



FOUNDATION INVESTIGATION AND DESIGN REPORT

For

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
HIGHWAY 403 AND QUEEN ELIZABETH WAY
TOWN OF OAKVILLE
REGIONAL MUNICIPALITY OF HALTON, ONTARIO
G.W.P. 2163-10-00
ASSIGNMENT NO. 2012-E-0057**

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PML Ref.: 14TF005-HM
Index No.: 109FIR and 110FDR
GEOCRES No.: 30M5-328
February 12, 2018



PART A –FOUNDATION INVESTIGATION REPORT

For

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
QUEEN ELIZABETH WAY AND HIGHWAY 403
TOWN OF OAKVILLE
REGIONAL MUNICIPALITY OF HALTON, ONTARIO
G.W.P. 2163-10-00
ASSIGNMENT NO. 2012-E-0057**

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Record of Geocres Borehole Sheets

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PART A - FOUNDATION INVESTIGATION REPORT

For

High Mast Light Poles and Overhead Signs
Queen Elizabeth Way and Highway 403,
G.W.P. 2163-10-00, Assignment No. 2012-E-0057
Town of Oakville, Regional Municipality of Halton, Ontario

1. INTRODUCTION

Stantec Consulting Ltd. has retained Peto MacCallum Ltd. (PML) on behalf of the Ministry of Transportation Ontario (MTO) to conduct the geotechnical investigation for the design and construction of sixty-six (66) High Mast Light Poles (HML) and two (2) Overhead Signs (OHS) located on Queen Elizabeth Way (QEW) and Highway 403 in the Town of Oakville, Regional municipality of Halton, Ontario.

Initial scope of work in the RFP provided for bidding purposes was to carry out foundation investigation for forty (40) HMLs and ten (10) OHSs. The scope was subsequently revised by Stantec and requested PML by e-mail dated September 09, 2016 to include eight (8) additional HML and carry out foundation investigation for a total of forty-eight (48) HMLs. The total number of HMLs to be investigated was again revised by Pavement and Foundation Section of MTO and requested PML by e-mail dated August 09, 2017, to investigate a total of sixty-six (66) locations of HMLs, located west of Erin Mills Parkway between Sta. 21+550 and Sta. 26+460.

The locations of OHSs were also revised by Stantec and requested PML by e-mail dated November 14, 2017 to carry out foundation investigations only for two (2) OHSs.

This report presents a summary of the subsurface conditions within the project limit, based on the soil data from thirteen (13) boreholes advanced by PML under the current assignment (2012-E-0057) and twenty-six (26) boreholes from the previous investigations carried out in the vicinity of the proposed overhead signs and high mast light poles.

2. SITE DESCRIPTION

The stretch of Land within the QEW / Highway 403 corridor near the project site are generally vacant and grass covered. The topography of the area is gently sloping down towards the south.



Outside of the highway corridor, land use primarily includes commercial and light industrial buildings and businesses. The Ford Motor Company occupies the majority of the land to the south of the QEW / Highway 403 interchange.

3. FIELD INVESTIGATION PROCEDURES

The PML staff visited the site on August 20, 2017 to mark out the borehole locations. The underground services at the borehole locations were cleared by the respective utility companies. Public and private utility authorities were informed and all the utility clearance documents were obtained before the commencement of drilling work.

The fieldwork was carried out from August 22 to 30, 2017 and from September 11 to 14, 2017. The location of the boreholes in the field were established by PML staff using a portable GPS device. Subsequently, the coordinates and ground surface elevations at the location of all 13 Boreholes were provided in MTM NAD 83 northing and easting by Callon Dietz Incorporated. Table A, listing the borehole coordinates is included with this report.

The drilling equipment used was owned and operated by Canadian Soil Drilling (CSD), a specialist drilling contractor. The fieldwork was carried out under the full-time supervision of a PML field supervisor. The investigation included advancing thirteen (13) boreholes, numbered 17-01 to 17-04 and 17-06 to 17-14, to maximum depths ranging from 4.6 m to 7.8 m (El.107.9 to El.153.4). These boreholes were advanced using solid stem augers powered by a track-mounted drill rig. The locations of boreholes are shown on the attached Drawings 1 to 9 in Appendix A. Representative soil samples were recovered from the boreholes at 0.75 m intervals using a conventional 51 mm O.D split spoon sampler in accordance with the Standard Penetration Test (SPT) procedure. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata.

The groundwater conditions at the borehole locations were observed during the drilling by visual examination of the soil samples, sampler and drill rods as the samples were retrieved. In addition, water level measurements were taken in open boreholes. Upon completion of drilling, the boreholes



were backfilled with bentonite/cement grout in accordance with the MTO guidelines and MOE Regulation 903 for borehole abandonment procedures.

The recovered soil samples were returned to our laboratory for detailed visual examination and index tests.

4. LABORATORY TEST PROCEDURES

Laboratory tests on representative SPT samples recovered during the fieldwork were carried out by the certified laboratory owned by PML, located in Toronto. The laboratory testing program included the following:

- Natural moisture content determinations (70)
- Grain size distribution analyses (17)
- Atterberg limits (12)

The laboratory tests to determine the index properties were performed in accordance with the MTO test procedures, which follow American Society for Testing Materials (ASTM) test procedures, with the exception of hydrometer test (LS-702). The results of the grain size distribution analyses are presented on Figures GS-1 to GS-3. The results of the Atterberg limit tests are provided on Figures PC-1 to PC-2. All of the test results are summarized on the attached Record of Borehole sheets.

5. SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Site Geology

The study area is located in the physiographic region known as the Iroquois Plain ("Physiography of Southern Ontario" by Chapman and Putnam and Map 1050 A of Lindsay-Peterborough Area, published by the Geological Survey of Canada). The Iroquois Plain extends to a distance of about 305 km around the Lake Ontario from the Niagara River at the west end to Trent River in the east end. In general, the plain is a mosaic of lacustrine sandy and



clayey deposits with till plains and drumlins. Small drainage courses and creeks currently drain the area southerly towards Lake Ontario.

5.2 Subsurface Conditions

The underlying subsoil in the area proposed for high mast light poles and overhead signs consists mainly of cohesive material followed by weathered Shale bedrock. The subsoil in this area consists of very dense to loose silty sand fill material followed by stiff to hard cohesive glacial till deposits. The till deposit is underlain by highly weathered Shale bedrock of Queenston Formation. However, for classification purposes, the soils encountered within the project area can be divided into ten different zones.

- a) Pavement Structure and Granular Base
- b) Sand to silty sand, some/with gravel (Fill)
- c) Silty clay to clayey Silt, some sand, trace gravel (Fill)
- d) Silty clay, trace/some sand, trace gravel
- e) Clayey silt, sand and gravel
- f) Silty clay, trace/some sand, trace/some gravel (Till)
- g) Silty clay to clayey silt, some sand, some gravel (Till)
- h) Silty sand, some gravel (Till)
- i) Highly weathered Shale Bedrock
- j) Weathered Shale bedrock

The subsurface conditions that may be expected in the proposed locations of the overhead signs and high mast light poles, together with the field and laboratory test results are shown on the Record of Borehole Sheets contained in the Appendix B of this report. The boreholes relevant to each high mast light pole and overhead sign and a summary of soil strata encountered at each borehole location is provided in Tables 5.2.a and 5.2.b, for reference purposes.



Table 5.2.a - Location of High Mast Light Poles and Relevant Boreholes

HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P1	21+550	110.613	4	30M05-205	109.1	109.3	Pavement Structure
					109.3	106.7	Dense to compact sand, some gravel (Fill)
					106.7	106.4	Hard silty clay, trace/ some sand and gravel (Till)
					106.4	104.6	Weathered Shale bedrock
P2	21+660	111.577	4	30M05-205	109.1	109.3	Pavement Structure
					109.3	106.7	Dense to compact sand, some gravel (Fill)
					106.7	106.4	Hard silty clay, trace/ some sand and gravel (Till)
					106.4	104.6	Weathered Shale bedrock
P3	21+775	112.885	17-01		113.4	113.1	75 mm Asphalt over silty sand with gravel (Pavement Fill)
					113.1	112.4	Compact silty sand with gravel (Fill)
					112.4	111.0	Silty clay, some sand, trace gravel (Fill)
					111.0	109.9	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					109.9	108.7	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P4	21+890	114.121	17-01		113.4	113.1	75 mm Asphalt over silty sand with gravel (Pavement Fill)
					113.1	112.4	Compact silty sand with gravel (Fill)
					112.4	111.0	Silty clay, some sand, trace gravel (Fill)
					111.0	109.9	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					109.9	108.7	Highly weathered Shale bedrock
P5	22+002	114.522	17-01		113.4	113.1	75 mm Asphalt over silty sand with gravel (Pavement Fill)
					113.1	112.4	Compact silty sand with gravel (Fill)
					112.4	111.0	Silty clay, some sand, trace gravel (Fill)
					111.0	109.9	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					109.9	108.7	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P6	22+115	114.818	17-01		113.4	113.1	75 mm Asphalt over silty sand with gravel (Pavement Fill)
					113.1	112.4	Compact silty sand with gravel (Fill)
					112.4	111.0	Silty clay, some sand, trace gravel (Fill)
					111.0	109.9	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					109.9	108.7	Highly weathered Shale bedrock
P7	22+230	115.129	17-02		114.4	114.1	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					114.1	113.4	Compact silty sand with gravel (Fill)
					113.4	112.3	Stiff silty clay, some sand, trace gravel (Fill)
					112.3	110.4	Dense to very dense silty sand, some gravel, occasional Shale and limestone fragments (Fill)
					110.4	109.3	Hard silty clay to clayey silt, some sand, some gravel (Till)
					109.3	107.9	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P8	22+240	115.466	17-02		114.4	114.1	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					114.1	113.4	Compact silty sand with gravel (Fill)
					113.4	112.3	Stiff silty clay, some sand, trace gravel (Fill)
					112.3	110.4	Dense to very dense silty sand, some gravel, occasional Shale and limestone fragments (Fill)
					110.4	109.3	Hard silty clay to clayey silt, some sand, some gravel (Till)
					109.3	107.9	Highly weathered Shale bedrock
P9	22+460	115.808	17-02		114.4	114.1	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					114.1	113.4	Compact silty sand with gravel (Fill)
					113.4	112.3	Stiff silty clay, some sand, trace gravel (Fill)
					112.3	110.4	Dense to very dense silty sand, some gravel, occasional Shale and limestone fragments (Fill)
					110.4	109.3	Hard silty clay to clayey silt, some sand, some gravel (Till)
					109.3	107.9	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P10	22+605	116.664	17-03		122.5	122.2	45 mm Asphalt over silty sand with gravel (Pavement Fill)
					122.2	122.0	Loose silty sand with gravel (Fill)
					122.0	119.5	Stiff silty clay, trace sand, trace gravel (Fill)
					119.5	116.0	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					116.0	115.8	Highly weathered Shale bedrock
			17-02		114.4	114.1	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					114.1	113.4	Compact silty sand with gravel (Fill)
					113.4	112.3	Stiff silty clay, some sand, trace gravel (Fill)
					112.3	110.4	Dense to very dense silty sand, some gravel, occasional Shale and limestone fragments (Fill)
					110.4	109.3	Hard silty clay to clayey silt, some sand, some gravel (Till)
					109.3	107.9	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P11	22+755	119.042	17-03		122.5	122.2	45 mm Asphalt over silty sand with gravel (Pavement Fill)
					122.2	122.0	Loose silty sand with gravel (Fill)
					122.0	119.5	Stiff silty clay, trace sand, trace gravel (Fill)
					119.5	116.0	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					116.0	115.8	Highly weathered Shale bedrock
P12	22+900	121.452	17-03		122.5	122.2	45 mm Asphalt over silty sand with gravel (Pavement Fill)
					122.2	122.0	Loose silty sand with gravel (Fill)
					122.0	119.5	Stiff silty clay, trace sand, trace gravel (Fill)
					119.5	116.0	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					116.0	115.8	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P13	23+040	123.753	17-03		122.5	122.2	45 mm Asphalt over silty sand with gravel (Pavement Fill)
					122.2	122.0	Loose silty sand with gravel (Fill)
					122.0	119.5	Stiff silty clay, trace sand, trace gravel (Fill)
					119.5	116.0	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					116.0	115.8	Highly weathered Shale bedrock
P14	23+185	126.271	17	30M05-112	120.0	119.4	Cobbles and gravel
					119.4	118.8	Silty clay, some sand
					118.8	114.8	Weathered Shale bedrock
			13-18	30M5-293	123.7	123.5	Topsoil
					123.5	122.8	Very stiff silty clay, trace sand, occasional Shale fragments (Fill)
					122.8	122.5	Very stiff silty clay, trace sand, trace gravel (Till)
					122.5	120.5	
					120.5	119.2	Highly weathered Shale bedrock
					119.2	116.0	Weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P15*							
P16*							
P17	23+325	128.606	13-20	30M5-291	127.7	127.6	Topsoil
					127.6	126.1	Firm to very stiff silty clay, trace/ some sand, trace gravel (Fill)
					126.1	121.3	Weathered Shale bedrock
P18	23+330	126.987	13-22	30M5-296	128.0	127.9	Topsoil
					127.9	127.3	Compact sand. some silt, some gravel (Fill)
					127.3	125.7	Stiff silty clay, trace sand, trace gravel
					125.7	120.4	Weathered Shale bedrock
P19	23+030	122.961	17-04		123.1	122.7	210 mm Asphalt over silty sand with gravel (Pavement Fill)
					122.7	122.5	Compact silty sand with gravel (Fill)
					122.5	122.3	Silty clay, trace sand, trace gravel (Fill)
					122.3	121.9	Hard silty clay to clayey silt, with gravel, some sand, occasional Shale and limestone fragments (Till)
					121.9	120.8	Hard silty clay to clayey silt, with gravel, some sand, occasional Shale and limestone fragments (Till)
					120.8	118.5	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P20	23+240	120.139	2, 3	30M05-115	118.8	118.7	Topsoil
					118.7	116.9	Very stiff clayey silt, sand and gravel
					116.9	115.4	weathered Shale bedrock
P21*							
P22*							
P23*							
P24*							
P25	23+435	132.596	13-21	30M5-296	125.1	124.9	150 mm Asphalt
					124.9	124.3	Dense sand and gravel, some silt (Fill)
					124.3	120.2	weathered Shale bedrock
			13-24	30M5-297	131.5	131.3	150 mm Asphalt
					131.3	130.0	Compact sand and gravel, some silt (Fill)
					130.0	129.7	Very stiff silty clay, trace sand, occasional Shale fragments (Till)
					129.7	126.6	Highly weathered Shale bedrock
					126.6	123.6	Weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P26	23+570	138.311	17-06		138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)
					137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)
					137.4	133.7	Highly weathered Shale bedrock
P27	23+700	141.032	17-06		138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)
					137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)
					137.4	133.7	Highly weathered Shale bedrock
P28	23+818	140.84	17-06		138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)
					137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)
					137.4	133.7	Highly weathered Shale bedrock
P29*							
P30*							



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE	
					FROM	TO		
P31	23+485	133.655	13-19	30M5-291	131.0	130.9	Topsoil	
					130.9	130.3	Compact Shale (Fill)	
					130.3	129.6	Very stiff silty clay, trace sand (Fill)	
					129.6	128.8	Very stiff silty clay, trace sand, occasional Shale fragments	
					128.8	126.5	Highly weathered Shale bedrock	
					126.5	123.4	weathered Shale bedrock	
P32	23+595	138.648	13-19	30M5-291	131.0	130.9	Topsoil	
					130.9	130.3	Compact Shale (Fill)	
					130.3	129.6	Very stiff silty clay, trace sand (Fill)	
					129.6	128.8	Very stiff silty clay, trace sand, occasional Shale fragments	
					128.8	126.5	Highly weathered Shale bedrock	
					126.5	123.4	weathered Shale bedrock	
	403-4				30M15-271	135.9	135.8	Topsoil
						135.8	134.4	Stiff to very stiff silty clay, some sand, trace gravel, Shale fragments (Fill)
						134.4	133.3	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P33	23+320	143.0	13-19	30M5-291	131.0	130.9	Topsoil
					130.9	130.3	Compact Shale (Fill)
					130.3	129.6	Very stiff silty clay, trace sand (Fill)
					129.6	128.8	Very stiff silty clay, trace sand, occasional Shale fragments
					128.8	126.5	Highly weathered Shale bedrock
					126.5	123.4	weathered Shale bedrock
			403-1	30M15-271	145.1	144.9	Topsoil
					144.9	143.9	Stiff to very stiff clayey silt to silty clay, some sand, trace gravel, Shale fragments (Fill)
					143.9	139.8	
					139.8	139.4	Highly weathered Shale bedrock
P34	23+840	145.091	7	30M05-114	143.8	143.7	Topsoil
					143.7	141.1	Hard clayey silt, trace sand
					141.1	139.4	weathered Shale bedrock
P35	23+955	142.373	13	30M05-110	148.7	146.5	Hard clayey silt, trace sand
					146.5	139.6	weathered Shale bedrock
P36	23+950	146.519	3	30M05-114	146.6	146.5	Topsoil
					146.5	145.1	Hard clayey silt, trace sand



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
					145.1	142.1	Shale bedrock
P37	24+065	153.31	13-08	30M5-294	151.8	151.7	Topsoil
					151.7	151.3	Very stiff silty clay, some sand (Fill)
					151.3	149.3	Highly weathered Shale bedrock
					149.3	146.3	Weathered Shale bedrock
P38	10+010	145.338	13-09	30M5-294	150.8	150.7	Topsoil
					150.7	150.0	Very stiff silty clay, trace sand, occasional Shale fragments (Fill)
					150.0	148.3	Highly weathered Shale bedrock
					148.3	144.8	weathered Shale bedrock
P39	24+280	153.176	17-14		158.1	157.8	Topsoil
					157.8	156.2	Hard silty clay to clayey silt, with gravel, some sand, occasional Shale and limestone fragments (Till)
					156.2	153.4	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P40	24+390	156.496	17-14		158.1	157.8	Topsoil
					157.8	156.2	Hard silty clay to clayey silt, with gravel, some sand, occasional Shale and limestone fragments (Till)
					156.2	153.4	Highly weathered Shale bedrock
P41	10+125	157.545	13-03	30M5-292	152.6	152.5	Topsoil
					152.5	151.9	Compact Shale (Fill)
					151.9	151.3	Hard silty clay, trace sand, occasional Shale fragments (Fill)
					151.3	150.2	Highly weathered Shale bedrock
					150.2	147.1	Weathered Shale bedrock
P42	23+415	133.68	13-24	30M5-297	131.5	131.3	150 mm Asphalt
					131.3	130.0	Compact sand and gravel, some silt (Fill)
					130.0	129.7	Very stiff silty clay, trace sand, occasional Shale fragments
					129.7	128.2	Highly weathered Shale bedrock
					128.2	123.6	Weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P43	23+565	135.037	17-6		138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)
					137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)
					137.4	133.7	Highly weathered Shale bedrock
P44	23+700	138.608	17-6		138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)
					137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)
					137.4	133.7	Highly weathered Shale bedrock
P45	23+985	146.965	117-A8	30M05-117	146.7	144.3	Very stiff to hard silty clay, trace sand
					144.3	141.3	Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P46	24+070	149.076	13-11	30M5-294	150.0	149.9	Topsoil
					149.9	149.4	Stiff silty clay, trace sand, occasional Shale fragments (Fill)
					149.4	147.6	Highly weathered Shale bedrock
					147.6	144.6	Weathered Shale bedrock
			13-12		149.1	149.0	Topsoil
					149.0	146.1	Very stiff silty clay, trace sand, occasional Shale fragments (Fill)
					146.1	148.2	Highly weathered Shale bedrock
					148.2	143.0	Weathered Shale bedrock
P47	24+137	149.154	13-13	30M5-294	149.9	149.8	Topsoil
					149.8	149.0	Stiff silty clay, trace sand, occasional rootlets (Fill)
					149.0	146.9	Highly weathered Shale bedrock
					146.9	143.8	Weathered Shale bedrock
			13-14		150.2	150.0	150 mm Asphalt
					150.0	149.7	Concrete
					149.7	149.3	Sand and gravel (Fill)
					149.3	147.2	Highly weathered Shale bedrock
					147.2	144.1	Weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P48	24+195	152.116	13-05	30M5-292	151.8	151.7	Topsoil
					151.7	150.9	Stiff silty clay, trace sand, occasional rootlets (Fill)
					150.9	148.8	Highly weathered Shale bedrock
					148.8	145.7	Weathered Shale bedrock
P49	24+305	150.674	13-15	30M5-294	150.2	150.1	Topsoil
					150.1	149.6	Compact sand and gravel, some silt (Fill)
					149.6	147.8	Highly weathered Shale bedrock
					147.8	144.3	Weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P50	24+330	151.903	13-07	30M5-292	151.3	151.2	Topsoil
					151.2	150.4	Stiff silty clay, trace sand, occasional rootlets (Fill)
					150.4	148.3	Highly weathered Shale bedrock
					148.3	145.2	Weathered Shale bedrock
P51	24+460	152.709	17-7		151.7	151.3	60 mm Asphalt over silty sand with gravel (Pavement Fill)
					151.3	151.1	Compact silty sand with gravel (Fill)
					151.1	150.2	Hard clayey silt, trace sand, some gravel, occasional Shale and limestone fragments (Till)
					150.2	147.0	Highly weathered Shale bedrock
P52	24+580	152.973	17-7		151.7	151.3	60 mm Asphalt over silty sand with gravel (Pavement Fill)
					151.3	151.1	Compact silty sand with gravel (Fill)
					151.1	150.2	Hard clayey silt, trace sand, some gravel, occasional Shale and limestone fragments (Till)
					150.2	147.0	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P53	24+680	152.424	17-7		151.7	151.3	60 mm Asphalt over silty sand with gravel (Pavement Fill)
					151.3	151.1	Compact silty sand with gravel (Fill)
					151.1	150.2	Hard clayey silt, trace sand, some gravel, occasional Shale and limestone fragments (Till)
					150.2	147.0	Highly weathered Shale bedrock
P54	24+795	151.267	17-8		150.0	149.3	70 mm Asphalt over silty sand with gravel (Pavement Fill)
					149.3	149.0	Loose sand and gravel, some silt (Fill)
					149.0	148.5	Silty clay, trace sand, trace gravel (Fill)
					148.5	147.7	Very stiff to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)
					147.7	145.3	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P55	24+910	150.655	17-8		150.0	149.3	70 mm Asphalt over silty sand with gravel (Pavement Fill)
					149.3	149.0	Loose sand and gravel, some silt (Fill)
					149.0	148.5	Silty clay, trace sand, trace gravel (Fill)
					148.5	147.7	Very stiff to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)
					147.7	145.3	Highly weathered Shale bedrock
P56	25+030	150.097	17-8		150.0	149.3	70 mm Asphalt over silty sand with gravel (Pavement Fill)
					149.3	149.0	Loose sand and gravel, some silt (Fill)
					149.0	148.5	Silty clay, trace sand, trace gravel (Fill)
					148.5	147.7	Very stiff to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)
					147.7	145.3	Highly weathered Shale bedrock
P57	25+140	149.309	6	30M12-121	144.2	144.1	Topsoil
					144.1	141.7	Stiff to hard clayey silt, trace of organics



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
					141.7	136.2	Weathered Shale bedrock
P58	25+260	146.612	6	30M12-121	144.2	144.1	Topsoil
					144.1	141.7	Stiff to hard clayey silt, trace of organics
					141.7	136.2	Weathered Shale bedrock
P59	25+360	143.215	3	30M12-121	142.7	141.5	Loose sand, trace gravel, trace silt (Fill)
					141.5	141.0	Hard clayey silt, trace gravel
					141.0	137.2	Weathered Shale bedrock
P60*							
P61*							
P62	25+205	146.492	17-12		147.2	146.8	220 mm Asphalt over silty sand with gravel (Pavement Fill)
					146.8	146.4	Silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					146.4	144.9	Firm to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)
					144.9	142.5	Highly weathered Shale bedrock
P63*							



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P64	25+110	148.524	17-12		147.2	146.8	220 mm Asphalt over silty sand with gravel (Pavement Fill)
					146.8	146.4	Silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					146.4	144.9	Firm to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)
					144.9	142.5	Highly weathered Shale bedrock
P65	25+335	142.685	7	30M12-121	143.8	143.2	Compact sand and gravel (Fill)
					143.2	141.2	Hard clayey silt, layer of fine sand, trace of organics
					141.2	137.7	Highly weathered Shale bedrock
P66	25+405	143.509	17-13		143.9	143.5	Loose silty sand, with gravel (Fill)
					143.5	141.2	Firm to Stiff silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					141.2	137.0	Hard silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)
					137.0	136.1	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P67	25+110	140.133	17-13		143.9	143.5	Loose silty sand, with gravel (Fill)
					143.5	141.2	Firm to Stiff silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					141.2	137.0	Hard silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)
					137.0	136.1	Highly weathered Shale bedrock
P68	25+485	141.163	17-9		139.5	138.8	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					138.8	137.8	Stiff to hard silty clay, some sand, trace gravel (Fill)
					137.8	137.2	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					137.2	134.8	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P69	25+610	140.28	17-9		139.5	138.8	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					138.8	137.8	Stiff to hard silty clay, some sand, trace gravel (Fill)
					137.8	137.2	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					137.2	134.8	Highly weathered Shale bedrock
P70	25+715	139.555	17-9		139.5	138.8	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					138.8	137.8	Stiff to hard silty clay, some sand, trace gravel (Fill)
					137.8	137.2	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)
					137.2	134.8	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P71	25+820	138.897	17-10		137.9	137.2	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					137.2	136.7	Compact silty sand, with gravel (Fill)
					136.7	136.2	Stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					136.2	135.6	Stiff silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)
					135.6	133.3	Highly weathered Shale bedrock
P72	25+925	138.709	17-10		137.9	137.2	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					137.2	136.7	Compact silty sand, with gravel (Fill)
					136.7	136.2	Stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					136.2	135.6	Stiff silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)
					135.6	133.3	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P73	26+035	137.589	17-10		137.9	137.2	85 mm Asphalt over silty sand with gravel (Pavement Fill)
					137.2	136.7	Compact silty sand, with gravel (Fill)
					136.7	136.2	Stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					136.2	135.6	Stiff silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)
					135.6	133.3	Highly weathered Shale bedrock
P74	26+140	136.067	17-11		133.8	133.4	75 mm Asphalt over silty sand with gravel (Pavement Fill)
					133.4	132.9	Compact silty sand, with gravel (Fill)
					132.9	131.0	Very stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					131.0	130.0	Hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)
					130.0	129.2	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P75	26+245	134.557	17-11		133.8	133.4	75 mm Asphalt over silty sand with gravel (Pavement Fill)
					133.4	132.9	Compact silty sand, with gravel (Fill)
					132.9	131.0	Very stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					131.0	130.0	Hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)
					130.0	129.2	Highly weathered Shale bedrock
P76	26+355	133.525	17-11		133.8	133.4	75 mm Asphalt over silty sand with gravel (Pavement Fill)
					133.4	132.9	Compact silty sand, with gravel (Fill)
					132.9	131.0	Very stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					131.0	130.0	Hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)
					130.0	129.2	Highly weathered Shale bedrock



HML STRUCTURE NUMBER	STATION	GROUND ELEVATION (m)	BOREHOLE NUMBER	GEOCRETS NO.	ELEVATION		SOIL TYPE
					FROM	TO	
P77	26+460	133.734	17-11		133.8	133.4	75 mm Asphalt over silty sand with gravel (Pavement Fill)
					133.4	132.9	Compact silty sand, with gravel (Fill)
					132.9	131.0	Very stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)
					131.0	130.0	Hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)
					130.0	129.2	Highly weathered Shale bedrock



Table 5.2.b - Location of Overhead Signs and Relevant Boreholes

OHS STRUCTURE NUMBER	STATION	BOREHOLE NUMBER	GEOCRES NO.	ELEVATION		SOIL TYPE
				FROM	TO	
OHS 1	23+350	13-23	30M5-297	129.7	129.5	150 mm Asphalt
				129.5	128.2	Dense to compact sand and gravel, some silt (Fill)
				128.2	126.1	Firm to very stiff silty clay, trace sand
				126.1	123.6	Highly weathered Shale bedrock
				123.6	120.6	Weathered Shale bedrock
OHS2	24+150	13-08	30M5-294	151.8	151.7	Topsoil
				151.7	151.3	Very stiff silty clay, some sand (Fill)
				151.3	149.3	Highly weathered Shale bedrock
				149.3	146.3	Weathered Shale bedrock

Notes

1. The top of the bedrock should be considered approximate and an allowance of +/- 0.5 m should be allowed.
- *2. The High Mast Light Poles identified in the table above with the asterisk (P*) are not considered structures and soil data is provided for these locations.



5.3 Groundwater Conditions

The groundwater was encountered in six (6) of the thirteen boreholes upon completion of drilling or during drilling. The groundwater level in each borehole is as follows.

Table 5.3.a - Groundwater Levels in new Boreholes

BOREHOLE NO.	ELEVATION OF WATER LEVEL (m)
17-01	109.0
17-02	110.7
17-03	---
17-04	120.8
17-06	136.3
17-07	---
17-08	---
17-09	136.2
17-10	---
17-11	129.5
17-12	---
17-13	---
17-14	---



Table 5.3.b - Groundwater Levels in Geocres Boreholes

BOREHOLE NO.	GEOCRES NO.	ELEVATION OF WATER LEVEL (m)
4	30M05-205	106.7
17	30M05-112	119.8
13-18	30M5-293	120.1
13-20	30M5-291	123.6
13-19		123.5
2	30M05-115	117.8
3		117.7
13-21	30M5-296	123.1
13-22		122.6
13-24	30M5-297	127.6
403-4	30M15-271	Dry
403-1		Dry
7	30M05-114	140.5
13	30M05-110	148.4
3	30M05-114	145.4
13-08	30M5-294	147.5
13-09	30M5-294	149.6
13-11		148.3
13-12		147.3
13-13		147.3
13-14		148.7
13-15		Not available
13-05		30M5-292
13-07	147.4	
13-03	148.2	
6	30M12-121	143.6
7		Not available
3		Not available
117-A8	30M05-117	143.4

Notes

1. The elevations and groundwater levels provided in the table are reported based on the information from previous investigations

The groundwater levels are subject to seasonal fluctuations and precipitation patterns.



6. CLOSURE

The fieldwork was carried out under the supervision of Mr. K. Pettit. Canadian Soil Drilling (CSD) supplied the drilling equipment for the subsurface exploration. The laboratory testing of the selected samples was carried out in the PML laboratory in Toronto.

This report was prepared by Ms. Asieh Khadem, M.Sc. Eng., EIT, Project Supervisor and reviewed by Mark Vasavithasan, M.Sc. Eng., P. Eng. Senior Engineer, Geotechnical Services. Mr. C.M.P. Nascimento, P. Eng., Principal Consultant, conducted an independent review of the report.

Yours very truly

Peto MacCallum Ltd.



Asieh Khadem

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Project Supervisor, Geotechnical Services

Mark Vasavithasan, M.Sc. Eng., P.Eng.
Senior Engineer, Geotechnical Services



Carlos M.P. Nascimento, P. Eng.
Project Manager and
MTO Designated Principal Contact

AK/MV/CN:nk



TABLE A - BOREHOLE COORDINATES

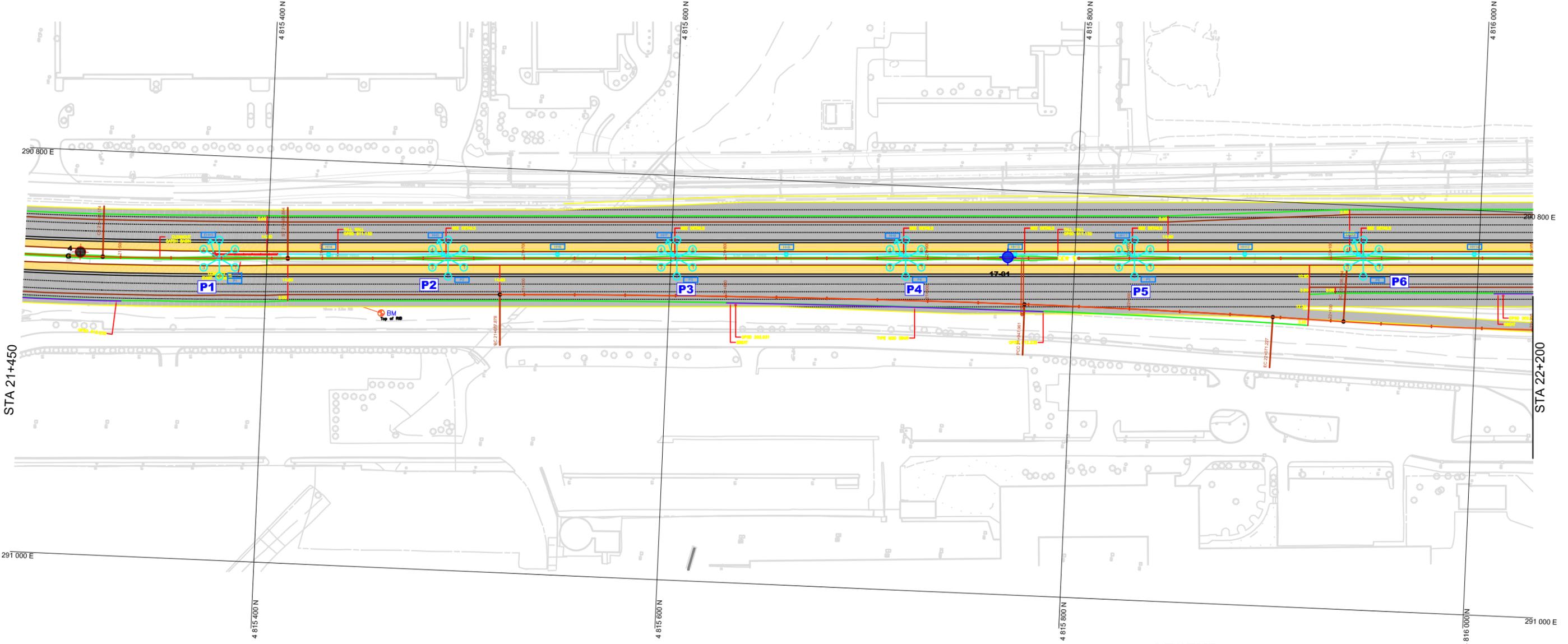
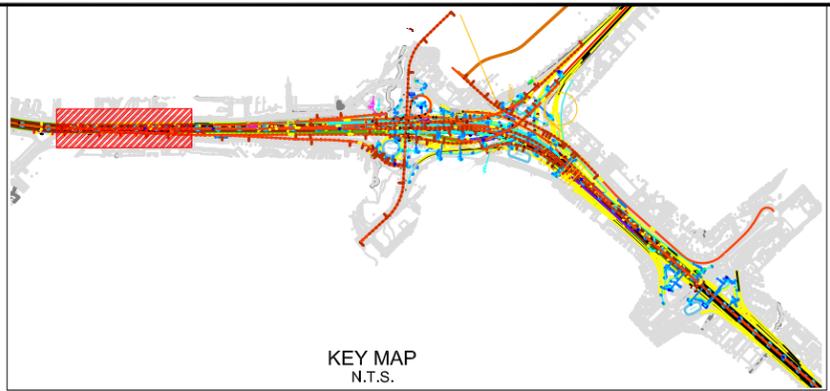
BOREHOLE NO.	COORDINATING (MTM)	
	NORTHING	EASTING
17-01	4815766.8	290818.1
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17-03	4816845.8	290786.6
17-04	4817159.8	290970.4
17-06	4817643.7	290815.9
17-07	4818197.2	291010.0
17-08	4818522.5	291274.8
17-09	4819104.6	291739.6
17-10	4819356.9	291941.3
17-11	4819607.4	292141.9
17-12	4818710.8	291598.4
17-13	4819025.4	291516.2
17-14	4818046.9	290420.1



APPENDIX A

Borehole Location Plans – Drawings 1 to 9

BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
17-01	4 815 766.8	290 818.1	113.4



- NOTES:
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

- LEGEND:**
- BOREHOLE BY PML, UNDER PRESENT INVESTIGATIONS
 - PREVIOUS BOREHOLE FROM GEOCRETS REPORTS

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
Queen Elizabeth Way and Highway 430 Improvements**

METRIC

STA. 21+450 TO STA. 22+200



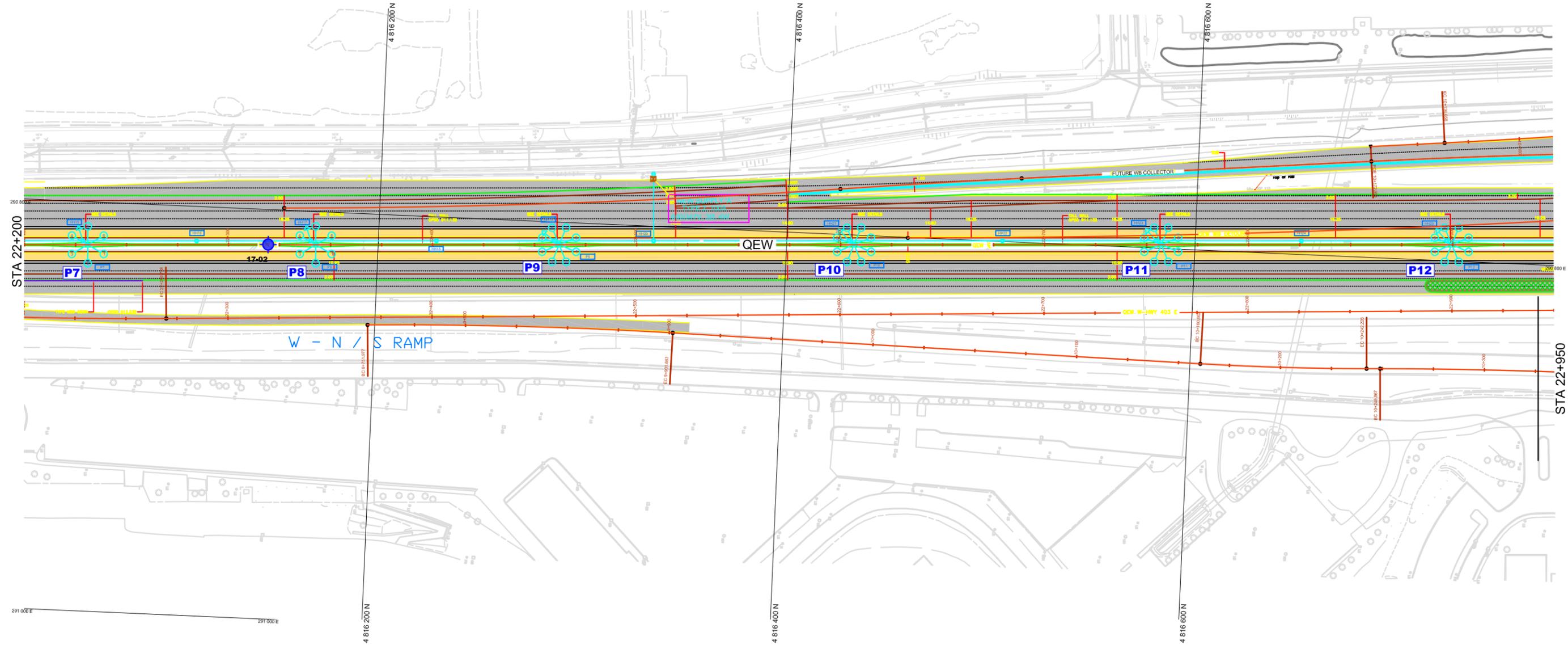
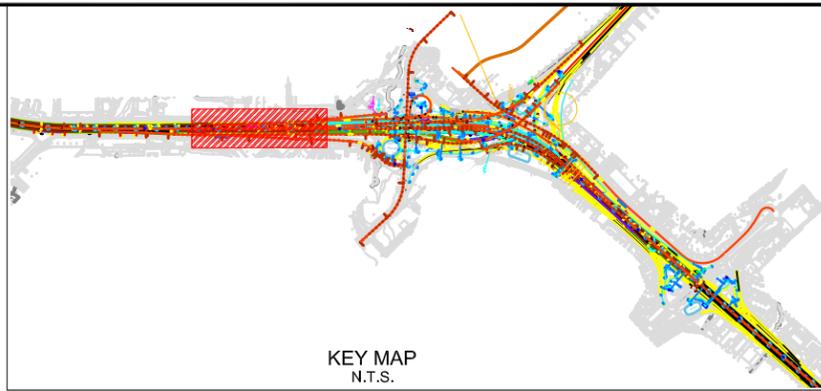
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DRAWN BY: N.A.	CHECKED BY: A.K.
CHECKED BY: M.V.	APPROVED BY: C.N.



QUEEN ELIZABETH WAY
G.W.P. No. 2163-10-00

DRAWING
01

BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
17-02	4 816 146.1	290 817.1	114.4



LEGEND:

-  BOREHOLE BY PML, UNDER PRESENT INVESTIGATIONS
-  PREVIOUS BOREHOLE FROM GEOCRETS REPORTS

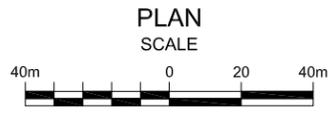
NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
Queen Elizabeth Way and Highway 403 Improvements**

METRIC

STA. 22+200 TO STA. 22+950



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DRAWN BY: N.A.	CHECKED BY: A.K.
CHECKED BY: M.V.	APPROVED BY: C.N.

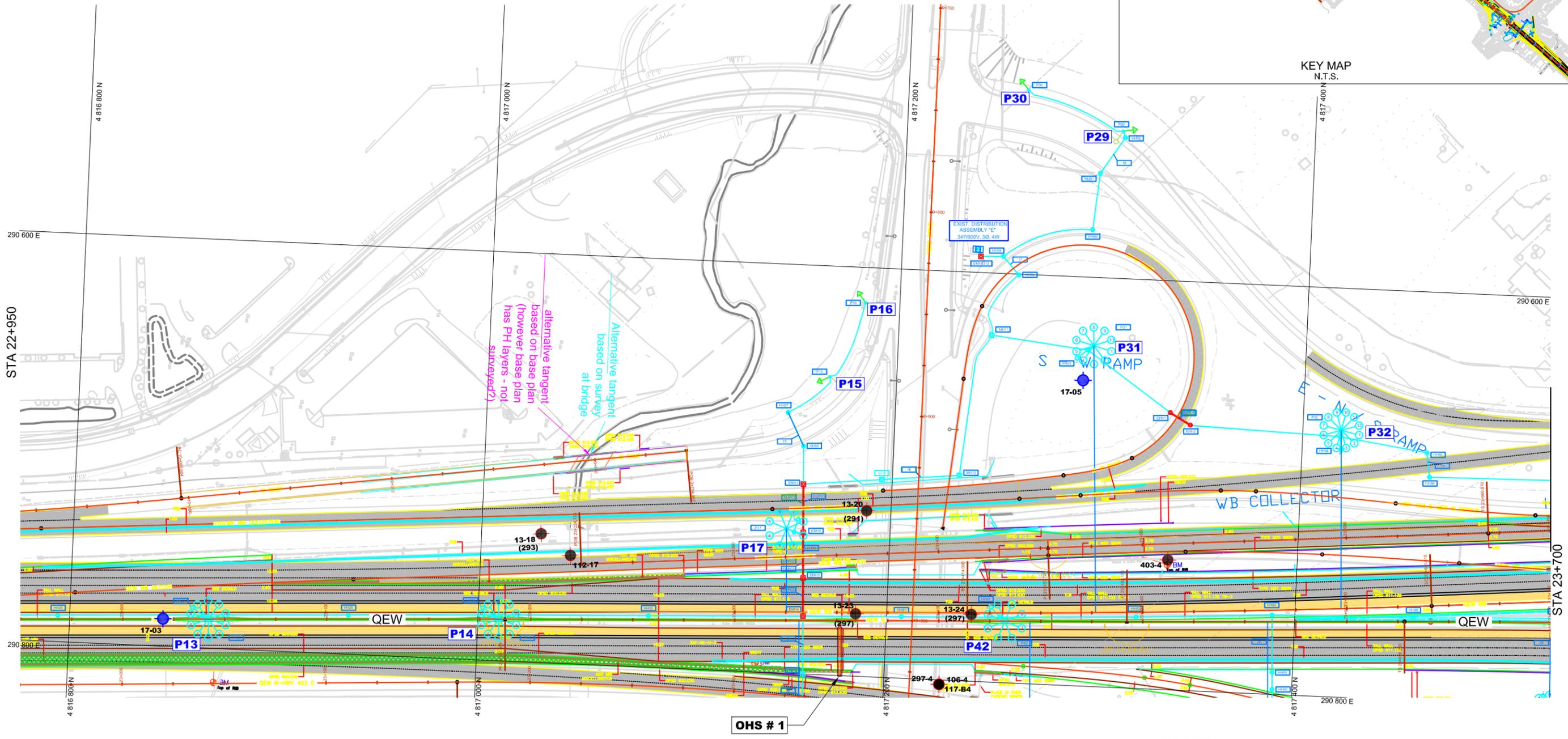
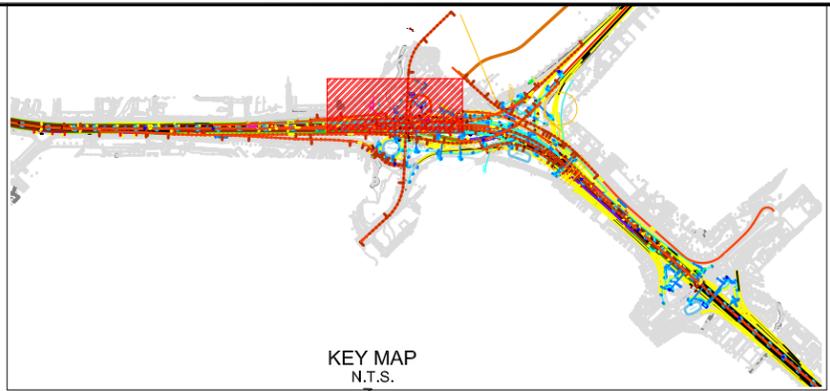


QUEEN ELIZABETH WAY
G.W.P. No. 2163-10-00



DRAWING
02

BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
17-03	4 816 845.8	290 786.6	122.5



- NOTES:
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

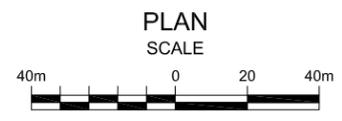
LEGEND:

- BOREHOLE BY PML, UNDER PRESENT INVESTIGATIONS
- PREVIOUS BOREHOLE FROM GEOCRE'S REPORTS

HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
Queen Elizabeth Way and Highway 403 Improvements

METRIC

STA. 22+950 TO STA. 23+700 (Western Part)



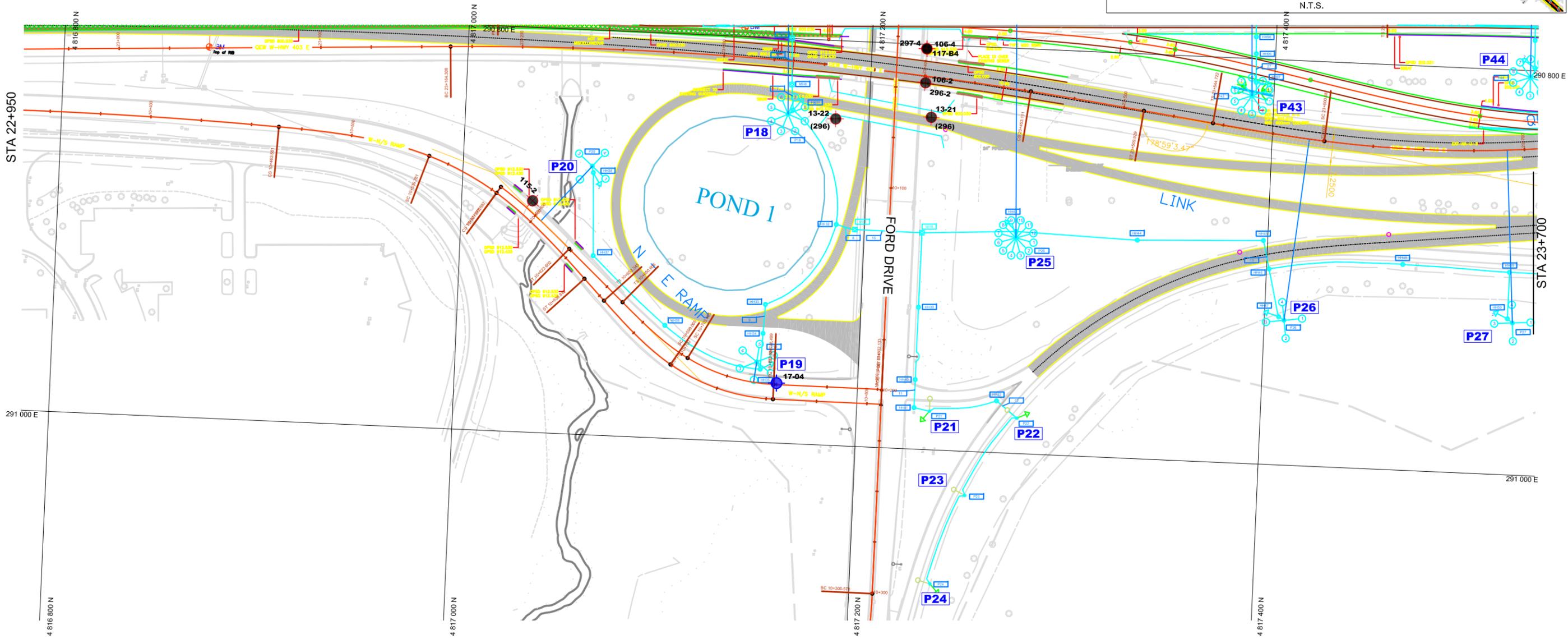
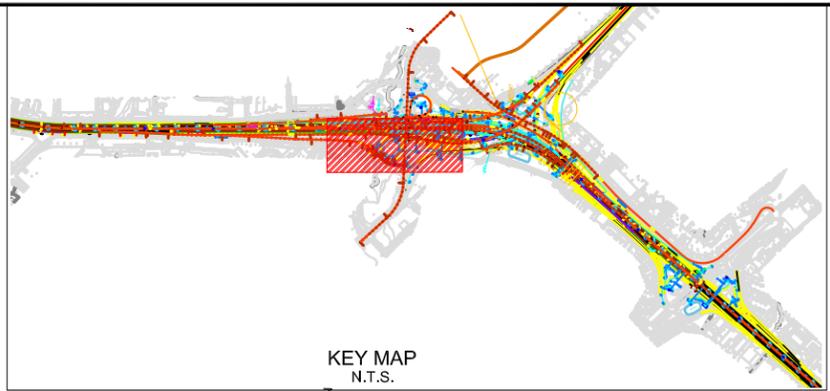
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DRAWN BY: N.A.	CHECKED BY: A.K.
CHECKED BY: M.V.	APPROVED BY: C.N.



QUEEN ELIZABETH WAY
 G.W.P. No. 2163-10-00

DRAWING
03

BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
17-04	4 817 159.8	290 970.4	123.1



- NOTES:
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

LEGEND:

- BOREHOLE BY PML, UNDER PRESENT INVESTIGATIONS
- PREVIOUS BOREHOLE FROM GEOCRETS REPORTS

HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
Queen Elizabeth Way and Highway 403 Improvements

METRIC

STA. 22+950 TO STA. 23+700 (Eastern Part)



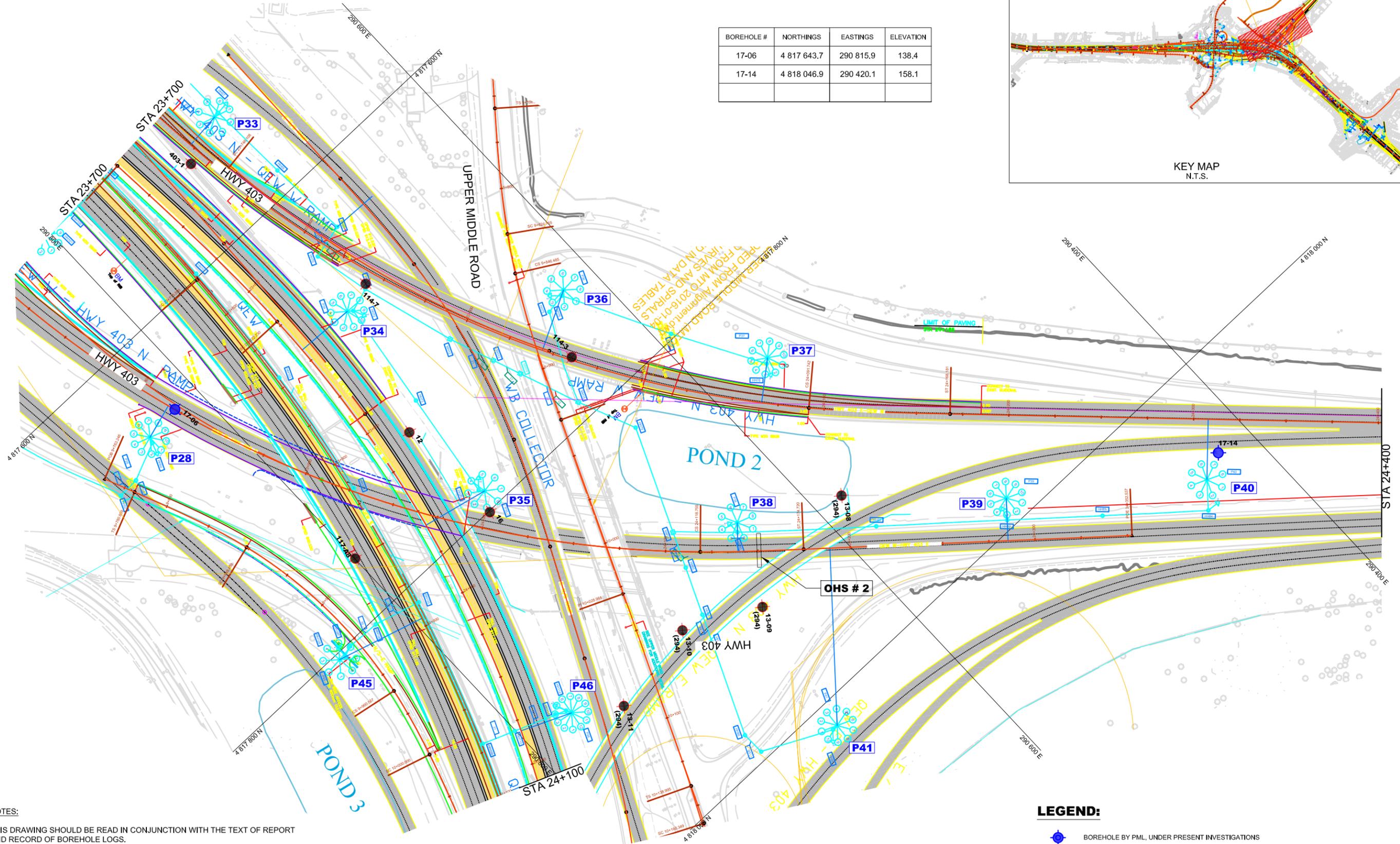
PML REF: 14TF005	DATE: JAN. 24, 2018
DRAWN BY: N.A.	CHECKED BY: A.K.
CHECKED BY: M.V.	APPROVED BY: C.N.



QUEEN ELIZABETH WAY
 G.W.P. No. 2163-10-00

DRAWING
04

BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
17-06	4 817 643.7	290 815.9	138.4
17-14	4 818 046.9	290 420.1	158.1



NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

LEGEND:

- BOREHOLE BY PML, UNDER PRESENT INVESTIGATIONS
- PREVIOUS BOREHOLE FROM GEOGRES REPORTS

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
Queen Elizabeth Way and Highway 403 Improvements**

METRIC

STA. 23+700 TO STA. 24+100



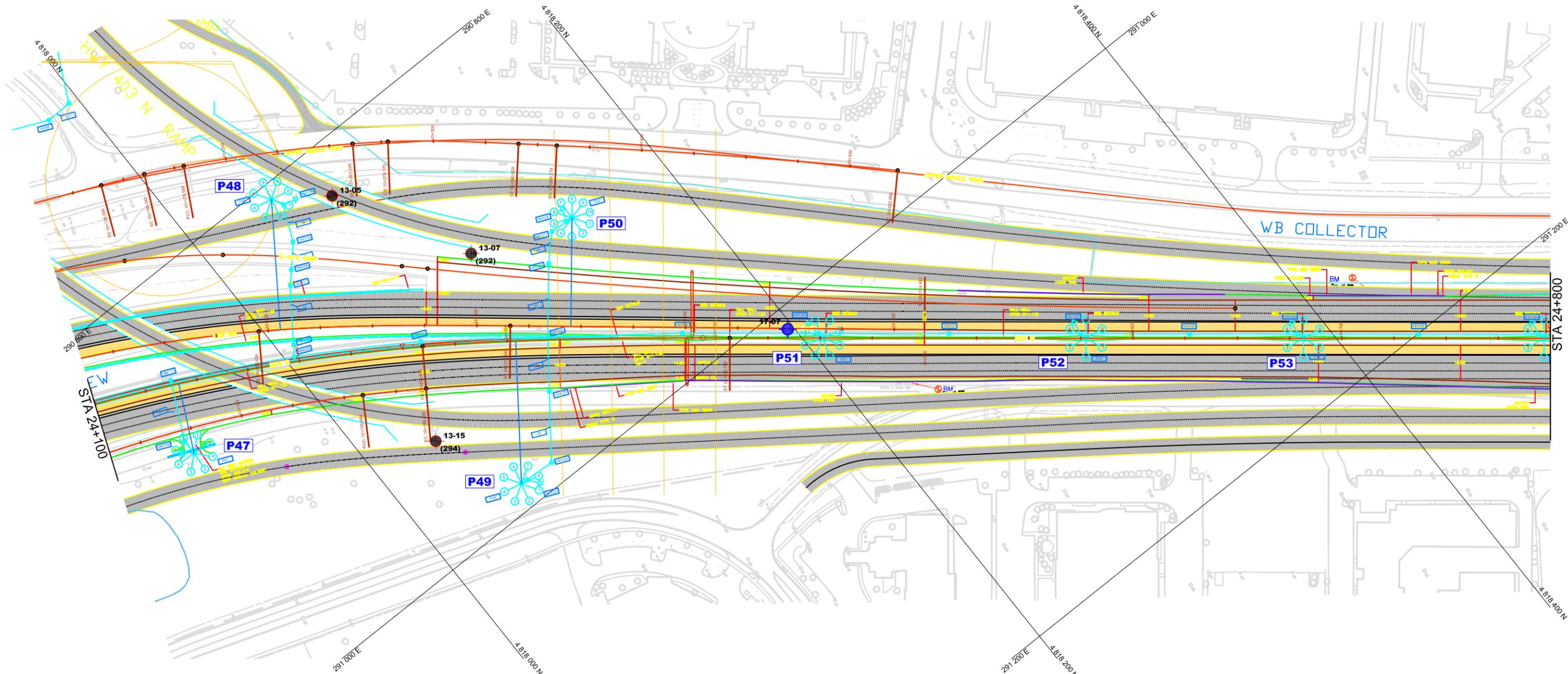
PML REF: 14TF005	DATE: JAN. 24, 2018
DRAWN BY: N.A.	CHECKED BY: A.K.
CHECKED BY: M.V.	APPROVED BY: C.N.



QUEEN ELIZABETH WAY
G.W.P. No. 2163-10-00

DRAWING
05

BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
17-07	4 818 197.2	291 010.0	151.7



NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

LEGEND:

- BOREHOLE BY PML, UNDER PRESENT INVESTIGATIONS
- PREVIOUS BOREHOLE FROM GEOCRE'S REPORTS

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
Queen Elizabeth Way and Highway 403 Improvements**

METRIC

STA. 24+100 TO STA. 24+800



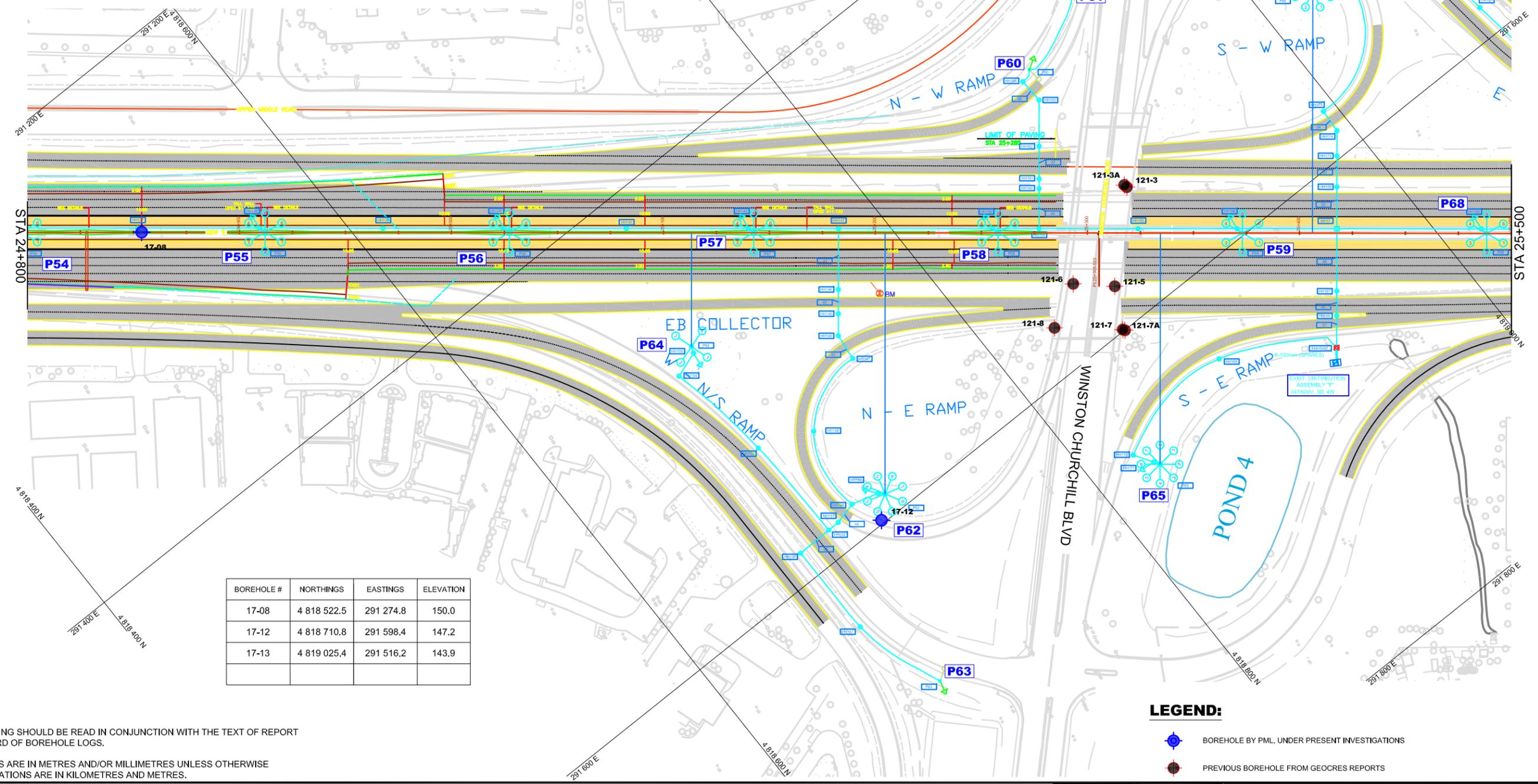
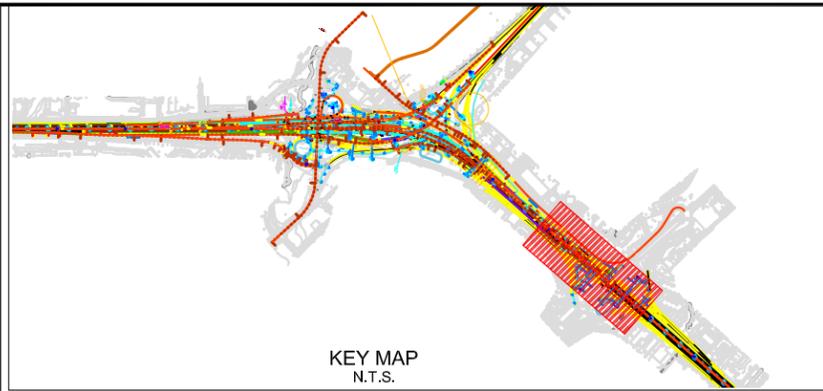
PML REF: 14TF005	DATE: JAN. 24, 2018
DRAWN BY: N.A.	CHECKED BY: A.K.
CHECKED BY: M.V.	APPROVED BY: C.N.



QUEEN ELIZABETH WAY
G.W.P. No. 2163-10-00



DRAWING
06



BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
17-08	4 818 522.5	291 274.8	150.0
17-12	4 818 710.8	291 598.4	147.2
17-13	4 819 025.4	291 516.2	143.9

- NOTES:
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

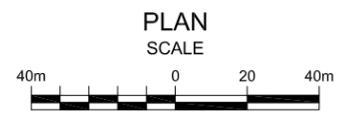
LEGEND:

- BOREHOLE BY PML, UNDER PRESENT INVESTIGATIONS
- PREVIOUS BOREHOLE FROM GEOCRE'S REPORTS

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
Queen Elizabeth Way and Highway 403 Improvements**

METRIC

STA. 24+800 TO STA. 25+500



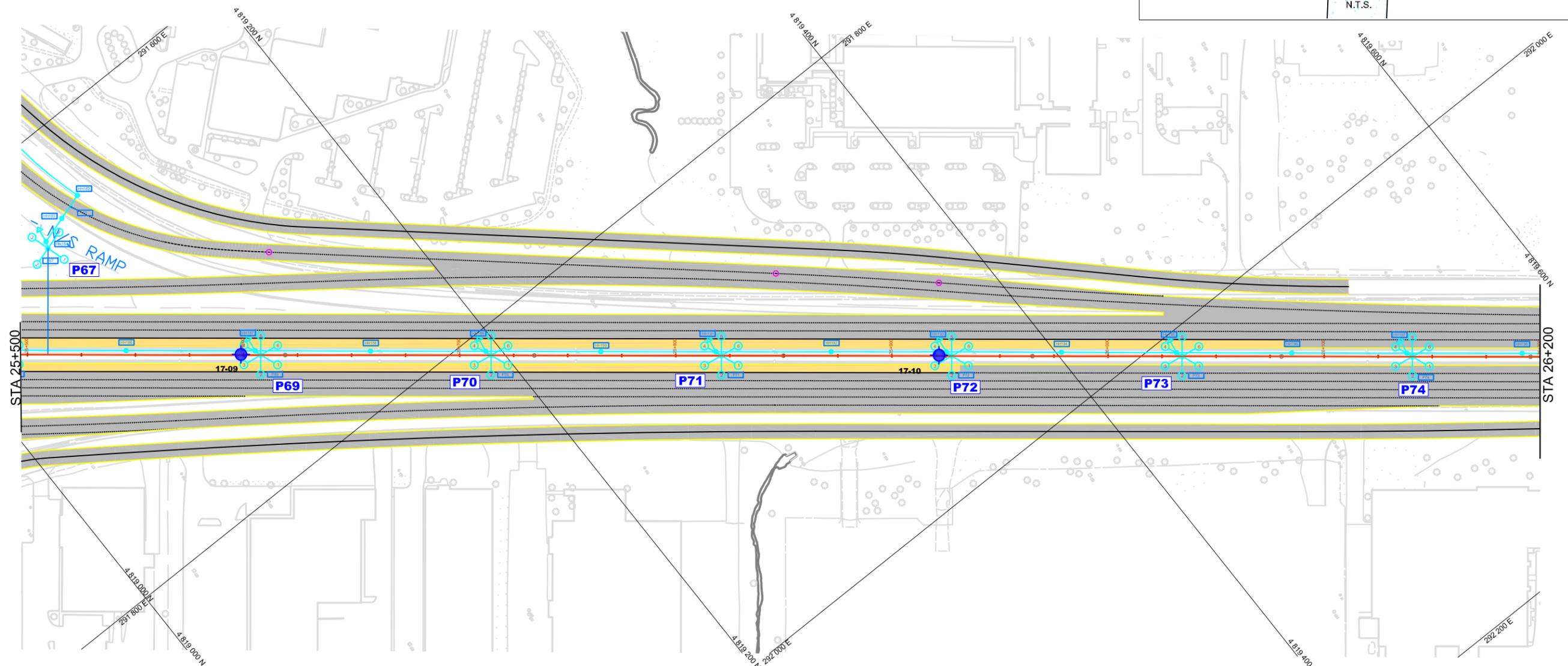
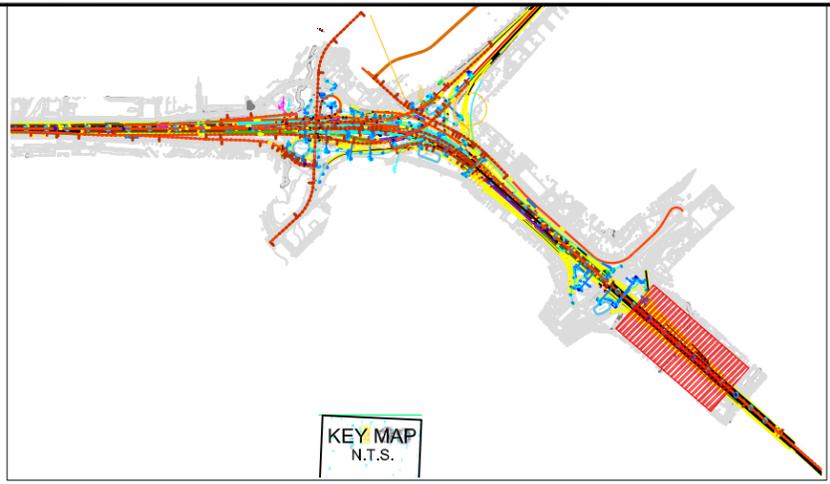
PML REF: 14TF005	DATE: JAN. 24, 2018
DRAWN BY: N.A.	CHECKED BY: A.K.
CHECKED BY: M.V.	APPROVED BY: C.N.



QUEEN ELIZABETH WAY
G.W.P. No. 2163-10-00

DRAWING
07

BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
17-09	4 819 104.6	291 739.6	139.5
17-10	4 819 356.9	291 941.3	137.9



NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

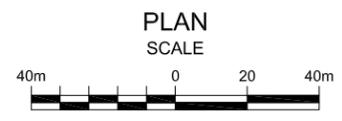
LEGEND:

- BOREHOLE BY PML, UNDER PRESENT INVESTIGATIONS
- PREVIOUS BOREHOLE FROM GEOGRES REPORTS

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
Queen Elizabeth Way and Highway 403 Improvements**

METRIC

STA. 25+500 TO STA. 26+200



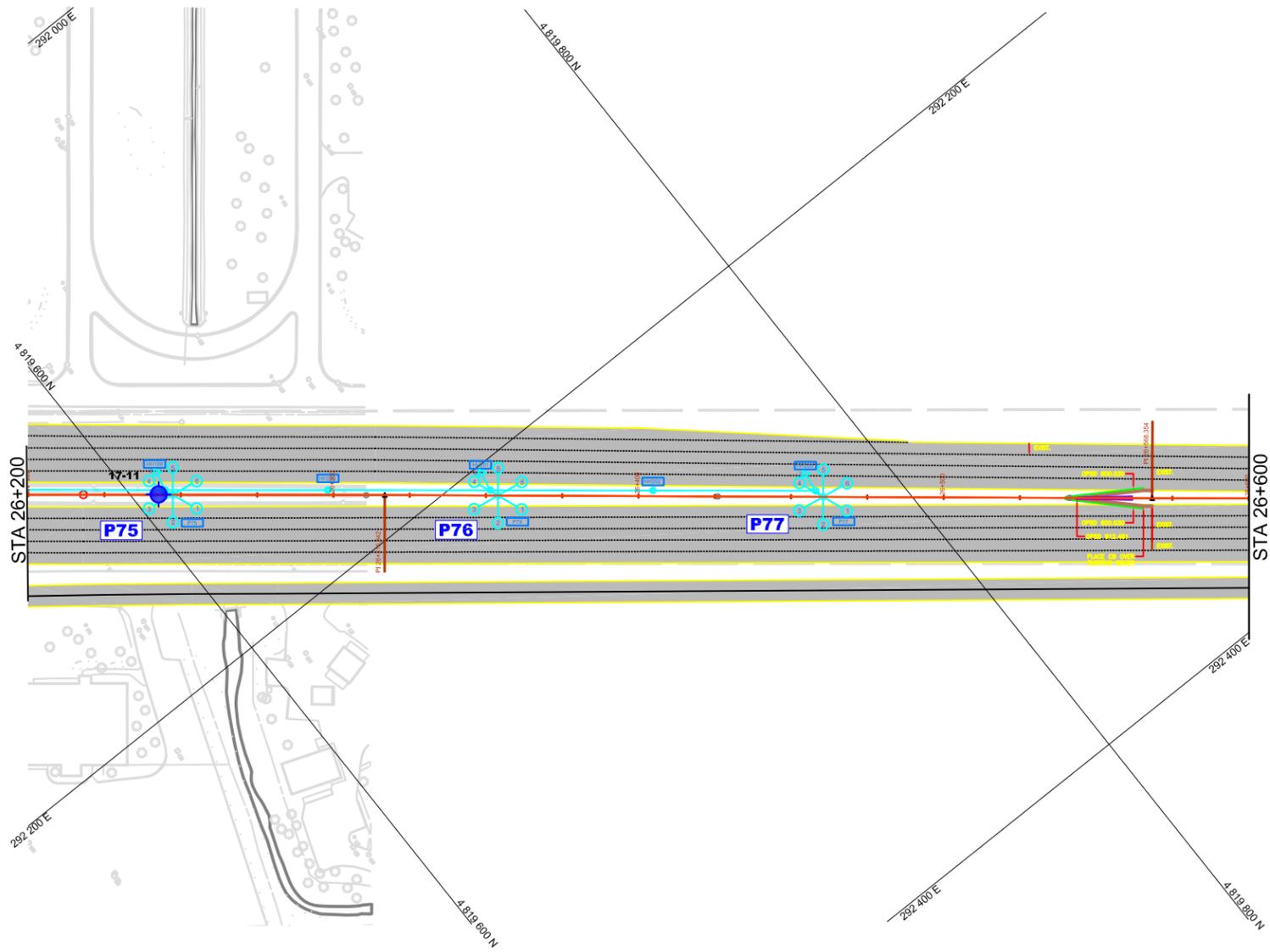
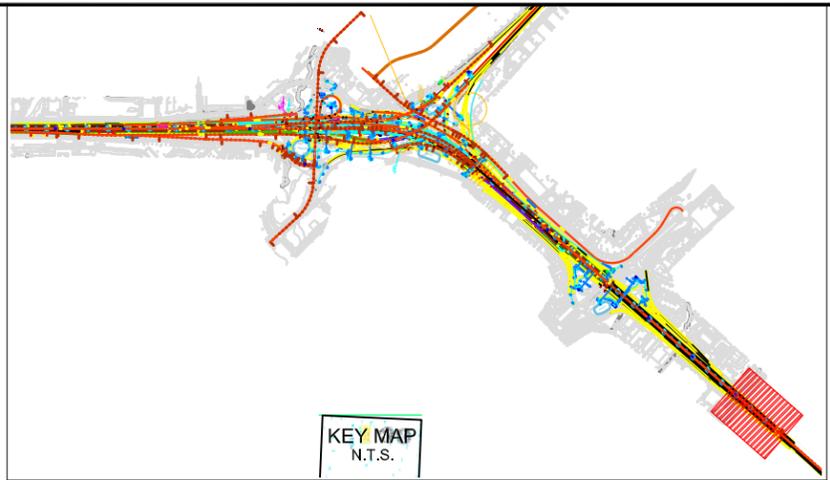
PML REF: 14TF005	DATE: JAN. 24, 2018
DRAWN BY: N.A.	CHECKED BY: A.K.
CHECKED BY: M.V.	APPROVED BY: C.N.



QUEEN ELIZABETH WAY
G.W.P. No. 2163-10-00

DRAWING
08

BOREHOLE #	NORTHINGS	EASTINGS	ELEVATION
17-11	4 819 607.4	292 141.9	133.8



NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

LEGEND:

-  BOREHOLE BY PML, UNDER PRESENT INVESTIGATIONS
-  PREVIOUS BOREHOLE FROM GEOGRES REPORTS

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
Queen Elizabeth Way and Highway 403 Improvements**

METRIC

STA. 26+200 TO STA. 26+600



PML REF.: 14TF005	DATE: JAN. 24, 2018
DRAWN BY: N.A.	CHECKED BY: A.K.
CHECKED BY: M.V.	APPROVED BY: C.N.



QUEEN ELIZABETH WAY
G.W.P. No. 2163-10-00



DRAWING
09



APPENDIX B

Explanation of Terms Used in Report
Record of Current Borehole Sheets 17-1 to 17-4 and 17-6 to 17-14
Record of Geocres Borehole Sheets
Results of Grain Size Distribution Analyses – Figures GS-1 to GS-3
Plasticity Chart – Figures PC-1 to PC-2

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

COMPOSITION: SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENT BY MASS	0-10	10-20	20-30	30-40	> 40
	TRACE	SOME	WITH	ADJECTIVE (SILTY)	AND (AND SILT)

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

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

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

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

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

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

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

R Q D (%)	0-25	25-50	50-75	75-90	90-100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	30-300mm	0.3m-1m	1m-3m	>3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	e_{max}	1, %	VOID RATIO IN LOOSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	e_{min}	1, %	VOID RATIO IN DENSEST STATE
ρ_w	kg/m^3	DENSITY OF WATER	S_r	%	DEGREE OF SATURATION	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
γ_w	kN/m^3	UNIT WEIGHT OF WATER	w_L	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_p	%	PLASTIC LIMIT	D_n	mm	n PERCENT - DIAMETER
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_s	%	SHRINKAGE LIMIT	C_u	1	UNIFORMITY COEFFICIENT
ρ_d	kg/m^3	DENSITY OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m^2/s	RATE OF DISCHARGE
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL	WTPL		WETTER THAN PLASTIC LIMIT	j	kN/m^2	SEEPAGE FORCE
e	1, %	VOID RATIO						

RECORD OF BOREHOLE No 17-01

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 815 766.8 N ; 290 818.1 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.08.28 LATITUDE 43.48168 LONGITUDE -79.67265 CHECKED BY M.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	20	40	60	80						100	20
113.4	GROUND SURFACE																	
0.0	75 mm ASPHALT over silty sand with gravel																	
113.1	(PAVEMENT FILL)																	
0.3	SILTY SAND, with gravel Compact, Brown, Dry		1	SS	14													
	Silty clay to Clayey silt some sand, trace gravel		2	SS	14													
	(FILL)		3	SS	11													9 23 34 34
111.0	SILTY CLAY TO CLAYEY SILT some sand, some gravel occasional shale & limestone fragments		4	SS	93/28cm													
2.4	Hard, Grey/red, Wet (TILL)		5	SS	50/8cm													
109.7	SHALE BEDROCK		6	SS	100/10cm													
3.7	Weathered, Grey, Dry		7	SS	100/5cm													
108.7	End of borehole																	
4.7																		

▼ Water level measured upon completion of drilling

ONTARIO.MTO_14TF005.GPJ ONTARIO.MTO.GDT_1/16/18

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

RECORD OF BOREHOLE No 17-03

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 816 845.8 N ; 290 786.6 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.08.28 LATITUDE 43.4914 LONGITUDE -79.67326 CHECKED BY M.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			20	40	60	80	100						20	40
122.5	GROUND SURFACE																		
0.0	45 mm ASPHALT over silty sand with gravel																		
122.2	(PAVEMENT FILL)																		
0.3	SILTY SAND, with gravel Loose, Brown, Wet		1	SS	5														
	Silty clay to Clayey silt trace sand, trace gravel		2	SS	11														
	Stiff to very stiff, Grey, Moist		3	SS	18														
	(FILL)		4	SS	27											5	13	44	38
119.5	SILTY CLAY TO CLAYEY SILT some sand, trace gravel occasional shale and limestone fragments		5	SS	38														
3.0	Hard, Reddish brown, Moist		6	SS	31											23	22	33	22
	(TILL)		7	SS	37														
116.0	SHALE BEDROCK		8	SS	100/10cm														
6.5	Weathered, Grey, Wet																		
115.8	End of borehole																		
6.7																			

NOTE: Ground water was not encountered during and after completion of drilling.

▼ Water level measured upon completion of drilling

ONTARIO.MTO_14TF005.GPJ ONTARIO.MTO.GDT_1/24/18

RECORD OF BOREHOLE No 17-04

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 159.8 N ; 290 970.4 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.09.11 LATITUDE 43.49423 LONGITUDE -79.671 CHECKED BY M.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			20	40	60	80	100						20
123.1 0.0	GROUND SURFACE																	
122.7 0.4	210 mm ASPHALT over silty sand with gravel (PAVEMENT FILL)		1	SS	12													
122.3 0.8	SILTY SAND, with gravel Compact, Brown, Damp Silty clay, trace sand, trace gravel (FILL)		2	SS	82/28cm													
	SILTY CLAY TO CLAYEY SILT with gravel, some sand occasional shale and limestone fragments		3	SS	95													
120.8 2.3	Hard, Grey, Moist (TILL) SHALE BEDROCK		4	SS	50/5cm													
	Highly weathered, Grey		5	SS	50/5cm													
118.5 4.6	End of borehole		6	SS	50/5cm													
	Water level observed during drilling																	

ONTARIO MTO 14TF005 HML.GPJ ONTARIO MTO.GDT 30/11/17

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

RECORD OF BOREHOLE No 17-06

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 643.7 N ; 290 815.9 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.08.30 LATITUDE 43.49858 LONGITUDE -79.67292 CHECKED BY M.V.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W		
138.4	GROUND SURFACE															
0.0	275 mm ASPHALT over silty sand with gravel (PAVEMENT FILL)															
137.9	SILTY SAND, with gravel occasional shale and limestone fragments		1	SS	29						○					
0.5			2	SS	50/10cm						○					61 24 (15)
137.4	Very dense, Brown, Moist (FILL)															
1.0	SHALE BEDROCK															
	Highly weathered, Red, Wet		3	SS	50/8cm											
			4	SS	50/8cm						○					
133.7	End of borehole		5	SS	50/10cm											
4.7																

▼ Water level measured upon completion of drilling

ONTARIO MTO 14TF005 HML.GPJ ONTARIO MTO.GDT 30/11/17

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

RECORD OF BOREHOLE No 17-07

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 818 197.2 N ; 291 010.0 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.08.29 LATITUDE 43.50357 LONGITUDE -79.67053 CHECKED BY M.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			20	40	60	80	100						20
151.7 0.0	GROUND SURFACE 60 mm ASPHALT over silty sand with gravel (PAVEMENT FILL)																	
151.3 151.4 0.6	SILTY SAND, with gravel Compact, Brown, Dry (FILL) CLAYEY SILT, trace sand, some gravel occasional shale and limestone fragments Hard, Grey/red, Moist (TILL)		1	SS	20													
150.2 1.5	SHALE BEDROCK Highly weathered, Red, Damp		2	SS	33													18 6 57 19
			3	SS	90/23cm													
			4	SS	50/8cm													
			5	SS	50/8cm													
147.0 4.7	End of borehole		6	SS	50/5cm													

NOTE: Ground water was not encountered during and after completion of drilling.

ONTARIO MTO 14TF005 HML.GPJ ONTARIO MTO.GDT 30/11/17

RECORD OF BOREHOLE No 17-08

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 818 522.5 N ; 291 274.8 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.08.24 LATITUDE 43.50650 LONGITUDE -79.66727 CHECKED BY M.V.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	W _p	W		
150.0	GROUND SURFACE															
0.0	70 mm ASPHALT over silty sand with gravel (PAVEMENT FILL)		1	SS	21											
149.3	SAND AND GRAVEL, some silt Loose, Brown, Moist Silty clay, trace sand, trace gravel (FILL)		2	SS	5											
148.5	SILTY CLAY TO CLAYEY SILT trace sand, trace gravel occasional shale and limestone fragments		3	SS	19											1 2 66 31
147.7	Very stiff to hard, Reddish brown, Damp (TILL)		4	SS	50/13cm											
2.3	SHALE BEDROCK Highly weathered, Red, Damp		5	SS	83/23cm											
145.3	End of borehole		6	SS	50/13cm											
4.7																

NOTE: Ground water was not encountered during and after completion of drilling.

ONTARIO MTO 14TF005 HML.GPJ ONTARIO MTO.GDT 30/11/17

RECORD OF BOREHOLE No 17-09

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 819 104.6 N ; 291 739.6 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.09.12 LATITUDE 43.51175 LONGITUDE -79.66153 CHECKED BY M.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			20	40	60	80	100						20
139.5	GROUND SURFACE																	
0.0	85 mm ASPHALT over silty sand with gravel (PAVEMENT FILL)		1	SS	23													
138.8	Silty clay to Clayey silt some sand, trace gravel		2	SS	9													
0.7	Stiff to hard, Brown, Moist (FILL)																	
137.8	SILTY CLAY TO CLAYEY SILT some sand, some gravel occasional shale and limestone fragments		3	SS	51													25 17 35 23
1.7	Hard, Reddish brown, Damp (TILL)		4	SS	50/13cm													
137.2	SHALE BEDROCK																	
2.3	Highly weathered, red, Damp		5	SS	50/15cm													
136																		
135																		
134.8	End of borehole		6	SS	15/8cm													
4.7																		

▼ Water level measured upon completion of drilling

ONTARIO MTO 14TF005 HML.GPJ ONTARIO MTO.GDT 30/11/17

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

RECORD OF BOREHOLE No 17-10

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 819 356.9 N ; 291 941.3 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.09.12 LATITUDE 43.51402 LONGITUDE -79.65904 CHECKED BY M.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			20	40	60	80	100						20
137.9 0.0	GROUND SURFACE 85 mm ASPHALT over silty sand with gravel (PAVEMENT FILL)		1	SS	29													
137.2 0.7	SILTY SAND, with gravel Compact to very loose, Brown, Damp Silty clay, some sand, trace gravel occasional shale and limestone fragments Stiff, Red, Damp		2	SS	3													
136.2 1.7	(FILL) SILTY CLAY TO CLAYEY SILT some sand, trace gravel occasional shale and limestone fragments Stiff, Red, Moist		3	SS	10													
135.6 2.3	(TILL) SHALES BEDROCK Highly weathered, Red, Damp		4	SS	50/13cm													
			5	SS	50/8cm													
133.3 4.6	End of borehole		6	SS	50/5cm													
<p>NOTE: Groundwater was not encountered during and after completion of drilling</p>																		

ONTARIO MTO 14TF005 HML.GPJ ONTARIO MTO.GDT 30/11/17

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

RECORD OF BOREHOLE No 17-11

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 819 607.4 N ; 292 141.9 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.09.14 LATITUDE 43.51628 LONGITUDE -79.65657 CHECKED BY M.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			20	40	60	80	100						20
133.8	GROUND SURFACE																	
0.0	75 mm ASPHALT over silty sand with gravel (PAVEMENT FILL)																	
133.4	SILTY SAND, with gravel		1	SS	25													
	Compact to loose, Brown, Damp		2	SS	6													
	Silty clay, some sand, trace gravel occasional shale and limestone fragments																	
	Very stiff, Reddish brown, Moist		3	SS	23													
	(FILL)		4	SS	16													
131.0	SILTY CLAY TO CLAYEY SILT trace sand, trace gravel occasional shale and limestone fragments Hard, Red, Moist		5	SS	46													
	(TILL)																	
130.0	SHALE BEDROCK		6	SS	50/10cm													
	Highly weathered, Red, Dry																	
129.2	End of borehole		7	SS														
4.6																		

▼ Water level measured upon completion of drilling

ONTARIO MTO 14TF005 HML.GPJ ONTARIO MTO.GDT 30/11/17

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

RECORD OF BOREHOLE No 17-12

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 818 710.8 N ; 291 598.4 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.08.29 LATITUDE 43.50520 LONGITUDE -79.66327 CHECKED BY M.V.

SOIL PROFILE		STRAT PLOT	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		NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
147.2	GROUND SURFACE																
0.0	220 mm ASPHALT over																
146.8	silty sand with gravel		1	SS	13												
0.4	(PAVEMENT FILL)																
146.4	Silty clay, some sand, trace gravel		2	SS	5												
0.8	occasional shale and limestone fragments (FILL)																
	SILTY CLAY TO CLAYEY SILT																
	trace sand, trace gravel																
	occasional shale and limestone fragments																
	Firm to hard, Red, Moist		3	SS	55												
144.9	(TILL)																
2.3	SHALE BEDROCK		4	SS	50/13cm												
	Highly weathered, Red, Dry																
			5	SS	50/10cm												
142.5																	
4.7	End of borehole		6	SS	50/0cm												
<p>NOTE: Ground water was not encountered during and after completion of drilling.</p>																	

ONTARIO MTO 14TF005 HML.GPJ ONTARIO MTO.GDT 30/11/17

RECORD OF BOREHOLE No 17-13

1 OF 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 819 025.4 N ; 291 516.2 E ORIGINATED BY K.P.
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY A.K.
 DATUM Geodetic DATE 2017.08.29 LATITUDE 43.51103 LONGITUDE -79.66429 CHECKED BY M.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			20	40	60	80	100						20
143.9	GROUND SURFACE																	
0.0	SILTY SAND, with gravel Loose, brown, Moist Silty clay to clayey silt some sand, trace gravel, shale fragments Firm to stiff, Reddish brown, Moist		1	SS	6													
			2	SS	12													
			3	SS	7													
	Silty sand, some gravel occasional shale and limestone fragments Compact to very dense, Brown, Moist		4	SS	14													13 59 (28)
	(FILL)		5	SS	35													
			6	SS	61													9 14 50 27
139.0	SILTY CLAY TO CLAYEY SILT some sand, trace gravel occasional shale and limestone fragments Hard, Reddish brown, Damp		7	SS	66													
4.9	(TILL)																	
137.0	SHALE BEDROCK		8	SS	100/10cm													
6.9	Weathered, Reddish, Wet																	
136.1	End of borehole		9	SS	100/5cm													
7.8																		
	NOTE: Ground water was not encountered during and after completion of drilling.																	

ONTARIO.MTO_14TF005.GPJ ONTARIO.MTO.GDT_1/17/18

PROJECT 991-1140 **RECORD OF BOREHOLE No 4** **1 OF 1** **METRIC**

W.P. 88-23024 **LOCATION** Sta. 21+480, 2m Left of centerline of the median **ORIGINATED BY** BVB

DIST HWY QEW **BOREHOLE TYPE** **COMPILED BY** BVB

DATUM Geodetic **DATE** 25.8.99 **CHECKED BY** AMP

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	TY VALUES			20	40	60	80	100					
109.12																	
108.99	Pavement																
0.19	Sand, some gravel Dense to compact Brown (F#)		1	50 DO	36												
			2	50 DO	44												
			3	50 DO	12												
106.69	Silty Clay, trace to some sand and gravel Hard Brown (T#)		4	50 DO	50/20												
106.36																	
2.74	Shale Bedrock Weathered Grey (Georgian Bay Formation)																
104.85	END OF BOREHOLE (AUGER REFUSAL) Note: Water level in open borehole at 2.3m depth on completion of drilling.																
4.57																	

ON MOT 991-1140.GPJ ON MOT.GOT 12/10/99

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

PROJECT 991-1140 **RECORD OF BOREHOLE No 15** 1 OF 1 **METRIC**
 W.P. 98-23024 LOCATION Sta. 21+400, 25m Right of centerline of the median ORIGINATED BY SB
 DIST HWY QEW BOREHOLE TYPE _____ COMPILED BY SVB
 DATUM Geodetic DATE 10.9.99 CHECKED BY AMP

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								
						20	40	60	80	100	20	40	60	kN/m ³	GR SA SI CL	
107.75 0.00	Silty Sand, some gravel, trace clay, trace rootlets Dense Brown (Fill)	[Pattern]	1	50 DO	31											
106.99 0.76	Silty Clay, some sand and gravel Stiff Brown/grey (Fill)	[Pattern]	2	50 DO	9											
106.38 1.37	Silty Clay, trace to some sand and gravel Hard Brown/grey (Fill)	[Pattern]	3	50 DO	5100											
106.15 1.60	Shale Bedrock Weathered Grey (Georgian Bay Formation)	[Pattern]	4	50 DO	5100											
103.94 3.81	END OF BOREHOLE (AUGER REFUSAL) Note: Open hole dry on completion of drilling. Water level in Piezometer at Elev. 105.8m on Sept. 28/99.															

ON MOT 991-1140.GPJ ON MOT GDT 12/10/99

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

125-66-72

RECORD OF BOREHOLE No 17

W P 159-75-85 LOCATION Co-ords. N 15,803,222; E 953,842 ORIGINATED BY JRW
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Augering - BXL Core COMPILED BY JRW
 DATUM Geodetic DATE June 17, 1977 CHECKED BY JRW

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQ. LIM. W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60					
393.7	Creek Bottom														
391.7	Cobbles and gravel														
389.7	Silty clay some sand		1	AS											
			2	SS	1.09										
4.0	Bedrock		4	RC	Rec 60%										RQD 50%
	80% Shale-Soft & weathered		5	RC	Rec 75%										RQD 20%
	Frequent laminations of limestone		6	RC	Rec 80%										RQD 20%
	Up to 8" thick														
376.8															
16.9	End of Borehole														

+3, x5: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 13-20

1 OF 1

METRIC

W.P. _____ LOCATION N 4 617 188.1 E 290 718.9 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.06.04 - 2013.06.04 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)	
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								20	40	60	80	100						
127.7																		
0.0	TOPSOIL: (100mm)																	
0.1	Silty CLAY, trace to some sand, trace gravel Firm to Very Stiff Brown (FILL)		1	SS	7													
			2	SS	22													2 13 49 36
126.1			3	SS	50/													
1.6	SHALE , with limestone interbeds, weathered, thinly bedded, grey				0.150													
			4	SS	50/	0.000												
			5	SS	50/	0.125												
	Start coring at 3.3m Weathered to fresh, thinly bedded, grey, occasional limestone interbeds																	
	Soft zone (175mm) at 3.3m		1	RUN														RUN #1 TCR=100% SCR=87% ROD=57% UCS=43MPa (Average)
	Sub-vertical fracture (50mm) at 3.6m																	
	Limestone interbeds (25mm to 50mm thick) at 3.7m, 3.8m, 4.0m, 4.3m, 4.7m, 4.8m, (125mm) at 4.4m and (75mm) at 4.5m																	
	Horizontal fracture at 3.5m, 3.6m, 3.7m, 3.8m, 3.9m, 4.1m, 4.3m, 4.5m, 4.8m		2	RUN														RUN #2 TCR=100% SCR=87% ROD=87% UCS=47MPa (Average)
	Limestone interbeds (25mm thick) at 4.9m, 5.3m, 5.7m, 5.8m, 5.9m, 6.0m, 6.1m, 6.2m, (100mm) at 5.1m and (125mm) at 5.5m																	
	Horizontal fracture at 4.9m, 5.2m, 5.4m, 5.6m, 5.7m, 5.8m, 6.0m																	
121.3																		
6.4	END OF BOREHOLE AT 6.4m. BOREHOLE OPEN TO 6.4m AND WATER LEVEL AT 4.2m UPON COMPLETION OF CORING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																	
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) June 7/13 4.2 123.5 June 26/13 4.1 123.6																	

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 11/10/13

+ 3 x 3 Numbers refer to Sensitivity 20 15 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-22

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 183.5 E 290 838.7 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.06.03 - 2013.06.04 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA S _i CL
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
128.0 0.0	TOPSOIL: (125mm)												
0.1	SAND, some silt, some gravel Compact Brown Damp (FILL)		1	SS	13								
127.3 0.8	Silty CLAY, trace sand, trace gravel Stiff Reddish Brown		2	SS	12								2 11 53 34
			3	SS	20								
125.7 2.4	SHALE with limestone interbeds, highly weathered, thinly bedded, grey, iron oxide staining		4	SS	50/ 0.150								
			5	SS	50/ 0.125								
	Start coring at 4.5m												
	Slightly weathered to fresh, thinly bedded, grey, occasional limestone interbeds												
	Clay seam (50mm) at 4.5m												
	Limestone interbeds (25mm thick) at 5.1m, 5.4m, 5.6m, 6.0m and (100mm) at 5.2m		1	RUN									RUN #1 TCR=100% SCR=83% RQD=75% UCS=49MPa (Average)
	Horizontal fractures at 4.8m, 4.9m, 5.4m, 5.5m, 5.7m, 5.9m												
	Limestone interbeds (25 to 50mm thick) at 6.1m, 6.2m, 6.4m, 6.6m, 6.8m, 7.2m and (300mm) at 7.3m		2	RUN									RUN #2 TCR=100% SCR=100% RQD=100% UCS=73MPa (Average)
	Horizontal fractures at 6.2m, 6.7m, 6.9m, 7.0m, 7.1m												
120.4 7.6	END OF BOREHOLE AT 7.6m. BOREHOLE OPEN TO 7.6m AND WATER LEVEL AT 5.4m UPON COMPLETION OF CORING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.												
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m)												
	June 7/13 5.4 122.6												
	June 26/13 5.2 122.8												

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 11/10/13

+ 3 x 3 Numbers refer to Sensitivity 20 15-5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 1

W P 125-66-23 LOCATION Co-ords N 15,803,181; E 954,335 ORIGINATED BY V.K.
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger; BXL Core and Cone Test COMPILED BY V.K.
 DATUM Geodetic DATE November 14, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
389.6 0.0 Topsoil	Ground Level												
384.6 5.0	Clayey Silt, Sand & Gravel Hard		1	SS	51								28 7 39 26
379.6	Shale Bedrock*						100/7"						
10.0	End of Borehole * Bedrock: Shale, grey, soft, fissile, 2" limestone seams R.Q.D. 15%												

RECORD OF BOREHOLE No 2

W P 125-66-23 LOCATION Co-ords N 15,803,193; E 954,297 ORIGINATED BY V.K.
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger; BXL Core and Cone Test COMPILED BY V.K.
 DATUM Geodetic DATE November 14, 1977 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
389.6 0.0 Topsoil	Ground Level												
383.6 5.0 Weathered	Clayey Silt, Sand and Gravel Very Stiff		1	SS	15								50 22 14 5
378.6	Shale Bedrock*						100/5"						
11.0	End of Borehole * Bedrock: Shale, grey, soft, fissile, 4" limestone seams R.Q.D. 20%												

+3, x5: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 3

W P 125-66-23 LOCATION Co-ords N 15,803,229; E 954,333 ORIGINATED BY V.K.
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger; BXL Core COMPILED BY V.K.
 DATUM Geodetic DATE November 14, 1977 CHECKED BY RS

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					
											○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)				
											● QUICK TRIAXIAL	x LAB VANE	10	20	30		
388.1	Ground Level																
0.0	Topsoil																
384.1	Clayey Silt, sand and Gravel																
4.0																	
379.1	A Bedrock*						380										
9.0	End of Borehole																
	* Bedrock:																
	A. Shale, grey, soft fissile with 1" seams of limestone																
	B. Limestone, light grey, fine to med. grained, hard. Fossiliferous																
	R.Q.D. 30%																

RECORD OF BOREHOLE No 4

W P 125-66-23 LOCATION Co-ords: N 15,803,217; E 954,368 ORIGINATED BY V.K.
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/2" Hollow Stem Auger; BXL Core COMPILED BY V.K.
 DATUM Geodetic DATE November 15, 1977 CHECKED BY RS

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					
											○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)				
											● QUICK TRIAXIAL	x LAB VANE	10	20	30		
388.0	Ground Level																
0.0	Topsoil																
383.0	Clayey Silt, Sand and Gravel, Very Stiff		1	SS	18											56 21 18 5	
5.0																	
378.0	A Bedrock*						380										
10.0	End of Borehole																
	* Bedrock:																
	A. Shale, grey, soft fissile, thin seams of limestone.																
	B. Limestone, light grey, med. grained, hard, fossiliferous																
	R.Q.D. 30%																

+3, x5: Numbers refer to Sensitivity
 20
 15 $\frac{1}{5}$ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 13-21

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 230.8 E 290 835.9 ORIGINATED BY GA
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.22 - 2013.05.22 CHECKED BY LRB

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
125.1	ASPHALT: (150mm)																
0.0																	
0.2	SAND and GRAVEL, some silt Dense Brown Damp (FILL)		1	SS	38												57 33 10 (SI+CL)
124.3																	
0.8	SHAILE with limestone Interbeds, highly weathered, thinly bedded		2	SS	71												
	Start coring from 1.8m																
	Slightly weathered, thinly bedded, grey, occasional limestone interbeds																
	Limestone interbed (25mm) at 2.4m 200mm at 2.2m																
	Horizontal fractures at 1.8m, 1.9m, 2.0m, 2.1m, 2.2m, 2.5m, 2.9m, 3.0m																
	150mm highly broken zone at 3.2m																
	Clay seam at 3.2m																
	Horizontal fractures at 3.4m, 3.5m, 3.6m, 3.7m, 3.9m, 4.1m, 4.3m, 4.7m, 4.8m																
	Limestone interbeds (25mm) at 3.8m, 4.2m, 4.4m, 4.6m and (75mm) at 4.0m																
120.2																	
4.9	END OF BOREHOLE AT 4.9m. BOREHOLE OPEN TO 4.9m AND WATER LEVEL AT 2.1m UPON COMPLETION OF CORING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, CONCRETE TO 0.15m, THEN ASPHALT PATCH TO SURFACE.																

ONTM14S 1184.GPJ 2012TEMPLATE(MTO).GDT 11/10/13

+ 3 . X 3 Numbers refer to 20
Sensitivity 15-5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-24

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 241.5 E 290 767.3 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.24 - 2013.05.25 CHECKED BY LRB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
131.5						20	40	60	80	100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
0.0	ASPHALT: (150mm)					UNCONFINED + FIELD VANE					W P	W	W L	
0.2	SAND and GRAVEL, some silt Compact Brown Damp (FILL)	1	SS	30		QUICK TRIAXIAL X LAB VANE					WATER CONTENT (%)			
130.0		2	SS	28		20	40	60	80	100	20	40	60	GR SA SI CL
1.5	Silty CLAY, trace sand, occasional shale fragments	3	SS	16										
129.7	Very Stiff Reddish Brown	4	SS	50/0.150										
1.8	SHALE, with limestone interbeds, highly weathered, grey	5	SS	50/0.100										
	Start coring at 3.3m	1	RUN											No Recovery
	Slightly weathered to fresh, thinly bedded, grey, occasional limestone interbeds	2	RUN											FI
	Clay seam (25mm) at 5.5m, 5.6m, 5.7m													>10
	Horizontal fracture at 5.5m, 5.6m, 5.9m, 6.0m													>10
	Limestone interbeds (25mm) at 5.9m, 6.0m, 6.1m and (100mm) at 5.5m													4
	Highly broken zones: 250mm at 4.8m 50mm at 5.2m 50mm at 5.4m													2
	Limestone interbeds (25mm to 75mm) at 6.6m, 6.9m, 7.0m, 7.3m, 7.6m, 7.7m	3	RUN											0
	Horizontal fracture at 6.4m, 6.5m, 6.6m, 6.7m, 6.9m, 7.0m, 7.4m, 7.8m													4
123.6														2
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN TO 7.9m AND WATER LEVEL AT 3.9m UPON COMPLETION OF CORING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.													1
														1

ONTMT4S_1184.GPJ 2012TEMPLATE(MTO).GDT 11/10/13

+³, x³: Numbers refer to Sensitivity
 20
 15 10 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-19

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 242.3 E 290 705.9 ORIGINATED BY GA
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.06.03 - 2013.06.03 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80					
131.0	TOPSOIL: (100mm)															
0.0	SHALE, occasional clay pockets, silty		1	SS	10											
130.3	Compact Reddish Brown Damp (FILL)		2	SS	24											0 8 65 27
0.7	Silty CLAY, trace sand Very Stiff Reddish Brown (FILL)		3	SS	28											
129.6	Silty CLAY, trace sand, occasional shale fragments Very Stiff		4	SS	50/ 0.150											
1.4	Brown/Reddish Brown		5	SS	50/ 0.125											
128.8	SHALE, with limestone interbeds, weathered, thinly bedded, brownish grey															
2.2	Start coring at 4.5m															
	Weathered to fresh, thinly bedded, grey, occasional limestone interbeds															
	Clay seam (100mm) at 4.6m															
	Limestone interbeds (25mm thick) at 4.1m, 4.8m, 5.7m and (125mm) at 5.0m		1	RUN												RUN #1 TCR=100% SCR=92% ROD=80% UCS=56MPa (Average)
	Horizontal fractures at 4.6m, 4.7m, 5.0m, 5.4m, 5.5m, 5.9m, 6.0m															
	Limestone interbeds (25mm to 50mm thick) at 6.1m, 6.6m, 7.0m, 7.1m, 7.4m, 7.5m and (150mm) at 6.2m		2	RUN												RUN #2 TCR=100% SCR=100% ROD=93% UCS=42MPa (Average)
	Horizontal fractures at 6.1m, 6.2m, 6.4m, 6.5m, 6.6m, 7.4m, 7.5m															
123.4	END OF BOREHOLE AT 7.6m. BOREHOLE OPEN TO 7.6m AND WATER LEVEL AT 4.5m UPON COMPLETION OF CORING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.															
7.6	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) June 7/13 7.1 123.9 June 26/13 7.5 123.5															

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 11/10/13

+ 3 x 3 Numbers refer to Sensitivity 20 15 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 403-1

1 of 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 553.0 N; 290 718.9 E ORIGINATED BY S.A.
 DIST Central HWY QEW BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY K.D.
 DATUM Geodetic DATE November 06, 2015 CHECKED BY C.N.

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
145.1	Ground Surface																
144.9	Topsoil	(FILL)	1	SS	9												
0.2	Clayey silt to silty clay some sand, trace gravel rootlets, organic inclusions shale fragments		2	SS	12												
	Stiff to Dark Moist very stiff brown/ reddish brown		3	SS	11												9 15 46 30
			4	SS	9												
			5	SS	17												
			6	SS	14												3 14 46 37
			7	SS	50/10cm												
139.8	Highly weathered shale bedrock																
5.3	Reddish brown																
139.4	End of borehole																
5.7	Refusal to augering																
	* Borehole dry																

RECORD OF BOREHOLE No 403-4

1 of 1

METRIC

G.W.P. 2163-10-00 LOCATION Coords: 4 817 336.6 N; 290 736.5 E ORIGINATED BY S.A.
 DIST Central HWY QEW BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY K.D.
 DATUM Geodetic DATE November 06, 2015 CHECKED BY C.N.

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					
135.9	Ground Surface															
135.8	Topsoil															
0.1	Silty clay some sand, trace gravel organic inclusions, rootlets shale fragments		1	SS	9											4 11 45 40
	Stiff to Reddish Moist very stiff brown (FILL)		2	SS	23											
134.4																
1.5	Highly weathered shale bedrock, siltstone bands		3	SS	50/13cm											
	Grey/ reddish brown															
133.3			4	SS	50/10cm											
2.6	End of borehole Refusal to augering															
	* Borehole dry															

RECORD OF BOREHOLE No 7

W P 159-75-09 LOCATION Co-ords N 15 805 259; E 953 669 ORIGINATED BY V.K.
 DIST 4 HWY 403 BOREHOLE TYPE 3/4" Hollow Stem Auger BXL Core COMPILED BY *sl*
 DATUM Geodetic DATE November 9th, 1977 CHECKED BY *wf*

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 (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40						60	80
471.8	Ground Level															
0.0	Topsoil															
462.8	Clayey Silt With Traces of Sand Hard		1	SS	32									0 3 67 30		
9.0	Weathered Shale With Seams of Shaly Limestone		3	SS	50/2	5"										
457.3	Bedrock		4	BXL	100% Rec.											
14.5	End of Borehole															
	Bedrock: Shale, brown red colour, fine texture, soft and fissile. Shaly limestone, light grey colour, fine texture, medium hard to soft, shale R.Q.D.0% limestone R.Q.D.50%															

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 13

WP 159-75-07 LOCATION Co-ords. N 15,805,861; E 953,791 ORIGINATED BY VK
 DIST 4 HWY 403 BORING DATE March 28, 1977 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Solid Stem Auger; BXL Core CHECKED BY RS

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
487.8	Ground Level															
0.0	Clayey silt Trace of sand Hard. Red		1	SS	38										0 6 74 20	
480.8			2	SS	129	480										
7.0 477.8	(weathered) (sound)		3	SS	100	477.8										
10.0	Shale Bedrock		4	RC BXL	100% Rec	470									RQD 30%	
	Shale Bedrock, red, fine texture, soft, fissile with lime- stone interbedded seams up to 2" thick thin horizontal bedding.		5	RC BXL	100% Rec	460									RQD 50%	
457.9																
29.9	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

W P 159-75-09 LOCATION Co-ords N 15 805 604; E 953 491 ORIGINATED BY V.K.
 DIST 4 HWY 403 BOREHOLE TYPE 3 1/4" Hollow Stem Auger BXL Core COMPILED BY *el.*
 DATUM Geodetic DATE November 9th, 1977 CHECKED BY *el.*

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60					
481.1	Ground Level														
0.0	Topsoil														
476.1	Clayey Silt with traces of sand Hard		1	SS	44									0 9 71 20	
5.0	Shale Bedrock		2	BXL	100% Rec.										
466.1	End of Borehole														
15.0	Bedrock: Shale, brown red colour, with few thin beds of grey shale, fine texture, soft and fissile -R.Q.D. 0%														

+3, x5: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 13-08

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 953.6 E 290 550.0 ORIGINATED BY GA
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.07 - 2013.05.07 CHECKED BY L.RB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
							20	40	60	80	100					
151.8	TOPSOIL: (50mm)															
0.0																
151.3	Silty CLAY, some sand Very Stiff Brown (FILL)		1	SS	17											
0.5	SHALE, highly weathered, brown		2	SS	50/ 0.150		151									
			3	SS	50/ 0.150		150									
	Start coring at 2.4m															
	Moderately weathered to fresh, occasional limestone interbeds															
	Horizontal fractures at 2.5m, 2.6m, 2.7m, 2.9m, 3.0m, 3.2m, 3.3m, 3.4m, 3.7m, 3.8m		1	RUN			149									
	Limestone interbeds (25mm thick) at 3.0m, 3.2m, 3.4m, 3.7m															
	Limestone interbed (150mm) at 4.1m															
	Horizontal fractures at 4.0m, 4.1m, 4.2m, 4.3m, 4.4m, 4.5m, 4.7m, 5.0m, 5.1m, 5.2m		2	RUN			148									
	Limestone interbeds (25mm thick) at 3.9m, 4.3m, 4.4m, 4.5m, 4.6m, 5.3m, (75mm) at 4.7m															
146.3	END OF BOREHOLE AT 5.5m. BOREHOLE OPEN TO 5.5m AND WATER LEVEL AT 0.9m UPON COMPLETION OF CORING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.						147									
5.5																
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m)															
	May 30/13 5.5 146.3															
	Jun 28/13 4.3 147.5															

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 8/1/13

RECORD OF BOREHOLE No 13-09

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 924.3 E 290 584.6 ORIGINATED BY GA
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.08 - 2013.05.08 CHECKED BY LRB

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	WATER CONTENT (%)
150.8 0.0	TOPSOIL: (50mm)																	
150.0 0.8	Silty CLAY, trace sand, occasional shale fragments Very Stiff Reddish Brown (FILL)		1	SS	22										0	6	58	36
	SHALE, highly weathered, thinly bedded, reddish brown		2	SS	50/	0.150												
			3	SS	50/	0.100												
	Start coring at 2.4m																	
	Slightly weathered to fresh, thinly bedded, reddish brown, occasional limestone interbeds																	
	Limestone interbeds (25mm to 75mm thick) at 2.7m, 2.9m, 3.1m, 3.4m, 3.6m		1	RUN														
	Clay seam at 3.1m																	
	Horizontal fractures at 2.5m, 2.9m, 3.0m, 3.1m, 3.2m, 3.3m, 3.4m, 3.5m, 3.9m																	
	Limestone interbeds (25mm thick) at 4.1m, 4.7m, 4.8m, 5.1m, 5.3m		2	RUN														
	Horizontal fractures at 4.0m, 4.1m, 4.4m, 4.9m																	
	Limestone Interbeds (25mm thick) at 5.4m, 5.7m, 5.8m		3	RUN														
144.8 5.9	END OF BOREHOLE AT 5.9m. BOREHOLE OPEN TO 5.9m AND WATER LEVEL AT 1.2m UPON COMPLETION OF CORING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																	

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 8/1/13

RECORD OF BOREHOLE No 13-03

1 OF 1

METRIC

W.P. _____ LOCATION N 4 818 025.2 E 290 735.9 ORIGINATED BY GA
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.08 - 2013.05.08 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
							20	40	60	80	100					
152.6	TOPSOIL: (25mm)															
151.9	SHALE, highly weathered, trace rootlets Compact Reddish Brown Damp (FILL)		1	SS	21											
151.3	Silty CLAY, trace sand, occasional shale fragments Hard Reddish Brown (FILL)		2	SS	45											0 5 68 27
147.1	SHALE, highly weathered, thinly bedded, reddish brown Start coring at 2.4m Slightly weathered to fresh, thinly bedded, reddish brown, occasional limestone interbeds Limestone interbeds (25mm thick) at 2.6m, 2.9m, 3.5m, 3.6m Horizontal fracture at 2.4m, 2.5m, 2.6m, 2.9m, 3.0m, 3.2m, 3.4m, 3.5m, 3.6m, 3.7m, 3.8m Limestone interbeds (25mm thick) at 4.1m, 4.7m, 5.1m Limestone interbed (25mm thick) at 4.6m, 4.8m, 5.3m Horizontal fracture at 4.1m, 4.4m, 4.5m, 4.6m, 4.7m, 4.8m, 5.1m, 5.2m, 5.3m		3	SS	39											
			1	RUN												3 3 2 4
			2	RUN												1 3 4 1 3
147.1	END OF BOREHOLE AT 5.5m. BOREHOLE OPEN TO 5.5m AND WATER LEVEL AT 0.6m UPON COMPLETION OF CORING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 30/13 4.5 148.1 Jun 26/13 4.4 148.2															

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 7/24/13

+ 3 x 3 Numbers refer to 20
Sensitivity 15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-24

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 241.5 E 290 757.3 ORIGINATED BY GA
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.24 - 2013.05.25 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
							20	40	60	80	100	20	40	60		
131.5	ASPHALT: (150mm)															
0.0																
0.2	SAND and GRAVEL, some silt Compact Brown Damp (FILL)		1	SS	30											
			2	SS	28											37 47 15 (SI+CL)
130.0																
1.5	Silty CLAY, trace sand, occasional shale fragments															
129.7	Very Stiff Reddish Brown		3	SS	16											
1.8	SHALE, with limestone interbeds, highly weathered, grey		4	SS	50/ 0.130											
	Start coring at 3.3m		5	SS	50/ 0.100											
			1	RUN												No Recovery
	Slightly weathered to fresh, thinly bedded, grey, occasional limestone interbeds															
	Clay seam (25mm) at 5.5m, 5.6m, 5.7m		2	RUN												FI >10 >10 4 2 0
	Horizontal fracture at 5.5m, 5.6m, 5.9m, 6.0m															
	Limestone interbeds (25mm) at 5.9m, 6.0m, 6.1m and (100mm) at 5.5m															
	Highly broken zones: 250mm at 4.8m 50mm at 5.2m 50mm at 5.4m															
	Limestone interbeds (25mm to 75mm) at 6.6m, 6.9m, 7.0m, 7.3m, 7.6m, 7.7m		3	RUN												RUN #3 TCR=100% SCR=97% RQD=70% UCS=85MPa (Average)
	Horizontal fracture at 6.4m, 6.5m, 6.8m, 6.7m, 6.9m, 7.0m, 7.4m, 7.8m															
123.6																
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN TO 7.9m AND WATER LEVEL AT 3.9m UPON COMPLETION OF CORING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.															

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

RECORD OF BOREHOLE No 7

W P 159-75-06 LOCATION N 15 805 525 E 953 990 Co-ords. ORIGINATED BY P.J.S.
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger, BX Casing, BXL Core COMPILED BY P.J.S.
 DATUM Geodetic DATE December 20, 1977 CHECKED BY R.S.

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					
479.4	Ground Level															GR SA SI CL
0.0	SILTY CLAY TRACE OF SAND Very Stiff		1	SS	21											0 4 45 51
471.4	To Hard		2	SS	116/15"											0 7 63 30
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/12"											0 3 71 26
	Red To Grey Red Fine Texture Soft And Fissile With Thin Bedding Including A Few Shaly Limestone Beds		4	BXL Core	98% Rec											RQD = 50
	Shaly Limestone 15'8"-16'0"		5	BXL Core	100% Rec											RQD = 67
	Shaly Limestone 49'8"-41'0"		6	BXL Core	100% Rec											RQD = 54
434.4	Shaly Limestone 43'5"-44'5"															
45.0	End Of Borehole Note: W.L. Not Established															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8

W P 159-75-06 LOCATION N 15 805 601 E 954 015 Co-ords. ORIGINATED BY P.J.S.
 DIST 4 HWY Q.E.W. BOREHOLE TYPE Solid Auger COMPILED BY P.J.S.
 DATUM Geodetic DATE December 21, 1977 CHECKED BY R.S.

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					
481.3	Ground Level															GR SA SI CL
0.0	SILTY CLAY TRACE OF SAND Very Stiff		1	SS	16											
473.3	To Hard		2	SS	56											
8.0	QUEENSTON SHALE BEDROCK		3	SS	100/7"											
	Red To Grey Red		4	SS	100/5"											
463.6			5	SS	75/3"											
17.7	End Of Borehole		6	SS	75/3"											

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

RECORD OF BOREHOLE No 13-11

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 918.5 E 290 697.1 ORIGINATED BY GA
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.10 - 2013.05.10 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
							20	40	60	80	100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	GR	SA	SI	CL	
150.0	TOPSOIL: (50mm)																		
149.4	Silty CLAY, trace sand, occasional shale fragments Stiff Reddish Brown (FILL)		1	SS	8														0 5 61 34
149.4	SHALE, highly weathered, reddish brown		2	SS	44														
			3	SS	50/ 0.150														
	Start coring at 2.4m																		
	Slightly weathered, thinly bedded, reddish brown, occasional limestone interbeds																		
	Limestone interbeds (25mm to 75mm) at 2.7m, 3.2m																		
	Horizontal fractures at 2.6m, 2.7m, 2.9m, 3.1m, 3.2m, 3.3m, 3.4m, 3.5m, 3.6m, 3.7m, 3.8m		1	RUN															RUN #1 TCR=100% SCR=95% RQD=57% UCS=6MPa (Average)
	Limestone interbeds (25mm thick) at 3.9m, 4.6m, 4.7m, 4.9m, 5.1m, 5.3m, 5.4m																		
	Horizontal fractures at 3.9m, 4.5m, 4.6m, 4.7m, 4.8m, 4.9m, 5.1m, 5.3m		2	RUN															RUN #2 TCR=100% SCR=97% RQD=37% UCS=14MPa (Average)
144.6	END OF BOREHOLE AT 5.5m. BOREHOLE OPEN TO 5.1m AND WATER LEVEL AT 1.8m UPON COMPLETION OF CORING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																		

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 8/11/13

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

RECORD OF BOREHOLE No 13-12

1 OF 1

METRIC

W.P. _____ LOCATION N 4 817 926.6 E 290 748.1 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/ND Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.28 - 2013.05.28 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
							20 40 60 80 100									
								○ UNCONFINED + FIELD VANE								
								● QUICK TRIAXIAL × LAB VANE								
								20 40 60 80 100								
149.1	TOPSOIL: (125mm)															
0.0																
0.1	Silly CLAY, trace sand, occasional rootlets Very Stiff Reddish Brown (FILL)		1	SS	16		149									0 0 83 37
148.2			2	SS	50/											
0.8	SHALE, highly weathered, thinly bedded, reddish brown				0.150		148									
			3	SS	50/											
					0.100		147									
	Start coring at 3.1m															
	Slightly weathered to fresh, thinly bedded, reddish brown, occasional limestone interbeds Soft zone (175mm) at 3.0m						146									
	Limestone Interbed (25mm) at 3.9m		1	RUN												RUN #1 TCR=100% SCR=87% RQD=67% UCS=16MPa (Average)
	Horizontal fractures at 3.2m, 3.3m, 3.4m, 3.7m, 3.8m, 4.2m						145									>5
	Highly broken zone (75mm) at 3.9m															
	Limestone Interbed (25mm) at 3.6m, 3.7m, 4.1m, 4.2m, 4.5m, 4.6m, 5.1m, 5.2m, 6.0m						144									
	Horizontal fractures at 4.7m, 5.1m, 5.7m, 5.9m		2	RUN												RUN #2 TCR=100% SCR=100% RQD=100% UCS=12MPa (Average)
143.0																
6.1	END OF BOREHOLE AT 6.1m. BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 1.8m UPON COMPLETION OF CORING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.															

ONTM4S 1184.GPJ 2012TEMPLATE(MTO).GDT 8/1/13

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

RECORD OF BOREHOLE No 13-13

1 OF 1

METRIC

W.P. _____ LOCATION N 4 617 944.0 E 290 794.5 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.28 - 2013.05.30 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
149.9	TOPSOIL: (125mm)																
0.0																	
0.1	Silly CLAY, trace sand, occasional rootlets Stiff Reddish Brown/Brown (FILL)		1	SS	10												
149.0																	
0.9	SHALE, highly weathered, thinly bedded, reddish brown		2	SS	48		149										
			3	SS	50/ 0.150		148										
	Start coring at 3.0m																
	Slightly weathered to fresh, thinly bedded, reddish brown, occasional limestone interbeds						147										
	Soft zone (225mm) at 3.0m																
	Limestone interbeds (25mm thick) at 3.5m, 3.6m, 4.2m, 4.3m		1	RUN			146										
	Horizontal fracture at 3.1m, 3.3m, 3.4m, 3.5m, 3.6m, 3.8m, 4.0m, 4.2m, 4.4m, 4.5m																
	Limestone interbeds (25mm thick) at 4.8m, 5.0m, 5.2m, 5.6m, 5.7m, 6.0m		2	RUN			145										
	Horizontal fracture at 5.0m, 5.2m, 5.4m																
143.8	Limestone interbed at 6.0m						144										
6.1	END OF BOREHOLE AT 6.1m. BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 3.3m UPON COMPLETION OF CORING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 30/13 3.0 146.9 Jun 26/13 2.7 147.2																

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 8/1/13

+ 3 x 3 Numbers refer to Sensitivity 20 15 10 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 13-05

1 OF 1

METRIC

W.P. _____ LOCATION N 4 818 066.3 E 290 824.0 ORIGINATED BY GA
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.27 - 2013.05.28 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
							20 40 60 80 100	20 40 60	20 40 60	20 40 60			
151.8 0.0	TOPSOIL: (110mm)												
0.1	Silty CLAY, trace sand, occasional rootlets Suff Brown to Reddish Brown (FILL)		1	SS	11								0 0 59 41
150.9 0.9	SHALE, highly weathered, thinly bedded, reddish brown		2	SS	30								
			3	SS	50/ 0.150								
	Start coring at 3.1m Slightly weathered to fresh, thinly bedded, reddish brown, occasional limestone interbeds Clay seam (100mm) at 3.2m												
	Horizontal fracture at 3.1m, 3.3m, 3.6m, 4.0m, 4.4m Highly broken zone (75mm) at 3.9m		1	RUN									RUN #1 TCR=100% SCR=67% RQD=80% UCS=11MPa (Average)
	Limestone interbeds (25mm) at 4.1m, 4.2m, 4.4m, 4.7m, 4.8m, 4.9m, 5.9m and (100mm) at 3.6m												
	Horizontal fracture at 4.9m, 5.2m, 5.5m, 5.8m		2	RUN									RUN #2 TCR=100% SCR=100% RQD=100% UCS=13MPa (Average)
145.7 6.1	END OF BOREHOLE AT 6.1m. BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 2.4m UPON COMPLETION OF CORING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.												
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 30/13 3.7 148.1 Jun 26/13 3.8 148.0												

ONTM14S 1184.GPJ 2012TEMPLATE(MTO).GDT 7/24/13

+ 3 x 3 Numbers refer to Sensitivity 20 15 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-15

1 OF 1

METRIC

W.P. _____ LOCATION N 4 818 008.5 E 290 914.7 ORIGINATED BY LRB
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.14 - 2013.05.14 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
150.2	TOPSOIL: (25mm)						20 40 60 80 100									
149.6	SAND and GRAVEL, some silt Compact Reddish Brown Moist (FILL)		1	SS	11										46 42 12 (SI+CL)	
0.6	SHALE, highly weathered, reddish brown, occasional limestone interbeds		2	SS	72											
	Start coring at 2.4m															
	Moderately to slightly weathered, thinly bedded		1	RUN										FI >10	RUN #1 TCR=96% SCR=63% ROD=50% UCS=13MPa (Average)	
	Highly broken from 2.4m to 2.6m													4	RUN #2 TCR=98% SCR=73% ROD=47% UCS=10MPa (Average)	
	Clayey (50mm) at 2.4m													>10		
	Limestone (75mm) at 2.8m and (50mm) at 2.9m		2	RUN										4		
	Oxidation from 4.2m to 4.3m													1		
	Highly broken (150mm) at 3.0m and 4.2m													4		
	Limestone (25mm) at 4.0m, 4.3m and (100mm) at 3.4m													3	RUN #3 TCR=100% SCR=85% ROD=65% UCS=14MPa (Average)	
	Limestone (25mm to 75mm) at 4.9m, 5.3m, 5.5m, 5.7m, 5.8m		3	RUN										2		
	Vertical fracture (50mm) at 5.3m and (125mm) at 5.6m													3		
144.3														2		
5.9	END OF BOREHOLE AT 5.9m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.															

ONTM145_1184.GPJ_2012TEMPLATE(MTO).GDT 8/1/13

+ 3 x 3 Numbers refer to
Sensitivity 20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-07

1 OF 1

METRIC

W.P. _____ LOCATION N 4 818 101.2 E 290 887.1 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.26 - 2013.05.27 CHECKED BY LRB

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			20	40	60	80					
151.3																
0.0	TOPSOIL: (125mm)															
0.1	Silly CLAY, trace sand, occasional rootlets Stiff Brown (FILL)		1	SS	14		151									
150.4																
0.9	SHALE, highly weathered, reddish brown		2	SS	18		150									
			3	SS	50/ 0.150		149									
	Start coring at 3.1m Highly weathered to fresh, thinly bedded, reddish brown, occasional limestone interbeds Highly broken zone (0.6m) at 3.0m Soft zone (305mm) at 3.0m Horizontal fracture at 3.8m, 4.1m Limestone interbeds (25mm) at 3.8m, 3.9m, 4.0m, 4.1m, 4.4m, 4.6m, 4.7m, 5.5m, 5.8m, 6.0m Horizontal fracture at 4.5m, 4.7m, 4.9m, 5.1m, 5.2m, 5.3m, 5.5m		1	RUN			148									Fi >10 >5
			2	RUN			147									
							146									
145.2																
6.1	END OF BOREHOLE AT 6.1m. BOREHOLE OPEN TO 6.1m AND WATER LEVEL AT 2.1m UPON COMPLETION OF CORING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) May 30/13 3.9 147.4 Jun 30/13 3.6 147.7															RUN #1 TCR=100% SCR=67% ROD=60% UCS=12MPa (Average) RUN #2 TCR=100% SCR=100% ROD=93% UCS=16MPa (Average)

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 7/24/13

+ 3 . x 3 Numbers refer to Sensitivity $\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

WP 125-66-12

LOCATION Co-ords. N.15,809,150 E.956,535

ORIGINATED BY RVV

DIST 4 HWY Q.E.W.

BORING DATE October 25 & 26, 1976

COMPILED BY RVV

DATUM Geodetic

BOREHOLE TYPE Solid Auger & EXL Core & Cone Test

CHECKED BY *[Signature]*

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT PLASTIC LIMIT WATER CONTENT			UNIT WEIGHT	REMARKS
			NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w _p	w _L	w		
473.0	Ground Level															
0.0	Topsoil															
	Clayey silt		1	SS	14	470										
	Red trace of organics		2	SS	61											
465.0	Stiff to Hard		3	SS	100%											
8.0	Bedrock - Red Shale		4	BXL	100%											
	Soft, fissile with bands of greyish-green shale and limestone.		5	RC EXL	80%	460										
			6	RC EXL	78%											
			7	BXL	100%											
			8	RC EXL	98%	450										
446.7	End of Borehole															
26.3																

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 125-66-12 LOCATION Co-ords. N.15,809,308 E.956,470 ORIGINATED BY RVV
 DIST 4 HWY Q.E.W. BORING DATE October 21, 1976 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE Solid Auger, BXL Core & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
468.1	Ground Level															
0.0	Sand, medium to coarse trace of fine gravel & silt. Fill. Loose		1	SS	5											
464.1	Clayey silt. Red trace of gravel. Hard		2	SS	65/9"											
462.6	Bedrock - Red Shale, Soft, Fissile with bands of greyish- green shale and limestone.		3	RC	Rec. 912	460				100/2"						
5.5			4	BXL	987											
			5	BXL	100%											
400.1	End of Borehole															
18.0	Note: Water Level not established.															

9 83 (8)
GR SA SI CL

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 125-66-12 LOCATION Co-ords. N.15,809,166 E.956,638 ORIGINATED BY RVV
 DIST 4 HWY Q.E.W. BORING DATE October 26, 1976 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE Solid Auger and Cone Test CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w $w_p \quad w \quad w_L$ WATER CONTENT % 20 40 60	UNIT WEIGHT γ Y	REMARKS	
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100				
471.9	Ground Level														
469.9	Sand & gravel (Rubble Fill) Compact	[Pattern]	1	SS	20										
2.0	Clayey silt, trace of organics	[Pattern]	2	SS	16										
463.4	layers of fine sand Hard	[Pattern]	3	SS	25										
8.5	Bedrock - Red Shale Soft, fissile with bands of greyish- green shale and limestone	[Pattern]	4	SS	130/10"										
			5	SS	180/8"										
			6	SS	100/4"										
451.7			7	SS	180/2"										
20.2	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 13-23

1 OF 2

METRIC

W.P. _____ LOCATION N 4 817 184.8 E 290 769.4 ORIGINATED BY GA
 HWY 403/OEW BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.25 - 2013.05.25 CHECKED BY LRB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)			
						20	40	60	80	100	20	40	60	GR	SA	SI	CL	
129.7 0.0	ASPHALT: (150mm)																	
0.2	SAND and GRAVEL, some silt Dense to Compact Brown to Reddish Brown Damp (FILL)		1	SS	31						o							39 46 15 (SI+CL)
			2	SS	19						o							
128.2	Silty CLAY, trace sand Firm to Very Stiff Reddish Brown		3	SS	6						o							
1.5			4	SS	8						o	—						0 4 40 56
			5	SS	19						o							
126.1	SHALE, with limestone interbeds, highly weathered, grey		6	SS	50/ 0.125						o							
3.7	Start coring at 6.1m Slightly weathered to fresh, thinly bedded, grey, occasional limestone interbeds Clay seam (200mm) at 6.1m Limestone interbeds (25mm to 75mm) at 6.3m, 6.4m, 6.5m, 6.7m, 6.8m, 7.0m, 7.2m and (125mm) at 7.4m Vertical fracture (125mm) at 7.4m Horizontal fracture at 6.4m, 6.5m, 6.6m, 6.7m, 6.8m, 6.9m, 7.7m, 7.9m, 8.1m, 8.5m, 8.7m Limestone interbeds (25mm) at 7.6m, 7.9m, 8.0m, 8.2m, 8.5m, 8.9m, 9.1m and (75mm) at 8.7m																	
			1	RUN														FI 0 4 3 0 0 1 2 0 2 0
			2	RUN														RUN #1 TCR=100% SCR=80% RQD=53% UCS=97MPa (Average) RUN #2 TCR=100% SCR=97% RQD=83% UCS=72MPa (Average)
120.8	END OF BOREHOLE AT 9.1m. BOREHOLE OPEN TO 9.1m AND WATER LEVEL AT 4.8m UPON COMPLETION OF CORING. BOREHOLE BACKFILLED WITH																	
9.1																		

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 11/10/13

Continued Next Page

+ 3 . x 3 Numbers refer to Sensitivity 20 15-0-5 10 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 13-23

2 OF 2

METRIC

W.P. _____ LOCATION N 4 817 184.8 E 290 769.4 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.25 - 2013.05.25 CHECKED BY LRB

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	100	20					
	Continued From Previous Page BENTONITE HOLEPLUG TO 0.3m, CONCRETE TO 0.15m, THEN ASPHALT COLD PATCH TO SURFACE.																

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 11/10/13

+ 3 x 3 Numbers refer to Sensitivity 20 15 10 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 13-08

1 OF 1

METRIC

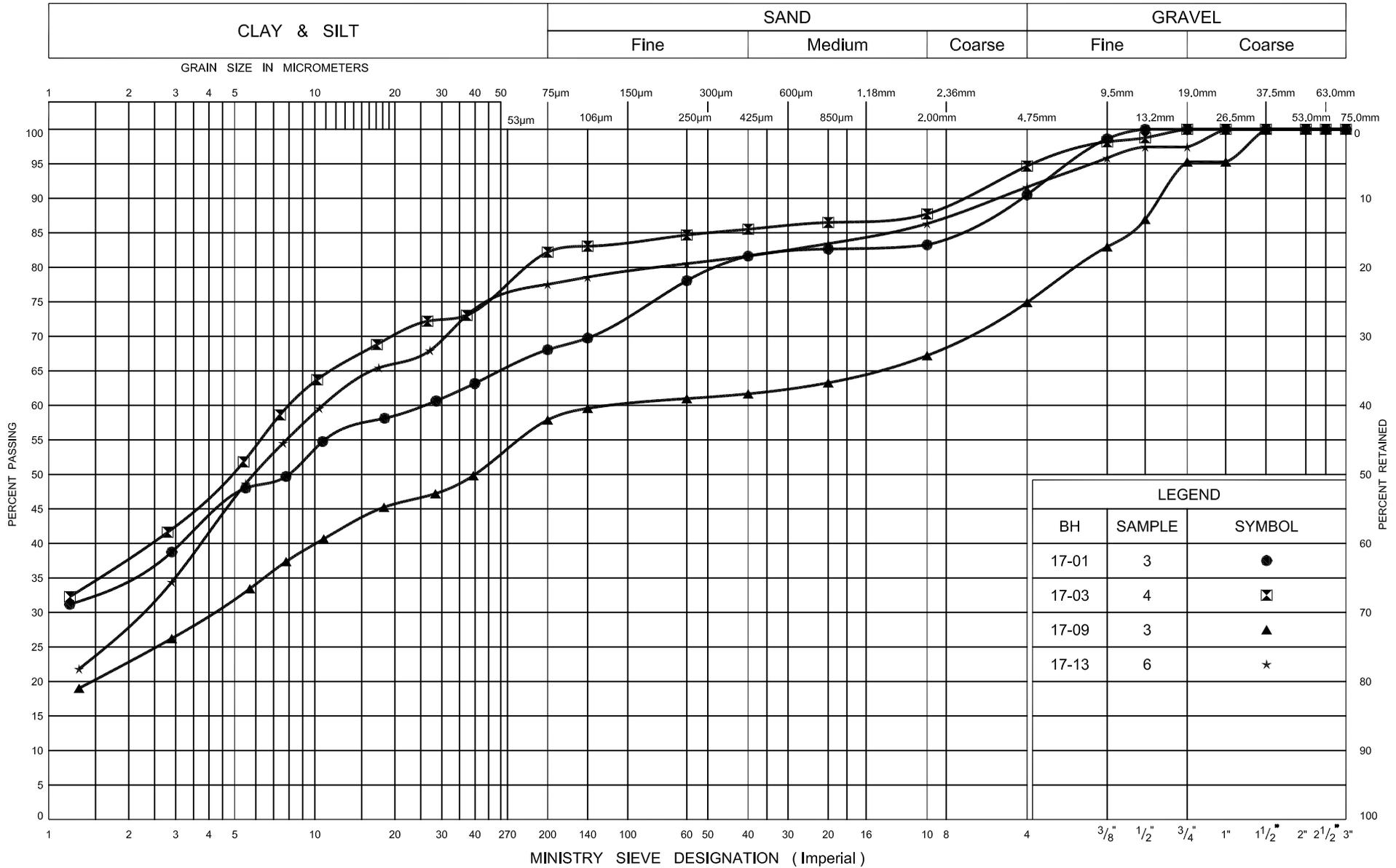
W.P. _____ LOCATION N 4 817 953.6 E 290 550.0 ORIGINATED BY GA
 HWY 403/QEW BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.05.07 - 2013.05.07 CHECKED BY LRB

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	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60		
151.8	TOPSOIL: (50mm)														
151.3	Silty CLAY, some sand Very Stiff Brown (FILL)	1	SS	17											
0.5	SHALE, highly weathered, brown	2	SS	50/ 0.150											
		3	SS	50/ 0.150											
	Start coring at 2.4m														
	Moderately weathered to fresh, occasional limestone interbeds														
	Horizontal fractures at 2.5m, 2.6m, 2.7m, 2.9m, 3.0m, 3.2m, 3.3m, 3.4m, 3.7m, 3.8m	1	RUN												
	Limestone interbeds (25mm thick) at 3.0m, 3.2m, 3.4m, 3.7m														
	Limestone interbed (150mm) at 4.1m														
	Horizontal fractures at 4.0m, 4.1m, 4.2m, 4.3m, 4.4m, 4.5m, 4.7m, 5.0m, 5.1m, 5.2m	2	RUN												
	Limestone interbeds (25mm thick) at 3.9m, 4.3m, 4.4m, 4.5m, 4.6m, 5.3m, (75mm) at 4.7m														
146.3	END OF BOREHOLE AT 5.5m. BOREHOLE OPEN TO 5.5m AND WATER LEVEL AT 0.9m UPON COMPLETION OF CORING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.														
5.5															
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m)														
	May 30/13 5.5 146.3														
	Jun 26/13 4.3 147.5														

ONTMT4S 1184.GPJ 2012TEMPLATE(MTO).GDT 8/1/13

+ 3 x 3 Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	SAMPLE	SYMBOL
17-01	3	●
17-03	4	⊠
17-09	3	▲
17-13	6	*

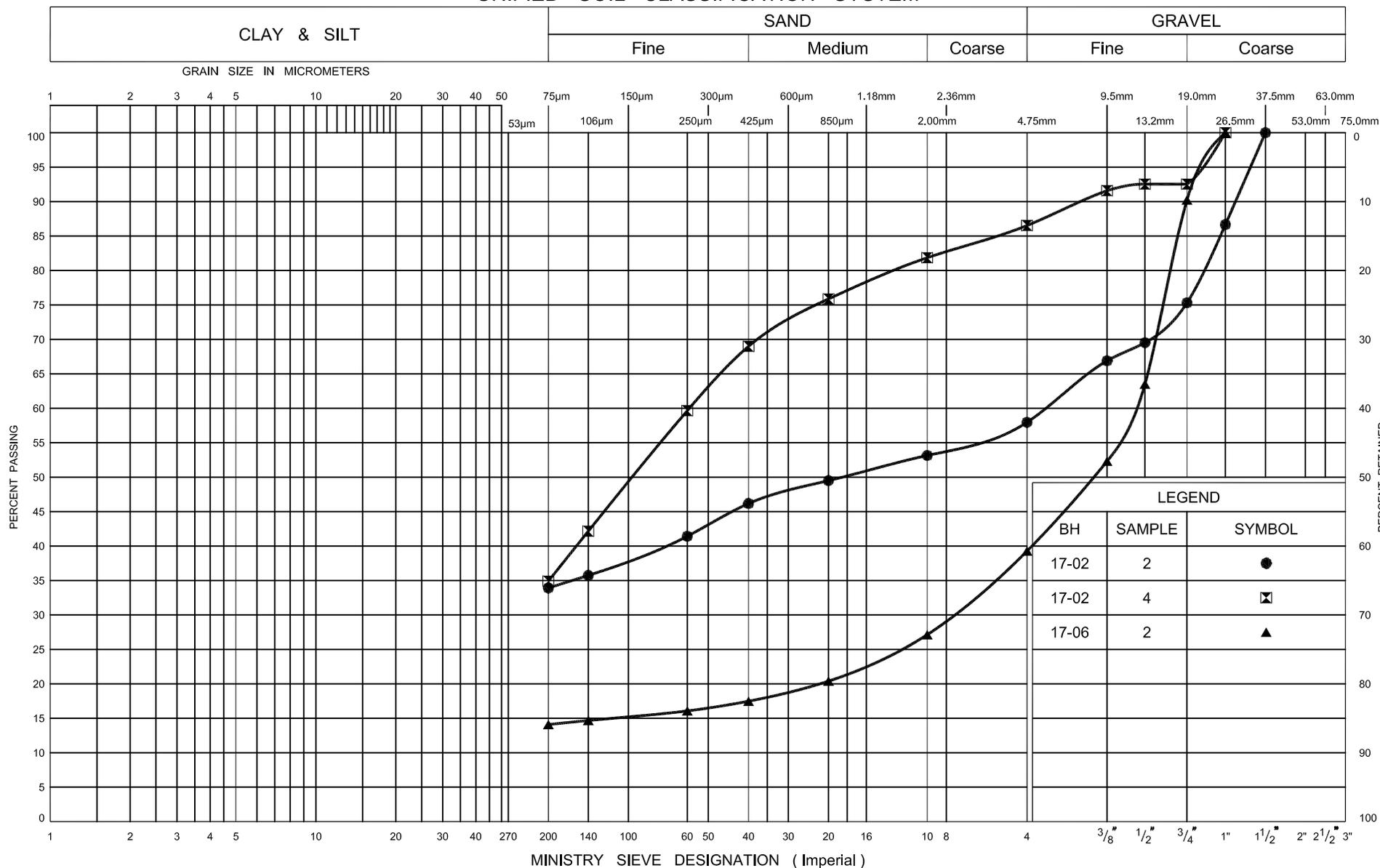
ONTARIO MOT GRAIN SIZE 16TF028 LABEL.GPJ ONTARIO.MOT.GDT 23/5/17



GRAIN SIZE DISTRIBUTION
 SILTY CLAY TO CLAYEY SILT, trace/some sand, trace gravel
 (FILL)

FIG No.	HML-GS-1
HWY	QEW
G.W.P. No.	2015-E-0011-010

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	SAMPLE	SYMBOL
17-02	2	●
17-02	4	◻
17-06	2	▲

ONTARIO MOT GRAIN SIZE 16TF028 LABEL.GPJ ONTARIO.MOT.GDT 23/5/17

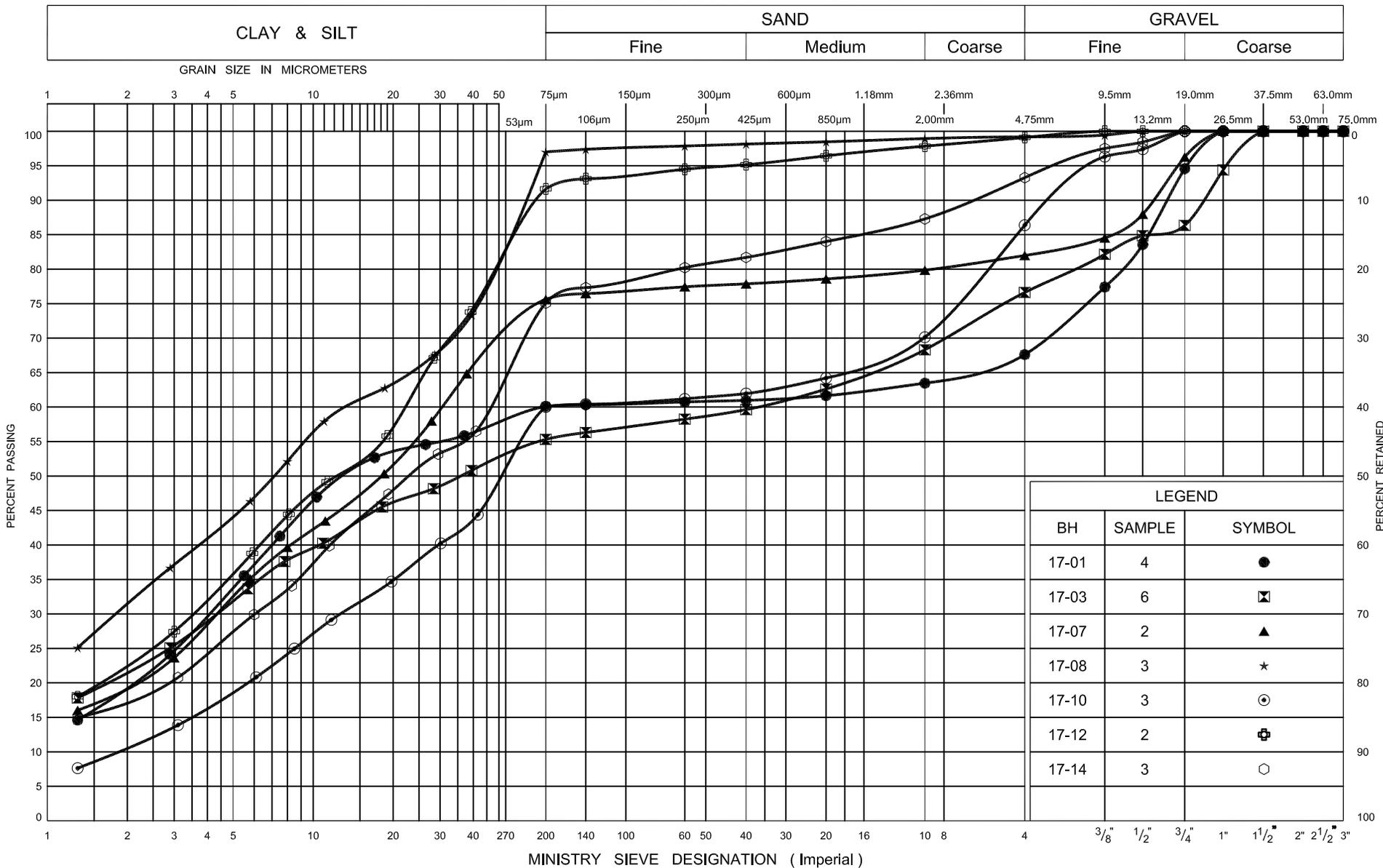


GRAIN SIZE DISTRIBUTION

SILTY SAND, some / with gravel, occasional shale and limestone fragments (FILL)

FIG No.	HML-GS-2
HWY	QEW / HWY 403
G.W.P. No.	2163-10-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	SAMPLE	SYMBOL
17-01	4	●
17-03	6	⊠
17-07	2	▲
17-08	3	★
17-10	3	⊙
17-12	2	⊞
17-14	3	○

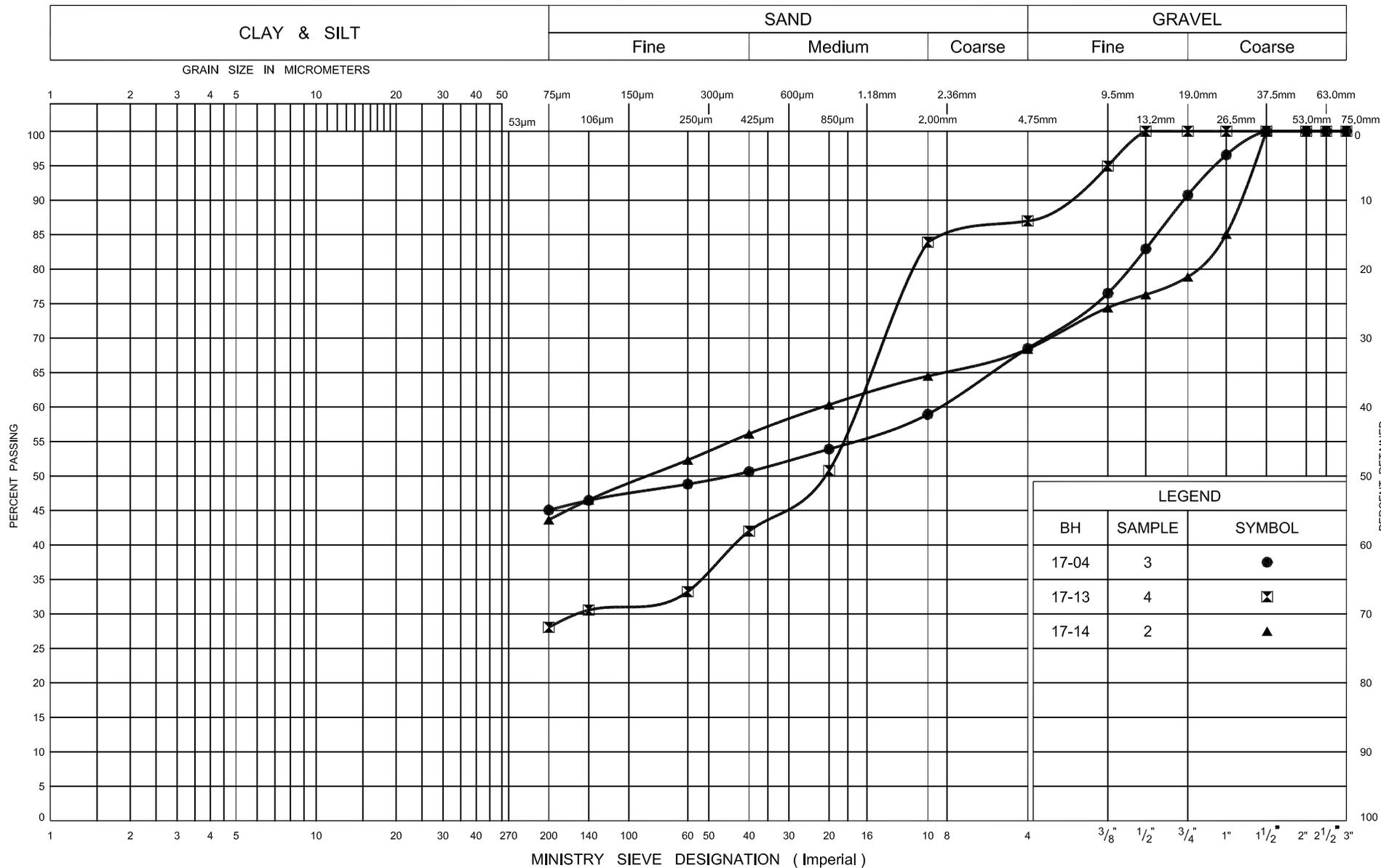
ONTARIO MOT GRAIN SIZE 16TF028 LAB.GPJ ONTARIO.MOT.GDT 23/5/17



GRAIN SIZE DISTRIBUTION
 SILTY CLAY TO CLAYEY SILT, some sand, some gravel
 occasional shale and limestone fragments
 (TILL)

FIG No.	HML-GS-3A
HWY	QEW / HWY 403
G.W.P. No.	2163-10-00

UNIFIED SOIL CLASSIFICATION SYSTEM

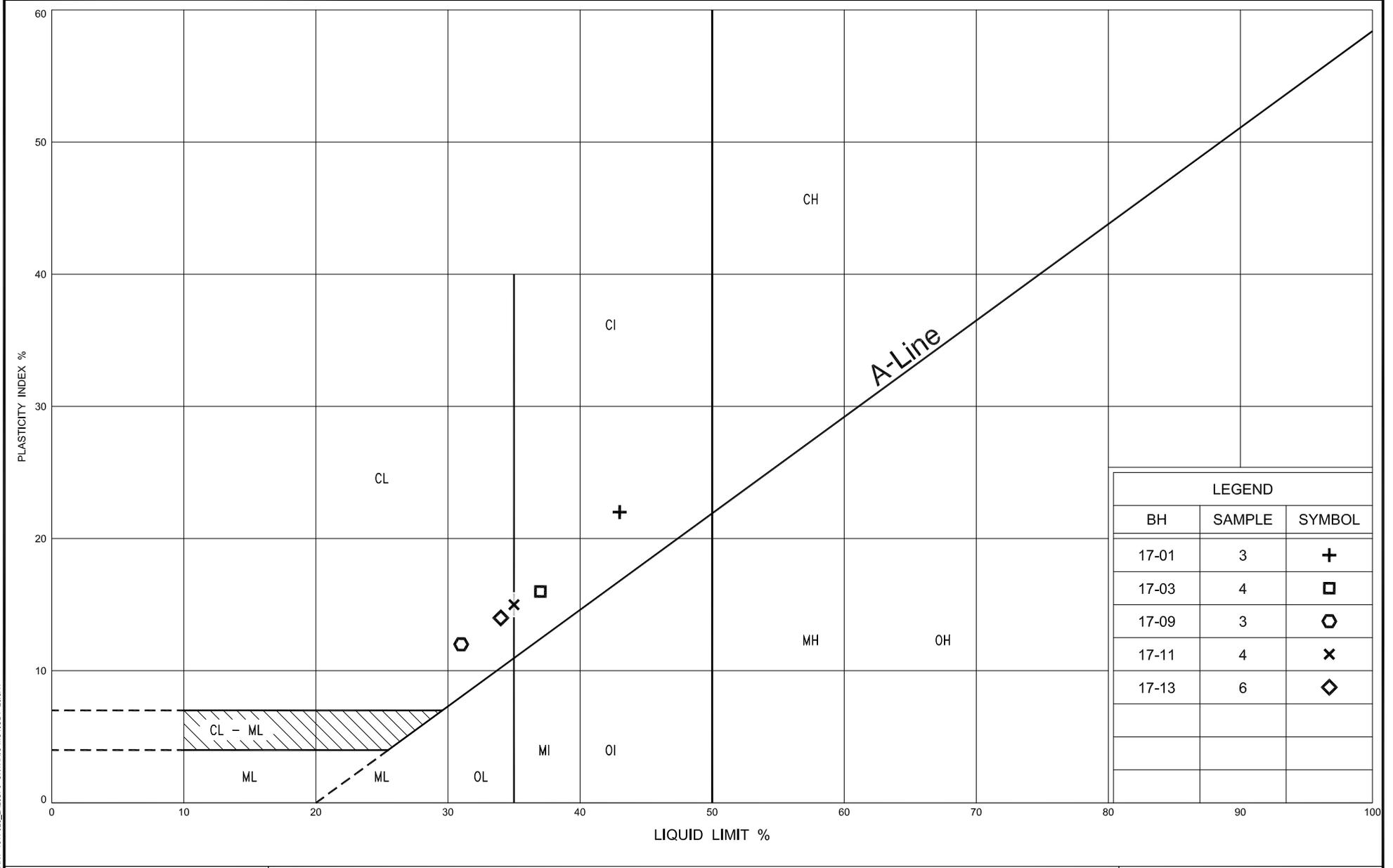


ONTARIO MOT GRAIN SIZE 16TF028 LAB/GPJ ONTARIO.MOT.GDT 23/5/17



GRAIN SIZE DISTRIBUTION
 SILTY CLAY TO CLAYEY SILT, some sand, some gravel
 occasional shale and limestone fragments
 (TILL)

FIG No.	HML-GS-3B
HWY	QEW / HWY 403
G.W.P. No.	2163-10-00



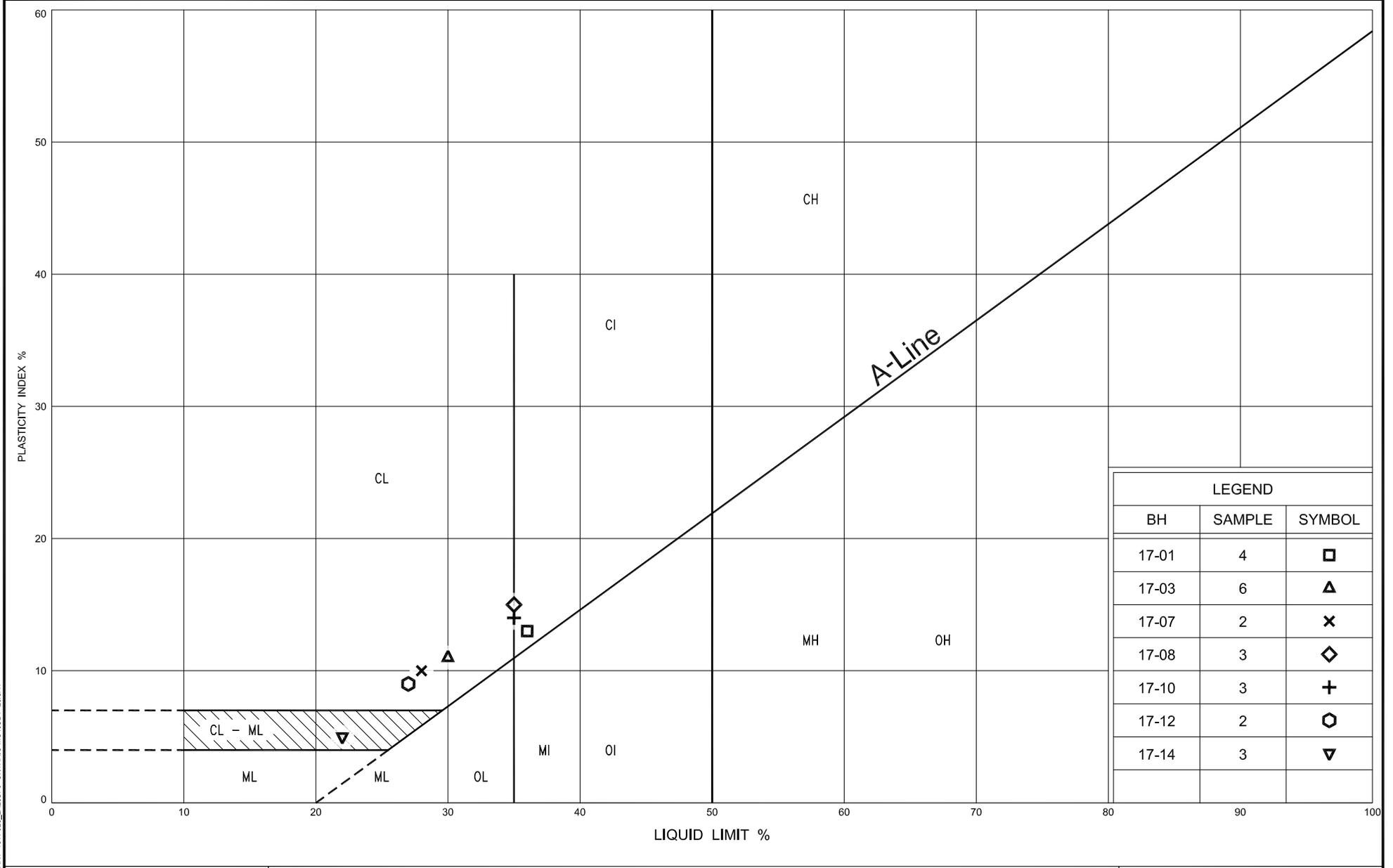
LEGEND		
BH	SAMPLE	SYMBOL
17-01	3	+
17-03	4	□
17-09	3	⊖
17-11	4	×
17-13	6	◇

ONTARIO MOT PLASTICITY CHART 16TF028 LAB.GPJ ONTARIO MOT.GDT 23/5/17



PLASTICITY CHART
 SILTY CLAY TO CLAYEY SILT, trace/some sand, trace gravel
 (FILL)

FIG No.	HML-PC-1
HWY	QEW / HWY 403
G.W.P. No.	2163-10-00



LEGEND		
BH	SAMPLE	SYMBOL
17-01	4	□
17-03	6	▲
17-07	2	×
17-08	3	◇
17-10	3	+
17-12	2	⊖
17-14	3	▽

ONTARIO MOT PLASTICITY CHART 16TF028_LAB.GPJ ONTARIO MOT.GDT 23/5/17



PLASTICITY CHART
 SILTY CLAY TO CLAYEY SILT, some sand, some gravel
 occasional shale and limestone fragments
 (TILL)

FIG No.	HML-PC-2
HWY	QEW / HWY 403
G.W.P. No.	2163-10-00



PART B – FOUNDATION DESIGN REPORT

for

**HIGH MAST LIGHT POLES AND OVERHEAD SIGNS
QUEEN ELIZABETH WAY AND HIGHWAY 403
TOWN OF OAKVILLE
REGIONAL MUNICIPALITY OF HALTON, ONTARIO
G.W.P. 2163-10-00
ASSIGNMENT NO. 2012-E-0057**

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 Non-Standard Special Provisions (NSSP)

PART B - FOUNDATION DESIGN REPORT

for

High Mast Lighting and Overhead Signs
Queen Elizabeth Way and Highway 403,
G.W.P. 2163-10-00, Assignment No. 2012-E-0057
Town of Oakville, Regional Municipality of Halton, Ontario

7. INTRODUCTION

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

8. PROJECT DESCRIPTION

8.1 General

This report provides foundation design recommendations based on interpretation of the geotechnical data presented in the factual report (Part A). This section of the report provides foundation recommendations for the design of proposed High Mast Light (HML) poles and Overhead Sign (OHS) structures along Queen Elizabeth Way and Highway 403 in the Regional Municipality of Halton, Ontario.

The discussions and recommendations presented in this report are based on the information provided by Stantec and the factual data obtained during the geotechnical investigation carried out by PML and borehole data from previous investigations.

It is anticipated that the proposed HML poles will be supported on caisson foundations meeting the requirements of MTO *Guidelines for the Design of High Mast Light Pole Foundations* and the design of OHS structure foundations will be in accordance with the *Sign Support Manual* Published by MTO.



Where a caisson is installed in proximity of a slope, the passive resistance within the portions of caisson closer than 3 m in plan to surface of the slope, should be neglected. The stability of the adjacent slope should also be checked, considering loads from the caisson to ensure adequate factor of safety against slope failures.

8.2 Design of High Mast Light Pole Foundation

The HML pole foundations should be designed in accordance with MTO Guidelines for the Design of High Mast Light Pole Foundations, dated April 2015. The caisson foundation design for support of the HML may be carried out using the geotechnical parameters recommended in Table 8.2.

For the design of caisson foundations, the passive resistance within the upper 1.2 m below ground surface should be neglected to account for frost action as per OPSD 3090.101 (Frost Penetration Depths for Southern Ontario). In accordance with MTO *Guidelines for the Design of High Mast Pole Foundations (2015)*, the ultimate passive lateral pressure can be taken as two times the passive lateral earth pressure.

The equation provided below for cohesive soils may be used to calculate the coefficient of horizontal subgrade reaction, k_s , distributed along the length of the caisson, based on the stratigraphy and geotechnical parameters given in Table 8.2.

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

Where: C_u = undrained shear strength (kPa)
 D = pile width or diameter (m);

In the case of cohesionless material, the horizontal subgrade reaction, k_s , may be calculated using the equation provided below, assuming a value of 2200 kN/m³ above water level and 1250 kN/m³ below water level for constant n_h , which relates to density of cohesionless material.

$$k_s = (n_h) Z / D \text{ (kN/m}^3\text{)}, \text{ where } Z \text{ is the depth of the cohesionless layer in meter (m)}$$

A resistance factor of 0.5 should be applied to the calculated ultimate lateral resistance to obtain the factored lateral geotechnical resistance at Ultimate Limit States (ULS), in accordance with the Canadian Highway Bridge Design Code (CHBDC 2014).



Table 8.2–Geotechnical Design Parameters for High Mast Light Foundation

HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P1	21+550	109.1	108.9	Pavement Structure			
		108.9	107.9	Dense to compact sand, some gravel (Fill)	*	*	*
		107.9	106.7		19	0	28
		106.7	106.4	Hard silty clay, trace/ some sand and gravel (Till)	20	200	0
		106.4	104.6	Weathered Shale bedrock	20	400	0
P2	21+660	109.1	108.9	Pavement Structure			
		108.9	107.9	Dense to compact sand, some gravel (Fill)	*	*	*
		107.9	106.7		19	0	28
		106.7	106.4	Hard silty clay, trace/ some sand and gravel (Till)	20	200	0
		106.4	104.6	Weathered Shale bedrock	20	400	0
P3	21+775	113.4	113.1	75 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		113.1	112.4	Compact silty sand with gravel (Fill)	*	*	*
		112.4	112.2	Silty clay, some sand, trace gravel (Fill)	*	*	*
		112.2	111.0		19	100	0
		111.0	109.9	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	19	200	0
		109.9	108.7	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P4	21+890	113.4	113.1	75 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		113.1	112.4	Compact silty sand with gravel (Fill)	*	*	*
		112.4	112.2	Silty clay, some sand, trace gravel (Fill)	*	*	*
		112.2	111.0		19	100	0
		111.0	109.9	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	19	200	0
		109.9	108.7	Highly weathered Shale bedrock	20	400	0
P5	22+002	113.4	113.1	75 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		113.1	112.4	Compact silty sand with gravel (Fill)	*	*	*
		112.4	112.2	Silty clay, some sand, trace gravel (Fill)	*	*	*
		112.2	111.0		19	100	0
		111.0	109.9	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	19	200	0
		109.9	108.7	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P6	22+115	113.4	113.1	75 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		113.1	112.4	Compact silty sand with gravel (Fill)	*	*	*
		112.4	112.2	Silty clay, some sand, trace gravel (Fill)	*	*	*
		112.2	111.0		19	100	0
		111.0	109.9	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	19	200	0
		109.9	108.7	Highly weathered Shale bedrock	20	400	0
P7	22+230	114.4	114.1	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		114.1	113.4	Compact silty sand with gravel (Fill)	*	*	*
		113.4	113.2	Stiff silty clay, some sand, trace gravel (Fill)	*	*	*
		113.2	112.3		19	50	0
		112.3	110.4	Dense to very dense silty sand, some gravel, occasional Shale and limestone fragments (Fill)	19	0	28
		110.4	109.3	Hard silty clay to clayey silt, some sand, some gravel (Till)	19	200	0
		109.3	107.9	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P8	22+240	114.4	114.1	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		114.1	113.4	Compact silty sand with gravel (Fill)	*	*	*
		113.4	113.2	Stiff silty clay, some sand, trace gravel (Fill)	*	*	*
		113.2	112.3		19	50	0
		112.3	110.4	Dense to very dense silty sand, some gravel, occasional Shale and limestone fragments (Fill)	19	0	28
		110.4	109.3	Hard silty clay to clayey silt, some sand, some gravel (Till)	19	200	0
		109.3	107.9	Highly weathered Shale bedrock	20	400	0
P9	22+460	114.4	114.1	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		114.1	113.4	Compact silty sand with gravel (Fill)	*	*	*
		113.4	113.2	Stiff silty clay, some sand, trace gravel (Fill)	*	*	*
		113.2	112.3		19	50	0
		112.3	110.4	Dense to very dense silty sand, some gravel, occasional Shale and limestone fragments (Fill)	19	0	28
		110.4	109.3	Hard silty clay to clayey silt, some sand, some gravel (Till)	19	200	0
		109.3	107.9	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P10	22+605	122.5	122.2	45 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		122.2	122.0	Loose silty sand with gravel (Fill)	*	*	*
		122.0	121.3	Stiff to very stiff silty clay, trace to some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		121.3	119.5		19	50	0
		119.5	116.0	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	20	200	0
		116.0	115.8	Highly weathered Shale bedrock	20	400	0
		114.4	114.1	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		114.1	113.4	Compact silty sand with gravel (Fill)	*	*	*
		113.4	113.2	Stiff silty clay, some sand, trace gravel (Fill)	*	*	*
		113.2	112.3		19	50	0
		112.3	110.4	Dense to very dense silty sand, some gravel, occasional Shale and limestone fragments (Fill)	19	0	28
		110.4	109.3	Hard silty clay to clayey silt, some sand, some gravel (Till)	19	200	0
		109.3	107.9	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P11	22+755	122.5	122.2	45 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		122.2	122.0	Loose silty sand with gravel (Fill)	*	*	*
		122.0	121.3	Stiff to very stiff silty clay, trace to some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		121.3	119.5	Stiff to very stiff silty clay, trace to some sand, trace gravel, occasional Shale and limestone fragments (Fill)	19	50	0
		119.5	116.0	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	20	200	0
		116.0	115.8	Highly weathered Shale bedrock	20	400	0
P12	22+900	122.5	122.2	45 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		122.2	122.0	Loose silty sand with gravel (Fill)	*	*	*
		122.0	121.3	Stiff to very stiff silty clay, trace to some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		121.3	119.5	Stiff to very stiff silty clay, trace to some sand, trace gravel, occasional Shale and limestone fragments (Fill)	19	50	0
		119.5	116.0	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	20	200	0
		116.0	115.8	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P13	23+040	122.5	122.2	45 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		122.2	122.0	Loose silty sand with gravel (Fill)	*	*	*
		122.0	121.3	Stiff to very stiff silty clay, trace to some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		121.3	119.5	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	19	50	0
		119.5	116.0	Highly weathered Shale bedrock	20	200	0
		116.0	115.8	Cobbles and gravel	20	400	0
P14	23+185	120.0	119.4	Silty clay, some sand	*	*	*
		119.4	118.8	Weathered Shale bedrock	20	600	0
		118.8	114.8	Topsoil			
		123.7	123.5	Very stiff silty clay, trace sand, occasional shale fragments (Fill)	*	*	*
		123.5	122.8	Very stiff silty clay, trace sand, trace gravel (Till)	*	*	*
		122.8	122.5	Highly weathered Shale bedrock	19	150	0
		122.5	120.5	Weathered Shale bedrock	20	400	0
		120.5	119.2	Weathered Shale bedrock	21	2000	0
P17	23+325	127.7	127.6				
		127.6	126.1	Firm to very stiff silty clay, trace to some sand, trace gravel (Fill)	*	*	*
		126.1	121.3	Weathered Shale bedrock	20	2000	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P18	23+330	128.0	127.9	Topsoil			
		127.9	127.3	Compact sand. some silt, some gravel (Fill)	*	*	*
		127.3	125.7	Stiff silty clay, trace sand, trace gravel	19	100	0
		125.7	120.4	Weathered Shale bedrock	21	2000	0
P19	23+030	123.1	122.7	210 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		122.7	122.5	Compact silty sand with gravel (Fill)	*	*	*
		122.5	122.3	Silty clay, trace sand, trace gravel (Fill)	*	*	*
		122.3	121.9	Hard silty clay to clayey silt, with gravel, some sand, occasional Shale and limestone fragments (Till)	*	*	*
		121.9	120.8	Highly weathered Shale bedrock	20	200	0
P20	23+240	120.8	118.5	Highly weathered Shale bedrock	20	400	0
		118.8	118.7	Topsoil			
		118.7	117.6	Very stiff clayey silt, sand and gravel	*	*	*
		117.6	116.9	Weathered Shale bedrock	20	150	0
P25	23+435	116.9	115.4	Weathered Shale bedrock	20	400	0
		125.1	124.9	150 mm Asphalt			
		124.9	124.3	Dense sand and gravel, some silt (Fill)	*	*	*
		124.3	120.2	Weathered Shale bedrock	21	2000	0
		131.5	131.3	150 mm Asphalt			
		131.3	130.0	Compact sand and gravel, some silt (Fill)	*	*	*
		130.0	129.7	Very stiff silty clay, trace sand, occasional Shale fragments (Till)	19	150	0
		129.7	126.6	Highly weathered Shale bedrock	20	400	0
126.6	123.6	Weathered Shale bedrock	21	2000	0		



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P26	23+570	138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		137.4	133.7	Highly weathered Shale bedrock	20	400	0
P27	23+700	138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		137.4	133.7	Highly weathered Shale bedrock	20	400	0
P28	23+818	138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		137.4	133.7	Highly weathered Shale bedrock	20	400	0
P31	23+485	131.0	130.9	Topsoil			
		130.9	130.3	Compact Shale (Fill)	*	*	*
		130.3	129.6	Very stiff silty clay, trace sand (Fill)	*	*	*
		129.6	128.8	Very still silty clay, trace sand, occasional Shale fragments	20	150	0
		128.8	126.5	Highly weathered Shale bedrock	20	400	0
		126.5	123.4	Weathered Shale bedrock	21	2000	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P32	23+595	131.0	130.9	Topsoil			
		130.9	130.3	Compact Shale (Fill)	*	*	*
		130.3	129.6	Very stiff silty clay, trace sand (Fill)	*	*	*
		129.6	128.8	Very stiff silty clay, trace sand, occasional Shale fragments	20	150	0
		128.8	126.5	Highly weathered Shale bedrock	20	400	0
		126.5	123.4	Weathered Shale bedrock	21	2000	0
		135.9	135.8	Topsoil			
		135.8	134.4	Stiff to very stiff silty clay, some sand, trace gravel, Shale fragments (Fill)	*	*	*
		134.4	133.3	Highly weathered Shale bedrock	20	400	0
P33	23+320	131.0	130.9	Topsoil			
		130.9	130.3	Compact Shale (Fill)	*	*	*
		130.3	129.6	Very stiff silty clay, trace sand (Fill)	*	*	*
		129.6	128.8	Very stiff silty clay, trace sand, occasional Shale fragments	20	150	0
		128.8	126.5	Highly weathered Shale bedrock	20	400	0
		126.5	123.4	Weathered Shale bedrock	21	2000	0
		145.1	144.9	Topsoil			
		144.9	143.9	Stiff to very stiff clayey silt to silty clay, some sand, trace gravel, Shale fragments (Fill)	*	*	*
		143.9	139.8	Highly weathered Shale bedrock	19	50	0
		139.8	139.4	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P34	23+840	143.8	143.7	Topsoil			
		143.7	142.6	Hard clayey silt, trace	*	*	*
		142.6	141.1	sand	20	200	0
		141.1	139.4	Weathered Shale bedrock	21	2000	0
P35	23+955	148.7	147.5	Hard clayey silt, trace	*	*	*
		147.5	146.5	sand	20	200	0
		146.5	139.6	Weathered Shale bedrock	21	2000	0
P36	23+950	146.6	146.5	Topsoil			
		146.5	145.4	Hard clayey silt, trace	*	*	*
		145.4	145.1	sand	20	200	0
		145.1	142.1	Shale bedrock	21	2000	0
P37	24+065	151.8	151.7	Topsoil			
		151.7	151.3	Very stiff silty clay, some sand (Fill)	*	*	*
		151.3	149.3	Highly weathered Shale bedrock	20	400	0
		149.3	146.3	Weathered Shale bedrock	20	1000	0
P38	10+010	150.8	150.7	Topsoil			
		150.7	150.0	Very stiff silty clay, trace sand, occasional Shale fragments (Fill)	*	*	*
		150.0	148.3	Highly weathered Shale bedrock	20	400	0
		148.3	144.8	weathered Shale bedrock	20	1000	0
P39	24+280	158.1	157.8	Topsoil			
		157.8	156.9	Hard silty clay to clayey silt, with gravel, some sand, occasional Shale and limestone fragments (Till)	*	*	*
		156.9	156.2		20	200	0
		156.2	153.4	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P40	24+390	158.1	157.8	Topsoil			
		157.8	156.9	Hard silty clay to clayey silt, with gravel, some sand, occasional Shale and limestone fragments (Till)	*	*	*
		156.9	156.2	Highly weathered Shale bedrock	20	200	0
		156.2	153.4	Highly weathered Shale bedrock	20	400	0
P41	10+125	152.6	152.5	Topsoil			
		152.5	151.9	Compact Shale (Fill)	*	*	*
		151.9	151.3	Hard silty clay, trace sand, occasional Shale fragments (Fill)	*	*	*
		151.3	150.2	Highly weathered Shale bedrock	20	400	0
		150.2	147.1	Weathered Shale bedrock	20	1000	0
P42	23+415	131.5	131.3	150 mm Asphalt			
		131.3	130.0	Compact sand and gravel, some silt (Fill)	*	*	*
		130.0	129.7	Very stiff silty clay, trace sand, occasional Shale fragments	20	150	0
		129.7	128.2	Highly weathered Shale bedrock	20	400	0
		128.2	123.6	Weathered Shale bedrock	21	2000	0
P43	23+565	138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		137.4	133.7	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P44	23+700	138.4	137.9	275 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		137.9	137.4	Very dense silty sand with gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		137.4	133.7	Highly weathered Shale bedrock	20	400	0
P45	23+985	146.7	145.5	Very stiff to hard silty clay, trace sand	*	*	*
		145.5	144.3		20	150	0
		144.3	141.3	Shale bedrock	20	400	0
P46	24+070	150.0	149.9	Topsoil			
		149.9	149.4	Stiff silty clay, trace sand, occasional Shale fragments (Fill)	*	*	*
		149.4	147.6	Highly weathered Shale bedrock	20	400	0
		147.6	144.6	Weathered Shale bedrock	20	1000	0
		149.1	149.0	Topsoil			
		149.0	148.2	Very stiff silty clay, trace sand, occasional Shale fragments (Fill)	*	*	*
		148.2	146.0	Highly weathered Shale bedrock	20	400	0
		146.0	143.0	Weathered Shale bedrock	20	1000	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P47	24+137	149.9	149.8	Topsoil			
		149.8	149.0	Stiff silty clay, trace sand, occasional rootlets (Fill)	*	*	*
		149.0	146.9	Highly weathered Shale bedrock	20	400	0
		146.9	143.8	Weathered Shale bedrock	20	1000	0
		150.2	150.0	150 mm Asphalt			
		150.0	149.7	Concrete			
		149.7	149.3	Sand and gravel(Fill)	*	*	*
		149.3	147.2	Highly weathered Shale bedrock	20	400	0
P48	24+195	147.2	144.1	Weathered Shale bedrock	20	1000	0
		151.8	151.7	Topsoil			
		151.7	150.9	Stiff silty clay, trace sand, occasional rootlets (Fill)	*	*	*
		150.9	148.8	Highly weathered Shale bedrock	20	400	0
P49	24+305	148.8	145.7	Weathered Shale bedrock	20	1000	0
		150.2	150.1	Topsoil			
		150.1	149.6	Compact sand and gravel, some silt (Fill)	*	*	*
		149.6	147.8	Highly weathered Shale bedrock	20	400	0
P50	24+330	147.8	144.3	Weathered Shale bedrock	20	1000	0
		151.3	151.2	Topsoil			
		151.2	150.4	Stiff silty clay, trace sand, occasional rootlets (Fill)	*	*	*
		150.4	148.3	Highly weathered Shale bedrock	20	400	0
		148.3	145.2	Weathered Shale bedrock	20	1000	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P51	24+460	151.7	151.3	60 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		151.3	151.1	Compact silty sand with gravel (Fill)	*	*	*
		151.1	150.5	Hard clayey silt, trace sand, some gravel, occasional Shale and limestone fragments (Till)	*	*	*
		150.5	150.2		20	200	0
		151.7	151.3	60 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
P52	24+580	151.7	151.3	60 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		151.3	151.1	Compact silty sand with gravel (Fill)	*	*	*
		151.1	150.5	Hard clayey silt, trace sand, some gravel, occasional Shale and limestone fragments (Till)	*	*	*
		150.5	150.2		20	200	0
		150.2	147.0	Highly weathered Shale bedrock	20	400	0
P53	24+680	151.7	151.3	60 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		151.3	151.1	Compact silty sand with gravel (Fill)	*	*	*
		151.1	150.5	Hard clayey silt, trace sand, some gravel, occasional Shale and limestone fragments (Till)	*	*	*
		150.5	150.2		20	200	0
		150.2	147.0	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P54	24+795	150.0	149.3	70 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		149.3	149.0	Loose sand and gravel, some silt (Fill)	*	*	*
		149.0	148.5	Silty clay, trace sand, trace gravel (Fill)	*	*	*
		148.5	147.7	Very stiff to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)	20	150	0
		147.7	145.3	Highly weathered Shale bedrock	20	400	0
P55	24+910	150.0	149.3	70 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		149.3	149.0	Loose sand and gravel, some silt (Fill)	*	*	*
		149.0	148.5	Silty clay, trace sand, trace gravel (Fill)	*	*	*
		148.5	147.7	Very stiff to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)	20	150	0
		147.7	145.3	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P56	25+030	150.0	149.3	70 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		149.3	149.0	Loose sand and gravel, some silt (Fill)	*	*	*
		149.0	148.5	Silty clay, trace sand, trace gravel (Fill)	*	*	*
		148.5	147.7	Very stiff to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)	20	150	0
		147.7	145.3	Highly weathered Shale bedrock	20	400	0
P57	25+140	144.2	144.1	Topsoil	*	*	*
		144.1	143.0	Stiff to hard clayey silt, trace of organics	*	*	*
		143.0	141.7		19	100	0
		141.7	136.2	Weathered Shale bedrock	20	1000	0
P58	25+260	144.2	144.1	Topsoil	*	*	*
		144.1	143.0	Stiff to hard clayey silt, trace of organics	*	*	*
		143.0	141.7		19	100	0
		141.7	136.2	Weathered Shale bedrock	20	1000	0
P59	25+360	142.7	141.5	Loose sand, trace gravel, trace silt (Fill)	*	*	*
		141.5	141.0	Hard clayey silt, trace gravel	20	200	0
		141.0	137.2	Weathered Shale bedrock	20	1000	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P62	25+205	147.2	146.8	220 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		146.8	146.4	Silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		146.4	146.0	Firm to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)	*	*	*
		146.0	144.9		20	50	0
		144.9	142.5	Highly weathered Shale bedrock	20	400	0
P64	25+110	147.2	146.8	220 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		146.8	146.4	Silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		146.4	146.0	Firm to hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)	*	*	*
		146.0	144.9		20	50	0
		144.9	142.5	Highly weathered Shale bedrock	20	400	0
P65	25+335	143.8	143.2	Compact sand and gravel (Fill)	*	*	*
		143.2	142.6	Hard clayey silt, layer of fine sand, trace of organics	*	*	*
		142.6	141.2		20	200	0
		141.2	137.7	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P66	25+405	143.9	143.5	Loose silty sand, with gravel (Fill)	*	*	*
		143.5	142.7	Firm to hard silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		142.7	141.2	Hard silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	19	50	0
		141.2	137.0	Hard silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)	20	200	0
		137.0	136.1	Highly weathered Shale bedrock	20	400	0
P67	25+110	143.9	143.5	Loose silty sand, with gravel (Fill)	*	*	*
		143.5	142.7	Firm to hard silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		142.7	141.2	Hard silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	19	50	0
		141.2	137.0	Hard silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)	20	200	0
		137.0	136.1	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P68	25+485	139.5	138.8	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		138.8	138.3	Stiff to hard silty clay, some sand, trace gravel (Fill)	*	*	*
		138.3	137.8	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	19	100	0
		137.8	137.2	Highly weathered Shale bedrock	20	200	0
		137.2	134.8	Highly weathered Shale bedrock	20	400	0
P69	25+610	139.5	138.8	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		138.8	138.3	Stiff to hard silty clay, some sand, trace gravel (Fill)	*	*	*
		138.3	137.8	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	19	100	0
		137.8	137.2	Highly weathered Shale bedrock	20	200	0
		137.2	134.8	Highly weathered Shale bedrock	20	400	0
P70	25+715	139.5	138.8	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		138.8	138.3	Stiff to hard silty clay, some sand, trace gravel (Fill)	*	*	*
		138.3	137.8	Hard silty clay to clayey silt, some sand, some gravel, occasional Shale and limestone fragments (Till)	19	100	0
		137.8	137.2	Highly weathered Shale bedrock	20	200	0
		137.2	134.8	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P71	25+820	137.9	137.2	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		137.2	136.7	Compact silty sand, with gravel (Fill)	*	*	*
		136.7	136.2	Stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	19	50	0
	25+820	136.2	135.6	Stiff silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)	19	100	0
		135.6	133.3	Highly weathered Shale bedrock	20	400	0
P72	25+925	137.9	137.2	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		137.2	136.7	Compact silty sand, with gravel (Fill)	*	*	*
		136.7	136.2	Stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	19	50	0
		136.2	135.6	Stiff silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)	19	100	0
		135.6	133.3	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P73	26+035	137.9	137.2	85 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		137.2	136.7	Compact silty sand, with gravel (Fill)	*	*	*
		136.7	136.2	Stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	19	50	0
		136.2	135.6	Stiff silty clay to clayey silt, some sand, trace gravel, occasional Shale and limestone fragments (Till)	19	100	0
		135.6	133.3	Highly weathered Shale bedrock	20	400	0
P74	26+140	133.8	133.4	75 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		133.4	132.9	Compact silty sand, with gravel (Fill)	*	*	*
		132.9	132.6	Very stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		132.6	131.0		19	50	0
		131.0	130.0	Hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)	20	200	0
		130.0	129.2	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P75	26+245	133.8	133.4	75 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		133.4	132.9	Compact silty sand, with gravel (Fill)	*	*	*
		132.9	132.6	Very stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		132.6	131.0		19	50	0
		131.0	130.0	Hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)	20	200	0
		130.0	129.2	Highly weathered Shale bedrock	20	400	0
P76	26+355	133.8	133.4	75 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		133.4	132.9	Compact silty sand, with gravel (Fill)	*	*	*
		132.9	132.6	Very stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		132.6	131.0		19	50	0
		131.0	130.0	Hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)	20	200	0
		130.0	129.2	Highly weathered Shale bedrock	20	400	0



HML STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
P77	26+460	133.8	133.4	75 mm Asphalt over silty sand with gravel (Pavement Fill)	*	*	*
		133.4	132.9	Compact silty sand, with gravel (Fill)	*	*	*
		132.9	132.6	Very stiff silty clay, some sand, trace gravel, occasional Shale and limestone fragments (Fill)	*	*	*
		132.6	131.0	Hard silty clay to clayey silt, trace sand, trace gravel, occasional Shale and limestone fragments (Till)	19	50	0
		131.0	130.0	Highly weathered Shale bedrock	20	200	0
		130.0	129.2		20	400	0

Notes

- *1. Passive resistance within the frost depth are neglected and soil parameters within the upper 1.2 m are not provided on the table. The passive resistance within the portion of the Shale bedrock that is encountered above the frost depth should also be neglected at this site.
2. The top of the bedrock should be considered approximate and an allowance of +/- 0.5 m should be allowed.



8.3 Design of Overhead Sign Foundations

The design of OHS structure foundations should be in accordance with the MTO *Sign Support Manual*, dated 2015.

The standard design for OHS foundation presented in the *Sign Support Manual (2015)* have been developed based on the following minimum soil strength parameters:

Non-cohesive soils: The length of caisson indicated in the Manual is based on cohesionless soil with a minimum angle of internal friction, Φ , of 30° . The design assumes a minimum angle of internal friction, Φ , of 28° within the upper two-third below the frost depth, and Φ equal to 30° within the lower third of the caisson below the frost depth.

Cohesive soils: “Soft” clay with an undrained shear strength, s_u , of 25 kPa in the upper two-thirds of the caisson foundation below the frost depth, and “firm” clay with an undrained shear strength, s_u , of 50 kPa in the lower third of the caisson foundation below the frost depth.

A site-specific caisson foundation design may be carried out by the structural engineer using the following equations to calculate the unfactored passive lateral earth pressure, P_p (kPa), distributed along the length of the caisson, assuming the stratigraphy and geotechnical design parameters given in Table 8.3.

$$P_p = K_p \gamma d_w \quad \text{Above the ground water table}$$

$$P_p = K_p \gamma d_w + K_p \gamma' (d - d_w) \quad \text{Below the ground water table}$$

K_p = passive earth pressure coefficient

γ = unit weight of backfill material above assumed water level (kN/m³)

γ' = unit weight of submerged backfill ($\gamma - \gamma_w$) material below assumed water level (kN/m³)

γ_w = 9.8 (kN/m³)

d = depth below the ground surface (m)

d_w = depth to the groundwater level (m)



Table 8.3 – Location of Proposed Structures and Geotechnical Design Parameters for Overhead Signs

OHS STRUCTURE NUMBER	STATION	ELEVATION		SOIL TYPE	DESIGN PARAMETERS		
		FROM	TO		BULK UNIT WEIGHT (KN/M3)	SHEAR STRENGTH (CU, KPA)	INTERNAL FRICTION ANGLE
OHS 1	23+350	129.7	129.5	150 mm Asphalt			
		129.5	128.2	Dense to compact sand and gravel, some silt (Fill)	*	*	*
		128.2	126.1	Firm to very stiff silty clay, trace sand	19	50	0
		126.1	123.6	Highly weathered Shale bedrock	20	400	0
		123.6	120.6	Weathered Shale bedrock	21	4000	0
OHS2	24+150	151.8	151.7	Topsoil			
		151.7	151.3	Very stiff silty clay, some sand (Fill)	*	*	*
		151.3	149.3	Highly weathered Shale bedrock	20	400	0
		149.3	146.3	Weathered Shale bedrock	20	1000	0

Notes

- *1. Passive resistance within the frost depth are neglected and soil parameters within the upper 1.2 m are not provided on the table. The passive resistance within the portion of the Shale bedrock that is encountered above the frost depth should also be neglected at this site.
2. The top of the bedrock should be considered approximate and an allowance of +/- 0.5 m should be allowed.

Based on the existing subsurface information, the soil conditions at the locations of OHS1 and OHS2 are expected to have equal to or higher internal friction angles /undrained shear strength values than that of the parameters assumed for the design provided in the manuals. Therefore, the standard caisson foundation design is applicable.



8.4 Construction Considerations

Construction of the caisson foundations for the OHS should be in accordance with *Ontario Provincial Standard Specification*, OPSS 915 (Sign Support System) and OPSS 903 (Deep Foundations).

Water-bearing non-cohesive native or fill soils should be expected to flow into the caisson hole during or after the drilling for the caisson foundations. Therefore, appropriate equipment and procedures should be employed to minimize ground loss during drilling and concrete placement. This may include the use of temporary or permanent liners, and/or the use of drilling mud. Majority of the locations, the installation of caissons will require advancing through the shale bedrock.

It is recommended that consideration be given to include Non-Standard Special Provisions (NSSPs) in the Contract Documents at Detail Design stage, to warn the contractor of the potential presence of wet non-cohesive soils and presence of cobbles and/or boulders which may affect the installation of the HML and OHS foundations. Provision should also be provided in the NSSP for installation of caissons within the bedrock.



9. CLOSURE

This Foundation Investigation and Design Report was prepared by Ms. A. Khadem, M.Sc. Eng., EIT., Project Supervisor, and reviewed by Mr. M. Vasavithasan, M.Sc. Eng., P.Eng. Senior Engineer, Geotechnical Services.

Mr. C.M.P. Nascimento, P.Eng., Project Manager and MTO Designated Principal Contact, conducted an independent review of the report.

Yours very truly

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APPENDIX C

List of Standard Specifications Relevant to Report
Non-Standard Special Provisions (NSSP)



LIST OF STANDARD SPECIFICATIONS RELEVANT TO REPORT

DOCUMENT	TITLE
OPSS 903	Construction Specification for Deep Foundations
OPSS 915	Construction Specification for Sign Support Structures
OPSD 3090.101	Foundation Frost Penetration Depths for Southern Ontario



NON-STANDARD SPECIAL PROVISIONS (NSSP)

NSSP 1 – Obstructions During Caisson Construction

The Contractor shall be advised that cobbles and boulders are present within the embankment fill and native soils. The Contractor shall be responsible for selecting construction methods and equipment that will enable operations to advance through the embankment fill and/or native soils including zones where cobbles and boulders are encountered.

NSSP 2 – Water Bearing Soils During Caisson Construction

Water-bearing non-cohesive native or fill soils should be expected to flow into the caisson hole during or after the drilling for the caisson foundations. Therefore, appropriate equipment and procedures will be required to minimize ground loss during drilling and concrete placement. This may include the use of temporary or permanent caisson liners, and/or the use of drilling mud.

NSSP 3 – Bedrock During Caisson Construction

The Contractor shall be advised that bedrock will be present at the location of almost all Caissons. The Contractor shall be responsible for selecting construction methods and equipment that will enable operations to advance through the soils and bedrock.