PRELIMINARY GEOTECHNICAL AND PAVEMENT INVESTIGATION
HUNTINGTON ROAD CLASS EA STUDY
FROM MAJOR MACKENZIE DRIVE TO NASHVILLE ROAD (PART B)
CITY OF VAUGHAN, ONTARIO

Prepared For:
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SPL Project No.: 10000163 B
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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 and urbanization of about 1.6 km of Huntington Road from north of Major Mackenzie Drive to Nashville Road 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 one culvert location. From the findings in the boreholes, recommendations for rehabilitation/reconstruction of Huntington Road will be provided. Preliminary foundation assessment at one (1) culvert location will also be given.

We understand that based on the latest design, Huntington Road within the project limits, will upgraded into a 2-lane urban section with minor widening and there will be a 400 m future road linking the proposed south end of Huntington Road and Major Mackenzie Drive, as shown in Drawing 1A. We also understand that there 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 Major Mackenzie Drive to Nashville Road within the project limits is classified as Urban Major Collector Road. Presently Huntington Road is a two lane rural road within project limits with a posted speed of 80 km/hr. We understand that this road will not be widened but it will converted to urban section.

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 Major Mackenzie Dr. to Nashville Rd	2021	5,305	0.62	11
		2034	5,745		

3. FIELD AND LABORATORY WORK

The field assignment was performed in May 2015. A total of 10 boreholes (BH15-1 to BH15-10) were drilled for the rehabilitation/reconstruction of Huntington Rd between Major Mackenzie Drive and south of Nashville Road. All boreholes were generally drilled to a depth of 2.1m except for BH 15-9 which was drilled at a culvert location to a depth of 6.7m. The borehole locations are shown on the Borehole Location Plan in Drawing No. 1.

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 piezometer was installed in borehole 15-9 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 three (3) 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, three (3) 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 the attached Drawings and Appendix A, respectively).

4. SITE AND SUBSURFACE CONDITIONS

Currently Huntington Road is a south-north rural arterial road under the jurisdiction of City of Vaughan. The project site is located between Major Mackenzie Drive (south limit at station 14+480) and south of Nashville Road (north limit at Station 16+127). The project includes approximately 1.6 km of Huntington Road.

4.1 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:

- Frequent slight to moderate alligator cracking, severe to very severe at few locations with potholes
- Extensive slight to moderate pavement edge cracking, mostly alligator cracking and few severe to very severe alligator pavement edge cracking with potholes and settlement around deteriorated areas
- Extensive slight to moderate longitudinal construction joint
- Intermittent to frequent slight to moderate multiple/alligator centerline cracking
- Extensive to throughout slight to moderate half/full transverse cracking at few locations
- Few slight to moderate wheel track rutting
- Throughout slight to moderate flushing

The uneven surface of the road, especially around settled deteriorated areas, caused a poor riding condition at some locations, some patching were also observed along the road and edge of pavement. Occasional garbage dumping in ditches and improper ditching were also noticed during condition survey.

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

4.2 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 2 below presents existing pavement structure data obtained from ten (10) boreholes (BH15-1 to BH15-10) drilled for the present investigation on Huntington Rd within the project limits. All boreholes were drilled in the old main lanes of the road except H 15-6 and BH 15-9 which were drilled in the new road widening and in the shoulder, respectively. The road widening at approximate location of BH 15-6 was to accommodate new a left turn lane for southbound lane.

The boreholes in the main lanes encountered a pavement structure consisting of 60 to 90mm of asphalt, with exception of 150mm asphalt in BH 15-6, underlain by 200 to 520mm of granular base and 0 to 420mm of granular subbase materials. Pavement structure of BH 15-9 drilled at a culvert location in the shoulder consisted of 400mm granular base and 400 mm granular subbase.

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

BH No		Offset from CL	Approx. Station	SBL[1]						NBL[2]		
				Shoulder			Mid-Lane			Mid-Lane		
				Asph.[3] (mm)	Base (mm)	Sub-Base (mm)	Asph. (mm)	Base (mm)	Sub-Base (mm)	Asph. (mm)	Base (mm)	Sub-Base (mm)
Major MacKenzie Dr (14+160)												
15-10	NBL	1.6 Rt	14+250							60	260	0
15-9	SBL	3.8 Lt	14+460	0	400	400						
15-8	NBL	1.3 Rt	14+670							85	210	165
15-7	SBL	1.4 Lt	14+890				85	200	275			
15-6	NBL	1.5 Rt	15+100							150	300	250
15-5	SBL	1.6 Lt	15+290				85	400	265			
15-4	NBL	1.5 Rt	15+430							80	520	0
15-3	SBL	1.9 Lt	15+710				90	300	310			
15-2	NBL	1.4 Rt	15+910							80	300	420
15-1	SBL	1.6 Lt	16+120				65	210	275			
Nashville Rd (16+127)												

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

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

For the Huntington Rd within project limit, two (2) samples of granular base material were tested for grain size distribution. The tested samples of granular base material contain 42 and 30% gravel, 46 and 51% sand, 12 and 19% fines (silt and clay size particles). The base course material is described as sand and gravel/gravelly sand, 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 the fines contents of both samples are higher than the upper limit of Granular 'A' and one of the them is marginally acceptable as granular base but the other sample 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 15.5%.

Three (3) tested granular subbase samples along Huntington Rd contain 24 to 36% gravel, 44 to 55% sand and 18 to 24% fines (silt and clay). The subbase course material is described as gravelly sand, some silt to silty and as indicated on Figure No. 2 in **Appendix C,** the fines contents of all three samples are higher than the upper limit of Granular 'B' Type 1 and they do not meet the required gradation of Granular 'B' type I (subbase material).

Fill Material:

Fill material was encountered below the pavement structure in all the boreholes except one (BH 15-2), extending to depths varying from 0.9 to 2.1m. In south half of the road, fill material below granular subbase generally consisted of clayey silt to silty clay, trace sand, trace gravel present in a stiff consistency with measured SPT 'N' values ranged from 9 to 13 blows per 300 mm of penetration. However, in Borehole 15-10 a compact layer of silty sand material containing trace clay with measured

SPT 'N' value of 17 was found below granular base. A compact silty sand fill layer with measured SPT 'N' value of 12, was also found below cohesive fill material in BH 15-7. In fill material of BH 15-9, drilled at a culvert location, topsoil and trace rootlets were also observed.

Fill material underneath the base/subbase granular of boreholes in north half of the road, was loose to compact sand to silty sand, trace gravel. These samples were collected either from auger without SPT 'N' values or from spoon with measured SPT 'N' value of 8 to 11.

Silty Clay/Silty Clay till:

Underneath the fill material in Boreholes 15-5 to 15-10, native soil consisting of silty clay/silty clay till , trace sand and trace gravel was encountered, extending to the maximum depth of penetration. Silty clay/silty clay till deposits were mostly present in a stiff to very stiff consistency, with measured SPT 'N' values of 12 and 30 blows per 300 mm of penetration. Below the silty clay layer in borehole 15-9, the silty clay till layer was present in a very stiff to hard state with measured SPT 'N' values of 22 to 47 per 300 mm of penetration.

In BH 15-1, a firm silty clay layer was found in the tip of the spoon below the loose native sand material.

Sand/Silty Sand:

Native sand to silty sand deposit was encountered in Boreholes 15-1 to 15-4 below the fill material. This layer was present in a loose to compact state with measured SPT 'N' values ranging from 6 to 16 blows per 300 mm of penetration.

Grain size analyses of two (2) 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
15-1	SS3	0	73	20	7
15-10	SS3	0	65	25	10

Based on the above grain size analysis, the subgrade material is considered to have low susceptibility to frost heaving (LSFH).

At the location of the culvert, sieve and hydrometer analysis of the native soil sample below culvert invert was conducted. The results are presented on Figure No.4 in **Appendix C** and are shown on the borehole log, with the following fractions:

Table 4 Test Results of Grain Size Analysis of Native Soil Sample below Culvert Invert

BH No.	Sample No.	Particle Fraction (%)			
		Gravel	Sand	Silt	Clay
15-9	SS5	0	3	43	54

Groundwater Conditions:

All the boreholes were found dry upon completion of drilling, except BH 15-3 and BH 15-4 where short-term (unstabilized) groundwater was found at depths of 1.8 and 2.1m, respectively. The groundwater level in one installed piezometer was measured on June 23, 2015 (about 1 month after installation) and the reading is presented in Table 5 below.

Table 5: Groundwater Level Observed in Borehole/Piezometer

BH No.	Date of Drilling	Groundwater Table at Completion (m)	Piezometer Readings on June 23, 2015 (m)
15-9	05/20/2015	dry	2.1

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

5. PAVEMENT DESIGN AND RECOMMENDATIONS

5.1 Summary of Existing Pavement Structure

Table 6 below presents the summary of existing pavement structure data obtained from the boreholes drilled in Huntington Rd within project limits.

Table 1: Summary of Existing Pavement Structure along Huntington Road

Route	Pavement Component	No. of Observations*	Thickness (mm)	
			Range	Mean
Huntington Rd	Total HMA[1]	7	60-90	81
	Granular Base Material	8	200-520	305
	Granular Subbase Material	8	0-420	245
	Total Granular Material	8	260-720	631
	Average Existing GBE[2]			**452**
	Total HMA in Shoulders	1	0	0
	Granular Base Material in Shoulders	1	400	400
	Granular Subbase Material in Shoulders	1	400	400
	Total Granular Material in Shoulders	1	800	800
	Average Existing GBE[2]			**500**

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

* The asphalt thickness for BH 15-6 (drilled in the new widened section) and pavement structure for BH 15-10 (between Major Mackenzie Dr. and proposed south limit of Huntington Rd) are not considered in average calculation.

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

Hot Mix Asphalt:	80 mm
Granular Base:	300 mm
Granular Subbase:	250 mm
Total Structure:	630 mm

The City of Vaughan standard for Collector and Arterial Roads require a minimum of 125 mm of Hot Mix Asphalt, 125mm of ggranular base and 350 mm granular subbase, with a minimum Granular Base Equivalency (GBE) of 610. Based on the above Table 6 and observations of present pavement condition (Refer to Section 4.1 of the report), the existing pavement structure within the project limits is inadequate to support the future traffic.

5.2 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 7 presents the input parameters used to calculate ESALs along Huntington Road within the project limits.

Table 7 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 Major Mackenzie Dr. to Nashville Rd	5,208	11	1.31	0.5	0.62	1	365	20	3.05

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

Figure 1 illustrates the cumulative ESAL for a two-lane road along Huntington Road within the project limits, for over 20-year design period.

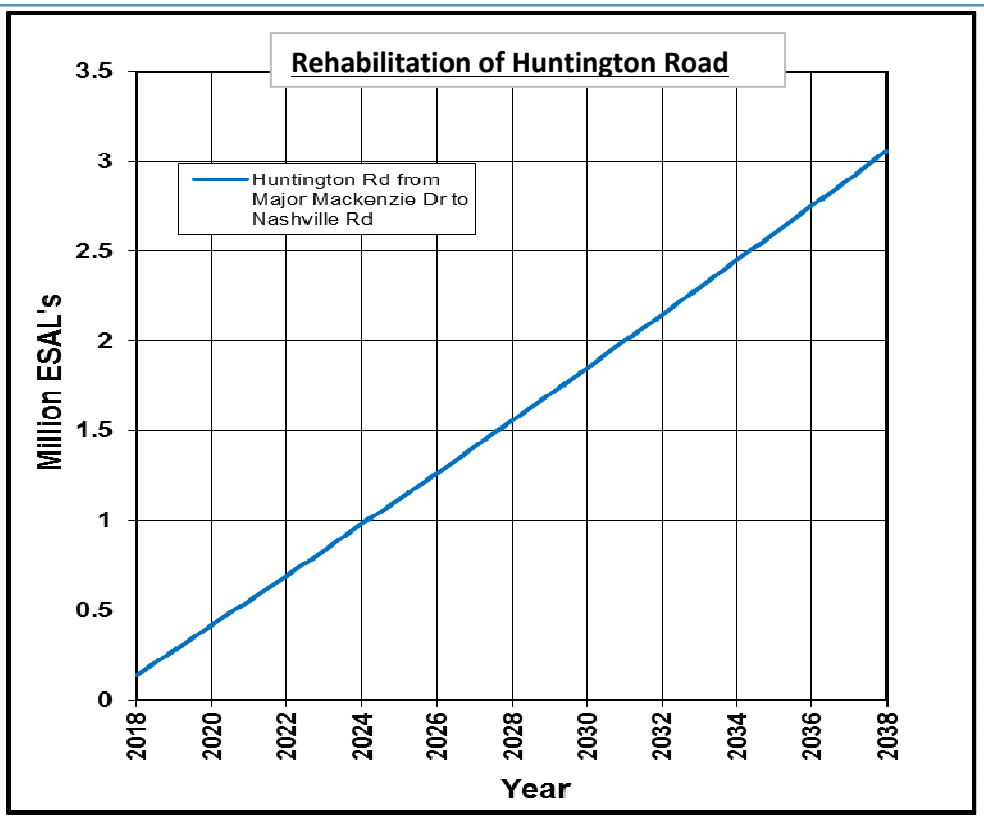

Figure 1 Cumulative ESAL for Huntington Rd from Major Mackenzie Dr. to Nashville Rd

5.3 Pavement Thickness Design

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

Pavement Thickness Design for New Construction

Table 8 Input Parameters for Pavement Structure Calculations for Huntington Road New Construction

Huntington Rd Section	Design Period	Initial/Terminal Serviceability	Cumulative ESAL's (million)	Subgrade Resilient Modulus (M_R), Mpa
From Major Mackenzie Dr. to Nashville Rd	20 years	p_i = 4.4 p_t =2.2	3.05	30

Common Parameters	Structural Coefficients ('a' values): New HMA : 0.42 New Gran Base : 0.14 Pulverized material : 0.12 Existing Gran Base : 0.11 Existing Gran Subbase : 0.075 Drainage Coefficient: m = 1.0 for new granular base and subbase m = 0.9 for existing granular Base and subbase Design Period: 20 Years (for new pavements) Reliability and Standard Deviation: R = 90%; S = 0.49

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 8 considering Low Susceptibility of Frost Heaving (LSFH) soil subgrade, are shown in Table 9 below for new construction from Major Mackenzie Drive to Nashville Road.

Table 9 Pavement Design Summary- Huntington Road from Major Mackenzie Drive to Nashville Road New Construction

Methodology	Material Thickness (mm)	SN*	GBE (mm)*
The City of Vaughan 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	711
AASHTO	150 mm hot mix, 150 mm Granular A, 400 mm Granular B Type I (structural requirements for 20 years design life)	120	718

*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 9 shows that pavement structure recommended by AASHTO pavement design method for new construction for 20-yr design life 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:

For 20 years initial design life: GBE = 718 & SN= 120

Pavement Thickness Design for Rehabilitation of the Existing Roadway

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 8 considering Low Susceptibility of Frost Heaving (LSFH) soil subgrade, are shown in Table 11 as follows:

Table 10 Pavement Design Options for Rehabilitation of Existing Lanes of Huntington Road From Major Mackenzie Drive to Nashville Road

Option	Methodology	Material Thickness (mm)	SN*	GBE (mm)*
Option 1 **Rehabilitation by Pulverization of existing Lanes with 150mm Grade raise**	AASHTO	**Option 1: Rehabilitation by Pulverization with 150 mm Grade Raise** 150 mm new hot mix over 250 mm Pulverized material over 130 mm existing Granular Base and 250 mmm existing Granular Subbase	123	772
Option 2 **Reconstruction of existing Lanes with No grade raise**	AASHTO	**Option 2: Rehabilitation by Partial Depth Reconstruction(380 mm) with no Grade Raise** 180 mm hot mix, 200 mm new Granular Base over 250 mm existing Granular Subbase (minimum structural requirements for 20 years design life)	120	685

*The Structural Number (**SN**) obtained was calculated using the following layer coefficients: HMA = 0.42; New Base= 0.14; New Subbase= 0.09; Existing Pulverized Material= 0.12; Existing Gran Base = 0.11; Existing Gran Subbase = 0.075

GBE was calculated using the equivalency factors: HMA=2; New Base=1.0; Pulverized Material=1.0; Existing Base =0.75; Existing Subbase=0.5.

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

5.4 Pavement Recommendations

Considering the above pavement thickness designs and methodologies, the following pavement rehabilitations for without and with grade raise options are presented below:

5.4.1 Rehabilitation with 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 in partial depth as follows:

- Excavate from the existing grade to a depth 380 mm to accommodate 380 mm new pavement structure
- Place 200 mm New 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) could be substituted for Base material.
** SP12.5 FC1 can be substituted by HL1 and SP19.0 by HDBC.

5.4.2 Rehabilitation with 150 mm Grade Raise Option

If the road design could accommodate a grade raise alternative, the rehabilitation by pulverization option is considered (most likely) cost effective, stronger pavement structure and the preferred option. The existing roadway is recommended to be rehabilitated as follow:

- Pulverize existing asphalt and underlying granular base to a depth of 250 mm
- Pave 150 mm Hot Mix Asphalt (50 mm SP 12.5 FC1 **surface course over 100 mm SP19.0 ** binder course in two lifts)

** SP12.5 FC1 can be substituted by HL1 and SP19.0 by HDBC.

5.5 General consideration

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

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.

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.

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.

5. FOUNDATION ASSESSMENT AT CULVERT STRUCTURE

As part of the EA study for this project, one (1) major crossing culvert in the area of Borehole 15-9 was investigated. Details of the culvert and corresponding borehole information is shown in Table 11 below.

Table 11 Details of Culvert within Project Limits

Road	Approx Station	Type of Culvert	Size (m)	Invert Depth (m)	BH No.	BH Depth (m)
Huntington Road	14+460	CSPA	1.8 x 1.2	1.8	15-9	6.7

5.1 Soil Conditions

In general, below the granular base and subbase material, Borehole 15-9encountered stiff silty clay fill deposit, overlying stiff native silty clay, which is underlain by very stiff to hard silty clay till. Details of the subsurface conditions encountered in the borehole is presented in the individual borehole log in **Appendix A** and is briefly summarized in Section 3.2.

5.2 Groundwater Condition

There was no groundwater observed in Borehole 15-9 upon completion of drilling. However, the groundwater table observed in the monitoring well installed in this borehole was at a depth of 2.1m on June 23, 2015, about one month after borehole completion.

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 CSPA culvert at Station 14+460 will be replaced, but the type of new culvert was not provided at this time. It is also understood that there may be a major vertical realignment (up to 1m), cut or fill, at this culvert location and road level may change.

Based on the information obtained from the borehole, the bottom culvert founded on the undisturbed native stiff silty clay deposit at a depth of 2.1 m or lower below existing grade can be designed for bearing capacity values of 120 kPa at SLS and 180 kPa at ULS. Higher bearing pressures are available at greater depths. The bearing values and the corresponding founding depths at the borehole location for the culvert location are summarized in Table 12 below.

Table 12 Bearing Value and Founding Level of the Culvert

Approx. Culvert Station	Culvert Invert Depth (m)	BH No.	Founding Soils	Bearing Capacity at SLS (kPa)	Bearing Capacity at ULS (kPa)	Minimum Depth below Existing Ground (m)
14+460	~1.8	BH15-9	Silty Clay	120 250	180 375	2.1 3.0

Bedding, cover and backfill details for the new culvert 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.

Stiff Silty Clay : Type 3 Soil below groundwater level

Very Stiff to Hard Silty Clay Till : Type 2 Soil below groundwater level; Type 3 soil below groundwater level

Dewatering will be required to stabilize the soil and/or to facilitate construction where excavations are required below the groundwater table or creek level. It is our opinion that in the silty clay and silty clay till 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

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Ramon Miranda, P.Eng.

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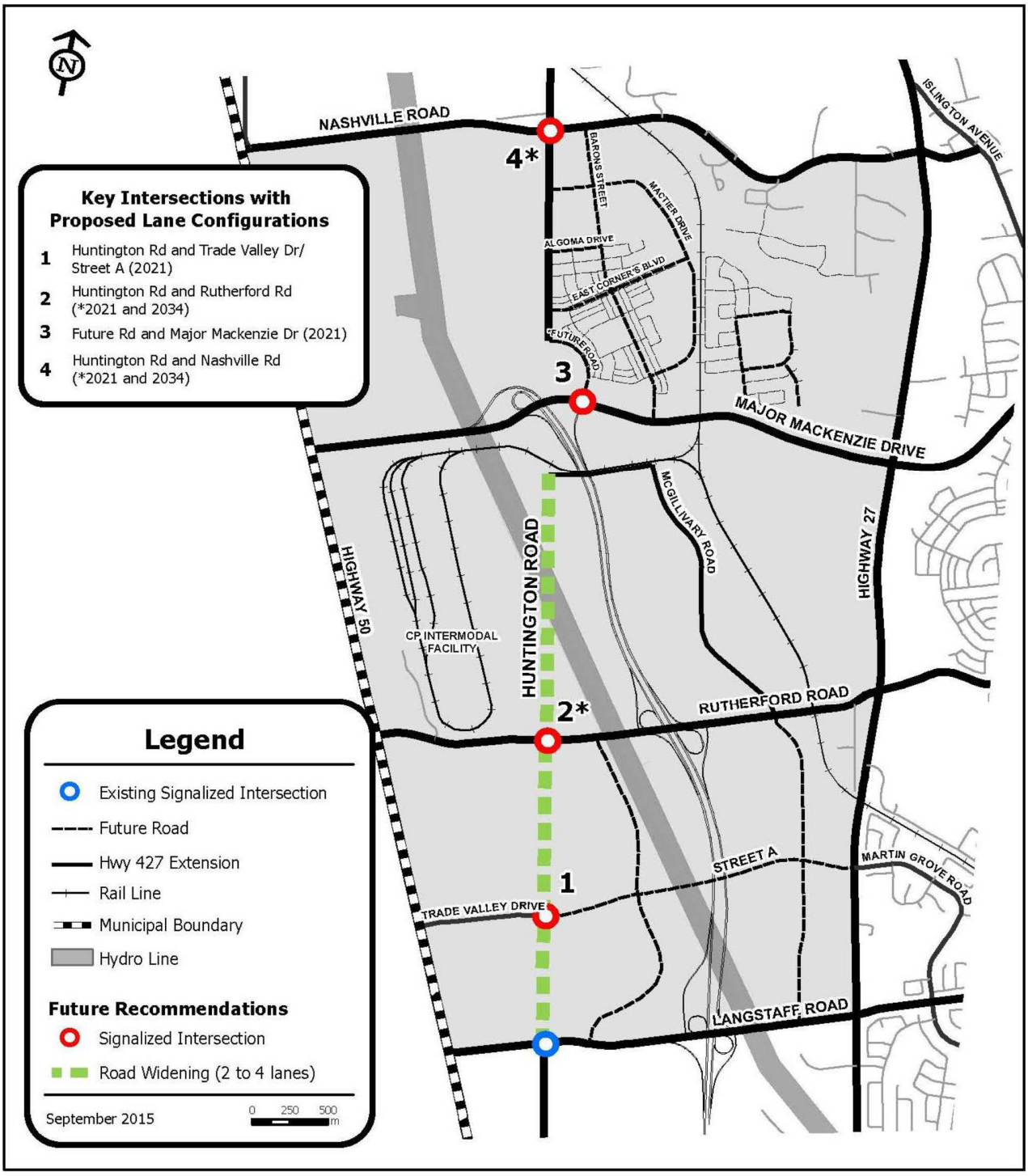
RAMON MIRANDA
PROVINCE OF ONTARIO

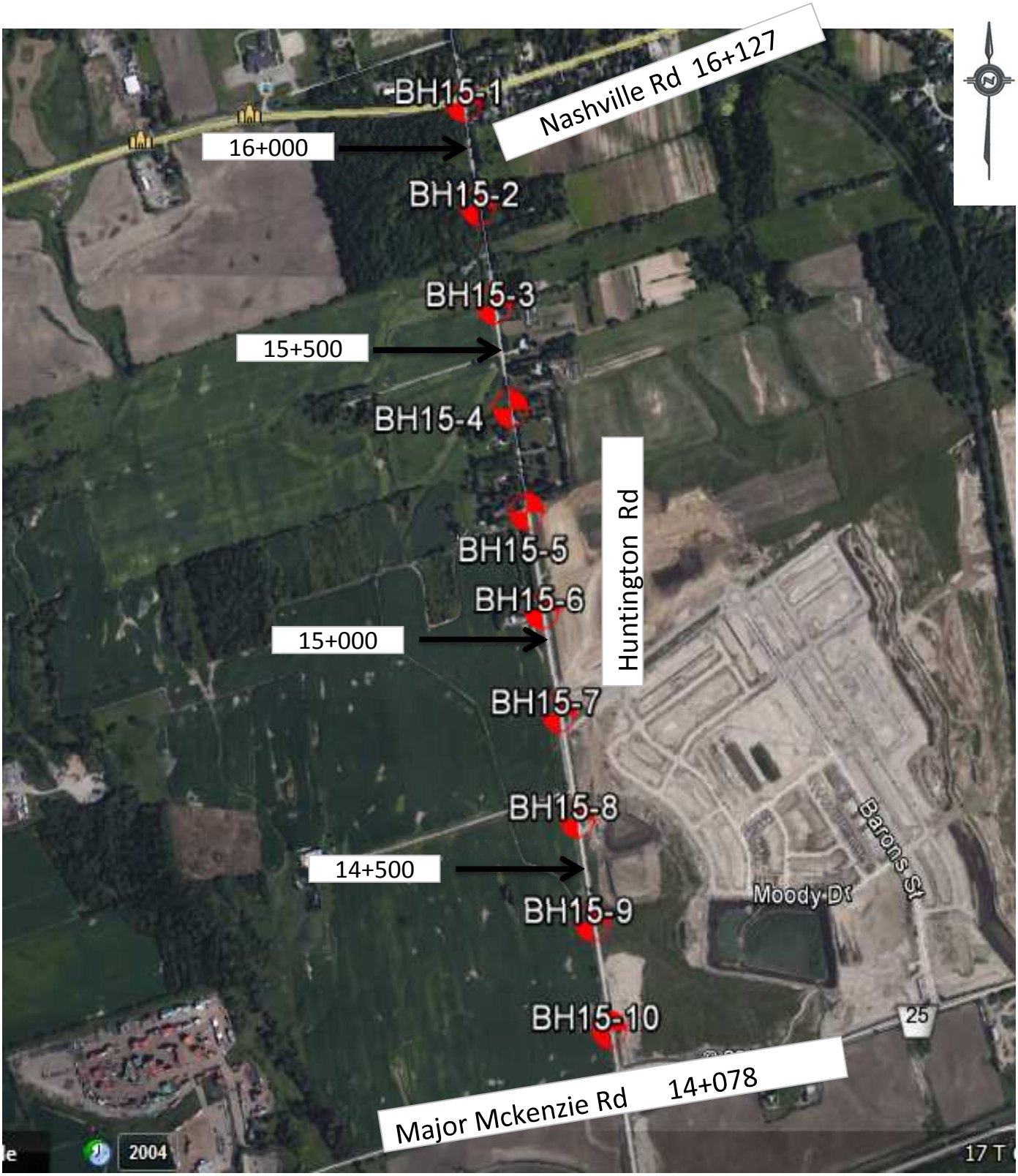
SPL Consultants Limited | ENGINEERING SOLUTIONS

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:	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

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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

LOG OF BOREHOLE BH15-1

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.: 1

(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 / 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:** 65mm		1	AS					○			
0.3	**GRANULAR BASE:** 210mm, sand and gravel, brown, moist.		2	AS					○			
0.6	**GRANULAR SUBBASE:** 275mm gravelly sand, brown, moist.											
1 0.9	**FILL:** silty sand, trace gravel, brown, compact. **SAND:** some silt, trace clay, brown, moist, loose to compact.		3	SS	11				○			0 73 20 7
2			4	SS	8				○			
2.1	~~**SILTY CLAY:** brown, moist, firm.~~											
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 BH15-2

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.: 2

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 / 0.1	**ASPHALT:** 80mm											
0.1 / 0.4	**GRANULAR BASE:** 300mm, sand and gravel, brown, moist.		1	AS								
0.4 / 0.8	**GRANULAR SUBBASE:** 420mm, sand and gravel, some silt, brown, moist.		2	AS					○			36 46 (18)
0.8 / 1	**SAND:** brown, damp, loose to compact.		3	SS	7					○		
	wet below 1.5m											
1 / 2			4	SS	12					○		
2.1	**END OF BOREHOLE** Note: 1) Borehole caved to 1.8m and was 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 BH15-3

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.: 3

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:** 90mm										
0.1	**GRANULAR BASE:** 300mm, sand and gravel, some silt, brown, moist.		1	AS							42 46 (12)
0.4	**GRANULAR SUBBASE:** 310mm, gravelly sand, brown, moist.		2	AS							
0.7	**FILL:** sand, trace gravel, dark brown, moist, loose.		3	AS							
0.9	**SILTY SAND:** brown, moist, loose to compact.		4	SS	10						
	moist to wet below 1.5m		5	SS	16						
2.1	**END OF BOREHOLE** Note: 1) Borehole caved to 2.1m and water level was at 1.8m 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 BH15-4

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.: 4

(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:** 80mm											
0.1	**GRANULAR BASE:** 520mm, sand and gravel, brown, moist.		1	AS								
0.6	**FILL:** sand, trace gravel, dark brown, moist, loose.		2	AS					○			
0.9	**SAND:** brown, moist, loose to compact.		3	SS	6				○			
	damp below 1.5m		4	SS	16				○			
2.1	**END OF BOREHOLE** Note: 1) Borehole was open and water level was at 2.1m 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 BH15-5

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.: 5

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:** 85mm										
	GRANULAR BASE: 400mm, sand and gravel, brown, moist.		1	AS							
0.5	**GRANULAR SUBBASE:** 265mm, gravelly sand, brown, moist.		2	AS					○		
0.8	**FILL:** silty sand, dark brown, moist, loose.		3	SS	8				○		
1.2	**SILTY CLAY:** brown, moist, stiff to very stiff.		4	SS	24				○	200	
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

SPL

LOG OF BOREHOLE BH15-6

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.: 6

(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:** 150mm											
0.2	**GRANULAR BASE:** 300mm, sand and gravel, brown, moist.		1	AS					○			
0.5	**GRANULAR SUBBASE:** 250mm, sand and gravel, brown, moist.		2	AS								
0.7	**FILL:** clayey silt, trace sand, trace gravel, trace topsoil, dark brown, moist.		3	AS					○			
1.1	**SILTY CLAY:** trace gravel, brown, moist.		4	AS					○			
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

LOG OF BOREHOLE BH15-7

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.: 7

(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:** 85mm											
0.1	**GRANULAR BASE:** 200mm, sand and gravel, brown, moist.		1	AS								
0.3	**GRANULAR SUBBASE:** 275mm, gravelly sand, some silt, brown, moist.		2	AS					○			24 55 (21)
0.6	**FILL:** clayey silt, some topsoil, brown, moist.		3	AS								
0.8	**FILL:** silty sand, brown, moist, compact.		4	SS	12					○		
1.1	**SILTY CLAY:** trace sand, trace gravel, brown, moise, stiff to very stiff.		5	SS	24					○		
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; ○ $^{\varepsilon=3\%}$ Strain at Failure

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

LOG OF BOREHOLE BH15-8

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.: 8

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:** 85mm										
0.3	**GRANULAR BASE:** 210mm, gravelly sand, some silt, brown, moist.		1	AS					○		30 51 (19)
0.5	**GRANULAR SUBBASE:** 165mm, gravelly sand, brown, moist.		2	AS							
1 0.9	**FILL:** silty clay, trace sand, trace gravel, brown, moist. **SILTY CLAY TILL:** trace sand, trace gravel, brown, moist, very stiff.		3	SS	19				○		
2			4	SS	30				○		
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 BH15-9

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.: 9

(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 / 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	**GRANULAR BASE:** 400mm, sand and gravel, brown, moist.		1	AS			Cement					
0.4	**GRANULAR SUBBASE:** 400mm, gravelly sand, brown, moist.		2	AS					○			
0.8	**FILL:** silty clay mixed with topsoil, dark brown, moist, stiff.		3	SS	9				○			
1.5	**FILL:** silty clay, trace gravel, trace rootlets, dark grey, moist, stiff.		4	SS	13				○			
2.1	**SILTY CLAY:** trace sand, brown, moist, stiff.		5	SS	12	▽	W. L. 2.1 mBGL Jun 24, 2015		○	150		0 3 43 54
3.1	**SILTY CLAY TILL:** trace sand, trace gravel, brown, moist, very stiff to hard.		6	SS	47				○	>225		
			7	SS	36		Sand		○			
	grey below 4.7m		8	SS	43				○	225		
							Screen					
			9	SS	22		Sand		○	100		
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 2015/06/24 W. L. Depth (m) 2.1											

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 BH15-10

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

(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 / 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 / 2	**SILTY CLAY TILL:** trace sand, trace gravel, brownish grey, moist, stiff.		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: $+^3$, $\times^3$: 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

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BH No.		Offset from CL (BH)	Approx. Station	Left (SBL)									Right (NBL)					Type of Subgrade (main)	Description
				Shoulder				Mid-Lane					Mid-Lane						
				Asph (mm)	Base (mm)	Subbase (mm)	Total Structure (mm)	Asph (mm)	Base (mm)	Subbase (mm)		Total Structure (mm)	Asph (mm)	Base (mm)	Subbase (mm)		Total Structure (mm)		
Major MacKenzie Dr (14+078)																			
BH 15-10	NBL	1.6 Rt	14+250										60	260	-	260	320	silty sand	South of Project Limit-south of Future Rd
BH 15-9	SBL	3.8 Lt	14+460	-	400	400	800											silty clay	
BH 15-8	NBL	1.3 Rt	14+670										85	210	165	375	460	silty clay	
BH 15-7	SBL	1.4 Lt	14+890					85	200	275	475	560						clayey silt	
BH 15-6	NBL	1.5 Rt	15+100										150	300	250	550	700	clayey silt	In the widened section of the road
BH 15-5	SBL	1.6 Lt	15+290					85	400	265	665	750						silty sand	
BH 15-4	NBL	1.5 Rt	15+430										80	520	-	520	600	sand	
BH 15-3	SBL	1.9 Lt	15+710					90	300	310	610	700						sand	
BH 15-2	NBL	1.4 Rt	15+910										80	300	420	720	800	sand	
BH 15-1	SBL	1.6 Lt	16+120					65	210	275	485	550						silty sand	
Nashville Rd (16+127)																			

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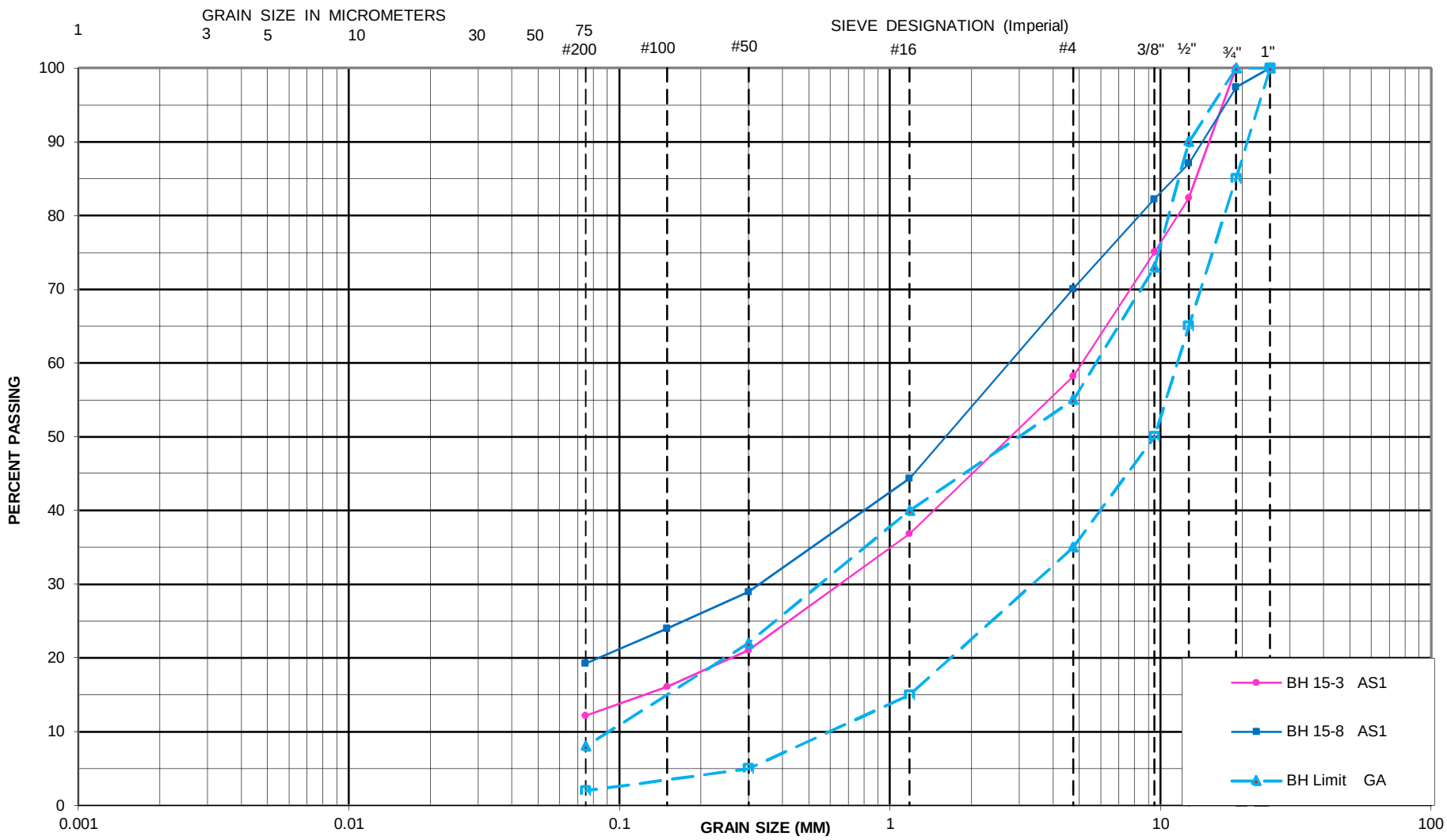
Appendix C

GRAIN SIZE DISTRIBUTION CURVES

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



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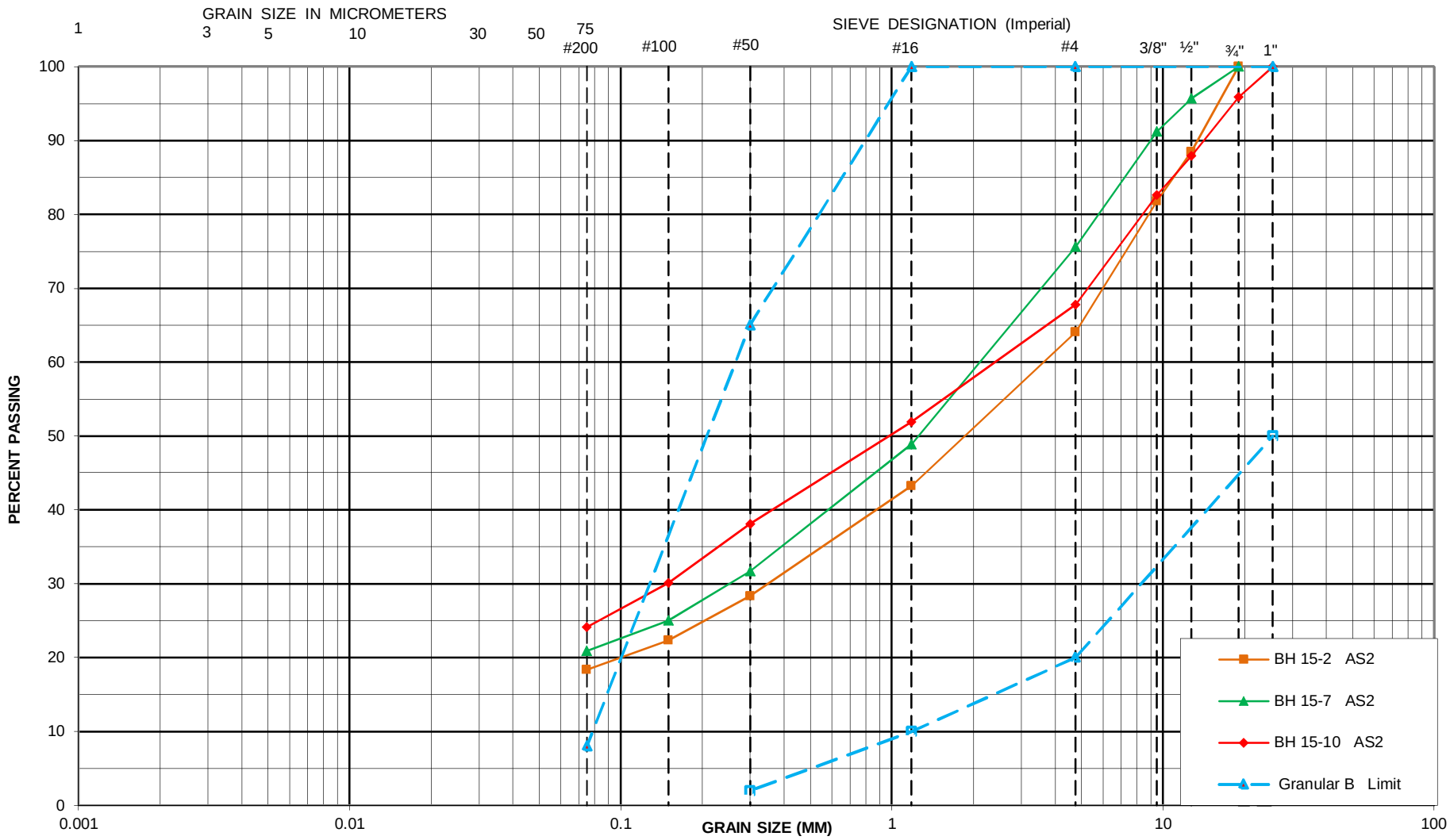
Geotechnical Environmental Materials Hydrogeology

GRAIN SIZE DISTRIBUTION

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

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



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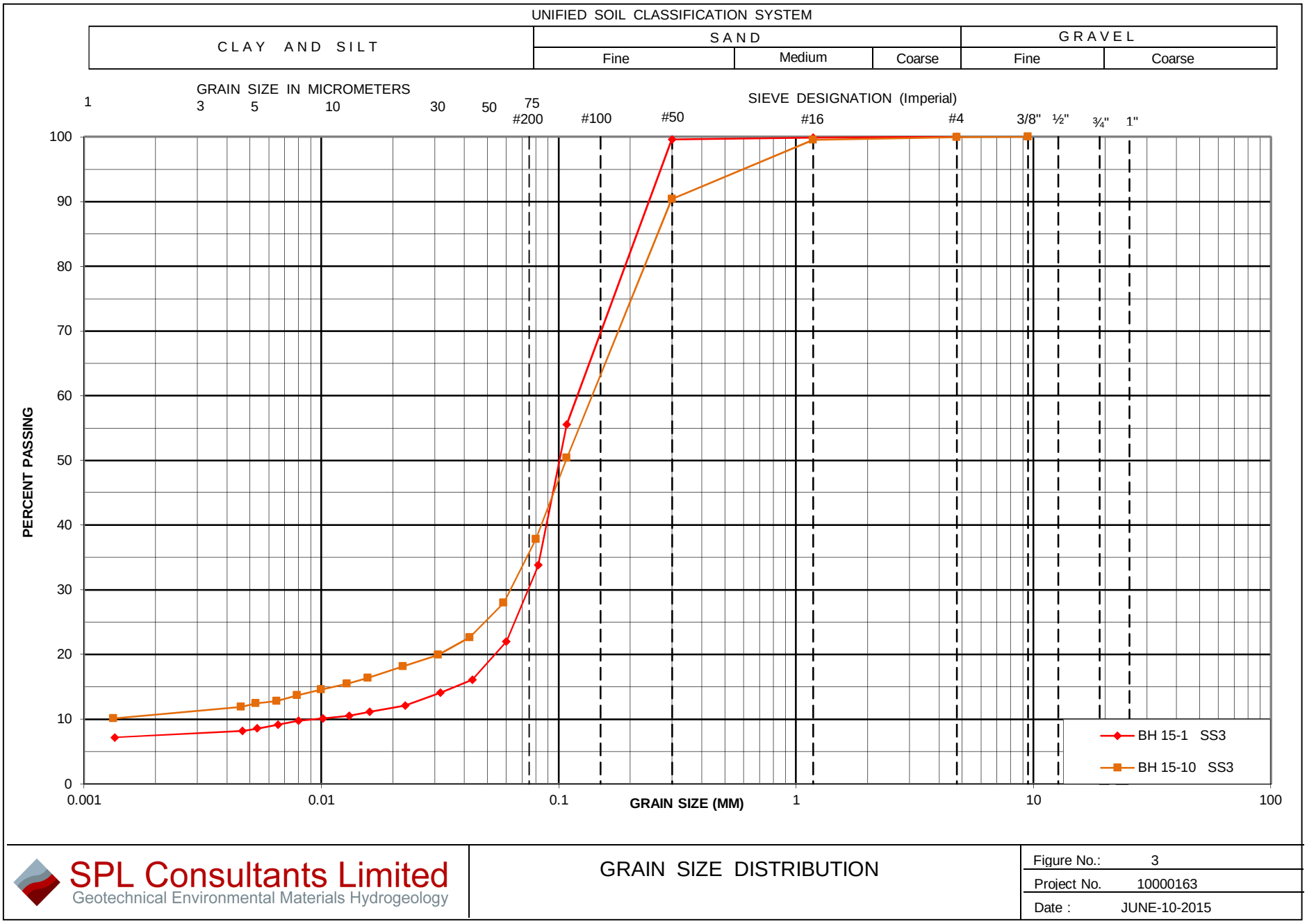
GRAIN SIZE DISTRIBUTION

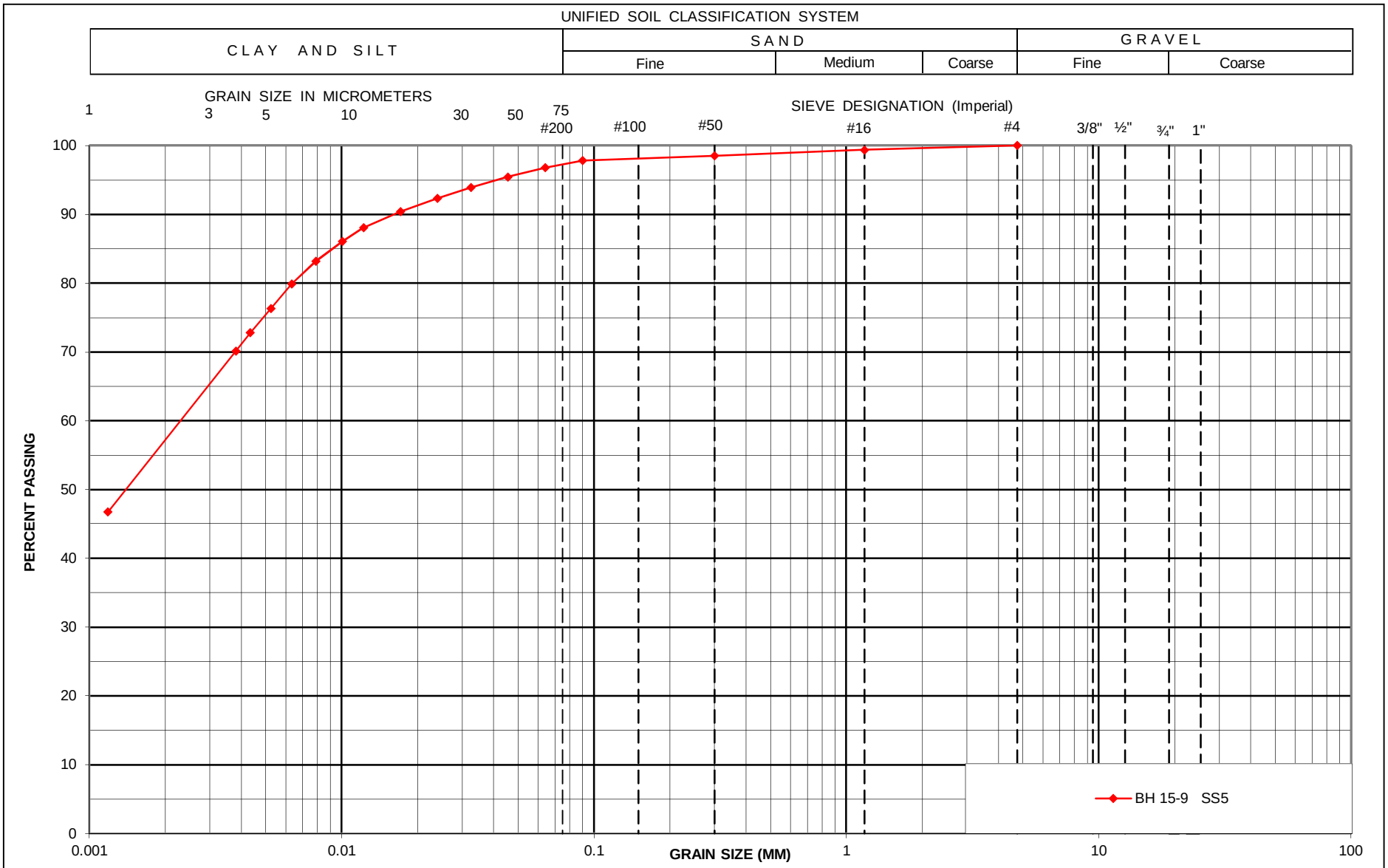
Figure No: 2
Project No. 10000163
Date : JUNE-11-2015



SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

GRAIN SIZE DISTRIBUTION

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



SPL Consultants Limited
Geotechnical Environmental Materials Hydrogeology

GRAIN SIZE DISTRIBUTION

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

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Appendix D

SITE PHOTOGRAPHS

Photo 1: Moderate alligator cracking at south-west corner of Major Mackenzie Dr and Huntingtoon Rd intersection

Photo 2: Moderate to severe alligator cracking with small potholes

Photo 3: Slight to moderate alligator cracking around patched area and improper ditching along the road

Photo 4: Severe to very severe alligator cracking with potholes from missing blocks

Photo 5: Slight to moderate alligator pavement edge cracking

Photo 6: Slight to moderate longitudinal construction joint

Photo 7: Slight to moderate alligator centerline cracking

Photo 8: Moderate to severe alligator pavement edge cracking with potholes

Photo 9: slight to moderate multiple centerline cracking and slight to moderate alligator pavement edge cracking

Photo 10: Standing water at the ditch of the road

Photo 11: Extension to the road and slight to moderate longitudinal cracking along the construction joint

Photo 12: Patching of the road close to construction area, slight to moderate longitudinal construction joint and multiple pavement edge cracking, no proper ditching

Photo 13: slight to moderate pavement edge cracking along the edge of patched section

Photo 14: Slight to moderate half transverse cracking and wheel track rutting

Photo 15: Slight to moderate alligator pavement edge cracking

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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 Rehab from Major Mackenzie Dr to Nashville Rd - New Construction -20 Yr

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,050,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	120 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	150	4	63
2	New Gran A	0.14	1	150	4	21
3	New Gran B Type I	0.09	1	400	4	36
Total	-	-	-	700	-	120

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 Rehab from Major Mackenzie Dr to Nashville Rd - Option 1: 150 mm Gr

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,050,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	120 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	150	4	63
2	Pulverized materail	0.12	1	250	4	30
3	Existing Base	0.11	0.9	130	4	13
4	Existing Subbase	0.075	0.9	250	4	17
Total	-	-	-	780	-	123

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

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 Rehab from Major Mackenzie Dr to Nashville Rd - Option 2: No Grade Raise

Flexible Structural Design

80-kN ESALs Over Initial Performance Period	3,050,000
Initial Serviceability	4.4
Terminal Serviceability	2.2
Reliability Level	90 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	30,000 kPa
Stage Construction	1
Calculated Design Structural Number	120 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	4	76
2	New Granular A	0.14	1	200	4	28
3	Existing Subbase	0.075	0.9	250	4	17
Total	-	-	-	630	-	120

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	-	-	-	-	-	-	-	-	-	-

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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
TEL (905)712-5100
FAX (905)712-5122
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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MISSISSAUGA, ONTARIO
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FAX (905)712-5122
http://www.agatlabs.com

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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CANADA L4Z 1Y2
TEL (905)712-5100
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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