TATHAM ENGINEERING

Enhancing our communities

505-533 Yonge Street, City of Barrie

FUNCTIONAL SERVICING REPORT

Renaissance Barrie Retirement Trust

File 421422 | May 31, 2023

Document Control

File:

421422

Date:

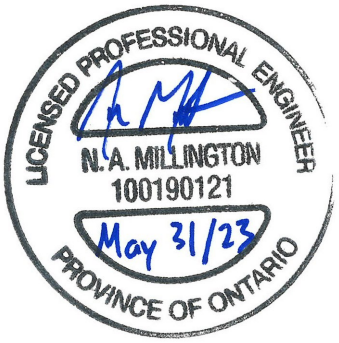
May 31, 2023

Prepared by:

Tatham Engineering Limited
41 King Street, Unit 4
Barrie, Ontario L4N 6B5
T 705-733-9037
tathameng.com

Prepared for:

Renaissance Barrie Retirement Trust
5045 Orbitor Road, Bldg. 11, Unit 101
Mississauga, Ontario L4W 4Y4

Authored by:	Reviewed by:
	 
Lawrence Carretas, B.A.Sc., EIT Engineering Intern	Nick Millington, P.Eng. Senior Manager – Land Development

Disclaimer	Copyright
The information contained in this document is solely for the use of the Client identified on the cover sheet for the purpose for which it has been prepared and Tatham Engineering Limited undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.	This document may not be used for any purpose other than that provided in the contract between the Owner/Client and the Engineer nor may any section or element of this document be removed, reproduced, electronically stored or transmitted in any form without the express written consent of Tatham Engineering Limited.

Issue	Date	Description
0	December 10, 2021	Draft for Client Review
1	December 14, 2021	ZBA (First Submission)
2	May 31, 2023	ZBA (Second Submission)

Document Contents

Tables

Figures

Appendices

1 Introduction

Tatham Engineering Limited (Tatham) has been retained by Renaissance Barrie Retirement Trust to prepare a Functional Servicing Report (FSR) in support of a Zoning By-Law Amendment (ZBA) application for the redevelopment of 505, 511, 515 and 533 Yonge Street (subject site) located in the City of Barrie (City).

This report presents a municipal servicing strategy, covering:

- water supply and distribution;
- sanitary sewage collection;
- drainage and stormwater management;
- grading and landscaping; and
- utility servicing.

1.1 SITE DESCRIPTION & SURROUNDING LAND USE

The site is located approximately 800 m northwest of the existing signalized intersection of Yonge Street and Big Bay Point Road. It is bound by existing developments to the north, Yonge Street to the west, and Lovers Creek to the east and south. The location of the property is illustrated on the Site Location Plan (Figure 1), overleaf. Under existing conditions, the site consists of buildings, parking lot area, and undisturbed treed area. The total site area is 2.70 ha, of which 1.80 ha is developed. The site topography slopes from Yonge Street towards Lovers Creek.

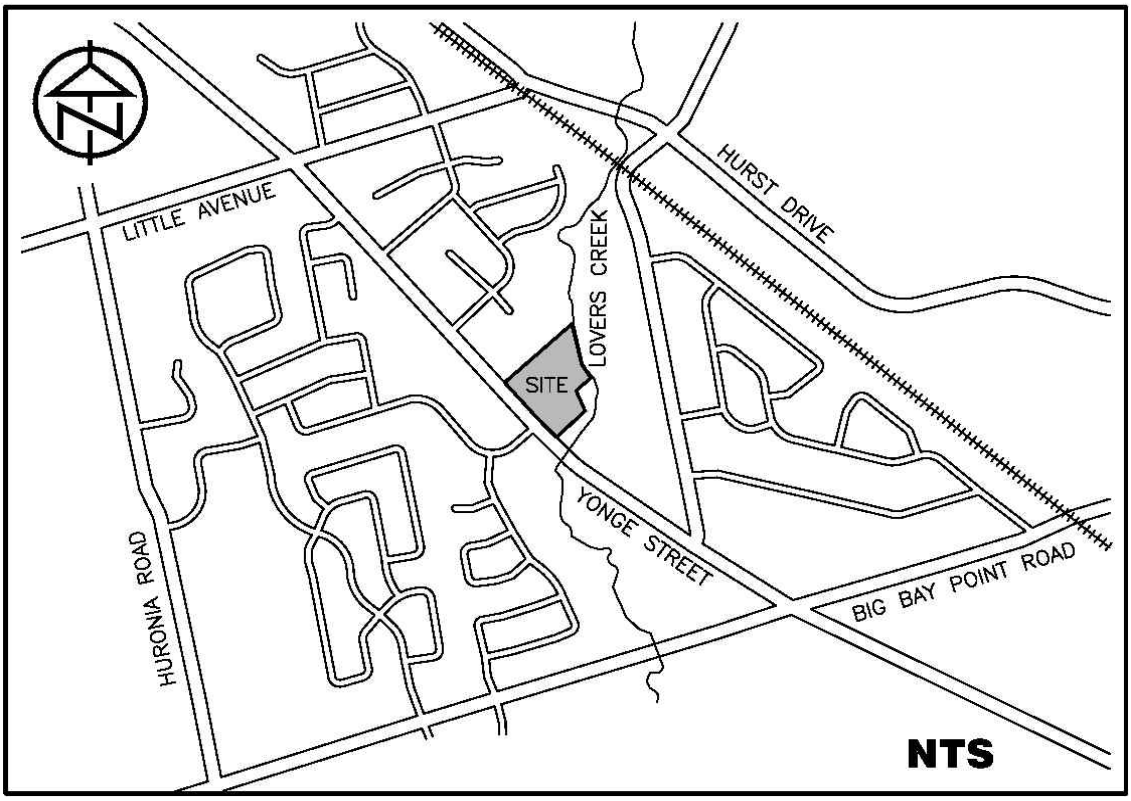
The site is located within the Lake Simcoe Region Conservation Authority (LSRCA) watershed and is located in their regulated area due to proximity to Lovers Creek. Therefore, the site will be subject to LSRCA review and approval. Ultimately a LSRCA works permit will be required prior to construction.

1.2 PROPOSED DEVELOPMENT

The proposed development consists of landscaped and outdoor amenity areas and three buildings (ranging from 8 to 12 storeys) with a total of 384 residential units. There will be approximately 1,020 m^2 of commercial space located on the ground floor of the proposed buildings. The development will be accessed from Yonge Street. The proposed site plan is provided in Appendix A.

The proposed development will be serviced by municipal water and sanitary systems. A private stormwater management system is proposed which will discharge into Lovers Creek. All existing water and sanitary services to the property will be permanently capped/cut off at the main to the satisfaction of the City of Barrie.

Figure 1: Site Location Plan



1.3 OBJECTIVES

The objective of this report is to present an overall servicing strategy to demonstrate the proposed development can be adequately serviced. This report will also document the preliminary stormwater management (SWM) strategy for the site, demonstrating the proposed development will not adversely affect local surface water conditions.

1.4 GUIDELINES & BACKGROUND INFORMATION

This report has been prepared in accordance with local and provincial guidelines, including the following publications:

- The Ministry of the Environment, Conservation, and Parks (MECP, formerly known as Ministry of Environment), *Stormwater Management Practices Planning and Design Manual* (2003);

- The Ministry of the Environment, Conservation, and Parks (MECP, formerly known as Ministry of Environment), *Lake Simcoe Protection Plan* (LSPP) (2009);
- Lake Simcoe Region Conservation Authority (LSRCA), *Technical Guidelines for SWM Submissions* (2022);
- Lake Simcoe Region Conservation Authority (LSRCA), *Phosphorus Offsetting Policy* (2021);
- City of Barrie, *Storm Drainage and Stormwater Management Policies and Design Guidelines* (2022);
- City of Barrie, *Sanitary Sewage Collection System Policies and Design Guideline* (2017); and
- City of Barrie, *Water Transmission and Distribution Design Standard* (2022).

Information relating to existing topography, ground cover, and drainage patterns was obtained through a review of relevant background studies, available plans, base mapping, and topographic survey.

2 Water Supply & Distribution

2.1 EXISTING WATER SYSTEM

The site is located in an area of the City which is serviced by the municipal water system. Specifically, the site is located within Pressure Zone 2S which is serviced by the City's surface water supply. There is an existing 300 mm dia. watermain on Yonge Street, which provides water supply and fire protection for the area.

According to the Water Supply Master Plan Update (2019) prepared by WSP, the surface water supply system is expected to have sufficient capacity to meet current and projected water demands up to 2035. Therefore, the system has sufficient supply capacity to service additional development in the area, including the subject site.

In addition, as per the Water Storage and Distribution Master Plan Update (2019) prepared by WSP, under existing conditions the storage systems which supply Pressure Zone 2 have a residual capacity of 11,890,000 L. There is expected to be sufficient storage volume to service Pressure Zone 2 under the 2041 growth scenario. Therefore, the system has sufficient storage volume to service additional development in the area, including the subject site.

2.2 PROPOSED WATER DEMANDS

The estimated population for the proposed development is 642 persons (applying the high-density unit population factor of 1.67 persons per unit as per the City's engineering standards). Residential water demands have been calculated using City standard values as summarized below. Demands generated by the commercial area have been estimated by applying a rate of 28 m^3/ha/day for the 1,020 m^2 of commercial space. Water system demands have been estimated by applying Maximum Day Factor and Peak Rate factors from Table 3-1 of the MOE Design Guidelines for Drinking Water Systems.

The estimated water system demands are:

- Average Day Demand (ADD), Residential: 642 persons x 225 L/person/day = 144,450 L/day = 1.67 L/s;
- Average Day Demand (ADD), Commercial: 1,020 m^2 x 28 m^3/ha/day = 2,856 L/day = 0.03 L/s;
- Total ADD: 147,306 L/day = 1.70 L/s;
- Total Maximum Daily Demand (MDD): 147,306 L/day x 2.75 = 405,092 L/day = 4.69 L/s; and
- Total Peak Hourly Demand (PHD): 147,306L/day x 4.13 = 608,374L/day = 7.04 L/s.

2.3 PROPOSED WATER SYSTEM

The proposed development will be serviced with a 150 mm dia. domestic water service and a dedicated 250 mm dia. fire service which will be connected to the existing 300 mm dia. watermain in Yonge Street which has a static pressure of 81 psi (558 kPa) based on the fire hydrant flow test referenced below. Additional preliminary water system information is provided on the Preliminary Site Servicing Plan (Drawing SS-1) provided in Appendix E. Preliminary watermain sizing is provided in Appendix B, based on the demands calculated above. The final water system design will be confirmed during the detailed design stage. Based on the preliminary calculations, there is not expected to be sufficient pressures (greater than 275 kPa) in the upper floors of the towers during PHD conditions. As such, it is expected that internal booster pumps will be required. However, the final watermain design and confirmation of need for booster pumps will be determined during the detailed design stage.

2.4 FIRE PROTECTION

Firefighting water demands have been estimated for the site using Water Supply Public Fire Protection (1999) prepared by the Fire Underwriters Survey (FUS). The required fire flow has been estimated at 200 L/s. Calculations provided in Appendix B.

A fire hydrant flow test was conducted using two nearby fire hydrants located on Essa Road, as provided in Appendix B. As shown in the test results, there was a minimal drop in residual pressures during the 3 conducted tests (i.e., system maintained a pressure of +/- 80 psi during the tests). Applying the equation provided in section 4.3.2 of the City's Water Transmission and Distribution Policies and Design Guideline, the estimated fire flow available at 20 psi is 13,684 U.S. GPM (862 L/s), which is greater than the required maximum water demand of 204.7 L/s (MDD + fire flow).

Details of the internal sprinkler systems and demands calculated by the mechanical engineering consultant have not yet been provided. Therefore, should the mechanical engineering consultant require additional information, or should the firefighting requirements change, our assessment will be updated accordingly.

3 Sanitary Sewer Collection

3.1 EXISTING SANITARY SYSTEM

The site is located in an area of the City serviced by a municipal sanitary sewer collection system that conveys flows to the Barrie Wastewater Treatment Facility (WWTF) located at the west end of Kempenfelt Bay on Lake Simcoe.

Currently, an existing 250 mm dia. sanitary sewer on Yonge Street runs along the frontage of the site. The sewer conveys sewage flows approximately 250 m south and connects to a 1,050 mm dia. sanitary trunk sewer. The sanitary trunk sewer conveys flow towards the Barrie WWTF. This is depicted in Drawing SAN-1 provided in Appendix C. The existing 250 mm dia. sewer on Yonge Street has a full flow capacity of 37.61 L/s. This is calculated in the Sanitary Sewer Design Sheet provided in Appendix C.

According to the Wastewater Treatment Master Plan (2019) prepared by WSP, we understand the WWTF is expected to reach its current rated capacity in 2031. It was expected to reach 80% of the rated capacity in 2021, at which time it is understood annual reports are required to be prepared to assess the function of the WWTF. As such, it is understood the WWTF has sufficient existing capacity to service additional development in the City, including the subject site.

3.2 PROPOSED SANITARY SYSTEM

The proposed development will discharge sewage to the existing 250 mm dia. sanitary sewer on Yonge Street via a new 200 mm dia. sanitary service. A sanitary maintenance hole will be constructed on the property line to provide a sampling location, as per City standards. Refer to Drawing SS-1 for additional information.

The full flow capacity of the 200 mm dia. sanitary service is 83.62 L/s, which can accommodate the design peak flow of 7.05 L/s from the proposed development. Peak flows have been estimated as per the following:

Estimated sanitary design flows:

- Average Day Flow, Residential: 1.67 ppu x 384 units = 642 persons x 225 L/cap/day = 144,288 L/day = 1.67 L/s; and
- Average Day Flow, Commercial: 1,020 m^2 x 28 m^3/ha/day = 2,856 L/day = 0.03 L/s;
- Total Average Day Flow: 147,144 L/day = 1.70 L/s; and
- Peak Flow = 7.05 L/s (incl. infiltration – see sanitary sewer design sheet).

Therefore, there is satisfactory capacity in the proposed service connection to service the development.

3.3 DOWNSTREAM CAPACITY ANALYSIS

The capacity within the Yonge Street sewers between the site and the 1,050 mm dia. trunk have been assessed to confirm they have sufficient capacity to convey the peak flows from the subject development. The existing external drainage area has been estimated as shown on the Sanitary Catchment Plan (Drawing SAN-1). The corresponding catchment areas and land uses have been included in the Sanitary Sewer Design sheet. As shown, the peak flow in the Yonge Street local sewer (including the subject site) is estimated to be 18.98 L/s, while the full flow capacity within the existing Yonge Street sewers is 37.61 L/s. Therefore, there is sufficient capacity within the local sanitary sewers on Yonge Street to convey sewage flows to the existing trunk sewer. We understand the trunk sewer is sufficiently sized to convey the contributing peak flows.

4 Stormwater Management Plan

4.1 BACKGROUND INFORMATION

Information relating to existing topography, ground cover and drainage patterns was obtained through a review of relevant studies, available plans, and base mapping. Detailed contour mapping was prepared based on a topographic survey of the site that was completed by Joe Topo Surveys and CADD Inc. in June 2021.

4.1.1 Floodplain Hazard Delineation

The LSRCA Generic HEC-RAS model was used to delineate 1:100-year and Regional (Hurricane Hazel) floodplain limits for Lovers Creek, which are delineated on the Drainage Plans (Drawings DP-1 and DP-2), Site Grading Plan (Drawing SG-1) and Site Servicing Plan (Drawing SS-1). As shown, the proposed development is located outside of the Regional floodplain limit, and therefore will not be subject to floodplain hazards.

Figure D1 is provided in Appendix D to illustrate the cross-section locations and corresponding flood elevations. Summary HEC-RAS model output is also provided in Appendix D for reference.

4.2 EXISTING CONDITIONS DRAINAGE

Under existing conditions, the site generally drains from west to east directly into Lovers Creek. Based on review of Ontario Soils Mapping data, the site is located in an area consisting of Bondhead sandy loam which is typically well drained and part of hydrologic soil group (HSG) AB. This is consistent with the findings of the geotechnical report prepared by Cambium Inc.

For the purposes of this preliminary SWM plan, two existing drainage catchments (Catchment 101 & Catchment 301) have been delineated as depicted on the Pre-Development Drainage Plan (Drawing DP-1), provided in Appendix E. Catchment 101 is approximately 1.43 ha and is comprised of woodland, lawn areas, an existing commercial development and two residential dwellings. Runoff from Catchment 101 flows east at an average slope of 9.1% toward Lovers Creek. Catchment 301 is approximately 1.26 ha and located downstream of Catchment 101 and is comprised of mostly woodland area. Runoff from Catchment 301 also flows east at an approximate slope of 7.7% into Lovers Creek. Composite runoff coefficients (RC) of 0.40 and 0.18 have been calculated for Catchments 101 and 301 per Table 3.2 of the City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines.

The Rational Method has been utilized to generate pre-development peak flow rates from the site for the 1:2-year through 1:100-year storm events utilizing City of Barrie IDF data in accordance with City standards for sites measuring less than 5.0 ha. Existing conditions peak

flows have been generated for Catchment 101 as Catchment 301 will remain relatively undisturbed and will not be affected by the proposed development. A summary of existing peak flow rates is provided in Table 1 while detailed calculations are provided in Appendix D for reference.

Table 1: Pre-Development Peak Flow Summary

STORM RETURN PERIOD	PEAK FLOW RATE (m^3/s)
1:2-Year	0.12
1:5-Year	0.16
1:10-Year	0.18
1:25-Year	0.24
1:50-Year	0.29
1:100-Year	0.33

4.3 PROPOSED STORMWATER MANAGEMENT PLAN DESIGN CRITERIA

This preliminary SWM plan is subject to the review and approval of the City and the LSRCA. Applicable SWM design criteria for the proposed development are presented below.

4.3.1 Stormwater Quantity Control

As per City and LSRCA requirements, water quantity controls must be provided to ensure post-development peak flow rates do not exceed pre-development rates at any outlet to protect against flooding and ensure no adverse impacts to downstream landowners. As mentioned, Catchment 301 will not be affected by the proposed development and, therefore, is not subject to water quantity controls (i.e., peak flows from this catchment are not considered).

4.3.2 Stormwater Quality Control

Water quality controls must be provided to satisfy the MECP's Stormwater Management Practices Planning and Design Manual. This corresponds to providing Enhanced Protection Level water quality protection of 80% total suspended solids (TSS) removal. Similar to the above, Catchment 301 will remain relatively undisturbed under proposed development conditions and, therefore, is not subject to water quality controls.

4.3.3 LSRCA Volume Control & LID Design

In accordance with LSRCA policies, any works meeting the definition of 'major development' are required to meet the volume control requirements as outlined in Section 3.2.4 of the LSRCA SWM Guidelines (2022). Best efforts must be demonstrated to infiltrate, filter or re-use the 25 mm storm event runoff from impervious areas on site.

4.3.4 Water Balance

In accordance with policies outlined in the Lake Simcoe Protection Plan (LSPP), any works designated as 'major development' (where the development area is over 500 m^2) must demonstrate that best efforts have been made to minimize changes in water balance due to the proposed development through the completion of a water balance assessment.

4.3.5 Phosphorus Budget

The proposed development is expected to be subject to the Lake Simcoe Phosphorus Offsetting Policy (LSPOP), which requires all 'major development' projects to phosphorus loadings to pre-development levels. Phosphorus loading that exceeds the pre-development phosphorus loading cannot be controlled/removed will require a cash contribution for off-site mitigation.

4.3.6 Siltation & Erosion Control

A siltation and erosion control strategy will be provided for implementation during construction.

4.4 PROPOSED STORMWATER MANAGEMENT PLAN

The preliminary SWM plan for the proposed development consists of an underground detention facility, storm structure and pipe storage as well as a Jellyfish filter to achieve the required SWM criteria.

4.4.1 Proposed Drainage Conditions

One post-development drainage catchment (Catchment 201) and one existing drainage catchment (Catchment 301) have been delineated as shown on the Post Development Drainage Plan (Drawing DP-2), provided in Appendix E. Catchment 201 is approximately 1.43 ha and comprised of the proposed building, pavement, and landscape areas. Runoff generated from Catchment 201 will be collected by the internal storm sewer network and conveyed to proposed underground storage chambers (SWM Facility #1) and ultimately discharge into Lovers Creek. An RC value of 0.95 has been applied to Catchment 201.

As mentioned, Catchment 301 remains relatively undisturbed under post-development conditions, and, therefore, is not subject to water quality or water quantity controls.

4.4.2 Flow Conveyance

Site runoff will be collected and conveyed to SWM Facility #1 via a network of storm sewers and catch basins.

4.4.3 Water Quantity

Water quantity controls for Catchment 201 will be provided by a combination of underground chamber (with impermeable liner) and pipe/structure storage. Post-development peak flow attenuation of the 1:2-year through 1:100-year design storms will be provided via a control maintenance hole structure (STM MH13) located downstream of SWM Facility #1. A summary of the operation of SWM Facility #1 including storage volumes, release rates and water surface elevations for each storm event is provided in Table 2 while detailed calculations and additional design details are provided in Appendix D.

Table 2: SWM Facility #1 Operating Characteristics Summary

STORM RETURN PERIOD	PEAK FLOW (m^3/s)	STORAGE VOLUME REQUIRED (m^3)	STORAGE VOLUME PROVIDED (m^3)	WATER SURFACE ELEVATION OF PROVIDED STORAGE VOLUME (m)
1:2-Year	0.12	146	150	239.03
1:5-Year	0.16	194	244	239.50
1:10-Year	0.18	228	263	239.61
1:25-Year	0.24	271	287	239.74
1:50-Year	0.29	278	309	239.86
1:100-Year	0.33	293	316	239.94

Peak flow attenuation will be provided by a two-stage orifice control located in the control maintenance hole. Peak flow attenuation of frequent storm events will be provided by a 252 mm dia. orifice at elevation 238.16 m. Peak flow attenuation of infrequent storm events will be provided by a 375 mm dia. orifice at elevation 239.44 m. A maximum storage volume of 293 m^3 is required to control post-development flow rates to pre-development rates or less. The storage provided in the underground stormwater storage chamber under the 1:100-year peak flow condition is 316 m^2 and is therefore sufficient. The storage chambers are located within the landscaped amenity area as depicted on the Drawing SS-1 provided in Appendix E.

Attenuated peak flows will discharge via a 450 mm dia. storm sewer to a riprap splash pad directed to Lovers Creek as depicted on Drawing SS-1.

4.4.4 Post-Development Peak Flow Summary

Due to the implementation of on-site water quantity controls, post-development peak flow rates discharging from Catchment 201 are less than or equal to pre-development rates for all storm events. A summary of post-development peak flows is provided in Table 3 while additional details are provided in Appendix D.

Table 3: Proposed Conditions Peak Flow Summary

STORM RETURN PERIOD	PEAK FLOW (m^3/s)
1:2-Year	0.12 *(0.12)*
1:5-Year	0.16 *(0.16)*
1:10-Year	0.18 *(0.18)*
1:25-Year	0.24 *(0.24)*
1:50-Year	0.29 *(0.29)*
1:100-Year	0.33 *(0.33)*

Note 1: Values in (italics) represent pre-development (Catchment 101) peak flow rates.

4.4.5 Water Quality

Enhanced level water quality control (corresponding to 80% TSS removal) is required for the site. Water quality controls will be provided for Catchment 201 via a Jellyfish filter unit which has been certified under the Environmental Technology Verification (ETV) process to provide TSS removal of 89%.

It should also be noted that SWM Facility #1 will include a sediment header row which is expected to provide an additional level of water quality treatment.

4.4.6 LSRCA Volume Control

In accordance with LSRCA requirements, projects defined as 'major development' are required to meet the volume control requirements outlined in Section 3.2.4 of the LSRCA 2022 SWM guidelines. As such, best efforts must be provided to infiltrate, filter, or re-use runoff generated from impervious areas on site.

Due to multiple site constraints (presented in Section 3.2.6 of the LSRCA SWM Guidelines) the site will not be able to provide infiltration-based volume control for the 25 mm runoff volume,

Flexible Treatment Alternative #1 (12.5 mm), and/or Flexible Treatment Alternative #2 (5 mm). The constraints consist of:

- zoning, setbacks or other land use requirements;
- property or infrastructure restrictions; and
- high groundwater (approximately 2.67 m below proposed ground surface).

Therefore, the primary preference for infiltration-based volume control measures cannot be provided. However, the secondary preference, filtration-based volume control measures, will be provided via the proposed Jellyfish Filter unit. Based on a total impervious area of 1.39 ha, the 25 mm event generates a runoff volume of 348 m^3. The 25 mm runoff volume from 1.00 ha of impervious area equal to 250 m^3 will be captured and filtered by the Jellyfish Filter unit. As such, considering the total impervious area of 1.39 ha, filtration-based volume control of the equivalent 18 mm event will be provided, which represents best efforts. In addition, since the quantity controls on site will be provided underground, it is assumed to provide some level of cooling to runoff and thereby providing minor thermal mitigation, further enhancing volume control measures.

4.4.7 Water Balance

A water balance analysis has been completed by Cambium to assess the potential impact of the development on local groundwater and surface water resources. Refer to the original report for details.

4.4.8 Phosphorus Mitigation

In order to comply with LSPOP requirements, an assessment of the phosphorus loading from the site under proposed conditions has been completed using the loading rates and removal efficiencies from the Sustainable Technologies Evaluation Program (STEP) Low Impact Development Treatment Train Tool (LID TTT).

Existing Conditions

The site has been modelled as four land use categories: paved surface, roof, landscape, and forest area with loading rates of 0.23 mg/L, 0.09 mg/L, 0.32 mg/L, and 0.23 mg/L. Applying these loading rates, the annual pre-development phosphorus load is 0.24 mg/L which is equivalent to 0.89 kg/year.

Proposed Conditions

The site has been modelled as three land use categories: paved surface, roof, and landscape area with loading rates of 0.23 mg/L, 0.09 mg/L, 0.32 mg/L. Applying these loading rates, the annual post-development phosphorus load is 0.19 mg/L which is equivalent to 1.95 kg/year.

Best efforts for phosphorus mitigation for the site will be provided via the Jellyfish filter and the underground storage chamber which have phosphorus removal efficiency rates of 59% and 25% respectively. As such, the combined removal efficiency rate is 69%.

Therefore, the total annual post-development phosphorus load is reduced to 0.03 mg/L which is equivalent to 0.60 kg/year. A summary of the phosphorus loading under the post-development and post-development with mitigation scenarios is provided in Table 4 below. Detailed model output is provided in Appendix D.

Table 4: Phosphorus Loading Summary

SCENARIO	AREA (ha)	PHOSPHOROS LOADING (kg/year)
Pre-Development (Without Controls)	1.45	0.89
Post-Development (Without Controls)	1.45	1.95
Post-Development (With Controls)	1.45	0.60

4.5 SWM FACILITY MAINTENANCE

Ongoing maintenance of SWM facilities is necessary to ensure continued effectiveness. The storage chambers and jellyfish filter unit should be inspected regularly and particularly after large rainfall events to ensure the system and all its component parts are functioning properly and are in good repair.

4.6 SILTATION & EROSION CONTROL PLAN

Siltation and erosion controls will be implemented for all construction activities, including earthworks, material stockpiling, pavement construction, and grading operations. Details of the sedimentation and erosion control will be provided during detailed design and are summarized as follows:

- heavy duty silt control fences will be erected to control sediment movement to abutting properties and the Yonge Street right-of-way;
- a stone mud mat will be installed at the construction entrances from Yonge Street; and

- regular inspection of control measures will be implemented, and repairs made as necessary during construction.

5 Grading & Landscaping

The grading of the proposed development will match to the existing grades along the limits of the development. The site will be graded to suit the existing boundary conditions on the boulevard of Yonge Street. Consideration will be taken for the steep sloping along Lovers Creek, the proposed development will match to the existing grade at the staked top of bank limit at the north and east development limits. Refer to the Preliminary Site Grading Plan (Drawing SG-1) provided in Appendix E for additional details.

6 Utilities

All utilities (electrical, gas, telecommunications) are expected to be available from Yonge Street to service the proposed development. Further coordination will be required during the detailed design stage.

7 Summary

7.1 WATER SUPPLY & DISTRIBUTION

The site will be serviced with a 150 mm dia. domestic water service and a dedicated 250 mm dia. fire service from the existing 300 mm dia. watermain on Essa Road. The existing municipal system has sufficient pressures, capacity, and storage volumes to provide service to the proposed development.

7.2 SANITARY SEWER COLLECTION

The site will be serviced via a 200 mm dia. sanitary sewer connecting to the existing 250 mm dia. sanitary sewer on Yonge Street. The existing local sanitary sewers in Yonge Street have sufficient capacity to convey the contributing peak flows to the downstream trunk sewer. The Barrie WWTP also has sufficient capacity, under existing conditions, to service the proposed development.

7.3 STORMWATER MANAGEMENT PLAN

The preliminary SWM plan demonstrates the proposed development will not result in negative impacts with respect to stormwater.

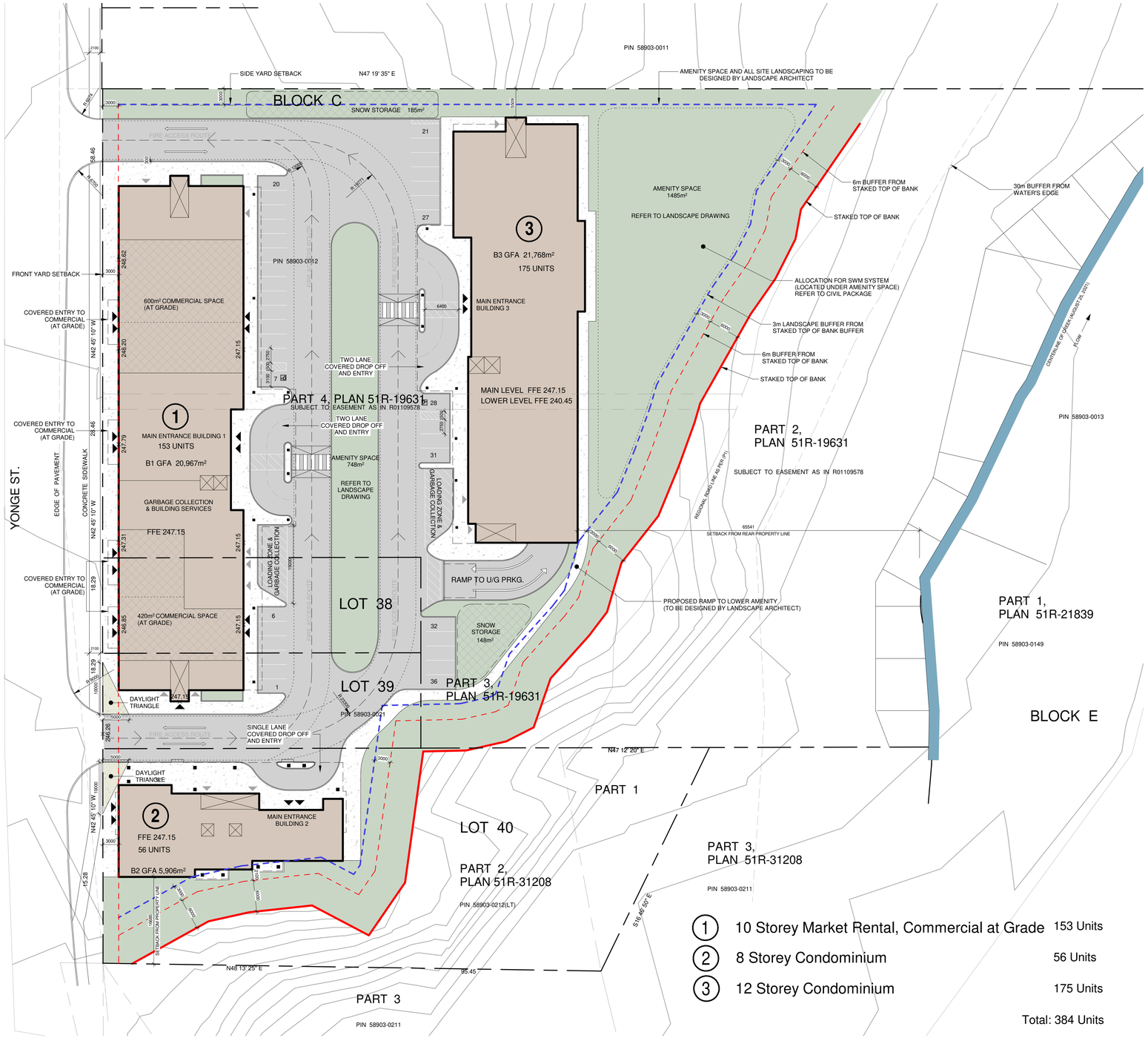
7.4 GRADING & LANDSCAPING

The grading of the proposed development will match to existing perimeter grades along the limits of the development.

7.5 UTILITIES

All utilities (electrical, gas, telecommunications) are expected to be available from Yonge Street to service the proposed development.

Appendix A:
Site Plan



1 10 Storey Market Rental, Commercial at Grade 153 Units

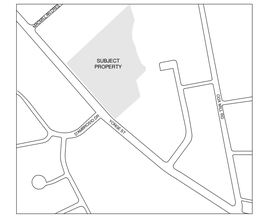
2 8 Storey Condominium 56 Units

3 12 Storey Condominium 175 Units

Total: 384 Units

1 / A101 Site Plan

1 : 400



KEY PLAN

SITE PLAN LEGEND:

- PROPERTY LINE
- PART LOT / EASEMENT LINE
- STABLE TOP OF SLOPE AS STAKED
- CENTRELINE OF LOVERS CREEK
- LANDSCAPE BUFFER
- COMMERCIAL (1 STOREY @ GRADE)
- SNOW STORAGE
- CONCRETE PAVING / SIDEWALK
- ASPHALT PAVEMENT
- GRASS / DEVELOPABLE LIMIT

APARTMENT DWELLING SECOND DENSITY - 2 (RA2-2) ZONE

PROVISIONS	REQUIRED	PROVIDED
LOT AREA	1300m²	26,815.2m²
DEVELOPABLE AREA	--	16,457.7m²
LOT FRONTAGE (min.)	30m²	167.6m
FRONT YARD SETBACK (min.)	7m	3m *
SIDE YARD SETBACK (min.)	5m	5.5m
REAR YARD SETBACK (min.)	7.0m	65m
LANDSCAPED OPEN SPACE (min.)	35%	58%
DWELLING UNIT FLOOR AREA (min.)	35.0m² / dwelling unit + 10.0m² / bedroom	55.0m² / dwelling unit + 12.0m² / bedroom
LOT COVERAGE (max.)	35%	17% - Lot Area 28% Developable Area
GROSS FLOOR AREA (max. % of lot area)	200%	181% Lot Area * 295% Developable Area
HEIGHT OF MAIN BUILDING (max.)	45m	40.8m
COMMERCIAL USES WITHIN APARTMENT DWELLINGS	Max. 25% of the ground floor area	23% - all buildings 47% - Building 1
PARKING: RESIDENTIAL BUILDINGS CONTAINING MORE THAN 3 DWELLING UNITS	1.5 spaces per dwelling unit (384 units x 1.5 = 576 spaces) B.F. Spaces 19 Type 'A' and 'B'	419 spaces * incl. 14 B.F. spaces (8 Type 'A' & 6 Type 'B')
PARKING: COMMERCIAL (PERSONAL SERVICE STORE (5.2.6))	1 space per 30m² of gross floor area (1061m²/30 = 36 spaces) B.F. spaces 1 Type 'A' Space & 1 Type 'B' Space	36 spaces incl. 2 B.F. spaces (1 Type 'A' & 1 Type 'B')
PARKING FOR UNDERGROUND STRUCTURE	The minimum setback from the street line to the nearest part of a parking structure underground shall be 1.8m, except where the minimum yard setback for the applicable zone is less than 1.8m	3m
PARKING FOR APARTMENT DWELLINGS - MAX. LOT COVERAGE (5.4.4.1)	35%	25%
LANDSCAPED BUFFER AREAS (PARKING AREAS)	A parking area which provides for more than 4 parking spaces adjoining a residentially zoned lot requires a continuous landscaped buffer area with a minimum width of 3m shall be provided along the abutting lot line and a continuous tight board fence with a minimum height of 2m is to be constructed along the lot line. The landscaped buffer area shall be planted with appropriate vegetation to effectively screen the parking area.	Complies
LANDSCAPED BUFFER AREAS (APARTMENT DWELLINGS)	A continuous landscaped buffer area shall be provided along the side and rear lot lines of any lot which is occupied by an Apartment Dwelling. The landscaped buffer area shall be 3m in width along the side and rear lot lines.	Min. 3m

* Indicates currently non-compliant

No.	Revision	Date
2	Zoning By-Law Ammendment Resubmission	
1	Issued for Zoning By-Law Ammendment	2021.12.17

Orientation

PROJECT NORTH

Seal

salterpilon architecture

151 Ferris Lane, Suite 400 Barrie, Ontario L4M 6C1
salterpilon.com t: 705.737.3530

Project Information

Renaissance Residences - Barrie

505 to 533 Yonge St., Barrie, ON

For

Core Advisory Group

Drawing Title

Site Plan

Date	Project No	Drawing No
Drawn by KT	20033	A101
Scale As indicated		

C:\Users\ktuckey\Documents\20033 - 505 Yonge St_Option 3_R20_ktuckey4LYBX.rvt
2023-04-18 11:01:12 AM

Appendix B:
Water Demand Calculations

PROJECT	505-533 Yonge Street, Barrie	FILE	421422
		DATE	May 25, 2023
SUBJECT	Preliminary Watermain Calculations	NAME	NM
		PAGE	1 OF 4

1.1 Proposed Development

Number of Units:	384		
Population Per Unit:	1.67	(per City of Barrie guidelines)	
Equivalent Population:	642		
Residential Design Rate:	225	L/p/day	
Commercial Area:	1020	m^2	
Commercial Design Rate:	28	m^3/Ha/day	

Peaking Factors		
Maximum Day	=	2.75
Peak Hour	=	4.13

(Per Table 3.1 of the Ministry of the Environment, Conservation & Parks (MECP) Design Guidelines for Drinking -Water Systems)

1.2 Design Water Demands

Average Daily Demand	=	147,306	L/day		=	147.31	m³/day
	=	1.70	L/s				
Maximum Daily Demand	=	147,306	L/day	x 2.75			
	=	405,092	L/day		=	405.09	m³/day
	=	4.69	L/s				
Peak Hour Demand	=	1.70	L/s	x 4.13			
	=	7.04	L/s				

1.3 Fire Flows (per Fire Underwriters Study (FUS), 1999)

See attached FUS Calculation sheet

Maximum Day Plus Fire Flow	=	4.69	L/s	+	200.0	L/s
	=	204.7	L/s			

1.4 Size of Watermain

Size of watermain required to accommodate Peak Hour Demand

Minimum Size: 75 mm dia. (per City of Barrie Water Transmission and Distrbution Design Standard, 2020)

Selected size: 150 mm dia.

Therefore, Peak Hour Velocity:

$$V = \frac{Q}{A} \qquad V = \frac{0.007}{0.018}$$

Where:

Q =	Peak Hour Demand (m3/s)	Q =	0.007	V =	0.3985 m/s
D =	Watermain Diameter (m)	D =	0.15		
A =	Area of Watermain (m2)	A =	0.018		

Size of watermain to accommodate Fire Flow

Minimum Size: 150 mm dia. (per City of Barrie Water Transmission and Distrbution Design Standard, 2020)

Selected size: 250 mm dia.

Therefore, Fire Flow Velocity:

$$V = \frac{Q}{A} \qquad V = \frac{0.2}{0.049}$$

Where:

Q =	Fire Flow Demand (m3/s)	Q =	0.2	V =	4.07 m/s
D =	Watermain Diameter (m)	D =	0.25		
A =	Area of Watermain (m2)	A =	0.049		

1.5 Peak Hour Headloss (Due to Friction) in Proposed 150 mm dia. Watermain

Connect to existing 300 mm dia. watermain in Yonge Street

Calculation assumes no significant change in elevation and a total length of 160 m

$$hf = 0.54\sqrt{\frac{Q}{0.278(C)D^{2.63}}} \times L$$

Where:

hf =	headloss in watermain due to friction		
Q =	Peak Hour Demand (m3/s)	Q =	0.0070
C =	Friction Factor (regardless of material)	C =	130
D =	Watermain Inside Diameter (m)	D =	0.15
L =	Watermain Length (m)	L =	160

$$hf = 0.54\sqrt{\frac{0.0072}{0.278(110)0.25^{2.63}}} \times 160$$

hf =	0.2218	m	Where 1 m of head = 1.42 PSI
	0.3149	psi	1.42 PSI = 6.8947 kPa
	1.5288	kPa	

1.6 Static Loss

Surface Elevation at Point of Connection =	246	m
Building FFE (Bldng 1) =	248.6	m
Height to Building Roof =	40	m
Height of Roof Above Watermain at Point of Connection =	42.6	m
Static Pressure Loss =	60.58	psi
	417.67	kPa

1.7 Minor Losses (fittings, bends, valves etc.)

$hv = k(V^2)/2g$

Where:

hv = minor loss (m)

k = loss coefficient

v = velocity (m/s)

g = acceleration dur to gravity (9.81 m/s²)

	#	K
Gate Valve	2	0.2
45° elbow - standard	1	0.35
45° elbow - long radius	0	0.20
90° elbow - standard	0	0.75
90° elbow - long radius	0	0.45
tee (flow through)	1	0.4
tee (as elbow)	0	0.95
Total k =		1.15

$$hv = \frac{1.15 \times 0.3985^2}{2 \times 9.81}$$

hv = 0.0093 m

0.0132 psi

0.0911 kPa

1.8 Total Head Loss (Peak Hour)

Total Head Loss hf = Friction Loss + Static Loss + Minor Loss

hf = 1.5288 + 417.67 + 0.0911

hf = 419.28 kPa

1.9 Available Water Supply

Hydrant 1546/3002 Test as per Vipond Hydrant Flow Test (appended)

Normal Operating Pressure = 81 psi = 558.41 kPa

1.10 Serviceability of Proposed Development

Minimum Available Pressure = operating pressure at connection - total head loss

= 558.414 - 419.28

= 139.13 kPa

Therefore 139.13 kPa < 275 kPa

As such, internal booster pumps are expected to be required to maintain mimimum pressure on upper floors of buildings. This will be confirmed during detailed design stage.

Min. Normal Operating Pressure in Yonge Street main to maintain minimum 275 kPa throughout the site (top floor) during peak hour conditions =

694 kPa

TATHAM ENGINEERING

PROJECT	505-533 Yonge Street, Barrie	FILE	421422
		DATE	May 26, 2023
SUBJECT	Available Fire Flow	NAME	NM
		PAGE	1 OF 1

Available Fire Flow At 20 PSI

Flow Test Completed By: Vipond Fire Protection Inc.

Date of Test: 8/11/2021

Test Location: City of Barrie Hydrants 3002 and 1546

Static Pressure: 81 PSI

$$QA = QT \left(\frac{ha}{ht}\right)^{0.5}$$

Where

QA = Flow at 20 PSI

QT = Flow at Test (U.S. GPM)

ha = Pressure Drop Available (PSI) (Static - 20)

ht = Pressure Drop at Test (PSI) (Static - Residual)

Note: Equation per City of Barrie Water Transmission and Distribution Policies and Design Guidelines

Test #1

QT	=	701		QA =	17,313	U.S. GPM
ha	=	81-20	= 61	QA =	1,091	L/s
ht	=	81-81	= 0			

Test #2

QT	=	984		QA =	24,303	U.S. GPM
ha	=	81-20	= 61	QA =	1,531	L/s
ht	=	81-81	= 0			

Test #3

QT	=	1752		QA =	13,684	U.S. GPM
ha	=	81-20	= 61	QA =	862	L/s
ht	=	81-80	= 1			

TATHAM ENGINEERING	Project: 505-533 Yonge Street, Barrie	Date:	May 26, 2023
	File No.: 421422	Designed:	LJC
	Subject: FUS Calculations - Largest Building	Checked	NM
	Revisions:		

Fire Underwriters Survey Fire Flow Calculations

Calculation Based on 2020 Publication "Water Supply for Public Fire Protection" by Fire Underwriters Survey (FUS).

Step	Description	Term	Options	Multiplier Associated with Option	Choose	Value used	Unit	Total Fire Flow (L/min)	
1	Frame Use for Construction of Unit	**Framing Material**							
		Coefficient related to type of construction (C)	Type V - Wood Frame Construction	1.5	Non-combustible Construction	**0.8**	%	N/A	
			Type IVA - Mass Timber Construction	0.8					
			Type IVB - Mass Timber Construction	0.9					
			Type IVC - Mass Timber Construction	1.0					
			Type IVD - Mass Timber Construction	1.5					
			Ordinary Construction	1.0					
			Non-combustible Construction	0.8					
			Fire Resistive Construction	0.6					
2	Total Effective Area	Largest Floor Area				**2280**	m^2	N/A	
		Percentage of the Total Area of the Other Floors for Coefficient 1.0 to 1.5			**100%**				
		Percentage of the Total Area of the Other Floors for Coefficient below 1.0:							
		a) If any vertical opening in the building are unprotected, consider the two largest adjoining floor areas plus 50% of all floors immediately above them up to a maximum of eight, **or**			**50%**				
		b) If all vertical openings and exterior vertical communications are properly protected in accordance with the National Building Code, consider only the single largest Floor Area plus 25% of each of the two immediately adjoining floors.			**25%**	**3420**			
		Total Effective Area				**5700**			
3	Required Fire Flow without Reductions or Increases	Required Fire Flows without Reductions or Increases per FUS): (RFF= 220 x C x $A^{0.5}$)						13,000	
4	Factors Affecting Burning	**Reductions / Increases Due to Factors Affecting Burning**							
4.1	Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	%	(1,950)	11,050
			Limited combustible	-0.15					
			Combustible	0.00					
			Free burning	0.15					
			Rapid burning	0.25					
4.2	Reduction Due to Presence of Sprinklers	Sprinkler reduction	For a fully supervised system the conditions a), b) and c) below must be met.			-0.3	%	(3,315)	7,735
			a) Automatic sprinkler protection designed and installed in accordance with NFPA 13	-0.3	Yes				
			b) Water supply is standard for both the system and the Fire Department hose lines	-0.1	No				
			c) Fully supervised system	-0.1	No				
			None	0.0	No				
4.3	Separation Distance Between Units (Use 10% for 2 hour Fire Separation between adjacent units)	Exposure distance between units	North Side	10.1 to 20.0 m	0.15	0.4	%	4,420	12,155
			East Side	20.1 to 30.0 m	0.10				
			South Side	10.1 to 20.0 m	0.15				
			West Side	Greater than 30.0 m	0.00				
4.4	Combustibility of Wood Shingle or Shake Roof Material	Surcharge for potential to spread fire	Non-combustible roofing material	0	Non-combustible roofing material	0	L/min	0	12,155
			Low risk of fire spread	2000					
			Moderate risk of fire spread	3000					
			High risk of fire spread	4000					
		Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:							12,000
5	Required Fire Flow, Duration and Volume	Total Required Fire Flow (above) in L/s:							200
		Required Duration of Fire Flow of 12,000 L/min (hrs):							2.5
		Required volume for Fire Flow of 12,000 L/min (m^3):							1,800

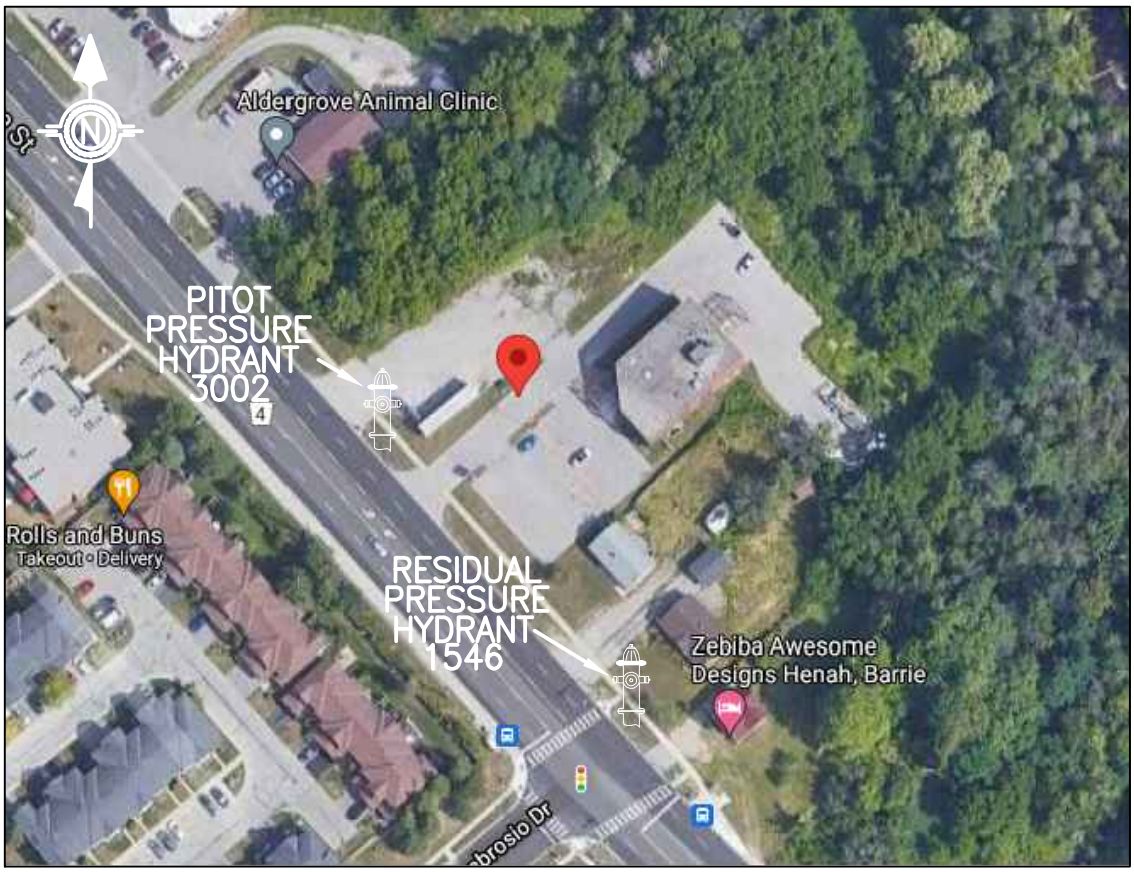
FLOW TEST RESULTS

FIRST FOR FIRE, LIFE SAFETY & SECURITY
VIPOND INC
est. 1945

DATE : AUGUST 11, 2021 TIME : 10:00 AM

LOCATION : 503 YONGE ST.
CITY OF BARRIE
ONTARIO

TEST BY : VIPOND FIRE PROTECTION AND LOCAL PUC



STATIC PRESSURE : 81 PSI

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1-3/4	0.995	81	62	701
2	1	2-1/2	0.9	81	34	984
3	2	2-1/2	0.9	80	27	1752

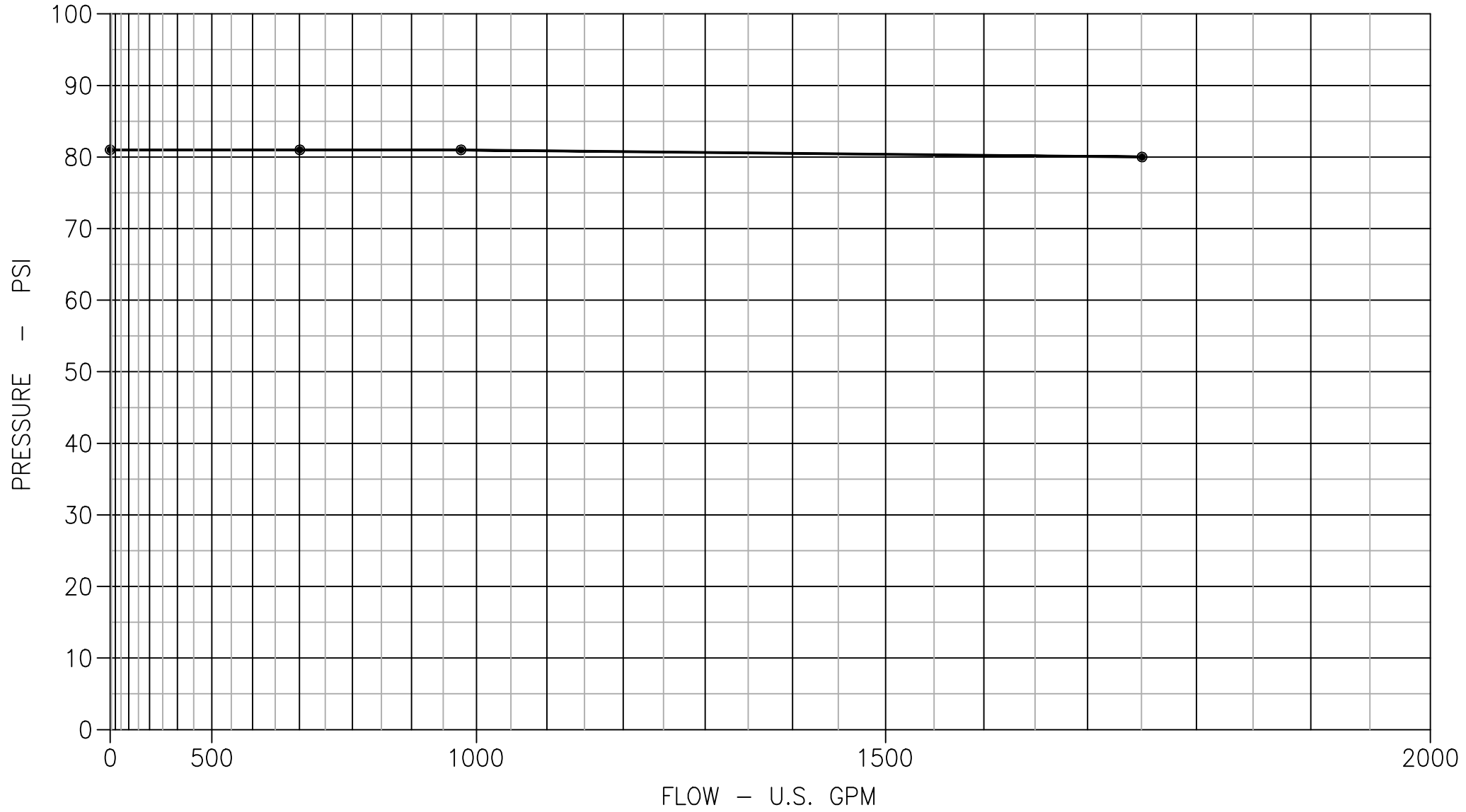
FIRST FOR FIRE, LIFE SAFETY & SECURITY

VIPOND INC est. 1945

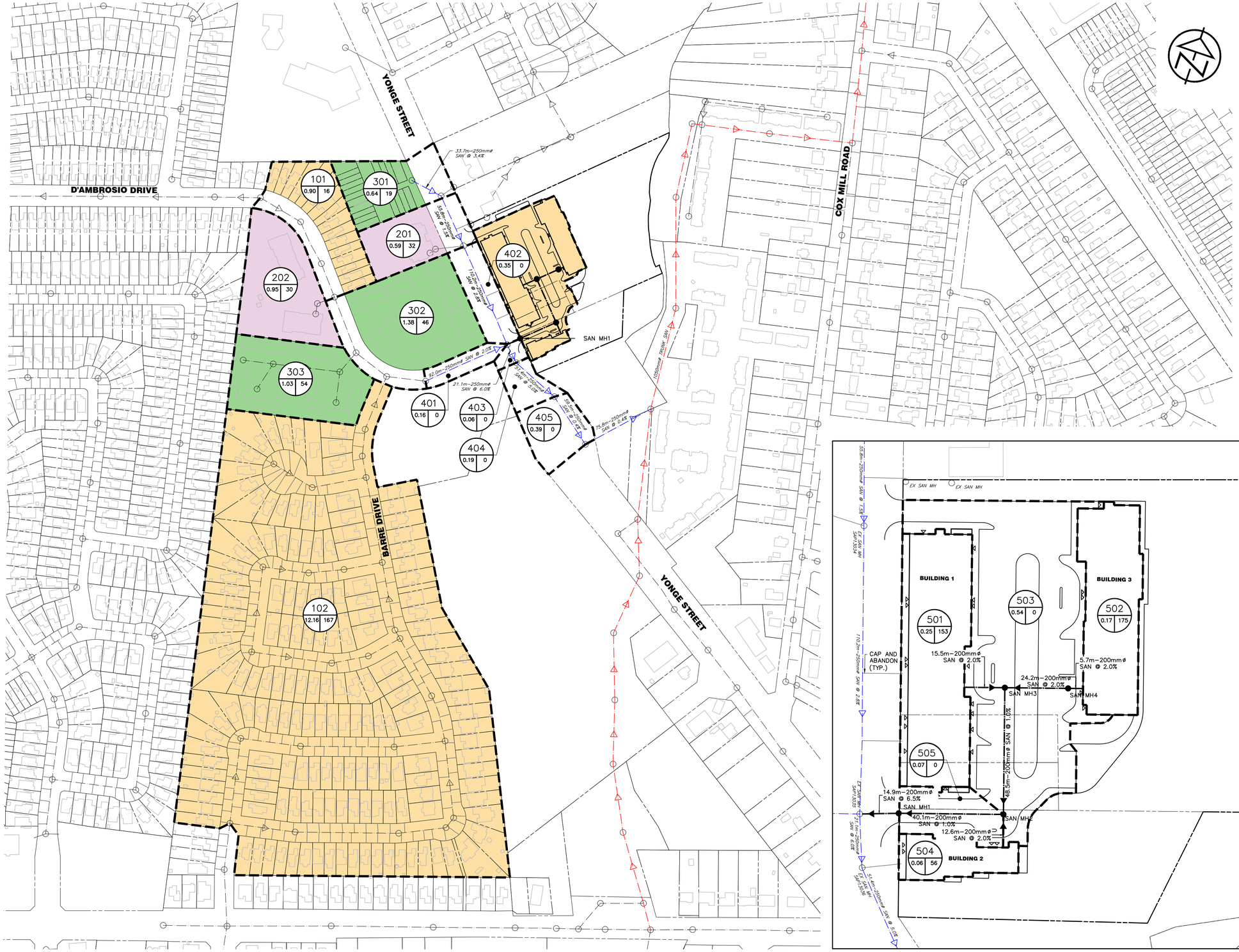
503 YONGE ST	BY : MIKE. P/RILEY P.
CITY OF BARRIE	OFFICE : BARRIE
ONTARIO	TEST BY : VIPOND & PUC
	DATE : AUGUST 11, 2021

STATIC: 81 PSI

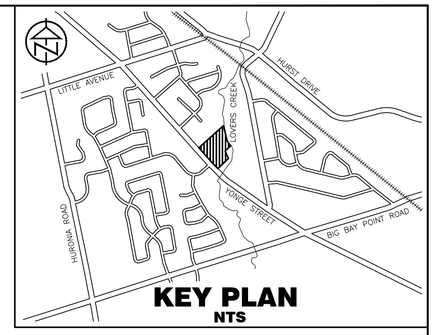
RESIDUAL:			FLOW:	
TEST#1	81 PSI	@	701	GPM
TEST#2	81 PSI	@	984	GPM
TEST#3	80 PSI	@	1752	GPM



Appendix C: Sanitary Sewage Design Calculations



DETAIL A
SCALE 1:750



KEY PLAN
NTS

LEGEND

- EXISTING PROPERTY LINE
- EXISTING SANITARY SEWER
- EXISTING LOCAL SANITARY SEWER
- EXISTING TRUNK SANITARY SEWER
- SAN MH — EXISTING SANITARY MANHOLE
- CATCHMENT BOUNDARY
- 101 | 0.00 | 0.00 — CATCHMENT ID / AREA (ha) | # OF UNITS
- LOW DENSITY POPULATION
- MEDIUM DENSITY POPULATION
- HIGH DENSITY POPULATION

DISCLAIMER AND COPYRIGHT

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

BENCHMARKS

ELEVATIONS SHOWN ARE GEODETIC BASED ON NAD83 (CANADA) AND ARE DERIVED FROM GPS REAL TIME NETWORK OBSERVATIONS USING THE 'CAN-NET' VRS NETWORK, IN UTM 17N.

BENCHMARK:
NAILS IN HYDRO POLES, OPPOSITE SIDE OF YONGE STREET.

NOTES

TOPOGRAPHIC SURVEY SHOWN ON THIS PLAN PREPARED BY JOE TOPO SURVEYS AND CADD INC., DATED JUNE 4, 2021.

SITE PLAN PREPARED BY SALTER PILON ARCHITECTURE, DATED APRIL 19, 2023.

No.	REVISION DESCRIPTION	DATE
1.	ISSUED FOR ZBA – FIRST SUBMISSION	DEC 14/21
2.	ISSUED FOR ZBA – SECOND SUBMISSION	MAY 31/23

ENGINEER STAMP

505 - 533 YONGE STREET
CITY OF BARRIE

SANITARY CATCHMENT PLAN

TATHAM ENGINEERING

DESIGN: LMB	FILE: 421422	DWG: SAN-1
DRAWN: LMB/LJC	DATE: OCT 2021	
CHECK: NM	SCALE: 1:2000	

Drawing Name: 421422-SAN01.dwg, Plotted: May 30, 2023

TATHAM ENGINEERING

Sanitary Sewer Design Sheet

Version Number: 2 **Version Date:** May 26, 2023

Project Information

505 - 533 Yonge Street	421422

Drawing Reference

Sanitary Catchment Plan (SAN-01)	05/26/2023

Prepared By

LMB/LJC	05/26/2023

Reviewed By

NM	05/26/2023

Municipality

City of Barrie

Population Density

Capita per Unit	Low	Medium	High
	3.13	2.34	1.67

Infiltration

Infiltration (L/s/ha)	0.1

Flow

Development Type	Average (L/cap/day)	Peaking Factor
Residential	225	Harmon
Development Type	**Average (L/ha/day)**	**Peaking Factor**
Institution	28,000	2
Commercial	28,000	2
Industrial High Intensity	55,000	-
Industrial Low Intensity	50,000	-

Manning's Coefficient

Pipe Material	Value
Concrete	0.013
PVC	0.013
Applied	0.013

Engineer Stamp

Street Name	Area Label/ID	Upstream Maintenance Hole	Downstream Maintenance Hole	Development Type	Population Density	Number of Units	Population (cap)	Accumulated Population (cap)	Peaking Factor	Area (ha)	Cumulative Area (ha)	Average Flow (L/s)			Peak Flow (L/s)			Proposed Sanitary Sewer						
												Development	Infiltration	Total	Development	Infiltration	Total	Sewer Length (m)	Sewer Slope (%)	Actual Sewer Diameter (mm)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Actual Velocity (m/s)	Calculated Sewer Diameter (mm)	Percentage of Full Flow Capacity (%)
	101, 102	A	SAP13040	Residential	Low	183	572.8	572.8	3.94	13.06	13.06	1.49	1.31	2.80	5.88	1.31	7.19	2.0	2.0%	250	1.71	84.10	1.01	99	8.5%
	202	B	SAP13040	Residential	High	30	50.1	50.1	4.31	0.95	0.95	0.13	0.10	0.23	0.56	0.10	0.66	2.0	2.0%	250	1.71	84.10	0.53	41	0.8%
	302, 303	C	SAP13040	Residential	Med.	100	234.0	234.0	4.12	2.41	2.41	0.61	0.24	0.85	2.51	0.24	2.75	2.0	2.0%	250	1.71	84.10	0.78	69	3.3%
D'Ambrosio Drive	401	SAP13040	SAP13035	Residential	Low	0	0.0	856.9	3.84	0.16	16.58	2.23	1.66	3.89	8.96	1.66	10.61	92.0	2.0%	250	1.71	84.10	1.13	115	12.6%
Yonge Street	301	EX SANMH	SAP13032	Residential	Med.	19	44.5	44.5	4.32	0.64	0.64	0.12	0.06	0.18	0.50	0.06	0.56	33.7	3.4%	250	2.23	109.65	0.62	35	0.5%
Yonge Street	201	SAP13032	SAP13034	Residential	High	32	53.4	97.9	4.25	0.59	1.23	0.25	0.12	0.38	1.09	0.12	1.21	55.8	1.5%	250	1.48	72.83	0.56	54	1.7%
Yonge Street	402	SAP13034	SAP13035	Residential	Low	0	0.0	97.9	4.25	0.35	1.58	0.25	0.16	0.41	1.09	0.16	1.25	110.2	2.8%	250	2.03	99.51	0.71	48	1.3%
	501A	COMM	BLDG1	Commercial				0.0	2.00	0.10	0.10	0.03	0.01	0.04	0.06	0.01	0.07								
	501	BLDG1	SAN MH3	Residential	High	153	255.5	255.5	4.11	0.15	0.25	0.70	0.03	0.72	2.80	0.03	2.82	15.5	2.0%	200	1.48	46.38	0.80	70	6.1%
	502	BLDG3	SAN MH4	Residential	High	175	292.3	292.3	4.08	0.17	0.17	0.76	0.02	0.78	3.11	0.02	3.12	5.7	2.0%	200	1.48	46.38	0.82	73	6.7%
		SAN MH4	SAN MH3	Residential	High	0	0.0	292.3	4.08	0.00	0.17	0.76	0.02	0.78	3.11	0.02	3.12	24.2	2.0%	200	1.48	46.38	0.82	73	6.7%
	503	SAN MH3	SAN MH2	Residential	High	0	0.0	547.8	3.95	0.54	0.96	1.46	0.10	1.55	5.91	0.10	6.00	48.5	1.0%	200	1.04	32.80	0.76	106	18.3%

1. Slopes highlighted red indicate assumed data.
2. Red pipe size represents existing sewer.
3. Manholes A, B, C and COMM. are arbitrary, used only to assist with the calculations.

TATHAM ENGINEERING

Sanitary Sewer Design Sheet

Version Number: 2 **Version Date:** May 26, 2023

Project Information

505 - 533 Yonge Street	421422

Drawing Reference

Sanitary Catchment Plan (SAN-01)	05/26/2023

Prepared By

LMB/LJC	05/26/2023

Reviewed By

NM	05/26/2023

Municipality

City of Barrie

Population Density

Capita per Unit	Low	Medium	High
	3.13	2.34	1.67

Infiltration

Infiltration (L/s/ha)	0.1

Flow

Development Type	Average (L/cap/day)	Peaking Factor
Residential	225	Harmon
Development Type	**Average (L/ha/day)**	**Peaking Factor**
Institution	28,000	2
Commercial	28,000	2
Industrial High Intensity	55,000	-
Industrial Low Intensity	50,000	-

Manning's Coefficient

Pipe Material	Value
Concrete	0.013
PVC	0.013
Applied	0.013

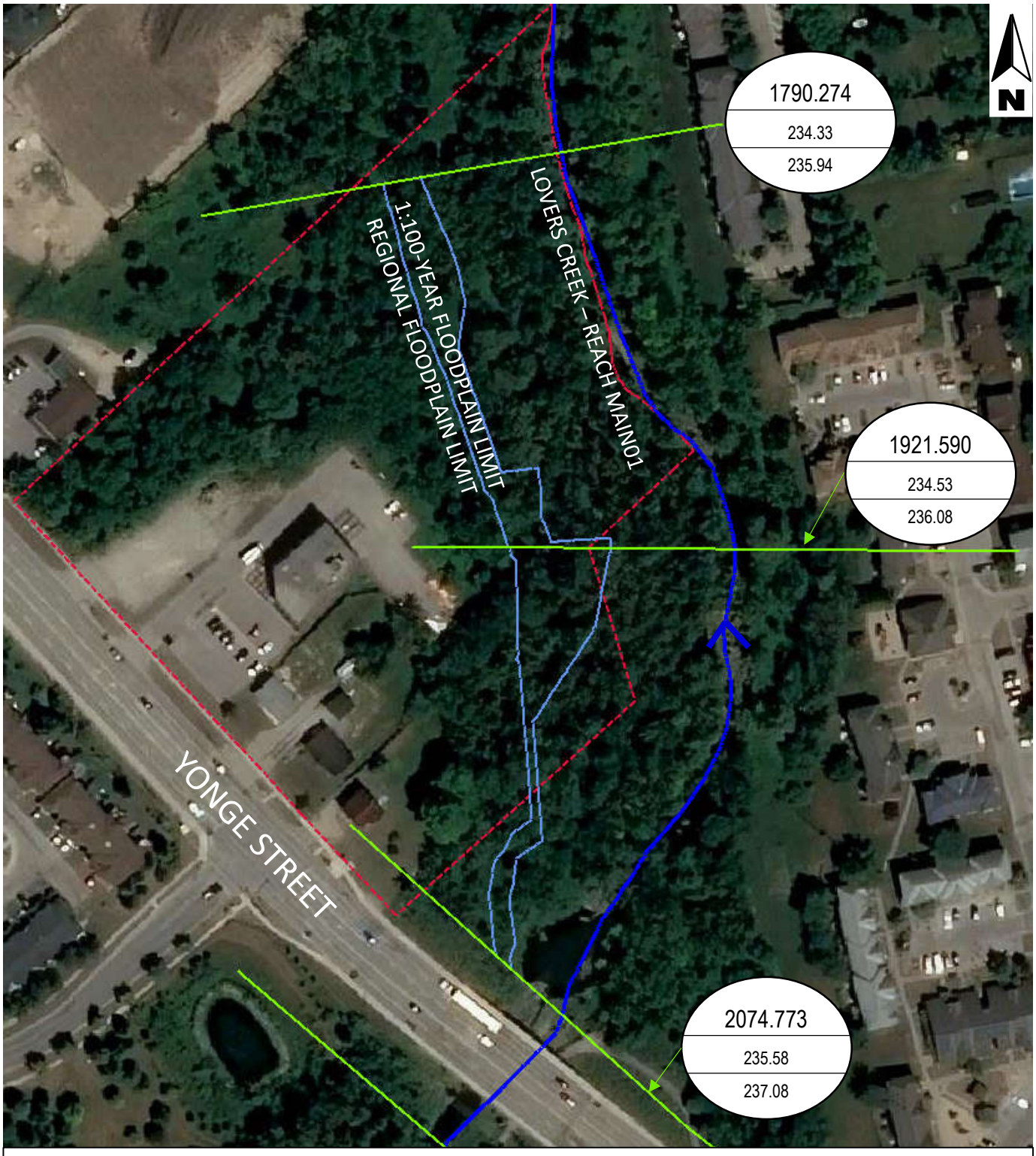
Engineer Stamp

Street Name	Area Label/ID	Upstream Maintenance Hole	Downstream Maintenance Hole	Development Type	Population Density	Number of Units	Population (cap)	Accumulated Population (cap)	Peaking Factor	Area (ha)	Cumulative Area (ha)	Average Flow (L/s)			Peak Flow (L/s)			Proposed Sanitary Sewer						
												Development	Infiltration	Total	Development	Infiltration	Total	Sewer Length (m)	Sewer Slope (%)	Actual Sewer Diameter (mm)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Actual Velocity (m/s)	Calculated Sewer Diameter (mm)	Percentage of Full Flow Capacity (%)
	504	BLDG2	SAN MH2	Residential	High	56	93.5	93.5	4.25	0.06	0.06	0.24	0.01	0.25	1.04	0.01	1.04	12.6	2.0%	200	1.48	46.38	0.61	48	2.2%
	505	SAN MH2	SAN MH1	Residential	High	0	0.0	641.3	3.92	0.07	1.09	1.70	0.11	1.81	6.94	0.11	7.05	40.1	1.0%	200	1.04	32.80	0.79	112	21.5%
		SAN MH1	SAP13035	Residential	High	0	0.0	641.3	3.92	0.00	1.09	1.70	0.11	1.81	6.94	0.11	7.05	14.9	6.5%	200	2.66	83.62	1.57	79	8.4%
Yonge Street	403	SAP13035	SAP13036	Residential	Low	0	0.0	1596.1	3.66	0.06	19.31	4.19	1.93	6.12	16.99	1.93	18.92	21.1	6.0%	250	2.97	145.67	1.97	116	13.0%
Yonge Street	404	SAP13036	SAP13101	Residential	Low	0	0.0	1596.1	3.66	0.19	19.50	4.19	1.95	6.14	16.99	1.95	18.94	51.4	5.0%	250	2.71	132.97	1.84	120	14.2%
Yonge Street	405	SAP13101	SAP13102	Residential	Low	0	0.0	1596.1	3.66	0.39	19.89	4.19	1.99	6.18	16.99	1.99	18.98	59.5	0.4%	250	0.77	37.61	0.73	193	50.5%
		SAP13102	SAP14009	Residential	Low	0	0.0	1596.1	3.66	0.00	19.89	4.19	1.99	6.18	16.99	1.99	18.98	75.8	0.4%	250	0.77	37.61	0.73	193	50.5%

1. Slopes highlighted red indicate assumed data.
2. Red pipe size represents existing sewer.
3. Manholes A, B, C and COMM. are arbitrary, used only to assist with the calculations.

Appendix D: Stormwater Management Plan Calculations

LSRCA Generic HEC-RAS
Model Results



LEGEND

- LOVERS CREEK WATERCOURSE
- LSRCA CROSS SECTION
- SITE AREA
- LSRCA FLOODPLAIN LIMIT

1000
250.00 — 1:100 YEAR FLOOD ELEVATION (m)
251.50 — REGIONAL FLOOD ELEVATION (m)

NOTE: ALL HEC-RAS LINEWORK SOURCED FROM LSRCA GENERIC HEC-RAS MODEL FOR LOVERS CREEK

505 – 533 Yonge Street, Barrie

Figure D1: LSRCA Generic HEC-RAS Modelling Results

HEC-RAS Plan: Rev2 River: Lovers Reach: Main01

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Main01	4159.121	Regional	357.32	239.65	242.86		242.90	0.000703	1.65	533.72	260.94	0.29
Main01	4159.121	100-YR	114.03	239.65	241.13		241.17	0.002405	1.81	164.41	169.73	0.48
Main01	3964.530	Regional	357.32	239.10	242.78		242.81	0.000349	1.24	584.70	280.41	0.21
Main01	3964.530	100-YR	114.03	239.10	240.89		240.92	0.000896	1.19	181.68	158.10	0.30
Main01	3809.847	Regional	357.32	238.68	242.75		242.77	0.000274	1.19	776.64	346.89	0.19
Main01	3809.847	100-YR	114.03	238.68	240.80		240.82	0.000726	1.24	237.18	229.37	0.28
Main01	3586.156	Regional	357.32	238.33	242.69		242.72	0.000346	1.41	737.59	319.14	0.22
Main01	3586.156	100-YR	114.03	238.33	240.59		240.65	0.001136	1.64	184.60	192.95	0.35
Main01	3452.079	Regional	357.32	238.14	242.59		242.65	0.000733	2.07	519.61	242.08	0.31
Main01	3452.079	100-YR	114.03	238.14	240.40		240.48	0.001680	1.99	153.15	128.85	0.43
Main01	3327.937	Regional	357.32	237.97	242.52		242.56	0.000404	1.58	528.24	289.02	0.24
Main01	3327.937	100-YR	114.03	237.97	240.18		240.26	0.001216	1.69	117.52	155.09	0.36
Main01	3220.862	Regional	357.32	237.83	242.46		242.52	0.000459	1.69	444.15	208.49	0.25
Main01	3220.862	100-YR	114.03	237.83	240.10		240.15	0.000795	1.38	137.19	156.15	0.29
Main01	3104.612	Regional	357.32	237.63	242.42		242.47	0.000319	1.42	430.95	131.57	0.21
Main01	3104.612	100-YR	114.03	237.63	239.98		240.03	0.001106	1.63	134.83	110.21	0.34
Main01	2988.457	Regional	357.32	237.07	242.41		242.44	0.000195	1.18	542.91	158.11	0.17
Main01	2988.457	100-YR	114.03	237.07	239.92		239.95	0.000591	1.33	176.51	131.52	0.26
Main01	2871.593	Regional	357.32	236.68	242.39		242.42	0.000183	1.20	515.94	136.79	0.16
Main01	2871.593	100-YR	114.03	236.68	239.88		239.91	0.000324	1.07	199.20	115.13	0.20
Main01	2734.631	Regional	357.32	236.38	242.09	239.76	242.35	0.001422	3.00	192.32	145.49	0.40
Main01	2734.631	100-YR	114.03	236.38	239.71	238.53	239.83	0.001304	2.00	97.34	126.45	0.35
Main01	2702.233		Bridge									
Main01	2676.375	Regional	357.32	236.31	241.84		242.13	0.001821	3.29	162.65	114.74	0.45
Main01	2676.375	100-YR	114.03	236.31	238.92	238.91	239.52	0.008744	4.36	42.24	40.64	0.86
Main01	2559.378	Regional	370.93	236.30	241.82		241.89	0.000822	2.24	480.01	136.93	0.30
Main01	2559.378	100-YR	117.55	236.30	238.70		238.80	0.002491	2.24	137.27	84.92	0.46
Main01	2417.413	Regional	370.93	236.01	241.76		241.80	0.000457	1.72	613.59	151.46	0.23
Main01	2417.413	100-YR	117.55	236.01	238.51		238.55	0.001290	1.65	188.24	102.38	0.33
Main01	2293.612	Regional	370.93	235.86	241.72		241.75	0.000414	1.65	642.23	157.00	0.22
Main01	2293.612	100-YR	117.55	235.86	238.32		238.38	0.001911	1.99	167.98	107.69	0.41
Main01	2127.919	Regional	370.93	234.72	241.68	237.78	241.72	0.000217	1.52	829.44	201.14	0.18
Main01	2127.919	100-YR	117.55	234.72	238.20	236.71	238.25	0.000588	1.57	231.58	117.76	0.27
Main01	2099.195		Bridge									
Main01	2074.773	Regional	370.93	233.74	237.08	237.08	238.29	0.007046	5.27	91.60	44.59	0.93
Main01	2074.773	100-YR	117.55	233.74	235.58	235.40	236.13	0.006767	3.42	38.81	27.40	0.82
Main01	1921.590	Regional	370.93	232.49	236.08		236.66	0.005930	5.11	200.48	88.30	0.86
Main01	1921.590	100-YR	117.55	232.49	234.53	234.52	235.02	0.008067	4.08	76.28	71.72	0.92
Main01	1790.274	Regional	370.93	231.57	235.94		236.18	0.001793	3.20	214.46	95.78	0.49
Main01	1790.274	100-YR	117.55	231.57	234.33	233.73	234.49	0.001822	2.37	86.83	61.79	0.46
Main01	1683.763	Regional	370.93	230.60	234.90	234.90	235.81	0.005668	5.66	132.11	78.62	0.87
Main01	1683.763	100-YR	117.55	230.60	232.79	232.79	233.98	0.012717	5.39	28.96	19.22	1.17
Main01	1601.441	Regional	370.93	230.19	234.78		234.99	0.001443	2.93	221.07	89.46	0.44
Main01	1601.441	100-YR	117.55	230.19	232.35		232.70	0.005412	3.39	57.55	49.95	0.75
Main01	1494.456	Regional	370.93	229.02	234.74		234.88	0.000929	2.72	282.86	104.40	0.36
Main01	1494.456	100-YR	117.55	229.02	232.15	231.01	232.36	0.002273	2.83	78.92	54.87	0.52
Main01	1357.490	Regional	370.93	228.31	233.70	233.16	234.58	0.004113	5.59	148.86	67.84	0.77
Main01	1357.490	100-YR	117.55	228.31	230.91	230.91	231.78	0.008500	4.92	38.84	24.22	0.98
Main01	1302.252	Regional	370.93	227.34	233.11	232.22	234.25	0.004295	5.99	120.72	61.70	0.80
Main01	1302.252	100-YR	117.55	227.34	230.73	230.01	231.23	0.003498	3.79	56.04	25.77	0.66
Main01	1284.874		Bridge									

HEC-RAS Plan: Rev2 River: Lovers Reach: Main01 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Main01	1264.763	Regional	370.93	226.44	231.23	231.23	233.08	0.008751	7.39	82.92	38.02	1.09
Main01	1264.763	100-YR	117.55	226.44	229.23	229.04	230.01	0.007093	4.58	40.21	25.13	0.90
Main01	1229.560	Regional	370.93	225.85	230.63	230.60	231.77	0.007258	6.71	109.65	46.24	1.00
Main01	1229.560	100-YR	117.55	225.85	229.04		229.59	0.005036	4.22	49.87	30.04	0.78
Main01	1160.818	Regional	370.93	225.85	230.09	230.09	231.20	0.009755	6.25	131.29	57.35	1.04
Main01	1160.818	100-YR	117.55	225.85	228.38	228.38	229.09	0.011286	4.56	50.87	35.23	1.02
Main01	1145.710		Bridge									
Main01	1129.299	Regional	370.93	225.59	229.22		229.92	0.007172	5.47	145.03	55.41	0.94
Main01	1129.299	100-YR	117.55	225.59	227.48	227.40	227.97	0.010978	4.25	56.61	45.71	1.03
Main01	1049.722	Regional	370.93	224.44	228.99		229.44	0.003404	4.53	210.06	69.22	0.68
Main01	1049.722	100-YR	117.55	224.44	227.39		227.53	0.001728	2.40	116.67	52.44	0.45
Main01	1003.578	Regional	370.93	224.22	228.89		229.17	0.002473	3.93	273.58	87.94	0.58
Main01	1003.578	100-YR	117.55	224.22	227.30		227.40	0.001347	2.18	148.04	71.67	0.40
Main01	874.3510	Regional	370.93	223.22	228.74		228.88	0.001121	2.99	369.69	92.59	0.41
Main01	874.3510	100-YR	117.55	223.22	227.23		227.27	0.000432	1.50	234.16	86.96	0.24
Main01	764.8872	Regional	370.93	222.20	228.70		228.80	0.000606	2.43	422.75	79.22	0.31
Main01	764.8872	100-YR	117.55	222.20	227.22		227.24	0.000157	1.04	308.87	74.81	0.15
Main01	653.6470	Regional	370.93	221.33	228.70		228.74	0.000259	1.73	607.43	110.93	0.20
Main01	653.6470	100-YR	117.55	221.33	227.22		227.23	0.000058	0.70	456.01	94.40	0.09
Main01	545.2612	Regional	370.93	220.37	227.55	227.55	228.56	0.005333	5.92	188.71	89.99	0.82
Main01	545.2612	100-YR	117.55	220.37	224.80	224.80	226.99	0.007515	6.55	17.95	56.46	1.00
Main01	531.9898		Culvert									
Main01	520.0164	Regional	370.93	221.50	226.61	226.61	227.17	0.008003	5.44	155.19	123.69	0.93
Main01	520.0164	100-YR	117.55	221.50	225.99	225.99	226.31	0.004426	3.55	81.27	113.60	0.67
Main01	407.9062	Regional	370.93	219.50	222.98		223.61	0.003908	4.72	140.50	68.95	0.81
Main01	407.9062	100-YR	117.55	219.50	221.92		222.15	0.002044	2.67	71.05	52.71	0.55
Main01	312.3078	Regional	370.93	219.50	222.43	222.43	223.23	0.005930	5.16	127.04	72.37	0.97
Main01	312.3078	100-YR	117.55	219.50	221.35	221.35	221.85	0.005572	3.66	52.61	56.85	0.87
Main01	149.9185	Regional	370.93	219.50	221.92	221.05	222.17	0.002728	3.14	185.32	83.84	0.64
Main01	149.9185	100-YR	117.55	219.50	220.96		221.03	0.001645	1.74	106.21	80.91	0.46
Main01	17.79831	Regional	370.93	219.50	220.92	220.92	221.49	0.011188	4.44	129.24	108.35	1.19
Main01	17.79831	100-YR	117.55	219.50	220.28	220.28	220.56	0.011370	3.01	61.50	103.91	1.09

Existing & Proposed Conditions Hydrology

TATHAM ENGINEERING

Project:	505-533 Yonge Street	Date:	May 26, 2023
File No.:	421422	Designed By:	LJC
Subject:	RC & TC Calculator - Outlet #1	Checked By:	NHF

RUNOFF COEFFICIENTS

CATCHMENT 101 (EXISTING CONDITION)

Land Use	*RC*	*Area (ha)*
Pavement	0.95	0.28
Building Area	0.95	0.09
Pavement Area (rough)	0.95	0.10
Lawn/Landscape	0.15	0.34
Woodland	0.18	0.62
	Total	1.43
Weighted RC	**0.40**	

As per City of Barrie Table 3.2

CATCHMENT 301 (EXISTING CONDITION)

Land Use	*RC*	*Area (ha)*
Woodland	0.18	1.26
	Total	1.26
Weighted RC	**0.18**	

As per City of Barrie Table 3.2

CATCHMENT 201 (PROPOSED CONDITION)

Land Use	*RC*	*Area (ha)*
Building Rooftop Area	0.95	0.48
Driveway Area	0.95	0.90
Lawn/Landscape	0.15	0.05
	Total	1.43
Weighted RC	**0.92**	**Round up to 0.95**

TIME OF CONCENTRATION

CATCHMENT 101 (EXISTING CONDITION)

Slope = 9.06 %
Length 115.9 m
RC= Total
RC= 0.40
Area= 1.43 ha

Airport Method	tc=	11.87	minutes
Bransby Williams Method	tc=	4.10	minutes
	tc=	**11.87**	**minutes**

CATCHMENT 301 (EXISTING CONDITION)

Slope = 7.74 %
Length 58.11 m
RC= Total
RC= 0.18
Area= 1.26 ha

Airport Method	tc=	11.64	minutes
Bransby Williams Method	tc=	2.15	minutes
	tc=	**11.64**	**minutes**

CATCHMENT 201 (PROPOSED CONDITION)

Slope = 1.79 %
Length 103.1 m
RC= 0.92
Area= 1.43 ha

Airport Method	tc=	4.86	minutes
Bransby Williams Method	tc=	5.04	minutes
	tc=	**10.00**	**minutes**

Tc less than 10.0 m therefore use 10.0 m in accordance with City of Barrie Drainage Requirements

TATHAM ENGINEERING

Modified Rational Method Calculation

Project Details

505-533 Yonge Street	421422

Prepared By

LJC	May 26, 2023

Municipality

City of Barrie

Pre-Development Analysis

Catchment ID:	101
Catchment Area (ha):	1.43
Runoff Coefficient:	0.40
Time of Concentration (min):	11.87

Post-Development Analysis

Controlled

Catchment ID:	201
Catchment Area (ha):	1.43
Runoff Coefficient:	0.95
Time of Concentration (min):	10.00

Design Storm	2YR	5YR	10YR	25YR	50YR	100YR
A	676	843	977	1133	1251	1384
B	4.68	4.58	4.75	4.73	4.85	4.91
C	0.78	0.76	0.76	0.76	0.75	0.75
i (mm/hr)	76	99	115	135	150	165
Runoff C	0.40	0.40	0.40	0.44	0.48	0.50
Q (m^3/s)	0.12	0.16	0.18	0.24	0.29	0.33

	Design Storm	2YR	5YR	10YR	25YR	50YR	100YR
	i (mm/hr)	83	109	126	148	164	180
201	Runoff C	0.95	0.95	0.95	1.00	1.00	1.00
	Q (m^3/s)	0.31	0.41	0.48	0.59	0.65	0.72
	i (mm/hr)	203	264	299	350	381	417
0	Runoff C	0.00	0.00	0.00	0.00	0.00	0.00
	Q (m^3/s)	0.00	0.00	0.00	0.00	0.00	0.00

Peak Runoff Rate (m^3/s) - Rational Method (Q=CiA/360)

Storm	$Q_{EXISTING}$	$Q_{NO\ CONTROLS}$	$Q_{UNCONTROLLED}$	$Q_{CONTROLLED}$	Q_{TOTAL}	$Q_{REDUCTION}$	
2YR	0.120	0.314	0.000	0.120	0.120	0.194	m^3/s
5YR	0.158	0.412	0.000	0.158	0.158	0.254	m^3/s
10YR	0.183	0.477	0.000	0.183	0.183	0.294	m^3/s
25YR	0.237	0.589	0.000	0.236	0.236	0.353	m^3/s
50YR	0.286	0.652	0.000	0.286	0.286	0.366	m^3/s
100YR	0.328	0.717	0.000	0.327	0.327	0.390	m^3/s

Required Storage Volumes (m^3) - Modified Rational Method ($V_p = Q_p \times D - Q_o \times ((D + t_c)/2)$)

Dur. (min)	2YR	5YR	10YR	25YR	50YR	100YR
5	76	99	114	136	138	145
10	116	152	176	212	220	234
15	135	177	207	248	257	273
20	143	189	221	265	273	290
25	146	194	228	272	278	293
30	145	194	228	271	274	287
35	141	190	224	266	265	275
40	136	184	218	256	252	258
45	129	176	209	244	235	239

Water Quantity Control

TATHAM ENGINEERING

PROJECT	505-533 Yonge Street	FILE	421422
		DATE	May 26, 2023
SUBJECT	Pipe Quantity Storage	NAME	LJC
		PAGE	1 OF 8

Stage Storage Table Pipe Quantity Storage Volume

Pipe Location	STM MH10 to STM MH11	STM MH10 to STM MH11	STM MH12 to SWMF
Diameter (m)	0.45	0.45	0.45
U/S Inv.	243.84	239.28	238.89
D/S Inv.	239.28	238.89	238.86
Average Inv.	241.56	239.09	238.88
Length (m)	35.70	61.60	6.70

Elevation	Volume (m^3)		
238.80	0.00	0.00	0.00
238.90	0.00	0.00	0.00
239.00	0.00	0.00	0.18
239.10	0.00	0.00	0.46
239.20	0.00	1.62	0.75
239.30	0.00	4.21	1.00
239.40	0.00	6.94	1.07
239.50	0.00	9.20	1.07
239.60	0.00	9.79	1.07
239.70	0.00	9.79	1.07
239.80	0.00	9.79	1.07
239.90	0.00	9.79	1.07
240.00	0.00	9.79	1.07
240.10	0.00	9.79	1.07
240.20	0.00	9.79	1.07
240.30	0.00	9.79	1.07
240.40	0.00	9.79	1.07
240.50	0.00	9.79	1.07

TATHAM ENGINEERING

PROJECT	505-533 Yonge Street	FILE	421422
		DATE	May 26, 2023
SUBJECT	Structure Quantity Storage	NAME	LJC
		PAGE	2 OF 8

Stage Storage Table Structure Quantity Storage Volume

ID	STM MH11	STM MH12
T/G Elev.	241.21	240.95
Inv. Elev.	239.28	238.89
Diameter	1.2	1.2
Area	3.77	3.77

Elevation	Volume (m^3)	
238.80	0.00	0.00
238.90	0.00	0.04
239.00	0.00	0.41
239.10	0.00	0.79
239.20	0.00	1.17
239.30	0.08	1.55
239.40	0.45	1.92
239.50	0.83	2.30
239.60	1.21	2.68
239.70	1.58	3.05
239.80	1.96	3.43
239.90	2.34	3.81
240.00	2.71	4.18
240.10	3.09	4.56
240.20	3.47	4.94
240.30	3.85	5.32
240.40	4.22	5.69
240.50	4.60	6.07

TATHAM ENGINEERING

PROJECT	505-533 Yonge Street	FILE	421422
		DATE	May 26, 2023
SUBJECT	Underground Quantity Storage - Chamber #1	NAME	LJC
		PAGE	3 OF 8

Stage Storage Table — Underground Quantity Storage Volume

Unit: Double Stacked StormTank ST-36 Module
System Footprint (m^2): 177 m^2
Height of Chamber (m): 1.83
Void Ratio per module: 97.00%
Void Ratio of stone: 40%

Elevation	Elevation Reference	Incremental Depth (m)	Incremental Volume (m^3)	Cumulative Volume - below outlet (m^3)	Cumulative Volume - above outlet (m^3)
237.93	Base of Stone	0.00	0.00	0.00	-
238.08	Base of Chamber	0.15	10.62	10.62	-
238.16	Outlet Pipe Invert	0.08	13.74	24.36	-
238.20		0.04	6.87	-	6.87
238.30		0.10	17.17	-	24.04
238.40		0.10	17.17	-	41.21
238.50		0.10	17.17	-	58.37
238.60		0.10	17.17	-	75.54
238.70		0.10	17.17	-	92.71
238.80		0.10	17.17	-	109.88
238.90		0.10	17.17	-	127.05
239.00		0.10	17.17	-	144.22
239.10		0.10	17.17	-	161.39
239.20		0.10	17.17	-	178.56
239.30		0.10	17.17	-	195.73
239.40		0.10	17.17	-	212.90
239.50		0.10	17.17	-	230.06
239.60		0.10	17.17	-	247.23
239.70		0.10	17.17	-	264.40
239.80		0.10	17.17	-	281.57
239.90	Top of Chamber	0.10	17.17	-	298.74
240.00				-	298.74
240.10				-	298.74
240.20				-	298.74
240.30				-	298.74
240.40				-	298.74
240.50				-	298.74

Note: Incremental volume calculated per incremental depth, footprint area of system and applicable void ratio for stone and StormTank module

System footprint area/volumes exclude all stone area/volumes

TATHAM ENGINEERING

PROJECT	505-533 Yonge Street	FILE	421422
		DATE	May 26, 2023
SUBJECT	Total Quantity Storage Summary	NAME	LJC
		PAGE	4 OF 8

Stage Storage Table Summary Table

Elevation	MH & CB Storage (m^3)	Pipe Storage (m^3)	U/G Chamber #1 (m^3)	Total Storage (m^3)
238.00	0	0	0	0
238.10	0	0	0	0
238.20	0	0	7	7
238.30	0	0	24	24
238.40	0	0	41	41
238.50	0	0	58	58
238.60	0	0	76	76
238.70	0	0	93	93
238.80	0	0	110	110
238.90	0	0	127	127
239.00	0	0	144	145
239.10	1	0	161	163
239.20	1	2	179	182
239.30	2	5	196	203
239.40	2	8	213	223
239.50	3	10	230	243
239.60	4	11	247	262
239.70	5	11	264	280
239.80	5	11	282	298
239.90	6	11	299	316
240.00	7	11	299	316
240.10	8	11	299	317
240.20	8	11	299	318
240.30	9	11	299	319
240.40	10	11	299	320
240.50	11	11	299	320

TATHAM ENGINEERING

PROJECT	505-533 Yonge Street	FILE	421422
		DATE	May 26, 2023
SUBJECT	Stage Storage Discharge Summary	NAME	LJC
		PAGE	5 OF 8

Stage Discharge Table Summary Table

Orifice Control

Orifice Control

Orifice Dia. (mm)	252
Orifice Invert (m)	238.16
Orifice Area (m)	0.050
Orifice Coef.	0.63

Secondary Outlet

Orifice Dia. (mm)	375
Orifice Invert (m)	239.44
Orifice Area (m)	0.110
Orifice Coef.	0.63

Orifice Equation

Q = C x A x (2gH)^0.5

Q = flow rate (m^3)

C = constant

A = area of opening (m^2)

H = net head on the orifice

g = Acceleration due to gravity

Values in shaded cells have been calculated using partially full orifice outlet control equations (Hydraulic Structures,C.D. Smith, University of Saskatchewan

Elevation	Head	Orifice Control Discharge	Head	Secondary Outlet Discharge	Total Discharge	Total Storage
	(m)	(m^3/s)	(m)	(m^3/s)	(m^3/s)	($m^{3)}$
238.00	0.00	0.00	0.00	0.00	0.0000	0.00
238.10	0.00	0.00	0.00	0.00	0.0000	0.00
238.20	0.00	0.00	0.00	0.00	0.0014	6.87
238.30	0.01	0.01	0.00	0.00	0.0131	24.04
238.40	0.11	0.03	0.00	0.00	0.0332	41.21
238.50	0.21	0.06	0.00	0.00	0.0644	58.37
238.60	0.31	0.08	0.00	0.00	0.0780	75.54
238.70	0.41	0.09	0.00	0.00	0.0895	92.71
238.80	0.51	0.10	0.00	0.00	0.0997	109.88
238.90	0.61	0.11	0.00	0.00	0.1090	127.09
239.00	0.71	0.12	0.00	0.00	0.1175	144.81
239.10	0.81	0.13	0.00	0.00	0.1255	162.64
239.20	0.91	0.13	0.00	0.00	0.1330	182.10
239.30	1.01	0.14	0.00	0.00	0.1401	202.56
239.40	1.11	0.15	0.00	0.00	0.1468	223.27
239.50	1.21	0.15	0.00	0.00	0.1570	243.46
239.60	1.31	0.16	0.00	0.02	0.1807	261.98
239.70	1.41	0.17	0.07	0.05	0.2187	279.90
239.80	1.51	0.17	0.17	0.09	0.2619	297.82
239.90	1.61	0.18	0.27	0.13	0.3025	315.75
240.00	1.71	0.18	0.37	0.19	0.3702	316.50
240.10	1.81	0.19	0.47	0.21	0.3992	317.25
240.20	1.91	0.19	0.57	0.23	0.4256	318.01
240.30	2.01	0.20	0.67	0.25	0.4502	318.76
240.40	2.11	0.20	0.77	0.27	0.4731	319.52
240.50	2.21	0.21	0.87	0.29	0.49	320.27

TATHAM ENGINEERING	Project:	505-533 Yonge Street	Designed By:	LJC
	File:	421422	Checked By:	NHF
	Municipality:	City of Barrie	Date:	May 26, 2023

Outlet Hydraulics - Partially Full Orifice - Orifice Control

Orifice Plate = C x A x (2gH)^0.5 C= 0.63

Water Elevation m	Depth From Min Elev m	Pipe Partially Full Inlet Control (Smith) m^3/s
238.16	0	
238.20	0.1	0.0014
238.30	0.2	0.0131
238.40	0.3	0.0332

	(invert of Control)	(Top of Ponding)
Depth Increment m	Min Elevation m	Max Elevation Max
0.1	238.16	238.40

Pipe Flowing Partially Full or full	
Coefficient Metric = 1, Imperial=1.49	1
Pipe Diameter (m)	0.252
Mannings N Full	0.013
Pipe Slope (m/m)	
Elevation (m)	238.16
Inlet Type: 1= Projecting 2= Flush	1

Inlet Control (Smith) Projecting Inlet MMF Model: y=(a*b+c*x^d)/(b+x^d) Coefficient Data:	
a =	1.68E-02
b =	1.77E+00
c =	3.06E+00
d =	2.27E+00
Inlet Control (Smith) Flush Inlet MMF Model: y=(a*b+c*x^d)/(b+x^d) Coefficient Data:	
a =	-1.08E-03
b =	2.30E+00
c =	3.95E+00
d =	2.08E+00

TATHAM ENGINEERING	Project:	505-533 Yonge Street	Designed By:	LJC
	File:	421422	Checked By:	NHF
	Municipality:	City of Barrie	Date:	May 26, 2023

Outlet Hydraulics - Partially Full Orifice - Secondary Outlet

Orifice Plate = C x A x (2gH)^0.5 C= 0.63

	(invert of Control)	(Top of Ponding)
Depth Increment m	Min Elevation m	Max Elevation Max
0.1	239.44	239.90

Water Elevation m	Depth From Min Elev m	Pipe Partially Full Inlet Control (Smith) m^3/s
239.44	0	
239.50	0.1	0.0037
239.60	0.2	0.0212
239.70	0.3	0.0532
239.80	0.4	0.0907
239.90	0.5	0.1258

Pipe Flowing Partially Full or full	
Coefficient Metric = 1, Imperial=1.49	1
Pipe Diameter (m)	0.375
Mannings N Full	0.013
Pipe Slope (m/m)	
Elevation (m)	239.44
Inlet Type: 1= Projecting 2= Flush	1

Inlet Control (Smith) Projecting Inlet MMF Model: y=(a*b+c*x^d)/(b+x^d) Coefficient Data:	
a =	1.68E-02
b =	1.77E+00
c =	3.06E+00
d =	2.27E+00
Inlet Control (Smith) Flush Inlet MMF Model: y=(a*b+c*x^d)/(b+x^d) Coefficient Data:	
a =	-1.08E-03
b =	2.30E+00
c =	3.95E+00
d =	2.08E+00

TATHAM ENGINEERING

PROJECT	505-533 Yonge Street	FILE	421422
		DATE	May 26, 2023
SUBJECT	SWM Facility Operating Characteristics	NAME	LJC
		PAGE	8 OF 8

Operation Summary

STORM EVENT	Volume	Peak Flow	Elevation
	m^3	m^3/s	m
1:2-year	150	0.120	239.03
1:5-year	244	0.158	239.50
1:10-year	263	0.183	239.61
1:25-year	287	0.236	239.74
1:50-year	308	0.286	239.86
1:100-year	316	0.327	239.94

Water Quality Control

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Wednesday, November 10, 2021
Project Name	505-533 Yonge Street
Project Number	
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 JF8-7-2 is recommended to meet the water quality objective by treating a flow of 40.4 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 455 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)
JF8-7-2	7	2	2.4	40.4	455

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:

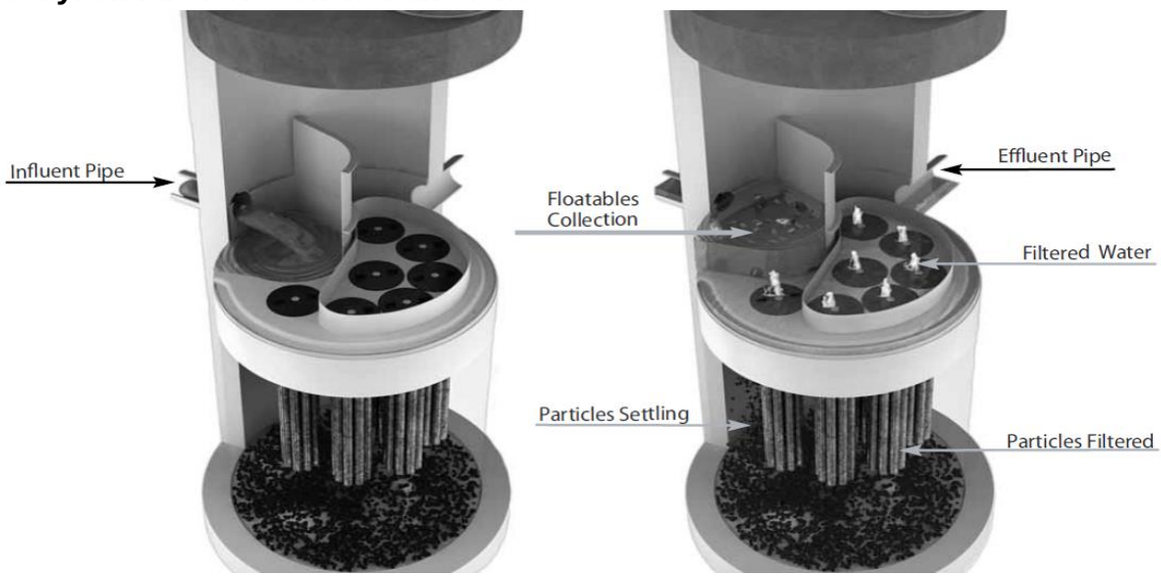
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash 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:	Wednesday, November 10, 2021
Project Name:	505-533 Yonge Street
Project Number:	
Location:	Barrie

Designer Information

Company:	Tatham Engineering Limited
Contact:	Lauren Buss, B.Eng., EIT
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:	1.52 ha
Imperviousness:	100%

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:	**38.1 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 4414 m³, with a suspended sediment concentration of 60 mg/L.	**265 kg**

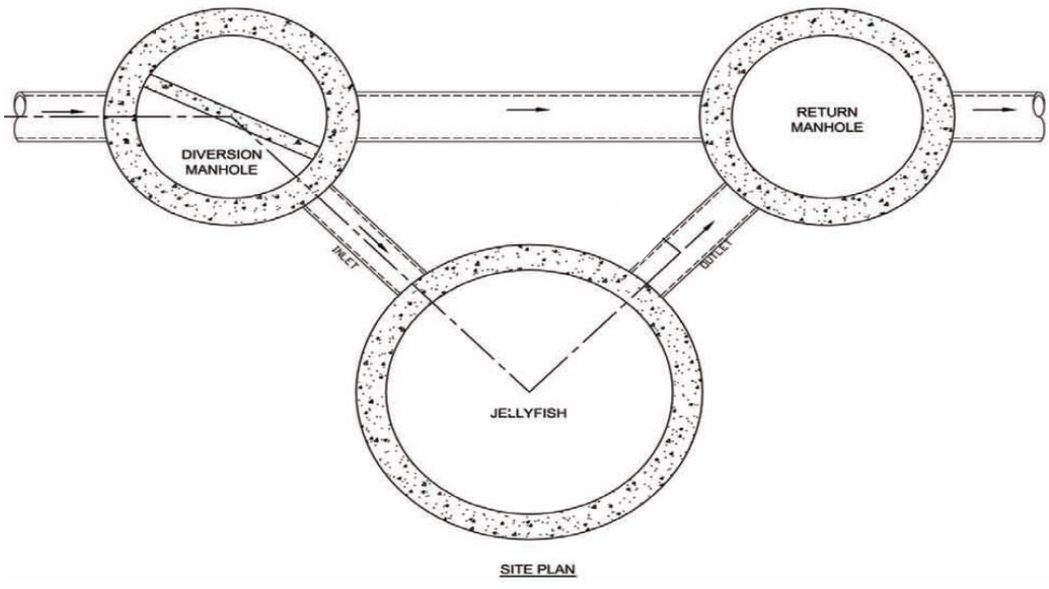
Recommendation

The Jellyfish Filter model JF8-7-2 is recommended to meet the water quality objective by treating a flow of 40.4 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 455 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

DRAWING NOT TO BE USED FOR CONSTRUCTION

GENERAL NOTES:

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. JELLYFISH STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE JELLYFISH SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR PROJECT BID DATE OR AS DIRECTED BY THE ENGINEER OF RECORD.

JELLYFISH STRUCTURE & DESIGN NOTES:

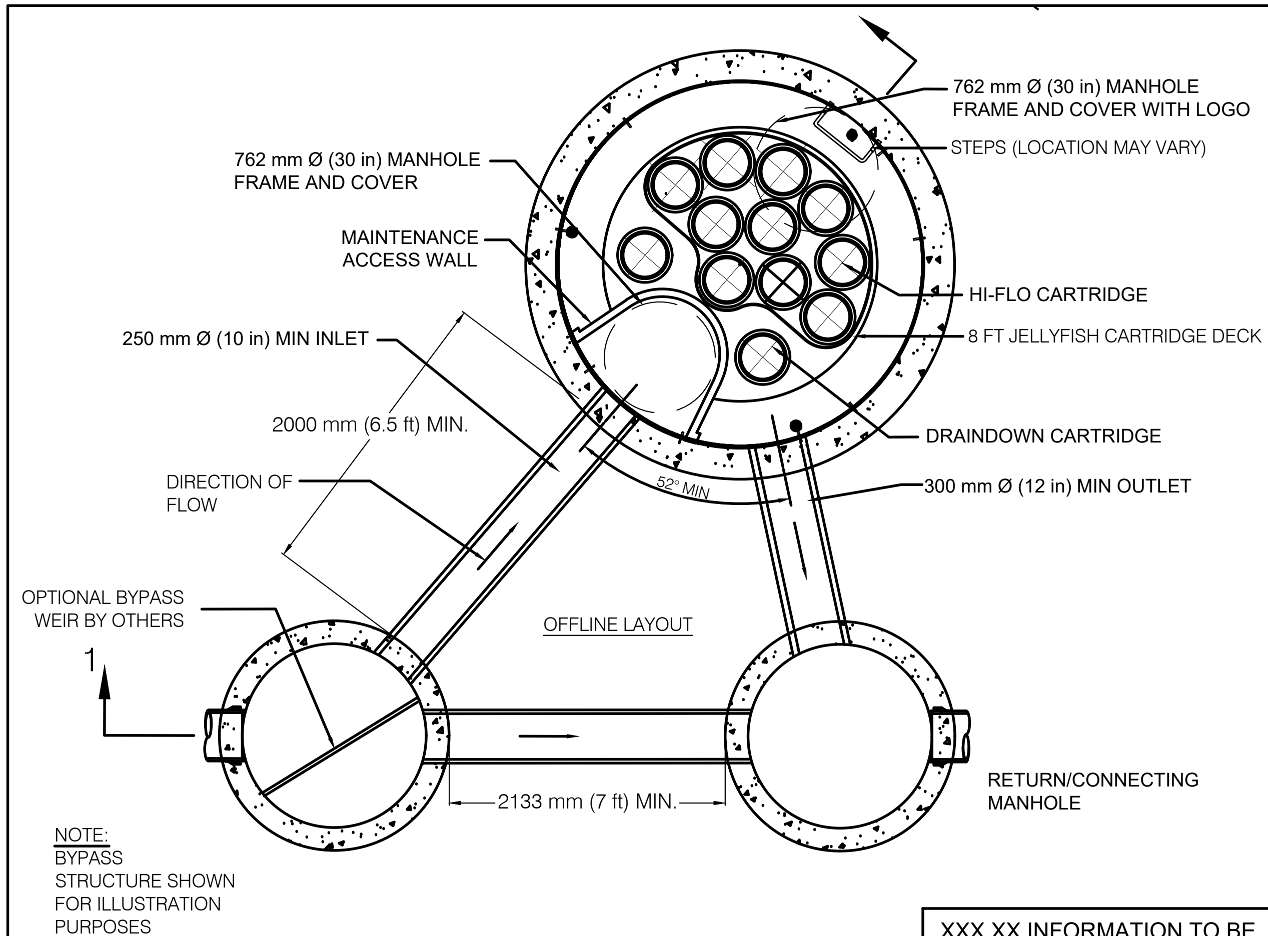
1. 762 MM Ø (30") MAINTENANCE ACCESS WALL TO BE USED FOR CLEANOUT AND ACCESS BELOW CARTRIDGE DECK.
2. CASTINGS OR DOORS OF THE JELLYFISH MANHOLE STRUCTURE TO EXTEND TO DESIGN FINISH GRADE. DEPTHS IN EXCESS OF 3.65 M (12') MAY REQUIRE THE DESIGN AND INSTALLATION OF INTERMEDIATE SAFETY GRATES OR OTHER STRUCTURAL ELEMENTS.
3. CASTINGS AND GRADE RINGS, OR DOORS AND DOOR RISERS, OR BOTH, SHALL BE GROUTED FOR WATERTIGHTNESS.
   STRUCTURE SHALL MEET AASHTO HS-20, ASSUMING EARTH COVER OF 0' - 3', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 LOAD RATING AND BE CAST WITH THE IMBRIUM LOGO.
4. ALL STRUCTURAL SECTIONS AND PARTS TO MEET OR EXCEED ASTM C-478, ASTM C-443, AND ASTM D-4097 CORRESPONDING TO AASHTO SPECIFICATIONS, AND ANY OTHER SITE OR LOCAL STANDARDS.
5. CONCRETE RISER SECTIONS FROM BOTTOM TO TOP WILL BE ADDED AS REQUIRED INCLUDING TRANSITION PIECES TO SMALLER DIAMETER RISERS FOR SURFACE ACCESSES WHERE WARRANTED BY SERVICING DEPTH.
6. IF MINIMUM DEPTH FROM TOP OF CARTRIDGE DECK TO BOTTOM OF STRUCTURAL TOP SLAB CANNOT BE ACHIEVED DUE TO PIPING INVERT ELEVATIONS OR OTHER SITE CONSTRAINTS. ALTERNATIVE HATCH CONFIGURATIONS MAY BE AVAILABLE. HATCH DOORS SHOULD BE SIZED TO PROVIDE FULL ACCESS ABOVE THE CARTRIDGES TO ACCOMMODATE MAINTENANCE.
7. STEPS TO BE APPROXIMATELY 330 MM (13") APART AND DIMENSIONS MUST MEET LOCAL STANDARDS. STEPS MUST BE INSTALLED AFTER CARTRIDGE DECK IS IN PLACE.
8. CONFIGURATION OF INLET AND OUTLET PIPE CAN VARY TO MEET SITE'S NEEDS.
9. IT IS THE RESPONSIBILITY OF OTHERS TO PROPERLY PROTECT THE TREATMENT DEVICE, AND KEEP THE DEVICE OFFLINE DURING CONSTRUCTION. FILTER CARTRIDGES SHALL NOT BE INSTALLED UNTIL THE PROJECT SITE IS CLEAN AND FREE OF DEBRIS, BY OTHERS. THE PROJECT SITE INCLUDES ANY SURFACE THAT CONTRIBUTES STORM DRAINAGE TO THE TREATMENT DEVICE. CARTRIDGES SHALL BE FURNISHED NEW, AT THE TIME OF FINAL ACCEPTANCE.
10. THIS DRAWING MUST BE VIEWED IN CONJUNCTION WITH THE STANDARD JELLYFISH SPECIFICATION, AND STORMWATER QUALITY FILTER TREATMENT JELLYFISH DOCUMENTS.

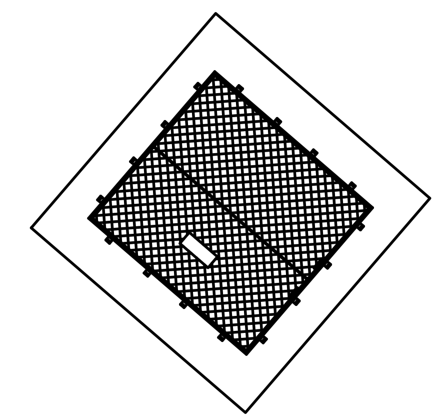
INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. CARTRIDGE INSTALLATION, BY IMBRIUM, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE JELLYFISH UNIT IS CLEAN AND FREE OF DEBRIS. CONTACT IMBRIUM TO COORDINATE CARTRIDGE INSTALLATION WITH SITE STABILIZATION.

STANDARD OFFLINE JELLYFISH RECOMMENDED PIPE DIAMETERS			
MODEL DIAMETER (m)	MINIMUM ANGLE INLET/OUTLET PIPES	MINIMUM INLET PIPE DIAMETER (mm)	MINIMUM OULTET PIPE DIAMETER (mm)
1.2	62	150	200
1.8	59	200	250
2.4	52	250	300
3.0	48	300	450
3.6	40	300	450
CONTACT IMBRIUM SYSTEMS FOR ALTERNATE PIPE DIAMETERS			

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL JELLYFISH FILTER REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE.

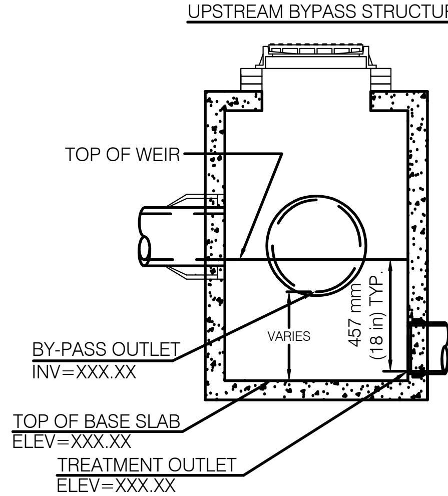




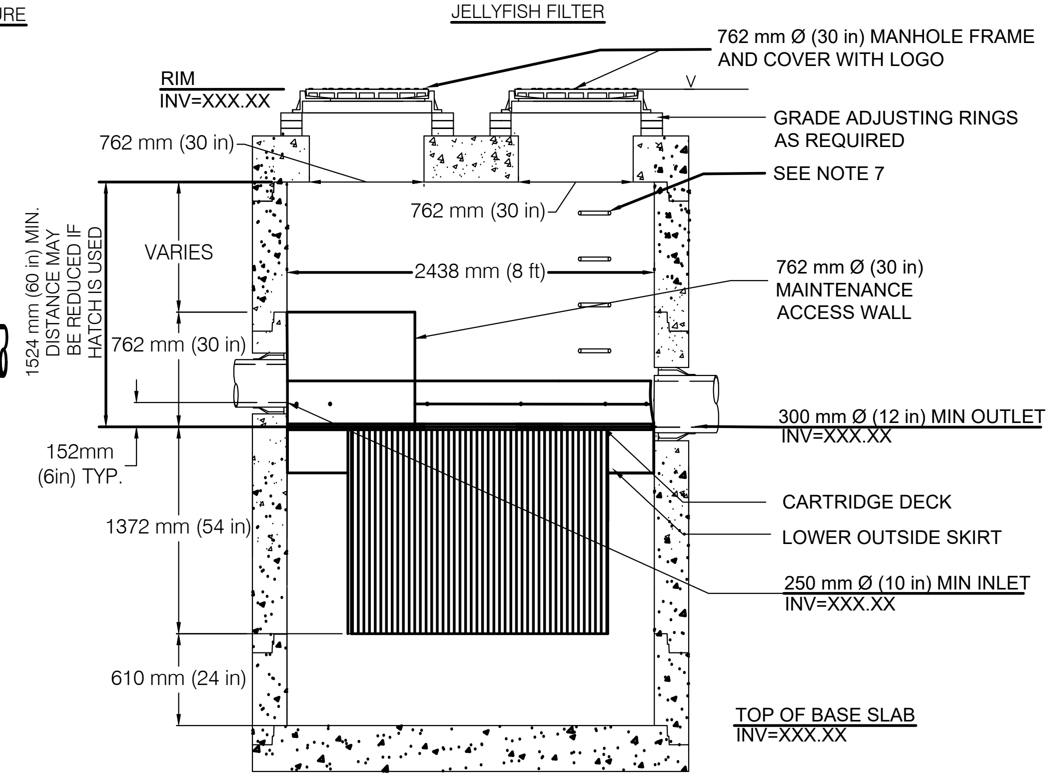
1829 mm x 1829 mm (72 in. x 72 in.)
OPTIONAL HATCH

XXX.XX INFORMATION TO BE SUPPLIED BY ENGINEER OF RECORD

UPSTREAM BYPASS STRUCTURE



JELLYFISH FILTER



CROSS SECTION 1-1

JELLYFISH DESIGN NOTES

JELLYFISH TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD MANHOLE STYLE IS SHOWN. Ø2438 mm (96") MANHOLE JELLYFISH PEAK TREATMENT CAPACITY IS 55.5 L/s (1.96 CFS). TREATMENT FLOW RATE IS BASED ON 457 MM (18") OF HEAD PRESSURE.

CARTRIDGE SELECTION				
CARTRIDGE DEPTH	54"	40"	27"	15"
OUTLET INVERT TO STRUCTURE BASE SLAB	90"	76"	63"	51"
FLOW RATE HIGH-FLO / DRAINDOWN (L/s) (per cart)	5.09 / 2.55	3.68 / 1.84	2.55 / 1.27	1.41 / 0.71
SEDIMENT CAPACITY HIGH-FLO / DRAINDOWN (kg) (per cart)	57 / 28	42 / 21	28 / 14	16 / 8
MAX. CARTS HIGH-FLO/DRAINDOWN	10 / 2			
MAX. SEDIMENT CAPACITY (kg)	626	462	308	176
MAX. TREATMENT (L/s)	55.5	41.6	27.7	15.3

SITE SPECIFIC DATA REQUIREMENTS					
JELLYFISH MODEL	*				
STRUCTURE ID					*
WATER QUALITY FLOW RATE (L/s)					*
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
# OF CARTRIDGES REQUIRED (HF / DD)					*
CARTRIDGE SIZE (inches)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*
* PER ENGINEER OF RECORD					

MARK	DATE	REVISION DESCRIPTION	BY
#	#	#	#
#	#	#	#
#	#	#	#
1	08/01/2015	NOTES	BSF
0	10/01/2014	INTIAL RELEASE	BSF

info@imbriumsystems.com

Jellyfish®

JF8 STANDARD

Scale - 1:50

www.imbriumsystems.com

imbrium®

7037 Ridge Road, Suite 350, Hanover, MD 21076

USA 888-279-8826 CA 800-565-4801 INTL +1-416-960-9900

Jellyfish® Filter

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING: AUS NO. 2008/286748, U.S.A. NO. US 8,287,726, US 8,221,618, US 8,123,935, CA 2,696,482, CA, 2,834,542, KR 10-1287539, NZ 583461, NZ 604227, ZA 2010/01068; OTHER INTERNATIONAL PATENTS PENDING

DATE: 10/01/14	
DESIGNED:	DRAWN: BSF
CHECKED: BSF	APPROVED: SP
PROJECT #: #####	PROJECT NAME: #####
SHEET: 1 OF 2	

\\AD.CONTECH-CPI.COM\ROOT\CORPORATE\MARKETING\IMBRIUM\CAD & PDF\JELLYFISH\JELLYFISH FILTER JF8 - OFFLINE.DWG 9/5/2016 10:09 AM

JELLYFISH® FILTER - SPECIFICATIONS

GENERAL

A. WORK INCLUDED: SPECIFIES REQUIREMENTS FOR CONSTRUCTION AND PERFORMANCE OF AN UNDERGROUND STORMWATER QUALITY, MEMBRANE FILTRATION, AND TREATMENT DEVICE THAT REMOVES POLLUTANTS FROM STORMWATER RUNOFF THROUGH THE UNIT OPERATIONS OF SEDIMENTATION, FLOATATION, AND MEMBRANE FILTRATION.

B. 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 990:	SPECIFICATION FOR JOINTS FOR CONCRETE MANHOLES USING PREFORMED FLEXIBLE JOINT SEALANTS
ASTM D 4101:	SPECIFICATION FOR COPOLYMER STEPS CONSTRUCTION

C. 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 PRECAST CONCRETE AND CALL OUT OR NOTE THE FIBERGLASS (FRP) INTERNALS/COMPONENTS.

D. 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.

E. HANDLING AND STORAGE: PREVENT DAMAGE TO MATERIALS DURING STORAGE AND HANDLING.

PRODUCTS

A. 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.

B. THE CYLINDRICAL CONCRETE DEVICE SHALL INCLUDE A FIBERGLASS CARTRIDGE DECK INSERT. THE RECTANGULAR CONCRETE DEVICE SHALL INCLUDE A COATED ALUMINUM INSERT. IN EITHER INSTANCE, THE INSERT SHALL BE BOLTED AND SEALED WATERTIGHT INSIDE THE PRECAST CONCRETE CHAMBER. THE INSERT 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); (D) A CONDUIT FOR CONVEYANCE OF TREATED WATER TO THE EFFLUENT PIPE.

C. MEMBRANE 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) OR GREATER 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 FLUX RATE SHALL BE 0.21 GPM/FT2 (0.142 LPS/M2). EACH MEMBRANE FILTER CARTRIDGE SHALL ALLOW FOR MANUAL INSTALLATION AND REMOVAL.

D. 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.

E. ACCESS SHALL HAVE A MINIMUM CLEAR HEIGHT OF 60" OVER ALL OF THE FILTER CARTRIDGES, OR BE ACCESSIBLE BY A HATCH OR OTHER MECHANISM THAT PROVIDES MINIMUM 60" 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.

F. 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" MAY HAVE AN IMPACT ON THE TOTAL PERFORMANCE AND/OR LONGEVITY BETWEEN CARTRIDGE MAINTENANCE/REPLACEMENT OF THE DEVICE.

G. 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.

H. GASKETS AND/OR SEALANTS TO PROVIDE WATER TIGHT SEAL BETWEEN CONCRETE JOINTS. JOINTS SHALL BE SEALED WITH PREFORMED JOINT SEALING COMPOUND CONFORMING TO ASTM C 990.

I. 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.

J. DOOR AND HATCHES, IF PROVIDED SHALL MEET DESIGNATED LOADING REQUIREMENTS OR AT A MINIMUM FOR INCIDENTAL VEHICULAR TRAFFIC.

K. ALL CONCRETE COMPONENTS SHALL BE MANUFACTURED ACCORDING TO LOCAL SPECIFICATIONS AND SHALL MEET THE REQUIREMENTS OF ASTM C 478.

L. 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.

M. 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.

N. 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.

PERFORMANCE

A. THE STORMWATER QUALITY FILTER TREATMENT DEVICE SHALL FUNCTION TO REMOVE POLLUTANTS BY THE FOLLOWING UNIT TREATMENT PROCESSES; SEDIMENTATION, FLOATATION, AND MEMBRANE FILTRATION.

B. 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.

C. 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 PASS WATER OVER THE CARTRIDGE DECK, AND AVOID PASSAGE THROUGH THE SUMP AND/OR CARTRIDGE FILTRATION ZONE.

D. THE STORMWATER QUALITY FILTER TREATMENT DEVICE SHALL TREAT 100% OF THE REQUIRED WATER QUALITY TREATMENT FLOW BASED ON A MAXIMUM TREATMENT FLUX RATE (SURFACE LOADING RATE) ACROSS THE MEMBRANE FILTER CARTRIDGES NOT TO EXCEED 0.21 GPM/FT2 (0.142 LPS/M2).

E. AT A MINIMUM, THE STORMWATER QUALITY FILTER DEVICE SHALL HAVE BEEN FIELD TESTED AND VERIFIED WITH A MINIMUM 25 QUALIFYING STORM EVENTS AND FIELD MONITORING CONDUCTED ACCORDING TO THE TARP TIER II OR TAPE FIELD TEST PROTOCOL, AND HAVE RECEIVED NJCAT VERIFICATION.

F. 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%.

G. 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 D50 OF 15 MICRONS OR LOWER FOR ALL MONITORED STORM EVENTS, AND AN EFFLUENT TURBIDITY OF 15 NTUS OR LOWER.

H. 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%.

I. THE STORMWATER QUALITY FILTER TREATMENT DEVICE SHALL HAVE DEMONSTRATED A MINIMUM MEDIAN TOTAL ZINC REMOVAL OF 50%, AND A MINIMUM MEDIAN TOTAL COPPER REMOVAL OF 75%.

INSPECTION AND MAINTENANCE

A. 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.

B. 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).

C. 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.

D. 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.

E. MAINTENANCE ACCESS SHALL HAVE A MINIMUM CLEAR HEIGHT OF 60" OVER ALL OF THE FILTER CARTRIDGES, OR BE ACCESSIBLE BY A HATCH OR OTHER MECHANISM THAT PROVIDES MINIMUM 60" 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.

F. FILTER CARTRIDGES SHALL BE ABLE TO BE MAINTAINED WITHOUT THE USE OF ADDITIONAL LIFTING EQUIPMENT.

EXECUTION

A. 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.

B. 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

C. 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.

D. 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.

E. 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.

F. FILTER CARTRIDGES SHALL BE INSTALLED IN THE CARTRIDGE DECK AFTER THE CONSTRUCTION SITE IS FULLY STABILIZED AND IN ACCORDANCE WITH THE MANUFACTURERS 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.

G. 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.

H. THE MANUFACTURER SHALL PROVIDE AN OWNER'S MANUAL UPON REQUEST.

I. 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.

J. 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

MARK	DATE	REVISION DESCRIPTION	BY
0	10/01/2014	INTIAL RELEASE	BSF
#	#	#	#
#	#	#	#
#	#	#	#
#	#	#	#

JELLYFISH FILTER SPECIFICATIONS

Jellyfish®

JF8 STANDARD

Scale = 1:50

www.imbriumsystems.com
info@imbriumsystems.com

imbrium®

7037 Ridge Road, Suite 350, Hanover, MD 21076

USA 888-279-8826 CA 800-565-4801 INTL +1-416-960-9900

Jellyfish® Filter

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING AUS NO. 2008/286748, U.S.A. NO. US 8,287,726, US 8,221,618, US 8,123,935, CA 2,696,482, CA, 2,834,542, KR 10-1287539, NZ 583461, NZ 604227, ZA 2010/01068; OTHER INTERNATIONAL PATENTS PENDING

DATE: #####	
DESIGNED:	DRAWN: BSF
CHECKED: BSF	APPROVED: SP
PROJECT #: #####	PROJECT NAME: #####
SHEET: 2 OF 2	

\\AD.CONTECH-CPI.COM\ROOT\CORPORATE\MARKETING\IMBRIUM\CAD & PDF\JELLYFISH\JELLYFISH FILTER JF8 - OFFLINE.DWG 8/5/2016 10:09 AM

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Jellyfish® Filter

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

Registration: GPS-ETV_V2022-03-01

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

March 1, 2022
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 detachable 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.

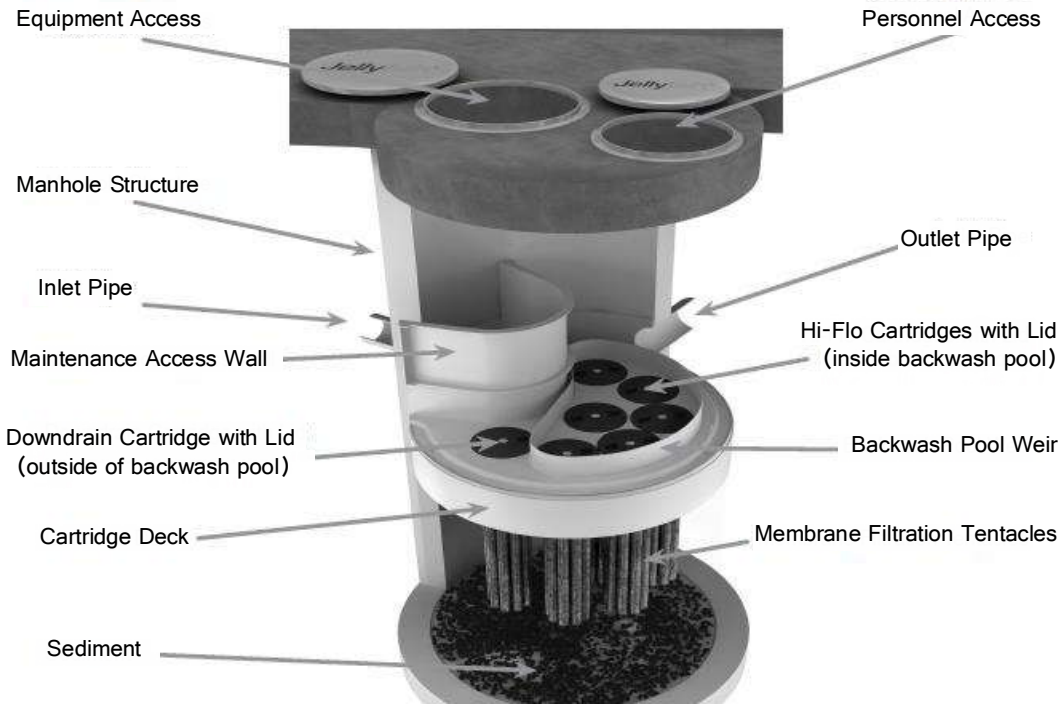


Figure 1. Cut-away graphic of a Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge

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 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 pre-treatment channel. As flow spreads throughout the pre-treatment channel, floatable pollutants accumulate at the surface of the pond behind the maintenance access wall and also beneath the cartridge deck in the pre-treatment 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 membrane 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 Verification Statement were obtained from the field testing conducted on a Jellyfish Filter JF6-6-1 (6-ft diameter manhole with 6 hi-flo cartridges and 1 draindown cartridge), in accordance with the requirements outlined by the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) as written by the Washington State Department of Ecology, (WADOE, 2011). The drainage area providing stormwater runoff to the test unit was 86 acres and was 32% impervious. Throughout the monitoring period (March 2017 – April 2020), a total of 25 individual storm events were sampled. The Basic Treatment standard outlined in the TAPE requires ≥ 80% total suspended solids (TSS) removal at influent TSS concentrations ranging from 100 to 200 mg/L. In addition, the Phosphorus Treatment standard outlined in the TAPE requires ≥ 50% removal of total phosphorus (TP) at influent concentrations ranging from 0.10 to 0.5 mg/L. For this verification, the performance claim for TSS removal is for influent TSS concentration ≥ 100 mg/L, and the performance claim for TP removal is for influent TP concentration ≥ 0.1 mg/L. Based on these requirements, 15 and 18 sample pairs deemed qualified for evaluating the removal performance of TSS and TP, respectively. Prior to starting the performance testing program, a quality assurance project plan (QAPP) was submitted to and approved by the State of Washington Department of Ecology.

Table 1 shows the specified and achieved TAPE criteria for storm selection and sampling.

Table 1. Specified and achieved TAPE criteria for storm selection and sampling

Description	TAPE criteria value	Achieved value
Total rainfall	> 3.8 mm (0.15 in)	> 3.8 mm (0.15 in)[1]
Minimum inter-event period	6 hours	6 hours
Minimum flow-weighted composite sample storm coverage	Minimum 70% including as much of the first 20% of the storm	> 70%
Minimum influent/effluent samples	10, but a minimum of 5 subsamples for composite samples	10, except for two events that had 9 aliquots
Total sampled rainfall	N/A	8.29 in
Number of storms	Minimum 15 (preferably 20)	25

[1]N.B. Storm event depth was greater than the TAPE rainfall depth guideline of 0.15 inches for all events sampled, except for the 3/21/2017, 3/22/2019, 3/26/2019, and 04/13/2019 events. Given the size of the drainage basin, storm events below this threshold produced adequate runoff volume for sampling. Only two of these events were used to evaluate performance, and all had rainfall depths of 0.11 inches or greater. These events were included as their runoff volumes, precipitation durations, and influent TSS concentrations were all within range of the total data set.

The 6-ft diameter test unit has sedimentation surface area of 2.62 m^2 (28.26 ft^2). Each of the seven 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 247.8 m^2 (2667 ft^2) for the seven cartridges combined. The design treatment flow rate is 5 L/s (80 gal/min) for each of the six hi-flo

cartridges and 2.5 L/s (40 gal/min) for the single draindown cartridge, for a total design treatment flow rate of 32.5 L/s (520 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/m² (0.21 gal/min/ft²) for each hi-flo cartridge and 0.07 L/s/m² (0.11 gal/min/ft²) 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 claim(s)

The Jellyfish® Filter demonstrated the removal efficiencies indicated in **Table 2** for TSS and TP during field monitoring conducted in accordance with the Washington State Department of Ecology's Technology Assessment Protocol – Ecology (TAPE), and using the following design parameters:

- System hydraulic loading rate (system treatment flow rate per unit of sedimentation surface area) of 12.5 L/s/m² (18.4 gal/min/ft²) or lower
- Filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m² (0.21 gal/min/ft²) or lower for each hi-flo cartridge and 0.07 L/s/m² (0.11 gal/min/ft²) 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 2. Bootstrapped mean, median, and 95% confidence interval (median) for removal efficiencies of Total Suspended Solids (TSS) and Total Phosphorus (TP)

Parameter	Mean (%)	Median (%)	Median – 95% Lower Limit	Median – 95% Upper Limit
TSS [1]	87.6	90.1	85.1	91.6
TP [2]	77.3	77.5	70.8	85.6

[1] TSS influent concentration ≥ 100 mg/L
[2] TP influent concentration ≥ 0.1 mg/L

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.
The performance claims can be applied to other Jellyfish® Filter models smaller or larger than the tested model as long as the untested models are designed in accordance with the design parameters specified in the performance claims.

Performance results

Performance Claims – Removal Efficiency for Total Suspended Solids

Raw data summarizing the percent removal of total suspended solids (TSS) by the Jellyfish® Filter at the design system hydraulic loading rate of 12.5 L/s/m² (18.4 gal/min/ft²) for 15 sample pairs deemed qualified are presented in **Table 3**. Data were analyzed and evaluated using a bootstrap approach of random sampling by replacement to estimate population distribution and thereby the upper and lower limit of the confidence interval.

Table 3. Raw data summarizing the percent removal of total suspended solids (TSS)

Event ID	TSS Influent (mg/L)	TSS Effluent (mg/L)	TSS Removal (%) (Inf ≥ 100 mg/L)
3/21/2017	102.0	22.0	78.4
4/7/2017	201.0	30.8	84.7
4/12/2017	108.0	24.4	77.4
4/19/2017	452.0	44.6	90.1
4/26/2017	257.0	10.0	96.1

6/15/2017	134.0	10.4	92.2
3/8/2018	755.0	47.2	93.8
3/14/2018	181.0	27.0	85.1
3/22/2018	224.0	20.0	91.1
4/5/2019	171.0	23.0	86.6
4/13/2019	117.0	25.0	78.6
5/18/2019	254.0	20.0	92.1
12/7/2019	200.0	17.0	91.5
3/30/2020	605.0	51.0	91.6
4/20/2020	210.0	29.0	86.2
n	15	15	15
Min	102.0	10.0	77.4
Max	755.0	51.0	96.1
Median	201.0	24.4	90.1
Mean	264.7	26.8	87.7
SD	190.9	12.3	5.9

Performance Claims – Removal Efficiency for Total Phosphorus

Raw data summarizing the percent removal of total phosphorus (TP) by the Jellyfish® Filter at the design system hydraulic loading rate of 12.5 L/s/m^2 (18.4 gal/min/ft^2) for 18 sample pairs deemed qualified are presented in **Table 4**. Data were analyzed and evaluated using a bootstrap approach of random sampling by replacement to estimate population distribution and thereby the upper and lower limit of the confidence interval.

Table 4. Raw data summarizing the percent removal of total phosphorus (TP)

Event ID	TP Influent (mg/L)	TP Effluent (mg/L)	TP Removal (%) (Inf ≥ 0.1 mg/L)
4/7/2017	0.706	0.092	87.0
4/12/2017	0.338	0.076	77.5
4/19/2017	0.500	0.036	92.8
4/26/2017	0.504	0.042	91.7
5/13/2017	0.256	0.110	57.0
6/8/2017	0.256	0.104	59.4
6/15/2017	0.362	0.052	85.6
3/8/2018	1.75	0.130	92.6
3/14/2018	0.652	0.094	85.6
3/22/2018	0.364	0.072	80.2
3/27/2019	0.226	0.070	69.1
4/5/2019	0.337	0.092	72.9
4/13/2019	0.249	0.087	65.1
5/18/2019	1.09	0.173	84.1
12/7/2019	0.335	0.105	68.7
12/19/2019	0.211	0.093	56.2
3/30/2020	1.05	0.092	91.2
4/20/2020	0.451	0.112	75.2
n	18	18	18
Min	0.211	0.036	56.2
Max	1.75	0.173	92.8
Median	0.363	0.092	78.9
Mean	0.535	0.091	77.3
SD	0.400	0.032	12.5

Verification

The verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), 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 "General Use Level Designation Technical Evaluation Report" prepared by CONTECH Engineered Solutions, Portland, OR, USA, and dated December 28, 2020. This report is based on a field testing completed by CONTECH personnel at a site in Dundee, Oregon between March 2017 and April 2020 in accordance with the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) as written by the Washington State Department of Ecology (WADOE, 2011).

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, Ontario
L1N 3A9, Canada
Tel: 416-960-9900
info@imbriumsystems.com

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

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

Phosphorous Mitigation

Loading Summary TP | Pre_505_533 Yonge Street

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	0.082 %	0.066 m^3/s	13,509.21 m^3 0.243 mg/l 3.285 kg	3,653 m^3 0.243 mg/l 0.888 kg
Total	**72.981 %**	**0.066 m^3/s**	**13,509.21 m^3** **0.243 mg/l** **3.285 kg**	**3,653 m^3** **0.243 mg/l** **0.888 kg**

Loading Summary TP | Post_505_533 Yonge Street

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	-0.019 %	0.195 m^3/s	13,509.21 m^3 0.185 mg/l 2.501 kg	10,518 m^3 0.185 mg/l 1.947 kg
Total	**22.127 %**	**0.195 m^3/s**	**13,509.21 m^3** **0.185 mg/l** **2.501 kg**	**10,518 m^3** **0.185 mg/l** **1.947 kg**

Loading Summary TP | Post_505_533 Yonge Street with LID

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	86.504 %	4.922 m^3/s	13,509.21 m^3 0.185 mg/l 2.501 kg	23,970 m^3 0.025 mg/l 0.599 kg
Total	**76.054 %**	**4.922 m^3/s**	**13,509.21 m^3** **0.185 mg/l** **2.501 kg**	**23,970 m^3** **0.025 mg/l** **0.599 kg**

Peak Flow | Pre_505_533 Yonge Street

Catchment	Element	Description	Peak outflow
1	101	PEAK RUNOFF FLOW from	0.07 m^3/s
	Site Outlet	MAXIMUM FLOW at	0.066 m^3/s

Peak Flow | Post_505_533 Yonge Street

Catchment	Element	Description	Peak outflow
1	201	PEAK RUNOFF FLOW from	0.19 m^3/s
	Site Outlet	MAXIMUM FLOW at	0.195 m^3/s

Peak Flow | Post_505_533 Yonge Street with LID

Catchment	Element	Description	Peak outflow
1	201	PEAK RUNOFF FLOW from	0.19 m^3/s
	Jellyfish	MAXIMUM LATERAL INFLOW at	0.195 m^3/s
	Site Outlet	MAXIMUM FLOW at	4.922 m^3/s
	U/G Chamber	MAXIMUM OUTFLOW from	4.922 m^3/s
	Pipe_1	MAXIMUM FLOW in	0.195 m^3/s
	Pipe_2	MAXIMUM FLOW in	4.922 m^3/s

Detailed Report Parameters | Pre_505_533 Yonge Street

101

Field	Value
Subcatchment name	101
Catchment	1
Soil type	Fine Sand
Weighted EMC TSS (mg/L)	72.37
Weighted EMC TP (mg/L)	0.24
Total AREA (HA)	1.43
Impervious area (HA)	0.3861
Roof area (HA)	0.08579999999999999
Landscaped area (HA)	0.34319999999999995
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0.6149
Wetland area (HA)	0
Other area (HA)	0

Detailed Report Parameters | Post_505_533 Yonge Street

201

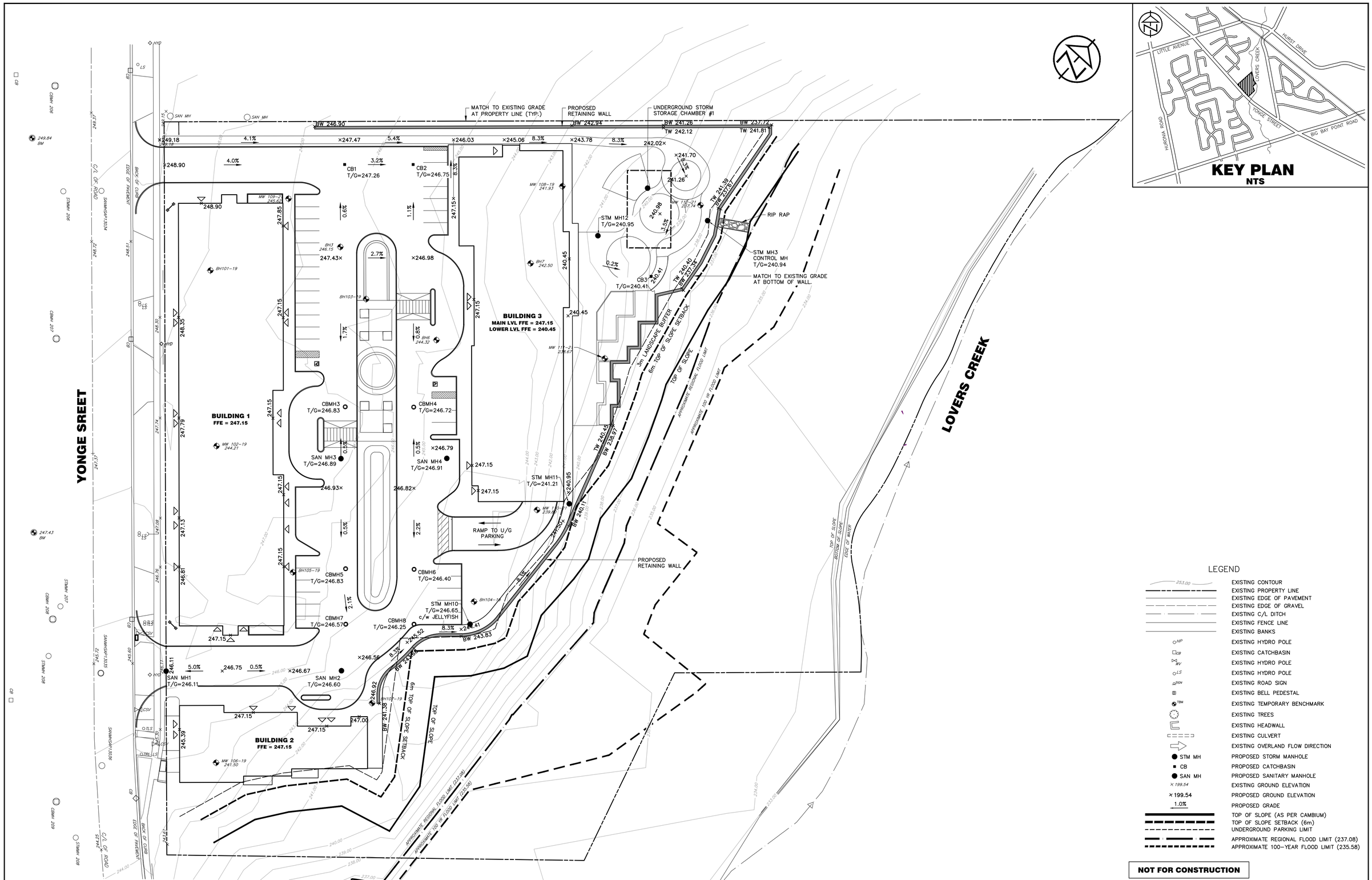
Field	Value
Subcatchment name	201
Catchment	1
Soil type	Fine Sand
Weighted EMC TSS (mg/L)	62.08
Weighted EMC TP (mg/L)	0.19
Total AREA (HA)	1.43
Impervious area (HA)	0.9008999999999999
Roof area (HA)	0.4862
Landscaped area (HA)	0.042899999999999994
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0

Detailed Report Parameters | Post_505_533 Yonge Street with LID

201

Field	Value
Subcatchment name	201
Catchment	1
Soil type	Fine Sand
Weighted EMC TSS (mg/L)	62.08
Weighted EMC TP (mg/L)	0.19
Total AREA (HA)	1.43
Impervious area (HA)	0.9008999999999999
Roof area (HA)	0.4862
Landscaped area (HA)	0.042899999999999994
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0

Appendix E: Drawings



LEGEND

- EXISTING CONTOUR
- EXISTING PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF GRAVEL
- EXISTING C/L DITCH
- EXISTING FENCE LINE
- EXISTING BANKS
- EXISTING HYDRO POLE
- EXISTING CATCHBASIN
- EXISTING HYDRO POLE
- EXISTING HYDRO POLE
- EXISTING ROAD SIGN
- EXISTING BELL PEDESTAL
- EXISTING TEMPORARY BENCHMARK
- EXISTING TREES
- EXISTING HEADWALL
- EXISTING CULVERT
- EXISTING OVERLAND FLOW DIRECTION
- PROPOSED STORM MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED SANITARY MANHOLE
- EXISTING GROUND ELEVATION
- PROPOSED GROUND ELEVATION
- PROPOSED GRADE
- TOP OF SLOPE (AS PER CAMBIUM)
- TOP OF SLOPE SETBACK (6m)
- UNDERGROUND PARKING LIMIT
- APPROXIMATE REGIONAL FLOOD LIMIT (237.08)
- APPROXIMATE 100-YEAR FLOOD LIMIT (235.58)

NOT FOR CONSTRUCTION

DISCLAIMER AND COPYRIGHT

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

BENCHMARKS

ELEVATIONS SHOWN ARE GEODETIC BASED ON NAD83 (CANADA) AND ARE DERIVED FROM GPS REAL TIME NETWORK OBSERVATIONS USING THE 'CAN-NET' VRS NETWORK, IN UTM 17N.

BENCHMARK:
NAILS IN HYDRO POLES, OPPOSITE SIDE OF YONGE STREET.

NOTES

TOPOGRAPHIC SURVEY SHOWN ON THIS PLAN PREPARED BY JOE TOPO SURVEYS AND CADD INC., DATED JUNE 4, 2021.

SITE PLAN PREPARED BY SALTER PILON ARCHITECTURE, DATED APRIL 19, 2023.

No.	REVISION DESCRIPTION	DATE
1.	ISSUED FOR ZBA – FIRST SUBMISSION	DEC 14/21
2.	ISSUED FOR ZBA – SECOND SUBMISSION	MAY 31/23

ENGINEER STAMP

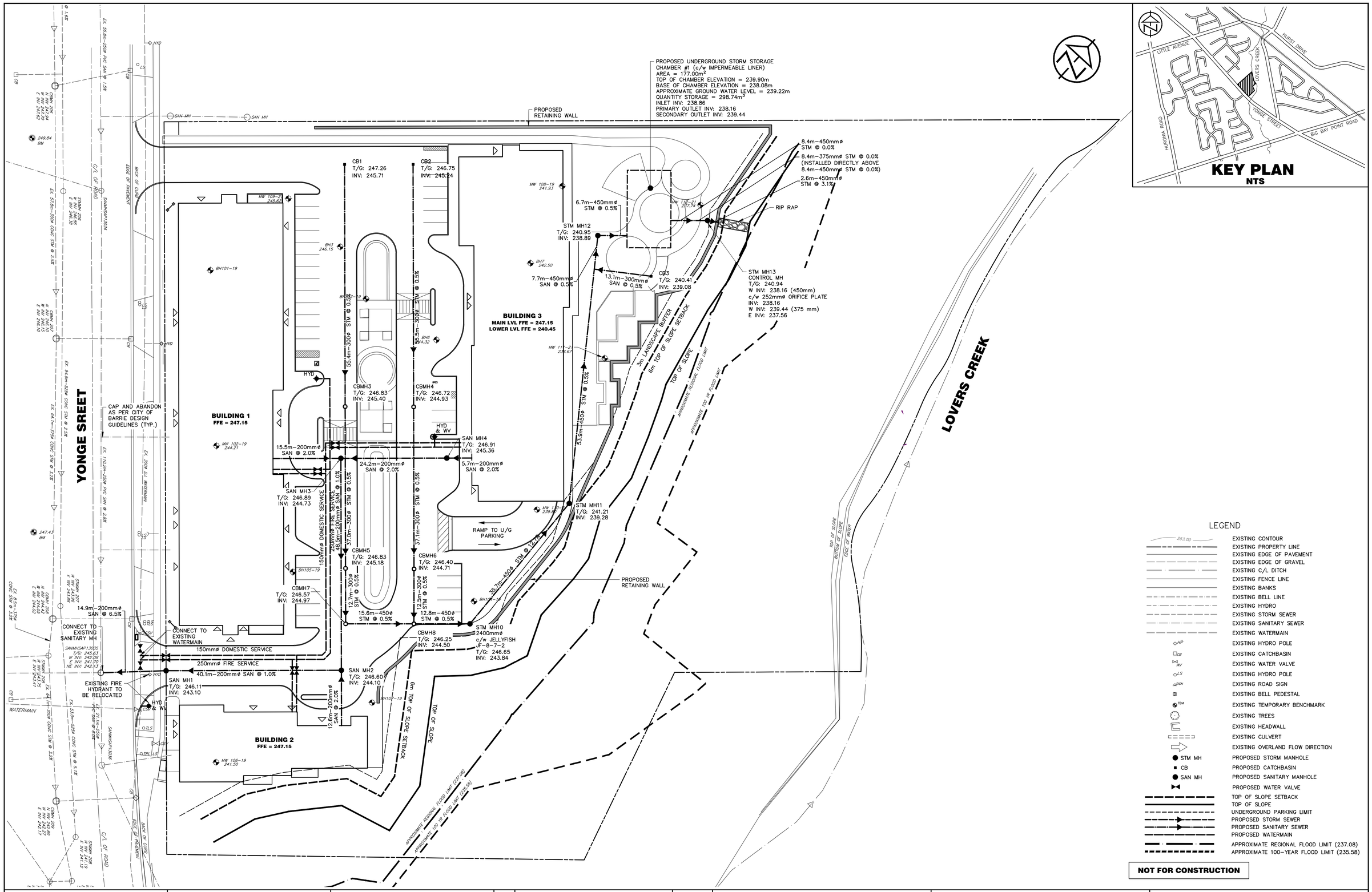
505 - 533 YONGE STREET
CITY OF BARRIE

TATHAM ENGINEERING

PRELIMINARY GRADING PLAN

DESIGN: LMB	FILE: 421422	DWG: SG-1
DRAWN: LMB	DATE: AUG 2021	
CHECK: NM	SCALE: 1:400	

Drawing Name: 421422-SG01.dwg, Plotted: May 30, 2023



DISCLAIMER AND COPYRIGHT

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

BENCHMARKS

ELEVATIONS SHOWN ARE GEODETIC BASED ON NAD83 (CANADA) AND ARE DERIVED FROM GPS REAL TIME NETWORK OBSERVATIONS USING THE 'CAN–NET' VRS NETWORK, IN UTM 17N.

BENCHMARK:
NAILS IN HYDRO POLES, OPPOSITE SIDE OF YONGE STREET.

NOTES

TOPOGRAPHIC SURVEY SHOWN ON THIS PLAN PREPARED BY JOE TOPO SURVEYS AND CADD INC., DATED JUNE 4, 2021.

SITE PLAN PREPARED BY SALTER PILON ARCHITECTURE, DATED APRIL 19, 2023.

No.	REVISION DESCRIPTION	DATE
1.	ISSUED FOR ZBA – FIRST SUBMISSION	DEC 14/21
2.	ISSUED FOR ZBA – SECOND SUBMISSION	MAY 31/23

ENGINEER STAMP

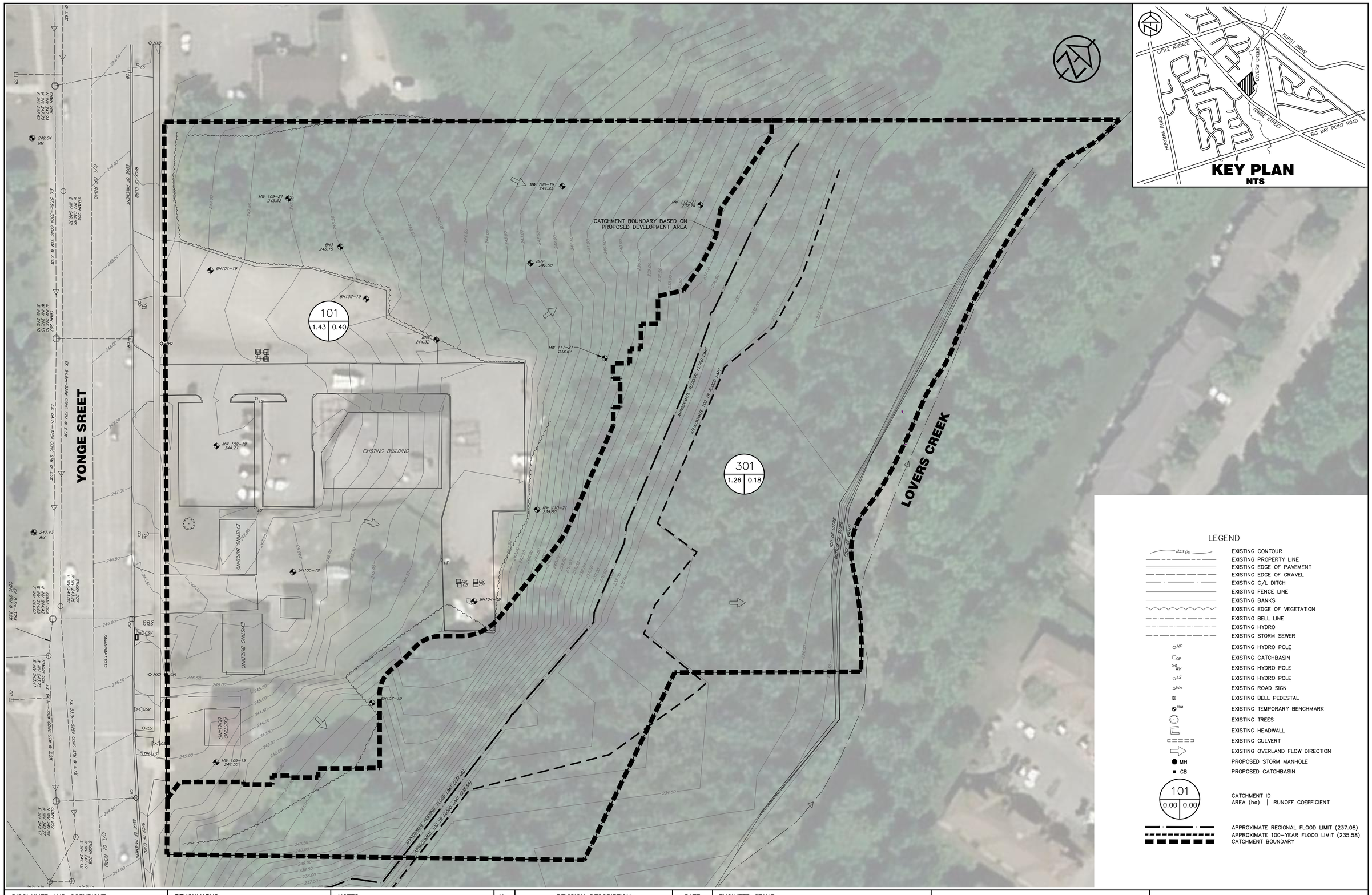
505 - 533 YONGE STREET
CITY OF BARRIE

PRELIMINARY SITE SERVICING PLAN

TATHAM ENGINEERING

DESIGN: LMB	FILE: 421422	DWG: SS-1
DRAWN: LMB/LJC	DATE: AUG 2021	
CHECK: NM	SCALE: 1:400	

Drawing Name: 421422–SS01.dwg, Plotted: May 31, 2023



DISCLAIMER AND COPYRIGHT

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

BENCHMARKS

ELEVATIONS SHOWN ARE GEODETIC BASED ON NAD83 (CANADA) AND ARE DERIVED FROM GPS REAL TIME NETWORK OBSERVATIONS USING THE 'CAN-NET' VRS NETWORK, IN UTM 17N.

BENCHMARK:
NAILS IN HYDRO POLES, OPPOSITE SIDE OF YONGE STREET.

NOTES

TOPOGRAPHIC SURVEY SHOWN ON THIS PLAN PREPARED BY JOE TOPO SURVEYS AND CADD INC., DATED JUNE 4, 2021.

SITE PLAN PREPARED BY SALTER PILON ARCHITECTURE, DATED APRIL 19, 2023.

No.	REVISION DESCRIPTION	DATE
1.	ISSUED FOR ZBA – FIRST SUBMISSION	DEC 14/21
2.	ISSUED FOR ZBA – SECOND SUBMISSION	MAY 31/23

ENGINEER STAMP

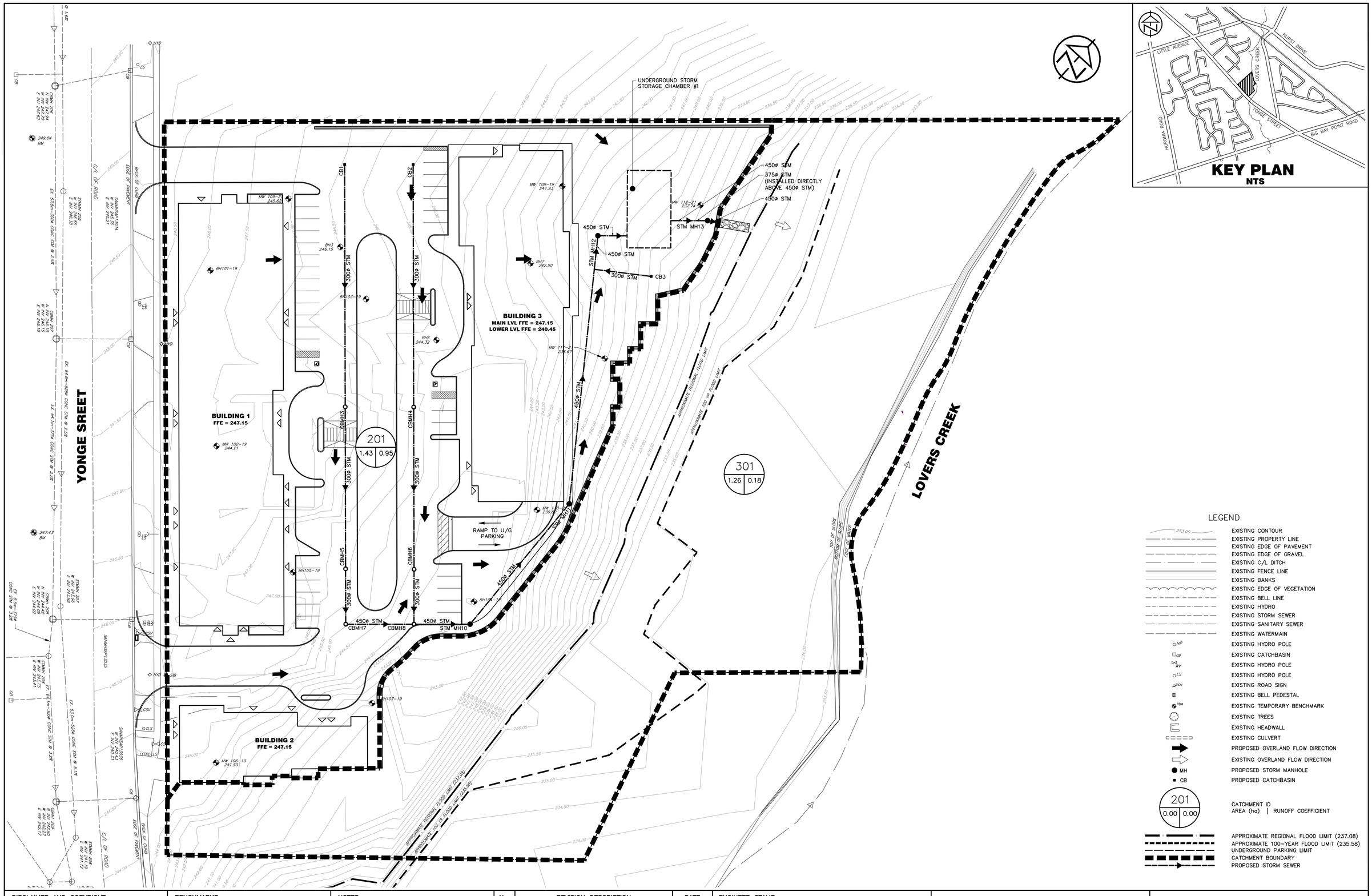
505 - 533 YONGE STREET
CITY OF BARRIE

PRE-DEVELOPMENT DRAINAGE PLAN

TATHAM ENGINEERING

DESIGN: LMB	FILE: 421422	DWG: DP-1
DRAWN: LMB	DATE: AUG 2021	
CHECK: NM	SCALE: 1:400	

Drawing Name: 421422-DP01.dwg, Plotted: May 30, 2023



LEGEND

- EXISTING CONTOUR
- EXISTING PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING EDGE OF GRAVEL
- EXISTING C/L DITCH
- EXISTING FENCE LINE
- EXISTING BANKS
- EXISTING EDGE OF VEGETATION
- EXISTING BELL LINE
- EXISTING HYDRO
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- EXISTING HYDRO POLE
- EXISTING CATCHBASIN
- EXISTING HYDRO POLE
- EXISTING HYDRO POLE
- EXISTING ROAD SIGN
- EXISTING BELL PEDESTAL
- EXISTING TEMPORARY BENCHMARK
- EXISTING TREES
- EXISTING HEADWALL
- EXISTING CULVERT
- PROPOSED OVERLAND FLOW DIRECTION
- EXISTING OVERLAND FLOW DIRECTION
- PROPOSED STORM MANHOLE
- PROPOSED CATCHBASIN
- CATCHMENT ID (201) / AREA (ha) (0.00) | RUNOFF COEFFICIENT (0.00)
- APPROXIMATE REGIONAL FLOOD LIMIT (237.08)
- APPROXIMATE 100-YEAR FLOOD LIMIT (235.58)
- UNDERGROUND PARKING LIMIT
- CATCHMENT BOUNDARY
- PROPOSED STORM SEWER

DISCLAIMER AND COPYRIGHT

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

TATHAM ENGINEERING LIMITED CLAIMS COPYRIGHT TO THIS DRAWING WHICH MAY NOT BE USED FOR ANY PURPOSE OTHER THAN THAT PROVIDED IN THE CONTRACT BETWEEN THE OWNER/CLIENT AND THE ENGINEER WITHOUT THE EXPRESS CONSENT OF TATHAM ENGINEERING LIMITED.

BENCHMARKS

ELEVATIONS SHOWN ARE GEODETIC BASED ON NAD83 (CANADA) AND ARE DERIVED FROM GPS REAL TIME NETWORK OBSERVATIONS USING THE 'CAN-NET' VRS NETWORK, IN UTM 17N.

BENCHMARK:
NAILS IN HYDRO POLES, OPPOSITE SIDE OF YONGE STREET.

NOTES

TOPOGRAPHIC SURVEY SHOWN ON THIS PLAN PREPARED BY JOE TOPO SURVEYS AND CADD INC., DATED JUNE 4, 2021.

SITE PLAN PREPARED BY SALTER PILON ARCHITECTURE, DATED APRIL 19, 2023.

No.	REVISION DESCRIPTION	DATE
1.	ISSUED FOR ZBA – FIRST SUBMISSION	DEC 14/21
2.	ISSUED FOR ZBA – SECOND SUBMISSION	MAY 31/23

ENGINEER STAMP

505 - 533 YONGE STREET
CITY OF BARRIE

POST-DEVELOPMENT DRAINAGE PLAN

TATHAM ENGINEERING

DESIGN: LMB	FILE: 421422	DWG: DP-2
DRAWN: LMB	DATE: AUG 2021	
CHECK: NM	SCALE: 1:400	

Drawing Name: 421422-DP02.dwg, Plotted: May 30, 2023