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Highway 427 Expansion
Hwy 427 NBL/SBL CPR/McGillivray Road Overheads (Structures B17A/B17B)

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1. INTRODUCTION

This report presents the results of a foundation investigation and provides foundation recommendations for the design and construction of the proposed overpasses to carry northbound lane (NBL) and southbound lane (SBL) of Highway 427 over CPR and McGillivray Road. The project is part of the proposed 6.6 km long extension of Highway 427 from Highway 7 to Major Mackenzie Drive in the City of Vaughan, Ontario.

Recommendations on the foundation aspects of the overpass design presented in this report were based on the interpretation of the subsurface information obtained during the current foundation investigation by Thurber Engineering (Thurber) as well as previous investigations at the site the results of which were presented in the reports listed below:

- GEOCRE 30M13-177: Preliminary Foundation Investigation and Design Report, High Fill Embankments, Highway 427 Extension from Highway 7 to Major Mackenzie Drive, Ministry of Transportation, Ontario, W.O. 05-20012, dated August 2009, prepared by Golder Associates.
- GEOCRE 30M13-216: Preliminary Foundation Investigation and Design Report, Highway 427 Expansion Project, Extension from Highway 7 to Major Mackenzie Drive, City of Vaughan, Ontario, W.O. 18, dated March 2016, prepared by Peto MacCallum Ltd.

Foundation recommendations presented in this report are prepared based on General Arrangement (GA) drawings H427-D-F-5-STR-B17A-DWG-500-A and H427-D-F-5-STR-B17B-DWG-600-A.

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

2. SITE DESCRIPTION, GEOLOGY BACKGROUND AND PROJECT DESCRIPTION

The site is located approximately 300 m south of the existing Major Mackenzie Drive and 250 m east of Huntington Road in Vaughan, Ontario. The site is surrounded by agricultural properties.

The site is situated within the Peel Plain physiographic region the subsurface condition in which generally comprises clayey silt to silty clay of Halton till with interlayers of sand and silt. Localized recent deposits of sands, silts and soft clays formed in small glacial meltwater ponds throughout the region may be encountered near the river and creek valleys. The site is underlain by shale bedrock of the Georgian Bay Formation with siltstone and limestone interlayers.

Based on the GA drawings, the two overhead structures proposed at this site are three-span bridges (NBL and SBL) with integral abutment configuration and reinforced soil systems (RSS) for false abutments and wingwalls. The proposed foundations for the north and south abutments and north and south piers are driven steel H-piles. The side slopes and foreslopes of the approach embankments will have a slope inclination of 2H:1V.

3. GEOTECHNICAL INVESTIGATION

The current field investigation at the proposed bridge site was conducted between May 10 and July 4, 2017, and consisted of advancing fifteen (15) boreholes, designated as Boreholes CPR 17-01 to CPR 17-15, to depths ranging between 9.8 and 58.4 m.

Borehole coordinates and ground surface elevations were provided CJV. The Record of Borehole sheets (which includes the approximate locations in MTM NAD 83, Zone 10 coordinates) and the Borehole Locations and Soil Strata Drawings are included in Appendix A and Appendix D, respectively.

Truck and track mounted drill rigs supplied by Landshark Drilling Inc. of Brantford, Ontario, and Walker Drilling Ltd., of Utopia, Ontario, were used to advance the boreholes. Soil samples were obtained at selected intervals

using a 50 mm nominal inner diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT) procedures as per ASTM D1586. The bedrock was confirmed by coring using NQ-sized coring in two boreholes, i.e. CPR 17-04 and CPR 17-10. All rock cores were logged, and Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD) and Fracture Index (FI) were determined.

Groundwater conditions were observed in the open boreholes throughout the drilling operations and measured upon completion of drilling. However, since water was used during the drilling operations these measurements were considered not reliable. Standpipe piezometers were installed in five Boreholes (CPR 17-04, CPR 17-06, CPR 17-08, CPR 17-09, and CPR 17-13). All other boreholes were backfilled as per O. Reg. 903. The piezometers will be decommissioning by Project Co. following last round of groundwater level measurements.

Eight (8) borehole logs are available from the previous investigations for this site. Boreholes S25 to S30 from the 2009 report and Boreholes MGR-1 and MGR-2 from the 2016 report are enclosed in Appendix C.

4. SUBSURFACE CONDITIONS

A general description of the stratigraphy is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description which was prepared for interpretation of the site conditions. Subsurface soil conditions may vary between and beyond borehole locations.

In general, the subsurface conditions at the site generally consist of a layer of surficial clayey silt to silty clay overlying a clayey silt to silty clay till deposit over a sand and silt till deposit. The sand and silt till deposit is generally underlain by a clayey silt to silt deposit which overlies sand and silt till over shale bedrock.

Granular fill was encountered in Boreholes CPR 17-05 and CPR 17-09 above the surficial clayey silt to silty clay in the boreholes advanced through the shoulder of the existing McGillivray Road. Occasional auger grinding, hard augering, and/or split spoon bouncing were noted during advancing the boreholes in the till, likely indicating presence of cobbles and/or boulders as expected in till deposits of southern Ontario.

More descriptions of the subsurface conditions at the site are presented below.

4.1 Topsoil

Topsoil was encountered at the ground surface in all boreholes except Boreholes CPR 17-05 and CPR 17-09. The thickness of the topsoil ranged from 75 to 175 mm.

4.2 Fill

Granular fill (gravelly sand) was encountered from ground surface in Boreholes CPR 17-05 and CPR 17-09 advanced through the shoulder of the existing McGillivray Road. The thickness of the fill ranged between 0.6 and 0.8 m with the base of the fill at Elev. 199.8 m and 199.9 m. The SPT-N values obtained within the fill ranged from 10 to 19 blows per 0.3 m of penetration, indicating a compact relative density.

4.3 Surficial Clayey Silt to Silty Clay

A surficial deposit of clayey silt to silty clay was encountered in all boreholes except CPR 17-05 and CPR 17-09. The thickness of the clayey silt to silty clay ranged from 0.6 to 1.7 m and the deposit extended to depths ranging between 0.5 and 1.6 m (Elev. 201.6 and 199.9 m). The SPT-N values recorded within the deposit ranged from 4 to 12 blows per 0.3 m of penetration, indicating a firm to stiff consistency.

4.4 Clayey Silt to Silty Clay Till (Upper)

A deposit of clayey silt to silty clay till was encountered underlying the surficial clayey silt to silty clay in all boreholes except Boreholes CPR 17-05 and CPR 17-09, where it was encountered beneath the granular fill. The thickness of the cohesive till ranged from at least 8 m to 15.4 m and the till extended from at least 9.8 m to 16.3 m below ground surface (below Elev. 192.5 to 184.3 m).

SPT-N values within the deposit ranged from 6 blows per 0.3 m of penetration to 100 blows per 0.275 m of penetration indicating a firm to hard consistency.

Glacial tills inherently contain cobbles and boulders.

4.5 Sand and Silt Till (Upper)

A sand and silt till deposit was encountered underlying the upper cohesive till in the boreholes which penetrated the cohesive till. The thickness of the sand and silt till ranged from at least 0.9 m to 9.2 m and the till extended from at least 12.3 m to 20.9 m below ground surface (below Elev. 189.6 to 180.9 m).

SPT-N values within the deposit ranged from 69 blows per 0.3 m of penetration to 100 blows per 0.075 m of penetration indicating a very dense relative density.

Glacial tills inherently contain cobbles and boulders.

4.6 Clayey Silt to Silty Clay Till (Lower)

A deposit of clayey silt to silty clay till was encountered underlying cohesionless till boreholes CPR 17-07 and CPR 17-10. The thickness of the cohesive till ranged from 1.0 to 3.3 m and extended to depths ranging from 19.3 m to 20.1 m (Elev. 182.8 to 182.0 m).

SPT-N values within the deposit ranged from 59 blows per 0.3 m of penetration to 100 blows per 0.15 m of penetration indicating a hard consistency.

Glacial tills inherently contain cobbles and boulders.

4.7 Clayey Silt

A deposit of clayey silt was encountered underlying cohesionless till in Boreholes CPR 17-04 to CPR 17-06, CPR 17-08 and 17-09, and underlying the cohesive till in Borehole CPR 17-10. The thickness of the clayey silt ranged from at least 5.7 m to 22.3 m and extended from at least 23.5 m to 43.1 m below ground surface (below Elev. 176.3 to 158.7 m).

SPT-N values within the deposit ranged from 19 blows per 0.3 m of penetration to 100 blows per 0.225 m of penetration indicating a very stiff to hard consistency.

4.8 Sandy Silt to Silt

A deposit of sandy silt to silt was encountered underlying the lower cohesive till in Borehole CPR 17-07 and under the clayey silt in Boreholes CPR 17-04 and CPR 17-10. The thickness of the sandy silt to silt ranged from 6.0 m to at least 14.3 m and the sandy silt to silt extended from at least 34.4 m to 51.8 m below ground surface (below Elev. 167.7 to 150.3 m).

SPT-N values within the deposit ranged from 23 to 94 per 0.3 m of penetration indicating a compact to very dense relative density.

4.9 Sand and Silt Till (Lower)

A sand and silt till deposit was encountered underlying the sandy silt to silt deposit in Boreholes CPR 17-04 and CPR 17-10. The thickness of the till ranged from 4.9 to 7.0 m and the till extended to depths ranging between 54.5 and 56.7 m (Elev. 147.0 and 145.4 m).

SPT-N values within the deposit ranged from 107 blows per 0.3 m of penetration to 100 blows per 0.05 m of penetration indicating very dense relative density.

Glacial tills inherently contain cobbles and boulders.

4.10 Shale Bedrock

Grey shale bedrock of the Georgian Bay Formation was confirmed by coring in Borehole CPR 17-04. The bedrock surface was encountered at depths ranging between 54.5 and 56.7 m (Elev. 147.0 and 145.4 m). The measured TCR and SCR values were 100%, while the RQD values ranged from 12 to 43%.

4.11 Groundwater Levels

Water levels measured in the piezometers installed during the current investigation are summarized in Table 4.1.

Table 4.1 – Groundwater Level Measurements in Piezometers

Borehole	Measurement Date	Water Level (m)		Native Material at Screen
		Depth	Elevation	
CPR 17-04	Jun 29, 2017	10.3	191.2	Sand and Silt Till
	Oct 23, 2017	10.4	191.1	
CPR 17-06	Jun 29, 2017	22.4	179.4	Clayey Silt
CPR 17-08	Jun 29, 2017	9.9	191.9	Sand and Silt Till
	Oct 23, 2017	10.1	191.7	
CPR 17-09 (S)	-	N/A	N/A	Clayey Silt to Silty Clay Till (Upper)
CPR 17-09 (D)	-	N/A	N/A	Clayey Silt to Silty Clay Till (Upper)
CPR 17-13	Jun 29, 2017	9.4	192.5	Clayey Silt to Silty Clay Till (Upper) to Sand and Silt Till
	Oct 23, 2017	9.6	192.3	

(S) denotes Shallow piezometer, (D) denotes Deep piezometer

The above groundwater levels represent relatively short-term readings and seasonal fluctuations of the groundwater level are to be expected. The groundwater level may be at higher elevations after the spring snowmelt or after periods of heavy rainfall. Perched water may be present at higher levels in lenses or zones of more permeable sands and silts within the till.

4.12 Corrosion and Sulphate Test Results

Soil samples collected from selected boreholes were submitted for analytical testing of corrosivity parameters and sulphate content. The laboratory certificates of analyses are presented in Appendix B. The results of the analytical tests are summarized in Table 4.2.

Table 4.2 – Corrosion and Sulphate Test Results

Parameter Tested	Unit	CPR 17-06	CPR 17-07	CPR 17-12
		SS3	SS5	SS3
Moisture	%	13.5	16.2	14.8
Corrosivity Index	-	11	7.5	4
pH	-	8.26	8.74	8.71
Soil Redox Potential	mV	409	254	252
Sulphide	%	< 0.02	0.07	< 0.02
Chloride	µg/g	5.0	5.2	2.1
Sulphate	µg/g	22	140	25
Electrical Conductivity	µS/cm	807	141	107
Resistivity	Ohms.cm	1240	7090	9350

5. GEOTECHNICAL RECOMMENDATIONS

5.1 Foundation Design

5.1.1 Spread Footings

Based on the available borehole information, shallow spread footings founded in native soil are not considered appropriate for support of the bridge abutments and piers in view of the relatively low bearing resistance available near surface and the risk for large footing settlement. Accordingly, this option has not been developed further.

5.1.2 Driven H-Piles

Steel piles driven into the till deposits are proposed to support the bridge abutments and piers. The recommendations and discussion on design and construction of driven H-piles are presented below. Cobbles and boulders generally exist within the till deposits.

5.1.2.1 Axial Pile Resistance

The axial resistances of a steel HP310x110 pile and a steel HP360x174 pile driven into the till deposits were assessed based on the subsurface conditions encountered at the proposed foundation locations. The estimated axial geotechnical resistances are summarized in Table 5.2 below.

The factored geotechnical resistance at SLS provided below corresponds to up to 25 mm of settlement. The value of factored geotechnical resistance at ULS was assessed assuming a consequence factor equal to 1 (Typical), and a resistance factor equal to 0.4 (Typical degree of understanding of the subsurface conditions), as per CHBDC (2014). The factored geotechnical resistance at SLS was assessed assuming a factor of 0.8 for typical degree of understanding of the subsurface conditions.

Table 5.2 – Geotechnical Resistances for Driven H-Piles

Location (Reference Borehole)	Estimated Pile Tip Elevation (m)	Founding Stratum	Factored ULS (kN)	Factored SLS (kN)
NBL Structure				
South Abutment (CPR17-04 & S26)	187.0	Very Dense Sand & Silt Till	1,200 (HP310x110)	1,000 (HP310x110)
South Pier (CPR17-05 & S28)	184.0	Very Dense Sand & Silt Till		
North Pier (CPR17-06 & MGR-2)	185.0	Very Dense Sand & Silt Till	1,500 (HP360x174)	1,300 (HP360x174)
North Abutment (CPR17-07)	187.0	Very Dense Sand & Silt Till		
SBL Structure				
South Abutment (CPR17-08 & S25)	188.0	Very Dense Sand & Silt Till	1,200 (HP310x110)	1,000 (HP310x110)
South Pier (CPR17-09 & S27)	184.0	Very Dense Sand & Silt Till		
North Pier (CPR17-06 & MGR-1)	185.0	Very Dense Sand & Silt Till	1,500 (HP360x174)	1,300 (HP360x174)
North Abutment (CPR17-10)	186.0	Very Dense Sand & Silt Till		

5.2 Lateral Pile Resistance

The geotechnical lateral resistance acting on a pile in cohesive soils may be calculated using coefficient of horizontal subgrade reaction (k_s) and ultimate lateral resistance (p_{ult}) as follows:

$$k_s = 67 s_u / D \quad (\text{kN/m}^3)$$

$$p_{ult} = 9 s_u \quad (\text{kPa})$$

Where: s_u = undrained shear strength (kPa)

D = pile width in metres (0.310 m for HP310x110 and 0.378 m for HP360x174)

The lateral resistance acting on a pile in cohesionless soils may be calculated using a value for the coefficient of horizontal subgrade reaction (k_s) and ultimate lateral resistance (p_{ult}) as follows:

$$k_s = n_h z / D \quad (\text{kN/m}^3)$$

$$p_{ult} = 3 \gamma' z K_p \quad (\text{kPa})$$

Where: z = depth of embedment of pile (m)

D = pile width in metres (0.310 m for HP310x110 and 0.378 m for HP360x174)

n_h = coefficient related to soil relative density (kN/m³)

γ' = effective unit weight (kN/m³)

K_p = passive earth pressure coefficient

The above equations and parameters provided in Table 5.3 may be used to analyze the interaction between a pile and the surrounding soil. Lateral pressures obtained from analysis must not exceed the ultimate lateral resistance.

The spring constant, K_s , for analysis may be obtained by the expression, $K_s = k_s L D$ (kN/m), where k_s is the coefficient of horizontal subgrade reaction (kN/m³), D is the pile width (m) and L is the length (m) of the pile segment or element used in the analysis. The ultimate lateral resistance, P_{ult} , can be obtained from the expression, $P_{ult} = p_{ult} L D$. This represents the ultimate load at which the pile fails and will not support any additional load at greater displacements.

Table 5.3 – Geotechnical Design Parameters for Lateral Pile Resistance

Soil Unit	Elevation (m)		γ' (kN/m ³)	n_h (kN/m ³)	K_p	S_u (kPa)
	Top	Bottom				
NBL South Abutment (CPR17-04, CPR17-11, CPR17-12)						
Clayey Silt – Firm	201.5	200	18	-	-	35
Cohesive Till – Stiff	200	197.5	19	-	-	75
Cohesive Till – Very Stiff	197.5	194.5	20	-	-	100
Cohesive Till – Stiff	194.5	191.5	19	-	-	60
Cohesive Till – Very Stiff to Hard	191.5	188	10 (*)	-	-	150
Sand & Silt Till – Very Dense	188	187	11.5 (*)	12,000	3.6	-
NBL South Pier (CPR17-05, S28)						
Cohesive Till – Stiff	200	199	19	-	-	50
Cohesive Till – Very Stiff	199	197.5	20	-	-	100
Cohesive Till– Firm	197.5	191.5	18.5	-	-	45
Cohesive Till – Hard	191.5	186	11 (*)	-	-	250
Sand & Silt Till – Very Dense	186	184	11.5 (*)	10,000	3.5	-
NBL North Pier (CPR17-06, MGR-2)						
Clayey Silt – Stiff	201.5	200.5	19	-	-	50
Cohesive Till – Very stiff	200.5	197.5	20	-	-	150
Cohesive Till – Stiff	197.5	191.5	19	-	-	60
Cohesive Till – Hard	191.5	187	11 (*)	-	-	250
Sand & Silt Till – Very Dense	187	185	11.5 (*)	10,000	3.5	-

Soil Unit	Elevation (m)		γ' (kN/m³)	n _h (kN/m³)	K _p	S _u (kPa)
	Top	Bottom				
NBL North Abutment (CPR17-07, S30)						
Silty Clay – Firm	202	201.5	18	-	-	35
Cohesive Till – Very Stiff	201.5	198.5	20	-	-	150
Cohesive Till – Stiff	198.5	192	19	-	-	75
Cohesive Till – Very Stiff to Hard	192	189	11 (*)	-	-	150
Sand & Silt Till – Very Dense	189	187	11.5 (*)	10,000	3.5	-
SBL South Abutment (CPR17-08, CPR17-14)						
Silty Clay – Firm	201.5	200.5	18	-	-	35
Cohesive Till – Stiff	200.5	197.5	19	-	-	75
Cohesive Till – Very Stiff	197.5	194.5	20	-	-	100
Cohesive Till – Stiff	194.5	191.5	19	-	-	75
Cohesive Till – Hard	191.5	190	11 (*)	-	-	175
Sand & Silt Till – Very Dense	190	188	11.5 (*)	12,000	3.6	-
SBL South Pier (CPR17-09, S27)						
Cohesive Till – Stiff	200	192	19	-	-	75
Cohesive Till – Very Stiff	192	190	10 (*)	-	-	125
Cohesive Till – Hard	190	184.5	11 (*)	-	-	250
Sand & Silt Till – Very Dense	184.5	184	11.5 (*)	10,000	3.5	-
SBL North Pier (CPR17-06, MGR-1)						
Clayey Silt – Stiff	201.5	200.5	19	-	-	50
Cohesive Till – Very Stiff	200.5	197.5	20	-	-	150
Cohesive Till – Stiff	197.5	191.5	19	-	-	60
Cohesive Till – Hard	191.5	187	11 (*)	-	-	250
Sand & Silt Till – Very Dense	187	185	11.5 (*)	10,000	3.5	-
SBL North Abutment (CPR17-10, CPR17-13, CPR17-15)						
Clayey Silt – Firm	202	201.5	18	-	-	35
Cohesive Till – Very Stiff	201.5	198	20	-	-	175
Cohesive Till – Stiff to Very Stiff	198	193.5	19	-	-	90
Cohesive Till – Very Stiff	193.5	188.5	10 (*)	-	-	150
Cohesive Till – Hard	188.5	186	11 (*)	-	-	250

Note (*): Submerged Unit Weight

The modulus of subgrade reaction and ultimate lateral resistance may have to be reduced, based on the pile spacing. The reduction factors to be used for a pile group oriented perpendicular or parallel to the direction of loading are provided in Table 5.4. Intermediate values may be obtained by linear interpolation.

Table 5.4 – Subgrade Reaction Reduction Factors for Pile Spacing

Condition	Pile Spacing, Centre to Centre	Reduction Factor
Pile group oriented perpendicular to direction of loading	4D	1.0
	1D	0.5
Pile group oriented parallel to direction of loading	8D	1.0
	6D	0.7
	4D	0.4
	3D	0.25

5.2.1 Downdrag

Downdrag forces will develop along the length of pile embedded in the cohesive till deposit at the abutment locations due to ground settlement induced by the approach embankment fill. For design purposes, an unfactored downdrag force of 400 kN per pile is recommended to evaluate the impact of downdrag. In accordance with Section 6.8.4 of the CHBDC, the factored downdrag load should be added to the factored permanent loads to assess the effects of downdrag. A check should be performed to confirm that the factored permanent and downdrag loads do not exceed the factored below-ground structural resistance of the pile. As per CHBDC, live loads and downdrag loads are not combined.

5.2.2 H-Pile Installation

Pile driving must be controlled in accordance with Standard Drawing SS103-11 (Hiley Formula) and an ultimate pile resistance (2 times the design load at ULS) should be specified by the designer.

The piles may encounter refusal on the cobbles and/or boulders that may be present in the till deposit above the design tip elevations. The pile installation equipment should be capable of penetrating through the cobbles and boulders. Oversize materials (e.g. greater than 75 mm nominal diameter) should not be used for any new fill which the piles will be driven through.

5.2.3 Pile Tips

To prevent structural damages to the piles when setting them in the very dense/hard till/shale bedrock or if cobbles or boulders are encountered, piles should be equipped with tip protection. All driven H-piles should be fitted with pile tip protection as per OPSS.PROV 903 and OPSD 3000.100 (Type I H-Pile Driving Shoe).

Care must be taken when driving piles to very dense/hard till with cobbles and boulders or to bedrock to avoid overdriving and damage to the piles. If pile damage or misalignment occurs, PDA testing may be required to assess the pile capacity and integrity. Consideration should be given to using Titus Steel (Standard H-point) or approved equivalent for the remaining piles at this site.

5.3 Frost Protection

The design depth of frost penetration at this site is 1.2 m. All pile caps and footing bases should be provided with 1.2 m of earth cover or an equivalent thickness of synthetic insulation.

5.4 Backfill to Abutments

Backfill to the abutment walls should be Granular A or Granular B Type II material meeting the requirements of OPSS. PROV 1010. The backfill should be in accordance with OPSS 902 and placed to the extent shown in OPSD 3101.150.

Compaction equipment to be used adjacent to retaining structures should be restricted in accordance with OPSS 501. The design of the abutment should incorporate a subdrain as shown in OPSD 3101.150.

5.5 Lateral Earth Pressure

Lateral earth pressures acting on the structure may be assumed to be triangular and to be governed by the characteristics of the abutment backfill. For a fully drained condition, the pressures should be computed in accordance with the CHBDC but generally are given by the expression:

$$P_h = K(\gamma h + q)$$

where:

$$P_h = \text{horizontal pressure on the wall at depth } h \text{ (kPa)}$$

$$K = \text{earth pressure coefficient}$$

γ	=	unit weight of retained soil (kN/m ³)
H	=	depth below top of fill where pressure is computed (m)
q	=	value of any surcharge (kPa)

In accordance with Clause 6.9.3 of the CHBDC, a compaction surcharge should be applied in the design.

Earth pressure coefficients for backfill to the abutment walls are dependent on properties of the granular fill used as the backfill. Typical values are shown in Table 5.5.

Table 5.5 – Coefficients of Lateral Earth Pressure

Loading Condition	OPSS Granular A or B Type II $\phi = 35^\circ, \gamma = 22.8 \text{ kN/m}^3$		OPSS Granular B Type I or Type III $\phi = 32^\circ, \gamma = 21.2 \text{ kN/m}^3$	
	Horizontal Surface Behind Wall	Sloping Backfill (2H:1V)	Horizontal Surface Behind Wall	Sloping Backfill (2H:1V)
Active (Unrestrained Wall)	0.27	0.38*	0.31	0.46*
At-rest (Restrained Wall)	0.43	-	0.47	-
Passive	3.7	-	3.3	-

* For wing walls

5.6 Seismic Considerations

Based on the encountered subsurface conditions, Site Class C may be assumed to evaluate the seismic site response, as per Table 4.1, Clause 4.4.3.2 of the CHBDC 2014.

The peak ground acceleration, PGA, for a 2% in 50-year probability of exceedance at this site is 0.11 g as per the National Building Code of Canada 2015 (NBCC 2015).

In accordance with Clause 4.6.5 of the CHBDC 2014, retaining structures should be designed using active (K_{AE}) and passive (K_{PE}) earth pressure coefficients that incorporate the effects of earthquake loading. The coefficients of horizontal earth pressure for seismic loading presented in Table 5.6 may be used:

Table 5.6 – Earth Pressure Coefficients for Earthquake Loading

Loading Condition	OPSS Granular A or OPSS Granular B Type II $\phi = 35^\circ, \gamma = 22.8 \text{ kN/m}^3$	OPSS Granular B Type I or Type III $\phi = 32^\circ, \gamma = 21.2 \text{ kN/m}^3$
Active (K_{AE})*	0.31	0.35
Passive (K_{PE})	3.5	3.1
At-rest (K_{OE})**	0.57	0.62

* After Mononobe and Okabe, passive case assumes a horizontal surface in front of the wall.

** After Woods

Given the low seismic ground motions and the presence of very stiff to hard clayey silt to silty clay till, the potential for liquefaction is considered low at this site.

5.7 Approach Embankments and Reinforced Soil System (RSS)

5.7.1 General

The GA drawing indicates that reinforced earth systems (RSS) for false abutments and wingwalls will be installed at each structure. The drawing shows the RSS walls up to 11 m at the south abutments and up to 12.5 m at the north abutments. It should be noted that no structural loading is applied to the RSS system in the case of false abutments. The RSS walls will be designed to “High Performance” and “High Appearance” at this site.

The existing soils at the abutments and approach embankments generally consist of 0.6 to 1.7 m of firm to stiff clayey silt to silty clay overlying a relatively thick deposit of stiff to hard clayey silt to silty clay till. The construction of the structure will require the placement of 11 to 13 m of fill at the north approaches and approximately 10 to 12 m of fill at the south approaches. The side slopes of the approach embankments will be at an inclination of 2H:1V.

5.7.2 Subgrade Preparation

Topsoil and any soft surficial clayey silt/silty clay, loose fill, disturbed soils and deleterious materials within the footprint of the approach embankments should be removed and replaced with suitable granular material compacted as per OPSS.PROV 501. The exposed subgrade surface should be proof rolled and inspected to confirm that the subgrade is suitable and uniformly competent.

The work should be carried out in accordance with OPSS.PROV 902 and construction should be carried out in the dry. Once the subgrade is prepared, the construction traffic and equipment should not travel on the subgrade.

The RSS walls should be founded on a minimum 500 mm thick layer of bedding material conforming to OPSS Granular A requirements to form a uniform subgrade. Engineered fill placed under the RSS mass to achieve the design founding level should be compacted to 100% of its SPMDD at a moisture content within 2% of optimum. The engineered fill layer should extend at least 500 mm beyond the limits of the RSS mass.

5.7.3 Geotechnical Resistance

As per MTO's RSS Design Guidelines, the minimum soil cover to the underside of the levelling pad shall be at least 800 mm, or 40% of the actual frost depth for the area, whichever is greater. The minimum soil cover to the top of the levelling pad shall be at least 500 mm.

The bases of RSS walls founded on very stiff clayey silt to silty clay till at a minimum 1.0 m depth below the existing ground surface should be designed for a Factored Geotechnical Resistance of 400 kPa and Geotechnical Resistance at SLS of 275 kPa.

The recommended geotechnical resistances are for vertical concentric loading. The effects of load inclination and eccentricity need to be considered in accordance with CHBDC (2014).

The RSS mass must be designed against various modes of failure including sliding and overturning. Sliding resistance along the base native clayey silt till and engineered fill may be estimated using an ultimate friction coefficient of 0.35 and 0.55, respectively.

The internal stability or structural integrity of the RSS walls should be analyzed by the supplier/designer of the proprietary product selected for this site.

5.7.4 Approach Embankment Stability

Slope stability analyses were carried out to assess the stability of the RSS wall/embankment using the commercially available program Slope/W, employing the Morgenstern-Price method of analysis. The analysis was performed on a critical longitudinal section of the RSS wall and considered the stability of the RSS wall.

The results of the analyses are provided in Figures E1 to E3. The computed Factor of Safety (FOS) exceed the minimum FOS of 1.3 and 1.5 for the short-term and long-term conditions, respectively, indicating that the RSS

wall will be stable up to the design height assuming proper subgrade preparation and proper placement and compaction of fill materials.

5.7.5 Approach Embankment Settlement

The settlements of the foundation soils were estimated to range between 50 and 75 mm under the approach embankments. Embankment settlement due to fill compression is estimated to 0.5% of the fill height for granular fill or earth fill compacted to 100% of their SPMDD at a moisture content within 2% of optimum. Approximately 50% of the total fill compression (or 0.25% of the fill height) will occur during construction and the remaining 50% or approximately 25 to 35 mm at this site will occur after construction.

In accordance with MTO's Embankment Settlement Criteria for Design (March 2, 2010) for bridge approach areas, the following post-construction settlement criteria (within 20 years following paving) have been adopted for the design:

- No more than 25 mm within 20 m behind the bridge abutment;
- 25 mm to 50 mm from 20 m to 50 m from the bridge abutment;
- 50 mm to 75 mm from 50 m to 75 m from the bridge abutment; and
- 75 mm to 100 mm greater than 75 m from the bridge abutment.

Based on the results of the settlement analysis, it is recommended that a preload period of 4 months be allowed for embankment settlement to take place following construction to full height. The actual waiting period duration should be determined by the actual foundation behaviour assessed from the settlement monitoring program by the foundation designer.

5.8 Excavation and Dewatering

All excavations should be carried out in accordance with the requirements of the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the cohesive till within the depth of excavation may be classed as Type 3 soil.

The excavation and backfilling for foundations should be carried out in accordance with OPSS 902.

The water level measured piezometers installed into the cohesive till varied between approximately Elev. 191 and 193 m, which is below the base of excavation for pier pile caps and RSS wall construction. Given the consistency and relatively low permeability of the cohesive till, groundwater control measures such as perimeter ditches and pumping from filtered sumps should be adequate to lower the groundwater table to below the base of excavation. The possibility exists that additional pumps may be required if localized zones of high volume of perched groundwater are encountered.

All pile caps and RSS walls should be constructed in the dry.

5.9 Corrosion and Sulphate Attack Potential

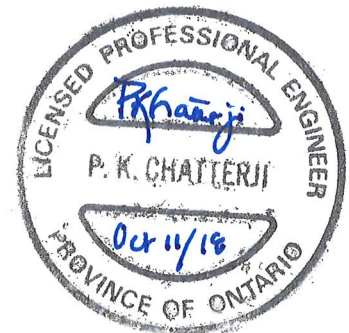
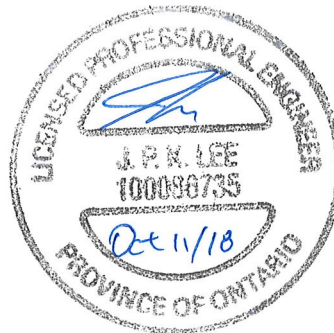
The results of the analytical testing for corrosivity and sulphate content of the soil samples indicate the following:

- The potential for sulphate attack on structural concrete from the surrounding soil is negligible based on the generally low concentration of sulphate in the samples tested.
- The potential for corrosion on metal elements of the structure is considered to be mild to severe.
- Appropriate protection measures are recommended if metal structural elements are used.

5.10 Construction Concerns

Potential construction concerns include, but not necessarily limited to:

- The driven steel H-pile installation in the glacial till may result in pile misalignment and/or damages at the pile tip due to the presence of cobbles and/or boulders. The piling contractors should be warned of the associated risks.
- All pile caps and RSS walls should be constructed in the dry. The clayey silt to silty clay subgrade should be covered/protected as soon as practical upon exposure and be protected from any disturbances that will likely weaken the material.
- Surface water inflow into the excavation may occur. The water inflow may be handled by pumping from filtered sumps.



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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

2. COMPLETE REPORT

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

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

3. BASIS OF REPORT

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

4. USE OF THE REPORT

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5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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

7. INDEPENDENT JUDGEMENTS OF CLIENT

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

Appendix A

Record of Borehole Sheets – Current Investigation

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

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

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

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

RECORD OF BOREHOLE No CPR 17-01

1 OF 2

METRIC

W.P. _____ LOCATION N 4 853 513.9 E 292 212.0 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.11 - 2017.05.11 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
202.3	GROUND SURFACE													
0.0	TOPSOIL: (125mm)													
0.1	Clayey SILT , sandy, trace gravel Firm to Stiff Brown Moist		1	SS	6									
201.6														
0.7	Clayey SILT to Silty CLAY , trace gravel, trace to some sand, trace roots Stiff to Very Stiff Brown Moist (TILL)		2	SS	15									
			3	SS	19									
			4	SS	26									
			5	SS	23									
			6	SS	12									
			7	SS	10									
			1	TW										
			8	SS	14									
192.5	END OF BOREHOLE AT 9.8m.													
9.8														

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-01

2 OF 2

METRIC

W.P. _____ LOCATION N 4 853 513.9 E 292 212.0 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.11 - 2017.05.11 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		
							20	40	60	80	100						
	Continued From Previous Page																
	BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No CPR 17-02

1 OF 2

METRIC

W.P. _____ LOCATION N 4 853 389.6 E 292 235.4 ORIGINATED BY JZ
 HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.04 - 2017.07.04 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
201.7	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL: (150mm)							20	40	60	80	100					
0.2	Clayey SILT , trace sand, trace gravel, occasional oxide, trace rootlets Firm Brown Moist		1	SS	8		201							○			
			2	SS	8									○			
199.9			3	SS	22		200							○			
1.8	Clayey SILT to Silty CLAY , trace sand, trace gravel Very Stiff to Stiff Brown to Grey Moist (TILL)		4	SS	27		199							○			
			5	SS	27		198							○			
			6	SS	18		197							○			
			7	SS	12		196							○			
			8	SS	14		194							○			
			9	SS	13		193							○			
191.9							192										
9.8	END OF BOREHOLE AT 9.8m.																

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-02

2 OF 2

METRIC

W.P. _____ LOCATION N 4 853 389.6 E 292 235.4 ORIGINATED BY JZ
 HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.04 - 2017.07.04 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page																
	BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No CPR 17-03

1 OF 2

METRIC


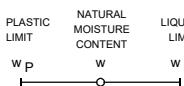
W.P. _____ LOCATION N 4 853 506.1 E 292 159.1 ORIGINATED BY JZ
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.11 - 2017.05.11 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
							20 40 60 80 100	20 40 60	W _p W W _L					
202.3	GROUND SURFACE													
0.0	TOPSOIL: (75mm)													
0.1	Clayey SILT , some sand, trace gravel, trace roots		1	SS	12									
201.6	Stiff to Very Stiff													
0.7	Brown Moist													
	Clayey SILT to Silty CLAY , trace sand, trace gravel		2	SS	19									
	Stiff to Hard													
	Brown to Grey Moist (TILL)		3	SS	27									
			4	SS	29									
			5	SS	21									
			6	SS	9									
			7	SS	32									
			8	SS	17									
			9	SS	31									
192.5	END OF BOREHOLE AT 9.8m.													
9.8														

Continued Next Page

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

METRIC

SOIL PROFILE								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	N° VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE		
						DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE WATER CONTENT (%) 	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
<div>Continued From Previous Page</div> <div>WATER LEVEL AT 7.6m UPON COMPLETION OF BOREHOLE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.</div>								

RECORD OF BOREHOLE No CPR 17-04

1 OF 6

METRIC

W.P. _____ LOCATION N 4 853 418.5 E 292 270.5 ORIGINATED BY TF/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.14 - 2017.06.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
201.5	GROUND SURFACE							20	40	60	80	100		
0.0	TOPSOIL: (100mm)							20	40	60	80	100		
0.1														
	ClayeySILT, some sand, trace gravel, trace organics and rootlets, oxide stains Firm Brown Moist		1	SS	6		201							
			2	SS	6									
200.1	ClayeySILT to Silty CLAY, trace sand to with sand, trace gravel, occasional cobbles and boulders Stiff to Very Stiff Brown to Grey Moist (TILL)						200							
1.4			3	SS	13									
			4	SS	18		199							
			5	SS	10		198							
			6	SS	21									
							196							
			7	SS	16		195							
							194							
			8	SS	11									
						193								
			9	SS	11		192							

Continued Next Page

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

2 OF 6

W.P.	LOCATION	N 4 853 418.5 E 292 270.5	ORIGINATED BY	TF/KK
HWY 427	BOREHOLE TYPE	Hollow Stem Augers/Tricone	COMPILED BY	AN
DATUM Geodetic	DATE	2017.06.14 - 2017.06.19	CHECKED BY	ME

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+³, ×³: Numbers refer to Sensitivity

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 11/29/17

RECORD OF BOREHOLE No CPR 17-04

3 OF 6

METRIC

W.P. _____ LOCATION N 4 853 418.5 E 292 270.5 ORIGINATED BY TF/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.14 - 2017.06.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L		
	Continued From Previous Page		16	SS	68									
	Clayey SILT , trace to some sand, trace gravel Hard Grey Moist						181							
							180							
							179							
			17	SS	56		178							
							177							
			18	SS	70		176							
							175							
							174							
			19	SS	40		173							
							172							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-04

4 OF 6

METRIC

W.P. _____ LOCATION N 4 853 418.5 E 292 270.5 ORIGINATED BY TF/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.14 - 2017.06.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page													
	Clayey SILT , trace to some sand, trace gravel, occasional cobbles and boulders Very Stiff to Hard Grey Moist		20	SS	92		171							
							170							
							169							
			21	SS	28		168							
							167							
							166							
			22	SS	31		165							
							164							
							163							
			23	SS	33		162							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-04

5 OF 6

METRIC

W.P. _____ LOCATION N 4 853 418.5 E 292 270.5 ORIGINATED BY TF/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.14 - 2017.06.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page													
160.0	Clayey SILT , trace sand to sandy, trace gravel, occasional cobbles and boulders Hard Grey Moist						161							
41.5	Sandy SILT , trace clay Dense to Very Dense Grey Wet		24	SS	46		160							
							159							
							158							
							157							
			25	SS	58		156							
							155							
154.0	SAND and SILT , trace clay, trace gravel Very Dense Grey Wet (TILL)		26	SS	101/ 0.275		154							
47.5							153							
							152							

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+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

METRIC

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ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 11/29/17

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No CPR 17-05

1 OF 3

METRIC

W.P. _____ LOCATION N 4 853 440.1 E 292 265.8 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.07 - 2017.06.07 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)	W _p	W	W _L		
200.6	GROUND SURFACE													
0.0	Gravelly SAND Compact Brown Moist (FILL)		1	SS	19									
199.8														
0.8	Clayey SILT to Silty CLAY , trace to some sand, occasional cobbles and boulders Firm to Very Stiff Brown to Grey Moist (TILL)		2	SS	9									
			3	SS	18									
			4	SS	17									
			5	SS	10									
			6	SS	7									
			7	SS	8									
			8	SS	10									
			9	SS	49									
	Hard													

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+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

METRIC

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+³, ×³: Numbers refer to Sensitivity

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 11/29/17

RECORD OF BOREHOLE No CPR 17-05

3 OF 3

METRIC

W.P. _____ LOCATION N 4 853 440.1 E 292 265.8 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.07 - 2017.06.07 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	W _p	W	W _L			
	Continued From Previous Page		16	SS	75												
	Moist Clayey SILT , trace sand, occasional cobbles and boulders Hard Grey Moist																
							180										
							179										
							178										
177.1			17	SS	57												
23.5	END OF BOREHOLE AT 23.5m. BOREHOLE OPEN TO 22.9m AND DRY. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, GROUT AND CUTTINGS TO SURFACE.																

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RECORD OF BOREHOLE No CPR 17-06

1 OF 5

METRIC

W.P. _____ LOCATION N 4 853 466.8 E 292 206.4 ORIGINATED BY JZ/ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.15 - 2017.05.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
201.8	GROUND SURFACE							20	40	60	80	100	W _P	W	W _L	kN/m ³	GR	SA	SI	CL
0.0	TOPSOIL: (150mm)																			
0.2	Clayey SILT , some sand, trace gravel, trace organics Stiff to Very Stiff		1	SS	9									○						
201.1	Brown Moist																			
0.7	Clayey SILT to Silty CLAY , trace sand, trace gravel Very Stiff to Stiff Brown to Grey Moist (TILL)		2	SS	16									○						
			3	SS	28									○						
			4	SS	29									○						
			5	SS	25									○						
			6	SS	11									○	○					
			7	SS	9									○						
			8	SS	10									○						
			9	SS	9									○						

Continued Next Page

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

RECORD OF BOREHOLE No CPR 17-06

2 OF 5

METRIC

W.P. _____ LOCATION N 4 853 466.8 E 292 206.4 ORIGINATED BY JZ/ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.15 - 2017.05.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page													
	Clayey SILT to Silty CLAY , trace sand, trace gravel Hard Grey Moist (TILL)		10	SS	83		191							0 30 52 18
							190							
			11	SS	66		189							
							188							
	Sand seams		12	SS	51		187							
187.0							186							
14.8	SAND and SILT , trace clay, trace cobbles Very Dense Grey Wet (TILL)		13	SS	78		185							
			14	SS	50/ 0.100		184							
			15	SS	130		183							
							182							

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+³, ×³: Numbers refer to Sensitivity
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 15 10 5 0
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-06

3 OF 5

METRIC

W.P. _____ LOCATION N 4 853 466.8 E 292 206.4 ORIGINATED BY JZ/ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.15 - 2017.05.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page		16	SS	101/									
180.9	SAND and SILT , trace clay, trace cobbles Very Dense Grey Wet (TILL)													
20.9	Clayey SILT , trace sand, trace gravel Hard Grey Moist		17	SS	64									
			18	SS	69									
			19	SS	67									
			20	SS	51									
			21	SS	50									
			22	SS	44									

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

RECORD OF BOREHOLE No CPR 17-06

4 OF 5

METRIC

W.P. _____ LOCATION N 4 853 466.8 E 292 206.4 ORIGINATED BY JZ/ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.15 - 2017.05.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page													
	Clayey SILT , trace sand Very Stiff to Hard Grey Wet		23	SS	40		171							
							170							
			24	SS	40									
							169							
			25	SS	25		168							
							167							
			26	SS	26									
							166							
			27	SS	29		165							
							164							
			28	SS	49		163							
							162							
			29	SS	33									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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15
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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-06

5 OF 5

METRIC

W.P. _____ LOCATION N 4 853 466.8 E 292 206.4 ORIGINATED BY JZ/ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.15 - 2017.05.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	Clayey SILT , trace sand Hard Grey Moist		30	SS	36		161										
							160										
158.7			31	SS	27		159										
43.1	END OF BOREHOLE AT 43.1m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.06.29 22.4 179.4																

METRIC

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No CPR 17-07

2 OF 4

METRIC

W.P. _____ LOCATION N 4 853 497.4 E 292 223.4 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.21 - 2017.06.22 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
	Continued From Previous Page							20 40 60 80 100		W _P W W _L				
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100		20 40 60				

Continued Next Page

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

RECORD OF BOREHOLE No CPR 17-07

3 OF 4

METRIC

W.P. _____ LOCATION N 4 853 497.4 E 292 223.4 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.21 - 2017.06.22 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)						
						20	40	60	80	100	20	40	60			
182.0	Continued From Previous Page															
20.1	SILT, trace sand, some clay, occasional cobbles Very Dense Grey Moist															
			16	SS	94											
			17	SS	53											
			18	SS	70											0 5 84 11

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-07

4 OF 4

METRIC

W.P. _____ LOCATION N 4 853 497.4 E 292 223.4 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.21 - 2017.06.22 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 20 40 60								
	Continued From Previous Page																
	SILT , trace sand, some clay, occasional cobbles Very Dense to Compact Grey Moist		19	SS	51		172										
							171										
							170										
							169										
			20	SS	23		168										
167.7																	
34.4	END OF BOREHOLE AT 34.4m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

1 OF 4

METRIC

W.P.	LOCATION	N 4 853 406.9 E 292 225.4	ORIGINATED BY	TF
HWY 427	BOREHOLE TYPE	Hollow Stem Augers/Tricone	COMPILED BY	AN
DATUM Geodetic	DATE	2017.06.20 - 2017.06.21	CHECKED BY	ME

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No CPR 17-08

2 OF 4

METRIC

W.P. _____ LOCATION N 4 853 406.9 E 292 225.4 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.21 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page													
190.1	Clayey SILT to Silty CLAY , trace to some sand, trace gravel, occasional cobbles and boulders Stiff to Very Stiff Brown to Grey Moist (TILL)		10	SS	30		191							
11.7	SAND and SILT , trace clay, trace gravel Very Dense Grey Moist (TILL)		11	SS	101/ 0.250		190							
			12	SS	100/ 0.250		189							
			13	SS	101/ 0.200		188							
			14	SS	100/ 0.125		187							
			15	SS	100/ 0.250		186							
			16	SS	104/		185							
							184							
							183							
							182							

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+³, ×³: Numbers refer to Sensitivity
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 (%) STRAIN AT FAILURE

3 OF 4

W.P.	LOCATION	N 4 853 406.9 E 292 225.4	ORIGINATED BY	TF
HWY 427	BOREHOLE TYPE	Hollow Stem Augers/Tricone	COMPILED BY	AN
DATUM Geodetic	DATE	2017.06.20 - 2017.06.21	CHECKED BY	ME

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No CPR 17-08

4 OF 4

METRIC

W.P. _____ LOCATION N 4 853 406.9 E 292 225.4 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.21 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
	Continued From Previous Page																
	Clayey SILT , some sand Very Stiff to Hard Grey Moist																
			21	SS	30												
166.1			22	SS	19												
35.7	END OF BOREHOLE AT 35.7m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.06.29 9.9 191.9 2017.10.23 10.1 191.7																

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RECORD OF BOREHOLE No CPR 17-09

1 OF 4

METRIC

W.P. _____ LOCATION N 4 853 431.1 E 292 222.1 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.09 - 2017.06.09 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
200.5	GROUND SURFACE													
0.0	Gravelly SAND Compact Brown Moist (FILL)		1	SS	10									
199.9														
0.6	Clayey SILT to Silty CLAY , trace to some sand, occasional cobbles and boulders Stiff to Hard Brown to Grey Moist (TILL)		2	SS	12									
			3	SS	15									
			4	SS	15									
			5	SS	38									
			6	SS	15									
			7	SS	8									
			8	SS	15									
			9	SS	22									

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+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-09

2 OF 4

METRIC

W.P. _____ LOCATION N 4 853 431.1 E 292 222.1 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.09 - 2017.06.09 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
	Continued From Previous Page													
	Clayey SILT to Silty CLAY , trace to some sand, occasional cobbles and boulders Stiff to Hard Brown to Grey Moist (TILL)		10	SS	57		190							
							189							
			11	SS	53		188							
							187							
			12	SS	45		186							
							185							
			13	SS	33		184							
184.3							183							
16.2	SAND and SILT , some clay, trace gravel, occasional cobbles and boulders Very Dense Grey Moist (TILL)		14	SS	100/ 0.075		182							
							181							
181.0			15	SS	90									
19.5	Clayey SILT , trace sand Hard Grey													

Continued Next Page

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 11/29/17

RECORD OF BOREHOLE No CPR 17-09

3 OF 4

METRIC

W.P. _____ LOCATION N 4 853 431.1 E 292 222.1 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.09 - 2017.06.09 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
	Continued From Previous Page																
	Clayey SILT , trace sand Hard Grey Moist																
			16	SS	69												
			17	SS	50												
			18	SS	54												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-09

4 OF 4

METRIC

W.P. _____ LOCATION N 4 853 431.1 E 292 222.1 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2017.06.09 - 2017.06.09 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
169.4	Clayey SILT , trace sand Very Stiff Grey Moist		19	SS	23		170										
31.1	END OF BOREHOLE AT 31.1m. BOREHOLE DRY UPON COMPLETION. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.06.29 Couldn't find - 2017.10.23																

RECORD OF BOREHOLE No CPR 17-10

1 OF 6

METRIC

W.P. _____ LOCATION N 4 853 488.7 E 292 169.3 ORIGINATED BY ES/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.05.19 - 2017.06.15 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
202.1	GROUND SURFACE							20 40 60 80 100		W _P W W _L				
0.0	TOPSOIL: (100mm)							20 40 60 80 100						
0.1	ClayeySILT, some sand, trace gravel, trace roots		1	SS	6		202							
201.4	Firm to Very Stiff													
0.7	Brown Moist													
	ClayeySILT to Silty CLAY, trace sand to sandy, trace gravel		2	SS	21		201							
	Very Stiff to Stiff													
	Brown to Grey													
	Moist (TILL)		3	SS	29		200							
			4	SS	29		199							
			5	SS	21		198							
			6	SS	11		197							
			7	SS	18		196							
			8	SS	16		195							
			9	SS	23		194							
							193							

Continued Next Page

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

RECORD OF BOREHOLE No CPR 17-10

2 OF 6

METRIC

W.P. _____ LOCATION N 4 853 488.7 E 292 169.3 ORIGINATED BY ES/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.05.19 - 2017.06.15 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE						
						● QUICK TRIAXIAL × LAB VANE								
						20 40 60 80 100	20 40 60							
Continued From Previous Page														
	Clayey SILT to Silty CLAY , trace sand to sandy, trace gravel Very Stiff to Stiff Brown to Grey Moist (TILL)		10	SS	22		192							
							191							
							190							
							189							
							188							
	Hard		12	SS	87									
			13	SS	100/ 0.275		187							
185.8							186							
16.3	SAND and SILT , some clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)		14	SS	103/ 0.175		185							
183.8							184							
18.3	Silty CLAY , sandy, trace gravel Hard Grey Moist (TILL)		15	SS	59									
182.8							183							
19.3	Clayey SILT , trace sand Hard Grey Moist		16	SS	100/ 0.175									

Continued Next Page

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

RECORD OF BOREHOLE No CPR 17-10

3 OF 6

METRIC

W.P. _____ LOCATION N 4 853 488.7 E 292 169.3 ORIGINATED BY ES/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.05.19 - 2017.06.15 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100								
	Continued From Previous Page						182									
	Clayey SILT , trace sand Hard Grey Moist				0.225		181									
			17	SS	69		180									
							179									
							178									
			18	SS	40		177									
							176									
							175									
			19	SS	58		174									
							173									

Continued Next Page

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

RECORD OF BOREHOLE No CPR 17-10

4 OF 6

METRIC

W.P. _____ LOCATION N 4 853 488.7 E 292 169.3 ORIGINATED BY ES/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.05.19 - 2017.06.15 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
							20 40 60 80 100	20 40 60 80 100	W _p W W _L	20 40 60				
	Continued From Previous Page													
	Clayey SILT , trace sand Very Stiff to Hard Grey Moist		20	SS	27		172							
							171							
							170							
							169							
			21	SS	28		168							
							167							
							166							
			22	SS	21		165							
							164							
							163							
			23	SS	30									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-10

5 OF 6

METRIC

W.P. _____ LOCATION N 4 853 488.7 E 292 169.3 ORIGINATED BY ES/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.05.19 - 2017.06.15 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)						
						20	40	60	80	100	20	40	60			
	Continued From Previous Page															
160.6	Clayey SILT , trace sand Very Stiff to Hard Grey Moist															
41.5	SILT , trace clay Dense to Very Dense Grey Wet															
			24	SS	45										0 0 91 9	
			25	SS	32											
			26	SS	43											

Continued Next Page

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

RECORD OF BOREHOLE No CPR 17-10

6 OF 6

METRIC

W.P. _____ LOCATION N 4 853 488.7 E 292 169.3 ORIGINATED BY ES/KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.05.19 - 2017.06.15 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page						152										
							151										
150.3							150										
51.8	SAND and SILT , trace clay, trace gravel Very Dense Grey Wet (TILL)	○	27	SS	107		149										
		○					148										
		○					147										
	Occasional cobbles at 55.0m	○	28	SS	100/	0.125	146										
		○					145										
145.4							144										
56.7	SHALE highly weathered	▨					143										
		▨					142										
144.1							141										
58.0	END OF BOREHOLE AT 58.0m UPPN SPLIT SPOON REFUSAL ON SHALE BEDROCK.	▨	29	SS	200/	0.050	140										

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 11/29/17

RECORD OF BOREHOLE No CPR 17-11

1 OF 2

METRIC

W.P. _____ LOCATION N 4 853 420.6 E 292 288.9 ORIGINATED BY KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
201.3	GROUND SURFACE							20 40 60 80 100		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
0.0	TOPSOIL: (100mm)							20 40 60 80 100		WATER CONTENT (%)				
0.1	Clayey SILT , some sand, trace gravel, trace gravel Firm Brown Moist		1	SS	6		201							
			2	SS	7									
200.1							200							
1.2	Clayey SILT to Silty CLAY , trace sand to sandy, trace gravel Stiff to Very Stiff Grey Moist (TILL)		3	SS	15									
			4	SS	20		199							
			5	SS	20									
							198							
			6	SS	12									
							196							
			7	SS	12		195							
							194							
			8	SS	11									
							193							
			9	SS	16		192							

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+³, ×³: Numbers refer to
Sensitivity

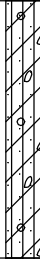
20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-11

2 OF 2

METRIC

W.P. _____ LOCATION N 4 853 420.6 E 292 288.9 ORIGINATED BY KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							PLASTIC LIMIT W _P NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L
	Continued From Previous Page							20 40 60 80 100							
189.6			10	SS	110		191								5 28 48 19
11.7			SAND and SILT , some clay, trace gravel Very Dense Grey Moist (TILL)	11	SS	101		190						○ ○	
188.5															
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.														

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No CPR 17-12

2 OF 2

METRIC

W.P. _____ LOCATION N 4 853 404.7 E 292 249.4 ORIGINATED BY KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.20 - 2017.06.20 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
190.8			10	SS	70/ 0.125		191										
11.0	SAND and SILT , some clay, trace gravel, occasional cobbles and boulders Very Dense Grey Moist (TILL)						190										
189.5			11	SS	100/												
12.3	END OF BOREHOLE AT 12.3m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND GROUT TO SURFACE.				0.100												

RECORD OF BOREHOLE No CPR 17-13

1 OF 2

METRIC

W.P. _____ LOCATION N 4 853 494.6 E 292 190.5 ORIGINATED BY JZ
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.12 - 2017.05.12 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
201.9	GROUND SURFACE													
0.0	TOPSOIL: (100mm)													
0.1	Clayey SILT , some sand, trace gravel, trace organics Firm Brown Moist		1	SS	5									
			2	SS	4									
200.5														
1.4	Clayey SILT to Silty CLAY , trace to some sand, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)		3	SS	12									
			4	SS	25									
			5	SS	27									
			6	SS	16									
			7	SS	8									
			8	SS	13									
			9	SS	15									

Continued Next Page

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

RECORD OF BOREHOLE No CPR 17-13

2 OF 2

METRIC

W.P. _____ LOCATION N 4 853 494.6 E 292 190.5 ORIGINATED BY JZ
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.12 - 2017.05.12 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
	Continued From Previous Page																
191.0	Clayey SILT to Silty CLAY , trace to some sand, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)																
10.9	SAND and SILT , gravelly Very Dense Brown Moist (TILL)		10	SS	72											21 64 15 (SI+CL)	
189.1			11	SS	69												
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.06.29 4.6 197.3 2017.06.29 9.4 192.5 2017.10.23 9.6 192.3																

RECORD OF BOREHOLE No CPR 17-14

1 OF 2

METRIC

W.P. _____ LOCATION N 4 853 399.7 E 292 209.9 ORIGINATED BY JZ
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.16 - 2017.06.16 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
201.7	GROUND SURFACE													
0.0	TOPSOIL: (175mm)													
0.2	Clayey SILT , trace sand, trace gravel, trace rootlets Firm to stiff Brown Moist		1	SS	8		201							
			2	SS	12									
200.3							200							
1.4	Clayey SILT to Silty CLAY , some sand to sandy, trace gravel, occasional cobbles and boulders Firm to Hard Brown to Grey Moist (TILL)		3	SS	15		200							
			4	SS	15		199							
			5	SS	21		199							
							198							
			6	SS	10		197							
							196							
			7	SS	6		195							
							194							
			8	SS	10		193							
							192							
			9	SS	13									

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+³, ×³: Numbers refer to
Sensitivity


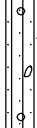
20
15
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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CPR 17-14

2 OF 2

METRIC

W.P. _____ LOCATION N 4 853 399.7 E 292 209.9 ORIGINATED BY JZ
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.06.16 - 2017.06.16 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page						20	40	60	80	100					
			10	SS	61											
190.0																
11.7	SAND and SILT , some clay, trace gravel Very Dense Grey Moist (TILL)		11	SS	99											2 40 42 16
188.9																
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No CPR 17-15

2 OF 2

METRIC

W.P. _____ LOCATION N 4 853 489.5 E 292 144.9 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.05.10 - 2017.05.10 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p	W	W _L		
	Continued From Previous Page							20	40	60	80	100					
190.5			10	SS	21		192										
11.7	SAND and SILT , trace gravel Very Dense Grey Moist (TILL)						191										
189.6			11	SS	100/ 0.250		190										
12.6	END OF BOREHOLE AT 12.6m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

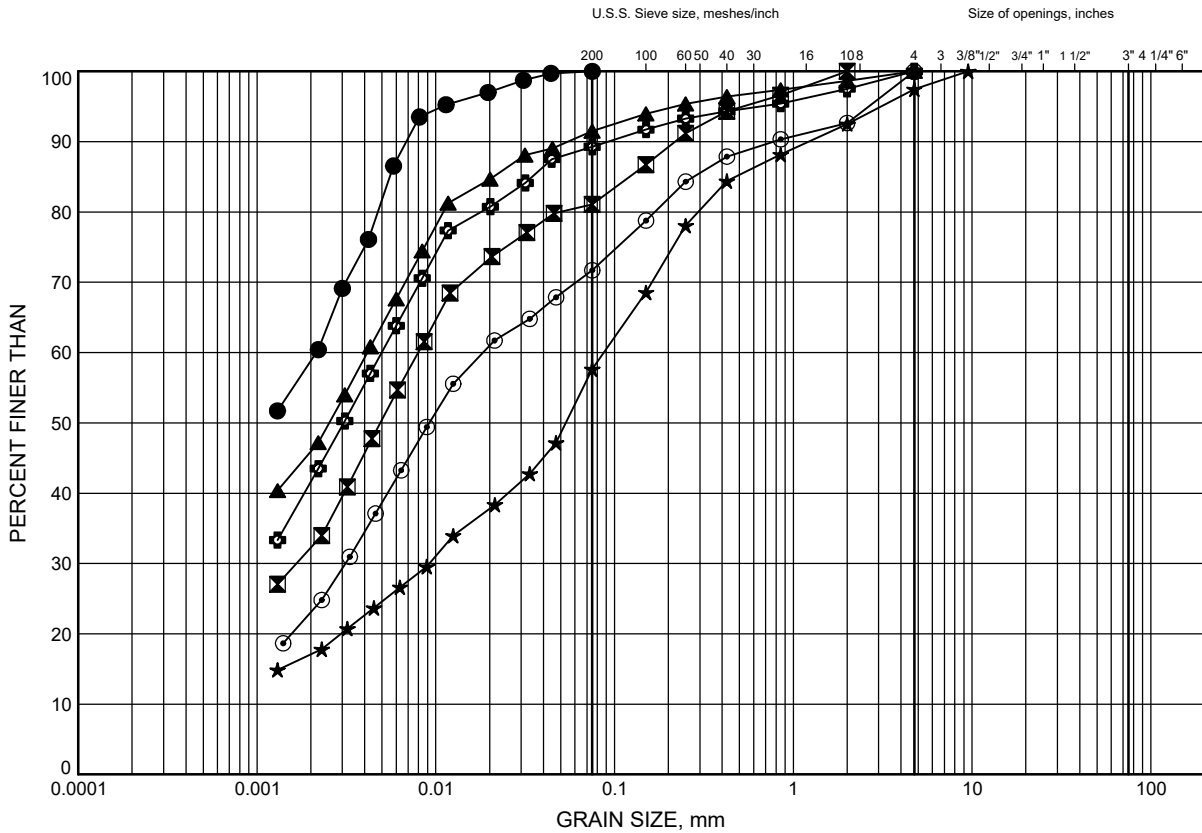
Appendix B

Geotechnical and Analytical Laboratory Test Results – Current Investigation

GRAIN SIZE DISTRIBUTION

FIGURE B1a

Clayey SILT to Silty CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-01	4.9	197.4
⊠	CPR 17-01	9.4	192.9
▲	CPR 17-03	2.6	199.7
★	CPR 17-03	6.4	195.9
⊙	CPR 17-04	11.0	190.5
⊕	CPR 17-05	7.9	192.7

Date November 2017

W.P.



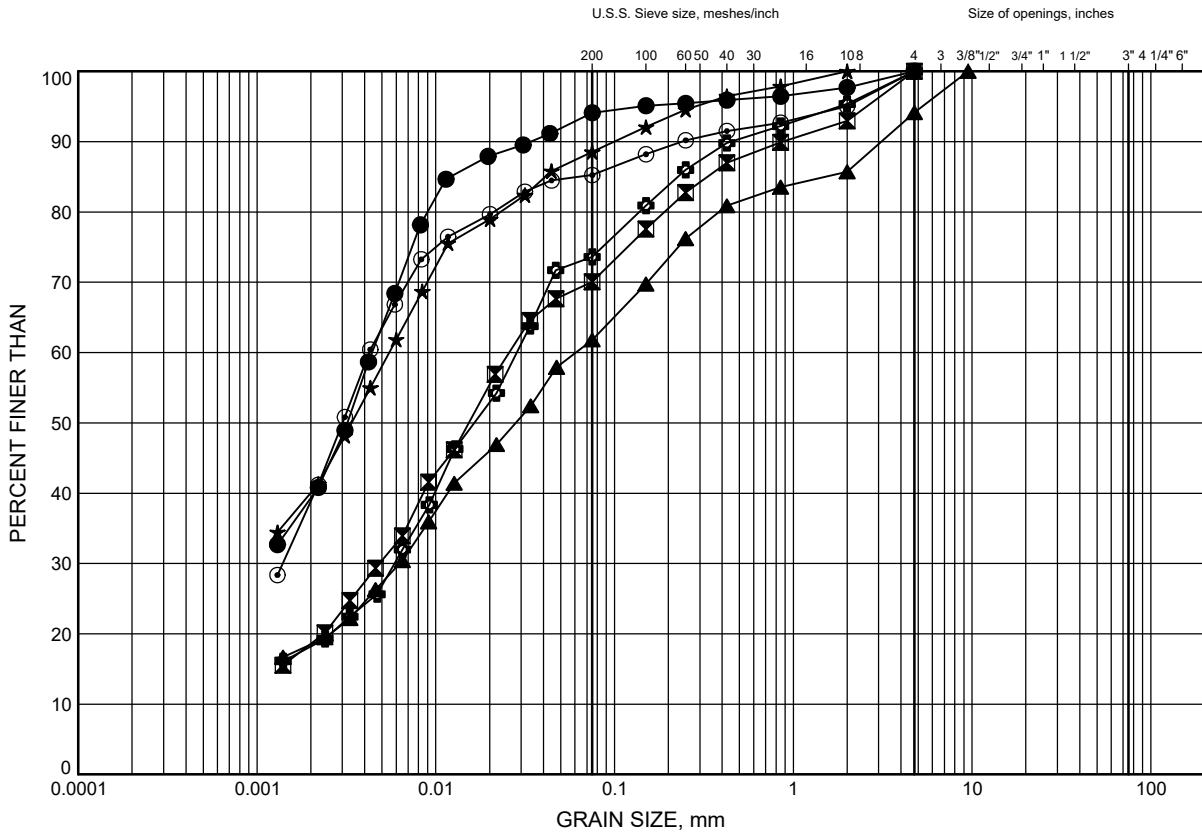
Prep'd AN

Chkd. GRL

GRAIN SIZE DISTRIBUTION

FIGURE B1b

Clayey SILT to Silty CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-05	14.2	186.4
⊠	CPR 17-06	11.0	190.8
▲	CPR 17-07	17.1	185.0
★	CPR 17-08	9.4	192.4
⊙	CPR 17-09	14.0	186.5
⊕	CPR 17-10	15.5	186.6

Date November 2017

W.P.



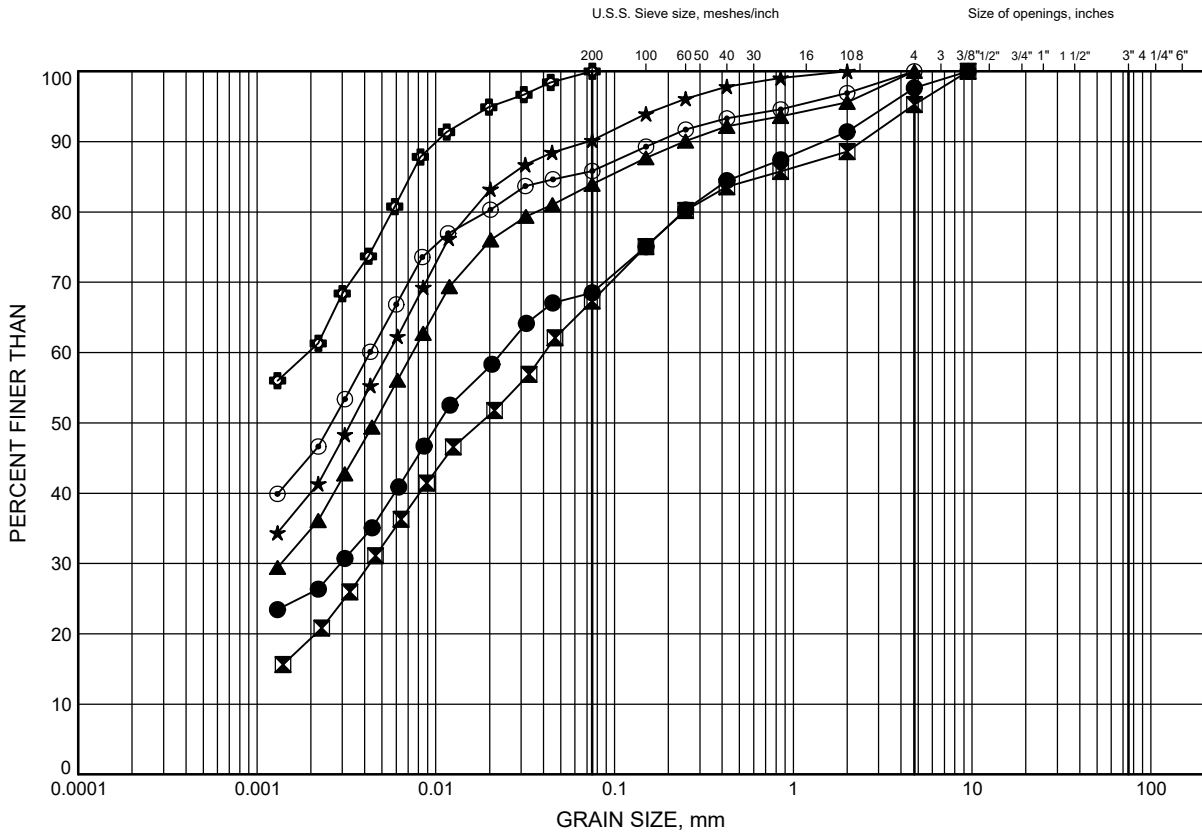
Prep'd AN

Chkd. GRL

GRAIN SIZE DISTRIBUTION

FIGURE B1c

Clayey SILT to Silty CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-10	18.6	183.5
⊠	CPR 17-11	10.9	190.4
▲	CPR 17-13	3.4	198.5
★	CPR 17-13	7.9	194.0
⊙	CPR 17-14	3.4	198.3
⊕	CPR 17-15	4.9	197.3

Date November 2017

W.P.



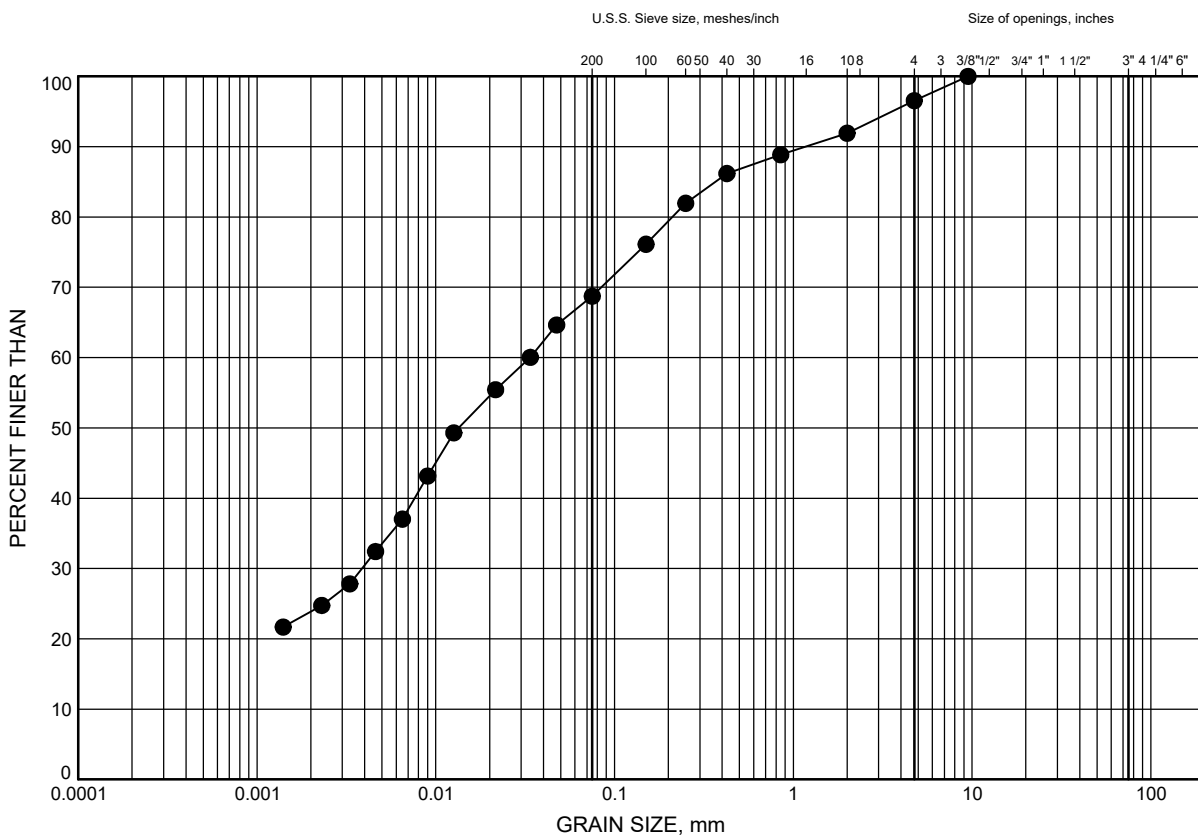
Prep'd AN

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GRAIN SIZE DISTRIBUTION

FIGURE B1d

Clayey SILT to Silty CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-15	11.0	191.2

Date November 2017

W.P.



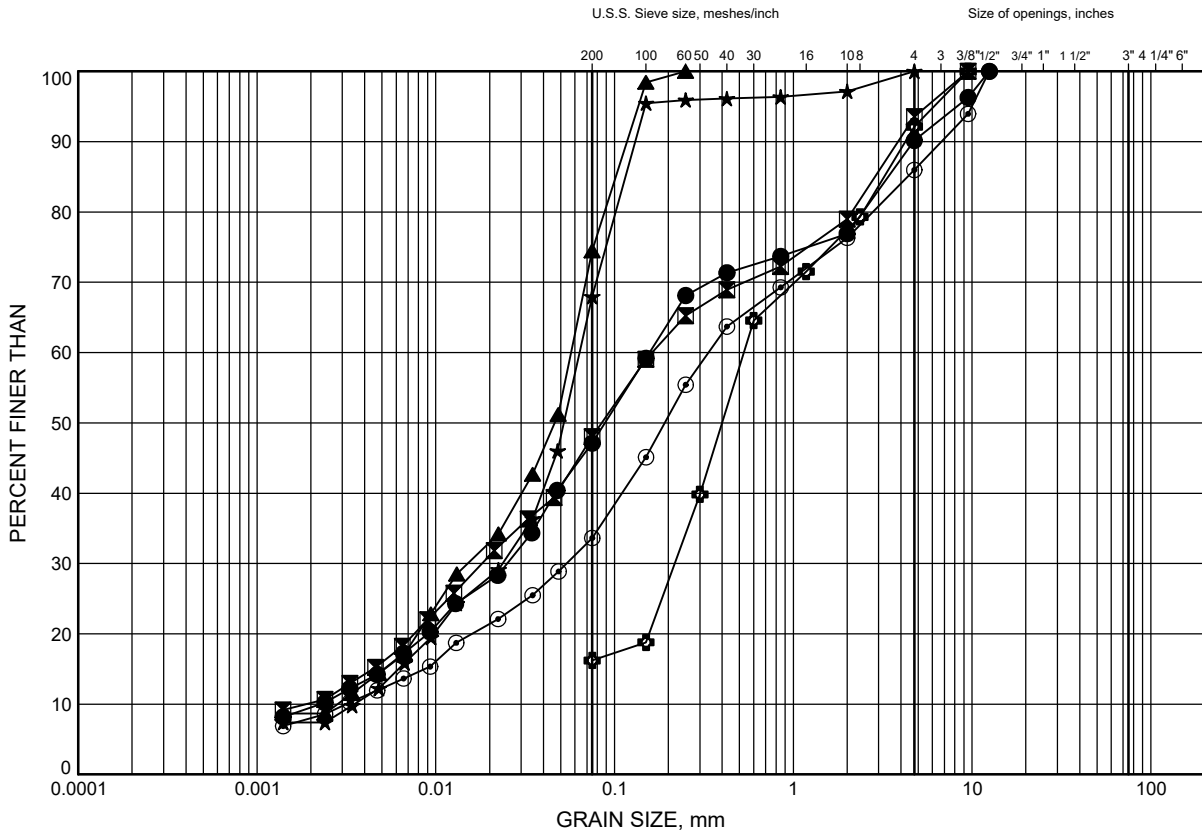
Prep'd AN

Chkd. GRL

GRAIN SIZE DISTRIBUTION

FIGURE B2a

SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-04	14.0	187.5
⊠	CPR 17-04	17.1	184.4
▲	CPR 17-05	18.6	182.0
★	CPR 17-06	20.0	181.8
⊙	CPR 17-07	6.4	195.7
⊕	CPR 17-08	13.8	188.0

Date November 2017

W.P.



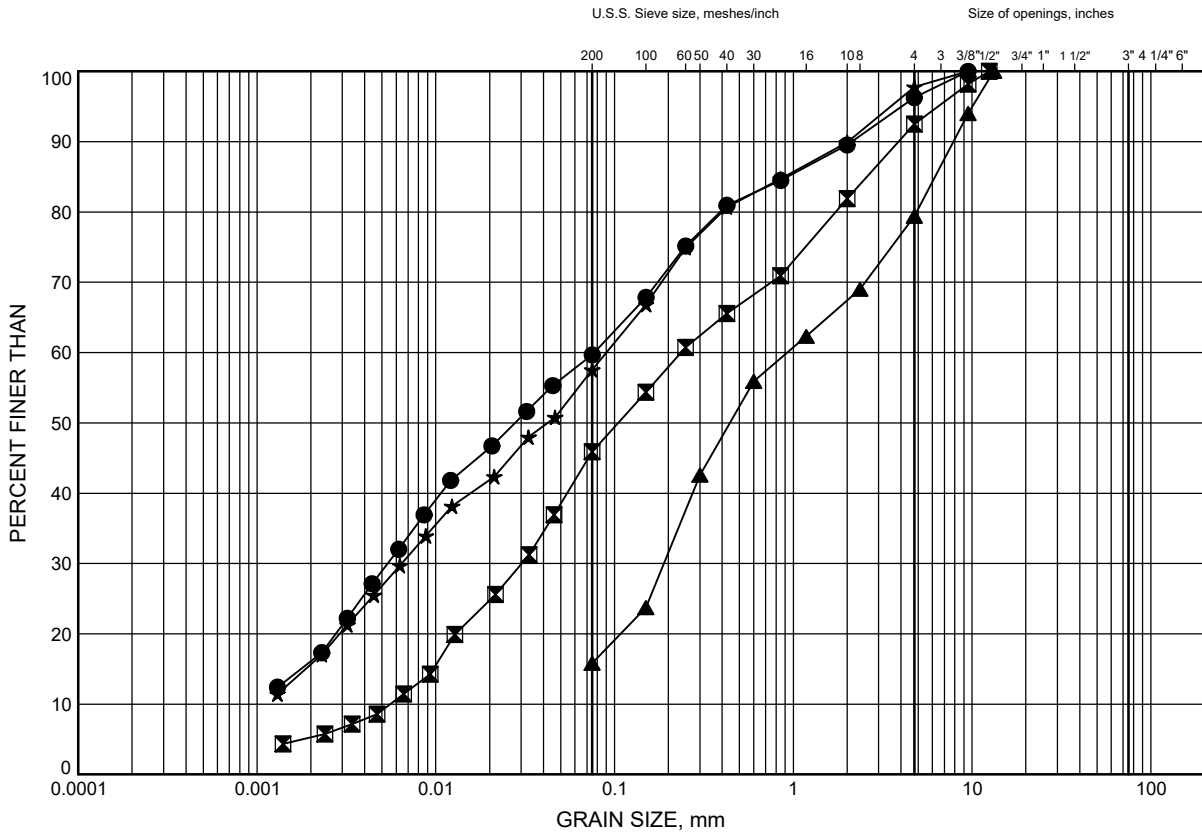
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Chkd. GRL

GRAIN SIZE DISTRIBUTION

FIGURE B2b

SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-09	17.1	183.4
⊠	CPR 17-10	52.0	150.1
▲	CPR 17-13	11.0	190.9
★	CPR 17-14	12.5	189.2

Date November 2017

W.P.



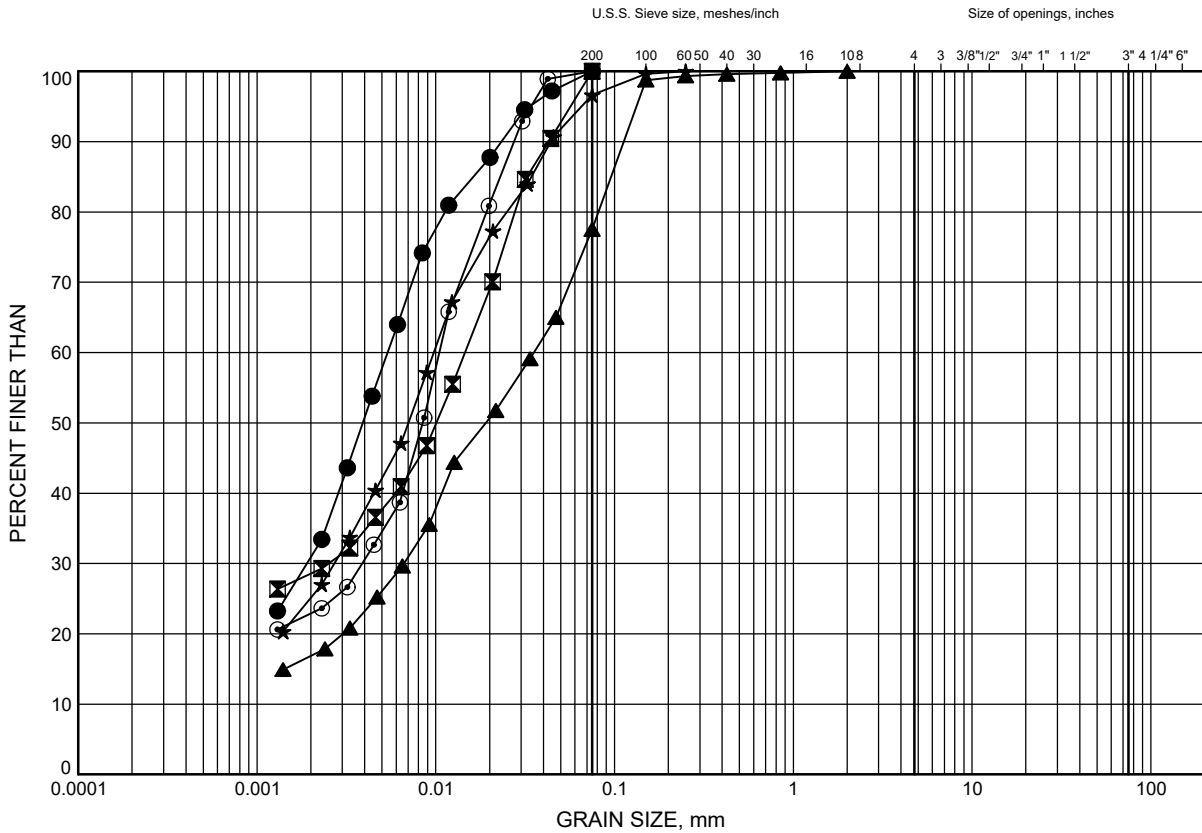
Prep'd AN

Chkd. GRL

GRAIN SIZE DISTRIBUTION

FIGURE B3

Clayey SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-04	27.7	173.8
⊠	CPR 17-04	36.9	164.6
▲	CPR 17-08	21.6	180.2
★	CPR 17-09	24.7	175.8
⊙	CPR 17-10	30.8	171.3

Date November 2017

W.P.

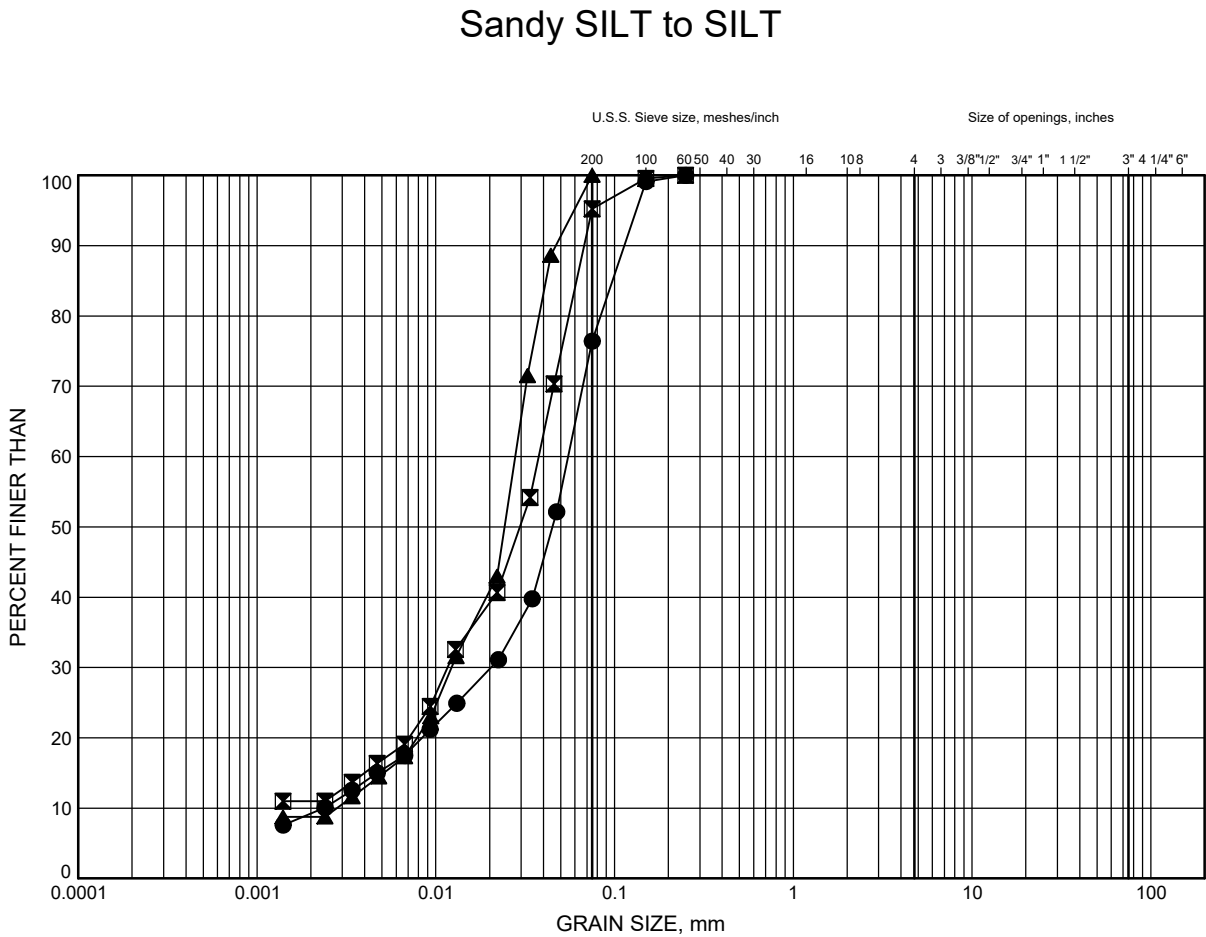


Prep'd an

Chkd. grl

GRAIN SIZE DISTRIBUTION

FIGURE B4



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-04	43.0	158.5
⊠	CPR 17-07	27.7	174.4
▲	CPR 17-10	43.0	159.1

Date November 2017
W.P. _____

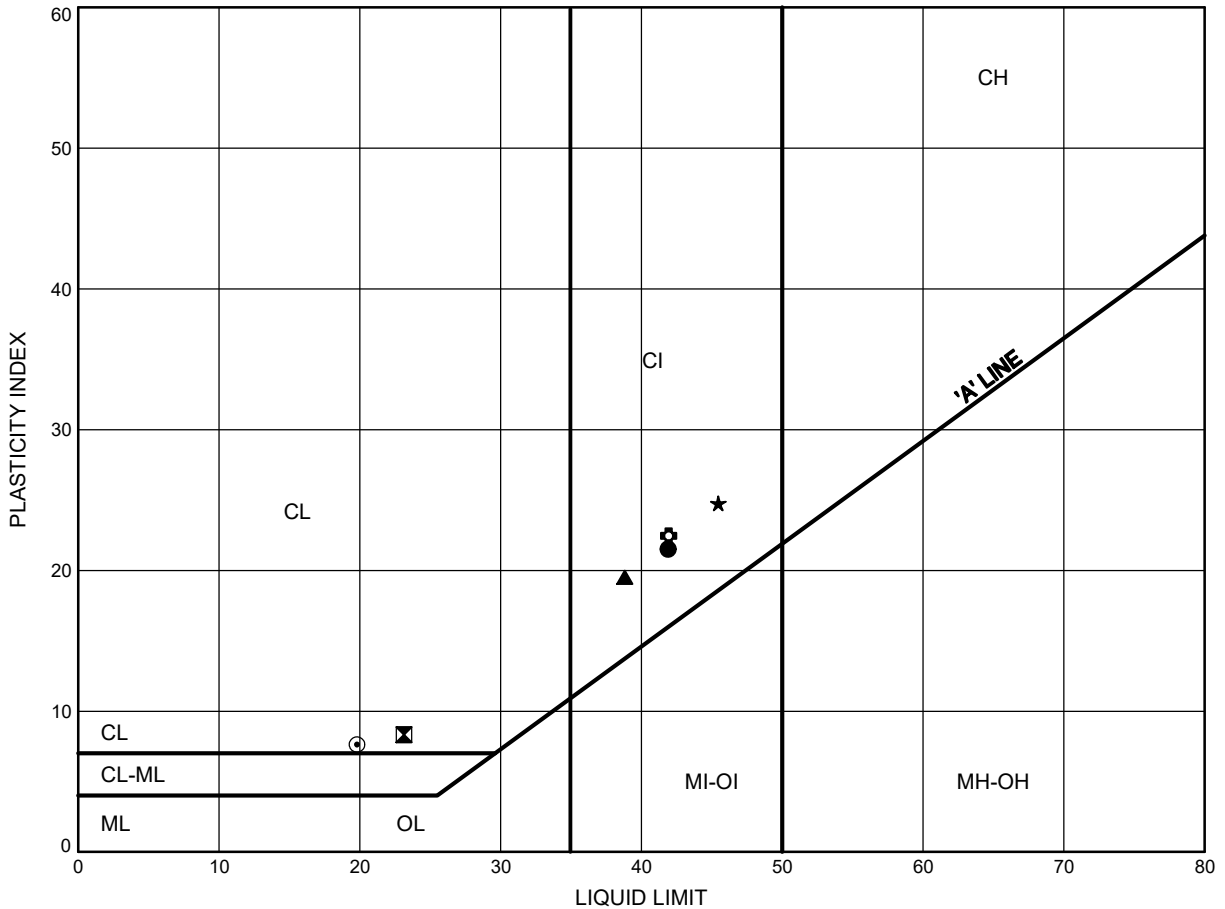


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ATTERBERG LIMITS TEST RESULTS

FIGURE B5a

Clayey SILT to Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-01	4.9	197.4
⊠	CPR 17-01	9.4	192.9
▲	CPR 17-03	2.6	199.7
★	CPR 17-04	4.9	196.6
⊙	CPR 17-04	11.0	190.5
⊕	CPR 17-05	1.8	198.8

Date November 2017
W.P.

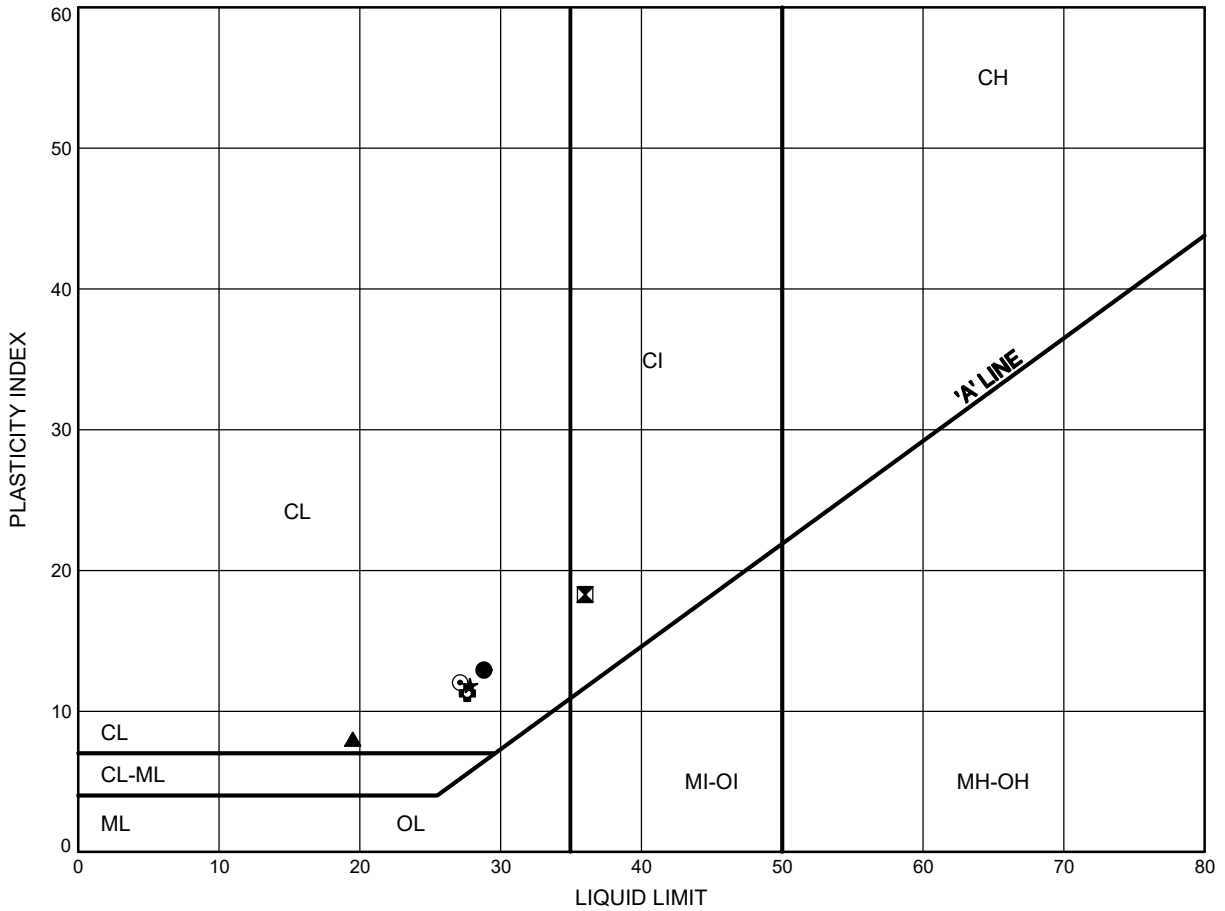


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ATTERBERG LIMITS TEST RESULTS

FIGURE B5b

Clayey SILT to Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-05	7.9	192.7
⊠	CPR 17-06	4.9	196.9
▲	CPR 17-07	11.0	191.1
★	CPR 17-08	9.4	192.4
⊙	CPR 17-09	6.4	194.1
⊕	CPR 17-09	14.0	186.5

Date November 2017
W.P.

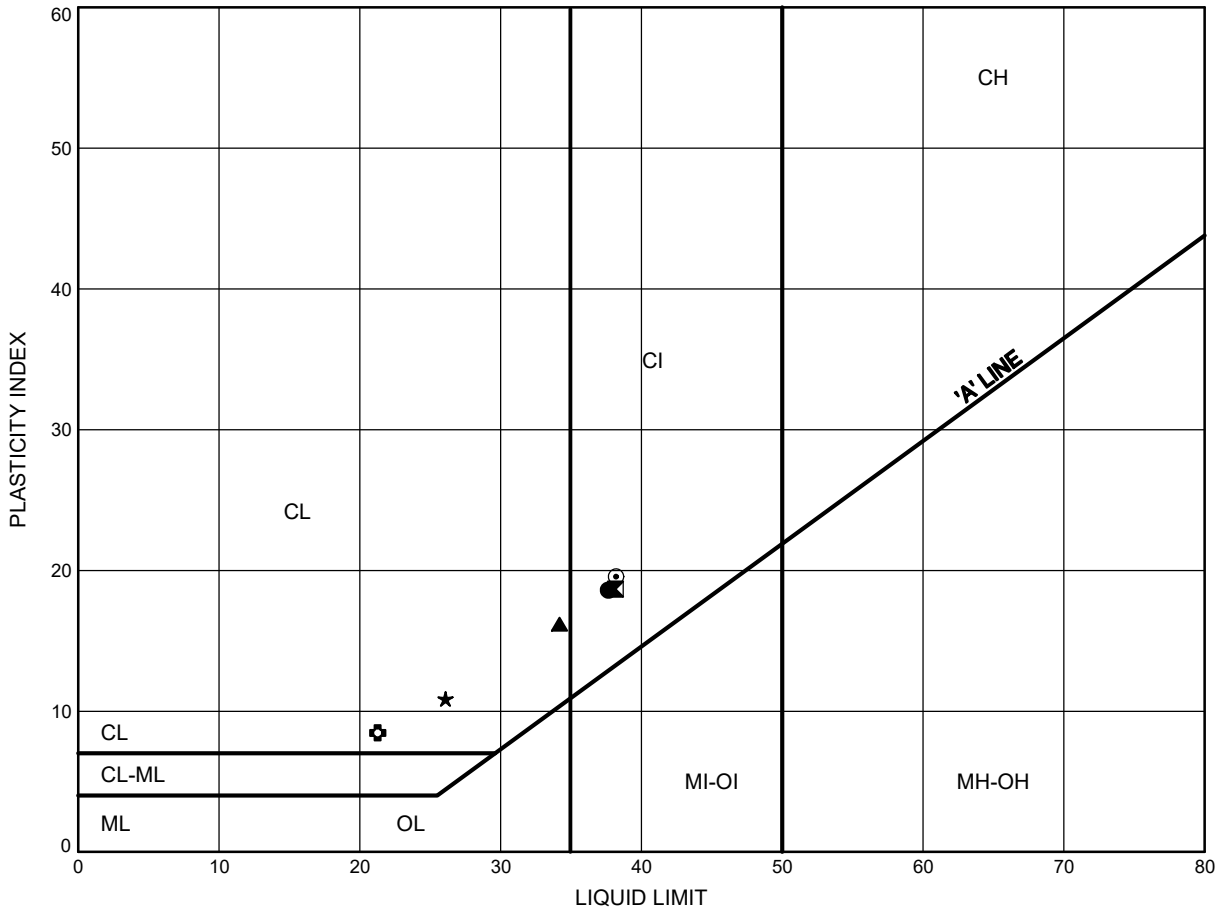


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ATTERBERG LIMITS TEST RESULTS

FIGURE B5c

Clayey SILT to Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-10	1.1	201.0
⊠	CPR 17-11	1.8	199.5
▲	CPR 17-13	3.4	198.5
★	CPR 17-13	7.9	194.0
⊙	CPR 17-14	3.4	198.3
⊕	CPR 17-14	9.4	192.3

Date November 2017
W.P.

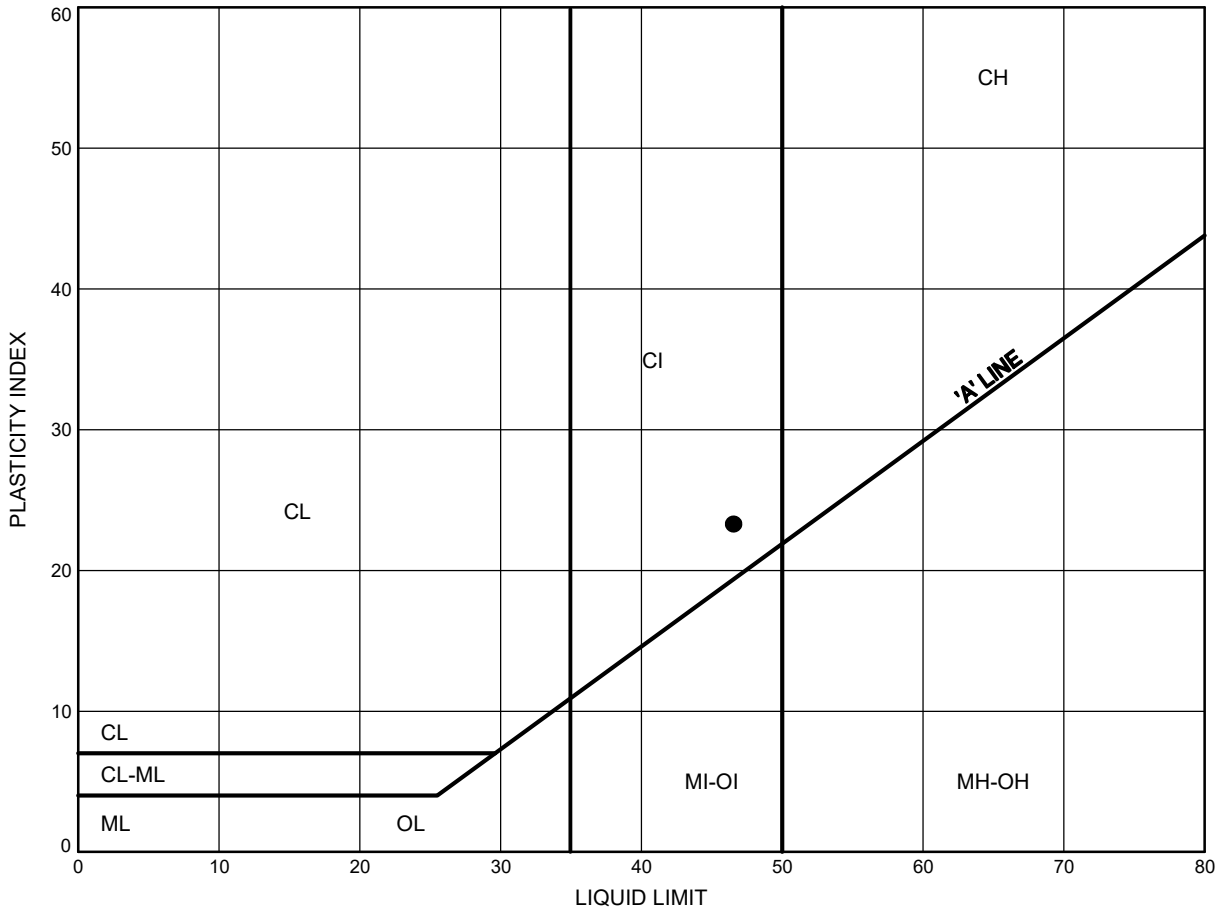


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ATTERBERG LIMITS TEST RESULTS

FIGURE B5d

Clayey SILT to Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-15	4.9	197.3

Date November 2017
W.P.

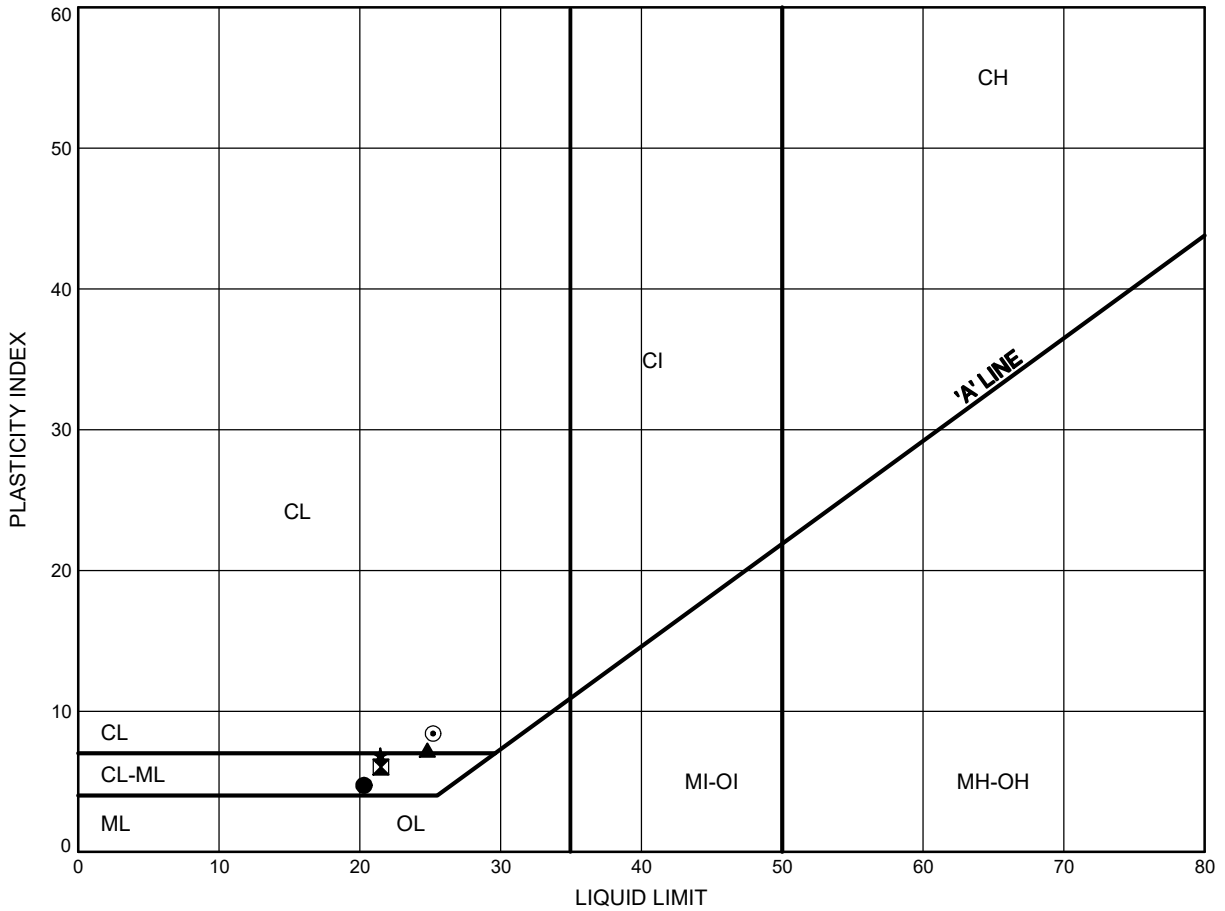


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ATTERBERG LIMITS TEST RESULTS

FIGURE B6

Clayey SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CPR 17-04	36.9	164.6
⊠	CPR 17-06	27.7	174.1
▲	CPR 17-08	32.3	169.5
★	CPR 17-10	21.6	180.5
⊙	CPR 17-10	36.9	165.2

Date November 2017
W.P.



Prep'd AN
Chkd. GRL



SGS Canada Inc.

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Thurber Engineering Ltd.
Attn : Mohammad Egtesadi

103, 2010 Winston Park Drive
Oakville, ON
L6H 5R7,

Phone: 905-829-8666 x 263
Fax:

CPR

Project : PO#12307 Hwy 427

01-June-2017

Date Rec. : 26 May 2017
LR Report: CA14807-MAY17
Reference: PO#12307 Mohammad Egtesadi

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: CPR 17-06 SS3
Sample Date & Time					15-May-17
Temperature Upon Receipt [°C]	---	---	---	---	8.0
Corrosivity Index [none]	01-Jun-17	17:14	01-Jun-17	17:14	11
Soil Redox Potential [mV]	29-May-17	14:52	30-May-17	10:34	409
Sulphide [%]	01-Jun-17	12:41	01-Jun-17	12:55	< 0.02
% Moisture (wet wt) [%]	30-May-17	18:23	30-May-17	18:23	13.5
pH [no unit]	30-May-17	07:51	31-May-17	09:00	8.26
Chloride [µg/g]	31-May-17	04:30	01-Jun-17	11:43	5.0
Sulphate [µg/g]	31-May-17	04:30	01-Jun-17	11:43	22
Conductivity [uS/cm]	30-May-17	07:51	31-May-17	09:00	807
Resistivity (calculated) [Ohms.cm]	30-May-17	07:51	31-May-17	09:43	1240

Certificate of Analysis

SGS Canada Inc.
185 Concession St. Box 4300
Lakefield, Ont., Canada, K0L 2H0



Client
SGS LIMS Number
Analysis Package:

Attention: Mohammad Eghtsadi
Project#: 12307-427
Thurber Engineering Ltd.
CA14597-JUL17
Corrosivity (Soil)

Sample ID	Unit	CPR 17-07, SS5 (10-12')	CPR 17-12, SS3 (5-7')
-----------	------	-------------------------	-----------------------

Sample Date/Time		21-Jun-17	20-Jun-17
Moisture	%	16.2	14.8
pH	no unit	8.74	8.71
Corrosivity Index	none	7.5	4.0
Soil Redox Potential	mV	254	252
Sulphide	%	0.07	<0.02
Chloride	µg/g	5.2	2.1
Sulphate	µg/g	140	25
Conductivity	uS/cm	141	107
Resistivity (calculated)	Ohms.cm	7090	9350

Corrosivity Scale according to AWWA C-105.
An index greater than 10 indicates the
soil matrix may be corrosive to cast iron alloys.

Deanna Edwards B.Sc., C.Chem
Project Specialist
Environment, Health and Safety

Appendix C

Record of Borehole Sheets - Previous Investigations

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

+3, ×3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



PROJECT 06-1111-012

W.O. 05-20012

DIST Central

DATUM Geodetic

RECORD OF BOREHOLE No S26

LOCATION N 4853413.1 :E 292274.0

BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers

DATE March 11 & 12, 2009

1 OF 2

METRIC

ORIGINATED BY CR

COMPILED BY VA

CHECKED BY SMN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL							× REMOULDED
201.5	GROUND SURFACE						20 40 60 80 100										
0.9	TOPSOIL																
201.2			1	SS	15												
0.3	SILTY CLAY, some gravel, some sand, containing organics and rootlets (Reworked to a depth of 0.8 m)																
	Stiff		2	SS	10												
200.1	Brown																
1.4	Moist																
	CLAYEY SILT, some sand, trace to some gravel (TILL), containing oxidation zones		3	SS	12												
	Stiff to very stiff																
	Brown		4	SS	27												
	Moist																
			5	SS	21												
197.8																	
3.7	SILTY CLAY, trace to some sand, trace gravel (TILL)		6	SS	17												
	Stiff to very stiff																
	Grey		7	SS	14												
	Moist to wet																
			8	SS	7												
			9	TO	PH												
			10	SS	13												
192.8																	
8.7	CLAYEY SILT, some sand, trace gravel, containing cobbles and boulders (TILL)		11	SS	21												
	Very stiff to hard																
	Grey																
	Moist																
			12	SS	67												
189.6																	
11.9	SAND and SILT, trace clay, trace gravel (TILL)		13	SS	128												
	Very dense																
	Grey																
	Moist																
			14	SS	185												



PROJECT 06-1111-012

W.O. 05-20012

DIST Central

DATUM Geodetic

RECORD OF BOREHOLE No S26

LOCATION N 4853413.1 :E 292274.0

BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers

DATE March 11 & 12, 2009


2 OF 2

METRIC

ORIGINATED BY CR

COMPILED BY VA

CHECKED BY SMN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100							
								SHEAR STRENGTH kPa							
								○ UNCONFINED	+	FIELD VANE					
						● QUICK TRIAXIAL	×	REMOULDED	WATER CONTENT (%)						
						20	40	60	80	100	10	20	30	kN/m ³	GR SA SI CL
185.7	SAND and SILT, trace clay, trace gravel (TILL) Very dense Grey Moist		15	SS	168										
15.9	END OF BOREHOLE														
	NOTES: 1. Water level in open borehole at a depth of 11.5 m below ground surface (Elev. 190.0 m) upon completion of drilling. 2. Borehole caved to a depth of 13.0 m below ground surface (Elev. 188.5 m) upon removal of augers and backfilled with bentonite.														

MIS-MTO 001 06-1111-012.GPJ GAL-MISS.GDT 8/5/09 SAC/DD

MIS-MTO 001 06-1111-012.GPJ GAL-MISS.GDT 8/5/09 SAC/DD

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

+ 3, X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



PROJECT 06-1111-012 RECORD OF BOREHOLE No S27 1 OF 3 METRIC

W.O. 05-20012 LOCATION N 4853423.2 : E 292203.6 ORIGINATED BY SB

DIST Central HWY 427 BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers COMPILED BY JB/VA

DATUM Geodetic DATE March 13, 2009 CHECKED BY SMM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20 40 60 80 100	20 40 60 80 100					
201.1	GROUND SURFACE					201							
0.0	Asphalt												
200.6	Sand and gravel (FILL)												
0.5	Compact Brown Moist												
	SILTY CLAY, trace gravel, trace sand (TILL)		1	SS	15								
	Stiff to very stiff		2	SS	29								
	Brown Moist												
	Becoming grey at a depth of 2.2 m		3	SS	17								
			4	SS	13								
			5	SS	13								
196.5	CLAYEY SILT, with sand, trace to some gravel (TILL)		6	SS	9								
4.6	Stiff to hard Grey Moist												
			7	SS	10								
			8	SS	14								
			9	SS	21								
			10	SS	74								
			11	SS	168								
			12	SS	128								

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE



PROJECT 06-1111-012 RECORD OF BOREHOLE No S27 2 OF 3 METRIC

W.O. 05-20012 LOCATION N 4853423.2 : E 292203.6 ORIGINATED BY SB

DIST Central HWY 427 BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers COMPILED BY JB/VA

DATUM Geodetic DATE March 13, 2009 CHECKED BY SMM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20 40 60 80 100	20 40 60 80 100					
	— CONTINUED FROM PREVIOUS PAGE —												
	CLAYEY SILT, with sand, trace to some gravel (TILL)		13	SS	77								
	Stiff to hard Grey Moist												
			14	SS	61								
183.1													
18.0	SAND and SILT, trace clay		15	SS	55								
	Dense to very dense Grey Moist to wet												
			16	SS	48								
177.4													
23.7	Sandy SILT, trace clay		17	SS	37								
	Compact to dense Grey Moist to wet												
			18	SS	27								
172.1													
29.0	SILT, trace clay												
	Compact Grey Moist to wet												

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE



PROJECT 06-1111-012		RECORD OF BOREHOLE No S27		3 OF 3 METRIC							
W.O. 05-20012		LOCATION N 4853423.2 E 292203.6		ORIGINATED BY SB							
DIST Central HWY 427		BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers		COMPILED BY JB/VA							
DATUM Geodetic		DATE March 13, 2009		CHECKED BY SMM							
SOIL PROFILE		SAMPLES		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	10 20 30	GR SA SI CL
— CONTINUED FROM PREVIOUS PAGE —											
167.0	SILT, trace clay Compact Grey Moist to wet		19	SS	28		171				0 1 90 9
167.0	END OF BOREHOLE						170				
162.7	Dynamic Cone Penetration Test (DCPT) was performed between depths of 33.8 m and 38.4 m		20	SS	13		169				
162.7	END OF DCPT						168				
162.7	NOTES: 1. Borehole open to 25 m and dry upon completion of drilling. 2. A Dynamic Cone Penetration Test was carried out between depths of 33.8 m and 38.4 m. 3. Borehole backfilled with bentonite.						167				
162.7							166				
162.7							165				
162.7							164				
162.7							163				
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162.7							11				
162.7							10				
162.7							9				
162.7							8				
162.7							7				
162.7							6				
162.7							5				
162.7							4				
162.7							3				
162.7							2				
162.7							1				
162.7							0				

+ 3, X 3, Numbers refer to Sensitivity
○ 3% STRAIN AT FAILURE



PROJECT 06-1111-012		RECORD OF BOREHOLE No S28		1 OF 2 METRIC							
W.O. 05-20012		LOCATION N 4853435.3 E 292253.3		ORIGINATED BY SB							
DIST Central HWY 427		BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers		COMPILED BY JB/VA							
DATUM Geodetic		DATE March 17, 2009		CHECKED BY SMM							
SOIL PROFILE		SAMPLES		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	20 40 60 80 100	10 20 30	GR SA SI CL
200.8	GROUND SURFACE						200				
0.0	Asphalt						199				
0.3	Sand and gravel, trace silt (FILL)						198				
	Brown Moist						197				
	CLAYEY SILT, trace gravel, trace sand (TILL)		1	SS	23		196				
	Very stiff		2	SS	21		195				
	Brown and grey Moist		3	SS	21		194				
197.8	SILT,										



PROJECT 06-1111-012		RECORD OF BOREHOLE No S28		2 OF 2		METRIC	
W.O. 05-20012		LOCATION N 4853435.3 :E 292253.3		ORIGINATED BY SB			
DIST Central HWY 427		BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers		COMPILED BY JBVA			
DATUM Geodetic		DATE March 17, 2009		CHECKED BY SMM			
SOIL PROFILE		SAMPLES		DYNAMIC CONE PENETRATION RESISTANCE PLOT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
184.8	SAND and SILT, trace gravel, trace clay (TILL) Very dense Grey Moist		12	SS	95		185
16.0	CLAYEY SILT, some sand, trace gravel (TILL) Hard Grey Moist		13	SS	132		184
183.6	END OF BOREHOLE						
17.2	NOTES: 1. A 50 mm diameter monitoring well was installed at a depth of 16.8 m (Elev. 184.0 m). Water level measurements Date Depth Elev. On Completion 12.8 m 188.0 m April 27, 2009 8.5 m 192.3 m May 13, 2009 8.5 m 192.3 m May 25, 2009 8.6 m 192.2 m June 15, 2009 9.1 m 191.7 m July 09, 2009 9.1 m 191.7 m 2. Borehole backfilled with bentonite.						

+ 3, X 3, Numbers refer to Sensitivity
○ 3% STRAIN AT FAILURE



PROJECT 06-1111-012		RECORD OF BOREHOLE No S29		1 OF 2		METRIC	
W.O. 05-20012		LOCATION N 4853505.8 :E 292191.2		ORIGINATED BY JEB			
DIST Central HWY 427		BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers		COMPILED BY PKSVA			
DATUM Geodetic		DATE April 27, 2009		CHECKED BY SMM			
SOIL PROFILE		SAMPLES		DYNAMIC CONE PENETRATION RESISTANCE PLOT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
202.0	GROUND SURFACE						
201.7	TOPSOIL		1	SS	9		
0.3	SILTY CLAY, trace sand, trace gravel (Reworked to a depth of 0.8 m) Stiff Brown Moist		2	SS	10		201
200.6	CLAYEY SILT, trace to some sand, trace gravel (TILL) Stiff to hard Brown becoming grey below a depth of 2.3 m Moist		3	SS	11		200
1.4			4	SS	23		199
			5	SS	18		198
			6	SS	18		197
			7	SS	12		196
			8	SS	10		195
			9	SS	8		194
			10	SS	14		193
			11	SS	32		192
			12	SS	79		191
			13	SS	20/0.25		190
188.3	SAND and SILT, trace gravel, trace clay (TILL) Very dense Grey Moist						189
13.7							188

Continued Next Page

+ 3, X 3, Numbers refer to Sensitivity
○ 3% STRAIN AT FAILURE



PROJECT 06-1111-012

W.O. 05-20012

DIST Central

DATUM Geodetic

RECORD OF BOREHOLE No S29

2 OF 2

METRIC

LOCATION N 4853505.8 ; E 292191.2

BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers

DATE April 27, 2009

ORIGINATED BY JEB

COMPILED BY PKS/VA

CHECKED BY SMM

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20	40	60	80	100	10
— CONTINUED FROM PREVIOUS PAGE —																							
	SAND and SILT, trace gravel, trace clay (TILL) Very dense Grey Moist Becoming wet below a depth of 15.2 m		14	SS	80																		
183.7																							
183.4	CLAYEY SILT, trace sand, trace gravel (TILL) Hard Grey Wet		15	SS	100/0.1																		
182.4	END OF BOREHOLE																						
19.7	End of DCPT Dynamic Cone Penetration Test (DCPT) below a depth of 18.7 m																						
NOTES: 1. At 15.2 m depth (Elev. 186.8 m) 1.0 m of sand was up inside the augers during drilling due to "blowing" sands. 2. Water level in open borehole at a depth of 15.2 m below ground surface (Elev. 186.8 m) upon completion of drilling. 3. Borehole backfilled with bentonite.																							

+ 3, X 3: Numbers refer to Sensitivity
O 3% STRAIN AT FAILURE



PROJECT 06-1111-012

W.O. 05-20012

DIST Central

DATUM Geodetic

RECORD OF BOREHOLE No S30

1 OF 2

METRIC

LOCATION N 4853513.2 ; E 292239.8

BOREHOLE TYPE 200 mm Outside Diameter Hollow Stem Augers

DATE April 27, 2009

ORIGINATED BY JEB

COMPILED BY PKS/VA

CHECKED BY SMM

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20	40	60	80	100	10
202.3	GROUND SURFACE																						
202.0	TOPSOIL																						
0.3	CLAYEY SILT, some sand, trace gravel, containing organics (Reworked)		1	SS	8																		
201.5	Stiff Brown Moist		2	SS	22																		
0.8	SILTY CLAY, trace sand, trace gravel (TILL) Stiff to very stiff Brown grey Moist		3	SS	27																		
			4	SS	28																		
			5	SS	29																		
			6	SS	14																		
	Becoming grey below a depth of 4.6 m		7	SS	13																		
196.7																							
5.6	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to very stiff Grey Moist		8	SS	9																		
			9	SS	9																		
			10	SS	18																		
191.9																							
10.4	Silty SAND, trace gravel, trace clay Dense Grey Wet		11	SS	32																		
191.1																							
11.2	CLAYEY SILT, with sand, trace gravel (TILL) Hard Grey Moist		12	SS	126																		
188.6	Auger grinding at a depth of 13.4 m																						
13.7	SAND and SILT, some gravel, trace clay (TILL) Very dense Grey Wet		13	SS	140																		

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity
O 3% STRAIN AT FAILURE

MIS-MTO 001 06-1111-012.GPJ GAL-MISS.GDT 8/5/09 SAC/DD

MIS-MTO 001 06-1111-012.GPJ GAL-MISS.GDT 8/5/09 SAC/DD



PROJECT <u>06-1111-012</u>		RECORD OF BOREHOLE No S30		2 OF 2	METRIC
W.O.	05-20012	LOCATION	N 4853513.2 ; E 292239.8	ORIGINATED BY	JEB
DIST	Central HWY 427	BOREHOLE TYPE	200 mm Outside Diameter Hollow Stem Augers	COMPILED BY	PKS/VA
DATUM	Geodetic	DATE	April 27, 2009	CHECKED BY	SMM <i>SM</i>

SOIL PROFILE						SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	20	40	60			80					
186.7 15.6	<p>— CONTINUED FROM PREVIOUS PAGE —</p> <p>SAND and SILT, some gravel, trace clay (TILL) Very dense Grey Wet Auger grinding at a depth of 14.6 m</p> <p>END OF BOREHOLE</p> <p>NOTES:</p> <p>1. Water level in open borehole at a depth of 10.7 m below ground surface (Elev. 191.6 m) upon completion of drilling.</p> <p>2. Borehole backfilled with bentonite.</p>		14	SS	20/0.25						187					

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

MIS-MTO 001 06-1111-012.GPJ GAL-MISS.GDT 8/5/09 SAC/DD

RECORD OF BOREHOLE No MGR-1 1 of 2 METRIC																						
G.W.P. _____		LOCATION Coords: 4 853 463.3 N; 292 187.8 E				ORIGINATED BY F.P.																
DIST Central HWY 427		BOREHOLE TYPE Solid Stem Augers to 3.5m, then Mud Rotary and Tricone				COMPILED BY N.L.																
DATUM Geodetic		DATE November 11, 2015				CHECKED BY A.V.																
SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE					○ QUICK TRIAXIAL × LAB VANE									
202.1	Ground Surface							20	40	60	80	100										
0.0	TOPSOIL		1	SS	6		202															
201.8																						
0.3	SILTY CLAY																					
	Firm to stiff Brown and grey Moist to wet		2	SS	10		201															
200.7																						
1.4	CLAYEY SILT to SILTY CLAY, trace to with sand, trace gravel		3	SS	30		200															
	Stiff to hard Brown becoming grey below a depth of 3.8m Moist		4	SS	29																	
	(TILL)		5	SS	20		199															
			6	SS	18		198															
			7	SS	15		197															
			8	SS	26																	
			9	SS	19		196															
			10	SS	9		195															
				FV			194															
			11	SS	15		193															
							192															
			12	SS	29		191															
			13	SS	41		190															
188.9							189															
13.2	SILT and SAND, trace clay, trace gravel		14	SS	101/25cm		188															
	Very dense Grey Moist																					
	(TILL)																					
187.1	Cont'd																					

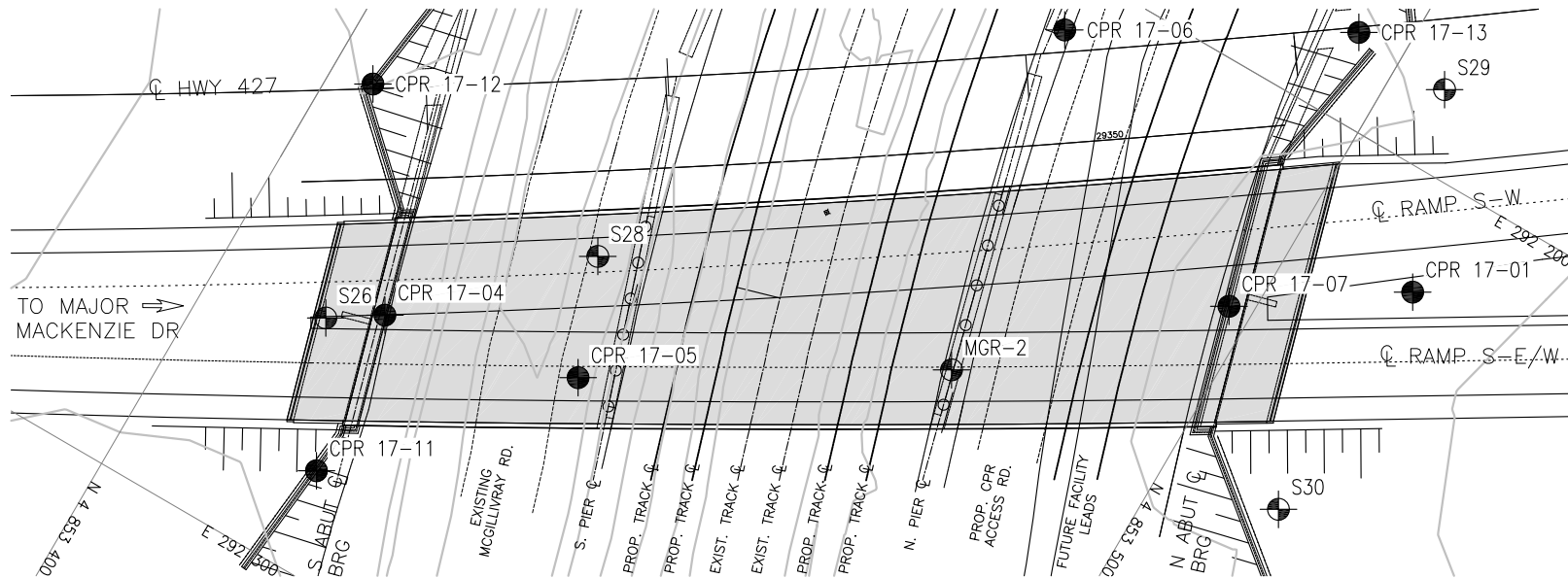
RECORD OF BOREHOLE No MGR-1 2 of 2 METRIC																			
G.W.P. _____		LOCATION Coords: 4 853 463.3 N; 292 187.8 E				ORIGINATED BY F.P.													
DIST Central HWY 427		BOREHOLE TYPE Solid Stem Augers to 3.5m, then Mud Rotary and Tricone				COMPILED BY N.L.													
DATUM Geodetic		DATE November 11, 2015				CHECKED BY A.V.													
SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)	
187.1								20	40	60	80	100							
15.0	(Cont'd) SAND and SILT, trace clay, trace gravel		15	SS	103/15cm		187												
	Very dense Grey Moist						186												
	(TILL)																		
185.0			16	SS	100/23cm		185												
17.1	End of borehole																		
	Note: 1. Groundwater level cannot be measured upon completion of drilling due to utilization of mud rotary drilling technique.																		

RECORD OF BOREHOLE No MGR-2 1 of 2 METRIC																					
G.W.P. _____		LOCATION Coords: 4 853 474.8 N; 292 244.6 E				ORIGINATED BY F.P.															
DIST Central HWY 427		BOREHOLE TYPE Solid Stem Augers to 3.8m, then Mud Rotary and Tricone				COMPILED BY N.L.															
DATUM Geodetic		DATE November 10, 2015				CHECKED BY A.V.															
SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE					○ QUICK TRIAXIAL × LAB VANE								
								20 40 60 80 100					20 40 60 80 100								
201.5	Ground Surface																				
0.0	TOPSOIL		1	SS	7		201														
201.2																					
0.3	SILTY CLAY, trace sand																				
200.7	Firm																				
0.8	Brown and grey		2	SS	34																
	Moist																				
	CLAYEY SILT to SILTY CLAY, trace to with sand, trace gravel						200														
			3	SS	28																
	Stiff to hard																				
	Brown becoming grey below a depth of 3.0m																				
	Moist to wet																				
	(TILL)		4	SS	26		199														
			5	SS	18																
							198														
			6	SS	19																
			7	SS	14		197														
			8	SS	13																
							196														
			9	SS	11																
							195														
				FV																	
			10	SS	11		194														
							193														
			11	SS	15		192														
							191														
							190														
			13	SS	64		189														
188.3																					
13.2	SILT and SAND, trace clay, trace gravel						188														
	Very dense																				
	Grey		14	SS	75																
	Wet																				
	(TILL)						187														
186.5	Cont'd																				

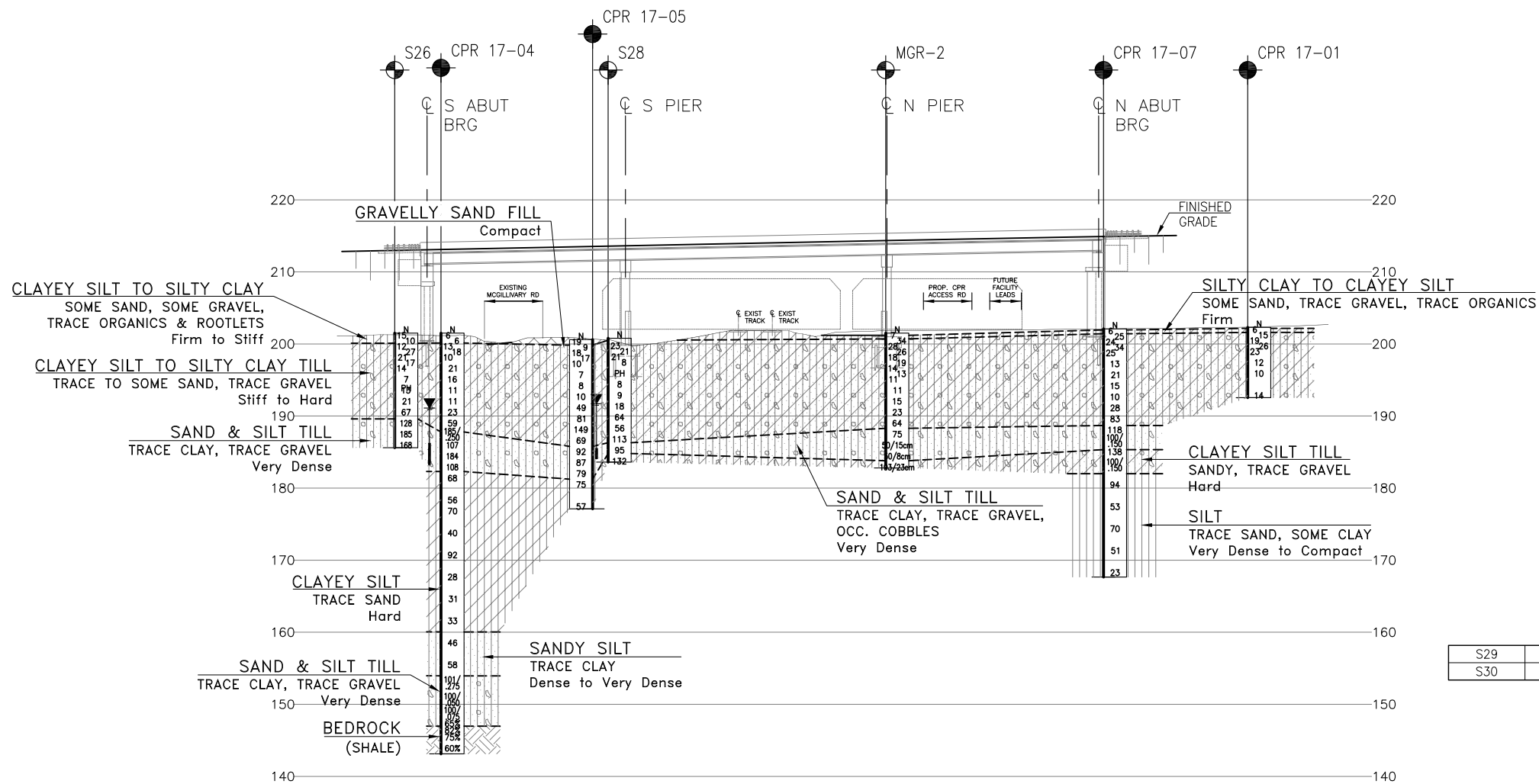
RECORD OF BOREHOLE No MGR-2 2 of 2 METRIC																					
G.W.P. _____		LOCATION Coords: 4 853 474.8 N; 292 244.6 E				ORIGINATED BY F.P.															
DIST Central HWY 427		BOREHOLE TYPE Solid Stem Augers to 3.8m, then Mud Rotary and Tricone				COMPILED BY N.L.															
DATUM Geodetic		DATE November 10, 2015				CHECKED BY A.V.															
SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE					○ QUICK TRIAXIAL × LAB VANE								
								20 40 60 80 100					20 40 60 80 100								
186.5																					
15.0	SILT and SAND, trace clay, trace gravel		15	SS	50/15cm		186														
	Very dense																				
	Grey																				
	Wet																				
	(TILL)						185														
			16	SS	50/8cm																
183.8							184														
17.7	CLAYEY SILT, some sand, trace gravel																				
	Hard																				
	Grey		17	SS	103/23cm		183														
182.8	Moist																				
18.7	(TILL)																				
	End of borehole																				
	Note:																				
	1. Groundwater level cannot be measured upon completion of drilling due to utilization of mud rotary drilling technique.																				

Appendix D

Borehole Locations and Soil Strata Drawings

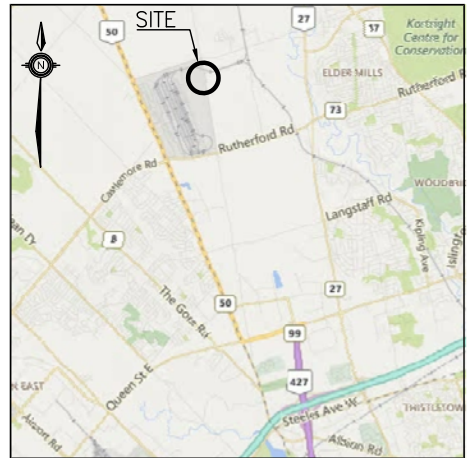


PLAN



PROFILE ALONG C℄ HWY 427 NBL

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



KEYPLAN

LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
CPR 17-01	202.3	4 853 513.9	292 212.0
CPR 17-02	201.7	4 853 389.6	292 235.4
CPR 17-03	202.3	4 853 506.1	292 159.1
CPR 17-04	201.5	4 853 418.5	292 270.5
CPR 17-05	200.6	4 853 440.1	292 265.8
CPR 17-06	201.8	4 853 466.8	292 206.4
CPR 17-07	202.1	4 853 497.4	292 223.4
CPR 17-08	201.8	4 853 406.9	292 225.4
CPR 17-09	200.5	4 853 431.1	292 222.1
CPR 17-10	202.1	4 853 488.7	292 169.3
CPR 17-11	201.3	4 853 420.6	292 288.9
CPR 17-12	201.8	4 853 404.7	292 249.4
CPR 17-13	201.9	4 853 494.6	292 190.5
CPR 17-14	201.7	4 853 399.7	292 209.9
CPR 17-15	202.2	4 853 489.5	292 144.9
MGR-1	202.1	4 853 463.3	292 187.8
MGR-2	201.5	4 853 474.8	292 244.6
S25	201.8	4 853 399.9	292 226.9
S26	201.5	4 853 413.1	292 274.0
S27	201.1	4 853 423.2	292 203.6
S28	200.8	4 853 435.3	292 253.3

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No.

HWY 427 EXPANSION
HWY 427 NBL AT CPR/McGILLIVRAY ROAD
OVERHEAD

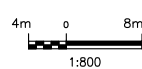
BOREHOLE LOCATIONS AND SOIL STRATA

PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	I	5	STR	B17A	DWG	501	0

FILENAME: H:\Drafting\19000\19484\1ED19484-DLPR-HWY 427 Ramp 407 CPR-McGillivray Rd.dwg
PLOTDATE: 7/17/2019 4:03 PM

NO.	DATE	REVISIONS	BY	CHK	LEAD	PROJ. MGR.
0	19/07/18	ISSUED FOR CONSTRUCTION	AN	KS	JL	JL

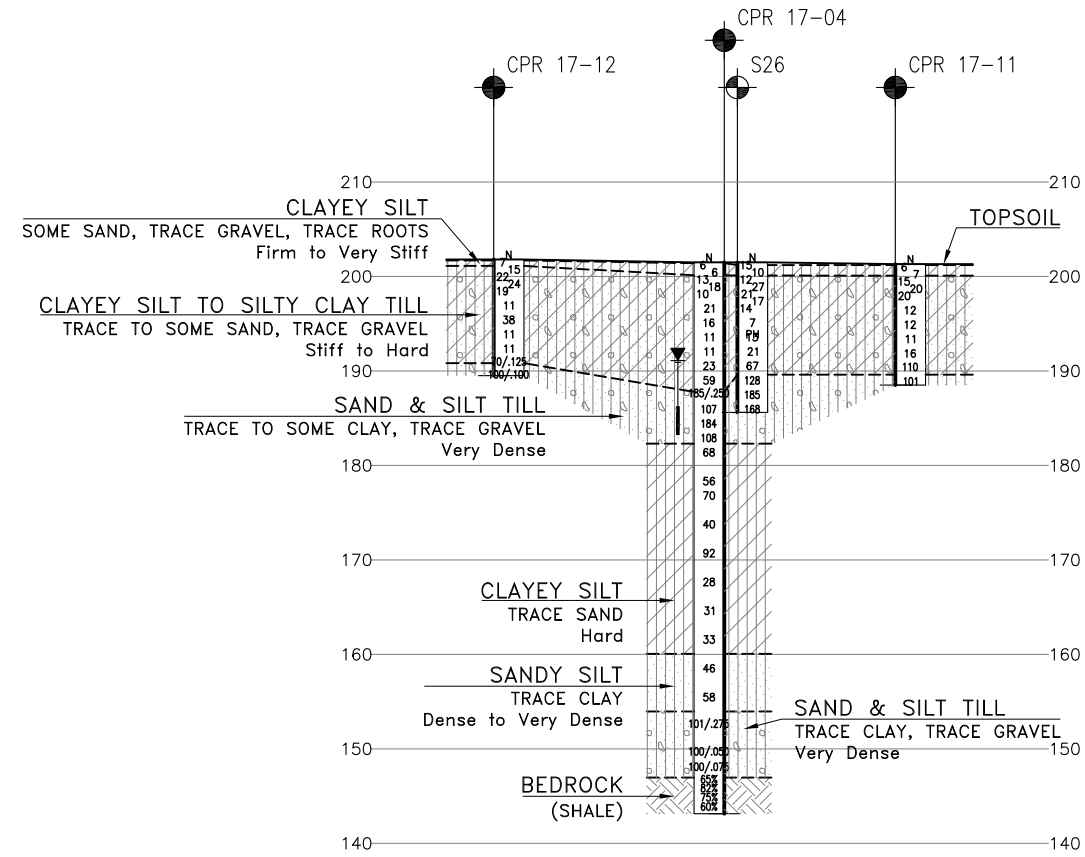
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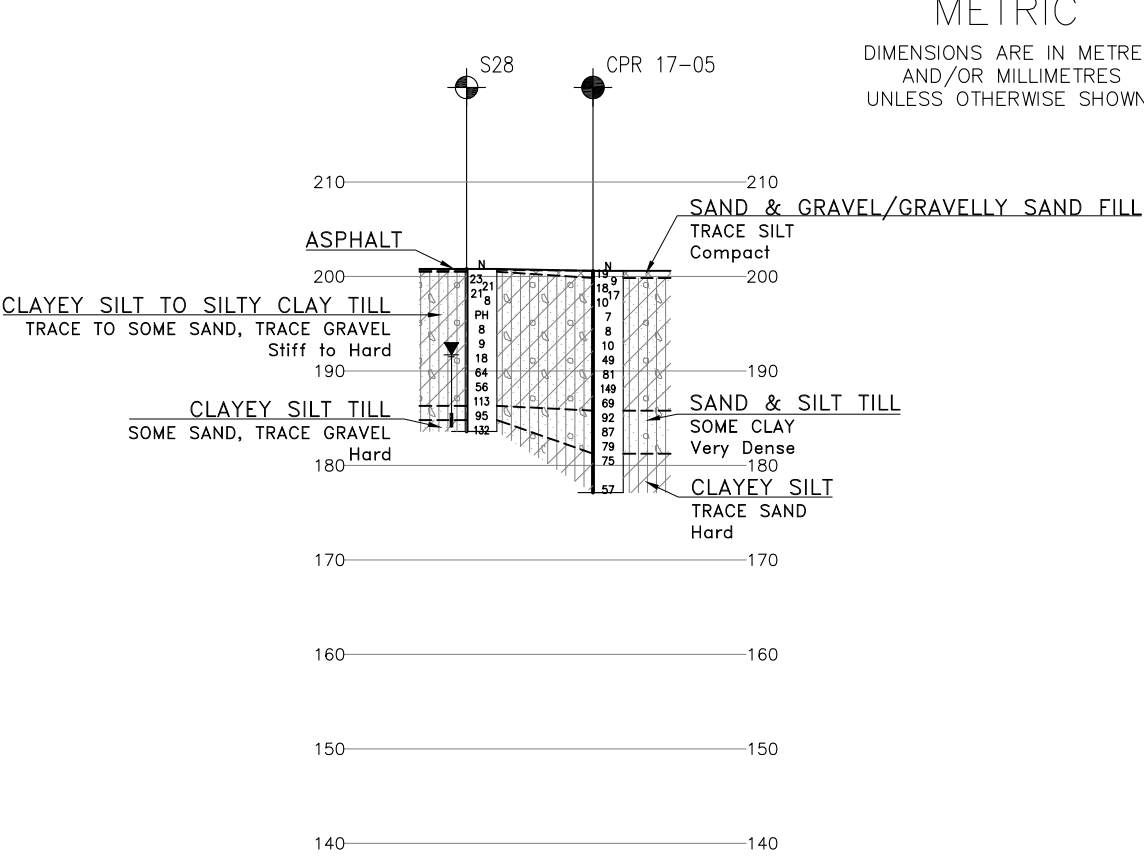
DESIGNED	A. PIASIK	AP	19/07/18
DRAWN	A. NOOR	AN	19/07/18
CHECKED	K. SHI	KS	19/07/18
APPROVED LEAD ENGINEER	J. LEE	JL	19/07/18
APPROVED PROJ. MANAGER	J. LEE	JL	19/07/18



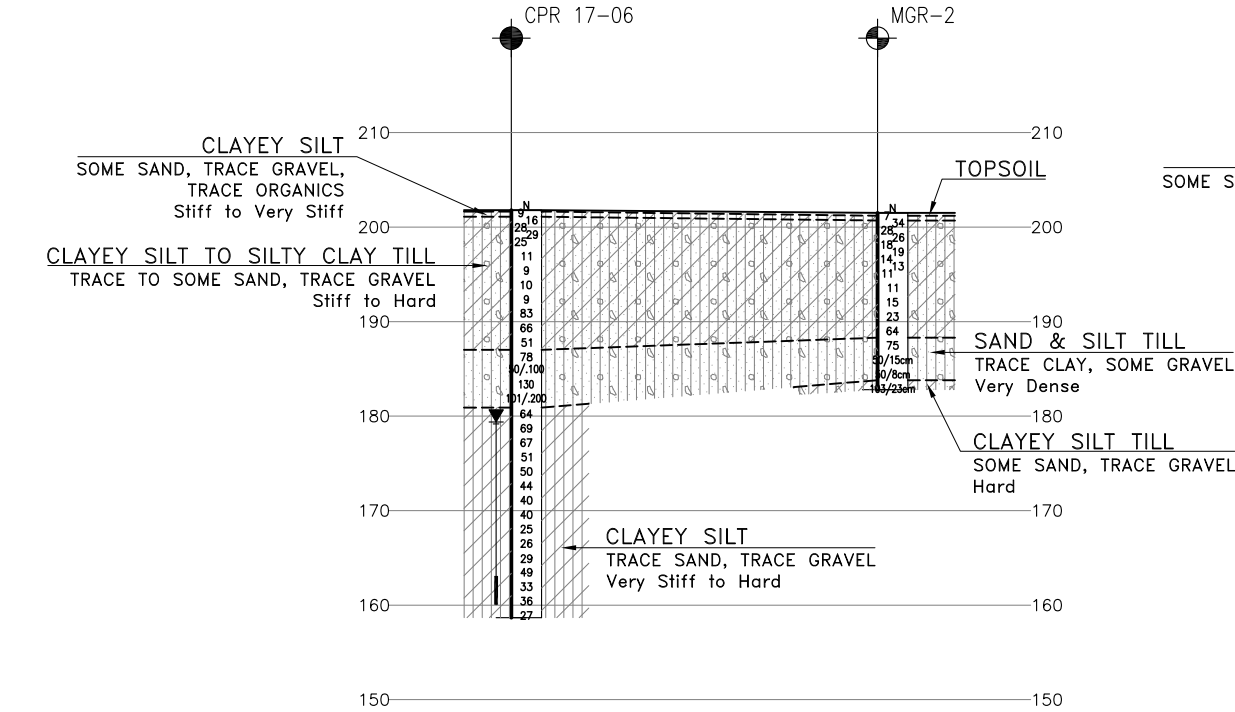
TITLE	PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
HWY 427 EXPANSION HWY 427 NBL AT CPR/McGILLIVRAY ROAD OVERHEAD	H427-D	I	5	STR	B17A	DWG	501	0



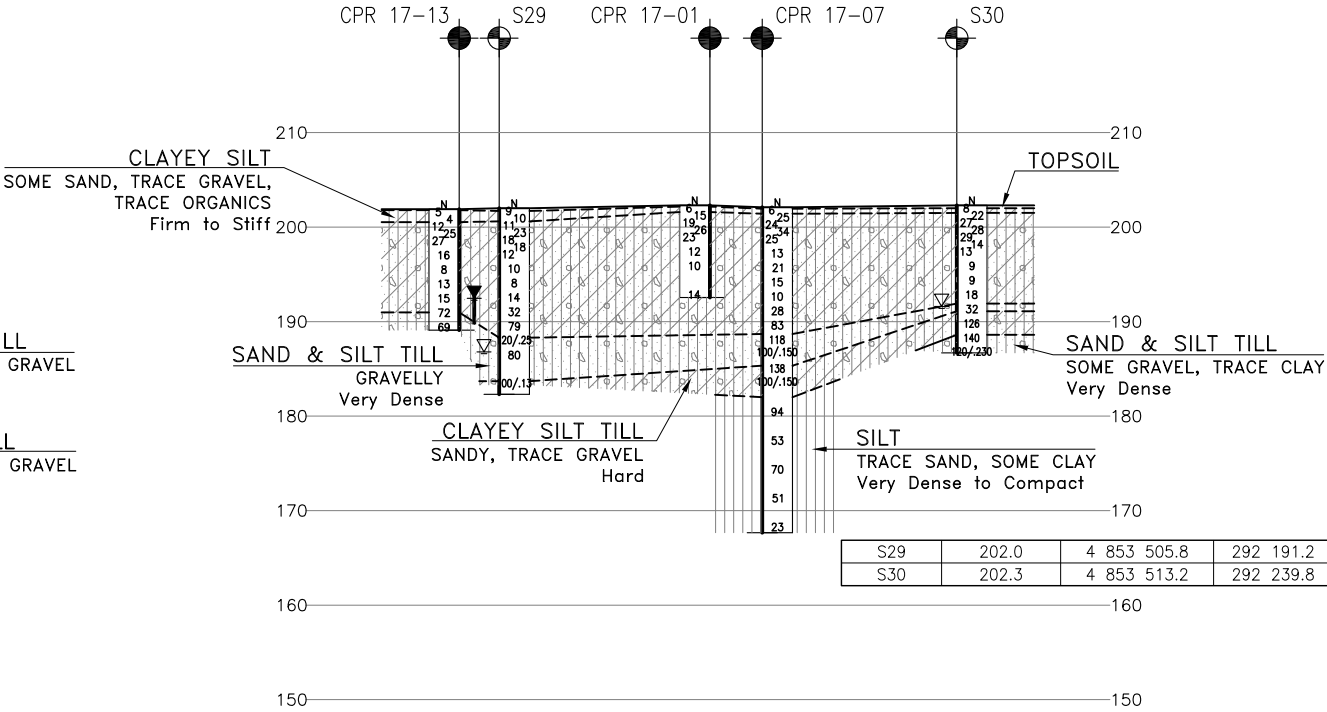
SECTION ALONG SOUTH ABUT BRG (NBL)



SECTION ALONG SOUTH PIER (NBL)



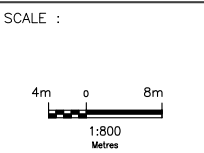
SECTION ALONG NORTH PIER (NBL)



SECTION ALONG NORTH ABUT BRG (NBL)

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PLOTDATE: 7/17/2019 4:04 PM

NO.	DATE	REVISIONS	BY	CHK	LEAD DES.	PROJ. MAN.
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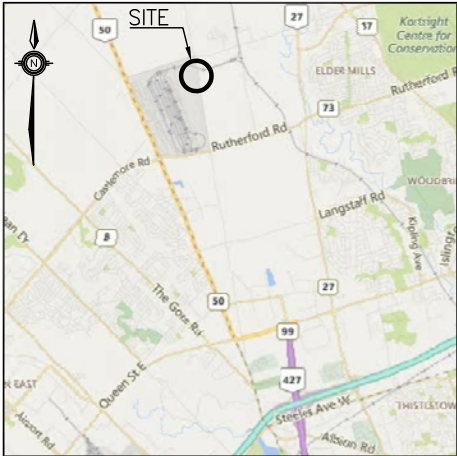
DESIGNED	A. PIASIK	AP	19/07/18
DRAWN	A. NOOR	AN	19/07/18
CHECKED	K. SHI	KS	19/07/18
APPROVED LEAD ENGINEER	J. LEE	JL	19/07/18
APPROVED PROJ. MANAGER	J. LEE	JL	19/07/18
NAME (PRINT)	INIT.	DATE	



TITLE							
HWY 427 EXPANSION HWY 427 NBL AT CPR/McGILLIVRAY ROAD OVERHEAD							
BOREHOLE LOCATIONS AND SOIL STRATA							
PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	I	5	STR	B17A	DWG	502	0

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



KEYPLAN

LEGEND

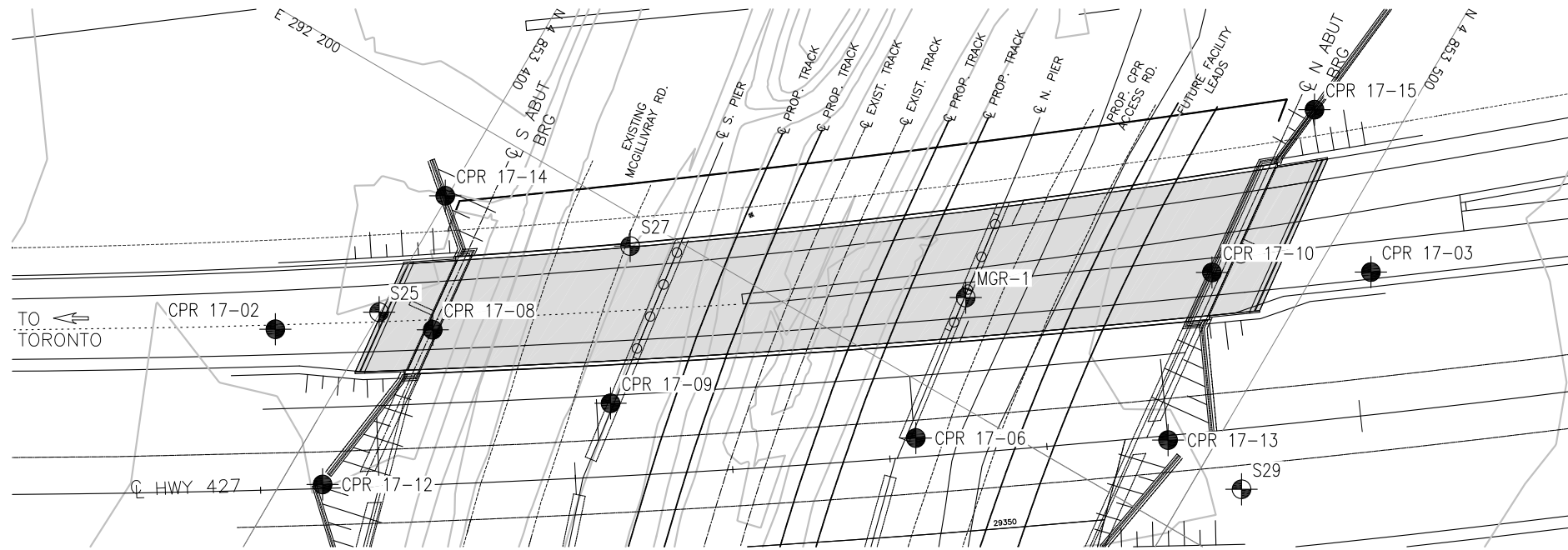
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
CPR 17-01	202.3	4 853 513.9	292 212.0
CPR 17-02	201.7	4 853 389.6	292 235.4
CPR 17-03	202.3	4 853 506.1	292 159.1
CPR 17-04	201.5	4 853 418.5	292 270.5
CPR 17-05	200.6	4 853 440.1	292 265.8
CPR 17-06	201.8	4 853 466.8	292 206.4
CPR 17-07	202.1	4 853 497.4	292 223.4
CPR 17-08	201.8	4 853 406.9	292 225.4
CPR 17-09	200.5	4 853 431.1	292 222.1
CPR 17-10	202.1	4 853 488.7	292 169.3
CPR 17-11	201.3	4 853 420.6	292 288.9
CPR 17-12	201.8	4 853 404.7	292 249.4
CPR 17-13	201.9	4 853 494.6	292 190.5
CPR 17-14	201.7	4 853 399.7	292 209.9
CPR 17-15	202.2	4 853 489.5	292 144.9
MGR-1	202.1	4 853 463.3	292 187.8
MGR-2	201.5	4 853 474.8	292 244.6
S25	201.8	4 853 399.9	292 226.9
S26	201.5	4 853 413.1	292 274.0
S27	201.1	4 853 423.2	292 203.6
S28	200.8	4 853 435.3	292 253.3

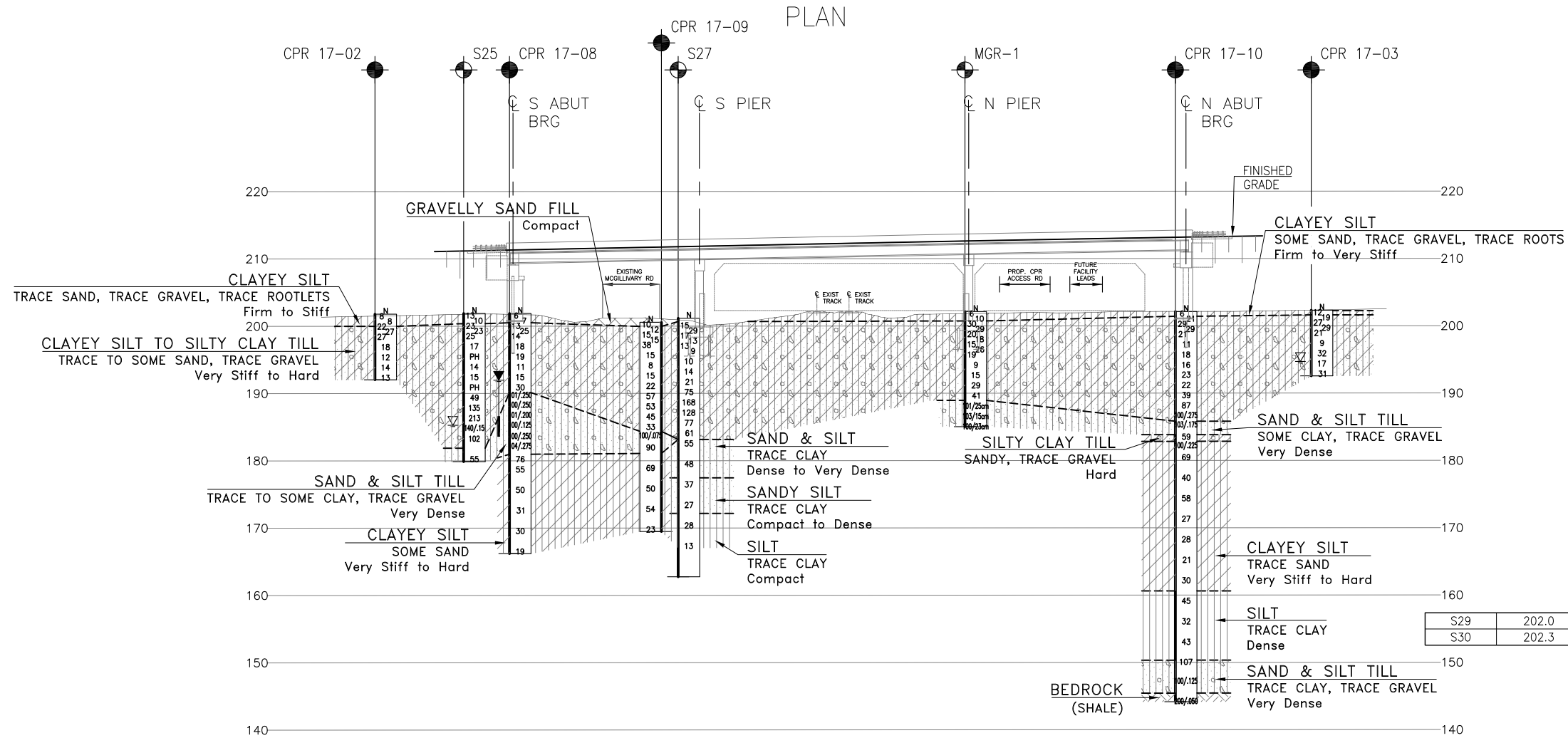
-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No.



PLAN



PROFILE ALONG C_L HWY 427 SBL

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



KEYPLAN

LEGEND

●	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
⊕	Water Level
⊕	Head Artesian Water
⊕	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
CPR 17-01	202.3	4 853 513.9	292 212.0
CPR 17-02	201.7	4 853 389.6	292 235.4
CPR 17-03	202.3	4 853 506.1	292 159.1
CPR 17-04	201.5	4 853 418.5	292 270.5
CPR 17-05	200.6	4 853 440.1	292 265.8
CPR 17-06	201.8	4 853 466.8	292 206.4
CPR 17-07	202.1	4 853 497.4	292 223.4
CPR 17-08	201.8	4 853 406.9	292 225.4
CPR 17-09	200.5	4 853 431.1	292 222.1
CPR 17-10	202.1	4 853 488.7	292 169.3
CPR 17-11	201.3	4 853 420.6	292 288.9
CPR 17-12	201.8	4 853 404.7	292 249.4
CPR 17-13	201.9	4 853 494.6	292 190.5
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MGR-2	201.5	4 853 474.8	292 244.6
S25	201.8	4 853 399.9	292 226.9
S26	201.5	4 853 413.1	292 274.0
S27	201.1	4 853 423.2	292 203.6
S28	200.8	4 853 435.3	292 253.3

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No.

TITLE
HWY 427 EXPANSION
HWY 427 SBL AT CPR/McGILLIVRAY ROAD
OVERHEAD

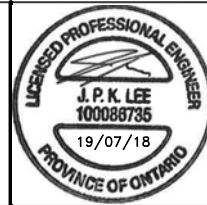
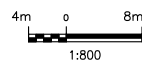
BOREHOLE LOCATIONS AND SOIL STRATA

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H427-D	I	5	STR	B17B	DWG	601	0

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PLOT DATE: 7/17/2019 4:05 PM

NO.	DATE	REVISIONS	BY	CHK	LEAD	PROJ
0	19/07/18	ISSUED FOR CONSTRUCTION	AN	KS	JL	JL

SCALE :

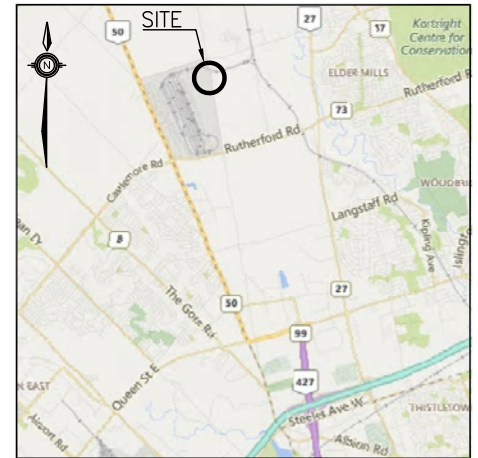


DESIGNED	A. PIASIK	AP	19/07/18
DRAWN	A. NOOR	AN	19/07/18
CHECKED	K. SHI	KS	19/07/18
APPROVED	J. LEE	JL	19/07/18
APPROVED	J. LEE	JL	19/07/18
PROJ. MGR			
NAME (PRINT)		INIT.	DATE



PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	I	5	STR	B17B	DWG	601	0

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



KEYPLAN

LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
CPR 17-01	202.3	4 853 513.9	292 212.0
CPR 17-02	201.7	4 853 389.6	292 235.4
CPR 17-03	202.3	4 853 506.1	292 159.1
CPR 17-04	201.5	4 853 418.5	292 270.5
CPR 17-05	200.6	4 853 440.1	292 265.8
CPR 17-06	201.8	4 853 466.8	292 206.4
CPR 17-07	202.1	4 853 497.4	292 223.4
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CPR 17-14	201.7	4 853 399.7	292 209.9
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S25	201.8	4 853 399.9	292 226.9
S26	201.5	4 853 413.1	292 274.0
S27	201.1	4 853 423.2	292 203.6
S28	200.8	4 853 435.3	292 253.3

-NOTES-

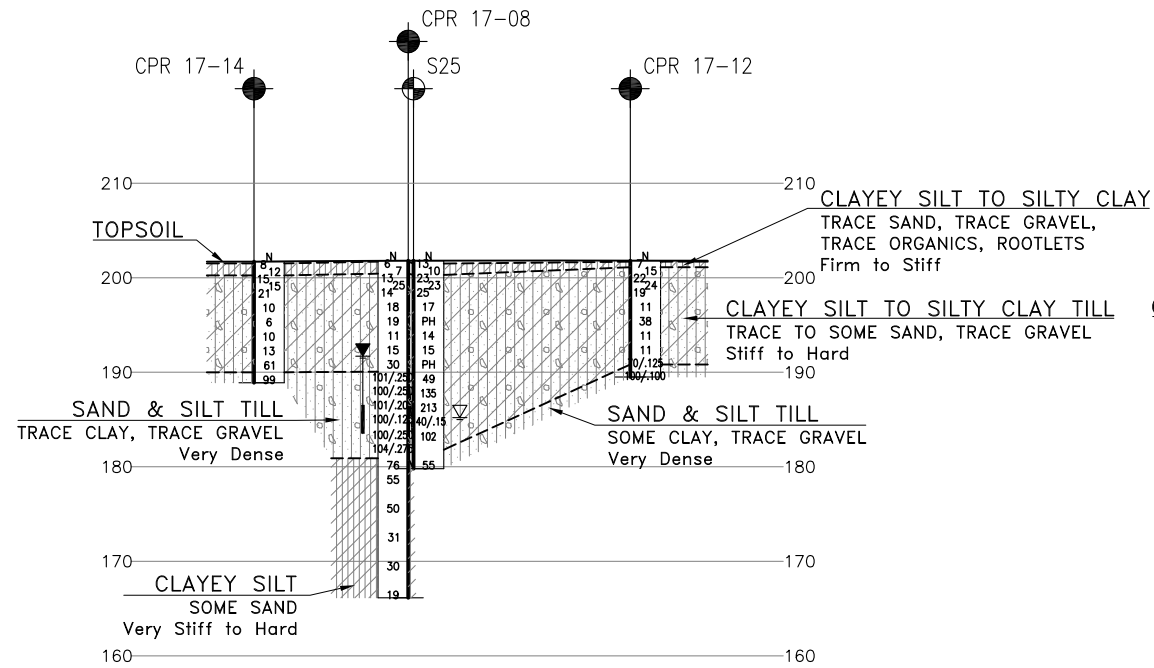
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
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GEOCRES No.

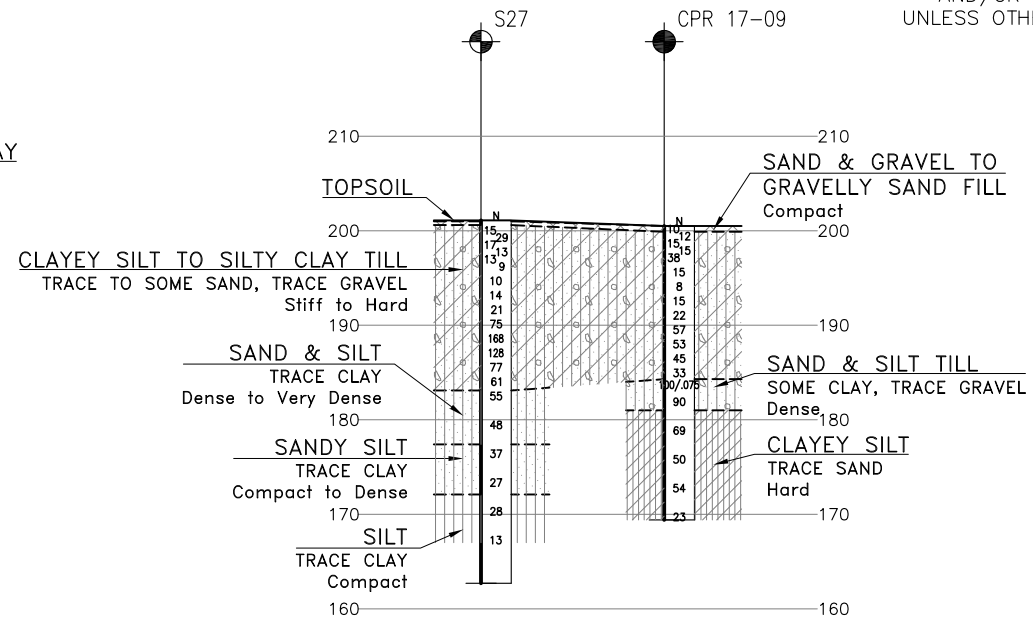
TITLE
HWY 427 EXPANSION
HWY 427 SBL AT CPR/McGILLIVRAY ROAD
OVERHEAD

BOREHOLE LOCATIONS AND SOIL STRATA

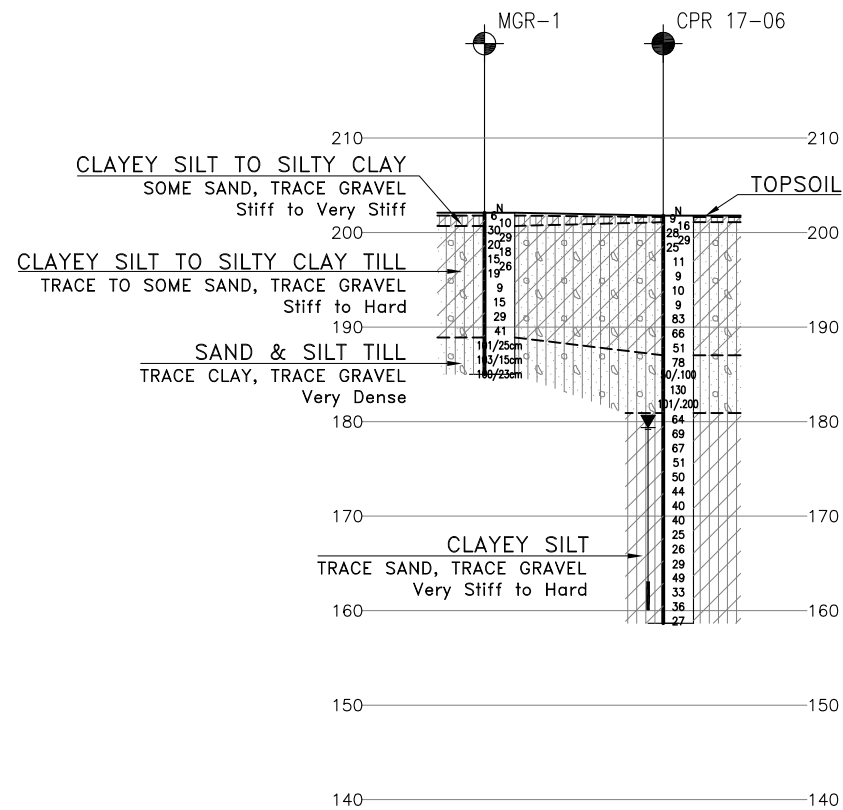
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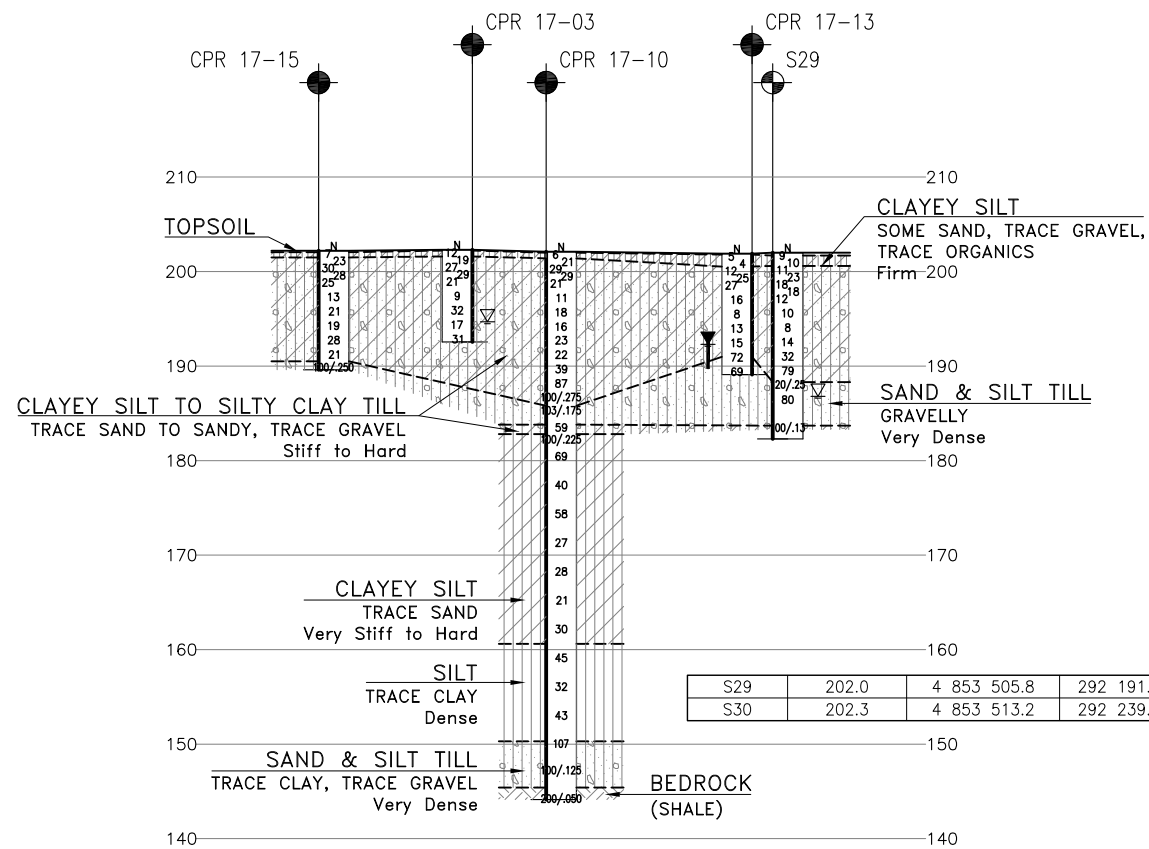
SECTION ALONG SOUTH ABUT BRG (SBL)



SECTION ALONG SOUTH PIER (SBL)



SECTION ALONG NORTH PIER (SBL)



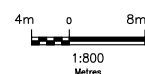
SECTION ALONG NORTH ABUT BRG (SBL)

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S30	202.3	4 853 513.2	292 239.8

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PLOT DATE: 7/17/2019 4:05 PM

NO.	DATE	REVISIONS	BY	CHK	LEAD DES.	PROJ. MGR.
0	19/07/18	ISSUED FOR CONSTRUCTION	AN	KS	JL	JL

SCALE :



DESIGNED	A. PIASIK	AP	19/07/18
DRAWN	A. NOOR	AN	19/07/18
CHECKED	K. SHI	KS	19/07/18
APPROVED LEAD ENGINEER	J. LEE	JL	19/07/18
APPROVED PROJ. MANAGER	J. LEE	JL	19/07/18
NAME (PRINT)		INIT.	DATE



PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	I	5	STR	B17B	DWG	602	0

Appendix E

Stability Analysis Output for Approach Embankments

FIGURE E1

CPR/MCGILLIVRAY RSS SECTION SHORT-TERM CONDITION

File Name: Critical RSS Section (Short Term).gsz

Last Edited By: Geoff Lay

Date: 1/17/2018

Method: Morgenstern-Price, Half Sine

Minimum Slip Surface Depth: 1 m

Seismic: 0

Compacted Earth Fill	18 kN/m ³	0 kPa	30 °
Clayey Silt	18 kN/m ³	50 kPa	0 °
Clayey Silt to Silty Clay Till (upper)	21 kN/m ³	100 kPa	0 °
Clayey Silt to Silty Clay Till (lower)	20 kN/m ³	75 kPa	0 °
Granular Fill	21 kN/m ³	0 kPa	35 °
Concrete	1 kN/m ³	1,000 kPa	0 °
RSS	22 kN/m ³	200 kPa	34 °

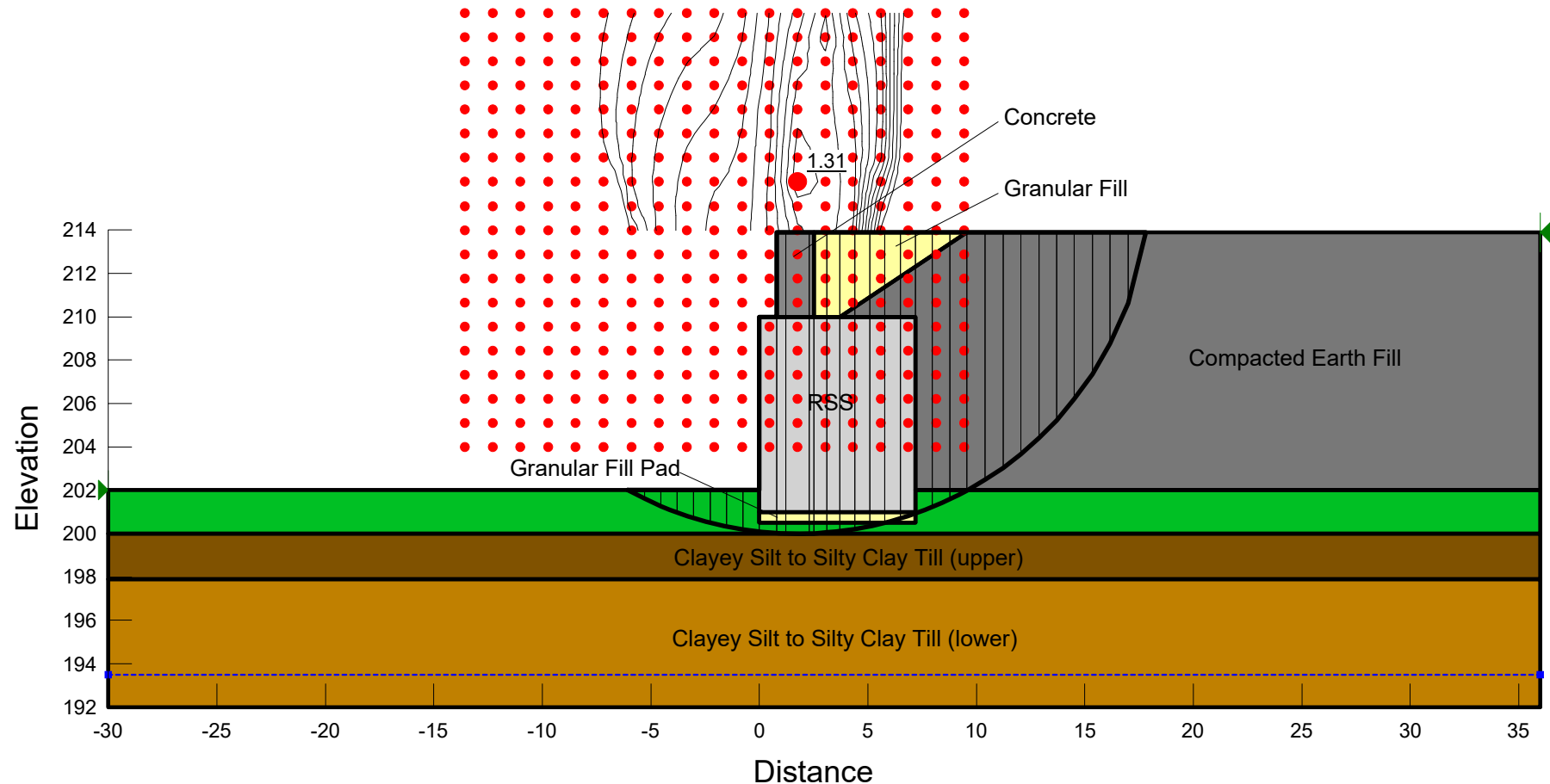


FIGURE E2

CPR/MCGILLIVRAY RSS SECTION LONG-TERM CONDITION

File Name: Critical RSS Section (Long Term).gsz
 Last Edited By: Geoff Lay
 Date: 1/17/2018
 Method: Morgenstern-Price, Half Sine
 Minimum Slip Surface Depth: 1 m
 Seismic: 0

Compacted Earth Fill	18 kN/m ³	0 kPa	30 °
Clayey Silt	18 kN/m ³	5 kPa	30 °
Clayey Silt to Silty Clay Till (upper)	21 kN/m ³	0 kPa	32 °
Clayey Silt to Silty Clay Till (lower)	20 kN/m ³	0 kPa	31 °
Granular Fill	21 kN/m ³	0 kPa	35 °
Concrete	1 kN/m ³	1,000 kPa	0 °
RSS	22 kN/m ³	200 kPa	34 °

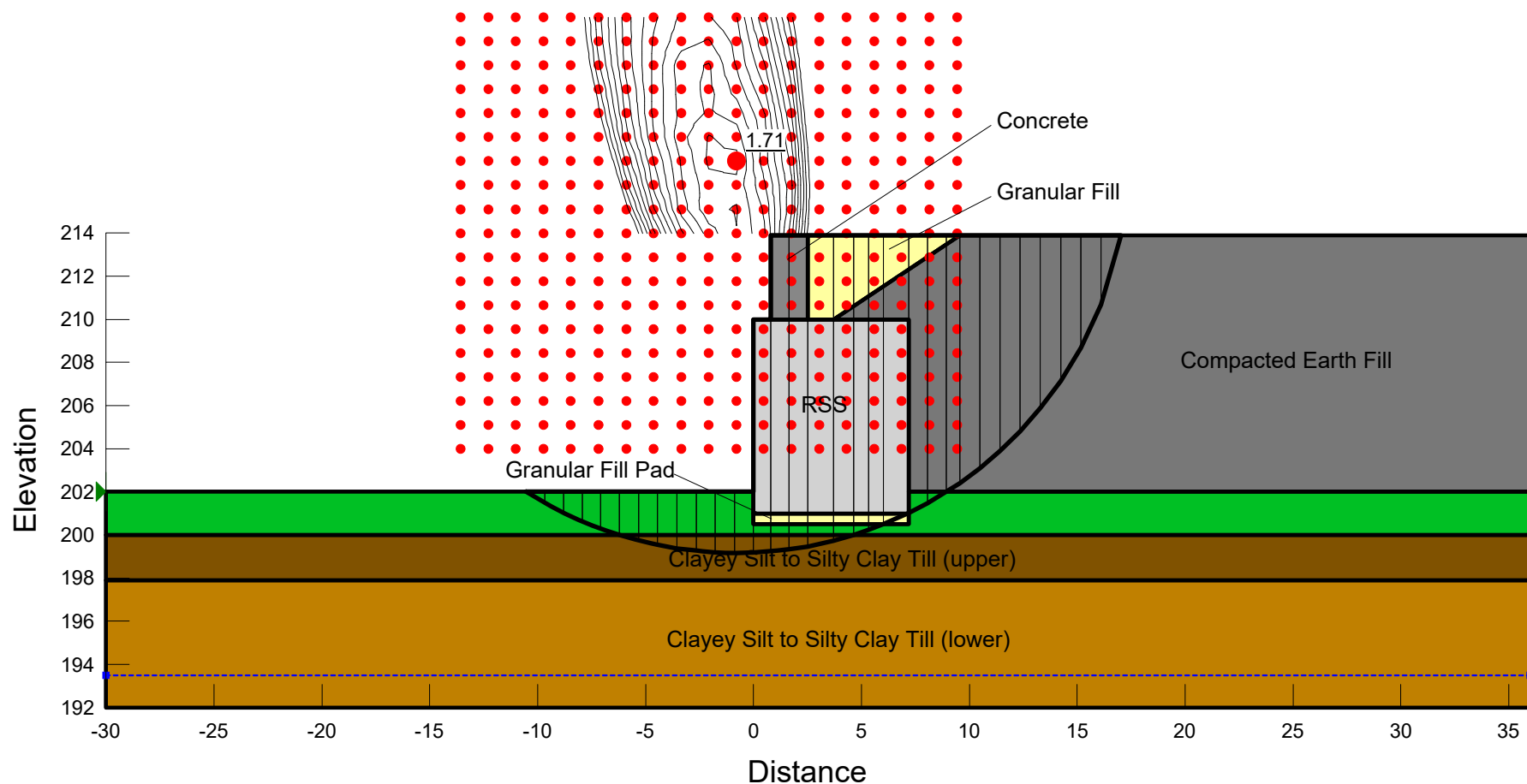


FIGURE E3

CPR/MCGILLIVRAY RSS SECTION SEISMIC CONDITION

File Name: Critical RSS Section (Seismic).gsz
 Last Edited By: Geoff Lay
 Date: 1/17/2018
 Method: Morgenstern-Price, Half Sine
 Minimum Slip Surface Depth: 1 m
 Seismic: 0.055g

Compacted Earth Fill	18 kN/m ³	0 kPa	30 °
Clayey Silt	18 kN/m ³	50 kPa	0 °
Clayey Silt to Silty Clay Till (upper)	21 kN/m ³	100 kPa	0 °
Clayey Silt to Silty Clay Till (lower)	20 kN/m ³	75 kPa	0 °
Granular Fill	21 kN/m ³	0 kPa	35 °
Concrete	1 kN/m ³	1,000 kPa	0 °
RSS	22 kN/m ³	200 kPa	34 °

