PRELIMINARY GEOTECHNICAL AND PAVEMENT INVESTIGATION
HUNTINGTON ROAD CLASS EA STUDY
FROM LANGSTAFF ROAD TO McGILLIVRAY ROAD (PART A)
CITY OF VAUGHAN, ONTARIO

Prepared For:
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1. INTRODUCTION

SPL Consultants Limited (SPL) was retained by PARSONS to undertake a preliminary geotechnical and pavement investigation for the proposed rehabilitation/reconstruction of 4.1 km of Huntington Road from Langstaff Road to McGillivray Road (south of Major Mackenzie Drive) in the City of Vaughan, Ontario.

The purpose of the geotechnical investigation was to determine the existing pavement structure and subsurface conditions of existing road at borehole locations and also subsurface conditions at five culvert locations. From the findings in the boreholes, recommendations for rehabilitation/reconstruction of Huntington Road will be provided. Preliminary foundation assessment at five (5) culvert locations will also be given.

We understand that based on the latest design, Huntington Road will be widened to 4 lane section from Langstaff Road to McGillivray Road (there will be a discontinuity on Huntington Road between McGillivray Road and north of Major Mackenzie Drive resulting from the Highway 427 extension), as shown in Drawing 1A. We also understand no major horizontal and vertical realignment are anticipated except at few locations. We further understand that no new sewers or watermains will be constructed on Huntington Road within the project limits.

This report is provided on the basis of the terms of reference presented above and on the assumption that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for PARSONS, the City of Vaughan and its designers. Third party use of this report without SPL consent is prohibited. The limitation conditions presented in this report form an integral part of the report and they must be considered in conjunction with this report.

2. TRAFFIC DATA AND ROAD CLASSIFICATION

As provided by PARSONS, Huntington Road from Rutherford Road to McGillivray Road within the project limits is classified as Urban Major Collector Road. Presently Huntington Road is a two lane road within project limits with a posted speed of 70 km/hr.

Traffic volumes as provided by PARSONS are presented in Table 1 below:

Table 1: Traffic Volumes on Huntington Road, Within the Project Limits

Route	Limits	AADT Data		% Growth Rate	% Commercial
		Corresponding Year	AADT		
Huntington Road	From Langstaff Road to Street A (Trade Valley Dr.)	2021	10,850	2.23	8
		2034	14,445		
	From Street A (Trade Valley Dr.) to Rutherford Road	2021	6,105	4.8	16
		2034	11,215		
	From Rutherford Road to McGillivray Rd	2015	970	4.8	16

3. FIELD AND LABORATORY WORK

The field assignment was performed in May 2015. A total of 20 boreholes (BH15-11 to BH15-30) were drilled for the rehabilitation/reconstruction of Huntington Rd between Langstaff Road and south of Major Mackenzie Drive. All boreholes were generally drilled to a depth of 2.1m except for BHs 15-12, 15-14, 15-18, 15-23 and 15-24 which were drilled at culvert locations to depths of 9.5, 8.2, 6.7, 6.7 and 9.8m, respectively. The borehole locations are shown on the Borehole Location Plans in Drawing Nos. 1 and 2.

The boreholes were carried out with solid stem continuous flight auger equipment by a drilling sub-contractor under the direction and supervision of SPL Consultants Limited personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the SPL Consultants Limited laboratory for detailed examination by the project engineer and for laboratory testing.

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. Standpipe piezometers were installed in five boreholes (BH 14-12, BH 15-14, BH 15-18, BH 15-23 and BH 15-24) for stabilized groundwater level monitoring.

Representative samples were selected for geotechnical index testing. The testing program consisted of the measurement of the natural moisture content of all samples, sieve analyses on five (5) selected samples of granular materials and seven (7) sieve and hydrometer analyses on selected non-granular samples. Test results are shown on the individual borehole logs presented in **Appendix A**. The grain size analysis curves are plotted on Figures 1 to 4 attached to this report in **Appendix C**.

In order to assess options for off-site disposal of excess excavated soil, six (6) selected soil samples were submitted for analysis of metals and inorganics including EC/SAR as set out in O.Reg.153/04 as amended, section XV.1 of the Environmental Protection Act (EPA). The test results are attached in **Appendix F (**for Borehole Location Plan and Borehole Logs, please refer to Drawings and Appendix A).

3. SITE AND SUBSURFACE CONDITIONS

Huntington Road is a south-north rural road under the jurisdiction of City of Vaughan. The project site is located between Langstaff Road (south limit) and south of Major Mackenzie Road (north limit). Huntington Road between Langstaff Rd (Station 10+000) and approximately 20m north of Rutherford Rd (Station 12+050) is a paved road; towards north is a gravel road up to approximately 110m south of Major Mackenzie Drive (Station 14+050). The project includes approximately 4.1 km of Huntington Road.

3.1 Pavement Condition

Visual pavement condition survey was conducted at the project site on June 16, 2015. The following distresses were observed, within the project limits:

Section A (Paved Road):

From Langstaff Rd to Rutherford Road

A) From Langstaff Rd to first construction joint (approximate Station 10+220)

- Extensive to throughout slight to moderate longitudinal construction joint
- Throughout slight to moderate midlane cracking
- Intermittent slight to moderate half/full transverse cracking, throughout close to intersection
- Frequent slight to moderate wheel track rutting and cracking
- Frequent uneven and undulation on surface of the road with patching around manholes
- Intermittent slight to moderate map cracking
- Improper side drainage and standing water at ditches
- Throughout slight to moderate flushing
- Localized distress and poor performing areas at Station 11+530 and Station 11+725

B) From Construction joint to start point of gravel road (approximate Station 12+050)

- Extensive slight to moderate flushing
- Intermittent ravelling, few coarse aggregate loss with few potholes
- Intermittent to frequent slight to moderate wheel track rutting
- Few to intermittent longitudinal wheel track cracking
- Few slight to moderate transverse cracking
- Few slight to moderate pavement edge cracking
- Intermittent slight to moderate longitudinal construction joint/centerline cracking
- Frequent uneven and undulation on surface of the road with patching around manholes
- Intermittent slight to moderate map cracking
- Improper side drainage and standing water at ditches
- Few slight to moderate map cracking
- Localized distress and poor performing areas at Station 12+500 and Station 13+790

Generally the surface of the road in this section was uneven resulting in a poor riding condition at some locations, some patching were also observed along the road and edge of pavement and around manholes. Frequent construction debris dumped in ditches and improper/no ditching at some areas were noticed during condition survey.

Section B (Gravel Road):
From Rutherford Road to McGillivray Road

There are lots of potholes/waterponds within Section B of Huntington Rd, however the density of the holes decreases towards north. Uneven surface along with potholes caused a poor riding condition in this section. Dumped construction debris, improper/no ditching and non-adequate/no shoulders were also observed along the road.

Photographs of the roads including typical distress are enclosed in **Appendix D**.

3.2 Subsurface Conditions

Detailed subsurface conditions encountered in the boreholes are presented on the Borehole Logs in **Appendix A**, and are briefly summarized below.

Existing Pavement Structure:

Table 1 below presents existing pavement structure data obtained from twenty (20) boreholes (BH15-11 to BH15-30) drilled for the present investigation on Huntington Rd within the project limits. Boreholes BH 15-11 to BH 15-19 were drilled in Section B of the road north of Rutherford Rd, while Boreholes BH 15-20 to BH 15-30 were drilled in the paved section, as shown in Table 2.

The boreholes in the paved section encountered a pavement structure consisting of 100 to 110 mm of asphalt underlain by 150 to 465mm of granular base and 0 to 300mm of granular subbase materials.

The pavement structure at BH 15-30, drilled about 105m north of Langstaff Rd on Huntington Rd for tie-in purpose, consists of 170mm asphalt, 300mm granular base and 390mm granular subbase.

For Section B (north of Rutherford Road), the granular base varied in thickness from 100 to 350mm, while the subbase thickness ranged from 0 to 610mm.

Table 2 Existing Pavement Structure Data along Huntington Rd within Project Limits

BH No		Offset from CL	Approx. Station	SBL[1] Mid-Lane			NBL[2] Mid-Lane		
				Asph. (mm)	Base (mm)	Sub-Base (mm)	Asph. (mm)	Base (mm)	Sub-Base (mm)
Langstaff Road (10+000)									
15-30	NBL	6.0 Rt	10+105				170	300	390
15-29	SBL	2.4 Lt	10+220	110	300	120			
15-28	SBL	2.1 Lt	10+415	100	300	300			
15-27	SBL	2.0 Lt	10+610	110	320	300			
15-26	NBL	1.5 Rt	10+790				105	335	-
15-25	SBL	2.0 Lt	10+965	105	415	-			
15-24	NBL	2.5 Rt	11+110				105	465	-
15-23	SBL	2.3 Lt	11+315	110	320	-			

15-22	NBL	2.9 Rt	11+520				110	300	-
15-21	SBL	1.7 Lt	11+715	105	255	-			
15-20	NBL	2.0 Rt	11+935				100	150	180
Rutherford Rd (12+031)									
15-19	SBL	-	12+095	-	150	560			
15-18	NBL	-	12+250				-	300	330
15-17	SBL	-	12+500	-	100	430			
15-16	SBL	-	12+760	-	320	480			
15-15	SBL	-	12+975	-	300	320			
15-14	NBL	-	13+095				-	300	350
15-13	SBL	-	13+360	-	350	530			
15-12	NBL	-	13+545				-	340	610
15-11	SBL	-	13+790	-	350	-			
McGillivray Road (13+812)									
Major MacKenzie Dr (14+160)									

1. SBL = Southbound Lane. 2. NBL = Northbound Lane. 3. Asph. = Asphalt

Existing pavement structure spreadsheet is presented in **Appendix B**.

For the paved section of Huntington Rd within project limit, two (2) samples (BH 15-20/AS1 and BH 15-27/AS1) of granular base material were tested for grain size distribution. The tested samples of granular base material contain 39 and 44% gravel, 40 and 49% sand, 21 and 7% fines (silt and clay size particles). The base course material is described as sand and gravel, trace to some silt. The grain size distribution of these two samples are presented on Figure No. 1 in **Appendix C.** The upper limit and lower limit of OPSS Granular 'A' are also shown in this figure. The test results of granular base, show that one of the tested samples is marginally acceptable as granular base but the fine content of the other sample is higher than the upper limit of Granular 'A' and it does not meet the required gradation of Granular 'A' (base material). Based on two tested samples of granular base material, the average amount of fine materials passing sieve 75 µm is 14%.

One tested granular base sample (BH 15-13/AS1) from gravel section of the road, contains 49% gravel, 33% sand and 18% fines (silt and clay). This sample is described as sandy gravel, some silt and as indicated on Figure No. 1 in **Appendix C,** the fine content of the sample is higher than the upper limit of Granular 'A' and it does not meet the required gradation of Granular 'A' (base material).

Along Huntington Rd, two (2) tested samples of granular subbase material, one from gravel road (BH 15-15/AS2) and one from paved section (BH 15-28/AS2), contain 45 and 61% gravel, 32 and 33% sand and 23 and 6% fines (silt and clay size particles), respectively. The subbase course material of gravelly road is described as sandy gravel, silty and as sandy gravel, trace silt for paved section. The grain size distribution curves for these samples are presented in Figure No. 2 in **Appendix C.** The acceptable limits of OPSS Granular 'B' Type I are also shown in this figure. The fine content of gravelly road sample is higher than the upper limit of Granular 'B' Type I and it does not meet the required gradation of Granular 'B' type I (subbase material). The test results show that tested sample of paved road meets specifications of granular subbase and is acceptable as granular subbase.

Fill Material:

In paved section of Huntington Rd, fill material was encountered below the pavement structure in all boreholes except one borehole (i.e BH 15-30 NBL at right lane taper -north of langstaff Rd intersection with no fill material) extending to depths of 1.2 to 3.2m. In all of these boreholes, fill material below granular subbase generally consisted of clayey silt to silty clay, trace sand to sandy, trace gravel present in a firm to very stiff consistency with measured SPT 'N' values ranging from 7 to 18 blows per 300 mm of penetration. However, in two boreholes, a thin (about 0.2m) fill layer of silty sand/sand, trace gravel was found between pavement structure and cohesive fill material. Fill material underneath the subbase granular of BH 15-26 and BH 15-27 was silty sand, trace gravel and sand, trace gravel, respectively. These samples were collected from auger, so the SPT 'N' values are not available. Trace topsoil was observed in fill material of one borehole of paved section.

Fill material including silty clay, trace sand to sandy, trace gravel was encountered below the pavement structure in all boreholes but BH 15-17, in gravelly road. Depth of fill material varied from 0.35 to 3.8m. This silty clay layer was present in a firm to very stiff consistency with measured SPT 'N' values ranged from 7 to 19 blows per 300 mm of penetration. Trace rootlets was observed in fill material of one borehole of gravelly section.

Silty clay/Silty clay till/Clayey silt till:

Underneath the fill material/pavement structure in all of the boreholes of Section B of Huntington Road, native soil consisting of silty clay/silty clay till was encountered, extending to the maximum depth of penetration or overlying sand and gravel layer (only in BH 15-12). Silty clay/silty clay till deposits were mostly present in a firm to very stiff consistency, with measured SPT 'N' values of 8 and 23 blows per 300 mm of penetration. Below the pavement structure in borehole 15-17, the silty clay till layer was present in a hard state with measured SPT 'N' values greater than 30.

In BH 15-12, a hard clayey silt till layer with measured SPT 'N' value of 100 for 150mm was found below the layer of sand and gravel.

Native soil was encountered in four (4) boreholes out of ten (10) boreholes drilled in the paved section of Huntington Road. In 50% of these boreholes, silty clay layer and in the other 50%, silty clay till to clayey silt till layer present in a very stiff to hard consistency with measured SPT 'N' values of 19 to 36 were found below fill material. Below the clayey silt till material in borehole 15-24, a hard silty clay layer with measured SPT "N" values of 31 and 35 was encountered.

Below pavement structure in BH 15-30, drilled for tie-in purpose, a stiff clayey silt till layer with measured SPT 'N' value of 14, extended to the full depth of borehole was found.

Sand and gravel:

Sand and gravel deposit was encountered in borehole 15-12 drilled in gravel section of Huntington Rd below the native silty clay till material and on top of a hard clayey silt material. Sand and gravel layer

was present in a loose to compact state with measured SPT 'N' values ranging from 8 to less than 30 blows per 300 mm of penetration.

Grain size analyses of five (5) samples of subgrade materials were conducted. The results are presented on Figure No.3 in **Appendix C**. They are also shown on the borehole logs, with the following fractions:

Table 3 Test Results of Grain Size Analysis of Subgrade Samples

BH No.	Sample No.	Particle Fraction (%)			
		Gravel	Sand	Silt	Clay
Gravel Road					
15-12	SS4	4	36	39	21
15-14	SS4	7	18	46	29
15-17	SS3	3	24	46	27
15-18	SS4	4	25	47	24
Paved Road					
15-24	SS3	4	27	44	25

Based on the above grain size analyses, the subgrade materials in both sections are considered to have low susceptibility to frost heaving (LSFH).

At the location of two culverts, sieve and hydrometer analyses of native soil samples below culvert inverts were conducted. The results are presented on Figure No.4 in **Appendix C** and are shown on the borehole logs, with the following fractions:

Table 4 Test Results of Grain Size Analysis of native soil Samples below Culvert Inverts

BH No.	Sample No.	Particle Fraction (%)			
		Gravel	Sand	Silt	Clay
Gravelly Road					
15-14	SS6	6	22	44	28
Paved Road					
15-23	SS5	0	7	53	40`

Groundwater Conditions:

All the boreholes were found dry upon completion of drilling, except BH 15-12 where short-term (unstabilized) groundwater was found at a depth of 3.4m upon completion of drilling. The groundwater levels in the five installed piezometers were measured on June 23, 2015 (about 1 month after installation) and readings are presented in Table 5 below.

Table 5 Groundwater Levels Observed in Boreholes /Piezometers

BH No.	Date of Drilling	Groundwater Table at Completion (m)	Piezometer Readings on June 24, 2015
15-12	05/21/2015	3.4	1.3
15-14	05/21/2015	dry	5.0
15-18	05/21/2015	dry	1.4
15-23	05/22/2015	dry	4.7
15-24	05/22/2015	dry	1.8

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

4. PAVEMENT DESIGN AND RECOMMENDATIONS

4.1 Summary of Existing Pavement Structure

Table 6 and Table 7 below present the summary of existing pavement structure data obtained from the boreholes drilled along Section A and Section B of Huntington Rd within project limits, respectively.

Table 6 Summary of Existing Pavement Structure along Paved Section of Huntington Road From Langstaff Road to Rutherford Road

Route	Pavement Component	No. of Observations	Thickness (mm)	
			Range	Mean
Huntington Rd	Total HMA[1]	10	100- 110	106
	Granular Base Material	10	150-465	316
	Granular Subbase Material	10	0-300	60
	Total Granular Material	10	255-600	376
			Average Existing GBE[2]	**399**

1. HMA = Hot Mix Asphalt 2. GBE Factors: Existing Asphalt = 1.25, Existing Granular Base = 0.75, Existing Subbase = 0.5

Table 7 Summary of Existing Pavement Structure along Section B of Huntington Road (North of Rutherford Road)

Route	Pavement Component	No. of Observations	Thickness (mm)	
			Range	Mean
Huntington Rd	Total HMA[1]	9	0	0
	Granular Base Material	9	100-350	279
	Granular Subbase Material	9	0-610	401
	Total Granular Material	9	350-950	680
			Average Existing GBE[2]	**409**

1. HMA = Hot Mix Asphalt 2. GBE Factors: Existing Asphalt = 1.25, Existing Granular Base = 0.75, Existing Subbase = 0.5

Based on the values shown in Pavement Structure Spreadsheet (**Appendix B**), Table 6 and Table 7, the chosen design values to represent the existing pavement structure in Section A and Section B of Huntington Road are as follow:

Section A:

From Langstaff Road to Rutherford Road

Hot Mix Asphalt:	100mm
Granular Base:	320mm
Granular Subbase:	no subbase
Total Structure:	420mm

Section B:

From Rutherford Road to McGillivray Road

Hot Mix Asphalt:	0mm
Granular Base:	280mm
Granular Subbase:	400mm
Total Structure:	680mm

4.2 Equivalent Single Axle Load (ESAL's)

The equivalent single axle loads (ESAL) for the design lanes were calculated using traffic data presented in Table 1. The input parameters for the design lane ESAL calculation were derived from MTO publication MI-183 *'Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions' and 'Procedures for Estimating Traffic Loads for Pavement Design, 1995'*. Table 8 presents the input parameters used to calculate ESALs along Huntington Road within the project limits.

Table 8 Input Parameters for ESAL Calculations, Huntington Road

Section	Base year AADT[1]	Commercial (%)	Avg. Truck Factor	DD[2]	Annual Traffic Growth (%)[3]	LD[4]	Design No. of Days per Year	Design Period (Year)	Cumulative ESAL's (million)
From Langstaff Rd to Street A	10,155	8	1.31	0.5	2.23	0.9	365	20	4.650
From Street A to Rutherford Rd	5,304	16	1.31	0.5	4.8	0.9	365	20	6.400
From Rutherford Rd to McGillivray Rd	1,116	16	1.31	0.5	4.8	0.9	365	20	1.350

1. Base Year = 2018
2. Directional Distribution
3. Average annual traffic growth rates were derived from traffic data provided.
4. Lane Distribution.

Figure 4.2, Figure 4.3 and Figure 4.4 illustrate the cumulative ESAL for a four-lane road along Huntington Road within the project limits, for over 20-year design period.

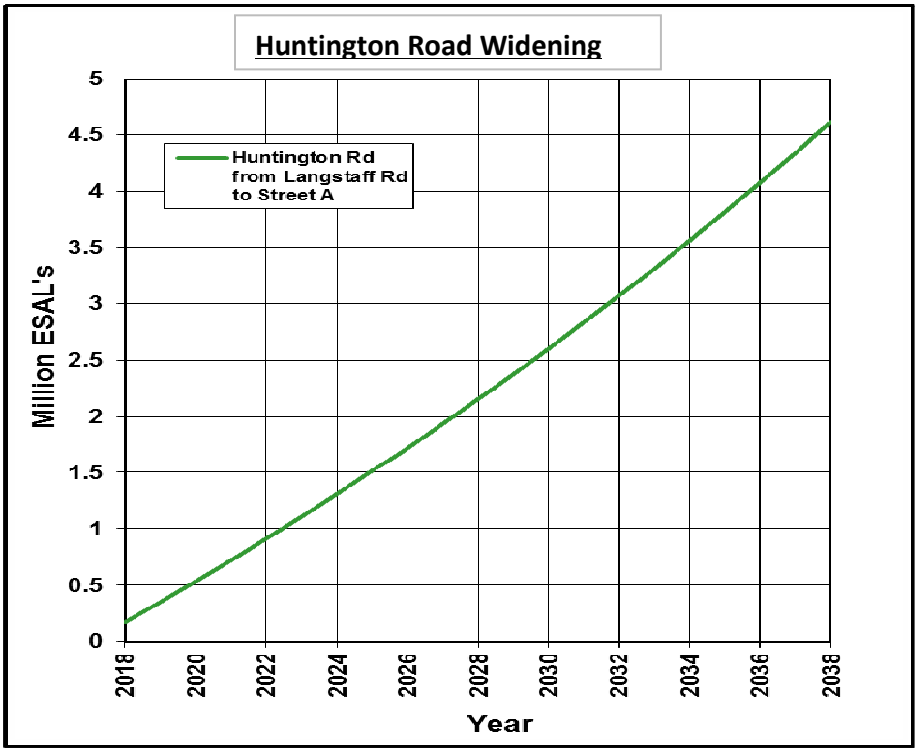

Figure 4.2 Cumulative ESAL for Huntington Rd from Langstaff Road to Street A

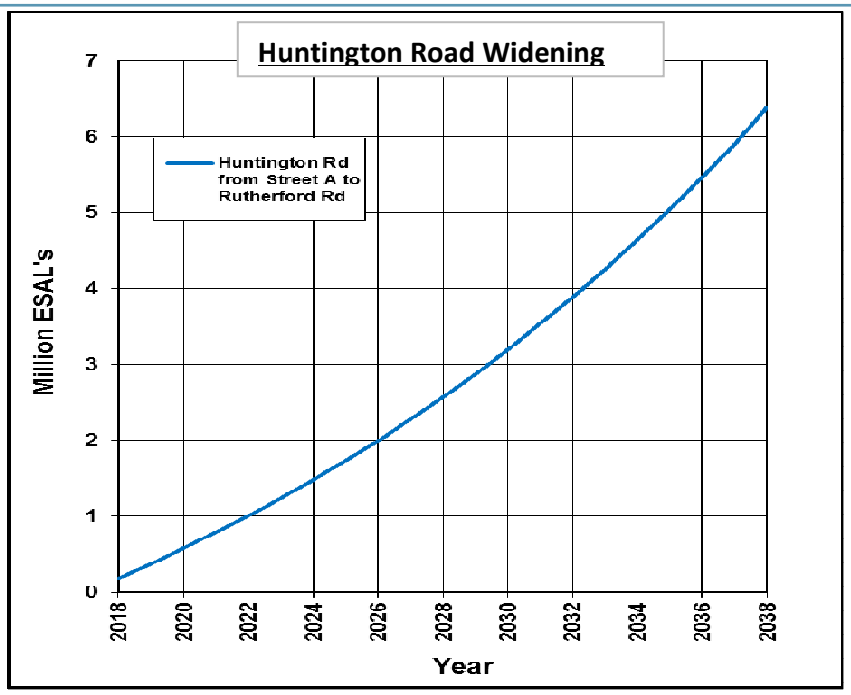

Figure 4.3 Cumulative ESAL for Huntington Rd from Street A to Rutherford Road

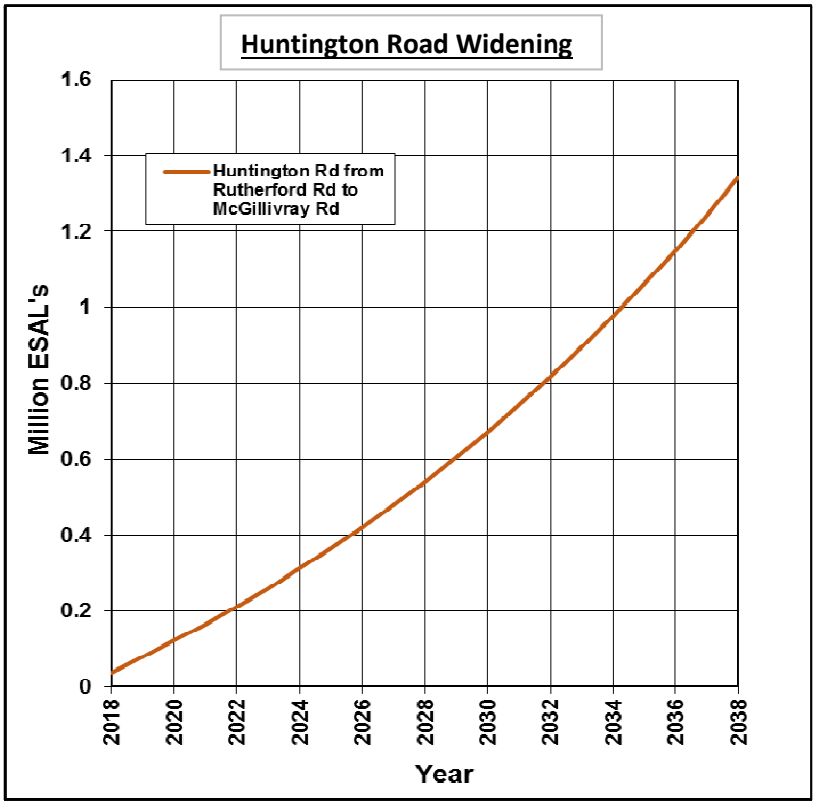

Figure 4.4 Cumulative ESAL for Huntington Rd from Rutherford Road to McGillivray Rd

4.4 Pavement Thickness Design

4.4.1 Huntington Road from Langstaff Road to McGillivray Road New Construction (Widening Section)

Pavement structure thickness design for the design lane was determined using the AASHTO design method, the Ministry's Pavement Design Manual and The City of Vaughan Standard. Input parameters are shown in Table 9 below for. The design output sheets are presented in **Appendix E**.

Table 9 Input Parameters for Pavement Structure Calculations for Huntington Road New Construction (Widening Section)

Huntington Rd Section	Design Period	Initial/Terminal Serviceability	Cumulative ESAL's (million)	Subgrade Resilient Modulus (M_R), Mpa
From Langstaff Rd to Street A *	20 years	p_i = 4.4 p_t =2.2	4.65	25
From Street A to Rutherford Rd *	20 years	p_i = 4.4 p_t =2.2	6.4	25
From Rutherford Rd to McGillivray Rd	20 years	p_i = 4.4 p_t =2.2	1.35	25
Common Parameters	Structural Coefficients ('a' values): New HMA : 0.42 New Gran Base : 0.14 New Gran Subbase : 0.09 Drainage Coefficient: m = 1.0 (for new granular base and subbase) Design Period: 20 Years (for new pavements) Reliability and Standard Deviation: R = 90%; S = 0.49			

***** Based on the above Input Parameters, Huntington Road from Street A to Rutherford Road has more impact in Pavement Structure Calculations and will be used in pavement design from Langstaff Road to Rutherford Road.

The required pavement structures for Huntington Road based on The City of Vaughan Standards, MTO Guideline and the AASHTO design method, for the input parameters noted in Table 9 considering Low Susceptibility of Frost Heaving (LSFH) soil subgrade, are shown in Table 10 and Table 11 for Section A (from Langstaff Road to Rutherford Road) and Section B (from Rutherford Rd to McGillivray Rd) of Huntington Road, respectively, as follows:

Table 10 Pavement Design Summary- Huntington Road from Langstaff Road to Rutherford Road New Construction and Widening Lane

Methodology	Material Thickness (mm)	SN*	GBE (mm)*
The City of Vaughn Design Standard	125 mm hot mix, 125 mm Base (20 mm Crusher-Run Limestone), 350 mm Subbase (50 mm Crusher-Run Limestone)	102	610
MTO Guideline	130 mm hot mix, 150 mm Granular A, 450 mm Granular B Type I	116	712
AASHTO	180 mm hot mix, 150 mm Granular A, 500 mm Granular B Type I (structural requirements for 20 years design life)	142	845

*The Structural Number (**SN**) obtained was calculated using the following layer coefficients: HMA = 0.42; New Base= 0.14; New Subbase= 0.09; **GBE** was calculated using the equivalency factors: HMA = 2; New Base = 1.0; New Subbase = 0.67.

Table 11 Pavement Design Summary- Huntington Road from Rutherford Road to McGillivray Road New Construction and Widening Lane

Methodology	Material Thickness (mm)	SN*	GBE (mm)*
The City of Vaughn Design Standard	125 mm hot mix, 125 mm Base (20 mm Crusher-Run Limestone), 350 mm Subbase (50 mm Crusher-Run Limestone)	102	610
MTO Guideline	50 mm hot mix, 150 mm Granular A, 250 mm Granular B Type I	65	418
AASHTO	120 mm hot mix, 150 mm Granular A, 500 mm Granular B Type I (structural requirements for 20 years design life)	116	725

Table 10 and Table 11 show that pavement structure recommended by AASHTO pavement design method for 20-yr design is thicker and stronger than the pavement structure for Arterial Roads under the City of Vaughan Standard and MTO Guideline. As a result, the minimum required Granular Base Equivalency (GBE) and Structural Number (SN) for new construction on Huntington Road will conform to the AASHTO design and are as follow:

Huntington Road from Langstaff Rd to Rutherford Rd

For 20 years initial design life: GBE = 845 & SN= 142

Huntington Road from Rutherford Rd to McGillivray Rd

For 20 years initial design life: GBE = 725 & SN= 116

4.4.2 Huntington Road from Langstaff Road to McGillivray Road Rehabilitation of the Existing Roadway

Pavement structure thickness design for the design lane was determined using the AASHTO design method, the Ministry's Pavement Design Manual and The City of Vaughan Standard. Input parameters are shown in Table 12 below for. The design output sheets are presented in **Appendix E**.

Table 12 Input Parameters for Pavement Structure Calculations for Huntington Road Rehabilitation (Existing Roadway Lanes)

Huntington Rd Section	Design Period	Initial/Terminal Serviceability	Cumulative ESAL's (million)	Subgrade Resilient Modulus (M_R), Mpa
From Langstaff Rd to Street A *	20 years	p_i = 4.4 p_t =2.2	4.65	25
From Street A to Rutherford Rd *	20 years	p_i = 4.4 p_t =2.2	6.4	25
From Rutherford Rd to McGillivray Rd	20 years	p_i = 4.4 p_t =2.2	1.35	25

Common Parameters

Structural Coefficients ('a' values):

New HMA	: 0.42
New Gran Base	: 0.14
New Gran Subbase	: 0.09
Pulverized Material	: 0.12
Existing Gran base	: 0.11
Existing Granular Subbase	: 0.07

Drainage Coefficient:
m = 1.0 (for new granular base and subbase) and 0.9 for existing granular Base

Design Period: 20 Years (for new pavements)

Reliability and Standard Deviation: R = 90%; S = 0.49

***** Based on the above Input Parameters, Huntington Road from Street A to Rutherford Road has more impact in Pavement Structure Calculations and will be used in pavement design from Langstaff Road to Rutherford Road section.

The required pavement structures for design options for rehabilitation of existing lanes of Huntington Road based on the AASHTO design method, for the input parameters noted in Table 12 considering Low Susceptibility of Frost Heaving (LSFH) soil subgrade, are shown in Table 13 and Table 14 for Section A (from Langstaff Road to Rutherford Road) and Section B (from Rutherford Rd to McGillivray Rd) of Huntington Road, respectively, as follows:

Table 13 Pavement Design Options for Rehabilitation of Existing Lanes of Huntington Road From Langstaff Road to Rutherford Road (Section A)

Option	Methodology	Material Thickness (mm)	SN*	GBE (mm)*
Option 1 **Rehabilitation by Pulverization of existing Lanes with 290mm Grade riase**	AASHTO	**Option 1: Rehabilitation by Pulverization with 290 mm Grade Raise** 190 mm hot mix over 100 mm new Granular A, 300 mm Pulverized material over 125 mm existing Granular Base (minimum structural requirements for 20 years design life)	142	874
Option 2 **Reconstruction of existing Lanes with No grade raise**	AASHTO	**Option 2: Reconstruction with no Grade Raise** 180 mm hot mix, 150 mm Granular A, 500 mm Granular B Type I (minimum structural requirements for 20 years design life)	142	845

*The Structural Number (**SN**) obtained was calculated using the following layer coefficients: HMA = 0.42; New Base= 0.14; New Subbase= 0.09; **GBE** was calculated using the equivalency factors: HMA = 2; New Base = 1.0; New Subbase = 0.67.

Table 14 Pavement Design Options for Rehabilitation of Existing Lanes of Huntington Road From Rutherford Road McGillivray Road (Section B)

Option	Methodology	Material Thickness (mm)	SN*	GBE (mm)*
Option 1 **Rehabilitation by Partial depth removal with 170 mm Grade raise**	AASHTO	**Option 1: Rehabilitation by Partial depth (100 mm) Removal from the surface of gravel road with 170 mm Grade Raise** 120 mm hot mix over 150 mm new Granular A, Over 180 mm existing Granular Base and 400 mm existing Granular Subbase (minimum structural requirements for 20 years design life)	114	725
Option 2 **Reconstruction of existing Lanes with No grade raise**	AASHTO	**Option 2: Reconstruction with no Grade Raise** 120 mm hot mix, 150 mm Granular A, 500 mm Granular B Type I (minimum structural requirements for 20 years design life)	116	725

*The Structural Number (**SN**) obtained was calculated using the following layer coefficients: HMA = 0.42; New Base= 0.14; New Subbase= 0.09; **GBE** was calculated using the equivalency factors: HMA = 2; New Base = 1.0; New Subbase = 0.67.

The design output sheets are presented in **Appendix E**.

4.5 Pavement Recommendations

Considering the above Pavement thickness Design and methodology, the following detailed description for new construction at widening section with full depth reconstruction at existing roadway with no grade raise option and also partial depth reconstruction with grade raise option are presented in below sections, respectively:

4.5.1 New Construction (For Existing Roadway and Widening)

No Grade Raise Option

By considering the existing pavement condition, keeping the existing grade of the roadway, the existing roadway is recommended to be reconstructed full depth. The recommendations are presented as follows for the road sections:

4.5.1.1 Huntington Road from Langstaff Road to Rutherford Road (Section A)

As presented in Section 4.1, considering the existing pavement design values on Huntington Road within the project limits (consisting of 100 mm of asphalt over 320 mm of granular base material with few location of having subbase) with low value of Granular Base Equivalency (GBE) for about 400 and based on visual condition survey of the existing road (generally in poor condition), the existing roadway is recommended to be reconstructed full depth including widening as follows:

- Excavate from the existing grade to the required depth to accommodate 830 mm new pavement structure (for existing roadway and widening section)
- Place 500 mm Granular Subbase (Granular B Type I *)
- Place 150 mm Granular Base (Granular A *)
- Pave 180 mm Hot Mix Asphalt (50 mm SP 12.5 FC1 **surface course over 60 mm of SP19.0 upper binder course over 70 mm SP 19.0 **lower binder course)

* 20 mm Crusher Run Limestone (CRL) & 50 mm CRL could be substituted for Base and Subbase material, respectively.
** SP12.5 FC1 can be substituted by HL1 and SP19.0 by HDBC.

4.5.1.2 Huntington Road from Rutherford Road to McGillivray Road (Section B)

Based on Section 4.1 by considering the existing pavement design values (consisting of only 280 mm of granular base over 400 mm of granular subbase material with no asphalt) with low value of Granular Base Equivalency (GBE) of existing road (approximate GBE of 400) and visual condition of the existing

road, the existing roadway is recommended to be reconstructed full depth including widening as follows:

- Excavate from the existing grade to the required depth to accommodate 770 mm new pavement structure (for existing roadway and widening section)
- Place 500 mm Granular Subbase (Granular B Type I *)
- Place 150 mm Granular Base (Granular A *)
- Pave 120 mm Hot Mix Asphalt (50 mm SP 12.5 FC1 **surface course over 70 mm of SP19.0 **binder course)

* 20 mm Crusher Run Limestone (CRL) & 50 mm CRL could be substituted for Base and Subbase material, respectively.
** SP12.5 FC1 can be substituted by HL1 and SP19.0 by HDBC.

Note: The excavated materials could be re-used as subbase or fill for the widening section depending on the quality of material.

4.5.2 Pavement Rehabilitation and Widening of Existing Roadway

Grade Raise Option

Alternatively, the roads can be rehabilitated with a grade raise, keeping most of the pavement structure. The existing roadway can be rehabilitated by partial depth reconstruction with new construction in the widening section. The following rehabilitation recommendations are presented for the road sections:

4.5.2.1 Huntington Road from Langstaff Road to Rutherford Road (Section A)

With 290 mm Grade Raise

Existing Roadway

- Pulverize existing asphalt and underlying granular base to a depth of 300 mm
- Place 100 mm New Granular Base (Granular A *) over the pulverized material
- Pave 190 mm Hot Mix Asphalt (50 mm SP 12.5 FC1 **surface course over 140 mm SP19.0 **binder course in two lifts)

* 20 mm Crusher Run Limestone (CRL) could be substituted for Base material.
** SP12.5 FC1 can be substituted by HL1 and SP19.0 by HDBC.

Widening Section

- Excavate from existing EP to a depth of 540 mm
- Place 500 mm Granular Subbase (Granular B Type I *)
- Place 150 mm Granular Base (Granular A *)

- Pave 180 mm Hot Mix Asphalt (50 mm SP 12.5 FC1 **surface course over 60 mm of SP19.0 **upper binder course over 70 mm SP 19.0 lower binder course)

* 20 mm Crusher Run Limestone (CRL) & 50 mm CRL could be substituted for Base and Subbase material, respectively.
** SP12.5 FC1 can be substituted by HL1 and SP19.0 by HDBC.

4.5.2.2 Huntington Road from Rutherford Road to McGillivray Road (Section B)

With 170 mm Grade Raise

Existing Roadway

- Excavate 100 mm from the top of existing granular
- Place 150 mm New Granular Base (Granular A *)
- Pave 120 mm Hot Mix Asphalt (50 mm SP 12.5 FC1 **surface course over 70 mm SP19.0** binder course)

* 20 mm Crusher Run Limestone (CRL) could be substituted for Base material.
** SP12.5 FC1 can be substituted by HL1 and SP19.0 by HDBC.

Widening Section

- Excavate from existing EP to a depth of 600 mm
- Place 500 mm Granular Subbase (Granular B Type I *)
- Place 150 mm Granular Base (Granular A *)
- Pave 120 mm Hot Mix Asphalt (50 mm SP 12.5 FC1 **surface course over 70 mm of SP19.0 **binder course)

* 20 mm Crusher Run Limestone (CRL) & 50 mm CRL could be substituted for Base and Subbase material, respectively.
** SP12.5 FC1 can be substituted by HL1 and SP19.0 by HDBC.

Proper side drainage by providing ditches or subdrains at both sides of the roads are also recommended for all the above Options within the project limits.

The excavated granular materials could be re-used as subbase or fill for the widening section depending on the quality of material.

Heavy construction equipment may have to be kept off the newly constructed roads before the placement of asphalt and/or immediately thereafter, to avoid damaging the subgrade by heavy truck traffic.

The granular base and sub-base materials should be placed in layers not exceeding 150mm (uncompacted thickness), and should be compacted to 100% *of* their respective SPMDD. The grading of the material should conform to current OPS Specifications.

4.6 Subgrade Preparation

For the subgrade preparation, all topsoil, organic material, loose fill, wet, soft or spongy subgrade areas or other unsuitable soils areas including frost susceptible soil should be sub-excavated, and backfilled with suitable approved backfill material prior to the placement of earth fill material for the construction of the pavement widening.

After stripping, the exposed subgrade should be inspected, proof-rolled and approved by a geotechnical engineer who is familiar with this report. Unsuitable or loose materials should also be sub-excavated and replaced with compacted indigenous material.

The new fill should be placed in lifts not exceeding 300 mm before compaction and each lift should be uniformly compacted to at least 95% of the Standard Proctor Maximum Dry Density (SPMDD), increasing to 98% within the top 0.6 m of the subgrade, at a placement water content of ±2% of optimum.

Proper benching of the existing embankment slope should be implemented if and where abutting into the existing embankments. This can be constructed in accordance with OPSD 208.01 – Benching of Earth Slope. Subdrains should be provided on both sides of the road.

The long term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade conditions are achieved. In addition, the need for adequate drainage is emphasized.

The finished subgrade should be free of depressions and should be sloped (preferably at a grade of 3%) to provide effective sub-surface drainage toward subdrains or ditches.

The Granular A base and Granular B subbase must be compacted to 100% of SPMDD and should be placed full-width.

The finished pavement surface should be sloped (preferably at a grade of 2 %) to provide effective surface drainage toward catch basins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas.

5. FOUNDATION ASSESSMENT AT CULVERT STRUCTURES

As part of the EA study for this project, five (5) major crossing culverts within the project limits were investigated. Details of each existing culvert and corresponding borehole information are shown in Table 15 below.

Table 15 Details of Existing Culverts within Project Limits

Road	Section	Approx Station	Type of Culvert	Diameter/Width (m)	Approx. Invert Depth*(m)	BH No.	BH Depth (m)
Huntington Road	A	11+110	CSPA	3.20×2.15	3	15-24	9.8
		11+320	CSP	0.75	2	15-23	6.7
	B	12+250	CSPA	1.88×1.26	1.7	15-18	6.7
		13+100	CSPA	2.24×1.63	2	15-14	8.2
		13+550	CSP	3	3.3	15-12	9.5

* Based on the provided drawing

5.1 Soil Conditions

In general, below the granular base and subbase material in Section, the borehole encountered firm to very stiff silty clay fill, some sand to sandy deposit, overlying stiff to very stiff native silty clay/silty clay till extending to the full depth of penetration in BHs 15-14 and 15-18 and underlain by loose to compact sand and gravel in BH 15-12. Below the sand and gravel layer in BH 15-12, a hard clayey silt till layer was found.

In paved section of the road, Boreholes BH 15-23 and 15-24 encountered firm to stiff silty clay fill, trace sand to sandy deposit, overlying very stiff to hard native silty clay/clayey silt till extending to the full depth of penetration.

Details of the subsurface conditions encountered in each borehole are presented in the individual borehole logs in **Appendix A** and are briefly summarized in Section 3.2.

5.2 Groundwater Condition

As described in Section 3.2, all the boreholes at culvert locations were found dry upon completion of drilling, except BH 15-12 where short-term (unstabilized) groundwater was found at a depth of 3.4m upon completion of drilling. The groundwater levels in the five installed piezometers were measured on June 23, 2015 (about 1 month after installation) and readings are presented in Table 16 below.

Table 16 Groundwater Levels Observed in Boreholes /Piezometers

BH No.	Date of Drilling	Groundwater Table at Completion (m)	Piezometer Readings on June 24, 2015
15-12	05/21/2015	3.4	1.3
15-14	05/21/2015	dry	5.0
15-18	05/21/2015	dry	1.4
15-23	05/22/2015	dry	4.7
15-24	05/22/2015	dry	1.8

It should be noted that the groundwater at the site would be subject to seasonal fluctuations as well as fluctuations due to weather events and the water level in the creek.

5.3 Discussion and Recommendations

It is understood that the existing CSP/CSPA culverts will be replaced, but the type of new culverts was not provided at this time. It is also understood that there may be major vertical realignment (up to 1 to 1.5m), cut or fill, at some of the culvert locations and road level might change.

Based on the information obtained from the boreholes, the tentative recommended bearing values and the corresponding founding depths at the borehole locations for the new culverts are summarized in Table 17 below.

Table 17 Tentative Bearing Values and Founding Levels at the Culvert Locations

Approx. Culvert Station	Approx. Invert Depth (m)	BH No.	Founding Soils	Bearing Capacity at SLS (kPa)	Bearing Capacity at ULS (kPa)	Minimum Depth below Existing Ground (m)
11+110	3	15-24	Very Stiff Clayey Silt Till	220	330	3.3
11+320	2	15-23	Very Stiff Silty Clay	200	300	2.2
12+250	1.8	15-18	Stiff to Very Stiff Silty Clay	150	225	2.0
13+100	2	15-14	Stiff to Very Stiff Silty Clay Till	150	225	2.4
13+550	3.3	15-12	Stiff Silty Clay Till	120	180	3.3

Bedding, cover and backfill details should be as per appropriate OPSD or municipal standards.

5.5 Construction Comments

All excavations should be carried out in accordance with the Occupational Health and Safety Act (OHSA).

The following soil classifications can be expected for temporary excavations in accordance with OHSA.

Fill : Type 3 soil above groundwater level and Type 4 soil below groundwater level.

Very stiff to hard Silty Clay/Clayey Silt : Type 2 above groundwater level; Type 3 Soil below groundwater level;

Dewatering will be required to stabilize the soil and to facilitate construction where excavations are required below the groundwater table or creek level. It is our opinion that in the silty clay deposits, the groundwater can be controlled by means of gravity drainage and strategically spaced and located filtered sumps. A system of cofferdams to cut-off the water flow from creek into the excavation may be required to assist in excavation.

5.6 FROST PROTECTION

Design frost protection for the general area is 1.2 m. A permanent soil cover of at least 1.2 m or its thermal equivalent is therefore required for frost protection. In case of riprap (rock fill), only one half of the rock fill thickness should be assumed to be effective in providing frost protection.

6. GENERAL COMMENTS AND LIMITATIONS OF REPORT

SPL Consultants Limited should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, SPL Consultants Limited will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole and test pit results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to SPL Consultants Limited at the time of preparation. Unless otherwise agreed in writing by SPL Consultants Limited, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SPL Consultants Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

SPL CONSULTANTS LIMITED

S. Gholamin

Siamak Gholamin, Pavement Specialist

Ramon Miranda, P.Eng.

LICENSED PROFESSIONAL ENGINEER
RAMON MIRANDA
PROVINCE OF ONTARIO

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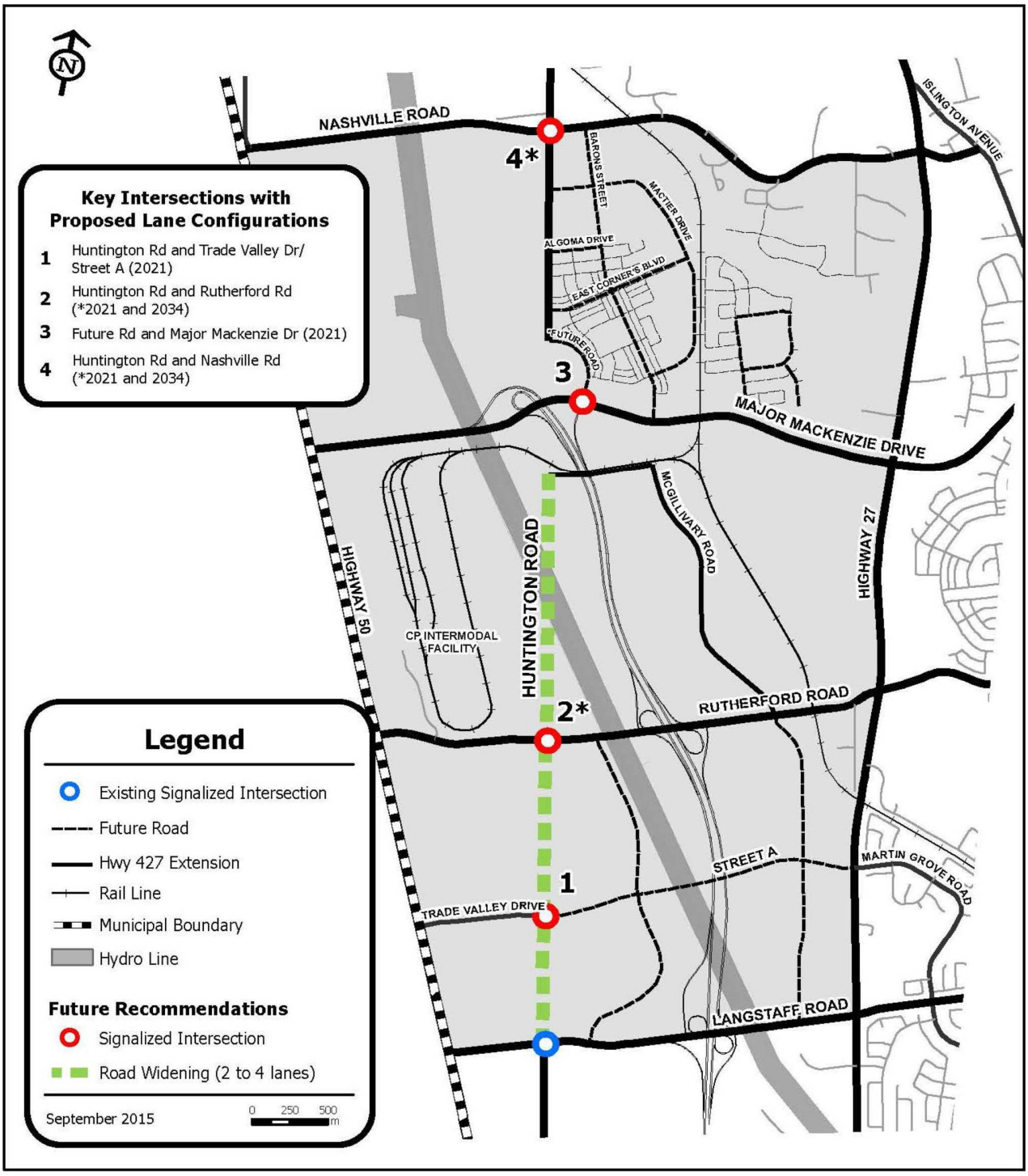
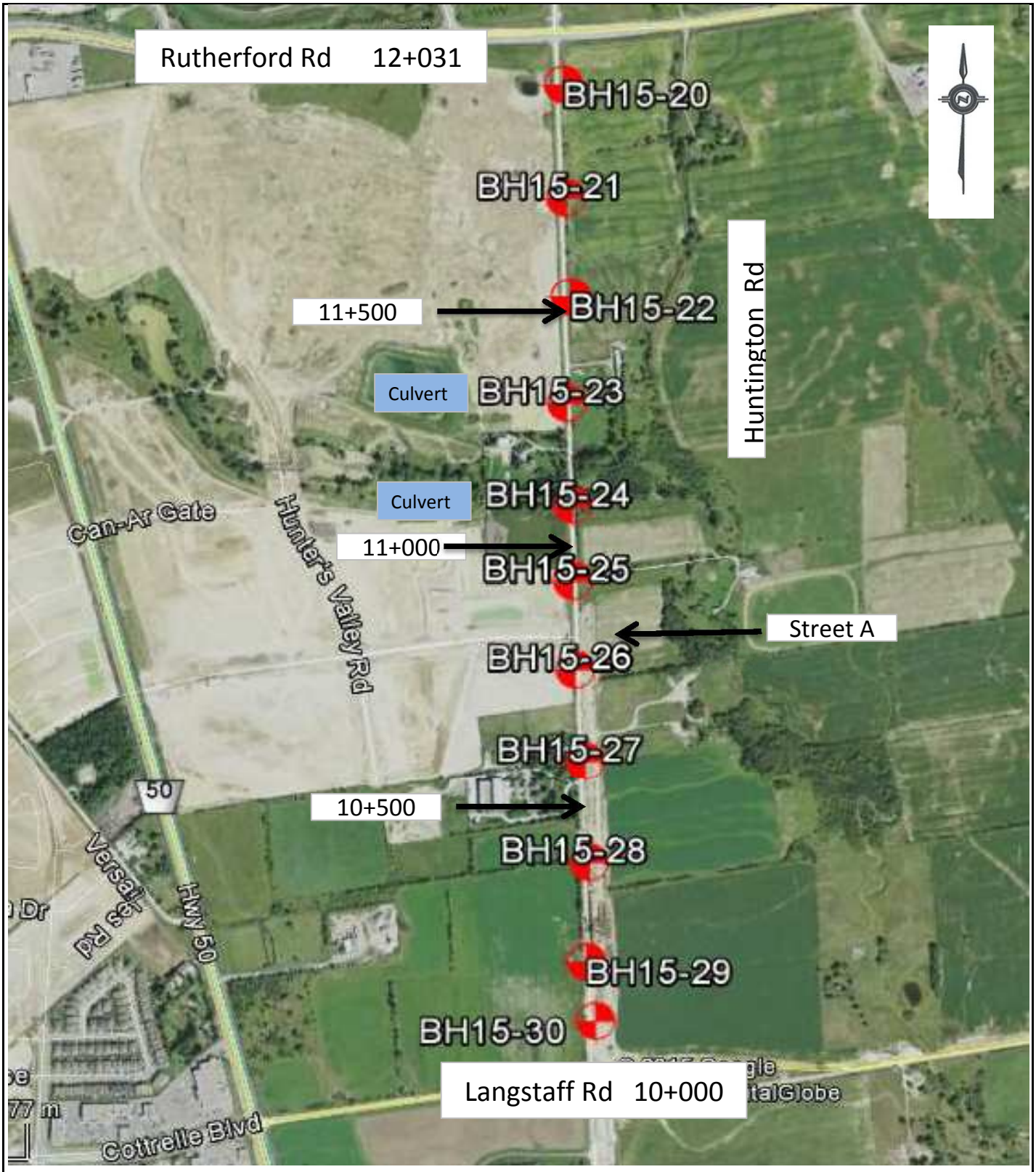
Drawings

BOREHOLE LOCATION PLANS



Drawing 1A: Site Plan



Client:	Delcan Corporation			Drawing No:	1
Drawn:	OB	Approved:	RM	Title:	Borehole Location Plan, Huntington Rd From Langstaff Rd to Nashville Rd
Date:	26-May-15	Scale:	N.T.S	Project:	Class EA Study, Huntington Rd
Original Size:	Letter	Rev:	N/A	SPL Consultants Limited Geotechnical Environmental Materials Hydrogeology	

Client:	Delcan Corporation			Drawing No:	2
Drawn:	OB	Approved:	RM	Title:	Borehole Location Plan, Huntington Rd From Langstaff Rd to Nashville Rd
Date:	4-Mar-15	Scale:	N.T.S	Project:	Class EA Study, Huntington Rd
Original Size:	Letter	Rev:	N/A	SPL Consultants Limited Geotechnical Environmental Materials Hydrogeology	

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Appendix A

Explanation of Terms Used in the Record of Borehole

Borehole Logs

SPL Consultants Limited
Geotechnical • Environmental • Materials • Hydrogeology • Ecology

Explanation of Terms Used in the Record of Boreholes

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube Sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:

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

WH – Samples sinks under "weight of hammer"

Dynamic Cone Penetration Resistance, N_d:

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

Textural Classification of Soils

Classification	Particle Size
Boulders	> 200 mm
Cobbles	75 mm - 200 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm – 4.75 mm
Silt	0.002 mm-0.075 mm
Clay	<0.002 mm

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

Soil Description

a) Cohesive Soils(*)

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

(*) Hierarchy of Shear Strength prediction

1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT "N" value
5. Pocket penetrometer

b) Cohesionless Soils

Density Index (Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

SPL

LOG OF BOREHOLE BH15-10

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/20/2015

REF. NO.: 10000163
ENCL NO.: 10

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0 / 0.1	**ASPHALT:** 60mm											
	GRANULAR BASE: 260mm, sand and gravel, brown, moist.		1	AS								
0.3	**FILL:** silty sand, trace clay, brown, damp, compact.		2	AS					○			32 44 (24)
1			3	SS	17				○			0 65 25 10
1.5	**SILTY CLAY TILL:** trace sand, trace gravel, brownish grey, moist, stiff.		4	SS	14				○			
2												
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.											

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3. Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-11

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 11

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**GRANULAR BASE:** 350mm, sand and gravel, brown, moist.		1	AS					○		
			2	AS							
0.4	**FILL:** silty clay, trace gravel, brown, moist, stiff.		3	SS	15				○		
1.2	**SILTY CLAY TILL:** trace sand, trace gravel, brown, moist, very stiff.		4	SS	18				○		
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.										

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-12

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 12

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**GRANULAR BASE:** 340mm, sand and gravel, brown, moist.		1	AS			Cement					
0.3	**GRANULAR SUBBASE:** 610mm, sand and gravel, brown, moist.		2	AS								
			3	AS								
1.0	**FILL:** silty clay, sandy, trace gravel, brown, moist, stiff to very stiff.		4	SS	15							4 36 39 21
						▽	W. L. 1.3 mBGL Jun 24, 2015					
2			5	SS	19							
2.3	**SILTY CLAY TILL:** trace sand, trace gravel, brownish grey, moist, stiff to very stiff.		6	SS	16		Bentonite					
3			7	SS	11							
4			8	SS	13					140		
5	grey below 4.9m		9	SS	12							
							Sand					
6			10	SS	8		Screen					Wet Spoon
6.6	**SAND AND GRAVEL:** grey, wet, loose to compact.											
7												
8			11	SS	68/ 300mm							
8.0	**CLAYEY SILT TILL:** trace sand, trace gravel, grey, moist, hard.						Sand					
9												
			12	SS	100/ 150mm							
9.5	**END OF BOREHOLE** Note: 1) Borehole caved to 8.2m and water level was at 3.4m upon											

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$. Numbers refer to Sensitivity ○ ε=3% Strain at Failure

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

LOG OF BOREHOLE BH15-12

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 12

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m							GR SA SI CL
	completion of drilling. 2) 50 mm dia. monitoring well was installed upon completion of drilling. 3) Water Level Readings in Monitoring Well: Date W. L. Depth (m) 2015/06/24 1.3											

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3 : Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-13

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 13

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**GRANULAR BASE:** 350mm, sandy gravel, some silt, brown, moist.		1	AS								
0.4	**GRANULAR SUBBASE:** 530mm, sand and gravel, brown, moist.		2	AS								
			3	AS					○			
0.9	**FILL:** silty clay, grey, moist, stiff.		4	SS	10					○		
1.2	**SILTY CLAY TILL:** trace sand, trace gravel, grey, moist, stiff.		5	SS	13					○		49 33 (18)
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

LOG OF BOREHOLE BH15-14

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 14

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**GRANULAR BASE:** 300mm, sand and gravel, brown, moist.		1	AS			Cement					
0.3	**GRANULAR SUBBASE:** 350mm, sand and gravel, brown, moist.		2	AS					○			
			3	AS					○			
0.7	**FILL:** silty clay, some sand, trace gravel, brownish grey, moist, stiff.		4	SS	14				○			7 18 46 29
1												
			5	SS	15				○			
2							Bentonite					
2.3	**SILTY CLAY TILL:** sandy, trace gravel, brown, moist, stiff to very stiff.		6	SS	18				○			6 22 44 28
3												
			7	SS	15				○			
4			8	SS	10		Sand		○			
			9	SS	15		W. L. 5.0 mBGL Jun 24, 2015		○			
5							Screen					
6			10	SS	13				○			
7							Sand					
			11	SS	11				○			
8.2	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling. 2) 50 mm dia. monitoring well was installed upon completion of drilling. 3) Water Level Readings in Monitoring Well: Date W. L. Depth (m) 2015/06/24 5.0											

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPLGDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

SPL

LOG OF BOREHOLE BH15-15

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 15

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m							GR SA SI CL
0.0	**GRANULAR BASE:** 300mm, sand and gravel, brown, moist.		1	AS								
0.3	**GRANULAR SUBBASE:** 320mm, sandy gravel, silty, brown, moist.		2	AS					○			45 32 (23)
0.6	**FILL:** silty clay, trace sand, trace gravel, brown, moist, stiff.		3	SS	9				○			
1.9	**SILTY CLAY TILL:** trace sand, trace gravel, grey, moist, stiff.		4	SS	13				○			
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.											

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-16

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 16

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**GRANULAR BASE:** 320mm, sand and gravel, brown, moist.		1	AS								
0.3	**GRANULAR SUBBASE:** 480mm, sand and gravel, brown, moist.		2	AS					○			
			3	AS					○			
0.8	**FILL:** silty clay, trace sand, trace gravel, brownish grey, moist, stiff.		4	SS	15					○		
1.8	**SILTY CLAY TILL:** trace sand, trace gravel, grey, moist, stiff.		5	SS	11					○		
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.											

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-17

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 17

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m							GR SA SI CL
0.0 / 0.1	**GRANULAR BASE:** 100mm, sand and gravel, brown, moist.		1	AS								
	GRANULAR SUBBASE: 430mm, sand and gravel, brown, moist.		2	AS					○			
0.5	**SILTY CLAY TILL:** sandy, trace gravel, brownish grey, moist, hard.		3	SS	35				○			3 24 46 27
	trace cobble fragments below 1.5m		4	SS	50/ initial 125mm							
1.7	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▽ 4th ▽

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

LOG OF BOREHOLE BH15-18

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 18

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**GRANULAR BASE:** 300mm, sand and gravel, brown, moist.		1	AS			Cement					
0.3	**GRANULAR SUBBASE:** 330mm, sand and gravel, brown, moist.		2	AS								
0.6	**FILL:** silty clay, sandy, trace gravel, brownish grey, moist, firm to very stiff.		3	SS	7							
	trace rootlets from 1.5m to 2.0m		4	SS	15		W. L. 1.4 mBGL Jun 24, 2015					4 25 47 24
2.0	**SILTY CLAY:** trace sand, trace gravel, grey, moist, stiff to very stiff. (possible fill)		5	SS	18		Bentonite					
			6	SS	11							
			7	SS	14		Sand					
4.8	**SILTY CLAY:** trace sand, trace gravel, grey, moist, stiff to very stiff.		8	SS	14		Screen					
			9	SS	23		Sand			150		
6.7	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling. 2) 50 mm dia. monitoring well was installed upon completion of drilling. 3) Water Level Readings in Monitoring Well: Date W. L. Depth (m) 2015/06/24 1.4											

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

LOG OF BOREHOLE BH15-19

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/21/2015

REF. NO.: 10000163
ENCL NO.: 19

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**GRANULAR BASE:** 150mm, sand and gravel, brown, moist.		1	AS							
0.2	**GRANULAR SUBBASE:** 560mm, sand and gravel, brown, moist.		2	AS					○		
0.7	**FILL:** silty clay, trace sand, trace gravel, brown, moist, firm.		3	SS	8				○		
1.2	**SILTY CLAY TILL:** trace sand, trace gravel, brown, moist, firm to very stiff.		4	SS	21				○		
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.										

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

LOG OF BOREHOLE BH15-20

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 20

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 100mm											
0.1	**GRANULAR BASE:** 150mm, sand and gravel, some silt, brown, moist.		1	AS					○			39 40 (21)
0.3			2	AS								
0.4	**GRANULAR SUBBASE:** 180mm, sand and gravel, brown, moist.											
1	**FILL:** silty clay, trace sand, trace gravel, brown, moist, stiff.		3	SS	10				○			
	trace plastic below 1.5m											
2			4	SS	14				○			
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-21

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 21

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 105mm										
0.1	**GRANULAR BASE:** 255mm, sand and gravel, brown, moist.		1	AS							
0.4	**FILL:** silty clay, trace sand, trace gravel, brown, moist, stiff.		2	AS					○		
			3	SS	13						
1.2	**SILTY CLAY:** trace sand, trace gravel, brown, moist, stiff to very stiff.		4	SS	25				○		
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.										

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPL

LOG OF BOREHOLE BH15-22

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 22

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 110mm										
0.1	**GRANULAR BASE:** 300mm, sand and gravel, brown, moist.		1	AS							
			2	AS							
0.4	**FILL:** silty clay, trace sand, trace gravel, brown, moist, stiff.								○		
1			3	SS	10				○		
2			4	SS	11				○		
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.										

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-23

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 23

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 110mm											
0.1	**GRANULAR BASE:** 320mm, sand and gravel, brown, moist.		1	AS			Cement		○			
			2	AS								
0.4	**FILL:** silty clay, trace sand, trace gravel, trace topsoil, brown, moist, stiff.											
1			3	SS	13				○			
	trace rootlets below 1.5m											
2			4	SS	15				○			
2.1	**SILTY CLAY:** trace sand, brown, moist, very stiff to hard.						Bentonite					
			5	SS	20				○	200		0 7 53 40
3			6	SS	34				○	>225		
4							Sand					
	grey below 4.6m					▽	W. L. 4.7 mBGL Jun 24, 2015					
5			7	SS	23				○	>225		
							Screen					
6												
			8	SS	21		Sand		○	225		
6.7	**END OF BOREHOLE**											

Note:
1) Borehole was open and dry upon completion of drilling.
2) 50 mm dia. monitoring well was installed upon completion of drilling.
3) Water Level Readings in Monitoring Well:

Date	W. L. Depth (m)
2015/06/24	4.7

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

LOG OF BOREHOLE BH15-24

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 24

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 105mm											
0.1	**GRANULAR BASE:** 465mm, sand and gravel, brown, moist.		1	AS			Cement		○			
			2	AS								
0.6	**FILL:** silty clay, sandy, trace gravel, brownish grey, moist, firm to stiff.		3	SS	7				○			4 27 44 25
			4	SS	12	▽	W. L. 1.8 mBGL Jun 24, 2015 Bentonite		○			
			5	SS	10				○			
3.2	**CLAYEY SILT TILL:** trace sand, trace gravel, brown, moist, very stiff.		6	SS	19				○			
	grey below 4.3m		7	SS	26		Sand		○			
	sandy between 4.6m and 6.1m		8	SS	21				○			
	silty clay till, hard below 6.1m		9	SS	36		Screen		○			
6.7	**SILTY CLAY :** trace sand, grey, moist, hard.		10	SS	31				○			
			11	SS	35		Sand		○			
9.8	**END OF BOREHOLE**											

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

LOG OF BOREHOLE BH15-24

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 24

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m							GR SA SI CL
	Note: 1) Borehole was open and dry upon completion of drilling. 2) 50 mm dia. monitoring well was installed upon completion of drilling. 3) Water Level Readings in Monitoring Well: Date W. L. Depth (m) 2015/06/24 1.8											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon=3\%}$ Strain at Failure

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

LOG OF BOREHOLE BH15-25

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 25

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 105mm										
0.1	**GRANULAR BASE:** 415mm, sand and gravel, brown, moist.		1	AS					○		
			2	AS							
0.5	**FILL:** silty clay, trace sand, trace gravel, brown, moist, stiff.										
1			3	SS	11				○		
1.2	**SILTY CLAY TILL:** trace sand, trace gravel, trace oxidation, brown, moist, very stiff.										
2			4	SS	19				○		
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.										

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-26

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 26

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE & Sensitivity, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (C_u) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 105mm										
0.1	**GRANULAR BASE:** 335mm, sand and gravel, brown, moist.		1	AS							
0.4	**FILL:** silty sand, trace gravel, dark brown, moist.		2	AS							
0.8	**FILL:** silty clay, trace to some sand, trace gravel, brown, moist, very stiff.		3	SS	16						
1											
2			4	SS	15						
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.										

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▽

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-27

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 27

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 110mm											
0.1	**GRANULAR BASE:** 320mm, sand and gravel, trace silt, brown, moist.		1	AS								44 49 (7)
0.4	**GRANULAR SUBBASE:** 300mm, sand, trace gravel, brown, moist.		2	AS								
0.8	**FILL:** silty clay, sandy, trace gravel, brown, moist, firm to stiff.		3	SS	7				○			
1												
2			4	SS	14				○			
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.											

SPL SOIL LOG 10000163-AUGUST 12, 2015 GPJ SPL GDT 12/1/15

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-28

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 28

(m) ELEV / DEPTH	SOIL PROFILE DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 100mm											
0.1	**GRANULAR BASE:** 300mm, sand and gravel, brown, moist.		1	AS								
0.4	**GRANULAR SUBBASE:** 300mm, sandy gravel, trace silt, brown, moist.		2	AS								61 33 (6)
0.7	**FILL:** clayey silt to silty clay, trace sand, trace gravel, brown, moist, firm to very stiff.		3	SS	7							
1												
2			4	SS	16							
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.											

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-29

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 29

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 110mm										
0.1	**GRANULAR BASE:** 300mm, sand and gravel, brown, moist.		1	AS							
0.4	**GRANULAR SUBBASE:** 120mm, sand and gravel, brown, moist.		2	AS							
0.5	**FILL:** clayey silt, sandy, trace gravel, brown, moist, very stiff.		3	SS	18						
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.		4	SS	18						

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH15-30

PROJECT: Geothechnical Investigation
CLIENT: Delcan Corporation
PROJECT LOCATION: Huntington Road, Vaughan, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Solid Stem Auger
Diameter: 170mm
Date: May/22/2015

REF. NO.: 10000163
ENCL NO.: 30

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:** 170mm										
0.2	**GRANULAR BASE:** 300mm, sand and gravel, brown, moist.		1	AS							
0.5	**GRANULAR SUBBASE:** 390mm, sand and gravel, brown, moist.		2	AS					○		
0.9	**CLAYEY SILT TILL:** sandy, trace gravel, brownish grey, moist, compact.		3	SS	14				○		
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and dry upon completion of drilling.		4	SS	14				○		

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

SPL SOIL LOG 10000163-AUGUST 12, 2015.GPJ SPL.GDT 8/12/15

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Appendix B

PAVEMENT STRUCTURE SPREADSHEET

Pavement Structure Spreadsheet Along Huntington Rd

SPL Consultants Limited

BH No.		Offset from CL (BH)	Approx. Station	Left (SBL) Mid-Lane				Right (NBL) Mid-Lane				Type of Subgrade (main)	Description
				Asph (mm)	Base (mm)	Subbase (mm)	Total Structure (mm)	Asph (mm)	Base (mm)	Subbase (mm)	Total Structure (mm)		
Langstaff Rd 10+000													
BH 15-30	NBL	6.0 Rt	10+110				-	170	300	390	860	clayey silt till, sandy	BH 15-30 was drilled on new pavement, lane 2
BH 15-29	SBL	2.4 Lt	10+220	110	300	120	530				-	clayey silt, sandy	
BH 15-28	SBL	2.1 Lt	10+410	100	300	300	700				-	clayey silt to silty clay	
BH 15-27	SBL	2.0 Lt	10+610	110	320	300	730				-	sand	
BH 15-26	NBL	1.5 Rt	10+790				-	105	335	-	440	silty sand	
BH 15-25	SBL	2.0 Lt	10+970	105	415	-	520				-	silty clay	
BH 15-24	NBL	2.5 Rt	11+110				-	105	465	-	570	silty clay, sandy	
BH 15-23	SBL	2.3 Lt	11+320	110	320	-	430				-	silty clay	
BH 15-22	NBL	2.9 Rt	11+520				-	110	300	-	410	silty clay	
BH 15-21	SBL	1.7 Lt	11+720	105	255	-	360				-	silty clay	
BH 15-20	NBL	2.0 Rt	11+940					100	150	180	430	silty clay	
Rutherford Rd (12+031)													
BH 15-19	SBL	-	12+090	-	150	560	710					silty clay	
BH 15-18	NBL	-	12+250					-	300	330	630	silty clay, sandy	
BH 15-17	SBL	-	12+500	-	100	430	530					silty clay till, sandy	
BH 15-16	SBL	-	12+760	-	320	480	800					silty clay	
BH 15-15	SBL	-	12+980	-	300	320	620					silty clay	
BH 15-14	NBL	-	13+100				-	-	300	350	650	silty clay, some sand	
BH 15-13	SBL	-	13+360	-	350	530	880					silty clay	
BH 15-12	NBL	-	13+550				-	-	340	610	950	silty clay, sandy	
BH 15-11	SBL	-	13+790	-	350	-	350					silty clay	
McGillivray Road (13+812)													

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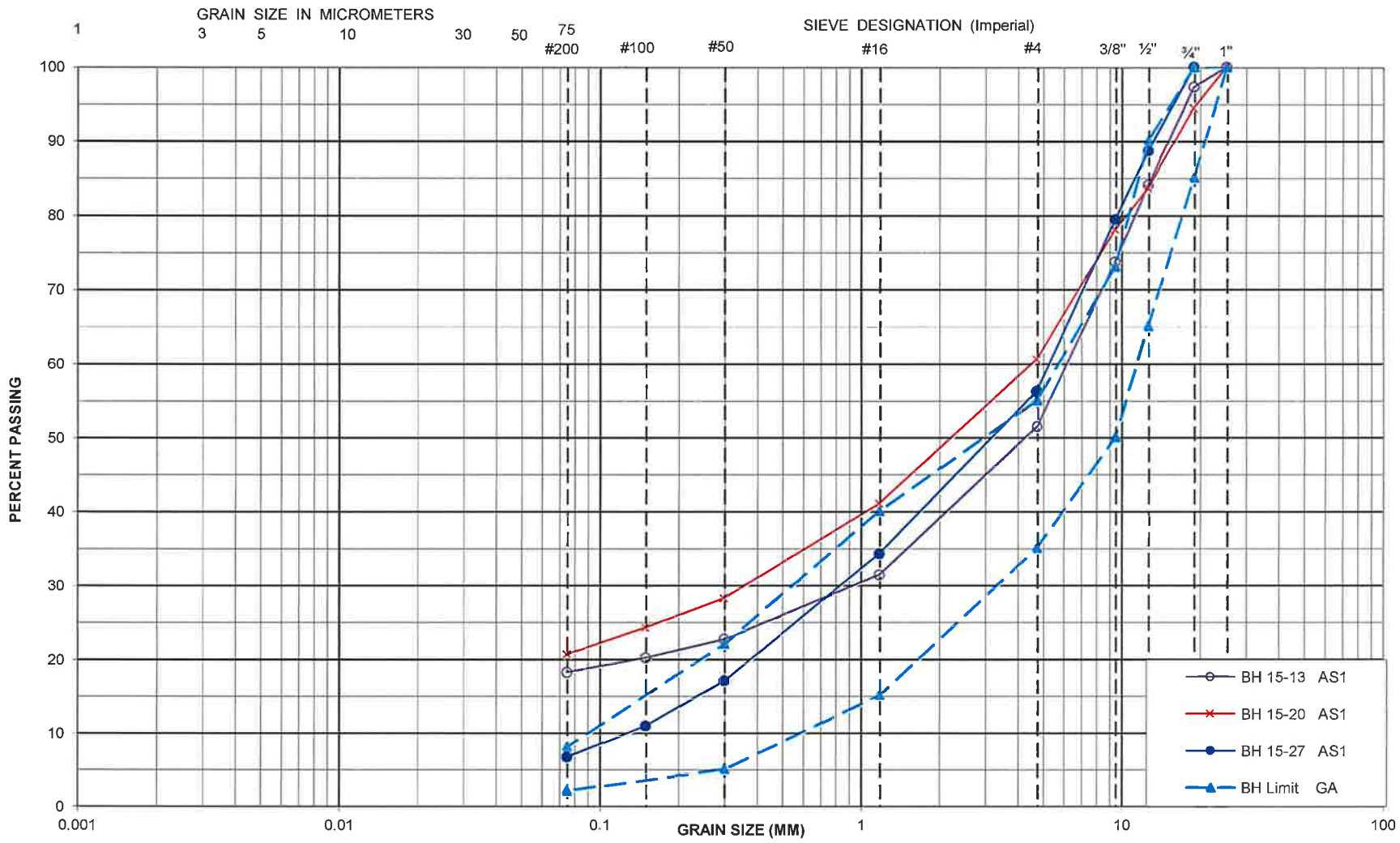
Appendix C

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION SYSTEM

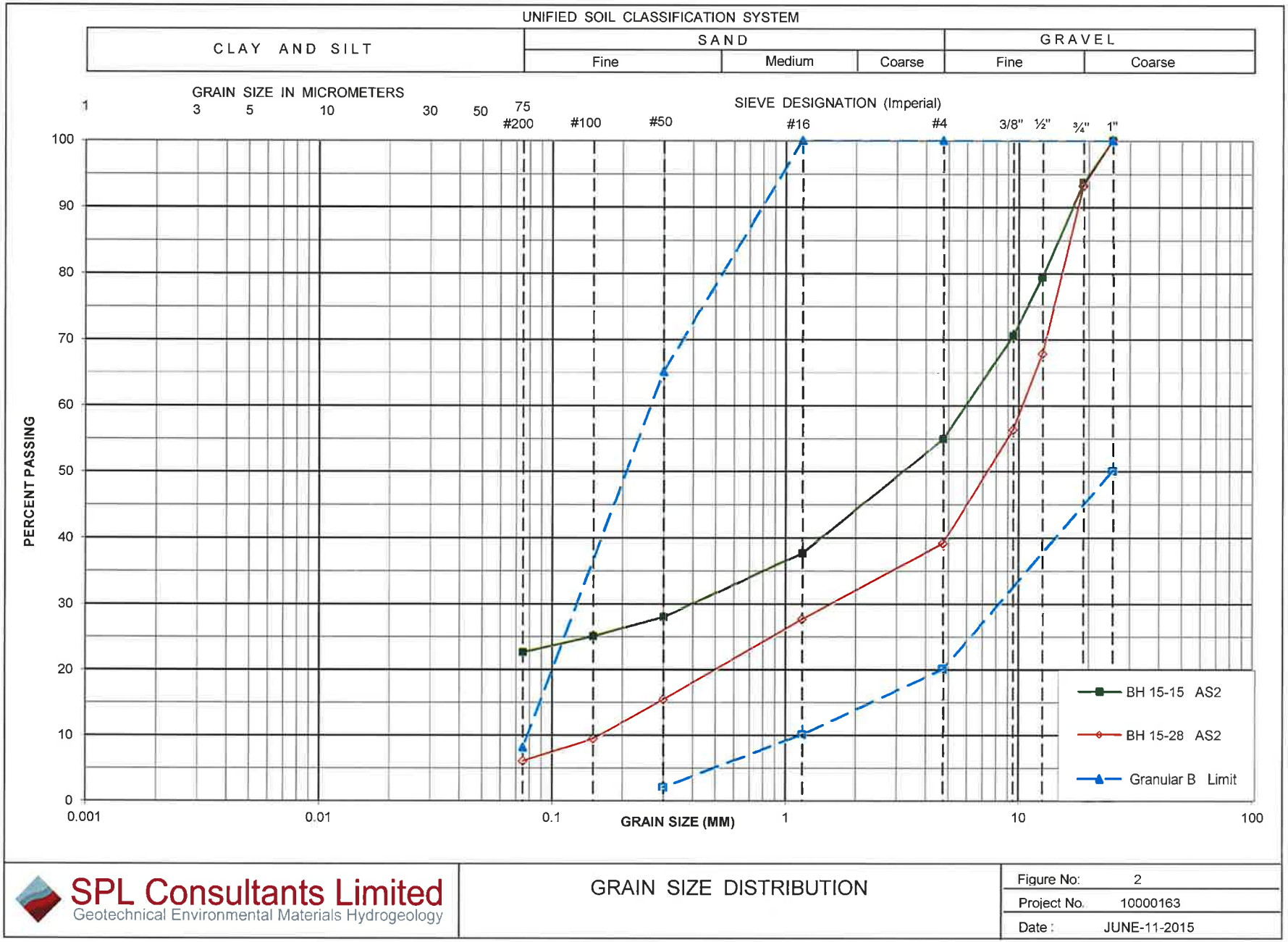
CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

GRAIN SIZE DISTRIBUTION

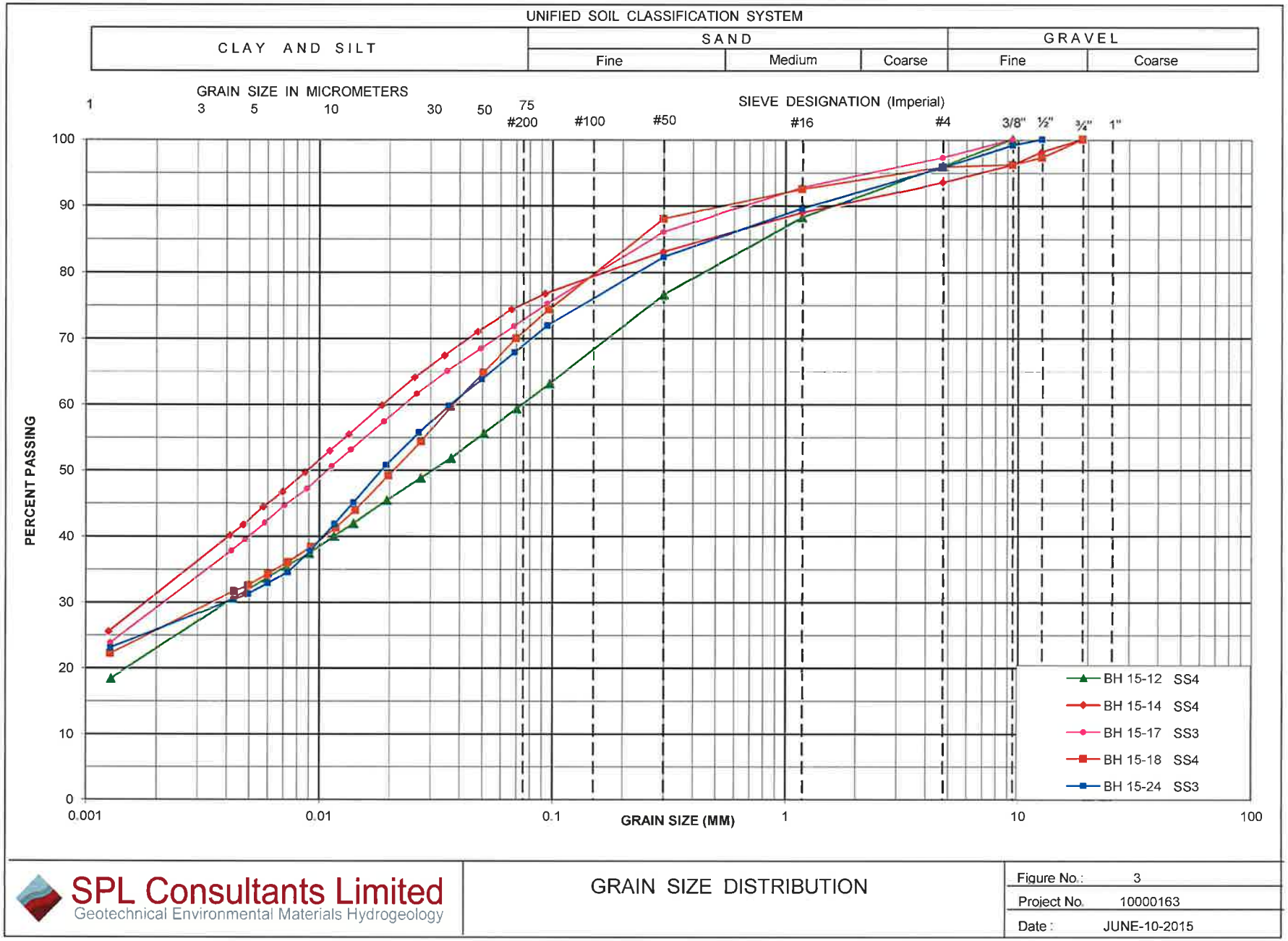
Figure No: 1
Project No. 10000163
Date : JUNE-11-2015



SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

GRAIN SIZE DISTRIBUTION

Figure No:	2
Project No.	10000163
Date :	JUNE-11-2015



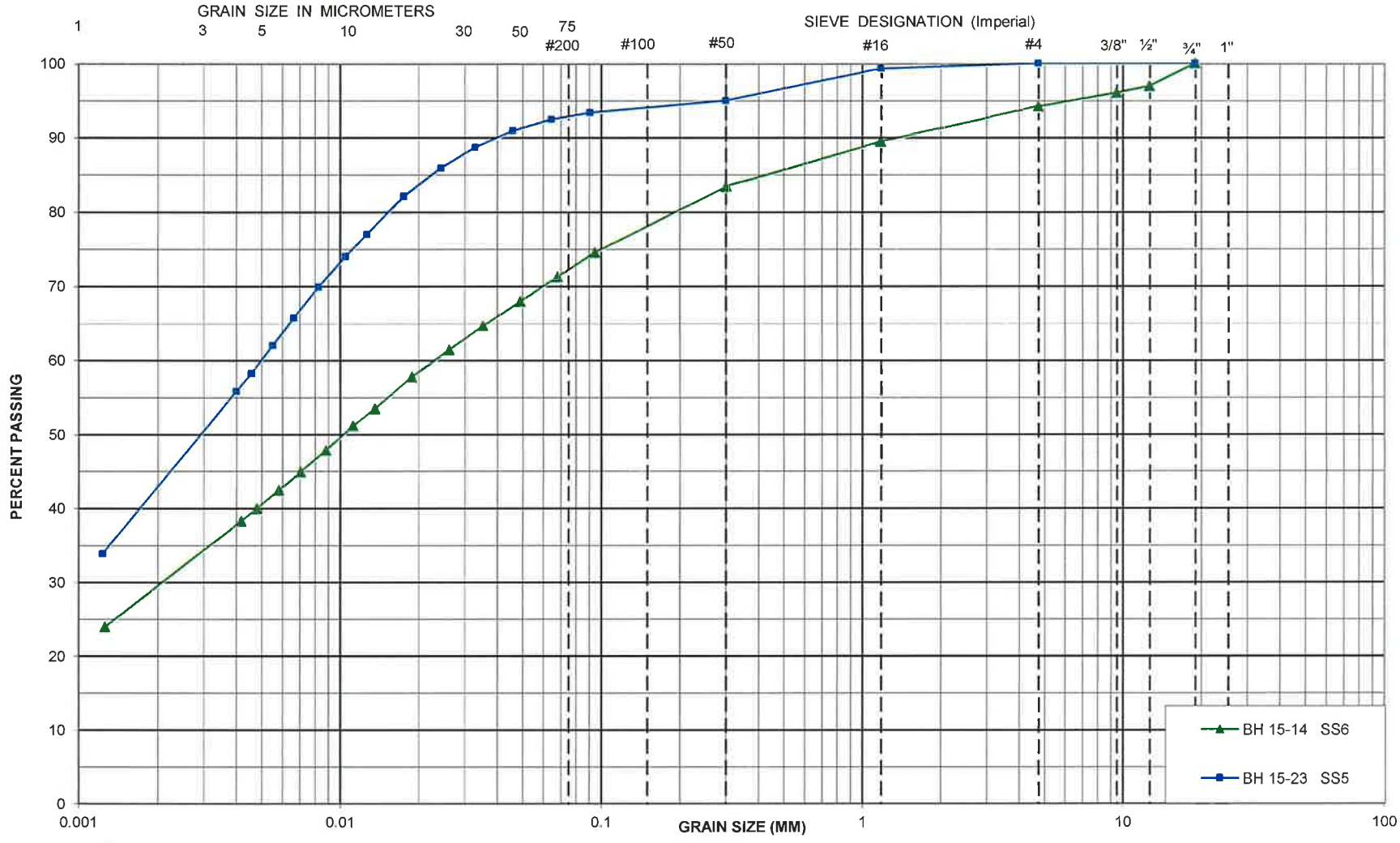
SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

GRAIN SIZE DISTRIBUTION

Figure No.: 3
Project No. 10000163
Date : JUNE-10-2015

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



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GRAIN SIZE DISTRIBUTION

Figure No: 4
Project No. 10000163
Date : June-15-2015

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Appendix D

SITE PHOTOGRAPHS

Photo 1: Standing water at northbound ditch, close to Langstaff Rd

Photo 2: Slight to moderate longitudinal construction joint and midlane cracking

Photo 3: Slight to moderate wheel track rutting and cracking

Photo 4: Slight to moderate transverse cracking

Photo 5: Slight to moderate transverse construction joint, moderate to severe transverse cracking, slight to moderate alligator cracking with potholes

Photo 6: Slight to moderate pavement edge cracking and flushing

Photo 7: Slight to moderate longitudinal construction joint

Photo 8: Standing water and dumped garbage at northbound ditch

Photo 9: Slight to moderate raveling and coarse aggregate loss with potholes

Photo 10: Patching along pavement edge of the road

Photo 11: Slight to severe multiple centerline cracking

Photo 12: Patching around manhole and uneven surface of the road

Photo 13: Slight to moderate wheel track rutting and cracking

Photo 14: Slight to moderate map cracking and uneven surface of the road

Photo 15: Uneven surface of the road and no proper ditching

Photo 16: Standing water at southbound ditch

Photo 17: Potholes/waterponds and uneven surface of the gravelly road

Photo 18: No proper ditching along the gravelly road

Photo 19: Standing water at northbound shoulder of the gravelly road

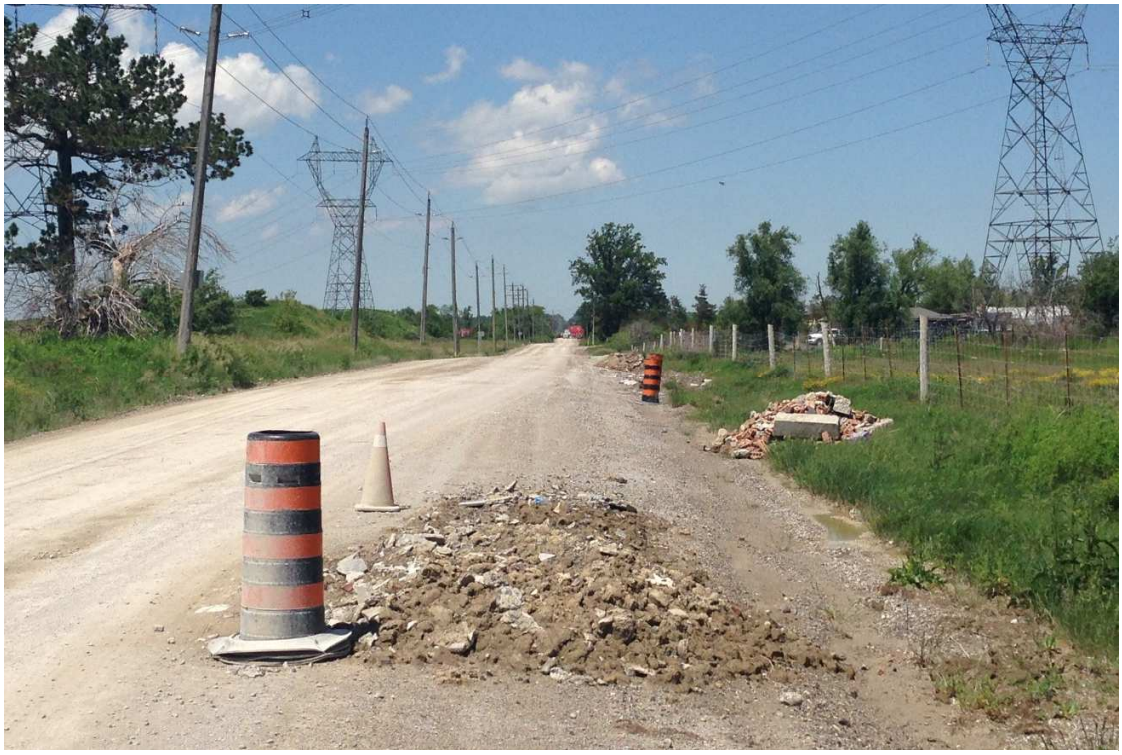

Photo 20: Improper construction debris disposal and no proper ditching along the road

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Appendix E

PAVEMENT THICKNESS DESIGN OUTPUT

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Ministry of Transportation
301 St. Paul Street
St. Catharines
Ontario

Flexible Structural Design Module

Huntington Widening from Langstaff Rd to Rutherford Rd -New Construction and Widening - 20 Yr

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	6,400,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	141 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Hot Mix	0.42	1	180	7	76
2	New Base - Granular A	0.14	1	150	7	21
3	New Subbase - Granular B Type I	0.09	1	500	7	45
Total	-	-	-	830	-	142

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

Optimized Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Cost (sq m/mm)	Min Thick (Di)(mm)	Max Thick (mm)	Width (m)	Optimum Thick (mm)	Calculated SN (mm)	Calculated Cost (sq m)
Total	-	-	-	-	-	-	-	-	-	-

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Computer Software Product

Ministry of Transportation
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St. Catharines
Ontario

Flexible Structural Design Module

Huntington Widening from Langstaff Rd to Rutherford Rd - Rehab Existing Lane - 20 Yr

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	6,400,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	141 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Hot Mix	0.42	1	190	4	80
2	New Base - Granular A	0.14	1	100	4	14
3	Pulverized materail	0.12	1	300	4	36
4	Existing Base	0.11	0.9	125	4	12
Total	-	-	-	715	-	142

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

Optimized Layer Design

1997 AASHTO Pavement Design

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301 St. Paul Street
St. Catharines
Ontario

Flexible Structural Design Module

Huntington Widening from Langstaff Rd to Street A-New Construction and Widening - 20 Yr

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	4,650,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	135 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Hot Mix	0.42	1	170	7	71
2	New Base - Granular A	0.14	1	150	7	21
3	New Subbase - Granular B Type I	0.09	1	500	7	45
Total	-	-	-	820	-	137

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

Optimized Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Cost (sq m/mm)	Min Thick (Di)(mm)	Max Thick (mm)	Width (m)	Optimum Thick (mm)	Calculated SN (mm)	Calculated Cost (sq m)
Total	-	-	-	-	-	-	-	-	-	-

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Computer Software Product

Ministry of Transportation
301 St. Paul Street
St. Catharines
Ontario

Flexible Structural Design Module

Huntington Widening from Street A to Rutherford Rd -New Construction and Widening - 20 Yr

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	6,400,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	141 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Hot Mix	0.42	1	180	7	76
2	New Base - Granular A	0.14	1	150	7	21
3	New Subbase - Granular B Type I	0.09	1	500	7	45
Total	-	-	-	830	-	142

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

Optimized Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Cost (sq m/mm)	Min Thick (Di)(mm)	Max Thick (mm)	Width (m)	Optimum Thick (mm)	Calculated SN (mm)	Calculated Cost (sq m)
Total	-	-	-	-	-	-	-	-	-	-

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Ministry of Transportation
301 St. Paul Street
St. Catharines
Ontario

Flexible Structural Design Module

Huntington Widening from Rutherford Rd to MCGillivray Rd - New Construction and Widening - 20 Yr

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	1,350,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	114 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Hot Mix	0.42	1	120	7	50
2	New Base - Granular A	0.14	1	150	7	21
3	New Subbase - Granular B Type I	0.09	1	500	7	45
Total	-	-	-	770	-	116

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

Optimized Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Cost (sq m/mm)	Min Thick (Di)(mm)	Max Thick (mm)	Width (m)	Optimum Thick (mm)	Calculated SN (mm)	Calculated Cost (sq m)
Total	-	-	-	-	-	-	-	-	-	-

1997 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Ministry of Transportation
301 St. Paul Street
St. Catharines
Ontario

Flexible Structural Design Module

Huntington Widening from Rutherford Rd to MCGillivray Rd - Rehab Existing Lane - 20 Yr

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	1,350,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	25,000 kPa
Stage Construction	1
Calculated Design Structural Number	114 mm

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(mm)	Width (m)	Calculated SN (mm)
1	New Hot Mix	0.42	1	120	4	50
2	New Base - Granular A	0.14	1	150	4	21
3	Existing Base	0.11	0.9	180	4	18
4	Existing Gran Subbase	0.07	0.9	400	4	25
Total	-	-	-	850	-	114

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(mm)	Min Thickness (Di)(mm)	Elastic Modulus (kPa)	Width (m)	Calculated Thickness (mm)	Calculated SN (mm)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

Optimized Layer Design

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Appendix F:

ENVIRONMENTAL SOIL TEST RESULTS AND REPORT

Date: June 17, 2015

SPL Project No.: 10000163

Delcan Corporation
625 Cochrane Drive, Suite 500
Markham, ON
L3R 9R9

Attention: Ms. Loren Polonsky

Re: Chemical Characterisation of Soil
Class EA Study, Huntington Road, Vaughan, Ontario

SPL Consultants Limited (SPL) was retained by Ms. Loren Polonsky of the Delcan Corporation to provide chemical characterisation of soils for offsite disposal options during the proposed construction activities at the above noted project.

In order to assess options for offsite soil disposal, soil samples were collected during the advancement of thirty (30) geotechnical boreholes (BH15-1 & BH15-30) by SPL in May 2015. The borehole locations are shown on **Drawing 1** and the soil sample description are presented in the attached borehole logs in **Appendix A**. The nine (9) selected soil samples were analysed for metal and inorganics parameters.

Soil samples were collected and handled in accordance with generally accepted sampling and handling procedures used by the environmental consulting industry. Prior to each sampling event, new disposable gloves were used to transfer samples in plastic bags and glass jars supplied by the laboratory. All soil samples were kept under refrigerated conditions during field storage and transportation to the environmental analytical laboratory.

The chemical analyses were conducted by AGAT Laboratories located in Mississauga, Ontario. AGAT is a member of the Canadian Association for Laboratory Accreditation (CALA) and meets the requirements of Section 47 of O.Reg. 153/04 certifying that the analytical laboratory be accredited in accordance with the International Standard ISO/IEC 17025 and with standards developed by the Standards Council of Canada. The applicable Certificates of Analysis are attached in **Appendix B**.

For the purposes of soil disposal, the results of chemical analyses were compared to the Background Site Condition Standards for All Property Uses other than Agricultural as contained in Table 1 of the "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act," published by the Ministry of Environment (MOE) on April 15, 2011. Additionally the results were also compared to Residential/Parkland/Institutional (RPI) and Industrial/Commercial/Community (ICC) Property Use Standards for Potable Ground Water Condition and Non-Potable Ground Water Condition

as contained in Tables 2 and 3, respectively of the aforementioned document. Based on the results of chemical analyses, SPL provides the following conclusions/recommendations:

- Exceedances of EC and/or SAR were identified in six (6) of the nine (9) soil samples submitted for analysis above the MOE Table 1 Standards for parameters analyzed.
- Analytical results indicate exceedances of EC and/or SAR in five (5) of the nine soils samples for analysis above the MOE Table 2 and 3 RPI Standards for parameters analyzed
- Chemical analysis indicated that EC exceedances were identified in one (1) of the nine (9) soil samples analyzed above the MOE Table 2 and 3 ICC Standards for parameters analyzed.
- The results of all samples met the MOE Table 1 Standards with the exception of EC and SAR. Material meeting the MOE Table 1 Standards excluding EC and SAR may be suitable for reuse at a Ministry of Natural Resources pit rehabilitation site. This letter should be provided for review and acceptance will be at the discretion of the receiving site.
- If a Ministry of Natural Resources pit rehabilitation site cannot be identified soil with exceedances above the MOE Table 3 ICC standards will require disposal as a waste material. Waste Classification testing in accordance with O.Reg. 558 will be required for the offsite disposal of soil defined as a waste.
- Acceptance of any excavated soil will be at the discretion of the receiving site. It is the responsibility of the receiving site and/or soil movement contractor of this material to ensure that the soil received is represented by this testing.
- The purpose of this testing was to assess the chemical quality of the soil and does not constitute a Phase Two Environmental Site Assessment as defined in O. Reg. 153/04 as amended.
- The purpose of this testing was to assess the chemical quality of the soil and does not pertain to the geotechnical suitability of the material.
- It should be noted that if any aesthetically impacted soils are identified during excavation it is recommended that SPL be notified in order to conduct further assessment and / or testing of the material in question.

This report was prepared for the account of the Delcan Corporation. The material in this report reflects SPL's judgment in light of the information available to it at the time of preparation. Any use, which a Third Party not noted above makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. SPL Consultants Limited accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

Thank you for the opportunity to be of service on this project. Should you have any questions or wish to review the contents of this letter in more detail, please do not hesitate to contact the undersigned.

Yours Very Truly,

SPL Consultants Limited

Prepared by:

Laura Brodhurst
Environmental Project Officer

Prepared by:

Randy Furtado, B.E.S.
Environmental Project Manager

Attachments:
Drawing 1 – Borehole Location Plan
Appendix A – Borehole Logs
Appendix B – Certificates of Analysis (AGAT work order 15T976932)

Appendix B
Certificates of Analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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http://www.agatlabs.com

CLIENT NAME: SPL CONSULTANTS
51 CONSTELLATION COURT
TORONTO, ON M9W1K4
(416) 798-0065

ATTENTION TO: Laura Brodhurst

PROJECT: 10000163

AGAT WORK ORDER: 15T976932

SOIL ANALYSIS REVIEWED BY: Anthony Dapaah, PhD (Chem), Inorganic Lab Manager

DATE REPORTED: Jun 01, 2015

PAGES (INCLUDING COVER): 7

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.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 15T976932

PROJECT: 10000163

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Laura Brodhurst

SAMPLING SITE:Huntington Road

SAMPLED BY:

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

DATE RECEIVED: 2015-05-25 **DATE REPORTED: 2015-06-01**

		SAMPLE DESCRIPTION:		BH15-9 SS4	BH15-18 SS4	BH15-21 SS3	BH15-28 SS3	BH15-13 SS4	BH15-5 SS3	BH15-2 SS3	BH15-15 SS3
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		5/20/2015	5/21/2015	5/22/2015	5/22/2015	5/21/2015	5/20/2015	5/20/2015	5/21/2015
Parameter	Unit	G / S	RDL	6579453	6579459	6579461	6579462	6579463	6579464	6587290	6587291
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	4	3	3	3	4	<1	<1	4
Barium	µg/g	220	2	84	110	117	73	81	28	20	71
Beryllium	µg/g	2.5	0.5	0.8	0.6	0.6	<0.5	0.6	<0.5	<0.5	0.6
Boron	µg/g	36	5	<5	8	9	7	9	<5	<5	9
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.24	0.29	0.29	0.15	0.38	0.20	<0.10	0.31
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	20	22	24	15	20	7	9	21
Cobalt	µg/g	21	0.5	11.6	9.2	9.9	7.9	10.4	2.9	2.8	11.2
Copper	µg/g	92	1	14	19	23	17	20	5	3	20
Lead	µg/g	120	1	11	7	9	6	8	4	3	8
Molybdenum	µg/g	2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g	82	1	22	20	22	16	23	5	5	24
Selenium	µg/g	1.5	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<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	<0.5	0.5	<0.5	<0.5	0.5	<0.5	<0.5	0.6
Vanadium	µg/g	86	1	31	32	34	23	27	15	17	28
Zinc	µg/g	290	5	62	47	56	37	50	17	13	48
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	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	**1.20**	0.473	**0.763**	**0.702**	0.521	**1.16**	**2.35**	0.431
Sodium Adsorption Ratio	NA	2.4	NA	**9.15**	**2.43**	**4.04**	2.34	0.772	**3.44**	**5.89**	1.06
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.61	7.70	7.69	7.96	7.86	7.01	7.24	7.85

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 15T976932

PROJECT: 10000163

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Laura Brodhurst

SAMPLING SITE:Huntington Road

SAMPLED BY:

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

DATE RECEIVED: 2015-05-25 **DATE REPORTED: 2015-06-01**

		SAMPLE DESCRIPTION:		BH15-26 SS3
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		5/22/2015
Parameter	Unit	G / S	RDL	6587292
Antimony	µg/g	1.3	0.8	<0.8
Arsenic	µg/g	18	1	3
Barium	µg/g	220	2	62
Beryllium	µg/g	2.5	0.5	<0.5
Boron	µg/g	36	5	6
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.31
Cadmium	µg/g	1.2	0.5	<0.5
Chromium	µg/g	70	2	18
Cobalt	µg/g	21	0.5	8.7
Copper	µg/g	92	1	16
Lead	µg/g	120	1	8
Molybdenum	µg/g	2	0.5	<0.5
Nickel	µg/g	82	1	17
Selenium	µg/g	1.5	0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2
Thallium	µg/g	1	0.4	<0.4
Uranium	µg/g	2.5	0.5	<0.5
Vanadium	µg/g	86	1	26
Zinc	µg/g	290	5	43
Chromium VI	µg/g	0.66	0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	0.481
Sodium Adsorption Ratio	NA	2.4	NA	2.35
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.64

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

6579453-6587292 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.

Certified By:

AGAT Laboratories

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Guideline Violation

AGAT WORK ORDER: 15T976932

PROJECT: 10000163

CLIENT NAME: SPL CONSULTANTS

ATTENTION TO: Laura Brodhurst

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
6579453	BH15-9 SS4	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	1.20
6579453	BH15-9 SS4	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	9.15
6579459	BH15-18 SS4	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	2.43
6579461	BH15-21 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	0.763
6579461	BH15-21 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	4.04
6579462	BH15-28 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	0.702
6579464	BH15-5 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	1.16
6579464	BH15-5 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	3.44
6587290	BH15-2 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	2.35
6587290	BH15-2 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	5.89

AGAT Laboratories

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Quality Assurance

CLIENT NAME: SPL CONSULTANTS

AGAT WORK ORDER: 15T976932

PROJECT: 10000163

ATTENTION TO: Laura Brodhurst

SAMPLING SITE:Huntington Road

SAMPLED BY:

Soil Analysis

RPT Date: Jun 01, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	6574077		<0.8	<0.8	0.0%	< 0.8	107%	70%	130%	96%	80%	120%	110%	70%	130%
Arsenic	6574077		7	7	0.0%	< 1	102%	70%	130%	92%	80%	120%	95%	70%	130%
Barium	6574077		84	82	2.4%	< 2	104%	70%	130%	99%	80%	120%	101%	70%	130%
Beryllium	6574077		0.7	0.7	0.0%	< 0.5	97%	70%	130%	101%	80%	120%	98%	70%	130%
Boron	6574077		12	12	0.0%	< 5	72%	70%	130%	101%	80%	120%	97%	70%	130%
Boron (Hot Water Soluble)	6593134		2.72	2.75	1.1%	< 0.10	126%	60%	140%	99%	70%	130%	93%	60%	140%
Cadmium	6574077		<0.5	<0.5	0.0%	< 0.5	103%	70%	130%	96%	80%	120%	94%	70%	130%
Chromium	6574077		23	23	0.0%	< 2	89%	70%	130%	97%	80%	120%	97%	70%	130%
Cobalt	6574077		11.2	11.2	0.0%	< 0.5	92%	70%	130%	102%	80%	120%	94%	70%	130%
Copper	6574077		18	18	0.0%	< 1	97%	70%	130%	99%	80%	120%	89%	70%	130%
Lead	6574077		7	7	0.0%	< 1	99%	70%	130%	83%	80%	120%	80%	70%	130%
Molybdenum	6574077		4.6	4.7	2.2%	< 0.5	100%	70%	130%	105%	80%	120%	106%	70%	130%
Nickel	6574077		32	32	0.0%	< 1	101%	70%	130%	107%	80%	120%	101%	70%	130%
Selenium	6574077		<0.4	<0.4	0.0%	< 0.4	94%	70%	130%	96%	80%	120%	96%	70%	130%
Silver	6574077		<0.2	<0.2	0.0%	< 0.2	97%	70%	130%	113%	80%	120%	107%	70%	130%
Thallium	6574077		<0.4	<0.4	0.0%	< 0.4	91%	70%	130%	97%	80%	120%	94%	70%	130%
Uranium	6574077		1.4	1.4	0.0%	< 0.5	87%	70%	130%	100%	80%	120%	99%	70%	130%
Vanadium	6574077		33	32	3.1%	< 1	93%	70%	130%	104%	80%	120%	102%	70%	130%
Zinc	6574077		46	45	2.2%	< 5	96%	70%	130%	101%	80%	120%	96%	70%	130%
Chromium VI	6579463	6579463	<0.2	<0.2	0.0%	< 0.2	98%	70%	130%	98%	80%	120%	100%	70%	130%
Cyanide	6579850		<0.040	<0.040	0.0%	< 0.040	107%	70%	130%	108%	80%	120%	104%	70%	130%
Mercury	6574077		<0.10	<0.10	0.0%	< 0.10	97%	70%	130%	82%	80%	120%	78%	70%	130%
Electrical Conductivity	6587238		0.113	0.117	3.5%	< 0.005	100%	90%	110%	NA			NA		
Sodium Adsorption Ratio	6587238		0.094	0.094	0.0%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	6587292	6587292	7.64	7.75	1.4%	NA	101%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: SPL CONSULTANTS

AGAT WORK ORDER: 15T976932

PROJECT: 10000163

ATTENTION TO: Laura Brodhurst

SAMPLING SITE:Huntington Road

SAMPLED BY:

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	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 6010B	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER