples were retrieved by split spoon sampler in accordance with Standard Penetration Test (ASTM D1586).

Standard Penetration 'N' values were recorded for assessment of the strength of the materials encountered. All subsoil samples were identified in the field and returned to the laboratory for further visual examination and testing. Groundwater levels were measured in each borehole and all boreholes were backfilled upon completion of the field work.

Surveying required to ascertain borehole locations and elevations was carried out by the Central Region Surveys and Plans Section.

SUBSURFACE CONDITIONS

The record of Borehole sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The location and elevation of the boreholes are shown on Drawing No. 3268801-A.

Since the investigation was spread over a large area of 30.5 kilometre (station 9+500 to 40+000), individual borehole logs should be referred to for information on soil conditions at any structure location. However, the predominant soil strata encountered at the site consisted of glacial till (made up primarily of silty clay to clayey silt and silt to silty sand). The surficial deposit at the site was generally a glacial till.

The Standard Penetration test in cohesive glacial till recorded 'N' values from 8 blows to more than 100 blows. Based on the 'N' values, the cohesive glacial till has a stiff to hard consistency. In non-cohesive glacial till the 'N' value ranged from 9 to more than 100 blows indicating the material to be loose to very dense.

GROUNDWATER CONDITIONS

Individual boreholes should be referred to for groundwater elevation at any proposed structure locations. Groundwater level was recorded in all boreholes except for Boreholes P27, P28, P39, and P41 where either the boreholes remained dry or water level couldn't be measured due to borehole collapse. The groundwater table stabilized at depths ranging from 0.7m (BH P24) to 9.1m (BH P34) below ground surface. The groundwater elevation ranged from 157.7m (BH P23) to 252.6m (BH P40). Groundwater levels are subject to seasonal fluctuations and may vary from the values provided in this report.

DISCUSSION AND RECOMMENDATIONS

General

This report contains recommendations pertaining to the structure foundations, approach embankments, cuts and hydrogeological aspects for various structures for the proposed Hwy 407 from Whitby/Oshawa boundary easterly to Hwy 35/115 in the City of Oshawa and Newcastle, Region of Durham. The recommendations given in the report are tentative based on the limited information available and should definitely be reviewed based on supplementary investigations. The site location is shown on Drawing No. 3268801-A.

Total 66 bridge structures (Structure 3 through 68) are proposed along the proposed Hwy 407 from Whitby/Oshawa boundary easterly to Hwy 35/115 in the City of Oshawa and Newcastle, Region of Durham. This includes 22 watercourse structure sites (W), 28 grade separated structure sites (GS) and 16 interchange structure sites (I).

In general, the geotechnical conditions within the proposed route corridors are favourable. There are no foundation concerns that would require realignment of the proposed Hwy 407 route from Whitby/Oshawa boundary easterly to Hwy 35/115. Subsurface conditions over the site are uniform and competent for structure foundation and embankment loadings. The glacial till is expected to provide adequate bearing for most structures and may be able to sustain low to medium loads on shallow spread footings. However, deep foundations such as caissons and piles may be required to transfer heavier loads to greater depths and to more competent bearing material. Our comments from the feasibility, design and construction of the various structures are given on the Foundation Data Sheets included in the Appendix. Twenty one data sheets (Area 21 through 41) are provided for the 66 structures; the area locations are also shown on Drawing No. 3268801-A. An explanation of information provided on the data sheet is outlined below:

1. The structure number (i.e. 03, 04, 05 etc.) are the numbers assigned to the structures for the purpose of the feasibility study. The area number such as 21, 22, 23, etc is based on the borehole numbers P21, P22, P23, etc drilled in those areas. The actual location is shown on Drawing No. 3268801-A
2. The original ground elevation is based on the survey results of the borehole locations along the proposed Hwy 407 from Whitby/Oshawa boundary easterly to Hwy 35/115 in the City of Oshawa and Newcastle, Region of Durham.

3. The grades of roadway given is based on the proposed grades of proposed Hwy 407 at the respective sites, obtained from a profile of the Technically Preferred Route supplied to us (no reference no).
4. Subsurface conditions are described very briefly and are based on generally one borehole per area.

5. Structure Foundations

The recommendations are for pier and abutment foundations. The options for structure foundations are given in preferential order based on geotechnical/economical considerations. Further elaboration of structure recommendations made on the data sheets are given below:

Compacted Granular 'A' Core (Engineered Fill) - This option is generally for abutments where subsurface conditions are competent. The minimum requirements of a compacted granular 'A' core are shown on Figure No. 1 (attached). Furthermore, the footing for this scheme could be designed using the following parameters:

Factored Bearing Capacity at U.L.S. = 900 kPa
Bearing Capacity at S.L.S. Type II = 350 kPa

Spread Footings: This option is given for abutments and piers where subsurface conditions are competent. The highest elevation and corresponding maximum design load is given. It is to be noted the spread footing should be provided with a minimum of 1.2m of earth cover for frost protection purposes. In addition, where the spread footing is to be founded on a cohesive deposit, subject to softening upon exposure to construction or weather conditions, it would be necessary to protect the base of the footing excavation from softening by placing a working slab of lean concrete immediately upon completion of the footing excavation. Also, where the footing is located in a non cohesive deposit and the water table is at or above the footing founding level, it will be necessary to prevent the base of the footing from "boiling" due to an unbalanced excess hydrostatic head. In this case a dewatering scheme would be required.

End-Bearing Piles: This founding scheme is recommended for the abutments and piers where appropriate. The recommendation gives the estimated pile tip elevation. Generally, the end-bearing piles can be designed for the factored axial capacity at U.L.S. and the axial capacity at S.L.S. Type II which is dependent on the pile section chosen. The following design parameters are recommended for the pile foundation:

<u>Pile Type</u>	<u>Factored Axial Capacity at U.L.S. (kN)</u>	<u>Axial Capacity at S.L.S. Type II (kN)</u>
310X79	1150	900
310X110	1600	1150

It is generally assumed that steel 'H' piles will be used. Pile driving would be controlled by the Hiley Formula unless it is being driven to the bedrock surface or in clayey subsoil.

6. Approaches

The recommendation for fill slopes, cut slopes and berm requirements, are based on the proposed preliminary grades assuming fills are constructed of acceptable earth borrow according to current MTO Specifications. Any changes in profile grade would require a reassessment of these recommendations. Also, discussed under this heading is special treatment, i.e. benching, slope protection, etc., that is anticipated at this location. No excessive settlements of embankments at the proposed fill heights are anticipated at this stage.

7. Other Considerations

The granular 'A' or 'B' backfill should be in accordance with Special Provision. The following properties will be used for the calculation of lateral pressure:

Granular 'A'	$\gamma = 22.8 \text{ kN/m}^3$, $\phi = 35^\circ$, $K_o = 0.43$, $K_a = 0.27$
Granular 'B'	$\gamma = 21.2 \text{ kN/m}^3$, $\phi = 30^\circ$, $K_o = 0.50$, $K_a = 0.33$
Native Soil	$\gamma = 20.0 \text{ kN/m}^3$, $\phi = 26^\circ$, $K_o = 0.56$, $K_a = 0.39$

If the structure is to be designed as a rigid frame then the coefficient of earth pressure at rest (K_0) will be used.

All foundation elements should have a minimum of 1.2m earth cover for frost protection. The concrete for the footings should be placed 'in the dry'. Consequently a dewatering scheme will be required if the concrete is poured below the prevailing water level

8. Remarks

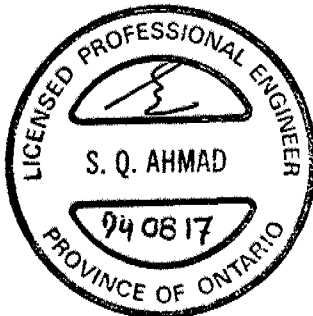
In this column comments are made about any construction difficulties, dewatering and hydrogeological concerns at any given site.

MISCELLANEOUS

The tentative foundation recommendations outlined in this report are for feasibility study or preliminary planning purposes only as they are based on very limited subsurface information. It will be necessary to carry out a detailed foundation investigation at each of the structure sites when the design details and geometries are finalized and approved. In some areas, groundwater studies and special in-situ field testing may be warranted.

The field work for this investigation was carried out under the supervision of Todd Barlow, Lori O'Malley and Tanya Cross Engineering students, using equipment owned and operated by Master Soil Investigation and Atcost Soil Drilling.

The report was prepared by K.S.Q. Ahmad, P. Eng. Foundation Engineer and reviewed and approved by D. Dundas, P. Eng. Acting Chief Foundation Engineer.



K.S.Q. Ahmad

K.S.Q. Ahmad, P. Eng.
Foundation Engineer



D. Dundas

D.H. Dundas, P. Eng.
Chief Foundation Engineer (Acting)

APPENDIX

FOUNDATION DATA SHEETS

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 21 STRUCTURE Nos. 03, 04, 05, 06 LOCATION Oshawa Creek Bridges, Thornton Road Overpasses

ORIGINAL GROUND ELEV. 172.0 m PROPOSED HWY 407 GRADE ELEV. 173.0 m, 177.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 21</u></p> <p>0.0 - 9.4 m Clayey Silt Hard (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>169.2 m</p>	<p>1.) For pier and abutments, spread footings placed within hard glacial till below elevation 171.0 m and below a frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 500 kPa - Bearing Capacity at S.L.S. Type II = 300 kPa <p>2.) For foundations at higher elevations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) Higher Bearing Capacities can be utilized at a lower depth below elevation 166.0 m.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 22 STRUCTURE Nos. 07 LOCATION Simcoe Road Underpass

ORIGINAL GROUND ELEV. 184.9 m PROPOSED HWY 407 GRADE ELEV. 182.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 22</u></p> <p>0.0 - 5.5 m Clayey Silt Hard (Glacial Till)</p> <p>5.5 - 12.6 m Silty Sand to Sandy Silt Dense to V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>181.8 m</p>	<p>1.) For abutments and piers, spread footings placed within hard glacial till below elevation 182.0 m and below a frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 600 kPa - Bearing Capacity at S.L.S. Type II = 400 kPa <p>2.) Higher Bearing Capacities can be utilized at a lower depth below elevation 176.0 m.</p>	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 23 STRUCTURE Nos. 08, 09, 10, 11 LOCATION Oshawa Creek Bridges, Ritson Road Overpasses

ORIGINAL GROUND ELEV. 166.3 m PROPOSED HWY 407 GRADE ELEV. 177.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 23</u></p> <p>0.0 - 5.5 m Silty Clay to Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p>5.5 - 9.6 m Silty Sand to Sandy Silt Dense to V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>157.7 m</p>	<p>1.) For pier and abutment foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>2.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 24 STRUCTURE Nos. 12, 13, 14 LOCATION Wilson Road, Harmony Road, Grandview Road Underpasses

ORIGINAL GROUND ELEV. 203.2 m PROPOSED HWY 407 GRADE ELEV. 183.0 m, 200.0 m, 196.0 m Respectively
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 24</u></p> <p>0.0 - 9.6 m Clayey Silt Hard (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>202.5 m</p>	<p>1.) For pier and abutment foundations, spread footings placed within hard glacial till below elevation 200.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 800 kPa - Bearing Capacity at S.L.S. Type II = Not Governed 	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 25 STRUCTURE Nos. 15 LOCATION West Townline Road Underpass

ORIGINAL GROUND ELEV. 212.3 m PROPOSED HWY 407 GRADE ELEV. 202.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>REFERENCE BOREHOLE</u> <u>P 25</u> 0.0 - 13.8 m Sandy Silt to Silt V. Dense (Glacial Till) <u>Groundwater Elevation</u> 211.9 m	1.) For abutment and pier foundations, spread footings placed within V. Dense glacial till below elevation 202.0 m and below frost depth of 1.2 m may be designed for: - Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Governed	Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.	1.) No serious foundation problems are anticipated. 2.) Dewatering will be required for excavation below water table. Dewatering may be limited to oversize excavation. 3.) This is not a suitable site for an infiltration pond. Due to possible high water table after construction.

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 26 STRUCTURE Nos. 16, 17 LOCATION Conlin Road, Langmaid Road Underpasses

ORIGINAL GROUND ELEV. 210.6 m PROPOSED HWY 407 GRADE ELEV. 198.0 m, 202.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 26</u></p> <p>0.0 - 9.8 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p>9.8 - 16.9 m Clayey Silt Hard (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>203.6 m</p>	<p>1.) For abutment and pier foundations, spread footings placed within V. Dense or Hard glacial till below elevation 202.0 m and below frost depth of 1.2 m may be designed for:</p> <p>- Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Governed</p>	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 27 STRUCTURE Nos. 18, 19 LOCATION Regional Road 34 Overpasses

ORIGINAL GROUND ELEV. 205.4 m PROPOSED HWY 407 GRADE ELEV. 213.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 27</u></p> <p>0.0 - 9.6 m Silty Sand to Sandy Silt Dense to V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>Dry</p>	<p>1.) For pier foundations, spread footings placed within Dense to V. Dense glacial till below elevation 204.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 500 kPa - Bearing Capacity at S.L.S. Type II = 300 kPa <p>2.) For abutment foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) Higher bearing capacities can be utilized at a lower depth below elevation 202.0 m.</p> <p>4.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This may be a potential site for an infiltration pond, but should be verified by further investigation.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 28 STRUCTURE Nos. 20, 21 LOCATION Farewell Creek Bridge, Solina Road Underpass

ORIGINAL GROUND ELEV. 211.1 m PROPOSED HWY 407 GRADE ELEV. 190.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 28</u></p> <p>0.0 - 12.4 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>Hole Collapsed</p>	<p>1.) For pier and abutment, spread footings placed within V. Dense glacial till below elevation 190.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Governed 	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 29 STRUCTURE Nos. 22, 23, 24 LOCATION Solina Road Underpass, Rundle Road Overpasses

ORIGINAL GROUND ELEV. 188.5 m PROPOSED HWY 407 GRADE ELEV. 187.0 m, 184.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 29</u></p> <p>0.0 - 4.9 m Silty Sand V. Dense</p> <p>4.9 - 9.3 m Clayey Silt Hard (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>184.9 m</p>	<p>1.) For Abutment and pier, spread footings placed within V. Dense Silty Sand or Hard glacial till below elevation 187.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Applicable <p>2.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p> <p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 30 STRUCTURE Nos. 25 LOCATION Holt Road Underpass

ORIGINAL GROUND ELEV. 192.6 m PROPOSED HWY 407 GRADE ELEV. 182.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 30</u></p> <p>0.0 - 12.3 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>186.5 m</p>	<p>1.) For abutment and pier, spread footings placed within V. Dense glacial till below elevation 182.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Governed 	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326-88-01 AREA 31 STRUCTURE Nos. 26, 27, 28, 29 LOCATION Bowmanville Creek Bridges, Old Scugog Road Overpass

ORIGINAL GROUND ELEV. 174.4 m PROPOSED HWY 407 GRADE ELEV. 180.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 31</u></p> <p>0.0 - 9.8 m Silty Clay to Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>173.9 m</p>	<p>1.) For abutment and pier foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>2.) Higher bearing capacities can be utilized at a lower depth below elevation 170.0 m.</p> <p>3.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326-88-01 AREA 32 STRUCTURE Nos. 30, 31, 32, 33, 34, 35, 36, 37 LOCATION Regional Road 57, Cedar Park Road and Creek Structures

ORIGINAL GROUND ELEV. 172.9 m PROPOSED HWY 407 GRADE ELEV. 182.0 m, 184.0 m, 187.0 m

Reference:

[illegible]

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 33 STRUCTURE Nos. 38, 39, 40, 41 LOCATION Middle Road and Creek East of Middle Road Structures

ORIGINAL GROUND ELEV. 178.2 m PROPOSED HWY 407 GRADE ELEV. 187.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 33</u></p> <p>0.0 - 2.4 m Silty Sand Loose</p> <p>2.4 - 9.8 m Silty Clay to Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>177.9 m</p>	<p>1.) For abutment and pier foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>2.) For higher bearing capacity, piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability and the water table is high.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 34 STRUCTURE Nos. 42 LOCATION Regional Road 14 Underpass

ORIGINAL GROUND ELEV. 188.4 m PROPOSED HWY 407 GRADE ELEV. 186.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 34</u></p> <p>0.0 - 4.0 m Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p>4.0 - 7.0 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p>7.0 - 12.6 m Silty Clay to Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>179.3 m</p>	<p>1.) For pier foundations, spread footings placed within V. Stiff to Hard glacial till below elevation 186.0 m and below frost depth of 1.2 m may be designed for:</p> <p>- Factored Bearing Capacity at U.L.S. = 650 kPa - Bearing Capacity at S.L.S. Type II = 400 kPa</p> <p>2.) For abutment foundation, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <p>- Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa</p> <p>3.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 35 STRUCTURE Nos. 43, 44, 45, 46, 47, 48 LOCATION Clemens Road, Mackie Creek and Bethesda Road Structures

ORIGINAL GROUND ELEV. 184.4 m PROPOSED HWY 407 GRADE ELEV. 185.0 m, 189.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 35</u></p> <p>0.0 - 9.8 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>182.0 m</p>	<p>1.) For pier foundations, spread footings placed within V. Dense glacial till below elevation 183.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 750 kPa - Bearing Capacity at S.L.S. Type II = 500 kPa <p>2.) For abutment foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) For higher bearing capacities, piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 36 STRUCTURE Nos. 49, 50, 51, 52, 53 LOCATION Acres Road, Cole Road and Soper Creek Structures

ORIGINAL GROUND ELEV. 171.9 m PROPOSED HWY 407 GRADE ELEV. 188.0 m, 180.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p>P 36</p> <p>0.0 - 9.6 m Silty Sand Compact to V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>166.2 m</p>	<p>1.) For abutment and pier foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>2.) Piles and caissons are also feasible, but should be selected on a cost comparison basis. If this option is selected, further investigation would be required.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This may be a potential site for an infiltration pond. Further investigation will be required to prove this site to be suitable for an infiltration pond.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 37 STRUCTURE Nos. 54, 55 LOCATION Darlington Town Line Road and Brown Road Structures

ORIGINAL GROUND ELEV. 191.0 m PROPOSED HWY 407 GRADE ELEV. 187.0 m, 197.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 37</u></p> <p>0.0 - 7.0 m Silty Sand to Sandy Silt V. Dense</p> <p>7.0 - 10.8 m Clayey Silt Hard (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>184.0 m</p>	<p>1.) For pier and abutment foundations, spread footings placed within V. Dense glacial till below elevation 187.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = 500 kPa <p>2.) For pier and abutment foundations at higher elevations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) For Higher bearing capacities, piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p> <p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This may be a potential site for an infiltration pond. The permeability of the soil is low to medium. Further study will be required to determine if the site is suitable for an infiltration pond.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 38 STRUCTURE Nos. 56, 57, 58, 59, 60, 61 LOCATION Mosport Road, Wilmot Creek and Leskard Road Structures

ORIGINAL GROUND ELEV. 202.3 m PROPOSED HWY 407 GRADE ELEV. 204.0 m, 209.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p>P 38</p> <p>0.0 - 9.5 m Silty Sand Compact to V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>195.1 m</p>	<p>1.) For pier foundations, spread footings placed within Compact to V. Dense glacial till below elevation 201.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 500 kPa - Bearing Capacity at S.L.S. Type II = 300 kPa <p>2.) For pier and abutment foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) For higher bearing capacities, piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This may be a potential site for an infiltration pond. Further investigation would be required to confirm this.</p>

FOUNDATION DATA SHEET

W.P. 326-88-01 AREA 39 STRUCTURE Nos. 62 LOCATION Best Road Structures

ORIGINAL GROUND ELEV. 244.4 m PROPOSED HWY 407 GRADE ELEV. 238.5 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 39</u></p> <p>0.0 - 12.3 m Silty Sand to Sandy Silt Compact to V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>Not Established</p>	<p>1.) For pier and abutment foundations, spread footings placed within Dense to V. Dense glacial till below elevation 238.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 650 kPa - Bearing Capacity at S.L.S. Type II = 400 kPa <p>2.) Higher bearing capacities can be utilized at a lower depth below elevation 237.0 m.</p> <p>3.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slopes. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) May be a candidate site for an infiltration pond. Further investigation will be required to prove this.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 40 STRUCTURE Nos. 63, 64, 65, 66 LOCATION A Creek East of Best Road and Concession Road 8 Structures

ORIGINAL GROUND ELEV. 255.9 m PROPOSED HWY 407 GRADE ELEV. 250.0 m, 259.0 m
Reference: _____

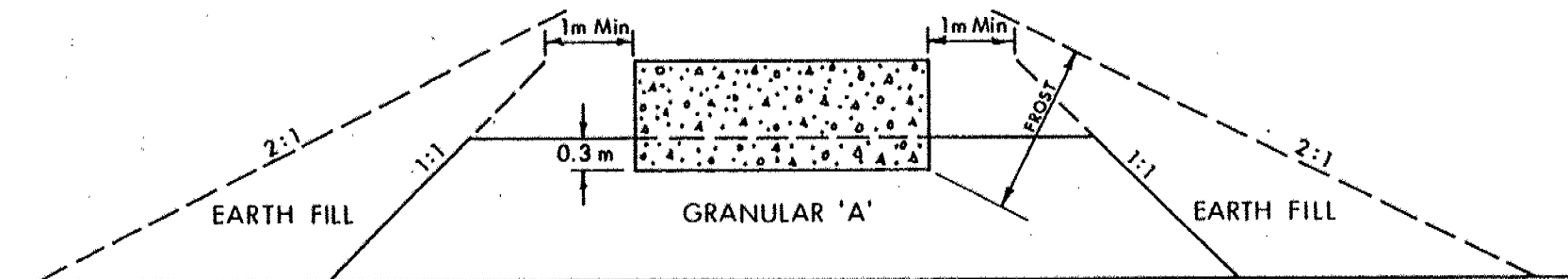
SUBSURFACE CONDITIONS		RECOMMENDATIONS		REMARKS
		STRUCTURE	APPROACHES	
<u>REFERENCE BOREHOLE</u> P 40 0.0 - 4.0 m Clayey Silt Stiff (Glacial Till) 4.0 - 9.6 m Silt to Silty Sand V. Dense <u>Groundwater Elevation</u> 252.6 m		1.) For pier foundations, spread footings placed within V. Dense Silt to Silty Sand below elevation 250.0 m and below frost depth of 1.2 m may be designed for: - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 300 kPa 2.) For pier and abutment foundations at higher elevations, spread footings can be placed on a well compacted granular 'A' pad designed for: - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa	Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill. Cuts up to 6 m deep will be stable at 2 H : 1 V side slopes. A berm would be required for deeper cuts.	1.) No serious foundation problems are anticipated. 2.) Dewatering will be required for excavation below water table in non cohesive material 3.) This is not a suitable site for an infiltration pond. The soil is of low permeability and the water table is likely to remain high after construction.

FOUNDATION DATA SHEET

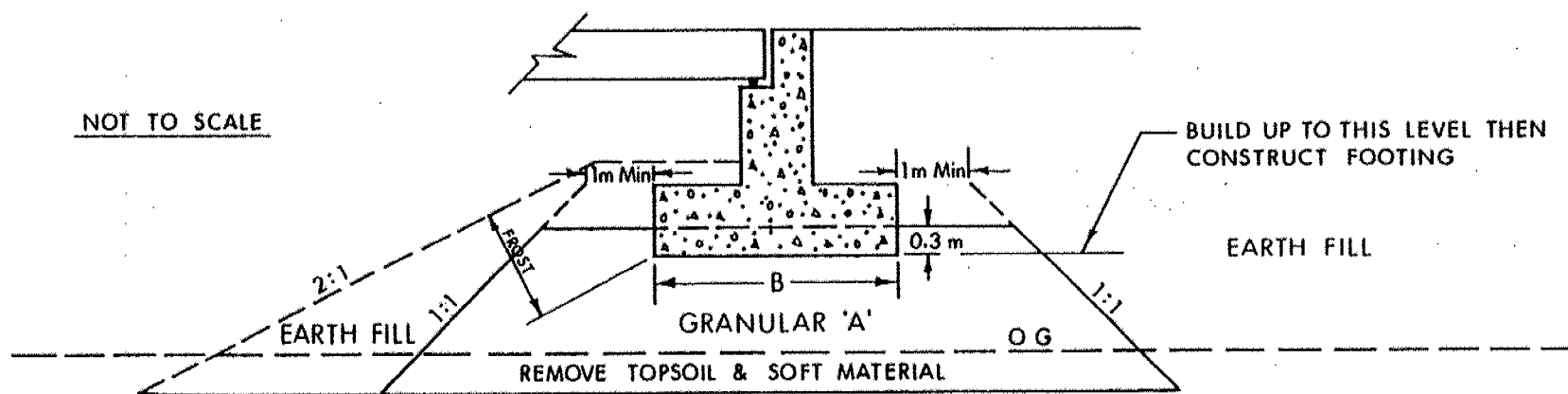
W.P. 326 - 88 - 01 AREA 41 STRUCTURE Nos. 67, 68 LOCATION Skelding Road Structure, Hwy 35/115 Underpass

ORIGINAL GROUND ELEV. 319.0 m PROPOSED HWY 407 GRADE ELEV. 310.0 m, 337.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>REFERENCE BOREHOLE</u> <u>P 41</u> 0.0 - 5.5 m Silty Clay to Clayey Silt V. Stiff to Hard 5.5 - 9.8 m Silt to Silty Sand V. Dense <u>Groundwater Elevation</u> Not Established	1.) For abutment and pier foundations, spread footings can be placed on a well compacted granular 'A' pad designed for: - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa 2.) For higher bearing capacities, piles and caissons are also feasible, but should be selected on a cost comparison basis.	Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill. Cuts up to 6 m deep will be stable at 2 H : 1 V side slopes. A berm would be required for deeper cuts.	1.) No serious foundation problems are anticipated. 2.) No major dewatering problems are anticipated. 3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.



X SECTION



LONGITUDINAL SECTION

NOTES:

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T O STANDARDS.
- 3 - CONSTRUCT CONCRETE FOOTING.
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.



Ontario

Ministry of
Transportation

ABUTMENT ON COMPACTED FILL
SHOWING GRANULAR 'A' CORE

FIG No 1

W P 326 - 88 - 01

RECORD OF BOREHOLE No P21

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 868 931.8, E 351 038.5 ORIGINATED BY LO
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem / Hollow Stem COMPILED BY LO
 DATUM Geodetic DATE 1994.05.30 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	W _P	W	W _L		
172.0	Ground Surface																
0.0	Clayey Silt Some Sand, Trace Gravel Hard (Glacial Till)		1	SS	31												
	Sandy Silt		2	SS	31												
			3	SS	41												
			4	SS	57												
			5	SS	104												
162.5			6	SS	120												
9.4	End of Borehole																

RECORD OF BOREHOLE No P22

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 869 896.0, E 352 482.8 ORIGINATED BY LO
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem / Hollow Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 26 CHECKED BY KA

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 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
184.9	Ground Surface															
0.0	Clayey Silt Some Sand, Trace Gravel Hard (Glacial Till)		1	SS	74											
			2	SS	100											
179.4																
5.5	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Dense to V. Dense (Glacial Till)		3	SS	39											
			4	SS	41											
			5	SS	108											
			6	SS	100											
172.3			7	SS	101											
12.6	End of Borehole															

RECORD OF BOREHOLE No P23

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 869 724.6, E 354 258.5 ORIGINATED BY LO
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 27 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	W _P	W			W _L
186.3	Ground Surface																
0.0	Silty Clay to Clayey Silt Some Sand, Trace Gravel V. Stiff to Hard (Glacial Till)		1	SS	16												
			2	SS	52												
			3	SS	27												
160.8	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Dense to V. Dense (Glacial Till)		4	SS	76												
5.5			5	SS	46												
			6	SS	53												
156.7																	
9.6	End of Borehole																

RECORD OF BOREHOLE No P24

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 869 574.1, E 356 028.6 ORIGINATED BY LO
DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
DATUM Geodetic DATE 1994 05 27 CHECKED BY KA

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 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
203.2	Ground Surface																
0.0	Clayey Silt Some Sand, Trace Gravel Hard (Glacial Till)		1	SS	44												
			2	SS	78												
			3	SS	120												
			4	SS	85												
			5	SS	104												
193.6			6	SS	105												
9.8	End of Borehole																

METRIC

[illegible]

1 OF 1

METRIC

[illegible]

RECORD OF BOREHOLE No P27

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 869 259.2, E 360 032.5 ORIGINATED BY LO
DIST 6 HWY 407 BOREHOLE TYPE Solid Stem / Hollow Stem COMPILED BY LO
DATUM G odetic DATE 1994 05 30 CHECKED BY KA

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 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					
205.4	Ground Surface																
0.0						DRY *											
			1	SS	33		204										
			2	SS	105		202										
	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Dense to V. Dense (Glacial Till)		3	SS	150	/27cm	200										
			4	SS	89		198										
			5	SS	70												
195.8			6	SS	116		196										
9.8	End of Borehole																

RECORD OF BOREHOLE No P28

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 859 551.5, E 361 241.7 ORIGINATED BY TC
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 25 CHECKED BY KA

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
211.1	Ground Surface																
0.0	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel V. Dense (Glacial Till)		1	SS	107												
			2	SS	96	/15cm											
			3	SS	150	/20cm											
			4	SS	120												
			5	SS	130	/18cm											
198.7																	
12.4	End of Borehole																
	• Unable to Measure Ground Water Due to the Hole Collapsing																

RECORD OF BOREHOLE No P29

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 869 697.3, E 362 491.2 ORIGINATED BY TC
DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
DATUM Geodetic DATE 1994 05 26 CHECKED BY KA

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 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					
188.5	Ground Surface												
0.0	Silty Sand Trace of Clay, Trace of Gravel V. Dense					188							
						186							
183.6						184							
4.9	Clayey Silt Some Sand, Trace Gravel Hard (Glacial Till)					182							
						180							
179.2													
9.3	End of Borehole												

RECORD OF BOREHOLE No P30

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 870 650.8, E 363 911.5 ORIGINATED BY TC
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 26 CHECKED BY KA

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
192.6	Ground Surface																
0.0	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Pockets of Gravely Sand V. Dense (Glacial Till)		1	SS	120	/15cm											
			2	SS	120												
			3	SS	90	/15cm											
			4	SS	160	/15cm											
180.3			5	SS	157	/15cm											
12.3	End of Borehole																

RECORD OF BOREHOLE No P31

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 871 079.4, E 364 649.2 ORIGINATED BY TC
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 27 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	W _p	W	W _L		
174.4	Ground Surface																
0.0	Silty Clay to Clayey Silt Some Sand, Trace Gravel V. Stiff to Hard (Glacial Till) ----- Lacustrine		1	SS	25												
			2	SS	42												
			3	SS	55												
			4	SS	55												
			5	SS	128												
			6	SS	122												
164.8	End of Borehole																
9.6																	

RECORD OF BOREHOLE No P32

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 871 347.3 E 365 431.0 ORIGINATED BY TC
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 30 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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		
172.9	Ground Surface																
0.0	Silty Clay Trace of Sand, Trace of Gravel Stiff to Hard Firm		1	SS	19												
			2	SS	43												
			3	SS	13												
			4	SS	6												
			5	SS	5												
			6	SS	8												
163.3																	
9.6	End of Borehole																

RECORD OF BOREHOLE No P33

1 OF 1

METRIC

W.P. 326-58-01 LOCATION Coords.: N 4 871 673.1, E 367 022.7 ORIGINATED BY TC & VB
DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
DATUM Geodetic DATE 1994 05 27 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W _p	W	W _L		
178.2	Ground Surface															
0.0	Silty Sand Trace of Clay, With Some Gravel (Glacial Till)		1	SS	9											
175.8																
2.4			2	SS	47											
	Silty Clay to Clayey Silt Some Sand, Trace Gravel V. Stiff to Hard (Glacial Till)		3	SS	37											
			4	SS	23											
			5	SS	36											
168.6			6	SS	21											
9.6	End of Borehole															

RECORD OF BOREHOLE No P34

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 871 786.0, E 367 844.0 ORIGINATED BY TC
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 30 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W _p	W	W _L		
188.4	Ground Surface															
0.0	Clayey Silt Some Sand, Trace of Gravel V. Stiff to Hard (Glacial Till)		1	SS	19	188										
184.4			2	SS	41	186										
4.0	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel V. Dense (Glacial Till)		3	SS	55	184										
181.4			4	SS	90	182										
7.0	Silty Clay to Clayey Silt Some Sand, Trace of Gravel V. Stiff to Hard (Glacial Till)		5	SS	38	180										
			6	SS	29	178										
			7	SS	42											
175.8			8	SS	164	176										
12.6	End of Borehole															

RECORD OF BOREHOLE No P35

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 872 244.1, E 369 422.3 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 25 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20	40	60	80	100	W _p	W	W _L		
184.4	Ground Surface																
0.0																	
			1	SS	66												
			2	SS	77												
			3	SS	81												
			4	SS	83												
			5	SS	152												
174.8			6	SS	125												
9.6	End of Borehole																

RECORD OF BOREHOLE No P36

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 873 130.2, E 370 875.9 ORIGINATED BY TB
 DIST. 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 25 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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
171.9	Ground Surface																
0.0	Silty Sand Trace of Clay, Trace of Gravel Compact to V. Dense (Glacial Till)		1	SS	18												
			2	SS	48												
			3	SS	63												
			4	SS	63												
			5	SS	26												
162.3			6	SS	20												
9.6	End of Borehole																

RECORD OF BOREHOLE No P37

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords: N 4 873 565.4, E 371 610.1 ORIGINATED BY TS
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 26 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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		
191.0	Ground Surface																
0.0																	
	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel V. Dense		1	SS	195												
184.0			2	SS	54												
7.0																	
	Clayey Silt Some Sand, Trace of Gravel Hard (Glacial Till)		3	SS	185	/28cm											
			4	SS	120	/13cm											
180.2			5	SS	117	/15cm											
10.8	End of Borehole																

RECORD OF BOREHOLE No P38

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 874 706.1, E 373 460.3 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 26 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	W _p	W			W _L
202.3	Ground Surface																
0.0	Silty Sand Trace of Clay, Trace of Gravel Occasional Pockets of Gravel Compact to V. Dense (Glacial Till)		1	SS	30												
			2	SS	28												
			3	SS	35												
			4	SS	46												
			5	SS	33												
192.8			6	SS	92												
9.5	End of Borehole																

RECORD OF BOREHOLE No P39

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 875 662.9, E 374 279.7 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 30 CHECKED BY KA

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
244.4	Ground Surface																
0.0						*	244										
	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Occasional Layers of Gravelly Sand Compact to V. Dense (Glacial Till)		1	SS	18		242										
			2	SS	37		240										
			3	SS	120		238										
			4	SS	99		236										
	Sandy Gravel		5	SS	120	/12cm	234										
232.0			6	SS	123	/15cm											
12.3	End of Borehole																
	* Ground Water Not Established																

RECORD OF BOREHOLE No P41

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 878 682.4, E 374 562.7 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 30 CHECKED BY KA

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		
319.0	Ground Surface															
0.0	Silty Clay to Clayey Silt Some Sand, Traces of Gravel V. Stiff to Hard		1	SS	26											
	Silty Sand		2	SS	17											
			3	SS	24											
313.6			4	SS	49											
5.5	Silt to Silty Sand V. Dense		5	SS	46											
			6	SS	144											
309.4																
9.6	End of Borehole															
	* Ground Water Not Established															

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 (R Q D), 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

MECHANICAL PROPERTIES OF SOIL

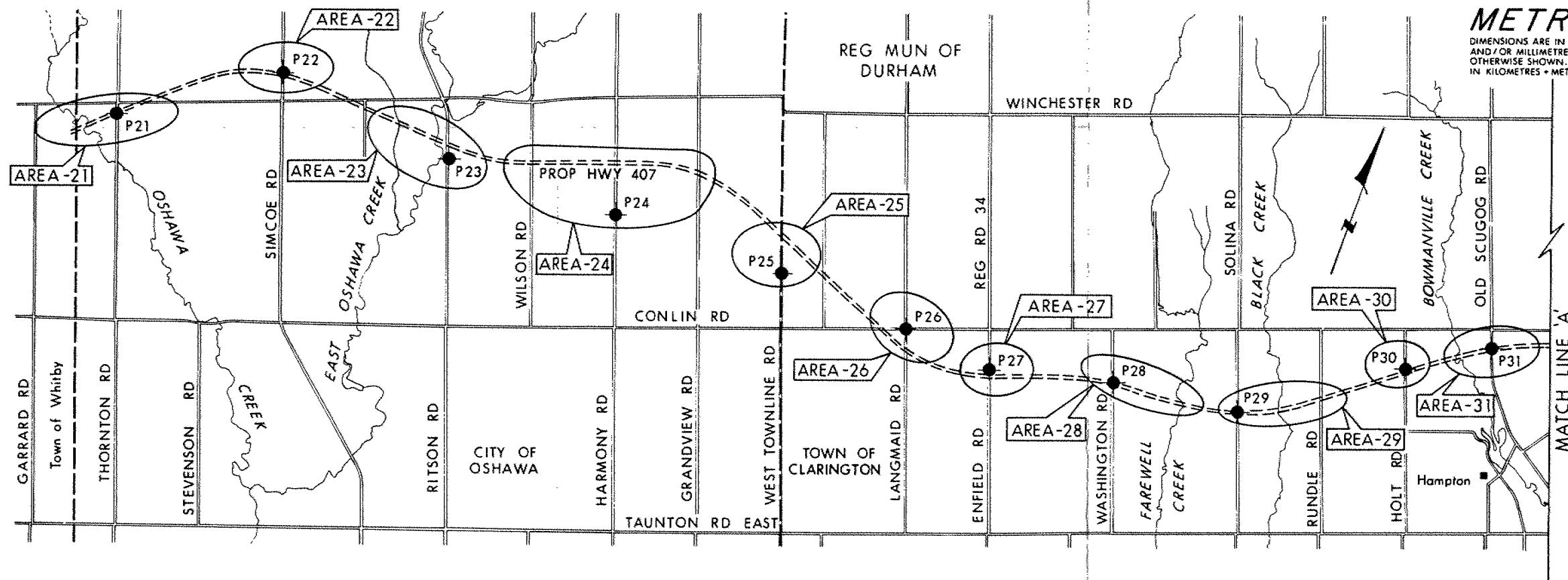
m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
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 = $\frac{c_u}{\tau_r}$

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
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

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^3/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						



PLAN
SCALE
500m 0 500m

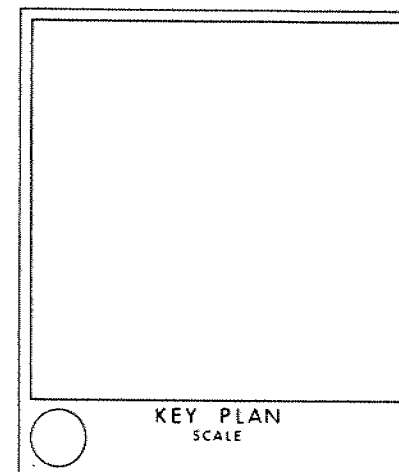
NOTE
For Soil Details Refer to
Record of Borehole Sheets

CONT No
WP No 326-88-01

FEASIBILITY STUDY FOR HWY 407
FROM WHITBY/OSHAWA BOUNDARY
TO HWY 35/115
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



KEY PLAN
SCALE

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 1994 05

AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
21	P21	3	OSHAWA CREEK BRIDGE WBL (W)
		4	OSHAWA CREEK BRIDGE EBL (W)
		5	THORNTON RD OVERPASS WBL (I)
		6	THORNTON RD OVERPASS EBL (I)
22	P22	7	SIMCOE RD UNDERPASS (I)
23	P23	8	EAST OSHAWA CREEK BRIDGE WBL (W)
		9	EAST OSHAWA CREEK BRIDGE EBL (W)
		10	RITSON RD OVERPASS-ALT A (GS)
		11	RITSON RD OVERPASS-ALT A (GS)
24	P24	12	WILSON RD UNDERPASS-ALT A (GS)
		13	HARMONY RD UNDERPASS-ALT A (I)
		14	GRANDVIEW RD UNDERPASS-ALT A (GS)
25	P25	15	WEST TOWNLINE RD UNDERPASS-ALT A (I)
26	P26	16	CONLIN RD UNDERPASS-ALT A (GS)
		17	LANGMAID RD UNDERPASS-ALT A (GS)

LEGEND

W - WATERCOURSE STRUCTURE SITES
GS - GRADE SEPARATED STRUCTURE SITES
I - INTERCHANGE STRUCTURE SITES

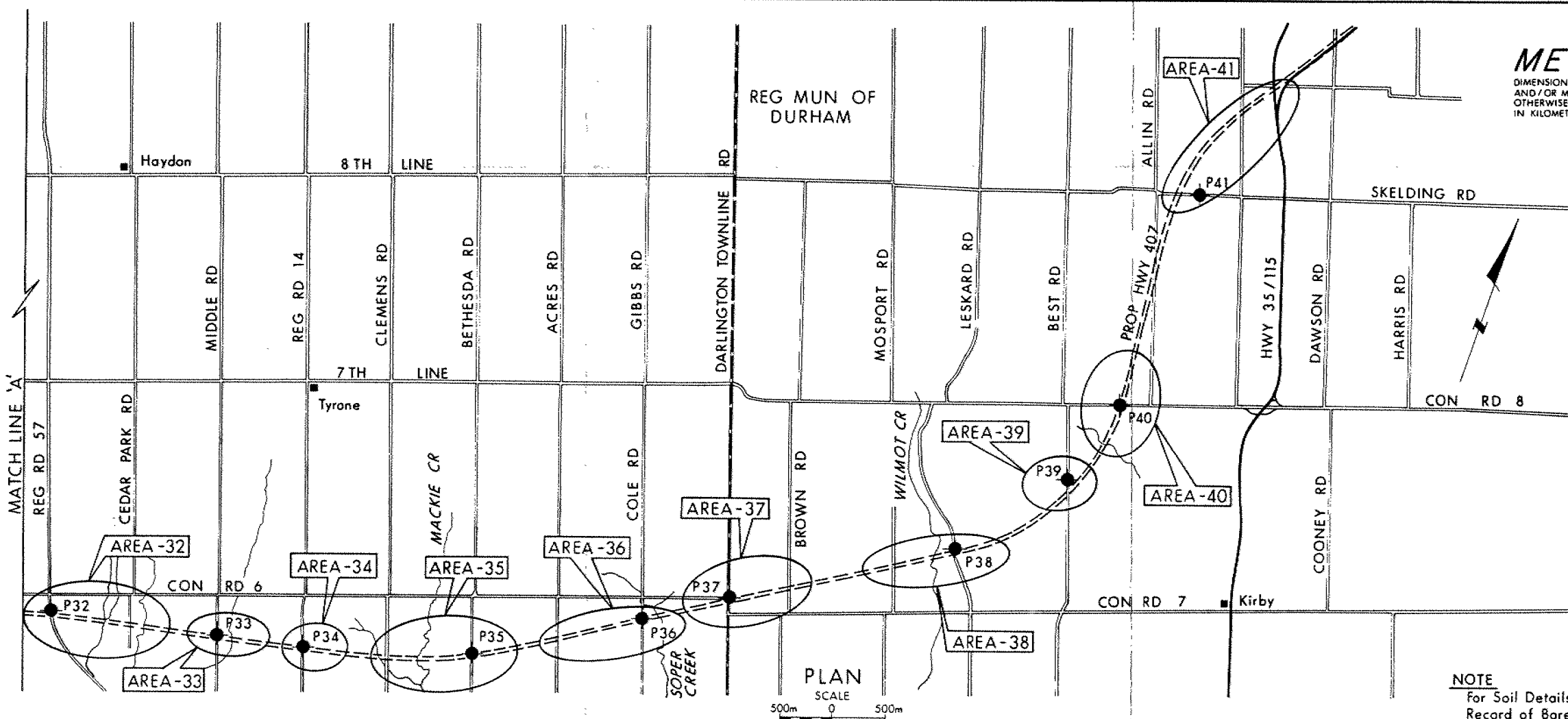
AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
27	P27	18	REGIONAL RD 34 OVERPASS WBL-ALT A (I)
		19	REGIONAL RD 34 OVERPASS EBL-ALT A (I)
28	P28	20	FAREWELL CREEK BRIDGE WBL (W)
		21	FAREWELL CREEK BRIDGE EBL (W)
29	P29	22	SOLINA RD UNDERPASS (GS)
		23	RUNDLE RD OVERPASS WBL (I)
		24	RUNDLE RD OVERPASS EBL (I)
30	P30	25	HOLT RD UNDERPASS (GS)
31	P31	26	BOWMANVILLE CREEK BRIDGE WBL (W)
		27	BOWMANVILLE CREEK BRIDGE EBL (W)
		28	OLD SCUGOG RD OVERPASS WBL (GS)
		29	OLD SCUGOG RD OVERPASS EBL (GS)

NOTE

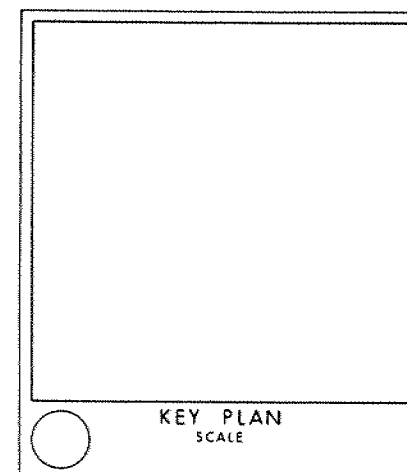
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen Cond.

REV.	DATE	BY	DESCRIPTION
1			
Geocres No 30M15-85			
HWY No 407			
SUBMD KA			
DRAWN DT			
DATE 1994 08 08			
DIST 6			
SITE			
DWG 3268801-A			

**METRIC**DIMENSIONS ARE IN METRES
AND / OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.CONT No
WP No 326-88-01FEASIBILITY STUDY FOR HWY 407
FROM WHITBY/OSHAWA BOUNDARY
TO HWY 35/115
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

KEY PLAN
SCALE

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 1994 05

NOTE
For Soil Details Refer to
Record of Borehole Sheets

AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
32	P32	30	REGIONAL RD 57 OVERPASS WBL (I)
		31	REGIONAL RD 57 OVERPASS EBL (I)
		32	CREEK EAST OF REG RD 57 BRIDGE WBL (W)
		33	CREEK EAST OF REG RD 57 BRIDGE EBL (W)
		34	CEDAR PARK RD OVERPASS WBL (GS)
		35	CEDAR PARK RD OVERPASS EBL (GS)
		36	CREEK EAST OF CEDAR PARK RD BRIDGE WBL (W)
33	P33	37	CREEK EAST OF CEDAR PARK RD BRIDGE EBL (W)
		38	MIDDLE RD OVERPASS WBL (GS)
		39	MIDDLE RD OVERPASS EBL (GS)
		40	CREEK EAST OF MIDDLE RD BRIDGE WBL (W)
34	P34	41	CREEK EAST OF MIDDLE RD BRIDGE EBL (W)
		42	REGIONAL RD 14 UNDERPASS (I)
35	P35	43	CLEMENS RD OVERPASS WBL (GS)
		44	CLEMENS RD OVERPASS EBL (GS)
		45	MACKIE CREEK BRIDGE WBL (W)
		46	MACKIE CREEK BRIDGE EBL (W)
		47	BETHESDA RD OVERPASS WBL (I)
		48	BETHESDA RD OVERPASS EBL (I)

LEGEND

W - WATERCOURSE STRUCTURE SITES
GS - GRADE SEPARATED STRUCTURE SITES
I - INTERCHANGE STRUCTURE SITES

AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
36	P36	49	ACRES RD UNDERPASS (GS)
		50	COLE RD OVERPASS WBL (GS)
		51	COLE RD OVERPASS EBL (GS)
		52	SOPER CREEK BRIDGE WBL (W)
		53	SOPER CREEK BRIDGE EBL (W)
37	P37	54	DARLINGTON TOWNLINE RD U'PASS (I)
		55	BROWN RD UNDERPASS (GS)
38	P38	56	MOSPORT RD OVERPASS WBL (GS)
		57	MOSPORT RD OVERPASS EBL (GS)
		58	WILMOT CREEK BRIDGE WBL (W)
		59	WILMOT CREEK BRIDGE EBL (W)
		60	LESKARD RD OVERPASS WBL (GS)
		61	LESKARD RD OVERPASS EBL (GS)
39	P39	62	BEST RD UNDERPASS (GS)
		63	CREEK EAST OF BEST RD BRIDGE WBL (W)
40	P40	64	CREEK EAST OF BEST RD BRIDGE EBL (W)
		65	CON RD 8 OVERPASS WBL (GS)
		66	CON RD 8 OVERPASS EBL (GS)
		67	SKELDING RD UNDERPASS (GS)
41	P41	68	HWY 35/115 UNDERPASS (I)

=NOTE=

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen Cond.

REV	DATE	BY	DESCRIPTION
1	1994 08 08	CA	APPROVED
2	1994 08 08	CA	APPROVED

Geocres No 30M15-85

HWY No 407
SUBMD KA CHECKED DATE 1994 08 08 SITE
DRAWN DT CHECKED CA APPROVED DWG 3268801-B

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M14-161

DIST. 6 REGION

W.P. No. 25-69-00

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. E. M. F.

LOCATION EAST METRO FREEWAY
FEAS BILITY Study

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



Memorandum

To: Mr. G.C.E. Burkhardt
Head, Structural Section
Central Region
3501 Dufferin Street, Downsview

From: Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

Attention:

Date: 78 09 26

Our File Ref.

In Reply to

Subject: Re: Feasibility Study, East Metro Freeway
W.P. 25-69-00, District 6, Toronto

Introduction

At the request of the Structural Planning Section of the Central Region, the Soil Mechanics Section carried out a foundation investigation for the feasibility study of the proposed East Metro Freeway (E.M.F.). Due to the urgency of this project, our findings and preliminary geotechnical recommendations were given to the Region verbally on August 31, 1976 and are summarized here in this report. A complete foundation report for the feasibility study will be issued in December, 1978 according to the Region's schedule.

Site and Geology

The proposed East Metro Freeway which runs basically north and south, is located partly in Scarborough, Metro Toronto and partly in Markham, County of York. The area under investigation is bounded to the south by Hwy. 401 between Conlins Road and Dean Park Road and to the north by Hwy. 7 just west of Conc. 10E. Most of the area is on a broad crest of high land projecting southward from an elevated plain north of Toronto. The presence of a high upland close to Lake Ontario has caused streams to cut deep youthful valleys. The Rouge River is the major stream of the area, entering near Buttonville in the northwest and reaching Lake Ontario just east of Rouge Hill in Pickering. The overall area is situated in three physiographic regions generally known as Iroquois Plains, South Slope and Peel Plain. According to available geological information, while most of the area is underlain by a glacial till (Leaside Formation of the late Wisconsinan period), lacustrine deposits of sand and gravel are found in the Iroquois Plain, lacustrine clays in the early peripheral lakes and recent terrace deposits of sand and gravel in the valleys of the Rouge River and its tributaries.

SUBSURFACE CONDITIONS AND RECOMMENDATIONS

In general, the subsurface conditions along the proposed route are favorable from a soil mechanics' point of view, except certain cut sections contemplated in the sand and gravel areas where groundwater problems may be anticipated. The subsurface conditions at the various structure sites and the corresponding recommendations are summarized as shown on the following pages.

cont'd.....

Location

Area 1 - Hwy. 401 and
Proposed E.M.F.

Subsurface Conditions

0'-13' Very dense sand and gravel
13'-22' Very dense glacial till
22'-43' Very dense sandy silt to
 silty fine sand
43'-51' Hard clayey silt
Groundwater level at 9 feet

Recommendations

Cut sections in granular soils below the groundwater level will require extensive temporary and permanent dewatering schemes and slope treatments. In addition, if cuts are contemplated, a detailed hydrogeological study should be carried out to evaluate the consequences of such cuts on the groundwater. In view of the above, a structure to carry E.M.F. over Hwy. 401 is preferred. Subsoil is competent. The structure can be supported on spread footings placed within the undisturbed natural subsoil with an allowable bearing pressure up to 3.0 tsf. The required fills can be constructed with 2:1 side slopes.

Area 2 - E.M.F. and
C.P.R. Spur (near
Sheppard Ave.)

0'- 9' Random landfill
9'-13' Loose to compact silty
 sand
13'-23' Very stiff to hard
 clayey silt
23'-96' Hard glacial till
Groundwater level at 6 feet

The proposed subway crossing will be acceptable; however, some slope treatments consisting of filter or granular blankets, together with permanent subdrain systems will be required. The subway structure can be supported on spread footings placed within the glacial till with an allowable bearing pressure of 3 tsf. The required cuts can be either retained by retaining walls founded in the till or constructed with 2:1 slopes.

<u>Location</u>	<u>Subsurface Conditions</u>	<u>Recommendations</u>
Area 3 - E.M.F. and CPR spur (North crossing)	0'-86' Hard glacial till Groundwater level at 12 feet	The proposed subway crossing should pose no problems. Cuts up to 30 feet in height can be constructed with 2:1 slopes; cuts of 30 feet and up to 40 feet in height, however, should be provided with a half height 10 feet wide bench incorporating an intercepting ditch. The subway structure can be supported on spread footings placed within the glacial till with an allowable bearing capacity of 3 tsf.
Area 3A - E.M.F. and Tributory of Rouge River	0'-27' Very dense silty fine sand 27'-38' Very dense glacial till 38'-43' Very dense sandy silt 43'-52' Hard clayey silt 52'-70' Very dense silty sand to sandy silt Groundwater level at 18 feet	The approach fills can be constructed with 2:1 slopes. The piers of the structure can be supported on spread footings placed within the undisturbed overburden with an allowable capacity of 3 tsf. The abutments can be supported on spread footings either placed within the undisturbed overburden or perched within the approach fills on a compacted granular 'A' pad with an allowable design bearing pressure of 2.5 tsf.
Depressed Section of E.M.F. Between Area 3A and Area 4	Very dense glacial till	Similar to the recommendations for the cuts in Area 3.
Area 4 - E.M.F. and Finch Ave. E.	0'-17' Very stiff silty clay 17'-51' Very dense glacial till Groundwater level at 15 feet	The required cuts of up to 25 ft. in depth can be constructed with 2:1 slopes. The structure can be supported on spread footings placed within the glacial till with an allowable bearing pressure up to 3 tsf.

LocationSubsurface ConditionsRecommendations

Area 5 - Finch Avenue
Crossing of Rouge River

(In the river valley)
0'- 4' Very dense sand and gravel
4'-17' Compact to very dense uniform
fine sand
17'-62' Sandy silt to silty sand
shale bedrock at 62 feet
Groundwater level at 5 feet

The proposed high level profile grade will require a very long structure and very high fills and, therefore, it is not preferred. In the alternative low profile scheme, the west approach may require fills up to 40 feet high. The fills should be constructed with 2:1 slopes and a 20 foot wide mid-height berm in both longitudinal and transversal directions. The piers and the west abutment which will be perched in the fills should be supported on steel H piles driven to bedrock. The east abutment can be supported on spread footings placed within the overburden with an allowable pressure of 3 tsf. The footings, however, should be kept at least 50 ft. from the cliff.

Area 6 - E.M.F. Crossing
of Rouge River

0'- 8' Compact sand and gravel
8'-33' Hard clayey silt to silty
clay
33'-43' Silty sand and clayey
silt interbedded. Very
dense or hard
43'-66' Very dense silty sand
Groundwater level at 6 feet

Recommendations for the fills will be similar to those for fills in Area 5. The footing elements of the structure should be supported on end bearing steel H piles. Estimated pile tip elevations around 40 feet below ground surface.

<u>Location</u>	<u>Subsurface Conditions</u>	<u>Recommendations</u>
Area 7 - E.M.F. Crossing of Relocated Finch Ave.	0'-36' Compact to very dense sand 36'-62' Hard silty clay to clayey silt Groundwater level at 20 feet	No stability problems are anticipated for the proposed cuts and fills. The structure can be supported on spread footings in the overburden with a design pressure of 3 tsf. This crossing is preferred to the Rouge crossing. Cuts up to 25 ft. deep will be required and can be constructed with 2:1 slopes. The structure can be supported on spread footings within the glacial till with a design pressure of 3 tsf.
Area 8 - E.M.F. Subway at CPR	0'-81' Very dense glacial till Groundwater level at 40 feet	Similar to Area 8
Area 9 - E.M.F. Subway at CNR	0'-42' Very dense glacial till 42'-46' Very dense silt Groundwater level at 13 feet	
Area 9A - E.M.F. Crossing Steeles Ave.	0'-7' Compact silty fine sand 7'-13' Hard clayey silt to silt some clay 13'-21' Very dense silt to sandy silt, interbedded 21'-33' Hard clayey silt to silt some clay 33'-48' Very dense silt 48'-52' Very dense sand Groundwater level at 14 feet	The cuts can be constructed with 2:1 slopes but should be protected with filter or granular blankets. The structure can be supported on spread footings in the overburden with an allowable pressure of 3 tsf.

<u>Location</u>	<u>Subsurface Conditions</u>	<u>Recommendations</u>
Area 9B - Existing Steeles Ave. Subway at CNR	0'- 7' Sand 7'-27' Glacial Till	This crossing can be left as it is. The existing structure is on spread footings.
Area 9C - E.M.F. Over Tributary to Little Rouge River	0'- 7' Stiff clayey silt 7'-46' Very dense glacial till	No stability problems for the 10 ft. fills
Area 10 - E.M.F. Overhead at CPR	0'- 9' Hard clayey silt to silt some clay 9'-21' Very dense sandy silt to silty sand 21'-31' Very dense glacial till 31'-47' Fine to medium sand under sub-artesian pressure 47'-51' Hard glacial till	Because of a water bearing sandy stratum and a sand stratum under sub-artesian condition, it is preferable to have E.M.F. go over the existing CPR. The abutments should be perched within the fills on end bearing steel H piles. Estimated tip elevations around 15 feet below ground surface.
Area 11 - E.M.F. and Hwy. 407	0'-46' Very dense glacial till	No stability problems for either cuts or fills. Structure can be supported on spread footings placed within the glacial till with an allowable pressure of 3 tsf.

The various comments outlined in this report are for feasibility study purposes based on very limited information. It will be necessary to carry out detailed subsurface investigations at each site of the proposed structure and related approaches and in some areas groundwater studies, together with pumping tests, may be necessary when the design details and geometrics are finalized. A complete report with borehole log sheets and drawings will be submitted at a later date by this Section.

B. Ly

B. Ly, P. Eng.
Senior Engineer

For: M. Devata, P. Eng.
Supervising Engineer

BL/MD/gs

cc: M. Thompson
I. Williams
Files✓

Structural Section,
Central Region,
3501 Dufferin Street,
Downsview, Ontario.
M3K 1N6
Telephone: 248-3097

September 1, 1978

M.M. Dillon Limited,
Consulting Engineers & Planners,
P.O. Box 219,
Station "K",
Toronto, Ontario.

Atten: Mr. Ian Williams,
Project Manager

Dear Sir:

RE: East Metro Transportation Corridor
from Highway 401 to Highway 7,
Preliminary Foundations Information Request,
District 6

We have now received preliminary (verbal) geotechnical information from our Soil Mechanics Section regarding the above project. More detailed findings and recommendations (in writing) will be received by this section on or shortly after September 15th, at which time their findings will also be forwarded to you.

In the interim we report the following geotechnical information:

Area 1 - Hwy. 401 & Proposed E.M.F.

This crossing should be an underpass (i.e. E.M.F. should go over the existing Hwy. 401) as the water table is quite high (granular subsoil). Spread footings on natural ground would be acceptable; no stability problems for fill slopes with standard side-slopes are anticipated.



.....2

PROPOSED STRUCTURE AREAS

- 2 -

Area 2 - E.M.F. & C.P.R. spur (South Crossing)

The proposed subway crossing (E.M.F. under C.P.R.) will be acceptable; however, some treatment of the cut-slopes will be necessary (i.e. filter or granular blanket). Permanent sub-drains may also be necessary. Spread footings and 2:1 side slopes will suffice.

Area 3 - E.M.F. & C.P.R. spur (North Crossing)

The proposed subway (E.M.F. under C.P.R.) should encounter no serious problems. Cuts up to 30' with 2:1 side slopes, will not need berms. However, a 35' deep cut may need 10' wide berms. Spread footings should be adequate.

Area 3A - E.M.F. & Tributary of Rouge River

No serious problems should be encountered here; this also goes for fills up to 25' in height. The structure may be founded on spread footings, from a geotechnical point of view.

X Depressed Section of E.M.F. between Area 3A & Area 4

It is anticipated that relatively good soil conditions exist here allowing the E.M.F. to be in a cut; however, berms may be needed.

Area 4 - E.M.F. & Finch Ave. E.

No problems should be encountered with cuts up to 20'; structures may be founded on spread footings.

Area 5 ^{Relocated} Finch Ave. Crossing of Rouge River (along existing R.O.W.)

The subsoil is granular. A structural scheme keeping a high profile grade for Finch Ave. would necessitate a long structure and high fills; the abutments should not be closer than 14:1 from the toe of the slopes at the river. A high fill would require multiple berms; piles should be driven through fill to natural soil. It is doubtful if the Conservation Authority would allow placing of substantial amounts of fill in the Rouge River valley. If a low grade for the Finch Ave. extension is planned, the Soil Mechanics Section would want to do further investigation.

Area 6 - E.M.F. Crossing Rouge River

High fills will need berms (eg. 40'-45' high fills will require 20' wide berms, each side). The abutments may be founded on piles to natural ground.

Area 7 - E.M.F. Crossing of a Relocated Finch Ave. (South of C.P.R.)

The proposed profile puts Finch Ave. in a small cut while the E.M.F. is on 20' of fill; no problems are anticipated. Spread footings are acceptable.

Area 8 - E.M.F. Subway at C.P.R.

Cuts up to 25' should not encounter any problems; spread footings are acceptable.

Area 9C - E.M.F. over Tributary to Little Rouge River

Fills up to 10' high should not encounter any problems.

Area 9 - E.M.F. at C.N.R.

Cuts up to 20' should not encounter any problems.

Area 9A - E.M.F. Crossing Steeles Ave.

A 20'-25' cut should not encounter any problems.

Area 9B - Existing Steeles Ave. Subway at C.N.R.

No foundation problems were encountered in the construction of this bridge; it is founded on spread footings. The subsoil consists of dense glacial till.

Area 10 - E.M.F. Overhead at C.P.R.

Due to a water bearing sand stratum at approximately 21' below ground, it is preferable to have E.M.F. go over the existing C.P.R. The structure should be founded on piles driven into the till.

Area 11 - E.M.F. and Hwy. 407 Interchange

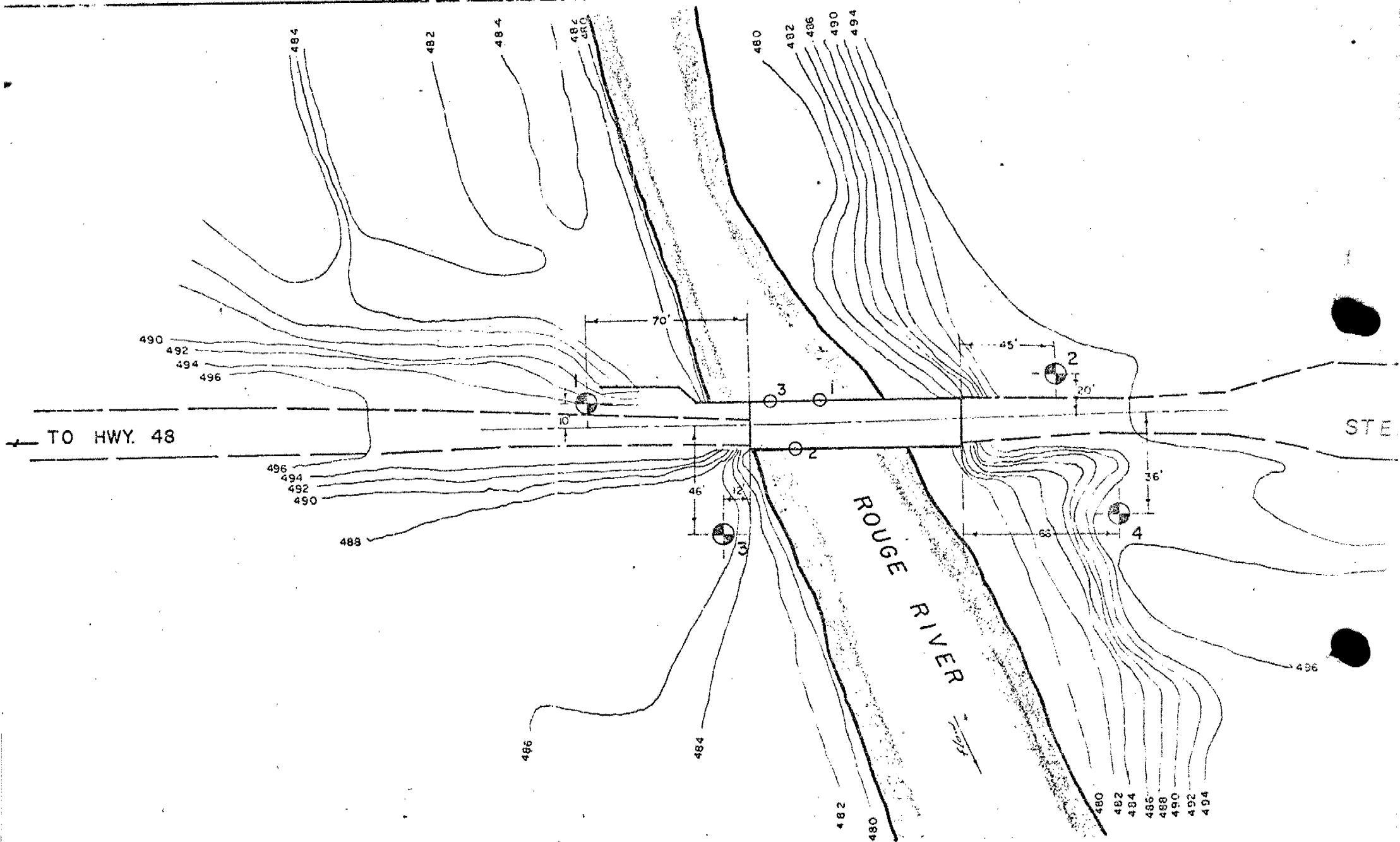
No major problems with cuts or fills. Spread footings may be adequate.

Yours truly,

VFB:qj

G.C. M. Thompson
B. Ly /

V.F. Boehnke,
Area Engineer-Structures,
for:
G.C.E. Burkhardt,
Head, Structural Section.



WILLIAM TROW ASSOCIATES LTD.

SITE INVESTIGATIONS - SOIL MECHANICS CONSULTATION

DRAWING No. 2
PROJECT No. J3742

LEGEND

PENETRATION RESISTANCE
2" O.D. SPLIT TUBE —○—○—
2" I.D. SHELBY TUBE —*—*—*—
2" DIA. CONE ————
SHEAR STRENGTH
UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE ⊙
UNCONFINED COMPRESSION ⊗
VANE TEST AND SENSITIVITY (S) †

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX X LI
ATTERBERG LIMITS
LIQUID LIMIT —○—
PLASTIC LIMIT ————
SAMPLE TYPE
2" O.D. SPLIT TUBE ⊠
2" I.D. SHELBY TUBE ⊡
3" O.D. SHELBY TUBE ⊢

BOREHOLE No. 1
PROJECT Proposed Bridge Replacement
LOCATION Freeman Bridge - Steeles Avenue East - Rouge River.
HOLE LOCATION See Dwg. 1
HOLE ELEVATION 495.3 feet
DATUM See Dwg. 1

SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FEET	PENETRATION RESISTANCE 350 FT. LB. BLOWS/FT.		NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	SAMPLE TYPE AND NO.	NATURAL UNIT WEIGHT P.C.F.		
				20	40				60	80
				SHEAR STRENGTH P.S.F.						
		495.3	0					10	20	
	ROAD EMBANKMENT-silty sand, till, compact, somewhat dirty, dry.									
		480.								
		475.	20							
	SANDY SILT-very dense, fine, moist, wet below 22 feet depth; caving below 21 feet depth.									
		468.							130.9	
		Required footing level								
	SILT TILL-moist, very dense, some gravel sizes, slightly cohesive.		30						138.5	
									140.5	
									142.0	
		446.0	40							

BOREHOLE NO. 2
PROJECT Proposed Bridge Replacement
LOCATION Freeman Bridge - Steeles Avenue East - Rouge River
HOLE LOCATION See Dwg. 1
HOLE ELEVATION 495.7 feet
DATUM See Dwg. 1

PENETRATION RESISTANCE

2" O.D. SPLIT TUBE

2" I.D. SHELBY TUBE

2" DIA. CONE

SHEAR STRENGTH

UNDRAINED TRIAXIAL

AT OVERBURDEN PRESSURE

UNCONFINED COMPRESSION

VANE TEST AND SENSITIVITY (S)

NATURAL MOISTURE CONTENT
AND LIQUIDITY INDEX

ATTERBERG LIMITS

LIQUID LIMIT

PLASTIC LIMIT

SAMPLE TYPE

2" O.D. SPLIT TUBE

2" I.D. SHELBY TUBE

3" O.D. SHELBY TUBE


SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FEET	PENETRATION RESISTANCE 20 40 60 80 350 FT. LB. BLOWS/FT SHEAR STRENGTH P.S.F.	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	SAMPLE TYPE AND NO.	NATURAL UNIT WEIGHT P.C.F.
F	FILL-moist, sandy, gravel, stone sizes.	495.7	0		10 20	1.	
F	Sandy fill.	487.7				2.	
F		484.7	10			3.	
	SANDY SILT-moist, very dense, some fine sand.		20			4.	
		470.7				5.	
			30			6.	
	SANDY SILT TILL-moist, very dense, cohesive.	468	Required footing level			7.	
						8.	123.3
			40			9.	
						10.	147.7
	End of Hole	449.2	50			11.	142.4
NOTES: 1) Boring by machine auger, hole uncased to full depth.							
2) Water level at 36.4 feet depth, hole open to 41 feet depth at end of bore.							
8 feet depth hole open to 12 feet depth after 5 days.							
			60				
			70				
			80				
			90				
			100				
			110				


LEGEND

BOREHOLE NO. 3
PROJECT Proposed Bridge Replacement
LOCATION Freeman Bridge - Steeles Avenue East - Rouge River
HOLE LOCATION See Dwg. 1
HOLE ELEVATION 486.8 feet
DATUM See Dwg. 1

PENETRATION RESISTANCE

2" O.D. SPLIT TUBE

2" I.D. SHELBY TUBE 

3" DIA. CONE 

SHEAR STRENGTH

UNDRAINED TRIAXIAL
AT OVERBURDEN PRESSURE
UNCONFINED COMPRESSION
VANE TEST AND SENSITIVITY (S) +

NATURAL MOISTURE CONTENT
AND LIQUIDITY INDEX

ATTERBERG LIMITS

ATTERBERG LIMITS

LIQUID LIMIT

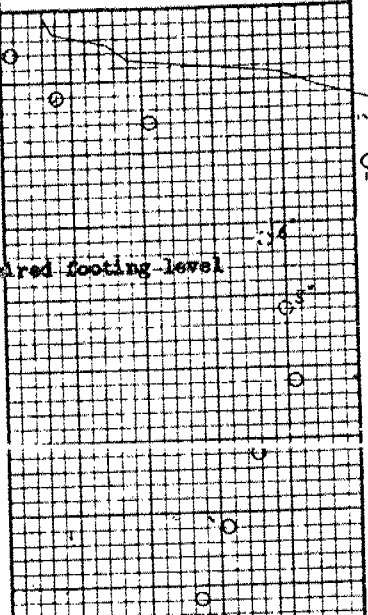
PLASTIC LIMIT

SAMPLE TYPE

3" O.D. SPLIT TUBE

2" I.D. SHELBY TUBE

3" O.D. SHELBY TUBE

SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FEET	PENETRATION RESISTANCE		350 FT. LB. BLOWS/FT. 80	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT		SAMPLE TYPE AND NO.	NATURAL UNIT WEIGHT P.C.F.
				20	40		60	80		
				SHEAR STRENGTH P.S.F.						
		486.8	0				10	20		
F.F.	FILL-sand, gravel sizes.	484.3					1			
	SAND-moist, loose, gravel sizes, (river alluvium)	479.7					2			
	SAND-grey, fine, very dense, silty.	479.	10				3			
	SILT TILL-moist, very dense, cohesive.	475.					4			
									5	134.0
									6	135.6
									7	
			20						8	137.8
									9	138.0
			40						10	137.6
	End of Hole	445.3								
NOTES:	1) Boring by machine auger, hole uncased to full depth. 2) Water level = 7.1 feet depth, open to 7.4 feet depth after 4 days.									
			50							
			60							
			70							
			80							
			90							
			100							
			110							

LEGEND

BOREHOLE NO. 4
PROJECT Proposed Bridge Replacement
LOCATION Freeman Bridge - Steeles Avenue East - Rouge River
HOLE LOCATION See Dwg. 1
HOLE ELEVATION 496.8 feet
DATUM See Dwg. 1

PENETRATION RESISTANCE

2" O.D. SPLIT TUBE —○—○—○—
2" I.D. SHELBY TUBE —+—+—+—
2" DIA. CONE ————

SHEAR STRENGTH

UNRAINED TRIAXIAL —●—
AT OVERBURDEN PRESSURE —●—
UNCONFINED COMPRESSION —●—
VANE TEST AND SENSITIVITY (S) —+—

NATURAL MOISTURE CONTENT
AND LIQUIDITY INDEX

ATTERBERG LIMITS

LIQUID LIMIT —○—

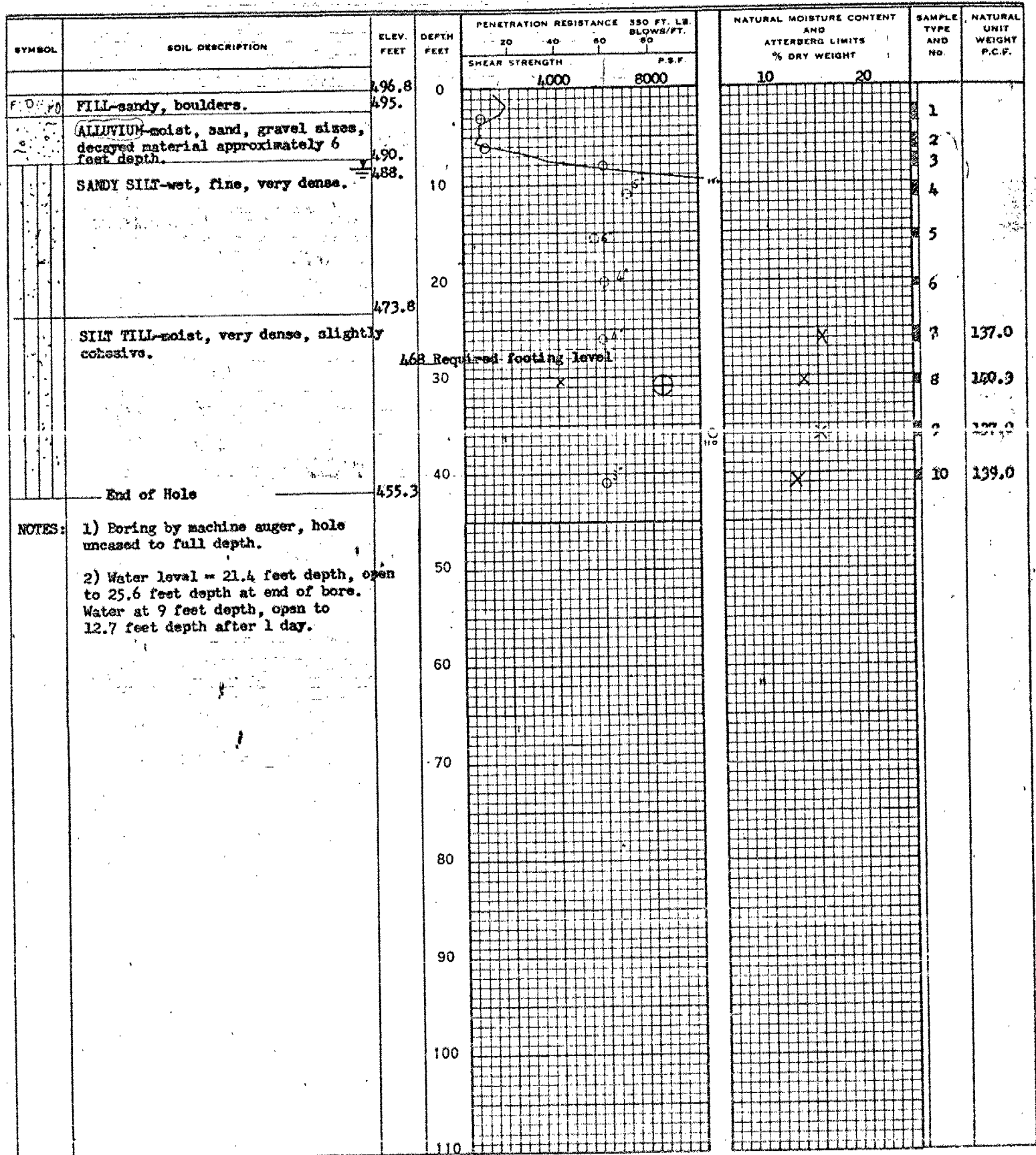
PLASTIC LIMIT ————

SAMPLE TYPE

2" O.D. SPLIT TUBE —■—

2" I.D. SHELBY TUBE —■—

3" O.D. SHELBY TUBE —■—

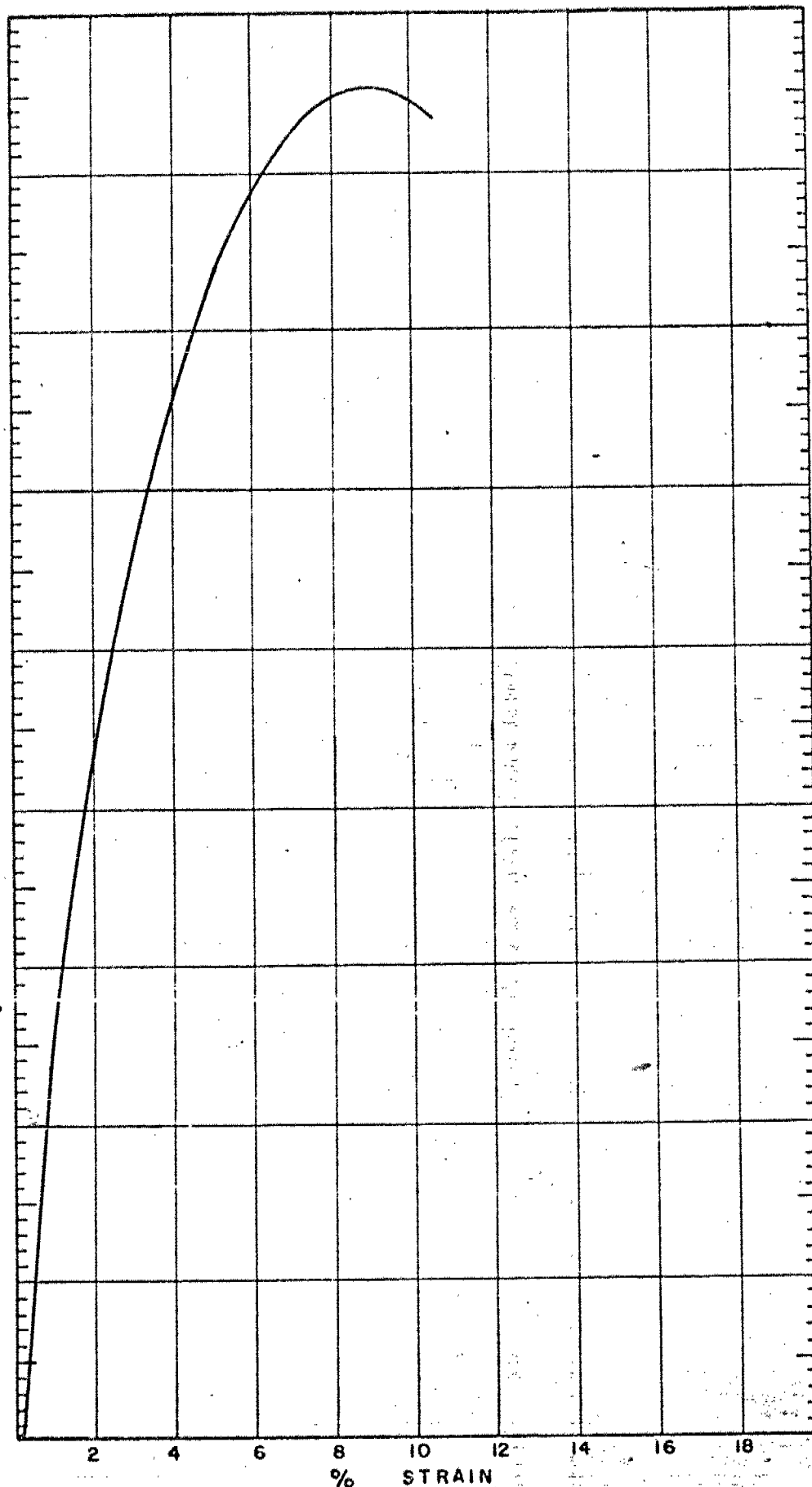




SHEAR STRESS ksf.

1

2



TEST NO 1

TEST Undrained

B.H. 4 DEPTH 30-31'

C = 8500 P.S.F.

γ = 140.3 P.C.F.

W = 13.6 %

σ₃ = 29.2 P.S.I.

SOIL

Grey Silty Clay

TEST NO

TEST

B.H. DEPTH

C = P.S.F.

γ = P.C.F.

W = %

σ₃ = P.S.I.

SOIL

TEST NO

TEST

B.H. DEPTH

C = P.S.F.

γ = P.C.F.

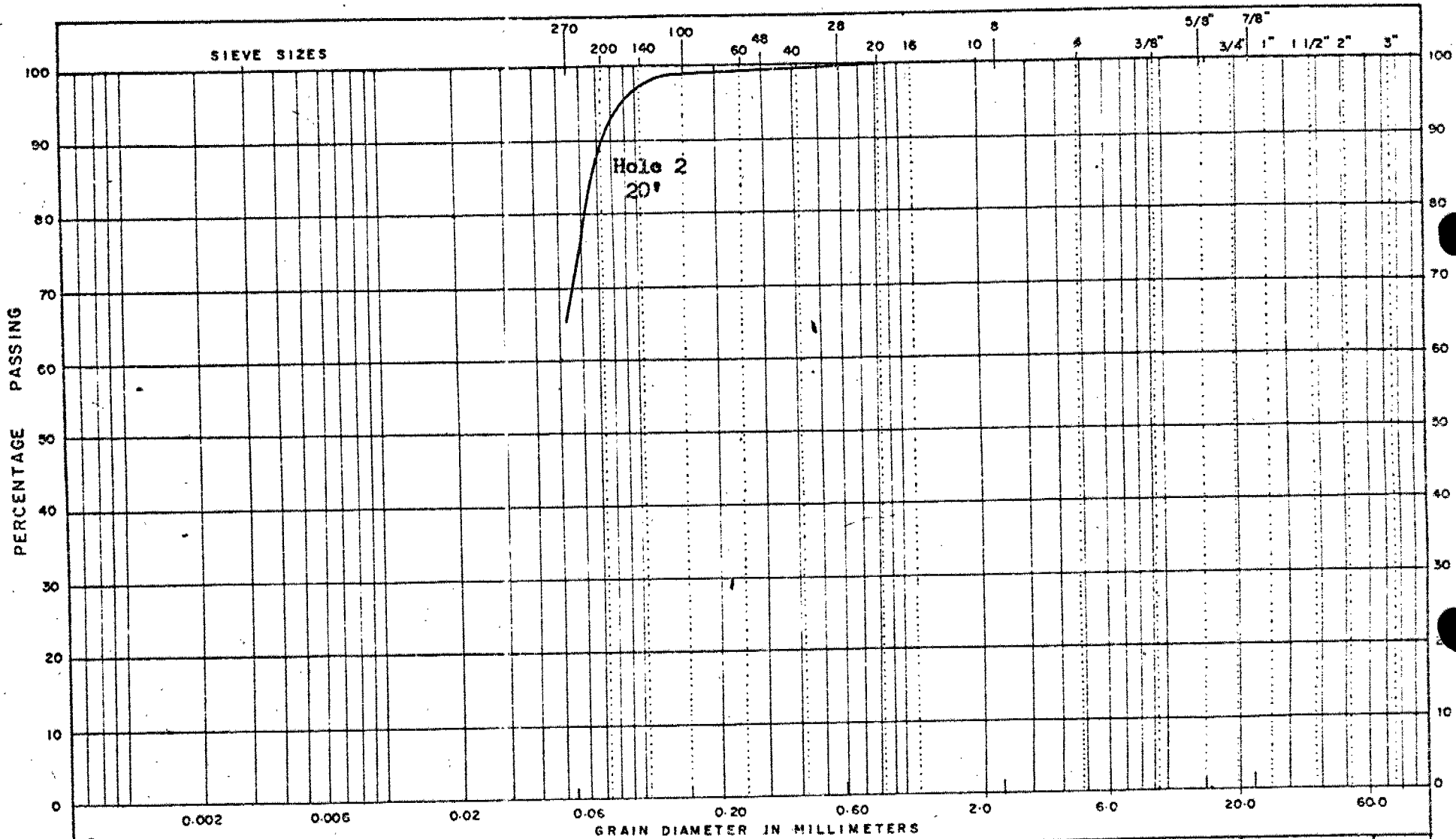
W = %

σ₃ = P.S.I.

SOIL

TRIAXIAL TEST RESULTS

MECHANICAL ANALYSIS



Project: J3742


PERCENTAGE PASSING

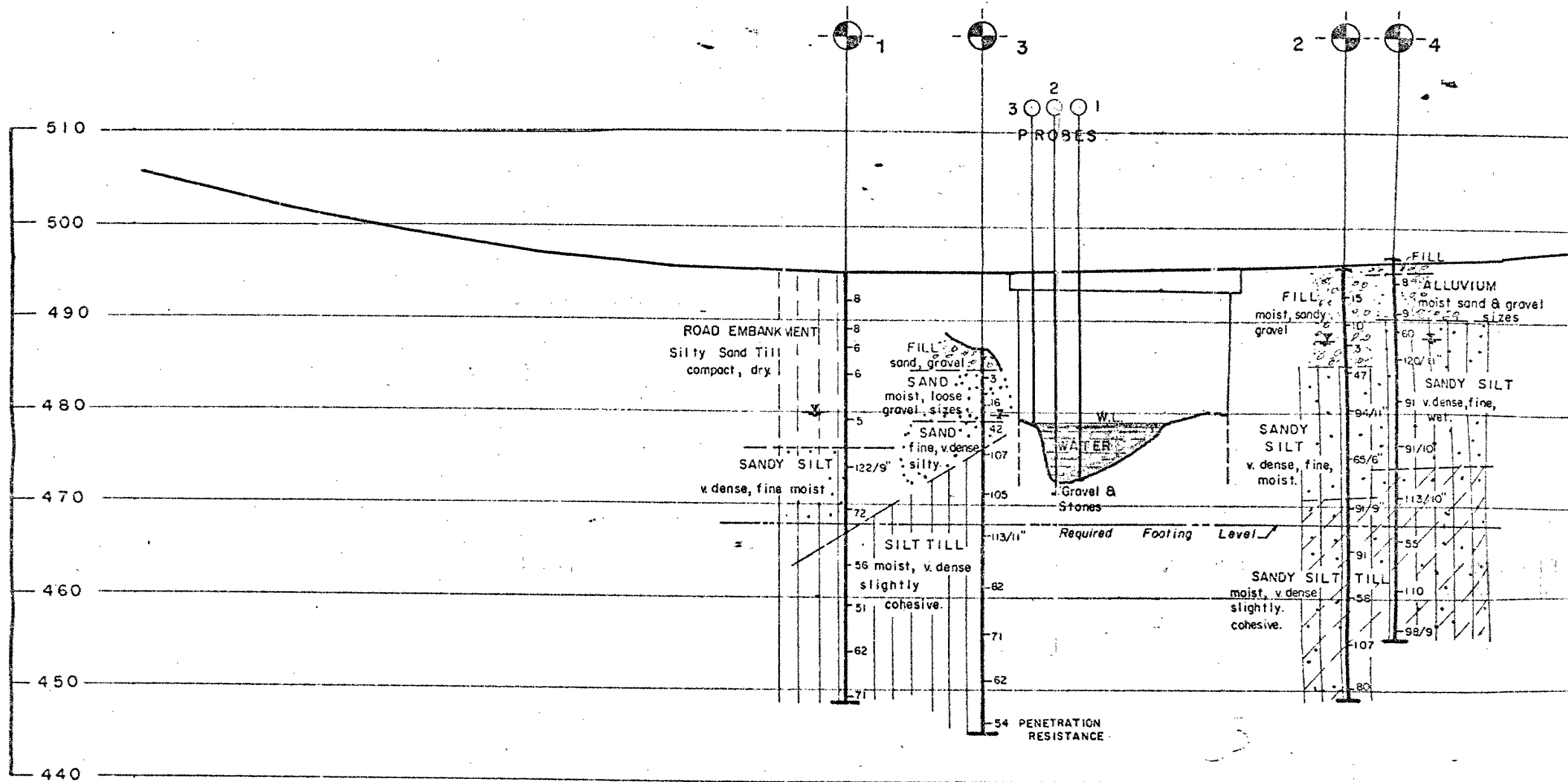
Dwg. 7

CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE
	SILT			SAND			GRAVEL		

MODIFIED M.I.T. CLASSIFICATION

GRAIN SIZE CURVE TO NO. 270 SCREEN FOR A SAMPLE OF SILT
HOLE 2 - 20 FEET

WILLIAM TROW  ASSOCIATES LTD.



INTERPRETED SUBSOIL STRATIGRAPHY

SCALE: HOR. 1 IN. = 40 FT.
VERT. 1 IN. = 10 FT.

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M14-161
30M14-227
30M15-85

DIST. 6/7 REGION _____

W.P. No. 282-86-01
326-88-01
25-69-00

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. 407

LOCATION HWY 407 ROUTE ENVIRONMENTAL
STUDY (FROM HWY 48 TO HWY 35/115)

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 25-69-00

DIST 6

HWY EMF STR SITE N/A

Feasibility Study
East Metro Freeway

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SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	79 01 12	MD
TUBES	—	—
ROCK CORES	—	—

FOUNDATION INVESTIGATION REPORT

For

Feasibility Study, East Metro Freeway
W.P. 25-69-00
District 6, Toronto

INTRODUCTION

This report contains the results of our foundation investigation carried out for the feasibility study of the proposed East Metro Freeway. The fieldwork was done during the period of August 8, 1978 to August 16, 1978 consisting of a total of 14 sampled boreholes advanced by means of an auger machine equipped with 3¼ inch I.D. hollow stem continuous flight augers. The borings ranged in depth from 45 feet to 96 feet below ground surface.

The results of three borings put down by CNR in 1964 for the subway structure at Steeles Avenue are also included here.

SITE AND GEOLOGY

The proposed East Metro Freeway which runs basically north and south is located partly in Scarborough, Metro Toronto and partly in Markham, County of York. The area under investigation is bounded to the south by Hwy. 401 between Conlins Road and Dean Park Road and to the north by Hwy. 7 just west of Conc. 10E. Most of the area is on a broad crest of high land projecting southward from an elevated plain north of Toronto. The ground surface of the general area varies from elevation 650 to 450 feet. The presence of a high upland close to Lake Ontario has caused streams to cut deep youthful valleys. The Rouge River is the major stream of the area, entering near Buttonville in the northwest and reaching Lake Ontario just east of Rouge Hill in Pickering.

The land is mainly used for industrial development in the southern section, parks and recreation near the Rouge River, residential development and farming in the northern section.

The overall area is situated in three physiographical regions generally known as Iroquois Plains, South Slope and Peel Plain. According to the available geological information, while most of the area is underlain by a glacial till (Leaside formation of the late Wisconsinan period), lacustrine deposits of sand and gravel are found in the Iroquois Plains, lacustrine clays in the early peripheral lakes and recent terrace deposits of sand and gravel in the valleys of the Rouge River and its tributaries.

SUBSURFACE CONDITIONS

Factual borehole data are shown in the Record of Borehole Sheets. The locations and elevations of the boreholes, together with the estimated stratigraphical profile, are shown in Drawing 256900-A, B and C. A brief description of the subsurface conditions along the route of EMF is as follows.

Area 1: This site is located in the Iroquois Plain. Subsoil here consists of 13 feet of very dense sand and gravel followed by 14 feet of very dense glacial till which is composed of a heterogeneous mixture of sand, silt and trace of gravel and clay. The glacial till is underlain by 16 feet of very dense silt to sandy silt and then followed by a stratum of hard silty clay. The groundwater was observed to be at elevation 424₊.

Area 2: This site is located in the beach area of Lake Iroquois. This area is underlain by a thin layer of loose sand, about 5 feet thick and then followed by an extensive stratum of hard glacial till. The glacial till has a cohesive matrix of low plasticity being composed of a heterogeneous mixture of clayey silt, sand and some gravel. In certain places random landfill about 9 feet thick has been left on the ground surface. The groundwater level was observed to be at elevation 445₊.

Area 3: Subsoil at this site consists of an extensive deposit of glacial till which is at least 86 feet thick. The glacial till is composed of a heterogeneous mixture of clayey silt, sand and gravel and has a consistency varying from very stiff to hard with depth. The upper 15 feet of the glacial till stratum is brown and desiccated; below that depth the glacial till is grey. Within the

desiccated zone a one foot thick sand layer was encountered at a depth of about 10 feet below ground surface. The groundwater was observed to be at elevation 463₊.

Area 3A: This site is at a tributary of Rouge River. The upper portion of the overburden at this location is a 25 foot thick stratum of dense to very dense fluvial fine to medium sand. This granular stratum is underlain by a 13 foot thick deposit of very dense glacial till (a heterogeneous mixture of sand, silt, some gravel and trace of clay) and then followed by a 5 foot thick layer of very dense silty fine sand. The lower granular layer overlies an 8 foot thick deposit of hard silty clay, which in turn overlies another stratum of very dense silty sand containing seams of silt and clay. The groundwater was observed to be at elevation 426₊.

Area 4: This site is located in a peripheral lake during the Pleistocene epoch. The upper 17 feet of the overburden is a lacustrine silty clay of intermediate plasticity. The silty clay was found to have a desiccated crust of about 13 feet. The consistency of the silty clay varies from very stiff to hard in the crust to stiff in the undesiccated zone. The silty clay is underlain by a stratum of hard, cohesive glacial till which is at least 34 feet thick. The groundwater was observed to be at elevation 457₊.

Area 5: This site is at the Rouge River. While the river valley banks are composed of a glacial till, the river valley floor is underlain by stream terrace deposits. Subsoil at the river valley floor consists of 3 feet of sand and gravel, followed by 15 feet of compact to very dense uniform fine sand and then followed by 43 feet of sandy silt to silty sand. The above sequence of subsoil is underlain by shale bedrock. The groundwater was observed to be at elevation 374₊, corresponding to the water level in the Rouge River.

Area 6: The predominant subsoil at this site is a 35 foot thick deposit of clayey silt. This cohesive deposit is overlain by an 8 foot thick stratum of compact sand and gravel. Underlain by a stratum of very dense silty sand which was found to be at least 23 feet thick. The clayey silt is grey and has a low plasticity. Within the cohesive deposit there are seams and thin layers of sand and silt. The groundwater was observed to be at elevation 416₊.

Area 7: Subsoil at this site consists of 36 feet of compact to very dense silty fine sand with occasional seams of clay, followed by a stratum at least 25 feet thick of hard clayey silt of intermediate plasticity. The groundwater was observed to be at elevation 433₊.

Area 8: Subsoil here consists of two sheets of glacial till. The upper sheet is about 48 feet thick and has a non-cohesive matrix. The lower sheet was investigated to a depth of 81 feet below ground surface and has a cohesive matrix with a low plasticity. The non-cohesive glacial till has a relative density of very dense, whereas the consistency of the cohesive glacial till is hard, generally increasing with depth. Within both glacial till sheets there are occasional seams and pockets of sand. The groundwater was observed to be at elevation 496₊.

Area 9: Subsoil here consists of 7 feet of silt with clay followed by a stratum of glacial till which was investigated to a depth of 46 feet below ground surface. The glacial till has a non-cohesive to slightly cohesive matrix and has a very dense relative density. The groundwater was observed to be at elevation 510₊.

Area 9A: Subsoil at this site consists of 7 feet of compact silty sand followed by 26 feet of generally hard clayey silt with a low plasticity. The cohesive deposit is underlain by a 15 foot thick stratum of very dense silt with trace of clay which in turn is followed by a stratum of very dense silty sand with seams of clay. The groundwater was observed to be at elevation 520₊.

Area 9B: The major subsoil type is a non-cohesive glacial till which is composed of a heterogeneous mixture of sand, silt, gravel and clay. The glacial till is overlain by 3 to 8 feet of sands and silts.

Area 9C: The site is underlain by a stratum of glacial till which was investigated to a depth of 46 feet below ground surface. The glacial till is composed of a heterogeneous mixture of sand, silt, some clay and gravel. Within this deposit there are occasional layers and seams of sand. The relative density of the overall stratum varies from compact to very dense with depth, being very dense below a depth of 25 feet below ground surface.

Area 10: The subsurface condition is rather complex at this site. From ground surface downward, subsoil consists of 9 feet of hard clayey silt, followed by 12 feet of very dense silty sand to sandy silt, which in turn is followed by 10 feet of very dense glacial till composed of a heterogeneous mixture of sand, silt, some gravel and clay. The glacial till is underlain by 16 feet of fine to medium sand and then another stratum of hard cohesive glacial till. The deposit of fine to medium sand sandwiched between the two glacial till sheets is under subartesian pressure, with a head stabilized below ground surface at around elevation 571 \pm .

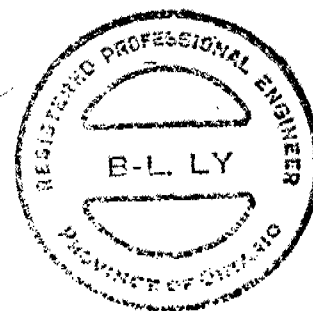
Area 11: The site is underlain by a stratum of glacial till which was investigated to a depth of 45 feet below ground surface. The glacial till is composed of a heterogeneous mixture of clayey silt, sand and gravel. The glacial till has a cohesive matrix with a low plasticity and a hard consistency. Because of the low permeability of the subsoil, the groundwater level did not stabilize during the course of investigation.

DISCUSSIONS AND RECOMMENDATIONS

The proposed alignment and profile of E.M.F., together with the proposed structure locations, are shown on Drawing 256900-A and 256900-B. In general, the subsurface conditions along the route are favourable from a soil mechanics point of view, except certain cut sections contemplated in the sand and gravel areas where groundwater problems may be anticipated. In most cases, the structures can be supported by spread footings placed within the undisturbed overburden, except a few locations where it may be more advantageous to perch the abutments within the very high approach fills on end-bearing piles. Our recommendations for the structure foundations and the related earthworks at the various sites are summarized on the following pages.

The various comments outlined in this report are for feasibility study purposes based on very limited information. It will be necessary to carry out detailed subsurface investigations at each structure location when the design details and geometries are finalized. In some areas groundwater studies, together with pumping tests, may also be necessary.

B. Ly
B. Ly, P. Eng.
Senior Engineer



M. Devata
M. Devata, P. Eng.
Supervising Engineer

January, 1979

APPENDIX

FOUNDATION DATA SHEET

W. P. 25-69-00 AREA 1 LOCATION Hwy. 401 & EMF

ORIGINAL GROUND ELEV. 433+

SUBSURFACE CONDITIONS		RECOMMENDATIONS		REMARKS
		STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> BH1 0'-13' very dense sand and gravel 13'-27' very dense glacial till 27'-43' very dense silt to sandy silt 43'-51' hard silty clay <u>Groundwater</u> Elev. 424+		Spread footings placed within the undisturbed sand and gravel stratum with an allowable bearing pressure up to 3 tsf.	Fill heights up to 30 feet will be stable with forward and side slopes of 2:1.	Cut sections in granular soil below the groundwater level will require extensive temporary and permanent dewatering schemes and slope treatments. Further, if cuts are contemplated, a detailed hydrogeological study should be carried out to evaluate the effects of such cuts on the groundwater. In view of the above, a structure to carry EMF over Hwy. 401 is preferred.

FOUNDATION DATA SHEET

W. P. 25-69-00 AREA 2 LOCATION EMF and CPR Spur (near Sheppard Ave.)

ORIGINAL GROUND ELEV. 451+

[illegible]

FOUNDATION DATA SHEET

W.P. 25-69-00 AREA _____ LOCATION Depressed Section of EMF Between Area 3A and Area 4

ORIGINAL GROUND ELEV. _____

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>Reference Boreholes</u> hard glacial till	N/A	Cuts up to 30 feet deep can be constructed with 2:1 slopes. Cuts of 30 feet and up to 40 feet deep should be provided with a half height 10 foot wide bench incorporating an intercepting ditch.	
<u>Groundwater</u>			

FOUNDATION DATA SHEET

W. P. 25-69-00 AREA 3 LOCATION EMF and CPR Spur (north crossing)
ORIGINAL GROUND ELEV. 475+

[illegible]

1

ORIGINAL GROUND ELEV. 444+ _____

[illegible]

FOUNDATION DATA SHEET

W.P. 25-69-00 AREA 4 LOCATION EMF and Finch Ave. E.
ORIGINAL GROUND ELEV. 472+

[illegible]

1

ORIGINAL GROUND ELEV. 379+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes BH5</u></p> <p>0'-4' sand and gravel</p> <p>4'-18' compact to very dense uniform fine sand</p> <p>18'-62' silty sand to sandy silt</p> <p>probable shale bedrock at 62 feet</p> <p><u>Groundwater Elev. 374+</u></p>	<p>The piers and the west abutment which will be perched in the fills, should be supported on steel 'H' piles driven to bedrock.</p> <p>The east abutment can be supported on spread footings placed within the overburden with an allowable pressure of 3 tsf. The footings, however, should be kept at least 50 feet from the cliff.</p>	<p>Fills up to 30 feet in height will be stable with forward and side slopes of 2:1.</p> <p>Fills of 30 feet and up to 40 feet in height should be constructed with 2:1 slopes and a 20 foot wide mid-height berm in both longitudinal and transversal directions.</p>	<p>The proposed high level profile grade will require a very long structure and very high fills, therefore, it is not preferred.</p> <p>The alternative low profile scheme should be adopted for this crossing.</p>

FOUNDATION DATA SHEET

V. P. 25-69-00 AREA 6 LOCATION EMF Crossing of Rouge River

ORIGINAL GROUND ELEV. 422+ _____

[illegible]

FOUNDATION DATA SHEET

W.P. 25-69-00 AREA 7 LOCATION EMF Crossing of Relocated Finch Ave. E.

ORIGINAL GROUND ELEV. 453+

[illegible]

FOUNDATION DATA SHEET

W. P. 25-69-00 AREA 8 LOCATION CPR Subway at EMF

ORIGINAL GROUND ELEV. 506+

[illegible]

FOUNDATION DATA SHEET

W.P. 25-69-00 AREA 9 LOCATION CNR Subway at EMF
ORIGINAL GROUND ELEV. 523+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes BH9</u></p> <p>0'-7' silt to silt with clay</p> <p>7'-46' very dense glacial till</p> <p><u>Groundwater Elev.</u> 510+</p>	Spread footings placed within the very dense glacial till with an allowable pressure of 3 tsf.	Cuts up to 25 feet deep can be constructed with 2:1 slopes.	

FOUNDATION DATA SHEET

W. P. 25-69-00 AREA 9A LOCATION EMF Crossing Steeles Ave.

ORIGINAL GROUND ELEV. 534+

[illegible]

FOUNDATION DATA SHEET

W. P. 25-69-00 AREA 9B LOCATION Existing CNR Subway at Steeles Ave.

ORIGINAL GROUND ELEV. 506+ _____

[illegible]

FOUNDATION DATA SHEET

W. P. 25-69-00 AREA 9C LOCATION EMF Over Tributary of Little Rouge River
ORIGINAL GROUND ELEV. 496+

[illegible]

FOUNDATION DATA SHEET

W.P. 25-69-00 AREA 10 LOCATION CPR Overhead at EMF
ORIGINAL GROUND ELEV. 589+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
Reference Boreholes BH 10			
0'-9' hard clayey silt to silt, some clay	The abutments could be composed of rein- forced earth or perched within the fills on end-bearing steel H piles. Estimated tip elevations around 567 feet.	Fill heights up to 35 feet will be stable with forward and side slopes of 2:1.	Because of a water bearing sandy stratum and a sand stratum under subartesian conditions, it is preferable to have EMF go over the existing CPR.
9'-21' very dense sandy silt to silty sand			
21'-31' very dense glacial till			
31'-47' fine to medium sand under subartesian conditions			
47'-52' hard glacial till			
<u>Groundwater</u> Elev. 571+			

FOUNDATION DATA SHEET

W. P. 25-69-00 AREA 11 LOCATION EMF and Hwy. 407

ORIGINAL GROUND ELEV. 633

[illegible]



RECORD OF BOREHOLE No 1

W P 25-69-00 LOCATION Coords. N 15,914,615, E 1,083,280 ORIGINATED BY J.J.
DIST 6 HWY EMF BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY J.J.
DATUM Geodetic DATE 78 08 08 CHECKED BY J.J.

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
433.1	Ground Surface																
0.0	Sand and Gravel Very Dense Brown,		1	SS	44		430										49 45 (67)
420.1			2	SS	63												
13.0	Glacial Till, Sandy Silt to Silty Sand With Trace of Clay and Gravel, Very Dense		3	SS	43		420										5 44 41 10
			4	SS	120												
406.1	Changing to Hard With Slight Plasticity		5	SS	60/	5"	410										
27.0	Silt to Sandy Silt With Occasional Sand Seams, Grey Very Dense		6	SS	87		400										0 11 (89)
			7	SS	60/	3"											
390.1			8	SS	60/	5"	390										
43.0	Silty Clay, Grey Trace of Fine Gravel Hard		9	SS	50/	4"											
381.6			10	SS	104												
51.5	End of Borehole																



RECORD OF BOREHOLE No 2

W P 25-69-00 LOCATION Coords. N 15 916 870; E 1 081 950 ORIGINATED BY J.J.
DIST 6 HWY EMF BOREHOLE TYPE Hollow Stem Auger COMPILED BY J.J.
DATUM Geodetic DATE 78 08 08 CHECKED BY J.J.

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			SHEAR STRENGTH								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
450.8	Ground Surface							20 40 60 80 100		10 20 30						
0.0	Fill, Silty Fine Sand, Black, Some Debris and Organics															
442.3																
8.5	Sand, Well Graded		1	SS	9									9 64 (27)		
437.8	Loose															
13.0	Glacial Till Heterogeneous Mixture of Clayey Silt, Sand and Some Gravel Grey, Very Stiff to Hard With Occasional Sand Layers		2	SS	19									9 40 38 13		
			3	SS	35											
			4	SS	41									9 36 40 15		
			5	SS	34											
			6	SS	34											
			7	SS	64											
			8	SS	51											
			9	SS	63											
			10	SS	55									2 39 40 19		
			11	SS	51											
			12	SS	96											
			13	SS	100/ 10"											
354.3																
96.5	End of Borehole															



RECORD OF BOREHOLE No 3

W P 25-69-00 LOCATION Coords. N 15 918 770; E 1 080 510 ORIGINATED BY J.J.
DIST 6 HWY EMF BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY J.J.
DATUM Geodetic DATE 78 08 09, 78 09 10 CHECKED BY *W.J.*

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100		W _p	W	W _L		
474.8	Ground Surface													
0.0	Glacial Till		1	SS	21		470							7 37 41 15
			2	SS	20									
			3	SS	24									
			4	SS	30									
			5	SS	38		460							
			6	SS	60									
			7	SS	75		450							
			8	SS	80									
			9	SS	91		440							
			10	SS	50									
			11	SS	58		430							4 16 52 28
			12	SS	51		420							
			13	SS	62		410							
			14	SS	47		400							
			15	SS	65/ 4"									7 40 (53)
388.3			16	SS	35/ 1"		390							
86.5	End of Borehole													



RECORD OF BOREHOLE No 3A

W P 25-69-00 LOCATION Coords. N 15 919 380; E 1 080 130 ORIGINATED BY J.J.
DIST 6 HWY EMF BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY J.J.
DATUM Geodetic DATE 78 08 09 CHECKED BY W.J.

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					
444.3	Ground Surface																
0.0	Silty Fine Sand to Medium Sand Dense to Very Dense <u>Brown</u> <u>Grey</u> With Occasional Seams of Clay		1	SS	33		440										3 54 33 10
			2	SS	57												
			3	SS	108		430										
			4	SS	91/	10"											
419.3			5	SS	134		420										17 64 (19)
25.0	Glacial Till Heterogeneous Mixture of Sand, Silt, Some Gravel and Trace of Clay Very Dense		6	SS	62/	6"											
			7	SS	92		410							N.P.			
406.3			8	SS	108												
38.0	Silty Fine Sand Very Dense		9	SS	70/	5"	400										0 56 (44)
401.3			10	SS	87												
43.0	Silty Clay Grey Hard		11	SS	100/	6"	390										
389.3																	
55.0	Silty Sand With Seams of Silt and Clay Very Dense		12	SS	100/	5"	380										1 65 19 15
373.8																	
70.5	End of Borehole																



RECORD OF BOREHOLE No 4

W P 25-69-00 LOCATION Coords. N 15 923 190; E 1 078 860 ORIGINATED BY J. J.
DIST 6 HWY EMF BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY J. J.
DATUM Geodetic DATE 78 08 10 CHECKED BY J. J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
472.2	Ground Surface										
0.0	Silty Clay, Brownish Grey, Very Stiff to Hard		1	SS	30		470				
			2	SS	24		460				
455.2	Grey and Stiff		3	SS	7		450				
17.0	Glacial Till Heterogeneous Mixture of Clayey Silt, Sand and Gravel With Occasional Boulders and Silt Seams		4	SS	43		440				
			5	SS	98		430				
	Hard		6	SS	83						
			7	SS	75/	5"					
			8	SS	92/	6"					
			9	SS	94/	6"					
421.2			10	SS	132						
51.0	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 5

W P 25-69-00 LOCATION Coords. N 15 923 760; E 1 080 100 ORIGINATED BY J.J.
DIST 6 HWY EMF BOREHOLE TYPE Hollow Stem Auger COMPILED BY J.J.
DATUM Geodetic DATE 78 08 10 CHECKED BY *el.f.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT Σ					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N' VALUES			20	40	60	80	100					
378.6	Ground Surface																
0.0	Sand and Gravel		1	SS	50												
375.1	Very Dense		2	SS	58												
3.5	Uniform Fine Sand Some Silt, Gray Compact to Very Dense		3	SS	40		370										
			4	SS	22												
	With Occasional Clay Seams		5	SS	36		360										
360.6			6	SS	55												
18.0	Silty Sand to Sandy Silt With Occasional Boulders		7	SS	0		350										0 78 (22)
			8	SS	0												
			9	SS	9		340										0 39 (61)
			10	SS	0												
	Trace of Clay		11	SS	11		330										
			12	SS	10												
			13	SS	18		320										0 51 (49)
317.1	Probable Shale Bedrock		14	SS	102/ 2"												
61.5	End of Borehole Note: Auger Refusal at 61.5 feet																



RECORD OF BOREHOLE No 6

W P 25-69-00 LOCATION Coords. N 15 924 420; E 1 078 760 ORIGINATED BY J.J.
DIST 6 HWY EMP BOREHOLE TYPE Hollow Stem Auger COMPILED BY J.J.
DATUM Geodetic DATE 78 08 11 CHECKED BY e.f.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
422.5	Ground Surface													
0.0	Sand and Gravel Compact		1	SS	20		420							52 42 (6)
414.5			2	SS	80									
8.0	Seams of Sand		3	SS	41		410							
	Clayey Silt, Grey Hard		4	SS	30									
			5	SS	25		400							
	Trace of Gravel		6	SS	53									
	With Thin Layers of Brown Sand and Silt		7	SS	82/	6"	390							
379.5			8	SS	132									
43.0	Silty Sand, Brown Very Dense		9	SS	74/	6"	380							
			10	SS	44									
			11	SS	134/	11"	370							
356.5	Seams of Silt & Clay		12	SS	100/	6"	360							
66.0	End of Borehole													



RECORD OF BOREHOLE No 7

W.P. 25-69-00 LOCATION Coords. N 15 925 280; E 1 078 200 ORIGINATED BY J.J.
DIST 6 HWY EMF BOREHOLE TYPE Solid Stem Auger COMPILED BY J.J.
DATUM Geodetic DATE 78 08 11 CHECKED BY J.J.

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					
452.5	Ground Surface																
0.0	Some Gravel Silty Fine Sand Brown, Compact to Very Dense With Occasional Clay Seams	A	1	SS	27		450										32 51 (17)
			2	SS	22												0 80 (20)
			3	SS	37												0 87 (13)
			4	SS	51												
			5	SS	100/ 10"		440										
			6	SS	100/ 10"												
			7	SS	116		430										0 80 (20)
			8	SS	126/ 5"		420										
416.5	Clayey Silt Grey and Hard	B	9	SS	150/ 6"												
36.0			10	SS	67/ 6"		410										
			11	SS	94												0 9 55 36
			12	SS	75		400										
391.0																	
61.5	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 8

W P 25-69-00 LOCATION Coords. N 15 926 140; E 1 077 940 ORIGINATED BY J.J.
DIST 6 HWY EMF BOREHOLE TYPE Hollow Stem Auger COMPILED BY J.J.
DATUM Geodetic DATE 78 08 14 CHECKED BY R.J.

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
505.5	Ground Surface																GR SA SI CL
0.0	Glacial Till																
	Heterogeneous Mixture of Sand, Silt, Some Clay and Gravel		1	SS	74		500										
	Very Dense		2	SS	49												9 39 37 15
			3	SS	85		490										
	Brown Grey		4	SS	45												
			5	SS	92		480										
			6	SS	113												15 41 34 10
	Occasional Fine Sand Seams		7	SS	154		470										5 39 (56)
			8	SS	100/	5"V											
457.5			9	SS	35		460										
48.0	Glacial Till		10	SS	59												
	Heterogeneous Mixture of Clayey Silt, Sand and Some Gravel, Grey Hard		11	SS	62		450										
			12	SS	83												1 22 49 28
			13	SS	117		440										
	Occasional Pockets of Sand		14	SS	96												
			15	SS	91		430										
424.5			16	SS	93												
81.0	End of Borehole																



RECORD OF BOREHOLE No 9

W P 25-69-00 LOCATION Coords. N 15 931 210; E 1 076 930 ORIGINATED BY J.J.
DIST 6 HWY EMP BOREHOLE TYPE Solid Stem Auger COMPILED BY J.J.
DATUM Geodetic DATE 78 08 15 CHECKED BY *elj*

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					
522.7	Ground Surface																
0.0	Silt to Silt With Clay, Brown Very Stiff		1	SS	11		520										
515.7			2	SS	12												
7.0	Glacial Till		3	SS	97												
	Heterogeneous Mixture of Sand, Silt, Some Clay and Gravel Non-Plastic to Slightly Plastic Grey		4	SS	50/	3"	510										6 43 37 14
	Very Dense		5	SS	50/	3"											
			6	SS	100/	9"	500										
			7	SS	60/	3"											8 54 28 10
			8	SS	50/	2"	490										
			9	SS	25/	2"											
			10	SS	50/	4"	480										
476.2			11	SS	50/	2"											
46.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 9A

W P 25-69-00 LOCATION Coords. N 15 931 880; E 1 076 670 ORIGINATED BY J.J.
DIST 6 HWY EMF BOREHOLE TYPE Solid Stem Auger COMPILED BY J.J.
DATUM Geodetic DATE 78 08 15 CHECKED BY J.J.

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					
533.9	Ground Surface																
0.0	Silty Sand With Gravel, Grey Compact		1	SS	26		530										8 53 30 9
526.9			2	SS	15												
7.0	Silt, Some Clay to Clayey Silt, Trace of Sand		3	SS	60												
			4	SS	54												
	Some Sand		5	SS	61		520										3 28 (69)
	Very Stiff to Hard		6	SS	50/3"												
			7	SS	71		510										0 8 (92)
			8	SS	100/2"												
500.9			9	SS	108/6"		500										
33.0	Silt, Trace of Clay Grey, Very Dense		10	SS	60/5"												
			11	SS	50/4"		490										
485.9			12	SS	50/4"												
48.0	Silty Sand, Some Clay Seams, Very Dense																3 50 (47)
482.4																	
51.5	End of Borehole																



RECORD OF BOREHOLE No 9B1

W P 25-69-00 LOCATION Coords. N 15 931 850; E 1 075 920 ORIGINATED BY C.N.R.
DIST 6 HWY EMF BOREHOLE TYPE Soil Information From C.N.R. COMPILED BY J.J.
DATUM Geodetic DATE 64 10 20 CHECKED BY el.

[illegible]

+3, x5: Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 9B2

W.P. 25-69-00 LOCATION Coords. N 15 931 800; E 1 076 010 ORIGINATED BY C.N.R.
DIST 6 HWY EMF BOREHOLE TYPE Soils Information From C.N.R. COMPILED BY J.J.
DATUM Geodetic DATE 64 10 20 CHECKED BY *W.J.*

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					
509.0	Ground Surface																
0.0	Silt and Sand																
505.0	Brown																
4.0	Fine Sand With																
501.0	Gravel, Brown																
8.0	Sandy Silt Till						500										
	Grey, Very Dense						490										
481.4																	
27.6	End of Borehole						480										



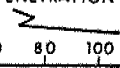
RECORD OF BOREHOLE No 9B3

W P 25-69-00 LOCATION Coords. N 15 931 760; E 1 076 110 ORIGINATED BY C.N.R.
DIST 6 HWY EMF BOREHOLE TYPE Soils Information From C.N.R. COMPILED BY J.J.
DATUM Geodetic DATE 64 10 20 CHECKED BY el.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			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	Wp	W	Wl	WATER CONTENT (%)					
506.0	Ground Surface																
0.0	Silt and Sand, Some Fine Gravel, Grey- Brown																
499.0																	
7.0	Sandy Silt Till Grey, Very Dense																
491.5																	
14.5	End of Borehole																

RECORD OF BOREHOLE No 9C

W P 25-69-00 LOCATION Cords. N 15 930 100; E 1 077 260 ORIGINATED BY J. J.
 DIST 6 HWY EMF BOREHOLE TYPE Hollow Stem Auger COMPILED BY J.J.
 DATUM Geodetic DATE 78 08 15 CHECKED BY J.J.

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					
496.9	Ground Surface																
0.0	Glacial Till Heterogeneous Mixture of Sand, Silt, Some Clay and Gravel Very Dense		1	SS	9		490										15 42 (43)
			2	SS	39												
			3	SS	44		480										13 49 28 10
	Fine to Medium Sand		4	SS	46												
	Fine Sand		5	SS	73/	6"	470										8 22 (70)
	Wet Sand Seam		6	SS	4												
			7	SS	90												
			8	SS	74/	6"	460										9 31 44 16
			9	SS	110/	6"											
450.9			10	SS	60/	3"											
46.0	End of Borehole Note: Groundwater Not Established																

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 10

W P 25-69-00 LOCATION Coords. N 15 938 160; E 1 075 270
DIST 6 HWY EME BOREHOLE TYPE Solid Stem Auger
DATUM Geodetic DATE 78 08 16
ORIGINATED BY J.J.
COMPILED BY J.J.
CHECKED BY J.J.

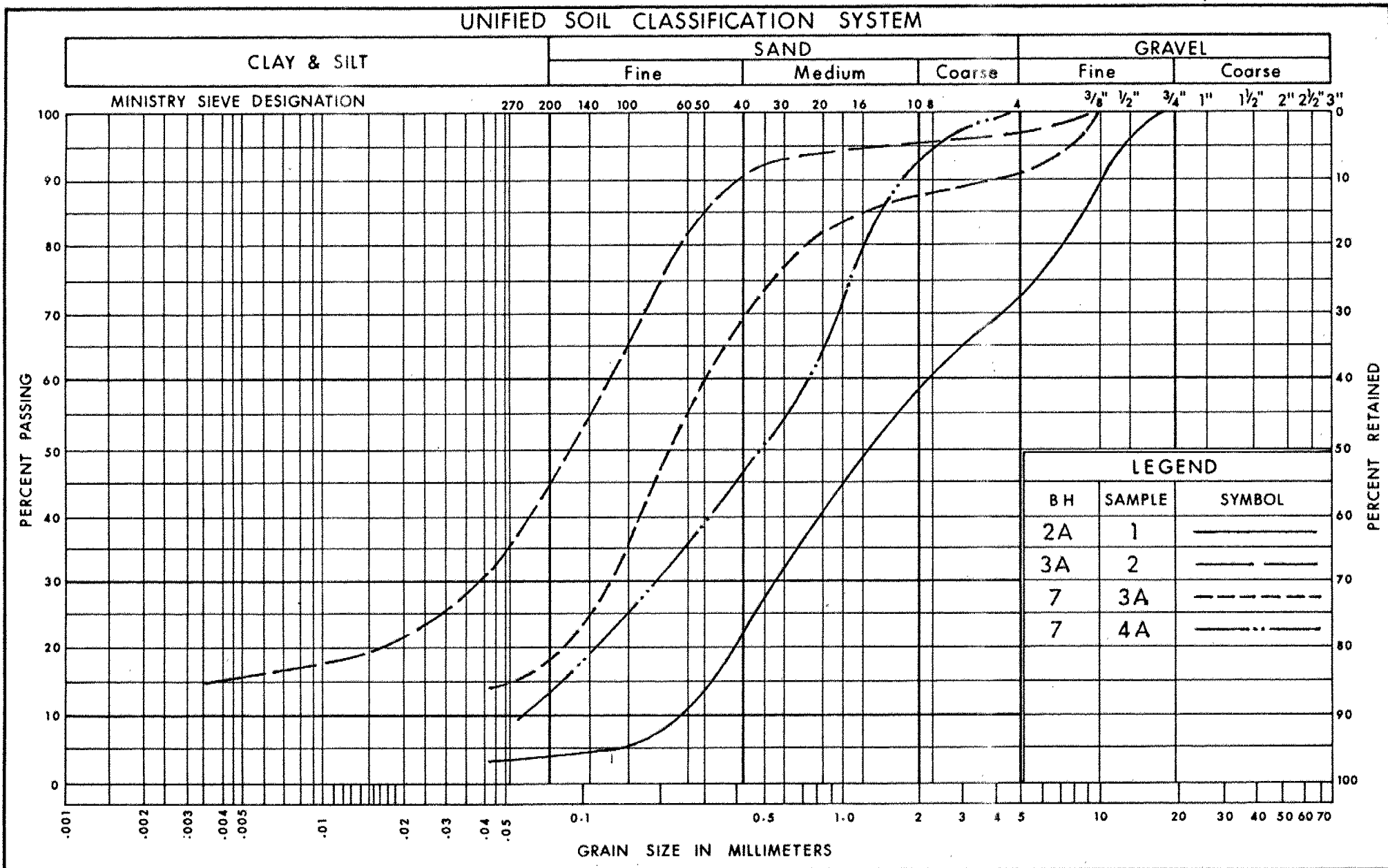
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
588.9	Ground Surface																
0.0	Some Organics		1	SS	31												
	Clayey Silt to Silt		2	SS	88												
579.9	Some Clay, Hard With Occasional Fine Sand Seams		3	SS	101	10"											
9.0	Sandy Silt to Silty Sand With Gravel, Grey, Very Dense		4	SS	64	6"											
			5	SS	50	2"											
567.9			6	SS	50	2"											
21.0	Glacial Till Heterogeneous Mixture of Sand, Silt Gravel and Clay Grey, Very Dense		7	SS	50	2"											
557.9			8	SS	95	6"											
31.0	Fine to Medium Sand Under Subartesian Pressure																
541.9																	
47.0	Glacial Till Hard		9	SS	100	4"											
537.4																	
51.5	End of Borehole																



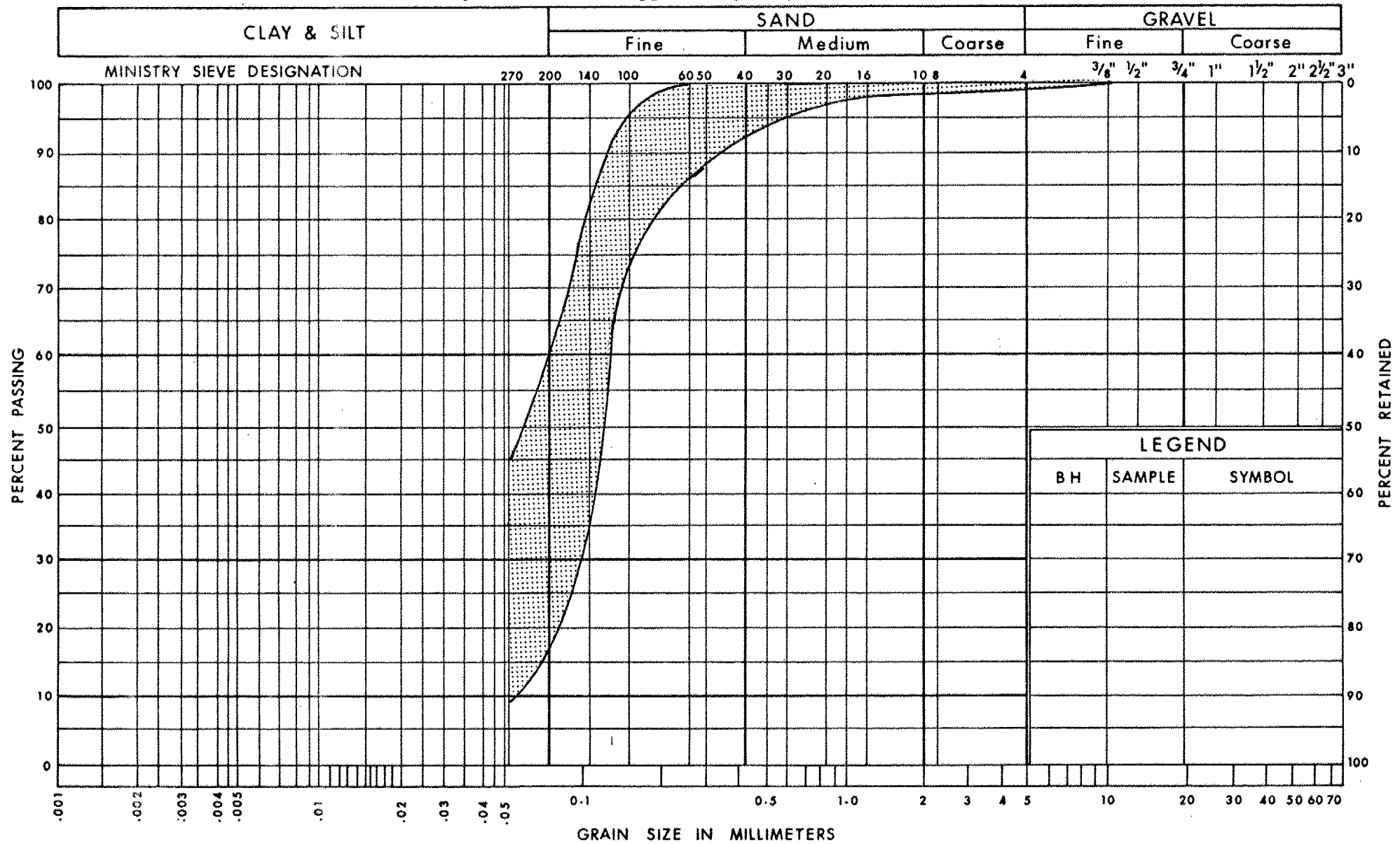
RECORD OF BOREHOLE No 11

W P 25-69-00 LOCATION Coords. N 15 943 790; E 1 074 350 ORIGINATED BY J.J.
 DIST 6 HWY EMF BOREHOLE TYPE Hollow Stem Auger COMPILED BY J.J.
 DATUM Geodetic DATE 78 08 16 CHECKED BY N.J.

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
633.0	Ground Surface																
0.0	Glacial Till Heterogeneous Mixture of Clayey Silt, Sand and Gravel Hard					No W.L.	630										
			1	SS	30												
			2	SS	60/	5"											
			3	SS	130		620										6 25 (69)
			4	SS	65/	6"											
			5	SS	70/	4"	610										9 35 (55)
			6	SS	108												
			7	SS	60/	4"	600										
			8	SS	60/	5"											
			9	SS	90/	6"	590										18 37 (45)
587.5	End of Borehole																
45.5																	



UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation and
Communications

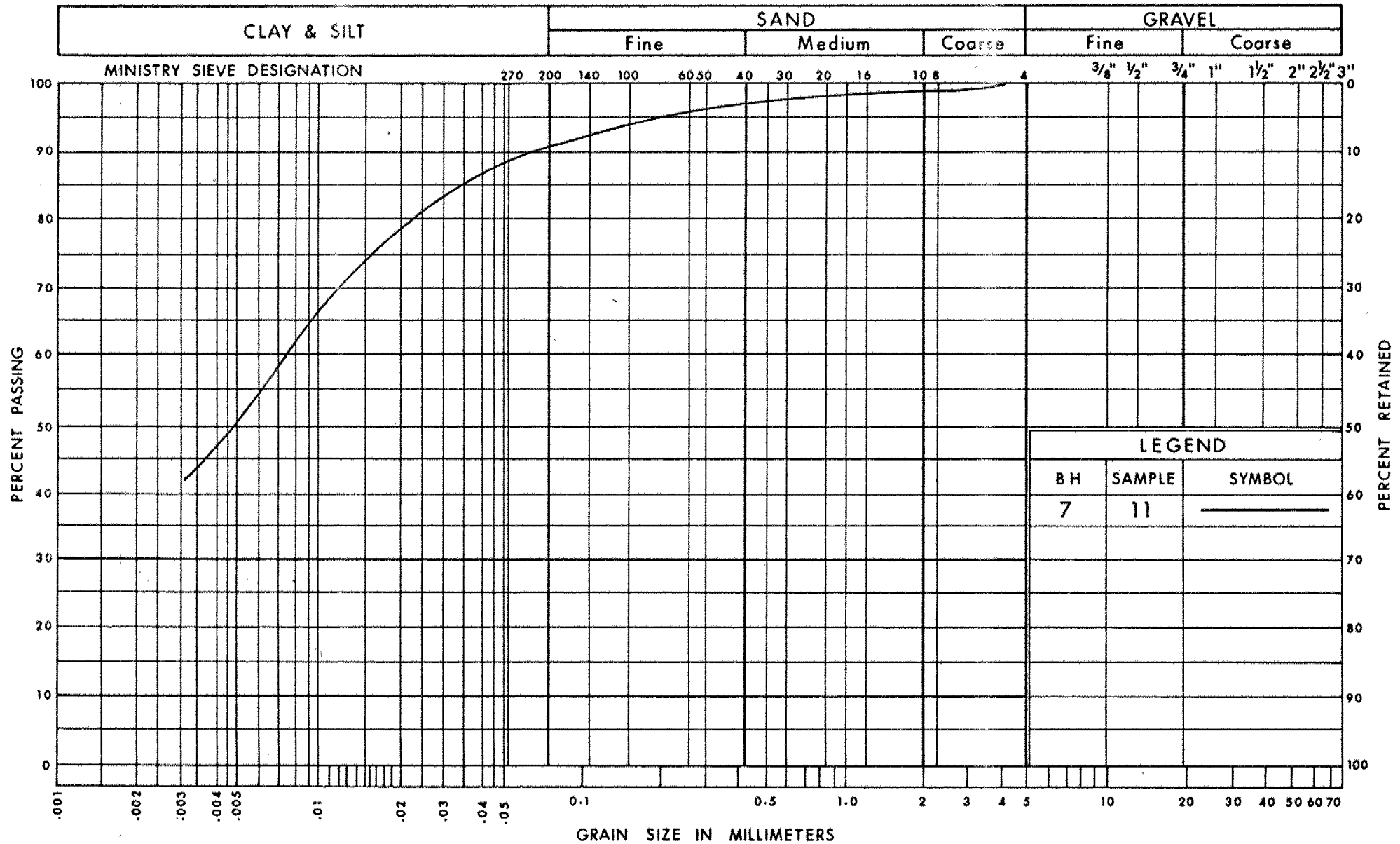
Ontario
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION SILTY FINE SAND

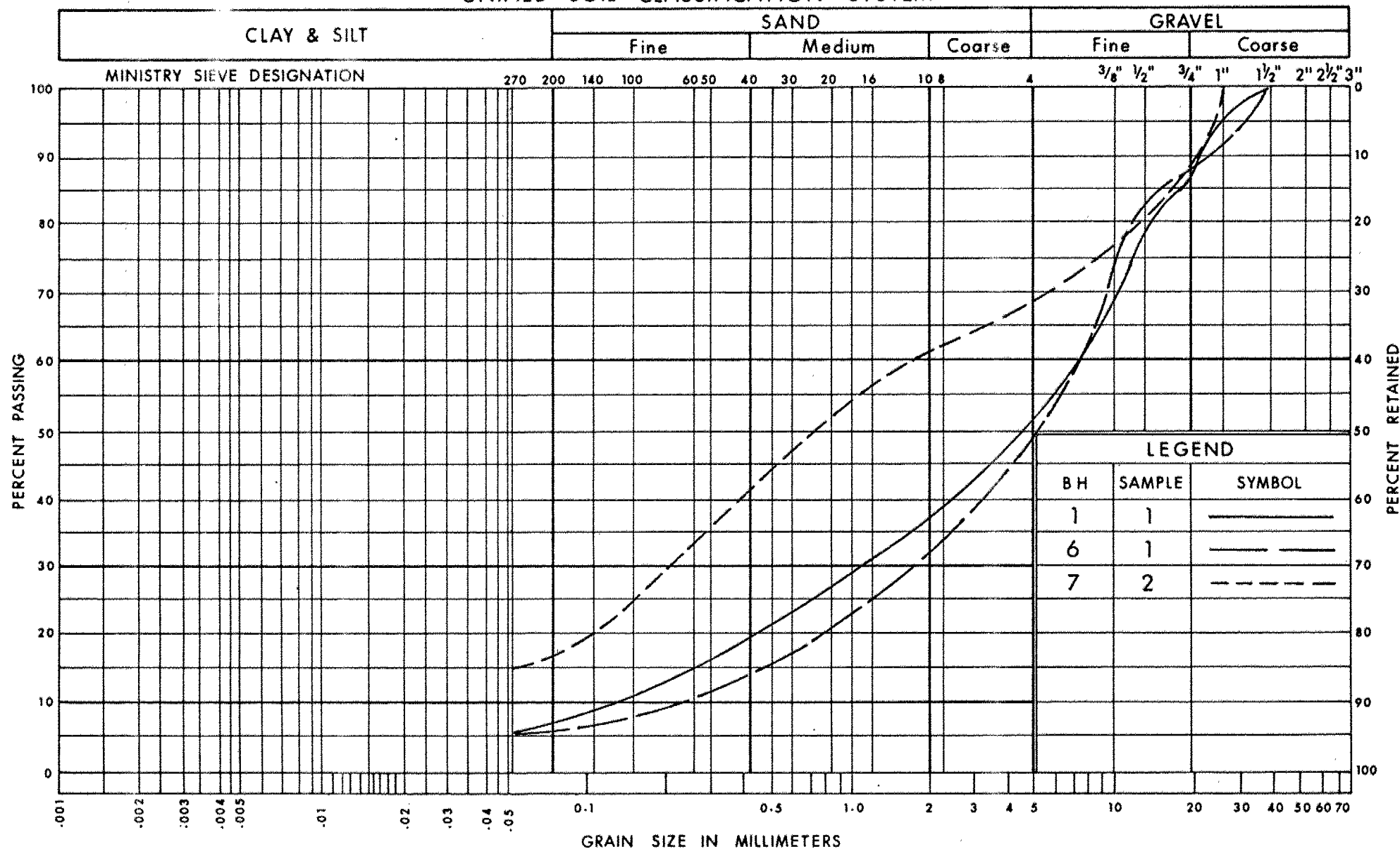
FIG No	2
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W P 25-69-00

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM





Ontario
ENGINEERING SERVICES BRANCH

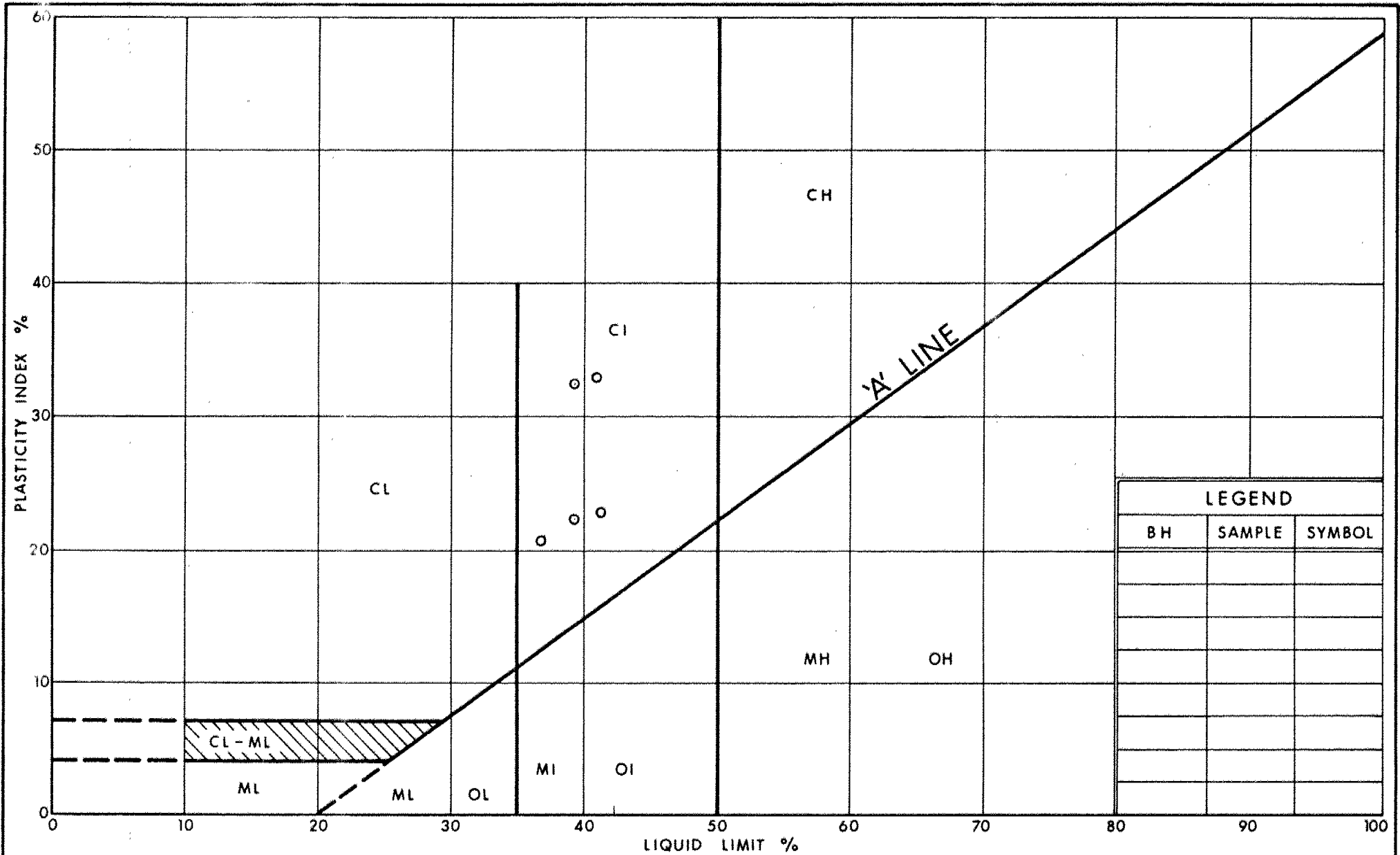
GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HET MIXTURE OF SAND SILT CLAY & GRAVEL

W P 25-69-00



GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HET MIXTURE OF CLAYEY SILT SAND & GRAVEL

FIG No	6
W P	25-69-00



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Transportation and
Communications

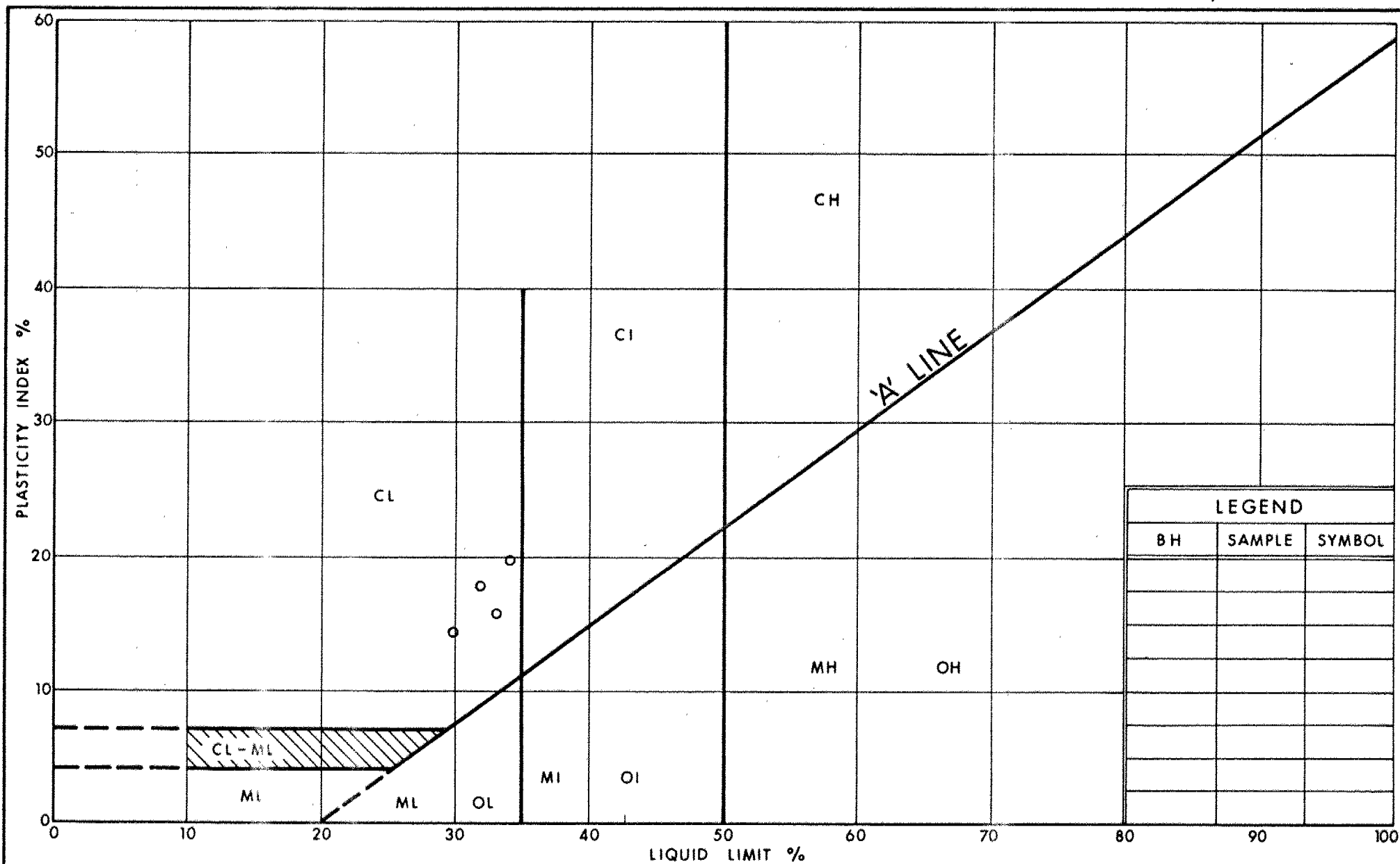
Ontario

ENGINEERING SERVICES BRANCH

PLASTICITY CHART SILTY CLAY TRACE OF GRAVEL

FIG No 7

W P 25-69-00



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Transportation and
Communications

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ENGINEERING SERVICES BRANCH

PLASTICITY CHART CLEY EY SILT

FIG No 8

W P 25-69-00



HETEROGENEOUS MIXTURE OF CLAYEY SILT SAND & GRAVEL

W P 25-69-00

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 "A" 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 UNDRAINED 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. CIU = 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 CHUNK 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
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_γ, N_q, N_c 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
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w_L - w_p$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{w_L - w_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{w_L - w_p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{I_p \text{ of } 2\mu m \text{ Soil Fraction}}$
 O_m ORGANIC MATTER CONTENT
 S SENSITIVITY = $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

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_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u 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
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS
NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 $\sigma' =$ EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_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

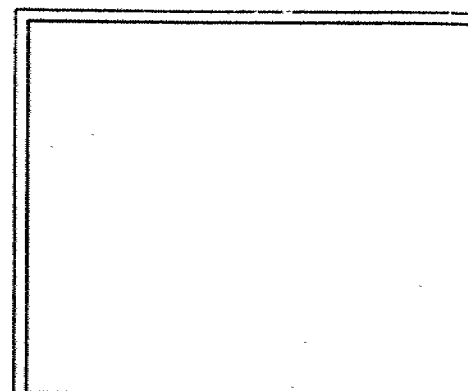
CONT No
WP No 25-69-00



EAST METRO FREEWAY
FROM HWY 401 TO HWY 7

SHEET

BORE HOLE LOCATIONS & SOIL STRATA



KEY PLAN

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- W Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- ↓ WL at time of investigation
NO WL established Bm No
9C 981 982 983 & 11

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	433.1	15 914 615	1 082 280
2	450.8	15 916 870	1 081 950
3	474.8	15 918 770	1 080 510
3A	444.3	15 919 380	1 080 130
4	472.2	15 923 190	1 078 860
5	378.6	15 923 760	1 080 100
6	422.5	15 924 420	1 078 760
7	452.5	15 925 280	1 078 200
8	505.5	15 926 140	1 077 940
9	522.7	15 931 210	1 076 930
9A	533.9	15 931 880	1 076 670
9B1	506.4	15 931 850	1 075 920
9B2	509.0	15 931 800	1 076 010
9B3	506.0	15 931 760	1 076 110
9C	496.9	15 930 100	1 077 260
10	588.9	15 938 160	1 075 270
11	633.0	15 943 790	1 074 350

NOTE

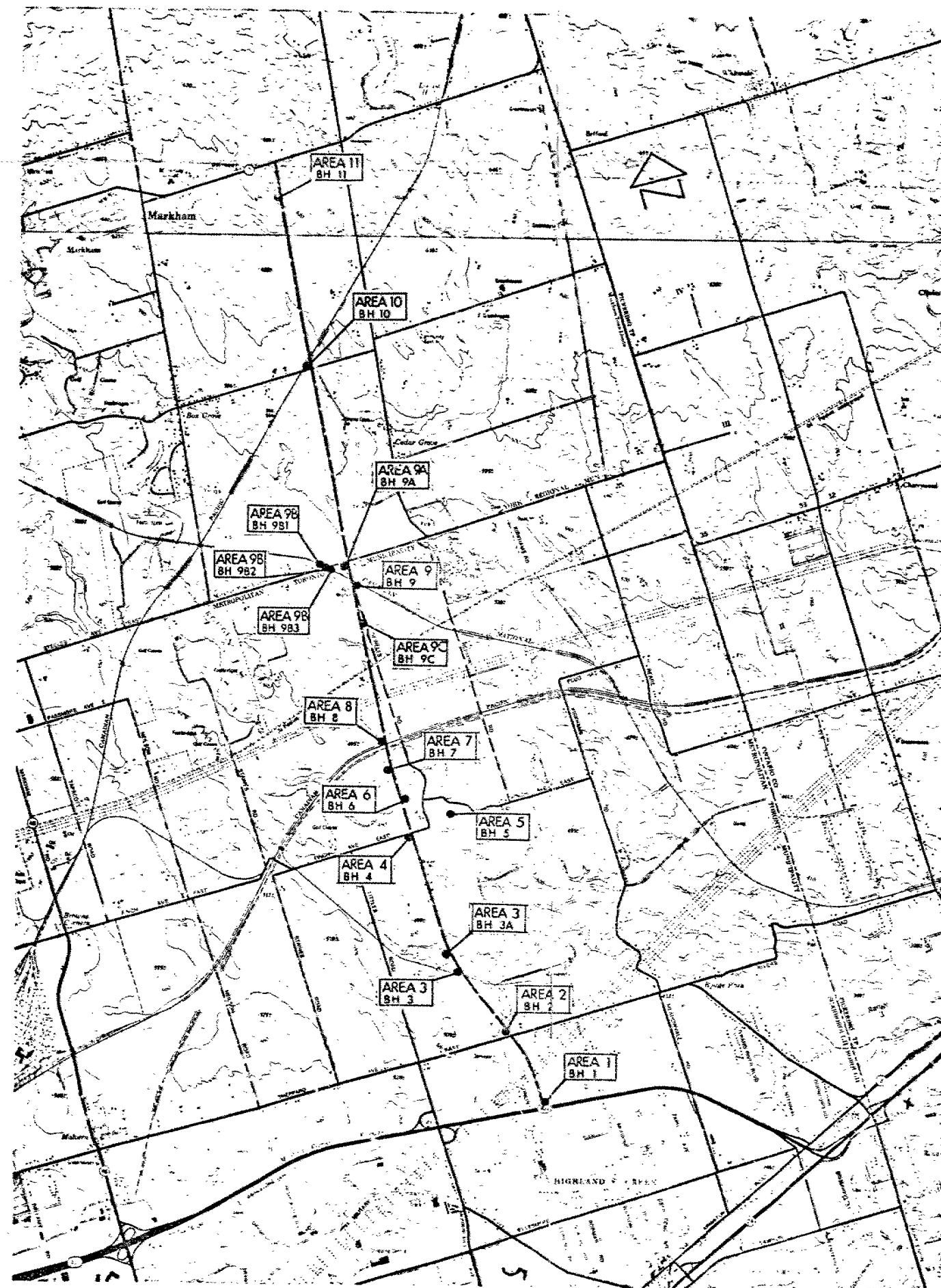
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

HWY No E M F DIST 6
SUBMITTAL CHECKED DATE 78 11 01 SITE
DRAUGHTS CHECKED APPROVED ENG 256930-A

PROPOSED STRUCTURE AREAS

- 1 Hwy 401 & Proposed E M F
- 2 C P R Spur (South Crossing) & E M F
- 3 C P R Spur (North Crossing) & E M F
- 3A Tributary of Rouge River & E M F
- 4 Finch Ave E & E M F
- 5 Relocated Finch Ave Crossing of Rouge River
- 6 Crossing Rouge River & E M F
- 7 Crossing of a Relocated Finch Ave & E M F
- 8 Subway at C P R & E M F
- 9 C N R at E M F
- 9A Crossing of Steeles Ave & E M F
- 9B Existing Steeles Ave Subway at C N R
- 9C Tributary to Little Rouge River & E M F
- 10 Overhead at C P R & E M F
- 11 Hwy 407 Interchange & E M F



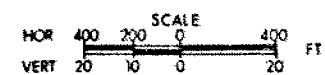
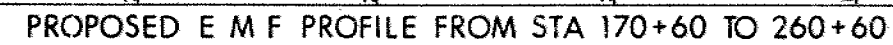
LEGEND

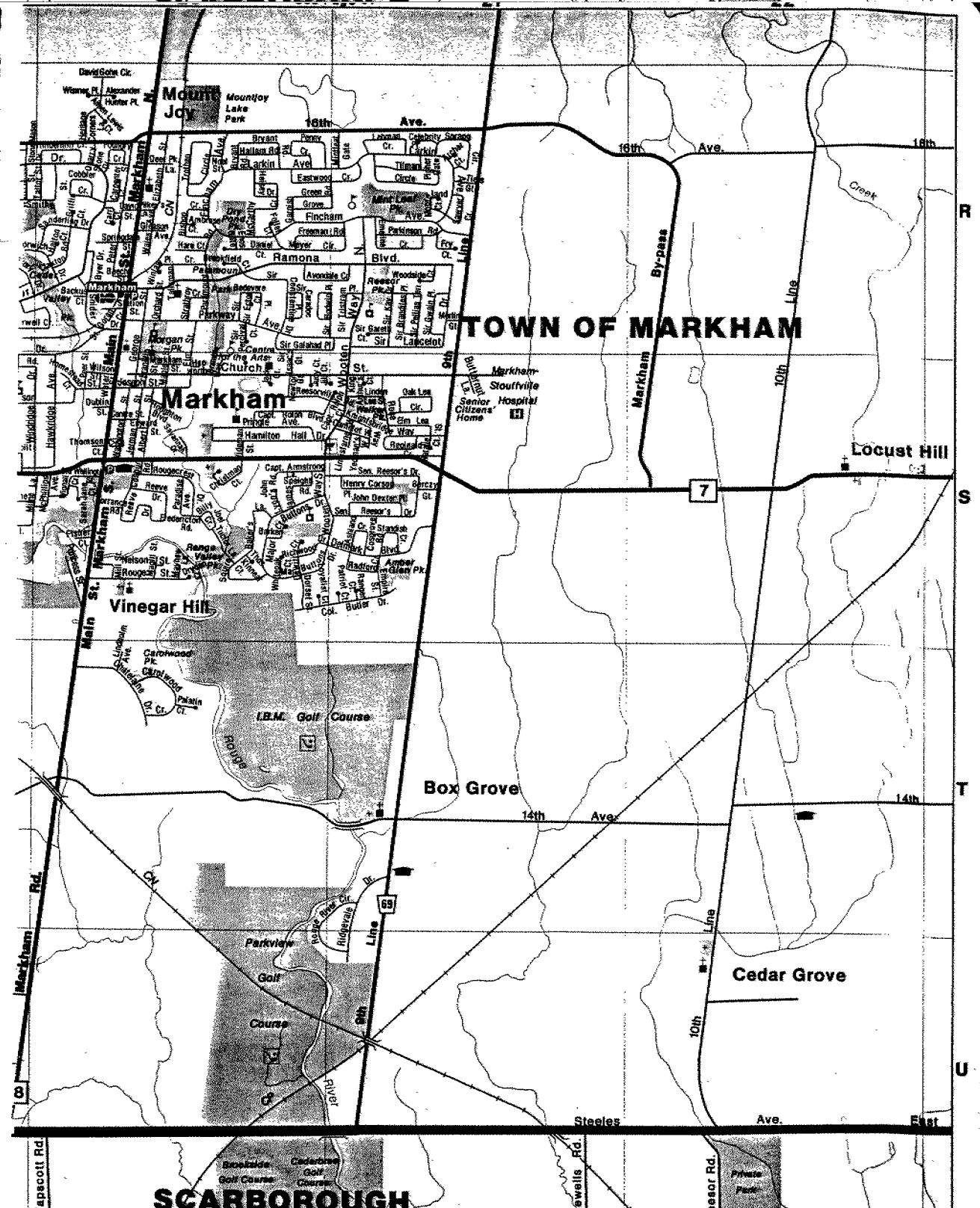
- | No | ELEVATION | | |
|----|-----------|--|--|
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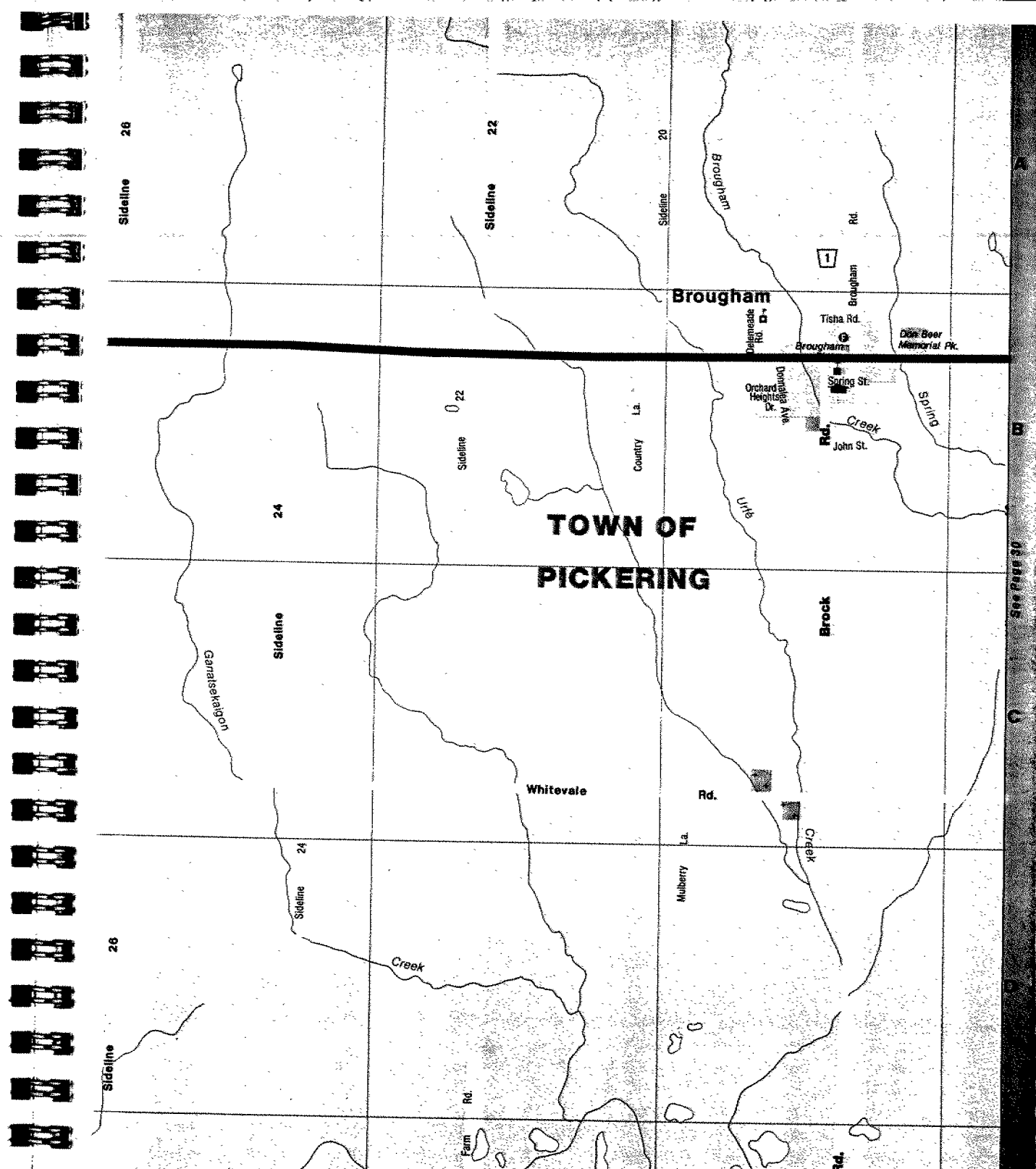
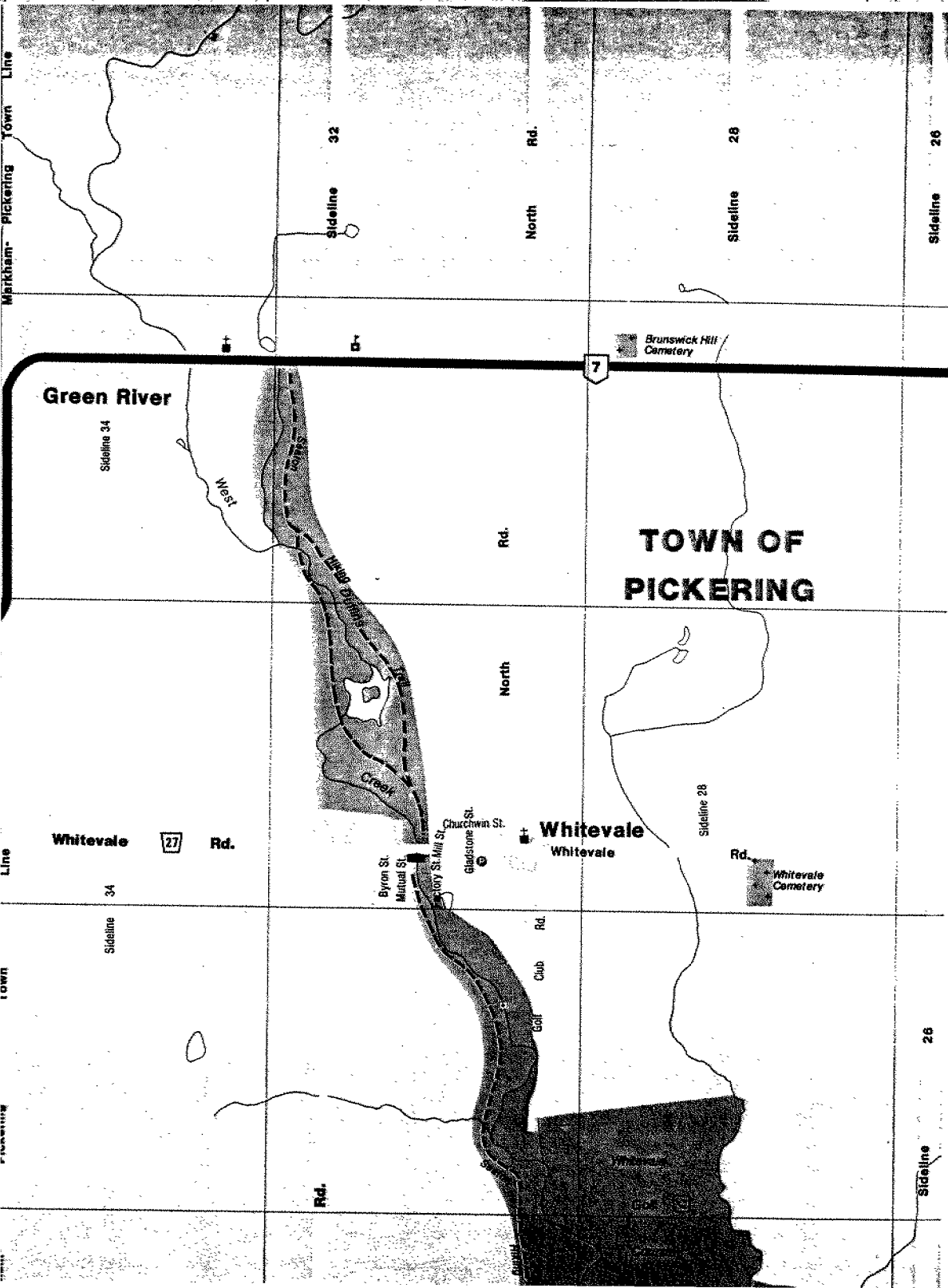
-NOTE-
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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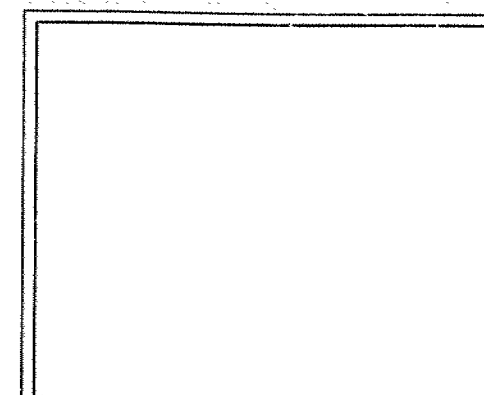


CONT No
WP No 25-69-00

FINCH AVE

SHEET

BORE HOLE LOCATIONS & SOIL STRATA



KEY PLAN

LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350ft lbs energy)
- CON Blows/ft (60° Cone, 350ft lbs energy)
- ↓ WL at time of investigation

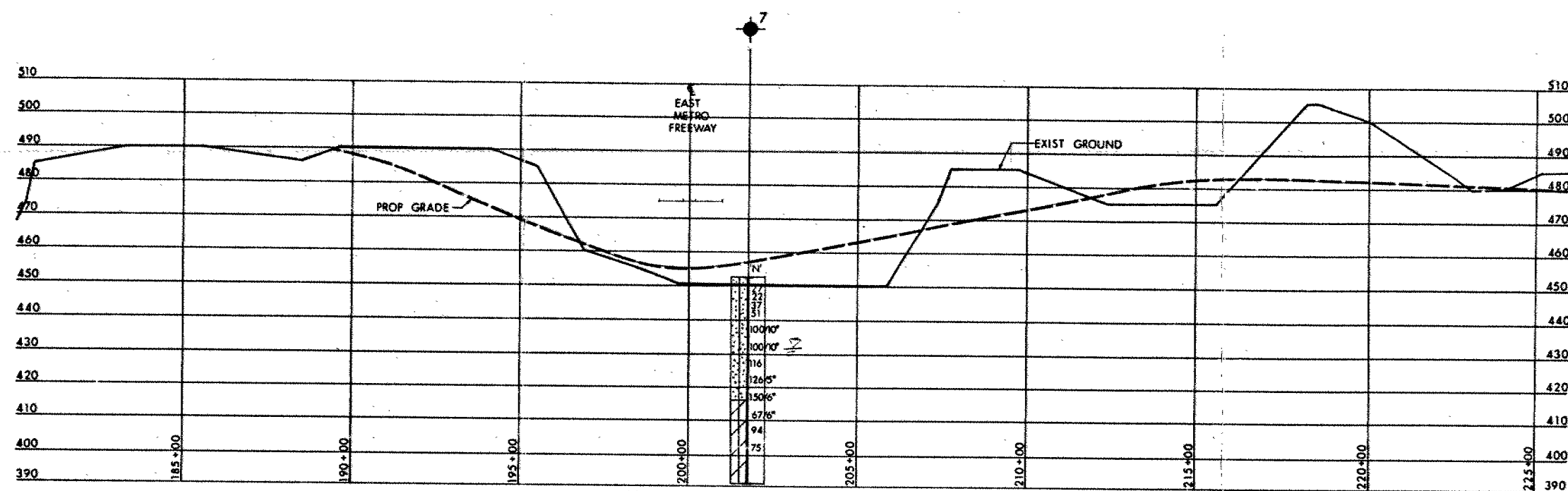
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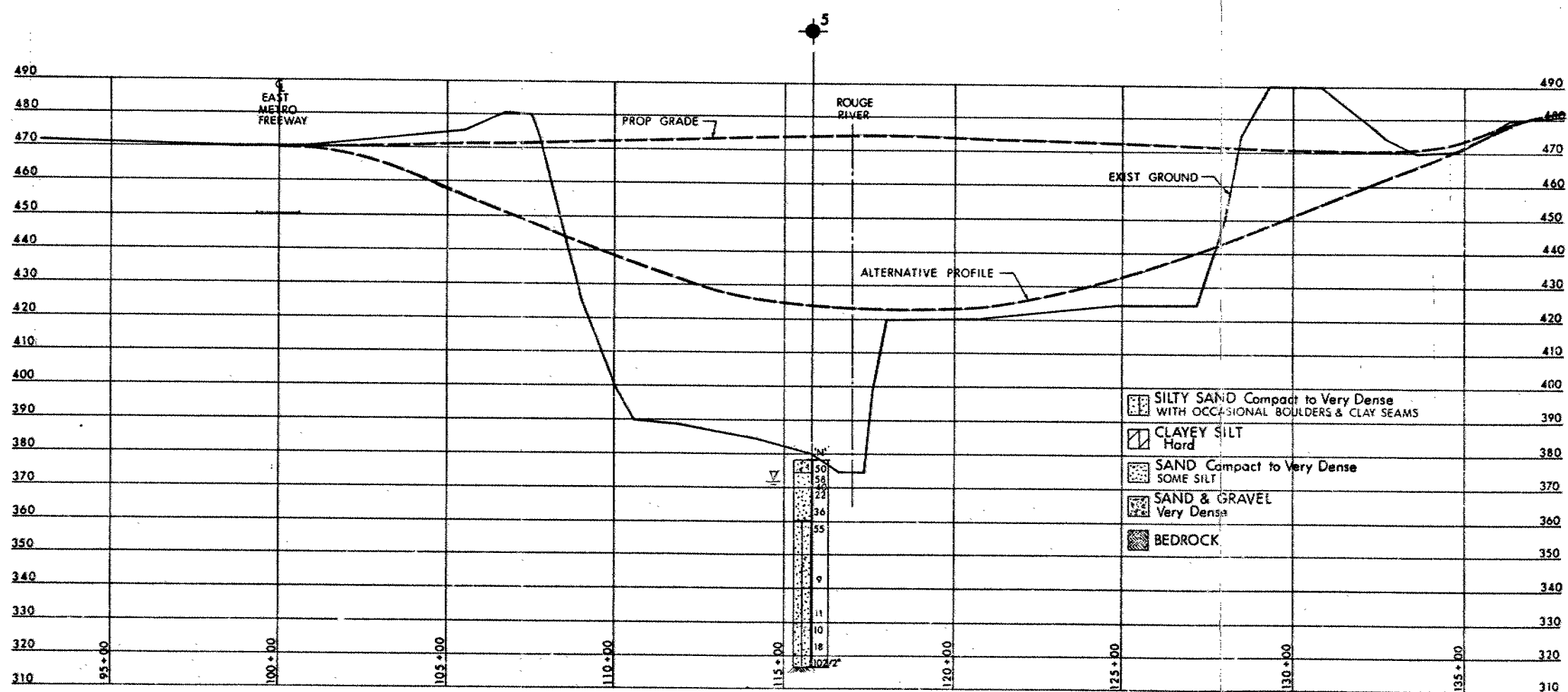
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

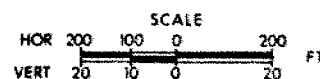
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PROFILE OF FINCH AVE SCHEME 1



PROFILE OF FINCH AVE SCHEME 2





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of
Transportation

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FOUNDATION DESIGN SECTION

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 326-88-01 DIST 6
HWY 407 STR SITE

Feasibility Study for Hwy 407
From Whitby/Oshawa Boundary to Hwy 35/115

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 326-88-01 DIST 6
HWY 407 STR SITE -

Feasibility Study for Hwy 407
From Whitby/Oshawa Boundary to Hwy 35/115

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DATE OCT 03 1994

FOUNDATION INVESTIGATION REPORT
For
Feasibility Study For Hwy 407
From Whitby/Oshawa Boundary to Hwy 35/115
W.P. 326-88-01, Central Region

INTRODUCTION

This report summarizes the results of a foundation investigation for the preliminary design study of the proposed Hwy 407 from Whitby/Oshawa boundary easterly to Hwy 35/115 in the City of Oshawa and Newcastle, Region of Durham. The investigation was carried out at the request of Central Region Structural Section.

Several routes were proposed for Hwy 407 between Whitby/Oshawa boundary and Hwy 35/115. All proposed routes were within the City of Oshawa and Town of Newcastle, except for one northerly route which extended into the Township of Manvers. However, the technically preferred route, where this foundation investigation took place, was the most southerly one, within the City of Oshawa and Town of Newcastle in the Region of Durham. The proposed technically preferred route originates at the intersection of Winchester Road and Whitby/Oshawa boundary. From that point it runs in a southeast direction, intersects Conlin Road just east of Oshawa and Newcastle boundary and then runs more or less parallel to Concession Road 6 in a zigzag manner towards the east, until it intersects Regional Road No. 42. The proposed route then runs in a northeast direction and connects to Hwy 35/115 intersection. The details of the proposed technically preferred route and structures are illustrated on Drawing No. 3268801-A.

This Foundation investigation was intended for initial assessment of the feasibility of the proposed alignment from a foundation point of view, with a general coverage of the area by limited number of boreholes.

Before initiating the Foundation investigation, a Preliminary Geotechnical Conditions report by Geocon Inc., dated July 10, 1990 was reviewed by this office (Geocon Report T11547/53425, Highway 407 Route Planning and Environmental Assessment Study, Hwy 48 to Hwy 35-115).

SITE DESCRIPTION

The site for the proposed Hwy 407 from Whitby/Oshawa boundary to Hwy 35/115 is located within the City of Oshawa and Town of Newcastle in the Region of Durham. Residential properties are primarily located along the major streets which the proposed highway would cross.

The existing ground elevation varies from 166.3m (BH P23) to 345.0m (east of BH P41, near Hwy 35/115 intersection). The proposed route is about 30.5 kilometre long (from station 9+500 to station 40+000). Between stations 31+000 and 40+000 the ground slopes down sharply from east to west at about 2.4 per cent slope (elevation drops from 345.0m to 163m). Further west of station 31+000 the ground surface is undulating, the slope ranges from 0.3 per cent to 2 per cent and the ground elevation varies from 155m and 225m.

Physiographically, the area is located in a region referred to as the "South Slope and Iroquois Plain" (Reference: Chapman and Putnam "The Physiography of Southern Ontario; 3rd Edition, 1984). This is the low land bordering Lake Ontario which was inundated in the Pleistocene time by Lake Iroquois. Subsoils in these areas generally are characterized by a mosaic of till plains, drumlins and areas of Glaciolacustrine deposits of silt, sand and clayey silt.

INVESTIGATION PROCEDURES

The field work for the investigation was carried out between 94 05 25 and 94 05 30. The investigation consisted of twenty one (21) sampled boreholes (BH P21 through P41). In general, at least one borehole was put down at each proposed major interchange. The boreholes were advanced to depths of 9.3 (BH P29) to 16.9 (BH P26).

The boreholes were advanced with three track mounted machines equipped with continuous flight augers. Conventional solid and hollow stem augers were used. The sampling program consisted of split spoon samples collected in the overburden. Soil samples were retrieved by split spoon sampler in accordance with Standard Penetration Test (ASTM D1586).

Standard Penetration 'N' values were recorded for assessment of the strength of the materials encountered. All subsoil samples were identified in the field and returned to the laboratory for further visual examination and testing. Groundwater levels were measured in each borehole and all boreholes were backfilled upon completion of the field work.

Surveying required to ascertain borehole locations and elevations was carried out by the Central Region Surveys and Plans Section.

SUBSURFACE CONDITIONS

The record of Borehole sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The location and elevation of the boreholes are shown on Drawing No. 3268801-A.

Since the investigation was spread over a large area of 30.5 kilometre (station 9+500 to 40+000), individual borehole logs should be referred to for information on soil conditions at any structure location. However, the predominant soil strata encountered at the site consisted of glacial till (made up primarily of silty clay to clayey silt and silt to silty sand). The surficial deposit at the site was generally a glacial till.

The Standard Penetration test in cohesive glacial till recorded 'N' values from 8 blows to more than 100 blows. Based on the 'N' values, the cohesive glacial till has a stiff to hard consistency. In non-cohesive glacial till the 'N' value ranged from 9 to more than 100 blows indicating the material to be loose to very dense.

GROUNDWATER CONDITIONS

Individual boreholes should be referred to for groundwater elevation at any proposed structure locations. Groundwater level was recorded in all boreholes except for Boreholes P27, P28, P39, and P41 where either the boreholes remained dry or water level couldn't be measured due to borehole collapse. The groundwater table stabilized at depths ranging from 0.7m (BH P24) to 9.1m (BH P34) below ground surface. The groundwater elevation ranged from 157.7m (BH P23) to 252.6m (BH P40). Groundwater levels are subject to seasonal fluctuations and may vary from the values provided in this report.

DISCUSSION AND RECOMMENDATIONS

General

This report contains recommendations pertaining to the structure foundations, approach embankments, cuts and hydrogeological aspects for various structures for the proposed Hwy 407 from Whitby/Oshawa boundary easterly to Hwy 35/115 in the City of Oshawa and Newcastle, Region of Durham. The recommendations given in the report are tentative based on the limited information available and should definitely be reviewed based on supplementary investigations. The site location is shown on Drawing No. 3268801-A.

Total 66 bridge structures (Structure 3 through 68) are proposed along the proposed Hwy 407 from Whitby/Oshawa boundary easterly to Hwy 35/115 in the City of Oshawa and Newcastle, Region of Durham. This includes 22 watercourse structure sites (W), 28 grade separated structure sites (GS) and 16 interchange structure sites (I).

In general, the geotechnical conditions within the proposed route corridors are favourable. There are no foundation concerns that would require realignment of the proposed Hwy 407 route from Whitby/Oshawa boundary easterly to Hwy 35/115. Subsurface conditions over the site are uniform and competent for structure foundation and embankment loadings. The glacial till is expected to provide adequate bearing for most structures and may be able to sustain low to medium loads on shallow spread footings. However, deep foundations such as caissons and piles may be required to transfer heavier loads to greater depths and to more competent bearing material. Our comments from the feasibility, design and construction of the various structures are given on the Foundation Data Sheets included in the Appendix. Twenty one data sheets (Area 21 through 41) are provided for the 66 structures; the area locations are also shown on Drawing No. 3268801-A. An explanation of information provided on the data sheet is outlined below:

1. The structure number (i.e. 03, 04, 05 etc.) are the numbers assigned to the structures for the purpose of the feasibility study. The area number such as 21, 22, 23, etc is based on the borehole numbers P21, P22, P23, etc drilled in those areas. The actual location is shown on Drawing No. 3268801-A
2. The original ground elevation is based on the survey results of the borehole locations along the proposed Hwy 407 from Whitby/Oshawa boundary easterly to Hwy 35/115 in the City of Oshawa and Newcastle, Region of Durham.

3. The grades of roadway given is based on the proposed grades of proposed Hwy 407 at the respective sites, obtained from a profile of the Technically Preferred Route supplied to us (no reference no).
4. Subsurface conditions are described very briefly and are based on generally one borehole per area.
5. Structure Foundations

The recommendations are for pier and abutment foundations. The options for structure foundations are given in preferential order based on geotechnical/economical considerations. Further elaboration of structure recommendations made on the data sheets are given below:

Compacted Granular 'A' Core (Engineered Fill) - This option is generally for abutments where subsurface conditions are competent. The minimum requirements of a compacted granular 'A' core are shown on Figure No. 1 (attached). Furthermore, the footing for this scheme could be designed using the following parameters:

Factored Bearing Capacity at U.L.S. = 900 kPa
Bearing Capacity at S.L.S. Type II = 350 kPa

Spread Footings: This option is given for abutments and piers where subsurface conditions are competent. The highest elevation and corresponding maximum design load is given. It is to be noted the spread footing should be provided with a minimum of 1.2m of earth cover for frost protection purposes. In addition, where the spread footing is to be founded on a cohesive deposit, subject to softening upon exposure to construction or weather conditions, it would be necessary to protect the base of the footing excavation from softening by placing a working slab of lean concrete immediately upon completion of the footing excavation. Also, where the footing is located in a non cohesive deposit and the water table is at or above the footing founding level, it will be necessary to prevent the base of the footing from "boiling" due to an unbalanced excess hydrostatic head. In this case a dewatering scheme would be required.

If the structure is to be designed as a rigid frame then the coefficient of earth pressure at rest (K_0) will be used.

All foundation elements should have a minimum of 1.2m earth cover for frost protection. The concrete for the footings should be placed 'in the dry'. Consequently a dewatering scheme will be required if the concrete is poured below the prevailing water level

8. Remarks

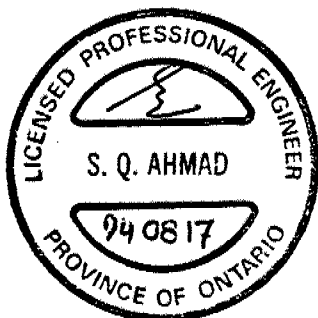
In this column comments are made about any construction difficulties, dewatering and hydrogeological concerns at any given site.

MISCELLANEOUS

The tentative foundation recommendations outlined in this report are for feasibility study or preliminary planning purposes only as they are based on very limited subsurface information. It will be necessary to carry out a detailed foundation investigation at each of the structure sites when the design details and geometries are finalized and approved. In some areas, groundwater studies and special in-situ field testing may be warranted.

The field work for this investigation was carried out under the supervision of Todd Barlow, Lori O'Malley and Tanya Cross Engineering students, using equipment owned and operated by Master Soil Investigation and Atcost Soil Drilling.

The report was prepared by K.S.Q. Ahmad, P. Eng. Foundation Engineer and reviewed and approved by D. Dundas, P. Eng. Acting Chief Foundation Engineer.



K.S.Q. Ahmad, P. Eng.
Foundation Engineer

D.H. Dundas, P. Eng.
Chief Foundation Engineer (Acting)

APPENDIX

FOUNDATION DATA SHEETS

FOUNDATION DATA SHEET

W.P. 326-88-01 AREA 21 STRUCTURE Nos. 03, 04, 05, 06 LOCATION Oshawa Creek Bridges, Thornton Road Overpasses

ORIGINAL GROUND ELEV. 172.0 m PROPOSED HWY 407 GRADE ELEV. 173.0 m, 177.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 21</u></p> <p>0.0 - 9.4 m Clayey Silt Hard (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>169.2 m</p>	<p>1.) For pier and abutments, spread footings placed within hard glacial till below elevation 171.0 m and below a frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 500 kPa - Bearing Capacity at S.L.S. Type II = 300 kPa <p>2.) For foundations at higher elevations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) Higher Bearing Capacities can be utilized at a lower depth below elevation 166.0 m.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 22 STRUCTURE Nos. 07 LOCATION Simcoe Road Underpass

ORIGINAL GROUND ELEV. 184.9 m PROPOSED HWY 407 GRADE ELEV. 182.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 22</u></p> <p>0.0 - 5.5 m Clayey Silt Hard (Glacial Till)</p> <p>5.5 - 12.6 m Silty Sand to Sandy Silt Dense to V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>181.8 m</p>	<p>1.) For abutments and piers, spread footings placed within hard glacial till below elevation 182.0 m and below a frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 600 kPa - Bearing Capacity at S.L.S. Type II = 400 kPa <p>2.) Higher Bearing Capacities can be utilized at a lower depth below elevation 176.0 m.</p>	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 23 STRUCTURE Nos. 08, 09, 10, 11 LOCATION Oshawa Creek Bridges, Ritson Road Overpasses

ORIGINAL GROUND ELEV. 166.3 m PROPOSED HWY 407 GRADE ELEV. 177.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 23</u></p> <p>0.0 - 5.5 m Silty Clay to Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p>5.5 - 9.6 m Silty Sand to Sandy Silt Dense to V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>157.7 m</p>	<p>1.) For pier and abutment foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>2.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 24 STRUCTURE Nos. 12, 13, 14 LOCATION Wilson Road, Harmony Road, Grandview Road Underpasses
 ORIGINAL GROUND ELEV. 203.2 m PROPOSED HWY 407 GRADE ELEV. 183.0 m, 200.0 m, 196.0 m Respectively
 Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>REFERENCE BOREHOLE</u> <u>P 24</u> 0.0 - 9.6 m Clayey Silt Hard (Glacial Till) <u>Groundwater Elevation</u> 202.5 m	1.) For pier and abutment foundations, spread footings placed within hard glacial till below elevation 200.0 m and below frost depth of 1.2 m may be designed for: - Factored Bearing Capacity at U.L.S. = 800 kPa - Bearing Capacity at S.L.S. Type II = Not Governed	Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.	1.) No serious foundation problems are anticipated. 2.) No major dewatering problems are anticipated. 3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 25 STRUCTURE Nos. 15 LOCATION West Townline Road Underpass

ORIGINAL GROUND ELEV. 212.3 m PROPOSED HWY 407 GRADE ELEV. 202.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 25</u></p> <p>0.0 - 13.8 m Sandy Silt to Silt V. Dense (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>211.9 m</p>	<p>1.) For abutment and pier foundations, spread footings placed within V. Dense glacial till below elevation 202.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Governed 	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) Dewatering will be required for excavation below water table. Dewatering may be limited to oversize excavation.</p> <p>3.) This is not a suitable site for an infiltration pond. Due to possible high water table after construction.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 26 STRUCTURE Nos. 16, 17 LOCATION Conlin Road, Langmaid Road Underpasses

ORIGINAL GROUND ELEV. 210.6 m PROPOSED HWY 407 GRADE ELEV. 198.0 m, 202.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 26</u></p> <p>0.0 - 9.8 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p>9.8 - 16.9 m Clayey Silt Hard (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>203.6 m</p>	<p>1.) For abutment and pier foundations, spread footings placed within V. Dense or Hard glacial till below elevation 202.0 m and below frost depth of 1.2 m may be designed for:</p> <p>- Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Governed</p>	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326-88-01 AREA 27 STRUCTURE Nos. 18, 19 LOCATION Regional Road 34 Overpasses
 ORIGINAL GROUND ELEV. 205.4 m PROPOSED HWY 407 GRADE ELEV. 213.0 m
 Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>REFERENCE BOREHOLE</u> <u>P 27</u> 0.0 - 9.6 m Silty Sand to Sandy Silt Dense to V. Dense (Glacial Till) <u>Groundwater Elevation</u> Dry	1.) For pier foundations, spread footings placed within Dense to V. Dense glacial till below elevation 204.0 m and below frost depth of 1.2 m may be designed for: - Factored Bearing Capacity at U.L.S. = 500 kPa - Bearing Capacity at S.L.S. Type II = 300 kPa 2.) For abutment foundations, spread footings can be placed on a well compacted granular 'A' pad designed for: - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa 3.) Higher bearing capacities can be utilized at a lower depth below elevation 202.0 m. 4.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.	Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.	1.) No serious foundation problems are anticipated. 2.) No major dewatering problems are anticipated. 3.) This may be a potential site for an infiltration pond, but should be verified by further investigation.

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 28 STRUCTURE Nos. 20, 21 LOCATION Farewell Creek Bridge, Solina Road Underpass

ORIGINAL GROUND ELEV. 211.1 m PROPOSED HWY 407 GRADE ELEV. 190.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 28</u></p> <p>0.0 - 12.4 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>Hole Collapsed</p>	<p>1.) For pier and abutment, spread footings placed within V. Dense glacial till below elevation 190.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Governed 	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326-88-01 AREA 29 STRUCTURE Nos. 22, 23, 24 LOCATION Solina Road Underpass, Rundle Road Overpasses
 ORIGINAL GROUND ELEV. 188.5 m PROPOSED HWY 407 GRADE ELEV. 187.0 m, 184.0 m
 Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>REFERENCE BOREHOLE</u> <u>P 29</u> 0.0 - 4.9 m Silty Sand V. Dense 4.9 - 9.3 m Clayey Silt Hard (Glacial Till) <u>Groundwater Elevation</u> 184.9 m	1.) For Abutment and pier, spread footings placed within V. Dense Silty Sand or Hard glacial till below elevation 187.0 m and below frost depth of 1.2 m may be designed for: - Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Applicable 2.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.	Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill. Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.	1.) No serious foundation problems are anticipated. 2.) No major dewatering problems are anticipated. 3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 30 STRUCTURE Nos. 25 LOCATION Holt Road Underpass

ORIGINAL GROUND ELEV. 192.6 m PROPOSED HWY 407 GRADE ELEV. 182.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 30</u></p> <p>0.0 - 12.3 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>186.5 m</p>	<p>1.) For abutment and pier, spread footings placed within V. Dense glacial till below elevation 182.0 m and below frost depth of 1.2 m may be designed for:</p> <p>- Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = Not Governed</p>	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 31 STRUCTURE Nos. 26, 27, 28, 29 LOCATION Bowmanville Creek Bridges, Old Scugog Road Overpass
 ORIGINAL GROUND ELEV. 174.4 m PROPOSED HWY 407 GRADE ELEV. 180.0 m
 Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>REFERENCE BOREHOLE</u> <p style="text-align: center;"><u>P 31</u></p> <p>0.0 - 9.8 m Silty Clay to Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>173.9 m</p>	<p>1.) For abutment and pier foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>2.) Higher bearing capacities can be utilized at a lower depth below elevation 170.0 m.</p> <p>3.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326-88-01 AREA 32 STRUCTURE Nos. 30, 31, 32, 33, 34, 35, 36, 37 LOCATION Regional Road 57, Cedar Park Road and Creek Structures

ORIGINAL GROUND ELEV. 172.9 m PROPOSED HWY 407 GRADE ELEV. 182.0 m, 184.0 m, 187.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 32</u></p> <p>0.0 - 9.6 m Silty Clay Firm to Hard</p> <p><u>Groundwater Elevation</u></p> <p>168.5 m</p>	<p>1.) For abutment and pier foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) For higher bearing capacities this structure can be supported on deep foundations. If deep foundations are considered, further investigation will be required.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 33 STRUCTURE Nos. 38, 39, 40, 41 LOCATION Middle Road and Creek East of Middle Road Structures

ORIGINAL GROUND ELEV. 178.2 m PROPOSED HWY 407 GRADE ELEV. 187.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 33</u></p> <p>0.0 - 2.4 m Silty Sand Loose</p> <p>2.4 - 9.8 m Silty Clay to Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>177.9 m</p>	<p>1.) For abutment and pier foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>2.) For higher bearing capacity, piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability and the water table is high.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 34 STRUCTURE Nos. 42 LOCATION Regional Road 14 Underpass

ORIGINAL GROUND ELEV. 188.4 m PROPOSED HWY 407 GRADE ELEV. 186.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 34</u></p> <p>0.0 - 4.0 m Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p>4.0 - 7.0 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p>7.0 - 12.6 m Silty Clay to Clayey Silt V. Stiff to Hard (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>179.3 m</p>	<p>1.) For pier foundations, spread footings placed within V. Stiff to Hard glacial till below elevation 186.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 650 kPa - Bearing Capacity at S.L.S. Type II = 400 kPa <p>2.) For abutment foundation, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 35 STRUCTURE Nos. 43, 44, 45, 46, 47, 48 LOCATION Clemens Road, Mackie Creek and Bethesda Road Structures

ORIGINAL GROUND ELEV. 184.4 m PROPOSED HWY 407 GRADE ELEV. 185.0 m, 189.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 35</u></p> <p>0.0 - 9.8 m Silty Sand to Sandy Silt V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>182.0 m</p>	<p>1.) For pier foundations, spread footings placed within V. Dense glacial till below elevation 183.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 750 kPa - Bearing Capacity at S.L.S. Type II = 500 kPa <p>2.) For abutment foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) For higher bearing capacities, piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 36 STRUCTURE Nos. 49, 50, 51, 52, 53 LOCATION Acres Road, Cole Road and Soper Creek Structures
 ORIGINAL GROUND ELEV. 171.9 m PROPOSED HWY 407 GRADE ELEV. 188.0 m, 180.0 m
 Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<u>REFERENCE BOREHOLE</u> <u>P 36</u> 0.0 - 9.6 m Silty Sand Compact to V. Dense (Glacial Till) <u>Groundwater Elevation</u> 166.2 m	1.) For abutment and pier foundations, spread footings can be placed on a well compacted granular 'A' pad designed for: - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa 2.) Piles and caissons are also feasible, but should be selected on a cost comparison basis. If this option is selected, further investigation would be required.	Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.	1.) No serious foundation problems are anticipated. 2.) No major dewatering problems are anticipated. 3.) This may be a potential site for an infiltration pond. Further investigation will be required to prove this site to be suitable for an infiltration pond.

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 37 STRUCTURE Nos. 54, 55 LOCATION Darlington Town Line Road and Brown Road Structures

ORIGINAL GROUND ELEV. 191.0 m PROPOSED HWY 407 GRADE ELEV. 187.0 m, 197.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 37</u></p> <p>0.0 - 7.0 m Silty Sand to Sandy Silt V. Dense</p> <p>7.0 - 10.8 m Clayey Silt Hard (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>184.0 m</p>	<p>1.) For pier and abutment foundations, spread footings placed within V. Dense glacial till below elevation 187.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 1000 kPa - Bearing Capacity at S.L.S. Type II = 500 kPa <p>2.) For pier and abutment foundations at higher elevations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) For Higher bearing capacities, piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p> <p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slope. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This may be a potential site for an infiltration pond. The permeability of the soil is low to medium. Further study will be required to determine if the site is suitable for an infiltration pond.</p>

FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 38 STRUCTURE Nos. 56, 57, 58, 59, 60, 61 LOCATION Mosport Road, Wilmot Creek and Leskard Road Structures

ORIGINAL GROUND ELEV. 202.3 m PROPOSED HWY 407 GRADE ELEV. 204.0 m, 209.0 m
Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p><u>P 38</u></p> <p>0.0 - 9.5 m Silty Sand Compact to V. Dense (Glacial Till)</p> <p><u>Groundwater Elevation</u></p> <p>195.1 m</p>	<p>1.) For pier foundations, spread footings placed within Compact to V. Dense glacial till below elevation 201.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 500 kPa - Bearing Capacity at S.L.S. Type II = 300 kPa <p>2.) For pier and abutment foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>3.) For higher bearing capacities, piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This may be a potential site for an infiltration pond. Further investigation would be required to confirm this.</p>

FOUNDATION DATA SHEET

W.P. 326-88-01 AREA 39 STRUCTURE Nos. 62 LOCATION Best Road Structures

ORIGINAL GROUND ELEV. 244.4 m PROPOSED HWY 407 GRADE ELEV. 238.5 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 39</u></p> <p>0.0 - 12.3 m Silty Sand to Sandy Silt Compact to V. Dense (Glacial Till)</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>Not Established</p>	<p>1.) For pier and abutment foundations, spread footings placed within Dense to V. Dense glacial till below elevation 238.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 650 kPa - Bearing Capacity at S.L.S. Type II = 400 kPa <p>2.) Higher bearing capacities can be utilized at a lower depth below elevation 237.0 m.</p> <p>3.) Piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slopes. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) May be a candidate site for an infiltration pond. Further investigation will be required to prove this.</p>

FOUNDATION DATA SHEET

W.P. 326-88-01 AREA 40 STRUCTURE Nos. 63, 64, 65, 66 LOCATION A Creek East of Best Road and Concession Road 8 Structures

ORIGINAL GROUND ELEV. 255.9 m PROPOSED HWY 407 GRADE ELEV. 250.0 m, 259.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 40</u></p> <p>0.0 - 4.0 m Clayey Silt Stiff (Glacial Till)</p> <p>4.0 - 9.6 m Silt to Silty Sand V. Dense</p> <p style="text-align: center;"><u>Groundwater Elevation</u></p> <p>252.6 m</p>	<p>1.) For pier foundations, spread footings placed within V. Dense Silt to Silty Sand below elevation 250.0 m and below frost depth of 1.2 m may be designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 300 kPa <p>2.) For pier and abutment foundations at higher elevations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa 	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p> <p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slopes. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) Dewatering will be required for excavation below water table in non cohesive material</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability and the water table is likely to remain high after construction.</p>

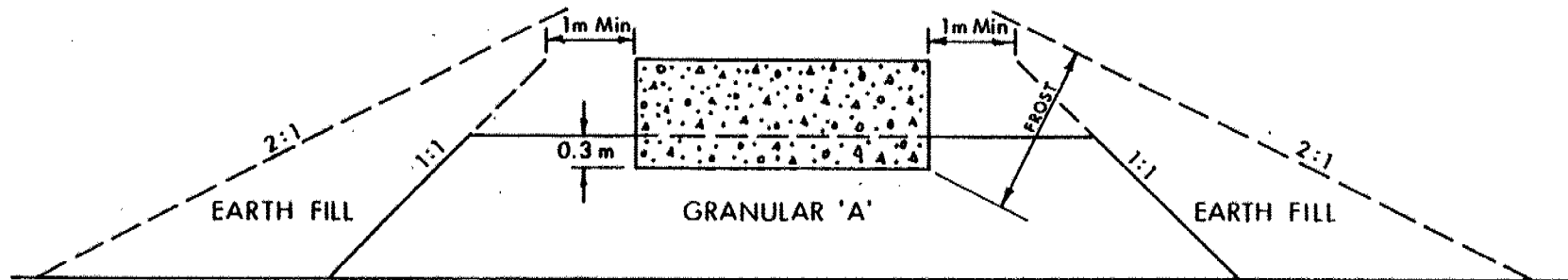
FOUNDATION DATA SHEET

W.P. 326 - 88 - 01 AREA 41 STRUCTURE Nos. 67, 68 LOCATION Skelding Road Structure, Hwy 35/115 Underpass

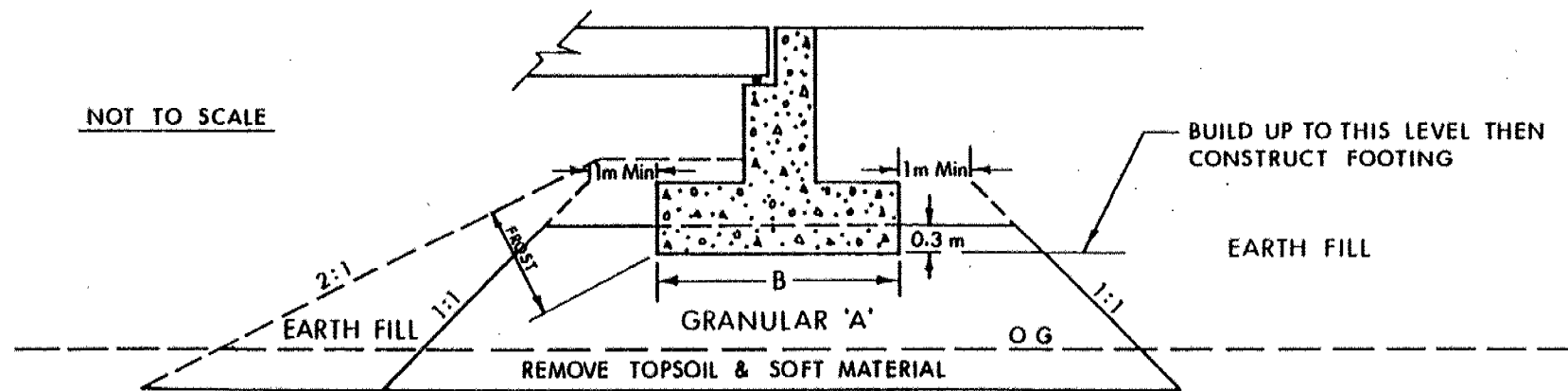
ORIGINAL GROUND ELEV. 319.0 m PROPOSED HWY 407 GRADE ELEV. 310.0 m, 337.0 m

Reference:

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>REFERENCE BOREHOLE</u></p> <p style="text-align: center;"><u>P 41</u></p> <p>0.0 - 5.5 m Silty Clay to Clayey Silt V. Stiff to Hard</p> <p>5.5 - 9.8 m Silt to Silty Sand V. Dense</p> <p><u>Groundwater Elevation</u></p> <p>Not Established</p>	<p>1.) For abutment and pier foundations, spread footings can be placed on a well compacted granular 'A' pad designed for:</p> <ul style="list-style-type: none"> - Factored Bearing Capacity at U.L.S. = 900 kPa - Bearing Capacity at S.L.S. Type II = 350 kPa <p>2.) For higher bearing capacities, piles and caissons are also feasible, but should be selected on a cost comparison basis.</p>	<p>Fill up to 8 m high can be constructed at 2 H : 1 V side slopes. A mid height berm would be required for higher fill.</p> <p>Cuts up to 6 m deep will be stable at 2 H : 1 V side slopes. A berm would be required for deeper cuts.</p>	<p>1.) No serious foundation problems are anticipated.</p> <p>2.) No major dewatering problems are anticipated.</p> <p>3.) This is not a suitable site for an infiltration pond. The soil is of low permeability.</p>



X SECTION



LONGITUDINAL SECTION

NOTES:

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T O STANDARDS.
- 3 - CONSTRUCT CONCRETE FOOTING.
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.



RECORD OF BOREHOLE No P21

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 868 931.8, E 351 038.5 ORIGINATED BY LO
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem / Hollow Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 30 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	W _p	W	W _L		
172.0	Ground Surface																
0.0	Clayey Silt Some Sand, Trace Gravel Hard (Glacial Till)		1	SS	31												
	Sandy Silt		2	SS	31												
			3	SS	41												
			4	SS	57												
			5	SS	104												
162.5			6	SS	120												
9.4	End of Borehole																

RECORD OF BOREHOLE No P22

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 869 896.0, E 352 482.8 ORIGINATED BY LO
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem / Hollow Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 26 CHECKED BY KA

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
184.9	Ground Surface																
0.0	Clayey Silt Some Sand, Trace Gravel Hard (Glacial Till)		1	SS	74												
179.4			2	SS	100												
5.5			3	SS	39												
	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Dense to V. Dense (Glacial Till)		4	SS	41												
			5	SS	108												
			6	SS	100												
172.3			7	SS	101												
12.6	End of Borehole																

RECORD OF BOREHOLE No P23

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 869 724.6, E 354 258.5 ORIGINATED BY LO
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 27 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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
186.3	Ground Surface																
0.0	Silty Clay to Clayey Silt Some Sand, Trace Gravel V. Stiff to Hard (Glacial Till)		1	SS	16												
			2	SS	52												
160.8			3	SS	27												
5.5	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Dense to V. Dense (Glacial Till)		4	SS	76												
			5	SS	48												
156.7			6	SS	53												
9.6	End of Borehole																

RECORD OF BOREHOLE No P24

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 869 574.1, E 356 028.6 ORIGINATED BY LO
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 27 CHECKED BY KA

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W		
203.2	Ground Surface															
0.0																
	Clayey Silt Some Sand, Trace Gravel Hard (Glacial Till)		1	SS	44											
			2	SS	78											
			3	SS	120											
			4	SS	85											
			5	SS	104											
			6	SS	105											
193.6	End of Borehole															
9.8																

RECORD OF BOREHOLE No P26

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coors.: N 4 869 399.7, E 359 124.9 ORIGINATED BY LO
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 25 CHECKED BY KA

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
210.8	Ground Surface																
0.0																	
	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel V. Dense (Glacial Till)		1	SS	136		210										
							208										
							206										
			2	SS	150		204										
							202										
200.8			3	SS	138												
			4	SS	150	/15cm											
9.8							200										
	Clayey Silt Some Sand, Some Gravel Hard (Glacial Till)		5	SS	150	/18cm											
			6	SS	150	/18cm	198										
			7	SS	138		196										
			8	SS	150	/15cm											
193.6			9	SS	150	/15cm	194										
16.9	End of Borehole																

RECORD OF BOREHOLE No P27

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 889 259.2, E 360 032.5 ORIGINATED BY LO
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem / Hollow Stem COMPILED BY LO
 DATUM G odetic DATE 1994 05 30 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	W _p	W			W _L
205.4	Ground Surface																
0.0	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Dense to V. Dense (Glacial Till)		1	SS	33												
			2	SS	105												
			3	SS	150												
			4	SS	89												
			5	SS	70												
195.8			6	SS	116												
9.6	End of Borehole																

METRIC

[illegible]

RECORD OF BOREHOLE No P29

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 869 697.3, E 362 491.2 ORIGINATED BY TC
DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
DATUM Geodetic DATE 1994 05 26 CHECKED BY KA



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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
188.5	Ground Surface															
0.0																
	Silty Sand Trace of Clay, Trace of Gravel V. Dense		1	SS	185											
183.6																
4.9			2	SS	189											
	Clayey Silt Some Sand, Trace Gravel Hard (Glacial Till)		3	SS	140											
179.2			4	SS	128											
9.3	End of Borehole															

RECORD OF BOREHOLE No P30

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 870 650.8 E 363 911.5 ORIGINATED BY TC
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 26 CHECKED BY KA

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20 40 60 80 100										10 20 30		
192.8	Ground Surface																			
0.0	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Pockets of Gravelly Sand V. Dense (Glacial Till)		1	SS	120	/15cm														
			2	SS	120															
			3	SS	90	/15cm														
			4	SS	160	/15cm														
180.3					5	SS	157	/15cm												
12.3	End of Borehole																			

RECORD OF BOREHOLE No P31

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coor. N 4 871 079.4, E 364 649.2 ORIGINATED BY TC
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 27 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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		
174.4	Ground Surface																
0.0	Silty Clay to Clayey Silt Some Sand, Trace Gravel V. Stiff to Hard (Glacial Till) Lacustrine		1	SS	25												
			2	SS	42												
			3	SS	55												
			4	SS	55												
			5	SS	128												
			6	SS	122												
164.8	End of Borehole																

RECORD OF BOREHOLE No P32

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 871 347.3, E 365 431.0 ORIGINATED BY TC
DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
DATUM Geodetic DATE 1994 05 30 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			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	W _p	W		
172.9	Ground Surface															
0.0																
	Silty Clay Trace of Sand, Trace of Gravel		1	SS	19											
			2	SS	43											
	Stiff to Hard		3	SS	13											
	Firm		4	SS	6											
			5	SS	5											
163.3			6	SS	8											
9.6	End of Borehole															

RECORD OF BOREHOLE No P33

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 871 673.1, E 367 022.7 ORIGINATED BY TC & VB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 27 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	W _p	W	W _L		
178.2	Ground Surface																
0.0	Silty Sand Trace of Clay. With Some Gravel (Glacial Till)		1	SS	9												
175.8																	
2.4			2	SS	47												
	Silty Clay to Clayey Silt Same Sand, Trace Gravel V. Stiff to Hard (Glacial Till)		3	SS	37												
			4	SS	23												
			5	SS	38												
168.6			6	SS	21												
9.6	End of Borehole																

RECORD OF BOREHOLE No P34

1 OF 1

METRIC

W.P. 328-88-01 LOCATION Coords.: N 4 871 786.0, E 367 844.0 ORIGINATED BY TC
 DIST 8 HWY 407 BOREHOLE TYPE Hollow Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 30 CHECKED BY KA

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
188.4	Ground Surface																
0.0	Clayey Silt Some Sand, Trace of Gravel V. Stiff to Hard (Glacial Till)		1	SS	19		188										
184.4			2	SS	41		186										
4.0	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel V. Dense (Glacial Till)		3	SS	55		184										
181.4			4	SS	90		182										
7.0	Silty Clay to Clayey Silt Some Sand, Trace of Gravel V. Stiff to Hard (Glacial Till)		5	SS	38		180										
			6	SS	29		178										
			7	SS	42												
175.8			8	SS	164	/25cm	176										
12.6	End of Borehole																

RECORD OF BOREHOLE No P35

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 872 244.1 E 369 422.3 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 25 CHECKED BY KA

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 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									
								SHEAR STRENGTH kPa									
								• UNCONFINED	+ FIELD VANE								
								• QUICK TRIAXIAL	* LAB VANE								
								20 40 60 80 100									

RECORD OF BOREHOLE No P36

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 873 130.2 E 370 875.9 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 25 CHECKED BY KA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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
171.9	Ground Surface																
0.0	Silty Sand Trace of Clay, Trace of Gravel Compact to V. Dense (Glacial Till)		1	SS	18												
			2	SS	48												
			3	SS	63												
			4	SS	63												
			5	SS	28												
162.3			6	SS	20												
9.6	End of Borehole																

RECORD OF BOREHOLE No P37

1 OF 1

METRIC

W.P. 326-88-01

LOCATION Coords.: N 4 873 565.4, E 371 610.1

ORIGINATED BY TB

DIST 6 HWY 407

BOREHOLE TYPE Solid Stem

COMPILED BY LO

DATUM Geodetic

DATE 1994 05 26

CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			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	W _p	W	W _L		
191.0	Ground Surface																
0.0																	
	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel V. Dense		1	SS	195												
184.0			2	SS	54												
7.0																	
	Clayey Silt Some Sand, Trace of Gravel Hard (Glacial Till)		3	SS	185	28cm											
			4	SS	120	13cm											
180.2																	
			5	SS	117	15cm											
10.8	End of Borehole																

RECORD OF BOREHOLE No P38

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 874 708.1, E 373 460.3 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 26 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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		
202.3	Ground Surface																
0.0	Silty Sand Trace of Clay, Trace of Gravel Occasional Pockets of Gravel Compact to V. Dense (Glacial Till)		1	SS	30												
			2	SS	28												
			3	SS	35												
			4	SS	46												
			5	SS	33												
192.8			6	SS	92												
9.5	End of Borehole																

RECORD OF BOREHOLE No P39

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 875 662.9, E 374 279.7 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 30 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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		
244.4	Ground Surface																
0.0						*	244										
	Silty Sand to Sandy Silt Trace of Clay, Trace of Gravel Occasional Layers of Gravely Sand Compact to V. Dense (Glacial Till)		1	SS	18		242										
							240										
			2	SS	37		238										
			3	SS	120		236										
	Sandy Gravel		4	SS	99		234										
			5	SS	120	/12cm											
232.0			6	SS	123	/15cm											
12.3	End of Borehole																
	* Ground Water Not Established																

RECORD OF BOREHOLE No P40

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 878 521.2, E 374 481.4 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 26 CHECKED BY KA

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
255.9	Ground Surface																
0.0	Clayey Silt Some Sand, Traces of Gravel (Glacial Till)		1	SS	11		254										
252.0			2	SS	8		252										
4.0	Silt to Silty Sand V. Dense		3	SS	48		250										
			4	SS	94		248										
			5	SS	25												
246.3			6	SS	57												
9.6	End of Borehole																

RECORD OF BOREHOLE No P41

1 OF 1

METRIC

W.P. 326-88-01 LOCATION Coords.: N 4 878 682.4, E 374 562.7 ORIGINATED BY TB
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem COMPILED BY LO
 DATUM Geodetic DATE 1994 05 30 CHECKED BY KA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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	W _p	W	W _L		
319.0	Ground Surface																
0.0	Silty Clay to Clayey Silt Some Sand, Traces of Gravel V. Stiff to Hard		1	SS	26												
	Silty Sand		2	SS	17												
313.6			3	SS	24												
5.5	Silt to Silty Sand V. Dense		4	SS	49												
			5	SS	46												
309.4			6	SS	144												
9.8	End of Borehole																
	• Ground Water Not Established																

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 (R Q D), 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

MECHANICAL PROPERTIES OF SOIL

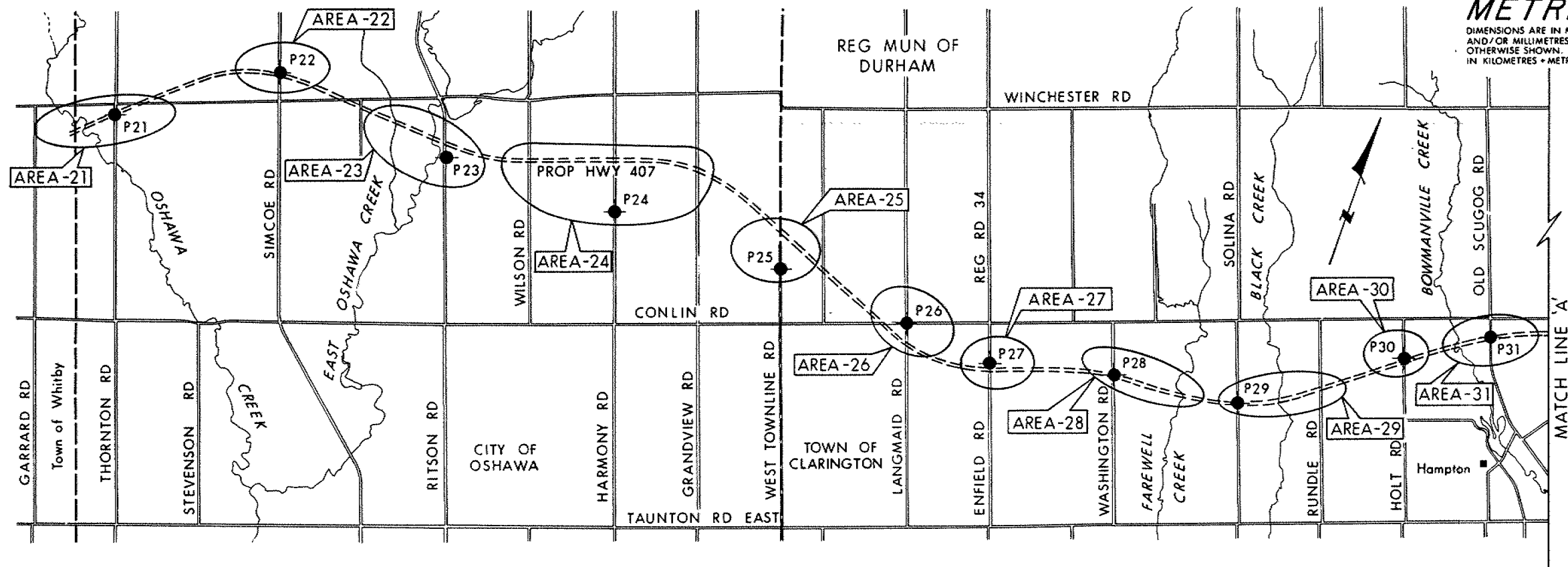
m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
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 = $\frac{c_u}{\tau_r}$

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

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^3/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						



PLAN
SCALE
500m 0 500m

NOTE
For Soil Details Refer to
Record of Borehole Sheets

AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
21	P21	3	OSHAWA CREEK BRIDGE WBL (W)
		4	OSHAWA CREEK BRIDGE EBL (W)
		5	THORNTON RD OVERPASS WBL (I)
		6	THORNTON RD OVERPASS EBL (I)
22	P22	7	SIMCOE RD UNDERPASS (I)
23	P23	8	EAST OSHAWA CREEK BRIDGE WBL (W)
		9	EAST OSHAWA CREEK BRIDGE EBL (W)
		10	RITSON RD OVERPASS -ALT A (GS)
		11	RITSON RD OVERPASS -ALT A (GS)
24	P24	12	WILSON RD UNDERPASS-ALT A (GS)
		13	HARMONY RD UNDERPASS-ALT A (I)
		14	GRANDVIEW RD UNDERPASS-ALT A (GS)
25	P25	15	WEST TOWNLINE RD UNDERPASS -ALT A (I)
26	P26	16	CONLIN RD UNDERPASS -ALT A (GS)
		17	LANGMAID RD UNDERPASS -ALT A (GS)

LEGEND

W - WATERCOURSE STRUCTURE SITES
GS - GRADE SEPARATED STRUCTURE SITES
I - INTERCHANGE STRUCTURE SITES

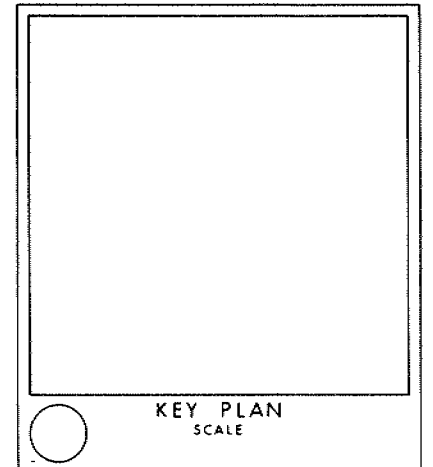
AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
27	P27	18	REGIONAL RD 34 OVERPASS WBL-ALT A (I)
		19	REGIONAL RD 34 OVERPASS EBL-ALT A (I)
28	P28	20	FAREWELL CREEK BRIDGE WBL (W)
		21	FAREWELL CREEK BRIDGE EBL (W)
29	P29	22	SOLINA RD UNDERPASS (GS)
		23	RUNDLE RD OVERPASS WBL (I)
		24	RUNDLE RD OVERPASS EBL (I)
30	P30	25	HOLT RD UNDERPASS (GS)
31	P31	26	BOWMANVILLE CREEK BRIDGE WBL (W)
		27	BOWMANVILLE CREEK BRIDGE EBL (W)
		28	OLD SCUGOG RD OVERPASS WBL (GS)
		29	OLD SCUGOG RD OVERPASS EBL (GS)

CONT No
WP No 326-88-01

FEASIBILITY STUDY FOR HWY 407
FROM WHITBY/OSHAWA BOUNDARY
TO HWY 35/115
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



KEY PLAN
SCALE

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 1994 05

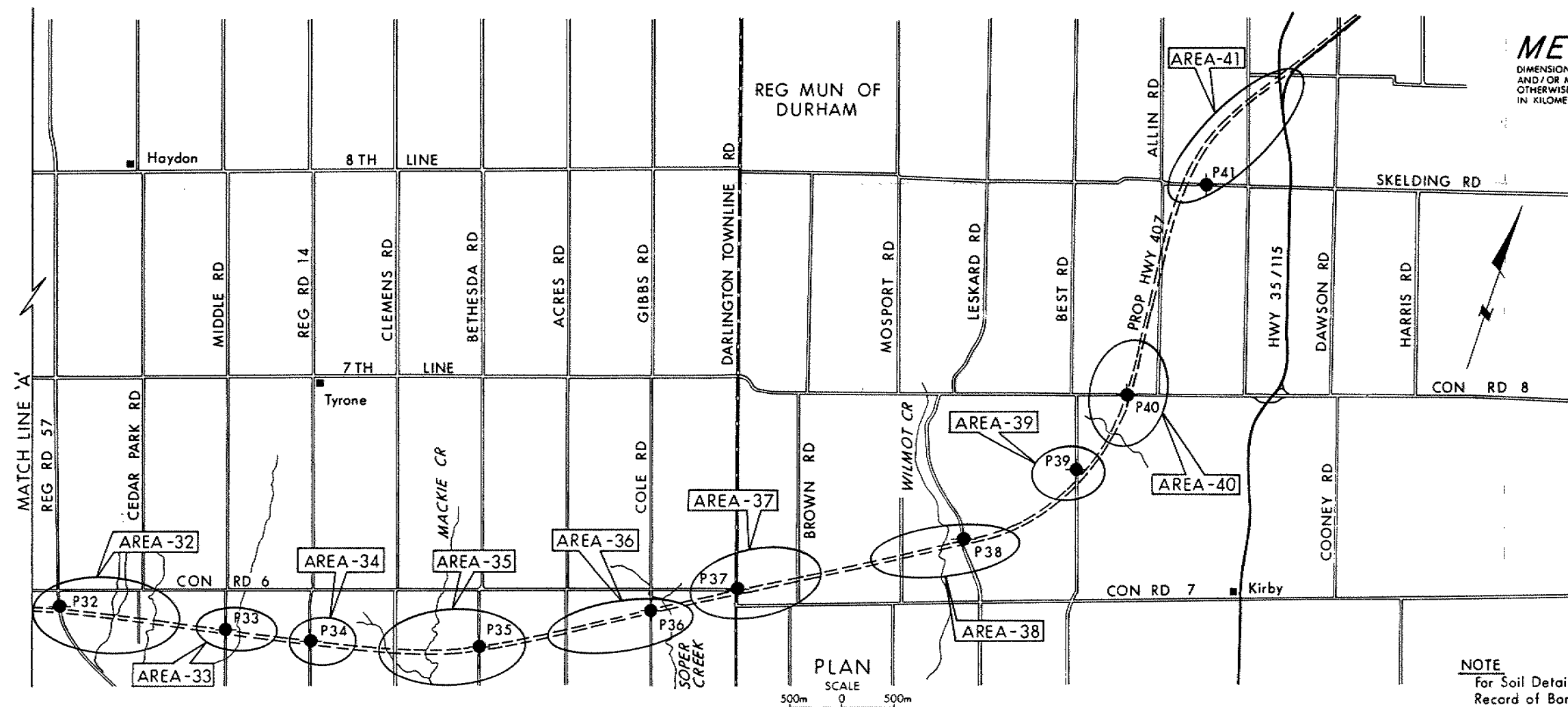
No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
P21	172.0	4 868 931.8	351 038.5
P22	184.9	4 869 896.0	352 482.8
P23	166.3	4 869 724.6	354 258.5
P24	203.2	4 869 574.1	356 028.6
P25	213.2	4 869 427.6	357 821.1
P26	210.6	4 869 399.7	359 124.9
P27	205.4	4 869 259.2	360 032.5
P28	211.1	4 869 551.5	361 241.7
P29	188.5	4 869 697.3	362 491.2
P30	192.6	4 870 650.8	363 911.5
P31	174.4	4 871 079.4	364 649.2

NOTE

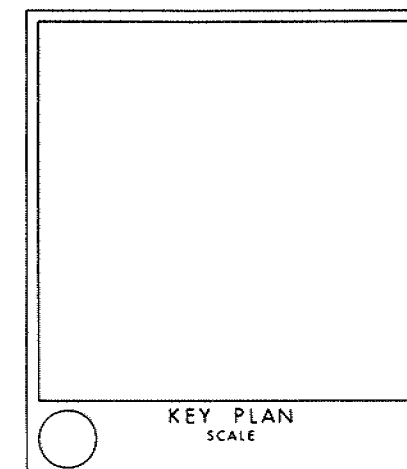
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen Cond

REV.	DATE	BY	DESCRIPTION
1			
Geocres No 30M15-85			
HWY No 407		DIST 6	
SUBMD KA		DATE 1994 08 08	
CHECKED		SITE	

**METRIC**DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.CONT No
WP No 326-88-01FEASIBILITY STUDY FOR HWY 407
FROM WHITBY/OSHAWA BOUNDARY
TO HWY 35/115
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation 1994.05

NOTE
For Soil Details Refer to
Record of Borehole Sheets

AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
32	P32	30	REGIONAL RD 57 OVERPASS WBL (I)
		31	REGIONAL RD 57 OVERPASS EBL (I)
		32	CREEK EAST OF REG RD 57 BRIDGE WBL (W)
		33	CREEK EAST OF REG RD 57 BRIDGE EBL (W)
		34	CEDAR PARK RD OVERPASS WBL (GS)
		35	CEDAR PARK RD OVERPASS EBL (GS)
		36	CREEK EAST OF CEDAR PARK RD BRIDGE WBL (W)
33	P33	37	CREEK EAST OF CEDAR PARK RD BRIDGE EBL (W)
		38	MIDDLE RD OVERPASS WBL (GS)
		39	MIDDLE RD OVERPASS EBL (GS)
		40	CREEK EAST OF MIDDLE RD BRIDGE WBL (W)
34	P34	41	CREEK EAST OF MIDDLE RD BRIDGE EBL (W)
35	P35	42	REGIONAL RD 14 UNDERPASS (I)
		43	CLEMENS RD OVERPASS WBL (GS)
		44	CLEMENS RD OVERPASS EBL (GS)
		45	MACKIE CREEK BRIDGE WBL (W)
		46	MACKIE CREEK BRIDGE EBL (W)
		47	BETHESDA RD OVERPASS WBL (I)
		48	BETHESDA RD OVERPASS EBL (I)

LEGEND

W - WATERCOURSE STRUCTURE SITES
GS - GRADE SEPARATED STRUCTURE SITES
I - INTERCHANGE STRUCTURE SITES

AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
36	P36	49	ACRES RD UNDERPASS (GS)
		50	COLE RD OVERPASS WBL (GS)
		51	COLE RD OVERPASS EBL (GS)
		52	SOPER CREEK BRIDGE WBL (W)
37	P37	53	SOPER CREEK BRIDGE EBL (W)
		54	DARLINGTON TOWNLINE RD U'PASS (I)
38	P38	55	BROWN RD UNDERPASS (GS)
		56	MOSPORT RD OVERPASS WBL (GS)
		57	MOSPORT RD OVERPASS EBL (GS)
		58	WILMOT CREEK BRIDGE WBL (W)
		59	WILMOT CREEK BRIDGE EBL (W)
		60	LESKARD RD OVERPASS WBL (GS)
		61	LESKARD RD OVERPASS EBL (GS)
39	P39	62	BEST RD UNDERPASS (GS)
40	P40	63	CREEK EAST OF BEST RD BRIDGE WBL (W)
		64	CREEK EAST OF BEST RD BRIDGE EBL (W)
		65	CON RD 8 OVERPASS WBL (GS)
		66	CON RD 8 OVERPASS EBL (GS)
41	P41	67	SKELDING RD UNDERPASS (GS)
		68	HWY 35/115 UNDERPASS (I)

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen Cond

REV	DATE	BY	DESCRIPTION

Geocres No 30M15-85

HWY No 407	DIST 6
SUBNO KA	CHECKED
DATE 1994 08 08	SITE
DRAWN DT	CHECKED
APPROVED	DWG 3268801-8



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Transportation

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FOUNDATION DESIGN SECTION

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FOUNDATION DESIGN SECTION

WP 282-86-01

DIST 6

HWY 407

STR SITE

Preliminary Design Study for Proposed Hwy. 407
From Hwy. 48 to Whitby/Oshawa Boundary

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 282-86-01

DIST 6

HWY 407

STR SITE

Preliminary Design Study for Proposed Hwy. 407
From Hwy. 48 to Whitby/Oshawa Boundary

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FOUNDATION INVESTIGATION REPORT
For
Preliminary Design Study For
Proposed Hwy 407
From Hwy 48 to Whitby/Oshawa Boundary
W.P. 282-86-01, District 6, Toronto

INTRODUCTION

This report summarizes the results of our foundation investigation carried out for the preliminary design study of the proposed Hwy 407 at the above location. This investigation is intended for initial assessment of the feasibility of the proposed alignment from a foundation point of view, with a general coverage of the area by limited number of boreholes. The recommendations given in the report are tentative based on the limited information available and should definitely be reviewed based on supplementary investigations.

Fieldwork was carried out during the period of 93 12 06 to 94 01 12 and is consisted of a total of fifteen (15) sampled boreholes advanced to depths ranging from 10.8 to 27.9 m below ground surface. A desk study carried out before the commencement of the fieldwork has revealed borehole information from existing reports that are relevant to the current design alignment. This information has been extracted and incorporated in this report.

SITE DESCRIPTION

The area investigated extends from the east end of the Town of Markham through the Town of Pickering to the east boundary of the Town of Whitby. The alignment of the proposed Hwy 407 in this area runs more or less in an east-west direction in the vicinity of Hwy 7. It is located within one km south of the existing Hwy 7 from Hwy 48 to around Sideline 16 in Pickering where it cuts across Hwy 7. From there on, it is located within one km approximately north of Hwy 7. It then runs south and intersects Hwy 7 again just east of Cochrane St. in Whitby. From this point on, it stays within one km south of Hwy 7/Winchester Road through the east end of Whitby. The proposed route is illustrated in Drawing Nos. 2828601-A & B.

The existing ground elevation varies from 180 \pm m at Hwy 48 to 225 \pm m just east of Sideline 24 and dips from there to 140 \pm m at Duffins Creek. The grade elevation then goes up easterly to 200 \pm m just east of Kinsale Road and smooths off gently to 170 \pm m at the east end of Whitby. The topography of the terrain is generally flat to undulating, except at major river or creek locations where relatively deep valleys can be found.

Most of the land along the proposed highway alignment has been cleared and cultivated. Other land use such as residential and commercial developments may be found in towns and along major roads.

Physiographically, the area is located in two regions known as the Peel Plain and South Slope (after Chapman & Putnam, 1984). These regions generally comprise glacial till deposits containing shale and limestone, with lacustrine clay and silt probably reworked by the glacier.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in-situ and laboratory testing. The procedures employed are discussed below.

Field

The field work for the investigation was carried out between 93 12 06 and 94 01 12 and consisted of fifteen (15) sampled boreholes with dynamic cone penetration tests. The boreholes were advanced to depths of 10.8 - 27.9 m.

The boreholes were advanced with a truck mounted machine equipped with continuous flight augers. Conventional hollow stem or solid stem augers were used supplemented by washboring with BW size casings in some boreholes. The sampling program consisted of split spoon samples collected in the overburden. Disturbed subsoil samples were retrieved by split spoon sampler in accordance with Standard Penetration Test (ASTM D1586). Standard Penetration ('N') values were recorded for assessment of the strength of the materials encountered. All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing. Dynamic Cone Penetration tests were carried out adjacent to each borehole. Groundwater levels were measured in each borehole and all boreholes were backfilled upon completion of the field work.

Surveying required to ascertain borehole locations and elevations was carried out by the Central Region Surveys and Plans Section.

Laboratory

The laboratory testing on selected soil samples consisted of the following:

- Atterberg Limit Test
- Grain Size Distribution
- Natural Moisture Content Determination

Laboratory test results are illustrated on Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

Reference should be made to the Record of Borehole sheets contained in the Appendix for subsurface conditions at a particular location. The locations and elevations of the borings are shown on Dwg. Nos. 2828601-A & B.

The predominant soil strata encountered in the boreholes consisted of glacial till with occasional sand layers and silt zones. Silty clay was contacted at two of the boreholes (BH P7 and P8) in the valley with the lowest ground elevations of the area investigated. A surficial layer of granular fill was generally found in all the boreholes as the holes were advanced from existing roads. Bedrock was not encountered at the termination depth of the boreholes.

The glacial till encountered is a heterogeneous mixture of clayey silt, sand and gravel for cohesive tills and a heterogeneous mixture of silt, sand and gravel for non-cohesive tills. Based on the 'N' values of the Standard Penetration test, the glacial till has a hard consistency in the case of a cohesive matrix and a very dense relative density in the case of a non-cohesive matrix. The sand layers or silt zones encountered are also competent with dense to very dense relative density according to the 'N' values obtained. The consistency of silty clay varies widely from hard in BH P8 to soft to stiff in BH P7.

Groundwater level was measured in the open boreholes during the investigation and is given in the Record of Borehole sheet for each borehole. Groundwater levels are subject to seasonal fluctuations and may vary from the values provided in this report.

DISCUSSION AND RECOMMENDATIONS

This report covers the proposed Hwy 407 alignment from Hwy 48 to the Whitby/Oshawa boundary over a distance of about 25 km. The current investigation is intended to collect minimum subsoil information to allow an initial assessment of the feasibility of the proposed route from a foundation point of view. Additional data collected from existing reports are also incorporated.

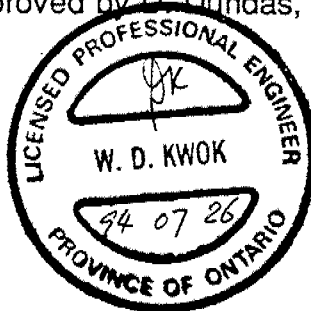
The subsurface conditions at the various structure sites and the corresponding tentative foundation recommendations are summarized in tabular form on the following pages.


It should be noted that the tentative foundation recommendations provided are for feasibility study or preliminary planning purposes only as they are based on very limited subsurface information. It will be necessary to carry out a detailed investigation at each structure site location when a structure scheme and a profile grade have been decided on.

MISCELLANEOUS


The fieldwork for this investigation was carried out under the supervision of D. Kwok, Project Foundation Engineer. The equipment was owned and operated by Master Soils Investigation Ltd.

The project was carried out by D. Kwok under the supervision of B. Iyer, Senior Foundation Engineer. This report was prepared by D. Kwok, reviewed by P. Payer, Senior Foundation Engineer and approved by D. Dundas, Acting Chief Foundation Engineer.




D. Kwok, P. Eng.
Project Foundation Engineer




D. Dundas, P. Eng.
Acting Chief Foundation Engineer

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 1

Struct. No. 01 : Markham Rd Underpass

Ground Elevation : 180.8 m Proposed Hwy 407 Grade Elevation : $175 \pm$ m
at BH Location

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<p><u>Ref. Boreholes</u> (W.P. 90-78-00)</p> <p>BH C12 -</p> <p>0-1.8m Roadway Fill</p> <p>1.8-15.7 m V. Stiff glacial till</p> <p>Groundwater -</p> <p> $173 \pm$ m</p>	<ol style="list-style-type: none">1. Spread footings placed within the very stiff glacial till stratum below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=500kPa Bearing Capacity at SLS Type II=300kPa2. Alternatively, spread footings can be placed on a well compacted Granular 'A' pad and designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa3. Cuts up to 8 m can be constructed with side slopes of 2H:1V4. Major subsoil deposit is of low permeability and ground water table is close to proposed Hwy 407 grade. It is not a feasible site for infiltration ponds.	

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 2

Struct. No. 02 : Rouge River Bridge WBL

No. 03 : Rouge River Bridge EBL

Ground Elevation : C13 178.7m Proposed Hwy 407 Grade Elevation : 178 ± m
at BH Location C14 178.6m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<p><u>Ref. Boreholes</u> (W.P.90-78-00)</p> <p>BH C13 (WBL)</p> <p>0-0.3m Topsoil</p> <p>0.3-22.9m V. stiff glacial till</p> <p>22.9-27.6m V. dense glacial till</p> <p>BH C13B (EBL)</p> <p>0-15.7m Stiff to V. stiff glacial till</p> <p>Groundwater -</p> <p>BH C13 168 m</p> <p>BH C13B not established</p>	<ol style="list-style-type: none"> 1. Spread footings placed within the very stiff glacial till stratum below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=500kPa Bearing Capacity at SLS Type II=300kPa 2. Alternatively, spread footings can be placed on a well compacted Granular 'A' pad and designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa 3. End bearing piles to an elevation of 153±m 4. Fills up to 8 m can be constructed with side slopes of 2H:1V 5. Base groundwater table at 10 ±m below proposed Hwy 407 grade. Subsoil is of low permeability at this depth. The site is not ideal for infiltration ponds. 	

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 3 Structure No. 4 : 9th Line Underpass

Ground Elevation : 182.4 m Proposed Hwy 407 Grade Elevation : 183.6 \pm m
at BH Location

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref Borehole</u> (W.P.90-78-00) BH C14 0-1.5 m Roadway Fill 1.5-15.7 m Hard glacial till Groundwater - Not established	<ol style="list-style-type: none">1. Spread footings placed within the hard glacial till stratum below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=1000kPa Bearing Capacity at SLS Type II does not control2. Fills up to 8 m can be constructed with side slopes of 2H:1V3. Subsoil is generally of low permeability. It is not an ideal site for infiltration ponds.	

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 4 Structure No. 5 : N-S Arterial Road Underpass

Ground Elevation : 192.9 m
at BH Location

Proposed Hwy 407 Grade Elevation : 195.6 \pm m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<p><u>Ref. Borehole</u> (W.P. 25-69-00)</p> <p>BH 11</p> <p>0-13.9 m Hard glacial till</p> <p>Groundwater - Not established</p>	<ol style="list-style-type: none">1. Spread footings placed within the hard glacial till stratum below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=1000kPa Bearing Capacity at SLS Type II does not control2. Fills up to 8 m can be constructed with side slopes of 2H:1V3. Subsoil is generally of low permeability. It is not an ideal site for infiltration ponds.	

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 5

Struct Nos.

06/07 : 10th Line Overpass

08/09 : CPR Overhead

10/11 : Little Rouge River Bridge

Ground Elevation : 193.4 m
at BH Location

Proposed Hwy 407 Grade Elevation : 196.2 ± m

200.8 ± m

199.6 \pm m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P.282-86-01) BH P1 0-0.6 m Granular Fill 0.6-10.8 m Hard glacial till Groundwater - 186.6 m	1. Spread footings placed within the hard glacial till stratum below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=700 kPa Bearing Capacity at SLS Type II does not govern. 2. Abutment footings may be placed on a well compacted Granular 'A' pad and designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa 3. Fills up to 12 m can be constructed at 2H:1V with a 2 m wide mid-height berm 4. Major subsoil deposit is of low permeability and the sites are not recommended for infiltration ponds.	

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 6 Struct. No.20 : Regional Road #30 Underpass

Ground Elevation : 205.3 m Proposed Hwy 407 Grade Elevation : 212 \pm m
at BH Location

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<p><u>Ref. Borehole</u> (W.P. 282-86-01)</p> <p>BH P2</p> <p>0-0.8m Granular Fill</p> <p>0.8-12.4m V. Stiff to Hard glacial till</p> <p>Groundwater - 195.4 m</p>	<ol style="list-style-type: none">1. Spread footings placed within the hard glacial till stratum below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=700 kPa Bearing Capacity at SLS Type II does not govern2. Abutment footings may be placed on a well compacted Granular 'A' pad and designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa3. Fills up to 8 m can be constructed at side slopes of 2H:1V.4. Subsoil is generally of low permeability. It is not an ideal site for infiltration ponds.	

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 7 Struct. Nos. 21/22 : West Duffin Creek Bridge

Ground Elevation : 176.2 m
at BH Location

Proposed Hwy 407 Grade Elevation : 186 \pm m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<p><u>Ref. Borehole</u> (W.P. 69-65-02)</p> <p>BH 3</p> <p>0-1m Firm Clayey Silt</p> <p>1-11.1m Dense to V.Dense Sand and Gravel</p> <p>Groundwater - 175.4 m</p>	<ol style="list-style-type: none">1. Spread footings placed within dense to very dense sand and gravel material below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=700kPa Bearing Capacity at SLS Type II does not govern.2. Alternatively, footings can be placed on a well compacted Granular 'A' pad built on the sand and gravel stratum and designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa3. Fills up to 12 m can be constructed at 2H:1V with a 2 m wide mid-height berm.4. High groundwater table with local artesian conditions. The site is not recommended for infiltration ponds.	<p>Prior dewatering is required for footing construction on sand and gravel</p> <p>Artesian conditions were found in boreholes south of West Duffin Creek @170 m. Water came up to 300 mm above ground level</p>

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 9

Struct. No. 24 : Sideline 24 Underpass

Ground Elevation : 215.6 m

Proposed Hwy 407 Grade Elevation : 216 \pm m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<p><u>Ref. Borehole</u> (W.P. 282-86-01)</p> <p>BH P4</p> <p>0-1.5m Fill</p> <p>1.5-10.8m Hard glacial till</p> <p>Groundwater - dry</p>	<ol style="list-style-type: none">1. Spread footings placed within the hard glacial till stratum below El. 216 m and the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=1000kPa Bearing Capacity at SLS Type II does not govern.2. Abutment footings may be placed on a well compacted Granular 'A' pad and designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa3. Subsoil is generally of low permeability. The site is not recommended for infiltration ponds.	

Area : 10 Struct. No. 25 : Brock Road Underpass
No. 26 : Sideline 16 Underpass
No. 27&28 : Hwy 7 Overpass WBL/EBL

Ground Elevation : 192.4 m	Proposed Hwy 407 Grade Elevation :	189 ± m
at BH Location		179 ± m
		174 ± m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P. 282-86-01) BH P5 0-0.9m Granular Fill 0.9-5.3 m Stiff to Hard Till 5.3-9.9m V. Dense Sand/Silt 9.9-10.8m Hard glacial till Groundwater - 186.1 m	1. Spread footings placed within the hard glacial till stratum below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=700kPa Bearing Capacity at SLS Type II does not govern. 2. Alternatively, footings may be placed on a well compacted Granular 'A' pad and designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II =350kPa 3. Cuts/Fills up to 10 m may be constructed at 2H:1V with a 2 m wide mid-height berm for fill heights or cut depths over 8 m. 4. Groundwater table generally close to proposed Hwy 407 grade. The site is not recommended for infiltration ponds.	

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 11 Structure No. 31 : Sideline 14 Underpass
Nos.40&41 : Structures @ Sideline 14 I/C

Ground Elevation : 167.1 m Proposed Hwy 407 Grade Elevation : 164 ± m
at BH Location

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P.282-86-01) BH P6 0-3.4 m Fill 3.4-6.9 m V. Stiff to Hard Till 6.9-15.7m Compact to Dense Silty Sand Groundwater - 165.3 m	<ol style="list-style-type: none"> 1. Spread footings placed within the glacial till stratum below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=600kPa Bearing Capacity at SLS Type II=350kPa 2. Abutment footings may be placed on a well compacted Granular 'A' pad and designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa 3. Cut slopes may be formed at 2H:1V with a 2 m berm every 8 m up to a maximum height of 25 m. 4. Groundwater table close to proposed Hwy 407 grade. The site is not recommended for infiltration ponds. 	Cuts up to 25±m high may be required west of the structure

Area : 12 Struct. No.32 : Paddock Road Underpass
Nos.33&34 : East Duffin Creek Bridge
No.35 : Westney Road Underpass

Proposed Hwy 407 Grade Elevation :

154	\pm m
157	\pm m
153	\pm m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P.282-86-01) BH P7 0-2.3m Granular Fill 2.3-3.5m Peat 3.5-5.3m Dense Alluvial Sand 5.3-11.4m Soft to Stiff Silty Clay 11.4-15.2m Compact Silty Sand 15.2-17.5m V. Stiff Silty Clay 17.5-18.7m Compact Silty Sand Groundwater - 147.6 m	1. Footings elements can be supported by piles driven to an end bearing stratum below El. 131 m, to be determined by additional investigation. 2. All organic material has to be removed prior to placement of fill 3. Stability and geometry of fill embankment has to be determined by additional investigation at structure locations. 4. Permeable sand layers are intercepted by clay strata of low permeability. The sites are not recommended for infiltration ponds.	Additional investigation is required to determine the pile founding stratum and stability of embankment

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 13

Structure 36 : Salem Road Underpass

Ground Elevation : 170.7 m Proposed Hwy 407 Grade Elevation : 166 ± m
at BH Location

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P.282-86-01) BH P8 0-0.5m Granular Fill 0.5-7.6m V. Stiff to Hard Till 7.6-10.7m Dense to V. dense Sand 10.7-19.1m Dense to V. dense Silt 19.1-27.9m Hard Silty Clay Groundwater - 168.8 m	1. Spread footings placed within the hard glacial till below the frost depth (1.2m) can be designed with Factored Bearing Capacity at ULS=700kPa Bearing Capacity at SLS Type II does not govern. 2. Alternatively, footings may be placed on a well compacted Granular 'A' pad and be designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa 3. Cut slopes may be formed at 2H:1V up to a maximum depth of 8 m. 4. Groundwater table close to proposed Hwy 407 grade. Not recommended for infiltration ponds.	

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 14

Struct. No.37 : Side Road #4 Underpass
No.38 : Kinsale Road Underpass

Ground Elevation : 181.1 m
at BH Location

Proposed Hwy 407 Grade Elevation : $177 \pm$ m
 $192 \pm$ m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref Borehole</u> (W.P. 282-86-01) BH P9 0-0.5m Granular Fill 0.5-1.5m Clayey Silt Fill 1.5-23.3m V. Stiff to Hard Till Groundwater - 177.7 m	<ol style="list-style-type: none"> 1. Spread footings placed within hard glacial till below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=1000kPa Bearing Capacity at SLS Type II does not govern 2. Abutment footings may be placed on a well compacted Granular 'A' pad and designed with Factored Bearing Capacity at ULS =900kPa Bearing Capacity at SLS Type II=350kPa 3. Cut slopes may be formed at 2H:1V up to 10 m deep with a 2m wide mid-height berm for cuts deeper than 8 m. 4. Subsoil generally of low permeability. Not an ideal site for infiltration ponds. 	Cuts up to 10 m deep may be required between the two structures

Struct No. 39 : Regional Road 23 Underpass
No. 50 : Halls Road Underpass

Ground Elevation : 191.4 m	Proposed Hwy 407 Grade Elevation :	194 ± m
at BH Location		186 ± m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P. 282-86-01) BH P10 0-0.8 m Granular Fill 0.8-7.0m Hard glacial till 7.0-9.1m Very Dense Silty Sand 9.1-12.2m Very Dense glacial till 12.2-15.4m Hard glacial till Groundwater - 192 m	1. Spread footings placed within hard glacial till below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=1000kPa Bearing Capacity at SLS Type II does not govern 2. Cut/fill slopes may be formed at 2H:1V up to 8 m maximum. 3. Groundwater table close to proposed Hwy 407 grade. The site is not recommended for infiltration ponds.	

Area : 16

Nos.52&53 : West Lynde Creek Bridge

No.54 : Country Lane Road Underpass

Proposed Hwy 407 Grade Elevation : 168 + m

161
+ m

157 $\pm m$

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<p><u>Ref. Borehole</u> (W.P. 282-86-01)</p> <p>BH P11</p> <p>0-0.3m Granular Fill</p> <p>0.3-1.5m Fill</p> <p>1.5-21.8m Stiff to Hard glacial till</p> <p>Groundwater - dry</p>	<ol style="list-style-type: none"> 1. Spread footings placed within hard glacial till below $163 \pm$ m and the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=1000kPa Bearing Capacity at SLS Type II does not govern 2. Alternatively, footings may be placed on a well compacted Granular 'A' pad built over native glacial till material and be designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa 3. Cut/fill slopes may be formed at 2H:1V to 10 m maximum with a mid-height berm for slopes more than 8 m high. 4. No aquifer encountered during the investigation. Subsoil generally dry and of low permeability. The site is not recommended for infiltration ponds. 	<p>Cuts up to $10 \pm$ m may be required in the vicinity of the structures.</p>

No.57 : Regional Road #41 Underpass

Proposed Hwy 407 Grade Elevation :

161	± m
164	± m
164	± m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P.282-86-01) BH P12 0-0.8m Granular Fill 0.8-3.8m Very Stiff to hard till 3.8-20.4m Compact to very dense till 20.4-24.8m Hard till Groundwater - 159.3 m	1. Spread footings placed within the upper very stiff to hard glacial till stratum below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=500kPa Bearing Capacity at SLS Type II=300kPa 2. Alternatively, footings may be placed on a well compacted Granular 'A' pad built over native soils and be designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa 3. End bearing piles may be founded within the lower hard till stratum at 137.5 ± m. 4. Cut/fill slopes may be formed at 2H:1V up to 8 m maximum. 5. Major aquifer in non-cohesive till with sand layers. The sites may be feasible for construction of infiltration ponds.	

FOUNDATION DATA SHEET

W.P. 282-86-01 Area : 18 Structure No.58 : Hwy 12 Underpass

Ground Elevation : 158.8 m Proposed Hwy 407 Grade Elevation : 157 ± m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P.282-86-01) BH P13 0-0.5m Granular Fill 0.5-1.4m Fill 1.4-2.1m Very Stiff Till 2.1-6.1m Dense to very dense till 6.1-12.4m Hard till Groundwater - 157.3 m	<ol style="list-style-type: none">1. Spread footings placed within dense to very dense till below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=700kPa Bearing Capacity at SLS Type II does not govern2. Abutment footings may be placed on a well compacted Granular 'A' pad built over native soils and be designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa3. Cut/fill slopes may be formed at 2H:1V up to 8m maximum.4. Groundwater level close to proposed Hwy 407 grade. The site is not recommended for infiltration ponds.	

FOUNDATION DATA SHEET

W.P. 282-86-01

Area : 19

Struct. Nos. 59 & 60 : Lynde Creek Bridge

61 : Anderson Road Underpass

Ground Elevation : 156.8 m

Proposed Hwy 407 Grade Elevation : 156 ± m

156 ± m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P.282-86-01) BH P14 0-0.8m Granular Fill 0.8-1.5m Fill 1.5-11.4m Hard till 11.4-20.6m Very dense silty sand with gravel 20.6-23.0m Hard till Groundwater - 152.6 m	1. Spread footings placed within the hard glacial till below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=500kPa Bearing Capacity at SLS Type II=300kPa 2. Abutment footings may be placed on a well compacted Granular 'A' pad built over native soils and be designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa 3. Cut/fill slopes may be formed at 2H:1V up to 8 m maximum. 4. Aquifer in silty sand stratum some 10 m below proposed Hwy 407 grade. Site No. 61 may be feasible for the construction of infiltration ponds. Site Nos. 59 & 60 are located next to Main Lynde Creek and are therefore environmentally sensitive.	

Struct. No.62 : Thickson Road Underpass
No.63 : Garrard Road Underpass

Proposed Hwy 407 Grade Elevation : 164 ± m
173 ± m

SUBSURFACE CONDITIONS	RECOMMENDATIONS	REMARKS
<u>Ref. Borehole</u> (W.P.282-86-01) BH P15 0-0.8m Granular Fill 0.8-8.4m Hard Till 8.4-17.0m Very dense till Groundwater - 168.2 m	1. Spread footings placed within hard glacial till below the frost depth (1.2 m) may be designed with Factored Bearing Capacity at ULS=650kPa Bearing Capacity at SLS Type II=400kPa 2. Abutment footings may be placed on a well compacted Granular 'A' pad built over native soils and be designed with Factored Bearing Capacity at ULS=900kPa Bearing Capacity at SLS Type II=350kPa 3. Cut/fill slopes may be formed at 2H:1V up to 8 m maximum. 4. Aquifer in non-cohesive till stratum some 10 m below the proposed Hwy 407 grade at Struct. No. 63. Groundwater level is at about 5 m below Hwy 407 grade. The site may be feasible for the construction of infiltration ponds.	

APPENDIX

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 1" 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

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'_{vo}	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 = $\frac{c_u}{\tau_r}$

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

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 ³ /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 ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

RECORD OF BOREHOLE No P1

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 859623.2 E 328166.1 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE S.S. Auger, Cone Test COMPILED BY DK
 DATUM Geodetic DATE 94 01 12 CHECKED BY SI

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20 40 60 80 100	20 40 60 80 100					
193.4	Ground Surface												
0.0	Granular Fill												
0.8													
	Very Stiff		1	SS	28								
	Hard		2	SS	80								
	Heterogeneous Mixture of Clayey Silt, Trace Gravel Occasional Sand Layers, Cobbles and Boulders		3	SS	100								
	Brown		4	SS	100								
	Grey		5	SS	100								
	(Glacial Till)		6	SS	100								
			7	SS	100								
182.6	End of Borehole												
10.8													
	• Unstabilized water level measured upon completion of drilling on 94 01 12												

RECORD OF BOREHOLE No P2

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 560936.6 E 329984.7 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE S.S. Auger, Cone Test COMPILED BY DK
 DATUM Geodetic DATE 94 01 11 - 94 01 12 CHECKED BY BI

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 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	20 40 60 80 100					
205.3	Ground Surface													
204.5	Granular Fill													
0.8														
	Very Stiff		1	SS	21									
	Hard													
	Heterogeneous Mixture of Clayey Silt, Trace Sand		2	SS	100									
	Trace Gravel				/25cm									
	Occasional		3	SS	100									
	Cobbles and Boulders				/28cm									
	(Glacial Till)		4	SS	114									
	Silty Sand with Gravel Very Dense		5	SS	51									
			6	SS	108									
					/18cm									
					/5cm									
192.9			8	SS	100									
12.4	End of Borehole				/18cm									
	* Unstabilized water level measured upon completion of drilling on 94 01 12													

RECORD OF BOREHOLE No P3

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 862074.3 E 331845.5 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE S.S. Auger, Cone Test COMPILED BY DK
 DATUM Geodetic DATE 94 01 10 - 94 01 11 CHECKED BY BI

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
210.0	Ground Surface													
0.0	50mm Asphalt over Granular Fill					DRY								
0.5														
			1	SS	27		208							
			2	SS	30		206							
			3	SS	120		204							
			4	SS	100		202							
			5	SS	103		200							
			6	SS	100		198							
			7	SS	101		196							
			8	SS	100									
			9	SS	100									
			10	SS	100									
194.6														
15.4	End of Borehole													
	• Borehole dry upon completion of drilling on 94 01 11													

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No P4

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 862825.5 E 334219.0 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE S.S. Auger, Cone Test COMPILED BY DK
 DATUM Geodetic DATE 94 01 10 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIMIT MOISTURE CONTENT		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	20 40 60 80 100	W _p	W		
215.8	Ground Surface												
0.0	300mm of Granular Fill over Clayey Silt Fill with Organic Inclusions, Brown (Fill)					DRY *							
214.1													
1.5			1	SS	14		214						
	Stiff												
	Hard		2	SS	100		212						14 36 33 17
	Brown												
	Grey		3	SS	100								
	Heterogeneous Mixture of Clayey Silt, Trace Gravel Some Sand, Occasional Cobbles and Boulders (Glacial Till)		4	SS	120		210						
			5	SS	120		208						
			6	SS	120		206						18 32 32 18
204.8			7	SS	100								
10.8	End of Borehole				/18cm								
	* Borehole dry upon completion of drilling on 94 01 10												

RECORD OF BOREHOLE No P5

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 863709.4 E 336527.6 ORIGINATED BY DK
DIST 5 HWY 407 BOREHOLE TYPE S.S. Auger, Cone Test COMPILED BY DK
DATUM Geodetic DATE 94 01 10 CHECKED BY BI

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 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	20 40 60 80 100					
192.4	Ground Surface													
0.0	Granular Fill						192	Predugured 800 mm of frozen ground						
191.5														
0.9														
	Heterogeneous Mixture of Clayey Silt, Trace Gravel Occasional Silt Zones, Brown (Glacial Till)	Silt Hard	1	SS	12									
			2	SS	31									
187.1			3	SS	60									
5.3	Sandy Silt to Silty Sand Very Dense	Brown Grey	4	SS	66									
			5	SS	85									
182.5			6	SS	53									
9.9	Heterogeneous Mixture of Clayey Silt, Trace Gravel, Grey, Hard		7	SS	110									
181.6														
10.8	End of Borehole													
	* Unstabilized water level measured upon completion of drilling on 94 01 10													

RECORD OF BOREHOLE No P6

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 865235.6 E 337903.4 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE H.S. Auger, Cone Test COMPILED BY DK
 DATUM Geodetic DATE 94.01.05 - 94.01.07 CHECKED BY BI

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa						
167.1	Ground Surface							20 40 60 80 100	10 20 30					
0.0	Clayey Silt, Trace Gravel Some Organic Inclusions Brown and Grey, Firm (Fill)		1	SS	6		166	○ UNCONFINED + FIELD VANE						
163.7			2	SS	17		164	● QUICK TRIAXIAL × LAB VANE						
3.4	Heterogeneous Mixture of Clayey Silt, Trace Gravel Some Sand layers, Grey Very Stiff to Hard (Glacial Till)		3	SS	33		162							
160.2			4	SS	30		160							
6.9			5	SS	17		158							0 42 52 6
	Silty Sand		6	SS	23		156							
	Trace Gravel		7	SS	34		154							
	Grey, Compact to Dense		8	SS	20		152							0 91 5 4
			9	SS	37									
151.4			10	SS	68									
15.7	End of Borehole • Unstabilized water level measured upon completion of drilling on 94 01 07													

RECORD OF BOREHOLE No P7

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 865854.8 E 338570.2 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE H.S. Auger, Cone Test COMPILED BY DK
 DATUM Geodetic DATE 94 01 05 CHECKED BY SI

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
145.4	Ground Surface													
0.0	Silty Sand, Trace Gravel Brown and Grey, Compact (Fill)		1	SS	27		144	Preaugered 600 mm of frozen ground						
143.1														
2.3	Organics with Wood Fibres Black, Loose (Peat)		2	SS	8		142							
141.9														
3.5	Sand with Gravel, Trace Silt Grey, Dense (Alluvial Deposit)		3	SS	32		140							
140.1														
5.3	Silty Clay Some silt zones Grey Soft to Stiff		4	SS	4		138							
			5	SS	6		136							
			6	SS	11		134							
134.0			7	SS	15		132							
11.4	Silty Sand Grey Compact		8	SS	4**		130							
			9	SS	3**		128							
130.2														
15.2	Silty Clay Grey, Very Stiff		10	SS	24									
127.9	more silty		11	SS	17									
17.5	Silty Sand, Grey, Compact Occasional Silt Zones		12	SS	8**									
126.7														
18.7	End of Borehole													
	* Unstabilized water level taken upon completion of drilling on 94 01 05 ** Unrepresentative blowcounts due to possible disturbance caused by unbalanced hydrostatic heads													

RECORD OF BOREHOLE No P8

1 OF 1 METRIC

W.P. 282-86-01 LOCATION N 4 866905.5 E 340849.2 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE H.S. Auger, Cone Test COMPILED BY DT
 DATUM Geodetic DATE 93 12 21 - 93 12 24 CHECKED BY SI

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
170.7	Ground Surface																
0.0	Granular Fill																
0.5	Very Stiff Hard Heterogeneous Mixture of Clay Silt, Trace Sand Trace Gravel, Occasional Cobbles and Boulders Brown Grey (Glacial Till) Some Sand Layers		1	SS	17		170										
			2	SS	31												
			3	SS	51		168										
			4	SS	100												
					/25cm												
			5	SS	45		166										
			6	SS	100												
					/23cm		164										
163.1			7	SS	33												
7.6	Silty Sand Dense to Very Dense Brown and Grey		8	SS	74		162										
160.0																	
10.7	Silt Trace Clay, Some Sand Grey Dense to Very Dense		9	SS	46		160										
			10	SS	91		158										
			11	SS	100												
					/18cm		156										
	Silty Sand layer		12	SS	40												
	Becoming more Clayey		13	SS	100		154										
					/23cm												
151.6			14	SS	100		152										
19.1	Silty Clay Grey, Hard (Lacustrine)		15	SS	76		150										
			16	SS	48		148										
							146										
			18	SS	70												
142.8			19	SS	58		144										
27.9	End of Borehole																
	• 93 12 24																

RECORD OF BOREHOLE No P9

1 OF 1 METRIC

W.P. 282-86-01 LOCATION N 4 867137.7 E 341645.3 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE H.S. Auger, Cone Test COMPILED BY DT
 DATUM Geodetic DATE 93 12 20 - 93 12 21 CHECKED BY BI

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 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				
181.1	Ground Surface															
0.0	Granular Fill															
0.5	Clayey Silt, Trace Gravel and Organics, Greenish Grey, Soft (Fill)		1	SS	4											
179.6			2	SS	21											
1.5	Very Stiff Hard		3	SS	68											
			4	SS	100											
					/20cm											
			5	SS	79											
	Heterogeneous Mixture of		6	SS	65											
	Clayey Silt, Trace Gravel		7	SS	64											
	Occasional Cobbles and		8	SS	66											
	Boulders, Grey		9	SS	43											
	(Glacial Till)		10	SS	61											
	Occasional Sand Layers		11	SS	72											
			12	SS	100											
					/28cm											
			13	SS	114											
					/20cm											
			14	SS	122											
					/25cm											
157.8			15	SS	120											
23.3	End of Borehole															
	* Unstabilized water table measured upon completion of drilling on 93 12 21															

RECORD OF BOREHOLE No P10

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 867555.7 E 343258.4 ORIGINATED BY DK
DIST 6 HWY 407 BOREHOLE TYPE H.S. Auger, Cone Test COMPILED BY DT
DATUM Geodetic DATE 93 12 17 - 93 12 20 CHECKED BY SI

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
191.4	Ground Surface																
190.6	Granular Fill																
0.8	Heterogeneous Mixture of Clayey Silt, Trace Gravel Occasional Sand Seams, Cobbles and Boulders, Hard (Glacial Till)		1	SS	33												
			2	SS	82												
			3	SS	110												
			4	SS	110												
			5	SS	59												
184.4			6	SS	120												
7.0	Silty Sand with Gravel Grey, Very Dense		7	SS	100												
182.3			8	SS	100												
9.1	Heterogeneous Mixture of Silt, Sand and Gravel Occasional Sand Layers Grey, Very Dense (Glacial Till)		9	SS	100												
179.2			10	SS	106												
12.2	Heterogeneous Mixture of Clayey Silt, Trace Gravel Occasional Sand Layers, Cobbles and Boulders Grey, Hard (Glacial Till)		11	SS	138												
176.0			12	SS	120												
15.4	End of Borehole																
	* 93 12 20																

METRIC

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No P12

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 867970.7 E 346795.7 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE H.S. Auger, Cone Test COMPILED BY DT
 DATUM Geodetic DATE 93 12 14 - 93 12 15 CHECKED BY BI

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80	100	WATER CONTENT (%)	7	GR SA SI CL
								SHEAR STRENGTH kPa												
161.5	Ground Surface																			
160.7	Granular Fill																			
0.8	Heterogeneous Mixture of Clayey Silt, Trace Sand and Gravel	Brown	1	SS	26															
		Grey	2	SS	33															
	Very Stiff to Hard		3	SS	21															
157.7	(Glacial Till)		4	SS	25															
3.8			5	SS	36															
	Silty Sand		6	SS	5**									6 47 36 11						
	Grey		7	SS	6**															
	Loose		8	SS	24															
	Heterogeneous Mixture of Silt, Sand and Gravel		9	SS	120															
	Occasional Cobbles and Boulders		10	SS	52															
	Grey, Compact to Very Dense		11	SS	80									29 37 26 2						
	(Glacial Till)		12	SS	40															
	Trace Clay		13	SS	54															
			14	SS	113															
	Trace Clay		15	SS	42															
			16	SS	115															
	Some Sand Layers		17	SS	120															
141.1																				
20.4	Heterogeneous Mixture of Clayey Silt, Trace Gravel																			
	Occasional Cobbles and Boulders																			
	Grey, Hard																			
136.9	(Glacial Till)																			
24.8	End of Borehole																			
	* Unstabilized water level measured upon completion of drilling on 93 12 15																			
	** Unrepresentative blowcounts due to possible disturbance caused by unbalanced hydrostatic heads																			

RECORD OF BOREHOLE No P13

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 867422.8 E 348100.7 ORIGINATED BY DK
 DIST 6 HWY 407 BOREHOLE TYPE H.S. Auger, Cone Test COMPILED BY DT
 DATUM Geodetic DATE 93 12 13 CHECKED BY BI

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 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					
158.8	Ground Surface																
0.0	Granular Fill																
0.5	Clayey Silt, Trace Sand, with																
157.4	Organic Inclusions (Fill)		1	SS	9												
1.4	Heterogeneous Mixture of Clayey																
156.7	Silt, Gravel, Brown, Very Stiff		2	SS	20												
2.1	Brown, Dense		3	SS	37												
	Grey, Very Dense		4	SS	123												
	Heterogeneous Mixture of Silt,																
	Sand and Gravel, Occasional		5	SS	120												
	Cobbles and Boulders				/18cm												
	(Glacial Till)		6	SS	103												
152.7					/15cm												
6.1	Heterogeneous Mixture of		7	SS	112												
	Clayey Silt, Trace Gravel				/23cm												
	Occasional Sand layers, Cobbles		8	SS	120												
	and Boulders, Grey, Hard				/20cm												
	(Glacial Till)		9	SS	120												
					/23cm												
148.4			10	SS	100												
					/23cm												
12.4	End of Borehole				/23cm												
	• Unstabilized water level measured upon completion of drilling on 93 12 13																

RECORD OF BOREHOLE No P14

1 OF 1

METRIC

W.P. 282-86-01 LOCATION N 4 867482.5 E 348937.8 ORIGINATED BY OK
DIST 6 HWY 407 BOREHOLE TYPE H.S. Auger, Cone Test, BW Casing COMPILED BY DT
DATUM Geodetic DATE 93 12 06 - 93 12 10 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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		
156.8	Ground Surface													
0.0	Granular Fill													
0.8	Clayey Silt, Trace Gravel		1	SS	6		156							
155.3	Brown, Firm (Fill)													
1.5	Heterogeneous Mixture of Clayey Silt		2	SS	30									
	Trace Sand and Gravel		3	SS	33									
	Silt and Sand		4	SS	39									
	Occasional Cobbles and Boulders		5	SS	30									
	Grey, Dense													
	Occasional Brown, Hard (Glacial Till)		6	SS	72									
	Sand layers and Silt zones Grey		7	SS	100									
					/23cm									
			8	SS	65									
145.4			9	SS	100									
					/18cm									
11.4	Silty Sand with Gravel		10	SS	58									
	Occasional Cobbles and Boulders		11	WS	-									
	Grey, Very Dense		12	SS	100									
					/18cm									
			13	SS	113									
					/20cm									
			14	WS	-									
136.2														
20.6	Heterogeneous Mixture of Clayey Silt, Trace Sand & Gravel		15	SS	150									
	Grey, Hard				/15cm									
133.8	(Glacial Till)		16	SS	150									
					/11cm									
23.0	End of Borehole													
	Unstabilized water level measured 1.5 hours after completion of drilling on 93 12 10													

1 OF 1

METRIC

[illegible]

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 69-65-02 LOCATION Sta. 37+87, 16 ft. Lt. (Imperial units) ORIGINATED BY VK
 DIST 6 HWY 7 BOREHOLE TYPE NX casing and washboring COMPILED BY VK
 DATUM Geodetic DATE 68 05 16 CHECKED BY MD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
176.2	Ground Surface												
0.0	Clayey Silt with Sand and a trace of Organic matter Grey, Firm						176						3.29% Organic Content
175.1			1	TW	-								27 55 15 3
1.1			2	SS	25								51 43 (S)
			3	SS	44								
	Sandy Gravel to		4	SS	84								
	Gravelly Sand with a		5	SS	157								
	Trace of Silt and Clay		6	SS	77								22 55 17 6
	Grey		7	SS	93								
	Compact to Very Dense		8	SS	154								
			9	SS	100								
			10	SS	100								
165.1	End of Borehole												

RECORD OF BOREHOLE No C 12 1 OF 1 METRIC

W.P. 90-78-00 LOCATION Coods. N 4 857926.8 E 324307.2 ORIGINATED BY BL
 DIST 6 HWY 407 BOREHOLE TYPE H.S. Augers COMPILED BY BL
 DATUM Geodetic DATE 79.02.19 CHECKED BY CJ

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 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							WATER CONTENT (%) 20 40 60			
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE										
180.8	Ground Surface																	
0.0	Sandy Roadway Fill						180											
179.0	Loose							178					OH			16 36 37 11		
1.8	Heterogeneous Mixture of Clayey Silt, Sand and Some Gravel Very Stiff (Glacial Till)		1	SS	5			176										
			2	SS	24							OH				18 40 33 9		
			3	SS	74													
			4	SS	25							OH						
			5	SS	30													
			6	SS	30							OH				10 41 40 9		
			7	SS	17													
			8	SS	17													
		9	SS	21														
165.1																		
15.7	End of Borehole																	

RECORD OF BOREHOLE No C 13

1 OF 1

METRIC

W.P. 90-78-00

LOCATION Coords. N 4 858121.9 E 324633.3

ORIGINATED BY BL

DIST 5 HWY 407

BOREHOLE TYPE H.S. Augers

COMPILED BY BL

DATUM Geodetic

DATE 79.02.19

CHECKED BY CJ

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 DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
178.7	Ground Surface													
0.0	Topsoil													
0.3			1	SS	24									
			2	SS	18									
			3	SS	45									
			4	SS	19									
			5	SS	24									
			6	SS	30									
			7	SS	26									
			8	SS	23									
			9	SS	39									
			10	SS	32									
			11	SS	14									
155.8			12	SS	101									
22.9			13	SS	60									
151.1														
27.6	End of Borehole													

W.P. 90-78-00 LOCATION Coords. N 4 858048.7 E 324727.8 ORIGINATED BY BL
DIST 6 HWY 407 BOREHOLE TYPE H.S. Augers COMPILED BY BL
DATUM Geodetic DATE 79 02 20 CHECKED BY CJ

+3, x3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No C 14 1 OF 1 METRIC

W.P. 90-78-00 LOCATION Coords. N 4 859210 E 326206.1 ORIGINATED BY BL
 DIST 6 HWY 407 BOREHOLE TYPE H.S. Augers COMPILED BY BL
 DATUM Geodetic DATE 79 02 22 CHECKED BY OJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
182.4	Ground Surface													
0.0	Roadway Fill Material					*	182							
180.9														
1.5			1	SS	20									
			2	SS	50		180							
	Brown				/13cm									19 38 32 11
	Grey		3	SS	60		178							11 35 36 18
					/13cm									
			4	SS	50		176							
	Heterogeneous Mixture of				/10cm									
	Clayey Silt, Sand and Gravel		5	SS	101		174							6 28 46 20
	Hard		6	SS	40									
	(Glacial Till)		7	SS	48		172							
			8	SS	60		170							
			9	SS	88									
166.7			10	SS	50		168							
					/13cm									
15.7	End of Borehole													
	* Groundwater level not established													

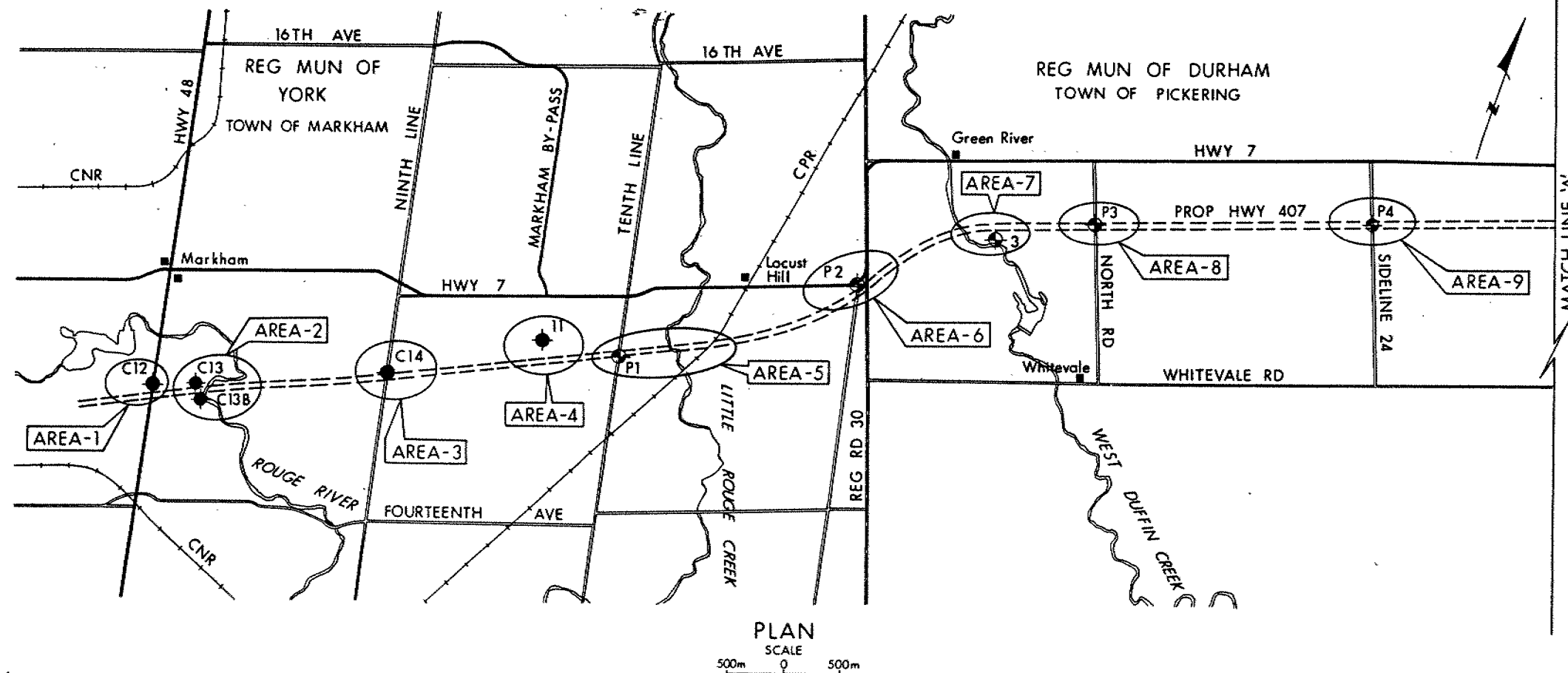
RECORD OF BOREHOLE No 11

1 OF 1

METRIC

W.P. 25-69-00 LOCATION Coords. N 4 859667.2 E 327461.9 ORIGINATED BY J.J.
 DIST 6 HWY EMF BOREHOLE TYPE H.S. Auger COMPILED BY J.J.
 DATUM Geodetic DATE 78 08 16 CHECKED BY O.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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		
192.9	Ground Surface																
0.0						DRY *											
			1	SS	30												
			2	SS	60												
			3	SS	130												
			4	SS	65												
			5	SS	70												
			6	SS	108												
			7	SS	80												
			8	SS	60												
			9	SS	90												
179.0																	
13.9	End of Borehole																



AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
1	C12 (WP 90-78-00)	1	MARKHAM ROAD UNDERPASS
2	C13 C13B (WP 90-78-00)	2 3	ROUGE RIVER BRIDGE WBL ROUGE RIVER BRIDGE EBL
3	C14 (WP 90-78-00)	4	9TH LINE UNDERPASS
4	11 (WP 25-69-00)	5	N-S ARTERIAL ROAD UNDERPASS
5	P1	6 7 8 9 10 11	10TH LINE OVERPASS WBL 10TH LINE OVERPASS EBL CPR OVERHEAD WBL CPR OVERHEAD EBL LITTLE ROUGE RIVER BRIDGE WBL LITTLE ROUGE RIVER BRIDGE EBL
6	P2	20	REGIONAL ROAD 30 UNDERPASS
7	3 (WP 69-65-02)	21 22	WEST DUFFIN CREEK BRIDGE WBL WEST DUFFIN CREEK BRIDGE EBL
8	P3	23	NORTH ROAD UNDERPASS
9	P4	24	SIDELINE 24 UNDERPASS

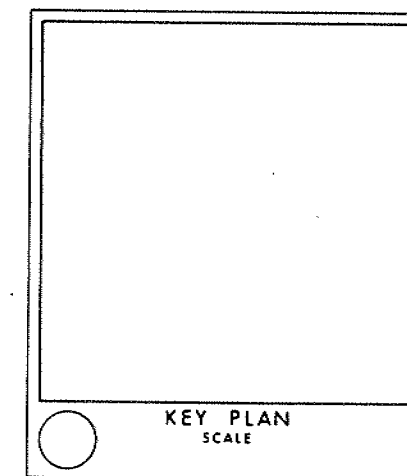
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 282-86-01

PROP HWY 407
From
HWY 48 TO WHITBY OSHAWA BOUNDARY
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N. Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 1968 05
1978 08, 1979 02, 1994 01

No	ELEVATION	CO-ORDINATES NORTH	EAST
P1	193.4	4 859 623.2	328 166.1
P2	205.3	4 860 936.6	329 984.7
P3	210.0	4 862 074.3	331 845.5
P4	215.6	4 862 825.5	334 219.0
C12	180.8	4 857 926.8	324 307.2
C13	178.7	4 858 121.9	324 633.3
C13B	178.6	4 858 048.7	324 727.8
C14	182.4	4 859 210.0	326 206.1
11	192.9	4 859 667.2	327 461.9
3	176.2		

NOTE

For Soil details refer to
Record of Borehole Sheets

NOTE
The boundaries between soil strata have been established
only at Bore Hole locations. Between Bore Holes the
boundaries are assumed from geological evidence.

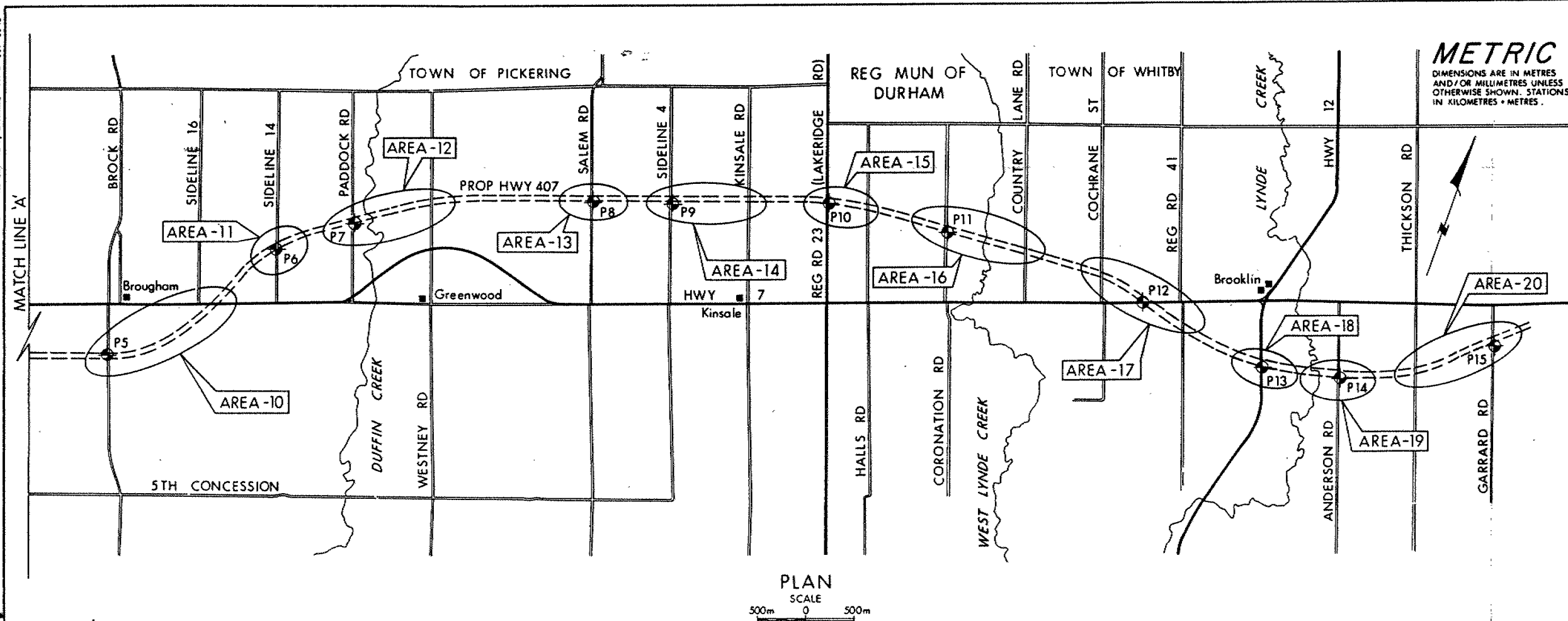
NOTE: The complete foundation investigation and design report for
this project and other related documents may be examined at the
Engineering Materials Office, Downsview. Information contained in
this report and related documents is specifically excluded in
accordance with the conditions of Section GC 2.01 of OPS Gen Cond.



REV	DATE	BY	DESCRIPTION

Geocres No 30M14-227

HWY No 407	DIST 6
SUBM'D OK	CHECKED
DRAWN DT	CHECKED
DATE 1994 02 18	SITE
APPROVED	DWG 2828601-A



PLAN
SCALE
500m 0 500m

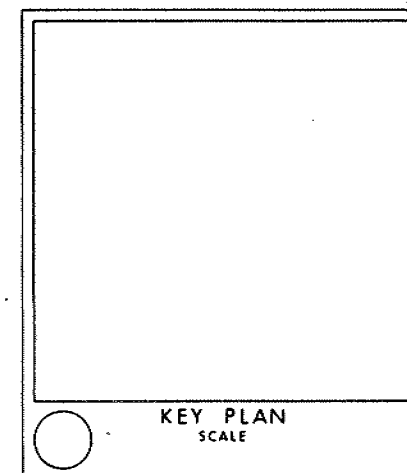
NOTE
For Soil details refer to
Record of Borehole Sheets

CONT No
WP No 282-86-01

PROP HWY 407

From
HWY 48 TO WHITBY OSHAWA BOUNDARY
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ◆ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation
1993 12 & 1994 01

AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
10	P5	25	BROCK ROAD UNDERPASS
		26	SIDELINE 16 UNDERPASS
		27	HWY 7 OVERPASS WBL
		28	HWY 7 OVERPASS EBL
		29 & 30	HWY 407/HWY 7 INTERCHANGE
11	P6	31 40 & 41	SIDELINE 14 UNDERPASS STRUCTURES AT SIDELINE 14 INTERCHANGE
12	P7	32	PADDOCK ROAD UNDERPASS
		33	EAST DUFFIN CREEK BRIDGE WBL
		34	EAST DUFFIN CREEK BRIDGE EBL
		35	WESTNEY ROAD UNDERPASS
13	P8	36	SALEM ROAD UNDERPASS
14	P9	37	SIDELINE 4 UNDERPASS
		38	KINSALE ROAD UNDERPASS
15	P10	39	REGIONAL ROAD 23 UNDERPASS
		50	HALLS ROAD UNDERPASS

AREA	BOREHOLE No	STRUCT REF No	DESCRIPTION
16	P11	51	CORONATION ROAD UNDERPASS
		52	WEST LYNDE CREEK WBL
		53	WEST LYNDE CREEK EBL
		54	COUNTRY LANE ROAD UNDERPASS
17	P12	55	COCHRANE STREET UNDERPASS
		56	HWY 7 UNDERPASS
		57	REGIONAL ROAD 41 UNDERPASS
18	P13	58	HWY 12 UNDERPASS
19	P14	59	LYNDE CREEK BRIDGE WBL
		60	LYNDE CREEK BRIDGE EBL
		61	ANDERSON ROAD UNDERPASS
20	P15	62	THICKSON ROAD UNDERPASS
		63	GARRARD ROAD UNDERPASS

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen Cond.



REF No NTS Maps 30M/14g, 30M/14h & 30M/15a

REV	DATE	BY	DESCRIPTION
1			
Geocres No 30M14-227			
HWY No 407			
SUBM'D OK	CHECKED	DATE 1994 02 18	DIST 6
DRAWN DT	CHECKED	APPROVED	SITE
			DWG 2828601-B

SOILS REPORT - NESBITT BRIDGE (SITE #148)

TABLE OF CONTENTS

<u>HEADING</u>	<u>PAGE NO.</u>
INTRODUCTION	1
SOIL CONDITIONS	2
FOUNDATION CONSIDERATIONS	3
PILE CONSIDERATIONS	3
EROSION AND SCOUR CONSIDERATIONS	4
SETTLEMENT CONSIDERATIONS	4
LOCATION PLAN & INFERRED SOIL STRATIGRAPHY	FIGURE 1
BOREHOLE SUMMARIES	FIGURES 2 and 3
EXPLANATION OF SYMBOLS & TERMINOLOGY	APPENDIX "A"

SOILS REPORT - NESBITT BRIDGE (SITE #146)

INTRODUCTION

An investigation of foundation soil conditions has been carried out at the Nesbitt Bridge site on Lots 16 and 17, Concession 5 of East Whitby Township. The County of Ontario proposes to construct a new bridge at the site of the existing crossing. It was intended that either a prestressed beam or a rigid frame design would be used for the new structure and that, soil conditions permitting, the abutments would be founded on concrete spread footings.

Authorization to proceed with the investigation was received on September 9th and the field work was subsequently done on September 14, 1970. A truck-mounted, hollow stem auger drill was used to advance 2 boreholes, one in each abutment area as shown on figure 1. Samples were obtained at 2 to 5-ft. intervals with a 2-inch open-end drive sampler while recording standard penetration resistances (N-values). A summary of the borehole data and test results will be found on figures 2 and 3 at the end of this report. An inferred sub-soil stratigraphy as well as the location plan is outlined on figure 1 and an explanation of some of the symbols and terminology used in this report is given in Appendix "A".

SOILS REPORT - NESBITT BRIDGE (SITE #146)

SOIL CONDITIONS

The bridge site is located in the physiographic region known as the "South Slope" of the Oak Ridges inter-lobate kame moraine. The area has been eroded by streams draining toward Lake Ontario, leaving recent alluvial deposits overlying the till soils in the eroded valleys.

The soils profiles obtained in the two boreholes at this site support the geological data for the area, revealing that under the existing approach embankment fill material there are loose fine-grained river deposits (silty sand, sand silt, clayey silt and clay) which in turn overlie relatively compact sandy till soils.

The river-deposited sediment extends approximately from elevation 88 feet down to elevation 78 feet and consists of irregularly stratified sand, silty sand, sandy silt and silty clay. Standard penetration resistances in this soft, loose material varied from 1 to 11 blows/ft.

Below elevation 78 feet, approximately, the subsoils are relatively compact and sandy in texture, consisting mainly of very fine to medium sand. Standard penetration resistances in this underlying sand till zone varied from 16 to over 30 blows/ft., there being a general increase in density with depth.

SOILS REPORT - NESBITT BRIDGE (SITE #146)

FOUNDATION CONSIDERATIONS

If spread footings are considered for supporting the abutments of the structure, the base of the footings will have to be at least as low as elevation 77 feet in order to reach the compact sand zone. At this level, the footings will be about 8 feet below the present creek bottom under 9 to 10 feet of water. The allowable load for such footings is estimated to be 4000 lbs per sq. ft. provided that the soils below the footing are not disturbed.

It should be noted that dewatering the excavation for these spread footings could be troublesome unless the water table is lowered in advance with a well-point system. Conventional pumping of the excavations will result in "piping" at the footing level which will seriously reduce the bearing capacity of these fine sand subsoils.

PILE FOUNDATION CONSIDERATIONS

As an alternative to spread footings, it is recommended that piles be considered for supporting the abutment loads on this project. Adequate pile capacity can be obtained by driving displacement type piles (wood, steel or concrete) to elevation 60 feet approximately. Timber piles will likely be the most economically feasible for this structure (although concrete or steel-tube piles are not ruled out) and the full allowable capacity, for the timber size selected, can be used.

SOILS REPORT - NESBITT BRIDGE (SITE #146)

EROSION AND SCOUR CONSIDERATIONS

The existing river bed materials are highly erodible, but, if footings are based 8 feet below stream bed level, or if piles are used, there should be adequate protection against scour damage. The toes of the approach embankments will need protection, however, and it is recommended that rip-rap be placed on these slopes up to the design high water level.

SETTLEMENT CONSIDERATIONS

The subsoils below the proposed foundation bearing levels are compact granular materials which are relatively incompressible. Any foundation settlement which does take place will occur during construction and will be well within tolerable limits.

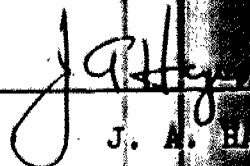


JAH/df

Submitted by:

SITE INVESTIGATION SERVICES LIMITED

per


J. A. HAYES, P. ENG.

BOREHOLE DATA and TEST SUMMARY

SITE INVESTIGATION SERVICES Ltd.

JOB No: 70-95 BOREHOLE No: 1

FIGURE No: 2

Project - NESBITT BRIDGE
 Location - LOT 16 & 17, CONC. 5, TWP. OF EAST WHITBY
 Hole Location - SEE FIGURE 1

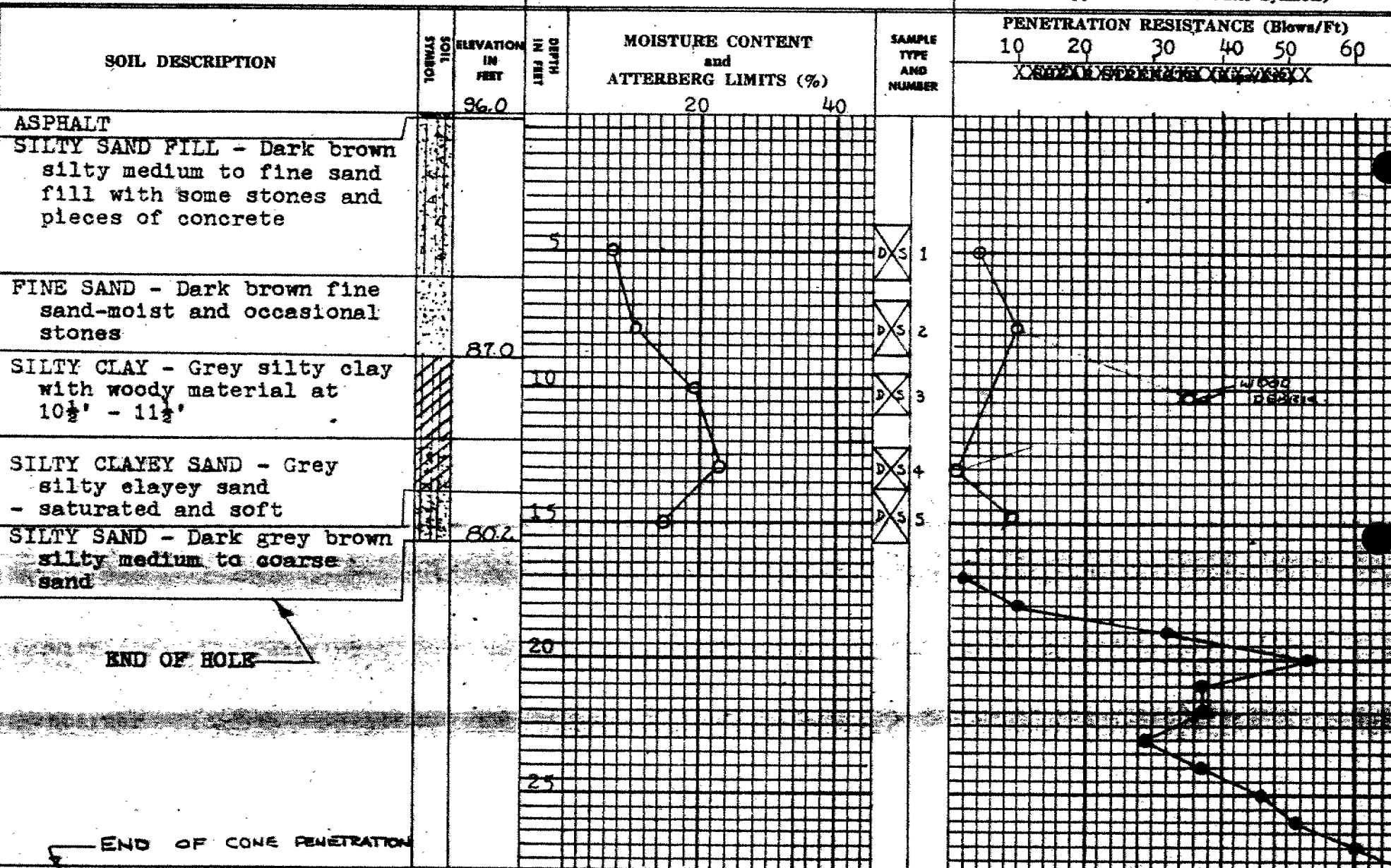
Date - SEPTEMBER 11, 1970
 Elevation Datum - ASSUMED 100.0'
(S.M. ON POST @ STA 10+94 (53' L))
 Type of Drill - HOLLOW STEM AUGER

LEGEND

Penetration Tests Moisture Contents

2" O.D. Split Spoon —○— In-Situ ○
 2" O.D. Cone —●— Liquid Limit —|—
 Plastic Limit —|—

(See Appendix "A" for Other Symbols)

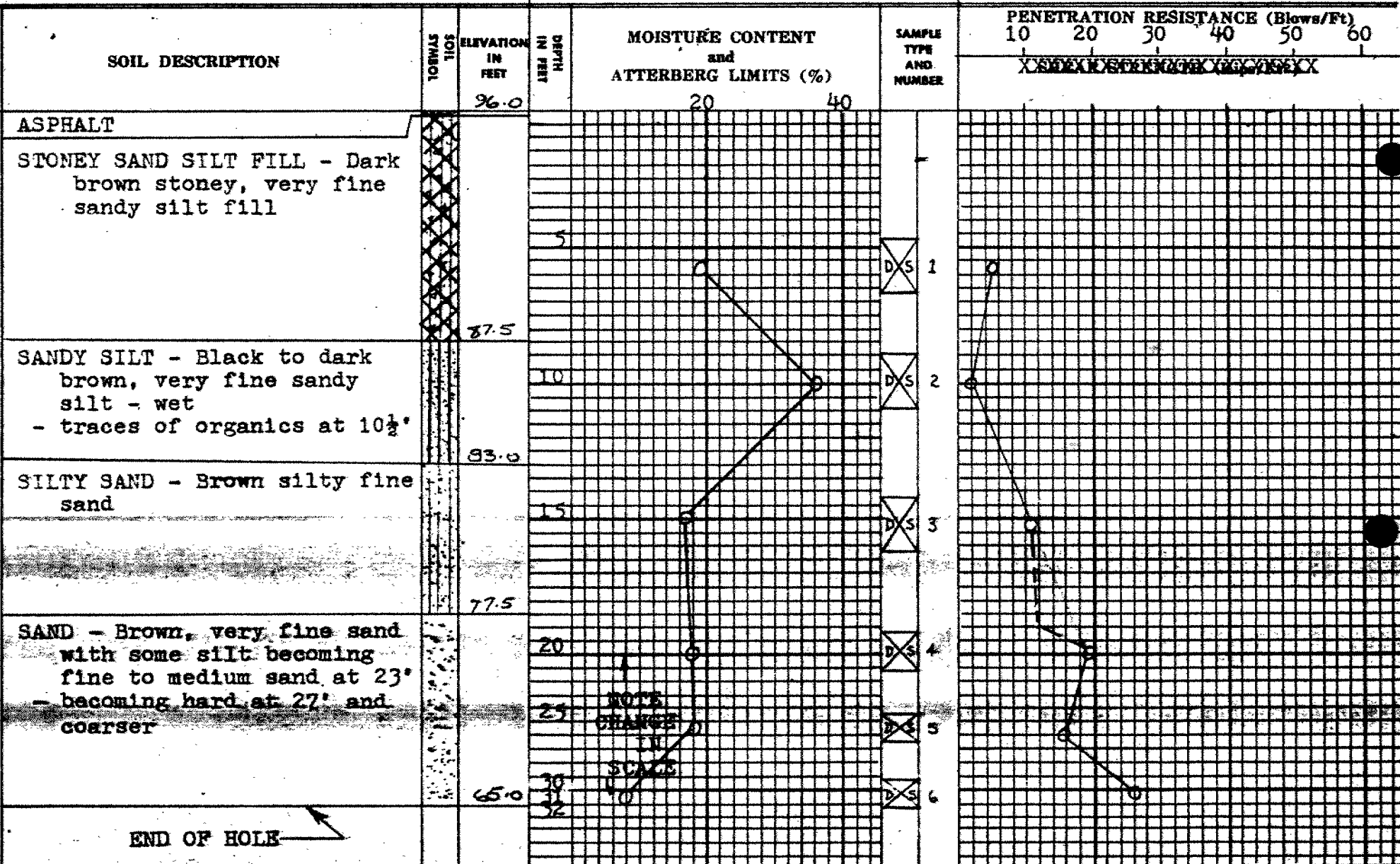


BOREHOLE DATA and TEST SUMMARY

Project - NESBITT BRIDGE
 Location - LOT 16 & 17, CONC. 5, TWP. OF
EAST WHITBY
 Hole Location - SEE FIGURE 1

Date - SEPTEMBER 14, 1970
 Elevation Datum - ASSUMED 100.0'
BM @ STA. 10+94 (S.P.D.)
 Type of Drill - HOLLOW STEM AUGER

LEGEND
 Penetration Tests
 2" O.D. Split Spoon —○— In-Situ ○
 2" O.D. Cone —●—●—●— Liquid Limit —
 Plastic Limit —
 (See Appendix "A" for Other Symbols)

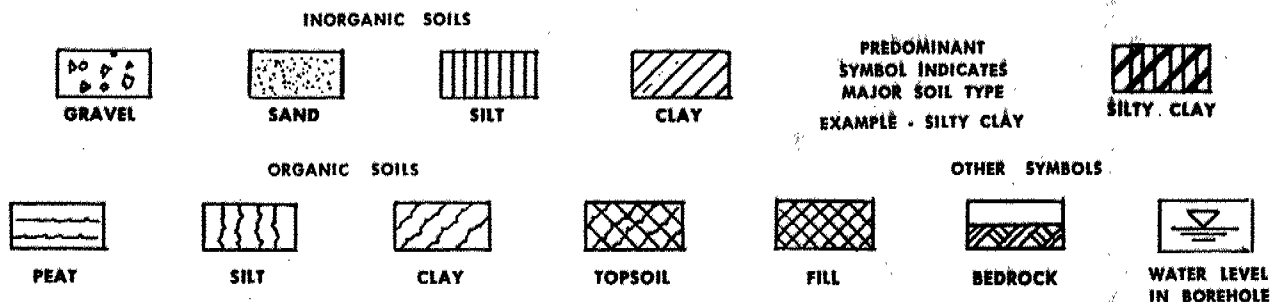


EXPLANATION OF SYMBOLS AND TERMINOLOGY

SOIL DESCRIPTION

A description of visible characteristics of the soil as determined in the field and altered, if necessary, on the basis of laboratory classification tests. The soil profile applies only to the borehole location and may be different at other locations on the site.

A soil symbol is usually found opposite each soil type as follows:



SAMPLES

Condition:



RELATIVELY
UNDISTURBED



DISTURBED



NOT
RECOVERED

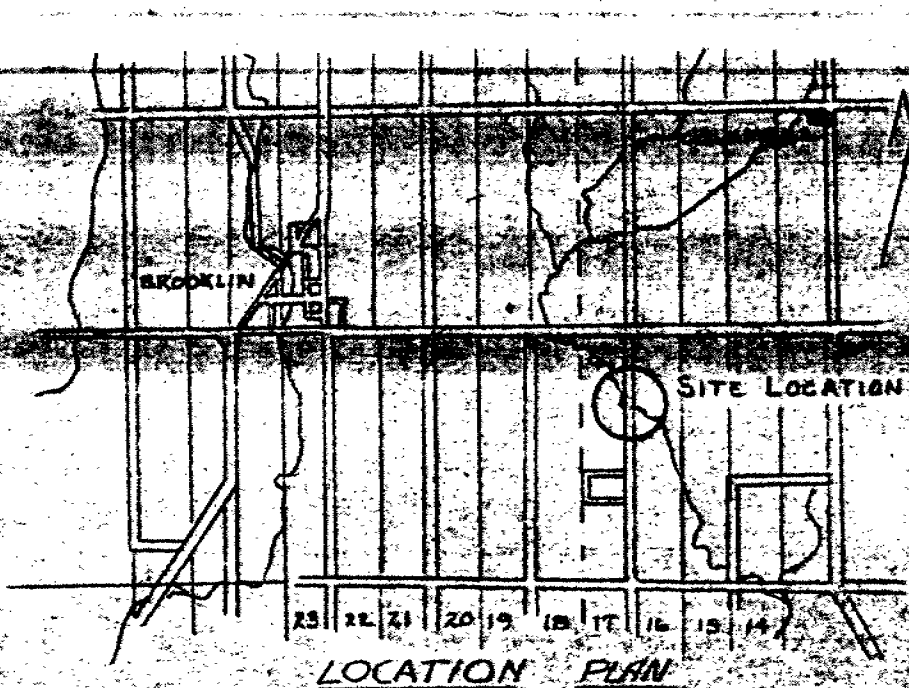
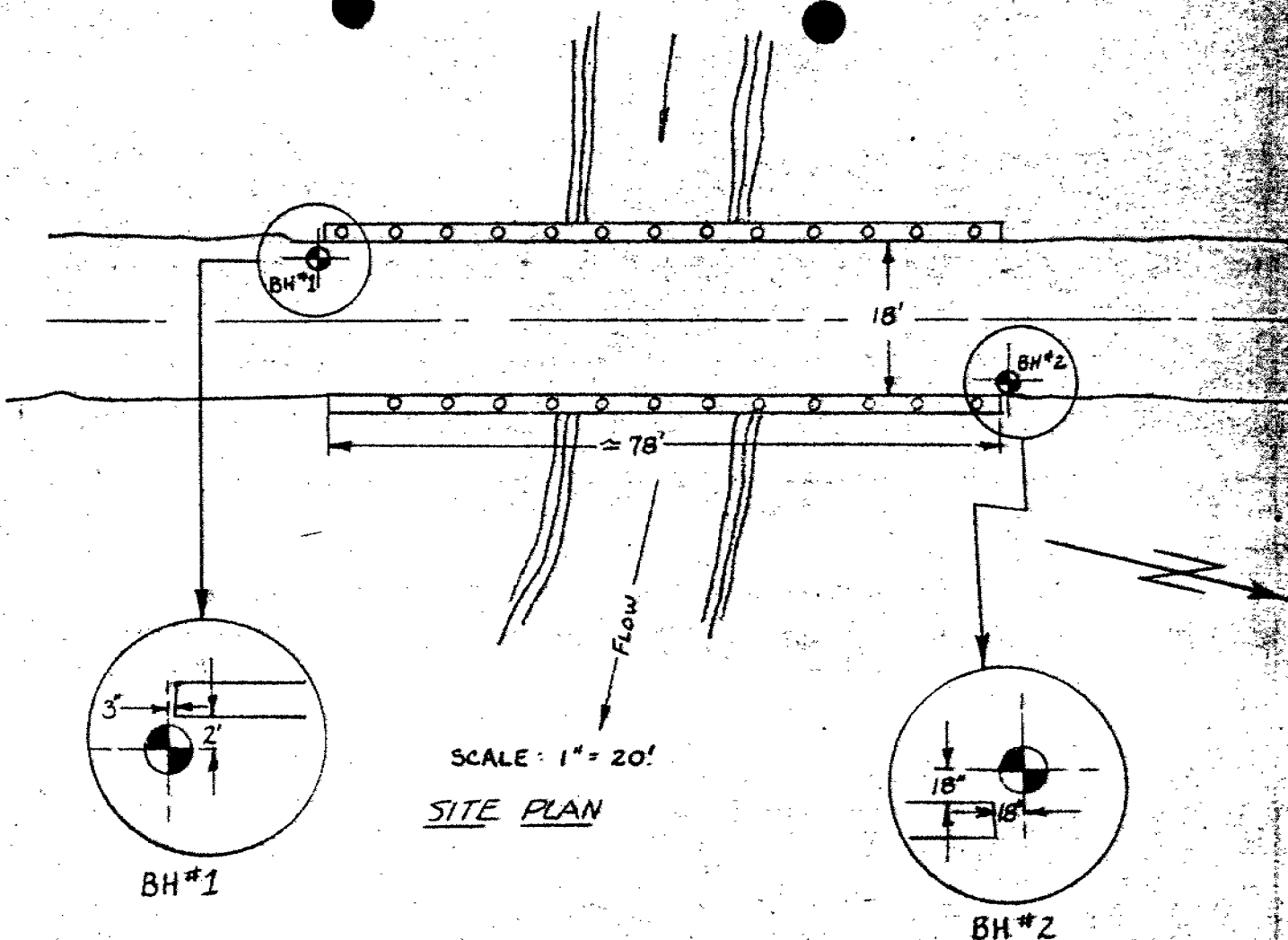
Type:

D.S. - 1 3/8" ID Drive Sample
 A.S. - Auger Sample
 U - Thin-walled Tube Sample
 J - Small Jar Sample
 B - Bag Sample

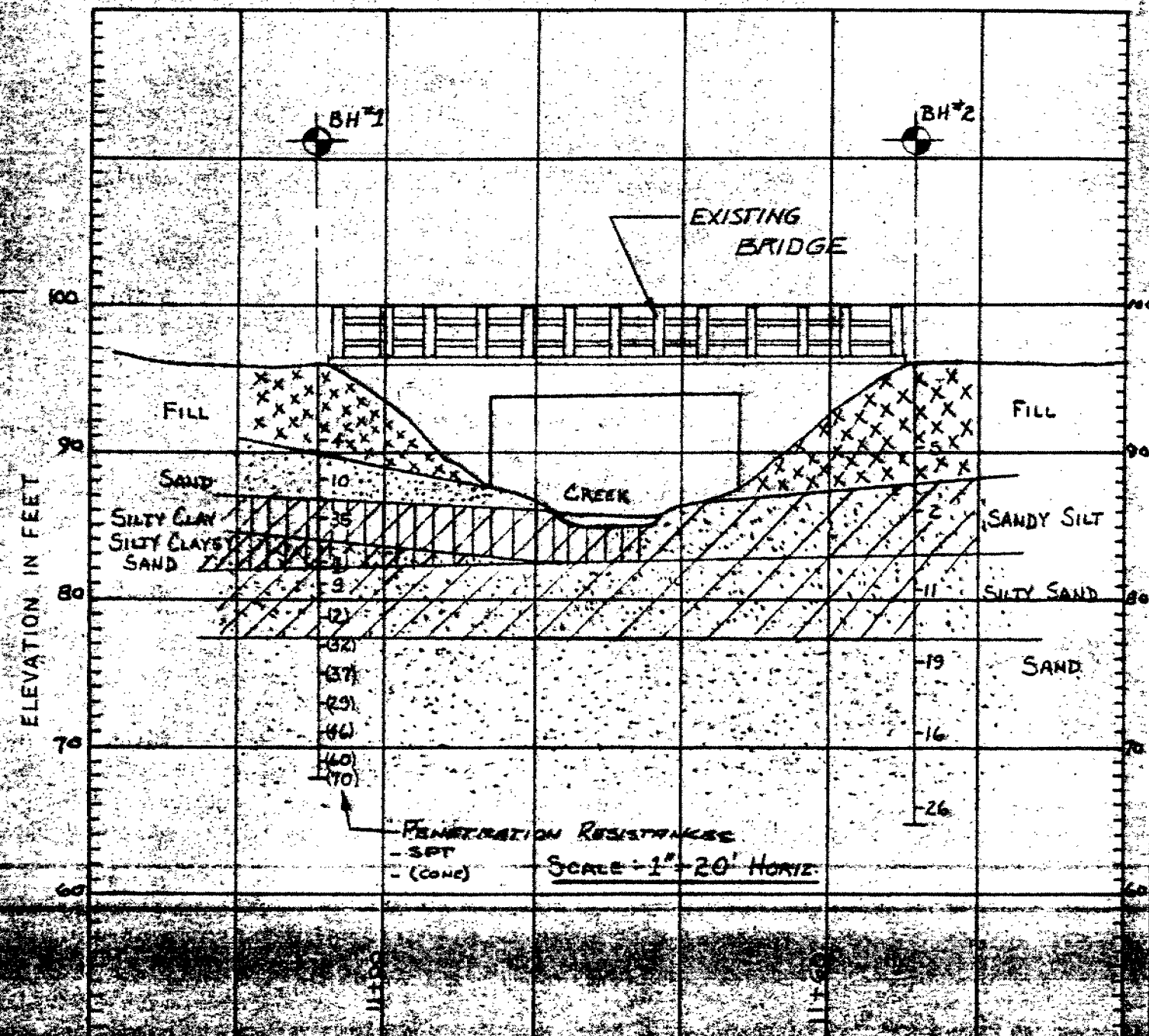
Penetration Resistance: (N) Indicates number of blows, of a 140-lb. hammer falling 30 inches, required to drive a 2" OD Drive Sampler a distance of 1 foot into the soil. This resistance is used to assess the relative density of cohesionless soils and the relative consistency of cohesive soils.

OTHER TESTS

- M - Grain size analysis using sieves or hydrometer or both - plotted graphically on a separate sheet.
- q_u - unconfined compressive strength.
- τ_f - field vane tests.
- τ_l - laboratory vane tests.
- γ_d - dry unit weight.
- C - consolidation test - results on a separate sheet.
- T - triaxial compression test - results on a separate sheet.



INFERRED SOIL STRATIGRAPHY



NOTE: SOIL DATA APPLIES ONLY TO THE ACTUAL BOREHOLE
 CONDITIONS MAY BE DIFFERENT AT OTHER PARTS
 OF THE SITE.

SITE INVESTIGATION SERVICES LIMITED

NESBITT BRIDGE (SITE No 146)
COUNTY OF ONTARIO

SCALE: As Shown | DWN. BY R.J.E. | DATE: Sept/70 | FIGURE No. 1

OSHAWA SUBURBAN ROAD COMMISSION

605 ROSSLAND ROAD EAST

WHITBY, ONTARIO

REPORT ON FOUNDATION CONDITIONS

~~EAST OSHAWA CREEK BRIDGE~~

OSHAWA SUBURBAN ROAD #3

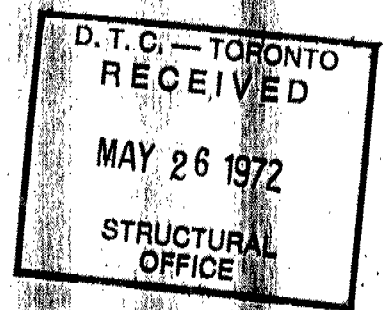
BRIDGE

TOWNSHIP OF EAST WHITBY

STRUCTURE SITE NO. 22-306

JOB NO. 71-87

OCTOBER 1971



SOILS REPORT - OSHAWA CREEK BRIDGE, SUBURBAN ROAD #3

TABLE OF CONTENTS

<u>HEADING</u>	<u>PAGE NO.</u>
INTRODUCTION	1
SOIL CONDITIONS	2 - 3
FOUNDATION CONSIDERATIONS	3
EXCAVATION CONSIDERATIONS	4
SCOUR PROTECTION	4
EROSION PROTECTION	5
LOCATION PLAN	FIGURE 1
SITE PLAN & INFERRED SOIL STRATIGRAPHY	FIGURE 2
BOREHOLE SUMMARIES	FIGURES 3 and 4
EXPLANATION OF SYMBOLS & TERMINOLOGY	APPENDIX "A"

SOILS REPORT - OSHAWA CREEK BRIDGE, SUBURBAN ROAD #3

INTRODUCTION

As part of the proposed reconstruction of Oshawa Suburban Road #3, it will be necessary to provide a new structure for the East Oshawa creek crossing at station 54+00±. A diversion of the creek is also planned. The proposed bridge site is located in Lot 9, Concession VI of East Whitby Township, as indicated on the Location Plan, Figure 1. At the request of Mr. W. Twelvetrees of the Oshawa Suburban Road Commission, an investigation of subsoil conditions has been carried out at the above site.

The field work for the soils investigation was done on September 9 1971 using a truck-mounted hollow stem power auger drill. Two boreholes were drilled to a minimum depth of 30 feet at the locations shown on the site plan portion of Figure 2. Samples were collected at 2- to 5-foot intervals with a 2-inch open-end drive sampler, while recording standard penetration resistances (ie=N-values). Elevation references for the boreholes were obtained from the plan and profile provided by the Commission.

This report summarizes the results of the soils survey and presents recommendations for the foundation design. A site plan and an inferred soil stratigraphy are outlined on Figure 2. Individual borehole data summaries are included as Figures 3 and 4, while Appendix "A" lists some of the soils symbols and terminology used in the report.

SOILS REPORT - OSHAWA CREEK BRIDGE, SUBURBAN ROAD #3

SOIL CONDITIONS

The site lies in a drumlinized till plain known as the South Slope, an area separating the glacial lake Iroquois Plain from the interlobate Oak ridges Moraine to the north. Locally, the East Oshawa Creek has cut a meandering channel into the till plain and deposited fine sand silt on the floor of the creek valley.

The subsoils at the site consist mainly of compact sand with some gravel content. A veneer (5 ft.) of loose fine sand and silt covers the compact sand at BH #2, while east of the proposed structure, at BH #1, the upper 13 feet of the overburden consists of very loose to loose fine to medium sand. The looseness of the sand (N=4 to 8 blows per foot) suggests that it is a post-glacial outwash deposit.

Below elevation 523 feet, approximately, the sandy subsoils become very dense with standard penetration resistances ranging from 35 to over 100 blows/ft. The dense sand zone continues below elevation 501.6 feet which was the maximum depth investigated.

Aside from the upper silt and peat material in BH #2 the only other variation from a sand texture in the soil deposits at this site occurred between elevation 522 and 525.5 feet in BH #2 where a layer of stiff sandy silt was encountered.

(SOIL CONDITIONS continued on next page)

SOILS REPORT - OSHAWA CREEK BRIDGE, SUBURBAN ROAD #3

SOIL CONDITIONS (cont.)

The natural ground water table in the relatively free-draining sand subsoils is controlled by the level of East Oshawa Creek. At the time of the field work, the creek water level was at elevation 533 feet.

FOUNDATION CONSIDERATIONS

In order to use conventional spread footings at this site, it is recommended that they be located at or below elevation 522 feet in the very dense sand stratum at that level. The allowable loading for the footings placed at this level on undisturbed ground should not exceed 7000 lbs/sq. ft. for design purposes.

Because of potential dewatering problems at this site (see following section), a pile-supported structure should be considered as an alternative to spread footings. A displacement-type pile such as a closed-end pipe pile or a timber pile is recommended.

It is anticipated that piles would be driven to elevation 510 feet, approximately, where the allowable capacity of a size 12 timber pile would be 20 to 25 tons and that of a 10 3/4-inch pipe pile would be 50 to 60 tons. The above values are for estimating purposes; the actual pile design selected should be reviewed to determine design capacities.

SOILS REPORT - OSHAWA CREEK BRIDGE, SUBURBAN ROAD #3

EXCAVATION CONSIDERATIONS

Excavation at this site will be mainly in fine sand with silt lenses and medium to coarse sand lenses. In order to remove material below the water table, it will be necessary to lower it below the level of the excavation.

The most effective technique for dewatering this site would be a well-point system. The effective use of well points will allow construction of footings "in the dry" and reduces the possibility of "quicking" conditions which would loosen and disturb the subsoils below the footing level.

SCOUR PROTECTION

The recommended depth for footings will result in about 7 or 8 feet of cover over the footings in the channel area. This should provide adequate scour protection although the fine sand below the river bed will be highly erodable. If severe flooding of the East Oshawa Creek is expected, then scour protection of the channel should be considered.

A pile-type foundation on the other hand has much superior resistance to scour activity. No special scour protection will be required if piles are used to support this structure.

SOILS REPORT - OSHAWA CREEK BRIDGE, SUBURBAN ROAD #3

EROSION PROTECTION

The approach embankments for this structure will probably be composed of the fine silty sand from the adjacent cut to the east. This material will be easily eroded and will require rip-rap protection up to the high water level. Sodding of the slopes above that level will protect the slopes against runoff erosion.



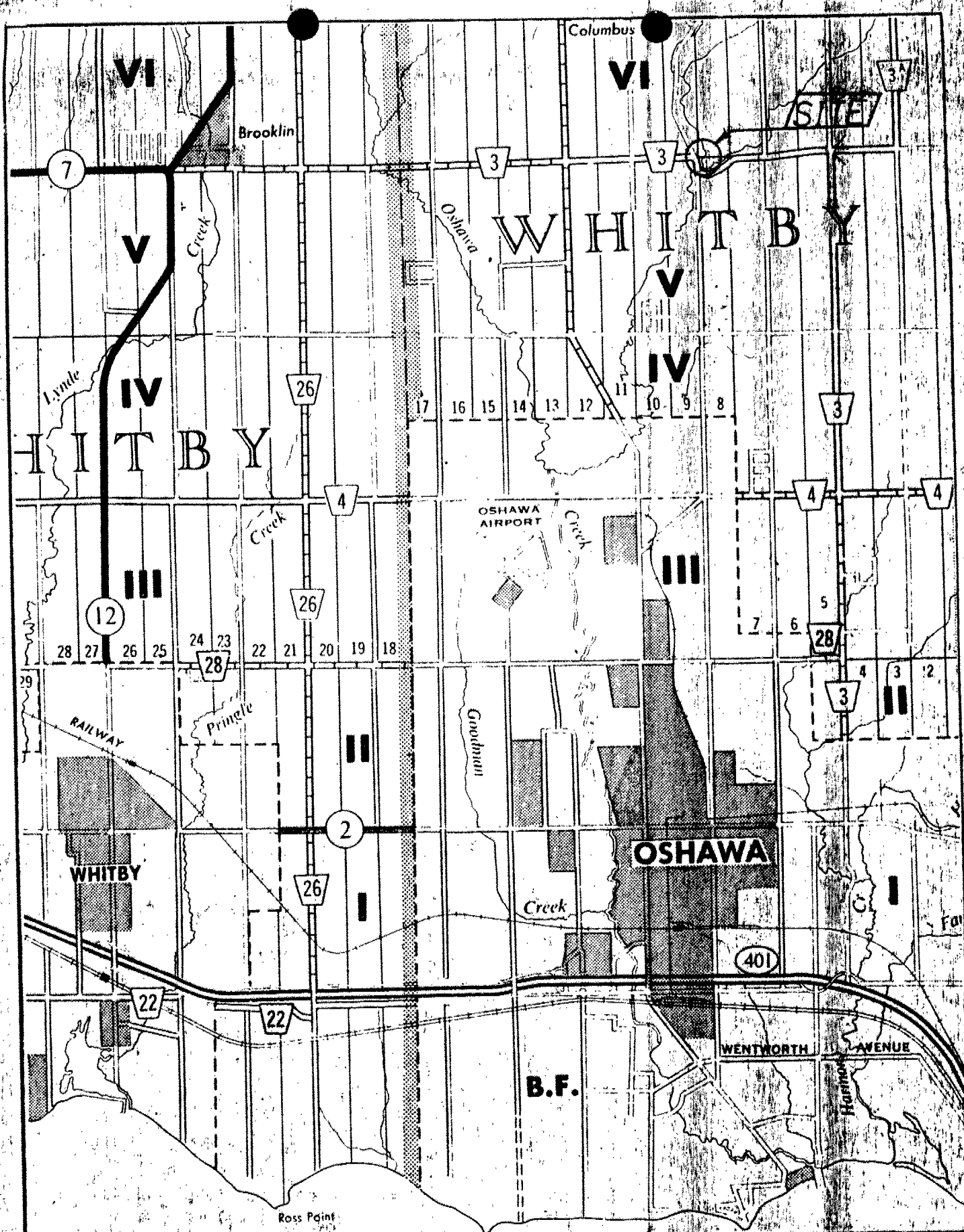
JAH/df

Submitted by:

SITE INVESTIGATION SERVICES LIMITED

per


J. A. HAYES, P. ENG.



SITE INVESTIGATION SERVICES LTD.

STRUCTURE - LOT 9, CONC. IV,

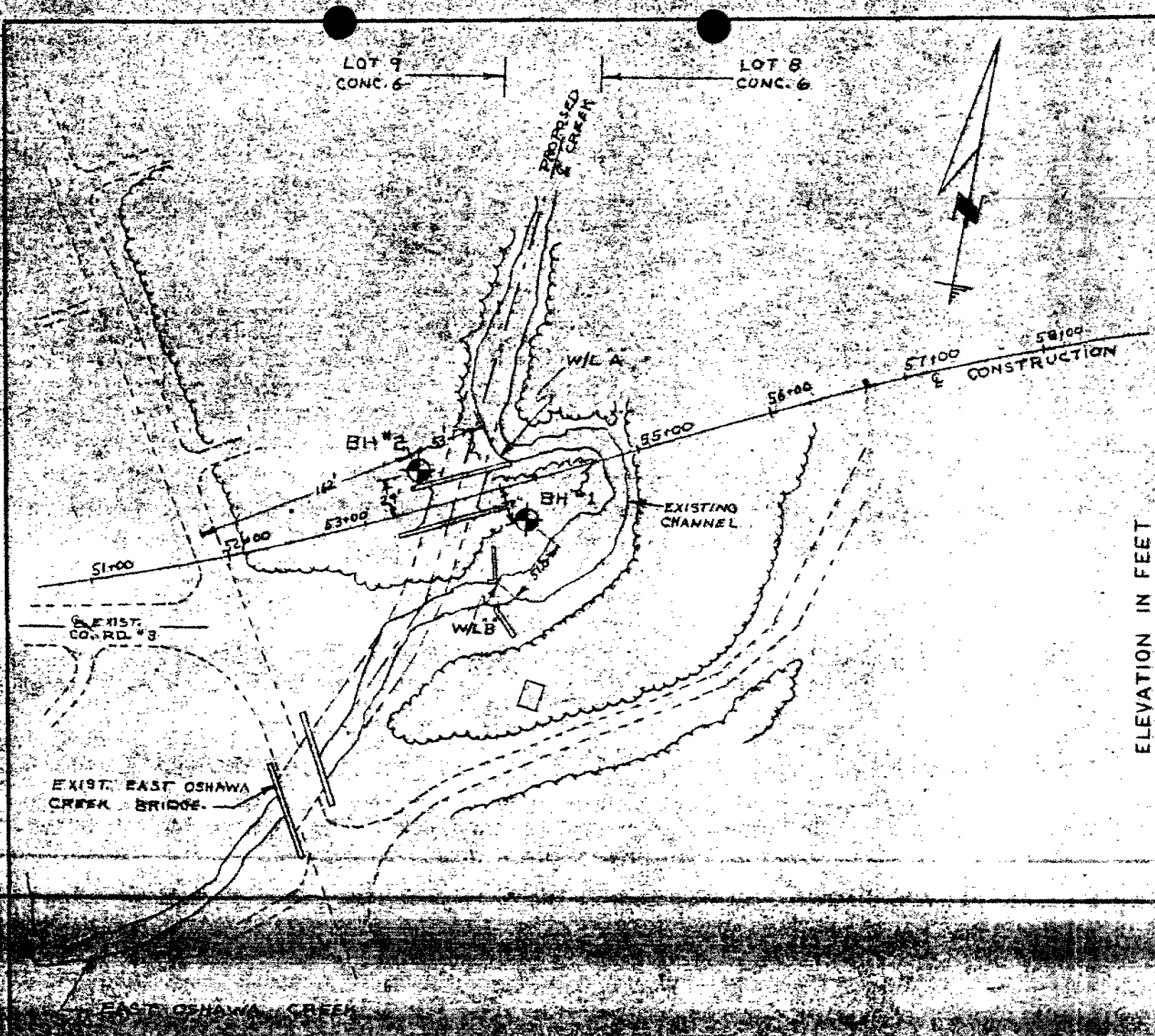
TWP. OF EAST WHITBY

SCALE: 1" = 1 mi

DRAWN: R.E.

DATE: SEPT./71

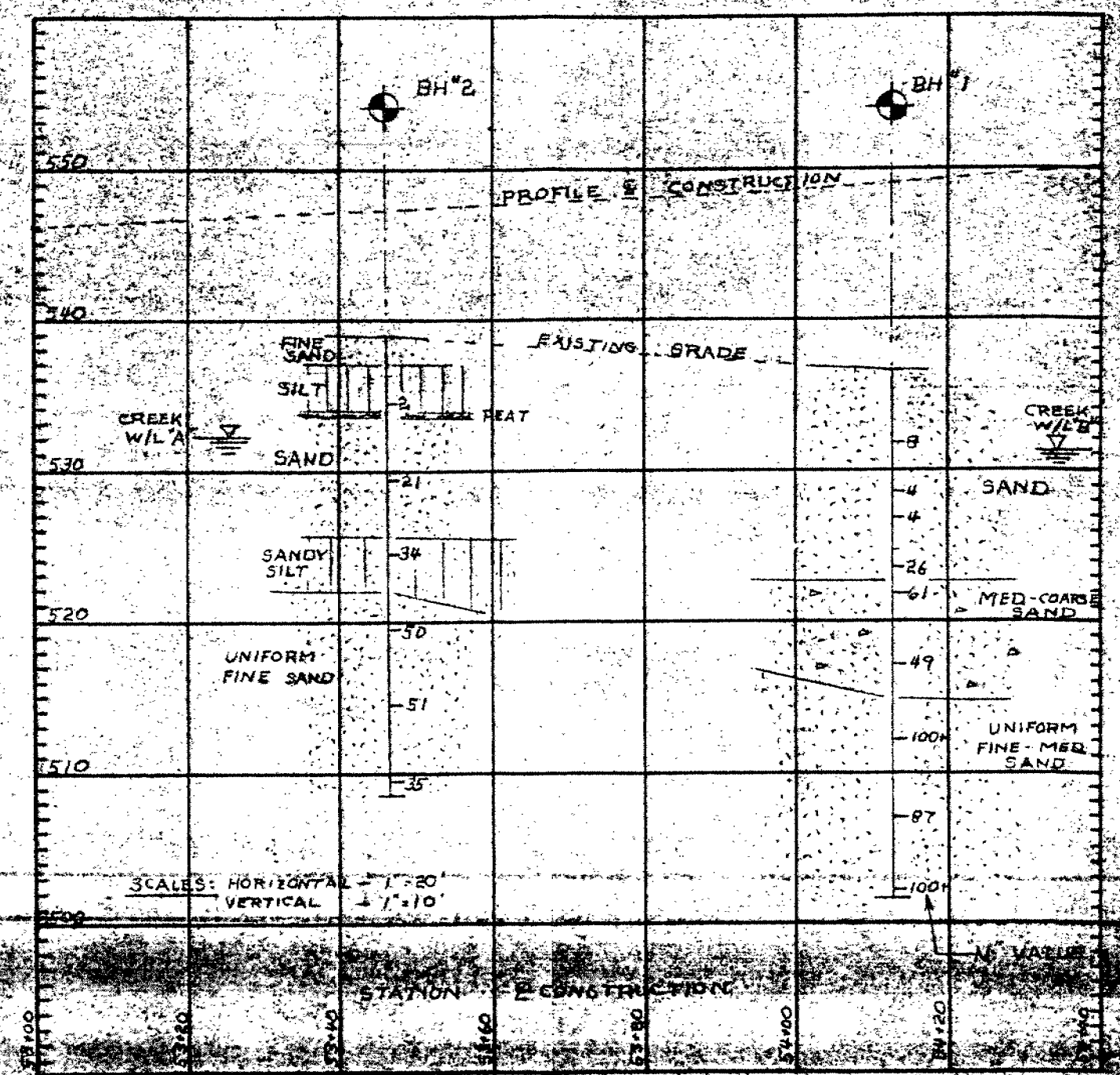
FIGURE 1



SITE PLAN

SCALE: 1" = 100'

INFERRED SOIL STRATIGRAPHY



NOTE: SOIL DATA APPLIES ONLY TO THE ACTUAL BOREHOLE LOCATION. CONDITIONS MAY BE DIFFERENT AT OTHER PARTS OF THE SITE.

SITE INVESTIGATION SERVICES LIMITED

STRUCTURE
 OSHAWA SUBURBAN ROAD # 3
 LOT 9, CONCESSION VI, WHITBY TWP

MAILING ADDRESS
P.O. Box 216, Postal Station "K"
TORONTO 12, ONT.



MONTREAL, QUEBEC
620 CATHCART ST.
UNIVERSITY 6-6871

RAYMOND
CONCRETE PILE COMPANY, LIMITED

HIGHWAY NO. 7, UNIONVILLE, ONTARIO

293-2486

TELEPHONES

364-3644

SOIL INVESTIGATION REPORT

PROJECT: Proposed Bridge Reconstruction

SITE: Doherty's Bridge
Concession 7, Whitby Township

CLIENT: County of Ontario
Whitby, Ontario.

TOPOGRAPHY: At the time of the field work, a location plan and profile were supplied by the County. Elevations were supplied, based on a bench mark as shown on the borehole location plan.

DATE OF FIELD WORK: 21 November to 22 November 1961

OUR JOB NUMBER: Raylin B-1230-T

CLIENT'S PROJECT NUMBER: B - 63

DATE OF REPORT: 1 December 1961.

INTRODUCTION

Two boreholes were made by the Raymond Concrete Pile Co. Ltd. at the above site, for purposes of evaluating soil conditions for foundation design of the proposed bridge construction.

The borings were made by standard exploratory techniques, using 2 1/2" casing. The Standard Penetration Test was performed every 2 to 3 feet to a depth of 15 feet, and at 5 foot intervals thereafter.



INTRODUCTION - Continued

A record was kept of the number of blows required to drive the 2" O.D. Sampling Spoon one foot, using a 140 lb. weight falling freely 30 inches. Soil samples were obtained after completion of each driving test.

Ground water levels were not observed. However, due to the granular nature of the soil deposits and nearness of the stream, for all intent and purpose the ground water level would be that of the stream.

SOIL CONDITIONS

Soil conditions observed at the two locations were similar and are loose to dense brown gravelly sand underlying 6 inches to 2'-4" of topsoil, extending to a depth of 8.5 feet below ground surface. Underlying the brown sand is a dense very silty fine grey sand, extending to completion of both boreholes. At the location of borehole #2 the grey sand extended to elevation 40, at which depth the N value is recorded as 100 blows for 9 inches, or practical refusal.

CONCLUSIONS

Assuming that the bridge foundations will be placed some 3 to 4 feet below present creek bottom, this would place the bottom of the foundation at approximate elevation 51.

Below elevation 51 foundations will be in the dense grey sand having an average minimum N value of 26, this being based on borehole #1. With an N value of 26, and making reference to Terzaghi and Peck, a soil bearing value of 4000 pounds per square foot is recommended with a maximum allowable settlement of 1 inch.

RAYMOND
CONCRETE PILE CO., LIMITED

PAGE NO.

3

CONCLUSIONS - Continued

It is pointed out that with the deposits being sand, as excavations are taken below the ground water level, water problems will arise, and if a differential hydrostatic head is formed, a possible "quick" condition will be formed. This condition should not be allowed, since it will affect and reduce the above bearing value.

RAYMOND CONCRETE PILE COMPANY LIMITED

James Hodd

jh/c

James Hodd, P. Eng.
Manager - Soil Investigation Department

RAYMOND

CONCRETE PILE COMPANY LTD.

LOCATION PLAN

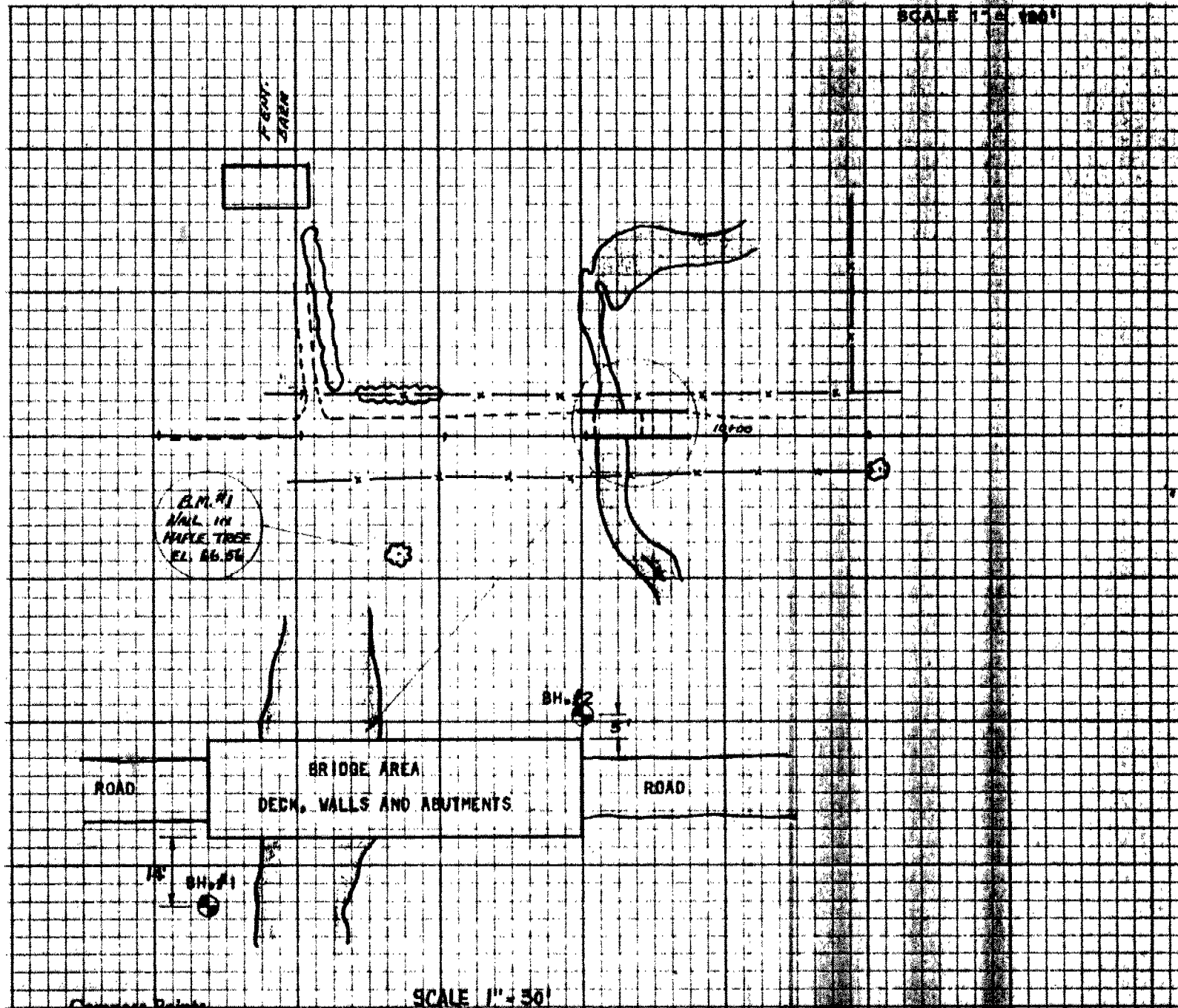
To COUNTY OF ONTARIO

Date NOVEMBER 19 61

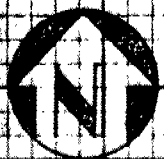
Address WHITBY, ONTARIO

Project B-68 DEHART'S BRIDGE

CON. 7, TOWNSHIP OF WHITBY



Compass Points



This boring report prepared in the
 TORONTO OFFICE of the
 Raymond Concrete Pile Company Ltd.

By J. H. HODD
 J.G.B. S.B. B-1230-1
 Page 61

TEST BORING REPORT RAYMOND

CONCRETE PILE COMPANY LTD.

SOIL TEST DIVISION

To COUNTY OF ONTARIO

Date NOVEMBER 1961 Job No. 8-1230-1

Location of Borings DEHART'S BRIDGE, CON. 7, WHITBY TOWNSHIP

All borings are plotted to a scale of 1" = 8 ft. using BENCH MARK AS SHOWN as a fixed datum.

No. _____

No. 1 _____

No. _____

No. 2 _____

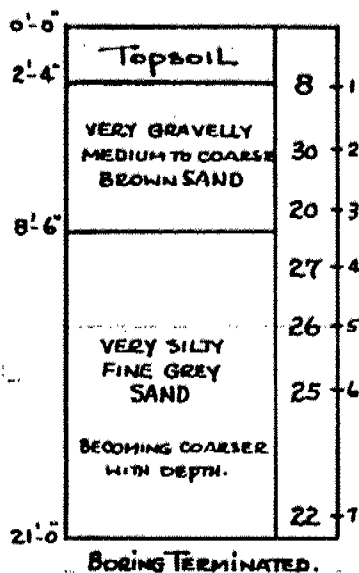
ELEVATION

70.0

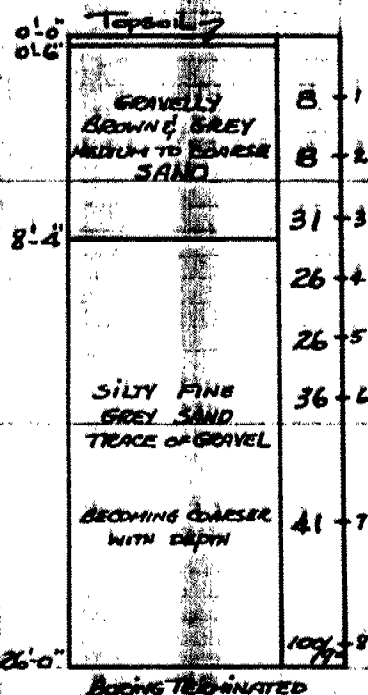
60.0

50.0

40.0



CREEK WATER LEVEL

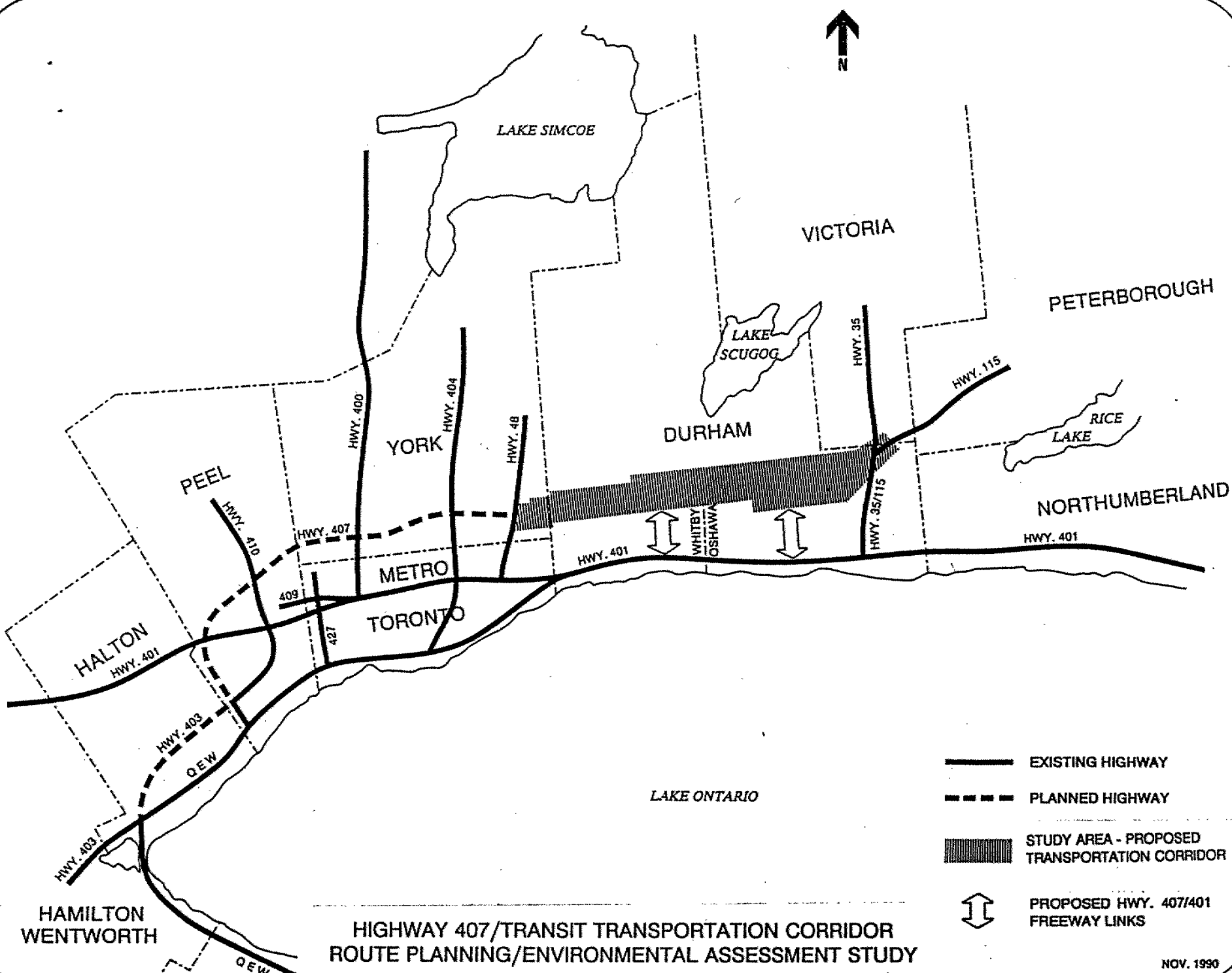


Classifications are made by VISUAL inspection.

Water levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.

Figures in right hand column indicate number of blows required to drive 2" O.D. casing nine one foot using 140-lb. weight falling 30 inches

Total Footage _____
Foreman K. KITCHENER
Classification by K. KITCHENER
Sheet _____ of _____



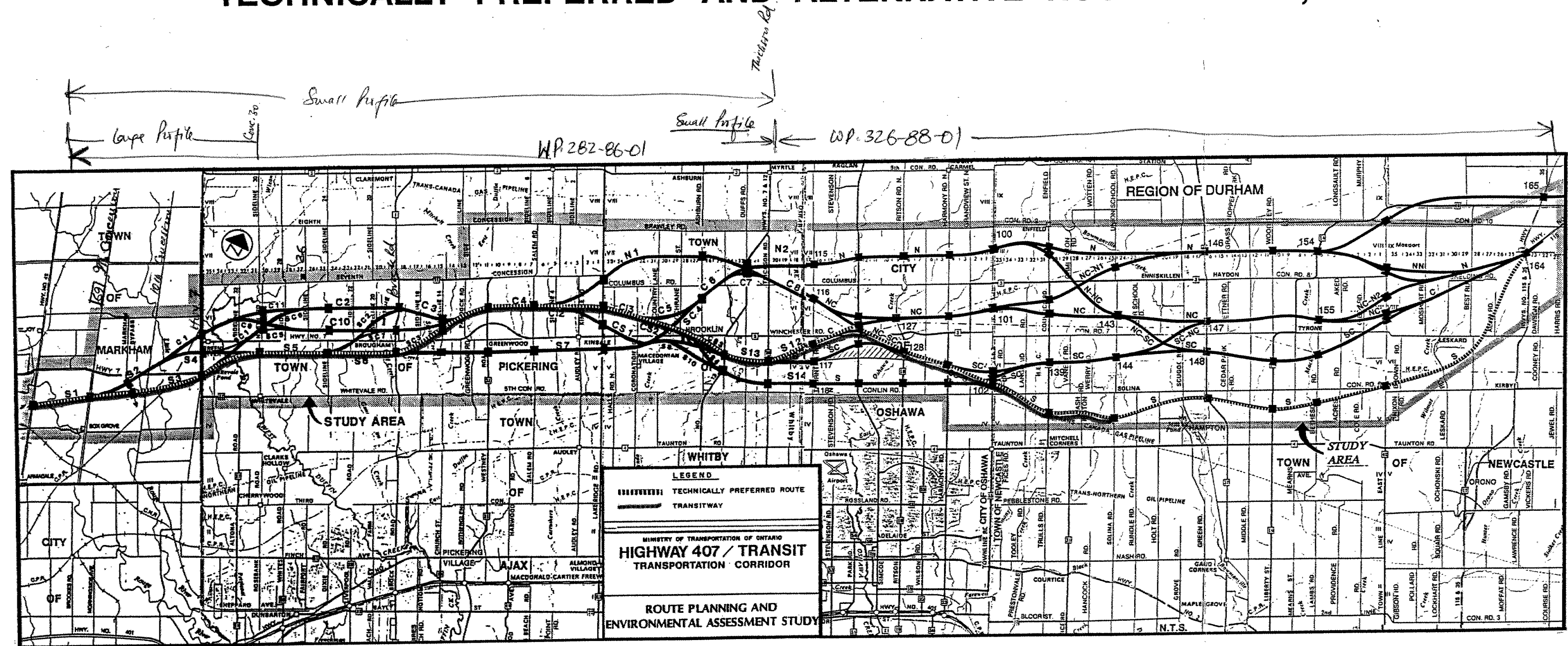
HIGHWAY 407/TRANSIT TRANSPORTATION CORRIDOR
ROUTE PLANNING/ENVIRONMENTAL ASSESSMENT STUDY

NOV. 1990

HWY 407/TRANSIT ROUTE PLANNING AND ENVIRONMENTAL ASSESSMENT STUDY

(HWY 48 TO HWY 35/115)

TECHNICALLY PREFERRED AND ALTERNATIVE ROUTES -- MAY, 1991





MEMORANDUM

TO	Mr. Pat Reynolds, P.Eng. MTO Transportation Section	DATE	May 30/90
FROM	I. Corbett, P.Eng. - Geocon	PROJECT No.	53425/T11547-2
SUBJECT			

RE: HIGHWAY 407 ROUTE PLANNING AND
ENVIRONMENTAL ASSESSMENT STUDY
PRELIMINARY ROUTES - GEOTECHNICAL APPRAISAL
WHITBY-OSHAWA BOUNDARY EAST TO HWY 115/35 - PARKER SECTION
WP 326-88-01

This memo outlines the results of our preliminary geotechnical appraisal of the proposed alternative routes for Highway 407 between the Whitby-Oshawa Boundary east to Highway 115/35. A copy of these routes, as supplied by C.C Parker Consultants Ltd., indicates that four basic routes are under consideration. Specifically, these include a Southerly Route (denoted S), two Central Routes (denoted NC and SC) and a North Route (denoted N). In addition to these main route corridors, several short parallel sections and/or crossovers between the four alignments are also under review at this time.

We understand that these routes are still preliminary and that they do not represent the final alignments to be subjected to a detailed route comparison study. However, at this stage of the route selection process, a preliminary appraisal of the geotechnical conditions along each of the proposed routes is required.

Geotechnical Appraisal

A preliminary analysis of the prevailing geotechnical conditions for this portion of the Highway 407 Route Corridor was presented in a Technical Paper by Geocon, issued in Draft format on January 26, 1990. Within that report, Drawing T11547B-02 presented the location of "Geotechnical Hazards" within this area of the route corridor. At this preliminary stage, the geotechnical appraisal of the proposed route alignments has been limited to their interaction with these identified areas. It should be noted, that the geotechnical hazard areas presented on the above quoted drawing, were selected based largely on air-photo interpretation and their anticipated geotechnical conditions have not been confirmed by field investigation.

Mr. Pat Reynolds, P.Eng.
MTO Transportation Section
May 30/90
Page 2

In general, the proposed routes are favourably located with respect to the geotechnical hazards indicating, that for the majority of their lengths the routes traverse areas with good foundation conditions with respect to allowable bearing pressure, slope stability, etc. However, as discussed in the technical paper, the region to the North and East of this portion of the route corridor is located either on or close to the Oak Ridges Moraine and subsequently comprises an area of quite high relief. While the subsoils in this region are considered competent, it is anticipated that, due to the undulating nature of the terrain, deep cuts and fills will be required for any potential alignment traversing this section. To the South and West, away from the Oak Ridges Moraine, the fine grained nature of the subsoils render the subgrades frost susceptible.

A detailed analysis of the interrelationship between the proposed routes and the geotechnical hazards, is presented in Table 1. Also contained in Table 1, is a brief statement on the anticipated geotechnical conditions within the hazard area. Three areas are of particular note, namely two areas of high water table located to the southwest of Enfield and the southwest of Enniskillen, and the Oak Ridges Moraine. In both of the former areas, the anticipated subsoil conditions are considered to be comprised of deposits which will be both soft and deep. Expected problems within the latter area will be as discussed above.

In conclusion therefore, at this preliminary stage, the geotechnical conditions along the North Route appear to limit the viability of this route. However, we understand that a potential route in this region of the route corridor is required for evaluation purposes. The identified hazardous areas along the remaining routes (Table 1), consist of a small percentage of the total route lengths and are representative of the range of geotechnical conditions that typically exist within these lengths of the route corridors. The full impact of these variations and those of the northern route together with other pertinent geotechnical conditions will be addressed during the detailed route comparison stage when more site specific information on the subsurface conditions within the identified hazard areas at other key locations will have been obtained.

Mr. Pat Reynolds, P.Eng.
MTO Transportation Section
May 30/90
Page 3

We trust that this preliminary geotechnical appraisal is sufficient for your present needs. Should you have any questions or require any further information, please do not hesitate to contact this office.

IC:dtj

cc: Mr. Doug Coutts, P.Eng.
C.C. Parker Consultants

Enclosed:

Table 1 - Highway 407 Route Planning and Environmental Assessment Study.
Proposed Routes - Preliminary Geotechnical Appraisal.
Whitby/Oshawa Boundary East to Highway 115/35.

TABLE 1
HIGHWAY 407 ROUTE PLANNING AND ENVIRONMENTAL ASSESSMENT STUDY
PROPOSED ROUTES - PRELIMINARY GEOTECHNICAL APPRAISAL
WHITBY/OSHAWA BOUNDARY EAST TO HIGHWAY 115/35

Identification	Assumed Route Limits		Length (km)	Geotechnical Hazards Within Route Limits	Anticipated Associated Geotechnical Conditions
N	Whitby/Oshawa Boundary	Hwy 115/35	26.9	<p>Erosion along creek at Ritson Road</p> <p>Areas of high water table</p> <ul style="list-style-type: none"> - 1.2 East of Ritson Road - at West Townline Road - immediate vicinity of Enfield Road - at Solina Road - 50 m East of Regional Road 14 <p>Areas of High Water Table</p> <p>1.0 km East of West Townline Road</p> <p>East of Aked Road undulating terrain</p>	<p>Erosion Protection at creek crossing</p> <p>Shallow *3 Soft Deposits</p> <ul style="list-style-type: none"> 100 m long 50 m long 100 m long 200 m long 150 m long <p>Deep*3 Soft Deposits</p> <p>120 m long</p> <p>Potential deep cuts and/or fills</p>
NC	Whitby/Oshawa Boundary	Darlington Townline Road	21.8	<p>Erosion along creek at Ritson Road</p> <p>Areas of High Water Table</p> <ul style="list-style-type: none"> - 2.5 km East of Thornton Road - 4.0 km East of Grandview Road - 20 m East of West Townline Road - at Regional Road 14 <p>Areas of High Water Table</p> <ul style="list-style-type: none"> - 200 m East of Holt Road <p>East of Aked Road undulating terrain</p>	<p>Erosion protection at creek crossing</p> <p>Shallow Soft Deposits</p> <ul style="list-style-type: none"> - 50 m long - 300 m long - 100 m long - 150 m long <p>Deep Soft Deposits</p> <ul style="list-style-type: none"> - 250 m long <p>Potential deep cuts and/or fills</p>
SC	Whitby/Oshawa Boundary	Darlington Townline Road	22.0	<p>Areas of High Water Table</p> <ul style="list-style-type: none"> -300 m East of Harmony Road -100 m West of Old Scugog Road - at Bethesda Road 	<p>Shallow Soft Deposits</p> <ul style="list-style-type: none"> - 100 m long - 150 m long - 150 m long

TABLE 1
HIGHWAY 407 ROUTE PLANNING AND ENVIRONMENTAL ASSESSMENT STUDY
PROPOSED ROUTES - PRELIMINARY GEOTECHNICAL APPRAISAL
WHITBY/OSHAWA BOUNDARY EAST TO HIGHWAY 115/35

Identification	Assumed Route Limits		Length (km)	Geotechnical Hazards Within Route Limits	Anticipated Associated Geotechnical Conditions
SC (cont'd)				East Aked Road undulating Terrain	Potential Deep Cuts and/or Fills
S	Whitby/Oshawa	Hwy 115/35	29.8	Areas of High Water Table - 300 m East of Leask Road - at Cole Road - at Regional Road 42	Shallow Soft Deposits - 150 m long - 100 m long - 150 m long
				Erosion along creek, 700 m West of Ritson Road	Erosion protection at creek crossing
				East of Aked Road Undulating Terrain	Potential Deep Cuts and/or Fills
C	Whitby/Oshawa Boundary	Ritson Road	3.6	None	
C	Darlington Townline Road	Hwy 115/35	5.5	Area of High Water Table 300 m West of Mosport Road	Shallow Soft Deposits - 150 m long
NC-SC	Simcoe Road	Ritson Road	1.7	None	
(SC-S) (S-SC)	Harmony Road	Courtice Road	3.9	None	
NC-N1	West Townline Road	1.6 km West of Regional Road 57	6.4	Area of High Water Table at Courtice Road	Shallow Soft Deposits - 170 m long
N-NC	Enfield Road	Solina Road	3.3	None	
SC-NC	Holt Road	Regional Road 57	2.0	Area of High Water Table 0.5 km East of Holt Road	Deep Soft Deposits - 200 m long
NC-N2	Bethesda Road	Darlington Townline Road	2.4	Area of High Water Table 200 m East of Bethesda Road	Shallow Soft Deposits - 100 m long

TABLE 1
HIGHWAY 407 ROUTE PLANNING AND ENVIRONMENTAL ASSESSMENT STUDY
PROPOSED ROUTES - PRELIMINARY GEOTECHNICAL APPRAISAL
WHITBY/OSHAWA BOUNDARY EAST TO HIGHWAY 115/35

Identification	Assumed Route Limits		Length (km)	Geotechnical Hazards Within Route Limits	Anticipated Associated Geotechnical Conditions
	From	To			
NC-N2 (cont'd)				East of Aked road Undulating Terrain	Potential Deep Cuts and/or Fills

1) Geotechnical hazards as noted were interpreted from Geocon Drawing No. T11547B-2 entitled "Highway 407 Route Planning and Environmental Assessment Study (Whitby/Oshawa Boundary East to I35/115) (WP-282-06-01) - GEOTECHNICAL HAZARDS"

2) Routes analyzed were presented on Drawing supplied by Parker Consultants dated May 1, 1990.

3) In the above table "Shallow" refers to deposits less than 3.0 m thick and "Deep" represents deposits between 3 and 10 m thick.



MEMORANDUM

TO Mr. Pat Reynolds, P.Eng.
MTO Transportation Planning Section DATE May 30/90

FROM I. Corbett, P.Eng. - Geocon PROJECT No. 53425/T11547-1

SUBJECT

RE: HIGHWAY 407 ROUTE PLANNING AND
ENVIRONMENTAL ASSESSMENT STUDY
PROPOSED ROUTES - PRELIMINARY GEOTECHNICAL APPRAISAL
HIGHWAY 48 EAST TO WHITBY-OSHAWA BOUNDARY

WP 282-86-01

- FENCO Section

This memo outlines the results of our preliminary geotechnical appraisal of the proposed alternative routes for Highway 407 between Highway 48 east to the Whitby-Oshawa Boundary. A copy of these routes, as supplied by Fenco Engineers Inc., indicates that from Highway 48 to Salem Road, two basic routes are under consideration. Specifically, these include a Southerly Route (denoted S) and a Central Route (denoted C). East of Salem Road, a third potential alignment, to the north of the Central Route (denoted N), is also under consideration. In addition to these main route corridors, several short parallel sections and/or crossovers between the three alignments are also under review at this time.

We understand that these routes are still preliminary and that they do not represent the final alignments to be subjected to a detailed route comparison study. However, at this stage of the route selection process, a preliminary appraisal of the geotechnical conditions along each of the proposed routes is required.

Geotechnical Appraisal

A preliminary analysis of the prevailing geotechnical conditions for this portion of the Highway 407 Route Corridor was presented in a Technical Paper by Geocon, issued in Draft format on January 26, 1990. Within that report, Drawing T11547A-02 presented the location of "Geotechnical Hazards" within this area of the route corridor. At this preliminary stage, the geotechnical appraisal of the proposed route alignments has been limited to their interaction with these identified areas. It should be noted, that the geotechnical hazard areas presented on the above quoted drawing, were selected based largely on air-photo interpretation and their anticipated geotechnical conditions have not been confirmed by field investigation.

In general, the proposed routes are favourably located with respect to the geotechnical hazards indicating, that for the majority of their lengths the routes traverse areas with good foundation conditions with respect to allowable bearing pressures, slope stability, etc. However, as discussed in the technical paper, the predominant foundation soils within this portion of the route corridor comprise of frost susceptible materials. These conditions are however applicable to all of the routes and are not discussed further.

A detailed analysis of the interrelationship between the proposed routes and the geotechnical hazards, is presented in Table 1. Also contained in Table 1, is a brief statement on the anticipated geotechnical conditions within the hazard area. The information presented in Table 1, indicates that the most southerly alignments traverse several extinct gravel pits which will require considerable volumes of fill and as a result, at this very preliminary stage, are less favourable than the Central or Northern routes. Of particular note along the Central Route, is the presence of a high water table area within the C4 route alignment. This area is highlighted because it is anticipated that the soil conditions at this location will be comprised of a combination of deposits which are both soft and deep. As such, special measures will have to be taken to cope with these subsoils such as excavation, isolation or pre-loading. The remaining hazardous areas intersected by the proposed routes, based on available information at this time, are not considered to pose major geotechnical problems although, they will result in an increase in costs above the norm.

In conclusion therefore, none of the proposed routes traverse areas which are considered to comprise of such poor geotechnical conditions to warrant route relocation based on this consideration alone. The identified hazardous areas along the routes, as outlined in Table 1, consist of a small percentage of the total route lengths and are representative of the range of geotechnical conditions that typically exist within these lengths of the route corridors. The full impact of these variations and other pertinent geotechnical conditions will be addressed during the detailed route comparison stage when more site specific information on the subsurface conditions within the identified hazard areas and at other key locations will have been obtained.

Mr. Pat Reynolds, P.Eng.
MTO Transportation Planning Section
May 30/90
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We trust that this preliminary geotechnical appraisal is sufficient for your present needs. Should you have any questions or require any further information, please do not hesitate to contact this office.

IC:dtj

cc: Mr. Ian Upjohn, P.Eng.
Fenco Engineers Inc.

Enclosed:

Table 1 - Highway 407 Route Planning and Environmental
Assessment Study.
Proposed Routes - Preliminary Geotechnical Appraisal
Highway 48 East to Whitby/Oshawa Boundary

TABLE 1
HIGHWAY 407 ROUTE PLANNING AND ENVIRONMENTAL ASSESSMENT STUDY
PROPOSED ROUTES - PRELIMINARY GEOTECHNICAL APPRAISAL
HIGHWAY 48 EAST TO WHITBY/OSHAWA BOUNDARY

Identification	Assumed Route Limits		Length (km)	Geotechnical Hazards Within Route Limits	Anticipated Associated Geotechnical Conditions
	From	To			
S1	Highway 48	Ninth Line	2.2	None	
S2	Ninth Line	Regional Road 30	4.9	None	
S3	Ninth Line	North Road	6.8	None	
S4	Tenth Line	Regional Road 30	2.1	None	
SC1	Regional Road 30	Sideline 30	2.7	None	
S5	North Road	Sideline 24	2.5	High Water Table Area 100 m West of Sideline 24	Shallow*3 Soft Deposits - Length 200 m
S6	Sideline 24	Westney Road	5.9	High Water Table Area - East of Sideline 24 Gravel Pit - 1.0 km East of Sideline 24 Gravel Pit - 4.5 km East of Sideline 24	Shallow Soft Deposits - Length 250 m Deep Road Fills - Length 200 m Deep Road Fills - Length 350 m
SC2	Sideline 24	Brock Road	3.0	High Water Table Area East of Sideline 24	Shallow Soft Deposits - Length 300 m
SC3	Brock Road	Sideline 1	2.2	None	
S7	Westney Road	Coronation Road	5.6	High Water Table Area - 1.3 km East of Westney Road Gravel Pit - 2.5 km East of Westney Road Gravel Pit - 4.0 km East of Westney Road	Shallow Soft Deposits - Length 250 m Deep Road Fills - Length 250 m Deep Road Fills - Length 200 m
SC4	Coronation Road	Regional Road 1	3.1	Gravel Pit - Adjacent to Coronation Road	Deep Road Fills - Length 300 m
S8	Coronation Road	Highway 12	3.5	Gravel Pit - Adjacent to Coronation Road	Deep Road Fills - Length 250 m

TABLE 1
HIGHWAY 407 ROUTE PLANNING AND ENVIRONMENTAL ASSESSMENT STUDY
PROPOSED ROUTES - PRELIMINARY GEOTECHNICAL APPRAISAL
HIGHWAY 48 EAST TO WHITBY/OSHAWA BOUNDARY

Route Identification	Assumed Route Limits		Length (km)	Geotechnical Hazards Within Route Limits	Anticipated Associated Geotechnical Conditions
	From	To			
S9	Coronation Road	Thickson Road	5.0	Gravel Pit - Adjacent to Coronation Road	Deep Road Fills - Length 250 m
S10	Highway 12	Whitby/Oshawa Boundary	3.0	High Water Table Area - Immediately East of Highway 12 High Water Table Area - 300 m East of Highway 12	Shallow Soft Deposits - Length 100 m Shallow Soft Deposits - Length 400 m
S11	Thickson Road	Whitby/Oshawa Boundary	1.2	None	
S12	Thickson Road	Whitby/Oshawa Boundary	1.3	High Water Table Area - 0.5 km East of Thickson Road	Shallow Soft Deposits - Length 200 m
C1	Regional Road 30	Sideline 30	2.3	High Water Table Area - Just East of Regional Road 30 River Bank Erosion - 0.5 km East of Regional Road 30	Shallow Soft Deposits - Length 200 m Erosion Protection to Bridge Abutment Across River Possibly Foundation Instability
C2	Sideline 30	Brock Road	5.0	None	
C9	Sideline 30	Sideline 1	7.6	High Water Table Area - 0.7 km East of Brock Road	Shallow Soft Deposits - Length 100 m
C3	Brock Road	Sideline 1	1.7	None	
C4	Sideline 1	Salem Road	3.4	High Water Table Area - 1.0 km East of Sideline 1	Deep*3 Soft Deposits - Length 350 m

TABLE 1
HIGHWAY 407 ROUTE PLANNING AND ENVIRONMENTAL ASSESSMENT STUDY
PROPOSED ROUTES - PRELIMINARY GEOTECHNICAL APPRAISAL
HIGHWAY 48 TO WHITBY/OSHAWA BOUNDARY

Route Identification	Assumed Route Limits			Geotechnical Hazards Within Route Limits	Anticipated Associated Geotechnical Conditions
	From	To	Length (km)		
C5	Salem Road	Regional Road 1	6.4	None	
CS1	Side Road 4	Coronation Road	3.3	Gravel Pit - 3.3 km East of Side Road 4	Deep Road Fills - Length - 80 m
C6	Regional Road 1	Duffs Road	2.1	High Water Table Area - 0.2 km East of Regional Road 1	Shallow Soft Deposits - Length 250 m
C8	Duffs Road	Whitby/Oshawa Boundary	2.4	None	
N1	Salem Road	Duffs Road	8.5	High Water Table Area - 0.3 km East of Pickering Whitby Boundary High Water Table Area - 1.0 km West of Duffs Road	Shallow Soft Deposits - Length 400 m Shallow Soft Deposits - Length 300 m
N2	Duffs Road	Whitby/Oshawa Boundary	2.0	None	

NOTES:

- 1) Geotechnical Hazards as noted above were interpreted from Geocon Drawing No. T11547A-02 entitled "Highway 407 Route Planning and Environmental Assessment Study (Hwy 48 East to Whitby/Oshawa Boundary) (WP-282-86-01) - GEOTECHNICAL HAZARDS"
- 2) Routes analysed were presented on Fenco Engineers' Drawing dated March 27, 1990
- 3) In the above table "Shallow" refers to deposits less than 3.0 m thick and "Deep" represents deposits between 3 and 10 m thick.