

FUNCTIONAL SERVICING REPORT

IN SUPPORT OF AN OFFICIAL PLAN AMENDMENT
AND ZONING BY-LAW AMENDMENT APPLICATIONS

Loon Avenue Lands

Proposed Townhome Community

City of Barrie, Ontario

counterpoint
ENGINEERING



Prepared For:

8395 Jane Street, Suite 100
Vaughan, Ontario L4K 5Y2
Tel: (905) 326-1404

Loon Avenue Lands OP Inc.

File Number: 21076

2	Issued For 2 ND Submission	May 5, 2023
1	Issued For 1 st Submission	February 10, 2022
No.	Revision	Date



EXECUTIVE SUMMARY

This Functional Servicing Report has been prepared on behalf of Loon Avenue Lands OP Inc., the registered owner of the subject land.

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

WATER SERVICING:

There is an existing 150mm $\varnothing$ watermain running along Loon Avenue to the north of the site that transitions to a 200mm $\varnothing$ watermain before connecting into an existing 300mm $\varnothing$ watermain on Huronia Road to the west. The adjacent 521 Huronia Road development to the west of the subject site will be constructed before currently proposed development will proceed and will connect to the existing 300mm $\varnothing$ watermain plug on Huronia Road. A looped connection to Loon Avenue through the northwest corner of the subject site will be provided as part of that development.

The proposed development will be serviced through a connection to the existing 150mm $\varnothing$ watermain on Loon Avenue and future connection to the watermain in the northwest corner of the site provided by the development of the adjacent 521 Huronia Road lands. The watermain through 521 Huronia Avenue will connect into the existing 300mm $\varnothing$ watermain on Huronia Road. A 200mm $\varnothing$ watermain network is proposed internally to service the site. Based on the watermain analysis prepared, the proposed watermain system will have adequate flow and pressure to service the proposed development under all applicable conditions including max day, peak hour, and max day + fire flow. The proposed water distribution system for the development shall adequately provide max day + fire flow demand while maintaining a residual pressure of over 140 kPa, as per the Fire Underwriter's Survey. Therefore, no external upgrades or retrofits are anticipated for the existing surrounding watermain network to service the proposed development.

SANITARY SERVICING:



There is an existing 250mm $\varnothing$ sanitary sewer on Loon Avenue beginning at a manhole located on the intersection at Huronia Road and drains from west to east. There is an existing manhole located approximately 180m east-northeast of the site on the adjacent City owned property with a west invert of 236.21. The site does not currently have any available sanitary sewer connection nor any available local sewer along the frontage.

The site will be serviced by an existing sanitary manhole located approximately 180m east-northeast of the site on the adjacent City owned property. The proposed peak design flow from the subject site to the existing 250mm sanitary system is **4.87 L/s**. Based on review of the available sanitary design sheet for the subdivision, the local sewers 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 $\varnothing$ storm sewer on Loon Avenue flowing west to east that drains into an existing 750mm $\varnothing$ storm sewer downstream. The proposed residential development will be serviced through surface conveyance and a minor storm sewer system. Stormwater flows will be directed east towards the existing wetland.

The proposed site release rate during the 100-year storm event will be controlled to the maximum allowable release rate of 209 L/s. This results in **639m³** of required storage within the site. The required storage will be provided by the green storm module system or stormtech chamber system.

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.

The resulting phosphorus offsetting cost is as follows:



$$0.69 \text{ kg/yr} \times 2.5 \text{ offset ratio} \times \$35,770 \text{ kg/yr} = \$61,703.25$$

$$\text{Total Cost} = \$61,703.25 + \$9,255.49 = \mathbf{\$70,958.74}$$

Volume control will be provided by the stormtech chamber isolator row meeting a minimum filtration treatment volume of 5mm from all impervious areas. Infiltration potential from the stormtech chamber is to be explored in areas of significant engineered fill when 1.0m groundwater separation from the stormtech chambers can be achieved.

The Water Balance Offsetting Fee has been calculated assuming infiltration will not be possible and can be revisited pending confirmation of the high groundwater table. Based on the fee schedule, the calculation is as follows:

$$2873 \text{ m}^3/\text{year} \times \$44.97 \text{ costs/m}^3 = \$129,198.81;$$

$$\text{Administration Fee} = 15\% \times 129,198.81 = \$19,379.82$$

$$\text{Total Fee} = \$129,198.81 + \$19,379.82 = \mathbf{\$149,578.63}$$

In accordance with the offsetting policies, the greater of the Water Balance Offset Fee and the Phosphorus Offsetting Fee will be payable. For the contemplated development proposal, it is expected that the Water Balance Offsetting Fee will be payable.



TABLE OF CONTENTS

Executive Summary	2
Table of Contents	5
List of Figures	6
List of Appendices	6
1.0 Introduction	7
1.1 <i>Background</i>	7
1.2 <i>Study Parameters</i>	8
2.0 Water Supply	9
2.1 <i>Existing Water Supply</i>	9
2.2 <i>Proposed Water Supply</i>	9
2.3 <i>Watermain Modeling</i>	12
3.0 Sanitary Servicing	14
3.1 <i>Existing Sanitary Servicing</i>	14
3.2 <i>Proposed Sanitary Servicing</i>	14
3.3 <i>Downstream Sanitary Analysis</i>	14
4.0 Stormwater Servicing	16
4.1 <i>Existing Stormwater Drainage</i>	16
4.2 <i>Allowable Release Rate</i>	16
4.3 <i>Proposed Stormwater Servicing</i>	17
4.4 <i>Proposed Stormwater Management</i>	18
4.4.1 <i>Quantity Control</i>	18
4.4.2 <i>Quality Control</i>	20
4.4.2.1 <i>Total Suspended Solids</i>	20
4.4.2.2 <i>Phosphorus control</i>	20
4.4.3 <i>Water Balance</i>	23
4.4.4 <i>Volume Control</i>	23
5.0 Site Grading	25
6.0 Future Development	26

**7.0 Conclusions27****LIST OF FIGURES**

Figure 1	Site Location
Figure 2	General Plan
Figure 3	Water Servicing Plan
Figure 4	Sanitary Servicing Plan
Figure 5	Storm Servicing Plan
Figure 6	Conceptual Grading Plan
Figure SWM-1	Pre-Development Drainage Plan
Figure SWM-2	Post-Development Drainage Plan
Figure WB-1	Pre-Development Water Balance Plan
Figure WB-2	Post-Development Water Balance Plan

LIST OF APPENDICIES

Appendix A	Water Demand Calculations and Watermain Modeling Results
Appendix B	Sanitary Design Flow Calculations
Appendix C	Stormwater Management Design Calculations
Appendix D	Hydrogeological Assessment (Excerpts)



1.0 INTRODUCTION

1.1 Background

This Functional Servicing Report has been prepared on behalf of Loon Avenue Lands OP Inc. in support of an official plan amendment and zoning by-law amendment applications for the proposed 5 acre Loon Avenue Townhome Community. The total gross area of the subject lands is 11.57 ha (28.59 acres) and the developable land area is 3.34 ha (8.25 acres). This application proposes to construct a new townhouse development. The purpose of this report is to demonstrate that the existing infrastructure within the surrounding area can accommodate the proposed development. The remainder of the site will be designated as Environmental Protection (EP) land. The calculations in this report will be based on the proposed developable area of 3.34 ha within the proposed development limit.

The subject site lies within the City of Barrie. It is in the southeast corner of Huronia Road and Loon Avenue. The site is bounded by single detached dwellings along Loon Ave to the north, undeveloped forest area to the east, and undeveloped forest/wetland to the south and west. **Figure 1 – Site Location** illustrates the subject site within the context of its surroundings. The proposed Loon Avenue Lands Townhome Community consists of 189 townhouse units, a proposed driveway, surface parking, and landscape features as shown on **Figure 2 – General Plan**. The proposal includes a 5.0m buffer from the limit of the wetland.

The existing site primarily consists of treed and wetland areas. The site generally slopes from northwest to southeast, as identified on **Figure SWM-1 – Pre-Development Drainage Plan**.



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,
- LSRCA Technical Guidelines for Stormwater Management Submissions, Lake Simcoe Region Conservation Authority
- Design Guidelines for Drinking-Water Systems prepared by Ministry of the Environment, Conservation and Parks 2019
- DRAFT Hydrogeological Report prepared by Grounded Engineering, dated May 2023



2.0 WATER SUPPLY

2.1 Existing Water Supply

There is an existing 150mm ø watermain running along Loon Avenue to the north of the site that transitions to a 200mm ø watermain before connecting into an existing 300mm ø watermain on Huronia Road to the west. The adjacent 521 Huronia Road development to the west of the subject site will be constructed before currently proposed development will proceed and will connect to the existing 300mm ø watermain plug on Huronia Road. A looped connection to Loon Avenue through the northwest corner of the subject site will be provided as part of that development. Existing and external land's watermain infrastructure are shown on **Figure 3 – Water Servicing Plan**.

Hydrant flow testing records from 2020 were provided by Vipond Inc. and have been used to evaluate the theoretical fire flow available for the site. Refer to **Appendix A** for the hydrant flow test.

2.2 Proposed Water Supply

The proposed development will be serviced through a connection to the existing 150mm ø watermain on Loon Avenue and future connection to the watermain in the northwest corner of the site provided by the development of the adjacent 521 Huronia Road lands. The watermain through 521 Huronia Avenue will connect into the existing 300mm ø watermain on Huronia Road. A 200mm ø watermain network is proposed internally to service the site. Check valves and chambers are required at the connection to the municipal watermain on Loon Avenue and Huronia road.

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. Hydrants shall be proposed on the site to provide



adequate fire protection coverage. 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 state 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 (Ministry of Environment, Conservation and Parks) . Refer to **Appendix A** for the supporting calculations of the proposed flows. The calculated daily demands for the proposed development are as follows:

Residential:

- Average Day Demand = 68 L/min
- Maximum Hour Demand = 281 L/min
- Maximum Day Demand = 187 L/min

The Fire Underwriter's Survey (FUS) guidelines were used to calculate the fire flow requirements of the residential site. The proposed stacked townhouse blocks are to have fire rated separation as required by the OBC. As the architectural details for the units are yet to be detailed, fire breaks have been assumed to achieve the required maximum GFA of 600m² between proposed fire breaks. It is currently assumed that the townhouses will not use a sprinkler system. Calculations have been conservatively assumed for the purposes of evaluating fire flow demand and can be further refined in future submissions when more information is available. Therefore, the size of the proposed watermain may be reduced in subsequent submissions. The calculations for water demand and fire flow are summarized in **Table 2.2** below. The watermain analysis for the site is included in report sections below.. Refer to **Appendix A** for the water and fire flow demand calculations.

**Table 2.2 – Proposed Conditions Water and Fire Flow Demand Results**

Block Number	Maximum Day Demand (L/s)	Maximum Hour Demand (L/s)
Block 1	0.201	0.302
Block 2	0.268	0.403
Block 3	0.268	0.403
Block 4	0.134	0.201
Block 5	0.134	0.201
Block 6	0.235	0.352
Block 7	0.101	0.151
Block 8	0.084	0.126
Block 9	0.134	0.201
Block 10	0.201	0.302
Block 11	0.235	0.352
Block 12	0.268	0.403
Block 13	0.134	0.201
Block 14	0.134	0.201
Block 15	0.134	0.201
Block 16	0.034	0.050
Block 17	0.151	0.227
Block 18	0.067	0.101
Block 19	0.067	0.101
Block 20	0.134	0.201

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

- Maximum pressure during the minimum hourly demand = 700 kPa (100 psi)
- Minimum pressure during maximum hour demand = 275 kPa (40 psi)
- Minimum Fire Flow pressure during simultaneous maximum day demand plus fire flow = 140 kPa (20 psi).



A watermain model has been prepared to analyze the proposed development watermain network to determine if the existing infrastructure has adequate pressure and flow to service the site in all applicable conditions. The results are summarized in Section 2.3 below.

2.3 Watermain Modeling

Hydrant flow testing and modeling using EPANET has been performed to evaluate the capacity and available pressures in the existing watermain infrastructure to service the proposed watermain network. The model was prepared with two connections to the existing surrounding watermain infrastructure as describe above – one at Huronia Road (connected via a proposed stub provided by the adjacent 521 Huronia Road development) and one at Loon Avenue.

The hydrant flow tests results were used to establish the boundary conditions. A hydrant test was taken at hydrant on Huronia Road and at a hydrant on Loon Ave to establish the respective boundary conditions that were used to generate flow curves that were inputted into the model. Refer to **Appendix A** for the hydrant flow test results.

The model was run based on the maximum daily demand, peak hour demand and simultaneous maximum day plus fire flow demand for proposed conditions. The maximum day plus fire flow conditions have been run at the most critical blocks observed in the development based on the location of the block within the site as well as the total fire demand. Multiple scenarios were analyzed for fire flow to ensure the entire development can be serviced with the existing network. In addition, the adjacent 521 Huronia Road development has been included in the EPANET model watermain analysis. The respective demands at each scenario have been inputted into the model. Selected critical blocks within the adjacent 521 Huronia Road development have also been analyzed for fire flow conditions to ensure the entire system can be serviced with the surrounding infrastructure.

The results of the most critical pressures of the water distribution modeling are summarized in **Tables 2.3.1** and **2.3.2** below.

**Table 2.3.1 – Proposed Conditions Residual Pressures During Non-Fire Flow Scenarios**

Scenario	Lowest Pressure			Satisfies Pressure Requirements?
	Pressure (m H ₂ O)	Pressure (psi)	Pressure (kPa)	
Max. Day	50.12	71.27	491.38	Yes
Peak Hour	50.10	71.24	491.19	Yes

Table 2.3.2 – Proposed Conditions Residual Pressures During Fire Flow Scenarios

Fire Flow Location	Max. Day + Fire Flow requirements (L/s)	Max. Velocity (m/s)	Lowest Pressure			Satisfies Fire Flow Requirements?
			Pressure (m H ₂ O)	Pressure (psi)	Pressure (kPa)	
Block 3 / J19, J22	283.60	2.88	44.10	62.71	432.36	Yes
Block 5 / J22, J25	183.47	2.06	48.84	69.45	478.83	Yes
Block 10 / J25, J28	216.87	2.27	46.73	66.45	458.15	Yes
Block 11 / J28, J35	250.23	2.49	44.43	63.18	435.60	Yes
<i>EXT - Huronia Block 5 / J6</i>	150.302	3.21	46.60	66.26	456.87	Yes
<i>EXT - Huronia Block 6 / J9</i>	100.101	1.77	49.49	70.37	485.21	Yes

Refer to **Appendix A** for the calculation details and full model outputs. The hydrant flow test and modelling results demonstrate that available flow in the municipal watermain will satisfy the water demand of the proposed development.

Based on the watermain analysis prepared, the proposed watermain system will have adequate flow and pressure to service the proposed development under all applicable conditions including max day, peak hour, and max day + fire flow. The proposed water distribution system for the development shall adequately provide max day + fire flow demand while maintaining a residual pressure of over 140 kPa, as per the Fire Underwriter's Survey. Therefore, no external upgrades or retrofits are anticipated for the existing surrounding watermain network to service the proposed development.



3.0 SANITARY SERVICING

3.1 Existing Sanitary Servicing

There is an existing 250mm $\varnothing$ sanitary sewer on Loon Avenue beginning at a manhole located on the intersection at Huronia Road and drains from west to east. There is an existing manhole located approximately 180m east-northeast of the site on the adjacent City owned property with a west invert of 236.21. The site does not currently have any available sanitary sewer connection nor any available local sewer along the frontage.

3.2 Proposed Sanitary Servicing

The site will be serviced by an existing sanitary manhole located northeast of the site on the adjacent property. Refer to **Figure 4** – Sanitary Servicing Plan for the proposed sanitary sewer layout.

Contributing sanitary flows from the proposed development are calculated based on the City of Barrie's sanitary guidelines. The proposed peak design flow from the subject site to the existing 250mm sanitary system is **4.87 L/s**. Based on review of the available sanitary design sheet for the subdivision, the local sewers downstream to the Lover's Creek Trunk sewer have adequate capacity to accommodate the subject site. Refer to **Appendix B** for supporting sanitary calculations. A downstream sanitary capacity analysis has been performed to assess the capacity of the existing downstream sewers and the results are discussed in **Section 3.3** below. When modeled under ultimate conditions, the downstream sanitary sewers record no surcharging conditions up to the Lovers Creek trunk sewer.

3.3 Downstream Sanitary Analysis

A downstream sanitary analysis was prepared for the proposed development to assess the sanitary capacity of the downstream sewers along Loon Avenue and the downstream sanitary easement. The analysis considers the upstream contributing sanitary drainage areas down to



the trunk sewer. Existing drainage plans, infrastructure maps and as-built drawing information was received from the City and were used to construct the sanitary design sheet analysis. The existing drainage plans and latest existing sanitary design sheet has been included in **Appendix D**. It has been assumed that the approved drawings and drainage plans received contain accurate information to be used for the analysis. Current development applications needed to be added to the design sheet to reflect the current existing conditions. One current development application has been identified upstream of the subject site that contributes to the downstream sanitary sewers, which has been mentioned previously and is referred to as 521 Huronia Road. This development has been included and identified in the overall sanitary design sheet included in **Appendix D**.

Based on the re-created existing sanitary design sheet, with the current development application added in, the total flow contributing to the trunk sewer from the contributing sanitary sewers is **30.17 L/s**. This flow results in the last sanitary sewer leg downstream to be at **68%** full. In the proposed conditions, the total contributing flow result is **37.61 l/s**. This results in an increase in sanitary flow of **4.87 L/s** and increases the sanitary operating capacity to **76.4%** full. There is a small increase in sanitary flows resulting from the proposed development and based on the analysis, there is no surcharging anticipated in the existing downstream sanitary sewers. The peak flow to flow full ratio is just above the City of Barrie criteria that requires upsizing once 70% flow full capacity is reached. However, upsizing is not recommended for the following reasons;

- The last leg of sewer prior to connecting to the Lovers Creek trunk sewer is a creek crossing. Upsizing would result in high cost compared with the benefit,
- the drainage area appears to be developed close to its full potential with the development proposal of the subject site and the adjacent 521 Huronia Avenue lands,
- the actual flows are typically much less than theoretical flows,
- and the downstream length of sewer are several hundred meters downstream of the nearest basement connection.

Therefore, the existing sanitary sewers have adequate capacity to service the proposed development. Refer to calculations in **Appendix D**.



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 a wetland feature. Existing drainage generally sheet drains 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 SWM-1** – Pre-Development Drainage Areas). The existing drainage areas are summarized in **Table 4.1** below.

Based on the City of Barrie's specified runoff coefficient standards, the pre-development existing site characteristics are as follows:

Table 4.1 – Pre-Development Drainage Areas

Area ID	Area (ha)	Runoff Coefficient
101	3.34	0.20

4.2 Allowable Release Rates

As per the City of Barrie and LSRCA design criteria the site will control peak runoff flows from the 2-year to the 100-year storm events under post-development conditions to the corresponding pre-development release rates or less.

The allowable discharge from the subject site is calculated as follows: $Q_A = C \times A \times i$ (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)	154	202	235	303	366	418

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

4.3 Proposed Stormwater Servicing

The proposed residential development will be serviced through surface conveyance and a minor storm sewer system. Stormwater flows will be directed east towards the existing wetland. The stormwater outlet for the site will require discharge to the existing wetland areas near the southeast corner of the site.

On-site stormwater flows from Area 201 will be conveyed along the private road and collected by a private storm sewer system and directed towards the proposed storage chamber located under proposed Street 'D'. Controlled storm flows from the underground storage chamber will be treated for quality and phosphorus via a Stormfilter unit and will be further discharge to Block 16 (e.g., wetland setback area) through a proposed level spreader. The level spreader shall allow for safe conveyance of the discharged stormwater to the wetland and will mitigate the potential erosion.

The remaining 0.96 ha of the site, Area 202, shall remain uncontrolled due to grading constraints which will consist of landscape areas and some rooftop areas, which are considered to be clean. The uncontrolled Area 202 located around the perimeter of the developed site will sheet flow into the adjacent wetland. The grading of the parkette area will not permit drainage from the parkette to be treated by the stormwater management system. As a result this report recommends that the pathways and ground cover in the vicinity of the amenities area be pervious surface and thereby drain uncontrolled toward the proposed EP lands to the south. Refer to **Figure SWM-2 – Post-Development Drainage Plan**.



A conveyance swale is proposed along the north property line to collect external drainage from the rear yards of existing single-family dwellings that front Loon Avenue. The outlet of the swale will be designed as part of detailed design.

Refer to **Figure 5 – Stormwater Servicing** for the proposed stormwater servicing strategy.

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. Under post-development conditions, for the purposes of this report, the controlled portion of the site will be represented as a single drainage area that will be controlled to the required release rates. During detailed design, the site may be divided further into separate drainage areas, for example, according to the drainage to each LID feature. The site shall be shown as one drainage area for clarity and simplicity in the calculations for the current application submission. Refer to **Figure SWM-2** for the post-development drainage plan. **Table 4.4** below summarizes the proposed peak flows for each storm event and associated storage requirements for the proposed development. The storage provided is based on the footprint of the largest primary LID / storage feature for the site. The storage provided in the small LID features on-site have been excluded from cumulative storage calculations, as a conservative approach.



Table 4.4 – Post-Development Peak Flow and Storage Summary – Area 201

Storm Event	Allowable Release Rate (L/s)*	Storage Required (m ³)	Storage Provided (m ³)	Total Site Release Rate (L/s)
2-Year	69	303	763	69
5-Year	90	407	763	90
10-Year	105	476	763	105
25-Year	140	576	763	140
50-Year	178	594	763	178
100-Year	209	639	763	209

**Note: Allowable release rates are calculated by subtracting the uncontrolled flows from the pre-development flows with the corresponding storm events*

The proposed site release rate during the 100-year storm event will be controlled to the maximum allowable release rate of 209 L/s. This results in **639m³** of required storage within the site. The required storage will be provided by the green storm module system or stormtech chamber system. The release rates shall be controlled by an outlet structure. Based on the outlet structure, a maximum of 639m³ of storage shall be utilized in the 100-year storm. The specific orifice control sizes can be provided at detailed design stage. Refer to **Appendix C** for storage volume calculations. The preliminary storage system top elevation can be as high as approximately 244.40m, while still providing frost cover. The preliminary storm outfall invert will be 242.75m, to be confirmed at detailed design.

The release rates shall be controlled by an orifice control plate welded and bolted into the inside of the tank outlet at a low elevation, that outlet to the Storm filter unit downstream. Conceptual size for the orifice was calculated to be 120mm. 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.

Emergency flows exceeding the conveyance capacity of the proposed swales and storage features will be directed overland towards the existing wetland. Refer to **Appendix C for storage volume calculations.**



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 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 most 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 of the filter cartridges and reduce overall maintenance requirements. 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 where the bottom elevation is less than 1m from the high-water table. Uncontrolled areas consisting of landscape, parkette and roof runoff is considered clean and do not require quality control. See **Appendix D** for Hydrogeological report excerpts.

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 3.34ha site, the resulting phosphorus loading was 0.20 kg/yr.

Under proposed conditions, the site is comprised of high intensity residential development for the purposes of the phosphorus loading calculation. The resulting phosphorus loading under



post-development conditions without mitigation is 4.41 kg/yr. The treatment provided by the Stormfilter system with Phosphosorb media 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 an additional 65% phosphorus removal, the Phosphosorb media plus the vegetative filter strip provide a treatment train approach with an overall removal of 93% (conservatively coded in as 86% on the phosphorus loading tool). The resulting phosphorus loading is 0.89 kg/yr. 3.52 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 $0.89 - 0.20 = 0.69$ kg/yr. Refer to **Appendix C** for the phosphorus loading calculations. Therefore, the cash-in-lieu calculation is as follows:

$$0.69 \text{ kg/yr} \times 2.5 \text{ offset ratio} \times \$35,770 \text{ kg/yr} = \$61,703.25$$

$$\text{Administration Fee} = \$61,703.25 \times 15\% = \$9,255.49$$

$$\text{Total Cost} = \$61,703.25 + \$9,255.49 = \textbf{\$70,958.74}$$

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 Stormfilter 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

The proposed development water balance shall take a best-efforts approach given the site constraints. Due to the presence of high groundwater and the compact physical layout of buildings and servicing, 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 **4,169 m³/year** of infiltration, while the post-development conditions indicate an infiltration of **1,296 m³/year**. This results in an anticipated water balance deficit of **2,873 m³/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:

$$2873 \text{ m}^3/\text{year} \times \$44.97 \text{ costs/m}^3 = \$129,198.81;$$

$$\text{Administration Fee} = 15\% \times 129,198.81 = \$19,379.82$$

$$\text{Total Fee} = \$129,198.81 + \$19,379.82 = \$149,578.63$$

4.4.4 Volume Control

The volume control target is on-site treatment / filtration of 25mm from all impervious area for the site. For the subject site there is approximately 13,000 m² of impervious area (asphalt and side walks) and approximately 10,000m² of building area (areas rounded up to the nearest 500 m² for the purposes of functional design). The 25mm volume control target for 23,000 m² is to retain or treat the first 575 m³ from each storm event.

For constrained sites, 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 as per LSRCA guidelines section 3.2.6. 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 applicable to the proposed development for further on-site retention are:

- High Groundwater Table
- Property, Spatial and Infrastructure restrictions

The layout of the townhouse community development is compact and guided by the developable area adjacent to the wetland. The dwellings, road and proposed servicing trenches limit the available space for infiltration measures.

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. Refer to the Hydrogeological Assessment prepared by Grounded Engineering Inc. for further details.

Where infiltration measures are not feasible, Filtration treatment is accepted as a secondary method for meeting volume control. The volume of filtration treatment must match at minimum the 5 mm depth over all proposed impervious areas of the site with the intent to treat as much as possible up to the 25mm target. The minimum 5mm target volume for filtration is **113.9 m³**.

It is proposed to implement Stormtech Isolator rows throughout the entirety of the stormwater conveyance system layout as shown on **Figure No 5**. Subject to ongoing groundwater monitoring, this system will be lined with an impermeable liner where separation from the groundwater is less than 1.0m. The Stormtech tank will be sized for at least 639 m³ of total storage per quantity control requirements. The isolator row can be sized to ensure a minimum volume of 113.9 m³ will be treated via filtration before stormwater will flow to the main storm system for conveyance and ultimately to the Stormfilter and outlet to the vegetated filter strip. The Stormtech Isolator rows have 80% TSS removal capabilities as per ETV testing. Subject



to final high groundwater levels, infiltration may be possible in areas of significant engineered fill where the bottom of storm filter tank can be shown 1m above the high ground water table. 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 parkette is contemplated to be constructed with impervious ground cover materials. Thus, all impervious areas are being treated by an LID method to aid in volume control.

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 6** – Conceptual Grading Plan.



6.0 FUTURE DEVELOPMENT

Currently, it is anticipated that the adjacent lands to the west, known as the 521 Huronia Road development shall be constructed prior to the subject site, however the phasing/timeline of the development is currently uncertain. It is possible that these external lands shall be developed prior to or in conjunction with the proposed development. This shall be a residential townhome development that proposes an access from Huronia Road and shall also drain towards the existing wetland.

As mentioned previously, the adjacent proposed 521 Huronia Road development shall provide a watermain servicing stub to service the subject site and therefore is co-dependent with the proposed development of these lands. Further provisions can be explored between the adjacent development and the subject site if required. If the properties are developed together, there is an opportunity to convey sanitary flows from the 521 Huronia through the Loon Avenue Lands to the downstream sanitary sewer. The benefit of this arrangement would be less sanitary sewer required to service the two properties and adding the sanitary flows from the two developments at the furthest possible downstream location.



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 150mm $\varnothing$ watermain running along Loon Avenue to the north of the site that transitions to a 200mm $\varnothing$ watermain before connecting into an existing 300mm $\varnothing$ watermain on Huronia Road to the west. The adjacent 521 Huronia Road development to the west of the subject site will be constructed before currently proposed development will proceed and will connect to the existing 300mm $\varnothing$ watermain plug on Huronia Road. A looped connection to Loon Avenue through the northwest corner of the subject site will be provided as part of that development.

The proposed development will be serviced through a connection to the existing 150mm $\varnothing$ watermain on Loon Avenue and future connection to the watermain in the northwest corner of the site provided by the development of the adjacent 521 Huronia Road lands. The watermain through 521 Huronia Avenue will connect into the existing 300mm $\varnothing$ watermain on Huronia Road. A 200mm $\varnothing$ watermain network is proposed internally to service the site. Based on the watermain analysis prepared, the proposed watermain system will have adequate flow and pressure to service the proposed development under all applicable conditions including max day, peak hour, and max day + fire flow. The proposed water distribution system for the development shall adequately provide max day + fire flow demand while maintaining a residual pressure of over 140 kPa, as per the Fire Underwriter's Survey. Therefore, no external upgrades or retrofits are anticipated for the existing surrounding watermain network to service the proposed development.

SANITARY SERVICING:



There is an existing 250mm $\varnothing$ sanitary sewer on Loon Avenue beginning at a manhole located on the intersection at Huronia Road and drains from west to east. There is an existing manhole located approximately 180m east-northeast of the site on the adjacent City owned property with a west invert of 236.21. The site does not currently have any available sanitary sewer connection nor any available local sewer along the frontage.

The site will be serviced by an existing sanitary manhole located approximately 150m east-northeast of the site on the adjacent City owned property. The invert of the manhole is 236.21. The proposed peak design flow from the subject site to the existing 250mm sanitary system is **4.87 L/s**. Based on review of the available sanitary design sheet for the subdivision, the local sewers 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 $\varnothing$ storm sewer on Loon Avenue flowing west to east that drains into an existing 750mm $\varnothing$ storm sewer downstream. The proposed residential development will be serviced through surface conveyance and a minor storm sewer system. Stormwater flows will be directed east towards the existing wetland.

The proposed site release rate during the 100-year storm event will be controlled to the maximum allowable release rate of 209 L/s. This results in **639m³** of required storage within the site. The required storage will be provided by the green storm module system or stormtech chamber system.

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.



The resulting phosphorus offsetting cost is as follows:

$$0.69 \text{ kg/yr} \times 2.5 \text{ offset ratio} \times \$35,770 \text{ kg/yr} = \$61,703.25$$

$$\text{Total Cost} = \$61,703.25 + \$9,255.49 = \textbf{\$70,958.74}$$

Volume control will be provided by the stormtech chamber isolator row meeting a minimum filtration treatment volume of 5mm from all impervious areas. Infiltration potential from the stormtech chamber is to be explored in areas of significant engineered fill when 1.0m groundwater separation from the stormtech chambers can be achieved.

The Water Balance Offsetting Fee has been calculated assuming infiltration will not be possible and can be revisited pending confirmation of the high groundwater table. Based on the fee schedule, the calculation is as follows:

$$2873 \text{ m}^3/\text{year} \times \$44.97 \text{ costs/m}^3 = \$129,198.81;$$

$$\text{Administration Fee} = 15\% \times 129,198.81 = \$19,379.82$$

$$\text{Total Fee} = \$129,198.81 + \$19,379.82 = \$149,578.63$$

In accordance with the offsetting policies, the greater of the Water Balance Offset Fee and the Phosphorus Offsetting Fee will be payable. For the contemplated development proposal, it is expected that the Water Balance Offsetting Fee will be payable.

**Loon Avenue Lands OP Inc.**

21076

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.

Prince Trinidad-Rhodium, E.I.T
PTRinidad-Rhodium@counterpointeng.com



Yelena Koshenkov, P. Eng.
YKoshenkov@counterpointeng.com

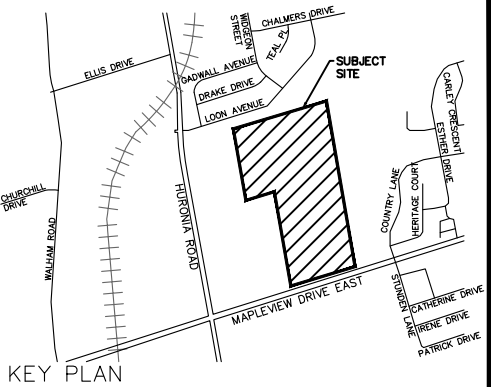
**Loon Avenue Lands OP Inc.**

21076

This Report was prepared by Counterpoint Engineering Inc. for the exclusive use of the 'Client' and in accordance with the Terms and Conditions set out in the Agreement between Counterpoint Engineering Inc. and said Client. The material contained in this Report and all information relating to this activity reflect Counterpoint Engineering's assessment based on the information made available at the time of preparation of this report and do not take into account any subsequent changes that may have occurred thereafter. It should be noted that the information included in this report and data provided to Counterpoint Engineering has not been independently verified. Counterpoint Engineering Inc. represents that it has performed services hereunder with a degree of care, skill, and diligence normally provided by similarly-situated professionals in the performance of such services in respect of projects of similar nature at the time and place those services were rendered. Counterpoint Engineering Inc. disclaims all warranties, or any other representations, or conditions, either expressed or implied. With the exception of any designated 'Approving Authorities' to whom this report was submitted to for approval by Counterpoint Engineering Inc., any reliance on this document by a third party is strictly prohibited without written permission from Counterpoint Engineering Inc.. Counterpoint Engineering Inc. accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this Report.



Figures

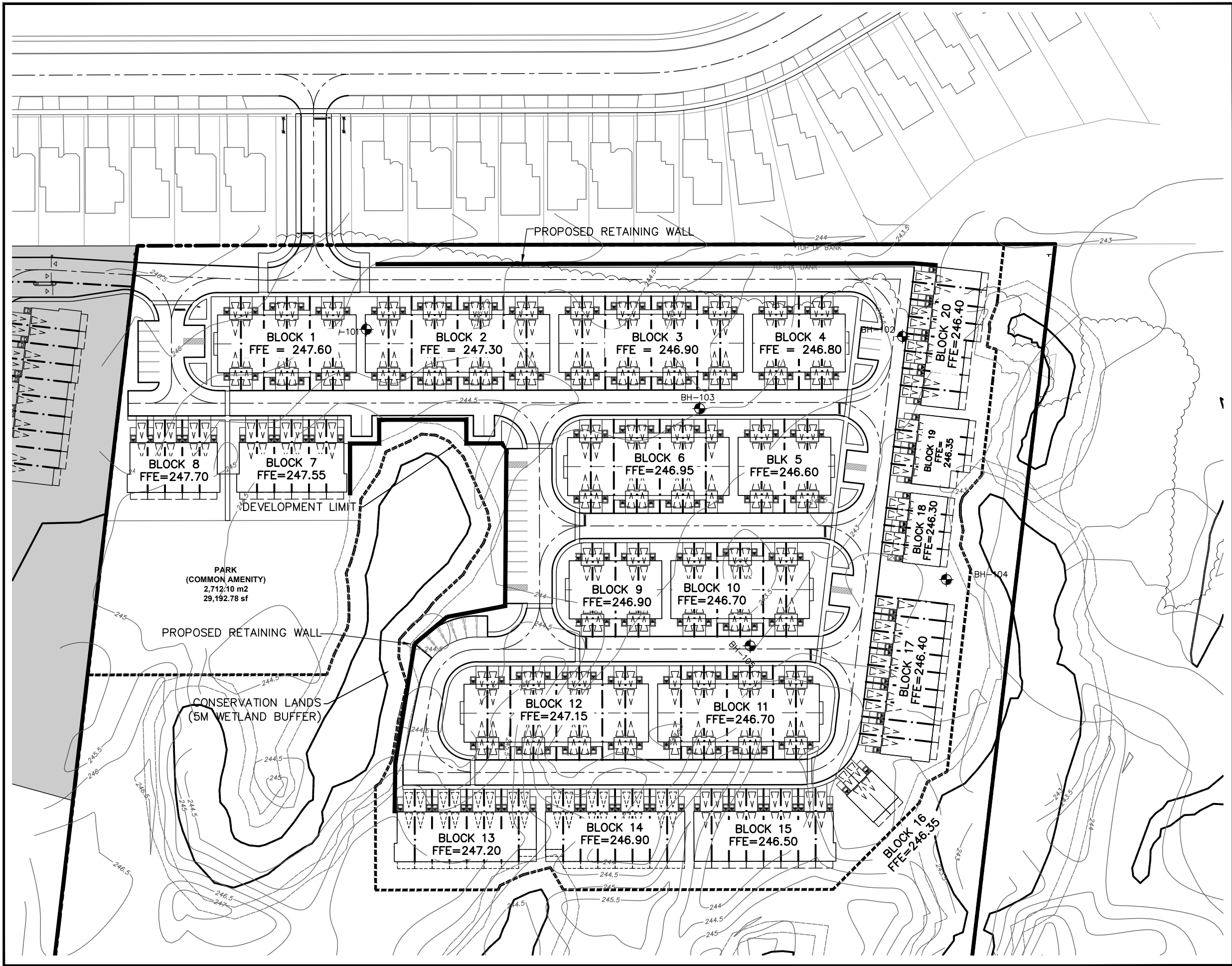


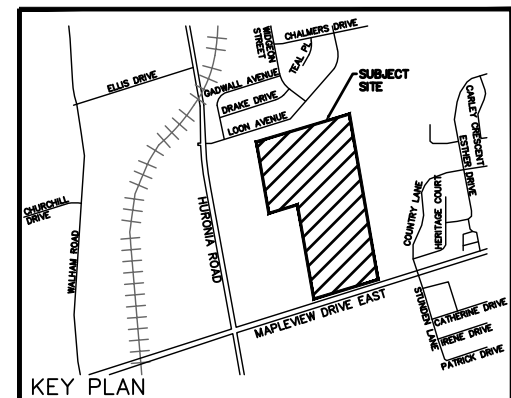
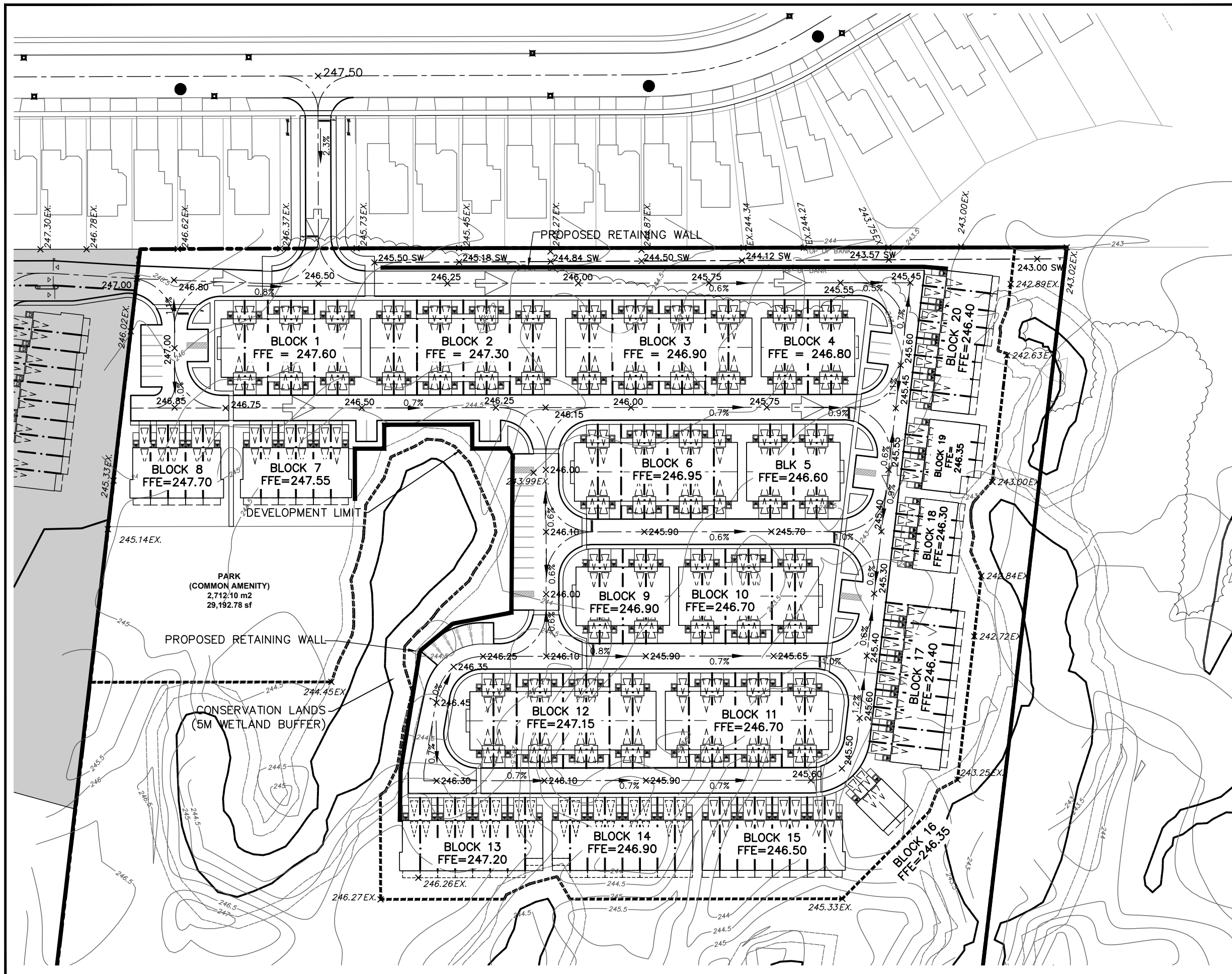
KEY PLAN

counterpoint 
ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

SITE LOCATION PLAN	
DESIGNED BY:	DATE: February 2022
CHECKED BY: KR	PROJECT No. 21076
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 1
SCALE: NTS	



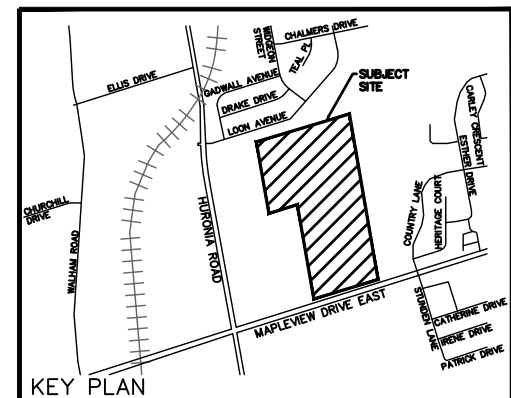
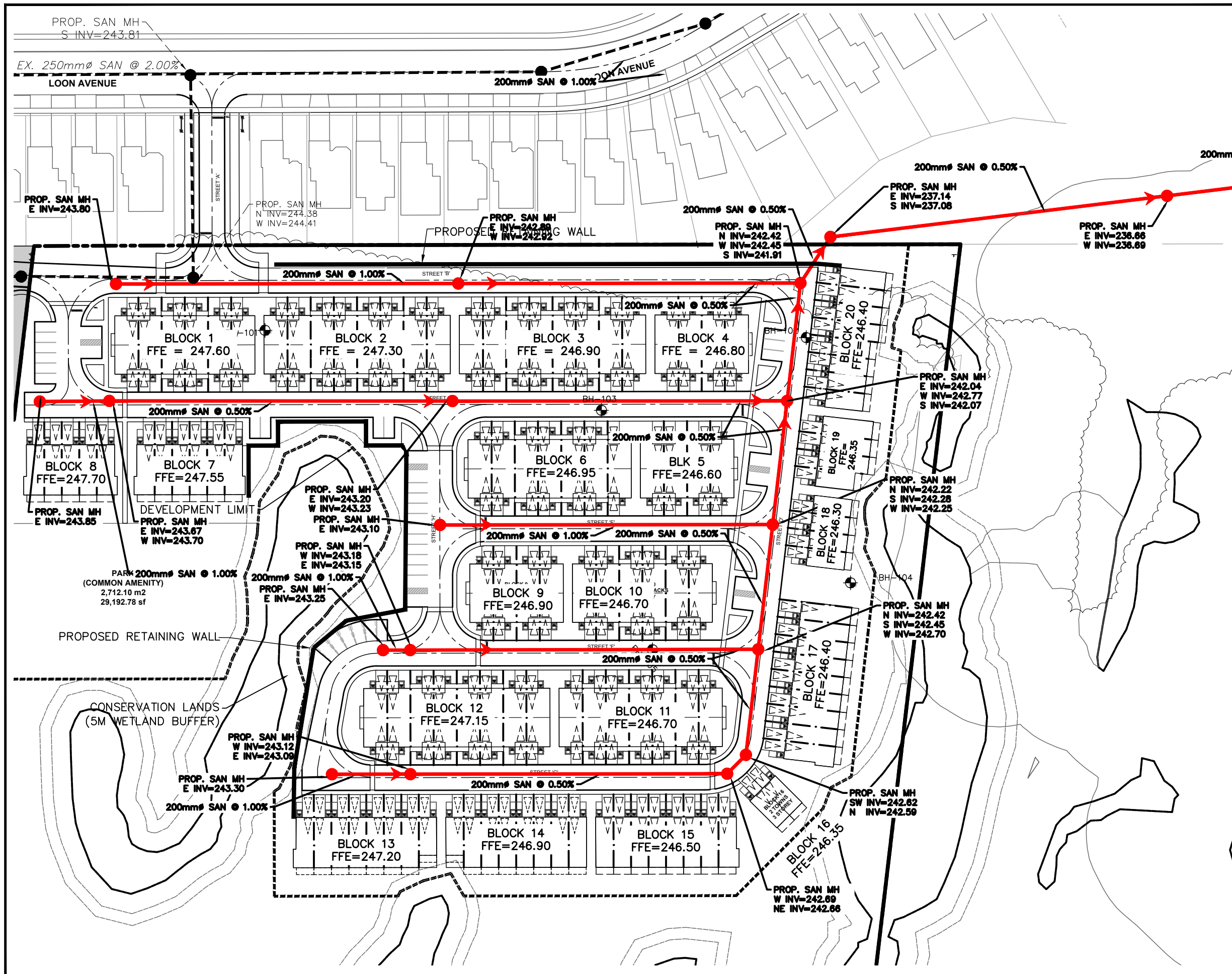


- LEGEND**
- PROPERTY LINE
 - DEVELOPMENT LIMIT
 - X246.80EX. EXISTING ELEVATION
 - X246.80 PROPOSED ELEVATION
 - 1.0% PROPOSED SLOPE
 - ➔ OVERLAND FLOW ROUTE

counterpoint 
ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

CONCEPTUAL GRADING PLAN	
DESIGNED BY:	DATE: February 2022
CHECKED BY: KR	PROJECT No. 21076
DRAWING BY:	FIGURE No. 6
CHECKED BY: KR	
SCALE: 1:1000	

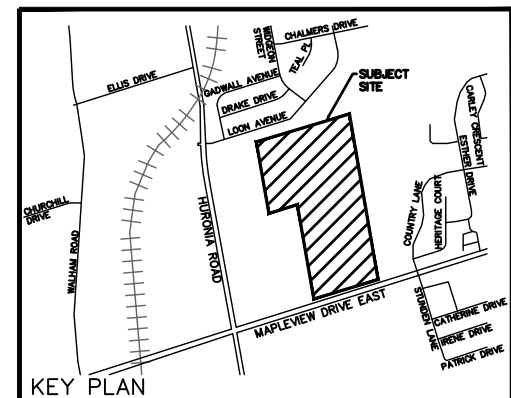
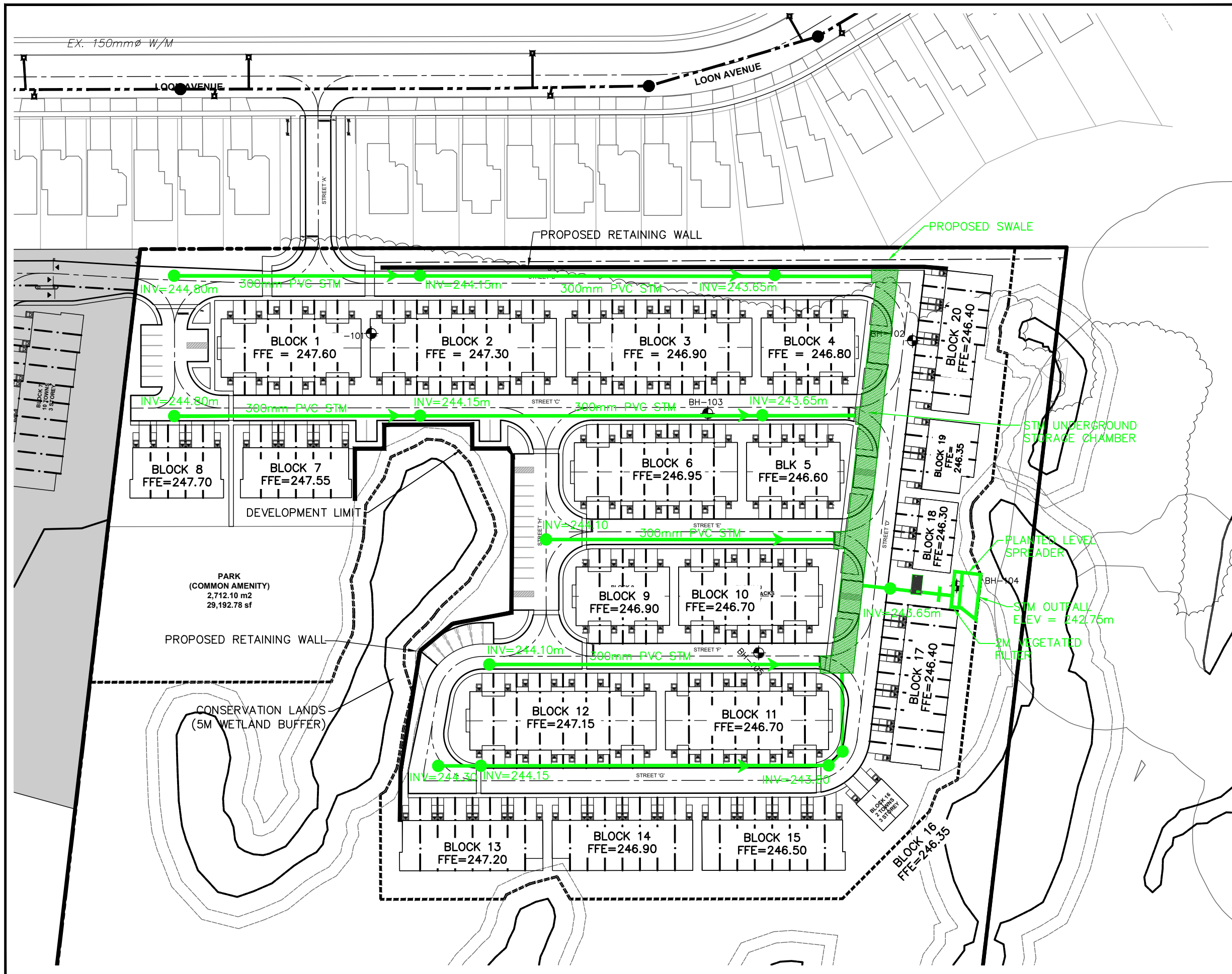


- LEGEND**
- PROPERTY LINE
 - - - EXISTING SANITARY SEWER
 - EXISTING SANITARY MANHOLE
 - PROPOSED SANITARY SEWER
 - PROPOSED SANITARY MANHOLE

counterpoint 
ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

SANITARY SERVICING PLAN	
DESIGNED BY:	DATE: February 2022
CHECKED BY: KR	PROJECT No. 21076
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 4A
SCALE: 1:1000	



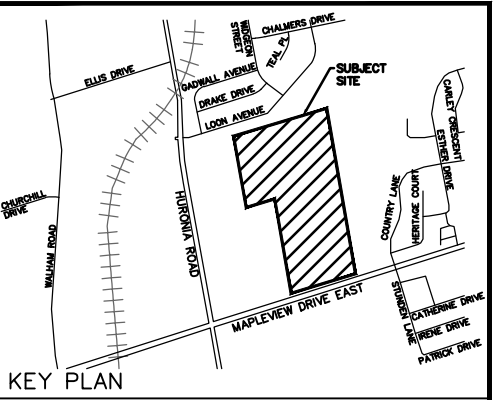
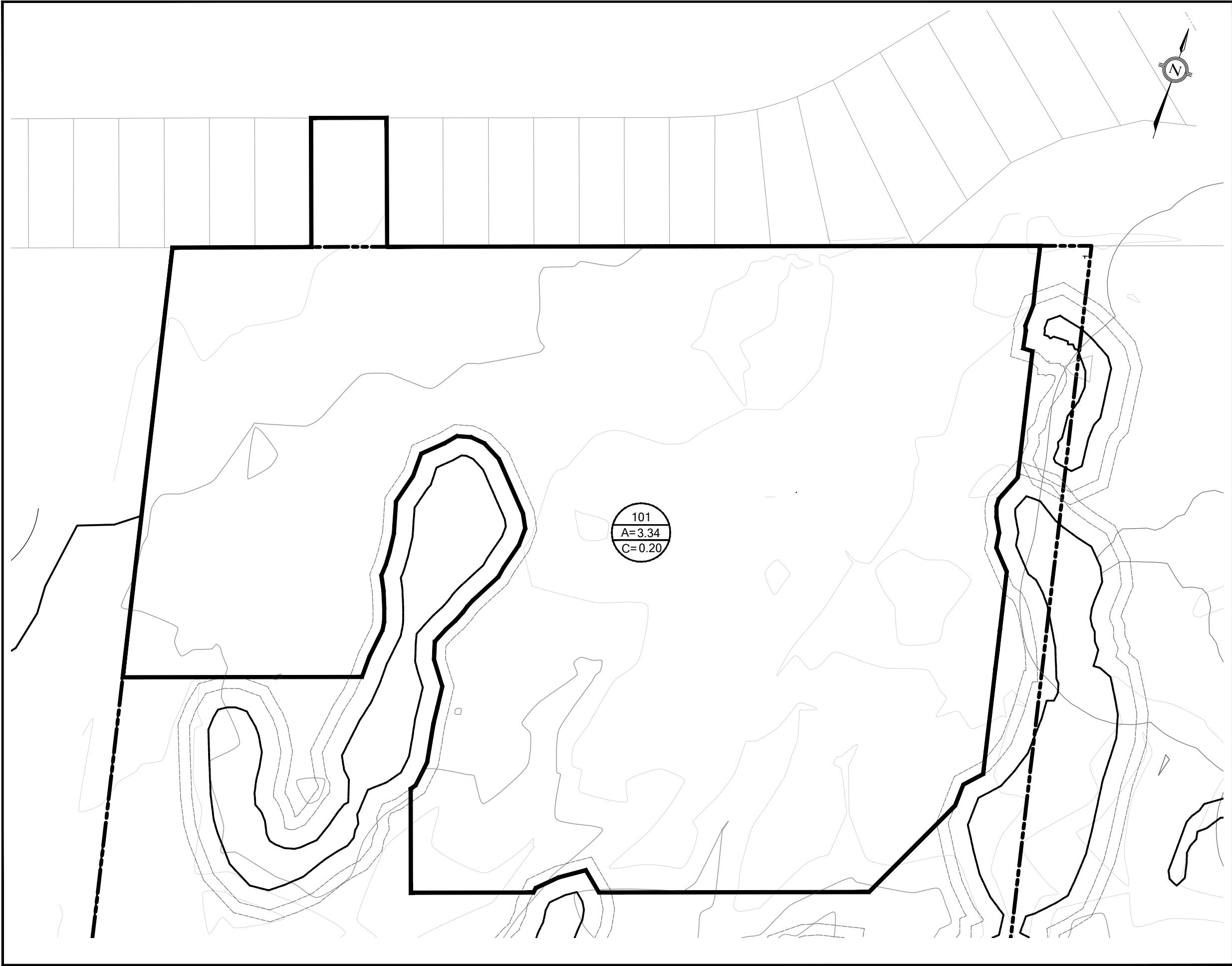
- LEGEND
- PROPERTY LINE
 - - - EXISTING STORM SEWER
 - EXISTING STORM MANHOLE
 - PROPOSED SWALE
 - - - - - PROPOSED STORMSEWER

counterpoint 
ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

STORM SERVICING PLAN	
DESIGNED BY:	DATE: February 2022
CHECKED BY: KR	PROJECT No. 21076
DRAWING BY:	
CHECKED BY: KR	FIGURE No. 5
SCALE: 1:1000	

P:\Projects\2021\21076_Forest_340 Mapview Dr\Design\Drawings\Drainage\21076_SWM Drainage.dwg



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

counterpoint
ENGINEERING



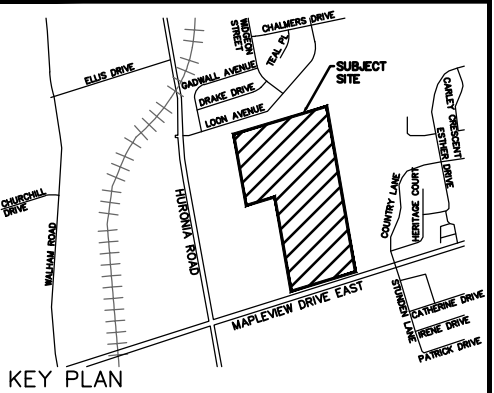
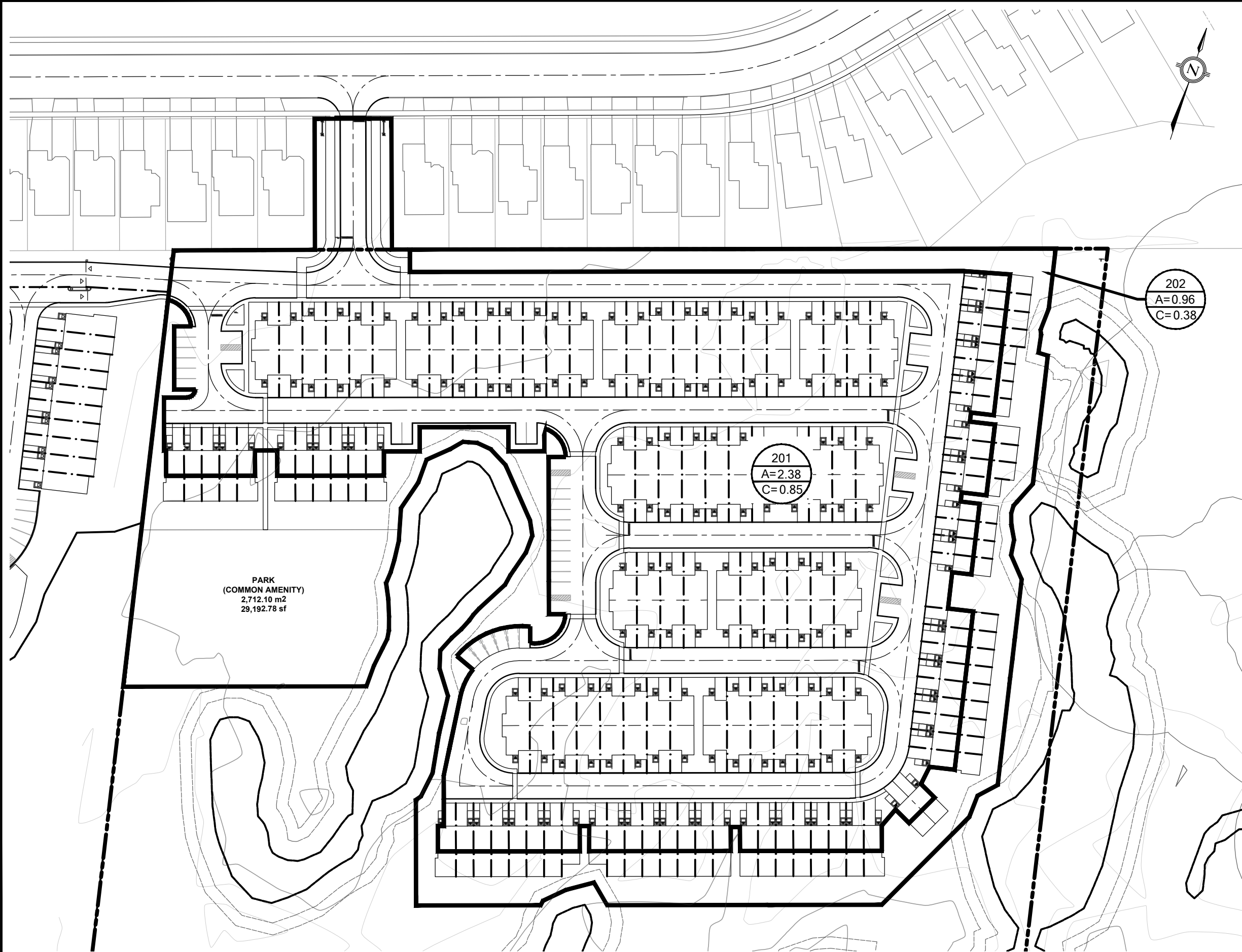
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

PRE DEVELOPMENT DRAINAGE PLAN

DESIGNED BY:	DATE: MAY 2023
CHECKED BY: KR	PROJECT No. 21076
DRAWING BY:	
CHECKED BY: KR	FIGURE No. SWM-1
SCALE: 1:1000	

P:\Projects\2021\21076_Forest_340 Mapleview Dr\Design\Drawings\Drainage\21076_SWM Drainage.dwg



LEGEND

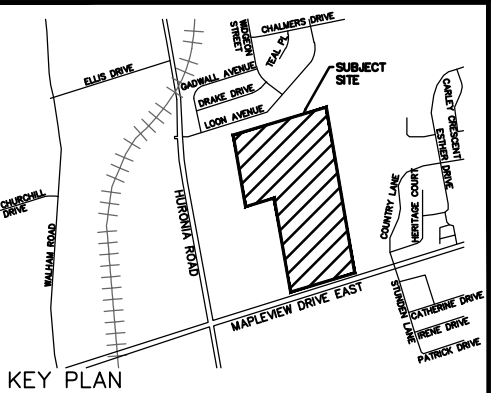
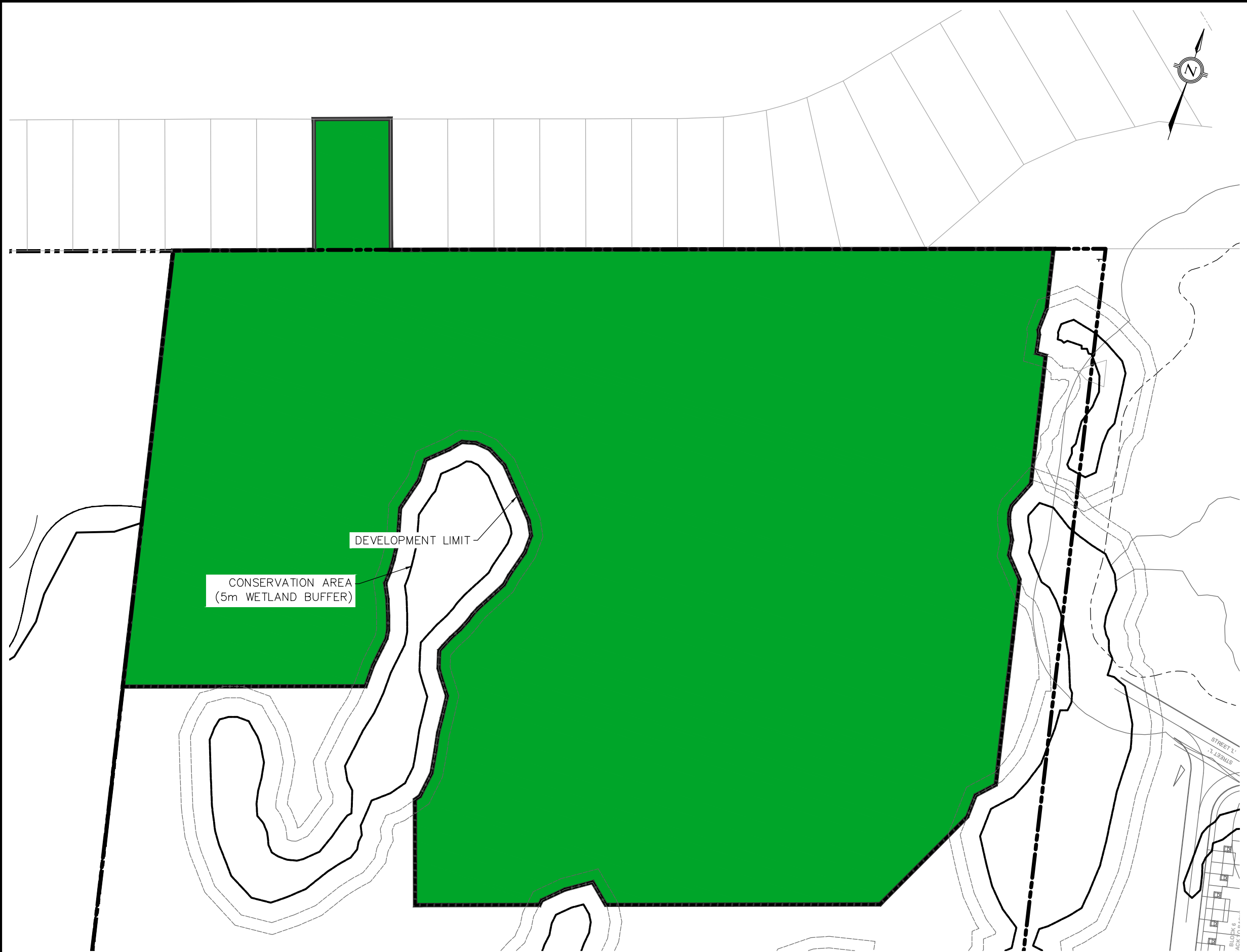
- DRAINAGE AREA BOUNDARY
- 101
A=1.13
C=0.20 DRAINAGE AREA (HA)
RUNOFF COEFFICIENT
(FOR 2-10 YEAR STORMS)
- OVERLAND FLOW PATH

counterpoint 
ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

POST DEVELOPMENT DRAINAGE PLAN

DESIGNED BY:	DATE: MAY 2023
CHECKED BY: KR	PROJECT No. 21076
DRAWING BY:	
CHECKED BY: KR	FIGURE No. SWM-2
SCALE: 1:1000	



LEGEND

EX PERVIOUS AREAS

		TOTAL
EX PERVIOUS AREA	33352	sq.m.
TOTAL		33352 sq.m.

counterpoint

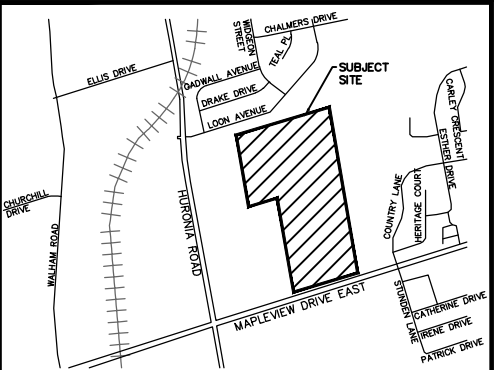
ENGINEERING

COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

PRE-DEVELOPMENT WATER BALANCE PLAN

DESIGNED BY:	DATE: MAY 2023
CHECKED BY: KR	PROJECT No. 21076
DRAWING BY:	
CHECKED BY: KR	FIGURE No. WB-1
SCALE: 1:1000	



KEY PLAN
LEGEND

- PROP PERVIOUS AREAS
- PROP BUILDING
- PROP IMPERVIOUS PAVEMENT

	TOTAL
PROP PERVIOUS AREA (i=0%)	10368 sq.m.
PROP BUILDING AREA (i=100%)	9935 sq.m.
PROP PAVEMENT AREA (i=100%)	13049 sq.m.
TOTAL	33352 sq.m. (i=68.91%)

counterpoint
ENGINEERING

COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

POST-DEVELOPMENT WATER BALANCE PLAN

DESIGNED BY:	DATE: MAY 2023
CHECKED BY: KR	PROJECT No. 21076
DRAWING BY:	
CHECKED BY: KR	FIGURE No. WB-2
SCALE: 1:1000	



Appendix A

Water Demand Calculations and Watermain Modeling Results

FLOW TEST RESULTS



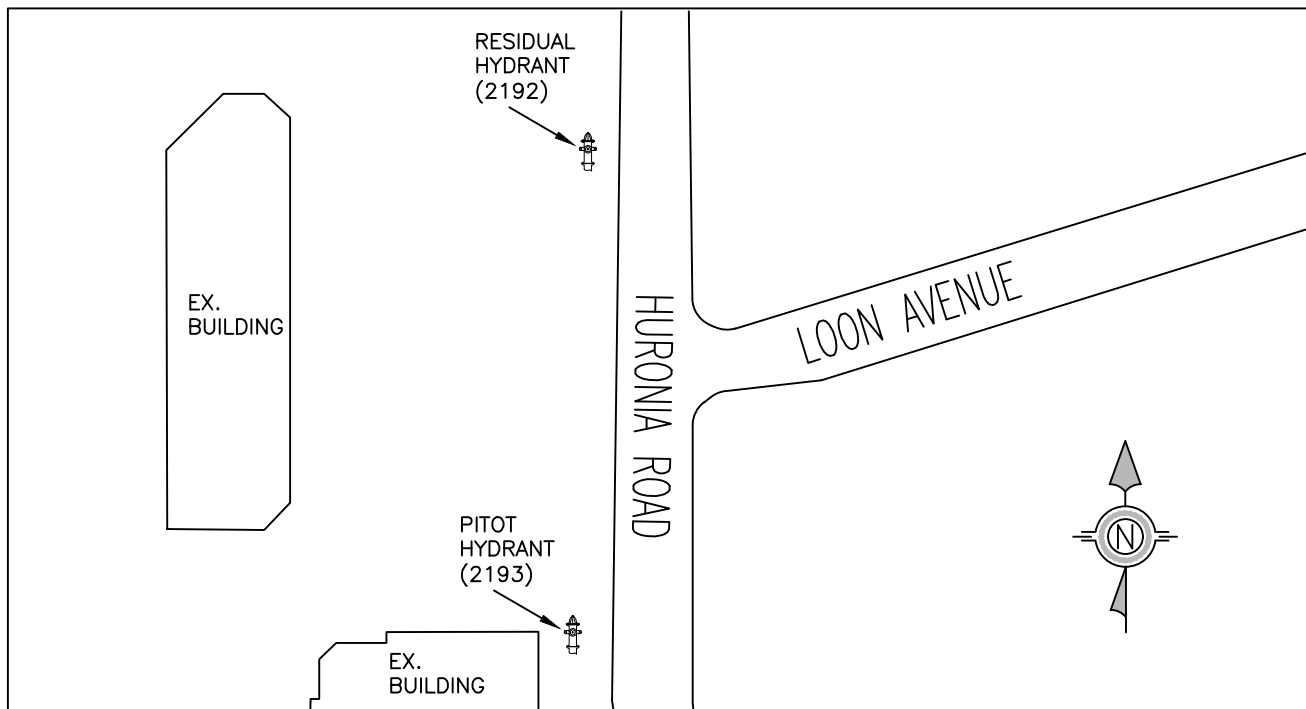
DATE : THURSDAY NOVEMBER 12, 2020 TIME : 3:00 PM

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



HURONIA ROAD & LOON AVENUE

BARRIE

ONTARIO

BY : GUS A.

OFFICE : BARRIE

TEST BY : VIPOND & PUC

DATE : NOVEMBER 12, 2020

STATIC:

70 PSI

RESIDUAL:

TEST#1 70 PSI

TEST#2 69 PSI

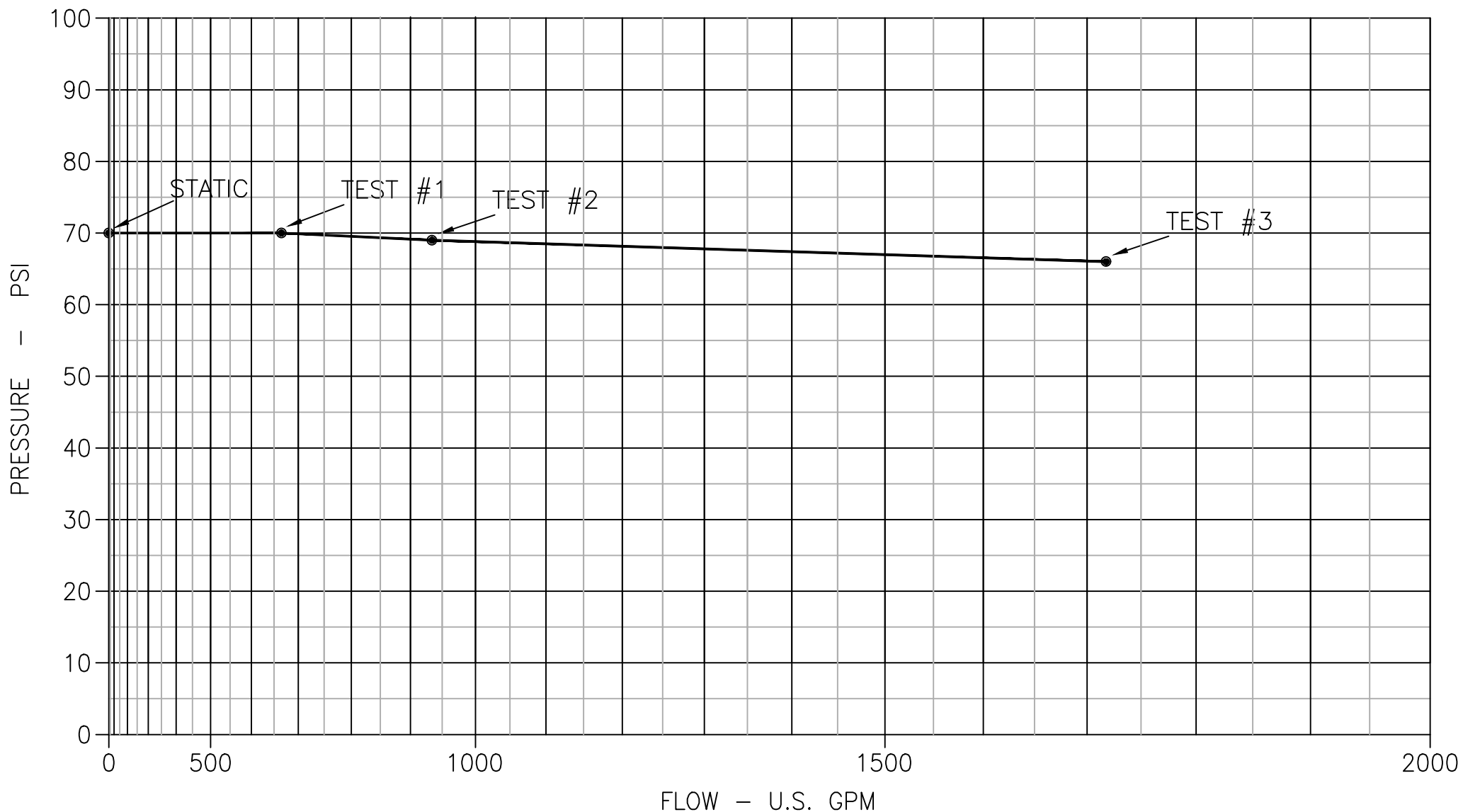
TEST#3 66 PSI

FLOW:

@ 660 GPM

@ 939 GPM

@ 1720 GPM



FLOW TEST RESULTS



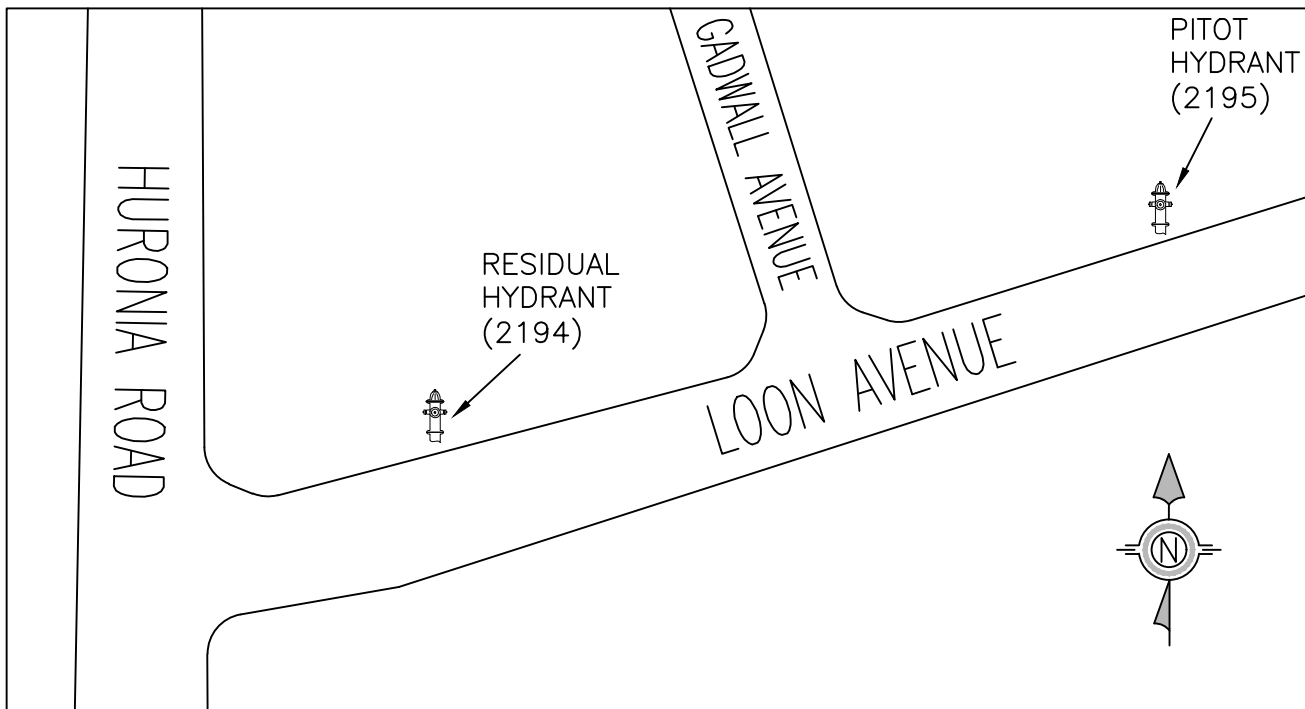
DATE : THURSDAY NOVEMBER 12, 2020 TIME : 2:30 PM

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



LOON AVENUE & GADWALL AVENUE

BARRIE

ONTARIO

BY : GUS A.

OFFICE : BARRIE

TEST BY : VIPOND & PUC

DATE : NOVEMBER 12, 2020

STATIC:

73 PSI

RESIDUAL:

TEST#1 72 PSI

TEST#2 71 PSI

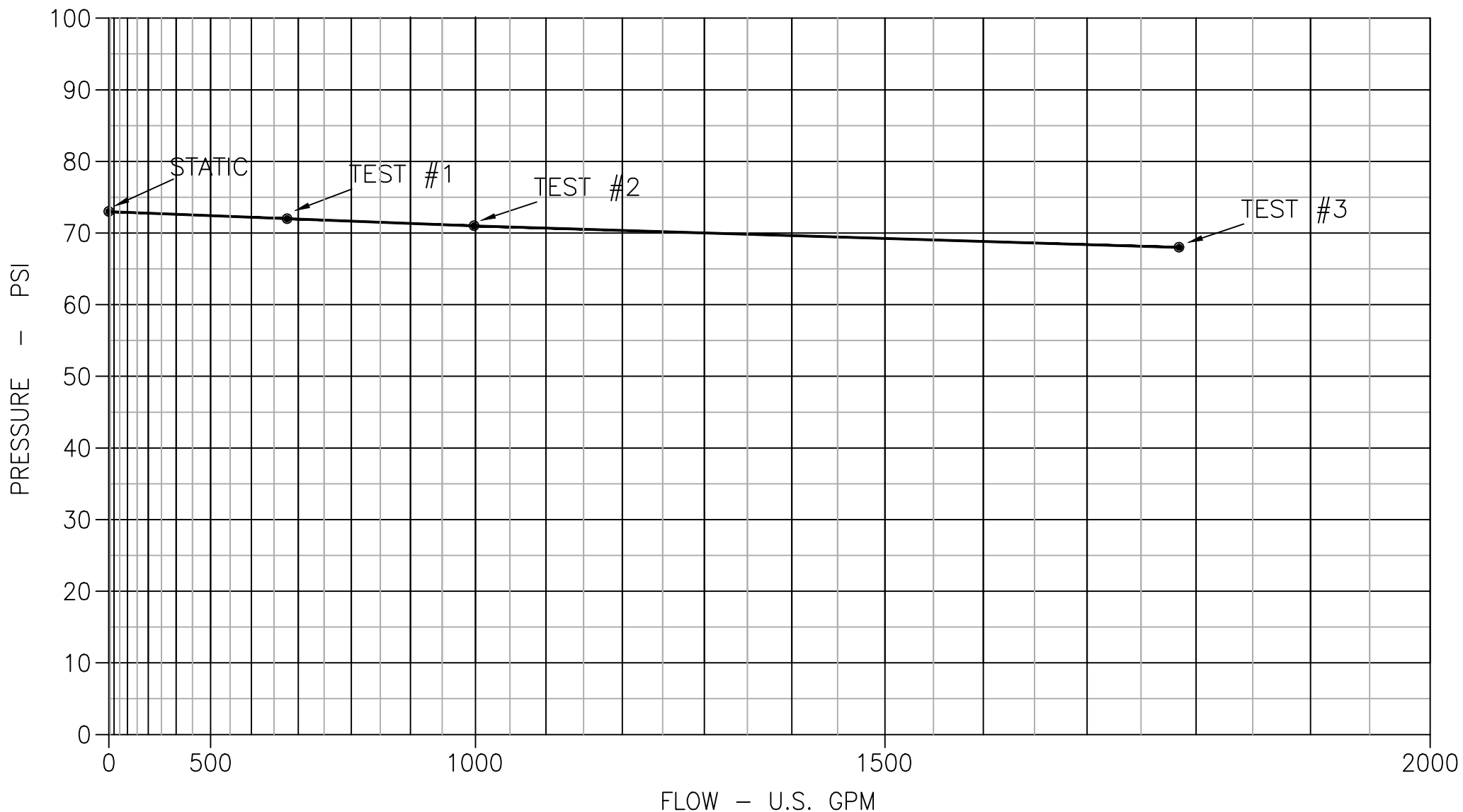
TEST#3 68 PSI

FLOW:

@ 672 GPM

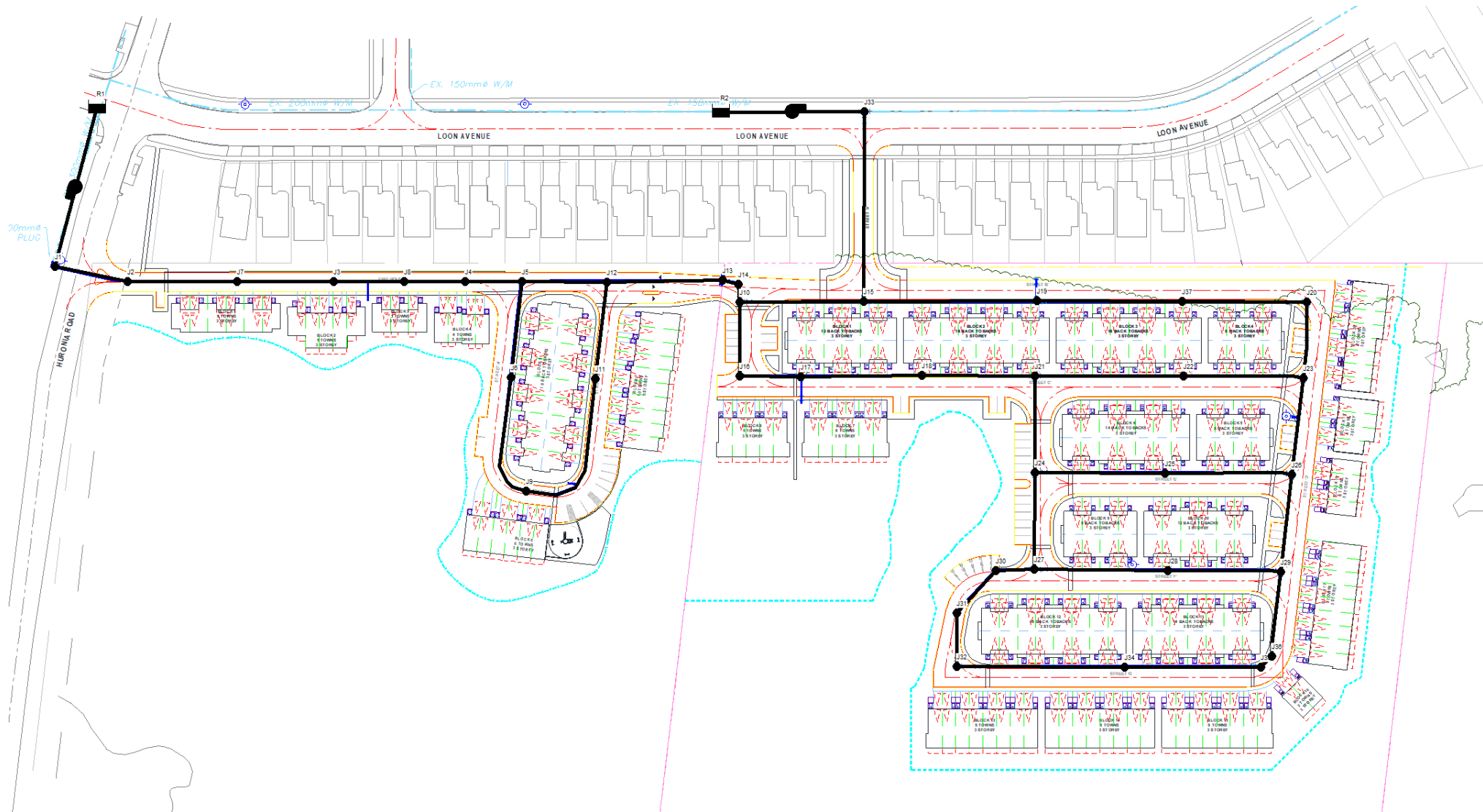
@ 998 GPM

@ 1786 GPM





Proposed Conditions EPANET Model Network





Model Results Summary Tables

Residual Pressure Non-Fire Scenarios

Scenario	Lowest Pressure			Satisfies Pressure Requirements?
	Pressure	Pressure	Pressure	
	(m H ₂ O)	(psi)	(kPa)	
Max. Day	53.19	75.63	521.48	Yes
Peak Hour	53.16	75.59	521.19	Yes

Scenario	Highest Pressure			Satisfies Pressure Requirements?
	Pressure	Pressure	Pressure	
	(m H ₂ O)	(psi)	(kPa)	
Max. Day	60.87	86.56	596.78	Yes
Peak Hour	60.84	86.51	596.48	Yes

Notes:

1. Preferred design pressure during minimum hour and peak hour is 275 kPa to 700 kPa
2. The minimum pressure under any non-fire demand scenario should not be less than 275 kPa

Residual Pressure based on Maximum Day Demand + Fire Flow

Fire Flow at Block / Node	Max. Velocity (m/s)	Lowest Pressure			Satisfies Pressure Requirements?
		Pressure	Pressure	Pressure	
		(m H ₂ O)	(psi)	(kPa)	
Block 3 / J19,J22	2.07	49.81	70.83	488.34	Yes
Block 5 / J22,J25	2.06	48.84	69.45	478.83	Yes
Block 10 / J25,J28	1.75	49.90	70.96	489.23	Yes
Block 11 / J28,J35	2.07	49.81	70.83	488.34	Yes
EXT - Huronia Block 5 / J6	2.07	49.81	70.83	488.34	Yes
EXT - Huronia Block 6 / J9	2.38	49.93	71.00	489.52	Yes

Notes:

1. Fire flow requirements satisfied if lowest pressure in system > 140 kPa (20 psi)
2. Maximum allowable flow velocity during fire flow conditions equals 5 m/s



Proposed Conditions Nodal Pressure Comparison

Watermain Model Nodes/Junction Residual Pressures (m head)								
Node ID	Maximum Day Demand	Peak Hour Demand	Max Day Demand + Fire Flow at Block 3	Max Day Demand + Fire Flow at Block 5	Max Day Demand + Fire Flow at Block 10	Max Day Demand + Fire Flow at Block 11	Max Day Demand + Fire Flow at Huronia Block 5	Max Day Demand + Fire Flow at Huronia Block 6
Junc J1	53.19	53.16	49.81	49.21	49.90	49.81	49.81	49.93
Junc J2	53.64	53.61	49.99	49.04	50.20	49.99	49.99	50.26
Junc J3	56.13	56.10	51.64	49.56	52.22	51.64	51.64	52.39
Junc J4	57.53	57.50	52.47	49.64	53.30	52.47	52.47	53.54
Junc J5	58.15	58.12	52.86	49.71	53.79	52.86	52.86	54.06
Junc J6	58.54	58.51	53.21	50.01	54.16	53.21	53.21	53.86
Junc J7	55.12	55.09	51.02	49.46	51.43	51.02	51.02	51.55
Junc J8	56.92	56.89	52.12	49.62	52.83	52.12	52.12	53.04
Junc J9	58.91	58.88	53.53	50.27	54.50	53.53	53.53	53.46
Junc J11	59.04	59.01	53.60	50.26	54.60	53.60	53.60	54.51
Junc J12	58.8	58.77	53.33	49.93	54.34	53.33	53.33	54.86
Junc J13	59.34	59.31	53.45	49.48	54.65	53.45	53.45	56.72
Junc J14	59.42	59.39	53.46	49.40	54.69	53.46	53.46	57.01
Junc J33	58.84	58.81	53.96	49.55	54.91	53.96	53.96	56.87
Junc J10	59.36	59.33	53.39	49.32	54.62	53.39	53.39	56.98
Junc J15	59.78	59.75	53.93	49.79	55.14	53.93	53.93	57.51
Junc J16	59.42	59.39	53.28	49.20	54.56	53.28	53.28	57.04
Junc J17	59.57	59.54	53.28	49.20	54.61	53.28	53.28	57.20
Junc J18	59.85	59.82	53.27	49.18	54.69	53.27	53.27	57.49
Junc J19	60.2	60.17	54.01	49.88	55.32	54.01	54.01	57.91
Junc J20	60.77	60.74	54.05	49.94	55.52	54.06	54.05	58.44
Junc J21	60.14	60.11	53.29	49.19	54.79	53.28	53.28	57.79
Junc J22	60.48	60.45	53.33	49.44	55.13	53.62	53.62	58.14
Junc J23	60.81	60.78	53.95	49.83	55.46	53.95	53.95	58.47
Junc J24	60.17	60.14	53.31	49.15	54.67	53.10	53.10	57.83
Junc J25	60.5	60.47	53.64	49.40	55.00	53.43	53.15	58.16
Junc J26	60.86	60.83	54.00	49.83	55.36	53.79	53.79	58.52
Junc J27	60.2	60.17	53.34	49.18	54.56	52.94	53.13	57.86
Junc J28	60.5	60.47	53.64	49.48	54.68	53.21	53.43	58.16
Junc J29	60.87	60.84	54.01	49.85	55.23	53.56	53.80	58.53
Junc J30	60.05	60.02	53.19	49.03	54.41	52.76	52.98	57.71
Junc J31	59.86	59.83	53.00	48.84	54.22	52.51	52.79	57.52
Junc J32	59.96	59.93	53.10	48.94	54.32	52.56	52.89	57.62
Junc J34	60.41	60.38	53.55	49.39	54.77	52.85	53.34	58.07
Junc J35	60.72	60.69	53.86	49.70	55.08	53.03	53.65	58.38
Junc J36	60.72	60.69	53.86	49.70	55.08	53.09	53.65	58.38
Junc J37	60.54	60.51	54.08	49.70	55.47	54.09	54.09	58.23

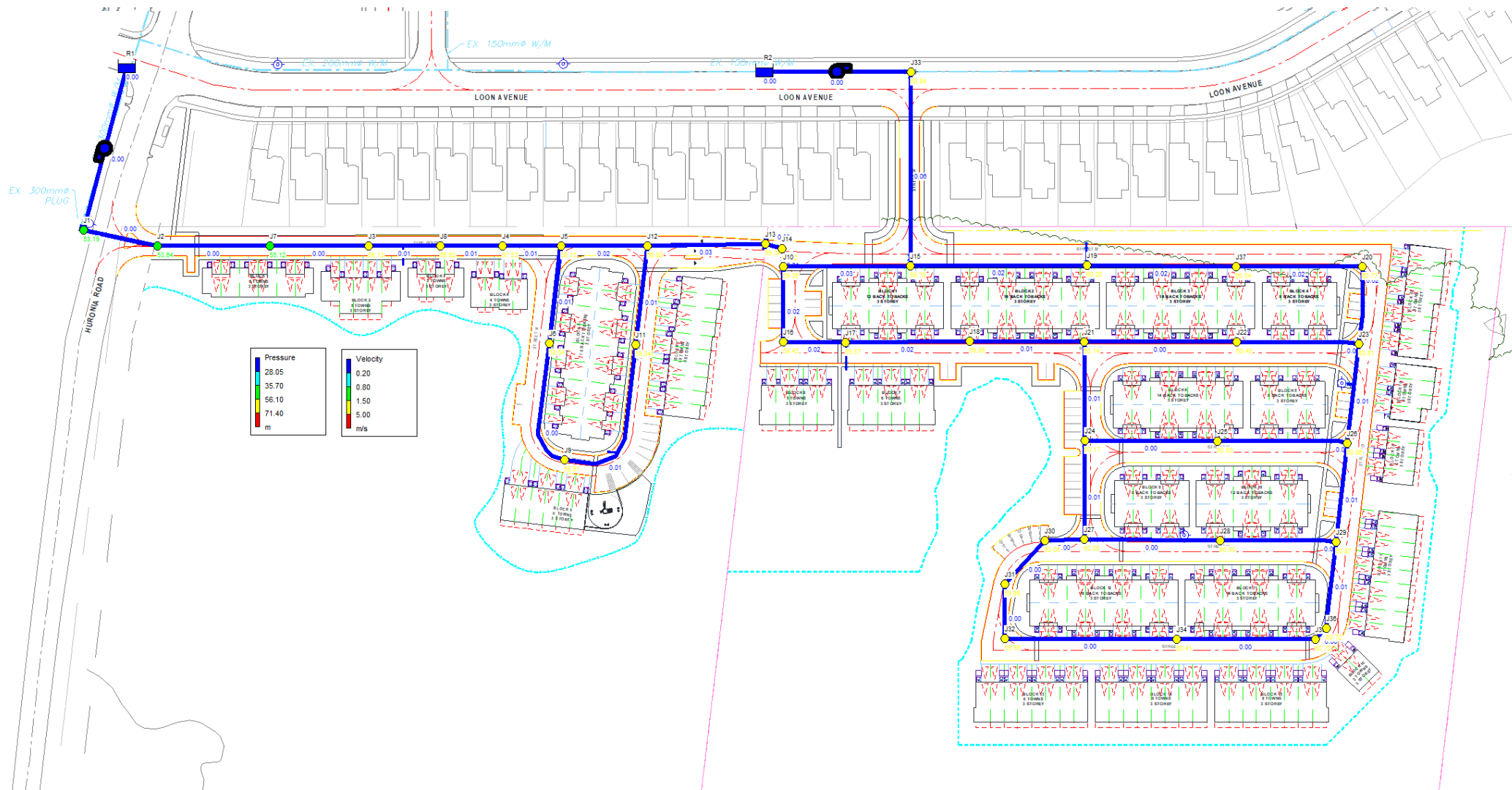


Proposed Conditions Pipe Comparison

Watermain Model Pipe Velocity Results (m/s)								
Pipe ID	Maximum Day Demand	Peak Hour Demand	Max Day Demand + Fire Flow at Block 3	Max Day Demand + Fire Flow at Block 5	Max Day Demand + Fire Flow at Block 10	Max Day Demand + Fire Flow at Block 11	Max Day Demand + Fire Flow at Huronia Block 5	Max Day Demand + Fire Flow at Huronia Block 6
Pipe P1	0.00	0.00	1.30	2.06	0.95	1.30	1.30	0.83
Pipe P4	0.01	0.01	1.29	2.05	0.94	1.29	1.29	0.82
Pipe P5	0.01	0.01	0.37	0.59	0.27	0.37	0.37	1.63
Pipe P6	0.00	0.00	1.30	2.06	0.95	1.30	1.30	0.83
Pipe P7	0.00	0.00	1.30	2.05	0.95	1.30	1.30	0.83
Pipe P8	0.01	0.01	1.30	2.05	0.95	1.30	1.30	0.83
Pipe P9	0.01	0.01	1.29	2.05	0.95	1.29	1.30	0.83
Pipe P2	0.00	0.01	0.36	0.58	0.26	0.36	0.36	1.62
Pipe P11	0.01	0.02	0.35	0.57	0.26	0.35	0.35	1.57
Pipe P12	0.02	0.02	0.92	1.46	0.67	0.92	0.92	0.81
Pipe P13	0.03	0.04	1.27	2.03	0.93	1.27	1.27	2.38
Pipe P14	0.03	0.04	1.27	2.03	0.93	1.27	1.27	2.38
Pipe P3	0.01	0.01	0.36	0.57	0.26	0.36	0.36	1.57
Pipe P10	0.06	0.08	2.07	1.74	1.75	2.07	2.07	1.10
Pipe P15	0.02	0.03	1.24	1.22	1.02	1.24	1.24	0.29
Pipe P17	0.02	0.02	1.23	1.22	1.01	1.23	1.23	0.28
Pipe P18	0.00	0.01	1.37	1.21	0.05	0.07	0.07	0.14
Pipe P19	0.00	0.00	1.23	0.63	0.05	0.08	0.07	0.13
Pipe P20	0.01	0.02	1.39	0.67	1.14	1.39	1.39	0.25
Pipe P21	0.02	0.02	1.39	1.41	1.14	1.40	1.40	0.25
Pipe P22	0.02	0.03	1.40	1.41	1.15	1.40	1.40	0.24
Pipe P23	0.02	0.03	1.40	1.42	1.15	1.40	1.40	0.24
Pipe P24	0.01	0.02	0.57	1.42	0.41	0.57	0.57	1.06
Pipe P25	0.03	0.05	0.83	0.90	0.73	0.83	0.83	0.81
Pipe P26	0.01	0.02	0.13	0.51	1.06	1.30	1.30	0.14
Pipe P27	0.00	0.00	0.07	0.58	0.00	0.08	1.34	0.07
Pipe P28	0.00	0.00	0.08	0.66	0.01	0.09	1.26	0.07
Pipe P29	0.01	0.02	0.16	0.64	1.09	1.32	1.32	0.12
Pipe P30	0.01	0.01	0.06	0.74	1.06	1.38	0.05	0.07
Pipe P31	0.00	0.00	0.04	0.08	1.08	0.39	0.03	0.04
Pipe P32	0.00	0.00	0.04	0.05	1.04	0.39	0.04	0.04
Pipe P33	0.01	0.01	0.08	0.06	1.08	1.23	0.06	0.05
Pipe P34	0.01	0.01	0.02	0.10	0.02	1.77	0.02	0.03
Pipe P35	0.00	0.01	0.02	0.03	0.02	1.77	0.02	0.03
Pipe P36	0.00	0.00	0.03	0.03	0.03	0.83	0.02	0.03
Pipe P37	0.00	0.00	0.03	0.03	0.03	0.83	0.02	0.02
Pipe P38	0.00	0.01	0.03	0.04	0.03	0.84	0.03	0.02
Pipe P39	0.00	0.01	0.03	0.04	0.03	0.84	0.03	0.02
Pipe P40	0.00	0.01	0.03	0.04	0.03	0.84	0.03	0.02
Pipe P16	0.02	0.03	1.24	0.04	1.02	1.23	1.23	0.28
Pipe P41	0.02	0.03	1.23	0.04	1.02	1.23	1.23	0.28



Max Day Demand Conditions Schematic





Page 1

2023-04-19 3:57:15 PM

```

*****
*                               E P A N E T                               *
*                               Hydraulic and Water Quality                 *
*                               Analysis for Pipe Networks                   *
*                               Version 2.2                                 *
*****

```

Input File: 21076_Max Day.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
P1	J1	J2	22.05	200
P4	J4	J5	19.49	200
P5	J5	J6	32.42	200
P6	J2	J7	37.41	200
P7	J7	J3	32.68	200
P8	J3	J8	25.97	200
P9	J8	J4	21.27	200
P2	J6	J9	42.67	200
P11	J11	J12	34.10	200
P12	J5	J12	29.21	200
P13	J12	J13	36.04	200
P14	J13	J14	5.68	200
P3	J9	J11	54.61	200
P10	J33	J15	64.2	300
P15	J15	J19	58.8	300
P17	J20	J23	25.3	300
P18	J23	J22	40.3	300
P19	J22	J21	50.4	300
P20	J21	J18	37.7	300
P21	J18	J17	40.4	300
P22	J17	J16	20	300
P23	J16	J10	24.3	300
P24	J10	J14	6.4	300
P25	J15	J10	41.7	300
P26	J23	J26	33.7	300
P27	J26	J25	40.2	300
P28	J25	J24	45.7	300
P29	J24	J21	32.6	300
P30	J26	J29	33.6	300
P31	J29	J28	39.4	300
P32	J28	J27	42.7	300
P33	J27	J24	32.5	300
P34	J29	J36	28.3	300



P35	J36	J35	5.2	300
P36	J35	J34	46.4	300
P37	J34	J32	57	300
P38	J32	J31	18.9	300



Page 2

Link - Node Table: (continued)

Link ID	Start Node	End Node	Length m	Diameter mm	
P39	J31	J30	19.5	300	
P40	J30	J27	12.7	300	
P16	J19	J37	45.35	300	
P41	J37	J20	45.35	300	
1	R1	J1	#N/A	#N/A	Pump
2	R2	J33	#N/A	#N/A	Pump

Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /m3	Avg. Kw	Peak Kw	Cost /day
1	0.00	0.00	0.00	0.00	0.00	0.00
2	100.00	75.00	1.11	15.91	15.91	0.00
Demand Charge:						0.00
Total Cost:						0.00

Node Results at 0:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.29	53.19	0.00
J2	0.00	306.29	53.64	0.00
J3	0.08	306.29	56.13	0.00
J4	0.07	306.29	57.53	0.00
J5	0.00	306.29	58.15	0.00
J6	0.30	306.29	58.54	0.00
J7	0.10	306.29	55.12	0.00
J8	0.05	306.29	56.92	0.00
J9	0.10	306.29	58.91	0.00
J11	0.17	306.29	59.04	0.00
J12	0.00	306.29	58.80	0.00
J13	0.00	306.29	59.34	0.00
J14	0.00	306.29	59.42	0.00
J33	0.00	306.29	58.84	0.00
J10	0.00	306.29	59.36	0.00



J15	0.10	306.29	59.78	0.00
J16	0.00	306.29	59.42	0.00
J17	0.28	306.29	59.57	0.00
J18	0.13	306.29	59.85	0.00
J19	0.13	306.29	60.20	0.00
J20	0.20	306.29	60.77	0.00
J21	0.00	306.29	60.14	0.00
J22	0.39	306.29	60.48	0.00
J23	0.07	306.29	60.81	0.00



Page 3

Node Results at 0:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.29	60.17	0.00
J25	0.35	306.29	60.50	0.00
J26	0.07	306.29	60.86	0.00
J27	0.20	306.29	60.20	0.00
J28	0.22	306.29	60.50	0.00
J29	0.15	306.29	60.87	0.00
J30	0.00	306.29	60.05	0.00
J31	0.00	306.29	59.86	0.00
J32	0.27	306.29	59.96	0.00
J34	0.13	306.29	60.41	0.00
J35	0.25	306.29	60.72	0.00
J36	0.03	306.29	60.72	0.00
J37	0.13	306.29	60.54	0.00
R1	0.00	0.00	0.00	0.00 Reservoir
R2	-3.97	0.00	0.00	0.00 Reservoir

Link Results at 0:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.30	0.01	0.00	Open
P5	0.19	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.10	0.00	0.00	Open
P8	-0.19	0.01	0.00	Open
P9	-0.24	0.01	0.00	Open
P2	-0.11	0.00	0.00	Open
P11	-0.38	0.01	0.00	Open
P12	-0.49	0.02	0.00	Open
P13	-0.87	0.03	0.01	Open
P14	-0.87	0.03	0.01	Open



P3	-0.21	0.01	0.00	Open
P10	3.97	0.06	0.02	Open
P15	1.62	0.02	0.00	Open
P17	1.16	0.02	0.00	Open
P18	0.24	0.00	0.00	Open
P19	-0.15	0.00	0.00	Open
P20	-0.97	0.01	0.00	Open
P21	-1.10	0.02	0.00	Open
P22	-1.38	0.02	0.00	Open
P23	-1.38	0.02	0.00	Open
P24	0.87	0.01	0.00	Open
P25	2.25	0.03	0.01	Open
P26	0.85	0.01	0.00	Open
P27	0.16	0.00	0.00	Open



Page 4

Link Results at 0:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-0.19	0.00	0.00	Open
P29	-0.82	0.01	0.00	Open
P30	0.62	0.01	0.00	Open
P31	0.10	0.00	0.00	Open
P32	-0.12	0.00	0.00	Open
P33	-0.63	0.01	0.00	Open
P34	0.37	0.01	0.00	Open
P35	0.34	0.00	0.00	Open
P36	0.09	0.00	0.00	Open
P37	-0.04	0.00	0.00	Open
P38	-0.31	0.00	0.00	Open
P39	-0.31	0.00	0.00	Open
P40	-0.31	0.00	0.00	Open
P16	1.49	0.02	0.00	Open
P41	1.36	0.02	0.00	Open
1	0.00	0.00	0.00	Closed Pump
2	3.97	0.00	-306.29	Open Pump

Node Results at 1:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.29	53.19	0.00
J2	0.00	306.29	53.64	0.00
J3	0.08	306.29	56.13	0.00
J4	0.07	306.29	57.53	0.00
J5	0.00	306.29	58.15	0.00



J6	0.30	306.29	58.54	0.00
J7	0.10	306.29	55.12	0.00
J8	0.05	306.29	56.92	0.00
J9	0.10	306.29	58.91	0.00
J11	0.17	306.29	59.04	0.00
J12	0.00	306.29	58.80	0.00
J13	0.00	306.29	59.34	0.00
J14	0.00	306.29	59.42	0.00
J33	0.00	306.29	58.84	0.00
J10	0.00	306.29	59.36	0.00
J15	0.10	306.29	59.78	0.00
J16	0.00	306.29	59.42	0.00
J17	0.28	306.29	59.57	0.00
J18	0.13	306.29	59.85	0.00
J19	0.13	306.29	60.20	0.00
J20	0.20	306.29	60.77	0.00
J21	0.00	306.29	60.14	0.00
J22	0.39	306.29	60.48	0.00
J23	0.07	306.29	60.81	0.00



Page 5

Node Results at 1:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.29	60.17	0.00
J25	0.35	306.29	60.50	0.00
J26	0.07	306.29	60.86	0.00
J27	0.20	306.29	60.20	0.00
J28	0.22	306.29	60.50	0.00
J29	0.15	306.29	60.87	0.00
J30	0.00	306.29	60.05	0.00
J31	0.00	306.29	59.86	0.00
J32	0.27	306.29	59.96	0.00
J34	0.13	306.29	60.41	0.00
J35	0.25	306.29	60.72	0.00
J36	0.03	306.29	60.72	0.00
J37	0.13	306.29	60.54	0.00
R1	0.00	0.00	0.00	0.00 Reservoir
R2	-3.97	0.00	0.00	0.00 Reservoir

Link Results at 1:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.30	0.01	0.00	Open



P5	0.19	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.10	0.00	0.00	Open
P8	-0.19	0.01	0.00	Open
P9	-0.24	0.01	0.00	Open
P2	-0.11	0.00	0.00	Open
P11	-0.38	0.01	0.00	Open
P12	-0.49	0.02	0.00	Open
P13	-0.87	0.03	0.01	Open
P14	-0.87	0.03	0.01	Open
P3	-0.21	0.01	0.00	Open
P10	3.97	0.06	0.02	Open
P15	1.62	0.02	0.00	Open
P17	1.16	0.02	0.00	Open
P18	0.24	0.00	0.00	Open
P19	-0.15	0.00	0.00	Open
P20	-0.97	0.01	0.00	Open
P21	-1.10	0.02	0.00	Open
P22	-1.38	0.02	0.00	Open
P23	-1.38	0.02	0.00	Open
P24	0.87	0.01	0.00	Open
P25	2.25	0.03	0.01	Open
P26	0.85	0.01	0.00	Open
P27	0.16	0.00	0.00	Open



Page 6

Link Results at 1:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-0.19	0.00	0.00	Open
P29	-0.82	0.01	0.00	Open
P30	0.62	0.01	0.00	Open
P31	0.10	0.00	0.00	Open
P32	-0.12	0.00	0.00	Open
P33	-0.63	0.01	0.00	Open
P34	0.37	0.01	0.00	Open
P35	0.34	0.00	0.00	Open
P36	0.09	0.00	0.00	Open
P37	-0.04	0.00	0.00	Open
P38	-0.31	0.00	0.00	Open
P39	-0.31	0.00	0.00	Open
P40	-0.31	0.00	0.00	Open
P16	1.49	0.02	0.00	Open
P41	1.36	0.02	0.00	Open
1	0.00	0.00	0.00	Closed Pump
2	3.97	0.00	-306.29	Open Pump



Node Results at 2:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.29	53.19	0.00
J2	0.00	306.29	53.64	0.00
J3	0.08	306.29	56.13	0.00
J4	0.07	306.29	57.53	0.00
J5	0.00	306.29	58.15	0.00
J6	0.30	306.29	58.54	0.00
J7	0.10	306.29	55.12	0.00
J8	0.05	306.29	56.92	0.00
J9	0.10	306.29	58.91	0.00
J11	0.17	306.29	59.04	0.00
J12	0.00	306.29	58.80	0.00
J13	0.00	306.29	59.34	0.00
J14	0.00	306.29	59.42	0.00
J33	0.00	306.29	58.84	0.00
J10	0.00	306.29	59.36	0.00
J15	0.10	306.29	59.78	0.00
J16	0.00	306.29	59.42	0.00
J17	0.28	306.29	59.57	0.00
J18	0.13	306.29	59.85	0.00
J19	0.13	306.29	60.20	0.00
J20	0.20	306.29	60.77	0.00
J21	0.00	306.29	60.14	0.00
J22	0.39	306.29	60.48	0.00
J23	0.07	306.29	60.81	0.00



Page 7

Node Results at 2:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.29	60.17	0.00
J25	0.35	306.29	60.50	0.00
J26	0.07	306.29	60.86	0.00
J27	0.20	306.29	60.20	0.00
J28	0.22	306.29	60.50	0.00
J29	0.15	306.29	60.87	0.00
J30	0.00	306.29	60.05	0.00
J31	0.00	306.29	59.86	0.00
J32	0.27	306.29	59.96	0.00
J34	0.13	306.29	60.41	0.00
J35	0.25	306.29	60.72	0.00
J36	0.03	306.29	60.72	0.00
J37	0.13	306.29	60.54	0.00



R1	0.00	0.00	0.00	0.00	Reservoir
R2	-3.97	0.00	0.00	0.00	Reservoir

Link Results at 2:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.30	0.01	0.00	Open
P5	0.19	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.10	0.00	0.00	Open
P8	-0.19	0.01	0.00	Open
P9	-0.24	0.01	0.00	Open
P2	-0.11	0.00	0.00	Open
P11	-0.38	0.01	0.00	Open
P12	-0.49	0.02	0.00	Open
P13	-0.87	0.03	0.01	Open
P14	-0.87	0.03	0.01	Open
P3	-0.21	0.01	0.00	Open
P10	3.97	0.06	0.02	Open
P15	1.62	0.02	0.00	Open
P17	1.16	0.02	0.00	Open
P18	0.24	0.00	0.00	Open
P19	-0.15	0.00	0.00	Open
P20	-0.97	0.01	0.00	Open
P21	-1.10	0.02	0.00	Open
P22	-1.38	0.02	0.00	Open
P23	-1.38	0.02	0.00	Open
P24	0.87	0.01	0.00	Open
P25	2.25	0.03	0.01	Open
P26	0.85	0.01	0.00	Open
P27	0.16	0.00	0.00	Open



Page 8

Link Results at 2:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-0.19	0.00	0.00	Open
P29	-0.82	0.01	0.00	Open
P30	0.62	0.01	0.00	Open
P31	0.10	0.00	0.00	Open
P32	-0.12	0.00	0.00	Open
P33	-0.63	0.01	0.00	Open
P34	0.37	0.01	0.00	Open
P35	0.34	0.00	0.00	Open



P36	0.09	0.00	0.00	Open
P37	-0.04	0.00	0.00	Open
P38	-0.31	0.00	0.00	Open
P39	-0.31	0.00	0.00	Open
P40	-0.31	0.00	0.00	Open
P16	1.49	0.02	0.00	Open
P41	1.36	0.02	0.00	Open
1	0.00	0.00	0.00	Closed Pump
2	3.97	0.00	-306.29	Open Pump

Node Results at 3:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.29	53.19	0.00
J2	0.00	306.29	53.64	0.00
J3	0.08	306.29	56.13	0.00
J4	0.07	306.29	57.53	0.00
J5	0.00	306.29	58.15	0.00
J6	0.30	306.29	58.54	0.00
J7	0.10	306.29	55.12	0.00
J8	0.05	306.29	56.92	0.00
J9	0.10	306.29	58.91	0.00
J11	0.17	306.29	59.04	0.00
J12	0.00	306.29	58.80	0.00
J13	0.00	306.29	59.34	0.00
J14	0.00	306.29	59.42	0.00
J33	0.00	306.29	58.84	0.00
J10	0.00	306.29	59.36	0.00
J15	0.10	306.29	59.78	0.00
J16	0.00	306.29	59.42	0.00
J17	0.28	306.29	59.57	0.00
J18	0.13	306.29	59.85	0.00
J19	0.13	306.29	60.20	0.00
J20	0.20	306.29	60.77	0.00
J21	0.00	306.29	60.14	0.00
J22	0.39	306.29	60.48	0.00
J23	0.07	306.29	60.81	0.00



Page 9

Node Results at 3:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.29	60.17	0.00
J25	0.35	306.29	60.50	0.00
J26	0.07	306.29	60.86	0.00



J27	0.20	306.29	60.20	0.00
J28	0.22	306.29	60.50	0.00
J29	0.15	306.29	60.87	0.00
J30	0.00	306.29	60.05	0.00
J31	0.00	306.29	59.86	0.00
J32	0.27	306.29	59.96	0.00
J34	0.13	306.29	60.41	0.00
J35	0.25	306.29	60.72	0.00
J36	0.03	306.29	60.72	0.00
J37	0.13	306.29	60.54	0.00
R1	0.00	0.00	0.00	0.00 Reservoir
R2	-3.97	0.00	0.00	0.00 Reservoir

Link Results at 3:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.30	0.01	0.00	Open
P5	0.19	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.10	0.00	0.00	Open
P8	-0.19	0.01	0.00	Open
P9	-0.24	0.01	0.00	Open
P2	-0.11	0.00	0.00	Open
P11	-0.38	0.01	0.00	Open
P12	-0.49	0.02	0.00	Open
P13	-0.87	0.03	0.01	Open
P14	-0.87	0.03	0.01	Open
P3	-0.21	0.01	0.00	Open
P10	3.97	0.06	0.02	Open
P15	1.62	0.02	0.00	Open
P17	1.16	0.02	0.00	Open
P18	0.24	0.00	0.00	Open
P19	-0.15	0.00	0.00	Open
P20	-0.97	0.01	0.00	Open
P21	-1.10	0.02	0.00	Open
P22	-1.38	0.02	0.00	Open
P23	-1.38	0.02	0.00	Open
P24	0.87	0.01	0.00	Open
P25	2.25	0.03	0.01	Open
P26	0.85	0.01	0.00	Open
P27	0.16	0.00	0.00	Open



Page 10

Link Results at 3:00 Hrs: (continued)

Link	Flow	Velocity	Unit Headloss	Status
------	------	----------	---------------	--------



ID	LPS	m/s	m/km	
P28	-0.19	0.00	0.00	Open
P29	-0.82	0.01	0.00	Open
P30	0.62	0.01	0.00	Open
P31	0.10	0.00	0.00	Open
P32	-0.12	0.00	0.00	Open
P33	-0.63	0.01	0.00	Open
P34	0.37	0.01	0.00	Open
P35	0.34	0.00	0.00	Open
P36	0.09	0.00	0.00	Open
P37	-0.04	0.00	0.00	Open
P38	-0.31	0.00	0.00	Open
P39	-0.31	0.00	0.00	Open
P40	-0.31	0.00	0.00	Open
P16	1.49	0.02	0.00	Open
P41	1.36	0.02	0.00	Open
1	0.00	0.00	0.00	Closed Pump
2	3.97	0.00	-306.29	Open Pump

Node Results at 4:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.29	53.19	0.00
J2	0.00	306.29	53.64	0.00
J3	0.08	306.29	56.13	0.00
J4	0.07	306.29	57.53	0.00
J5	0.00	306.29	58.15	0.00
J6	0.30	306.29	58.54	0.00
J7	0.10	306.29	55.12	0.00
J8	0.05	306.29	56.92	0.00
J9	0.10	306.29	58.91	0.00
J11	0.17	306.29	59.04	0.00
J12	0.00	306.29	58.80	0.00
J13	0.00	306.29	59.34	0.00
J14	0.00	306.29	59.42	0.00
J33	0.00	306.29	58.84	0.00
J10	0.00	306.29	59.36	0.00
J15	0.10	306.29	59.78	0.00
J16	0.00	306.29	59.42	0.00
J17	0.28	306.29	59.57	0.00
J18	0.13	306.29	59.85	0.00
J19	0.13	306.29	60.20	0.00
J20	0.20	306.29	60.77	0.00
J21	0.00	306.29	60.14	0.00
J22	0.39	306.29	60.48	0.00
J23	0.07	306.29	60.81	0.00



Page 11

Node Results at 4:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.29	60.17	0.00
J25	0.35	306.29	60.50	0.00
J26	0.07	306.29	60.86	0.00
J27	0.20	306.29	60.20	0.00
J28	0.22	306.29	60.50	0.00
J29	0.15	306.29	60.87	0.00
J30	0.00	306.29	60.05	0.00
J31	0.00	306.29	59.86	0.00
J32	0.27	306.29	59.96	0.00
J34	0.13	306.29	60.41	0.00
J35	0.25	306.29	60.72	0.00
J36	0.03	306.29	60.72	0.00
J37	0.13	306.29	60.54	0.00
R1	0.00	0.00	0.00	0.00 Reservoir
R2	-3.97	0.00	0.00	0.00 Reservoir

Link Results at 4:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.30	0.01	0.00	Open
P5	0.19	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.10	0.00	0.00	Open
P8	-0.19	0.01	0.00	Open
P9	-0.24	0.01	0.00	Open
P2	-0.11	0.00	0.00	Open
P11	-0.38	0.01	0.00	Open
P12	-0.49	0.02	0.00	Open
P13	-0.87	0.03	0.01	Open
P14	-0.87	0.03	0.01	Open
P3	-0.21	0.01	0.00	Open
P10	3.97	0.06	0.02	Open
P15	1.62	0.02	0.00	Open
P17	1.16	0.02	0.00	Open
P18	0.24	0.00	0.00	Open
P19	-0.15	0.00	0.00	Open
P20	-0.97	0.01	0.00	Open
P21	-1.10	0.02	0.00	Open
P22	-1.38	0.02	0.00	Open
P23	-1.38	0.02	0.00	Open



P24	0.87	0.01	0.00	Open
P25	2.25	0.03	0.01	Open
P26	0.85	0.01	0.00	Open
P27	0.16	0.00	0.00	Open



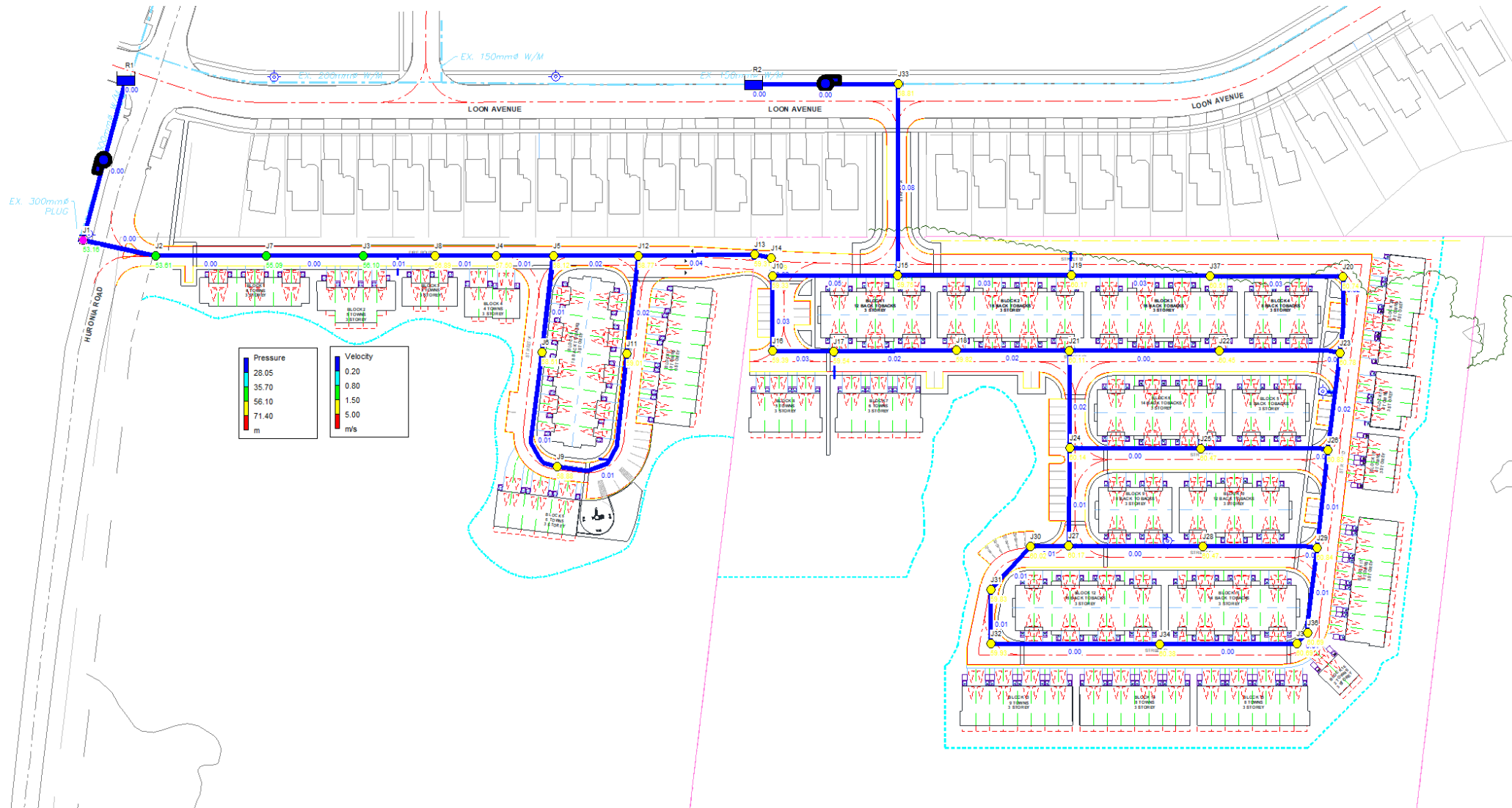
Page 12

Link Results at 4:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-0.19	0.00	0.00	Open
P29	-0.82	0.01	0.00	Open
P30	0.62	0.01	0.00	Open
P31	0.10	0.00	0.00	Open
P32	-0.12	0.00	0.00	Open
P33	-0.63	0.01	0.00	Open
P34	0.37	0.01	0.00	Open
P35	0.34	0.00	0.00	Open
P36	0.09	0.00	0.00	Open
P37	-0.04	0.00	0.00	Open
P38	-0.31	0.00	0.00	Open
P39	-0.31	0.00	0.00	Open
P40	-0.31	0.00	0.00	Open
P16	1.49	0.02	0.00	Open
P41	1.36	0.02	0.00	Open
1	0.00	0.00	0.00	Closed Pump
2	3.97	0.00	-306.29	Open Pump



Peak Hour Demand Conditions Schematic





Page 1

2023-04-19 3:56:53 PM

```

*****
*                               E P A N E T                               *
*                               Hydraulic and Water Quality                 *
*                               Analysis for Pipe Networks                   *
*                               Version 2.2                                 *
*****

```

Input File: 21076_Peak Hour.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
P1	J1	J2	22.05	200
P4	J4	J5	19.49	200
P5	J5	J6	32.42	200
P6	J2	J7	37.41	200
P7	J7	J3	32.68	200
P8	J3	J8	25.97	200
P9	J8	J4	21.27	200
P2	J6	J9	42.67	200
P11	J11	J12	34.10	200
P12	J5	J12	29.21	200
P13	J12	J13	36.04	200
P14	J13	J14	5.68	200
P3	J9	J11	54.61	200
P10	J33	J15	64.2	300
P15	J15	J19	58.8	300
P17	J20	J23	25.3	300
P18	J23	J22	40.3	300
P19	J22	J21	50.4	300
P20	J21	J18	37.7	300
P21	J18	J17	40.4	300
P22	J17	J16	20	300
P23	J16	J10	24.3	300
P24	J10	J14	6.4	300
P25	J15	J10	41.7	300
P26	J23	J26	33.7	300
P27	J26	J25	40.2	300
P28	J25	J24	45.7	300
P29	J24	J21	32.6	300
P30	J26	J29	33.6	300
P31	J29	J28	39.4	300
P32	J28	J27	42.7	300
P33	J27	J24	32.5	300
P34	J29	J36	28.3	300



P35	J36	J35	5.2	300
P36	J35	J34	46.4	300
P37	J34	J32	57	300
P38	J32	J31	18.9	300



Page 2

Link - Node Table: (continued)

Link ID	Start Node	End Node	Length m	Diameter mm	
P39	J31	J30	19.5	300	
P40	J30	J27	12.7	300	
P16	J19	J37	45.35	300	
P41	J37	J20	45.35	300	
1	R1	J1	#N/A	#N/A	Pump
2	R2	J33	#N/A	#N/A	Pump

Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /m3	Avg. Kw	Peak Kw	Cost /day
1	0.00	0.00	0.00	0.00	0.00	0.00
2	100.00	75.00	1.11	23.98	23.98	0.00
Demand Charge:						0.00
Total Cost:						0.00

Node Results at 0:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.26	53.16	0.00
J2	0.00	306.26	53.61	0.00
J3	0.13	306.26	56.10	0.00
J4	0.10	306.26	57.50	0.00
J5	0.00	306.26	58.12	0.00
J6	0.45	306.26	58.51	0.00
J7	0.15	306.26	55.09	0.00
J8	0.08	306.26	56.89	0.00
J9	0.15	306.26	58.88	0.00
J11	0.25	306.26	59.01	0.00
J12	0.00	306.26	58.77	0.00
J13	0.00	306.26	59.31	0.00
J14	0.00	306.26	59.39	0.00
J33	0.00	306.26	58.81	0.00
J10	0.00	306.26	59.33	0.00



J15	0.15	306.26	59.75	0.00
J16	0.00	306.26	59.39	0.00
J17	0.43	306.26	59.54	0.00
J18	0.20	306.26	59.82	0.00
J19	0.20	306.26	60.17	0.00
J20	0.30	306.26	60.74	0.00
J21	0.00	306.26	60.11	0.00
J22	0.58	306.26	60.45	0.00
J23	0.10	306.26	60.78	0.00



Page 3

Node Results at 0:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.26	60.14	0.00
J25	0.53	306.26	60.47	0.00
J26	0.10	306.26	60.83	0.00
J27	0.30	306.26	60.17	0.00
J28	0.33	306.26	60.47	0.00
J29	0.23	306.26	60.84	0.00
J30	0.00	306.26	60.02	0.00
J31	0.00	306.26	59.83	0.00
J32	0.40	306.26	59.93	0.00
J34	0.20	306.26	60.38	0.00
J35	0.38	306.26	60.69	0.00
J36	0.05	306.26	60.69	0.00
J37	0.20	306.26	60.51	0.00
R1	0.00	0.00	0.00	0.00 Reservoir
R2	-5.99	0.00	0.00	0.00 Reservoir

Link Results at 0:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.45	0.01	0.00	Open
P5	0.29	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.15	0.00	0.00	Open
P8	-0.28	0.01	0.00	Open
P9	-0.35	0.01	0.00	Open
P2	-0.17	0.01	0.00	Open
P11	-0.57	0.02	0.00	Open
P12	-0.74	0.02	0.01	Open
P13	-1.31	0.04	0.02	Open
P14	-1.31	0.04	0.02	Open



P3	-0.32	0.01	0.00	Open
P10	5.99	0.08	0.04	Open
P15	2.44	0.03	0.01	Open
P17	1.74	0.02	0.00	Open
P18	0.36	0.01	0.00	Open
P19	-0.22	0.00	0.00	Open
P20	-1.46	0.02	0.00	Open
P21	-1.66	0.02	0.00	Open
P22	-2.09	0.03	0.01	Open
P23	-2.09	0.03	0.01	Open
P24	1.31	0.02	0.00	Open
P25	3.40	0.05	0.01	Open
P26	1.28	0.02	0.00	Open
P27	0.25	0.00	0.00	Open



Page 4

Link Results at 0:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-0.28	0.00	0.00	Open
P29	-1.24	0.02	0.00	Open
P30	0.93	0.01	0.00	Open
P31	0.14	0.00	0.00	Open
P32	-0.19	0.00	0.00	Open
P33	-0.96	0.01	0.00	Open
P34	0.56	0.01	0.00	Open
P35	0.51	0.01	0.00	Open
P36	0.13	0.00	0.00	Open
P37	-0.07	0.00	0.00	Open
P38	-0.47	0.01	0.00	Open
P39	-0.47	0.01	0.00	Open
P40	-0.47	0.01	0.00	Open
P16	2.24	0.03	0.01	Open
P41	2.04	0.03	0.01	Open
1	0.00	0.00	0.00	Closed Pump
2	5.99	0.00	-306.26	Open Pump

Node Results at 1:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.26	53.16	0.00
J2	0.00	306.26	53.61	0.00
J3	0.13	306.26	56.10	0.00
J4	0.10	306.26	57.50	0.00
J5	0.00	306.26	58.12	0.00



J6	0.45	306.26	58.51	0.00
J7	0.15	306.26	55.09	0.00
J8	0.08	306.26	56.89	0.00
J9	0.15	306.26	58.88	0.00
J11	0.25	306.26	59.01	0.00
J12	0.00	306.26	58.77	0.00
J13	0.00	306.26	59.31	0.00
J14	0.00	306.26	59.39	0.00
J33	0.00	306.26	58.81	0.00
J10	0.00	306.26	59.33	0.00
J15	0.15	306.26	59.75	0.00
J16	0.00	306.26	59.39	0.00
J17	0.43	306.26	59.54	0.00
J18	0.20	306.26	59.82	0.00
J19	0.20	306.26	60.17	0.00
J20	0.30	306.26	60.74	0.00
J21	0.00	306.26	60.11	0.00
J22	0.58	306.26	60.45	0.00
J23	0.10	306.26	60.78	0.00



Page 5

Node Results at 1:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.26	60.14	0.00
J25	0.53	306.26	60.47	0.00
J26	0.10	306.26	60.83	0.00
J27	0.30	306.26	60.17	0.00
J28	0.33	306.26	60.47	0.00
J29	0.23	306.26	60.84	0.00
J30	0.00	306.26	60.02	0.00
J31	0.00	306.26	59.83	0.00
J32	0.40	306.26	59.93	0.00
J34	0.20	306.26	60.38	0.00
J35	0.38	306.26	60.69	0.00
J36	0.05	306.26	60.69	0.00
J37	0.20	306.26	60.51	0.00
R1	0.00	0.00	0.00	0.00 Reservoir
R2	-5.99	0.00	0.00	0.00 Reservoir

Link Results at 1:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.45	0.01	0.00	Open



P5	0.29	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.15	0.00	0.00	Open
P8	-0.28	0.01	0.00	Open
P9	-0.35	0.01	0.00	Open
P2	-0.17	0.01	0.00	Open
P11	-0.57	0.02	0.00	Open
P12	-0.74	0.02	0.01	Open
P13	-1.31	0.04	0.02	Open
P14	-1.31	0.04	0.02	Open
P3	-0.32	0.01	0.00	Open
P10	5.99	0.08	0.04	Open
P15	2.44	0.03	0.01	Open
P17	1.74	0.02	0.00	Open
P18	0.36	0.01	0.00	Open
P19	-0.22	0.00	0.00	Open
P20	-1.46	0.02	0.00	Open
P21	-1.66	0.02	0.00	Open
P22	-2.09	0.03	0.01	Open
P23	-2.09	0.03	0.01	Open
P24	1.31	0.02	0.00	Open
P25	3.40	0.05	0.01	Open
P26	1.28	0.02	0.00	Open
P27	0.25	0.00	0.00	Open



Page 6

Link Results at 1:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-0.28	0.00	0.00	Open
P29	-1.24	0.02	0.00	Open
P30	0.93	0.01	0.00	Open
P31	0.14	0.00	0.00	Open
P32	-0.19	0.00	0.00	Open
P33	-0.96	0.01	0.00	Open
P34	0.56	0.01	0.00	Open
P35	0.51	0.01	0.00	Open
P36	0.13	0.00	0.00	Open
P37	-0.07	0.00	0.00	Open
P38	-0.47	0.01	0.00	Open
P39	-0.47	0.01	0.00	Open
P40	-0.47	0.01	0.00	Open
P16	2.24	0.03	0.01	Open
P41	2.04	0.03	0.01	Open
1	0.00	0.00	0.00	Closed Pump
2	5.99	0.00	-306.26	Open Pump



Node Results at 2:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.26	53.16	0.00
J2	0.00	306.26	53.61	0.00
J3	0.13	306.26	56.10	0.00
J4	0.10	306.26	57.50	0.00
J5	0.00	306.26	58.12	0.00
J6	0.45	306.26	58.51	0.00
J7	0.15	306.26	55.09	0.00
J8	0.08	306.26	56.89	0.00
J9	0.15	306.26	58.88	0.00
J11	0.25	306.26	59.01	0.00
J12	0.00	306.26	58.77	0.00
J13	0.00	306.26	59.31	0.00
J14	0.00	306.26	59.39	0.00
J33	0.00	306.26	58.81	0.00
J10	0.00	306.26	59.33	0.00
J15	0.15	306.26	59.75	0.00
J16	0.00	306.26	59.39	0.00
J17	0.43	306.26	59.54	0.00
J18	0.20	306.26	59.82	0.00
J19	0.20	306.26	60.17	0.00
J20	0.30	306.26	60.74	0.00
J21	0.00	306.26	60.11	0.00
J22	0.58	306.26	60.45	0.00
J23	0.10	306.26	60.78	0.00



Page 7

Node Results at 2:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.26	60.14	0.00
J25	0.53	306.26	60.47	0.00
J26	0.10	306.26	60.83	0.00
J27	0.30	306.26	60.17	0.00
J28	0.33	306.26	60.47	0.00
J29	0.23	306.26	60.84	0.00
J30	0.00	306.26	60.02	0.00
J31	0.00	306.26	59.83	0.00
J32	0.40	306.26	59.93	0.00
J34	0.20	306.26	60.38	0.00
J35	0.38	306.26	60.69	0.00
J36	0.05	306.26	60.69	0.00
J37	0.20	306.26	60.51	0.00



R1	0.00	0.00	0.00	0.00	Reservoir
R2	-5.99	0.00	0.00	0.00	Reservoir

Link Results at 2:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.45	0.01	0.00	Open
P5	0.29	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.15	0.00	0.00	Open
P8	-0.28	0.01	0.00	Open
P9	-0.35	0.01	0.00	Open
P2	-0.17	0.01	0.00	Open
P11	-0.57	0.02	0.00	Open
P12	-0.74	0.02	0.01	Open
P13	-1.31	0.04	0.02	Open
P14	-1.31	0.04	0.02	Open
P3	-0.32	0.01	0.00	Open
P10	5.99	0.08	0.04	Open
P15	2.44	0.03	0.01	Open
P17	1.74	0.02	0.00	Open
P18	0.36	0.01	0.00	Open
P19	-0.22	0.00	0.00	Open
P20	-1.46	0.02	0.00	Open
P21	-1.66	0.02	0.00	Open
P22	-2.09	0.03	0.01	Open
P23	-2.09	0.03	0.01	Open
P24	1.31	0.02	0.00	Open
P25	3.40	0.05	0.01	Open
P26	1.28	0.02	0.00	Open
P27	0.25	0.00	0.00	Open



Page 8

Link Results at 2:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-0.28	0.00	0.00	Open
P29	-1.24	0.02	0.00	Open
P30	0.93	0.01	0.00	Open
P31	0.14	0.00	0.00	Open
P32	-0.19	0.00	0.00	Open
P33	-0.96	0.01	0.00	Open
P34	0.56	0.01	0.00	Open
P35	0.51	0.01	0.00	Open



P36	0.13	0.00	0.00	Open
P37	-0.07	0.00	0.00	Open
P38	-0.47	0.01	0.00	Open
P39	-0.47	0.01	0.00	Open
P40	-0.47	0.01	0.00	Open
P16	2.24	0.03	0.01	Open
P41	2.04	0.03	0.01	Open
1	0.00	0.00	0.00	Closed Pump
2	5.99	0.00	-306.26	Open Pump

Node Results at 3:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.26	53.16	0.00
J2	0.00	306.26	53.61	0.00
J3	0.13	306.26	56.10	0.00
J4	0.10	306.26	57.50	0.00
J5	0.00	306.26	58.12	0.00
J6	0.45	306.26	58.51	0.00
J7	0.15	306.26	55.09	0.00
J8	0.08	306.26	56.89	0.00
J9	0.15	306.26	58.88	0.00
J11	0.25	306.26	59.01	0.00
J12	0.00	306.26	58.77	0.00
J13	0.00	306.26	59.31	0.00
J14	0.00	306.26	59.39	0.00
J33	0.00	306.26	58.81	0.00
J10	0.00	306.26	59.33	0.00
J15	0.15	306.26	59.75	0.00
J16	0.00	306.26	59.39	0.00
J17	0.43	306.26	59.54	0.00
J18	0.20	306.26	59.82	0.00
J19	0.20	306.26	60.17	0.00
J20	0.30	306.26	60.74	0.00
J21	0.00	306.26	60.11	0.00
J22	0.58	306.26	60.45	0.00
J23	0.10	306.26	60.78	0.00



Page 9

Node Results at 3:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.26	60.14	0.00
J25	0.53	306.26	60.47	0.00
J26	0.10	306.26	60.83	0.00



J27	0.30	306.26	60.17	0.00	
J28	0.33	306.26	60.47	0.00	
J29	0.23	306.26	60.84	0.00	
J30	0.00	306.26	60.02	0.00	
J31	0.00	306.26	59.83	0.00	
J32	0.40	306.26	59.93	0.00	
J34	0.20	306.26	60.38	0.00	
J35	0.38	306.26	60.69	0.00	
J36	0.05	306.26	60.69	0.00	
J37	0.20	306.26	60.51	0.00	
R1	0.00	0.00	0.00	0.00	Reservoir
R2	-5.99	0.00	0.00	0.00	Reservoir

Link Results at 3:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.45	0.01	0.00	Open
P5	0.29	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.15	0.00	0.00	Open
P8	-0.28	0.01	0.00	Open
P9	-0.35	0.01	0.00	Open
P2	-0.17	0.01	0.00	Open
P11	-0.57	0.02	0.00	Open
P12	-0.74	0.02	0.01	Open
P13	-1.31	0.04	0.02	Open
P14	-1.31	0.04	0.02	Open
P3	-0.32	0.01	0.00	Open
P10	5.99	0.08	0.04	Open
P15	2.44	0.03	0.01	Open
P17	1.74	0.02	0.00	Open
P18	0.36	0.01	0.00	Open
P19	-0.22	0.00	0.00	Open
P20	-1.46	0.02	0.00	Open
P21	-1.66	0.02	0.00	Open
P22	-2.09	0.03	0.01	Open
P23	-2.09	0.03	0.01	Open
P24	1.31	0.02	0.00	Open
P25	3.40	0.05	0.01	Open
P26	1.28	0.02	0.00	Open
P27	0.25	0.00	0.00	Open



Page 10

Link Results at 3:00 Hrs: (continued)

Link	Flow	Velocity	Unit Headloss	Status
------	------	----------	---------------	--------



ID	LPS	m/s	m/km	
P28	-0.28	0.00	0.00	Open
P29	-1.24	0.02	0.00	Open
P30	0.93	0.01	0.00	Open
P31	0.14	0.00	0.00	Open
P32	-0.19	0.00	0.00	Open
P33	-0.96	0.01	0.00	Open
P34	0.56	0.01	0.00	Open
P35	0.51	0.01	0.00	Open
P36	0.13	0.00	0.00	Open
P37	-0.07	0.00	0.00	Open
P38	-0.47	0.01	0.00	Open
P39	-0.47	0.01	0.00	Open
P40	-0.47	0.01	0.00	Open
P16	2.24	0.03	0.01	Open
P41	2.04	0.03	0.01	Open
1	0.00	0.00	0.00	Closed Pump
2	5.99	0.00	-306.26	Open Pump

Node Results at 4:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	306.26	53.16	0.00
J2	0.00	306.26	53.61	0.00
J3	0.13	306.26	56.10	0.00
J4	0.10	306.26	57.50	0.00
J5	0.00	306.26	58.12	0.00
J6	0.45	306.26	58.51	0.00
J7	0.15	306.26	55.09	0.00
J8	0.08	306.26	56.89	0.00
J9	0.15	306.26	58.88	0.00
J11	0.25	306.26	59.01	0.00
J12	0.00	306.26	58.77	0.00
J13	0.00	306.26	59.31	0.00
J14	0.00	306.26	59.39	0.00
J33	0.00	306.26	58.81	0.00
J10	0.00	306.26	59.33	0.00
J15	0.15	306.26	59.75	0.00
J16	0.00	306.26	59.39	0.00
J17	0.43	306.26	59.54	0.00
J18	0.20	306.26	59.82	0.00
J19	0.20	306.26	60.17	0.00
J20	0.30	306.26	60.74	0.00
J21	0.00	306.26	60.11	0.00
J22	0.58	306.26	60.45	0.00
J23	0.10	306.26	60.78	0.00



Page 11

Node Results at 4:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	306.26	60.14	0.00
J25	0.53	306.26	60.47	0.00
J26	0.10	306.26	60.83	0.00
J27	0.30	306.26	60.17	0.00
J28	0.33	306.26	60.47	0.00
J29	0.23	306.26	60.84	0.00
J30	0.00	306.26	60.02	0.00
J31	0.00	306.26	59.83	0.00
J32	0.40	306.26	59.93	0.00
J34	0.20	306.26	60.38	0.00
J35	0.38	306.26	60.69	0.00
J36	0.05	306.26	60.69	0.00
J37	0.20	306.26	60.51	0.00
R1	0.00	0.00	0.00	0.00 Reservoir
R2	-5.99	0.00	0.00	0.00 Reservoir

Link Results at 4:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	0.00	0.00	0.00	Open
P4	-0.45	0.01	0.00	Open
P5	0.29	0.01	0.00	Open
P6	0.00	0.00	0.00	Open
P7	-0.15	0.00	0.00	Open
P8	-0.28	0.01	0.00	Open
P9	-0.35	0.01	0.00	Open
P2	-0.17	0.01	0.00	Open
P11	-0.57	0.02	0.00	Open
P12	-0.74	0.02	0.01	Open
P13	-1.31	0.04	0.02	Open
P14	-1.31	0.04	0.02	Open
P3	-0.32	0.01	0.00	Open
P10	5.99	0.08	0.04	Open
P15	2.44	0.03	0.01	Open
P17	1.74	0.02	0.00	Open
P18	0.36	0.01	0.00	Open
P19	-0.22	0.00	0.00	Open
P20	-1.46	0.02	0.00	Open
P21	-1.66	0.02	0.00	Open
P22	-2.09	0.03	0.01	Open
P23	-2.09	0.03	0.01	Open



P24	1.31	0.02	0.00	Open
P25	3.40	0.05	0.01	Open
P26	1.28	0.02	0.00	Open
P27	0.25	0.00	0.00	Open



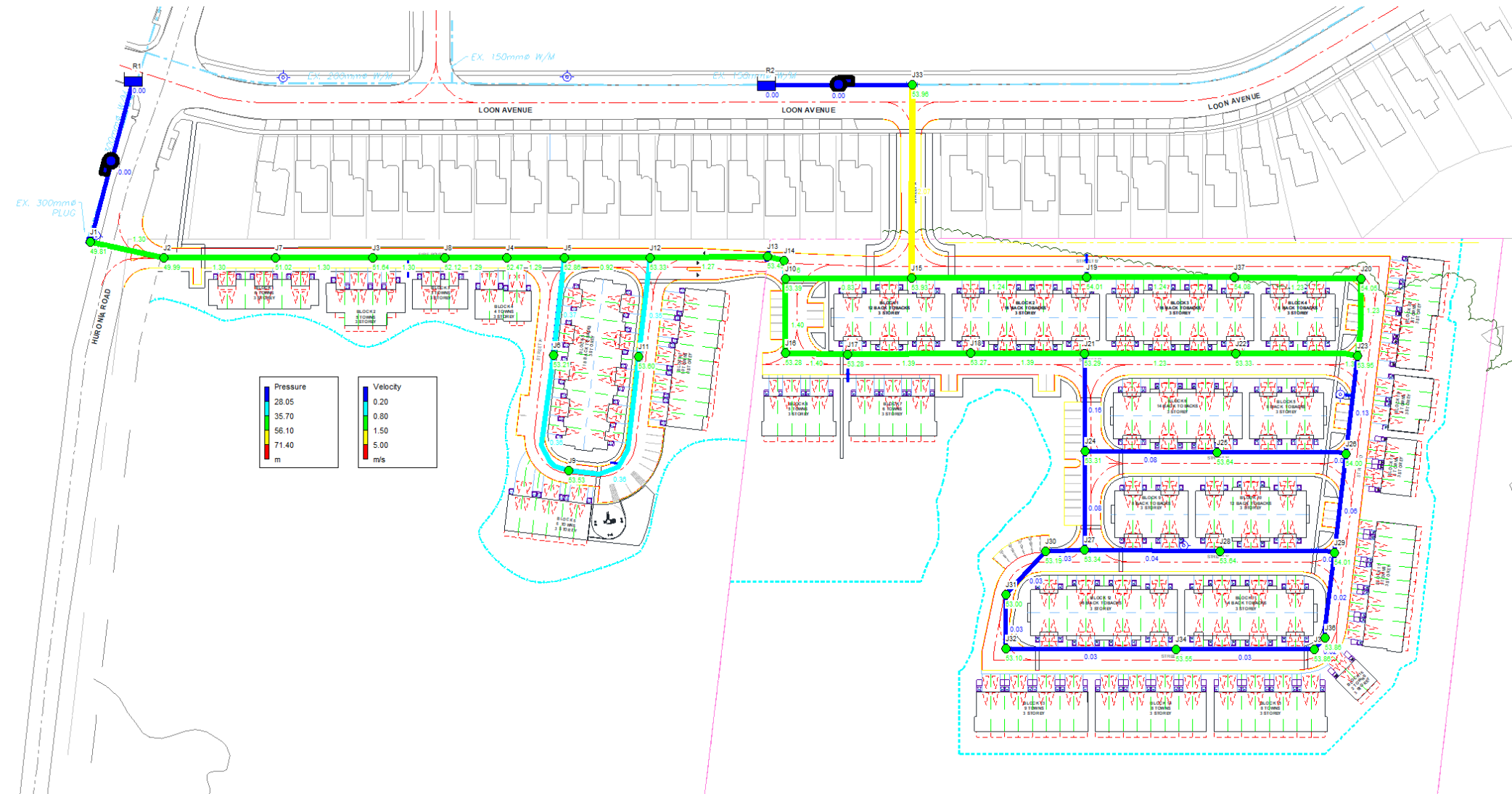
Page 12

Link Results at 4:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-0.28	0.00	0.00	Open
P29	-1.24	0.02	0.00	Open
P30	0.93	0.01	0.00	Open
P31	0.14	0.00	0.00	Open
P32	-0.19	0.00	0.00	Open
P33	-0.96	0.01	0.00	Open
P34	0.56	0.01	0.00	Open
P35	0.51	0.01	0.00	Open
P36	0.13	0.00	0.00	Open
P37	-0.07	0.00	0.00	Open
P38	-0.47	0.01	0.00	Open
P39	-0.47	0.01	0.00	Open
P40	-0.47	0.01	0.00	Open
P16	2.24	0.03	0.01	Open
P41	2.04	0.03	0.01	Open
1	0.00	0.00	0.00	Closed Pump
2	5.99	0.00	-306.26	Open Pump



Max Day + Fire Flow Demand Conditions at Block 3 (J19,J22) Schematic





Page 1

2023-04-19 3:58:35 PM

```

*****
*                               E P A N E T                               *
*                               Hydraulic and Water Quality                 *
*                               Analysis for Pipe Networks                 *
*                               Version 2.2                                *
*****

```

Input File: 21076_Max Day + Fire @ Block 3.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
P1	J1	J2	22.05	200
P4	J4	J5	19.49	200
P5	J5	J6	32.42	200
P6	J2	J7	37.41	200
P7	J7	J3	32.68	200
P8	J3	J8	25.97	200
P9	J8	J4	21.27	200
P2	J6	J9	42.67	200
P11	J11	J12	34.10	200
P12	J5	J12	29.21	200
P13	J12	J13	36.04	200
P14	J13	J14	5.68	200
P3	J9	J11	54.61	200
P10	J33	J15	64.2	300
P15	J15	J19	58.8	300
P17	J20	J23	25.3	300
P18	J23	J22	40.3	300
P19	J22	J21	50.4	300
P20	J21	J18	37.7	300
P21	J18	J17	40.4	300
P22	J17	J16	20	300
P23	J16	J10	24.3	300
P24	J10	J14	6.4	300
P25	J15	J10	41.7	300
P26	J23	J26	33.7	300
P27	J26	J25	40.2	300
P28	J25	J24	45.7	300
P29	J24	J21	32.6	300
P30	J26	J29	33.6	300
P31	J29	J28	39.4	300
P32	J28	J27	42.7	300
P33	J27	J24	32.5	300
P34	J29	J36	28.3	300



P35	J36	J35	5.2	300
P36	J35	J34	46.4	300
P37	J34	J32	57	300
P38	J32	J31	18.9	300



Page 2

Link - Node Table: (continued)

Link ID	Start Node	End Node	Length m	Diameter mm	
P39	J31	J30	19.5	300	
P40	J30	J27	12.7	300	
P16	J19	J37	45.35	300	
P41	J37	J20	45.35	300	
1	R1	J1	#N/A	#N/A	Pump
2	R2	J33	#N/A	#N/A	Pump

Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /m3	Avg. Kw	Peak Kw	Cost /day
1	100.00	75.00	1.10	161.97	161.97	0.00
2	100.00	75.00	1.09	576.68	576.68	0.00
Demand Charge:						0.00
Total Cost:						0.00

Node Results at 0:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00
J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00



J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.57	54.05	0.00
J21	0.00	299.44	53.29	0.00
J22	183.72	299.14	53.33	0.00
J23	0.07	299.43	53.95	0.00



Page 3

Node Results at 0:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.43	53.31	0.00
J25	0.35	299.43	53.64	0.00
J26	0.07	299.43	54.00	0.00
J27	0.20	299.43	53.34	0.00
J28	0.22	299.43	53.64	0.00
J29	0.15	299.43	54.01	0.00
J30	0.00	299.43	53.19	0.00
J31	0.00	299.43	53.00	0.00
J32	0.27	299.43	53.10	0.00
J34	0.13	299.43	53.55	0.00
J35	0.25	299.43	53.86	0.00
J36	0.03	299.43	53.86	0.00
J37	0.13	299.83	54.08	0.00
R1	-40.91	0.00	0.00	0.00 Reservoir
R2	-146.39	0.00	0.00	0.00 Reservoir

Link Results at 0:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	40.91	1.30	12.06	Open
P4	40.61	1.29	11.89	Open
P5	11.72	0.37	1.19	Open
P6	40.91	1.30	12.06	Open
P7	40.81	1.30	12.00	Open
P8	40.73	1.30	11.96	Open
P9	40.68	1.29	11.93	Open
P2	11.42	0.36	1.13	Open
P11	11.15	0.35	1.09	Open
P12	28.89	0.92	6.33	Open
P13	40.04	1.27	11.58	Open
P14	40.04	1.27	11.58	Open



P3	11.32	0.36	1.12	Open
P10	146.39	2.07	15.10	Open
P15	87.54	1.24	5.82	Open
P17	87.08	1.23	5.77	Open
P18	96.51	1.37	6.98	Open
P19	-87.21	1.23	5.78	Open
P20	-98.38	1.39	7.23	Open
P21	-98.51	1.39	7.25	Open
P22	-98.79	1.40	7.29	Open
P23	-98.79	1.40	7.29	Open
P24	-40.04	0.57	1.37	Open
P25	58.75	0.83	2.78	Open
P26	-9.50	0.13	0.10	Open
P27	-5.22	0.07	0.03	Open



Page 4

Link Results at 0:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-5.57	0.08	0.04	Open
P29	-11.17	0.16	0.13	Open
P30	-4.36	0.06	0.02	Open
P31	-2.94	0.04	0.01	Open
P32	-3.16	0.04	0.01	Open
P33	-5.61	0.08	0.04	Open
P34	-1.56	0.02	0.00	Open
P35	-1.59	0.02	0.00	Open
P36	-1.84	0.03	0.00	Open
P37	-1.97	0.03	0.01	Open
P38	-2.24	0.03	0.01	Open
P39	-2.24	0.03	0.01	Open
P40	-2.24	0.03	0.01	Open
P16	87.41	1.24	5.81	Open
P41	87.28	1.23	5.79	Open
1	40.91	0.00	-302.91	Open Pump
2	146.39	0.00	-301.41	Open Pump

Node Results at 1:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00



J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00
J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.57	54.05	0.00
J21	0.00	299.44	53.29	0.00
J22	183.72	299.14	53.33	0.00
J23	0.07	299.43	53.95	0.00



Page 5

Node Results at 1:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.43	53.31	0.00
J25	0.35	299.43	53.64	0.00
J26	0.07	299.43	54.00	0.00
J27	0.20	299.43	53.34	0.00
J28	0.22	299.43	53.64	0.00
J29	0.15	299.43	54.01	0.00
J30	0.00	299.43	53.19	0.00
J31	0.00	299.43	53.00	0.00
J32	0.27	299.43	53.10	0.00
J34	0.13	299.43	53.55	0.00
J35	0.25	299.43	53.86	0.00
J36	0.03	299.43	53.86	0.00
J37	0.13	299.83	54.08	0.00
R1	-40.91	0.00	0.00	0.00 Reservoir
R2	-146.39	0.00	0.00	0.00 Reservoir

Link Results at 1:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Headloss m/km	Status
P1	40.91	1.30	12.06	Open
P4	40.61	1.29	11.89	Open



P5	11.72	0.37	1.19	Open
P6	40.91	1.30	12.06	Open
P7	40.81	1.30	12.00	Open
P8	40.73	1.30	11.96	Open
P9	40.68	1.29	11.93	Open
P2	11.42	0.36	1.13	Open
P11	11.15	0.35	1.09	Open
P12	28.89	0.92	6.33	Open
P13	40.04	1.27	11.58	Open
P14	40.04	1.27	11.58	Open
P3	11.32	0.36	1.12	Open
P10	146.39	2.07	15.10	Open
P15	87.54	1.24	5.82	Open
P17	87.08	1.23	5.77	Open
P18	96.51	1.37	6.98	Open
P19	-87.21	1.23	5.78	Open
P20	-98.38	1.39	7.23	Open
P21	-98.51	1.39	7.25	Open
P22	-98.79	1.40	7.29	Open
P23	-98.79	1.40	7.29	Open
P24	-40.04	0.57	1.37	Open
P25	58.75	0.83	2.78	Open
P26	-9.50	0.13	0.10	Open
P27	-5.22	0.07	0.03	Open



Page 6

Link Results at 1:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-5.57	0.08	0.04	Open
P29	-11.17	0.16	0.13	Open
P30	-4.36	0.06	0.02	Open
P31	-2.94	0.04	0.01	Open
P32	-3.16	0.04	0.01	Open
P33	-5.61	0.08	0.04	Open
P34	-1.56	0.02	0.00	Open
P35	-1.59	0.02	0.00	Open
P36	-1.84	0.03	0.00	Open
P37	-1.97	0.03	0.01	Open
P38	-2.24	0.03	0.01	Open
P39	-2.24	0.03	0.01	Open
P40	-2.24	0.03	0.01	Open
P16	87.41	1.24	5.81	Open
P41	87.28	1.23	5.79	Open
1	40.91	0.00	-302.91	Open Pump
2	146.39	0.00	-301.41	Open Pump



Node Results at 2:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00
J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00
J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.57	54.05	0.00
J21	0.00	299.44	53.29	0.00
J22	183.72	299.14	53.33	0.00
J23	0.07	299.43	53.95	0.00



Page 7

Node Results at 2:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.43	53.31	0.00
J25	0.35	299.43	53.64	0.00
J26	0.07	299.43	54.00	0.00
J27	0.20	299.43	53.34	0.00
J28	0.22	299.43	53.64	0.00
J29	0.15	299.43	54.01	0.00
J30	0.00	299.43	53.19	0.00
J31	0.00	299.43	53.00	0.00
J32	0.27	299.43	53.10	0.00
J34	0.13	299.43	53.55	0.00
J35	0.25	299.43	53.86	0.00
J36	0.03	299.43	53.86	0.00
J37	0.13	299.83	54.08	0.00



R1	-40.91	0.00	0.00	0.00	Reservoir
R2	-146.39	0.00	0.00	0.00	Reservoir

Link Results at 2:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	40.91	1.30	12.06	Open
P4	40.61	1.29	11.89	Open
P5	11.72	0.37	1.19	Open
P6	40.91	1.30	12.06	Open
P7	40.81	1.30	12.00	Open
P8	40.73	1.30	11.96	Open
P9	40.68	1.29	11.93	Open
P2	11.42	0.36	1.13	Open
P11	11.15	0.35	1.09	Open
P12	28.89	0.92	6.33	Open
P13	40.04	1.27	11.58	Open
P14	40.04	1.27	11.58	Open
P3	11.32	0.36	1.12	Open
P10	146.39	2.07	15.10	Open
P15	87.54	1.24	5.82	Open
P17	87.08	1.23	5.77	Open
P18	96.51	1.37	6.98	Open
P19	-87.21	1.23	5.78	Open
P20	-98.38	1.39	7.23	Open
P21	-98.51	1.39	7.25	Open
P22	-98.79	1.40	7.29	Open
P23	-98.79	1.40	7.29	Open
P24	-40.04	0.57	1.37	Open
P25	58.75	0.83	2.78	Open
P26	-9.50	0.13	0.10	Open
P27	-5.22	0.07	0.03	Open



Page 8

Link Results at 2:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-5.57	0.08	0.04	Open
P29	-11.17	0.16	0.13	Open
P30	-4.36	0.06	0.02	Open
P31	-2.94	0.04	0.01	Open
P32	-3.16	0.04	0.01	Open
P33	-5.61	0.08	0.04	Open
P34	-1.56	0.02	0.00	Open
P35	-1.59	0.02	0.00	Open



P36	-1.84	0.03	0.00	Open
P37	-1.97	0.03	0.01	Open
P38	-2.24	0.03	0.01	Open
P39	-2.24	0.03	0.01	Open
P40	-2.24	0.03	0.01	Open
P16	87.41	1.24	5.81	Open
P41	87.28	1.23	5.79	Open
1	40.91	0.00	-302.91	Open Pump
2	146.39	0.00	-301.41	Open Pump

Node Results at 3:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00
J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00
J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.57	54.05	0.00
J21	0.00	299.44	53.29	0.00
J22	183.72	299.14	53.33	0.00
J23	0.07	299.43	53.95	0.00



Page 9

Node Results at 3:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.43	53.31	0.00
J25	0.35	299.43	53.64	0.00
J26	0.07	299.43	54.00	0.00



J27	0.20	299.43	53.34	0.00	
J28	0.22	299.43	53.64	0.00	
J29	0.15	299.43	54.01	0.00	
J30	0.00	299.43	53.19	0.00	
J31	0.00	299.43	53.00	0.00	
J32	0.27	299.43	53.10	0.00	
J34	0.13	299.43	53.55	0.00	
J35	0.25	299.43	53.86	0.00	
J36	0.03	299.43	53.86	0.00	
J37	0.13	299.83	54.08	0.00	
R1	-40.91	0.00	0.00	0.00	Reservoir
R2	-146.39	0.00	0.00	0.00	Reservoir

Link Results at 3:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	40.91	1.30	12.06	Open
P4	40.61	1.29	11.89	Open
P5	11.72	0.37	1.19	Open
P6	40.91	1.30	12.06	Open
P7	40.81	1.30	12.00	Open
P8	40.73	1.30	11.96	Open
P9	40.68	1.29	11.93	Open
P2	11.42	0.36	1.13	Open
P11	11.15	0.35	1.09	Open
P12	28.89	0.92	6.33	Open
P13	40.04	1.27	11.58	Open
P14	40.04	1.27	11.58	Open
P3	11.32	0.36	1.12	Open
P10	146.39	2.07	15.10	Open
P15	87.54	1.24	5.82	Open
P17	87.08	1.23	5.77	Open
P18	96.51	1.37	6.98	Open
P19	-87.21	1.23	5.78	Open
P20	-98.38	1.39	7.23	Open
P21	-98.51	1.39	7.25	Open
P22	-98.79	1.40	7.29	Open
P23	-98.79	1.40	7.29	Open
P24	-40.04	0.57	1.37	Open
P25	58.75	0.83	2.78	Open
P26	-9.50	0.13	0.10	Open
P27	-5.22	0.07	0.03	Open



Page 10

Link Results at 3:00 Hrs: (continued)

Link	Flow	Velocity	Unit Headloss	Status
------	------	----------	---------------	--------



ID	LPS	m/s	m/km	
P28	-5.57	0.08	0.04	Open
P29	-11.17	0.16	0.13	Open
P30	-4.36	0.06	0.02	Open
P31	-2.94	0.04	0.01	Open
P32	-3.16	0.04	0.01	Open
P33	-5.61	0.08	0.04	Open
P34	-1.56	0.02	0.00	Open
P35	-1.59	0.02	0.00	Open
P36	-1.84	0.03	0.00	Open
P37	-1.97	0.03	0.01	Open
P38	-2.24	0.03	0.01	Open
P39	-2.24	0.03	0.01	Open
P40	-2.24	0.03	0.01	Open
P16	87.41	1.24	5.81	Open
P41	87.28	1.23	5.79	Open
1	40.91	0.00	-302.91	Open Pump
2	146.39	0.00	-301.41	Open Pump

Node Results at 4:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00
J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00
J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.57	54.05	0.00
J21	0.00	299.44	53.29	0.00
J22	183.72	299.14	53.33	0.00
J23	0.07	299.43	53.95	0.00



Page 11

Node Results at 4:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.43	53.31	0.00
J25	0.35	299.43	53.64	0.00
J26	0.07	299.43	54.00	0.00
J27	0.20	299.43	53.34	0.00
J28	0.22	299.43	53.64	0.00
J29	0.15	299.43	54.01	0.00
J30	0.00	299.43	53.19	0.00
J31	0.00	299.43	53.00	0.00
J32	0.27	299.43	53.10	0.00
J34	0.13	299.43	53.55	0.00
J35	0.25	299.43	53.86	0.00
J36	0.03	299.43	53.86	0.00
J37	0.13	299.83	54.08	0.00
R1	-40.91	0.00	0.00	0.00 Reservoir
R2	-146.39	0.00	0.00	0.00 Reservoir

Link Results at 4:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Headloss m/km	Status
P1	40.91	1.30	12.06	Open
P4	40.61	1.29	11.89	Open
P5	11.72	0.37	1.19	Open
P6	40.91	1.30	12.06	Open
P7	40.81	1.30	12.00	Open
P8	40.73	1.30	11.96	Open
P9	40.68	1.29	11.93	Open
P2	11.42	0.36	1.13	Open
P11	11.15	0.35	1.09	Open
P12	28.89	0.92	6.33	Open
P13	40.04	1.27	11.58	Open
P14	40.04	1.27	11.58	Open
P3	11.32	0.36	1.12	Open
P10	146.39	2.07	15.10	Open
P15	87.54	1.24	5.82	Open
P17	87.08	1.23	5.77	Open
P18	96.51	1.37	6.98	Open
P19	-87.21	1.23	5.78	Open
P20	-98.38	1.39	7.23	Open
P21	-98.51	1.39	7.25	Open
P22	-98.79	1.40	7.29	Open
P23	-98.79	1.40	7.29	Open



P24	-40.04	0.57	1.37	Open
P25	58.75	0.83	2.78	Open
P26	-9.50	0.13	0.10	Open
P27	-5.22	0.07	0.03	Open



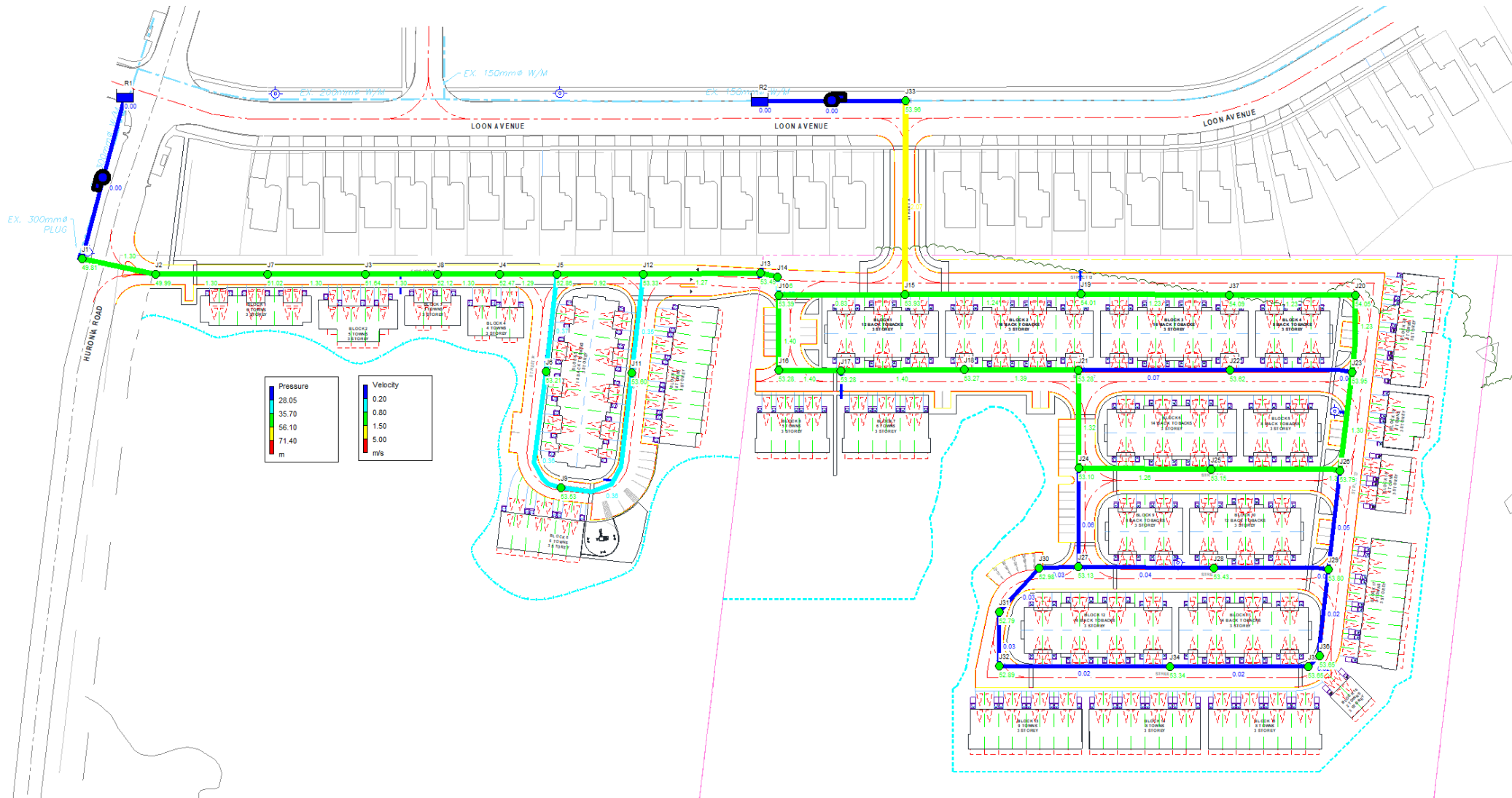
Page 12

Link Results at 4:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-5.57	0.08	0.04	Open
P29	-11.17	0.16	0.13	Open
P30	-4.36	0.06	0.02	Open
P31	-2.94	0.04	0.01	Open
P32	-3.16	0.04	0.01	Open
P33	-5.61	0.08	0.04	Open
P34	-1.56	0.02	0.00	Open
P35	-1.59	0.02	0.00	Open
P36	-1.84	0.03	0.00	Open
P37	-1.97	0.03	0.01	Open
P38	-2.24	0.03	0.01	Open
P39	-2.24	0.03	0.01	Open
P40	-2.24	0.03	0.01	Open
P16	87.41	1.24	5.81	Open
P41	87.28	1.23	5.79	Open
1	40.91	0.00	-302.91	Open Pump
2	146.39	0.00	-301.41	Open Pump



Max Day + Fire Flow Demand Conditions at Block 5 (J19,J22) Schematic





Page 1

2023-04-19 3:58:15 PM

```

*****
*                               E P A N E T                               *
*                               Hydraulic and Water Quality                 *
*                               Analysis for Pipe Networks                   *
*                               Version 2.2                                 *
*****

```

Input File: 21076_Max Day + Fire @ Block 5.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
P1	J1	J2	22.05	200
P4	J4	J5	19.49	200
P5	J5	J6	32.42	200
P6	J2	J7	37.41	200
P7	J7	J3	32.68	200
P8	J3	J8	25.97	200
P9	J8	J4	21.27	200
P2	J6	J9	42.67	200
P11	J11	J12	34.10	200
P12	J5	J12	29.21	200
P13	J12	J13	36.04	200
P14	J13	J14	5.68	200
P3	J9	J11	54.61	200
P10	J33	J15	64.2	300
P15	J15	J19	58.8	300
P17	J20	J23	25.3	300
P18	J23	J22	40.3	300
P19	J22	J21	50.4	300
P20	J21	J18	37.7	300
P21	J18	J17	40.4	300
P22	J17	J16	20	300
P23	J16	J10	24.3	300
P24	J10	J14	6.4	300
P25	J15	J10	41.7	300
P26	J23	J26	33.7	300
P27	J26	J25	40.2	300
P28	J25	J24	45.7	300
P29	J24	J21	32.6	300
P30	J26	J29	33.6	300
P31	J29	J28	39.4	300
P32	J28	J27	42.7	300
P33	J27	J24	32.5	300
P34	J29	J36	28.3	300



P35	J36	J35	5.2	300
P36	J35	J34	46.4	300
P37	J34	J32	57	300
P38	J32	J31	18.9	300



Page 2

Link - Node Table: (continued)

Link ID	Start Node	End Node	Length m	Diameter mm	
P39	J31	J30	19.5	300	
P40	J30	J27	12.7	300	
P16	J19	J37	45.35	300	
P41	J37	J20	45.35	300	
1	R1	J1	#N/A	#N/A	Pump
2	R2	J33	#N/A	#N/A	Pump

Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /m3	Avg. Kw	Peak Kw	Cost /day
1	100.00	75.00	1.10	161.99	161.99	0.00
2	100.00	75.00	1.09	576.70	576.70	0.00
Demand Charge:						0.00
Total Cost:						0.00

Node Results at 0:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00
J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00



J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.57	54.05	0.00
J21	0.00	299.43	53.28	0.00
J22	0.39	299.43	53.62	0.00
J23	0.07	299.43	53.95	0.00



Page 3

Node Results at 0:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.22	53.10	0.00
J25	183.69	298.94	53.15	0.00
J26	0.07	299.22	53.79	0.00
J27	0.20	299.22	53.13	0.00
J28	0.22	299.22	53.43	0.00
J29	0.15	299.22	53.80	0.00
J30	0.00	299.22	52.98	0.00
J31	0.00	299.22	52.79	0.00
J32	0.27	299.22	52.89	0.00
J34	0.13	299.22	53.34	0.00
J35	0.25	299.22	53.65	0.00
J36	0.03	299.22	53.65	0.00
J37	0.13	299.84	54.09	0.00
R1	-40.92	0.00	0.00	0.00 Reservoir
R2	-146.39	0.00	0.00	0.00 Reservoir

Link Results at 0:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	40.92	1.30	12.06	Open
P4	40.62	1.29	11.90	Open
P5	11.72	0.37	1.19	Open
P6	40.92	1.30	12.06	Open
P7	40.82	1.30	12.01	Open
P8	40.73	1.30	11.96	Open
P9	40.68	1.30	11.93	Open
P2	11.42	0.36	1.13	Open
P11	11.15	0.35	1.09	Open
P12	28.90	0.92	6.33	Open
P13	40.05	1.27	11.59	Open
P14	40.05	1.27	11.59	Open



P3	11.32	0.36	1.12	Open
P10	146.39	2.07	15.10	Open
P15	87.36	1.24	5.80	Open
P17	86.90	1.23	5.75	Open
P18	-4.76	0.07	0.03	Open
P19	-5.15	0.07	0.03	Open
P20	-98.57	1.39	7.26	Open
P21	-98.70	1.40	7.27	Open
P22	-98.98	1.40	7.31	Open
P23	-98.98	1.40	7.31	Open
P24	-40.05	0.57	1.37	Open
P25	58.93	0.83	2.80	Open
P26	91.59	1.30	6.33	Open
P27	94.85	1.34	6.76	Open



Page 4

Link Results at 0:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-88.84	1.26	5.99	Open
P29	-93.42	1.32	6.57	Open
P30	-3.33	0.05	0.01	Open
P31	-2.32	0.03	0.01	Open
P32	-2.54	0.04	0.01	Open
P33	-4.58	0.06	0.02	Open
P34	-1.16	0.02	0.00	Open
P35	-1.19	0.02	0.00	Open
P36	-1.44	0.02	0.00	Open
P37	-1.57	0.02	0.00	Open
P38	-1.84	0.03	0.00	Open
P39	-1.84	0.03	0.00	Open
P40	-1.84	0.03	0.00	Open
P16	87.23	1.23	5.79	Open
P41	87.10	1.23	5.77	Open
1	40.92	0.00	-302.91	Open Pump
2	146.39	0.00	-301.41	Open Pump

Node Results at 1:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00



J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00
J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.57	54.05	0.00
J21	0.00	299.43	53.28	0.00
J22	0.39	299.43	53.62	0.00
J23	0.07	299.43	53.95	0.00



Page 5

Node Results at 1:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.22	53.10	0.00
J25	183.69	298.94	53.15	0.00
J26	0.07	299.22	53.79	0.00
J27	0.20	299.22	53.13	0.00
J28	0.22	299.22	53.43	0.00
J29	0.15	299.22	53.80	0.00
J30	0.00	299.22	52.98	0.00
J31	0.00	299.22	52.79	0.00
J32	0.27	299.22	52.89	0.00
J34	0.13	299.22	53.34	0.00
J35	0.25	299.22	53.65	0.00
J36	0.03	299.22	53.65	0.00
J37	0.13	299.84	54.09	0.00
R1	-40.92	0.00	0.00	0.00 Reservoir
R2	-146.39	0.00	0.00	0.00 Reservoir

Link Results at 1:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Headloss m/km	Status
---------	----------	--------------	---------------	--------

Node Results at 2:00 Hrs:



Node	Demand	Head	Pressure	Quality
ID	LPS	m	m	

Link Results at 2:00 Hrs:

Link	Flow	Velocity	Unit	Headloss	Status
ID	LPS	m/s		m/km	

Node Results at 3:00 Hrs:

Node	Demand	Head	Pressure	Quality
ID	LPS	m	m	



Page 6

Link Results at 3:00 Hrs:

Link	Flow	Velocity	Unit	Headloss	Status
ID	LPS	m/s		m/km	

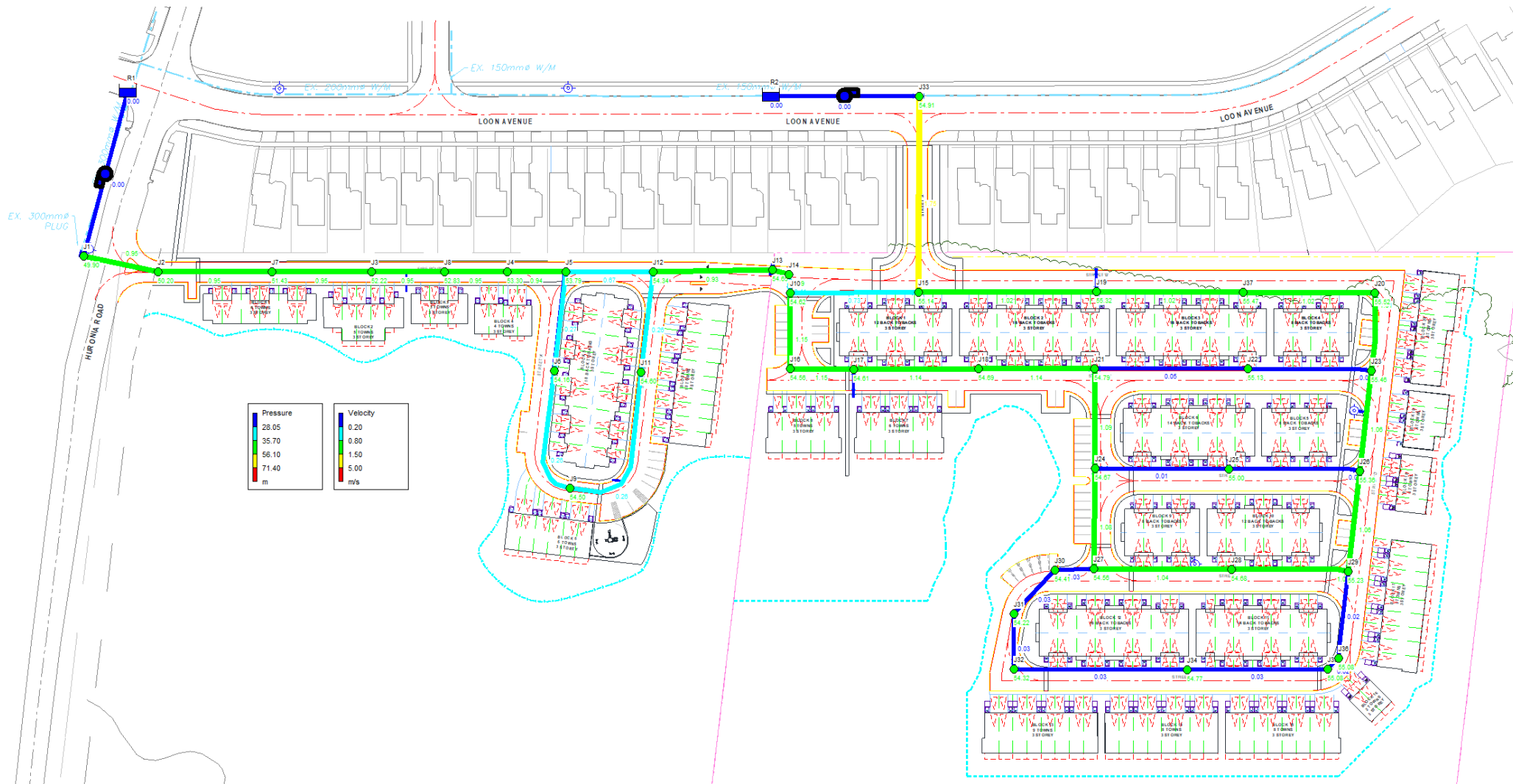
Node Results at 4:00 Hrs:

Node	Demand	Head	Pressure	Quality
ID	LPS	m	m	

Link Results at 4:00 Hrs:

Link	Flow	Velocity	Unit	Headloss	Status
ID	LPS	m/s		m/km	

Max Day + Fire Flow Demand Conditions at Block 10 (J25,J28) Schematic





Page 1

2023-04-19 3:58:02 PM

```

*****
*                               E P A N E T                               *
*                               Hydraulic and Water Quality                 *
*                               Analysis for Pipe Networks                 *
*                               Version 2.2                               *
*****

```

Input File: 21076_Max Day + Fire @ Block 10.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
P1	J1	J2	22.05	200
P4	J4	J5	19.49	200
P5	J5	J6	32.42	200
P6	J2	J7	37.41	200
P7	J7	J3	32.68	200
P8	J3	J8	25.97	200
P9	J8	J4	21.27	200
P2	J6	J9	42.67	200
P11	J11	J12	34.10	200
P12	J5	J12	29.21	200
P13	J12	J13	36.04	200
P14	J13	J14	5.68	200
P3	J9	J11	54.61	200
P10	J33	J15	64.2	300
P15	J15	J19	58.8	300
P17	J20	J23	25.3	300
P18	J23	J22	40.3	300
P19	J22	J21	50.4	300
P20	J21	J18	37.7	300
P21	J18	J17	40.4	300
P22	J17	J16	20	300
P23	J16	J10	24.3	300
P24	J10	J14	6.4	300
P25	J15	J10	41.7	300
P26	J23	J26	33.7	300
P27	J26	J25	40.2	300
P28	J25	J24	45.7	300
P29	J24	J21	32.6	300
P30	J26	J29	33.6	300
P31	J29	J28	39.4	300
P32	J28	J27	42.7	300
P33	J27	J24	32.5	300
P34	J29	J36	28.3	300



P35	J36	J35	5.2	300
P36	J35	J34	46.4	300
P37	J34	J32	57	300
P38	J32	J31	18.9	300



Page 2

Link - Node Table: (continued)

Link ID	Start Node	End Node	Length m	Diameter mm	
P39	J31	J30	19.5	300	
P40	J30	J27	12.7	300	
P16	J19	J37	45.35	300	
P41	J37	J20	45.35	300	
1	R1	J1	#N/A	#N/A	Pump
2	R2	J33	#N/A	#N/A	Pump

Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /m3	Avg. Kw	Peak Kw	Cost /day
1	100.00	75.00	1.10	118.68	118.68	0.00
2	100.00	75.00	1.10	490.04	490.04	0.00
Demand Charge:						0.00
Total Cost:						0.00

Node Results at 0:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	303.00	49.90	0.00
J2	0.00	302.85	50.20	0.00
J3	0.08	302.38	52.22	0.00
J4	0.07	302.06	53.30	0.00
J5	0.00	301.93	53.79	0.00
J6	0.30	301.91	54.16	0.00
J7	0.10	302.60	51.43	0.00
J8	0.05	302.20	52.83	0.00
J9	0.10	301.88	54.50	0.00
J11	0.17	301.85	54.60	0.00
J12	0.00	301.83	54.34	0.00
J13	0.00	301.60	54.65	0.00
J14	0.00	301.56	54.69	0.00
J33	0.00	302.36	54.91	0.00
J10	0.00	301.55	54.62	0.00



J15	0.10	301.65	55.14	0.00
J16	0.00	301.43	54.56	0.00
J17	0.28	301.33	54.61	0.00
J18	0.13	301.13	54.69	0.00
J19	0.13	301.41	55.32	0.00
J20	0.20	301.04	55.52	0.00
J21	0.00	300.94	54.79	0.00
J22	0.39	300.94	55.13	0.00
J23	0.07	300.94	55.46	0.00



Page 3

Node Results at 0:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	300.79	54.67	0.00
J25	0.35	300.79	55.00	0.00
J26	0.07	300.79	55.36	0.00
J27	0.20	300.65	54.56	0.00
J28	150.22	300.47	54.68	0.00
J29	0.15	300.65	55.23	0.00
J30	0.00	300.65	54.41	0.00
J31	0.00	300.65	54.22	0.00
J32	0.27	300.65	54.32	0.00
J34	0.13	300.65	54.77	0.00
J35	0.25	300.65	55.08	0.00
J36	0.03	300.65	55.08	0.00
J37	0.13	301.22	55.47	0.00
R1	-29.97	0.00	0.00	0.00 Reservoir
R2	-124.00	0.00	0.00	0.00 Reservoir

Link Results at 0:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
---------	----------	--------------	--------------------	--------

Node Results at 1:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
---------	------------	--------	------------	---------

Link Results at 1:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
---------	----------	--------------	--------------------	--------



Node Results at 2:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
------------	---------------	-----------	---------------	---------



Page 4

Link Results at 2:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
------------	-------------	-----------------	-----------------------	--------

Node Results at 3:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
------------	---------------	-----------	---------------	---------

Link Results at 3:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
------------	-------------	-----------------	-----------------------	--------

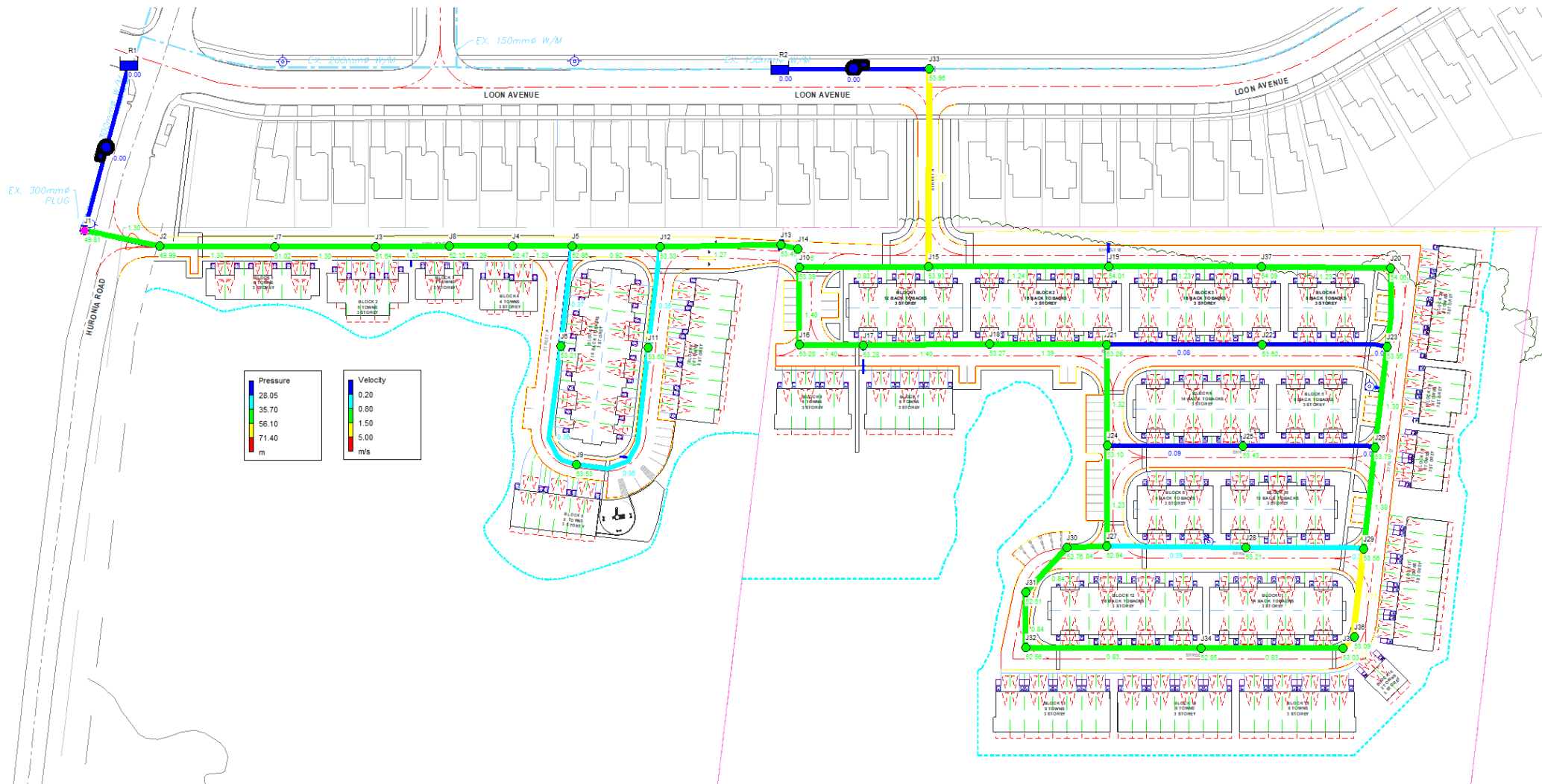
Node Results at 4:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
------------	---------------	-----------	---------------	---------

Link Results at 4:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
------------	-------------	-----------------	-----------------------	--------

Max Day + Fire Flow Demand Conditions at Block 11 (J28,J35) Schematic





Page 1

2023-04-19 3:57:49 PM

```

*****
*                               E P A N E T                               *
*                               Hydraulic and Water Quality                 *
*                               Analysis for Pipe Networks                   *
*                               Version 2.2                                 *
*****

```

Input File: 21076_Max Day + Fire @ Block 11.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
P1	J1	J2	22.05	200
P4	J4	J5	19.49	200
P5	J5	J6	32.42	200
P6	J2	J7	37.41	200
P7	J7	J3	32.68	200
P8	J3	J8	25.97	200
P9	J8	J4	21.27	200
P2	J6	J9	42.67	200
P11	J11	J12	34.10	200
P12	J5	J12	29.21	200
P13	J12	J13	36.04	200
P14	J13	J14	5.68	200
P3	J9	J11	54.61	200
P10	J33	J15	64.2	300
P15	J15	J19	58.8	300
P17	J20	J23	25.3	300
P18	J23	J22	40.3	300
P19	J22	J21	50.4	300
P20	J21	J18	37.7	300
P21	J18	J17	40.4	300
P22	J17	J16	20	300
P23	J16	J10	24.3	300
P24	J10	J14	6.4	300
P25	J15	J10	41.7	300
P26	J23	J26	33.7	300
P27	J26	J25	40.2	300
P28	J25	J24	45.7	300
P29	J24	J21	32.6	300
P30	J26	J29	33.6	300
P31	J29	J28	39.4	300
P32	J28	J27	42.7	300
P33	J27	J24	32.5	300
P34	J29	J36	28.3	300



P35	J36	J35	5.2	300
P36	J35	J34	46.4	300
P37	J34	J32	57	300
P38	J32	J31	18.9	300



Page 2

Link - Node Table: (continued)

Link ID	Start Node	End Node	Length m	Diameter mm	
P39	J31	J30	19.5	300	
P40	J30	J27	12.7	300	
P16	J19	J37	45.35	300	
P41	J37	J20	45.35	300	
1	R1	J1	#N/A	#N/A	Pump
2	R2	J33	#N/A	#N/A	Pump

Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /m3	Avg. Kw	Peak Kw	Cost /day
1	100.00	75.00	1.10	161.98	161.98	0.00
2	100.00	75.00	1.09	576.67	576.67	0.00
Demand Charge:						0.00
Total Cost:						0.00

Node Results at 0:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00
J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00



J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.58	54.06	0.00
J21	0.00	299.43	53.28	0.00
J22	0.39	299.43	53.62	0.00
J23	0.07	299.43	53.95	0.00



Page 3

Node Results at 0:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.22	53.10	0.00
J25	0.35	299.22	53.43	0.00
J26	0.07	299.22	53.79	0.00
J27	0.20	299.03	52.94	0.00
J28	0.22	299.00	53.21	0.00
J29	0.15	298.98	53.56	0.00
J30	0.00	299.00	52.76	0.00
J31	0.00	298.94	52.51	0.00
J32	0.27	298.89	52.56	0.00
J34	0.13	298.73	52.85	0.00
J35	183.58	298.60	53.03	0.00
J36	0.03	298.66	53.09	0.00
J37	0.13	299.84	54.09	0.00
R1	-40.92	0.00	0.00	0.00 Reservoir
R2	-146.39	0.00	0.00	0.00 Reservoir

Link Results at 0:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	40.92	1.30	12.06	Open
P4	40.61	1.29	11.89	Open
P5	11.72	0.37	1.19	Open
P6	40.92	1.30	12.06	Open
P7	40.81	1.30	12.00	Open
P8	40.73	1.30	11.96	Open
P9	40.68	1.29	11.93	Open
P2	11.42	0.36	1.13	Open
P11	11.15	0.35	1.09	Open
P12	28.89	0.92	6.33	Open
P13	40.04	1.27	11.59	Open
P14	40.04	1.27	11.59	Open



P3	11.32	0.36	1.12	Open
P10	146.39	2.07	15.10	Open
P15	87.36	1.24	5.80	Open
P17	86.90	1.23	5.75	Open
P18	-4.94	0.07	0.03	Open
P19	-5.33	0.08	0.03	Open
P20	-98.56	1.39	7.26	Open
P21	-98.69	1.40	7.27	Open
P22	-98.97	1.40	7.31	Open
P23	-98.97	1.40	7.31	Open
P24	-40.04	0.57	1.37	Open
P25	58.93	0.83	2.80	Open
P26	91.77	1.30	6.36	Open
P27	-5.91	0.08	0.04	Open



Page 4

Link Results at 0:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-6.26	0.09	0.04	Open
P29	-93.23	1.32	6.55	Open
P30	97.61	1.38	7.13	Open
P31	-27.39	0.39	0.68	Open
P32	-27.61	0.39	0.69	Open
P33	-86.97	1.23	5.76	Open
P34	124.85	1.77	11.24	Open
P35	124.82	1.77	11.23	Open
P36	-58.76	0.83	2.78	Open
P37	-58.89	0.83	2.80	Open
P38	-59.16	0.84	2.82	Open
P39	-59.16	0.84	2.82	Open
P40	-59.16	0.84	2.82	Open
P16	87.23	1.23	5.79	Open
P41	87.10	1.23	5.77	Open
1	40.92	0.00	-302.91	Open Pump
2	146.39	0.00	-301.41	Open Pump

Node Results at 1:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00



J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00
J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.58	54.06	0.00
J21	0.00	299.43	53.28	0.00
J22	0.39	299.43	53.62	0.00
J23	0.07	299.43	53.95	0.00



Page 5

Node Results at 1:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.22	53.10	0.00
J25	0.35	299.22	53.43	0.00
J26	0.07	299.22	53.79	0.00
J27	0.20	299.03	52.94	0.00
J28	0.22	299.00	53.21	0.00
J29	0.15	298.98	53.56	0.00
J30	0.00	299.00	52.76	0.00
J31	0.00	298.94	52.51	0.00
J32	0.27	298.89	52.56	0.00
J34	0.13	298.73	52.85	0.00
J35	183.58	298.60	53.03	0.00
J36	0.03	298.66	53.09	0.00
J37	0.13	299.84	54.09	0.00
R1	-40.92	0.00	0.00	0.00 Reservoir
R2	-146.39	0.00	0.00	0.00 Reservoir

Link Results at 1:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Headloss m/km	Status
P1	40.92	1.30	12.06	Open
P4	40.61	1.29	11.89	Open



P5	11.72	0.37	1.19	Open
P6	40.92	1.30	12.06	Open
P7	40.81	1.30	12.00	Open
P8	40.73	1.30	11.96	Open
P9	40.68	1.29	11.93	Open
P2	11.42	0.36	1.13	Open
P11	11.15	0.35	1.09	Open
P12	28.89	0.92	6.33	Open
P13	40.04	1.27	11.59	Open
P14	40.04	1.27	11.59	Open
P3	11.32	0.36	1.12	Open
P10	146.39	2.07	15.10	Open
P15	87.36	1.24	5.80	Open
P17	86.90	1.23	5.75	Open
P18	-4.94	0.07	0.03	Open
P19	-5.33	0.08	0.03	Open
P20	-98.56	1.39	7.26	Open
P21	-98.69	1.40	7.27	Open
P22	-98.97	1.40	7.31	Open
P23	-98.97	1.40	7.31	Open
P24	-40.04	0.57	1.37	Open
P25	58.93	0.83	2.80	Open
P26	91.77	1.30	6.36	Open
P27	-5.91	0.08	0.04	Open



Page 6

Link Results at 1:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-6.26	0.09	0.04	Open
P29	-93.23	1.32	6.55	Open
P30	97.61	1.38	7.13	Open
P31	-27.39	0.39	0.68	Open
P32	-27.61	0.39	0.69	Open
P33	-86.97	1.23	5.76	Open
P34	124.85	1.77	11.24	Open
P35	124.82	1.77	11.23	Open
P36	-58.76	0.83	2.78	Open
P37	-58.89	0.83	2.80	Open
P38	-59.16	0.84	2.82	Open
P39	-59.16	0.84	2.82	Open
P40	-59.16	0.84	2.82	Open
P16	87.23	1.23	5.79	Open
P41	87.10	1.23	5.77	Open
1	40.92	0.00	-302.91	Open Pump
2	146.39	0.00	-301.41	Open Pump



Node Results at 2:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	302.91	49.81	0.00
J2	0.00	302.64	49.99	0.00
J3	0.08	301.80	51.64	0.00
J4	0.07	301.23	52.47	0.00
J5	0.00	301.00	52.86	0.00
J6	0.30	300.96	53.21	0.00
J7	0.10	302.19	51.02	0.00
J8	0.05	301.49	52.12	0.00
J9	0.10	300.91	53.53	0.00
J11	0.17	300.85	53.60	0.00
J12	0.00	300.82	53.33	0.00
J13	0.00	300.40	53.45	0.00
J14	0.00	300.33	53.46	0.00
J33	0.00	301.41	53.96	0.00
J10	0.00	300.32	53.39	0.00
J15	0.10	300.44	53.93	0.00
J16	0.00	300.15	53.28	0.00
J17	0.28	300.00	53.28	0.00
J18	0.13	299.71	53.27	0.00
J19	0.13	300.10	54.01	0.00
J20	0.20	299.58	54.06	0.00
J21	0.00	299.43	53.28	0.00
J22	0.39	299.43	53.62	0.00
J23	0.07	299.43	53.95	0.00



Page 7

Node Results at 2:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	299.22	53.10	0.00
J25	0.35	299.22	53.43	0.00
J26	0.07	299.22	53.79	0.00
J27	0.20	299.03	52.94	0.00
J28	0.22	299.00	53.21	0.00
J29	0.15	298.98	53.56	0.00
J30	0.00	299.00	52.76	0.00
J31	0.00	298.94	52.51	0.00
J32	0.27	298.89	52.56	0.00
J34	0.13	298.73	52.85	0.00
J35	183.58	298.60	53.03	0.00
J36	0.03	298.66	53.09	0.00
J37	0.13	299.84	54.09	0.00



R1	-40.92	0.00	0.00	0.00	Reservoir
R2	-146.39	0.00	0.00	0.00	Reservoir

Link Results at 2:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	40.92	1.30	12.06	Open
P4	40.61	1.29	11.89	Open
P5	11.72	0.37	1.19	Open
P6	40.92	1.30	12.06	Open
P7	40.81	1.30	12.00	Open
P8	40.73	1.30	11.96	Open
P9	40.68	1.29	11.93	Open
P2	11.42	0.36	1.13	Open
P11	11.15	0.35	1.09	Open
P12	28.89	0.92	6.33	Open
P13	40.04	1.27	11.59	Open
P14	40.04	1.27	11.59	Open
P3	11.32	0.36	1.12	Open
P10	146.39	2.07	15.10	Open
P15	87.36	1.24	5.80	Open
P17	86.90	1.23	5.75	Open
P18	-4.94	0.07	0.03	Open
P19	-5.33	0.08	0.03	Open
P20	-98.56	1.39	7.26	Open
P21	-98.69	1.40	7.27	Open
P22	-98.97	1.40	7.31	Open
P23	-98.97	1.40	7.31	Open
P24	-40.04	0.57	1.37	Open
P25	58.93	0.83	2.80	Open
P26	91.77	1.30	6.36	Open
P27	-5.91	0.08	0.04	Open



Page 8

Link Results at 2:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	-6.26	0.09	0.04	Open
P29	-93.23	1.32	6.55	Open
P30	97.61	1.38	7.13	Open
P31	-27.39	0.39	0.68	Open
P32	-27.61	0.39	0.69	Open
P33	-86.97	1.23	5.76	Open
P34	124.85	1.77	11.24	Open
P35	124.82	1.77	11.23	Open



P36	-58.76	0.83	2.78	Open
P37	-58.89	0.83	2.80	Open
P38	-59.16	0.84	2.82	Open
P39	-59.16	0.84	2.82	Open
P40	-59.16	0.84	2.82	Open
P16	87.23	1.23	5.79	Open
P41	87.10	1.23	5.77	Open
1	40.92	0.00	-302.91	Open Pump
2	146.39	0.00	-301.41	Open Pump

Node Results at 3:00 Hrs:

Node	Demand	Head	Pressure	Quality
ID	LPS	m	m	

Link Results at 3:00 Hrs:

Link	Flow	Velocity	Unit	Headloss	Status
ID	LPS	m/s		m/km	

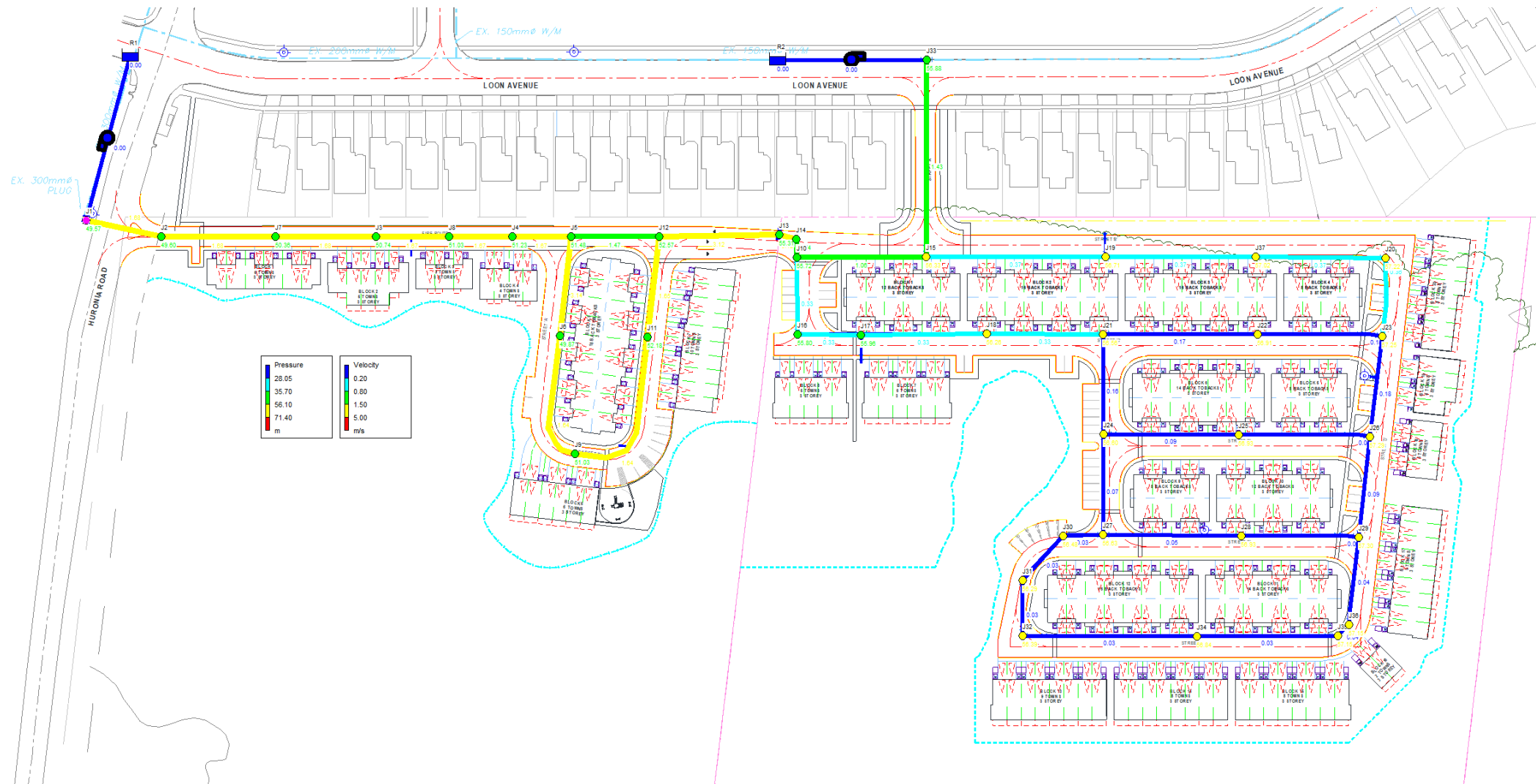
Node Results at 4:00 Hrs:

Node	Demand	Head	Pressure	Quality
ID	LPS	m	m	

Link Results at 4:00 Hrs:

Link	Flow	Velocity	Unit	Headloss	Status
ID	LPS	m/s		m/km	

Max Day + Fire Flow Demand Conditions at Huronia Block 5 (J6) Schematic





```

*****
*                               E P A N E T                               *
*                               Hydraulic and Water Quality                 *
*                               Analysis for Pipe Networks                 *
*                               Version 2.2                               *
*****

```

Input File: 21076_Max Day + Fire @ Huronia Block 5.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
P1	J1	J2	22.05	200
P4	J4	J5	19.49	200
P5	J5	J6	32.42	200
P6	J2	J7	37.41	200
P7	J7	J3	32.68	200
P8	J3	J8	25.97	200
P9	J8	J4	21.27	200
P2	J6	J9	42.67	200
P11	J11	J12	34.10	200
P12	J5	J12	29.21	200
P13	J12	J13	36.04	200
P14	J13	J14	5.68	200
P3	J9	J11	54.61	200
P10	J33	J15	64.2	300
P15	J15	J19	58.8	300
P17	J20	J23	25.3	300
P18	J23	J22	40.3	300
P19	J22	J21	50.4	300
P20	J21	J18	37.7	300
P21	J18	J17	40.4	300
P22	J17	J16	20	300
P23	J16	J10	24.3	300
P24	J10	J14	6.4	300
P25	J15	J10	41.7	300
P26	J23	J26	33.7	300
P27	J26	J25	40.2	300
P28	J25	J24	45.7	300
P29	J24	J21	32.6	300
P30	J26	J29	33.6	300
P31	J29	J28	39.4	300
P32	J28	J27	42.7	300
P33	J27	J24	32.5	300
P34	J29	J36	28.3	300



P35	J36	J35	5.2	300
P36	J35	J34	46.4	300
P37	J34	J32	57	300
P38	J32	J31	18.9	300



Page 2

Link - Node Table: (continued)

Link ID	Start Node	End Node	Length m	Diameter mm	
P39	J31	J30	19.5	300	
P40	J30	J27	12.7	300	
P16	J19	J37	45.35	300	
P41	J37	J20	45.35	300	
1	R1	J1	#N/A	#N/A	Pump
2	R2	J33	#N/A	#N/A	Pump

Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /m3	Avg. Kw	Peak Kw	Cost /day
1	100.00	75.00	1.10	208.60	208.60	0.00
2	100.00	75.00	1.10	401.36	401.36	0.00
Demand Charge:						0.00
Total Cost:						0.00

Node Results at 0:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
---------	------------	--------	------------	---------

Link Results at 0:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
---------	----------	--------------	--------------------	--------

Node Results at 1:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
---------	------------	--------	------------	---------

Link Results at 1:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
---------	----------	--------------	--------------------	--------



Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
------------	-------------	-----------------	-----------------------	--------



Page 3

Node Results at 2:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
------------	---------------	-----------	---------------	---------

Link Results at 2:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
------------	-------------	-----------------	-----------------------	--------

Node Results at 3:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
------------	---------------	-----------	---------------	---------

Link Results at 3:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
------------	-------------	-----------------	-----------------------	--------

Node Results at 4:00 Hrs:

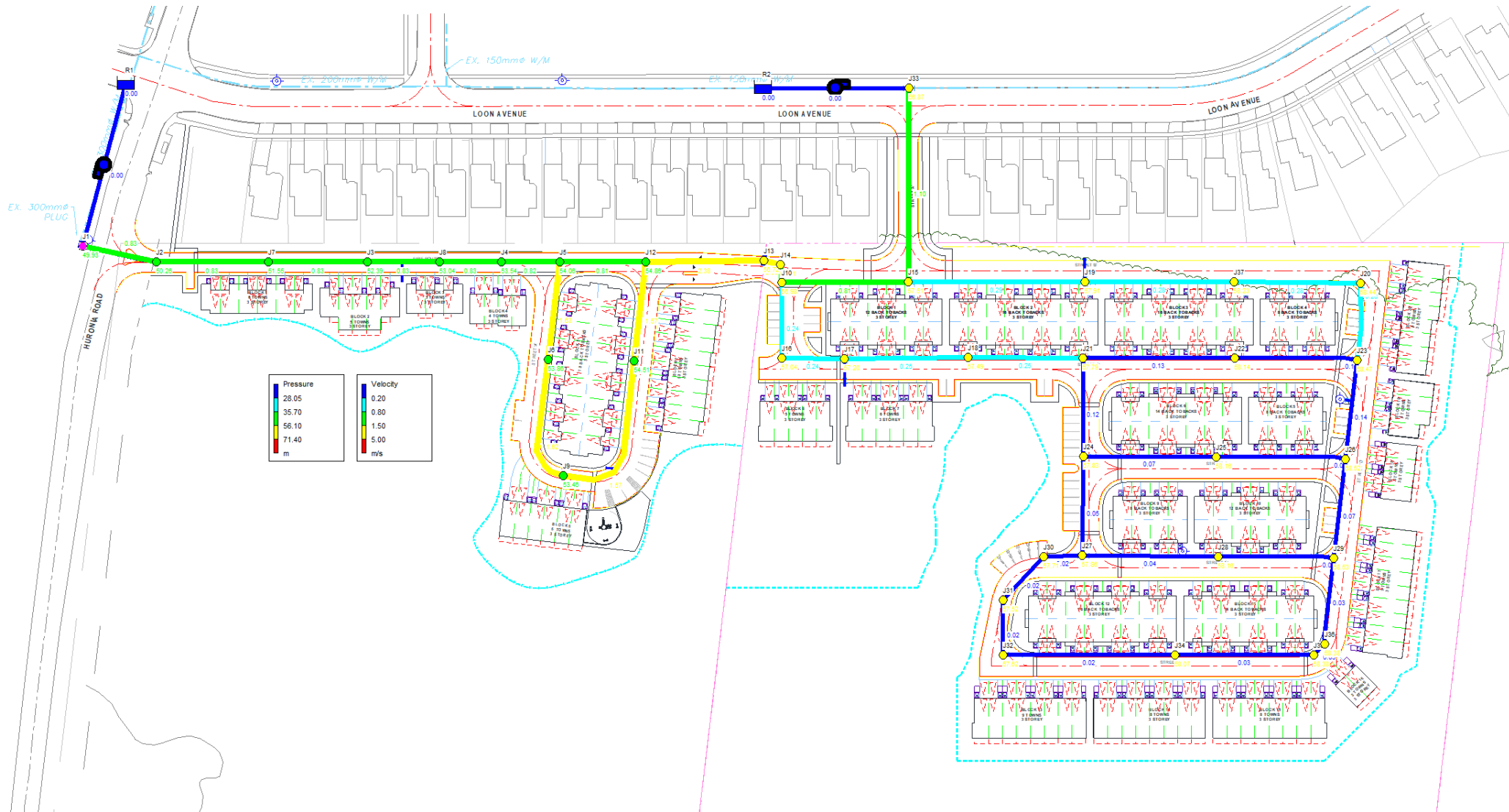
Node ID	Demand LPS	Head m	Pressure m	Quality
------------	---------------	-----------	---------------	---------

Link Results at 4:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
------------	-------------	-----------------	-----------------------	--------



Max Day + Fire Flow Demand Conditions at Huronia Block 6 (J9) Schematic





Page 1

2023-04-19 3:57:25 PM

```

*****
*                               E P A N E T                               *
*                               Hydraulic and Water Quality                 *
*                               Analysis for Pipe Networks                   *
*                               Version 2.2                                 *
*****

```

Input File: 21076_Max Day + Fire @ Huronia Block 6.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
P1	J1	J2	22.05	200
P4	J4	J5	19.49	200
P5	J5	J6	32.42	200
P6	J2	J7	37.41	200
P7	J7	J3	32.68	200
P8	J3	J8	25.97	200
P9	J8	J4	21.27	200
P2	J6	J9	42.67	200
P11	J11	J12	34.10	200
P12	J5	J12	29.21	200
P13	J12	J13	36.04	200
P14	J13	J14	5.68	200
P3	J9	J11	54.61	200
P10	J33	J15	64.2	300
P15	J15	J19	58.8	300
P17	J20	J23	25.3	300
P18	J23	J22	40.3	300
P19	J22	J21	50.4	300
P20	J21	J18	37.7	300
P21	J18	J17	40.4	300
P22	J17	J16	20	300
P23	J16	J10	24.3	300
P24	J10	J14	6.4	300
P25	J15	J10	41.7	300
P26	J23	J26	33.7	300
P27	J26	J25	40.2	300
P28	J25	J24	45.7	300
P29	J24	J21	32.6	300
P30	J26	J29	33.6	300
P31	J29	J28	39.4	300
P32	J28	J27	42.7	300
P33	J27	J24	32.5	300
P34	J29	J36	28.3	300



P35	J36	J35	5.2	300
P36	J35	J34	46.4	300
P37	J34	J32	57	300
P38	J32	J31	18.9	300



Page 2

Link - Node Table: (continued)

Link ID	Start Node	End Node	Length m	Diameter mm	
P39	J31	J30	19.5	300	
P40	J30	J27	12.7	300	
P16	J19	J37	45.35	300	
P41	J37	J20	45.35	300	
1	R1	J1	#N/A	#N/A	Pump
2	R2	J33	#N/A	#N/A	Pump

Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /m3	Avg. Kw	Peak Kw	Cost /day
1	100.00	75.00	1.10	103.61	103.61	0.00
2	100.00	75.00	1.10	309.49	309.49	0.00
Demand Charge:						0.00
Total Cost:						0.00

Node Results at 0:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	303.03	49.93	0.00
J2	0.00	302.91	50.26	0.00
J3	0.08	302.55	52.39	0.00
J4	0.07	302.30	53.54	0.00
J5	0.00	302.20	54.06	0.00
J6	0.30	301.61	53.86	0.00
J7	0.10	302.72	51.55	0.00
J8	0.05	302.41	53.04	0.00
J9	100.10	300.84	53.46	0.00
J11	0.17	301.76	54.51	0.00
J12	0.00	302.35	54.86	0.00
J13	0.00	303.67	56.72	0.00
J14	0.00	303.88	57.01	0.00
J33	0.00	304.32	56.87	0.00
J10	0.00	303.91	56.98	0.00



J15	0.10	304.02	57.51	0.00
J16	0.00	303.91	57.04	0.00
J17	0.28	303.92	57.20	0.00
J18	0.13	303.93	57.49	0.00
J19	0.13	304.00	57.91	0.00
J20	0.20	303.96	58.44	0.00
J21	0.00	303.94	57.79	0.00
J22	0.39	303.95	58.14	0.00
J23	0.07	303.95	58.47	0.00



Page 3

Node Results at 0:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	303.95	57.83	0.00
J25	0.35	303.95	58.16	0.00
J26	0.07	303.95	58.52	0.00
J27	0.20	303.95	57.86	0.00
J28	0.22	303.95	58.16	0.00
J29	0.15	303.95	58.53	0.00
J30	0.00	303.95	57.71	0.00
J31	0.00	303.95	57.52	0.00
J32	0.27	303.95	57.62	0.00
J34	0.13	303.95	58.07	0.00
J35	0.25	303.95	58.38	0.00
J36	0.03	303.95	58.38	0.00
J37	0.13	303.98	58.23	0.00
R1	-26.16	0.00	0.00	0.00 Reservoir
R2	-77.81	0.00	0.00	0.00 Reservoir

Link Results at 0:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	26.16	0.83	5.27	Open
P4	25.86	0.82	5.15	Open
P5	51.21	1.63	18.27	Open
P6	26.16	0.83	5.27	Open
P7	26.06	0.83	5.23	Open
P8	25.98	0.83	5.20	Open
P9	25.93	0.83	5.18	Open
P2	50.90	1.62	18.07	Open
P11	-49.36	1.57	17.07	Open
P12	-25.35	0.81	4.97	Open
P13	-74.71	2.38	36.78	Open
P14	-74.71	2.38	36.78	Open



P3	-49.20	1.57	16.96	Open
P10	77.81	1.10	4.68	Open
P15	20.27	0.29	0.39	Open
P17	19.81	0.28	0.37	Open
P18	9.60	0.14	0.10	Open
P19	9.21	0.13	0.09	Open
P20	17.68	0.25	0.30	Open
P21	17.55	0.25	0.30	Open
P22	17.27	0.24	0.29	Open
P23	17.27	0.24	0.29	Open
P24	74.71	1.06	4.34	Open
P25	57.44	0.81	2.67	Open
P26	10.13	0.14	0.11	Open
P27	5.00	0.07	0.03	Open



Page 4

Link Results at 0:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	4.65	0.07	0.03	Open
P29	8.46	0.12	0.08	Open
P30	5.06	0.07	0.03	Open
P31	2.82	0.04	0.01	Open
P32	2.60	0.04	0.01	Open
P33	3.81	0.05	0.02	Open
P34	2.09	0.03	0.01	Open
P35	2.06	0.03	0.00	Open
P36	1.81	0.03	0.00	Open
P37	1.68	0.02	0.00	Open
P38	1.41	0.02	0.00	Open
P39	1.41	0.02	0.00	Open
P40	1.41	0.02	0.00	Open
P16	20.14	0.28	0.38	Open
P41	20.01	0.28	0.38	Open
1	26.16	0.00	-303.03	Open Pump
2	77.81	0.00	-304.32	Open Pump

Node Results at 1:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	303.03	49.93	0.00
J2	0.00	302.91	50.26	0.00
J3	0.08	302.55	52.39	0.00
J4	0.07	302.30	53.54	0.00
J5	0.00	302.20	54.06	0.00



J6	0.30	301.61	53.86	0.00
J7	0.10	302.72	51.55	0.00
J8	0.05	302.41	53.04	0.00
J9	100.10	300.84	53.46	0.00
J11	0.17	301.76	54.51	0.00
J12	0.00	302.35	54.86	0.00
J13	0.00	303.67	56.72	0.00
J14	0.00	303.88	57.01	0.00
J33	0.00	304.32	56.87	0.00
J10	0.00	303.91	56.98	0.00
J15	0.10	304.02	57.51	0.00
J16	0.00	303.91	57.04	0.00
J17	0.28	303.92	57.20	0.00
J18	0.13	303.93	57.49	0.00
J19	0.13	304.00	57.91	0.00
J20	0.20	303.96	58.44	0.00
J21	0.00	303.94	57.79	0.00
J22	0.39	303.95	58.14	0.00
J23	0.07	303.95	58.47	0.00



Page 5

Node Results at 1:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	303.95	57.83	0.00
J25	0.35	303.95	58.16	0.00
J26	0.07	303.95	58.52	0.00
J27	0.20	303.95	57.86	0.00
J28	0.22	303.95	58.16	0.00
J29	0.15	303.95	58.53	0.00
J30	0.00	303.95	57.71	0.00
J31	0.00	303.95	57.52	0.00
J32	0.27	303.95	57.62	0.00
J34	0.13	303.95	58.07	0.00
J35	0.25	303.95	58.38	0.00
J36	0.03	303.95	58.38	0.00
J37	0.13	303.98	58.23	0.00
R1	-26.16	0.00	0.00	0.00 Reservoir
R2	-77.81	0.00	0.00	0.00 Reservoir

Link Results at 1:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Headloss m/km	Status
P1	26.16	0.83	5.27	Open
P4	25.86	0.82	5.15	Open



P5	51.21	1.63	18.27	Open
P6	26.16	0.83	5.27	Open
P7	26.06	0.83	5.23	Open
P8	25.98	0.83	5.20	Open
P9	25.93	0.83	5.18	Open
P2	50.90	1.62	18.07	Open
P11	-49.36	1.57	17.07	Open
P12	-25.35	0.81	4.97	Open
P13	-74.71	2.38	36.78	Open
P14	-74.71	2.38	36.78	Open
P3	-49.20	1.57	16.96	Open
P10	77.81	1.10	4.68	Open
P15	20.27	0.29	0.39	Open
P17	19.81	0.28	0.37	Open
P18	9.60	0.14	0.10	Open
P19	9.21	0.13	0.09	Open
P20	17.68	0.25	0.30	Open
P21	17.55	0.25	0.30	Open
P22	17.27	0.24	0.29	Open
P23	17.27	0.24	0.29	Open
P24	74.71	1.06	4.34	Open
P25	57.44	0.81	2.67	Open
P26	10.13	0.14	0.11	Open
P27	5.00	0.07	0.03	Open



Page 6

Link Results at 1:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	4.65	0.07	0.03	Open
P29	8.46	0.12	0.08	Open
P30	5.06	0.07	0.03	Open
P31	2.82	0.04	0.01	Open
P32	2.60	0.04	0.01	Open
P33	3.81	0.05	0.02	Open
P34	2.09	0.03	0.01	Open
P35	2.06	0.03	0.00	Open
P36	1.81	0.03	0.00	Open
P37	1.68	0.02	0.00	Open
P38	1.41	0.02	0.00	Open
P39	1.41	0.02	0.00	Open
P40	1.41	0.02	0.00	Open
P16	20.14	0.28	0.38	Open
P41	20.01	0.28	0.38	Open
1	26.16	0.00	-303.03	Open Pump
2	77.81	0.00	-304.32	Open Pump



Node Results at 2:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	303.03	49.93	0.00
J2	0.00	302.91	50.26	0.00
J3	0.08	302.55	52.39	0.00
J4	0.07	302.30	53.54	0.00
J5	0.00	302.20	54.06	0.00
J6	0.30	301.61	53.86	0.00
J7	0.10	302.72	51.55	0.00
J8	0.05	302.41	53.04	0.00
J9	100.10	300.84	53.46	0.00
J11	0.17	301.76	54.51	0.00
J12	0.00	302.35	54.86	0.00
J13	0.00	303.67	56.72	0.00
J14	0.00	303.88	57.01	0.00
J33	0.00	304.32	56.87	0.00
J10	0.00	303.91	56.98	0.00
J15	0.10	304.02	57.51	0.00
J16	0.00	303.91	57.04	0.00
J17	0.28	303.92	57.20	0.00
J18	0.13	303.93	57.49	0.00
J19	0.13	304.00	57.91	0.00
J20	0.20	303.96	58.44	0.00
J21	0.00	303.94	57.79	0.00
J22	0.39	303.95	58.14	0.00
J23	0.07	303.95	58.47	0.00



Page 7

Node Results at 2:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	303.95	57.83	0.00
J25	0.35	303.95	58.16	0.00
J26	0.07	303.95	58.52	0.00
J27	0.20	303.95	57.86	0.00
J28	0.22	303.95	58.16	0.00
J29	0.15	303.95	58.53	0.00
J30	0.00	303.95	57.71	0.00
J31	0.00	303.95	57.52	0.00
J32	0.27	303.95	57.62	0.00
J34	0.13	303.95	58.07	0.00
J35	0.25	303.95	58.38	0.00
J36	0.03	303.95	58.38	0.00
J37	0.13	303.98	58.23	0.00



R1	-26.16	0.00	0.00	0.00	Reservoir
R2	-77.81	0.00	0.00	0.00	Reservoir

Link Results at 2:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	26.16	0.83	5.27	Open
P4	25.86	0.82	5.15	Open
P5	51.21	1.63	18.27	Open
P6	26.16	0.83	5.27	Open
P7	26.06	0.83	5.23	Open
P8	25.98	0.83	5.20	Open
P9	25.93	0.83	5.18	Open
P2	50.90	1.62	18.07	Open
P11	-49.36	1.57	17.07	Open
P12	-25.35	0.81	4.97	Open
P13	-74.71	2.38	36.78	Open
P14	-74.71	2.38	36.78	Open
P3	-49.20	1.57	16.96	Open
P10	77.81	1.10	4.68	Open
P15	20.27	0.29	0.39	Open
P17	19.81	0.28	0.37	Open
P18	9.60	0.14	0.10	Open
P19	9.21	0.13	0.09	Open
P20	17.68	0.25	0.30	Open
P21	17.55	0.25	0.30	Open
P22	17.27	0.24	0.29	Open
P23	17.27	0.24	0.29	Open
P24	74.71	1.06	4.34	Open
P25	57.44	0.81	2.67	Open
P26	10.13	0.14	0.11	Open
P27	5.00	0.07	0.03	Open



Page 8

Link Results at 2:00 Hrs: (continued)

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P28	4.65	0.07	0.03	Open
P29	8.46	0.12	0.08	Open
P30	5.06	0.07	0.03	Open
P31	2.82	0.04	0.01	Open
P32	2.60	0.04	0.01	Open
P33	3.81	0.05	0.02	Open
P34	2.09	0.03	0.01	Open
P35	2.06	0.03	0.00	Open



P36	1.81	0.03	0.00	Open
P37	1.68	0.02	0.00	Open
P38	1.41	0.02	0.00	Open
P39	1.41	0.02	0.00	Open
P40	1.41	0.02	0.00	Open
P16	20.14	0.28	0.38	Open
P41	20.01	0.28	0.38	Open
1	26.16	0.00	-303.03	Open Pump
2	77.81	0.00	-304.32	Open Pump

Node Results at 3:00 Hrs:

Node ID	Demand LPS	Head m	Pressure m	Quality
J1	0.00	303.03	49.93	0.00
J2	0.00	302.91	50.26	0.00
J3	0.08	302.55	52.39	0.00
J4	0.07	302.30	53.54	0.00
J5	0.00	302.20	54.06	0.00
J6	0.30	301.61	53.86	0.00
J7	0.10	302.72	51.55	0.00
J8	0.05	302.41	53.04	0.00
J9	100.10	300.84	53.46	0.00
J11	0.17	301.76	54.51	0.00
J12	0.00	302.35	54.86	0.00
J13	0.00	303.67	56.72	0.00
J14	0.00	303.88	57.01	0.00
J33	0.00	304.32	56.87	0.00
J10	0.00	303.91	56.98	0.00
J15	0.10	304.02	57.51	0.00
J16	0.00	303.91	57.04	0.00
J17	0.28	303.92	57.20	0.00
J18	0.13	303.93	57.49	0.00
J19	0.13	304.00	57.91	0.00
J20	0.20	303.96	58.44	0.00
J21	0.00	303.94	57.79	0.00
J22	0.39	303.95	58.14	0.00
J23	0.07	303.95	58.47	0.00



Page 9

Node Results at 3:00 Hrs: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality
J24	0.00	303.95	57.83	0.00
J25	0.35	303.95	58.16	0.00
J26	0.07	303.95	58.52	0.00



J27	0.20	303.95	57.86	0.00	
J28	0.22	303.95	58.16	0.00	
J29	0.15	303.95	58.53	0.00	
J30	0.00	303.95	57.71	0.00	
J31	0.00	303.95	57.52	0.00	
J32	0.27	303.95	57.62	0.00	
J34	0.13	303.95	58.07	0.00	
J35	0.25	303.95	58.38	0.00	
J36	0.03	303.95	58.38	0.00	
J37	0.13	303.98	58.23	0.00	
R1	-26.16	0.00	0.00	0.00	Reservoir
R2	-77.81	0.00	0.00	0.00	Reservoir

Link Results at 3:00 Hrs:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
P1	26.16	0.83	5.27	Open
P4	25.86	0.82	5.15	Open
P5	51.21	1.63	18.27	Open
P6	26.16	0.83	5.27	Open
P7	26.06	0.83	5.23	Open
P8	25.98	0.83	5.20	Open
P9	25.93	0.83	5.18	Open
P2	50.90	1.62	18.07	Open
P11	-49.36	1.57	17.07	Open
P12	-25.35	0.81	4.97	Open
P13	-74.71	2.38	36.78	Open
P14	-74.71	2.38	36.78	Open
P3	-49.20	1.57	16.96	Open
P10	77.81	1.10	4.68	Open
P15	20.27	0.29	0.39	Open
P17	19.81	0.28	0.37	Open
P18	9.60	0.14	0.10	Open
P19	9.21	0.13	0.09	Open
P20	17.68	0.25	0.30	Open
P21	17.55	0.25	0.30	Open
P22	17.27	0.24	0.29	Open
P23	17.27	0.24	0.29	Open
P24	74.71	1.06	4.34	Open
P25	57.44	0.81	2.67	Open
P26	10.13	0.14	0.11	Open
P27	5.00	0.07	0.03	Open



Page 10

Link Results at 3:00 Hrs: (continued)

Link	Flow	Velocity	Unit Headloss	Status
------	------	----------	---------------	--------



ID	LPS	m/s	m/km	
P28	4.65	0.07	0.03	Open
P29	8.46	0.12	0.08	Open
P30	5.06	0.07	0.03	Open
P31	2.82	0.04	0.01	Open
P32	2.60	0.04	0.01	Open
P33	3.81	0.05	0.02	Open
P34	2.09	0.03	0.01	Open
P35	2.06	0.03	0.00	Open
P36	1.81	0.03	0.00	Open
P37	1.68	0.02	0.00	Open
P38	1.41	0.02	0.00	Open
P39	1.41	0.02	0.00	Open
P40	1.41	0.02	0.00	Open
P16	20.14	0.28	0.38	Open
P41	20.01	0.28	0.38	Open
1	26.16	0.00	-303.03	Open Pump
2	77.81	0.00	-304.32	Open Pump

Node Results at 4:00 Hrs:

Node	Demand	Head	Pressure	Quality
ID	LPS	m	m	

Link Results at 4:00 Hrs:

Link	Flow	Velocity	Unit Headloss	Status
ID	LPS	m/s	m/km	

Counterpoint Engineering Inc.
Water Demand Design Calculations

Project: 340 Mapleview Drive
Project No: 21076
Location: Barrie, Ontario
Site Area: 3.34 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 (Units)	Commercial (m ²)	Residential Population
Block 1	12		28
Block 2	16		37
Block 3	16		37
Block 4	8		19
Block 5	8		19
Block 6	14		33
Block 7	6		14
Block 8	5		12
Block 9	8		19
Block 10	12		28
Block 11	14		33
Block 12	16		37
Block 13	8		19
Block 14	8		19
Block 15	8		19
Block 16	2		5
Block 17	9		21
Block 18	4		9
Block 19	4		9
Block 20	8		19
TOTAL UNITS / AREA (m²)	186	-	435

	Residential Population	TOTAL POPULATION
Residential	435	435
Total Equivalent Population		435

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
Commercial	0.84	2.00	1.50
Industrial	0.84	2.00	1.50

(MECP factors for populations from 500 - 1000)
 (MOECP factors)

Water Demand based on Equivalent Population

	Population	Average Daily Usage (L/min)	Maximum Hour (L/min)	Maximum Day (L/min)	Governing Fire Flow Required (L/min)	Water Demand (L/min)
Residential	435	68	281	187	11,000	11,187
Totals	435	68	281	187	11,000	11,187

Note: 2020 guidelines do not mention a max fireflow of 8000 L/min for continuous buildings

Water Demand per Block based on Equivalent Population (for modeling)

	Population	Average Daily Usage (L/s)	Maximum Hour (L/s)	Maximum Day (L/s)	Max Day + Fire Flow (L/s)
Block 1	28	0.073	0.302	0.201	-
Block 2	37	0.098	0.403	0.268	-
Block 3	37	0.098	0.403	0.268	183.60
Block 4	19	0.049	0.201	0.134	-
Block 5	19	0.049	0.201	0.134	183.47
Block 6	33	0.085	0.352	0.235	-
Block 7	14	0.037	0.151	0.101	-
Block 8	12	0.030	0.126	0.084	-
Block 9	19	0.049	0.201	0.134	-
Block 10	28	0.073	0.302	0.201	150.20
Block 11	33	0.085	0.352	0.235	166.90
Block 12	37	0.098	0.403	0.268	-
Block 13	19	0.049	0.201	0.134	-
Block 14	19	0.049	0.201	0.134	-
Block 15	19	0.049	0.201	0.134	-
Block 16	5	0.012	0.050	0.034	-
Block 17	21	0.055	0.227	0.151	-
Block 18	9	0.024	0.101	0.067	-
Block 19	9	0.024	0.101	0.067	-
Block 20	19	0.049	0.201	0.134	-

Counterpoint Engineering Inc.

Block 5 Fire Flow Demand

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT

Fire Underwriters Survey

Project : 340 Mapleview Drive

Project No: 21076

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

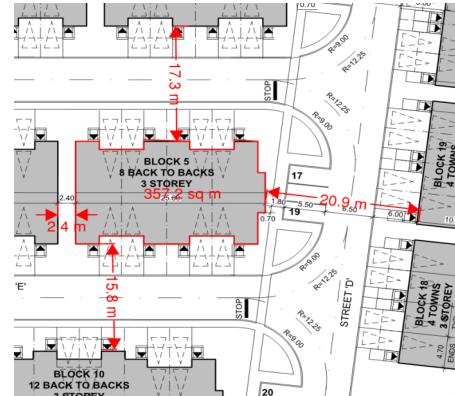
$$RFF = 220C\sqrt{A}$$

Where:

- RFF = the Required Fire Flow in litres per minutes (LPM)
C = the Construction Coefficient is related to the type of construction of the building
A = the Total Effective Floor Area (effective building area) in square metres of the building

Type of Construction		Coefficient
Type V	Wood Frame	1.5
Type IV-A	Encapsulated Mass Timber	0.8
Type IV-B	Rated Mass Timber	0.9
Type IV-C	Ordinary Mass Timber	1.0
Type IV-D	Un-Rated Mass Timber	1.5
Type III	Ordinary	1.0
Type II	Noncombustible	0.8
Type I	Fire Resistive	0.6

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



1) Required Fire Flow

Type of Construction:

C=

A*=

F=

Type V
1.5
536 m ²
7,639 L/min

2) Occupancy and Contents Adjustment Factor

Type of Occupancy

Contents Adjustment Factor

F=

LC	-15%	=	-1,146 L/min
7639 L/min +	-1146	L/min =	6,493 L/min

3) System Type Reduction

NFPA 13 Sprinkler:

Standard Water Supply:

Fully Supervised:

Total Credit

Reduction of:

F=

	NO	0%
	NO	0%
	NO	0%
		0%
	0% L/min	=
6493L/min -	0 L/min	=

0	L/min
6,493	L/min

4) Exposure Adjustment Charge

Building Face

North

East

South

West

Total

Dist(m)	Charge
17.3	15%
20.9	10%
15.8	15%
2.4	25%
65%	

6492.833 L/min = 4,220 L/min
(max exposure charge can be 75%)

Separation Distance	Maximum Exposure Adjustment Charge
0 m to 3 m	25%
3.1 m to 10 m	20%
10.1 m to 20 m	15%
20.1 m to 30 m	10%
Greater than 30	0%

F= 6493 L/min + 4220 L/min = 10,713 L/min

F=	11,000 L/min	(round to the nearest 1,000L/min)
F=	183 L/s	
F=	2,906 gpm	

Counterpoint Engineering Inc.
Block 10 Fire Flow Demand
REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT
Fire Underwriters Survey

Project : 340 Mapleview Drive
Project No: 21076

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

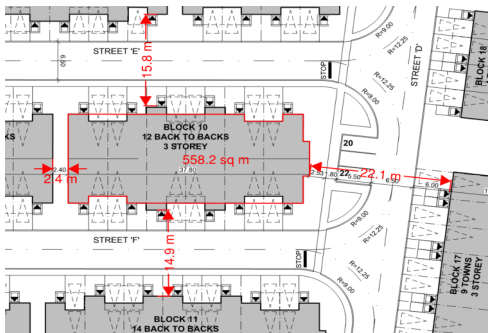
$$RFF = 220C\sqrt{A}$$

Where:

RFF = the Required Fire Flow in litres per minutes (LPM)
C = the Construction Coefficient is related to the type of construction of the building
A = the Total Effective Floor Area (effective building area) in square metres of the building

Type of Construction		Coefficient
Type V	Wood Frame	1.5
Type IV-A	Encapsulated Mass Timber	0.8
Type IV-B	Rated Mass Timber	0.9
Type IV-C	Ordinary Mass Timber	1.0
Type IV-D	Un-Rated Mass Timber	1.5
Type III	Ordinary	1.0
Type II	Noncombustible	0.8
Type I	Fire Resistive	0.6

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



1) Required Fire Flow

Type of Construction:

C=

A*=

F=

Type V
1.5
419 m ²
6,752 L/min

2) Occupancy and Contents Adjustment Factor

Type of Occupancy

Contents Adjustment Factor

F=

LC	-15%	=	-1,013 L/min
6,752 L/min +	-1013	L/min =	5,739 L/min

3) System Type Reduction

NFPA 13 Sprinkler:

Standard Water Supply:

Fully Supervised:

Total Credit

Reduction of:

F=

	NO	0%
	NO	0%
	NO	0%
		0%
	0% L/min	=
5739L/min -	0	L/min =

	0	L/min
	5,739	L/min

4) Exposure Adjustment Charge

Building Face

North

East

South

West

Total

Dist(m)	Charge
15.8	15%
22.1	10%
14.9	15%
2.4	25%
65%	

Note: Firewall charged at 10% according FUS Standards (2020)

Separation Distance	Maximum Exposure Adjustment Charge
0 m to 3 m	25%
3.1 m to 10 m	20%
10.1 m to 20 m	15%
20.1 m to 30 m	10%
Greater than 30	0%

of 5,739.293 L/min = 3,731 L/min
(max exposure charge can be 75%)

F= 5,739 L/min + 3,731 L/min = 9,470 L/min

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

Counterpoint Engineering Inc.

Block 11 Fire Flow Demand

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT

Fire Underwriters Survey

Project : 340 Mapleview Drive

Project No: 21076

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

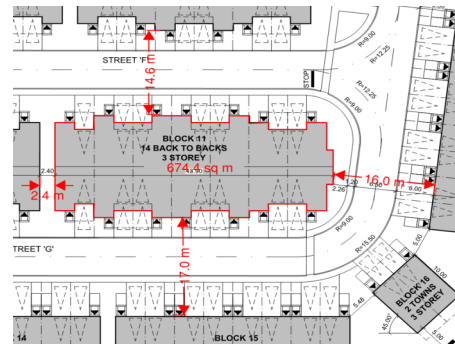
$$RFF = 220C\sqrt{A}$$

Where:

RFF = the Required Fire Flow in litres per minutes (LPM)
C = the Construction Coefficient is related to the type of construction of the building
A = the Total Effective Floor Area (effective building area) in square metres of the building

Type of Construction		Coefficient
Type V	Wood Frame	1.5
Type IV-A	Encapsulated Mass Timber	0.8
Type IV-B	Rated Mass Timber	0.9
Type IV-C	Ordinary Mass Timber	1.0
Type IV-D	Un-Rated Mass Timber	1.5
Type III	Ordinary	1.0
Type II	Noncombustible	0.8
Type I	Fire Resistive	0.6

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



1) Required Fire Flow

Type of Construction:

C=

A*=

F=

Type V
1.5
506 m ²
7,422 L/min

2) Occupancy and Contents Adjustment Factor

Type of Occupancy

Contents Adjustment Factor

F=

LC	-15%	=	-1,113 L/min
7422 L/min +	-1113	L/min =	6,308 L/min

3) System Type Reduction

NFPA 13 Sprinkler:

Standard Water Supply:

Fully Supervised:

Total Credit

Reduction of:

F=

	NO	0%
	NO	0%
	NO	0%
		0%
6308L/min -	0 L/min =	0 L/min
	0 L/min =	6,308 L/min

4) Exposure Adjustment Charge

Building Face

North

East

South

West

Total

Dist(m)	Charge
14.6	15%
20.1	10%
17	15%
2.4	25%
65%	

Note: Firewall charged at 10% according FUS Standards (2020)

Separation Distance	Maximum Exposure Adjustment Charge
0 m to 3 m	25%
3.1 m to 10 m	20%
10.1 m to 20 m	15%
20.1 m to 30 m	10%
Greater than 30	0%

6308.444 L/min = 4,100 L/min
(max exposure charge can be 75%)

F= 6308 L/min + 4100 L/min = 10,409 L/min

F=	10,000 L/min	(round to the nearest 1,000L/min)
F=	167 L/s	
F=	2,642 gpm	

NFPA Theoretical Flow Calculations - Hydrant at Loon Avenue & Gadwall Avenue

Project Name: 340 Mapleview Drive

Project Number: 21076

Based on National Fire Protection Association Guidelines, the available flow at the minimum residual pressure of 20psi can be calculated based on the observed flow at the observed pressure readings, as follows:

$$Q_F = 29.83 \times c \times d^2 \times p^{0.5}, \text{ where}$$

Q_F = observed flow (US GPM)

c = hydrant nozzle coefficient (0.90 - 0.95)

d = nozzle diameter (in)

p = observed pitot pressure

$$Q_R = Q_F \times h_F^{0.54} / h_R^{0.54}, \text{ where}$$

Q_R = available flow

Q_F = observed flow (US GPM)

h_F = drop from measured static to desired baseline pressure

h_R = drop from measured static to measured residual pressure

Based on flow test results obtained by ViPond Inc., November 12, 2020

c =	0.9
d =	2.5 in
number of ports =	2
p =	28

$$Q_F = 1786 \text{ US GPM}$$

Measured Static Pressure =	73 psi	
Measured Residual Pressure =	68 psi	
Desired Residual Pressure =	20 psi	, minimum per City of Toronto design criteria

$$Q_R = 6391 \text{ US GPM} \text{ per fire connection}$$

24,194 L/min



Appendix B

Sanitary Design Flow Calculations

Counterpoint Engineering Inc.

Project: 340 Maplevue Drive
Project No: 21076
Location: Barrie, Ontario
Site Area: 3.34 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)	186	186	-

	Population 1BR / 1B + D	TOTAL POPULATION
Residential	435	435
Commercial	-	n/a
Total Equivalent Population		435

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

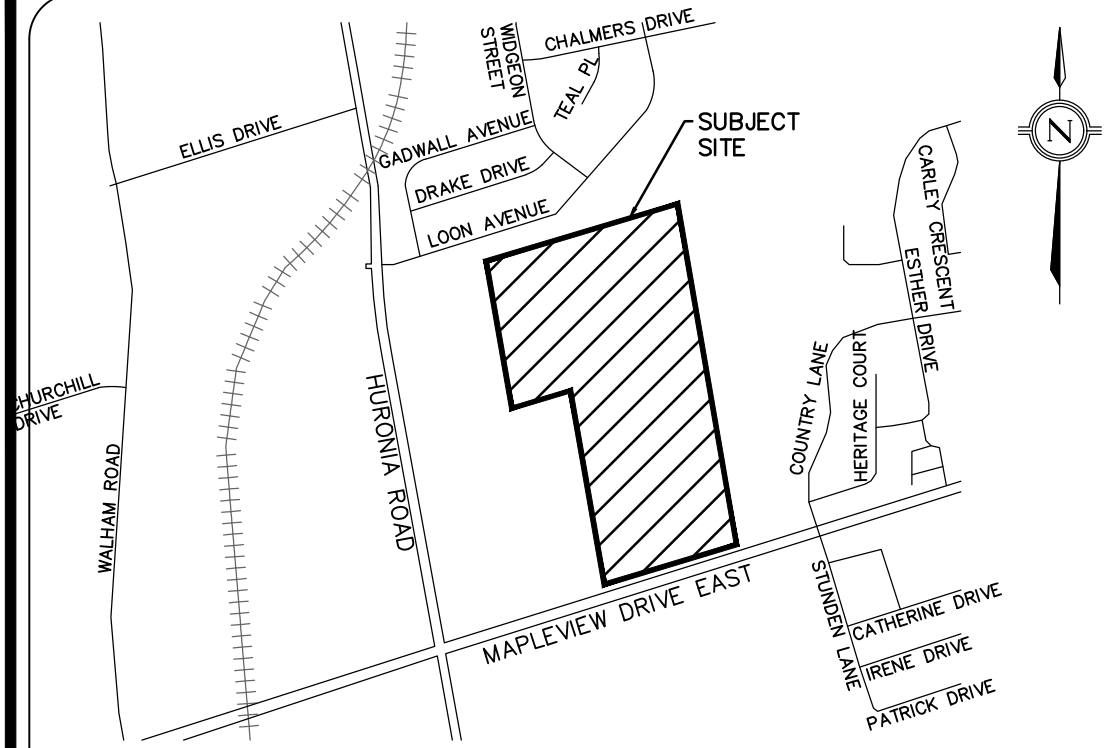
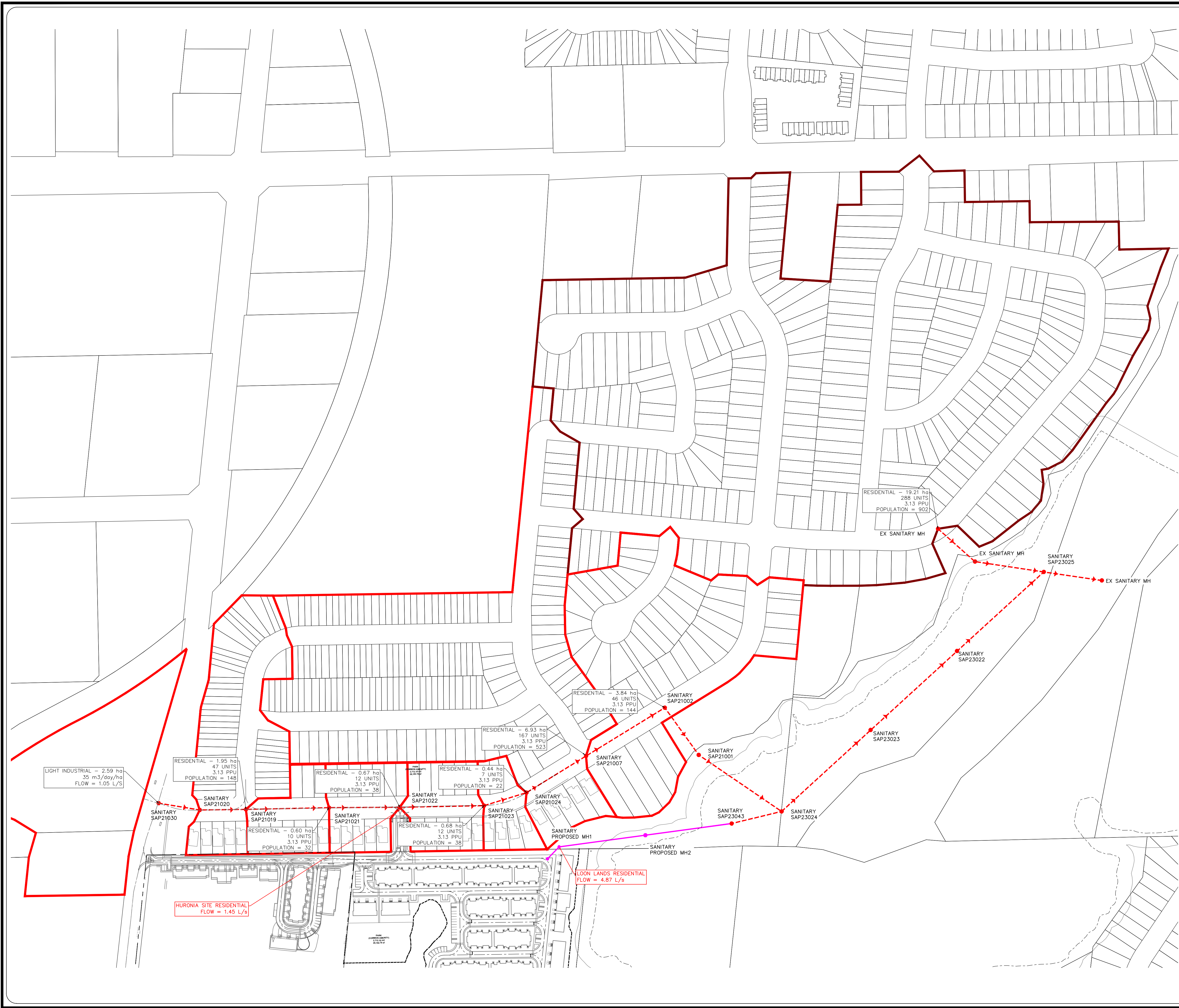
Harmon Peaking Factor

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

Residential Population	Harmon Peak Factor
435	4.00

Residential Flow	4.54	l/s
Commercial Flow	-	l/s
Infiltration	0.33	l/s
Groundwater Flows	0.00	l/s

Flow	4.87	l/s
-------------	-------------	------------



KEY PLAN

LEGEND

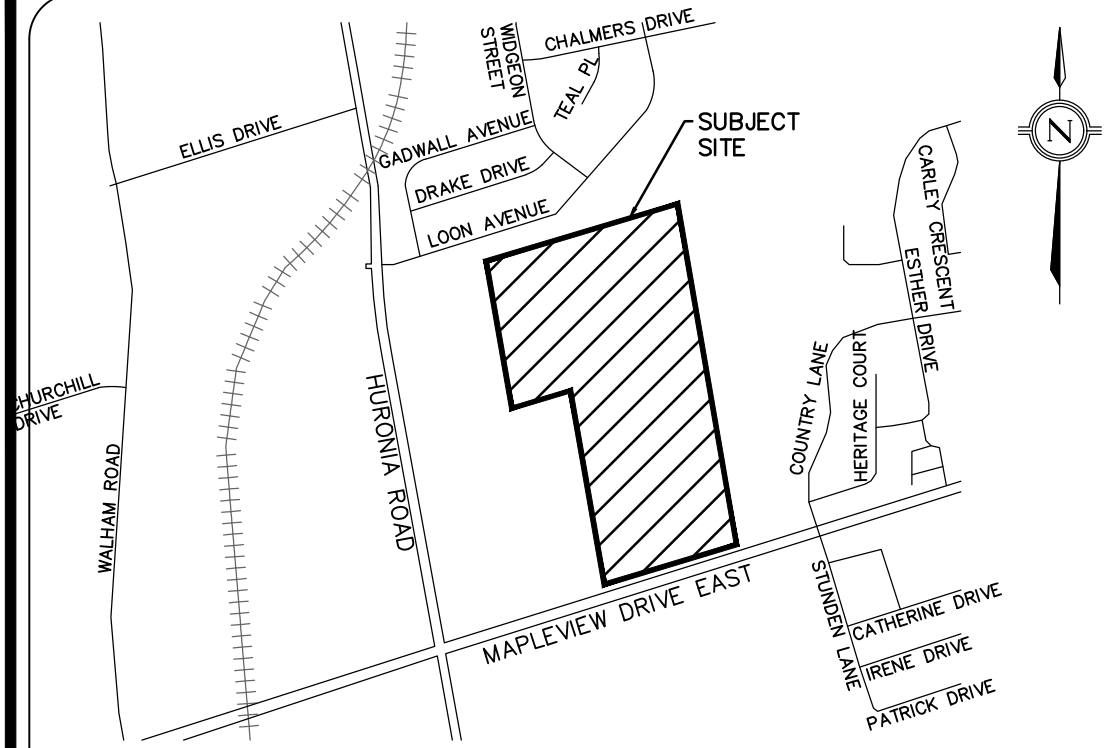
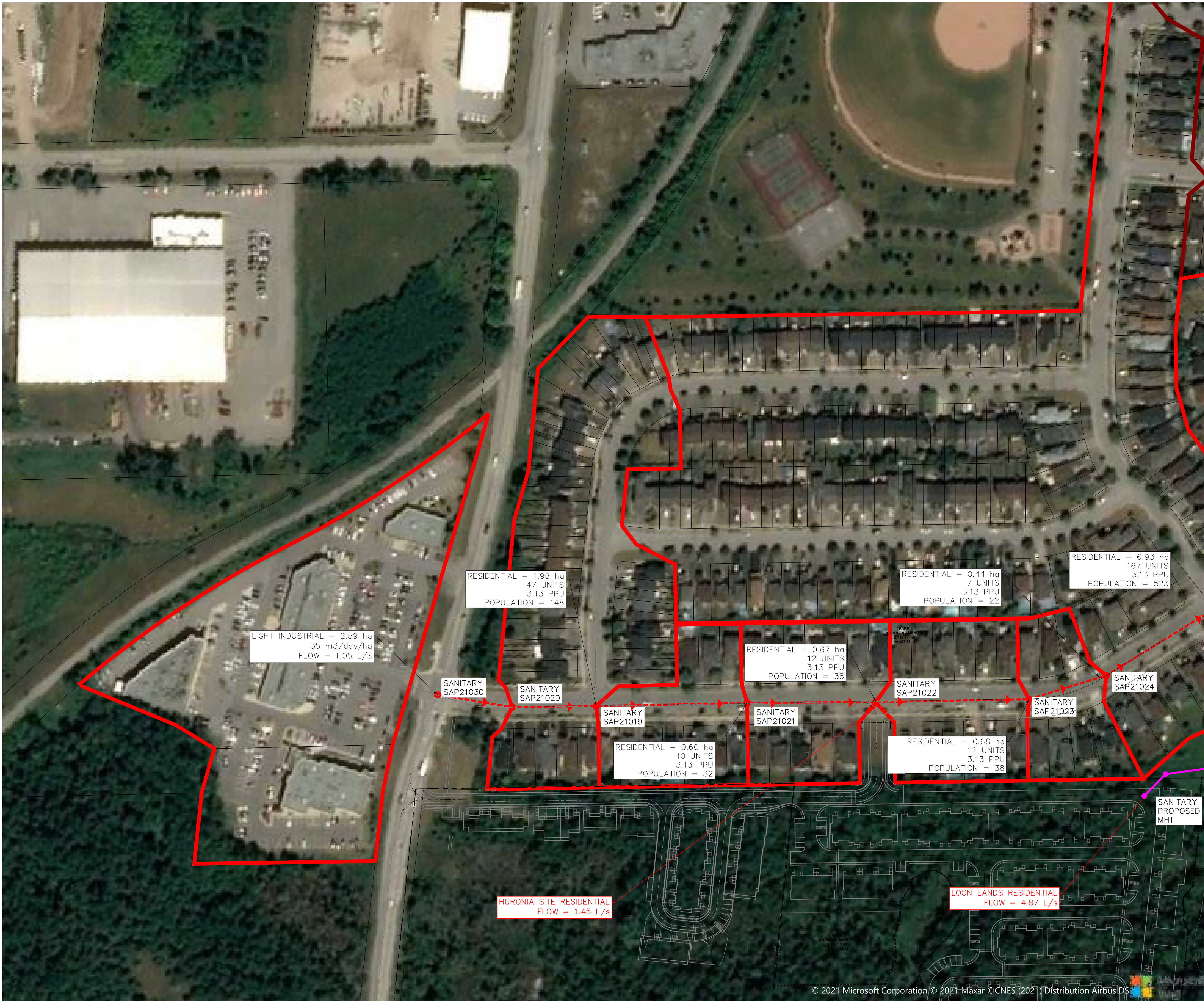
- SANITARY DRAINAGE BOUNDARY NORTH
- SANITARY DRAINAGE BOUNDARY SOUTH
- EXISTING SANITARY SEWER
- PROPOSED SANITARY SEWER

counterpoint 
ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

SITE LOCATION:
340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

SANITARY DRAINAGE ANALYSIS

DESIGNED BY: S.C	CHECKED BY: K.R	DATE: MAY 2023
DRAWING BY: S.C	CHECKED BY: K.R	PROJECT NO. 21076
SCALE: 1:1750m	0m 25m 70m 105m	DRAWING NO. SAN-1



KEY PLAN

LEGEND

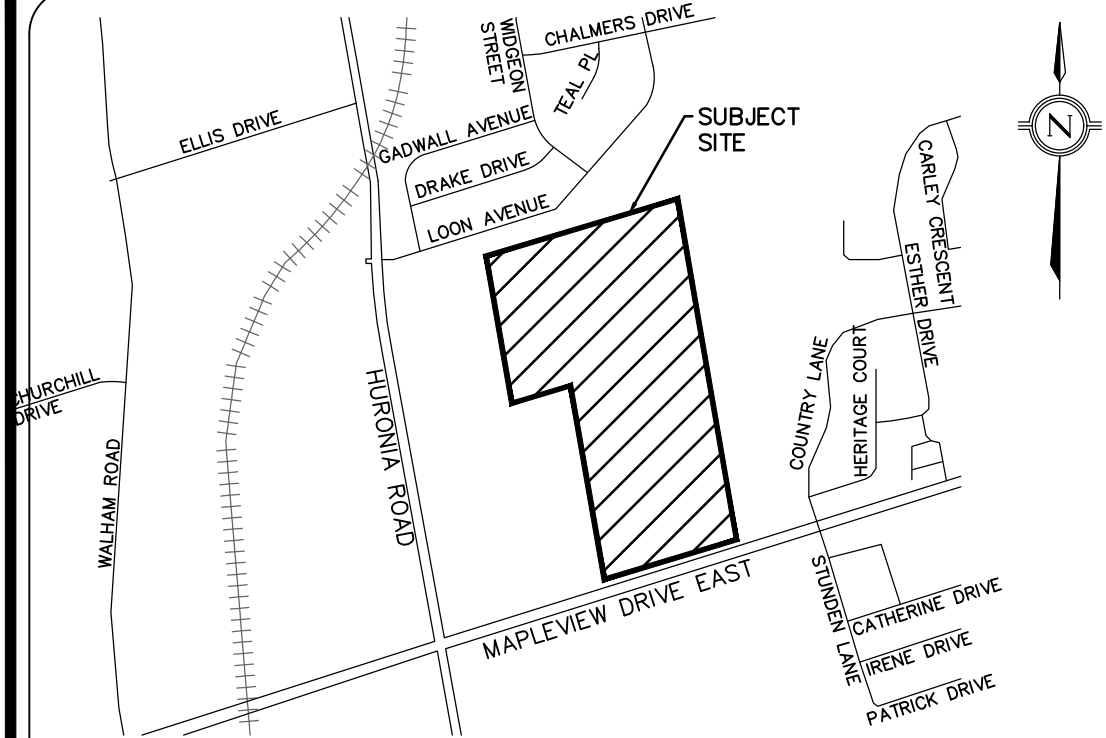
- SANITARY DRAINAGE BOUNDARY NORTH
- SANITARY DRAINAGE BOUNDARY SOUTH
- EXISTING SANITARY SEWER
- PROPOSED SANITARY SEWER



SITE LOCATION:
340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

SANITARY DRAINAGE ANALYSIS

DESIGNED BY: S.C.	CHECKED BY: K.R.	DATE: MAY 2023
DRAWING BY: S.C.	CHECKED BY: K.R.	PROJECT NO. 21076
SCALE: 1:1000m	0m 20m 40m 60m	DRAWING NO. SAN-2



- KEY PLAN
- LEGEND
- SANITARY DRAINAGE BOUNDARY NORTH
 - SANITARY DRAINAGE BOUNDARY SOUTH
 - EXISTING SANITARY SEWER
 - PROPOSED SANITARY SEWER

COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

SITE LOCATION:

340 MAPLEVIEW DRIVE
PROPOSED TOWNHOME COMMUNITY
BARRIE, ONTARIO

SANITARY DRAINAGE ANALYSIS

DESIGNED BY: S.C	CHECKED BY: K.R	DATE: MAY 2023
DRAWING BY: S.C	CHECKED BY: K.R	PROJECT NO. 21076
SCALE: 1:1000m		DRAWING NO. SAN-3

REGION FILE No.:



n ≥ 0.013
M = 5/P^{0.2} Babbitt

Q_p = P^{0.7}q^{0.3}M/86400

Q_i = I^{1.48}A

Q_{tot} = Q_p + Q_i

Numbers in blue or text in red are equations
(Harmon or Babbitt peaking factor where; M ≥ 2), the greater of the two is used in the spreadsheet. Please refer to Section 3.3.1.1 of the Barrie Sanitary Design Guidelines for additional guidance on which peaking factor to use.

(Peak population flow where; q = 225 L/day/person; P = population)

(Peak extraneous flow; I = 0.1 L/s/ha over development area)

(Total peak flow as the sum of peak population flow and peak extraneous flow)

225 litres/person/day.

SANITARY SEWER DESIGN

Development Details Basis

DESIGN SHEET _____

FILE NO _____

CONTRACT / PROJECT _____

STREET / AREA	MAINTENANCE HOLE		DWELL UNITS	DWELL (ACC) UNITS	DENSITY P.P.U.	POP. (P)	POP. (ACC)	M PEAKING FACTOR BABBIT	M PEAKING FACTOR HARMON	Max PEAKING FACTOR	Q _p ⁽⁶⁾ (l/s)	AREA (ha)	AREA (ACC) (ha)	Q _i (l/s)	Q _{tot} (l/s)	L (m)	D (mm)	S ⁽⁵⁾ (%)	Q _f FULL (l/s)	d/D ⁽³⁾	d/D ⁽³⁾ >0.5 or >0.85	Velocity FULL (m/s)	Velocity Partial ⁽¹⁾ (m/s)	Velocity ⁽⁴⁾ > 0.6 (m/s)
	FROM	TO																						
Commercial											1.05													
Loon Avenue	SAP21030	SAP21020	0	0	3.13	0	0	4.000	4.491	4.491	1.051	0.00	0.00	0.00	1.051	43.0	250	1.07%	61.514	0.090	Ok	1.253	0.470	Check
Loon Avenue	SAP21020	SAP21019	148	148	3.13	464	464	4.000	3.991	4.000	5.884	1.95	1.95	0.20	6.079	47.0	250	3.64%	113.457	0.157	Ok	2.311	1.214	Ok
Loon Avenue	SAP21019	SAP21021	10	158	3.13	32	496	4.000	3.976	4.000	6.218	0.60	2.55	0.26	6.473	84.8	250	3.00%	103.001	0.169	Ok	2.098	1.154	Ok
Loon Avenue	SAP21021	SAP21022	12	170	3.13	38	534	4.000	3.959	4.000	6.614	0.67	3.22	0.32	6.936	73.3	250	2.00%	84.100	0.194	Ok	1.713	1.019	Ok
Huronia Site											1.05													
Loon Avenue	SAP21022	SAP21023	12	182	3.13	38	572	4.000	3.943	4.000	8.459	0.68	3.90	0.39	8.849	86.7	250	0.50%	42.050	0.311	Ok	0.857	0.670	Ok
Loon Avenue	SAP21023	SAP21024	7	189	3.13	22	594	4.000	3.935	4.000	8.689	0.44	4.34	0.43	9.123	44.9	250	0.50%	42.050	0.316	Ok	0.857	0.674	Ok
Loon Avenue	SAP21024	SAP21007	167	356	3.13	523	1117	4.000	3.768	4.000	14.136	6.93	11.27	1.13	15.263	71.6	250	0.50%	42.050	0.416	Ok	0.857	0.772	Ok
Loon Avenue	SAP21007	SAP21002	46	402	3.13	144	1261	4.000	3.733	4.000	15.636	3.84	15.11	1.51	17.147	94.5	250	0.46%	40.333	0.455	Ok	0.822	0.769	Ok
Easement	SAP21002	SAP21001	0	0	3.13	0	1261	4.000	3.733	4.000	15.638	0.00	15.11	1.51	17.149	60.9	250	2.00%	84.100	0.306	Ok	1.713	1.310	Ok
Easement	SAP21001	SAP23024	0	0	3.13	0	1261	4.000	3.733	4.000	15.639	0.00	15.11	1.51	17.150	103.8	250	2.00%	84.100	0.306	Ok	1.713	1.310	Ok
Loon Lands Site	Ex Land										0.000	1.89	17.00	1.70	0.000	92.0	250	0.48%	41.200	#N/A	#N/A	0.839	#N/A	#N/A
Easement	SAP23043	SAP23024									0.000	0.00	17.00	1.70	0.000	52.5	250	0.50%	42.050	#N/A	#N/A	0.857	#N/A	#N/A
Easement	SAP23024	SAP23023	0	0	3.13	0	1261	4.000	3.733	4.000	15.640	0.00	32.11	3.21	18.851	121.9	250	0.38%	36.658	0.508	Check	0.747	0.717	Ok
Easement	SAP23023	SAP23022	0	0	3.13	0	1262	4.000	3.733	4.000	15.641	0.00	32.11	3.21	18.852	120.1	250	0.36%	35.681	0.516	Check	0.727	0.703	Ok
Easement	SAP23022	SAP23025	0	0	3.13	0	1262	4.000	3.733	4.000	15.642	0.00	32.11	3.21	18.853	121.5	250	0.38%	36.658	0.508	Check	0.747	0.717	Ok
Chalmers Drive	EX SAN MH	EX SAN MH	288	288	3.13	902	902	4.000	3.828	4.000	9.396	19.21	19.21	1.92	11.317	50.6	250	0.40%	37.611	0.376	Ok	0.766	0.636	Ok
Easement	EX SAN MH	SAP23025	0	288	3.13	0	902	4.000	3.828	4.000	9.397	0.00	19.21	1.92	11.318	70.6	250	0.40%	37.611	0.376	Ok	0.766	0.636	Ok
Easement	SAP23025	EX SAN MH	0	0	3.13	0	2164	4.000	3.559	4.000	25.040	0.00	51.32	5.13	30.172	63.7	250	0.40%	37.611	0.677	Check	0.766	0.820	Ok
DATE:	CALCULATED BY:										CHECKED BY:													

- Notes:
- (1) without extraneous flow
 - (2) with extraneous flow
 - (3) d/D>0.5 for pipes 375 and less, d/D>0.85 for pipes greater than 375
 - (4) Velocity check based on the lesser of full flow or partial velocity
 - (5) Slopes highlighted yellow are unknown and assumed as the minimum allowable slope
 - (6) Peak flows highlighted red are inputs from proposed developments



$n \geq 0.013$
 $M = 5/P^{0.2}$ Babbitt

$Q_p = P \cdot q \cdot M/86400$

$Q_i = I \cdot A$

$Q_{tot} = Q_p + Q_i$

Numbers in blue or text in red are equations
(Harmon or Babbitt peaking factor where; $M \geq 2$), the greater of the two is used in the spreadsheet. Please refer to Section 3.3.1.1 of the Barrie Sanitary Design Guidelines for additional guidance on which peaking factor to use.

(Peak population flow where; $q = 225$ L/day/person; P = population)

(Peak extraneous flow; $I = 0.1$ L/s/ha over development area)

(Total peak flow as the sum of peak population flow and peak extraneous flow)

225 litres/person/day.

SANITARY SEWER DESIGN

Development Details Basis

DESIGN SHEET _____

FILE NO _____

CONTRACT / PROJECT _____

STREET / AREA	MAINTENANCE HOLE		DWELL UNITS	DWELL (ACC) UNITS	DENSITY P.P.U.	POP. (P)	POP. (ACC)	M PEAKING FACTOR BABBIT	M PEAKING FACTOR HARMON	Max PEAKING FACTOR	Q _p ⁽⁶⁾ (l/s)	AREA (ha)	AREA (ACC) (ha)	Q _i (l/s)	Q _{tot} (l/s)	L (m)	D (mm)	S ⁽⁵⁾ (%)	Qf FULL (l/s)	d/D ⁽²⁾	d/D ⁽³⁾ >0.5 or >0.85	Velocity FULL (m/s)	Velocity Partial ⁽¹⁾ (m/s)	Velocity ⁽⁴⁾ > 0.6 (m/s)
	FROM	TO																						
Commercial											1.05													
Loon Avenue	SAP21030	SAP21020	0	0	3.13	0	0	4.000	4.491	4.491	1.051	0.00	0.00	0.00	1.051	43.0	250	1.07%	61.514	0.090	Ok	1.253	0.470	Check
Loon Avenue	SAP21020	SAP21019	148	148	3.13	464	464	4.000	3.991	4.000	5.884	1.95	1.95	0.20	6.079	47.0	250	3.64%	113.457	0.157	Ok	2.311	1.214	Ok
Loon Avenue	SAP21019	SAP21021	10	158	3.13	32	496	4.000	3.976	4.000	6.218	0.60	2.55	0.26	6.473	84.8	250	3.00%	103.001	0.169	Ok	2.098	1.154	Ok
Loon Avenue	SAP21021	SAP21022	12	170	3.13	38	534	4.000	3.959	4.000	6.614	0.67	3.22	0.32	6.936	73.3	250	2.00%	84.100	0.194	Ok	1.713	1.019	Ok
Huronia Site											1.55													
Loon Avenue	SAP21022	SAP21023	12	182	3.13	38	572	4.000	3.943	4.000	8.459	0.68	3.90	0.39	8.849	86.7	250	0.50%	42.050	0.311	Ok	0.857	0.670	Ok
Loon Avenue	SAP21023	SAP21024	7	189	3.13	22	594	4.000	3.935	4.000	8.689	0.44	4.34	0.43	9.123	44.9	250	0.50%	42.050	0.316	Ok	0.857	0.674	Ok
Loon Avenue	SAP21024	SAP21007	167	356	3.13	523	1117	4.000	3.768	4.000	14.136	6.93	11.27	1.13	15.263	71.6	250	0.50%	42.050	0.416	Ok	0.857	0.772	Ok
Loon Avenue	SAP21007	SAP21002	46	402	3.13	144	1261	4.000	3.733	4.000	15.636	3.84	15.11	1.51	17.147	94.5	250	0.46%	40.333	0.455	Ok	0.822	0.769	Ok
Easement	SAP21002	SAP21001	0	0	3.13	0	1261	4.000	3.733	4.000	15.638	0.00	15.11	1.51	17.149	60.9	250	2.00%	84.100	0.306	Ok	1.713	1.310	Ok
Easement	SAP21001	SAP23024	0	0	3.13	0	1261	4.000	3.733	4.000	15.639	0.00	15.11	1.51	17.150	103.8	250	2.00%	84.100	0.306	Ok	1.713	1.310	Ok
Loon Lands Site	ROPOSED MH1	PROPOSED MH2									4.870	1.89	17.00	1.70	4.870	92.0	250	0.48%	41.200	0.232	Ok	0.839	0.563	Check
Easement	ROPOSED MH2	SAP23043									4.870	0.00	17.00	1.70	4.870	92.0	250	0.48%	41.200	0.232	Ok	0.839	0.563	Check
Easement	SAP23043	SAP23024									4.870	0.00	17.00	1.70	4.870	52.5	250	0.50%	42.050	0.229	Ok	0.857	0.571	Check
Easement	SAP23024	SAP23023	0	0	3.13	0	1261	4.000	3.733	4.000	20.510	0.00	32.11	3.21	23.721	121.9	250	0.38%	36.658	0.585	Check	0.747	0.767	Ok
Easement	SAP23023	SAP23022	0	0	3.13	0	1262	4.000	3.733	4.000	20.511	0.00	32.11	3.21	23.722	120.1	250	0.36%	35.681	0.595	Check	0.727	0.752	Ok
Easement	SAP23022	SAP23025	0	0	3.13	0	1262	4.000	3.733	4.000	20.512	0.00	32.11	3.21	23.723	121.5	250	0.38%	36.658	0.585	Check	0.747	0.767	Ok
Chalmers Drive	EX SAN MH	EX SAN MH	288	288	3.13	902	902	4.000	3.828	4.000	9.396	19.21	19.21	1.92	11.317	50.6	250	0.40%	37.611	0.376	Ok	0.766	0.636	Ok
Easement	EX SAN MH	SAP23025	0	288	3.13	0	902	4.000	3.828	4.000	9.397	0.00	19.21	1.92	11.318	70.6	250	0.40%	37.611	0.376	Ok	0.766	0.636	Ok
Easement	SAP23025	EX SAN MH	0	0	3.13	0	2164	4.000	3.559	4.000	29.910	0.00	51.32	5.13	35.042	63.7	250	0.40%	37.611	0.764	Check	0.766	0.850	Ok

DATE: _____

CALCULATED BY: _____

CHECKED BY: _____

Notes:

- (1) without extraneous flow
- (2) with extraneous flow
- (3) $d/D > 0.5$ for pipes 375 and less, $d/D > 0.85$ for pipes greater than 375
- (4) Velocity check based on the lesser of full flow or partial velocity
- (5) Slopes highlighted yellow are unknown and assumed as the minimum allowable slope
- (6) Peak flows highlighted red are inputs from proposed developments



Appendix C

Stormwater Management Design Calculations

SWM DESIGN CALCULATIONS DRAINAGE AREAS AND RUNOFF COEFFICIENT CALCULATIONS

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Adjustment Ratio:	1	1.1	1.2	1.25
Runoff Coefficients:	1 to 10-year	25-year	50-year	100-year
<i>Landscaped/Grass:</i>	0.20	0.22	0.24	0.25
<i>Pavement:</i>	0.95	1.00	1.00	1.00
<i>Roof:</i>	0.95	1.00	1.00	1.00

Runoff Coefficients based on City of Barrie/MTO Design Standards

PRE DEVELOPMENT CONDITIONS

Area 101:

Storm Event:	Grass (m ²)	Pavement (m ²)	Roof (m ²)	Total Area (m ²)	Total Area (ha)	Runoff Coefficient
2 to 10-year:	33411	0	0	33411	3.34	0.20
25-year:	33411	0	0	33411	3.34	0.22
50-year:	33411	0	0	33411	3.34	0.24
100-year:	33411	0	0	33411	3.34	0.25

POST DEVELOPMENT CONDITIONS

Area 201:

Storm Event:	Grass (m ²)	Pavement (m ²)	Roof (m ²)	Total Area (m ²)	Total Area (ha)	Runoff Coefficient
2 to 10-year:	3314	12801	7630	23745	2.37	0.85
25-year:	3314	12801	7630	23745	2.37	0.89
50-year:	3314	12801	7630	23745	2.37	0.89
100-year:	3314	12801	7630	23745	2.37	0.90

Area 202:

Storm Event:	Grass (m ²)	Pavement (m ²)	Roof (m ²)	Total Area (m ²)	Total Area (ha)	Runoff Coefficient
2 to 10-year:	7312	25	2329	9666	0.97	0.38
25-year:	7312	25	2329	9666	0.97	0.41
50-year:	7312	25	2329	9666	0.97	0.43
100-year:	7312	25	2329	9666	0.97	0.43

Post-Development Imperviousness:

Grass (m ²)	Pavement (m ²)	Roof (m ²)	Total Area (m ²)	Total Area (ha)	Imperviousness
0.00	1.00	1.00			
10626	12826	9959	33411	3.34	0.68

Counterpoint Engineering Inc.

8395 Jane Street, Suite 100 Vaughan, Ontario L4K 5Y2

TEL: (905) 326-1404 FAX: (905) 326-1405

www.counterpointeng.com



SWM DESIGN CALCULATIONS
Pre-Development 100-Year Flow Rate Calculations

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	1426.408
Event	100-year	b	5.273
		c	0.759

Site Data

Area (ha)	3.34
Runoff Coefficient	0.25
AC	0.84
Tc (min)	10
Rainfall Intensity (mm/hr)	180
Rational Flow Rate (l/s)	418

The Rational Equation:

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

where,

- Q = the design flow (m³/s)
- C = the site specific runoff coefficient
- A = the drainage area (ha)
- i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Storage Calculations for 100-Year Storm Event for Area 201

Project Name: 340 Maplevue Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	1426.408
Event	100-year	b	5.273
		c	0.759

Site Data

Area (ha)	2.37
Runoff Coefficient	0.90
AC	2.13
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	209
Storage Required (m ³)	639

= 418 - 209

The Rational Equation:

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

where,

- Q = the design flow (m³/s)
- C = the site specific runoff coefficient
- A = the drainage area (ha)
- i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume
(min)	(mm/hr)	(m ³ /s)	(m ³)	(m ³)	(m ³)
10	180	1.06	639	125	514
15	145	0.86	773	188	585
20	123	0.73	872	251	621
25	107	0.63	950	313	637
30	95	0.56	1015	376	639
35	86	0.51	1071	439	633
40	79	0.47	1120	501	619
45	73	0.43	1164	564	600
50	68	0.40	1203	627	577
55	64	0.38	1239	689	550
60	60	0.35	1273	752	521
65	57	0.33	1304	815	489
70	54	0.32	1333	877	455
75	51	0.30	1360	940	420
80	49	0.29	1385	1003	383
85	47	0.28	1410	1065	344
90	45	0.27	1433	1128	305
95	43	0.26	1455	1191	264
100	42	0.25	1476	1253	223
105	40	0.24	1496	1316	180
110	39	0.23	1515	1379	137
115	38	0.22	1534	1441	93
120	36	0.22	1552	1504	48

Counterpoint Engineering Inc.

8395 Jane Street, Suite 100 Vaughan, Ontario L4K 5Y2

TEL: (905) 326-1404 FAX: (905) 326-1405

www.counterpointeng.com



SWM DESIGN CALCULATIONS

Post-Development 100-Year Flow Rate Calculations for Area 202 (Uncontrolled)

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	1426.408
Event	100-year	b	5.273
		c	0.759

Site Data

Area (ha)	0.97
Runoff Coefficient	0.43
AC	0.42
Tc (min)	10
Rainfall Intensity (mm/hr)	180
Rational Flow Rate (l/s)	209

The Rational Equation:

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

where,

- Q = the design flow (m³/s)
- C = the site specific runoff coefficient
- A = the drainage area (ha)
- i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Pre-Development 50-Year Flow Rate Calculations

Project Name: 340 Maplevue Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	1236.152
Event	50-year	b	4.699
		c	0.751

Site Data

Area (ha)	3.34
Runoff Coefficient	0.24
AC	0.80
Tc (min)	10
Rainfall Intensity (mm/hr)	164
Rational Flow Rate (l/s)	366

The Rational Equation:

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

where,

Q = the design flow (m³/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS

Storage Calculations for 50-Year Storm Event for Area 201

Project Name: 340 Maplevue Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	1236.152
Event	50-year	b	4.699
		c	0.751

Site Data

Area (ha)	2.37
Runoff Coefficient	0.89
AC	2.12
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	178
Storage Required (m ³)	594

= 366 - 188

The Rational Equation:

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

where,

- Q = the design flow (m³/s)
- C = the site specific runoff coefficient
- A = the drainage area (ha)
- i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume
(min)	(mm/hr)	(m ³ /s)	(m ³)	(m ³)	(m ³)
10	164	0.97	581	107	474
15	132	0.78	700	161	539
20	111	0.66	788	214	573
25	97	0.57	857	268	589
30	86	0.51	915	321	594
35	78	0.46	965	375	590
40	71	0.42	1009	428	580
45	66	0.39	1048	482	566
50	61	0.36	1084	535	548
55	57	0.34	1116	589	527
60	54	0.32	1146	643	504
65	51	0.30	1174	696	478
70	48	0.29	1201	750	451
75	46	0.27	1225	803	422
80	44	0.26	1249	857	392
85	42	0.25	1271	910	360
90	41	0.24	1292	964	328
95	39	0.23	1312	1017	294
100	38	0.22	1331	1071	260
105	36	0.21	1349	1125	225
110	35	0.21	1367	1178	189
115	34	0.20	1384	1232	153
120	33	0.19	1401	1285	115

Counterpoint Engineering Inc.

8395 Jane Street, Suite 100 Vaughan, Ontario L4K 5Y2

TEL: (905) 326-1404 FAX: (905) 326-1405

www.counterpointeng.com



SWM DESIGN CALCULATIONS
Post-Development 50-Year Flow Rate Calculations for Area 202 (Uncontrolled)

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	1236.152
Event	50-year	b	4.699
		c	0.751

Site Data

Area (ha)	0.97
Runoff Coefficient	0.43
AC	0.41
Tc (min)	10
Rainfall Intensity (mm/hr)	164
Rational Flow Rate (l/s)	188

The Rational Equation:

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

where,

Q = the design flow (m³/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Pre-Development 25-Year Flow Rate Calculations

Project Name: 340 Maplevue Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	1146.275
Event	25-year	b	4.922
		c	0.757

Site Data

Area (ha)	3.34
Runoff Coefficient	0.22
AC	0.74
Tc (min)	10
Rainfall Intensity (mm/hr)	148
Rational Flow Rate (l/s)	303

The Rational Equation:

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

where,

Q = the design flow (m³/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Storage Calculations for the 25-Year Storm Event for Area 201

Project Name: 340 Maplevue Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	1146.275
Event	25-year	b	4.922
		c	0.757

Site Data

Area (ha)	2.37
Runoff Coefficient	0.89
AC	2.12
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	140
Storage Required (m ³)	576

= 303 - 163

The Rational Equation:

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

where,

Q = the design flow (m³/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume
(min)	(mm/hr)	(m ³ /s)	(m ³)	(m ³)	(m ³)
10	148	0.87	523	84	439
15	119	0.70	630	126	505
20	100	0.59	709	167	542
25	87	0.51	772	209	563
30	78	0.46	824	251	573
35	70	0.41	869	293	576
40	64	0.38	908	335	573
45	59	0.35	943	377	566
50	55	0.32	975	419	556
55	52	0.30	1004	460	544
60	49	0.29	1031	502	529
65	46	0.27	1056	544	512
70	44	0.26	1079	586	493
75	42	0.24	1101	628	473
80	40	0.23	1122	670	452
85	38	0.22	1141	712	430
90	37	0.21	1160	753	406
95	35	0.21	1178	795	382
100	34	0.20	1195	837	357
105	33	0.19	1211	879	332
110	32	0.19	1227	921	306
115	31	0.18	1242	963	279
120	30	0.17	1256	1005	252

Counterpoint Engineering Inc.

8395 Jane Street, Suite 100 Vaughan, Ontario L4K 5Y2

TEL: (905) 326-1404 FAX: (905) 326-1405

www.counterpointeng.com



SWM DESIGN CALCULATIONS
Post-Development 25-Year Flow Rate Calculations for Area 202 (Uncontrolled)

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	1146.275
Event	25-year	b	4.922
		c	0.757

Site Data

Area (ha)	0.97
Runoff Coefficient	0.41
AC	0.40
Tc (min)	10
Rainfall Intensity (mm/hr)	148
Rational Flow Rate (l/s)	163

The Rational Equation:

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

where,

Q = the design flow (m³/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Pre-Development 10-Year Flow Rate Calculations

Project Name: 340 Maplevue Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	975.865
Event	10-year	b	4.699
		c	0.760

Site Data

Area (ha)	3.34
Runoff Coefficient	0.20
AC	0.67
Tc (min)	10
Rainfall Intensity (mm/hr)	127
Rational Flow Rate (l/s)	235

The Rational Equation:

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

where,

Q = the design flow (m³/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Storage Calculations for 10-Year Storm Event for Area 201

Project Name: 340 Maplevue Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	975.865
Event	10-year	b	4.699
		c	0.76

Site Data

Area (ha)	2.37
Runoff Coefficient	0.85
AC	2.01
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	105
Storage Required (m ³)	476

= 235 - 130

The Rational Equation:

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

where,

Q = the design flow (m³/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume
(min)	(mm/hr)	(m ³ /s)	(m ³)	(m ³)	(m ³)
10	127	0.71	424	63	361
15	101	0.57	509	94	414
20	85	0.48	571	126	445
25	74	0.41	621	157	463
30	66	0.37	662	189	473
35	59	0.33	697	220	476
40	54	0.30	728	252	476
45	50	0.28	755	283	472
50	47	0.26	780	315	465
55	44	0.24	803	346	457
60	41	0.23	824	378	446
65	39	0.22	844	409	434
70	37	0.21	862	441	421
75	35	0.20	879	472	407
80	33	0.19	896	504	392
85	32	0.18	911	535	376
90	31	0.17	926	567	359
95	30	0.16	940	598	341
100	28	0.16	953	630	323
105	27	0.15	966	661	304
110	27	0.15	978	693	285
115	26	0.14	990	724	266
120	25	0.14	1001	756	245

Counterpoint Engineering Inc.

8395 Jane Street, Suite 100 Vaughan, Ontario L4K 5Y2

TEL: (905) 326-1404 FAX: (905) 326-1405

www.counterpointeng.com



SWM DESIGN CALCULATIONS
Post-Development 10-Year Flow Rate Calculations for Area 202 (Uncontrolled)

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	975.865
Event	10-year	b	4.699
		c	0.760

Site Data

Area (ha)	0.97
Runoff Coefficient	0.38
AC	0.37
Tc (min)	10
Rainfall Intensity (mm/hr)	127
Rational Flow Rate (l/s)	130

The Rational Equation:

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

where,

- Q = the design flow (m³/s)
- C = the site specific runoff coefficient
- A = the drainage area (ha)
- i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Pre-Development 5-Year Flow Rate Calculations

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	853.608
Event	5-year	b	4.699
		c	0.766

Site Data

Area (ha)	3.34
Runoff Coefficient	0.20
AC	0.67
Tc (min)	10
Rainfall Intensity (mm/hr)	109
Rational Flow Rate (l/s)	202

The Rational Equation:

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

where,

- Q = the design flow (m³/s)
- C = the site specific runoff coefficient
- A = the drainage area (ha)
- i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Storage Calculations for 5-Year Storm Event for Area 201

Project Name: 340 Maplevue Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	853.608
Event	5-year	b	4.699
		c	0.766

Site Data

Area (ha)	2.37
Runoff Coefficient	0.85
AC	2.01
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	90
Storage Required (m ³)	407

= 202 - 112

The Rational Equation:

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

where,

Q = the design flow (m³/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume
(min)	(mm/hr)	(m ³ /s)	(m ³)	(m ³)	(m ³)
10	109	0.61	365	54	310
15	87	0.49	437	81	356
20	73	0.41	490	108	382
25	64	0.35	532	136	396
30	56	0.31	567	163	404
35	51	0.28	596	190	407
40	46	0.26	622	217	405
45	43	0.24	645	244	402
50	40	0.22	666	271	395
55	37	0.21	686	298	387
60	35	0.20	703	325	378
65	33	0.18	720	352	367
70	31	0.17	735	379	355
75	30	0.17	749	407	343
80	28	0.16	763	434	329
85	27	0.15	776	461	315
90	26	0.15	788	488	300
95	25	0.14	799	515	284
100	24	0.14	811	542	269
105	23	0.13	821	569	252
110	23	0.13	831	596	235
115	22	0.12	841	623	218
120	21	0.12	851	650	200

Counterpoint Engineering Inc.

8395 Jane Street, Suite 100 Vaughan, Ontario L4K 5Y2

TEL: (905) 326-1404 FAX: (905) 326-1405

www.counterpointeng.com



SWM DESIGN CALCULATIONS
Post-Development 5-Year Flow Rate Calculations for Area 202 (Uncontrolled)

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	853.608
Event	5-year	b	4.699
		c	0.766

Site Data

Area (ha)	0.97
Runoff Coefficient	0.38
AC	0.37
Tc (min)	10
Rainfall Intensity (mm/hr)	109
Rational Flow Rate (l/s)	112

The Rational Equation:

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

where,

- Q = the design flow (m³/s)
- C = the site specific runoff coefficient
- A = the drainage area (ha)
- i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Pre-Development 2-Year Flow Rate Calculations

Project Name: 340 Maplevue Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	678.085
Event	2-year	b	4.699
		c	0.781

Site Data

Area (ha)	3.34
Runoff Coefficient	0.20
AC	0.67
Tc (min)	10
Rainfall Intensity (mm/hr)	83
Rational Flow Rate (l/s)	154

The Rational Equation:

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

where,

Q = the design flow (m³/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS
Post-Development 2-Year Flow Rate Calculations for Area 202 (Uncontrolled)

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	678.085
Event	2-year	b	4.699
		c	0.781

Site Data

Area (ha)	0.97
Runoff Coefficient	0.38
AC	0.37
Tc (min)	10
Rainfall Intensity (mm/hr)	83
Rational Flow Rate (l/s)	85

The Rational Equation:

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

where,

- Q = the design flow (m³/s)
- C = the site specific runoff coefficient
- A = the drainage area (ha)
- i = rainfall intensity (mm/hr)



SWM DESIGN CALCULATIONS

Storage Calculations for 2-Year Storm Event for Area 201

Project Name: 340 Mapleview Drive

Prepared by: P.T

Municipality: Barrie, ON

Project No.: 21076

Last Revised: 29-Mar-23

Date: 29-Mar-23

Rainfall Data

Location:	City of Barrie, ON	a	678.085
Event	2-year	b	4.699
		c	0.781

Site Data

Area (ha)	2.37
Runoff Coefficient	0.85
AC	2.01
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	69
Storage Required (m ³)	303

= 154 - 85

The Rational Equation:

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

where,

- Q = the design flow (m³/s)
- C = the site specific runoff coefficient
- A = the drainage area (ha)
- i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume
(min)	(mm/hr)	(m ³ /s)	(m ³)	(m ³)	(m ³)
10	83	0.46	278	41	237
15	66	0.37	332	62	270
20	55	0.31	371	83	288
25	48	0.27	402	103	298
30	42	0.24	427	124	303
35	38	0.21	448	145	303
40	35	0.19	467	165	302
45	32	0.18	484	186	297
50	30	0.17	499	207	292
55	28	0.16	512	227	285
60	26	0.15	525	248	277
65	25	0.14	536	269	268
70	23	0.13	547	289	258
75	22	0.12	557	310	247
80	21	0.12	567	331	236
85	20	0.11	576	352	224
90	19	0.11	585	372	212
95	19	0.10	593	393	200
100	18	0.10	600	414	187
105	17	0.10	608	434	174
110	17	0.09	615	455	160
115	16	0.09	622	476	146
120	16	0.09	629	496	132

Counterpoint Engineering Inc.

8395 Jane Street, Suite 100 Vaughan, Ontario L4K 5Y2

TEL: (905) 326-1404 FAX: (905) 326-1405

www.counterpointeng.com



SWM DESIGN CALCULATIONS
SWM Storage Outlet Structure Calculation

Project Name: 340 Mapleview Drive
Municipality: Barrie, ON
Project No.: 21076
Date: 29-Mar-23

Prepared by: P.T
Checked by:
Last Revised: 29-Mar-23

Return Period	Elevation	Tail Water Elevation	Q _{TARGET}	H _{ORIFICE PLATE 1}	H _{WEIR}	Head Difference to TW	Q _{ORIFICE PLATE 1}	Q _{WEIR}	Q _{TOTAL_PROVIDED}	Required Storage	Storage Provided
	[m]	[m]	[m ³ /s]	[m]	[m]	[m]	[m ³ /s]	[m ³ /s]	[m ³ /s]	[m ³]	[m ³]
100YR*	244.40	243.39	0.209	0.949	0.143	1.009	0.029	0.179	0.209	639	N/A
50YR*	244.38	243.39	0.178	0.935	0.129	0.995	0.029	0.149	0.178	594	N/A
25YR*	244.36	243.39	0.140	0.914	0.108	0.974	0.029	0.111	0.140	576	N/A
10YR*	244.34	243.39	0.105	0.892	0.086	0.952	0.028	0.076	0.105	476	N/A
5YR*	244.33	243.39	0.090	0.882	0.076	0.942	0.028	0.062	0.090	407	N/A
2YR*	244.32	243.39	0.069	0.865	0.059	0.925	0.028	0.041	0.069	303	N/A

Reference Points	Elevations (m)
Top of Storage Elevation:	244.40
Bottom of Storage Elevation:	243.39
Weir Invert Bottom:	244.26
Orifice 1 Invert Bottom:	243.39
Max Head:	1.01

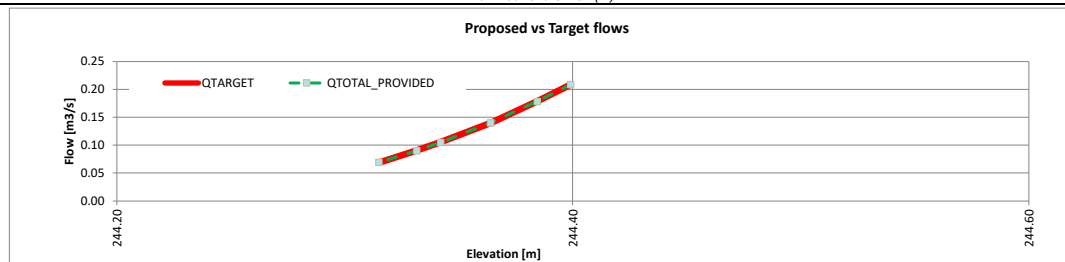
Weir		
Bottom Width(m):	Height(m):	Side Slope:
1.52	0.20	3 : 1
INV. =		244.26m

Orifice Plate 1	
Diameter (mm):	120
INV. =	243.39m

Weir equation:	$Q = B \times C_d \times H^{3/2}$	$C_d = 1.7$
where:	q = flow rate (m ³ /s) h = head on the weir (m) b = width of the weir (m)	$g = 9.81$ (m/s ²) gravity C_d = coefficient of discharge

Orifice equation:	$Q = C_d \times A \times (2gH)^{0.5}$	$C_d = 0.6$, $A = (1/4 \times \pi \times D^2)$
where:	q = flow rate (m ³ /s) h = head on the weir (m) a = area of orifice (m ²)	$g = 9.81$ (m/s ²) gravity C_d = coefficient of discharge

Emergency Spillway equation:	$Q = B \times C_d \times H^{3/2} + S \times C_d \times H^{5/2}$	$C_d = 1.5$ $S = 5\%$ (20:1) $g = 9.81$ (m/s ²) gravity C_d = coefficient of discharge
where:	q = flow rate (m ³ /s) h = head on the weir (m) b = width of the weir (m)	



Project DEVELOPMENT Summary

DEVELOPMENT: 340 Maplevue Drive

Subwatershed: Lovers Creek

Total Pre-Development Area (ha):	3.34	Total Pre-Development Phosphorus Load (kg/yr):	0.20
----------------------------------	-------------	--	-------------

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Forest	3.34	0.06	0.20

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Residential	0.97	1.32	Vegetated Filter Strips/Stream Buffers	0.45
<i>Uncontrolled area (primarily grass)</i>				
High Intensity - Residential	2.37	1.32	Other	0.44

*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 86%.*

Post-Development Area Altered:	3.34		P Load (kg/yr)
Total Pre-Development Area:	3.34		
Unaffected Area:	0		
		Pre-Development:	0.20
		Post-Development:	4.41
		Change (Pre - Post):	-4.21
		2100% Net Increase in Load	
		Post-Development (with BMPs):	0.89
		Change (Pre - Post):	-0.69
		342.17% Net Increase in Load	

DEVELOPMENT: 340 Mapleview Drive
Subwatershed: Lovers Creek

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs		P Load (kg/yr)
Pre-Development:		0.20
Construction Phase Amortized Over 8 Years :		to be determined
Post-Development:		0.89
Post-Development + Amortized Construction:		to be determined
Pre-Development Load - Post-Development Load:		-0.69
Conclusion:		342% Increase in Load
Pre-Development Load - (Post-Development + Amortized Construction Load):		to be determined
Conclusion:		to be determined
Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:		
Not approve development as site specific appropriate		

Recharge Compensation Form

Application Details	
Site Name (Developer):	
Site Location:	340 Maplevue Drive
File/APIID #	
Anticipated Construction Start:	
Subwatershed:	Lovers Creek
Phosphorous Balance	
Kg/year	0.69
Compensation Costs	
Offsetting Value	2.5
Compensation Cost (P load *2.5*\$35,000)	\$61,703.25
Administration Fee (15%)	\$9,255.49
Total	\$70,958.74

Determining Number of Cartridges for Flow Based Systems

Date

05/04/2023

Black Cells = Calculation

Site Information

Project Name

Loon Avenue

Project Location

Barrie, ON

OGS ID

OGS

Drainage Area, Ad

5.85 ac (2.37 ha)

Impervious Area, Ai

5.40 ac

Pervious Area, Ap

0.45

% Impervious

92%

Runoff Coefficient, Rc

0.85

Treatment storm flow rate, Q_{treat}

0.95 cfs (27 L/s)

Peak storm flow rate, Q_{peak}

7.38 cfs (209 L/s)

Filter System

Filtration brand

StormFilter

Cartridge height

18 in

Specific Flow Rate

1.00 gpm/ft²

Flow rate per cartridge

7.50 gpm

SUMMARY

Number of Cartridges	58
Media Type	Phosphosorb

Event Mean Concentration (EMC)

150 mg/L

Annual TSS Removal

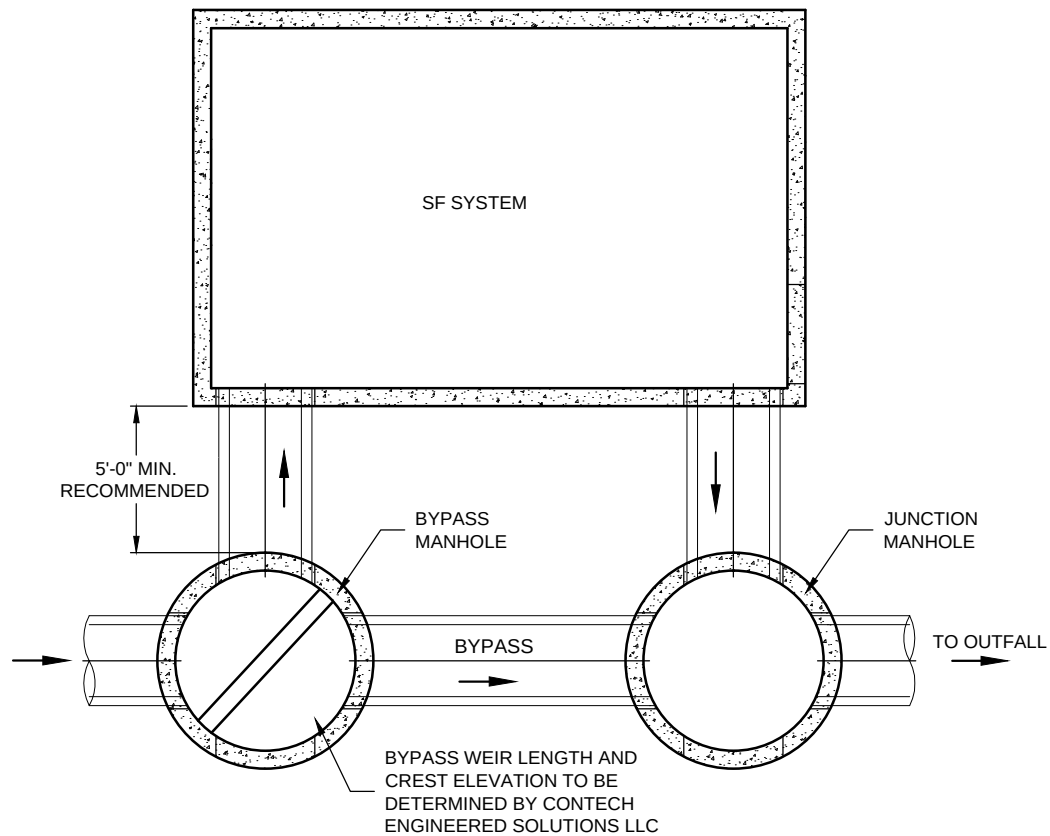
80%

Percent Runoff Capture

90%

Recommend SF0824 vault with Diversion and Junction Structure or CIP

FOR INFORMATIONAL PURPOSES ONLY
 NOT INTENDED AS A CONSTRUCTION DOCUMENT
- BYPASS AND JUNCTION STRUCTURES MAY OR MAY NOT BE SUPPLIED BY CONTECH -



ACTUAL ORIENTATION AND LAYOUT MAY VARY DUE TO
 SITE SPECIFIC CONSIDERATIONS



The design and information shown on this drawing is provided as a service to the project owner, engineer and contractor by Contech Engineered Solutions LLC ("Contech"). Neither this drawing, nor any part thereof, may be used, reproduced or modified in any manner without the prior written consent of Contech. Failure to comply is done at the user's own risk and Contech expressly disclaims any liability or responsibility for such use.

If discrepancies between the supplied information upon which the drawing is based and actual field conditions are encountered as site work progresses, these discrepancies must be reported to Contech immediately for re-evaluation of the design. Contech accepts no liability for designs based on missing, incomplete or inaccurate information supplied by others.



200 Enterprise Drive, Scarborough, ME 04074

877-907-8676 207-885-9830 207-885-9825 FAX

TYPICAL BYPASS LAYOUT STORMFILTER STORMWATER TREATMENT SYSTEM

DATE: 3/25/15 SCALE: NONE PROJECT No.: TYPVXBPLOR SEQ. No.: N/A DRAWN: SDS CHECKED: ---

I:\AD_CONTECH-CPI\COMROOT\STORMWATER\COMMOP\SF10 STORMFILTER40 STANDARD DRAWINGS\VAULT\SF0824-DTL.DWG 1/19/2014 4:18 PM

STORMFILTER DESIGN NOTES

STORMFILTER TREATMENTCAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD VAULT STYLE IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (61). VAULT STYLE OPTIONS INCLUDE INLET BAY (56), INLET BAY/OUTLET BAY (51), OUTLET BAY (59), INLET BAY/FULL HEIGHT BAFFLE WALL (45), FULL HEIGHT BAFFLE WALL (54). STORMFILTER 8X24 PEAK HYDRAULIC CAPACITY IS 1.8 CFS. IF THE SITE CONDITIONS EXCEED 1.8 CFS AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"		18"		LOW DROP	
RECOMMENDED HYDRAULIC DROP (H)	3.05'		2.3'		1.8'	
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	15	7.5	10	5

SITE SPECIFIC
DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	*
PEAK FLOW RATE (cfs)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
# OF CARTRIDGES REQUIRED	*
CARTRIDGE FLOW RATE	*
MEDIA TYPE (CSF, PERLITE, ZPG, GAC, PHS)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	*	*	*
INLET PIPE #2	*	*	*
OUTLET PIPE	*	*	*

UPSTREAM RIM ELEVATION	*
DOWNSTREAM RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

FRAME, COVER, AND HATCH
(SIZE AND CONFIGURATION VARY)
N.T.S.

GENERAL NOTES

- CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
- DIMENSIONS MARKED WITH () ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
- FOR SITE SPECIFIC DRAWINGS WITH DETAILED VAULT DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
- STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
- 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.
- 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 39 SECONDS.
- SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

INSTALLATION NOTES

- ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
- CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER VAULT (LIFTING CLUTCHES PROVIDED).
- CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL VAULT SECTIONS AND ASSEMBLE VAULT.
- CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
- CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

CONTECH
ENGINEERED SOLUTIONS LLC

www.contechES.com

9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069

800-338-1122

513-645-7000

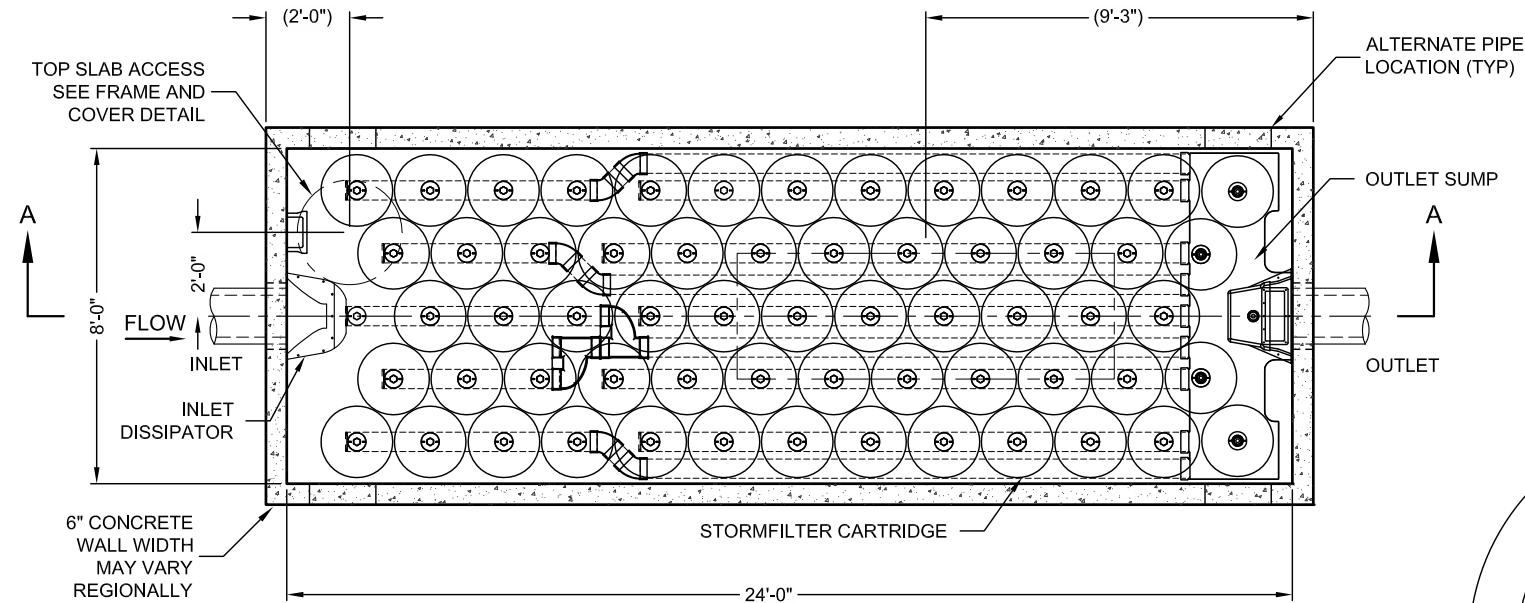
513-645-7993 FAX

SF0824

STORMFILTER
STANDARD DETAIL

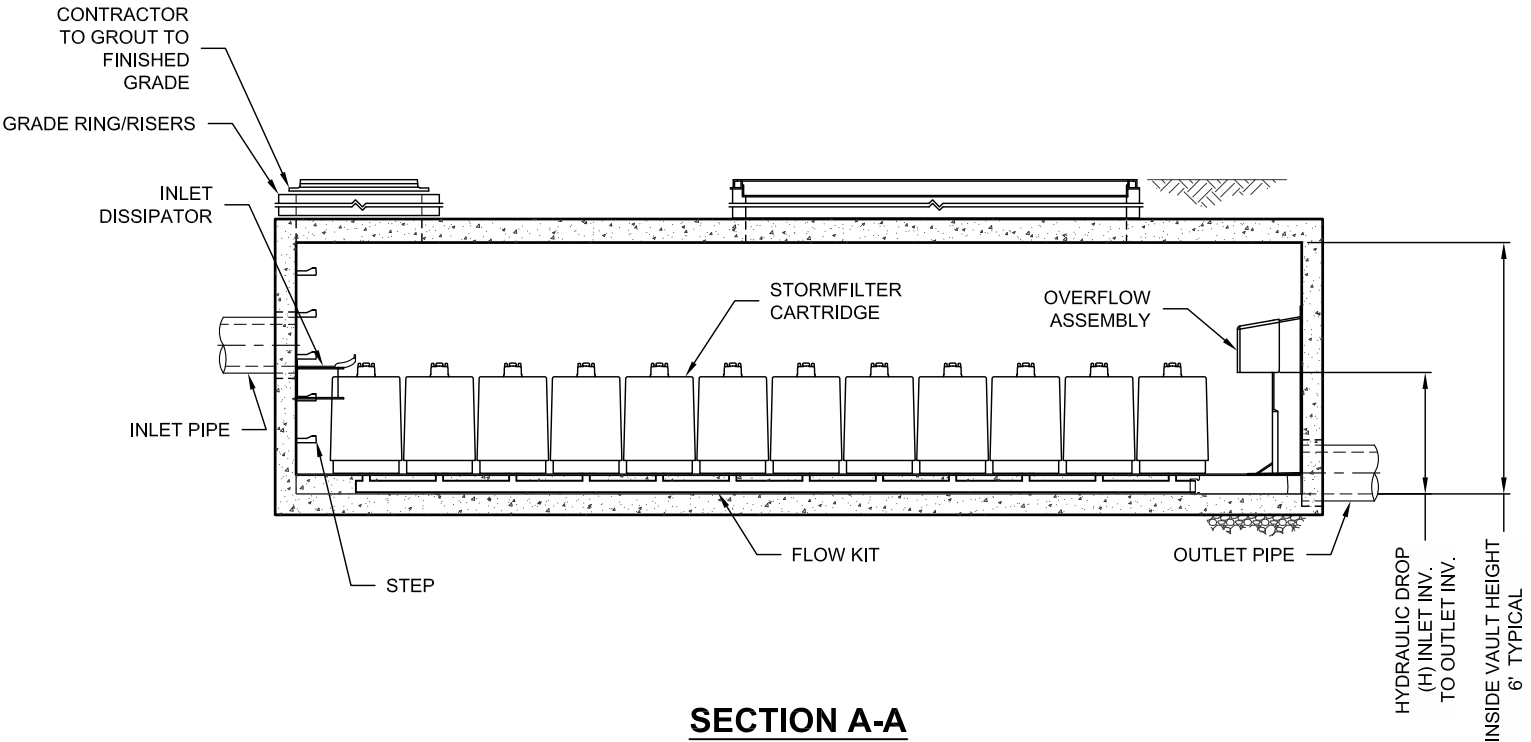
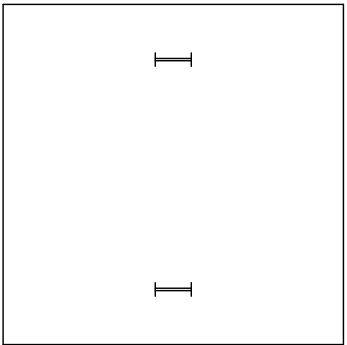
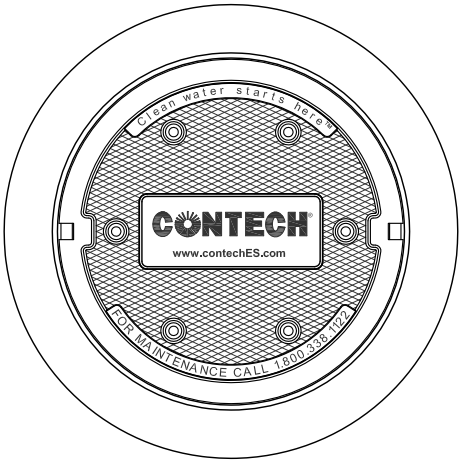


THE PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING:
U.S. PATENTS: 5,322,229; 5,344,492; 6,197,037; 6,486,185; 6,803,439; 6,803,440; 6,803,441;
RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.



PLAN VIEW

VAULT STYLE: OUTLET SUMP (NIB)



SECTION A-A

Determining Number of Cartridges for Flow Based Systems

Date

05/04/2023

Black Cells = Calculation

Site Information

Project Name

Loon Avenue

Project Location

Barrie, ON

OGS ID

OGS

Drainage Area, Ad

5.85 ac (2.37 ha)

Impervious Area, Ai

5.40 ac

Pervious Area, Ap

0.45

% Impervious

92%

Runoff Coefficient, Rc

0.85

Treatment storm flow rate, Q_{treat}

0.95 cfs (27 L/s)

Peak storm flow rate, Q_{peak}

7.38 cfs (209 L/s)

Filter System

Filtration brand

StormFilter

Cartridge height

27 in

Specific Flow Rate

1.00 gpm/ft²

Flow rate per cartridge

11.25 gpm

SUMMARY

Number of Cartridges	38
Media Type	Phosphosorb

Event Mean Concentration (EMC)

150 mg/L

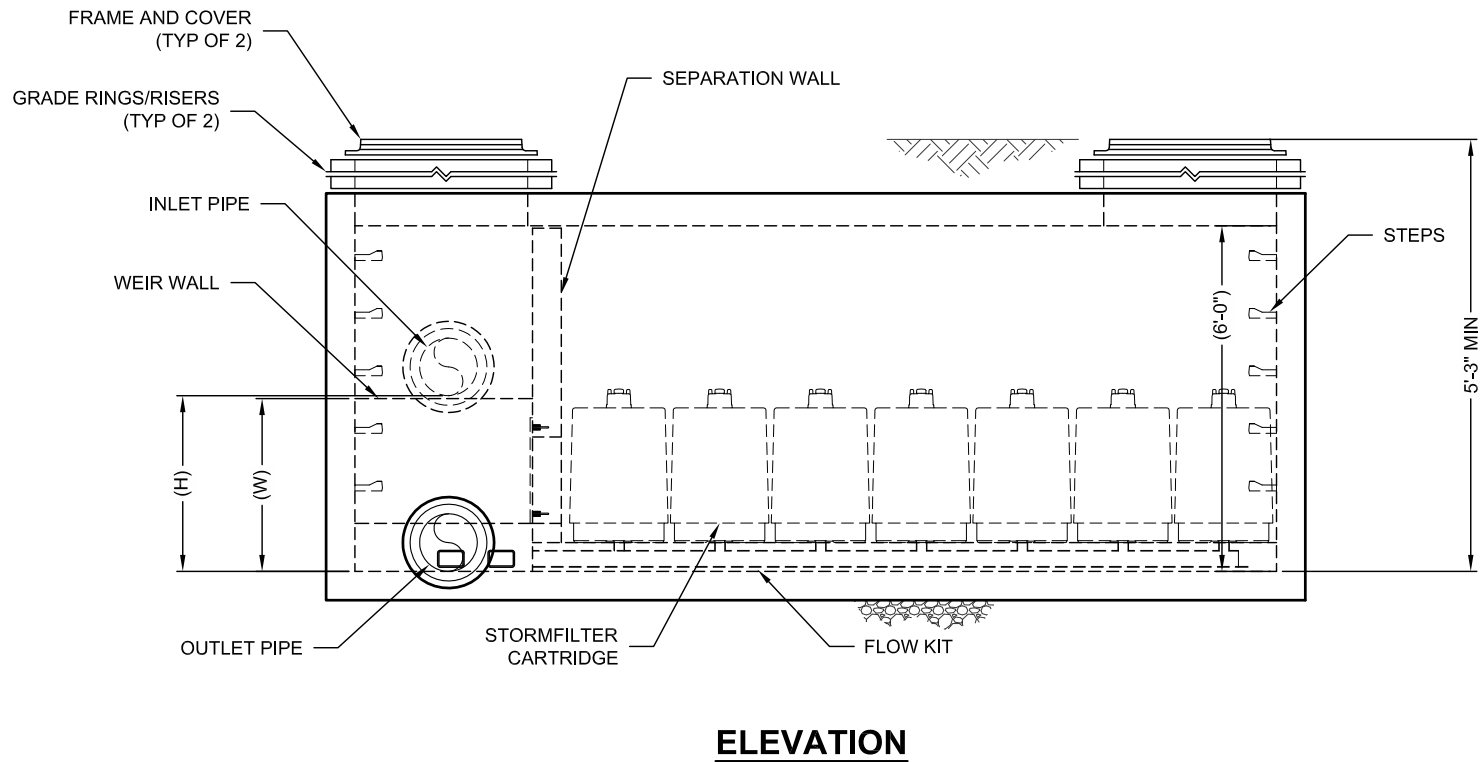
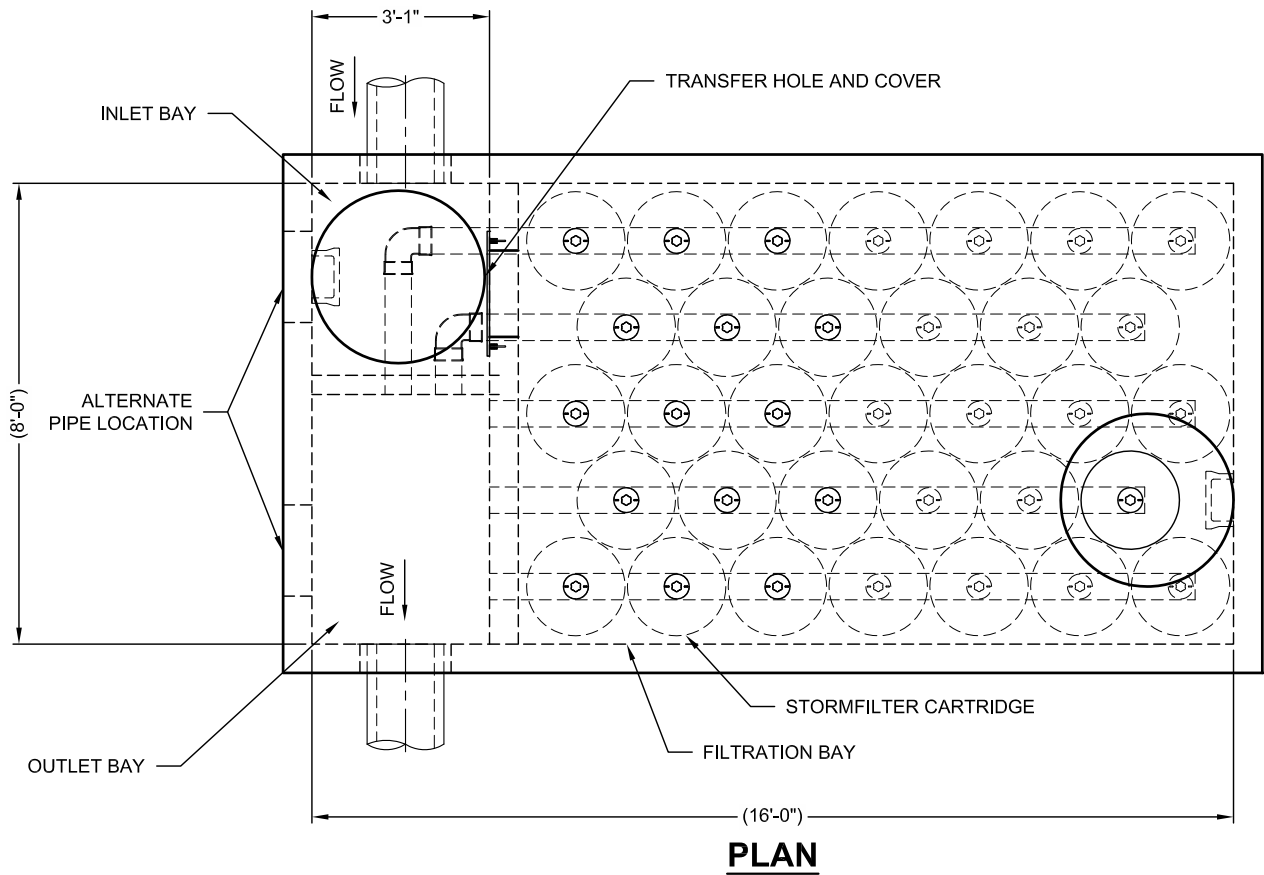
Annual TSS Removal

80%

Percent Runoff Capture

90%

Recommend SFPD0816 vault or CIP



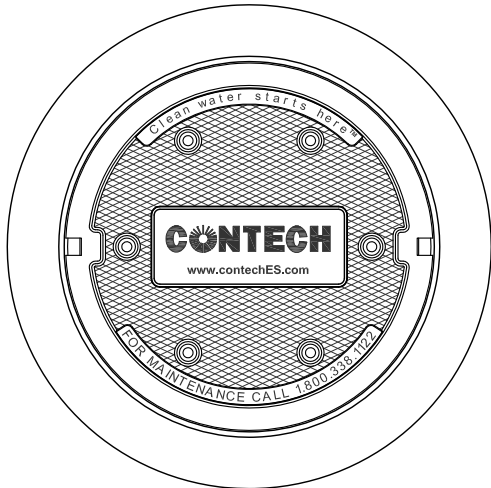
STORMFILTER DESIGN NOTES

- 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.



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

Mitchell Community College Stormwater Treatment System Field Evaluation:

Stormwater Management StormFilter® with PhosphoSorb Media at 1 gpm/ ft²

Abstract

This report presents the results of a twenty month field study conducted at The Mitchell Community College testing site located in the Town of Mooresville, NC. The study was conducted in an effort to demonstrate the effectiveness of The Stormwater Management StormFilter® (StormFilter) Stormwater Treatment System (system) in treating stormwater runoff with respect to the removal of solid and nutrient pollutants.

Testing of the StormFilter system was conducted for Total Suspended Solids (TSS), Suspended Sediment Concentration (SSC), Total Volatile Suspended Solids (TVSS), Total Phosphorus (TP), Dissolved Phosphorus (Diss. P), Ortho-phosphate (Ortho-P), and Particulate Phosphorus (PP) in accordance with the approved Project Plan, (Contech, 2010) as well as the conditions outlined in the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ) Preliminary Evaluation Period (PEP) program, (NCDENR, 2007).

Results from the twenty month study, that represented a total of 13 storm events and 23.73 inches of precipitation, show that the StormFilter system tested was highly effective in removing solid and nutrient pollutants from stormwater runoff. Significant reductions for solid and nutrient pollutants were observed between influent and effluent sampling locations using the Efficiency Ratio (ER) efficiency calculation (TSS 90.4% and TP 86.1%) and Summation of Load (SOL) efficiency calculation methods (TSS 90.9% and TP 87.1%).

Keywords

BMP; stormwater; TP; TSS; NCDENR DWQ PEP; StormFilter; media filter cartridge

Introduction

Contech Engineered Solutions LLC (formerly Contech Construction Products Inc., Stormwater360 Inc., and Stormwater Management Inc.) is the leading provider of innovative, long-term, stormwater treatment solutions, offering a variety of products, maintenance, laboratory, and engineering support to meet stormwater treatment needs. Contech Engineered Solutions LLC's patented product, the Stormwater Management StormFilter® (StormFilter) Stormwater Treatment System (system) is a Best Management Practice (BMP) designed to meet federal, state, and local requirements for treating stormwater runoff in compliance with the Clean Water Act. The StormFilter system improves the quality of stormwater runoff before it enters receiving waterways through the use of customizable filter media, which removes non-point source pollutants, including sediment particles, oil and grease, soluble metals, nutrients, and organics.

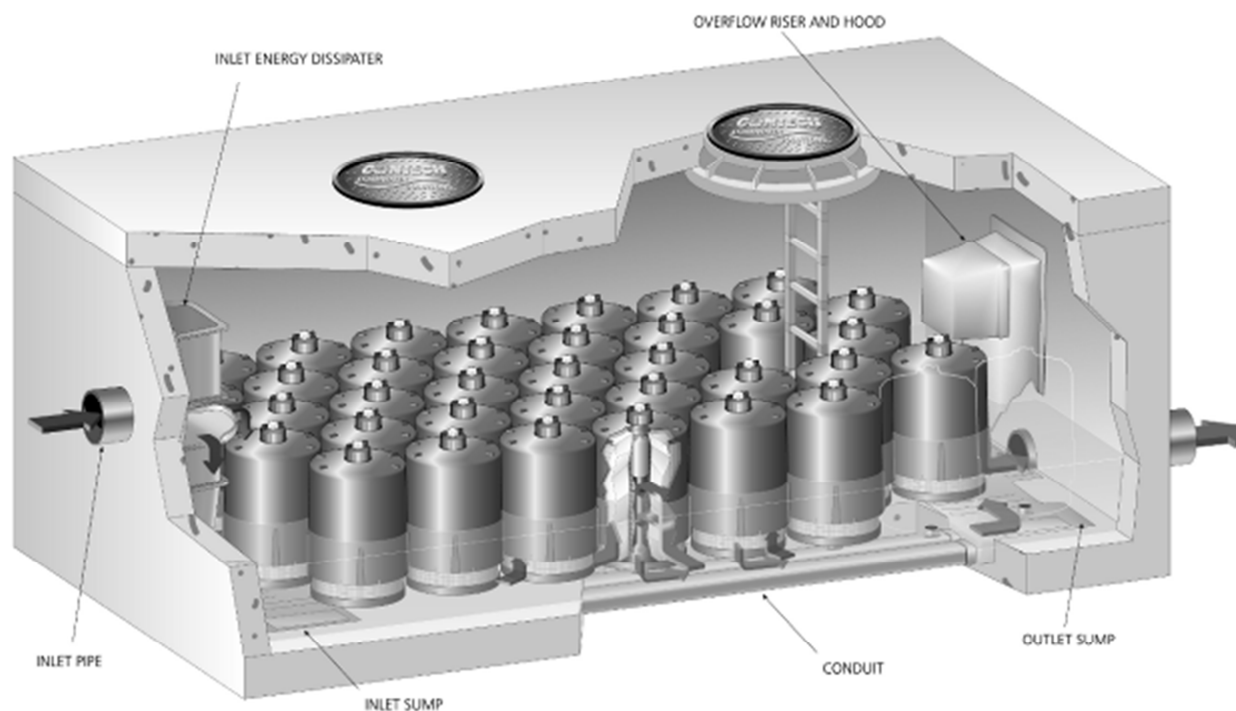


Figure 1. Standard StormFilter® Configuration.

The StormFilter system, as seen in Figure 1, is typically comprised of a vault that houses rechargeable, media-filled, filter cartridges. Stormwater entering the system percolates horizontally through these media-filled cartridges, where pollutant removal processes occur. Once filtered through the media, the treated stormwater is directed to a collection pipe and discharged to an open channel drainage way or storm sewer.

The StormFilter system is offered in a variety of configurations or containers depending on the specific application and site conditions: precast vault, box culvert vault, panel vault, manhole, and cast-in-place concrete. The StormFilter system is also offered in a steel catch basin or a concrete curb inlet configuration. The precast, manhole, and inlet configuration models utilize standard pre-manufactured units and arrive at the construction site with the filter cartridges and other internal components already in place to ease the installation process; the box culvert, panel vault, and cast-in-place units are customized for larger flows and require installation of cartridges at the site.

The Mitchell Community College StormFilter system installation (located in Mooresville, NC) was evaluated over a twenty month period following system maintenance in November of 2010. This project was managed by Contech in cooperation with the site owner and the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ). Independent oversight of all aspects of the project was provided by Ryan Winston, M.S., Extension Associate Engineer in the Department of Biological and Agricultural Engineering at North Carolina State University. Independent sample handling services were provided by Pace Analytical Services (Pace) of Huntersville, NC, and independent laboratory work was conducted by Pace and Test America of Beaverton, OR. Monitoring over a twenty month period resulted in the collection of 13 qualified storm events representing 23.73 inches of cumulative precipitation.

Site and System Description

The Mitchell Community College testing site is located in the Town of Mooresville, NC. Mooresville is located in southern Iredell County in the Piedmont region of North Carolina. The town is located between the Charlotte metropolitan area and the city of Statesville, the County seat. Mooresville is located within 15 miles of three interstate highways and is approximately 23 miles from the Charlotte-Douglas International Airport. The testing site was located at the intersection of West Moore Avenue and North Academy Street, (Lat: 35°35'3.60"N, Lon: 80°48'47.76"W, Elevation AMSL: 862ft). The site was owned and operated by Mitchell Community College and used primarily for parking. The site was swept periodically, however minor amounts of sediment and organic debris were typically present on site. Based on information provided by the design engineer, the site was 68% impervious and the total drainage area for the site was 1.08 acres. An aerial view of the site from 2010 is shown in Figure 2. Stormwater runoff from the contributing drainage area was directed to the StormFilter system before eventually discharging into Reed's Creek Basin and ultimately Lake Norman.

Stormwater treatment for the site was provided by a StormFilter system, designed as a capture-and-treat system. The storage component of the system (tank) was comprised of a 30 inch diameter corrugated metal pipe (CMP) network designed to capture 75% of the calculated water quality volume (i.e. the runoff volume associated with the 1.0 inch event). The treatment component (StormFilter) was designed on a mass-loading basis and was required to meet the annual pollutant loading requirements of the site with a minimum estimated interval between maintenance of 1 year. The StormFilter contained a total of eight 18 inch tall, media filled filter cartridges operating at a maximum surface area specific flow rate of 1 gpm/ft² (7.5 gpm/cartridge). Each of the filter cartridges was filled with an innovative coated reactive perlite media (PhosphoSorb). The PhosphoSorb media employs both physical straining and adsorption as primary and secondary pollutant removal mechanisms respectively thus allowing the media to sequester both particulate and dissolved pollutants.

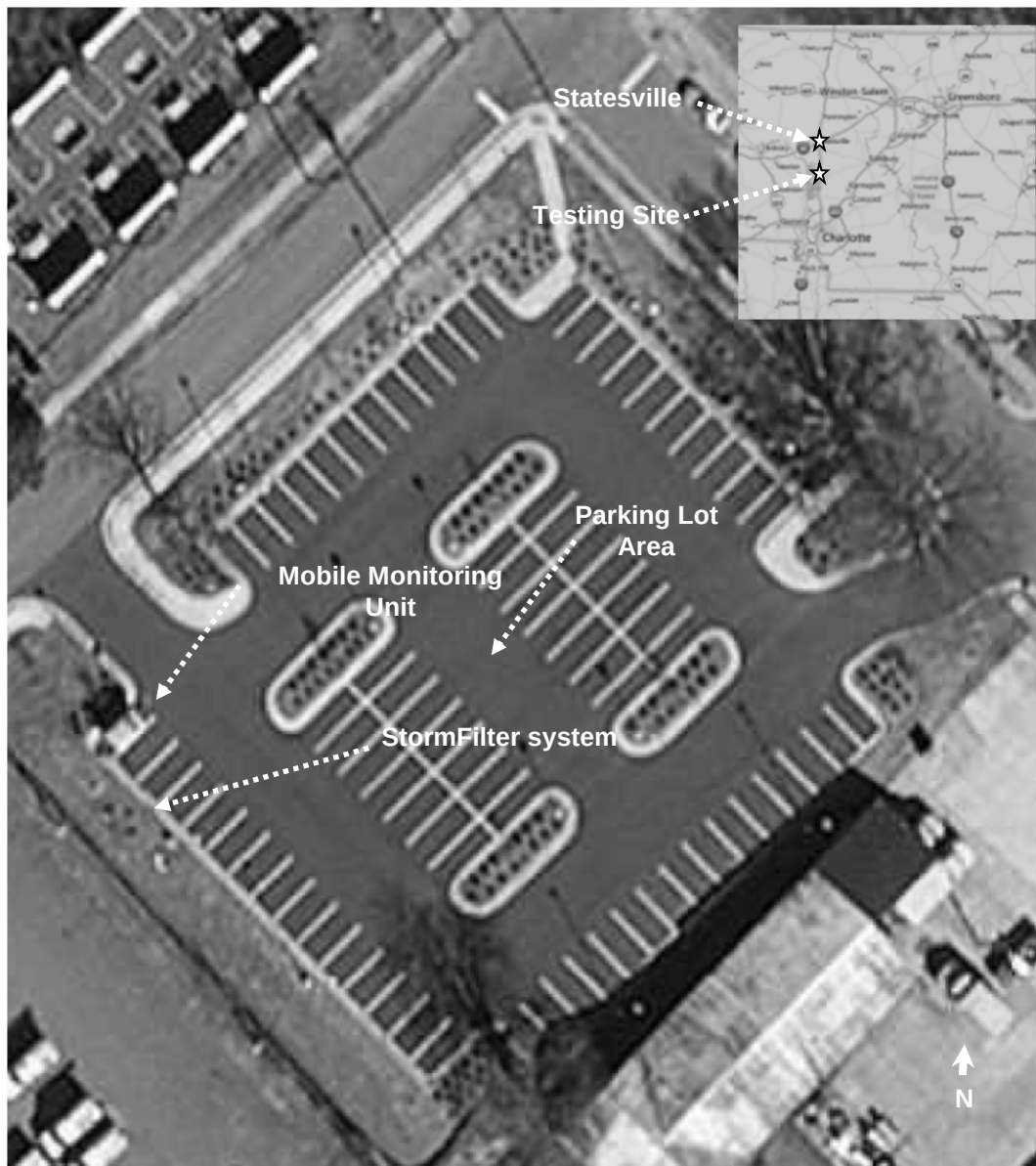


Figure 2. Aerial view of the Mitchell Community College testing site.

Sampling Design

The equipment and sampling techniques used for this study were in accordance with the Project Plan (Contech, 2010) developed by Contech in consultation with NCDENR DWQ. The Project Plan met the conditions outlined in the NCDENR DWQ preliminary evaluation period (PEP) program. Contech personnel were responsible for the installation, programming, and maintenance of the sampling equipment. Pace analytical provided independent sample retrieval, system reset, and sample submittal activities. Water sample processing and analysis was performed by Pace and Test America.

A Mobile Monitoring Unit (MMU) was provided, installed, maintained, and operated by Contech for sampling purposes. The MMU is a towable, fully enclosed, self-contained stormwater monitoring system specially designed and built by Contech for remote, extended-deployment stormwater monitoring. The design allows for remote control of sampling equipment, eliminates confined space

entry requirements, and streamlines the sample and data collection process. The MMU installed at the Mitchell Community College testing site is shown in Figure 3.



Figure 3. View of the Mobile Monitoring Unit (MMU) installed at the Mitchell Community College testing site.

Influent and effluent water quality samples were collected using individual ISCO 6712 Portable Automated Samplers configured for standard, individual, round, 1 liter wide-mouth HDPE bottles with sample bottles in the 1 through 12 positions for sample collection. The samplers were connected to individual 12V DC batteries recharged with solar panels. The influent sampler was equipped with an ISCO 750 Area Velocity Flow Module with a Low Profile Area Velocity Flow Sensor for flow analysis and influent sample pacing. The effluent sampler was equipped with an ISCO 730 Bubbler Flow Module used in conjunction with a 6 inch diameter Thel-Mar Weir for flow analysis and effluent sample pacing. Each sampler was also connected to an ISCO SPA 1489 Digital Cell Phone Modem to allow for remote communication and data access. Rainfall was measured using a 0.01-in resolution Texas Electronics TR-4 tipping bucket-type rain gauge. The sample intake for each automated sampler was connected to a stainless steel sample strainer (9/16" diameter, 6" length, with multiple 1/4" openings) via a length of 3/8" ID Acutech Duality FEP/LDPE tubing. Sample strainers and flow measurement equipment were secured to the invert of the influent and effluent pipes using stainless steel spring rings.

Following a precipitation event, Contech personnel remotely communicated with the automated sampling equipment to confirm sample collection and dispatch personnel from Pace to retrieve the samples and reset the automated sampling equipment. Samples were delivered to Pace and Test America on ice (<4 degrees C) and accompanied by chain-of-custody documentation. Sample bottles were combined by Pace to create composite samples. Sample bottles were thoroughly shaken and sieved through a 2000µm sieve. Samples were then emptied into a cone splitter to obtain a single, composite sample (USGS, 1980). Composite samples were then submitted for analysis according to the analytical methods specified in Table 1. The field monitoring methods used for this study represent the current state-of-the practice, and are very similar to those used by researchers in North Carolina and elsewhere to evaluate Stormwater BMPs.

Table 1. Analytical methods used for analytical parameters of interest.

Parameter	Analytical Method
Total Suspended Solids (TSS)	SM2540 D
Suspended Sediment Conc. (SSC)	ASTM D3977
Total Volatile Suspended Solids (TVSS)	EPA 160.4
Total Phosphorus (TP)	EPA 365.1
Dissolved Phosphorus (Diss. P)	EPA 365.1

As per the Project Plan, the following quality control samples were used to assess the quality of both field sampling and analytical activities: equipment rinsate blanks, equipment field blanks, method blank, and duplicate analysis. Sample processing blank samples were not taken. Except for solids analyses that employ the use of the whole sample volume (SSC), all method blanks and duplicate analyses were handled by Pace and Test America. Since solids analyses that employ the use of whole sample volume (SSC) consume the entire sample volume, replicate samples were prepared in place of duplicate samples and analyzed to allow for the assessment of analytical accuracy. The results of equipment rinsate blanks and equipment field blanks are shown in Table 2 accompanied by associated decisions and action items for instances of detection. Equipment rinsate blanks and equipment field blanks were submitted for analysis of the following parameters TSS, TVSS, and TP.

Table 2. Instances of detection in equipment rinsate blank and equipment field blank samples.

Date	Blank Type	Detections	Action	% of Sample Pairs Affected
7/8/2011	Rinsate	None	None	0
6/28/2011	Field	None	None	0
6/14/2012	Field	None	None	0

Precipitation Measurement

Precipitation was measured with a Texas Electronics TR-4 tipping bucket-type rain gauge. The rain gauge was connected to an ISCO 6712 Automated Sampler programmed to record the total number of tips (0.01 inch per tip) every 5 minutes. Equipment calibrations performed on site during the monitoring period indicated that the rain gauge was working properly during the monitoring period.

A comparison of monthly precipitation totals measured at the NOAA NWS COOP weather station in Statesville, NC during the monitoring period to the 30 year monthly mean precipitation totals shows that precipitation in the area was below normal in 15 of the 20 months studied (Table 3). Rainfall was above normal in March (2011), July (2011), September (2011), November (2011), and May (2012) as seen in Table 3.

Table 3. Monthly precipitation totals compared to 30 year monthly mean precipitation totals (NOAA NWS COOP Weather Station Statesville, NC)

Month	NOAA NWS COOP Station Statesville, NC Precipitation Total (in.)	Percent of Monthly Precipitation Total Normal (%)	30 Year Monthly Precipitation Total Normal (in.)
November (2010)	1.08	33	3.30
December (2010)	2.63	72	3.64
January (2011)	1.59	42	3.83
February (2011)	1.76	50	3.55
March (2011)	5.66	127	4.45
April (2011)	2.72	80	3.42
May (2011)	3.82	92	4.15
June (2011)	1.78	40	4.49
July (2011)	6.26	158	3.95
August (2011)	3.29	90	3.67
September (2011)	4.89	120	4.07
October (2011)	2.39	69	3.45
November (2011)	4.14	125	3.30
December (2011)	3.32	91	3.64
January (2012)	1.8	47	3.83
February (2012)	1.81	51	3.55
March (2012)	2.64	59	4.45
April (2012)	1.77	52	3.42
May (2012)	6.43	155	4.15
June (2012)	4.36	97	4.49

For sampled storm events, rainfall durations ranged from 8 to 36 hours, rainfall depth ranged from 0.85 to 4.41 inches, and 15 and 30 minute maximum intensities were 3.28 and 1.90 inches/hour respectively. Based on design information provided by the design engineer, runoff was calculated using the Curve Number Method using a CN of 89. Calculated runoff volumes ranged from 5796 to 94,133 gallons as seen in Table 4.

Table 4. Precipitation and runoff statistics for sampled events at the Mitchell Community College testing site.

Event ID	Duration of storm event (hours)	Total Precipitation (in.)	P15 (in/hr)	P30 (in/hr)	Calculated Runoff Volume (gal)
MCC041611	8	1.04	1.32	0.96	9086
MCC051011	8	0.93	1.24	0.80	7126
MCC051611	22	1.04	0.40	0.26	9086
MCC062811	24	2.06	1.36	1.00	31611
MCC070811	13	4.41	3.28	1.90	94133
MCC073111	19	1.37	2.04	1.88	15674
MCC090511	36	1.94	1.92	0.96	28694
MCC092111	13	3.75	2.16	1.60	75933
MCC110311	24	1.40	0.56	0.50	16316
MCC111611	14	1.01	1.68	1.34	8538
MCC051312	21	1.82	1.28	0.92	25828
MCC052112	30	0.85	1.68	0.86	5796
MCC060612	30	2.11	1.00	0.88	32841

Flow Measurement

An ISCO 750 Area Velocity Flow Module with a Low Profile Area Velocity Flow Sensor was used to measure flow and pace sample collection at the influent sample location. An ISCO 730 Bubbler Flow Module was used in conjunction with a 6 inch diameter Thel-Mar Weir to measure flow and pace sample collection at the effluent sample location. Level measurements were adjusted by applying corrections that reflected differences between recorded and measured water surface elevations at the influent and effluent sampling locations. On average, 105% of the calculated total rainfall volume as runoff was measured, as effluent for the monitored events, as shown in Table 5.

Table 5. Percentage of calculated rainfall runoff volumes represented by actual measured runoff volumes at the Mitchell Community College testing site.

Event ID	Calculated Runoff Volume (gal)	Effluent Volume (gal)	Effluent Volume / Calc. Runoff Volume (%)
MCC041611	9086	12748	140
MCC051011	7126	9392	132
MCC051611	9086	18104	199
MCC062811	31611	26364	83
MCC070811	94133	49090	52
MCC073111	15674	16093	103
MCC090511	28694	35039	122
MCC092111	75933	67321	89
MCC110311	16316	20220	124
MCC111611	8538	9926	116
MCC051312	25828	13154	51
MCC052112	5796	4879	84
MCC060612	32841	21569	66

Stormwater Data Collection Requirements

Of the 13 qualifying storm events sampled; 1) the total rainfall was greater than 0.1 inches for all storm events sampled, 2) the minimum inter-event period was greater than 6 hours for all storm events sampled, 3) the minimum number of influent and effluent aliquots collected per storm event was ≥ 5 , 4) influent flow-weighted composite samples covered $\geq 50\%$ of the total storm flow for all storm events sampled with the exception of the MCC070811, MCC090511, MCC092111, MCC110311, MCC051312, and MCC060612 events, and 5) effluent flow-weighted composite samples covered $\geq 50\%$ of the total storm flow for all storm events sampled. All events have been determined to meet the conditions outlined in the PEP program as shown in Table 6.

Table 6. Stormwater data collection requirement results.

Event ID	Influent Coverage	Effluent Coverage	Influent Number of Aliquots	Effluent Number of Aliquots	Antecedent Dry Period > 6 hours	Event Depth (in.)
MCC041611	101%	100%	18	14	√	1.04
MCC051011	91%	79%	6	6	√	0.93
MCC051611	79%	90%	8	8	√	1.04
MCC062811	98%	97%	19	13	√	2.06
MCC070811	41%	98%	24	24	√	4.41
MCC073111	97%	98%	16	16	√	1.37
MCC090511	46%	90%	29	26	√	1.94
MCC092111	49%	93%	48	48	√	3.75
MCC110311	34%	60%	48	48	√	1.40
MCC111611	100%	100%	39	40	√	1.01
MCC051312	36%	92%	28	48	√	1.82
MCC052112	100%	74%	31	5	√	0.85
MCC060612	46%	73%	42	48	√	2.11

Data Analysis

Of the 13 qualifying storm events sampled, data verification and validation did not lead to the outright disqualification of any events due to obvious monitoring, handling or analytical errors, or the substantial exceedance of the design operating parameters. Event Mean Concentrations (EMC) from influent and effluent samples are summarized in Table 7-9.

Using SSC (<500µm) EMC results, the percent of corresponding SSC (<2000µm) EMC results was calculated. The calculated percentages of corresponding SSC (<2000µm) EMC results indicated the portion of material that was less than 500µm in size and are summarized in Table 10.

Using TVSS EMC results, the percent of corresponding SSC results was calculated. The calculated percentages of corresponding SSC (<2000µm) and SSC (<500µm) results indicated the percent of combustible materials that are assumed to be organic in nature and are summarized in Table 11.

Non-parametric statistical methods were used to evaluate correlations and differences between non-transformed influent and effluent EMCs since influent and effluent EMCs were generally not from the same statistical distribution. To test for positive correlations between influent and effluent EMCs, the Spearman Rank Order Correlation test was used (USGS, 1991). To evaluate the significance of differences between influent and effluent EMCs, the Mann-Whitney Rank Sum Test was used (USGS, 1991). For the Mann-Whitney Rank Sum Test the null hypothesis was that the two samples were not drawn from populations with different medians. A significant difference between influent and effluent EMCs was concluded when $P < 0.05$.

Detectable concentrations were observed for all parameters analyzed except for TSS for the MCC051011, MCC051611, MCC062811, MCC073111, MCC090511, MCC092111, MCC110311, and MCC060612 events; SSC (<2000µm) for the MCC073111, MCC051312, and MCC060612 events; SSC (<500µm) for the MCC051611, MCC051312, and MCC060612 events; TVSS (<2000µm) for the MCC111611 event; TVSS (<500µm) for the MCC110311 and MCC111611 events; TP for the MCC051611, MCC062811, MCC070811, MCC092111, MCC110311, MCC111611, MCC051312,

MCC052112, and MCC060612 events ; Diss. P for the MCC041611, MCC062811, MCC070811, MCC073111, MCC092111, MCC110311, MCC111611, MCC051312, and MCC060612 events; Ortho-P for the MCC041611, MCC062811, MCC070811, MCC073111, MCC092111, MCC110311, MCC111611, MCC051312, and MCC060612 events; For values that were reported as non-detect, substitutions were made using half of the Method Reporting Limit (MRL) for statistical testing and calculation of efficiencies. For calculated parameters values calculated as ≤ 0 were reported as 0 for statistical testing and calculation of efficiencies.

Performance was calculated using the Efficiency Ratio (ER) efficiency calculation method. The ER method defines the efficiency as the average event mean concentration of pollutants over some time period.

$$ER = 1 - \frac{\text{mean effluent EMC}}{\text{mean influent EMC}}$$

The ER method assumes; 1) The weight of all storm events is equal regardless of the relative magnitude of the storm event and 2) that if all storm events at the site had been monitored, the average inlet and outlet EMCs would be similar to those that were monitored (URS/ EPA 1999). ER efficiency calculations for the 13 events sampled at the Mitchell Community College testing site are summarized in Tables 7-19.

Performance was also calculated using the Summation of Loads (SOL) efficiency calculation method. The SOL method defines the efficiency as a percentage based on the ratio of the summation of all influent loads to the summation of all effluent loads.

$$SOL = 1 - \frac{\text{sum of all effluent loads}}{\text{sum of all influent loads}}$$

The SOL method assumes; 1) monitoring data accurately represents the actual entire total loads in and out of the BMP for a period long enough to overshadow any temporary storage or export of pollutants and 2) any significant storm events that were not monitored had a ratio of inlet to effluent loads similar to the storms events that were monitored (URS/ EPA 1999). In an effort to eliminate the introduction of potential bias associated with observed discrepancies between influent and effluent measured volumes it was assumed that the influent volume was equal to the effluent volume. Measured effluent volume was used to calculate loads for both the influent and effluent sample locations. Sum of Loads (SOL) Efficiency Calculations for the 13 events sampled at the Mitchell Community College testing site are summarized in Tables 12,13, and 14.

Results

Based on the use of the Spearman Rank Order correlation test, positive correlations ($P < 0.05$) were determined between influent and effluent EMCs for Ortho-P.

Based on the use of the Mann-Whitney Rank Sum test, the difference in the median values between the influent and effluent EMCs is greater than would be expected by chance. Therefore, a statistically significant difference ($P < 0.05$) was observed for TSS, SSC ($< 2000\mu\text{m}$), SSC ($< 500\mu\text{m}$), TVSS ($< 2000\mu\text{m}$), TP, and PP as seen in Tables 7, 8, and 9.

Based on the use of the Mann-Whitney Rank Sum test, the difference in the median values between the influent and effluent EMCs is not great enough to exclude the possibility that the difference is due to

random sampling variability. A statistically significant difference ($P > 0.05$) was not observed for TVSS ($<500\mu\text{m}$), Diss. P, and Ortho-P as seen in Tables 7, 8, and 9.

Suspended Solids Parameters

Influent EMCs for TSS ranged from 10.3 mg/l to 98.2 mg/l with a median of 27.6 mg/l and a mean of 34.6 mg/l. Corresponding effluent EMCs ranged from 1.3 mg/l to 6.6 mg/l with a median of 2.8 mg/l and a mean of 3.3 mg/l, resulting in an ER efficiency of 90.4%. Total event loadings for the study were 32.7 kg at the influent and 3.0 kg at the effluent sampling location, resulting in an SOL TSS efficiency of 90.9%.

Influent EMCs for SSC ($<2000\mu\text{m}$) ranged from 17.7 mg/l to 2080.0 mg/l with a median of 53.4 mg/l and a mean of 231.0 mg/l. Corresponding effluent EMCs ranged from 1.9 mg/l to 7.2 mg/l with a median of 3.4 mg/l and a mean of 3.9 mg/l, resulting in an ER efficiency of 98.3%. Total event loadings for the study were 222.0 kg at the influent and 3.9 kg at the effluent sampling location, resulting in an SOL SSC efficiency of 98.3%. In general, the relationship between TSS and SSC ($<2000\mu\text{m}$) was determined not to be significant based on the linear regression results for both influent ($R^2 = 0.0130$) and effluent ($R^2 = 0.410$) EMCs.

Influent EMCs for SSC ($<500\mu\text{m}$) ranged from 9.0 mg/l to 393.0 mg/l with a median of 28.6 mg/l and a mean of 66.1 mg/l. Corresponding effluent EMCs ranged from 1.7 mg/l to 10.0 mg/l with a median of 2.8 mg/l and a mean of 4.4 mg/l, resulting in an ER efficiency of 93.4%. Total event loadings for the study were 63.3 kg at the influent and 4.0 kg at the effluent sampling location, resulting in an SOL efficiency of 93.7%. For each storm event, the percent of SSC ($<2000\mu\text{m}$) represented by SSC ($<500\mu\text{m}$) was calculated (Table 11). Influent and effluent median percentages of SSC ($<2000\mu\text{m}$) were 68.0% and 94.2%, respectively. The percentage of corresponding SSC ($<2000\mu\text{m}$) results indicated the portion of material that were less than 500 μm in size.

Volatile Suspended Solids Parameters

Influent EMCs for TVSS ($<2000\mu\text{m}$) ranged from 1.1 mg/l to 99.2 mg/l with a median of 11.9 mg/l and a mean of 23.8 mg/l. Corresponding effluent EMCs ranged from 0.5 mg/l to 6.7 mg/l with a median of 3.0 mg/l and a mean of 2.9 mg/l, resulting in an ER efficiency of 87.7%. Total event loadings for the study were 24.6 kg at the influent and 2.9 kg at the effluent sampling location, resulting in an SOL efficiency of 88.2%. For each storm event, the percent of SSC ($<2000\mu\text{m}$) represented by TVSS ($<2000\mu\text{m}$) was calculated (Table 12). Influent and effluent median percentages of SSC ($<2000\mu\text{m}$) were 29.0% and 65.1%, respectively. Percentage of corresponding SSC ($<2000\mu\text{m}$) results indicated the percent of combustible materials that were assumed to be organic in nature.

Influent EMCs for TVSS ($<500\mu\text{m}$) ranged from 1.1 mg/l to 48.0 mg/l with a median of 7.3 mg/l and a mean of 11.6 mg/l. Corresponding effluent EMCs ranged from 0.6 mg/l to 5.3 mg/l with a median of 3.4 mg/l and a mean of 3.1 mg/l, resulting in an ER efficiency of 73.4%. Total event loadings for the study were 9.9 kg at the influent and 3.3 kg at the effluent sampling location, resulting in an SOL efficiency of 67.1%. For each storm event, the percent of SSC ($<500\mu\text{m}$) represented by TVSS ($<500\mu\text{m}$) was calculated (Table 12). Influent and effluent median percentages of SSC ($<500\mu\text{m}$) were 31.4% and 86.4% respectively. Percentage of corresponding SSC ($<500\mu\text{m}$) results indicated the percent of combustible materials that were assumed to be organic in nature.

Phosphorus Parameters

Influent EMCs for TP ranged from 0.07 mg/l to 0.90 mg/l with a median of 0.14 mg/l and a mean of 0.22 mg/l. Corresponding effluent EMCs ranged from 0.03 mg/l to 0.06 mg/l with a median of 0.03 mg/l and a mean of 0.03 mg/l, resulting in an ER efficiency of 86.1%. Total event loadings for the study were 218.6 g at the influent and 28.1 g at the effluent sampling location, resulting in an SOL efficiency of 87.1%.

Influent EMCs for Diss. P ranged from 0.03 mg/l to 0.85 mg/l with a median of 0.05 mg/l and a mean of 0.16 mg/l. Corresponding effluent EMCs ranged from 0.03 mg/l to 0.16 mg/l with a median of 0.05 mg/l and a mean of 0.04 mg/l, resulting in an ER efficiency of 74.2%. Total event loadings for the study were 109.6 g at the influent and 35.9 g at the effluent sampling location, resulting in an SOL efficiency of 67.3%.

Influent EMCs for Ortho-P ranged from 0.03 mg/l to 0.86 mg/l with a median of 0.03 mg/l and a mean of 0.14 mg/l. Corresponding effluent EMCs ranged from 0.03 mg/l to 0.03 mg/l with a median of 0.03 mg/l and a mean of 0.03 mg/l, resulting in an ER efficiency of 82.5%. Total event loadings for the study were 102.8 g at the influent and 22.4 g at the effluent sampling location, resulting in an SOL efficiency of 78.2%.

Calculated influent EMCs for PP, calculated as the difference between TP and Diss. P, ranged from 0.02 mg/l to 0.23 mg/l with a median of 0.06 mg/l and a mean of 0.08 mg/l. Corresponding effluent EMCs ranged from 0.03 mg/l to 0.00 mg/l with a median of 0.00 mg/l and a mean of 0.01 mg/l, resulting in an ER efficiency of 91.3%. Total event loadings for the study were 97.7 g at the influent and 3.5 g at the effluent sampling location, resulting in an SOL efficiency of 96.4%.

Table 7. Suspended Solids Efficiency Ratio (ER) Efficiency Calculations and Statistical Testing for the 13 events sampled at the Mitchell Community College testing site.

Event ID	TSS (mg/l)		SSC (<2000µm) (mg/l)		SSC (<500µm) (mg/l)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
MCC041611	21.2	6.2	55.7	7.2	45.8	7.3
MCC051011	98.2	5.1	90.6	4.6	104.0	5.1
MCC051611	21.8	2.8	51.0	6.2	9.6	1.9
MCC062811	10.3	1.4	18.0	3.0	9.0	2.6
MCC070811	18.2	3.3	29.7	3.8	16.0	3.0
MCC073111	28.4	2.5	17.7	2.7	29.1	4.0
MCC090511	25.1	2.5	81.8	2.5	74.5	2.4
MCC092111	27.6	1.3	86.0	1.9	20.4	1.7
MCC110311	23.6	1.3	2080.0	2.4	393.0	1.8
MCC111611	56.9	3.4	186.0	2.7	16.3	2.5
MCC051312	52.4	5.7	27.0	5.0	28.0	10.0
MCC052112	28.2	6.6	NT	NT	NT	NT
MCC060612	38.0	1.3	48.0	5.0	48.0	10.0
Min	10.3	1.3	17.7	1.9	9.0	1.7
Max	98.2	6.6	2080.0	7.2	393.0	10.0
Median	27.6	2.8	53.4	3.4	28.6	2.8
Mean	34.6	3.3	231.0	3.9	66.1	4.4
Efficiency Ratio	90.4%		98.3%		93.4%	
Mann-Whitney U statistic	0.000		0.000		4.000	
P value for U statistic	<0.001		<0.001		<0.001	

NT = Not tested

QC DQ = Quality Control Disqualification

Table 8. Total Volatile Suspended Solids Efficiency Ratio (ER) Efficiency Calculations and Statistical Testing for the 13 events sampled at the Mitchell Community College testing site.

Event ID	TVSS (<2000µm) (mg/l)		TVSS (<500µm) (mg/l)	
	Influent	Effluent	Influent	Effluent
MCC041611	30.8	4.1	24.0	5.3
MCC051011	53.0	6.7	48.0	4.2
MCC051611	13.0	3.1	10.4	3.6
MCC062811	10.8	3.4	4.8	4.3
MCC070811	8.0	2.1	7.6	3.3
MCC073111	19.6	3.8	3.4	3.9
MCC090511	7.4	2.8	4.2	3.4
MCC092111	27.3	1.7	6.1	1.5
MCC110311	99.2	1.6	13.3	1.0
MCC111611	1.1	0.5	1.1	0.6
MCC051312	8.4	3.2	9.2	3.2
MCC052112	NT	NT	NT	NT
MCC060612	7.2	2.2	7.0	2.8
Min	1.1	0.5	1.1	0.6
Max	99.2	6.7	48.0	5.3
Median	11.9	3.0	7.3	3.4
Mean	23.8	2.9	11.6	3.1
Efficiency Ratio	87.7%		73.4%	
Mann-Whitney U statistic	11.000		0.000	
P value for U statistic	<0.001		0.667	

NT = Not tested

QC DQ = Quality Control Disqualification

Table 9. Phosphorus Efficiency Ratio (ER) Efficiency Calculations and Statistical Testing for the 13 events sampled at the Mitchell Community College testing site.

Event ID	TP (mg/l)		Diss. P (mg/l)		Ortho-P (mg/l)		PP (mg/l)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
MCC041611	0.160	0.058	0.025	0.025	0.025	0.025	0.135	0.033
MCC051011	NT	NT	NT	NT	NT	NT	NT	NT
MCC051611	0.110	0.025	NT	NT	NT	NT	NT	NT
MCC062811	0.130	0.025	0.025	0.160	0.025	0.025	0.105	0.000
MCC070811	0.065	0.025	0.025	0.025	0.025	0.025	0.040	0.000
MCC073111	0.140	0.057	0.061	0.025	0.025	0.025	0.079	0.032
MCC090511	NT	NT	NT	NT	NT	NT	NT	NT
MCC092111	0.250	0.025	0.025	0.025	0.025	0.025	0.225	0.000
MCC110311	0.900	0.025	0.850	0.025	0.860	0.025	0.050	0.000
MCC111611	0.100	0.025	0.081	0.025	0.063	0.025	0.019	0.000
MCC051312	0.088	0.025	0.054	0.025	0.025	0.025	0.034	0.000
MCC052112	0.200	0.025	NT	NT	NT	NT	NT	NT
MCC060612	0.310	0.025	0.250	0.025	0.210	0.025	0.060	0.000
Min	0.065	0.025	0.025	0.025	0.025	0.025	0.019	0.000
Max	0.900	0.058	0.850	0.160	0.860	0.025	0.225	0.033
Median	0.140	0.025	0.054	0.025	0.025	0.025	0.060	0.000
Mean	0.223	0.031	0.155	0.040	0.143	0.025	0.083	0.007
Efficiency Ratio	86.1%		74.2%		82.5%		91.3%	
Mann-Whitney U statistic	0.000		23.000		27.000		2.000	
P value for U statistic	<0.001		0.074		0.077		<0.001	

NT = Not tested

QC DQ = Quality Control Disqualification

Table 10. Calculated Percentages of material less than 500µm for the 13 events sampled at the Mitchell Community College testing site.

Event ID	SSC (<500µm)/ SSC (<2000µm) (%)	
	Influent	Effluent
MCC041611	82.2	100.0
MCC051011	100.0	100.0
MCC051611	18.9	31.1
MCC062811	49.8	86.0
MCC070811	53.9	79.9
MCC073111	100.0	100.0
MCC090511	91.1	98.4
MCC092111	23.7	85.9
MCC110311	18.9	75.2
MCC111611	8.8	90.1
MCC051312	100.0	100.0
MCC052112	NT	NT
MCC060612	100.0	100.0
Min	8.8	31.1
Max	100.0	100.0
Median	68.0	94.2
Mean	62.3	87.2

NT = Not tested

QC DQ = Quality Control Disqualification

Table 11. Calculated percentages of combustible materials that were assumed to be organic in nature for the 13 events sampled at the Mitchell Community College testing site.

Event ID	TVSS (<2000µm)/ SSC (<2000µm) (%)		TVSS (<500µm)/ SSC (<500µm) (%)	
	Influent	Effluent	Influent	Effluent
MCC041611	55.3	56.9	52.4	72.6
MCC051011	58.5	100.0	46.2	81.9
MCC051611	25.5	50.0	100.0	100.0
MCC062811	60.0	100.0	53.6	100.0
MCC070811	26.9	55.6	47.5	100.0
MCC073111	100.0	100.0	11.7	98.7
MCC090511	9.0	100.0	5.6	100.0
MCC092111	31.7	88.5	29.9	90.9
MCC110311	4.8	66.1	3.4	54.9
MCC111611	0.6	18.3	6.7	22.4
MCC051312	31.1	64.0	32.9	32.0
MCC052112	NT	NT	NT	NT
MCC060612	15.0	44.0	14.6	28.0
Min	0.6	18.3	3.4	22.4
Max	100.0	100.0	100.0	100.0
Median	29.0	65.1	31.4	86.4
Mean	34.9	70.3	33.7	73.5

NT = Not tested

QC DQ = Quality Control Disqualification

Table 12. Suspended Solids Summation of Loads (SOL) Efficiency Calculations for the 13 events sampled at the Mitchell Community College testing site.

Event ID	TSS (kg)		SSC (<2000µm) (kg)		SSC (<500µm) (kg)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
MCC041611	1.0	0.3	2.7	0.3	2.2	0.4
MCC051011	3.5	0.2	3.2	0.2	3.7	0.2
MCC051611	1.5	0.2	3.5	0.4	0.7	0.1
MCC062811	1.0	0.1	1.8	0.3	0.9	0.3
MCC070811	3.4	0.6	5.5	0.7	3.0	0.6
MCC073111	1.7	0.2	1.1	0.2	1.8	0.2
MCC090511	3.3	0.3	10.8	0.3	9.9	0.3
MCC092111	7.0	0.3	21.9	0.5	5.2	0.4
MCC110311	1.8	0.1	159.2	0.2	30.1	0.1
MCC111611	2.1	0.1	7.0	0.1	0.6	0.1
MCC051312	2.6	0.3	1.3	0.2	1.4	0.5
MCC052112	0.5	0.1	NT	NT	NT	NT
MCC060612	3.1	0.1	3.9	0.4	3.9	0.8
Sum	32.7	3.0	222.0	3.9	63.3	4.0
SOL Efficiency	90.9%		98.3%		93.7%	

NT = Not tested

QC DQ = Quality Control Disqualification

Table 13. Total Volatile Suspended Solids Summation of Loads (SOL) Efficiency Calculations for the 13 events sampled at the Mitchell Community College testing site.

Event ID	TVSS (<2000µm) (kg)		TVSS (<500µm) (kg)	
	Influent	Effluent	Influent	Effluent
MCC041611	1.5	0.2	1.2	0.3
MCC051011	1.9	0.2	1.7	0.1
MCC051611	0.9	0.2	0.7	0.2
MCC062811	1.1	0.3	0.5	0.4
MCC070811	1.5	0.4	1.4	0.6
MCC073111	1.2	0.2	0.2	0.2
MCC090511	1.0	0.4	0.6	0.5
MCC092111	7.0	0.4	1.6	0.4
MCC110311	7.6	0.1	1.0	0.1
MCC111611	0.0	0.0	0.0	0.0
MCC051312	0.4	0.2	0.5	0.2
MCC052112	NT	NT	NT	NT
MCC060612	0.6	0.2	0.6	0.2
Sum	24.6	2.9	9.9	3.3
SOL Efficiency	88.2%		67.1%	

NT = Not tested

QC DQ = Quality Control Disqualification

Table 14. Phosphorus Summation of Loads (SOL) Efficiency Calculations for the 13 events sampled at the Mitchell Community College testing site.

Event ID	TP (g)		Diss. P (g)		Ortho-P (g)		PP (g)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
MCC041611	7.7	2.8	1.2	1.2	1.2	1.2	6.5	1.6
MCC051011	NT	NT	NT	NT	NT	NT	NT	NT
MCC051611	7.5	1.7	NT	NT	NT	NT	NT	NT
MCC062811	13.0	2.5	2.5	16.0	2.5	2.5	10.5	0.0
MCC070811	12.1	4.6	4.6	4.6	4.6	4.6	7.4	0.0
MCC073111	8.5	3.5	3.7	1.5	1.5	1.5	4.8	1.9
MCC090511	NT	NT	NT	NT	NT	NT	NT	NT
MCC092111	63.7	6.4	6.4	6.4	6.4	6.4	57.3	0.0
MCC110311	68.9	1.9	65.1	1.9	65.8	1.9	3.8	0.0
MCC111611	3.8	0.9	3.0	0.9	2.4	0.9	0.7	0.0
MCC051312	4.4	1.2	2.7	1.2	1.2	1.2	1.7	0.0
MCC052112	3.7	0.5	NT	NT	NT	NT	NT	NT
MCC060612	25.3	2.0	20.4	2.0	17.1	2.0	4.9	0.0
Sum	218.6	28.1	109.6	35.9	102.8	22.4	97.7	3.5
SOL Efficiency	87.1%		67.3%		78.2%		96.4%	

NT = Not tested

QC DQ = Quality Control Disqualification

Residual Solids Assessment Results

In an effort to verify the capture of materials by the StormFilter system over the course of the monitoring period, a qualitative assessment of materials captured by the StormFilter system was performed during the site visit conducted on November 3, 2011. The mass of materials contained in the system was estimated using a mean depth measurement and a texture based bulk density estimate. The mean depth of material captured by the StormFilter at the time of inspection was determined to be approximately 3 inches. A composite sample of the material captured by the StormFilter was collected and texture was determined in the field by hand texturing of the sample. Hand texture analysis of the composite sample revealed that the materials captured by the StormFilter had a loamy sand texture (USDA classification). The estimated mass of materials contained in the StormFilter, using the mean depth of material captured by the StormFilter and a bulk density assumption for loamy sand texture soils of 1.65 gm/cc, was approximately 150 kg.

Following the maintenance of the system on November 3, 2011 which involved the removal of accumulated solids from the system as well as the replacement of cartridges, a qualitative assessment of materials captured by the StormFilter system was performed during the site visit conducted on June 14, 2012. The mass and texture of materials contained in the system was estimated as described above. The mean depth of material captured by the StormFilter was determined to be approximately 0.5 inches; and had a loamy sand texture (USDA classification). The estimated mass of materials was approximately 25 kg.

Summary and Conclusion

The primary purpose of this report was to document StormFilter system performance with respect to solid and nutrient pollutant removal and quantify performance in accordance with the conditions outlined in the NCDENR DWQ PEP program. Between November (2010) and June (2012), a total of 13 qualifying storm events were monitored and were determined to meet the storm data collection requirements as per the conditions outlined in the NCDENR DWQ PEP program.

Significant reductions for solid and nutrient pollutant concentrations were observed between influent and effluent sampling locations using the Efficiency Ratio (ER) efficiency calculation (TSS 90.4% and TP 86.1%) and Summation of Load (SOL) efficiency calculation methods (TSS 90.9% and TP 87.1%). The capture of solids by the system was verified as part of the residual solids assessment during site visits conducted on November 3, 2011 and June 14, 2012.

Given that the solid performance standard for this project is based solely on TSS removal efficiency, the review of additional data was required to further understand removal efficiency results. In an effort to isolate suspended sediment removal efficiency based on specific particle size ranges, SSC samples were sieved prior to analysis. The particle size ranges that were isolated for this study included 2000µm to 1.5µm and 500µm to 1.5µm. The isolation of suspended solids removal efficiencies based on particles 2000µm to 1.5µm and particles between 500µm and 1.5 µm resulted in an overall removal efficiency of 98.3% and 93.4% respectively using the ER efficiency calculation method and 98.3% and 93.7% respectively using the SOL efficiency calculation method. These results demonstrate performance greater than the performance goal of 85% removal of TSS. In addition to these results demonstrating performance greater than the performance goal of 85% removal of TSS, research by (Rutgers/ NJDEP, 2006) suggests the difference between TSS and SSC results becomes smaller as the particle size of the material analyzed becomes finer.

Given that the phosphorus removal performance standard for this project is based solely on TP removal efficiency, the review of additional data was required to further understand removal efficiency results. In an effort to isolate phosphorus removal efficiency based on speciation TP, Diss. P, Ortho-P, and PP results were isolated. TP, Diss. P, and Ortho-P results were provided by the analytical lab. PP was calculated as the difference between TP and Diss. P. Removal efficiencies for TP, Diss. P, Ortho-P, and PP results resulted in an overall removal efficiency 86.1%, 74.2%, 82.5%, and 91.3% respectively using the ER efficiency calculation method. Removal efficiencies for TP, Diss. P, Ortho-P, and PP results resulted in an overall removal efficiency of 87.1%, 67.3%, 78.2%, and 96.4% using the SOL efficiency calculation method. These results not only demonstrate that the system was able to meet the performance goal but was able to attenuate TP captured by the system over the course of the study.

Results from the twenty month study, that represented a total of 13 storm events and 23.73 inches of precipitation, show that the StormFilter system tested was highly effective in removing solid and nutrient pollutants from the stormwater runoff.

References

Contech Stormwater Solutions Inc. (Contech) (2010). The Mitchell Community College Stormwater Management StormFilter Field Evaluation Project Plan Portland, Oregon: Author.

North Carolina Department of Environment and Natural Resources (NCDENR), Division of Water Quality (2007). Stormwater Best Management Practices Manual (Publication Number). Raleigh, NC: Available online: <http://portal.ncdenr.org/web/wq/ws/su/bmp-manual>

URS Greiner Woodward Clyde, Urban Drainage and Flood Control District, Urban Water Resources Research Council (UWRRC) of ASCE, Office of Water, US Environmental Protection Agency (URS/EPA) (1999). Development of Performance Measures Task 3.1 – Technical Memorandum Determining Urban Stormwater Best Management Practice (BMP) Removal Efficiencies. Washington, D.C.: Author.

U.S. Geological Survey (USGS). (1980). Water Resources Division by Office of Water Quality (OWQ) Technical Memorandum No. 80.17.

U.S. Geological Survey (USGS). (1991) U.S. Geological Survey, Techniques of Water-Resources Investigations Reston, Virginia. D.R. Helsel and R.M. Hirsch.

Revision History

Original

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	



340 MAPLEVIEW RD
BARRIE, ON, CANADA

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

- CHAMBERS SHALL BE STORMTECH MC-3500.
- CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
- CHAMBERS SHALL BE CERTIFIED TO CSA B184, "POLYMERIC SUB-SURFACE STORMWATER MANAGEMENT STRUCTURES", AND MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
- CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
- THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE CSA S6 CL-625 TRUCK AND THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
- CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
- REQUIREMENTS FOR HANDLING AND INSTALLATION:
 - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
 - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 75 mm (3").
 - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 23° C / 73° F), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
- ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
 - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
 - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
 - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
- CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

- STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
- STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
- CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
 - STONESHOOTER LOCATED OFF THE CHAMBER BED.
 - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
 - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
- THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
- JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
- MAINTAIN MINIMUM - 150 mm (6") SPACING BETWEEN THE CHAMBER ROWS.
- INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 300 mm (12") INTO CHAMBER END CAPS.
- EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE WELL GRADED BETWEEN ¾" AND 2" (20-50 mm).
- STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
- THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
- ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

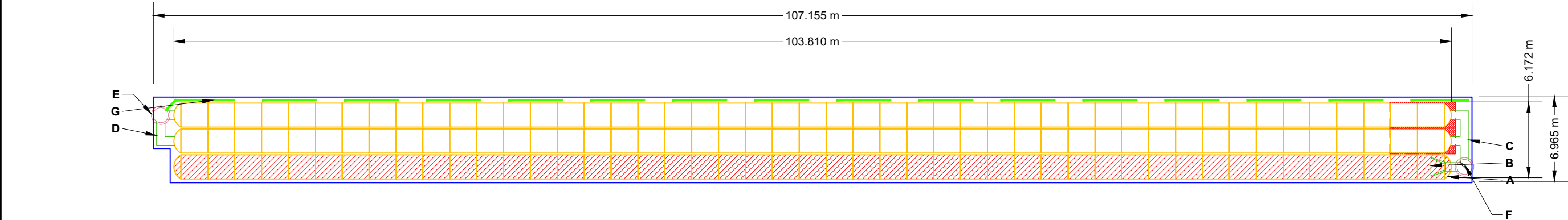
NOTES FOR CONSTRUCTION EQUIPMENT

- STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
- THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
 - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
 - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
 - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
- FULL 900 mm (36") OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

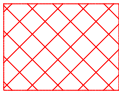
USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT		CONCEPTUAL ELEVATIONS		*INVERT ABOVE BASE OF CHAMBER				
				PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
141	STORMTECH MC-3500 CHAMBERS	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	3.810	PREFABRICATED END CAP	A	600 mm BOTTOM CORED END CAP, PART#: MC3500IEPP24BC / TYP OF ALL 600 mm BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	52 mm	
6	STORMTECH MC-3500 END CAPS	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	1.981		B	INSTALL FLAMP ON 600 mm ACCESS PIPE / PART#: MCFLAMP		
305	STONE ABOVE (mm)	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	1.829		C	600 mm x 600 mm BOTTOM MANIFOLD, ADS N-12	52 mm	
229	STONE BELOW (mm)	MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	1.829	FLAMP	B	INSTALL FLAMP ON 600 mm ACCESS PIPE / PART#: MCFLAMP		
40	STONE VOID	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	1.829	MANIFOLD	C	600 mm x 600 mm BOTTOM MANIFOLD, ADS N-12	52 mm	
762.8	INSTALLED SYSTEM VOLUME (m³) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)	TOP OF STONE:	1.676	MANIFOLD	D	600 mm x 600 mm BOTTOM MANIFOLD, ADS N-12	52 mm	
		TOP OF MC-3500 CHAMBER:	1.372	CONCRETE STRUCTURE	E	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		396 L/s OUT
		600 mm x 600 mm BOTTOM MANIFOLD INVERT:	0.281	CONCRETE STRUCTURE	F	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		481 L/s IN
		600 mm x 600 mm BOTTOM MANIFOLD INVERT:	0.281	W/WEIR				
742.5	SYSTEM AREA (m²)	600 mm ISOLATOR ROW PLUS INVERT:	0.281	UNDERDRAIN	G	150 mm ADS N-12 DUAL WALL PERFORATED HDPE UNDERDRAIN		
228.2	SYSTEM PERIMETER (m)	600 mm BOTTOM CONNECTION INVERT:	0.281					
1351	THERMOPLASTIC LINER (m²) (20% OVERAGE)	BOTTOM OF MC-3500 CHAMBER:	0.229					
		UNDERDRAIN INVERT:	0.000					
		BOTTOM OF STONE:	0.000					



- 

ISOLATOR ROW PLUS
(SEE DETAIL)
- 

PLACE MINIMUM 5.334 m OF ADSPLUS175 WOVEN GEOTEXTILE OVER
BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR
PROTECTION AT ALL CHAMBER INLET ROWS
- 

THERMOPLASTIC LINER (SEE TECH NOTE #6.50 PROVIDED BY OTHERS /
DESIGN BY OTHERS)

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

340 MAPLEVIEW RD

BARRIE, ON, CANADA

DRAWN: PT

CHECKED: N/A

StormTech®
Chamber System

888-892-2694 | WWW.STORMTECH.COM

4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

SCALE = 1 : 350

SHEET

2 OF 5

DATE

CHK

DRW

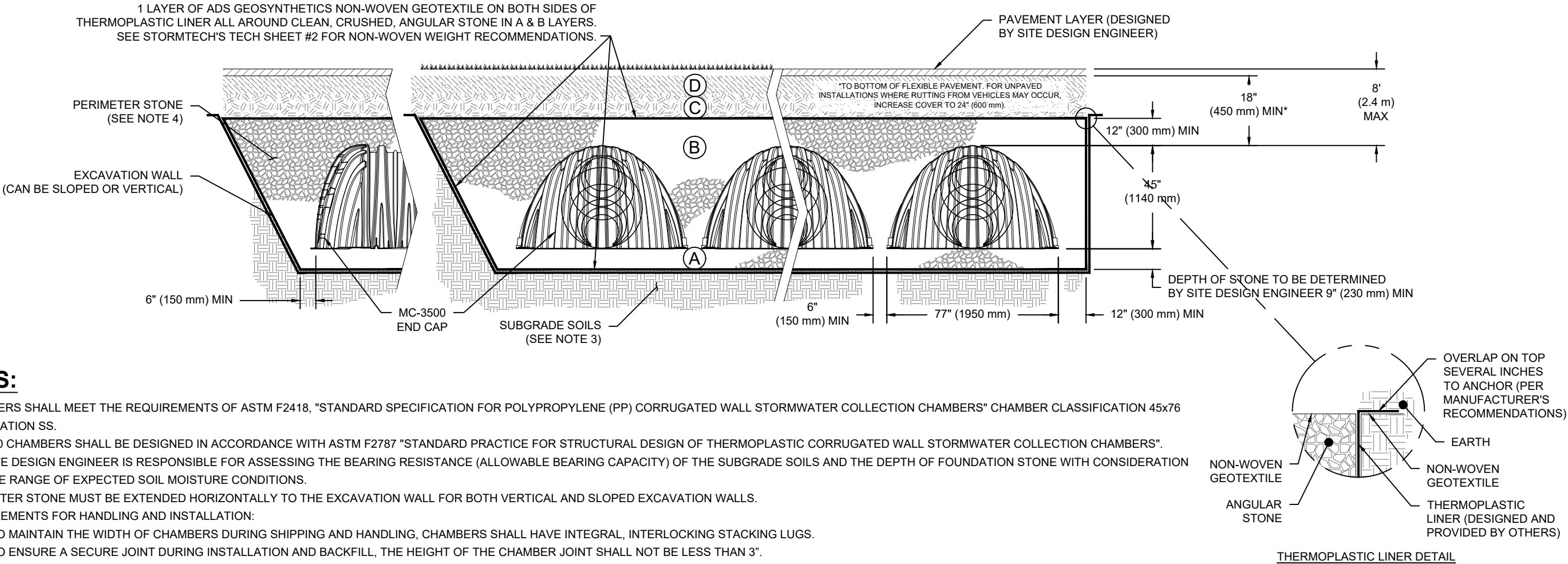
DESCRIPTION

REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	FINAL FILL: FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	INITIAL FILL: FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145 ¹ A-1, A-2-4, A-3 OR AASHTO M43 ¹ 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	EMBEDMENT STONE: FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43 ¹ 3, 4	NO COMPACTION REQUIRED.
A	FOUNDATION STONE: FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43 ¹ 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE. ^{2,3}

- PLEASE NOTE:
- THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
 - STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
 - WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
 - ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

- CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
- MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
- THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
- PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
- REQUIREMENTS FOR HANDLING AND INSTALLATION:
 - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
 - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
 - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT³%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

340 MAPLEVIEW RD

BARRIE, ON, CANADA

DRAWN: PT

CHECKED: N/A

DATE:

PROJECT #:

DESCRIPTION

CHK

DRW

DATE

StormTech®

Chamber System

888-892-2694 | WWW.STORMTECH.COM

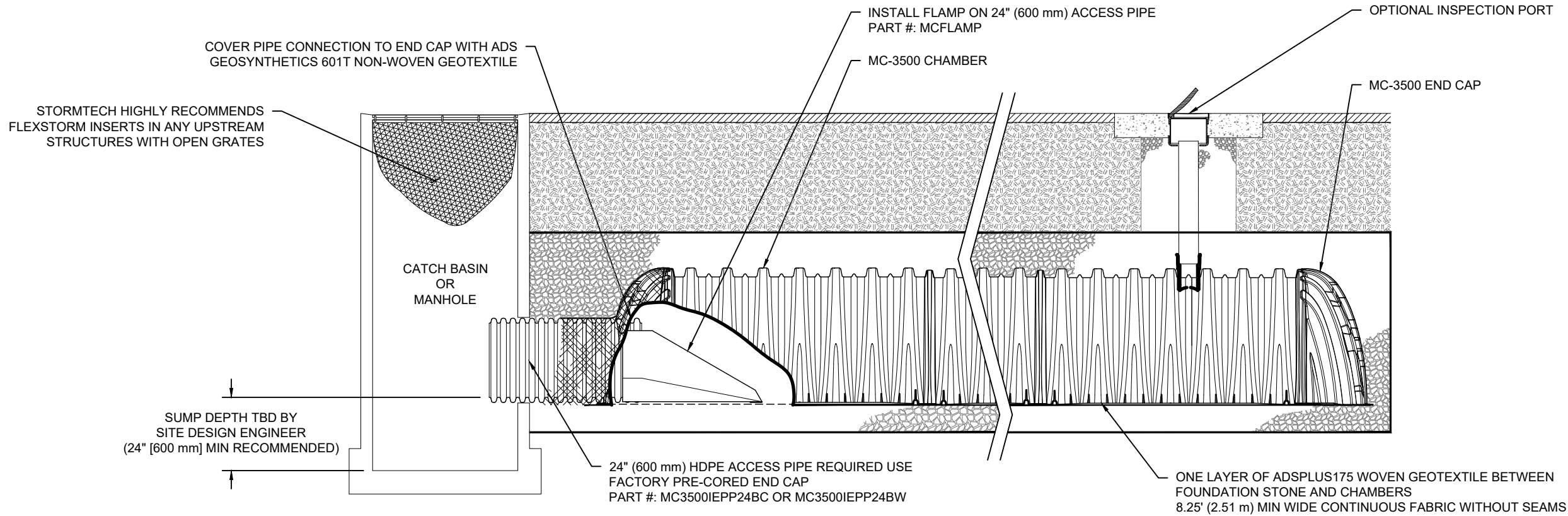
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

ADS

SHEET

3 OF 5

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



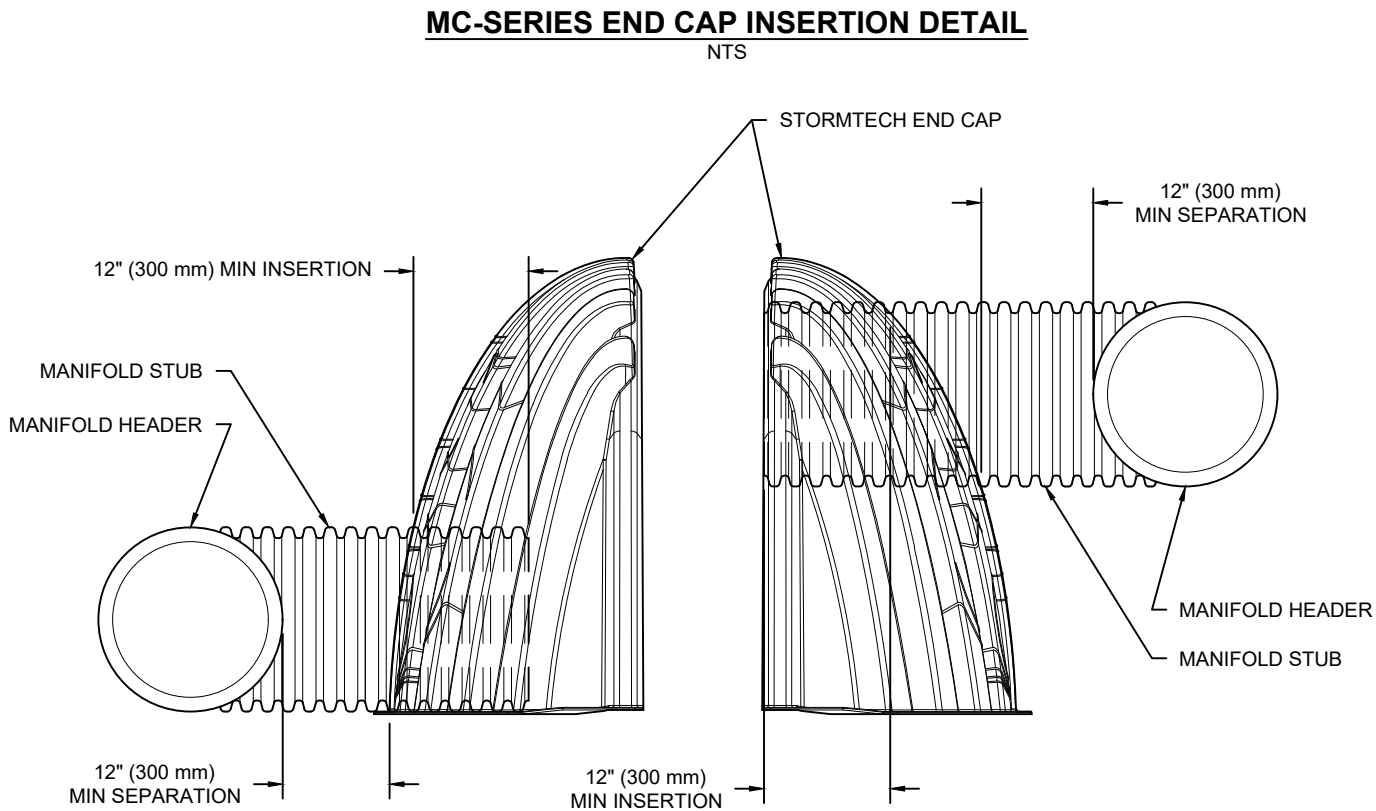
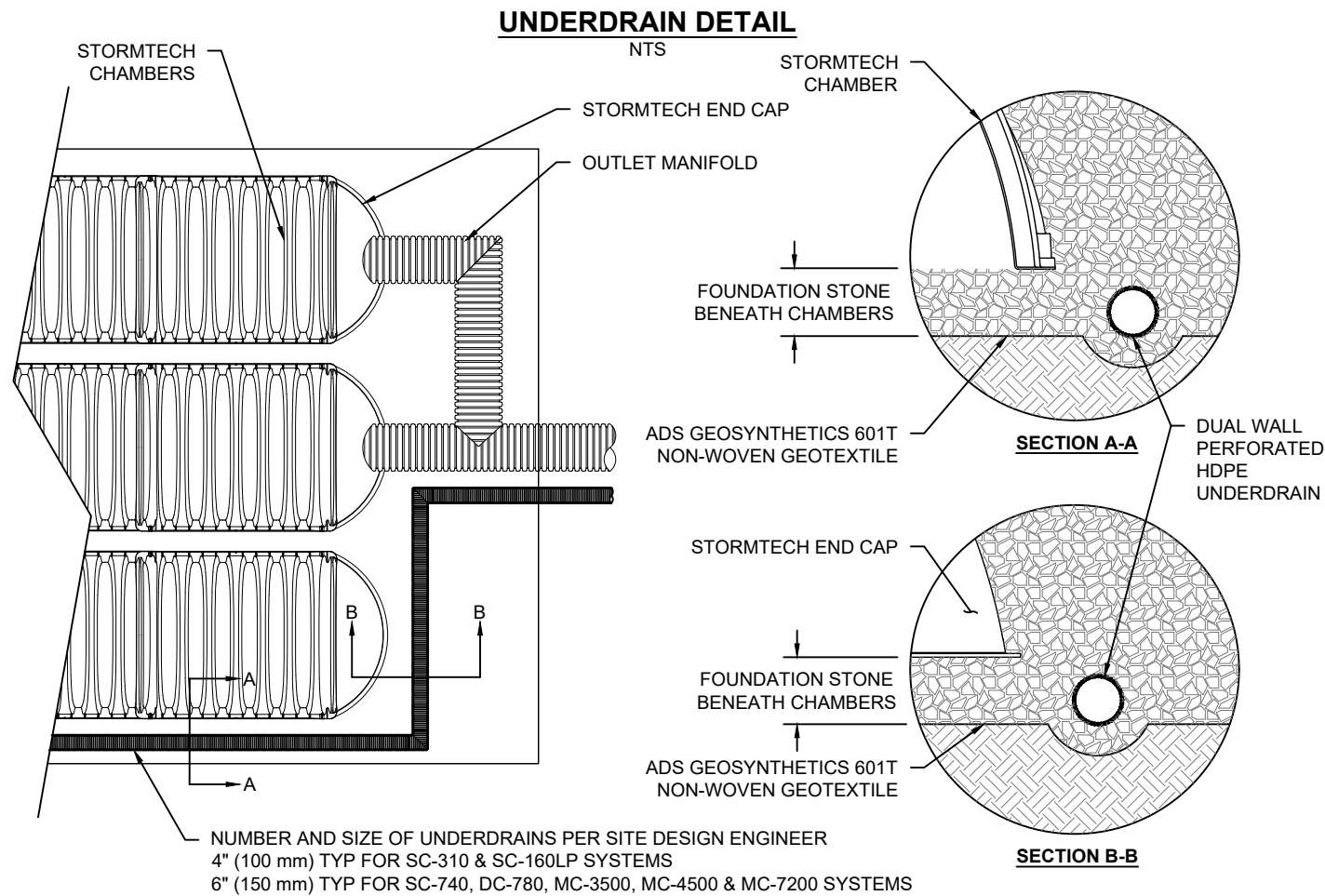
MC-3500 ISOLATOR ROW PLUS DETAIL
NTS

INSPECTION & MAINTENANCE

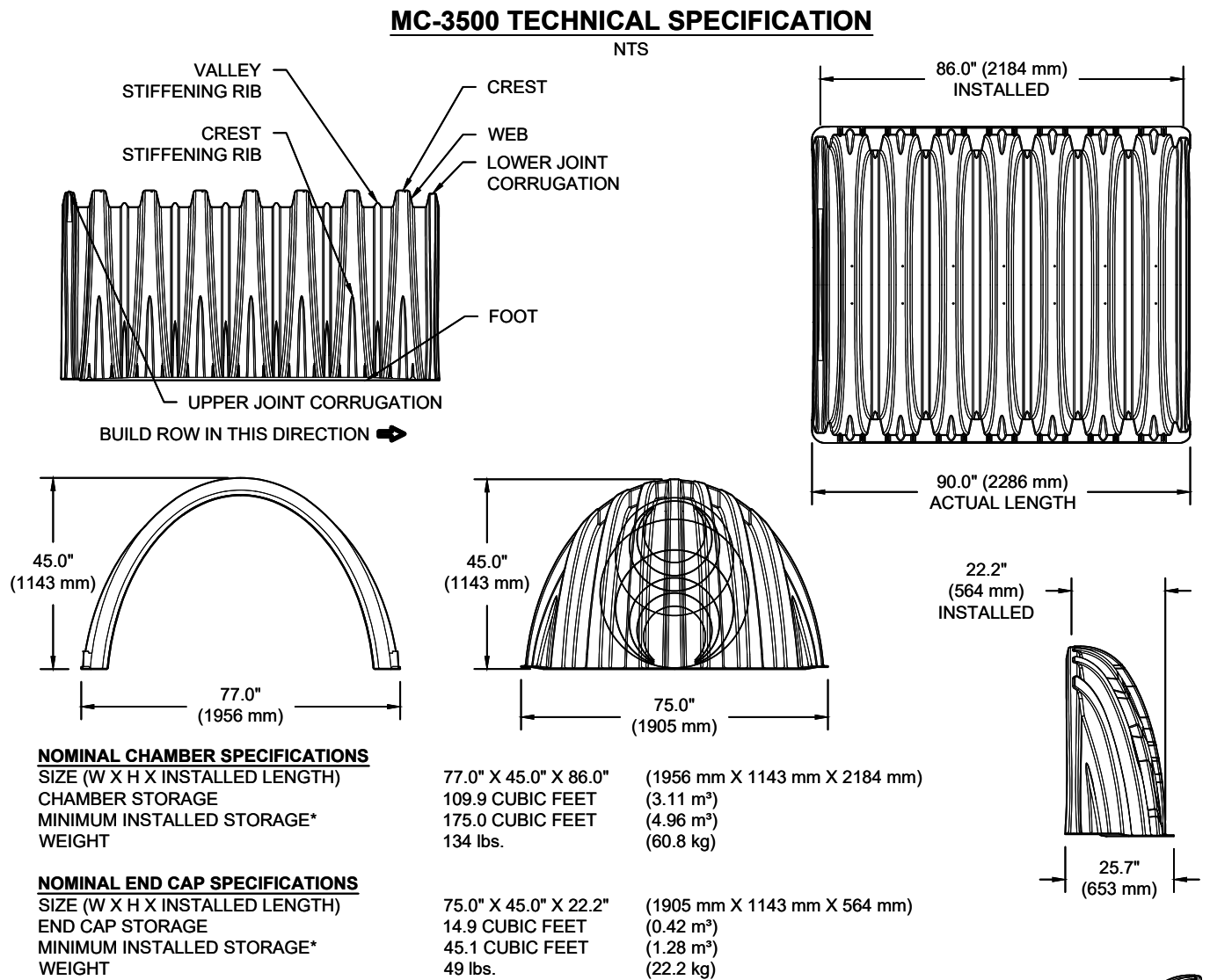
- STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
 - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
 - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
 - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
 - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
 - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
 - B. ALL ISOLATOR PLUS ROWS
 - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
 - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
 - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
 - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
 - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
 - B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
 - C. VACUUM STRUCTURE SUMP AS REQUIRED
- STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.
- STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.



*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" SPACING BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18TW		---	1.77" (45 mm)
MC3500IEPP18BC			
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW		---	2.06" (52 mm)
MC3500IEPP24BC			
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL

CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

340 MAPLEVIEW RD

BARRIE, ON, CANADA

DRAWN: PT

CHECKED: N/A

DATE:

PROJECT #:

DESCRIPTION

CHK

DATE

DRW

StormTech®
Chamber System

888-892-2694 | WWW.STORMTECH.COM

4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

ADS

SHEET

5 OF 5

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



7.0 GUIDELINES FOR HYDROLOGIC AND HYDRAULIC ANALYSES

The guidelines in this section provide some direction for completing hydrologic and hydraulic studies for submission to and review by the City of Barrie. Prior to undertaking hydrology and hydraulic modeling work, the City of Barrie Infrastructure Department shall be contacted to confirm the use of an approved and appropriate software package. A number of relevant sample problems and calculations are provided in **Appendix C**.

7.1 Rainfall Data

7.1.1 City of Barrie IDF Curves

Until the Regional Intensity-Duration-Frequency (IDF) curves are available, stormwater management facilities should be designed based on the most current IDF tables developed by Environment Canada for Barrie including a 15% increase in rainfall intensity data to account for impacts due to climate change. The Chicago distribution parameters for different return periods provided in **Table 7.1** should be used for modeling purposes.

Table 7.1: Barrie WPCC IDF Curve Parameters - Adjusted to Account for Climate Change (REVISED)

Parameter	Return Period					
	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
A	675.586	843.019	976.898	1133.123	1251.473	1383.628
B	4.681	4.582	4.745	4.734	4.847	4.905
C	0.780	0.763	0.760	0.756	0.753	0.754

Rainfall Intensity, I (mm/hr) = $A/(t+B)^C$, where t is time duration in minutes

Parameters based on rain gauge data for the period 1979 – 2003 for the Barrie WPCC Station #6110557

Based on a review of the literature, the IDF intensity values for Barrie WPCC Station were increased by 15% before calculating a , b , c values to account for climate change.

7.1.2 Return Period Design Storms and Regional Storm

1: 2 year, 1:5 year, 1:10 year, 1:25 year, 1:50 year, 1:100 year and the Regional Storms shall be applied for quantity control and the 25 mm 4-hour Chicago storm shall be applied for erosion control as required. In order to determine the critical design storms, the SCS Type II (6-hr, 12-hr and 24-hr durations) and the 4-hour Chicago storm distributions for the 1:2 year through 1:100 year return period shall be applied.

Unless otherwise directed by the City, Hurricane Hazel shall be applied throughout the City as the Regional storm for the sizing of municipal infrastructure associated with storm drainage and stormwater management. It should be noted, however, that either the Timmins storm or



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	33,352 m ²	3.34 ha
TOTAL	33,352 m ²	3.34 ha

4. Post-Development Coverage

Area Covered by Building with Additions	9,935 m ²	0.99 ha
Area Covered by Hard Surface Paving	13,049 m ²	1.30 ha
Area Covered by Landscaped Area	10,368 m ²	1.04 ha
TOTAL:	33,352 m ²	3.34 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)	33,352	30,484	18,177		4,169	8,138
TOTAL	25,623	30,484	18,177	0	4,169	8,138

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)	9,935	9,081	-	-	-	9,081
Hard Surface Paving	13,049	11,927	-	-	-	11,927
Landscape Area (entire site)	10,368	9,476	5,651	-	1,296	2,530
TOTAL	33,352	30,484	5,651	0	1,296	23,537

7. Comparison of Pre-Development (before building 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	30,484	18,177	-	4,169	8,138
Post-Development	30,484	5,651	-	1,296	23,537

2,873

8. Requirement for Infiltration of Roof Runoff

Volume of roof (building additions) run-off captured (90%)	9,081 m ³
Volume of post-development infiltration without roof run-off	1,296 m ³
Volume of roof run-off required to match pre-development infiltration rates	2,873 m ³
Percentage of roof run-off (building additions roof) required to match pre-development infiltration	32%



LEGEND

- PROPOSED DEVELOPMENT AREA
- MONITORING WELL/BOREHOLE BY GROUND
- GUELPH PERMEAMETER TESTS COMPLETED BY GROUND

Note

Reference

Conceptual Grading Plan, dated Feb 28, 2023, Received on April 17, 2023, prepared by Counterpoint Engineering Inc.

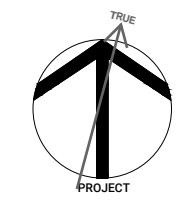
Project

**338 MAPLEVIEW DR E
BARRIE, ON**

Figure Title

**BOREHOLE LOCATION
PLAN - PROPOSED
CONDITIONS**

North



Date

APRIL 2023

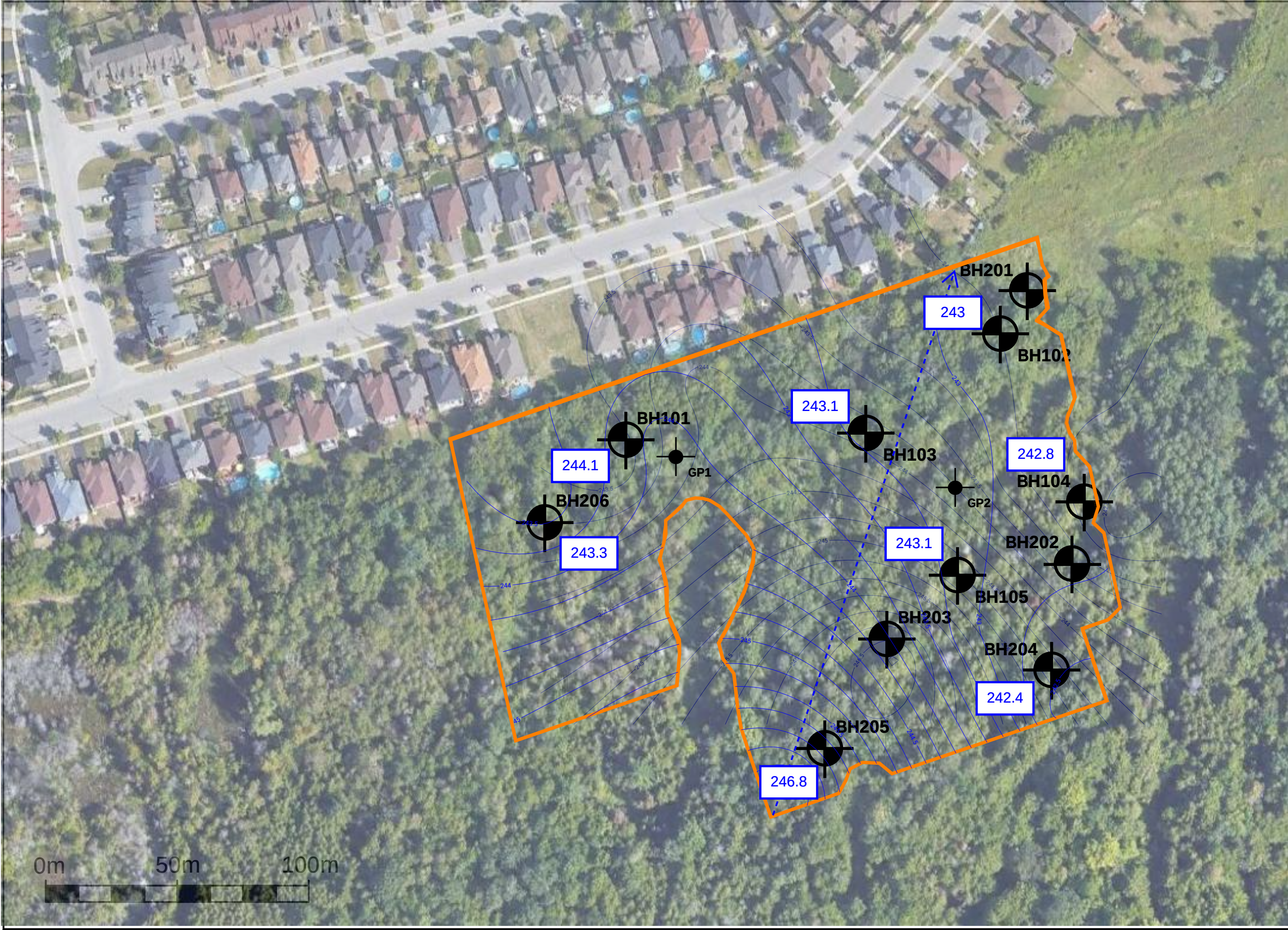
Scale

Job No

20-295

Figure No

FIGURE 3





**GROUND
ENGINEERING**

1 BANIGAN DRIVE, TORONTO, ONT., M4H 1G3
www.groundedeng.ca

LEGEND

- PROPOSED DEVELOPMENT AREA
- MONITORING WELL/BOREHOLE BY GROUNDED
- GUELPH PERMEAMETER TESTS COMPLETED BY GROUNDED
- 119.4 MARCH 3, 2023 GROUNDWATER ELEVATIONS (masl)
- 119.4 GROUNDWATER CONTOURS (masl)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

Note

Reference

Google Earth Pro 2023

Project

**338 MAPLEVIEW DR E
BARRIE, ON**

Figure Title

**GROUNDWATER ELEVATIONS
AND GROUNDWATER FLOW
DIRECTION**

North



Date

Scale

AS INDICATED

Job No

20-295

Figure No

FIGURE 6A



assessment. Grounded advanced three new monitoring wells in February of 2023 and collected water levels from the existing and newly installed wells on March 3, 2023. Water level data is presented in Appendix M.

Observations pertaining to the depth of the water level and caving were made in the open boreholes immediately after completion of drilling and are reported on the borehole logs. The measured water level along with other boreholes detailed are presented in Appendix F. Groundwater levels collected to date are summarized in the following table:

Groundwater levels may be influenced by climatic variations, seasonal fluctuations, and presence of underground services and structures.

The groundwater table within the Development Limit ranges from approximately elev. 242.4 ± masl to elev. 246.8 ± masl. Groundwater at the Development Limit generally follows the topographic contours of the site, flowing eastward towards Lovers Creek.

For design purposes, and to account for seasonal fluctuations in the groundwater table, the design water table is the maximum groundwater levels observed to date in order to represent the seasonally high water table within/near each of the development blocks. The following **design water table elevations** should be assumed:

Block	Relevant Monitoring Wells	Design Groundwater Table (masl)
1	BH101	244.1
2	BH101	244.1
3	BH103	243.1
4	BH102	243.0
5	BH104	242.8
6	BH103	243.1
7	BH206	243.3
8	BH206	243.3
9	BH105	243.1
10	BH105	243.1
11	BH105	243.1
12	BH205	246.8
13	BH205	246.8
14	BH205	246.8
15	BH204	242.4
16	BH204	242.4
17	BH204	242.4



Block	Relevant Monitoring Wells	Design Groundwater Table (masl)
18	BH104	242.8
19	BH104	242.8
20	BH102	243.0

2.11 Groundwater Quality

Groundwater samples were obtained from one monitoring well on-site and submitted for laboratory analysis on September 29, 2021. All the monitoring wells were screened in the overburden materials. Each sample was analyzed with respect to the City of Barrie Sewer Use bylaw. The result of the groundwater testing is presented in Appendix H and summarized below.

City of Barrie Bylaw	Exceedance
Table 1 –Storm Sewer Discharge Criteria	None
Table 2 - Sanitary Discharge Criteria	None

2.12 Hydraulic Conductivity

In-situ single well response tests (SWRT) were conducted in five (5) of the monitoring wells (BH101 to BH105) on June 7, 2021 to assess the hydraulic conductivity of the underlying soil. The monitoring wells were installed in the clayey silt and lower sand glacial till. The tests were conducted by drawing down the water levels (rising head test).

Data from the SWRT were analyzed using Bouwer and Rice. The table below summarized the results of the hydraulic conductivity testing. The analysis graphs of the tests are presented in Appendix I.

Monitoring Well	Hydraulic Conductivity (m/sec)	Well Screen Strata
BH101	1.43×10^{-7} m/sec	Lower Silty Sand Glacial Till
BH102	1.42×10^{-8} m/sec	Upper Silty Sand Glacial Till
BH103	4.71×10^{-7} m/sec	Clayey Silt
BH104	3.23×10^{-8} m/sec	Lower Silty Sand Glacial Till
BH105	8.48×10^{-9} m/sec	Lower Silty Sand Glacial Till