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FOUNDATION INVESTIGATION REPORT
CNR OVERHEAD AT BROCK ROAD
HIGHWAY 401
PICKERING, ONTARIO
SITE 22-276-1&2
G.W.P. 2120-18-00
GEOCRES No. 30M14-673

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FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the then proposed rehabilitation and widening of the existing CNR overhead located at the crossing of Brock Road and CNR tracks, just south of Highway 401 in the Pickering, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the proposed foundation locations, and based on the data obtained, to provide borehole location and soil strata drawings, records of boreholes, laboratory test results, and a written description of the subsurface conditions. A model of the subsurface conditions was developed for the site, based on data obtained from the present investigation.

The original plan for this site involved widening to the east of the existing overhead structure located at the crossing of CN tracks and Brock Road. The road widening involved adding one lane to the east of Brock Road, which would become a dedicated right-turn onto the N/S-E ramp (EB on-ramp). A full rehabilitation program was to include complete superstructure replacement of the concrete deck, barrier walls and girders, repairs to remaining substructure components including piers, abutments, wingwalls and retaining walls; elimination of abutment expansion joints and conversion to semi-integral type structure.

Borehole layout for the foundation investigation was planned in accordance with the above-described rehabilitation and widening program. After completion of the field investigation, Thurber was advised by Egis that all project work should be stopped immediately. Subsequent to the work stoppage, Egis advised that MTO requested Thurber to prepare a Foundation Investigation Report to document all the boreholes and associated laboratory testing carried out during the present

investigation.

Thurber was retained by Egis Canada Ltd. (Egis) (formerly McIntosh Perry) to carry out this foundation investigation under the Ministry of Transportation Ontario (MTO) Agreement Number 2017-E-0009. This report presents factual data from the foundation investigation carried out for the CNR Overhead at Brock Road.

Reference has been made to information on subsurface conditions contained in previous foundation reports prepared by others for this site. The titles of these reports are:

- Foundation Investigation Report, Proposed Brock Rd. – CNR Overhead, Township of Pickering, County of Ontario, District No. 6 (Toronto), W.J. 69-F-52, W.P. 29-67-07, GEOCRES No. 30M14-011 prepared by the Department of Highways Ontario, Foundation Section, dated November 4, 1969. (Reference 1).
- Geotechnical Investigation, GO ALRT-Brock Road Structure, Pickering, Ontario, W.P. 470-711-609, GEOCRES No. 30M14-269 prepared by Geocon, dated March 6, 1984. (Reference 2).

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement for Use and Interpretation of Report.

2. SITE DESCRIPTION

The existing structure is located at the crossing of Brock Road over CNR rail tracks, just south of Highway 401 in Pickering, Ontario.

The existing overhead was built in 1971 and consists of a three-span structure carrying Brock Road over two rail tracks. The structure is a reinforced slab-on pre-cast concrete girder bridge supported on two abutments and two piers. According to available archive drawings, the existing abutments and piers are supported on steel HP 12 @ 74 (HP 310 x 10 equivalent) H-piles. The span arrangement for the bridge is 12.7 m, 25.6 m, and 12.7 m for a total length of 51 m. The width of the bridge deck is approximately 32.4 m. At the site, the Brock Road grade varies from north to south from Elevations 97.7 to 96.3. The north and south approach embankments are approximately 9.2 m to 9.5 m high, with an inclination slope of about 2H : 1 V.

The overall surface topography in the vicinity of the site is relatively flat with the ground surface gently sloping towards the south. Commercial developments currently occupy the southeast quadrant of the bridge crossing.

Photographs of the site, taken during the course of the investigation, are presented in Appendix F.

Based on published geological information, the site area is located within the Iroquois Plain physiographic region. The Iroquois Plain is a nearly level terrace, approximately 3 to 6 kilometres wide, bordering the north shore of Lake Ontario.

The soil deposits in the project area are a result of glacial depositional systems that took place largely during the Wisconsin glacial period. This fluctuating glacial advance and retreat produced a complex distribution of heavily over-consolidated hard plastic glacial till layers, separated by interstadial stratified deposits of very stiff to hard glacio-lacustrine clays and very dense, non-plastic, silts and sands.

The soil deposits overlie bedrock of the Georgian Bay Formation which consists of shale, interbedded dolomitic siltstone and occasional limestone. The bedrock surface gently slopes to the southeast at a rate of about 5 m/km. The upper portion of the bedrock is generally weathered for a depth of 1 m to 2 m. The distinction between overburden and weathered bedrock is somewhat unclear due to gradual weathering and glacial effects.

3. SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing program were carried out on November 15 to 19, 2021, December 10 and 14, 2021, July 19 and 20, 2022, August 16 and 17, 2022, and consisted of drilling and sampling nine (9) boreholes, designated as Boreholes 21-02, 21-04 to 21-09, 21-11 and 21-07B. Drilled from the Brock Road platform, Boreholes 21-02, 21-05, 21-06 and 21-11 were located along the northbound lane of Brock Road, and positioned in proximity to the east side of the existing foundation elements (piers and abutments) of the overhead, while Borehole 21-08/08B was drilled on the south approach. Borehole 21-04 was drilled near the track grade in proximity to Pier 2. Boreholes 21-07, 21-07B and 21-09 were drilled on the east side and at the bottom of the existing south approach embankment. In general, the boreholes were terminated at depths ranging from 9.5 m to 25.9 m (Elevations 67.0 to 83.8), except for Borehole 21-07B which was terminated at 3.7 m depth (Elevation 84.2). The Record of Borehole sheets of the present investigation are provided in Appendix B.

A Dynamic Cone Penetration Test (DCPT) numbered DCPT-01 was advanced between Boreholes 21-07 and 21-09 to 5.5 m depth (Elevation 82.9).

A geotechnical investigation was carried out at this site in August 1969 (Reference 1) and consisted of drilling eight boreholes (numbered 1 to 5, 1A, 2A and 3A) ranging in depths from

4.1m to 17.4 m (Elevations 71.7 to 84.7). A subsequent geotechnical investigation was conducted in July 1983 and January 1984 (Reference 2) in which seventeen boreholes (numbered 1 to 3, 5 to 15 and 2A) were advanced to depths varying from 5.9 m to 18.7 m (Elevations 78.9 to 96.3). The Record of Borehole sheets for the boreholes from this previous investigation are included in Appendix E.

The approximate locations of boreholes from the previous and present investigations are shown on the Borehole Locations and Soil Strata drawings in Appendix A.

Thurber obtained the coordinates and ground surface elevations of the as-drilled borehole locations in the field using a Trimble R10 GPS survey equipment. The horizontal and vertical accuracy of the survey results meet the MTO terms of reference requirements. The coordinates and elevations of the boreholes are given on the drawing and Record of Borehole sheets in Appendices A and B, respectively.

Lane closures and traffic control were implemented for boreholes drilled on the Brock Road platform.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

Road occupancy permits were obtained for boreholes drilled on Brock Road. CN and Metrolinx work permits were requested and obtained for Borehole 21-04.

In order to access and carry out the drilling operations at the location of Borehole 21-04, drilled near Pier 2 and within CN's right-of-way, flagging was provided by CN for track protection.

Hydro-vac services were used to daylight the immediate area of Borehole 21-02 within the upper 12.2 m to ensure that the borehole was advanced at a safe location and to avoid contact with a series of anchors previously installed for an existing retaining wall located near the north abutment.

A paid duty police officer with cruiser was required during the drilling operation of Borehole 21-02 due to close proximity of the intersection between Brock Road and the N/S-E ramp.

The current boreholes were advanced using track-mounted and truck-mounted drill rigs using hollow stem augers as well as wash boring with tri-cone and PW casings. Soil samples were obtained at selected depth intervals using a 50 mm outside diameter split-spoon sampler driven in conjunction with the Standard Penetration Test (SPT) which was performed in accordance with ASTM D1586. Rock coring was carried out using a HQ core barrel in conjunction with HW casings in Boreholes 21-02, 21-04 and 21-05.

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

In the cohesive deposits, the undrained shear strength of the material was measured in-situ by means of field vane tests (MTO N-Vane) where applicable. Firm to soft cohesive soils were encountered in Borehole 21-07. Therefore, Borehole 21-07B was advanced in proximity to Borehole 21-07 to collect a relatively undisturbed sample using a thin-walled (Shelby) tube sampler.

The current field investigation was observed on a full-time basis by a member of Thurber's technical staff who marked/staked the boreholes in the field, directed the drilling, sampling and in-situ testing operations, logged the boreholes and processed the recovered soil and rock samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the current drilling operations. Four piezometers (19 mm and 50 mm diameter Schedule 40 PVC pipes) were installed and enclosed in filter sand in Boreholes 21-05, 21-06, 21-07 and 21-09 to permit groundwater level monitoring. Details of the piezometer installations are shown in Table 3.1.

Table 3.1: Borehole Completion Details

Foundation Unit	Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
South Abutment	21-05(1)	25.9 / 71.2	20.1 / 77.0	Bentonite holeplug from 24.4 m to 20.4 m. Piezometer with 3.0 m slotted screen installed within sand filter from 20.4 m to 16.5 m, backfilled with bentonite holeplug from 16.5 m to 0.3 m, then concrete to ground surface.
South Approach	21-06(1)	17.4 / 79.5	12.2 / 84.7	Borehole caved-in to 16.5 m. Bentonite holeplug from 16.5 m to 12.5 m. Piezometer with 3.0 m slotted screen installed within sand filter from 12.5 m to 8.5 m, backfilled with bentonite holeplug from 8.5 m to 0.3 m, then concrete to ground surface.
Beyond South Approach Embankment (approx. 36 m south of south abutment)	21-07(2)	9.5 / 78.4	8.3 / 79.6	Piezometer with 3.0 m slotted screen installed within sand filter from 9.5 m to 4.7 m, backfilled with bentonite holeplug from 4.7 m to ground surface.
Beyond South Approach Embankment (approx. 78 m south of south abutment)	21-09(2)	11.5 / 76.9	11.3 / 77.1	Piezometer with 1.5 m slotted screen installed within sand filter from 11.5 m to 9.2 m, backfilled with bentonite holeplug from 9.2 m to ground surface.

(1) Piezometer diameter 19 mm
(2) Piezometer diameter 50 mm

All boreholes without piezometer installations were backfilled upon completion of drilling in general accordance with O.Reg. 903. In 2023, Thurber was directed to suspend work due to revisions to the original design plan and other project considerations, and as a result, the four installed piezometers were not decommissioned. From a foundation and geotechnical perspective, these piezometers remain valuable for monitoring groundwater levels should the project resume in the future. Alternatively, contracts for this site or surrounding sites may contain provisions stipulating contractors to decommission these piezometers in general accordance with O.Reg. 903. The asphalt surface was reinstated in boreholes drilled on the road platform.

4. LABORATORY TESTING

The recovered soil samples were subjected to visual identification (VI) and natural moisture content determination. Selected soil samples were subjected to grain size distribution analyses (sieve and/or hydrometer), and Atterberg Limits testing. All the geotechnical laboratory tests were carried out in accordance with MTO and/or ASTM Standards, as appropriate. Geotechnical laboratory testing results of the current investigation are summarized on the Record of Borehole sheets in Appendix B and are presented on the figures in Appendix C.

Core samples of the shale bedrock were carefully protected to prevent drying during transport to the laboratory. Unconfined compression tests and point load tests were carried out on selected samples of intact shale upon arrival at the laboratory to assist in evaluation of the unconfined compressive strength (UCS) of the bedrock. Detailed results of compression tests and point load tests are included in Appendix C and summarized results are presented on the Record of Borehole sheets in Appendix B. Rock core photos are presented in Appendix D.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for metal corrosion associated with the buried portions of the structures, selected soil samples were submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing for corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 5.12 and are presented in Appendix C.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered subsurface stratigraphy from the current and previous investigations are presented on the Record of Borehole sheets included in Appendices B and D, and on the Borehole Locations and Soil Strata drawings in Appendix A. A general description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized and anticipated that soil conditions may vary between and beyond the borehole locations.

The following soil stratigraphy descriptions are only based on data obtained from the present investigation.

In general, the subsurface stratigraphy encountered during the present investigation consists of pavement structure overlying embankment fill (along Brock Road) which is underlain by native soils consisting of soft to stiff silty clay to clayey silt, or stiff to hard clayey silt till. The cohesive deposits contain interlayers and lenses of loose to very dense silty sand to silty sand till, and very dense gravelly sand to sand and gravel. The site is underlain by grey shale bedrock. The

groundwater level was observed to be at approximately 8 m to 10 m depths below the Brock Road grade, and within 2 m below the toe of the approach embankment.

More detailed descriptions of the individual stratum are presented below.

5.1 Topsoil

A 300 mm thick layer of topsoil was encountered surficially in Boreholes 21-07, drilled at the toe of the existing south approach embankment.

The natural moisture content measured on a sample of the topsoil was 29 percent.

The topsoil thickness may vary between and beyond the borehole locations, and the data is not intended for the purpose of estimating quantities.

5.2 Pavement Structure

Pavement structure consisting of approximately 175 mm to 250 mm of asphalt overlying granular (sand and gravel, gravelly sand) road base was encountered in the boreholes advanced through the Brock Road platform (Boreholes 21-02, 21-05, 21-06, 21-08 and 21-11). The granular fill ranged in thickness from 0.6 m to 1.7 m.

SPT 'N' values recorded in the granular fill ranged from 38 to 80 blows per 0.3 m of penetration indicating a dense to very dense condition. An SPT 'N' value of 100 blows for less than 0.3 m of penetration, indicating a very dense state, was measured in Borehole 21-08. The moisture contents measured on samples of the granular fill ranged approximately from 3 percent to 10 percent.

The results of grain size analyses conducted on samples of the pavement granular fill obtained from Boreholes 21-02 (SS2), 21-05 and 21-11 are provided on the Record of Borehole sheets in Appendix B and illustrated on Figure C1 in Appendix C. The results are summarized as follows:

Soil Particle	Granular Fill (Percent)
Gravel	21 to 23
Sand	62 to 69
Silt and Clay	9 to 15

5.3 Fill

Embankment fill was encountered underlying the pavement structure in the boreholes advanced from the Brock Road platform (Boreholes 21-02, 21-05, 21-06, 21-08 and 21-11). Fill was contacted surficially in Boreholes 21-04 and 21-09, and below the topsoil in Borehole 21-07.

The embankment fill typically consisted of layers of cohesive and cohesionless soils. The cohesionless soil typically consists of brown to grey gravelly sand, brown to dark brown silt, sand, and silty sand containing trace to some silt, trace clay. Black gravelly sand was observed in Borehole 21-02 at 0.8 m depth. Occasional organics were encountered within the silty sand fill in Borehole 21-07. The cohesive fill consisted of brown to grey silty clay with sand and trace gravel and was considered part of the embankment fill in Boreholes 21-04, 21-05, 21-06, 21-08 and 21-11.

Grinding of augers were noted in the gravelly sand fill at depths ranging from 1.8 m to 2.7 m in Borehole 21-05. Occasional decayed wood pieces and occasional rootlets were encountered within the silty clay fill in Borehole 21-06. In Borehole 21-08, occasional inferred cobbles and grinding of augers were encountered throughout the silty clay fill.

The SPT ‘N’ values recorded in the cohesionless sand and silt fill ranged from 5 to 66 blows per 0.3 m of penetration indicating a variable loose to very dense condition. An SPT ‘N’ value of 100 blows for less than 0.3 m of penetration was measured within the gravelly sand fill near 2.3 m depth in Borehole 21-05, which was consistent with the presence of wood chunks and cobbles noted near that depth. SPT ‘N’ values of 4 to 22 blows per 0.3 m of penetration were measured in the cohesive silty clay fill and clayey silt fill indicating a variable soft to very stiff consistency. An SPT ‘N’ value of 0 blows per 0.3 m of penetration, indicating a very soft consistency, was measured in the silty clay fill near 1.8 m depth in Borehole 21-04. An SPT ‘N’ value of 100 blows for less than 0.3 m of penetration was measured within the silty clay fill near 7.8 m depth in Borehole 21-08, which was consistent with the inferred cobbles noted near that depth.

The natural moisture contents measured on samples of the cohesionless fill generally ranged from 2 percent to 30 percent. Natural moisture contents varying between 7 percent and 36 percent were measured in the cohesive fill.

The results of grain size analyses conducted on samples of the cohesionless fill obtained from Boreholes 21-02 (SS4 and SS8) and cohesive fill are provided on the Record of Borehole sheets in Appendix B and illustrated on Figures C1 and C2, respectively, in Appendix C. The results are summarized as follows:

Soil Particle	Cohesionless Fill (Percent)	Cohesive Fill (Percent)
Gravel	5 to 16	0 to 4
Sand	68 to 81	5 to 46
Silt	14 to 16	36 to 62
Clay		14 to 33

The results of Atterberg Limits tests conducted on samples of the silty clay fill are presented on the Record of Borehole sheets in Appendix B and illustrated in Figure C9 of Appendix C. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	19 to 37
Plasticity Index	8 to 18

The results of the Atterberg Limits testing indicate that the silty clay fill has a low to medium plasticity with group symbols of CL and CI.

5.4 Clayey Silt to Silty Clay

Layers of brown to grey clayey silt and silty clay with sand to some sand and containing trace gravel were contacted at depths varying from 0.7 m to 12.0 m in Boreholes 21-02, 21-04, 21-06, 21-07 and 21-09. The thicknesses of the clayey silt to silty clay ranged from 1.1 m to 4.3 m.

The depths to the base of the clayey silt and silty clay varied from 1.8 m to 15.1 m (Elevations 82.6 to 87.5).

SPT ‘N’ values measured in the clayey silt and silty clay ranged from 3 to 12 blows per 0.3 m of penetration. SPT ‘N’ values of 0 blow for 0.3 m of penetration was measured in Boreholes 21-04 and 21-07 at approximately 4 to 4.5 m depths, and an SPT ‘N’ value of 1 blow per 0.3 m of penetration was measured near 12.5 m depth in Borehole 21-02. Shear strengths from field vane tests carried out in the clayey silt and silty clay at selected depths ranged between approximately 26 kPa and 105 kPa. This combined information indicates that the clayey silt and silty clay deposits have a typically soft to stiff consistency.

Moisture contents measured in the clayey silt and silty clay ranged approximately from 6 percent to 39 percent.

The results of grain size distribution analyses carried out on selected samples of the clayey silt and silty clay are presented on the Record of Borehole sheets included in Appendix B. Grain size distribution curves of samples tested are presented on Figures C3 and C4 in Appendix C. The

results of the grain size distribution analyses are summarized below:

Soil Particle	Silty Clay to Clayey Silt (Percent)
Gravel	0 to 4
Sand	1 to 49
Silt	34 to 67
Clay	12 to 50

The results of Atterberg Limits tests conducted on samples of the silty clay and clayey silt are presented on the Record of Borehole sheets in Appendix B and illustrated in Figures C10 and C11, respectively, of Appendix C. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	17 to 44
Plasticity Index	7 to 25

The results of the Atterberg Limits testing indicate that the clayey silt is generally of slight plasticity with a group symbol of CL-ML. The silty clay has a low to medium plasticity with group symbols of CL and CI.

5.5 Silt mixed with Organics

A 600 mm thick layer of silt mixed with organics containing occasional rootlets was encountered below the silty clay at 10.2 m depth in Borehole 21-02.

The depth to the base of the silt with organics was at 10.8 m (Elevation 86.9).

An SPT ‘N’ value recorded in the silt with organics was 4 blows per 0.3 m of penetration indicating a loose state. The natural moisture content measured on a sample of the silt with organics was 30 percent.

5.6 Silty Sand

Grey silty sand containing trace to some gravel, trace clay was contacted in Boreholes 21-05 and 21-07 at 14.1 m and 5.3 m depth, respectively. The thickness of the silty sand was 0.7 m and 2.2m.

The depth to the base of the silty sand was at 14.8 m and 7.5 m (Elevations 82.3 and 80.4) in Boreholes 21-05 and 21-07, respectively.

SPT ‘N’ values of 3 and 5 for 0.3 m of penetration, indicating a very loose to loose condition, were measured in Borehole 21-07. A higher N-value of 43 blows was obtained near the bottom of this layer, which was consistent with the noted grinding of augers. The natural moisture contents measured on samples of the silty sand ranged from 12 percent to 21 percent.

The results of grain size distribution analyses carried out on a selected sample of the silty sand are shown on Figure C5 in Appendix C. The results are summarized as follows:

Soil Particle	Silty Sand (Percent)
Gravel	1
Sand	77
Silt	18
Clay	4

5.7 Gravelly Sand, Gravel, Sand and Gravel

Interlayers and/or lenses of grey gravelly sand, sand and gravel, and gravel containing trace to some silt and trace clay were contacted at depths varying from 13.3 m to 16.3 m in Boreholes 21-02, 21-05 and 21-06, and at 5.6 m and 7.2 m in Borehole 21-09. The thickness of these deposits ranged from 0.8 m to 3.0 m.

The depth to the base of the gravelly sand, sand and gravel to gravel ranged from 14.1 m to 19.4 m (Elevations 77.7 to 83.0) in Boreholes 21-02 and 21-05. In Borehole 21-09 the depth to the base of these deposits was at 8.6 m (Elevation 79.8). Borehole 21-06 was terminated within the sand and gravel layer at 17.4 m (Elevation 79.5).

The SPT ‘N’ values recorded in the gravelly sand, sand and gravel to gravel ranged from 54 to 100 blows per 0.3 m of penetration indicating a very dense state. SPT ‘N’ values higher than 100 blows for less than 0.3 m of penetration were measured in the sand and gravel layer in Boreholes 21-06 and 21-09. The natural moisture contents measured on samples of these deposits ranged from 9 percent to 13 percent.

The results of grain size distribution analyses carried out on selected samples of the gravelly sand and sand and gravel are shown on Figure C6 in Appendix C. The results are summarized as follows:

Soil Particle	Gravelly Sand, Sand and Gravel (Percent)
Gravel	20 to 48
Sand	32 to 62
Silt and Clay	18 to 20

5.8 Sand and Silt to Silty Sand Till

Grey sand and silt to silty sand till containing trace to some gravel, trace to some clay with occasional cobbles and occasional shale fragments was encountered at depths varying from 5.9m to 15.1 m in Boreholes 21-02, 21-04, 21-06, 21-07 and 21-09. Where fully penetrated, the thickness of the cohesionless till varied from 1.2 m to 4.1 m.

The depth to the base of the silty sand till ranged from 10.0 m to 16.3 m (Elevations 79.0 to 81.4). Boreholes 21-07 and 21-09 were terminated within the sand and silt till and silty sand till at 9.5 m and 11.5 m depth (Elevations 78.4 and 76.9), respectively.

The SPT 'N' values recorded in these cohesionless tills ranged from 17 to 71 blows per 0.3 m of penetration and typically increasing with depth to greater than 100 blows for less than 0.3 m penetration, indicating compact to very dense conditions. Higher 'N" values may be attributed to the presence of cobbles and boulders. The natural moisture contents measured on samples of the cohesionless till ranged from 9 percent to 17 percent.

The results of grain size distribution analyses carried out on selected samples of the sand and silt till and silty sand till are shown on Figure C7 in Appendix C. The results are summarized as follows:

Soil Particle	Sand and Silt Till, Sandy Silt Till (Percent)
Gravel	1 to 13
Sand	55 to 64
Silt	22 to 35
Clay	3 to 13

Glacial tills inherently contain cobbles and boulders. Grinding of augers were noted in the cohesionless tills in Boreholes 21-04 and 21-09 at 7.9 m and 9.1 m depths, respectively.

5.9 Silty Clay to Clayey Silt Till

Brown to grey clayey silt to silty clay till with sand, trace gravel and occasional cobbles were encountered in all but Borehole 21-07. The cohesive till was contacted at depths ranging from 1.8 m to 8.6 m in Boreholes 21-08, 21-09 and 21-11, and at lower depths of 10.0 m to 19.4 m in Boreholes 21-02, 21-04, 21-05 and 21-06. Where fully penetrated in Boreholes 21-02, 21-04, 21-05, 21-06 and 21-09, the thickness of the cohesive tills ranged from 1.1 m to 4.0 m.

The depth to the base of the silty clay till and clayey silt till varied from 13.1 m to 21.3 m (Elevations 75.0 to 83.8). Locally, in Borehole 21-09, the depth to the base of the silty clay till was at 5.6 m (Elevation 82.8). Boreholes 21-08 and 21-11 were terminated within the clayey silt till at 12.5 m and 13.7 m depth (Elevations 83.8 and 83.6), respectively.

SPT 'N' values measured in the clayey silt till and silty clay till typically ranged from 11 blows per 0.3 m penetration to greater than 100 blows for less than 0.3 m of penetration, indicating a stiff to hard consistency. Higher 'N" values may be attributed to the presence of cobbles and boulders. An SPT 'N' value of 4 blows per 0.3 m of penetration was measured in Borehole 21-09 near 2.5m depth indicating a firm consistency.

Shear strength from a field vane test carried out in the silty clay till at about 3.5 m depth in Borehole 21-09 was 26 kPa, indicating a firm consistency.

Moisture contents measured in the silty clay till and clayey silt till ranged approximately from 6 percent to 34 percent.

The results of grain size distribution analyses carried out on selected samples of the silty clay till and clayey silt till are presented on the Record of Borehole sheets included in Appendix B. Grain size distribution curves of samples tested are presented on Figure C8 in Appendix C. The results of the grain size distribution analyses are summarized below:

Soil Particle	Silty Clay Till/Clayey Silt Till (Percent)
Gravel	1 to 8
Sand	28 to 55
Silt	31 to 34
Clay	6 to 32

The results of Atterberg Limits tests conducted on samples of the silty clay till and clayey silt till are presented on the Record of Borehole sheets in Appendix B and illustrated in Figure C12 of Appendix C. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	15 to 28
Plasticity Index	4 to 16

The results of the Atterberg Limits testing indicate that the clayey silt till is generally of slight plasticity with a group symbol CL-ML, and the silty clay till is of low plasticity with a group symbol of CL.

Grinding of augers was noted at various locations in the cohesive till. Glacial tills inherently contain cobbles and boulders.

5.10 Shale Bedrock

The soil deposits above were found to be underlain by shale bedrock of the Georgian Bay Formation. The shale is generally described as highly to moderately weathered becoming slightly weathered to fresh with depth, thinly bedded, grey with frequent limestone interbeds. The joints are largely horizontal to sub-horizontal and there are occasional fractured zones. Bedrock was proved by coring below the termination of augering or tri-coning in Boreholes 21-02, 21-04 and 21-05. Rock core photos are presented in Appendix E.

Table 5.1 below summarizes depths to bedrock and top of bedrock elevations encountered in these boreholes.

Table 5.1: Top of Bedrock

Borehole Number	Approximate Top of Bedrock		
	Depth (m)	Elevation (m)	
21-02	21.3	76.4	Proved by coring
21-04	14.0	75.0	Proved by coring
21-05	21.1	76.0	Proved by coring

Total Core Recovery (TCR) in the core runs are at 100 percent, except for Runs 1 in Boreholes 21-02 and 21-05, where 44 and 0 percent were recorded, respectively. The Rock Quality Designation (RQD) values typically ranged from 27 percent to 84 percent indicating fair to good overall rock quality. Lower RQD values of 0 and 10 percent, indicating very poor rock quality, was recorded for Run 1 in Borehole 21-02 and Runs 1 and 2 in Borehole 21-05. An RQD of 92 percent was recorded in Run 4 in Borehole 21-05 indicating excellent rock quality.

The Fracture Index (FI) of the rock, expressed as number of fractures per 0.3 m of core, typically ranged from 10 to greater than 10 within the upper portion of the shale decreasing to lower values with depth. FI values greater than 10 are generally associated with fracture zones.

Unconfined compressive strengths (UCS) interpreted from point load tests conducted on selected rock cores ranged from 6 MPa to 35 MPa. The UCS of the rock determined from laboratory unconfined compression tests were 13.5 MPa and 15 MPa in Runs 2 and 3 in Borehole 21-02, respectively; 49.7 MPa in Run 5 of Borehole 21-04, and 41 MPa in Run 4 of Borehole 21-05. The combined results indicate a generally weak rock with medium strong zones. Results of these rock strength tests are summarized on the Records of Boreholes in Appendix B and presented in Appendix C.

5.11 Groundwater Conditions

Groundwater levels in the boreholes were observed during the drilling operations and measured upon completion of drilling. Piezometers were installed in Boreholes 21-05, 21-06, 21-07 and 21-09 to permit monitoring of groundwater levels. Water was added to all the boreholes in conjunction with tri-coning and rock coring for borehole advancement; therefore, stabilized groundwater levels might not have been established in some boreholes upon completion of drilling. Water levels recorded in open boreholes upon completion were likely not stabilized readings (see table below).

Water levels measured in the piezometers and open boreholes are presented in Table 5.2 below.

Table 5.2: Groundwater Level Measurements

Borehole	Date	Groundwater Level		Comments
		Depth (m)	Elevation (m)	
21-04	July 20, 2022	3.2*	85.8*	Observed during drilling
21-05	November 17, 2021 November 19, 2021 December 10, 2021 August 17, 2022	N/A 10.0 10.1 10.4	- 87.1 87.0 86.7	Piezometer
21-06	November 18, 2021 November 19, 2021 December 10, 2021 July 19, 2022 August 17, 2022	8.3 8.9 9.1 9.5 9.9	88.6 88.0 87.8 87.4 87.0	Piezometer
21-07	October 12, 2021	1.8	86.1	Piezometer
21-09	December 14, 2021 September 17, 2022	3.6* 1.5	84.8* 86.9	Piezometer

Note: * May not be stabilized.

The groundwater levels measured in the piezometers in Table 5.2 are short-term readings where seasonal fluctuations are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant or prolonged precipitation.

5.12 Corrosivity Test Results

Selected soil samples were submitted for analytical testing of corrosivity parameters including sulphate content. The results of the analytical tests are summarized in Table 5.3. The laboratory certificates of analysis and detail results are presented in Appendix C.

Table 5.3: Analytical Corrosivity Test Results

Sample ID	Depth (m)	Soil Sample Description	Sulphide (percent)	Chloride (µg/g)	Sulphate (µg/g)	pH	Resistivity (ohm.cm)	Redox Potential (mV)	Electrical Conductivity (µS/cm)
21-02 SS4	2.3 – 2.9	Sand fill	0.06	580	23	9.43	653	313	1,530
21-02 SS10	9.1 – 9.7	Silty clay	< 0.04	430	67	8.35	1,490	294	672
21-02 SS17	19.8 - 20.4	Clayey silt till	0.35	23	320	8.72	3,050	303	328
21-04 SS2B	0.9 - 1.4	Silty clay fill	< 0.04	320	37	9.01	2,020	499	496
21-04 SS4B	2.6 - 2.9	Silty clay	< 0.04	360	74	8.56	2,120	376	471
21-05 SS5	3.0 - 3.7	Silty clay fill	< 0.04	820	51	8.41	501	218	2,000
21-05 SS8	7.6 - 8.2	Silty clay fill	< 0.04	520	35	7.38	959	208	1,040

6. MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Thurber surveyed the as-drilled boreholes in the field, and obtained the coordinates and ground surface elevations.

Landshark Drilling of Brantford, Ontario supplied and operated the drilling and sampling equipment for the field program.

Full time observation of the field activities was carried out by Messrs. Joshua Alexander and Sergey Gladkiy of Thurber. Overall supervision of the field program was performed by Mr. Joshua Alexander, P.Eng. and Ms. Rocio Palomeque Reyna, P.Eng. of Thurber.

Interpretation of the field data and preparation of the report were carried out by Ms. Rocio Palomeque Reyna, P.Eng. The report was reviewed by Messrs. Sydney Pang, P.Eng. and Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

Rocio Palomeque Reyna, P. Eng.
Associate, Senior Geotechnical Engineer

Sydney Pang, P. Eng.
Senior Associate, Senior Foundation Engineer

Date: ***May 21, 2026***
File: ***30524***

Jason Lee, P. Eng.
Partner, Senior Foundation Engineer
Designated MTO Contact

THURBER

STATEMENT FOR USE AND INTERPRETATION OF REPORT

1. STANDARD OF CARE

This Report has been prepared in a manner consistent with that degree of care and skill ordinarily exercised by members of the same profession currently practicing under similar circumstances at the same time and in the same or similar locality and in compliance with all applicable laws.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment, including this Statement For Use and Interpretation of Report, are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT, AS DESCRIBED ABOVE. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TOTHE WHOLE OF THE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives, and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client for the development, design objectives, and/or purposes described to Thurber by the Client. **NO OTHER PARTY MAY USE OR RELY ON THE REPORT OR ANY PORTION THEREOF FOR OTHER THAN THE CLIENT'S BENEFIT IN CONNECTION WITH THE PURPOSES DESCRIBED IN THE REPORT**. Any use which a third party makes of the Report is the sole responsibility of such third party and is always subject to this Statement for Use and Interpretation of Report. Thurber accepts no liability or responsibility for damages suffered by any third party resulting from use of the Report for purposes outside the reasonable contemplation of Thurber at the time it was prepared or in any manner unintended by Thurber.

5. INTERPRETATION OF THE REPORT

a) **Nature and Exactness of Soil and Contaminant Description:** Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors is inherently judgement-based. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other parties making use of such documents or records with or without our express written consent need to be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other parties. Some conditions are subject to change over time and those making use of the Report need to be aware of this possibility and understand that the Report only presents the interpreted conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client must disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) **Reliance on Provided Information:** The evaluation and conclusions contained in the Report have been prepared based on conditions in evidence at the time of site inspections and based on information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report resulting from misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other parties providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) **Design Services:** The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber is recommended to be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design need to be reported to Thurber immediately so that Thurber can address potential conflicts.

d) **Construction Services:** During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions to confirm and document that the site conditions do not materially differ from those conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

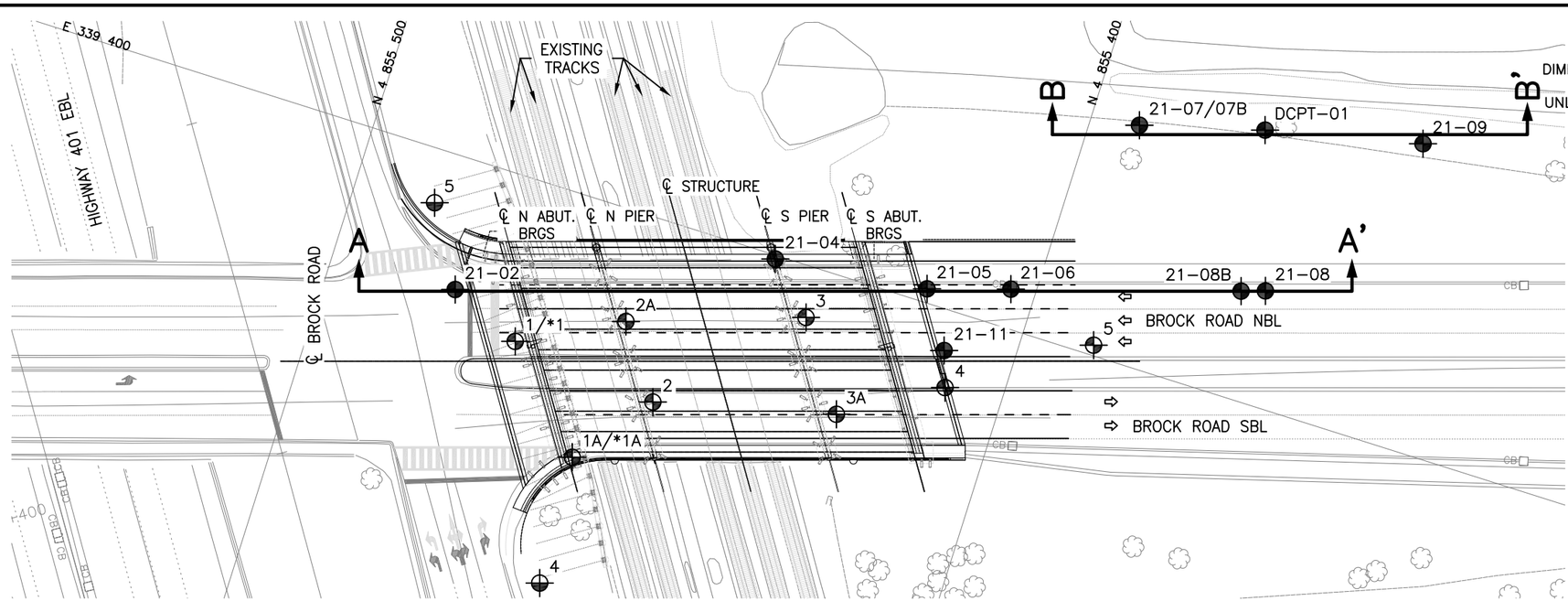
6. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or other parties who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes, but is not limited to, decisions made to develop, purchase, or sell land, unless such decisions expressly form part of the stated purpose of the Report as described in Paragraph 3.

APPENDIX A

Drawings 1 and 2 – Borehole Locations and Soil Strata

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

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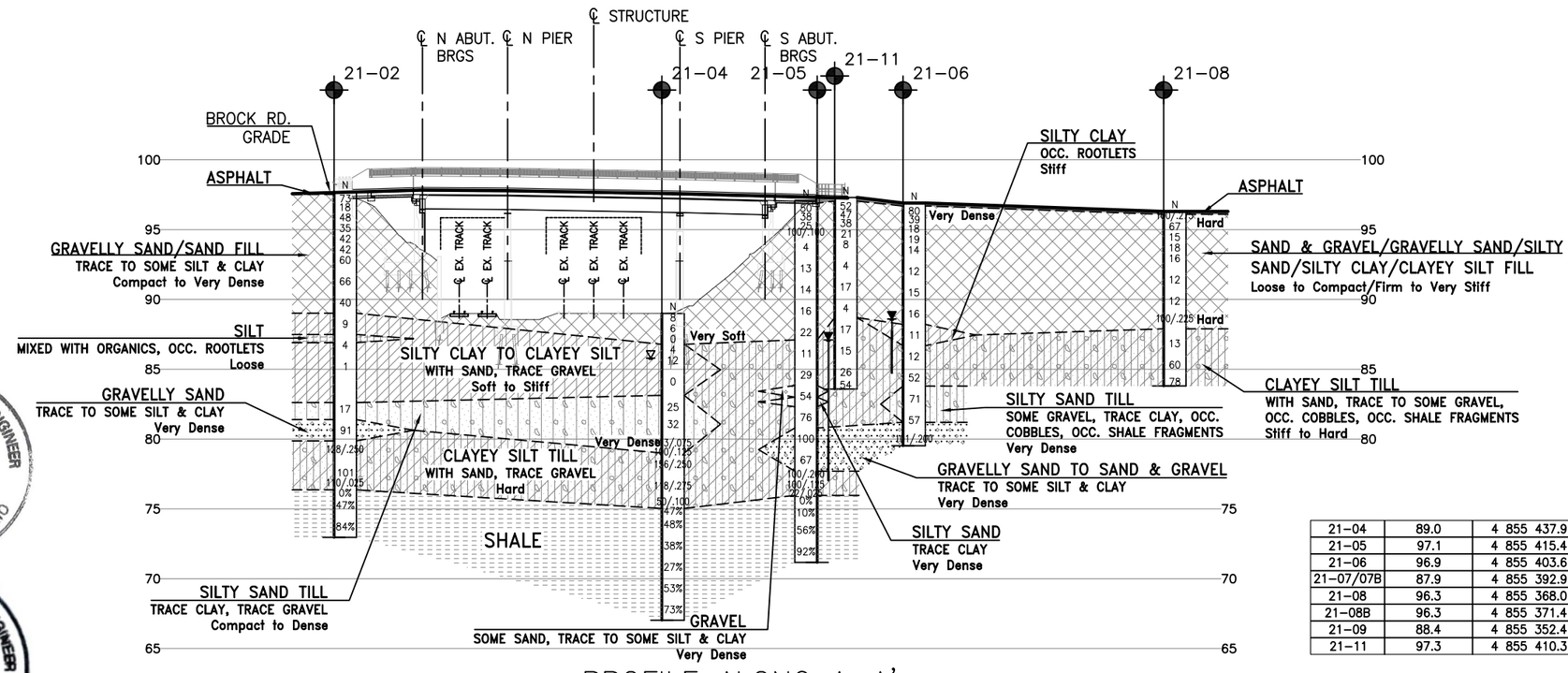

PROFILE ALONG A–A'

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8 0 8 16m V 1:400

21-04	89.0	4 855 437.9	339 399.5
21-05	97.1	4 855 415.4	339 402.0
21-06	96.9	4 855 403.6	339 405.7
21-07/07B	87.9	4 855 392.9	339 434.3
21-08	96.3	4 855 368.0	339 416.7
21-08B	96.3	4 855 371.4	339 415.6
21-09	88.4	4 855 352.4	339 444.2
21-11	97.3	4 855 410.3	339 394.1

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

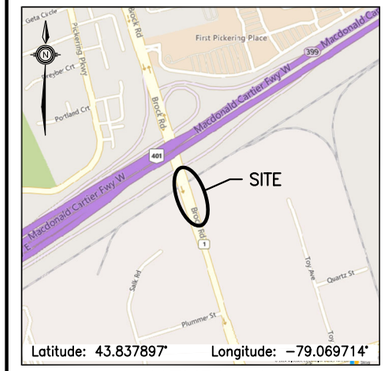
CONT No
WP No 2120-18-00

CNR OVERHEAD AT BROCK ROAD HIGHWAY 401
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

egis

THURBER



KEYPLAN

LEGEND

⊕	Borehole (By Thurber)
⊕	Borehole – 1983-84 (30M14-296)
⊕	Borehole – 1969 (30M14-011)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
▽	Water Level Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
1/*1	87.9	4 855 470.6	339 376.4
1A/*1A	88.8	4 855 457.5	339 362.8
2	87.5	4 855 448.7	339 374.1
2A	87.3	4 855 456.0	339 384.1
3	89.0	4 855 431.0	339 392.6
3A	88.7	4 855 422.5	339 380.5
4	89.0	4 855 408.5	339 389.0
4	90.9	4 855 456.5	339 343.7
5	89.2	4 855 389.6	339 401.5
5	97.6	4 855 488.0	339 392.2
DCPT-01	88.4	4 855 375.1	339 439.1
21-02	97.7	4 855 481.3	339 381.0

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
3) Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 30M14-673

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REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	RPR	CHK SKP	CODE	LOAD	DATE MAY 2026
DRAWN	AN	CHK RPR	SITE 22-276-1&2	STRUCT	DWG 1

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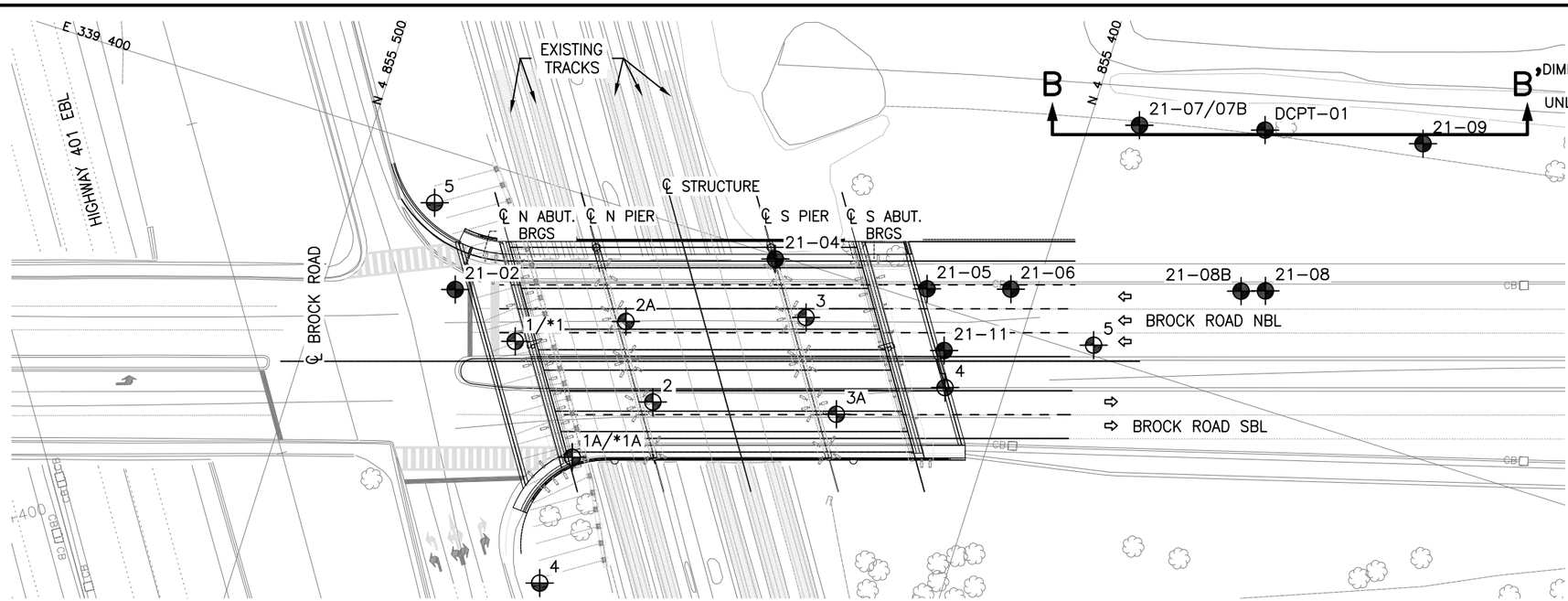
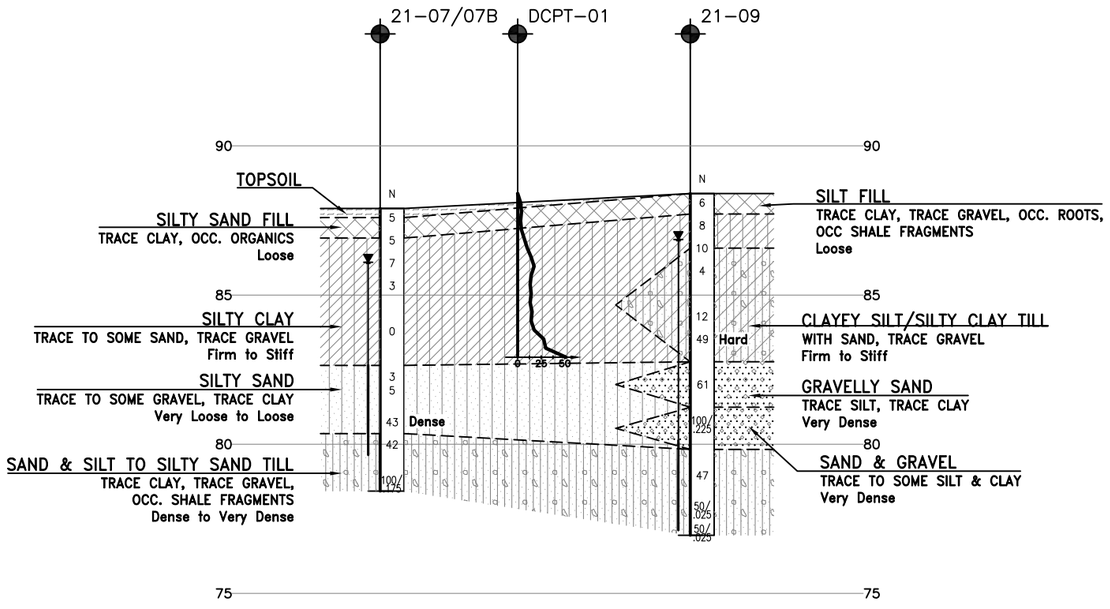
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

16 0 16 32m

SCALE 1:800



PROFILE ALONG B–B'

16 0 16 32m H 1:800

4 0 4 8m V 1:200

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

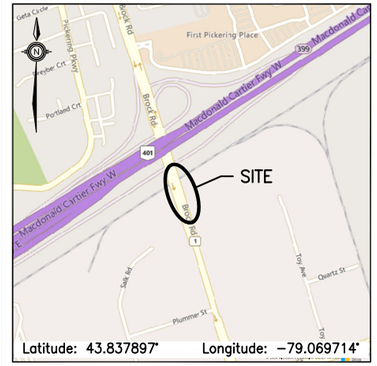
CONT No
WP No 2120-18-00

CNR OVERHEAD AT BROCK ROAD HIGHWAY 401
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

egis

THURBER



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2026/05/21
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REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN RPR	CHK SKP	CODE	LOAD
DRAWN AN	CHK RPR	SITE 22-276-1&2	STRUCT
		DATE MAY 2026	DWG 2

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APPENDIX B

Record of Borehole Sheets – Current Investigation

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT[(1)] 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

1) Laboratory Triaxial Testing
2) Field Insitu Vane Testing
3) Laboratory Vane Testing
4) SPT value
5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample		TP Thin Wall Piston Sample
	PH Sampler Advanced by Hydraulic Pressure		PM Sampler Advanced by Manual Pressure
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

▼ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

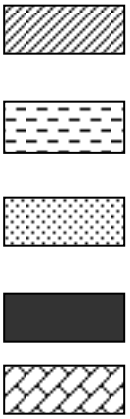
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

SYMBOLS



CLAYSTONE

SILTSTONE

SANDSTONE

COAL

Bedrock (general)

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	(psi)	Field Estimation of Hardness*
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

THURBER

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 21-02 1 OF 3 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 481.3 E 339 381.0 ORIGINATED BY SG

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers/Tricone and PW Casing/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2022.08.16 - 2022.08.17 LATITUDE 43.838491 LONGITUDE -79.069970 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
97.7	GROUND SURFACE										
0.0	**ASPHALT:**(175mm)										
0.2	**SAND** and **GRAVEL**, trace silt, occasional cobbles Very Dense Brown		1	SS	73				○		
96.9							97				
0.8	Moist (FILL)		2	SS	18				○		22 69 9 (SI+CL)
96.1	Gravelly **SAND**, trace silt and clay, occasional asphalt fragments, occasional plastic pieces								○		
1.6	Compact Black to Grey Moist (FILL)		3	SS	48		96		○		
	Black to Brown										
	SAND, trace gravel, trace to some silt and clay Dense Brown Moist (FILL)		4	SS	35		95		○		5 81 14 (SI+CL)
			5	SS	42				○		
			6	SS	42		94		○		
	Layer of sandy silt (200mm) Very Dense Dark Brown Moist to Wet		7	SS	60		93		○ ○		Mud rotary and tricone used from 4.5m
	Some gravel		8	SS	66		92		○		16 68 16 (SI+CL)
	Dense		9	SS	40		91		○		
89.0							90				
8.7	Silty **CLAY**, trace sand Stiff Grey Wet		10	SS	9		89		⊖		0 6 67 27
							88				

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 21-02 2 OF 3 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 481.3 E 339 381.0 ORIGINATED BY SG

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers/Tricone and PW Casing/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2022.08.16 - 2022.08.17 LATITUDE 43.838491 LONGITUDE -79.069970 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
87.5 / 10.2	Silty **CLAY**, trace sand Stiff Grey Wet										
86.9 / 10.8	**SILT**, mixed with organics, occasional rootlets Loose Black to Grey Wet		11	SS	4		87				0 34 50 16
85.7	Clayey **SILT**, with sand Stiff Grey Wet						86				
12.0	Silty **CLAY**, trace sand Stiff Brown to Grey Wet		12	SS	1		85				0 3 47 50
			1	TW			84				
82.6							83	2.0			
15.1	Silty **SAND**, some gravel, trace clay Compact Grey Wet (TILL)		13	SS	17		82				13 56 23 8
81.4											
16.3	Gravelly **SAND**, trace to some silt and clay Very Dense Grey Wet Spoon bouncing at 16.5m		14	SS	91		81				
79.9							80				
17.8	Clayey **SILT**, with sand, trace gravel Hard Grey Wet (TILL)		15	SS	128/ 0.250		79				6 47 38 9
	Occasional shale fragments						78				

Continued Next Page

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20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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Ministry of Transportation Ontario

THURBER

RECORD OF BOREHOLE No 21-02

METRIC

W.P. 2120-18-00	LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 481.3 E 339 381.0		ORIGINATED BY SG
DIST Central HWY 401	BOREHOLE TYPE Hollow Stem Augers/Tricone and PW Casing/HQ Coring		COMPILED BY AN
DATUM Geodetic	DATE 2022.08.16 - 2022.08.17	LATITUDE 43.838491 LONGITUDE -79.069970	CHECKED BY RPR

Column headings: SOIL PROFILE (ELEV / DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, "N" VALUES); GROUND WATER CONDITIONS; ELEVATION SCALE; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20, 40, 60, 80, 100); PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) (20, 40, 60); UNIT WEIGHT γ kN/m³; REMARKS & GRAIN SIZE DISTRIBUTION (%) (GR SA SI CL)

Continued From Previous Page

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	UNIT WEIGHT	REMARKS
	Clayey **SILT**, with sand, trace gravel Hard Grey Wet (TILL)	16	SS	101	77		
76.4	Shale-till complex Coring started at 21.3m	17	SS	110/0.025		FI	
21.3	**SHALE**, moderately weathered, thinly bedded, grey to dark grey, with limestone interbeds: (Georgian Bay Formation)	1	RUN		76	2 10	RUN #1 TCR=44% SCR=33% RQD=0%
	Rubble zone from 21.4m to 21.5m					5	
	Horizontal fractures at 21.5m Sub-vertical fracture at 21.5m	2	RUN			2	RUN #2 TCR=100% SCR=98% RQD=47% UCS=13.5MPa (UCT)
	Clay layer from 21.5m to 21.6m				75	10	
	Sub-horizontal fractures at 22.5m, 22.6m, 22.3m, 22.4m and 22.5m					4	
	Horizontal fractures at 21.9m, 22.0m, 22.1m, 22.3m, 22.4m, 22.5m, 22.6m, 22.8m, 22.9m, 23.0m and 23.1m					10	
	Slightly weathered to fresh Vertical fractures at 21.9m, 22.1m, 22.4m, 22.5m, 22.6m, 23.1m and 23.2m	3	RUN		74	1 3	RUN #3 TCR=100% SCR=100% RQD=84% UCS=15.0MPa (UCT)
	Horizontal fractures at 23.4m, 23.6m, 23.8m, 24.0m, 24.3m and 24.5m					3	
73.0	Sub-horizontal fracture at 24.5m				73	1	
24.7	END OF BOREHOLE AT 24.7m BOREHOLE BACKFILLED WITH CEMENT FROM 24.7m TO 4.6m, BENTONITE HOLEPLUG FROM 4.6m TO 0.3m, THEN ASPHALT COLD PATCH TO SURFACE. HYDRO-VAC WAS USED TO DAYLIGHT THE UPPER 12.2m AT AN ADJACENT LOCATION.						

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+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No 21-04 1 OF 3 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 437.9 E 339 399.5 ORIGINATED BY SG

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers/Tricone and PW Casing/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2022.07.19 - 2022.07.20 LATITUDE 43.838100 LONGITUDE -79.069744 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
89.0	GROUND SURFACE										
0.0	**SAND** and **GRAVEL**, trace silt Loose Brown Moist		1	SS	8						
88.4	(FILL)		1	AS							
0.6 88.1	Clayey **SILT**, trace gravel, trace sand, occasional organics Brown to Dark Brown Moist (FILL)		2	SS	6		88				
0.9	Silty **CLAY**, with sand, trace gravel Firm to Very Soft Brown Moist		3	SS	0		87				3 28 39 30
86.8 2.2	(FILL) Silty **CLAY**, with sand, trace gravel Firm to Stiff Brown Wet		4	SS	4		86				Mud rotary and tricone used from 3.0m
			5	SS	12	▽	85				4 38 34 24
84.9 4.1	Clayey **SILT**, with sand, trace gravel Soft Grey Wet		6	SS	0		84	1.5 +			3 49 36 12
83.1 5.9	Silty **SAND**, trace gravel, trace clay Compact Grey Wet (TILL)		1	TW			83				3 59 32 6
			7	SS	25		82				
	Occasional inferred cobbles Dense to Very Dense		8	SS	32		81				
	Augers grinding from 7.9m to 10.0m		9	SS	113/ 0.075		80				1 64 32 3
79.0					100/						

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20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 21-04 2 OF 3 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 437.9 E 339 399.5 ORIGINATED BY SG

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers/Tricone and PW Casing/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2022.07.19 - 2022.07.20 LATITUDE 43.838100 LONGITUDE -79.069744 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
10.0	Clayey **SILT**, with sand, trace gravel Hard Grey Wet (TILL)		10	SS	0.125						
			11	SS	156/ 0.250		78				1 50 40 9
	Occasional inferred cobbles		12	SS	118/ 0.275		77				8 55 31 6
	Occasional shale fragments Spoon bouncing						76			FI 10	
75.0	Coring started at 14.0m		13	SS	50/ 0.100					10	
14.0	**SHALE**, highly weathered, thinly bedded, grey to dark grey, with limestone interbeds: (Georgian Bay Formation)		1	RUN			75			10 10 10	**RUN #1** TCR=100% SCR=98% RQD=47%
	Vertical fractures from 13.9m to 14.0m		2	RUN			74			10	**RUN #2** TCR=100% SCR=62% RQD=48% UCS=15.5MPa (Average PLT)
	Highly fractured zone between 13.8m to 13.9m and 14.0m to 14.3m									9 2	
	Clay seams at 14.1m and from 14.2m to 14.3m						73			8 3	
	Horizontal fractures at 14.5m, 14.6m, 14.7m, 14.8m, 14.89m, 15.1m, 15.2m, 15.4m, 15.6m, 15.8m and 15.9m		3	RUN						10	**RUN #3** TCR=100% SCR=60% RQD=38% UCS=26.2MPa (Average PLT)
	Highly fractured zone between 14.3m to 14.5m and 14.8m to 15.1m						72			10 4	
	Sub-horizontal fractures at 15.0m, 15.1m, 14.6m, 15.4m, 15.76m and 15.7m									2 5	
	Sub-horizontal fractures from 15.9m to 16.0m and 16.1m to 16.2m		4	RUN			71			5	**RUN #4** TCR=100% SCR=63% RQD=27% UCS=18.7MPa (Average PLT)
	Horizontal fractures at 16.0m, 16.2m, 16.3m, 16.4m, 16.45m, 16.6m and 17.1m									3 3	
	Highly fractured zones from 16.3m to 16.4m and 16.6m to 16.9m						70			4 4	**RUN #5** TCR=100% SCR=72% RQD=53% UCS=24.4MPa (Average PLT) UCS=49.7MPa (UCT)
	Vertical fractures from 16.7m to 16.8m		5	RUN						5 6	

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
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THURBER

RECORD OF BOREHOLE No 21-04 3 OF 3 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 437.9 E 339 399.5 ORIGINATED BY SG

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers/Tricone and PW Casing/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2022.07.19 - 2022.07.20 LATITUDE 43.838100 LONGITUDE -79.069744 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
	SHALE, highly to moderately weathered, thinly bedded, grey to dark grey, with limestone interbeds: (Georgian Bay Formation) Horizontal fractures at 17.5m, 17.7m, 17.8m, 18.1m, 18.2m, 18.7m and 18.8m Highly fractured zone at 17.6m and 18.4m to 18.5m Sub-horizontal fractures at 17.8m, 17.9m to 18.0m, 18.1m to 18.2m and 18.8m to 18.9m		6	RUN			68			2 3 2 0 3 8	**RUN #6** TCR=100% SCR=60% RQD=73% UCS=38.3MPa (Average PLT)
67.0 22.0	END OF BOREHOLE AT 22.0m WATER LEVEL OBSERVED AT 3.2m DURING DRILLING. BOREHOLE BACKFILLED WITH CEMENT GROUT FROM 22.0m TO GROUND SURFACE.									

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 21-05 1 OF 3 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 415.4 E 339 402.0 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers/Tricone and PW Casing/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2021.11.16 - 2021.11.17 LATITUDE 43.837897 LONGITUDE -79.069714 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
97.1	GROUND SURFACE										
0.0	**ASPHALT:** (200mm)						97				
0.2	**SAND** and **GRAVEL**, trace silt, occasional cobbles Very Dense Brown Moist (FILL)		1	SS	50				○		
96.2							96				
0.9	Gravelly **SAND**, some silt and clay Dense to Compact Brown Moist (FILL)		2	SS	38				○		
			3	SS	25				○		23 62 15 (SI+CL)
	Augers grinding from 1.8m to 2.7m						95				
			4	SS	100/ 0.100				○		
94.1	Occasional decayed wood chunks, occasional cobbles										
3.0	Silty **CLAY**, with sand, trace gravel Firm to Stiff Brown to Grey Moist to Wet (FILL)		5	SS	4		94		○		Switch to tri-cone at 3.0m
			6	SS	13		93		○		
			7	SS	14		92		⊢○⊣		2 39 39 20
			8	SS	16		91		○		
	Very Stiff Occasional rootlets at 8.1m						90				
			9	SS	22		89		○ ⊢ ○		1 27 44 28
87.1							88				

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+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
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THURBER

RECORD OF BOREHOLE No 21-05 2 OF 3 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 415.4 E 339 402.0 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers/Tricone and PW Casing/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2021.11.16 - 2021.11.17 LATITUDE 43.837897 LONGITUDE -79.069714 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
10.0	Silty **CLAY**, with sand, trace to some gravel Stiff to Very Stiff Brown to Grey Wet (TILL)						87				
			10	SS	11		86		○		
							85				
			11	SS	29				○		
83.8							84				
13.3	**GRAVEL**, some sand, trace to some silt and clay Very Dense Grey Wet								○		
83.0			12	SS	54		83		○		
14.1	Silty **SAND**, trace clay Very Dense Grey Wet								○		
82.3							82				
14.8	Silty **CLAY**, with sand, trace to some gravel Hard Grey Wet (TILL)		13	SS	76				○		
80.8							81				
16.3	Gravelly **SAND**, trace to some silt and clay Very Dense Grey Wet		14	SS	100		80		○		20 62 18 (SI+CL)
			15	SS	67		79		○		
77.7							78				
19.4	Clayey **SILT**, with sand, trace gravel, occasional cobbles, occasional shale fragments (TILL)				100/						

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$+^3$, $\times^3$: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 21-05 3 OF 3 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 415.4 E 339 402.0 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers/Tricone and PW Casing/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2021.11.16 - 2021.11.17 LATITUDE 43.837897 LONGITUDE -79.069714 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										4 47 39 10
	Clayey **SILT**, with sand, trace gravel, occasional cobbles, occasional shale fragments Hard Grey Wet (TILL)		16	SS	0.200		77				
			17	SS	100/ 0.125						
76.0	Highly weathered shale-till complex, thinly laminated		18	SS	22/ 0.025		76			FI	
21.1	Coring started at 21.1m										**RUN #1** TCR=0% SCR=0% RQD=0%
	Highly weathered shale-till complex, thinly laminated		1	RUN						>10 11	
	SHALE, highly weathered, thinly bedded, grey to dark grey, with limestone interbeds: (Georgian Bay Formation)		2	RUN			75			>10	**RUN #2** TCR=100% SCR=13% RQD=10% UCS=26.8MPa (PLT)
	Clay and gravel layer (75mm) at 22.5m						74			3 2	
	Moderately weathered Sub-vertical fracture at 22.8m Horizontal fractures at 22.9m, 23.1m, 23.2m, 23.3m, 23.5m and 23.6m		3	RUN						2 2 1	**RUN #3** TCR=100% SCR=80% RQD=56% UCS=16.5MPa (Average PLT)
	Clay seams (25mm) at 23.3m and 23.5m						73			1	
	Slightly weathered to fresh Sub-horizontal fractures at 23.8m, 24.1m and 24.2m Sub-horizontal fractures at 24.4m and 25.9m		4	RUN			72			1 1 4	**RUN #4** TCR=100% SCR=100% RQD=92% UCS=41.0MPa (UCT) UCS=16.0MPa (Average PLT)
71.2										2	
25.9	END OF BOREHOLE AT 24.4m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2021.11.17	N/A	-
2021.11.19	10.0	87.1
2021.12.10	10.1	87.0
2022.08.17	10.4	86.7

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 21-06 1 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 403.6 E 339 405.7 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.11.18 - 2021.11.18 LATITUDE 43.837791 LONGITUDE -79.069669 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
96.9	GROUND SURFACE										
0.0	**ASPHALT:** (200mm)										
0.2	**SAND** and **GRAVEL**, trace silt, trace clay Very Dense to Dense Brown Moist (FILL)		1	SS	80						
			2	SS	39		96				
95.4											
1.5	Silty **SAND**, trace clay, trace gravel Compact Brown Moist (FILL)		3	SS	18		95				
94.7											
2.2	Silty **CLAY**, with sand, trace gravel, occasional rootlets, occasional decayed wood pieces Very Stiff to Stiff Brown to Grey Wet (FILL)		4	SS	19		94				
			5	SS	14						1 40 44 15
							93				
92.0			6	SS	12		92				
4.9	Silty **SAND**, trace to some gravel, trace clay Compact Brown Wet (FILL)										
90.5			7	SS	15		91				
6.4	Silty **CLAY**, trace sand Very Stiff Grey Wet (FILL)						90				
89.7											
7.2	Silty **SAND**, some gravel, occasional clay seams Compact Brown to Grey Moist (FILL)		8	SS	16		89				
88.2											
8.7	Silty **CLAY**, occasional roolets Stiff Grey Wet		9	SS	11		88				
							87				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No 21-06 2 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 403.6 E 339 405.7 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.11.18 - 2021.11.18 LATITUDE 43.837791 LONGITUDE -79.069669 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page											
86.7	Silty **CLAY**											
10.2	Stiff Grey Wet											
	Silty **CLAY**, with sand, trace gravel Stiff to Hard Brown to Grey Wet (TILL)		10	SS	12		86					4 33 41 22
	No recovery		11	SS	52		85					
83.8	Augers grinding from 13.1m to 13.7m						84					
13.1	Silty **SAND**, some gravel, trace clay, occasional cobbles, occasional shale fragments Very Dense Grey Wet (TILL)		12	SS	71		83					
81.2			13	SS	57		82					12 58 26 4
15.7	**SAND** and **GRAVEL**, trace silt, trace clay Very Dense Grey Wet		14	SS	101/ 0.200		81					
79.5							80					
17.4	END OF BOREHOLE AT 17.4m. BOREHOLE CAVED-IN TO 16.5m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.											

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2021.11.18	8.3	88.6
2021.11.19	8.9	88.0
2021.12.10	9.1	87.8
2022.07.19	9.5	87.4
2022.08.17	9.9	87.0

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 21-07 1 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 392.9 E 339 434.3 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.12.10 - 2021.12.10 LATITUDE 43.837693 LONGITUDE -79.069314 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
87.9	GROUND SURFACE										
0.0 / 87.6	**TOPSOIL:** (300mm)		1	SS	5						
0.3 / 86.9	Silty **SAND**, trace clay, occasional organics Loose Brown Wet										
1.0	(FILL)		2	SS	5		87				0 16 66 18
	Silty **CLAY**, trace to some sand, trace gravel Firm Grey Moist to Wet		3	SS	7	▼	86				
			4	SS	3		85				0 1 63 36
	With sand, trace gravel		5	SS	0		84	2.0			1 35 41 23
82.6	Augers grinding at 5.2m						83	1.7			
5.3	Silty **SAND**, trace to some gravel, trace clay Very Loose to Loose Grey Wet		6	SS	3		82				
	(No recovery)		7	SS	5						
	Augers grinding from 6.2m to 6.4m		8	SS	43		81				1 77 18 4
80.4											
7.5	**SAND** and **SILT**, trace clay, trace gravel, occasional shale fragments Dense to Very Dense Grey Wet (TILL)		9	SS	42		80				
78.4			10	SS	100/ 0.175		79				4 55 35 6
9.5	END OF BOREHOLE AT 9.5m. Piezometer installation consists of 50mm diameter Schedule 40 PVC										

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
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RECORD OF BOREHOLE No 21-07 2 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 392.9 E 339 434.3 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.12.10 - 2021.12.10 LATITUDE 43.837693 LONGITUDE -79.069314 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	pipe with a 3.05m slotted screen.										
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2021.10.12 1.8 86.1										

$+^3$, $\times^3$: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 21-07B 1 OF 1 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 392.9 E 339 434.3 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.12.14 - 2021.12.14 LATITUDE 43.837693 LONGITUDE -79.069314 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
87.9	GROUND SURFACE										
0.0	Borehole augered to 3.0m depth below ground surface to collect an undisturbed Thin Walled Shelby Tube sample. Borehole 21-07B is associated with Borehole 21-07. Therefore, refer to the Record of Borehole Sheet 21-07 for soil description.						87 86 85				
84.2			1	TW							
3.7	END OF BOREHOLE AT 3.7m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG FROM 3.7m TO GROUND SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 21-08/21-08B 1 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 368.0 E 339 416.7 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.11.15 - 2021.11.15 LATITUDE 43.837469 LONGITUDE -79.069534 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
96.3	GROUND SURFACE										
0.0	**ASPHALT:** (200mm)										
0.2	**SAND** and **GRAVEL**, trace silt, trace clay, organic like odour Very Dense Grey Wet (FILL)		1	SS	100/ 0.275		96				
			2	SS	67						
94.9							95				
1.4	Silty **CLAY**, with sand, trace gravel Very Stiff to Stiff Brown to Grey Moist (FILL)		3	SS	15						
			4	SS	18		94				4 41 40 15
	Occasional inferred cobbles Augers grinding from 3.0m to 3.3m		5	SS	16		93				
							92				
	Augers grinding from 4.8m to 5.5m		6	SS	12						4 46 36 14
							91				
			7	SS	12		90				
	Occasional inferred cobbles		8	SS	100/ 0.225		89				During the first attempt to drill this borehole, it was not possible to advance the borehole beyond 8.4m depth. Therefore, the borehole was moved 3.0m north and advanced without sampling to 8.4m depth. Soil sampling resumed beyond this depth.
87.9							88				
8.4	Clayey **SILT**, with sand, trace gravel Stiff Brown to Grey Wet (TILL)		9	SS	13		87				

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No 21-08/21-08B 2 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 368.0 E 339 416.7 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.11.15 - 2021.11.15 LATITUDE 43.837469 LONGITUDE -79.069534 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Clayey **SILT**, with sand, trace gravel Hard Brown to Grey Wet (TILL)						86				
			10	SS	60				○ H		7 44 37 12
							85				
	Augers grinding at 11.5m Inferred cobbles and boulders at 11.6m										
			11	SS	78				○		
83.8	Augers grinding at 12.5m						84				
12.5	END OF BOREHOLE AT 12.5m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, THEN ASPHALT COLD PATCH TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

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

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 21-09 1 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 352.4 E 339 444.2 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.12.14 - 2021.12.14 LATITUDE 43.837328 LONGITUDE -79.069193 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
88.4	GROUND SURFACE										
0.0 / 87.7	**SILT**, trace sand, trace clay, trace gravel, occasional roots, occasional shale fragments Loose Brown Wet (FILL)		1	SS	6		88				
0.7 / 86.6	Silty **CLAY**, some sand, occasional rootlets Stiff Grey Moist		2	SS	8	▼	87				0 17 55 28
1.8 / 83.9	Silty **CLAY**, with sand, trace gravel Firm to Stiff Grey Wet (TILL)		3	SS	10		86				
			4	SS	4						1 28 39 32
			5	SS	12		85	1.7			
4.5 / 82.8	Clayey **SILT**, with sand, trace gravel Hard Grey Wet (TILL) Augers grinding from 5.2m to 5.5m		6	SS	49		84				4 41 42 13
5.6 / 81.2	Gravelly **SAND**, trace silt, trace clay Very Dense Grey Wet Clayey silt seam at 6.2m (150mm)		7	SS	61		83				
7.2 / 79.8	**SAND** and **GRAVEL**, trace to some silt and clay Very Dense Grey Wet		8	SS	100/ 0.225		82				48 32 20 (SI+CL)
8.6	Silty **SAND**, some clay, trace gravel Dense Grey Wet (TILL) Augers grinding from 9.1m to 9.4m		9	SS	47		81				1 64 22 13
							80				
							79				

Continued Next Page

+ ^{3}, × ^{3} : Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 21-09 2 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 352.4 E 339 444.2 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.12.14 - 2021.12.14 LATITUDE 43.837328 LONGITUDE -79.069193 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SAND**, trace clay, trace gravel Very Dense Grey Wet (TILL) No recovery		10	SS	50/ 0.025		78				
76.9	No recovery		11	SS	50/ 0.025		77				
11.5	END OF BOREHOLE AT 11.5m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2021.12.14 3.6 84.8 2022.09.17 1.5 86.9										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 21-11 1 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 410.3 E 339 394.1 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.11.19 - 2021.11.19 LATITUDE 43.837851 LONGITUDE -79.069812 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
97.3	GROUND SURFACE										
0.0 / 97.0	**ASPHALT:** (250mm)										
0.3	Gravelly **SAND**, trace to some silt and clay Very Dense to Dense Brown Moist (FILL)		1	SS	52		97		○		21 65 14 (SI+CL)
			2	SS	47		96		○		
95.3			3	SS	38				○		
2.0	Silty **SAND**, trace to some gravel, trace clay, occasional clay pockets Compact to Loose Brown Moist (FILL)		4	SS	21		95		○		
	Organic like odour		5	SS	8		94		○		
93.2											
4.1	Silty **CLAY**, trace sand Firm to Very Stiff Grey to Brown Wet (FILL)		6	SS	4		93		○ ○		
	Occasional inferred cobbles at 6.0m		7	SS	17		92				
	Augers grinding from 6.7m to 7.3m		8	SS	4		91		○		0 5 62 33
88.7							90				
8.6	Clayey **SILT**, with sand, trace gravel Very Stiff Grey Wet (TILL)		9	SS	17		89				
							88		○		

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No 21-11 2 OF 2 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 410.3 E 339 394.1 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2021.11.19 - 2021.11.19 LATITUDE 43.837851 LONGITUDE -79.069812 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Clayey **SILT**, with sand, trace gravel Very Stiff to Hard Grey Wet (TILL)						87				
			10	SS	15				○		
	Layer of wet sand at 10.9m						86				
			11	SS	26		85		○+		8 40 44 8
	Layer of inferred cobbles and augers grinding at 12.8m										
83.6			12	SS	54		84		○		
13.7	END OF BOREHOLE AT 13.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, THEN ASPHALT COLD PATCH TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

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

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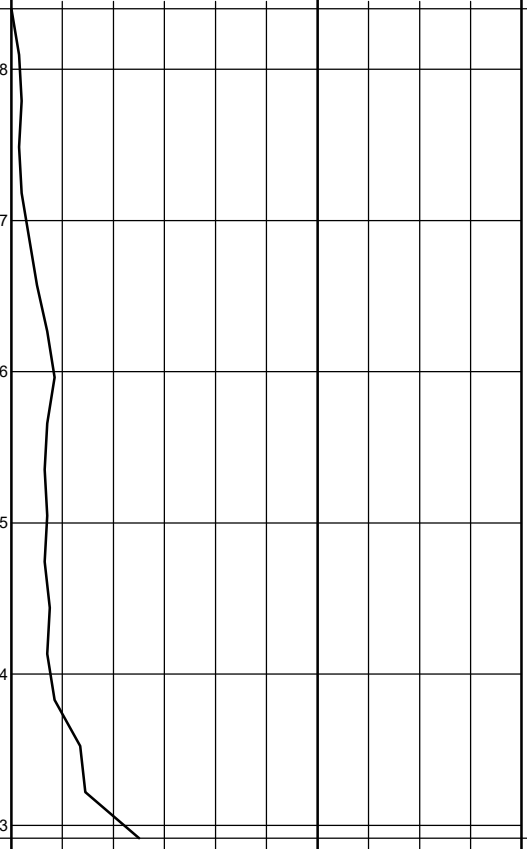
RECORD OF BOREHOLE No DCPT-01 1 OF 1 METRIC

W.P. 2120-18-00 LOCATION Brock Rd. Bridge Over GO/CNR; NAD83-10: N 4 855 375.1 E 339 439.1 ORIGINATED BY JA

DIST Central HWY 401 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2021.12.14 - 2021.12.14 LATITUDE 43.837532 LONGITUDE -79.069255 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
88.4	GROUND SURFACE										
0.0	Start DCPT from surface.										
82.9											
5.5	END OF DCPT AT 5.5m.										



$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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APPENDIX C

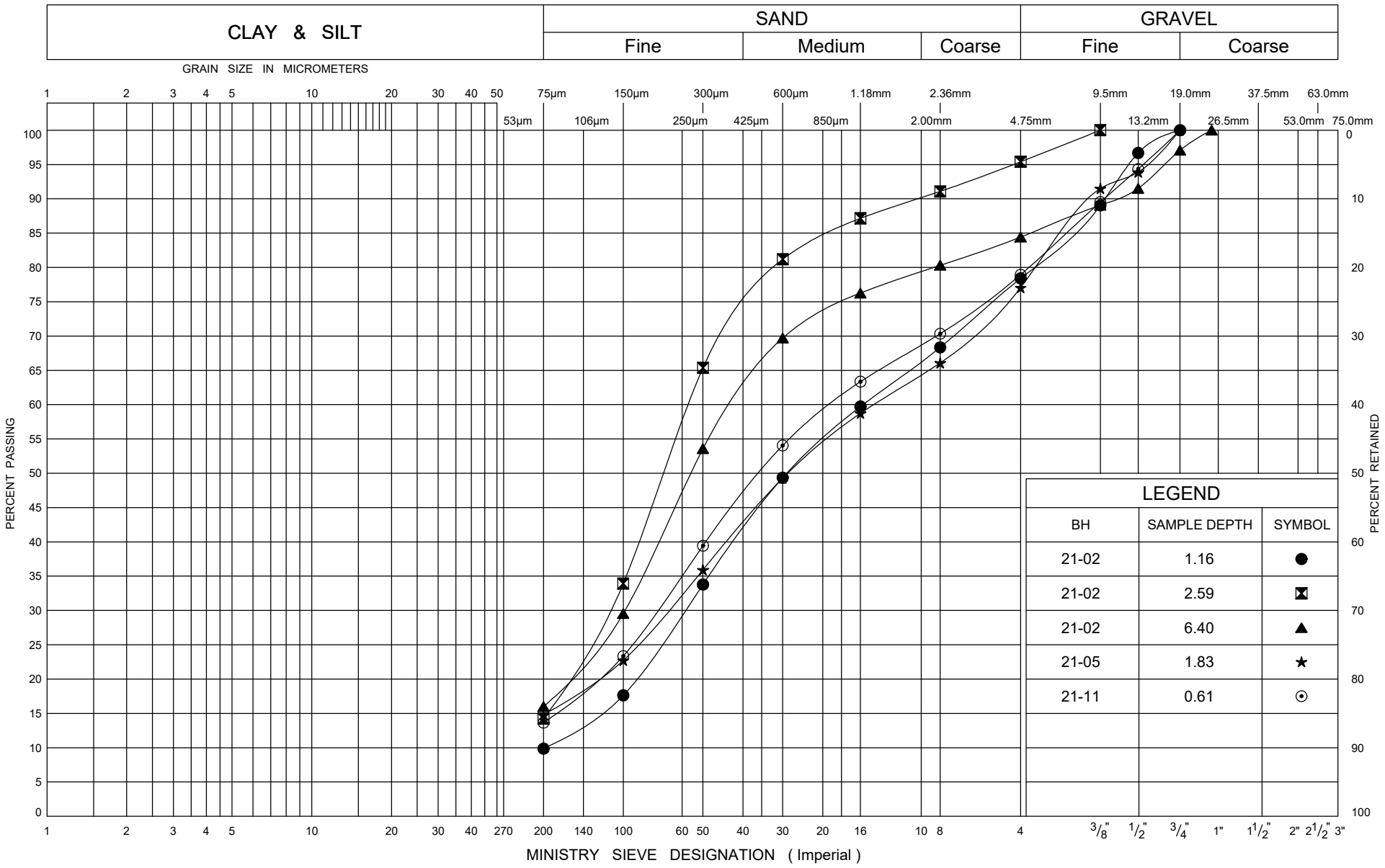
Geotechnical and Analytical Laboratory Test Results

Geotechnical Laboratory Test Results

Analytical Laboratory Test Results

Point Load Test Results

Unconfined Compression Test Results



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GRAIN SIZE DISTRIBUTION

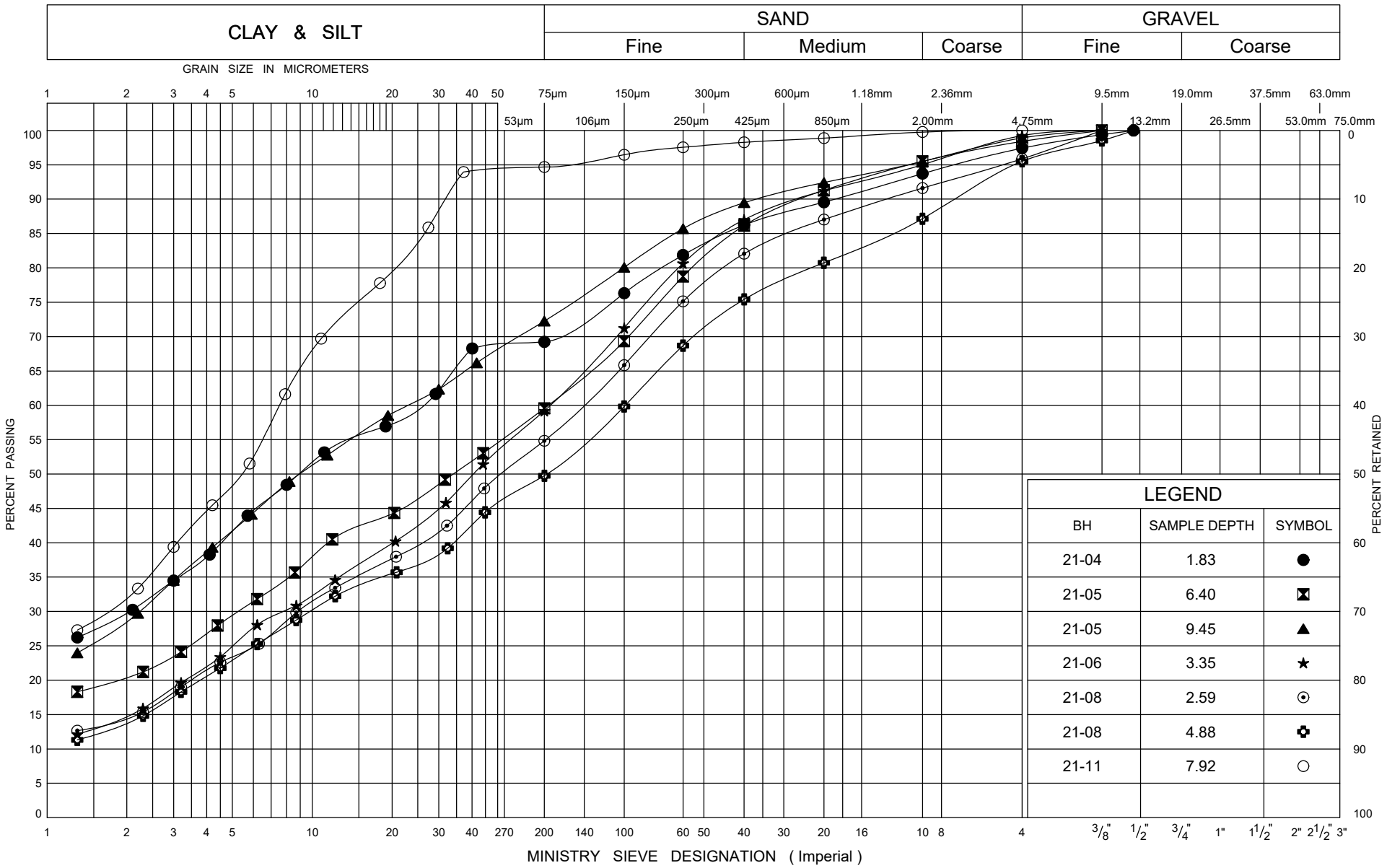
SAND and GRAVEL / Gravelly SAND / SAND / Silty SAND FILL

FIG No C1

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

ONTARIO MOT GRAIN SIZE 3 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24



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GRAIN SIZE DISTRIBUTION

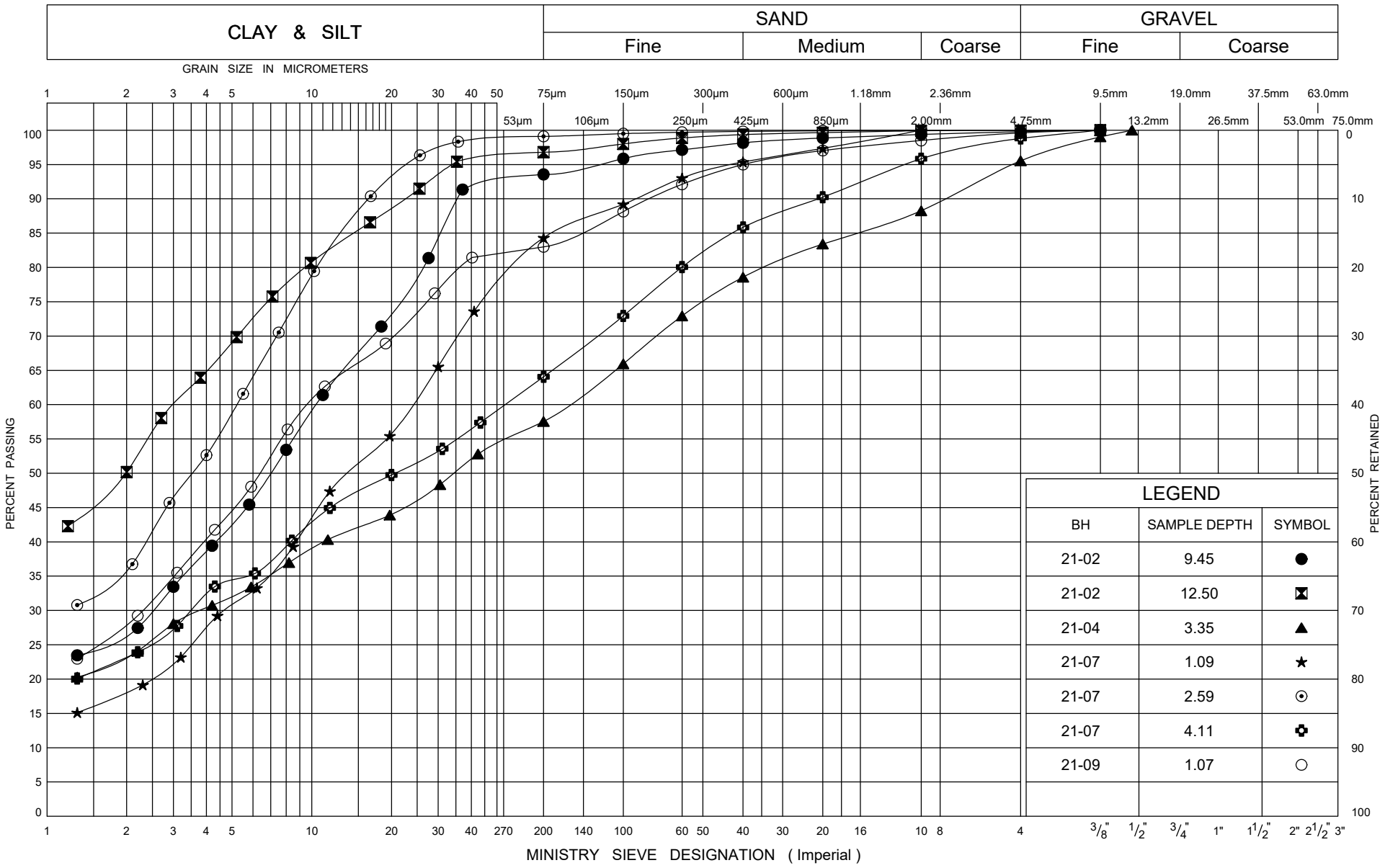
Silty CLAY / Clayey SILT FILL

FIG No C2

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

ONTARIO MOT GRAIN SIZE 3 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24



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GRAIN SIZE DISTRIBUTION

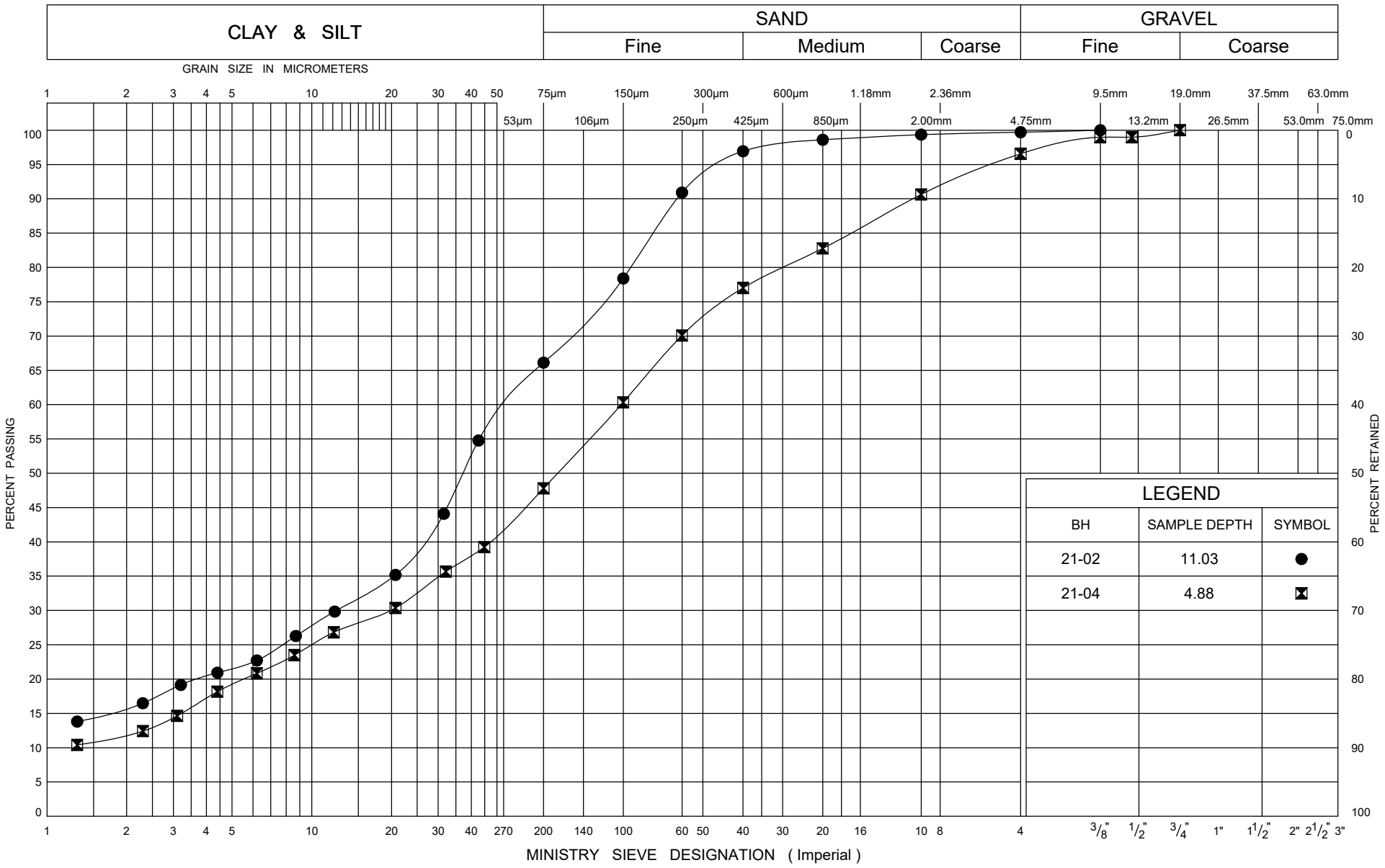
Silty CLAY

FIG No C3

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

ONTARIO MOT GRAIN SIZE 3 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24



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GRAIN SIZE DISTRIBUTION

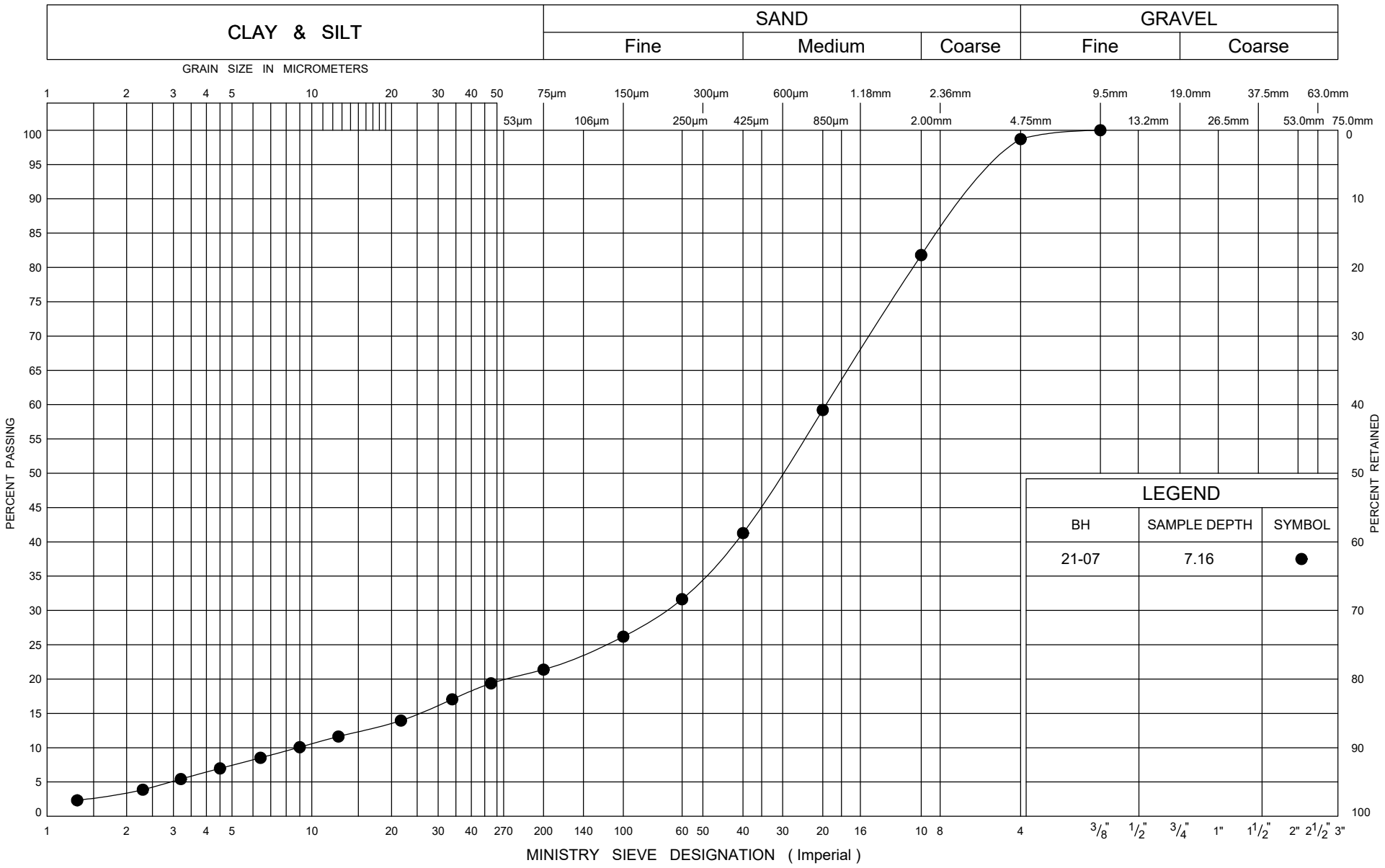
Clayey SILT

FIG No C4

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

ONTARIO MOT GRAIN SIZE 3 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

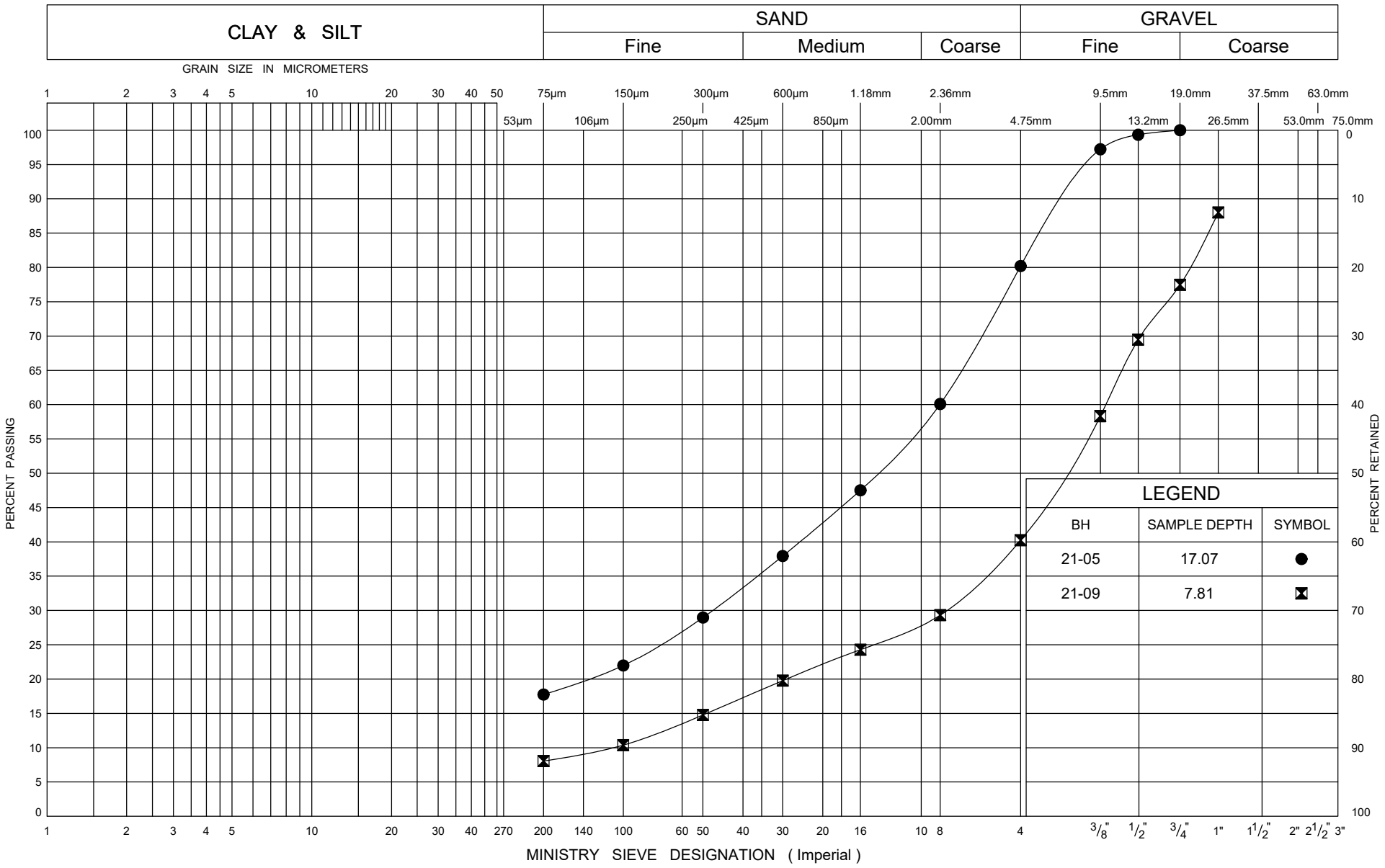
Silty SAND

FIG No C5

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

ONTARIO MOT GRAIN SIZE 3 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

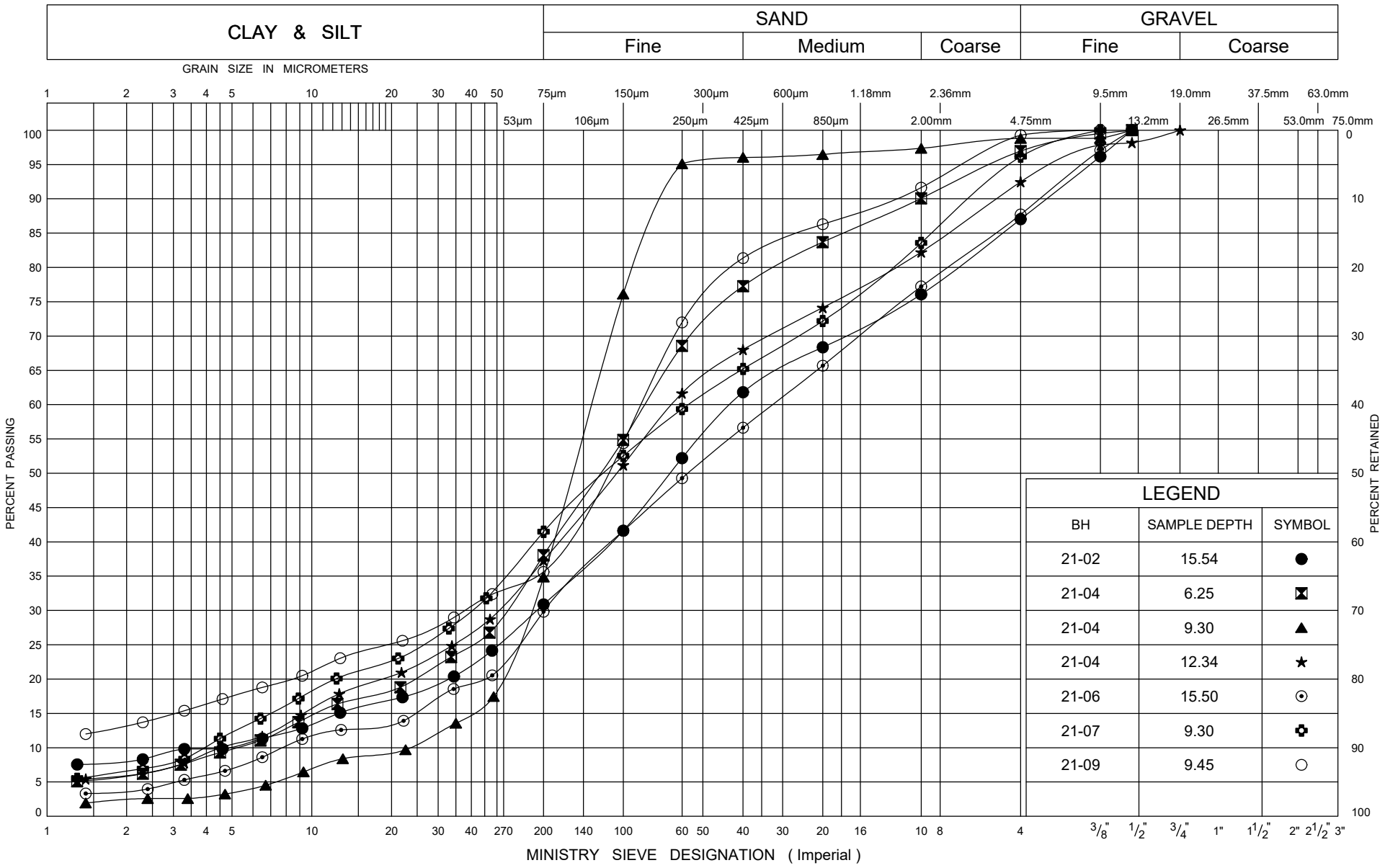
Gravelly SAND / SAND and GRAVEL

FIG No C6

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

ONTARIO MOT GRAIN SIZE 3 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24



ONTARIO MOT GRAIN SIZE 3 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24

Ministry of Transportation
Ontario

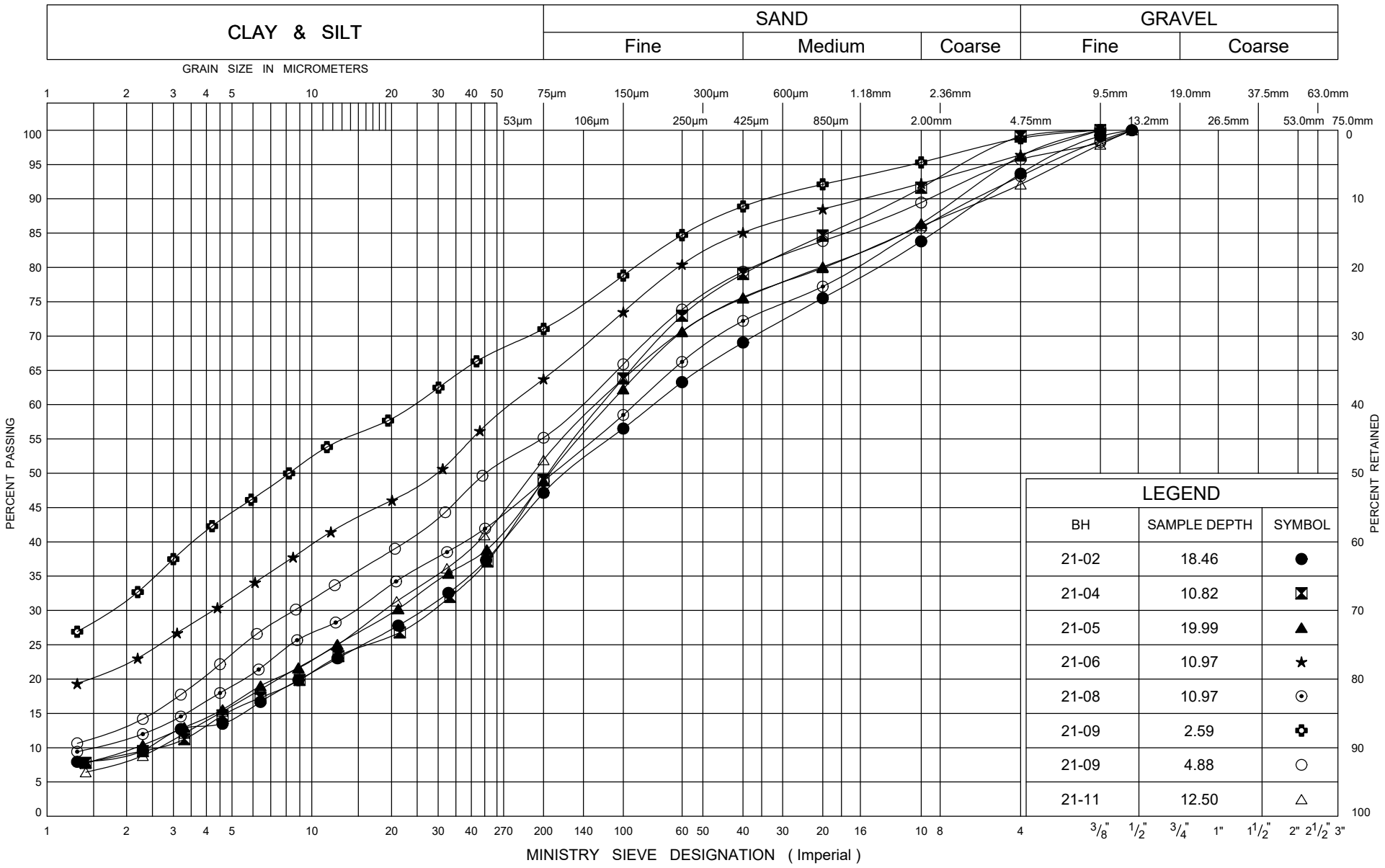
GRAIN SIZE DISTRIBUTION

Silty SAND TILL / SAND and SILT TILL

FIG No C7

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

Silty CLAY TILL / Clayey SILT TILL

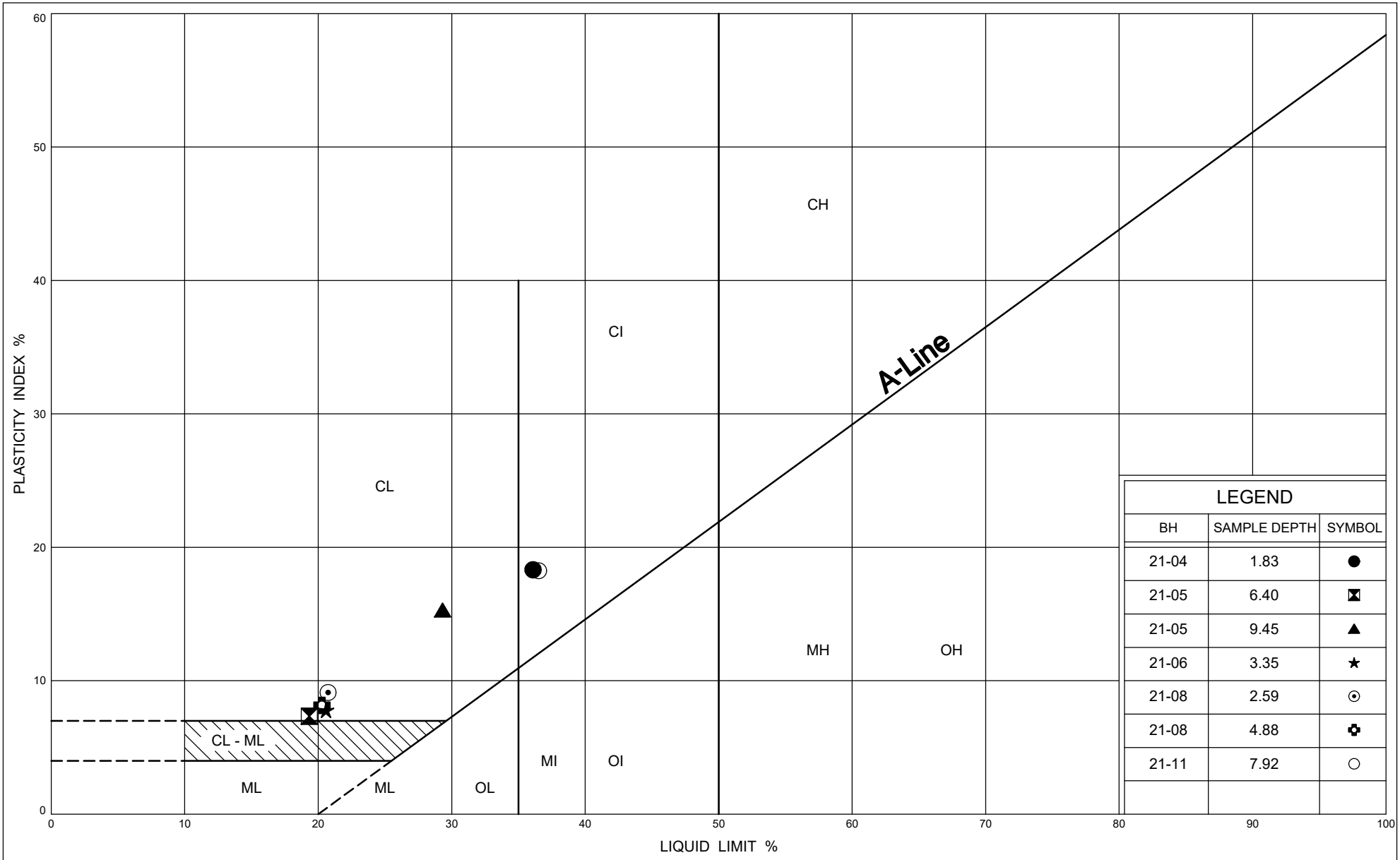
FIG No C8

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

ONTARIO MOT GRAIN SIZE 3 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24

Oct 75, FF - S - 21



Ministry of Transportation
Ontario

PLASTICITY CHART

Silty CLAY FILL

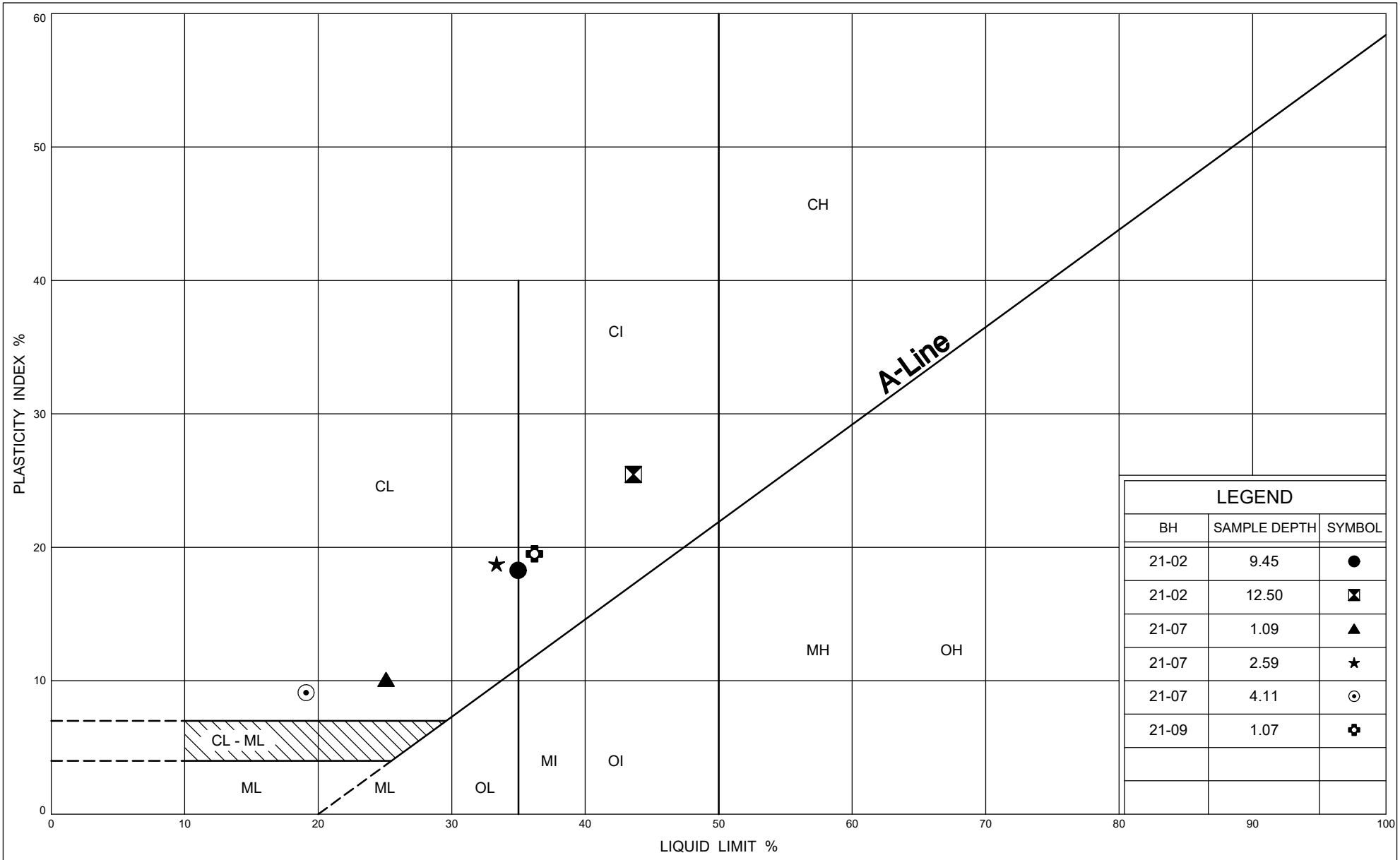
FIG No C9

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

ONTARIO MOT PLASTICITY CHART 2 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24

Ministry of Transportation
Ontario

PLASTICITY CHART

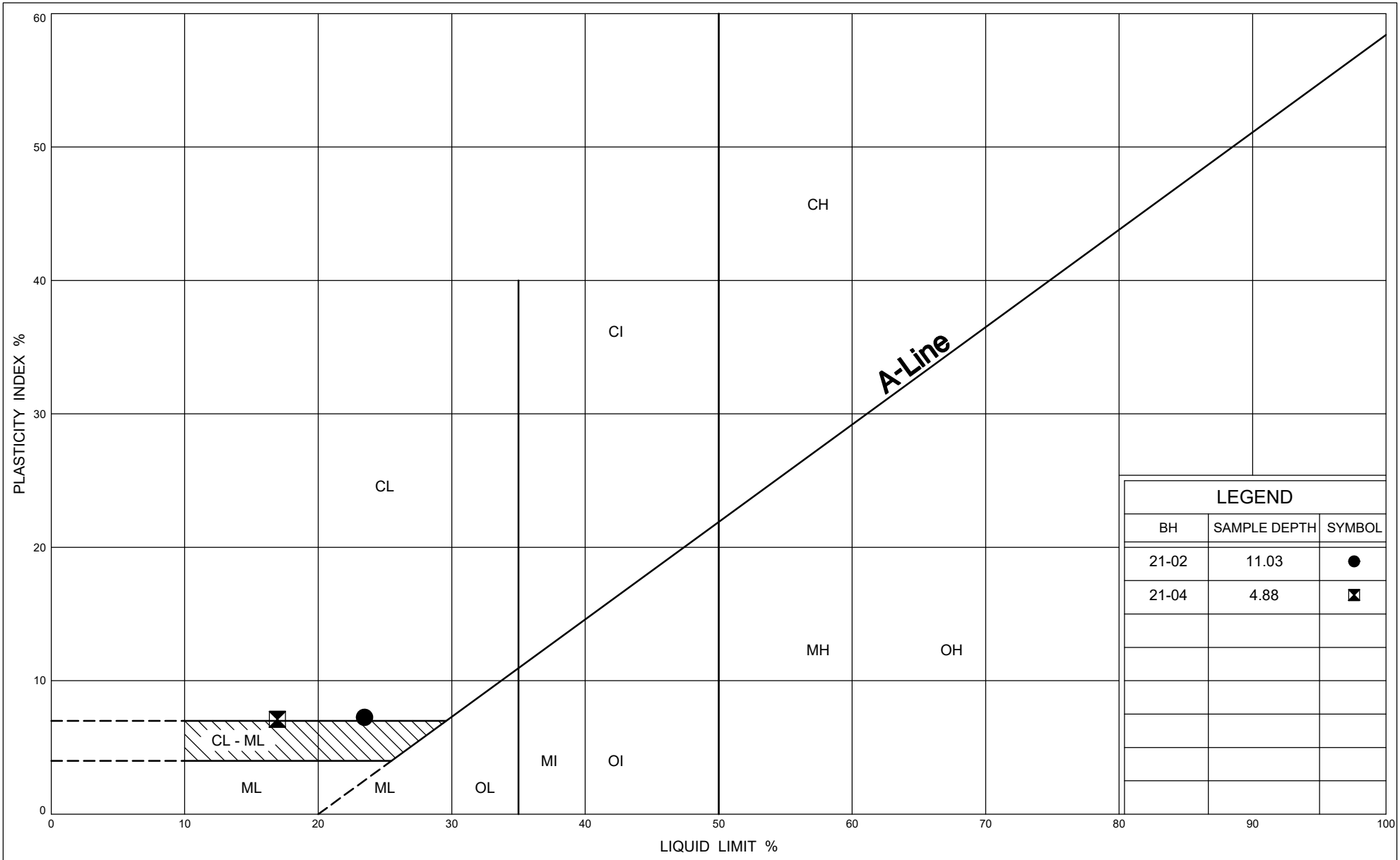
Silty CLAY

FIG No C10

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24

Ministry of Transportation
Ontario

PLASTICITY CHART

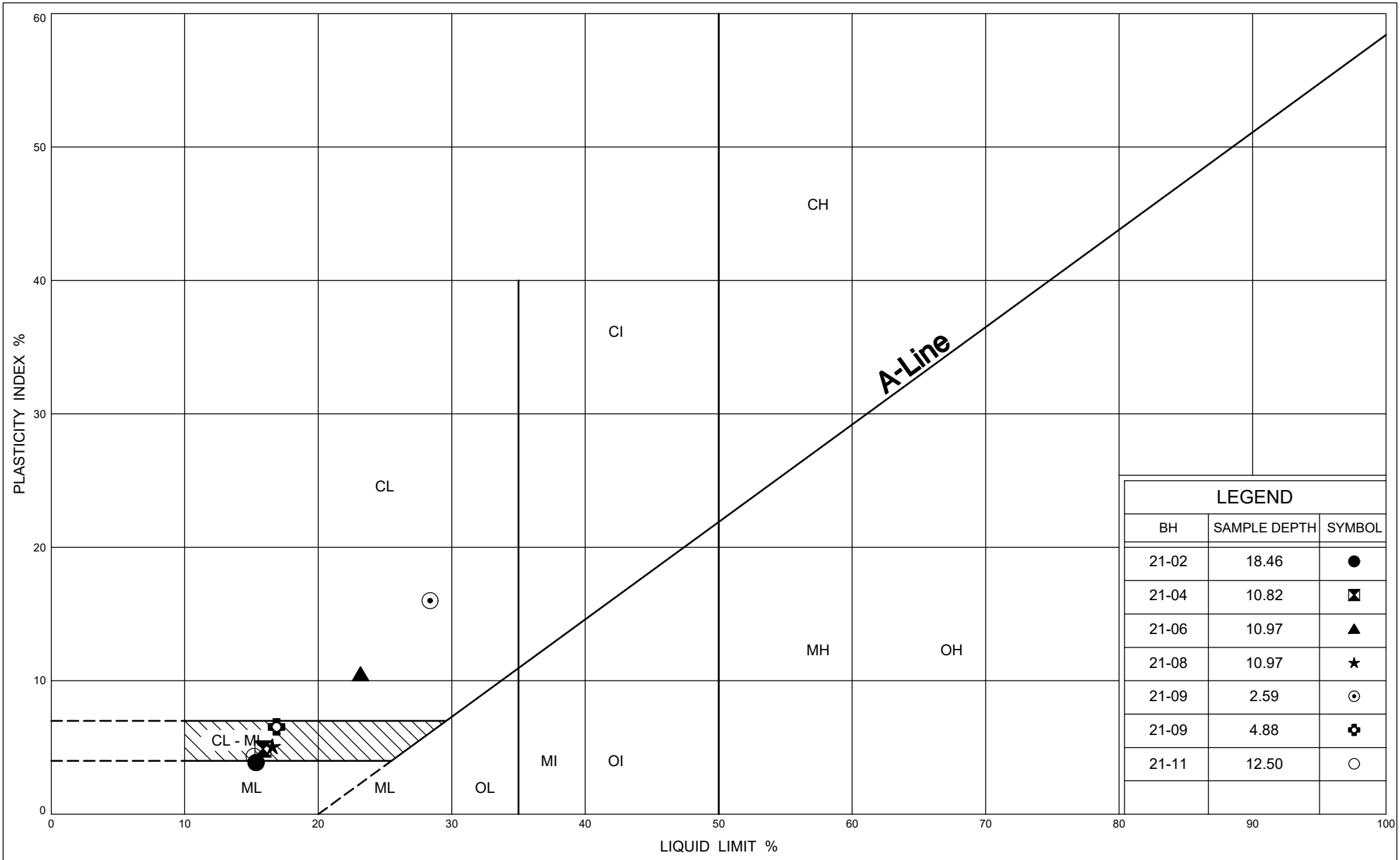
Clayey SILT

FIG No C11

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-30524.GPJ ONTARIO MOT.GDT 1/11/24

Ministry of Transportation
Ontario

PLASTICITY CHART

Silty CLAY TILL/ Clayey SILT TILL

FIG No C12

W.P. 2120-18-00

Brock Rd. Bridge Over GO/CNR

FINAL REPORT

CA40293-AUG22 R1

30524, HYwy 401 & Brock Rd. Pickering, ON

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada
Contact	Rocío Reyna
Telephone	905-829-8666 x 263
Facsimile	
Email	rreyna@thurber.ca
Project	30524, HYwy 401 & Brock Rd. Pickering, ON
Order Number	
Samples	Soil (3)

LABORATORY DETAILS

Project Specialist	Jill Campbell, B.Sc.,GISAS
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	2165
Facsimile	705-652-6365
Email	jill.campbell@sgs.com
SGS Reference	CA40293-AUG22
Received	08/30/2022
Approved	09/06/2022
Report Number	CA40293-AUG22 R1
Date Reported	09/06/2022

COMMENTS

Temperature of Sample upon Receipt: 9 degrees C
Cooling Agent Present: Yes
Custody Seal Present: Yes

Chain of Custody Number: N/A

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

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Client: Thurber Engineering Ltd.
Project: 30524, HYwy 401 & Brock Rd. Pickering, ON
Project Manager: Rocío Reyna
Samplers: SG/EA

MATRIX: SOIL

Sample Number	5	6	7
Sample Name	BH21-02 SS4	BH21-02 SS10	BH21-02 SS17
Sample Matrix	Soil	Soil	Soil
Sample Date	16/08/2022	17/08/2022	17/08/2022

Parameter	Units	RL		Result	Result	Result
Corrosivity Index						
Corrosivity Index	none	1		16	11	8
Soil Redox Potential	mV	no		313	294	303
Sulphide (Na2CO3)	%	0.04		0.06	< 0.04	0.35
pH	pH Units	0.05		9.43	8.35	8.72
Resistivity (calculated)	ohms.cm	-9999		653	1490	3050
General Chemistry						
Conductivity	uS/cm	2		1530	672	328
Metals and Inorganics						
Moisture Content	%	0.1		3.3	15.5	8.9
Sulphate	µg/g	0.4		23	67	320
Other (ORP)						
Chloride	µg/g	0.4		580	430	23

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0010-SEP22	µg/g	0.4	<0.4	4	35	99	80	120	107	75	125
Sulphate	DIO0010-SEP22	µg/g	0.4	<0.4	15	35	98	80	120	112	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0004-SEP22	%	0.04	< 0.04	7	20	119	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0601-AUG22	uS/cm	2	< 2	0	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0601-AUG22	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.
Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.
"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.
Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No:

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: ED
Received Date (mm/dd/yy): 8/30/22
Received Time: 1100
Received By (signature):
Custody Seal Present: ☑
Custody Seal Intact: ☑
Cooling Agent Present: ☑
Temperature Upon Receipt (°C): 2x3
LAB LIMS #: CA40293-Aug 22

REPORT INFORMATION

Company: Thurber Eng.
Contact: Rocio Palomeque Reyna
Address: 103-2010 Winston Park Drive, Oakville ON L6H 5R7
Phone: 905-829-8666
Email: rreyna@thurber.ca
Email:

INVOICE INFORMATION

☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

PROJECT INFORMATION

Quotation #:
P.O. #:
Project #: 30524
Site Location/ID: Hwy 401 & Brock Rd., Pickering, ON

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date:
Rush Confirmation ID:

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ____ ☐ R/P/I ☐ I/C/C ☐ A/O
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH ☑ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	PHC F1-F4 ☐ VOC ☐ BTEX ☐ BTEX/F1 ☐ F2-F4 ☐	VOC ☐ BTEX ☐ THM ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use: ☐	ORGANIC CONTENT ☐	CORROSIVITY			COMMENTS:
1	BH 21-02 , SS4	8/16/22		1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐
2	BH21-02, SS10	8/17/22		1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐
3	BH21-02, SS17	8/17/22		1	soi		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐
4							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
8							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Observations/Comments/Special Instructions

Sampled By (NAME): SG/EA	**Signature:**	Date: 08/29/22 (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME):	**Signature:**	Date: (mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.1
Date of Issue: 04 April, 2018

FINAL REPORT

CA40032-AUG22 R1

30524, Hwy 401 & Brock Rd., Pickering ON

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

CA40032-AUG22 R1

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Rocío Reyna	Telephone	705-652-2143
Telephone	905-829-8666 x 263	Facsimile	705-652-6365
Facsimile		Email	brad.moore@sgs.com
Email	rreyna@thurber.ca	SGS Reference	CA40032-AUG22
Project	30524, Hwy 401 & Brock Rd., Pickering ON	Received	08/03/2022
Order Number		Approved	08/10/2022
Samples	Soil (2)	Report Number	CA40032-AUG22 R1
		Date Reported	08/10/2022

COMMENTS

Temperature of Sample upon Receipt: 9 degrees C
Cooling Agent Present: Yes
Custody Seal Present: Yes

Chain of Custody Number: n/a

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Brad Moore Hon. B.Sc

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FINAL REPORT

CA40032-AUG22 R1

Client: Thurber Engineering Ltd.
Project: 30524, Hwy 401 & Brock Rd., Pickering ON
Project Manager: Rocío Reyna
Samplers: SG/EA

MATRIX: SOIL

Sample Number	5	6
Sample Name	BH 21-04, SS2B	BH 21-04, SS4B
Sample Matrix	Soil	Soil
Sample Date	19/07/2022	19/07/2022

Parameter	Units	RL		Result	Result
Corrosivity Index					
Corrosivity Index	none	1		9	6
Soil Redox Potential	mV	no		499	376
Sulphide (Na2CO3)	%	0.04		< 0.04	< 0.04
pH	pH Units	0.05		9.01	8.56
Resistivity (calculated)	ohms.cm	-9999		2020	2120
General Chemistry					
Conductivity	uS/cm	2		496	471
Metals and Inorganics					
Moisture Content	%	0.1		10.2	21.2
Sulphate	µg/g	0.4		37	74
Other (ORP)					
Chloride	µg/g	0.4		320	360

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0099-AUG22	µg/g	0.4	<0.4	2	35	102	80	120	92	75	125
Sulphate	DIO0099-AUG22	µg/g	0.4	<0.4	7	35	93	80	120	90	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0020-AUG22	%	0.04	< 0.04	ND	20	120	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0103-AUG22	uS/cm	2	< 2	12	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0103-AUG22	pH Units	0.05	NA	1		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

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LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.
Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.
"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.
Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

This report supersedes all previous versions.

-- End of Analytical Report --

SGS

Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Request for Laboratory Services and CHAIN OF CUSTODY

No:

Page 1 of 1

Laboratory Information Section - Lab use only [illegible]

Received By: [illegible]
Received Date (mm/dd/yy): AUG 0 3 2022
Received Time: 1337

Received By (signature): [illegible]
Custody Seal Present: ☐
Custody Seal Intact: ☐

Cooling Agent Present: ☑
Temperature Upon Receipt (°C): 9°C
LAB LIMS #: CA40032-AUG22

REPORT INFORMATION	INVOICE INFORMATION	PROJECT INFORMATION
Company: Thurber Eng.	☑ (same as Report Information)	Quotation #:
Contact: Rocio Palomeque Reyna	Company:	P.O. #:
Address: 103-2010 Winston Park Drive, Oakville ON L6H 5R7	Contact:	Project #: 30524
Phone: 905-829-8666	Address:	Site Location/ID: Hwy 401 & Brock Rd., Pickering, ON
Email: rreyna@thurber.ca	Phone:	
Email:	Email:	

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: Rush Confirmation ID:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ___ ; ☐ R/P/I ☐ I/C/C ☐ A/O ; Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ CCME ☐ MISA ☐ MMER ☐ Other:

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

#	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH ☑ ABN ☐ SVOC(all) ☐	PCB Total ☐ Aroclor ☐	PHC F1-F4 ☐ VOC ☐ BTEX ☐ BTEX/F1 ☐ F2-F4 ☐	VOC ☐ BTEX ☐ THM ☐	Pesticides OC ☐ OP ☐	TCLP M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit. ☐	Water Pkg Gen. ☐ Ext. ☐	Sewer Use:	ORGANIC CONTENT	CORROSIVITY				COMMENTS:
1	BH 21-04 , SS2B	7/19/22		1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	
2	BH21-04, SS4B	July 19, 2022		1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	
3							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
4							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
5							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
6							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
7							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
8							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Observations/Comments/Special Instructions

Sampled By (NAME): SG/EA	Signature:	Date: 08/02/22 (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME):	Signature:	Date: (mm/dd/yy)	Yellow & White Copy - SGS

FINAL REPORT

CA40355-NOV21 R1

30524, HWY 401 - Brock Rd, CNR OH Bridge

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada
Contact	Joshua Alexander
Telephone	613-606-7303
Facsimile	
Email	jalexander@thurber.ca
Project	30524, HWY 401 - Brock Rd, CNR OH Bridge
Order Number	
Samples	Soil (2)

LABORATORY DETAILS

Project Specialist	Maarit Wolfe, Hon.B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2000
Facsimile	705-652-6365
Email	Maarit.Wolfe@sgs.com
SGS Reference	CA40355-NOV21
Received	11/24/2021
Approved	11/30/2021
Report Number	CA40355-NOV21 R1
Date Reported	12/01/2021

COMMENTS

Temperature of Sample upon Receipt: 4 degrees C
Cooling Agent Present: Yes
Custody Seal Present: Yes

Chain of Custody Number: 023480

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Maarit Wolfe, Hon.B.Sc

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Legend..... 7
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Client: Thurber Engineering Ltd.
Project: 30524, HWY 401 - Brock Rd, CNR OH Bridge
Project Manager: Joshua Alexander
Samplers: Josh Alexander

PACKAGE: **- Corrosivity Index** (SOIL)

			Sample Number	5	6	
			Sample Name	21-05, SS5	21-05, SS8	
			Sample Matrix	Soil	Soil	
			Sample Date	16/11/2021	16/11/2021	
Parameter	**Units**	**RL**		**Result**	**Result**	
Corrosivity Index						
Corrosivity Index	none	1		11	11	
Soil Redox Potential	mV	-		218	208	
Sulphide (Na2CO3)	%	0.04		< 0.04	< 0.04	
pH	pH Units	0.05		8.41	7.38	
Resistivity (calculated)	ohms.cm	-9999		501	959	

PACKAGE: **- General Chemistry** (SOIL)

			Sample Number	5	6	
			Sample Name	21-05, SS5	21-05, SS8	
			Sample Matrix	Soil	Soil	
			Sample Date	16/11/2021	16/11/2021	
Parameter	**Units**	**RL**		**Result**	**Result**	
General Chemistry						
Conductivity	uS/cm	2		2000	1040	

PACKAGE: **- Metals and Inorganics** (SOIL)

			Sample Number	5	6	
			Sample Name	21-05, SS5	21-05, SS8	
			Sample Matrix	Soil	Soil	
			Sample Date	16/11/2021	16/11/2021	
Parameter	**Units**	**RL**		**Result**	**Result**	
Metals and Inorganics						
Moisture Content	%	0.1		18.1	18.6	
Sulphate	µg/g	0.4		51	35	

FINAL REPORT

CA40355-NOV21 R1

Client: Thurber Engineering Ltd.
Project: 30524, HWY 401 - Brock Rd, CNR OH Bridge
Project Manager: Joshua Alexander
Samplers: Josh Alexander

PACKAGE: **- Other (ORP)** (SOIL)

Sample Number	5	6
Sample Name	21-05, SS5	21-05, SS8
Sample Matrix	Soil	Soil
Sample Date	16/11/2021	16/11/2021

Parameter	Units	RL		Result	Result
Other (ORP)					
Chloride	µg/g	0.4		820	520

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0648-NOV21	µg/g	0.4	<0.4	5	35	102	80	120	NV	75	125
Sulphate	DIO0648-NOV21	µg/g	0.4	<0.4	1	35	97	80	120	96	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0083-NOV21	%	0.04	< 0.04	5	20	119	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0556-NOV21	uS/cm	2	< 2	0	20	100	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0556-NOV21	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.
RL Reporting Limit.
↑ Reporting limit raised.
↓ Reporting limit lowered.
NA The sample was not analysed for this analyte
ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 023480 Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Dustin
Received Date: 11/24 Nov/21 (mm/dd/yy)
Received Time: 12:10 (hr : min)
Received By (signature):
Custody Seal Present: Yes ☒ No ☐
Custody Seal Intact: Yes ☒ No ☐
Cooling Agent Present: Yes ☐ No ☐ Type: ice pack
Temperature Upon Receipt (°C) 4°c 4°c
LAB LIMS #: CA40355-NOV21

REPORT INFORMATION	INVOICE INFORMATION
Company: Thurber	☐ (same as Report Information)
Contact: Joshua Alexander	Company:
Address: 2010-310 Winston Park Dr. Oakville	Contact:
Phone: 613-606-7303	Address:
Fax:	Phone:
Email: jalexander@thurber.ca	Email: accountingON@thurber.ca

Quotation #:
P.O. #: HWY 401 - Brock Rd.
Project #: 30524
Site Location/ID: CNR Olt Bridge

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:

*NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

☐ O.Reg 153/04 ☐ O.Reg 406/19
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium/Fine
☐ Table 3 ☐ Agri/Other
☐ Table _____ Appx. _____
Soil Volume ☐ <350m3 ☐ >350m3

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA
☐ ODWS Not Reportable *See note

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1	21-05, SS5	16/11/21	—	1	Soil
2	21-05, SS8	16/11/21	—	1	Soil
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

M & I				SVOC		PCB	PHC		VOC		Pest	Other (please specify)						SPLP	TCLP	COMMENTS:
Field Filtered (Y/N)	Metals & Inorganics Incl CrVI, CN,Hg pH,(B(HWS),EC,SAR–soil) (Cl, Na-water)	Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI	ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni,	PAHs only	SVOCs all Incl PAHs, ABNs, CPs	PCBs Total ☐ Aroclor ☐	F1-F4 + BTEX	F1-F4 only no BTEX	VOCs all incl BTEX	BTEX only	Pesticides Organochlorine or specify other	X Soil Corrosivity			Sewer Use: Specify pkg:	Water Characterization Pkg General ☐ Extended ☐		Specify tests ☐ Metals ☐ VOC ☐ 1,4-Dioxane ☐ OCP ☐ ABN	Specify tests ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.	
												X								

Observations/Comments/Special Instructions

Sampled By (NAME):	Signature:	Date: __/__/__ (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME): Josh Alexander	Signature:	Date: 11/24/21 (mm/dd/yy)	Yellow & White Copy - SGS

Revision #: 1.5
Date of Issue: 11 June 2021

THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No:	30524	**Date Drilled:**	20-Jul-22
Client:	McIntosh Perry	**Date Tested:**	27-Jul-22
Project Name:	HWY 401 - Brock Road CNR OH Bridge	**Tester:**	GF
Core Size:	**BH No :** 21-04	**Reviewed by:**	

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	2	15.1	A	2.2	63.2	62.8	0.5	11.4	Shale	Weak
2	2	15.6	A	2.6	63.1	58.9	0.6	14.2	Shale	Weak
3	2	15.8	A	3.9	63.1	61.6	0.9	20.8	Shale	Weak
4	3	17.1	A	5.4	63.4	57.2	1.3	30.6	Shale	Medium Strong
5	3	17.2	A	4.6	63.2	71.7	0.9	21.9	Shale	Weak
6	4	17.6	A	1.3	63.1	67.8	0.3	6.3	Shale	Weak
7	4	18.1	A	5.1	63.5	65.5	1.1	25.8	Shale	Medium Strong
8	4	18.8	A	4.3	63.2	58.3	1.0	23.9	Shale	Weak
9	5	19.1	A	4.5	63.2	61.8	1.0	23.8	Shale	Weak
10	5	19.8	A	4.7	63.2	61.9	1.0	25.0	Shale	Weak
11	6	20.7	A	7.7	63.3	61.6	1.7	41.3	Shale	Medium Strong
12	6	21.3	A	6.8	63.2	63.7	1.5	35.3	Shale	Medium Strong
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

* Correlation factor to obtain UCS values is 24.

THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No:	30524	**Date Drilled:**	17-Nov-21
Project Name:	HWY 401 - Brock Road CNR OH Bridge	**Date Tested:**	26-Nov-21
		Tester:	BS
Core Size:	HQ **BH No :** 21-05	**Client:**	McIntosh Perry

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	Run 2	22.7	A	5.1	63.4	62.8	1.1	26.8	Shale	Medium Strong
2	Run 3	23.2	A	1.7	63.3	65.2	0.4	8.7	Shale	Weak
3	Run 3	23.7	A	2.7	63.2	62.4	0.6	14.3	Shale	Weak
4	Run 3	24.3	A	5.1	63.2	63.9	1.1	26.5	Shale	Medium Strong
5	Run 4	24.8	A	1.7	63.0	63.5	0.4	8.9	Shale	Weak
6	Run 4	25.2	A	4.4	63.0	63.4	1.0	23.1	Shale	Weak
7	Run 4	25.7	A	3.1	63.0	64.7	0.7	16.0	Shale	Weak
8										
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

* Correlation factor to obtain UCS values is 24.

THURBER ENGINEERING LTD.

UNCONFINED COMPRESSION TEST REPORT

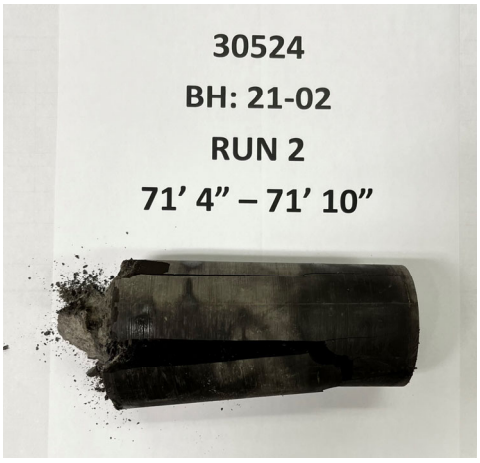
ASTM D7012-14

CLIENT:	McIntosh Perry	PROJECT NUMBER:	30524
PROJECT NAME:	Hwy 401 - Brock Road CNR OH Bridge	REPORT DATE:	20-Nov-23
BOREHOLE No.:	BH 21-02	TEST DATE:	19-Aug-22
SAMPLE No.:	Run 2		
SAMPLE DEPTH:	71' 4" - 71' 10"		
DESCRIPTION:	Pickering Shale		

Avg. Height (cm):	15.0	Weight (g):	1123.1
Avg. Diameter (cm):	6.2	Wet Density (kg/m^3):	2,480
H. to Dia. Ratio**:	2.4:1	Dry Density (kg/m^3):	2,415
Cross Sectional Area (cm^2):	30.19	Moisture Content* (%):	2.7
Sample Volume (cm^3):	452.86		

ORIGINAL SPECIMEN

FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	0.250	MPa/s
MAXIMUM COMPRESSIVE LOAD:	40.9	kN
UNCONFINED COMPRESSIVE STRENGTH:	13.5	MPa

Note: * The moisture content was obtained before the test.
** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: GF
REVIEWED BY: WM

THURBER ENGINEERING LTD.

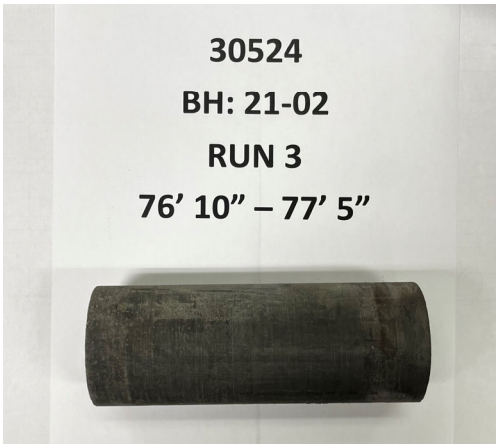
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	McIntosh Perry	PROJECT NUMBER:	30524
PROJECT NAME:	Hwy 401 - Brock Road CNR OH Bridge	REPORT DATE:	20-Nov-23
BOREHOLE No.:	BH 21-02	TEST DATE:	19-Aug-22
SAMPLE No.:	Run 3		
SAMPLE DEPTH:	76' 10" - 77' 5"		
DESCRIPTION:	Pickering Shale		

Avg. Height (cm):	15.5	Weight (g):	1189.5
Avg. Diameter (cm):	6.2	Wet Density (kg/m^3):	2,542
H. to Dia. Ratio**:	2.5:1	Dry Density (kg/m^3):	2,461
Cross Sectional Area (cm^2):	30.19	Moisture Content* (%):	3.3
Sample Volume (cm^3):	467.96		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN

AVG. RATE OF STRAIN TO FAILURE:	0.250	MPa/s
MAXIMUM COMPRESSIVE LOAD:	45.2	kN
UNCONFINED COMPRESSIVE STRENGTH:	15.0	MPa

Note: * The moisture content was obtained before the test.
** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: GF
REVIEWED BY: WM

THURBER ENGINEERING LTD.

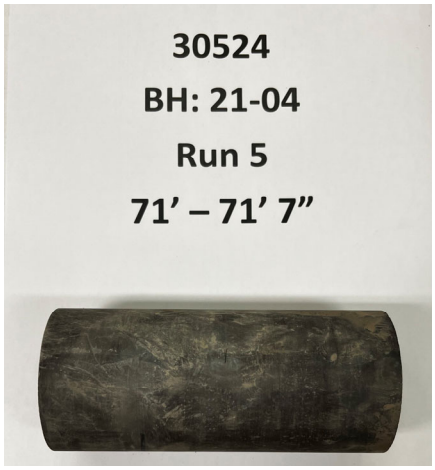
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	McIntosh Perry	PROJECT NUMBER:	30524
PROJECT NAME:	Hwy 401 - Brock Road CNR OH Bridge	REPORT DATE:	20-Nov-23
BOREHOLE No.:	BH 21-04	TEST DATE:	19-Aug-22
SAMPLE No.:	Run 5		
SAMPLE DEPTH:	71' - 71' 7"		
DESCRIPTION:	Pickering Shale		

Avg. Height (cm):	13.9	Weight (g):	1160.6
Avg. Diameter (cm):	6.3	Wet Density (kg/m^3):	2,679
H. to Dia. Ratio**:	2.2:1	Dry Density (kg/m^3):	2,642
Cross Sectional Area (cm^2):	31.17	Moisture Content* (%):	1.4
Sample Volume (cm^3):	433.30		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN

AVG. RATE OF STRAIN TO FAILURE:	0.250	MPa/s
MAXIMUM COMPRESSIVE LOAD:	154.8	kN
UNCONFINED COMPRESSIVE STRENGTH:	49.7	MPa

Note: * The moisture content was obtained before the test.
** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: GF
REVIEWED BY: WM

THURBER ENGINEERING LTD.

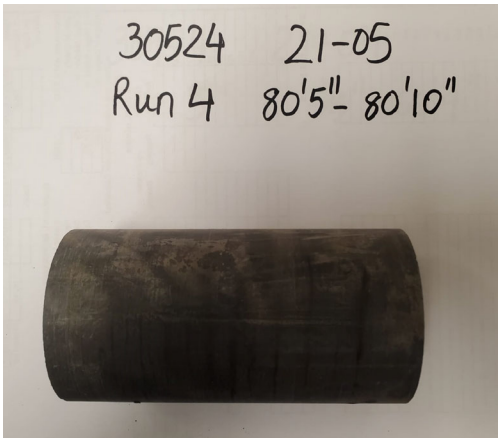
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

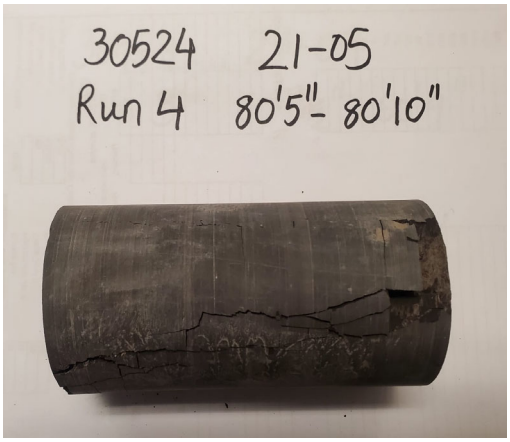
CLIENT:	McIntosh Perry	FILE NUMBER:	30524
PROJECT NAME:	HWY-401 - Brock Road CNR OH Bridge	REPORT DATE:	15-Feb-22
BOREHOLE No.:	21-05	TEST DATE:	26-Nov-21
SAMPLE No.:	Run 4		
SAMPLE DEPTH:	24.51-24.64 m		
DESCRIPTION:	Shale		

Avg. Height (cm):	12.7	Weight (g):	1047.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m^3):	2,645
H. to Dia. Ratio*:	2:1	Dry Density (kg/m^3):	2,550
Cross Sectional Area (cm^2):	31.17	Moisture Content (%):	N/A
Sample Volume (cm^3):	395.89		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2%	/ min
MAXIMUM COMPRESSIVE LOAD:	127.9	kN
UNCONFINED COMPRESSIVE STRENGTH:	41.0	MPa

Note:

* Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

THURBER

APPENDIX D

Rock core photographs

PHOTOGRAPHS OF ROCK CORES – BOREHOLE 21-02

RUNS 1 to 3

Run 1

Run 2

Run 3

TOP **BOTTOM**

Date Drilled: August 17, 2022

Run #	Depth (ft)	Depth (m)
1	(70'4" – 71'1")	(21.44 – 21.67)
2	(71'1" – 76'1")	(21.67 – 21.19)
3	(76'1" – 81'2")	(21.19 – 24.74)

PHOTOGRAPHS OF ROCK CORES – BOREHOLE 21-04

RUNS 1 to 4

Run 1

Run 2

Run 3

Run 4

TOP **BOTTOM**

Date Drilled: July 20, 2022

Run #	Depth (ft)	Depth (m)
1	(43'8" – 47')	(13.31 – 14.33)
2	(47' – 52'1")	(14.33 – 15.88)
3	(52'1" – 57'1")	(15.88 – 17.40)
4	(57'1" – 62'1")	(17.40 – 18.92)

PHOTOGRAPHS OF ROCK CORES – BOREHOLE 21-04

RUNS 5 to 6

Run 5

Run 6

TOP **BOTTOM**

Date Drilled: July 20, 2022

Run #	Depth (ft)	Depth (m)
5	(62'1" – 67'1")	(18.92 – 20.45)
6	(67'1" – 72'1")	(20.45 – 21.97)

PHOTOGRAPHS OF ROCK CORES – BOREHOLE 21-05

RUNS 1 to 4

Run 1

Run 2

Run 3

Run 4

TOP **BOTTOM**

Date Drilled: August 17, 2022

Run #	Depth (ft)	Depth (m)
1	(69'4" – 71'9")	(21.13 – 21.87)
2	(71'9" – 75')	(21.87 – 22.86)
3	(76' – 79'11")	(22.86 – 24.36)
4	(79' – 85'1")	(24.36 – 25.93)

APPENDIX E

Record of Boreholes Sheets – Previous Investigation

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS 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 :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.
VERY SOFT	0 - 2	0 - 250
SOFT	2 - 4	250 - 500
FIRM	4 - 8	500 - 1000
STIFF	8 - 15	1000 - 2000
VERY STIFF	15 - 30	2000 - 4000
HARD	> 30	> 4000

DENSENESS	'N' BLOWS / FT.
VERY LOOSE	0 - 4
LOOSE	4 - 10
COMPACT	10 - 30
DENSE	30 - 50
VERY DENSE	> 50

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

Q_u	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q_{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q_d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY. DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

FORM OB-MT-126 (REV 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-52 LOCATION Co-ords. 15,929,295 N; 1,113,385 E. ORIGINATED BY HS
W.P. 29-67-07 BORING DATE August 7-8, 1969 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing; Cone CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
288.3	Ground Level					
0.0	Topsoil					
1.0	Clayey silt with some sand & trace gravel. Stiff to very stiff Mottled Brown-Grey		1	SS	12	
			2	SS	16	
278.3						280
10.0	Glacial Till Het.mix. silt, sand & gravel with trace to some clay Compact - Very dense Grey		3	TW	PH	
			4	SS	14	
			5	SS	38	
			6	SS	79	
			7	SS	99	
260.0						270
28.3	with occ. boulders up to 8" in size and shale fragments		8	SS	100/3"	
			10	SS	150/6"	
			11	SS	-	
253.3						260
252.0	weathered		12	SS	100/3"	
36.3	Shale Bedrock		13	AXT	80%	
246.3	Sound		14	AXT	90%	250
42.0	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE
400 800 1200 1600 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS	GR.	SA.	SI.	CL.
▽ 285.3				
	9	44	39	8
	12	43	41	4
	24	48	(28)	
	6	44	44	6

143

FORM OB-MT-126 (REV 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1A

FOUNDATION SECTION

JOB 69-F-52 LOCATION Co-ords. 15,929,252 N; 1,113,340 E. ORIGINATED BY BS
W.P. 29-67-07 BORING DATE August 8, 1969 COMPILED BY CH
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Test CHECKED BY

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
291.2	Ground Level									
0.0	Probably Clayey Silt					290				
283.2										
8.0	Probably Glacial Till					280				
276.5										
14.7	End of Cone Test					270				Practical refusal

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-52 LOCATION Co-ords. 15,929,223 N; 1,113,377 E. ORIGINATED BY BS
W.P. 29-67-07 BORING DATE August 12-13, 1969 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing; Cone CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
286.2	Ground Level					
0.0	Clayey silt with some sand & occ. gravel		1	SS	8	
277.9	Firm-Stiff. Grey		2	TW	PH	280
9.0	Glacial Till		3	SS	50	
	Het.mix. silt, sand & gravel with trace of clay		4	SS	45	
			5	SS	133	270
	Dense - Very dense		6	SS	136	
	Grey		7	SS	165/10"	260
257.4						
29.5	Shale Bedrock		8	SS	100/5"	
			9	SS	100/1"	
	Weathered		10	AXT	13%	250
247.9						
39.0						
243.9	Sound		11	AXT	70%	
43.0	End of Borehole					240

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
400 800 1200 1600 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS	GR.	SA.	SI.	CL.
▼ 285.1				
	31	31	33	5
	11	47	40	2
	11	46	41	2
No recovery				

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2A

FOUNDATION SECTION

JOB 69-F-52 LOCATION Co-ords. 15,929,247 N; 1,113,410 E. ORIGINATED BY HS
W.P. 29-67-07 BORING DATE August 12, 1969 COMPILED BY CH
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT (20 40 60 80 100) / SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE)	LIQUID LIMIT w_L / PLASTIC LIMIT w_p / WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
286.4	Ground Level									
0.0	Probably Clayey Silt					280				
276.4										
10.0	Probably Glacial Till					270				
267.8										
18.6	End of Cone Test					260				Practical refusal

GR.SA.SI.CL.

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-52 LOCATION Co-ords. 15,929,165 N; 1,113,438 E. ORIGINATED BY HS
W.P. 29-67-07 BORING DATE August 13-15, 1969 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Washboring-NX & BX Casings; Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS/FOOT
292.0	Ground Level				
0.0	Topsoil & Fill				
288.5	Material				
3.5	Clayey silt with some sand & trace gravel		1	SS	15
			2	SS	11
283.0	Stiff		3	SS	33
9.0	Glacial Till		4	SS	57
	Het. mix. silt, sand & some gravel with trace to some clay occ. shale fragments		5	SS	65
			6	SS	99
			7	SS	118
	Dense to very dense Grey		8	SS	193/9"
			9	SS	120/6"
251.0			10	SS	150/5"
41.0	weathered				
247.0					
45.0	Shale Bedrock		11	AXT	80%
	Sound; occ. weathered seams up to 6" thick		12	AXT	80%
237.0					
55.0	End of Borehole				

ELEV. SCALE: 290, 280, 270, 260, 250, 240, 230

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P — w — w_L
WATER CONTENT % — 10 20 30

BULK DENSITY γ P.C.F.

REMARKS

▼ 285.5

21 30 39 10

18 66 (16)

GR. SA. SI. CL.

20
15 ✛ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3A

FOUNDATION SECTION

JOB 69-F-52 LOCATION Co-ords. 15,929,137 N; 1,113,398 E. ORIGINATED BY HS
W.P. 29-67-07 BORING DATE August 15, 1969 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE	LIQUID LIMIT w_L / PLASTIC LIMIT w_p / WATER CONTENT w / WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
291.3	Ground Level									
0.0	Probably Fill Material					290				
286.0										
5.5	Probably Glacial Till					280				
278.0										
13.3	End of Cone Test					270				Practical refusal

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTIO

JOB 69-F-52 LOCATION Co-ords. 15,929,091 N; 1,113,426 E. ORIGINATED BY HS
W.P. 29-67-07 BORING DATE August 11-13, 1969 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Washboring - BX Casing; Cone CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
292.1	Ground Level					
0.0						
288.1	Fill Material		1	SS	9	
4.0	Clayey Silt		2	SS	25	
284.1	Very stiff		3	SS	16	
8.0			4	SS	32	
	Glacial Till		5	SS	118	
	Het. mix. silt, sand & gravel with trace to some clay		6	SS	61	
			7	SS	100/4"	
	Compact to very dense Grey		8	SS	100/4"	
			9	SS	12/6"	
			10	SS	100/4"	
			11	SS	100/4"	
248.0						
44.1	weathered with occ. mud seams		12	AXT	16%	
242.1						
50.0	Shale Bedrock		13	AXT	80%	
235.1	Sound		14	AXT	100%	
57.0	End of Borehole					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR. SA. SI. C

▼ 285.4
14 37 40
14 46 35
54 24 (12)
10 36 40 1

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM 08-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 69-F-52 LOCATION Co-ords. 15,929,029 N; 1,113,467 E. ORIGINATED BY [redacted]
W.P. 29-67-07 BORING DATE August 15, 1969 COMPILED BY [redacted]
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY [redacted]

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT
292.5	Ground Level				
0.0	Probably				
288.5	Fill Material				
4.0	Probably Glacial Till				
277.6					
14.9	End of Cone Test				

ELEV SCALE: 290, 280, 270

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

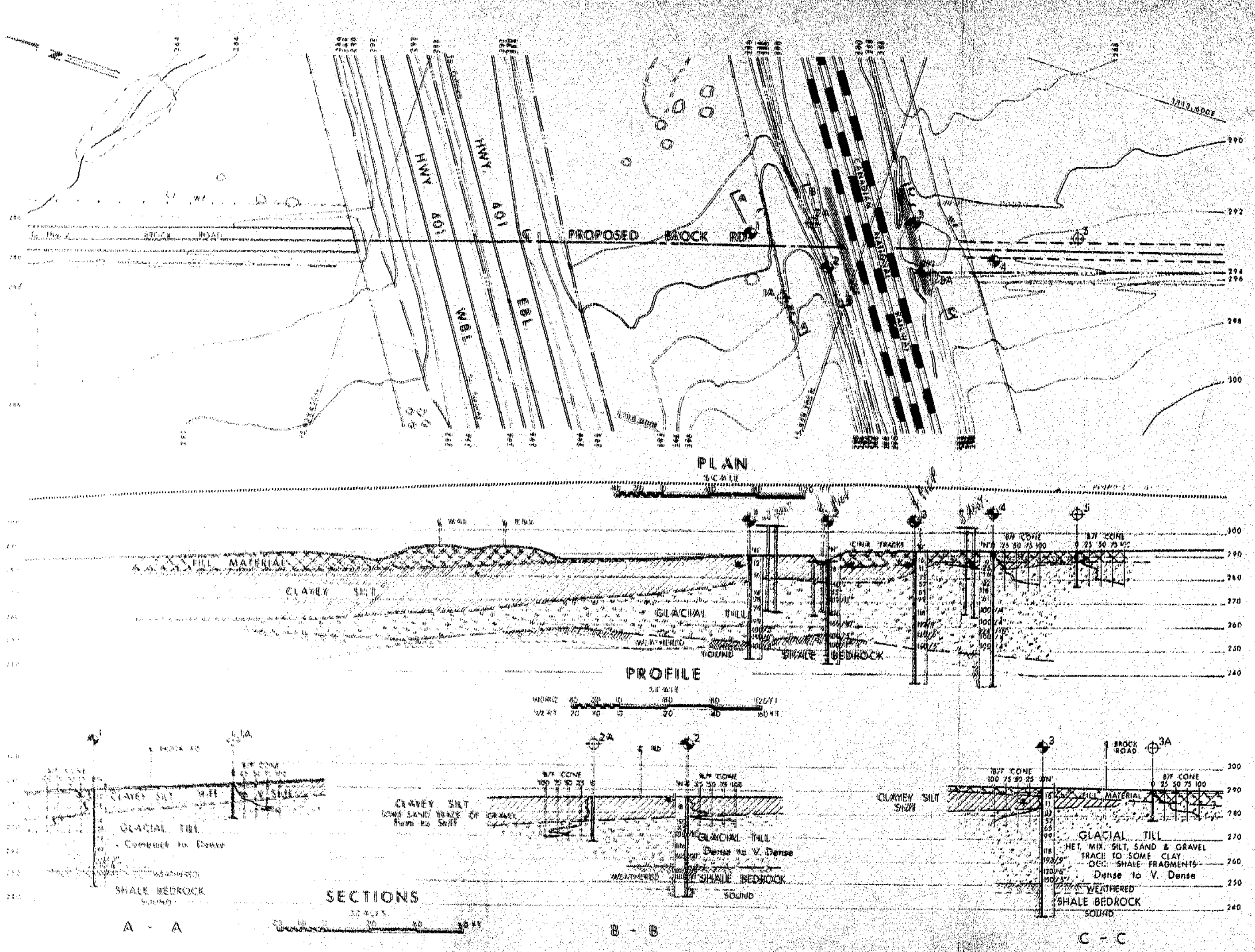
LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P — w — w_L
WATER CONTENT %

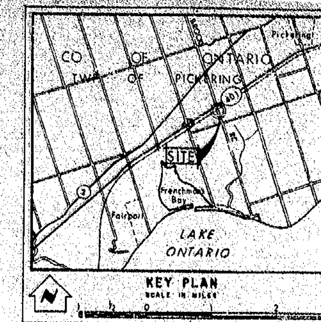
BULK DENSITY γ P.C.F.

REMARKS

GR. SA. SI CL.

Practical refusal





LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. AUG. 1969

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	288.3	15,929,295	1,113,385
1A	291.2	" 252	" 340
2	286.9	" 223	" 377
2A	286.4	" 247	" 410
3	292.0	" 165	" 438
3A	291.3	" 137	" 394
4	292.1	" 091	" 42[illegible]
5	292.5	" 029	" 467

- NOTE -

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

BROCK ROAD & C.N.R.

KING'S HIGHWAY NO. ______ DIST. NO. 6
CO. ONTARIO
TWP. PICKERING LOT ______ CON. ______

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D C.M.	CHECKED	W.P. NO. 29-67-07	M.&T. DRAWING NO. 69-F-52A
DRAWN A.N.	CHECKED	JOB NO. 69-F-52	
DATE OCT. 20, 1969		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

RECORD OF BOREHOLE No 1 METRIC

W P 470-711-609 LOCATION 4 855 178.5N ; 339 259.0E ORIGINATED BY TH

DIST 6 HWY GO ALRT BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY GAB

DATUM Geodetic DATE 1983 07 20 CHECKED BY RWB

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
91.6	Ground Level									
0.0	Topsoil									
0.3	Sand, some silt, trace gravel (fill) Very Dense Brown		1	SS	19					
			2	SS	70		90			
87.9			3	SS	52			136 0.3m		
3.7	Silt and Sand, some Gravel, trace clay (till) Very dense Brown to Grey		4	SS	69	No Water Level Recorded	88		o	
			5	SS	110/0.15m		86			
			6	SS	115		84			
			7	SS	74		82			
80.7			8	SS	85/0.2m					
10.9	End of Borehole									

+3, ×5 : Numbers refer to 20 15 5 (%) STRAIN AT FAILURE

Ontario

RECORD OF BOREHOLE No 5 — METRIC

W P 470-711-609 — LOCATION 4 855 266.5N ; 339 375.5E — ORIGINATED BY TH

DIST 6 HWY GO ALRT — BOREHOLE TYPE Hollow Stem Auger & Cone Test — COMPILED BY GAB

DATUM Geodetic — DATE 1983 07 26 — CHECKED BY RWB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS
97.6	Ground Level					
0.0	Sand, some silt to Sand and Silt, trace to some gravel (fill) Compact to Very Dense Brown		1	SS	19	
			2	SS	21	
			3	SS	39	
			4	SS	72	
			5	SS	43	
			6	SS	27	
	Layer of silt clay		7	TW	PH	
86.6	Silty Clay, some Sand and Organics		8	SS	37	
11.0	Silty Clay, trace sand and gravel, varves 11.1 to 13.0 m (CL) Firm to Hard Grey		9	SS	7	
			10	TW	PH	
81.1			11	TW	PH	
16.5	Silt and Sand, some gravel, trace clay (till) Compact to Very Dense Grey		12	SS	11	
78.9			13	SS	115	
18.7	End of Borehole					
75.0						
22.6	End of Cone Test					

ELEVATION SCALE: 96, 94, 92, 90, 88, 86, 84, 82, 80, 78, 76

DYNAMIC CONE PENETRATION RESISTANCE PLOT — 20 40 60 80 100

SHEAR STRENGTH kPa — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE — 20 40 60 80 100

125, 214, 135, 179, 140, 138, 143, 138

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

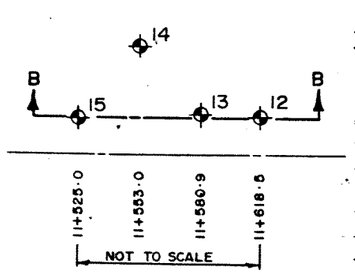
WATER CONTENT (%) — 10 20 30

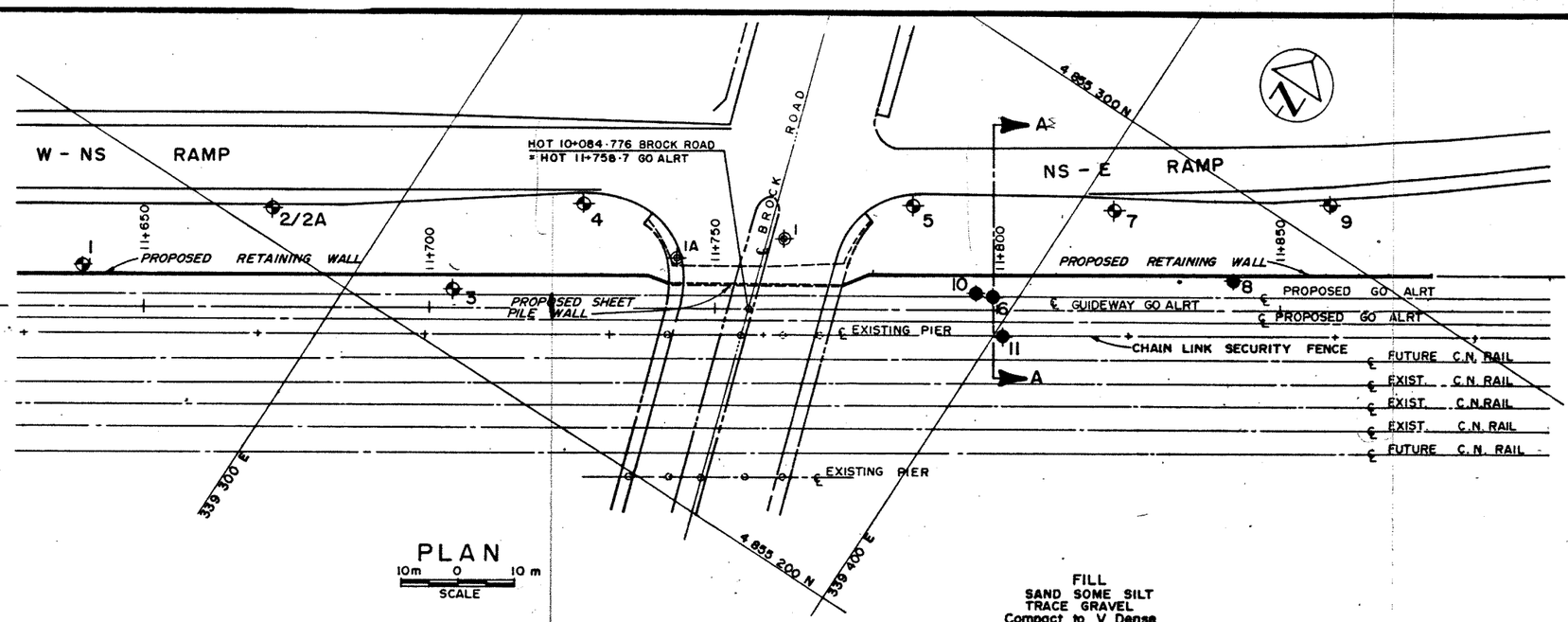
UNIT WEIGHT γ kN/m³ — 19.76

REMARKS & GRAIN SIZE DISTRIBUTION (%) — GR SA SI CL

METRIC

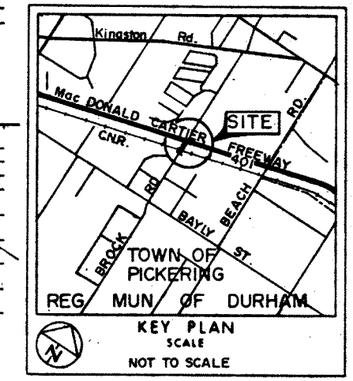
ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE NOTED.



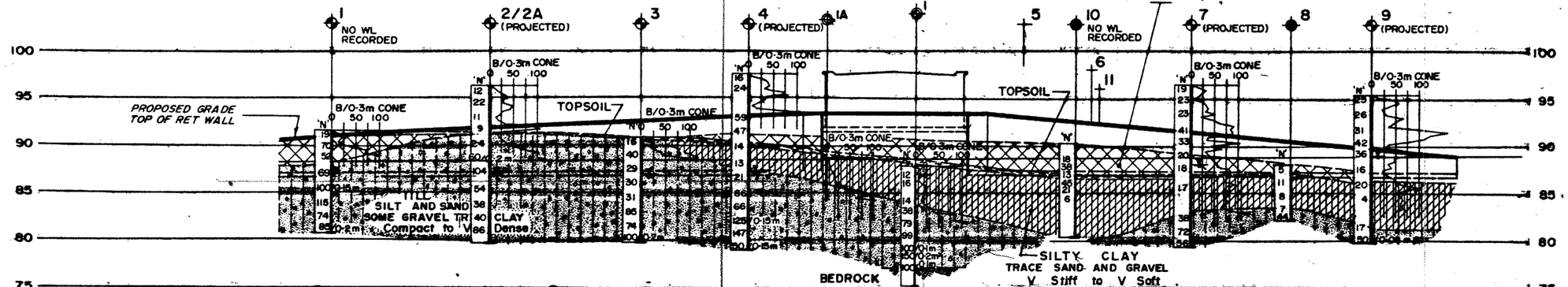


PLAN

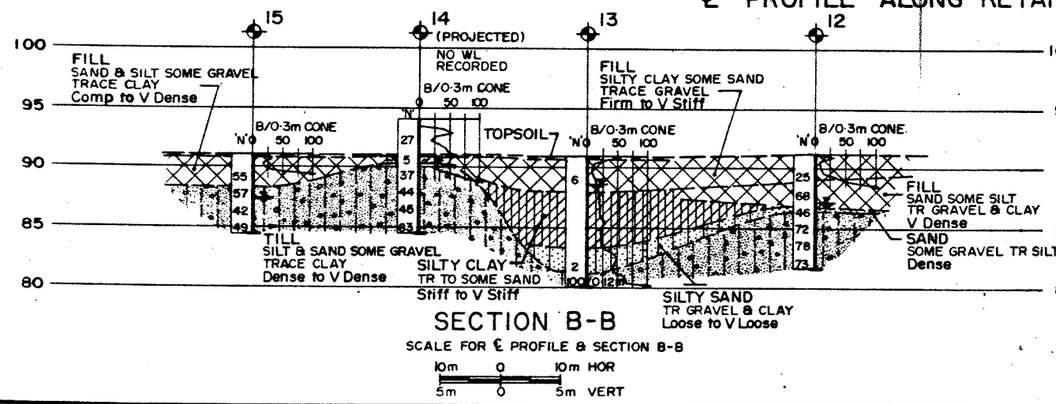
10m 0 10 m SCALE



KEY PLAN
SCALE
NOT TO SCALE



℄ PROFILE ALONG RETAINING WALL

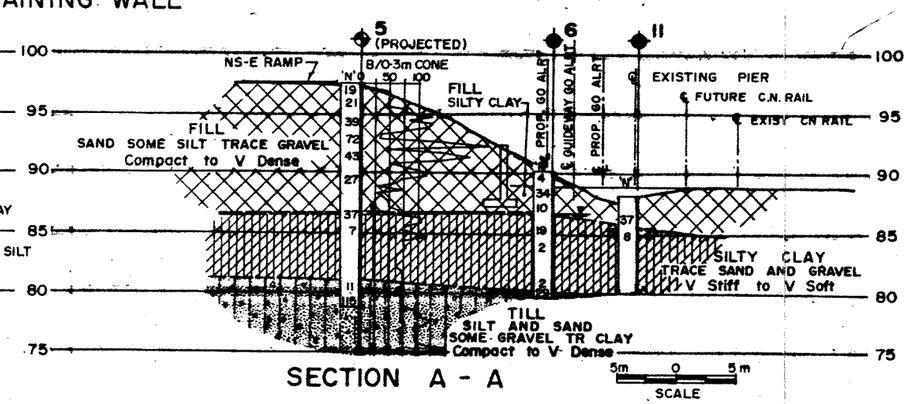


SECTION B-B

SCALE FOR ℄ PROFILE & SECTION B-B

10m 0 10m HOR

5m 0 5m VERT



SECTION A - A

5m 0 5m SCALE

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L at time of investigation 83.08
- Cone Test *(Previous Investigation)
- Bore Hole & Cone *(Previous Investigation)

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	91·6	4 855 178·5	339 259·0
2	96·3	4 855 205·0	339 281·5
2A	96·3	4 855 205·0	339 281·5
3	90·9	4 855 210·0	339 315·8
4	97·6	4 855 235·0	339 327·0
5	97·6	4 855 266·5	339 375·5
6	90·1	4 855 260·5	339 396·5
7	96·6	4 855 285·0	339 406·0
8	88·0	4 855 286·4	339 430·0
9	95·4	4 855 306·5	339 437·4
10	90·3	4 855 259·5	339 393·2
11	88·3	4 855 255·7	339 401·5
12	91·2	4 855 165·7	339 239·1
13	90·9	4 855 103·2	339 251·0
14	94·1	4 855 142·0	339 246·0
15	91·0	4 855 055·9	339 221·2
* 1	87·9	4 855 249·1	339 359·7
* 1A	88·8	4 855 236·0	339 346·0

Geocres No

≠NOTE≠

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

GO-ALRT REF _____

REFERENCE DRAWINGS	
PDI 600 222	STANDARD PLANNING REPORT
	GO ALRT EXTENTION
	BROCK RD. RETAINING WALL

REVISIONS

DRAWN BY: A.E. LOCKHART 84 02 23	DESIGNED BY: RB
CHK'D BY: RB	APPROVED BY:
SCALE: AS SHOWN	FULL SIZE ONLY

REGISTERED PROFESSIONAL ENGINEER R.W. BROWNE PROVINCE OF ONTARIO

GEOCON INC.

GO-ALRT

Ministry of Transportation and Communications

PICKERING - OSHAWA SECTION

PROJECT MANAGER

BORE HOLE LOCATION & SOIL STRATA
GO ALRT EXTENTION
BROCK ROAD RETAINING WALL

CONTRACT NO	DWG NO	REV	SHEET
	470 711609 - A		

THURBER

APPENDIX F

Selected Site Photographs

Photo 1- Brock Road NBL and CN Overhead (looking north)
Date: May 2022

Photo 2- Northeast side of Brock Road and CN Overhead (looking north)
Date: May 2022

Photo 3- Southeast side of Brock Road and CN Overhead (looking norh)
Date: May 2022

Photo 4- Pier 1 and south abutment of Brock Road and CN Overhead (looking south)
Date: May 2022

Photo 5- Piers 1 and 2 of Brock Road and CN Overhead (looking north)
Date: May 2021