Preliminary Stormwater Management Report, 113 & 117 Bayfield Street

Coral-Sophia Lane Housing Inc.

P/N 3103 | May 4, 2020

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

County of Simcoe
City of Barrie
113 & 117 Bayfield Street

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Preliminary Stormwater Management Report

Coral Sophia Lane Housing Inc.

113-117 Bayfield Street

P/N 17-3103 May 4, 2020

1.0 Introduction

Skelton, Brumwell & Associates Inc. (SBA) were retained by Coral Sophia Lane Housing Inc. (Coral) to prepare civil design drawings and reports for an 8–storey multi-residential rental building at the above noted address. The property is legally described as Part of Lots 9, 10, and 11 on the East Side of Bayfield Street, Registered Plan 31, in the City of Barrie, County of Simcoe. The site address is 113 & 117 Bayfield Street and 6, 8 & 12 Sophia Street East. The subject property has an approximate area of 3,729 m^2. The subject property is located on the northeast corner of Bayfield Street and Sophia Street East, and is also bounded by Drury Lane on the east side of the property.

The proposed 8–storey building will include approximately 284 m2 of amenity (lobby, lounge, and indoor amenity area), and one hundred and eight (108) residential units.

In support of the application for Zoning By–law Amendment for the property, the City of Barrie requires a Stormwater Management Report to be prepared in order to demonstrate that the proposed development can be completed in accordance with City of Barrie and Lake Simcoe Region Conservation Authority requirements.

2.0 Existing Conditions

The property currently had five (5) commercial businesses on it and two (2) entrances, onto Sophia Street East and Drury Lane, respectively. Three (3) of the businesses are serviced from Sophia Street East, and the other two (2) are serviced from Bayfield Street. There is also an existing onsite storm sewer consisting of two (2) catch basins which collect onsite drainage and convey it to the existing storm sewer on Sophia Street East. The site was cleared of the previous buildings and parking in approximately 2017 as part of the re-development an is now vacant. However, this former use will be considered to represent pre-development conditions.

The residential rear yard of the property to the north of the site drains to the site in the existing condition. This 0.6 Ha drainage area consists of approximately half of the residential roof, with the rest of the catchment consisting of grass and landscaping.

Geotechnical and Hydrogeological studies have been undertaken by WSP Group. These studies have indicated the site soils are a silty sand mix with generally low permeability. Seasonal high groundwater on the site has been noted to be shallow which has significantly influenced the design of the building to-date, precluding the inclusion of a basement for vehicular parking and building mechanical servicing.

3.0 Project Anticipated Stormwater Impacts and Controls

3.1 Quantity Control

Given that the subject property was developed for commercial use with storm sewer drainage, the net impact on stormwater quality, quantity and water balance is moderate. The overall site imperviousness will increase however and as such, stormwater detention will be required to maintain peak flows at pre-development levels.

3.2 Quality Control

Stormwater quality controls will be required to implemented in accordance with requirements of the City of Barrie (COS) and Lake Simcoe Region Conservation Authority (LSRCA) with a targeted Total Suspended Solids (TSS) removal of 80% in accordance with provincial policy. With vehicular parking indoors on the ground and second floors, the site impervious area will be largely building roof and permeable pedestrian walkways, which produce lower amounts of contaminates found in stormwater. The site will also have a stormwater filter treatment system for phosphorous control which will also be highly effective in reducing TSS. The change in land use reducing impermeable surfaces used by automobiles and addition of a stormwater treatment system will result in net cleaner runoff leaving the proposed development site than the current condition.

3.3 Water Balance

The water balance analysis for the project has been completed by WSP and summarized in their report dated May 1, 2020 (Ref Proj No: 191-04692-00). Their analysis shows a net increase in infiltration on the site of 65 cu.m./year without implementation of site-specific infiltration measures.

3.4 Phosphorous Loading

LSRCA policies call for zero net phosphorous discharge from development sites. To achieve this, several LID measures can be implemented, with infiltration being the only one that can potentially reduced phosphorous loading to zero. As discussed above however, infiltration features cannot be employed due to proximity to foundations. Instead, the site will rely on a Permeable Paving with underdrains and a Jellyfish filter system installed in an off line

configuration. This unit will treat runoff from the majority of the site and external drainage area and is rated to capture 59% of phosphorous on an annual basis.

While the project is reducing vehicular paved surfaces and replacing them with roof and permeable pedestrian surfaces, we have not conducted a comparison between existing and proposed condition as the LSRCA policy is focused on net proposed development loading. Like water balance, the LSRCA policy allows for the paying financial compensation where a net zero phosphorus export cannot be met. This compensation is calculated as follows:

Annual Phosphorous Load kg/yr x 2.5 x $35,000.00/kg/yr or simplified; $87,500.00 per Kg/yr loading.

4.0 Proposed Stormwater Management

4.1 Quantity Control

In accordance with COB policies, the existing and proposed drainage conditions for the site have been analysed using the rational method. Peak flows were calculated for the existing condition treating the development site and external area as a single composite catchment. The same approach was taken in an initial analysis of the proposed condition. Flows were both existing and proposed were calculated for the 1 in 2, 5, 10, 25, 50 and 100 year return periods using current COB IDF curve parameters that are increased from historical records by 15% to account for climate change. As expected, for all storm events, the calculated post-development peak flows are higher than pre-development. Please refer to Appendix A for calculations. The existing and proposed drainage conditions are illustrated on drawings SWM1 and SWM2 which are included with this report.

In order to control peak flows, the majority of the site will drain to a below grade detention storage system (Stormtech) installed on the north side of the site. This system will be located under the grade level amenity space and loading space. This will collect runoff from the building roof, amenity space, loading space and the external drainage area. The system will drain through a pair of orifice plates in a downstream control catch basin manhole structure, which in turn will drain via storm sewers to connect to the existing trunk sewer on Sophia Street.

The west, south and east perimeter of the site will not drain to this system, and as such the peak flows from these areas is subtracted from the existing condition flows to determine the allowable flows from detention. These calculations are detailed in Appendix A.

Sizing of the detention storage volume and control orifices was completed through iterative calculations completed with the MTO storage method. Using volume calculation spreadsheets provided by Stormtech and the orifice equation, a stage-storage rating curve for the detention

system was developed. This curve then allowed for interpolation of peak flows and storage to determine an accurate estimate of the peak flows resulting for each storm event. These calculations are detailed in Appendix B. The results are summarised in Table 1 below

Table 1 – Summary of Existing and Proposed Peak Flow Rates

Storm	Existing (cms)	Proposed Uncontrolled (cms)	Proposed Controlled (cms)	Total Proposed (cms)	Change Ext to Prop (cms)
2 year	0.073	0.010	0.040	0.050	-0.023
5 year	0.096	0.014	0.059	0.073	-0.023
10 year	0.111	0.016	0.072	0.088	-0.023
25 year	0.137	0.020	0.092	0.112	-0.025
50 year	0.154	0.024	0.104	0.128	-0.026
100 year	0.170	0.028	0.114	0.142	-0.028

As illustrated the proposed detention storage controls will effectively maintain post-development peak flows below existing condition magnitudes for all storm events analysed.

4.1.1 Detention System Description

As stated above, the site is proposed to utilize the Stormtech Detention system. In general terms, this will consist of a section of plastic pipe arches installed linearly between two catch basin manholes (CBMH). The downstream CBMH will be fitted with a 200mm diameter high and 150mm diameter low flow orifice plate to restrict discharge out of the system. Each of these orifices will drain to one of pair of vertically twined storm sewer pipes routed to the next downstream storm structure. Flows to the system will be introduced via the CBMH grates upstream and downsteam, which will collect runoff from the external drainage area, grade level amenity space and loading space. Flows from the building roof will flow to the upstream CBMH via the building storm sewer connection.

The total storage volume in the Stormtech system is made up of the space under the arches as well as the void space in the surrounding clear stone. The storage volume in the stone under the storage chambers is being ignored as flows from the downstream CBMH cannot drain into this freely.

Ignoring the base stone void space, the total volume in the system as designed is 33.5 cu.m. The calculated maximum used for the 1 in 100 year even is approximately 31 cu.m. The calculated top water level is 235.43m compared to a top of grate in the downstream CBMH of 236.11m.

4.2 Quality Control

The proposed site has a relatively low proportion of area that is considered to required quality treatment in terms of contaminates (oils, trash, suspended solids). The only exterior area subject to vehicular traffic is the loading space and driveway entrance with a total area of 143 sq.m (0.014 Ha) which amounts to about 3.8% of the total site area.

Pedestrian hardscape is included in the project; however, this is intended to be surfaced with permeable pavement with an underdrain. This will greatly reduce surface flows and will serve to trap a portion of sediment in the pavement structure itself (which will then necessitate maintenance). The under drains below the permeable pavement will be routed such that flows are directed through the downstream control device described below.

Regardless of low proportions of site area considered to generate contaminates for treatment, all noted areas and the building roof will be routed through a Jellyfish filter for treatment. The only area to completely by-pass this unit for quality control is the grassed area on the east side of the site which is not considered to produce runoff needing treatment for oils and TSS.

The Jellyfish unit has been specified primarily for phosphorous treatment but it also provides substantial treatment for TSS as well as trash and oil like a more conventional hydro-dynamic filter system. It is rated to trap in the order of 89% of TSS on an average annual basis, thus meeting requirements for quality control

As part of phosphorus treatment analysis, the proposed development site has been modelled using the Low Impact Development Treatment Train Tool (LID TTT) developed by the Ministry of the Environment, LSRCA, Toronto Region Conservation Authority and Credit Valley Conservation Authority. This tool also models the quality impact of a treatment train and for this project the result is more than 95% when accounting for TSS removal in the Jellyfish (89%) and Permeable paving (75%). This latter removal efficiency is the recommended default value for the model.

Modelling results for the LID TTT model are included in Appendix E

4.3 Permeable Paving

In order to minimize the nutrient discharge off site it was determined that exterior pedestrian areas should be designed with permeable paving. In an ideal scenario, this paving would be designed to infiltrate at least the first flush (25mm) rainfall event for both water balance and nutrient management. Instead, due to the proximity to the foundation, this project will include an under drain below the permeable paving to collect infiltrating runoff and convey it to the downstream drainage system on site.

The pavement is intended to capture the 25mm first flush rainfall event. The pavement will be made up of interlock stone, either with porous pavers or pavers with significant gaps filled with pea gravel as opposed to sand. The pavers will be supported on 300mm of clear stone. Assuming this provides 40% of void space, this thickness of stone will provide approximately 120mm of storage depth compared to the 25mm of targeted rainfall depth.

The permeable pavement provides the following net benefits to stormwater quality control

1) Filtration of runoff from the surface, trapping sediments in the joints between the stones

2) Capturing the 25mm storm event and directing it via under drains to the downstream Jellyfish filter for further treatment.

3) Reduction of winter salt application requirements due to the free draining surface being resistant to icing conditions as compared to conventional asphalt or concrete.

4.4 Nutrient Management – Phosphorous Removal

As previously noted, the project site is unable to make use of infiltration measures for nutrient management. Instead, in order to minimize the amount of phosphorous being discharge from the site pedestrian surfaces will be surfaced with permeable pavers with under drain. Using guidelines in the LID TTT model, phosphorus removal for this type of feature is 60%. The under drains will then discharge to the site storm sewer system upstream of the Jellyfish Filter. This treatment unit has been specified due to its ability to treat phosphorus. According to manufacture's information, this is rated to remove 59% of phosphorus. Sizing information for the specified Jellyfish JF4-2-1 filter is included in Appendix D.

Modelling of the site shows the net removal efficiency for the site with the two systems in place is estimated to be 72% and remaining annual phosphorous load of 0.1 Kg/year. As this is greater than the zero-loading required by the LSRCA, the project will be required to pay compensation

in accordance to their policies. The amount of compensation required will be 0.1 Kg/yr x $87,000/Kg/yr = $8,700.00

4.5 Conveyance

4.5.1 Storm Sewers

The majority of the site will drain via a storm sewer system sized for the peak 1 in 100-year flow from the contributing catchment area. This is necessary to ensure that the below grade detention feature can capture and control this magnitude of event. Upstream of the detention system, flows from the building roof, grade level amenity space, loading space and external drainage area will be conveyed in sewers sized based on rational method analysis.

Flows from the detention system orifice outlets will be routed via twin storm sewers to STMH#2 and then along the east side of the site toward Sophia Street. This sewer has been sized to convey the maximum possible flow from the detention system, 0.123 cms. This is greater than the estimated peak 1 in 100-year flow of 0.114 cms.

At the south east corner of the building, sewer flows will enter STMH#3 which is intended to divert high flows from the Jellyfish filter. Low flows will exit the structure to the Jellyfish for treatment and then be conveyed to STMH#4. As water levels rise in the diversion manhole when flow rates are higher than the treatment flow rate of the Jellyfish, sewer flows will spill to a high flow outlet pipe connected to STMH#4 located at the south property line. The high flow sewer from STMH#3 to STMH#4 has been sized to convey the full 1 in 100-year flow from the detention feature upstream.

From STMH#4 flow will be conveyed to the trunk storms sewer on Sophia Street. Connection will require breaking into the wall of the concrete box structure that encloses the former Sophia Creek. Sizing calculations for the storms sewer system are included in Appendix C. Please also refer to drawing 3103-SS1 and SWM3 for a view of the proposed storm sewer.

4.5.2 Sheet flow, Pavers and Landscaped Area

There will be a vegetated landscaped area on the east side of the site that is proposed to be allowed to drain uncontrolled via sheet flow to the adjacent right-of-way on Drury Lane and Sophia Street.

The proposed permeable pavers on the west and south side of the site will be drained by a 100mm under drain pipe with the intent of collecting runoff from the 25mm rainfall event. It is expected that the actual collection and conveyance may be greater than this, however to be conservative in the sizing of flow controls it will be assumed that all return period storm events (2-100 year) will simply sheet to the Sophia Street right-of-way. Drawing 3103-GP1 shows the

proposed grading for the landscaped areas, permeable pavers, amenity space and loading space. Drawing 3103-SS1 provides a typical detail of the permeable paving construction.

We have not completed flow calculations for the underdrain. It is surrounded by clear stone storage media which is well in excess of the volume requirement for a 25mm event. In the event that flow rates from the stone storage to the underdrain are greater than the pipe flow capacity, collected runoff will simply be stored into the stone and drainage will take place over time.

5.0 Maintenance Requirements

In order to ensure continued operation of the site stormwater management features, regular maintenance will be required. The following summaries the expected maintenance measures:

a) Annual inspection and cleaning of the Jellyfish filter

b) Annual vacuum cleaning of permeable pavers

c) Annual inspection of site catch basin structures and hydro-vac cleaning when required (inspection can be done when Jellyfish inspection is completed and if determined to be required, cleaning at the same time

d) Annual inspection of the Stormtech system to verify sediment depths are not impacting storage. When cleaning is required, hydro-jet flushing will need to be employed

6.0 Conclusions and Recommendations

Based on the analysis summarized in this report, we conclude that the proposed development at 117 Bayfield Street can be completed while meeting the stormwater management requirements of the City of Barrie, Lake Simcoe Conservation Authority and Ministry of Environment, Conservation and Park. To this end we recommend the following measures be employed:

a) No infiltration LID techniques be employed due to proximity to proposed and existing foundations.

b) Pedestrian walking spaces be surfaced with permeable pavers with under drains.

c) Storm sewers in site be sized for the peak flow from the 1 in 100-year event

d) A 33 cu.m. Stormtech detention storage system to collect and detain runoff from the building roof, grade level amenity space, loading space and external drainage area.

e) Flows from the detention system be restricted with a 150mm low flow and 200mm high flow orifice plate.

f) Low flow from site storm sewers and permeable paver under drain be routed through a Jellyfish JF4-2-1 filter for quality and nutrient management treatment.

g) A diversion manhole be installed upstream of the Jellyfish to convey flows in excess of the treatment capacity of the treatment unit.

h) Connect site storm sewers to the Sophia Street Trunk storm sewer

i) Site landscaped and permeable paver areas on the west, south and east side of the site be allowed to sheet flow to the Sophia Street and Drury Lane right-of-way.

j) Maintenance actives as summarised in Section 5.0 be employed once site works are completed

k) Financial compensation be paid to the LSRCA for shortfalls in water balance and phosphorous loading requirements.

7.0 Disclaimer of Responsibilities to Third Parties

This report was prepared by Skelton, Brumwell & Associates Inc. for the account of Coral-Sophia Housing Inc. in support of the property rezoning application and future site plan approval from the City of Barrie and Lake Simcoe Region Authority.

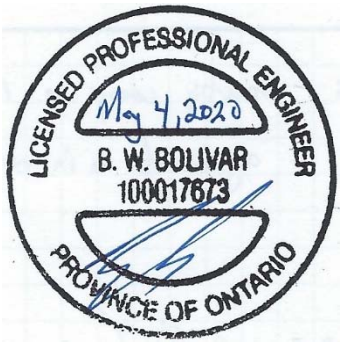
The material in it reflects Skelton, Brumwell & Associates Inc.'s best judgement in light of the information available to it at the time of preparation. Any use which a third party, not listed above, makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Skelton, Brumwell & Associates Inc. accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this report.

All of which is respectfully submitted,

SKELTON, BRUMWELL & ASSOCIATES INC.

per:



Bryan W. Bolivar, P.Eng

Senior Project Engineer, Partner

Appendix A

Rational Method Analysis

PN 17-3103
117 Bayfield Street - Coral / Sophia Development

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE April 24, 2020
CALCS BDD/BWB
Revised

Soils investigation on site indicates silt at surface, though soils investigation is localized.

CATCHMENT EXT		AREA =	**0.06**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0066			0.102	0.95	0.95	1.00	1.00	1.00
GRASS	0.058			0.898	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.06**	**Ha**		**WEIGHTED C**	**0.32**	**0.32**	**0.35**	**0.37**	**0.38**

PREDEVELOPMENT SITE

DEVELOPMENT SITE (ext)		AREA =	**0.37**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2870			0.772	0.95	0.95	1.00	1.00	1.00
Grassed	0.085			0.228	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.372**	**Ha**		**WEIGHTED C**	**0.79**	**0.79**	**0.83**	**0.84**	**0.84**

COMBINED EXISTING DRAINAGE AREA		AREA =	**0.44**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2936			0.673	0.95	0.95	1.00	1.00	1.00
Grassed	0.1424			0.327	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.44**	**Ha**		**WEIGHTED C**	**0.72**	**0.72**	**0.76**	**0.77**	**0.78**

City of Barrie IDF Curve Parameters			**2 yr**	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**	
		a	678.085	856.608	975.855	1146.28	1236.15	1426.41	
		b	4.699	4.699	4.699	4.92	4.70	5.27	
		c	0.781	0.766	0.76	0.76	0.75	0.76	
t =	10.00								
i= a/(t+b)^c		i=	83.1	109.3	126.5	148.2	164.2	180.2	(mm/hr)
Q = 0.00278 C*I*A		**Q =**	**0.073**	**0.096**	**0.111**	**0.137**	**0.154**	**0.170**	**cms**

PN 17-3103
117 Bayfield Street - Coral / Sophia Development

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE April 24, 2020
CALCS BDD/BWB

POSTDEVELOPMENT SITE

DEVELOPMENT SITE		AREA =	**0.37**	**Ha**					
GROUND COVER TYPE			**PROPORTION**		**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2853		0.771		0.95	0.95	1.00	1.00	1.00
Grassed	0.0446		0.121		0.25	0.25	0.28	0.30	0.31
Pervious Paving	0.0401		0.108		0.95	0.95	1.05	1.14	1.19
			1.000						
TOTAL	**0.370**	**Ha**		**WEIGHTED C**	**0.87**	**0.87**	**0.92**	**0.93**	**0.94**

COMBINED PROPOSED DRAINAGE AREA		AREA =	**0.43**	**Ha**					
GROUND COVER TYPE			**PROPORTION**		**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2919		0.672		0.95	0.95	1.00	1.00	1.00
Grassed	0.1024		0.236		0.25	0.25	0.28	0.30	0.31
Pervious Paving	0.0401		0.092		0.95	0.95	1.05	1.14	1.19
TOTAL	**0.43**	**Ha**		**WEIGHTED C**	**0.78**	**0.78**	**0.83**	**0.85**	**0.86**

City of Barrie IDF Curve Parameters			**2 yr**	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**	
		a	678.085	856.608	975.855	1146.28	1236.15	1426.41	
		b	4.699	4.699	4.699	4.92	4.70	5.27	
		c	0.781	0.766	0.76	0.76	0.75	0.76	
t =	10.00								
i= a/(t+b)^c		i=	83.1	109.3	126.5	148.2	164.2	180.2	(mm/hr)
Q = 0.00278 C*I*A		**Q =**	**0.079**	**0.104**	**0.120**	**0.149**	**0.168**	**0.186**	**cms**

Runof Coefficient from: Table 3.2 City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines

Change from Existing to Proposed (cms)	**0.006**	**0.008**	**0.009**	**0.012**	**0.014**	**0.016**

Detention Storage is required to maintain peak flows at pre-development magnitudes

Appendix B

Detention Storage Calculations

PN 17-3103
117 Bayfield Street - Coral / Sophia Development

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE April 24, 2020
CALCS BWB
Revised

Soils investigation on site indicates silt at surface, though soils investigation is localized.

EXTERNAL CATCHMENT		AREA =	**0.06**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0066			0.102	0.95	0.95	1.00	1.00	1.00
GRASS	0.058			0.898	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.06**	**Ha**		**WEIGHTED C**	**0.32**	**0.32**	**0.35**	**0.37**	**0.38**

PREDEVELOPMENT SITE

PROJECT SITE (exisitng)		AREA =	**0.37**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2870			0.772	0.95	0.95	1.00	1.00	1.00
Grassed	0.085			0.228	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.372**	**Ha**		**WEIGHTED C**	**0.79**	**0.79**	**0.83**	**0.84**	**0.84**

COMBINED EXISTING DRAINAGE AREA		AREA =	**0.44**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2936			0.673	0.95	0.95	1.00	1.00	1.00
Grassed	0.1424			0.327	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.44**	**Ha**		**WEIGHTED C**	**0.72**	**0.72**	**0.76**	**0.77**	**0.78**

City of Barrie IDF Curve Parameters			**2 yr**	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**	
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		b	4.699	4.699	4.699	4.92	4.70	5.27	
		c	0.781	0.766	0.76	0.76	0.75	0.76	
t =	10.00								
i= a/(t+b)^c		i=	83.1	109.3	126.5	148.2	164.2	180.2	(mm/hr)
Q = 0.00278 C*I*A		**Q =**	**0.073**	**0.096**	**0.111**	**0.137**	**0.154**	**0.170**	**cms**

Existing Condition Peak Flows

PN 17-3103
117 Bayfield Street - Coral / Sophia Development

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS
DATE April 24, 2020

Opton 1 - Underground detention controlling Building Roof, Dog Park and Loading Area. Balance of site drains uncontrolled
Most conservative approach, treat all pavers as impervious

POSTDEVELOPMENT SITE

Uncontrolled Catchment 201 -East, South and West Perimeter			AREA =	**0.07**	**Ha**				
GROUND COVER TYPE			**PROPORTION**		**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0051		0.075		0.95	0.95	1.00	1.00	1.00
Grassed	0.0278		0.409		0.25	0.25	0.28	0.30	0.31
Pervious Paving	0.0351		0.516		0.95	0.95	1.05	1.14	1.19
			1.000						
TOTAL	**0.068**	**Ha**		**WEIGHTED C**	**0.66**	**0.66**	**0.73**	**0.79**	**0.82**

City of Barrie IDF Curve Parameters			**2 yr**	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**	
		a	678.085	856.608	975.855	1146.28	1236.15	1426.41	
		b	4.699	4.699	4.699	4.92	4.70	5.27	
		c	0.781	0.766	0.76	0.76	0.75	0.76	
t =	10.00								
i= a/(t+b)^c		i=	83.1	109.3	126.5	148.2	164.2	180.2	(mm/hr)
Q = 0.00278 C*I*A		**Q =**	**0.010**	**0.014**	**0.016**	**0.020**	**0.024**	**0.028**	**cms**

Runof Coefficient from: Table 3.2 City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines

Allowable Flow from site detention = Existing flow - Uncontrolled Post flow	**0.062**	**0.082**	**0.095**	**0.117**	**0.130**	**0.142**	**cms**

External Area - assume that external area to be drained to site with drainage over top of retaining wall or via weepers

CATCHMENT EXT		AREA =	**0.06**	**Ha**					
GROUND COVER TYPE			**PROPORTION**		**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0066		0.102		0.95	0.95	1.00	1.00	1.00
GRASS	0.058		0.898		0.25	0.25	0.28	0.30	0.31
TOTAL	**0.06**	**Ha**		**WEIGHTED C**	**0.32**	**0.32**	**0.35**	**0.37**	**0.38**

Catchment 202 -Buidling, Dog Park, Loading Space			AREA =	**0.31**	**Ha**				
GROUND COVER TYPE			**PROPORTION**		**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2865		0.924		0.95	0.95	1.00	1.00	1.00
Grassed	0.0185		0.060		0.25	0.25	0.28	0.30	0.31
Pervious Paving	0.0050		0.016		0.95	0.95	1.05	1.14	1.19
			1.000						
TOTAL	**0.310**	**Ha**		**WEIGHTED C**	**0.91**	**0.91**	**0.96**	**0.96**	**0.96**

COMBINED DRAINAGE AREA TO DETENTION		AREA =	**0.37**	**Ha**					
GROUND COVER TYPE			**PROPORTION**		**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2931		0.783		0.95	0.95	1.00	1.00	1.00
Grassed	0.0763		0.204		0.25	0.25	0.28	0.30	0.31
Pervious Paving	0.0050		0.013		0.95	0.95	1.05	1.14	1.19
TOTAL	**0.37**	**Ha**		**WEIGHTED C**	**0.81**	**0.81**	**0.85**	**0.86**	**0.86**

Inputs for Combined area utilized for sizing of detention to volumes to meeting allowable flows from site detention

PN 3103

CORRAL SOPHIA AFFORDABLE HOUSING

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

SITE STORMWATER DETENTION RATING CURVE POND (STORMTECH CHAMBERS)

DATE April 24, 2020
CALCS BWB
Revised

Low Flow Outlet: 234.3 m Elevation
150 mm Orifice pipe

High Flow Outlet 234.80 m Elevation
200 mm Orifice pipe

		LOW FLOW OUTLET				HIGH FLOW OUTLET					RATING CURVE		Base stone	Stormtech
	TWL (m)	Height Above Invert (m)	Orifice Diameter (mm)	Orifice C	Q Low Pipe (cms)	Height Above Invert (m)	Orifice Diameter (mm)	Orifice C	Q High Pipe (cms)	Total Out flow (cms)	Storage Volume (cu.m.)	TWL (m)	Volume subtracted (cu.m.)	Calculated Volume (cu.m.)
1	234.30	0.00	150	0.63	0.000		200	0.63	0	0.000	0.00	234.30	0	0
2	234.45	0.15	150	0.63	0.014		200	0.63	0.000	0.014	0.00	234.45	3.45	3.45
3	234.60	0.30	150	0.63	0.023		200	0.63	0.000	0.023	5.09	234.60	3.45	8.539
4	234.65	0.35	150	0.63	0.026		200	0.63	0.000	0.026	7.09	234.65	3.45	10.54
5	234.80	0.50	150	0.63	0.032		200	0.63	0.000	0.032	12.93	234.80	3.45	16.38
6	234.90	0.60	150	0.63	0.036	0.10	200	0.63	0.000	0.036	16.63	234.90	3.45	20.08
7	235.01	0.71	150	0.63	0.039	0.21	200	0.63	0.020	0.059	20.14	235.01	3.45	23.59
8	235.11	0.81	150	0.63	0.042	0.31	200	0.63	0.040	0.082	23.35	235.11	3.45	26.8
9	235.21	0.91	150	0.63	0.045	0.41	200	0.63	0.049	0.094	26.03	235.21	3.45	29.48
10	235.31	1.01	150	0.63	0.048	0.51	200	0.63	0.056	0.104	28.34	235.31	3.45	31.79
11	235.41	1.11	150	0.63	0.050	0.61	200	0.63	0.063	0.113	30.64	235.41	3.45	34.09
12	235.54	1.24	150	0.63	0.053	0.74	200	0.63	0.070	0.123	33.51	235.54	3.45	36.96

Notes:
1. Orifice flow rates calculated from the centroid of the orifice.
2. Low Flow orifice constant per MTO
3. Volumes ignore clear stone base layer below chambers because runoff can only enter here via chambers which are at an invert 234.47m (subdrain will empty stone, protected by flap gate)

PN 19-3245
220 Fairview Drive, Barrie

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

MTO Storage Sizing Method

Skelton, Brumwell and Associates Inc.

DATE	April 24, 2020
CALCS	BWB
Revised	

Storm:	2	year
Area:	0.37	hectares
Max Permissible Ouflow Rate:	0.058	cms
Design Outflow Rate:	**0.040**	**cms**
Runoff Coefficient:	0.81	
Depression Storage:	0	mm

TIME	Rainfall Rate (mm/hr)	Rainfall Volume (cu.m.)	Runoff Volume (cu.m.)	Outflow (cu.m.)	Storage (cu.m.)
5 min	115.50	35.6	28.8	12.0	16.8
10 min	81.50	50.3	40.7	24.0	16.7
15 min	67.40	62.3	50.5	36.0	14.5
20 min	59.30	73.1	59.2	48.0	11.2
25 min	51.20	78.9	63.9	60.0	3.9
30 min	43.10	79.7	64.6	72.0	0.0
35 min	40.13	86.6	70.2	84.0	0.0
40 min	37.17	91.7	74.3	96.0	0.0
45 min	34.20	94.9	76.9	108.0	0.0
50 min	31.23	96.3	78.0	120.0	0.0
55 min	28.27	95.9	77.7	132.0	0.0
1 hr	25.30	93.6	75.8	144.0	0.0
2 hr	15.50	114.7	92.9	288.0	0.0
3 hr	13.38	148.5	120.3	432.0	0.0
4 hr	11.25	166.5	134.9	576.0	0.0
5 hr	9.13	168.8	136.7	720.0	0.0
6 hr	7.00	155.4	125.9	864.0	0.0
7 hr	6.48	167.9	136.0	1008.0	0.0
8 hr	5.97	176.6	143.1	1152.0	0.0
9 hr	5.45	181.5	147.0	1296.0	0.0
10 hr	4.93	182.5	147.9	1440.0	0.0
11 hr	4.42	179.8	145.6	1584.0	0.0
12 hr	3.90	173.2	140.3	1728.0	0.0
13 hr	3.77	181.2	146.8	1872.0	0.0
14 hr	3.63	188.2	152.4	2016.0	0.0
15 hr	3.50	194.3	157.3	2160.0	0.0
16 hr	3.37	199.3	161.4	2304.0	0.0
17 hr	3.23	203.4	164.7	2448.0	0.0
18 hr	3.10	206.5	167.2	2592.0	0.0
19 hr	2.97	208.6	168.9	2736.0	0.0
20 hr	2.83	209.7	169.8	2880.0	0.0
21 hr	2.70	209.8	169.9	3024.0	0.0
22 hr	2.57	208.9	169.2	3168.0	0.0
23 hr	2.43	207.1	167.7	3312.0	0.0
24 hr	2.30	204.2	165.4	3456.0	0.0

Max volume required:	16.8
Volume @ Design Flow:	17.3

Interpolate Volume from rating curve

Flow	Volume	TWL
0.036	16.630	234.9
0.059	20.140	235.01
0.04	17.3	234.92

PN 19-3245
220 Fairview Drive, Barrie

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

MTO Storage Sizing Method

Storm:	5 year
Area:	0.37 hectares
Max Permissible Ouflow Rate:	0.076 cms
Design Outflow Rate:	**0.059 cms**
Runoff Coefficient:	0.81
Depression Storage:	0 mm

Skelton, Brumwell and Associates Inc.

DATE	April 24, 2020
CALCS	BWB
Revised	

TIME	Rainfall Rate (mm/hr)	Rainfall Volume (cu.m.)	Runoff Volume (cu.m.)	Outflow (cu.m.)	Storage (cu.m.)
5 min	150.00	46.3	37.5	17.7	19.8
10 min	107.90	66.5	53.9	35.4	18.5
15 min	89.90	83.2	67.4	53.1	14.3
20 min	78.67	97.0	78.6	70.8	7.8
25 min	67.43	104.0	84.2	88.5	0.0
30 min	56.20	104.0	84.2	106.2	0.0
35 min	52.30	112.9	91.4	123.9	0.0
40 min	48.40	119.4	96.7	141.6	0.0
45 min	44.50	123.5	100.0	159.3	0.0
50 min	40.60	125.2	101.4	177.0	0.0
55 min	36.70	124.5	100.8	194.7	0.0
1 hr	32.80	121.4	98.3	212.4	0.0
2 hr	21.80	161.3	130.7	424.8	0.0
3 hr	18.83	209.0	169.3	637.2	0.0
4 hr	15.85	234.6	190.0	849.6	0.0
5 hr	12.88	238.2	192.9	1062.0	0.0
6 hr	9.90	219.8	178.0	1274.4	0.0
7 hr	9.15	237.0	192.0	1486.8	0.0
8 hr	8.40	248.6	201.4	1699.2	0.0
9 hr	7.65	254.7	206.3	1911.6	0.0
10 hr	6.90	255.3	206.8	2124.0	0.0
11 hr	6.15	250.3	202.7	2336.4	0.0
12 hr	5.40	239.8	194.2	2548.8	0.0
13 hr	5.22	250.9	203.2	2761.2	0.0
14 hr	5.03	260.7	211.2	2973.6	0.0
15 hr	4.85	269.2	218.0	3186.0	0.0
16 hr	4.67	276.3	223.8	3398.4	0.0
17 hr	4.48	282.0	228.4	3610.8	0.0
18 hr	4.30	286.4	232.0	3823.2	0.0
19 hr	4.12	289.4	234.4	4035.6	0.0
20 hr	3.93	291.1	235.8	4248.0	0.0
21 hr	3.75	291.4	236.0	4460.4	0.0
22 hr	3.57	290.3	235.2	4672.8	0.0
23 hr	3.38	287.9	233.2	4885.2	0.0
24 hr	3.20	284.2	230.2	5097.6	0.0

Max volume required:	19.8
Volume @ Design Flow:	20.1

Interpolate Volume from rating curve

Flow	Volume	TWL
0.036	16.6	234.90
0.059	20.1	235.01
0.059	20.1	235.01

PN 19-3245
220 Fairview Drive, Barrie

SBA Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

MTO Storage Sizing Method

Skelton, Brumwell and Associates Inc.

DATE	April 24, 2020
CALCS	BWB
Revised	

Storm:	10 year
Area:	0.37 hectares
Max Permissible Ouflow Rate:	0.088 cms
Design Outflow Rate:	**0.072 cms**
Runoff Coefficient:	0.81
Depression Storage:	0 mm

TIME	Rainfall Rate (mm/hr)	Rainfall Volume (cu.m.)	Runoff Volume (cu.m.)	Outflow (cu.m.)	Storage (cu.m.)
5 min	173.00	53.3	43.2	21.6	21.6
10 min	125.50	77.4	62.7	43.2	19.5
15 min	104.90	97.0	78.6	64.8	13.8
20 min	91.63	113.0	91.5	86.4	5.1
25 min	78.37	120.8	97.9	108.0	0.0
30 min	65.10	120.4	97.6	129.6	0.0
35 min	60.52	130.6	105.8	151.2	0.0
40 min	55.93	138.0	111.8	172.8	0.0
45 min	51.35	142.5	115.4	194.4	0.0
50 min	46.77	144.2	116.8	216.0	0.0
55 min	42.18	143.1	115.9	237.6	0.0
1 hr	37.60	139.1	112.7	259.2	0.0
2 hr	26.10	193.1	156.4	518.4	0.0
3 hr	22.53	250.0	202.5	777.6	0.0
4 hr	18.95	280.5	227.2	1036.8	0.0
5 hr	15.38	284.4	230.4	1296.0	0.0
6 hr	11.80	262.0	212.2	1555.2	0.0
7 hr	10.88	281.9	228.3	1814.4	0.0
8 hr	9.97	295.0	239.0	2073.6	0.0
9 hr	9.05	301.4	244.1	2332.8	0.0
10 hr	8.13	300.9	243.8	2592.0	0.0
11 hr	7.22	293.7	237.9	2851.2	0.0
12 hr	6.30	279.7	226.6	3110.4	0.0
13 hr	6.09	293.0	237.3	3369.6	0.0
14 hr	5.88	304.8	246.9	3628.8	0.0
15 hr	5.68	315.0	255.1	3888.0	0.0
16 hr	5.47	323.6	262.1	4147.2	0.0
17 hr	5.26	330.7	267.9	4406.4	0.0
18 hr	5.05	336.3	272.4	4665.6	0.0
19 hr	4.84	340.4	275.7	4924.8	0.0
20 hr	4.63	342.9	277.7	5184.0	0.0
21 hr	4.43	343.8	278.5	5443.2	0.0
22 hr	4.22	343.2	278.0	5702.4	0.0
23 hr	4.01	341.1	276.3	5961.6	0.0
24 hr	3.80	337.4	273.3	6220.8	0.0

Max volume required:	21.6
Volume @ Design Flow:	21.9

Interpolate Volume from rating curve

Flow	Volume	TWL
0.059	20.1	235.01
0.082	23.4	235.11
0.072	21.9	235.06

PN 19-3245
220 Fairview Drive, Barrie

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

MTO Storage Sizing Method

Skelton, Brumwell and Associates Inc.

DATE	April 24, 2020
CALCS	BWB
Revised	

Storm:	25	year
Area:	0.37	hectares
Max Permissible Ouflow Rate:	0.108	cms
Outflow Rate:	**0.092**	**cms**
Runoff Coefficient:	0.85	
Depression Storage:	0	mm

TIME	Rainfall Rate (mm/hr)	Rainfall Volume (cu.m.)	Runoff Volume (cu.m.)	Outflow (cu.m.)	Storage (cu.m.)
5 min	201.80	62.2	52.9	27.6	25.3
10 min	147.40	90.9	77.3	55.2	22.1
15 min	123.70	114.4	97.3	82.8	14.5
20 min	107.80	133.0	113.0	110.4	2.6
25 min	91.90	141.7	120.4	138.0	0.0
30 min	76.00	140.6	119.5	165.6	0.0
35 min	70.63	152.5	129.6	193.2	0.0
40 min	65.27	161.0	136.8	220.8	0.0
45 min	59.90	166.2	141.3	248.4	0.0
50 min	54.53	168.1	142.9	276.0	0.0
55 min	49.17	166.8	141.7	303.6	0.0
1 hr	43.80	162.1	137.8	331.2	0.0
2 hr	31.40	232.4	197.5	662.4	0.0
3 hr	27.13	301.1	255.9	993.6	0.0
4 hr	22.85	338.2	287.5	1324.8	0.0
5 hr	18.58	343.6	292.1	1656.0	0.0
6 hr	14.30	317.5	269.8	1987.2	0.0
7 hr	13.18	341.4	290.2	2318.4	0.0
8 hr	12.07	357.2	303.6	2649.6	0.0
9 hr	10.95	364.6	309.9	2980.8	0.0
10 hr	9.83	363.8	309.3	3312.0	0.0
11 hr	8.72	354.8	301.6	3643.2	0.0
12 hr	7.60	337.4	286.8	3974.4	0.0
13 hr	7.34	353.1	300.2	4305.6	0.0
14 hr	7.08	366.9	311.9	4636.8	0.0
15 hr	6.83	378.8	322.0	4968.0	0.0
16 hr	6.57	388.7	330.4	5299.2	0.0
17 hr	6.31	396.8	337.3	5630.4	0.0
18 hr	6.05	402.9	342.5	5961.6	0.0
19 hr	5.79	407.2	346.1	6292.8	0.0
20 hr	5.53	409.5	348.0	6624.0	0.0
21 hr	5.28	409.9	348.4	6955.2	0.0
22 hr	5.02	408.4	347.1	7286.4	0.0
23 hr	4.76	404.9	344.2	7617.6	0.0
24 hr	4.50	399.6	339.7	7948.8	0.0

Max volume required: 25.3

Volume @ Design Flow: 25.6

Interpolate Volume from rating curve

Flow	Volume	TWL
0.082	23.4	235.11
0.094	26.0	235.21
0.092	25.6	235.19

PN 19-3245
220 Fairview Drive, Barrie

SBA Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

MTO Storage Sizing Method

Skelton, Brumwell and Associates Inc.

DATE	April 24, 2020
CALCS	BWB
Revised	

Storm:	50 year
Area:	0.37 hectares
Max Permissible Ouflow Rate:	0.119 cms
Outflow Rate:	**0.104 cms**
Runoff Coefficient:	0.86
Depression Storage:	0 mm

TIME	Rainfall Rate (mm/hr)	Rainfall Volume (cu.m.)	Runoff Volume (cu.m.)	Outflow (cu.m.)	Storage (cu.m.)
5 min	223.30	68.9	59.2	31.2	28.0
10 min	163.90	101.1	86.9	62.4	24.5
15 min	137.70	127.4	109.5	93.6	15.9
20 min	119.90	147.9	127.2	124.8	2.4
25 min	102.10	157.4	135.4	156.0	0.0
30 min	84.30	156.0	134.1	187.2	0.0
35 min	78.32	169.0	145.4	218.4	0.0
40 min	72.33	178.4	153.4	249.6	0.0
45 min	66.35	184.1	158.3	280.8	0.0
50 min	60.37	186.1	160.1	312.0	0.0
55 min	54.38	184.5	158.6	343.2	0.0
1 hr	48.40	179.1	154.0	374.4	0.0
2 hr	35.40	262.0	225.3	748.8	0.0
3 hr	30.55	339.1	291.6	1123.2	0.0
4 hr	25.70	380.4	327.1	1497.6	0.0
5 hr	20.85	385.7	331.7	1872.0	0.0
6 hr	16.00	355.2	305.5	2246.4	0.0
7 hr	14.75	382.0	328.5	2620.8	0.0
8 hr	13.50	399.6	343.7	2995.2	0.0
9 hr	12.25	407.9	350.8	3369.6	0.0
10 hr	11.00	407.0	350.0	3744.0	0.0
11 hr	9.75	396.8	341.3	4118.4	0.0
12 hr	8.50	377.4	324.6	4492.8	0.0
13 hr	8.22	395.2	339.9	4867.2	0.0
14 hr	7.93	410.9	353.4	5241.6	0.0
15 hr	7.65	424.6	365.1	5616.0	0.0
16 hr	7.37	436.1	375.1	5990.4	0.0
17 hr	7.08	445.5	383.2	6364.8	0.0
18 hr	6.80	452.9	389.5	6739.2	0.0
19 hr	6.52	458.1	394.0	7113.6	0.0
20 hr	6.23	461.3	396.7	7488.0	0.0
21 hr	5.95	462.3	397.6	7862.4	0.0
22 hr	5.67	461.3	396.7	8236.8	0.0
23 hr	5.38	458.1	394.0	8611.2	0.0
24 hr	5.10	452.9	389.5	8985.6	0.0

Max volume:	28.0
Volume @ Design Flow:	28.4

Interpolate Volume from rating curve

Flow	Volume	TWL
0.104	28.3	235.31
0.113	30.6	235.41
0.104	28.4	235.31

PN 19-3245
220 Fairview Drive, Barrie

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

MTO Storage Sizing Method

Skelton, Brumwell and Associates Inc.

Storm:	100	year
Area:	0.37	hectares
Max Permissible Ouflow Rate:	0.13	cms
Outflow Rate:	**0.114**	**cms**
Runoff Coefficient:	0.86	
Depression Storage:	0	mm

DATE April 24, 2020
CALCS BWB
Revised

TIME	Rainfall Rate (mm/hr)	Rainfall Volume (cu.m.)	Runoff Volume (cu.m.)	Outflow (cu.m.)	Storage (cu.m.)
5 min	244.70	75.4	64.9	34.2	30.7
10 min	180.10	111.1	95.5	68.4	27.1
15 min	151.60	140.2	120.6	102.6	18.0
20 min	131.83	162.6	139.8	136.8	3.0
25 min	112.07	172.8	148.6	171.0	0.0
30 min	92.30	170.8	146.8	205.2	0.0
35 min	85.75	185.1	159.2	239.4	0.0
40 min	79.20	195.4	168.0	273.6	0.0
45 min	72.65	201.6	173.4	307.8	0.0
50 min	66.10	203.8	175.3	342.0	0.0
55 min	59.55	202.0	173.7	376.2	0.0
1 hr	53.00	196.1	168.6	410.4	0.0
2 hr	39.30	290.8	250.1	820.8	0.0
3 hr	33.90	376.3	323.6	1231.2	0.0
4 hr	28.50	421.8	362.7	1641.6	0.0
5 hr	23.10	427.4	367.5	2052.0	0.0
6 hr	17.70	392.9	337.9	2462.4	0.0
7 hr	16.32	422.6	363.4	2872.8	0.0
8 hr	14.93	442.0	380.1	3283.2	0.0
9 hr	13.55	451.2	388.0	3693.6	0.0
10 hr	12.17	450.2	387.1	4104.0	0.0
11 hr	10.78	438.9	377.4	4514.4	0.0
12 hr	9.40	417.4	358.9	4924.8	0.0
13 hr	9.08	436.5	375.4	5335.2	0.0
14 hr	8.75	453.3	389.8	5745.6	0.0
15 hr	8.43	467.6	402.1	6156.0	0.0
16 hr	8.10	479.5	412.4	6566.4	0.0
17 hr	7.78	489.0	420.6	6976.8	0.0
18 hr	7.45	496.2	426.7	7387.2	0.0
19 hr	7.13	500.9	430.8	7797.6	0.0
20 hr	6.80	503.2	432.8	8208.0	0.0
21 hr	6.48	503.1	432.7	8618.4	0.0
22 hr	6.15	500.6	430.5	9028.8	0.0
23 hr	5.83	495.7	426.3	9439.2	0.0
24 hr	5.50	488.4	420.0	9849.6	0.0

Max volume required: 30.7

Volume @ Design Flow: 31.0

Interpolate Volume from rating curve

Flow	Volume	TWL
0.113	30.640	235.41
0.123	33.510	235.54
0.114	30.972	235.43

Project: **3103 Coral Sophia**

Chamber Model -	SC-740	
Units -	**Metric**	Click Here for Imperial
Number of chambers -	12	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	234.32	m
Amount of Stone Above Chambers -	300	mm
Amount of Stone Below Chambers -	152	mm
Area of system -	56.6	sq.meters

Include Perimeter Stone in Calculations

Min. Area - 37.68 sq.meters

Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Total Chamber *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Ch & St *(cubic meters)*	Cumulative Chamber *(cubic meters)*	Elevation *(meters)*
1219	0.00	0.00	0.57	0.57	36.960	235.54
1194	0.00	0.00	0.57	0.57	36.386	235.51
1168	0.00	0.00	0.57	0.57	35.811	235.49
1143	0.00	0.00	0.57	0.57	35.236	235.46
1118	0.00	0.00	0.57	0.57	34.661	235.44
1092	0.00	0.00	0.57	0.57	34.086	235.41
1067	0.00	0.00	0.57	0.57	33.511	235.39
1041	0.00	0.00	0.57	0.57	32.937	235.36
1016	0.00	0.00	0.57	0.57	32.362	235.34
991	0.00	0.00	0.57	0.57	31.787	235.31
965	0.00	0.00	0.57	0.57	31.212	235.29
940	0.00	0.00	0.57	0.57	30.637	235.26
914	0.00	0.02	0.57	0.59	30.062	235.23
889	0.00	0.06	0.55	0.61	29.476	235.21
864	0.01	0.10	0.54	0.63	28.868	235.18
838	0.02	0.21	0.49	0.70	28.236	235.16
813	0.02	0.27	0.47	0.74	27.538	235.13
787	0.03	0.32	0.45	0.77	26.800	235.11
762	0.03	0.37	0.43	0.79	26.031	235.08
737	0.03	0.40	0.41	0.82	25.237	235.06
711	0.04	0.43	0.40	0.83	24.422	235.03
686	0.04	0.46	0.39	0.85	23.589	235.01
660	0.04	0.49	0.38	0.87	22.738	234.98
635	0.04	0.52	0.37	0.89	21.866	234.96
610	0.04	0.54	0.36	0.90	20.981	234.93
584	0.05	0.56	0.35	0.91	20.083	234.90
559	0.05	0.58	0.34	0.92	19.174	234.88
533	0.05	0.60	0.34	0.93	18.252	234.85
508	0.05	0.61	0.33	0.94	17.320	234.83
483	0.05	0.63	0.32	0.95	16.378	234.80
457	0.05	0.64	0.32	0.96	15.425	234.78
432	0.05	0.66	0.31	0.97	14.464	234.75
406	0.06	0.67	0.31	0.98	13.495	234.73
381	0.06	0.68	0.30	0.98	12.517	234.70
356	0.06	0.69	0.30	0.99	11.533	234.68
330	0.06	0.71	0.29	1.00	10.541	234.65
305	0.06	0.72	0.29	1.00	9.543	234.62
279	0.06	0.72	0.29	1.01	8.539	234.60
254	0.06	0.73	0.28	1.01	7.530	234.57
229	0.06	0.74	0.28	1.02	6.516	234.55
203	0.06	0.75	0.28	1.02	5.497	234.52
178	0.06	0.75	0.27	1.02	4.474	234.50
152	0.00	0.00	0.57	0.57	3.449	234.47
127	0.00	0.00	0.57	0.57	2.874	234.45
102	0.00	0.00	0.57	0.57	2.299	234.42

PROPOSED LAYOUT

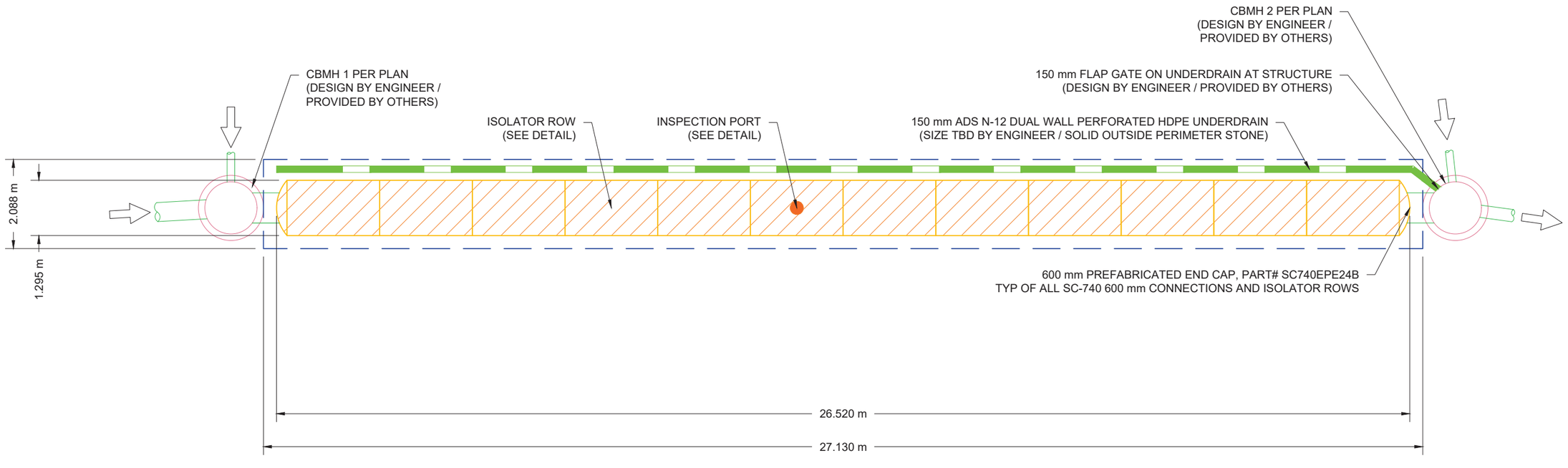
12	STORMTECH SC-740 CHAMBERS
2	STORMTECH SC-740 END CAPS
152	STONE ABOVE (mm)
152	STONE BELOW (mm)
40	% STONE VOID
33.5	**INSTALLED SYSTEM VOLUME (m^3) (PERIMETER STONE INCLUDED)**
56.6	SYSTEM AREA (m^2)
58.4	SYSTEM PERIMETER (m)

PROPOSED ELEVATIONS

237.672	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):
235.844	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):
235.691	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):
235.691	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):
235.691	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT):
235.386	TOP OF STONE:
235.234	TOP OF SC-740 CHAMBER:
234.475	600 mm ISOLATOR ROW INVERT:
234.472	BOTTOM OF SC-740 CHAMBER:
234.320	UNDERDRAIN INVERT:
234.320	BOTTOM OF STONE:

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECHNICAL NOTE 6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- THE SITE DESIGN ENGINEER MUST REVIEW THE PROXIMITY OF THE CHAMBERS TO THE BUILDING/STRUCTURE. NO FOUNDATION LOADS SHALL BE TRANSMITTED TO THE CHAMBERS. THE SITE DESIGN ENGINEER MUST CONSIDER EFFECTS OF POSSIBLE SATURATED SOILS ON BEARING CAPACITY OF SOILS AND SEEPAGE INTO BASEMENTS.
-



117 BAYFIELD STREET
BARRIE, ON.

DATE: 04/21/20 | DRAWN: RCT | CHECKED: JKL | PROJECT #: S180483

DATE	DRWN	CHKD	DESCRIPTION

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

StormTech
Detention • Retention • Water Quality
520 CROMWELL AVENUE | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

ADS
ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026

SCALE = 1 : 100

Appendix C

Storm Sewer Sizing

PN 17-3103

117 Bayfield Street - Coral / Sophia Development

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

DATE April 23, 2020
CALCS BWB
Revised

PROPOSED CONDITION CATCHMENTS

CATCHMENT 301		AREA =	**0.05**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0376			0.752	0.95	0.95	1.00	1.00	1.00
GRASS	0.012			0.248	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.05**	**Ha**		**WEIGHTED C**	**0.78**	**0.78**	**0.82**	**0.83**	**0.83**

CATCHMENT 302		AREA =	**0.27**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2700			1.000	0.95	0.95	1.00	1.00	1.00
GRASS	0.000			0.000	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.27**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

CATCHMENT 303		AREA =	**0.02**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS				0.000	0.95	0.95	1.00	1.00	1.00
GRASS	0.020			1.000	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.02**	**Ha**		**WEIGHTED C**	**0.25**	**0.25**	**0.28**	**0.30**	**0.31**

CATCHMENT 304		AREA =	**0.02**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.020			1.000	0.95	0.95	1.00	1.00	1.00
GRASS	0.000			0.000	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.02**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

CATCHMENT EXT		AREA =	**0.06**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0022			0.037	0.95	0.95	1.00	1.00	1.00
GRASS	0.058			0.963	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.06**	**Ha**		**WEIGHTED C**	**0.28**	**0.28**	**0.30**	**0.33**	**0.34**

CATCHMENT 303 + EXT DRAIN TO CBMH#1 - CALCULATE COMBINED INPUTS									
		AREA =	**0.08**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0022			0.028	0.95	0.95	1.00	1.00	1.00
GRASS	0.0778			0.973	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.08**	**Ha**		**WEIGHTED C**	**0.27**	**0.27**	**0.29**	**0.32**	**0.33**

PN 17-3103
117 Bayfield Street

Rational Method Storm Sewer Design

100 year STORM FLOWS - SEWER SIZING

Q = 0.00278 C.I.A. - IN C.M.S. (CUBIC METRES /SEC)
C =RUNNOFF COEFFICIENT
A = AREA - IN HECTARES
i = RAINFALL INTENSITY (mm/hr) = A / (t+B)^C

A (idf) = 1426.41
B (idf) = 5.27
C (idf) = 0.76
t = flow time

intial t = 10 minutes

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

Skelton, Brumwell and Associates Inc.
DATE April 24, 2020
CALCS BWB
Revised

AREA	LOCATION		PIPE LENGTH (METRES)	INCREMENT		CA	TOTAL CA	FLOW TIME (MIN)		I	TOTAL PEAK Q (CMS)	S (%)	D (mm)	Mannings 'n' for pipe	Q PIPE FULL (CMS)	V PIPE FULL (m/sec)	REMARKS	PIPE CAPACITY GREATER THAN FLOW RATE?
	FROM	TO		C	A			TO SECTION	IN SECTION									
302	Building	STMH#1	1.8	1.00	0.27	0.270	0.270	10.00	0.02	180.15	0.135	2.00	300	0.013	0.137	1.933	PVC 100 YR FLOW	OK
	STMH#1	CBMH#1	6.5				0.270	10.02	0.07	180.02	0.135	1.00	375	0.013	0.175	1.586	PVC 100 YR FLOW	OK
303+Ext	CBMH#1	Detention	1.0	0.33	0.08	0.026	0.296	10.08		179.41	0.148	1.00	375	0.013	0.175	1.586	PVC 100 YR FLOW	OK
Low flow	Detention	STMH#2									0.053	1.50	250	0.013	0.073	1.482	Max Low Flow Pipe	OK
High Flow	Detention	STMH#2									0.070	1.50	250	0.013	0.073	1.482	Max High Flow Pipe	OK
Combined Low and High Flow Max	STMH#2	STMH#3	36.5								0.123	0.50	375	0.013	0.124	1.122	Peak flow from detention	OK
	STMH#3	STMH#4	1.9								0.123	20.00	375	0.013	0.783	7.094	Peak flow from detention	OK
	STMH#4	Sophia	2.2								0.123	1.00	375	0.013	0.175	1.586	Peak flow from detention	OK

Note: Peak flows from detention shown are max flows through the respective orifices if water level in detetion reaches max elevation. Calculated peak 1 in 100 year flow is 0.114 cms

Appendix D

Jellyfish Filter Sizing

PN 17-3103
117 Bayfield Street - Coral / Sophia Development

DATE April 17, 2020
CALCS BWB
Revised

Soils investigation on site indicates silt at surface, though soils investigation is localized.

CATCHMENT EXT		AREA = **0.06** **Ha**					
GROUND COVER TYPE		**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0066	0.102	0.95	0.95	1.00	1.00	1.00
GRASS	0.058	0.898	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.06** **Ha**	**WEIGHTED C**	**0.32**	**0.32**	**0.35**	**0.37**	**0.38**

POSTDEVELOPMENT SITE

DEVELOPMENT SITE		AREA = **0.37** **Ha**					
GROUND COVER TYPE		**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.2853	0.771	0.95	0.95	1.00	1.00	1.00
Grassed	0.0446	0.121	0.25	0.25	0.28	0.30	0.31
Pervious Paving	0.0401	0.108	0.95	0.95	1.05	1.14	1.19
		1.000					
TOTAL	**0.370** **Ha**	**WEIGHTED C**	**0.87**	**0.87**	**0.92**	**0.93**	**0.94**

DRAINAGE TO JELLYFISH FILTER - 25mm EVENTS

COMBINED PROPOSED DRAINAGE AREA		AREA = **0.43** **Ha**					
GROUND COVER TYPE		**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS + Pervious Paving	0.3320	0.764	0.95	0.95	1.00	1.00	1.00
Grassed	0.1024	0.236	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.43** **Ha**	**WEIGHTED C**	**0.78**	**0.78**	**0.83**	**0.83**	**0.84**

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Monday, April 20, 2020
Project Name	Corral Sophia Housing
Project Number	3103
Location	Barrie

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.

Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF4-2-1 is recommended to meet the water quality objective by treating a flow of 12.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 36 years of BARRIE WPCC rainfall data for this site. This model has a sediment capacity of 142 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-2-1	2	1	1.2	12.6	142

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

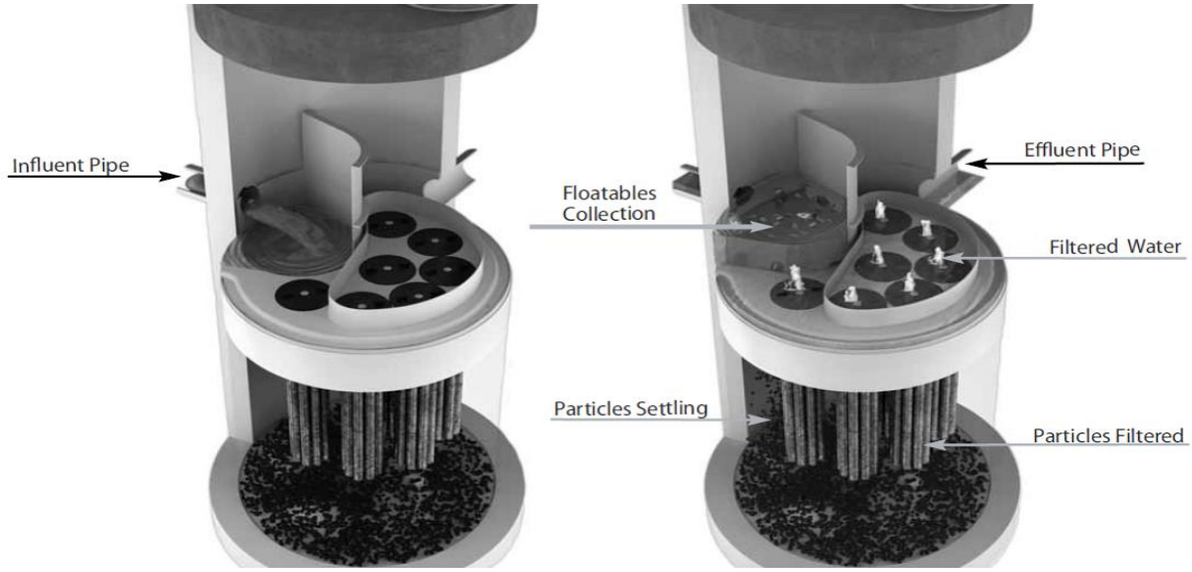
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 59%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Monday, April 20, 2020
Project Name:	Corral Sophia Housing
Project Number:	3103
Location:	Barrie

Designer Information

Company:	Skelton Brumwell
Contact:	Bryan Bolivar
Phone #:	

Notes

Rainfall

Name:	BARRIE WPCC
State:	ON
ID:	557
Record:	1968 to 2003
Co-ords:	44°23'N, 79°41'W

Drainage Area

Total Area:	0.43 ha
Imperviousness:	76.4%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 36 years of BARRIE WPCC rainfall data:	**8.9 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 967 m³, with a suspended sediment concentration of 60 mg/L.	**58 kg**

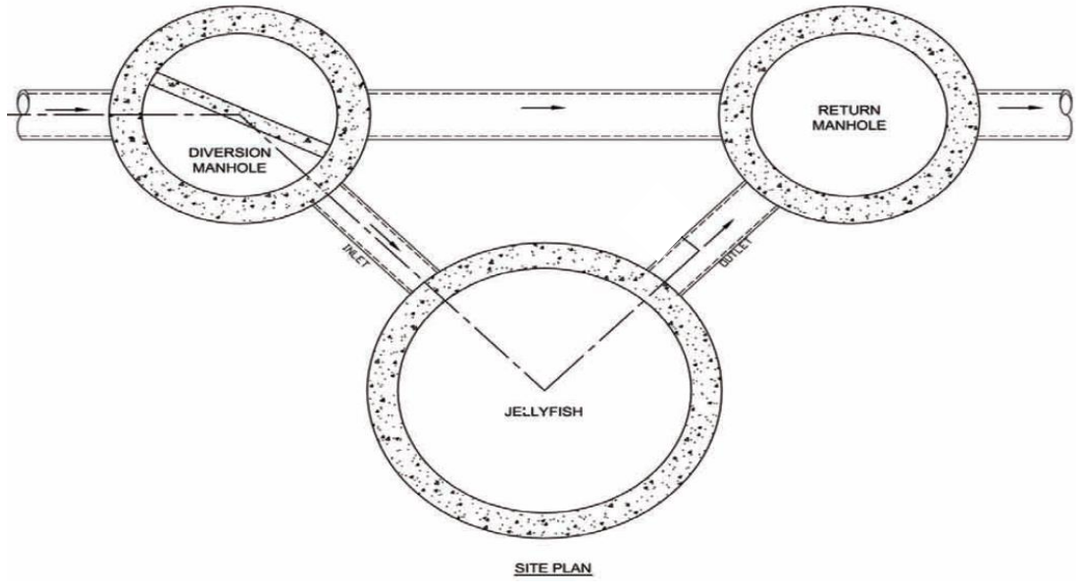
Recommendation

The Jellyfish Filter model JF4-2-1 is recommended to meet the water quality objective by treating a flow of 12.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 36 years of BARRIE WPCC rainfall data for this site. This model has a sediment capacity of 142 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	2313	0.34	379	7.6	85
JF4-2-1	**2**	**1**	**1.2**	**2313**	**0.34**	**379**	**12.6**	**142**
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	**62º**	**150**	**200**
1.8	59º	200	250
2.4	52º	250	300
3.0	48º	300	450
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft² (0.142 lps/m²).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Jellyfish® Filter JF4-2-1

Developed by Imbrium Systems, Inc.,
Whitby, Ontario, Canada

In accordance with

ISO 14034:2016

Environmental management —
Environmental technology verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

August 3, 2017
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

The Jellyfish® Filter is an engineered stormwater quality treatment technology designed to remove a variety of stormwater pollutants including floatable trash and debris, oil, coarse and fine suspended sediments, and particulate-bound pollutants such as nutrients, heavy metals, and hydrocarbons. The Jellyfish Filter combines gravitational pre-treatment (sedimentation and floatation) and membrane filtration in a single compact structure. The system utilizes membrane filtration cartridges comprised of multiple pleated filter elements ("filtration tentacles") that provide high filtration surface area with the associated advantages of high flow rate, high sediment capacity, and low filtration flux rate.

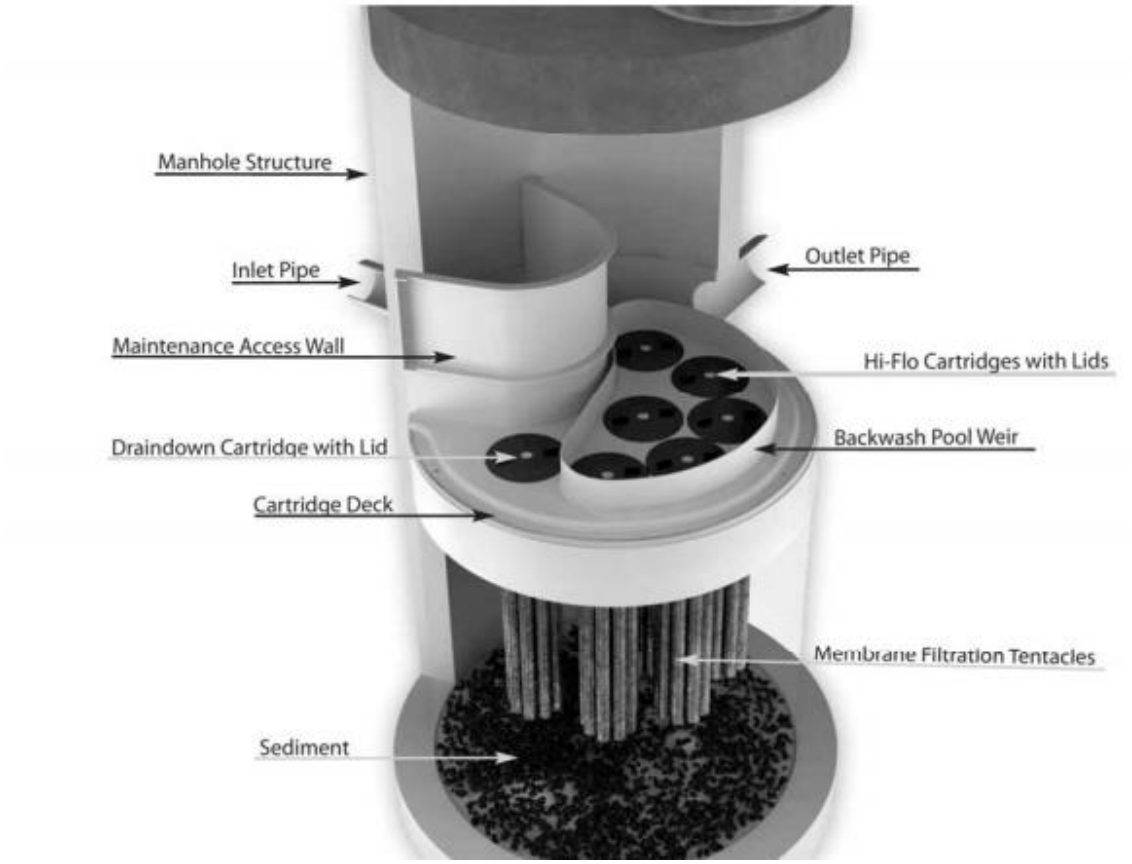


Figure 1. Cut-away graphic of a Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge

Figure 1 depicts a cut-away graphic of a typical 6-ft diameter Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge (JF6-6-1). Stormwater influent enters the system through the inlet pipe and builds a pond behind the maintenance access wall, with the pond elevation providing driving head. Flow is channeled downward into the lower chamber beneath the cartridge deck. A flexible separator skirt (not shown in the graphic) surrounds the filtration zone where the filtration tentacles of each cartridge are suspended, and the volume between the vessel wall and the outside surface of the separator skirt comprises a pretreatment channel. As flow spreads throughout the pretreatment channel, floatable pollutants accumulate at the surface of the pond behind the maintenance access wall and also beneath the cartridge deck in the pretreatment channel, while coarse sediments settle to the sump. Flow proceeds under the separator skirt and upward into the filtration zone, entering each filtration tentacle and depositing fine suspended sediment and associated particulate-bound pollutants on the outside surface of the membranes. Filtered water proceeds up the center tube of each tentacle, with the flow from each tentacle combining under the cartridge lid, and discharging to the top of the

cartridge deck through the cartridge lid orifice. Filtered effluent from the hi-flo cartridges enters a pool enclosed by a 15-cm high weir, and if storm intensity and resultant driving head is sufficient, filtered water overflows the weir and proceeds across the cartridge deck to the outlet pipe. Filtered effluent discharging from the draindown cartridge(s) passes directly to the outlet pipe, and requires only a minimal amount of driving head (2.5 cm) to provide forward flow. As storm intensity subsides and driving head drops below 15 cm, filtered water within the backwash pool reverses direction and passes backward through the hi-flo cartridges, and thereby dislodges sediment from the membranes which subsequently settles to the sump below the filtration zone. During this passive backwashing process, water in the lower chamber is displaced only through the draindown cartridge(s). Additional self-cleaning processes include gravity, as well as vibrational pulses emitted when flow exits the orifice of each cartridge lid, and these combined processes significantly extend the cartridge service life and maintenance cleaning interval. Sediment removal from the sump by vacuum is required when sediment depths reach 30 cm, and cartridges are typically removed, externally rinsed, and recommissioned on an annual basis, or as site-specific maintenance conditions require. Filtration tentacle replacement is typically required every 3 – 5 years.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from a field monitoring program conducted on a Jellyfish® Filter JF4-2-1 (4-ft diameter manhole with 2 hi-flo cartridges and 1 draindown cartridge), in accordance with the provisions of the TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements—Amendments to TARP Tier II Protocol (NJDEP, 2009). Testing was completed by researchers led by Dr. John Sansalone at the University of Florida's Engineering School of Sustainable Infrastructure and Environment. The drainage area providing stormwater runoff to the test unit varied between 502 m^2 and 799 m^2 (5400 ft^2 to 8600 ft^2) depending on storm intensity and wind direction. The unit was monitored for a total of 25 TARP qualifying storm events (i.e. $\geq$ 2.5 mm of rainfall) contributing cumulative rainfall of 381 mm (15 in) over the 13-month period between May 28, 2010 and June 27, 2011. Only TARP-qualified storms were routed through the unit, and maintenance was not required during the testing period based on sediment accumulation less than the depth indicated for maintenance, and also based on hydraulic testing performed on the system after the conclusion of monitoring.

Table 1 shows the specified and achieved amended TARP criteria for storm selection and sampling.
Table 2 shows the observed ranges of operational conditions that occurred over the testing period.

Table 1. Specified and achieved amended TARP criteria for storm selection and sampling

Description	Criteria value	Achieved value
Total rainfall	$\geq$ 2.5 mm (0.1 in)	> 2.5 mm (0.1 in)
Minimum inter-event period	6 hrs	10 hrs
Minimum flow-weighted composite sample storm coverage	70% including as much of the first 20% of the storm	100%
Minimum influent/effluent samples	10, but a minimum of 5 subsamples for composite samples	Minimum of 8 subsamples for composite samples
Total sampled rainfall	Minimum 381 mm (15 in)	384 mm (15.01 in)
Number of storms	Minimum 20	25

Table 2. Observed operational conditions for events monitored over the study period

Operational condition	Observed range
Storm durations	26 – 691 min
Previous dry hours	10 - 910 hrs
Rainfall depth	3 – 50 mm
Initial rainfall to runoff lag time	1 – 34 min
Runoff volume	206 – 13,229 L
Peak rainfall intensity	5 – 137 mm/hr
Peak runoff flow rate	0.5 – 14.3 L/s
Event median flow rate	0.01 – 5.5 L/s

The 4-ft diameter test unit has sedimentation surface area of 1.17 m^2 (12.56 ft^2). Each of the three filter cartridges employed in the test unit uses filtration tentacles of 137 cm (54 in) length, with filter surface area of 35.4 m^2 (381 ft^2) per cartridge, and total filter surface area of 106.2 m^2 (1143 ft^2) for the three cartridges combined. The design treatment flow rate is 5 L/s (80 gal/min) for each of the two hi-flo cartridges and 2.5 L/s (40 gal/min) for the single draindown cartridge, for a total design treatment flow rate of 12.6 L/s (200 gal/min) at design driving head of 457 mm (18 in). This translates to a filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m^2 (0.21 gal/min/ft^2) for each hi-flo cartridge and 0.07 L/s/m^2 (0.11 gal/min/ft^2) for the draindown cartridge. The design flow rate for each cartridge is controlled by the sizing of the orifice in the cartridge lid. The distance from the bottom of the filtration tentacles to the sump is 61 cm (24 in).

Performance claims

The Jellyfish® Filter demonstrated the removal efficiencies indicated in **Table 3** for respective constituents during field monitoring of 25 TARP qualified storm events with cumulative rainfall of 381 mm, conducted in accordance with the provisions of the TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements—Amendments to TARP Tier II Protocol (NJDEP, 2009), and using the following design parameters:

- System hydraulic loading rate (system treatment flow rate per unit of sedimentation surface area) of 10.8 L/s/m^2 (15.9 gal/min/ft^2) or lower
- Filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m^2 (0.21 gal/min/ft^2) or lower for each hi-flo cartridge and 0.07 L/s/m^2 (0.11 gal/min/ft^2) or lower for each draindown cartridge
- Distance from the bottom of the filtration tentacles to the sump of 61 cm (24 in) or greater
- Driving head of 457 mm (18 in) or greater

Table 3. Mean, median and 95% confidence interval (median) for removal efficiencies of selected stormwater constituents

Parameter	Mean	Median	Median - 95% Lower Limit	Median - 95% Upper Limit
TSS	84.7	85.6	82.8	89.8
SSC	97.5	98.3	97.1	98.7
Total phosphorus	48.8	49.1	43.3	60.1
Total nitrogen	37.9	39.3	31.2	54.6
Zinc	55.3	69	39	75
Copper	83.0	91.7	75.1	98.9
Oil and grease	60.1	60	42.7	100

N.B. As with any field test of stormwater treatment devices, removal efficiencies will vary based on pollutant influent concentrations and other site specific conditions.

Performance results

The frequency of rainfall depths monitored during the study is presented in **Figure 2**. The median and 90th percentile rainfall depths were 11 mm and 31.7 mm, respectively. These values represent the depth of rainfall that is not exceeded in 50 and 90 percent of the monitored rainfall events.

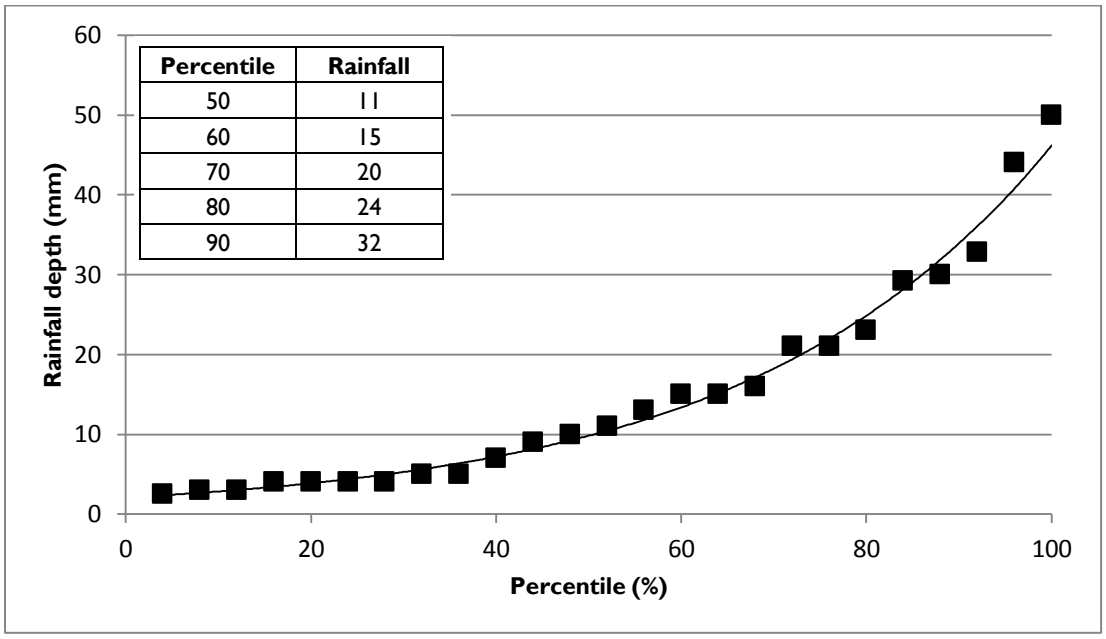


Figure 2. Rainfall depth frequency curve

Sediment removal performance was assessed by measuring the event mean concentration and mass of suspended sediment entering and leaving the unit during runoff events. This involved sampling the full cross-section of influent and effluent flows manually at 2 - 10 minute intervals for the full duration of each storm event and combining discrete samples into flow-weighted composites. Comparing the theoretical mass recovery from the sump calculated by the difference between the influent and effluent mass to the actual dry weight of the recovered sump mass showed an overall mass balance recovery of 94.5% over the study period.

The median d50 particle size (i.e. 50th percentile particle size) of the influent and effluent was 82 and 3 µm, respectively (**Figure 3**). The median influent particles sizes ranged between 22 and 263 µm, whereas median effluent particle sizes ranged between 1 and 11 µm.

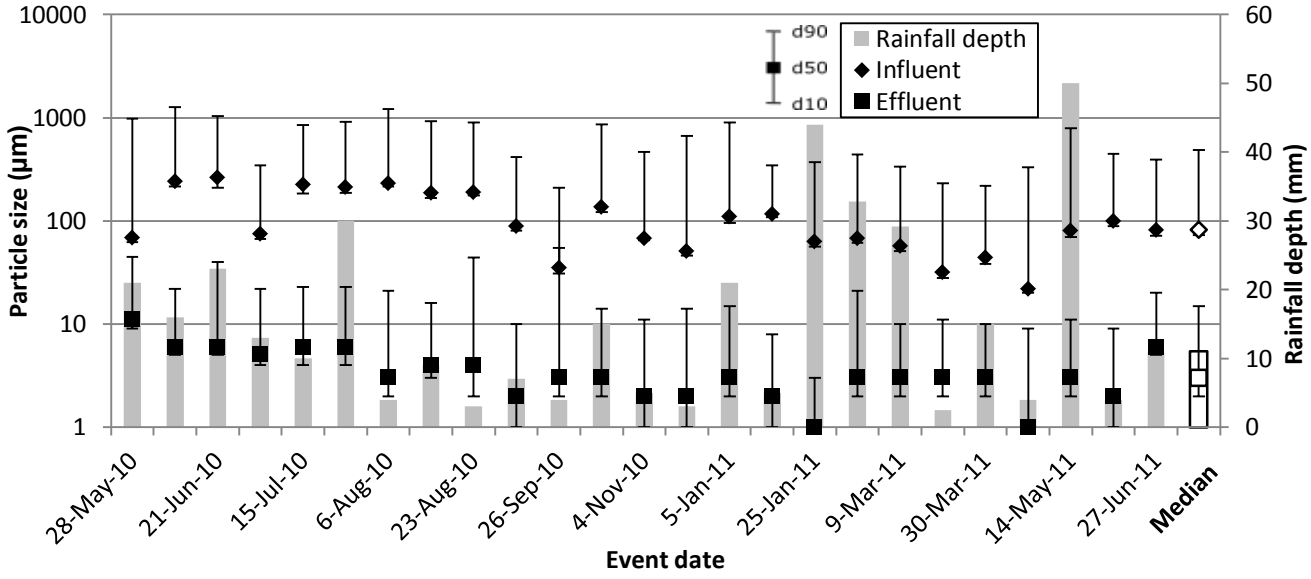


Figure 3. The rainfall depth and d10, d50, and d90 particle sizes of the influent and effluent composite samples for each monitored storm event over the 13-month testing period

Sampling of flows into and out of the Jellyfish Filter over the testing period showed statistically significant reductions ($p < 0.05$; Wilcoxon signed-rank test) in influent event mean concentrations for all selected stormwater constituents (**Table 4** and **Figure 4**). Effluent event mean Suspended Sediment Concentrations (SSC) were below 19 mg/L during all monitored events. Load-based removal rates were also calculated based on the sum of loads over the study period. These removal rages ranged from 46.3 for Total Nitrogen to 98.6 for SSC (**Table 4**).

Table 4. Summary statistics for influent and effluent event mean concentrations for selected constituents

Water Quality Variable	Sampling Location	Min	Max	Median	Range	Mean	SD	Load based removal efficiency (%)
TSS	Influent (mg/L)	16.30	261.00	79.30	244.70	86.26	51.37	87.2
	Effluent (mg/L)	3.20	21.70	11.80	18.50	10.99	4.79	
SSC	Influent (mg/L)	78.20	1401.70	444.50	1323.50	482.26	338.34	98.6
	Effluent (mg/L)	2.80	18.10	7.30	15.30	7.88	3.77	
TP	Influent (µg/L)	887.00	8793.00	3063.00	7906.00	3550.20	1914.50	64.2
	Effluent (µg/L)	472.00	4769.00	1480.00	4297.00	1688.08	1059.98	
TN	Influent (µg/L)	1170.00	10479.00	3110.00	9309.00	3519.32	2161.47	46.3
	Effluent (µg/L)	553.00	6579.00	1610.00	6026.00	2091.76	1613.61	
Zn	Influent (µg/L)	0.005	7600.00	1500.00	7600.00	1792.00	1852.91	76.1
	Effluent (µg/L)	0.005	2760.00	450.00	2760.00	561.64	594.70	
Cu	Influent (µg/L)	0.001	880.40	79.50	880.40	171.28	229.33	92.1
	Effluent (µg/L)	0.001	51.30	6.90	51.30	14.36	17.22	
Oil and Grease	Influent (mg/L)	0.20	4.06	0.93	3.86	1.07	0.82	46.4
	Effluent (mg/L)	0.00	2.32	0.35	2.32	0.50	0.60	

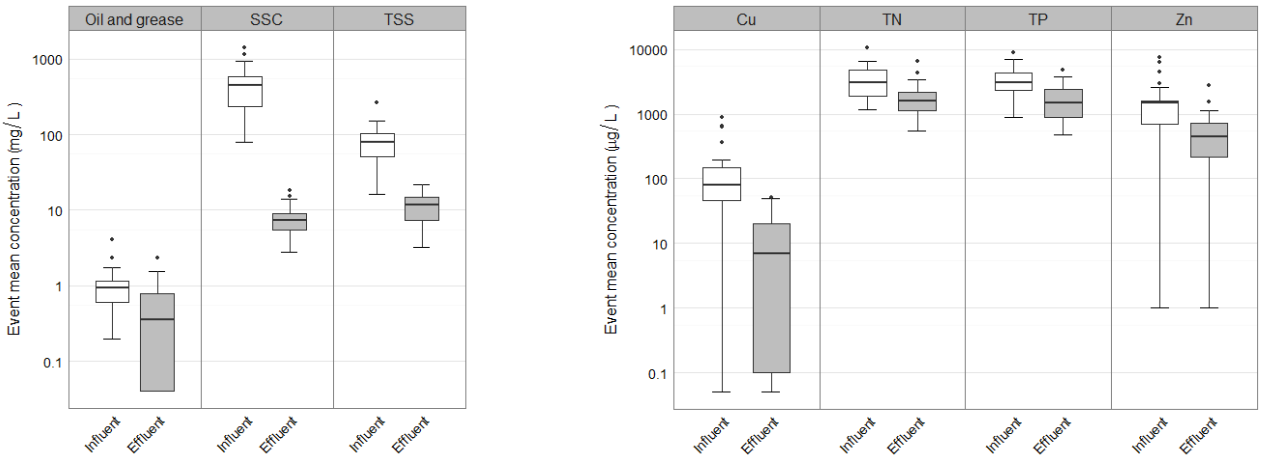


Figure 4. Boxplots showing the distribution of influent and effluent event mean concentrations (EMC) for selected stormwater constituents over the study period

Verification

The verification was completed by the Verification Expert, Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Imbrium Systems to support the performance claim included the performance monitoring report prepared by University of Florida, Engineering School of Sustainable Infrastructure and Environment, and dated November 2011. This report is based on testing completed in accordance with the Technology Acceptance Reciprocity Partnership (TARP) Tier II Protocol (2003) and New Jersey Tier II Stormwater Test Requirements--Amendments to TARP Tier II Protocol (NJDEP, 2009).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Jellyfish® Filter please contact:

Imbrium Systems, Inc.
407 Fairview Drive
Whitby, ON
L1N 3A9, Canada
Tel: 416-960-9900
info@imbriumsystems.com

For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
World Trade Centre
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com

Appendix E

LID TTT Modelling Results

Summary

Site	Project Name	Project Title	Storm Type
Pre-Development			
Post-Development	3103 Coral Sophia Proposed	Coral Sophia Proposed	avg-annual

Water Balance | Post-Development

Catchment	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
1	0.38 ha	944.70 mm 3,552.07 m^3	125.83 mm 473.10 m^3	195.14 mm 733.72 m^3	625.00 mm 2,350.00 m^3	319.70 mm 33.84 %
TOTAL	**0.38 ha**	**944.70 mm** **3,552.07 m^3**	**125.83 mm** **473.10 m^3**	**195.14 mm** **733.72 m^3**	**625.00 mm** **2,350.00 m^3**	**319.70 mm** **33.84 %**

Map | Post-Development

Loading Summary TSS | Post Development

Catchment	Total Catchment TSS Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	95.076 %	0.048 m^3/s	2,755.161 m^3 26.307 mg/l 72.480 kg	2,351.000 m^3 1.518 mg/l 3.569 kg
Total	**95.076 %**	**0.048 m^3/s**	**2,755.161 m^3** **26.307 mg/l** **72.480 kg**	**2,351.000 m^3** **1.518 mg/l** **3.569 kg**

Loading Summary TP | Post Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	72.020 %	0.048 m^3/s	2,755.161 m^3 0.130 mg/l 0.357 kg	2,351.000 m^3 0.043 mg/l 0.100 kg
Total	**72.020 %**	**0.048 m^3/s**	**2,755.161 m^3** **0.130 mg/l** **0.357 kg**	**2,351.000 m^3** **0.043 mg/l** **0.100 kg**

Peak Flow | Post-Development

Catchment	Element	Description	Peak outflow
1	Sophia Street Storm	MAXIMUM FLOW at	0.048 m^3/s
	Filter	MAXIMUM LATERAL INFLOW at	0.047 m^3/s
	Per pave#1	PEAK RUNOFF FLOW from	0.01 m^3/s
	Per pave#2	PEAK RUNOFF FLOW from	0.00 m^3/s
	Building, Dog Patch, Loading Bay	PEAK RUNOFF FLOW from	0.04 m^3/s
	East side Landscaped	PEAK RUNOFF FLOW from	0.00 m^3/s
	Storm Outfall Sewer	MAXIMUM FLOW in	0.047 m^3/s

Loading TSS | Post Development

TSS - Catchment 1

Name	LID Type (removal)	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Building, Dog Patch, Loading Bay	0 %	0.04 m^3/s	2,796.312 m^3 11.995 mg/l 33.542 kg	2,150.000 m^3 11.995 mg/l 25.789 kg
East side Landscaped	0 %	0 m^3/s	160.599 m^3 32.544 mg/l 5.227 kg	10.000 m^3 32.544 mg/l 0.325 kg
Per pave#1	75 %	0.01 m^3/s	529.032 m^3 76.392 mg/l 40.414 kg	170.000 m^3 19.098 mg/l 3.247 kg
Per pave#2	75 %	0 m^3/s	66.129 m^3 90.000 mg/l 5.952 kg	20.000 m^3 22.500 mg/l 0.450 kg
Filter	89 %	0.047 m^3/s	2,340.000 m^3	2,340.000 m^3

			12.601 mg/l 29.486 kg	1.386 mg/l 3.243 kg
Storm Outfall Sewer	0 %	0.047 m^3/s	2,340.000 m^3 1.386 mg/l 3.243 kg	2,340.000 m^3 1.386 mg/l 3.243 kg
Sophia Street Storm	0 %	0.048 m^3/s	2,351.000 m^3 1.518 mg/l 3.569 kg	2,351.000 m^3 1.518 mg/l 3.569 kg

Loading TP | Post Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Building, Dog Patch, Loading Bay	0 %	0.04 m^3/s	2,796.312 m^3 0.103 mg/l 0.289 kg	2,150.000 m^3 0.103 mg/l 0.222 kg
East side Landscaped	0 %	0 m^3/s	160.599 m^3 0.203 mg/l 0.033 kg	10.000 m^3 0.203 mg/l 0.002 kg
Per pave#1	60 %	0.01 m^3/s	529.032 m^3 0.224 mg/l 0.118 kg	170.000 m^3 0.089 mg/l 0.015 kg
Per pave#2	60 %	0 m^3/s	66.129 m^3 0.230 mg/l 0.015 kg	20.000 m^3 0.092 mg/l 0.002 kg
Filter	59 %	0.047 m^3/s	2,340.000 m^3	2,340.000 m^3

			0.102 mg/l 0.239 kg	0.042 mg/l 0.098 kg
Storm Outfall Sewer	0 %	0.047 m^3/s	2,340.000 m^3 0.042 mg/l 0.098 kg	2,340.000 m^3 0.042 mg/l 0.098 kg
Sophia Street Storm	0 %	0.048 m^3/s	2,351.000 m^3 0.043 mg/l 0.100 kg	2,351.000 m^3 0.043 mg/l 0.100 kg

Detailed Report Parameters | Post Development

Sophia Street Storm

Field	Value
Name	Sophia Street Storm
Catchment	1
Outfall Elevation (m)	232.9

Filter

Field	Value
Name	Filter
Junction Type	sorbitive-media
Catchment	1
Invert Elevation (m)	233
Depth to Surface (m)	1.5

Per pave#1

Field	Value
Name	Per pave#1
LID type	perm-pavement

Catchment	1
Outlet (name)	5
% Imperv	100
Width (m)	4
Paved surface (HA)	0.043904000000000006
Roof (HA)	0
Landscaped Area (HA)	0
Row Crop (HA)	0
Open Space/Parkland (HA)	0.012096
Forest (HA)	0
Wetland (HA)	0
(HA)	0
Berm Height (mm)	0
Surface Slope (%)	2.5
Thickness (mm)	300
Void Ratio	0.4
Impervious Surface Fraction	0.9
Permeability (mm/hr)	10
Clogging Factor	0
Soil	
Porosity (Fraction)	0.5

Field Capacity (Fraction)	0.3
Wilting Point (Fraction)	0.1
Conductivity (mm/hr)	10
Conductivity Slope (Dimensionless)	45
Suction Head (mm)	200
Seepage Rate (mm/hr)	10
Flow Coefficient	1
Flow Exponent	1
Offset Height (mm)	0
Mannings Roughness	

Per pave#2

Field	Value
Name	Per pave#2
LID type	perm-pavement
Catchment	1
Outlet (name)	5
% Imperv	100
Width (m)	100
Paved surface (HA)	0.007
Roof (HA)	0
Landscaped Area (HA)	0

Row Crop (HA)	0
Open Space/Parkland (HA)	0
Forest (HA)	0
Wetland (HA)	0
(HA)	0
Berm Height (mm)	0
Surface Slope (%)	3
Thickness (mm)	300
Void Ratio	0.4
Impervious Surface Fraction	0.9
Permeability (mm/hr)	10
Clogging Factor	0
Soil	
Porosity (Fraction)	0.5
Field Capacity (Fraction)	0.3
Wilting Point (Fraction)	0.1
Conductivity (mm/hr)	10
Conductivity Slope (Dimensionless)	45
Suction Head (mm)	200
Seepage Rate (mm/hr)	10
Flow Coefficient	1

Flow Exponent	1
Offset Height (mm)	0
Mannings Roughness	

Building, Dog Patch, Loading Bay

Field	Value
Subcatchment name	Building, Dog Patch, Loading Bay
Catchment	1
Total AREA (HA)	0.296
Impervious area (HA)	0.013319999999999999
Roof area (HA)	0.264032
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0.018647999999999998
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	76

East side Landscaped

Field	Value
Subcatchment name	East side Landscaped
Catchment	1
Total AREA (HA)	0.017
Impervious area (HA)	0.0014960000000000002
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0.015504000000000002
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	38

Storm Outfall Sewer

Field	Value
Name	Storm Outfall Sewer
Catchment	1
Upstream Node	Filter
Downstream Node	Sophia-Street-Storm
Length (m)	14
Manning's Roughness	0.013
Upstream Invert (m)	233
Downstream Invert (m)	232.9
Pipe Diameter (m)	0.375

LID TI Inputs

Permiable Paving Area #1 (West + South Side of Building)

Gross area = 526 m^2 (560m in LID TI Mode)
Grassed = 114 m^2 : 21.6%
Paved = 412 m^2 = 78.4 %

Berm = 0 mm
Surface Slope: Varies 1-5% set @ 2.5%
Paved Portion = 0.9
Soil Thickness = 0mm

Storage = 300 mm
Void = 0.4 (clear stone)

Drain - yes
Offset = 0 mm

Modelled as draining direct to the site filter system

LID TT Inputs

Permiable Paving Area #2 (North East corner of Site)

Gross Area = 61.5 m^2 70 m^2 in LID TT Model)

Paved = 100%

Berm: 0 mm

Surface slope = 3%

Width = 23m

Paved Post,m: 0.9

Soil Thickness: 0mm

Storage: 300 mm

Void: 0.4 (clear stone)

Drain - yes

Offset: 0mm

Modelled as draining directly to the site filter system

LID π Inputs

Buildy, Dog, Loading

Area = 2980 (2960 in LID π)

Perious (Dog Park): 187 m² = 6.3%
Loading Area = 133 m² = 4.5%
Buildy (Roof) = = 89.2%
Soils - Silt Loam
Width = 64m (Full Length of building)
Slope = 2%

Landscaped Area (East and Southeast of Building)
Area = 170 sq.m (170 sq.m in LID π)

Pave = 15 sq.m - 8.8%
Grass) = " 91.2%
Slope 20%

Modelled as draining direct to Sophia Street (not to filter)

External Drainage Area - Not included in Modelly for Phosphorus as project is not responsible for treatment of same

Detention Storage not modelled - has no effect on Tp treatment when modelly average annual rainfall

TP results

TP Load generated : 0.357 kg.yr

After Treatment = 0.100 kg.yr

Compensation Amount : Loading kg/yr × 2.5 × $ 35,000 /kg/yr

= 0.1 × 2.5 × 35,000

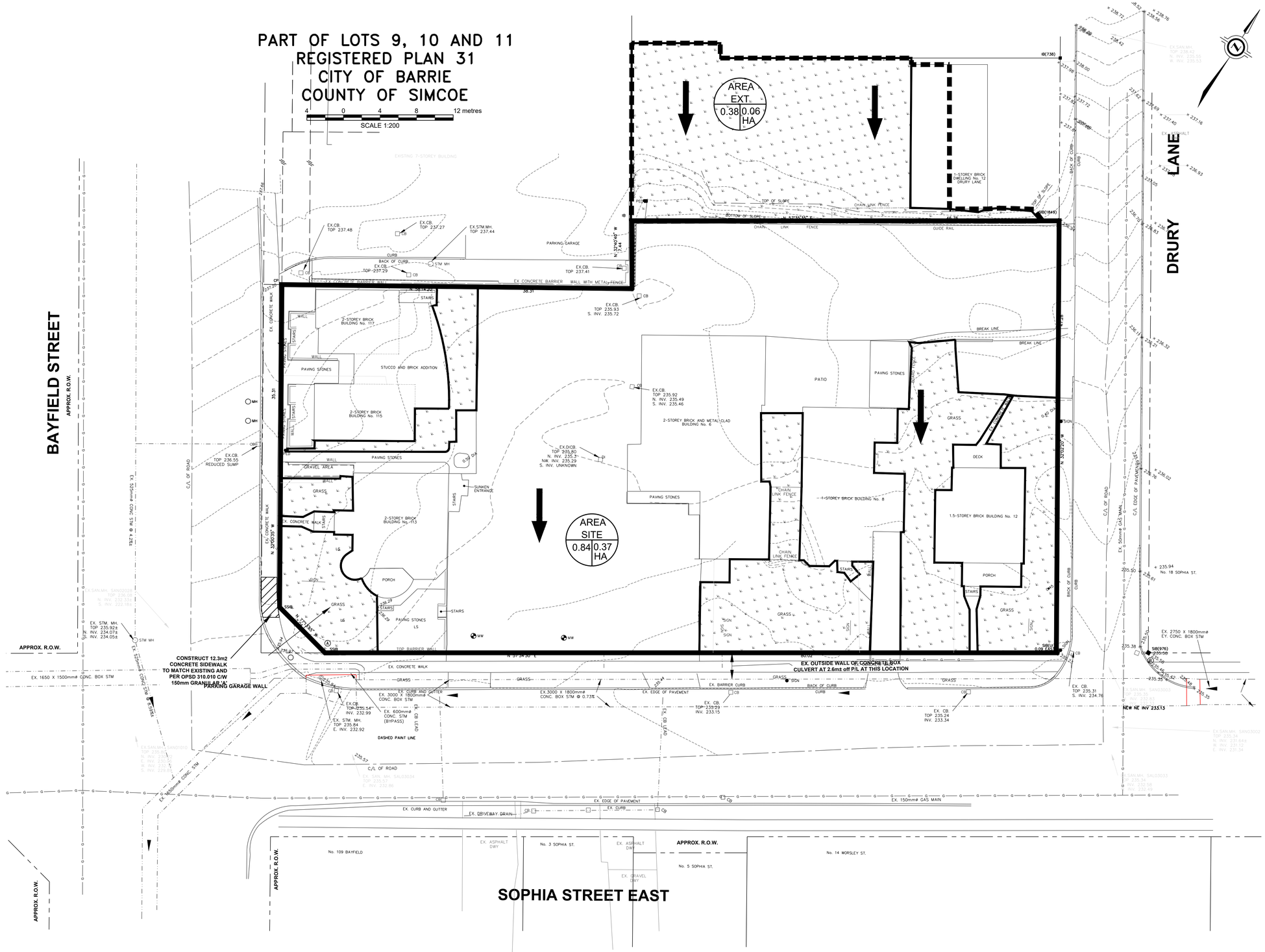
= $ 8,750.00

3103 – SWM1

PART OF LOTS 9, 10 AND 11
REGISTERED PLAN 31
CITY OF BARRIE
COUNTY OF SIMCOE

4 0 4 8 12 metres

SCALE 1:200



KEY MAP
N.T.S.

LEGEND

- DEVELOPMENT BOUNDARY
- EXISTING LIMIT OF R.O.W.
- IB — FOUND IRON BAR
- SIB — FOUND SQUARE IRON BARS
- × 263.20 — EXISTING ELEVATIONS
- CB — EXISTING CATCH BASIN
- STM MH — EXISTING STORM MANHOLE
- EXISTING STORM SEWER
- SIGN — EXISTING SIGN
- 0.XX DIA — EXISTING TREE WITH TRUNK DIAMETER
- EXISTING 1.00 m CONTOUR
- EXISTING 0.50 m CONTOUR
- MW — EXISTING MONITOURING WELL
- AREA 106 0.95 0.09 HA — CATCHMENT ID / CATCHMENT AREA
- RATIONAL C FACTOR (100 YEAR)
- CATCHMENT BOUNDARY
- EXTERNAL CATCHMENT BOUNDARY
- OVERLAND FLOW DIRECTION
- PERVIOUS AREA

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1	APRIL 2020	SUBMISSION FOR REZONING	BWB

LICENSED PROFESSIONAL ENGINEER
B. W. BOLIVAR
100012673
April 24, 2020
PROVINCE OF ONTARIO

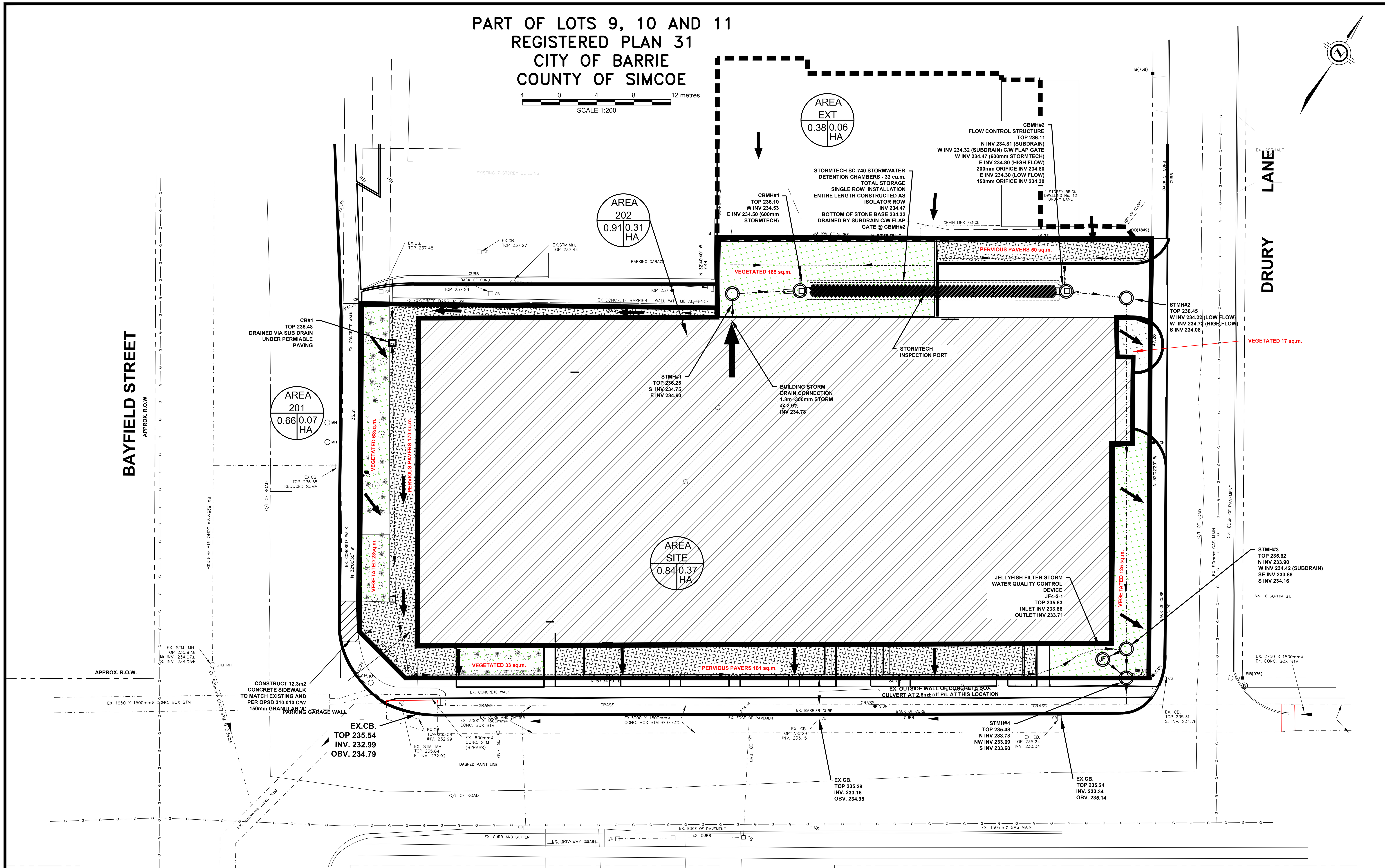
CORAL SOPHIA HOUSING
117 BAYFIELD ST.
BARRIE, ONTARIO
COUNTY OF SIMCOE

EXISTING DRAINAGE CATCHMENT PLAN

PROJECT NO. 17-3103	DRWG NO. SWM1
DATE APRIL 2020	SCALE: 1:200 HOR.
DRAWN: BDD/BWB	CHECKED: APPROVED:

SBA Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS
93 BELL FARM ROAD, SUITE 107
BARRIE, ONTARIO L4M 5G1
www.skeltonbrumwell.ca
TELEPHONE (705) 726-1141
FAX (705) 726-0331
TOLL FREE (877) 726-1141

3103 – SWM2


PART OF LOTS 9, 10 AND 11
REGISTERED PLAN 31
CITY OF BARRIE
COUNTY OF SIMCOE
SCALE 1:200
12 metres
AREA EXT 0.38 0.06 HA
AREA 202 0.91 0.31 HA
AREA 201 0.66 0.07 HA
AREA SITE 0.84 0.37 HA
CBMH#2
FLOW CONTROL STRUCTURE
TOP 236.11
N INV 234.81 (SUBDRAIN)
W INV 234.32 (SUBDRAIN) C/W FLAP GATE
W INV 234.47 (600mm STORMTECH)
E INV 234.80 (HIGH FLOW)
200mm ORIFICE INV 234.80
E INV 234.30 (LOW FLOW)
150mm ORIFICE INV 234.30
STORMTECH SC-740 STORMWATER DETENTION CHAMBERS - 33 cu.m. TOTAL STORAGE SINGLE ROW INSTALLATION ENTIRE LENGTH CONSTRUCTED AS ISOLATOR ROW INV 234.47 BOTTOM OF STONE BASE 234.32 DRAINED BY SUBDRAIN C/W FLAP GATE @ CBMH#2
CBMH#1
TOP 236.10
W INV 234.53
E INV 234.50 (600mm STORMTECH)
1-STOREY BRICK DWELLING No. 12 DRURY LANE
CHAIN LINK FENCE
VEGETATED 185 sq.m.
PERVIOUS PAVERS 50 sq.m.
STMH#2
TOP 236.45
W INV 234.22 (LOW FLOW)
W INV 234.72 (HIGH FLOW)
S INV 234.08
VEGETATED 17 sq.m.
STORMTECH INSPECTION PORT
CB#1
TOP 235.48
DRAINED VIA SUB DRAIN UNDER PERMIABLE PAVING
STMH#1
TOP 236.25
S INV 234.75
E INV 234.60
BUILDING STORM DRAIN CONNECTION 1.8m -300mm STORM @ 2.0% INV 234.78
PARKING GARAGE
EX. CONCRETE BARRIER WALL
EX. CONCRETE BARRIER WALL WITH METAL FENCE
EX. CONCRETE WALK
VEGETATED 68sq.m.
PERVIOUS PAVERS 170 sq.m.
VEGETATED 23sq.m.
VEGETATED 125 sq.m.
JELLYFISH FILTER STORM WATER QUALITY CONTROL DEVICE
JF4-2-1
TOP 235.63
INLET INV 233.86
OUTLET INV 233.71
STMH#3
TOP 235.62
N INV 233.90
W INV 234.42 (SUBDRAIN)
SE INV 233.88
S INV 234.16
No. 18 SOPHIA ST.
EX. 2750 X 1800mmø EY. CONC. BOX STM
VEGETATED 33 sq.m.
PERVIOUS PAVERS 181 sq.m.
EX. OUTSIDE WALL OF CONCRETE BOX CULVERT AT 2.6m± off P/L AT THIS LOCATION
CONSTRUCT 12.3m2 CONCRETE SIDEWALK TO MATCH EXISTING AND PER OPSD 310.010 C/W 150mm GRANULAR 'A'
PARKING GARAGE WALL
EX.CB.
TOP 235.54
INV. 232.99
OBV. 234.79
STMH#4
TOP 235.48
N INV 233.78
NW INV 233.69
S INV 233.60
EX.CB.
TOP 235.29
INV. 233.15
OBV. 234.95
EX.CB.
TOP 235.24
INV. 233.34
OBV. 235.14
BAYFIELD STREET
DRURY
LANE
APPROX. R.O.W.
C/L OF ROAD
EX. 150mmø GAS MAIN
SOPHIA STREET EAST
No. 109 BAYFIELD
No. 3 SOPHIA ST.
No. 5 SOPHIA ST.
No. 14 WORSLEY ST.

KEY MAP
N.T.S.

LEGEND

DEVELOPMENT BOUNDARY
EXISTING LIMIT OF R.O.W.
FOUND IRON BAR
FOUND SQUARE IRON BARS
EXISTING ELEVATIONS
EXISTING CATCH BASIN
EXISTING STORM MANHOLE
EXISTING STORM SEWER
EXISTING SIGN
EXISTING TREE WITH TRUNK DIAMETER
EXISTING 1.00 m CONTOUR
EXISTING 0.50 m CONTOUR
EXISTING MONITOURING WELL
AREA 106 0.95 0.09 HA
CATCHMENT iD
CATCHMENT AREA
RATIONAL C FACTOR (100 YEAR)
CATCHMENT BOUNDARY
EXTERNAL CATCHMENT BOUNDARY
OVERLAND FLOW DIRECTION
PERVIOUS AREA
PROPOSED BUILDING

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1	APRIL 2020	SUBMISSION FOR REZONING	BWB

LICENSED PROFESSIONAL ENGINEER
B. W. BOLIVAR
100012673
PROVINCE OF ONTARIO

CORAL SOPHIA HOUSING
117 BAYFIELD ST.
BARRIE, ONTARIO
COUNTY OF SIMCOE

PROPOSED CATCHMENT PLAN

PROJECT NO. 17-3103	DRWG NO. SWM2
DATE APRIL 2020	SCALE: 1:200 HOR.
DRAWN: BDD/BWB	CHECKED:
APPROVED:	

Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS
93 BELL FARM ROAD, SUITE 107
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TOLL FREE (877) 726-1141

CONTROL MONUMENTS

HORIZONTAL CONTROL MONUMENT

THE HORIZONTAL MONUMENT 01019860463

THE HORIZONTAL MONUMENT IS LOCATED IN PAVED DRIVEWAY UNDER WATER VALVE COVER ON THE WEST SIDE OF MULCASTER STREET IMMEDIATELY NORTH OF #108 MULCASTER STREET.

NORTHING (SECOND ORDER): 4916487.811
EASTING (SECOND ORDER): 604671.596

HORIZONTAL MONUMENT 03120040046

THE HORIZONTAL MONUMENT 03120040046 IS LOCATED IN QUEEN'S PARK ON SOUTH-EAST CORNER OF ROSS STREET AND PARKSIDE DRIVE. NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.

NORTHING (SECOND ORDER): 4916082.772
EASTING (SECOND ORDER): 603662.430

NOTES

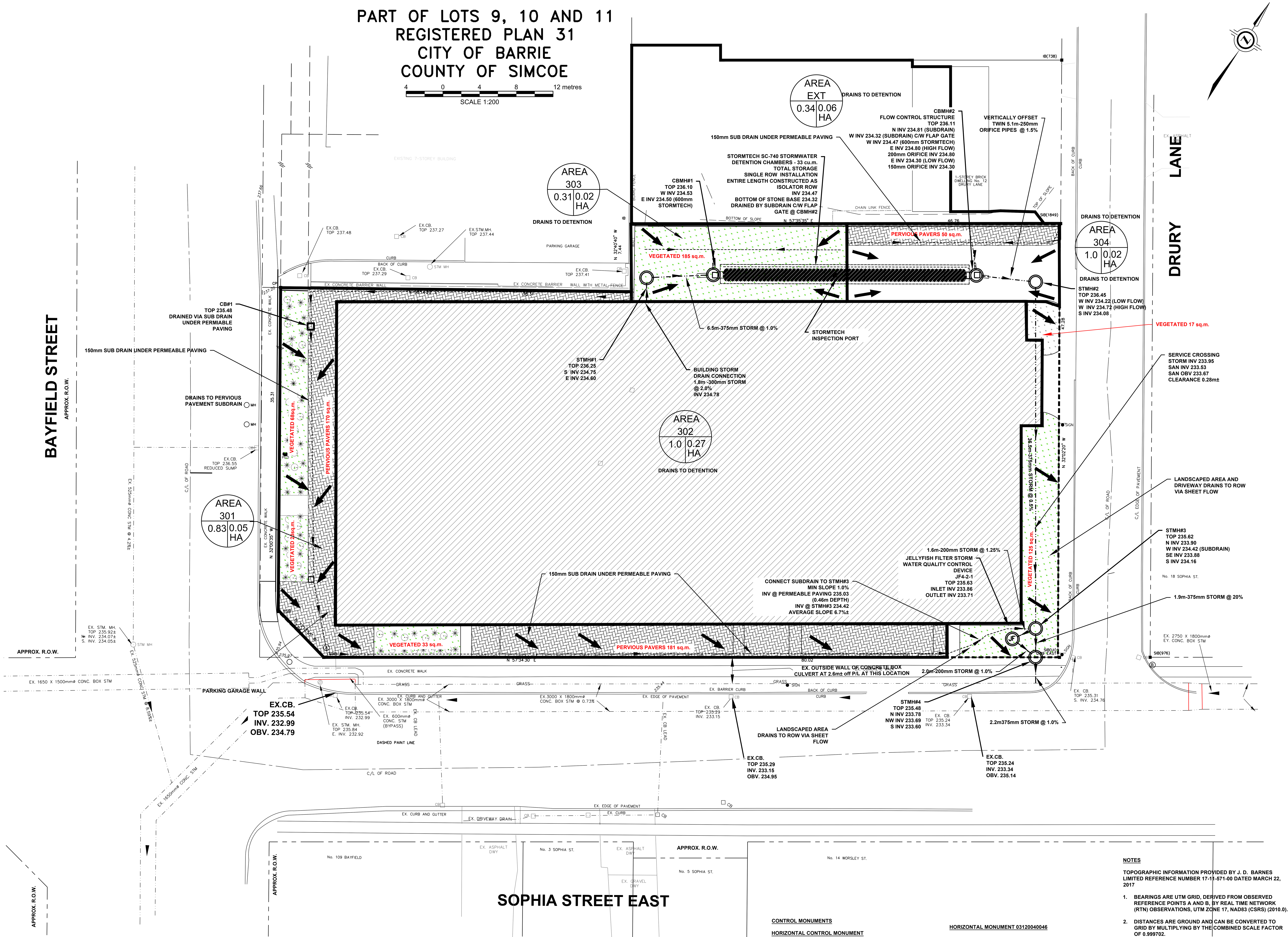
TOPOGRAPHIC INFORMATION PROVIDED BY J. D. BARNES LIMITED REFERENCE NUMBER 17-11-571-00 DATED MARCH 22, 2017

1. BEARINGS ARE UTM GRID, DERIVED FROM OBSERVED REFERENCE POINTS A AND B, BY REAL TIME NETWORK (RTN) OBSERVATIONS, UTM ZONE 17, NAD83 (CSRS) (2010.0).
2. DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.999702.
3. ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM BENCH MARK No 03120080022 HAVING A PUBLISHED ELEVATION OF 222.437 METRES.

UNDERGROUND SERVICES AND UTILITIES LOCATION AND ELEVATIONS SHOWN ARE APPROXIMATE ONLY AND COMPILED FROM COUNTY OF SIMCOE DRAWING NUMBER 2002-02 SHEET PP7, SHEET PP2 AND CONTRACT NUMBER 71-31 DRAWING NO. 71-41.

TOPOGRAPHIC CONTOURS BY SKELTON BRUMWELL UTILZING TOPOGRAPHIC INFORMATION BY J. D. BARNES LIMITED AS NOTED ABOVE.

3103 – SWM3



KEY MAP
N.T.S.

LEGEND

DEVELOPMENT BOUNDARY
EXISTING LIMIT OF R.O.W.
FOUND IRON BAR
FOUND SQUARE IRON BARS
EXISTING ELEVATIONS
EXISTING CATCH BASIN
EXISTING STORM MANHOLE
EXISTING STORM SEWER
EXISTING SIGN
EXISTING TREE WITH TRUNK DIAMETER
EXISTING 1.00 m CONTOUR
EXISTING 0.50 m CONTOUR
EXISTING MONITOURING WELL
AREA 106 0.95 0.09 HA — CATCHMENT ID; CATCHMENT AREA; RATIONAL C FACTOR (100 YEAR)
CATCHMENT BOUNDARY
EXTERNAL CATCHMENT BOUNDARY
OVERLAND FLOW DIRECTION
PERVIOUS AREA
PROPOSED BUILDING

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1	APRIL 2020	SUBMISSION FOR REZONING	BWB

LICENSED PROFESSIONAL ENGINEER
April 24, 2020
B. W. BOLIVAR
100017673
PROVINCE OF ONTARIO

CORAL SOPHIA HOUSING
117 BAYFIELD ST.
BARRIE, ONTARIO
COUNTY OF SIMCOE

PROPOSED CATCHMENT PLAN

PROJECT NO. 17-3103	DRWG NO. SWM3
DATE APRIL 2020	SCALE: 1:200 HOR.
DRAWN: BDD/BWB CHECKED:	APPROVED:

SBA Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS
93 BELL FARM ROAD, SUITE 107
BARRIE, ONTARIO L4M 5G1
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TELEPHONE (705) 726-1141
FAX (705) 726-0331
TOLL FREE (877) 726-1141

CONTROL MONUMENTS

HORIZONTAL CONTROL MONUMENT

THE HORIZONTAL MONUMENT 01019860463

THE HORIZONTAL MONUMENT IS LOCATED IN PAVED DRIVEWAY UNDER WATER VALVE COVER ON THE WEST SIDE OF MULCASTER STREET IMMEDIATELY NORTH OF #108 MULCASTER STREET.

NORTHING (SECOND ORDER): 4916487.811
EASTING (SECOND ORDER): 604671.596

HORIZONTAL MONUMENT 03120040046

THE HORIZONTAL MONUMENT 03120040046 IS LOCATED IN QUEEN'S PARK ON SOUTH-EAST CORNER OF ROSS STREET AND PARKSIDE DRIVE. NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.

NORTHING (SECOND ORDER): 4916082.772
EASTING (SECOND ORDER): 603662.430

NOTES

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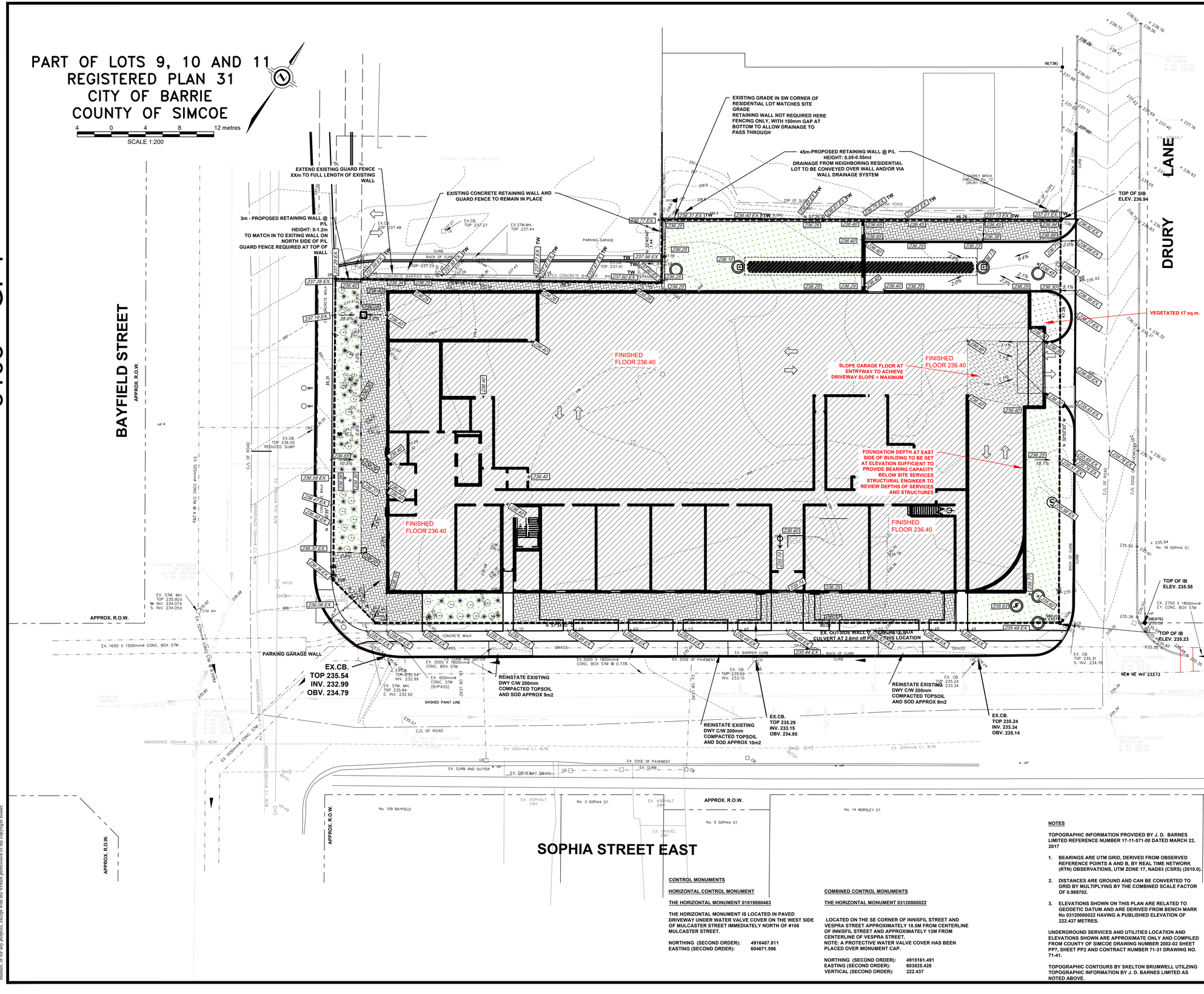
TOPOGRAPHIC CONTOURS BY SKELTON BRUMWELL UTILZING TOPOGRAPHIC INFORMATION BY J. D. BARNES LIMITED AS NOTED ABOVE.

3103 – GP1

PART OF LOTS 9, 10 AND 11
REGISTERED PLAN 31
CITY OF BARRIE
COUNTY OF SIMCOE

4 0 4 8 12 metres
SCALE 1:200



KEY MAP
N.T.S.

LEGEND

- DEVELOPMENT BOUNDARY
- EXISTING LIMIT OF R.O.W.
- IB — FOUND IRON BAR
- SB — FOUND SQUARE IRON BARS
- × 263.20 — EXISTING ELEVATIONS
- CB — EXISTING CATCH BASIN
- STM MH — EXISTING STORM MANHOLE
- STM — EXISTING STORM SEWER
- SAN MH — EXISTING SANITARY MANHOLE
- SAN — EXISTING SANITARY SEWER
- SAN — EXISTING SANITARY SERVICE
- HYD — EXISTING FIRE HYDRANT PER TOPO SURVEY
- WV — EXISTING WATER VALVE PER TOPO SURVEY
- EXISTING CURB STOP PER TOPO SURVEY
- EXISTING WATERMAIN
- E.M.H. — EXISTINGELECTRICAL MANHOLE
- LS — EXISTING LIGHT STANDARD
- HP — EXISTING HYDRO POLE
- OH — EXISTING OVERHEAD HYDRO
- PED — EXISTING BELL PEDESTAL
- SIGN — EXISTING SIGN
- 1M — EXISTING 1.00 m CONTOUR
- 0.5M — EXISTING 0.50 m CONTOUR
- MW — EXISTING MONITOURING WELL
- × 263.80 / 236.16 — PROP. SPOT ELEVATION
- × 263.80 TC — PROP. TOP OF CURB SPOT ELEVATION
- × 263.80 TW — PROP. TOP OF WALL SPOT ELEVATION
- × 263.80 BW — PROP. BOTTOM OF WALL SPOT ELEVATION
- 18.7% — PROPOSED GRADE
- PROPOSED TREES AND/OR SHRUBS
- PROPOSED VEGETATED SURFACE
- PROPOSED PERMEABLE PAVING WITH UNDERDRAIN

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1.	MARCH 20, 2020	ISSUED FOR PRE-CONSULTATION	BWB
2.	APRIL 2020	SUBMISSION FOR REZONING	BWB

LICENSED PROFESSIONAL ENGINEER
April 15, 2020
B. W. BOLIVAR
100013673
PROVINCE OF ONTARIO

CORAL SOPHIA HOUSING
117 BAYFIELD ST.
BARRIE, ONTARIO
COUNTY OF SIMCOE

SITE GRADING PLAN

CONTROL MONUMENTS

HORIZONTAL CONTROL MONUMENT

THE HORIZONTAL MONUMENT 01019860463

THE HORIZONTAL MONUMENT IS LOCATED IN PAVED DRIVEWAY UNDER WATER VALVE COVER ON THE WEST SIDE OF MULCASTER STREET IMMEDIATELY NORTH OF #108 MULCASTER STREET.

NORTHING (SECOND ORDER): 4916487.811
EASTING (SECOND ORDER): 604671.596

COMBINED CONTROL MONUMENTS

THE HORIZONTAL MONUMENT 03120080022

LOCATED ON THE SE CORNER OF INNISFIL STREET AND VESPRA STREET APPROXIMATELY 18.5M FROM CENTERLINE OF INNISFIL STREET AND APPROXIMATELY 13M FROM CENTERLINE OF VESPRA STREET.
NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.

NORTHING (SECOND ORDER): 4915161.491
EASTING (SECOND ORDER): 603825.428
VERTICAL (SECOND ORDER): 222.437

NOTES

TOPOGRAPHIC INFORMATION PROVIDED BY J. D. BARNES LIMITED REFERENCE NUMBER 17-11-071-00 DATED MARCH 22, 2017

1. **BEARINGS ARE UTM GRID, DERIVED FROM OBSERVED REFERENCE POINTS A AND B, BY REAL TIME NETWORK (RTN) OBSERVATIONS, UTM ZONE 17, NAD83 (CSRS) (2010.0).**
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TOPOGRAPHIC CONTOURS BY SKELTON BRUMWELL UTILIZING TOPOGRAPHIC INFORMATION BY J. D. BARNES LIMITED AS NOTED ABOVE.

PROJECT NO. 17-3103	DRWG NO. 3103-GP1
DATE APRIL 2020	SCALE: 1:200 HOR.
DRAWN: BDD/BWB	CHECKED: APPROVED:

SBA Skelton Brumwell & Associates Inc.
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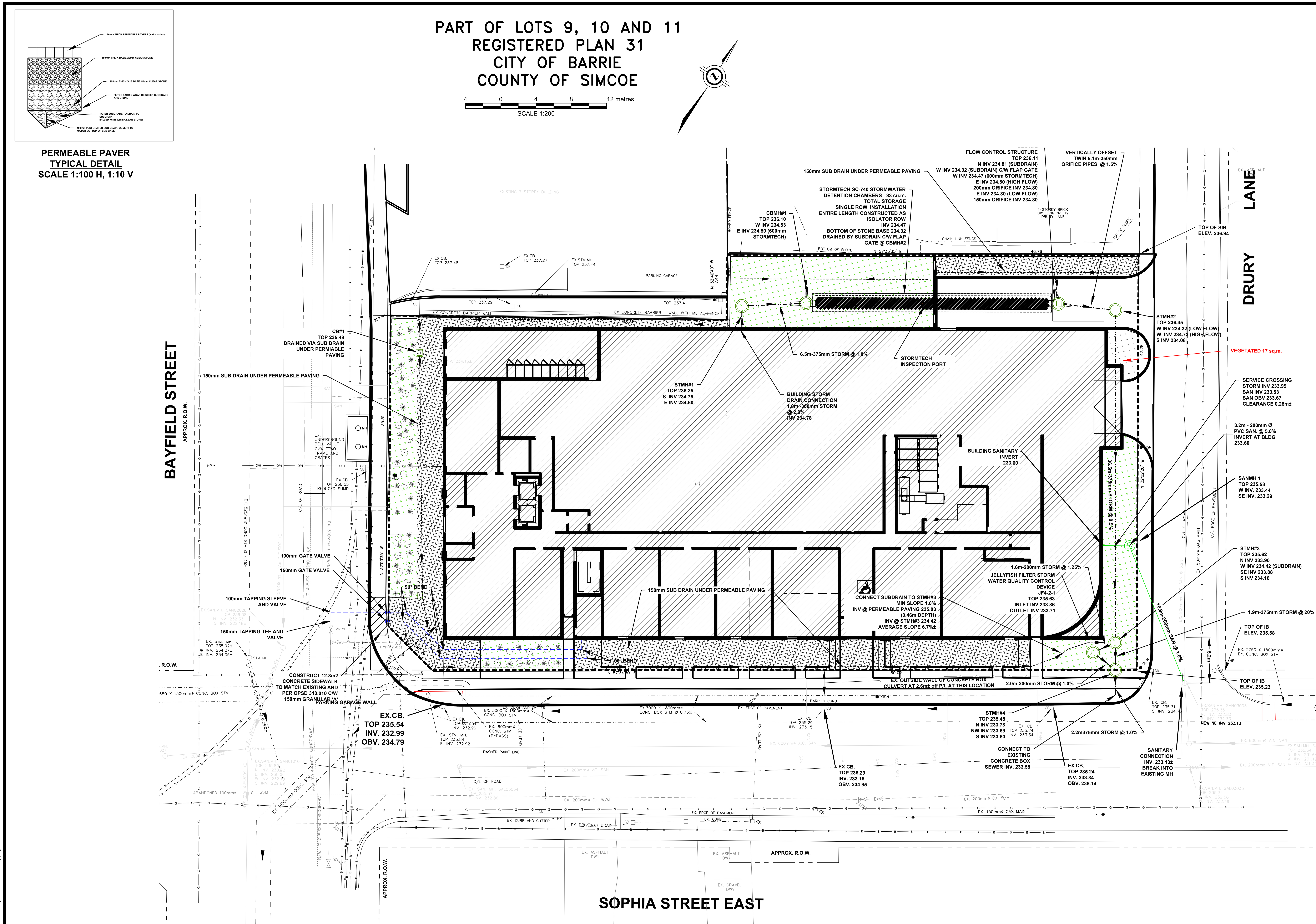

KEY MAP
N.T.S.

LEGEND

- DEVELOPMENT BOUNDARY
- EXISTING LIMIT OF R.O.W.
- FOUND IRON BAR
- FOUND SQUARE IRON BARS
- EXISTING CATCH BASIN
- EXISTING STORM MANHOLE
- EXISTING STORM SEWER
- EXISTING SANITARY MANHOLE
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- EXISTING SANITARY SERVICE
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- EXISTING WATERMAIN
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- EXISTING LIGHT STANDARD
- EXISTING HYDRO POLE
- EXISTING OVERHEAD HYDRO
- EXISTING BELL PEDESTAL
- EXISTING GAS
- EXISTING UNDERGROUND BELL
- EXISTING SIGN
- PROP. SANITARY MANHOLE
- PROP. SANITARY SEWER
- PROP. STORM SEWER
- PROP. STORM MANHOLE
- PROP. CATCH BASIN MANHOLE
- PROP. SUBDRAIN
- PROPOSED PERMEABLE PAVING WITH UNDERDRAIN

SCHEDULE OF REVISIONS

NO.	DATE	DESCRIPTION	CHECKED
1.	MARCH 20, 2020	ISSUED FOR PRE-CONSULTATION	BWB
2.	APRIL 2020	PRE-DEVELOPMENT SUBMISSION	BWB

LICENSED PROFESSIONAL ENGINEER
B. W. BOLIVAR
100017673
PROVINCE OF ONTARIO

CORAL SOPHIA HOUSING
117 BAYFIELD ST.
BARRIE, ONTARIO
COUNTY OF SIMCOE

SITE SERVICING PLAN ABOVE GROUND

PROJECT NO. 17-3103	DRWG NO. 3103-SS1
DATE APRIL 2020	SCALE: 1:200 HOR.
DRAWN: BDD/BWB	CHECKED: / APPROVED:

Skelton Brumwell & Associates Inc.
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3103 – SS1