STORMWATER MANGEMENT REPORT
217 Dunlop Street East
Condominium Development

PBM Realty Holdings Inc.

P/N 3315 | December 15, 2020

Skelton Brumwell & Associates Inc.
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City of Barrie
217 Dunlop Street East

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Stormwater Management Report
PBM Realty Holdings Inc.
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P/N 20–3315 December 15, 2020

1.0 Introduction

PBM Realty Holdings Inc. (PBM) is proposing to develop an existing vacant lot located at 217 Dunlop Street East in the City of Barrie into a fifteen (15) storey, forty–one (41) unit residential condominium building, complete with three (3) levels of indoor parking. The subject property is located on the south side of Dunlop Street East at the intersection of Dunlop Street East and Sampson Street in the City of Barrie.

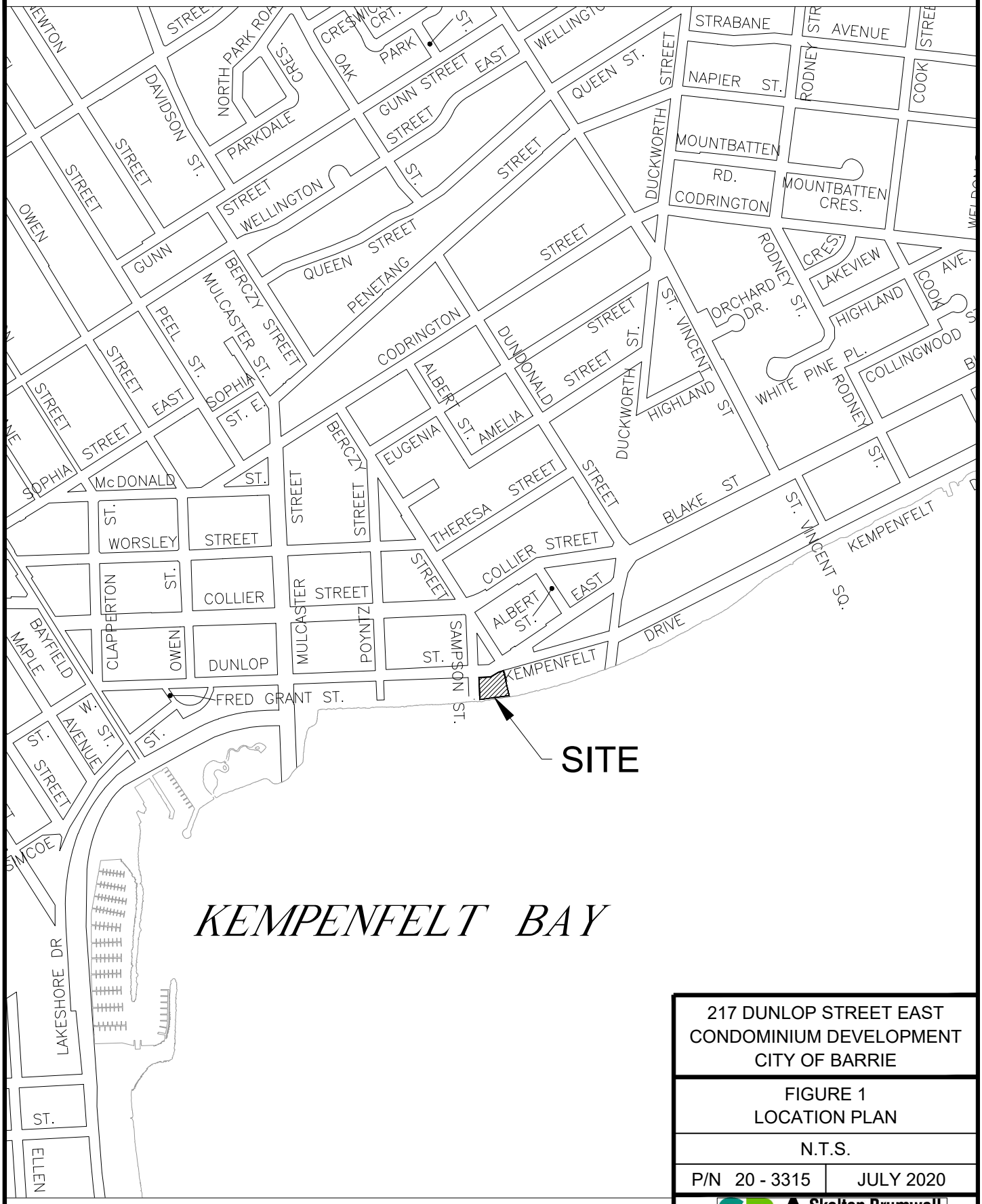
The property is irregular in shape and comprises an area of approximately 0.201 ha. The subject property is legally described as Part of Lot 24, Concession 4, Geographic Township of Vespra, County of Simcoe, now in the City of Barrie. It is further described as Broken Lots 33, 135 and 136 on the south side of Dunlop Street, and Part of Water Lots 33, 135 and 136 Lying in Front of the Broken Lots in Front of Registered Plan 2, in the City of Barrie, County of Simcoe. The location is shown on Figure 1 – Location Plan.

The property is bounded by Dunlop Street East to the north, existing high–rise condominiums know as the Flamenco Condos to the west, a single detached dwelling to the east, and the City of Barrie North Shore Trail along Kempenfelt Bay to the south, which is the former Canadian National Railway line. Figure 2 shows the proposed site plan for the project.

Skelton, Brumwell & Associates Inc. (SBA) has been retained to provide consulting engineering services in support of the redevelopment of the subject property. In support of the proposed Rezoning and Site Plan Approval, a stormwater management design for the property has been completed as summarized herein.

2.0 Pre-Consultation

In advance of the application, pre-consultation was conducted by the development consulting team with both the City of Barrie (COB) and Lake Simcoe Conservation Authority (LSRCA). This pre-consultation identified specific reports and studies that are required for this development project. This stormwater management report is being completed to address, in part, these requirements.



217 DUNLOP STREET EAST
CONDOMINIUM DEVELOPMENT
CITY OF BARRIE

FIGURE 1
LOCATION PLAN

N.T.S.

P/N 20 - 3315 | JULY 2020

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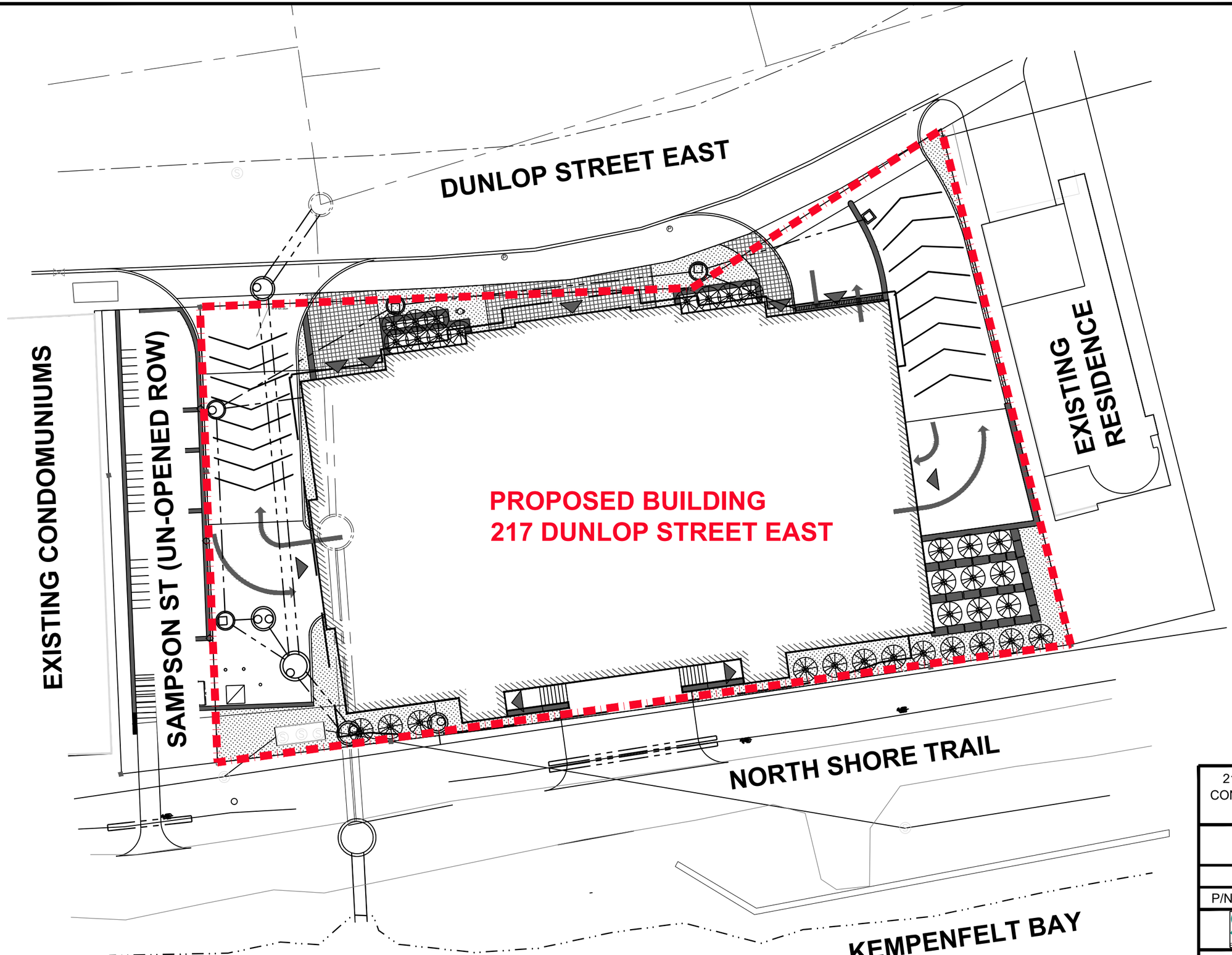

217 DUNLOP STREET EAST
CONDOMINIUM DEVELOPMENT
CITY OF BARRIE

FIGURE 2
SITE PLAN

N.T.S.

P/N 20 - 3315 | NOVEMBER 2020

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3.0 Existing Site Conditions

The existing site is currently vacant; however, there was formerly a dry–cleaning business on the subject lands. Topographic information for the site was compiled by Rudy Mak Surveying Ltd. in May and June 2020, and shows total relief on the site to be in the order of 5.7 metres, generally falling from north to south towards Kempenfelt Bay with an average slope of approximately 15%.

The existing site is accessed via two (2) driveways off of Dunlop Street East, which has a two–lane cross section with on street parking and a width of about 15 metres. Sidewalks are present on both sides of the roadway. Dunlop Street East is defined as an Arterial Road in the City of Barrie's Official Plan.

There is an existing 750 mm diameter storm sewer running from north to south through the subject property, along the former Sandford Street right-of-way. The sewer is 750mm from storm manhole DDML00021 at Dunlop Street East to storm manhole DDML00011 on the property. Stormwater is then conveyed via twin 525 mm diameter storm sewers running from north to south storm manhole DDML00271, crossing under a trunk sanitary sewer. This lower manhole structure is drained by a 900mm CSP pipe that outsets south of the walkway, directly into Kempenfelt Bay. Existing topography for the site also directs flow overland generally from north to south across the trail system and into Kempenfelt Bay. There is an existing ditch system on the north side of the trail that intercepts most of the flow form the subject site and directs it to the storm sewer which drains under the walkway.

3.1 Brownfield Site Conditions

We understand that the Site has a Record of Site Condition (RSC No.: 4074-7KGNKA) and a Certificate of Property Use (CPI No.: 6278-AYRLD6) have been issued for the Site by the Ministry of Environment, Conservation & Parks (MECP). It is understood that the concern is currently only within the upper sand aquifer, with an impervious till layer providing a level of protection for the lower sand aquifer unit. In order to contain the contamination, the site must be developed in accordance with the Certificate of Property Use.

This condition eliminates the potential for infiltration measures to be utilized for water balance and phosphorous treatment.

3.2 LSRCA Regulation Area

Review of LSRCA interactive mapping shows that this site is regulated, similar to the vast majority of the Lake Simcoe Shoreline. For this site, the regulations would be for flooding and erosion hazard.

3.2.1 Flooding

Lake Simcoe is not subject to flooding due to a storm event in the same way a watercourse (river, stream) would be. The historical high-water level for the lake is 219.5m. Review of topographic survey information for the project shows that the entire site is above this elevation. Even the top of the north shore trail is above this historic high-water level. As such, in our opinion there is no risk of flooding of the property and development of the site.

3.2.2 Erosion Hazard

Being adjacent to Lake Simcoe and buffered by the north shore trail, the site is not subject to erosion hazards from wave action at its lower elevation. Existing drainage infrastructure on Dunlop Street and upstream protect the site from erosion caused by runoff flowing through the site. There is technically the potential for some erosion on the property from direct rainfall, however there is no evidence that this is taking place at this time, likely due to the vegetative cover that is currently in place. Development of the site will maintain and enhance protection from erosion through addition of hard surfaces (driveways, sidewalks, building roof) and ensuring that landscaped surfaces are fully covered with vegetation.

4.0 Stormwater Management Requirements

The stormwater management design for the project has been prepared in accordance with policies and requirements of the Ministry of Environment, Conservation and Parks (MOECP), Lake Simcoe Protection Plan (LSPP), LSRAC and City of Barrie. Standard stormwater management requirements for these projects are as follows:

1) Control Post-Development peak flows to Pre-Development magnitudes for storms from the 1 in 2-year to 1 in 100-year return period.

2) Site grading and drainage to be completed to comply with the Ontario Building Code.

3) Provide Enhanced level quality treatment for storm water leaving the site (80% TSS Removal)

4) Provide water balance to achieve pre-development infiltration rates

5) Provide 80% Total Phosphorus removal plus target a net zero discharge.

In addition, the existing Sampson Street Storm sewer is in conflict with the proposed building. This sewer will need to be re-aligned to allow for the proposed building footprint to be constructed.

5.0 Proposed Stormwater Management

5.1 Sampson Street Storm Re-Alignment

Based on City of Barrie Record drawings, GIS information and site topographic survey, the existing storm sewer along the former Sampson Street right-of-way has been identified and determined to be in conflict with the proposed building foot print. It is proposed to re-align this sewer to the west, providing clearance for the building while maintaining its current flow capacity. The new alignment will be under the west site access ramp for the lower-level interior site parking area. All new pipe will be 750mm diameter matching the size of the pipe being replaced and the upstream sewer on Dunlop Street.

The re-alignment will include adding two new manhole structures to facilitate the shift in alignment around the building and tying back into the downstream most existing manhole, upstream of the trunk sanitary sewer. From here the original storm sewer consisting of twin 525mm concrete pipes and downstream 900mm CSP outlet sewer will be retained so as to avoid having to construct a new storm sewer under the trunk sanitary. This configuration also eliminates the need to disturb the North Shore Trail or construct a new outlet to Kempenfelt Bay.

5.1.1 New Sewer Capacity

City drawings show that the upstream catchment for this sewer is 16.8 Ha in size with a C factor of 0.40. Based on topographic mapping and street patterns, the overall flow path and slope was determined so as to be able to calculate the time of concentration (20min) of flows entering this lower branch of the sewer. This in turn was utilized in calculating the expected peak flows in the sewer. To be conservative, current City of Barrie IDF data was utilised for determining peak flows. As these are increased by 15% to account for Climate Change, calculated peak flows would be higher than originally calculated when the sewer was designed in mid-90s.

From here, the new sewer is designed to convey the newly calculated peak flows. All new sections of sewer will convey the peak flow from the 1 in 100-year event. The limiting factor in both the existing and proposed sewer alignment is the twin 525mm pipes which only have capacity to convey the 1 in 10-year event. However, in our opinion, this is sufficient conveyance for the crossing of a recreational trail. The calculations are also for free flow conditions. Under surcharge, the existing twin 525mm sewers can be expected to carry a greater flow. In the event that the surcharge causes the manhole upstream of the trunk sanitary and trail to over top, flows will simply spill over the walkway to Kempenfelt Bay without impacts to neighboring properties.

Please refer to drawing SWM1, C002 and Appendix A for calculations related to the design of the sewer realignment.

5.1.2 Sewer Works Considerations – Groundwater

The majority of the proposed storm sewer works for the project will be above the seasonal high groundwater elevation as noted in the Azimuth Hydrogeological Assessment (November 2020). The connection point to the storm sewer under the North Shore Trail, STMH#3 could intercept the shallow groundwater. To mitigate this risk, it is suggested that construction of the site storm sewer be scheduled in the historically driest time of year, late July and August, when the groundwater elevation is likely to be the lowest. We have discussed this approach with Azimuth and they agree as a general best practice approach.

Further options to be considered would be founding STMH#3 and the upstream storm sewer to be constructed on filter wrapped clear stone or possibly lean mix concrete which would limit the amount of work to be completed at depth, shortening the time line of construction and reducing the risk of groundwater interception and the need to dewater the excavation.

Sewer works installations will also include provisions for a soil cap/barrier as well as impermeable seals across the sewer trench to prevent groundwater draining along the granular backfill.

The detailed design phase of the project examines the options and details for trench construction and sewer installation will be developed to meet the requirements of the Certificate of Property Use.

5.2 Site Grading and Drainage

Give the steep existing grades between Dunlop Street and the North Shore Trail along with the difference in elevations between the various parking levels, the site will make extensive use of ramps for vehicular access and stairs maintain pedestrian access from Dunlop Street and the proposed building, down to the trail.

Barrier free street access will be provided at the front entrance from Dunlop Street. Here grading will be maintained with moderate slopes (1-5%) for this reason. Vehicular ramps to the various parking levels will be at significantly steeper slopes. The design consulting team for the project have reviewed this condition and determined that the exterior vehicle ramps will be provided with a glycol loop for heating during the winter months. This is intended to maintain the ramps free of ice and snow so that vehicles can traverse them safely.

The areas outside of the building and vehicle access ramps will be landscaped and vegetated. These portions of the site, with a combined area of only 0.01 Ha (5% of the site) will continue to drain southward toward the North Shore Trail consistent with existing conditions. From here the

majority of this flow will be collected in existing swales and conveyed to the storm sewer crossing under the North Shore Trail as per existing conditions.

The balance of the site will be drained by a storm sewer system sized for peak flow from a 1 in 5-year event. This includes all vehicular driving surfaces, the entire building roof and some portions of the Dunlop Street right-of-way where existing grades require the sidewalk to drain back toward the site in order to maintain barrier free access at the front entrance. Flows from the site storm sewer will enter the re-aligned municipal storm sewer at the south side of the site at STMH#3, located at the south west corner of the proposed building.

The proposed storm sewer system is illustrated on drawing C002 and SWM 2. For ease of computation and to be conservative, all of the catchments were assumed to be have a C factor of at least 0.95 which reflects full imperviousness. The building roof was given a C factor of 1.0 which assumes no evapotranspiration or other losses. Sizing calculations for the site storm sewer are included in Appendix A.

Collecting the majority of hard surfaces and all vehicular access surfaces in a storm sewer facilitates quality control treatment as well, which is discussed in Section 4.4. The site storm sewer will tie into the re-aligned Sampson Street storm sewer so no new outlet across the North Shore Trail or into Kempenfelt Bay will be required.

5.3 Peak Flow Control

The subject site is at the downstream limit of the Sanford Street storm sewer which is sized for a 16.8 Ha catchment. The calculated time of concentration from the upstream drainage catchment is in the order of 20min compared to the conventionally assumed 10-minute initial time of concentration of the site. This means that the peak flow from the site sewers should pass through to Kempenfelt Bay well before the upstream peak flows arrive.

By routing the majority (95%) of the site drainage via sewers to the Sanford Street sewer, the amount of sheet flow to the North Shore trail will be greatly reduced from the existing condition, (0.201 Ha existing to 0.01 Ha in the proposed) preventing any adverse impacts (flooding, erosion) on the trail itself.

Because the Sanford Street storm sewer drains directly to Kempenfelt Bay, under the north short walkway, there are no downstream properties than can be affected by storm runoff.

With consideration of these three points, no on-site peak flow control is proposed for the project.

5.4 Quality Control

The site coverage for the project, steep grading and existing soil contamination limit stormwater treatment options. In order to provide quality control as well as phosphorous treatment, it is proposed to route all of the site storm sewers through a Jellyfish Membrane filter. These filters are rated to remove approximately 85% of Total Suspended Solids (TSS) and 49% of phosphorous. Sizing for the filter will be completed at the detailed design stage.

By routing all of the site storm sewers through the Jellyfish, all of the site surface subject to vehicular loading will be treated for quality control and the MOE required 80% TSS reduction will be achieved. The filter will also capture hydrocarbons and provide treatment for heavy metals as are likely to be present due to vehicles exhaust and wearing of brake components.

The remaining hard surfaces on the site will be pedestrian stairs and walkways at the south side of the property. These will produce significantly less contaminated runoff, largely limited to sand and de-icing salt, the later of which cannot be treated by conventional stormwater treatment measures.

Vegetated surfaces are not considered to require quality treatment, so having these areas drain without quality control provides no risk to the environment downstream.

5.4.1 TSS Modelling – LID TTT

The project site has been modelled with the Low Impact Development Treatment Train Tool as developed in part by the LSCRA. This model includes a module for analysing TSS removal in a treatment train. The results of this modelling are summarized in Table 1.

Table 1 – TSS Removal

Development Condition	TSS Loading (Kg/yr)	TSS Removal (%)
Pre	34.5	
Post (no controls)	42.4	
Post (with controls)	6.8	83.9

The LID TTT modeling results for total suspended solids are included in Appendix B of this report.

5.5 Phosphorous Control

As previously noted, the site has contamination in the shallow aquifer below the site, which precludes infiltration of stormwater. Also, per the Ontario Building Code, infiltration facilities must be located greater than 5m from foundations. The proximity of the proposed foundation and the foundations of the existing adjacent buildings to the property lines significantly limits space where infiltration features can be implemented.

As such, infiltration is not considered a feasible option for phosphorus treatment. Instead, the site will rely on a Jellyfish filter to remove phosphorus from the majority of the site area. This means however, that it will not be possible to achieve the LSRCAs target of 80% removal. This is a best-efforts approach to phosphorus control.

A phosphorus model has been developed using the Low Impact Development Treatment Train Tool (LID TTT). For consistency with the water balance analysis, we have utilized the pre- and post-development land use summaries as provided by Azimuth Hydrogeological Assessment (November 2020). We have also reviewed historical mapping from Simcoe County which shows the site for various time periods. Air photos from 2002 show the former building on site which allows us to determine building coverage as a component land use. For the proposed condition, the site is divided into two catchments. One which drains to the proposed Jellyfish treatment unit and one that drains directly to the outfall, all of which is consistent with the proposed drainage design for the site.

Table 2 – LID TTT Inputs

Pre-Development		
Building Roof	280 sq.m.	13.9%
Impervious (Concrete/Asphalt Surfaces including parking)	620 sq.m.	30.8%
Landscaped, Open Space	1,111 sq.m.	55.3%
Total Pre-Development Area*	2,011 sq.m.	100%
Post-Development – Drains to Jelly Fish		
Building Roof	1300 sq.m.	69.5%
Impervious (Concrete/Asphalt Surfaces including parking)	304 sq.m.	16.2%
Landscaped Open Space	267 sq.m.	14.3%
Total to Jellyfish*	1,871 sq.m.	100%
Post-Development – Drain directly to Outlet		
Landscaped Open Space*	140 sq.m.	100%
Total Post-Development Area*	2,011 sq.m.	

**Note that the graphical interface of the LID TTT model does not allow sufficient precision for individual site boundaries to be drawn. As such, catchment areas in the model will vary from those shown in the table.*

The LID TTT model shows that with the Jellyfish treatment in place, the net phosphorous discharge from the site will be in the order of 0.100 Kg/yr.

Current LSRCA policy will require financial compensation to be paid by the project for this phosphorus discharge, the amount of which is calculated as follows:

0.100 Kg/yr x 2.5 x $35,000 /Kg/yr = $8,700.00 + 15% administration = $10,620.00

5.6 Phosphorus Budget

As a requirement of the LSPP, the project is required to determine a phosphorus budget to compare pre and post development phosphorous loadings. Using the LID TTT, pre and post development phosphorous loadings have been estimated and are summarized in Table 1 below.

Table 3 – Phosphorus Budget

Development Condition	TP Loading (Kg/yr)	TP Removal (%)
Pre	0.153	
Post (no controls)	0.185	
Post (with controls)	0.100	46

Comparing the pre-development condition with the post-development condition with controls, we see a net reduction in phosphorous load of 0.53 Kg/yr which is 35%.

The LID TTT modeling results for phosphorus are included in Appendix B of this report.

5.7 Water Balance

Our office has reviewed the November 2020 Hydrological Assessment for the project completed by Azimuth Environmental. This assessment includes the water budget for the project which determines the pre- and post-development change in infiltration. Again, recognizing that on-site infiltration practices cannot be implemented, Azimuth has determined that the infiltration deficit from the pre-development to post-development site condition is 167 cu.m./year (Azimuth, November 2020).

Azimuth's report includes calculation of compensation value for this water balance shortfall which totals $8,450.00.

The LSRCA practice is to collect only the larger of phosphorus or water balance compensation values. The calculated compensation value for phosphorous loading is higher than for infiltration. For this reason, the project will not be required to pay for the water balance deficit.

6.0 North Shore Trail Drainage

The North Shore trail in the area of the project drains northward, toward the site, to a series of swales. These in turn are drained to the storm sewer crossings under the trail to Kempenfelt Bay. The proposed development includes two pedestrian access points to the trail from the site which will cross these existing swales. In order to maintain the current general drainage pattern

and continue to utilise current drainage outfalls, it is proposed to install culverts in these swales set at the existing inverts.

The west most culvert is proposed to be 450mm HDPE. This will be installed under the pedestrian access from Dunlop to the North Shore Trail. The east most access, directly in front of crosses a much shallower existing swale. For this reason, the culvert proposed is made up of twin 300mm HDPE pipes.

These culverts are illustrated on drawing C002.

7.0 Salt Management

Pollution from de-icing salt is an ongoing concern. Once applied to exterior surfaces and dissolved with meltwater there is no way to remove the salt before it enters downstream sewers and waterways.

The proposed development has minimal exterior hard surfaces that will require salt application. The vehicular ramps are quite steep with slopes of 15-25% which will cause melt water to sheet away rapidly to site storm sewer inlets, preventing re-freezing. Further, the ramps will be heated via a glycol loop, which will reduce the incidence of freezing to almost nothing. As such there should be no salt required for these areas.

The front entrance grades will be much shallower, between 1-5% to facilitate pedestrian access by the mobility challenged persons. Building maintenance can reduce the reliance on de-icing materials through diligent manual snow clearing.

8.0 Erosion and Sediment Controls During Construction

The construction phase of the project will provide the highest risk of erosion causing sediment to be deposited off site.

During construction it is anticipated that the site will be fully hoarded on the west, south and east sides to prevent un-authorized access to the site for safety and security reasons. This hoarding can support siltation fence that will effectively trap sediment on the site.

As storm works are advanced on the project, storm inlets will be protected with silt sacks or similar measures to prevent site sediment draining to the downstream sewer system.

A comprehensive sediment and erosion control plan will be developed at the detailed design stage.

9.0 Stormwater Management System Maintenance

Maintenance of the site stormwater management features will be critical for the long-term function of the system. The following measures and frequencies are recommended:

Stormwater System Feature	Frequency
Site Storm Sewer System	
Maintaining grates free of obstruction	Weekly or seasonally with regular yard maintenance
Inspection of drainage structures for sediment build up	Annual
Cleaning of drainage structures (hydro-vac) to remove accumulated sediment	Variable – every 2-5 years possibly
Cleaning of pipes (hydro-vac) to remove accumulated sediment	Variable – every 5-10 years possibly
Jellyfish Filter	
Inspection unit and flushing of membranes	Annually
Cleaning of drainage structures (hydro-vac) to remove accumulate sediment	Variable – every year to 5 years possibly
Cleaning of storm sewers (hydro-vac) to remove accumulated sediment	Variable – every 5-10 years possibly

10.0 Conclusions and Recommendations

Based on the preceding analysis, it is our opinion that the proposed condominium development at 217 Dunlop Street, Barrie can be completed while meeting the stormwater management requirements of the City of Barrie, Lake Simcoe Region Conservation Authority and MOECP. To this end, we recommend the following:

1) Re-align the existing sewer from Sampson Street with a new 750mm storm sewer, tying back in at the south side of the property, north of the existing trunk sanitary sewer.

2) Install an on-site storm sewer system sized for the 1 in 5-year return period event.

3) Drain the site sewer through a Jellyfish filter to provide stormwater quality control and phosphorus reduction.

4) Provide no stormwater peak flow controls for the project due to the proximity of the site to Kempenfelt Bay which is the ultimate outlet point for storm drainage in the area.

5) Utilize no stormwater infiltration features due to proximity of existing and proposed foundations to the property line and presence of contaminated shallow aquifer below site.

6) Develop a comprehensive erosion and sediment control plan at the detailed design stage utilizing the basic recommendations included in Section 7.0.

7) Undertake long term maintenance measures for the storm sewer system as discussed in Section 8.0.

11.0 Disclaimer of Responsibilities to Third Parties

This report was prepared by Skelton, Brumwell & Associates Inc. for the account of PBM Realty Holdings Inc in support of a re-zoning application to the City of Barrie

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 other than those named 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

SBA 50 1970 -2020

Appendix A

Rational Method SWM Calculations

3.0 STORMWATER DRAINAGE SYSTEM POLICIES AND DESIGN GUIDELINES

This section discusses the policies and design guidelines applicable to the storm drainage system including foundation drains, the minor system (storm sewers), the major system (roads and swales), bridges and culverts, watercourses, and easements and buffers. When constructing on private property, construction materials and practices must be in accordance with the Ontario Building Code (OBC), the City of Barrie Standards and the City's *Lot Grading Criteria and Drainage Control Procedures*. A number of relevant sample problems and storm drainage calculations are provided in **Appendix C**.

3.1 Foundation Drain Collector Outlet System

Foundation drain collector systems shall be designed on the basis of a continuous flow rate of 0.075 liters per second per residential lot plus infiltration. The minimum foundation drain collector diameter shall be 200 mm. Material and bedding standards applicable to foundation drain collectors shall be in accordance with Barrie Standard Drawings.

3.1.1 Foundation Drains

In order to minimize the flow rate from foundation drains, piezometer tests will be completed prior to design and construction to determine the seasonal high water level. Foundation elevations should then be set 0.5 m higher than the water table or as high as is practical. Where the anticipated flow from sump pumps will be considered a nuisance as deemed by the City, the City may request that Options 2 and 3 be implemented. Foundation drains shall have an accessible outlet for maintenance/cleanout.

Foundation drains shall not be connected to the storm sewer system unless as identified in the options below. The City will allow for an approved outlet which could include the storm sewer system. The following alternatives are acceptable to the City:

1. *Option 1 – Sump pump with discharge of foundation drain flow to ground surface.* Flow collecting in the foundation drain shall be pumped to the surface using a sump pump and then conveyed overland via lot drainage to the street or surface drain as per **City of Barrie Standard BSD-76** (see **Appendix A**).
2. *Option 2 – Sump pump with discharge of foundation drain flow to storm sewer extension at surface or subsurface.* Lots shall be constructed with a storm sewer extension extending from the storm sewer to the surface or subsurface adjacent the building as per **City of Barrie Standard BSD-75A** **or** **BSD-75B**, respectively (see **Appendix A**). Flow collecting in the foundation drain shall be pumped to the surface (or subsurface) using a sump pump and into the storm sewer extension and then conveyed to the storm sewer. A benefit of this configuration is the ability to discharge flow from foundation drains to the storm sewer while eliminating the risk of basement flooding and avoiding surface discharge and nuisance flooding.
3. *Option 3 – Gravity drain or sump pump with discharge to third pipe (foundation drain collector - FDC).* A third pipe (FDC) shall be constructed in the right-of-way (ROW) to collect foundation drain flow by gravity (or using a sump pump if grades do not permit) and to convey the flow to a nearby watercourse or other acceptable receiving body. Similar to the option above, an FDC eliminates the risk of basement flooding and surface discharge and nuisance flooding.
4. *Option 4 – Sump pump discharge piping in boulevard (retrofit option only).* In the event of overactive sump pump activity, a 150 mm diameter PVC DR-28 sewer may be installed, when so directed by the City, along the frontages of designated lots, with an offset of 0.6 m from back of curb. This sewer is to have a cleanout at the upstream end and is to outlet into the nearest catchbasin downstream. The depth of sewer is to be equal to the subdrain depth. The discharge piping shall not be directly connected to the foundation drains.

3.2 Minor System

Storm sewers shall be provided on all roads with curb and gutter. Storm sewers shall be designed to convey, as a minimum, the 1:5 year design storm.

3.2.1 Service Area

The drainage system shall be designed to accommodate all upstream drainage areas plus any external area tributary to the system for the existing, interim and ultimate development conditions, as determined by the delineation of appropriate topographic mapping and the preparation of drainage plans.

3.2.2 Design Flow

Storm sewer systems with a drainage area ≤ 50 ha shall be designed to convey the 1:5 year (minimum) design storm using the Rational Method and the City's IDF regression equation for rainfall intensity unless otherwise approved or directed by the City. Storm sewer systems with a drainage area > 50 ha shall be designed using an approved computer program and verified with the Rational Method. The storm sewer design shall be based on the larger of the two flows calculated using the computer model and the Rational Method. Under no circumstances shall the storm system be designed in a surcharged condition.

The design of the storm sewers shall be computed using the City of Barrie's Storm Sewer Design Sheet as provided in **Appendix A.**

All storm sewers shall be designed according to the Rational Formula where:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow in (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

The rainfall intensity shall be calculated in accordance with the following table and equation:

Table 3.1: Barrie WPCC IDF Curve Parameters - Adjusted to Account for Climate Change

Parameter	Return Period					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
A	678.085	853.608	975.865	1146.275	1236.152	1426.408
B	4.699	4.699	4.699	4.922	4.699	5.273
C	0.781	0.766	0.760	0.757	0.751	0.759

Rainfall Intensity, I (mm/hr) = $A/(t+B)^C$, where t is time duration in minutes
Parameters based on rain gauge data for the period 1979 – 2003 for the Barrie WPCC Station #6110557
Based on a review of the literature, the IDF intensity values for Barrie WPCC Station were increased by 15% before calculating a, b, c values to account for climate change.

$$i = \frac{A}{(t_d + B)^C}$$

where,

i = the rainfall intensity (mm/hr)
t_d = the storm duration (minutes)
A, B, C = a function of the local intensity-duration data.

The storm duration is set to the time of concentration (i.e. the sewer inlet time plus the time of travel in the pipe or channel) for the total cumulative drainage area to the node of interest. The maximum inlet time for the first pipe of a storm sewer system is 10 minutes.

The runoff coefficient shall be calculated in accordance with the following table:

Table 3.2: Runoff Coefficients (Rational *C*) (5-yr to 10-yr) Based on Hydrologic Soil Group

Land Use	Runoff Coefficient "C"		
	A-AB	B-BC	C-D
Cultivated Land, 0 - 5% grade	0.22	0.35	0.55
Cultivated Land, 5 - 10% grade	0.30	0.45	0.60
Cultivated Land, 10 - 30% grade	0.40	0.65	0.70
Pasture Land, 0 - 5% grade	0.10	0.28	0.40
Pasture Land, 5 - 10% grade	0.15	0.35	0.45
Pasture Land, 10 - 30% grade	0.22	0.40	0.55
Woodlot or Cutover, 0 – 5% grade	0.08	0.25	0.35
Woodlot or Cutover, 5 - 10% grade	0.12	0.30	0.42
Woodlot or Cutover, 10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands	0.05	0.05	0.05
Impervious Area (i.e., buildings, roads, parking lots, etc.)	0.95	0.95	0.95
Gravel (not to be used for proposed parking or storage areas)	0.40	0.50	0.60
Residential – Single Family	0.30	0.40	0.50
Residential – Multiple (i.e., semi, townhouse, apartment)	0.50	0.60	0.70
Industrial – light	0.55	0.65	0.75
Industrial – heavy	0.65	0.75	0.85
Commercial	0.60	0.70	0.80
Unimproved Areas	0.10	0.20	0.30
Lawn, < 2% grade	0.05	0.11	0.17
Lawn, 2 - 7% grade	0.10	0.16	0.22
Lawn, > 7% grade	0.15	0.25	0.35

Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual," MTO. (1997)

An approximation of the runoff coefficient can be calculated based on the following relationship with:

$$c = (0.7)(TIMP) + 0.2$$

where,

c = the runoff coefficient

TIMP = total impervious fraction (dimensionless)

The runoff coefficient shall be adjusted for return period events greater than the 10-yr storm per the following table:

Table 3.3: Runoff Coefficient Adjustment for 25-yr to 100-yr Storms

Return Period	Runoff Coefficient "C"
25 years	$C_{25} = 1.1*C_5$
50 years	$C_{50} = 1.2*C_5$
100 years	$C_{100} = 1.25*C_5$

Adapted from Design Chart 1.07, Ontario Ministry of Transportation,
"MTO Drainage Management Manual," MTO. (1997).
Note: When applying the runoff coefficient adjustment, the maximum c-value should not exceed 1.0.

Given that the direct connection of foundation drains to the storm sewer is not permitted, a detailed HGL analysis is typically not required unless deemed otherwise by the City due to special circumstances. Refer to **Section 7.3** for details regarding HGL analysis requirements.

The calculation of total percent impervious (TIMP) values for modeling shall be in accordance with **Section 7.2.5** (**Table 7.6**).

3.2.3 Pipe Capacity and Size

The storm sewer capacity shall be calculated using the Manning's equation assuming the pipe is flowing full as follows:

$$Q = \left[\frac{1}{n}\right] A(R)^{\frac{2}{3}}(S)^{\frac{1}{2}}$$

where,

Q = the pipe capacity (m3/s)
n = the Manning roughness value
R = the hydraulic radius (m)
S = the sewer pipe slope (m/m).

A maximum inlet time of 10 minutes shall be used for the first pipe of a storm sewer system.

The velocity of flow in the storm sewer (assuming pipe flowing full) shall be calculated as follows:

$$v = \left[\frac{Q}{A}\right]$$

where,

Q = flow in the pipe when flowing full (m3/s)
A = cross sectional area of the pipe (m2)

The appropriate roughness coefficients shall be used as identified in **Table 3.4**.
The minimum size for a storm sewer (within a street) shall be 300 mm in diameter. No decrease of pipe size from a larger size upstream to a smaller size downstream shall be allowed regardless of the increase in grade.

3.2.4 Roughness Coefficients

The following roughness coefficients shall be used for hydraulic calculations of storm sewers:

Table 3.4: Sewer Pipe Manning's Coefficient

Material	Manning's "n"
Concrete, PVC, Profile Rib Pipe	0.013
Corrugated Metal with 25% Paved Invert	0.021
Corrugated Metal 68 x 13 mm Corrugations	0.024

3.2.5 Flow Velocity

The minimum flow velocity in the storm sewer shall be 0.75 m/s (full flow conditions).

The maximum flow velocity in the storm sewer shall be 4.0 m/s (full flow conditions).

3.2.6 Minimum Slope

The minimum storm sewer slope shall be not less than 0.5% unless specifically approved by the Director of Engineering.

3.2.7 Sewer Alignment

The storm sewers shall be laid as per City Standard Drawings **BSD-301**, **BSD-302**, **BSD-303**, **BSD-304**, **BSD-305**, **BSD-306**, **BSD-307**, **BSD-308**, **BSD-309**, **BSD-310**, **BSD-313** **and** **BSD-314** in a straight line between maintenance holes unless radius pipe has been designed.

3.2.8 Curved Sewers (radius pipe)

Curved pipe (radius pipe) shall be allowed for storm sewers 1200 mm in diameter and larger. The minimum center line radius allowable shall be in accordance with the minimum radii table as provided by the manufacturer.

3.2.9 Depth of Storm Sewers

A minimum 1.5 m cover below the centerline of road to obvert shall be provided for storm sewers. Under certain conditions where sufficient cover is not feasible, shallow insulated pipes may be permitted subject to review by the City.

3.2.10 Pipe Crossing and Clearance

A minimum clearance of 500 mm between the obvert of the sanitary sewer and the invert of the storm sewer shall be provided if the sanitary sewer connections are required to go under the storm sewer.

The minimum horizontal clearance between the outside wall of the adjacent sewer pipes shall be 800 millimeters. On crescent roads or roads with numerous bends, the sewer position may generally follow the same relative side of the road allowance.

The minimum clearance from a sewer to a watermain shall be 2.5 m horizontally and 0.5 m vertically.

3.2.11 Sewer Bedding

The type and classification of the storm sewer pipe and the sewer bedding type shall be clearly indicated on all profile drawings for each sewer length.

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Skelton Brumwell & Associates Inc.
ENGINEERING PLANNING ENVIRONMENTAL CONSULTANTS

SAMPSON STREET STORM SEWER RE-ALIGNMENT

DATE July 16, 2020
CALCS BWB
Revised

Per City of Barrie Storm Sewer drawings, Catchment is: 16.8 Ha
C = 0.4

City of Barrie/TOI 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

Because C = 0.4, Time of Concentration is Calculated with Bransby Williams.

$Tc = 0.057*L*S^{-2}*A^{-1}$

Where S Slope in %
L Flow Length
A Area in Ha

Flow Length = 746 m
U/S Elev = 268.6 m
D/S Elev = 226 m
Slope = 5.710456 % Tc = 20.9 min

20.91 min

		2 yr	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**	
i= a/(t+b)^c	i=	53.9	71.4	83.0	97.8	108.2	119.7	(mm/hr)
Q = 0.00278 C*I*A	**Q =**	**1.0064**	**1.3348**	**1.5505**	**1.8270**	**2.0222**	**2.2357**	**cms**

Design - Sampson Street Storm Sewer Realignment

LOCATION FROM	LOCATION TO	PIPE LENGTH (METRES)		TOTAL PEAK Q (CMS)	S (%)	D (mm)	Mannings 'n' for pipe	Q PIPE FULL (CMS)	Flow as Capacity of Pipe %	V PIPE FULL (m/sec)	REMARKS
DDML00021	STMH#1	6.3		1.335	10.00	750	0.013	3.519	37.9	7.964	100 YR CAPACITY
STMH#1	STMH#2	26.6		1.335	3.60	750	0.013	2.111	63.2	4.779	50 YR CAPACITY
STMH#2	STMH#3	5.5		1.335	6.00	750	0.013	2.725	49.0	6.169	100 YR CAPACITY
STMH#3	Existing		Twin Pipes	1.335	4.70	525	0.013	1.863	71.6	8.608	25 YEAR CAPACITY

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217 Dunlop Street, Barrie

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OVERALL SITE PEAK FLOWS

DATE July 16, 2020
CALCS BWB
Revised

Overall Site to Storm Sewer		AREA =	**0.19**	**Ha**	Flows Uncontrolled				
GROUND COVER TYPE			**PROPORTION**		**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.1900		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	**0.19**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

City of Barrie/TOI 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 =**	**0.0417**	**0.0548**	**0.0635**	**0.0783**	**0.0867**	**0.0952**	**cms**
Sampson Street Storm Sewer		**Q =**	**1.006**	**1.335**	**1.550**	**1.827**	**2.022**	**2.236**	**cms**
Site flow propotion to upstream flow			4.1%	4.1%	4.1%	4.3%	4.3%	4.3%	

* Upstream drainage area time to peak = 20 min, site peak will pass through well ahead and thus not add to overall peak

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Site Storm Sewer Catchments

CATCHMENT 1		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	0.0200			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 2		AREA =	**0.005**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0050			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	**0.01**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

CATCHMENT 3		AREA =	**0.005**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.005			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	**0.01**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

CATCHMENT 4		AREA =	**0.006**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.006			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	**0.01**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

CATCHMENT ROOF		AREA =	**0.13**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.1300			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	**0.13**	**Ha**		**WEIGHTED C**	**0.95**	**0.95**	**1.00**	**1.00**	**1.00**

CATCHMENT 5		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	0.0000			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 6		AREA =	**0.04**	**Ha**					
GROUND COVER TYPE				**PROPORTION**	**C 2-5 YR**	**C 10 YR**	**C 25 YR**	**C 50 YR**	**C 100 YR**
IMPERVIOUS	0.0200	(assumed)		0.500	0.95	0.95	1.00	1.00	1.00
GRASS	0.020	(assumed)		0.500	0.25	0.25	0.28	0.30	0.31
TOTAL	**0.04**	**Ha**		**WEIGHTED C**	**0.60**	**0.60**	**0.64**	**0.65**	**0.66**

Catchment 6 Drains by sheet flow to south, not to site storm sewers

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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

Rational Method Storm Sewer Design

5 year STORM FLOWS - SEWER SIZING

A (idf) = 856.61
B (idf) = 4.699
C (idf) = 0.766
t = flow time

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AREA	LOCATION		PIPE LENGTH	INCREMENT		CA	TOTAL CA	FLOW TIME (MIN)		I	TOTAL PEAK Q	S	D	Mannings 'n'	Q PIPE FULL	Flow as Capacity of Pipe	V PIPE FULL	REMARKS	Sufficient Pipe Capacity
	FROM	TO	(METRES)	C	A			TO SECTION	IN SECTION		(CMS)	(%)	(mm)	for pipe	(CMS)	%	(m/sec)		
1	CB#1	CBMH#1	12.4	0.95	0.02	0.019	0.019	10.00	0.09	109.30	0.006	3.80	250	0.013	0.116	5.0	2.359	5 yr flow	Yes
2	Strip Drain	CBMH#1	7.0	0.95	0.005	0.005	0.005	10.00	0.07	109.30	0.001	2.00	250	0.013	0.084	1.7	1.712	5 yr flow	Yes
3	CBMH#1	CBMH#2	21.4	0.95	0.005	0.005	0.029	10.09	0.29	108.81	0.009	1.00	250	0.013	0.059	14.5	1.210	5 yr flow	Yes
4	CBMH#2	STMH#4	14.2	0.95	0.005	0.005	0.033	10.38	0.08	107.18	0.010	6.60	250	0.013	0.153	6.5	3.109	5 yr flow	Yes
ROOF	Building	STMH#4	5.9	1.00	0.13	0.130	0.130	10.00	0.07	109.30	0.040	2.00	200	0.013	0.046	85.2	1.475	5 yr flow	Yes
	STMH#4	CBMH#3	14.5				0.163	10.46	0.08	106.76	0.048	5.90	250	0.013	0.144	33.6	2.940	5 yr flow	Yes
5	CBMH#3	STMH#2	7.7	0.92	0.02	0.018	0.182	10.54	0.02	106.32	0.054	18.70	250	0.013	0.257	20.9	5.234	5 yr flow	Yes

Note: CBMH#3 is a diversion structure for the Jellfish filter. Pipe sizing above assumes full design flow is conveyed by main line sewer pipe, which is conservative. Treatment flow is diverted to Jellyfish

Appendix B

LID TTT Modeling Results – Phosphorous

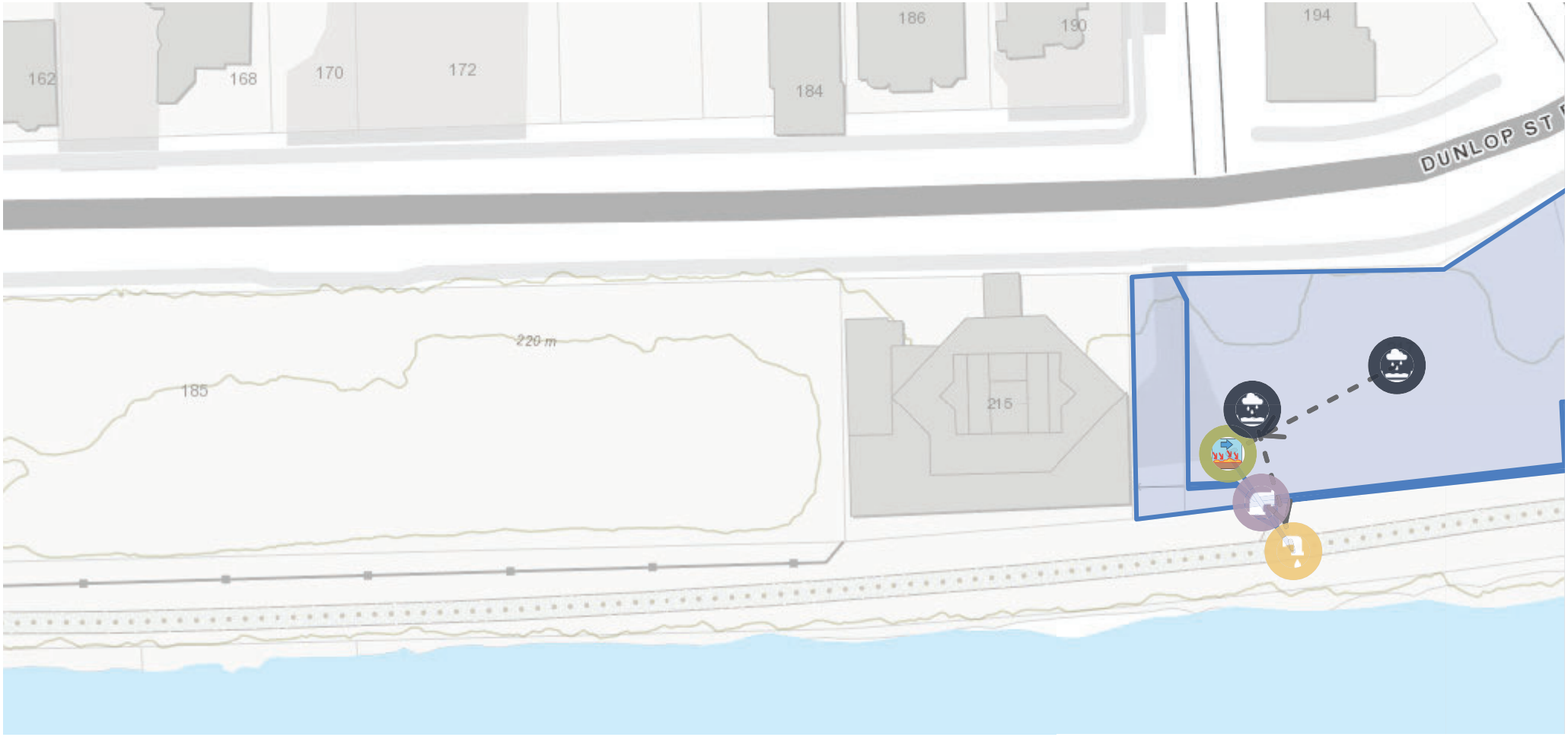
Summary

Site	Project Name	Project Title	Storm Type
Pre-Development			
Post-Development	3315 - 277 Dunlop Street	277 Dunlop Street - 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	0.22 ha	944.70 mm 2,031.11 m^3	19.95 mm 42.89 m^3	264.26 mm 568.17 m^3	674.42 mm 1,450.00 m^3	270.28 mm 28.61 %
TOTAL	**0.22 ha**	**944.70 mm** **2,031.11 m^3**	**19.95 mm** **42.89 m^3**	**264.26 mm** **568.17 m^3**	**674.42 mm** **1,450.00 m^3**	**270.28 mm** **28.61 %**

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	66.918 %	0.808 m^3/s	1,420.000 m^3 34.453 mg/l 48.924 kg	1,452.000 m^3 11.147 mg/l 16.185 kg
Total	**66.918 %**	**0.808 m^3/s**	**1,420.000 m^3** **34.453 mg/l** **48.924 kg**	**1,452.000 m^3** **11.147 mg/l** **16.185 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	51.536 %	0.808 m^3/s	1,420.000 m^3 0.142 mg/l 0.202 kg	1,452.000 m^3 0.068 mg/l 0.098 kg
Total	**51.536 %**	**0.808 m^3/s**	**1,420.000 m^3** **0.142 mg/l** **0.202 kg**	**1,452.000 m^3** **0.068 mg/l** **0.098 kg**

Peak Flow | Post-Development

Catchment	Element	Description	Peak outflow
1	Jellyfish filter	MAXIMUM LATERAL INFLOW at	0.025 m^3/s
	Catchment 1 - no treatment	PEAK RUNOFF FLOW from	0.00 m^3/s
	BUILDING AND RAMPS	PEAK RUNOFF FLOW from	0.02 m^3/s
	MUNICIPAL STORM	MAXIMUM FLOW at	0.808 m^3/s
	Outlet sewer	MAXIMUM FLOW in	0.808 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)
Catchment 1 - no treatment	0 %	0 m^3/s	321.198 m^3 100.000 mg/l 32.120 kg	80.000 m^3 100.000 mg/l 8.000 kg
BUILDING AND RAMPS	0 %	0.02 m^3/s	1,709.907 m^3 30.540 mg/l 52.221 kg	1,340.000 m^3 30.540 mg/l 40.924 kg
Jellyfish filter	80 %	0.025 m^3/s	1,340.000 m^3 30.540 mg/l 40.924 kg	1,340.000 m^3 6.108 mg/l 8.185 kg
Outlet sewer	0 %	0.808 m^3/s	1,340.000 m^3 6.108 mg/l 8.185 kg	1,340.000 m^3 6.108 mg/l 8.185 kg
MUNICIPAL STORM	0 %	0.808 m^3/s	1,452.000 m^3	1,452.000 m^3

			11.147 mg/l 16.185 kg	11.147 mg/l 16.185 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)
Catchment 1 - no treatment	0 %	0 m^3/s	321.198 m^3 0.320 mg/l 0.103 kg	80.000 m^3 0.320 mg/l 0.026 kg
BUILDING AND RAMPS	0 %	0.02 m^3/s	1,709.907 m^3 0.132 mg/l 0.226 kg	1,340.000 m^3 0.132 mg/l 0.177 kg
Jellyfish filter	59 %	0.025 m^3/s	1,340.000 m^3 0.132 mg/l 0.177 kg	1,340.000 m^3 0.054 mg/l 0.072 kg
Outlet sewer	0 %	0.808 m^3/s	1,340.000 m^3 0.054 mg/l 0.072 kg	1,340.000 m^3 0.054 mg/l 0.072 kg
MUNICIPAL STORM	0 %	0.808 m^3/s	1,452.000 m^3	1,452.000 m^3

			0.068 mg/l 0.098 kg	0.068 mg/l 0.098 kg

Detailed Report Parameters | Post Development

Jellyfish filter

Field	Value
Name	Jellyfish filter
Junction Type	sorbitive-media
Catchment	1
Invert Elevation (m)	219.92
Depth to Surface (m)	1.5

Catchment 1 - no treatment

Field	Value
Subcatchment name	Catchment 1 - no treatment
Catchment	1
Total AREA (HA)	0.034
Impervious area (HA)	0
Roof area (HA)	0
Landscaped area (HA)	0.034
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0

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	82

BUILDING AND RAMPS

Field	Value
Subcatchment name	BUILDING AND RAMPS
Catchment	1
Total AREA (HA)	0.181
Impervious area (HA)	0.04525
Roof area (HA)	0.13032
Landscaped area (HA)	0.00543
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
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	82

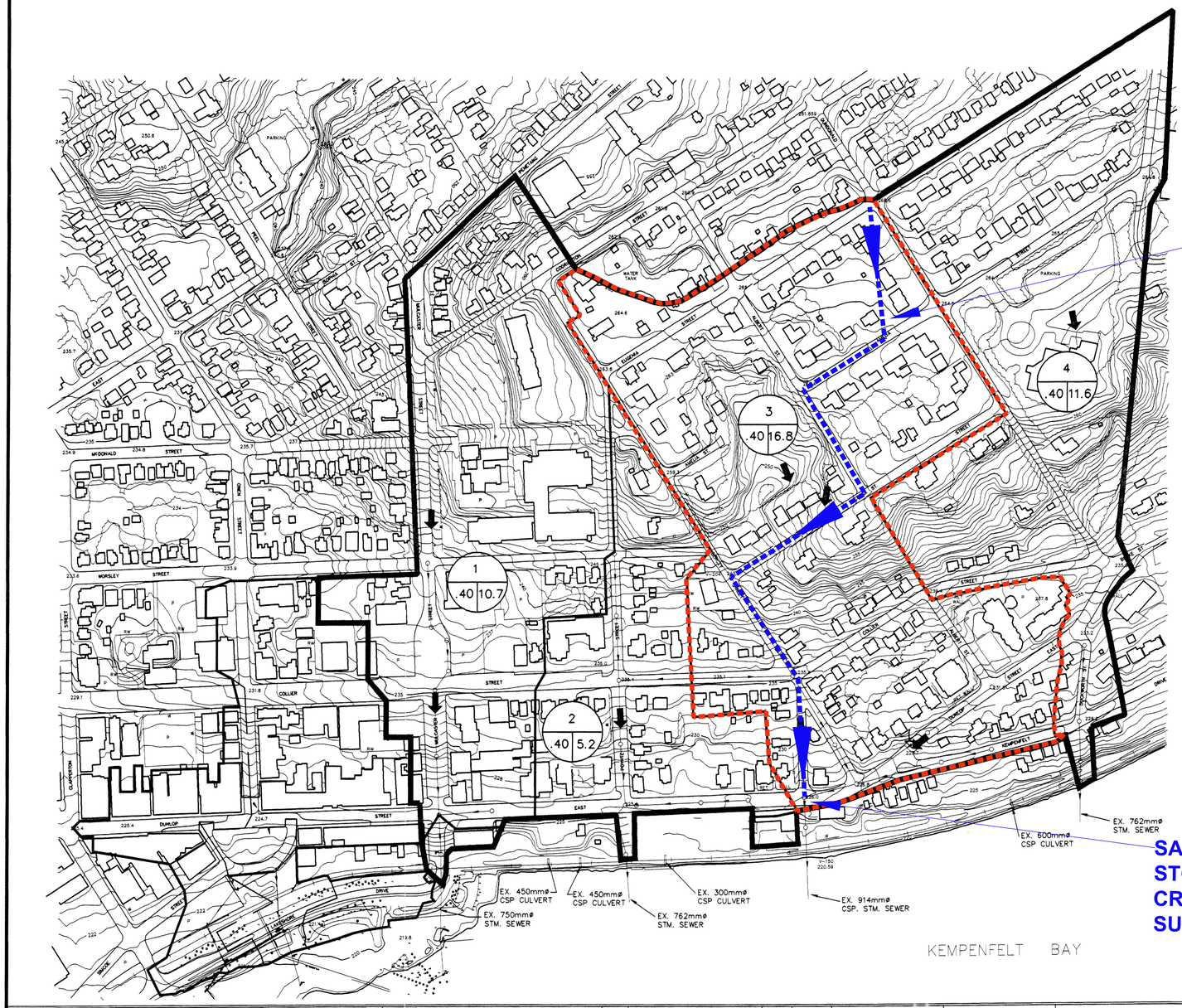
MUNICIPAL STORM

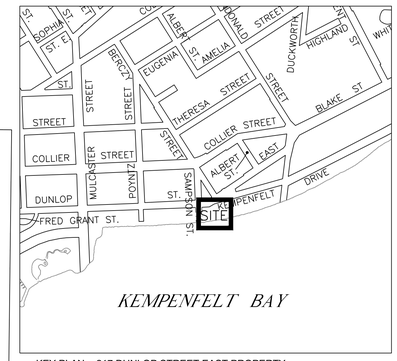
Field	Value
Name	MUNICIPAL STORM
Catchment	1
Outfall Elevation (m)	219.09

Outlet sewer

Field	Value
Name	Outlet sewer
Catchment	1
Upstream Node	Jellyfish-filter
Downstream Node	MUNICIPAL-STORM
Length (m)	17
Manning's Roughness	0.013
Upstream Invert (m)	221.43

Downstream Invert (m)	219.09
Pipe Diameter (m)	0.3





KEY PLAN - 217 DUNLOP STREET EAST PROPERTY

SCALE : N.T.S.

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GENERAL NOTES

BENCH MARKS

NO.	REVISIONS	DATE	APPROVED

CITY OF BARRIE APPROVED
DATE 95.04.11
R. W. McAllister, P.Eng.
DIRECTOR OF MUNICIPAL WORKS

LICENSED PROFESSIONAL ENGINEER R. J. FORWARD 95.04.11 PROVINCE OF ONTARIO

LAKESHORE TRUNK SANITARY SEWER RECONSTRUCTION
DUCKWORTH ST. TO MULCASTER ST.

EXTERNAL STORM DRAINAGE PLAN

CITY OF BARRIE INCORPORATED

CITY of BARRIE
MUNICIPAL WORKS DEPARTMENT

SCALE HOR.	1:2000	VERT.	——	DRAWING NO.	94-09
DESIGN	M.D.N.	DRAWN	C.L.M.	SHEET NO.	STM1
REVIEWED	R.J.F.	DATE	95.04.27		

No.	Revision	Date
2.	ISSUED FOR REZONING APPLICATION	2020 12 15
1.	PRELIMINARY DESIGN	2020 07 17

Orientation

PROJECT NORTH

Seal

LICENSED PROFESSIONAL ENGINEER
Dec. 15, 2020
B. W. BOLIVAR
100017673
PROVINCE OF ONTARIO

All dimensions to be checked and verified on the job by the Contractor. Any discrepancies are to be reported to the Consultant prior to action. Only the latest approved drawings to be used for construction in conformance with all applicable codes, by-laws and regulations. All drawings remain the property of the Consultant.

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FAX (705) 726-0331
TOLL FREE (877) 726-1141

Project Information

217 Dunlop St. East

217 Dunlop Street E., Barrie ON

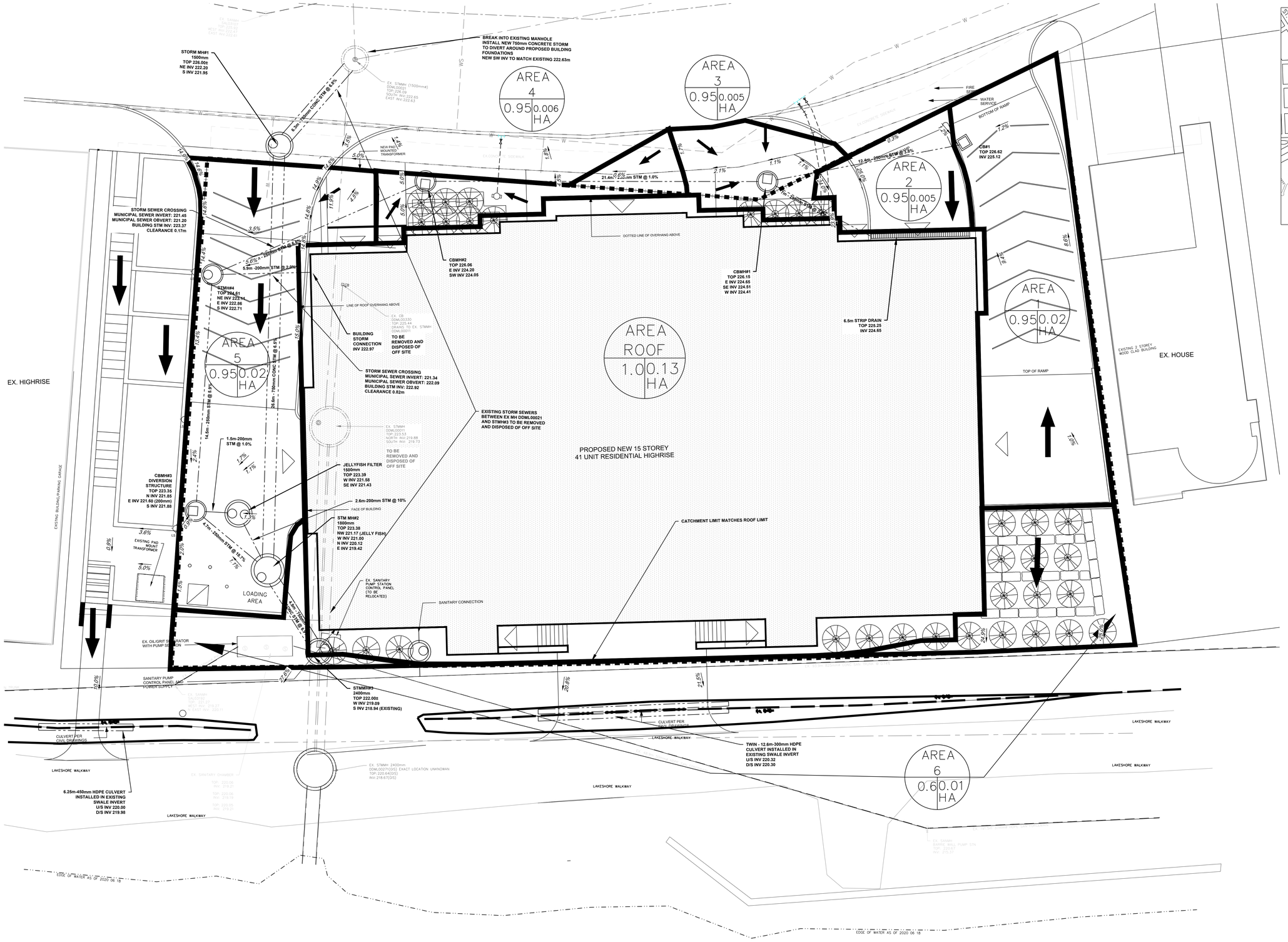
For

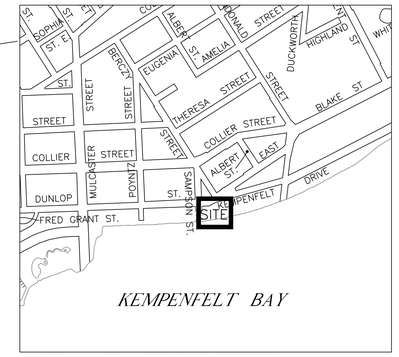
PBM Realty Holdings Inc.

Drawing Title

Civil - Upstream Drainage Area

Date	Project No	Drawing No
Drawn by BDD/BWB	3315	SWM1
Scale 1 : 100		





KEY PLAN - 217 DUNLOP STREET EAST PROPERTY

SCALE : N.T.S.

- EXISTING LIMIT OF R.O.W.
- EXISTING EASEMENT
- EXISTING CATCH BASIN
- EXISTING TWIN INLET CATCH BASIN
- EXISTING STORM MANHOLE, EXISTING CATCH BASIN MANHOLE
- EXISTING STORM SEWER
- EXISTING CULVERT
- EXISTING SANITARY MANHOLE
- EXISTING SANITARY SEWER
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING WATERMAIN
- EXISTING BELL PEDESTAL
- PROPOSED CATCH BASIN
- PROPOSED STORM SEWER
- PROPOSED STORM MANHOLE
- BOREHOLE LOCATION
- EXISTING CHAIN LINK FENCE
- EXISTING 1.00 m CONTOUR
- EXISTING 0.20 m CONTOUR
- STORM SEWER CATCHMENT BOUNDARY
- PERVIOUS AREA
- AREA 6 / 0.60.04 HA — STORM SEWER CATCHMENT NUMBER / STORM SEWER CATCHMENT AREA
- RUNOFF COEFFICIENT (5 YEAR)

No.	Revision	Date
3.	ISSUED FOR REZONING APPLICATION	2020 12 15
2.	REVISED SITE PLAN	2020 07 30
1.	PRELIMINARY DESIGN	2020 07 17

Orientation

PROJECT NORTH

Seal

LICENSED PROFESSIONAL ENGINEER
Dec. 15, 2020
B. W. BOUVAR
100017673
PROVINCE OF ONTARIO

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Project Information

217 Dunlop St. East

217 Dunlop Street E., Barrie ON

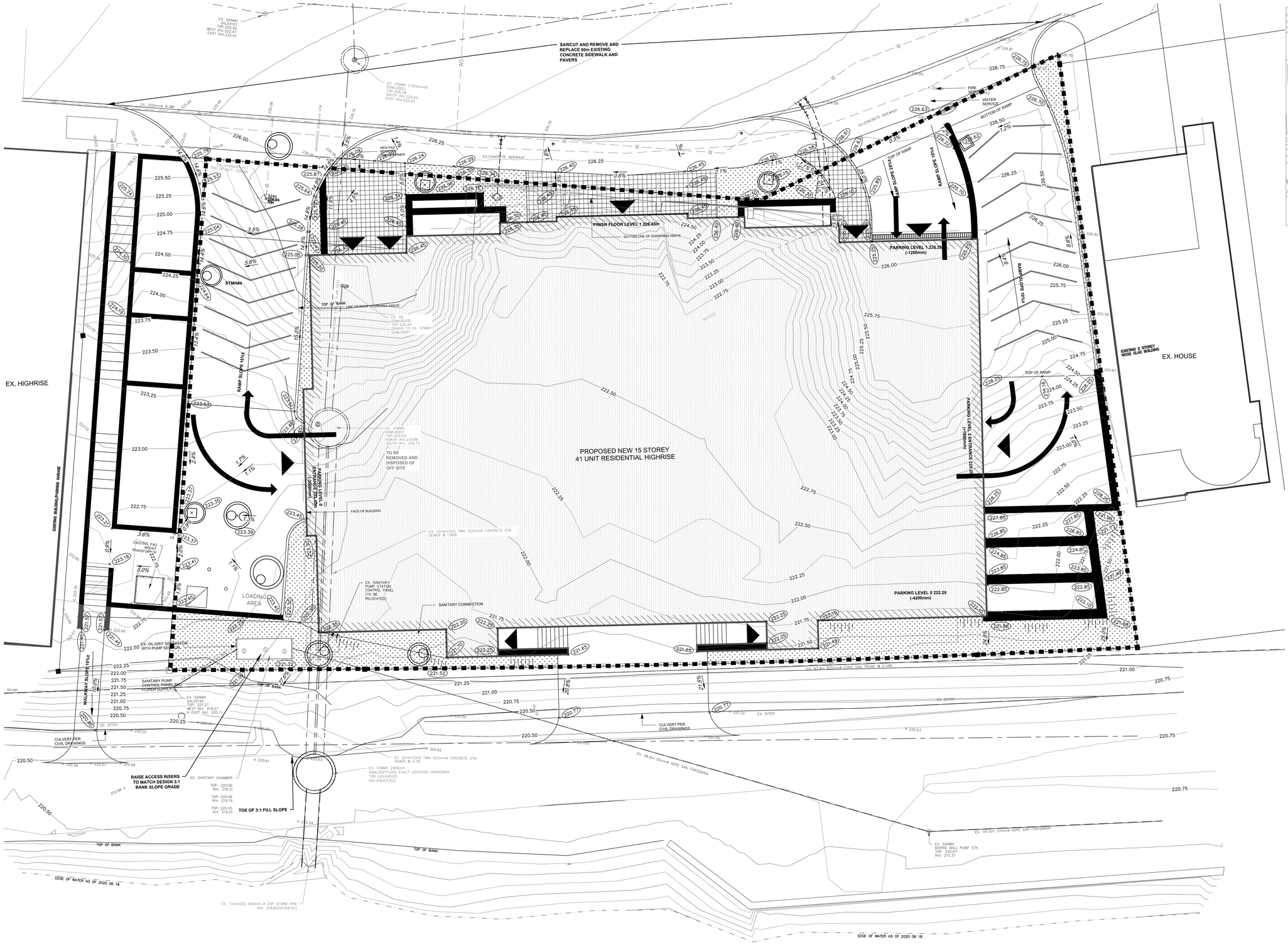
For

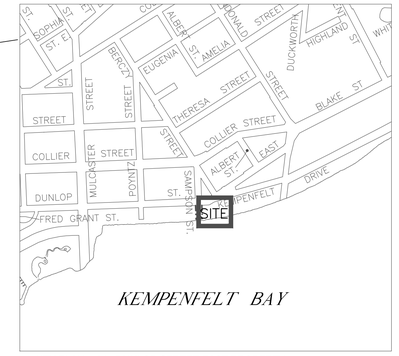
PBM Realty Holdings Inc.

Drawing Title

Civil - Site Storm Catchments

Date		Project No	Drawing No
Drawn by	BDD/BWB	3315	SWM2
Scale	1 : 100		





KEY PLAN - 217 DUNLOP STREET EAST PROPERTY

SCALE : N.T.S.

LEGEND

× 222.65 MEET (225.59)	EXISTING ELEVATION
(223.35)	MATCH EXISTING ELEVATION
	PROPOSED ELEVATION
PROP. CB	PROPOSED CATCH BASIN
PROP. STMMH	PROPOSED MAINTENANCE HOLE
PROP. CBMH	PROPOSED CATCH BASIN MAINTENANCE HOLE
PROP.SANMH	PROPOSED SANITARY MAINTENANCE HOLE
	EXISTING CURB
	EXISTING PAVEMENT
X	EXISTING FENCE
	EXISTING LOT
	EXISTING BUILDINGS
	EXISTING SIDEWALK
	EXISTING TREE LINE
EX.SAN.MH.	EXISTING SANITARY MAINTENANCE HOLE
	EXISTING SANITARY SEWER
EX.STM.	EXISTING STORM MAINTENANCE HOLE
EX. CB	EXISTING STORM CATCH BASIN
	EXISTING STORM SEWER
W	EXISTING WATER MAIN
WS	EXISTING WATER SERVICE
	EXISTING UNDERGROUND BELL
	EXISTING UNDERGROUND CCTV
	EXISTING UNDERGROUND GAS
	EXISTING UNDERGROUND HYDRO
	EXISTING UNDERGROUND CONDUIT
	EXISTING ABOVEGROUND BELL
	EXISTING ABOVEGROUND CCTV
	EXISTING ABOVEGROUND HYDRO

No.	Revision	Date
3.	ISSUED FOR REZONING APPLICATION	2020 12 15
2.	REVISED SITE PLAN	2020 07 30
1.	PRELIMINARY DESIGN	2020 07 17

Orientation

PROJECT NORTH

Seal

LICENSED PROFESSIONAL ENGINEER — Dec. 15, 2020 — B. W. BOLIVAR — 100017673 — PROVINCE OF ONTARIO

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Project Information

217 Dunlop St. East

217 Dunlop Street E., Barrie ON

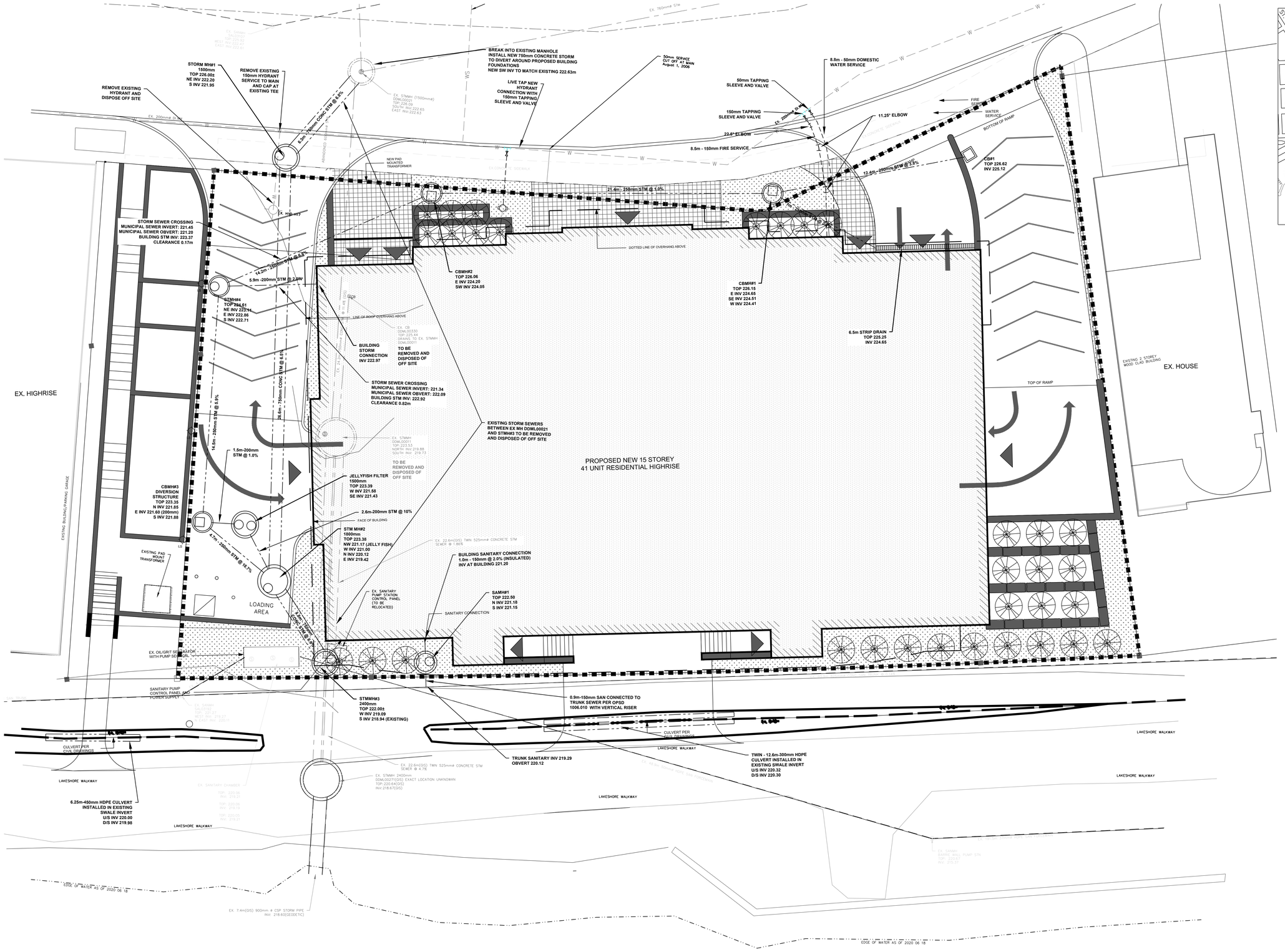
For

PBM Realty Holdings Inc.

Drawing Title

Civil - Site Grading

Date	Project No	Drawing No
Drawn by BDD/BWB	3315	C001
Scale 1 : 100		



KEY PLAN - 217 DUNLOP STREET EAST PROPERTY

SCALE : N.T.S.

LEGEND

PROP. CB	PROPOSED CATCH BASIN
PROP. STMMH	PROPOSED MAINTENANCE HOLE
PROP. CBMH	PROPOSED CATCH BASIN MAINTENANCE HOLE
	PROPOSED STORM MAIN
PROP.SANMH	PROPOSED SANITARY MAINTENANCE HOLE
	PROPOSED SANITARY MAIN
	PROPOSED WATER MAIN
	EXISTING CURB
	EXISTING PAVEMENT
	EXISTING FENCE
	EXISTING LOT
	EXISTING BUILDINGS
	EXISTING SIDEWALK
	EXISTING TREE LINE
EX.SAN.MH.	EXISTING SANITARY MAINTENANCE HOLE
	EXISTING SANITARY SEWER
EX.STM.	EXISTING STORM MAINTENANCE HOLE
EX. CB	EXISTING STORM CATCH BASIN
	EXISTING STORM SEWER
W	EXISTING WATER MAIN
WS	EXISTING WATER SERVICE
	EXISTING UNDERGROUND BELL
	EXISTING UNDERGROUND CCTV
	EXISTING UNDERGROUND GAS
	EXISTING UNDERGROUND HYDRO
	EXISTING UNDERGROUND CONDUIT
	EXISTING ABOVEGROUND BELL
	EXISTING ABOVEGROUND CCTV
	EXISTING ABOVEGROUND HYDRO

No.	Revision	Date
3.	ISSUED FOR REZONING APPLICATION	2020 12 15
2.	REVISED SITE PLAN	2020 07 30
1.	PRELIMINARY DESIGN	2020 07 17

Orientation

PROJECT NORTH

Seal

LICENSED PROFESSIONAL ENGINEER
Dec. 15, 2020
B. W. BOLIVAR
100017073
PROVINCE OF ONTARIO

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Project Information

217 Dunlop St. East

217 Dunlop Street E., Barrie ON

For

PBM Realty Holdings Inc.

Drawing Title

Civil - Site Servicing

Date	Project No	Drawing No
Drawn by BDD/BWB	3315	C002
Scale 1 : 100		