Airport Road Improvements

APPENDICES

ESR

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Municipal Class Environmental Assessment
Airport Road

from 1.0km north of Mayfield Road to 0.6km north of King Street

October 2015

Region of Peel
Working for you

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FOUNDATIONS & STRUCTURES

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

PRELIMINARY
FOUNDATION INVESTIGATION AND DESIGN REPORT
SALT CREEK CULVERT, DEANS CULVERT AND NORRIS BRIDGE
AIRPORT ROAD CLASS ENVIRONMENTAL ASSESSMENT (EA)
FROM 930 m NORTH OF MAYFIELD ROAD
TO 244 m NORTH OF KING STREET
REGIONAL MUNICIPALITY OF PEEL, ONTARIO

PREPARED FOR: IBI Group
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Toronto, Ontario

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Associate

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1.0 INTRODUCTION

Terraprobe Inc. (“Terraprobe”) has been retained by IBI Group (“IBI”) on behalf of the Regional Municipality of Peel (Region of Peel) to provide geotechnical engineering services in support of the Airport Road Class EA Study from about 930 m north of Mayfield Road to about 244 m north of King Street in the Town of Caledon, Ontario.

The scope of work for the geotechnical engineering services of this project is outlined in Terraprobe’s proposal titled “Airport Road Upgrading, Region of Peel RFP Document 2012-050FP, Town of Caledon, Ontario” dated March 01, 2012.

This report addresses the foundation investigations and preliminary designs carried out for the Salt Creek Culvert, Deans Culvert and Norris Bridge. The purpose of this investigation was to explore the subsurface conditions at the three structure sites by borehole drilling, in-situ testing and laboratory testing on soil and rock samples. The data obtained from this investigation was used to provide Borehole Location Plans, Borehole Logs, laboratory test results, a description of the subsurface conditions and preliminary design recommendations.

Based on IBI’s e-mail of October 07, 2014 and the “pdf” drawings provided i.e. Airport Road-plan.pdf, Airport Road-profile.pdf, Airport Road-Typical Sections.pdf, Airport_Rd_Salt Creek_ga.pdf, Airport_Rd_Deans_ga.pdf, and Airport_Rd_Norris_ga.pdf; we understand that the three structures i.e. Salt Creek Culvert, Deans Culvert and Norris Bridge will now be replaced with new structures.

It should be noted that this study is for preliminary design. Further investigations will be required for detail design.

2.0 SITE DESCRIPTION AND PHYSIOGRAPHY

The site is located in the Town of Caledon, Regional Municipality of Peel, Ontario. The roadway is approximately 5.5 km long, extending from 930 m north of Mayfield Road to 244 m north of King Street. Currently, Airport Road consists of one through lane in each direction, with dedicated turning lanes at the King Street, Old School Road and Healey Road intersections. A site location plan is provided as Figure 1.

Further details of each site are provided below.

- ***Salt Creek Culvert*****:** This culvert is located below Airport Road at Station 3+440 approximately, about 0.82 km north of Old School Road. This culvert is approximately 22.4 m long and has one span measuring approximately 8.2 m.
- ***Deans Culvert:*** This culvert is located below Airport Road at Station 3+040 approximately, about 0.42 km north of Old School Road. The culvert is approximately 19.4 m long and has one span measuring approximately 6.3 m.
- ***Norris Bridge:*** This rigid frame bridge is located on Airport Road at Station 1+100 approximately, about 1.6 km north of Mayfield Road. The bridge has a span length of about 10.7 m and an overall width of 17.2 m.

The sites are located in the South Slope physiographic region which is defined as the area along the southern slope of the Oak Ridges Moraine that extends along the moraine between Durham Region in the east to the Niagara Escarpment in the west. The South Slope is characterized by topography that gently slopes southward towards Lake Ontario. It consists of a faintly drumlinized clay till plain that contains deeply incised stream valleys.

The underlying bedrock in the study area is known to consist of grey shale of the Georgian Bay Formation (also known as the Meaford-Dundas Formation). The Georgian Bay Formation belongs to the Ordovician Period and is approximately 450 million years old. It is known to consist of grey shale with interbeds of relatively more competent siltstone and sandstone and harder limestone. It is also known to contain occasional thin clay seams. The hard layers/seams are usually less than about 100 mm to 150 mm thick but some layers are much thicker. These are actually lenses and they can vary significantly in thickness over short distances. Stress relief features, such as folds and faults are also found in the formation.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out during the period November 28 to 30, 2012, and consisted of drilling and sampling six boreholes to depths ranging from approximately 9.2 m to 11.1 m below ground surface. The borehole locations are shown on Figures 2, 3 and 4.

The boreholes were drilled using conventional CME 75 truck and track mounted drill rigs supplied and operated by Strong Soil Search of Claremont, Ontario. The borings were extended through the overburden soils and bedrock using solid stem augering techniques and soil samples were obtained at intervals of depth ranging from 0.75 m to 1.5 m, using a 50 mm outer diameter (O.D.) split-barrel sampler in conjunction with the Standard Penetration Test (SPT) procedures as specified in ASTM Method D1586[1]. Members of Terraprobe's technical staff observed and recorded the drilling and sampling operations on a full-time basis.

Ground water conditions were observed in the open boreholes during and immediately following the drilling operations. To permit longer term ground water level monitoring, one selected borehole at each site was instrumented with a standpipe piezometer consisting of a 50 mm diameter PVC pipe with a slotted screen enclosed in sand. The piezometer installation details and water level readings are described on the Borehole Logs in Appendix A. The remaining boreholes were abandoned in accordance with Ontario Regulation 903 (as amended) by backfilling to the surface with bentonite pellets.

The borehole locations were staked in the field by a member of Terraprobe's technical staff by referring to existing features shown on the base plans provided by IBI. Utility clearances were obtained by Terraprobe prior to drilling.

The ground surface elevations of the boreholes at Salt Creek Culvert and Deans Culvert were referred to temporary benchmarks with an assigned elevation of 100 m, established on the top of each concrete culvert. At the Norris Bridge site the ground surface elevations of the boreholes were referred to the

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[1] ASTM D1586 – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of Soils.

Region of Peel benchmark RPBM No. 13 located on the west face at the north corner of the structure, the elevation of which is 239.716 m.

The recovered soil samples were subjected to Visual Identification (VI) and select soils samples were subjected to a laboratory testing programme consisting of natural water content, grain size distribution and Atterberg limits in accordance with MTO and/or ASTM Standards as appropriate. The results of the soil testing programme are presented on the Borehole Logs in Appendix A and on the figures in Appendix B.

Three soil samples were also submitted to AGAT Laboratories for soil chemical testing to assess soil disposal options for excess soils generated during construction. The results of the soil chemical tests are provided in Appendix C.

4.0 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Borehole Logs in Appendix A. An overall description of the stratigraphy at the three sites is given in the following paragraphs; however, the factual data presented in the Borehole Logs governs any interpretation of the site conditions. Further investigations will be required for detail designs.

The stratigraphic boundaries shown on the Borehole Logs are inferred from non-continuous soil sampling and observations during drilling and therefore represent transitions between soil types rather than exact planes of geological change. The subsurface conditions will vary between and beyond the borehole locations.

4.1 Salt Creek Culvert (Airport Road Station 3+440)

In general, Boreholes SC1 and SC2 indicate that the site is underlain by an asphalt pavement, loose to compact and firm to stiff fill materials and a very stiff to hard clayey silt till deposit.

4.1.1 Pavement

Borehole SC1 was drilled through the Airport Road pavement. This borehole encountered a 150 mm thick layer of asphaltic concrete underlain by a 300 mm thick layer of sand, some gravel that comprises the base/subbase layers of the pavement structure. Borehole SC2 was drilled through the Airport Road shoulder and this borehole encountered a 400 mm thick layer of sand some gravel. The Airport Road pavement/shoulder extends to depths of 0.4 m and 0.5 m below ground surface.

Standard Penetration tests in the granular fill gave SPT ‘N’ values of 19 and 25 blows per 0.3 m penetration indicating a compact relative density. The moisture contents of samples of the granular fill material range from 3% to7% by weight.

4.1.2 Fill – Sand and Clayey Silt

Borehole SC1 encountered a layer of sand fill and Borehole SC2 encountered a layer of clayey silt fill. The fill material in both boreholes extends to depths of 2.9 m below ground surface.

Standard Penetration tests in the sand fill gave SPT ‘N’ values of 4 to 13 blows per 0.3 m penetration indicating a loose to compact relative density. The moisture contents of samples of the granular fill material range from 5% to10% by weight.

The ‘N’ values of Standard Penetration tests carried out in the clayey silt fill material range from 5 to 15 blows for 0.3 m penetration suggesting a firm to stiff consistency. The moisture content of samples of the clayey silt fill material range from 9% to 14% by weight.

4.1.3 Clayey Silt Till

Both boreholes encountered a deposit of clayey silt till that extends at least to borehole termination depths of 10.8 m and 11.1 m below ground surface.

The ‘N’ values of Standard Penetration tests carried out in this deposit range from 17 blows per 0.3 m penetration to 95 blows for less than 0.3 m penetration, suggesting a deposit of very stiff to hard consistency. The moisture contents of samples of the clayey silt till range from 9% to 17% by weight.

A sample of the clayey silt till was subjected to a grain size distribution test and the results are shown on Figure B1 in Appendix B. The results show a grain size distribution consisting of 10% gravel, 27% sand and 63% silt and clay size particles. Random cobble and boulder inclusions can also be expected to occur within the matrix of this deposit.

Atterberg limits tests were also carried out on one sample of the clayey silt till and the results are plotted on the plasticity chart on Figure B2 in Appendix B. The results indicate that the till matrix is a cohesive soil of low plasticity (CL-ML). The Atterberg limits test results are summarized below:

Liquid Limit:	21%
Plastic Limit:	14%
Plasticity Index:	7%
Natural Moisture Content:	11%

4.2 Deans Culvert (Airport Road Station 3+040)

In general, Boreholes DC1 and DC2 indicate that the site is underlain by an asphalt pavement, topsoil, compact and stiff fill materials and a firm to hard clayey silt till deposit.

4.2.1 Topsoil

Borehole DC1 encountered an approximately 100 mm thick topsoil layer. Topsoil thickness may vary between and beyond the boreholes.

4.2.2 Pavement

Borehole DC2 was drilled through the Airport Road pavement. This borehole encountered a 180 mm thick layer of asphaltic concrete underlain by a 200 mm thick layer of sand, some gravel that comprises the base/subbase layers of the pavement structure. The Airport Road pavement extends to a depth of 0.4 m below ground surface.

A Standard Penetration test in the granular fill gave an SPT ‘N’ value of 34 blows per 0.3 m penetration indicating a dense relative density. The moisture content of a sample of the granular fill material is 11% by weight.

4.2.3 Fill – Sand and Clayey Silt

Borehole DC2 encountered a layer of sand fill underlain by a layer of clayey silt fill. The sand fill extends to a depth of 1.4 m below ground surface and the clayey silt fill extends to a depth of 2.6 m below ground surface.

A Standard Penetration test carried out in the sand fill measured an SPT ‘N’ value of 24 blows per 0.3 m penetration indicating a compact relative density. The moisture content of a sample of the sand fill material is 3% by weight.

The ‘N’ values of Standard Penetration tests carried out in the clayey silt fill materials are 9 and 14 blows for 0.3 m penetration suggesting a stiff consistency. The moisture contents of samples of the clayey silt fill material range from 20% to 24% by weight.

4.2.4 Clayey Silt Till

Both boreholes encountered a deposit of clayey silt till that extends at least to borehole termination depths of 10.7 m and 10.8 m below ground surface.

The ‘N’ values of Standard Penetration tests carried out in this deposit range from 4 blows per 0.3 m penetration to 78 blows for less than 0.3 m penetration. Based on these results the consistency of the clayey silt till is described as generally firm to hard. The moisture contents of samples of the clayey silt till range from 5% to 15% by weight.

Three samples of the clayey silt till were subjected to a grain size distribution test and the results are shown on Figure B3 in Appendix B. The results show a grain size distribution consisting of 0% to 12% gravel, 3% to 36% sand and 53% to 97% silt and clay size particles. Random cobble and boulder inclusions can also be expected to occur within the matrix of this deposit.

Atterberg limits tests were also carried out on two samples of the clayey silt till and the results are plotted on the plasticity chart on Figure B4 in Appendix B. The results indicate that the till matrix is a cohesive soil of low plasticity (CL-ML).

The Atterberg limits test results are summarized below:

Liquid Limit:	20% and 23%
Plastic Limit:	14% and 18%
Plasticity Index:	5% and 6%
Natural Moisture Content:	9% and 15%

4.3 Norris Bridge (Airport Road Station 1+120)

In general, Boreholes NB1 and NB2 indicate that the site is underlain by an asphalt pavement, topsoil, loose to very dense and firm to stiff fill materials, and a very stiff to hard silty clay till deposit. These overburden soils are underlain by inferred shale bedrock of the Georgian Bay Formation.

4.3.1 Topsoil

Borehole NB2 encountered an approximately 120 mm thick topsoil layer. Topsoil thickness may vary between and beyond the boreholes.

4.3.2 Pavement

Borehole NB1 was drilled through the Airport Road pavement. This borehole encountered a 180 mm thick layer of asphaltic concrete underlain by a 200 mm thick layer of sand, some gravel that comprises the base/subbase layers of the pavement structure. The Airport Road pavement extends to a depth of 0.4 m below ground surface.

A Standard Penetration test in the granular fill gave an SPT ‘N’ value of 101 blows per 0.3 m penetration indicating a very dense relative density. The moisture content of a sample of the granular fill material is 4% by weight.

4.3.3 Fill – Sand and Clayey Silt

Borehole NB1 encountered a layer of sand fill underlain by a layer of clayey silt fill. Borehole NB2 encountered a layer of clayey silt fill. The fill material in both boreholes extends to depths of 3.7 m below ground surface.

Standard Penetration tests in the sand fill gave SPT ‘N’ values of 9 and 73 blows per 0.3 m penetration indicating a loose to very dense relative density. The moisture contents of samples of the granular fill material range from 1% to9% by weight.

The ‘N’ values of Standard Penetration tests carried out in the clayey silt fill material ranges from 6 to 12 blows for 0.3 m penetration suggesting a firm to stiff consistency. The moisture contents of samples of the clayey silt fill material range from 9% to 35% by weight.

4.3.4 Silty Clay Till

Both boreholes (NB1 and NB2) encountered a silty clay till deposit that extends to depths of 5.4 m and 5.6 m below ground surface.

The 'N' values from Standard Penetration tests carried out in the silty clay till range from 24 blows to 100 blows for less than 0.3 m penetration suggesting a very stiff to hard consistency. The moisture contents of the clayey silt till range from 10% to 15% by weight.

A sample of the silty clay till was subjected to a grain size distribution test and the results are shown on Figure B5 in Appendix B. The results show a grain size distribution consisting of 6% gravel, 14% sand and 80% silt and clay size particles. Random cobble and boulder inclusions can also be expected to occur within the matrix of this deposit.

An Atterberg limits test was also carried out on a sample of the silty clay till and the results are plotted on the plasticity chart on Figure B6 in Appendix B. The test results indicate that the till matrix is a low plasticity (CL) cohesive silty clay soil as summarized below:

Liquid Limit:	39%
Plastic Limit:	22%
Plasticity Index:	17%
Natural Moisture Content:	15%

4.3.5 Shale Bedrock

The bedrock underlying the site is comprised of grey shale of the Georgian Bay Formation. The shale bedrock encountered within the depths of the current investigation was penetrated by augering and samples were obtained by split spoon sampling. It should be emphasized that it is not possible to accurately determine the top of bedrock unless bedrock coring is carried out. Therefore, the bedrock depths reported herein are approximate and further investigations will be required for detail design. Tabulated below are the inferred depths to bedrock and the bedrock surface elevations.

Borehole No.	Depth to Bedrock (m)	Inferred Top of Bedrock Elevation (m)
NB1	5.4	235.0
NB2	5.6	234.9

4.4 Ground water Levels

Standpipe piezometers were installed in Borehole SC2 (Salt Creek Culvert site), Borehole DC1 (Deans Culvert site) and Borehole NB2 (Norris Bridge site). The water level readings measured on separate visits made after the completion of drilling are presented below.

Water Level Measurements

Borehole Number Structure Site	Date	Water Levels	
		Depth (m)	Elevation (m)
SC2 Salt Creek Culvert	December 17, 2012 January 7, 2013	2.1 2.4	N/A
DC1 Deans Culvert	December 17, 2012 January 7, 2013	1.1 1.2	N/A
NB2 Norris Bridge	December 17, 2012 January 7, 2013	3.7 3.7	236.8 236.8

The readings taken in the piezometers are considered to be stabilized water levels. The ground water levels can however be expected to fluctuate seasonally as well as in response to major weather events. The ground water levels will also be controlled by the free water level in the existing watercourses. Perched water can also be expected to occur where permeable sandy soils are underlain by relatively impermeable clayey soils.

5.0 DISCUSSION AND RECOMMENDATIONS

This section of the report presents an interpretation of the factual geotechnical data and provides preliminary geotechnical design recommendations. The discussions and recommendations presented are for preliminary design purposes and are based on our understanding of the project and our interpretation of the factual data obtained. Further investigations are required to undertake detail designs.

It is understood that the three structures, namely Salt Creek Culvert, Deans Culvert and Norris Bridge will be removed and replaced with new structures to accommodate a widened Airport Road platform. The preliminary general arrangement drawings provided by IBI indicate that the following replacement structures are being considered:

- Salt Creek Culvert, replace existing structure with a 10.67 m x 2.44 m precast open footing culvert;
- Deans Culvert, replace existing structure with 10.67 m x 2.44 m precast open footing culvert; and
- Norris Bridge, replace existing bridge with a 14.64 m x 3.35 m CON-SPAN structure.

6.0 STRUCTURE FOUNDATIONS

6.1 Geotechnical Resistances

Based on the subsurface stratigraphy of the sites, the recommended founding depths and geotechnical resistances for structure foundations founded on undisturbed competent natural soils are tabulated below.

Geotechnical Resistances – Salt Creek Culvert

Borehole Number	Existing Ground Surface Elevation (m)	Recommended Bottom of Footing Level Below Existing Ground Surface (m)	Founding Elevation (m)	Geotechnical Resistances		Subgrade Soil
				Factored ULS (kPa)	SLS (kPa)	
SC1	N/A	2.9 to 4.0	N/A	250	175	Clayey Silt Till
		Below 4.0	N/A	450	300	
SC2	N/A	2.9 to 4.0	N/A	250	175	Clayey Silt Till
		Below 4.0	N/A	450	300	

Assumes a minimum footing width of 1.0 m and a ground water table at the footing level.

Soft weak soils if encountered at the founding subgrade must be removed and replaced with OPSS 1010 Granular “A” compacted to 98% Standard Proctor Maximum Dry Density.

Geotechnical Resistances – Deans Culvert

Borehole Number	Existing Ground Surface Elevation (m)	Recommended Bottom of Footing Level Below Existing Ground Surface (m)	Founding Elevation (m)	Geotechnical Resistances		Subgrade Soil
				Factored ULS (kPa)	SLS (kPa)	
DC1	N/A	0.6 to 2.9	N/A	375	250	Clayey Silt Till
		Below 2.9	N/A	450	300	
DC2	N/A	2.6 to 5.5	N/A	375	250	Clayey Silt Till
		Below 5.5	N/A	450	300	

Assumes a minimum footing width of 1.0 m and a ground water table at the footing level.

Soft weak soils if encountered at the founding subgrade must be removed and replaced with OPSS 1010 Granular “A” compacted to 98% Standard Proctor Maximum Dry Density.

Geotechnical Resistances – Norris Bridge

Borehole Number	Existing Ground Surface Elevation (m)	Recommended Bottom of Footing Level Below Existing Ground Surface (m)	Founding Elevation (m)	Geotechnical Resistances		Subgrade Soil
				Factored ULS (kPa)	SLS (kPa)	
NB1	240.4	3.7 to 5.4	236.7 – 235.0	450	300	Clayey Silt Till
		Below 5.4	Below 235.0	1000	700	Shale Bedrock
NB2	240.5	3.7 to 5.6	236.8 – 234.9	450	300	Clayey Silt Till
		Below 5.6	Below 234.9	1000	700	Shale Bedrock

Assumes a minimum footing width of 1.0 m and a ground water table at the footing level.

Soft weak soils if encountered at the founding subgrade must be removed and replaced with OPSS 1010 Granular “A” compacted to 98% Standard Proctor Maximum Dry Density.

The geotechnical resistance values tabulated above are for concentric, vertical loads only. Effects of load inclination and eccentricity should be taken into account as illustrated in the *Canadian Highway Bridge Design Code (CHBDC) CAN/CSA-S6-06*, Clauses 6.7.3 and 6.7.4. The SLS values provided correspond to a settlement of up to 25 mm assuming that the founding soils will remain undisturbed during construction.

6.2 Ultimate Coefficient of Friction

Resistance to lateral forces/sliding resistance between the concrete footing and the subgrade soils should be evaluated in accordance with the CHBDC 2006. The following ultimate coefficient of friction values are recommended between the concrete and the bedding material or subgrade soils:

- OPSS Granular “A” bedding – ultimate coefficient of friction of 0.7; and
- Silty clay till and shale bedrock – ultimate coefficient of friction of 0.6.

6.3 Design Frost Depth

Footings for structure extensions and for any associated concrete wing/retaining walls, should be founded at a minimum depth of 1.2 m of earth cover below the lowest surrounding grade to provide adequate protection against frost penetration.

7.0 LATERAL EARTH PRESSURE

Earth pressures are generally calculated using the following expression:

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

where P_h = horizontal pressure on the wall (kPa)
K = earth pressure coefficient
γ = unit weight of retained soil
h = depth below top of fill where pressure is computed (m)
q = value of any surcharge (kPa)

Earth pressures acting on the structure should be computed in accordance with Clause 6.9 of the CHBDC 2006 and according to Clause 6.9.3 of the CHBDC 2006, a compaction surcharge should also be added. For soils with an angle of internal friction ranging from 30º to 35º the magnitude should be 12 kPa at the top of the fill decreasing linearly to 0 kPa at a depth of 1.7 m; or decreasing linearly to 0 kPa at a depth of 2.0 m for soils with an angle of internal friction that exceeds 35º. Compaction equipment including hand operated vibratory equipment should be in accordance with OPSS 501.

Earth pressure coefficients for backfill to the bridge abutments, culvert and wing walls are dependent on the material used as backfill and typical values are provided in the following table.

Earth Pressure Coefficients

Wall Condition	**Earth Pressure Coefficient (K)**			
	OPSS Granular A or OPSS Granular B Type II $\phi = 35°; \gamma = 22.8\ kN/m^3$		OPSS Granular B Type I $\phi = 32°; \gamma = 21.2\ kN/m^3$	
	Horizontal Surface Behind Wall	Sloping Surface Behind Wall (2H:1V)	Horizontal Surface Behind Wall	Sloping Surface Behind Wall (2H:1V)
Active (Unrestrained Wall)	0.27	0.38*	0.30	0.46*
At rest (Restrained Wall)	0.43	-	0.47	-
Passive (Movement Towards Soil Mass)	3.70	-	3.30	-

* For wing walls.

The earth pressure coefficients in the table above are “ultimate” values and require certain movements for the respective conditions to be mobilized. The values to use in design can be estimated from Figure C6.16 in the Commentary to the CHBDC, 2006.

8.0 EXCAVATIONS

All excavations must be carried out in accordance with the guidelines outlined in the *Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects*. Where workers must enter excavations extending deeper than 1.2 m, the trench walls must be suitably slopes and/or braced in accordance with the OHSA. Within the envisaged depths of temporary excavations, the OHSA soil classifications for the various sites are provided in the following table.

Structure Site	Stratum	OHSA Soil Classification
Salt Creek Culvert	Fill – Sand and Clayey Silt	Type 3 soil
	Clayey Silt Till	Type 2 soil
Deans Culvert	Fill – Sand and Clayey Silt	Type 3 soil
	Clayey Silt Till	Type 2 soil
Norris Bridge	Fill – Sand and Clayey Silt	Type 3 soil
	Silty Clay Till	Type 2 soil
	Shale Bedrock	Type 1 soil

Where workers must enter excavations extending deeper than 1.2 m, the excavation walls must be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

9.0 GROUND WATER CONTROL

To allow excavation and foundation construction to be carried out, control of surface water and ground water will be necessary. We recommend temporarily diverting the flow of water away from the construction area as per OPSD 221.010 as appropriate so that construction will proceed in sufficiently dry conditions.

The design of the unwatering system should be the responsibility of the Contractor. Where the excavation is advanced through existing fill and cohesive soils to terminate within cohesive soils (i.e. no excavation through water-bearing cohesionless soils), a suitable system that might be employed would be gravity drainage and pumping from strategically placed filtered sumps.

10.0 EMBANKMENTS

10.1 Stability

Based on the profile drawings provided by IBI the road profile will be raised by approximately 0.1 m, 0.25 m and 0.5 m at Salt Creek Culvert, Deans Culvert and Norris Bridge sites respectively. The global, internal and surficial stability of the embankments will depend on the slope geometry and also to a large degree on the material used to construct the embankment. For preliminary designs we recommend that embankments be designed at a minimum 2H:1V side slopes.

10.2 Settlement

As mentioned previously, the road profile will be raised by 0.1 m, 0.25 m and 0.5 m at Salt Creek Culvert, Deans Culvert and Norris Bridge sites respectively. With these relatively minor grade raises, it is estimated that the new fill will induce less than 20 mm of settlement in the foundation soils. Embankments comprised of local earth fill will also settle during construction (fill compression) and this settlement is expected to be about 1% of the fill height. The settlement of non-cohesive fill should be immediate in nature and essentially be complete shortly after construction is complete.

10.3 Construction

Materials used for embankment construction should be placed in lifts not exceeding 300 mm (before compaction), and each lift should be uniformly compacted to at least 95 % of the material's Standard Proctor Maximum Dry Density (SPMDD). Embankment construction should be in accordance with OPSS 501 and OPSS 206 and borrow material must meet the requirements of OPSS 212. Benching between existing fill and new fill should be undertaken in accordance with OPSD 208.010.

Proper erosion control measures should be implemented both during construction and permanently. Temporary erosion and sediment control must be provided in accordance with OPSS 803 and OPSS 804 and embankment slopes must be reinstated with permanent erosion protection in accordance with OPSS 511. It is also imperative that the designs include provisions for preventing the flow of surface water down the face of slopes. Surface water must be directed to armoured outfalls/outlets designed to drain into roadside ditches.

11.0 BACKFILL

Backfill around the culverts and at the bridge abutments should be carried out as per OPSD 3101.150. The backfill should consist of free-draining, non-frost susceptible granular materials in accordance with OPSS 1010. All granular fill (meeting OPSS 1010 specifications) should be placed in loose lifts not exceeding 150 mm thick and should be compacted to at least 95 % of the materials SPMDD. For fills below the ground water level or immediately below the roadway, it is recommended that Granular "A" material be used.

Equal heights of backfill should be maintained on both sides of the structure during all stages of backfill placement, and backfilling operations should be undertaken in accordance with OPSS 902. Heavy compaction equipment should not be used adjacent to the walls and roof of the culvert. Compaction equipment should be restricted in accordance with OPSS 501.

The excavated soils at these sites can be used for backfilling purposes provided they are free of organics and other deleterious material. To achieve the specified compaction, soils must neither be too wet nor too dry of their optimum moisture content. Soils that are too wet cannot be used immediately because the material will have to be dried to a moisture content of 2± % of optimum. If the construction operations are time sensitive, the use of imported granular material may be considered. Soils that are dry of optimum can be used immediately provided that the material is moisture conditioned (i.e. water added) to achieve a moisture content of 2± % of optimum.

12.0 SCOUR AND EROSION PROTECTION

12.1 General

The depth of scour and the design of an erosion protection scheme will depend on the channel hydrology, its cross-section and the engineering properties of the materials below the streambed. We recommend that a qualified hydraulics engineer be consulted to design the erosion protection scheme taking into consideration such specifics as channel geometry, bridge abutment and foundations, culvert outlet and inlet (i.e. thickness and extent of protection) and scour depth. Footings must be placed below the scour depth.

12.2 Culverts

Erosion protection should be provided at the culvert inlets and outlets (including the slopes and sides). At the inlet area a clay seal can be provided such that water flow is channelled through the culvert and does not seep through the backfill around and underneath the structure. Therefore, the clay seal should extend to cover all the granular backfill materials, should be a continuous layer around the culvert, should have a minimum compacted thickness of 0.6 m, and should extend at least 1 m above the high water level. The clay seal should also be protected by a layer of rip-rap. Material used for the clay seal should conform to the requirements stipulated in OPSS 1205. Alternatively, concrete cut-off and head walls can be constructed to protect the granular backfill and prevent seepage around the culvert.

Concrete cut-off and head walls can also be used to protect the granular fill around the culvert outlet from erosion. In this case, however, filtered erosion protection such as rip-rap should be provided along the channel and the sides beyond the concrete cut-off and head walls at the outlet.

In the inlet and outlet areas of the culvert rip-rap protection is typically provided. The rip-rap layer should cover all surfaces on the embankment slopes with which the creek water is likely to be in contact.

12.3 Bridge

The base of the bridge abutments and footings should be protected from scour and proper erosion and scour protection must be provided along the sides of the creek and a suitable distance beyond. Storm events will cause temporarily higher water levels at the site and these elevated water levels should also be considered when determining the lateral and vertical extent of the protection.

Suitable rip-rap protection should be installed to protect the bridge abutments and its foundations as well as any forward slopes.

13.0 TEMPORARY SHORING

The shape of the soil pressure distribution diagram behind a shoring system depends upon the type of soil to be retained and the amount of movement that can be permitted. The shoring system can be restrained, fixed or flexible. The sequence of work may also alter the shape of the pressure diagram during the various construction phases.

Earth pressure computations must also take into account the ground water level. Above the ground water level, earth pressure is computed using the bulk unit weight of the retained soil. The soil effective stress and hydrostatic pressures need to be considered if the retained soil is not fully drained.

Earth pressures acting on the shoring system should be computed from the following expression for a triangular earth pressure distribution:

$$p_h = K[\gamma (h - h_w) + (\gamma' h_w) + q] + h_w\gamma_w$$

where, p_h = horizontal pressure on the wall (kPa)
K = lateral earth pressure coefficient
γ = bulk unit weight of retained soil (kN/m^3)
γ' = submerged unit weight of soil ($\gamma - \gamma_w$) (kN/m^3)
γ_w = unit weight of water (9.81 kN/m^3)
h = depth below ground surface (m)
h_w = depth below the ground water level (m)
q = surcharge loading (kPa)

The appropriate values of the parameters for use in the preliminary design of structures subject to unbalanced earth pressures are provided in the following tables. The active earth pressure coefficients are based on the assumption that the ground surface behind the temporary excavation support system is horizontal. Where the retained ground is sloping, the lateral earth pressure coefficients must be adjusted to account for the slope and these earth pressure coefficients can be estimated from the equations provided on Figures C6.17 and C6.18 in the *Canadian Highway Bridge Design Code* (CHBDC) 2006.

Stratigraphic Unit	**Friction Angle φ (degrees)**	**Unit Weight γ (kN/m)**	**Active Earth Pressure Coefficient**
			K_a
Existing Fill Soils	30	19	0.33
Clayey Silt Till	30	20	0.33

The lateral earth pressure coefficients given above are "ultimate values" and require specific wall movements for the active and passive conditions to be mobilized. The values to use in design can be estimated from Figure C6.16 in the Commentary to the CHBDC, 2006.

Where the excavation penetrates the bedrock, the rock is nominally self supporting in a vertical face, provided the rock bedding is horizontally oriented. The rock induces no pressure on shoring systems that require structural support and the requirement for lagging support of partially weathered rock depends on the cleanliness of the excavation break.

Where shoring systems are perched in the bedrock above the excavation base, great care and consideration must be given to providing protection and support for the rock in the area of influence directly beneath the base of the soldier pile toe as appropriate. Where soldier pile toes are perched in the rock above the level of the excavation base, it is necessary to leave a minimum 1 m wide shelf between the excavation face and soldier pile toes.

14.0 SEISMIC REQUIREMENTS

The site is treated as lying in Seismic Zone 0. Reference to Annex A3.1 of the CHBDC 2006 indicates that the following seismic parameters (Brampton) should be used for design:

• Velocity Related Seismic Zone	0
• Zonal Velocity Ratio	0.05
• Acceleration Related Seismic Zone	1
• Zonal Acceleration Ratio	0.05
• Peak Horizontal Acceleration	0.08 g (10% in 50 years)

The soil profile types at these sites are classified as Type I and the Site Coefficient “S” (ground motion amplification factor) that should be used in seismic design as per Clause 4.4.6.1, Table 4.4 of the CHBDC is 1.0.

15.0 SOIL CHEMICAL ANALYSES

Three soil samples (Sample SS1 of Borehole DC1, Sample SS2 of Borehole SC2 and Sample SS 2 of Borehole NB1) were submitted to AGAT Laboratories for chemical characterization with respect to general inorganic parameters including metals, pH, sodium adsorption ration (SAR) and electrical conductivity (EC). Based on visual and/or olfactory screening of soil samples, these nominal parameters are analysed when there are no indications of environmental impacts. However, additional sampling/testing will be required during detail design to confirm disposal or re-use options. The Certificates of Analysis are included in Appendix C.

The analytical results were compared to Table 1 Standard (Residential/Parkland/Industrial/Commercial/Community Property Use) of the *MOE Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011*. Comparison of the test results to the MOE Standard indicates that the SAR and/or electrical conductivity of the tested samples exceeded the guideline limits stipulated in Table 1.

During the detail design phase, we recommend that additional sampling and chemical testing be carried out. Soil that does not meet the Ontario Regulation 153/04 Table 3 Standards will typically have to be managed as waste.

16.0 RECOMMENDED ADDITIONAL STUDIES

It is recommended that the following issues be considered during the future detailed design studies:

- Carry out detailed field investigations at the structure sites to confirm the thickness and founding elevation of the existing footings and the composition and properties of the fill material comprising the embankments;
- Core the bedrock at the Norris Bridge site to refine the top of bedrock elevation;
- Confirm the ground water level(s), perched or otherwise, at the sites; and
- Confirm and further refine the preliminary geotechnical recommendations provided in this report.

17.0 LIMITATIONS AND RISK

17.1 Procedures

This preliminary investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The preliminary discussions and recommendations that have been presented are based on the factual data obtained by Terraprobe and are to be used only for preliminary designs.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing preliminary design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Further investigations will be required to complete detail designs.

17.2 Changes in Site and Scope

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Ground water levels are particularly susceptible to seasonal fluctuations.

The discussion and recommendations are based on the factual data obtained from preliminary investigations made at the site by Terraprobe and are intended for use by the owner and its retained designers in the preliminary design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the preliminary geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant or complete for the revised project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

This report was prepared for the express use of IBI, The Regional Municipality of Peel and their retained design consultants and is not for use by others. This report is copyright of Terraprobe Inc. and no part of this report may be reproduced by any means, in any form, without the prior written permission of Terraprobe Inc. IBI, The Regional Municipality of Peel and their retained design consultants are authorized users.

18.0 CLOSURE

This report was prepared by Mr. W. Lei, P.Eng., a Senior Geotechnical Engineer with Terraprobe, and reviewed by Mr. Rehman Abdul, M.S., P.Eng., a Senior Geotechnical Engineer and Associate with Terraprobe.

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LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
Dec. 18, 2014
PROVINCE OF ONTARIO

Rehman Abdul
Report Reviewed by:
R. Abdul, P. Eng.,
Associate, Senior Geotechnical Engineer

REFERENCES

ASTM D1586 - 08a, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils, 2008.

Bowles, J.E., 1984. Physical and Geotechnical Properties of Soils, Second Edition. McGraw Hill Book Company, New York.

Canadian Geotechnical Society, 2006, Canadian Foundation Engineering Manual, 4th Edition. The Canadian Geotechnical Society, BiTech Publisher Ltd., British Columbia.

Canadian Standards Association (CSA), 2006. Canadian Highway Bridge Design Code and Commentary on CAN/CSA S6 06. CSA Special Publication, S6.1 06.

Chapman, L. J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, 3rd Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.

Ministry of the Environment, April 15, 2011. Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act, PIBS # 7382e01.

Ontario Provincial Standard Specifications (OPSS)

OPSS 206	Construction Specification for Grading.
OPSS 501	Construction Specification for Compacting
OPSS 511	Construction Specification for Rip-Rap, Rock Protection and Granular Sheeting
OPSS 803	Construction Specification for Sodding.
OPSS 804	Construction Specification for Seed and Cover.
OPSS 902	Construction Specification for Excavation & Backfilling Structures
OPSS 1010	Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material

Ontario Provincial Standard Drawings (OPSD)

OPSD 208.010	Benching of Earth Slopes
OPSD 221.010	Temporary Water Passage System, Culvert in Watercourse
OPSD 3101.150	Walls, Abutment, Backfill, Minimum Granular Requirement

FIGURES

TERRAPROBE INC.

Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

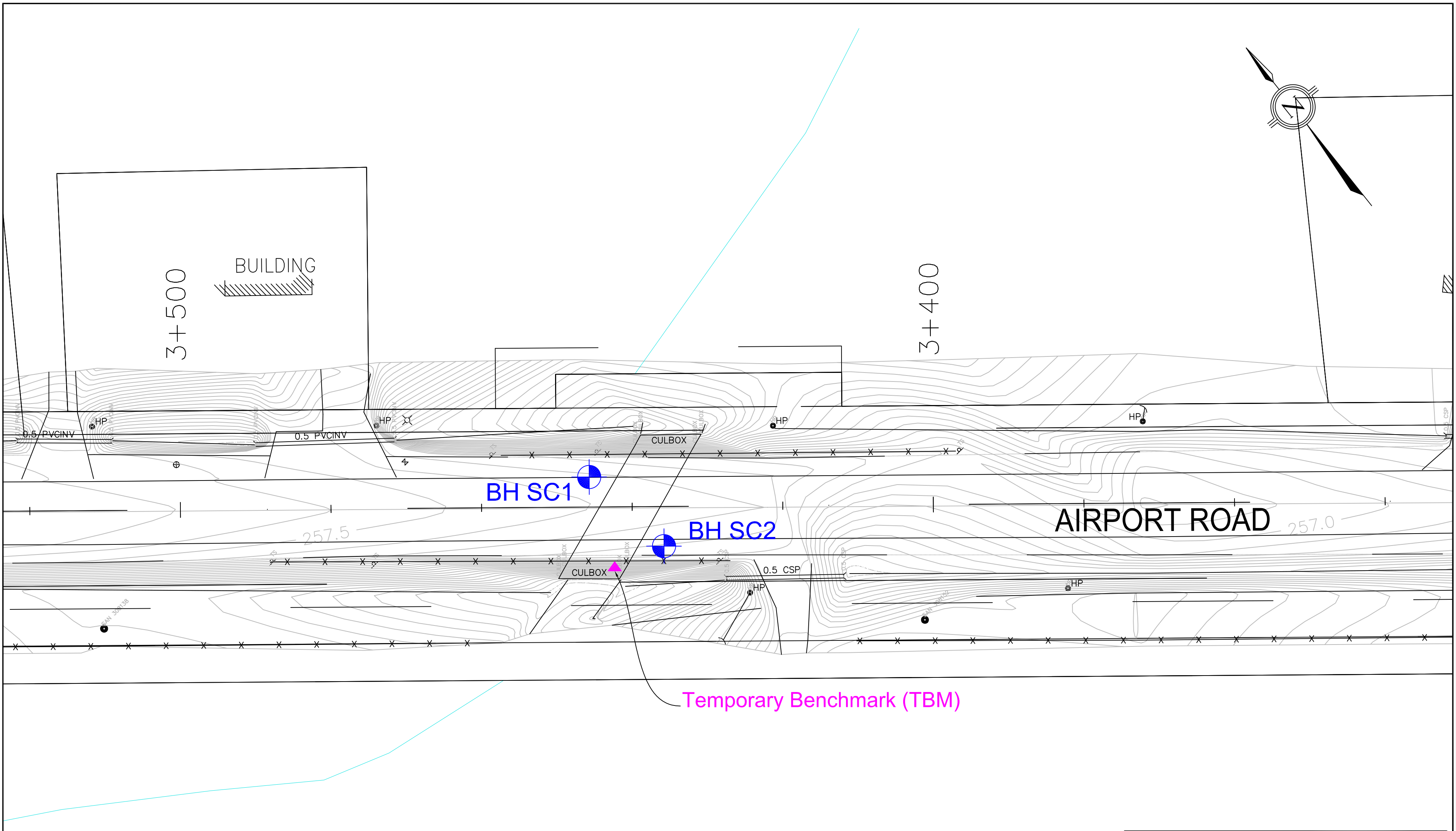
Title:

SITE LOCATION PLAN

File No. 11-12-2096

FIGURE : 1

\\PDC\Server\1-Project Files\11-Geo\2012\11-12-2001 - 2099\11-12-2096\A. Dwgs, Logs\AutoCAD\11-12-2096 Site Location Plan (MARCH 2013).dwg, KAMAL



LEGEND

⊕ Borehole Location

▲ TBM (Elevation 100.0m)

REFERENCE

Base plans provided in digital format by IBI Group, drawing files Airport 12-4380 base plan .dgn, 12-4380 Preliminary Property Nov-11 .dgn, 12-4380 Airport Rd Title Plan .dgn, Airport 2d 03-4040 Contour .dgn.

SCALE 1:750

10 5 0 5 10 15 20m

Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

SALT CREEK CULVERT
(Borehole Location Plan)

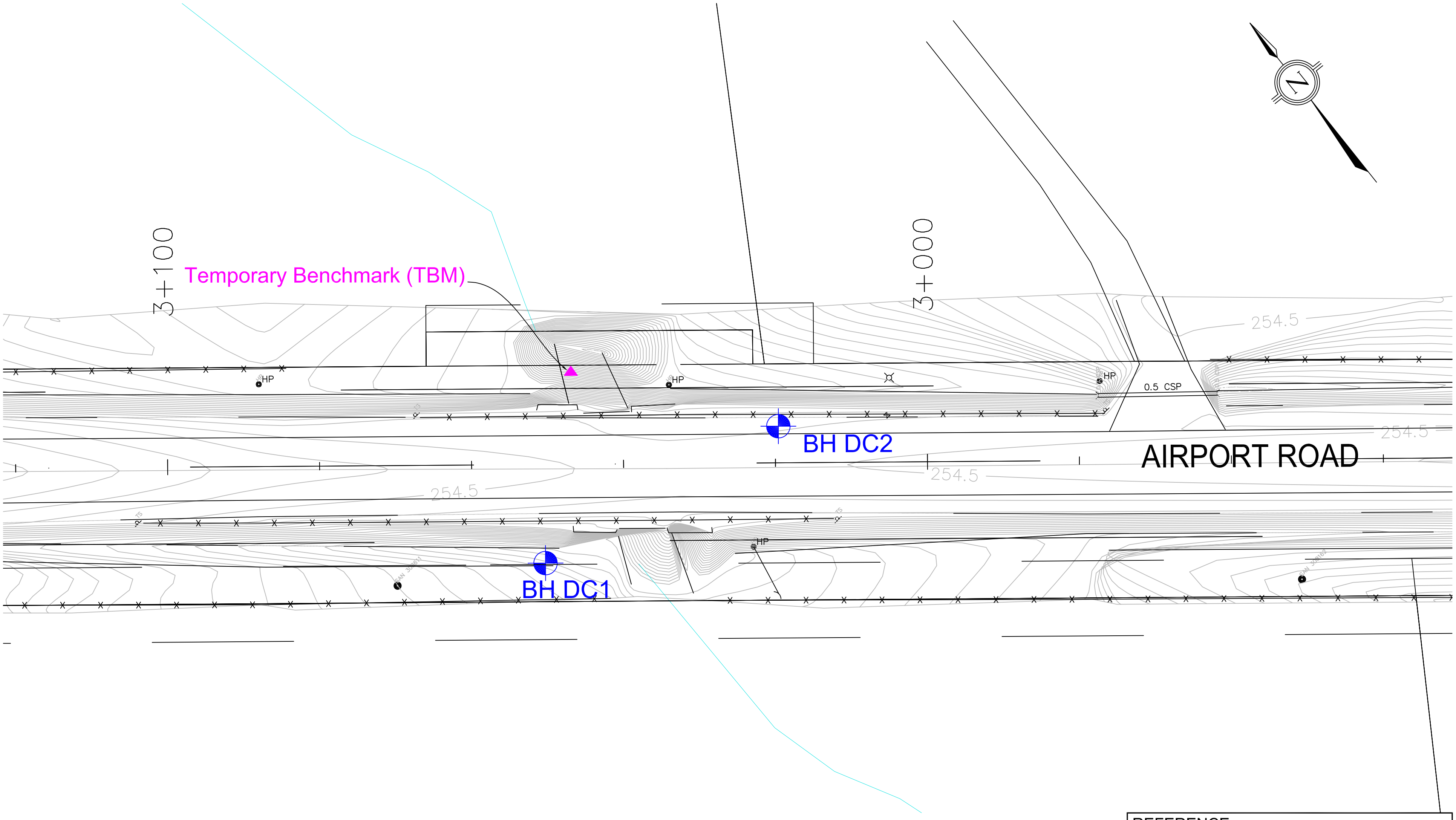
File No.

11-12-2096

FIGURE :

2

Z:\1-Project Files\11-Geo\2012\11-12-2001 - 2099\11-12-2096\A_Dwgs_Logs\AutoCAD\11-12-2096 BH Location Plan (Culverts MAY 2013).dwg, KAMAL



LEGEND

⊕ Borehole Location

▲ TBM (Elevation 100.0m)

REFERENCE

Base plans provided in digital format by IBI Group, drawing files Airport 12-4380 base plan .dgn, 12-4380 Preliminary Property Nov-11 .dgn, 12-4380 Airport Rd Title Plan .dgn, Airport 2d 03-4040 Contour .dgn.

SCALE 1:750

10 5 0 5 10 15 20m

Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

DEANS CULVERT
(Borehole Location Plan)

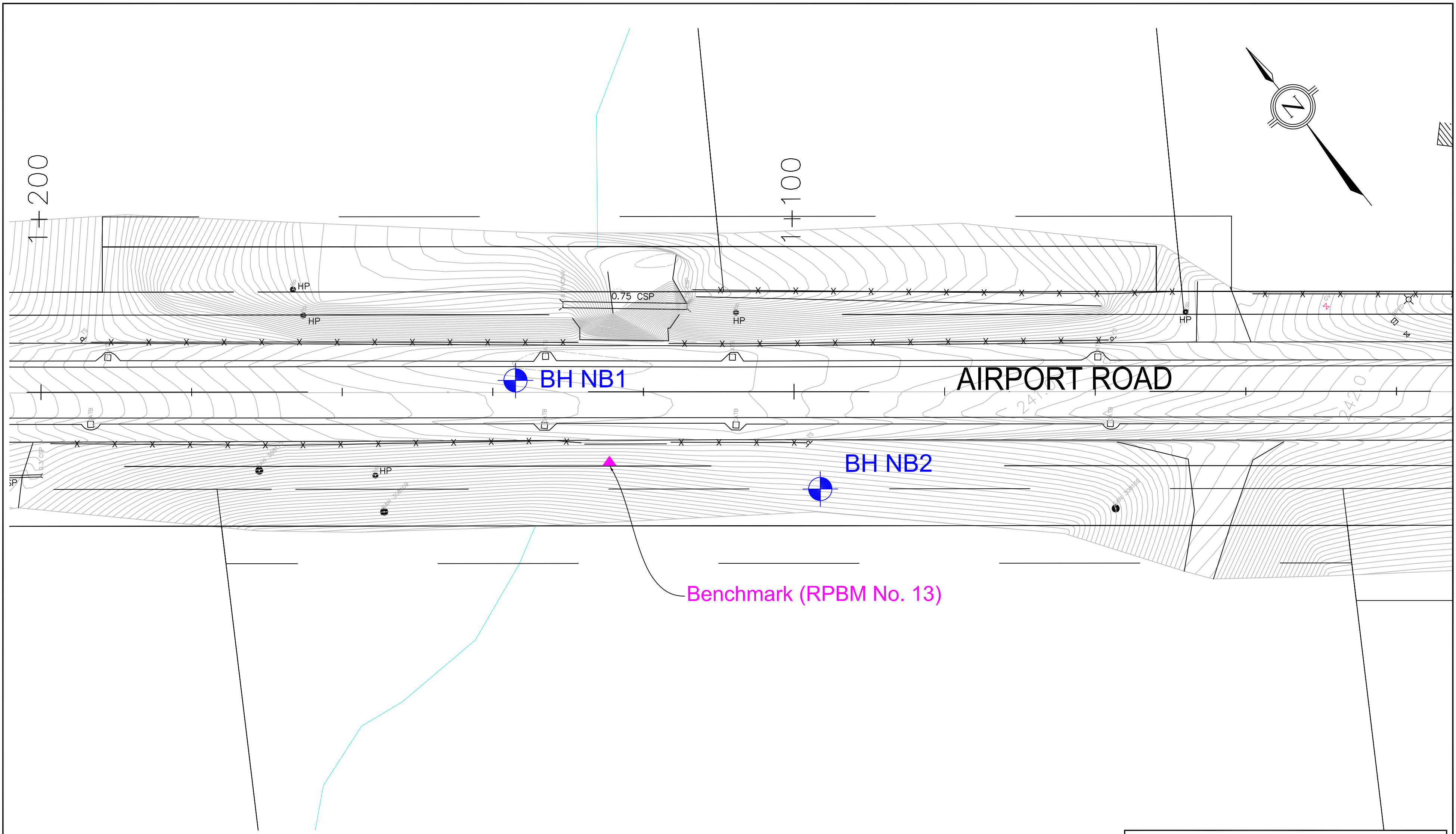
File No.

11-12-2096

FIGURE :

3

Z:\1-Project Files\11-Geo\2012\11-12-2001 - 2099\11-12-2096\A. Dwgs, Logs\AutoCAD\11-12-2096 BH Location Plan (Culverts MAY 2013).dwg, KAMAL



LEGEND
- ⌖ Borehole Location
- ▲ BM (Elevation 239.716m)

REFERENCE
Base plans provided in digital format by IBI Group,
drawing files Airport 12-4380 base plan .dgn,
12-4380 Preliminary Property Nov-11 .dgn,
12-4380 Airport Rd Title Plan .dgn,
Airport 2d 03-4040 Contour .dgn.

SCALE 1:750
10 5 0 5 10 15 20m

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:
NORRIS BRIDGE
(Borehole Location Plan)

File No.
11-12-2096

FIGURE :
4

Z:\1-Project Files\11-Geo\2012\11-12-2001 - 2099\11-12-2096\A_Dwgs, Logs\AutoCAD\11-12-2096 BH Location Plan (Culverts MAY 2013).dwg, KAMAL

APPENDIX A

TERRAPROBE INC.

ABBREVIATIONS AND TERMINOLOGY

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silt*y*	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	Unstabilized water level
⧨	1st water level measurement
⧩	2nd water level measurement
▼	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

Terraprobe

BOREHOLE LOG SC1

Client	: IBI Group	Project No.:	11-12-2096
Project	: Airport Road Class EA	Date started :	November 28, 2012
Location	: Peel Region, Ontario	Sheet No. :	1 of 2

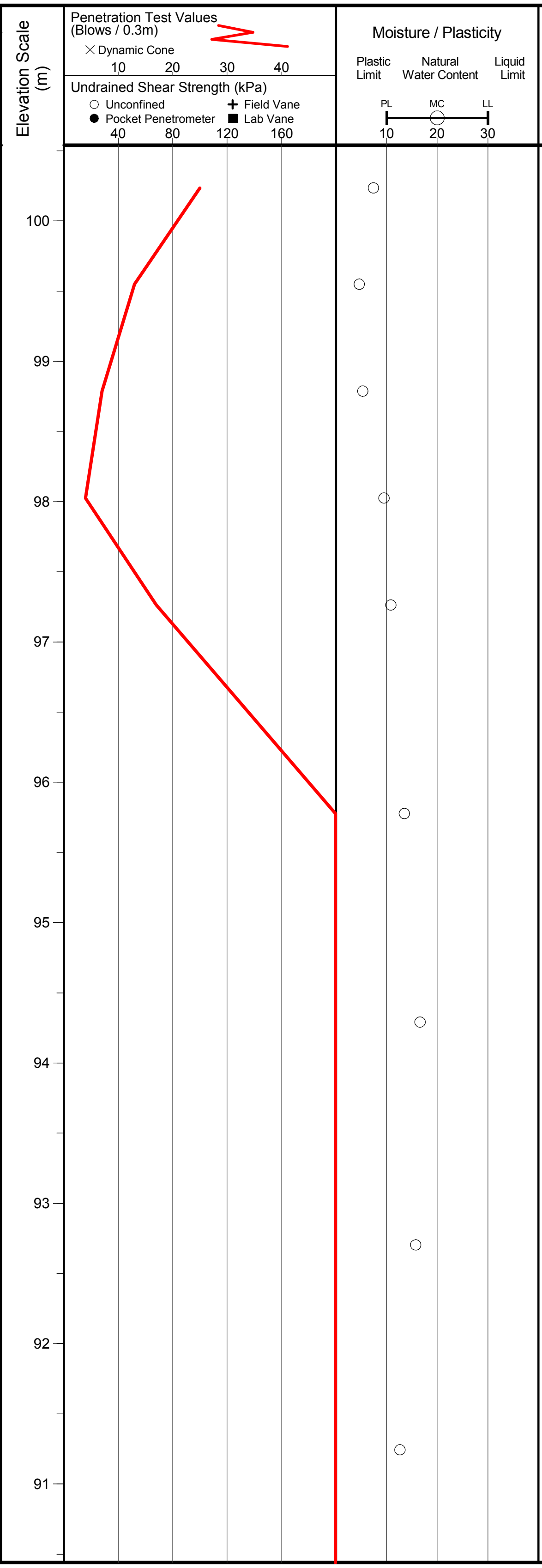
Position :		Elevation Datum : Local	
Rig type : CME 75		Drilling Method : Solid stem augers	Station : 3+460

SOIL PROFILE

Elev Depth (m)	Description	Graphic Log
100.5	**GROUND SURFACE**	
100.3 0.2	150mm **ASPHALTIC CONCRETE**	
100.0 0.5	**FILL**, sand, some gravel, trace silt, compact, brown, moist	
	FILL, sand, some silt, trace gravel, loose to compact, brown, moist	
97.6 2.9	**CLAYEY SILT**, trace to some gravel, brown to 4.0m, grey below, very stiff to hard, moist (GLACIAL TILL)	

SAMPLES

Number	Type	SPT 'N' Value	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (USCS) GR SA SI&CL
1	SS	25				
2	SS	13				
3	SS	7				
4	SS	4				...at 2.3m, sampler was wet
5	SS	17				
6	SS	90 / 225mm				
7	SS	50 / 150mm				
8	SS	95 / 275mm				
9	SS	50 / 150mm				



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library: library - terraprobe gint.glb **report:** terraprobe soil log **file:** 11-12-2096 culvert (deep bh).gpj

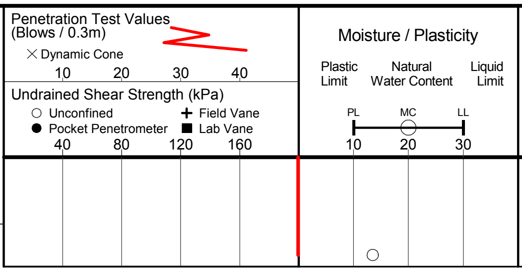
BOREHOLE LOG SC1

Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario

Project No.: 11-12-2096
Date started : November 28, 2012
Sheet No. : 2 of 2

Position :
Rig type : CME 75
Elevation Datum : Local
Drilling Method : Solid stem augers
Station : 3+460

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
		(continued)					
		CLAYEY SILT, trace to some gravel, brown to 4.0m, grey below, very stiff to hard, moist (GLACIAL TILL) *(continued)*	▨	10	SS	50 / 150mm	90
11	89.7 10.8	**END OF BOREHOLE** Wet cave at 2.5m below ground surface upon completion of drilling.					



Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (USCS) GR SA SI&CL

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BOREHOLE LOG SC2

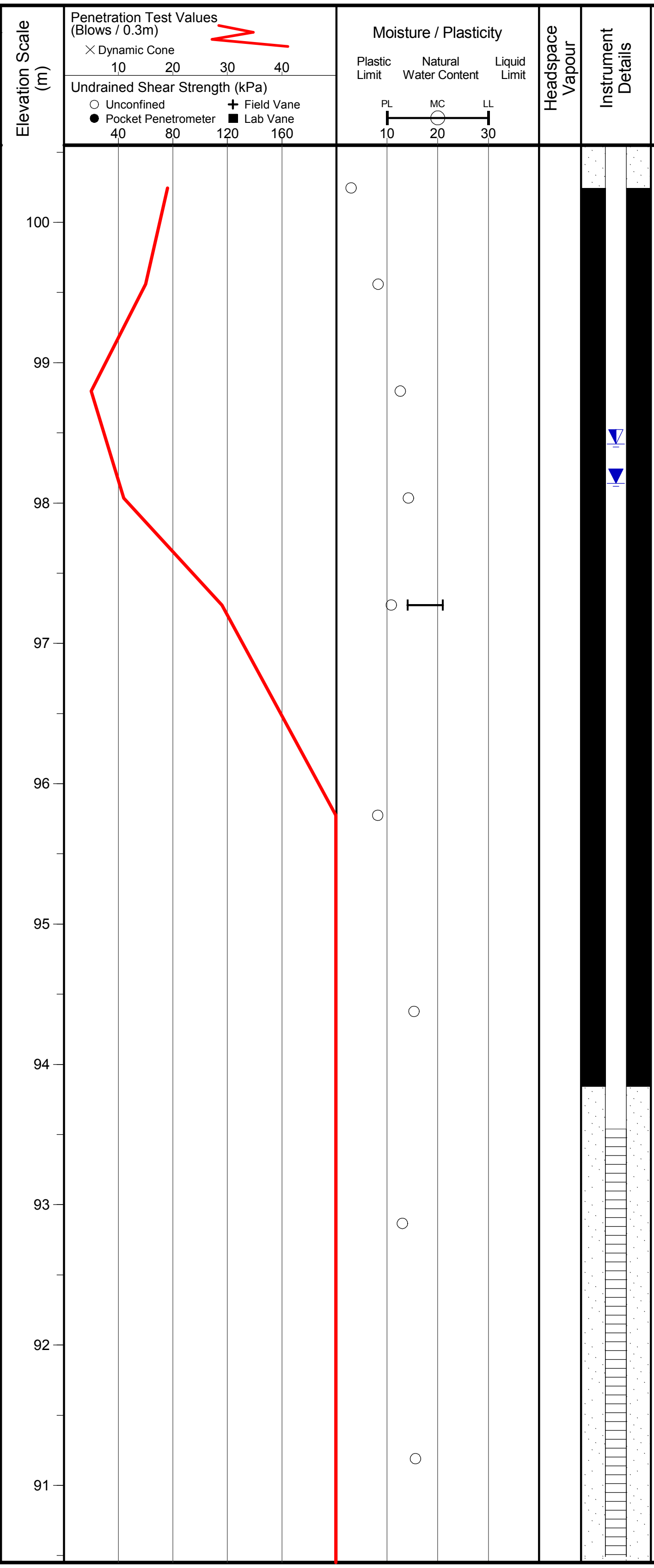
Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario

Project No.: 11-12-2096
Date started : November 29, 2012
Sheet No. : 1 of 2

Position :
Rig type : CME 75
Elevation Datum : Local
Drilling Method : Solid stem augers
Station : 3+420

Elev Depth (m)	Description	Graphic Log
100.6	**GROUND SURFACE**	
	FILL, sand, some gravel, trace silt, compact, brown, moist	▨
100.2 0.4	**FILL**, clayey silt, some sand, trace gravel, firm to stiff, greyish brown, moist	▨
97.7 2.9	**CLAYEY SILT**, trace to some gravel, sandy to 4.0m, brown to 4.0m, grey below, containing cobbles, very stiff to hard, grey, moist (GLACIAL TILL)	

Number	Type	SPT 'N' Value	Comments	GR	SA	SI&CL
1	SS	19				
2	SS	15				
3	SS	5	no recovery for sample SS3, resampling was attempted			
4	SS	11				
5	SS	29		10	27	63
6	SS	85 / 250mm				
7	SS	50 / 150mm				
8	SS	50 / 125mm				
9	SS	88 / 275mm				



Depth Scale (m): 0 1 2 3 4 5 6 7 8 9 10

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (USCS)
GR SA SI&CL

(continued next page)

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Terraprobe

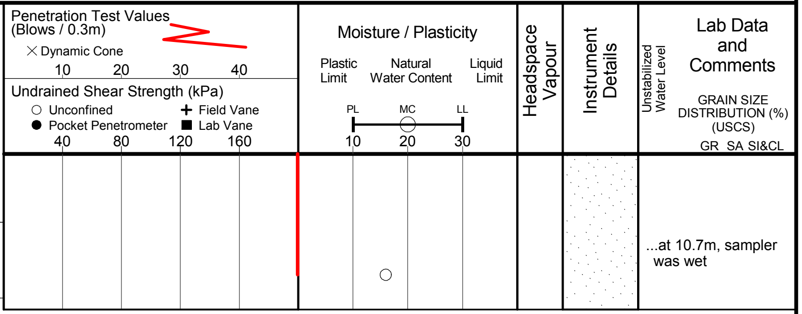
BOREHOLE LOG SC2

Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario

Project No.: 11-12-2096
Date started : November 29, 2012
Sheet No. : 2 of 2

Position :
Rig type : CME 75
Elevation Datum : Local
Drilling Method : Solid stem augers
Station : 3+420

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description *(continued)*	Number	Type	SPT 'N' Value	Elevation Scale (m)	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (USCS) GR SA SI&CL
		CLAYEY SILT, trace to some gravel, sandy to 4.0m, brown to 4.0m, grey below, containing cobbles, very stiff to hard, grey, moist (GLACIAL TILL) *(continued)*				90	
11	89.5 11.1		10	SS	86		...at 10.7m, sampler was wet



END OF BOREHOLE

Piezometer installation consists of a 50mm diameter Schedule 40 PVC pipe with a 3m slotted screen.
Increased resistance to augering at 3.0m and from 3.9m to 4.6m below ground surface.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Dec 17, 2012	2.1	98.4
Jan 7, 2013	2.4	98.1

BOREHOLE LOG DC1

Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario

Project No.: 11-12-2096
Date started : November 30, 2012
Sheet No. : 1 of 2

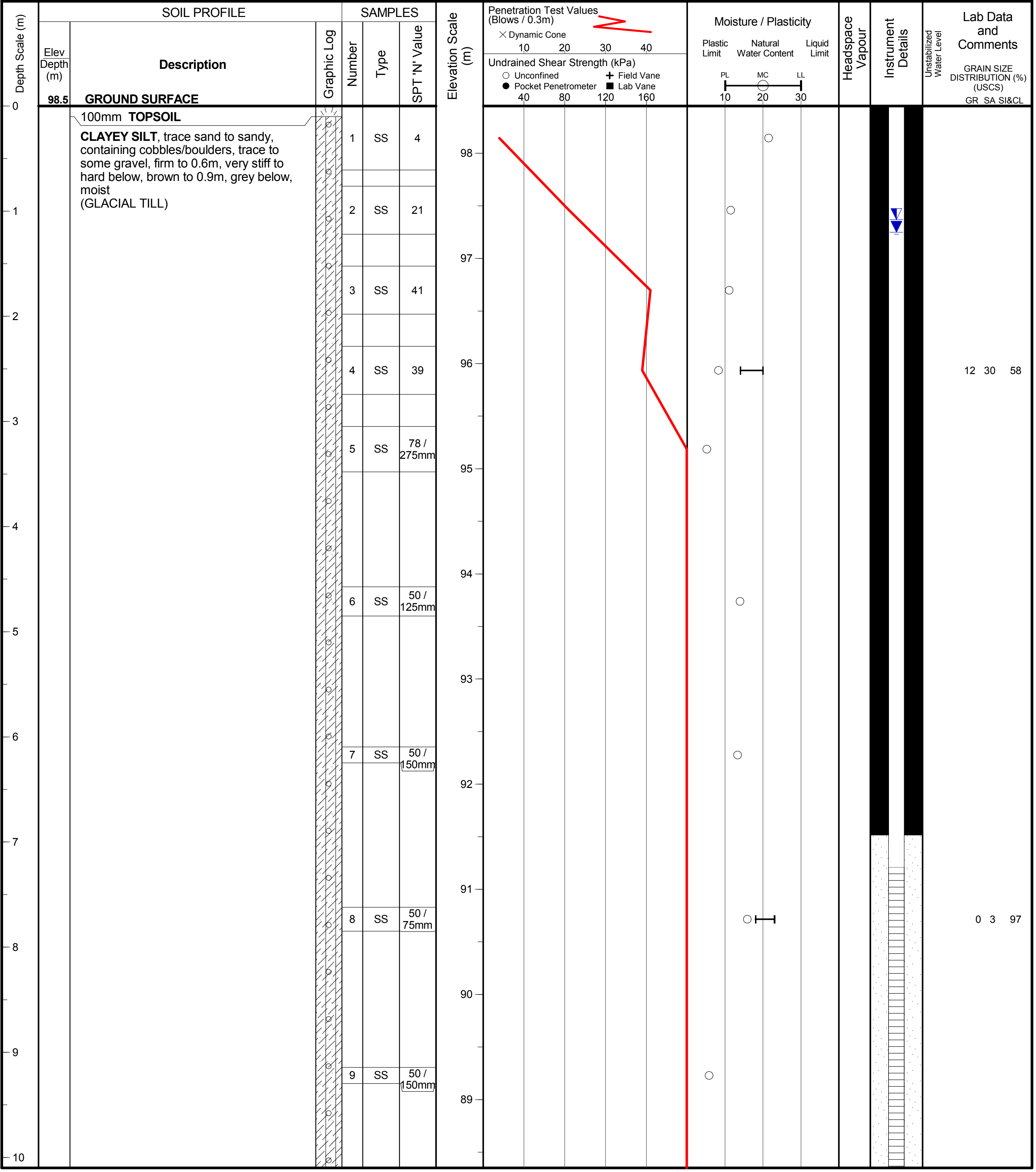
Position :
Rig type : CME 75, track-mounted
Elevation Datum : Local
Drilling Method : Solid stem augers
Station : 3+060

SOIL PROFILE

Elev Depth (m)	Description
98.5	**GROUND SURFACE**
	100mm **TOPSOIL**
	CLAYEY SILT, trace sand to sandy, containing cobbles/boulders, trace to some gravel, firm to 0.6m, very stiff to hard below, brown to 0.9m, grey below, moist (GLACIAL TILL)

SAMPLES

Number	Type	SPT 'N' Value	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (USCS) GR SA SI&CL
1	SS	4	
2	SS	21	
3	SS	41	
4	SS	39	12 30 58
5	SS	78 / 275mm	
6	SS	50 / 125mm	
7	SS	50 / 150mm	
8	SS	50 / 75mm	0 3 97
9	SS	50 / 150mm	



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Terraprobe

BOREHOLE LOG DC1

Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario

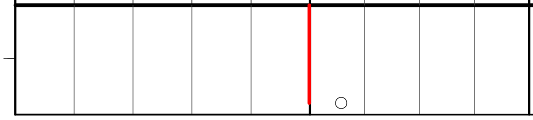
Project No.: 11-12-2096
Date started : November 30, 2012
Sheet No. : 2 of 2

Position :
Rig type : CME 75, track-mounted

Elevation Datum : Local
Drilling Method : Solid stem augers

Station : 3+060

Depth Scale (m)	Elev Depth (m)	Description *(continued)*	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40 / Undrained Shear Strength (kPa) ○ Unconfined ✚ Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160	Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit (PL MC LL) 10 20 30	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (USCS) GR SA SI&CL
	87.7 10.8			10	SS	50 / 150mm	88		○				11 36 53
11													



END OF BOREHOLE

Unstabilized water level measured at 10.2m below ground surface; borehole caved at 10.3m below ground surface upon completion of drilling.
Piezometer installation consists of a 50mm diameter Schedule 40 PVC pipe with a 3m slotted screen.
Increased resistance to augering at 3.3m and from 8.0m to 9.1m below ground surface.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Dec 17, 2012	1.1	97.4
Jan 7, 2013	1.2	97.3

BOREHOLE LOG DC2

Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario

Project No.: 11-12-2096
Date started : November 28, 2012
Sheet No. : 1 of 2

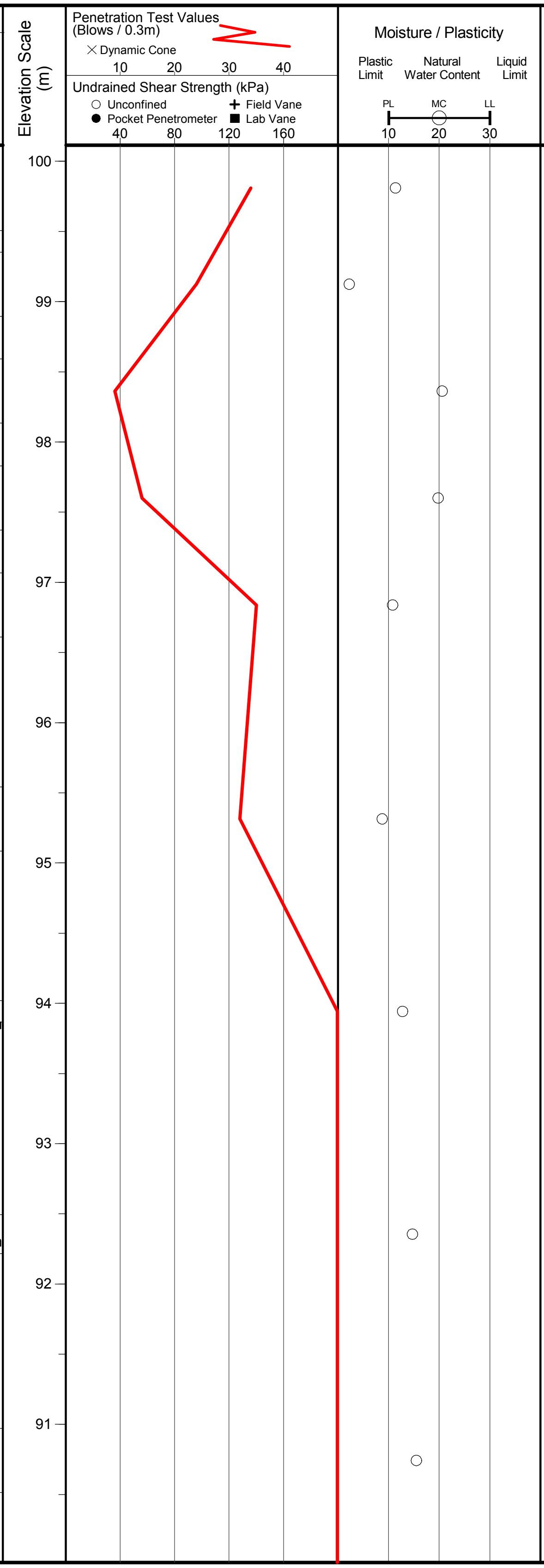
Position :
Rig type : CME 75, track-mounted
Elevation Datum : Local
Drilling Method : Solid stem augers
Station : 3+020

SOIL PROFILE

Elev Depth (m)	Description
100.1	**GROUND SURFACE**
99.9 0.2	180mm **ASPHALTIC CONCRETE**
99.7 0.4	**FILL**, sand, some gravel, trace silt, dense, brown, moist
	FILL, sand, some gravel, compact, brown, moist
98.7 1.4	**FILL**, clayey silt, trace gravel, trace sand, stiff, greyish brown, moist
97.5 2.6	**CLAYEY SILT**, trace sand to sandy, trace to some gravel, brown to 5.5m, grey below, hard, moist (GLACIAL TILL)

SAMPLES

Number	Type	SPT 'N' Value
1	SS	34
2	SS	24
3	SS	9
4	SS	14
5	SS	35
6	SS	32
7	SS	50 / 150mm
8	SS	50 / 125mm
9	SS	94



Depth Scale (m): 0 1 2 3 4 5 6 7 8 9 10

Headspace Vapour

Instrument Details

Unstabilized Water Level ▽

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (USCS)
GR SA SI&CL

(continued next page)

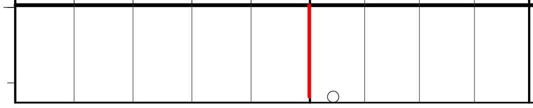
Terraprobe

BOREHOLE LOG DC2

Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario

Project No.: 11-12-2096
Date started : November 28, 2012
Sheet No. : 2 of 2

Position :
Rig type : CME 75, track-mounted
Elevation Datum : Local
Drilling Method : Solid stem augers
Station : 3+020

	SOIL PROFILE			SAMPLES									
Depth Scale (m)	Elev Depth (m)	Description *(continued)*	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40 Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160	Moisture / Plasticity Plastic Limit Natural Water Content Liquid Limit PL MC LL 10 20 30	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (USCS) GR SA SI&CL
		CLAYEY SILT, trace sand to sandy, trace to some gravel, brown to 5.5m, grey below, hard, moist (GLACIAL TILL) *(continued)*					90						
	89.4 10.7			10	SS	50 / 75mm							...at 10.7m, sampler was wet
11		**END OF BOREHOLE** Unstabilized water level measured at 8.8m below ground surface; borehole caved at 10.7m below ground surface upon completion of drilling. Increased resistance to augering from 10.3m to 10.7m below ground surface.											

Terraprobe

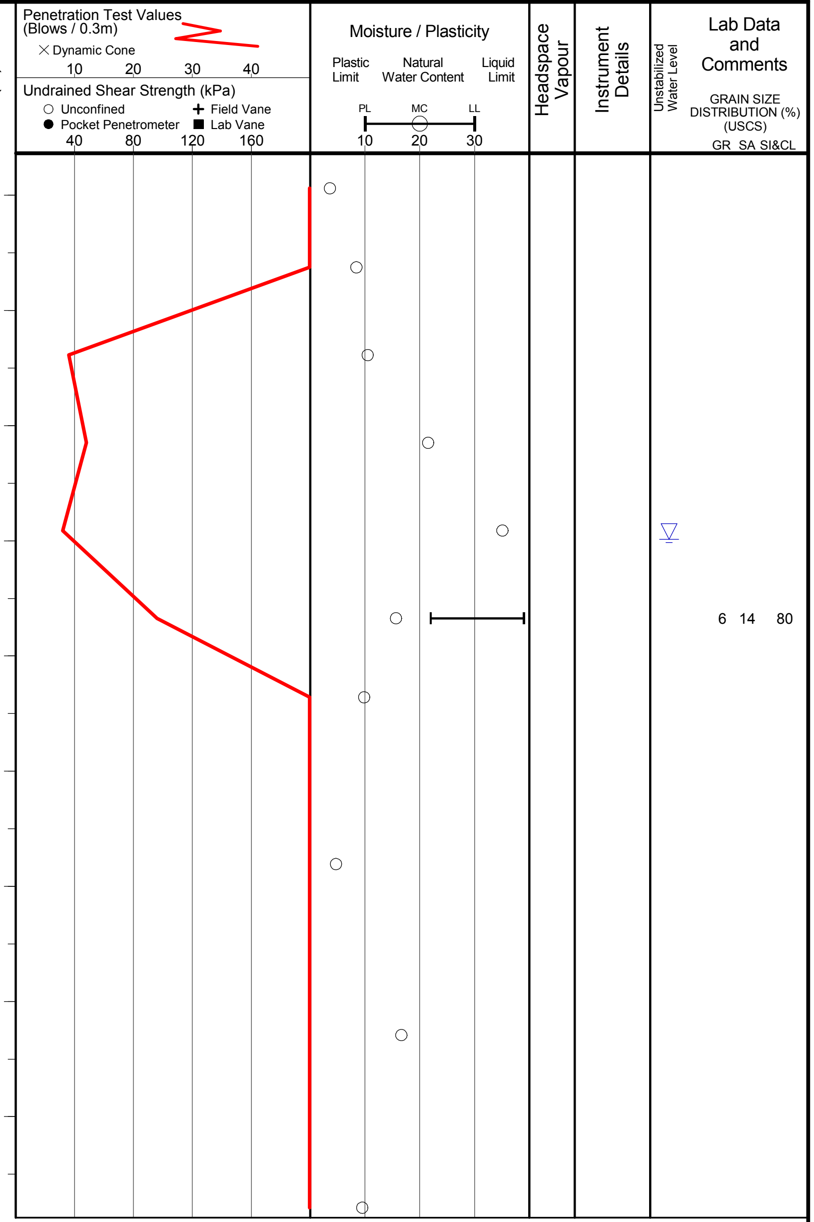
BOREHOLE LOG NB1

Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario

Project No.: 11-12-2096
Date started : November 29, 2012
Sheet No. : 1 of 1

Position :
Rig type : CME 75
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers
Station : 1+140

Elev Depth (m)	Description	Number	Type	SPT 'N' Value	GR SA SI&CL
240.4	**GROUND SURFACE**				
240.2 0.2	180mm **ASPHALTIC CONCRETE**				
240.0 0.4	**FILL**, sand, some gravel, some silt, very dense, brown, moist	1	SS	101	
	FILL, sand, some gravel, very dense, brown, moist	2	SS	73	
238.7 1.7	**FILL**, clayey silt, trace gravel, trace sand, trace organics, stiff, grey, moist	3	SS	9	
		4	SS	12	
	...some organics	5	SS	8	
236.7 3.7	**SILTY CLAY**, some sand, trace gravel, containing shale fragments, very stiff to hard, grey, moist	6	SS	24	6 14 80
		7	SS	100 / 150mm	
235.0 5.4	Inferred Shale Bedrock (Georgian Bay Formation), grey	8	SS	100 / 150mm	
		9	SS	100 / 75mm	
231.2 9.2		10	SS	100 / 25mm	



END OF BOREHOLE

Borehole was moved from shoulder to south bound lane because of pavement heaving at the original locations.
Borehole terminated at 9.2m because of auger refusal.
Unstabilized water level measured at 3.4m below ground surface; borehole caved to 5.8m below ground surface upon completion of drilling.
Increased resistance to augering from 4.8m to 5.5m and at 8.5m.

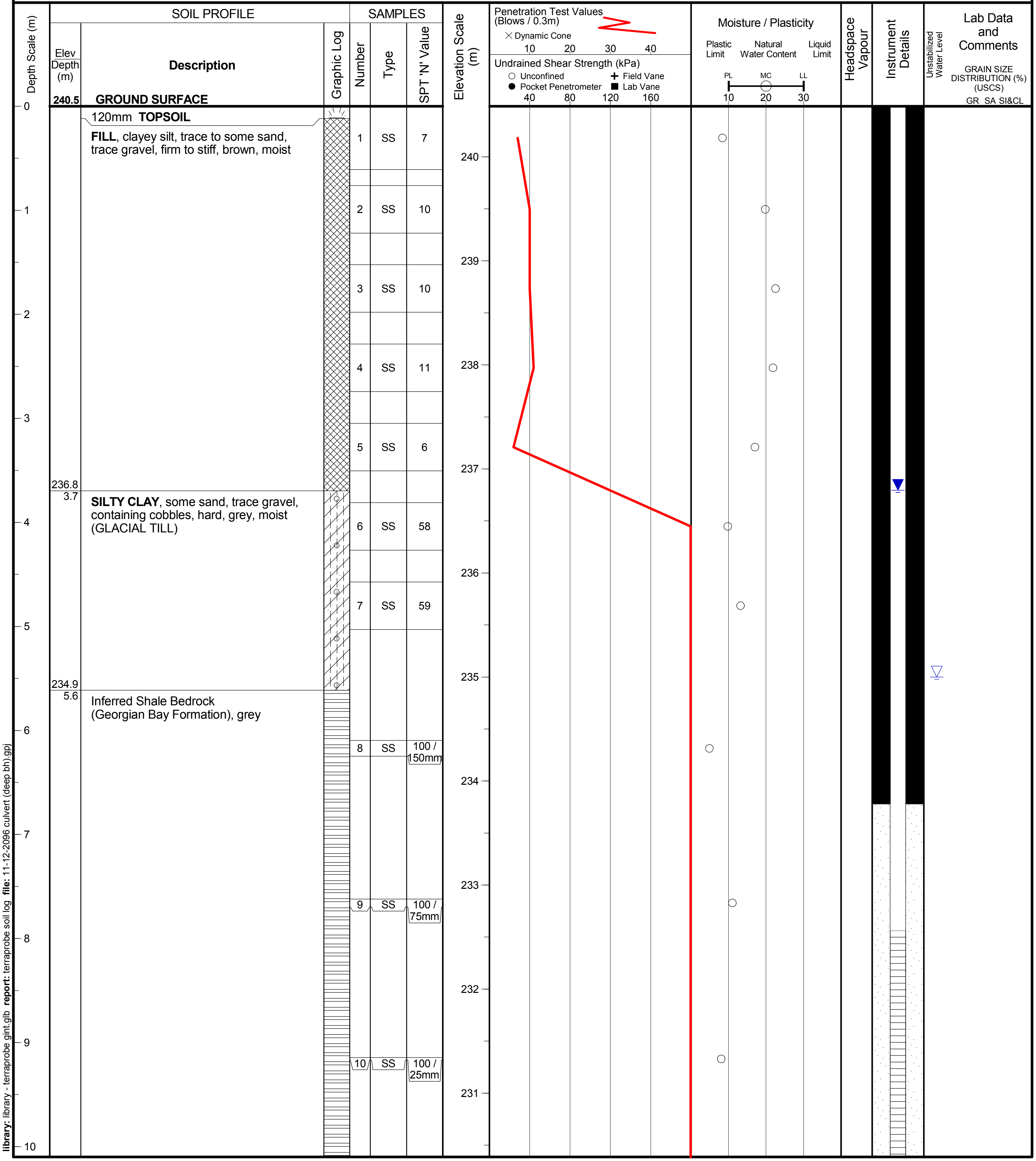
Terraprobe

BOREHOLE LOG NB2

Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario
Project No.: 11-12-2096
Date started : November 30, 2012
Sheet No. : 1 of 2

Position :
Rig type : CME 75, track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers
Station : 1+100

Elev Depth (m)	Description	Number	Type	SPT 'N' Value
240.5	**GROUND SURFACE**			
	120mm **TOPSOIL**			
	FILL, clayey silt, trace to some sand, trace gravel, firm to stiff, brown, moist	1	SS	7
		2	SS	10
		3	SS	10
		4	SS	11
		5	SS	6
236.8 3.7	**SILTY CLAY**, some sand, trace gravel, containing cobbles, hard, grey, moist (GLACIAL TILL)	6	SS	58
		7	SS	59
234.9 5.6	Inferred Shale Bedrock (Georgian Bay Formation), grey	8	SS	100 / 150mm
		9	SS	100 / 75mm
		10	SS	100 / 25mm



(continued next page)

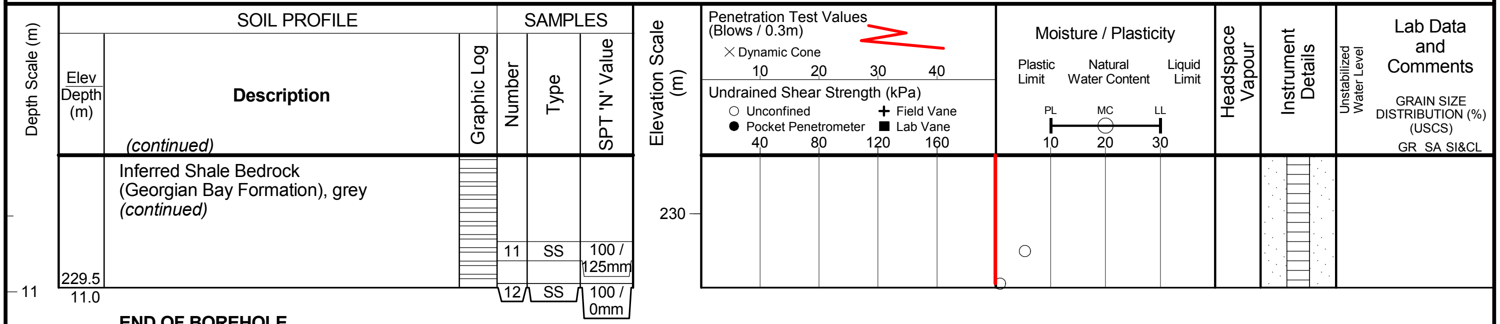
library: library - terraprobe gint.glb report: terraprobe soil log file: 11-12-2096 culvert (deep bh).gpj

BOREHOLE LOG NB2

Client : IBI Group
Project : Airport Road Class EA
Location : Peel Region, Ontario

Project No.: 11-12-2096
Date started : November 30, 2012
Sheet No. : 2 of 2

Position :
Rig type : CME 75, track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers
Station : 1+100



Inferred Shale Bedrock (Georgian Bay Formation), grey *(continued)*

Elev Depth (m)	Number	Type	SPT 'N' Value
	11	SS	100 / 125mm
229.5 11.0	12	SS	100 / 0mm

END OF BOREHOLE

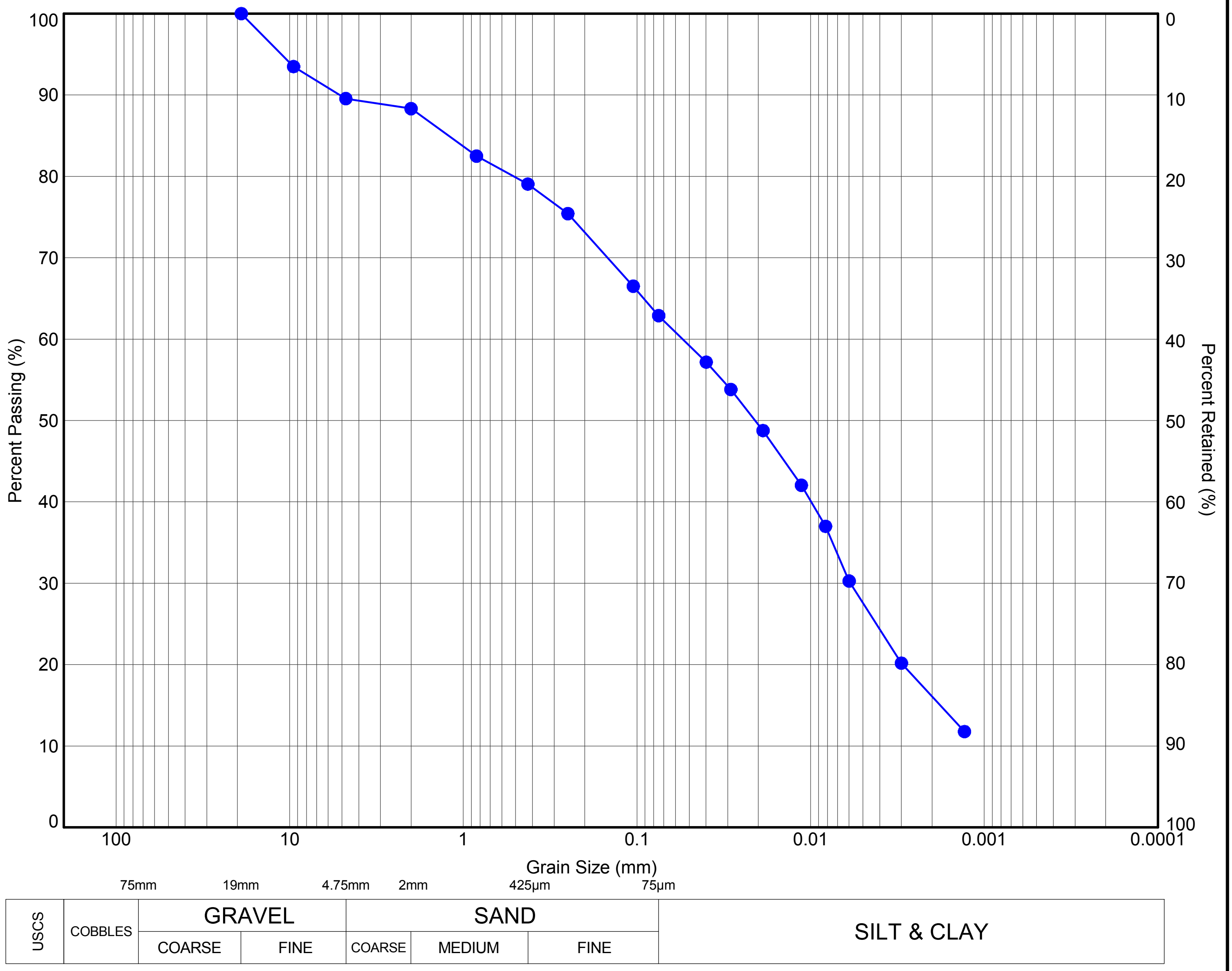
Unstabilized water level measured at 5.5m below ground surface. Borehole terminated at 11.0m because of auger refusal.
Piezometer installation consists of a 50mm diameter Schedule 40 PVC pipe with a 3m slotted screen.
Increased resistance to augering from 5.1m to 5.8m and from 6.0m to 10.7m below grade surface.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Dec 17, 2012	3.7	236.8
Jan 7, 2013	3.7	236.8

APPENDIX B

TERRAPROBE INC.



UNIFIED SOIL CLASSIFICATION SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt & Clay (%)	Sample Description
●	**SC2**	SS5	3.3	97.3	10	27	63	

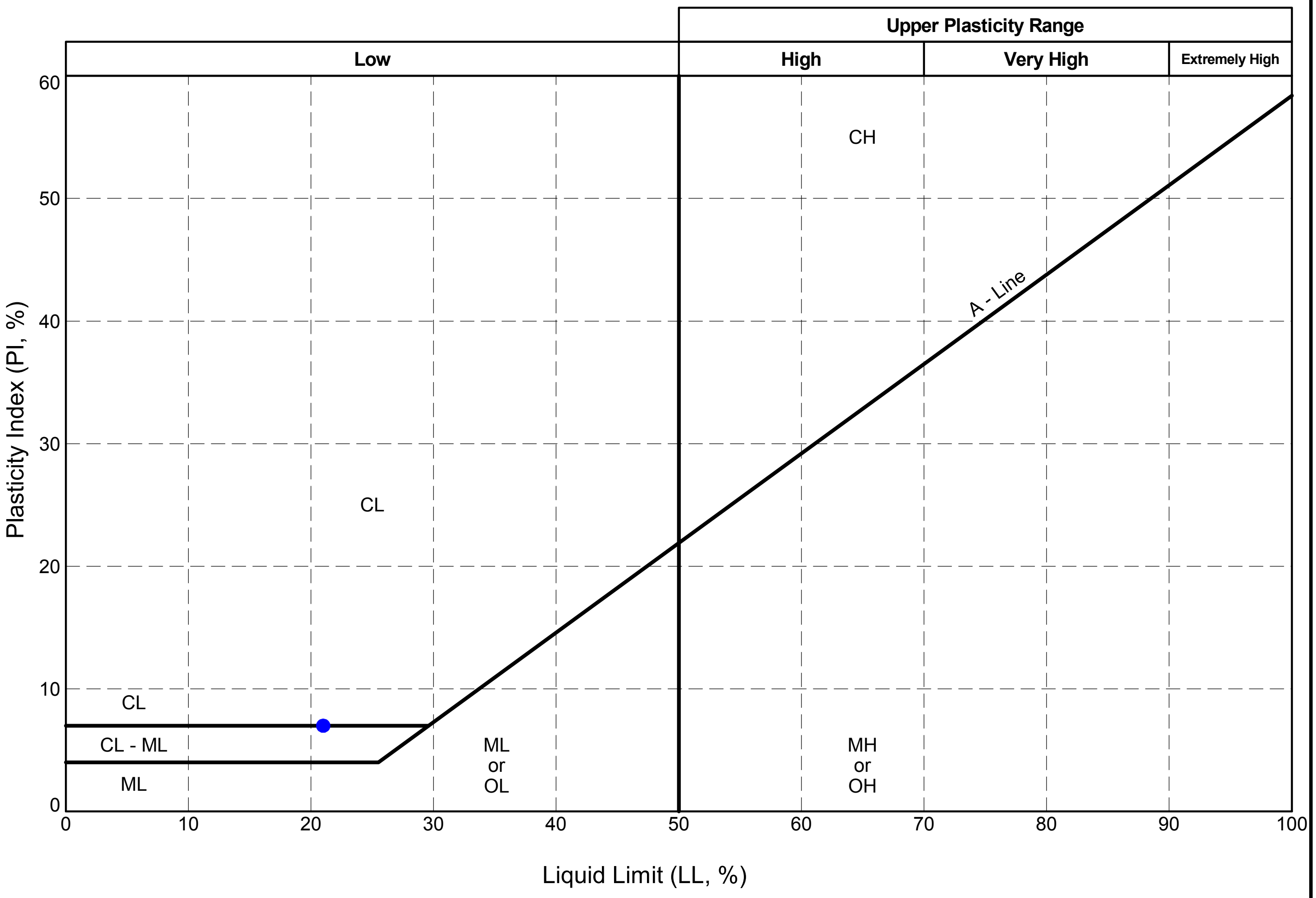
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
FIGURE B1 - CLAYEY SILT TILL

File No.: **11-12-2096**



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)	USCS Description
●	SC2	SS5	3.3	97.3	21	14	7	

Terraprobe

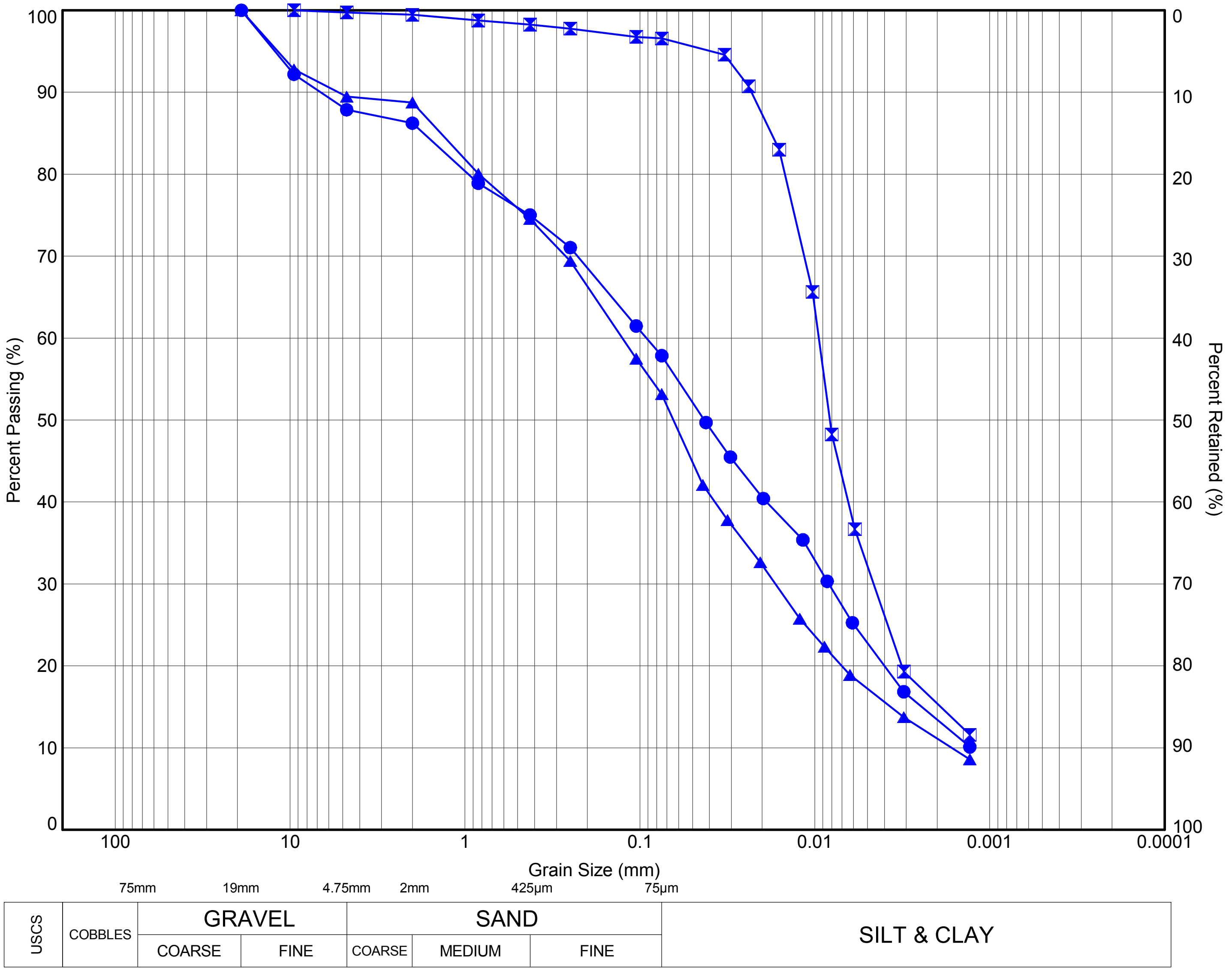
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

ATTERBERG LIMITS TEST RESULTS
FIGURE B2 - CLAYEY SILT TILL

File No.:

11-12-2096



UNIFIED SOIL CLASSIFICATION SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt & Clay (%)	Sample Description
●	**DC1**	SS4	2.5	95.9	12	30	58	
☒	**DC1**	SS8	7.7	90.7	0	3	97	
▲	**DC1**	SS10	10.7	87.7	11	36	53	

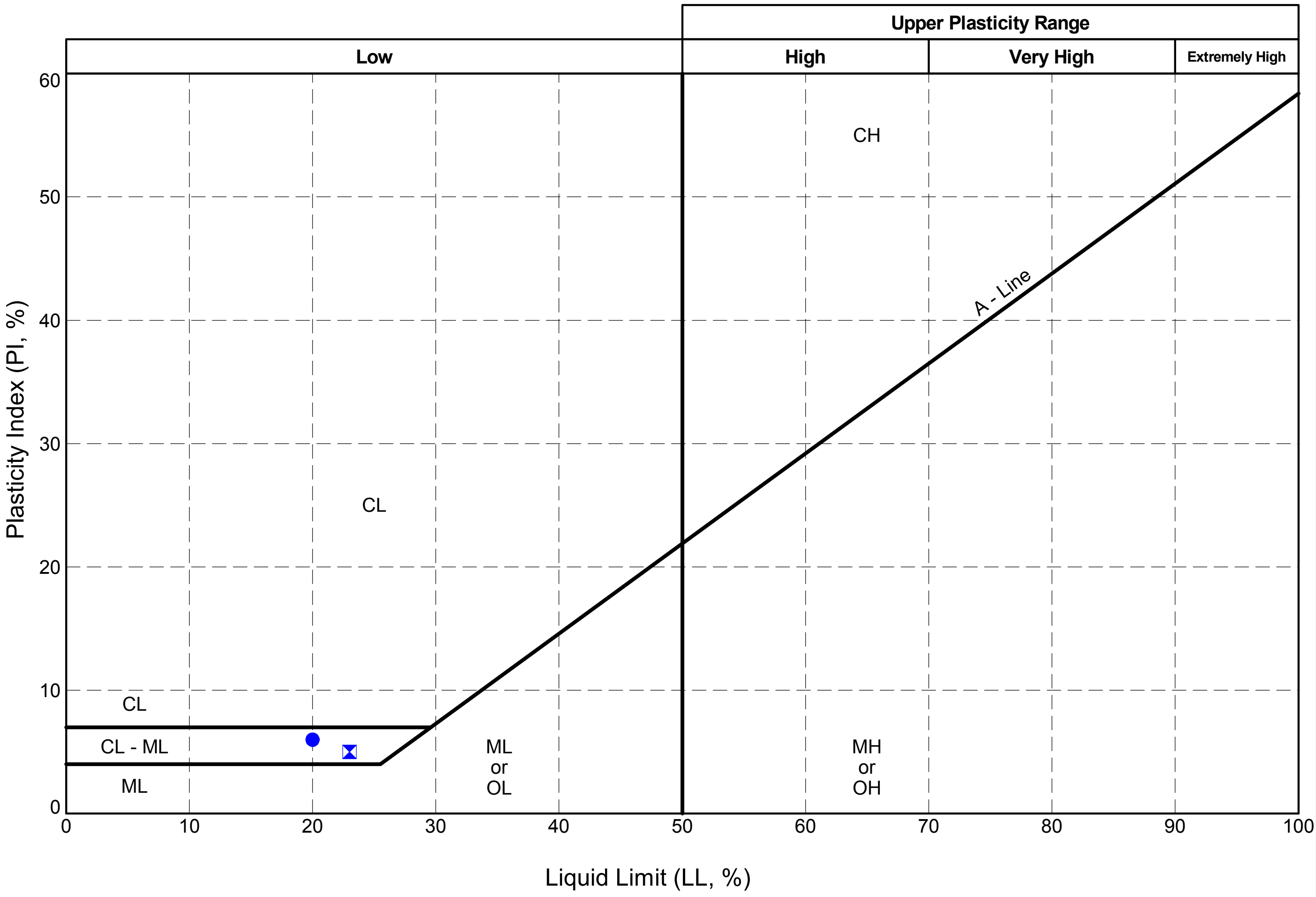
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
FIGURE B3 - CLAYEY SILT TILL

File No.: **11-12-2096**



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)	USCS Description
●	DC1	SS4	2.5	95.9	20	14	6	
⧗	DC1	SS8	7.7	90.7	23	18	5	

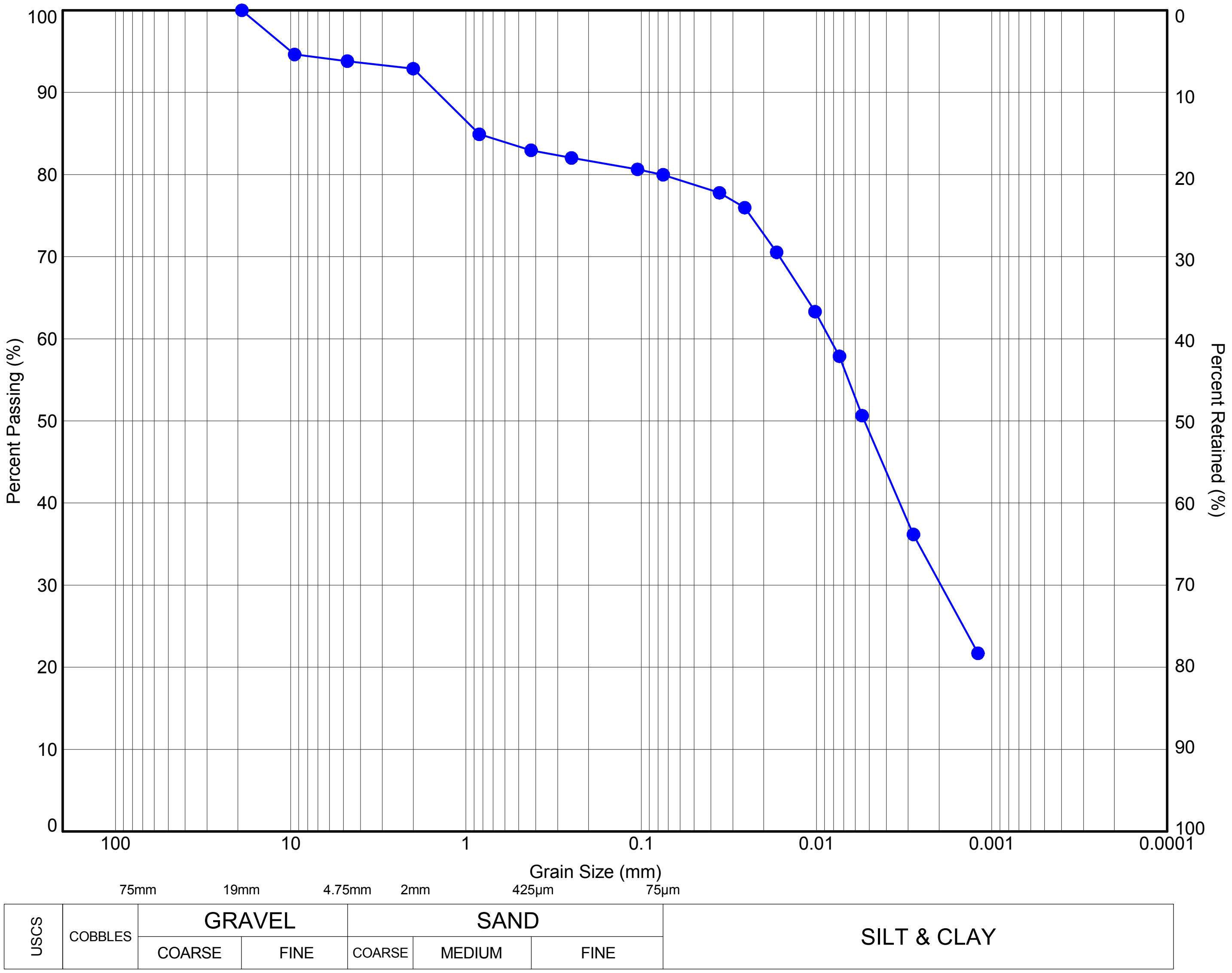
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

ATTERBERG LIMITS TEST RESULTS
FIGURE B4 - CLAYEY SILT TILL

File No.: **11-12-2096**



UNIFIED SOIL CLASSIFICATION SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt & Clay (%)	Sample Description
●	**NB1**	SS6	4.0	236.3	6	14	80	

Terraprobe

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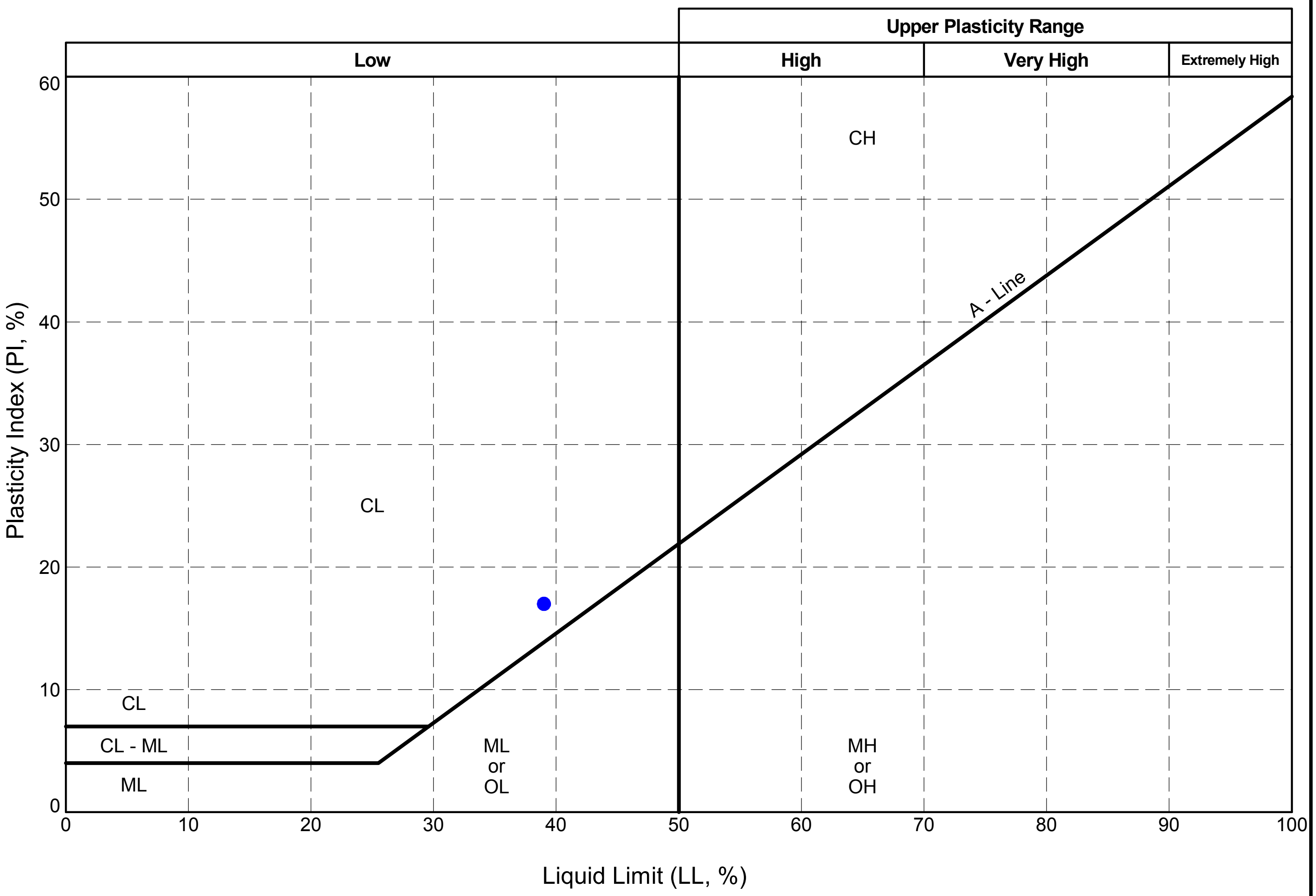
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
FIGURE B5 - SILTY CLAY TILL

File No.:

11-12-2096



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)	USCS Description
●	NB1	SS6	4.0	236.3	39	22	17	

Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

ATTERBERG LIMITS TEST RESULTS
FIGURE B6 - SILTY CLAY TILL

File No.: **11-12-2096**

APPENDIX C

TERRAPROBE INC.

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TERRAPROBE INC.
11 INDELL LANE
BRAMPTON, ON L6T3Y3
(905) 796-2650

ATTENTION TO: Hussein Ahmed

PROJECT NO: 11-12-2096

AGAT WORK ORDER: 13T690568

SOIL ANALYSIS REVIEWED BY: Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab Supervisor

DATE REPORTED: Feb 27, 2013

PAGES (INCLUDING COVER): 6

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Certificate of Analysis

AGAT WORK ORDER: 13T690568
PROJECT NO: 11-12-2096

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Hussein Ahmed

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2013-02-21

DATE REPORTED: 2013-02-27

Parameter	Unit	G / S	RDL								
		SAMPLE DESCRIPTION:		DC-1 SS-1(0'-2')	SC-2 SS-2(2'-4')	NB-1 SS-2(2'-4')	BH-1P SS-2(4'-6')	BH-3 SS-1(0'-2')	BH-6 SS-1(0'-3')	BH-9 SS-1(0'-3')	BH-12 SS-1(0'-3')
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2/20/2013	2/20/2013	2/20/2013	2/20/2013	2/20/2013	2/20/2013	2/20/2013	2/20/2013
				4148046	4148053	4148054	4148055	4148056	4148057	4148058	4148059
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	6	4	4	5	6	6	4	4
Barium	µg/g	220	2	94	51	77	124	112	118	84	102
Beryllium	µg/g	2.5	0.5	0.8	<0.5	<0.5	1.1	0.9	1.0	0.7	0.9
Boron	µg/g	36	5	7	<5	6	9	8	8	7	7
Boron (Hot Water Soluble)	µg/g		0.10	0.37	0.17	0.19	0.19	0.33	0.36	0.25	0.36
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	2	21	8	10	32	25	27	20	25
Cobalt	µg/g	21	0.5	9.5	4.6	5.6	13.4	11.7	11.8	8.7	11.0
Copper	µg/g	92	1	28	24	36	27	29	31	27	23
Lead	µg/g	120	1	22	9	20	13	158	11	44	19
Molybdenum	µg/g	2	0.5	0.7	<0.5	<0.5	<0.5	0.6	1.1	0.5	<0.5
Nickel	µg/g	82	1	19	8	11	29	24	28	16	21
Selenium	µg/g	1.5	0.4	0.6	<0.4	<0.4	0.6	0.5	<0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	0.6	<0.5	<0.5	0.8	0.5	0.8	<0.5	0.7
Vanadium	µg/g	86	1	31	14	18	43	36	37	29	38
Zinc	µg/g	290	5	67	36	91	76	77	60	68	65
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10	<0.10	0.78	<0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.441	0.605	1.17	4.44	1.05	2.33	0.452	0.810
Sodium Adsorption Ratio	NA	2.4	NA	5.63	14.2	23.3	22.0	12.0	19.2	7.29	10.7
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.54	8.05	8.02	7.40	7.89	7.76	7.75	7.78

Certified By: Elizabeth Rolakowska

AGAT Laboratories

5835 COOPERS AVENUE
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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 13T690568
PROJECT NO: 11-12-2096

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Hussein Ahmed

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2013-02-21

DATE REPORTED: 2013-02-27

				BH-11	BH-16	BH-19	BH-22	BH-23	BH-26	BH-27
			SAMPLE DESCRIPTION:	SS-1(0'-3')	SS-1(0'-3')	SS-2(2'-4')	SS-1B(0'-2')	SS-2(3'-6')	SS-2(3'-6')	SS-1(0'-2')
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2/20/2013	2/20/2013	2/20/2013	2/20/2013	2/20/2013	2/20/2013	2/20/2013
Parameter	Unit	G / S	RDL	4148060	4148061	4148062	4148063	4148064	4148065	4148066
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	5	4	4	4	5	4	3
Barium	µg/g	220	2	110	138	127	117	99	110	25
Beryllium	µg/g	2.5	0.5	1.1	1.6	1.1	0.9	1.0	1.0	<0.5
Boron	µg/g	36	5	9	10	12	9	10	9	6
Boron (Hot Water Soluble)	µg/g		0.10	0.27	0.24	0.15	0.24	0.15	0.39	0.13
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	2	30	40	31	25	26	28	8
Cobalt	µg/g	21	0.5	12.4	17.3	14.9	10.0	12.6	14.0	3.7
Copper	µg/g	92	1	33	29	27	23	29	25	24
Lead	µg/g	120	1	16	14	12	13	12	25	7
Molybdenum	µg/g	2	0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5
Nickel	µg/g	82	1	28	46	32	22	28	25	7
Selenium	µg/g	1.5	0.4	<0.4	0.7	<0.4	<0.4	<0.4	0.5	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	0.6	0.7	0.6	0.6	0.6	0.6	<0.5
Vanadium	µg/g	86	1	41	50	42	32	35	40	11
Zinc	µg/g	290	5	70	84	65	60	60	91	26
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.831	0.473	0.834	2.52	1.28	1.72	0.734
Sodium Adsorption Ratio	NA	2.4	NA	8.92	6.15	1.34	35.9	4.04	11.5	13.1
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.90	7.97	7.79	7.98	7.82	7.60	8.08

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to T1(ALL) - Current

4148046-4148066 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Elizabeth Rolakowska

Certified By:

Guideline Violation

AGAT WORK ORDER: 13T690568

PROJECT NO: 11-12-2096

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Hussein Ahmed

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
4148046	DC-1 SS-1(0'-2')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	5.63
4148053	SC-2 SS-2(2'-4')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	0.605
4148053	SC-2 SS-2(2'-4')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	14.2
4148054	NB-1 SS-2(2'-4')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.17
4148054	NB-1 SS-2(2'-4')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	23.3
4148055	BH-1P SS-2(4'-6')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	4.44
4148055	BH-1P SS-2(4'-6')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	22.0
4148056	BH-3 SS-1(0'-2')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.05
4148056	BH-3 SS-1(0'-2')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Lead	120	158
4148056	BH-3 SS-1(0'-2')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Mercury	0.27	0.78
4148056	BH-3 SS-1(0'-2')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	12.0
4148057	BH-6 SS-1(0'-3')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	2.33
4148057	BH-6 SS-1(0'-3')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	19.2
4148058	BH-9 SS-1(0'-3')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	7.29
4148059	BH-12 SS-1(0'-3')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	0.810
4148059	BH-12 SS-1(0'-3')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	10.7
4148060	BH-11 SS-1(0'-3')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	0.831
4148060	BH-11 SS-1(0'-3')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	8.92
4148061	BH-16 SS-1(0'-3')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	6.15
4148062	BH-19 SS-2(2'-4')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	0.834
4148063	BH-22 SS-1B(0'-2')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	2.52
4148063	BH-22 SS-1B(0'-2')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	35.9
4148064	BH-23 SS-2(3'-6')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.28
4148064	BH-23 SS-2(3'-6')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	4.04
4148065	BH-26 SS-2(3'-6')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.72
4148065	BH-26 SS-2(3'-6')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	11.5
4148066	BH-27 SS-1(0'-2')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	0.734
4148066	BH-27 SS-1(0'-2')	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	13.1

AGAT Laboratories

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Quality Assurance

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 13T690568

PROJECT NO: 11-12-2096

ATTENTION TO: Hussein Ahmed

Soil Analysis

RPT Date: Feb 27, 2013			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	1	4148046	< 0.8	< 0.8	0.0%	< 0.8	101%	70%	130%	97%	80%	120%	98%	70%	130%
Arsenic	1	4148046	6	6	0.0%	< 1	107%	70%	130%	102%	80%	120%	102%	70%	130%
Barium	1	4148046	94	94	0.0%	< 2	102%	70%	130%	104%	80%	120%	104%	70%	130%
Beryllium	1	4148046	0.8	0.8	0.0%	< 0.5	99%	70%	130%	97%	80%	120%	109%	70%	130%
Boron	1	4148046	7	7	0.0%	< 5	75%	70%	130%	105%	80%	120%	116%	70%	130%
Boron (Hot Water Soluble)	1	4148060	0.27	0.26	4.6%	< 0.10	122%	60%	140%	97%	70%	130%	99%	60%	140%
Cadmium	1	4148046	< 0.5	< 0.5	0.0%	< 0.5	105%	70%	130%	118%	80%	120%	103%	70%	130%
Chromium	1	4148046	21	21	0.0%	< 2	99%	70%	130%	104%	80%	120%	103%	70%	130%
Cobalt	1	4148046	9.5	9.7	2.1%	< 0.5	99%	70%	130%	101%	80%	120%	94%	70%	130%
Copper	1	4148046	28	28	0.0%	< 1	103%	70%	130%	104%	80%	120%	94%	70%	130%
Lead	1	4148046	22	23	4.4%	< 1	105%	70%	130%	106%	80%	120%	104%	70%	130%
Molybdenum	1	4148046	0.7	0.8	13.3%	< 0.5	101%	70%	130%	102%	80%	120%	110%	70%	130%
Nickel	1	4148046	19	19	0.0%	< 1	100%	70%	130%	104%	80%	120%	95%	70%	130%
Selenium	1	4148046	0.6	0.4	NA	< 0.4	113%	70%	130%	104%	80%	120%	97%	70%	130%
Silver	1	4148046	< 0.2	< 0.2	0.0%	< 0.2	74%	70%	130%	106%	80%	120%	104%	70%	130%
Thallium	1	4148046	< 0.4	< 0.4	0.0%	< 0.4	97%	70%	130%	101%	80%	120%	98%	70%	130%
Uranium	1	4148046	0.6	0.6	0.0%	< 0.5	102%	70%	130%	101%	80%	120%	103%	70%	130%
Vanadium	1	4148046	31	31	0.0%	< 1	101%	70%	130%	101%	80%	120%	104%	70%	130%
Zinc	1	4148046	67	69	2.9%	< 5	100%	70%	130%	111%	80%	120%	97%	70%	130%
Chromium VI	1	4148046	< 0.2	< 0.2	0.0%	< 0.2	96%	70%	130%	94%	80%	120%	96%	70%	130%
Cyanide	1	4148046	< 0.040	< 0.040	0.0%	< 0.040	104%	70%	130%	106%	80%	120%	92%	70%	130%
Mercury	1	4148046	< 0.10	< 0.10	0.0%	< 0.10	107%	70%	130%	100%	80%	120%	101%	70%	130%
Electrical Conductivity (2:1)	1	4148046	0.441	0.437	0.9%	< 0.005	99%	90%	110%	NA			NA		
Sodium Adsorption Ratio	1	4148046	5.63	5.55	1.4%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	1	4148046	7.54	7.54	0.0%	NA	100%	90%	110%	NA			NA		

Comments: NA signifies Not Applicable. As the average value (Se) for the sample and a duplicate is less than 5X RDL, lab's RPD acceptance criteria is not applicable.

Certified By: Elizabeth Rolakowska

Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 13T690568

PROJECT NO: 11-12-2096

ATTENTION TO: Hussein Ahmed

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010C	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

Region of Peel

Final Report

Structural Assessment Report

Prepared for The Regional Municipality of Peel
by IBI Group

November 2014

Document Control Page

CLIENT:	The Regional Municipality of Peel
PROJECT NAME:	Class EA for Improvements to Airport Road from Mayfield Road to King Street
REPORT TITLE:	Structural Assessment Report
IBI REFERENCE:	24RX12.0105.00
VERSION:	Final (Nov 2014)
DIGITAL MASTER:	J:\24RX12.0105_Peel Airport Rd EA\5.0 Design (Work) Phase\04 - Structural\STRUCTURAL ASSESSMENT REPORT
ORIGINATOR:	Rose Wang, P.Eng.
REVIEWER:	Ted Brumfitt, P. Eng; Allan Ortlieb, P. Eng
AUTHORIZATION:	
CIRCULATION LIST:	
HISTORY:	Initial Draft June 30 2014 Second Draft September 2014 Final November 2014

Table of Contents

APPENDICES

1 Introduction

The Region of Peel has retained IBI Group to supply bridge engineering services in support of the Class Environmental Assessment (EA) for improvements to Airport Road from approximately 300 m north Mayfield Road to approximately 100 m north of King Street. There are three (3) major concrete bridge/culvert crossings of Airport Road within the project limits: Norris Bridge (C2), Deans Culvert (C6) and Salt Creek Culvert (C7). The overall study area and location of the three structures is illustrated in Appendix A.

This report summarizes the findings of the Biennial Bridge Inspection Reports carried out by Engineered Management System Inc. dated on April 27, 2010 (Norris Bridge), and May 11, 2010 (Deans Culvert and Salt Creek Culvert), provides a review of the existing structural condition, preliminary recommendations for structural improvements to accommodate the proposed widening of Airport Road, preliminary construction cost estimate, and traffic staging review. The report also includes a summary of the subsurface conditions and the foundation recommendations as outlined in the Terraprobe Preliminary Foundation Investigation and Design Report.

2 Existing Conditions

Within the project limits, Airport Road is a two lane rural roadway. At all three structure locations, an existing 600 mm dia. concrete sanitary sewer is buried to the west side of the road and a 300 mm dia. watermain is buried to the east side; both are offset more than 15m from the existing centreline of Airport Road.

A visual field inspection of three culverts was performed on January 30, 2013. Photographs of the three existing culverts are provided in Appendix B.

2.1 Norris Bridge

Norris Bridge is located on Airport Road approximately 1.6 km north of Mayfield Road. It was built in 1955. It is a concrete rigid frame structure with 10.7 m span and a vertical opening 2.8 m. The deck has an overall width of 17.2 m. The height of fill over the structure is approximately 0.50 m. Concrete headwalls with parapet walls on top and retaining walls are located on both ends of the structure. Steel beam guiderails have been provided on the approaches and are attached to the end posts of parapet walls.

The following is a summary of our observations and findings:

- Concrete barriers are in good condition.
- Steel beam guiderail and channel are in good condition.
- Frame legs have no significant defects, and except as noted, are in overall good condition.
- South-east frame wing wall show some hairline shrinkage cracking and requires surface repair.
- Watercourse both upstream and downstream has light aggradations, and there is degradation affecting the stream bed, and especially the south side. Stream bed protection should be provided.
- Sodded roadway embankments are in good condition with only light surface deterioration.

2.2 Deans Culvert

Deans culvert, located on Airport Road approximately 0.42 km north of Old School Road, was built in 1955. It is a non-rigid open footing culvert with 6.5 m span and a vertical opening of 2.2 m. The culvert has an overall length of 19.4 m (measured along the skew). The height of fill above the culvert is approximately 0.70 m. Concrete headwalls and gabion retaining walls are located at each end of the culvert. Steel beam guiderails have been provided on the culvert and approaches.

The culvert is generally in good condition and there are no significant defects or major concerns to report, with the exception of a small area of north east culvert's leg with severe scaling.

2.3 Salt Creek Culvert

Salt Creek culvert, located on Airport Road approximately 0.82 km North of Old School Road, was built in 1960. It is a rigid frame culvert with 7.2 m span and a vertical clearance of 1.7 - 2.3m. The culvert has an overall length of 22.4 m (measured along the skew). The height of fill above the culvert is approximately 0.45 m. Steel beam guiderails have been provided on the culvert and approaches.

The culvert is generally in good condition and there are no significant defects or major concerns. However, there are some leaking cracks and efflorescence on the west side of the soffit.

The watercourse, both upstream and downstream, has medium aggradations.

3 Bridge/ Culvert Hydrology

A preliminary hydraulic analysis was undertaken by IBI Group to evaluate crossings C2 (Norris Bridge), C6 (Deans Culvert) and C7 (Salt Creek Culvert). The evaluation was based on design year storm event in accordance with the MTO Design Flood Criteria (adopted by Region of Peel) requirements. The existing culverts C2, C6 and C7 are concrete structures and the openings do not meet current design criteria. The HEC-RAS model was updated for the crossings to reflect the proposed sizing option to meet current design criteria. The hydraulic analysis indicated that the proposed sizing of structures (as outlined in Section 4) will eliminate overtopping completely at all three crossings.

4 Bridge/ Culvert Rehabilitation Alternatives

Based on the results of the field inspection and hydraulics analysis, a rehabilitation and replacement alternative has been assessed at each of the three water crossings to accommodate the Airport Road widening. A cost estimate break-down for each alternative is provided in Appendix D.

Staging alternatives were reviewed and a preferred staging identified. Due to lack of viable detours, any rehabilitation or extension will be carried out in two stages with two lanes of traffic maintained throughout construction.

Terraprobe completed a preliminary foundation investigation and a geotechnical design report for all three culvert locations. Recommendations regarding the foundation design at the three structures are noted below.

Preliminary General Arrangement Drawings of the rehabilitation and replacement alternatives at each of the three culverts are included in Appendix C.

4.1 Norris Bridge

4.1.1 Alternatives

Alternative 1 – Extend both sides of the existing bridge/ culvert ($591,613)

The structure was built in 1955, at which time structures were commonly constructed for a service life of 50 years. Although the existing structure has been in service for 59 years, it remains in good condition and there is no apparent sign of distress. The bridge can be widened on either side, as required to accommodate the future roadway widening.

The scope of work of this alternative includes:

- Remove existing headwalls and retaining walls at both ends
- Remove existing guiderails
- Extend the culvert to both west and east ends with cast-in-place concrete culvert
- Construct new retaining walls and headwalls at both ends
- Construct new guiderails

With this alternative the existing road profile would be maintained, even though deficient to 90km/h design speed. The existing structure will be extended on both sides approximately 6.15 m (maintaining the exiting centreline).

Alternative 2 – Replace the culvert with Con-Span ($1,102,936)

The existing culvert will be removed and replaced with a new structure. The proposed structure will be a precast Con-Span with 14.64 m span and 3.66m (3.35m above invert), with a total length of 29.9 m. The minimum fill on Con-Span is 600 mm. The headwall and retaining wall will be precast. Parapet wall with railings will be provided on headwalls. Steel beam guiderails will be provided at both north and south approaches and connected to the parapet end walls.

Alternative 3 – Replace the culvert with 40m Span Bridge ($3,588,000)

The option of removing and replacing the existing structure with a new bridge which spans the meanderbelt width (38-40m) was initially considered; however not carried forward based on an initial evaluation screening This alternative requires a precast 40 m span CPCI 2300 girder bridge with cast-in-place deck, with a total deck width of 29.9 m. The road profile at the bridge would need to be raised approximately 2 m.

Given the additional structure cost, grading impacts associated with the grade raise, and the fact that the fluvial geomorphology study indicates “the existing openings would likely support the long term form and function of each watercourse and limit risk to proposed infrastructure, provided that the channel form is restored at each site” and that “rather than increasing structure width geomorphic function would benefit from improvements to the channel form”, Alternative 3 was not be carried forward.

4.1.2 Substructure Conditions and Foundation Recommendations

In general, borehole logs indicate that the site is an asphalt pavement or topsoil, underlain by loose to very dense and firm to stiff materials, and a very stiff to hard silty clay till deposit. These overburden soils are underlain by shale bedrock of the Georgian Bay Formation. Bottom of footing level is approximately 5.4 m below existing ground surface. The precast structures will be supported on conventional designed spread footing and founded in the clayey silt till with factored ULS of 450 kPa and SLS of 300 kPa.

4.2 Deans Culvert

4.2.1 Alternatives

Alternative 1 – Extend both ends of the existing culvert ($365,750)

The structure was built in 1955, at which time structures were commonly constructed for a service life of 50 years. Although the existing structure has been in service for 59 years, it remains in good condition and there is no apparent sign of distress. The bridge can be widened on either side, as required to accommodate the future roadway widening.

The scope of work of this alternative includes:

- Remove existing headwalls and gabion retaining walls at both ends
- Remove existing guiderails
- Extend the culvert to both west and east ends with cast-in-place concrete culvert
- Construct new retaining walls and headwalls at both ends
- Construct new guiderails

With this alternative the existing road profile and centreline would be maintained and existing structure will be extended 5.4 - 5.7 m on both sides (measured perpendicular to the roadway).

Alternative 2 – Replace the culvert with Con-Span ($1,006,388)

The existing culvert will be removed and replaced with a new structure. The proposed structure will be a precast open footing culvert with 10.668 m span and 2.44 m rise (2.13 m above invert). It will be on a 19º skew with a total length of 31.62m to accommodate road width of 29.9 m. The minimum fill on culvert is 600 mm. The headwall and retaining wall will be cast-in-place concrete. Parapet wall with railings will be provided on headwalls.

4.2.2 Substructure Conditions and Foundation Recommendations

In general, borehole logs indicate that the site is asphalt pavement underlain by topsoil, compact and stiff fill materials and firm hard clayey silt till deposit. Bottom of footing level is approximately 5 m below existing ground surface. The precast culverts will be supported on conventional designed spread footing and founded in the clayey silt till with factored ULS of 375 kPa and SLS of 250 kPa.

4.3 Salt Creek Culvert

4.3.1 Alternatives

Alternative 1 – Extend both ends of the existing culvert ($444,500)

The structure was built in 1960, at which time structures were commonly constructed for a service life of 50 years. Although the existing structure has been in service for 54 years, it remains in good condition. The bridge can be widened on either side, as required to accommodate the future roadway widening.

The scope of work of this alternative includes:

- Remove existing headwalls and retaining walls at both ends
- Remove existing guiderails
- Extend the culvert to both west and east ends with cast-in-place concrete culvert
- Construct new retaining walls and headwalls at both ends
- Construct new guiderails

With this alternative the existing road profile and centreline would be maintained and existing structure will be extended on both sides approximately 5.05 m (measured perpendicular to the roadway).

Alternative 2 – Replace the culvert with Con-Span ($1,057,308)

The existing culvert will be removed and replaced with a new structure. The proposed structure will be a precast open footing culvert with 10.668 m span and 2.44 m rise (2.13 m above invert). It will be on a 30º skew with a total length of 34.53m to accommodate road width of 29.9 m. The minimum fill on culvert is 600 mm. The headwall and retaining wall will be cast-in-place concrete. Parapet wall with railings will be provided on headwalls.

4.3.2 Substructure Conditions and Foundation Recommendations

In general, borehole logs indicate that the site is asphalt pavement underlain by loose to compact and firm to stiff fill materials and a very stiff to hard clayey silt till deposit. Bottom of footing level is approximately 5.2 m below existing ground surface. The precast structures will be supported on conventional designed spread footing and founded in the clayey silt till with factored ULS of 450 kPa and SLS of 300 kPa.

5 Recommendations and Discussion

According to Biennial Bridge Inspection Report, all three existing water crossing structures have been in service for over 50 years. The estimated remaining service life of the structures is limited. Aggradations were observed in all three water courses. The estimated remaining service life of water courses is 15 years.

Based on hydrologic/hydraulic analysis, it is recommended to replace all three culverts with increased opening culverts to accommodate hydraulics requirements. And the new structures will be extended to both west and east to accommodate future roadway alignment, 4 lanes traffic and sidewalks on both sides. The structure replacements could be undertaken using precast elements to reduce environmental impacts during construction.

Table 4.1 – Summary of Alternative 2 Culvert Replacement Cost

BRIDGE/ CULVERT	EQIVALENT DECK AREA (m^2)	UNIT PRICE ($ / m^2)	TOTAL COST ESTIMATE ($)
Norris Bridge	462	2,387	1,102,936
Deans Culvert	346	2,906	1,006,388
Salt Creek Culvert	346	3,053	1,057,308

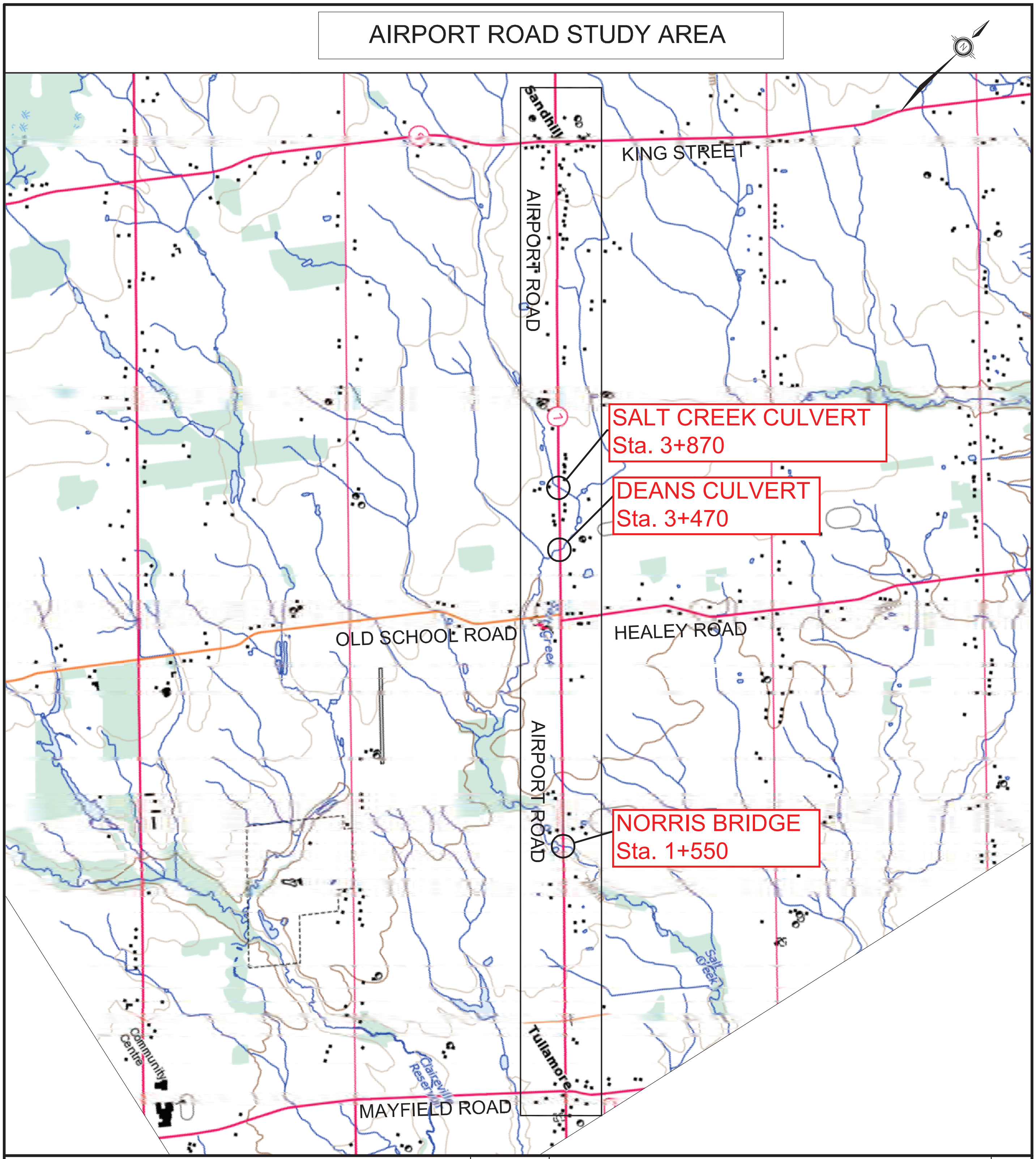
The report was prepared and reviewed by:

< *Original Signed*>	< *Original Signed*>
Rose Wang, P.Eng. Bridge Engineer IBI Group	Ted Brumfitt, P.Eng. Manager Bridge Engineering/Associate IBI Group

Appendix A

Culvert Location Plans

AIRPORT ROAD STUDY AREA



Date	Issued For	Rev.

IBI GROUP

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Client PEEL REGION, ONTARIO

Project AIRPORT ROAD IMPROVEMENTS

Drawing Title
KEY PLAN

Project No.
24RX12.0105

Drawing No.
FIGURE 1

DRAWING NAME: J:\24RX12.0105_PEEL AIRPORT RD EA\5.9 DRAWING\59BRIDGE\KEYPLAN_A_S.DWG

MODIFIED:Jun. 20, 2013 11:53 AM

Appendix B

Site Photographs

NORRIS BRIDGE

1. South Approach

2. North Approach

3. Bridge Outlet

4. Downstream

5. Bridge Barrel looking East

6. Bridge Soffit

7. Efflorescent and staining on wingwall

8. Upstream

9. Looking West Through Bridge

10. Bridge Inlet

11. Deck Drain in Soffit

DEANS CULVERT

1. Culvert Outlet

2. Looking West through East Barrel

3. Severe scaling on North- West Culvert Wall

4. Culvert Soffit

5. Culvert Inlet – East Gabion Retaining Walls

6. Culvert Inlet – East Headwall

7. Upstream

SALT CREEK CULVERT

1. South Approach

2. North Approach

3. Culvert Outlet

4. Efflorescence and leaking construction joint in soffit

5. Culvert Inlet

6. Upstream

7. Downstream

8. Culvert Soffit

Appendix C

Preliminary General Arrangement

Rehabilitation Alternatives
Preliminary General Arrangement

SERVICE DATA

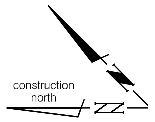
SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			HYDRO ONE		
PARKS & REC.			CTV		
ONT. CLEAN WATER			COMMUNIC. CABLES		

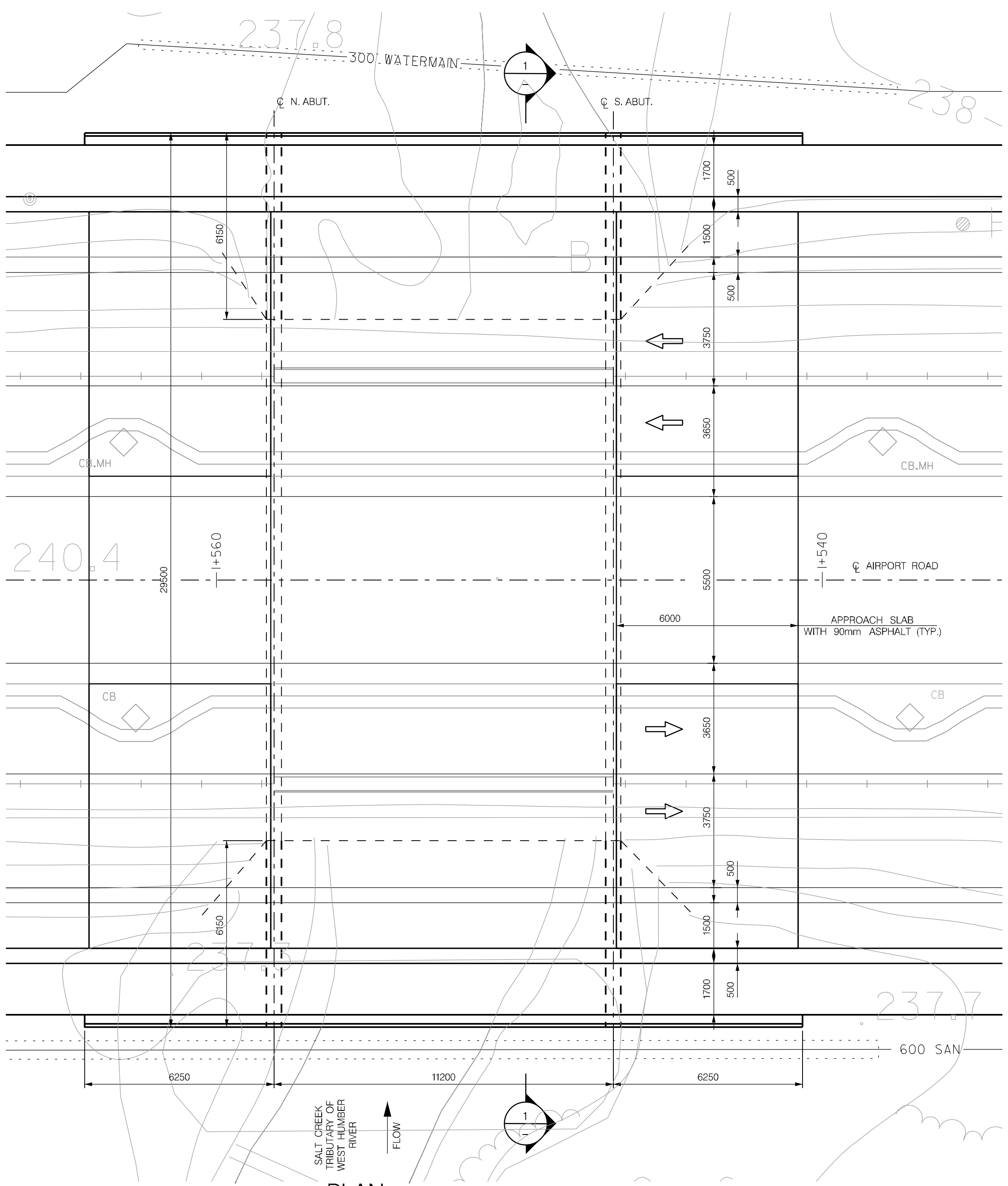
REVISIONS

DATE	DETAILS	INIT.

LIST OF ABREVIATIONS:

B/L	DENOTES BIKE LANE
S/W	DENOTES SIDE WALK
SHLD	DENOTES SHOULDER
CONC.	DENOTES CONCRETE
SAN.	DENOTES SANITARY





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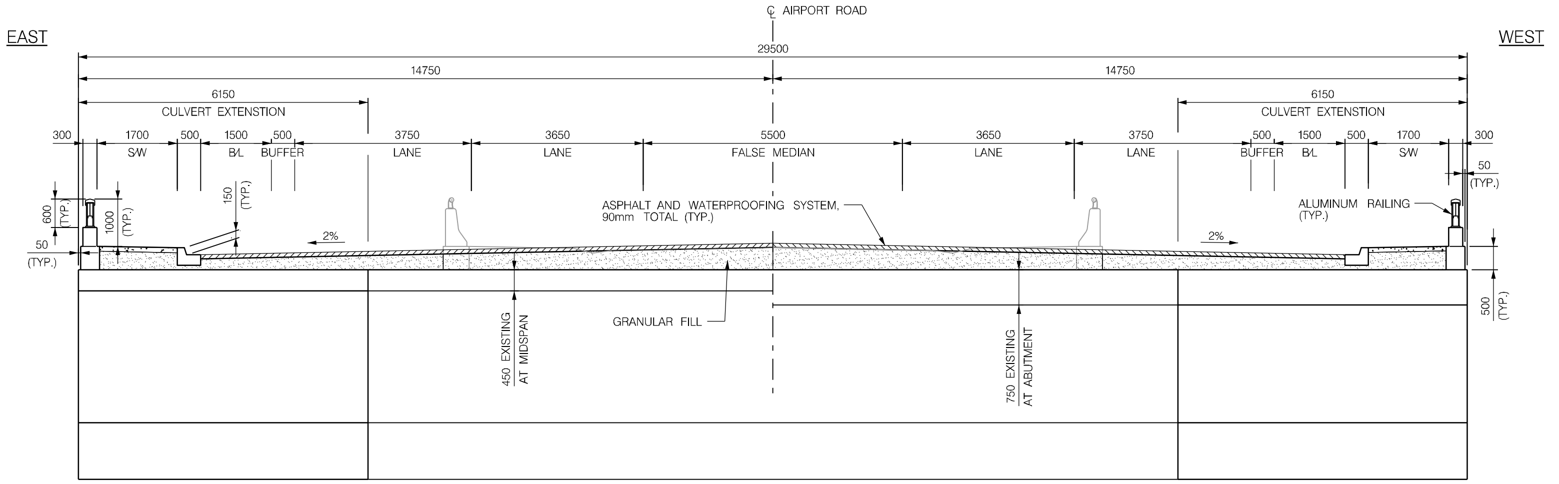

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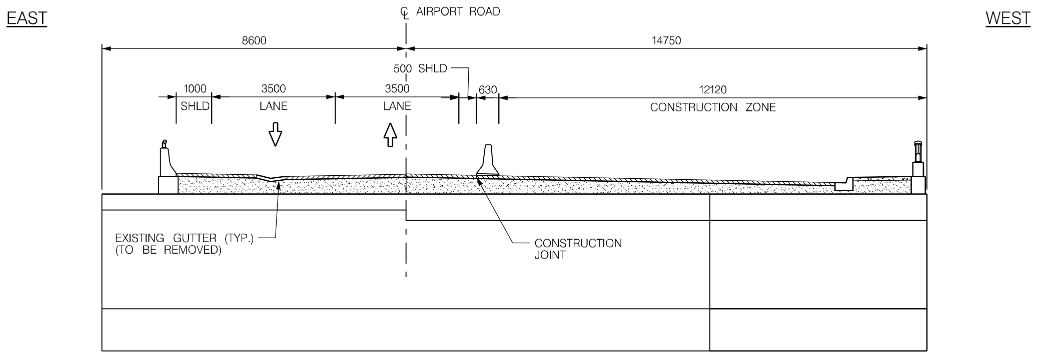
EX. 600mm
CONC. SAN



STAGE 1
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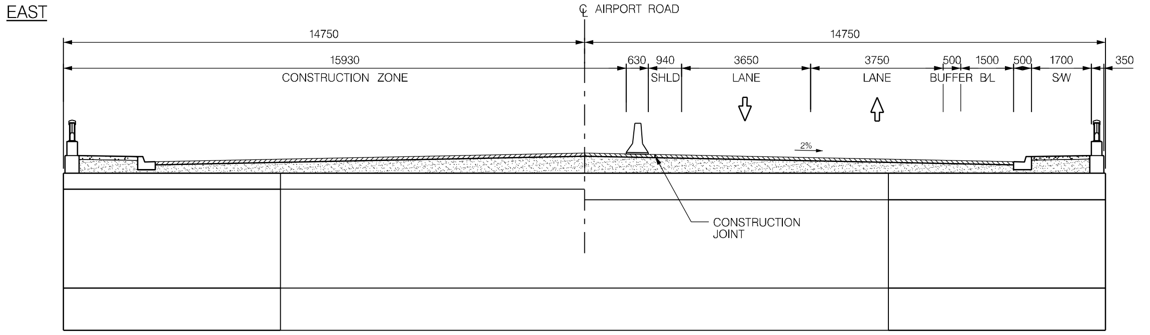
EX. 600mm
CONC. SAN.



STAGE 2
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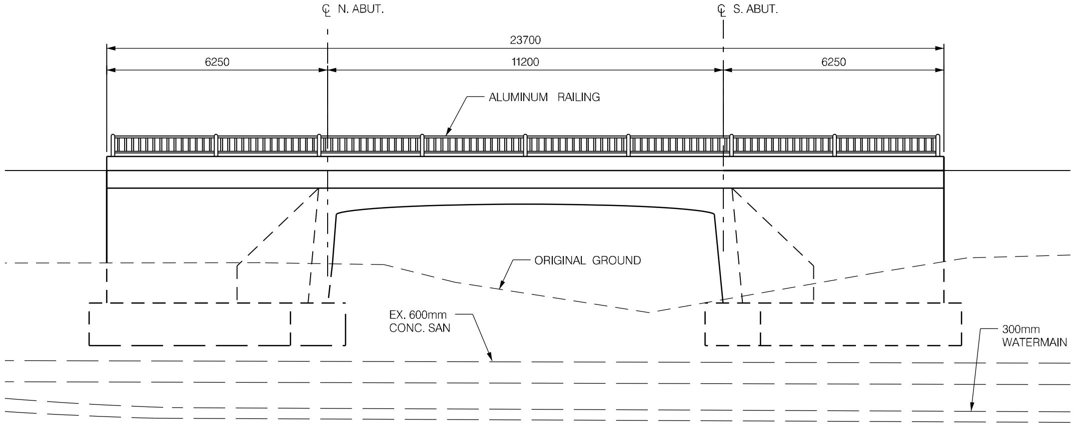
EX. 600mm
CONC. SAN.



ELEVATION
1:100

8/27/2013 USER:anna.savin J:\24RX12.0105_PeelAirport Rd EA\5.9 Drawing\59bridge\Airport_Rd_Noris_ga_.dgn

IBI
GROUP

IBI Group
30 International Boulevard
Toronto ON M9W 5P3 Canada

M. B. VAKILI

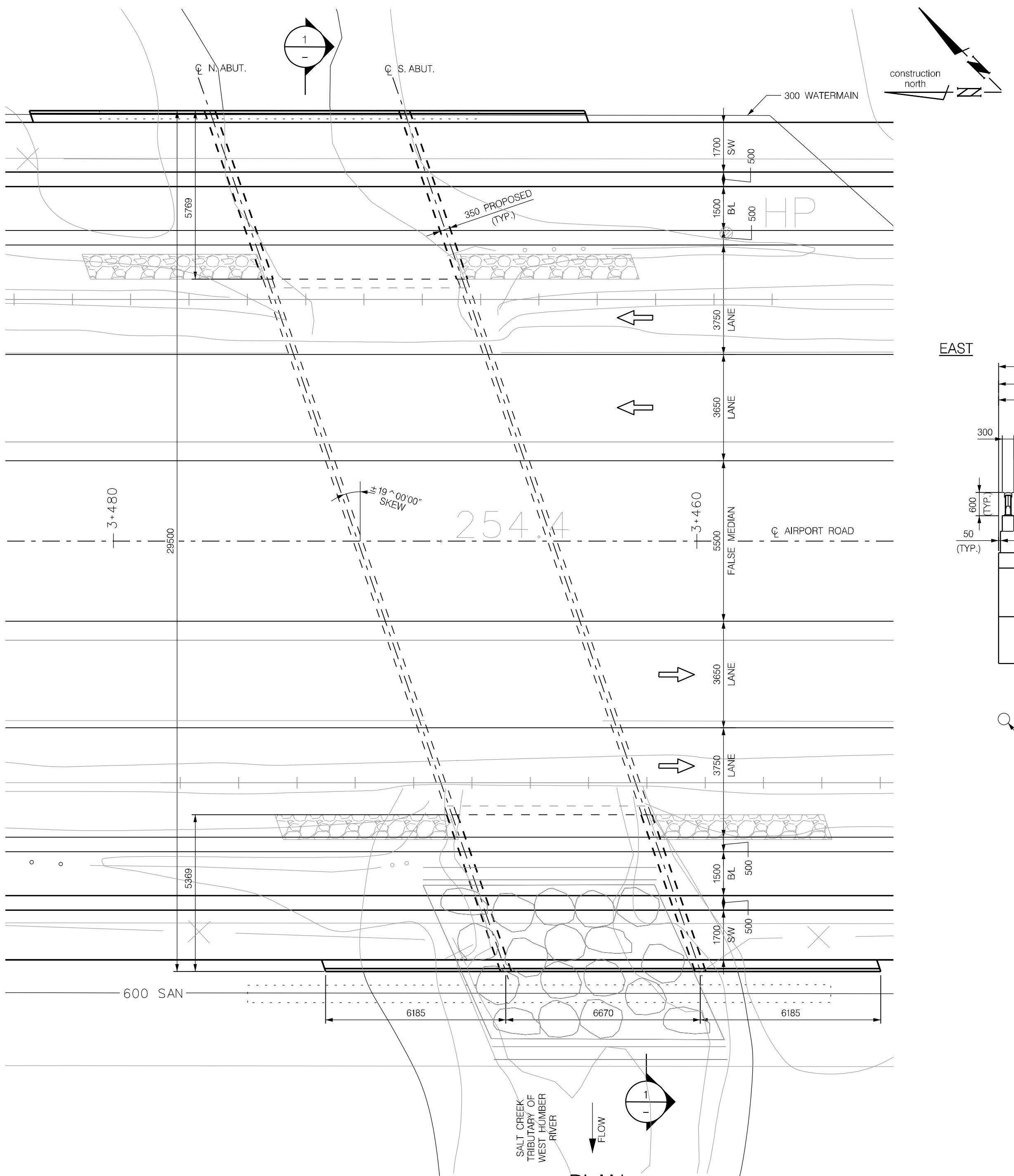
E.P. BRUMFITT

Designed by ______ Chkd. ______ Approved by ______

Region of Peel
Working for you

AIRPORT ROAD
(FROM N. OF MAYFIELD RD. TO N. OF OLD SCHOOL. RD.)
NORRIS RIGID FRAME BRIDGE
PRELIMINARY GENERAL ARRANGEMENT

CAD Area	Area Z-8	Project No. __-___
Checked by M.B.V.	Drawn by A.S.	
Date APR, 2013	Sheet of *	Plan No. -D



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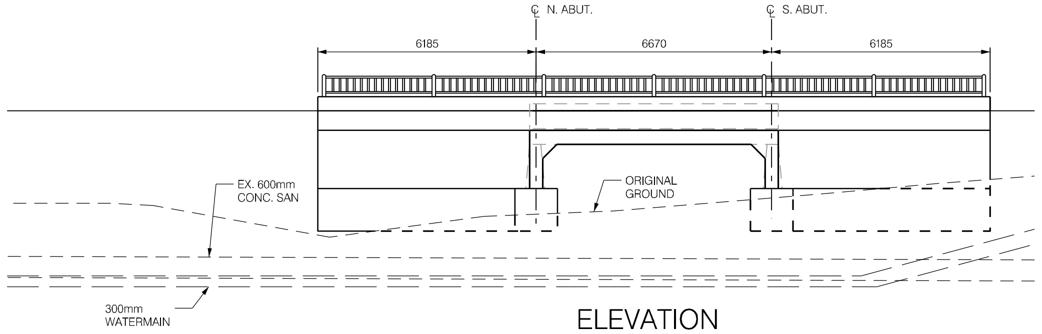

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SERVICE DATA					
SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
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PARKS & REC.			CTV		
ONT. CLEAN WATER			COMMUNIC. CABLES		

REVISIONS		
DATE	DETAILS	INIT.

LIST OF ABREVIATIONS:

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S/W	DENOTES SIDE WALK
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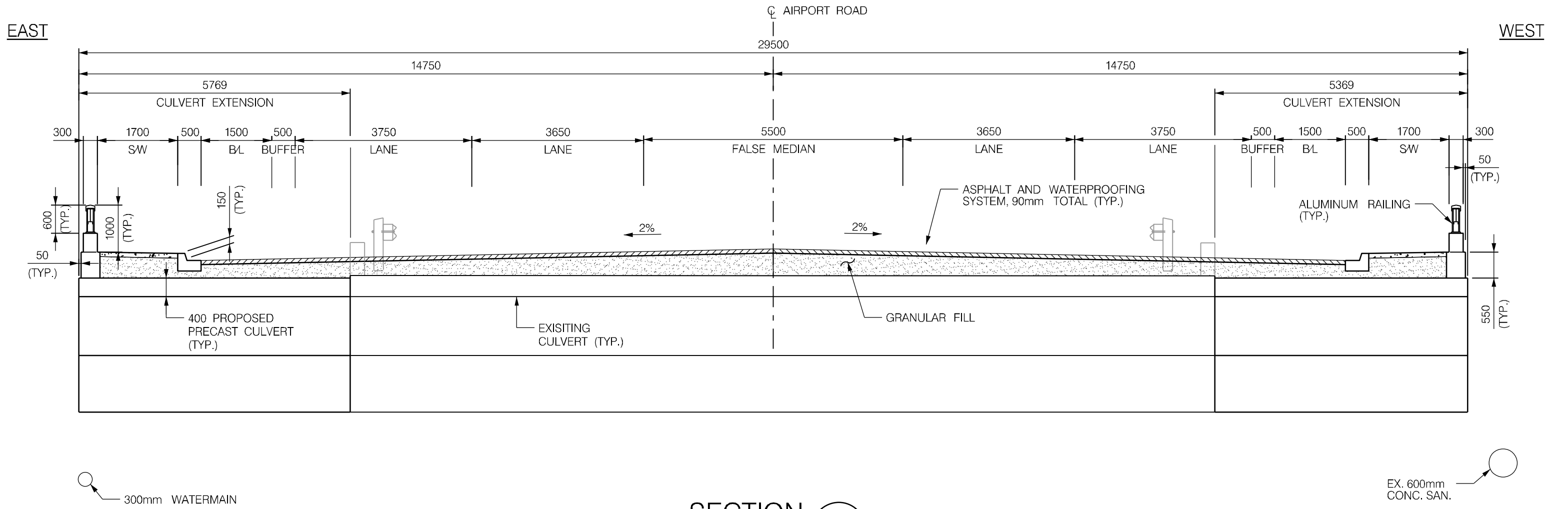

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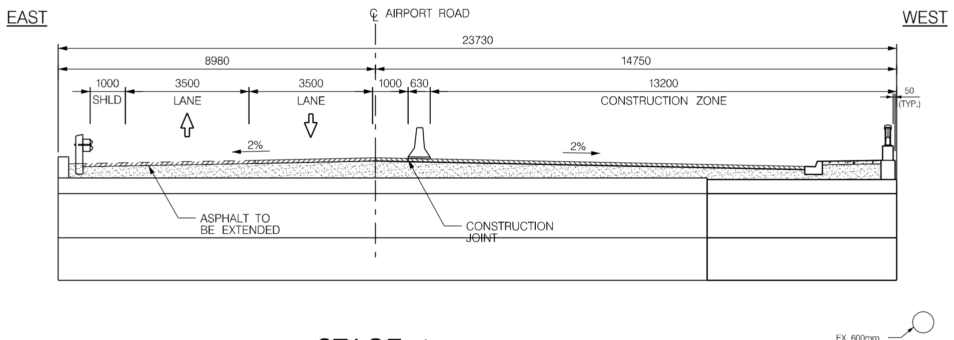

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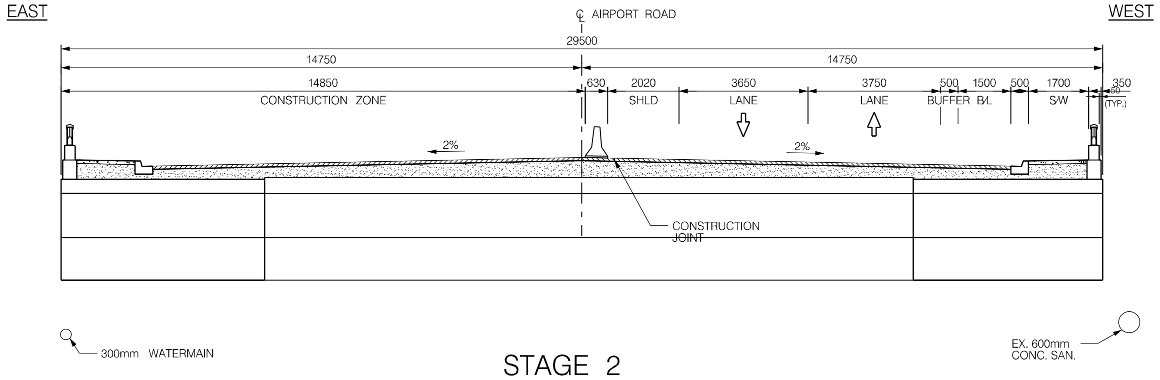

STAGE 2
1:100

IBI Group
30 International Boulevard
Toronto ON M9W 5P3 Canada

M. B. VAKILI
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Chkd.

E.P. BRUMFITT
Approved by

Region of Peel
Working for you

AIRPORT ROAD
(FROM N. OF MAYFIELD RD. TO N. OF OLD SCHOOL. RD.)
DEANS CULVERT
PRELIMINARY GENERAL ARRANGEMENT

CAD Area	Area Z-8	Project No. __-___
Checked by M.B.V.	Drawn by A.S.	
Date APR, 2013	Sheet of *	Plan No. -D

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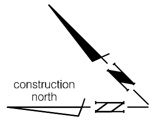
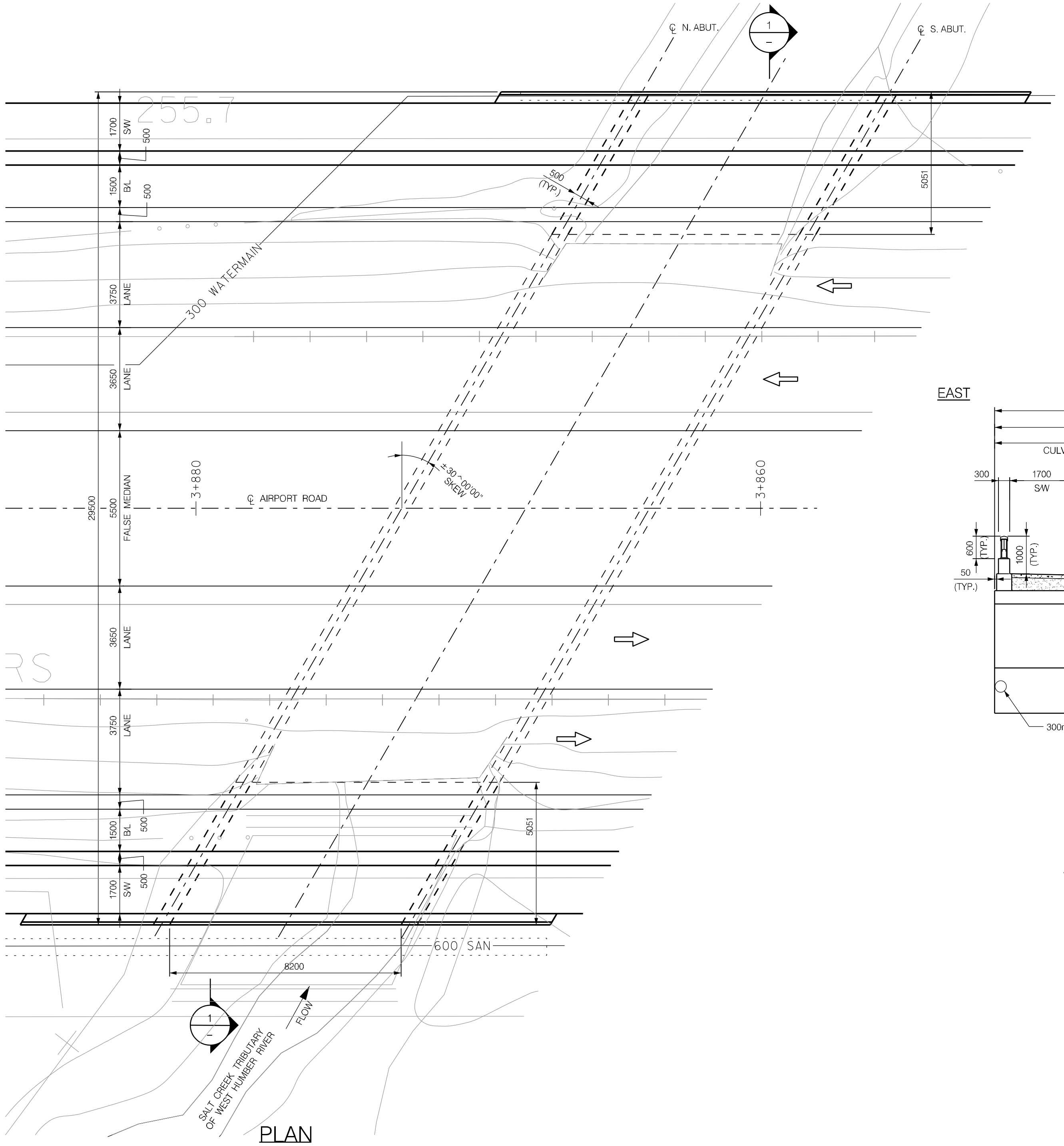
USER:sulaf.zear
8/28/2013





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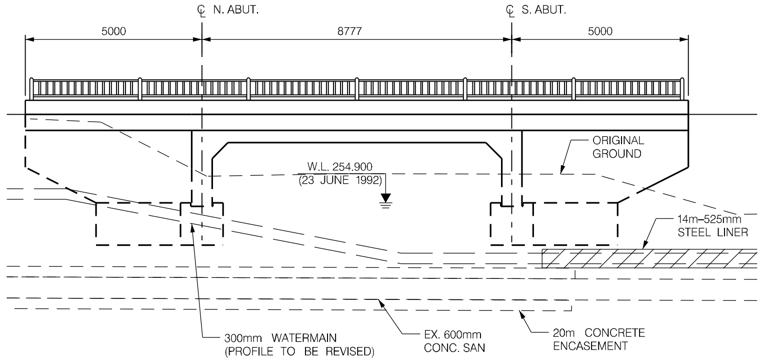

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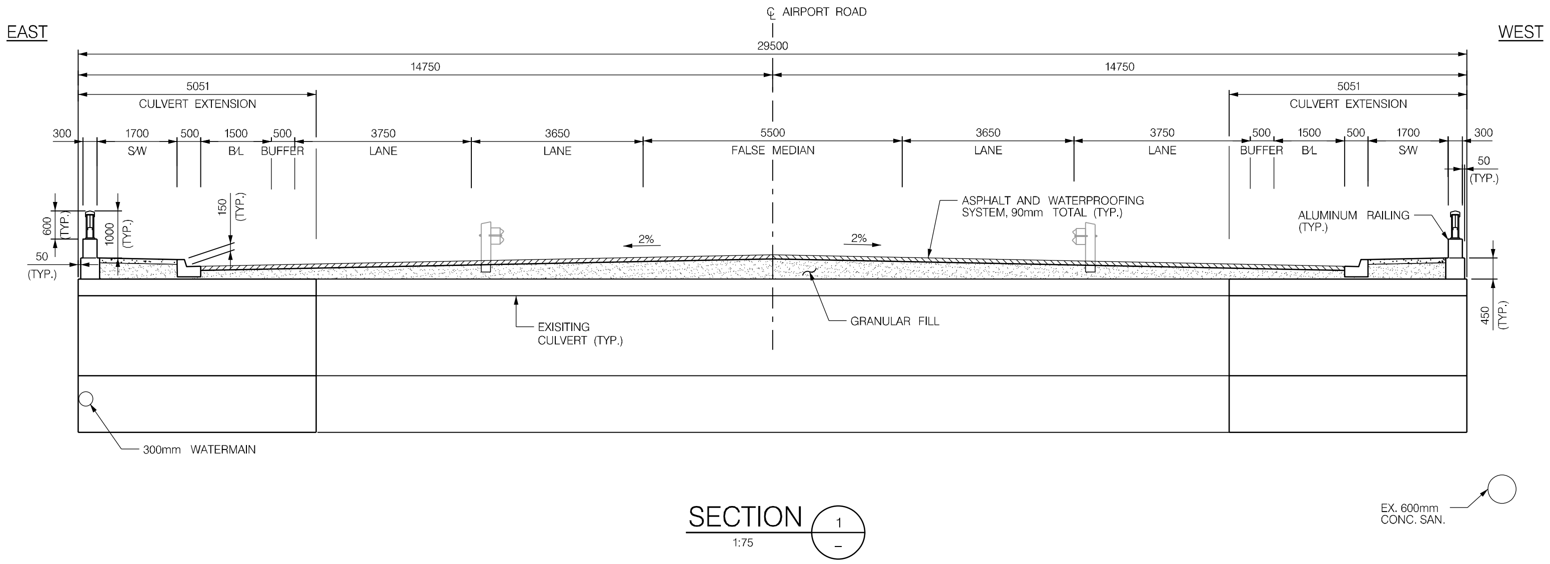

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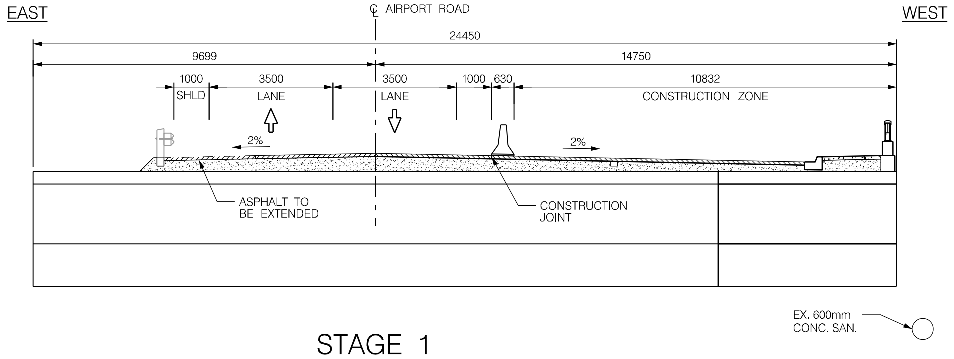

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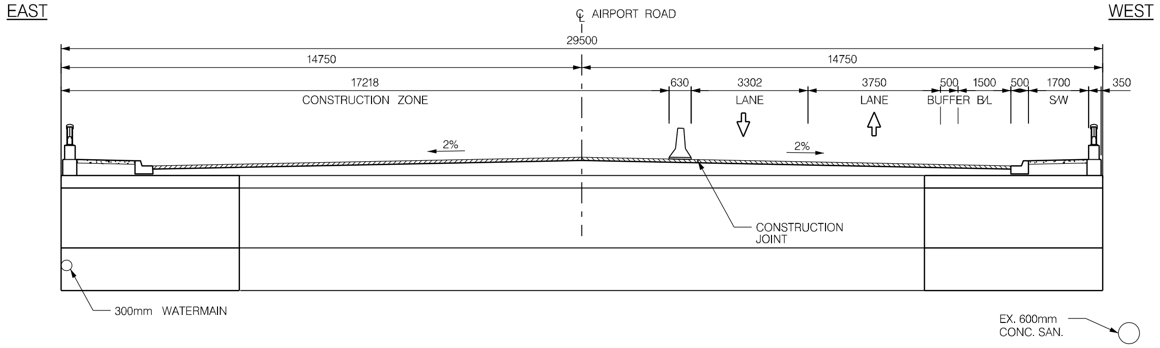

STAGE 2
1:100

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
WATERMAINS			HYDRO U/G CABLE		
TRANSIT			HYDRO ONE		
PARKS & REC.			CTV		
ONT. CLEAN WATER			COMMUNIC. CABLES		

REVISIONS

DATE	DETAILS	INIT.

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Working for you

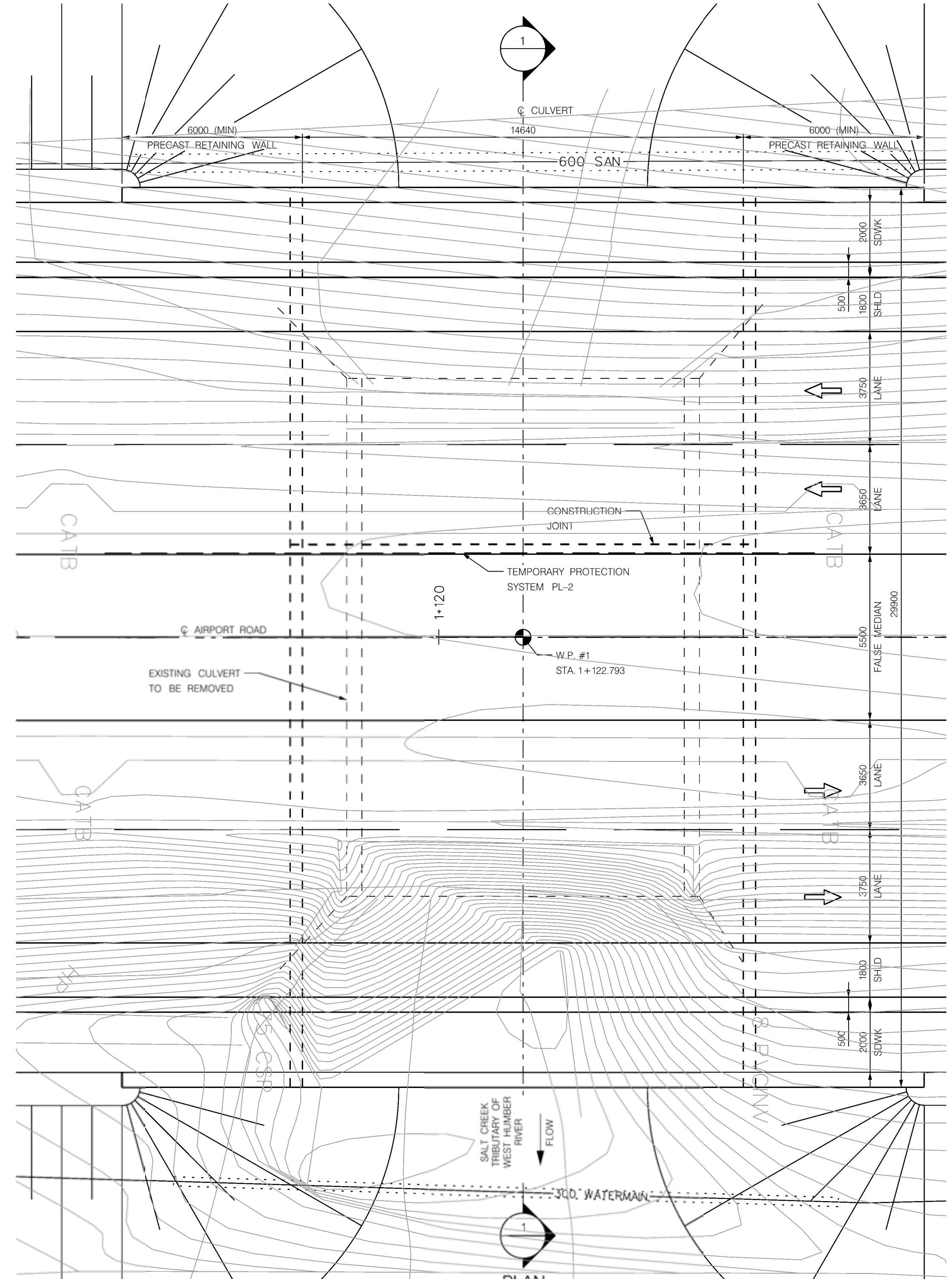
AIRPORT ROAD
(FROM N. OF MAYFIELD RD. TO N. OF OLD SCHOOL. RD.)
SALT CREEK BOX CULVERT
PRELIMINARY GENERAL ARRANGEMENT

CAD Area	Area Z-8	Project No. __-___
Checked by M.B.V.	Drawn by A.S.	
Date APR, 2013	Sheet of *	Plan No. -D

8/13/2013 USER:anna.savin J:\24RX12.0105_Peel Airport Rd EA\5.9 Drawing\59bridge\Airport_Rd_Salt Creek_ga.dgn

Replacement Alternatives

Preliminary General Arrangement



PLAN
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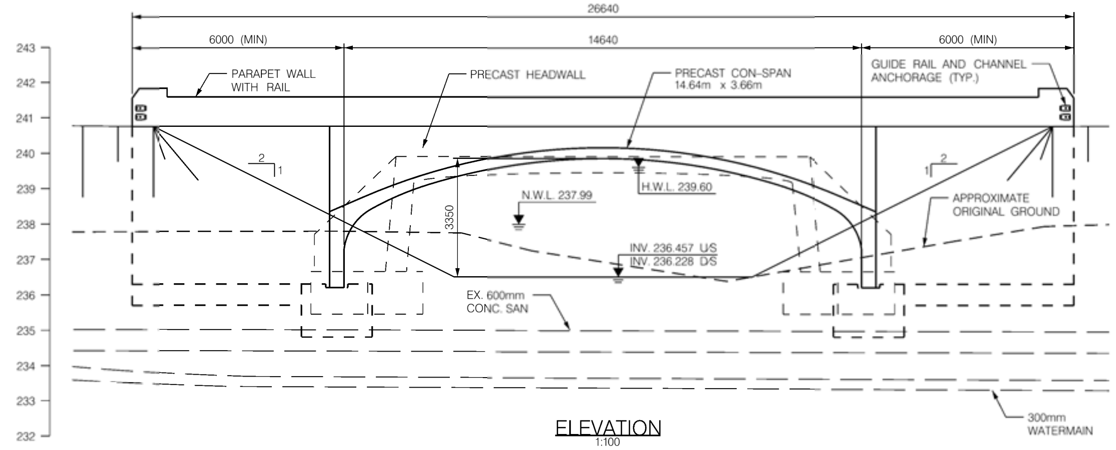

ELEVATION
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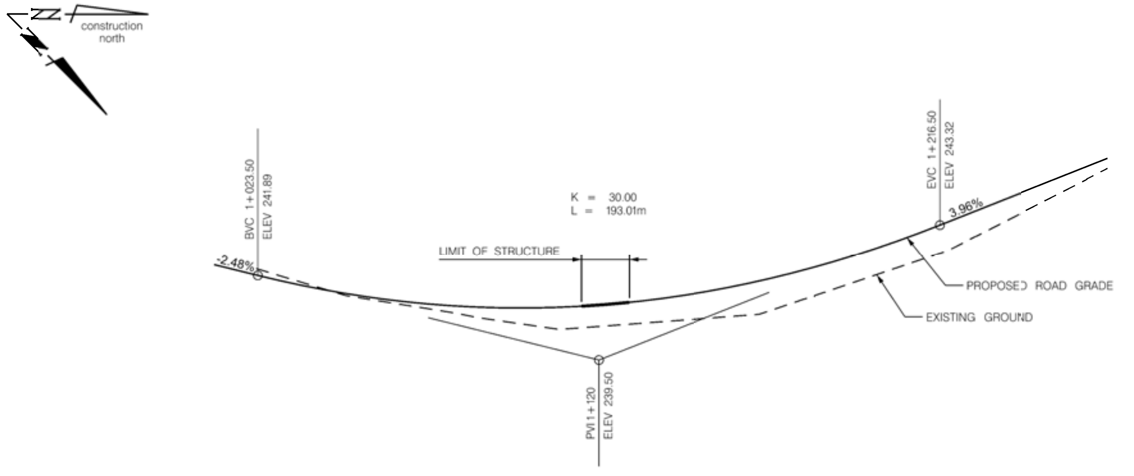
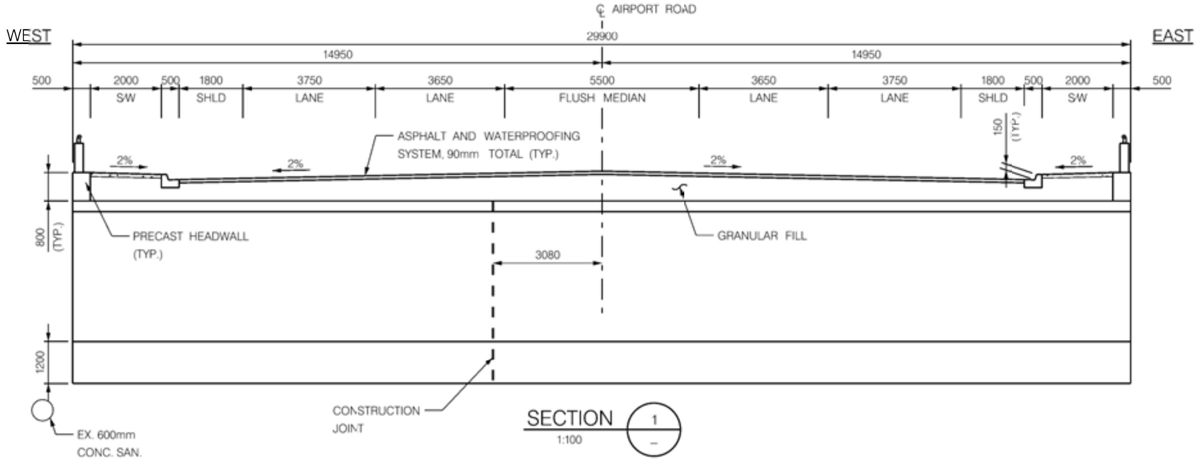
9/25/2014 USER:anna.savin J:\24RX12.0105_Peel Airport Rd EA\5.9 Drawing\59bridge\Airport_Rd_Noris_ga.dgn



PROFILE OF AIRPORT ROAD
N.T.S.



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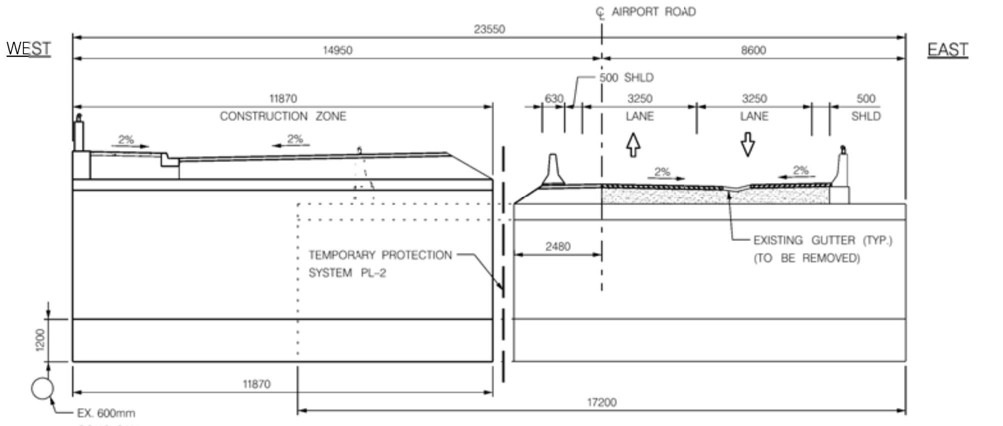

STAGE 1
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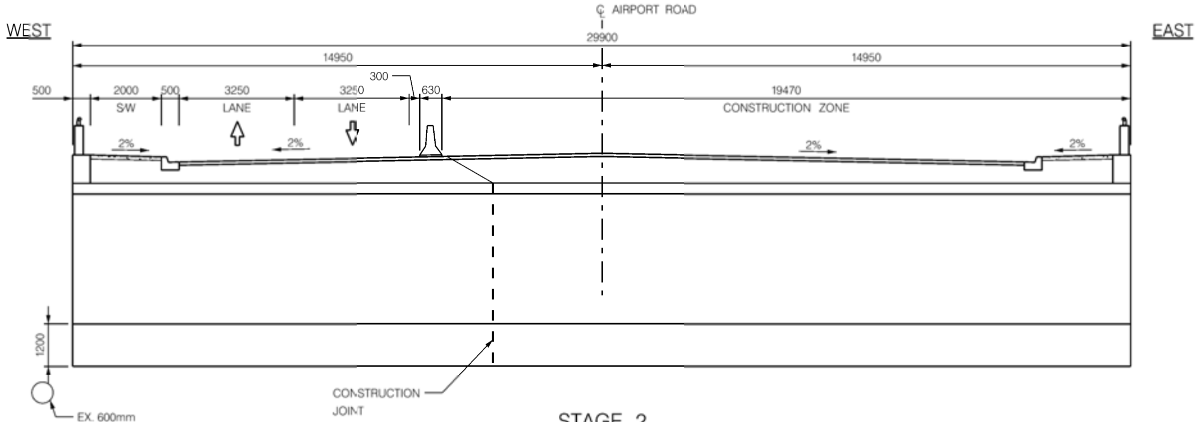

STAGE 2
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SERVICE DATA					
SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
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TRANSIT			HYDRO ONE		
PARKS & REC.			CTV		
ONT. CLEAN WATER			COMMUNIC. CABLES		

REVISIONS

DATE	DETAILS	INIT.

GENERAL NOTES

DESIGN CODE : CHBDC CAN/CSA-S6-06

CLASS OF CONCRETE

ALL CONCRETE..............................35 MPa
(UNLESS NOTED OTHERWISE)

CLEAR COVER TO REINFORCING STEEL

FOOTINGS..............................100 ± 25mm
REMAINDER..............................70 ± 20mm
(UNLESS OTHERWISE SPECIFIED)

REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.

UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL SHALL BE CLASS B.

STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN, DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.

BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS.

BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1 UNLESS INDICATED OTHERWISE.

RETAINED SOIL SYSTEM

RETAINED SOIL SYSTEM WALLS SHALL HAVE THE FOLLOWING ATTRIBUTES:
APPLICATION : VERTICAL WALL
PERFORMANCE : HIGH
APPEARANCE : HIGH

CONSTRUCTION NOTES

REMOVAL OF CULVERT AND ANY IN-WATER WORK IS PERMITED ONLY BETWEEN JULY 1 AND SEPTEMBER 15 UNLESS OTHERWISE GRANTED IN WRITING BY MNR.

BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH SIDES OF CULVERT KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.

THE CROSS SECTION OF THE ROAD SHOWN ON THIS DRAWING REPRESENTS ULTIMATE CONFIGURATION OF THE LANES. SEE ROAD DRAWINGS FOR PRESENT CONFIGURATION OF LANES.

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LIST OF ABREVIATIONS:

S/W	DENOTES SIDE WALK
SHLD	DENOTES SHOULDER
CONC.	DENOTES CONCRETE
SAN.	DENOTES SANITARY

APPLICABLE STANDARD DRAWINGS

OPSD 803.010	BACKFILL AND COVER FOR CONCRETE CULVERTS WITH SPAN LESS THAN OR EQUAL RO 3.0m
OPSD 3419.100	BARRIERS AND RAILINGS, STEEL BEAM, GUIDE RAIL AND CHANNEL ANCHORAGE

IBI Group
30 International Boulevard
Toronto ON M9W 5P3 Canada

M. B. VAKILI
Designed by
Chkd.

E.P. BRUMFITT
Approved by

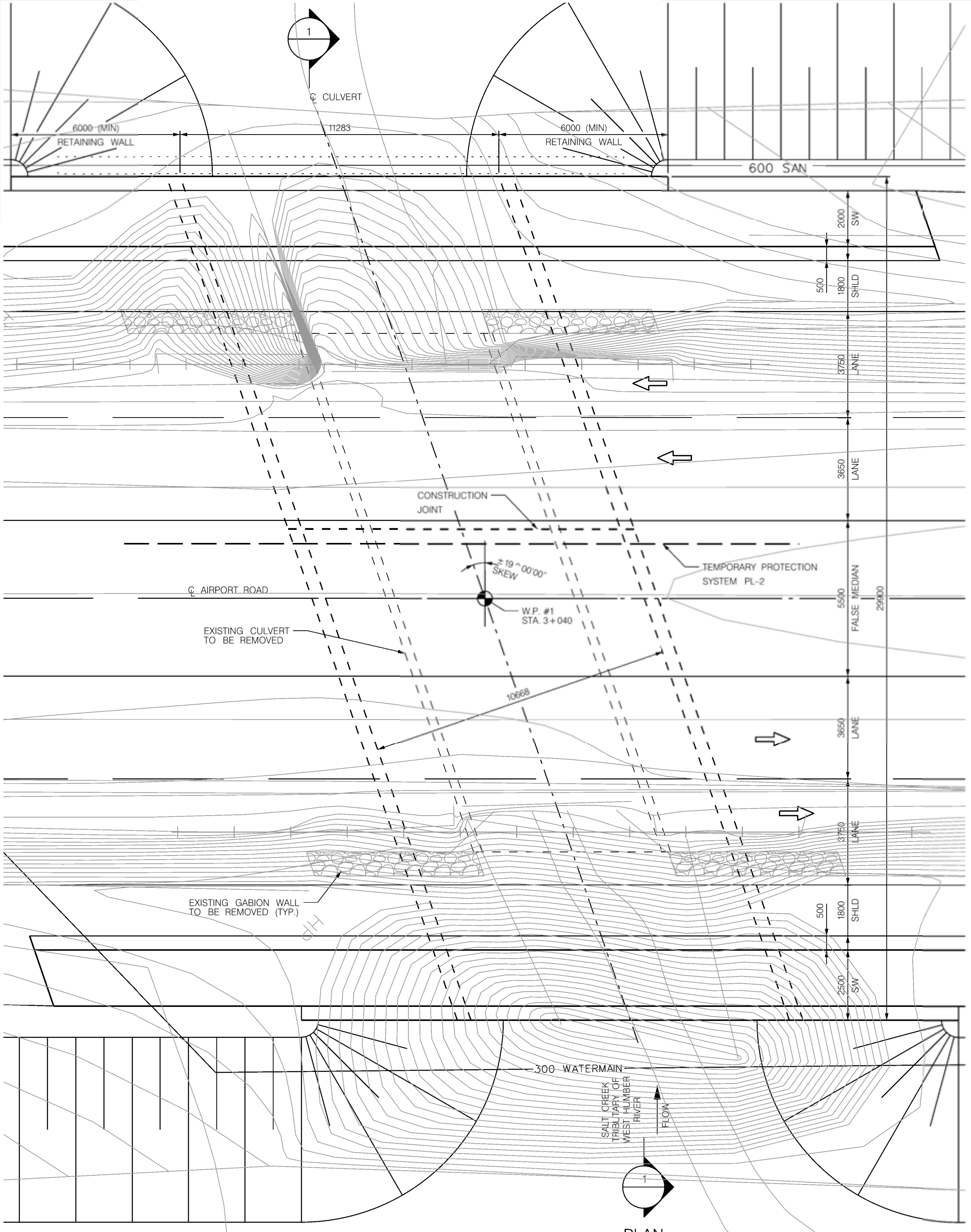
Region of Peel
Working for you

AIRPORT ROAD

(FROM N. OF MAYFIELD RD. TO N. OF OLD SCHOOL. RD.)
NORRIS RIGID FRAME BRIDGE

PRELIMINARY GENERAL ARRANGEMENT

CAD Area	Area Z-8	Project No. __-___
Checked by M.B.V.	Drawn by A.S.	
Date APR, 2013	Sheet of •	Plan No. -D



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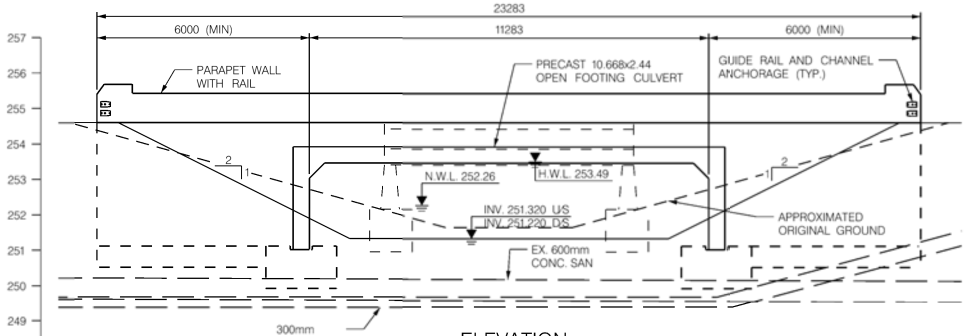

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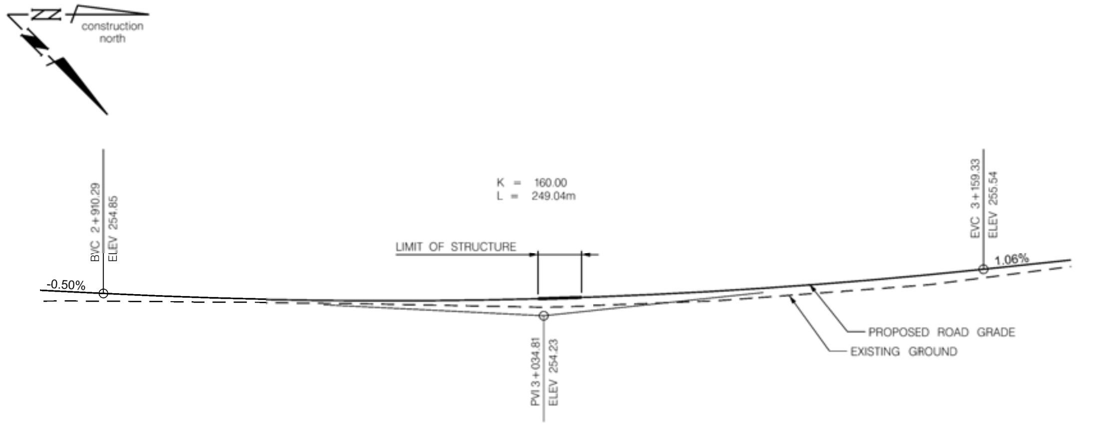
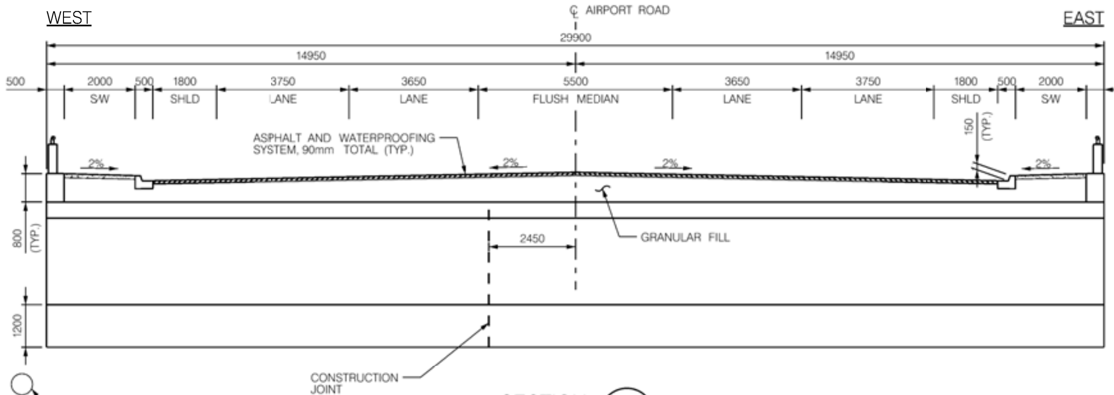


PROFILE OF AIRPORT ROAD
N.T.S.



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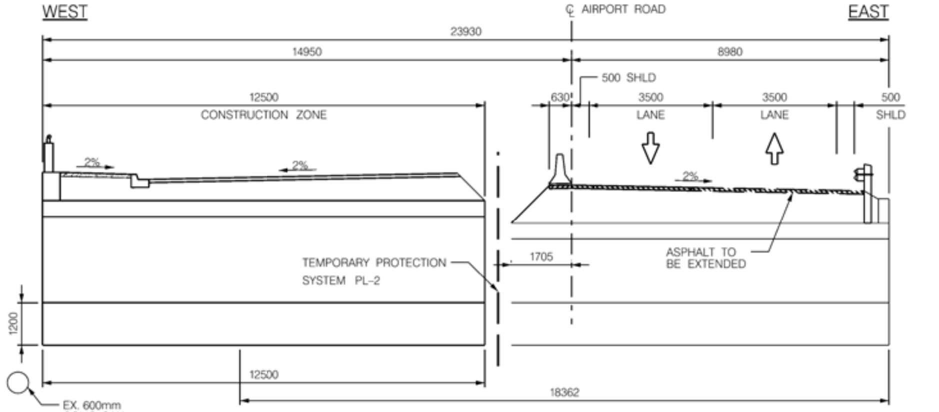

STAGE 1
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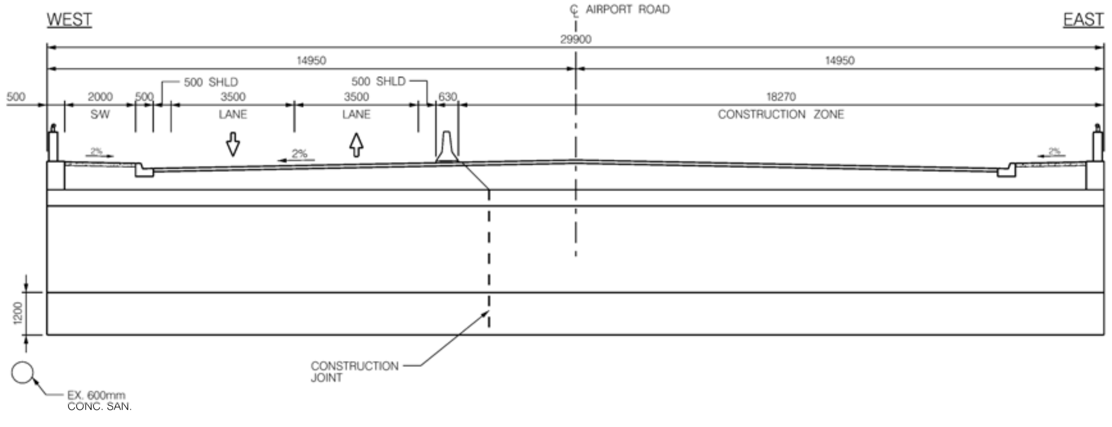

STAGE 2
1:100

SERVICE DATA					
SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
STORM SEWERS			BELL U/G CABLE		
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PARKS & REC.			CTV		
ONT. CLEAN WATER			COMMUNIC. CABLES		

REVISIONS

DATE	DETAILS	INIT.

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DESIGN CODE : CHBDC CAN/CSA-S6-06

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M. B. VAKILI
Designed by ____ Chkd. ____

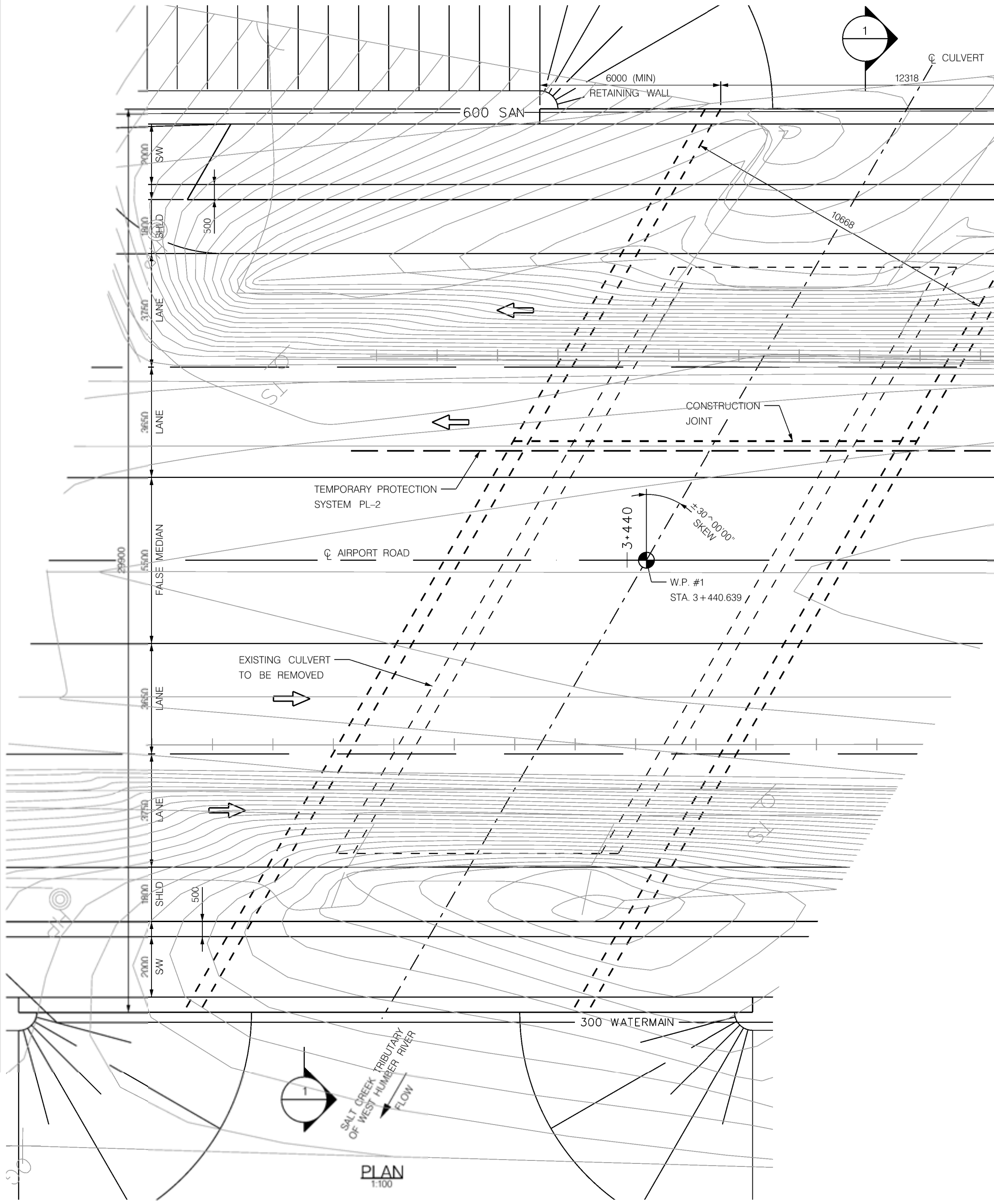
E.P. BRUMFITT
Approved by ____

Region of Peel
Working for you

AIRPORT ROAD
(FROM N. OF MAYFIELD RD. TO N. OF OLD SCHOOL. RD.)
DEANS CULVERT
PRELIMINARY GENERAL ARRANGEMENT

CAD Area	Area Z-8	Project No. __-___
Checked by M.B.V.	Drawn by A.S.	
Date APR, 2013	Sheet of •	Plan No. -D

9/25/2014 USER:anna.savin J:\24RX12.0105_Peel Airport Rd EA\5.9 Drawing\59bridge\Airport_Rd_Deans_ga.dgn



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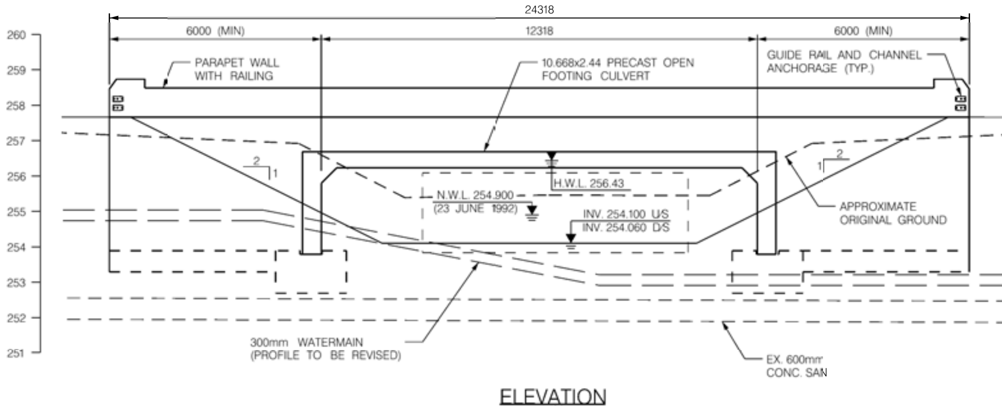

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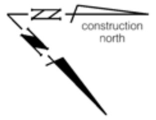
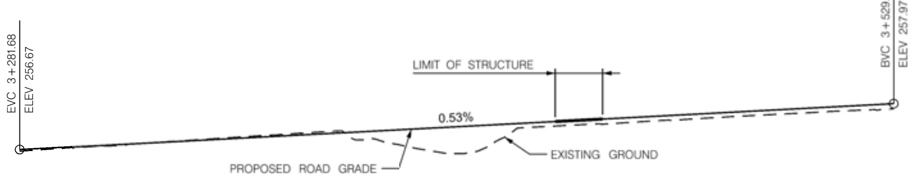
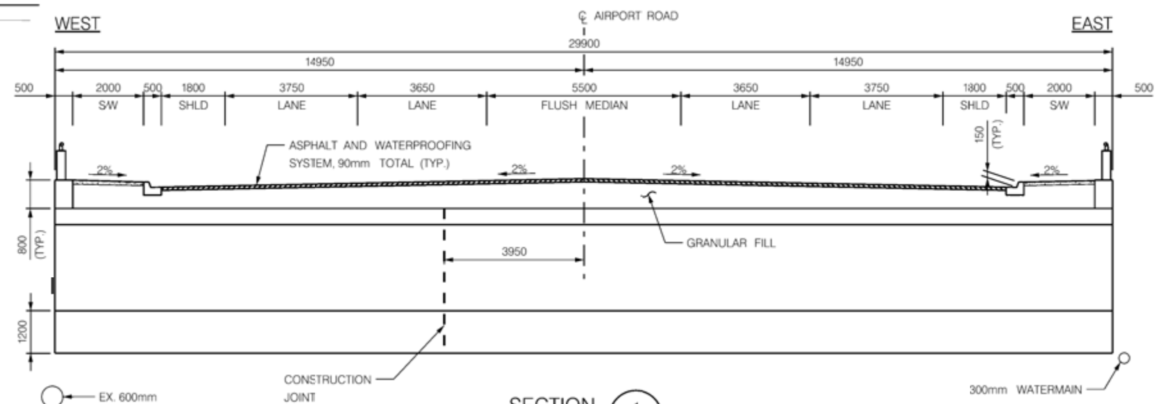




PROFILE OF AIRPORT ROAD
N.T.S.



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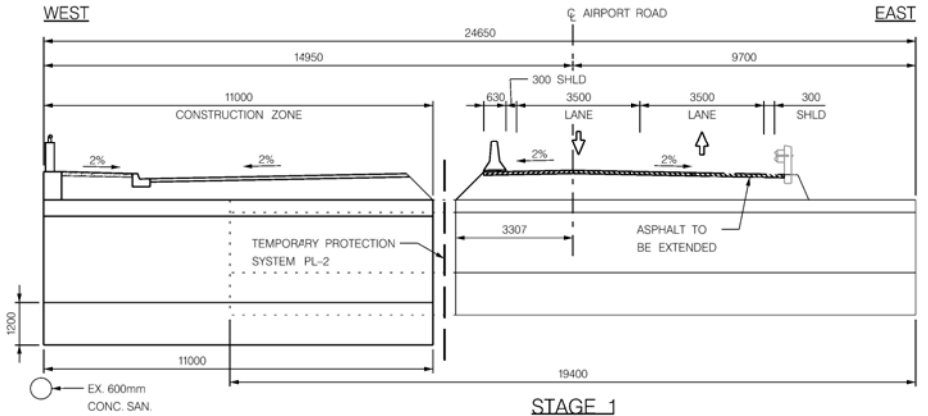

STAGE 1
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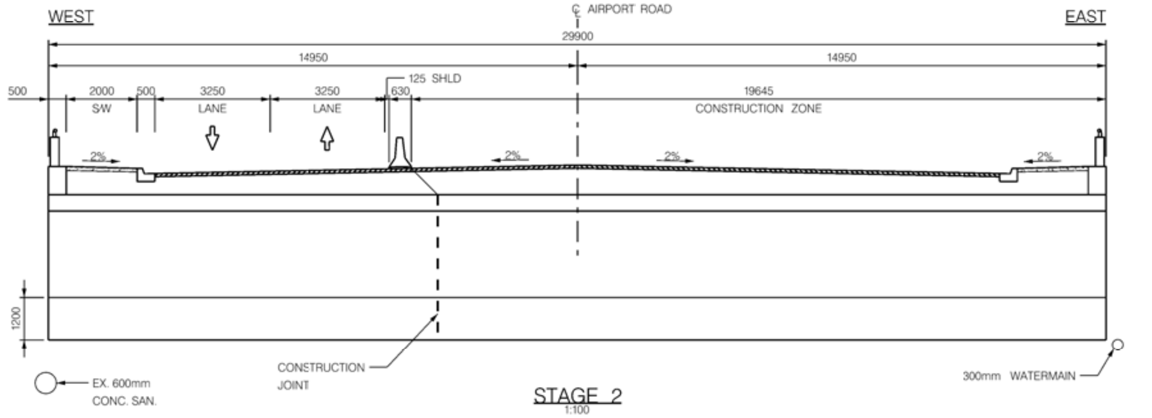

STAGE 2
1:100

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
SAN SEWERS			GAS MAINS		
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TRANSIT			HYDRO ONE		
PARKS & REC.			CTV		
ONT. CLEAN WATER			COMMUNIC. CABLES		

REVISIONS

DATE	DETAILS	INIT.

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BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH SIDES OF CULVERT KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.

THE CROSS SECTION OF THE ROAD SHOWN ON THIS DRAWING REPRESENTS ULTIMATE CONFIGURATION OF THE LANES. SEE ROAD DRAWINGS FOR PRESENT CONFIGURATION OF LANES.

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND ELEVATIONS OF THE EXISTING WORK AND ALL DETAILS ON SITE AND REPORT DISCREPANCIES TO THE CONTRACT ADMINISTRATOR BEFORE PROCEEDING WITH THE WORK.

LIST OF ABREVIATIONS:

SW	DENOTES SIDE WALK
SHLD	DENOTES SHOULDER
CONC.	DENOTES CONCRETE
SAN.	DENOTES SANITARY

APPLICABLE STANDARD DRAWINGS

OPSD 803.010	BACKFILL AND COVER FOR CONCRETE CULVERTS WITH SPAN LESS THAN OR EQUAL RO 3.0m
OPSD 3419.100	BARRIERS AND RAILINGS, STEEL BEAM, GUIDE RAIL AND CHANNEL ANCHORAGE

IBI Group
30 International Boulevard
Toronto ON M9W 5P3 Canada

LICENSED PROFESSIONAL ENGINEER
M. B. VAKILI
PROVINCE OF ONTARIO
Designed by ____ Chkd. ____

REGISTERED PROFESSIONAL ENGINEER
E.P. BRUMFITT
PROVINCE OF ONTARIO
Approved by ____

Region of Peel
Working for you

AIRPORT ROAD
(FROM N. OF MAYFIELD RD. TO N. OF OLD SCHOOL. RD.)
SALT CREEK BOX CULVERT
PRELIMINARY GENERAL ARRANGEMENT

CAD Area	Area Z-8	Project No. __-___
Checked by M.B.V.	Drawn by A.S.	
Date APR, 2013	Sheet of •	Plan No. -D

USER:anna.savin J:\24RX12.0105_Peel Airport Rd EA\5.9 Drawing\59bridge\Airport_Rd_Salt Creek_ga.dgn
9/25/2014

Appendix D
Quantity / Cost Estimate

Quantity estimate for bridge widening- Conspan precast culvert
Airport Rd. Widening- Norris Bridge
Region of Peel
24RX12.0105.00

Part "A" Roadwork

v

Item No.	Item Description	Unit	Quantity	Preliminary design Unit Price	Preliminary design Total
A1	Install and Maintain Project Signboard	LS	1	$5,000.00	$5,000.00
A2	Base Course Asphalt (H.L.4PG 58-28)	tonne	95	$110.00	$10,450.00
A3	Surface Course Asphalt (H.L.3 PG 64-28)	tonne	75	$150.00	$11,250.00
A4	Removal of Asphalt Pavement, Partial Depth	m^2	100	$30.00	$3,000.00
A5	Removal of Asphalt Pavement from Concrete Surfaces on Structures	m^2	228	$15.00	$3,420.00
A6	Removal of Steel Beam Guide Rail	m	60	$15.00	$900.00
A7	Traffic Control (Signing)	LS	1	$5,000.00	$5,000.00
A8	unwatering the structure	LS	1	$15,000.00	$15,000.00
A9	Pavement Marking, Temporary	m	600	$5.00	$3,000.00
A10	Single Rail Steel Beam Guide Rail with Channel	m	60	$110.00	$6,600.00
A11	Steel Beam Guide Rail Structure Connections	each	4	$1,000.00	$4,000.00
A12	Temporary Concrete Barrier	m	120	$80.00	$9,600.00
A13	Temporary Concrete Barrier - Relocation	m	120	$25.00	$3,000.00
A14	Environmental protection	LS	1	$20,000.00	$20,000.00
	TOTAL PART "A"				**$100,220.00**

Part "B" Bridgework

				Preliminary design	
Item No.	Item Description	Unit	Quantity	Unit Price	Total
B1	Conspan Precast culvert fabrication/deliv	LS/m	12.3	$10,000.00	$123,000.00
B2	Conspan Precast head wall fabrication/de	LS/Pc	2.0	$15,000.00	$30,000.00
B3	Conspan precast wingwall Fabr/Deliv/Ins	LS/PC	4.0	$15,000.00	$60,000.00
B4	Concrete in parapet wall	m^3	10.0	$2,000.00	$20,000.00
B5	Reinforcing Steel Bar	LS/t	7.0	$2,500.00	$17,500.00
B6	Railing	m	46.0	$500.00	$23,000.00
B7	Deck Waterproofing	LS/m2	430.0	$50.00	$21,500.00
B8	Curb and Gutter	m	46.0	$85.00	$3,910.00
B9	Sidewalk	m^2	78.0	$100.00	$7,800.00
B10	Concrete in pile cap footing	m^3	0.0	$700.00	$0.00
B11	356x13 mm pipe pile- supply/driving	m	0.0	$370.00	$0.00
B12	Dowels in concrete	EA	130.0	$30.00	$3,900.00
B13	Plain Elastomeric Strip Bearing	m	0.0	$50.00	$0.00
B14	Rehabilitation of existing structure	LS	1.0	$50,000.00	$50,000.00
B15	Excavation	m^3	500.0	$30.00	$15,000.00
B16	cofferdam/sheetpiling	LS	1.0	$50,000.00	$50,000.00
B17	Granular material backfill-type B	tonne	600.0	$20.00	$12,000.00

TOTAL PART "B"	**$437,610**
TOTAL	**$537,830**
10% contigency	$53,783.00
Gr. Total	**$591,613.00**
Unit price (for total culvert deck area)	$1,724.82

Culvert	Area	Unit Price	Total Cost
Norris	343	$1,750	**$600,250**
Deans	209	$1,750	**$365,750**
SaltCreek	254	$1,750	**$444,500**

Quantity Estimate for Bridge Replacement- Precast Conspan
Airport Rd. Widening- Norris Bridge
Region of Peel
24RX12.0105.00

Part "A" Bridgework

				Preliminary design	
Item No.	Item Description	Unit	Quantity	Unit Price	Total
B1	Conspan Precast Culvert Fabrication/Delivery/Installation	LS/m	30.0	$13,300.00	$399,000.00
B2	Conspan Precast Headwall Fabrication/Delivery/Installation	LS/ea.	2.0	$17,000.00	$34,000.00
B3	Conspan Precast Wingwall Fabrication/Delivery/Installation	LS/ea.	4.0	$30,000.00	$120,000.00
B4	Reinforcing Steel Bar	LS/t	24.2	$2,500.00	$60,480.00
B5	Reinforcing Stainless Steel Bar	LS/t	2.7	$12,000.00	$32,368.32
B6	Parapet Wall Railing	m	49.1	$250.00	$12,275.00
B7	Concrete in Footing	m^3	201.6	$700.00	$141,120.00
B8	Concrete in Parapet Wall	m^3	13.5	$1,750.00	$23,601.90
B9	Steel Beam Guide Rail Structure Connections	ea	4.0	$1,000.00	$4,000.00
B10	Temporary Protection System	LS/ea.	1.0	$20,000.00	$20,000.00
B11	Dewatering Structure Excavations	LS/ea.	1.0	$15,000.00	$15,000.00
B12	Removal of Existing Structure	LS	1.0	$50,000.00	$50,000.00
B13	Earth Excavation for Structure	m^3	900.0	$30.00	$27,000.00
B14	Cofferdam/Sheetpiling	LS	1.0	$50,000.00	$50,000.00
B15	Granular Backfill to Strucure Type B	tonne	691.2	$20.00	$13,824.00

TOTAL PART "A"	**$1,002,669**
10% contigency	$100,266.92
Gr. Total	**$1,102,936.14**

Quantity Estimate for Bridge Replacement- Precast Culvert
Airport Rd. Widening- Deans Culvert
Region of Peel
24RX12.0105.00

Part "A" Bridgework

				Preliminary design	
Item No.	Item Description	Unit	Quantity	Unit Price	Total
B1	Precast Open Footing Culvert Fabrication/Delivery/Installation	LS/m	31.6	$13,000.00	$410,800.00
B2	Concrete in Headwall & Retaining Wall	LS/ea.	48.8	$1,000.00	$48,769.80
B3	Reinforcing Steel Bar	LS/t	26.0	$2,500.00	$64,992.45
B4	Reinforcing Stainless Steel Bar	LS/t	2.4	$12,000.00	$28,376.64
B5	Parapet Wall Railing	m	42.4	$500.00	$21,200.00
B6	Concrete in Footing	m^3	211.2	$700.00	$147,840.00
B7	Concrete in Parapet Wall	m^3	11.8	$1,750.00	$20,691.30
B8	Steel Beam Guide Rail Structure Connections	ea	4.0	$1,000.00	$4,000.00
B9	Temporary Protection System	LS/ea.	1.0	$20,000.00	$20,000.00
B10	Dewatering Structure Excavations	LS/ea.	1.0	$15,000.00	$15,000.00
B11	Removal of Existing Structure	LS	1.0	$50,000.00	$50,000.00
B12	Earth Excavation for Structure	m^3	816.0	$30.00	$24,480.00
B13	Cofferdam/Sheetpiling	LS	1.0	$50,000.00	$50,000.00
B14	Granular Backfill to Strucure Type B	tonne	437.4	$20.00	$8,748.00

TOTAL PART "A"	**$914,898**
10% contigency	$91,489.82
Gr. Total	**$1,006,388.01**

Quantity Estimate for Bridge Widening- Precast Culvert
Airport Rd. Widening- Salt Creek Culvert
Region of Peel
24RX12.0105.00

Part "A" Bridgework

				Preliminary design	
Item No.	Item Description	Unit	Quantity	Unit Price	Total
B1	Precast Open Footing Culvert Fabrication/Delivery/Installation	LS/m	34.5	$13,000.00	$448,500.00
B2	Concrete in Headwall & Retaining Wall	LS/ea.	48.8	$1,000.00	$48,769.80
B3	Reinforcing Steel Bar	LS/t	27.7	$2,500.00	$69,342.45
B4	Reinforcing Stainless Steel Bar	LS/t	2.5	$12,000.00	$29,612.16
B5	Parapet Wall Railing	m	44.5	$250.00	$11,125.00
B6	Concrete in Footing	m^3	228.6	$700.00	$160,020.00
B7	Concrete in Parapet Wall	m^3	12.3	$1,750.00	$21,592.20
B8	Steel Beam Guide Rail Structure Connections	ea	4.0	$1,000.00	$4,000.00
B9	Temporary Protection System	LS/ea.	1.0	$20,000.00	$20,000.00
B10	Dewatering Structure Excavations	LS/ea.	1.0	$15,000.00	$15,000.00
B11	Removal of Existing Structure	LS	1.0	$50,000.00	$50,000.00
B12	Earth Excavation for Structure	m^3	816.0	$30.00	$24,480.00
B13	Cofferdam/Sheetpiling	LS	1.0	$50,000.00	$50,000.00
B14	Granular Backfill to Strucure Type B	tonne	437.4	$20.00	$8,748.00

TOTAL PART "A"	**$961,190**
10% contigency	$96,118.96
Gr. Total	**$1,057,308.57**

Cultural Heritage Evaluation and Heritage Impact Assessment: Norris Bridge

Airport Road
Lot 20, Concession VI East in former Chinguacousy Township and
Lot 3, Concession I in former Albion Township, Peel County
Town of Caledon, Regional Municipality of Peel

Prepared for:

IBI Group
30 International
Fergus, ON N1N 1S6
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ASI File 14EA-258

November 2014 (Revised January 2015)

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Cultural Heritage Evaluation and
Heritage Impact Assessment:
Norris Bridge

Airport Road
Lot 20, Concession VI East in former Chinguacousy Township and
Lot 3, Concession I in former Albion Township, Peel County
Town of Caledon, Regional Municipality of Peel

EXECUTIVE SUMMARY

Archaeological Services Inc. (ASI) was contracted by IBI Group Limited to conduct a Cultural Heritage Evaluation and Heritage Impact Assessment of the Norris Bridge located on Airport Road in the Town of Caledon. This report will establish the cultural heritage significance of the structure and assess impacts of the proposed undertaking in consideration of its determined cultural heritage value. This assessment is being conducted under the Municipal Class Environmental Assessment Process as part of the Airport Road from Mayfield Road to King Street Class EA Study. The bridge carries one lane each of northbound and southbound vehicular traffic over Salt Creek in the Town of Caledon, Regional Municipality of Peel. According to available bridge documentation, the bridge was built in 1955 and has never been rehabilitated.

Based on the results of archival research, an analysis of bridge design and construction in Ontario, field investigations and application of *Ontario Heritage Act* Regulation 9/06, the Norris Bridge was not determined to retain cultural heritage value.

Given this evaluation of the structure, the following recommendations should be considered and implemented:

1) This report should be filed with the heritage staff at the Town of Caledon, the Town of Caledon Heritage Committee, and other local heritage stakeholders that may have an interest in this project

2) This report should be archived at the Ontario Archives.

3) This report should be filed with the Ministry of Tourism, Culture, and Sport for review and comment.

4) This report serves as sufficient documentation of the bridge.

ARCHAEOLOGICAL SERVICES INC.
CULTURAL HERITAGE DIVISION

PROJECT PERSONNEL

Senior Project Manager:	Annie Veilleux, MA *Cultural Heritage Specialist* *Manager, Cultural Heritage Division*
Project Manager:	Joel Konrad, Ph.D. *Cultural Heritage Specialist*
Cultural Heritage Specialist:	Joel Konrad
Project Coordinator:	Sarah Jagelewski, Hon. BA *Staff Archaeologist* *Assistant Manager, Environmental Assessment Division*
Project Administrator:	Carol Bella, Hon. BA *Research Archaeologist*
Archival Research:	Joel Konrad
Report Preparation:	Joel Konrad
Graphics Preparation:	Joel Konrad
	Blake Williams, MLitt *Geomatics Specialist*
Report Reviewer:	Annie Veilleux

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1.0 INTRODUCTION

Archaeological Services Inc. (ASI) was contracted by IBI Group Limited to conduct a Cultural Heritage Evaluation and Heritage Impact Assessment of the Norris Bridge located on Airport Road in the Town of Caledon. This report will establish the cultural heritage significance of the structure and assess impacts of the proposed undertaking in consideration of its determined cultural heritage value. This assessment is being conducted under the Municipal Class Environmental Assessment Process as part of the Airport Road from Mayfield Road to King Street Class EA Study. The bridge carries one lane each of northbound and southbound vehicular traffic over Salt Creek in the Town of Caledon, Regional Municipality of Peel (Figure 1). According to available bridge documentation, the bridge was built in 1955 and has never been rehabilitated.

Figure 1: Location of the Study Area.
Base Map: ©OpenStreetMap and contributors, Creative Commons-Share Alike License (CC-BY-SA ESRI Street Maps)

The following report is presented as part of an approved planning and design process subject to Environmental Assessment (EA) requirements. This portion of the EA study is intended to address the proposed replacement/rehabilitation of the subject structure. The principal aims of this report are to:

- Describe the methodology that was employed and the legislative and policy context that guides heritage evaluations of bridges over 40 years old;
- Provide an historical overview of the design and construction of the bridge within the broader context of the surrounding township and bridge construction generally;

- Describe existing conditions and heritage integrity;
- Evaluate the bridge within Regulation 9/06 of the *Ontario Heritage Act* and draw conclusions about the heritage attributes of the structure; and
- If warranted, assess impacts of the undertaking, ascertaining sensitivity to change in the context of identified heritage attributes and recommend appropriate mitigation measures.

2.0 LEGISLATION AND POLICY CONTEXT

Infrastructure projects have the potential to impact cultural heritage resources in a variety of ways. These include loss or displacement of resources through removal or demolition and the disruption of resources by introducing physical, visual, audible or atmospheric elements that are not in keeping with the resources and/or their setting.

A 40-year-old threshold is used as a guiding principle when considering cultural heritage resources in the context of improvements to specified areas. While identification of a resource that is 40 years old or older does not confer outright heritage significance, this threshold provides a means to collect information about resources that may retain heritage value. Similarly, if a resource is slightly younger than 40 years old, this does not preclude the resource from retaining heritage value.

The analysis used throughout the cultural heritage resource assessment process addresses cultural heritage resources under various pieces of legislation and their supporting guidelines:

- *Environmental Assessment Act* (R.S.O. 1990, Chapter E.18)
    - *Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments* (MCC 1992)
    - *Guidelines on the Man-Made Heritage Component of Environmental Assessments* (MCR 1981)

- *Ontario Heritage Act* (R.S.O. 1990, Chapter O.18) and a number of guidelines and reference documents prepared by the Ministry of Tourism and Culture (MTC):
    - *Ontario Heritage Tool Kit* (MCL 2006)
    - *Screening for Impacts to Built Heritage and Cultural Heritage Landscapes (November 2010)*

2.1 Municipal Context and Policies

2.1.1 The Town of Caledon Official Plan

Section 3.2 of the Town of Caledon's Official Plan emphasizes the active stewardship of cultural heritage, stating that the "Town seeks to wisely manage cultural heritage resources within its municipal boundaries that are of historical, architectural and archaeological value" (Town of Caledon 2008: 19).

Section 3.2.3 outlines the Town of Caledon's heritage policies, with particular attention paid to Cultural Heritage Surveys outlined in section 3.2.3.1.4:

> Cultural Heritage Surveys:

> All development or redevelopment proposals will be reviewed by the Town to determine whether a Cultural Heritage Survey is required or whether, as appropriate, a Cultural Heritage Survey will be requested. In making this determination, the Town will consider the scope of the proposal and, through reference to the archaeological master plan, built heritage resources inventory, cultural heritage landscape inventory, or local information, the likelihood of significant cultural heritage resources being encountered.
>
> Where a Cultural Heritage Survey is required, the proponent is encouraged to consult with the Town and other relevant agencies concerning the scope of the work to be undertaken. The Cultural Heritage Survey will be the responsibility of the proponent and must be undertaken by a qualified professional with appropriate expertise, and it should generally:
>
> a) identify the level of significance of any cultural heritage resources, including archaeological resources and potential, existing on and in close proximity to the subject lands; and
>
> b) make recommendations for the conservation of the cultural heritage resources including whether a Cultural Heritage Impact Statement should be prepared.

Additionally, section 3.2.3.1.7 states that “should a development proposal change significantly in scope or design after completion of an associated Cultural Heritage Survey, Cultural Heritage Planning Statement or Cultural Heritage Impact Statement, additional cultural heritage investigations may be required by the Town.” Section 3.2.3.1.8 continues:

> Appropriate conservation measures, identified in a Cultural Heritage Planning statement, Cultural Heritage Survey or Cultural Heritage Impact Statement, may be required as a condition of any development approval. Where the Town has the authority to require development agreements and, where appropriate, the Town may require development agreements respecting the care and conservation of the affected cultural heritage resource. This provision will not apply to cultural heritage resources in so far as these cultural heritage resources are the subject of another agreement respecting the same matters made between the applicant and another level of government or Crown agency.

The Town of Caledon also encourages the conservation of significant cultural heritage landscapes and vegetation, as outlined in sections 3.2.3.1.14 and 3.2.3.15. These sections place a “regard for the interrelationship between cultural heritage landscapes and scenic natural landscapes” and promote the “retention of significant cultural heritage vegetation” in development contexts. In addition, the latter section emphasizes the importance of conserving cultural heritage vegetation “along streets and roads.”

2.2.1 Municipal Consultation

The Town of Caledon was consulted for additional information pertaining to the bridge and it was confirmed that the structure is not a recognized as a heritage resource by the Town.[1]

---

[1] Email correspondence occurred on 12 November 2014.

2.2 Cultural Heritage Evaluation and Heritage Impact Assessment Report

The scope of a Cultural Heritage Evaluation (CHE) is guided by the Ministry of Tourism, Culture and Sport's *Ontario Heritage Toolkit* (2006). Generally, CHEs include the following components:

- A general description of the history of the study area as well as a detailed historical summary of property ownership and building(s) development;
- A description of the cultural heritage landscape and built heritage resources;
- Representative photographs of the exterior and interior of a building or structure, and character-defining architectural details;
- A cultural heritage resource evaluation guided by the *Ontario Heritage Act* criteria;
- A summary of heritage attributes;
- Historical mapping, photographs; and
- A location plan.

Using background information and data collected during the site visit, the cultural heritage resource is evaluated using criteria contained within Regulation 9/06 of the *Ontario Heritage Act*.

Ontario Heritage Act Regulation 9/06 provides a set of criteria, grouped into the following categories which determine the cultural heritage value or interest of a potential heritage resource in a municipality:

i) Design/Physical Value;
ii) Historical/Associative Value; and
iii) Contextual Value.

Should the potential heritage resource meet one or more of the above mentioned criteria, a Heritage Impact Assessment (HIA) is required and the resource considered for designation under the *Ontario Heritage Act*.

In early 2011, the Ministry of Tourism and Culture (MTC) indicated that bridges not owned by the Ministry of Transportation be evaluated against Ontario Regulation 9/06 and not the Ministry of Transportation's *Ontario Heritage Bridge Guidelines* (Interim, 2008) or the *Ontario Heritage Bridge Program* (1991). With this in mind, the MTC recommends that a Heritage Impact Assessment is necessary for structures found to have potential heritage significance, as determined by the cultural heritage evaluation (MTC, June 2011).

The scope of a Heritage Impact Assessment (HIA) is provided by the MTC's *Ontario Heritage Tool Kit.* An HIA is a useful tool to help identify cultural heritage value and provide guidance in supporting environmental assessment work. As part of a heritage impact assessment, proposed site alterations and project alternatives are analyzed to identify impacts of the undertaking on the heritage resource and its heritage attributes. The impact of the proposed development on the cultural heritage resource is assessed, with attention paid to identifying potential negative impacts, which may include, but not limited to:

- Destruction of any, or part of any, significant heritage attributes or features;
- Alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance;
- Shadows created that alter the appearance of a heritage attribute or change the viability of an associated natural feature or plantings, such as a garden;

- Isolation of a heritage attribute from its surrounding environment, context or a significant relationship;
- Direct or indirect obstruction of significant views or vistas within, from, or of built and natural features;
- A change in land use (such as rezoning a church to a multi-unit residence) where the change in use negates the property's cultural heritage value;
- Land disturbances such as a change in grade that alters soils, and drainage patterns that adversely affect a cultural heritage resource, including archaeological resources.

Where negative impacts of the development on the cultural heritage resource are identified, mitigative or avoidance measures, alternative development, or site alteration approaches are considered.

3.0 HISTORICAL CONTEXT AND CONSTRUCTION

3.1 Introduction

Built in 1955, the Norris Bridge is a single span concrete rigid frame structure carrying two lanes of Airport Road vehicular traffic over Salt Creek in the Town of Caledon, Regional Municipality of Peel. Historically, the study corridor forms the road allowance between Lot 20, Concession VI East in Chinguacousy Township and Lot 3, Concession I in Albion Township, Peel County (Figures 2 and 3).

Cultural heritage resources are those buildings or structures that have one or more heritage attributes. Heritage attributes are constituted by and linked to historical associations, architectural or engineering qualities and contextual values. Inevitably many, if not all, heritage resources are inherently tied to "place"; geographical space, within which they are uniquely linked to local themes of historical activity and from which many of their heritage attributes are directly distinguished today. In certain cases, however, heritage features may also be viewed within a much broader context. Section 3.0 of this report details a brief historical background to the settlement of the surrounding area. A description is also provided of the construction of the bridge within its historical context.

3.2 Local History and Settlement

3.2.1 Township of Chinguacousy

The land within Chinguacousy Township was acquired by the British from the Mississaugas in 1818. The first township survey was undertaken in 1818, and the first legal settlers occupied their land holdings in the same year. The township is said to have been named by Sir Peregrine Maitland after the Mississauga word for the Credit River, and which signified "young pine." Other scholars assert that it was named in honour of the Ottawa Chief Shinguacose, which was corrupted to the present spelling of 'Chinguacousy,' who led the capture of Fort Michilimacinac from the Americans in the War of 1812. Chinguacousy was initially settled by the children of Loyalists, soldiers who had served during the War of 1812, and by immigrants from England, Scotland and Ireland. By the 1840s, the township was noted for its excellent land, many good farms and the excellent wheat grown there (Mika and Mika 1977: 416; Smith 1846:32; Armstrong 1985:142; Rayburn 1997:68).

3.2.2 Township of Albion

The land within Albion Township was acquired by the British from the Mississaugas in 1818. The first township survey was undertaken in 1819, and the first legal settlers occupied their land holdings in the same year. The township was named by surveyor James G. Chewett after a poetic name for Britain. The word is Celtic in origin and means “the land.” Albion was initially settled by the children of Loyalists, soldiers who had served during the War of 1812, and by immigrants from England, Scotland and Ireland. By the 1840s, the township was noted for its good farms (Smith 1846:2; Armstrong 1985:141; Rayburn 1997:6).

3.2.3 Sandhill

This village was located at the intersection of what is now Airport Road and King Street, on part Lot 10 Concession 1, Albion Township, and on part Lots 27 and 28 Concession 6 East, Chinguacousy Township. The settlement was first named “Newton Hewitt” after its earliest settler, John Hewitt. The name of the village was officially changed to Sandhill when the post office was relocated here in 1844. It contained three churches (Presbyterian, Wesleyan Methodist and Anglican), two hotels, one of which was known as the Sandhill Commercial Hotel or ‘Little Hotel’, two stores, blacksmith shops, saddlery, shoe maker, tanners, carriage and wagon makers, harness shop and telegraph office. Other hotels in the immediate vicinity of Sandhill included the Temperance Hotel or the Morning Stage Hotel, and also the “Four Alls” Hotel. A school stood to the south of Sandhill on Airport Road which was known as the Kennedy School (SS19 Chinguacousy). Two other churches, known as the Hope/Grove Primitive Methodist Churches, stood south of Sandhill near the intersection of Bramalea and Old School Roads. The population was about 200 in 1873 (Smith 1851:281; Crossby 1873:307; Heyes 1961:280-282; Charters 1967:231; Davies 2000:66, 87, 104, 110, 114-115, 117).

3.2.4 Tullamore

This post office village was located south of the study corridor at the intersection of what is now Airport Road and Mayfield Road, on part Lots 17 and 18, Concession 6 East, in Chinguacousy Township, part Lot 1, Concession 1, in Albion Township and on part Lot 17 Concession 7, in Toronto Gore Township. Registered plans of subdivision for this village date from 1856. It was a thriving village during the mid-nineteenth century, but its prosperity dwindled following the construction of the railways. As early as 1851, it was described as “a miserable, tumble-down, dilapidated looking place.” The name of the village was suggested by a settler named Abraham Odlum after his native place in Ireland. It contained a school, a church, stores, a cabinet maker, a blacksmith, a wagon maker, a harness maker, a boot and shoemaker and one hotel. It had a population of about 250 (Smith 1851:281; Crossby 1873:340; Charters 1967:267; Winearls 1991:847).

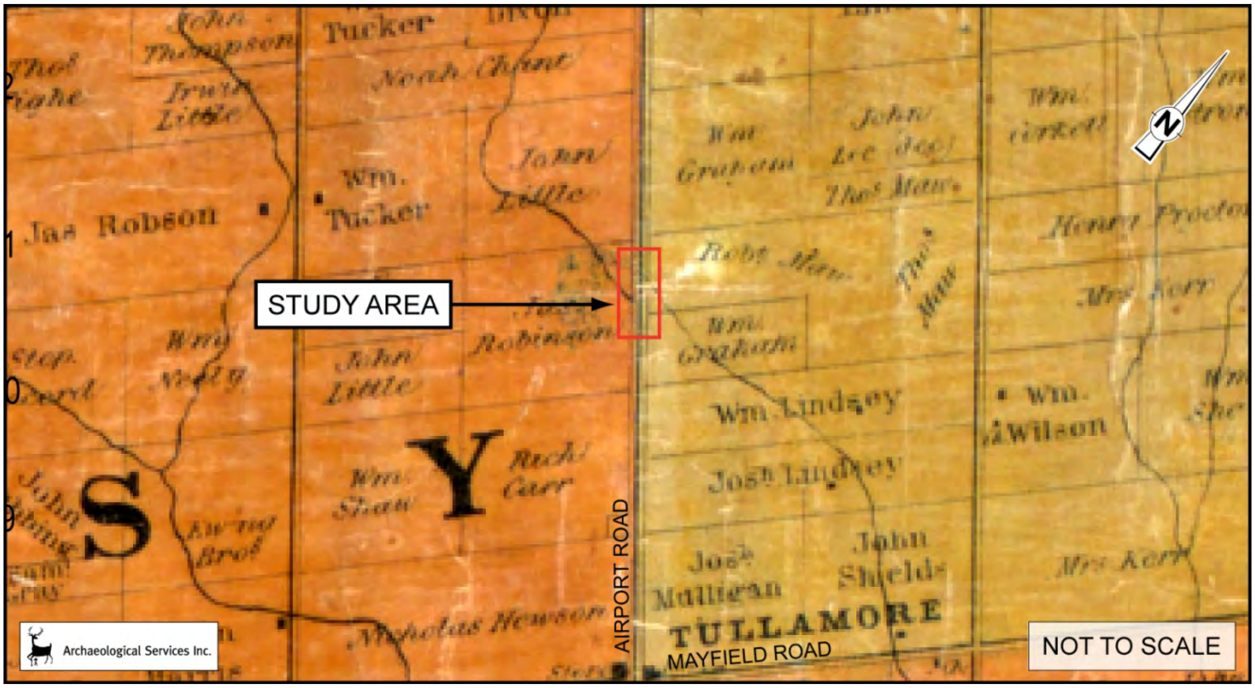


Figure 2: Location of the Study Area on mapping from 1859.

Base Map: *Tremaine's Map of the County of Peel*, 1859

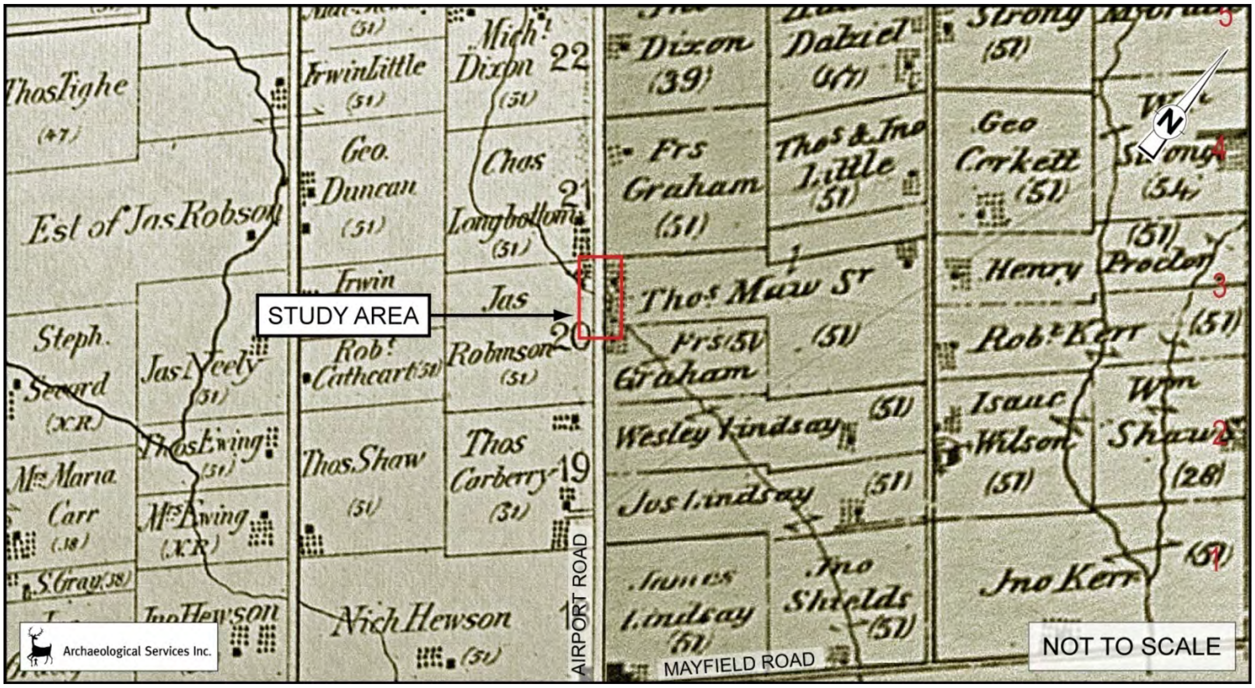
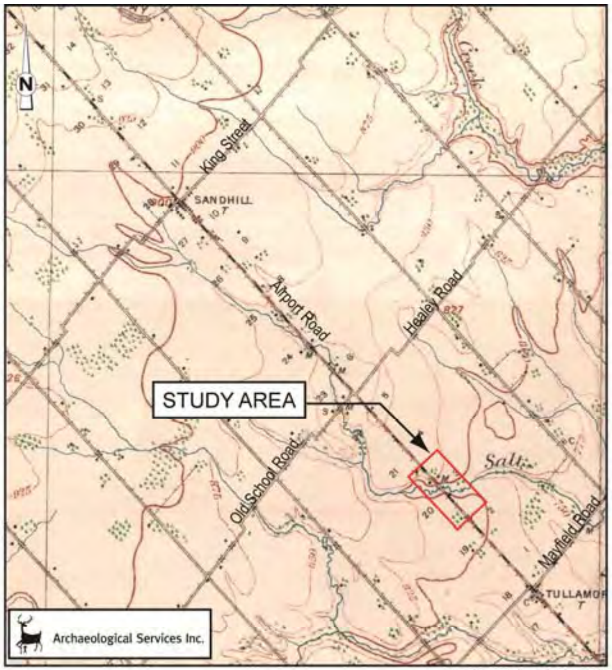


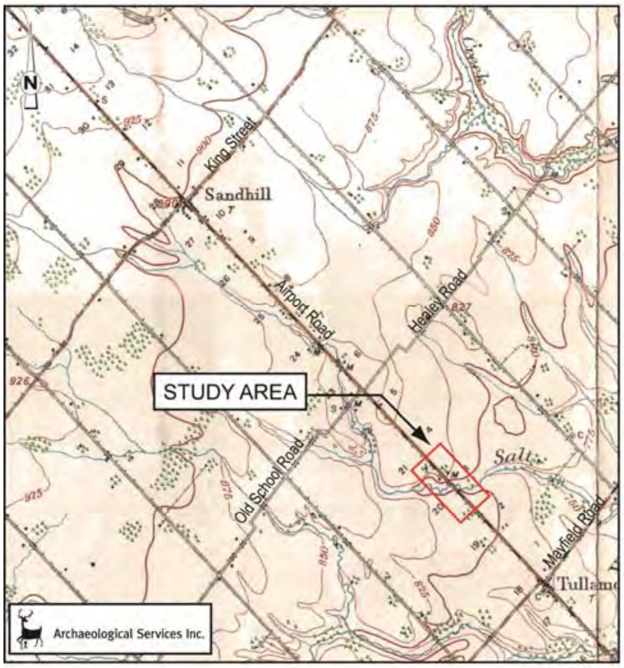
Figure 3: Location of the study area on 1877 mapping.

Base Map: *Illustrated Historical Atlas of the County of Peel, Ont.*, 1877

Bolton Sheet No. 59
Department of Militia and Defence 1914; Reprinted with corrections 1919



Bolton Sheet No. 59
Department of National Defence; Reprinted with corrections 1926



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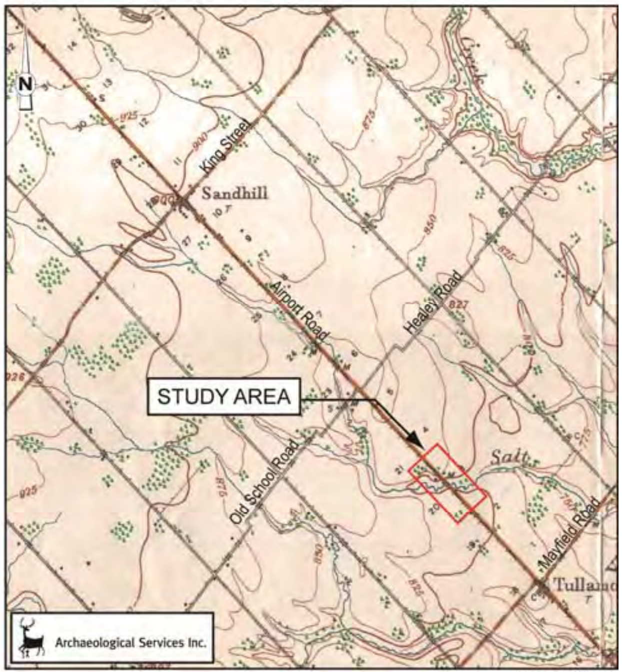
Department of National Defence 1914; Revised 1934



Bolton Sheet
Department of National Defence 1914; Reprinted 1940

Figure 4: Location of the study area in the Townships of Chinguacousy and Albion on a series of Topographic Maps.

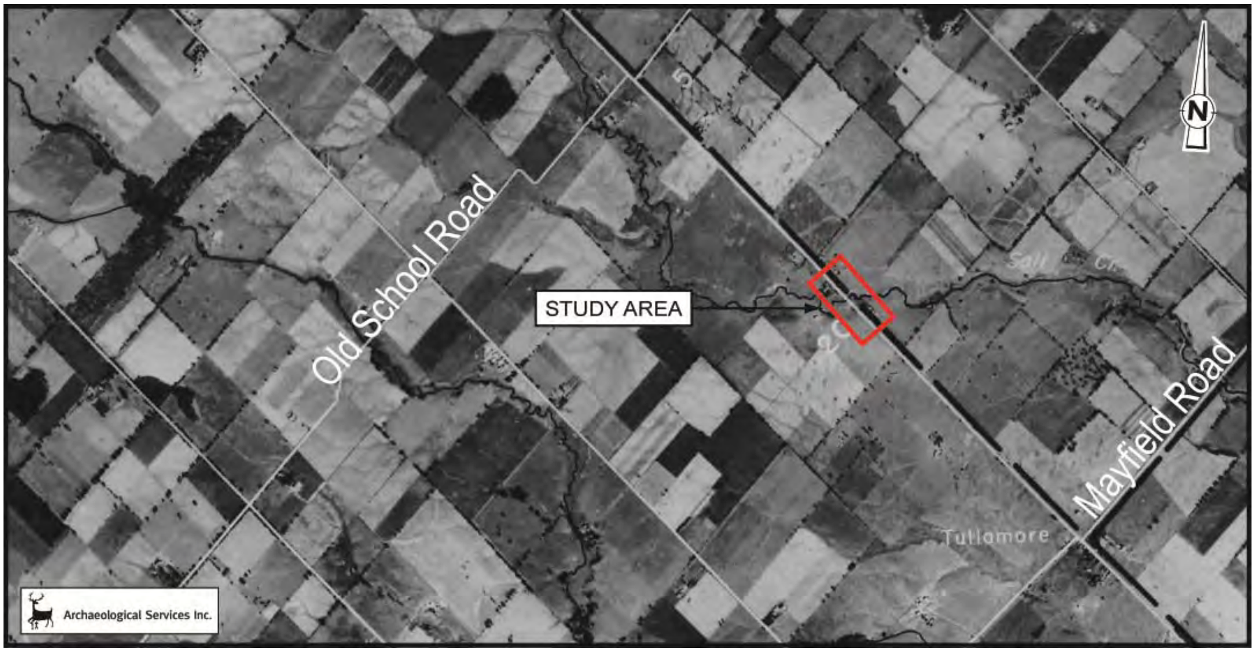


Figure 5: Location of the study area in the Townships of Chinguacousy and Albion, 1954.
Base Map: Hunting Survey Corporation Limited, 1954

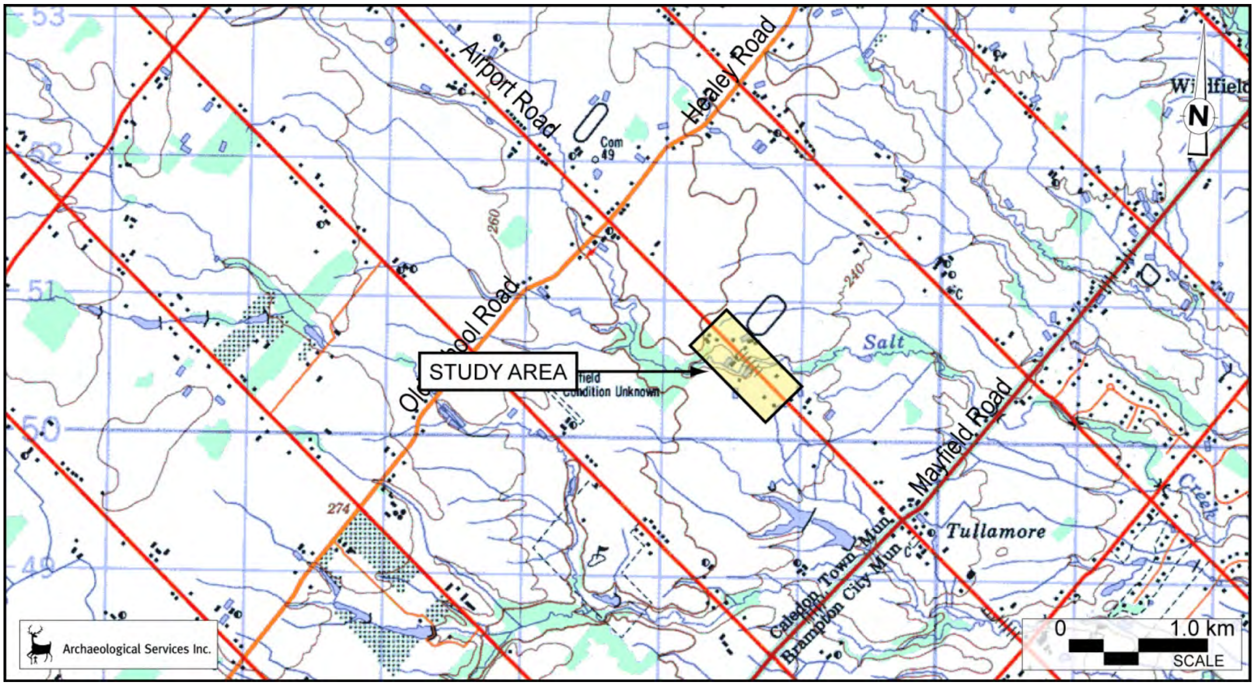


Figure 6: Location of the study area in the Town of Caledon, Regional Municipality of Peel.
Base Map: NTS Sheet Bolton (30 M/13)

3.3 Previous Bridge Crossings

Historically, the subject bridge is situated within the road allowance between Lot 20, Concession VI East in Chinguacousy Township and Lot 3, Concession I in Albion Township, Peel County, Ontario. The structure was built in 1955 to carry what is now Airport Road over Salt Creek. Airport Road was an historically surveyed road. As a result, a previous structure must have spanned the watercourse. A review of historic mapping reveals that this was a "Masonry" bridge, though archival records and periodicals could not confirm any further details.

3.4 History of Airport Road

Road and bridge building and maintenance were underdeveloped in Albion and Chinguacousy Townships during the first half of the nineteenth century due to regular flooding of the region's abundant creeks. However, settlement intensified in the townships by mid century and, as a result, roads were needed to facilitate commerce. According to the *Tremaine'sMap of the County of Peel, 1877* (Figure 2), what is now Airport Road was a surveyed concession road at that time. Though the creek is evident on the map, no bridge is indicated, however this does not preclude the existence of an earlier structure. The *Illustrated Historical Atlas of the County of Peel, 1877* (Figure 3), records Salt Creek crossing what is now Airport Road. In addition, the map reveals that two residences were located on the east side of the road, one to the north and one to the south of Salt Creek, while one residence was located to the west, on the north side of the creek. The map indicates that orchards surrounded all three residences, suggesting an area of high agricultural fertility.

National Topographic Mapping dating to 1919 (Figure 4) demonstrates that an improved road, likely macadamized, existed between the lots at that time and that a bridge was extant. Though the mapping does confirm that a stone bridge existed prior to the Norris Bridge, no information on the bridge size could be determined using available archival documents and reports. The three residences adjacent to the study were still extant at this time and the map indicates an abundance of vegetation in the area. While topographic mapping from 1926 (Figure 4) indicates no significant change from 1919, topographic mapping from 1934 and 1940 (Figure 4) indicate that Airport Road had been paved by that time. According to available aerial photography, the area had changed little by 1954 (Figure 5). NTS mapping dating to 1994 (Figure 6) demonstrates that Airport Road to the north and south of the Norris Bridge had been graded, indicating that a larger structure might have existed prior to the present bridge. Additional structures are recorded to the northeast and northwest of the bridge, though no changes in the stream or Airport Road appear.

3.5 Bridge Construction

3.5.1 Early Bridge Building in Ontario

Up until the 1890s, timber truss bridges were the most common bridge type built in southern Ontario. Stone and wrought iron materials were also employed but due to higher costs and a lack of skilled craftsmen, these structures were generally restricted to market towns. By the 1890s, steel was becoming the material of choice when constructing bridges given that concrete was less expensive and more durable than its wood and wrought iron predecessors. Steel truss structures were very common by 1900, as were steel girder bridges. The use of concrete in constructing bridges was introduced at the beginning of the twentieth century, and by the 1930s, it was challenging steel as the primary bridge construction material in Ontario (Ministry of Culture and Ministry of Transportation [n.d.]:7-8).

3.5.2 Construction of Norris Bridge

Norris Bridge is a single span, rigid frame bridge carrying two lanes of Airport Road over Salt Creek in the Town of Caledon, Regional Municipality of Peel, Ontario. According to the Biennial Bridge Inspection Report on the Norris Bridge, completed by Engineered Management Systems Inc. in 2010, the subject bridge was built in 1955. Despite a review of Council Minutes, county and township histories, and sundry available archival documents, no further information could be gleaned about the construction of the structure.

According to the available reference documents, no refurbishments have been undertaken on the subject bridge.

4.0 EXISTING CONDITIONS AND INTEGRITY

A field review was undertaken by Joel Konrad on 9 October 2014 to conduct photographic documentation of the bridge crossing and to collect data relevant for completing a heritage evaluation of the structure. Results of the field review and bridge inspection reports received from the client were then utilized to describe the existing conditions of the bridge crossing. This section provides a general description of the bridge crossing and associated cultural heritage features. For ease of description the bridge is considered to have a north-south orientation. Photographic documentation of the bridge crossing is provided in Appendix A.

The Norris Bridge is located in the road allowance between Lot 20, Concession VI East in Chinguacousy Township and Lot 3, Concession I in Albion Township, Peel County, Ontario. According to available information, the single span rigid frame bridge was built in 1955 to carry two lanes of Airport Road traffic over Salt Creek. The bridge crossing is bounded by fields under cultivation to the northeast, wetlands to the east and grasslands to the south. Grassland and wooded areas are visible to the northwest, west, and southwest of the structure. The subject bridge is not identified as a heritage structure by the Town of Caledon, and thus is not designated under Part IV of the *Ontario Heritage Act* and is not currently on the *Ontario Heritage Bridge List*.

The Norris Bridge is currently owned/maintained by the Region of Peel. According to an inspection undertaken in 2010, the structure features a crossing length of 10.7 m, a travelled deck width of 6.85 m and an overall width of 17.2 m (*Biennial Bridge Inspection Report* 2010: 1). The speed limit is posted as 80 km, though there is no load limit posted for the structure. The bridge features an asphalt wearing surface atop a concrete deck and abutments. The wearing surface of the bridge deck is bounded by concrete guttering, asphalt shoulders, and single metal railings atop concrete barriers to form the overall railing system. A metal barrier system extends from the railing system, attached to the interior of concrete barriers at all four corners of the bridge, Both the north and south abutments terminate at Salt Creek and retain wingwalls decorated with horizontal fluting. The concrete soffit retains plastic piping for drainage.

According to the data received from the client, the bridge has not been refurbished by the Region of Peel.

The *Biennial Bridge Inspection Report* for the Norris Bridge, completed in 2010, presented the following recommendations:

- Approaches: Transverse cracking should be sealed;
- Wearing Surface: All cracks should be sealed; and
- Degradation affecting the bottom water bed – water bed protection should be taken into account to protect the frame legs.

4.1 Comparative Geographic and Historic Context of Bridges in the Region of Peel

ASI requested IBI Group to procure an inventory of bridges owned by the Region of Peel. Unfortunately, no inventory could be provided.

4.2 Additional Cultural Heritage Resources

There are no identified cultural heritage resources located adjacent to the subject bridge.

5.0 HERITAGE EVALUATION OF THE NORRIS STREET BRIDGE

Table 1 contains the evaluation of the Norris Bridge against criteria as set out in *Ontario Heritage Act* Regulation 9/06. Within the Municipal EA process, Regulation 9/06 is the prevailing evaluation tool when determining if a heritage resource, in this case a bridge, has cultural heritage value.

Table 1: Evaluation of the Norris Bridge using *Ontario Heritage Act* Regulation 9/06

1. The property has design value or physical value because it:

Ontario Heritage Act Criteria	Analysis
i. is a rare, unique, representative or early example of a style, type, expression, material or construction method;	The Norris Bridge's rigid frame construction and build date are common within Ontario. Unfortunately, no data was available to compare the bridge to other structures in the region.
ii. displays a high degree of craftsmanship or artistic merit, or;	While the horizontal fluting on the wingwalls points to some consideration of artistic ornamentation, the subject bridge generally exhibits a low degree of craftsmanship or artistic merit.
iii. demonstrates a high degree of technical or scientific achievement.	This bridge exhibits a low degree of technical achievement given its build date, short span, easy access, and gentle water flow.

2. The property has historical value or associative value because it:

Ontario Heritage Act Criteria	Analysis
i. has direct associations	The structure maintains a direct connection with Airport Road, a road

Table 1: Evaluation of the Norris Bridge using *Ontario Heritage Act* Regulation 9/06

with a theme, event, belief, person, activity, organization or institution that is significant to a community;	associated with settlement, growth, and development in the Region, and previous structures fording Salt Creek. Though it was determined that a stone bridge was extant on the site prior to the Norris Bridge, no further information concerning this or earlier structures is available.
ii. yields, or has the potential to yield, information that contributes to an understanding of a community or culture, or;	This criterion is not satisfied given that the structure does not contribute to an understanding of a community or culture.
iii. demonstrates or reflects the work or ideas of an architect, artist, builder, designer or theorist who is significant to a community.	This criterion is not satisfied given that the architect and contractor are unknown.

3. The property has contextual value because it:

Ontario Heritage Act Criteria	Analysis
i. is important in defining, maintaining or supporting the character of an area;	The design, scale, and general massing of the bridge is simple, reflecting the surrounding natural/agricultural landscape.
ii. is physically, functionally, visually or historically linked to its surroundings, or;	The bridge is physically, functionally and historically linked to its surroundings. It serves as a bridging point for vehicles over the creek and is physically associated with the creek and the surrounding rural landscape.
iii. is a landmark.	Due to the relatively small scale of the bridge and its proximity to a major settlement, the structure does not serve as a landmark feature.

The cultural heritage evaluation of the Norris Bridge determined that the subject structure does not retain cultural heritage value. Therefore, a Heritage Impact Assessment of the bridge does not need to be conducted as part of the environmental assessment work.

6.0 RECOMMENDATIONS

Based on the results of archival research, an analysis of bridge design and construction in Ontario, field investigations and application of *Ontario Heritage Act* Regulation 9/06, the Norris Bridge was not determined to retain cultural heritage value.

Given this evaluation of the Norris Bridge, the following recommendations should be considered and implemented:

1) This report should be filed with the heritage staff at the Town of Caledon, the Town of Caledon Heritage Committee, and other local heritage stakeholders that may have an interest in this project

2) This report should be archived at the Ontario Archives.
3) This report should be filed with the Ministry of Tourism, Culture, and Sport for review and comment.
4) This report serves as sufficient documentation of the bridge.

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APPENDIX A:
Photographic Plates

Plate 1: East elevation of the subject bridge, looking northwest.

Plate 2: West elevation of the bridge, looking northeast.

Plate 3: Oblique view of the east elevation, looking south.

Plate 4: Oblique view of west elevation, looking south.

Plate 5: Detail of the east elevation, looking northwest.

Plate 6: View of the bridge deck, concrete drainage system, asphalt shoulders, and concrete railing system, looking southwest.

Plate 7: View towards the railing system and metal barrier system located on the west side of the bridge, looking west.

Plate 8: Detail of the metal railing system at the northeast corner of the bridge.

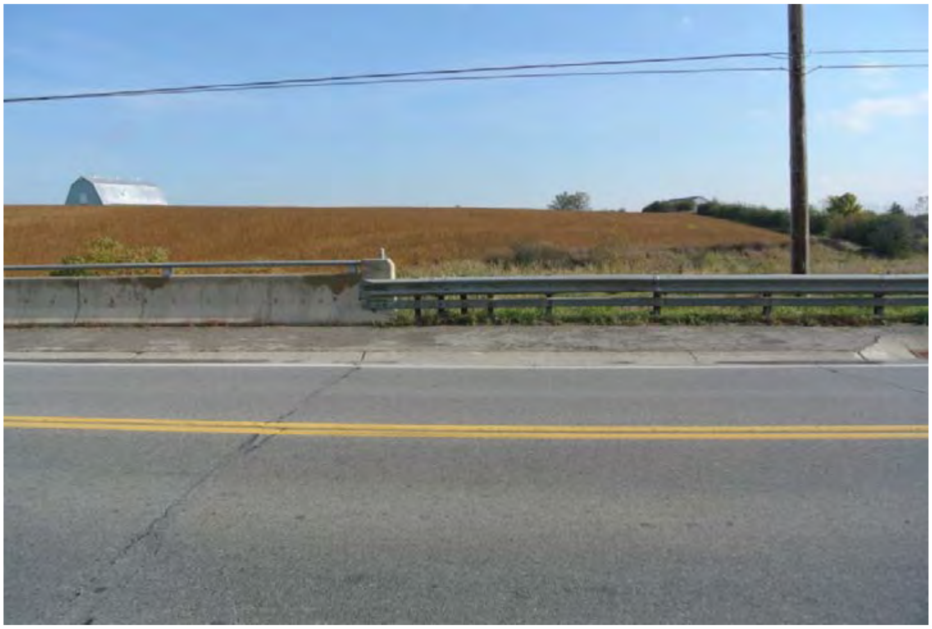

Plate 9: Detail of metal barrier system and concrete railing system located at the southeast corner of the bridge.

Plate 10: Detail of south abutment, looking east. Note the horizontal fluting on the wingwall.

Plate 11: Detail of the abutment, deck, and concrete railing system on the southeast side of the bridge.

Plate 12: View underneath the bridge, looking east.

Plate 13: View towards the north abutment, looking northeast.

Plate 14: Detail of the north abutment. Note the indication of fluctuating water level.

Plate 15: Detail of the bridge soffit and south abutment, looking southwest.

Plate 16: Detail of the bridge soffit and north abutment, looking west.

Plate 17: View of Salt Creek to the east of the bridge, looking south.

Plate 18: View of Salt Creek to the west of the subject bridge, looking west.

Plate 19: View of the northern approach to the bridge, looking south.

APPENDIX B:
Available Schematic Drawings

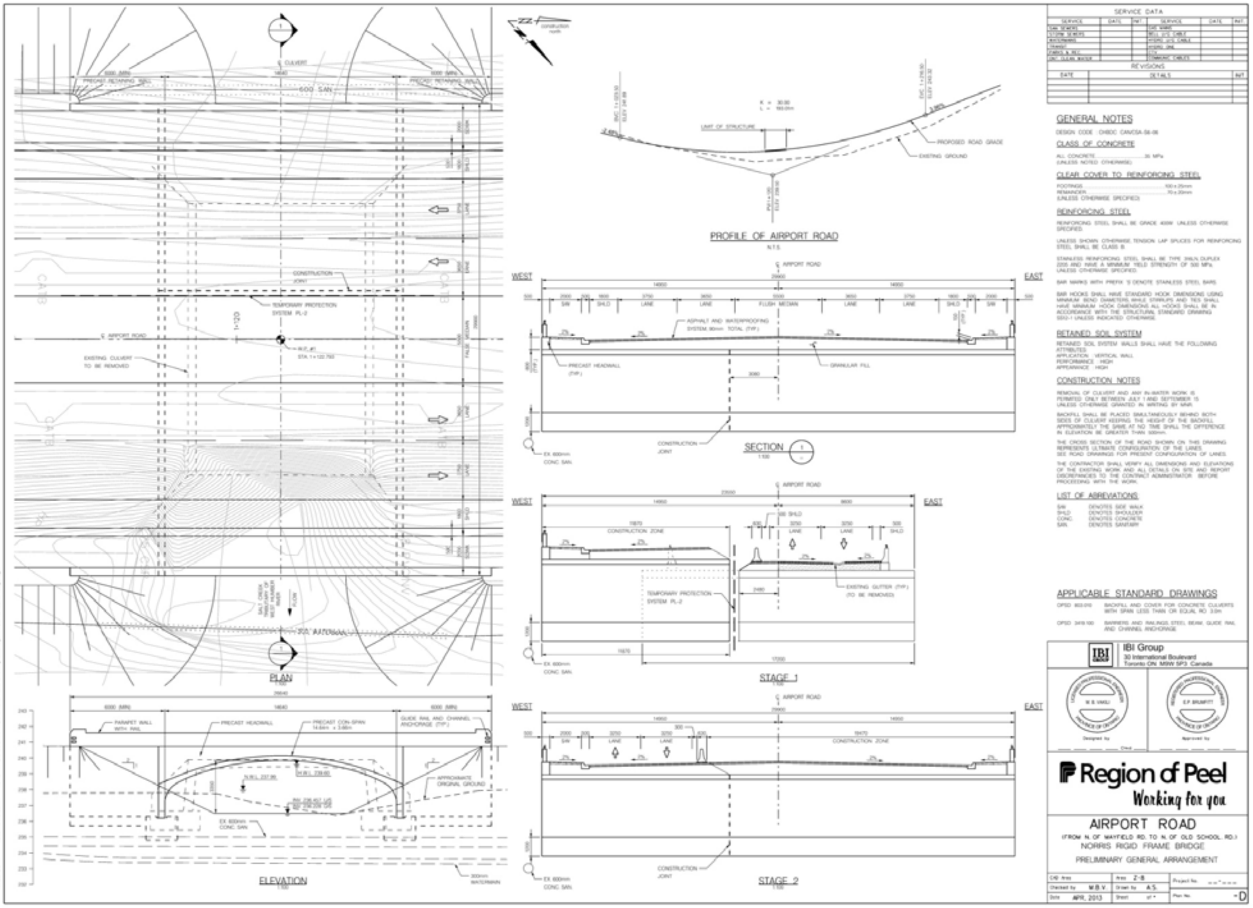

Figure 7: Preliminary General Arrangement of Norris Bridge.

Source: IBI Group, 2013