FUNCTIONAL SERVICING REPORT

IN SUPPORT OF AN OFFICIAL PLAN AMENDMENT

AND ZONING BYLAW AMENDMENT APPLICATIONS

521 Huronia Road

Proposed Townhome Community

City of Barrie, Ontario

counterpoint ENGINEERING

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Prepared For:

Huronia Barrie Land Inc.

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EXECUTIVE SUMMARY

This Functional Servicing Report has been prepared on behalf of Huronia Barrie Land Inc., the registered owner of the subject land in support of Zoning By-Law Amendment and Official Plan Amendment.

The servicing strategy for the proposed development is summarized as follows:

Water Servicing:

There is an existing 300mm ø watermain on the west side of Huronia Road that terminates at a plug near the northwest corner of the subject site. There is also an existing 150mm ø watermain on the north side of Loon Avenue which transitions to a 200mm ø watermain prior to connecting into the 300mm ø watermain on Huronia Avenue. The site is currently not serviced with a connection to either system.

The proposed development will be serviced through a connection to the existing 300mm ø watermain stub on the west side of Huronia Avenue. A 150mm ø PVC combined domestic watermain and firemain is proposed along the private road to service the site. A private easement is contemplated over the adjacent parcel to the east to complete a watermain loop to Loon Avenue through the unopened road allowance located north and east of the subject site. Based on the recent hydrant fire flow tests conducted, the watermain at Loon Avenue can supply 24,194 L/min and the watermain on Huronia Road can supply 25,472 L/min. The maximum day plus fire flow demand was calculated to be 9,052 L/min. As the site is lower in elevation than the connections at Huronia Road and Loon Avenue, the available pressure is expected to be greater than the results of the fire flow test. Therefore, the supply capacity of the existing surrounding water distribution system can adequately service the site. The City has indicated detailed modeling will be required at detailed design.

Sanitary Servicing:

The site does not currently have any available sanitary sewer connection nor any available local sewer along the frontage. There is an existing 250mm ø sanitary sewer on Loon Avenue beginning at a manhole located on the intersection at Huronia Avenue and drains from west to east. The upstream invert of the sanitary sewer in the manhole is 250.80m.

The ground elevation for majority of the subject site is below the invert of the closest sanitary sewer located within Huronia Avenue. Therefore, a private easement is contemplated on the adjacent parcel to the east. A gravity service can be accommodated through a connection to Loon Avenue sanitary sewer at the unopened road allowance. In the proposed condition, the peak design flow from the subject site to the existing 250mm sanitary system is **1.45 L/s**. Based on review of the available sanitary design sheet for the subdivision, the local sewers within Loon Avenue downstream to the Lover's Creek Trunk sewer have adequate capacity to accommodate the subject site.

Stormwater Servicing:

There is currently no storm servicing infrastructure in the vicinity of the subject site. The nearest storm system consists of an existing 450mm ø storm sewer on Loon Avenue flowing west to east that drains into an existing 750mm ø storm sewer downstream. The proposed residential development will be serviced through a treatment train comprised of; Stormtech filtration, stormfilter filtration, an enhanced swale on the eastern side and a vegetated filter strip. The storm sewers and Stormtech system will convey storm water to the storage tank and the downstream end of the site and this will be controlled and discharge to a stormfilter. The pre-cast stormfilter quality and phosphorus cartridge filtration system located downstream of the quantity tank will direct all controlled flows south towards a level spreader set at existing grades near the wetland buffer in the south east corner then towards a natural vegetated filter strip towards the wetland. Due to high groundwater levels infiltration is not feasible on the site. However, rooftop downspouts discharging to pervious areas provide a

water balance effort to reduce the volume of runoff. The treatment train described above represents best efforts for the filtration features given the site conditions.

The proposed site release rate during the 100-year storm event will be controlled to the maximum allowable release rate of 80 L/s. This results in **344m3** of required storage within the site. A total of **344 m3** can be provided by the proposed stormwater storage tank and Stormtech system based on conceptual dimensions (235 m2 base area with a lower orifice outlet at 245.67 and a top of tank structure at 247.20) as noted on Figure 9 – **Servicing Cross-Section, which satisfies** the quantity storage requirements. Quality control will be provided by the proposed Stormfilter cartridge system that is equipped with PhosphoSorb media that shall provide the necessary stormwater treatment, including 80% TSS, phosphorus, oil, grease, and heavy metal pollutant removal. The Phosphosorb will provide 79% phosphorus removal as per ETV testing results.

Due to site constraints of high groundwater, water balance, volume control and phosphorus targets cannot be fully achieved on this site. The offsetting fee for the Phosphorus deficit is estimated at $29,181.25 and the fee for the water balance deficit is estimated at $41,032. As an alternative measure to meeting volume control a filtration method that has storage greater than the 5 mm depth over the impervious area of the site has been proposed. This LID method is the Stormtech Isolator Row that makes up the majority of the stormwater conveyance and storage system. It allows for TSS to settle within the Isolator row and provides 80% TSS removal as per ETV testing results.

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1.0 INTRODUCTION

1.1 Background

This Functional Servicing Report has been prepared on behalf of Huronia Barrie Land Inc. in support of an official plan amendment and zoning bylaw amendment applications for the proposed 6.28 ha Proposed Townhome Community. This application proposes to construct a new townhouse development on the buildable portion of the property. The purpose of this report is to demonstrate that the existing infrastructure within 521 Huronia Road and the surrounding area can accommodate the proposed development. The majority of the site is currently covered by an existing wetland and forested areas, which will remain untouched. The calculations in this report will be based on the developable **1.13 ha** of land located outside the limit of the wetland and recommended buffer. The site generally slopes from northwest to southeast, as identified on **Figure 6 – Pre-Development Drainage Plan**.

The subject site lies within the City of Barrie. It is located at the southeast corner of Huronia Road and Loon Avenue. The site is bounded by Huronia Road to the west, single detached dwellings along Loon Ave to the north, future development lands to the east, and undeveloped forest/wetland to the south. **Figure 1 – Site Location** illustrates the subject site within the context of its surroundings. The Proposed Townhome Community consists of 52 townhouse units, a driveway, surface parking, and landscape features as shown on **Figure 2 – General Plan**. It also includes a 5.0m buffer from the limit of the wetland. After subtracting the buffer area from the site, all development will be contained within the remaining 1.13 ha of land. The site will have primary access from Loon Avenue via an easement over the adjacent parcel to the east and the existing unopened ROW. Huronia Road will act as an emergency access/egress route.

1.2 Study Parameters

This servicing assessment is based on:

- Topographic Survey, prepared by Rudy Mak Surveying Ltd.,
- Conceptual Architectural Plans (Drawing: Site Plan), prepared by We Merchandise Space Inc.
- As-recorded Plan & Profile Plans and Drainage Plans, provided by the City of Barrie,
- Engineering Standards, Policies and Guidelines, City of Barrie,
- Water Supply Master Plan Update, dated April 2019, City of Barrie,
- Fire Underwriters Survey, 1999,
- Correspondence with Region/Town Staff
- LSRCA Technical Guidelines for Stormwater Management Submissions, Lake Simcoe Region Conservation Authority

2.0 WATER SUPPLY

2.1 Existing Water Supply

There is an existing 300mm ø watermain on the west side of Huronia Road that terminates at a plug near the northwest corner of the subject site. There is also an existing 150mm ø watermain on the north side of Loon Avenue which transitions to a 200mm ø watermain prior to connecting into the 300mm ø watermain on Huronia Avenue. The site is currently not serviced with a connection to either system. Existing watermain infrastructure are shown on **Figure 3** – Water Servicing Plan.

There is an existing hydrant at the northwest corner of the site on the west side of Huronia Road just before the watermain plug. There are also two hydrants in the vicinity of the site on the north side of Loon Avenue.

New hydrant flow tests were conducted in November 2020 for the hydrant located on the intersection of Huronia Road and Loon Avenue, and the hydrant on Loon Avenue and Gadwall Avenue. These tests have been used to evaluate the theoretical fire flow available for the site. Refer to **Appendix A2** for the hydrant flow tests.

2.2 Proposed Water Supply

The proposed development will be serviced through a connection to the existing 300mm ø watermain stub on the west side of Huronia Avenue. A 150mm ø PVC combined domestic watermain and firemain is proposed along the private road to service the site. A private easement is contemplated over the adjacent parcel to the east to complete a watermain loop to Loon Avenue through the unopened road allowance located north and east of the subject site. An easement over the watermain in favour of the municipality would be required if the watermain is connected through an adjacent parcel and/or provides service to the adjacent parcel. It has been determined that mid-block fire breaks will be installed in the townhouse

blocks. The calculations have therefore been prepared according to half the critical townhouse block's total floor area to determine the most critical scenario. Further exploration and modelling can be performed during detailed design and, as a result, the size of the proposed watermain may be reduced in subsequent submissions.

The townhouse units shall each have an individual service connection to the proposed watermain as per the City of Barrie standard drawings. Municipal metering for townhomes shall be determined during detailed design. Two hydrants are also proposed on the site to provide adequate fire protection. Refer to **Figure 3** – Water Servicing Plan for the proposed watermain layout.

The City of Barrie's Water Transmission and Distribution Policies and Design Guidelines states that governing flows shall be determined by the maximum day demand plus fire flow. An average daily demand of 225 L/cap/day was used and factors of 2.75 and 4.13 were applied to calculate the residential maximum day and maximum hour demand as specified by the City of Barrie and the MECP. Refer to **Appendix A1** for the supporting calculations of the proposed flows. The calculated daily demands for the proposed development are as follows:

Residential:

- Average Day Demand = 19 L/min
- Maximum Hour Demand = 79 L/min
- Maximum Day Demand = 52 L/min

The Fire Underwriter's Survey (FUS) guidelines were used to calculate the fire flow requirements of the residential site. Each unit will have fire rated separation and firewalls will be provided where the block size exceeds the maximum permitted by the OBC. Based on these requirements as well as correspondence with the architect, The most critical townhouse block shall have a midblock firewall as mentioned previously. The calculations resulted in a

required fire flow of 9,000 L/min. Therefore, the maximum day plus fire flow calculation results in **9,052 L/min** (9,000 + 52). Refer to **Appendix A1** for the fire flow demand calculations.

The City of Barrie's design criteria dictates the following system pressure requirements:

- Maximum pressure during the minimum hourly demand = 620 kPa (90 psi)
- Minimum pressure during maximum hour demand = 345 kPa (50 psi)
- Minimum Fire Flow pressure during simultaneous maximum day demand plus fire flow = 138 kPa (20 psi).

Based on the recent hydrant fire flow tests conducted, the watermain at Loon Avenue can supply 24,194 L/min and the watermain on Huronia Road can supply 25,472 L/min. The maximum day plus fire flow demand was calculated to be 9,052 L/min. As the site is lower in elevation than the connections at Huronia Road and Loon Avenue, the available pressure is expected to be greater than the results of the fire flow test. Therefore, the supply capacity of the existing surrounding water distribution system can adequately service the site. The City has indicated detailed modeling will be required at detailed design.

3.0 SANITARY SERVICING

3.1 Existing Sanitary Servicing

The site does not currently have any available sanitary sewer connection nor any available local sewer along the frontage. There is an existing 250mm ø sanitary sewer on Loon Avenue beginning at a manhole located on the intersection at Huronia Avenue and drains from west to east. The upstream invert of the sanitary sewer in the manhole is 250.80m.

3.2 Proposed Sanitary Servicing

The ground elevation for majority of the subject site is below the invert of the closest sanitary sewer located within Huronia Avenue. Therefore, a private easement is contemplated on the adjacent parcel to the east. A gravity service can be accommodated through a connection to Loon Avenue sanitary sewer at the unopened road allowance. Refer to **Figure 4** – Sanitary Servicing Plan for the proposed sanitary sewer layout.

In the proposed condition, the peak design flow from the subject site to the existing 250mm sanitary system is **1.45 L/s**. Based on review of the available sanitary design sheet for the subdivision, the local sewers within Loon Avenue downstream to the Lover's Creek Trunk sewer have adequate capacity to accommodate the subject site.

Refer to **Figure 4** – Sanitary Servicing Plan for the existing and proposed sanitary sewer layout and to **Appendix B** for supporting sanitary calculations.

4.0 STORMWATER SERVICING

4.1 Existing Stormwater Drainage

There is currently no storm servicing infrastructure in the vicinity of the subject site. The nearest storm system consists of an existing 450mm ø storm sewer on Loon Avenue flowing west to east that drains into an existing 750mm ø storm sewer downstream. The site is currently comprised of forest cover and wetland and stormwater flows generally sheet drain from northwest to southeast, toward the wetland feature located along the south boundary of the developable area.

The existing site is considered as a single drainage area (Refer to **Figure 6** – Pre-Development Drainage Areas). The existing drainage areas are summarized in **Table 4.1** below**.**

Based on a run-off coefficient of 0.20 and the City of Barrie's specified IDF curves, the pre-development existing site characteristics are as follows:

Table 4.1 – Pre-Development Drainage Areas

Area ID	Area (ha)	Runoff Coefficient
101	1.13	0.20

4.2 Allowable Release Rate

As per the City of Barrie and LSRCA design criteria the site is required to control peak runoff flows from the 2-year to the 100-year storm event under post-development conditions to the corresponding pre-development release rate or less. The Airport method was used to determine the existing conditions time of concentration to be 27 minutes.

The allowable discharge from the subject site is calculated as follows: **Q_A = C x A x i (L/s)**

Table 4.2: Allowable Release Rates

Storm Event	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Pre-development Release Rates (L/s)	25	38	44	58	69	80

Refer to **Appendix C** for allowable release rate calculations.

4.3 Proposed Stormwater Servicing

The proposed residential development will be serviced through a treatment train comprised of; Stormtech filtration, stormfilter filtration, an enhanced swale on the eastern side and a vegetated filter strip. The storm sewers and Stormtech system will convey storm water to the storage tank and the downstream end of the site and this will be controlled and discharge to a stormfilter. The pre-cast stormfilter quality and phosphorus cartridge filtration system located

downstream of the quantity tank will direct all controlled flows south towards a level spreader set at existing grades near the wetland buffer in the south east corner then towards a natural vegetated filter strip towards the wetland. Due to high groundwater levels infiltration is not feasible on the site. However, rooftop downspouts discharging to pervious areas provide a water balance effort to reduce the volume of runoff. The treatment train described above represents best efforts for the filtration features given the site conditions. The level spreader downstream of the storm filter outlet shall allow for safe conveyance of the discharged stormwater to the wetland and will mitigate the potential erosion.

Area 201, will be directed towards a storage tank and controlled via an outlet structure prior to discharge from the site. The remaining 0.30 ha of the site shall remain uncontrolled due to grading constraints which will consist of landscape areas and a small portion of road. The uncontrolled landscape section, Area 202 located around the south perimeter of the site will sheet flow into the adjacent wetland. Uncontrolled Area 203, at the eastern perimeter of the site will drain to an enhanced swale, a flow spreader and then towards a natural vegetated filter strip. Refer to **Figure 6 – Post-Development Drainage Plan**.

Refer to **Figure 5 – Stormwater Servicing** for the existing and proposed stormwater servicing strategies and proposed storage location and treatment system.

As requested by the LSRCA, minimizing the impact of de-icing salt during the winter should be considered for the site as well. It is notable that the proposed development will be a low traffic residential area and will generate minimal pollutants and require a minimal amount of salt. In addition, it is proposed that a salt management plan shall be developed to reduce the sale impact. The site's internal roads shall be designed to minimize the need for winter salt. The site shall also consider methods such as a proper location for snow storage, use of deciduous plants to reduce winter shading, permeable pavement if feasible, minimal road grades at intersections and rougher pavement in order to reduce the need for and impact of winter salt.

4.4 Proposed Stormwater Management

4.4.1 Quantity Control

As mentioned above, the 2 to the 100-year post-development peak run-off rates will be controlled to the corresponding 2 to 100-year pre-development peak run-off rates. All release rates from uncontrolled areas have been accounted for when determining the post-development flows and storage requirements. Refer to **Figure 7** for the post-development drainage plan. **Table 4.4** below summarizes the proposed peak flows for each storm event and associated storage requirements under post-development conditions.

Table 4.4 – Post-Development Peak Flow and Storage Summary

Storm Event	Allowable Release Rate (L/s)	Area 201 Release Rate (L/s)	Area 202 + 203 Uncontrolled Release Rate (L/s)	Storage Required (m^3)	Storage Provided (m^3)	Total Site Release Rate (L/s)
2-Year	25	7	15	122	122	22
5-Year	38	13	24	166	166	37
10-Year	44	16	28	191	236	44
25-Year	58	22	36	246	246	58
50-Year	69	27	43	297	297	70
100-Year	80	30	50	344	344	80

The proposed site release rate during the 100-year storm event will be controlled to the maximum allowable release rate of 80 L/s. This results in **344m^3** of required storage within the site. A total of **344 m^3** can be provided by the proposed stormwater storage tank and Stormtech system based on conceptual dimensions (235 m^2 base area with a lower orifice outlet at 245.67 and a top of tank structure at 247.20) as noted on **Figure 9 – Servicing Cross-Section**, which satisfies the quantity storage requirements. The proposed storage system bottom elevation shall be approximately 245.50m, while the design water level elevation is 246.81m during the 100-year storm which remains below the southernmost catch basin drain at an elevation of 246.90m.

The release rates shall be controlled by two orifice control plates welded and bolted into the inside of the tank outlet at a low and high elevation, that outlet to the Stormfilter unit downstream. Conceptual sizes for the orifice plates are 80 and 95 mm. Two orifice control structures are used to optimize storage within the design while meeting all of the storm even target flows. The details and sizes of the orifice plates shall be confirmed during detailed design. An emergency overflow weir is proposed to be installed on the tank and drain to the flow spreader. This weir would be set at the 100 year water level and be activated in case the orifice control structures were to block. In addition an emergency overflow hatch will be provided on the tank for maintenance and to allow for overflow of stormwater. Refer to **Appendix C** for storage volume calculations. The tank is exposed to the surface and also acts as a backyard terrace for the southern most units.

4.4.2 Quality Control

4.4.2.1 TOTAL SUSPENDED SOLIDS

The proposed development shall target an enhanced level of quality control (80% Total Suspended Solids removal) for the site. Quality control will be provided by the proposed Stormfilter cartridge system that is equipped with PhosphoSorb media that shall provide the necessary stormwater treatment, including 80% TSS, phosphorus, oil, grease, and heavy metal pollutant removal. The Stormfilter SFPD 0816 vault system is proposed downstream of the storage tank that will provide the required 80% TSS removal from the stormwater runoff. Refer to **Appendix C** for the specifications on the Stormfilter system. The stormwater tank will outlet to the proposed level spreader towards the existing wetland. In addition to this all collected stormwater will drain towards a long Stormtech Isolator row system for the majority of the stormwater conveyance system. This Isolator row will provide an additional 80% TSS removal and act as pre-treatment for the Stormfilter to increase the longevity and the filter cartridges and reduce overall needed maintenance. The Isolator row has been shown to provide 80% TSS removal as per ETV testing which is included in **Appendix C**. The Stormtech system will be lined so that oil does not infiltrate into the groundwater system. At

detailed design a buoyancy analysis will be provided to demonstrate that the Stormtech system will provide appropriate counter buoyancy against high groundwater. A soil bearing capacity analysis will also be done at detailed design to ensure that the soils are suitable to support the Stormtech System (some counter measures include increasing clear stone depth if required).

A small area of the proposed road at the east limit of the site cannot be directed to the stormwater quantity tank and Stormfilter system due to grading restraints. This area is part of the uncontrolled drainage area but will be treated for quality control by a proposed enhanced swale followed by a flow splitter and vegetated filter strip. All the proposed efforts on-site shall provide at a minimum the overall required 80% TSS removal. A general detail of the enhanced swale based on the TRCA CVC SWM LID manual is included as **Figure 10**. At detailed design a 25 mm 4 hours Chicago storm will be modelled and the velocity will be checked to ensure that it is below 0.5 m/s.

4.4.2.2 PHOSPHORUS CONTROL

The proposed development shall make efforts to control post-development phosphorus loading to pre-development levels as per LSRCA standards. The development shall adhere to the Lake Simcoe Protection Plan Policy 4.8DP and LSRCA's Phosphorus Offsetting Policy. A phosphorus calculation has been prepared to determine the pre- and post-development phosphorus loading from the site. The pre-development conditions of the site have been considered as a forest land use, which has a phosphorus coefficient of 0.06 kg/ha. Given the 1.13ha site, the resulting phosphorus loading was **0.07 kg/yr**.

Under proposed conditions, the site is comprised of high intensity residential development. The resulting phosphorus loading under post-development conditions without mitigation is 1.49 kg/yr. With the treatment mitigation provided by the Stormfilter system with Phosphosorb media, which is expected to treat at least 79% of the phosphorus concentration as per ETV Testing Results included in **Appendix C**. In addition to this downstream vegetation from the

outlet and for uncontrolled areas acts as a natural vegetative filter strip prior to stormwater entering the wetland. The vegetative filter strip provides 65% phosphorus removal the Phosphosorb media plus the vegetative filter strip provide a treatment train approach overall removal of 93% (conservatively coded in as 86% on the phosphorus loading tool). All of the backyards that cannot be controlled drain towards natural vegetative filter strips that provide 65% phosphorus removal. The resulting phosphorus loading is **0.29 kg/yr**. 1.2 kg/yr of phosphorus is removed which is approximately **80%** phosphorus removal. As per the LSRCA's Lake Simcoe Phosphorus Offsetting Policy, a cash-in-lieu is proposed for the development based on the net pre- and post-development phosphorus loading. The net increase in phosphorus loading for the proposed site is 0.29 – 0.07 = **0.22 kg/yr**. Refer to **Appendix C** for the phosphorus loading calculations. Therefore, the cash-in-lieu calculation is as follows:

0.29 kg/yr x 2.5 offset ratio x $35,700 kg/yr = $25,882.50

It is noted that the Stormtech Isolator Row likely does provide some phosphorus removal but has conservatively not been accounted for. This is based upon the assumption that phosphorus binds to TSS and some of it would have been removed via settling within the Stormtech Isolator rows.

4.4.2.3 WINTER SALT

The proposed site is a relatively small townhouse condo development, with low traffic and salt pollution risk. In addition, all controlled stormwater flows shall be treated by the proposed Stormfilter Cartridge system with Phosphosorb media. Based on documentation regarding the Stormfilter cartridges, the system is able to provide treatment for pollutants such as soluble metals and nutrients as well, therefore, some salt shall also be removed from the runoff prior to discharge to the wetland, further reducing concern for salt pollution. Refer to **Appendix C** for documentation and specifications on the Stormfilter Cartridge System.

4.4.2.4 TEMPERATURE

The proposed development shall consist of underground storm infrastructure to convey captured drainage. All flows will be conveyed in the piping towards the treatment system, reducing the exposure of the runoff to heat. The underground conveyance will also contribute to cooling the runoff if temperature increased during overland drainage of the stormwater. Shading of the level spreader area with plantings such as shrubs can be implemented at the detailed design stage to further mitigate potential temperature increase in runoff.

4.4.2.5 OTHER CONTAMINANTS

The stormwater shall be treated by the proposed Stormfilter Cartridge system, as stated previously, which can provide treatment for oil, grease and gas pollutants.

Similarly, heavy metals can also be treated by the Stormfitler Cartridge system, as indicated in the documentation for the Stormfilter system. Refer to **Appendix C** for documentation and specifications on the Stormfilter Cartridge System. Heavy metals are also recognized to adsorb to suspended sediment particles in runoff and therefore, are also removed when treating the TSS. Therefore, the system shall provide treatment for these pollutants. Regular inspection and maintenance of the Stormfilter Cartridge system is required to ensure ongoing removal of accumulated sediment and maintain optimal function of the treatment system.

It is also notable that the site shall be a relatively low traffic area and poses low risk of contaminants being discharged from the site.

4.4.3 Water Balance and Volume Control

The proposed development water balance shall take a best-efforts approach given the site constraints. Due to the presence of high groundwater, infiltration is not feasible anywhere on the site. Refer to **Appendix D** for excerpts from the Hydrogeological Assessment prepared by

Grounded Engineering Inc. Therefore, the proposed water balance will be limited to the natural infiltration that will occur in the pervious areas, rooftop disconnection to landscape areas draining to the frontage and natural evapotranspiration throughout the site. An annual water balance calculation has been prepared by Grounded Engineering Inc. for the proposed site development to determine the water balance deficit. Under pre-development conditions, it was calculated that there will be **1,387 m^3/year** of infiltration, while the post-development conditions indicate an infiltration of **576 m^3/year**. This results in an anticipated water balance deficit of **811 m^3/year**. Excerpts from the Hydrogeological Assessment relating to water balance have also been included in **Appendix D**. Water balance will be met via cash in lieu as per the LSRCA Water Balance Offsetting Fee, which will provide the implementation of programs to make up the difference. Based on the fee schedule, the calculation is as follows:

811 m^3/year x \$44.88 costs/m^3 based on deficit volume = 36.40m^3

36.40m^3 x \$1,000/m^3 = \$36,397.68;

Administration Fee = 15% x 35,680 = \$5,459.65

Total Fee = \$36,397.68 + \$5,459.65 = **\$41,857**

A volume control calculation has been provided in **Appendix C**. Options for volume control include: 25mm volume control target as well as alternative #1 for 12.5mm on-site retention, and Alternative #2 for minimum 5mm on-site retention. Various LID efforts have been explored in the design, but due to the site constraints, they have been deemed unfeasible for the development.

The primary constraints to further on-site retention are:

- High Groundwater Table
- Property, Spatial and Infrastructure restrictions

The layout of the townhouse community development is guided by the developable area adjacent to the wetland and unique property shape, along with the required emergency entrance access location at Huronia Road. The primary access route and sidewalk

connection to Loon Avenue is at the east of the site as well, which further contributes to limiting potential space for LIDs.

The groundwater table has been reviewed and it has been determined that the groundwater level is close to the surface due to proximity to the existing wetland. During field testing, the soils were saturated during dry-weather conditions, which indicates groundwater approaching the surface elevation and unfeasible infiltration. Refer to the Hydrogeological Assessment prepared by Grounded Engineering Inc. that indicate the saturated soil conditions and high groundwater levels.

Through discussion with the LSRCA on April 23, 3021, it was agreed that filtration treatment would be acceptable where the capacity for treatment matches the minimum the 5 mm depth over all the proposed impervious areas of the site. It was acknowledged that given the site constraint, the contributing drainage area to these filtration features would not comprise of all impervious area but that the contributing impervious area would be maximized to the greatest extend practicable. This filtration volume requirement is approximately 32 m^3.

As stated in **Section 4.4.2**. It is proposed to implement Stormtech Isolator rows throughout the entirety of the stormwater conveyance system layout as shown on **Figure No 5**. Due to high groundwater, these system are lined with an impermeable liner. These Stormtech Isolator row systems have effectively 33 m^3 (20 m^3 downstream Stormtech + 13 m^3 upstream Stormtech) of storage for filtration before stormwater will flow to the main storm system for conveyance and ultimately to the stormwater tank, storm filter and then to Lovers Creek. The downstream system will have two isolator rows while the upstream system will have one isolator row. The downstream system includes storage from both of the rows below the outlet of the pipe. The upstream system includes storage below the isolator row outlet and below the secondary row outlet. The secondary row for the upstream system will be wrapped in filter fabric as well to provide isolator row quality treatment. For both systems, the underdrain in the system is placed within the clear stone at the base of the system is to remove any

potential stagnant water. The Stormtech Isolator rows have 80% TSS removal capabilities as per ETV testing. Volume control calculations (Stormtech Stage Storage), Stormtech General Section, Stormtech Manual and ETV testing results are provided in **Appendix C**. Furthermore, the downstream vegetation from the outlet of the site acts as a natural filter strip that aids with providing this alternative method to meeting the volume control requirements. The enhanced swale on the north east end provides TSS removal for the small uncontrolled impervious road. Thus, all impervious areas are being treated by an LID method to aid in volume control.

4.4.4 Overland Flow Considerations

Emergency flows exceeding the conveyance and capture capacity of the proposed minor storm system will be safely directed overland towards the existing wetland to the southeast. Refer to **Figure 8** – Conceptual Grading Plan for the schematic grading plan and overland flow concept. Emergency overland flow calculations evaluating critical overland flow route areas will be included at detailed design.

5.0 SITE GRADING

The site will be graded in accordance with the City of Barrie standards, requirements under the Accessibility for Ontarians with Disabilities Act (AODA), and building design. The grading design will respect the existing overland drainage patterns. This will minimize disturbance to the existing site and surrounding land. It is not anticipated that grading will be required within any of the environmental setbacks. Refer to **Figure 8** – Conceptual Grading Plan.

The geotechnical report recommends grade raise be limited to 0.9m above existing grade due to the presence of compressible soils. The area of concern is primarily the west half of the site (Blocks 1 to 4) and proposed grade remains as a cut or close to existing grading throughout this area. However, a grade raise greater than 0.9m is required at the south east quadrant of the site to provide servicing cover. A pre-loading program has been

recommended for this area. In general, the grade is to be raise to proposed Refer to the Geotechnical Report by Grounded Engineering for details and pre-loading recommendations.

6.0 FUTURE DEVELOPMENT

At this point future development in the catchment draining to the existing wetland is unknown. The parcel to the west of the site consists of office/institutional lands and the lands to the north consist of existing single-detached residential development. The areas to the east future development lands and EP lands. We understand that the City is endorsing a change from present employment designations to residential for the portion of the lands to the east that are developable and it is reasonable to assume the lands to the east will be developed with a residential use. These future development lands to the east could be serviced via connection to the proposed watermain and to the proposed sanitary connection through the unopened road allowance to the extent that grading will allow.

7.0 CONCLUSIONS

Based on the assessment provided above, the existing adjacent infrastructure can accommodate the proposed change in lands use as follows:

Water Servicing:

There is an existing 300mm ø watermain on the west side of Huronia Road that terminates at a plug near the northwest corner of the subject site. There is also an existing 150mm ø watermain on the north side of Loon Avenue which transitions to a 200mm ø watermain prior to connecting into the 300mm ø watermain on Huronia Avenue. The site is currently not serviced with a connection to either system.

The proposed development will be serviced through a connection to the existing 300mm ø watermain stub on the west side of Huronia Avenue. A 150mm ø PVC combined domestic watermain and firemain is proposed along the private road to service the site. A private easement is contemplated over the adjacent parcel to the east to complete a watermain loop to Loon Avenue through the unopened road allowance located north and east of the subject site. Based on the recent hydrant fire flow tests conducted, the watermain at Loon Avenue can supply 24,194 L/min and the watermain on Huronia Road can supply 25,472 L/min. The maximum day plus fire flow demand was calculated to be 9,052 L/min. As the site is lower in elevation than the connections at Huronia Road and Loon Avenue, the available pressure is expected to be greater than the results of the fire flow test. Therefore, the supply capacity of the existing surrounding water distribution system can adequately service the site. The City has indicated detailed modeling will be required at detailed design.

Sanitary Servicing:

The site does not currently have any available sanitary sewer connection nor any available local sewer along the frontage. There is an existing 250mm ø sanitary sewer on Loon

Avenue beginning at a manhole located on the intersection at Huronia Avenue and drains from west to east. The upstream invert of the sanitary sewer in the manhole is 250.80m.

The ground elevation for majority of the subject site is below the invert of the closest sanitary sewer located within Huronia Avenue. Therefore, a private easement is contemplated on the adjacent parcel to the east. A gravity service can be accommodated through a connection to Loon Avenue sanitary sewer at the unopened road allowance. In the proposed condition, the peak design flow from the subject site to the existing 250mm sanitary system is **1.45 L/s**. Based on review of the available sanitary design sheet for the subdivision, the local sewers within Loon Avenue downstream to the Lover's Creek Trunk sewer have adequate capacity to accommodate the subject site.

Stormwater Servicing:

Stormwater Conveyance:

- Stormwater will be captured and conveyed through a series of Stormtech chambers that outlet to a Stormwater tank and then through a filter and ultimately to Lovers Creek

Quantity Control:

- Post development flows will be controlled to pre-development levels via Stormtech chambers in combination with a stormwater tank and orifice control structure.

Quality Control:

- 80% TSS removal will be achieved via a Stormfilter, naturally clean landscape areas, an enhanced swale, vegetated filter strip and Stormtech Isolator rows
- Phosphorus removal will be achieved via a Stormfilter with Phosphosorb for the controlled areas followed by a vegetated filter strip. The uncontrolled areas will be treated by a vegetated filter strip. Overall phosphorus removal is 80%. The phosphorus offsetting cost is as follows:

  0.29 kg/yr x 2.5 offset ratio x $35,000 kg/yr = $25,375

Water Balance:

- Due to high groundwater infiltration is not feasible on site and water balance will be achieved via cash in lieu.

Volume Control:

As agreed upon with the LSRCA, volume control will be met via filtration that provides a storage equivalent to 5 mm across all impervious areas of the site. This filtration volume has been provided within the Isolator Row portion of the Stormtech System. It provides 80% TSS removal as per ETV results.

We trust the information provided in the report meets with your requirements. Should there be any questions or comments, please feel free to contact the undersigned.

Sincerely,

Counterpoint Engineering Inc.

Karl Repka, P.Eng
krepka@counterpointeng.com

Jowell Liang
jliang@counterpointeng.com

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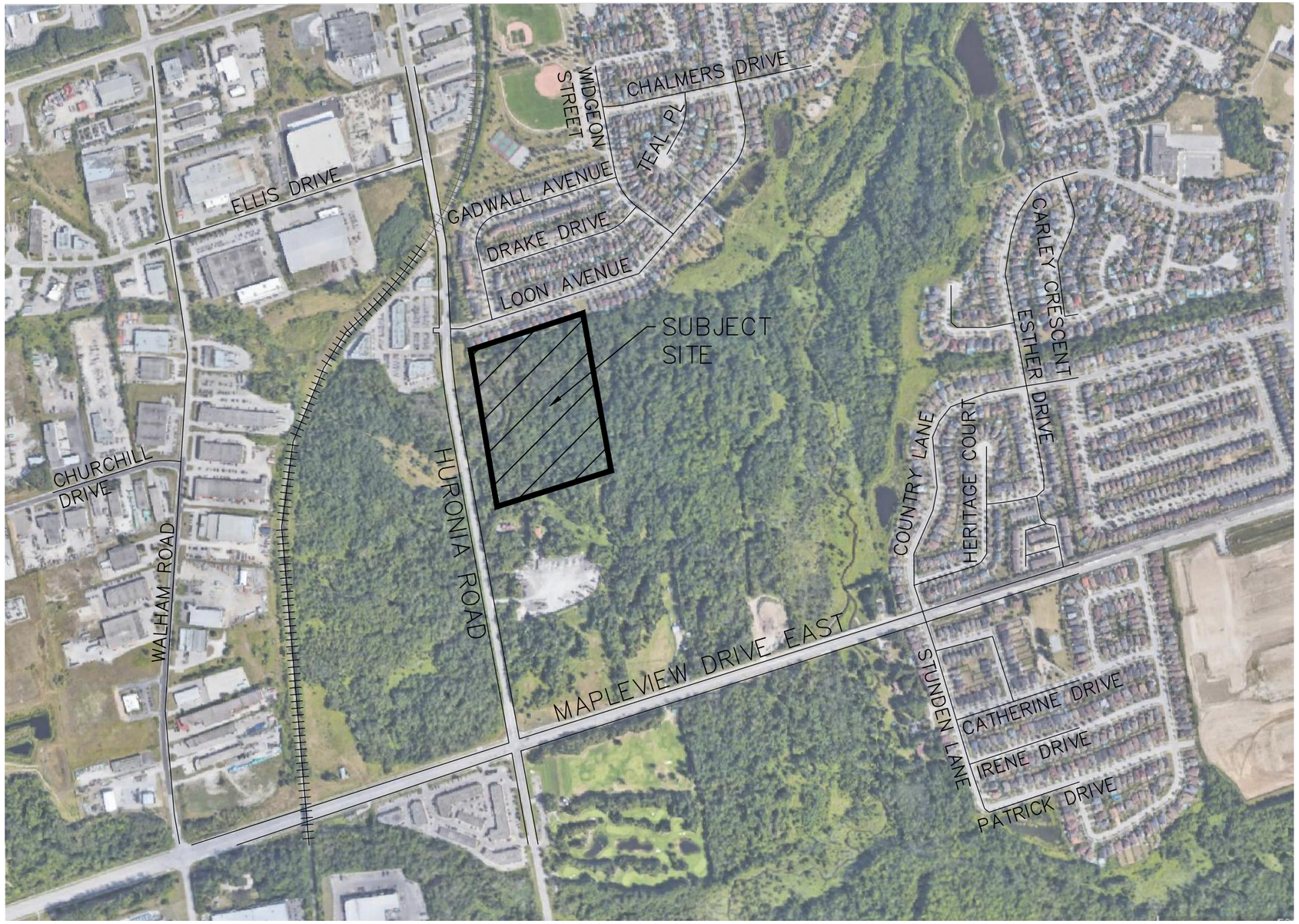
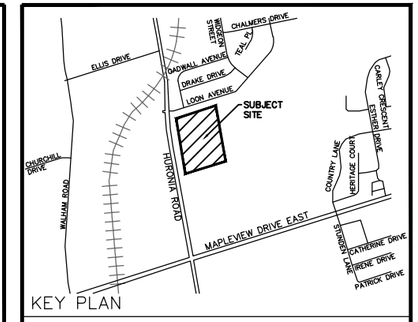
Figures





KEY PLAN

counterpoint ENGINEERING
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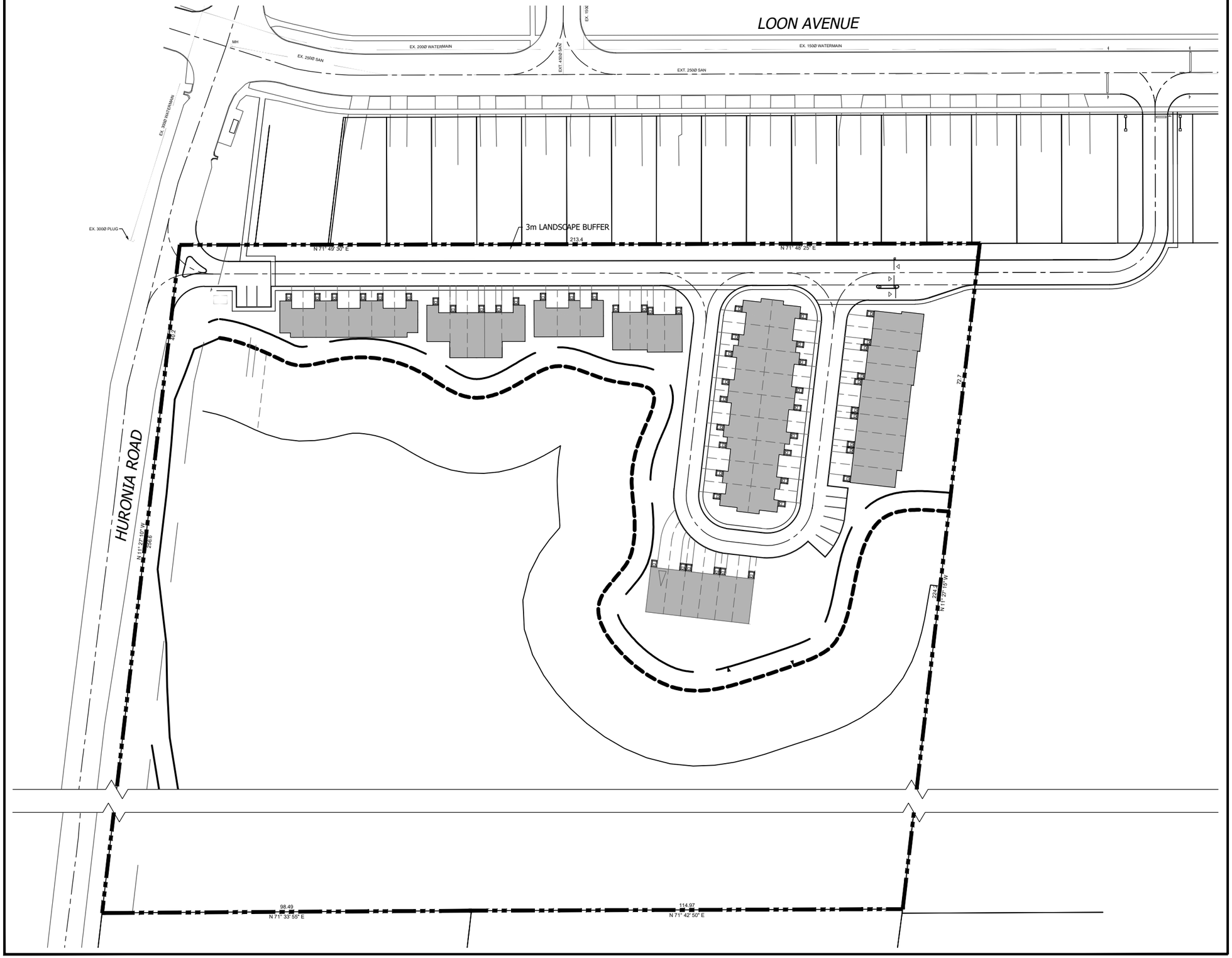
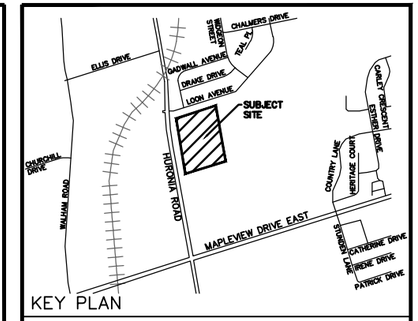
521 HURONIA ROAD
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

SITE LOCATION PLAN

DESIGNED BY:	DATE: OCTOBER 2021
CHECKED BY: KR	PROJECT No. 19082
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 1
SCALE: NTS	





KEY PLAN

LEGEND

PROPERTY LINE

LIMIT OF WETLAND

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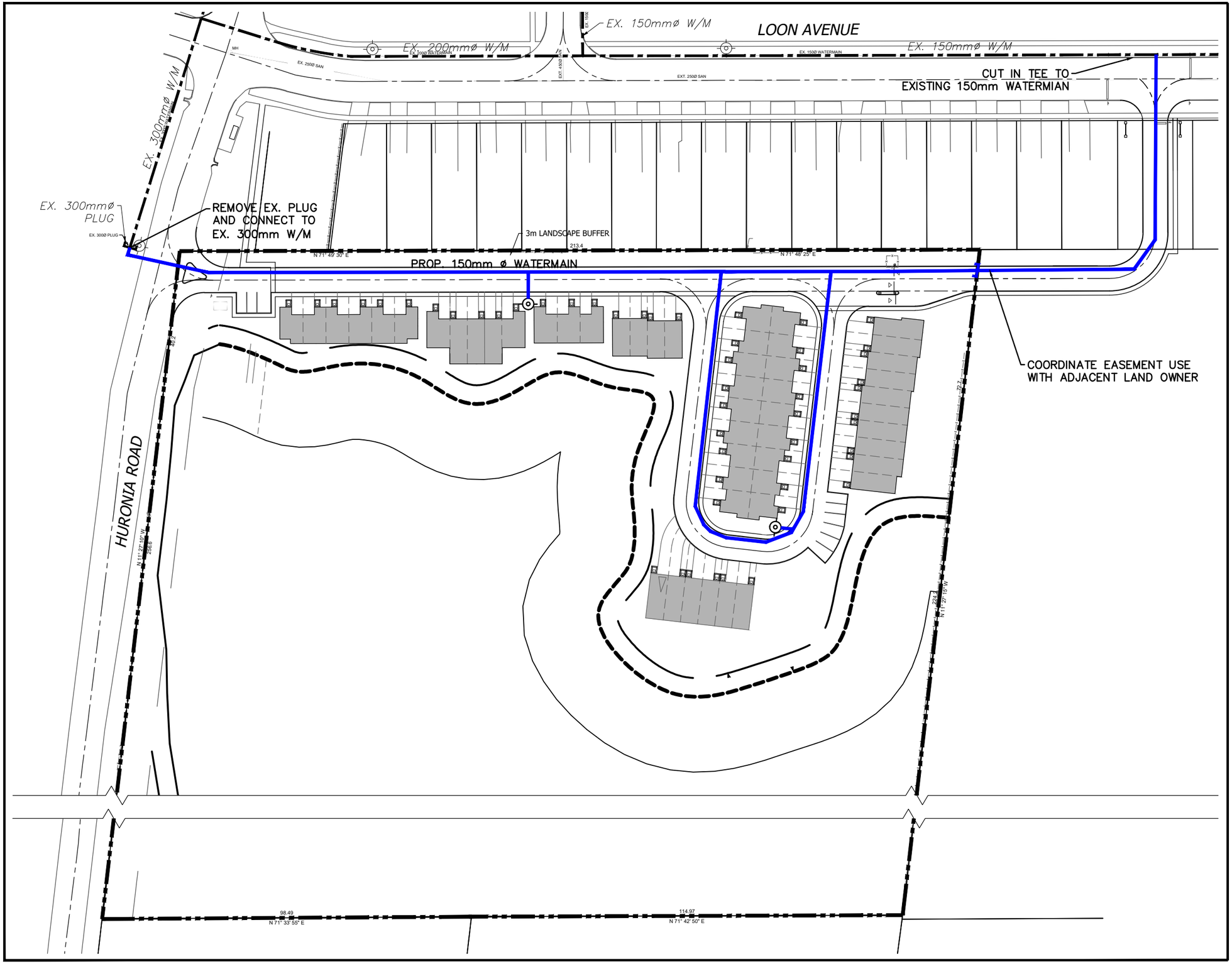
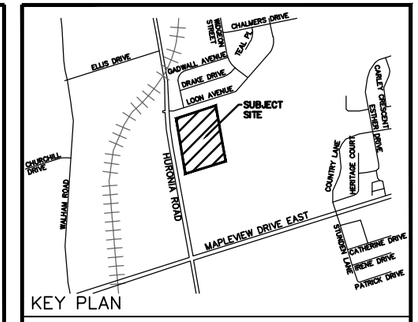
521 HURONIA ROAD
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

GENERAL PLAN

DESIGNED BY:	DATE: OCTOBER 2021
CHECKED BY: KR	PROJECT No. 19082
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 2
SCALE: 1:1000	





KEY PLAN

LEGEND

- PROPERTY LINE
- LIMIT OF UNDERGROUND GARAGE
- EXISTING WATERMAIN
- EXISTING HYDRANT
- PROPOSED WATERMAIN
- PROPOSED HYDRANT

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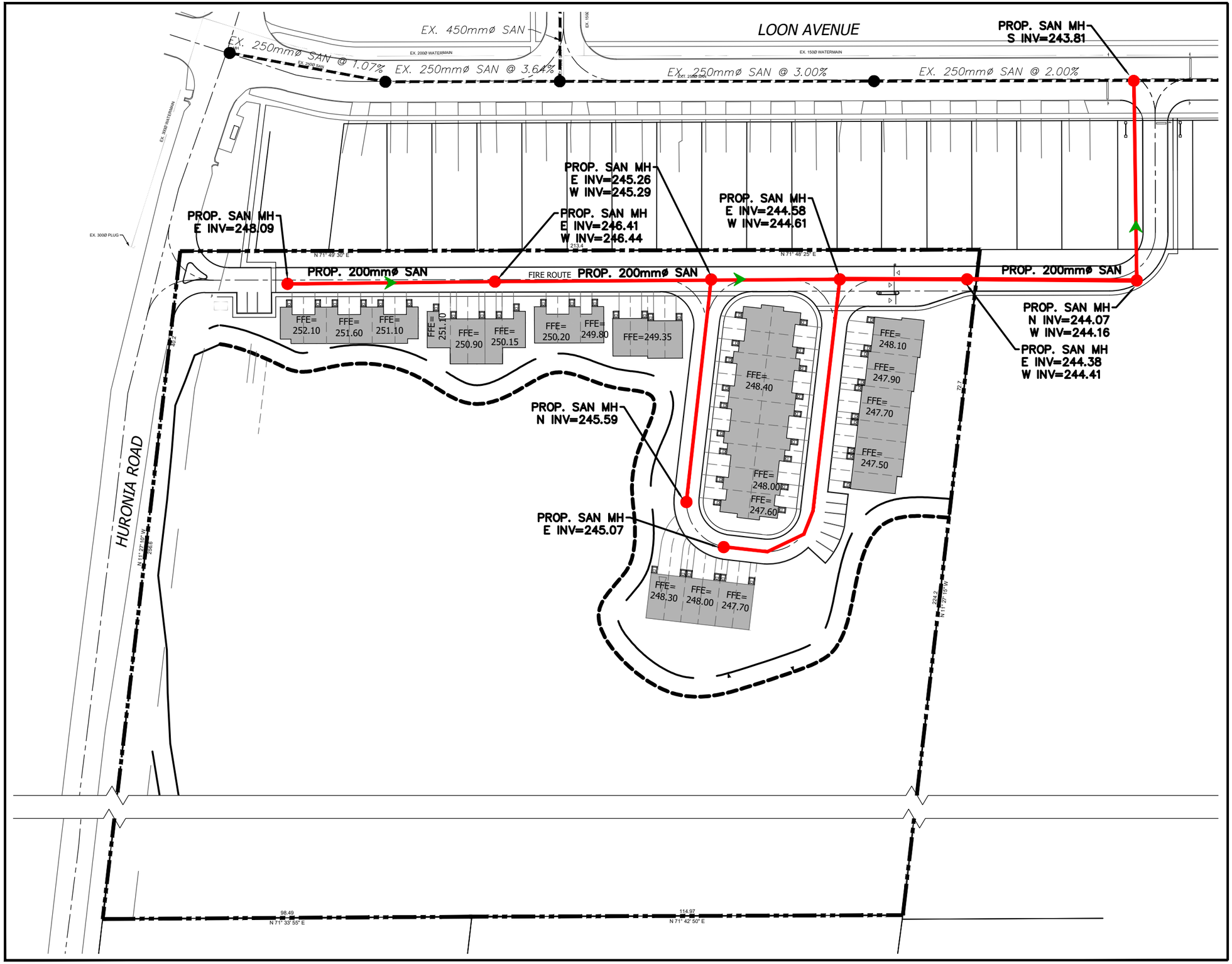
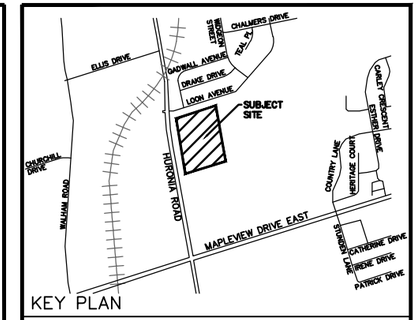
521 HURONIA ROAD
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

WATER SERVICING PLAN

DESIGNED BY:	DATE: OCTOBER 2021
CHECKED BY: KR	PROJECT No. 19082
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 3
SCALE: 1:1000	





KEY PLAN

LEGEND

- PROPERTY LINE
- EXISTING SANITARY SEWER
- EXISTING SANITARY MANHOLE
- PROPOSED SANITARY SEWER
- PROPOSED SANITARY MANHOLE

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521 HURONIA ROAD
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

SANITARY SERVICING PLAN - OPTION A

DESIGNED BY:	DATE: OCTOBER 2021
CHECKED BY: KR	PROJECT No. 19082
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 4
SCALE: 1:1000	

LOON AVENUE

EX. 450mmø STM

EX. 450mmø STM @ 3.00%

EX. 450mmø STM @ 0.30%

EX. 200Ø WATERMAIN

EX. 250Ø SAN

EX. 150Ø WATERMAIN

EXT. 250Ø SAN

EX. 300Ø WATERMAIN

EX. 300Ø PLUG

PROPOSED FORCEMAIN

PROPOSED 200Ø SAN

3m LANDSCAPE BUFFER

INV 246.64

213.4

N 48° 25' E

FFE= 252.10

FFE= 251.60

FFE= 251.10

FFE= 251.10

FFE= 250.90

FFE= 250.15

FFE= 250.20

FFE= 249.80

FFE=249.35

FFE= 248.40

FFE= 248.00

FFE= 247.60

FFE= 248.10

FFE= 247.90

FFE= 247.70

FFE= 247.50

FFE= 248,30

FFE= 248.00

FFE= 247.70

LIMIT OF WETLAND

HURONIA ROAD

N 11° 27' 16" W

BIOSWALE (SEE DETAIL ON FIGURE 10)

LEVEL SPREADER TO VEGETATED FILTER STRIP

SWM TANK EMERGENCY OVERFLOW WEIR SET ABOVE 100 YEAR WATER LEVEL
EL. 246.85
0.35 m TALL WEIR 1.8 M WIDE

LEVEL SPREADER
EL. = 245.50
OUTLETS TO NATURAL VEGETATED FILTER STRIP

STORMWATER FILTER OUTLET
EL. = 245.52

STORMWATER TANK INLET
EL. = 245.67

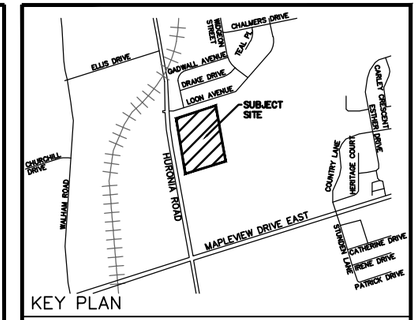
ORIFICE CONTROL STRUCTURES WELDED AND BOLTED TO OUTLET OF STORM TANK
80 mm DIA ORIFICE PLATE EL. 245.67
95 mm DIA ORIFICE PLATE EL. 246.02

STORMWATER QUALITY FILTER TANK

STORMWATER QUALITY FILTER TANK OUTLET

98.49
N 71° 33' 55" E

114.97
N 71° 42' 50" E



KEY PLAN

LEGEND

- PROPERTY LINE
- EXISTING STORM SEWER
- EXISTING STORM MANHOLE
- PROPOSED SWALE
- PROPOSED UPSTREAM STORMTECH SYSTEM
- PROPOSED DOWNSTREAM STORMTECH SYSTEM

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521 HURONIA ROAD
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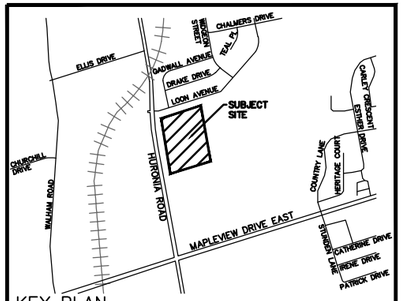
BARRIE, ONTARIO

STORM SERVICING PLAN

DESIGNED BY:	DATE: OCTOBER 2021
CHECKED BY: KR	PROJECT No. 19082
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 5
SCALE: 1:1000	



KEY PLAN

LEGEND

- DRAINAGE AREA BOUNDARY
- 101 — AREA ID
- A=1.13 — DRAINAGE AREA (HA)
- C=0.20 — RUNOFF COEFFICIENT (FOR 2–10 YEAR STORMS)
- OVERLAND FLOW PATH

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521 HURONIA ROAD
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BARRIE, ONTARIO

PRE-DEVELOPMENT DRAINAGE PLAN

DESIGNED BY:	DATE: OCTOBER 2021
CHECKED BY: KR	PROJECT No. 19082
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 6
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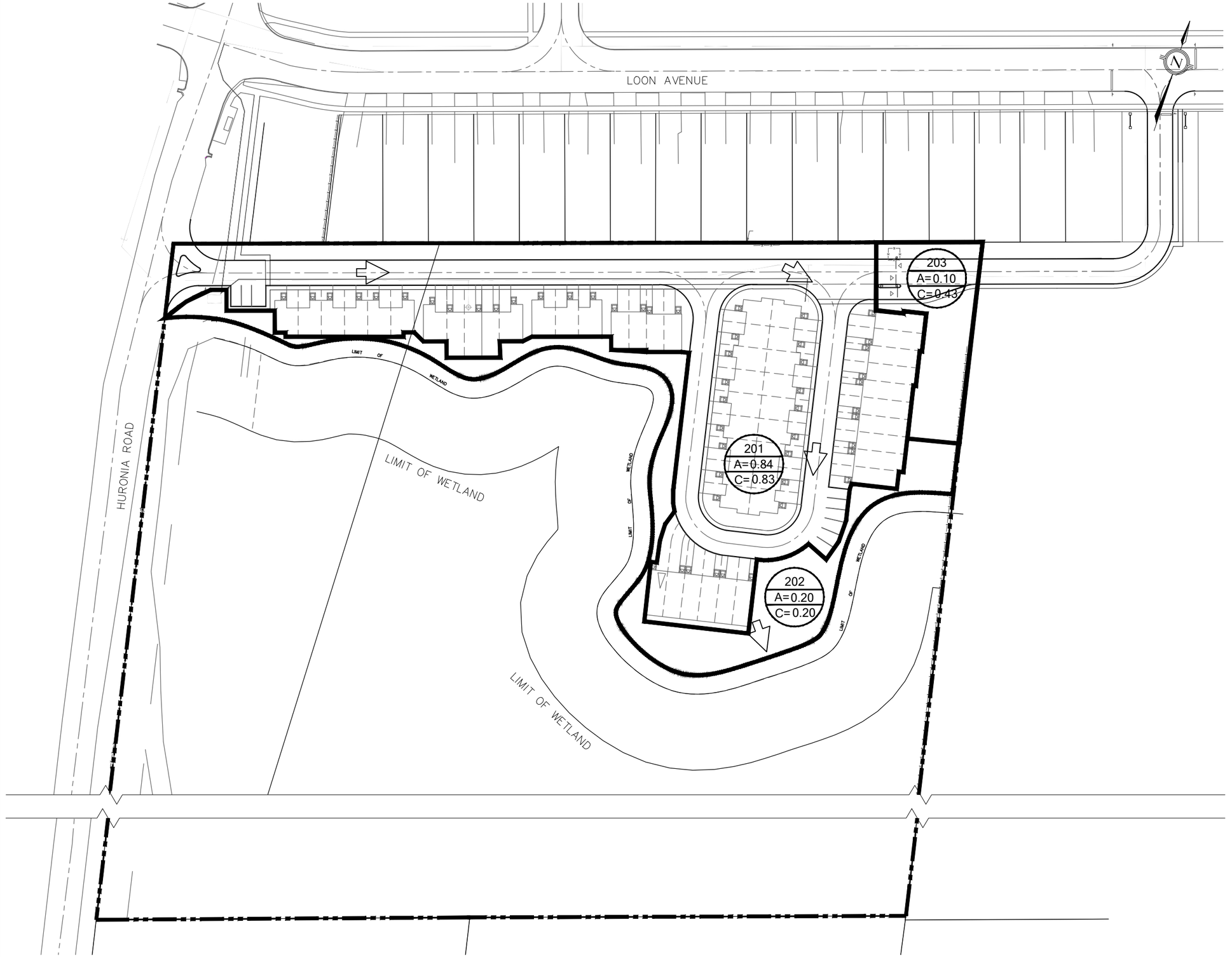

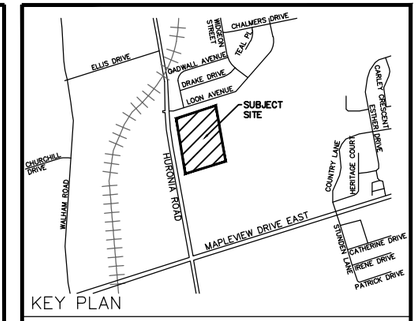

LEGEND

- DRAINAGE AREA BOUNDARY
- 101 / A=1.13 / C=0.20 — AREA ID; DRAINAGE AREA (HA); RUNOFF COEFFICIENT (FOR 2–10 YEAR STORMS)
- OVERLAND FLOW PATH

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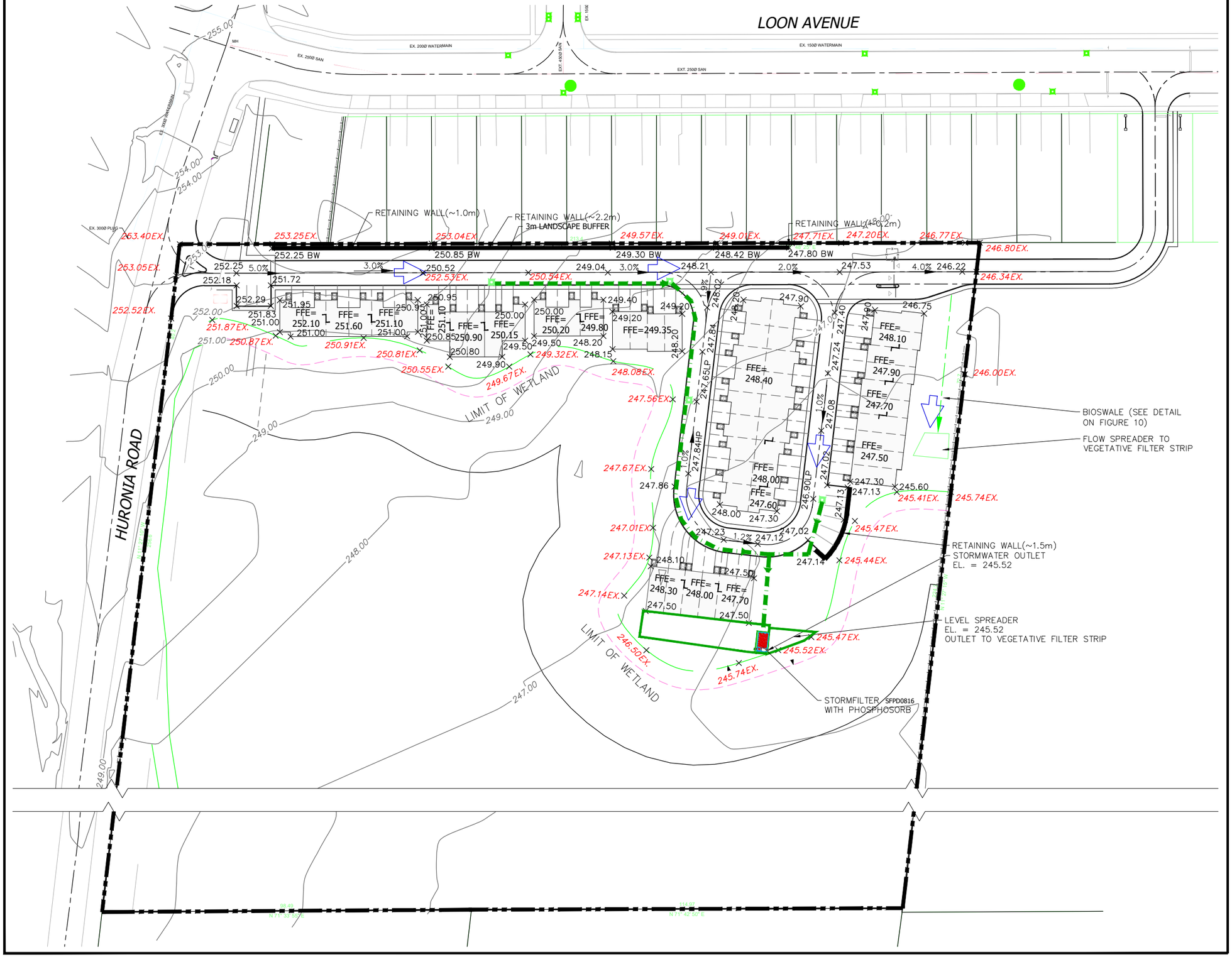
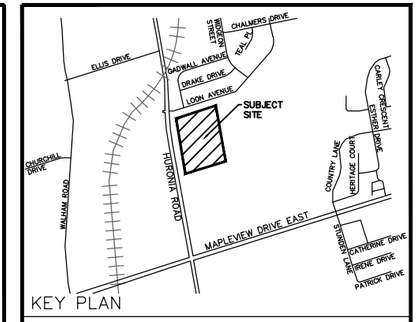
521 HURONIA ROAD
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

POST-DEVELOPMENT DRAINAGE PLAN

DESIGNED BY:	DATE: OCTOBER 2021
CHECKED BY: KR	PROJECT No. 19082
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 7
SCALE: 1:1000	





LEGEND

- PROPERTY LINE
- ×246.80EX. EXISTING ELEVATION
- ×246.80 PROPOSED ELEVATION
- 1.0% PROPOSED SLOPE
- OVERLAND FLOW ROUTE
- EXISTING STORM MANHOLE
- PROPOSED SWALE
- PROPOSED UPSTREAM STORMTECH SYSTEM
- PROPOSED DOWNSTREAM STORMTECH SYSTEM

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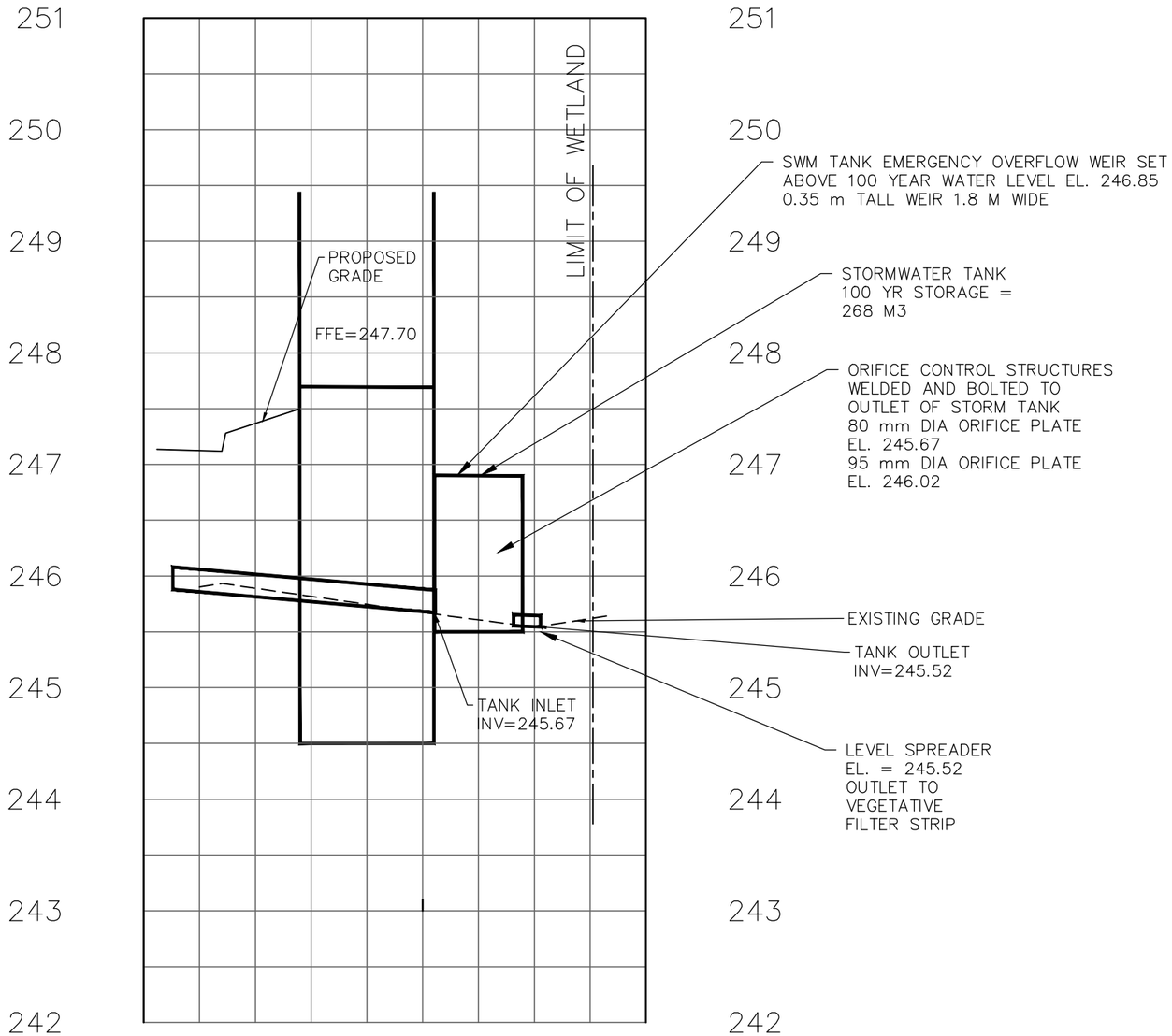
521 HURONIA ROAD
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

CONCEPTUAL GRADING PLAN

DESIGNED BY:	DATE: OCTOBER 2021
CHECKED BY: KR	PROJECT No. 19082
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 8
SCALE: 1:1000	

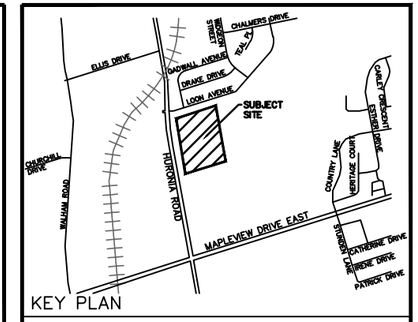
STORMTANK PROFILE



SECTION C–C

SCALE:

HORIZONTAL 1:500
VERTICAL 1:50



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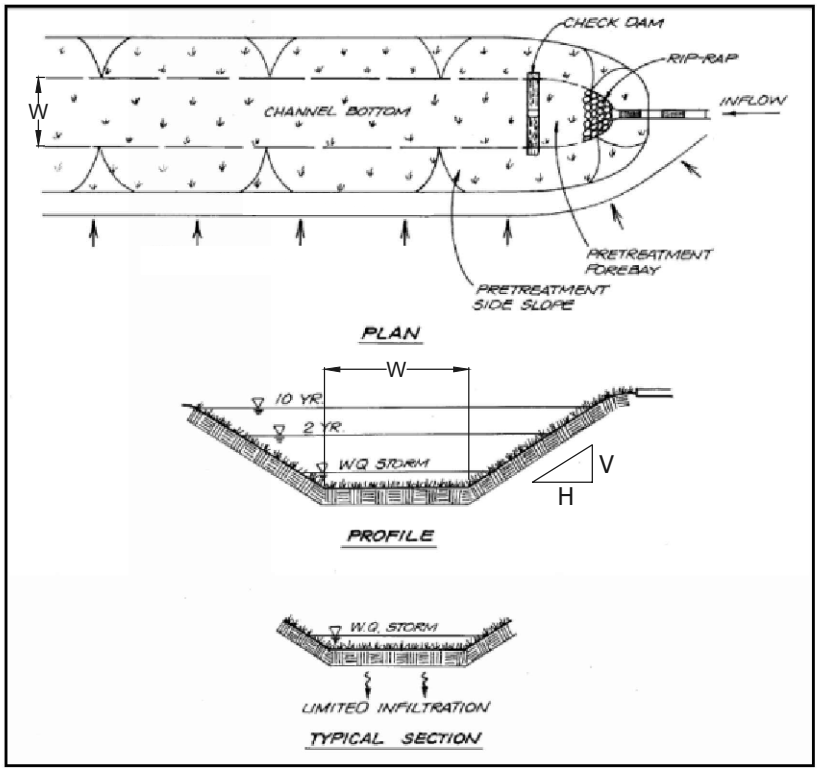
521 HURONIA ROAD
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

SERVICING CROSS SECTION

DESIGNED BY:	DATE: OCTOBER 2021
CHECKED BY: KR	PROJECT No. 19082
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 9
SCALE:	



Source: ARC, 2001

	PROPERTY	
VEGETATION TYPE	GRASSED SWALE	
WIDTH (W) (NOTE 1)	m	
WQ DEPTH	mm	
2-YR DEPTH	mm	
10-YR DEPTH	mm	
VELOCITY (NOTE 8)	m/s	
SIDE SLOPE (NOTE 9)	H:V	
SWALE SLOPE (NOTE 3)	%	
PRE-TREATMENT		

NOTES:

1. BOTTOM WITH TO BE 0.75m TO 3.0m
2. THE MINIMUM LENGTH OF SWALE SHALL BE 5m
3. SLOPE OF THE SWALE IS TO BE 0.5% TO 4% SLOPE, CHECK DAMS FOR SLOPES STEEPER THAN 3%
4. PRE-TREATMENT TO BE PROVIDED FOR ALL SWALES.
5. A MINIMUM OF 1m SHALL BE MAINTAINED FROM THE GROUNDWATER TABLE
6. CONTRIBUTING DRAINAGE TO SWALE AREA SHALL NOT BE GREATER THAN 10:1.
7. SWALE MUST BE LOCATED 4m FROM BUILDINGS
8. FLOW VELOCITY FROM 4hr 25mm CHICAGO STORM SHALL NOT EXCEED 0.5m/s
9. SIDE SLOPE SHALL NOT EXCEED 3:1

ENHANCED GRASS SWALE

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SCALE	N.T.S.	REV	1.0
DWN BY	SDS	DWG	
CHD BY	KR		10
DATE	9 NOV, 2021		

Appendix A1

Water Demand Calculations

Counterpoint Engineering Inc.

Water Demand Design Calculations

Project: **521 Huronia Road**
Project No: **19082**
Location: **Barrie, Ontario**
Site Area: 1.13 ha
(Area within wetland limit)

Equivalent Population per Land Use

Low Density (Single detached, etc.)	3.13	ppu
Medium Density (Townhouse, etc.)	2.34	ppu
High Density (Apartment, etc.)	1.67	ppu

	Townhouse	Commercial (m^2)	Residential Population
Block 1	6	-	14
Block 2	5		12
Block 3	3		7
Block 4	4		9
Block 5	18		42
Block 6	6		14
Block 7	10		23
TOTAL UNITS / AREA (m^2)	52	-	122

	Residential Population	TOTAL POPULATION
Residential	122	122
Total Equivalent Population		**122**

City of Barrie Watermain Guidelines

Per Capita Demand

Average Daily Demand	225	(L/capita/day)

Commercial Demand	28	m^3/day/ha

Peaking Factors

Land Use	Minimum Hour	Maximum Day	Maximum Hour	
Residential	0.40	2.75	4.13	(MECP factors for populations from 500 - 1000)
Commercial	0.84	2.00	1.50	(MOECP factors)
Industrial	0.84	2.00	1.50	

Proposed Site

Water Demand based on Equivalent Population

	Population	Average Daily Usage (L/min)	Maximum Hour (L/min)	Maximum Day (L/min)	Fire Flow Required (L/min)	Water Demand (L/min)
Residential	122	19	79	52	9,000	9,052
Totals	**122**	**19**	**79**	**52**	**9,000**	**9,052**

Water Demand per Block based on Equivalent Population

	Population	Average Daily Usage (L/min)	Maximum Hour (L/min)	Maximum Day (L/min)
Block 1	14	2	9	6
Block 2	12	2	8	5
Block 3	7	1	5	3
Block 4	9	1	6	4
Block 5	42	7	27	18
Block 6	14	2	9	6
Block 7	23	4	15	10

Counterpoint Engineering Inc.

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT TOWNHOUSE BLOCK 3
Fire Underwriters Survey

Project : **521 Huronia Road**
Project No: **19082**

Guide for Determination of Required Flow Copyright I.S.O

$$F = 220C\sqrt{A}$$ where

F = the required fire flow in litres per minute.
C = coefficient related to the type of construction.
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).
= 0.6 for fire-resistive construction (fully protected frame, floors, roof).
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered.

Type of Construction		Class Factor
WF	Wood Frame	1.5
OC	Ordinary Construction	1.0
NC	Non-Combustible	0.8
FC	Fire-Resistive	0.6

Contents		% Reduction
NC	Non-Combustible	25
LC	Limited Combustible	15
C	Combustible	0
FB	Free Burning	15
RB	Rapid Burning	25

Area Notes for Fire Resistive Buildings (from FUS manual, 1999):

If Vertical Openings are inadequately protected (less than 1-hour fire rating): Area is the total of the two largest adjoining floors (above ground level) plus 50% of the area of each of the next 8 adjoining floors above that.

If Vertical Openings are adequately protected (at least 1-hour fire rating): Area is the total of the largest floor (above ground level) plus 25% of the area of each of the next 2 immediately adjoining floors above that.

1) Fire Flow

Type of Construction:	OC	
C=	1.0	
A*=	855 m^2	(Largest townhouse unit = 1082sq.ft = 101 sq.m)
F=	6,000 **L/min**	(rounded to nearest 1,000 L/min)

It is currently proposed that firewalls will be installed in between the townhouse units.

2) Occupancy Reduction/Surcharge

Contents Factor:		C			
Reduction/Surcharge of		0%	=	0	L/min
F=	6000L/min +	0 **L/min**	=	6,000	**L/min**

3) System Type Reduction

NFPA 13 Sprinkler:		NO	0%		
Standard Water Supply:		NO	0%		
Fully Supervised:		NO	0%		
Total			0%		
Reduction of		0%	L/min =	0	L/min
F=	6000L/min -	0 **L/min**	=	6,000	**L/min**

4) Separation Charge

Building Face	Dist(m)	Charge	
North	23	10%	(Charge based on firewall)
East	17	15%	
South	17	15%	
West	15	15%	(>45m)
Total		55% **of** 6000 **L/min** =	3,300 **L/min**

(max exposure charge can be 75%)

Separation	Charge	Separation	Charge
0 to 3m	25%	20.1 to 30 m	10%
3.1 to 10m	20%	30.1 to 45m	5%
10.1 to 20m	15%		

F= 6000L/min + 3300L/min = 9,300 **L/min** (2,000L/min<F<45,000L/min)

F=	9,000	**L/min** (round to the nearest 1,000L/min)
F=	150	**L/s**
F=	2,378	**gpm**

Appendix A2

Hydrant Flow Test Results

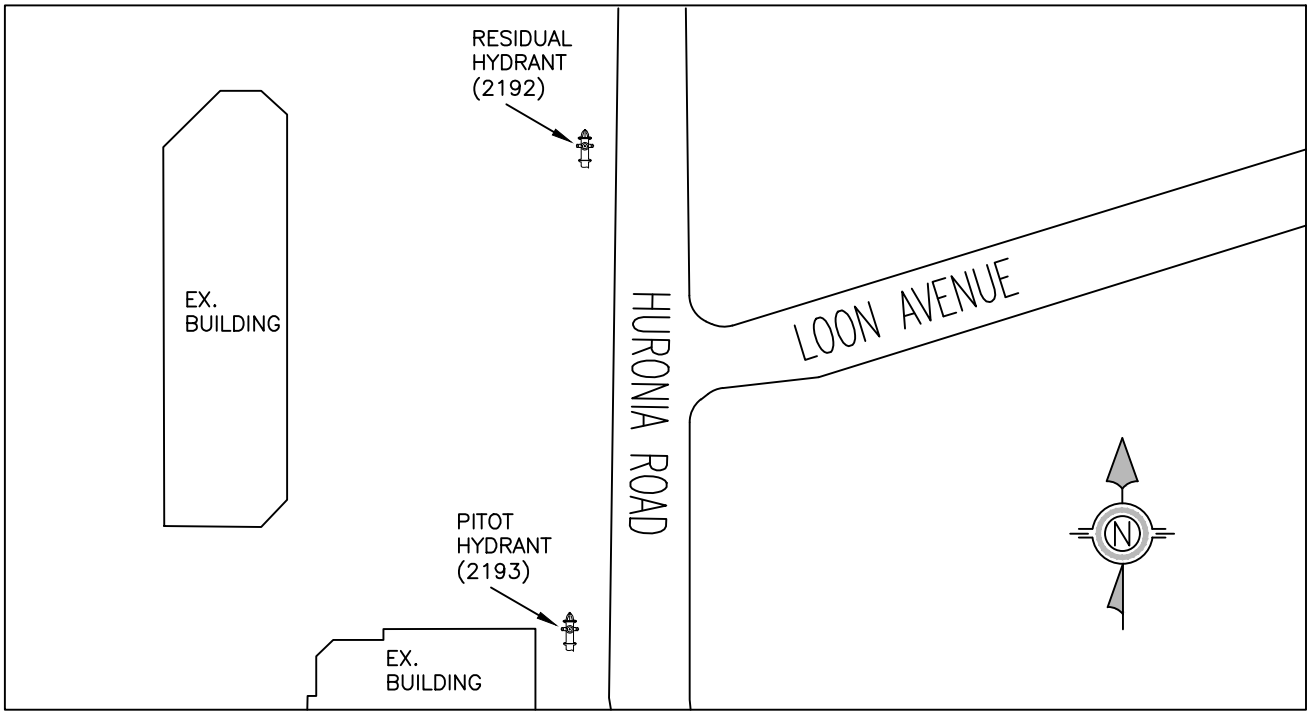
FLOW TEST RESULTS

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

DATE : THURSDAY NOVEMBER 12, 2020 TIME : 3:00 PM

LOCATION : HURONIA ROAD & LOON AVENUE
BARRIE
ONTARIO

TEST BY : VIPOND FIRE PROTECTION AND LOCAL PUC



STATIC PRESSURE : 70 PSI

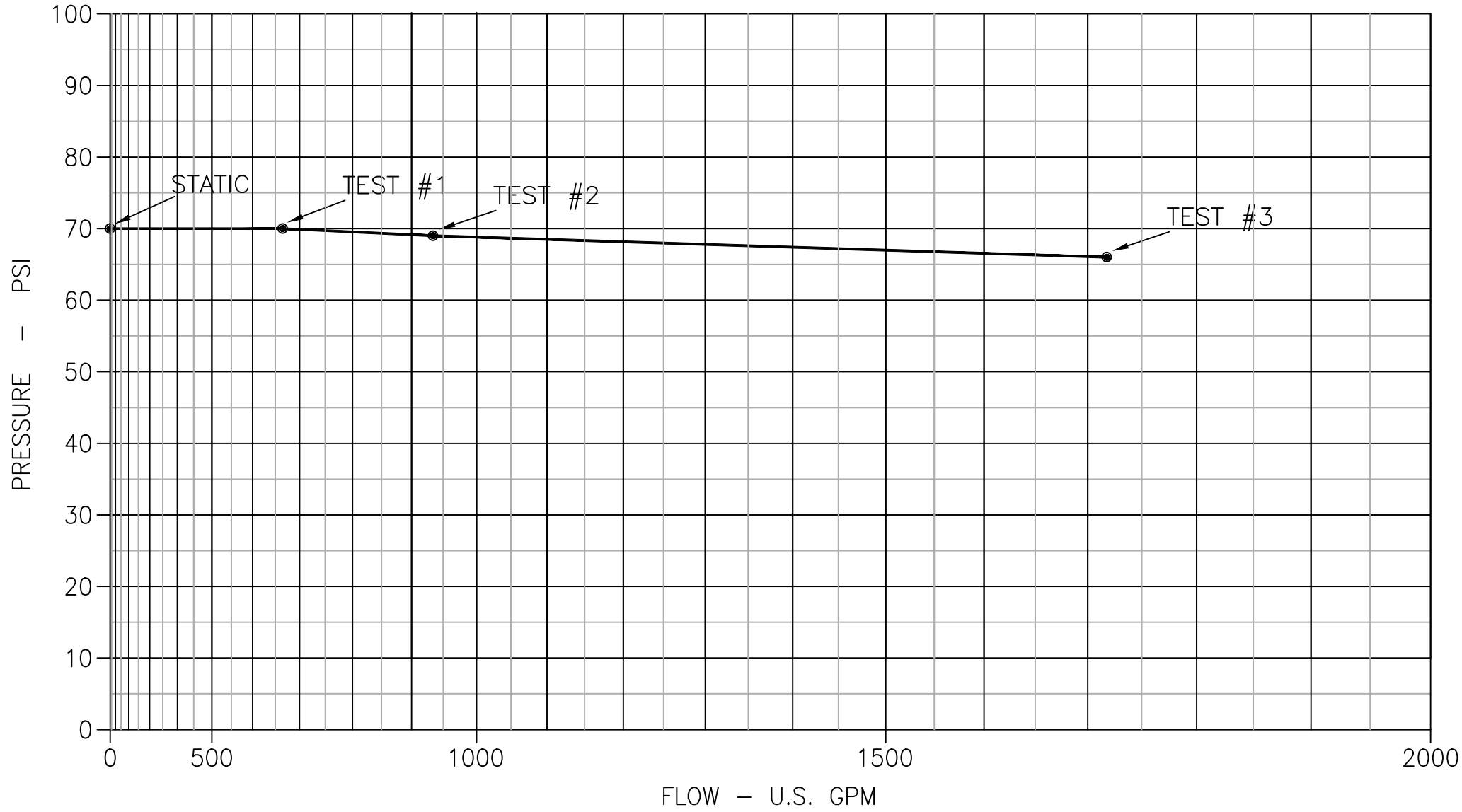
TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1-3/4	0.995	70	55	660
2	1	2-1/2	0.9	69	31	939
3	2	2-1/2	0.9	66	26	1720

FIRST FOR FIRE, LIFE SAFETY & SECURITY

VIPOND INC est. 1945

HURONIA ROAD & LOON AVENUE	BY : GUS A.
BARRIE	OFFICE : BARRIE
ONTARIO	TEST BY : VIPOND & PUC
	DATE : NOVEMBER 12, 2020

STATIC:	RESIDUAL:		FLOW:	
70 PSI	TEST#1	70 PSI	@	660 GPM
	TEST#2	69 PSI	@	939 GPM
	TEST#3	66 PSI	@	1720 GPM



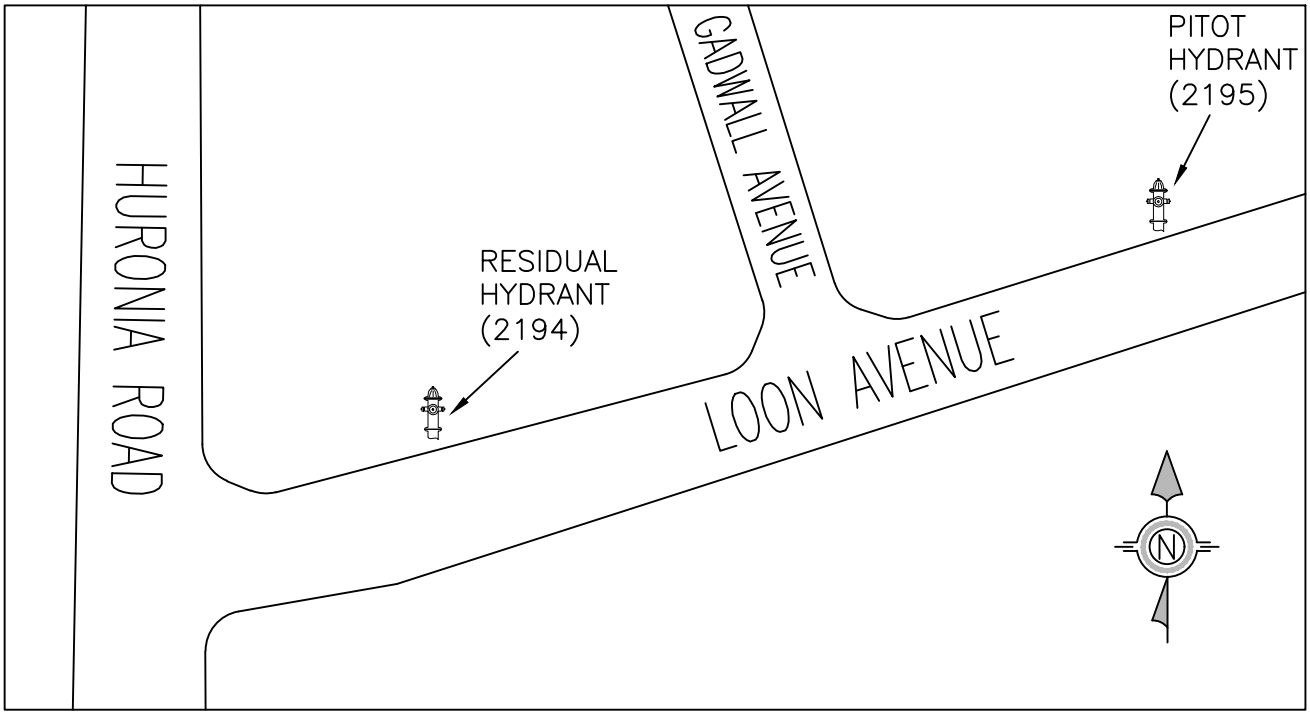
FLOW TEST RESULTS

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

DATE : THURSDAY NOVEMBER 12, 2020 TIME : 2:30 PM

LOCATION : LOON AVENUE & GADWALL AVENUE
BARRIE
ONTARIO

TEST BY : VIPOND FIRE PROTECTION AND LOCAL PUC



STATIC PRESSURE : 73 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	72	57	672
2	1	2-1/2	0.9	71	35	998
3	2	2-1/2	0.9	68	28	1786

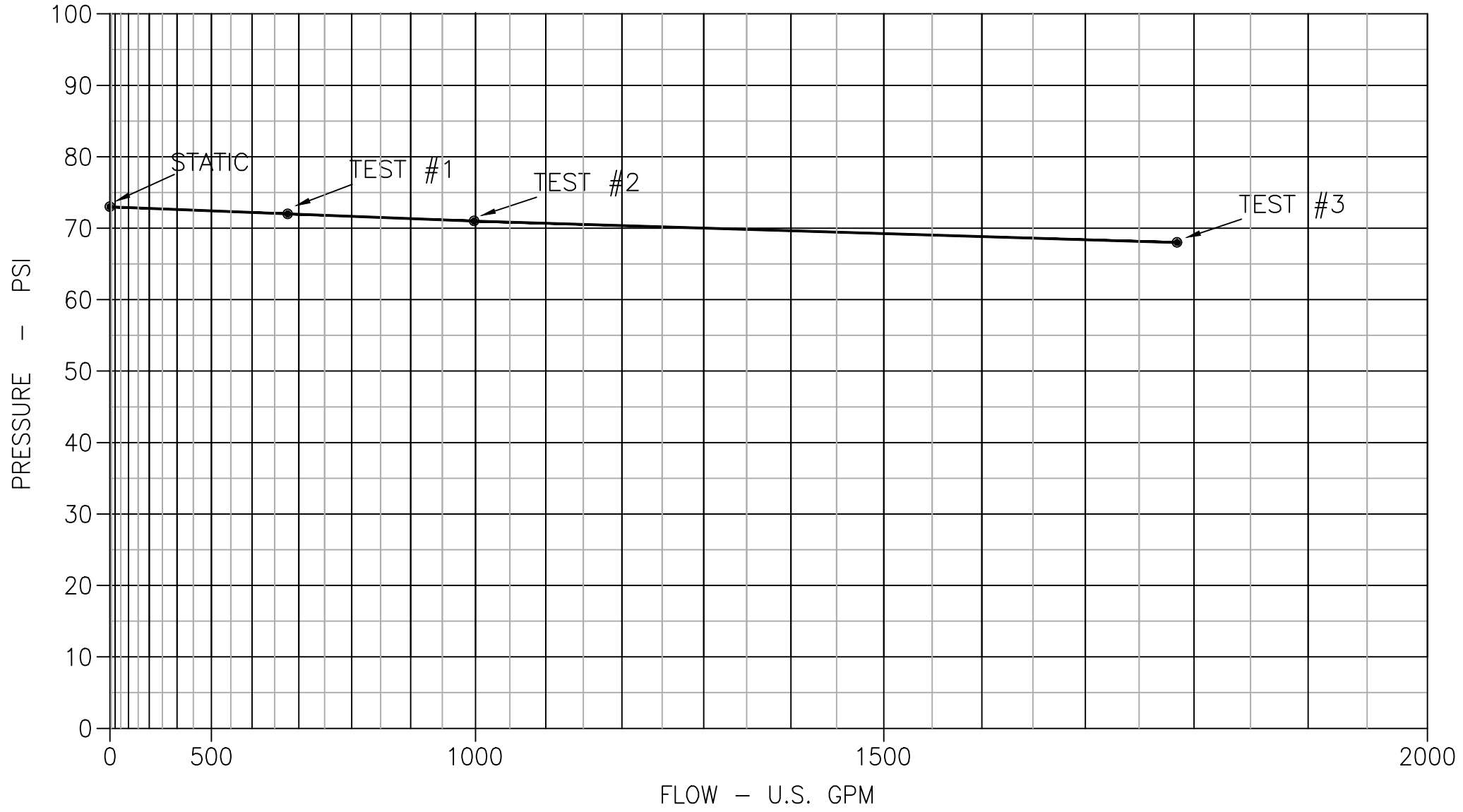
FIRST FOR FIRE, LIFE SAFETY & SECURITY

VIPOND INC

est. 1945

LOON AVENUE & GADWALL AVENUE	BY : GUS A.
BARRIE	OFFICE : BARRIE
ONTARIO	TEST BY : VIPOND & PUC
	DATE : NOVEMBER 12, 2020

STATIC:	RESIDUAL:		FLOW:
73 PSI	TEST#1 72 PSI	@	672 GPM
	TEST#2 71 PSI	@	998 GPM
	TEST#3 68 PSI	@	1786 GPM



Appendix B

Sanitary Design Flow Calculations

Counterpoint Engineering Inc.

Project: 521 Huronia Road
Project No: 19082
Location: Barrie, Ontario
Site Area: 1.13 ha
(Area within limit of wetland)

Proposed Sanitary Flow Calculations

As per Sanitary Sewage Collection System Policies and Design Guidelines, City of Barrie, 2017

Design flow = (Population in Thousands x Average Daily Flow x Peaking Factor)/86.4 + (Infiltration Rate x Area)

Persons Per Unit and per Land Use

Low Density (Single detached, etc.)	3.13	ppu
Medium Density (Townhouse, etc.)	2.34	ppu
High Density (Apartment, etc.)	1.67	ppu
Commercial / Retail	1.1	persons/100m^2
Offices	3.3	persons/100m^2

	Residential Units		Retail
	Townhouse	**Total Units**	**Area (m^2)**
TOTAL UNITS / AREA (m^2)	**52**	**52**	**-**

	Population 1BR / 1B + D	TOTAL POPULATION
Residential	122	122
Commercial	-	n/a
Total Equivalent Population		**122**

Peak Flow Design Parameters

Residential Average flow	225	litres/person/day
Commercial Average flow	28	m^3/day/ha
Infiltration	0.1	litres/second/ha

Harmon Peaking Factor

PF = 1 + (14/(4+(P/1000)$^{1/2}$))

Residential Population	Harmon Peak Factor
122	**4.22**

Residential Flow	1.34	**l/s**
Commercial Flow	-	**l/s**
Infiltration	0.11	**l/s**
Groundwater Flows	0.00	**l/s**
Flow	**1.45**	**l/s**

Appendix C

Stormwater Management Design Calculations

Quantity Control

Pre Development Composite Runoff Coefficient

521 Huronia Road
19082
June 18 2021

Prepared By Tim Ng

Drainage Area 101

	(ha)		
Total Area:	1.13		
Impervious:	0.00	**Coefficient:**	0.9
Landscaping:	1.13	**Coefficient:**	0.2
Composite C:	**0.20**		
Percent Impervious	**0.00%**		

Time Of Concentration Calculations

The Airport formula should be used when the composite runoff coefficient for the catchment is < 0.40. The Airport formula is defined as follows:

$$t_c = \frac{3.26(1.1-C)(L)^{0.5}}{S_w^{0.33}}$$

where,

t_c = time of concentration (minutes)

C = runoff coefficient

S_w = watershed slope (%) calculated as per MTO methodology (*MTO Drainage Management Manual*, 1997)

L = watershed length (m) calculated as per MTO methodology (*MTO Drainage Management Manual*, 1997)

C	0.20	
Sw	3	%
L	160	(m)
tc	27	mins

Rational Method
Pre-Development Flow Calculation

521 Huronia Road
19082
June 18 2021

Prepared By Tim Ng

Input Parameters

Area Number	Area	C	Tc
	(ha)		(min.)
Drainage Area 101	1.13	0.20	27

Rational Method Calculations

Formula:	$I = a(T+b)^c$	
	a,b,c	Constants
	T	Time of concentration
	I	Rainfall intensity

IDF Data Set: City of Barrie
Event 2-Year
a = 662.00
b = 7.50
c = -0.7900

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
Drainage Area 101	1.13	0.20	0.23	27	40.4	0.025	25

IDF Data Set: City of Barrie
Event 5-Year
a = 853.61
b = 4.70
c = -0.7660

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
Drainage Area 101	1.13	0.20	0.23	27	60.5	0.038	38

IDF Data Set: City of Barrie
Event 10-Year
a = 975.87
b = 4.70
c = -0.7600

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
Drainage Area 101	1.13	0.20	0.23	27	70.6	0.044	44

IDF Data Set: City of Barrie
Event 25-Year
a = 1146.28
b = 4.92
c = -0.7570

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
Drainage Area 101	1.13	0.22	0.25	27	83.3	0.058	58

IDF Data Set: City of Barrie
Event 50-Year
a = 1236.15
b = 4.70
c = -0.7510

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
Drainage Area 101	1.13	0.24	0.27	27	92.2	0.069	69

IDF Data Set: City of Barrie
Event 100-Year
a = 1426.41
b = 5.27
c = -0.7590

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
Drainage Area 101	1.13	0.25	0.28	27	102.1	0.080	80

Prepared By Tim Ng	Post Development Composite Runoff Coefficient 521 Huronia Road 19082 June 18 2021

Area 201 Post Controlled

	(ha)		
Total Area:	0.84		
Impervious:	0.62	**Coefficient:**	0.9
Landscaping:	0.22	**Coefficient:**	0.2
Composite C:	**0.72**		
Percent Impervious	**74.05%**		

Area 202 + 203 Post Uncontrolled

	(ha)		
Total Area:	0.30		
Impervious:	0.03	**Coefficient:**	0.9
Landscaping:	0.27	**Coefficient:**	0.2
Composite C:	**0.27**		
Percent Impervious	**9.68%**		

Prepared By Tim Ng

Modified Rational Method - 2 Year Storm
Site Flow and Storage Summary
521 Huronia Road
19082
June 18 2021

Area 201 Post Controlled

Area=	**0.84**	ha
"C" =	**0.72**	
AC1=	**0.60**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Orifice Release Rate =	**7**	L/s
Max. Required Storage =	**121.6**	m^3

Area 202 + 203 Post Uncontrolled

Area=	**0.30**	ha
"C" =	**0.27**	
AC1=	**0.08**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Releasee Rate =	**15**	L/s

Flow Summary

Target Flow	**25**	L/s
Total Design Flow	**22**	L/s

Rainfall Intensity Parameters	
a=	662.00
b=	7.50
c=	-0.79
I=	A(T+b)^c

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (m^3/s)	Runoff Volume (m^3)	Target Released Volume (m^3)	Total Required Storage Volume (m^3)	Storm Runoff (m^3/s)	Runoff Volume (m^3)
10.0	69.0	0.12	69.11	4.31	64.80	0.02	9.10
15.0	56.6	0.09	85.00	6.46	78.54	0.01	11.19
20.0	48.3	0.08	96.72	8.62	88.10	0.01	12.73
25.0	42.3	0.07	105.95	10.77	95.18	0.01	13.95
30.0	37.8	0.06	113.55	12.93	100.63	0.01	14.95
35.0	34.2	0.06	120.01	15.08	104.92	0.01	15.80
40.0	31.4	0.05	125.61	17.24	108.38	0.01	16.54
45.0	29.0	0.05	130.57	19.39	111.18	0.01	17.19
50.0	27.0	0.05	135.02	21.54	113.47	0.01	17.78
55.0	25.2	0.04	139.05	23.70	115.35	0.01	18.31
60.0	23.8	0.04	142.74	25.85	116.89	0.01	18.79
65.0	22.4	0.04	146.15	28.01	118.14	0.00	19.24
70.0	21.3	0.04	149.32	30.16	119.15	0.00	19.66
75.0	20.3	0.03	152.27	32.32	119.96	0.00	20.05
80.0	19.3	0.03	155.05	34.47	120.58	0.00	20.41
85.0	18.5	0.03	157.66	36.63	121.04	0.00	20.76
90.0	17.8	0.03	160.14	38.78	121.36	0.00	21.08
95.0	17.1	0.03	162.48	40.93	121.55	0.00	21.39
100.0	16.4	0.03	164.72	43.09	121.63	0.00	21.69
105.0	15.9	0.03	166.85	45.24	121.61	0.00	21.97
110.0	15.3	0.03	168.90	47.40	121.50	0.00	22.24
115.0	14.8	0.02	170.86	49.55	121.30	0.00	22.49
120.0	14.4	0.02	172.74	51.71	121.03	0.00	22.74
125.0	13.9	0.02	174.55	53.86	120.69	0.00	22.98
130.0	13.5	0.02	176.30	56.02	120.28	0.00	23.21
135.0	13.2	0.02	177.98	58.17	119.81	0.00	23.43
140.0	12.8	0.02	179.61	60.33	119.29	0.00	23.65
145.0	12.5	0.02	181.19	62.48	118.71	0.00	23.85
150.0	12.2	0.02	182.73	64.63	118.09	0.00	24.06
155.0	11.9	0.02	184.21	66.79	117.42	0.00	24.25
160.0	11.6	0.02	185.66	68.94	116.71	0.00	24.44
165.0	11.3	0.02	187.06	71.10	115.96	0.00	24.63
170.0	11.1	0.02	188.43	73.25	115.17	0.00	24.81
175.0	10.8	0.02	189.76	75.41	114.35	0.00	24.98
180.0	10.6	0.02	191.06	77.56	113.50	0.00	25.15
185.0	10.4	0.02	192.32	79.72	112.61	0.00	25.32
190.0	10.2	0.02	193.56	81.87	111.69	0.00	25.48
195.0	10.0	0.02	194.77	84.02	110.74	0.00	25.64
200.0	9.8	0.02	195.95	86.18	109.77	0.00	25.80
205.0	9.6	0.02	197.11	88.33	108.77	0.00	25.95
210.0	9.4	0.02	198.24	90.49	107.75	0.00	26.10
215.0	9.3	0.02	199.35	92.64	106.70	0.00	26.24
220.0	9.1	0.02	200.43	94.80	105.64	0.00	26.39
225.0	8.9	0.01	201.50	96.95	104.55	0.00	26.53
230.0	8.8	0.01	202.54	99.11	103.44	0.00	26.67
235.0	8.6	0.01	203.57	101.26	102.31	0.00	26.80
240.0	8.5	0.01	204.57	103.41	101.16	0.00	26.93
245.0	8.4	0.01	205.56	105.57	99.99	0.00	27.06
250.0	8.2	0.01	206.53	107.72	98.81	0.00	27.19
255.0	8.1	0.01	207.49	109.88	97.61	0.00	27.32
260.0	8.0	0.01	208.42	112.03	96.39	0.00	27.44
265.0	7.9	0.01	209.35	114.19	95.16	0.00	27.56
270.0	7.8	0.01	210.25	116.34	93.91	0.00	27.68
275.0	7.7	0.01	211.15	118.50	92.65	0.00	27.80
280.0	7.6	0.01	212.03	120.65	91.38	0.00	27.91
285.0	7.5	0.01	212.89	122.80	90.09	0.00	28.03
290.0	7.4	0.01	213.75	124.96	88.79	0.00	28.14
295.0	7.3	0.01	214.59	127.11	87.48	0.00	28.25
300.0	7.2	0.01	215.42	129.27	86.15	0.00	28.36

Prepared By Tim Ng

Modified Rational Method - 5 Year Storm
Site Flow and Storage Summary
521 Huronia Road
19082
June 18 2021

Area 201 Post Controlled

Area=	**0.84**	ha
"C" =	**0.72**	
AC1=	**0.60**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Orifice Release Rate =	**13**	L/s
Max. Required Storage =	**166.2**	m^3

Area 202 + 203 Post Uncontrolled

Area=	**0.30**	ha
"C" =	**0.27**	
AC1=	**0.08**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Releasee Rate =	**24**	L/s

Flow Summary

Target Flow	**38**	L/s
Total Design Flow	**37**	L/s

Rainfall Intensity Parameters	
a=	853.61
b=	4.70
c=	-0.77
I=	A(T+b)^c

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (m^3/s)	Runoff Volume (m^3)	Target Released Volume (m^3)	Total Required Storage Volume (m^3)	Storm Runoff (m^3/s)	Runoff Volume (m^3)
10.0	108.9	0.18	109.10	7.75	101.35	0.02	14.36
15.0	87.0	0.15	130.77	11.63	119.14	0.02	17.22
20.0	73.2	0.12	146.62	15.51	131.12	0.02	19.30
25.0	63.6	0.11	159.14	19.38	139.76	0.01	20.95
30.0	56.4	0.09	169.51	23.26	146.25	0.01	22.32
35.0	50.9	0.08	178.39	27.13	151.25	0.01	23.49
40.0	46.5	0.08	186.16	31.01	155.15	0.01	24.51
45.0	42.8	0.07	193.09	34.89	158.21	0.01	25.42
50.0	39.8	0.07	199.36	38.76	160.60	0.01	26.25
55.0	37.2	0.06	205.08	42.64	162.44	0.01	27.00
60.0	35.0	0.06	210.36	46.52	163.84	0.01	27.69
65.0	33.1	0.06	215.26	50.39	164.87	0.01	28.34
70.0	31.4	0.05	219.84	54.27	165.57	0.01	28.94
75.0	29.8	0.05	224.13	58.14	165.99	0.01	29.51
80.0	28.5	0.05	228.19	62.02	166.17	0.01	30.04
85.0	27.3	0.05	232.03	65.90	166.13	0.01	30.55
90.0	26.1	0.04	235.68	69.77	165.91	0.01	31.03
95.0	25.1	0.04	239.16	73.65	165.51	0.01	31.49
100.0	24.2	0.04	242.48	77.53	164.96	0.01	31.92
105.0	23.4	0.04	245.67	81.40	164.27	0.01	32.34
110.0	22.6	0.04	248.73	85.28	163.45	0.00	32.75
115.0	21.8	0.04	251.68	89.16	162.52	0.00	33.13
120.0	21.2	0.04	254.51	93.03	161.48	0.00	33.51
125.0	20.5	0.03	257.25	96.91	160.35	0.00	33.87
130.0	20.0	0.03	259.90	100.78	159.12	0.00	34.22
135.0	19.4	0.03	262.47	104.66	157.81	0.00	34.55
140.0	18.9	0.03	264.95	108.54	156.42	0.00	34.88
145.0	18.4	0.03	267.37	112.41	154.96	0.00	35.20
150.0	18.0	0.03	269.71	116.29	153.42	0.00	35.51
155.0	17.5	0.03	272.00	120.17	151.83	0.00	35.81
160.0	17.1	0.03	274.22	124.04	150.18	0.00	36.10
165.0	16.7	0.03	276.38	127.92	148.46	0.00	36.39
170.0	16.4	0.03	278.49	131.79	146.70	0.00	36.66
175.0	16.0	0.03	280.55	135.67	144.88	0.00	36.94
180.0	15.7	0.03	282.57	139.55	143.02	0.00	37.20
185.0	15.4	0.03	284.53	143.42	141.11	0.00	37.46
190.0	15.1	0.03	286.46	147.30	139.16	0.00	37.71
195.0	14.8	0.02	288.34	151.18	137.16	0.00	37.96
200.0	14.5	0.02	290.19	155.05	135.13	0.00	38.20
205.0	14.2	0.02	291.99	158.93	133.06	0.00	38.44
210.0	14.0	0.02	293.76	162.81	130.96	0.00	38.68
215.0	13.7	0.02	295.50	166.68	128.82	0.00	38.90
220.0	13.5	0.02	297.21	170.56	126.65	0.00	39.13
225.0	13.3	0.02	298.88	174.43	124.44	0.00	39.35
230.0	13.0	0.02	300.52	178.31	122.21	0.00	39.56
235.0	12.8	0.02	302.14	182.19	119.95	0.00	39.78
240.0	12.6	0.02	303.72	186.06	117.66	0.00	39.99
245.0	12.4	0.02	305.28	189.94	115.35	0.00	40.19
250.0	12.3	0.02	306.82	193.82	113.00	0.00	40.39
255.0	12.1	0.02	308.33	197.69	110.64	0.00	40.59
260.0	11.9	0.02	309.82	201.57	108.25	0.00	40.79
265.0	11.7	0.02	311.28	205.44	105.84	0.00	40.98
270.0	11.6	0.02	312.72	209.32	103.40	0.00	41.17
275.0	11.4	0.02	314.14	213.20	100.95	0.00	41.36
280.0	11.3	0.02	315.54	217.07	98.47	0.00	41.54
285.0	11.1	0.02	316.92	220.95	95.97	0.00	41.72
290.0	11.0	0.02	318.28	224.83	93.46	0.00	41.90
295.0	10.8	0.02	319.63	228.70	90.92	0.00	42.08
300.0	10.7	0.02	320.95	232.58	88.37	0.00	42.25

Prepared By Tim Ng

Modified Rational Method - 10Year Storm
Site Flow and Storage Summary
521 Huronia Road
19082
June 18 2021

Area 201 Post Controlled

Area=	**0.84**	ha
"C" =	**0.72**	
AC1=	**0.60**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Orifice Release Rate =	**16**	L/s
Max. Required Storage =	**191.0**	m^3

Area 202 + 203 Post Uncontrolled

Area=	**0.30**	ha
"C" =	**0.27**	
AC1=	**0.08**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Releasee Rate =	**28**	L/s

Flow Summary

Target Flow	**44**	L/s
Total Design Flow	**44**	L/s

Rainfall Intensity Parameters	
a=	975.87
b=	4.70
c=	-0.76
I=	A(T+b)^c

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (m^3/s)	Runoff Volume (m^3)	Target Released Volume (m^3)	Total Required Storage Volume (m^3)	Storm Runoff (m^3/s)	Runoff Volume (m^3)
10.0	126.5	0.21	126.75	9.62	117.13	0.03	16.69
15.0	101.3	0.17	152.20	14.43	137.77	0.02	20.04
20.0	85.3	0.14	170.88	19.24	151.64	0.02	22.50
25.0	74.1	0.12	185.67	24.04	161.63	0.02	24.44
30.0	65.9	0.11	197.96	28.85	169.10	0.01	26.06
35.0	59.5	0.10	208.49	33.66	174.83	0.01	27.45
40.0	54.3	0.09	217.73	38.47	179.26	0.01	28.67
45.0	50.1	0.08	225.98	43.28	182.70	0.01	29.75
50.0	46.6	0.08	233.45	48.09	185.36	0.01	30.73
55.0	43.6	0.07	240.28	52.90	187.38	0.01	31.63
60.0	41.0	0.07	246.58	57.71	188.87	0.01	32.46
65.0	38.8	0.06	252.44	62.52	189.92	0.01	33.23
70.0	36.8	0.06	257.91	67.33	190.59	0.01	33.95
75.0	35.0	0.06	263.06	72.13	190.92	0.01	34.63
80.0	33.4	0.06	267.91	76.94	190.97	0.01	35.27
85.0	32.0	0.05	272.52	81.75	190.76	0.01	35.88
90.0	30.7	0.05	276.89	86.56	190.33	0.01	36.45
95.0	29.5	0.05	281.07	91.37	189.70	0.01	37.00
100.0	28.5	0.05	285.06	96.18	188.88	0.01	37.53
105.0	27.5	0.05	288.89	100.99	187.90	0.01	38.03
110.0	26.6	0.04	292.56	105.80	186.76	0.01	38.52
115.0	25.7	0.04	296.10	110.61	185.49	0.01	38.98
120.0	24.9	0.04	299.51	115.42	184.10	0.01	39.43
125.0	24.2	0.04	302.81	120.22	182.58	0.01	39.87
130.0	23.5	0.04	306.00	125.03	180.96	0.01	40.29
135.0	22.9	0.04	309.09	129.84	179.24	0.01	40.69
140.0	22.3	0.04	312.08	134.65	177.43	0.00	41.09
145.0	21.7	0.04	314.99	139.46	175.53	0.00	41.47
150.0	21.2	0.04	317.81	144.27	173.54	0.00	41.84
155.0	20.6	0.03	320.56	149.08	171.48	0.00	42.20
160.0	20.2	0.03	323.24	153.89	169.35	0.00	42.56
165.0	19.7	0.03	325.85	158.70	167.15	0.00	42.90
170.0	19.3	0.03	328.40	163.51	164.89	0.00	43.23
175.0	18.9	0.03	330.88	168.31	162.57	0.00	43.56
180.0	18.5	0.03	333.31	173.12	160.19	0.00	43.88
185.0	18.1	0.03	335.69	177.93	157.75	0.00	44.19
190.0	17.8	0.03	338.01	182.74	155.27	0.00	44.50
195.0	17.4	0.03	340.28	187.55	152.73	0.00	44.80
200.0	17.1	0.03	342.51	192.36	150.15	0.00	45.09
205.0	16.8	0.03	344.69	197.17	147.52	0.00	45.38
210.0	16.5	0.03	346.83	201.98	144.86	0.00	45.66
215.0	16.2	0.03	348.93	206.79	142.15	0.00	45.94
220.0	15.9	0.03	350.99	211.60	139.40	0.00	46.21
225.0	15.7	0.03	353.01	216.40	136.61	0.00	46.48
230.0	15.4	0.03	355.00	221.21	133.79	0.00	46.74
235.0	15.2	0.03	356.95	226.02	130.93	0.00	46.99
240.0	14.9	0.02	358.87	230.83	128.04	0.00	47.25
245.0	14.7	0.02	360.76	235.64	125.12	0.00	47.50
250.0	14.5	0.02	362.62	240.45	122.17	0.00	47.74
255.0	14.3	0.02	364.45	245.26	119.19	0.00	47.98
260.0	14.1	0.02	366.25	250.07	116.18	0.00	48.22
265.0	13.9	0.02	368.02	254.88	113.14	0.00	48.45
270.0	13.7	0.02	369.76	259.69	110.08	0.00	48.68
275.0	13.5	0.02	371.48	264.49	106.99	0.00	48.91
280.0	13.3	0.02	373.18	269.30	103.87	0.00	49.13
285.0	13.1	0.02	374.85	274.11	100.74	0.00	49.35
290.0	13.0	0.02	376.50	278.92	97.58	0.00	49.57
295.0	12.8	0.02	378.12	283.73	94.39	0.00	49.78
300.0	12.6	0.02	379.73	288.54	91.19	0.00	49.99

Prepared By Tim Ng

Modified Rational Method - 25Year Storm
Site Flow and Storage Summary
521 Huronia Road
19082
June 18 2021

Area 201 Post Controlled

Area=	**0.84**	ha
"C" =	**0.79**	
AC1=	**0.66**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Orifice Release Rate =	**22**	L/s
Max. Required Storage =	**245.8**	m^3

Area 202 + 203 Post Uncontrolled

Area=	**0.30**	ha
"C" =	**0.29**	
AC1=	**0.09**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Releasee Rate =	**36**	L/s

Flow Summary

Target Flow	**58**	L/s
Total Design Flow	**58**	L/s

Rainfall Intensity Parameters	
a=	1146.28
b=	4.92
c=	-0.76
I=	A(T+b)^c

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (m^3/s)	Runoff Volume (m^3)	Target Released Volume (m^3)	Total Required Storage Volume (m^3)	Storm Runoff (m^3/s)	Runoff Volume (m^3)
10.0	148.2	0.27	163.23	13.05	150.18	0.04	21.49
15.0	119.0	0.22	196.73	19.57	177.17	0.03	25.90
20.0	100.5	0.18	221.41	26.09	195.32	0.02	29.15
25.0	87.5	0.16	240.99	32.61	208.38	0.02	31.73
30.0	77.8	0.14	257.26	39.14	218.13	0.02	33.87
35.0	70.3	0.13	271.23	45.66	225.57	0.02	35.71
40.0	64.3	0.12	283.49	52.18	231.30	0.02	37.32
45.0	59.4	0.11	294.43	58.71	235.73	0.01	38.76
50.0	55.2	0.10	304.34	65.23	239.12	0.01	40.07
55.0	51.7	0.09	313.41	71.75	241.66	0.01	41.26
60.0	48.7	0.09	321.78	78.27	243.50	0.01	42.36
65.0	46.0	0.08	329.55	84.80	244.76	0.01	43.39
70.0	43.7	0.08	336.82	91.32	245.50	0.01	44.34
75.0	41.6	0.08	343.66	97.84	245.82	0.01	45.24
80.0	39.7	0.07	350.11	104.36	245.75	0.01	46.09
85.0	38.0	0.07	356.23	110.89	245.34	0.01	46.90
90.0	36.5	0.07	362.04	117.41	244.63	0.01	47.66
95.0	35.1	0.06	367.59	123.93	243.66	0.01	48.39
100.0	33.8	0.06	372.90	130.46	242.44	0.01	49.09
105.0	32.7	0.06	377.98	136.98	241.00	0.01	49.76
110.0	31.6	0.06	382.87	143.50	239.37	0.01	50.41
115.0	30.6	0.06	387.57	150.02	237.55	0.01	51.03
120.0	29.7	0.05	392.11	156.55	235.56	0.01	51.62
125.0	28.8	0.05	396.49	163.07	233.42	0.01	52.20
130.0	28.0	0.05	400.73	169.59	231.14	0.01	52.76
135.0	27.2	0.05	404.84	176.12	228.72	0.01	53.30
140.0	26.5	0.05	408.82	182.64	226.18	0.01	53.82
145.0	25.8	0.05	412.69	189.16	223.53	0.01	54.33
150.0	25.2	0.05	416.45	195.68	220.76	0.01	54.83
155.0	24.6	0.05	420.10	202.21	217.90	0.01	55.31
160.0	24.0	0.04	423.67	208.73	214.94	0.01	55.78
165.0	23.5	0.04	427.14	215.25	211.89	0.01	56.23
170.0	23.0	0.04	430.53	221.77	208.75	0.01	56.68
175.0	22.5	0.04	433.83	228.30	205.54	0.01	57.12
180.0	22.0	0.04	437.06	234.82	202.24	0.01	57.54
185.0	21.6	0.04	440.22	241.34	198.88	0.01	57.96
190.0	21.2	0.04	443.31	247.87	195.45	0.01	58.36
195.0	20.8	0.04	446.34	254.39	191.95	0.01	58.76
200.0	20.4	0.04	449.30	260.91	188.39	0.00	59.15
205.0	20.0	0.04	452.21	267.43	184.77	0.00	59.54
210.0	19.7	0.04	455.06	273.96	181.10	0.00	59.91
215.0	19.3	0.04	457.85	280.48	177.37	0.00	60.28
220.0	19.0	0.03	460.59	287.00	173.59	0.00	60.64
225.0	18.7	0.03	463.29	293.53	169.76	0.00	60.99
230.0	18.4	0.03	465.93	300.05	165.88	0.00	61.34
235.0	18.1	0.03	468.53	306.57	161.96	0.00	61.68
240.0	17.8	0.03	471.09	313.09	157.99	0.00	62.02
245.0	17.5	0.03	473.60	319.62	153.98	0.00	62.35
250.0	17.3	0.03	476.07	326.14	149.93	0.00	62.68
255.0	17.0	0.03	478.51	332.66	145.84	0.00	63.00
260.0	16.8	0.03	480.90	339.18	141.72	0.00	63.31
265.0	16.6	0.03	483.26	345.71	137.55	0.00	63.62
270.0	16.3	0.03	485.58	352.23	133.35	0.00	63.93
275.0	16.1	0.03	487.88	358.75	129.12	0.00	64.23
280.0	15.9	0.03	490.13	365.28	124.86	0.00	64.53
285.0	15.7	0.03	492.36	371.80	120.56	0.00	64.82
290.0	15.5	0.03	494.55	378.32	116.23	0.00	65.11
295.0	15.3	0.03	496.72	384.84	111.87	0.00	65.39
300.0	15.1	0.03	498.85	391.37	107.49	0.00	65.68

Prepared By Tim Ng

Modified Rational Method - 50Year Storm
Site Flow and Storage Summary
521 Huronia Road
19082
June 18 2021

Area 201 Post Controlled

Area=	**0.84**	ha
"C" =	**0.86**	
AC1=	**0.72**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Orifice Release Rate =	**27**	L/s
Max. Required Storage =	**296.7**	m^3

Area 202 + 203 Post Uncontrolled

Area=	**0.30**	ha
"C" =	**0.32**	
AC1=	**0.09**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Releasee Rate =	**43**	L/s

Flow Summary

Target Flow	**69**	L/s
Total Design Flow	**70**	L/s

Rainfall Intensity Parameters	
a=	1236.15
b=	4.70
c=	-0.75
I=	A(T+b)^c

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (m^3/s)	Runoff Volume (m^3)	Target Released Volume (m^3)	Total Required Storage Volume (m^3)	Storm Runoff (m^3/s)	Runoff Volume (m^3)
10.0	164.2	0.33	197.39	15.90	181.49	0.04	25.99
15.0	131.8	0.26	237.64	23.85	213.79	0.03	31.29
20.0	111.2	0.22	267.35	31.80	235.55	0.03	35.20
25.0	96.8	0.19	290.98	39.75	251.23	0.03	38.31
30.0	86.2	0.17	310.67	47.70	262.97	0.02	40.90
35.0	77.9	0.16	327.60	55.65	271.94	0.02	43.13
40.0	71.2	0.14	342.48	63.60	278.88	0.02	45.09
45.0	65.8	0.13	355.80	71.55	284.25	0.02	46.84
50.0	61.2	0.12	367.88	79.50	288.37	0.02	48.43
55.0	57.3	0.11	378.94	87.45	291.48	0.02	49.89
60.0	54.0	0.11	389.15	95.40	293.75	0.01	51.23
65.0	51.0	0.10	398.66	103.35	295.31	0.01	52.49
70.0	48.4	0.10	407.56	111.30	296.26	0.01	53.66
75.0	46.1	0.09	415.93	119.25	296.68	0.01	54.76
80.0	44.1	0.09	423.85	127.20	296.64	0.01	55.80
85.0	42.2	0.08	431.35	135.15	296.20	0.01	56.79
90.0	40.5	0.08	438.49	143.11	295.39	0.01	57.73
95.0	39.0	0.08	445.31	151.06	294.25	0.01	58.63
100.0	37.6	0.08	451.83	159.01	292.83	0.01	59.49
105.0	36.3	0.07	458.09	166.96	291.13	0.01	60.31
110.0	35.1	0.07	464.11	174.91	289.20	0.01	61.10
115.0	34.0	0.07	469.90	182.86	287.04	0.01	61.86
120.0	33.0	0.07	475.49	190.81	284.68	0.01	62.60
125.0	32.0	0.06	480.89	198.76	282.14	0.01	63.31
130.0	31.1	0.06	486.12	206.71	279.41	0.01	64.00
135.0	30.3	0.06	491.19	214.66	276.53	0.01	64.67
140.0	29.5	0.06	496.10	222.61	273.50	0.01	65.31
145.0	28.7	0.06	500.88	230.56	270.32	0.01	65.94
150.0	28.0	0.06	505.52	238.51	267.01	0.01	66.55
155.0	27.4	0.05	510.04	246.46	263.58	0.01	67.15
160.0	26.8	0.05	514.45	254.41	260.04	0.01	67.73
165.0	26.2	0.05	518.74	262.36	256.38	0.01	68.29
170.0	25.6	0.05	522.93	270.31	252.62	0.01	68.85
175.0	25.1	0.05	527.02	278.26	248.76	0.01	69.38
180.0	24.5	0.05	531.02	286.21	244.81	0.01	69.91
185.0	24.1	0.05	534.93	294.16	240.77	0.01	70.43
190.0	23.6	0.05	538.76	302.11	236.65	0.01	70.93
195.0	23.1	0.05	542.51	310.06	232.45	0.01	71.42
200.0	22.7	0.05	546.18	318.01	228.17	0.01	71.91
205.0	22.3	0.04	549.78	325.96	223.82	0.01	72.38
210.0	21.9	0.04	553.31	333.91	219.40	0.01	72.85
215.0	21.5	0.04	556.78	341.86	214.91	0.01	73.30
220.0	21.2	0.04	560.18	349.81	210.36	0.01	73.75
225.0	20.8	0.04	563.52	357.76	205.75	0.01	74.19
230.0	20.5	0.04	566.80	365.71	201.09	0.01	74.62
235.0	20.2	0.04	570.02	373.66	196.36	0.01	75.05
240.0	19.9	0.04	573.20	381.61	191.58	0.01	75.46
245.0	19.6	0.04	576.32	389.56	186.75	0.01	75.87
250.0	19.3	0.04	579.39	397.51	181.87	0.01	76.28
255.0	19.0	0.04	582.41	405.46	176.94	0.01	76.68
260.0	18.7	0.04	585.38	413.41	171.97	0.00	77.07
265.0	18.5	0.04	588.32	421.37	166.95	0.00	77.45
270.0	18.2	0.04	591.20	429.32	161.89	0.00	77.83
275.0	18.0	0.04	594.05	437.27	156.78	0.00	78.21
280.0	17.7	0.04	596.86	445.22	151.64	0.00	78.58
285.0	17.5	0.04	599.62	453.17	146.46	0.00	78.94
290.0	17.3	0.03	602.35	461.12	141.23	0.00	79.30
295.0	17.1	0.03	605.04	469.07	135.98	0.00	79.66
300.0	16.9	0.03	607.70	477.02	130.68	0.00	80.01

Prepared By Tim Ng

Modified Rational Method - 100Year Storm
Site Flow and Storage Summary
521 Huronia Road
19082
June 18 2021

Area 201 Post Controlled

Area=	**0.84**	ha
"C" =	**0.90**	
AC1=	**0.75**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Orifice Release Rate =	**30**	L/s
Max. Required Storage =	**344.1**	m^3

Area 202 + 203 Post Uncontrolled

Area=	**0.30**	ha
"C" =	**0.33**	
AC1=	**0.10**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Releasee Rate =	**49**	L/s

Flow Summary

Target Flow	**80**	L/s
Total Design Flow	**80**	L/s

Rainfall Intensity Parameters	
a=	1426.41
b=	5.27
c=	-0.76
I=	A(T+b)^c

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (m^3/s)	Runoff Volume (m^3)	Target Released Volume (m^3)	Total Required Storage Volume (m^3)	Storm Runoff (m^3/s)	Runoff Volume (m^3)
10.0	180.2	0.38	225.56	18.14	207.42	0.05	29.70
15.0	145.3	0.30	272.90	27.21	245.69	0.04	35.93
20.0	122.9	0.26	307.80	36.28	271.52	0.03	40.52
25.0	107.2	0.22	335.49	45.35	290.14	0.03	44.17
30.0	95.4	0.20	358.48	54.42	304.07	0.03	47.20
35.0	86.3	0.18	378.20	63.49	314.71	0.02	49.79
40.0	79.0	0.16	395.49	72.55	322.93	0.02	52.07
45.0	72.9	0.15	410.92	81.62	329.29	0.02	54.10
50.0	67.9	0.14	424.87	90.69	334.18	0.02	55.94
55.0	63.6	0.13	437.63	99.76	337.86	0.02	57.62
60.0	59.8	0.12	449.39	108.83	340.56	0.02	59.16
65.0	56.6	0.12	460.32	117.90	342.41	0.02	60.60
70.0	53.7	0.11	470.53	126.97	343.56	0.01	61.95
75.0	51.1	0.11	480.12	136.04	344.08	0.01	63.21
80.0	48.8	0.10	489.17	145.11	344.06	0.01	64.40
85.0	46.8	0.10	497.74	154.18	343.56	0.01	65.53
90.0	44.9	0.09	505.89	163.25	342.65	0.01	66.60
95.0	43.2	0.09	513.67	172.32	341.35	0.01	67.63
100.0	41.6	0.09	521.09	181.39	339.71	0.01	68.60
105.0	40.2	0.08	528.21	190.46	337.76	0.01	69.54
110.0	38.9	0.08	535.05	199.53	335.53	0.01	70.44
115.0	37.6	0.08	541.63	208.60	333.04	0.01	71.31
120.0	36.5	0.08	547.98	217.66	330.31	0.01	72.14
125.0	35.4	0.07	554.10	226.73	327.37	0.01	72.95
130.0	34.4	0.07	560.03	235.80	324.22	0.01	73.73
135.0	33.5	0.07	565.76	244.87	320.89	0.01	74.49
140.0	32.6	0.07	571.33	253.94	317.39	0.01	75.22
145.0	31.8	0.07	576.73	263.01	313.72	0.01	75.93
150.0	31.0	0.06	581.98	272.08	309.89	0.01	76.62
155.0	30.3	0.06	587.08	281.15	305.93	0.01	77.29
160.0	29.6	0.06	592.05	290.22	301.83	0.01	77.95
165.0	28.9	0.06	596.90	299.29	297.61	0.01	78.58
170.0	28.3	0.06	601.62	308.36	293.26	0.01	79.21
175.0	27.7	0.06	606.24	317.43	288.81	0.01	79.81
180.0	27.1	0.06	610.74	326.50	284.25	0.01	80.41
185.0	26.6	0.06	615.15	335.57	279.58	0.01	80.99
190.0	26.0	0.05	619.46	344.64	274.82	0.01	81.55
195.0	25.5	0.05	623.68	353.71	269.97	0.01	82.11
200.0	25.1	0.05	627.81	362.77	265.03	0.01	82.65
205.0	24.6	0.05	631.85	371.84	260.01	0.01	83.19
210.0	24.2	0.05	635.82	380.91	254.91	0.01	83.71
215.0	23.8	0.05	639.71	389.98	249.73	0.01	84.22
220.0	23.4	0.05	643.53	399.05	244.48	0.01	84.72
225.0	23.0	0.05	647.28	408.12	239.16	0.01	85.22
230.0	22.6	0.05	650.97	417.19	233.78	0.01	85.70
235.0	22.2	0.05	654.59	426.26	228.33	0.01	86.18
240.0	21.9	0.05	658.15	435.33	222.82	0.01	86.65
245.0	21.6	0.05	661.65	444.40	217.25	0.01	87.11
250.0	21.2	0.04	665.09	453.47	211.62	0.01	87.56
255.0	20.9	0.04	668.47	462.54	205.94	0.01	88.01
260.0	20.6	0.04	671.81	471.61	200.20	0.01	88.45
265.0	20.3	0.04	675.09	480.68	194.42	0.01	88.88
270.0	20.1	0.04	678.33	489.75	188.58	0.01	89.30
275.0	19.8	0.04	681.51	498.82	182.70	0.01	89.72
280.0	19.5	0.04	684.65	507.88	176.77	0.01	90.14
285.0	19.3	0.04	687.75	516.95	170.79	0.01	90.54
290.0	19.0	0.04	690.80	526.02	164.78	0.01	90.95
295.0	18.8	0.04	693.81	535.09	158.72	0.01	91.34
300.0	18.6	0.04	696.78	544.16	152.62	0.01	91.73

Prepared By Tim Ng	Orifice Control and Storage Summary 521 Huronia Road 19082 June 18 2021

Orifice Equation

$$Q = C \times A \times \sqrt{2 \times g \times h}$$

		Orifice 1					Orifice 2										
Storm Event	**Orifice Coefficient**	**Diameter of Orifice**	**Orifice Invert**	**Total Head**	**Area of Orifice**	**Release Rate**	**Diameter of Orifice**	**Orifice Invert**	**Total Head**	**Area of Orifice**	**Release Rate**	**Headwater Elevation**	**Total Control Flow**	**Required Storage**	**Stormtech Storage Provided**	**Tank Storage Provided**	**Total Provided Storage**
		(mm)	(m)	(m)	(m^2)	(L/s)	(mm)	(m)	(m)	(m^2)	(L/s)	(m)	(L/s)	(m^3)	(m^3)	(m^3)	(m^3)
2-Year	0.60	80	245.67	0.29	0.005	7	95	246.02	0.00	0.007	0	246.00	7.2	122	45	77.32	122
5-Year	0.60	80	245.67	0.41	0.005	9	95	246.02	0.05	0.007	4	246.12	12.9	166	60	105.98	166
10-Year	0.60	80	245.67	0.49	0.005	9	95	246.02	0.13	0.007	7	246.20	16.0	191	68	123.38	191
25-Year	0.60	80	245.67	0.68	0.005	11	95	246.02	0.32	0.007	11	246.39	21.7	246	76	169.47	246
50-Year	0.60	80	245.67	0.90	0.005	13	95	246.02	0.54	0.007	14	246.61	26.5	297	76	220.34	297
100-Year	0.60	80	245.67	1.10	0.005	14	95	246.02	0.74	0.007	16	246.81	30.2	344	76	267.73	344

Tank Storage Calculations

521 Huronia Road
19082
June 18 2021

Prepared By Tim Ng

Quantity Control Tank Storage

			2 Year		5 Year		10 Year		25 Year		50 Year		100 Year	
			Water Level	**246.00**	Water Level	**246.12**	Water Level	**246.20**	Water Level	**246.39**	Water Level	**246.61**	Water Level	**246.81**
Orifice Invert	**Top of Tank (underside of slab)**	**Base Area (m^2)**	Active Depth used for Storage (m)	Volume (m^3)	Active Depth used for Storage (m)	Volume (m^3)	Active Depth used for Storage (m)	Volume (m^3)	Active Depth used for Storage (m)	Volume (m^3)	Active Depth used for Storage (m)	Volume (m^3)	Active Depth used for Storage (m)	Volume (m^3)
245.67	247.2	235.00	0.33	77.32	0.45	105.98	0.53	123.38	0.72	169.47	0.94	220.34	1.14	267.73
		Total		**77.32**		**105.98**		**123.38**		**169.47**		**220.34**		**267.73**

Stormtech Outlet Invert	245.67
Dead Storage	0

Stormtech (1)

Volume (m^3)	Elevation (m)
76.343	246.28
73.764	246.25
71.185	246.23
68.605	246.20
66.026	246.18
63.447	246.15
60.867	246.13
58.180	246.10
55.317	246.08
52.126	246.05
48.616	246.03
44.900	246.00
41.022	245.97
37.009	245.95
32.879	245.92
28.649	245.90
24.332	245.87
19.940	245.85
15.476	245.82
12.897	245.80
10.317	245.77
7.738	245.75
5.159	245.72
2.579	245.70

Prepared By Tim Ng	**Stormtech Storage Calculations** **521 Huronia Road** **19082** **June 18 2021**

Storm	Water Level	Stormtech (1) Total Storage (m^3)	Stormtech (1) Quantity Storage (m^3)
2	246.00	45	45
5	246.12	60	60
10	246.20	68	68
25	246.39	76	76
50	246.61	76	76
100	246.81	76	76

[1] Dead storage/Retention Storage is not used for quantity storage as it is not active on the flow control structure

Quality Control & Phosphorus Calculations

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

POST-DEVELOPMENT Phosphorus LOAD - BMPs applied

Subwatershed: Lovers Creek

Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		BMP P Load (kg/yr)
DEVELOPMENT:	**521 Huronia Road**				
High Intensity - Residential	0.29	1.32	Vegetated Filter Strips/Stream Buffers	65%	0.13
Uncontrolled area (primarily grass)					
High Intensity - Residential	0.84	1.32	Other	86%	0.16
Controlled area treated by Stormfilter with PhosphoSorb media - Treatment efficiency = 79%+ as per ETV TESTING. Also the downstream natural vegetation acts as a vegetative filter strip. As a treatment train approach this provides 95%.					

			P Load (kg/yr)
Post-Development Area Altered:	**1.13**	Pre-Development:	**0.07**
Total Pre-Development Area:	**1.13**	Post-Development Load:	**1.49**
Unaffected Area:	**0**	Change (Pre- Post):	**-1.42**
		2096% Net Increase in Load	
		Post-Development (with BMP):	**0.29**
		Change (Pre-Post):	**-0.22**
		325.78% Net Increase in Load	

Recharge Compensation Form

Application Details	
Site Name (Developer):	
Site Location:	521 Huronia
File/APID #	
Anticipated Construction Start:	
Subwatershed:	Lovers Creek
Phosphorous Balance	
Kg/year	0.29
Compensation Costs	
Offsetting Value	2.5
Compensation Cost (P load *2.5*$35,700)	$25,882.50
Administration Fee (15%)	$3,882.38
Total	$29,764.88

Determining Number of Cartridges for Flow Based Systems

Date	**24/07/2020**	**Black Cells =**	**Calculation**

Site Information

Project Name	**521 Huronia Road**		
Project Location	**Barrie, ON**		
OGS ID	**OGS 1**		
Drainage Area, Ad	**2.07**	ac	(0.84 ha)
Impervious Area, Ai	**1.50**	ac	
Pervious Area, Ap	**0.57**		
% Impervious	**72%**		
Runoff Coefficient, Rc	**0.72**		
Treatment storm flow rate, Q_{treat}	**0.77**	cfs	(21.8 L/s)
Peak storm flow rate, Q_{peak}	**TBD**	cfs	

Filter System

Filtration brand	**StormFilter**	
Cartridge height	**18**	in
Specific Flow Rate	**1.67**	gpm/ft^2
Flow rate per cartridge	**12.53**	gpm

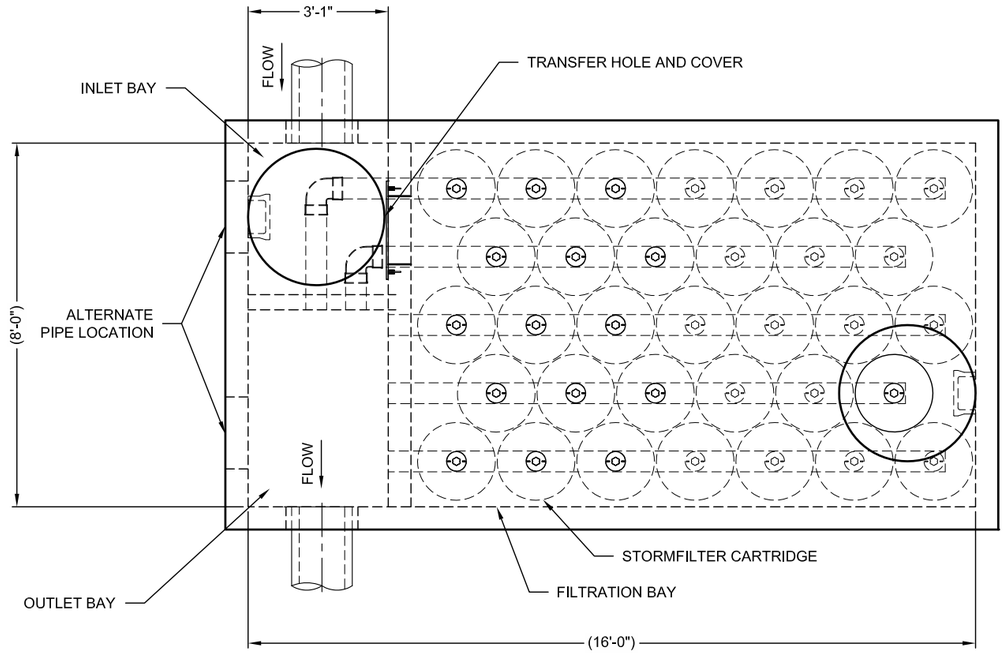
SUMMARY

Number of Cartridges	28
Media Type	Phosphosorb

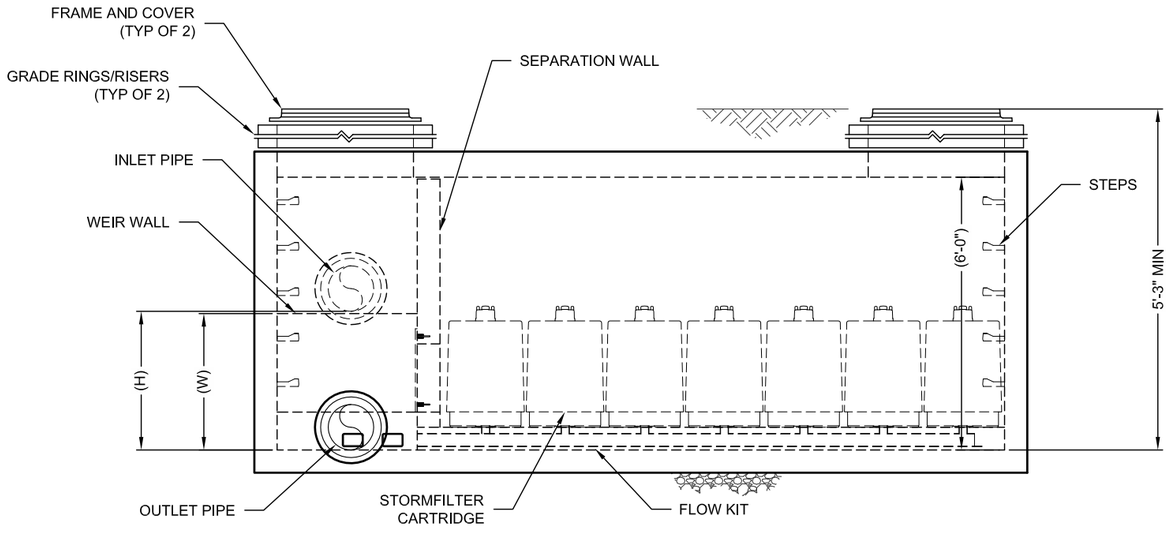
Event Mean Concentration (EMC)	**150**	mg/L
Annual TSS Removal	**80%**	
Percent Runoff Capture	**90%**	

Recommend SFPD0816 vault or CIP

200 Enterprise Drive
Scarborough, ME 04074
Phone 877-907-8676
Fax 207-885-9825



PLAN



ELEVATION

The Stormwater Management StormFilter®

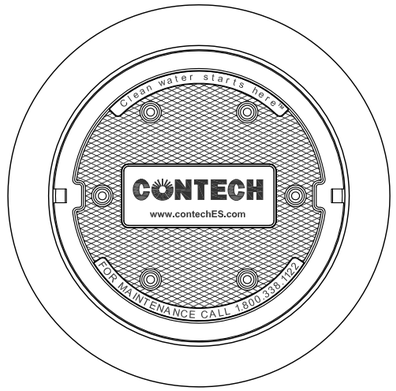
STORMFILTER DESIGN NOTES

- THE 8' x 16' PEAK DIVERSION STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD.
- THE PEAK DIVERSION STORMFILTER IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR RIGHT INLET CONFIGURATION.
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS OTHERWISE NOTED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			LOW DROP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			1.8'		
HEIGHT OF WEIR (W)	3.00'			2.25'			1.75'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	10	8.35	5

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB ® (PSORB) MEDIA ONLY



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	*
PEAK FLOW RATE (cfs)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
CARTRIDGE HEIGHT (27", 18", LOW DROP(LD))	*
NUMBER OF CARTRIDGES REQUIRED	*
CARTRIDGE FLOW RATE	*
MEDIA TYPE (PERLITE, ZPG, PSORB)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE	*	*	*
OUTLET PIPE	*	*	*

UPSTREAM RIM ELEVATION	*
DOWNSTREAM RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **38 SECONDS**.
SPECIFIC FLOW RATE SHALL BE 2 **GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM).**

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.contechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

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 STORMFILTER STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
F. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

CONTECH®
ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

THE STORMWATER MANAGEMENT STORMFILTER 8' x 16' PEAK DIVERSION STORMFILTER STANDARD DETAIL

Media Cartridge Filtration System Drawing Specifications

- Each rechargeable, media-filled, filter cartridge shall incorporate a protective hood over the media cartridge and a siphon-actuated surface self-cleaning mechanism to increase the effective life of the filter media and to reduce the accumulation of material on the cartridge/media interface.
- Media filter cartridges shall operate at a predetermined flow rate through the use of an integrated flow control orifice located within each filter cartridge outlet manifold.
- The media-filled cartridges shall trap particulates (TSS) and have the capacity to adsorb pollutants such as dissolved metals, nutrients and hydrocarbons.
- At the design flow rate the maximum filter hydraulic loading rate is not to exceed 2.1 gallons per minute per square foot of filter surface area and the average contact time shall be no less than 35 seconds.
- The media cartridge filtration system shall consist of no less than 0.12 cubic feet of filter media for each 1-gallon per minute of water quality treatment flow.
- Filter cartridges shall be of a design that has demonstrated a minimum sediment retention capacity of 22 pounds of silty loam per cartridge in laboratory tests without a reduction in hydraulic capacity. Laboratory data shall be corroborated with field observations and/or data demonstrating equivalent or improved longevity without impacting normal hydraulic performance.
- The Filtration system shall have the State of Washington Department of Ecology, General Use Level Designation (GULD) Certification and current approval status from the New Jersey Department of Environmental Protection. (NJDEP).

StormFilter Media Options

Flexibility to target site-specific pollutants ...

- PhosphoSorb® is a lightweight media built from a Perlite-base that removes total phosphorus (TP) by adsorbing dissolved-P and filtering particulate-P simultaneously.
- CSF® Leaf Media is created from deciduous leaves processed into granular, organic media. CSF is most effective for removing soluble metals, TSS, oil and grease, and buffering acid rain.
- Perlite is naturally occurring puffed volcanic ash. Effective for removing TSS, oil, and grease.
- Zeolite is a naturally occurring mineral used to remove soluble metals, ammonium, and some organics.
- GAC (Granular Activated Carbon) has a micro-porous structure with an extensive surface area to provide high levels of adsorption. It is primarily used to remove oil and grease and organics such as PAHs and phthalates.

	PHOSPHOSORB	CSF	ZPG	PERLITE
Sediments	✓	✓	✓	✓
Oil and Grease	✓	✓	✓	✓
Soluble Metals	✓	✓	✓	
Organics		✓	✓	
Nutrients	✓	✓	✓	
Total Phosphorus	✓			

Note: Indicated media are most effective for associated pollutant type. Other media may treat pollutants, but to a lesser degree.

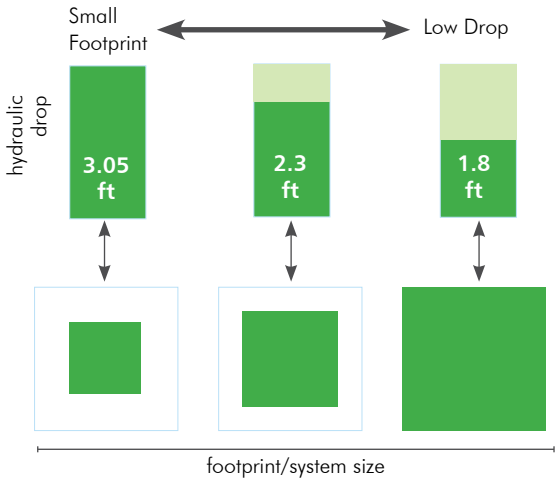
ZPG™ media is a proprietary blend of zeolite, perlite, and GAC, and is also available.

Cartridge Options

Flexibility to reduce size and costs ...

Every site is different, and one size does not fit all. Multiple cartridge heights give you design flexibility to design the StormFilter specifically for your site and reduce the cost of the system for the owner.

- 27″ cartridge – Capitalizing on sites with at least 3.05 feet of available driving head, media surface area is maximized to allow the greatest treatment rate per cartridge; best for sites with footprint constraints
- 18″ cartridge - The original StormFilter cartridge size provides a middle ground and operates with 2.3 feet of driving head
- Low Drop – Provides filtration treatment with only 1.8 feet of headloss; best for sites with limited by hydraulic constraints



CARTRIDGE FLOW RATES			
Cartridge Height	2 gpm/ft²	1.67* gpm/ft²	1 gpm/ft²
12″ LD	10 gpm	8.35 gpm	5 gpm
18″	15 gpm	12.53 gpm	7.5 gpm
27″	22.5 gpm	18.79 gpm	11.25 gpm

** For use with Phosphosorb media as per WA DOE GULD approval.*

MASS LOAD CAPACITY			
Cartridge Height	2 gpm/ft²	1.67* gpm/ft²	1 gpm/ft²
12″ LD	15 lbs	18 lbs	24 lbs
18″	22.5 lbs	27 lbs	36 lbs
27″	33.8 lbs	40.45 lbs	54 lbs

** For use with Phosphosorb media as per WA DOE GULD approval.*

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

The Stormwater Management StormFilter®

Developed by CONTECH Engineered Solutions LLC
Scarborough, Maine, USA

Registration: GPS-ETV_2020-06-15_TAPE

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

June 15, 2020
Vancouver, BC, Canada

GLOBE PERFORMANCE SOLUTIONS

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

Verification Overview

This Environmental Technology Verification (ETV) of The Stormwater Management StormFilter® (StormFilter) is the second part of a two-part verification process and entails the verification of performance claims (#3 – 9) based on field testing data collected in accordance with The Washington State Department of Ecology emerging stormwater treatment technologies, in accordance with guidelines identified by Ecology (2011) in the Technology Assessment Protocol – Ecology (TAPE). This complements the first part of the verification which verifies performance test data collected in accordance with the New Jersey Department of Environmental Protection (NJDEP) *Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device (January, 2013)*.

Technology description and application

The Stormwater Management StormFilter® (StormFilter) is a manufactured treatment device that is provided by Contech Engineered Solutions LLC (Contech). The StormFilter improves the quality of stormwater runoff before it enters receiving waterways through the use of its customizable filter media, which removes non-point source pollutants. As illustrated in **Figure 1,** the StormFilter is typically comprised of a vault or manhole structure that houses rechargeable, media-filled filter cartridges. Stormwater entering the system percolates through these media-filled cartridges, which trap particulates and remove pollutants. Once filtered through the media, the treated stormwater is discharged through an outlet pipe to a storm sewer system or receiving water.

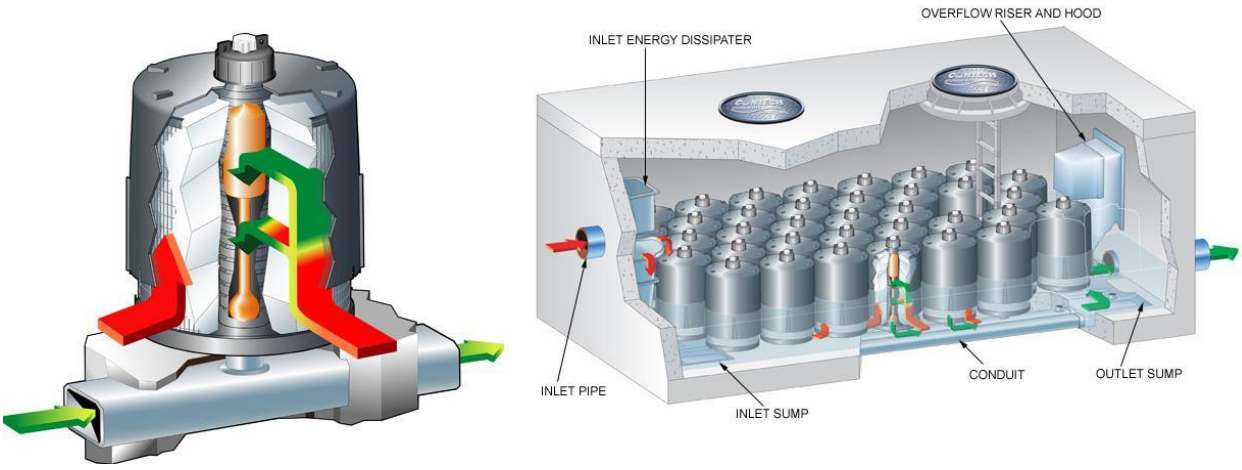


Figure 1 Individual StormFilter Cartridge (Left) and Typical Vault StormFilter Installation (Right)

Depending on the treatment requirements and expected pollutant characteristics at an individual site, the per cartridge filtration flow rate and driving head can be adjusted. The flow rate is individually controlled for each cartridge by a restrictor disc located at the connection point between the cartridge and the underdrain manifold.

Driving head is managed by positioning of the inlet, outlet, and overflow elevations. The StormFilter is typically designed so that the restrictor disc passes the design treatment rate once the water surface reaches the shoulder of the cartridge which is equivalent to the cartridge height. Since the StormFilter uses a restrictor disc to restrict treatment flows below the hydraulic capacity of the media the system

typically operates under consistent driving head for the useful life of the media. Site specific head constraints are also addressed by three different cartridge heights (low drop (effective height of 12 inches), 18, and 27 inches) which operate on the same principal and surface area specific loading rates.

The StormFilter requires a minimum of 1.8 ft, 2.3 ft and 3.05 ft of drop between inlet invert and outlet invert to accommodate the low drop, 18 and 27 inch cartridges, respectively, without backing up flow into the upstream piping during operation. When site conditions limit the amount of drop available across the StormFilter then flow is typically backed up into the upstream piping during operation to ensure sufficient driving head is provided. If desirable the StormFilter can be designed to operate under additional driving head.

The StormFilter is offered in multiple configurations including plastic, steel, and concrete catch basins; and precast concrete manholes, and vaults. Other configurations include panel vaults, CON/SPAN®, box culverts, and curb inlets. The filter cartridges operate consistently and act independently regardless of housing which enables linear scaling.

The StormFilter cartridge can house different types of media including perlite, zeolite, granular activated carbon (GAC), CSF® leaf media, MetalRx™, PhosphoSorb® or various media blends such as ZPG™ (perlite, zeolite and GAC). All of the media use processes associated with depth filtration to remove solids. Some media configurations also provide additional treatment mechanisms such as cation exchange, and/or adsorption, chelation, and precipitation. This verification is specific to a field evaluation of the StormFilter with PhosphoSorb® media.

Performance conditions

The data and results published in this Verification Statement were obtained from the field testing conducted on The Stormwater Management StormFilter® device, 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). 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.

Performance claim(s)

Performance Claim 3 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 23 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 89% removal of total suspended solids at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 4 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 23 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 79% removal of total phosphorus at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 5 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 23 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 56% removal of total nitrogen at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 6 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 77% removal of total copper at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 7 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 75% removal of total zinc at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 8 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 70% removal of total lead at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 9 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 80% removal of total aluminium at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance results

Performance Claim 3 (TAPE):

Raw data summarizing the percent removal of total suspended solids (TSS) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent TSS (mg/L)	Average Effluent TSS (mg/L)	Percent Removal (%)
LPR021012	182	63.0	65.4
LPR021412	539	32.0	94.1
LPR021712	387	48.0	87.6
LPR022012	246	5.0	98.0
LPR022412	512	43.0	91.6
LPR031012	360	27.0	92.5
LPR031212a	150	18.0	88.0
LPR032912b	370	47.0	87.3
LPR052412	510	43.0	91.6
LPR060112	780	16.0	98.0
LPR060412	580	32.0	94.5
LPR060712	570	120.0	79.0
LPR110612	40.0	10.0	75.0
LPR112312	110	5.0	95.5
LPR113012	230	17.0	92.6
LPR051713	94.0	6.0	93.6
LPR052113	389	24.0	93.8
LPR062513	308	21.0	93.2
LPR013014	170	17.0	90.0
LPR030314	280	95.0	66.1
LPR030814a	173	26.0	85.0
LPR011815	529	72.8	86.2
LPR020215	397	67.0	83.1
Sum	2022		
N (COUNT)	23		
Median	91.6		
STDEV.s	8.99		
VAR.s	80.7		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	89.0		

Performance Claim 4 (TAPE):

Raw data summarizing the percent removal of total phosphorus (TP) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent TP (mg/L)	Average Effluent TP (mg/L)	Percent Removal (%)
LPR021012	0.141	0.104	26.2
LPR021412	0.220	0.062	71.8
LPR021712	0.310	0.067	78.3
LPR022012	0.163	0.026	84.1
LPR022412	0.424	0.070	83.5
LPR031012	0.140	0.049	65.0
LPR031212a	0.150	0.037	75.3
LPR032912b	0.280	0.081	71.1
LPR052412	0.170	0.070	58.8
LPR060112	0.200	0.035	82.5
LPR060412	0.210	0.043	79.5
LPR060712	0.170	0.140	17.6
LPR110612	0.068	0.025	63.2
LPR112312	0.082	0.025	69.5
LPR113012	0.170	0.025	85.3
LPR051713	0.282	0.029	89.9
LPR052113	0.558	0.050	91.1
LPR062513	0.583	0.045	92.2
LPR013014	0.317	0.053	83.3
LPR030314	0.417	0.133	68.1
LPR030814a	0.261	0.051	80.3
LPR011815	0.649	0.124	80.9
LPR020215	0.693	0.100	85.6
Sum	1683		
N (COUNT)	23		
Median	79.5		
STDEV.s	18.5		
VAR.s	343.7		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	79.0		

Performance Claim 5 (TAPE):

Raw data summarizing the percent removal of total nitrogen (TN) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent TN (mg/L)	Average Effluent TN (mg/L)	Percent Removal (%)
LPR021012	1.06	0.265	75.1
LPR021412	1.20	0.531	55.9
LPR021712	1.58	0.638	59.5
LPR022012	0.696	0.265	61.9
LPR022412	1.11	0.265	76.0
LPR031012	1.72	0.265	84.5
LPR031212a	0.760	0.400	47.4
LPR032912b	1.23	0.265	78.5
LPR052412	1.85	0.400	78.4
LPR060112	2.40	0.872	63.7
LPR060412	1.06	0.327	69.1
LPR060712	0.579	0.555	4.1
LPR110612	0.569	0.555	2.5
LPR112312	0.515	0.515	0.0
LPR113012	1.22	0.515	57.6
LPR051713	1.37	0.250	81.8
LPR052113	0.531	0.248	53.4
LPR062513	0.619	0.253	59.2
LPR013014	0.240	0.212	11.8
LPR030314	0.530	0.230	56.6
LPR030814a	0.432	0.080	81.5
LPR011815	0.180	0.110	38.9
LPR020215	2.32	0.370	84.1
Sum	1281		
N (COUNT)	23		
Median	59.5		
STDEV.s	27.0		
VAR.s	727		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	56.0		

Performance Claim 6 (TAPE):

Raw data summarizing the percent removal of total copper (Cu) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Cu (mg/L)	Average Effluent Cu (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	0.032	0.006	81.3
LPR022012	0.014	0.001	92.9
LPR022412	0.032	0.005	84.4
LPR031012	0.019	0.003	84.2
LPR031212a	0.012	0.003	75.0
LPR032912b	0.023	0.004	82.6
LPR052412	0.050	0.050	0.0
LPR060112	0.040	0.003	92.5
LPR060412	0.021	0.003	85.7
LPR060712	0.028	0.010	64.3
LPR110612	0.006	0.003	50.0
LPR112312	0.006	0.001	83.3
LPR113012	0.016	0.002	87.5
LPR051713	0.016	0.003	81.3
LPR052113	0.027	0.006	77.8
LPR062513	0.029	0.005	82.8
LPR013014	0.021	0.004	81.0
LPR030314	0.019	0.006	68.4
LPR030814a	0.018	0.002	88.9
LPR011815	0.055	0.010	81.8
LPR020215	0.044	0.007	84.1
Sum	1610		
N (COUNT)	21		
Median	82.6		
STDEV.s	20.06		
VAR.s	403		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	77.0		

Performance Claim 7 (TAPE):

Raw data summarizing the percent removal of total zinc (Zn) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Zn (mg/L)	Average Effluent Zn (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	0.151	0.034	77.8
LPR022012	0.076	0.011	85.8
LPR022412	0.191	0.031	84.0
LPR031012	0.120	0.022	81.7
LPR031212a	0.068	0.017	75.0
LPR032912b	0.160	0.029	81.9
LPR052412	0.250	0.250	0.0
LPR060112	0.230	0.012	94.8
LPR060412	0.130	0.015	88.5
LPR060712	0.170	0.048	71.8
LPR110612	0.022	0.014	36.4
LPR112312	0.049	0.010	79.6
LPR113012	0.110	0.016	85.5
LPR051713	0.068	0.010	85.2
LPR052113	0.126	0.021	83.5
LPR062513	0.120	0.017	85.5
LPR013014	0.108	0.026	76.1
LPR030314	0.095	0.029	69.8
LPR030814a	0.088	0.013	84.8
LPR011815	0.151	0.039	74.4
LPR020215	0.192	0.038	80.2
Sum	1582		
N (COUNT)	21		
Median	81.7		
STDEV.s	20.69		
VAR.s	428		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	75.0		

Performance Claim 8 (TAPE):

Raw data summarizing the percent removal of total lead (Pb) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Pb (mg/L)	Average Effluent Pb (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	0.013	0.003	73.7
LPR022012	0.005	0.001	79.6
LPR022412	0.015	0.003	77.3
LPR031012	0.009	0.002	78.5
LPR031212a	0.006	0.002	71.9
LPR032912b	0.012	0.003	75.0
LPR052412	0.025	0.025	0.00
LPR060112	0.016	0.005	68.8
LPR060412	0.013	0.001	90.8
LPR060712	0.013	0.005	62.3
LPR110612	0.001	0.001	0.0
LPR112312	0.002	0.001	50.0
LPR113012	0.005	0.001	80.0
LPR051713	0.004	0.001	74.8
LPR052113	0.009	0.009	0.336
LPR062513	0.009	0.002	82.5
LPR013014	0.006	0.001	80.5
LPR030314	0.007	0.003	62.1
LPR030814a	0.005	0.001	71.5
LPR011815	0.015	0.003	81.4
LPR020215	0.011	0.002	81.0
Sum	1342		
N (COUNT)	21		
Median	74.8		
STDEV.s	28.05		
VAR.s	787		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	70.0		

Performance Claim 9 (TAPE):

Raw data summarizing the percent removal of total aluminium (Al) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Pb (mg/L)	Average Effluent Pb (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	9.15	1.86	79.7
LPR022012	2.62	0.319	87.8
LPR022412	9.65	1.99	79.4
LPR031012	6.20	1.10	82.3
LPR031212a	4.30	0.810	81.2
LPR032912b	6.40	1.70	73.4
LPR052412	9.70	1.30	86.6
LPR060112	11.0	0.370	96.6
LPR060412	12.0	1.00	91.7
LPR060712	9.60	4.10	57.3
LPR110612	1.30	0.300	76.9
LPR112312	1.20	0.190	84.2
LPR113012	3.00	0.440	85.3
LPR051713	1.44	0.134	90.7
LPR052113	3.24	0.358	89.0
LPR062513	3.94	0.466	88.2
LPR013014	3.45	0.796	76.9
LPR030314	2.64	1.13	57.2
LPR030814a	1.67	0.342	79.5
LPR011815	5.32	1.17	78.0
LPR020215	3.85	1.20	68.8
Sum	1691		
N (COUNT)	21		
Mean (AVE)	80.5		
STDEV.s	10.13		
VAR.s	103		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized mean	80.0		

Verification

This verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), contracted by GLOBE Performance Solutions, applying the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Contech Engineered Solutions LLC to support the performance claim included the following:

- Performance test report "The Stormwater Management StormFilter® - PhosphoSorb® at a Specific Flow Rate of 1.67 gpm/ft^2 – Performance Evaluation Report" prepared by Contech Engineered Solutions, November 8, 2017. This report is based on a field testing program conducted by Contech personnel at a roadway site in Zigzag, Oregon between January 2012 and February 2015. Testing was conducted in accordance with the 2011 version of the Washington Department of Ecology TAPE (TAPE, 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 The Stormwater Management StormFilter® please contact:

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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

Water Balance

Used for Volume Control	
	Upstream Stormtech sc310
Endcaps/row	2
Rows	2
Length	46.36
Total Length of chambers	47.01
Width	2.478
Approximate Area	116
Number of Chambers	42
Volume	44

Used for Detention and Volume Control	
	Downstream Stormtech sc160
Endcaps/row	2
Rows	2
Length	135.00
Total Length of chambers	135.65
Width	1.87
Approximate Area	254
Number of Chambers	124
Volume	76

upstream stormtech

Project:

top of chamber = 247.76 m

250 mm raised connection on isolator row and outlet is invert of 247.76-.037-.25 = 247.47
volume at 247.47
2nd row outlet invert of approximately 247.38

storage below each outlet is 13 m3 for solids settling storage (16/2+9.3/2=13)

Chamber Model -	SC-310	
Units -	Metric	Click Here for Imperial
Number of chambers -	42	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	247.20	m
Amount of Stone Above Chambers -	152	mm
Amount of Stone Below Chambers -	152	mm
Area of system -	116	sq.meters

Include Perimeter Stone in Calculations

Min. Area - 92.598 sq.meters

Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Total Chamber *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Ch & St *(cubic meters)*	Cumulative Chamber *(cubic meters)*	Elevation *(meters)*
711	0.00	0.00	1.18	1.18	43.549	247.91
686	0.00	0.00	1.18	1.18	42.370	247.89
660	0.00	0.00	1.18	1.18	41.191	247.86
635	0.00	0.00	1.18	1.18	40.012	247.84
610	0.00	0.00	1.18	1.18	38.833	247.81
584	0.00	0.00	1.18	1.18	37.655	247.78
559	0.00	0.07	1.15	1.22	36.476	247.76
533	0.00	0.18	1.11	1.29	35.255	247.73
508	0.01	0.32	1.05	1.37	33.965	247.71
483	0.02	0.65	0.92	1.57	32.597	247.68
457	0.02	0.84	0.84	1.68	31.029	247.66
432	0.02	0.98	0.79	1.77	29.347	247.63
406	0.03	1.10	0.74	1.84	27.579	247.61
381	0.03	1.21	0.70	1.90	25.740	247.58
356	0.03	1.30	0.66	1.96	23.837	247.56
330	0.03	1.37	0.63	2.00	21.876	247.53
305	0.03	1.45	0.60	2.05	19.873	247.50
279	0.04	1.52	0.57	2.09	17.826	247.48
254	0.04	1.58	0.55	2.12	15.737	247.45
229	0.04	1.62	0.53	2.15	13.612	247.43
203	0.04	1.67	0.51	2.18	11.459	247.40
178	0.04	1.71	0.50	2.20	9.277	247.38
152	0.00	0.00	1.18	1.18	7.073	247.35
127	0.00	0.00	1.18	1.18	5.894	247.33
102	0.00	0.00	1.18	1.18	4.715	247.30
76	0.00	0.00	1.18	1.18	3.537	247.28
51	0.00	0.00	1.18	1.18	2.358	247.25
25	0.00	0.00	1.18	1.18	1.179	247.23

TSS Storage Elevation is here i.e the outlet pipe connection.

16 divide by 2 for first row

See page 25 of the manual for SC - 310 End Cap Pipe Connection

https://www.stormtech.com/download_files/pdf/StormTech_SC-160_310_740_780_Design_Manual_09-20.pdf

TSS storage is for the final outlet pipe connection
9.3 divide by 2 for 2nd row.

SC-310 END CAPS

	PIPE DIA.	INV. (IN)	INV. (FT)	INV. (MM)
TOP	6 (150 mm)	5.8	0.48	146
	8 (200 mm)	3.5	0.29	88
	10 (250 mm)	1.4	0.12	37
BOTTOM	6 (150 mm)	0.5	0.04	12
	8 (200 mm)	0.6	0.05	15
	10 (250 mm)	0.7	0.06	18
	12 (750 mm)	0.9	0.08	24

Project: Downstream stormtech

Chamber Model -	SC-160	
Units -	Metric	Click Here for Imperial
Number of chambers -	124	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	245.67	m
Amount of Stone Above Chambers -	152	mm
Amount of Stone Below Chambers -	152	mm
Area of system -	254	sq.meters

Include Perimeter Stone in Calculations

Min. Area - 170.866 sq.meters

Volume that can be filtered.

Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Total Chamber *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Ch & St *(cubic meters)*	Cumulative Chamber *(cubic meters)*	Elevation *(meters)*
610	0.00	0.00	2.58	2.58	76.343	246.28
584	0.00	0.00	2.58	2.58	73.764	246.25
559	0.00	0.00	2.58	2.58	71.185	246.23
533	0.00	0.00	2.58	2.58	68.605	246.20
508	0.00	0.00	2.58	2.58	66.026	246.18
483	0.00	0.00	2.58	2.58	63.447	246.15
457	0.00	0.18	2.51	2.69	60.867	246.13
432	0.00	0.47	2.39	2.86	58.180	246.10
406	0.01	1.02	2.17	3.19	55.317	246.08
381	0.01	1.55	1.96	3.51	52.126	246.05
356	0.02	1.89	1.82	3.72	48.616	246.03
330	0.02	2.16	1.71	3.88	44.900	246.00
305	0.02	2.39	1.62	4.01	41.022	245.97
279	0.02	2.58	1.55	4.13	37.009	245.95
254	0.02	2.75	1.48	4.23	32.879	245.92
229	0.02	2.90	1.42	4.32	28.649	245.90
203	0.02	3.02	1.37	4.39	24.332	245.87
178	0.03	3.14	1.32	4.46	19.940	245.85
152	0.00	0.00	2.58	2.58	15.476	245.82
127	0.00	0.00	2.58	2.58	12.897	245.80
102	0.00	0.00	2.58	2.58	10.317	245.77
76	0.00	0.00	2.58	2.58	7.738	245.75
51	0.00	0.00	2.58	2.58	5.159	245.72
25	0.00	0.00	2.58	2.58	2.579	245.70

outlet elevation

See page 25 of the manual for SC - 160 End Cap Pipe Connection

https://www.stormtech.com/download_files/pdf/StormTech_SC-160_310_740_780_Design_Manual_09-20.pdf

SC-160LP END CAPS

PIPE DIA.	INV. (IN)	INV. (FT)	INV. (MM)
6 (150mm)	0.66	0.05	16
8 (200mm)	0.80	0.07	20
8 (200mm) Cored	0.96	0.08	24

	5 mm Volume Control Requirement
	521 Huronia Road 19082
Prepared By Tim Ng	June 18 2021

Site Area =	11321	m^2
Rainfall Depth to be Retained over Impervious Surfaces =	5.0	mm
Impervious Area =	6480	m^2
Impervious Percentage =	57%	
Total Rainfall Volume to be Treated =	**32.4**	**m^3**
Stormtech Filtration Volume=	**33.0**	**m^3**

*Isolator Row is one of the two rows of the stormtech storage system and is therefore approximately half the volume of the Stormtech system

Appendix D

Hydrogeological Assessment (Excerpts)

Water Balance

1. Climate Information *(for LSRCA use the rate provided on their website)*

Precipitation	914	mm/a	0.91	m/a
Evapotranspiration	545	mm/a	0.55	m/a
Water Surplus	369	mm/a	0.37	m/a

2. Infiltration Rates

Table 2 Approach - Infiltration Factors

Hilly land, average slope of 28 to 47 m per km	0.1
Open Sandy Loam	0.4
Woodland	0.2
TOTAL:	0.7

Infiltration (Infil. Fac - Water Surplus)	258.3	mm/a	0.2583	m/a
Run-off (Water Surplus - B19)	111	mm/a	0.1107	m/a

Table 3 Approach - Typical Recharge Rates

silty sand to sandy silt	150 - 200	mm/a
silt	125 - 150	mm/a
clayey silt	100 - 125	mm/a

The site development area is underlain by silty sand to silty clay till.

Based on the above, the recharge rate is	125	mm/a	0.125	m/a
with runoff of	244	mm/a	0.244	m/a

Property Statistics

3. Pre- Development Site Coverage

Area Covered by Existing Building	0	m^2	0.00	ha
Area Covered by Existing Hard Surface Paving	0	m^2	0.00	ha
Area Covered by Existing Landscaped area	11,092	m^2	1.11	ha
TOTAL	11,092	m^2	1.11	ha

4. Post-Development Coverage

Area Covered by Building with Additions	2,731	m^2	0.27	ha
Area Covered by Hard Surface Paving	3,750	m^2	0.38	ha
Area Covered by Landscaped Area	4,611	m^2	0.46	ha
TOTAL:	11,092	m^2	1.11	ha

Water Balance

5. Annual Water Balance Before Building Additions

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building (entire site)	0	0	-	-	-	-
Hard Surface Paving	0	0	-	-	-	-
Landscape Area (entire site)	11,092	10,138	6,045		1,387	2,706
TOTAL	**11,092**	**10,138**	**6,045**	**0**	**1,387**	**2,706**

6. Annual Water Balance After Building Additions

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building (entire site)	2,731	2,496	-	-	-	2,496
Hard Surface Paving	3,750	3,428	-	-	-	3,428
Landscape Area (entire site)	4,611	4,214	2,513	-	576	1,125
TOTAL	**11,092**	**10,138**	**2,513**	**0**	**576**	**7,049**

7. Comparison of Pre-Development (before buidling additions) and Post-Development (after building additions)

	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Pre-Development	10, 138	6,045	-	1,387	2,706
Post-Development	10,138	2,513	-	576	7,049
				811	

8. Requirement for Infiltration of Roof Runoff

Volume of roof (building additions) run-off captured (90%)	2,496	m^3
Volume of post-development infiltration without roof run-off	576	m^3
Volume of roof run-off required to match pre-development infiltration rates	811	m^3
Percentage of roof run-off (building additions roof) required to match pre-development infiltration	32%	