MEMO

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PINESTONE ENGINEERING LTD.

To:	Gary Matthie, P.Eng.	**Sender:**	Joe Voisin, P.Eng.
Date:	June 5th, 2019	**P.N.:**	18-11404B

REFERENCE: **196 BURTON AVENUE, CITY OF BARRIE**
PROPOSED 6 UNIT LIVE/WORK TOWNHOUSES
PARKSHORE VILLAGE SUBDIVSION CONFORMANCE REVIEW & SERVICING BRIEF

1.0 INTRODUCTION

The owner of the property is proposing to develop a 6-unit live/work towns house development located at 196 Burton Avenue in the City of Barrie. The subject development is located on a registered Block located within the Parkshore Village Subdivision (City File: D12-405). The purpose of this memo is to describe the proposed servicing strategy for the site and detail conformance with the overall approved subdivision design.

2.0 SANITARY SERVICING

The proposed development will require a new sanitary connection to the existing sanitary sewer along Burton Ave. Based on a review of the previously approved servicing report prepared by Gerrits Engineering Ltd. it was intended for this Block to be serviced directly from Burton Ave.

3.0 WATER SERVICING

The proposed development will be serviced with a new 50mm dia. water service from the existing 150mm dia. watermain located along the frontage of the property within the Burton Avenue right of way. Based on a review of the previously approved servicing report prepared by Gerrits Engineering Ltd. it was intended for this Block to be serviced directly from Burton Ave.

4.0 STORM WATER MANAGEMENT

The subject Block was included in the overall drainage plan prepared for the Parkshore Village Subdivision anticipated development. The subject property was allocated a runoff coefficient of 0.85 (see attached drainage plan in Appendix A). The proposed developments composite runoff coefficient is calculated at 0.67. Therefore, post development flows are less than the allowable rates anticipated within the approved Parkshore Village Subdivision engineering design. Pre and post rational method flow rates are included on drawing PRE-1 and POST-1.

Quality control, a phosphorus budget, and water balance have been previously addressed through the overall subdivision design through implementation of infiltration galleries at locations where existing soils are conducive for infiltration. Due to the limited space available on the subject site, development size, and generally high ground water conditions (see attached soils report in Appendix B), onsite infiltration is not recommended or required to conform with the overall approved subdivision design. A complete copy of the approved servicing report prepared by Gerrits Engineering Ltd. is included in Appendix A to support this memo. The water balance for the overall subdivision design incorporates the subject site.

5.0 CONFORMANCE REVIEW / CONCLUSION

The proposed development generally conforms with the overall approved Parkshore Village Subdivision design (Servicing Report prepared by Gerrits Engineering Ltd. - Rev. August 2016) and will not cause any adverse impact on the approved design.

We trust this is satisfactory and should you have any questions, please call.

Sincerely,
PINESTONE ENGINEERING LTD.

Joe Voisin, P.Eng.
Senior Engineer, Partner

Attachments

Appendix A

Approved Servicing Report by Gerrits Engineering Ltd.
Approved Storm Drainage Plan by Gerrits Engineering Ltd.
Approved Sanitary Drainage Plan by Gerrits Engineering Ltd.

SERVICING REPORT

PLAN OF PROPOSED SUBDIVISION

PARKSHORE VILLAGE
CITY OF BARRIE
COUNTY OF SIMCOE

GERRITS ENGINEERING
LIMITED

402-002-13
July 2015
(Rev. August 2016)

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SERVICING REPORT

PARKSHORE VILLAGE

1. Introduction

Gerrits Engineering Ltd. (GEL) has been retained by Celeste Phillips Planning Inc. (Client) to prepare a Servicing Report (Report) in support of the development being proposed on the south side of Burton Avenue, north side of Holgate Street and Part of Lot 9 on Concession 14, in the City of Barrie (City), County of Simcoe. The subject lands are legally described as Lots 1 through 5 on the south side of Burton Avenue, Lots 1 through 9 on the north side of Holgate Street and Part of Lot 9 on Concession 14, City of Barrie, County of Simcoe (Development). This report is to examine and identify the servicing requirements of the proposed development.

This report will be submitted to the City of Barrie and other required agencies in support of an Application for Plan of Subdivision Approval for the subject land. The subject land is approximately 4.01 ha in area, and it is proposed to construct ninety-five (95) street townhouses on 3.51 ha, a commercial block exiting onto Burton Avenue on 0.12 ha, and a future medium density block with twenty (20) units on 0.38 ha.

2. Supporting Documents

The following documents have been referenced in the preparation of this report:

- Ministry of the Environment, Guidelines for the Design of Sanitary Sewage Works and Water Works – 2008
- Ministry of the Environment, Stormwater Management Planning and Design Manual, March 2003
- Ontario Building Code 2006 (O.B.C.)
- City of Barrie By-Laws and Design Criteria Manual
- Trip Generation Manual, 9th Edition, Volumes 2 and 3
- LSRCA Technical Guidelines for Stormwater Management Submissions (Apr. 26, 2013)

3. Servicing

3.1. Overview

Servicing of the Development will involve the connection to the City's water and sanitary sewers. The Development's internal water mains will be constructed as per the City's design guidelines. It is proposed to connect to the existing 200 mm diameter municipal watermain located on Robinson Street. The site's internal water distribution system is designed to account for domestic and fire protection requirements. The site will require fire hydrants throughout the development constructed as per BSD-50 in order to provide proper coverage for the Development. It is anticipated that the Commercial Block will connect to services along Burton Ave.

The Development's internal gravity sanitary sewers are designed to meet the Ministry of the Environment (MOE) and the City's design guidelines. The development connects into the existing sanitary manhole SAB01199 located on Robinson St. It is anticipated that the Commercial Block will connect to services along Burton Ave.

The Development site slopes from south to north with the existing drainage flowing overland to Robinson St. and Burton Ave. There is an existing storm water feature located on the north side of Burton Ave. across from Melinda Cr. A review of the City of Barrie Storm Drainage plan indicates the Project has been allocated an impervious coefficient of 0.60.

3.2. Design Population

Based on the land use concepts being considered the Development's ultimate yield is 95 Townhouses, a future medium density block with 20 units, and a commercial block on 0.18 ha. Using a design population of 2.34 persons per unit results in a projected design population of 270 persons, as outlined in the enclosed design data.

3.3. Sanitary Servicing

3.3.1. General

Sanitary servicing of this Development has been considered from an internal perspective and the preliminary analysis of the onsite sanitary sewer has been completed as per the City of Barrie and the MOE guidelines, and include the following criteria:

Design Criteria

Average Day Flow (ADF):	Commercial Block: 28 cu.m./day
	Residential: 225 L/c/day
Peaking Factor:	Harmon Formula
Peak Flow (PF):	ADF x Peak Factor +Peak Extraneous Flow

3.3.2. Internal Collection System

It is proposed that the sanitary sewers be constructed in accordance with the City's Engineering Standards and the MOE guidelines to service the Development. The proposed sewers consist of PVC, DR35 pipe with pipe diameters of 250mm and designed to meet minimum and maximum velocities under full flow conditions.

A 250mm diameter sanitary sewer is to be extended from the existing municipal sewer and manhole located just north of the intersection of Holgate and Robinson St. The City's Engineering Standards require manhole structures at maximum intervals of 110m and at bends or deflections in the sewer. The minimum manhole diameter is 1200mm, larger structures are not anticipated to be required at this time.

The following design calculations are provided:

To Robinson St:

Average Daily Flows (ADF)

ADF = 0.70 L/sec

Peak Flow (PF)

PF = 2.80 L/sec

To Burton Ave. (Commercial Block Only):

Average Daily Flows (ADF)

ADF = 0.09 L/sec

Peak Flow (PF)

PF = 0.38 L/sec

3.3.3. External Collection System

The municipal trunk sanitary sewer is located approximately 54m north of the proposed connection point to the City's sewer network. A review of the Burton Ave. Reconstruction Sanitary Drainage Areas drawing SAN-2 (City of Barrie Contract 1998-004-005) indicates that the subject area was allocated flows based on a combination of RM1 and C4 zoning. Using the RM1 zoning designation and the density of 25 units/ha (at 3.13 ppu), it is reasonable to assume that the downstream system was sized to accommodate a design population of 308 persons from the subject property, which is greater than the design population determined above.

3.4. Water Supply and Distribution

3.4.1. Design Criteria

The water servicing of this Development has been considered from an internal perspective and the preliminary analysis of the onsite demands has been as per the City of Barrie and the MOE guidelines, and include the following criteria:

▪ Maximum Day Factor (MDF)	= 2.00
▪ Peak Hour Factor (PHF)	= 3.00
▪ Pressure at Max. Day demand (minimum)	= 350 kPa (50 psi)
▪ Pressure at Max. Day demand (maximum)	= 550 kPa (80 psi)
▪ Pressure at Peak Hour demand (minimum)	= 275 kPa (40 psi)
▪ Pressure at Fire + Max. Day demand (minimum)	= 140 kPa (20 psi)

To service the Development, the internal water distribution consists of a connection to the existing 200mm municipal watermain located at the intersection of Holgate and Robinson St., looping through the site and connecting into Burton Ave.. We suggest that the City review the watermain design requirement for this Development with respect to the City's water treatment and supply capacities and confirm that capacity allocation is available for this Development. Given the location of the development in the City, this is not expected to be a concern.

4. Storm Drainage and Stormwater Management

A key component of the Development is the need to address environmental and related SWM issues. These are examined in a framework aimed at meeting the City, Lake Simcoe Region Conservation Authority (LSRCA), and MOE requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems.

It is understood that the objectives of the SWM plan are to:

- Protect life and property from flooding and erosion.
- Maintain water quality for ecological integrity, recreational opportunities etc.
- Protect and maintain groundwater flow regime(s).
- Protect aquatic and fishery communities and habitats.
- Maintain and protect significant natural features.
- Protect and provide diverse recreational opportunities that are in harmony with the environment.

As indicated above, the subject land is approximately 4.01 ha in area, and it is proposed to construct ninety-five (95) street townhouses on 3.51 ha, a commercial block exiting onto Burton Avenue on 0.12 ha, and a future medium density block with twenty (20) units on 0.38 ha. The subject site is incorporated into the City of Barrie's drainage plans and ultimately outlets into Kempenfelt Bay after passing through a dry pond/drainage channel, two culvert crossings and a storm outlet. As per the City of Barrie drawing STM-2 of Contract 1998-004-004 the subject site has been included in the downstream facilities for quantity control to a runoff coefficient of 0.6 for the majority of the site.

4.1. Stormwater Quantity Control

4.1.1. Existing Drainage

The existing drainage from the subject property flows south to north. Based on current City of Barrie drawings the property is shown as being a part of four (4) sub-catchment areas. These areas drain via overland flow to the Burton Ave. and Robinson St. storm drainage system. From Burton Ave. the system discharges to a municipal drainage channel and pond located between Burton Ave. and Lakeshore Dr. The subject property has been allocated an impervious coefficient of 0.6 for the residential zoned lands, and 0.7 for the commercially zoned lands. This is as per the City of Barrie Storm Drainage map STM-2 of Contract 1998-004-004. Further, discussions with City Staff have indicated that if the proposed site meets the runoff coefficients as detailed on the aforementioned plan, than the required quantity control has already been accounted for in the downstream systems and sized accordingly.

4.1.2. Future Drainage

The proposed Development may increase the imperviousness of the site and it is important to quantify this potential change to determine if any additional onsite works are required. According to the *Soil Survey of Simcoe County, Report No.29 of the Ontario Soil Survey, Ministry of Agriculture and Food*, surface soils on the subject property consist of a combination of Tioga Loamy Sand (SCS type A) and Vasey Sandy Loam (SCS type AB). The typical runoff coefficients as detailed in the City of Barrie Stormwater Policy and Guidelines were referenced to determine the post-development weighted runoff coefficient.

Impervious Area	=	15,529 m^2	R	=	0.95	AR	=	14,752.6
Soft Landscape	=	19,770 m^2	R	=	0.10	AR	=	1,977.0
Residential (multiple)	=	3,815 m^2	R	=	0.50	AR	=	1,907.5
Commercial	=	1,229 m^2	R	=	0.60	AR	=	737.4
					Total	AR	=	19,374.5

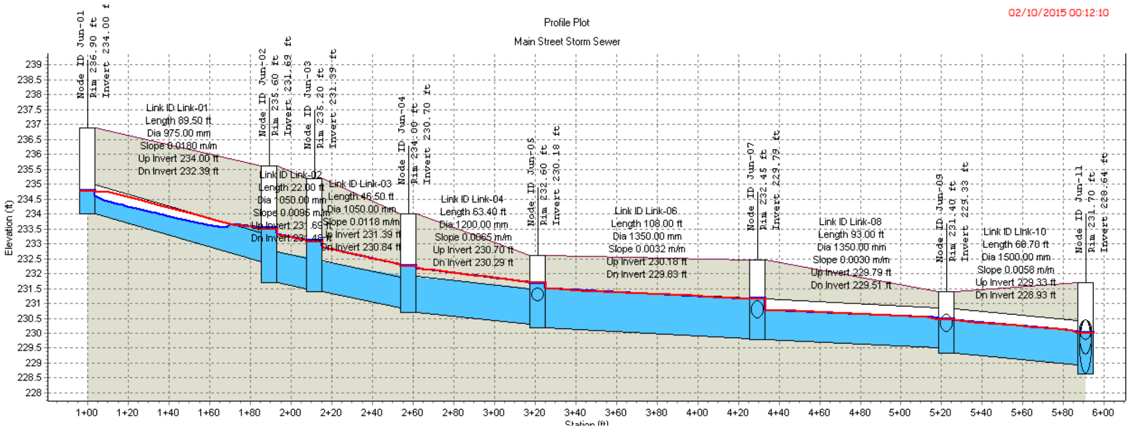
Site Area = 40,343 m^2 AR = 19,374.5 m^2 Weighted R = 0.48

The anticipated post-development runoff coefficient of 0.48 is reasonable for a development of this type. Further, the anticipated runoff coefficient is less than the allowable as per the current City drawings and therefore no additional storm water works with regards to quantity control are anticipated at this time.

4.1.3. External Drainage System

We have compiled the drainage maps for the external system and the as-built plan-profiles for the pipes within Holgate, Robinson and Burton Ave. We then proceeded to analyze the Hydraulic Grade Line for the external storm system. The software used for this analysis is the Autodesk Storm and Sanitary Analysis (2015) software package. This program allows the user to import catchment and runoff coefficients directly from the AutoCAD suite of software. In conjunction with the location specific IDF curves that are inputted separately, an analysis of the sewer system can be completed for the various storm events using several different storm water management methods. For the purposes of our analysis, we selected the Rational Method.

What the analysis has shown is that the sewer along Robinson, as well as the first sewer along Holgate. Although the sewer is surcharged, we can see from the image below that the Hydraulic and Energy grade is not to surface and the 5 year event is maintained below ground. A copy of the analysis has been included within the detailed calculations. It should be noted that this analysis does not take into account any of the onsite water balance storage or a review of the upstream stormwater management facility.



4.2. Stormwater Quality Control

4.2.1. During Construction Activities

During construction, earth grading and excavation will create the potential for soil erosion and sedimentation. It is imperative that effective environmental and sedimentation controls are in place and maintained throughout the duration of construction activities to ensure the stormwater runoff's quality. Therefore, the following recommendations shall be implemented and maintained during construction to achieve acceptable stormwater runoff quality:

- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit;
- Installation of filter strips, silt fences and rock check dams or other similar facilities throughout the site, and specifically during all construction activities, in order to reduce stormwater drainage velocities and trap sediment on-site; and,

4.2.2. Post Construction Activities

The developments hardened surfaces pose a risk to stormwater quality through the collection of grit, salt, sand and oils on the paved and gravel surfaces. A treatment train approach is proposed that will capture runoff from the site and provide quality control through a series of lot level methods, infiltration in the boulevards, and a CDS treatment unit as an end-of-pipe facility prior to discharging to the municipal system. It should be noted that shortly downstream of the subject site, is a municipal dry pond facility that provides quantity control, and inherently a level of quality control due to its design and function. We have not included the downstream facility in our review. The CDS PMSU 30_30 model will treat the post development flows to the required MOE quality standard, with a TSS removal rate of approximately 80.5%. However, as per NJDEP testing, this type of facility is only credited with 50% TSS removal.

It is proposed to infiltrate runoff from the site through a combination of on-site infiltration trenches and infiltration facilities within the municipal boulevards. The area being directed to the infiltration facilities is about 2.3 ha.

$A_D = 2.3\ m^2$

TIMP = 60%

From Table 3.2 (interpolating for TIMP=60%)

$V_{Req'd} = 31.7\ m^3/ha$

$= 31.7\ m^3/ha \times 2.3\ ha$

$= 72.9\ m^3$

Therefore, the volume of the LID facilities must provide about 73 m^3 of volume for infiltration to meet MOE Enhanced removal requirements.

The proposed facilities on site have a calculated volume in excess of 88 m^3 of infiltration volume being provided which well exceeds the MOE requirements. Calculations of the infiltration facilities sizing and details have been provided within Appendix A. These methods, in a treatment train approach, provide a TSS removal of 80.2%. Detailed calculations are provided in Appendix A.

4.3. Phosphorous Budget

In July 2009, the Lake Simcoe Protection Plan (LSPP) was finalized as a result of a collaboration and partnership among various agencies including, but not limited to, the MOE and the LSRCA. Through the study of Lake Simcoe's ecological health it was determined that there is an over-abundance of phosphorous within Lake Simcoe.

As per Section 4.8-DP of the LSPP, new developments are to be demonstrate ***"through an evaluation of anticipated changes in phosphorous loading between the pre & post-development, how the loadings shall be minimized".***

We have completed such an analysis and have included our finding below and in Appendix A. The existing site generates approximately 4.22 kg of phosphorous annually and the proposed Project will generate approximately 4.34 kg of phosphorous annually. .

The following chart details the anticipated phosphorous loadings for the pre- and uncontrolled post-development conditions.

	Total P (kg/yr)
Pre-Development	4.22
Uncontrolled Post Development	4.34

As per the Phosphorous Budget Tool documentation as provided by the MOE, the removal efficiency of 60% was selected for the efficiency of the onsite infiltration measures proposed. The following chart details the anticipated phosphorous loading for the post-development treated condition.

	Total P (kg/yr)
Controlled Post-Development	2.53

The post-development treated site has an approximate 40% decrease of total phosphorous loading.

4.4. Water Balance

Paragraph 6.3 of the LSRCA Watershed Development Policies state that "the SWM plan must make every feasible effort to maintain the pre-development infiltration and evapotranspiration rates and temperatures to the receiving waterbody and watershed". The proposed development will increase the impervious cover of the site, which decreases the infiltration of groundwater. This decrease in infiltration reduces groundwater recharge and soil moisture replenishment. Therefore, it is important to maintain this natural hydrologic cycle as much as possible.

Referencing Section 3.2 of the MOE "Stormwater Management Planning and Design Manual, (March 2003), and the historical rainfall distribution for the City of Barrie, the following review of the water balance has been completed. The site area is approximately 4.03 ha in area, and referencing the Simcoe County Soil Maps, we know the soil is typically characterised as a Tioga Sandy Loam and a Vasey Sandy Loam, with a soil group ranging from A to AB. Referencing Table 3.1 of the

MOE manual, a Pasture/Shrub ground cover comprised of a Sandy Loam, has an average annual evapotranspiration of 531mm Using this information, combined with the calculated infiltration factor determined for the subject property and the LSRCA water balance spreadsheet we calculate about 8,520 m^3 of infiltration per year.

We have assumed that the average percolation rate for the onsite soil material will be 25 mm/hr. Further, we are proposing that at minimum 2.5mm of each rainfall event will be infiltrated through the use of a perforated pipe and infiltration trench method. These methods, in addition to the pervious infiltration across the site, result in a volume of 8,590 m^3 to be infiltrated per year which exceeds the current regime of the site. The following table details the various infiltration with detailed calculations of these methods included in Appendix A.

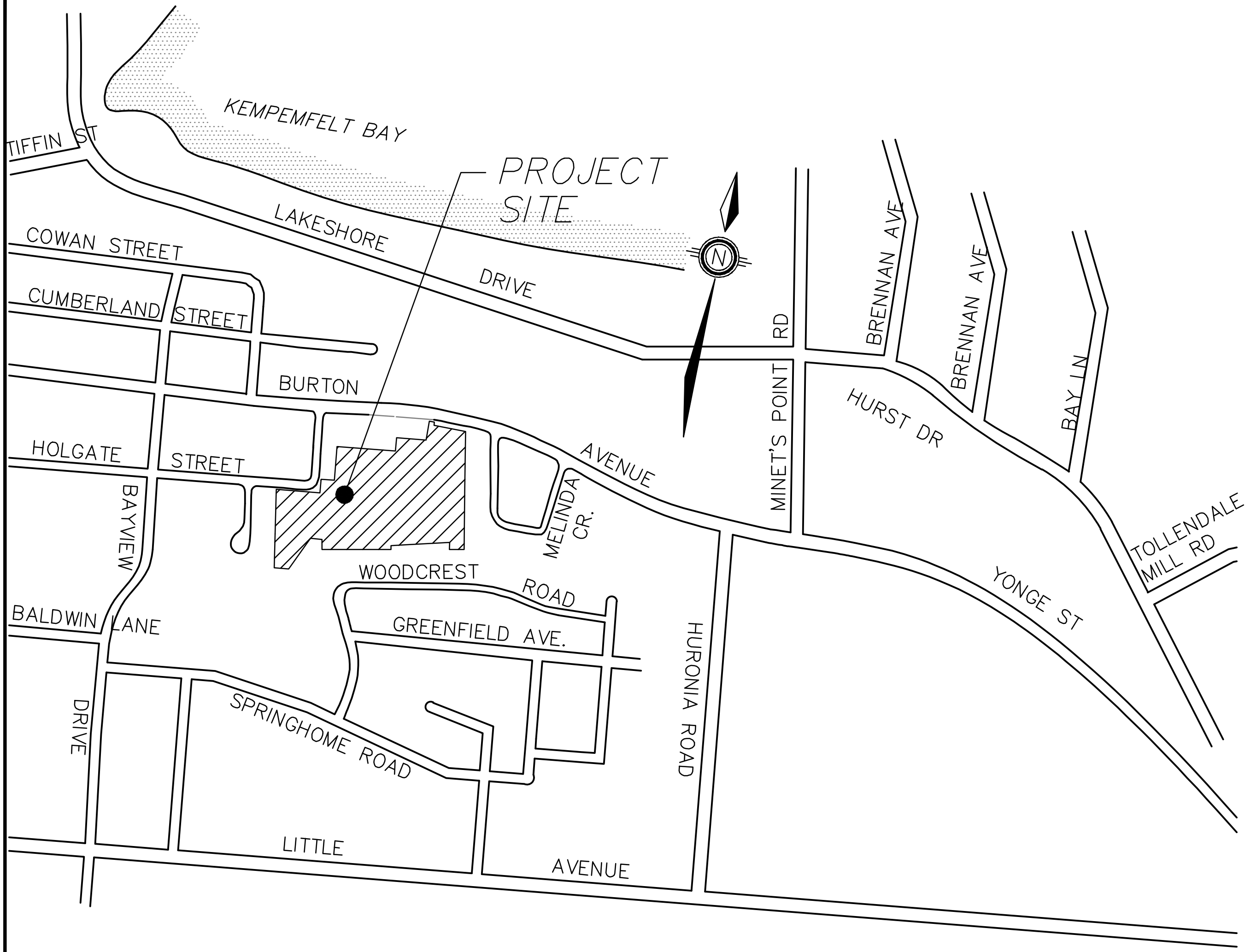
	Total Infiltration (m^3/yr)
Pre-Development	8,517
Uncontrolled Post Development	1,318
Controlled Post Development	8,590

5. Conclusions

The proposed development will require the connection of internal sanitary and watermain services to the existing municipal services. The SWM design for this site takes into account the existing drainage conditions and conforms to the City's drainage mapping. The analysis and designs outlined in this report demonstrates that the servicing of this proposed residential development is feasible and will become a cohesive part of the City of Barrie

All of which is respectfully submitted,
Gerrits Engineering Limited

Jeff McCuaig, P.Eng.
Partner



PARKSHORE VILLAGE
HOLGATE & ROBINSON ST.
CITY OF BARRIE, ON

FIGURE 1

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DESIGNED BY	NL	HORIZ SCALE	N.T.S.	PROJECT #	402-002-13
DRAWN BY	NL	VERT SCALE		DRAWING #	FIG 1
CHECKED BY	JDM	DATE	JUNE 2016	REVISION #	0

Appendix A

DESIGN CALCULATIONS

SANITARY

City of Barrie

Gerrits Engineering

Limited

n=0.013

M=1+(14/(4+(P/1000)^0.5)) (2<="M"<=4)

Qp=P*Q*M/86400 (Q=225 l/day/person)

Qi= 0.1 L/s/ha

(includes peaking factor)

Qtot=Qp+Qi

SANITARY SEWER DESIGN

LEVEL - 3

DESIGN SHEET NO. SAN-1
FILE 402-002
CONTRACT/PROJECT Robinson St.

STREETS / AREA ID	MANHOLE		DWELLING	DENSITY	POP.	POP.	M	Qp	Area	Area	Qi	TOTAL	Length	D	S	Q	V
			UNITS	P.P.U	(P)	(ACC.)				(ACC.)		Q				FULL	FULL
	FROM	TO						(l/s)	(ha)	(ha)	(l/s)	(l/s)	(m)	(mm)	(%)	(l/s)	(m/s)
01	SAN 01	SAN 03	5	2.34	11.70	11.70	4.00	0.12	0.20	0.20	0.02	0.14	13.60	250	1.00	59.48	1.21
04	SAN 03	SAN 04	7	2.34	16.38	28.08	4.00	0.29	0.20	0.40	0.04	0.33	36.70	250	0.55	44.11	0.90
05	SAN 04	SAN 05	3	2.34	7.02	35.10	4.00	0.37	0.10	0.50	0.05	0.42	7.90	250	0.40	37.62	0.77
06	SAN 05	SAN 06	12	2.34	28.08	63.18	4.00	0.66	0.48	0.98	0.10	0.76	96.20	250	0.40	37.62	0.77
07	SAN 06	SAN 07	3	2.34	7.02	70.20	4.00	0.73	0.10	1.08	0.11	0.84	8.30	250	0.40	37.62	0.77
08	SAN 07	SAN 08	7	2.34	16.38	86.58	4.00	0.90	0.24	1.32	0.13	1.03	51.60	250	0.40	37.62	0.77
02	SAN 01	SAN 02	26	2.34	60.84	60.84	4.00	0.63	1.07	1.07	0.11	0.74	86.60	250	1.20	65.16	1.33
08	SAN 02	SAN 08	2	2.34	4.68	65.52	4.00	0.68	0.10	1.17	0.12	0.80	18.20	250	0.40	37.62	0.77
09	SAN 08	SAN 09	7	2.34	16.38	168.48	4.00	1.76	0.37	2.86	0.29	2.04	42.30	250	0.40	37.62	0.77
10	SAN 09	SAN 10	6	2.34	14.04	182.52	4.00	1.90	0.27	3.13	0.31	2.21	36.40	250	0.40	37.62	0.77
11	SAN 10	EX SAB01199	35/Ha	2.34	39.31	221.83	4.00	2.31	0.48	3.61	0.36	2.67	35.70	250	0.40	37.62	0.77

STORM WATER MANAGEMENT

Runoff Calculation for Post Development Area and Sub-Areas

	Total Site	to Robinson	to Burton
Area	4.03 ha	3.91 ha	0.12 ha
Runoff Coefficient	0.48	0.48	0.60
	Interpolated	Interpolated	Interpolated
Return Rate	2 year	2 year	2 year
Coefficient	1	1	1
Time of Concentration	10	10	10
Rainfall Intesity	83.1 mm/hr	83.1 mm/hr	83.1 mm/hr
Allowable Release Rate	0.45 m^3/s	0.43 m^3/s	0.02 m^3/s
Return Rate	5 year	5 year	5 year
Coefficient	1	1	1
Time of Concentration	17	17	17
Rainfall Intesity	80.8 mm/hr	80.8 mm/hr	80.8 mm/hr
Allowable Release Rate	0.43 m^3/s	0.42 m^3/s	0.02 m^3/s
Return Rate	10 year	10 year	10 year
Coefficient	1	1	1
Time of Concentration	10	10	10
Rainfall Intesity	126.5 mm/hr	126.5 mm/hr	126.5 mm/hr
Allowable Release Rate	0.68 m^3/s	0.66 m^3/s	0.03 m^3/s
Return Rate	25 year	25 year	25 year
Coefficient	1.1	1.1	1.1
Time of Concentration	10	10	10
Rainfall Intesity	148.2 mm/hr	148.2 mm/hr	148.2 mm/hr
Allowable Release Rate	0.88 m^3/s	0.84 m^3/s	0.03 m^3/s
Return Rate	50 year	50 year	50 year
Coefficient	1.2	1.2	1.2
Time of Concentration	10	10	10
Rainfall Intesity	164.2 mm/hr	164.2 mm/hr	164.2 mm/hr
Allowable Release Rate	1.06 m^3/s	1.02 m^3/s	0.04 m^3/s
Return Rate	100 year	100 year	100 year
Coefficient	1.25	1.25	1.25
Time of Concentration	10	10	10
Rainfall Intesity	180.2 mm/hr	180.2 mm/hr	180.2 mm/hr
Allowable Release Rate	1.21 m^3/s	1.17 m^3/s	0.05 m^3/s

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	**678.085**	**4.699**	**0.781**
5	**853.608**	**4.699**	**0.766**
10	**975.865**	**4.699**	**0.76**
25	**1146.275**	**4.922**	**0.757**
50	**1236.152**	**4.699**	**0.751**
100	**1426.408**	**5.273**	**0.759**

Modified Rational Method

$$Q = C_iCIA / 360$$

Where:

Q - Flow Rate (m3/s)
Ci - Peaking Coefficient
C - Rational Method Runoff Coefficient
I - Storm Intensity (mm/hr)
A - Area (ha.)

Determine Overland flow.

Q_{pipes} = 0.48 m³/s flowing full.

Q_{100} = 1.17 m³/s.

∴ Q_{over} = 0.69 m³/s

from following calc. sheet, a 18^m^ R.O.W. @ 0.5% slope conveys 0.39 m³/s @ 0.1m depth and 1.11 m³/s @ 0.15 m depth.

∴ overland flow will be conveyed within the asphalt area without overtopping the curb.

R 0.056467 R 0.104445 R 0.114198 R 0.004

	H = 0.10			H = 0.15			H = 0.16				
	Asphalt			Asphalt			Asphalt		Grass		Total
Road Grade	Aw	V	Q	Aw	V	Q	Aw	V	Aw	V	Q_T
0.50	0.492	0.80	0.39	0.921	1.21	1.11	1.007	1.28	0.002	0.14	1.29
0.75	0.492	0.98	0.48	0.921	1.48	1.36	1.007	1.57	0.002	0.17	1.58
1.00	0.492	1.13	0.56	0.921	1.71	1.57	1.007	1.81	0.002	0.19	1.82
1.25	0.492	1.27	0.62	0.921	1.91	1.76	1.007	2.02	0.002	0.22	2.04
1.50	0.492	1.39	0.68	0.921	2.09	1.92	1.007	2.22	0.002	0.24	2.23
1.75	0.492	1.50	0.74	0.921	2.26	2.08	1.007	2.40	0.002	0.26	2.41
2.00	0.492	1.60	0.79	0.921	2.41	2.22	1.007	2.56	0.002	0.27	2.58
2.50	0.492	1.79	0.88	0.921	2.70	2.48	1.007	2.86	0.002	0.31	2.88
3.00	0.492	1.96	0.96	0.921	2.95	2.72	1.007	3.14	0.002	0.34	3.16
3.50	0.492	2.12	1.04	0.921	3.19	2.94	1.007	3.39	0.002	0.36	3.41
4.00	0.492	2.26	1.11	0.921	3.41	3.14	1.007	3.62	0.002	0.39	3.65
4.50	0.492	2.40	1.18	0.921	3.62	3.33	1.007	3.84	0.002	0.41	3.87
5.00	0.492	2.53	1.25	0.921	3.81	3.51	1.007	4.05	0.002	0.43	4.08
5.50	0.492	2.66	1.31	0.921	4.00	3.68	1.007	4.25	0.002	0.45	4.28
6.00	0.492	2.77	1.36	0.921	4.18	3.85	1.007	4.44	0.002	0.47	4.47

- The SWMPs must not affect the fluvial processes in the floodplain; and

- The outlet invert elevation of the SWMP should be higher than the 2 year floodline and the overflow elevation must be above the 25 year floodline.

Table 4.1: Physical Constraints for SWMP Types

SWMP	Topography	Soils	Bedrock	Groundwater	Area
wet pond	none	none	none	none	> 5 ha
dry pond	none	none	none	none	> 5 ha
wetland	none	none	none	none	> 5 ha
infiltration basin	none	loam (min. inf. rate ≥ 60 mm/h)	> 1 m below bottom	> 1 m below bottom	< 5 ha
infiltration trench	none	loam (min. inf. rate ≥ 15 mm/h)	> 1 m below bottom	> 1 m below bottom	< 2 ha
reduced lot grading	< 5%	loam (min. inf. rate ≥ 15 mm/h)	none	none	none
soakaway pit	none	loam (min. inf. rate ≥ 15 mm/h)	> 1 m below bottom	> 1 m below bottom	< 0.5 ha
rear yard ponding	< 2%	loam (min. inf. rate ≥ 15 mm/h)	> 1 m below bottom	> 1 m below bottom	< 0.5 ha
grassed swales	< 5%	none	none	none	< 2 ha
pervious pipes	none	loam (min. inf. rate ≥ 15 mm/h)	> 1 m below bottom	> 1 m below bottom	none
vegetated filter strips	< 10%	none	none	> 0.5 m below bottom	< 2 ha
sand filters	none	none	none	> 0.5 m below bottom	< 5 ha
oil/grit separators	none	none	none	none	< 2 ha

Scarification, or tilling of the soil to a depth of approximately 300 mm, will enhance infiltration; thereby helping to overcome the soil compaction that normally occurs during construction.

Table 4.4: Minimum Soil Percolation Rates

Soil Type	Percolation Rate (mm/h)
sand	210
loamy sand	60
sandy loam	25
loam	15

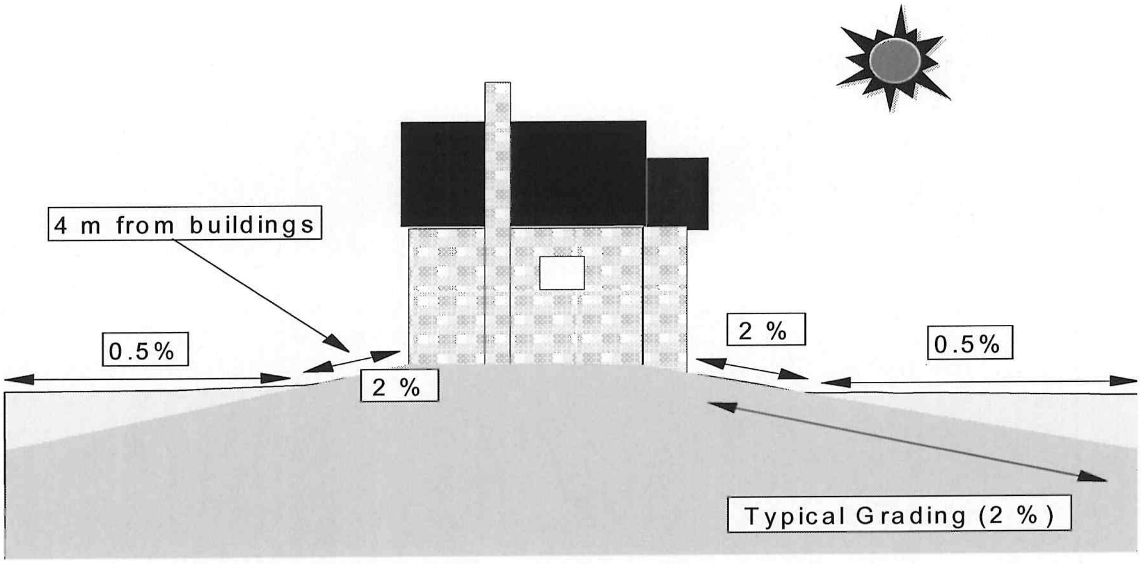
Topography

A reduction in the lot grading should be evaluated if the land is naturally flat. In hilly areas, alterations to the natural topography should be minimized (as indicated in Appendix A).

Setbacks

In order to ensure that foundation drainage problems do not occur, the grading within 2 metres - 4 metres of a building should be maintained at 2% or higher (local municipal standards should be reviewed to ensure that the grading around a building is in compliance). Areas outside of this boundary may be graded at less than 2% to create greater depression storage, and promote natural infiltration (Figure 4.1).

Figure 4.1 Lot Grading Changes



The appropriate bottom area of the trench can be calculated using Equation 4.3. This equation assumes that all of the infiltration occurs through the bottom of the trench.

$$A = \frac{1,000V}{Pn\Delta t}$$

Equation 4.3: Infiltration Trench Bottom Area

where A = bottom area of the trench (m^2)
V = runoff volume to be infiltrated (Table 3.2)
P = percolation rate of surrounding native soil (mm/h)
n = porosity of the storage media (0.4 for clear stone)
Δt = retention time (24 to 48 hours)

Location/Setbacks

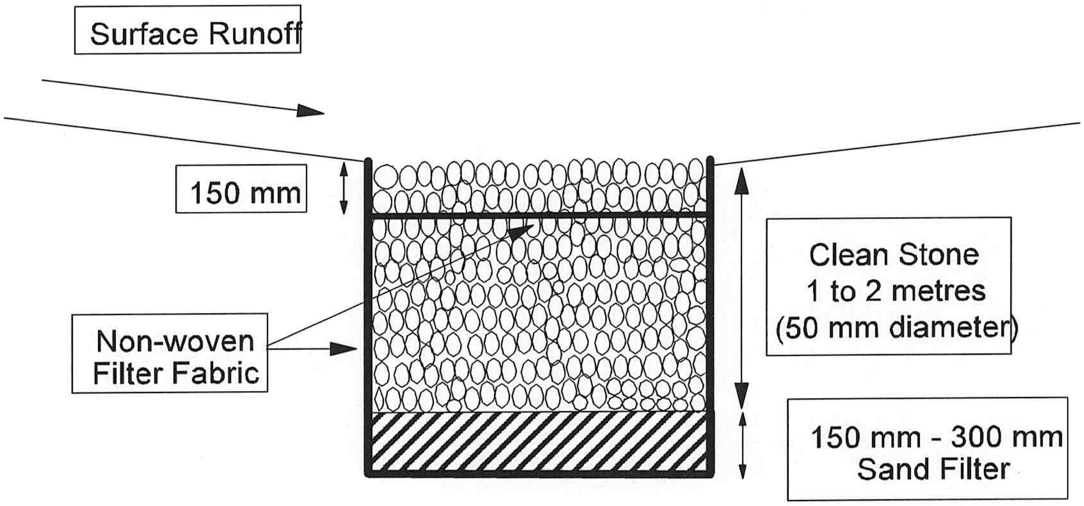
Groundwater mounding calculations may be required to ensure that infiltration trenches do not interfere with sewage system leaching beds. A hydrogeologist should be consulted with respect to the necessity for mounding calculations and the requirements for a setback from the tile field. It is anticipated that calculations will be required in areas where the soils are marginally acceptable for infiltration.

The setbacks from wells specified in the Building Code for leaching bed systems shall also be observed for infiltration trenches.

Storage Media

The storage media holds the stormwater until it can percolate into the surrounding native material. It is recommended that 50 mm diameter clear stone be used (Figure 4.7). While gravel is the most common medium used, precast infiltration storage media are available which are also generally acceptable.

Figure 4.7: Surface Infiltration Trench



From:	Alexander Winkelmann <awinkelmann@terraprobe.ca>
Sent:	Monday, June 06, 2016 1:05 PM
To:	Jeff McCuaig
Cc:	Joshua Battiston
Subject:	RE: Geotechnical Reports

Hello Jeff,

Terraprobe conducted three grain size distribution tests as part of the following geotechnical investigation: "Geotechnical Investigation, Proposed Residential Neighborhood, Parkshore Village - 196 Burton Avenue, Barrie, Ontario": File No. 3-16-0037, dated May 25, 2016.

Based on the results of the grain size distribution tests, the following estimated infiltration rates are provided based on "Supplementary Guidelines to the Ontario Building Code 1997, SG-6 Percolation Time and Soil Descriptions":

- Borehole 2, Sample 4:
    - Location: Northeast corner of site
    - Soil Classification: Sand, some silt, trace clay (SM)
    - Estimated Infiltration Rate: 12 mins/cm (or 50 mm/hr)

- Borehole 4, Sample 5:
    - Location: Southwest corner of site
    - Soil Classification: Clay and Silt, trace sand (CH)
    - Estimated Infiltration Rate: >50 mins/cm (or <12 mm/hr)

- Borehole 5, Sample 6:
    - Location: Southeast corner of site
    - Soil Classification: Fine Sand and Silt, trace clay, trace gravel (SC)
    - Estimated Infiltration Rate: 24 mins/cm (or 25 mm/hr)

In general, a sand with some silt to a fine sand and silt deposit with an infiltration rate of less than 24 mins/cm (greater than 25 mm/hr) was encountered in the central and eastern portions of the site. In general, a clay and silt deposit with an infiltration rate of greater than 50 mins/cm (less than 12 mm/hr) was encountered in the western portion of the site.

Regards,

Alexander Winkelmann, P.Eng.
Geotechnical Engineer
\- -

Terraprobe
Consulting Geotechnical & Environmental Engineering Construction Materials, Inspection & Testing
220 Bayview Drive, Unit 25 - Barrie, Ontario Canada L4N 4Y8 Ph. (705) 739-8355 / Fax: (705) 739-8369
www.terraprobe.ca

Soak Away Pit Design - R.O.W. Total Length of Infiltration Facility

Width of Trench =	1.20 m	Dia. Of Pipe =	0 mm
Height of Trench =	0.50 m		
Trench Area (A_T)=	0.6 sq.m.	Pipe Area (A_P)=	0.000 sq.m.
Trench SurfaceArea (A_T)=	114 sq.m.		

Void Area (A_V) = A_T x 0.95 = 0.57

Length of Trench (L_T) =	95 m	Total Volume (V_P) =	54.150 m^3

Determine Minimum Sizing of Infiltration Gallery

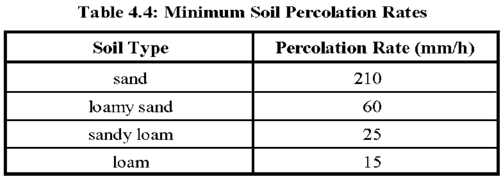
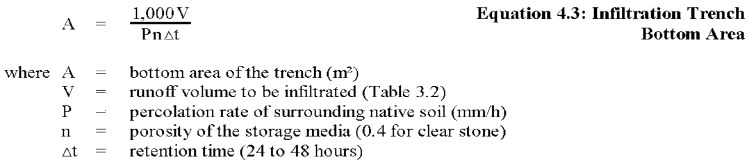


Table 4.4: Minimum Soil Percolation Rates

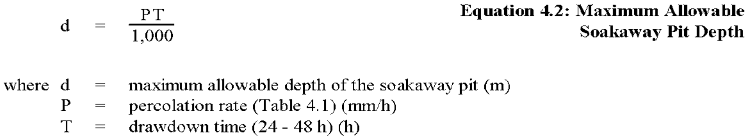
Soil Type	Percolation Rate (mm/h)
sand	210
loamy sand	60
sandy loam	25
loam	15



$$A = \frac{1,000V}{Pn\Delta t}$$

Equation 4.3: Infiltration Trench Bottom Area

where A = bottom area of the trench (m^2)
V = runoff volume to be infiltrated (Table 3.2)
P – percolation rate of surrounding native soil (mm/h)
n = porosity of the storage media (0.4 for clear stone)
Δt = retention time (24 to 48 hours)



$$d = \frac{PT}{1,000}$$

Equation 4.2: Maximum Allowable Soakaway Pit Depth

where d = maximum allowable depth of the soakaway pit (m)
P = percolation rate (Table 4.1) (mm/h)
T = drawdown time (24 - 48 h) (h)

Soil Type
Tioga Sandy Loam

Volume Required:	54.150 m^3
Assumed Porosity:	0.4
Percolation Rate:	25 mm/h
Area Req'd (24hr):	225.6 m^2
Area Req'd (48hr):	112.8 m^2
Maximum Depth:	0.6 m

Therefore: As the proposed trench footprint is greater than area required for a 48hr drawdown, the anticipated drawdown time is less than or equal to 48hrs.

Soak Away Pit Design - Lot Level Infiltration (per unit)

Width of Trench = 0.50 m

Height of Trench = 0.40 m

Dia. Of Pipe = 150 mm

Trench Area (A_T)= 0.2 sq.m.

Trench SurfaceArea (A_T)= 1.5 sq.m.

Pipe Area (A_P)= 0.018 sq.m.

Stone Area (A_{ST}) = A_T - A_P = 0.18

Length of Trench (L_T) = 3 m

Length of Pipe (L_P) = 8 m

Pipe Volume (V_P) = A_P x L_P = 0.14 m^3

Stone Volume (V_{ST}) = A_{ST} x L_T x n = 0.22 m^3

Total Volume (V_P) = 0.360 m^3

Determine Minimum Sizing of Infiltration Gallery

Table 4.4: Minimum Soil Percolation Rates

Soil Type	Percolation Rate (mm/h)
sand	210
loamy sand	60
sandy loam	25
loam	15

$$A = \frac{1{,}000V}{Pn\Delta t}$$

Equation 4.3: Infiltration Trench Bottom Area

where A = bottom area of the trench (m²)

V = runoff volume to be infiltrated (Table 3.2)

P – percolation rate of surrounding native soil (mm/h)

n = porosity of the storage media (0.4 for clear stone)

Δt = retention time (24 to 48 hours)

$$d = \frac{PT}{1{,}000}$$

Equation 4.2: Maximum Allowable Soakaway Pit Depth

where d = maximum allowable depth of the soakaway pit (m)

P = percolation rate (Table 4.1) (mm/h)

T = drawdown time (24 - 48 h) (h)

Soil Type

Tioga Sandy Loam

Volume Required:	0.360 m^3
Assumed Porosity:	0.4
Percolation Rate:	25 mm/h
Area Req'd (24hr):	1.5 m^2
Area Req'd (48hr):	0.8 m^2
Maximum Depth:	0.6 m

Therefore: As the proposed trench footprint is equal to the area required for a 24hr drawdown, the anticipated drawdown time for each trench is 24hr.

TEMPORARY SEDIMENT CONTROL POND

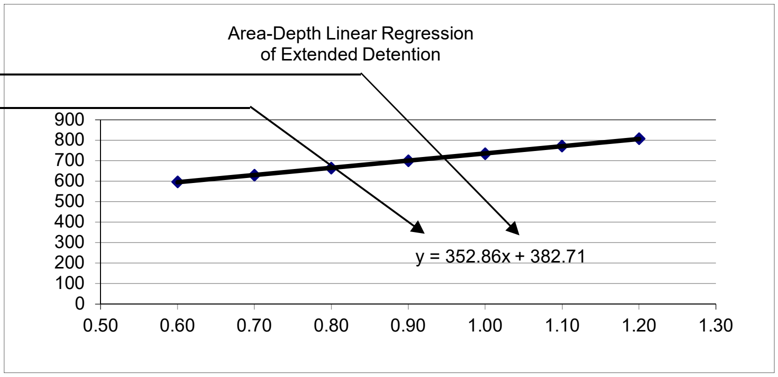
Project 402-002-14

Orifice Invert Elevation	233.00	
Size of Orifice	75	mm
Orifice Constant	0.63	

Elevation	Area	Volume	Cum. Volume	Storage Vol.	Depth over Orifice	h	Flow
232.7	327						0.0
232.8	354	34.1	34	0			0.0
232.9	381	36.7	71	0			0.0
233	410	39.5	110	0			0.0
233.1	439	42.4	153	0			0.0
233.2	469	45.4	198	0			0.0
233.3	500	48.4	247	0			0.0
233.4	531	51.5	298	0			0.0
233.5	563	54.7	353	0			0.0
233.6	596	57.9	411	0	0.60	0.56	0.0000
233.7	630	61.3	472	61	0.70	0.66	0.0100
233.8	664	64.7	537	126	0.80	0.76	0.0108
233.9	699	68.1	605	194	0.90	0.86	0.0114
234	734	71.6	677	266	1.00	0.96	0.0121
234.1	771	75.2	752	341	1.10	1.06	0.0127
234.2	808	78.9	831	420	1.20	1.16	0.0133

Elevation of Perm. Pool	233.60	m
Intercept of Regression	382.71	C_3
Slope of Regression	352.86	C_2
Elevation of Overflow	234.2	m
Depth over Orifice	1.1625	m
Orifice Area	0.00442	sq.m

Drawdown Time 24.61 hrs.



CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A Barrie PARTICLE SIZE DISTRIBUTION

Project Name: Parkshore Village
Location: Barrie, ON
OGS #: 1

Engineer: **Gerrits Engineering Ltd.**
Contact: Jeff McCuaig, P.Eng.
Report Date: 5-Jun-14

Area	3.91	ha
Weighted C	0.50	
CDS Model	3030	

Rainfall Station #	203	
Particle Size Distribution	Barrie	
CDS Treatment Capacity	85	l/s

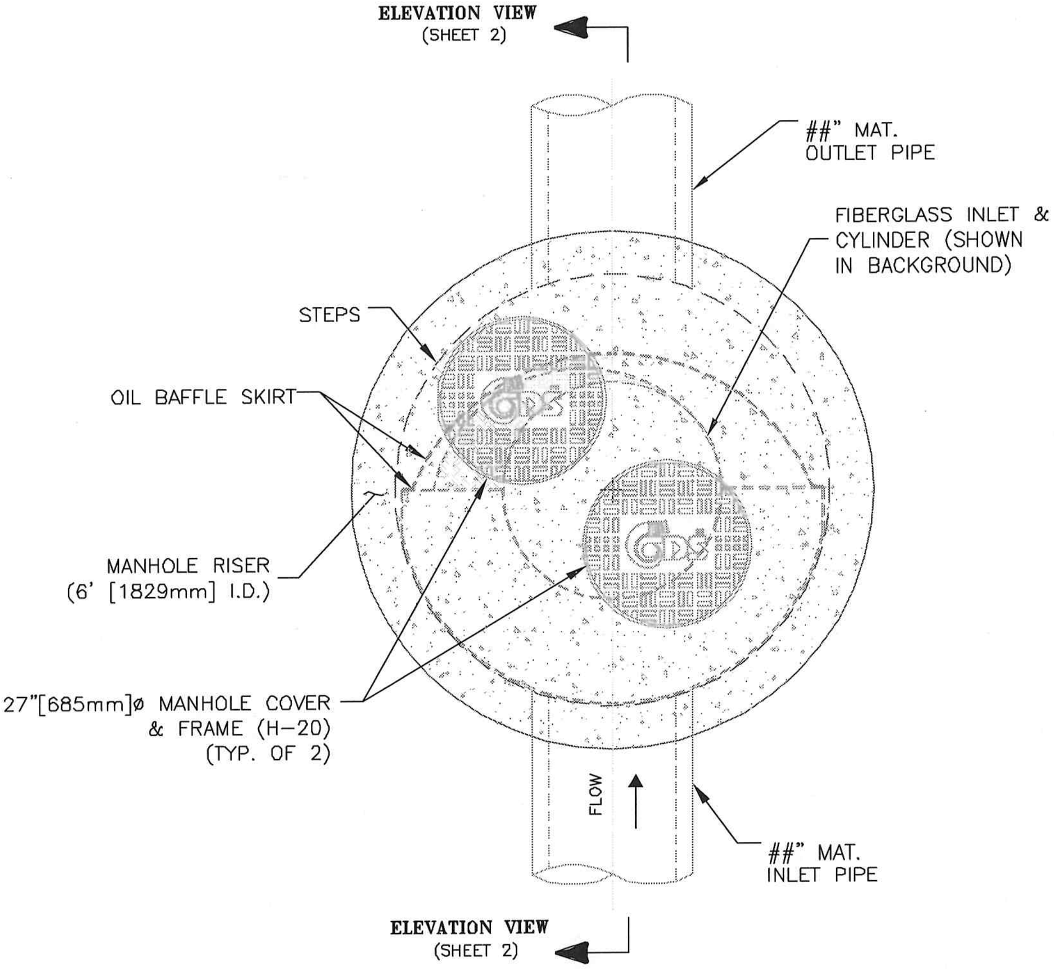
Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
1.0	10.8%	19.6%	5.4	5.4	6.4	95.0	10.3
1.5	9.5%	29.0%	8.2	8.2	9.6	94.3	8.9
2.0	8.4%	37.4%	10.9	10.9	12.8	93.6	7.9
2.5	6.8%	44.2%	13.6	13.6	16.0	92.9	6.3
3.0	5.6%	49.8%	16.3	16.3	19.2	92.3	5.2
3.5	5.1%	54.9%	19.0	19.0	22.4	91.6	4.7
4.0	4.9%	59.8%	21.7	21.7	25.6	90.9	4.4
4.5	4.1%	63.9%	24.5	24.5	28.8	90.2	3.7
5.0	3.5%	67.4%	27.2	27.2	32.0	89.5	3.1
6.0	4.9%	72.3%	32.6	32.6	38.4	88.1	4.3
7.0	4.0%	76.3%	38.1	38.1	44.8	86.8	3.4
8.0	3.2%	79.5%	43.5	43.5	51.2	85.4	2.8
9.0	2.2%	81.7%	48.9	48.9	57.6	84.0	1.9
10.0	2.0%	83.7%	54.4	54.4	64.0	82.7	1.6
15.0	8.2%	91.9%	81.6	81.6	96.0	75.8	6.2
20.0	3.4%	95.2%	108.7	85.0	100.0	58.6	2.0
25.0	2.5%	97.7%	135.9	85.0	100.0	46.8	1.2
30.0	1.4%	99.1%	163.1	85.0	100.0	39.0	0.6
35.0	0.3%	99.4%	190.3	85.0	100.0	33.5	0.1
40.0	0.6%	100.0%	217.5	85.0	100.0	29.3	0.2
45.0	0.0%	100.0%	244.7	85.0	100.0	26.0	0.0
50.0	0.0%	100.0%	271.9	85.0	100.0	23.4	0.0
							87.0

Removal Efficiency Adjustment[2] =	6.5%
Predicted Net Annual Load Removal Efficiency =	**80.5%**
Predicted Annual Rainfall Treated =	**96.8%**

1 - Based on 27 years of hourly rainfall data from Canadian Station 6110557, Barrie ON

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

PLAN VIEW



CDS MODEL PMSU30_30m, 3.0 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

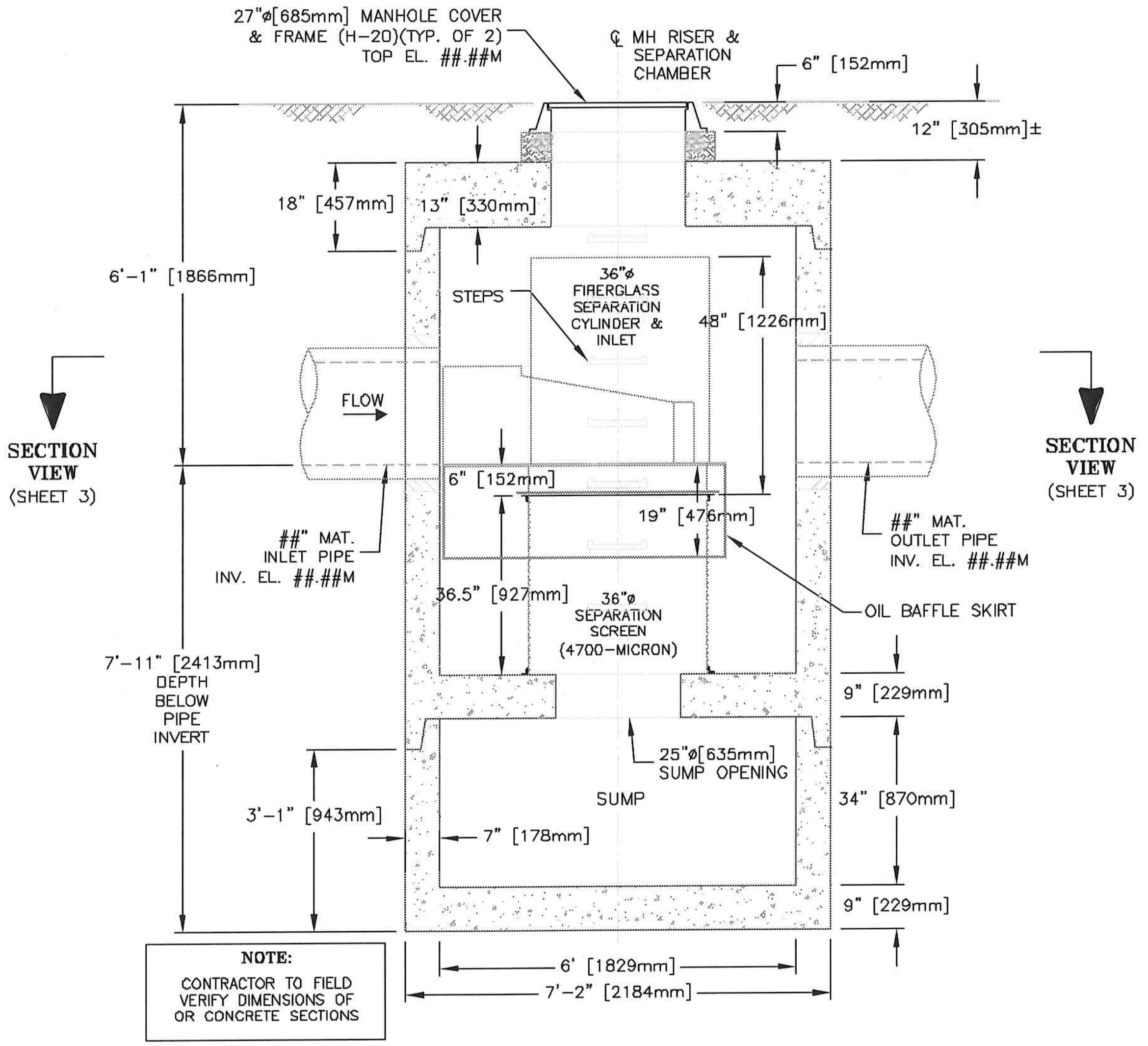
CONTECH
STORMWATER SOLUTIONS

PROJECT NAME
CITY, STATE

JOB#	CAN-##-###	SCALE 1" = 2.5'
DATE	##/##/##	SHEET
DRAWN	INITIALS	1
APPROV.		

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

ELEVATION VIEW



NOTE:
CONTRACTOR TO FIELD
VERIFY DIMENSIONS OF
OR CONCRETE SECTIONS

CDS MODEL PMSU30_30m, 3.0 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS

PROJECT NAME
CITY, STATE

JOB#	CAN-##-###	SCALE 1" = 3'
DATE	##/##/##	SHEET
DRAWN	INITIALS	2
APPROV.		

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

~1.66 ha is treated through r.o.w. infiltration

~0.64 ha is soakaway pits.

of 0.64 ha, 2/3rds is treated additionally through R.O.W infiltration

0.75 ha is natural slope w/o any interference.

Pass through infiltration

$$[0.64(0.2)] = 0.128 \rightarrow 0.042.$$

$$\downarrow$$

$$(0.086 + 1.66)[0.2] = 0.349$$

pass through O.G.S.

$$[(0.042+0.349)+0.86]\,0.5$$

$$= 0.6255$$

$$\text{Site Area} = 3.911 - 0.75 \quad \text{(natural slope)}$$
$$= 3.161.$$

$$\therefore \text{Removal} = \frac{0.6255}{3.161} = 0.1979$$

∴ 80.2% removal efficiency of the developed lands.

PHOSPHORUS EXPORT COEFFICIENTS

Updated: September 2011

Land-Use Specific Phorphorus Export Coefficients for Lake Simcoe Watersheds

Subwatershed		Annual Phosphorus Load (kg/ha/year)											
		Agricultural			Urban			Natural Heritage		Other			
		HayPasture	Cropland	Sod Farm / Golf Course	Low Intensity Development	High Intensity Comm/Ind	High Intensity Residential	Forest	Wetland	Quarry	Unpaved Road	Transition	Open Water
Monitored	Beaver River	0.04	0.22	0.01	0.19	1.82	1.32	0.02	0.02	0.16	0.83	0.04	0.26
	Black River	0.08	0.23	0.02	0.17	1.82	1.32	0.05	0.04	0.15	0.83	0.06	0.26
	East Holland	0.12	0.36	0.24	0.13	1.82	1.32	0.10	0.10	0.18	0.83	0.16	0.26
	Hawkestone Creek	0.10	0.19	0.06	0.09	1.82	1.32	0.03	0.03	0.10	0.83	0.04	0.26
	Lovers Creek	0.07	0.16	0.17	0.07	1.82	1.32	0.06	0.05	0.06	0.83	0.06	0.26
	Pefferlaw-Uxbridge Brook	0.06	0.11	0.02	0.13	1.82	1.32	0.03	0.04	0.04	0.83	0.04	0.26
	Whites Creek	0.10	0.23	0.42	0.15	1.82	1.32	0.10	0.09	0.08	0.83	0.11	0.26
Unmonitored	Barrie Creeks	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Georgina Creeks	0.12	0.36	0.24	0.13	1.82	1.32	0.10	0.10	0.08	0.83	0.16	0.26
	Hewitts Creek	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Innisfil Creeks	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Maskinonge River	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Oro Creeks North	0.12	0.36	0.24	0.13	1.82	1.32	0.10	0.10	0.08	0.83	0.16	0.26
	Oro Creeks South	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Ramara Creeks	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Talbot/Upper Talbot River	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.10	0.08	0.83	0.06	0.26
	West Holland	0.12	0.36	0.24	0.13	1.82	1.32	0.10	0.05	0.08	0.83	0.16	0.26

Summary for 17 sub-watersheds

Min	0.04	0.11	0.01	0.07	1.82	1.32	0.02	0.02	0.04	0.83	0.04	0.26
Max	0.12	0.36	0.42	0.19	1.82	1.32	0.10	0.10	0.18	0.83	0.16	0.26
Average	0.084	0.230	0.147	0.131	1.820	1.320	0.061	0.060	0.092	0.830	0.083	0.260
Standard deviation	0.025	0.079	0.104	0.026	0.000	0.000	0.028	0.027	0.036	0.000	0.047	0.000

Phosphorous Concentrations by Land Use

	High Intensity		Transition		Forest / slope		
Average Total P (kg/ha/year)	1.32		0.07		0.06		

Pre-Development Condition

Total Annual Rainfall Percipitation 933.0 mm

	Low Intensity	Transition	Forest/slope
Area (ha):	3.161	0	0.843
Total P (kg/yr) :	4.17	0.00	0.05
Total Pre-Development P (kg) :		**4.22**	

Post Development Condition - Untreated

	High Intensity	Transition	Forest/slope
Area (ha):	3.254	0	0.75
Total P (kg/yr) :	4.30	0.00	0.05
Total Post Development P (kg/yr) :		4.34	

Post Development Condition - Treated

	SWM Facility / ROW	High Intensity	Transition	Forest/slope
Area (ha):	2.3	0.95	0	0.75
Total P (kg/yr) :	3.04	1.26	0.00	0.05
Without Treatment				
Total Post Development P (kg/yr) :	4.35			
With Treatment				
Treatment Train Approach Efficiency :	60	0	0	0
P Removed (kg/yr) :	1.82	0.00	0.00	0.00
Total Post Development P (kg/yr) :		**2.53**		

Project Description

```
File Name ............................................................................ Burton Stm Analysis_5yr.SPF
```

Project Options

```
Flow Units ............................................................................ CMS
Elevation Type ..................................................................... Elevation
Hydrology Method ................................................................ Rational
Time of Concentration (TOC) Method ................................. User-Defined
Link Routing Method ............................................................ Hydrodynamic
Enable Overflow Ponding at Nodes ...................................... YES
Skip Steady State Analysis Time Periods ........................... NO
```

Analysis Options

```
Start Analysis On .................................................................. Feb 10, 2015     00:00:00
End Analysis On .................................................................... Feb 11, 2015     00:00:00
Start Reporting On ................................................................ Feb 10, 2015     00:00:00
Antecedent Dry Days ............................................................ 0                days
Runoff (Dry Weather) Time Step .......................................... 0 01:00:00       days hh:mm:ss
Runoff (Wet Weather) Time Step ........................................ 0 00:05:00       days hh:mm:ss
Reporting Time Step ............................................................ 0 00:05:00       days hh:mm:ss
Routing Time Step ................................................................ 30               seconds
```

Rainfall Details

```
Return Period........................................................................ 5 year(s)
```

Subbasin Summary

SN	Subbasin ID	Area (ha)	Weighted Runoff Coefficient	Total Rainfall (mm)	Total Runoff (mm)	Total Runoff Volume (ha-mm)	Peak Runoff (cms)	Time of Concentration (days hh:mm:ss)
1	Sub-01	0.21	0.6500	18.15	11.80	2.48	0.04	0 00:10:00
2	Sub-02	0.12	0.6000	18.15	10.89	1.31	0.02	0 00:10:00
3	Sub-03	1.00	0.4200	23.97	10.07	10.07	0.09	0 00:19:12
4	Sub-05	3.36	0.5300	20.23	10.72	36.02	0.47	0 00:12:40
5	Sub-06	0.63	0.6200	18.15	11.26	7.09	0.12	0 00:10:00
6	Sub-07	0.64	0.7400	18.15	13.43	8.60	0.14	0 00:10:00
7	Sub-08	1.21	0.6400	18.15	11.62	14.06	0.23	0 00:10:00
8	Sub-09	0.80	0.5600	18.15	10.17	8.13	0.13	0 00:10:00
9	Sub-10	0.14	0.8200	18.15	14.89	2.08	0.03	0 00:10:00
10	Sub-11	0.82	0.5200	18.15	9.44	7.74	0.13	0 00:10:00
11	Sub-12	0.28	0.8000	18.15	14.52	4.07	0.07	0 00:10:00
12	Sub-13	1.60	0.5800	18.15	10.53	16.85	0.28	0 00:10:00
13	Sub-14	8.50	0.5800	21.98	12.75	108.36	1.17	0 00:15:18

Node Summary

SN	Element ID	Element Type	Invert Elevation (m)	Ground/Rim (Max) Elevation (m)	Initial Water Elevation (m)	Surcharge Elevation (m)	Ponded Area (m^2)	Peak Inflow (cms)	Max HGL Elevation Attained (m)	Max Surcharge Depth Attained (m)	Min Freeboard Attained (m)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ha-mm)	Total Time Flooded (min)
1	Jun-01	Junction	234.00	236.90	234.00	236.90	0.00	2.10	234.76	0.00	2.14	0 00:00	0.00	0.00
2	Jun-02	Junction	231.69	235.60	231.69	235.60	0.00	2.11	233.53	0.00	2.07	0 00:00	0.00	0.00
3	Jun-03	Junction	231.39	235.20	231.39	235.20	0.00	2.56	233.10	0.00	2.10	0 00:00	0.00	0.00
4	Jun-04	Junction	230.70	234.00	230.70	234.00	0.00	2.65	232.25	0.00	1.75	0 00:00	0.00	0.00
5	Jun-05	Junction	230.18	232.60	230.18	232.60	0.00	2.93	231.69	0.00	0.91	0 00:00	0.00	0.00
6	Jun-06	Junction	231.30	232.82	231.30	232.82	0.00	0.14	232.36	0.00	0.46	0 00:00	0.00	0.00
7	Jun-07	Junction	229.79	232.45	229.79	232.45	0.00	3.08	231.16	0.00	1.29	0 00:00	0.00	0.00
8	Jun-08	Junction	230.54	232.60	230.54	232.60	0.00	0.13	231.17	0.00	1.43	0 00:00	0.00	0.00
9	Jun-09	Junction	229.33	231.40	229.33	231.40	0.00	3.22	230.46	0.00	0.94	0 00:00	0.00	0.00
10	Jun-10	Junction	230.09	231.45	230.09	231.45	0.00	0.13	230.47	0.00	0.98	0 00:00	0.00	0.00
11	Jun-11	Junction	228.64	231.70	228.64	231.70	0.00	4.40	230.01	0.00	1.69	0 00:00	0.00	0.00
12	Jun-12	Junction	229.29	231.45	229.29	231.45	0.00	0.09	230.02	0.00	1.43	0 00:00	0.00	0.00
13	Jun-13	Junction	231.04	233.55	231.04	233.55	0.00	1.17	232.86	0.00	0.69	0 00:00	0.00	0.00
14	Out-01	Outfall	228.58					4.38	229.60					

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (m)	Inlet Invert Elevation (m)	Outlet Invert Elevation (m)	Average Slope (%)	Diameter or Height (mm)	Manning's Roughness	Peak Flow (cms)	Design Flow Capacity (cms)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (m/sec)	Peak Flow Depth (m)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Link-01	Pipe	Jun-01	Jun-02	89.50	234.00	232.39	1.8000	975.000	0.0130	2.11	3.01	0.70	3.86	0.87	0.89	0.00	Calculated
2	Link-02	Pipe	Jun-02	Jun-03	22.00	231.69	231.48	0.9500	1050.000	0.0130	2.14	2.67	0.80	2.66	1.05	1.00	12.00	SURCHARGED
3	Link-03	Pipe	Jun-03	Jun-04	46.50	231.39	230.84	1.1800	1050.000	0.0130	2.56	2.97	0.86	3.10	1.05	1.00	10.00	SURCHARGED
4	Link-04	Pipe	Jun-04	Jun-05	63.40	230.70	230.29	0.6500	1200.000	0.0130	2.65	3.14	0.84	2.63	1.20	1.00	7.00	SURCHARGED
5	Link-05	Pipe	Jun-06	Jun-05	75.00	231.30	231.07	0.3100	450.000	0.0130	0.14	0.16	0.88	0.88	0.45	1.00	3.00	SURCHARGED
6	Link-06	Pipe	Jun-05	Jun-07	108.00	230.18	229.83	0.3200	1350.000	0.0130	2.94	3.04	0.97	2.07	1.34	0.99	0.00	Calculated
7	Link-07	Pipe	Jun-08	Jun-07	9.50	230.54	230.50	0.4200	600.000	0.0130	0.13	0.40	0.33	0.82	0.60	1.00	3.00	SURCHARGED
8	Link-08	Pipe	Jun-07	Jun-09	93.00	229.79	229.51	0.3000	1350.000	0.0130	3.06	2.93	1.05	2.36	1.15	0.85	0.00	> CAPACITY
9	Link-09	Pipe	Jun-10	Jun-09	14.00	230.09	230.03	0.4300	600.000	0.0130	0.12	0.40	0.31	0.95	0.41	0.68	0.00	Calculated
10	Link-10	Pipe	Jun-09	Jun-11	68.70	229.33	228.93	0.5800	1500.000	0.0130	3.21	5.39	0.59	2.52	1.10	0.74	0.00	Calculated
11	Link-11	Pipe	Jun-12	Jun-11	12.80	229.29	229.26	0.2300	1200.000	0.0130	0.09	1.89	0.05	0.62	0.74	0.62	0.00	Calculated
12	Link-15	Pipe	Jun-13	Jun-11	100.00	231.04	229.77	1.2700	675.000	0.0130	1.17	0.95	1.23	3.29	0.66	0.97	0.00	> CAPACITY
13	Link-16	Pipe	Jun-11	Out-01	17.00	228.64	228.58	0.3800	1800.000	0.0130	4.38	7.11	0.62	2.44	1.20	0.66	0.00	Calculated

Junction Results

SN	Element ID	Peak Inflow (cms)	Peak Lateral Inflow (cms)	Max HGL Elevation Attained (m)	Max HGL Depth Attained (m)	Max Surcharge Depth Attained (m)	Min Freeboard Attained (m)	Average HGL Elevation Attained (m)	Average HGL Depth Attained (m)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ha-mm)	Total Time Flooded (min)
1	Jun-01	2.10	2.10	234.76	0.76	0.00	2.14	234.70	0.70	0 00:13	0 00:00	0.00	0.00
2	Jun-02	2.11	0.00	233.53	1.84	0.00	2.07	232.76	1.07	0 00:12	0 00:00	0.00	0.00
3	Jun-03	2.56	0.47	233.10	1.71	0.00	2.10	232.26	0.87	0 00:12	0 00:00	0.00	0.00
4	Jun-04	2.65	0.12	232.25	1.55	0.00	1.75	231.62	0.92	0 00:11	0 00:00	0.00	0.00
5	Jun-05	2.93	0.23	231.69	1.51	0.00	0.91	231.15	0.97	0 00:11	0 00:00	0.00	0.00
6	Jun-06	0.14	0.14	232.36	1.06	0.00	0.46	231.31	0.01	0 00:10	0 00:00	0.00	0.00
7	Jun-07	3.08	0.03	231.16	1.37	0.00	1.29	230.75	0.96	0 00:12	0 00:00	0.00	0.00
8	Jun-08	0.13	0.13	231.17	0.63	0.00	1.43	230.75	0.21	0 00:12	0 00:00	0.00	0.00
9	Jun-09	3.22	0.07	230.46	1.13	0.00	0.94	230.09	0.76	0 00:12	0 00:00	0.00	0.00
10	Jun-10	0.13	0.13	230.47	0.38	0.00	0.98	230.10	0.01	0 00:12	0 00:00	0.00	0.00
11	Jun-11	4.40	0.28	230.01	1.37	0.00	1.69	229.49	0.85	0 00:13	0 00:00	0.00	0.00
12	Jun-12	0.09	0.00	230.02	0.73	0.00	1.43	229.49	0.20	0 00:13	0 00:00	0.00	0.00
13	Jun-13	1.17	1.17	232.86	1.82	0.00	0.69	231.06	0.02	0 00:15	0 00:00	0.00	0.00

Pipe Results

SN	Element ID	Peak Flow (cms)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cms)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (m/sec)	Travel Time (min)	Peak Flow Depth (m)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	2.11	0 00:13	3.01	0.70	3.86	0.39	0.87	0.89	0.00		Calculated
2	Link-02	2.14	0 00:16	2.67	0.80	2.66	0.14	1.05	1.00	12.00		SURCHARGED
3	Link-03	2.56	0 00:12	2.97	0.86	3.10	0.25	1.05	1.00	10.00		SURCHARGED
4	Link-04	2.65	0 00:12	3.14	0.84	2.63	0.40	1.20	1.00	7.00		SURCHARGED
5	Link-05	0.14	0 00:10	0.16	0.88	0.88	1.42	0.45	1.00	3.00		SURCHARGED
6	Link-06	2.94	0 00:11	3.04	0.97	2.07	0.87	1.34	0.99	0.00		Calculated
7	Link-07	0.13	0 00:10	0.40	0.33	0.82	0.19	0.60	1.00	3.00		SURCHARGED
8	Link-08	3.06	0 00:12	2.93	1.05	2.36	0.66	1.15	0.85	0.00		> CAPACITY
9	Link-09	0.12	0 00:10	0.40	0.31	0.95	0.25	0.41	0.68	0.00		Calculated
10	Link-10	3.21	0 00:12	5.39	0.59	2.52	0.45	1.10	0.74	0.00		Calculated
11	Link-11	0.09	0 00:04	1.89	0.05	0.62	0.34	0.74	0.62	0.00		Calculated
12	Link-15	1.17	0 00:15	0.95	1.23	3.29	0.51	0.66	0.97	0.00		> CAPACITY
13	Link-16	4.38	0 00:13	7.11	0.62	2.44	0.12	1.20	0.66	0.00		Calculated

WATER BALANCE

Table 3.1: Hydrologic Cycle Component Values

	Water Holding Capacity mm	Hydrologic Soil Group	Precipitation mm	Evapo-transpiration mm	Runoff mm	Infiltration* mm
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)						
Fine Sand	50	A	940	515	149	276
Fine Sandy Loam	75	B	940	525	187	228
Silt Loam	125	C	940	536	222	182
Clay Loam	100	CD	940	531	245	164
Clay	75	D	940	525	270	145
Moderately Rooted Crops (corn and cereal grains)						
Fine Sand	75	A	940	525	125	291
Fine Sandy Loam	150	B	940	539	160	241
Silt Loam	200	C	940	543	199	199
Clay Loam	200	CD	940	543	218	179
Clay	150	D	940	539	241	160
Pasture and Shrubs						
Fine Sand	100	A	940	531	102	307
Fine Sandy Loam	150	B	940	539	140	261
Silt Loam	250	C	940	546	177	217
Clay Loam	250	CD	940	546	197	197
Clay	200	D	940	543	218	179
Mature Forests						
Fine Sand	250	A	940	546	79	315
Fine Sandy Loam	300	B	940	548	118	274
Silt Loam	400	C	940	550	156	234
Clay Loam	400	CD	940	550	176	215
Clay	350	D	940	549	196	196

Notes: Hydrologic Soil Group A represents soils with low runoff potential and Soil Group D represents soils with high runoff potential. The evapotranspiration values are for mature vegetation. Streamflow is composed of baseflow and runoff.

* *This is the total infiltration of which some discharges back to the stream as base flow. The infiltration factor is determined by summing a factor for topography, soils and cover.*

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2

Figure 1a- % of Total Annual Average Rainfall Depth Vs. Daily Rainfall Amounts
(Based on 1991 Toronto Rainfall Data from 16 Rain Gauge Stations)

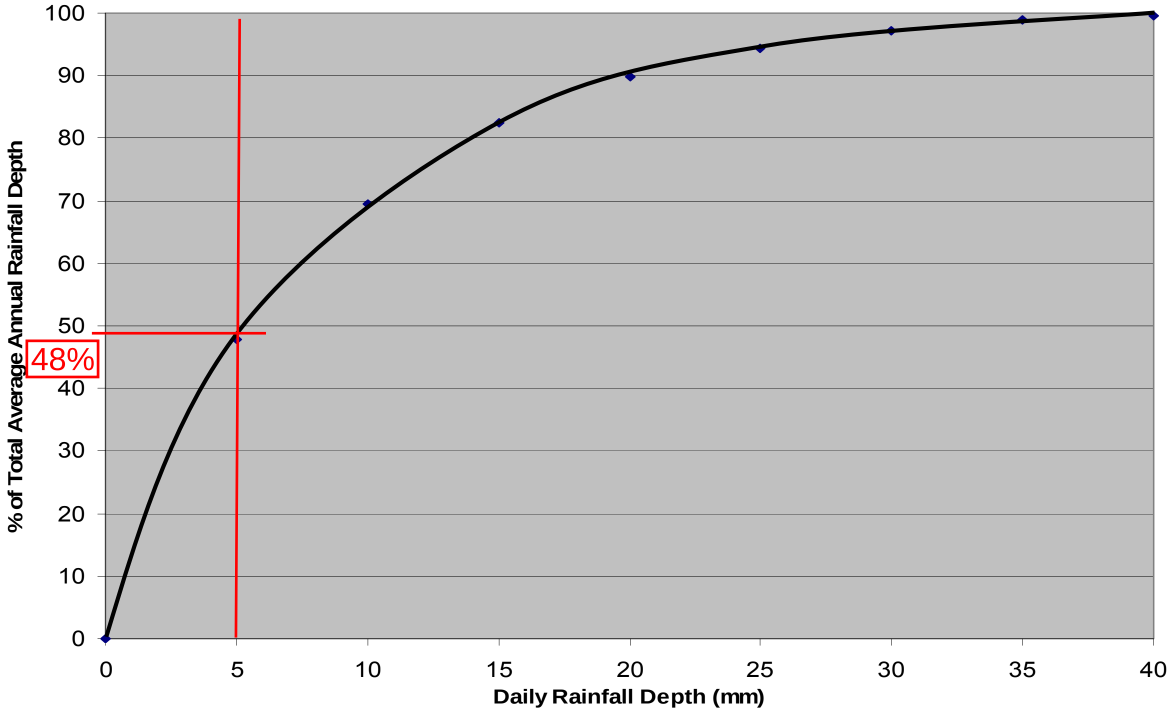
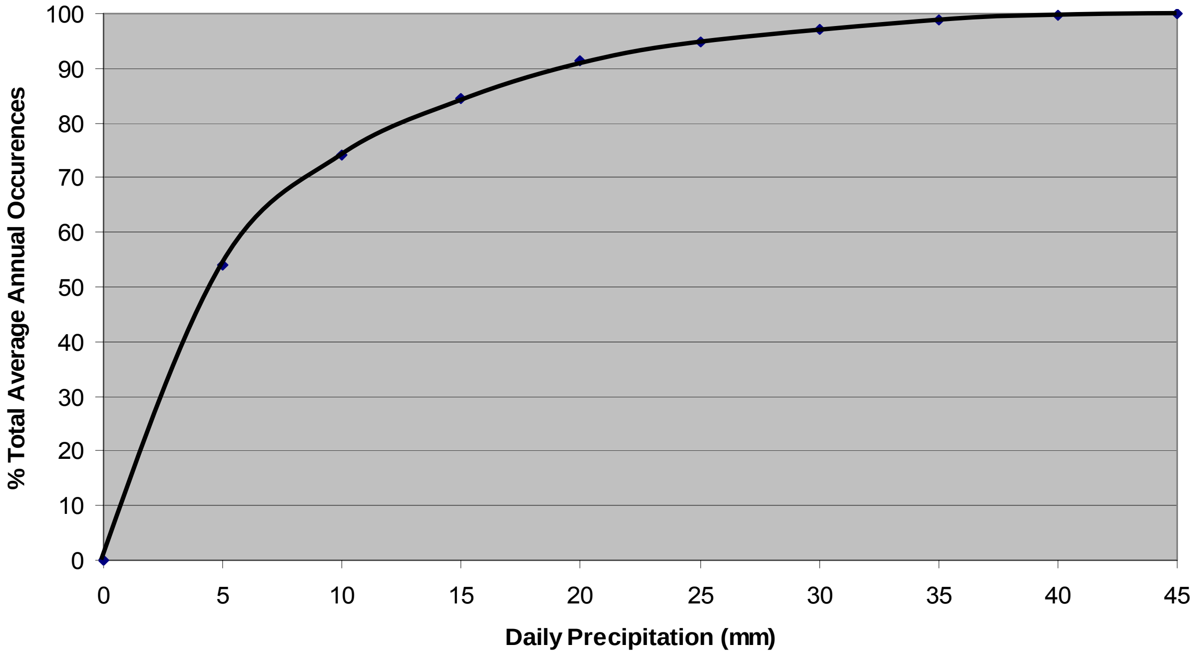


Figure 1b-Total Average Annual Occurences vs Daily Precipitation
(based on 1991 Toronto Rainfall Data from 16 Rain Gauge Stations)



PRE-DEVELOPMENT	Site	
Catchment Designation	Pasture/Open Space	TOTALS
Area (m^2)	40,040	40,040
Pervious Area (m^2)	30,265	30,265
Impervious Area (m^2)	9,775	9,775
MOE Infiltration Factors		
Topography Infiltration Factor	0.20	
Soil Infiltration Factor	0.40	
Land Cover Infiltration Factor	0.10	
MOE Total Infiltration Factor	0.70	
Runoff Coefficient	0.3	
Runoff from Impervious Surfaces	0	
Inputs (per Unit Area)		
Precipitation (mm/yr)	933	933
TOTAL INPUTS (mm/yr)	933	933
Outputs (per Unit Area)		
Precipitation Surplus (mm/yr)	402	
Evapotranspiration (mm/yr)	531	
Infiltration (mm/yr)	281	
Rooftop Infiltration (mm/yr)	0	
Total Infiltration (mm/yr)	281	
Runoff Pervious Areas (mm/yr)	121	
Runoff Impervious Areas (mm/yr)	0	
Total Runoff (mm/yr)	121	
TOTAL OUTPUTS (mm/yr)	933	933
Difference (INPUTS-OUTPUTS)	0	0
Inputs (Volumes)		
Precipitation (m^3/yr)	37,357	37,357
TOTAL INPUTS (m^3/yr)	37,357	37,357
Outputs (Volumes)		
Precipitation Surplus (m^3/yr)	16,096	
Evapotranspiration (m^3/yr)	16,071	
Infiltration (m^3/yr)	8,517	
Rooftop Infiltration (m^3/yr)	0	
Total Infiltration (m^3/yr)	8,517	
Runoff Pervious Areas (m^3/yr)	4,829	
Runoff Impervious Areas (m^3/yr)	0	
Total Runoff (m^3/yr)	4,829	
TOTAL OUTPUTS (m^3/yr)	32,167	32,167
Difference (INPUTS-OUTPUTS)	5,191	5,191

POST-DEVELOPMENT	Site			
Catchment Designation	Grass/Open Space	Paved	Building	TOTALS
Area (m^2)	12,920	26,115	8,130	47,165
Pervious Area (m^2)	12,920	0	0	12,920
Impervious Area (m^2)	0	26,115	8,130	34,245
MOE Infiltration Factors				
Topography Infiltration Factor	0.10	0.10	0.10	
Soil Infiltration Factor	0.10	0.10	0.10	
Land Cover Infiltration Factor	0.10	0.00	0.00	
MOE Total Infiltration Factor	0.3	0	0	
Runoff Coefficient	0.7	1	1	
Runoff from Impervious Surfaces	0	0.8	0.8	
Inputs (per Unit Area)				
Precipitation (mm/yr)	815	815	815	815
TOTAL INPUTS (mm/yr)	815	815	815	815
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	341	652	652	
Evapotranspiration (mm/yr)	474	163	163	
Infiltration (mm/yr)	102	0	0	
Rooftop Infiltration (mm/yr)	0	0	0	
Total Infiltration (mm/yr)	102	0	0	
Runoff Pervious Areas (mm/yr)	239	0	0	
Runoff Impervious Areas (mm/yr)	0	652	652	
Total Runoff (mm/yr)	239	652	652	
TOTAL OUTPUTS (mm/yr)	815	815	815	
Difference (INPUTS-OUTPUTS)	0	0	0	
Inputs (Volumes)				
Precipitation (m^3/yr)	10,530	21,284	6,626	38,439
TOTAL INPUTS (m^3/yr)	10,530	21,284	6,626	38,439
Outputs (Volumes)				
Precipitation Surplus (m^3/yr)	4,406	17,027	5,301	26,733
Evapotranspiration (m^3/yr)	6,124	4,257	1,325	11,706
Infiltration (m^3/yr)	1,318	0	0	1,318
Rooftop Infiltration (m^3/yr)	0	0	0	0
Total Infiltration (m^3/yr)	1,318	0	0	1,318
Runoff Pervious Areas (m^3/yr)	3,084	0	0	3,084
Runoff Impervious Areas (m^3/yr)	0	17,027	5,301	22,328
Total Runoff (m^3/yr)	3,084	17,027	5,301	25,412
TOTAL OUTPUTS (m^3/yr)	10,530	21,284	6,626	38,439
Difference (INPUTS-OUTPUTS)	0	0	0	0

POST-DEVELOPMENT with MITIGATION	Site				
Catchment Designation	ROW	Res. Lots	Mdm. Block	Com. Block	TOTALS
Area (m^2)	7,155	27,885	3,800	1,200	40,040
Pervious Area (m^2)	2,782	15,337	760	180	19,059
Impervious Area (m^2)	4,373	12,548	3,040	1,020	20,981
MOE Infiltration Factors					
Topography Infiltration Factor	0.30	0.30	0.30	0.30	
Soil Infiltration Factor	0.40	0.40	0.40	0.40	
Land Cover Infiltration Factor	0.10	0.10	0.10	0.10	
MOE Total Infiltration Factor	0.8	0.8	0.8	0.8	
Runoff Coefficient	0.2	0.2	0.2	0.2	
Runoff from Impervious Surfaces	0	0	0	0	
Inputs (per Unit Area)					
Precipitation (mm/yr)	933	933	933	933	933
TOTAL INPUTS (mm/yr)	933	933	933	933	933
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	418	418	418	418	
Evapotranspiration (mm/yr)	515	515	515	515	
Infiltration (mm/yr)	334	334	334	334	
Impervious Infiltration (mm/yr)	0	146	125	0	
Total Infiltration (mm/yr)	334	481	460	334	
Runoff Pervious Areas (mm/yr)	84	84	84	84	
Runoff Impervious Areas (mm/yr)	418	418	418	418	
Total Runoff (mm/yr)	502	502	502	502	
TOTAL OUTPUTS (mm/yr)	933	933	933	933	
Difference (INPUTS-OUTPUTS)	0	0	0	0	
Inputs (Volumes)					
Precipitation (m^3/yr)	6,676	26,017	3,545	1,120	37,357
TOTAL INPUTS (m^3/yr)	6,676	26,017	3,545	1,120	37,357
Outputs (Volumes)					
Precipitation Surplus (m^3/yr)	2,991	11,656	1,588	502	16,737
Evapotranspiration (m^3/yr)	3,685	14,361	1,957	618	20,621
Infiltration (m^3/yr)	930	5,129	254	60	6,373
Impervious Infiltration (m^3/yr)	0	1,836	381	0	2,217
Total Infiltration (m^3/yr)	930	6,964	635	60	8,590
Runoff Pervious Areas (m^3/yr)	233	1,282	64	15	1,593
Runoff Impervious Areas (m^3/yr)	1,828	5,245	1,271	426	8,770
Total Runoff (m^3/yr)	2,060	6,527	1,334	441	10,363
TOTAL OUTPUTS (m^3/yr)	6,676	26,017	3,545	1,120	37,357
Difference (INPUTS-OUTPUTS)	0	0	0	0	0

City of Barrie

Gerrits Engineering Limited

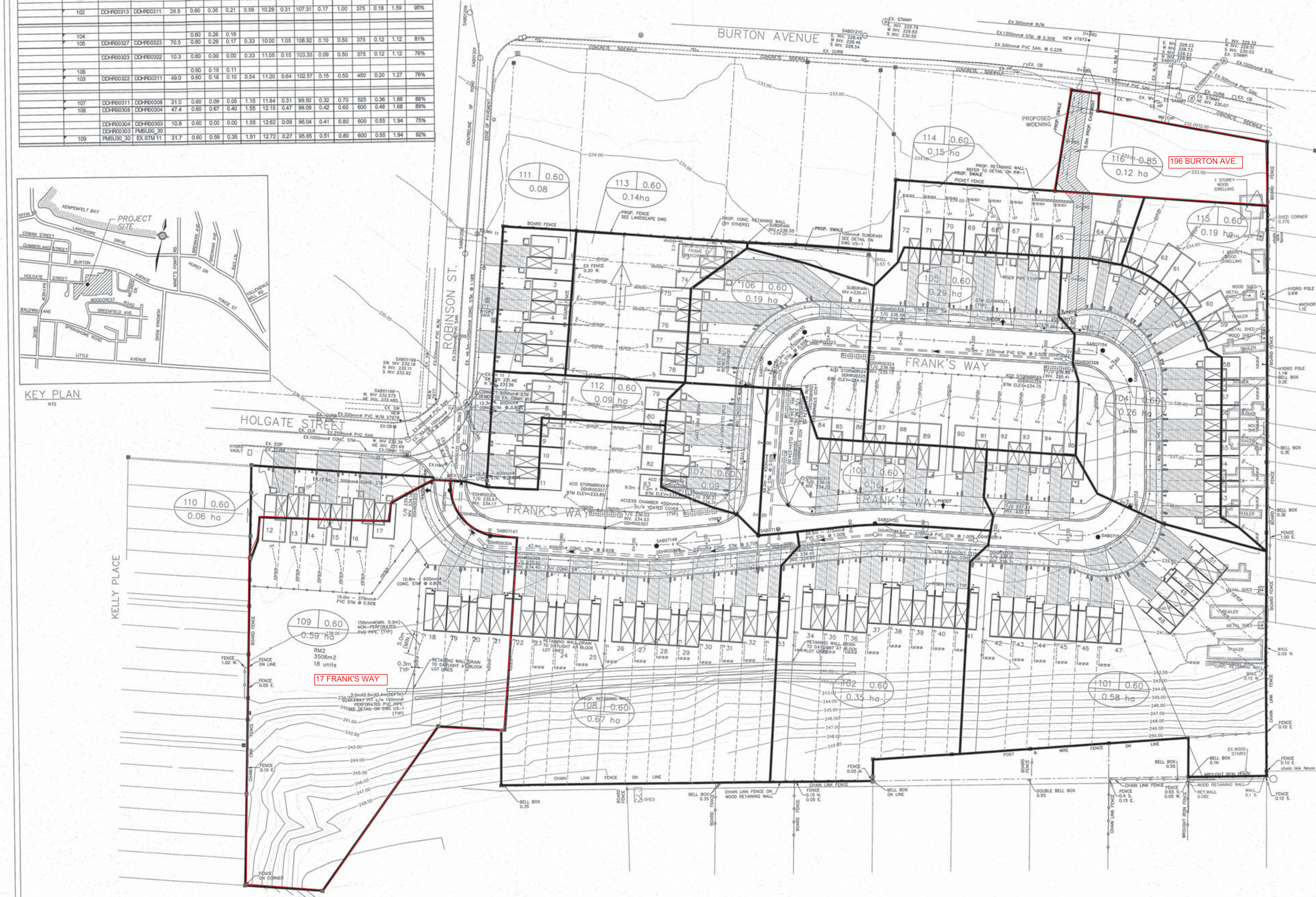
STORM SEWER DESIGN

$I = A/(t_c+B)^C$
A= 853.608
B= 4.699
C= 0.766

Q= 0.0028*C*I*A (cms)
C=RUNOFF COEFFICIENT
I=RAINFALL INTENSITY
A=AREA (ha)

DESIGN SHEET NO. STM-1
FILE 402-002
CONTRACT/PROJECT Robinson St.

STREET NAME	SUBBASIN	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	SLOPE	DIA.	Q FULL	V FULL	% FULL
		FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	
	101	DDHR00314	DDHR00313	27.6	0.60	0.58	0.35	0.35	10.00	0.29	108.92	0.11	1.00	375	0.18	1.59	60%
	102	DDHR00313	DDHR00311	29.5	0.60	0.35	0.21	0.56	10.29	0.31	107.31	0.17	1.00	375	0.18	1.59	95%
	104				0.60	0.26	0.16										
	105	DDHR00327	DDHR00323	70.5	0.60	0.29	0.17	0.33	10.00	1.05	108.92	0.10	0.50	375	0.12	1.12	81%
		DDHR00323	DDHR00322	10.3	0.60	0.00	0.00	0.33	11.05	0.15	103.33	0.09	0.50	375	0.12	1.12	76%
	106				0.60	0.19	0.11										
	103	DDHR00322	DDHR00311	49.0	0.60	0.16	0.10	0.54	11.20	0.64	102.57	0.15	0.50	450	0.20	1.27	76%
	107	DDHR00311	DDHR00308	31.0	0.60	0.09	0.05	1.15	11.84	0.31	99.50	0.32	0.70	525	0.36	1.66	88%
	108	DDHR00308	DDHR00304	47.4	0.60	0.67	0.40	1.55	12.15	0.47	98.09	0.42	0.60	600	0.48	1.68	89%
		DDHR00304	DDHR00303	10.8	0.60	0.00	0.00	1.55	12.62	0.09	96.04	0.41	0.80	600	0.55	1.94	75%
		DDHR00303	PMSU30_30														
	109	PMSU30_30	EX.STM 11	31.7	0.60	0.59	0.35	1.91	12.72	0.27	95.65	0.51	0.80	600	0.55	1.94	92%



KEY PLAN
NTS

LEGEND

⇨	OVERLAND FLOW
AREA # 101, RUNOFF COEFFICIENT 'C' 0.60, 0.21 ha AREA (ha.)	
▬	CATCHMENTS BOUNDARY

GERRITS ENGINEERING
LIMITED
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T.705.737.3303, F.705.737.1772
mail@gerreng.com
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0 5 10 20 30 40 50mm
0" 1/4" 1/2" 1" 1 1/2" 2"

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5.	FIFTH SUBMISSION	08/18/16

CITY OF BARRIE
ACCEPTED
DATE Aug 27/16
DIRECTOR OF ENGINEERING

ISSUED FOR:

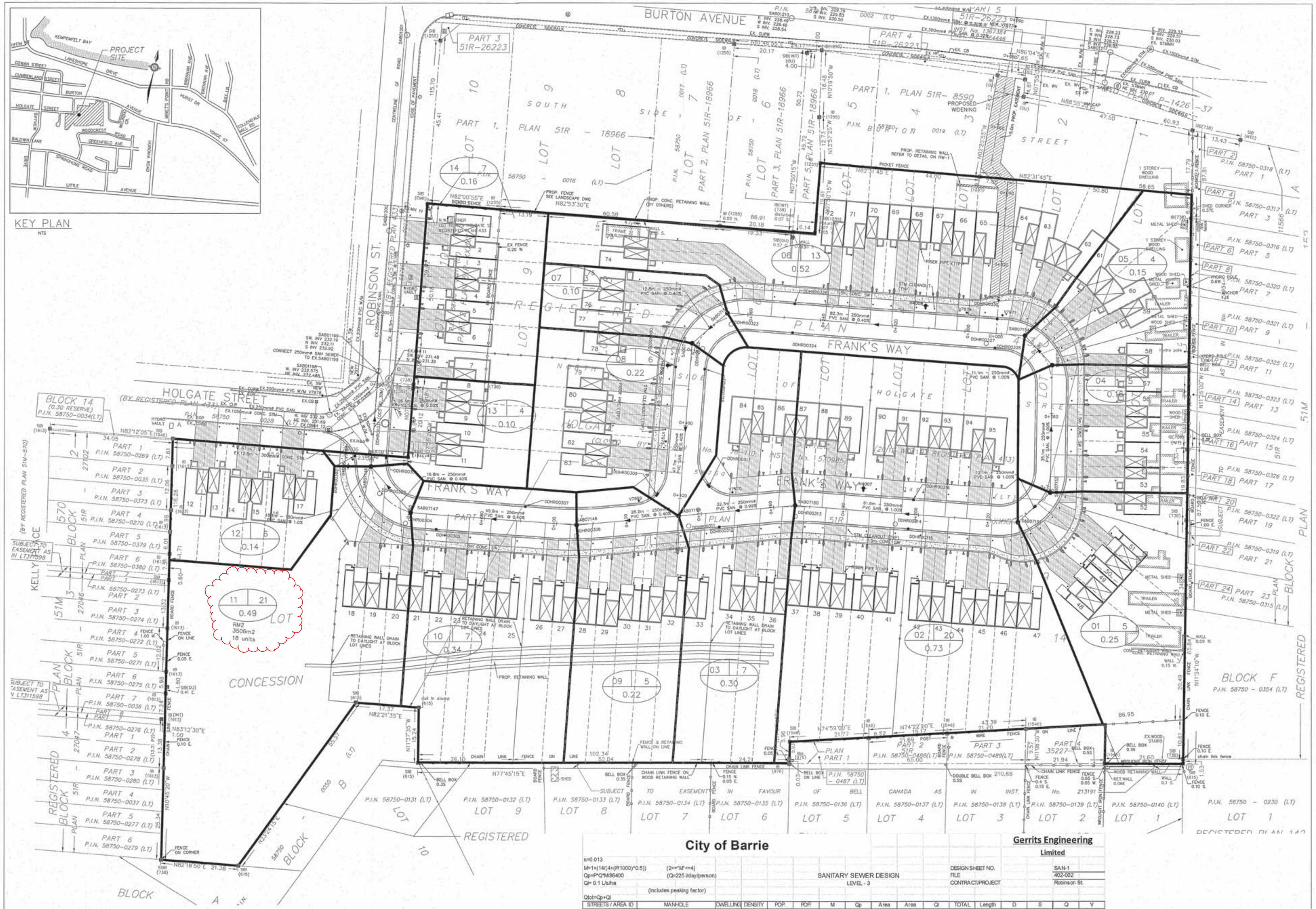
FIFTH SUBMISSION

Client
MELCHIOR
MANAGEMENT
CORPORATION

Project
PARKSHORE VILLAGE
HOLGATE & ROBINSON ST.
BARRIE, ON

Drawing:
POST-DEVELOPMENT
STORM DRAINAGE
PLAN

Project No. 402-002-13
Designed by: AY
Checked by: RCC
Scale: 1:1000
Drawn by: AY
Approved by: JDM
Orientation
Stamp
J.D.J. McCuaig
100064896
08/18/16
Drawing No.
STM-1



City of Barrie

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n=0.013
M=1+(14/(4+(P/1000)^0.5)) (2<="M"<=4)
Qp=P*Q*M/86400 (Q=225 l/day/person)
Qi= 0.1 L/s/ha
(includes peaking factor)
Qtot=Qp+Qi

SANITARY SEWER DESIGN
LEVEL - 3

DESIGN SHEET NO. SAN-1
FILE 402-002
CONTRACT/PROJECT Robinson St.

STREETS / AREA ID	MANHOLE		DWELLING UNITS	DENSITY P.P.U	POP. (P)	POP. (ACC.)	M	Qp (l/s)	Area (ha)	Area (ACC.) (ha)	Qi (l/s)	TOTAL Q (l/s)	Length (m)	D (mm)	S (%)	Q FULL (l/s)	V FULL (m/s)
	FROM	TO															
04	SAB07152	SAB07153	5	2.34	11.70	11.70	4.00	0.12	0.16	0.16	0.02	0.14	35.10	250	1.00	59.48	1.21
05	SAB07153	SAB07154	4	2.34	9.36	21.06	4.00	0.22	0.15	0.31	0.03	0.25	11.10	250	1.00	59.48	1.21
06	SAB07154	SAB07155	13	2.34	30.42	51.48	4.00	0.54	0.52	0.83	0.08	0.62	82.30	250	0.40	37.62	0.77
07	SAB07155	SAB07156	3	2.34	7.02	58.50	4.00	0.61	0.10	0.93	0.09	0.70	12.80	250	0.40	37.62	0.77
08	SAB07156	SAB07149	6	2.34	14.04	72.54	4.00	0.76	0.22	1.15	0.12	0.87	47.70	250	0.40	37.62	0.77
01	SAB07152	SAB07151	5	2.34	11.70	11.70	4.00	0.12	0.25	0.25	0.03	0.15	12.10	250	1.00	59.48	1.21
02	SAB07151	SAB07150	20	2.34	46.80	46.80	4.00	0.49	0.73	0.98	0.10	0.59	61.60	250	1.00	59.48	1.21
03	SAB07150	SAB07149	7	2.34	16.38	28.08	4.00	0.29	0.30	1.28	0.13	0.42	32.30	250	1.00	59.48	1.21
09	SAB07149	SAB07148	5	2.34	11.70	112.32	4.00	1.17	0.22	2.65	0.27	1.44	42.30	250	0.40	37.62	0.77
10	SAB07148	SAB07147	7	2.34	16.38	128.70	4.00	1.34	0.34	2.99	0.30	1.64	36.40	250	0.40	37.62	0.77
11	SAB07147	SAB07146	21	2.34	49.14	177.84	4.00	1.85	0.49	3.48	0.35	2.20	16.80	250	0.40	37.62	0.77
13	SAB07146	EX SAB01199	4	2.34	8.19	186.03	4.00	1.94	0.10	3.58	0.36	2.30	26.40	250	0.40	37.62	0.77

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CITY OF BARRIE
ACCEPTED
DATE . Aug 23/16 . . . . . .
. . . . Ymweber . . . .
DIRECTOR OF ENGINEERING

LEGEND

ID UNITS NUMBER
05 3
0.10
AREA (ha.)

▬ CATCHMENTS BOUNDARY

ISSUED FOR:

FIFTH SUBMISSION

Client

MELCHIOR
MANAGEMENT
CORPORATION

Project

PARKSHORE VILLAGE
HOLGATE & ROBINSON ST.
BARRIE, ON

Drawing

SANITARY DRAINAGE
AREA PLAN

Project No. 402-002-13	Designed by: AY	Checked by: RCC
Scale: 1:500	Drawn by: AY	Approved by: JDM

Orientation

Stamp

J.D.J. McCuaig
100064896
08/18/16

Drawing No.

SAN-1

Appendix B

Geotechnical Report

PINESTONE ENGINEERING LTD.

655423 ONTARIO INC.

6 UNIT TOWNHOUSE DEVELOPMENT, 196 BURTON AVENUE, BARRIE, ON

GEOTECHNICAL INVESTIGATION

FEBRUARY 14, 2019

6 UNIT TOWNHOUSE DEVELOPMENT, 196 BURTON AVENUE, BARRIE, ON

GEOTECHNICAL INVESTIGATION

655423 ONTARIO INC.

PROJECT NO.: 181-17106-00

DATE: FEBRUARY 14, 2019

WSP
UNITS C AND D
561 BRYNE DRIVE
BARRIE, ON, CANADA L4N 9Y3

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WSP.COM

February 05, 2019

655423 ONTARIO INC.
Box 628
Barrie, ON
L4M 4V1

Attention: Mr. D. Melchoir

Dear Mr. Melchoir,

Subject: 6 Unit Townhouse Development, 196 Burton Avenue, Barrie - Geotechnical Investigation

WSP Canada Inc. was retained to complete a geotechnical investigation at the above noted site. The purpose of the geotechnical investigation is to identify the subsurface conditions at select borehole locations and to provide design recommendations toward the proposed site development, as well as identify any potential constraints which may be encountered during construction.

Kind regards,

Kent Malcolm Senior Geotechnical Engineer	Nick La Posta, P.Eng. Team Lead - Environment

MKM/

WSP ref.: 181-17106-00

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SIGNATURES

PREPARED BY

February 14, 2019

Nick La Posta, P.Eng.
Team Lead - Environment

Date

APPROVED BY

February 14, 2019

Kent Malcolm, P.Eng.
Senior Geotechnical Engineer

Date

WSP Canada Inc. prepared this report solely for the use of the intended recipient, 655423 ONTARIO INC., in accordance with the professional services agreement. The intended recipient is solely responsible for the disclosure of any information contained in this report. The content and opinions contained in the present report are based on the observations and/or information available to WSP Canada Inc. at the time of preparation. If a third party makes use of, relies on, or makes decisions in accordance with this report, said third party is solely responsible for such use, reliance or decisions. WSP Canada Inc. does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken by said third party based on this report. This limitations statement is considered an integral part of this report.

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DRAWINGS

Figure 1 Site Location Plan
Figure 2 Borehole Location Plan

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APPENDICES

Appendix A – ISM Architects Preliminary Concept Plans

1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by Mr. John Vellinga on behalf of 655423 Ontario Inc. to undertake a geotechnical investigation at 196 Burton Avenue, west of Melinda Crescent, in the City of Barrie, Ontario. The location of the site is shown on the attached ***Site Location Plan - Figure 1.***

The scope of this geotechnical investigation was to obtain information about the subsurface conditions through the advancement of four (4) boreholes and based upon the findings of the boreholes ultimately provide recommendations herein pertaining to the following:

- Site preparation and grading;
- Appropriate foundation type, geotechnical resistances (ULS and SLS) and founding depth;
- Floor slab design and construction;
- General excavation, backfill and bedding requirements, and groundwater control;
- Preliminary infiltration rates; and,
- A preliminary pavement design.

This report deals with geotechnical issues only.

This report is provided based on 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.

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 follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for 655423 Ontario Inc. Third party use of this report without WSP consent is prohibited.

2 SITE BACKGROUND AND PROJECT DESCRIPTION

The subject site previously included a detached residence on the western half of the site. At the time of the field investigation, the residence had been demolished and site roughly graded. The presence of a basement in the previous residence is unknown but should be a consideration in the proposed development.

Based on information provided to our office, it is understood that the development comprises the construction of a six (6) unit, three (3) storey residential townhouse block with basement and an at grade parking area and infiltration area at the site. The preliminary ISM Architects Site Plan, Floor Plans and Elevations are attached to this report in ***Appendix A***.

3 INVESTIGATION METHODOLOGY

The field investigation consisted of four (4) boreholes (BH19-1 to BH19-4) drilled on the site on February 1, 2019. The borehole locations are shown on the attached ***Borehole Location Plan - Figure 2***.

The boreholes were advanced to depths between 3.5 metres below ground surface (mbgs) and 6.5 mbgs. The boreholes were drilled with solid stem continuous flight auger equipment.

Drilling equipment was supplied and operated by a drilling sub-contractor under the direction and supervision of WSP personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer in accordance with the Standard Penetration Test (ASTM D 1586) method. This sampling method recovers samples from the soil strata, and the number of blows required to drive the sampler a 0.3 m depth into the undisturbed soil (SPT 'N' values) gives an indication of the compactness condition or consistency of the sampled soil material. The SPT 'N' values are indicated on the ***Borehole Logs - Enclosures 1-4***.

Soil samples were visually classified in the field and re-evaluated by a senior engineer in our laboratory. All soil samples were tested for moisture contents. Laboratory Grain Size Analyses were carried out on representative samples and the results are provided in ***Enclosures 5-7.***

Water level observations were made during the drilling and in the open boreholes upon the completion of drilling operations. Standpipes were installed at two borehole locations; WSP returned to the site on February 7, 2019 to obtain groundwater levels at the site.

4 SITE AND SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered are presented on the Borehole Logs and summarized in the following sections. It is noted that subsurface conditions can change between boreholes and the details provided below refer to soil conditions that were encountered at the borehole locations only.

4.1 GENERAL SUBSURFACE CONDITIONS

Based on the results of the field investigation and as the site was previously developed, the subsurface conditions at the borehole locations generally comprised shallow fill or topsoil at each borehole. The surface cover and fill were underlain by a non-cohesive deposit comprised of silty sand to sand and silt.

4.1.1 SURFACE COVER

Fill materials were encountered at the surface of BH19-1 and BH19-4 and below a layer of topsoil at BH19-2 and BH19-3. The fill at BH19-1 comprised a grey, crushed limestone fill that extended to a depth of 0.7 mbgs. A brown, moist, silty sand fill with some gravel was encountered below the topsoil at BH19-2 that extended to a depth of 1.2 mbgs and at the surface of BH19-4 extending to a depth of 0.6 mbgs. A brown, moist sand and gravel fill was encountered at BH19-3 and BH19-4 extending to a depth of 1.4 mbgs.

It should be noted that topsoil and fill quantities should not be calculated from the borehole information, as large variations in depth may exist between boreholes. A detailed topsoil/fill thickness survey is recommended to determine an accurate evaluation of quantity. The topsoil was generally dark brown in colour and moist but frozen.

A summary of the fill encountered at the site is provided in the following table.

BOREHOLE	DEPTH OF TOP OF FILL (MBGS)	DEPTH OF BOTTOM OF FILL (MBGS)	FILL THICKNESS (M)	FILL COMPOSITION
BH19-1	0.0	0.8	0.8	Crushed Limestone
BH19-2	0.3	1.2	0.9	Silty Sand
BH19-3	0.3	1.4	1.1	Sandy Gravel
BH19-4	0.0	1.4	1.4	Silty Sand over Sand and Gravel

The surface fill was frozen but the measured SPT ‘N’ values in the unfrozen fill ranged from 20 blows per 0.3 m of penetration to 52 blows per 0.3 m of penetration, indicating that the fill varied from compact to very dense.

The moisture content of fill soils ranged between 2% and 9%.

Grain size analyses of a sample of fill was completed and the gradation curve is presented in ***Enclosure 6 - Laboratory Analyses***. A review of the grain size analyses indicates the following ranges of clay, silt, sand and gravel percentages:

— Gravel: 15%
— Sand: 77%
— Fines (Silt & Clay): 8%

4.1.2 NON-COHESIVE DEPOSITS

A non-cohesive deposit of silty sand to sand and silt was encountered at each borehole below the fill. The deposit was brown and moist becoming wet below a depth of 2.0 mbgs. The non-cohesive deposits extended beyond the final depth investigated at all boreholes.

The measured SPT ‘N’ values in the non-cohesive deposit ranged from 20 blows per 0.3 m of penetration to 59 blows per 0.3 m of penetration, indicating that the deposit varied from compact to very dense, generally being compact to dense.

The natural moisture content of non-cohesive soils ranged between 2% and 24%.

Grain size analyses of two (2) samples of the deposit were completed and the gradation curves are presented in ***Enclosures 5 and 7 – Laboratory Analyses.*** A review of the grain size analyses indicates the following ranges of clay, silt, sand and gravel percentages:

— Gravel: 3% - 38%
— Sand: 53% - 77%
— Fines (Silt & Clay): 9% - 20%

4.2 GROUNDWATER

A summary of the groundwater levels observed at the site, both upon completion of the drilling of the boreholes, as well as in the standpipes installed in two (2) of the boreholes, is tabulated below.

BOREHOLE	DATE	GROUNDWATER DEPTH (MBGS)	MEASUREMENT SOURCE
BH19-1	February 1, 2019	3.7	Borehole caved to 4.9 mbgs
	February 7, 2019	2.4	Standpipe
BH19-2	February 1, 2019	3.7	Borehole caved to 3.7 mbgs
BH19-3	February 1, 2019	3.0	Borehole caved to 3.0 mbgs
BH19-4	February 1, 2019	2.1	Borehole caved to 2.7 mbgs
	February 7, 2019	2.2	Standpipe

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events. Future monitoring of the groundwater levels is recommended to determine the seasonal high level.

5 DISCUSSIONS/RECOMMENDATIONS

5.1 GENERAL

The following recommendations for the proposed site development are based on the information obtained from the borehole investigation and laboratory testing, which we believe fairly represents the subsurface conditions of the site. These recommendations are intended for the guidance of the design engineer to establish constructability and should not be construed as instructions to contractors. If significant differences in the subsurface conditions described above are found, we request to be contacted immediately to review and revise our findings and recommendations, if necessary.

The construction methods described in this report must not be considered as being specifications or recommendations to the prospective contractors, or as being the only suitable methods. Prospective contractors should evaluate all the information, obtain additional subsurface information as they might deem necessary and should select their construction methods, sequencing and equipment based on their own experience in similar ground conditions. The readers of this report are also reminded that the conditions are known only at the borehole locations and in view of the generally wide spacing of the boreholes, conditions may vary significantly between boreholes.

It is noted that, as no detailed design information was available at the time of this investigation, the information and recommendations provided below should be considered preliminary in nature only.

5.2 SITE BACKGROUND

As indicated above the proposed development comprises the construction of a three (3) storey six-unit townhouse block with full basement and an at grade exterior parking area and infiltration area.

The results of the geotechnical investigation indicate that the subsurface conditions at the site comprise a shallow layer of fill or topsoil overlying compact to very dense silty sand, sand & silt. Groundwater was encountered during the drilling at all boreholes between 2.1 mbgs and 3.7 mbgs. A short term stabilized groundwater was also encountered within the two (2) standpipes on February 7, 2019 as high as 2.2 mbgs.

5.3 SITE PREPARATION AND GRADING

Removal of all fill and any organic matter will be required to facilitate the proposed development on the site. Regarding the reuse of the site fill, the fill may be reused in landscaping applications or if not organically included as subgrade parking area fill. WSP should be contacted to review all proposed fill reuse on site. The existing fill in the proposed parking areas must be assessed during construction operations by confirmation sampling and proofroll to ascertain whether it should be removed and replaced in the proposed parking area.

After the completion of the required stripping and removal of unsuitable materials (fill and organic matter), the sub-grade should be proof-rolled and inspected by experienced WSP geotechnical engineering personnel. The proof-rolling and compaction of the exposed sub-grade is recommended to be conducted using a vibratory compactor with a minimum static weight of 10 tonnes. The proof-rolling program should consist of a minimum of six (6) passes per unit area and be tested to assure that the sub-grade is compacted to a minimum of 98% of the exposed material’s Standard Proctor Maximum Dry Density (SPMDD). Any loose/soft or wet areas identified at the time of proof-rolling that cannot be uniformly compacted are recommended to be sub-excavated and backfilled with approved fill.

Compacted fill may be required to develop the design grades and elevations or for use in other backfilling excavations created through the removal of unsuitable materials or soils as described above. The excavated native on-site non-cohesive materials may be re-used, subject that these are free of organic and other unsuitable materials and have adequate moisture content. Boulders or cobbles greater than 200 mm in size should be removed from the fill. Alternatively, Ontario Provincial Standard Specification (OPSS) Granular B – Type I, OPSS Select Subgrade Material (SSM), or an approved equal may be used at the site for engineered fill purposes.

All fill materials imported to the site must meet all applicable municipal, provincial and federal guidelines and requirements associated with environmental characterization of the materials.

Fill is to be placed in maximum 200 mm thick loose lifts under full time supervision of qualified WSP geotechnical personnel. Each lift is to be uniformly compacted to achieve the required degree of compaction.

5.4 FOUNDATION RECOMMENDATIONS

Details of the proposed development such as underside of footing elevations were not available at the time when this report was prepared. When this information is available, the recommendations provided herein should be reviewed by WSP to confirm that the recommendations are still valid based on the design information.

Based on the soil conditions encountered in the boreholes and provided that the site is prepared in accordance with the recommendations presented in this report, footings that are founded at a minimum depth of 1.5 mbgs into the undisturbed compact to very dense native soils may be designed based on a preliminary factored ultimate geotechnical resistance at Ultimate Limit States (ULS) of 225 kPa. A preliminary serviceability geotechnical resistance at Serviceability Limit States (SLS) of 150 kPa may be used in the design of the foundations. An increased SLS capacity of 200 kPa (300 ULS) is available at a minimum depth of 2.3 mbgs.

Foundations designed to the specified bearing capacities at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

5.4.1 GENERAL FOUNDATION COMMENTS

All footings exposed to seasonal freezing conditions should be provided with at least 1.5 m of earth cover or equivalent thermal insulation against frost. It is recommended to keep footings as high as possible to avoid or minimize penetration below groundwater levels while considering the minimum frost cover requirement.

Variations in the soil conditions are expected in between the borehole locations, and during construction, the geotechnical resistances should be confirmed by experienced WSP site personnel.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper foundations.

The silt soils at the base of footings can be easily disturbed by construction machinery and foot traffic or lose their strength in contact with surface water. We recommend that an allowance be made for placing a 50-mm thick skim coat of low-strength concrete on the founding subgrade immediately after its approval, to prevent its disturbance by construction activities and from ground or surface water, where necessary.

During winter construction, foundations and slab on grades must not be poured on frozen soil. Foundations must be adequately protected always from cold weather and freezing conditions.

Near the existing buried utilities, all footings must be lowered to undisturbed native soils, or alternatively the services must be structurally bridged.

It should be noted that the recommended geotechnical resistances have been calculated by WSP from the borehole information for the preliminary design stage only. Additional input may be required as new design information becomes available and is refined. For example, more specific information is available with respect to conditions between boreholes when construction is underway. In this regard, the interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by WSP to validate the information for use during the construction stage.

5.5 FLOOR SLAB CONSTRUCTION AND DRAINAGE

The floor slabs can be placed on undisturbed native soils or on compacted fill. For bedding and moisture barrier purposes, a 200-mm thick layer of 19 mm clear crushed stone must be provided under the concrete basement floor slab. Where localized wet and/or fine-grained soil conditions exist, the moisture barrier should be separated from the subgrade by a geotextile fabric to avoid loss of soil/fines and settlement problems.

As noted above the groundwater levels at the site are relatively high at this time of year and will likely be higher in the spring and fall seasons. It is not recommended to construct a basement below the high groundwater level. Future monitoring of groundwater levels is recommended prior to determining the basement floor slab elevation.

When considering an underground basement, it is critical that a robust subfloor drainage system be installed under the floor slab for any slab constructed beneath the groundwater table. The drainage system could consist of a series of drains running parallel under the floor slabs, all of which would be required to lead to a positive gravity drain. In areas where gravity drainage is not feasible, the water collected by all drain pipes are to be channelled into a sump from where the water could be removed by pumping. We do advise that the groundwater level measured during the investigation will require the proposed underground walls of the basement to be waterproofed and will likely result in frequent sump operation unless the final site grades allow for effective gravity drainage.

5.6 EARTHQUAKE CONSIDERATIONS

The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4A of the Ontario Building Code (2012). The classification is based on the determination of the average shear wave velocity in the top 30 meters of the site stratigraphy, where shear wave velocity measurements have been taken or alternatively estimated based on rational analysis of un-drained shear strength or penetration resistance.

At this site, the subsurface conditions include fill overlying compact to very dense non-cohesive sand and silt soil or very stiff to hard cohesive clayey soil. We note that the boreholes only extended to a maximum depth of 6.5 mbgs. The site designation for seismic analysis is estimated as Class D (OBC 4.1.8.4 Table 4.1.8.4.A.) for seismic design purposes.

5.7 LATERAL EARTH PRESSURES

The lateral earth pressure for the design of retaining walls, foundation walls, shoring, or trench boxes can be estimated from the following expressions:

Below groundwater table:

$$P = K \{\gamma(h - h_w) + \gamma'(h_w) + q\} + \gamma_w h_w$$

K = Earth pressure coefficient;

γ = Unit weight of soil above groundwater table, in kN/m^3;

h = Height of restrained soil, in meters;

h_w = Height of soil below groundwater level, in meters;

γ_w = Unit weight of water; (9.8 kN/m^3);

γ' = Submerged unit weight of soil above groundwater table, ($\gamma_{sat} - \gamma_w$) in kN/m^3;

q = Value of Surcharge (kPa)

Where the backfill is effectively drained to eliminate hydrostatic pressure on the wall the equation is simplified to:

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

The suggested soil parameters (unfactored) for the retaining wall design and/or ground support systems are summarized below.

SOIL TYPE	UNIT WEIGHT γ (KN/M^3)	EFFECTIVE ANGLE OF INTERNAL FRICTION (Φ')	COEFFICIENT OF EARTH PRESSURE		
			ACTIVE K_A	AT REST K_O	PASSIVE K_P
Granular A	22	35	0.27	0.43	3.69
Granular B	21	32	0.31	0.47	3.25
Non-Cohesive Deposits	19	30	0.33	0.50	3.00

Backfilling of the footing wall excavations is recommended to be placed in 200 mm thick lifts, uniformly compacted to 98% SPMDD to proposed sub-grade elevations.

5.8 TEMPORARY EXCAVATIONS AND GROUNDWATER CONTROL

The details for the proposed services installations are not available at the time of preparing this report. The recommendations provided below assume that conventional depths for services will be carried out (approximately three to four mbgs).

Based upon the subsurface conditions at the borehole locations, excavations can be carried out with heavy hydraulic back-hoes. It is recommended that provision be carried in the contract for the excavation and disposal of obstructions on site, including cobbles and boulders.

All temporary excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). In accordance with OHSA, the deposits (assuming they are above the groundwater table or properly dewatered) would be classified as a Type 3 soil. If space limitations exist due to adjacent structures or facilities, consideration could be given to the construction of a temporary support system to provide protection to the structures and/or facilities. All excavated spoil should be placed at least the depth of the trench away from the edge of the trench for safety reasons.

As noted above, seepage in the form of wet samples were encountered below a depth of 1.5 mbgs and water was measured as high 2.2 mbgs (BH19-4) in the standpipes installed at the site. We further stress that the groundwater will likely rise during the spring and fall seasons. As such and depending upon the season of construction, it is likely that dewatering will be required at the site and an Environmental Activity and Sector Registry (EASR) or a Permit to Take Water (PTTW) will be required for the underground parking and service excavations.

Daily water takings of 50 m3/day require registration of the MECP EASR database, and daily water takings of 400 m3/day require a PTTW. Both the EASR and the PTTW require a hydrogeological assessment report to support the specific application. In addition, a permit to discharge the collected water to the sewer system/water body will be required from the applicable agency. A PTTW application requires a minimum of 90 days for the MOECC to process; in this regard, appropriate lead time should be factored into the overall project schedule to accommodate the PTTW process, if required.

In any areas requiring dewatering, the groundwater table must be lowered a minimum of one (1) meter below the lowest excavation level. A specialized dewatering contractor should be retained to design and install the dewatering system.

5.9 PIPE BEDDING AND COVER

The soils above the groundwater level or properly dewatered soil, where excavations are extended below the groundwater level, will provide adequate support for the sewer pipes and allow the use of normal Class B type bedding. The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, must be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered, especially when the soil at the trench base level consists of wet, dilatant silt.

The bedding material should consist of well graded granular material such as Granular ‘A’ or equivalent. The bedding material should be compacted to at least 95 percent of its SPMDD. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local authority or municipality, should be placed. It is recommended that WSP be on site during excavations to assess the suitability of the subgrade materials to support the pipes.

If localized wet trench conditions are encountered, a uniformly graded clear stone may be used provided a suitable, approved filter fabric (geotextile) is placed in conjunction with the clear stone. The geotextile must extend underneath the clear stone, along the sides of the trench, and wrapped on top of the clear stone such that **the clear stone is fully wrapped by the geotextile.** A minimum geotextile overlap of 1 m is required; alternatively stitching of the geotextile could be considered. **WSP should be on site on a full-time basis if this method is being considered.**

Localized, wet and unstable soils encountered within generally stable soil zones can be generally stabilized by ‘punching’ a 50 mm well graded crusher run limestone pad into the soft subgrade prior to bedding placement. The thickness of the ‘pad’ will depend on field conditions and should be examined by WSP personnel during the construction operations.

5.10 TRENCH BACKFILL

The excavated native soils can be used as construction backfill provided their moisture content at the time of placement is within 2% of the optimum moisture content. Boulders or cobbles greater than 200 mm in size should be removed from the trench backfill. Portions of the fill / reworked soils contained organic materials; any soils with organics should not be used as trench backfill.

For the non-cohesive soils, smooth drum type vibratory rollers are recommended. Cohesive soils, if encountered or imported to the site for fill, should be compacted with sheepsfoot type vibratory compactors. The trench backfill should be placed in maximum 0.3 m lift thickness and compacted to at least 98 percent of its SPMDD. Trench backfilling operations should be avoided during freezing weather.

It is preferable that the native soils be re-used from approximately the position at which they are excavated so that frost response characteristics of the soils after construction remain essentially similar. If required, consideration may also be given to backfilling trenches with a well graded, compacted granular soil such as Granular ‘B’ material.

It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for the compaction requirements noted above. Stockpiles should therefore be covered with tarpaulins to help minimize moisture increases.

5.11 PRELIMINARY PAVEMENT DESIGN

The investigation has shown that the predominant subgrade soils encountered at the site, after stripping any fill, will be non-cohesive sand and silt or possibly compacted fill.

Prior to the placement of granular materials as part of the pavement structure, the subgrade should be prepared and heavily proof-rolled under the supervision of WSP. Any poorly performing areas should be sub-excavated and replaced with either granular earth fill approved by WSP or imported Granular B, Type I material conforming to the requirements of OPSS.

Based on the above, the following minimum pavement thickness is recommended:

PAVEMENT LAYER	COMPACTION REQUIREMENTS	DRIVEWAY	PARKING
Asphaltic Concrete	92.0 to 96.5% Maximum Relative Density (MRD)	40 mm HL 3	
		50 mm HL 4 / HL 8	50 mm HL 4
OPSS Granular A Base	100% SPMDD	150 mm	150 mm
OPSS Granular B	100% SPMDD	300 mm	300 mm

We note that the pavement design noted above should be considered preliminary only. If required, a more refined pavement structure design can be performed based on specific traffic data and design life requirements and will involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific data input from the client.

5.12 INFILTRATION CHARACTERISTICS

Graphical depiction of the laboratory grain size analyses performed on a sample recovered from the borehole advanced within the proposed infiltration and a sample of the silty sand are provided on ***Enclosures 5 and 7 – Laboratory Analyses***. Based on the gradation results, the material encountered is tabulated below.

MATERIAL	BOREHOLE SAMPLE	PERCOLATION TIME PERMEABILTY (min/cm)
Sand and Gravel Fill	BH19-4, Sample 2	5 to 10
Silty Sand	BH19-2, Sample 3	10 to 20

We note that the Percolation Time (“T” time) or Permeability of the subsoil sampled was estimated. The materials, as defined in the Ministry of the Environment Manual of Policy, Procedures and Guidelines for Onsite Sewage Systems, in the appendices 6.3.1 and 6.3.2, mostly resemble sand and gravel with Medium Permeability or sand silt with Medium to Low Permeability.

We must state that these values are strictly for an unsaturated sample.

The value is solely based on the grain size distribution analysis shown in appendices 6.3.1 and 6.3.2 in the Ministry of the Environment Manual of Policy, Procedures and Guidelines for Onsite Sewage Systems. Furthermore, the estimates provided is indicative of the sample in a disturbed state only. We must emphasize that factors between boreholes such as, but not limited to, structure, consistency, density, organic content and degree of saturation influence the estimates.

An accurate analysis of soil infiltration characteristic is best determined with on-site permeameter testing at the location and level of the proposed infiltration condition.

5.13 DESIGN REVIEW, TESTING AND INSPECTIONS

WSP requests to be afforded the opportunity to complete a final review of the proposed development discussed in this report to verify that geotechnical recommendations are appropriate. If not given this opportunity, we cannot assume liability for omissions, misinterpretations or deficiencies in our recommendations.

WSP should be contacted to provide geotechnical testing and inspections during construction operations. Exposed subgrade soils for all structures are to be inspected to confirm the material is stable and competent. Inspections of seepage and groundwater conditions during construction are also required, as discussed in this report. Testing and inspections for general QA/QC are to include sampling and laboratory testing of fill materials and asphalt, compaction testing for the placement of fill materials and asphalt, and field and laboratory testing of concrete (including mix design reviews).

DRAWINGS

FIGURE 1: SITE LOCATION PLAN
FIGURE 2: BOREHOLE PLAN

NOTE: BASE PLAN OBTAINED FROM COUNTY OF SIMCOE MAPS, 2017.

561 BRYNE DRIVE, UNITS C & D
BARRIE, ONTARIO CANADA L4N 9Y3
TEL.: 705-735-9771 | FAX: 705-735-6450 | WWW.WSP.COM

PROJECT:
GEOTECHNICAL INVESTIGATION,196 BURTON AVENUE, BARRIE, ONTARIO

CLIENT:
655423 ONTARIO INC.

TITLE:
SITE LOCATION PLAN

SCALE:
1: 6000

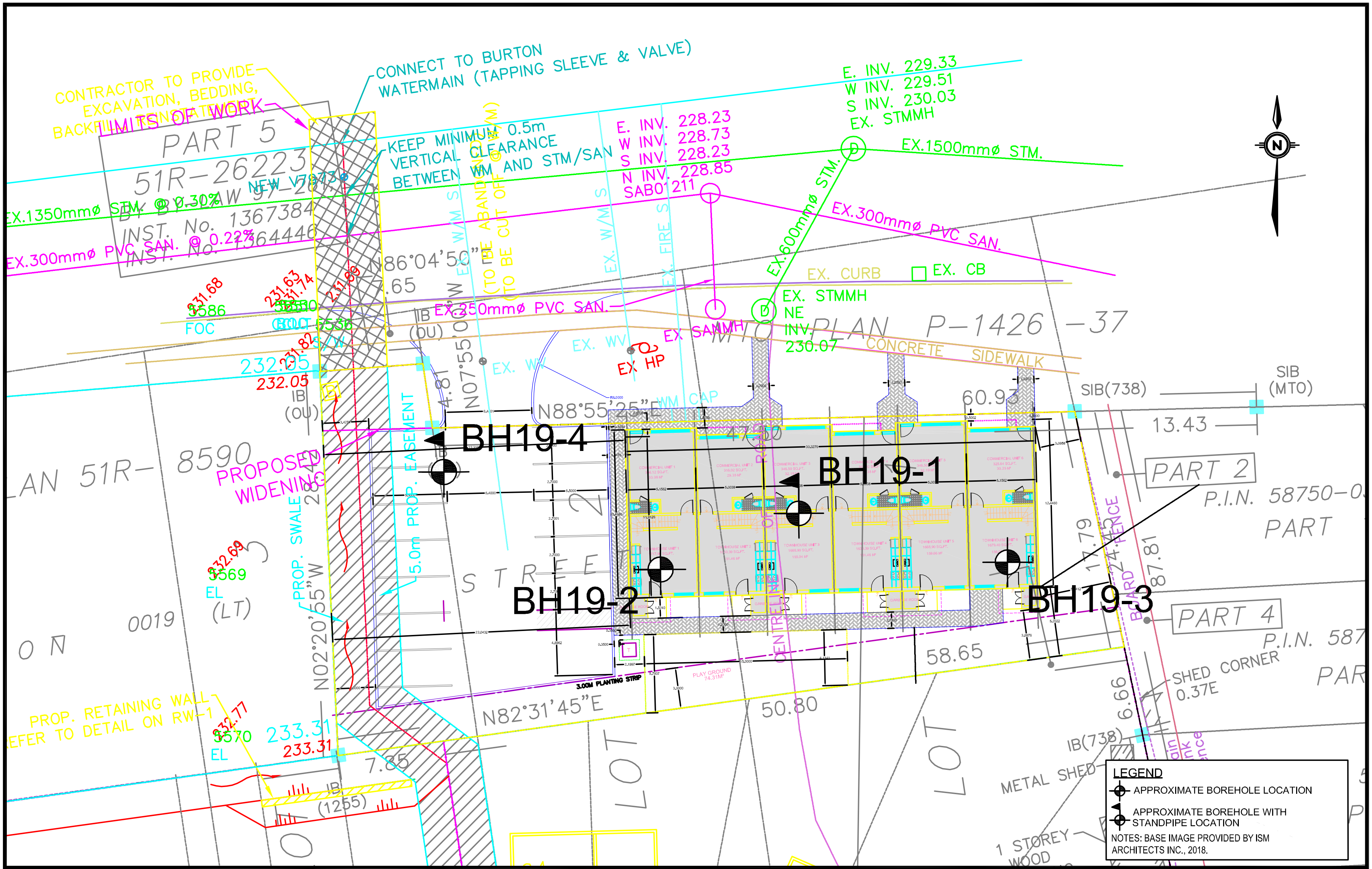
DATE:
FEBRUARY / 2019

PROJECT NO:
181-17106-00

FIGURE NO:
1

REV. #

K:\PROJECTS\2018\181-17106-00 196 burton ave\SITE LOCATION PLAN_181-17106-00.dwg Feb 11, 2019-10:52am BY:(kaurel.tamasauskas)



wsp

561 BRYNE DRIVE, UNITS C & D
BARRIE, ONTARIO CANADA L4N 9Y3
TEL.: 705-735-9771 | FAX: 705-735-6450 | WWW.WSP.COM

PROJECT:
GEOTECHNICAL INVESTIGATION, 196 BURTON AVENUE, BARRIE, ONTARIO

CLIENT:
655423 ONTARIO INC.

TITLE:
BOREHOLE LOCATION PLAN

SCALE:
1:400

DATE:
FEBRUARY / 2019

PROJECT NO:
181-17106-00

FIGURE NO:
2

REV. #

K:\PROJECTS\2018\181-17106-00 196 burton ave\BH PLAN_181-17106-00_196 burton ave.dwg Feb 11, 2019-9:52am BY:(kaurel.tamasauskas)

ENCLOSURES

ENCLOSURES 1 - 4: BOREHOLE LOGS
ENCLOSURES 5 - 7: LABORATORY ANALYSES

LOG OF BOREHOLE 19-1

PROJECT: 196 Burton Avenue

REF. NO.: 181-17106-00

CLIENT: Melchoir

Method: Solid Stem Auger

ENCL NO.: 1

PROJECT LOCATION: Barrie, Ontario

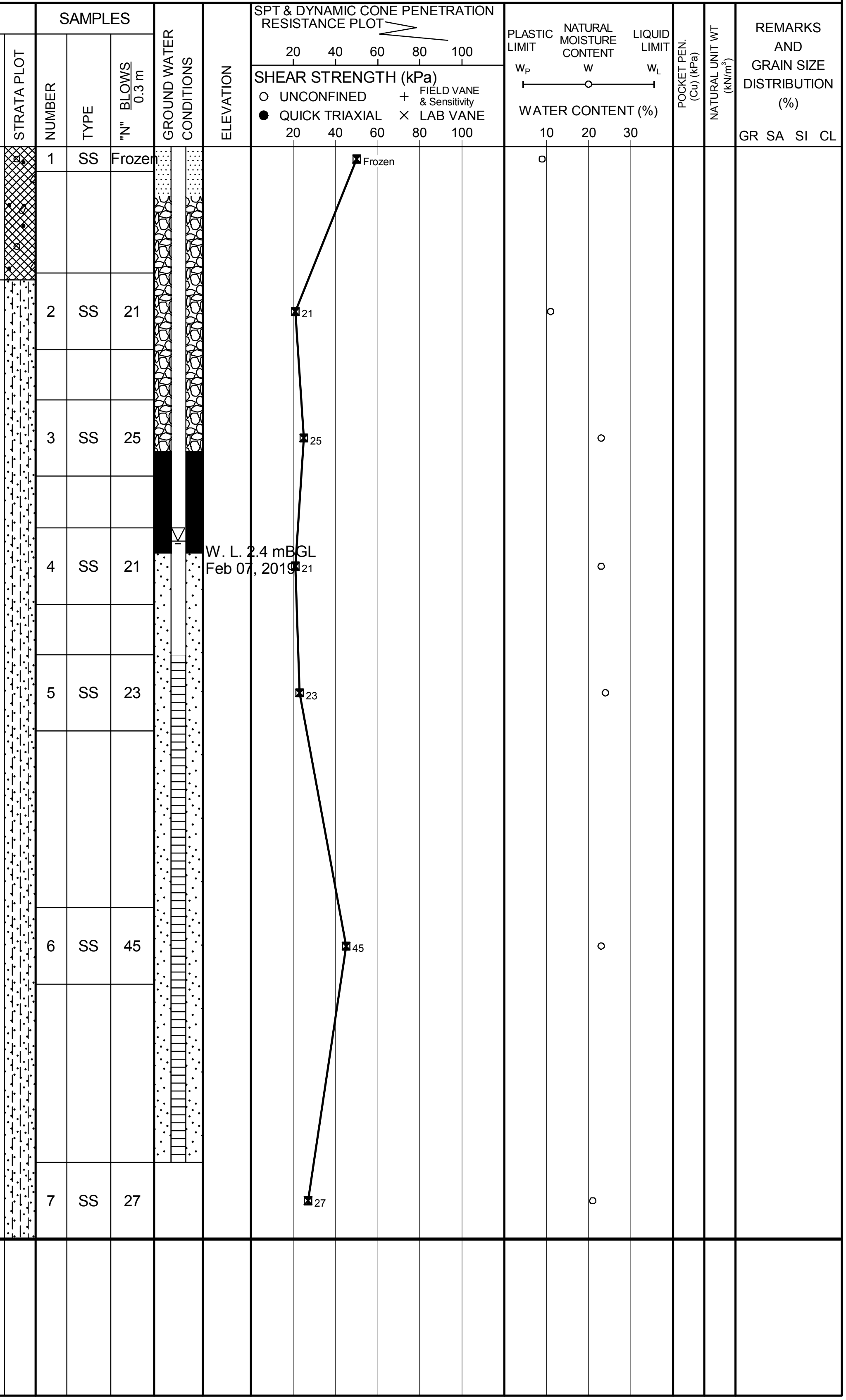
Diameter: 100 mm

DATUM: Relative

Date: Feb/01/2019

BH LOCATION: See Figure 1

(m) ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m
	Ground Surface			
0.0	**LIMESTONE CRUSHER FILL** *frozen*, grey, moist	1	SS	Frozen
0.8	**SILTY SAND** trace gravel, brown, moist, compact to dense	2	SS	21
		3	SS	25
	Becoming wet			
		4	SS	21
		5	SS	23
		6	SS	45
		7	SS	27
6.6	End of Borehole Note 1: Borehole caved at 4.9 meters below ground surface (mbgs) with water measured in the open borehole at 3.7 mbgs 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 19-2

PROJECT: 196 Burton Avenue

REF. NO.: 181-17106-00

CLIENT: Melchoir

Method: Solid Stem Auger

ENCL NO.: 2

PROJECT LOCATION: Barrie, Ontario

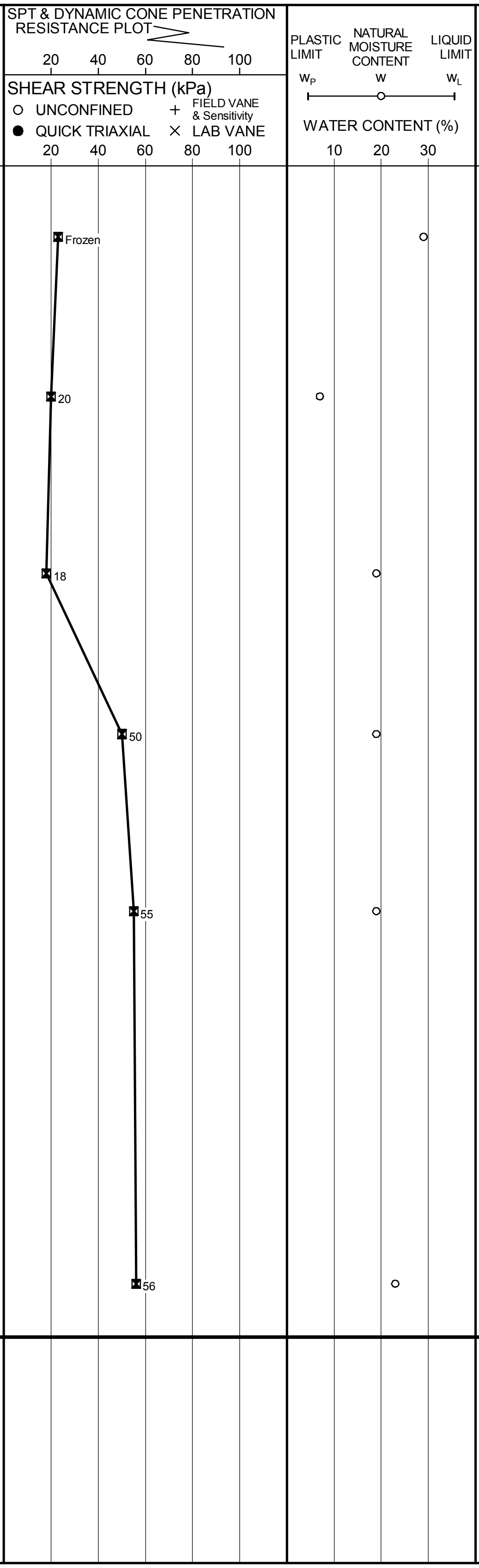
Diameter: 100 mm

DATUM: Relative

Date: Feb/01/2019

BH LOCATION: See Figure 1

SOIL PROFILE			SAMPLES									REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	SPT & DYNAMIC CONE PENETRATION RESISTANCE PLOT	WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	GR	SA	SI	CL
	Ground Surface														
0.0	**TOPSOIL** *frozen*, dark brown, wet														
0.3	**SILTY SAND FILL** some gravel, brown, moist, compact		1	SS	Frozen			Frozen							
			2	SS	20			20							
1.2	**SILTY SAND to SAND and SILT** trace gravel, brown, wet, compact to very dense		3	SS	18			18				3	77	(20)	
			4	SS	50			50							
			5	SS	55			55							
			6	SS	56			56							
5.0	End of Borehole Note 1: Borehole caved at 4.0 meters below ground surface (mbgs) with water measured in the open borehole at 3.7 mbgs upon completion of drilling.														



GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

$+^3, \times^3$: Numbers refer to Sensitivity

○ ^{8}=3% Strain at Failure

LOG OF BOREHOLE 19-3

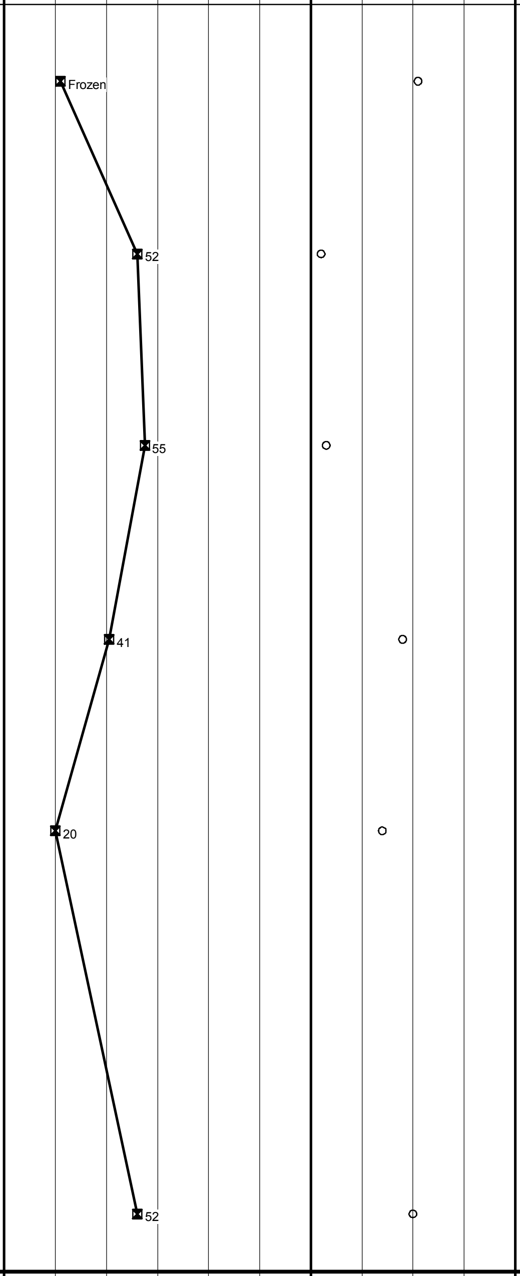
PROJECT: 196 Burton Avenue
REF. NO.: 181-17106-00
CLIENT: Melchoir
Method: Solid Stem Auger
ENCL NO.: 3
PROJECT LOCATION: Barrie, Ontario
Diameter: 100 mm
DATUM: Relative
Date: Feb/01/2019
BH LOCATION: See Figure 1

(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m	GR	SA	SI	CL
	Ground Surface							
0.0	**TOPSOIL** *frozen*, dark brown, wet							
0.3	**SANDY GRAVEL FILL** brown, moist, very dense	1	SS	Frozen				
		2	SS	52				
1.4	**SAND** some gravel, trace silt, brown, dry, very dense	3	SS	55	15	77	(8)	
2.1	**SILTY SAND** trace gravel, brown, wet, compact to very dense	4	SS	41				
		5	SS	20				
		6	SS	52				
5.0	End of Borehole Note 1: Borehole caved at 3.0 meters below ground surface (mbgs) with water measured in the open borehole at 3.0 mbgs upon completion of drilling.							

SPT & DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100
SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × 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/m^3)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)



GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

WSP-SOIL-ROCK-MAY-29-2017.GLB
WSP SOIL LOG-SPT & DCPT PLOT-120 MAX 196 BURTON BH LOGS (DD).GPJ 11/2/19

LOG OF BOREHOLE 19-4

1 OF 1

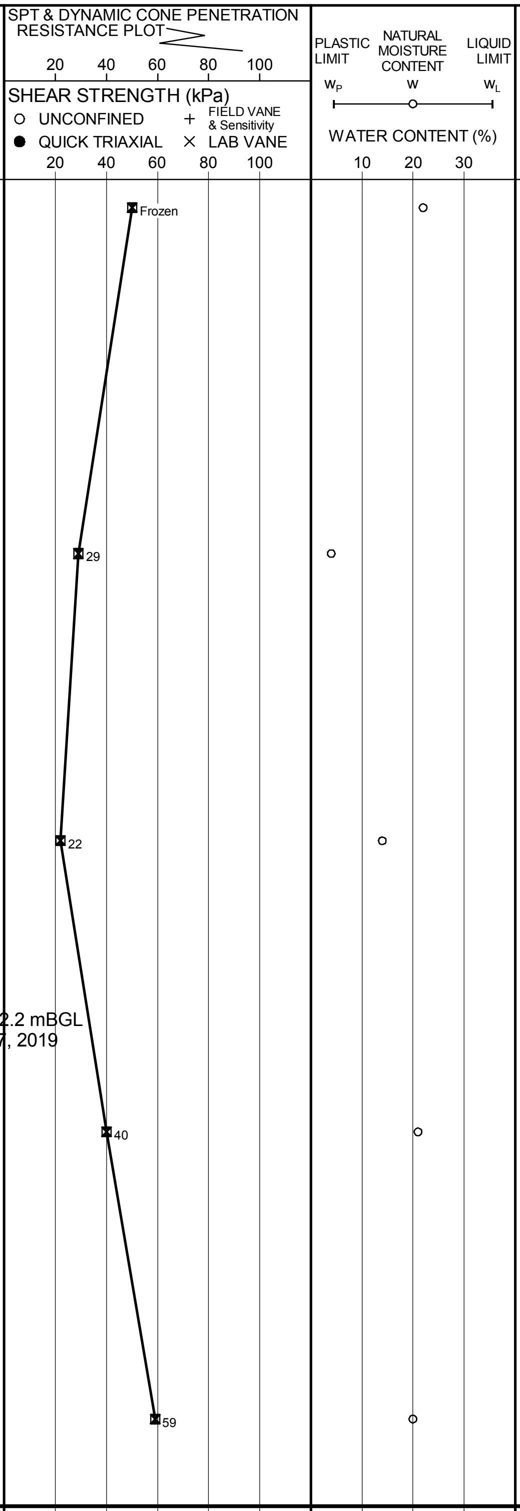
PROJECT: 196 Burton Avenue
CLIENT: Melchoir
PROJECT LOCATION: Barrie, Ontario
DATUM: Relative
BH LOCATION: See Figure 1

Method: Solid Stem Auger
Diameter: 100 mm
Date: Feb/01/2019

REF. NO.: 181-17106-00
ENCL NO.: 4

SOIL PROFILE		SAMPLES			REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m	GR SA SI CL
	Ground Surface				
0.0	**SILTY SAND FILL** *frozen*, some gravel, brown, wet	1	SS	Frozen	
0.6	**SAND and GRAVEL FILL** trace silt, brown, moist, compact	2	SS	29	38 53 (9)
1.4	**SILTY SAND** brown, moist, compact to very dense	3	SS	22	
	Becoming wet	4	SS	40	
		5	SS	59	
3.5	End of Borehole Note 1: Borehole caved at 2.7 meters below ground surface (mbgs) with water measured in the open borehole at 2.1 mbgs upon completion of drilling.				

W. L. 2.2 mBGL
Feb 07, 2019



POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

GROUNDWATER ELEVATIONS

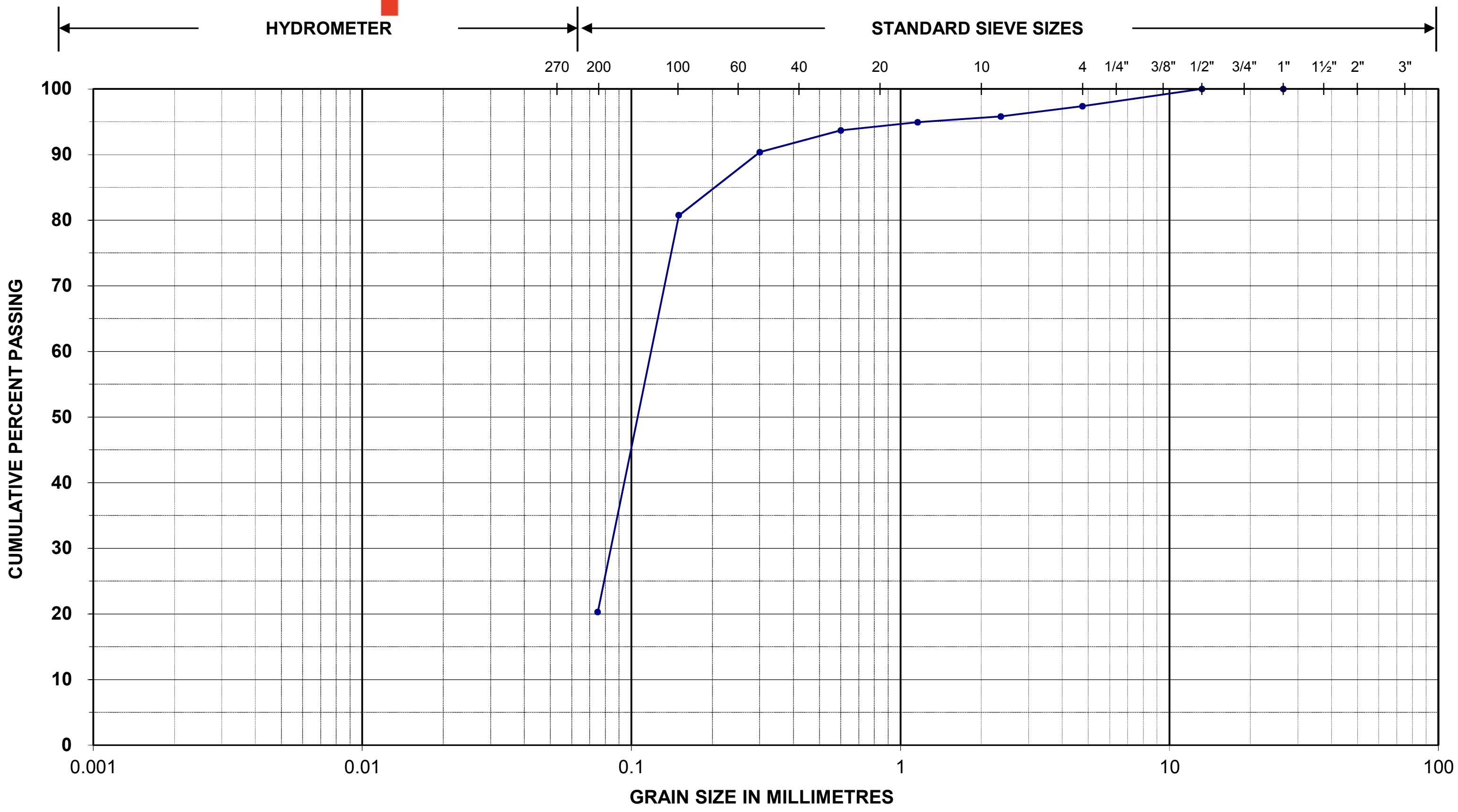
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity

○ ^{8}=3% Strain at Failure

WSP-SOIL-ROCK-MAY-29-2017.GLB
WSP SOIL LOG-SPT & DCPT PLOT-120 MAX 196 BURTON BH LOGS (DD).GPJ 11/2/19

PARTICLE SIZE DISTRIBUTION



Unified Classification System

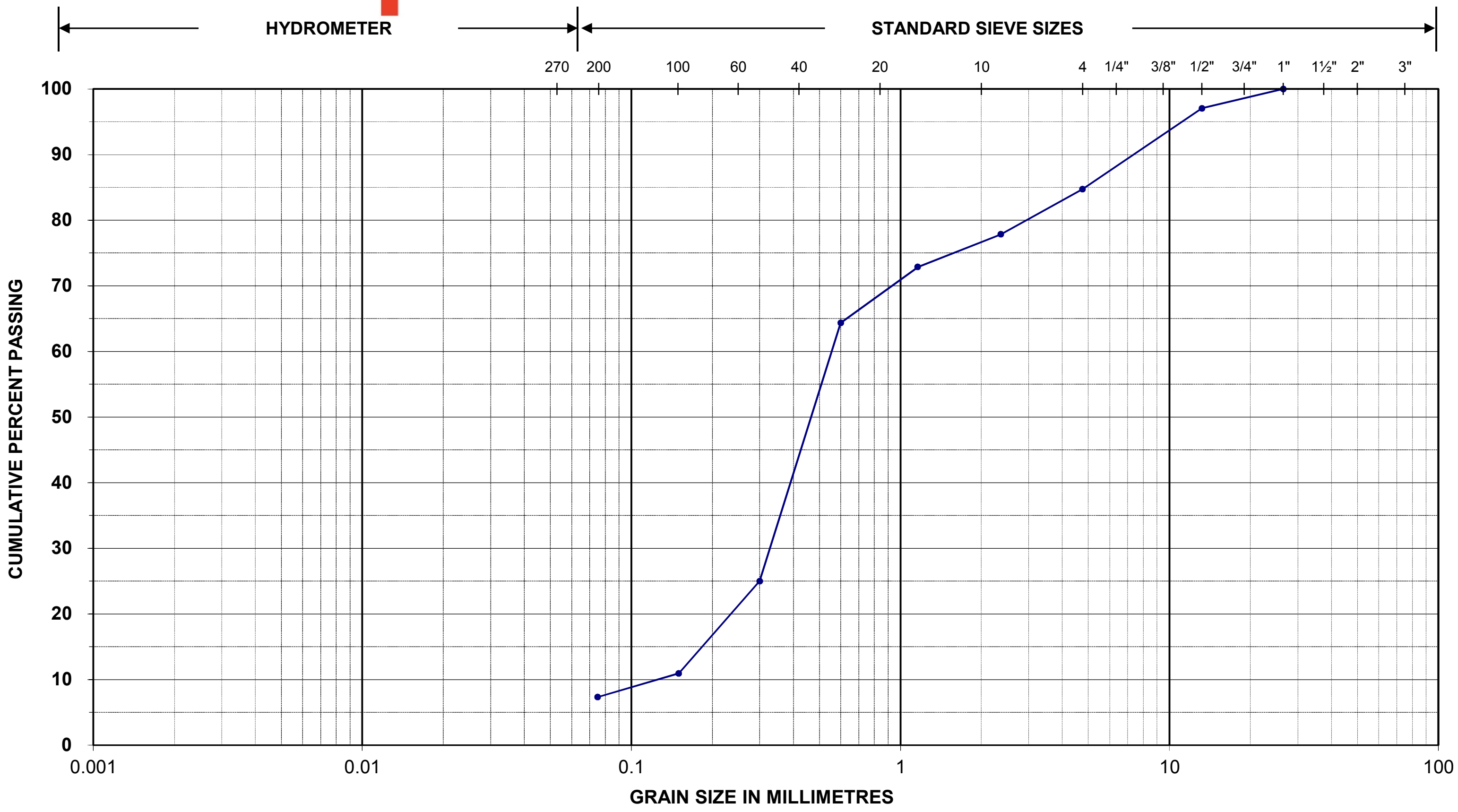
SILT AND CLAY	SAND	GRAVEL

Project Name:	196 Burton Avenue	**Project No.:**	181-17106-00
Location ID.:	BH19-2	**Sample No./Depth:**	SS3 / 1.5-2.0 m

Sieve Size	% Passing Coarse	**Sieve Size**	% Passing Fine
37.5 mm	100.0	**1.16 mm**	94.9
26.5 mm	100.0	**0.60 mm**	93.7
13.2 mm	100.0	**0.30 mm**	90.4
4.75 mm	97.4	**0.15 mm**	80.8
2.36 mm	95.8	**0.075 mm**	20.3

Enclosure No.: 5

PARTICLE SIZE DISTRIBUTION



Unified Classification System

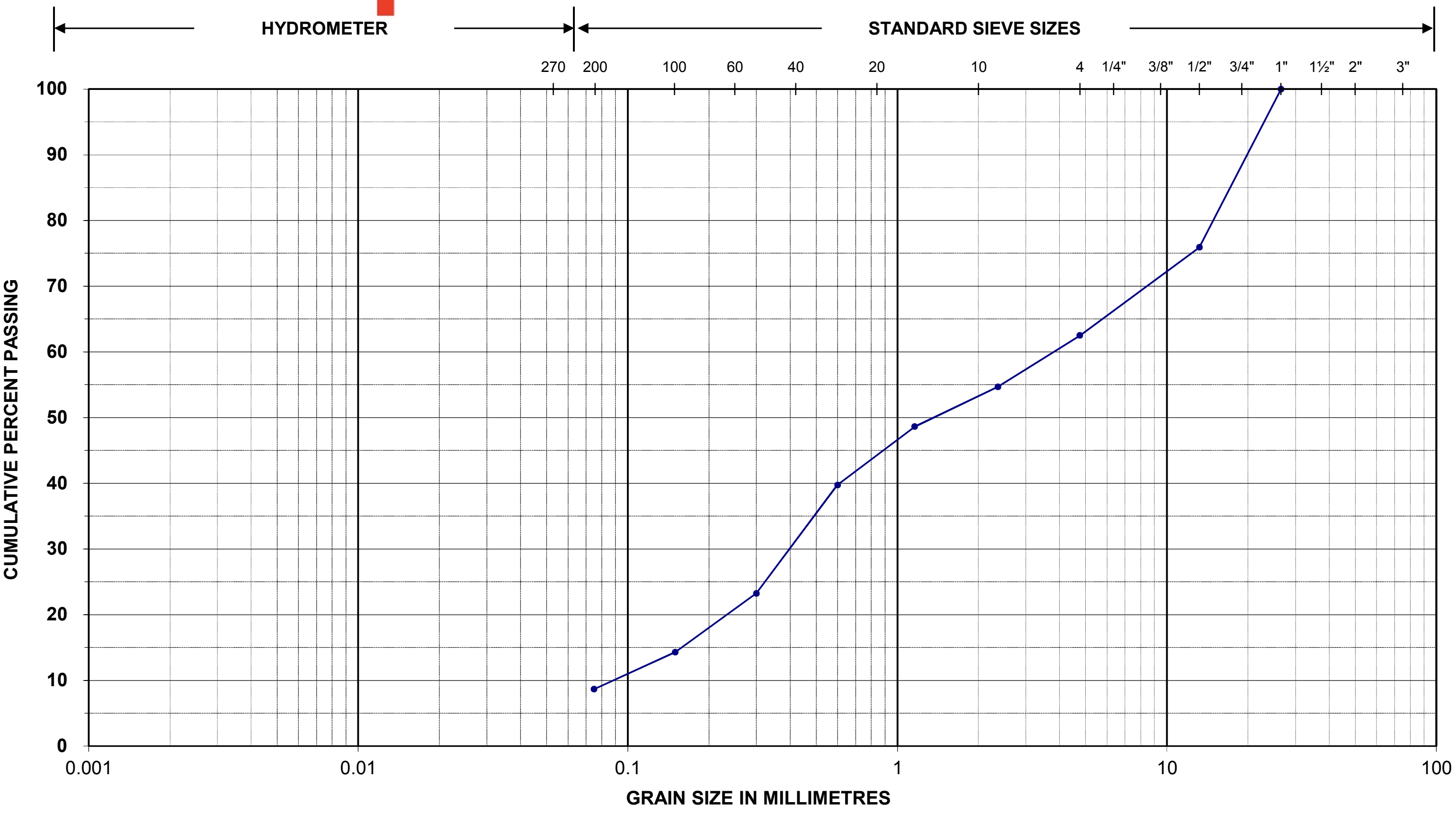
SILT AND CLAY	SAND	GRAVEL

Project Name:	196 Burton Avenue	**Project No.:**	181-17106-00
Location ID.:	BH19-3	**Sample No./Depth:**	SS3 / 1.5-2.0 m

Sieve Size	% Passing Coarse	Sieve Size	% Passing Fine
37.5 mm	100.0	**1.16 mm**	72.9
26.5 mm	100.0	**0.60 mm**	64.4
13.2 mm	97.1	**0.30 mm**	25.0
4.75 mm	84.7	**0.15 mm**	10.9
2.36 mm	77.9	**0.075 mm**	7.3

Enclosure No.: 6

PARTICLE SIZE DISTRIBUTION



Unified Classification System

SILT AND CLAY	SAND	GRAVEL

Project Name: 196 Burton Avenue **Project No.:** 181-17106-00

Location ID.: BH19-4 **Sample No./Depth:** SS2 / 0.8-1.2 m

Sieve Size	% Passing Coarse	Sieve Size	% Passing Fine
37.5 mm	100.0	**1.16 mm**	48.6
26.5 mm	100.0	**0.60 mm**	39.8
13.2 mm	75.9	**0.30 mm**	23.2
4.75 mm	62.5	**0.15 mm**	14.3
2.36 mm	54.7	**0.075 mm**	8.7

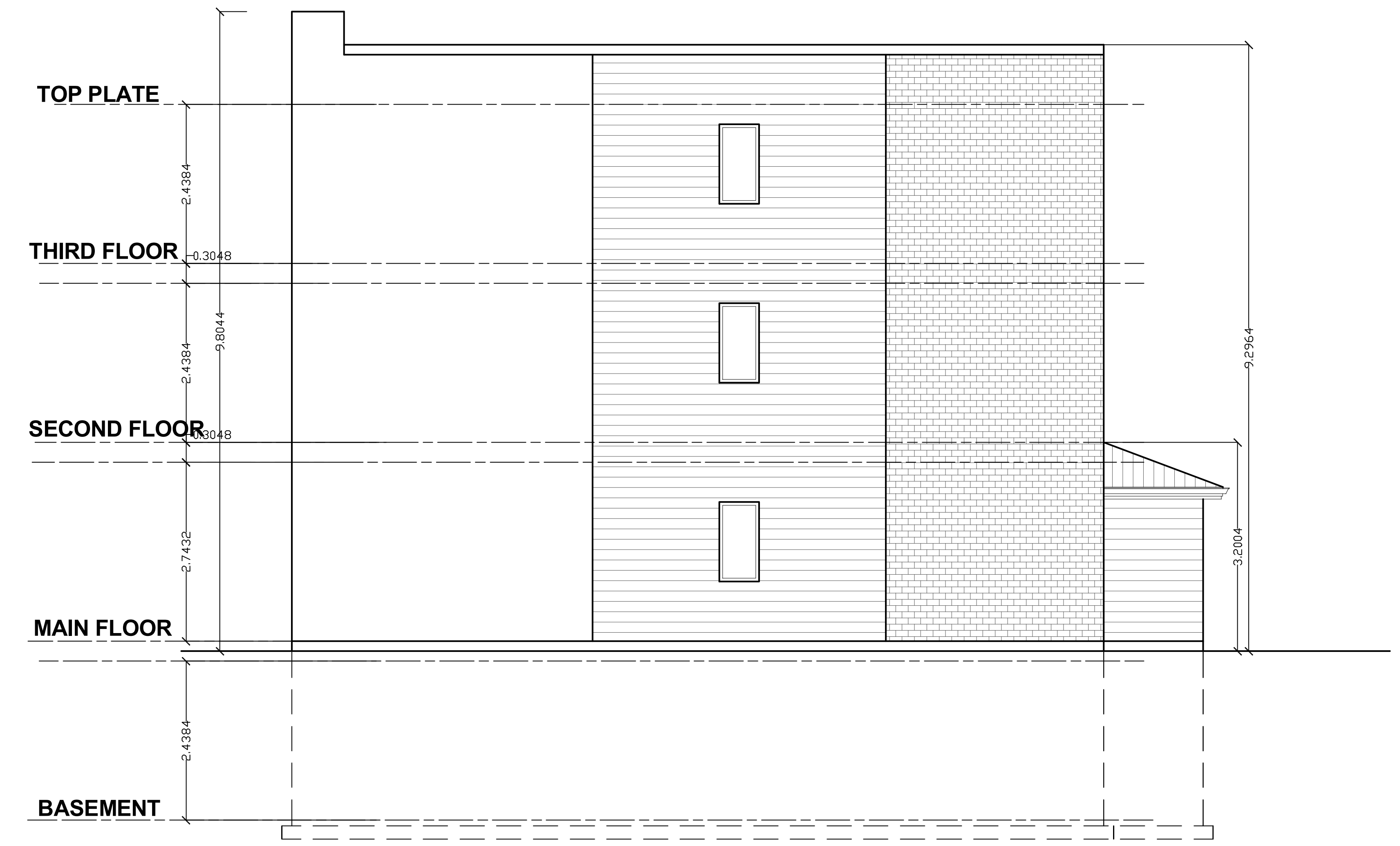
Enclosure No.: 7

APPENDIX

A

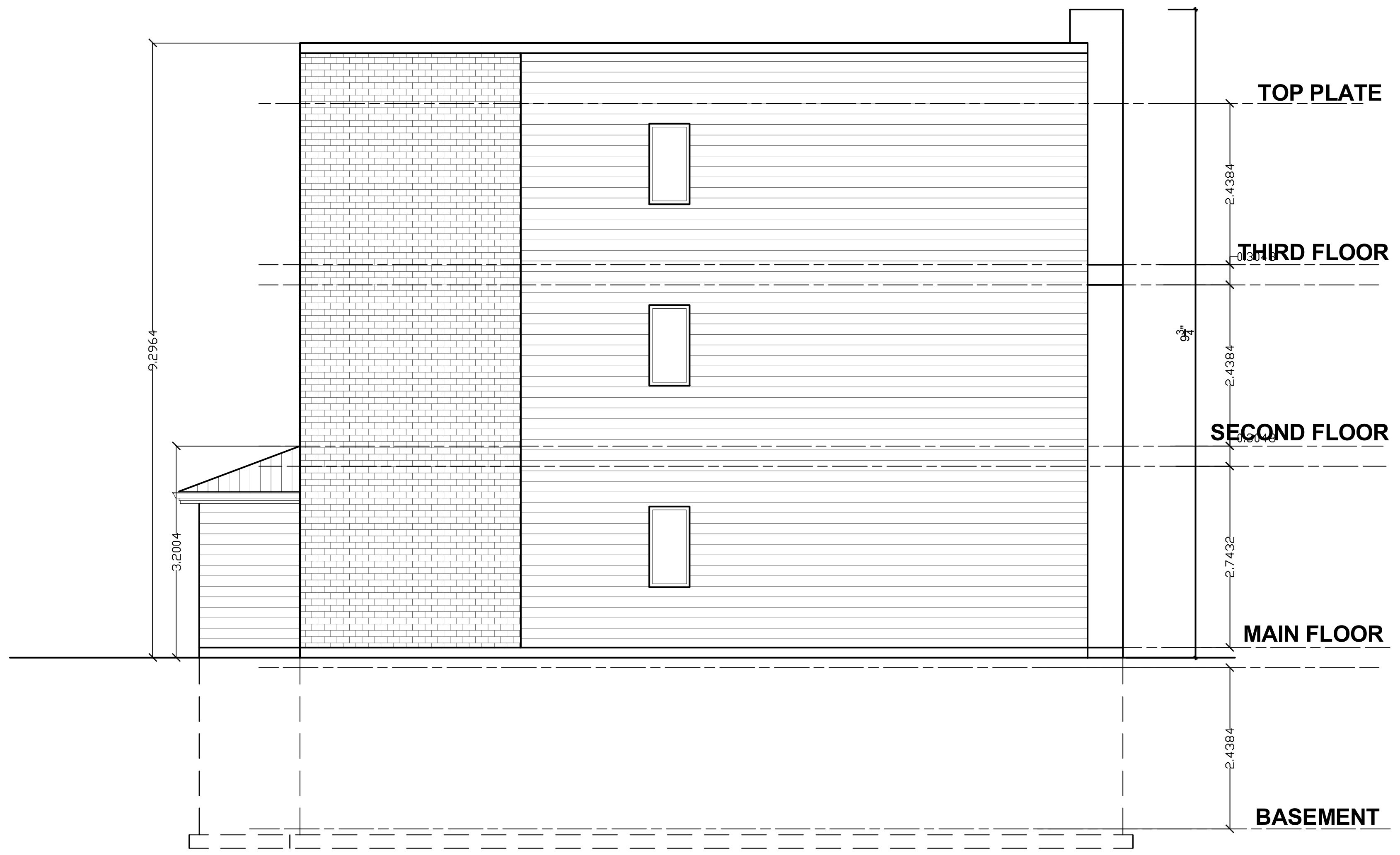
ISM ARCHITECTS PRELIMINARY CONCEPT PLANS

FRONT (NORTH) ELEVATION



SIDE (WEST) ELEVATION

REAR (SOUTH) ELEVATION



SIDE (EAST) ELEVATION

SCALE: 1:75

ISM ARCHITECTS INC.
97 Toronto St.
Barrie, ON L4N 1V1
T: 705.726.2342 E: ian@ismarchitects.ca

No.	ISSUE/ REVISION	DATE
1	ISSUE FOR REVIEW	JUL.12.2018
2	TOWNHOUSE CONVERTION	AUG.08.2018
3	PRE SPC SUB'M	AUG.22.2018
4	CHANGE TO 6 UNITS	NOV.06.2018

STAMP

ONTARIO ASSOCIATION OF ARCHITECTS
IAN S. MALCOLM
LICENCE
2853

Do not scale drawings.
The Contractor shall check and verify all dimensions and report all errors and omissions to the Architect before proceeding with the work.
A Detail No.
B Sheet No. where detailed.

ORIENTATION

CLIENT
655423 LTD.
DINO MELCHIOR
JOHN VELINGA

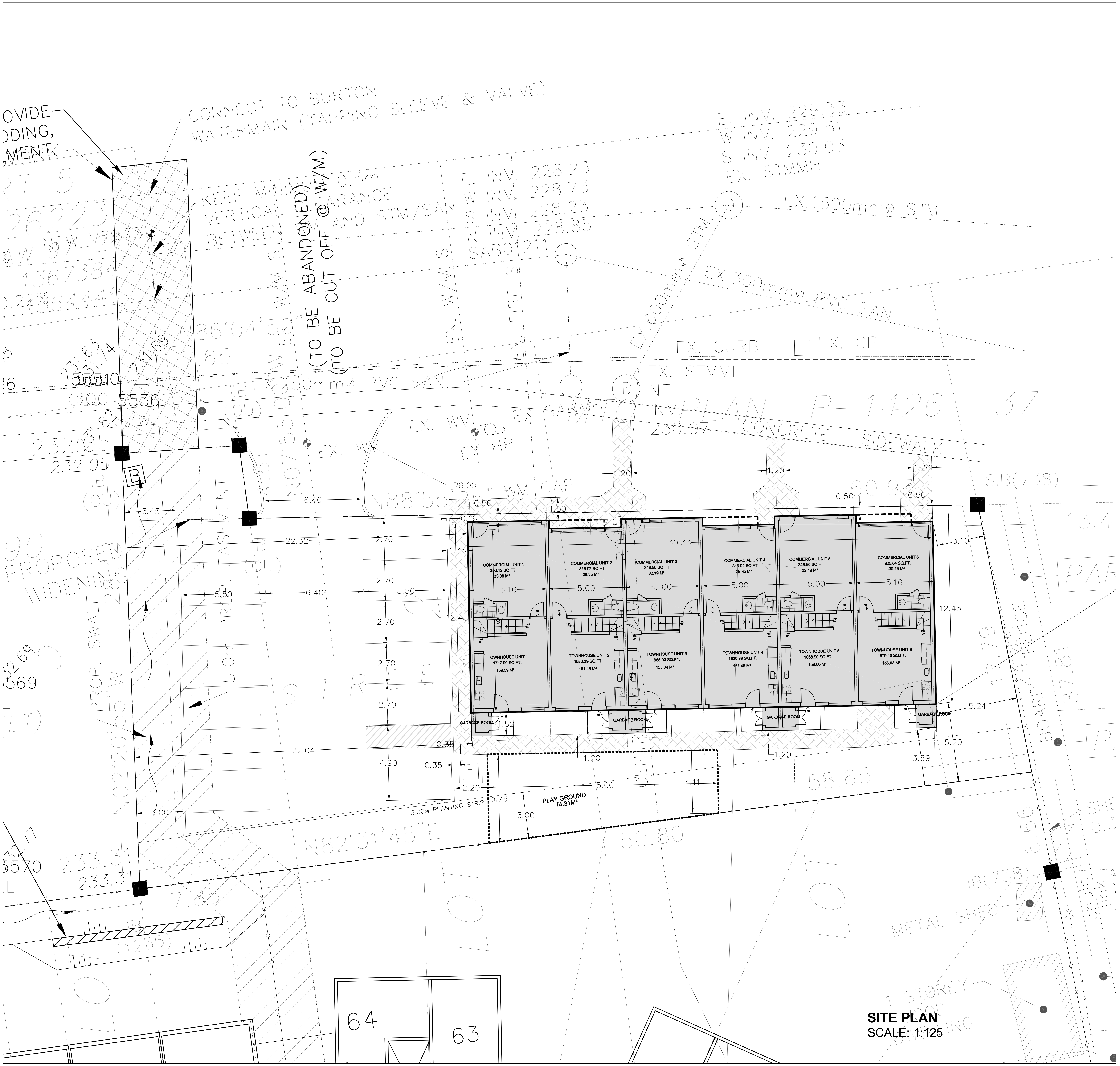
PROJECT
6 LIVE WORK TOWNHOUSES 196 BURTON AVE. BARRIE, ON.

PROJECT INFORMATION

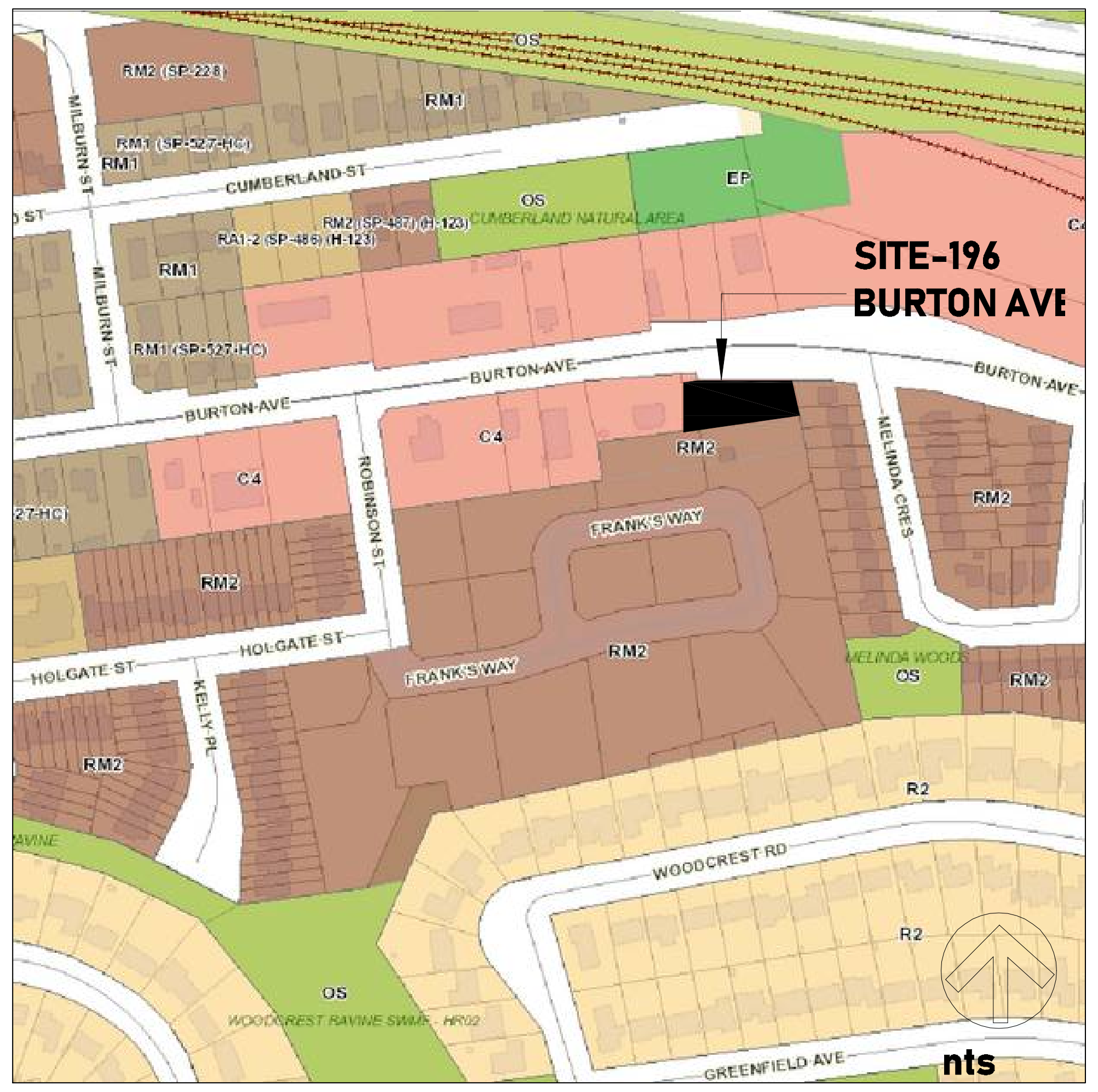
PROJECT No.: 184007
DRAWN BY: NI
CHECKED BY: ISM
DATE: 07.11.2018
SCALE: AS NOTED

DRAWING
ELEVATIONS

DRAWING No.
A300



SITE PLAN
SCALE: 1:125



STANDARDS			
	REQUIRED BY BY-LAW (C4)	REQUIRED BY BY-LAW (MU2)	PROPOSED
LOT AREA (min.)	450 m²	-	1224.38 m² Before widening 1188.21 m² After Widening
LOT FRONTAGE (min.)	15 m	-	55.6 m
FRONT YARD (min.)	6 m	1 m for 75% frontage (min.) 5 m for 25% frontage (max.)	0.5 m
WEST INTERIOR SIDE YARD (min.)	3 m	3 m (max.)	22.04 m
EAST SIDE YARD ABUTTING RESIDENTIAL (min.)	6 m	3 m	3.10 m
REAR YARD ABUTTING RESIDENTIAL (min.)	10 m	7 m	5.20 m 3.69 m
NUMBER OF UNITS	-	-	6
COMMERICAL GROSS FLOOR AREA (min. % of GFA)	20%	50%	186.43 m² - 20.07%
GROSS FLOOR AREA	-	1326.7 m²	928.64 m²
DWELLING UNIT AREA (min.)	35m²+10m² /bedroom	35m²+10m²/bedroom	4 Bedroom: >151.45m²
LOT COVERAGE (max.)	50%	-	386.92 m² 32.56% After Widening
LANDSCAPING (min.)	-	-	-
G.F.A. (max.)	-	-	928.64 m² Residential 186.43 m² Commercial Total: 1115.07m²
STREET LEVEL FLOOR HT. (min.)	-	4.5 m	3.05 m
AMENITY AREA (min.)	12m²/unit (72m²)	12m²/unit (72m²)	74.31m²
BUILDING HEIGHT (min.)	9 m (abutting res,) 14 m (standard)	7.5 m (min.)/ 16.5 m (max.) 25.5 m (max.) with ground floor commercial	8.54 m
PARKING (min.)	1/24m² of GFA = 8 spaces 1/unit = 6spaces Total - 14 spaces (incl. 1 Type A barrier-free space)	1/24 m² of GFA = 8 spaces 1/unit = 6 spaces Total - 14 spaces (incl. 1 Type A barrier-free space)	13 spaces (incl. 1 Type A barrier-free space
DRIVE AISLE WIDTH (min.)	6.4 m	6.4m	6.4m
BARRIER FREE (min.)	1 Type A @ 3.4mx5.5m Each B.F. space shall contain a 1.5m access aisle	1 Type A @ 3.4mx5.5m Each B.F. space shall contain a 1.5m access aisle	1 Type A @ 3.4mx5.5m C/W a B.F. access aisle of 1.5m in width
LANDSCAPED BUFFER STRIP	3 m landscaped buffer & 2 m high tight board fence abutting res. zone	3 m landscaped buffer & 2 m high tight board fence abutting res. zone	3 m to the rear 3 m to the west 3 m to the east 2m fence around rear & eas
FENCING (min.)	N/A	N/A	2m (tight board fence)

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No.	ISSUE/ REVISION	DATE
1	ISSUE FOR REVIEW	JUL.12.2018
2	TOWNHOUSE CONVERTION	AUG.08.2018
3	PRE SPC SUB'M	AUG.22.2018
4	CHANGE TO 6 UNITS	NOV.06.2018

STAMP
ONTARIO ASSOCIATION OF ARCHITECTS
IAN S. MALCOLM
LICENCE
2853

Do not scale drawings.
The Contractor shall check and verify all dimensions and report all errors and omissions to the Architect before proceeding with the work.
A Detail No.
B Sheet No. where detailed.

ORIENTATION

CLIENT
655423 LTD.
DINO MELCHIOR
JOHN VELINGA

PROJECT
6 LIVE WORK TOWNHOUSES 196 BURTON AVE. BARRIE, ON.

PROJECT INFORMATION
PROJECT No.: 184007
DRAWN BY: NI
CHECKED BY: ISM
DATE: 06.11.2018
SCALE: AS NOTED

DRAWING
SITE PLAN &
SITE STATISTICS

DRAWING No.
A100