FINAL REPORT

Foundation Investigation
Retaining Wall Rehabilitation and Replacement
Highway 417 from Holland Avenue to Kent Street
Ottawa, Ontario

G.W.P. 4173-15-00

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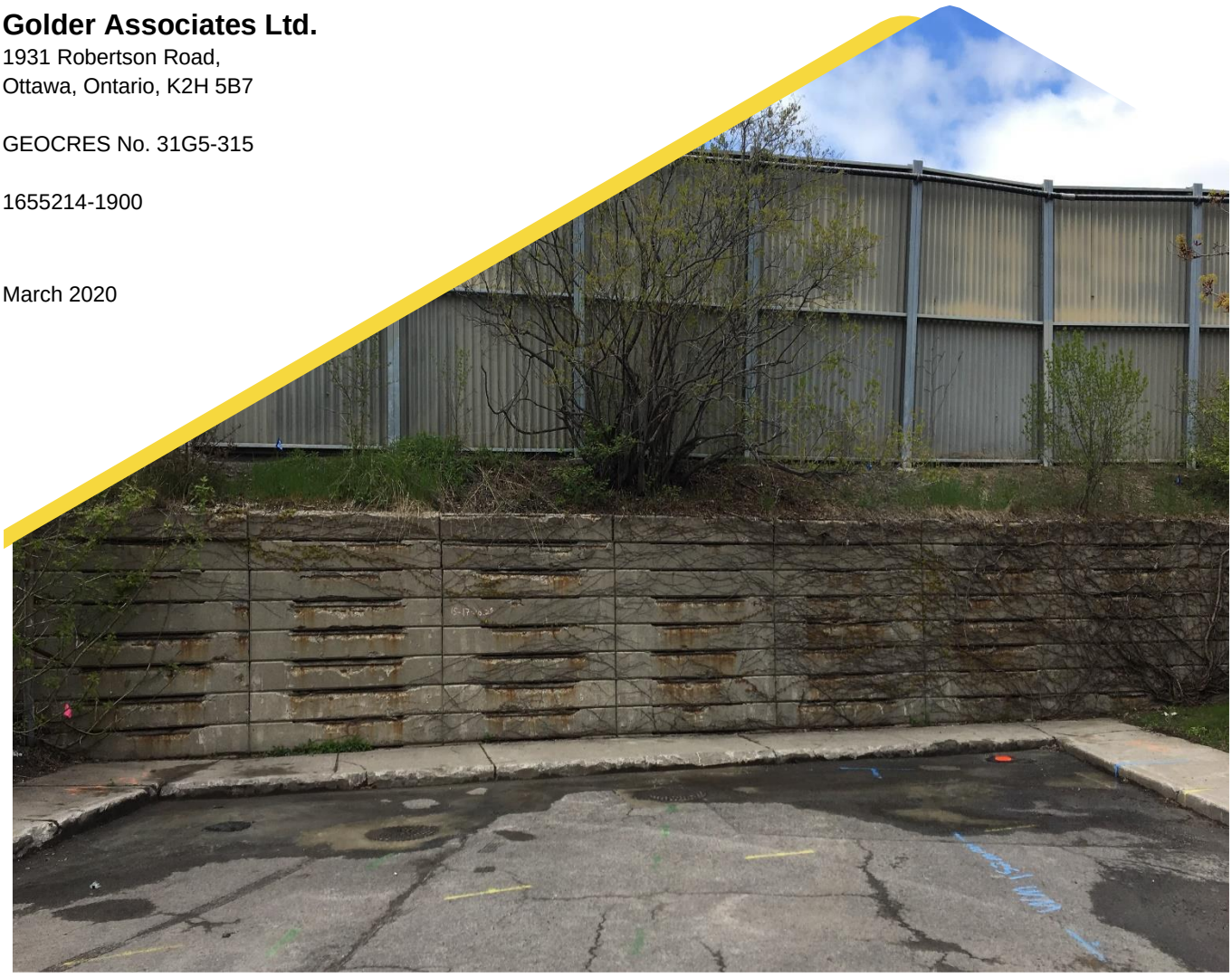

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PART A

Foundation Investigation
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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by WSP Canada Group Limited (WSP) on behalf of the Ministry of Transportation, Ontario (MTO) to carry out foundation investigations associated with the detailed design of numerous bridge replacements, overhead signs, noise barrier walls, retaining walls, temporary roadway protection systems, replacement of storm sewers (including trenchless crossings) and a high fill embankment on Highway 417 between Island Park Drive and Kent Street in Ottawa, Ontario (Assignment number 4016-E-0001).

This report presents the results of the foundation investigation carried out for the rehabilitation/replacement of ten retaining wall structures between Holland Avenue and Kent Street. The rehabilitation/replacement of the structures is to be carried out in accordance with the current version of the Canadian Highway Bridge Design Code, S6-14 (CHBDC).

The work described herein was not included in the original Terms of Reference for this assignment or the scope of work for Foundations Engineering outlined in MTO's Request for Proposal, dated April 2016, subsequent addenda or included as part of Golder's original scope of work for Foundations Engineering services contained in WSP's Technical Proposal.

The scope of work for the foundation engineering services associated with the rehabilitation/replacement of the Highway 417 retaining walls was outlined in Golder's Change Order #2 Technical Memorandum dated July 27, 2018. The investigation program was developed to meet the requirements of Table 17.8a of the RFP Terms of Reference (where applicable) as well as the structural requirements of WSP to complete the designs.

The work has been carried out in accordance with Golder's Quality Control Plan for foundation engineering services for the project dated August 29, 2016.

2.0 SITE DESCRIPTION AND GEOLOGY

2.1 Site Description

The retaining wall structures are located along both the north and south sides of Highway 417, between Holland Avenue and Kent Street. The locations of the retaining wall structures are shown on Drawings 1 through 9.

Brief descriptions of the structures, and their location with reference to current Highway 417 stationing and direction, are summarized in Table 1. The description numbering and highway stationing for the retaining walls are based on information provided in the Retaining Wall Summary sheet, dated June 2019, and the revised 60% Contract Drawings provided by WSP on November 8, 2019. Copies of the reference information have been provided after the text of this report.

Table 1: Summary of Retaining Wall Locations and Proposed Rehabilitation/Replacement Works

Retaining Wall	Highway 417 Stationing Direction	Location	Proposed Rehabilitation or Replacement	Maximum Wall Height (m)	Approximate Wall Length (m)
RW2N	225+201 to 225+357 Westbound	Harmer to Holland	Rehabilitation	6.4	156
RW5N	25+960 to 26+077 Westbound	East of Parkdale offramp at Sherbrooke	Rehabilitation	3.3	117
RW10N	27+256 to 27+356 Westbound	South side of Raymond Rochester to Booth	Replacement	5.0	100
RW11N	27+380 to 27+412 Westbound	South side of Raymond Booth to LeBreton	Replacement	5.5	32
RW13N	828+168 to 828+301 Westbound	Lyon onramp to Bronson offramp	Replacement	4.9	133
RW1S	35+440 to 35+490 Eastbound	South of highway at north end of Hinton	Replacement	2.4	50
RW2S	25+983 to 26+103 Eastbound	East of Parkdale onramp Reid towards Fairmont	Rehabilitation	4.0	120
RW4S	27+394 to 27+586 Eastbound	South of Highway 417 along Orangeville from Booth to Bell	Replacement	3.0	192
RW5S	27+617 to 27+689 Eastbound	South of Highway 417 along EB offramp to Bronson	Replacement	1.5	72
RW7S	28+378 to 28+437 Eastbound	South of Highway 417 along Chamberlain from Glendale and Kent	Replacement	2.7	59

2.2 Regional Geology

As delineated in *The Physiography of Southern Ontario*[1], this section of Highway 417 lies within the minor physiographic region known as the Ottawa Valley Clay Plain, which lies within the major physiographic region of the Ottawa-St. Lawrence Lowland.

The Ottawa Valley Clay Plain region is characterized by relatively thick deposits of sensitive marine clay, silt and silty clay that were deposited within the former Champlain Sea basin. These deposits, known as the Champlain Sea clay or Leda clay, overlie relatively thin, commonly reworked glacial till and glaciofluvial deposits, that in turn overlie bedrock[2].

This region is underlain by a series of sedimentary rocks, consisting of sandstones, dolostones, limestones and shales that are, in turn, underlain at depth by igneous and metamorphic bedrock of the Precambrian Shield. Regional bedrock mapping indicates that the bedrock west of Parkdale Avenue is dominantly interbedded

[1] Chapman, L. J. and Putnam, D. F., 1984. The Physiography of Southern Ontario, Ontario Geological Survey. Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000. Ontario Ministry of Natural Resources

[2] Belanger, J.R. "Urban Geology of Canada's National Capital Area", in *Urban Geology of Canadian Cities*, Geological Association of Canada Special Paper 42, Ed. P.F. Karrow and O.L. White, 1998.

limestone and dolomite of the Gull River Formation. East of Parkdale Avenue, the bedrock is indicated to be limestone of the Verulam Formation.[3] The limestone is described as interbedded bioclastic, sublithographic to fine crystalline with very thin to medium bedded shale interbeds up to 8 cm thick. Bedrock outcrops are mapped north and south of Highway 417 from about Fairwater Avenue to Bronson Avenue.

Highway 417 crosses two main faults striking southeast to northwest. The more prominent fault, the Gloucester fault, crosses Highway 417 at the approximate location of Preston Street[4]. The second fault crosses Highway 417 at the approximate location of Kent Street. Bedding which is normally sub-horizontal often dips steeply adjacent to and within fault zones.

The sites fall within the Western Québec (WQ) seismic zone according to the Geological Survey of Canada. The WQ zone constitutes a large area which encompasses the urban areas of Montreal, Ottawa-Hull and Cornwall. Within the WQ zone recent seismic activity has been concentrated in two subzones: one along the Ottawa River and another more active subzone along the Montreal-Maniwaki axis. The two major earthquakes that have recently occurred in the WQ zone are the 1935 Témiscaming event, which had a magnitude (i.e., a measure of the intensity of the earthquake) of 6.2, and the 1944 Cornwall-Massena event, which had a magnitude of 5.6.

3.0 INVESTIGATION PROCEDURES

3.1 Current Investigation

The field work for the current investigation was carried out in two parts, the first in the fall of 2018 and the second in the spring/summer of 2019 and included advancing a total of 20 boreholes, numbered as 18-801, 18-802, 18-901 to 18-904, 18-906 to 18-918, and 18-923.

Tables 2 and 3 further outline the location of the boreholes with respect to the current Highway 417 stationing and related retaining wall structures.

Boreholes 18-901, 18-906, 18-907, and 18-912 to 18-915 were advanced using truck-mounted drilling equipment, while Boreholes 18-902, 18-910, 18-911 and 18-916 to 18-918 were advanced using a combination of hydro-excavation and truck-mounted drilling equipment. The hydro-excavation equipment was supplied and operated by PGC Services (PGC) of Ottawa, Ontario and the drilling equipment was supplied and operated by George Downing Estate Drilling of Hawkesbury, Ontario.

Boreholes 18-908 and 18-909 were advanced using portable rotary drilling equipment using NW and HW sized casing due to the proximity of the borehole locations to the adjacent utilities and embankment slopes. This equipment was supplied and operated by Marathon Underground Constructors Corporation of Greely, Ontario.

[3] Urban geology of the National Capital area / Géologie urbaine de la région de la Capitale nationale; Bélanger, R. Geological Survey of Canada, Open File 5311, 2008; 1 DVD, https://doi.org/10.4095/226165

[4] MacDonald, G. and Harrison, J.E. 1976: Generalized Bedrock Geology, Ottawa-Hull, Ontario and Quebec, Geological Survey of Canada, Map 1508A, scale 1:125,000. Geology 1967

Boreholes 18-802 and 18-904 were advanced using portable rotary drilling equipment employing a third weight hammer lifted manually and dropped from the SPT height. Where a third weight hammer was used, the N values presented on the Record of Boreholes are “uncorrected” and should be interpreted in consideration of their reduced penetration energy. This equipment was supplied and operated by Ohlmann Geotechnical Services Inc. of Almonte, Ontario.

Two separate attempts were made to advanced Borehole 18-903, which was located near the middle and in front of retaining wall RW5N, to core the existing footing and determine the underlying founding material. During the first attempt, hydro-excavation activities revealed a fibre optic line that was not previously detected during the utility locate process prior to commencing fieldwork. The location of the borehole was then adjusted such that hydro-excavation and coring activities would not impact the existing utility and a second attempt was carried out. While hydro-excavating the borehole the second time, a large diameter drainage pipe was encountered below the fibre optic line and just above the existing footing. The stacked alignments of the two utilities and the location of the drainage pipe relative to the footing made coring of the footing impossible without damaging the existing utilities.

To resolve the utility conflicts a new Borehole 18-923 was advanced near the western end and behind RW5N.

Boreholes 18-903 and 18-923 were advanced using a combination of hydro-excavation and portable rotary drilling equipment using HW sized casing. The hydro-excavation equipment was supplied and operated by PGC while the drilling equipment was supplied and operated by CCC Geotechnical & Environmental Drilling Ltd. of Ottawa, Ontario.

Traffic control required to close either the driving lanes of Highway 417 or the various City of Ottawa roadways, while carrying out field operations, was provided by Beacon Lite Ltd. of Ottawa, Ontario.

Grab samples of the overburden were recovered from within the hydro-excavations carried out at Boreholes 18-902, 18-903, 18-910, 18-911, 18-916 to 18-918, 18-923. Soil samples in Boreholes 18-901, 18-906, 18-907, and 18-912 to 18-915 and below the depth of hydro-excavation in Boreholes 18-910, 18-911 and 18-916 to 18-918 were obtained at vertical sampling intervals of about 0.76 m, using a 50 mm outer diameter split-spoon sampler in general accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586). Soil samples from Borehole 18-904 which was advanced with the portable drilling equipment were obtained in continuous vertical increments of about 0.6 m.

Concrete core samples of the existing retaining wall footings were obtained in Boreholes 18-801, 18-802 and 18-904. Concrete and bedrock core samples were obtained in Borehole 18-923. Bedrock core samples were obtained in Boreholes 18-908, 18-909 and 18-912. Both the concrete and bedrock core samples were obtained using a combination of NQ and HQ sized equipment.

Monitoring wells were installed in Boreholes 18-902, 18-911, and 18-913 to 18-917, to observe the stabilised groundwater at the various retaining wall sites. The monitoring wells consisted of 32 mm outside diameter PVC tubing with a 1.5 m long slotted tip. The final groundwater levels were measured in the wells on June 19, 2019. The wells were subsequently decommissioned according to Ontario MOE Regulation 903 (O.Reg 903) by a licenced well technician.

The boreholes were backfilled with bentonite within the bedrock, and bentonite mixed with soil cuttings within the overburden. The boreholes were then capped with either asphaltic concrete cold patch or granular material, depending on the surrounding surface cover. The boreholes were backfilled in general accordance with the intent of O.Reg 903, as amended. The site conditions were restored following completion of the field work.

The field work was supervised on a full-time basis by members of Golder's staff who located the boreholes in the field, directed the drilling, sampling, and in-situ testing operations, logged the boreholes and examined and cared for the samples. The soil, concrete and bedrock core samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Ottawa for further examination and testing. Index and classification tests consisting of water content determinations, Atterberg Limits Testing and grain size distribution analyses were carried out on selected soil samples at Golder's Ottawa laboratory. Unconfined compressive strength testing was carried out on select core samples of the bedrock and concrete footings at Golder's Mississauga laboratory. The laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate.

Eight soil samples were submitted to Eurofins Environment Testing for chemical analysis related to potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack).

The borehole locations and elevations were surveyed by Golder using a Trimble R8 GPS unit referenced to the NAD83 CSRS CBNv6-2010.0 MTM Zone 9 geodetic datum. The borehole locations, including northing and easting coordinates, ground surface and top of existing retaining wall footing elevations (where encountered), and drilled depths are summarized in Tables 2 and 3.

Table 2: Summary of Borehole Locations North Side for the Highway 417

Retaining Wall	Borehole	Location Approximate Highway 417 (Stationing)	NAD83 CSRS CBNv6-2010.0 MTM Zone 9		Ground Surface Elevation (m)	Top of Existing Footing Elevation (m)	Footing Thickness (m)	Drilled Length (m)
			Northing (m)	Easting (m)				
RW2N	18-801	Parking lot 250 Holland (25+355)	5028691.4	365104.3	67.4	66.6	1.1	2.4
	18-802	Highway 417 WB Embankment East of Holland (25+405)	5028731.2	365132.6	69.7	66.3	1.0	5.2
RW5N	18-903	Highway 417 WB East of Sherbrooke (26+008)	5029102.8	365614.2	71.6	N/A		1.3[1]
	18-923	Highway 417 WB West of Sherbrooke (25+955)	5029080.2	365569.0	72.1	69.3	0.6	5.1
RW10N	18-906	Highway 417 WB Embankment toe Raymond West of Booth (27+300 / 27+340)	5029624.1	366799.1	65.5	N/A		0.9
	18-907		5029631.9	366837.8	66.3			1.3
RW11N	18-908	Highway 417 WB Embankment toe Raymond East of Booth (27+400 / 27+455)	5029647.0	366893.3	66.7			4.0
	18-909		5029667.4	366944.3	69.1			4.9
RW13N	18-913	Highway 417 WB Embankment toe Southeast Corner of City Yard at 380 Catherine (28+170)	5029932.5	367605.0	66.9			5.5
	18-914	Highway 417 WB Embankment toe Southwest Corner of 370 Catherine (28+225)	5029958.8	367649.0	67.5			3.7
RW13N	18-915	Highway 417 WB Embankment toe East of the Southeast Building Corner 340 Catherine (28+305)	5029997.9	367718.4	68.1			7.0

Note: [1] Borehole terminated at top of existing buried utility

Table 3: Summary of Borehole Locations South Side for the Highway 417

Retaining Wall	Borehole	Location Approximate Highway 417 Stationing	NAD83 CSRS CBNv6-2010.0 MTM Zone 9		Ground Surface Elevation (m)	Top of Existing Footing Elevation (m)	Footing Thickness (m)	Drilled Length (m)
			Northing (m)	Easting (m)				
RW1S	18-901	Highway 417 EB Embankment toe West of Hinton (25+450)	5028734.4	365200.6	70.0	N/A		6.3
	18-902	Highway 417 EB Embankment toe East of Hinton (25+460)	5028741.6	365206.9	70.0			6.2
RW2S	18-904	Highway 417 EB East of Reid (26+075)	5029102.8	365691.1	71.0	69.8	0.9	4.0
RW4S	18-910	Highway 417 EB Embankment toe Orangeville West of Bell (27+550)	5029641.4	367056.5	72.1	N/A		3.7
	18-911	Highway 417 EB Embankment toe Bell East of Orangeville (27+585)	5029650.4	367089.2	72.9			3.3
RW5S	18-912	Highway 417 EB Embankment toe North End of Arthur Lane (27+630)	5029660.0	367131.5	72.8			2.7
RW7S	18-916	Highway 417 EB Embankment toe Chamberlain East of Glendale (28+270)	5029928.2	367723.2	67.1			4.8
	18-917	Highway 417 EB Embankment toe Chamberlain West of Lyon (28+330)	5029956.2	367774.1	66.3			7.5
RW7S	18-918	Highway 417 EB Embankment toe Chamberlain East of Lyon (28+390)	5029986.3	367825.5	66.6			6.1

3.2 Previous Investigations

As part of the current assignment, previously collected subsurface information pertinent to the retaining wall sites was reviewed and compiled.

The Record of Borehole sheets from the previous investigations pertinent to the current sites are provided for reference in Appendix C. The borehole locations and ground surface elevations for these boreholes are shown on Drawings 7 and 8. The subsurface conditions within the boreholes from the previous investigations are referenced in Section 4.0, only with respect to the bedrock conditions.

3.2.1 Replacement of Sites 3-56/1 & 3-56/2

A foundation investigation was carried out for the rapid bridge replacement of the Highway 417 Overpass Structures at Rochester Street (Sites 3-56/1 and 3-56/2) by Golder in 2018 and 2019. The subsurface information and results of the investigation are contained in the report titled:

- *Foundation Investigation and Design Highway 417 Overpass Structures at Rochester Street Rapid Bridge Replacement Sites: 3-56/1 and 3-56/2, Ottawa, Ontario*, dated July 2019, (Report No. 1655214-1110), GEOCRES No. 31G5-295.

A total of 24 coreholes and four boreholes were advanced along Rochester Street and twelve boreholes within the Highway 417 approach embankments. In particular, Boreholes 17-114, 18-1103 and 18-1107 were advanced along the south side of Highway 417 in the general vicinity of retaining wall RW10N. In general, at the borehole locations the subsurface conditions consist of PCC sidewalk or topsoil at surface, overlying granular sand fill materials, all underlain by limestone bedrock.

3.2.2 Replacement of Sites 3-57/1 and 3-57/2

A foundation investigation was carried out for the rapid bridge replacement of the Highway 417 Overpass Structures at Booth Street (Sites 3-57/1 and 3-57/2) by Golder in 2018 and 2019. The subsurface information and results of the investigation are contained in the report titled:

- *Foundation Investigation and Design Highway 417 Overpass Structures at Booth Street Rapid Bridge Replacement Sites: 3-57/1 and 3-57/2, Ottawa, Ontario*, dated July 2019, (Report No. 1655214-1120), GEOCRES No. 31G5-308.

A total of 24 coreholes and four boreholes were advanced along Booth Street and eight boreholes within the Highway 417 approach embankments. In particular, Boreholes 17-122, 18-1204 and 18-1208 were advanced along the south side of Highway 417 in the general vicinity of retaining wall RW4S. Also, Boreholes 17-123, 17-124, 18-1203 were advanced along the north side of the highway in the general vicinity to retaining walls RW10N and RW11N. In general, at the borehole locations the subsurface conditions consist of PCC sidewalk or asphaltic concrete pavement at surface, overlying granular sand fill materials overlying, glacial till, all underlain by limestone bedrock.

3.2.3 Highway 417 Operational Improvements

A foundation investigation was carried out for the Highway 417 Operational Improvements at the Bronson Avenue Interchange and Off-Ramp Noise Barrier Wall by Thurber Engineering Ltd. in 2014. The subsurface information and results of the investigation are contained in the report titled:

- *Foundation Investigation and Design Report Bronson Avenue W-N/S Ramp Noise Barrier Wall Highway 417 Operational Improvements – Bronson Avenue Interchange Ottawa, Ontario*, dated March 2014. (File No. 19-1351-201D), GEOCRES No. 31G5-254.

A total of seven boreholes were advanced along the south side of the Highway 417. In particular, Boreholes NB-03 to NB-05, 17S-01 and 17S-02 were advanced in the general vicinity of retaining walls RW4S and RW5S. Boreholes NB-03 to NB-05 were terminated upon auger refusal on probable bedrock at depths ranging from 2.9 to 7.8 m. Boreholes 17S-01 and 17S-02 were drilled to depths of 10.4 and 7.3 m, including coring 3.0 and 3.1 m into bedrock respectively. At the borehole locations, the subsurface conditions consist of asphaltic concrete and PCC pavement overlying sandy fill materials underlain by limestone bedrock.

4.0 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 General

The subsurface soil, bedrock and groundwater conditions encountered in the boreholes and the results of in-situ testing from the current investigation are given on the Record of Borehole and Drillhole sheets presented in Appendix A. The results of the laboratory testing carried out during the current investigation are presented on the Record of Borehole sheets as well as on Figures B1 to B24 in Appendix B. The borehole locations and the interpreted stratigraphic profile projected along each retaining wall location are provided on Drawings 1 to 9.

Photographs of the core recovered from the concrete footings and underlying bedrock are shown on Figures A1 to A14 provided in Appendix A. The results of basic chemical analysis completed on select soil samples are provided in Appendix D.

The stratigraphic boundaries shown on the Record of Borehole sheets and on the interpreted stratigraphic sections from Drawings 1 to 9 are inferred from observations of drilling progress and noncontinuous sampling and therefore represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

A detailed description of the overburden soil deposits is provided in Sections 4.2 to 4.11. A detailed description of the concrete footings where encountered is provided in Section 4.12. Auger refusal and bedrock geology where encountered at the borehole locations is discussed in detail in Sections 4.13 and 4.14 and groundwater conditions encountered during the field investigation is provided Section 4.15.

4.2 Retaining Wall 2N

Boreholes 18-801 and 18-802 were advanced at the location of RW2N at the toe of the highway embankment on the north side of Highway 417. The locations of the retaining wall and associated boreholes are shown on Drawing 1.

4.2.1 Surface Cover / Surficial Materials

Asphaltic concrete pavement with a thickness of 25 mm was encountered at the surface of Borehole 18-801.

Topsoil with a thickness of 0.2 m was encountered at the surface of Borehole 18-802.

4.2.2 Fill Materials

Pavement structure fill consisting predominantly of sand and gravel was encountered below the asphaltic concrete pavement at Borehole 18-801. The top of this layer was encountered at Elevation 67.4 m. The thickness of the fill is about 300 mm.

Fill consisting predominantly of sand with varying amounts of silt was encountered below the pavement structure fill at Borehole 18-801 and below the topsoil in Borehole 18-802. The top of this layer was encountered at elevations 67.1 and 69.4 m and the layer has thicknesses of 0.5 and 2.9 m in Boreholes 18-801 and 18-802, respectively. The measured moisture contents of the two samples tested were 13 and 14 percent. The results of grain size analysis testing carried out on two samples of this material are provided on Figure B1 in Appendix B.

Sand and gravel fill were encountered below the sand fill at Borehole 18-802, at Elevation 66.7 m, and is 0.3 m in thickness. The SPT blow count (i.e., > 50/0.150) noted on the Record of Borehole may have been influenced by the presence of the underlying concrete footing, rather than the state of packing of the soil matrix.

4.2.3 Glacial Till

Glacial till was encountered below the retaining wall footings in both boreholes. The glacial till generally consists of a heterogeneous mixture of sand and gravel within a soil matrix of silt and clay. The top of this layer was encountered at Elevations 65.3 and 65.5 m. The till was not fully penetrated but was proven to the depth of splitspoon refusal of 2.4 and 5.2 m, corresponding to Elevations 65.0 and 64.5 m in Boreholes 18-801 and 18-802 respectively. A SPT N value was 38 blows per 0.3 m of penetration indicating a dense state of packing.

The measured moisture contents of the two samples tested were 7 and 14 percent. The results of grain size analysis testing carried out on two samples of the glacial till are provided on Figure B2 of Appendix B.

4.3 Retaining Wall 5N

Boreholes 18-903 and 18-923 were advanced at the location of RW5N in front of and behind the existing retaining wall, respectively. The locations of the retaining wall and associated boreholes are shown on Drawing 2. Due to conflict with existing buried utilities, Borehole 18-903 was discontinued prior to reaching the required termination depth.

4.3.1 Surface Cover / Surficial Materials

Asphaltic concrete pavement with a thickness of 25 mm was encountered at the surface of Borehole 18-903.

Topsoil with a thickness of 0.2 m was encountered at the surface of Borehole 18-923.

4.3.2 Fill Materials

Fill consisting predominantly of sand with varying amounts of gravel and silt was encountered below the asphaltic concrete pavement in Borehole 18-903 and below the topsoil in Borehole 18-923. This layer was encountered at Elevations 71.6 and 71.9 m and is about 2.6 m in thickness in Borehole 18-923.

4.4 Retaining Wall 10N

Boreholes 18-906 and 18-907 were advanced at the location of RW10N, at the toe of the highway embankment on the north side of Highway 417. The locations of the retaining wall and associated boreholes are shown on Drawing 3.

4.4.1 Surface Cover / Surficial Materials

Asphaltic concrete pavement with thicknesses of 150 and 100 mm was encountered at the surface of Boreholes 18-906 and 18-907 respectively.

4.4.2 Fill Materials

Pavement structure fill consisting predominantly of sand and gravel was encountered below the asphaltic concrete pavement in both boreholes. This layer was encountered at Elevations 65.3 and 66.2 m and is 0.3 and 0.2 m in thickness at Boreholes 18-906 and 18-907, respectively

Fill consisting predominantly of sand with varying amounts of silt was encountered below the pavement structure fill at Boreholes 18-906 and 18-907 at Elevations 65.1 to 66.0 m respectively. The thickness of the sand fill was 0.5 m in both boreholes. The measured moisture contents of the samples tested ranged from 8 to 10 percent. The results of grain size analysis testing carried out on two samples of the sand fill material are provided on Figure B3 in Appendix B.

A layer of sandy gravel fill was encountered in Borehole 18-907 below the sand fill. This layer was encountered at Elevation 66.5 m and is 0.5 m in thickness.

4.5 Retaining Wall 11N

Boreholes 18-908 and 18-909 were advanced at the location of RW11N at the toe of the highway embankment on the north side of Highway 417. The locations of the retaining wall and associated boreholes are shown on Drawing 3.

4.5.1 Surface Cover / Surficial Materials

Asphaltic concrete pavement with a thickness of 100 mm was encountered at the surface of Borehole 18-908.

Topsoil with a thickness of 0.2 m was encountered at the surface of Borehole 18-909.

4.5.2 Fill Materials

Pavement structure fill consisting predominantly of sand and gravel was encountered below the asphaltic concrete pavement in Borehole 18-908. This layer was encountered at Elevation 66.6 m and is 1.5 m in thickness. An SPT N value of 21 blows per 0.3 m of penetration was measured in this layer, indicating a compact state of packing. The high SPT blow count (i.e., > 50/0.150) noted on the Record of Borehole may have been influenced by the presence of the underlying bedrock, rather than the state of packing of the soil matrix. The measured moisture content of a single sample of the pavement structure fill was 5 percent. The results of grain size analysis testing carried out on a single sample of this material are provided on Figure B4 in Appendix B.

Fill consisting predominantly of sand with varying amounts of silt and gravel was encountered below the topsoil in Borehole 18-909 at Elevation of 68.9 m and is 0.6 m in thickness.

4.5.3 Glacial Till

Glacial till was encountered below the sand fill in Borehole 18-909. The glacial till generally consists of a heterogeneous mixture of sand and gravel within a soil matrix of silt and clay and cobbles. The till was encountered at Elevation 68.3 m and is about 2.3 m in thickness. SPT N values of 13 and 32 blows per 0.3 m of penetration were measured in this layer, indicating a compact to dense state of packing. Cobbles and boulders were encountered in the till and coring techniques were required to advance the borehole though the till layer.

The measured moisture contents of two samples of the glacial till were about 8 percent. The results of grain size analysis testing carried out on two samples of this material are provided on Figure B5 in Appendix B.

4.6 Retaining Wall 13N

Boreholes 18-913 to 18-915 were advanced at the location of RW13N at the toe of the highway embankment on the north side of Highway 417. The locations of the retaining wall and associated boreholes are shown on Drawing 4.

4.6.1 Surface Cover / Surficial Materials

Asphaltic concrete pavement with thicknesses ranging from 50 to 100 mm was encountered at the ground surface at Boreholes 18-913, 18-914, and 18-915.

4.6.2 Fill Materials

Pavement structure fill consisting predominantly of sand and gravel was encountered below the asphaltic concrete pavement at all three boreholes. The top of this layer was encountered at elevations ranging from 66.8 to 68.1 m. The thickness of the pavement structure fill ranges from about 50 to 400 mm.

Fill consisting predominantly of sand with varying amounts of silt and gravel was encountered below the pavement structure fill in all three boreholes. The top of this layer was encountered at elevations ranging from 66.6 to 68.0 m. The thickness of the sand fill ranges from about 1.0 to 2.6 m. The SPT N values ranged from 4 to 7 blows per 0.3 m of penetration, indicating a loose state of packing. The measured moisture content of one sample of the sand fill layer was about 10 percent. The results of grain size analysis testing carried out on a single sample of this material provided on Figure B6 in Appendix B.

Fill consisting of a mixture of sand and peat, containing metal debris, was encountered beneath the sand fill in Borehole 18-914. The layer was encountered at Elevation 66.0 m and is about 0.5 m in thickness.

Sandy gravel fill was encountered beneath the sand fill in Borehole 18-913, at Elevation 64.5 m. The thickness of the sandy gravel fill is about 1.3 m. An SPT N value of 19 blows per 0.3 m of penetration was measured in this layer, indicating a compact state of packing. Strong hydrocarbon odour was noted in this layer. Further details with regards to the material handling, reuse and/or disposal of environmentally impacted materials are provided in WSP's 2018 Phase II ESA and Earth Management Plan Reports, which are provided under separate cover.

4.6.3 Silty Sand

Silty sand was encountered beneath the sand fill in Borehole 18-915. This layer was encountered at Elevation 64.4 m and is about 1.0 m in thickness. An SPT N value of 7 blows per 0.3 m of penetration was measured in this layer, indicating a loose state of packing.

4.6.4 Peat

Peat was encountered beneath the fill materials in Borehole 18-914. The peat was encountered at Elevation 65.5 m and is about 0.6 m in thickness.

4.6.5 Silty Clay

Silty clay was encountered beneath the peat in Borehole 18-914. This layer was encountered at Elevation 64.9 m and is about 0.5 m in thickness.

4.6.6 Glacial Till

Glacial till was encountered below the fill materials at Borehole 18-913, below the silty clay at Borehole 18-914 and below the silty sand at Borehole 18-915. The glacial till generally consists of a heterogeneous mixture of sand and gravel within a soil matrix of silt. This deposit was encountered at elevations ranging from 63.2 to 64.5 m and is about 0.6 to 3.3 m in thickness. The SPT N values ranged from 6 to 31 blows per 0.3 m of penetration indicating a loose to dense state of packing. The higher blow counts (i.e., > 50/0.150) noted on the Record of Boreholes may have been influenced by the presence of the underlying bedrock, rather than the state of packing of the soil matrix.

The measured moisture contents of three samples of the glacial till ranged from 8 to 11 percent. The results of grain size analysis tests carried out on two samples of the glacial till are provided on Figure B7 in Appendix B. The results of an Atterberg Limits test completed on a single sample of this material indicated a liquid limit value of 19, a plastic limit value of 12 and a plasticity index value of 7. The Atterberg Limits analysis results are provided on Figure B8 in Appendix B and indicate that the fines portion of the till is clayey silt to silt (CL-ML) of low plasticity.

4.7 Retaining Wall 1S

Boreholes 18-901 and 18-902 were advanced at the location of RW1S at the toe of the highway embankment on the south side of Highway 417. The locations of the retaining wall and associated boreholes are shown on Drawing 5.

4.7.1 Surface Cover / Surficial Materials

Asphaltic concrete pavement with a thickness of 100 mm was encountered at the ground surface at both boreholes.

4.7.2 Fill Materials

Pavement structure fill consisting predominantly of sand and gravel was encountered below the asphaltic concrete pavement at Elevation 69.9 m at both boreholes. The thickness of the pavement structure fill is 500 and 200 mm at Boreholes 18-901 and 18-902 respectively.

Fill consisting predominantly of sand with varying amounts of silt and gravel was encountered below the pavement structure fill in both boreholes. The top of this layer was encountered at elevations ranging from 69.4 to 69.7 m. The thickness of the sand fill is 0.9 and 0.3 m in Boreholes 18-901 and 18-902, respectively. The measured moisture content of a single sample of the sand fill was about 20 percent. The results of a grain size analysis test carried out on a single sample of this material is provided on Figure B9 in Appendix B.

4.7.3 Buried Topsoil

Buried topsoil was encountered beneath the fill materials at Borehole 18-902 at Elevation 69.4 m and is about 0.2 m in thickness.

4.7.4 Silty Sand to Sand

Sand with varying amounts of silt was encountered beneath the fill materials in both boreholes. This deposit was encountered at Elevations 68.5 and 69.2 m and is 3.1 to 3.8 m in thickness at Boreholes 18-901 and 18-902, respectively. The SPT N values ranged from 10 to 37 blows per 0.3 m of penetration, indicating a compact to dense state of packing.

The measured moisture content of a single sample of this material was about 12 percent. The results of grain size analysis testing carried out on a single sample of this material are provided on Figure B10 in Appendix B.

4.7.5 Glacial Till

Glacial till was encountered below the silty sand to sand in both boreholes. The glacial till generally consists of a heterogeneous mixture of sand and silt with varying amounts of gravel. This layer was encountered at Elevation 65.4 m in both boreholes and is about 1.6 to 1.7 m in thickness. The SPT N values ranged from 18 to 44 blows per 0.3 m of penetration indicating a compact to dense state of packing.

The measured moisture contents of three samples of the glacial till ranged from 10 to 12 percent. The results of grain size distribution testing carried out on three samples of the glacial till are provided on Figure B11 in Appendix B.

4.8 Retaining Wall 2S

Borehole 18-904 was advanced at the location of RW2S in the eastbound shoulder of Highway 417. The locations of the retaining wall and associated borehole are shown on Drawing 6.

4.8.1 Surface Cover / Surficial Materials

Topsoil with a thickness of 50 mm was encountered at the surface of Borehole 18-904.

4.8.2 Fill Materials

Fill consisting predominantly of sand with varying amounts of gravel was encountered below the topsoil in Borehole 18-904. The top of this layer was encountered at Elevation 70.9 m and the layer is about 1.2 m in thickness. The measured moisture content of one sample of the fill layer was about 12 percent. The results of grain size analysis testing carried out on a single sample of this material provided on Figure B12 in Appendix B.

4.8.3 Glacial Till

Glacial till was encountered below the retaining wall footing at Elevation 68.9 m in Borehole 18-904. The glacial till generally consists of a heterogeneous mixture of sand and gravel within a soil matrix of silt and clay. The till was not fully penetrated but was proven to extend to a depth of 4.0 m below existing grade (i.e., Elevation 67.0 m).

The measured moisture content of one sample of the glacial till was about 12 percent. The results of grain size distribution testing carried out on a single sample of this material provided on Figure B13 of Appendix B.

4.9 Retaining Wall 4S

Boreholes 18-910 and 18-911 were advanced during the current investigation at the location of RW4S, at the toe of the highway embankment on the south side of Highway 417.

A total of six boreholes were advanced along the proposed alignment for RW4S during the previous investigations. Boreholes 18-1204, 18-1208, NB-03, 17S-01, 17S-02 were advanced through the highway embankment to the north of the proposed alignment while Borehole 17-122 was advanced at the toe of the highway embankment on the south side of Highway 417.

The locations of the retaining wall and associated boreholes are shown on Drawing 7.

4.9.1 Surface Cover / Surficial Materials

Asphaltic concrete pavement with a thickness of 150 mm was encountered at ground surface at Boreholes18-910 and 18-911.

4.9.2 Fill Materials

Pavement structure fill consisting predominantly of sand and gravel was encountered below the asphaltic concrete pavement at Boreholes 18-910 and 18-911. This layer was encountered at Elevations 72.0 and 72.8 m and is about 1.2 and 0.8 m in thickness at Boreholes 18-910 and 18-911 respectively.

Fill consisting predominantly of sand with varying amounts of gravel and silt was encountered below the pavement structure fill at Boreholes 18-910 and 18-911. This sand fill layer was encountered at Elevations 70.9 and 72.1 m and is 1.8 to 2.4 m in thickness. The measured moisture contents of two samples of this material were about 9 and 15 percent. The results of grain size distribution testing carried out on two samples of the gravel and sand fill are provided on Figure B14 of Appendix B.

4.9.3 Silt and Sand

Silt and sand were encountered beneath the sand fill in Borehole 18-910. This deposit was encountered at Elevation 69.1 m and is about 0.6 m in thickness. A SPT N value of 20 blows per 0.3 m of penetration was recorded in this deposit, indicating a compact state of packing.

The measured moisture content of one sample of this material was about 22 percent. The results of grain size analysis testing carried out on a single sample of the silt and sand are provided on Figure B15 in Appendix B.

4.10 Retaining Wall 5S

Borehole 18-912 was advanced during the current investigation at the location of RW5S at the toe of the highway embankment on the south side of the Highway 417.

A total of two boreholes were advanced along the proposed alignment for RW5S during the previous investigations. Boreholes NB-04 and NB05 were advanced through the highway embankment to the north of the proposed alignment.

The locations of the retaining wall and associated boreholes are shown on Drawing 8.

4.10.1 Surface Cover / Surficial Materials

Asphaltic concrete pavement with a thickness of 100 mm was encountered at the surface at Borehole 18-912.

4.10.2 Fill Materials

Pavement structure fill consisting predominantly of sand and gravel with varying amounts of silt was encountered below the asphaltic concrete pavement in Borehole 18-912. This layer was encountered at Elevation 72.7 m and is about 0.7 m in thickness. Debris, consisting of metal fragments, was noted in the pavement structure fill. The measured moisture content of one sample of this material was about 26 percent. The results of grain size analysis testing carried out on a single sample of the fill provided on Figure B16 in Appendix B.

4.11 Retaining Wall 7S

Boreholes 18-916 to 18-918 were advanced at the location of RW7S at the toe of the highway embankment on the south side of Highway 417. The location of the retaining wall and associated boreholes are shown on Drawing 9.

4.11.1 Surface Cover / Surficial Materials

Topsoil with a thickness of 0.2 m was encountered at the ground surface at Borehole 18-916.

Asphaltic concrete pavement with a thickness of 100 mm was encountered at the ground surface at Boreholes 18-917 and 18-918.

Portland cement concrete (PCC) was encountered beneath the asphaltic concrete pavement with thicknesses of 300 and 400 mm at Boreholes 18-917 and 18-918, respectively.

4.11.2 Fill Materials

Sand fill was encountered below the PCC pavement at Boreholes 19-917 and 18-918 at Elevations 65.9 and 66.1 m respectively. The thickness of the sand fill is 0.8 and 1.5 m. Debris, including brick fragments, was observed at Borehole 18-918. The measured moisture content of a single sample of the sand fill was about 4 percent. The results of grain size analysis testing carried out on single sample of this material is provided on Figure B17 in Appendix B.

Fill consisting predominantly of sand and gravel was encountered below the topsoil at Borehole 18-916 and the sand fill at Boreholes 18-917 and 18-918. The top of this layer was encountered at elevations ranging from 64.6 to 66.9 m. The thickness of this layer ranges from about 0.7 to 1.3 m. This layer was observed to contain debris including brick, concrete, wood, glass, and porcelain fragments, mixed with rock fill. The measured moisture content of a single sample of this material was about 16 percent. The results of grain size analysis testing carried out on a single sample of the sand and gravel fill are provided on Figure B18 in Appendix B.

Sandy clayey silt fill was encountered beneath the sand and gravel fill in Borehole 18-916. This layer was encountered at Elevation 65.6 m and is about 2.0 m in thickness. Debris, including brick, concrete, wood, glass, and metal fragments, was observed throughout the layer.

Gravelly silty sand fill was encountered beneath the clayey silt fill at Borehole 18-916. This layer was encountered at Elevation 63.6 m and is about 0.9 m in thickness. A SPT N value of 20 blows for 0.3 m of penetration was measured in this layer indicating a compact state of packing. The measured moisture content of one sample of the silty sand fill layer was about 7 percent. The results of grain size analysis testing carried out on a single sample of this material are provided on Figure B19 in Appendix B.

4.11.3 Clayey Silt

Clayey silt was encountered beneath the fill materials at Borehole 18-918. This layer was encountered at Elevation 64.0 m and is about 0.5 m in thickness.

The measured moisture content of a single sample of this material was about 31 percent. The results of an Atterberg Limits test completed on a single sample of the clayey silt indicated a liquid limit value of 23, a plastic limit value of 14 and a plasticity index value of 9. The Atterberg Limits analysis results are provided on Figure B20 in Appendix B and indicate a clayey silt of low plasticity (CL).

4.11.4 Sand

Sand with varying amounts of silt was encountered beneath the gravelly sand fill at Borehole 18-917. This layer was encountered at Elevation 63.8 m and is about 1.5 m in thickness. A SPT N value of 7 blows for 0.3 m of penetration was measured in this layer, indicating a loose state of packing.

4.11.5 Sandy Silt

Sandy silt was encountered beneath the clayey silt at Borehole 18-918. This layer was encountered at Elevation 63.4 m and is about 2.1 m in thickness. The SPT N values ranged from 15 to 19 blows per 0.3 m of penetration, indicating a compact state of packing.

The measured moisture content of one sample of the sandy silt was about 20 percent. The results of grain size analysis testing carried out on a single sample of this material are provided on Figure B21 in Appendix B.

4.11.6 Glacial Till

Glacial till was encountered below the sand and silt deposits at both boreholes. The glacial till generally consists of a heterogeneous mixture of sand and silt within a soil matrix of gravel, clay and cobbles. The glacial till deposit was not fully penetrated but was proven to the depths of auger refusal at 7.5 and 6.1 m below the existing grade at Boreholes 18-917 and 18-918, respectively. The SPT N values ranged from 4 to 21, indicating a loose to compact state of packing.

The measured moisture contents of four samples of the glacial till ranged from about 5 to 14 percent. The results of grain size distribution testing carried out on two samples of this material are provided on Figure B22 in Appendix B. The results of an Atterberg Limits test completed on a single sample of glacial till material encountered at Borehole 18-918 indicate a liquid limit value of 20, a plastic limit value of 13 and a plasticity index value of 7. The Atterberg Limits analysis results are provided on Figure B23 in Appendix B and indicate a clayey silt to silt of low plasticity (CL-ML).

4.12 Concrete Footings

The existing concrete footings for retaining walls RW2N, RW5N and RW2S were cored in order to assess the quality and compressive strength of the concrete and assess the existing founding material. Table 4 summarizes the top of footing elevation, the footing thickness, the anticipated founding material and the results of unconfined compression tests carried out on the concrete cores.

Photographs of the concrete core from the current investigation are provided on Figures A1 to A6, A13 and A14 in Appendix A.

Table 4: Concrete Retaining Wall Footing Summary

Retaining Wall	Borehole	Ground Surface Elevation (m)	Top of Existing Footing Elevation (m)	Footing Thickness (m)	Concrete Footing UCS Test Results (MPa)	Anticipated Founding Material
RW2N	18-801	67.4	66.6	1.1	26.4	Bedrock
	18-802	69.7	66.3	1.0	N/A	
RW5N	18-923	72.1	69.3	0.6	47	
RW2S	18-904	71.0	69.8	0.9	N/A	Glacial Till

4.13 Auger Refusal

Bedrock was not proven by coring at most retaining wall locations. Auger or sampler refusal was however encountered at several borehole locations.

Based on boreholes from previous investigations along Highway 417, auger/sampler refusal could represent the presence of cobbles and boulders in the fill or glacial till or the bedrock surface.

Table 5 summarizes the auger refusal depths and elevations as encountered at the borehole locations, from both the current and previous investigations, referenced to the particular retaining wall.

Table 5: Summary of Depths to Auger or Sampler (indicated with *) Refusal

Retaining Wall	Borehole	Existing Ground Surface Elevation (m)	Depth to Auger Refusal (m)	Elevation of Auger Refusal (m)
RW2N	18-801	67.4	2.4*	65.0
	18-802	69.7	5.2*	64.5
RW10N	18-906	65.5	0.9	64.6
	18-907	66.3	1.3	65.0
RW13N	18-913	66.9	5.5	61.4
	18-914	67.5	3.7	63.8
	18-915	68.1	7.0	61.1
RW1S	18-901	70.0	6.3	63.7
	18-902	70.0	6.2	63.8
RW4S	18-910	72.1	3.7	68.4
	18-911	72.9	3.3	69.6
	18-1208	72.9	7.6	65.3
	NB-03	73.3	7.8	65.6
RW5S	NB-04	74.7	2.9	71.7
	NB-05	73.5	4.7	68.8
RW7S	18-916	67.1	4.8	62.3
	18-917	66.3	7.5	58.8
	18-918	66.6	6.1	60.5

4.14 Bedrock

Regional bedrock mapping indicates that the retaining wall locations are underlain by limestone bedrock.

Bedrock was proven by coring using a combination of NQ and HQ sized equipment in Boreholes 18-908, 18-909, 18-912 and 18-923. Photographs of the bedrock core from the current investigation are provided in Appendix A.

Weathered bedrock was encountered during SPT testing at Elevations 72.0 and 62.7 m in Boreholes 18-912 and 18-916, respectively.

Bedrock was also proven by coring using NQ sized equipment in Boreholes 17-114, 17-122 to 17-124, 18-1103, 18-1107, 18-1204, 18-1203, 18-1204, 17S-01 and 17S-02 during the previous investigations.

Table 6 summarizes the depths and the elevations of the bedrock surface as encountered at the borehole locations from both the current and previous investigations.

Table 6: Summary of Bedrock Surface Depths and Elevations

Retaining Wall	Borehole	Existing Ground Surface Elevation (m)	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)	UCS Test Results (MPa)
RW5N	18-923	72.1	3.4	68.7	29
RW10N	17-114	63.8	1.1	62.7	60
	18-1103	66.3	3.3	63.0	N/A
	18-1107	68.9	5.3	63.6	N/A
	17-123	66.3	1.2	65.2	N/A
RW11N	17-124	66.4	0.9	65.5	N/A
	12-1203	68.7	3.7	65.0	N/A
	18-908	66.7	1.6	65.1	66
	18-909	69.1	3.1	66.0	N/A
RW4S	17-122	66.7	1.0	65.7	N/A
	18-1204	70.5	5.3	65.2	70
	17S-01	73.7	7.4	66.3	N/A
	17S-02	74.1	4.2	69.9	N/A
RW5S	18-912	72.8	1.2	71.6	72

The bedrock encountered during coring operations was slightly weathered to fresh and thinly to medium bedded limestone. Thin shale partings were also present in the bedrock core. Rock Quality Designation (RQD) values measured on recovered bedrock core samples from the current investigation ranged from about 52 to 100 percent, indicating a fair to excellent quality rock

The results of UCS testing carried out on three bedrock core samples from the current investigation are summarized in Table 6; are presented on Figure B24 provided in Appendix B; and, indicate a medium strong to strong bedrock.

4.15 Groundwater Conditions

Monitoring wells were installed in Boreholes 18-902, 18-911, 18-913 to 18-917 to observe the stabilised groundwater level across the various retaining wall sites.

Table 7 summarizes the depths and the elevations of the groundwater levels measured in the monitoring wells installed during the current investigation at the retaining wall sites. All monitoring wells were measured on June 19, 2019 and then decommissioned.

It is expected that the groundwater levels will be subject to fluctuations both seasonally and as a result of precipitation events.

Table 7: Summary of Groundwater Conditions

Retaining Wall	Borehole	Screened Interval	Depth (m)	Elevation (m)
RW13N	18-913	Fill / Glacial Till	3.1	63.9
	18-914	Fill / Peat / Silty Clay / Glacial Till	2.0	65.5
	18-915	Fill / Sand / Glacial Till	2.4	65.7
RW1S	18-902	Sand / Glacial Till	2.9	67.2
RW4S	18-911	Fill	3.1	69.8
RW7S	18-916	Fill	2.3	64.9
	18-917	Glacial Till	1.8	64.5

4.16 Steel Corrosion and Sulphate Attack, Chemical Analysis

A total of eight soil samples were submitted to Eurofins Environmental Testing for chemical analysis related to potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack). The test results are provided in Appendix D and are summarized in Table 8.

Table 8: Steel Corrosion and Sulphate Attack, Chemical Analysis

Retaining Wall	Borehole	Sample (Depth)	Sample Type	Chloride (%)	Sulphate (%)	Electrical Conductivity (mS/cm)	pH	Resistivity (ohm-cm)
RW2N	18-802	SS3 (1.2 – 1.8)	Fill	0.027	<0.01	0.64	9.7	1,560
RW10N	18-907	SS2 (0.8 – 1.1)	Fill	0.008	<0.01	0.50	9.4	2,000
RW11N	18-909	SS1B (0.5 – 0.8)	Fill	0.006	0.04	0.41	8.1	2,440
RW13N	18-913	SS2 (0.8 – 1.4)	Fill	0.031	<0.01	0.70	8.3	1,430
RW1S	18-901	SS4 (2.1 - 2.7)	Silty Sand	0.007	<0.01	0.29	9.1	3,450
RW4S	18-910	SS1 (1.3 – 1.7)	Fill	0.016	0.02	0.50	8.4	2,000
RW7S	18-917	SS4 (2.5 – 3.1)	Sand	0.051	<0.01	0.73	9.6	1,370
	18-917	SS8 (5.3 – 5.9)	Glacial Till	0.023	0.02	0.38	8.5	2,630

5.0 CLOSURE

This report was prepared by Mr. Kenton Power, P.Eng. It was reviewed by Mr. Bill Cavers, P.Eng., a Senior Geotechnical Engineer and Associate with Golder. Mr. Fintan Heffernan, P.Eng. a Senior Consultant with Golder and the Designated MTO Foundations Contact for this project, carried out an independent quality control review of this report.

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Geotechnical Engineer

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Designated MTO Foundations Contact

KCP/FJH/hdw
https://golderassociates.sharepoint.com/sites/18579g/foundations/6 - reports/1900 retaining walls/3-final rw/1655214-1900-001-reva-final rws-2020-03-04 - fir.docx

MINISTRY OF TRANSPORTATION, ONTARIO

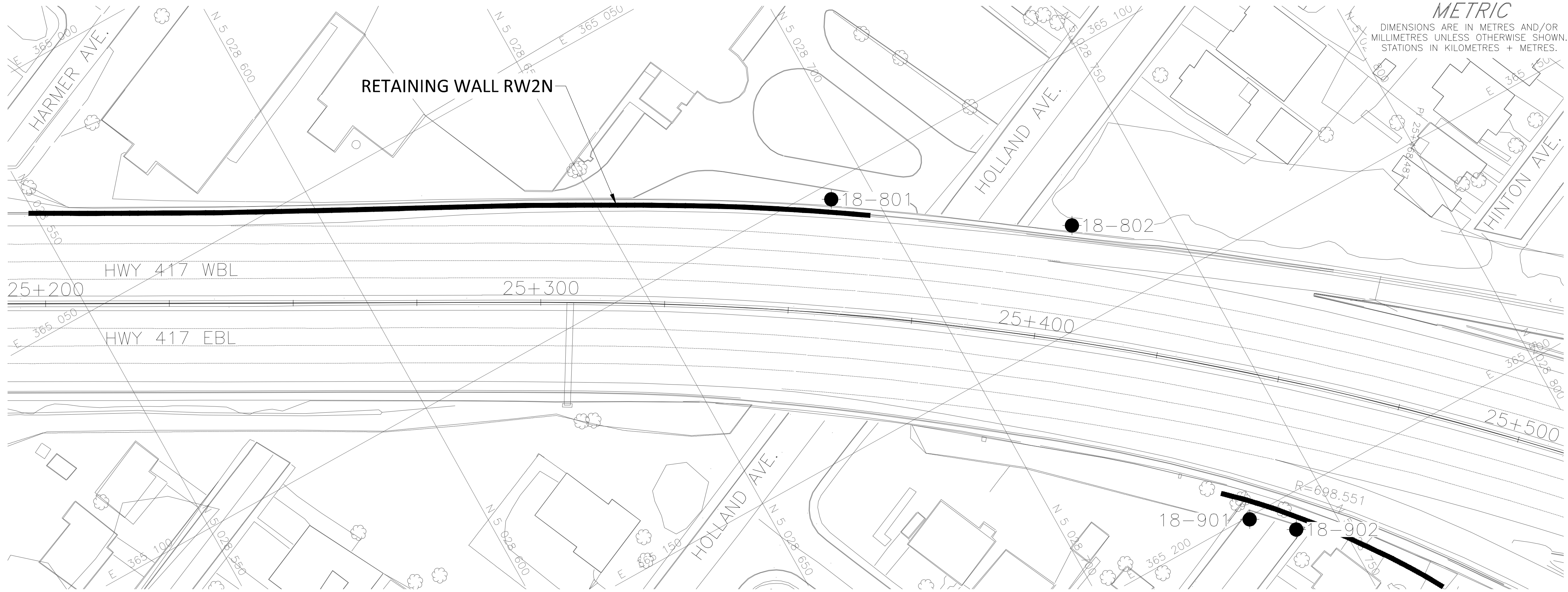
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 4173-15-00

RETAINING WALL REPLACEMENT/REHABILITATION RW2N
HIGHWAY 417
BOREHOLE LOCATIONS AND SOIL STRATA
LAT. 45.391846 LONG. -75.732469

SHEET

GOLDER



PLAN

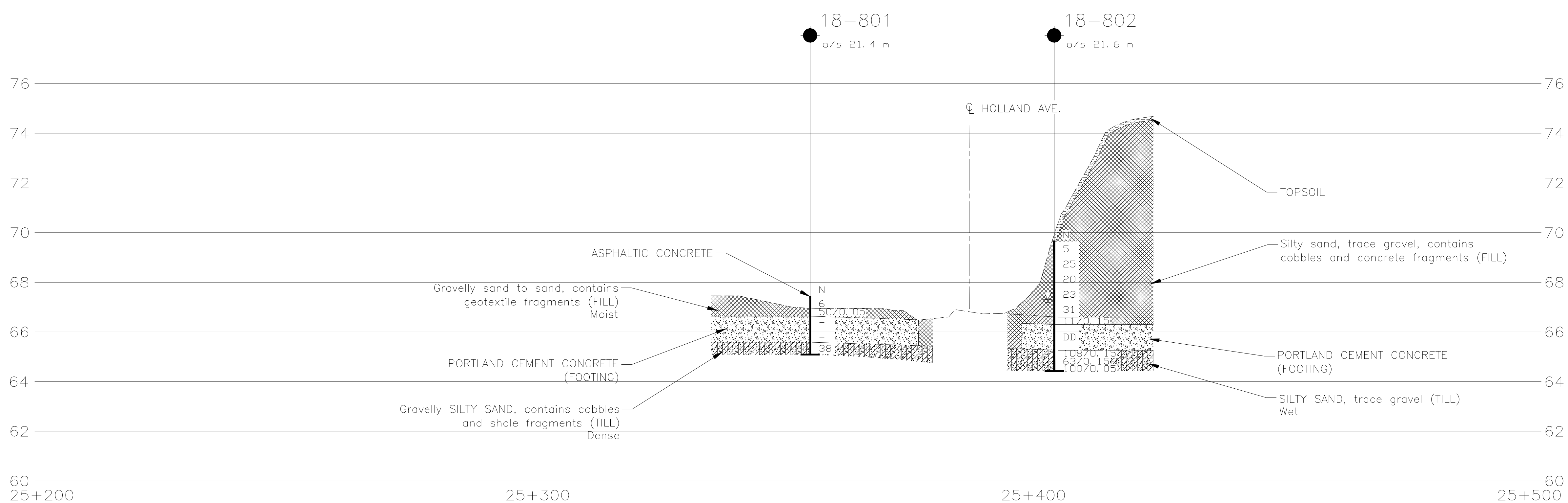
SCALE 10 0 10 20 m

KEY PLAN
SCALE 500 0 500 1000 m

LEGEND

- ● Borehole – Current Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL upon completion of drilling
- Retaining Wall (RW)

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
18-801	67.4	5028691.4	365104.3
18-802	69.7	5028731.2	365132.6
18-901	70.0	5028734.4	365200.6
18-902	70.0	5028741.6	365206.9
18-903	71.6	5029102.8	365614.2
18-904	71.0	5029102.8	365691.1
18-906	65.5	5029624.1	366799.1
18-907	66.3	5029631.9	366837.8
18-908	66.7	5029647.0	366893.3
18-909	69.1	5029667.4	366944.3
18-910	72.1	5029641.4	367056.5
18-911	72.9	5029650.4	367089.2
18-912	72.8	5029660.0	367131.5
18-913	66.9	5029932.5	367605.0
18-914	67.5	5029958.8	367649.0
18-915	68.1	5029997.9	367718.4
18-916	67.1	5029928.2	367723.2
18-917	66.3	5029956.2	367774.1
18-918	66.6	5029986.3	367825.5
18-923	72.1	5029080.2	365569.0



PROFILE ALONG CENTRE-LINE HIGHWAY 417

SCALE 10 0 10 20 m
3 0 2 4 m

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plans provided in digital format by WSP, drawing file no. 3416024-Noise and Retaining wall overview.dwg, received MAR. 18, 2019.

LICENSED PROFESSIONAL ENGINEER K.T.C. POWER 100130652 2020/03/06 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER F. J. HEFFERNAN PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 31G5-315

HWY. 417	PROJECT NO. 1655214-1900		DIST. EASTERN
SUBM'D. RK	CHKD. RK	DATE: 3/6/2020	SITE: -
DRAWN: JM	CHKD. KP	APPD. FJH	DWG. 1

PLOT DATE: March 6, 2020

MINISTRY OF TRANSPORTATION, ONTARIO

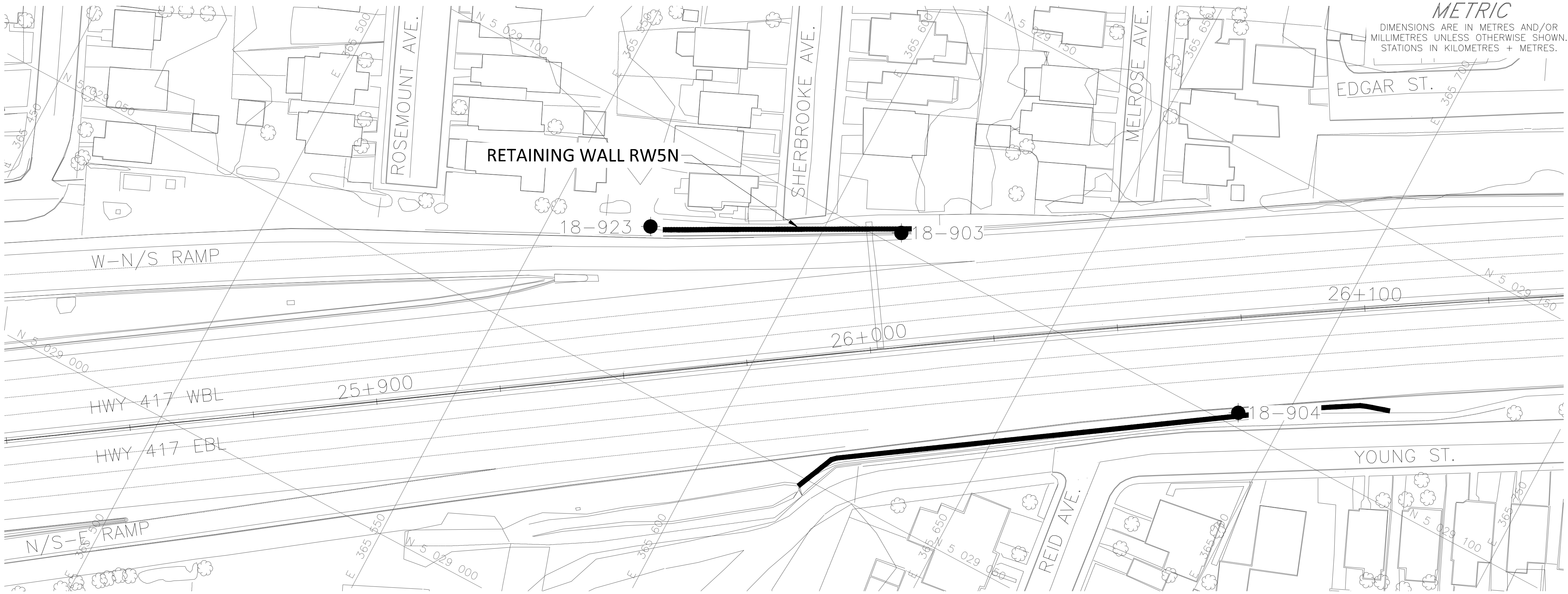
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 4173–15–00

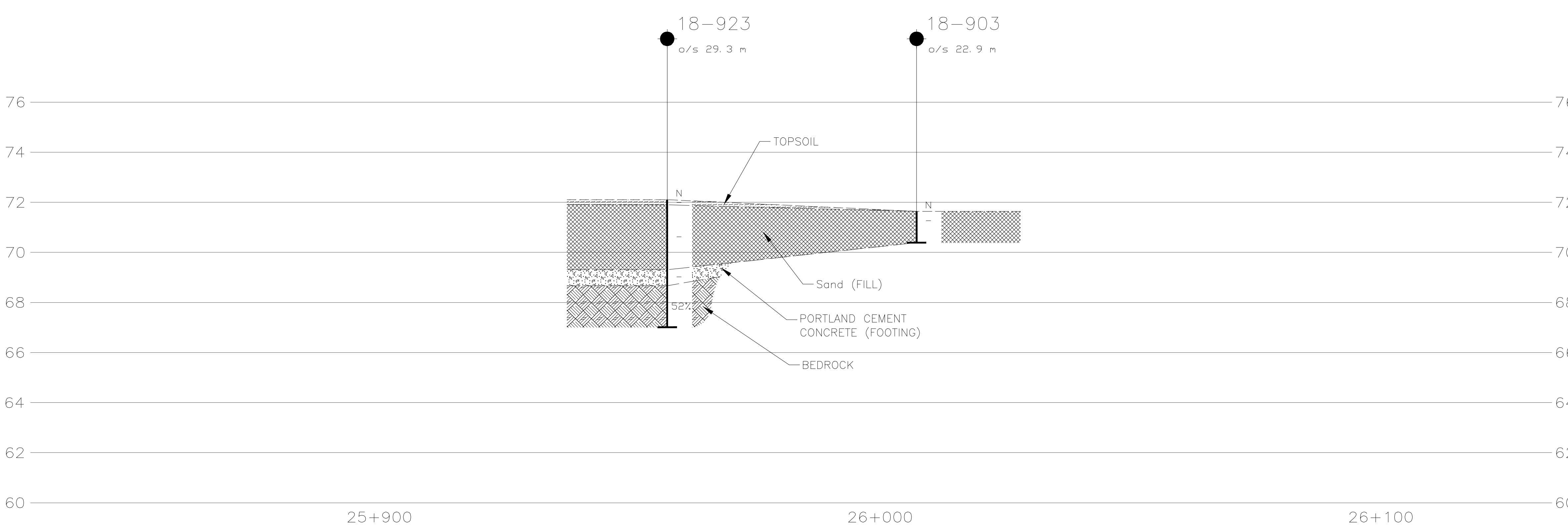
SHEET

RETAINING WALL REPLACEMENT/REHABILITATION RW5N
HIGHWAY 417
BOREHOLE LOCATIONS AND SOIL STRATA
LAT. 45.399231 LONG. –75.723216

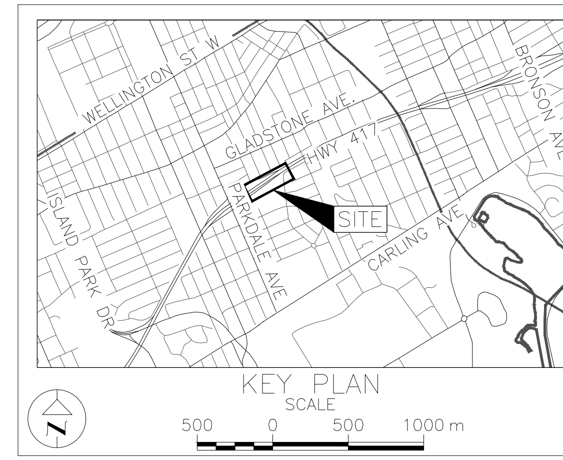
GOLDER



PLAN
SCALE 10 0 10 20 m



PROFILE ALONG CENTRE–LINE HIGHWAY 417
SCALE 10 0 10 20 m
3 0 3 6 m



KEY PLAN
SCALE 500 0 500 1000 m

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- Retaining Wall (RW)

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
18–801	67.4	5028691.4	365104.3
18–802	69.7	5028731.2	365132.6
18–901	70.0	5028734.4	365200.6
18–902	70.0	5028741.6	365206.9
18–903	71.6	5029102.8	365614.2
18–904	71.0	5029102.8	365691.1
18–906	65.5	5029624.1	366799.1
18–907	66.3	5029631.9	366837.8
18–908	66.7	5029647.0	366893.3
18–909	69.1	5029667.4	366944.3
18–910	72.1	5029641.4	367056.5
18–911	72.9	5029650.4	367089.2
18–912	72.8	5029660.0	367131.5
18–913	66.9	5029932.5	367605.0
18–914	67.5	5029958.8	367649.0
18–915	68.1	5029997.9	367718.4
18–916	67.1	5029928.2	367723.2
18–917	66.3	5029956.2	367774.1
18–918	66.6	5029986.3	367825.5
18–923	72.1	5029080.2	365569.0

NOTES

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

REFERENCE

Base plans provided in digital format by WSP, drawing file no. 3416024–Noise and Retaining wall overview.dwg, received MAR. 18, 2019.

LICENSED PROFESSIONAL ENGINEER K.T.C. POWER 100130652 2020/03/05 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER F. J. HEFFERNAN 2020/03/05 PROVINCE OF ONTARIO

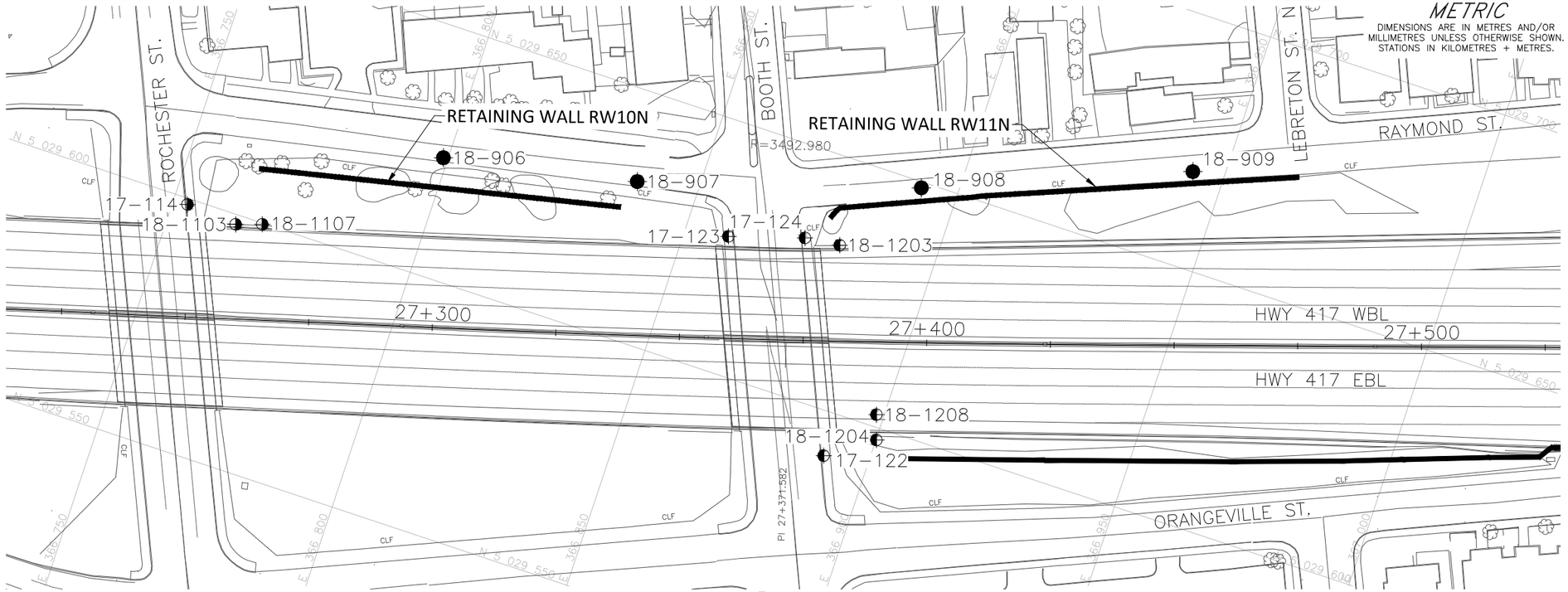
NO.	DATE	BY	REVISION

Geocres No. 31G5–315

HWY. 417	PROJECT NO. 1655214–1900		DIST. EASTERN
SUBM'D. KCP	CHKD. KCP	DATE: 3/5/2020	SITE: -
DRAWN: ZS	CHKD. FJH	APPD. FJH	DWG. 2

PLOT DATE: March 6, 2020

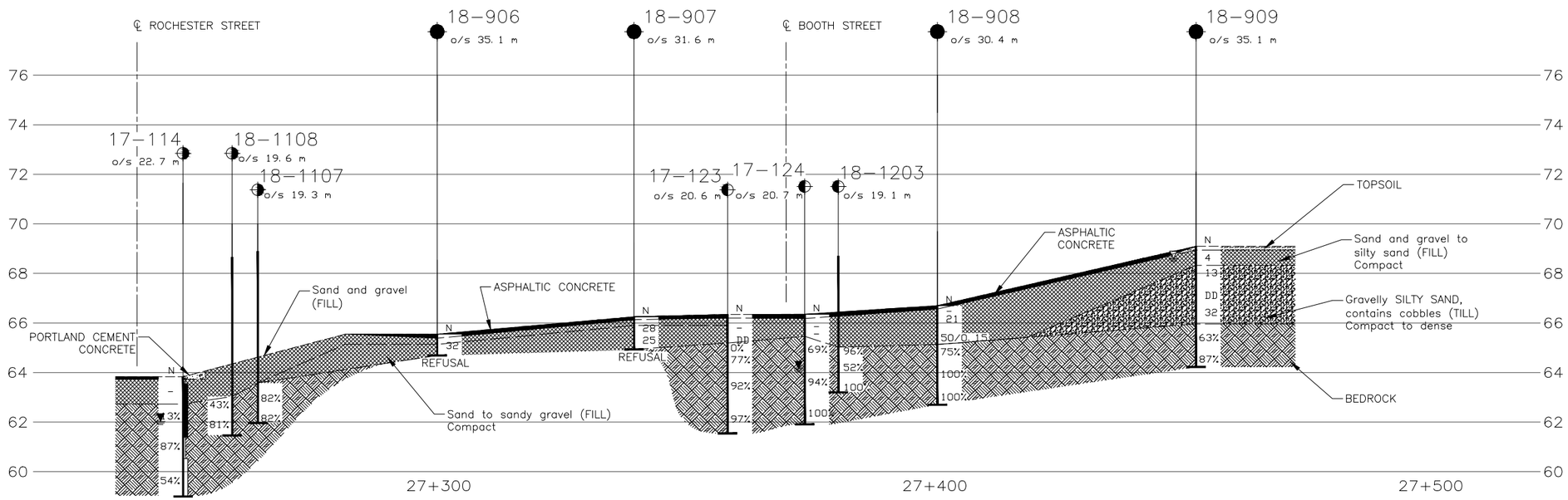
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

SCALE

10 0 10 20 m



PROFILE ALONG CENTRE–LINE HIGHWAY 417

SCALE

10 0 10 20 m

3 0 3 6 m

NOTES

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

REFERENCE

Base plans provided in digital format by WSP, drawing file no. 3416024–Noise and Retaining wall overview.dwg, received MAR. 18, 2019.

METRIC

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

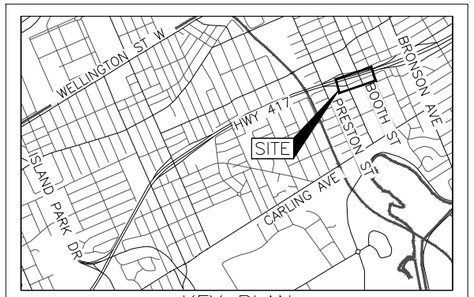
CONT No.

GWP No. 4173–15–00

RETAINING WALL REPLACEMENT/ REHABILITATION RW10N & RW11N
HIGHWAY 417
BOREHOLE LOCATIONS AND SOIL STRATA
LAT. 45.391846 LONG. –75.732469

SHEET

GOLDER



KEY PLAN

SCALE

500 0 500 1000 m

LEGEND

- Borehole – Current Investigation
- Borehole – From Geocres 31G5–295
- Borehole – From Geocres 31G5–308
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- WL upon completion of drilling
- WL in piezometer, measured on April 26, 2017 and October27, 2017
- Retaining Wall (RW)

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
18–906	65.5	5029624.1	366799.1
18–907	66.3	5029631.9	366837.8
18–908	66.7	5029647.0	366893.3
18–909	69.1	5029667.4	366944.3
17–114	63.8	5029598.8	366753.0
18–1103	66.3	5029598.0	366763.5
18–1107	68.9	5029599.8	366768.6
17–123	66.3	5029627.2	366858.8
17–124	66.4	5029631.8	366873.5
18–1203	68.7	5029632.6	366880.7
17–122	66.7	5029591.2	366891.0
18–1204	70.5	5029597.6	366900.1
18–1208	72.9	5029602.4	366898.5

LICENSED PROFESSIONAL ENGINEER K.T.C. POWER 100130652 PROVINCE OF ONTARIO 2020/03/05

REGISTERED PROFESSIONAL ENGINEER F. J. HEFFERNAN PROVINCE OF ONTARIO 2020/03/05

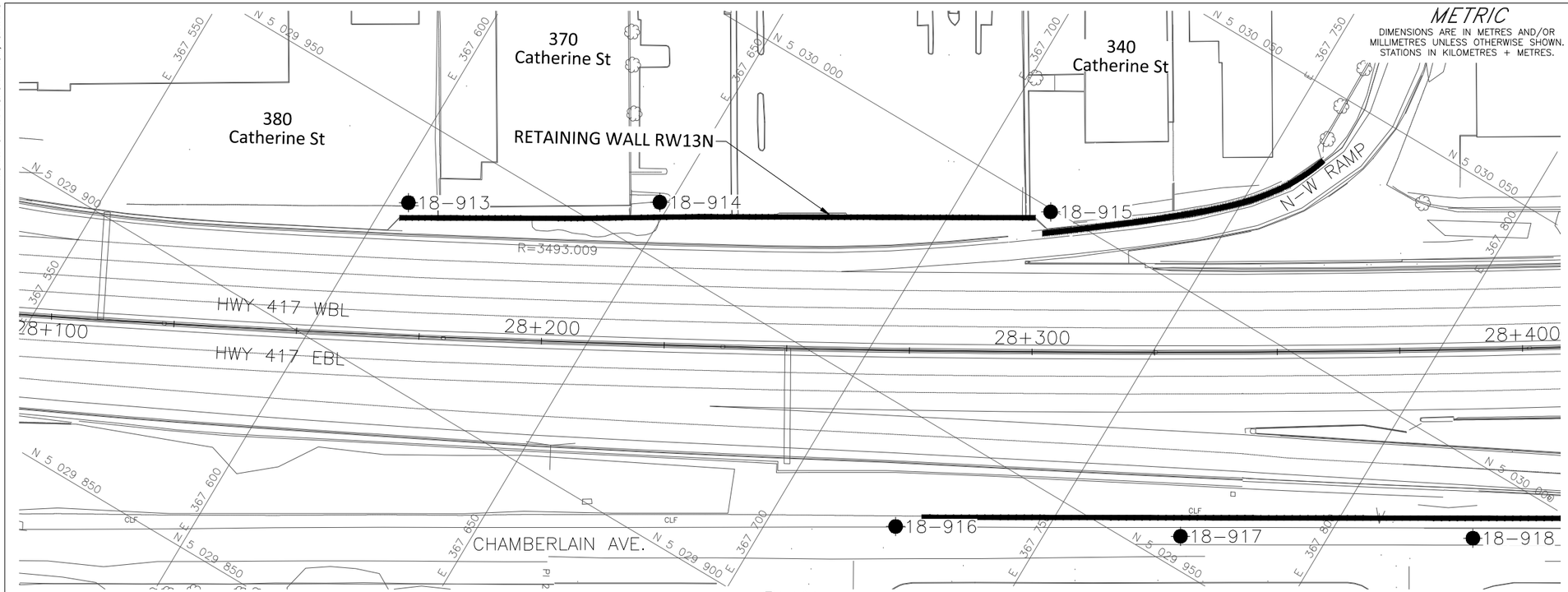
NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31G5–315

HWY. 417		PROJECT NO. 1655214–1900	DIST. EASTERN
SUBM'D. KCP	CHKD. KCP	DATE: 3/5/2020	SITE: –
DRAWN: ZS	CHKD. FJH	APPD. FJH	DWG. 3

PLOT DATE: March 6, 2020
FILENAME: N:\Active\Sprdsl_MTO\Hwy417Rehab&Widening\99_PRO\1655214_MTO_Hwy417BridgeReplacement\45_PROD\Phase1900_Retaining Walls\1655214–1900–BE–0003.dwg

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

SCALE
10 0 10 20 m

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

CONT No.
GWP No. 4173-15-00

RETAINING WALL
REPLACEMENT/REHABILITATION RW13N
HIGHWAY 417
BOREHOLE LOCATIONS AND SOIL STRATA
LAT. 45.391846 LONG. -75.732469

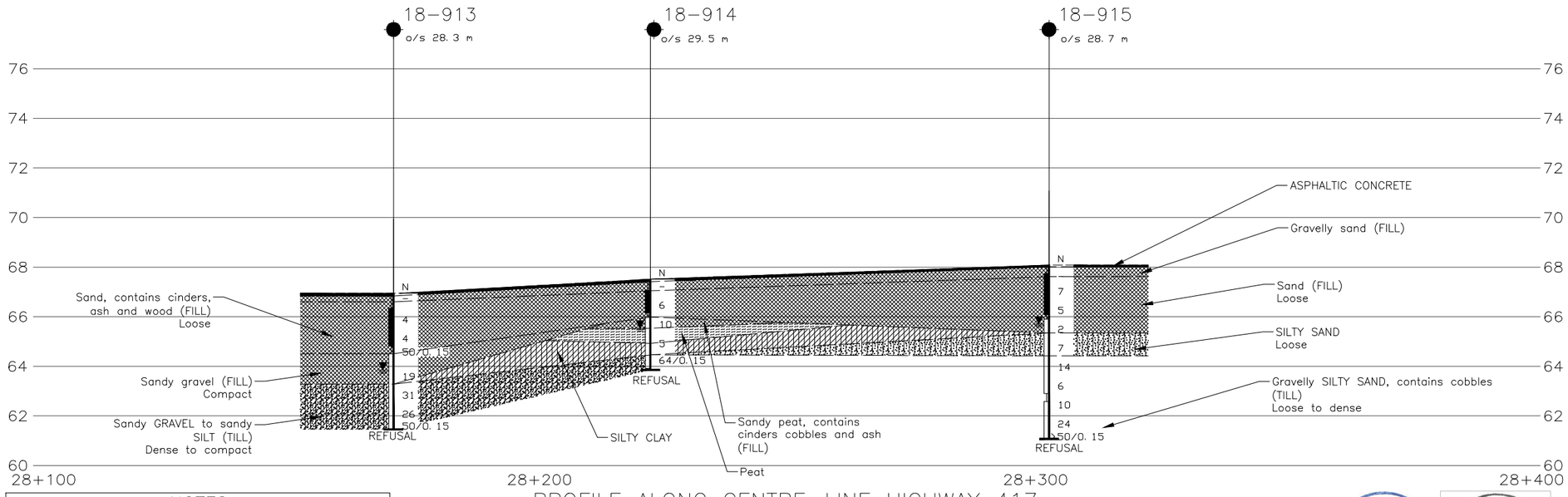
SHEET

GOLDER

KEY PLAN
SCALE
500 0 500 1000 m

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- WL in piezometer, measured on June 19, 2019
- Retaining Wall (RW)



PROFILE ALONG CENTRE-LINE HIGHWAY 417

SCALE
10 0 10 20 m
3 0 3 6 m

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
18-801	67.4	5028691.4	365104.3
18-802	69.7	5028731.2	365132.6
18-901	70.0	5028734.4	365200.6
18-902	70.0	5028741.6	365206.9
18-903	71.6	5029102.8	365614.2
18-904	71.0	5029102.8	365691.1
18-906	65.5	5029624.1	366799.1
18-907	66.3	5029631.9	366837.8
18-908	66.7	5029647.0	366893.3
18-909	69.1	5029667.4	366944.3
18-910	72.1	5029641.4	367056.5
18-911	72.9	5029650.4	367089.2
18-912	72.8	5029660.0	367131.5
18-913	66.9	5029932.5	367605.0
18-914	67.5	5029958.8	367649.0
18-915	68.1	5029997.9	367718.4
18-916	67.1	5029928.2	367723.2
18-917	66.3	5029956.2	367774.1
18-918	66.6	5029986.3	367825.5
18-923	72.1	5029080.2	365569.0

NOTES

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

REFERENCE

Base plans provided in digital format by WSP, drawing file no. 3416024-Noise and Retaining wall overview.dwg, received MAR. 18, 2019.

LICENSED PROFESSIONAL ENGINEER K.T.C. POWER 100130652 2020/03/05 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER F. J. HEFFERNAN 2020/03/05 PROVINCE OF ONTARIO

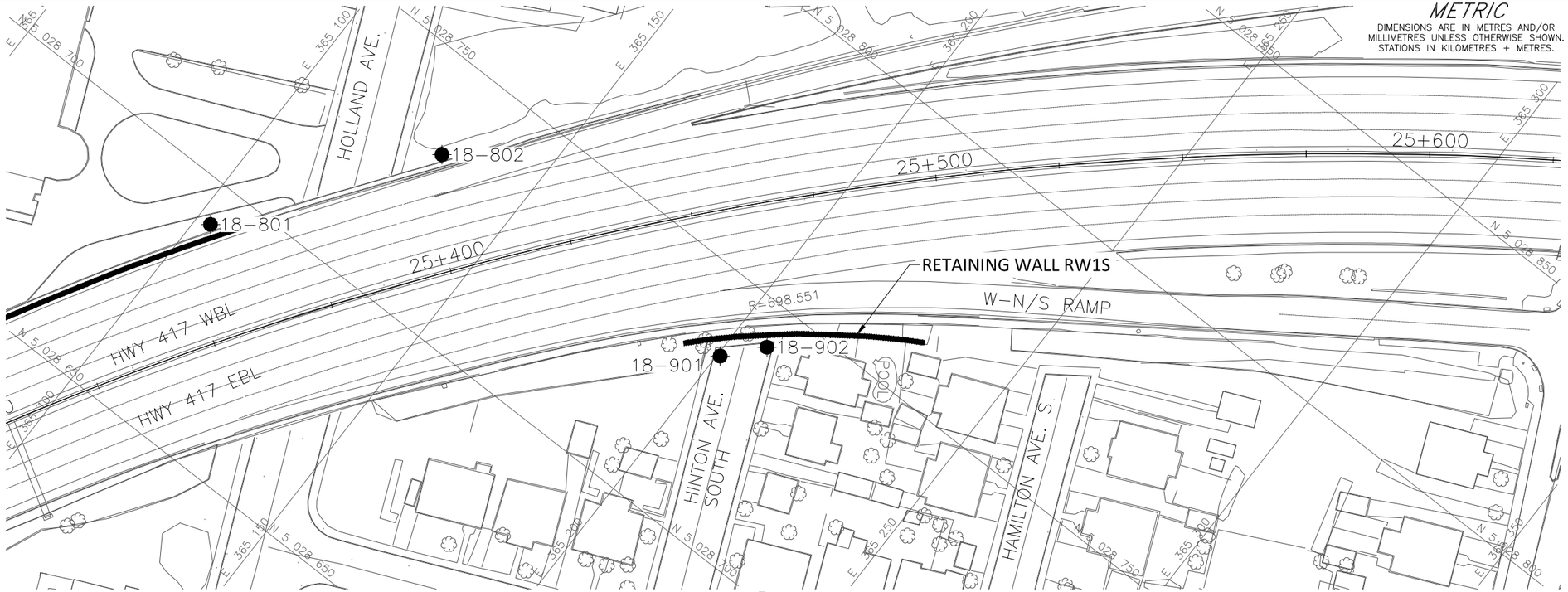
NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31G5-315

HWY. 417		PROJECT NO. 1655214-1900	DIST. EASTERN
SUBM'D. KCP	CHKD. KCP	DATE: 3/5/2020	SITE: -
DRAWN: ZS	CHKD. FJH	APPD. FJH	DWG. 4

PLOT DATE: March 6, 2020
FILENAME: N:\Active\Spatial_Mkt\MTO\Hwy417Rehab&Widening\99_PROJ\1655214_MTO_Hwy417BridgeReplacement\40_PROD\1Phase1900_RetainingWalls\1655214-1900-BS-0004.dwg

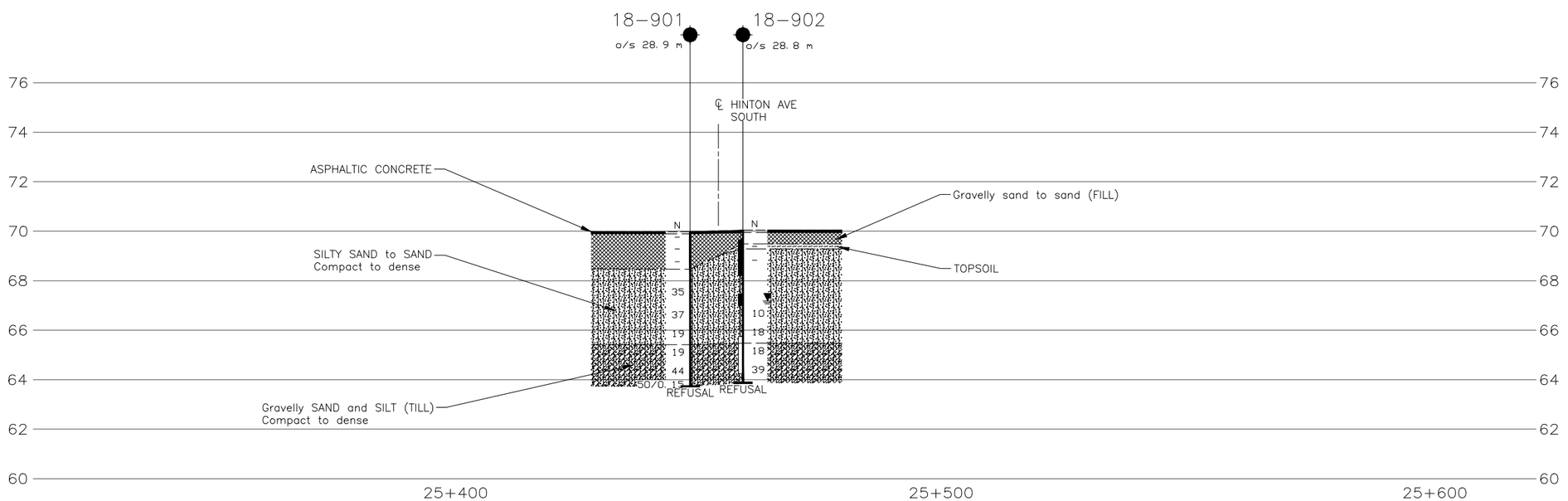
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

SCALE

10 0 10 20 m



PROFILE ALONG CENTRE–LINE HIGHWAY 417

SCALE

10 0 10 20 m

3 0 3 6 m

NOTES

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REFERENCE

Base plans provided in digital format by WSP, drawing file no. 3416024–Noise and Retaining wall overview.dwg, received MAR. 18, 2019.

METRIC

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

CONT No.

GWP No. 4173–15–00

RETAINING WALL REPLACEMENT/REHABILITATION RW1S

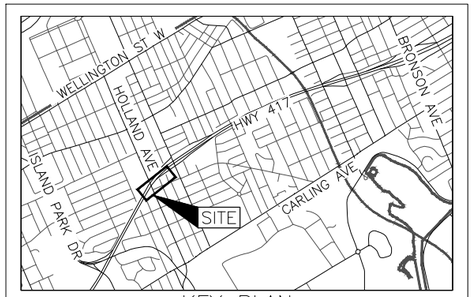
HIGHWAY 417

BOREHOLE LOCATIONS AND SOIL STRATA

LAT. 45.399231 LONG. –75.723216

SHEET

GOLDER



KEY PLAN

SCALE

500 0 500 1000 m

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL in piezometer, measured on June 19, 2019
- Retaining Wall (RW)

BOREHOLE CO–ORDINATES

No.	ELEVATION	NORTHING	EASTING
18–801	67.4	5028691.4	365104.3
18–802	69.7	5028731.2	365132.6
18–901	70.0	5028734.4	365200.6
18–902	70.0	5028741.6	365206.9
18–903	71.6	5029102.8	365614.2
18–904	71.0	5029102.8	365691.1
18–906	65.5	5029624.1	366799.1
18–907	66.3	5029631.9	366837.8
18–908	66.7	5029647.0	366893.3
18–909	69.1	5029667.4	366944.3
18–910	72.1	5029641.4	367056.5
18–911	72.9	5029650.4	367089.2
18–912	72.8	5029660.0	367131.5
18–913	66.9	5029932.5	367605.0
18–914	67.5	5029958.8	367649.0
18–915	68.1	5029997.9	367718.4
18–916	67.1	5029928.2	367723.2
18–917	66.3	5029956.2	367774.1
18–918	66.6	5029986.3	367825.5
18–923	72.1	5029080.2	365569.0

LICENSED PROFESSIONAL ENGINEER K.T.C. POWER 100130652 2020/03/05 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER F. J. HEFFERNAN 2020/03/05 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 31G5–315

HWY. 417		PROJECT NO. 1655214–1900	DIST. EASTERN
SUBM'D. KCP	CHKD. KCP	DATE: 3/5/2020	SITE: –
DRAWN: ZS	CHKD. FJH	APPD. FJH	DWG. 5

PLOT DATE: March 6, 2020
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METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

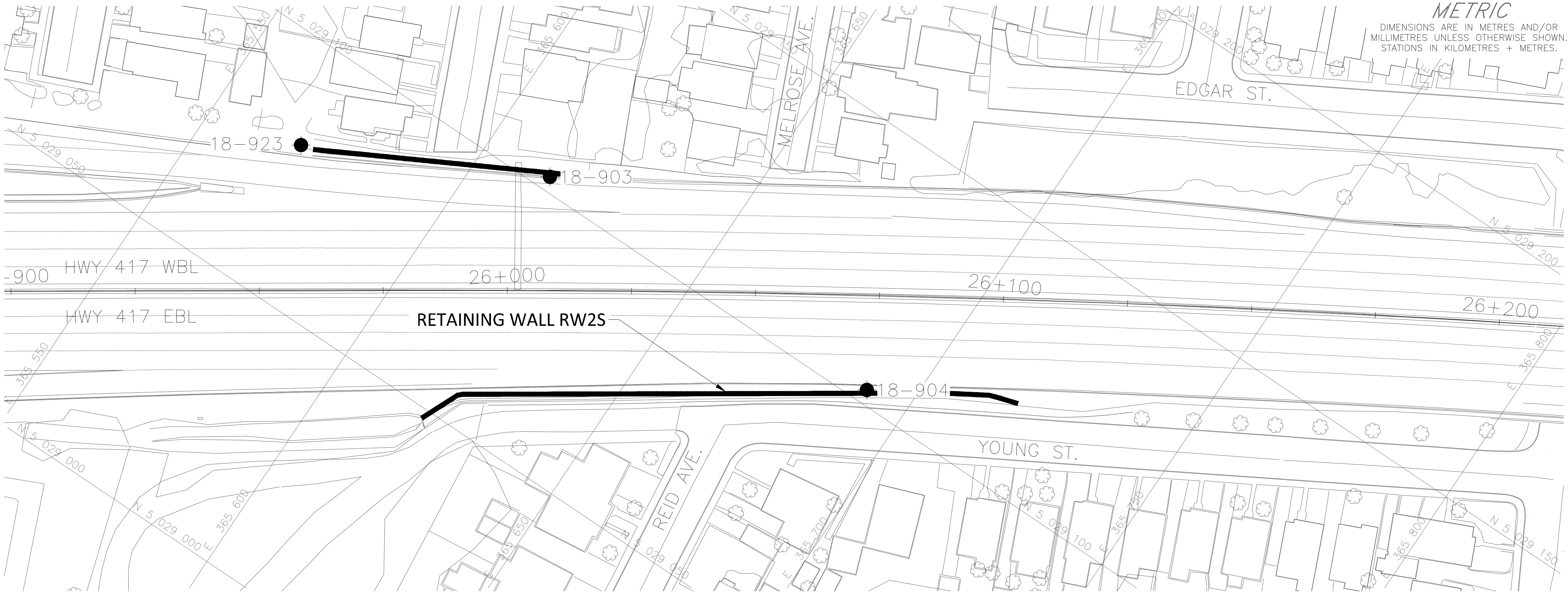
CONT No.
GWP No. 4173-15-00

SHEET

RETAINING WALL REPLACEMENT/REHABILITATION RW2S

HIGHWAY 417
BOREHOLE LOCATIONS AND SOIL STRATA
LAT. 45.399224 LONG. -75.722234

GOLDER

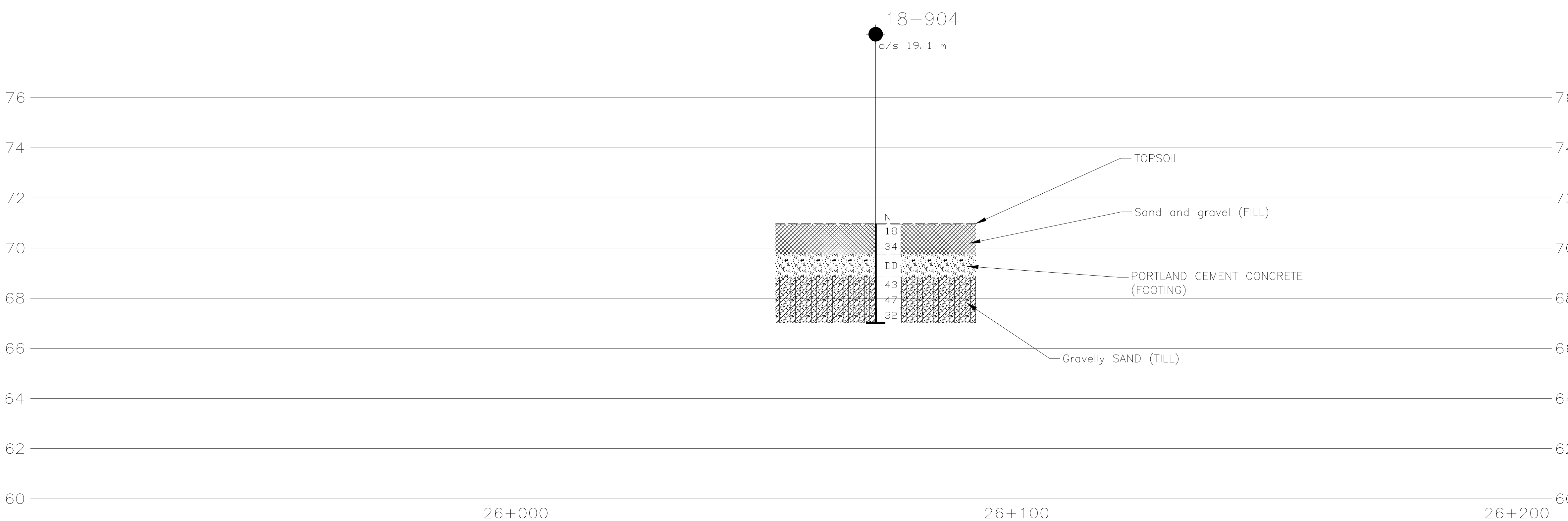


PLAN
SCALE 10 0 10 20 m

KEY PLAN
SCALE 500 0 500 1000 m

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- Retaining Wall (RW)



PROFILE ALONG CENTRE-LINE HIGHWAY 417
SCALE 10 0 10 20 m / 3 0 3 6 m

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
18-801	67.4	5028691.4	365104.3
18-802	69.7	5028731.2	365132.6
18-901	70.0	5028734.4	365200.6
18-902	70.0	5028741.6	365206.9
18-903	71.6	5029102.8	365614.2
18-904	71.0	5029102.8	365691.1
18-906	65.5	5029624.1	366799.1
18-907	66.3	5029631.9	366837.8
18-908	66.7	5029647.0	366893.3
18-909	69.1	5029667.4	366944.3
18-910	72.1	5029641.4	367056.5
18-911	72.9	5029650.4	367089.2
18-912	72.8	5029660.0	367131.5
18-913	66.9	5029932.5	367605.0
18-914	67.5	5029958.8	367649.0
18-915	68.1	5029997.9	367718.4
18-916	67.1	5029928.2	367723.2
18-917	66.3	5029956.2	367774.1
18-918	66.6	5029986.3	367825.5
18-923	72.1	5029080.2	365569.0

NOTES

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REFERENCE

Base plans provided in digital format by WSP, drawing file no. 3416024-Noise and Retaining wall overview.dwg, received MAR. 18, 2019.

LICENSED PROFESSIONAL ENGINEER K.T.C. POWER 100130652 2020/03/05 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER F. J. HEFFERNAN 2020/03/05 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 31G5-315

HWY. 417	PROJECT NO. 1655214-1900		DIST. EASTERN
SUBM'D. KCP	CHKD. KCP	DATE: 3/5/2020	SITE: -
DRAWN: ZS	CHKD. FJH	APPD. FJH	DWG. 6

PLOT DATE: March 6, 2020
FILENAME: N:\Active\Spatial_IM\MTO\Hwy417Rehab&Widening\99_PROJ\1655214_MTO_Hwy417BridgeReplacement\40_PROD\Phase1900_RetainingWalls\1655214-1900-BC-0006.dwg

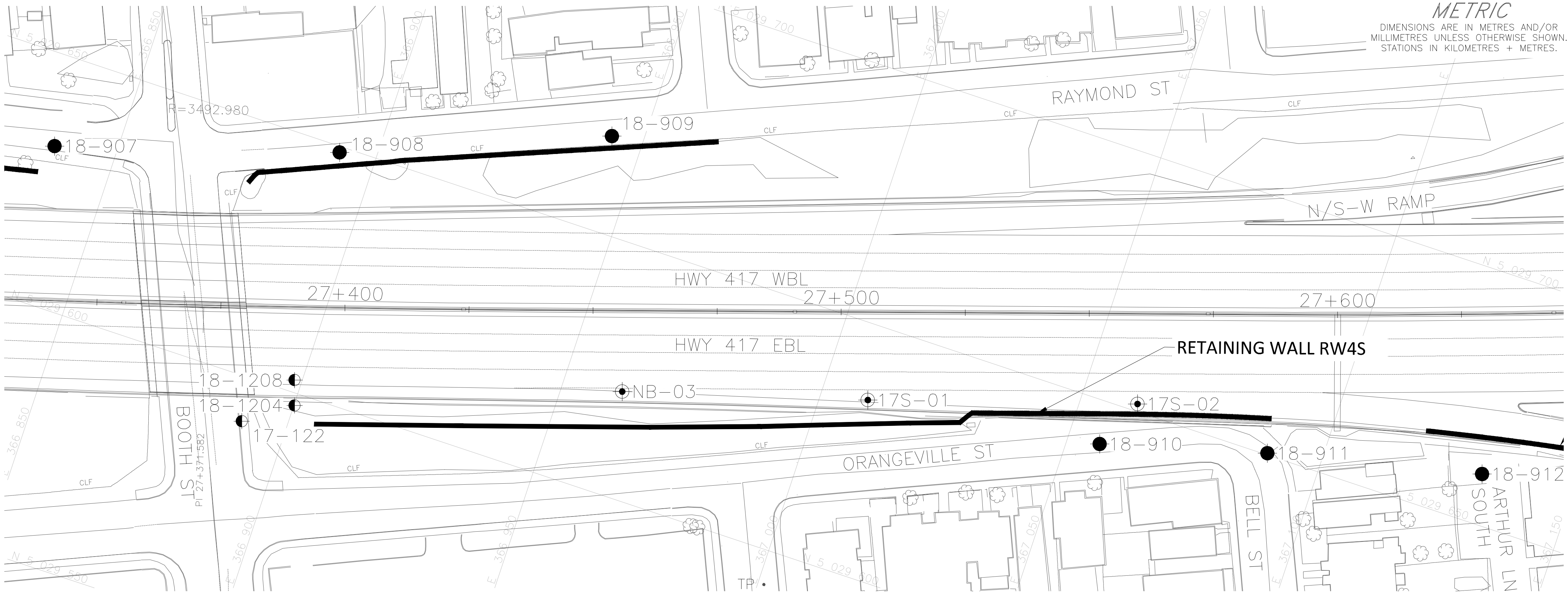
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 4173-15-00

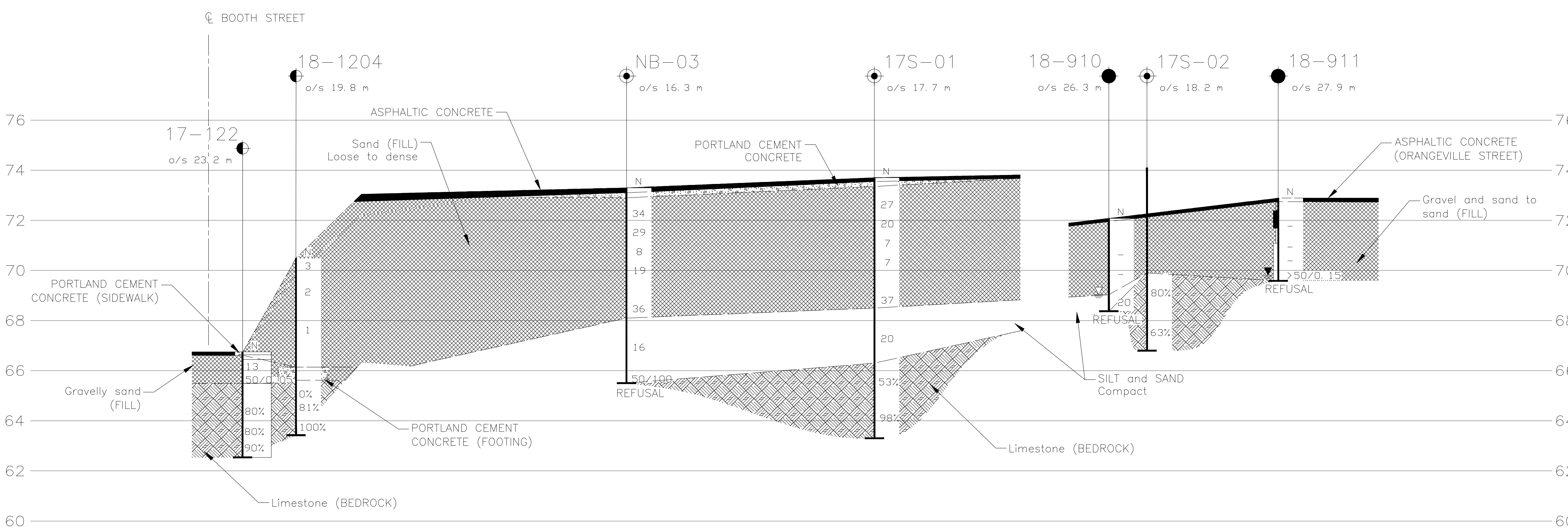
RETAINING WALL REPLACEMENT/REHABILITATION RW4S
HIGHWAY 417
BOREHOLE LOCATIONS AND SOIL STRATA
LAT. 45.403951 LONG. -75.704727

SHEET

GOLDER



PLAN
SCALE 10 0 10 20 m



PROFILE ALONG CENTRE-LINE HIGHWAY 417
SCALE 10 0 10 20 m
3 0 3 6 m

KEY PLAN
SCALE 500 0 500 1000 m

LEGEND

- Borehole – Current Investigation
- Borehole – From Geocres 31G5-308
- Borehole – From Geocres 31G5-254
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL in piezometer, measured on June 19, 2019
- WL upon completion of drilling
- Retaining Wall (RW)

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
18-907	66.3	5029631.9	366837.8
18-908	66.7	5029647.0	366893.3
18-909	69.1	5029667.4	366944.3
18-910	72.1	5029641.4	367056.5
18-911	72.9	5029650.4	367089.2
18-912	72.8	5029660.0	367131.5
18-1204	70.5	5029597.6	366900.1
18-1208	72.9	5029602.4	366898.5
17-122	66.7	5029591.2	366891.0
NB-03	73.3	5029621.1	366961.9
17S-01	73.7	5029635.1	367009.4
17S-02	74.1	5029651.5	367061.2

NOTES

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

REFERENCE

Base plans provided in digital format by WSP, drawing file no. 3416024-Noise and Retaining wall overview.dwg, received MAR. 18, 2019.

LICENSED PROFESSIONAL ENGINEER K.T.C. POWER 100130652 2020/03/05 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER F. J. HEFFERNAN 2020/03/05 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION

Geocres No. 31G5-315

HWY. 417		PROJECT NO. 1655214-1900	DIST. EASTERN
SUBM'D. KCP	CHKD. KCP	DATE: 3/5/2020	SITE: -
DRAWN: ZS	CHKD. FJH	APPD. FJH	DWG. 7

PLOT DATE: March 6, 2020

MINISTRY OF TRANSPORTATION, ONTARIO

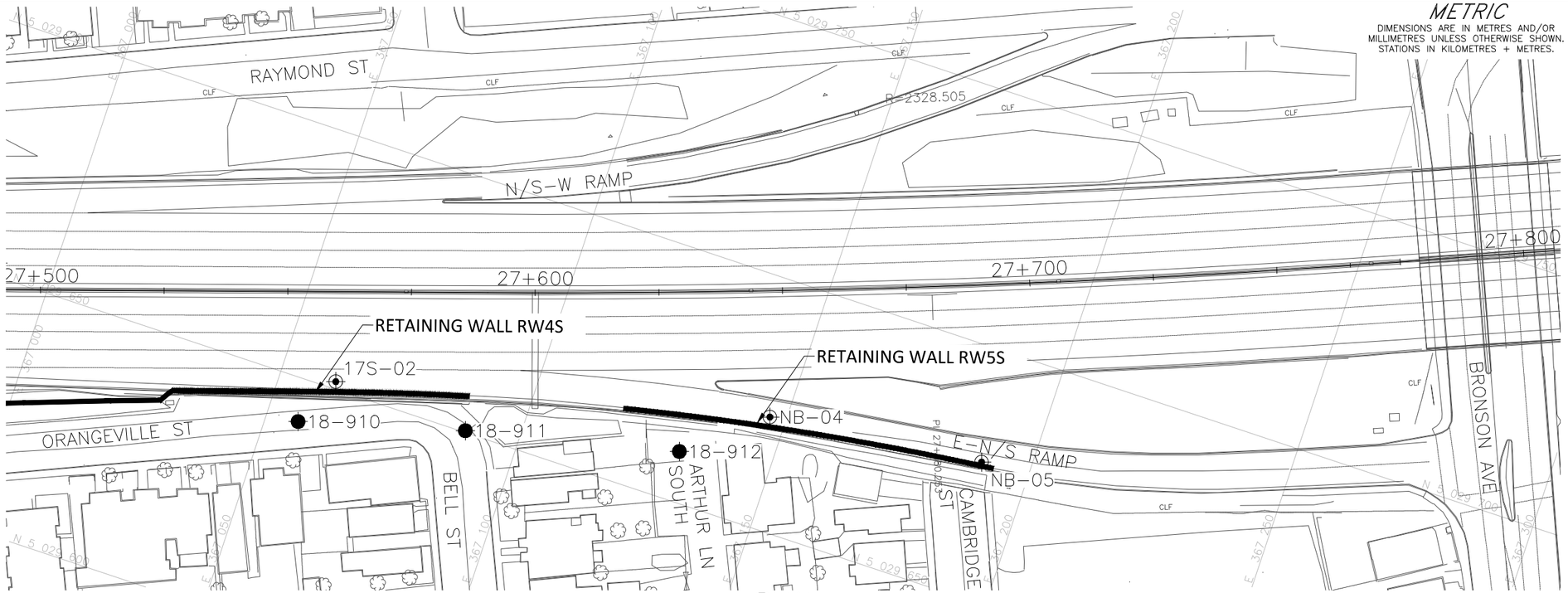
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 4173-15-00

RETAINING WALL REPLACEMENT/REHABILITATION RW5S
HIGHWAY 417
BOREHOLE LOCATIONS AND SOIL STRATA
LAT. 45.404112 LONG. -75.703767

SHEET

GOLDER

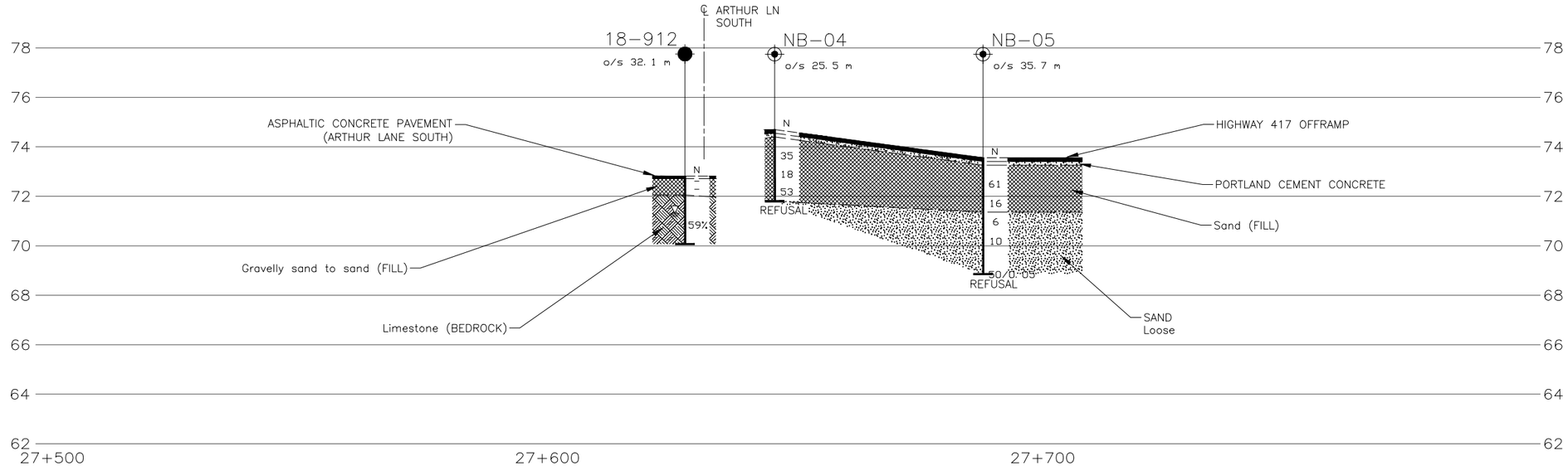


PLAN
SCALE
10 0 10 20 m

KEY PLAN
SCALE
500 0 500 1000 m

LEGEND

- Borehole – Current Investigation
- Borehole – From Geocres 31G5-254
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- WL upon completion of drilling
- Retaining Wall (RW)



PROFILE ALONG CENTRE-LINE HIGHWAY 417
SCALE
10 0 10 20 m
3 0 3 6 m

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
18-910	72.1	5029641.4	367056.5
18-911	72.9	5029650.4	367089.2
18-912	72.8	5029660.0	367131.5
NB-04	74.7	5029672.4	367146.7
NB-05	73.5	5029677.3	367190.2

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plans provided in digital format by WSP, drawing file no. 3416024-Noise and Retaining wall overview.dwg, received MAR. 18, 2019.

LICENSED PROFESSIONAL ENGINEER K.T.C. POWER 100130652 2020/03/05 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER F. J. HEFFERNAN 2020/03/05 PROVINCE OF ONTARIO

NO.	DATE	BY	REVISION
A	.	.	.

Geocres No. 31G5-315

HWY. 417		PROJECT NO. 1655214-1900	DIST. EASTERN
SUBM'D. KCP	CHKD. KCP	DATE: 3/5/2020	SITE: -
DRAWN: ZS	CHKD. FJH	APPD. FJH	DWG. 8

PLOT DATE: March 6, 2020
FILENAME: N:\Active\Ottawa\1655214_MTO\Hwy417Rehab&Widening\99_PROJ\1655214_MTO_Hwy417BridgeReplacement\40_PROD\Phase1900_RetainingWalls\1655214-1900-BD-0008.dwg

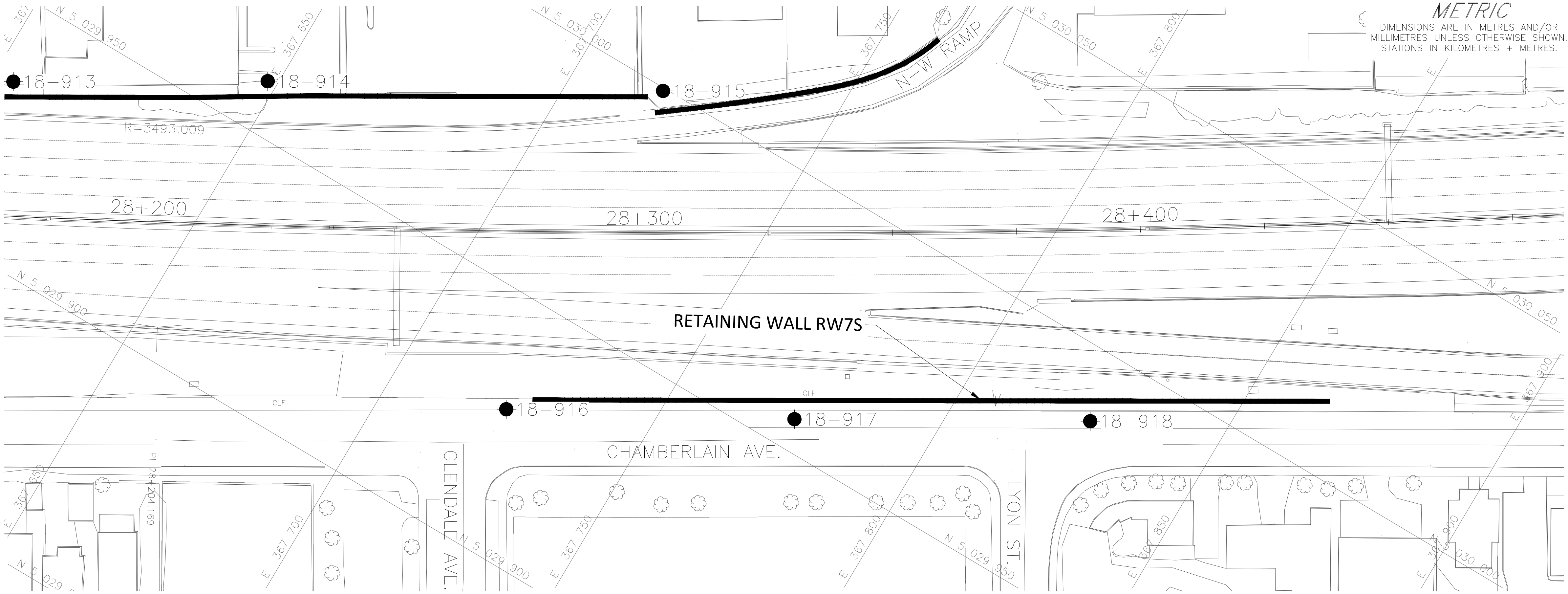
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 4173-15-00

SHEET

RETAINING WALL REPLACEMENT/REHABILITATION RW7S
HIGHWAY 417
BOREHOLE LOCATIONS AND SOIL STRATA
LAT. 45.406719 LONG. -75.695522

GOLDER

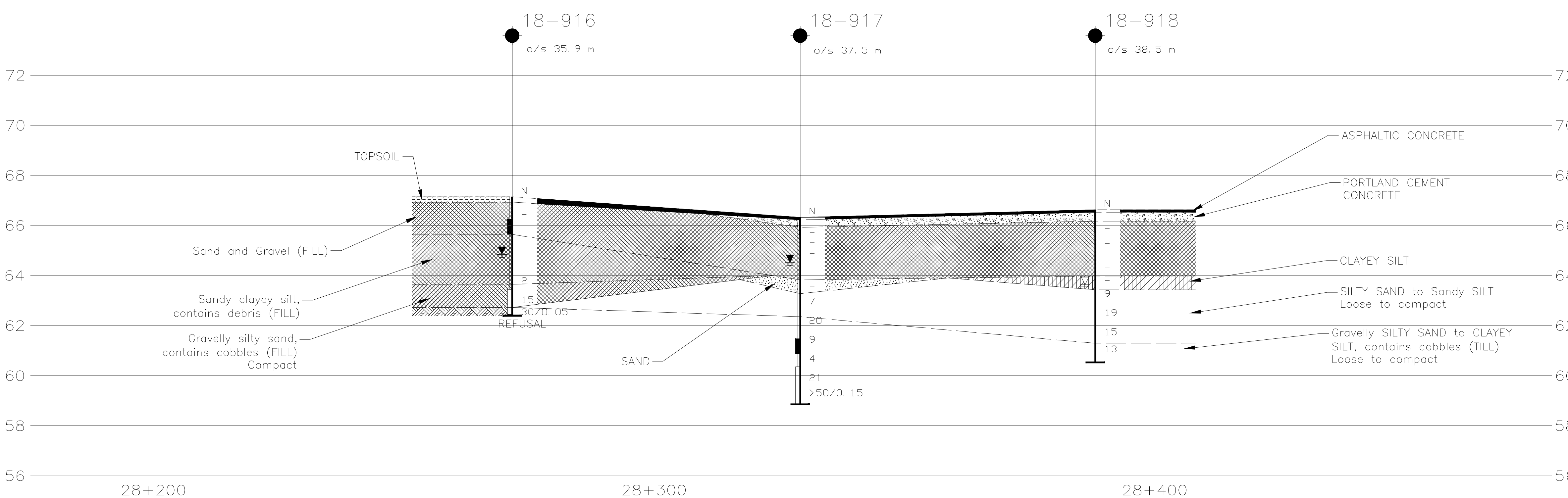


PLAN
SCALE
10 0 10 20 m

KEY PLAN
SCALE
500 0 500 1000 m

LEGEND

- Borehole – Current Investigation
- Seal
- Piezometer
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% — Rock Quality Designation (RQD)
- WL in piezometer, measured on June 19, 2019
- WL upon completion of drilling
- Retaining Wall (RW)



PROFILE ALONG CENTRE-LINE HIGHWAY 417
SCALE
10 0 10 20 m
3 0 3 6 m

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
18-801	67.4	5028691.4	365104.3
18-802	69.7	5028731.2	365132.6
18-901	70.0	5028734.4	365200.6
18-902	70.0	5028741.6	365206.9
18-903	71.6	5029102.8	365614.2
18-904	71.0	5029102.8	365691.1
18-906	65.5	5029624.1	366799.1
18-907	66.3	5029631.9	366837.8
18-908	66.7	5029647.0	366893.3
18-909	69.1	5029667.4	366944.3
18-910	72.1	5029641.4	367056.5
18-911	72.9	5029650.4	367089.2
18-912	72.8	5029660.0	367131.5
18-913	66.9	5029932.5	367605.0
18-914	67.5	5029958.8	367649.0
18-915	68.1	5029997.9	367718.4
18-916	67.1	5029928.2	367723.2
18-917	66.3	5029956.2	367774.1
18-918	66.6	5029986.3	367825.5
18-923	72.1	5029080.2	365569.0

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

REFERENCE

Base plans provided in digital format by WSP, drawing file no. 3416024-Noise and Retaining wall overview.dwg, received MAR. 18, 2019.

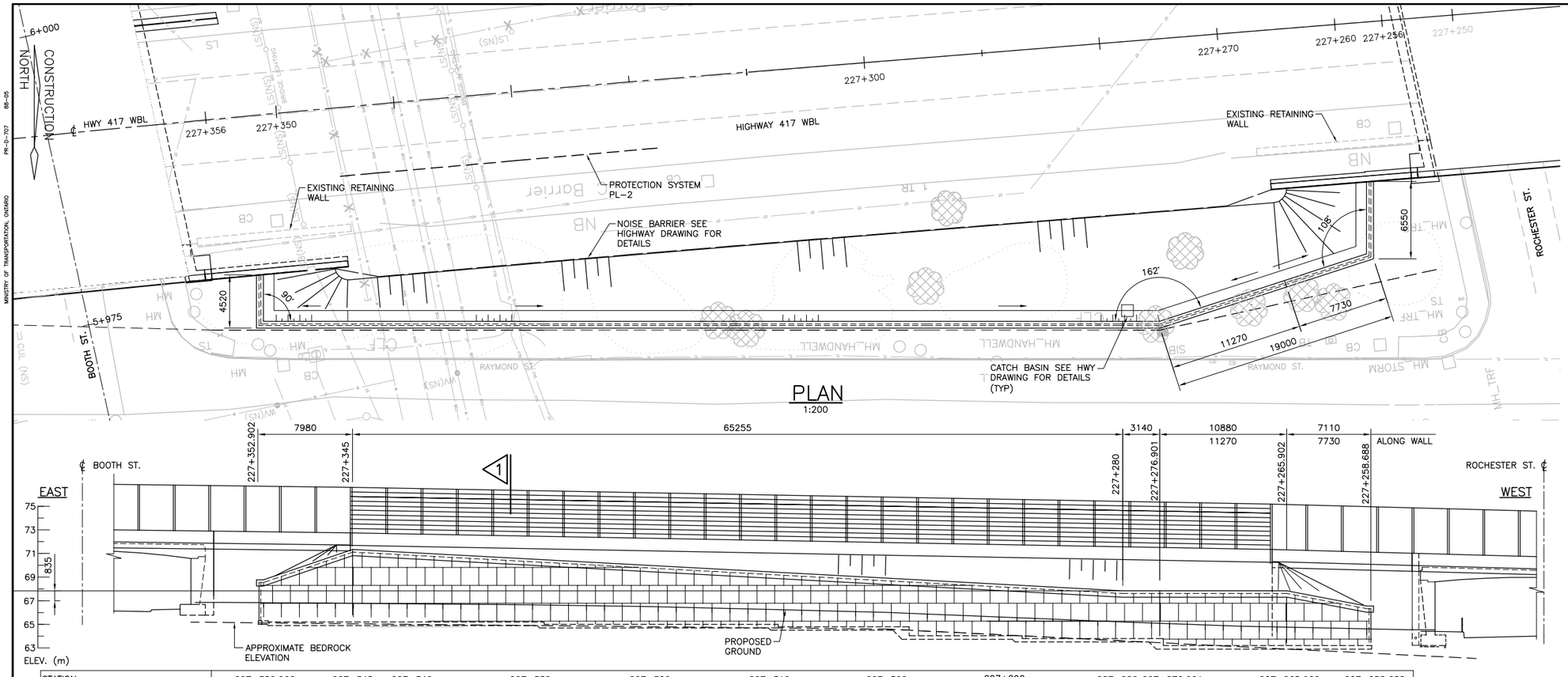
LICENSED PROFESSIONAL ENGINEER K.T.C. POWER 100130652 2020/03/05 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER F. J. HEFFERNAN 2020/03/05 PROVINCE OF ONTARIO

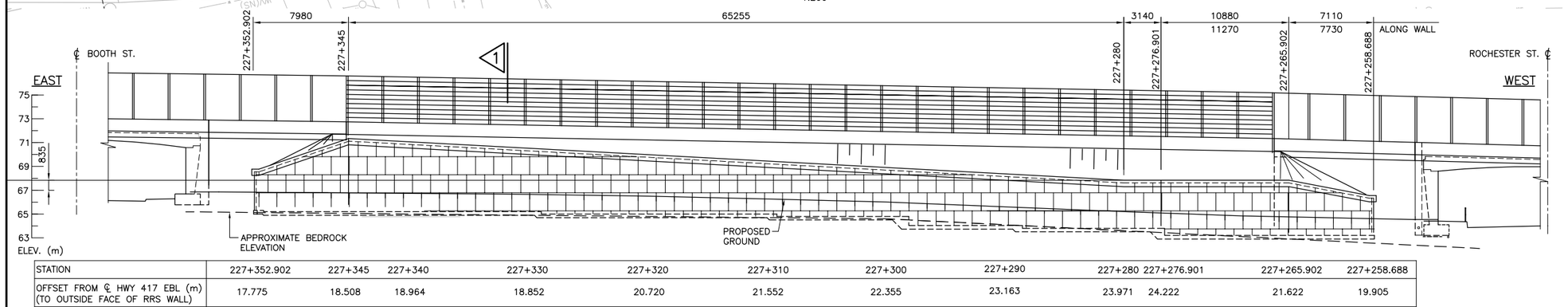
NO.	DATE	BY	REVISION

Geocres No. 31G5-315

HWY. 417	PROJECT NO. 1655214-1900	DIST. EASTERN
SUBM'D. KCP	CHKD. KCP	DATE: 3/5/2020	SITE: -
DRAWN: ZS	CHKD. FJH	APPD. FJH	DWG. 9

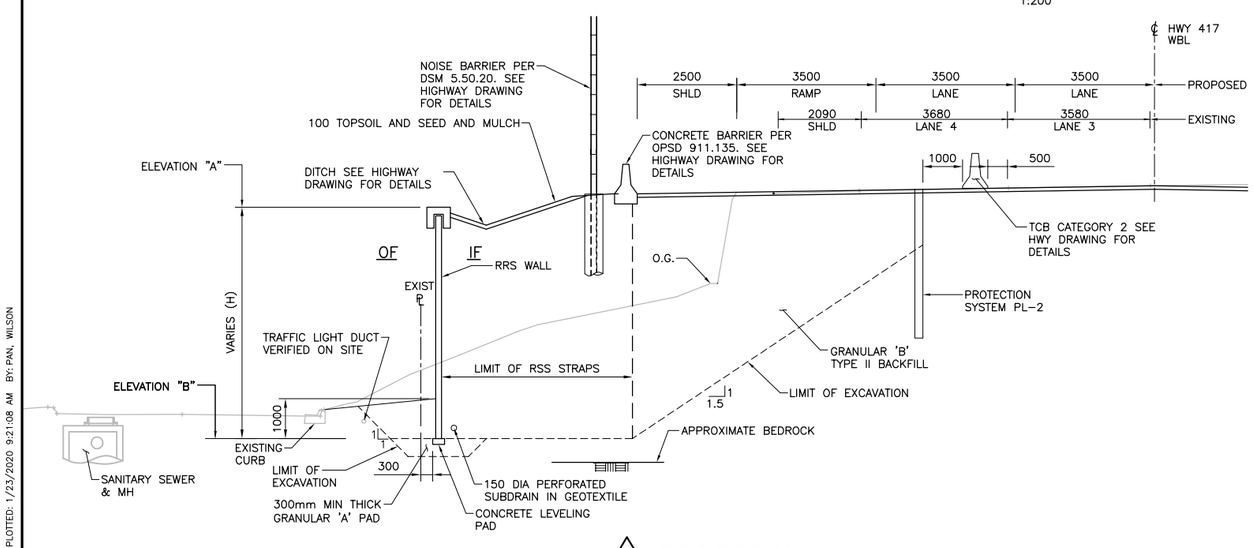


PLAN
1:200



STATION	227+352.902	227+345	227+340	227+330	227+320	227+310	227+300	227+290	227+280	227+276.901	227+265.902	227+258.688
OFFSET FROM ℄ HWY 417 EBL (m) (TO OUTSIDE FACE OF RRS WALL)	17.775	18.508	18.964	18.852	20.720	21.552	22.355	23.163	23.971	24.222	21.622	19.905
ELEVATION "A"	67.030	71.344	71.028	70.555	69.975	69.406	68.833	68.233	67.835	67.835	67.835	66.559
ELEVATION "B"	65.300	65.200	65.200	65.200	65.000	65.000	64.800	64.030	63.800	63.200	63.200	63.200

ELEVATION – PROPOSED
1:200



1 PROPOSED
1:75

CONT. No.
WP No.

HIGHWAY 417
RETAINING WALL 10-N (RW26)
STA 227+256 TO STA 227+356

GENERAL ARRANGEMENT

wsp

SHEET
S30

METRIC

GENERAL NOTES:

ALL REINFORCING STEEL IN RSS WALL PANELS, COPING, AND SLIP JOINTS SHALL BE STAINLESS STEEL TYPE 316LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPA. UNLESS OTHERWISE SPECIFIED.

RETAINED SOIL SYSTEM:

1. WALL SHALL BE AS LISTED IN THE MTO DESIGNATED SOURCE OF MATERIALS MANUAL WITH THE FOLLOWING
2. RETAINED SOIL SYSTEM WALLS SHALL HAVE THE FOLLOWING ATTRIBUTES:
   - PERFORMANCE – HIGH
   - APPEARANCE – HIGH
   - MAX. ANGLE – 90°
3. LENGTH OF RETAINED SOIL SYSTEM MAY BE INCREASED TO SUIT NEAREST NUMBER OF WHOLE PANELS FOR RETAINED SOIL SYSTEM, INCLUDING GRANULAR FILL, EXCAVATION, CONCRETE CAP AND THE LIKE, WITH NO ADDITIONAL COST TO THE OWNER. ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE CONTRACT ADMINISTRATOR.
4. TOP SOIL, SOFT/LOOSE SOIL, AND ANY SOFT/WET NATIVE MATERIAL SHOULD BE STRIPPED FROM THE FOOTING OF THE RSS. THE NATIVE SUBGRADE UNDER THE RSS FOUNDATION SHOULD BE PROOF ROLLED TO DETECT AND REPLACE ANY SOFT AREAS.
5. PRIOR TO PLACING THE GRANULAR PAD FOR THE RSS, THE SUBEXCAVATED GRADE SHALL BE PROOF-ROLLED AND THE CONTRACTOR AND RSS SUPPLIER SHALL INSPECT THE SUBEXCAVATED GRADE AND CONFIRM ITS CAPACITY TO SUPPORT THE RSS SYSTEM BEFORE PROCEEDING WITH THE WORK.
6. THE GRANULAR 'A' PADS SHALL BE COMPACTED TO 100% STANDARD PROCTOR MAXIMUM DRY DENSITY (SPMDD) AT A MOISTURE CONTENT WITHIN 2% OF OPTIMUM.
7. PROTECTION SYSTEMS SHALL BE DESIGNED BY CONTRACTOR IN ACCORDANCE WITH OPSS 539 PERFORMANCE LEVEL 2. PROTECTION SYSTEM IS SHOWN SCHEMATIC ONLY, EXACT LIMITS SHALL BE DETERMINED BY THE CONTRACTOR.
8. RSS REINFORCING STRIP LOCATIONS SHALL NOT INTERFERE AND WITH NOISE BARRIER FOUNDATION AND CATCH BASIN LOCATIONS.

APPLICABLE STANDARD DRAWINGS:

OPSD 3121.150	WALLS RETAINING, BACKFILL MINIMUM GRANULAR REQUIREMENT
OPSD 600.040	CONCRETE BARRIER CURB WITH STANDARD GUTTER
CITY STANDARD	SC1.1

LIST OF DRAWINGS:

1. GENERAL ARRANGEMENT
2. RETAINING WALL DETAILS

LEGEND:

REMOVALS

LIST OF ABBREVIATIONS

IF	DENOTES INSIDE FACE
OF	DENOTES OUTSIDE FACE
RSS	DENOTES RETAINED SOIL SYSTEM
℄	DENOTES PROPERTY LINE

LICENSED PROFESSIONAL ENGINEER
Y. H. WAN
100228242
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
Y. YANG
100132961
PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN	WW	CHK	YY	CODE CHBDC 2014	LOAD CL-625-ONT	DATE	JAN/20
DRAWN	ZP	CHK	WW	SITE 03X-0938/W0		DWG	1

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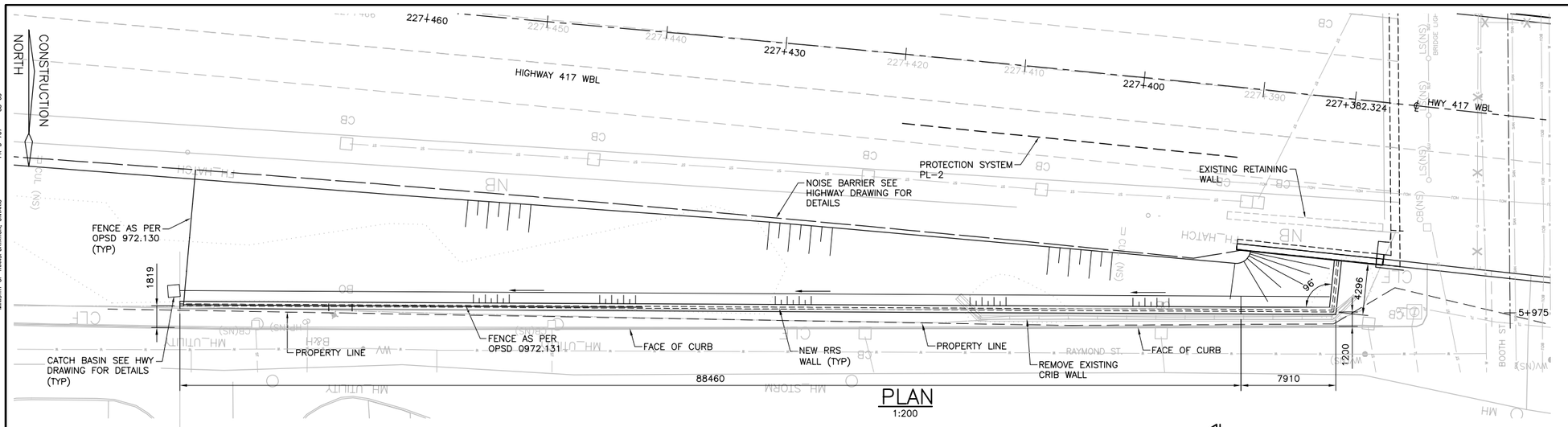
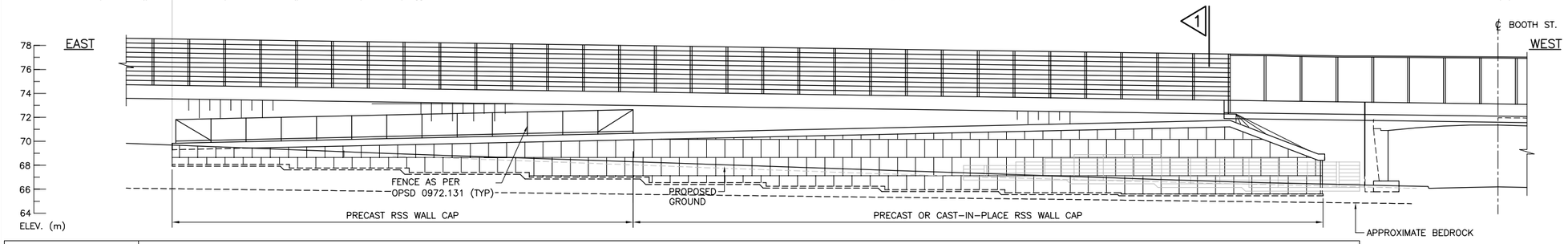
DATE PLOTTED: 1/23/2020 9:21:08 AM BY: PAN, WILSON

MINISTRY OF TRANSPORTATION, ONTARIO
PR-D-707 88-05

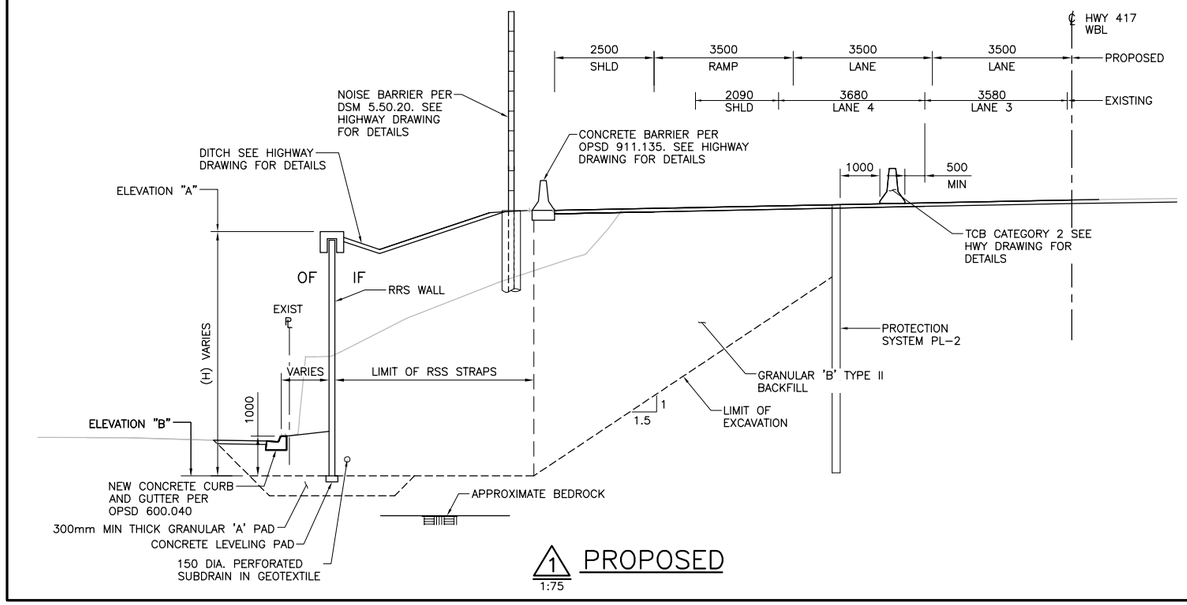




STATION	227+478.416	227+470	227+460	227+450	227+440	227+430	227+420	227+410	227+400	227+390	227+382.324
OFFSET FROM ℄ HWY 417 EBL (m) (TO OUTSIDE FACE OF RRS WALL)	26.309	25.603	24.764	24.045	23.201	22.326	21.442	21.518	19.570	18.580	17.820
ELEVATION "A"	69.827	70.009	70.311	70.443	70.672	70.747	70.982	71.247	71.576	71.738	68.939
ELEVATION "B"	67.070	68.070	67.770	67.400	67.000	66.550	66.250	65.950	65.700	65.500	65.500

ELEVATION – PROPOSED

1:200



1 PROPOSED

1:75

CONT. No.
WP No. 4173-15-00

HIGHWAY 417 RETAINING WALL
RETAINING WALL 11-N (RW10)
STA 227+478 TO STA 227+382

GENERAL ARRANGEMENT

wsp

SHEET S32

METRIC

GENERAL NOTES:

ALL REINFORCING STEEL IN RSS WALL PANELS, COPING, AND SLIP JOINTS SHALL BE STAINLESS STEEL TYPE 316LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPA. UNLESS OTHERWISE SPECIFIED.

RETAINED SOIL SYSTEM:

1. WALL SHALL BE AS LISTED IN THE MTO DESIGNATED SOURCE OF MATERIALS MANUAL WITH THE FOLLOWING
2. RETAINED SOIL SYSTEM WALLS SHALL HAVE THE FOLLOWING ATTRIBUTES:
   PERFORMANCE – HIGH
   APPEARANCE – HIGH
   MAX. ANGLE – 90°
3. LENGTH OF RETAINED SOIL SYSTEM MAY BE INCREASED TO SUIT NEAREST NUMBER OF WHOLE PANELS FOR RETAINED SOIL SYSTEM, INCLUDING GRANULAR FILL, EXCAVATION, CONCRETE CAP AND THE LIKE, WITH NO ADDITIONAL COST TO THE OWNER. ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE CONTRACT ADMINISTRATOR.
4. TOP SOIL, SOFT/LOOSE SOIL, AND ANY SOFT/WET NATIVE MATERIAL SHOULD BE STRIPPED FROM THE FOOTING OF THE RSS. THE NATIVE SUBGRADE UNDER THE RSS FOUNDATION SHOULD BE PROOF ROLLED TO DETECT AND REPLACE ANY SOFT AREAS.
5. PRIOR TO PLACING THE GRANULAR PAD FOR THE RSS, THE SUBEXCAVATED GRADE SHALL BE PROOF-ROLLED AND THE CONTRACTOR AND RSS SUPPLIER SHALL INSPECT THE SUBEXCAVATED GRADE AND CONFIRM ITS CAPACITY TO SUPPORT THE RSS SYSTEM BEFORE PROCEEDING WITH THE WORK.
6. THE GRANULAR 'A' PADS SHALL BE COMPACTED TO 100% STANDARD PROCTOR MAXIMUM DRY DENSITY (SPMDD) AT A MOISTURE CONTENT WITHIN 2% OF OPTIMUM.
7. PROTECTION SYSTEMS SHALL BE DESIGNED BY CONTRACTOR IN ACCORDANCE WITH OPSS 539 PERFORMANCE LEVEL 2. PROTECTION SYSTEM IS SHOWN SCHEMATIC ONLY, EXACT LIMITS SHALL BE DETERMINED BY THE CONTRACTOR.
8. RSS REINFORCING STRIP LOCATIONS SHALL NOT INTERFERE AND WITH NOISE BARRIER FOUNDATION AND CATCH BASIN LOCATIONS.

APPLICABLE STANDARD DRAWINGS:

OPSD 3121.150	WALLS RETAINING, BACKFILL MINIMUM GRANULAR REQUIREMENT
OPSD 972.130	FENCE, CHAIN-LINK INSTALLATION – ROADWAY
OPSD 972.131	FENCE, CHAIN-LINK INSTALLATION –CONCRETE BARRIER
CITY STANDARD	SC1.1

LIST OF DRAWINGS:

1. GENERAL ARRANGEMENT
2. RETAINING WALL DETAILS

LIST OF ABBREVIATIONS

IF	DENOTES INSIDE FACE
OF	DENOTES OUTSIDE FACE
RSS	DENOTES RETAINED SOIL SYSTEM
℄	DENOTES PROPERTY LINE

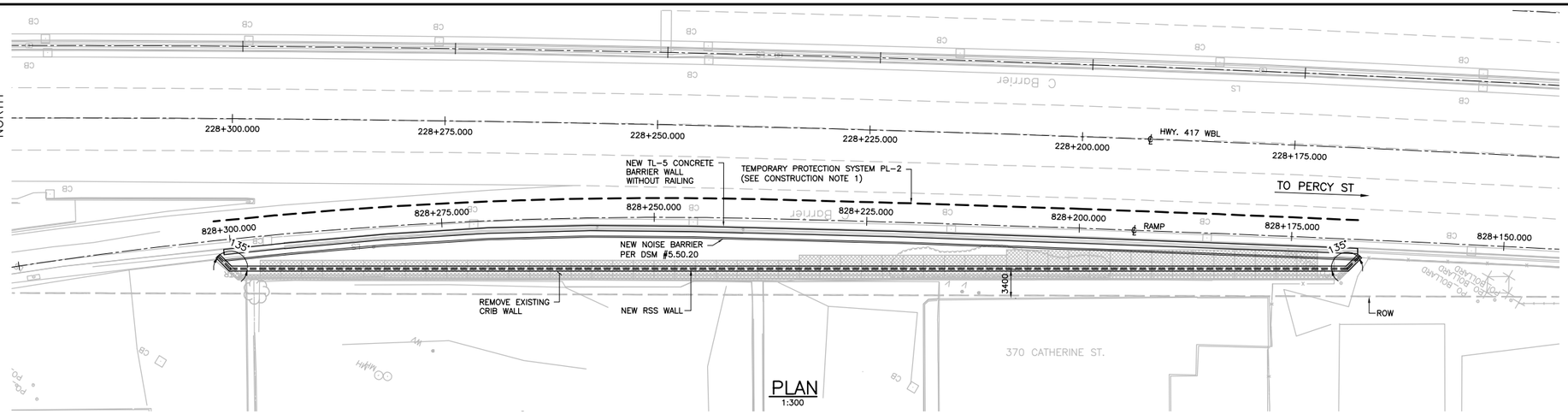
LICENSED PROFESSIONAL ENGINEER
Z. L. PAN
100147300
PROVINCE OF ONTARIO

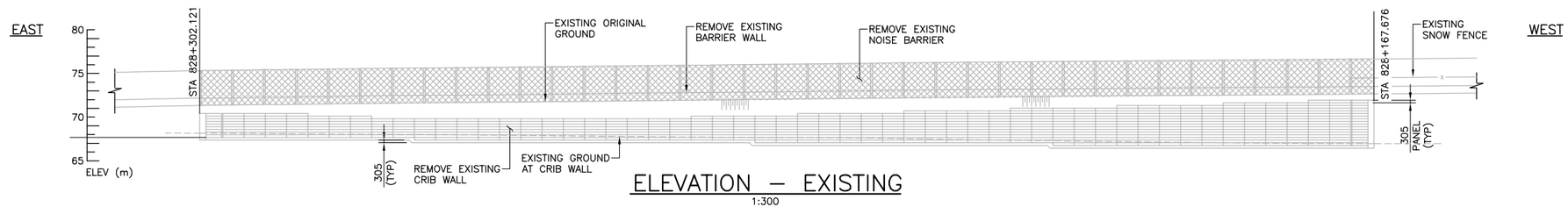
LICENSED PROFESSIONAL ENGINEER
Y. H. WAN
100228242
PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

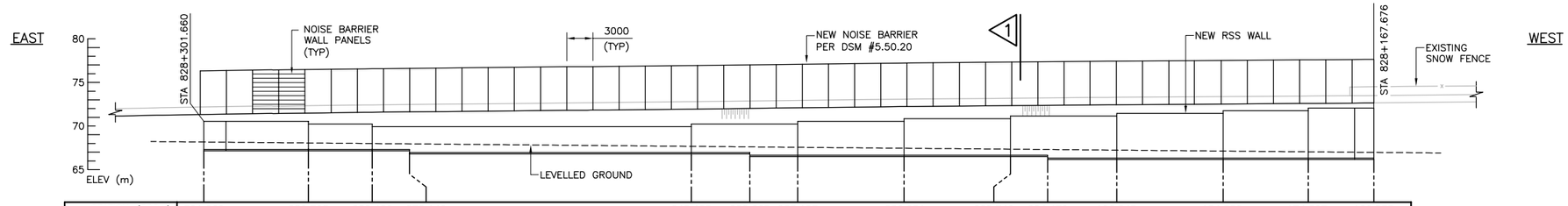
REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN	ZP	CHK	WW	CODE CHBDC 2014	LOAD CL-625-ONT	DATE	JAN/20
DRAWN	ZP	CHK	WW	SITE 03X-0749/W0		DWG	1





ELEVATION – EXISTING
1:300



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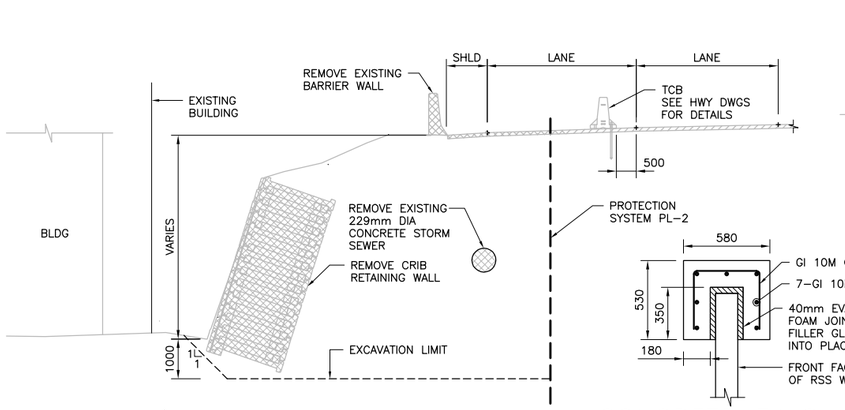
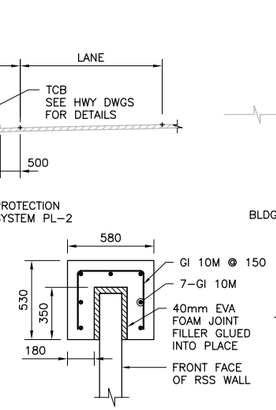
OFFSET FROM ℄ RAMP TO OUTSIDE FACE OF RSS WALL	1.885	4.481	5.019	5.503	6.091	6.214	5.858	5.518	5.135	4.991	4.709	4.240	3.834	1.999
ELEVATION POINT 'A'	70.531	70.226	69.921	69.921	70.226	70.226	70.531	70.836	71.141	71.141	71.446	71.751	72.056	72.055
ELEVATION POINT 'B'	67	67	67	67	67	67	67	67	67	67	67	67	67	67

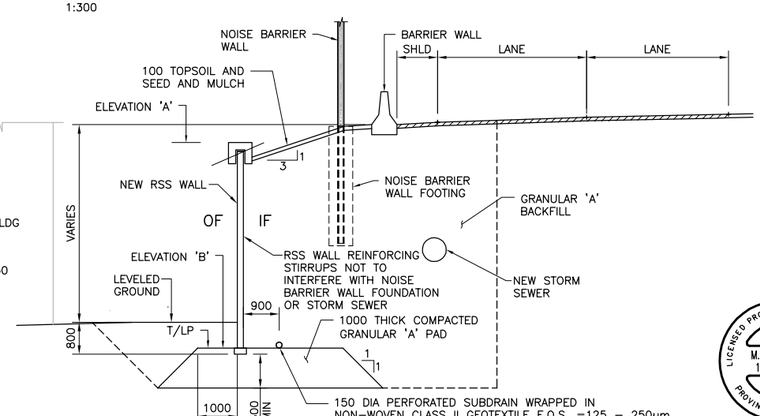
ELEVATION – REHABILITATED
1:300



1 TYPICAL EXISTING SECTION
1:75



CONCRETE FINISHING CAP
1:20



1 TYPICAL RSS WALL SECTION
1:75

DISTRICT
CONT. No.
WP No. 4173-15-00

HIGHWAY 417
RETAINING WALL 13-N (RW11)
STA 282+167.676 TO STA 828+300.850

GENERAL ARRANGEMENT

SHEET S34

METRIC

GENERAL NOTES:

ALL REINFORCING STEEL IN RSS WALL PANELS, COPING, AND SLIP JOINTS SHALL BE STAINLESS STEEL TYPE 316LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPA. UNLESS OTHERWISE SPECIFIED.

CLASS OF CONCRETE:

30 MPa

CLEAR COVER TO REINFORCING STEEL:

70 ± 20 mm UNLESS OTHERWISE NOTED

REINFORCING STEEL:

1. REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
2. BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
3. STAINLESS REINFORCING STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500MPa, UNLESS OTHERWISE SPECIFIED.
4. UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BARS SHALL BE CLASS 'B'.
5. BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE.

RETAINED SOIL SYSTEM (RSS):

1. WALL SHALL BE AS LISTED IN THE MTO DESIGNATED SOURCE OF MATERIALS MANUAL WITH THE FOLLOWING
2. RSS WALL SHALL HAVE THE FOLLOWING ATTRIBUTES:

APPLICATION	WALL/SLOPE
GEOMETRY	VERTICAL
PERFORMANCE	MEDIUM
APPEARANCE	HIGH

3. LENGTH OF RETAINED SOIL SYSTEM MAY BE INCREASED TO SUIT NEAREST NUMBER OF WHOLE PANELS FOR RETAINED SOIL SYSTEM, INCLUDING GRANULAR FILL, EXCAVATION, CONCRETE CAP AND THE LIKE, WITH NO ADDITIONAL COST TO THE OWNER. ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE CONTRACT ADMINISTRATOR.
4. TOP SOIL, SOFT/LOOSE SOIL, AND ANY SOFT/WET NATIVE MATERIAL SHOULD BE STRIPPED FROM THE FOOTING OF THE RSS. THE NATIVE SUBGRADE UNDER THE RSS FOUNDATION SHOULD BE PROOF ROLLED TO DETECT AND REPLACE ANY SOFT AREAS.
5. PRIOR TO PLACING THE GRANULAR PAD FOR THE RSS, THE SUBEXCAVATED GRADE SHALL BE PROOF-ROLLED AND THE CONTRACTOR AND RSS SUPPLIER SHALL INSPECT THE SUBEXCAVATED GRADE AND CONFIRM ITS CAPACITY TO SUPPORT THE RSS SYSTEM BEFORE PROCEEDING WITH THE WORK.
6. THE GRANULAR 'A' PADS SHALL BE COMPACTED TO 100% STANDARD PROCTOR MAXIMUM DRY DENSITY (SPMDD) AT A MOISTURE CONTENT WITHIN 2% OF OPTIMUM.
7. PROTECTION SYSTEMS SHALL BE DESIGNED BY CONTRACTOR IN ACCORDANCE WITH OPSS 539 PERFORMANCE LEVEL 2. PROTECTION SYSTEM IS SHOWN SCHEMATIC ONLY, EXACT LIMITS SHALL BE DETERMINED BY THE CONTRACTOR.
8. RSS REINFORCING STRIP LOCATIONS SHALL NOT INTERFERE AND WITH NOISE BARRIER FOUNDATION AND CATCH BASIN LOCATIONS.

CONSTRUCTION NOTE:

1. TEMPORARY PROTECTION SYSTEM SHALL BE REMOVED TO 1.8m BELOW GRADE WHEN NO LONGER REQUIRED.

LIST OF DRAWINGS:

1. GENERAL ARRANGEMENT
2. STANDARD DETAILS

LEGEND:

REMOVAL

LIST OF ABBREVIATIONS:

F.O.S.	–	DENOTES FILTRATION OPENING SIZE
IF	–	DENOTES INSIDE FACE
OF	–	DENOTES OUTSIDE FACE
RSS	–	DENOTES RETAINED SOIL SYSTEM

LICENSED PROFESSIONAL ENGINEER
M.H.M ZAWAM
100211348
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
T. P. A. SMALL
PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN JY	CHK TS	CODE CHBDC 2014	LOAD CL-625-ONT	DATE JAN/20	
DRAWN RYR	CHK JY	SITE 03X-0745/W0	STRUCT	SCHEME	DWG 1

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DATE PLOTTED: 1/24/2020 3:26:39 PM BY: AWAD, CLAIR
PR-S-707 88-05
MINISTRY OF TRANSPORTATION, ONTARIO

CAD FILE LOCATION AND NAME: P:\Transportation\Oakville\2019\COMPLETE\RW 3-N & 1-S-REV3\16M-01636-01-312-0010A_REV4_200121.dwg
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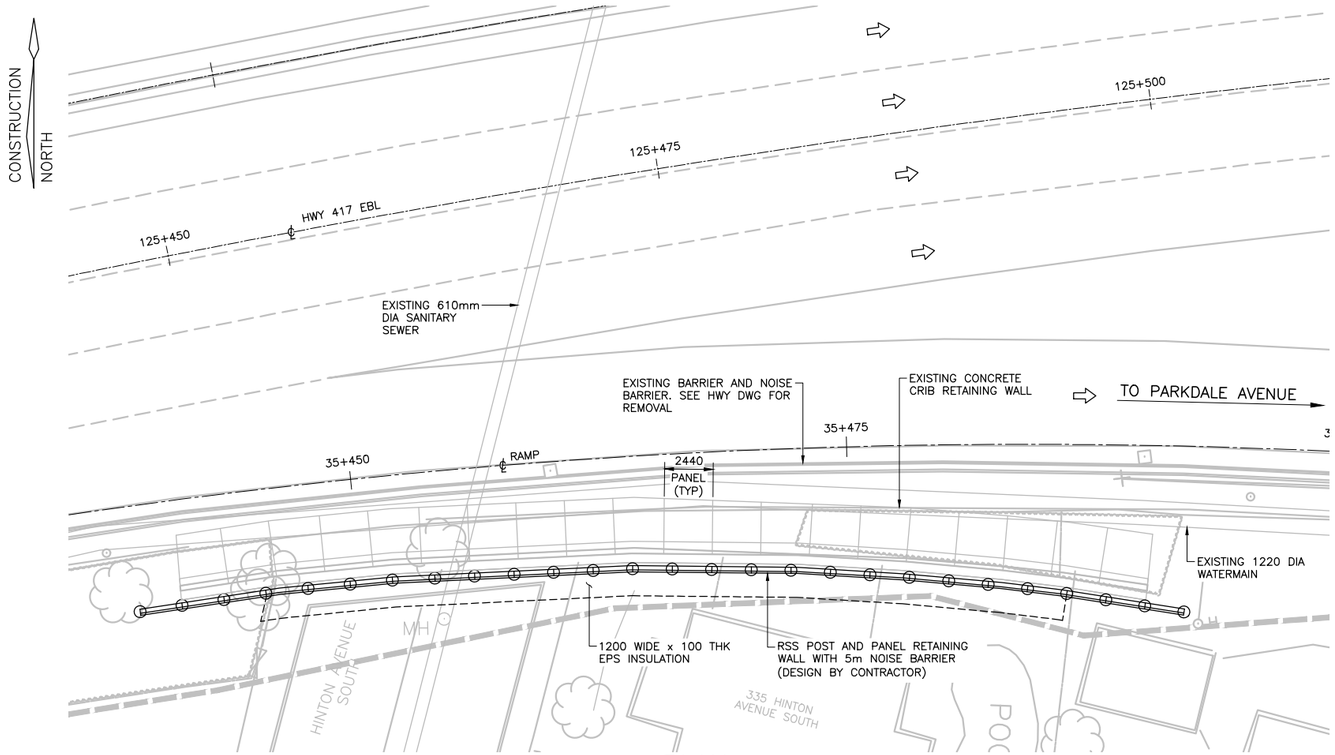
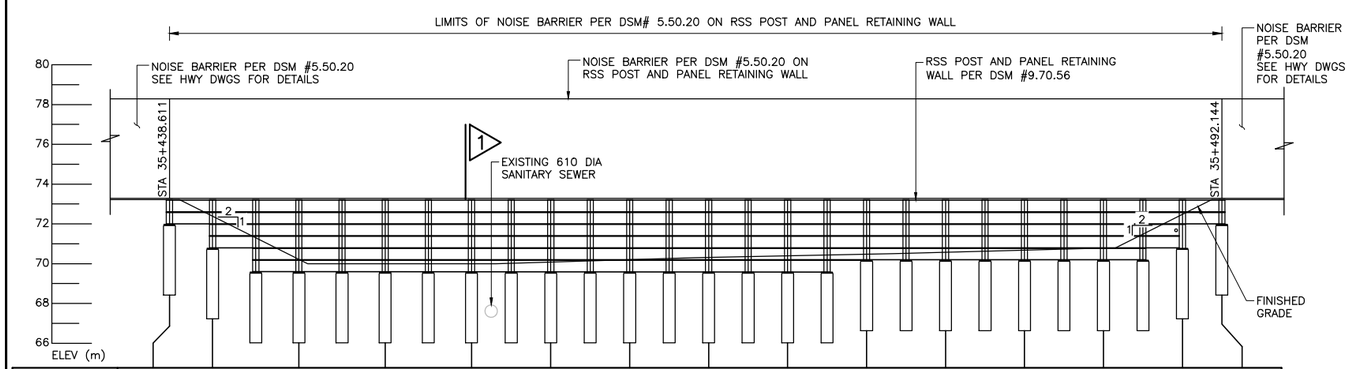
DATE PLOTTED: 1/21/2020 4:08:11 PM BY: HILL, CORY



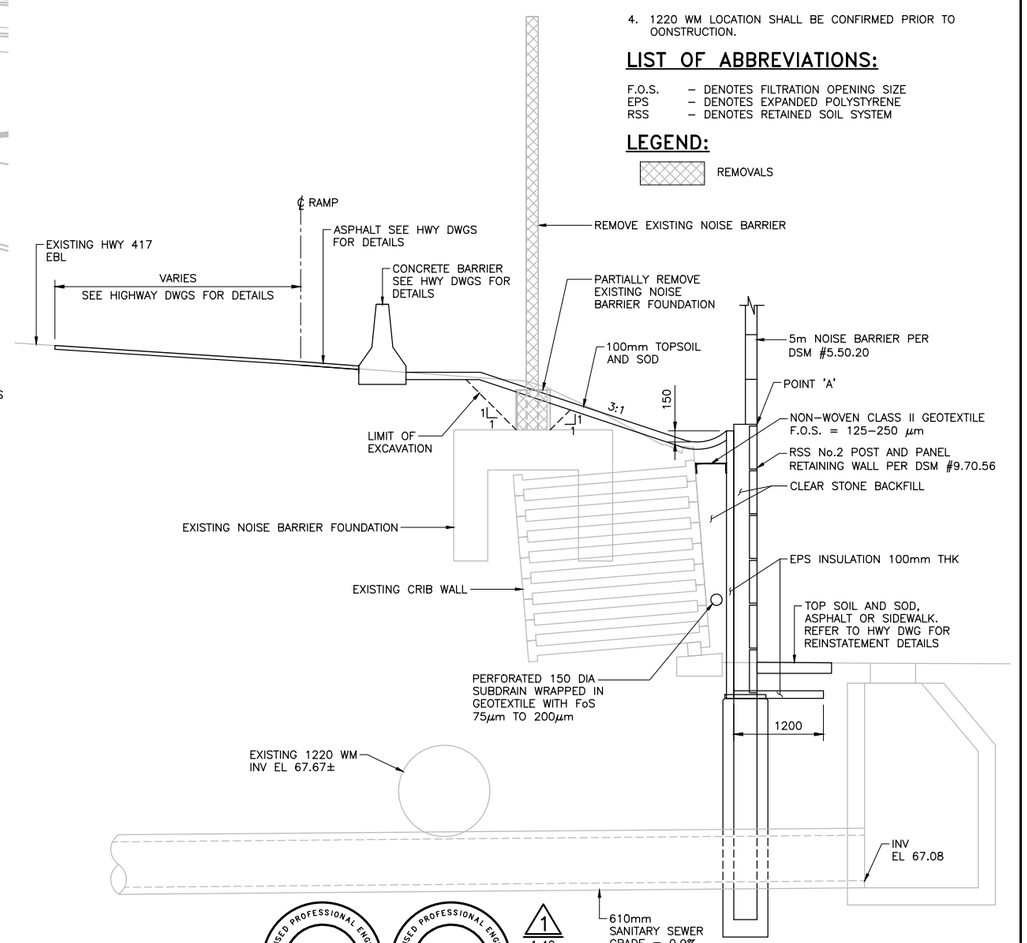
PLAN
1:150



STATION (35+)	438.611	440.805	445.111	449.436	453.760	457.815	461.842	465.896	469.941	473.977	478.016	482.059	486.089	490.255	492.144
OFFSET FROM ℄ RAMP TO POINT 'A'	5.52	5.48	5.38	5.40	5.51	5.66	5.78	5.94	6.17	6.44	6.79	7.19	7.66	8.23	8.50
ELEVATION POINT 'A'	73.200	73.200	73.200	73.200	73.200	73.200	73.200	73.200	73.200	73.200	73.200	73.200	73.200	73.200	73.200

ELEVATION
1:150

* ACTUAL CAISSON SPACING FOR RSS POST AND PANEL RETAINING WALL SHALL BE IN ACCORDANCE WITH DSM #9.70.56



DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

DISTRICT	
CONT. No.	
WP No. 4173-15-00	
HIGHWAY 417 RETAINING WALL 1-S (RW14) STA 35+438 TO STA 35+492	SHEET S44
GENERAL ARRANGMENT	
wsp	METRIC

GENERAL NOTES:

CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, DETAILS AND ELEVATIONS OF THE EXISTING STRUCTURE THAT ARE RELEVANT TO THE WORK SHOWN ON THE DRAWINGS PRIOR TO THE COMMENCEMENT OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE CONTRACT ADMINISTRATOR AND THE PROPOSED ADJUSTMENT OF THE WORK TO MATCH THE EXISTING STRUCTURE SHALL BE SUBMITTED FOR APPROVAL.
2. THE CONTRACTOR SHALL COORDINATE WITH UTILITY OWNERS TO VERIFY LOCATION AND TO AVOID CONFLICT OR DAMAGE TO THE UTILITIES DURING CONSTRUCTION.
3. CAISSONS SHALL NOT BE LOCATED WITHIN 800mm CLEAR OF EXISTING 610 DIA SANITARY SEWER.
4. 1220 WM LOCATION SHALL BE CONFIRMED PRIOR TO OONSTRUCTION.

LIST OF ABBREVIATIONS:

F.O.S. – DENOTES FILTRATION OPENING SIZE
EPS – DENOTES EXPANDED POLYSTYRENE
RSS – DENOTES RETAINED SOIL SYSTEM

LEGEND:

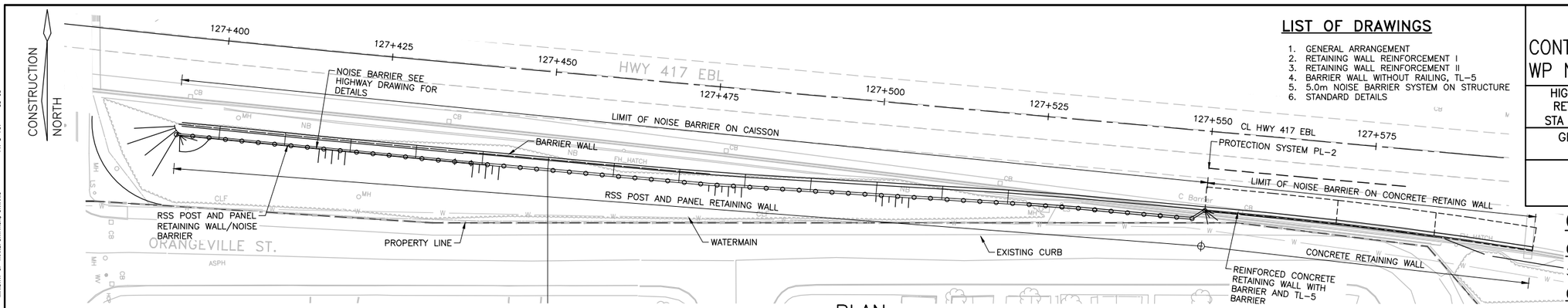
REMOVALS

LICENSED PROFESSIONAL ENGINEER
J. A. YEUNG
100179431
PROVINCE OF ONTARIO

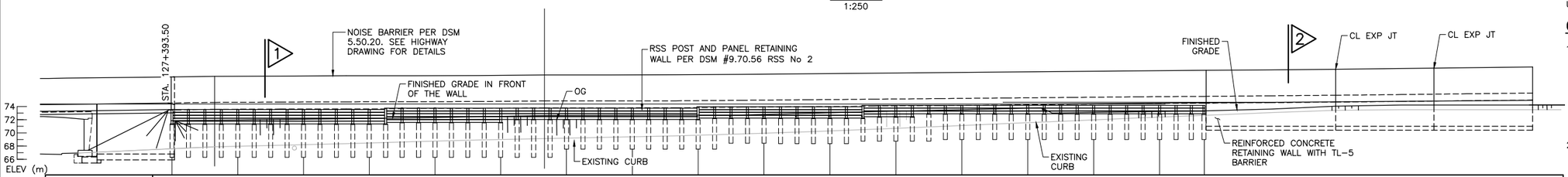
LICENSED PROFESSIONAL ENGINEER
T. P. A. SMALL
PROVINCE OF ONTARIO

REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN JY	CHK TS	CODE CHBDC 2014	LOAD CL-625-ONT	DATE NOV/19	
DRAWN RYR	CHK JY	SITE 03X-0939/W0		DWG 1	



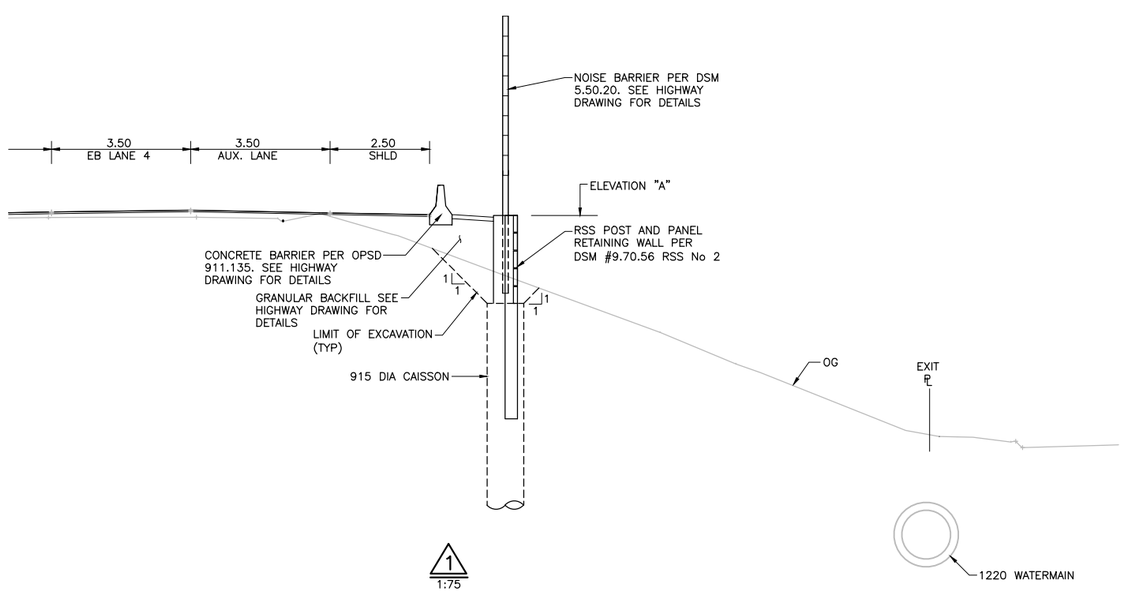
PLAN
1:250

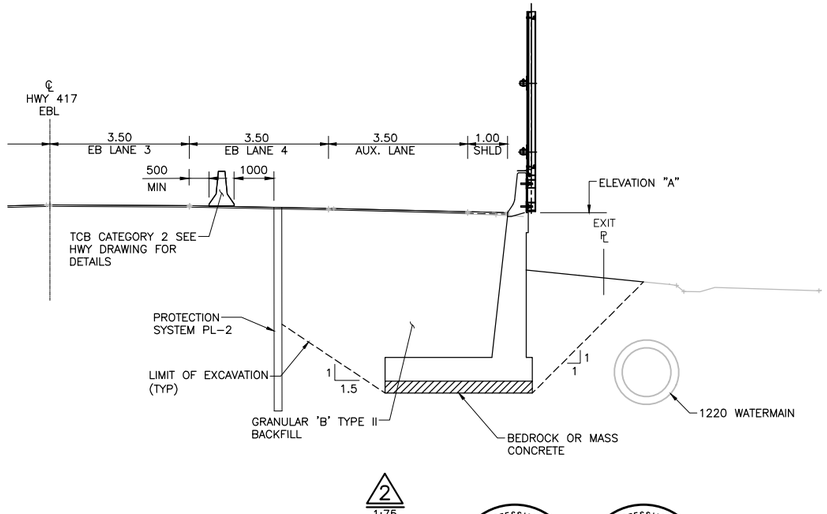


STATION (127+)	393.50	403.50	413.50	423.50	433.50	443.335	453.335	463.335	473.335	483.335	493.329	503.325	513.321	523.317	533.330	543.317	550.00	560.00	570.00	585.00	600.00
OFFSET FROM ℄ HWY 417 EBL (m) (TO CENTER OF CAISSON)	14.939	14.917	14.917	14.917	14.917	14.945	14.945	14.945	14.945	14.698	14.416	14.134	13.852	13.570	13.485	13.470	12.043				
OFFSET FROM ℄ HWY 417 EBL (m) (TO FRONT FACE OF RETAINING WALL)																		11.977	12.137	12.682	14.74
ELEVATION POINT 'A'	73.044	73.044	73.044	73.044	73.255	73.255	73.255	73.255	73.466	73.466	73.466	73.677	73.677	73.759	73.849	73.932	74.052	74.126	74.199	74.310	74.420
TOP OF FOOTING ELEVATION																	70.50	70.50	70.50	70.50	70.50

ELEVATION
1:250

* ACTUAL CAISSONS SPACING FOR POST AND PANEL RETAINING WALL SHALL BE IN ACCORDANCE WITH DSM #9.70.56 RSS No 2 AND SHALL AVOID CONFLICT WITH REINFORCED CONCRETE RETAINING WALL





LIST OF DRAWINGS

1. GENERAL ARRANGEMENT
2. RETAINING WALL REINFORCEMENT I
3. RETAINING WALL REINFORCEMENT II
4. BARRIER WALL WITHOUT RAILING, TL-5
5. 5.0m NOISE BARRIER SYSTEM ON STRUCTURE
6. STANDARD DETAILS

CONT. No.
WP No. 4173-15-00

HIGHWAY 417 RETAINING WALL
RETAINING WALL 4-S (RW17)
STA 127+393 TO STA 127+600

GENERAL ARRANGEMENT

SHEET

METRIC

GENERAL NOTES:

CLASS OF CONCRETE:

30MPa

CLEAR COVER TO REINFORCING:

FOOTING BOTTOM	100 ± 25mm
UNLESS OTHERWISE NOTED	70 ± 20mm

CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, DETAILS AND ELEVATIONS OF THE EXISTING STRUCTURE THAT ARE RELEVANT TO THE WORK SHOWN ON THE DRAWINGS PRIOR TO THE COMMENCEMENT OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE CONTRACT ADMINISTRATOR AND THE PROPOSED ADJUSTMENT OF THE WORK TO MATCH THE EXISTING STRUCTURE SHALL BE SUBMITTED FOR APPROVAL.
2. THE CONTRACTOR SHALL COORDINATE WITH UTILITY OWNERS TO VERIFY THE LOCATION AND TO AVOID CONFLICT OR DAMAGE TO THE UTILITIES DURING CONSTRUCTION.

REINFORCING:

1. REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
2. UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BARS SHALL BE CLASS 'B'.
3. BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE.
4. HORIZONTAL LAP SPLICES MUST NOT LAP THROUGH CONTROL JOINTS.
5. BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
6. STAINLESS REINFORCING STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.

APPLICABLE STANDARD DRAWINGS:

OPSD 911.381	GUIDE RAIL SYSTEM, CONCRETE BARRIER PERMANENT TRANSITION INSTALLATION ROADSIDE CONCRETE BARRIER TO STRUCTURE
OPSD 911.382	GUIDE RAIL SYSTEM, CONCRETE BARRIER DOWEL CONNECTION DETAIL
OPSD 3121.150	WALLS RETAINING, BACKFILL MINIMUM GRANULAR REQUIREMENT
OPSD 3190.100	WALLS, RETAINING AND ABUTMENT WALL DRAIN
OPSD 3950.100	JOINTS, CONCRETE EXPANSION AND CONSTRUCTION ON STRUCTURE

LICENSED PROFESSIONAL ENGINEER
J. A. YEUNG
100179431
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
M.H.M ZAWAM
100211348
PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	JY	CHK	MZ	CODE CHBDC 2014	LOAD CL-625-ONT	DATE	JAN/20
DRAWN	CH	CHK	JY	SITE 03X-0926/WO		DWG	1

MINISTRY OF TRANSPORTATION, ONTARIO
PR-D-707 88-05

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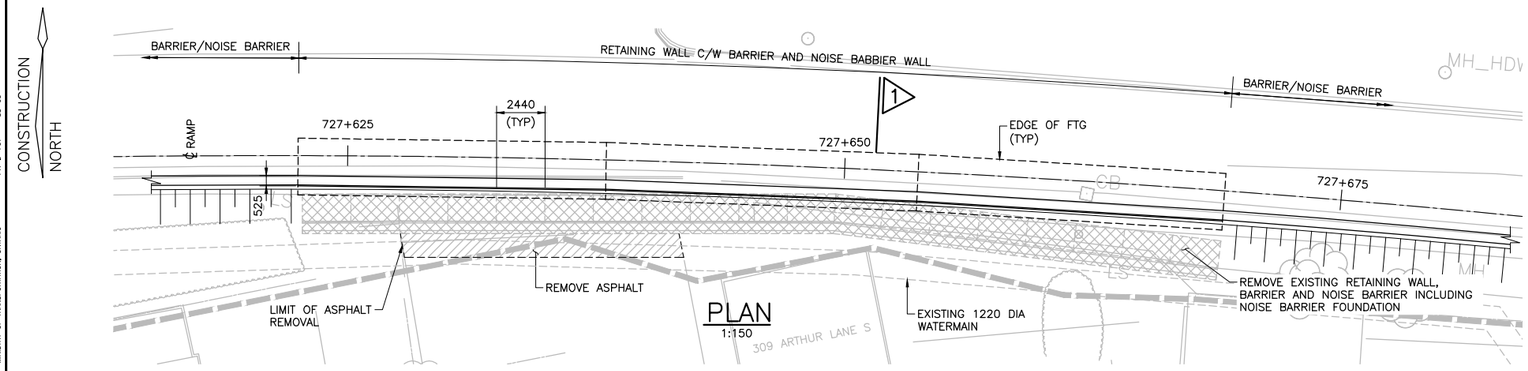
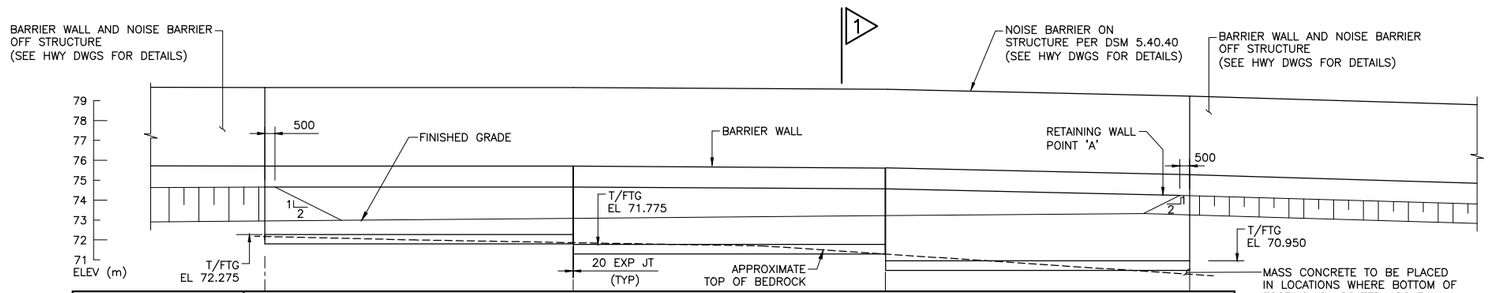
DATE PLOTTED: 1/28/2020 10:17:17 AM BY: HILL, CORY

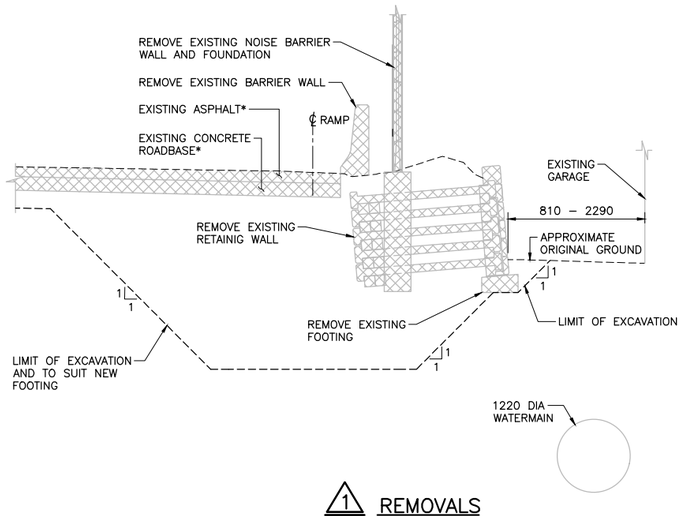


PLAN
1:150



STATION (727+)	622.500	638.000	653.700	669.000
OFFSET FROM ℄ RAMP TO POINT 'A'	1.000	1.000	1.000	1.000
ELEVATION POINT 'A'	74.655	74.655	74.565	74.240

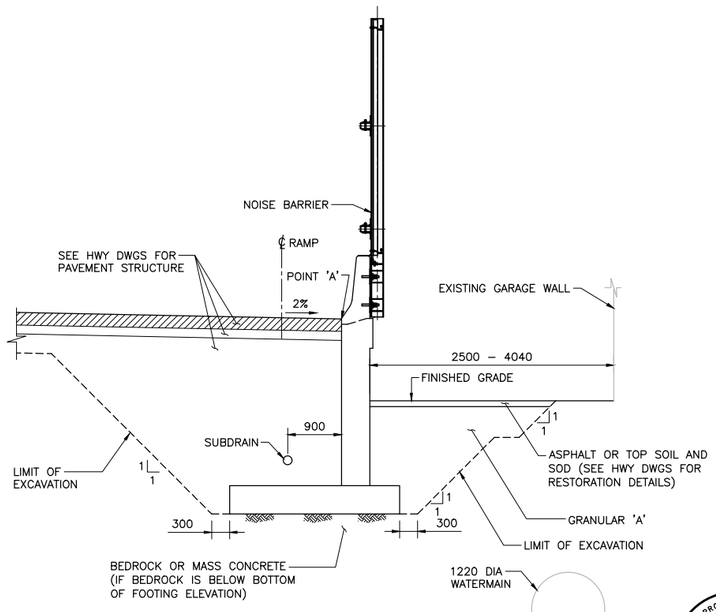
ELEVATION
1:150



1 REMOVALS
1:50

SECTION AT 309 ARTHUR LANE S SHOWN,
SEE HIGHWAY DRAWINGS FOR ASPHALT REMOVAL
AT ARTHUR LANE AND HWY 417 RAMP

* SEE HIGHWAY DRAWINGS FOR DETAILS



1
1:50

LIST OF DRAWINGS

CONT. No.
WP No.

HIGHWAY 417
RETAINING WALL 5-S (RW 18)
STA 727+622 TO STA 727+669

GENERAL ARRANGEMENT

wsp

SHEET

METRIC

GENERAL NOTES:

CLASS OF CONCRETE:

30MPa

CLEAR COVER TO REINFORCING:

FOOTING BOTTOM	100 ± 25mm
UNLESS OTHERWISE NOTED	70 ± 20mm

CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, DETAILS AND ELEVATIONS OF THE EXISTING STRUCTURE THAT ARE RELEVANT TO THE WORK SHOWN ON THE DRAWINGS PRIOR TO THE COMMENCEMENT OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE CONTRACT ADMINISTRATOR AND THE PROPOSED ADJUSTMENT OF THE WORK TO MATCH THE EXISTING STRUCTURE SHALL BE SUBMITTED FOR APPROVAL.
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3. BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1, UNLESS INDICATED OTHERWISE.
4. HORIZONTAL LAP SPLICES MUST NOT LAP THROUGH CONTROL JOINTS.
5. BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.
6. STAINLESS REINFORCING STEEL SHALL BE TYPE 316 LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.

LEGEND:

REMOVALS

ASPHALT REMOVALS

APPLICABLE STANDARD DRAWINGS:

OPSD 911.381	GUIDE RAIL SYSTEM, CONCRETE BARRIER PERMANENT TRANSITION INSTALLATION ROADSIDE CONCRETE BARRIER TO STRUCTURE
OPSD 911.382	GUIDE RAIL SYSTEM, CONCRETE BARRIER DOWEL CONNECTION DETAIL
OPSD 3121.150	WALLS RETAINING, BACKFILL MINIMUM GRANULAR REQUIREMENT
OPSD 3190.100	WALLS, RETAINING AND ABUTMENT WALL DRAIN
OPSD 3950.100	JOINTS, CONCRETE EXPANSION AND CONSTRUCTION ON STRUCTURE

LICENSED PROFESSIONAL ENGINEER
J. A. YEUNG
100179431
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
M.H.M ZAWAM
100211348
PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS			
	DATE	BY	DESCRIPTION

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DRAWN	CH	CHK	JY	SITE	

DATE JAN 2020
DWG 1

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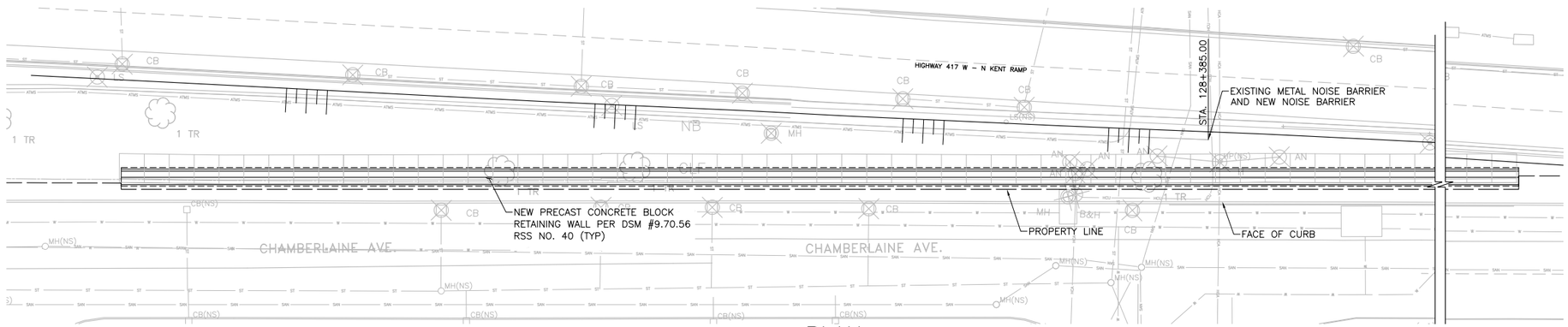
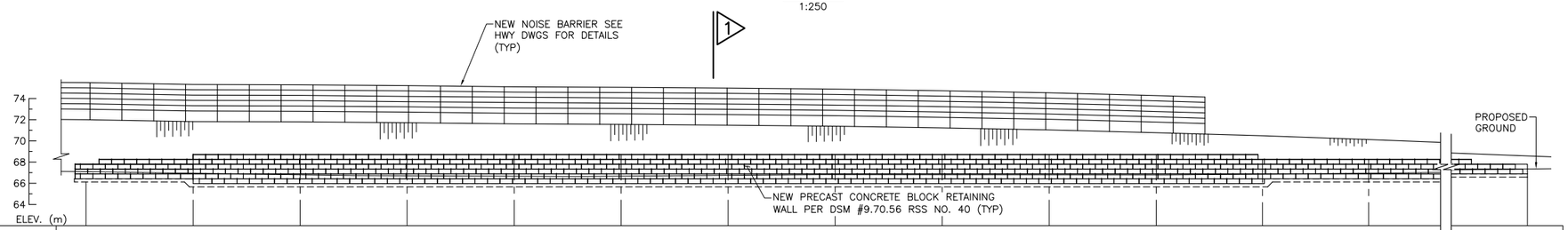
DATE PLOTTED: 1/28/2020 10:05:55 AM BY: HILL, CORY

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

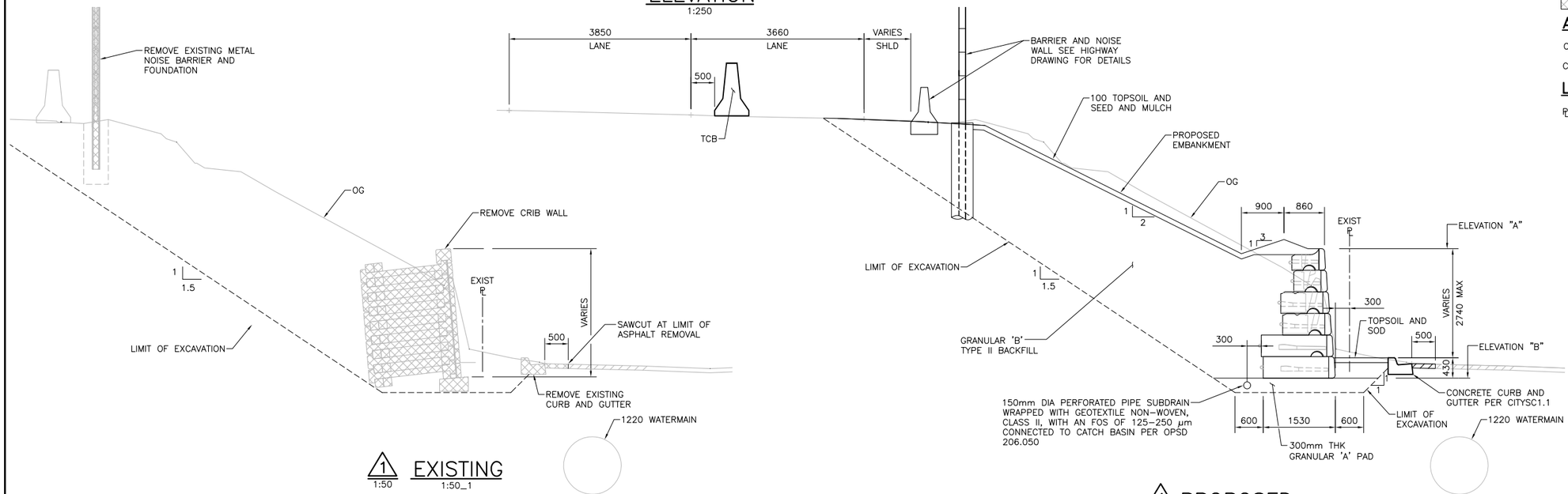


PLAN
1:250



STATION	128+278.61	128+290	128+300	128+310	128+320	128+330	128+340	128+350	128+360	128+370	128+380	128+390	128+400	128+349.144
OFFSET FROM ℄ HWY 417 EBL (m) (TO BOTTOM OF BLOCK WALL)	25.689	25.571	25.482	25.421	25.389	25.386	25.411	25.465	25.549	25.661	25.802	26.970	26.167	27.212
ELEVATION "A" (m)	67.798	68.712	68.712	68.712	68.712	68.712	68.712	68.712	68.712	68.712	68.712	68.255	68.255	67.798
ELEVATION "B" (m)	66.427	66.427	65.970	65.970	65.970	65.970	65.970	65.970	65.970	65.970	65.970	65.970	66.427	66.884

ELEVATION
1:250



1 EXISTING
1:50 1:50_1

1 PROPOSED
1:50 1:50_1

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

DISTRICT
CONT. No.
WP No. 4173-15-00

HIGHWAY 417
RETAINING WALL 7-S (RW19)
STA. 128+280 TO STA. 128+440

GENERAL ARRANGEMENT

wsp

SHEET
S51

METRIC

GENERAL NOTES:

CONSTRUCTION NOTES:

1. THIS DESIGN IS BASED ON THE FOLLOWING PROPERTIES:

PROPERTY	RETAINING FILL
FRICTION ANGLE: ϕ	30°
UNIT WEIGHT: γ	22kN/m³
SOIL TYPE: TYPE II	OPSS GRANULAR B

2. WALL GEOMETRY AND GRADE ELEVATIONS ABOVE AND BELOW THE WALL SHOULD CONFORM WITH GRADING. IF ACTUAL SITE GRADES VARY SIGNIFICANTLY FROM THOSE SHOWN OR IF THE BACK SLOPE DOES NOT CONFORM. INSTALLATION SHALL NOT PROCEED UNTIL THE CALL DESIGN IS VERIFIED OR MODIFIED IN THE APPLICABLE AREA.
3. THE GRANULAR B TYPE II SHOULD BE COMPACTED TO MIN. 98% OF THE MATERIALS SPMDD AND TESTED BY THE GEOTECHNICAL CONSULTANT AT THE TIME OF CONSTRUCTION.
4. INSTALL 150mm DIAMETER PERFORATED PIPE DRAIN BEHIND HEEL OF WALL. PROVIDE CLEAR STONE SURROUND TO PROTECT PIPE FROM CLOGGING AND DAMAGE. PROVIDE OUTLETS THROUGH WALL.
5. THE CONDITIONS WILL BE EVALUATED BY THE GEOTECHNICAL ENGINEER DURING PREPARATION FOR WALL CONSTRUCTION IN EACH AREA. WHERE GRANULAR BEDDING WILL NOT BE SUFFICIENT THE USE OF CONCRETE BEDDING MAY BE REQUIRED.
6. BACK FILL MATERIAL SHALL BE APPROVED BY THE SITE GEOTECHNICAL ENGINEER PRIOR TO USE AND SHOULD CONSIST OF OPSS GRANULAR B TYPE II BUFFER OF MINIMUM 1.0M WIDTH, FOLLOWED BY SUITABLE GRANULAR FILL. ALL FILL ZONE UP AND BACK FROM THE HEEL SHOULD ALSO BE COMPACTED BACKFILL SHALL BE PLACED IN MAXIMUM 300mm LOOSE LIFTS AND COMPACTED TO A MINIMUM 98% OF SPMDD.
7. MAINTAIN TEMPORARY GRADES TO DIVERT SURFACE WATER AWAY FROM THE RETAINING WALL EXCAVATION. SLOPE FINAL BACKFILL TO PROVIDE POSITIVE DRAINAGE AND TO ELIMINATE PONDING.

LEGEND:

REMOVALS

APPLICATION STANDARD DRAWING

OPSD 206.050	SUBDRAIN PIPE CONNECTION AND OUTLET RURAL
CITY STANDARD	SC1.1

LIST OF ABBREVIATIONS

℄ DENOTES PROPERTY LINE

LICENSED PROFESSIONAL ENGINEER Y. H. WAN 100228242 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER T. P. A. SMALL PROVINCE OF ONTARIO

REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN	ZP	CHK	TS	CODE CHBDC 2014	LOAD CL-625-ONT	DATE	NOV/19
DRAWN	ZP	CHK	WW	SITE 03X-0744/W0	STRUCT	SCHEME	DWG 1

MINISTRY OF TRANSPORTATION, ONTARIO 88-05 PR-D-707

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APPENDIX A

Lists of Abbreviations and Symbols
Lithological and Geotechnical Rock Description Terminology
Record of Boreholes 18-801, 18-802, 18-901 to 18-904, 18-906 to 18-918 and 18-923
Bedrock Core Photographs, Figures A1 to A14

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c′	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split-spoon
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

Dynamic Cone Penetration Resistance; N_d:

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60º cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

Compactness Condition	N Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 10	Trace	Trace sand
10 to 20	Some	Some sand
20 to 35	(ey) or (y)	Sandy
over 35	And	Sand and Gravel

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERINGS STATE

Fresh: no visible sign of weathering

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90º angle is horizontal.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

JN Joint
FLT Fault
SH Shear
VN Vein
FR Fracture
SY Stylolite
BD Bedding
FO Foliation
CO Contact
AXJ Axial Joint
KV Karstic Void
MB Mechanical Break

PL Planar
CU Curved
UN Undulating
IR Irregular
K Slickensided
PO Polished
SM Smooth
SR Slightly Rough
RO Rough
VR Very Rough

GOLDER

RECORD OF BOREHOLE No 18-801

SHEET 1 OF 1

METRIC

PROJECT 1655214-1800

G.W.P. 4173-15-00

LOCATION N 5028691.4; E 365104.3 NAD 83 MTM ZONE 9 (LAT. 45.395573; LONG. -75.729778)

ORIGINATED BY CRG

DIST Eastern HWY 417

BOREHOLE TYPE Track Mount Portable/Power Rotary Drill, HW Casing, HQ Core

COMPILED BY ZS

DATUM Geodetic

DATE July 25, 2019

CHECKED BY KCP

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 × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
67.4	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
67.1	(SW) Gravelly sand (FILL) Grey brown Moist		1	SS	6		67				
0.3	(SP) Sand, trace silt, contains geotextile fragments (FILL)		2	SS	50/0.05						
66.6	Grey brown Moist - Cobbles from 0.7 to 0.8 m depth		R1	RC	-						UCS = 26 MPa
0.8	PORTLAND CEMENT CONCRETE (FOOTING)						66				
			R2	RC	-						
65.5											
1.9	(SM/ML) Gravelly SILTY SAND, contains cobbles and bedrock fragments (TILL)		3	SS	38				○		25 47 (28)
65.0	Dense Grey Moist										
2.4	END OF BOREHOLE SPLITSPOON REFUSAL										

+³, ×³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 20-3-5 JM

GOLDER

RECORD OF BOREHOLE No 18-802

SHEET 1 OF 1

METRIC

PROJECT 1655214-1800

G.W.P. 4173-15-00

LOCATION N 5028731.2; E 365132.6 NAD 83 MTM ZONE 9 (LAT. 45.395929; LONG. -75.729413)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Portable Rotary Drill, NW Casing, NQ Core

COMPILED BY ZS

DATUM Geodetic

DATE May 23-24, 2019

CHECKED BY

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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
69.7	GROUND SURFACE										
0.0	(SM) Silty sand, contains organic matter (TOPSOIL) Brown		1	SS	5						
0.2	(SM/ML) Silty sand, trace gravel, trace concrete fragments, contains cobbles (FILL) Grey brown Moist to wet		2	SS	25		69		○		10 52 28 10
			3	SS	20						
			4	SS	23	▽	68		○		5 58 28 9
			5	SS	31		67				
66.7											
3.1	(SW/GW) Sand and gravel (FILL) Brown		6	SS	>50/0.15						
66.3	Wet										
3.4	PORTLAND CEMENT CONCRETE (FOOTING)		7	RC	-		66				
65.3											
4.4	(SM) SILTY SAND, trace gravel (TILL) Grey Wet		8	SS	146		65		○		6 61 (33)
			9	SS	173						
64.5			10	SS	100/0.05						
5.2	Limestone fragments END OF BOREHOLE SPLITSPOON REFUSAL										

NOTES:

1. Manual third weight hammer used for all split spoon samples. "N" values are not representative of ASTM D1586 SPT N values and should be interpreted in consideration of their reduced energy.

2. Water level in open borehole at a depth of 2.4 m (Elev. 67.3 m) on may 24, 2019

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

$\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 20-3-5 JM

GOLDER

RECORD OF BOREHOLE No 18-901

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5028734.4; E 365200.6 NAD 83 MTM ZONE 9 (LAT. 45.395952; LONG. -75.728544)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 16, 2019

CHECKED BY KCP

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 × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 25 50 75	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
70.0	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
0.1	(SW) Gravelly sand (FILL) Grey		1	GS	-						
69.4							69				
0.6	(SM) Sand, some silt and gravel (FILL) Grey brown Moist		2	GS	-				○		13 69 (18)
			3	GS	-						
68.5							68				
1.5	(SM) SILTY SAND, contains cobbles Dense to compact Grey Moist to wet		4	SS	35						
			5	SS	37		67		○		3 68 (29)
			6	SS	19		66				
65.4											
4.6	(SM/ML) Gravelly SAND and SILT (TILL) Compact to dense Grey Wet		7	SS	19		65				
			8	SS	44				○		23 41 (36)
63.7			9	SS	50/0.15		64				
6.3	END OF BOREHOLE AUGER REFUSAL										

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

$\circ^{3\%}$ STRAIN AT FAILURE

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GOLDER

RECORD OF BOREHOLE No 18-902

SHEET 1 OF 1 **METRIC**

PROJECT 1655214-1900
G.W.P. 4173-15-00
DIST Eastern HWY 417
DATUM Geodetic

LOCATION N 5028741.6; E 365206.9 NAD 83 MTM ZONE 9 (LAT. 45.396016; LONG. -75.728462)
BOREHOLE TYPE Hydro Excavation/Power Auger, 200 mm Diam. (Hollow Stem)
DATE May 16, 2019

ORIGINATED BY PAH
COMPILED BY ZS
CHECKED BY KCP

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 × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
70.0	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
69.7	(SW) Gravelly sand (FILL) Grey										
69.4	(SP) Sand (FILL) Brown										
69.2	Moist		1	GS	-						
0.8	(SM) Silty sand, contains rootlets (TOPSOIL) Dark brown Moist										
	(SM) SILTY SAND, some gravel Grey brown		2	GS	-		69				
68.5	Moist										
1.5	(SP-SM) SAND, some silt Compact Grey brown Moist to wet						68				
			3	SS	10		67				
			4	SS	18		66				
65.4											
4.6	(SM/ML) SAND and SILT, trace gravel (TILL) Compact to dense Wet		5	SS	18		65		○		1 43 (56)
			6	SS	39				○		7 53 (40)
63.8							64				
6.2	END OF BOREHOLE AUGER REFUSAL										

NOTE:

1. Water level in well screen at a depth of 2.9 m below ground surface (Elev. 67.2 m), measured on June 19, 2019

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GOLDER

RECORD OF BOREHOLE No 18-903

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029102.8; E 365614.2 NAD 83 MTM ZONE 9 (LAT. 45.399231; LONG. -75.723216)

ORIGINATED BY RI

DIST Eastern HWY 417

BOREHOLE TYPE Hydro-excavation

COMPILED BY ZS

DATUM Geodetic

DATE July 14-15, 2019

CHECKED BY KCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
71.6	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
0.0	(SW/GW) Gravelly sand, contains wood and concret Grey Moist		1	GS	-		71				
70.4											
1.3	END OF BOREHOLE										

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED

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

$\circ^{3\%}$ STRAIN AT FAILURE

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GOLDER

RECORD OF BOREHOLE No 18-904

SHEET 1 OF 1 **METRIC**

PROJECT 1655214-1900
G.W.P. 4173-15-00
LOCATION N 5029102.8; E 365691.1 NAD 83 MTM ZONE 9 (LAT. 45.399224; LONG. -75.722234)
ORIGINATED BY DJG
DIST Eastern HWY 417
BOREHOLE TYPE Portable Drill, NW Casing/NQ Core
COMPILED BY ZS
DATUM Geodetic
DATE October 15, 2018
CHECKED BY KCP

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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
71.0	GROUND SURFACE										
0.0 / 0.1	(SM) Silty sand (TOPSOIL) Dark Brown Moist		1	SS	18						
70.4	(SP/GP) Sand and gravel, contains wood pieces (FILL)										
0.6	Dark brown Moist		2	SS	34		70		○		17 76 (7)
69.9	(SP-SM) Sand, some gravel, trace silt (FILL) Brown Wet										
1.2	(GP) Gravel (FILL) Grey		3	RC	-						
68.9	PORTLAND CEMENT CONCRETE (FOOTING)						69				
2.1	(SM/ML) Gravelly SAND, some silt, contains clayey silt seams (TILL) Grey Wet		4	SS	43						
			5	SS	47		68		○		28 51 14 7
			6	SS	32						
67.0											
4.0	END OF BOREHOLE										

NOTES:

1. Manual third weight hammer used for all split spoon samples. "N" values are not representative of ASTM D1586 SPT N values and should be interpreted in consideration of their reduced energy.

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

$\circ^{3\%}$ STRAIN AT FAILURE

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GOLDER

RECORD OF BOREHOLE No 18-906

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029624.1; E 366799.1 NAD 83 MTM ZONE 9 (LAT. 45.403818; LONG. -75.708018)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 8, 2019

CHECKED BY KCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
65.5	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
65.1	(SW/GW) Sand and gravel (FILL) Brown		1	SS	32		65		○		19 66 (15)
0.4	(SM) Sand, some silt and gravel (FILL) Brown Moist										
64.6	END OF BOREHOLE AUGER REFUSAL										
0.9											

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

GOLDER

RECORD OF BOREHOLE No 18-907

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029631.9; E 366837.8 NAD 83 MTM ZONE 9 (LAT. 45.403884; LONG. -75.707522)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 8, 2019

CHECKED BY KCP

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 × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.3	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
66.0	(SW/GW) Sand and gravel (FILL) Brown						66				
0.3	(SM) Sand, some silt, trace gravel (FILL) Brown Moist		1	SS	28				○		9 72 (19)
65.5											
0.8	(GW-SW) Sandy gravel, some silt (FILL) Compact Brown Moist		2	SS	25						
65.0							65				
1.3	END OF BOREHOLE AUGER REFUSAL										

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

$\circ^{3\%}$ STRAIN AT FAILURE

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GOLDER

RECORD OF BOREHOLE No 18-908

SHEET 1 OF 2

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029647.0; E 366893.3 NAD 83 MTM ZONE 9 (LAT. 45.404016; LONG. -75.706812)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Rotary Drill, HW Casing/NQ Core

COMPILED BY ZS

DATUM Geodetic

DATE May 22, 2019

CHECKED BY KCP

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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.7	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
0.1	(GW/SW) SAND and GRAVEL (FILL) Compact Grey		1	GS	-						
			2	SS	21				○		45 45 (10)
							66				
			3	SS	50/0.15						
65.1											
1.6	Limestone (BEDROCK), with thin black shale partings Bedrock cored from depths 1.6 m to 4.0 m For bedrock coring details refer to Record of Drillhole 18-908		1	RC	REC 98%		65				RQD = 75%
			2	RC	REC 100%		64				RQD = 100%
			3	RC	REC 100%		63				RQD = 100%
62.7											
4.0	END OF BOREHOLE										

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

$\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 20-3-5 JM

PROJECT: 1655214-1900

RECORD OF DRILLHOLE: 18-908

SHEET 2 OF 2

LOCATION: N 5029647.0 ;E 366893.3

DRILLING DATE: May 22, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: EXPLO 220

DRILLING CONTRACTOR: Marathon Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER (5 10 15 20)	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: Jr	DISCONTINUITY DATA: Ja	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	
		Continued from Record of Borehole 18-908		65.13														
2	Rotary Drill / NQ Core	Limestone (BEDROCK), with thin black shale partings Fresh Fine to medium bedded Good to excellent quality Strong Grey		1.57	1													
3					2													UCS = 65.8 KPa
4					3													
				62.70														
		END OF DRILLHOLE		4.00														
5																		
6																		
7																		
8																		
9																		
10																		
11																		

DEPTH SCALE

1 : 50

GOLDER

LOGGED: PAH

CHECKED: KCP

GOLDER

RECORD OF BOREHOLE No 18-909

SHEET 1 OF 2

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029667.4; E 366944.3 NAD 83 MTM ZONE 9 (LAT. 45.404195; LONG. -75.706157)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Rotary Drill, HW Casing/HQ Core

COMPILED BY ZS

DATUM Geodetic

DATE May 21, 2019

CHECKED BY KCP

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 × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
69.1	GROUND SURFACE						69				
0.0	(SM) Silty sand, contains organic matter (roots) (TOPSOIL) Brown										
0.2 / 68.6	(SM) Silty sand, trace organic matter (FILL) Brown Moist			SS	4						
0.5 / 68.3	(SW) Gravelly sand (FILL) Grey		2	SS	13		68		○		16 56 (28)
0.8	(SM/GM) Gravelly SILTY SAND, contains cobbles (TILL) Compact to dense Grey brown Moist - Cobbles and bouldersfrom 1.5 m to 2.3 m depth		3	RC	-		67				
			4	SS	32				○		26 48 (26)
66.0							66				
3.1	Limestone (BEDROCK), with thin black shale partings Bedrock cored from depths 3.1 m to 4.9 m For bedrock coring details refer to Record of Drillhole 18-909		1	RC	REC 95%						RQD = 63%
			2	RC	REC 98%		65				RQD = 87%
64.2											
4.9	END OF BOREHOLE										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 20-3-5 JM

PROJECT: 1655214-1900

RECORD OF DRILLHOLE: 18-909

SHEET 2 OF 2

LOCATION: N 5029667.4 ;E 366944.3

DRILLING DATE: May 21, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: EXPLO 220

DRILLING CONTRACTOR: Marathon Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER (5 10 15 20)	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: Jr	DISCONTINUITY DATA: Ja	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WEATH-ERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES
		Continued from Record of Borehole 18-909		65.97													
4	Rotary Drill / NQ Core	Limestone (BEDROCK), thin, black with shale partings Fresh Fine to medium grained Non-porous Thinly to medium bedded Fair to good quality Medium strong to strong		3.13	1												
					2												
				64.23													
5		END OF DRILLHOLE		4.87													
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	

DEPTH SCALE
1 : 50

GOLDER

LOGGED: PAH
CHECKED: KCP

GOLDER

RECORD OF BOREHOLE No 18-910

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029641.4; E 367056.5 NAD 83 MTM ZONE 9 (LAT. 45.403951; LONG. -75.704727)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Hydro Excavation/Power Auger, 200 mm Diam, (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 3, 2019

CHECKED BY KCP

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 × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
72.1	GROUND SURFACE						72				
0.0	ASPHALTIC CONCRETE										
0.1	(SW) Gravelly sand (FILL) Grey										
70.9							71				
1.3	(SP/SM) Sand, fine, trace silt (FILL) Brown Moist		1	GS	-						
70.4											
1.7	(SM/GM) Gravelly sand, some silt, contains cobbles (FILL) Brown Moist		2	GS	-		70		○		34 49 (17)
69.1						▽	69				
3.1	(ML/SM) SILT and SAND Compact Brown Wet		3	SS	20				○		0 42 54 4
68.4											
3.7	END OF BOREHOLE AUGER REFUSAL										

NOTE:

1. Water level in open borehole at a depth of 3.1 m below ground surface (Elev. 69.0 m), upon completion of drilling.

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

$\circ^{3\%}$ STRAIN AT FAILURE

GOLDER

RECORD OF BOREHOLE No 18-911

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029650.4; E 367089.2 NAD 83 MTM ZONE 9 (LAT. 45.404028; LONG. -75.704309)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Hydro Excavation/Power Auger, 200 mm Diam, (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 3, 2019

CHECKED BY KCP

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 × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
72.9	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
0.1	(SW) Gravelly sand (FILL) Grey										
72.1											
0.9	(SP-SM) Sand, some silt (FILL) Brown to red brown Moist		1	GS	-		72				
71.6											
1.3	(SP-SM) Sand, some silt (FILL) Grey Moist		2	GS	-		71				
70.6											
2.4	(GW/SW) Gravel and sand, trace silt, contains cobbles (FILL) Brown Moist		3	GS	-				○		50 44 (6)
			4	SS	>50/0.1	▼	70				
69.6											
3.3	END OF BOREHOLE AUGER REFUSAL										

NOTE:

1. Water level in well screen at a depth of 3.1 m below ground surface (Elev. 69.8 m), on June 19, 2019

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

$\circ^{3\%}$ STRAIN AT FAILURE

GOLDER

RECORD OF BOREHOLE No 18-912

SHEET 1 OF 2 **METRIC**

PROJECT 1655214-1900
G.W.P. 4173-15-00
DIST Eastern HWY 417
DATUM Geodetic

LOCATION N 5029660.0; E 367131.5 NAD 83 MTM ZONE 9 (LAT. 45.404112; LONG. -75.703767)
BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)/NW Casing/NQ Core
DATE May 10, 2019

ORIGINATED BY PAH
COMPILED BY ZS
CHECKED BY KCP

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 × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
72.8	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
0.1	(SM) Gravelly silty sand, contains metal fragments (FILL) Grey Moist		1	AS	-						
			2	AS	-				○		29 49 (22)
72.0							72				
0.8	Weathered Limestone (BEDROCK)		3	SS	95						
71.6											
1.2	Limestone (BEDROCK), with thin black shale partings Bedrock cored from depths 1.2 m to 2.7 m For bedrock coring details refer to Record of Drillhole 18-912		1	RC	REC 100%	▽	71				RQD = 59%
70.1											
2.7	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 1.5 m below ground surface (Elev. 71.3 m), upon completion of drilling										

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

$\circ^{3\%}$ STRAIN AT FAILURE

PROJECT: 1655214-1900

RECORD OF DRILLHOLE: 18-912

SHEET 2 OF 2

LOCATION: N 5029660.0 ;E 367131.5

DRILLING DATE: May 10, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Downing Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER (5 10 15 20)	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES	
		Continued from Record of Borehole 18-912		71.59														
2	Rotary Drill / NQ Core	Limestone (BEDROCK), with thin, black shale partings Slightly weathered to fresh Grey Fine to medium grained Thinly bedded Fair quality Strong		1.22	1	100-85												▽ UCS = 71.5 KPa
				70.07														
		END OF DRILLHOLE		2.74														
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE
1 : 50

GOLDER

LOGGED: PAH
CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-MISS.GDT 20-3-5 JM

GOLDER

RECORD OF BOREHOLE No 18-913

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029932.5; E 367605.0 NAD 83 MTM ZONE 9 (LAT. 45.406521; LONG. -75.697685)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 13, 2019

CHECKED BY KCP

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 × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 25 50 75	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.9	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
66.6	(SW) Gravelly sand (FILL)		1	AS	-						
0.3	(SP) Sand, some gravel, contains cinders, ash and wood (FILL) Loose Brown Moist		2	SS	4		66				
			3	SS	4		65				
64.5			4	SS	50/0.15						
2.4	(GW) Sandy gravel, with strong hydrocarbon odour (FILL) Compact Grey Wet		5	SS	19		64				
63.2											
3.7	(GM/SM) Sandy GRAVEL, some silt (TILL) Dense to compact Grey Wet		6	SS	31		63				
			7	SS	26		62		○		64 22 11 3
61.7											
5.2	(ML) Sandy SILT, some gravel (TILL) Grey Wet		8	SS	50/0.15						
61.4											
5.5	END OF BOREHOLE AUGER REFUSAL										

NOTES:

1. Water level in well screen at a depth of 3.1 m below ground surface (Elev. 63.9 m), measured on June 19, 2019

+³, ×³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 20-3-5 JM

GOLDER

RECORD OF BOREHOLE No 18-914

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029958.8; E 367649.0 NAD 83 MTM ZONE 9 (LAT. 45.406754; LONG. -75.697119)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 14, 2019

CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS
67.5	GROUND SURFACE					
0.0	ASPHALTIC CONCRETE					
0.1	(SW) Gravelly sand (FILL) Grey		1	AS	-	
67.0						
0.5	(SM) Silty sand, some gravel, trace organic matter, contains metal fragments (FILL) Loose Dark brown Moist		2	SS	6	
66.0						
1.5	(PT) Organics, sandy peat, trace gravel, contains cinders and ash (FILL)		3	SS	10	
65.5						
2.0	(PT) Fibrous PEAT Black					
64.9			4	SS	5	
2.6	(CI) Silty clay, contains organic matter (rootlets) Grey					
64.5						
3.1	(SM) SILTY SAND, some gravel (TILL) Dark grey Wet		5	SS	64/0.15	
63.8						
3.7	END OF BOREHOLE AUGER REFUSAL					

NOTE:

1. Water level in well screen at a depth of 2.0 m below ground surface (Elev. 65.5 m), measured on June 19, 2019

ELEVATION SCALE: 67, 66, 65, 64

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 25 50 75

UNIT WEIGHT γ kN/m^3

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

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

$\circ^{3\%}$ STRAIN AT FAILURE

GOLDER

RECORD OF BOREHOLE No 18-915

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029997.9; E 367718.4 NAD 83 MTM ZONE 9 (LAT. 45.407099; LONG. -75.696227)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 14, 2019

CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
68.1	GROUND SURFACE						68		
0.0	ASPHALTIC CONCRETE								
0.1	(SW) Gravelly sand (FILL) Grey								
67.6	(SP) Sand (FILL) Grey Moist		1	AS	-				
0.5	(SM) Sand, some silt (FILL) Loose Red brown to brown		2	SS	7		67		0 85 (15)
			3	SS	5		66		
65.4			4	SS	2				
2.7	(SM) SILTY SAND Loose Grey Wet		5	SS	7		65		
64.4									
3.7	(SM/ML) Gravelly SILTY SAND, some clay, contains cobbles (TILL) Compact to loose Grey Wet		6	SS	14		64		21 32 33 14
			7	SS	6		63		
			8	SS	10				
			9	SS	24		62		
61.1			10	SS	>50/0.1				
7.0	END OF BOREHOLE AUGER REFUSAL								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

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

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
25 50 75

NOTE:

1. Water level in well screen at a depth of 2.4 m below ground surface (Elev. 65.7 m), measured on June 19, 2019

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

$\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 20-3-5 JM

GOLDER

RECORD OF BOREHOLE No 18-916

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029928.2; E 367723.2 NAD 83 MTM ZONE 9 (LAT. 45.406471; LONG. -75.696176)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Hydro Excavation/Power Auger, 200 mm Diam, (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 2 and 9, 2019

CHECKED BY KCP

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, × REMOULDED	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
67.1	GROUND SURFACE						67				
0.0 / 66.9	(SM) Silty sand, fine, contains organic matter (TOPSOIL)										
0.2	Dark brown										
	(SW/GW) Sand and gravel, contains rock fill, concrete and brick fragments (FILL) Brown		1	GS	-						
65.6							66				
1.5	(ML-CL) Sandy clayey silt, contains organic matter, wood fibers, brick, wood, glass and metal wire (FILL) Grey and black Moist										
			2	SS	2		65				
63.6											
3.5	(MM/SM) Gravelly silty sand, contains cobbles (FILL) Compact Grey brown Wet						64				
			3	SS	15		63		○		32 41 (27)
62.7											
4.4	Weathered BEDROCK		4	SS	>50/0.15						
62.3											
4.8	END OF BOREHOLE AUGER REFUSAL										

NOTE:

1. Water level in well screen at a depth of 2.3 m below ground surface (Elev. 64.9 m), measured on June 19, 2019

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 20-3-5 JM

GOLDER

RECORD OF BOREHOLE No 18-917

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029956.2; E 367774.1 NAD 83 MTM ZONE 9 (LAT. 45.406719; LONG. -75.695522)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Hydro Excavation/Power Auger, 200 mm Diam, (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 2 and 9, 2019

CHECKED BY KCP

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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.3	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
0.1 / 65.9	PORTLAND CEMENT CONCRETE										
0.4	(SP) Sand (FILL) Brown Moist		1	GS	-						
65.1			2	GS	-		66		○		0 99 (1)
1.2	(SW) Gravelly sand, contains brick, wood, glass and porcelain (FILL) Grey Moist		3	GS	-		65				
63.8							64				
2.5 / 63.3	(SP) SAND Grey Wet		4	GS	-						
3.1	(SM) SILTY SAND Loose Grey Wet		5	SS	7		63				
62.3											
4.0	(SM) Gravelly SILTY SAND, contains cobbles and shale fragments (TILL) Loose to compact Grey Wet		6	SS	20		62				
			7	SS	9				○		24 36 27 13
			8	SS	4		61				
			9	SS	21		60		○		
			10	SS	>50/0.1				○		22 49 (29)
58.8							59				
7.5	END OF BOREHOLE AUGER REFUSAL										

NOTES:

1. Water level in well screen at a depth of 1.8 m below ground surface (Elev. 64.5 m), measured on June 19, 2019

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

$\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 20-3-5 JM

GOLDER

RECORD OF BOREHOLE No 18-918

SHEET 1 OF 1

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029986.3; E 367825.5 NAD 83 MTM ZONE 9 (LAT. 45.406985; LONG. -75.694861)

ORIGINATED BY PAH

DIST Eastern HWY 417

BOREHOLE TYPE Hydro Excavation/Power Auger, 200 mm Diam, (Hollow Stem)

COMPILED BY ZS

DATUM Geodetic

DATE May 2 and 9, 2019

CHECKED BY KCP

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 × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.6	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
0.1 / 66.1	PORTLAND CEMENT CONCRETE										
0.5	(SP) Sand, contains brick fragments (FILL) Brown Moist		1	GS	-		66				
			2	GS	-		65				
64.6											
2.0	(SW/GW) Sand and gravel, trace silt (FILL) Brown Wet		3	GS	-				○		37 54 (9)
64.0							64				
2.7	(CL) CLAYEY SILT, some gravel, contains silty sand seams Grey brown to grey		4	GS	-	▽			H ○		
63.4											
3.2	(ML) Sandy SILT, trace gravel and clay Compact Grey Wet		5	SS	9		63				
			6	SS	19				○		5 25 65 5
			7	SS	15		62				
61.3											
5.3	(CL-ML) CLAYEY SILT to SILT, some gravel (TILL) Compact Grey Wet		8	SS	13		61		H		
60.5											
6.1	END OF BOREHOLE AUGER REFUSAL										

NOTE:

1. Water level measured in open borehole at a depth of 3.0 m below ground surface (Elev. 63.6 m), upon completion of drilling

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

$\circ^{3\%}$ STRAIN AT FAILURE

GOLDER

RECORD OF BOREHOLE No 18-923

SHEET 1 OF 2

METRIC

PROJECT 1655214-1900

G.W.P. 4173-15-00

LOCATION N 5029080.2; E 365569.0 NAD 83 MTM ZONE 9 (LAT. 45.399032; LONG. -75.723797)

ORIGINATED BY DJG/SB

DIST Eastern HWY 417

BOREHOLE TYPE Hydro-excavation/Portable Rotary Drill, HW Casing, HQ Core

COMPILED BY ZS

DATUM Geodetic

DATE August 20, 2019

CHECKED BY KCP

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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
72.1	GROUND SURFACE										
0.0 / 71.9	(SM) Silty sand, contains organic matter (rootlets) (TOPSOIL)		1	GS	-		72				
0.2	Brown, moist (SP) Sand, trace silt (FILL) Brown		2	GS	-		71				
69.3							70				
2.8 / 68.7	PORTLAND CEMENT CONCRETE (FOOTING)		3	RC	-		69				UCS = 47 MPa
3.4	Limestone (BEDROCK), with thin black shale partings Bedrock cored from depths 3.4 m to 5.1 m For bedrock coring details refer to Record of Drillhole 18-923		4	RC	REC 100%		68				RQD = 52%
67.0											
5.1	END OF BOREHOLE										

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 20-3-5 JM

PROJECT: 1655214-1900

RECORD OF DRILLHOLE: 18-923

SHEET 2 OF 2

LOCATION: N 5029080.2 ;E 365569.0

DRILLING DATE: August 20, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Portable Drill

DRILLING CONTRACTOR: CCC

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: Jr	DISCONTINUITY DATA: Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES	
		Continued from Record of Borehole 18-923		68.67														
4	Rotary Drill / HW Casing	Limestone (BEDROCK), with thin black shale partings Thinly bedded Medium to fine grained Fair quality Medium strong		3.44	4													UCS = 28.7 MPa
5		END OF DRILLHOLE		67.01 5.10														
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		

DEPTH SCALE
1 : 50

GOLDER

LOGGED: DJG/SB
CHECKED: KCP

BH 18-801 (Dry)

Core Box 1 of 1

Cobbles

Top of Footing Elevation 66.6 m

Bottom of Footing Elevation 65.6 m

Elevation 65.0 m EOH

GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
Checked:	KCP
Review:	FJH

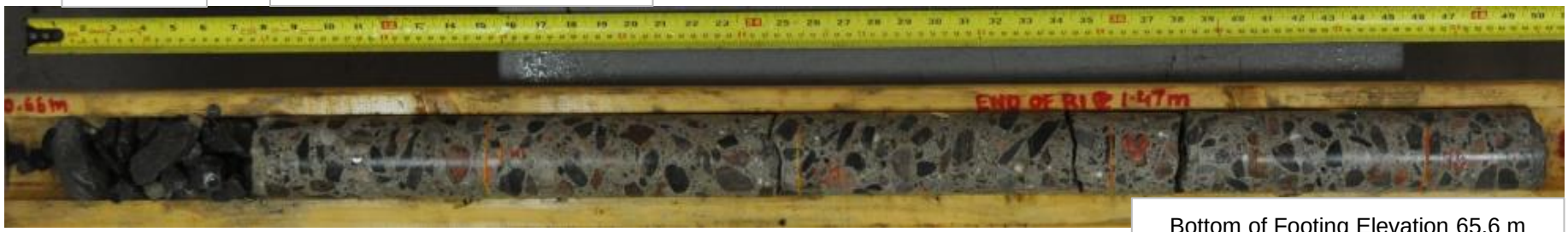
Figure A1

BH 18-801 (Wet)

Core Box 1 of 1

Cobbles

Top of Footing Elevation 66.6 m



Bottom of Footing Elevation 65.6 m

Elevation 65.0 m EOH

GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

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Project No.	1655214 / 1900
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Figure A2

BH 18-802 (Dry)

Core Box 1 of 1

Bottom of Footing Elevation 65.3 m

Elevation 64.5 m EOH

GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
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Figure A3

BH 18-802 (Dry)

Core Box 1 of 1

GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
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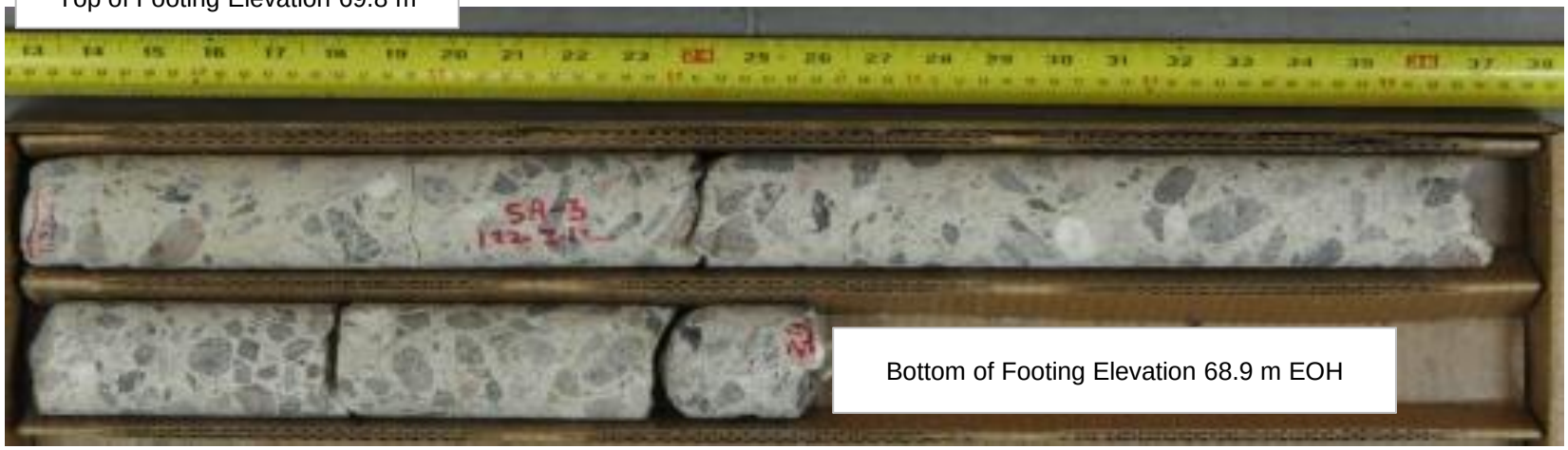
Figure A4

BH 18-904 (Dry)

Core Box 1 of 1

Top of Footing Elevation 69.8 m



Bottom of Footing Elevation 68.9 m EOH

Elevation 67.0 m EOH

GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

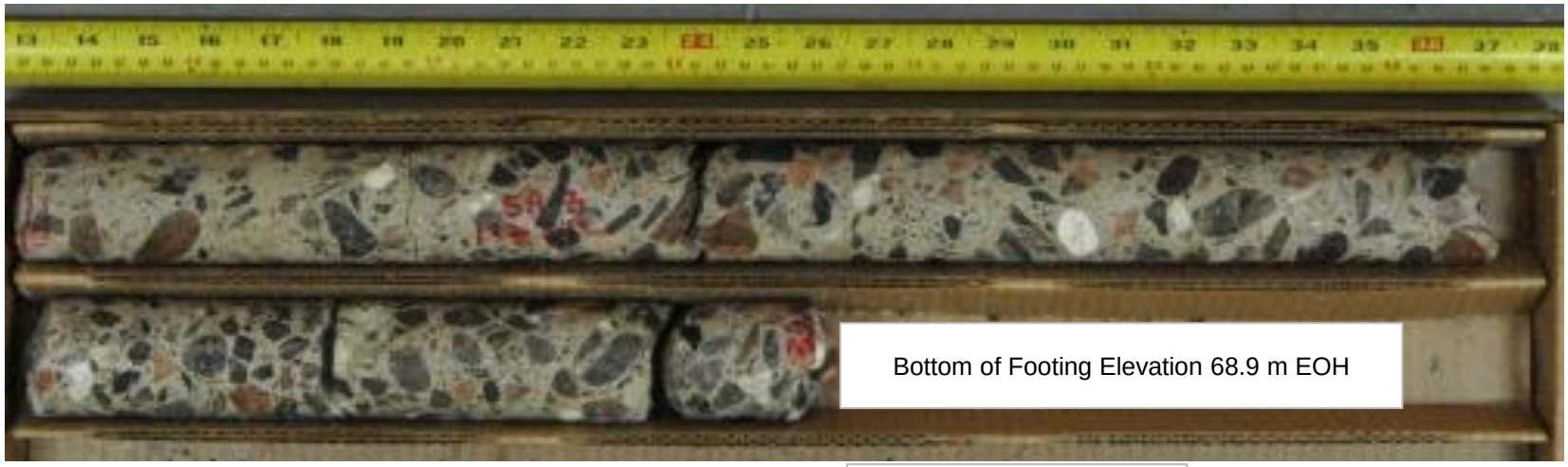
Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
Checked:	KCP
Review:	FJH

Figure A5

BH 18-904 (wet)

Core Box 1 of 1

Top of Footing Elevation 69.8 m



Bottom of Footing Elevation 68.9 m EOH

Elevation 67.0 m EOH

GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

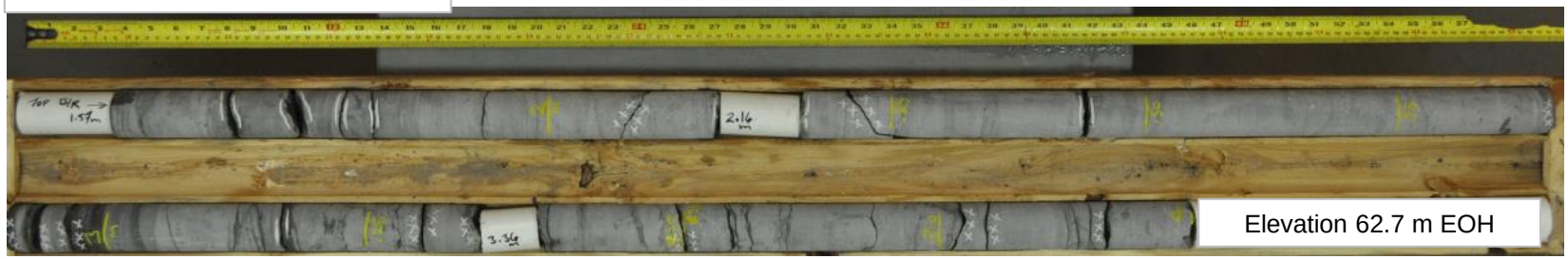
Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
Checked:	KCP
Review:	FJH

Figure A6

BH 18-908 (Dry)

Core Box 1 of 1

Top of Bedrock elevation 65.1 m



GOLDER	**Foundation Investigation** **Highway 417 Retaining Wall Structures** **Ottawa, Ontario**	Project No. 1655214 / 1900 Drawn: RA Date: 2019-10-18 Checked: KCP Review: FJH	**Figure A7**

BH 18-908 (wet)

Core Box 1 of 1

Top of Bedrock Elevation 65.1 m

Elevation 62.7 m EOH

GOLDER	**Foundation Investigation** **Highway 417 Retaining Wall Structures** **Ottawa, Ontario**	Project No. 1655214 / 1900 Drawn: RA Date: 2019-10-18 Checked: KCP Review: FJH	**Figure A8**

BH 18-909 (Dry)

Core Box 1 of 1

Cobbles

Top of Bedrock Elevation 66.0 m

GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
Checked:	KCP
Review:	FJH

Figure A9

BH 18-909 (wet)

Core Box 1 of 1

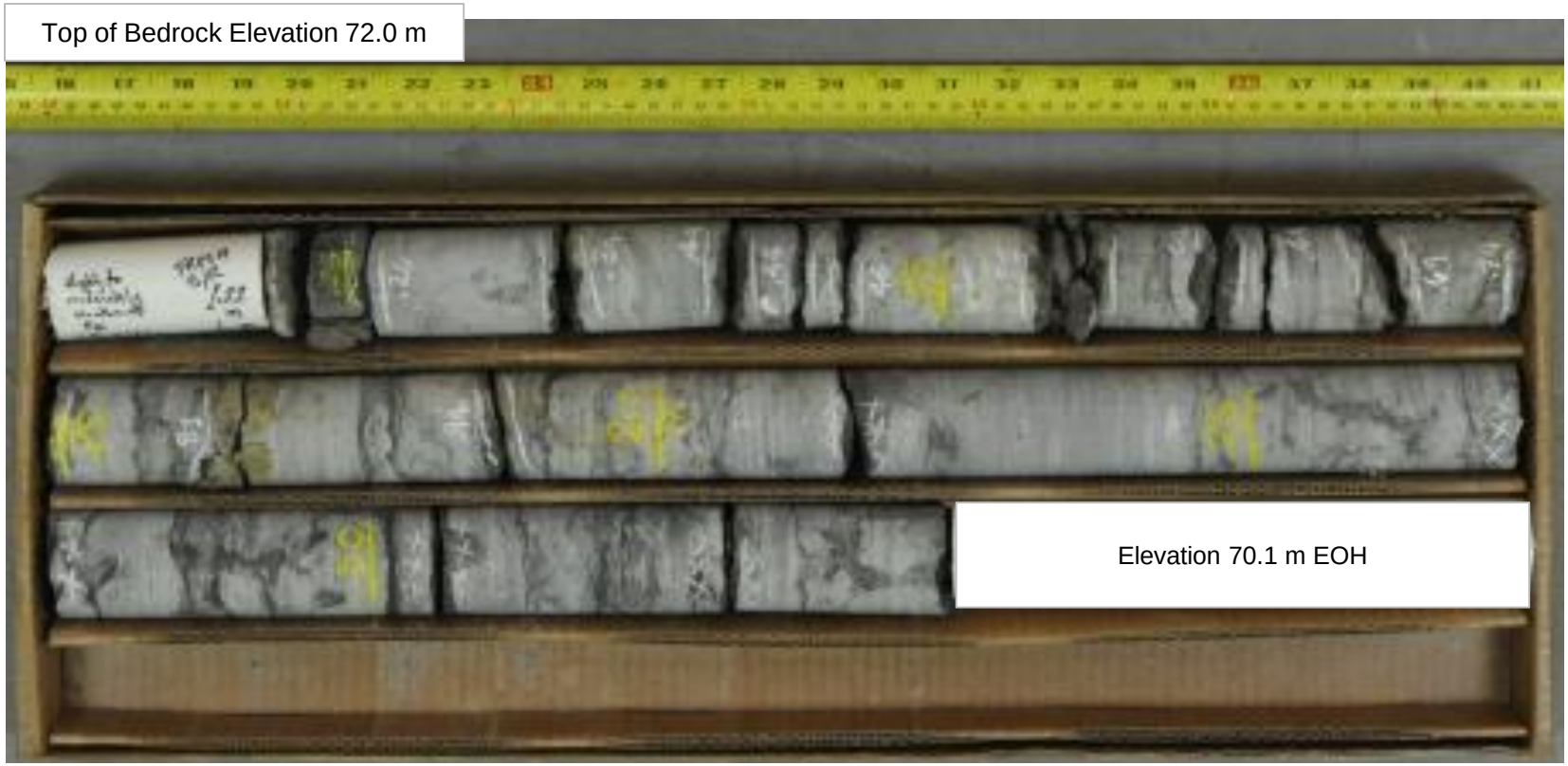
Cobbles

Top of Bedrock Elevation 66.0 m

GOLDER	**Foundation Investigation** **Highway 417 Retaining Wall Structures** **Ottawa, Ontario**	Project No. 1655214 / 1900 Drawn: RA Date: 2019-10-18 Checked: KCP Review: FJH	**Figure A10**

BH 18-912 (Dry)

Core Box 1 of 1



GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

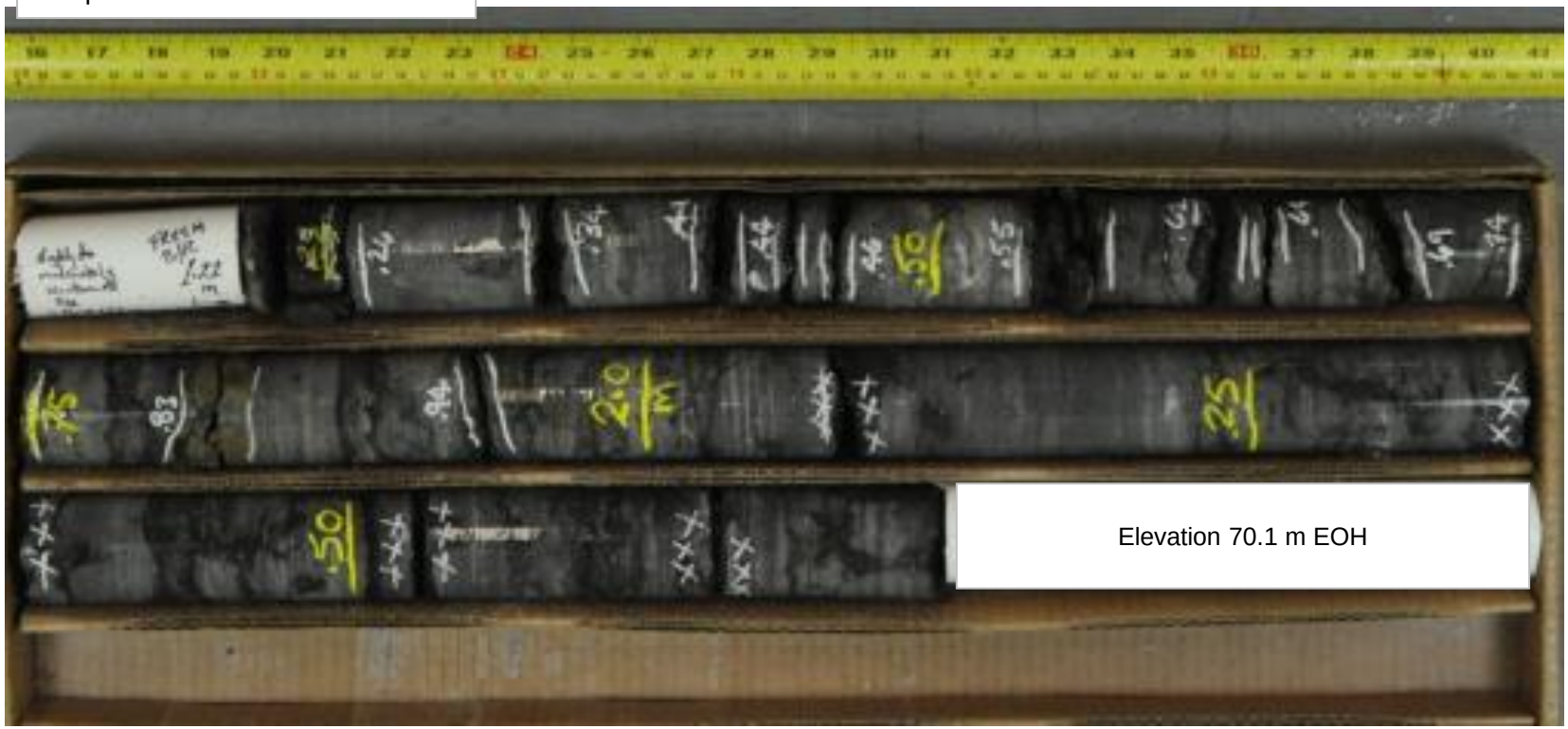
Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
Checked:	KCP
Review:	FJH

Figure A11

BH 18-912 (wet)

Core Box 1 of 1

Top of Bedrock Elevation 72.0 m



GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
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Review:	FJH

Figure A12

BH 18-923 (Dry)

Core Box 1 and 2 of 2

Top of Footing Elevation 69.3 m

Top of Bedrock elevation 68.7 m

Elevation 67.0 m EOH

GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
Checked:	KCP
Review:	FJH

Figure A13

BH 18-923 (wet)

Core Box 1 and 2 of 2

Top of Footing Elevation 69.3 m

Top of Bedrock elevation 68.7 m

Elevation 67.0 m EOH

GOLDER

Foundation Investigation

Highway 417 Retaining Wall Structures

Ottawa, Ontario

Project No.	1655214 / 1900
Drawn:	RA
Date:	2019-10-18
Checked:	KCP
Review:	FJH

Figure A14

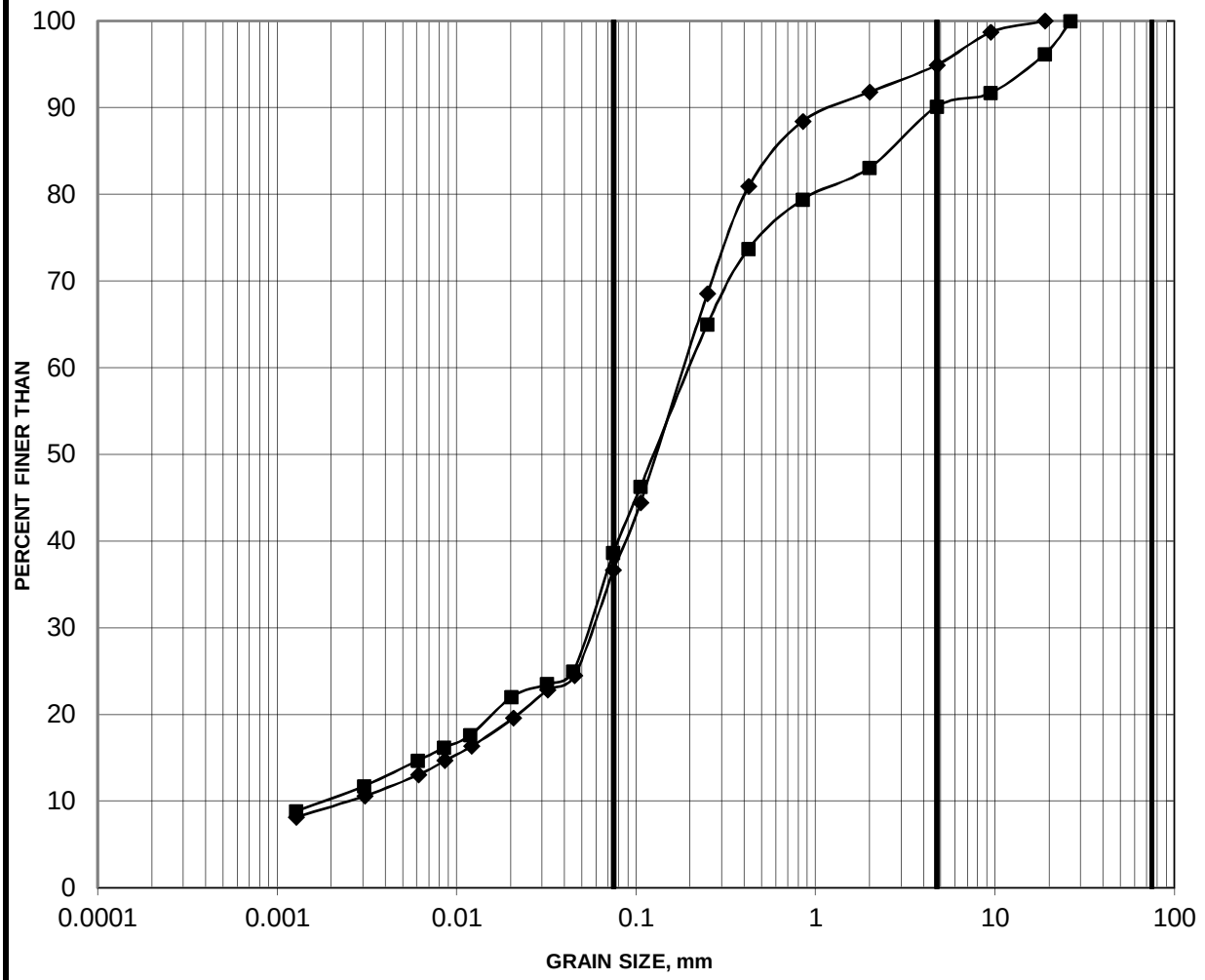
APPENDIX B

Laboratory Test Results, Current Investigation

Figures B1 to B24

GRAIN SIZE DISTRIBUTION	FIGURE B1

RETAINING WALL 2N: SILTY SAND (FILL)



Borehole	Sample	Depth (m)
18-802	2	0.61-1.22
18-802	4	1.83-2.44

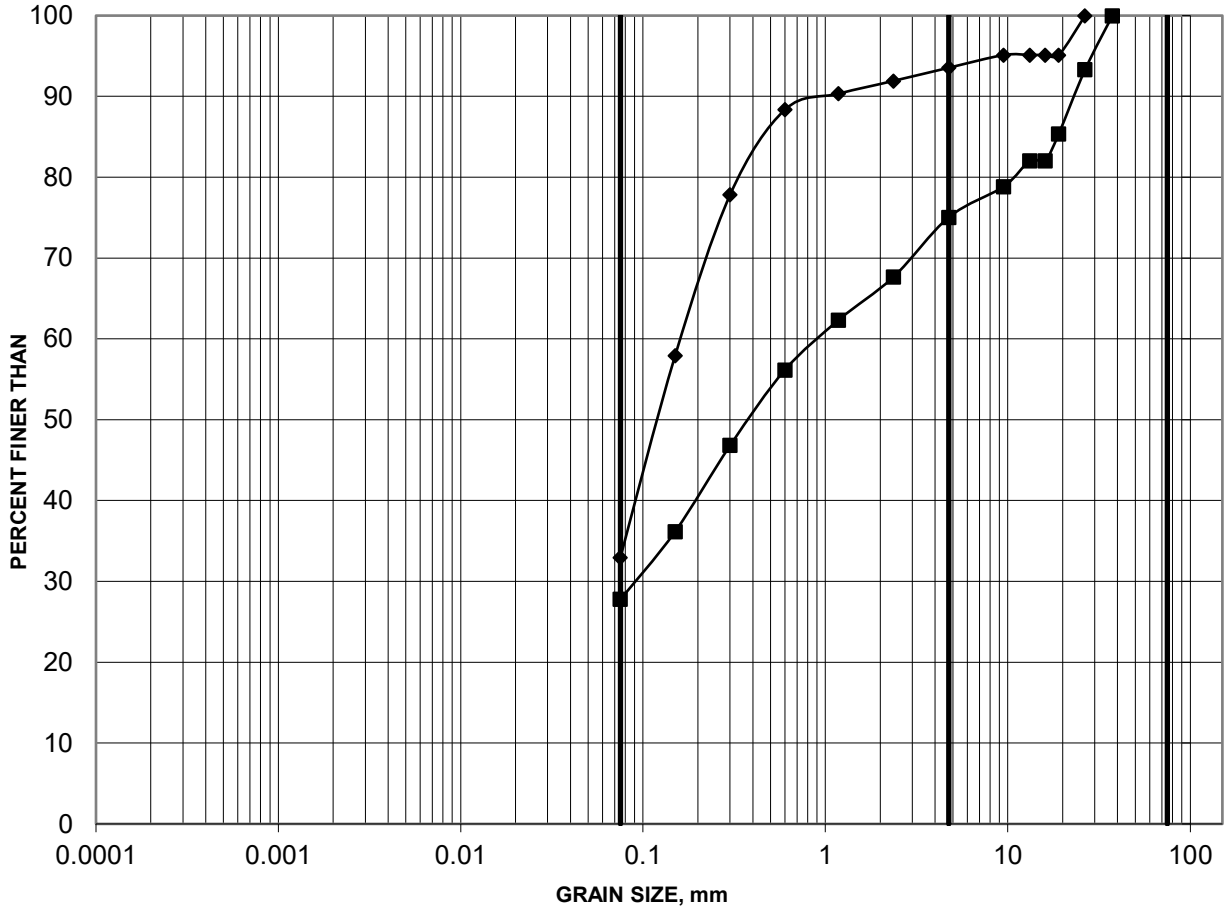
Project: 1655214/1900

Golder Associates

Created by: MI
Checked by: CW

GRAIN SIZE DISTRIBUTION	FIGURE B2

RETAINING WALL 2N: GLACIAL TILL



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)
18-801	3	1.85-2.36
18-802	8	4.42-4.88

Project: 1655214/1900

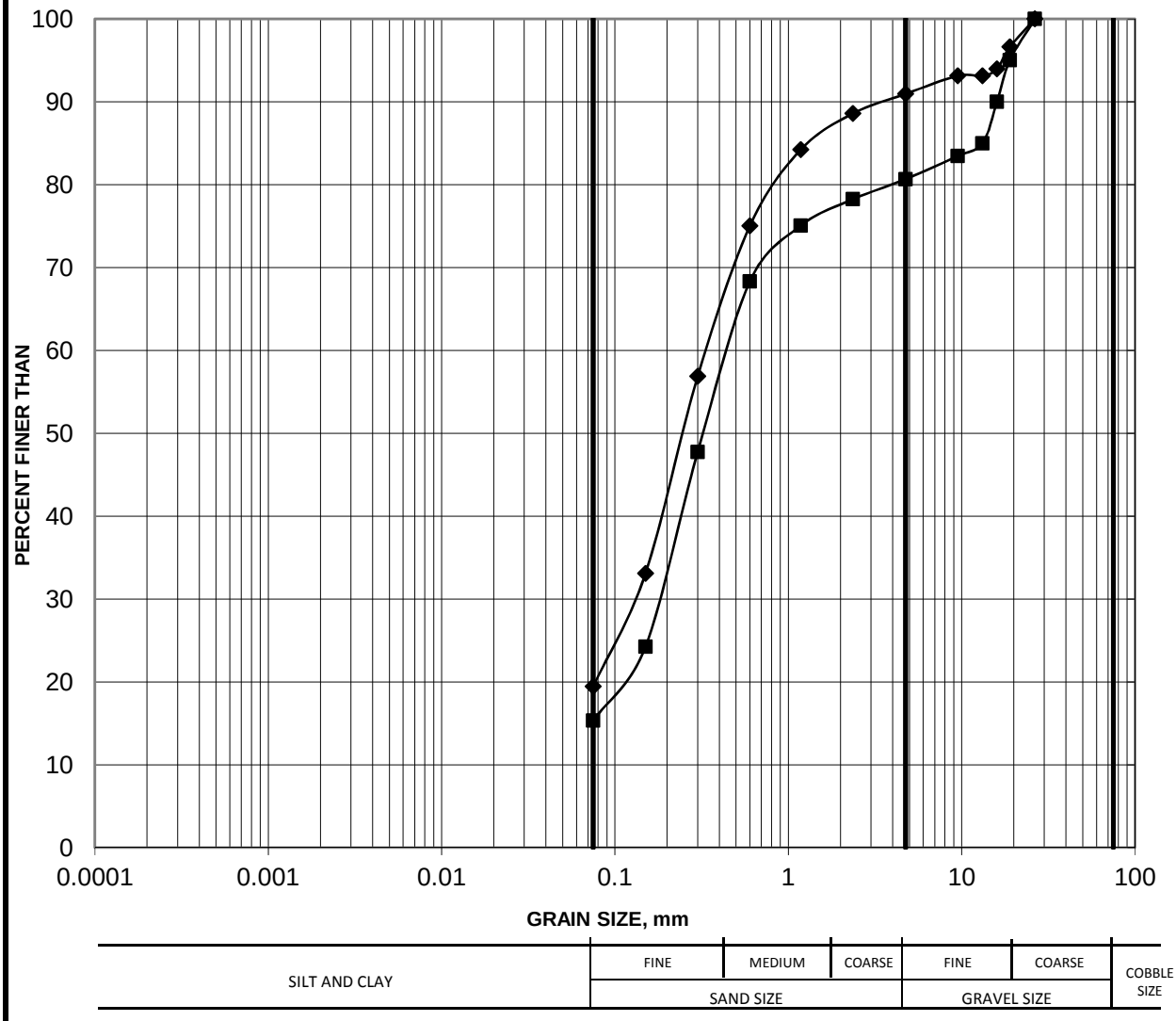
Golder Associates

Created by: KCP

Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B3

RETAINING WALL 10N: SAND (FILL)



Borehole	Sample	Depth (m)
18-906	1B	0.41-0.76
18-907	1B	0.34-0.76

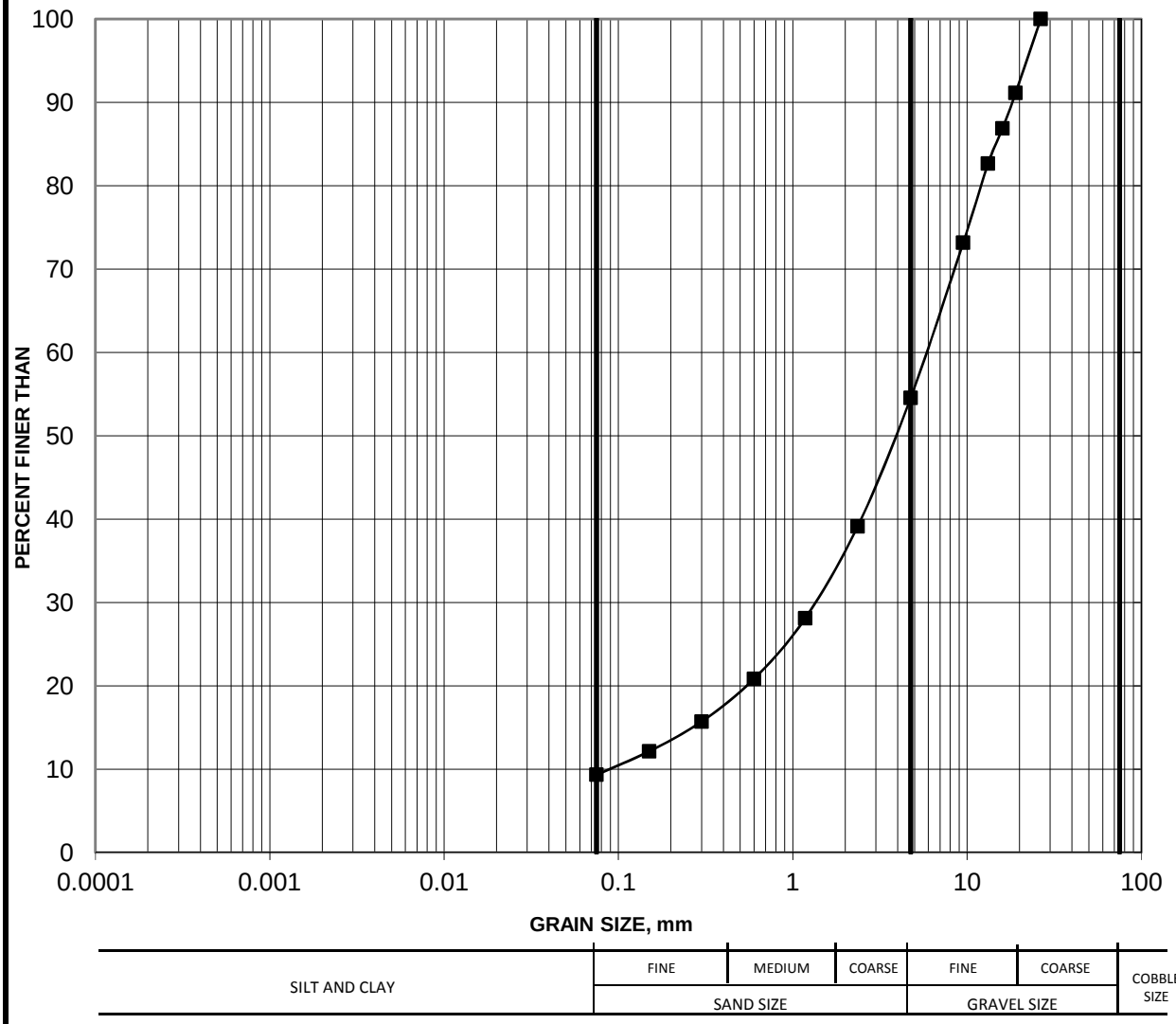
Project: 1655214/1900

Golder Associates

Created by: MI
Checked by: CW

GRAIN SIZE DISTRIBUTION	FIGURE B4

RETAINING WALL 11N: SAND AND GRAVEL (FILL)



Borehole	Sample	Depth (m)
18-908	2	0.30-1.52

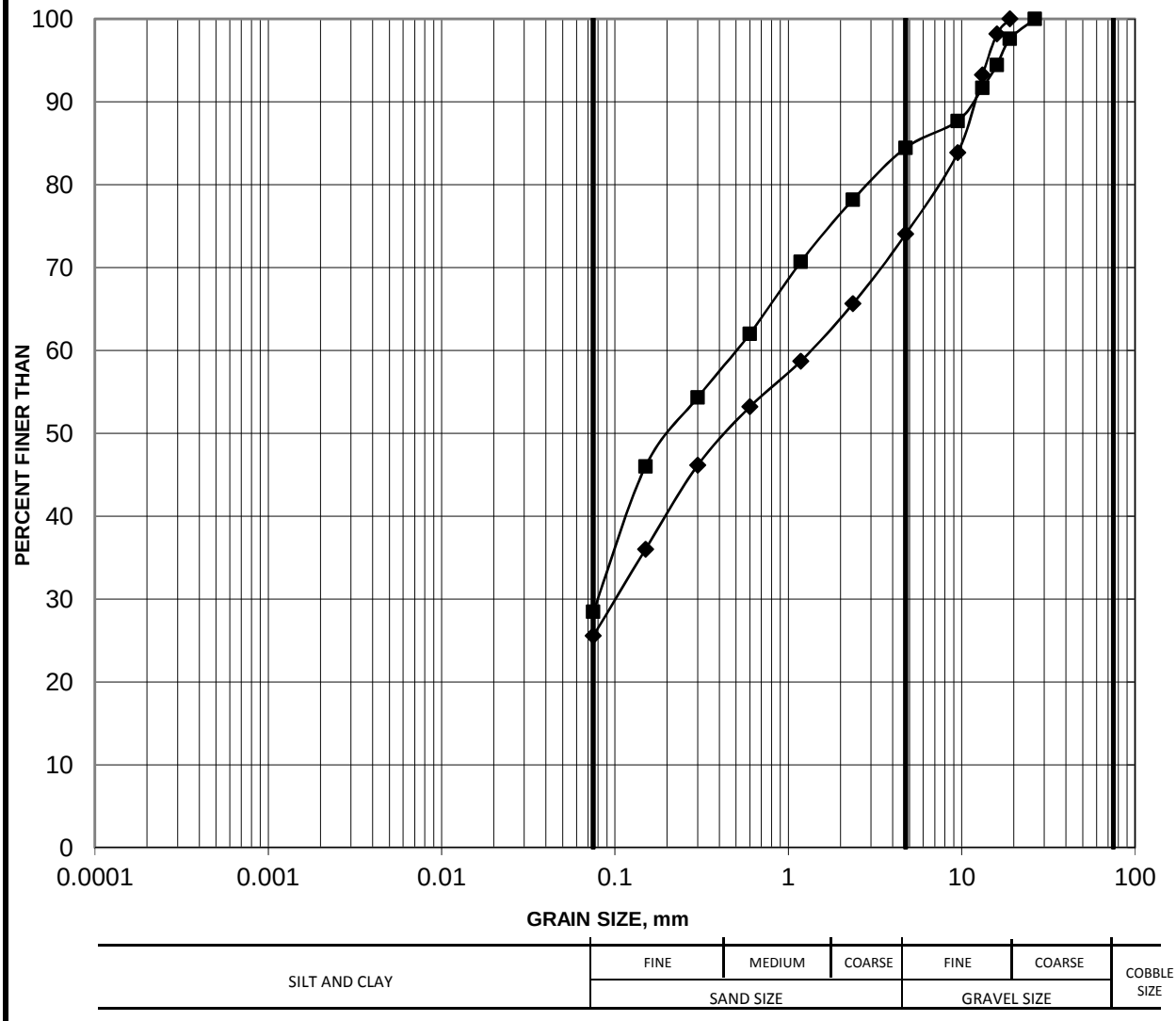
Project: 1655214/1900

Golder Associates

Created by: MI
Checked by: CW

GRAIN SIZE DISTRIBUTION	FIGURE B5

RETAINING WALL 11N: GLACIAL TILL



Borehole	Sample	Depth (m)
18-909	2	0.76-1.37
18-909	4	2.44-2.90

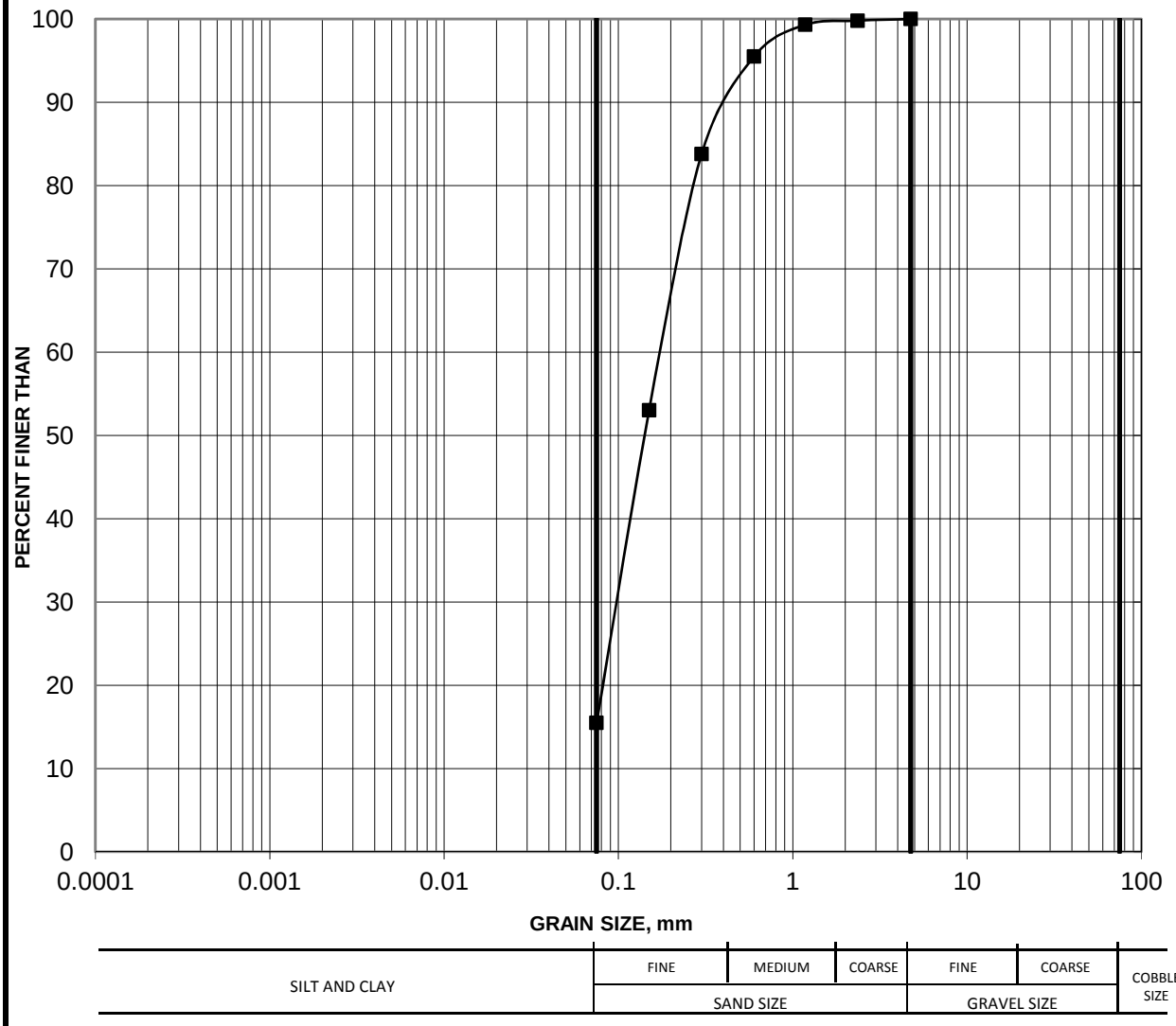
Project: 1655214/1900

Golder Associates

Created by: MI
Checked by: CW

GRAIN SIZE DISTRIBUTION	FIGURE B6

RETAINING WALL 13N: SAND (FILL)



Borehole	Sample	Depth (m)
18-915	2	0.76-1.37

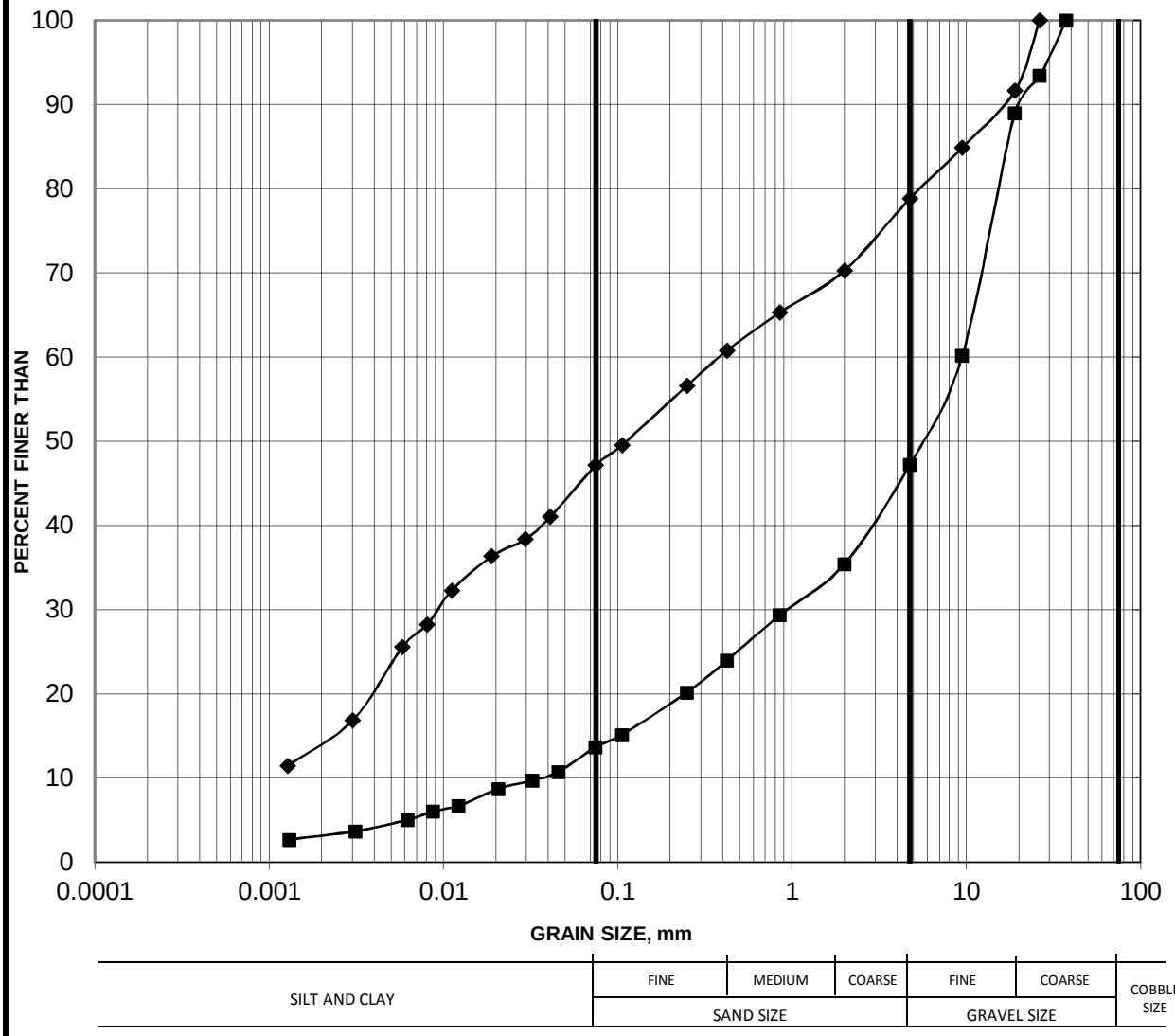
Project: 1655214/1900

Golder Associates

Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B7

RETAINING WALL 13N: GLACIAL TILL



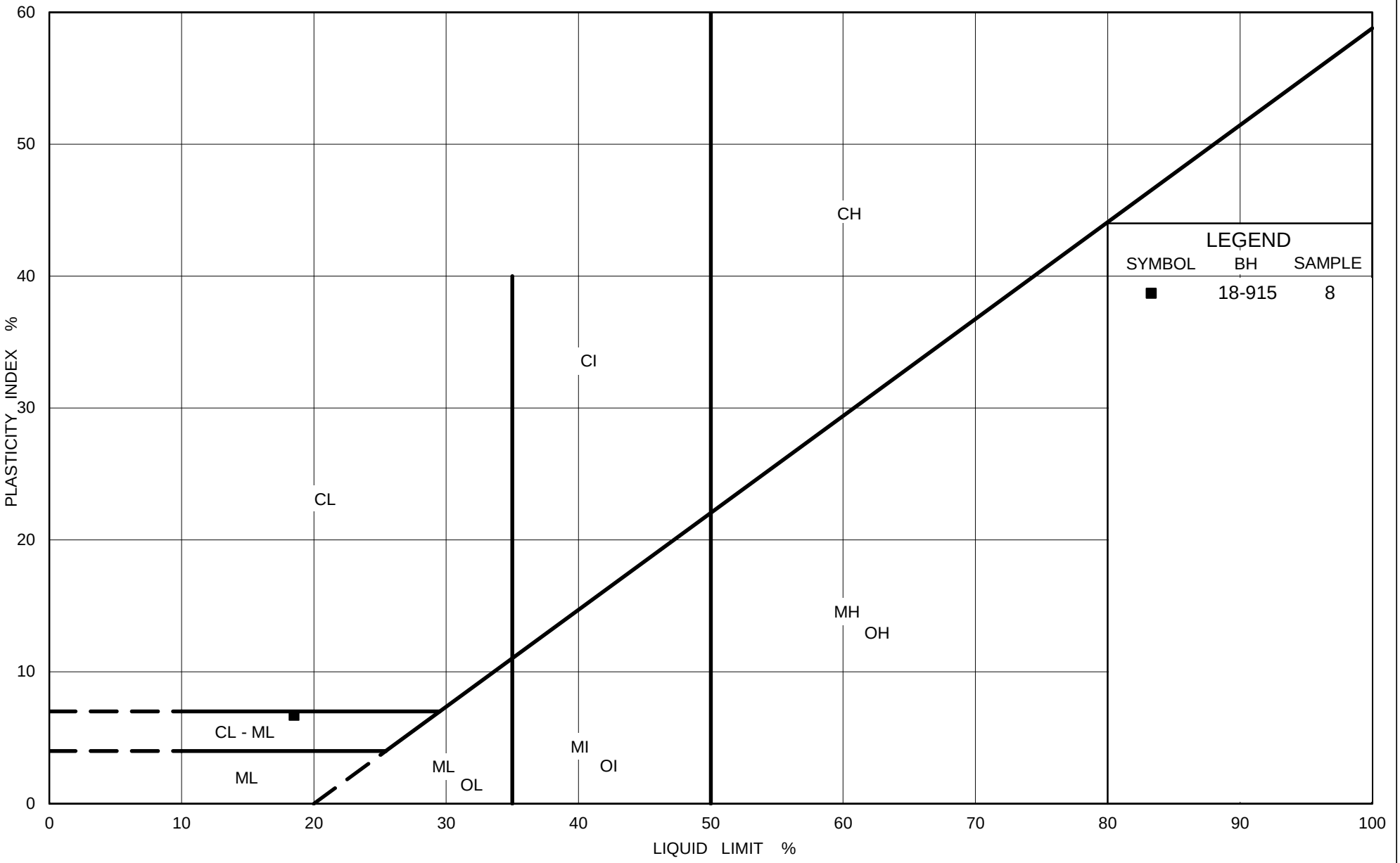
Borehole	Sample	Depth (m)
18-913	7	4.57-5.18
18-915	6	3.81-4.42

Project: 1655214/1900

Golder Associates

Created by: KP
Checked by: MI

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART

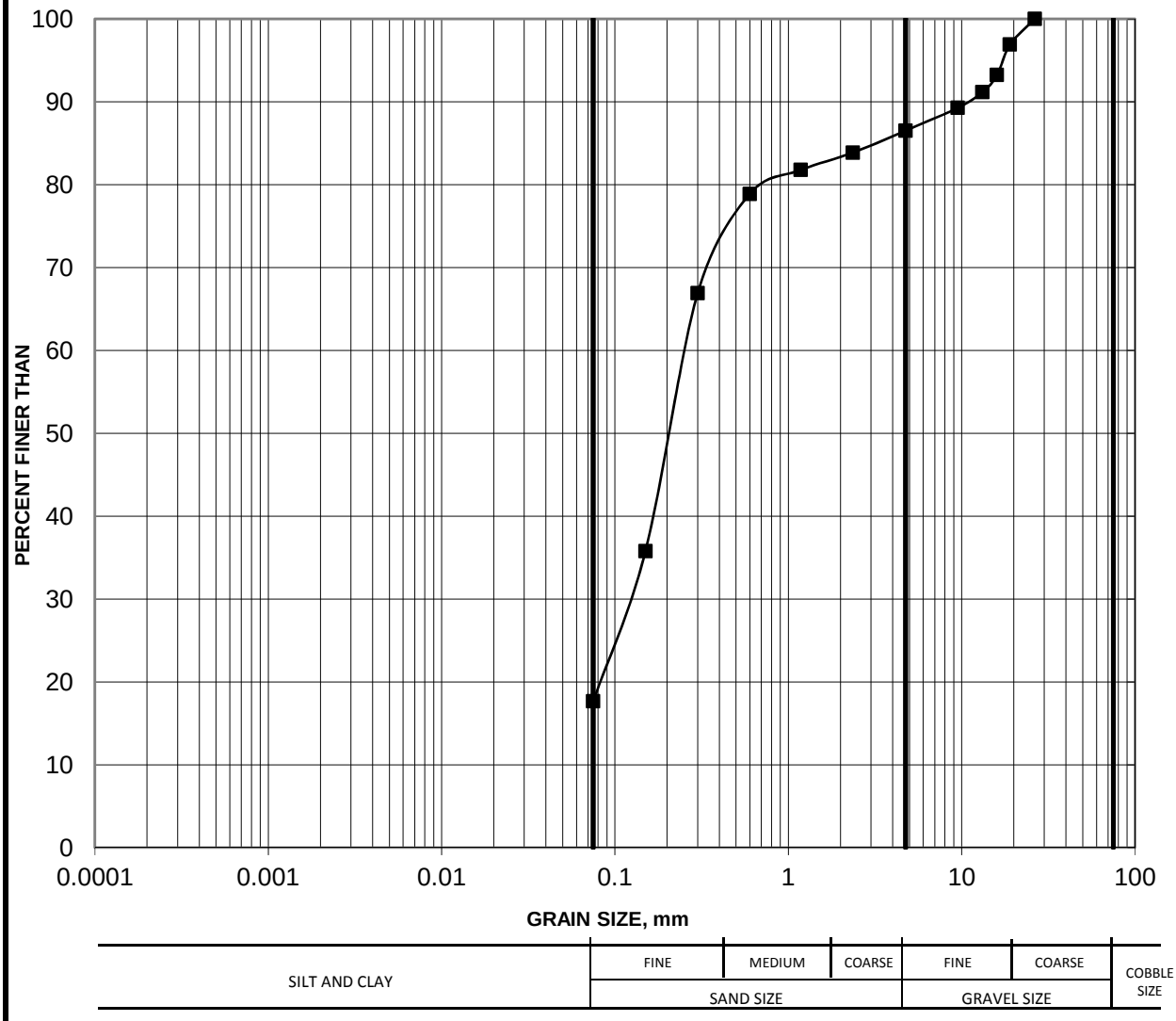
FIG No. B8

Project No. 1655214/1900

Compiled By : KP Checked By : MI

GRAIN SIZE DISTRIBUTION	FIGURE B9

RETAINING WALL 1S: SAND (FILL)



Borehole	Sample	Depth (m)
19-901	2	0.56-0.84

Project: 1655214/1900

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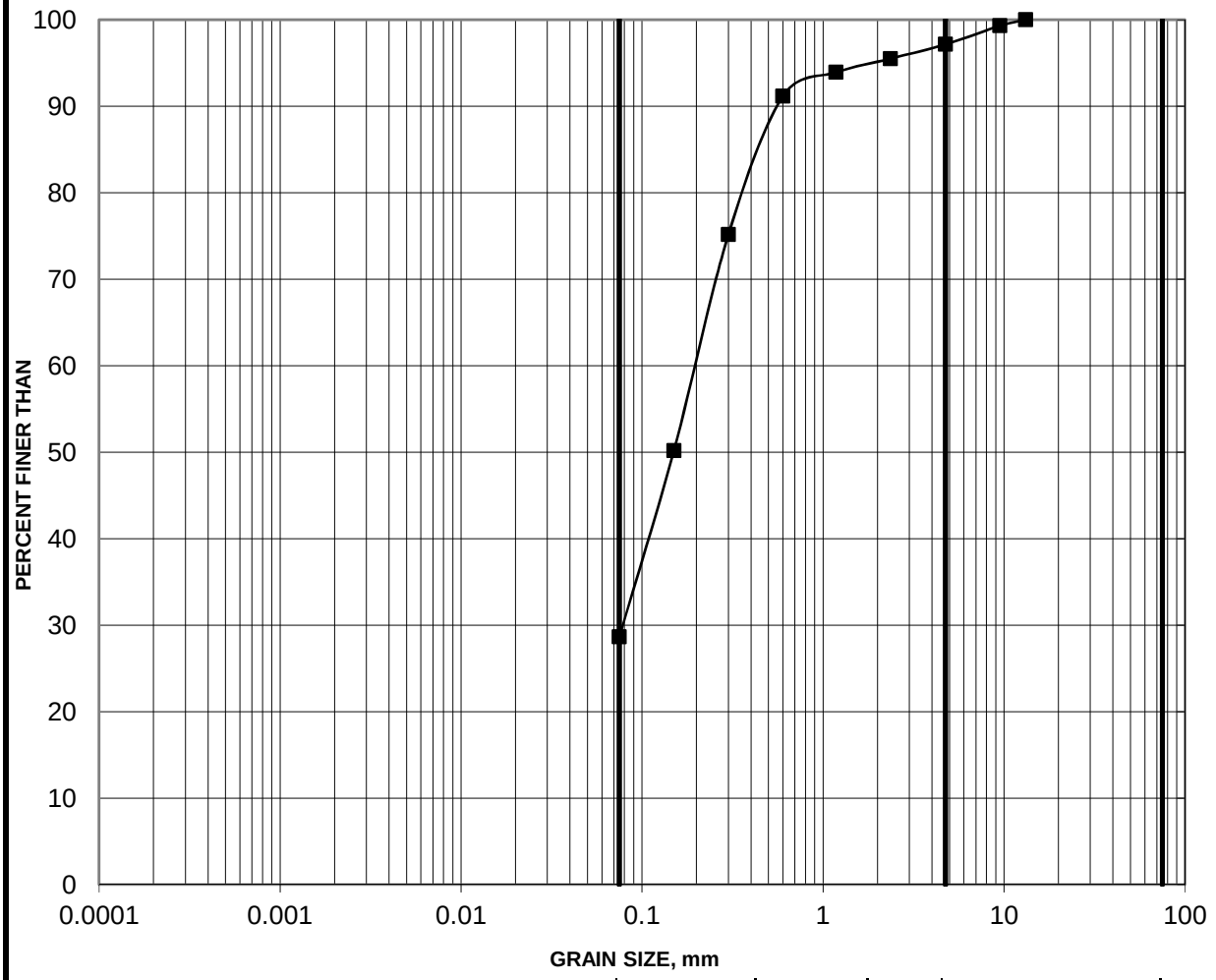
Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B10

RETAINING WALL 1S: SILTY SAND



Borehole	Sample	Depth (m)
18-901	5	3.05-3.66

Project: 1655214/1900

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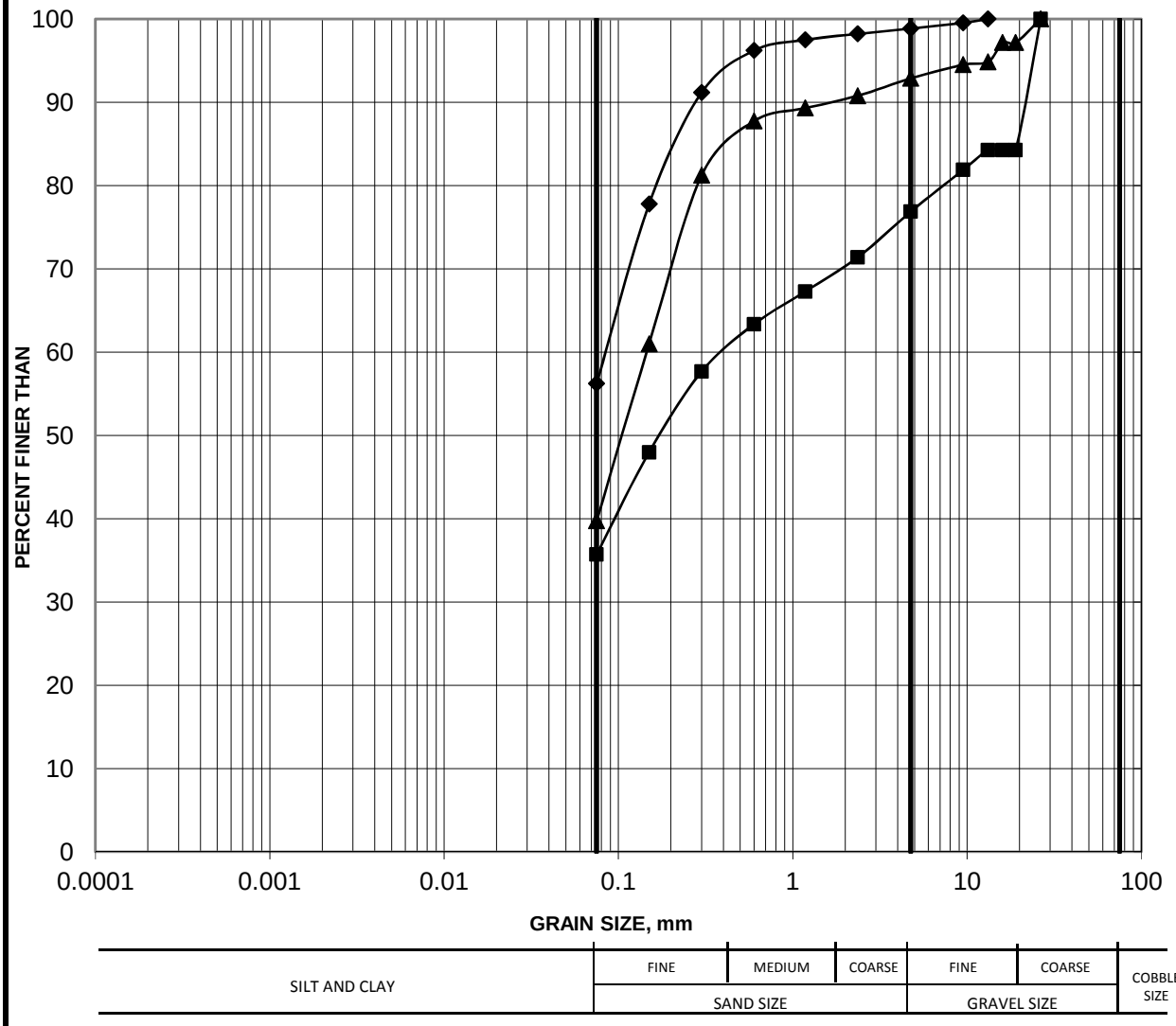
Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B11

RETAINING WALL 1S: GLACIAL TILL



Borehole	Sample	Depth (m)
18-901	8	5.49-5.94
18-902	5	4.57-5.18
18-902	6	5.33-5.94

Project: 1655214/1900

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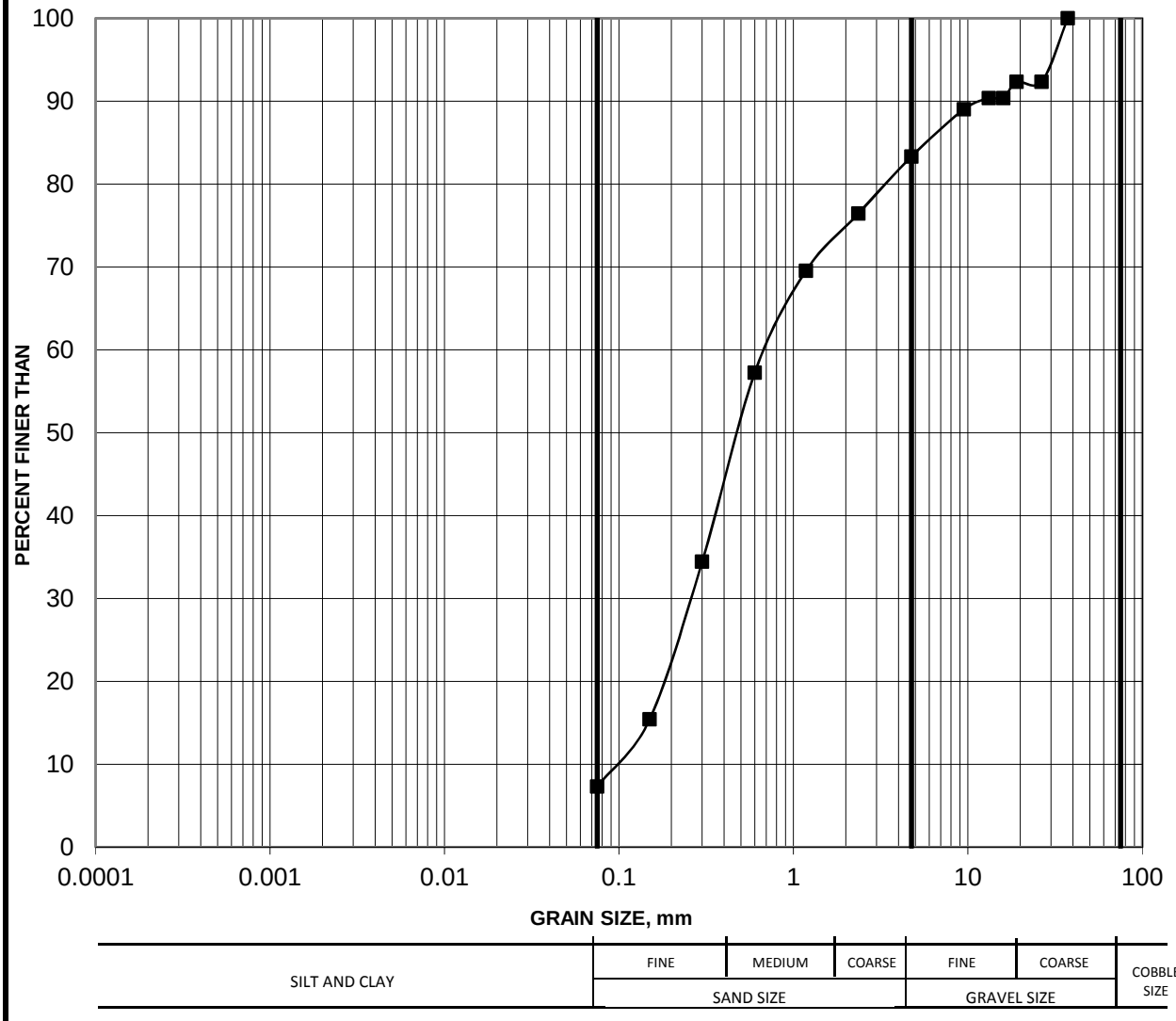
Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B12

RETAINING WALL 2S: SAND (FILL)



Borehole	Sample	Depth (m)
18-904	2A	0.61-1.13

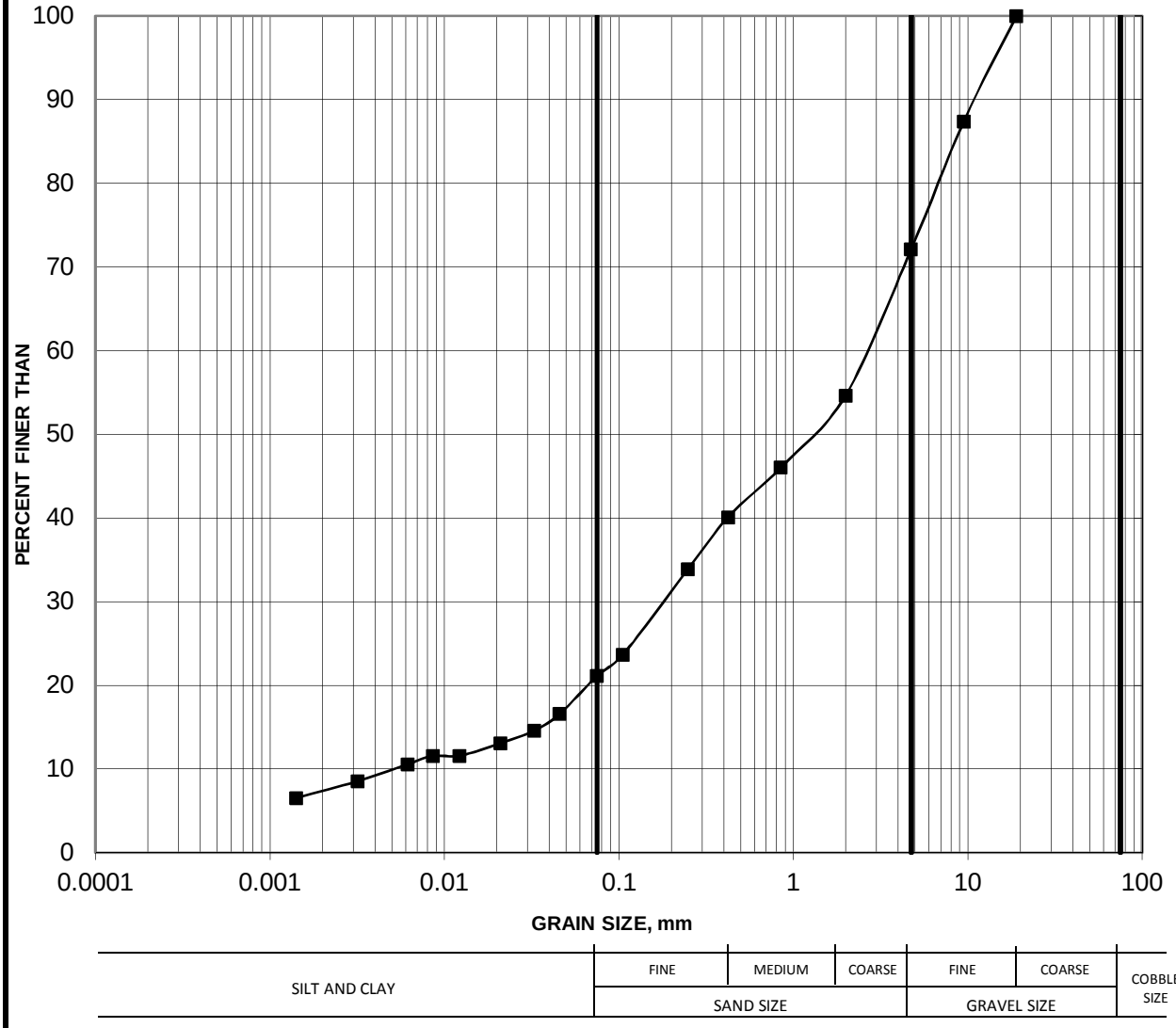
Project: 1655214/1900

Golder Associates

Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B13

RETAINING WALL 2S: GLACIAL TILL



Borehole	Sample	Depth (m)
18-904	5	2.7-3.35

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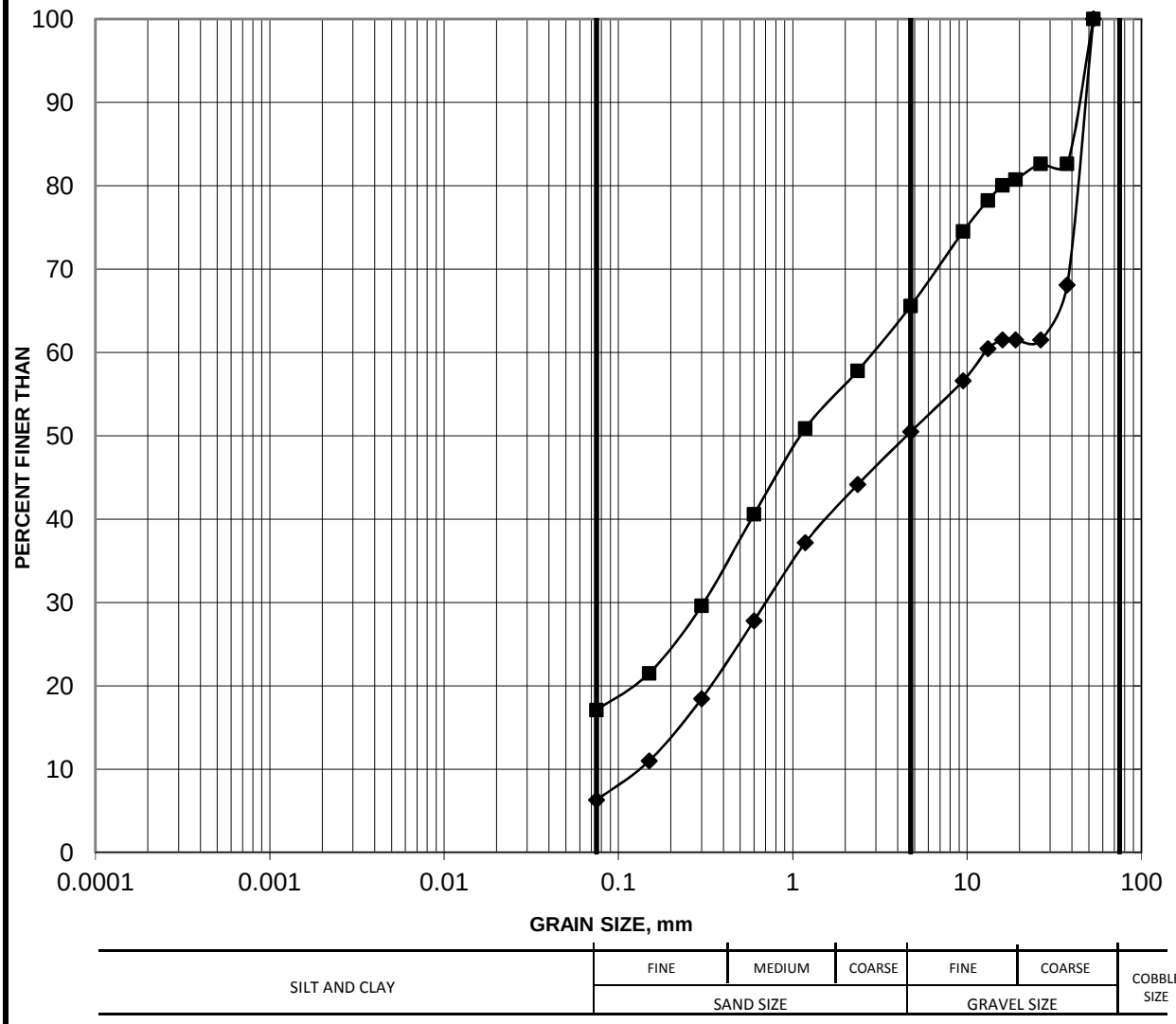
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B14

RETAINING WALL 4S: GRAVEL AND SAND (FILL)



Borehole	Sample	Depth (m)
18-910	2	2.00-2.50
18-911	3	2.40-2.60

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Golder Associates

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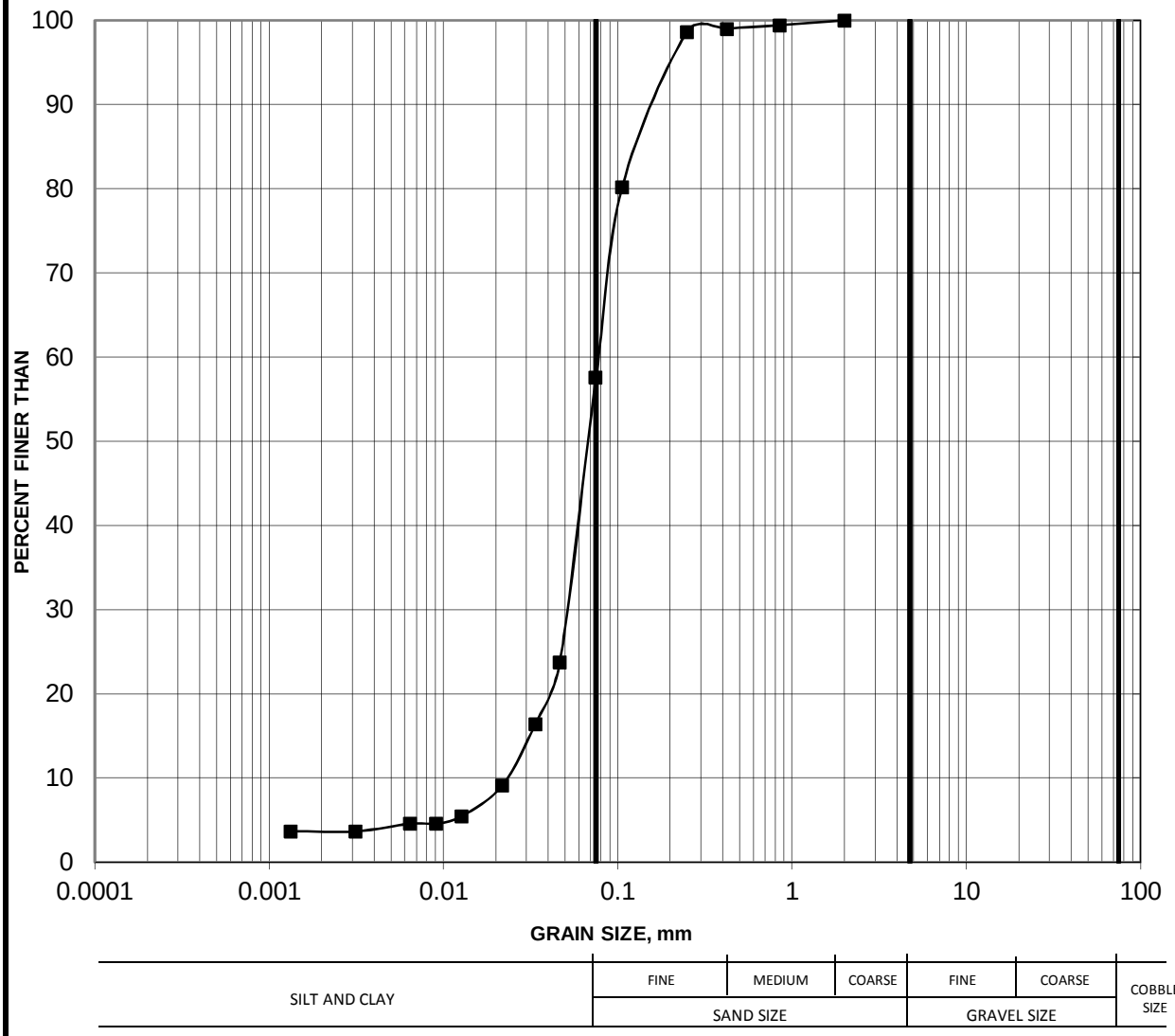
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B15

RETAINING WALL 4S: SILT AND SAND



Borehole	Sample	Depth (m)
18-910	3	3.05-3.66

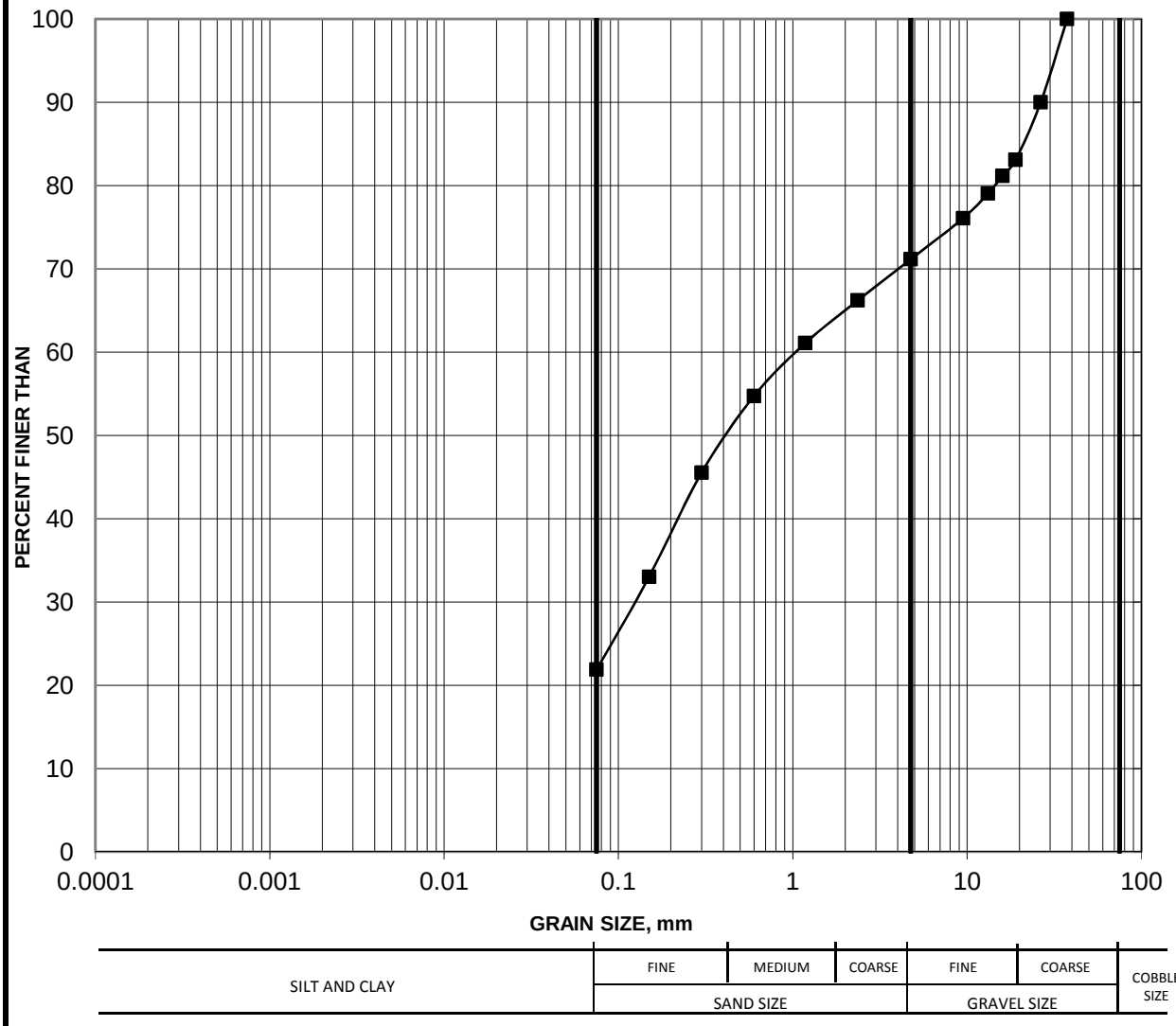
Project: 1655214/1900

Golder Associates

Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B16

RETAINING WALL 5S: SILTY SAND (FILL)



Borehole	Sample	Depth (m)
18-912	2	0.30-0.76

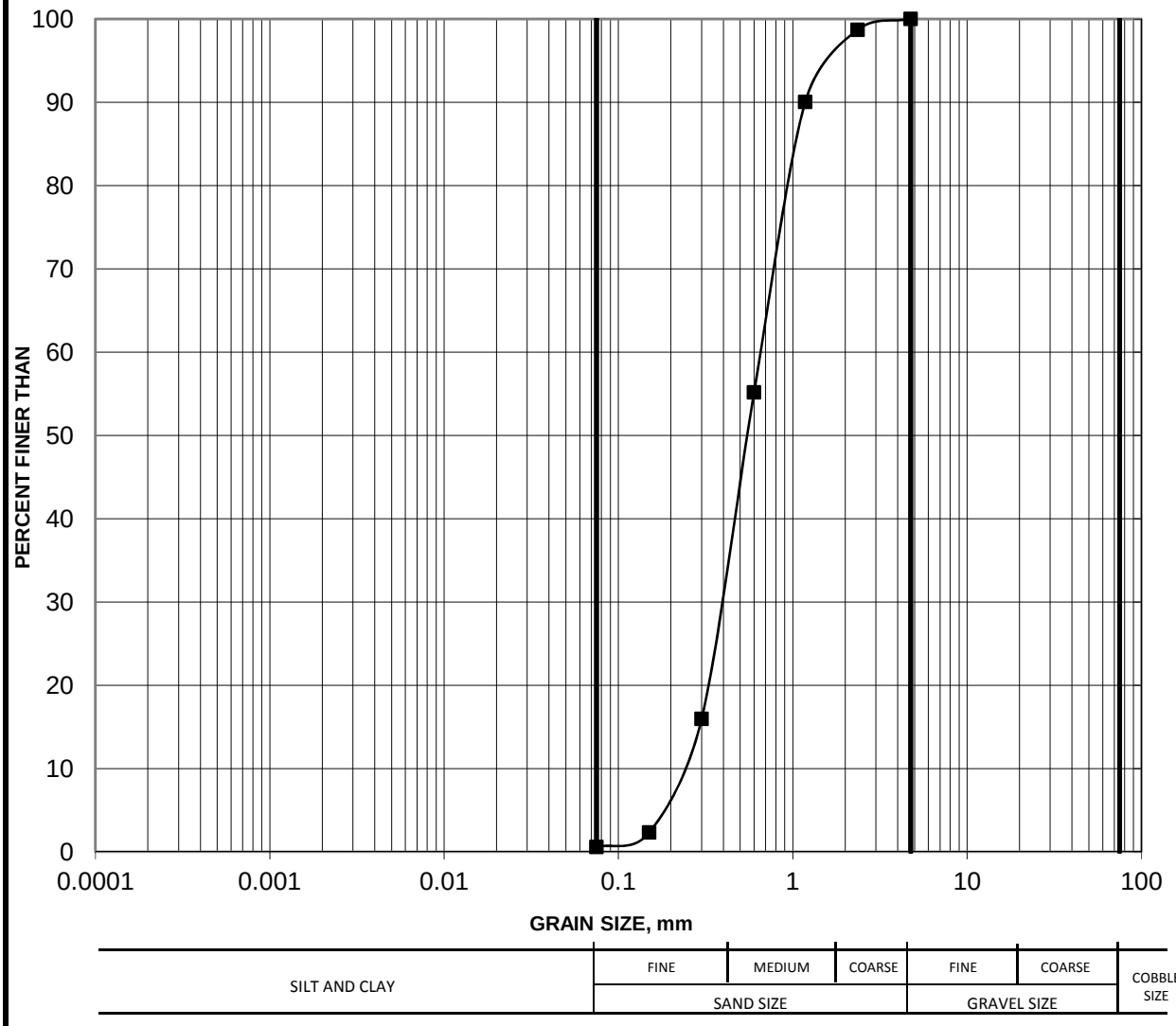
Project: 1655214/1900

Golder Associates

Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B17

RETAINING WALL 7S: SAND (FILL)



Borehole	Sample	Depth (m)
18-917	2	0.80-0.12

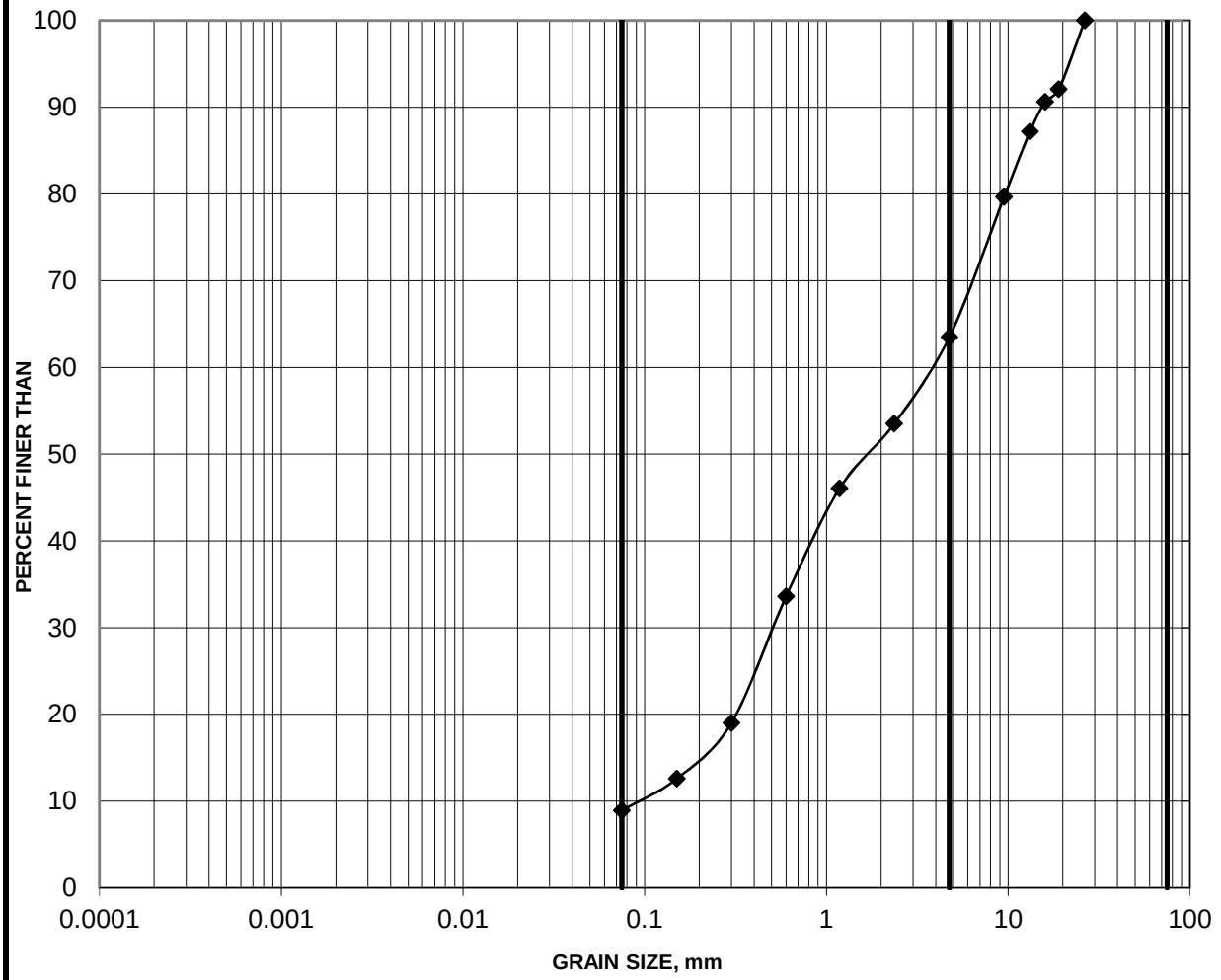
Project: 1655214/1900

Golder Associates

Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B18

RETAINING WALL 7S: SAND AND GRAVEL (FILL)



Borehole	Sample	Depth (m)
18-918	3	2.00-2.65

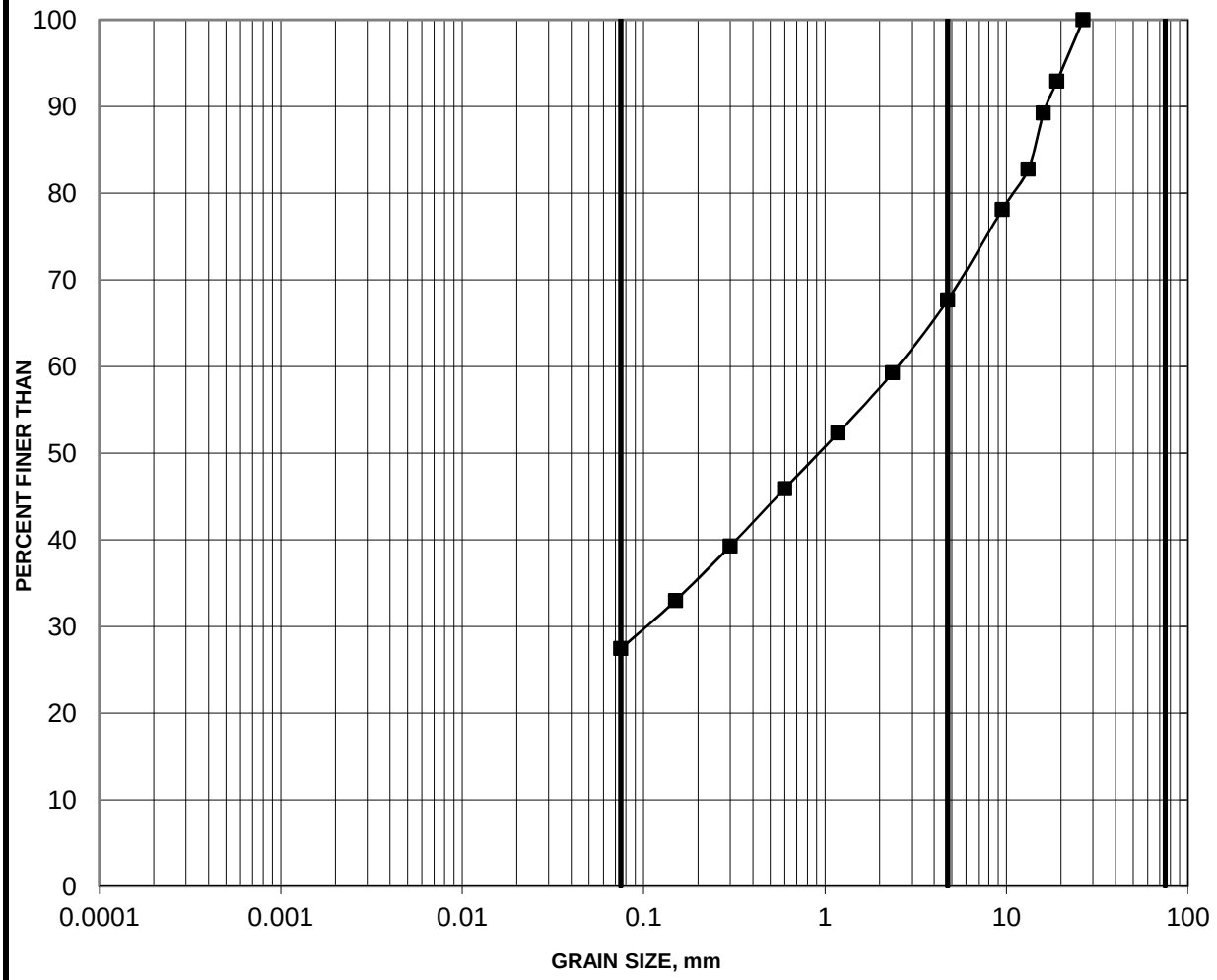
Project: 1655214/1900

Golder Associates

Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B19

RETAINING WALL 7S: GRAVELLY SILTY SAND (FILL)



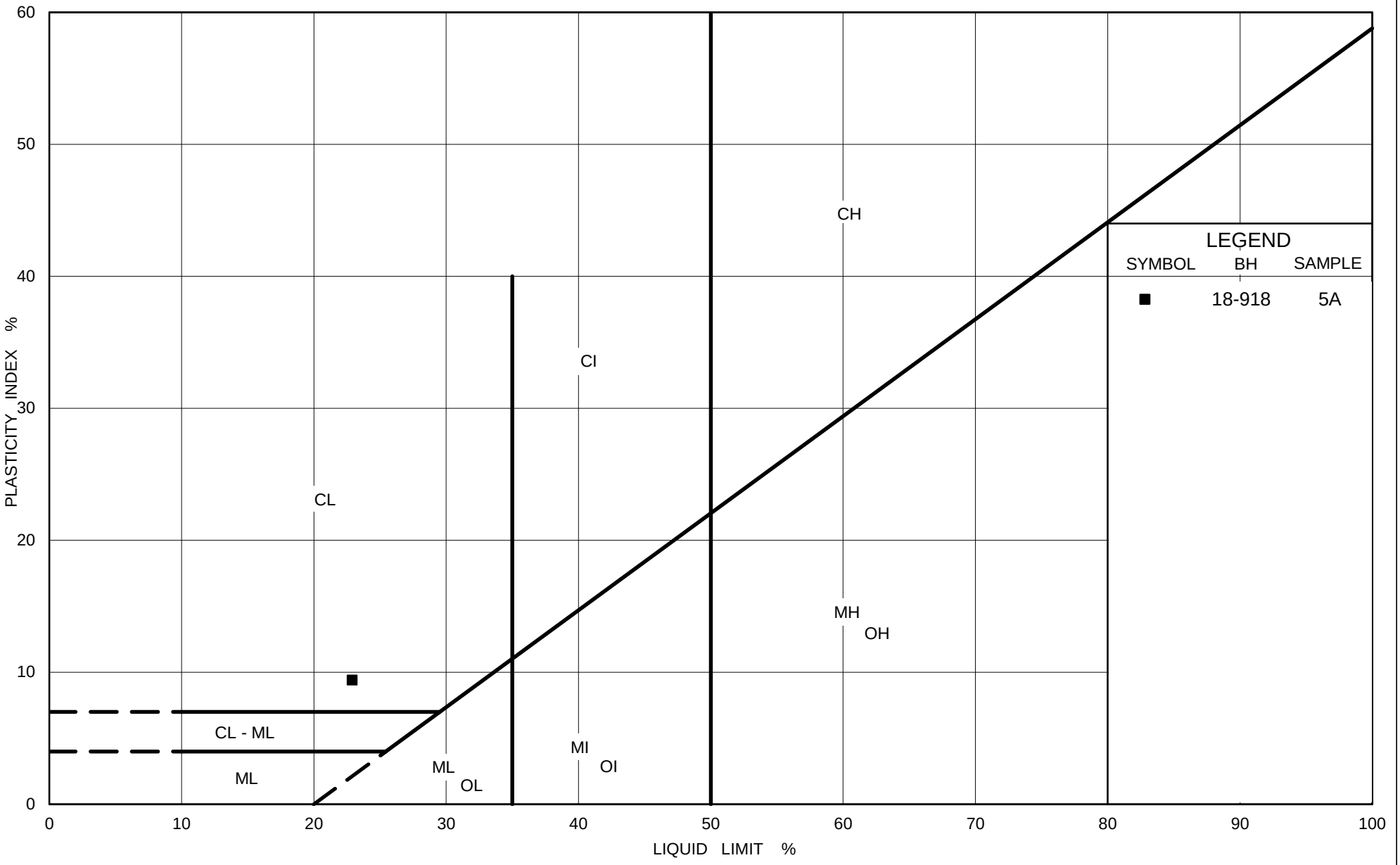
Borehole	Sample	Depth (m)
18-916	3	3.81-4.42

Project: 1655214/1900

Golder Associates

Created by: KP
Checked by: MI

Oct 75, FF-S-21



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PLASTICITY CHART

FIG No. B20

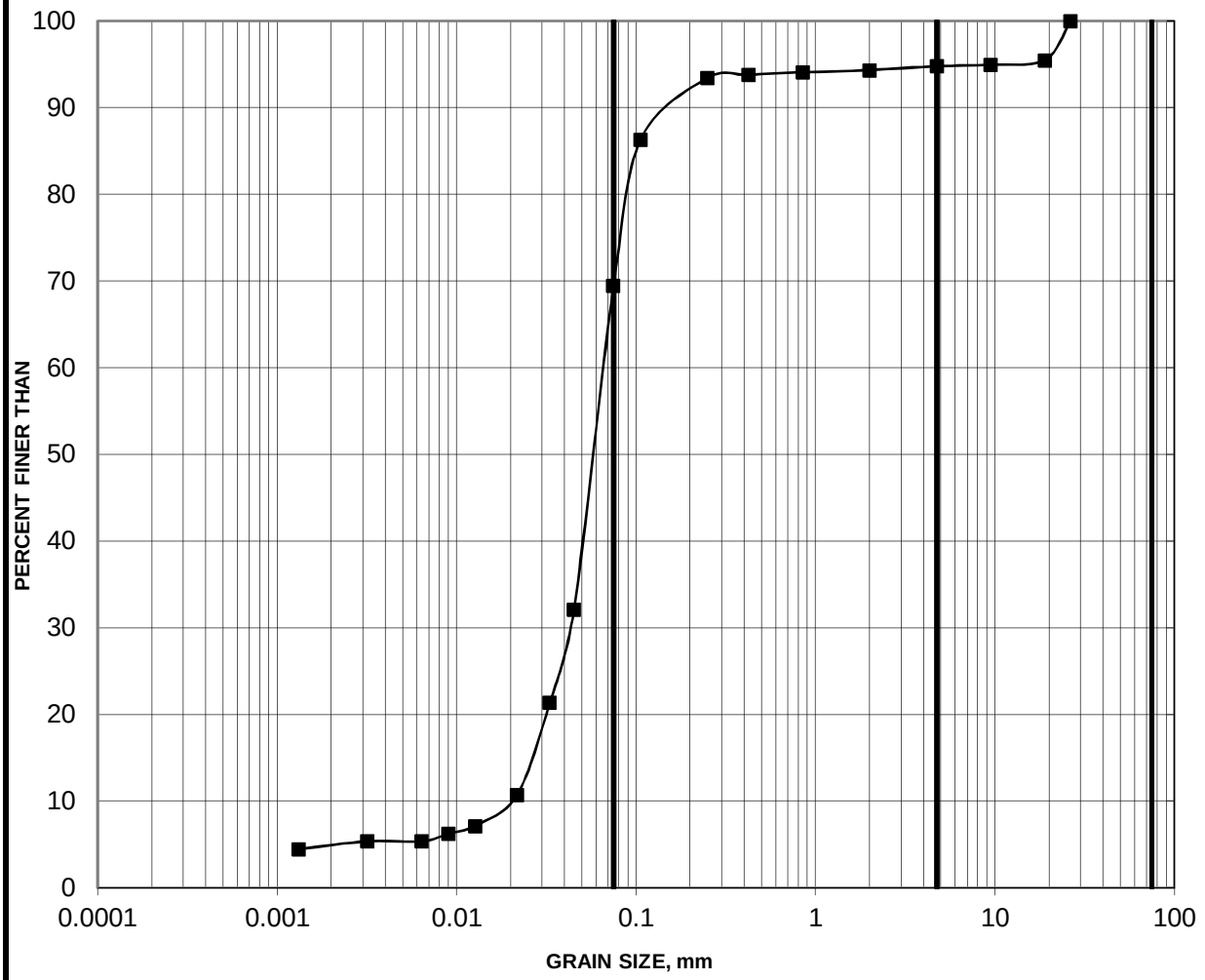
Project No. 1655214/1900

Compiled By : KP Checked By : MI

GRAIN SIZE DISTRIBUTION

FIGURE B21

RETAINING WALL 7S: SANDY SILT



Borehole	Sample	Depth (m)
18-918	6	3.81-4.42

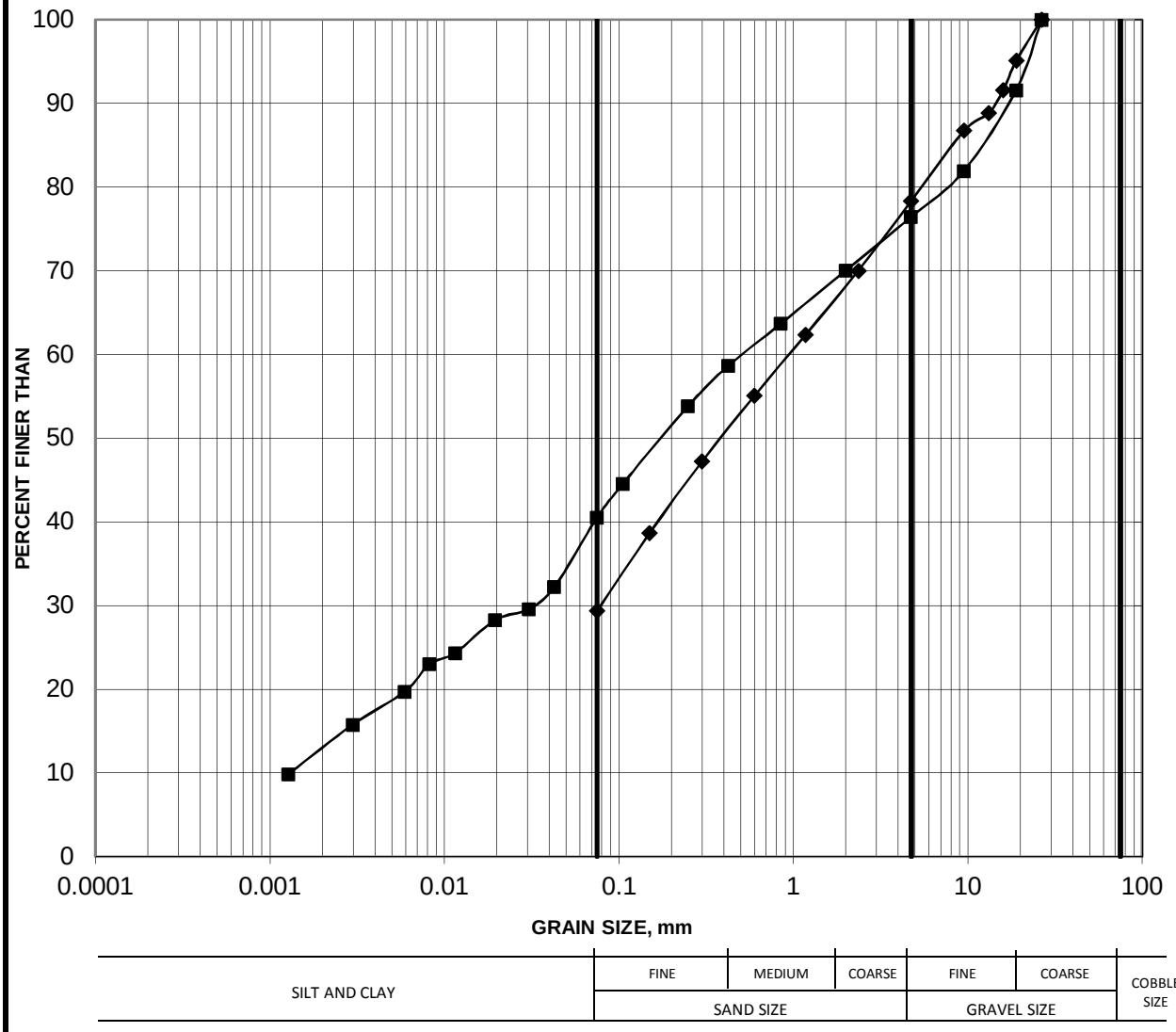
Project: 1655214/1900

Golder Associates

Created by: KP
Checked by: MI

GRAIN SIZE DISTRIBUTION	FIGURE B22

RETAINING WALL 7S: GLACIAL TILL



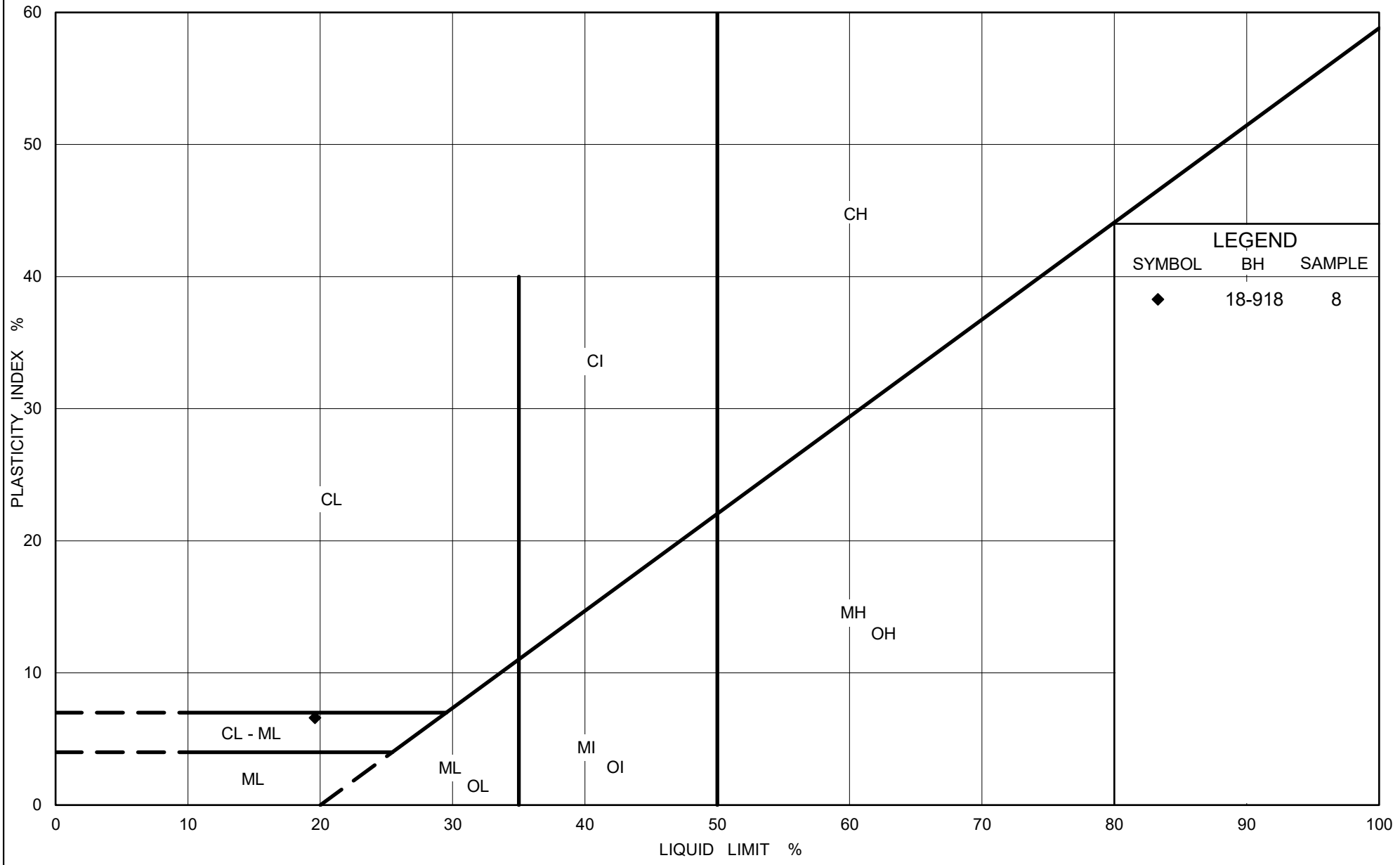
Borehole	Sample	Depth (m)
18-917	7	4.57-5.18
18-917	10	6.86-7.16

Project: 1655214/1900

Golder Associates

Created by: MI
Checked by: CW

Oct 75, FF-S-21



Ministry of Transportation

Ontario

PLASTICITY CHART

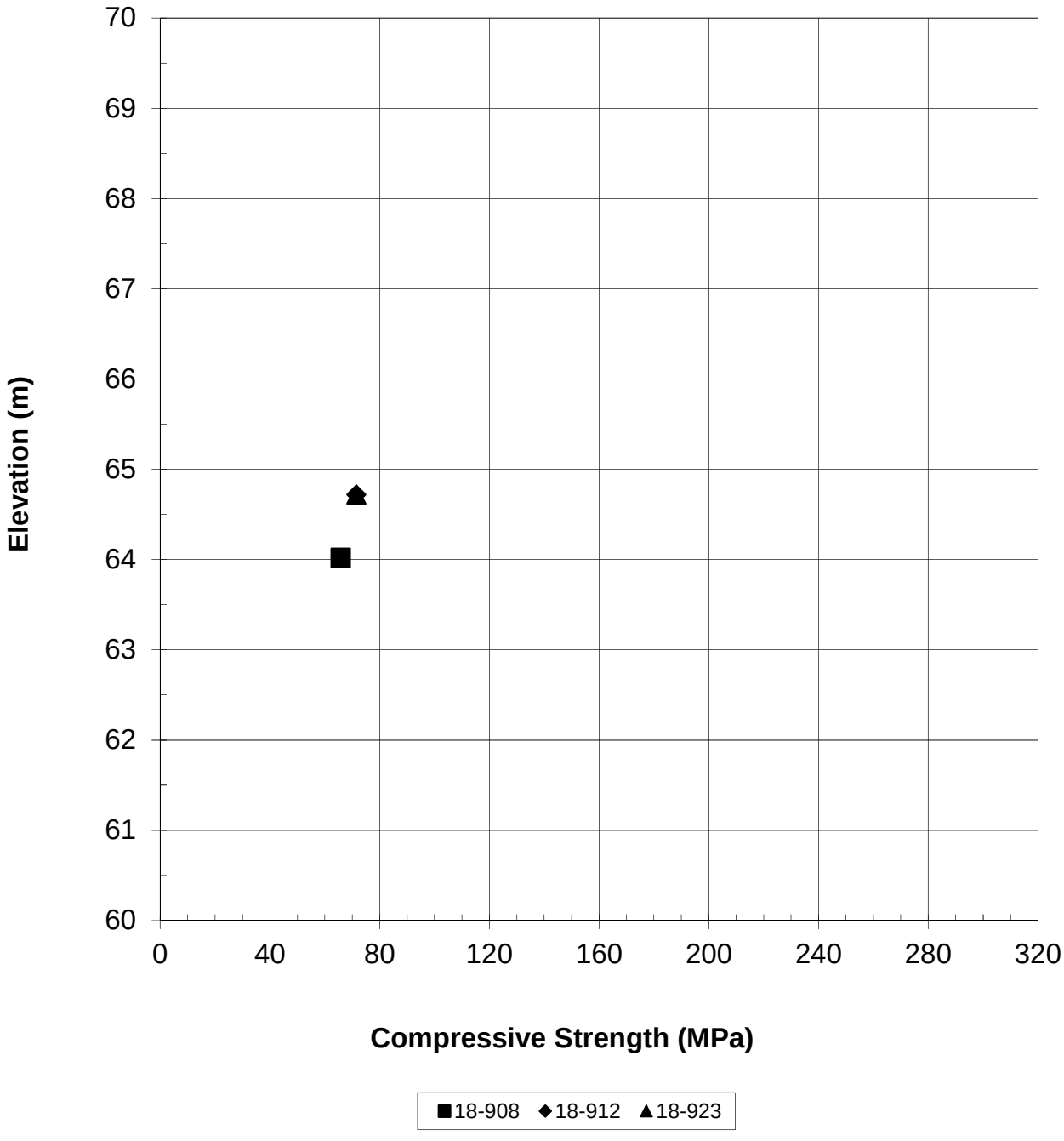
FIG No. B23

Project No. 1655214/1900

Compiled By : KCP Checked By : MI

SUMMARY OF LABORATORY COMPRESSIVE STRENGTH
UNCONFINED COMPRESSION TESTS

FIGURE B24



Project: 1655214/1900

GOLDER

Created by: KP
Checked by: MI

APPENDIX C

Previous Investigations

GEOCRES No. 31G5-308: Record of Boreholes 17-122 to 17-124, 18-1203, 18-1204 and 18-1208

GEOCRES No. 31G5-295: Record of Boreholes 17-114, 18-1103 and 18-1107

GEOCRES No. 31G5-254: Record of Boreholes NB-03 to NB-05, 17S-01 and 17S-02

GOLDER

RECORD OF BOREHOLE No 17-122

SHEET 1 OF 2

METRIC

PROJECT 1655214-1120

G.W.P. 4173-15-00 LOCATION N 5029591.2; E 366891.0 NAD 83 MTM ZONE 9 (LAT. 45.403514; LONG. -75.706847) ORIGINATED BY DWM

DIST Eastern HWY 417 BOREHOLE TYPE Continuous 50 mm Diam. Split Spoon/NQ Core COMPILED BY ZS

DATUM Geodetic DATE April 3, 2017 CHECKED BY KCP

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 × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 25 50 75	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.7	GROUND SURFACE										
0.0 / 66.6	PORTLAND CEMENT CONCRETE (SIDEWALK)										
0.1 / 66.4	(SP) Gravelly sand (FILL) Grey										
0.3	(SP) Sand, some gravel, trace silt (FILL) Compact Grey brown Dry		1	SS	13						
65.7			2	SS	50/0.05						
1.0	Limestone (BEDROCK) Bedrock cored from depths of 1.0 m to 4.2 m. For bedrock coring details refer to Record of Drillhole 17-122		C1	RC	REC 96%		66				RQD = 80%
			C2	RC	REC 99%		65				RQD = 80%
			C3	RC	REC 100%		64				RQD = 90%
62.5							63				
4.2	END OF BOREHOLE										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 6/12/19 JM

PROJECT: 1655214-1120

RECORD OF DRILLHOLE: 17-122

SHEET 2 OF 2

LOCATION: N 5029591.2 ;E 366891.0

DRILLING DATE: April 3, 2017

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: CCC

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES
		Continued from Record of Borehole 17-122		65.72													
1	Rotary Drill / NQ Core	Limestone (BEDROCK), with black shale partings Slightly weathered to fresh Thinly to medium bedded Grey Fine grained Non-porous Medium strong to strong		0.96	C1	0											
2																	
3					C2	0											
4					C3	0											
				62.47													
		END OF DRILLHOLE		4.21													
5																	

DEPTH SCALE
1 : 25

GOLDER

LOGGED: DWM
CHECKED: KCP

GOLDER

RECORD OF BOREHOLE No 17-123

SHEET 1 OF 2

METRIC

PROJECT 1655214-1120

G.W.P. 4173-15-00 LOCATION N 5029627.2; E 366858.8 NAD 83 MTM ZONE 9 (LAT. 45.403840; LONG. -75.707255) ORIGINATED BY KM

DIST Eastern HWY 417 BOREHOLE TYPE Hydro-excavation/NQ Core COMPILED BY ZS

DATUM Geodetic DATE April 6/10, 2017 CHECKED BY KCP

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 × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 25 50 75	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.3	GROUND SURFACE										
0.0 / 66.2	PORTLAND CEMENT CONCRETE (SIDEWALK)										
0.1 / 66.0	(SP) Gravelly sand (FILL) Grey										
0.3 / 65.5	(SP) Sand, trace gravel and silt, contains organic matter (FILL) Brown Moist		1	GRAB	-		66				
0.8 / 65.2	(GP) Gravel and cobbles (FILL)		2	RC	DD						
1.2	Limestone (BEDROCK) Bedrock cored from depths of 1.2 m to 4.8 m For bedrock coring details refer to Record of Drillhole 17-123		C1	RC	REC 65%		65				RQD = 0%
			C2	RC	REC 95%						RQD = 77%
			C3	RC	REC 99%		64				RQD = 92%
			C4	RC	REC 97%		63				RQD = 97%
61.5							62				
4.8	END OF BOREHOLE										

$+^3, \times^3$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 6/12/19 JM

PROJECT: 1655214-1120

RECORD OF DRILLHOLE: 17-123

SHEET 2 OF 2

LOCATION: N 5029627.2 ;E 366858.8

DRILLING DATE: April 6/10, 2017

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: CCC

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES
		Continued from Record of Borehole 17-123		65.19													
2	Rotary Drill NQ Core	Limestone (BEDROCK), with black shale partings Slighlty weathered to fresh Thinly to medium bedded Grey Fine grained Non-porous Medium strong to strong		1.15	C1	70											
					C2	95											
3					C3	100											
4					C4	100											
				61.54													
		END OF DRILLHOLE		4.80													
5																	
6																	

HYDRAULIC CONDUCTIVITY K, cm/sec: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WEATHERING INDEX: W1 W2 W3 W4 W5 W6

DEPTH SCALE
1 : 25

GOLDER

LOGGED: KM
CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-MISS.GDT 6/12/19 JM

GOLDER

RECORD OF BOREHOLE No 17-124

SHEET 1 OF 2

METRIC

PROJECT 1655214-1120

G.W.P. 4173-15-00 LOCATION N 5029631.8; E 366873.5 NAD 83 MTM ZONE 9 (LAT. 45.403880; LONG. -75.707066) ORIGINATED BY DWM

DIST Eastern HWY 417 BOREHOLE TYPE Hydro-excavation/NQ Core COMPILED BY ZS

DATUM Geodetic DATE April 6/10, 2017 CHECKED BY KCP

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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.4	GROUND SURFACE										
0.0 66.2	PORTLAND CEMENT CONCRETE										
66.1	(SP) Gravelly sand (FILL) Grey										
0.3 65.7	(SP-SM) Sand, some gravel, trace silt (FILL) Moist		1	GRAB	-		66		○		11 78 9 2
0.7 65.5	(GP) Gravel and cobbles (FILL)		2	GRAB	-						
0.9	Limestone (BEDROCK) Bedrock cored from depths 0.9 m to 4.4 m For bedrock coring details refer to Record of Drillhole 17-124		C1	RC	REC 96%	▼	65			UCS = 36 MPa	RQD = 69%
			C2	RC	REC 96%		64				RQD = 94%
			C3	RC	REC 100%		63				RQD = 100%
62.0							62				
4.4	END OF BOREHOLE NOTES: 1. Water level in well screen at a depth of 2.2 m below ground surface (Elev. 64.2 m), measured on October 27, 2017.										

+ ^{3}, × ^{3}: Numbers refer to Sensitivity ○ $^{3\%}$ STRAIN AT FAILURE

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PROJECT: 1655214-1120

RECORD OF DRILLHOLE: 17-124

SHEET 2 OF 2

LOCATION: N 5029631.8 ;E 366873.5

DRILLING DATE: April 6/10, 2017

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: CCC

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH-ERING INDEX	FEATURES
		Continued from Record of Borehole 17-124		65.46													
1	Rotary Drill NQ Core	Limestone (BEDROCK), with black shale partings Slighlty weathered to fresh Thinly to medium bedded Grey Fine grained Non-porous Medium strong to strong		0.89	C1	85											
2					C2	100											
3																	
4					C3	100											
				61.91													
		END OF DRILLHOLE		4.44													
5																	

DEPTH SCALE
1 : 25

GOLDER

LOGGED: DWM
CHECKED: KCP

GOLDER

RECORD OF BOREHOLE No 18-1203

SHEET 1 OF 2

METRIC

PROJECT 1655214-1120

G.W.P. 4173-15-00

LOCATION N 5029632.6; E 366880.7 NAD 83 MTM ZONE 9 (LAT. 45.403880; LONG. -75.706970)

ORIGINATED BY RI

DIST Eastern HWY 417

BOREHOLE TYPE Rotary Drill/Wash Boring, HW Casing/HQ Core

COMPILED BY ZS

DATUM Geodetic

DATE April 15, 2019

CHECKED BY KCP

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 × REMOULDED)	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
68.7	GROUND SURFACE										
0.0	(SW) Sand (FILL) Brown Moist		1	SS	1						
			2	SS	1		68		○		1 96 (3)
			3	SS	1		67				
66.7											
2.0	(SM/ML) Silty sand to sandy silt, some gravel, contains wood, mortar, organic matter, brick and cobbles (FILL) Compact		4	SS	12						
66.1			5	SS	50/0.10						
2.6	Black to dark brown Moist to wet		1	RC	-		66				
	PORTLAND CEMENT CONCRETE (FOOTING)		2A	RC	-						
65.0											
3.7	Limestone (BEDROCK) Bedrock cored from depths 3.7 m to 5.5 m For bedrock coring details refer to Record of Drillhole 18-1203		2B	RC	REC 100%		65				RQD = 96%
			3	RC	REC 74%		64				RQD = 52%
63.2			4	RC	REC 100%					UCS = 74 MPa	RQD = 100%
5.5	END OF BOREHOLE NOTE: 1. A reduced SPT hammer drop of 0.61 m was used for all split spoon samples "N" values are not representative of ASTM D1586 SPTN and should be interpreted in consideration of this reduced energy.										

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

$\circ^{3\%}$ STRAIN AT FAILURE

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PROJECT: 1655214-1120

RECORD OF DRILLHOLE: 18-1203

SHEET 2 OF 2

LOCATION: N 5029632.6 ;E 366880.7

DRILLING DATE: April 15, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: EXPLO 220

DRILLING CONTRACTOR: Marathon Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH-ERING INDEX	FEATURES
		Continued from Record of Borehole 18-1203		66.10													
3	Rotary Drill / HQ Rod	PORTLAND CEMENT CONCRETE (FOOTING)		2.60	1												
					2A												
				65.03													
4	Rotary Drill / NQ Core	Limestone (BEDROCK), with fresh, thin laminations to thin beds, black, fine grained shale partings Fresh Thinly to medium bedded Grey to brown Fine to medium grained Non-porous Medium strong		3.67	2B	100											
					3	100											
5					4	100											
				63.20													
		END OF DRILLHOLE		5.50													
6																	
7																	
8																	
9																	
10																	
11																	
12																	

DEPTH SCALE
1 : 50

GOLDER

LOGGED: RI
CHECKED: KCP

GTA-RCK 031 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-MISS.GDT 6/12/19 JM

GOLDER

RECORD OF BOREHOLE No 18-1204

SHEET 1 OF 2

METRIC

PROJECT 1655214-1120

G.W.P. 4173-15-00

LOCATION N 5029597.6; E 366900.1 NAD 83 MTM ZONE 9 (LAT. 45.403560; LONG. -75.706730)

ORIGINATED BY RI/RK

DIST Eastern HWY 417

BOREHOLE TYPE Rotary Drill/Wash Boring, NW Casing/NQ Core

COMPILED BY ZS

DATUM Geodetic

DATE April 10, 2019

CHECKED BY KCP

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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
70.5	GROUND SURFACE										
0.0 / 69.9	(SM) Silty sand, contains organic matter (FILL) Brown to dark brown Moist		1	SS	3		70				
0.6	(SW) Sand (FILL) Brown Moist to wet		2	SS	2		69				
67.3			3	SS	1		68		○		3 94 (3)
3.2 / 66.7	BOULDER						67				
3.8 / 66.2	(SW) Sand, contains cobbles (FILL) Brown Moist to wet		1	RC	-						
4.3 / 65.2	PORTLAND CEMENT CONCRETE (FOOTING)		2A	RC	-		66				
5.3	Limestone (BEDROCK)		2B	RC	REC 100%						RQD = 0%
	Bedrock cored from depths 5.3 m to 7.1 m For bedrock coring details refer to Record of Drillhole 18-1204		3	RC	REC 93%		65			UCS = 70 MPa	RQD = 81%
63.4			4	RC	REC 100%		64				RQD = 100%
7.1	END OF BOREHOLE NOTE: 1. A reduced SPT hammer drop of 0.61 m was used for all split spoon samples "N" values are not representative of ASTM D1586 SPTN and should be interpreted in consideration of this reduced energy.										

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

$\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 6/12/19 JM

PROJECT: 1655214-1120

RECORD OF DRILLHOLE: 18-1204

SHEET 2 OF 2

LOCATION: N 5029597.6 ;E 366900.1

DRILLING DATE: April 10, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: EXPLO 220

DRILLING CONTRACTOR: Marathon Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES
		Continued from Record of Borehole 18-1204		66.15													
		PORTLAND CEMENT CONCRETE (FOOTING)		4.34	1												
5					2A												
				65.15													
	Rotary Drill NQ Core	Limestone (BEDROCK), with black, fine grained shale partings Fresh Thinly to medium bedded Grey to brown Fine to medium grained Non-porous Medium strong		5.34	2B	0											
6					3	0											
					4	0											
7				63.43													
		END OF DRILLHOLE		7.06													
8																	
9																	
10																	
11																	
12																	
13																	
14																	

HYDRAULIC CONDUCTIVITY K, cm/sec: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WEATHERING INDEX: W1 W2 W3 W4 W5 W6

DEPTH SCALE
1 : 50

GOLDER

LOGGED: RI/RK
CHECKED: KCP

GOLDER

RECORD OF BOREHOLE No 18-1208

SHEET 1 OF 1 **METRIC**

PROJECT 1655214-1120
G.W.P. 4173-15-00
DIST Eastern HWY 417
DATUM Geodetic

LOCATION N 5029602.4; E 366898.5 NAD 83 MTM ZONE 9 (LAT. 45.403610; LONG. -75.706750)
BOREHOLE TYPE Power Auger, 200 mm Diam. (Hollow Stem)
DATE October 9, 2018

ORIGINATED BY DJG
COMPILED BY ZS
CHECKED BY KCP

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 × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 25 50 75	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
72.9	GROUND SURFACE										
0.0	ASPHALTIC CONCRETE										
72.5	PORTLAND CEMENT CONCRETE, with rebar										
0.4	(SP/GP) Sand and gravel (FILL) Grey		1	GS	-						
72.1	Moist										
0.8	(SP) Sand, trace silt and gravel (FILL) Very dense to compact Brown Dry		2	SS	55		72		○		
			3	SS	51		71				
			4	SS	52				○		
			5	SS	35		70				
			6	SS	39		69				
			7	SS	12		68		○		2 96 (2)
67.6											
5.3	(CL) Sandy clayey silt (FILL) Firm Brown Moist		8	SS	2				○		2 45 32 21
67.0							67				
5.9	(SP) Sand, trace silt (FILL) Very loose to compact Brown Moist		9	SS	2						
			10	SS	24		66		○		
65.3											
7.6	END OF BOREHOLE AUGER REFUSAL										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 N:\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-GTA.GDT 6/12/19 JM

GOLDER

RECORD OF BOREHOLE No 17-114

SHEET 1 OF 2

METRIC

PROJECT 1655214-1110

G.W.P. 4173-15-00 LOCATION N 5029598.8; E 366753.0 NAD 83 MTM ZONE 9 (LAT. 45.403594; LONG. -75.708610) ORIGINATED BY DWM

DIST Eastern HWY 417 BOREHOLE TYPE Hydro-excavation/NQ Core COMPILED BY ZS

DATUM Geodetic DATE April 6/7, 2017 CHECKED BY KCP

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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
63.8	GROUND SURFACE										
0.0 / 63.7	PORTLAND CEMENT CONCRETE (SIDEWALK)										
0.1	(GP/SP) Gravel and sand, trace silt (FILL) Grey Moist		1	GRAB	-				○		53 42 4 1
62.7							63				
1.1	Limestone (BEDROCK) Bedrock cored from depths 1.1 m to 4.8 m For bedrock coring details refer to Record of Drillhole 17-114		C1	RC	REC 56%					UCS = 60 MPa	RQD = 13%
							62				
			C2	RC	REC 100%						RQD = 87%
							61				
			C3	RC	REC 91%						RQD = 54%
							60				
59.0 / 4.8							59				

Continued Next Page

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GOLDER

PROJECT 1655214-1110

RECORD OF BOREHOLE No 17-114

SHEET 2 OF 2

METRIC

G.W.P. 4173-15-00 LOCATION N 5029598.8; E 366753.0 NAD 83 MTM ZONE 9 (LAT. 45.403594; LONG. -75.708610) ORIGINATED BY DWM

DIST Eastern HWY 417 BOREHOLE TYPE Hydro-excavation/NQ Core COMPILED BY ZS

DATUM Geodetic DATE April 6/7, 2017 CHECKED BY KCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 25 50 75	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	--- CONTINUED FROM PREVIOUS PAGE ---										
	END OF BOREHOLE NOTES: 1. Water level in well screen at a depth of 1.8 m below ground surface (Elev. 62.0 m), measured on April 26, 2017.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 1655214-1110

RECORD OF DRILLHOLE: 17-114

SHEET 2 OF 2

LOCATION: N 5029598.8 ;E 366753.0

DRILLING DATE: April 6/7, 2017

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 45

DRILLING CONTRACTOR: CCC

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER (5 10 15 20)	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WEATHERING INDEX (W1 W2 W3 W4 W5 W6)	FEATURES
		Continued from Record of Borehole 17-117		62.73													
2	Rotary Drill / NQ Core	Limestone (BEDROCK), with black shale partings Fresh to slightly weathered Thinly to medium bedded Grey Fine grained Non-porous Strong		1.10	C1	0											UCS = 60 MPa
3					C2	0											
4					C3	0											
				59.00													
5		END OF DRILLHOLE		4.83													
6																	

DEPTH SCALE
1 : 25

GOLDER

LOGGED: DWM
CHECKED: KCP

GTA-RCK 031 \\GOLDER.GDS\GAL\OTTAWA\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-MISS.GDT 19-8-1 JM

GOLDER

RECORD OF BOREHOLE No 18-1103

SHEET 1 OF 2

METRIC

PROJECT 1655214-1110

G.W.P. 4173-15-00 LOCATION N 5029598.0; E 366763.5 NAD 83 MTM ZONE 9 (LAT. 45.403580; LONG. -75.708470) ORIGINATED BY RI

DIST Eastern HWY 417 BOREHOLE TYPE Rotary Drill, HW Casing/HQ Core COMPILED BY ZS

DATUM Geodetic DATE April 16, 2019 CHECKED BY KCP

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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (25 50 75)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
66.3	GROUND SURFACE										
0.0	(SW) Sand (FILL) Brown Moist		1	SS	4		66				
65.1											
1.2	(SM) Gravelly silty sand, contains brick (FILL) Brown Moist to wet		2	SS	13		65				
64.5											
1.8	PORTLAND CEMENT CONCRETE (FOOTING)		1	RC	-						
			2	RC	-		64				
63.0			3A	RC	-						
3.3	Limestone (BEDROCK) Bedrock cored from depths 3.3 m to 4.9 m For bedrock coring details refer to Record of Drillhole 18-1102		3B	RC	REC 96%		63				RQD = 0%
			4	RC	REC 96%						RQD = 59%
			5	RC	REC 98%		62				RQD = 73%
61.4											
4.9	END OF BOREHOLE NOTES: 1. A reduced hammer drop of 0.61 m was used for all split spoon samples. "N" values are not representative of ASTM D1586 SPT N values and should be interpreted in consideration of this reduced energy.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 1655214-1110

RECORD OF DRILLHOLE: 18-1103

SHEET 2 OF 2

LOCATION: N 5029598.0 ;E 366763.5

DRILLING DATE: April 16, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: EXPLO 220

DRILLING CONTRACTOR: Marathon Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATH-ERING INDEX	FEATURES
		Continued from Record of Borehole 18-1103		64.55													
2	Rotary Drill / HQ Core	PORTLAND CEMENT CONCRETE (FOOTING)		1.77	1												
					2												
3					3A												
				63.03													
		Limestone (BEDROCK), with black shale partings Fresh Thinly bedded to medium bedded Grey Fine to medium grained Non-porous Medium strong		3.29	3B	100											
4					4	100											
					5	100											
				61.40													
5		END OF DRILLHOLE		4.92													
6																	
7																	
8																	
9																	
10																	
11																	

DEPTH SCALE
1 : 50

GOLDER

LOGGED: RI
CHECKED: KCP

GTA-RCK 031 \\GOLDER.GDS\GAL\OTTAWA\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-MISS.GDT 19-8-1 JM

GOLDER

RECORD OF BOREHOLE No 18-1107

SHEET 1 OF 2

METRIC

PROJECT 1655214-1110

G.W.P. 4173-15-00 LOCATION N 5029599.8; E 366768.6 NAD 83 MTM ZONE 9 (LAT. 45.403590; LONG. -75.708410) ORIGINATED BY RI

DIST Eastern HWY 417 BOREHOLE TYPE Rotary Drill, HW Casing/HQ Core COMPILED BY ZS

DATUM Geodetic DATE April 17, 2019 CHECKED BY KCP

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 × REMOULDED)	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
68.9	GROUND SURFACE										
0.0	(SW) Sand, some silt, trace gravel (FILL) Dark brown to brown moist to wet		1	SS	7						
			2	SS	2		68		○		4 84 (12)
			3	SS	2		67				
64.9							66				
64.6	(SW) Sand, some gravel, contains cobbles and wood (FILL)		4	SS	50/0.08		65				
4.3	Brown Moist to wet PORTLAND CEMENT CONCRETE (FOOTING)		1	RC	-		64				
63.6			2A	RC	-						
5.3	Limestone (BEDROCK) Bedrock cored from depths 5.3 m to 6.9 m For bedrock coring details refer to Record of Drillhole 18-1107		2B	RC	REC 100%		63				RQD = 82%
62.0			3	RC	REC 97%		62				RQD = 82%
6.9	END OF BOREHOLE										

NOTES:

1. A reduced hammer drop of 0.61 m was used for all split spoon samples. "N" values are not representative of ASTM D1586 SPT N values and should be interpreted in consideration of this reduced energy.

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT: 1655214-1110

RECORD OF DRILLHOLE: 18-1107

SHEET 2 OF 2

LOCATION: N 5029599.8 ;E 366768.6

DRILLING DATE: April 17, 2019

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: EXPLO 220

DRILLING CONTRACTOR: Marathon Drilling

NOTE:
For abbreviations, symbols and descriptions refer to
LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	WEATHERING INDEX	FEATURES
		Continued from Record of Borehole 18-1107		64.62													
5	Rotary Drill HQ Core	PORTLAND CEMENT CONCRETE (FOOTING)		4.27	1												
				63.58	2A												
6		Limestone (BEDROCK), with black shale partings Fresh Thinly to medium bedded Grey to brown Fine to medium grained Non-porous Medium strong		5.31	2B												
				61.96	3												
7		END OF DRILLHOLE		6.93													
8																	
9																	
10																	
11																	
12																	
13																	
14																	

DEPTH SCALE
1 : 50

GOLDER

LOGGED: RI
CHECKED: KCP

GTA-RCK 031 \\GOLDER.GDS\GAL\OTTAWA\ACTIVE\SPATIAL_IMMTO\HWY417REHAB&WIDENING\02_DATA\GINT\1655214.GPJ GAL-MISS.GDT 19-8-1 JM

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17S-01 1 OF 2 METRIC

W.P. 4089-07-01 LOCATION N 5 029 635.1 E 367 009.4 ORIGINATED BY GM

HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2012.07.31 - 2012.07.31 CHECKED BY LRB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
73.7											
0.0	**ASPHALT:** (150mm)										
0.2											
73.3	**CONCRETE:** (200mm)										
0.4	**SAND**, trace gravel, trace silt, occasional cobbles Compact to Loose Brown Damp (FILL)		1	SS	27		73		○		
			2	SS	20		72		○		
			3	SS	7		71		○		
			4	SS	7		70		○		
			5	SS	37		69		○		
68.5											
5.2	Silty **SAND** Compact Brown Moist		6	SS	20		68				
	Auger refusal at 7.4m						67				
66.3											
7.4	**BEDROCK**, limestone with shale interbeds, thinly laminated, dark grey Broken cores at 7.4 to 7.5, and 7.7 to 7.9m. Horizontal fractures at 7.5, 7.6, 7.7, 8.0, 8.1, 8.2, 8.4, 8.5, and 8.7m. Subvertical fractures at 7.9, and 8.4m.		1	RUN			66			FI >5 >10 5 3	RUN #1 TCR=93% SCR=82% RQD=53% UCS=65MPa (Average)
	Horizontal fractures at 8.9, 9.0, 9.2, 9.6, 9.7, 10.0, 10.1, and 10.2m. Subhorizontal fractures at 9.4, 9.5, and 10.2m. Broken core at 9.7 to 9.8m.		2	RUN			65			3 2 2 4	RUN #2 TCR=100% SCR=93% RQD=93% UCS=102MPa (Average)
							64				

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S 1201D.GPJ 2012TEMPLATE(MTO).GDT 10/25/13

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Ontario

THURBER

RECORD OF BOREHOLE No 17S-01 2 OF 2 METRIC

W.P. 4089-07-01 LOCATION N 5 029 635.1 E 367 009.4 ORIGINATED BY GM

HWY 417 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2012.07.31 - 2012.07.31 CHECKED BY LRB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
63.2										2 6	
10.4	END OF BOREHOLE AT 10.4m. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.										

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

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

ONTMT4S 1201D.GPJ 2012TEMPLATE(MTO).GDT 10/25/13

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17S-02

METRIC

W.P. 4089-07-01	LOCATION N 5 029 651.5 E 367 061.2	ORIGINATED BY GM
HWY 417	BOREHOLE TYPE Hollow Stem Augers/NQ Coring	COMPILED BY MFA
DATUM Geodetic	DATE 2012.08.01 - 2012.08.01	CHECKED BY LRB

ELEV / DEPTH	DESCRIPTION (SOIL PROFILE)	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	WATER CONTENT (%)	UNIT WEIGHT kN/m³ (FI)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
74.1 / 0.0	**ASPHALT:**(225mm)				74			
73.9 / 0.2	**CONCRETE:**(200mm)							
73.6 / 0.4	**SAND**, trace gravel, trace silt, occasional cobbles Dense to Very Dense Brown Damp (FILL)	1	SS	34	73	○		
		2	SS	51	72	○		4 85 11 (SI+CL)
		3	SS	32		○		
	Loose Wet	4	SS	8	71	○		
69.9 / 4.2	Auger refusal at 4.2m				70			
69.9 / 4.2	**BEDROCK**, limestone, thinly laminated, dark grey Subvertical fracture at 4.2m. Horizontal fractures at 4.3, 4.4, 4.5, 5.0, 5.2, and 5.4m. Broken core at 4.5, and 4.7m. Subhorizontal joint at 4.8m.	1	RUN		69		FI: 4, 2, 1, 2, 0	RUN #1 TCR=90% SCR=82% RQD=80% UCS=83MPa (Average)
	Horizontal fractures at 5.8, 5.9, 6.0, 6.1, 6.3, 6.4, 6.6, 6.7, 7.0, 7.1, and 7.2m. Vertical fracture at 5.9m. Broken core at 6.6m.	2	RUN		68		6, 3, 4, 2, 3	RUN #2 TCR=98% SCR=93% RQD=63% UCS=79MPa (Average)
66.8 / 7.3	END OF BOREHOLE AT 7.3m.				67			

END OF BOREHOLE AT 7.3m.
WATER LEVEL AT 4.4m UPON COMPLETION.
Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.

WATER LEVEL READINGS:

DATE	DEPTH (m)	ELEV. (m)
2012.08.21	5.1	69.0
2012.11.21	5.2	68.9

Chart headings: 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); STRAT PLOT; GROUND WATER CONDITIONS.

+ 3, × 3: Numbers refer to Sensitivity   20 / 15 ◐ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No NB-03 1 OF 1 METRIC

W.P. 4089-07-01 LOCATION N 5 029 621.1 E 366 961.9 ORIGINATED BY GM

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2012.08.01 - 2012.08.01 CHECKED BY LRB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
73.3											
0.0	**ASPHALT:** (225mm)										
0.2	**CONCRETE:** (200mm)										
72.9											
0.4	**SAND**, trace gravel, trace silt, occasional cobbles and metal fragments Dense to Loose Brown Damp (FILL)		1	SS	34		73		○		
							72		○		
	Asphalt (50mm) at 2.0m		2	SS	29						
			3	SS	8		71		○		7 88 5 (SI+CL)
			4	SS	19		70		○		
							69				
68.1			5	SS	36				○		1 94 5 (SI+CL)
5.2	Silty **SAND**, trace gravel, occasional cobbles Compact Brown/Grey Moist						68				
			6	SS	16		67		○		
65.6			7	SS	50/.100		66				
7.8	END OF BOREHOLE AT 7.8m UPON AUGER REFUSAL ON PROBABLE BEDROCK. WATER LEVEL AT 5.8m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS:

DATE	DEPTH (m)	ELEV. (m)
2012.08.21	6.5	66.8
2012.11.21	4.4	68.9

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

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

ONTMT4S 1201D.GPJ 2012TEMPLATE(MTO).GDT 10/25/13

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No NB-04 1 OF 1 METRIC

W.P. 4089-07-01 LOCATION N 5 029 672.4 E 367 146.7 ORIGINATED BY GM

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2012.07.24 - 2012.07.24 CHECKED BY LRB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
74.7											
0.0	**ASPHALT:** (150mm)										
74.2 0.2	**CONCRETE:** (150mm)										
0.3	**SAND**, trace gravel, some silt, occasional cobbles Dense to Compact Brown Damp (FILL)						74				
			1	SS	35				○		5 82 13 (SI+CL)
			2	SS	18		73		○		
			3	SS	53		72		○		
71.7											
2.9	END OF BOREHOLE AT 2.9m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 2.9m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS AND BENTONITE TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.										

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

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

ONTMT4S 1201D.GPJ 2012TEMPLATE(MTO).GDT 10/25/13

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No NB-05 1 OF 1 METRIC

W.P. 4089-07-01 LOCATION N 5 029 677.3 E 367 190.2 ORIGINATED BY GM

HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2012.07.31 - 2012.07.31 CHECKED BY LRB

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
73.5								20 40 60 80 100	20 40 60		
0.0	**ASPHALT:** (150mm)										
70.2	**CONCRETE:** (150mm)										
0.3	Gravelly **SAND**, trace silt, occasional cobbles Very Dense to Compact Brown Damp (FILL)		1	SS	61		73		○		24 66 10 (SI+CL)
	Hydrocarbon odour		2	SS	16		72		○		
71.3											
2.2	**SAND**, some gravel, trace silt, occasional bedrock fragments Loose Brown Moist		3	SS	6		71		○		
			4	SS	10	▼	70		○		
68.8			5	SS	50/.050		69		○		
4.7	END OF BOREHOLE AT 4.7m UPON REFUSAL ON PROBABLE BEDROCK. WATER LEVEL AT 4.7m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2012.08.21 2.8 70.7 2012.11.21 3.6 69.9										

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

15 20 10 5 (%) STRAIN AT FAILURE

ONTMT4S 1201D.GPJ 2012TEMPLATE(MTO).GDT 10/25/13

APPENDIX D

Results of Chemical Analysis

Results of Chemical Analysis Eurofins Environment Testing Report No. 1911490

Results of Chemical Analysis Eurofins Environment Testing Report No. 1908451

Results of Chemical Analysis Eurofins Environment Testing Report No. 1911489

Results of Chemical Analysis Eurofins Environment Testing Report No. 1908709

Certificate of Analysis

eurofins | Environment Testing

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario
.
Attention: Kenton Power
PO#:
Invoice to: Golder Associates Ltd

Report Number: 1911490
Date Submitted: 2019-07-04
Date Reported: 2019-07-11
Project: 1655214/1805
COC #: 845746

				Lab I.D.	1437984
				Sample Matrix	Soil
				Sample Type	
				Sampling Date	2019-05-23
				Sample I.D.	18-802sa3/4-6'
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
Anions	Cl	0.002	%		0.027
	SO4	0.01	%		<0.01
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.64
	pH	2.00			9.69
	Resistivity		mS/cm		1560

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

eurofins | Environment Testing

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario
.
Attention: Kenton Power
PO#:
Invoice to: Golder Associates Ltd

Report Number: 1911489
Date Submitted: 2019-07-04
Date Reported: 2019-07-11
Project: 165521411900
COC #: 845745

				Lab I.D.	1437983
				Sample Matrix	Soil
				Sample Type	
				Sampling Date	2019-05-21
				Sample I.D.	18-909sa1B/1.5-2.5'
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
Anions	Cl	0.002	%		0.006
	SO4	0.01	%		0.04
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.41
	pH	2.00			8.07
	Resistivity		mS/cm		2440

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

eurofins | Environment Testing

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario
.
Attention: Kenton Power
PO#:
Invoice to: Golder Associates Ltd

Report Number: 1908451
Date Submitted: 2019-05-29
Date Reported: 2019-06-05
Project: 1655214/1900
COC #: 843944

				Lab I.D.	1429395	1429396	1429397	1429398
				Sample Matrix	Soil	Soil	Soil	Soil
				Sample Type				
				Sampling Date	2019-05-16	2019-05-08	2019-05-03	2019-05-13
				Sample I.D.	18-901 sa4 7-9	18-907 sa2 2.5-3.75	18-910 sa1 1250-1660mm	18-913 sa2 2.5-4.5
Group	**Analyte**	**MRL**	**Units**	**Guideline**				
Anions	SO4	0.01	%		<0.01	<0.01	0.02	<0.01
Cl in Concrete	Cl	0.002	%		0.007	0.008	0.016	0.031
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.29	0.50	0.50	0.70
	pH	2.00			9.08	9.40	8.41	8.34
	Resistivity	1	ohm-cm		3450	2000	2000	1430

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

eurofins | Environment Testing

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario
K2E 7Y1
Attention: Kenton Power
PO#:
Invoice to: Golder Associates Ltd

Report Number: 1908709
Date Submitted: 2019-06-03
Date Reported: 2019-06-13
Project: 1655214/1900
COC #: 844282

				Lab I.D.	1430165	1430166
				Sample Matrix	Soil	Soil
				Sample Type		
				Sampling Date	2019-05-02	2019-05-02
				Sample I.D.	18-917 SA 4/2.5-2.8	18-917 SA 8/17.5
Group	**Analyte**	**MRL**	**Units**	**Guideline**		
Anions	Cl	0.002	%		0.051	0.023
	SO4	0.01	%		<0.01	0.02
General Chemistry	Electrical Conductivity	0.05	mS/cm		0.73	0.38
	pH	2.00			9.61	8.48
	Resistivity	1	ohm-cm		1370	2630

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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