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FOUNDATION INVESTIGATION AND DESIGN REPORT

NOISE BARRIER WALL, SOUTHEAST OF CUBERT STREET AND HIGHWAY 401 OVERPASS
CITY OF OSHAWA, ONTARIO
G.W.P. 2555-17-00
GEOCRES No. 30M15-352

Client Name: Egis Canada Ltd.
Date: July 26, 2024
File: 30915

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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the detailed design of a noise barrier wall to be constructed from just west of the proposed Highway 401 and Cubert Street overpass replacement structure, extending easterly adjacent to the Highway 401 EBL located in the City of Oshawa, Ontario.

The purpose of this investigation was to explore the subsurface conditions near the alignment of the noise barrier wall and, based on the data obtained, to provide a borehole location plan and soil strata drawing, 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 the data obtained from the investigation, to describe the geotechnical conditions influencing design and construction of the noise barrier wall. Selected boreholes from another aspect of this interchange reconstruction project are also utilized.

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 2019-E-0076. The overall assignment includes replacement of the Highway 401 at Park Road South and Cubert Street overpass structures, proposed retaining walls and noise barrier walls on both sides of the highway, and overhead signs. This report addresses the proposed noise barrier wall to be located adjacent to Highway 401 EBL on the southeast side of the Cubert Street bridges.

Reference has been made to information on subsurface conditions contained in a previous foundation report prepared by Thurber for the bridge site. The title of this report is:

- Draft Foundation Investigation Report, Cubert Street Overpass Replacement, Highway 401, Site No. 22X-174/B1&B2, Highway City of Oshawa, Ontario, G.W.P. 2555-17-00, prepared by Thurber Engineering Ltd., Job 30915, dated October 17, 2023 (Reference 1).

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. SITE DESCRIPTION

The site is located from just west of the existing Cubert Street overpass structures, extending easterly towards Oshawa Creek. The bridges are approximately 1 km east of Stevenson Road in the City of Oshawa, Ontario. Cubert Street generally runs in a north-south direction and the two bridges carry the two directions of traffic on Highway 401 over Cubert Street. An existing noise barrier wall is located parallel to and along the south side of the Highway 401 EBL.

The highway grade is at about Elevation 112.2 about 100 m west of Cubert Street and decreases easterly to about Elevation 100 near the east end of this investigation. The Highway 401 embankments are about 6.5 m to 7 m high near Cubert Street and decrease in height towards the east.

Based on information provided by Egis, the proposed replacement noise barrier wall will run adjacent to the proposed Highway 401 EBL widening and extend from about 100 m west of Cubert Street to about 400 m east of Cubert Street, and end just west of Oshawa Creek.

The overall surface topography in the vicinity of the site is relatively flat with the ground surface gently sloping towards the south. Beyond the highway right-of-way, the lands are currently occupied by residential developments.

Selected photographs of the site taken during the investigation are presented in Appendix E.

Based on published geological information, the site area is located within the Iroquois Plain physiographic region. This region extends around the western shores of Lake Ontario and consists of lakebed and beaches of the former glacial Lake Iroquois. The subsoils in this area are typically comprised of glacial tills and glaciolacustrine clays, silts and sands. Limestone bedrock underlies the soil deposits.

3. SITE INVESTIGATION AND FIELD TESTING

The current site investigation and field testing program completed for the noise barrier wall was

carried out on July 4, 6 and 11, 2023, November 12, 2023 and December 12, 2023 and consisted of drilling and sampling six (6) boreholes, designated as Boreholes NBW-01 to NBW-06. The boreholes were located near the proposed noise barrier wall alignment. Boreholes NBW-04 to NBW-06 were drilled from the existing Highway 401 EBL platform. Boreholes NBW-02 and NBW-03 were drilled at the cul-de-sac of Burton Street and Oxford Street, respectively. Borehole NBW-01 was drilled just south of Highway 401 EBL. All six (6) boreholes were terminated at depths ranging from 7.8 m to 8.2 m (Elevations 91.7 to 104.4). The Record of Borehole sheets of these boreholes are provided in Appendix B.

Reference has been made to previous Boreholes CS-03, CS-04, CS-09 and CS-10 which were located near the westerly limit of the wall (Reference 1). Boreholes CS-03, CS-04 and CS-10 were terminated at depths ranging from 14.1 m to 18.6 m (Elevations 95.8 and 86.6), and Borehole CS-09 at 6.4 m (Elevation 104.4). The Record of Borehole sheets of these boreholes are provided in Appendix D.

Approximate locations of the ten relevant boreholes (previous and present investigations) are shown on the Borehole Locations Plan and Soil Strata Drawing in Appendix A.

Thurber surveyed the as-drilled borehole locations in the field using a Trimble R10 GPS survey equipment to obtain the coordinates and forwarded them to Egis, who then provided the ground surface elevations. It is understood that the horizontal and vertical accuracy of the survey results meet the MTO terms of reference requirements. The coordinates and elevations of the boreholes drilled during the previous and present investigations are given on the drawings in Appendix A and in the Record of Borehole sheets in Appendices B and D.

Traffic control was implemented for drilling each borehole for the current and previous investigations. Lane closures were also implemented for Boreholes NBW-04 to NBW-06 drilled on the Highway 401 EBL platform. Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

The current boreholes were advanced using a truck-mounted drill rig using solid stem augers. 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.

The current field investigation was supervised 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 samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the current and previous drilling operations. During the previous investigation, a monitoring well (50 mm diameter Schedule 40 PVC) was installed and enclosed in filter sand in Borehole CS-04 to permit groundwater level monitoring. Details of the well installation are shown in Table 3.1.

Table 3.1: Borehole Completion Details

Approximate Station	Borehole	Borehole Depth / Base Elevation (m)	Well Tip Depth / Elevation (m)	Completion Details
12+300	CS-04	18.6 / 86.6	17.7 / 87.5	Monitoring well with 1.5 m slotted screen installed within sand filter from 18.6 to 15.8 m, bentonite from 15.8 to 0.25 m, then concrete from 0.25 to 0.13 m, then asphalt to ground surface.

During the present investigation, all boreholes were backfilled upon completion of drilling in general accordance with O.Reg. 903. The asphalt surface was reinstated as much as practicable in boreholes drilled on the highway or 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. 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.

During the previous investigation, in order to assess the potential for sulphate attack on concrete and potential for metal corrosion associated with the foundations, selected samples of the soils were submitted to SGS, 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 5.7 and are presented in Appendix C.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered subsurface stratigraphy from the boreholes are presented on the Record of Borehole sheets included in Appendices B and D, and on the Borehole Locations and

Soil Strata drawing 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.

In general, the subsurface stratigraphy encountered at the site consists of pavement structure overlying embankment fill within the highway and road platform and surficial fill in Borehole NBW-01. Below the fill, the native soils consist of an extensive deposit of very stiff to hard clayey silt to silty clay till, and interlayers of dense to very dense sand and silt till, sand till and silty sand till. Interbedded layers of firm to very stiff silty clay and clayey silt were encountered within the clayey silt to silty clay till. During the present investigation, the groundwater levels observed in the boreholes upon completion of drilling ranged between 6 and 7 m depths below existing ground surface. A groundwater level measured in a deep monitoring well at the bridge was at about 12m depth below ground surface.

More detailed descriptions of the individual stratum are presented below.

5.1 Pavement Structure

Pavement structure consisting of approximately 100 mm and 75 mm of asphalt overlying granular (sand) road base was encountered in Boreholes NBW-02 and NBW-03, drilled at the cul-de-sac of Burton Road and Oxford Street, respectively. The granular fill was 0.6 m and 0.7 m thick in Boreholes NBW-02 and NBW-03, respectively. On the highway platform, pavement structure consisting of approximately 150 mm to 175 mm of asphalt overlying granular (gravelly sand to sand) road base fill was encountered in Boreholes CS-09, CS-10, NBW-04 to NBW-06. The granular base ranged from 0.5 m to 1.2 m in thickness in these boreholes. On Cubert Street, pavement structure consisting of 125 mm asphalt overlying granular road base fill was encountered in Boreholes CS-03 and CS-04. The thickness of the granular fill was 1.3 and 0.6 m in Boreholes CS-03 and CS-04, respectively.

SPT ‘N’ values recorded in the granular fill ranged from 4 to 42 blows per 0.3 m of penetration indicating a loose to dense condition. The moisture contents measured on samples of the granular fill ranged from 2 percent to 16 percent.

The results of grain size analyses conducted on samples of the sand and gravelly sand fill 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	15 to 30
Sand	53 to 62
Silt	15 to 16
Clay	2 to 7

5.2 Fill

Embankment fill was encountered underlying the pavement structure in the boreholes advanced from the Highway 401 platform (Boreholes CS-09, CS-10 and NBW-06). This fill typically consisted of brown sandy silt to and sand and silt containing trace gravel and trace to some clay. The thickness of the embankment fill ranged from 0.8 m to 2.7 m.

A 1.4 m thick layer of brown sand fill containing trace silt and trace gravel was contacted surficially in Borehole NBW-01. In Borehole NBW-02, drilled on the Burton Street cul-de-sac, a layer of brown sandy silt fill was contacted below the pavement structure. The thickness of the sandy silt fill was 0.7 m.

SPT 'N' values recorded in the cohesionless silty sand, sandy silt to sand and silt fill typically ranged from 4 to 74 blows per 0.3 m of penetration indicating a loose to very dense condition.

The natural moisture contents measured on samples of the cohesionless fill generally ranged from 6 percent to 14 percent.

Results of grain size analyses conducted on samples of the silty sand, sandy silt and, sand and silt fill are provided on the Record of Borehole sheets in Appendix B and illustrated on Figure C2, respectively in Appendix C. The results are summarized as follows:

Soil Particle	Cohesionless Fill (Percent)
Gravel	8 to 9
Sand	32 to 60
Silt	23 to 49
Clay	5 to 10

5.3 Sand Till, Silty Sand Till and Sand and Silt Till

Brown to grey sand and silt till, silty sand till, and sand till containing trace to some gravel and trace clay was contacted below the fill in Boreholes NBW-01, CS-09 and CS-10, below the silty clay in Borehole NBW-04, and below the clayey silt till in Borehole NBW-05 at depths ranging from 1.4 m to 4.1 m. The thickness of these cohesionless tills varied from 2.6 m to 4.1 m in Boreholes NBW-01, NBW-05 and CS-10.

The depth to the base of the cohesionless till layers ranged from 5.5 m to 7.2 m depths (Elevations 96.2 to 106.7) in Boreholes NBW-01, NBW-05, CS-09 and CS-10. Boreholes NBW-04 and CS-09 were terminated within the sand till and sandy silt till at 8.1 m and 6.4 m depths (Elevations 95.4 and 104.4), respectively.

The SPT 'N' values recorded in the cohesionless till ranged from 40 blows per 0.3 m of penetration to 100 blows for less than 0.3 m of penetration indicating a dense to very dense state. Some of the 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 5 percent to 15 percent.

The results of grain size distribution analyses carried out on selected samples of the sand and silt till, silty sand till, and sand till are shown on Figure C3 in Appendix C. The results are summarized as follows:

Soil Particle	Sand Till, Silty Sand Till, Sand and Silt Till
Gravel	1 to 15
Sand	26 to 72
Silt	17 to 65
Clay	2 to 8

Grinding of augers were noted in the cohesionless till in Borehole NBW-04. These occurrences are indication of possible obstructions such as cobbles or boulders.

Glacial tills inherently contain cobbles and boulders.

5.4 Clayey Silt to Silty Clay Till

An extensive deposit of native brown to grey clayey silt to silty clay till with sand and containing trace gravel and occasional cobbles and boulders was encountered below the fill and native sand and silt to silty sand till in all the boreholes, except in Boreholes NBW-04 and CS-09. The cohesive till deposits were contacted typically at depths ranging from 1.4 m to 7.2 m, and at 0.8 m in Boreholes NBW-03 and CS-04. A layer of 1.1 m thick layer of silty clay till was contacted at 3.0m depth in Borehole NBW-06.

Boreholes NBW-01 to NBW-03, NBW-05 and NBW-06 were terminated within the clayey silt to silty clay till at depths ranging from 7.8 m to 8.2 m (Elevations 91.7 to 104.4). Boreholes CS-03, CS-04 and CS-10 drilled during the previous investigation were terminated within the clayey silt till at depths varying from 14.1 m to 18.6 m (Elevations 86.6 to 95.8).

SPT 'N' values measured in the cohesive till typically increased with depth from 13 blows per 0.3m penetration to greater than 100 blows for less than 0.3 m of penetration, indicating a stiff to predominantly hard consistency. Some of the higher "N" values may be attributed to the presence of cobbles and boulders.

The natural moisture contents measured in the cohesive till ranged approximately from 5 percent to 24 percent.

The results of grain size distribution analyses carried out on selected samples of the clayey silt to silty clay till are presented on the Record of Borehole sheets included in Appendix B. Grain size distribution curves of samples tested are presented on Figures C4 to C6 in Appendix C. The results of the grain size distribution analyses are summarized below:

Soil Particle	Clayey Silt Till (Percent)	Silty Clay Till (Percent)
Gravel	0 to 8	0 to 4
Sand	34 to 52	32 to 39
Silt	31 to 45	36 to 50
Clay	8 to 24	18 to 23

The results of Atterberg Limits tests conducted on samples of the clayey silt to silty clay till are presented on the Record of Borehole sheets in Appendix B and illustrated in Figures C9 to C11 of Appendix C. The results are summarized as follows:

Index Property	Clayey Silt Till Percentage (%)	Silty Clay Till Percentage (%)
Liquid Limit	13 to 20	19 to 30
Plasticity Index	6 to 10	10 to 13

The results of the Atterberg Limits testing indicate that the clayey silt till to silty clay till is of low to slight plasticity with group symbols of CL to CL-ML.

Grinding of augers and/or split spoon sampler refusal were noted in the cohesive till in Boreholes NBW-03 and NBW-05. These occurrences are indication of possible obstructions such as cobbles or boulders.

Glacial tills inherently contain cobbles and boulders.

5.5 Silty Clay and Clayey Silt

A layer of brown silty clay containing trace sand and trace clay was contacted at 1.4 m depth,

below the pavement structure in Borehole NBW-04. The silty clay layer was 2.7 m thick.

A 3.1 m thick layer of grey clayey silt with sand and trace of gravel was contacted within the silty clay till in Borehole NBW-06 at 4.1 m depth. The colour of the clayey silt becomes black near 6.5m depth. A layer of sand was found embedded within the clayey silt.

The depth to the base of the silty clay and clayey silt was at 4.1 m and 7.2 m (Elevations 99.4 and 92.7) in Boreholes NBW-04 and NBW-06, respectively.

SPT 'N' values measured in the silty clay and clayey silt varied from 5 to 25 blows per 0.3 m of penetration indicating a firm to very stiff consistency. Moisture contents measured in the silty clay and clayey silt ranged from 16 to 27 percent.

The results of grain size distribution analyses carried out on a sample of the silty clay are presented on the Record of Borehole sheets included in Appendix B. Grain size distribution curves of samples tested are presented on Figure C7 in Appendix C. The results of the grain size distribution analyses are summarized below:

Soil Particle	Silty Clay (Percent)
Gravel	0
Sand	6
Silt	46
Clay	48

The results of Atterberg Limits tests conducted on a sample of the silty clay are presented on the Record of Borehole sheets in Appendix B and illustrated in Figure C11 of Appendix C. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	57
Plasticity Index	37

The results of the Atterberg Limits testing indicate that the silty clay is of high plasticity with a group symbol of CH.

5.6 Groundwater Conditions

Groundwater levels in the boreholes were observed during the drilling operations and upon completion of drilling. Water levels measured in open boreholes are presented in Table 5.1 below.

Table 5.1: Groundwater Level Measurements

Borehole	Date	Groundwater Level		Comments
		Depth (m)	Elevation (m)	
NBW-01	July 6, 2023	6.1	106.1	Open borehole upon completion
NBW-02	July 11, 2023	Dry	Dry	Open borehole upon completion
NBW-03	July 4, 2023	Dry	Dry	Open borehole upon completion
NBW-04	November 12, 2023	6.9	96.6	Open borehole upon completion
NBW-05	December 12, 2023	Dry	Dry	Open borehole upon completion
NBW-06	December 12, 2023	Dry	Dry	Open borehole upon completion
CS-03	December 5, 2022	3.6*	101.5*	Open borehole upon completion
CS-04	April 14, 2023 May 18, 2023 July 14, 2023 September 13, 2023	10.5** 12.2** 11.2** 11.9**	94.7** 93.0** 94.0** 93.3**	Monitoring Well (levelogger used since July 2023)
	May 18, 2023	12.2	93.0	Monitoring Well
CS-09	November 7, 2022	Dry	Dry	Open borehole upon completion
CS-10	November 6, 2022	Dry	Dry	Open borehole upon completion

Note: * Not stabilized as water was added into the borehole during drilling.
** Possibly not stabilized due to influence from gas pressure present in the borehole at the time of the readings.

The groundwater levels presented in Table 5.1 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.

5.7 Corrosivity Test Results

Selected soil samples were submitted for analytical testing of corrosivity parameters including sulphate content. The results of the analytical tests are shown in Table 5.2. The laboratory certificates of analysis are presented in Appendix C.

Table 5.2: 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)
CS-03 SS3	1.5 - 2.1	Clayey silt with sand till	0.07	47	200	8.57	3,150	314	317
CS-04 SS4	2.3 - 2.9	Clayey silt with sand till	0.05	14	210	8.54	5,460	291	183

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 forwarded the borehole coordinates to Egis (then McIntosh Perry) who provided the ground surface elevations.

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

Full time supervision of the field activities was carried out by Mr. Sergey Gladkiy of Thurber. Overall supervision of the field program was performed by Messrs. Rod de Castro, P.Eng. and Cory Zanatta, P.Eng. of Thurber.

Interpretation of the field data and preparation of the report was carried out by Ms. Rocio Reyna, P.Eng. This report was reviewed by Messrs. Sydney Pang, P.Eng. and P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

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Date: ***July 26, 2024***
File: ***30915***

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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7. GENERAL

This section of the report presents foundation recommendations for the design of the proposed noise barrier wall to be constructed adjacent to the Highway 401 EBL widening at the southeast side of the Highway 401 and Cubert Street crossing in Oshawa, Ontario.

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

Based on information provided by Egis, the proposed replacement noise barrier wall will run adjacent to the proposed Highway 401 EBL widening and extend from about 100 m west of Cubert Street to about 400 m east of Cubert Street, and end just west of Oshawa Creek.

It is important to note that the foundation investigation carried out for this project/site extended from approximate Stations 12+200 to 12+700. Therefore, the recommendations provided in this report for the proposed noise barrier wall correspond only to this area of investigation. Recommendations for the noise barrier wall to be located on the southeast side of Highway 401 and Park Road South are presented in a separate report prepared for the proposed retaining wall and noise barrier wall at that location.

The discussion and recommendations presented in this report are based on the design information provided by Egis, the factual data obtained during the course of the current investigation and selected data from a previous investigation.

8. FOUNDATION DESIGN PARAMETERS

For design of the noise barrier wall foundations, reference may be made to the following documents:

- Canadian Highway Bridge Design Code and Commentary (2019). CAN/CSA S6:19 and S6.1:19 (Reference 2).
- Ontario Provincial Standard Specification, OPSS.MUN 760 April 2019 “Construction Specification for Noise Barrier Systems” and Special Provision SP 760F01 March 2018 (Reference 3).
- Ministry of Transportation, Ontario (2004) “Guidelines for the Design of High Mast Pole Foundations”, Fourth Edition, BRO-009, Engineering Standards Branch, Bridge Office (Reference 4).

It is noted that SP 760F01 in Reference 3 should only be used for design guidance and general reference only. The document quotes the use of a Quality Verification Engineer (QVE) to be retained by the Contractor for providing foundation inspection, approval and related services. This practice is no longer adopted by the MTO and has been replaced with the use of a Foundation Engineering Specialist (FES) to be retained by the Contract Administrator.

It is anticipated that the proposed noise barrier wall will be supported on conventional augered caissons (i.e. drilled shafts). Table 1 following the text of this report presents the recommended geotechnical design parameters for the augered caisson foundations. The foundations are expected to typically extend through fill and native dense to very dense sand and silt till/sand till/silty sand till and very stiff to hard clayey silt to silty clay till. There are occasional layers of firm to very stiff clayey silt and high plastic silty clay. During the present investigation, the groundwater levels observed in the boreholes upon completion of drilling ranged between 6 and 7 m depths below existing ground surface. A groundwater level measured in a deep monitoring well at the bridge was at about 12 m depth below ground surface.

In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance of a caisson within the upper 1.2 m below final grade should be neglected in the

foundation design. It is recommended that all surficial, relatively incompetent soils including topsoil and organics be neglected in determining lateral resistance.

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

When designing for portions of the caissons below the groundwater level in cohesionless soils (sands and silts), the submerged soil unit weight, γ', should be used. The required depth of the drilled shaft will be governed by lateral loads, including wind loads, acting on the wall. The length of the caisson should also be sufficient to counteract frost jacking (upward) forces.

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

8.1 Caisson Installation

Caisson installation should generally be carried out in accordance with OPSS.PROV 903. The installation should be monitored to verify that the encountered soil conditions are consistent with the design assumptions.

Some boreholes have encountered and/or inferred the presence of obstructions such as cobbles and boulders in the native tills. It is possible that oversize obstructions are also present in the existing fills. Caisson installation equipment must be able to dislodge, handle, remove and penetrate any obstructions if encountered.

Soil sloughing and water seepage will occur in unsupported holes especially in cohesionless soils at depths below the groundwater level. Temporary liners must be available to support the caisson sidewalls and provide partial seepage cut-off where required. Cohesionless soils at the caisson base would be susceptible to disturbance due to base “boiling” under conditions of unbalanced hydrostatic head, which should be counteracted by maintaining a full head of water inside the caisson hole until concrete is placed. Base heave could occur if softer cohesive soils are exposed at the caisson base. Furthermore, the base and sidewalls of the caisson hole should be free of loose, soft or otherwise disturbed soils prior to placing concrete within four (4) hours of completion of augering of the caisson hole. The concrete may have to be placed by the pumped tremie

method.

Suggested wordings for an NSSP to cover the above aspects are provided in Appendix F.

8.2 Construction Concerns

Potential construction concerns include, but are not necessarily limited to, the following:

- Concerns during caisson construction mainly involve soil sloughing and water seepage from caisson sidewalls, and basal instability due to unbalanced hydrostatic pressure.
- Handling and removal of possible obstructions that might be encountered.

Recommendations on how to address these issues have been outlined in the previous section.

8.3 Construction Inspection and Testing

It is preferable that caisson construction be monitored to confirm that relevant contract requirements are met.

9. SOIL CORROSION POTENTIAL

The results of corrosivity and sulphate analytical tests conducted on selected soil samples are included in Appendix C. Based on the test results, the following statements can be made:

- The potential for sulphate attack on concrete from the surrounding native soils is considered negligible due to the low concentration of sulphate and slightly alkaline pH values.
- The overall potential for corrosion on metal is presented in Table 9.1.

Table 9.1: Potential for Corrosion on Metal

Sample ID	Depth (m)	Elevation (m)	Soil Sample Description	Degree of Corrosivity on metal
CS-03 SS3	1.5 - 2.1	103.6 – 103.0	Clayey silt with sand till	Moderately corrosive
CS-04 SS4	2.3 - 2.9	102.9 – 102.3	Clayey silt with sand till	Mildly corrosive

- The effects of road de-icing salts should also be considered when selecting the class of concrete and corrosion mitigation measures.

10. SIGNATURES/CLOSURE

Engineering analysis and preparation of the foundation design report were carried out by Ms. Rocio Reyna, P.Eng. This report was reviewed by Messrs. Sydney Pang, P.Eng. and P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

This report was issued before any final design or construction details had been prepared or issued. Therefore, differences may exist between the report recommendations and the final design, the contract documents, or conditions during construction. In such instances, Thurber Engineering Ltd. should be contacted immediately to address these differences. Designers and contractors undertaking or bidding the work should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for design and construction, and make their own interpretation of the data as it may affect their proposed scope of work, cost, schedules, safety, and equipment capabilities.

We trust this information meets your present needs. If you have any questions, please contact the undersigned at your convenience.

THURBER ENGINEERING LTD.

Thurber Engineering Ltd.

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

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

Date: ***July 26, 2024***
File: ***30915***

P.K. Chatterji, P. Eng.
Review Principal, Designated MTO Contact

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TABLE 1
GEOTECHNICAL DESIGN PARAMETERS
NOISE BARRIER WALL
SOUTHEAST OF HIGHWAY 401 AT CUBERT STREET

Approx. Station	Borehole Number	Reference Simplified Subsurface Stratigraphy for Design	Approx. depth below ground surface (m)	Geotechnical Design Parameters						
				C_u (kPa)	ϕ' (deg.)	γ (kN/m^3)	γ' (kN/m^3)	n_h (kPa/m)	K_p	Design Groundwater Depth (m)
12+300	NBW-01	Compact to very dense Sand fill	0.0 – 1.4	-	30	20	-	3,000	3.0	5
		Very dense Sand and silt till	1.4 – 5.5	-	34	22	-	8,000	3.5	
		Hard Silty clay till	5.5 – 7.8	250	-	21	-	-	-	
12+270 to 12+310	CS-03 CS-04 CS-09 CS-10	Compact to dense Sand to gravelly sand fill	0.2 – 1.4	-	30	20	-	3,000	3.0	6
		Loose Sand and silt fill	1.4 – 4.0	-	30	20	-	2,500	3.0	
		Dense to very dense Sand and silt to sandy silt till	4.0 – 7.0	-	32	21	11	5,000	3.2	
		Hard to very stiff Clayey silt till	7.0 – 18.5	200	-	21	-	-	-	
12+385 to 12+480	NBW-02 NBW-03	Loose to compact Sand to sandy silt fill	0.1 – 1.4	-	30	20	-	3,000	3.0	5
		Very stiff to hard Clayey silt till	1.4 – 2.0	200	-	21	-	-	-	
		Hard Clayey silt to silty clay till	2.0 – 8.0	250	-	21	-	-	-	

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TABLE 1
GEOTECHNICAL DESIGN PARAMETERS
NOISE BARRIER WALL
SOUTHEAST OF CUBERT STREET
OF CUBERT STREET

Approx. Station	Borehole Number	Reference Simplified Subsurface Stratigraphy for Design	Approx. depth below ground surface (m)	Geotechnical Design Parameters						
				C_u (kPa)	ϕ' (deg.)	γ (kN/m^3)	γ' (kN/m^3)	n_h (kPa/m)	K_p	Design Groundwater Depth (m)
12+555	NBW-04	Dense to loose sand fill	0.0 – 1.4	-	30	20	-	3,000	3.0	6
		Firm to stiff Silty clay	1.4 – 4.1	50	-	19	-	-	-	
		Dense to very dense Sand till	4.1 – 8.1	-	33	21	11	5,000	3.4	
12+615	NBW-05	Dense to loose sand fill	0.2 – 1.4	-	30	20	-	3,000	3.0	3
		Very stiff Clayey silt till	1.4 – 3.0	150	-	20	-	-	-	
		Dense to very dense Sand till	3.0 – 5.6	-	33	-	11	5,000	3.4	
		Hard Clayey silt till	5.6 – 7.9	250	-	21	-	-	-	
12+690	NBW-06	Compact Sand to silty sand fill	0.2 – 3.0	-	30	20	-	3,000	3.0	3
		Stiff Silty clay till	3.0 – 4.1	80	-	20	-	-	-	
		Firm Clayey silt	4.1 – 5.5	50	-	19	-	-	-	
		Very stiff Clayey silt	5.5 – 7.2	150	-	20	-	-	-	
		Hard Silty clay till	7.2 – 8.2	200	-	21	-	-	-	

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TABLE 1
GEOTECHNICAL DESIGN PARAMETERS
NOISE BARRIER WALL
SOUTHEAST OF CUBERT STREET
OF CUBERT STREET

Borehole Number	Reference Simplified Subsurface Stratigraphy for Design	Approx. depth below ground surface (m)	Geotechnical Design Parameters						
			C_u (kPa)	ϕ' (deg.)	γ (kN/m^3)	γ' (kN/m^3)	n_h (kN/m^3)	K_p	Design Groundwater Depth (m)
New Fill (see Note 3)	Variable height above ground surface	-	-	30	20	-	3,000	3.0	Below base of all fills

Legend:

ϕ' = angle of internal friction
γ = bulk unit weight
γ' = submerged unit weight
n_h = coefficient related to soil density
K_p = coefficient of passive earth pressure
C_u = undrained shear strength (kPa)

Notes:

1. This table must be read in conjunction with the report. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.2 m below final grade should be neglected in the foundation design.

2. The design groundwater levels have been selected based on the observed groundwater levels in the open boreholes, soil texture and colour, and anticipated seasonal fluctuations.

3. If new fill is placed, some caissons may be partially embedded within the new fill.

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment 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. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE 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. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

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 are judgmental in nature. 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 persons making use of such documents or records with our express written consent should 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 persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should 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 on the basis of conditions in evidence at the time of site inspections and on the basis of 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 as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons 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 should 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 detailed in the contract documents should 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 in order to confirm and document that the site conditions do not materially differ from those interpreted 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. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. 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 others 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.

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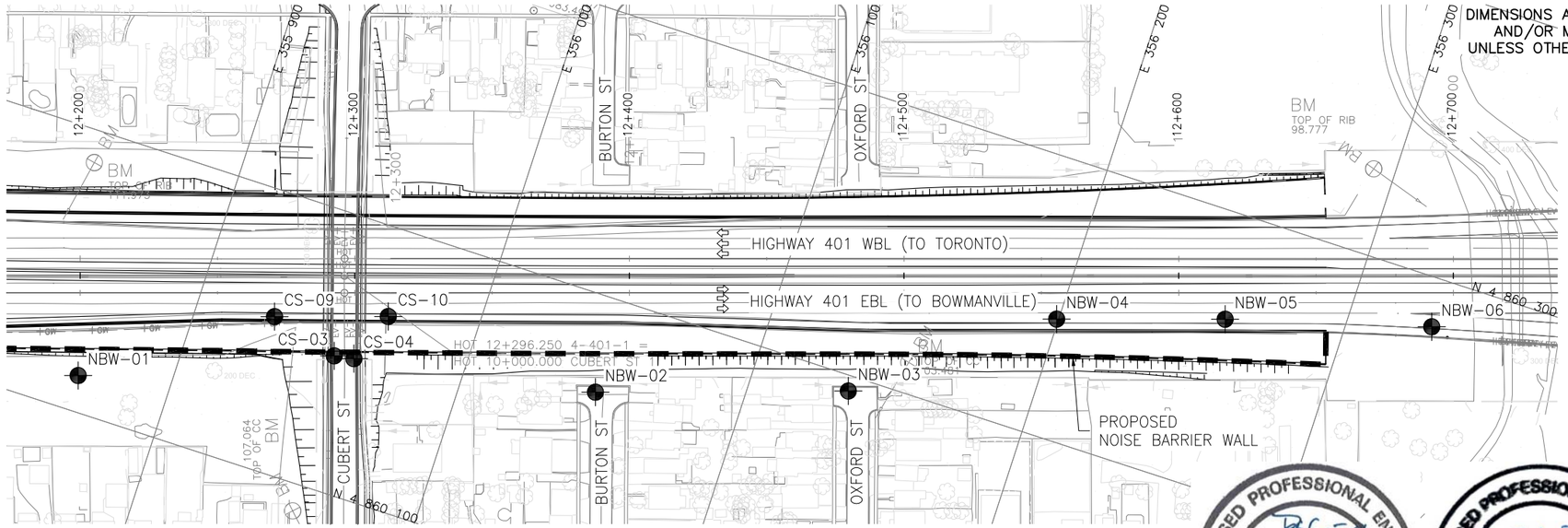
APPENDIX A

Drawing 1 - Borehole Locations and Soil Strata

METRIC

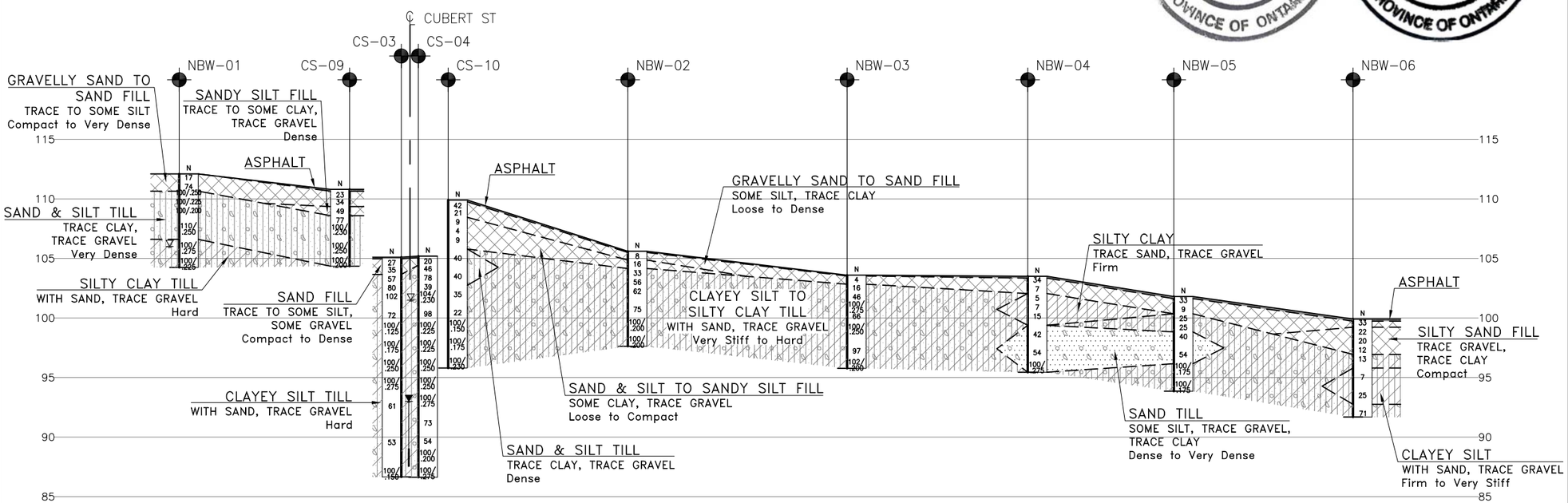
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



PLAN

40 0 40 80m

SCALE 1:2000



PROFILE ALONG PROP. NOISE BARRIER WALL

40 0 40 80m H 1:2000

8 0 8 16m V 1:400

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
2024/07/26
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
S. PANG
35314509
2024/07/26
PROVINCE OF ONTARIO

CONT No
WP No

SHEET

NOISE BARRIER WALL
SE & SW SIDES OF HWY 401
CUBERT STREET OVERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

egis

THURBER ENGINEERING LTD.

Latitude: 43.879684° Longitude: -78.862273°

KEYPLAN

	LEGEND
⊕	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level 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
CS-03	105.1	4 860 148.6	355 953.3
CS-04	105.2	4 860 149.9	355 960.4
CS-09	110.8	4 860 155.5	355 928.3
CS-10	109.9	4 860 168.4	355 967.6
NBW-01	112.2	4 860 112.9	355 866.9
NBW-02	105.6	4 860 165.5	356 047.9
NBW-03	103.6	4 860 194.5	356 135.3
NBW-04	103.5	4 860 242.9	356 199.3
NBW-05	101.8	4 860 261.8	356 257.6
NBW-06	99.9	4 860 282.5	356 330.0

-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. 30M15-352

REVISIONS		
DATE	BY	DESCRIPTION
DESIGN RPR	CHK SKP	CODE / LOAD / DATE JUL 2024
DRAWN AN	CHK RPR	SITE / STRUCT / DWG 1

FILENAME: H:\Drafting\30000\30915\TES-30915-PLPR-SE CUBERT ST NBW.dwg
PLOTDATE: 8/6/2024 2:22 PM

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APPENDIX B

Record of Boreholes - 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

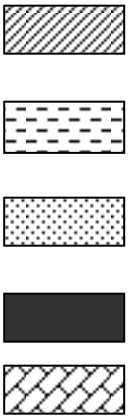
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, 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

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RECORD OF BOREHOLE No NBW-01 1 OF 1 METRIC

WP# 2555-17-00 LOCATION Noise Barrier Wall - SE Cubert St.; MTM83-10: N 4 860 112.9 E 355 866.9 ORIGINATED BY SG

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

DATUM Geodetic DATE 2023.07.06 - 2023.07.06 LATITUDE 43.879223 LONGITUDE -78.864529 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)	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
112.2	GROUND SURFACE										
0.0	**SAND**, trace silt, trace gravel Compact to Very Dense Brown Moist (FILL)		1	SS	17		112		○		
			2	SS	74				○		
110.8							111				
1.4	**SAND** and **SILT**, trace gravel, trace clay, occasional oxidized stains Very Dense Brown Moist (TILL)		3	SS	100/ 0.250				○		
			4	SS	100/ 0.225		110		○		5 52 36 7
			5	SS	100/ 0.200		109		○		
							108				
			6	SS	110/ 0.250				○		2 38 52 8
106.7							107				
5.5	Silty **CLAY**, with sand, trace gravel Hard Grey Moist (TILL)					▽					
			7	SS	100/ 0.275		106		○⊢		2 39 36 23
							105				
104.4			8	SS	100/				○		
7.8	END OF BOREHOLE AT 7.8m. WATER LEVEL IN OPEN BOREHOLE AT 6.1m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO GROUND SURFACE.				0.225						

+ ³, × ³: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No NBW-02 1 OF 1 METRIC

WP# 2555-17-00 LOCATION Noise Barrier Wall - SE Cubert St.; MTM83-10: N 4 860 165.5 E 356 047.9 ORIGINATED BY SG

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

DATUM Geodetic DATE 2023.07.11 - 2023.07.11 LATITUDE 43.879684 LONGITUDE -78.862273 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
105.6	GROUND SURFACE										
0.0	**ASPHALT:** (100mm)										
0.1	**SAND**, some gravel, some silt, trace clay Loose Brown		1	SS	8		105	○	○		15 62 16 7
104.9											
0.7	Moist (FILL)		2	SS	16			○	○		
104.2	Sandy **SILT**, some clay, trace gravel Compact										
1.4	Brown Moist (FILL)		3	SS	33		104	○	○		
	Clayey **SILT**, with sand, trace gravel Hard Brown Moist (TILL)		4	SS	56		103	○	⊢ ○		5 46 32 17
	Occasional oxidized seams		5	SS	62		102	○	○		
	Grey		6	SS	75		101	○	○		
100.0							100				
5.6	Silty **CLAY**, with sand, trace gravel Hard Grey Moist (TILL)		7	SS	100/0.200		99	○	⊢ ○		4 36 37 23
97.6			8	SS	100/0.200		98	○	○		
8.0	END OF BOREHOLE AT 8.0m. NO FREE WATER IN BOREHOLE UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS FROM 8.0m TO 0.2m, THEN ASPHALT COLD PATCH TO GROUND SURFACE.										

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

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

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Ontario

THURBER

RECORD OF BOREHOLE No NBW-03 1 OF 1 METRIC

WP# 2555-17-00 LOCATION Noise Barrier Wall - SE Cubert St.; MTM83-10: N 4 860 194.5 E 356 135.3 ORIGINATED BY SG

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

DATUM Geodetic DATE 2023.07.04 - 2023.07.04 LATITUDE 43.879938 LONGITUDE -78.861182 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, ● QUICK TRIAXIAL, + FIELD VANE, × 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 (%) GR SA SI CL
103.6	GROUND SURFACE										
0.0	**ASPHALT:** (75mm)										
0.1	**SAND**, some gravel, some silt, trace clay Loose Brown		1	SS	4		103	○	○		
102.8											
0.8	Moist (FILL)		2	SS	16				○		
	Clayey **SILT**, with sand, trace gravel Very Stiff to Hard Brown to Grey Moist to Dry (TILL)		3	SS	46		102		○⊢		6 45 31 18
			4	SS	100/ 0.275		101		○		
			5	SS	66				○		5 43 34 18
	Occasional cobbles and boulders Grey Augers grinding at 4.3m		6	SS	100/ 0.250		100		○		
			7	SS	97		99				
							98		○⊢		4 45 33 18
95.8			8	SS	102/ 0.200		97				
7.8	END OF BOREHOLE AT 7.8m. NO FREE WATER IN BOREHOLE UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS FROM 7.8m TO 0.2m, THEN ASPHALT COLD PATCH TO GROUND SURFACE.						96		○		

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

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

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No NBW-04 1 OF 1 METRIC

WP# 2555-17-00 LOCATION Noise Barrier Wall - SE Cubert St.; MTM83-10: N 4 860 242.9 E 356 199.3 ORIGINATED BY SG

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

DATUM Geodetic DATE 2023.11.12 - 2023.11.12 LATITUDE 43.880369 LONGITUDE -78.860381 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
103.5	GROUND SURFACE										
0.0	**ASPHALT:** (150mm)										
0.2	**SAND**, some gravel, trace to some silt, trace clay Dense to Loose Brown Moist (FILL)		1	SS	34		103		○		
			2	SS	7				○		
102.1							102				
1.4	Silty **CLAY**, trace sand, trace gravel Firm to Stiff Brown to Grey Moist		3	SS	5				○		
			4	SS	7		101		⊢○⊣		0 6 46 48
			5	SS	15				○		
99.4							100				
4.1	**SAND**, some gravel, some silt, trace clay Dense to Very Dense Brown to Grey Moist (TILL)		6	SS	42		99		○		
	Augers grinding at 5.6m						98				
			7	SS	54	▽	97		○		15 64 17 4
							96				
95.4			8	SS	100/ 0.275				○		
8.1	END OF BOREHOLE AT 8.1m. WATER LEVEL IN OPEN BOREHOLE AT 6.9m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.3m, THEN ASPHALT COLD PATCH TO GROUND SURFACE.										

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

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

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Ontario

THURBER

RECORD OF BOREHOLE No NBW-05 1 OF 1 METRIC

WP# 2555-17-00 LOCATION Noise Barrier Wall - SE Cubert St.; MTM83-10: N 4 860 261.8 E 356 257.6 ORIGINATED BY SG

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

DATUM Geodetic DATE 2023.12.12 - 2023.12.12 LATITUDE 43.880535 LONGITUDE -78.859653 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
101.8	GROUND SURFACE							20 40 60 80 100	20 40 60		
0.0	**ASPHALT:** (175mm)										
0.2	**SAND**, some gravel, trace to some silt, trace clay Dense to Loose Brown Moist to Wet (FILL)		1	SS	33			○			
100.4			2	SS	9		101	○			
1.4	Clayey **SILT**, with sand, trace gravel Very Stiff Brown to Grey Moist (TILL)		3	SS	25		100	○			5 52 35 8
98.8			4	SS	25		99	○			
3.0	**SAND**, some silt, trace gravel, trace clay Dense to Very Dense Grey Moist (TILL)		5	SS	40		98	○			
96.2			6	SS	54		97	○			9 72 17 2
5.6	Clayey **SILT**, with sand, trace gravel Hard Grey Moist (TILL) Augers grinding at 7.0m		7	SS	100/ 0.175		96	○			
93.9			8	SS	100/ 0.175		95 94	○			2 44 40 14
7.9	END OF BOREHOLE AT 7.9m. NO FREE WATER IN BOREHOLE UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.3m, THEN ASPHALT COLD PATCH TO GROUND SURFACE.										

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

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

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Ontario

THURBER

RECORD OF BOREHOLE No NBW-06 1 OF 1 METRIC

WP# 2555-17-00 LOCATION Noise Barrier Wall - SE Cubert St.; MTM83-10: N 4 860 282.5 E 356 330.0 ORIGINATED BY SG

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

DATUM Geodetic DATE 2023.12.12 - 2023.12.12 LATITUDE 43.880717 LONGITUDE -78.858750 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
99.9	GROUND SURFACE							20 40 60 80 100	20 40 60		
0.0	**ASPHALT:** (175mm)										
0.2	**SAND**, some gravel, trace to some silt, trace clay		1	SS	33				○		
99.2	Dense										
0.7	Brown Wet (FILL)		2	SS	22		99		○		8 60 23 9
	Silty **SAND**, trace gravel, trace clay Compact Brown to Grey Moist (FILL)		3	SS	20		98		○		
			4	SS	12				○		
96.9							97				
3.0	Silty **CLAY**, with sand Stiff Grey Wet (TILL)		5	SS	13				⊢○⊣		0 32 50 18
95.8							96				
4.1	Clayey **SILT**, with sand, trace gravel Firm Grey Moist		6	SS	7		95		○		
							94				
	Very Stiff Grey to Black Moist to Wet Layer of sand (200mm) Augers grinding at 6.7m		7	SS	25				○		
92.7							93				
7.2	Silty **CLAY**, with sand, trace gravel Hard Grey Moist (TILL)		8	SS	71		92		⊢○⊣		0 39 41 20
91.7											
8.2	END OF BOREHOLE AT 8.2m. NO FREE WATER IN BOREHOLE UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.3m, THEN ASPHALT COLD PATCH TO GROUND SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

20
15 5
10
(%) STRAIN AT FAILURE

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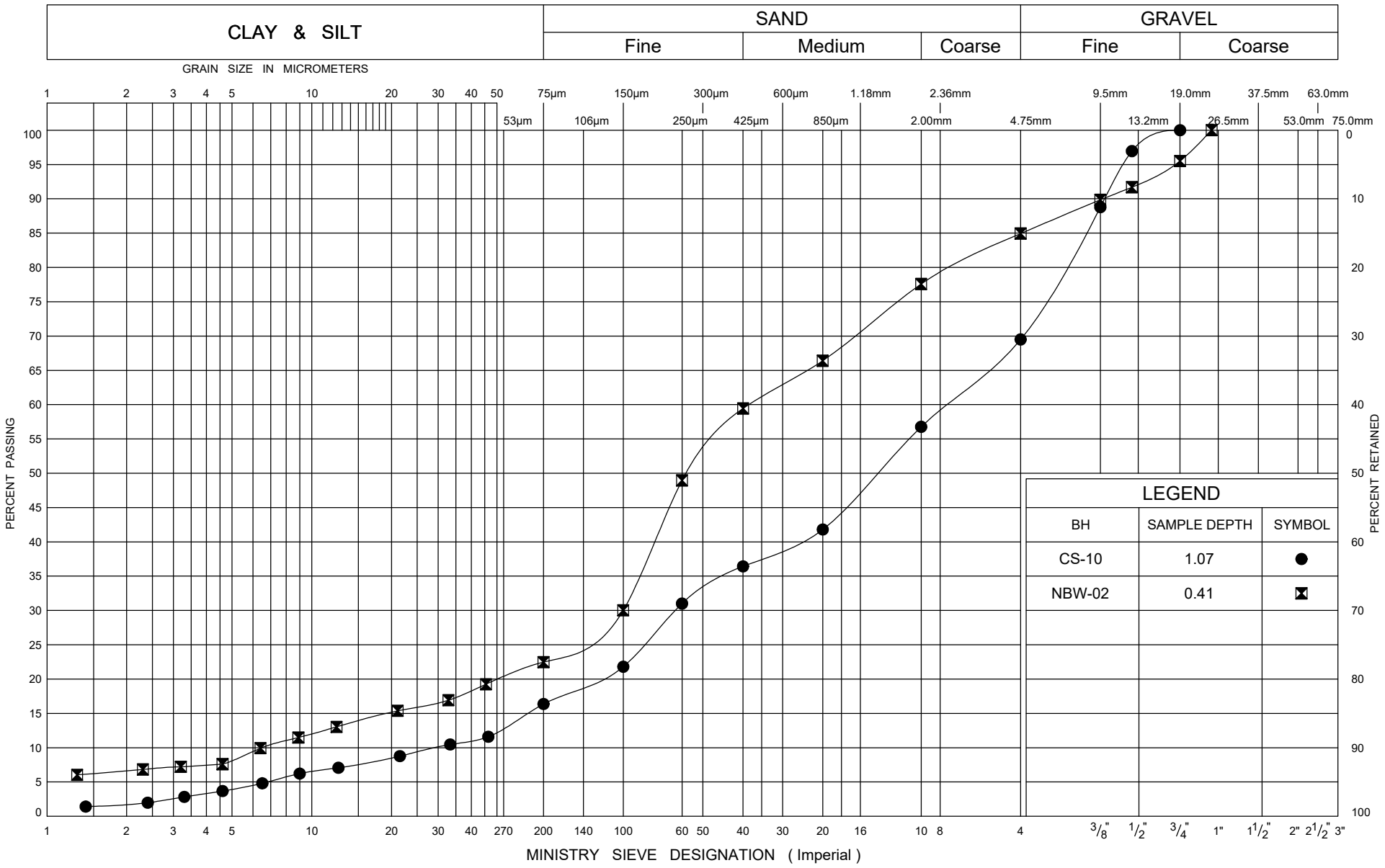
THURBER ENGINEERING LTD.

APPENDIX C

Geotechnical and Analytical Laboratory Test Results



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Ontario

GRAIN SIZE DISTRIBUTION

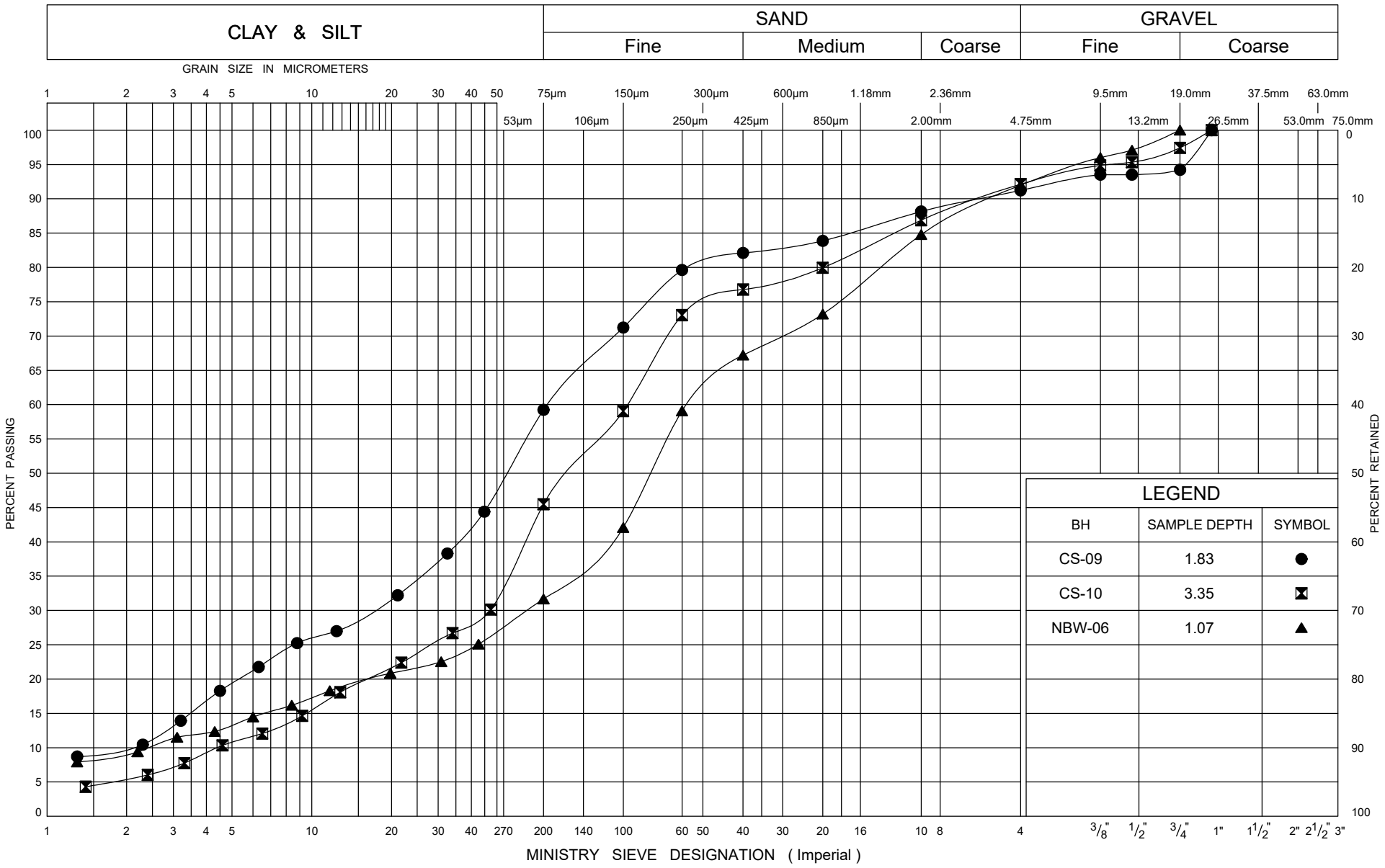
Gravelly SAND to SAND FILL

FIG No C1

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.

ONTARIO MOT GRAIN SIZE 3 MTO-30915.GPJ ONTARIO MOT.GDT 3/12/24



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Ontario

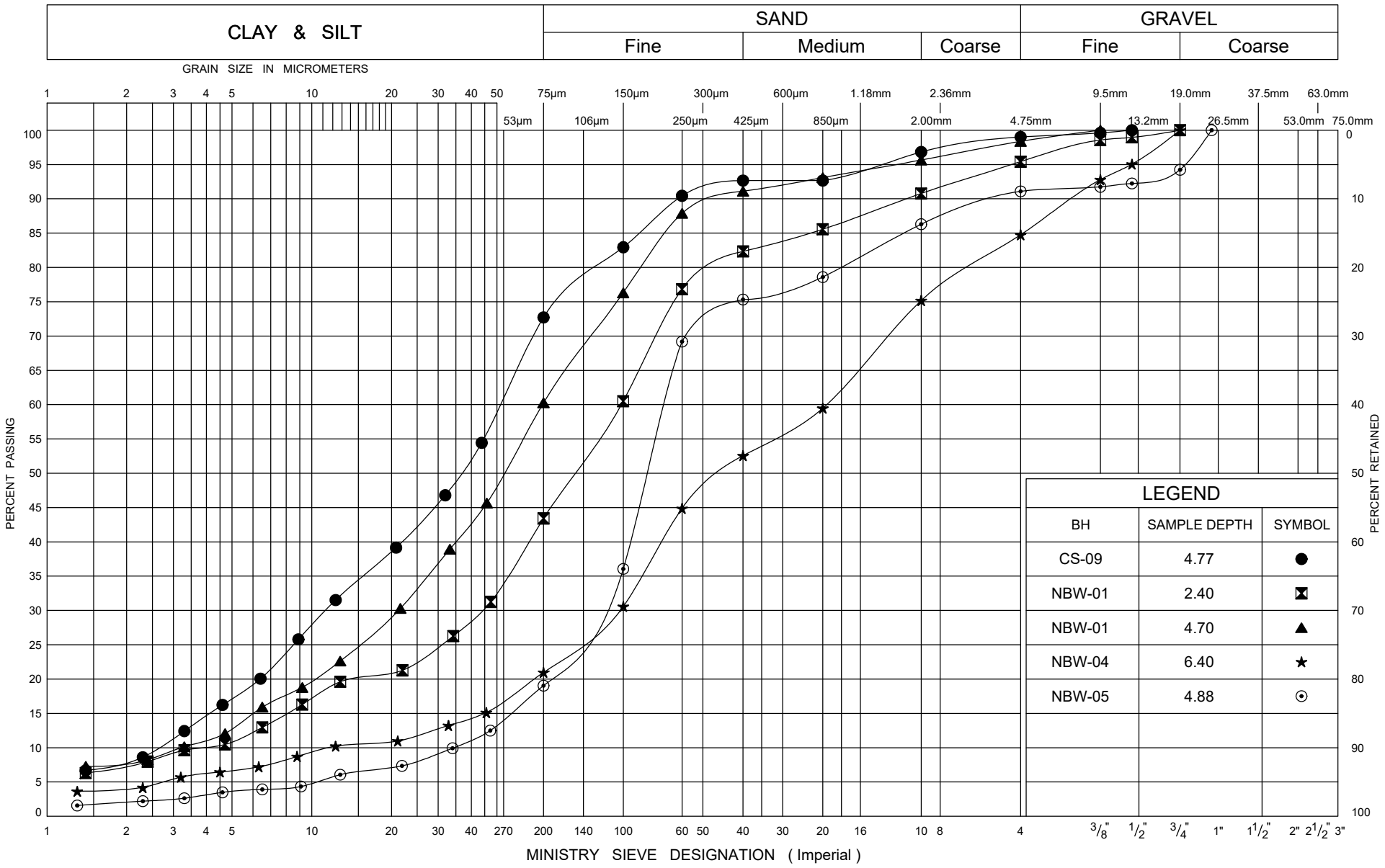
GRAIN SIZE DISTRIBUTION

Silty SAND / Sandy SILT / SAND and SILT

FIG No C2

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.



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Ontario

GRAIN SIZE DISTRIBUTION

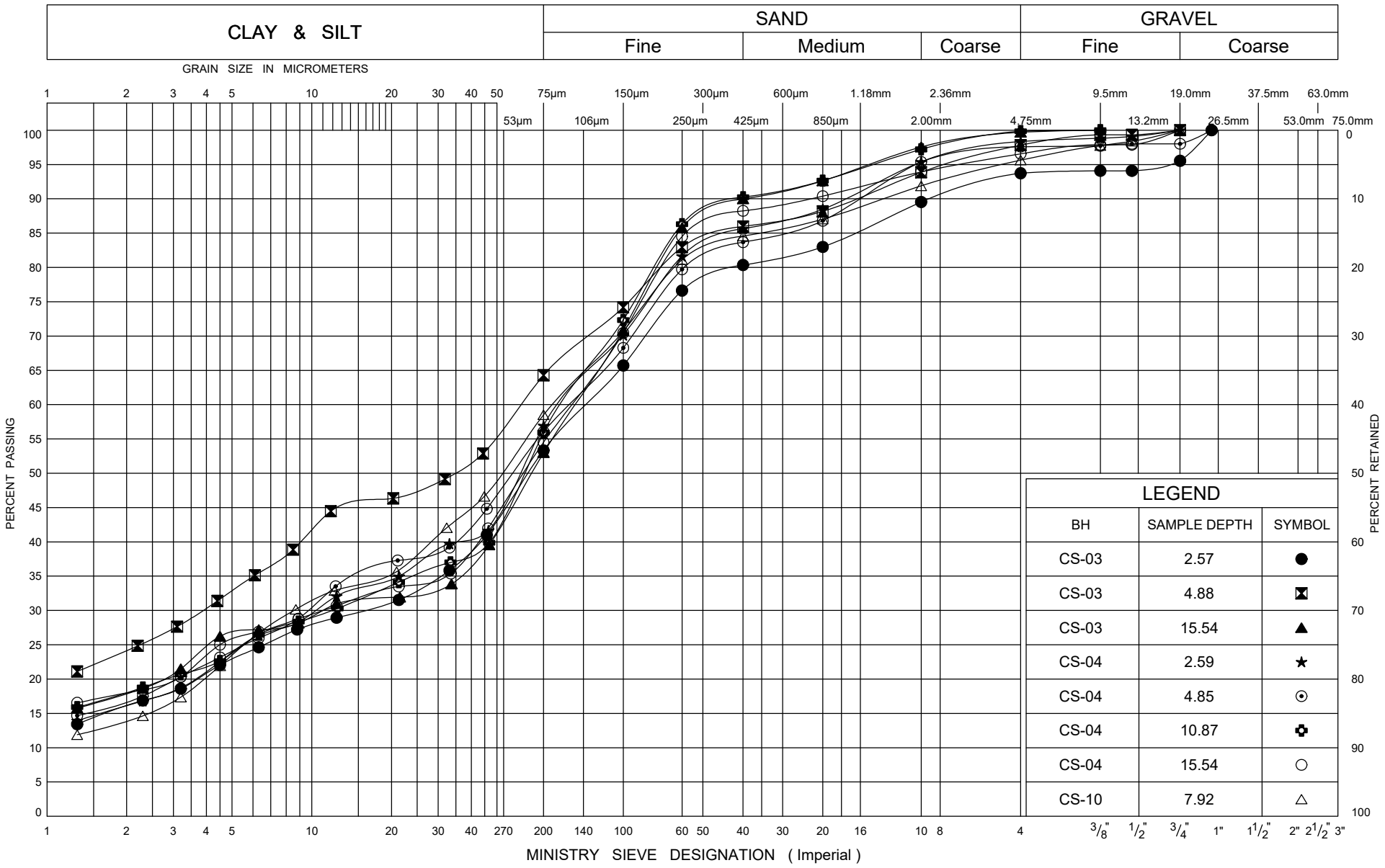
SAND TILL / Silty SAND TILL / SAND and SILT TILL

FIG No C3

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.

ONTARIO MOT GRAIN SIZE 3 MTO-30915.GPJ ONTARIO MOT.GDT 3/12/24



ONTARIO MOT GRAIN SIZE 3 MTO-30915.GPJ ONTARIO MOT.GDT 1/22/24

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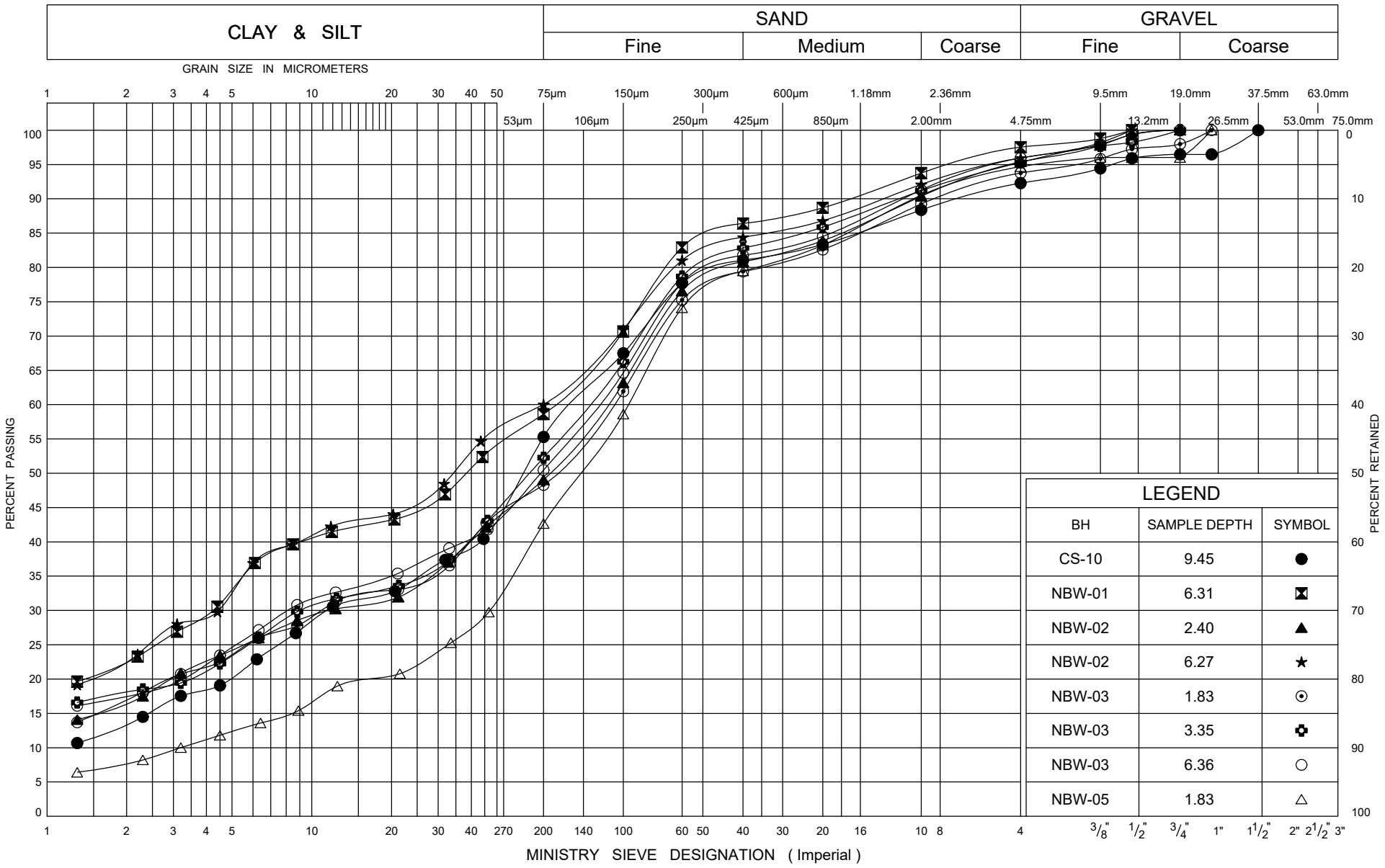
GRAIN SIZE DISTRIBUTION

Clayey SILT TILL / Silty CLAY TILL

FIG No C4

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.



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Ontario

GRAIN SIZE DISTRIBUTION

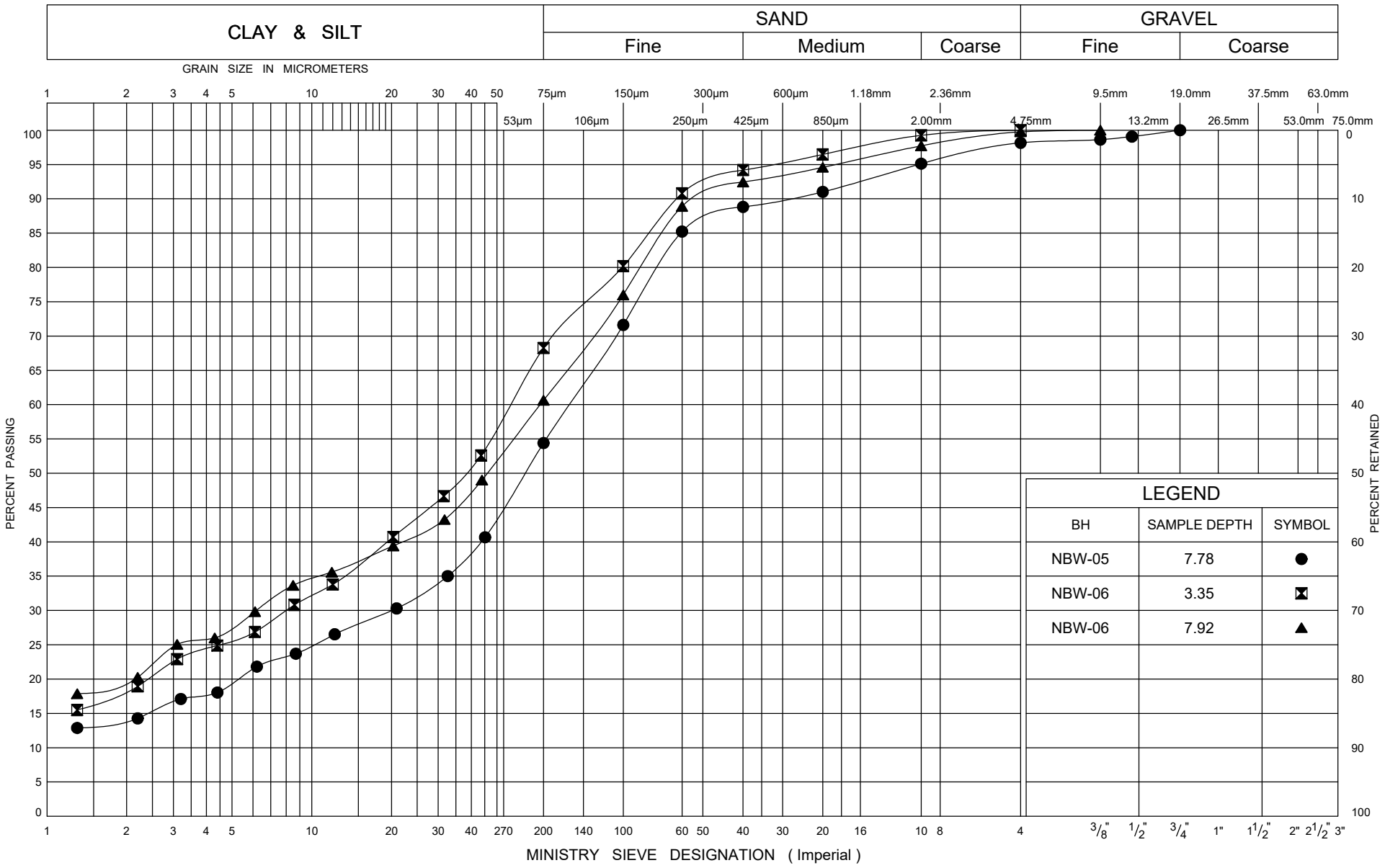
Clayey SILT TILL / Silty CLAY TILL

FIG No C5

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.

ONTARIO MOT GRAIN SIZE 3 MTO-30915.GPJ ONTARIO MOT.GDT 1/23/24



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GRAIN SIZE DISTRIBUTION

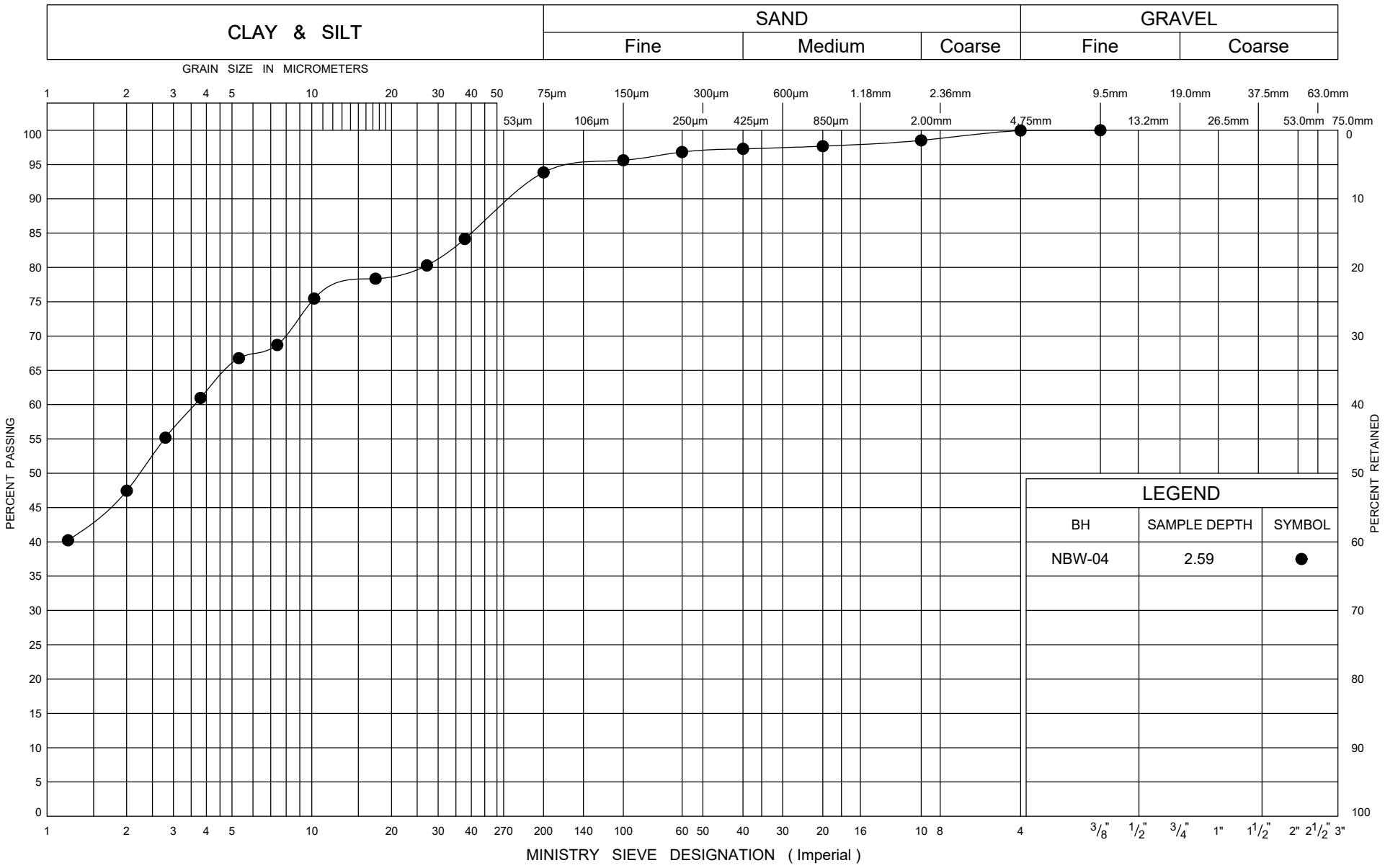
Clayey SILT TILL / Silty CLAY TILL

FIG No C6

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.

ONTARIO MOT GRAIN SIZE 3 MTO-30915.GPJ ONTARIO MOT.GDT 1/23/24



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Ontario

GRAIN SIZE DISTRIBUTION

Silty CLAY

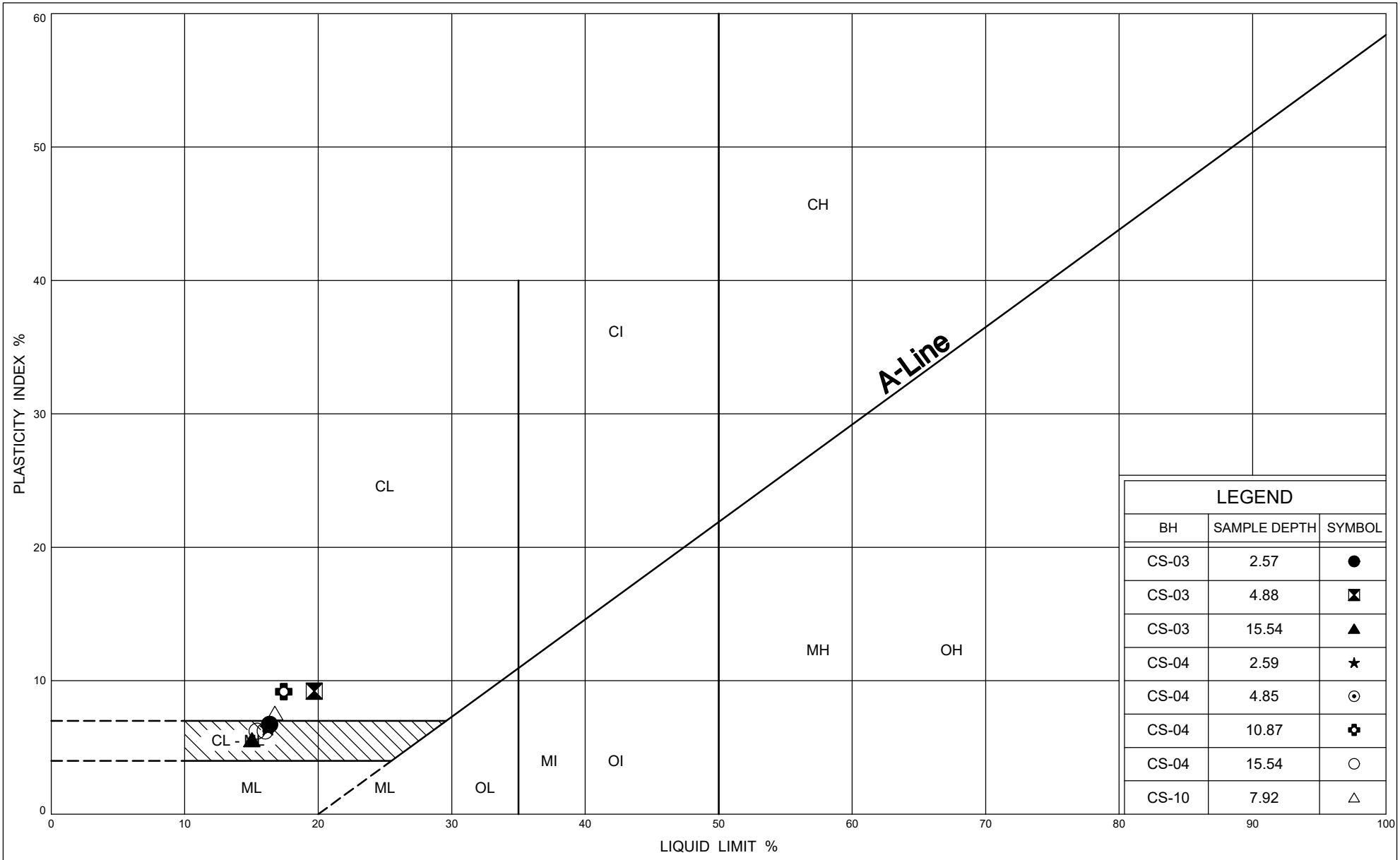
FIG No C7

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.

ONTARIO MOT GRAIN SIZE 3 MTO-30915.GPJ ONTARIO MOT.GDT 1/23/24

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
CS-03	2.57	●
CS-03	4.88	⊠
CS-03	15.54	▲
CS-04	2.59	★
CS-04	4.85	⊙
CS-04	10.87	✿
CS-04	15.54	○
CS-10	7.92	△

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PLASTICITY CHART

Clayey SILT TILL / Silty CLAY TILL

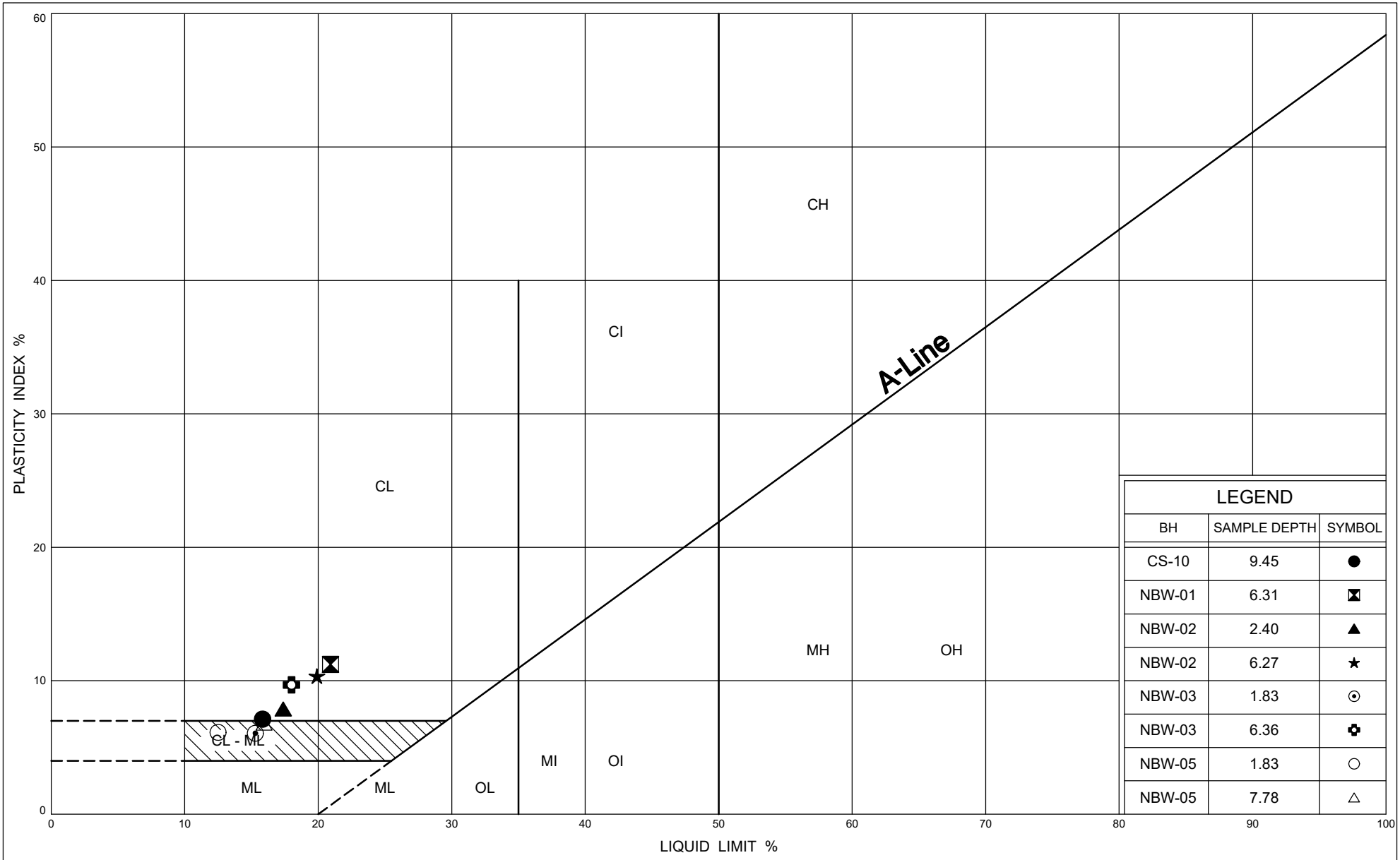
FIG No C8

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.

ONTARIO MOT PLASTICITY CHART 2 MTO-30915.GPJ ONTARIO MOT.GDT 1/23/24

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
CS-10	9.45	●
NBW-01	6.31	⊠
NBW-02	2.40	▲
NBW-02	6.27	★
NBW-03	1.83	⊙
NBW-03	6.36	✿
NBW-05	1.83	○
NBW-05	7.78	△

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PLASTICITY CHART

Clayey SILT TILL / Silty CLAY TILL

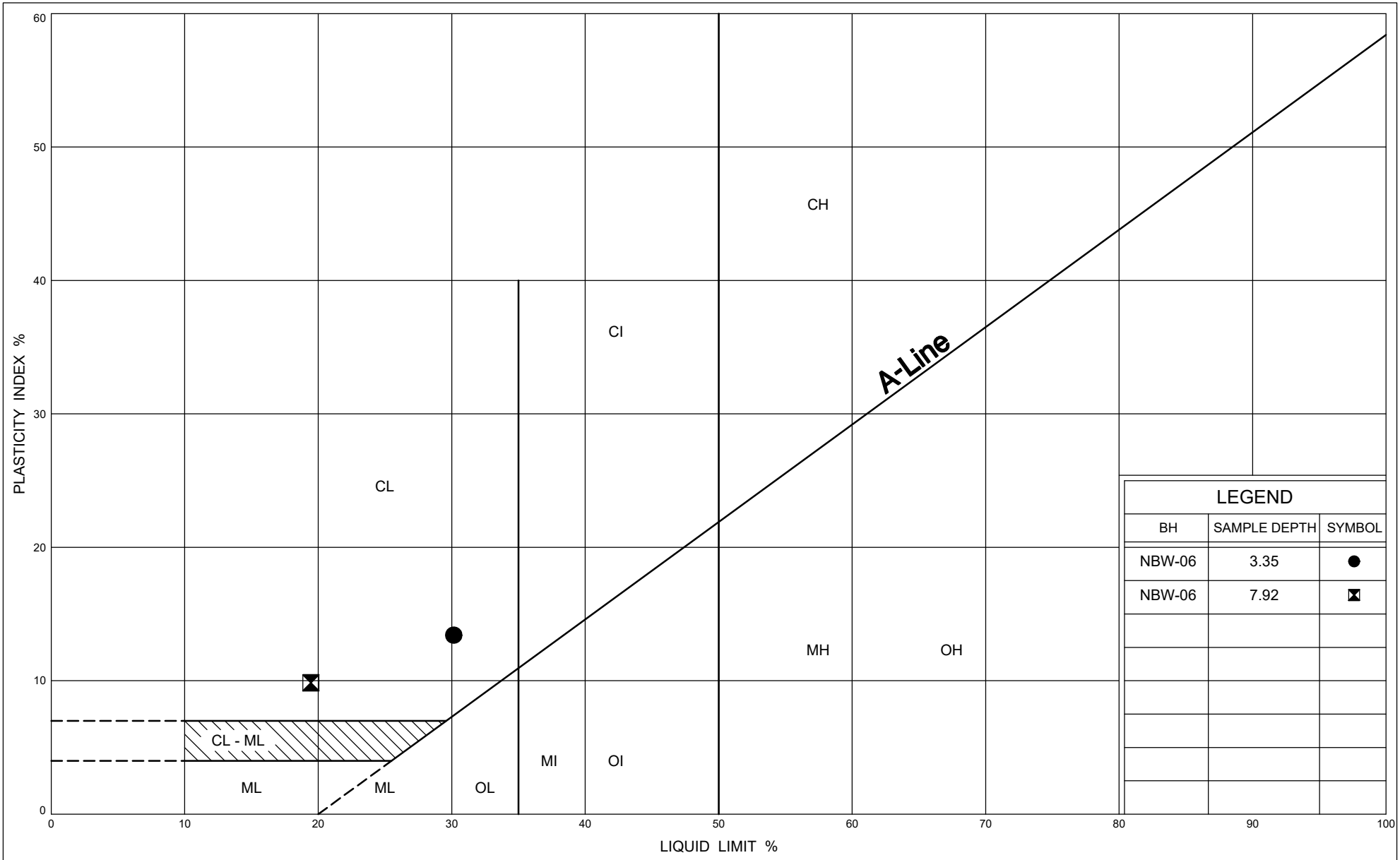
FIG No C9

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.

ONTARIO MOT PLASTICITY CHART 2 MTO-30915.GPJ ONTARIO MOT.GDT 1/23/24

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-30915.GPJ ONTARIO MOT.GDT 1/23/24

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PLASTICITY CHART

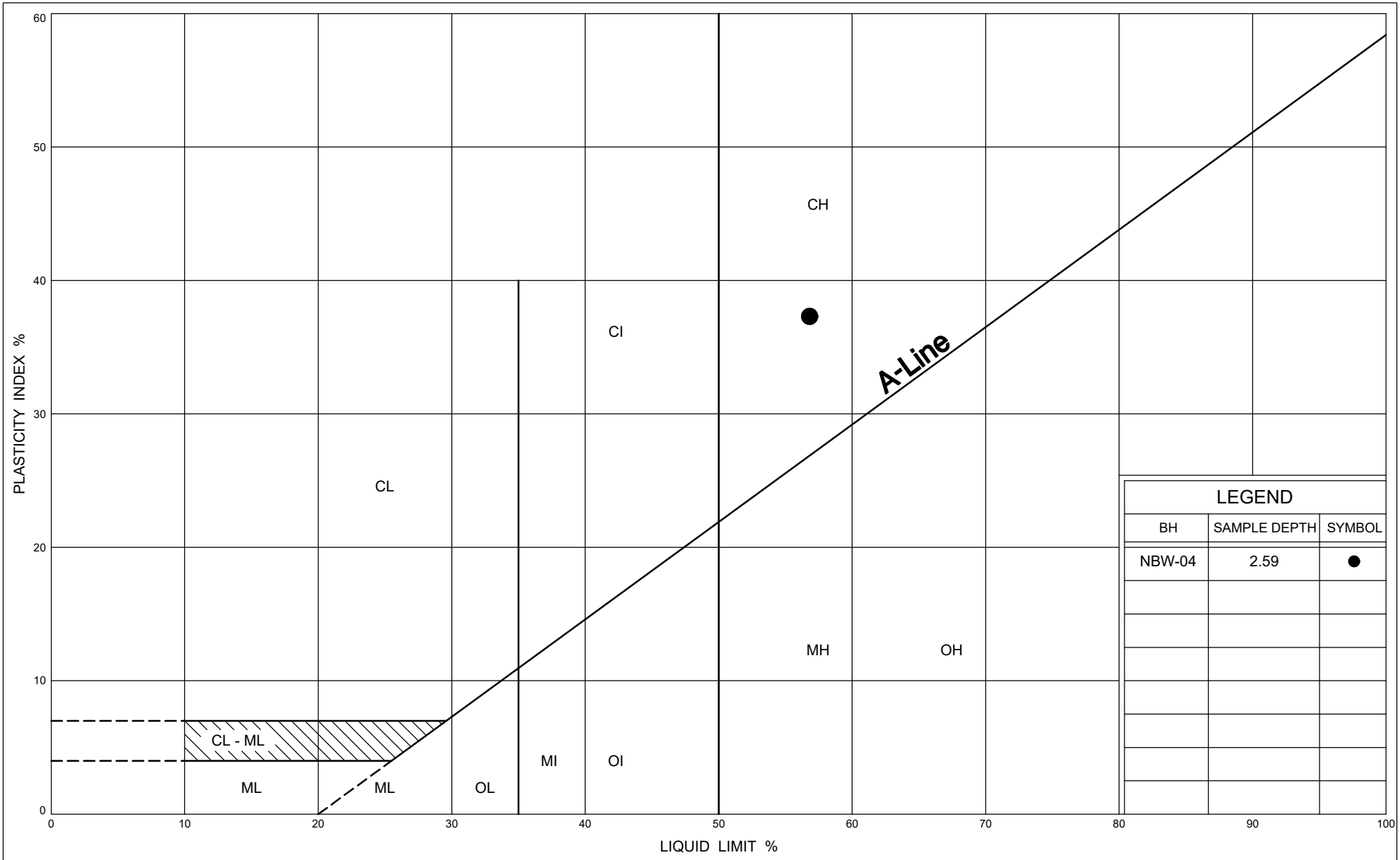
Clayey SILT TILL / Silty CLAY TILL

FIG No C10

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-30915.GPJ ONTARIO MOT.GDT 1/23/24

Ministry of Transportation
Ontario

PLASTICITY CHART

Silty CLAY

FIG No C11

WP# 2555-17-00

Noise Barrier Wall - SE Cubert St.

FINAL REPORT

CA40202-JUN23 R1

30915

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	Rod de Castro
Telephone	
Facsimile	
Email	rdecastro@thurber.ca
Project	30915
Order Number	
Samples	Soil (8)

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	CA40202-JUN23
Received	06/20/2023
Approved	06/29/2023
Report Number	CA40202-JUN23 R1
Date Reported	06/29/2023

COMMENTS

Temperature of Sample upon Receipt: 12 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

Maarit Wolfe, Hon.B.Sc

TABLE OF CONTENTS

FINAL REPORT

CA40202-JUN23 R1

Client: Thurber Engineering Ltd.
Project: 30915
Project Manager: Rod de Castro
Samplers: Abdul Basit

MATRIX: SOIL

			Sample Number	5	6	7	8	9	10	11	12
			Sample Name	PRS-01 SS5	PRS-02 SS5	PRS-03 SS5	PRS-04 SS4	CS-01 SS5	CS-02 SS5	CS-03 SS3	CS-04 SS4
			Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			Sample Date	16/11/2022	17/11/2022	14/11/2022	22/11/2022	23/11/2022	12/01/2023	12/12/2022	25/11/2022
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Corrosivity Index											
Corrosivity Index	none	1		6	6	6	18	8	4	6	6
Soil Redox Potential	mV	no		254	210	241	204	269	314	314	291
Sulphide (Na2CO3)	%	0.04		0.06	0.05	0.06	0.06	0.11	0.06	0.07	0.05
pH	pH Units	0.05		8.63	8.52	8.39	8.61	8.69	8.44	8.57	8.54
Resistivity (calculated)	ohms.cm	-9999		5590	7300	2480	972	2650	5050	3150	5460
General Chemistry											
Conductivity	uS/cm	2		179	137	403	1030	378	198	317	183
Metals and Inorganics											
Moisture Content	%	0.1		0.9	4.2	3.6	5.7	0.7	1.6	0.6	0.4
Sulphate	µg/g	0.4		100	120	160	160	350	250	200	210
Other (ORP)											
Chloride	µg/g	0.4		47	40	2400	3400	18	18	47	14

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	DIO0625-JUN23	µg/g	0.4	<0.4	4	35	95	80	120	100	75	125
Sulphate	DIO0625-JUN23	µg/g	0.4	<0.4	15	35	96	80	120	99	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)	ECS0057-JUN23	%	0.04	< 0.04	ND	20	109	80	120			
Sulphide (Na2CO3)	ECS0066-JUN23	%	0.04	< 0.04	ND	20	115	80	120			

QC SUMMARY

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-JUN23	uS/cm	2	< 2	0	20	98	90	110	NA		

pH

Method: SM 4500 | 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-JUN23	pH Units	0.05	NA	0		100			NA		

QC SUMMARY

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: K.McKinnon
Received Date (mm/dd/yy): 06-20-23
Received Time: 14:40
Received By (signature):
Custody Seal Present: ☑
Custody Seal Intact: ☑
Cooling Agent Present: ☑
Temperature Upon Receipt (°C): 12.3
LAB LIMS #: CA40202-Jn23

REPORT INFORMATION	INVOICE INFORMATION	PROJECT INFORMATION
Company: Thurber Engineering Ltd.	☑ (same as Report Information)	Quotation #: P.O. #:
Contact: Rod de Castro	Company:	Project #: 30915 Site Location/ID:
Address: 103-2010 Winston Park Drive, Oakville, Ontario	Contact:	**TURNAROUND TIME (TAT) REQUIRED**
Phone: 905 829 8666 x 5244	Address:	☑ 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
Email: rdecastro@thurber.ca	Phone:	**RUSH TAT (Additional Charges May Apply):** ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
Email:	Email:	**PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION**
		Specify Due Date: Rush Confirmation ID:

REGULATIONS

Regulation 153/04:	Other Regulations:	Sewer By-Law:
☐ Table 1 ☐ R/P/I	☐ Reg 347/558 (3 Day min TAT)	☐ Sanitary
☐ Table 2 ☐ I/C/C	☐ PWQO ☐ MMER	☐ Storm
☐ Table 3 ☐ A/O	☐ CCME ☐ Other:	Municipality:
☐ Table ____	☐ MISA	
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine		

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

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 ☐ BTEX ☐ VOC ☐ 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:	Corrosivity/Resistivity					COMMENTS:
1	PRS-01 SS5	11/16/22	AM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
2	PRS-02 SS5	11/17/22	AM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
3	PRS-03 SS5	11/14/22	AM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
4	PRS-04 SS4	11/22/22	AM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
5	CS-01 SS5	11/23/22	AM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
6	CS-02 SS5	1/12/23	AM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
7	CS-03 SS3	12/5/22	AM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
8	CS-04 SS4	11/25/22	AM	1	SOIL		☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	
9							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
10							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
11							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
12							☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Observations/Comments/Special Instructions

Sampled By (NAME):	Abdul Basit	**Signature:** AB	Date: 06/19/23	(mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME):	Czarlene Pontejos	**Signature:** C-P.	Date: 06/20/23	(mm/dd/yy)	Yellow & White Copy - SGS

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

THURBER ENGINEERING LTD.

APPENDIX D

Record of Boreholes - Previous Investigation

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CS-03 1 OF 2 METRIC

WP# 2555-17-00 LOCATION Cubert Street Bridge; MTM83-10: N 4 860 148.6 E 355 953.3 ORIGINATED BY SG

DIST HWY 401 BOREHOLE TYPE Hollow Stem Augers/PW Casing/Tri-Coring COMPILED BY AN

DATUM Geodetic DATE 2022.12.05 - 2022.12.05 LATITUDE 43.879538 LONGITUDE -78.863451 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
105.1	GROUND SURFACE										
0.0	**ASPHALT:** (125mm)						105				
0.1	**SAND**, trace to some silt, some gravel Compact to Dense Brown Wet (FILL)		1	SS	27				○		
			2	SS	35		104		○		
103.7											
1.4	Clayey **SILT**, with sand, trace gravel Hard Grey Moist (TILL)		3	SS	57				○		
			4	SS	80		103		○⊢		6 40 37 17
			5	SS	102	▽	102				
			6	SS	72		101		⊢●		2 34 40 24
			7	SS	100/.125		100		○		
			8	SS	100/.175		99		○		
			9	SS	100/.250		98		○		
							97				
							96		○		

Continued Next Page

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CS-03 2 OF 2 METRIC

WP# 2555-17-00 LOCATION Cubert Street Bridge; MTM83-10: N 4 860 148.6 E 355 953.3 ORIGINATED BY SG

DIST HWY 401 BOREHOLE TYPE Hollow Stem Augers/PW Casing/Tri-Coring COMPILED BY AN

DATUM Geodetic DATE 2022.12.05 - 2022.12.05 LATITUDE 43.879538 LONGITUDE -78.863451 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Clayey **SILT**, with sand, trace gravel Hard Grey Moist (TILL)						95				
			10	SS	100/.275		94		○		
			11	SS	61		93		○		
			12	SS	53		92		⊖		0 47 35 18
							91				
							90				
							89				
							88				
86.7			13	SS	100/.150		87		○		
18.4	END OF BOREHOLE AT 18.4m ON SPLIT SPOON REFUSAL ON POSSIBLE BEDROCK. WATER ADDED TO BOREHOLE DURING DRILLING AND WATER LEVEL MEASURED AT 3.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, THEN CONCRETE TO 0.2m, THEN ASPHALT 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 CS-04 1 OF 2 METRIC

WP# 2555-17-00 LOCATION Cubert Street Bridge; MTM83-10: N 4 860 149.9 E 355 960.4 ORIGINATED BY SG

DIST HWY 401 BOREHOLE TYPE Hollow Stem Augers/PW Casing/Tri-Coring COMPILED BY AN

DATUM Geodetic DATE 2022.11.25 - 2022.11.28 LATITUDE 43.879549 LONGITUDE -78.863362 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
105.2	GROUND SURFACE										
0.0	**ASPHALT:** (125mm)										
0.1	**SAND**, trace to some gravel, trace silt Compact Brown Moist (FILL)		1	SS	20		105		○		
104.4 0.8	Clayey **SILT**, with sand, trace gravel Hard Grey Moist to wet (TILL)		2	SS	46		104		○		
			3	SS	78		103		○		
			4	SS	39				○⊢		2 41 41 16
			5	SS	104/.230		102		○		
			6	SS	98		101		○⊢		2 42 39 17
			7	SS	100/.225		100		○		
			8	SS	100/.225		99		○		
			9	SS	100/.250		98		○		
							97				
							96				

Continued Next Page

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CS-04 2 OF 2 METRIC

WP# 2555-17-00 LOCATION Cubert Street Bridge; MTM83-10: N 4 860 149.9 E 355 960.4 ORIGINATED BY SG

DIST HWY 401 BOREHOLE TYPE Hollow Stem Augers/PW Casing/Tri-Coring COMPILED BY AN

DATUM Geodetic DATE 2022.11.25 - 2022.11.28 LATITUDE 43.879549 LONGITUDE -78.863362 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										
	Clayey **SILT**, with sand, trace gravel Hard Grey Moist to wet (TILL)						95				
			10	SS	100/.250						0 44 38 18
							94				
			11	SS	100/.275		93				
							92				
			12	SS	73						
							91				
			13	SS	54		90				3 42 37 18
							89				
			14	SS	100/.200		88				
							87				
86.6			15	SS	100/.275						
18.6	END OF BOREHOLE AT 18.6m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.5m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.05.18 12.2 93.0										

$+^3$, $\times^3$: 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 CS-09 1 OF 1 METRIC

WP# 2555-17-00 LOCATION Cubert Street Bridge: MTM83-10; N 4 860 155.5 E 355 928.3 ORIGINATED BY SG

DIST HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2022.11.07 - 2022.11.07 LATITUDE 43.879601 LONGITUDE -78.863762 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
110.8	GROUND SURFACE										
0.0	**ASPHALT:** (150mm)										
0.2	Gravelly **SAND**, trace to some silt Compact to Dense Brown Moist (FILL)		1	SS	23				○		
			2	SS	34		110		○		
109.4											
1.4	Sandy **SILT**, trace to some clay, trace gravel Dense Brown Moist (FILL)		3	SS	49		109		○		9 32 49 10
108.6											
2.2	Sandy **SILT**, trace clay, trace gravel Very Dense Brown Moist (TILL)		4	SS	77		108		○		
			5	SS	100/ 230		107		○		
			6	SS	100/ 250		106		○		1 26 65 8
							105				
104.4	Grey		7	SS	100/ 200				○		
6.4	END OF BOREHOLE AT 6.4m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 0.3m, THEN CONCRETE TO 0.2m, THEN ASPHALT TO GROUND SURFACE.										

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

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

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CS-10 1 OF 2 METRIC

WP# 2555-17-00 LOCATION Cubert Street Bridge: MTM83-10; N 4 860 168.4 E 355 967.6 ORIGINATED BY SG

DIST HWY 401 BOREHOLE TYPE COMPILED BY AN

DATUM Geodetic DATE 2022.11.06 - 2022.11.06 LATITUDE 43.879715 LONGITUDE -78.863271 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
109.9	GROUND SURFACE										
0.0	**ASPHALT:** (150mm)										
0.2	Gravelly **SAND**, some silt, trace clay Dense to Compact Brown Moist (FILL)		1	SS	42						
			2	SS	21		109				30 53 15 2
108.5											
1.4	**SAND** and **SILT**, trace clay, trace gravel Loose Brown Wet (FILL)		3	SS	9		108				
			4	SS	4		107				
			5	SS	9						8 47 40 5
105.8							106				
4.1	**SAND** and **SILT**, trace clay, trace gravel Dense Brown Moist (TILL)		6	SS	40		105				
	Grey		7	SS	40		104				
102.7							103				
7.2	Clayey **SILT**, with sand, trace gravel Hard to Very Stiff Grey Moist (TILL)		8	SS	35		102				4 37 45 14
			9	SS	22		101				8 37 42 13
							100				

Continued Next Page

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

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CS-10 2 OF 2 METRIC

WP# 2555-17-00 LOCATION Cubert Street Bridge: MTM83-10; N 4 860 168.4 E 355 967.6 ORIGINATED BY SG

DIST HWY 401 BOREHOLE TYPE COMPILED BY AN

DATUM Geodetic DATE 2022.11.06 - 2022.11.06 LATITUDE 43.879715 LONGITUDE -78.863271 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							20 40 60 80 100	20 40 60		
	Clayey **SILT**, with sand, trace gravel Hard Grey Moist (TILL)		10	SS	100/.150		99		○		
			11	SS	100/.175		98		○		
							97				
95.8			12	SS	100/.230		96		○		
14.1	END OF BOREHOLE AT 14.1m. BOREHOLE OPEN AND DRY UPON COMPLETION. BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m THEN CONCRETE TO 0.2m THEN ASPHALT TO GROUND SURFACE.										

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

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

THURBER ENGINEERING LTD.

APPENDIX E

Selected Site Photographs

Photo 1- South Side of Highway 401 and Cubert St. Overpass
Date: July 2023

Photo 2- South Side of Highway 401 and Cubert St. Overpass
East abutment, south side (looking east)
Date: July 2023

Photo 3- South Side of Highway 401 and Cubert St. Overpass
West abutment, south side (looking west)
Date: July 2023

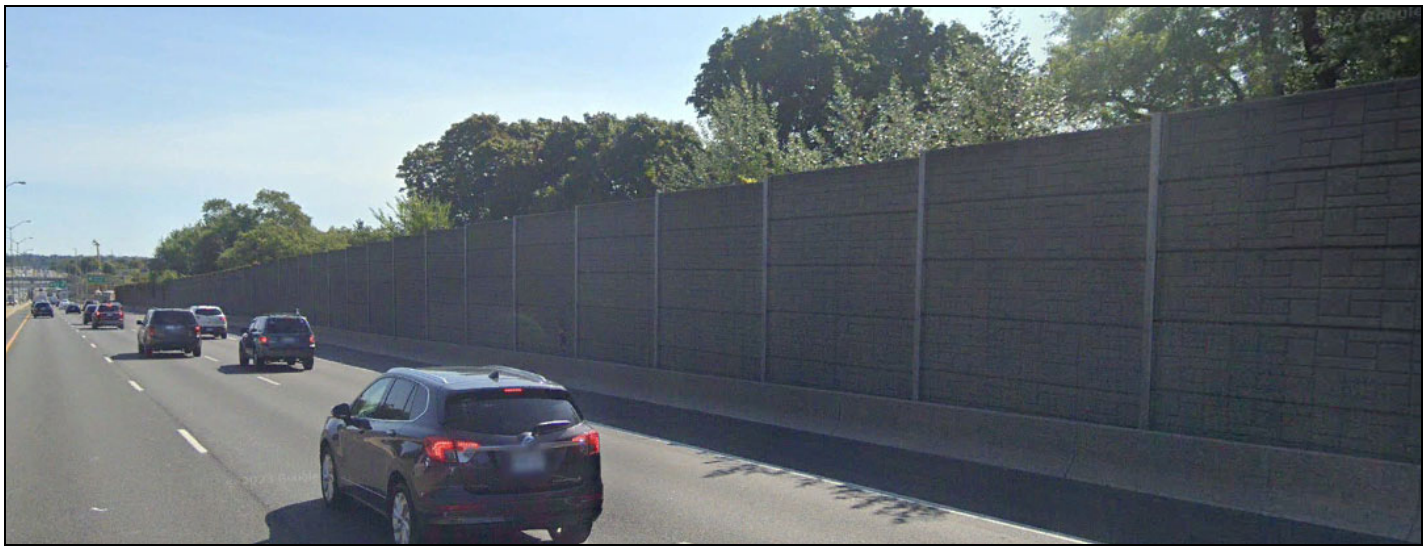

Photo 4- South Side of Highway 401 and Cubert St. (looking east)

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APPENDIX F

NBCC Seismic Hazard Calculation

30915-Cubert St. & Hwy 401

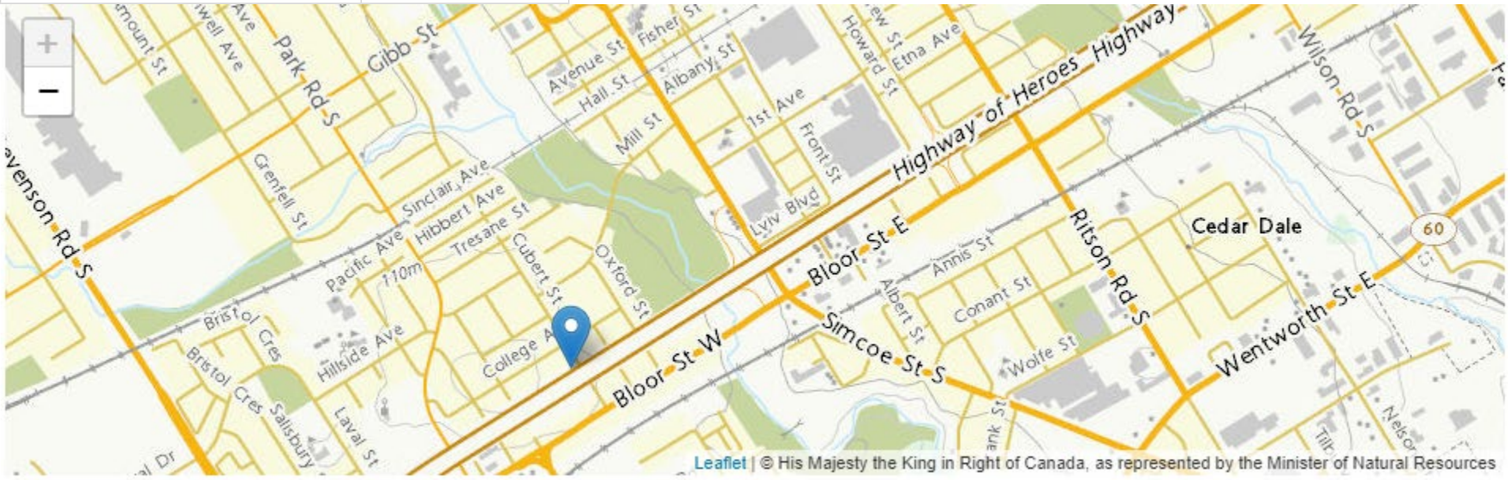
2020 National Building Code of Canada Seismic Hazard Tool

This application provides seismic values for the design of buildings in Canada under Part 4 of the National Building Code of Canada (NBC) 2020 as prescribed in Article 1.1.3.1. of Division B of the NBC 2020.

Seismic Hazard Values

User requested values

Code edition	NBC 2020
Site designation X_s	X_c
Latitude (°)	43.88
Longitude (°)	-78.864



Selected coordinates are 43.880,-78.864

The 5%-damped spectral acceleration (S_a(T,X), where T is the period, in s, and X is the site designation) and peak ground acceleration (PGA(X)) values are given in units of acceleration due to gravity (g, 9.81 m/s^2). Peak ground velocity (PGV(X)) values are given in m/s. Probability is expressed in terms of percent exceedance in 50 years. Further information on the calculation of seismic hazard is provided under the *Background Information* tab.

The 2%-in-50-year seismic hazard values are provided in accordance with Article 4.1.8.4. of the NBC 2020. The 5%- and 10%-in-50-year values are provided for additional performance checks in accordance with Article 4.1.8.23. of the NBC 2020.

See the *Additional Values* tab for additional seismic hazard values, including values for other site designations, periods, and probabilities not defined in the NBC 2020.

NBC 2020 - 2%/50 years (0.000404 per annum) probability

$S_a(0.2, X_C)$	$S_a(0.5, X_C)$	$S_a(1.0, X_C)$	$S_a(2.0, X_C)$	$S_a(5.0, X_C)$	$S_a(10.0, X_C)$	$PGA(X_C)$	$PGV(X_C)$
0.319	0.198	0.106	0.0494	0.013	0.00442	0.169	0.13

The log-log interpolated 2%/50 year $S_a(4.0, X_C)$ value is : **0.0180**

Code	Latitude	Longitude	Site Designation	Probability (% in 50 years)	Sa(0.2) [g]	Sa(0.5) [g]	Sa(1.0) [g]	Sa(2.0) [g]	Sa(5.0) [g]	Sa(10.0) [g]	PGA [g]	PGV [m/s]	Log-log interpolated Sa(4.0) [g]	Date Generated
nbc2020	43.88	-78.864	XC	2	0.319	0.198	0.106	0.0494	0.013	0.00442	0.169	0.13	0.018	Tue Oct 10 2023 21:40:52 GMT-0400 (Eastern Daylight Time)
nbc2020	43.88	-78.864	XC	5	0.18	0.115	0.0607	0.0278	0.0069	0.00238	0.091	0.071	0.0097	Tue Oct 10 2023 21:40:52 GMT-0400 (Eastern Daylight Time)
nbc2020	43.88	-78.864	XC	10	0.11	0.0717	0.0375	0.0167	0.00388	0.00135	0.0532	0.0418	0.0055	Tue Oct 10 2023 21:40:52 GMT-0400 (Eastern Daylight Time)

THURBER ENGINEERING LTD.

APPENDIX G

OPS Used in the Report and Suggested Wordings for NSSP

THURBER ENGINEERING LTD.

1. List of OPSS and OPSD Referenced in this Report

- OPSS.PROV 903 Construction Specification for Deep Foundations
- OPSS.MUN 760 Construction Specification for Noise Barrier Systems
- SP 760F01 Noise Barrier Systems

2. Suggested Text for Augered Caisson Construction for Noise Barrier Wall Foundations

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

The following shall be noted for caisson installation/construction:

1. The design groundwater level is selected to be ranging within 2 m and 3 m depths below existing ground surface. Water seepage and/or soil sloughing into the caisson hole will occur from the cohesionless soils if unsupported. The cohesionless soils at the base will be susceptible to disturbance under conditions of unbalanced hydrostatic head. Base heave could occur if softer cohesive soils are exposed at the caisson base. Water supply shall be made available on site to maintain a balancing water head inside the caisson hole during installation. Temporary liners shall be available on site to support the caisson sidewalls and provide partial seepage cut-off. The pumped tremie technique may be used to place the concrete. Concrete must be placed within 4 hours after completing the excavation of the caisson hole.
2. Caisson installation equipment must be able to dislodge, handle, remove or otherwise penetrate any obstructions that might be encountered.

The Contractor is responsible for constructing the noise barrier wall foundations without disturbing the materials at the sides or bases of the foundations.