

GEOCRES No. 30MS-156

DIST. 4 REGION \_\_\_\_\_

W.P. No. \_\_\_\_\_

CONT. No. \_\_\_\_\_

W. O. No. 2000-11026

STR. SITE No. \_\_\_\_\_

HWY. No. \_\_\_\_\_

LOCATION BURLINGTON STREET  
RECONSTRUCTION

NO. OF PAGES -         



OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. \_\_\_\_\_

REMARKS: \_\_\_\_\_

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SUPPLEMENTARY INVESTIGATION  
PROPOSED BURLINGTON STREET  
RECONSTRUCTION  
HAMILTON, ONTARIO.  
FOR  
THE REGIONAL MUNICIPALITY OF  
HAMILTON-WENTWORTH  
c/o PARKER CONSULTANTS

Distribution:

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Job No. 80 F 240/241

February, 1981.

*GEO. No. 30M5-156*



# PETO MACCALLUM LTD.

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CONSULTING ENGINEERS

(416) 561-2231

(HEAD OFFICE:- 165 CARTWRIGHT AVE., TORONTO M6A 1V5 (416) 789-4105)

Job No. 80F240/241

February 4, 1981.

The Regional Municipality of  
Hamilton-Wentworth,  
c/o Parker Consultants,  
1400 Rymal Road East,  
Hamilton, Ontario.  
LOR 1P0

Attention: Mr. J. W. Disher, P. Eng.,  
Project Manager.

Re: Supplementary Investigation,  
Proposed Burlington St. Reconstruction,  
Hamilton, Ontario.

---

Gentlemen:

We are pleased to present the results of the supplementary geotechnical investigation carried out at the above noted site. Authorization for the work described in the report was contained in The Regional Municipality of Hamilton-Wentworth Purchase Order No's R32183 dated June 24, 1980 and R32639 dated August 29, 1980.

A preliminary geotechnical investigation was carried out in the summer of 1979 and the results presented in Peto MacCallum Ltd. report 79F59, dated October, 1979. The investigation revealed the presence of cobbles and boulders which may adversely affect piles during driving. Secondly, a buried valley was identified in the bedrock





surface in the vicinity of bents 19 to 23, however, the limits of the valley were not well defined during this phase of the work. Thirdly, a significant range in the founding level for a deep foundation system, together with a variation in the bearing material, very dense silt till or shale were identified.

Subsequent to issuance of the preliminary report, the proposed bridge structure was redesigned and the length extended some 400 m to the west.

The purpose of the present investigation was to determine:

- a) the subsurface conditions within the area of the 400 m westerly extension
- b) the driveability of the proposed pile, particularly within areas of boulders identified during the preliminary investigation
- c) the type of bearing material which will be supporting the pile cognizant of the driving resistance encountered together with the recommended pile type and capacity

Two other phases of work carried out concurrently with this investigation include a detailed pavement evaluation and full scale preconstruction pile load tests, described respectively under separate cover in Peto MacCallum Ltd. reports 80F239 and 80F240A.

It was previously recommended that the piles be driven from holes preaugered to a depth of 6 m to minimize disturbance of underground services. Therefore, any obstructions which may exist in the surficial fills should not affect pile driving procedures. Further, the results of the investigation indicate that the



cobbles and boulders detected during the preliminary field work are generally located within the very dense basal silt till unit. Since the driven piles are expected to meet practical refusal within this unit, in areas where it is encountered, the cobbles and boulders are not expected to adversely affect the pile driving operations. Consequently, no problems are anticipated with respect to driveability of the proposed piles.

The proposed pile type, a 324 X 6.3 mm (12.75 X 0.250 in.) steel pipe filled with 20 MPa (3000 psi) concrete driven from a 300 mm diameter hole preaugered to 6.0 m depth, was defined on the basis of a comprehensive economic evaluation by Parker Consultants of alternative foundation systems presented in our preliminary report.

The founding depth at each pier and abutment along the 1433 m long elevated bridge structure was evaluated. The approximate founding level is indicated by a line defined as final refusal on Drawing 1 enclosed with the report. Further details and comments in this regard are presented in tabular format in the report. In general, it is anticipated the proposed 324 X 6.3 mm (12.75 X 0.250 in.) steel pipe piles will meet practical refusal at 10 to 13 m depth (elevation 67 to 69) at the west abutment, and bents 1 to 13, at about 12 to 13 m depth, (elevation 65 to 67) from bent 14 to 26 and at about 8 to 12 m depth (elevation 67 to 70) from bent 27 to 39 and the east abutment.

Piles will be driven into and bear on either the very dense basal silt till or weathered shale bedrock. The



very high driving resistance offered by the basal silt till during dynamic cone tests, and the difficulty of drilling in this material suggest it is equivalent to the shale bedrock with respect to bearing capacity for the pile size and load under consideration.

Based on the preliminary results from pile load tests conducted on 324 X 6.3 mm (12.75 X 0.250 in.) concrete filled pipe piles, a design capacity of 1160 kN (130 T) is recommended for piles founded both on very dense basal till and shale bedrock. It is anticipated a slightly greater penetration will be required during pile driving operations to obtain an equivalent set and capacity. Further comments regarding the pile driving and installation operations is contained in our report 80F240A.

We believe this report has been completed within our terms of reference and trust that the geotechnical information provided herein will be sufficient for your present purposes. If you have any questions, or if we may be of further service during the construction phase of the project, please do not hesitate to call our office.

Yours very truly,  
PETO MacCALLUM LTD.

JFW/BRG/rf

Brian R. Gray, P. Eng.,  
Manager,  
Geotechnical Services.



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## INTRODUCTION

Peto MacCallum Ltd. was retained by The Regional Municipality of Hamilton-Wentworth to carry out a supplementary geotechnical investigation for the proposed Burlington Street Reconstruction in Hamilton, Ontario.

Details of the preliminary geotechnical investigation carried out for the project were provided in Peto MacCallum Ltd. report 79F59 dated October, 1979.

Subsequent to issuance of the initial report, the west abutment of the proposed elevated bridge structure was relocated to the west of the original design location by some 400 m. Consequently, additional drilling was required to define subsurface information in that area.

It is understood the proposed elevated bridge structure will extend over a length of some 1433 m from the west to east abutments. Individual spans will vary from 28 to 40 m involving a total of thirty-nine bents typically supported on two piers with three piers to be used in the area of access ramps.

As a result of a comprehensive economic evaluation of the alternate deep foundation systems for the structure presented in our preliminary report, it is understood all pier and abutment loads will be supported on 324 X 6.3 mm (12.75 X 0.250 in.) driven steel pipe piles. Further, the piles will be installed in 300 mm diameter preaugered holes extending to a depth of 6 m.



The objectives of this geotechnical study were to determine:

- a) the subsurface conditions within the area of the 400 m westerly extension
- b) the driveability of the proposed piles, particularly within areas of boulders identified during the preliminary investigation
- c) the length of pile required at each pier and abutment location
- d) the type of bearing material which will be supporting the pile cognizant of the driving resistance encountered together with the recommended pile type and capacity

Reference is made within the body of this report to two preconstruction pile load tests which were carried out in conjunction with the current geotechnical investigation. The final analysis and report on the load tests will be presented under separate cover (Peto MacCallum Ltd. report 80F240A).

In addition, further studies were carried out with respect to road pavement design and construction which will be described under separate cover in Peto MacCallum Ltd. report 80F239.

#### INVESTIGATION PROCEDURE

The field work for the investigation was carried out during the period October 1 to November 5, 1980. The investigation programmed initially involved a total of six (6) sampled boreholes together with 1.5 m of rock core at each hole. In addition, forty-eight (48)



dynamic cone penetration tests were programmed which would be conducted in 6.0 m deep preaugered holes to simulate pile driving operations and driven to refusal (100 blows/0.3 m).

It was anticipated that premature refusal within the clay till would be experienced at some of the test locations which would be easy to identify by examination of the driving records. A second dynamic cone penetration test would then be conducted at the same location following preaugering to the initial refusal level. Ultimately it was expected that refusal, which would be recognized by an abrupt change in driving resistance, would occur in the very dense/hard till or the shale bedrock.

The results of the initial dynamic cone tests were somewhat different from that expected. The cones were refusing prematurely in the very stiff clay till and it became necessary to repeat the dynamic cone penetration test and preaugering process several times at each test location. Consequently, it became necessary to revise the field methodology as follow:

- a) Conduct the dynamic cone penetration test preaugering process a maximum of 3 times at each test location. Refer to Note 3 on Drawing No. 1 for further comments in this regard.
- b) Drill additional boreholes with conventional sampling at regular intervals below the level of first refusal of the dynamic cone penetration in order to determine the strata in which refusal was occurring.
- c) Conduct a combination of a) and b) as noted above.



The completed field work actually comprised twenty-four (24) dynamic cone probes (numbered C1 to C24), sixteen (16) sampled boreholes (numbered 16 to 32) and nine (9) dynamic cone tests carried out in conjunction with these sampled boreholes identified by the suffix "C" after the borehole number. Boreholes 1 to 15 were presented in our previous report 79F59.

The locations of all boreholes, dynamic cone probes and preconstruction test pile locations are shown on the site plan, Drawing 1, Sheets 1 and 2.

The boreholes and dynamic cones were advanced using a truck mounted CME-55 drillrig supplied and operated by the Client. The field work was supervised throughout by members of our engineering staff who directed the drilling and sampling operations, prepared the stratigraphic Log of the Boreholes and cared for the recovered overburden samples and rock core specimens. A representative from Parker Consultants recorded the dynamic cone penetration tests.

Standard penetration tests were conducted during sampling operations at regular intervals within the overburden for the entire exploration depth at boreholes 16 and 17 (revised location for west abutment), and generally below the depth of initial refusal at all other sampled borehole locations. At borehole 30C and 31C, however, single samples were taken at termination of drilling to identify bearing stratum. Pocket penetrometer tests were carried out on the cohesive soils at boreholes 16 and 17 in order to determine the undrained shear strength of the clayey soils.



At a number of locations where the borehole penetrated the existing roadway, details of the pavement construction were recorded, and are presented in the appended Log of Borehole sheets. The pavement construction is discussed in Peto MacCallum Ltd. report 80F239 under separate cover.

Rotary diamond drilling techniques were used to obtain 1.5 m of BXL core of the shale bedrock at boreholes 16, 17, 25 and 27.

Groundwater observations made in the open boreholes during and following the completion of drilling are also reported on the borehole Logs.

The location and ground surface elevations at the boreholes were established in the field by a survey crew from Parker Consultants. This information was forwarded to our office on December 2, 1980. It is assumed that the ground surface elevations are related to geodetic datum. Peto MacCallum Ltd. obtained all necessary underground utility and ground surface clearances at the proposed borehole locations and carried out all requisite traffic channelization.

All samples obtained during the investigation were brought to our laboratory for detailed examination and routine classification testing to confirm field visual identification. Natural moisture contents were made on all recovered samples and the results shown on the appended Log of Borehole sheets.



## SUMMARIZED SUBSURFACE CONDITIONS

We recommend that Peto MacCallum Ltd. report 79F59 dated October, 1979, which provides details concerning the site description and geologic background as well as further details of the groundwater conditions and engineering properties of the soil units, be read in conjunction with this report.

We refer to the Log of Borehole sheets appended for details of the drilling work, including soil classifications, inferred stratigraphy, standard penetration "N" values, groundwater observations during and following the completion of drilling, laboratory moisture content determinations and dynamic cone test results.

For illustrative purposes, we have included on the site plans, Drawing 1, Sheets 1 and 2, a summarized stratigraphic profile of the major soil units contacted along the section of Burlington Street scheduled for reconstruction.

Information obtained from borehole 6, Peto Associates Ltd. report 66F166 and boreholes 1 to 8, Peto MacCallum Ltd. report 79F59 have been included on the drawing. It is noteworthy that the interpreted stratigraphy and contact elevations for boreholes 1 to 8 as reported previously have been modified somewhat cognizant of the more detailed field information now available.

The majority of the testholes drilled during the preliminary investigation were unsampled auger probes



extended to refusal with the stratigraphy inferred by observations during drilling. The presence of cobbles and small boulders were identified during this unsampled drilling operation. The detailed information obtained during the current work reveals that all cobbles or boulders encountered which caused any significant drilling difficulties, are located within the very dense basal till unit.

As discussed previously in report 79F59, the surficial soil units are dependent upon the location of the boreholes in the limits of road pavement or boulevard areas. The asphaltic concrete pavement, granular base courses, slag fill, clay fill, topsoil or alluvium which comprise the surficial materials are identified as unit 1. Routinely, these materials extended to depths of 1.5 m below existing ground surface with local variations to 0.3 m at borehole 5 and 3.7 and 6.0 m depth at boreholes 17 and 4 respectively. Local increases in the thickness of fill may be attributed variously to proximity to manholes, utility trench backfill or infilling of old inlet areas. These surficial deposits overlie the generally stiff to very stiff silty clay till (unit 2) which is the major overburden unit encountered at the site.

The clay till was penetrated typically at depths of 8.5 to 10.4 m and overlies shale bedrock from the west abutment to bent 8 (borehole 19). Between bents 8 and 28 (boreholes 19 and 28C) through the centre of the site, the clay till overlies a relatively thick deposit of very dense silt till which was contacted at depths of 11.6 to 12.3 m. East of bent 28 (bore-



hole 28C) the thickness of the silt till generally decreases, and it was contacted at depths of 7.0 to 11.5 m.

The very dense basal till (unit 3) encountered through the central and eastern portion of the site varied from silty sand to sandy silt to clayey silt. This unit was encountered throughout the site east of bent 8 (borehole 19). As noted previously, the till varied significantly in thickness.

It was typically 1.2 to 1.8 m thick between bent 8 and a point immediately west of bent 17 (borehole 19 to 24), 3.0 m to 9.6 m thick from just west of bent 17 to bent 28 (borehole 24 and 28C) where it has infilled a buried valley in the bedrock surface, and 1.0 to 2.5 m thick through the remaining eastern portion of the site, bent 28 to the east abutment.

The clay and silt till units overlie Queenston shale bedrock throughout the site which exists as a shale till complex (unit 4), weathered shale (unit 5) and sound shale (unit 6).

Two dashed lines are included on the stratigraphic profile to indicate selected dynamic cone test penetration levels:

----- Initial Refusal  
\_\_\_ \_\_\_ \_\_\_ Final Refusal

These two lines were constructed on the basis of dynamic cone penetration data defined by the initial and final refusal levels as described below:



- a) The initial refusal level is defined as the depth at which first refusal of the dynamic cone test, conducted from a borehole preaugered to 6.0 m depth, encountered a resistance of 100 blows/0.3 m.
- b) The secondary refusal level is defined as the depth at which a dynamic cone test, conducted from a borehole preaugered to the initial refusal level, encountered a resistance of 100 blows/0.3 m.
- c) The final refusal level is defined as the depth at which a dynamic cone test, conducted from a borehole preaugered to the secondary refusal level, encountered a resistance of 100 blows/0.3 m.

The initial refusal level generally occurred at varying depths within the clay till while the final refusal level is generally believed to occur within 1 to 2 m of the upper boundary of the very dense basal till or weathered shale bedrock.

It should be noted that these refusal definitions were selected following evaluation of the progress of the field work after the initial dynamic cone tests had been carried out. At several locations the holes were preaugered to a significant depth below the "initial" or "secondary" refusal levels prior to commencement of the subsequent dynamic cone penetration test, e.g. C16. In these cases, as with those where several successive cone tests were conducted at the same location, e.g. C12, the definition of "final" refusal level was not satisfied and is therefore not indicated on the stratigraphic profile or the Logs.



## ENGINEERING CONSIDERATIONS

It was pointed out in the introduction that the purpose of this supplementary investigation is to:

- a) predict the length to which piles will be driven prior to meeting practical refusal
- b) assess their driveability, and
- c) estimate their capacity.

We understand the proposed bridge structure will be supported on 324 X 6.3 mm (12.75 X 0.250 in.) steel pipe piles filled with 20 MPa (3000 psi) concrete.

### Pile Length

Based on the subsurface information revealed during the present investigation, our general experience and knowledge with refusal depths for driven piles in similar materials as well as the penetration of the two piles driven for load testing purposes, it is our opinion that the proposed piles will meet practical refusal at a depth close to the line noted as "final refusal" on Drawing No. 1. The anticipated pile length and founding level and material which the pile is expected to meet practical refusal in, along with any other pertinent comments for each pile location is indicated on Table I.

It is worthwhile to note that the driven piles for the two load tests met practical refusal within 0.4 m of the "final refusal" as interpreted from dynamic cone tests conducted in the immediate area and shown on



Drawing 1. Further, the line is based on actual final refusal levels as previously defined at 22 points only and is interpreted for intermediate locations.

Local variations in cross fall from south to north of the final refusal level across the width of the structure, as noted on Table I, should not be ruled out. These do not appear to be as significant as corresponding cross falls in the bedrock surface.

#### Driveability

It was previously recommended that the design locations for installation of each of the driven piles be pre-augered to a depth of 6 m below ground surface to minimize disturbance of underground services during the pile driving operations. Hence, any obstructions which may exist in the fills should not affect the installation procedures.

Due to the cobbles and boulders detected during the preliminary field work carried out for the proposed bridge structure, it was expected that some difficulties may be experienced during the pile driving operations. The results of the present investigation, however, reveal that the cobbles and boulders are present in the basal till unit. Further, the driven piles are expected to meet practical refusal within this very dense silt till encountered over the central and eastern portions of the proposed bridge or in the shale bedrock on the west end of the site. Therefore, the cobbles and boulders are not expected to adversely affect the pile driving operations.



Pile Capacity

Based on the results of the dynamic cone and standard penetration tests and the preliminary results of two preconstruction pile load tests, it is considered that the proposed 324 X 6.3 mm (12.75 X 0.250 in.) concrete filled steel pipe piles driven closed end will support a working load of 1160 kN (130 T).

It is recommended that the piles are installed using a pile driver capable of developing at least 33 kJ (24,000 ft.lb.) energy per stroke. Care should be exercised to ensure the piles are not overdriven since damage to the pile may occur. The pile driving and installation operations should be closely supervised and the pile penetration correlated with the anticipated founding level presented in Table I and approximated by the "final" refusal line noted on Drawing No. 1.

Further comments regarding the pile design and installation operations will be presented in our report, 80F240A, which is in progress.

PETO MacCALLUM LTD.

John F. Wright, B. Sc.,  
Geologist.

Dennis W. Kerr, P. Eng.,  
Regional Geotechnical Engineer.



JFW/DWK/rf

TABLE 1

ANTICIPATED PILE LENGTHS

Proposed Burlington Street Reconstruction  
Kenilworth Avenue to Parkdale Avenue  
Hamilton, Ontario.

---

Pier Number	Anticipated Pile Length (m)	Founding Elevation	Founding Material	Remarks
1N	10.3	69.0	Shale	4
1S	10.3	69.3	Shale	4
2N	10.5	68.6	Shale	2
2S	10.5	69.0	Shale	4
3N	11.2	68.1	Shale	3
3S	10.9	68.6	Shale	4
4N	11.2	68.2	Shale	4
4S	11.0	68.3	Shale	4
5N	11.3	68.3	Shale	4
5S	11.3	68.1	Shale	2 & 3
6N	11.4	67.9	Shale	4
6C	11.4	68.3	Shale	4
6S	11.7	68.0	Shale	4
7N	11.5	67.7	Shale	3
7C	11.8	68.9	Shale	4
7S	12.0	68.0	Shale	4
8N	11.5	67.8	Till/Shale	4
8C	12.0	67.8	Till/Shale	4
8S	12.4	67.9	Till/Shale	3
9N	11.5	67.9	Till/Shale	2
9S	12.3	67.6	Till/Shale	4

1. Pier is identified by substructure unit number as provided on Drawing No. 1 followed by suffix N, C or S to denote north, central or south respectively.
2. Based on dynamic cone penetration test data.
3. Based on stratigraphic information.
4. Based on extrapolation from adjacent boreholes (ground surface elevation not confirmed).

# TABLE I - CONT'D

## ANTICIPATED PILE LENGTHS

Proposed Burlington Street Reconstruction  
Kenilworth Avenue to Parkdale Avenue  
Hamilton, Ontario.

Pier Number	Anticipated Pile Length (m)	Founding Elevation	Founding Material	Remarks
10N	11.8	67.7	Till/Shale	4
10S	13.0	67.3	Till/Shale	3
11N	12.5	67.4	Till/Shale	4
11S	12.5	67.4	Till/Shale	4
12N	12.4	67.4	Till/Shale	4
12S	12.1	67.4	Till/Shale	2
13N	12.7	67.2	Till/Shale	3
13S	12.6	67.1	Till/Shale	4
14N	12.8	67.0	Till/Shale	4
14S	12.5	67.3	Till/Shale	4
15N	12.8	66.7	Till/Shale	2
15S	12.6	67.1	Till/Shale	4
16N	13.1	66.2	Till/Shale	4
16S	12.8	66.9	Till/Shale	2
17N	13.3	66.0	Till	2
17S	13.6	64.5	Till	3
18N	13.1	66.1	Till	4
18S	13.2	65.8	Till	4
19N	13.0	66.3	Till	4
19S	13.3	66.5	Till	2
20N	12.8	66.4	Till	2
20S	12.9	66.3	Till	4

1. Pier is identified by substructure unit number as provided on Drawing No. 1 followed by suffix N, C or S to denote north central or south respectively.
2. Based on dynamic cone penetration test data.
3. Based on stratigraphic information.
4. Based on extrapolation from adjacent boreholes (ground surface elevation not confirmed).

# TABLE I - CONT'D

## ANTICIPATED PILE LENGTHS

Proposed Burlington Street Reconstruction  
Kenilworth Avenue to Parkdale Avenue  
Hamilton, Ontario.

Pier Number	Anticipated Pile Length (m)	Founding Elevation	Founding Material	Remarks
21N	12.5	66.6	Till	4
21S	13.1	66.1	Till	3
22N	12.1	66.8	Till	2
22S	12.6	66.2	Till	4
23N	12.3	66.6	Till	4
23S	12.4	66.3	Till	4
24N	12.4	66.2	Till	3
24S	12.4	66.3	Till	4
25N	12.6	66.2	Till	4
25S	12.4	66.2	Till	3
26N	12.8	66.2	Till	2
26S	12.1	66.8	Till	4
27N	12.4	66.6	Till	4
27S	11.8	67.3	Till	2
28N	11.9	67.0	Till	4
28S	13.2	66.0	Till	3
29N	11.5	67.4	Till	2
29S	12.5	66.4	Till	4
30N	11.3	67.4	Till	2
30S	11.9	67.1	Till	4
31N	11.5	67.3	Till	4
31S	11.5	67.4	Till	2

1. Pier is identified by substructure unit number as provided on Drawing No. 1 followed by suffix N, C or S to denote north central or south respectively.
2. Based on dynamic cone penetration test data.
3. Based on stratigraphic information.
4. Based on extrapolation from adjacent boreholes (ground surface elevation not confirmed).

# TABLE I - CONT'D

## ANTICIPATED PILE LENGTHS

Proposed Burlington Street Reconstruction  
Kenilworth Avenue to Parkdale Avenue  
Hamilton, Ontario.

Pier Number	Anticipated Pile Length (m)	Founding Elevation	Founding Material	Remarks
32N	11.6	67.1	Till/Shale	2
32C	11.4	67.3	Till/Shale	4
32S	11.2	67.4	Till/Shale	4
33N	11.7	67.0	Till/Shale	2
33C	11.3	67.2	Till/Shale	4
33S	10.8	67.4	Till/Shale	3
34N	10.9	67.3	Till/Shale	4
34C	10.3	68.0	Till/Shale	4
34S	9.7	68.5	Till/Shale	2
35N	9.8	68.1	Till/Shale	2
35S	9.5	68.7	Till/Shale	4
36N	9.8	68.3	Till/Shale	4
36S	9.3	69.0	Till/Shale	3
37N	9.1	68.5	Till/Shale	2
37S	9.0	69.1	Till/Shale	4
38N	9.0	68.7	Till/Shale	4
38S	8.4	69.3	Till/Shale	2
39N	9.0	68.9	Till/Shale	4
39S	8.4	69.6	Till/Shale	4

1. Pier is identified by substructure unit number as provided on Drawing No. 1 followed by suffix N, C or S to denote north central or south respectively.
2. Based on dynamic cone penetration test data.
3. Based on stratigraphic information.
4. Based on extrapolation from adjacent boreholes (ground surface elevation not confirmed).

## LIST OF ABBREVIATIONS

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N', - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 0.3m INTO THE SUBSOIL, DRIVEN BY MEANS OF A 63.5kg HAMMER FALLING FREELY A DISTANCE OF 0.76m.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 51mm, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS. 0.3m INTO THE SUBSOIL. THE DRIVING ENERGY BEING 475j PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS/0.3 m</u>	<u>c kPa</u>	<u>DENSENESS</u>	<u>'N' BLOWS/0.3 m</u>
VERY SOFT	0 - 2	0 - 12	VERY LOOSE	0 - 4
SOFT	2 - 4	12 - 25	LOOSE	4 - 10
FIRM	4 - 8	25 - 50	COMPACT	10 - 30
STIFF	8 - 15	50 - 100	DENSE	30 - 50
VERY STIFF	15 - 30	100 - 200	VERY DENSE	> 50
HARD	> 30	> 200		

W.T.P.L. WETTER THAN PLASTIC LIMIT

D.T.P.L. DRIER THAN PLASTIC LIMIT

A.P.L. ABOUT PLASTIC LIMIT

### TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W	THINWALL OPEN
W.S	WASHED SAMPLE	T.P	THINWALL PISTON
S.B	SCRAPER BUCKET SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE
S.T	SLOTTED TUBE SAMPLE		
	P.H	SAMPLE ADVANCED HYDRAULICALLY	
	P.M	SAMPLE ADVANCED MANUALLY	

### SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL		



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 21, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

SOIL PROFILE			SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *				WATER CONTENT %			
							20 40 60 80				$W_p$		$W$	$W_L$
	GROUND ELEVATION: 79.07													
0.00	ASPHALTIC CONCRETE													
0.30	CONCRETE													
1.5	Unsampled (probable clay till)		78											
			77											
			76											
			75											
			74											
			73											
6.10	Dynamic Cone Test													
7.5			72											
			71											
8.84	Augered to 8.84 m					102								
9.0	Dynamic Cone Test													
9.15	SILT TILL		70			100/200 mm								
9.45	Augered to 9.45 m													
9.75	Dynamic Cone Test					100/200 mm								
10.5	Test hole terminated at 9.65 m												Initial refusal 8.53 m	
	Soil description based on auger cuttings.												Final refusal 9.65 m	

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY

*JFW*





**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. c2**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 9, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

SOIL PROFILE		SAMPLES		SHEAR STRENGTH $C_u$		LIQUID LIMIT $W_L$		GROUNDWATER OBSERVATIONS AND REMARKS										
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST $q$			WATER CONTENT $W$									
						BLOWS/0.3m	WATER CONTENT %											
	GROUND ELEVATION: 79.65					20	40	60	80									
1.5	Unsampled (probable fill over clay till)		79															
3.0			78															
4.5			77															
6.0			76															
7.5			75															
9.0	Dynamic Cone Test		74															
9.0	Augered to 8.84 m Dynamic Cone Test SHALE TILL COMPLEX		73															Initial refusal 8.84 m
9.75	Augered to 9.75 m Dynamic Cone Test		72															
10.02	Test hole terminated at 10.02 m		71															Final refusal 10.02 m
10.5	Soil description based on auger cuttings.		70			108	100/250	mm										

NOTES Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY *JFW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 23, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

DEPTH in METERS	SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST				WATER CONTENT $W$			
						BLOWS/0.3m N - VALUES				WATER CONTENT %			
						20	40	60	80	10	20	30	
	GROUND ELEVATION: 79.10												
1.5	Unsampled (probable fill over clay till)		78										
			77										
3.0			76										
4.5			75										
6.0			74										
6.1	Dynamic Cone Test		73										
7.5			72										
			71										
8.84	Augered to 8.84 m Dynamic Cone Test		70			100	250	mm					Initial refusal 8.78 m
	WEATHERED SHALE		69			100	280	mm					
10.36	Augered to 10.36 m Dynamic Cone Test					100	150	mm					Final refusal 10.52 m
10.52	Test hole terminated at 10.52 m												
12.0	Soil description based on auger cuttings.												
13.5													
15.0													
16.5													
18.0													

NOTES  
Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY *JFW*



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. C4**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 14, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

SOIL PROFILE		LEGEND	ELEVATION	SAMPLES		SHEAR STRENGTH $C_u$	LIQUID LIMIT $w_L$			GROUNDWATER OBSERVATIONS AND REMARKS			
DEPTH IN METERS	DESCRIPTION			NUMBER	TYPE		BLOWS/0.3m N - VALUES	PLASTIC LIMIT $w_p$					
		DYNAMIC CONE PENETRATION = STANDARD PENETRATION TEST *				$w_p$		$w$	$w_L$				
	GROUND ELEVATION: 79.43					20	40	60	80	10	20	30	
1.5	Unsampled (probable fill over clay till)		79										
			78										
			77										
			76										
			75										
6.0	Dynamic Cone Test		74										
			73										
			72										
			71										
			70										
10.06			69			100/200 mm							Initial refusal 10.06 m
11.25			68			100/280 mm							Final refusal 11.25 m

NOTES  
Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY *JFW*



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. C5**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 2, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

DEPTH in METERS	SOIL PROFILE		SAMPLES		SHEAR STRENGTH $C_u$			LIQUID LIMIT $w_L$			GROUNDWATER OBSERVATIONS AND REMARKS			
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST			PLASTIC LIMIT $w_p$		WATER CONTENT $w$		
	GROUND ELEVATION: 79.15						20	40	60	80	10	20	30	
1.5	Unsampled (probable fill over clay till)		79											
			78											
			77											
3.0			76											
			75											
4.5			74											
6.0	6.36		73											
	Dynamic Cone Test		72											
7.5			71											
9.0			70											
			69			103								
10.5	10.6		68			101/50 mm								Initial refusal 10.06 m Secondary refusal 10.72 m
	Augered to 10.67 m Dynamic Cone Test		67											
12.0	12.19													
	Augered to 12.19 m. WEATHERED SHALE													
13.5	Test hole terminated at 12.19 m													
	Soil description based on auger cuttings.													
15.0														
16.5														
18.0														

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY *JFW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario

BORING DATE Oct. 29, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

SOIL PROFILE		LEGEND	ELEVATION	SAMPLES		BLOWS/0.3m N-VALUES	SHEAR STRENGTH $C_u$	LIQUID LIMIT $w_L$	PLASTIC LIMIT $w_p$	WATER CONTENT $w$	GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METERS	DESCRIPTION			NUMBER	TYPE						
	GROUND ELEVATION: 79.35										
0.10	ASPHALTIC CONCRETE		79								
0.61	FILL: Dense fine to coarse sand and gravel, slag										
1.5	Unsampled (probable fill over clay till)		78								
3.0			77								
4.5			76								
6.0			75								
7.5			74								
9.0			73								
10.06	Augered to 10.06 m Dynamic Cone Test		73			105					Initial refusal 10.06 m
11.48	Augered to 11.28 m Dynamic Cone Test		69			100/250 mm 100/200 mm					Final refusal 11.48 m
11.48	Test hole terminated at 11.48 m		68								

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY: 43W



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 6, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsay

SOIL PROFILE		LEGEND	ELEVATION	SAMPLES		SHEAR STRENGTH $C_u$	LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$	GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METERS	DESCRIPTION			NUMBER	TYPE			
	GROUND ELEVATION: 79.67							
	Unsampled (probable fill over clay till)		79					
1.5			78					
2.14	Coarse gravel or cobbles		77					
2.74								
3.0			76					
4.5			75					
6.0			74					
6.34	Dynamic Cone Test		73					
7.5			72					
9.0			71					
10.5			70					
11.28	Augered to 11.28 m Dynamic Cone Test		69					Initial refusal 10.97 m
12.0			68					
12.19	Augered to 12.19 m Dynamic Cone Test		67		105			
12.78	Test hole terminated at 12.78 m				100/280 mm			Final refusal 12.78 m
13.5								
15.0								
16.5								
18.0								

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY JFW



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. cs**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET  
LOCATION Hamilton, Ontario.  
BORING METHOD Dynamic Cone Test

JOB No. 80 F 240  
BORING DATE Oct. 6, 1980  
ENGINEER J.F. Wright  
TECHNICIAN M. Rapsey

SOIL PROFILE			SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_p$ WATER CONTENT $W$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST				WATER CONTENT %			
						BLOWS/0.3m				$W_p$	$W$		$W_L$
	GROUND ELEVATION: 79.32					20	40	60	80				
1.5	Unsampled (probable fill over clay till)		79										
			78										
			77										
3.0			76										
4.5	Coarse gravel or cobble		75										
			74										
6.0			73										
6.0 - 6.30	Dynamic Cone Test		73										
7.5			72										
9.0			71										
			70										
10.5			69										
11.28	Augered to 11.28 m Dynamic Cone Test		68										Initial refusal 11.28 m
12.0			67			100	250						
12.80	Augered to 12.80 m Dynamic Cone Test		67			100	200						Final refusal 13.31 m
13.31	Test hole terminated at 13.31 m		66										

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY gfu



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. C9**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 7, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

DEPTH in METERS	SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$				LIQUID LIMIT $w_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION = STANDARD PENETRATION TEST *				PLASTIC LIMIT $w_p$	WATER CONTENT $w$			
	GROUND ELEVATION: 79.81					BLOWNS/300 N - VALUES					WATER CONTENT %			
						20	40	60	80		10	20	30	
79	Unsampled (probable fill over clay till)													
78														
77														
76														
75														
74														
73	Dynamic Cone Test													
72														
71														
70														
69	Augered to 10.67 m Dynamic Cone Test													Initial refusal 10.36 m
68														
67	Augered to 12.80 m Dynamic Cone Test													
66	Test hole terminated at 13.34 m													Final refusal 13.34 m

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY: *JFW*



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. c10**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET  
LOCATION Hamilton, Ontario.  
BORING METHOD Dynamic Cone Test

JOB No. 80 F 240  
ENGINEER J.F. Wright  
TECHNICIAN M. Rapsey

SOIL PROFILE			SAMPLES		SHEAR STRENGTH $C_u$			LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *			WATER CONTENT %		
							20	40	60	80	10	20
	GROUND ELEVATION: 79.18		79									
1.5	Unsampled (probable fill over clay till)		78									
3.0			77									
4.5			76									
6.0			75									
7.5			74									
9.0			73									
10.0	Augered to 10.06 m Dynamic Cone Test		72									
10.5			71									
12.0	Augered to 12.19 m Dynamic Cone Test		70			101						Initial refusal 9.75 m
12.75	Test hole terminated at 12.78 m		69									
13.5			68									
15.0			67			100/280						Final refusal 12.78 m
16.5												
18.0												

NOTES Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY JFW





JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 2, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

SOIL PROFILE		LEGEND		ELEVATION		SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *				WATER CONTENT %				
							BLOWS/0.3m				WATER CONTENT %				
							20	40	60	80	10	20	30		
GROUND ELEVATION: 78.51															
1.5	Unsampled (probable fill over clay till)		78												
3.0			77												
4.5			76												
6.0			75												
7.5			74												
9.0			73												
6.10	Dynamic Cone Test		72												
7.92	Augered to 7.92 m Dynamic Cone Test		71			100/250 mm								Initial refusal 7.57 m	
10.5			70												
12.19	Augered to 12.19 m Dynamic Cone Test		69												
13.72	Augered to 13.72 m Dynamic Cone Test		68			110								Secondary refusal 10.67 m	
15.24	Augered to 15.24 m Dynamic Cone Test		67												
16.76	Augered to 16.76 m Dynamic Cone Test		66			101									
17.68	Augered to 17.68 m Dynamic Cone Test		65			100/130 mm									
18.29	Augered to 18.29 m Dynamic Cone Test		64			100/25 mm									
18.29	Augered to 18.29 m Dynamic Cone Test		63			100/50 mm									
18.29	(Probable shale)		62												
18.29	Test hole terminated at 18.29 m		61												
18.29			60												

NOTES  
Refer to text and Note 3 on Drawing 1 for definition of refusal.  
Soil description based on auger cuttings.

CHECKED BY *JFW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 3, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$				LIQUID LIMIT $w_L$			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUES	DYNAMIC CONE PENETRATION : STANDARD PENETRATION TEST				WATER CONTENT			
							BLOWS/0.3m				$w_p$		$w$	$w_L$
	GROUND ELEVATION: 79.00						20	40	60	80	10	20	30	
1.5	Unsampled (probable fill over clay till)		78											
			77											
3.0			76											
4.5			75											
6.0			74											
6.10	Dynamic Cone Test		73											
7.5	Augered to 9.75 m Dynamic Cone Test		72											
9.0			71											
9.75			70				100	200	mm					Initial refusal 9.34 m
10.5	Augered to 12.19 m Dynamic Cone Test (Probable silt till)		69											
12.0			68											
12.19			67				100	230	mm					Final refusal 12.80 m
13.5	Augered to 13.72 m Dynamic Cone Test Coarse gravel or cobbles		66											
13.72			65				120							
15.0	Augered to 16.76 m. Soil description based on auger cuttings.		64											
16.76			63											
16.76	Test hole terminated at 16.76 m													

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY JFU



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. c14**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 7, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH IN METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION & STANDARD PENETRATION TEST				WATER CONTENT $W$			
						BLOWS/0.1m N-VALUES				WATER CONTENT %			
GROUND ELEVATION: 79.10						20	40	60	80	$W_p$	$W$	$W_L$	
1.5	Unsampled (probable fill over clay till)		78										
3.0			77										
4.5			76										
6.0			75										
7.5			74										
9.0	Dynamic Cone Test		73										
10.5	Augered to 9.14 m Dynamic Cone Test		72										
12.0	Augered to 10.97 m Dynamic Cone Test		71										
13.5	Augered to 10.97 m Dynamic Cone Test		70										Initial refusal 8.84 m
15.0	Augered to 10.97 m Dynamic Cone Test		69										
16.5	Augered to 10.97 m Dynamic Cone Test		68		101								
18.0	Test hole terminated at 11.76 m		67		100/180 mm								Final refusal 11.76 m

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY JFW



**PETO MacCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. c15**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 3, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

DEPTH in METERS	SOIL PROFILE		SAMPLES		SHEAR STRENGTH $C_u$	LIQUID LIMIT $W_L$		GROUNDWATER OBSERVATIONS AND REMARKS
	DESCRIPTION	LEGEND	ELEVATION	NUMBER		DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *	PLASTIC LIMIT $W_p$	
	GROUND ELEVATION: 78.90							
1.5	Unsampled (probable fill over clay till)		78					
			77					
3.0			76					
			75					
4.5			74					
			73					
6.0	6.10 Dynamic Cone Test		72					
7.5			71					
9.0			70					
10.06	Augered to 10.06 m Dynamic Cone Test		69	106				Initial refusal 9.75 m
10.5			68	103				Secondary refusal 11.28 m
12.0	Augered to 12.19 m Dynamic Cone Test		67	100/250 mm				
12.44	Test hole terminated at 12.44 m		66					

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY *JF*



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. c16**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 2, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

SOIL PROFILE			SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION = STANDARD PENETRATION TEST				WATER CONTENT $W$			
						BLOWS/0.3m N - VALUES				WATER CONTENT %			
GROUND ELEVATION: 78.73						20	40	60	80	$W_p$	$W$	$W_L$	
1.5	Unsampled (probable fill over clay till)		78										
			77										
			76										
			75										
			74										
6.0	Dynamic Cone Test		73										
			72										
			71										
			70										
			69										Initial refusal 9.45 m
			68										
			67										
			66										Secondary refusal 11.28 m
10.5		Augered to 9.75 m Dynamic Cone Test											
12.0			Augered to 12.19 m Dynamic Cone Test										
12.65	Test hole terminated at 12.65 m												

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY JFW



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. c17**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET  
LOCATION Hamilton, Ontario.  
BORING METHOD Dynamic Cone Test

JOB No. 80 F 240  
ENGINEER J.F. Wright  
TECHNICIAN M. Rapsy

DEPTH IN METERS	SOIL PROFILE DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS
							DYNAMIC CONE PENETRATION = STANDARD PENETRATION TEST				WATER CONTENT %			
GROUND ELEVATION: 78.88							20	40	60	80	10	20	30	
78	Unsampled (probable fill over clay till)													
77														
76														
75														
74														
73														
6.10	Dynamic Cone Test													
72														
71														
70														
9.14	Augered to 9.14 m Dynamic Cone Test													Initial refusal 9.14 m
69														
10.67	Augered to 10.67 m Dynamic Cone Test													
68														
11.51	Test hole terminated at 11.51 m													Final refusal 11.51 m
67														
103														
100/230 mm														

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY *JFW*





**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. c18**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET  
LOCATION Hamilton, Ontario.  
BORING METHOD Dynamic Cone Test

JOB No. 80 P 240  
ENGINEER J.F. Wright  
TECHNICIAN M. Rapsay

DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	SAMPLES		BLOWING IN N-VALUES	SHEAR STRENGTH $C_u$				LIQUID LIMIT, PLASTIC LIMIT, WATER CONTENT			GROUNDWATER OBSERVATIONS AND REMARKS
				NUMBER	TYPE		DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *				W <sub>L</sub>	W <sub>p</sub>	W	
SOIL PROFILE							BLOWS/0.3m				WATER CONTENT %			
GROUND ELEVATION: 78.65							20	40	60	80	10	20	30	
78	Unsampled (probable fill over clay till)													
77														
76														
75														
74														
73														
72	Dynamic Cone Test													
71														
70	Augered to 8.53 m Dynamic Cone Test													Initial refusal 8.23 m
69														
68	Augered to 10.67 m Dynamic Cone Test													
67														
66	Augered to 12.19 m Dynamic Cone Test													
66	Test hole terminated at 12.58 m													Final refusal 11.58 m

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY: *JRW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 1, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapany

SOIL PROFILE		LEGEND		SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METERS	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *				WATER CONTENT $W$			
						BLOWS/0.3m				$W_p$	$W$	$W_L$	
						20	40	60	80	10	20	30	
GROUND ELEVATION: 78.67													
1.5	Unsampled (probable fill over clay till)	78											
3.0		77											
4.5		76											
6.0		75											
7.5		74											
9.0	Dynamic Cone Test	73											
9.14	Coarse gravel or cobbles	72											
9.14	Augered to 9.14 m Dynamic Cone Test	71											Initial refusal 8.84 m
10.5	Augered to 10.67 m Dynamic Cone Test	70			107								
10.67	Augered to 10.67 m Dynamic Cone Test	69											
12.0	Augered to 12.19 m Dynamic Cone Test	68			102	150 mm							Final refusal 11.73 m
12.19	Augered to 12.19 m Dynamic Cone Test	67			77	100 mm							
12.29	Test hole terminated at 12.29 m												

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY: *JFW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 8, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

DEPTH in METERS	SOIL PROFILE		SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $w_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST				WATER CONTENT %			
						BLOWS/0.3m N - VALUES				Wp			
						20	40	60	80	10	20	30	
	GROUND ELEVATION: 78.16												
1.5	Unsampled (probable fill over clay till)		77										
3.0			76										
4.5			75										
6.0			74										
7.5			73										
6.0	Dynamic Cone Test		72										
7.5	Augered to 7.92 m Dynamic Cone Test		71										Initial refusal 7.92 m
9.0	Augered to 9.45 m Dynamic Cone Test		70		106								
9.73	Test hole terminated at 9.73 m		69		106								Final refusal 9.73 m
10.5					100/280 mm								

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY: JFW



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 1, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Raprey

DEPTH in METERS	SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$				LIQUID LIMIT $w_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST				WATER CONTENT %			
							BLOWS/0.3m				$w_p$	$w$		$w_L$
	GROUND ELEVATION: 77.56						20	40	60	80	10	20	30	
1.5	Unsampled (probable fill over clay till)		77											
3.0			76											
4.5			75											
6.0			74											
7.5			73											
6.10	Dynamic Cone Test		72											
8.07	Augered to 8.07 m Dynamic Cone Test		71											Initial refusal 7.92 m
8.84	Augered to 8.07 m Dynamic Cone Test		70											Secondary refusal 8.84 m
9.75	Augered to 9.75 m Dynamic Cone Test		69											
9.83	Test hole terminated at 9.83 m		68			70/75 mm								

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY: *JFW*





JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 8, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

DEPTH in METERS	SOIL PROFILE		SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST				WATER CONTENT			
						BLOWS/0.3m				$W_p$	$W$		$W_L$
	GROUND ELEVATION: 77.73					20	40	60	80	10	20	30	
1.5	Unsampled (probable fill over clay till)		77										
3.0			76										
4.5			75										
6.0			74										
7.5			73										
6.10	Dynamic Cone Test		72										
7.32	Augered to 7.32 m Dynamic Cone Test		71										Initial refusal 7.32 m
8.23	Augered to 8.23 m Dynamic Cone Test		70										Final refusal 8.38 m
8.38	Test hole terminated at 8.38 m		69										

NOTES  
Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY: *JRW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 8, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

SOIL PROFILE		LEGEND		SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH IN METERS	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *				WATER CONTENT %			
						BLOWS/0.3m				$W_p$	$W$	$W_L$	
	GROUND ELEVATION: 78.24					20	40	60	80	10	20	30	
1.5	Unsampled (probable fill over clay till)	78											
		77											
		76											
3.0		75											
		74											
4.5		73											
6.0	Dynamic Cone Test	72											
7.5	Augered to 7.62 m Dynamic Cone Test	71											Initial refusal 7.62 m Final refusal 8.28 m
	Augered to 8.23 m Dynamic Cone Test	70				100	280 mm						
9.0	Test hole terminated at 8.28 m					100	50 mm						

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY: 470



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**LOG OF BOREHOLE No. C24**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 8, 1980

ENGINEER J.F. Wright

BORING METHOD Dynamic Cone Test

TECHNICIAN M. Rapsey

DEPTH in METERS	SOIL PROFILE		SAMPLES				SHEAR STRENGTH $C_u$		LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS		
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/30 cm - VALUES	DYNAMIC CONE PENETRATION - STANDARD PENETRATION TEST		PLASTIC LIMIT $W_p$	WATER CONTENT $W$				
	GROUND ELEVATION: 78.01						20	40	60	80	10	20	30	
1.5	Unsampled (probable fill over clay till)		77											
3.0			76											
4.5			75											
6.0			74											
7.5			73											
8.20		Dynamic Cone Test		72										
7.62	Augered to 7.62 m Dynamic Cone Test		71											
8.20	Test hole terminated at 8.20 m		70				100/280							

Initial refusal  
7.62 m  
Secondary refusal  
8.20 m

NOTES

Refer to text and Note 3 on Drawing 1 for definition of refusal.

CHECKED BY



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET (WEST ABUTMENT) JOB No. 80 P 241  
 LOCATION Hamilton, Ontario, BORING DATE Oct. 9/1980 ENGINEER J.F. Wright  
 BORING METHOD Continuous Flight Solid Stem Augers TECHNICIAN M. Radey

SOIL PROFILE				SAMPLES		SHEAR STRENGTH $C_u$ kPa			LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST			WATER CONTENT $W$			
						BLOWS/300 mm - VALUES			WATER CONTENT %			
GROUND ELEVATION: 79.65						50	100	150	200	$W_p$	$W_L$	
						20	40	60	80	10	20	30
0.61	FILL: dense, black to brown fine sandy silt, trace clay and gravel (50 mm), damp	(X)	79									
1.5	CLAY TILL: very stiff, brown silty clay, trace sand, D.T.P.L. with occasional gypsum crystals.	(P)	78	1	SS	25						
	becoming very hard and fissured with thin layers of fine sandy silt	(P)	77	2	SS	59						
		(P)	76	3	SS	61						
		(P)	75	4	SS	53						
	becoming very stiff, W.T.P.L.	(P)	74	5	SS	27						
		(P)	73	6	SS	21						
	becoming stiff, grey with occasional thin layers of grey clayey silt or silt	(P)	72	7	SS	12						
		(P)	71	8	SS	16						
	with little fine to coarse sand and trace of gravel (50 mm)	(P)	70	9	SS	23						
		(P)	69	10	SS	31						
	becoming reddish brown	(P)	68	11	SS	103						
9.58	SHALE TILL COMPLEX: very hard, red silty clay and weathered shale	(S)	67									
10.19	SHALE: red weathered shale, low strength, very close to close spacing of discontinuities, very poor quality	(S)	66									
	becoming grey	(S)	65									
11.89	Queenston Formation	(S)	64									
12.2	BOREHOLE TERMINATED AT 11.89 m		63									
	NOTE: Log of Borehole Sheets 1 to 15 submitted with previous report 79P59 dated October, 1979.		62									
			61									
			60									
			59									
			58									
			57									
			56									
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			5									
			4									
			3									
			2									
			1									
			0									

NOTES 1000 psf = 47.88 kPa

- ▲ undrained shear strength using pocket penetrometer
- \* Mod. R.Q.D. (modified Rock Quality Designation) is the total length of BXL core longer than 100 mm that is sound and hard expressed as percent of drill run.
- Refer to Log of Borehole No. C2 for Dynamic Cone Test Results

CHECKED BY: *JFW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET (WEST ABUTMENT) JOB No. 80 P 241  
 LOCATION Hamilton, Ontario. BORING DATE Oct. 14, 1980 ENGINEER J.F. Wright  
 BORING METHOD Continuous Flight Hollow Stem Augers and BCL Wash Boring TECHNICIAN M. Rapsey

SOIL PROFILE			SAMPLES		SHEAR STRENGTH $C_u$ kPa				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	50 100 150 200				PLASTIC LIMIT $W_p$			
						DYNAMIC CONE PENETRATION = STANDARD PENETRATION TEST				WATER CONTENT %			
						BLOWS/0.3m N-VALUES				WATER CONTENT %			
	GROUND ELEVATION: 79.43					20	40	60	80	10	20	30	
0.19	ASPHALTIC CONCRETE		79	1	AS								
0.91	SLAG FILL: dense, dark grey, sand, some gravel		78	2	SS	25							
1.5	CLAY FILL: very stiff to stiff dark brown, silty clay, little sand, with inclusions of silt, A.P.L.		78	3	SS	9							
2.12			77										
2.59	SILT TOPSOIL: loose, dark brown silt, little sand, trace clay, with occ. organics, becoming clayey		77	4	SS	6							
3.0	ORGANIC CLAY: firm, black, silty clay, with fine black organics, and occasional pieces of decayed wood		76	5	SS	5							
3.66	CLAY TILL: very stiff brown silty clay, trace sand, fissured W.T.P.L.		75	6	SS	15							
4.5			75	7	SS	24							
6.0			74	8	SS	16							
6.50	becoming stiff, grey, with occasional gravel (50 mm)		73	9	SS	14							
7.5			72										
8.50	becoming very stiff with little fine to coarse sand		71	10	SS	13							
9.0			70	11	SS	22							
10.36			69										
10.9	SHALE: red and grey weathered shale, low strength, very close to close spacing of discontinuities, very poor quality.		68	12	SS	70/180 mm Run (mm)	Recovery (%)	Mod. R.Q.D. (%)	Drill Water Return (%)				
12.0	Queenston Formation		67										
12.65	becoming sound shale, fair quality		67			2.68	1320	77	17	100			
13.16	BOREHOLE TERMINATED AT 13.16 m		66			3.16	480	100	71	100			

one half hour after completion of augering water at 9.60 m, cave at 11.00 m.

NOTES 1000 pcf = 47.88 kPa  
 \* Undrained shear strength using pocket penetrometer  
 \* Mod. R.Q.D. (Modified Rock Quality Designation) is the total length of BCL core longer than 100 mm that is sound and hard expressed as percent of drill run.  
 Refer to Log of Borehole C4 for Dynamic Cone Test Results

CHECKED BY JFW



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario

BORING DATE Nov. 4, 1980

ENGINEER J.E. Wright

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN M. Rapney

SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$		LIQUID LIMIT $W_L$		GROUNDWATER OBSERVATIONS AND REMARKS				
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST		WATER CONTENT					
						BLOWS/0.3m N - VALUES	BLOWS/0.3m	$W_p$		$W_L$			
	GROUND ELEVATION: 79.34					20	40	60	80	10	20	30	
	Unsampled (probable fill over clay till)		79										
1.5			78										
3.0		⊙	77										
4.5			76										
6.0			75										
6.30			74										
	Dynamic Cone Test		73										
7.5		⊙	72										
9.0			71										
9.35			70			104							
9.45	CLAY TILL: very stiff grey silty clay, some sand, occasional gravel, W.T.P.L	⊙	69	1	SS	25							Initial Refusal 9.45 m
10.35	SHALE: red weathered shale	⊙		2	SS	154/178 mm							
10.85	BOREHOLE TERMINATED AT 10.85 m												Upon completion of augering, no water no cave

NOTES

CHECKED BY: *[Signature]*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET JOB No. 80 F 240  
 LOCATION Hamilton, Ontario. BORING DATE Oct. 29, 1980 ENGINEER J.F. Wright  
 BORING METHOD Continuous Flight Solid Stem Augers TECHNICIAN M. Rappey

DEPTH in METERS	SOIL PROFILE DESCRIPTION	LEGEND	ELEVATION	SAMPLES		BLOWS/30 N-VALUES	SHEAR STRENGTH $C_u$	LIQUID LIMIT $W_L$	PLASTIC LIMIT $W_P$	WATER CONTENT $W$	GROUNDWATER OBSERVATIONS AND REMARKS
				NUMBER	TYPE						
	GROUND ELEVATION: 80.25										
0.11	ASPHALTIC CONCRETE		80								
	SLAG FILL: dense, brown fine to coarse sand, with gravel (to 100 mm), trace silt, damp		79								
1.57	Unsampled, (Probable Clay Till)		78								
			77								
			76								
			75								
			74								
			73								
8.00	Layers of saturated sand		72								
9.10			71								
	CLAY TILL: very stiff, brownish grey, silty clay, little sand, trace gravel (to 75 mm) W.T.P.L.		70	1	SS	19					
			69	2	SS	24					
11.60			68								
	SILT TILL: very dense, reddish brown, fine to coarse sandy silt, trace clay, some gravel (to 75 mm)		67	3	SS	137					
13.36			67								
13.72	SHALE: red weathered shale			4	SS	100/mm					
	BOREHOLE TERMINATED ON REFUSAL TO SPLIT SPOON AT 13.72 m										

After sample 1 water at 8.20 m

Upon completion of surging water and cave at 13.27 m

NOTES

CHECKED BY JDW



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Nov. 4, 1980

ENGINEER J.F. Wright

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN M. Repey

SOIL PROFILE			SAMPLES			SHEAR STRENGTH $C_u$			LIQUID LIMIT $w_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *			WATER CONTENT $w$			
							BLOWS/0.3m			WATER CONTENT %			
GROUND ELEVATION: 80.29						20	40	60	80	10	20		30
0.74	ASPHALTIC CONCRETE	(A)	80										
1.08	BASE COURSE: dense, brown, slag (to 25 mm) and fine to coarse sand, little silt,	(B)	79										
1.52	FILL: compact black cinders	(C)											
	Unsampled (Probable Clay Till)		78										
		(D)	77										
			76										
			75										
6.30	Dynamic Cone Test		74										
		(D)	73										
			72										
		(D)	71										
			70										
			69										
11.42	CLAY TILL: very stiff, grey silt/clay, some sand, occasional gravel, W.T.P.L.	(E)		1	SS	28							
12.18	SILT TILL: very dense reddish brown sandy silt, boulders	(F)		2	SS	50/0 mm							
13.41	SHALE: red weathered shale	(G)		3	SS	138/80 mm							
15.24	BORING TERMINATED AT 15.24 m		65										

Initial Refusal  
10.96 m

Upon completion of Augering no water no cave

NOTES

CHECKED BY: *JFW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET  
 LOCATION Hamilton, Ontario.  
 BORING METHOD Continuous Flight Solid Stem Augers

JOB No. 80 P 240  
 ENGINEER J.E. Wright  
 TECHNICIAN M. Rapney

DEPTH IN METERS	SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION = STANDARD PENETRATION TEST =				WATER CONTENT $W_p$			
						BLOWS/0.3m				WATER CONTENT %			
						20	40	60	80	10	20	30	
	GROUND ELEVATION: 79.67												
0.00	ASPHALTIC CONCRETE												
1.50	FILL: dense brown gravel, rounded and crushed (to 25 mm size) and fine to coarse sand, little silt damp to moist	⊗	79										
2.13			78	1	AS								
	Unsampled (Probable Clay Till)		77										
3.00			76										
4.50		⊙	75										
6.00			74										
6.30	Dynamic Cone Test		73										
7.50			72										
9.00			71										
9.00		⊙	70										
10.50			69										
11.20	Augered to 11.28 m												
11.20	Dynamic Cone test												Initial Refusal
11.09													11.28 m
12.00	Dynamic Cone test												Final Refusal
12.00													12.09 m
12.19													
12.00	SILT TILL: very dense, reddish brown silt, some fine to coarse sand, trace clay, with some gravels.	⊗	67	2	SS								
13.50			66										
13.56	SHALES: red weathered shale	⊙											
13.75	BORING TERMINATED AT 13.75 m												Upon completion of augering no water no cave

NOTES Depth of fill likely reflects proximity of borehole to manhole.

CHECKED BY *JRW*



**PETO MacCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No.22c**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET  
 LOCATION Hamilton, Ontario.  
 BORING METHOD Continuous Flight Solid Stem Augers

JOB No. 80 F 240  
 ENGINEER J.F. Wright  
 TECHNICIAN M. Rzepcy

DEPTH in METERS	SOIL PROFILE		LEGEND	SAMPLES		SHEAR STRENGTH C <sub>v</sub>			LIQUID LIMIT W <sub>L</sub> PLASTIC LIMIT W <sub>P</sub> WATER CONTENT W			GROUNDWATER OBSERVATIONS AND REMARKS
	DESCRIPTION	ELEVATION		NUMBER	TYPE	BLOWS/0.3m N - VALUES	20	40	60	10	20	
	GROUND ELEVATION: 79.86											
0.00	ASPHALTIC CONCRETE											
1.22	FILL: dense, greyish brown, fine to coarse sand and gravel (to 75 mm), trace to little silt. (resembles Granular "A" slag)		⊗									Minor seepage from about 1.5 m
1.50	FILL: compact brown sand		⊗									
1.65	Unsampled (Probable Clay Till)											
6.00	Dynamic Cone Test											
10.64	CLAY TILL: very stiff, grey silty clay, little sand and gravel (to 75 mm) W.T.P.L		⊗	69	1	SS	100/250 mm	25				Initial Refusal 10.64 m
11.90	SILT TILL: very dense, reddish brown, silt, some sand, occasional gravel, D.T.P.L.		⊗	68	2	SS	128/380 mm					
13.56	SHALE: red weathered shale		⊗	66	3	SS	50/0 mm					Upon completion of augering water and cave at 13.28 m
13.72	BOREHOLE TERMINATED ON REFUSAL TO SPLIT SPOON AT 13.72 m											

NOTES

CHECKED BY: *JFW*



**PETO MacCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. 23c**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET  
LOCATION Hamilton, Ontario.  
BORING METHOD Continuous Flight Solid Stem Augers

JOB No. 80 P 240  
BORING DATE Nov. 3, 1980  
ENGINEER J.F. Wright  
TECHNICIAN M. Papey

DEPTH in METERS	SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$		LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST		WATER CONTENT $W$			
						BLOWS/0.3m	N - VALUES	$W_p$	$W$	$W_L$	
	GROUND ELEVATION: <u>79.50</u>										
	Unsampled (probable fill over clay till)		79								
1.5			78								
3.0		⊙	77								
4.5			76								
6.0			75								
7.5			74								
9.0		⊙	73								
10.5	Dynamic Cone Test		72								
12.0			71								
13.5			70								
15.0			69								
16.5	Augered to 10.67 m Dynamic Cone Test		68				103				Initial Refusal 10.67 m
18.0			67								
19.5	Augered to 12.50 m Dynamic Cone Test		66								
21.0			65								
22.5	SHALE: red weathered shale	⊙			1 SS 70/0 mm						Final Refusal 12.80 m
24.0											
25.5	BOREHOLE TERMINATED AT 15.24 m										

NOTES

CHECKED BY: *JFW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 15, 1980

ENGINEER J.P. Wright

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN M. Reesey

SOIL PROFILE			SAMPLES		SHEAR STRENGTH $C_u$ kPa $\Delta$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS		
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N-VALUE	DYNAMIC CONE PENETRATION = STANDARD PENETRATION TEST $\circ$				WATER CONTENT %			
							50 100 150 200				$W_p$ $W$ $W_L$			
							BLOWS/0.3m				WATER CONTENT %			
				20	40	60	80	10	20	30				
	GROUND ELEVATION: <u>78.05</u> Unsampled (probable fill over clay till)													
1.5			77											
3.0			76											
4.5			75											
6.0			74											
7.5			73											
9.0			72											
10.5			71											
12.0			70											
13.5			69											
15.0			68											
16.5			67	1	SS	18								
18.0			66											
19.5			65	2	SS	73								
21.0			64	3	SS	151								
22.5			63											
24.0	With boulder (.30 m)		62	4	SS	102/150 mm								
25.5	SHALE: red weathered shale		61	5	SS	100/75 mm								
27.0	BOREHOLE TERMINATED UPON REFUSAL TO SPLIT SPOON AT 16.86 m.												Upon completion of augering no water no cave	

NOTES 1000 pcf = 47.88 kPa

$\Delta$  Undrained shear strength- using pocket penetrometer

CHECKED BY: JRW

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 15 & 22, 1980

ENGINEER J. F. Wright

BORING METHOD Continuous Flight Solid Stem Augers, Wash Boring, BXL coring

TECHNICIAN M. Rappey

DEPTH IN METERS	SOIL PROFILE		SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS		
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWN/0.3m N-VALUES	DYNAMIC CONE PENETRATION & STANDARD PENETRATION TEST *				WATER CONTENT $W$			
							BLOWN/0.3m				WATER CONTENT %			
	GROUND ELEVATION: 79.25						20	40	60	80	10	20	30	
	Unsampled (probable fill over clay till)		79											
1.5			78											
2.0			70	1	SS	20								
2.14	CLAY TILL: very stiff, grey silty clay, little sand, trace gravel, W.T.P.L.		69											
10.5	becoming hard, brown clayey silt		68	2	SS	39								
11.60			67	3	SS	104								
12.0	SILT TILL: very hard reddish brown clayey silt, little sand, some gravel, D.T.P.L.		66											
13.5	becoming very dense silt, with some fine sand and gravel, trace clay		65	4	SS	100/75 mm								
18.0	with coarse gravel or cobbles		64	5	SS	209/200 mm								
16.5			63											
16.0			62	6	SS	207/200 mm								
10.4			61	7	SS	100/75 mm	Run (mm)	Recovery (%)	Mod. R.Q.D. (%)	R.O.D. Drill Water Return (%)				
19.5	with numerous boulders		60	8	BXL RC	19.69	1250	12	0	100				
			59	9	BXL RC	20.35	670	0	0	100				
			59	10	RC	20.42	61	10	0	100				
21.0			58				Run BW casing to 21.18 m							
21.18			58			21.32								
22.31	SHALE: red and grey shale, weathered, low to medium strength, very close to close spacing of discontinuities, very poor quality, Queenston Formation		57	11	BXL RC	22.31	991	87	23	100				
22.5	BOREHOLE TERMINATED AT 22.31 m													

Upon completion of Augering no water no cave

NOTES \*Mod. R.O.D. (Modified Rock Quality Designation) is the total length of BXL core longer than 100 mm that is sound and hard expressed as per cent of drill run.

CHECKED BY: *gfw*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario

BORING DATE Oct. 16 & 17, 1980 ENGINEER J.E. Wright

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN M. Sapey

DEPTH in METERS	SOIL PROFILE DESCRIPTION	LEGEND	ELEVATION	SAMPLES		BLOWS/0.3m N - VALUES	SHEAR STRENGTH $C_u$ kPa				LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$				GROUNDWATER OBSERVATIONS AND REMARKS
				NUMBER	TYPE		DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST				WATER CONTENT %				
							BLOWS/0.3m								
	GROUND ELEVATION: 78.63						20	40	60	80	10	20	30		
	Unsampled (probable fill over alluvium over clay till)		78												
1.5		①	77												
9.0	9.14														
	CLAY TILL: very stiff, grey, silty clay, little sand and gravel, A.P.L.		69	1	SS	29									
	becoming hard, brown	②	68	2	SS	32									
	11.60		67												
	SILT TILL: very hard, brown clayey silt, little sand and gravel, D.T.P.L.		66	3	SS	140									
	becoming very dense, non plastic		65	4	SS	152/230 mm									
	with cobbles or boulders	③	64												
	becoming reddish brown, silt and fine to coarse sand, some gravel; damp		63	5	SS	100/150 mm									
	17.70		62	6	SS	158/300 mm									
	SHALE TILL COMPLEX: very dense reddish brown silt, little fine sand, dry.		61												
		④	60	7	SS	245/200 mm									
			59												
			58	8	SS	188/100 mm									
	20.70		57												
	SHALE: red weathered shale	⑤	56												
	22.86														
	BOREHOLE TERMINATED AT 22.86 m														

Borehole left open overnight at 18.5 m depth water at 7.92 m

NOTES ▲ Undrained shear strength using pocket penetrometer.

CHECKED BY *JRW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F 240

LOCATION Hamilton, Ontario.

BORING DATE Oct. 16 & 23, 1980

ENGINEER J.F. Wright

BORING METHOD Continuous Flight Solid Stem Augers, Wash Boring, BXL Coring

TECHNICIAN M. Rapsey

SOIL PROFILE			SAMPLES		SHEAR STRENGTH $C_u$ kPa				LIQUID LIMIT $w_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST				WATER CONTENT $w$			
						BLOWB/0.3m N-VALUES				WATER CONTENT %			
						50	100	150	200	20	40		60
GROUND ELEVATION: 78.62													
0.14	ASPHALTIC DRIVEWAY												Minor seepage from about 3.0 m
0.76	BASE COURSE: compact, grey, 20 mm gravel and fine to coarse sand, trace silt		78										
	Unsampled (probable fill over clay till)												
9.14	CLAY TILL: very stiff grey silty clay, trace of gravel, W.T.P.L.		69	1	SS	20							
	becoming hard, brown		68	2	SS	40							
11.60	SILT TILL: very dense, reddish brown, fine sandy silt, little gravel, trace clay, with occasional thin layers of grey clayey silt		67										
	with occasional cobbles		66	3	SS	118							
			65	4	SS	156/230 mm							
			64										
			63	5	SS	100/75 mm							
16.25	SHALE: grey weathered shale, refusal to split spoon		62	6	SS	100/25 mm	Run	Recovery	Mod. R.Q.D.	Drill Water			
16.79	becoming red shale, weathered, low to medium strength, very close spacing of discontinuities very poor quality,		61	7	RC	17.07	(mm)	(%)	(%)	Return (%)			
						17.22	150	100	0	100			
18.56	Queenston Formation												
	BOREHOLE TERMINATED AT 18.56 m		60	8	RC	18.56	1340	87	0	100			

NOTES 1000 psf = 47.88 kPa

- ▲ Undrained shear strength - using pocket penetrometer
- \* Mod. R.Q.D. (modified rock quality designation) is the total length of BXL core longer than 100 mm that is sound and hard expressed as percent of drill run.

CHECKED BY: AW



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario

BORING DATE Oct. 21, 1980

ENGINEER J.F. Wright

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN M. Reesey

SOIL PROFILE			SAMPLES			SHEAR STRENGTH $C_u$			LIQUID LIMIT $W_L$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST			PLASTIC LIMIT $W_p$				
						BLOWS/0.3m N - VALUES			WATER CONTENT %				
GROUND ELEVATION: 79.10						20	40	60	80	10	20		30
1.5	Unsampled (probable fill over clay till)	⊙	78										
3.0			77										
4.5			76										
6.0			75										
7.5			74										
6.0	6.10		73										
7.5	Dynamic cone test	⊙	72										
9.0			71										
10.5			70										
12.0			69										
10.5	10.67		68	1	SS				31				
12.0	11.90		67	2	SS				70				
13.5			66										
15.0			65	3	SS				191/280 mm				
15.0	15.09		64	4	SS				100/80 mm				
15.0	15.29												
16.5													
18.0													

Initial Refusal  
9.75 m

Upon completion of  
augering, water and  
cave at 14.78 m

NOTES

CHECKED BY JFW



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. 29**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 F. 240

LOCATION Hamilton, Ontario,

BORING DATE Oct. 15, 1980

ENGINEER J.F. Wright

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN M. Roesky

SOIL PROFILE		SAMPLES			SHEAR STRENGTH C <sub>s</sub>		LIQUID LIMIT W <sub>L</sub>			GROUNDWATER OBSERVATIONS AND REMARKS				
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS in N-VALUES	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST		WATER CONTENT %					
							BLOWS/0.3m		W <sub>p</sub>		W	W <sub>L</sub>		
	GROUND ELEVATION: 78.24		78				20	40	60	80	10	20	30	
1.5	Unsampled (probable fill over clay till)		77											
3.0			76											
4.5		⊙	75											
6.0			74											
7.5	coarse gravel or cobble		73											
9.0			72											
9.24	CLAY TILL: hard brown silty clay some sand and gravel, A.F.L	②	69	1	SS	67								
10.00	SILT TILL: very dense, reddish brown silt, little fine sand, trace clay with numerous gravel sizes	③	68											
11.28	SHALE: red weathered shale	⊙	67	2	SS	83/150 mm								
12.22	BOREHOLE TERMINATED UPON REFUSAL TO SPLIT SPOON AT 12.22 m	⊙	66	3	SS	100/25 mm								

Upon completion of Augering, no water no cave

NOTES

CHECKED BY *JFW*



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. 30c**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario

BORING DATE Oct. 7<sup>th</sup> / Nov. 3, 1980

ENGINEER J.F. Wright

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN M. Rapney

SOIL PROFILE			SAMPLES			SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *				WATER CONTENT % $W_P$ $W$ $W_L$			
	GROUND ELEVATION: 77.90						20	40	60	80	10	20	30	
	Unsampled (probable fill over clay till)		77											
1.5			76											
3.0			75											
4.5			74											
6.0			73											
6.0	6.70		72											
	Dynamic Cone Test		71											
7.5			70											
8.84	Augered to 8.84 m		69			100/280 mm								Initial Refusal 8.81 m
9.0	Dynamic cone test													
9.75	Augered to 9.75 m		68			75/75 mm								Final Refusal 9.83 m
9.75	Dynamic cone test													
10.36	SHALE: red weathered shale	⊗	67	1	SS	100/0 mm								Upon completion of augering, no water, no cave.
10.67	BOREHOLE TERMINATED AT 10.67 m													

NOTES

CHECKED BY: grw



**PETO MACCALLUM LTD.**  
CONSULTING ENGINEERS

**LOG OF BOREHOLE No. 31c**

JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET  
LOCATION Hamilton, Ontario  
BORING METHOD Continuous Flight Hollow Stem Augers

JOB No. 80 P 240  
ENGINEER J.F. Wright  
TECHNICIAN M. Rapsay

SOIL PROFILE			SAMPLES		SHEAR STRENGTH $C_u$				LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			GROUNDWATER OBSERVATIONS AND REMARKS	
DEPTH in METERS	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST				WATER CONTENT %			
						BLOWS/0.3m				10	20		30
	GROUND ELEVATION: 78.29					20	40	60	80				
	FILL: loose silty sand, wet, contaminated with gasoline		78										
1.5			77										
3.0	3.00: Unsampld (Probable Clay Till)		75										
4.5			74										
6.0	6.30: Dynamic Cone Test		72										
7.5			71										
9.0	9.29: SILT TILL: very dense, reddish brown silt, some sand, trace clay with some gravel. BOREHOLE TERMINATED UPON REFUSAL TO AUGER AND SPLIT SPOON AT 9.29 m		69	1	SS	125/	150						Initial Refusal 7.62 m  Upon completion of augering no water no cave.
10.5													
12.0													
13.5													
15.0													
16.5													
18.0													

NOTES

CHECKED BY *JFW*



JOB NAME PROPOSED RECONSTRUCTION OF BURLINGTON STREET

JOB No. 80 P 240

LOCATION Hamilton, Ontario.

BORING DATE OCT. 8 & NOV. 3, 1980

ENGINEER J.F. Wright

BORING METHOD Continuous Flight Solid Stem Augers

TECHNICIAN M. Rapsey

DEPTH in METERS	SOIL PROFILE		SAMPLES			SHEAR STRENGTH $C_u$			LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			GROUNDWATER OBSERVATIONS AND REMARKS	
	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWN/3m N - VALUES	DYNAMIC CONE PENETRATION * STANDARD PENETRATION TEST *			WATER CONTENT %			
							20	40	60	80	10		20
	GROUND ELEVATION: <u>77.96</u>												
1.5	Unsampled (probable fill over clay till)		77										
3.0			76										
4.5			75										
6.0			74										
7.5			73										
6.0	6.30		72										
7.5	Dynamic Cone Test		71										
7.5	Augered to 7.92 m		70								Initial Refusal 7.92 m		
7.5	Dynamic Cone Test										Secondary Refusal 8.93 m		
9.0	8.84		69	1	SS	100/90 mm 114/40 mm							
9.0	9.85		68										
10.5	10.67		67	2	SS	100/0 mm					Upon completion of Augering no water no cave.		
10.5	BOREHOLE TERMINATED AT 10.67 m												

NOTES

CHECKED BY JFW



