

**FOUNDATION INVESTIGATION REPORT
FOR
HIGH FILL EMBANKMENTS
G.W.P. 60-00-00
HIGHWAY 401 WIDENING
WINDSOR, ONTARIO**

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FOUNDATION INVESTIGATION REPORT

for
High Fill Embankments
G.W.P. 60-00-00
Highway 401 Widening
Windsor, Ontario

INTRODUCTION

This report summarizes the results of the foundation investigation carried out for construction/widening of three high fill embankments along Highway 401 in the 45 kilometer long study corridor that extends from the Highway 401/Highway 3 junction in Windsor to Tilbury, Ontario. The investigation was conducted for the Southwestern Region Structural Section of the Ontario Ministry of Transportation.

For the purposes of this report, the embankments have been identified by sequential numbers as follows:

Embankment 1 – Eastbound Lanes, North Leg at Dougall Avenue

Embankment 2 – Walker Road to Essex Road 46

Embankment 3 – 100 m west of Belle River to Belle River Road

Details concerning the location, length, height and type of each embankment (widening or new) are provided in Table I (Appendix A).

PHYSIOGRAPHY AND GEOLOGY

The study area is part of the Essex Clay Plain physiographic sub-region. It is essentially a till plain smoothed by deposits of lacustrine clay which settled in the depressions while the knolls were being lowered by wave action. In general, the deposits in the sub-region consist of silty clays and/or clayey silts.

The surrounding lands are mainly level and used for a mix of residential, commercial and industrial purposes. The area is crossed by ditches and rivers generally flowing south to north. The west bank of Belle River tapers down gradually to almost river level, while the east bank rises sharply to the general ground level in the area.

The bedrock belonging to the Dundee Formation and anticipated at depths of 35 to 40 m is largely composed of Middle Devonian limestone, dolostone and shale.

INVESTIGATION PROCEDURES

The field work for this investigation was carried out during the period from January to April 2002 and comprised 75 (seventy-five) boreholes put down to depths of 5.0 to 40.7 m below existing grade. The approximate locations of the boreholes advanced at each embankment are shown on the Borehole Location and Soil Strata Plans, Drawings 1-1 to 1-3, 2-1 to 2-3 and 3-1 to 3-4 for Embankments 1, 2 and 3 respectively (Appendix B).

A separate borehole numbering system was established for each of the three embankment locations:

- Embankment 1 includes boreholes designated by numbers 1 to 14 as well as boreholes 71-1 to 71-6 drilled for the Dougall Avenue underpass structure.
- Embankment 2 incorporates boreholes designated by numbers 101 to 112 as well as boreholes 72-1 to 72-4, 73-1 to 73-4, 74-1, 74-3 and 74-4 drilled for the Walker Road, Conrail Railway and Essex Road 46 overpass structures.
- Embankment 3 includes boreholes designated by numbers 201 to 224 and boreholes 84-1 to 84-4 and 85-1 to 85-4 drilled for the Belle River bridge and Belle River Road overpass structures.

The locations of and ground surface elevations at the boreholes were established in the field by Peto MacCallum Ltd. using the following four benchmarks for vertical reference:

BM: Top of standard iron bar designated
SP-HCP 130
Elevation 189.733 (geodetic)

BM 993: Plate on north wall of house at
1965 Provincial Road, 0.2 ft from west
wall and 1.2 ft above grade
Elevation 190.896 (geodetic)

BM: Top of round iron bar on south side of
Highway 401 west of Belle River 15.646
RT 22+793.284
Elevation 184.545 (geodetic)

BM: Top of round iron bar on south side of
Highway 401 west of Belle River Road
18.848 RT 10+435.567
Elevation 187.184 (geodetic)

The boreholes were advanced using continuous flight hollow and solid stem augers as well as mud rotary methods, powered by track-mounted CME-75 Nodwell and truck-mounted CME-75 drill rigs, supplied and operated by specialist drilling contractors, working under the full-time supervision of a member of our engineering staff.

Representative samples of the deposits were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. In situ vane shear and pocket penetrometer tests were also performed to further assess the shear strength of the cohesive soils. Approximately 3.0 m of rock core was recovered from eight boreholes using NQ rock coring equipment.

The groundwater conditions in the boreholes were closely monitored during the course of the field work. Upon completion of drilling, nine piezometers each consisting of 19 mm PVC pipe slotted over the bottom 600 to 900 mm were installed in boreholes to monitor groundwater conditions.

The annular space around the pipe was filled with filter gravel or sand, a bentonite seal placed and native material used as backfill or grout poured up to the ground surface as illustrated on the relevant borehole logs. The water level in the piezometers was measured regularly until May 6, 2002.

The deep boreholes were sealed with cement-bentonite grout upon completion of drilling and coring. The remaining boreholes (without piezometers) were backfilled with auger cuttings to the ground surface.

Soils were identified visually in the field in accordance with the MTO Soil Classification procedures. All of the recovered samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determinations. Consolidation, unconfined uniaxial compression and undrained triaxial compression tests were performed on samples retrieved from each embankment to determine the compressibility and strength characteristics of the cohesive soils. Atterberg Limits tests and grain size distribution analyses were carried out on selected samples, their results being presented in Figures 1 to 6 (Appendix A) and on the Record of Borehole sheets (Appendix B). The results of consolidation tests are presented in Figures 7 to 9 (Appendix A).

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, boundary elevations, standard penetration test N-values, in situ vane shear/pocket penetrometer test results and groundwater observations. The results of laboratory Atterberg Limits tests, grain size distribution analyses and moisture content determinations are also shown on the borehole logs.

Stratigraphic soil profiles along the toe(s) of each embankment prepared from the borehole data are presented on Drawings 1-1 to 1-3, 2-1 to 2-3 and 3-1 to 3-4 for Embankments 1, 2 and 3 respectively. The boundaries between soil strata have been established at the borehole locations only. Between boreholes, the boundaries are assumed and may vary.

The subsurface stratigraphy revealed in the boreholes drilled at the site generally comprised a surficial fill or topsoil underlain by clay till containing discontinuous deposits of silt and sand. Limestone bedrock was contacted below the predominantly clay till deposit at depths of 31.9 to 40.7 m (elevation 150.3 to 161.0).

The subsoil conditions existing at each embankment are summarized in Table II (Appendix A). An embankment-specific description of the geotechnical characteristics of the major types of soil encountered is presented below.

Embankment 1

The subsurface stratigraphy revealed in the boreholes drilled at the site generally comprised a surficial fill or topsoil underlain by cohesive sandy silty clay till overlying a discontinuous sand and gravel deposit. Limestone bedrock was contacted below the predominantly clay till deposit at depths of 39.9 to 40.7 m (elevation 150.3 to 151.4). The strata encountered are summarized below.

Fill

Surficial fill was present in boreholes 71-2 to 71-4 and 71-6. It typically consisted of firm to stiff silty clay and was 0.7 to 1.7 m thick. In borehole 71-3 put down near a maintenance hole, 2.9 m of very loose crushed limestone was encountered. The moisture content of the fill measured in borehole 71-4 was 14%.

Topsoil

Surficial topsoil was present in boreholes 1, 2, 4 to 6, 9 to 11, 13 and 71-5. It was 100 to 200 mm thick and composed of silty clay. A 200 to 400 mm thick topsoil layer of stiff silty clay was revealed directly beneath the fill in boreholes 71-4 and 71-6 at respective depths of 1.7 and 0.7 m (elevation 189.8 and 190.9). In borehole 71-4, the topsoil had a moisture content of 30%.

Silty Clay

A 2.1 m thick layer of stiff cohesive silty clay was identified surficially in borehole 71-1. Having moisture contents of 14 and 21%, the silty clay showed a value of unconfined strength of 95 kPa in one pocket penetrometer test conducted.

Sandy Clayey Silt Till

Cohesive sandy clayey silt till was revealed below the topsoil in borehole 13. The silt till was 1.3 m thick and very stiff in consistency.

Sand

Underlying the silt till at 1.4 m depth (elevation 189.7) in borehole 13 was silty fine sand. This unit was 400 mm thick and loose in relative density.

Sandy Silty Clay Till

Cohesive sandy silty clay till was encountered either surficially or at depths of 0.1 to 2.9 m (elevation 188.6 to 191.0) in all the boreholes. The consistency of this stratum was stiff to hard. Standard penetration test 'N' values ranged from 8 to 68, being in a typical range of 10 to 25 between depths of about 4 and 25 m. The results of vane shear testing carried out in this unit at depths of 10.0 to 11.5 m indicate undisturbed and remolded shear strengths of 100 to 130 kPa and 60 to 80 kPa respectively (soil sensitivity is about 1.7). A number of pocket penetrometer tests conducted within the unit at various depths gave values of undrained shear strength varying broadly between 10 and 250 kPa, generally decreasing with depth from about 100 to 30 kPa. (Values less than about 30 kPa were likely obtained from testing of disturbed/remoulded samples). The moisture content of the clay till ranged from 11 to 34%, typically from 13 to 20%.

The results of the Atterberg Limits tests performed on the sandy silty clay till are presented in Figure 1 (Appendix A). The till plots as a clay of low plasticity with liquid limits of 26 to 32 and plastic limits of 12 to 16. The results of grain size distribution analyses conducted on the clay till are presented in Figure 4 (Appendix A).

The results of one consolidation test performed on the clay till are presented in Figure 7 (Appendix A) and indicate a preconsolidation pressure of 250 kPa, a compression index C_c of 0.16 and a recompression index C_r of 0.03. The unconfined uniaxial compression test gave a value of 158 kPa that corresponds to an estimated shear strength of about 80 kPa.

The clay till had a confirmed thickness of 33.9 to 39.8 m in boreholes 71-1, 71-4 and 71-5. The unit was not penetrated upon termination of the remaining boreholes at depths of 6.6 to 9.6 m (elevation 180.7 to 184.1).

Sand and Gravel

Underlying the clay till at depths of 36.0 to 38.1 m (elevation 152.9 to 155.5) were the following non-cohesive deposits: a 2.6 m thick layer of fine to coarse sand and gravel in borehole 71-1 and a 4.1 m thick layer of fine to coarse sand in borehole 71-4. The relative density of these deposits ranged from compact to very dense with N-values of 25 and 62.

Bedrock

Limestone bedrock was contacted below the native clay till/sand and gravel at depths of 39.9 to 40.7 m (elevation 150.3 to 151.4) in boreholes 71-1, 71-4 and 71-5.

The measured core recovery varied between 80 and 95%. The RQD determined from the rock cores was in a range of 50 to 70%, indicating a fair quality rock. Complete loss of drill water circulation was experienced immediately following the start of coring in borehole 71-5. Voids of 75 and 100 mm in size were encountered at depths of 41.0 m (elevation 150.5) and 43.9 m (elevation 147.6) in borehole 71-4. No loss of drill water was evident in the remaining cored boreholes.

The unconfined compressive strength of the rock determined on two representative samples from borehole 71-1, corresponding to depths of 41.5 and 43.3 m (elevation 149.5 and 147.7), was 70 and 50 MPa respectively.

Embankment 2

The subsurface stratigraphy revealed in the boreholes drilled at the site generally comprised a surficial fill or topsoil underlain by sandy silty clay till overlying discontinuous deposits of sand or silt. Limestone bedrock was contacted below the predominantly cohesive overburden at depths of 31.9 to 37.3 m (elevation 154.4 to 161.0). The highway embankment fill at the location of the Walker Road overpass is approximately 7 m high and will be raised by about 0.5 m. The existing approaches to the Conrail Railway overpass comprise a fill embankment with a height of approximately 9 m on the west side (the proposed increase being less than 0.5 m) and an existing multi-span structure (to be demolished) on the east side. The highway embankment fill at the location of the Essex Road 46 overpass is 8.6 m high and will be raised by about 0.5 m. The strata encountered are summarized below.

Fill

Surficial fill was present in five boreholes. In boreholes 72-2 and 72-3, the fill was composed of a 750 to 1200 mm thick layer of Granular 'A' crushed limestone over 650 to 900 mm of firm silty clay. In boreholes 73-3 and 73-4 drilled along the alignment of former Conrail railway tracks, the fill consisted of crushed limestone (ballast material) and was 1.2 m thick. In borehole 74-4 drilled through the approach embankment to the existing structure, the silty clay fill was 8.6 m thick, stiff to very stiff in consistency and had a moisture content of 13 to 17%.

Topsoil

Surficial topsoil was present in boreholes 101 to 105, 107 to 109, 111, 112, 72-1, 72-4, 73-2, 74-1 and 74-3. It was 50 to 280 mm thick and composed of silty clay.

Fine to coarse fibrous peat of 300 mm thickness was present surficially in borehole 106.

Silty Clay

A 900 mm thick layer of cohesive silty clay was encountered below the fill in borehole 73-3. In borehole 110, the silty clay was 280 mm thick and present surficially.

Sand

Directly beneath the topsoil in boreholes 102 and 104 was sand – fine to coarse, 0.9 m thick and loose in the former borehole and silty, 1.2 m thick and very loose in the latter.

Sandy Silty Clay Till

Cohesive sandy silty clay till was encountered surficially in borehole 73-1 and at depths varying between 0.1 and 8.6 m (elevation 189.0 to 190.9) in the remaining boreholes. The consistency of this stratum was generally stiff to hard. Standard penetration test 'N' values ranged from 5 to over 100, being in a typical range of 10 to 25 between depths of about 4 and 25 m. The results of one vane shear test carried out in borehole 73-4 at an approximate depth of 18.5 m (elevation 173.5) indicate undisturbed and remolded shear strengths of 100 kPa and 70 kPa respectively (soil sensitivity is 1.4). A number of pocket penetrometer tests conducted within the unit at various depths gave the values of undrained shear strength of 10 to 210 kPa, typically 35 to 110 kPa and generally decreasing with depth from 110 to 35 kPa. (Values less than about 30 kPa were likely obtained from testing of disturbed samples). The moisture content of the clay till typically varied between 13 and 18%, increasing locally to 36%.

The results of the Atterberg Limits tests performed on the clay till are presented in Figure 2 (Appendix A). The clay till plots as a clay of low plasticity with liquid limits of 20 to 32 and plastic limits of 11 to 16. The results of grain size distribution analyses conducted on the clay till are presented in Figure 5 (Appendix A).

The results of one consolidation test performed on the clay till, presented in Figure 8 (Appendix A), indicate a preconsolidation pressure of 250 kPa, a compression index C_c of 0.16 and recompression index C_r of 0.03. The quick undrained triaxial and unconfined uniaxial compression tests gave respective values of 116 and 123 kPa that correspond to an estimated shear strength of about 60 kPa.

The clay till had a confirmed thickness of 23.2 to 36.6 m in boreholes 72-1, 72-4, 73-1, 73-4, 74-1 and 74-4. A 1.4 m thick layer of dense fine sand was encountered within this unit at a depth of 21.2 m (elevation 177.1) in borehole 74-4. The clay till was not penetrated upon termination of the remaining boreholes at depths of 9.1 to 9.6 m (elevation 180.9 to 182.5).

Sand/Silt

Fine sand was revealed at an approximate depth of 25.9 m (elevation 164.9 to 166.2) in boreholes 73-1 and 73-4. It was contacted within the clay till in borehole 73-1 and had a thickness of 2.6 m. In borehole 73-4, this unit was not penetrated upon termination of drilling at 30.4 m depth (elevation 161.8) and was at least 4.5 m thick. The sand was very dense and had a moisture content of 12 to 18%.

A deposit of either fine sand or sandy silt was identified below the clay till in boreholes 74-1 and 74-4. The thickness of the sand deposit (borehole 74-1) was 6.6 m. It was dense to very dense and had a moisture content of about 13%. The silt deposit (borehole 74-4) was 5.5 m in thickness and very dense in relative density.

Silty Clay Till

A 4.3 m thick layer of cohesive silty clay till was encountered at 28.5 m depth (elevation 162.3) in borehole 73-1. The silty clay till was very stiff in consistency and had a moisture content of 25%.

The results of one Atterberg Limits test are included in the envelope shown in Figure 2 (Appendix A). The silty clay till plots as a clay of medium plasticity (liquid limit of 37, plastic limit of 19). The results of a particle size distribution analysis conducted on the silty clay till are presented in Figure 5 (Appendix A).

Bedrock

Limestone bedrock was contacted in boreholes 72-1, 72-4, 73-1, 74-1 and 74-4 below the clay till, sand or silt overburden at depths of 31.9 to 37.3 m (elevation 154.4 to 161.0) confirmed by rock coring.

The measured core recovery varied between 84 and 100%. The RQD determined from the rock cores was in a range of 76 to 85%, indicating a good quality rock. Complete loss of drill water circulation was experienced on encountering a void of 350 mm in size at about 37 m depth (elevation 154.0) in borehole 72-1 and at a depth of 34.6 m (elevation 156.0) in borehole 74-1. No loss of drill water was evident in the remaining cored boreholes.

The unconfined compressive strength of the rock determined on six representative samples from boreholes 72-4, 73-1 and 74-4, corresponding to depths of 33.1 to 39.5 m (elevation 152.8 to 160.8), was in a range of 54 to 90 MPa.

Embankment 3

The subsurface stratigraphy revealed in the boreholes drilled at the site generally comprised a surficial fill or topsoil underlain by cohesive silty clay till containing/overlying discontinuous deposits of sand, silt and sand/silt till. The existing approaches to the Belle River bridge comprise fill embankments of some 4 m in height. The highway embankment fill at the location of the Belle River Road overpass is some 3 to 5 m high and will be raised by up to 0.6 m. The strata encountered are summarized below.

Fill

Surficial fill was present in boreholes 219, 85-1 to 85-4. A 1.4 m thick layer of firm silty clay fill was identified in borehole 219. In the remaining boreholes drilled at the toe of the highway embankment fill, the fill consisted of a 150 to 900 mm thick layer of fine to coarse sand and

crushed gravel, underlain by 300 mm of gravel/cobbles over 900 mm of loose sand in borehole 85-1, by 650 mm of compact sand and silt in borehole 85-2, and by 900 mm of stiff clay in borehole 85-4. Where measured, the moisture content of the fill ranged from 13 to 22%.

Topsoil

Surficial topsoil was present in boreholes 201, 204 to 209, 211, 213, 215, 217, 221, 223, 224, 84-1 to 84-4. It was 50 to 200 mm thick and composed of silty clay. An approximate 1.3 m thick layer of alluvium/topsoil was identified surficially in borehole 202.

Silty Clay Till

Cohesive silty clay till was encountered surficially in boreholes 203, 210, 212, 214, 216, 218, 220, 222 or directly beneath the fill/topsoil at depths of 0.1 to 2.1 m (elevation 178.5 to 184.5) in the remaining boreholes. The consistency of this stratum was generally stiff to hard, locally firm. Standard penetration test 'N' values ranged from 3 to 57, being in a typical range of 10 to 25 between depths of about 4 and 25 m. The results of vane shear testing carried out in this unit at various depths indicate undisturbed and remolded shear strengths of 65 to 185 kPa and 35 to 100 kPa respectively (soil sensitivity is about 1.5 to 1.6). A number of pocket penetrometer tests conducted within the unit gave values of undrained shear strength varying broadly between 15 and 210 kPa, generally decreasing with depth. (Values less than about 30 kPa were likely obtained from testing of disturbed samples). The moisture content of the clay till typically ranged from 18 to 24%, increasing locally to 28 and 36%.

The results of the Atterberg Limits tests performed on the clay till are presented in Figure 3 (Appendix A). The clay till plots as a clay of low to medium plasticity with liquid limits of 26 to 45 and plastic limits of 13 to 28. The results of grain size distribution analyses conducted on the clay till are presented in Figure 6 (Appendix A).

The results of one consolidation test performed on the clay till and presented in Figure 9 (Appendix A) indicate a preconsolidation pressure of 125 kPa, a compression index C_c of 0.24 and recompression index C_r of 0.05. The quick undrained triaxial and unconfined uniaxial compression tests gave respective values of 69 and 97 kPa that correspond to a shear strength of 40 to 45 kPa.

This clay till had a confirmed thickness of about 25 m in borehole 85-4 (4.0 to 5.6 m in boreholes 208, 210 and 218) and was not penetrated upon termination of the remaining boreholes at depths of 5.0 to 24.8 m (elevation 155.3 to 179.7).

Silt/Sand

Within the silty clay till in boreholes 203, 204, 84-1 and 84-2 located on the west side of Belle River were discontinuous deposits of cohesionless silt and/or sand. A 300 to 700 mm thick layer of loose to very loose silt was encountered at depths of 1.4 to 1.6 m (elevation 177.3 to 178.9). The moisture content of the silt was about 18%. The silt deposit was underlain at 2.1 m depth (elevation 177.8 and 178.2) by 800 and 900 mm of loose to compact saturated sand in boreholes 84-1 and 203 respectively. Another layer of sand was contained within the clay till in boreholes 204 and 84-2. Being compact to very dense and 1.5 m thick, it was encountered at depths of 4.0 and 5.6 m (elevation 174.9 and 173.1). The moisture content of the sand was about 15%.

Underlying the clay till at a depth of 26.1 m (elevation 155.3) in borehole 85-4 was a 3.6 m thick deposit of cohesionless silt. The silt was compact in relative density (N-value of 10) and had a moisture content of 7%. It is worth noting that a cobble/boulder was encountered at the bottom of this deposit.

Silt and Sand Till

Silt and sand till of 0.9 and 2.0 m thickness was revealed at depths of 4.0 (elevation 177.1) and 29.7 m (elevation 151.7) in boreholes 214 and 85-4 respectively. This deposit was cohesionless and compact/very dense, with a moisture content of 10%.

Silt Till

Sandy/clayey silt till was identified in boreholes 208, 210, 218 and 85-4 at respective depths of 4.0 to 5.6 m (elevation 175.5 to 176.6) and 31.7 m (elevation 149.7). This unit was compact to very dense/stiff to hard in relative density/consistency and had a moisture content of 11 to 21%. The unit was not penetrated at depths of 5.0 to 6.6 m (elevation 175.2 to 175.6) in boreholes 208, 210, 218 and at 32.7 m depth (elevation 148.7) in borehole 85-4.

Groundwater

Water was observed in 24 of the 75 boreholes during the course of the field work at depths of 0.0 to 7.0 m.

At Embankment 1, groundwater was observed in five boreholes during the course of the field work at depths of 0.0 to 6.6 m. During drilling, it was detected at 1.4 m depth (elevation 189.7) in borehole 13. Upon completion of augering, water was measured at a depth of 6.6 m (elevation 183.9) in borehole 12. Perched water was present surficially in the granular material encountered in borehole 71-3 drilled near a maintenance hole.

At Embankment 2, groundwater was observed in seven boreholes during the course of the field work at depths of 0.0 to 1.7 m. In the process of augering, it was measured at depths of 0.0 to 1.2 m (elevation 189.8 to 191.0) in boreholes 102, 104, 106 and 72-3. Upon completion of drilling, groundwater was observed in borehole 112 at a depth of 0.3 m (elevation 190.1).

At Embankment 3, groundwater was observed in twelve boreholes during the course of the field work at depths of 0.0 to 7.0 m. Water was present surficially in boreholes 210, 212, 216 and perched in the surficial layer of sand and gravel in borehole 85-1. Water was detected in boreholes 84-3 and 84-4 at respective depths of 7.0 and 6.6 m (elevation 173.1 and 173.4) in the process of augering. Water was observed in borehole 85-4 at 12.7 m depth (elevation 168.7) during drilling and at 6.4 m depth (elevation 175.0) one day later. Upon completion of drilling, groundwater was measured at depths of 0.4 and 1.8 m (elevation 178.5 and 178.4) in boreholes 204 and 217 respectively.

Upon completion of drilling, piezometers were installed in nine boreholes (one piezometer was destroyed prior to reading). A number of piezometer readings subsequently taken showed water levels to be at minimum depths of 0.1 to 2.2 m (elevation 189.1 to 190.5 at Embankments 1 and 2, elevation 180.4 to 181.4 at Embankment 3). The details of depths/elevations are provided in the following table:

Date	Embankment 1				Embankment 2			
	Borehole 71-2 (Station 12+700, Dougall Ave. chainage)		Borehole 71-6 (Station 12+845, Dougall Ave. chainage)		Borehole 103 (Station 12+685, Highway 401 chainage)		Borehole 109 (Station 12+925, Highway 401 chainage)	
	Depth (m)	Elevation	Depth (m)	Elevation	Depth (m)	Elevation	Depth (m)	Elevation
February 7, 2002	6.0	185.4	8.6	183.1	-	-	-	-
February 14, 2002	3.6	187.8	7.3	184.4	-	-	-	-
February 25, 2002	-	-	-	-	8.6	182.2	5.3	185.5
March 5, 2002	1.4	190.0	2.5	189.2	-	-	-	-
March 28, 2002	1.1	190.3	2.3	189.4	1.7	189.1	0.5	190.3
May 6, 2002	0.9	190.5	2.2	189.5	-	-	-	-

Date	Embankment 2		Embankment 3					
	Borehole 112 (Station 13+095, Highway 401 chainage)		Borehole 202 (Station 22+735, Highway 401 chainage)		Borehole 219 (Station 10+390, Highway 401 chainage)		Borehole 85-3 (Station 10+485, Highway 401 chainage)	
	Depth (m)	Elevation	Depth (m)	Elevation	Depth (m)	Elevation	Depth (m)	Elevation
January 18, 2002	-	-	-	-	-	-	9.0	172.7
January 21, 2002	-	-	-	-	-	-	8.9	172.8
February 25, 2002	4.7	185.7	-	-	-	-	-	-
March 28, 2002	0.2	190.2	-	-	1.3	180.4	0.3	181.4
April 1, 2002	-	-	0.1	180.6	-	-	-	-

Groundwater levels may fluctuate subject to seasonal variations and precipitation patterns.

CLOSURE

The field work was carried out under the supervision of Mr. M. Rapsey and direction of Mr. M.R. Anderson, M. Eng., P.Eng., Senior Foundation Engineer. The equipment was supplied by All-Terrain Drilling Limited.

The report was prepared by Mr. G.O. Degil, Ph.D., Senior Project Supervisor. It was reviewed by Mr. M.R. Anderson, M.Eng., P.Eng., Senior Foundation Engineer, and Mr. D.W. Kerr, M.Eng., P.Eng., Chief Foundation Engineer. Mr. B.R. Gray, M.Eng., P.Eng. carried out an independent review of the report.



Yours very truly

Peto MacCallum Ltd.

A handwritten signature of Murray R. Anderson in black ink, written over a horizontal line.

Murray R. Anderson, M.Eng., P.Eng.
Senior Foundation Engineer



A handwritten signature of Dennis W. Kerr in black ink, written over a horizontal line.

Dennis W. Kerr, M.Eng., P.Eng.
Chief Foundation Engineer



A handwritten signature of Brian R. Gray in black ink, written over a horizontal line.

Brian R. Gray, M.Eng., P.Eng.
President

GD:lad

APPENDIX A

TABLE I	-	SUMMARY OF LOCATIONS AND CHARACTERISTIC FEATURES OF EMBANKMENTS
TABLE II	-	SUMMARY OF SUBSOIL CONDITIONS
FIGURES 1 TO 3	-	PLASTICITY CHARTS
FIGURES 4 TO 6	-	PARTICLE SIZE DISTRIBUTION CHARTS
FIGURES 7 TO 9	-	LABORATORY CONSOLIDATION TEST RESULTS

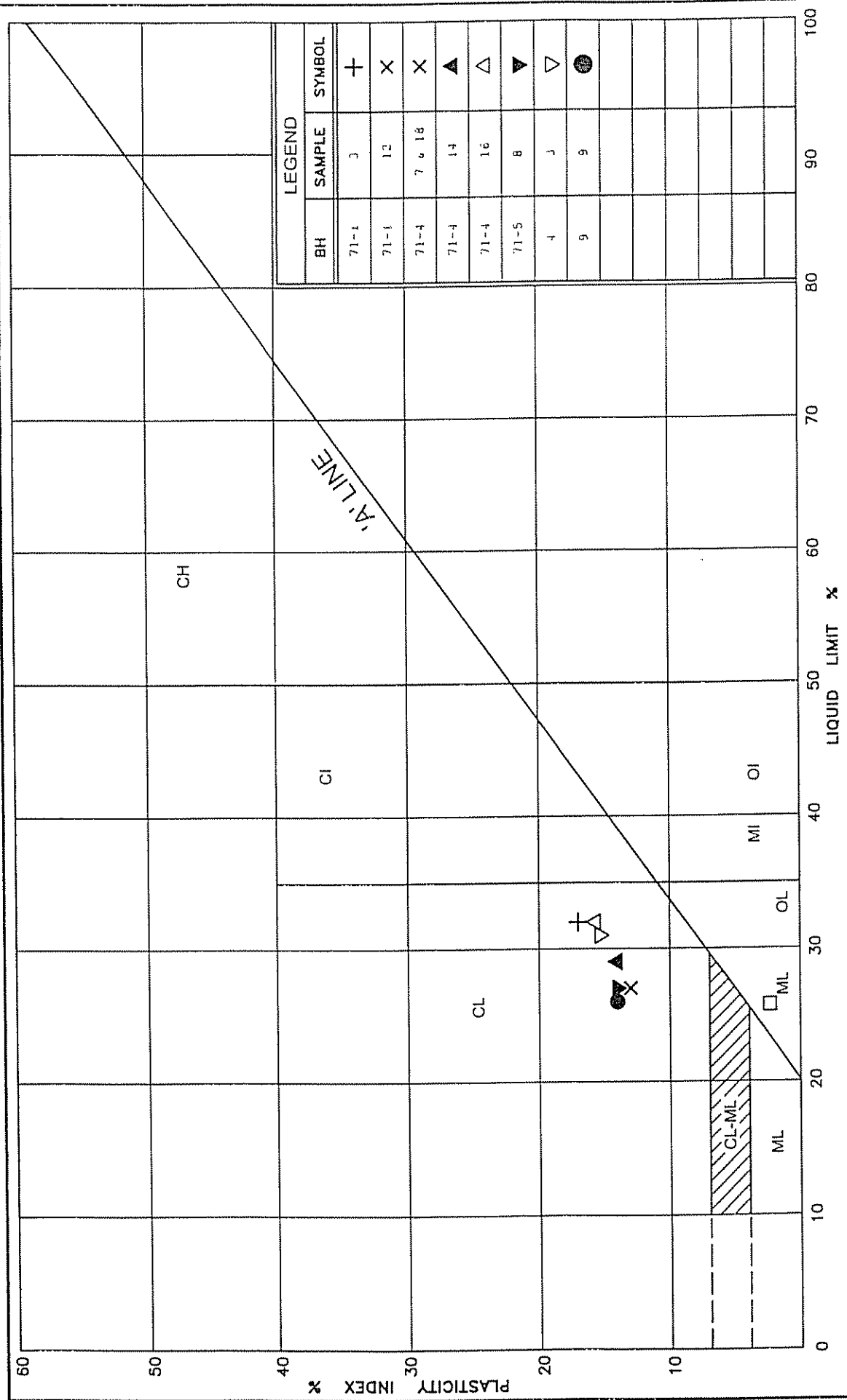
TABLE I
SUMMARY OF LOCATIONS AND
CHARACTERISTIC FEATURES OF EMBANKMENTS
G.W.P. 60-00-00
HIGHWAY 401 WIDENING
WINDSOR, ONTARIO

Embankment No.	Location ⁽¹⁾	Length ⁽¹⁾ (m)	Height (m)	Remarks
1	North leg at Dougall Avenue, Approx. Station 12+480 to 13+000, Dougall Avenue chainage	520	9	New embankment
2	Walker Road to Essex Road 46, Approx. Station 12+550 to 13+200, Highway 401 chainage	650	9	Widening of the existing embankment to the north. Removing an approximate 80 m long section of the Conrail Railway structure and filling in
3	100 m west of Belle River to Belle River Road, Approx. Station 22+700 (Township of Maidstone) to 10+550 (Township of Rochester), Highway 401 chainage	600	5	Widening of the existing embankment on both sides. A wetland is reported to exist on the north side of the embankment

⁽¹⁾ Deduced from the drawings provided by MTO.

TABLE II
SUMMARY OF SUBSOIL CONDITIONS
G.W.P. 60-00-00
HIGHWAY 401 WIDENING
WINDSOR, ONTARIO

Embankment No.	Location	No. of Boreholes	Fill/Topsoil Thickness (m)	Clay Till Thickness (m)	Depth to Bedrock (m)	Notes and/or Underlying Materials
1 (Dougall Ave.)	Approx. Sta. 12+480 to 13+000, Dougall Ave. chainage	20	0.0-2.9	33.9-39.8	39.9-40.7 (El. 150.3-151.4)	Surficial fill/topsoil in 4 boreholes, surficial thin topsoil layer in 10 boreholes, and surficial native clay/clay till in 6 boreholes underlain by clayey silt till. (Predominantly sandy clayey silt) Basal sand and gravel revealed in 2 boreholes below sandy silty clay till. Bedrock contacted in 3 boreholes
2 (Walker Rd. to Essex Rd. 46)	Approx. Sta. 12+550 to 13+200, Highway 401 chainage	23	0.8-8.6	23.2-36.6	31.9-37.3 (El. 154.4-161.0)	Surficial fill in 5 boreholes, thin surficial topsoil layer in 15 boreholes, peat in 1 borehole, and native clay till at surface in 1 borehole underlain by silty clay till. (Predominantly sandy silty clay) Sand revealed below topsoil in 1 borehole. Fine sand encountered within sandy silty clay till in 2 boreholes and below till in 2 boreholes; sandy silt identified beneath sandy silty clay till in 1 borehole. Bedrock contacted in 5 boreholes
3 (Belle River)	Approx. Sta. 22+700 to 10+550, Highway 401 chainage	32	0.1-2.1	25.0	Bedrock not contacted at exploration depths of 5.0-32.7 (El. 148.7-179.7)	Surficial fill in 5 boreholes, thin surficial topsoil layer in 18 boreholes, alluvium in 1 borehole, and clay till at surface in 8 boreholes underlain by silty clay till. (Predominantly silty clay) Discontinuous deposits of silt and/or sand encountered within silty clay till in 8 boreholes. Silt over gravelly sand and silt till underlain by clayey sandy silt till revealed below silty clay till in 1 borehole



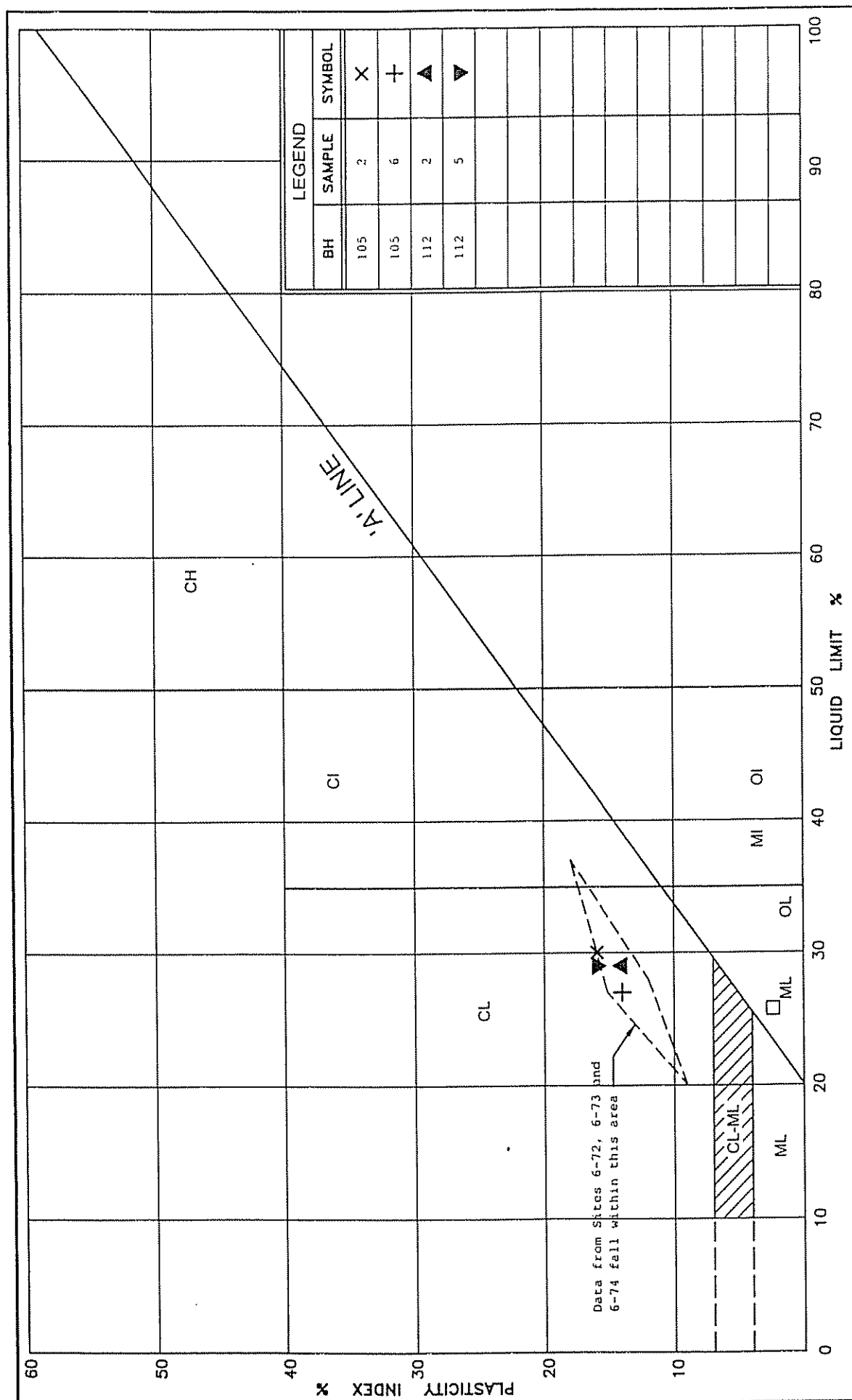
PLASTICITY CHART


SANDY SILTY CLAY, trace to some gravel (CL)

FIG No 1

HIGHWAY 401

G.W.P. 60-00-00



 Ministry of
Transportation
Ontario

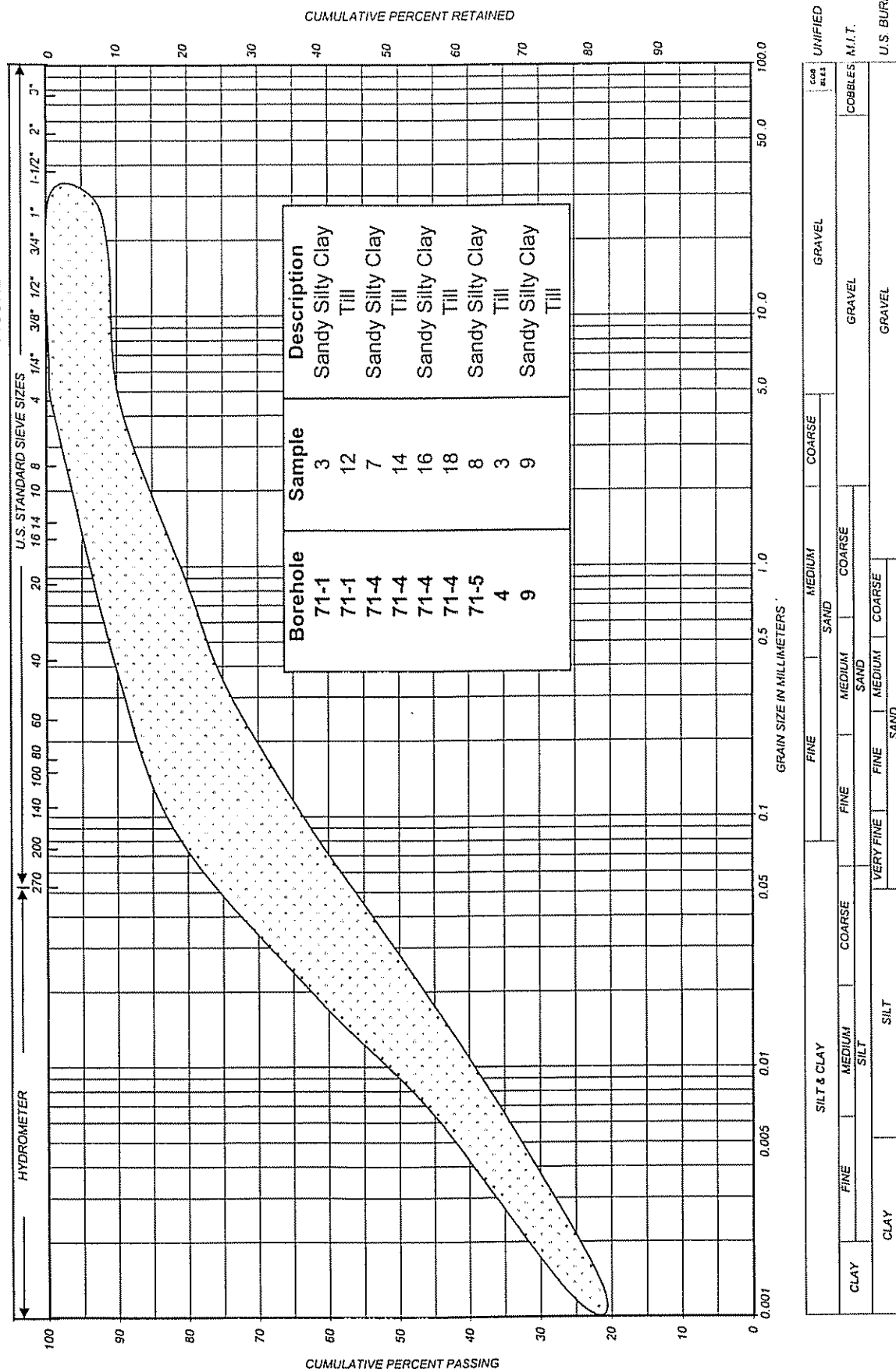
PLASTICITY CHART

FIG No 2

HIGHWAY 401

G.W.P. 60-00-00

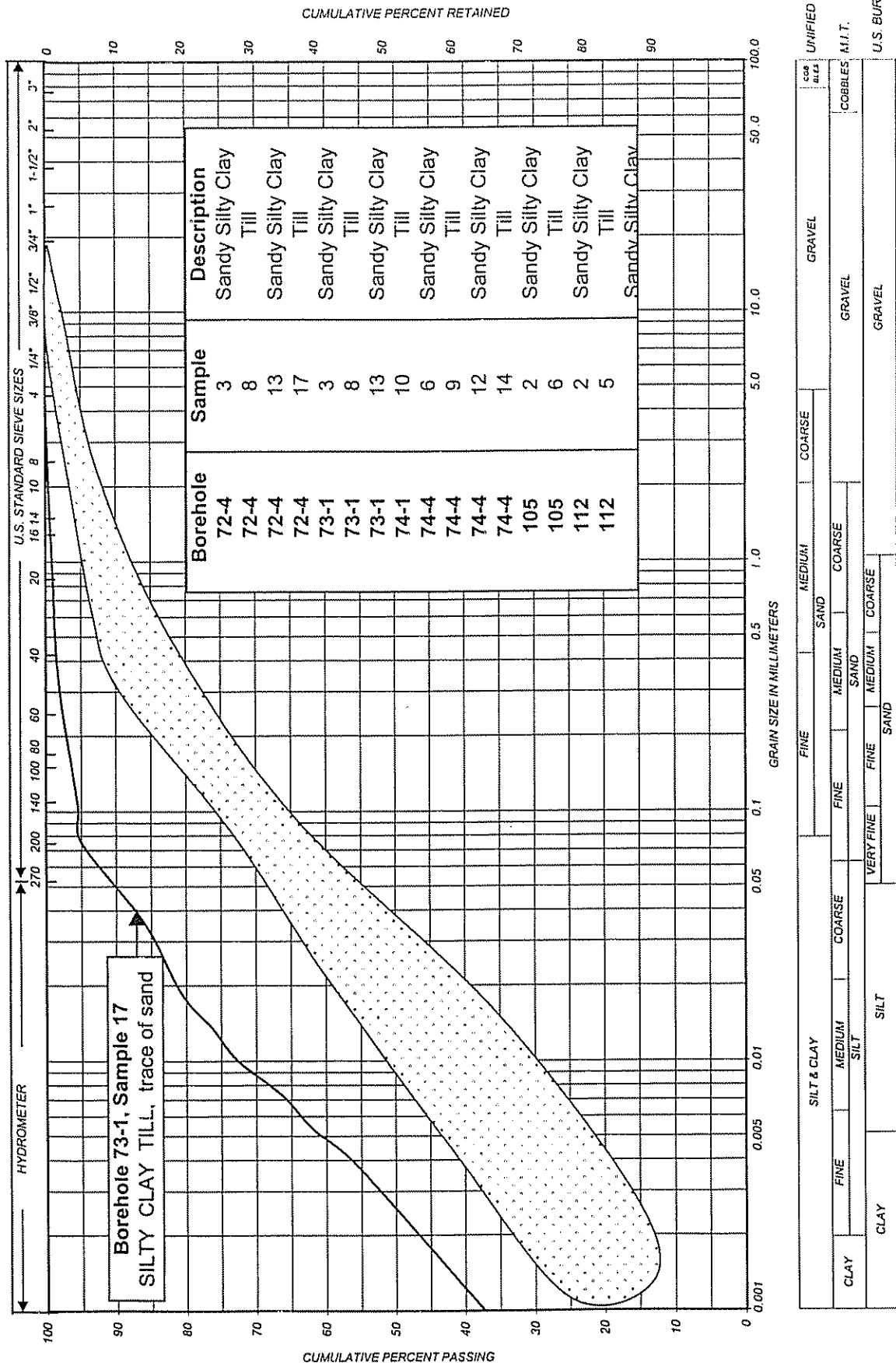
PARTICLE SIZE DISTRIBUTION CHART



REMARKS SANDY SILTY CLAY TILL, trace to some gravel

PML REF.	01TF072
G.W.P.	60-00-00
FIGURE	5

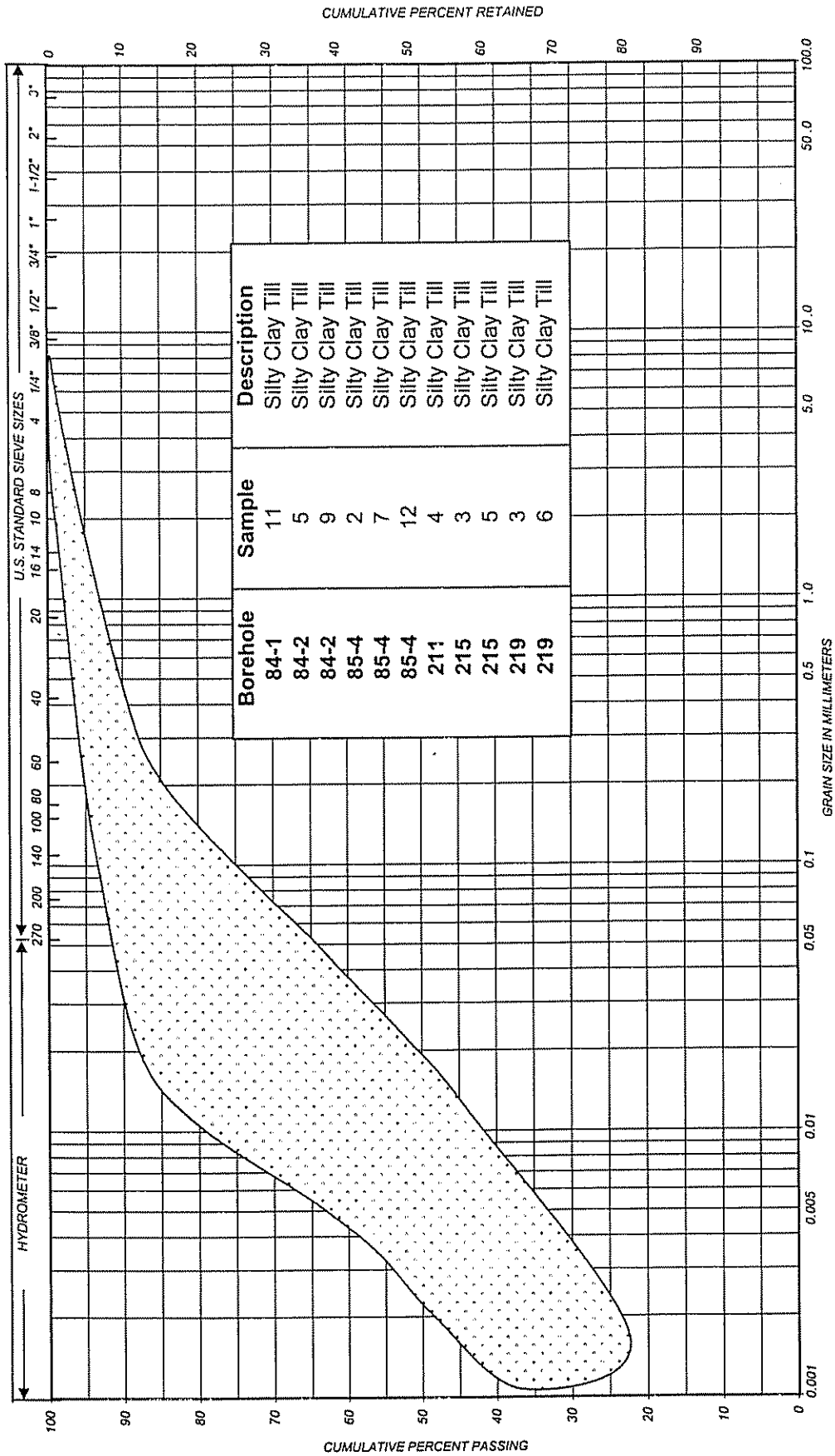
PARTICLE SIZE DISTRIBUTION CHART



REMARKS SANDY SILTY CLAY TILL, trace of gravel

PML REF. 01TF072
G.W.P. 60-00-00
FIGURE 6

PARTICLE SIZE DISTRIBUTION CHART



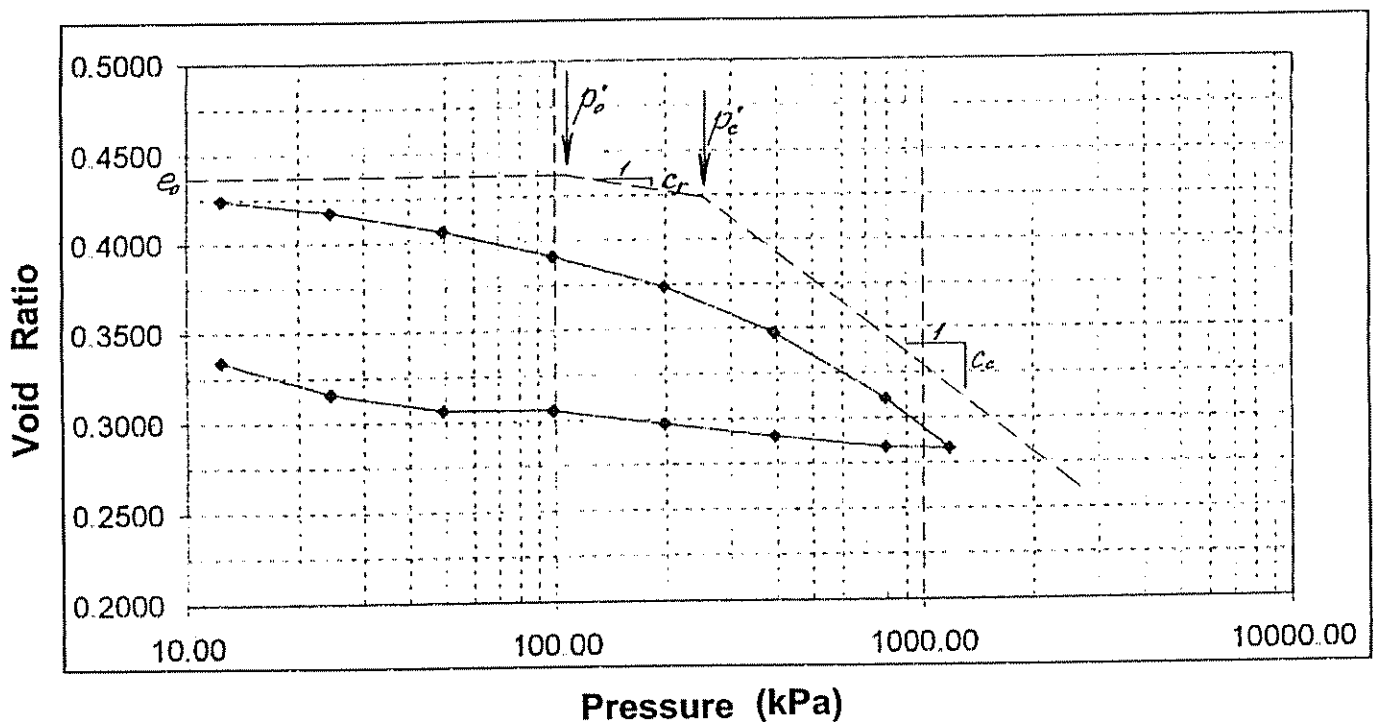
SILT & CLAY										COARSE SAND		GRAVEL		COB		
CLAY	FINE		MEDIUM		SILT		COARSE		FINE		MEDIUM SAND		COARSE		M.I.T.	
	CLAY		SILT		SILT		SILT		SILT		SILT		SILT			
CLAY										SILT		SILT		SILT		U.S. BUREAU
CLAY										SILT		SILT		SILT		U.S. BUREAU

REMARKS SILTY CLAY TILL, trace to some sand, trace of gravel

Laboratory Consolidation Test Results

Highway 401
Dougall Avenue to Belle River Road
G.W.P. 60-00-00
District 31, Township of Sandwich South, Windsor, Ontario
BOREHOLE 9, SAMPLE 9

Void Ratio versus Log of Pressure



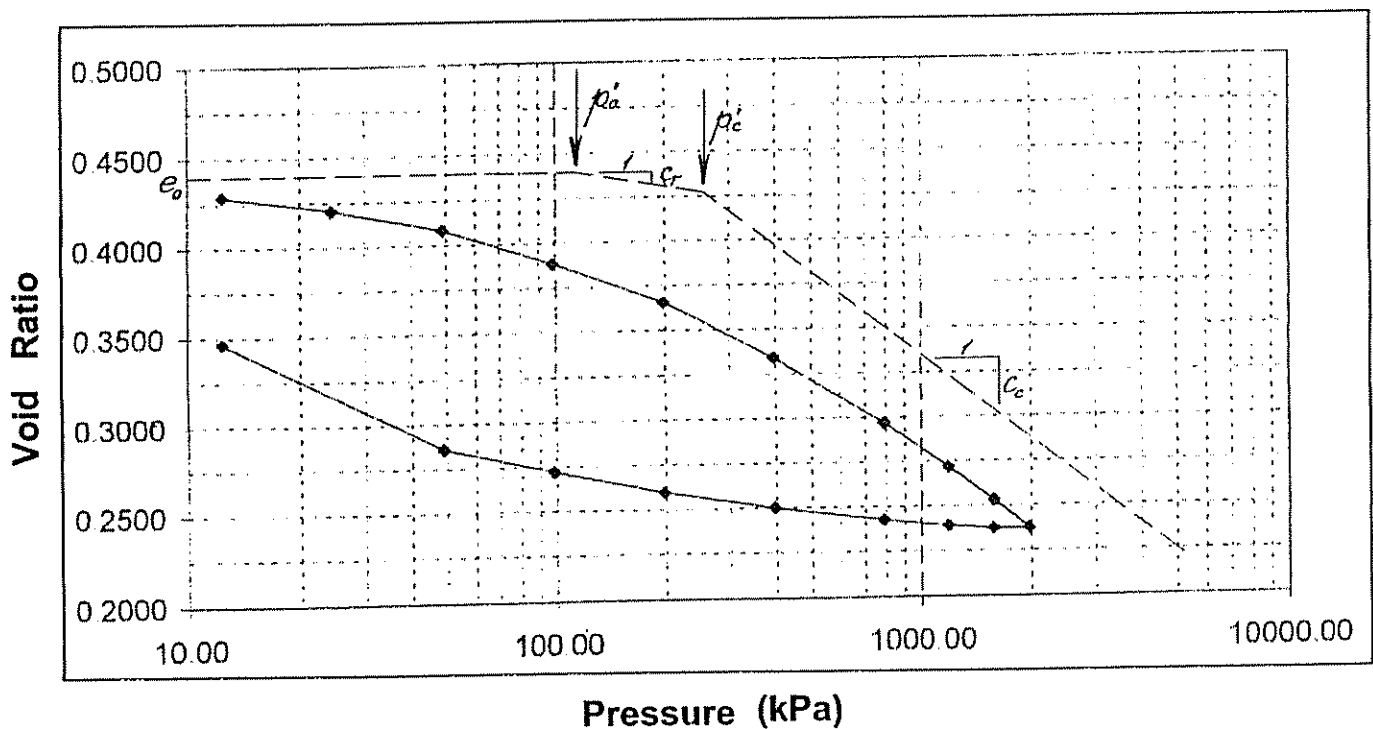
SOIL TYPE: SANDY SILTY CLAY, trace to some gravel		DEPTH: 9.2 - 9.6 m
$e_o = 0.44$ $w_o = 17\%$ $\gamma = 22.0 \text{ kN/m}^3$ $w_L = 26; w_p = 12; PI = 14$	$p'_o = 105 \text{ kPa}$ $p'_c = 250 \text{ kPa}$ $C_c = 0.16$ $C_r = 0.03$	FIGURE: 7
		HIGHWAY 401 / Embankment 1
		TWP OF SANDWICH SOUTH, WINDSOR
		G. W. P. 60 - 00 - 00

Laboratory Consolidation Test Results

Highway 401
Dougall Avenue to Belle River Road
G.W.P. 60-00-00
District 31, Township of Sandwich South, Windsor, Ontario

BOREHOLE 74-1, SAMPLE 10

Void Ratio versus Log of Pressure

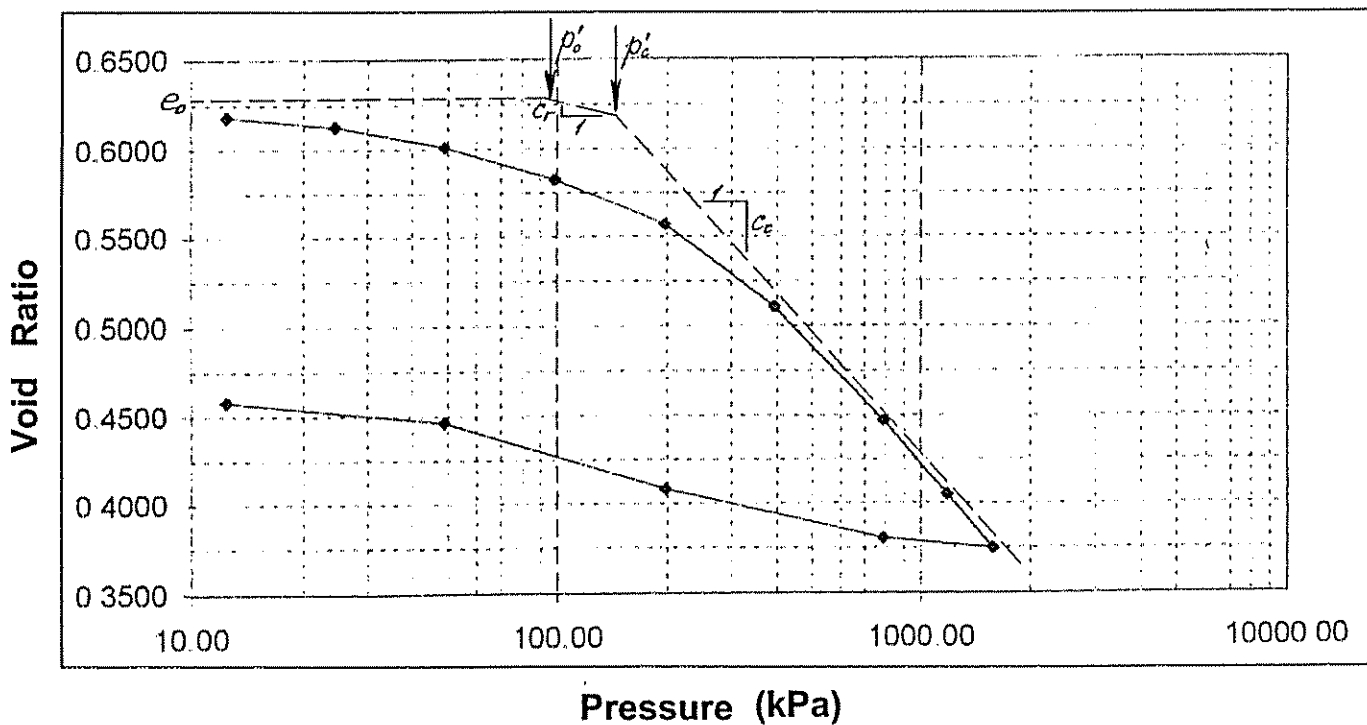


SOIL TYPE : SANDY SILTY CLAY , trace of gravel		DEPTH : 10.7 - 11.1 m
$e_0 = 0.44$	$p'_0 = 110$ kPa	FIGURE : 8
$w_0 = 16\%$	$p'_c = 250$ kPa	HIGHWAY 401 / Embankment 2
$\gamma = 21.5$ kN / m ³	$C_c = 0.16$	TWP OF SANDWICH SOUTH , WINDSOR
$w_L = 27 ; w_p = 12 ; PI = 15$	$C_r = 0.03$	G. W. P. 60 - 00 - 00

Laboratory Consolidation Test Results

Highway 401
Dougall Avenue to Belle River Road
G.W.P. 60-00-00
District 31, Townships of Maidstone and Rochester,
North Woodslee, Ontario
BOREHOLE 84-2, SAMPLE 9

Void Ratio versus Log of Pressure



SOIL TYPE : SILTY CLAY , trace to some sand, trace of gravel		DEPTH : 9.2 - 9.6 m
$e_o = 0.63$	$p'_o = 95 \text{ kPa}$	FIGURE : 9
$w_o = 25\%$	$p'_c = 125 \text{ kPa}$	HIGHWAY 401 / Embankment 3
$\gamma = 20.6 \text{ kN / m}^3$	$C_c = 0.24$	TWPS OF MAIDSTONE and ROCHESTER
$w_L = 35 ; w_p = 14 ; PI = 21$	$C_r = 0.05$	G. W. P. 60 - 00 - 00

APPENDIX B

EMBANKMENT 1	RECORD OF BOREHOLE SHEETS DRAWINGS 1-1 to 1-3
EMBANKMENT 2	RECORD OF BOREHOLE SHEETS DRAWINGS 2-1 to 2-3
EMBANKMENT 3	RECORD OF BOREHOLE SHEETS DRAWINGS 3-1 to 3-4

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

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

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

▲, Δ - UNDISTURBED AND REMOULDED SHEAR STRENGTH DETERMINED FROM IN SITU VANE TEST

■ - UNDRAINED SHEAR STRENGTH DETERMINED FROM POCKET PENETROMETER TEST

EMBANKMENT 1

RECORD OF BOREHOLE No 1

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 01, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		GR	SA	SI	CL
190.70	Ground Level																			
0.00	Topsoil, silty clay																			
0.20	Dark Brown																			
	Sandy silty clay, trace of gravel		1	SS	11		190													
	Stiff Brown (Till)		2	SS	9		189													
	Hard — — — —		3	SS	48		188													
			4	SS	50		187													
	Very Stiff — — — — Grey		5	SS	26		186													
							185													
			6	SS	20															
184.15																				
6.55	End of Borehole																			
	Borehole dry on completion of drilling																			
	■ Penetrometer Test																			

RECORD OF BOREHOLE No 2

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg Sta. 12+489, o/s 15.5m Rt. of CL ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 04, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p w w _L							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)							
189.74	Ground Level							20	40	60	80	100								
0.00	Topsoil, silty clay																			
0.12	Dark Brown																			
	Sandy silty clay, trace of gravel		1	SS	34		189							○						
	Hard Brown (Till)																			
			2	SS	56		188							○						
			3	SS	54		187							○						
	Very Stiff Grey																			
			4	SS	26		186							○						
			5	SS	19		185							○						
							184													
			6	SS	15									○						
183.19	End of Borehole																			
6.55	Borehole dry on completion of drilling																			

RECORD OF BOREHOLE No 3

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg Sta. 12+539, o/s 17.1m Lt. of CL ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 01, 2002 CHECKED BY MRA

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
190.67	Ground Level																
0.00	Sandy silty clay, trace of gravel																
	Stiff Brown (Till)		1	SS	11												
	Hard		2	SS	31												
			3	SS	56												
			4	SS	61												
	Very Stiff Grey		5	SS	28												
	Stiff		6	SS	13												
			7	SS	12												
182.57	End of Borehole																
8.10	Groundwater level not established due to piezometer destruction																
	Penetrometer Test																
	Borehole Backfill Legend:																
	Native Backfill																
	Bentonite Seal																
	Filter Gravel																
	Slotted Pipe																

RECORD OF BOREHOLE No 4

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg Sta. 12+532, o/s 14.8m Lt. of CL ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 04, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				w _p	w	w _L				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)									
189.92	Ground Level							20	40	60	80	100						
0.00	Topsoil, silty clay																	
0.12	Dark Brown																	
	Sandy silty clay, trace of gravel		1	SS	39		189											
	Hard Brown (Till)																	
			2	SS	19*		188											* Bouncing on cobble
			3	SS	47													1 30 42 27
	Very Stiff Grey		4	SS	21		187											
							186											
	Stiff		5	SS	15		185											
			6	SS	14		184											
							183											
			7	SS	11		182											
181.82	End of Borehole																	
8.10																		
	Borehole dry on completion of drilling																	
	■ Penetrometer Test																	

RECORD OF BOREHOLE No 5

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg ORIGINATED BY MR
 DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
 DATUM Geodetic DATE February 11, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W _p	W	W _L			
								○ UNCONFINED + FIELD VANE					WATER CONTENT (%)				
						● QUICK TRIAXIAL × LAB VANE	20	40	60	80	100	20	40	60			
190.44	Ground Level																
0.00	Topsoil, silty clay																
0.20	Dark Brown																
	Sandy silty clay, trace of gravel		1	SS	11												
	Stiff to Very Stiff Brown (Till)		2	SS	19												
	Hard		3	SS	50												
			4	SS	62												
	Very Stiff Grey		5	SS	24												
			6	SS	20												
			7	SS	17												
182.34	End of Borehole																
8.10																	
	Borehole dry on completion of drilling																
	■ Penetrometer Test																

RECORD OF BOREHOLE No 6

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg Sta. 12+589, o/s 10.5m Rt. of CL ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 04, 2002 CHECKED BY MRA

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									
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE	WATER CONTENT (%)					

190.05	Ground Level						190										
0.00	Topsoil, silty clay																
0.20	Dark Brown																
	Sandy silty clay, trace of gravel		1	SS	30		189						○				
	Hard Brown (Till)		2	SS	50								○				
							188						○				
			3	SS	65								○				
	Very Stiff Grey		4	SS	26		187						○				
							186										
			5	SS	19								150	○			
							185										
	Stiff						184						○				
							183										
			6	SS	14								○				
							182						○				
			7	SS	12												

181.95	End of Borehole																
8.10																	
	Borehole dry on completion of drilling																
	■ Penetrometer Test																

RECORD OF BOREHOLE No 7

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg Sta. 12+637, o/s 26.1m Lt. of CL ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 02, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE						
190.28	Ground Level																
0.00	Sandy silty clay, some gravel Very Stiff																
	Brown (Till)		1	SS	16												
	Hard		2	SS	43												
			3	SS	60												
	Very Stiff		4	SS	26												
	Grey		5	SS	25												
			6	SS	18												
			7	SS	16												
	Stiff		8	SS	14												
180.68	End of Borehole	9	SS	10													
9.60	Borehole dry on completion of drilling																
	■ Penetrometer Test																

RECORD OF BOREHOLE No 8

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg Sta. 12+642, o/s 12.5m Rt. of CL ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 04, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p w w _L				
								○ UNCONFINED + FIELD VANE					● QUICK TRIAXIAL × LAB VANE				
190.73 0.00	Ground Level						20	40	60	80	100	20	40	60		GR SA SI CL	
	Sandy silty clay, trace of gravel																
	Stiff to Very Stiff																
	Brown (Till)		1	SS	9												
	Hard		2	SS	30												
			3	SS	49												
			4	SS	50												
	Very Stiff																
	Grey		5	SS	21												
			6	SS	16												
	Stiff																
			7	SS	14												
			8	SS	11												
181.13 9.60	End of Borehole																
	Borehole dry on completion of drilling																
	■ Penetrometer Test																

RECORD OF BOREHOLE No 9

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg ORIGINATED BY MR
 DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
 DATUM Geodetic DATE February 01, 2002 CHECKED BY MRA

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
190.48	Ground Level							20	40	60	80	100					
0.00	Topsoil, silty clay																
0.20	Dark Brown																
	Sandy silty clay, trace of gravel		1	SS	30		190										
	Hard Brown (Till)		2	SS	44		189										
			3	SS	40		188										
	Very Stiff Grey		4	SS	26		187										
			5	SS	29		186										
			6	SS	20		185										
			7	SS	19		184										
	Stiff		8	SS	12		183										
							182										
180.88			9	TW	PH		181									22.0	9 30 35 26
9.60	End of Borehole																
	Borehole dry on completion of drilling																
	■ Penetrometer Test																

METRIC

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 11

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg Sta. 12+876, o/s 17.0m Rt. of CL ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 05, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE	WATER CONTENT (%)								
190.56	Ground Level							20	40	60	80	100		20	40	60				
0.00	Topsoil, silty clay																			
0.10	Dark Brown																			
	Sandy silty clay, trace of gravel		1	SS	13		190							○						
	Stiff to Hard Brown (Till)		2	SS	34		189							○						
			3	SS	46		188							○						
	Very Stiff Grey		4	SS	26		187							○						
							186													
			5	SS	22		185							○						
							184							○						
			6	SS	17		183													
							182													
181.56	End of Borehole		7	SS	15									○						
9.00	Borehole dry on completion of drilling																			
	Penetrometer Test																			

RECORD OF BOREHOLE No 12

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg Sta. 12+912, o/s 10.1m Lt. of CL ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 11, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
								○ UNCONFINED	● QUICK TRIAXIAL	✕ LAB VANE	✚ FIELD VANE	WATER CONTENT (%)								
190.49 0.00	Ground Level						20	40	60	80	100									
	Sandy silty clay, trace of gravel																			
	Stiff Brown (Till)		1	SS	10															
	Hard — — — —		2	SS	47															
			3	SS	45															
	Very Stiff — — — —		4	SS	27															
	— Grey — — —		5	SS	17															
	Stiff — — — —		6	SS	13															

RECORD OF BOREHOLE No 13

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg Sta. 12+914, o/s 12.6m Rt. of CL ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 05, 2002 CHECKED BY MRA

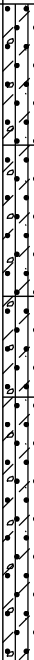
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL						× LAB VANE		
191.11	Ground Level						20	40	60	80	100									
0.00 0.10	Topsoil, silty clay					V _u *	191													
	Dark Brown						190													
	Sandy clayey silt, trace of gravel		1	SS	15															
189.71	Compact/Very Stiff Rusty Brown (Till)																			
1.40	Silty fine sand, some gravel		2	SS	11															
189.31	Loose						189													
1.80	Rusty Brown Saturated																			
	Sandy silty clay, trace of gravel		3	SS	38															
	Very Stiff to Hard						188													
	Brown to Grey(at 2.55m) (Till)		4	SS	29															
						187														
			5	SS	18															
						186														
			6	SS	19*		185													
						184														
183.01			7	SS	19*															
8.10	End of Borehole																			
	▽ Water level observed during drilling																			

RECORD OF BOREHOLE No 14

1 of 1

METRIC

W.P. 64-00-00 LOCATION Dougall Parkway, EBL-N Leg ORIGINATED BY MR
 DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
 DATUM Geodetic DATE February 12, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
190.56	Ground Level																			
0.00	Sandy silty clay, trace of gravel																			
	Very Stiff																			
	Brown (Till)		1	SS	16			190												
	Hard		2	SS	41			189							○					
			3	SS	68			188							○					
	Grey		4	SS	32			187							○					
	Very Stiff							186												
			5	SS	21			185												
			6	SS	16															
184.01	End of Borehole												○							
6.55	Borehole dry on completion of drilling																			
	■ Penetrometer Test																			

RECORD OF BOREHOLE No 71-1

1 of 4

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp Sta. 12+725, o/s 9.5m Lt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE January 28 to 30, 2002 CHECKED BY DWK

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE					
191.00	Ground Level						20	40	60	80	100					
0.00	Silty clay, trace of sand, with bluish grey fissures Stiff															
	Brown		1	SS	8											
			2	SS	9											
188.90																
2.10	Sandy silty clay, trace of gravel		3	SS	45											
	(Till)															
	Hard Brown		4	SS	48											
	Very Stiff to Stiff															
	Grey		5	SS	23											
			6	SS	19											
			7	SS	10											
			8	SS	16											
			9	SS	13											
			10	SS	9											
				FV												
			11	SS	11											

RECORD OF BOREHOLE No 71-1

2 of 4

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp Sta. 12+725, o/s 9.5m Lt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE January 28 to 30, 2002 CHECKED BY DWK




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		
176.0																	
	Very Stiff to Stiff Grey																
			13	SS	13												
			14	SS	12												
			15	SS	9												
	some gravel Very Stiff to Hard		16	SS	22												
161.00	Cont'd																

RECORD OF BOREHOLE No 71-1

3 of 4

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp Sta. 12+725, o/s 9.5m Lt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE January 28 to 30, 2002 CHECKED BY DWK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				w _p	w	w _L				
161.00							20	40	60	80	100							
30.00	Sandy silty clay, some gravel Very Stiff to Hard Grey (Till)		17	SS	35													
				18	SS	61												
				19	SS	13												
152.90																		
38.10	Fine to coarse sand and gravel, some silt Very Dense Grey																	
			20	SS	62													
150.30																		
40.70	Bedrock Unweathered, strong limestone Grey to Light Grey		21	RC	*												* Lost sample	
				22	RC	REC 80%												RQD=70%
			23	RC	REC 90%												RQD=50%	
146.85																		
44.15	End of Borehole																	
	Cont'd																	

RECORD OF BOREHOLE No 71-1

4 of 4

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE January 28 to 30, 2002 CHECKED BY DWK

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		
	Borehole dry on completion of drilling ■ Penetrometer Test																

RECORD OF BOREHOLE No 71-2

1 of 1

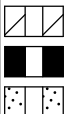
METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp Sta. 12+688, o/s 9.8m Rt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY MRA
DATUM Geodetic DATE February 05, 2002 CHECKED BY DWK

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 (%)
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
191.38 0.00	Ground Level															
190.03 1.35	Silty clay, some sand Firm Brown (Fill)		1	SS	5											
	Sandy silty clay, trace of gravel (Till)		2	SS	11											
	Stiff to Hard Brown		3	SS	48											
			4	SS	67											
			5	SS	67											
			6	SS	30											
			7	SS	28											
			8	SS	16											
181.78 9.60	End of Borehole		9	SS	15											
<div>■ Penetrometer Test</div> <div>Piezometer Readings: Date Depth (m) Feb.07/02 6.00 Feb.14/02 3.55 Mar.05/02 1.40 Mar.28/02 1.05 May 06/02 0.85</div> <div>Borehole Backfill Legend: <div><div></div>Native Backfill</div><div><div></div>Bentonite Seal</div><div><div></div>Filter Sand</div></div>																

■ Penetrometer Test
Piezometer Readings:
Date Depth (m)
Feb.07/02 6.00
Feb.14/02 3.55
Mar.05/02 1.40
Mar.28/02 1.05
May 06/02 0.85

Borehole Backfill
Legend:



Native Backfill

Bentonite Seal

Filter Sand

RECORD OF BOREHOLE No 71-3

1 of 1

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp ORIGINATED BY MR
 DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid and Hollow Stem Augers COMPILED BY MRA
 DATUM Geodetic DATE February 11, 2002 CHECKED BY DWK

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 (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
191.47 0.00	Ground Level					▽*		20	40	60	80	100							
	Crushed limestone	X					191										* Low N value due to hydraulic disturbance		
	Very Loose																		
	Saturated (Fill)		1	SS	2*														
			2	SS	1*		190												
			3	SS	2*		189												
188.57 2.90	Sandy silty clay, trace of gravel, with oxidized stains	•	4	SS	44		188												
	Hard to Stiff		5	SS	26		187												
	Brown (Till)		6	SS	20		186												
	Grey		7	SS	17		185												
			8	SS	11		184												
							183												
							182												
				9	SS	13													
181.87 9.60	End of Borehole																		
	▽ Groundwater level at surface																		
	■ Penetrometer Test																		

METRIC

+⁷, ×⁵: Numbers refer to Sensitivity

20
15 — ○ — 5
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 71-4

2 of 4

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp
Sta. 12+778, o/s 8.9m Rt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 05, 2002 CHECKED BY DWK

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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE					● QUICK TRIAXIAL		
176.5			12	SS	15		20	40	60	80	100	20	40	60	GR SA SI CL		
161.46	Stiff Grey (Till) <																

RECORD OF BOREHOLE No 71-4

3 of 4

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp Sta. 12+778, o/s 8.9m Rt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 05, 2002 CHECKED BY DWK

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		GR	SA	SI	CL	
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE	WATER CONTENT (%)									
161.46							20	40	60	80	100										
30.00																					
	Sandy silty clay, some gravel Hard Grey (Till)		17	SS	30								○								
																</					

RECORD OF BOREHOLE No 71-4

4 of 4

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 05, 2002 CHECKED BY DWK

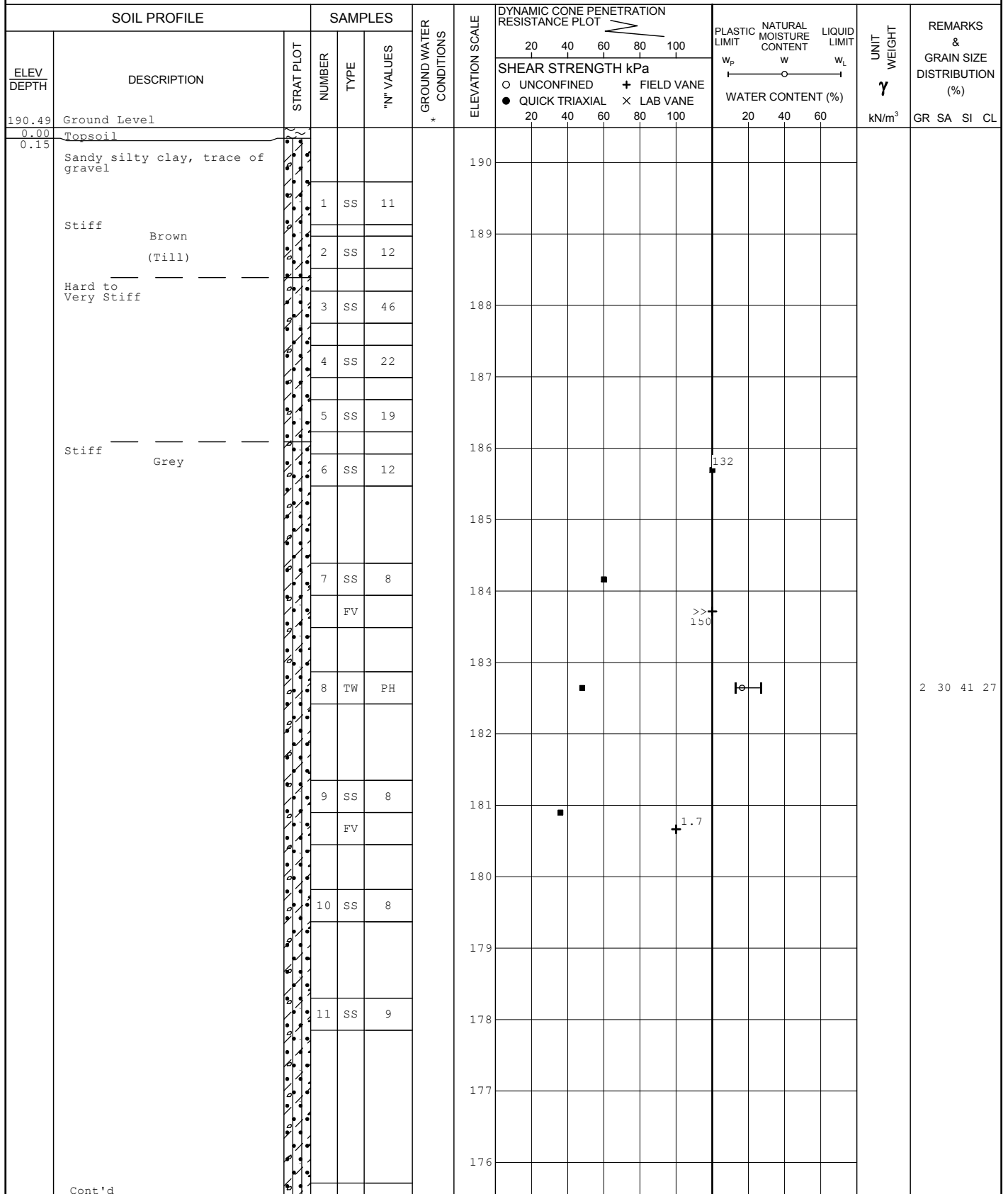
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	Borehole dry on completion of drilling ■ Penetrometer Test																

RECORD OF BOREHOLE No 71-5

1 of 3

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp Sta. 12+850, o/s 6.3m Lt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 7, 8 and 11, 2002 CHECKED BY DWK



RECORD OF BOREHOLE No 71-5

2 of 3

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp
Sta. 12+850, o/s 6.3m Lt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 7, 8 and 11, 2002 CHECKED BY DWK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE							w _p w w _L		
						● QUICK TRIAXIAL × LAB VANE	20	40	60	80	100	20	40	60			
175.5			12	SS	11												
Stiff to Very Stiff (Till)							175										
							174										
							173										
			13	SS	15		172										
							171										
							170										
			14	SS	15*		169										
							168										
							167										
			15	SS	19		166										
							165										
							164										
			16	SS	24		163										
							162										
	Hard						161										
Cont'd																	

* No
recovery

RECORD OF BOREHOLE No 71-5

3 of 3

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp Sta. 12+850, o/s 6.3m Lt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary & NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 7, 8 and 11, 2002 CHECKED BY DWK

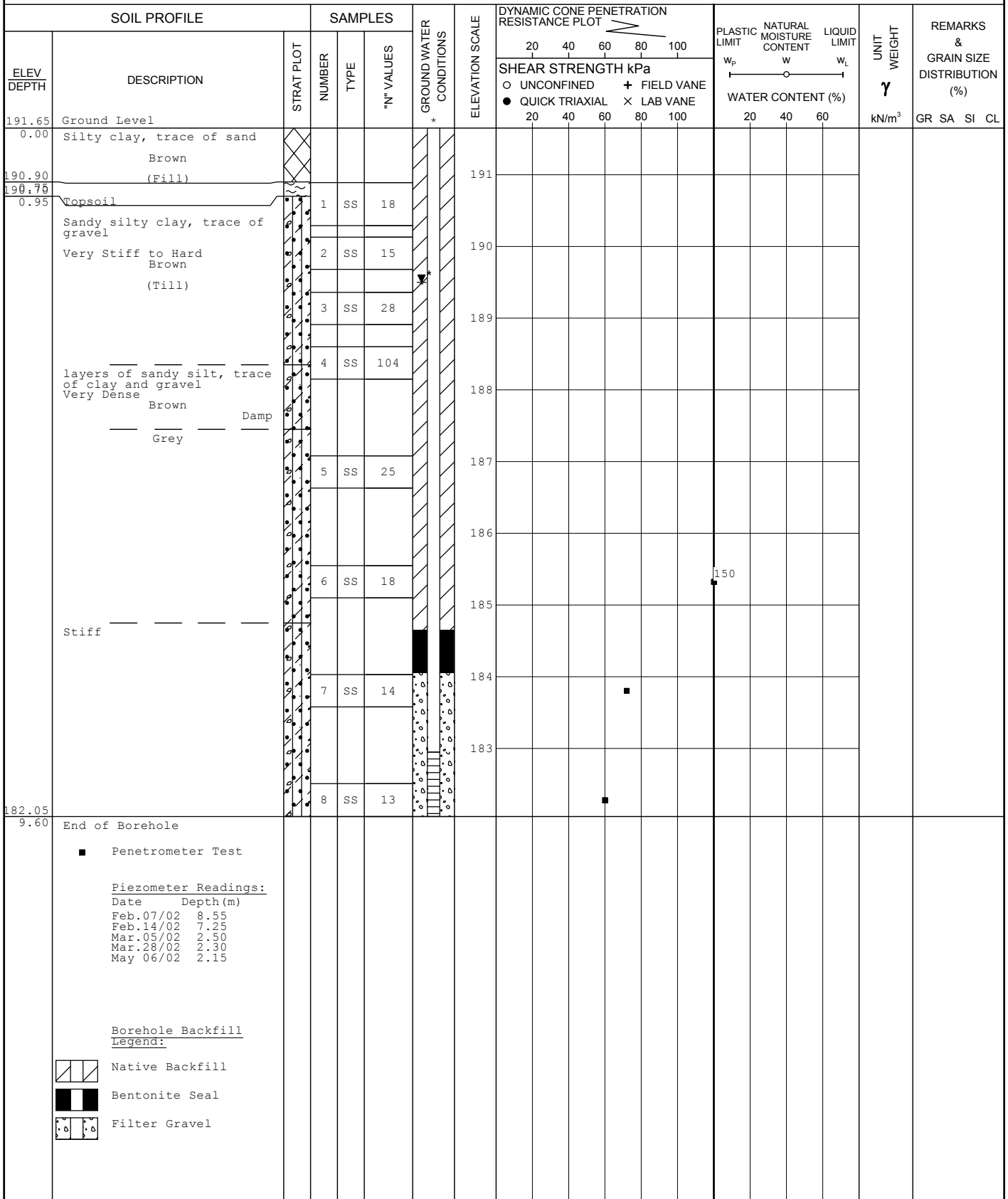
SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+	FIELD VANE							
160.49			17	SS	30		○	+		×							
	(Till)																
	Very Stiff		18	SS	50												
														</			

RECORD OF BOREHOLE No 71-6

1 of 1

METRIC

W.P. 64-00-02 LOCATION Dougall Parkway, N-E Ramp Sta. 12+845, o/s 8.8m Rt. of Lt. EP ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY MRA
DATUM Geodetic DATE February 05, 2002 CHECKED BY DWK



METRIC

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

CONT No 2007-3043

WP No 64-00-00

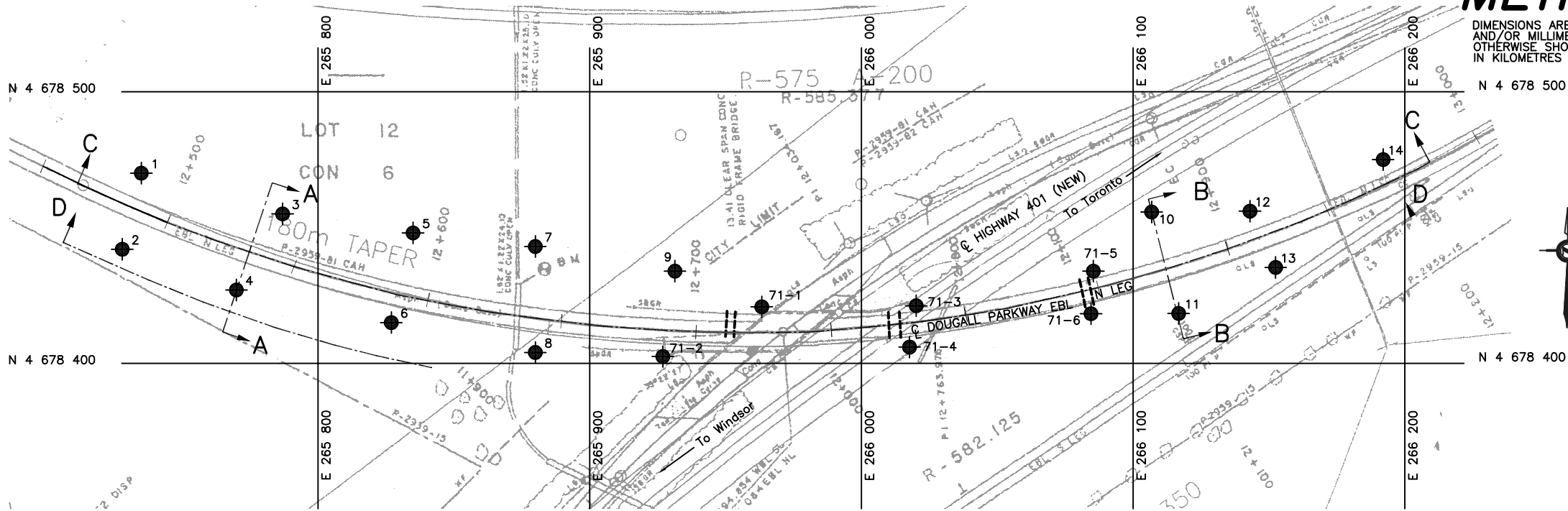
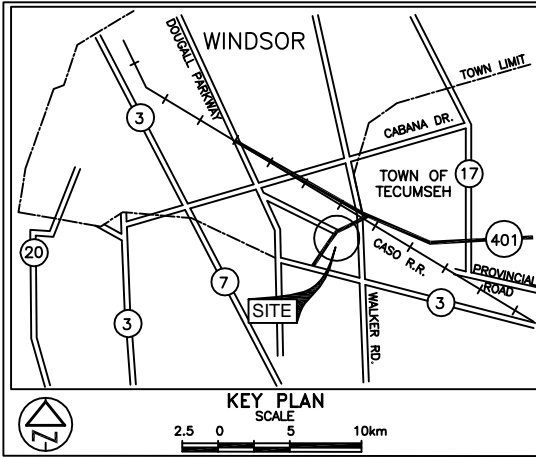
HIGHWAY 401
EMBANKMENT ON EBL
NORTH LEG AT DOUGALL PARKWAY
BOREHOLE LOCATIONS & SOIL STRATA



SHEET

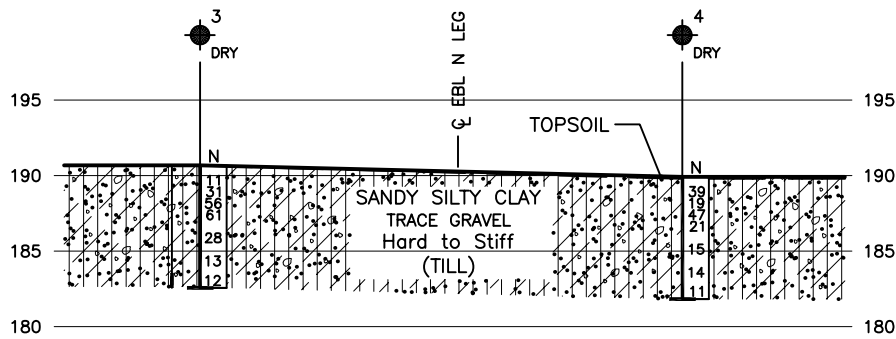
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PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

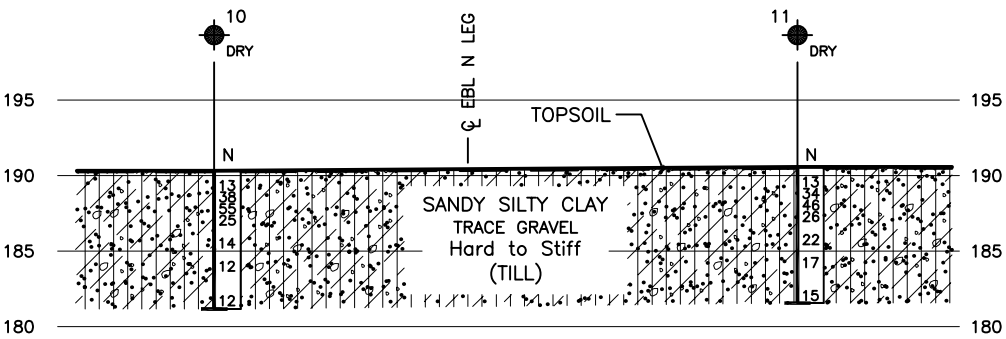


PLAN
SCALE

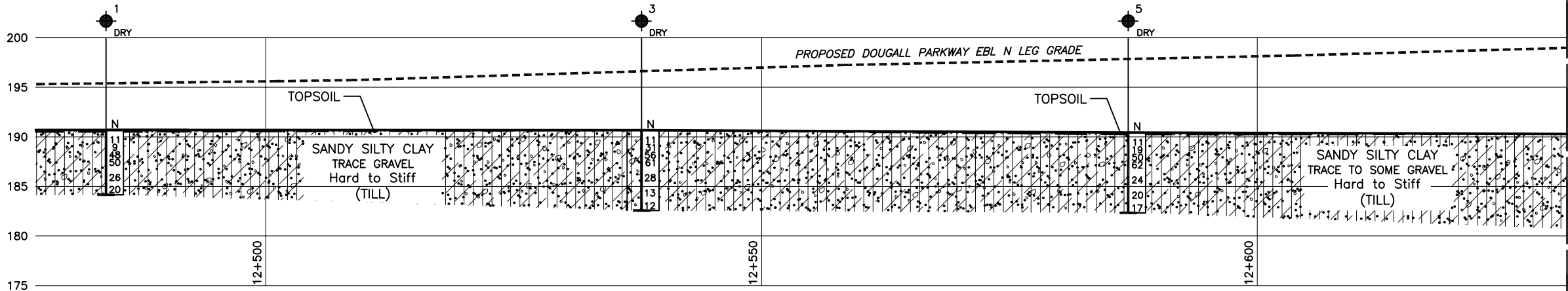
20 10 0 20 40m



A-A



B-B



C-C

NOTES:

- REFER TO DRAWING 1-2 FOR SECTION C-C CONTINUED AND DRAWING 1-3 FOR SECTION D-D.
- SECTIONS ARE PROVIDED SOLELY FOR ILLUSTRATIVE PURPOSES. REFER TO RECORD OF BOREHOLES FOR DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS, IN-SITU TEST DATA AND LABORATORY TEST RESULTS.

SECTIONS
SCALE

5 2.5 0 5 10m

REF No Survey Plan 2001 Site # 6-71, entitled
Proposed Bridge Site at Tunnel Diversion and
Highway 401 and Plan, undated, untitled,
Provided by Planning and Design Section, MTO.



(Legend Continued)

BH No	ELEVATION	EBL-N LEG STA.	o/s CL
10	190.32	12+877	21.6m Lt.
11	190.56	12+876	17.0m Rt.
12	190.49	12+912	10.1m Lt.
13	191.11	12+914	12.6m Rt.
14	190.56	12+967	8.5m Lt.
71-1	191.00	12+725	9.5m Lt.
71-2	191.38	12+688	9.8m Rt.
71-3	191.47	12+782	6.0m Lt.
71-4	191.46	12+778	8.9m Rt.
71-5	190.49	12+850	6.3m Lt.
71-6	191.65	12+845	8.8m Rt.

LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & 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
Jan - Mar 2002
- Head
- ARTESIAN WATER
Encountered
- PIEZOMETER

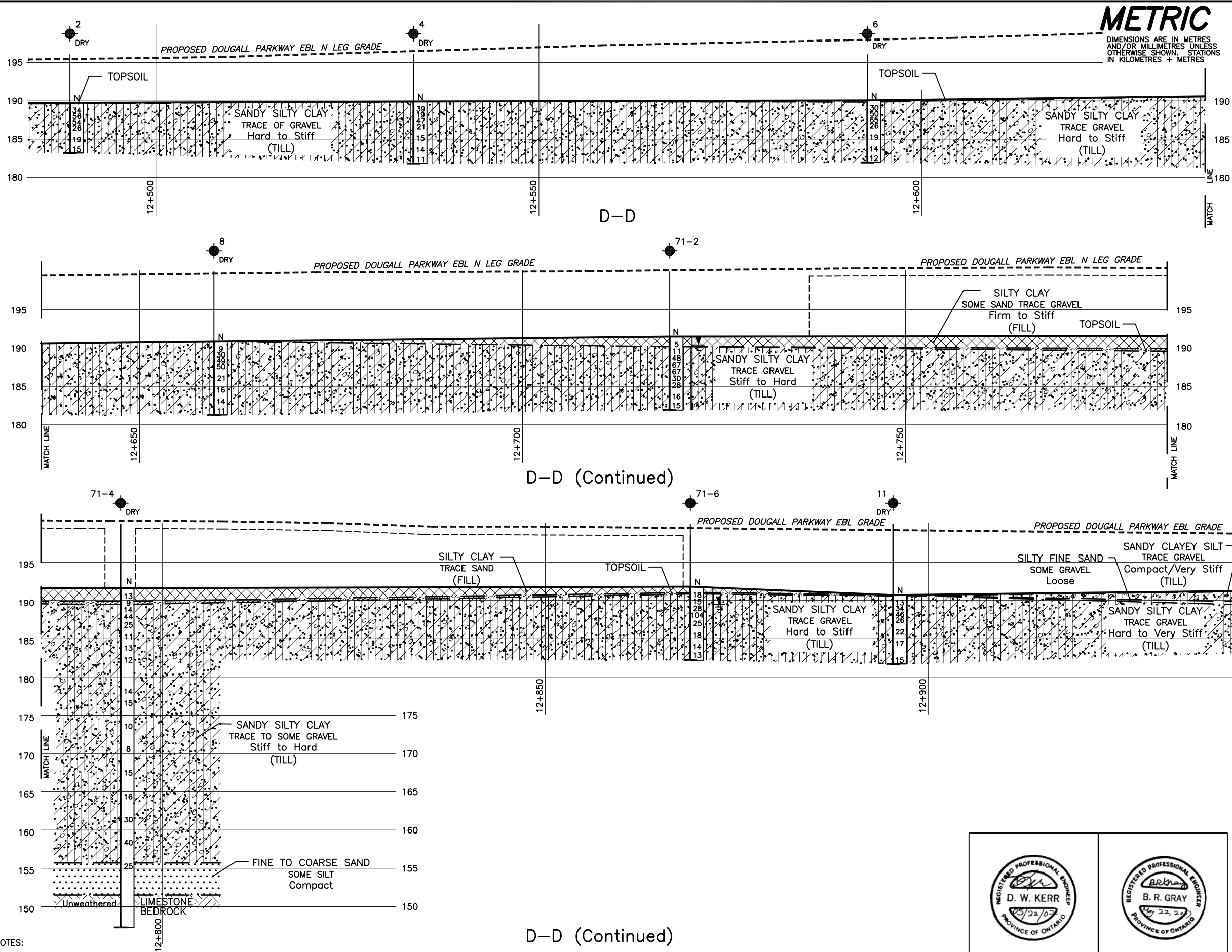
BH No	ELEVATION	EBL-N LEG STA.	o/s CL
1	190.70	12+484	13.0m Lt.
2	189.74	12+489	15.5m Rt.
3	190.67	12+539	17.1m Lt.
4	189.92	12+532	14.8m Rt.
5	190.44	12+589	23.5m Lt.
6	190.05	12+589	10.5m Rt.
7	190.28	12+637	26.1m Lt.
8	190.73	12+642	12.5m Rt.
9	190.48	12+691	21.9m Lt.

(Legend Continues)

- NOTE -

The boundaries between soil strata have been established
only at Borehole locations. Between Boreholes the
boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION
	MAY 22/07	CN	CHANGED FOR CONTRACT DOCUMENTS AS PER EMAIL
			DATED APRIL 27, 2007, FROM DILLON CONSULTING LIMITED
Geocres No. 40J2-43			
HWY No	401	DIST	31
SUBM'D	GD	CHECKED	MRA
DRAWN	MM	CHECKED	BRG
DATE	NOV 29, 2002	APPROVED	DWK
DWG	1-1		



CONT No 2007-3043
WP No 64-00-00

HIGHWAY 401
EMBANKMENT ON EBL
NORTH LEG AT DOUGALL PARKWAY
BOREHOLE LOCATIONS & SOIL STRATA

SHEET
246

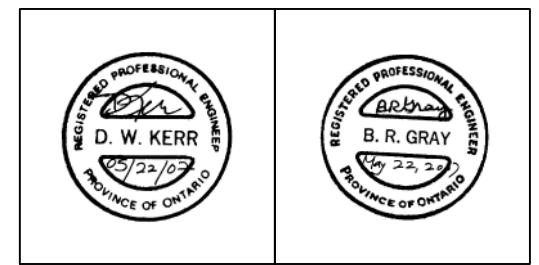
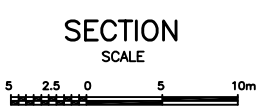
LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J / blow)
- CONE Blows/0.3m (60° Cone, 475 J / blow)

BH No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
(Refer to drawing 1-1 for co-ordinates)			

- NOTES:
- REFER TO DRAWING 1-1 FOR PLAN AND SECTIONS A-A, B-B, C-C
DRAWING 1-2 FOR SECTION C-C.
 - SECTIONS ARE PROVIDED SOLELY FOR ILLUSTRATIVE PURPOSES. REFER
TO RECORD OF BOREHOLES FOR DETAILED DESCRIPTION OF SUBSURFACE
CONDITIONS, IN-SITU TEST DATA AND LABORATORY TEST RESULTS.

D-D (Continued)



REF No Survey Plan 2001 Site # 6-71, entitled
Proposed Bridge Site at Tunnel Diversion and
Highway 401 and Plan, undated, untitled,
Provided by Planning and Design Section, MTO.

— NOTE —
The boundaries between soil strata have been established
only at Borehole locations. Between Boreholes the
boundaries are assumed from geological evidence.

REVISIONS		CHANGED FOR CONTRACT DOCUMENTS AS PER EMAIL	
DATE	BY	DATE	DESCRIPTION
MAY 22/07	CN	DATED APRIL 27, 2007 FROM DILLON CONSULTING LIMITED	
Geocres No. 40J2-43		HWY No 401	DIST 31
		SUBM'D GD	CHECKED MRA DATE NOV 29, 2002 SITE
		DRAWN MM	CHECKED BRG APPROVED DWK DWG 1-3

EMBANKMENT 2

RECORD OF BOREHOLE No 72-1

1 of 3

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+642, o/s 19.0m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary and NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 25 and 26, 2002 CHECKED BY DWK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W	W _L		
190.94	Ground Level																
0.00																	
0.20	Silty clay Dark Brown Topsoil																
	Sandy silty clay, trace of gravel Firm Brown (Till)		1	SS	5		190										
	Stiff		2	SS	13		189										
	Hard		3	SS	72		188										
			4	SS	37		187										
	Very Stiff Grey		5	SS	20		186										
			6	SS	20		185										
			7	SS	22		184										
			8	SS	16		183										
	Stiff		9	SS	14		182										
			10	SS	11		181										
			11	SS	15		180										
							179										
							178										
							177										
	Cont'd						176										

RECORD OF BOREHOLE No 72-1

2 of 3

METRIC

W.P.	<u>64-00-00</u>	LOCATION	<u>Hwy 401 Sta. 12+642, o/s 19.0m Lt. of CL median</u>	ORIGINATED BY	<u>MR</u>
DIST	<u>31</u>	HWY	<u>401</u>	BOREHOLE TYPE	<u>C.F.H.S.A., Mud Rotary and NQ Rock Coring</u>
COMPILED BY	<u>MRA</u>	DATUM	<u>Geodetic</u>	DATE	<u>February 25 and 26, 2002</u>
CHECKED BY	<u>DWK</u>				



[illegible]

RECORD OF BOREHOLE No 72-1

3 of 3

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+642, o/s 19.0m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary and NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 25 and 26, 2002 CHECKED BY DWK

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									
								○ UNCONFINED	● QUICK TRIAXIAL	✕ LAB VANE	✚ FIELD VANE						
160.94							20	40	60	80	100						
	(Till)		17	SS	37												
			18	SS	30												
154.74																	
36.20	Bedrock																
	Unweathered, strong limestone																
	Grey to Light Grey																
	100% drill water return to 37.2m, 0% after; 0.35m void at 37.0m		19	RC	REC 84%											RQD = 76%	
151.24	End of Borehole																
39.70																	
	Borehole dry on completion of drilling																
	■ Penetrometer Test																

RECORD OF BOREHOLE No 72-2

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+626, o/s 25.5m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY MRA
DATUM Geodetic DATE February 28, 2002 CHECKED BY DWK

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
191.20	Ground Level							20	40	60	80	100								
0.00	Granular 'A' crushed limestone (Fill)						191													
190.45	Sandy silty clay, some gravel		1	SS	7															
189.80	Firm Brown (Fill)						190													
1.40	Sandy silty clay, some gravel		2	SS	40															
	Hard Brown (Till)						189													
	trace of gravel																			
	Grey		4	SS	33		188													
			5	SS	30															
							187													
			6	SS	34		186													
	Very Stiff						185													
			7	SS	26															
							184													
			8	SS	21		183													
							182													
181.60			9	SS	29															
9.60	End of Borehole																			
	Borehole dry on completion of drilling																			

RECORD OF BOREHOLE No 72-3

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+665, o/s 16.2m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY MRA
DATUM Geodetic DATE February 28, 2002 CHECKED BY DWK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
191.07 0.00	Ground Level						20	40	60	80	100						GR	SA	SI	CL
189.87 1.20	Granular 'A' crushed limestone (Fill)					V _u *	191													
188.97 2.10	Silty clay, trace of gravel Firm Brown (Fill)		1	SS	4		190													
							189													
	Sandy silty clay, trace of gravel Hard Brown (Till)		2	SS	49		188							○						
			3	SS	82		187							○						
	Very Stiff — — — — Grey		4	SS	25		186							○						
			5	SS	23		185													
			6	SS	29		184													
			7	SS	20	183							○							
181.47 9.60	End of Borehole		8	SS	18	182							○							
	▽ Water level observed during drilling																			

RECORD OF BOREHOLE No 72-4

1 of 3

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+649, o/s 30.0m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary and NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 26 and 27, 2002 CHECKED BY DWK

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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE	20						40	60	80
191.17	Ground Level																			
0.00																				
0.22	Silty clay Dark Brown Topsoil						191													
	Sandy silty clay, trace of gravel		1	SS	12		190						○							
	Stiff Brown		2	SS	31		189						○							
	Hard (Till)		3	SS	47		188						○							
			4	SS	64		187						○							
			5	SS	31		186						○							
			6	SS	21		185						○							
			7	SS	24		184						○							
			8	SS	23		183						○							
			9	SS	24		182						○							
			10	SS	23		181						○							
			11	SS	17		180						○							
							179						○							
							178													
							177													
176.17	Cont'd																			

RECORD OF BOREHOLE No 72-4

2 of 3

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+649, o/s 30.0m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary and NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 26 and 27, 2002 CHECKED BY DWK


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 (%)		
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL						× LAB VANE		
176.2			12	SS	20		20	40	60	80	100									
15.00	Sandy silty clay, trace of gravel (Till)																			
							176													
							175													
							174													
			13	SS	16		173						16	1			3 29 38 30			
							172													
							171													
			14	SS	25		170						10							
							169													
							168													
							167							10						
							166													
	Hard						165													
			16	SS	84		164													
							163													
							162													
161.17	Cont'd																			

RECORD OF BOREHOLE No 72-4

3 of 3

METRIC

W.P.	<u>64-00-00</u>	LOCATION	<u>Hwy 401 Sta. 12+649, o/s 30.0m Rt. of CL median</u>	ORIGINATED BY	<u>MR</u>
DIST	<u>31</u>	HWY	<u>401</u>	BOREHOLE TYPE	<u>C.F.H.S.A., Mud Rotary and NQ Rock Coring</u>
DATUM	<u>Geodetic</u>	DATE	<u>February 26 and 27, 2002</u>	COMPILED BY	<u>MRA</u>
				CHECKED BY	<u>DWK</u>

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
161.17 30.00	Sandy silty clay, trace of gravel (Till)		17	SS	43																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													</

METRIC

+⁷, ×⁵: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 73-1

2 of 3

METRIC

W.P.	<u>64-00-04</u>	LOCATION	<u>Hwy 401 Sta. 12+937, o/s 15.0m Lt. of CL median</u>	ORIGINATED BY	<u>MR</u>
DIST	<u>31</u>	HWY	<u>401</u>	BOREHOLE TYPE	<u>C.F.H.S.A., Mud Rotary and NQ Rock Coring</u>
				COMPILED BY	<u>MRA</u>
DATUM	<u>Geodetic</u>	DATE	<u>February 20, 2002</u>	CHECKED BY	<u>DWK</u>

SOIL PROFILE						SAMPLES
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	* GROUND WATER CONDITIONS
175.8	(Till)		12	SS	15	
			13	SS	13	
			14	SS	14	
			15	SS	10	
164.86 25.90	Fine sand, some silt Very Dense Grey Saturated		16	SS	73	
162.26 28.50	Silty clay, trace of sand Very Stiff Grey (Till) Cont'd					



DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>	<div><div>w_pww_L</div><div>WATER CONTENT (%)</div></div>	<div><div>γ</div><div>kN/m³</div></div>	<div>GRSA SILCL</div>
<div><div>20406080100</div><div>■</div></div>	<div><div>204060</div><div>○</div></div>		<div>2294227</div>
175			
174			
173			
172			
171			
170			
169			
168			
167			
166			
165			
164			
163			
162			
161			

RECORD OF BOREHOLE No 73-1

3 of 3

METRIC

W.P. 64-00-04 LOCATION Hwy 401 Sta. 12+937, o/s 15.0m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary and NQ Rock Coring COMPILED BY MRA
DATUM Geodetic DATE February 20, 2002 CHECKED BY DWK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						WATER CONTENT (%)				
160.76			17	SS	25			20	40	60	80	100		20	40	60	0 5 46 49	
158.01 32.75	Bedrock Unweathered, strong limestone Light Grey 100% drill water return						160										RQD = 85%	
								159										
								158										
								157										
154.96 35.80	End of Borehole Borehole dry on completion of drilling ■ Penetrometer Test						156											
								155										

RECORD OF BOREHOLE No 73-2

1 of 1

METRIC

W.P. 64-00-04 LOCATION Hwy 401 Sta. 12+959, o/s 18.0m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY MRA
DATUM Geodetic DATE February 22, 2002 CHECKED BY DWK

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									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
					WATER CONTENT (%)												
190.96	Ground Level						20	40	60	80	100	20	40	60			
0.08	Topsoil																
	Sandy silty clay, trace of gravel, with bluish grey fissures and oxidized stains		1	SS	15												
	Stiff Brown (Till)		2	SS	11												
			3	SS	23												
	Hard — — — —		4	SS	48												
	Very Stiff — — — —		5	SS	30												
	Grey		6	SS	26												
			7	SS	19												
			8	SS	22												
			9	SS	17												
181.36	End of Borehole																
9.60	Borehole dry on completion of drilling																
	■ Penetrometer Test																

RECORD OF BOREHOLE No 73-3

1 of 1

METRIC

W.P. 64-00-04 LOCATION Hwy 401 Sta. 12+950, o/s 8.4m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY MRA
DATUM Geodetic DATE February 19, 2002 CHECKED BY DWK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p W W _L					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)					
192.06 0.00	Ground Level						192	20	40	60	80	100	20	40	60	* No recovery	GR SA SI CL	
190.86 1.20	Limestone, railway ballast (Fill)						191											
	Silty clay, some sand Firm Black to Brown		1	SS	7*		190											
189.96 2.10	Sandy silty clay, trace of gravel, with bluish grey fissures and oxidized stains		2	SS	11		189											
	Stiff to Very Stiff Brown (Till)		3	SS	25		188											
	Hard ——— ——— ———		4	SS	52		187											
			5	SS	45		186											
							185											
	Very Stiff ——— ——— ——— to Stiff Grey		6	SS	22		184											
			7	SS	15		183											
182.46 9.60	End of Borehole		8	SS	13													
	Borehole dry on completion of drilling																	
	■ Penetrometer Test																	

RECORD OF BOREHOLE No 73-4

1 of 3

METRIC

W.P. 64-00-04 LOCATION Hwy 401 Sta. 12+978, o/s 19.0m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A. and Mud Rotary COMPILED BY MRA
DATUM Geodetic DATE February 19, 2002 CHECKED BY DWK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		WATER CONTENT (%)	GR	SA	SI	CL
192.12	Ground Level																				
0.00	Crushed limestone (Fill)						192														
190.92							191														
1.20	Sandy silty clay, trace of gravel, with bluish grey fissures		1	SS	6																
	Firm to Stiff						190														
	Olive Brown to Brown (Till)		2	SS	7																
							189														
			3	SS	11																
	Hard						188														
			4	SS	35																
							187														
			5	SS	38																
							186														
			6	SS	18																
							185														
			7	SS	15		184														
							183														
			8	SS	13																
							182														
							181														
			9	SS	16*		180														
							179														
			10	SS	13		178														
177.12	Cont'd																				



* No
recovery

RECORD OF BOREHOLE No 73-4

2 of 3

METRIC

W.P. 64-00-04 LOCATION Hwy 401 Sta. 12+978, o/s 19.0m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A. and Mud Rotary COMPILED BY MRA
DATUM Geodetic DATE February 19, 2002 CHECKED BY DWK

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							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)						
177.1 15.00	Sandy silty clay, trace of gravel, with bluish grey fissures (Till)		11	SS	11*		177							* No recovery	
								176							
								175							
				12	SS		8	174							
					FV										
								173							
								172							
								171							
				13	SS		11								
								170							
					169										
					168										
					167										
					166										
166.22 25.90	Fine sand, some silt, trace of gravel Very Dense Grey Saturated		15	SS	09/23cm**		165							** 50 blows for last 75mm	
								164							
								163							
	Cont'd														

RECORD OF BOREHOLE No 73-4

3 of 3

METRIC

W.P. 64-00-04 LOCATION Hwy 401 Sta. 12+978, o/s 19.0m Rt. of CL median ORIGINATED BY MR
 DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A. and Mud Rotary COMPILED BY MRA
 DATUM Geodetic DATE February 19, 2002 CHECKED BY DWK

SOIL PROFILE				SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa						w _p	w	w _L	GR	SA	SI		CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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162.12		• •	16	SS	88																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

RECORD OF BOREHOLE No 74-1

1 of 3

METRIC

W.P. 64-00-05 LOCATION Hwy 401 Sta. 13+034, o/s 17.6m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary and NQ Rock Coring COMPILED BY GD
DATUM Geodetic DATE February 13 and 14, 2002 CHECKED BY MRA

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 (%)
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE						
190.60	Ground Level							20	40	60	80	100		20	40	60	
0.00	Silty clay							20	40	60	80	100					
0.28	Dark Brown Topsoil																
	Sandy silty clay, trace of gravel		1	SS	9		190							○			
	Stiff																
	Brown (Till)		2	SS	13		189							○			
	Hard																
			3	SS	44		188							○			
			4	SS	49		187							○			
	Very Stiff		5	SS	25		186							○			
	Stiff		6	SS	13		186							○			
							185										
			7	SS	13		184							○			
			8	SS	12		183							○			
							182										
			9	SS	11		181							○			
			10	TW	PH		180							○			
							179										
			11	SS	14*		178										
							177										
							176										
175.60	Cont'd																

RECORD OF BOREHOLE No 74-1

2 of 3

METRIC

W.P.	<u>64-00-05</u>	LOCATION	<u>Hwy 401 Sta. 13+034, o/s 17.6m Lt. of CL median</u>	ORIGINATED BY	<u>MR</u>
DIST	<u>31</u>	HWY	<u>401</u>	BOREHOLE TYPE	<u>C.F.H.S.A., Mud Rotary and NQ Rock Coring</u>
COMPILED BY	<u>GD</u>	DATE	<u>February 13 and 14, 2002</u>	CHECKED BY	<u>MRA</u>

[illegible]

RECORD OF BOREHOLE No 74-1

3 of 3

METRIC

W.P. 64-00-05 LOCATION Hwy 401 Sta. 13+034, o/s 17.6m Lt. of CL median ORIGINATED BY MR
 DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary and NQ Rock Coring COMPILED BY GD
 DATUM Geodetic DATE February 13 and 14, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						w _p	w	w _L					
								○ UNCONFINED + FIELD VANE													
								● QUICK TRIAXIAL × LAB VANE													
						20 40 60 80 100						20 40 60									
160.60																					
30.00																					
	Fine sand, some silt, trace of gravel	•••••	17	SS	47																
	Dense Grey Saturated	•••••																			
	occ. thin distorted layers of grey silty clay	•••••																			
158.70		•••••																			
31.90	Bedrock	▨▨▨▨▨																			
	Unweathered, strong limestone	▨▨▨▨▨																			
	Light Grey	▨▨▨▨▨																			
		▨▨▨▨▨	18	RC	REC 88%																
		▨▨▨▨▨																			
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RECORD OF BOREHOLE No 74-3

1 of 1

METRIC

W.P. 64-00-05 LOCATION Hwy 401 Sta. 13+071, o/s 18.1m Lt. of CL median ORIGINATED BY MR
 DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
 DATUM Geodetic DATE February 13, 2002 CHECKED BY MRA

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 (%)		
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL						× LAB VANE		
190.48	Ground Level						20	40	60	80	100									
0.00	Silty clay																			
0.28	Dark Brown Topsoil																			
	Sandy Silty clay, trace of gravel																			
	Stiff																			
	Brown (Till)		1	SS	8															
	Hard		2	SS	36															
			3	SS	58															
			4	SS	54															
	Very Stiff		5	SS	18															
	Grey		6	SS	27															
			7	SS	18															

METRIC

+⁷, **×**⁵: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 74-4

2 of 3

METRIC

W.P. 64-00-05 LOCATION Hwy 401 Sta. 13+096, o/s 22.1m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary and NQ Rock Coring COMPILED BY GD
DATUM Geodetic DATE February 28, 2002 CHECKED BY MRA

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												
								20 40 60 80 100												
183.3																				
15.00	Sandy silty clay, trace of gravel		9	SS	27															
	Very Stiff Grey (Till)																			
	Stiff																			
177.13			10	SS	18															
21.20	Fine sand, trace of silt		11	SS	24															
	Dense Grey Saturated																			
175.73																				
22.60	Sandy silty clay, trace of gravel																			
	Stiff Grey (Till)																			
	trace of fine sand																			

RECORD OF BOREHOLE No 74-4

3 of 3

METRIC

W.P. 64-00-05 LOCATION Hwy 401 Sta. 13+096, o/s 22.1m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE C.F.H.S.A., Mud Rotary and NQ Rock Coring COMPILED BY GD
DATUM Geodetic DATE February 28, 2002 CHECKED BY MRA

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 (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA
168.33			14	SS	53		168										3	35	48	14	
							167														
166.53																					
31.80	Fine sandy silt Very Dense Grey Saturated						166														
			15	SS	102/25cm		165														
							164														
							163														
			16	SS	80		162														
161.03							161														
37.30	Bedrock Unweathered, strong limestone Light Grey		17	RC	REC 100%		160													RQD = 84%	
							159														
157.93							158														
40.40	End of Borehole Borehole dry on completion of drilling ■ Penetrometer Test																				

RECORD OF BOREHOLE No 101

1 of 1

METRIC

W.P.	64-00-00	LOCATION	Hwy 401 Sta. 12+567, o/s 35.9m Lt. of CL median	ORIGINATED BY	MR
DIST	31	HWY	401	BOREHOLE TYPE	Continuous Flight Solid Stem Augers
DATUM	Geodetic	DATE	February 26, 2002	CHECKED BY	MRA

[illegible]

RECORD OF BOREHOLE No 102

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+623, o/s 24.6m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 13, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED		+ FIELD VANE			● QUICK TRIAXIAL				
191.00	Ground Level						20	40	60	80	100	20	40	60	kN/m³	GR SA SI CL	
0.00	Topsoil, silty clay																
0.20	Dark Brown Fine to coarse sand, some gravel and silt Loose																
189.90	Brown Saturated		1	SS	6												
1.10	Sandy silty clay, trace of gravel																
	Firm to Hard Brown (Till)		2	SS	31												
			3	SS	38												
	Grey		4	SS	40												
			5	SS	36												
	Very Stiff		6	SS	22												
181.85			7	SS	20												
9.15	End of Borehole																
	2002-2-13 Water level observed during drilling																

RECORD OF BOREHOLE No 103

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+692, o/s 19.5m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 23, 2002 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			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	20	40	60				
190.77	Ground Level																
0.00	Topsoil																
0.18	Sandy silty clay, trace of gravel																
	Very Stiff to Hard		1	SS	21												
	Brown																
	(Till)		2	SS	43												
	Grey																
			3	SS	40												
			4	SS	30												
	Very Stiff																
			5	SS	24												
181.62			6	SS	17												
9.15	End of Borehole																
	<div>■ Penetrometer Test</div> <div>▼ Water level measured after drilling</div> <div>Piezometer Readings:</div> <div>Date Depth (m)</div> <div>Feb.25/02 8.60</div> <div>Mar.28/02 1.65</div> <div>Borehole Backfill Legend:</div> <div> <div>Native Backfill</div> <div>Bentonite Seal</div> <div>Filter Gravel</div> <div>Slotted Pipe</div> </div>																

RECORD OF BOREHOLE No 104

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+734, o/s 40.1m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 23, 2002 CHECKED BY MRA

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										
								○ UNCONFINED	● QUICK TRIAXIAL	✕ LAB VANE	✚ FIELD VANE	WATER CONTENT (%)						
190.97	Ground Level					▽*												
0.00	Topsoil																	
0.20	Silty sand, some gravel, trace of clay																	
	Very Loose Brown Saturated	1	SS	3*			190											*No recovery
189.57																		
1.40	Sandy silty clay, trace of gravel	2	SS	26			189											
	Very Stiff to Hard Brown (Till)																	
		3	SS	38			188											
	Grey																	
		4	SS	31			187											
						186												
						185												
		5	SS	26		184												
						183												
181.82			6	SS	16	182												
9.15	End of Borehole																	
	▽ Water level observed during drilling																	
	■ Penetrometer Test																	

RECORD OF BOREHOLE No 105

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+784, o/s 27.2m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 23, 2002 CHECKED BY MRA

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									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
190.81	Ground Level						20	40	60	80	100						
0.00	Topsoil																
0.15	Sandy silty clay, trace of gravel																
	Stiff to Hard		1	SS	11												
	Brown																
	(Till)		2	SS	38											2 30 36 32	
			3	SS	48												
	Very Stiff		4	SS	29												
	Grey																
			5	SS	23												
181.66	End of Borehole		6	SS	16											3 30 40 27	
9.15	Borehole dry on completion of drilling																
	■ Penetrometer Test																

RECORD OF BOREHOLE No 106

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+837, o/s 44.0m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 23, 2002 CHECKED BY MRA

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									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL × LAB VANE									
					WATER CONTENT (%)												
190.96	Ground Level						20	40	60	80	100	20	40	60			
0.00	Peat, fine to coarse, fibrous																
0.30	Dark Brown																
	Sandy silty clay, trace of gravel		1	SS	11		190										
	Stiff to Hard																
	Brown (Till)		2	SS	31		189										
							188										
			3	SS	62												
	Very Stiff						187										
	Grey		4	SS	28		186										
							185										
			5	SS	23		184										
							183										
181.81			6	SS	16		182										
9.15	End of Borehole																
	2002-2-23 Groundwater level at surface																

RECORD OF BOREHOLE No 107

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+876, o/s 28.6m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 22, 2002 CHECKED BY MRA

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								
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE					
191.01	Ground Level															
0.00	Topsoil															
0.10	Sandy silty clay, trace of gravel															
	Stiff to Hard		1	SS	14											
	Brown															
	(Till)		2	SS	15											
			3	SS	83											
	Grey		4	SS	34											
			5	SS	23											

RECORD OF BOREHOLE No 108

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+914, o/s 21.6m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 22, 2002 CHECKED BY MRA

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										
								○ UNCONFINED + FIELD VANE										
								● QUICK TRIAXIAL × LAB VANE										
								WATER CONTENT (%)										
								20	40	60	80	100	20	40	60			
190.76	Ground Level																	
0.89	Topsoil																	
	Sandy silty clay, trace of gravel																	
	Stiff to Hard		1	SS	12		190											
	Brown																	
	(Till)		2	SS	26		189											
							188											
			3	SS	46		187											
	Very Stiff						186											
	Grey		4	SS	28		185											
							184											
			5	SS	21		183											
							182											
181.61	End of Borehole		6	SS	15													
9.15																		
	Borehole dry on completion of drilling																	
	■ Penetrometer Test																	

RECORD OF BOREHOLE No 109

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+924, o/s 26.0m Rt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 22, 2002 CHECKED BY MRA

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
190.80	Ground Level							20	40	60	80	100					
0.89	Topsoil																
	Sandy silty clay, trace of gravel																
	Very Stiff to Hard		1	SS	16		190										
	Brown																
	(Till)		2	SS	26		189										
							188										
			3	SS	66		187										
	Grey						186										
			4	SS	24		185										
							184										
			5	SS	18		183										
							182										
181.65	End of Borehole		6	SS	17												
9.15																	
	■ Penetrometer Test ▼ Water level measured after drilling <u>Piezometer Readings:</u> Date Depth (m) Feb.25/02 5.30 Mar.28/02 0.50 <u>Borehole Backfill</u> <u>Legend:</u> <div><div>Native Backfill</div><div>Bentonite Seal</div><div>Filter Gravel</div><div>Slotted Pipe</div></div>																

RECORD OF BOREHOLE No 110

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 12+972, o/s 31.6m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 15, 2002 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		
190.71	Ground Level						20	40	60	80	100						
0.00	Silty clay, trace of sand Dark Brown																
0.28	Sandy silty clay, trace of gravel																
	Stiff Brown (Till)		1	SS	12												
	Very Stiff																
			2	SS	23												
	Hard																
			3	SS	53												
	Very Stiff Grey																
			4	SS	17												
	Stiff		5	SS	15												
181.56			6	SS	13												
9.15	End of Borehole																
	Borehole dry on completion of drilling																
	■ Penetrometer Test																

RECORD OF BOREHOLE No 111

1 of 1

METRIC

W.P. 64-00-00 LOCATION Sta. 13+009, o/s 34.0m Lt. of CL median ORIGINATED BY MR
 DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
 DATUM Geodetic DATE February 13, 2002 CHECKED BY MRA

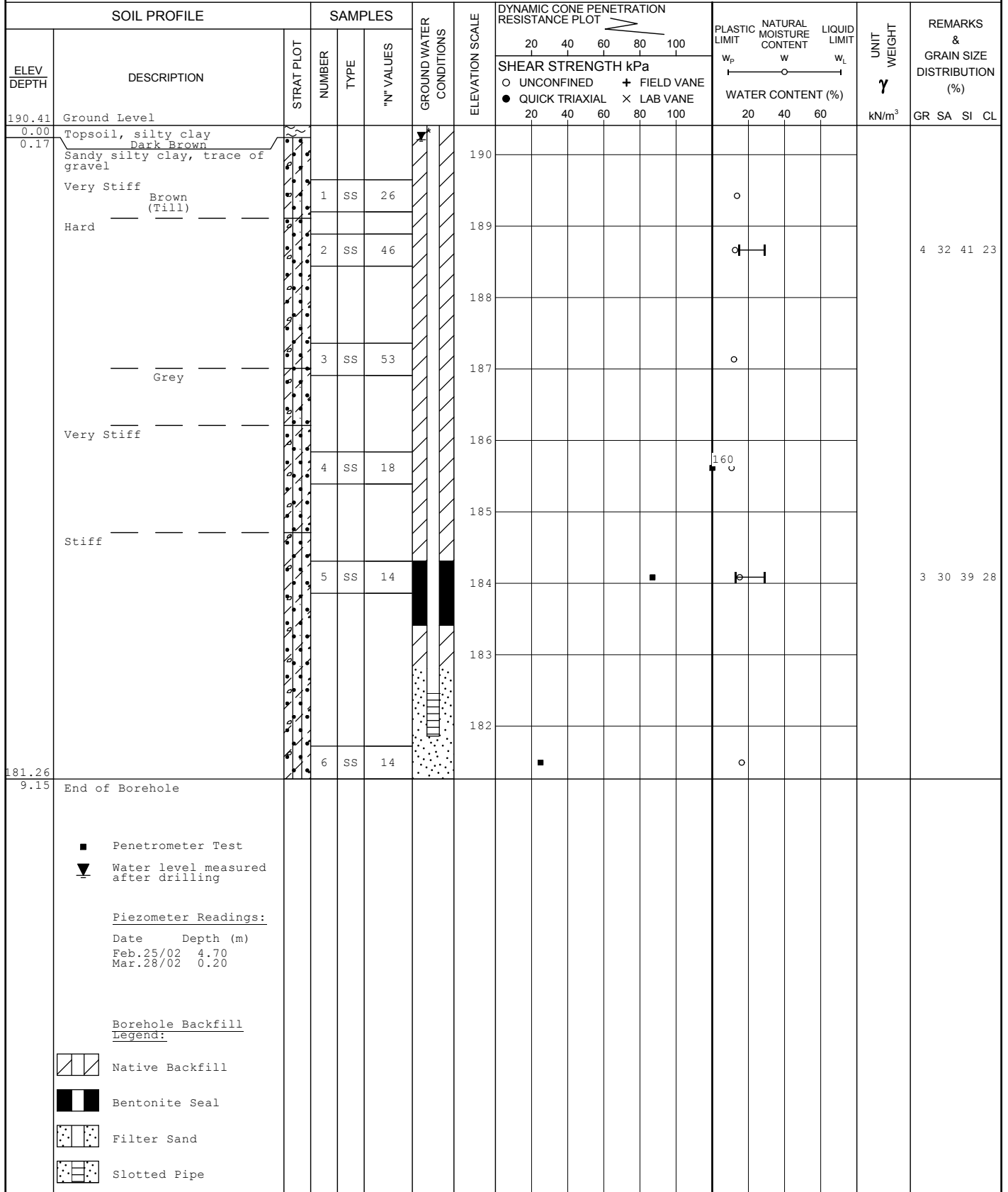
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p W W _L								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)								
190.51	Ground Level							20	40	60	80	100		20	40	60		GR	SA	SI	CL
0.00	Topsoil																				
0.22	Sandy silty clay, trace of gravel						190														
	Stiff Brown (Till)		1	SS	12																
	Hard — — — —		2	SS	39		189														
							188														
			3	SS	48		187														
							186														
	Very Stiff — — — — Grey		4	SS	21		185														
							184														
	Stiff — — — —		5	SS	15		183														
							182														
181.36			6	SS	12																
9.15	End of Borehole																				
	Borehole dry on completion of drilling																				
	■ Penetrometer Test																				

RECORD OF BOREHOLE No 112

1 of 1

METRIC

W.P. 64-00-00 LOCATION Hwy 401 Sta. 13+091, o/s 19.7m Lt. of CL median ORIGINATED BY MR
DIST 31 HWY 401 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY GD
DATUM Geodetic DATE February 13, 2002 CHECKED BY MRA



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

CONT No 2007-3043

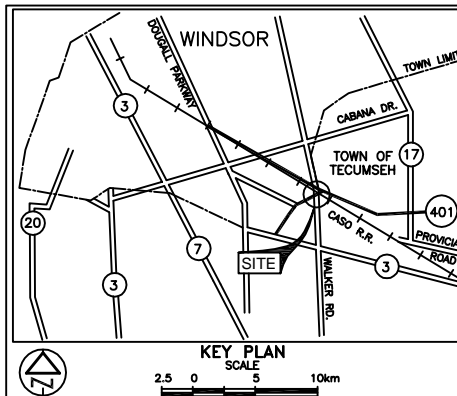
WP No 64-00-00

HIGHWAY 401
EMBANKMENT BETWEEN WALKER ROAD
AND PROVINCIAL ROAD
BOREHOLE LOCATIONS & SOIL STRATA



SHEET
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PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & 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 Feb 2002
- Head
- ARTESIAN WATER
Encountered
- PIEZOMETER

(Legend Continued)

BH No	ELEVATION	HWY 401 STA.	o/s CL MED
105	190.81	12+784	27.2m Lt.
106	190.96	12+837	44.0m Lt.
107	191.01	12+876	28.6m Rt.
108	190.76	12+914	21.6m Lt.
109	190.80	12+924	26.0m Rt.
110	190.71	12+972	31.6m Lt.
111	190.51	13+009	34.0m Lt.
112	190.41	13+091	19.7m Lt.

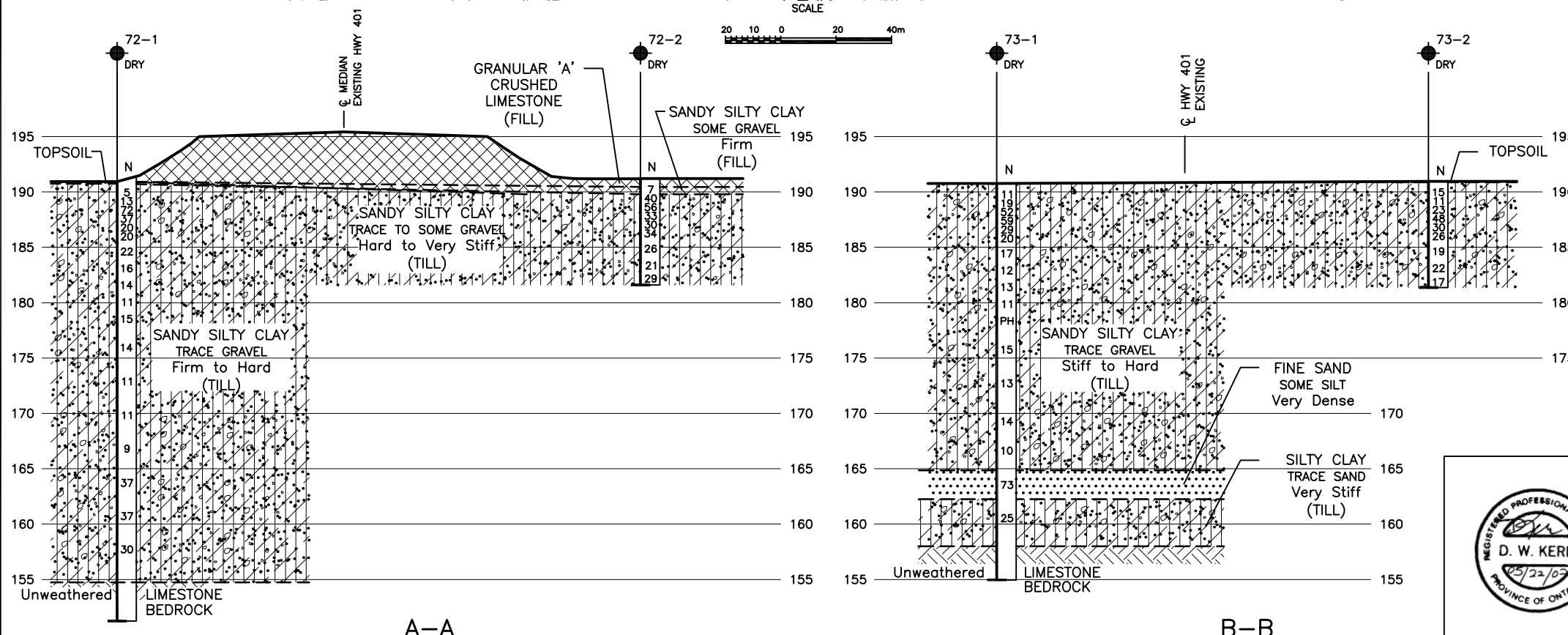
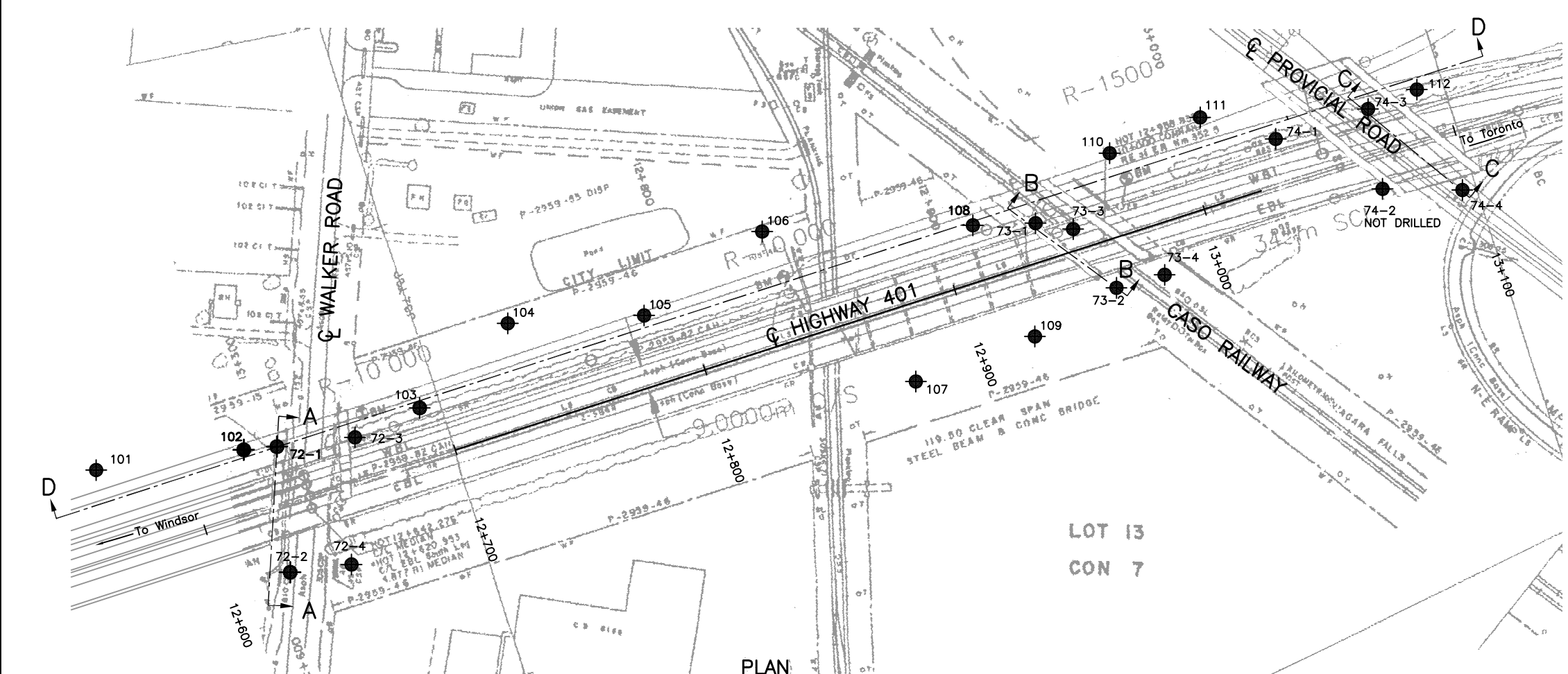
BH No	ELEVATION	HWY 401 STA.	o/s CL MED
72-1	190.94	12+642	19.0m Lt.
72-2	191.20	12+626	25.5m Rt.
72-3	191.07	12+665	16.2m Lt.
72-4	191.17	12+649	30.0m Rt.
73-1	190.76	12+937	15.0m Lt.
73-2	190.96	12+959	18.0m Rt.
73-3	192.06	12+950	8.4m Lt.
73-4	192.12	12+978	19.0m Rt.
74-1	190.60	13+034	17.6m Lt.
74-2 (NOT DRILLED)	-	-	-
74-3	190.48	13+071	18.1m Lt.
74-4	198.33	13+096	22.1m Rt.
101	190.91	12+567	35.9m Lt.
102	191.00	12+623	24.6m Lt.
103	190.77	12+692	19.5m Lt.
104	190.97	12+734	40.1m Lt.

(Legend Continues)

— NOTE —
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION
1	MAY 22/07	CN	CHANGED FOR CONTRACT DOCUMENTS AS PER EMAIL DATED APRIL 27, 2007, FROM DILLON CONSULTING LIMITED

Geocres No. 40J2-43	HWY No 401	DIST 31
SUBM'D GD	CHECKED MRA	DATE DEC 2, 2002
DRAWN MM	CHECKED BRG	APPROVED DWK
		DWG 2-1



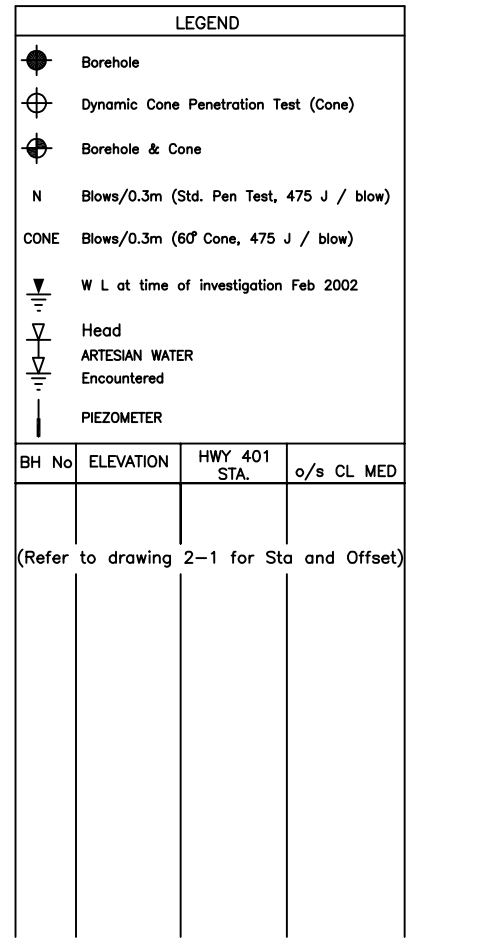
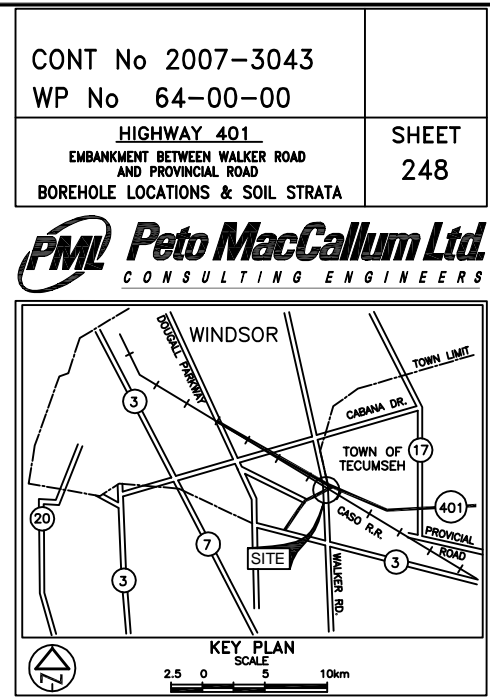
- NOTES:
- REFER TO DRAWING 2-2 FOR SECTIONS C-C AND D-D, DRAWING 2-3 FOR SECTION D-D CONTINUED.
 - SECTIONS ARE PROVIDED SOLELY FOR ILLUSTRATIVE PURPOSES. REFER TO RECORD OF BOREHOLES FOR DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS, IN-SITU TEST DATA AND LABORATORY TEST RESULTS.

SECTIONS
SCALE



REF No Survey Plan 2001 Site # 6-72, entitled Proposed Bridge Site at Walker Road and Highway 401, Site # 6-73, entitled Proposed Bridge Site at Conrail Railway and Highway 401, Site # 6-74, entitled Proposed Bridge Site at County Road 46 and Highway and Plan, untitled, undated, Provided by Planning and Design Section, MTO.












HWY No	401				DIST	31
SUBM'D	GD	CHECKED	MRA	DATE DEC 2, 2002	SITE	
DRAWN	MM	CHECKED	BRC	APPROVED DWK	DWG 2-2	

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

EMBANKMENT BETWEEN WALKER ROAD
AND PROVINCIAL ROAD
BOREHOLE LOCATIONS & SOIL STRATA

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The key plan map shows the location of the site relative to Windsor, Town of Tecumseh, and various roads. The map includes a north arrow, a scale bar (0 to 10 km), and labels for roads such as Cabana Dr., Gasco R.R., and Provincial Road 401. The site is marked with a circle and labeled 'SITE'.

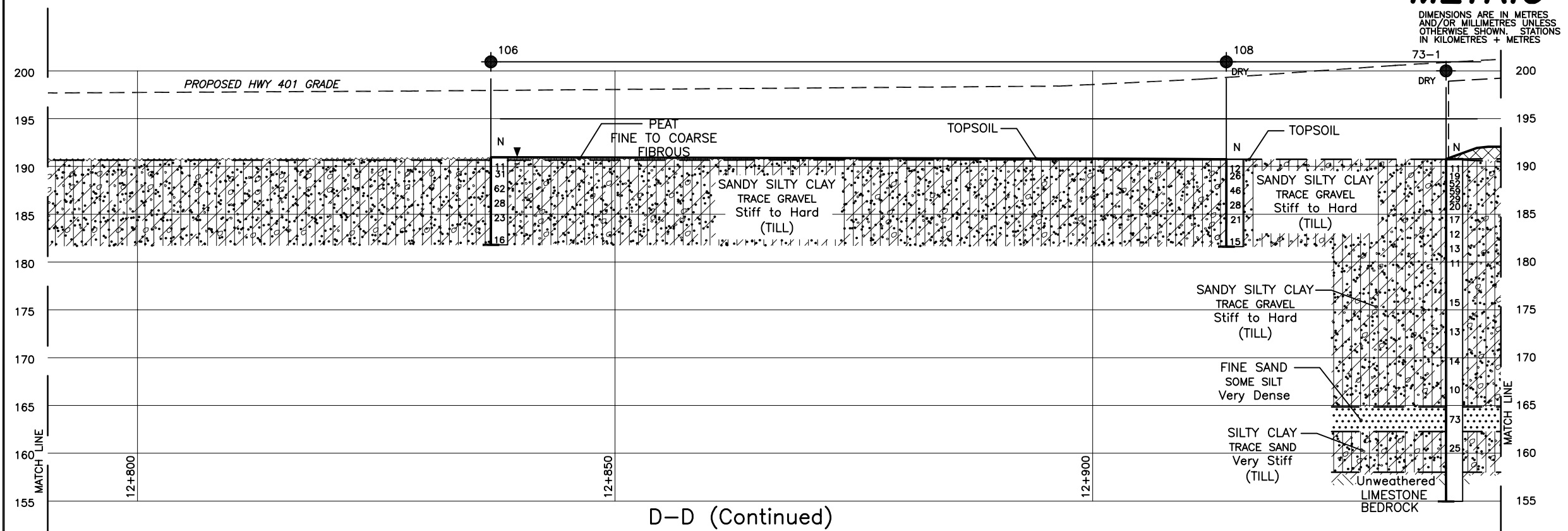
	Borehole
	Dynamic Cone Penetration Test (Cone)
	150
	Borehole & Cone
N	Blows/0.3m (Std. Pen Test, 475 J / blow)
CONE	Blows/0.3m (60° Cone, 475 J / blow)
0	 W L at time of investigation Feb 2002
	 Head
	ARTESIAN WATER
5	 Encountered
	 PIEZOMETER

BH No	ELEVATION	HWY 401 STA.	o/s CL MED
5			
(Refer to drawing 2-1 for Sta and Offset)			
0			
5			
0			
5			

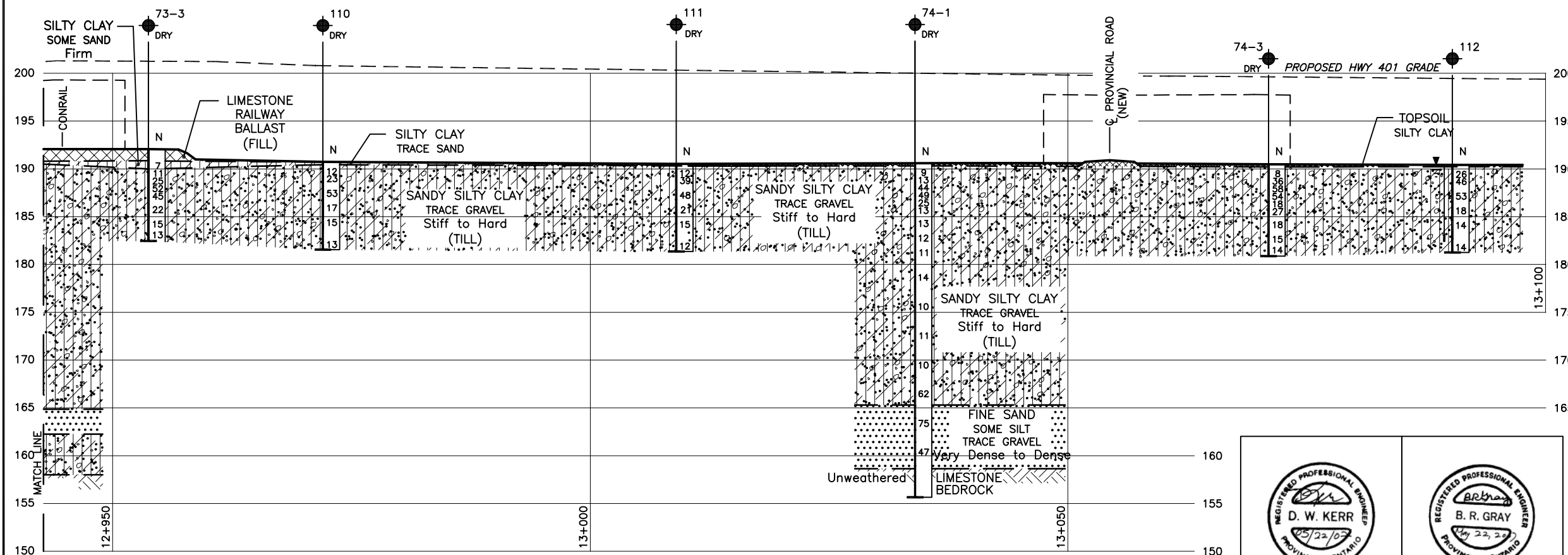
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS			
	MAY22/07	CN	CHANGED FOR CONTRACT DOCUMENTS AS PER EMAIL DATED APRIL 27, 2007, FROM DILLON CONSULTING LIMITED
	DATE	BY	DESCRIPTION

HWY No 401					DIST 31	
SUBM'D	GD	CHECKED	MRA	DATE DEC 2, 2002		SITE
DRAWN	MM	CHECKED	DWK	APPROVED	BRG	DWG 2-3



D-D (Continued)



D-D (Continued)

1. REFER TO DRAWING 2-1 FOR PLAN AND SECTIONS A-A AND B-B, DRAWING 2-2 FOR SECTIONS C-C AND D-D.
2. SECTIONS ARE PROVIDED SOLELY FOR ILLUSTRATIVE PURPOSES. REFER TO RECORD OF BOREHOLES FOR DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS, IN-SITU TEST DATA AND LABORATORY TEST RESULTS.

SCALE

5 2.5 0 5 10m

REF No Survey Plan 2001 Site # 6-72, entitled Proposed Bridge Site at Walker Road and Highway 401, Site # 6-73, entitled Proposed Bridge Site at Conrail Railway and Highway 401, Site # 6-74, entitled Proposed Bridge Site at County Road 46 and Highway 401 and Plan, untitled, undated, Provided by Planning and Design Section, MTO.

EMBANKMENT 3

**RECORDS OF BOREHOLE SHEETS AND FOUNDATION DRAWINGS
RELATED TO EMBANKMENT 3 ARE REMOVED FOR THIS PROJECT**