FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

375 KINGSTON ROAD
CITY OF PICKERING

PROJECT 2021-5093 **DECEMBER 2021**

Revision	Description	Prepared		Checked	
		By	Date	By	Date
0.	1st Submission	J.P.	Dec 2021	K. Sh.	Dec 2021

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CONSULTING ENGINEERS
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Concord, Ontario L4K 4R3

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1 INTRODUCTION

1.1 Scope and Purpose

Schaeffer and Associates Ltd. (SCE) has been retained to provide a Functional Servicing and Stormwater Management Report in support of the proposed residential condominium development at 375 Kingston Road in the City of Pickering.

The objective of this report is to provide a stormwater, water supply and sanitary sewer servicing plan based on the City of Pickering and Durham Region Design Criteria.

1.2 Subject Site Location

The site is approximately 0.85ha and bound by Kingston Road to the north and Rougemount Drive to the west with the Highway 401 corridor located on the south. A site location plan is provided in **Figure 1.1**.

1.3 Proposed Development Plan

It is proposed that the subject land will be developed into a mixed-use development consisting of two high-rise residential towers with a total of 580 units and 1,532m^2 GFA of retail space. Building A is proposed to be a 25-storey tower and Building B is proposed to be a 31-storey tower. Reference can be made to **Figure 1.2** for the proposed development plan.

1.4 Existing Site Conditions

The site currently consists of a commercial complex with mostly paved asphalt parking area. Numerous trees are present to the south of the site. The site's existing conditions are graded to slope in a south-easterly direction.

W:\5000's\5093\Drawings\Services\2021-11-15-5093-Services.dwg

Phil Gotfried

CITY OF PICKERING

LEGEND

SUBJECT SITE LOCATION

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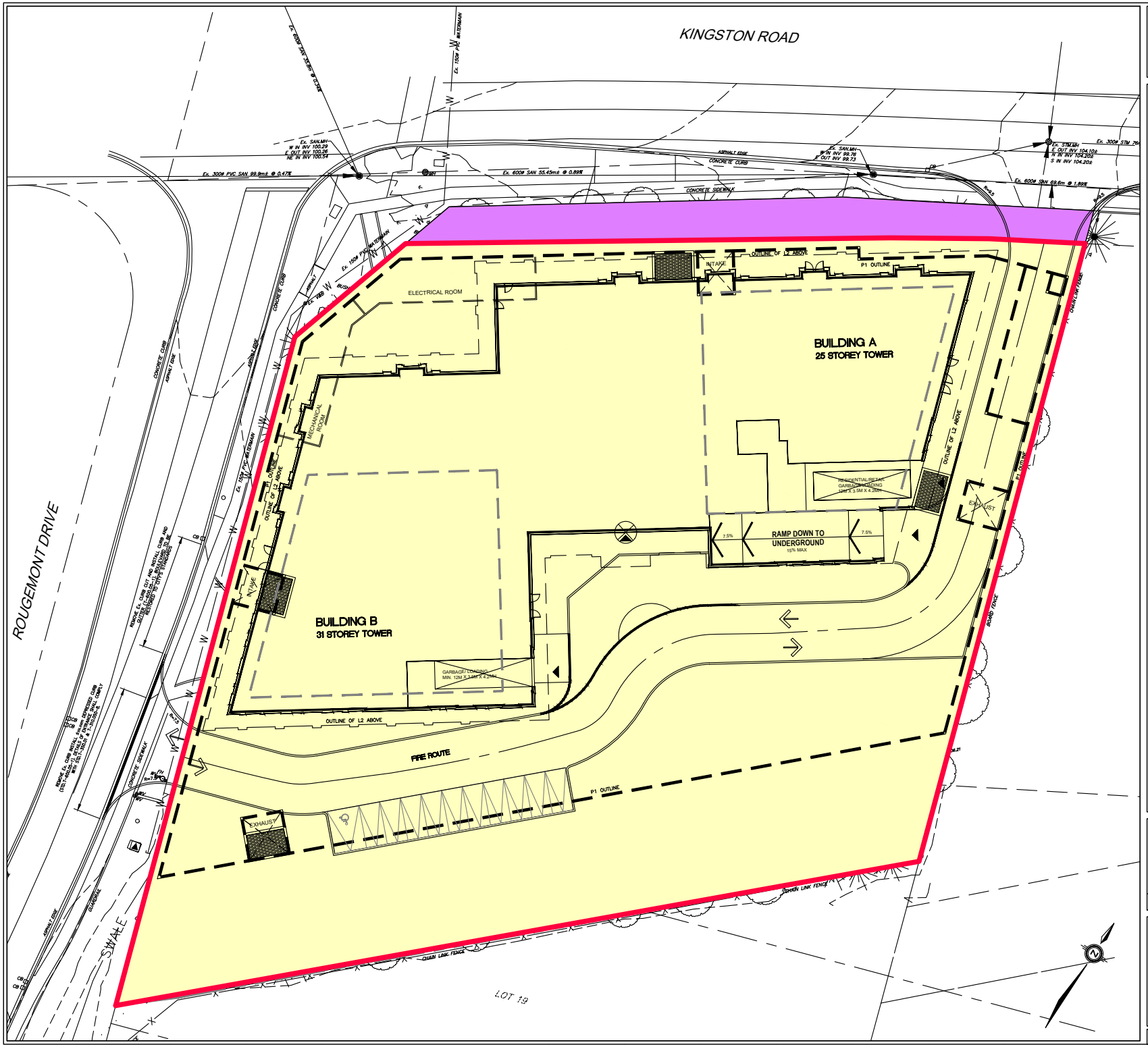
FIGURE 1.1
LOCATION PLAN

2021-5093	NOVEMBER 2021	SCALE: N.T.S.



CITY OF PICKERING

LEGEND

SUBJECT SITE
DEVELOPABLE AREA

ROAD WIDENING

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FIGURE 1.2
PROPOSED SITE PLAN

2021-5093	NOVEMBER 2021	SCALE: N.T.S.

2 STORMWATER MANAGEMENT

2.0 Existing and Proposed Storm Infrastructure

A 300mmØ storm sewer exists to the north of the site along Kingston Road. The existing site is currently serviced by this sewer. Drainage within the site is picked up by a 300mmØ storm sewer along the site's east boundary, which drains to the municipal sewers on Kingston Road. The existing site is composed of predominantly paved commercial parking and roof area, and stormwater management controls, which exist on site as per the Stormwater Detention Facilities Rougemount Drive – Commercial Development report from the City of Pickering. The existing and proposed stormwater infrastructures are illustrated in **Figure 2.1**.

2.1 Stormwater Design Criteria

As per the City of Pickering's Design Criteria and the Region of Durham Stormwater Management Criteria, the following guidelines were used in the design calculations:

- Storm sewers shall be designed to convey at least the 5-year return frequency storm without any surcharging during any storm return frequency event;
- Minimum pipe diameter for storm sewers is 300mmØ;
- Storm sewers shall be designed using Rational Formula: Q = 0.00278x C x I x A, where Q is the flow rate in [m^3/s], C is the runoff coefficient (dimensionless) for 2, 5 and 10- year storm frequencies. For less frequent storms an Antecedent Precipitation Factor (Ca) should be used and Rational formula is modified accordingly to: Q = 0.00278 A x I x Ca x C where, 'Ca' values are listed below:
    - 1-to-10-year storm – Ca = 1.00
    - 25-year storm - Ca = 1.10
    - 50-year storm - Ca = 1.20
    - 100-year storm - Ca = 1.25 and the product of 'Ca x C' should not exceed 1.00.
- 'A' is area in [ha] smaller than 40 hectares, 'I' is the rainfall intensity in mm/hr.
- Design storms should be derived from the City of Pickering Rainfall Intensity-Duration Frequency: $I = A/ (Tc+B)^C$, where I is rainfall intensity in [mm/hr] and Tc is time of concentration in minutes (10 minutes),
- Enhanced stormwater quality control must be provided for the site (removal of 80% of TSS for 90% of the cumulative annual runoff);

- First 5 mm of rainfall shall be retained on site.

2.2 Proposed Stormwater Management Scheme

The proposed development will have its stormwater management scheme designed to meet quantity, quality and water balance requirements. To meet quantity control targets, an underground storage tank is proposed for Building A, which will control storm events from the 2 – 100-year return period. The release rates and storage volumes have been discussed in the subsequent sections.

To provide water quality controls, flows will be treated using an on-site jellyfish unit to provide an enhanced level of treatment. Additionally, 5mm retention will be provided through the use of on-site rainwater harvesting tanks in order to meet water balance and erosion requirements. Clean water collected by these tanks will be utilized in a maximum of 72 hours. The site's stormwater management system has been discussed in further detail throughout the following sections. Please refer to **Figure 2.1** for the proposed storm water infrastructure.

2.2.1 Allowable Release Rate

The City has provided information to SCE regarding the previous considerations for the subject site. Based on the given documents, the site was originally designed to consider a pre-development drainage area of approximately 0.082 ha. In this original design, a release rate of 28.5 L/s was considered from this site with a runoff coefficient of 0.90 and an intensity of 138 mm/hr (based on the 10-year design storm). Please note that this release rate considered the old City of Pickering design criteria, where the City's 10-year design storm was used.

As per the current criteria, storm sewers are to be sized based on the 5-year storm event. Furthermore, the current drainage area of the subject site to the Kingston Road sewer has significantly increased from the pre-development condition to approximately 0.75 ha. Using the existing site area with a pre-development runoff coefficient of 0.5, the allowable release rate from the site would be 106 L/s based on the current criteria. However, since the downstream storm sewers have been designed based on a maximum release rate of 28.5 L/s, and this rate is smaller than the 5-year pre-development condition, 28.5 L/s will be considered as the allowable release rate from the site.

Please refer to **Appendix D** for more details on the City's background information provided to SCE.

2.2.2 Quantity Control

As discussed in the previous section, an allowable release rate of 28.5L/s has been considered from the subject site. In the post development condition, the proposed controlled area is 0.85ha, with an expected runoff coefficient of approximately 0.85. Based on the proposed controlled area and maximum allowable release rate, a rational method analysis was conducted and estimates a required storage of approximately 383 m^3. It is to be noted that this requirement includes consideration for groundwater. A groundwater allowance of 3 L/s has been considered from the site to the storm sewer. Once the Hydrogeological Report has been finalized, the groundwater allowance to the storm sewer will be revised accordingly.

Due to grading constraints and the depth of the existing sewer on Kingston Road, a gravity storage solution will not be possible. As a result, the proposed detention volumes will be required to be pumped up to a stabilization chamber where flows to the storm sewer south of Kingston Road will be controlled by an orifice control structure. A minimum acceptable orifice plate size of 185mmØ will require 0.15 m of head to achieve the allowable release rate. An overflow weir will be provided within the stabilization chamber in order to regulate flows through the orifice to within the maximum release rate to the municipal storm sewer.

For detailed storage and quantity control calculations please refer to calculations presented in **Appendix A**.

2.2.3 Quality Control

Quality control for the site is proposed to be provided by an on-site jellyfish unit located within the sewers along the eastern boundary of the site. The filtration unit was sized for an area of 0.85 ha and an imperviousness of 85%. A Jellyfish **JF6-5-1** model (or approved equivalent as accepted by the City and Conservation Authority) is expected to be required to provide an enhanced water quality control (80% TSS removal) to 90% of site annual runoff flows. Preliminary sizing of the proposed Jellyfish unit is provided in **Appendix A**.

2.2.4 Water Balance/Erosion Control

Based on the Ontario Source Protection Atlas the subject site was found to not be located within a WHP-Q1/Q2 area. However, as per the City of Pickering criteria, the subject site requires the retention of the first 5 mm of runoff through either infiltration, evaporation, or rainwater re-use to reduce runoff volumes to receiving waters. To comply with the criterion mentioned above, it is

required to retain **39.5 m³** (i.e., 5 mm x 0.85 ha x 93% (imperviousness) x 10 = 39.5 m^3) of water for the site and this water will be re-used for irrigation.

All retention water will be stored in a water re-use tank. The tank will collect clean water from clean site surfaces, such as the proposed podium and roof areas on-site. During large rainfall events, excess flows will be allowed to spill to the primary detention storage tank via an overflow weir. Water that is detained by the proposed rainwater harvesting tank will be stored for a maximum 72 hours and re-used for a variety of purposes including site irrigation, mechanical cooling or greywater. The final re-use methods will be confirmed during the detailed design stage.

2.2.5 Groundwater Considerations

As previously discussed, a Hydrogeological Report is to be completed to determine the long-term discharge from the subject site to the storm sewer system. To be able to conservatively size the SWM storage tank, a groundwater allowance of 3 L/s has been considered in this report. Once the Hydrogeological Report has been finalized, the groundwater allowance to the storm sewer can be revised accordingly.

Note that any required site groundwater treatment system should be provided prior to discharging any groundwater flows to the downstream detention storage tank. Any provided groundwater treatment system shall be designed by a filtration specialist, and should ensure that groundwater discharge remains within the City of Pickering's water quality standards for storm sewers.

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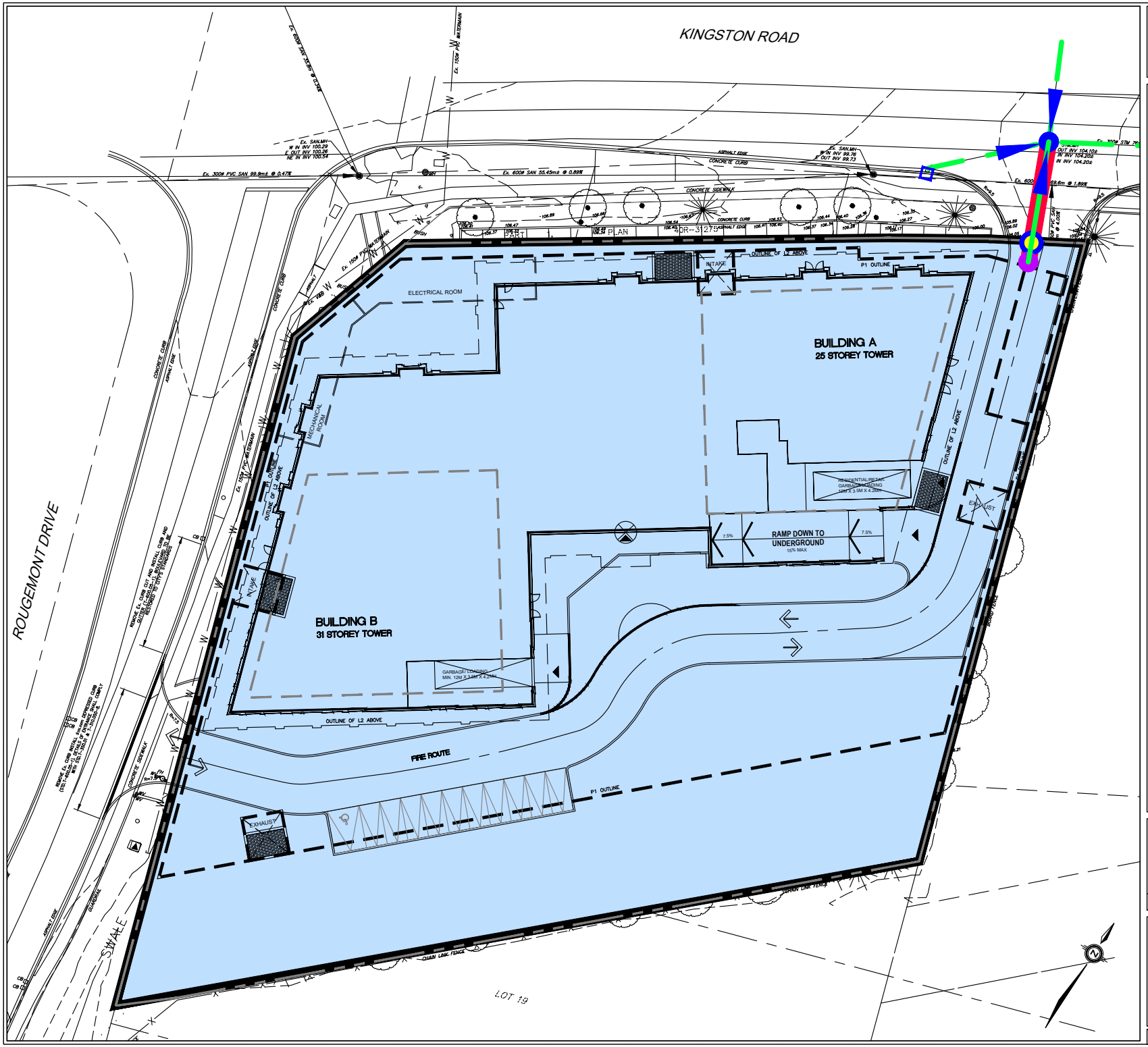

CITY OF PICKERING

LEGEND

- SUBJECT SITE
- PROPOSED STORM SEWERS
- EXISTING STORM SEWERS
- PROPOSED CONTROL MANHOLE
- PROPOSED JELLYFISH
- CONTROLLED DRAINAGE AREA
  AREA = 0.80 ha
  RUNOFF COEFFICIENT = 0.85

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FIGURE 2.1
STORM SERVICING PLAN

2021-5093	NOVEMBER 2021	SCALE: N.T.S.

3 SANITARY SERVICING

3.0 Existing Sanitary Servicing

An existing 600mmØ sanitary sewer lies north of the site along Kingston Road, which routes easterly. The site also has a 300mmØ sanitary sewer on the eastern boundary, which drains northerly into the 600mmØ sewer on Kingston Road.

3.1 Sanitary Design Criteria

As per the Regional Municipality of Durham's Design Criteria for Sanitary Sewers, the following

Average Flow

- Daily flows of 364 L/cap/d;

Infiltration

- 22.5 m^3/gross ha/day - when foundation drains are not connected to the sanitary sewer
- 45.0 m^3/gross ha/day - when foundation drains are connected to sanitary sewers
- (in accordance with Region of Durham policy).
- An infiltration rate of 0.26 L/s/ha.

Peaking Factor

- K = 1 + (14 / (4 + P0.5))
- Where K = Harmon Peaking Factor and P = Population in thousands
- K-Maximum = 3.8, K-Minimum = 1.5
- Calculation of population for the proposed development shall be based on the following:
  Apartment(s)
  - 1 Bedroom or smaller (Bachelor) 1.5
  - 2 Bedroom 2.5
  - 3 Bedroom 3.5
  - 4 Bedroom or larger 4.5

  Commercial
  - Design Flow: 180 m^3 /gross floor area ha/day including infiltration and peaking effect.

3.2 Proposed Sanitary Servicing Plan

The site will be serviced via connection to the existing 600mmØ sanitary sewer on Kingston Road. The residential population of the subject site is estimated to be 1,096 people. Based on the Durham design criteria of 364 L/cap/day and Harmon Peaking Factor formula of $K_H = 1+14/(4+(P)^{0.5})$, the estimated peak sanitary flow from the total site is calculated to be **17.96 L/s**. Please refer to **Appendix B** for detailed sanitary flow calculations. A detailed plan of the existing and proposed sanitary servicing can be seen on **Figure 3.1**.

Table 3-1: Proposed Sanitary Peak Flow

Category	Design Parameter	Sanitary Demand	Average Demand (L/s)	M	Infiltration (L/s)	Total Peak Flow (L/s)
Residential	1,096 people	364 L/cap/day	4.62	3.77	0.22	**17.65**
Commercial	0.15 ha	180,000L/cap/ha	0.32	-	-	**0.32**
Total						**17.96**

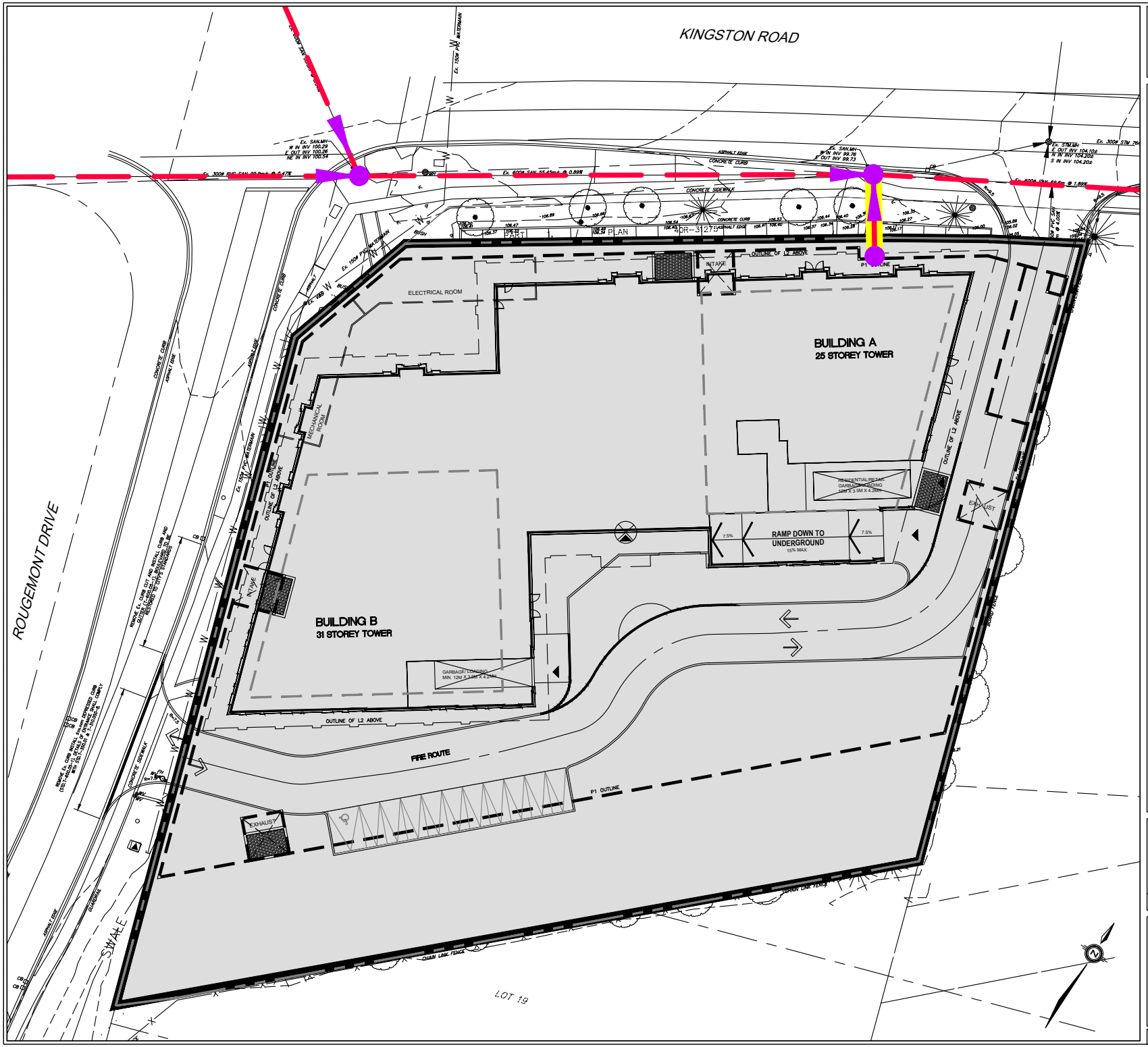
3.0 Downstream Sanitary Sewer Assessment

A downstream sanitary sewer assessment has been completed by SCE to determine the capacity within the system from the proposed development to the outlet location. This analysis has been completed using theoretical design sheets. The Region's design criteria has been considered to analyze the downstream sewers during Dry Weather Flow (DWF) conditions. Furthermore, the City of Pickering's current development proposals have been reviewed and included in the pre-development condition scenario to reflect the conditions prior to the construction of the proposed development. The pre-development condition scenario has been used as a baseline to determine the capacity of the system under the post-development condition.

Reference can be made to **Appendix B** for the design sheet analysis and associated figures. Based on the results from the analysis, several surcharge conditions have been found in the system during the pre-and post-development conditions downstream of the Kingston Road and Rosebank Road intersection. The majority of these conditions continue through the valley to Beachpoint Promenade. Furthermore, an HGL analysis has also been completed to determine the status of the freeboards within the system. Typically, a freeboard of less than 1.8m is anticipated to cause a risk to basement flooding for the properties connected to the sewer with this issue. The pre-and post-development condition analyses indicate seven HGL issues where the freeboards are less than 1.8m within the valley area.

Considering the proposed development and the currently anticipated development proposals within the sewer system, the post-development condition analysis indicates that approximately 31 sewers will be required to be upgraded to eliminate the surcharge conditions. In the event, the Region permits these surcharges, and not the HGL issues, then only seven pipes will require upgrades to improve the freeboards with less than 1.8m freeboard. **Figure B-1** and **Figure B-2** in **Appendix B** illustrate the surcharge and HGL issues found within the system. It is to be noted that the proposed development and the anticipated development proposals contribute to the increased pressure within the system; therefore, any upgrades constructed within the downstream system can be cost shared between the developers.

It is to be further noted that the Kingston Road intensification is anticipated to be developed within this sewershed area by 2041. Currently, the plan does not include an expected population for the intensification area. However, as the intensification areas within this sewershed area become constructed, the pressure within the system will continue to increase where further upgrades will be required.



CITY OF PICKERING

LEGEND

- SUBJECT SITE
- PROPOSED SANITARY SEWERS
- EXISTING SANITARY SEWERS

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FIGURE 3.1
SANITARY SERVICING PLAN

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4 WATER SUPPLY SERVICING

4.0 Existing Water Supply Servicing

There is currently an existing 150mmØ watermain along Rougemont Drive, which is located on the west side of the property. Reference can be made to **Figure 4.1** for the water supply servicing plan**.**

4.1 Supply Servicing Design Criteria

The following guidelines from the MOE Guidelines for Drinking Water Systems (2008) were used in the design calculations for the water supply:

- an average daily demand of 450 L/Capita/day (residential);
- an average daily demand of 4000 L/day/1000 m² (commercial);
- a maximum day demand factor of 2.75;
- a peak hour demand factor of 4.13;
- a minimum pressure of 275 kPa (40 psi) during the peak hour demand;
- a minimum watermain diameter of 150mmØ;

4.2 Proposed Water Supply Servicing Plan

Two connections are proposed to the existing 150mmØ watermain on Rougemont Drive. The proposed water supply infrastructure is illustrated in **Figure 4.1**. A summary of the required flow demands for the site are provided in **Table 4-1**.

The required fire flow is calculated based on the FUS 2019 Draft guidelines with the following assumptions: non-combustible (construction factor of 0.8), limited combustible occupancy (-15% occupancy factor), NFPA 13 Sprinkler system (-30% sprinkler factor), and an exposure factor of 22% for the three exposed sides. This also assumes protected exterior communications and vertical openings with a fire resistance rating of not less than one hour. Based on the FUS calculation, an estimated fire flow of 9,000 L/min (150 L/s) is required. As per the FUS 2019 Draft guidelines, the building's GFA used for the calculation was based on the largest adjoining floor plus 25% of the next two floors for non-combustible standards.

Due to the height of the proposed buildings the site's mechanical engineer should confirm pressure and to determine if a booster pump is required. The mechanical engineer will be responsible to design the plumbing and booster pump system.

The estimated water demand is determined using the aforementioned criteria and is summarized in **Table 4-1**. The detailed water demand calculations are provided in **Appendix C**.

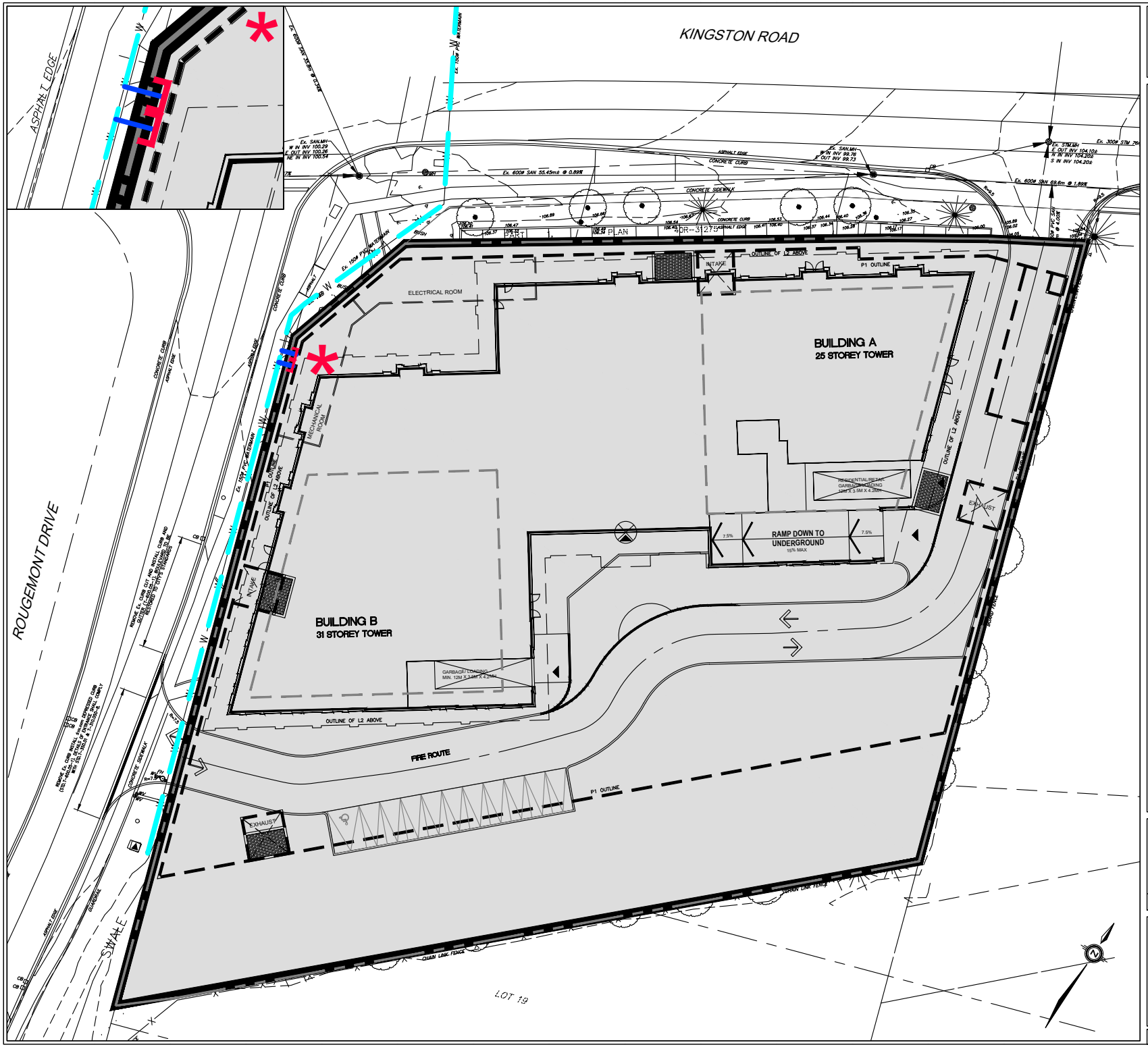
Table 4-1: Estimated Water Supply Demands

Average Day Demand (L/s) [2]	Peak Hour Demand (L/s) [3]	Maximum Day Demand (L/s) [4]	Fire Flow Demand (L/s)	Max Day + Fire Demand (L/s)
5.80	23.94	15.94	150.00	165.94

4.3 Hydrant Flow Test

A hydrant flow test was conducted by Durham Region along Rougemont Drive adjacent to the subject site to verify that sufficient flow and pressures are available for the proposed development. Based on the flow test, the static pressure within Rougemont Drive watermain is **93.2 psi**. The test also indicates that a flow of approximately **232 L/s** is available at the minimum operating pressure of 20 psi (140 kPa). Since this flow is greater than the required max day + fire demand, it is expected that the existing infrastructure will be able to provide sufficient servicing conditions for the proposed development. For detailed hydrant test results and analyses please see **Appendix C**.

Phil Gotfried



CITY OF PICKERING

LEGEND

SUBJECT SITE

PROPOSED WATERMAINS

EXISTING WATERMAINS

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FIGURE 4.1
WATER SUPPLY PLAN

2021-5093	NOVEMBER 2021	SCALE: N.T.S.

5 CONCLUSIONS

The report demonstrates that the servicing plan for the proposed development at 375 Kingston Road is consistent with the City of Pickering and Durham Region Design Criteria. The key points have been summarized as follow:

Stormwater Management Plan

Background information from the City has been collected and reviewed by SCE. This information indicates that the site was considered for an allowable release rate of 28.5 L/s. Based on this rate, a minimum volume of 383 m^3 is required for the storage tank. Building A will require flows from the storage tank to be pumped up to a stabilization chamber where flows to the storm sewer south of Kingston Road will be controlled by an orifice control structure. A minimum acceptable orifice plate size of 185mmØ will be required to achieve the allowable release rate.

A Jellyfish **JF6-5-1** model (or approved equivalent as accepted by the City and Conservation Authority) is expected to be required to provide an enhanced water quality control (80% TSS removal) to 90% of site annual runoff flows.

Sanitary Servicing

The sanitary flow from the subject site will be discharged to the existing 600mmØ sanitary sewer along Kingston Road.

A downstream sanitary sewer capacity assessment has been completed to determine if the sewers from the subject site to the outlet have sufficient capacity within the system. The sewers have been modelled using a static design sheet analysis. Several surcharge conditions have been found within the system during the pre-and post-development conditions downstream of the Kingston Road and Rosebank Road intersection. The majority of these conditions continue through the valley to Beachpoint Promenade. The HGL analysis has also been completed to determine the status of the freeboards within the system. Typically, a freeboard of less than 1.8m is anticipated to cause a risk to basement flooding for the properties connected to the sewer with this issue. The pre-and post-development condition analyses indicate seven HGL issues where the freeboards are less than 1.8m within the valley area. Therefore, an upgrade solution will be required to address these capacity constraints. It is to be noted that the proposed development and the anticipated development proposals contribute to the increased pressure within the system; therefore, any upgrades constructed within the downstream system can be cost-shared between the developers.

Water Supply Servicing

There are two connections proposed to the existing 150mmØ watermain on Rougemont Drive. These connections are located on the western portion of the subject site.

The required fire flow is calculated based on the FUS 2019 Draft guidelines with the following assumptions: non-combustible (construction factor of 0.8), limited combustible occupancy (-15% occupancy factor), NFPA 13 Sprinkler system (-30% sprinkler factor), and an exposure factor of 22% for the three exposed sides. This also assumes protected exterior communications and vertical openings with a fire resistance rating of not less than one hour. Based on the FUS calculation, an estimated fire flow of 9,000 L/min (150 L/s) is required. Based on the hydrant test results, the static pressure of the Rougemont Drive watermain is 93.2 psi. A flow of approximately 232 L/s is available at the minimum operating pressure of 20 psi (140 kPa). It is expected that the existing infrastructure will be able to provide sufficient servicing conditions for the proposed development.

We trust this report meets your satisfaction and look forward to your approval. Should you have any questions, please do not hesitate to contact our office.

Respectfully Submitted,

SCHAEFFER & ASSOCIATES LTD.

Jenny Pathmanapan, C.E.T.
Water Resources Analyst

Koryun Shahbikian, LLM, M.Eng., P.Eng.,
Partner

Appendix A

Stormwater Management

Storage Volume Calculation

375 Kingston Road
City of Pickering

Modified Rational Method

Internal Area

Controlled Drainage Area (ha) =	0.85
C =	0.85
C =	1.00
Allowable Release Rate (l/s) =	28.50
Actual Release Rate (l/s) =	25.50

*Takes into account 3L/s groundwater pump rate

Groundwater (l/s)=	3.00

100 Year Storm

Design Storm =	City of Pickering
A =	2096.425
B =	6.485
C =	0.863

	100 Year					Total	Maximum	Required
Time	Intensity	Total	Rooftop	External	Total	Runoff	Release	Storage
(min)	100 year	Runoff	Runoff	Runoff	Runoff	Volume	Volume	Volume
	(mm/hr)	(l/s)	(l/s)	(l/s)	(l/s)	(m^3)	(m^3)	(m^3)
7	222.03	521.58	0.00	0.00	521.58	219.06	10.71	208.35
8	208.74	490.35	0.00	0.00	490.35	235.37	12.24	223.13
9	197.05	462.90	0.00	0.00	462.90	249.97	13.77	236.20
10	186.69	438.56	0.00	0.00	438.56	263.14	15.30	247.84
20	124.00	291.29	0.00	0.00	291.29	349.55	30.60	318.95
30	94.05	220.94	0.00	0.00	220.94	397.69	45.90	351.79
40	76.31	179.26	0.00	0.00	179.26	430.23	61.20	369.03
50	64.50	151.52	0.00	0.00	151.52	454.55	76.50	378.05
60	56.04	131.63	0.00	0.00	131.63	473.88	91.80	382.08
70	49.65	116.64	0.00	0.00	116.64	489.90	107.10	382.80
80	44.66	104.91	0.00	0.00	104.91	503.55	122.40	381.15
90	40.63	95.45	0.00	0.00	95.45	515.45	137.70	377.75
100	37.32	87.67	0.00	0.00	87.67	526.00	153.00	373.00
150	26.77	62.89	0.00	0.00	62.89	565.97	229.50	336.47
160	25.38	59.61	0.00	0.00	59.61	572.28	244.80	327.48
170	24.13	56.69	0.00	0.00	56.69	578.19	260.10	318.09
180	23.01	54.05	0.00	0.00	54.05	583.77	275.40	308.37
190	22.00	51.67	0.00	0.00	51.67	589.04	290.70	298.34
200	21.07	49.50	0.00	0.00	49.50	594.04	306.00	288.04
210	20.23	47.52	0.00	0.00	47.52	598.79	321.30	277.49
220	19.46	45.71	0.00	0.00	45.71	603.33	336.60	266.73
230	18.75	44.03	0.00	0.00	44.03	607.67	351.90	255.77
240	18.09	42.49	0.00	0.00	42.49	611.83	367.20	244.63
250	17.48	41.05	0.00	0.00	41.05	615.82	382.50	233.32

Required Storage (m^3):	**383**

Schaeffers Consulting Engineers
Dec-21

City of Pickering - 375 Kingston Road
Embedded Orifice Plate Sizing

Allowable Release Rate = 0.02850 m^3/s

CALCULATE DIAMETER KNOWING Q & H	
Q(m^3/s)=	0.029
Td(m) =	0.27
Approx A=	0.0200
Approx D=	159
A(m^2) =	0.024
D(mm) =	**174**

Control Manhole Orifice Plate

DIA (mm)=	**185**	
AREA m^2=	0.027	
COEFF =	**0.62**	
GRAVITY =	9.81	
K =	1.0	
D/S HGL=	N/A	m
Orifice Inv.=	104.48	m

Effective Head m	Depth Water At CTL MH m	Qp m^3/s	TOTAL FLOW Qp m^3/s	ELEVATION of Water m
0.000	0.092	0.00000	0.0000	104.57
0.150	**0.242**	**0.02850**	**0.0285**	**104.72**
1.000	1.092	0.07358	0.0736	105.57
1.500	1.592	0.09012	0.0901	106.07
1.750	1.842	0.09734	0.0973	106.32
2.000	2.092	0.10406	0.1041	106.57

ORIFICE FLOW Q(m^3/s)= COEF*AREA*(2*GRAVITY*HEAD/K)^0.5

WEIR FLOW Q(m^3/s)= CLH^1.5 C=1.5

Schaeffers Consulting Engineers

Printed: 13-Dec-21

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Sunday, November 21, 2021
Project Name	375 Kingston Rd.
Project Number	
Location	Pickering

Jellyfish Filter Design Overview

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

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

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF6-5-1 is recommended to meet the water quality objective by treating a flow of 27.8 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 313 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF6-5-1	5	1	1.8	27.8	313

The Jellyfish Filter System

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

Maintenance

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

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

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

Performance

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

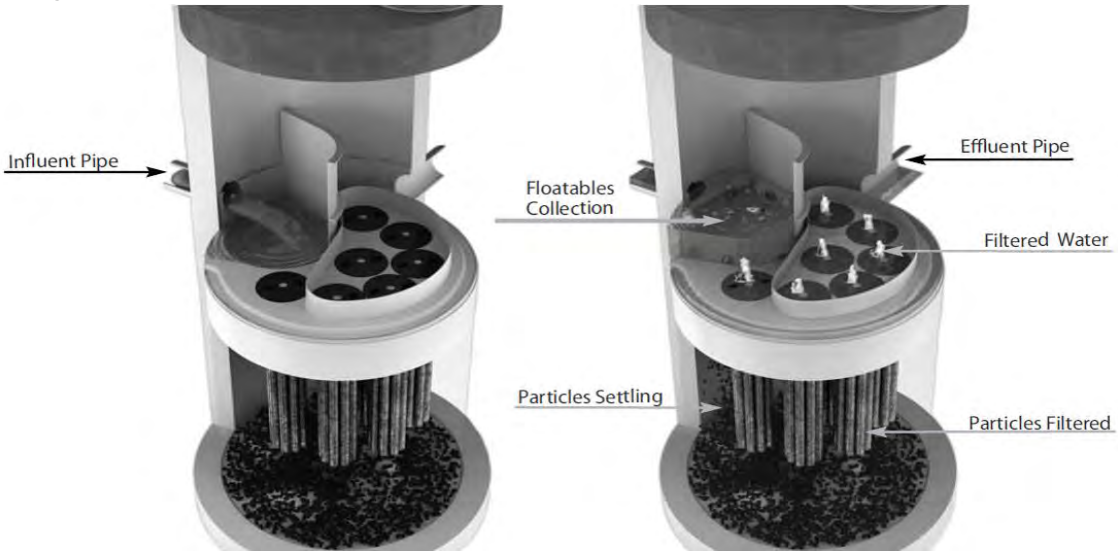
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash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

Field Proven Peformance

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

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

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Project Information

Date:	Sunday, November 21, 2021
Project Name:	375 Kingston Rd.
Project Number:	
Location:	Pickering

Designer Information

Company:	Schaeffers Consulting Engineers
Contact:	Janaani Pathmanapan
Phone #:	

Notes

Rainfall

Name:	TORONTO CENTRAL
State:	ON
ID:	100
Record:	1982 to 1999
Co-ords:	45°30'N, 90°30'W

Drainage Area

Total Area:	0.85 ha
Runoff Coefficient:	0.85

Upstream Detention

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

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 18 years of TORONTO CENTRAL rainfall data:	**21.5 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 4712 m³, with a suspended sediment concentration of 60 mg/L.	**283 kg***

** Indicates that sediment loading is the limiting parameter in the sizing of this Jellyfish system*

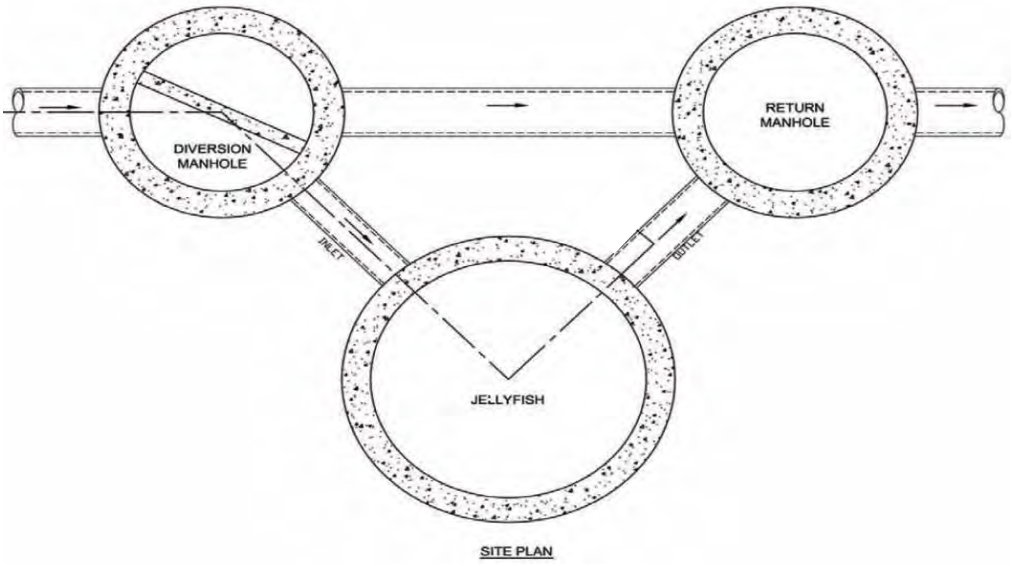
Recommendation

The Jellyfish Filter model JF6-5-1 is recommended to meet the water quality objective by treating a flow of 27.8 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 313 kg, which meets or exceeds the estimated average annual sediment load.

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

Jellyfish Filter Design Notes

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



Jellyfish Filter Typical Layout

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

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

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

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

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

1.2 REFERENCE STANDARDS

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

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

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

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

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

1.4 PRODUCT SUBSTITUTIONS

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

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

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

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

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

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

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

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

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

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

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

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

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

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

2.2 PRECAST CONCRETE SECTIONS

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

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

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

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

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

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

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

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

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

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

PART 3 – PERFORMANCE

3.1 GENERAL

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

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

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

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

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

3.2 FIELD TEST PERFORMANCE

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

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

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

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

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

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

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

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

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

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

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

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

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

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

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

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

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

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

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

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

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

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

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

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

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

PART 5 – QUALITY ASSURANCE

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

5.2 INSPECTION AND MAINTENANCE

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

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

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

END OF SECTION

Appendix B

Sanitary Servicing

Population Estimate Calculation

Project: 375 Pickering

Project No: 5093

Municipality: City of Pickering

Site/Unit Type	Units/Area	Pop. Density (Person/unit) (1)	Population (2)
1-Bedroom	416 units	1.5	624
2-Bedroom	103 units	2.5	258
3-Bedroom	61 units	3.5	214
Commercial	1532 m²		0
Office	0 m²		0
Institutional	0 m²		0
Total			1096

Total Population	**1096**

Notes:

(1) - Populations Densities based on City of Pickering Design Criteria for Sanitary Sewers

(2) - Population rounded up for each site/unit type before being carried forward for additional calculations

(3) - Unit breakdown based on latest available Architectural plan.

Sanitary Demand Calculation - Total Development

Project: 375 Pickering
Project No: 5093
Municipality: City of Pickering

Proposed Development Demands

Infiltration Rate:	All types*	0.26	litre/second/ha
Generation Rate:	Residential*	364	litres/capita/day
Generation Rate:	Commercial*	180	m^3/gross ha/day including peaking factor and infiltration

Site Area Overall 0.84 ha

Site Discharge	Units	Population	Average Demand (L/s)
Residential	580	1096	4.62

Full Site	Total Average Demand (L/s)	Peaking Factor (K)	Peak Flow (L/s)	Infiltration (L/s)**	Total Peak Flow (L/s)
Residential	4.62	3.77	17.43	0.220	**17.65**

Site Discharge	Floor Area (ha)	Population	Average Demand (L/s)*
Commercial	0.153	-	0.32

*Includes Infiltration & Peaking Factor

Total Site	Total Peak Flow (L/s)
	17.96

*As per the City of Pickering Design Criteria for Sanitary Sewers
** Infiltration for the total site area is considered in the demand calculation

City of Pickering

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Fax: (905) 738-6875
design@schaeffers.com

Development Applications Summary

PROJECT No.:	5093
PROJECT NAME:	375 Kingston Rd
LOCATION:	375 Kingston Rd
DATE:	13-Dec-21
DESIGNED BY:	P.R.
CHECKED BY:	K.S.

Location	Floor Area [ha]	Units	Population Rate	Population Unit	Total Pop	ICI Flow	Infiltration L/s	Groundwater L/s
375 Kingston Road								
Highrise residential - 1 bed		416	1.5	pp/unit	624			
Highrise residential - 2 bed		103	2.5	pp/unit	258			
Highrise residential - 3 bed		61	3.5	pp/unit	214			
Commercial - Retail	0.15		180	m^3/floor area ha/day	-	0.32		
Sub Total - Area	-	580			1,096	0.32	-	-
603-643, 645-699 Kingston Rd								
Townhouse		144	3.0	pp/unit	432			
Apartment Highrise residential - 1 bed		822	1.5	pp/unit	1,233			
Apartment Highrise residential - 2 bed		1,918	2.5	pp/unit	4,795			
Apartment Highrise residential - 3 bed		-	3.5	pp/unit	-			
Commercial	0.67		180	m^3/floor area ha/day	-	1.39		
					6,460	1.39		11.59
1985-1999 Altona Rd								
Townhouse		85	3.0	pp/unit	255			
313 Toynevale Rd								
Single Detached		19	3.5	pp/unit	67			
1939 Altona Rd								
Townhouse		61	3.0	pp/unit	183			
1279-1281 Commerce St								
Townhouse			3.0	pp/unit	11			

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REGIONAL MUNICIPALITY OF DURHAM
SANITARY SEWER DESIGN SHEET
Pre-Development Condition

Prepared By: J.P.
Checked By: K. Shahbikian, P. Eng.
Date: December 13, 2021
File No.: 5093
Demand Flow: 364 L/c/day

LOCATION	MANHOLE		RESIDENTIAL											COMMERCIAL			IND. & INST.			Total	SEWER DESIGN							Remarks
	From	To	No. of Units	P.P.U.	Pop	Acc Pop	Avg Day	Peaking Factor	Peak Day Flow	Sect Area	Accum Area	Infilt. Flow	Res. Flow	Area	ACC Area	Peak Flow	Area	ACC Area	Peak Flow	Flow	Pipe Dia	Actual Dia	Grade	Length	Cap.	Full Velocity	Ratio	
	MH	MH					(L/s)		(L/s)	(ha)	(ha)	(L/s)	(L/s)	(ha)	(ha)	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(mm)	(mm)	(%)	(m)	(L/s)	(m/s)	(%)	
Lateral from Northwest		21			9445	9445				318.32	318.32																	
Kingston Rd	21	22			0	9445	39.79	3.0	118.55		318.32	82.76	201.31	0.84	0.84	1.75	4.89	4.89	5.09	208.16	600	609.6	0.89	55.45	604.3	2.07	34%	
	22	23			0	9445	39.79	3.0	118.55		318.32	82.76	201.31	0.29	1.13	2.35	0.00	4.89	5.09	208.75	600	609.6	1.89	69.60	880.6	3.02	24%	
	23	24			0	9445	39.79	3.0	118.55		318.32	82.76	201.31	0.00	1.13	2.35	0.74	5.63	5.86	209.52	600	609.6	1.89	97.55	880.6	3.02	24%	
	24	40			0	9445	39.79	3.0	118.55	0.39	318.70	82.86	201.41	0.00	1.13	2.35	0.00	5.63	5.86	209.62	600	609.6	1.98	33.41	901.3	3.09	23%	
	40	39			0	9445	39.79	3.0	118.55		318.70	82.86	201.41	0.00	1.13	2.35	0.00	5.63	5.86	209.62	600	609.6	0.29	115.00	345.0	1.18	61%	
	39	38			0	9445	39.79	3.0	118.55	0.30	319.00	82.94	201.49	0.00	1.13	2.35	0.00	5.63	5.86	209.70	600	609.6	0.18	59.80	271.8	0.93	77%	
	38	37			0	9445	39.79	3.0	118.55		319.00	82.94	201.49	0.20	1.32	2.76	0.00	5.63	5.86	210.11	600	609.6	0.12	57.55	221.9	0.76	95%	
	37	36			0	9445	39.79	3.0	118.55		319.00	82.94	201.49	0.00	1.32	2.76	0.89	6.51	6.78	211.04	600	609.6	0.27	58.10	332.8	1.14	63%	
	36	35			0	9445	39.79	3.0	118.55		319.00	82.94	201.49	0.00	1.32	2.76	0.00	6.51	6.78	211.04	600	609.6	6.81	16.75	1671.6	5.73	13%	
Subtotal					***9445***	***9445***				**319.00**	***319.00***			***1.32***	***1.32***		***6.51***	***6.51***										
Lateral from north of Rosebank Rd		35			8800	8800				105.97	105.97			0.67	0.67													
Rosebank Rd	35	34			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	16.18	18.17	37.85	15.45	21.96	22.88	378.19	600	609.6	0.19	112.60	279.2	0.96	135%	
	34	33			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	21.96	22.88	378.19	600	609.6	0.17	106.30	264.1	0.90	143%	
	33	32			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	21.96	22.88	378.19	600	609.6	0.20	34.50	286.5	0.98	132%	
Easement	32	31			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	21.96	22.88	378.19	600	609.6	0.16	59.00	256.2	0.88	148%	
	31	30			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	21.96	22.88	378.19	600	609.6	0.32	58.00	362.4	1.24	104%	
	30	29			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	21.96	22.88	378.19	600	609.6	0.27	96.00	332.8	1.14	114%	
	29	28			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	3.08	25.04	26.08	381.39	675	685.8	0.14	54.00	328.1	0.89	116%	
Lateral from Granite Ct	8A	9A			0	0	0.00	3.8	0.00		0.00	0.00	0.00	0.00	0.00	0.00	15.59	15.59	16.24	16.24	250	254	0.48	56.36	43.0	0.85	38%	
	9A	10A			0	0	0.00	3.8	0.00		0.00	0.00	0.00	0.00	0.00	0.00	2.52	18.11	18.87	18.87	250	254	0.27	25.80	32.2	0.64	59%	
	10A				0	0	0.00	3.8	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.11	18.87	18.87	250	254	0.40	5.75	39.2	0.77	48%	
Easement	28	27			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	18.10	43.14	44.94	400.24	675	685.8	0.12	71.00	303.8	0.82	132%	
	27	26			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	43.14	44.94	400.24	675	685.8	0.08	80.90	248.0	0.67	161%	
	26	13A			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	43.14	44.94	400.24	675	685.8	0.19	47.00	382.2	1.03	105%	*HGL less than 1.8m*
Lateral from Sandstone Manor		13A			0	0	0.00	3.8	0.00		0.00	0.00	0.00	0.00	0.00	0.00	5.57	5.57	5.80	5.80	250	254	0.46	110.41	42.1	0.83	14%	
Easement	13A	25			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	5.57	48.70	50.73	406.04	675	685.8	0.15	64.00	339.6	0.92	120%	*HGL less than 1.8m*
	25	24			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	48.70	50.73	406.04	675	685.8	0.15	110.10	339.6	0.92	120%	*HGL less than 1.8m*
	24	23			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	48.70	50.73	406.04	675	685.8	0.16	89.50	350.8	0.95	116%	*HGL less than 1.8m*
	23	22			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	48.70	50.73	406.04	675	685.8	0.17	76.20	361.6	0.98	112%	*HGL less than 1.8m*
	22	21			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	48.70	50.73	406.04	675	685.8	0.16	115.00	350.8	0.95	116%	*HGL less than 1.8m*
	21	20			0	18245	76.87	2.7	206.97		424.97	110.49	317.46	0.00	18.17	37.85	0.00	48.70	50.73	406.04	675	685.8	0.15	112.00	339.6	0.92	120%	*HGL less than 1.8m*
	20	19	150	3.5	525	18770	79.08	2.7	211.94	10.70	435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.12	78.00	303.8	0.82	136%	
	19	18			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.19	77.00	382.2	1.03	108%	
	18	17			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.15	82.00	339.6	0.92	122%	
	17	16			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.16	90.50	350.8	0.95	118%	
	16	15			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.10	57.00	277.3	0.75	149%	
	15	14			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.16	58.00	350.8	0.95	118%	
	14	13			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.15	130.20	339.6	0.92	122%	
	13	12			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.18	57.00	372.1	1.01	111%	
	12	11			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.13	142.78	316.2	0.86	131%	
	11	10			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	0.14	120.81	328.1	0.89	126%	
	10	9			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	1.30	111.93	999.9	2.71	41%	
	9	8			0	18770	79.08	2.7	211.94		435.68	113.28	325.22	0.00	18.17	37.85	0.00	48.70	50.73	413.80	675	685.8	1.33	38.00	1011.3	2.74	41%	
Park Cres	8	7			5528	24298	102.36	2.6	262.86	162.30	597.98	155.47	418.33	0.00	18.17	37.85	3.55	52.25	54.43	510.61	675	685.8	0.32	75.91	496.1	1.34	103%	
Easement	7	6	3	3.5	11	24308	102.41	2.6	262.95	0.95	598.93	155.72	418.68	0.00	18.17	37.85	0.00	52.25	54.43	510.95	675	685.8	2.87	127.00	1485.6	4.02	34%	
Marksbury Rd	6	5	4	3.5	14	24322	102.47	2.6	263.08	0.40	599.32	155.82	418.90	0.00	18.17	37.85	0.00	52.25	54.43	511.18	675	685.8	0.27	70.00	455.7	1.23	112%	
Easement	5	4			0	24322	102.47	2.6	263.08		599.32	155.82	418.90	0.00	18.17	37.85	0.00	52.25	54.43	511.18	675	685.8	2.47	133.90	1376.8	3.73	37%	
Lakecrest Dr	4	3	131	3.5	459	24781	104.40	2.6	267.20	15.62	614.94	159.89	427.08	0.00	18.17	37.85	0.00	52.25	54.43	519.36	675	685.8	0.94	58.80	850.2	2.30	61%	

GENERATION RATE = 364 L/cap/day
INFILTRATION RATE = 0.26 L/s/ha

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REGIONAL MUNICIPALITY OF DURHAM
SANITARY SEWER DESIGN SHEET
Pre-Development Condition

Prepared By: J.P.
Checked By: K. Shahbikian, P. Eng.
Date: December 13, 2021
File No.: 5093
Demand Flow: 364 L/c/day

LOCATION	MANHOLE		RESIDENTIAL											COMMERCIAL			IND. & INST.			Total	SEWER DESIGN							Remarks
	From	To	No. of Units	P.P.U.	Pop	Acc Pop	Avg Day	Peaking Factor	Peak Day Flow	Sect Area	Accum Area	Infilt. Flow	Res. Flow	Area	ACC Area	Peak Flow	Area	ACC Area	Peak Flow	Flow	Pipe Dia	Actual Dia	Grade	Length	Cap.	Full Velocity	Ratio	
	MH	MH					(L/s)		(L/s)	(ha)	(ha)	(L/s)	(L/s)	(ha)	(ha)	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(mm)	(mm)	(%)	(m)	(L/s)	(m/s)	(%)	
	3	2			0	24781	104.40	2.6	267.20		614.94	159.89	427.08	0.00	18.17	37.85	0.00	52.25	54.43	519.36	675	685.8	1.05	104.25	898.6	2.43	58%	
	2	1			0	24781	104.40	2.6	267.20		614.94	159.89	427.08	0.00	18.17	37.85	0.00	52.25	54.43	519.36	675	685.8	0.93	113.05	845.7	2.29	61%	
	1	19			0	24781	104.40	2.6	267.20		614.94	159.89	427.08	0.00	18.17	37.85	0.00	52.25	54.43	519.36	675	685.8	1.03	91.70	890.0	2.41	58%	
	19	18A			0	24781	104.40	2.6	267.20		614.94	159.89	427.08	0.00	18.17	37.85	0.00	52.25	54.43	519.36	900	914.4	0.10	24.30	600.2	0.91	87%	
	18A	18	3	3.5	11	24791	104.44	2.6	267.29	3.19	618.14	160.72	428.01	0.00	18.17	37.85	0.00	52.25	54.43	520.28	900	914.4	0.10	50.20	600.2	0.91	87%	
	18	17			5087	29878	125.87	2.5	312.04	123.51	741.65	192.83	504.86	2.01	20.18	42.04	9.01	61.26	63.81	610.72	900	914.4	0.10	25.00	597.2	0.91	102%	
	17	16			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.10	78.00	597.2	0.91	102%	
	16	15			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.10	83.50	597.2	0.91	102%	
	15	14			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.10	143.00	600.2	0.91	102%	
	14	13			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.10	130.00	597.2	0.91	102%	
	13	12			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.10	130.00	597.2	0.91	102%	
	12	11			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.10	123.50	597.2	0.91	102%	
	11	10			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.18	112.20	799.0	1.22	76%	
	10	9			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.15	88.90	724.1	1.10	84%	
	9	8			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.17	91.50	769.5	1.17	79%	
	8	7			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.17	66.60	783.3	1.19	78%	
	7	6			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.17	14.00	781.0	1.19	78%	
	6	5			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.17	14.00	776.4	1.18	79%	
	5	4			0	29878	125.87	2.5	312.04		741.65	192.83	504.86	0.00	20.18	42.04	0.00	61.26	63.81	610.72	900	914.4	0.15	14.00	741.1	1.13	82%	
	4	3	91	3	284	30162	127.07	2.5	314.49	4.73	746.38	194.06	508.55	5.98	26.16	54.51	0.00	61.26	63.81	626.86	900	914.4	0.17	14.00	774.1	1.18	81%	
	3	2			0	30162	127.07	2.5	314.49		746.38	194.06	508.55	0.00	26.16	54.51	0.00	61.26	63.81	626.86	900	914.4	0.10	14.00	597.2	0.91	105%	
	2	1			0	30162	127.07	2.5	314.49		746.38	194.06	508.55	0.00	26.16	54.51	0.00	61.26	63.81	626.86	900	914.4	0.10	14.00	603.2	0.92	104%	
Sub-total					***0***	***30162***				***746.38***	***746.38***			***25.50***	***26.16***		***84.94***	***61.26***										

GENERATION RATE = 364 L/cap/day
INFILTRATION RATE = 0.26 L/s/ha

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REGIONAL MUNICIPALITY OF DURHAM
SANITARY SEWER DESIGN SHEET
Post-Development Condition

Prepared By: J.P.
Checked By: K. Shahbikian, P. Eng.
Date: December 13, 2021
File No.: 5093 5093
Demand Flow: 364 L/c/day

LOCATION	MANHOLE From MH	MANHOLE To MH	RESIDENTIAL No. of Units	RESIDENTIAL P.P.U.	RESIDENTIAL Pop	RESIDENTIAL Acc Pop	RESIDENTIAL Avg Day (L/s)	RESIDENTIAL Peaking Factor	RESIDENTIAL Peak Day Flow (L/s)	RESIDENTIAL Sect Area (ha)	RESIDENTIAL Accum Area (ha)	RESIDENTIAL Infilt. Flow (L/s)	RESIDENTIAL Res. Flow (L/s)	COMMERCIAL Area (ha)	COMMERCIAL ACC Area (ha)	COMMERCIAL Peak Flow (L/s)	IND. & INST. Area (ha)	IND. & INST. ACC Area (ha)	IND. & INST. Peak Flow (L/s)	Total Flow (L/s)	SEWER DESIGN Pipe Dia (mm)	Actual Dia (mm)	Grade (%)	Length (m)	Cap. (L/s)	Full Velocity (m/s)	Ratio (%)	Proposed Upgrade Dia. (mm)	Proposed Upgrade Act. Dia. (mm)	Proposed Cap. (L/s)	Proposed Upgrade Ratio (%)
Lateral from Northwest		21			9445	9445				318.32	318.32																				
Kingston Rd (Proposed Development)	**21**	**22**			**1096**	**10541**	**44.41**	**2.9**	**130.20**		**318.32**	**82.76**	**212.96**	**0.15**	**0.15**	**0.32**	**4.89**	**4.89**	**5.09**	**218.37**	**600**	**609.6**	**0.89**	**55.45**	**604.3**	**2.07**	**36%**	**600**	**609.6**	**604.3**	**36%**
	22	23			0	10541	44.41	2.9	130.20		318.32	82.76	212.96	0.29	0.44	0.92	0.00	4.89	5.09	218.97	600	609.6	1.89	69.60	880.6	3.02	25%	600	609.6	880.6	25%
	23	24			0	10541	44.41	2.9	130.20		318.32	82.76	212.96	0.00	0.44	0.92	0.74	5.63	5.86	219.74	600	609.6	1.89	97.55	880.6	3.02	25%	600	609.6	880.6	25%
	24	40			0	10541	44.41	2.9	130.20	0.39	318.70	82.86	213.07	0.00	0.44	0.92	0.00	5.63	5.86	219.84	600	609.6	1.98	33.41	901.3	3.09	24%	600	609.6	901.3	24%
	40	39			0	10541	44.41	2.9	130.20		318.70	82.86	213.07	0.00	0.44	0.92	0.00	5.63	5.86	219.84	600	609.6	0.29	115.00	345.0	1.18	64%	600	609.6	345.0	64%
	39	38			0	10541	44.41	2.9	130.20	0.30	319.00	82.94	213.14	0.00	0.44	0.92	0.00	5.63	5.86	219.92	600	609.6	0.18	59.80	271.8	0.93	81%	600	609.6	271.8	81%
	38	37			0	10541	44.41	2.9	130.20		319.00	82.94	213.14	0.20	0.64	1.33	0.00	5.63	5.86	220.33	600	609.6	0.12	57.55	221.9	0.76	99%	600	609.6	221.9	99%
	37	36			0	10541	44.41	2.9	130.20		319.00	82.94	213.14	0.00	0.64	1.33	0.89	6.51	6.78	221.26	600	609.6	0.27	58.10	332.8	1.14	66%	600	609.6	332.8	66%
	36	35			0	10541	44.41	2.9	130.20		319.00	82.94	213.14	0.00	0.64	1.33	0.00	6.51	6.78	221.26	600	609.6	6.81	16.75	1671.6	5.73	13%	600	609.6	1671.6	13%
Subtotal					***10541***	***10541***				**319.00**	***319.00***			***0.64***	***0.64***		***6.51***	***6.51***													
Lateral from north of Rosebank Rd		35			8800	8800				105.97	105.97			0.67	0.67															
Rosebank Rd	35	34			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	16.18	17.48	36.42	15.45	21.96	22.88	387.11	600	609.6	0.19	112.60	279.2	0.96	139%	**750**	762	506.2	76%
	34	33			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	21.96	22.88	387.11	600	609.6	0.17	106.30	264.1	0.90	147%	**750**	762	478.9	81%
	33	32			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	21.96	22.88	387.11	600	609.6	0.20	34.50	286.5	0.98	135%	**750**	762	519.4	75%
Easement	32	31			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	21.96	22.88	387.11	600	609.6	0.16	59.00	256.2	0.88	151%	**750**	762	464.6	83%
	31	30			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	21.96	22.88	387.11	600	609.6	0.32	58.00	362.4	1.24	107%	**750**	762	657.0	59%
	30	29			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	21.96	22.88	387.11	600	609.6	0.27	96.00	332.8	1.14	116%	**750**	762	603.5	64%
	29	28			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	3.08	25.04	26.08	390.32	675	685.8	0.14	54.00	328.1	0.89	119%	**825**	838.2	560.3	70%
Lateral from Granite Ct	8A	9A			0	0	0.00	3.8	0.00		0.00	0.00	0.00	0.00	0.00	0.00	15.59	15.59	16.24	16.24	250	254	0.48	56.36	43.0	0.85	38%	250	254	43.0	38%
	9A	10A			0	0	0.00	3.8	0.00		0.00	0.00	0.00	0.00	0.00	0.00	2.52	18.11	18.87	18.87	250	254	0.27	25.80	32.2	0.64	59%	250	254	32.2	59%
	10A				0	0	0.00	3.8	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.11	18.87	18.87	250	254	0.40	5.75	39.2	0.77	48%	250	254	39.2	48%
Easement	28	27			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	18.10	43.14	44.94	409.17	675	685.8	0.12	71.00	303.8	0.82	135%	**825**	838.2	518.7	79%
	27	26			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	43.14	44.94	409.17	675	685.8	0.08	80.90	248.0	0.67	165%	**900**	914.4	534.2	77%
	26	13A			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	43.14	44.94	409.17	675	685.8	0.19	47.00	382.2	1.03	107%	**825**	838.2	652.7	63%
Lateral from Sandstone Manor		13A			0	0	0.00	3.8	0.00		0.00	0.00	0.00	0.00	0.00	0.00	5.57	5.57	5.80	5.80	250	254	0.46	110.41	42.1	0.83	14%	250	254	42.1	14%
Easement	13A	25			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	5.57	48.70	50.73	414.97	675	685.8	0.15	64.00	339.6	0.92	122%	**825**	838.2	580.0	72%
	25	24			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	48.70	50.73	414.97	675	685.8	0.15	110.10	339.6	0.92	122%	**825**	838.2	580.0	72%
	24	23			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	48.70	50.73	414.97	675	685.8	0.16	89.50	350.8	0.95	118%	**825**	838.2	599.0	69%
	23	22			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	48.70	50.73	414.97	675	685.8	0.17	76.20	361.6	0.98	115%	**825**	838.2	617.4	67%
	22	21			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	48.70	50.73	414.97	675	685.8	0.16	115.00	350.8	0.95	118%	**825**	838.2	599.0	69%
	21	20			0	19341	81.48	2.7	217.32		424.97	110.49	327.82	0.00	17.48	36.42	0.00	48.70	50.73	414.97	675	685.8	0.15	112.00	339.6	0.92	122%	**825**	838.2	580.0	72%
	20	19	150	3.5	525	19866	83.69	2.7	222.24	10.70	435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.12	78.00	303.8	0.82	139%	**825**	838.2	518.7	81%
	19	18			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.19	77.00	382.2	1.03	111%	**825**	838.2	652.7	65%
	18	17			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.15	82.00	339.6	0.92	124%	**825**	838.2	580.0	73%
	17	16			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.16	90.50	350.8	0.95	120%	**825**	838.2	599.0	71%
	16	15			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.10	57.00	277.3	0.75	152%	**900**	914.4	597.2	71%
	15	14			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.16	58.00	350.8	0.95	120%	**825**	838.2	599.0	71%
	14	13			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.15	130.20	339.6	0.92	124%	**825**	838.2	580.0	73%
	13	12			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.18	57.00	372.1	1.01	114%	**825**	838.2	635.3	67%
	12	11			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.13	142.78	316.2	0.86	134%	**825**	838.2	539.9	78%
	11	10			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	0.14	120.81	328.1	0.89	129%	**825**	838.2	560.3	75%
	10	9			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	1.30	111.93	999.9	2.71	42%	675	685.8	999.9	42%
	9	8			0	19866	83.69	2.7	222.24		435.68	113.28	335.52	0.00	17.48	36.42	0.00	48.70	50.73	422.67	675	685.8	1.33	38.00	1011.3	2.74	42%	675	685.8	1011.3	42%
Park Cres	8	7			5528	25394	106.98	2.5	272.68	162.30	597.98	155.47	428.15	0.00	17.48	36.42	3.55	52.25	54.43	518.99	675	685.8	0.32	75.91	496.1	1.34	105%	**750**	762	657.0	79%
Easement	7	6	3	3.5	11	25404	107.03	2.5	272.77	0.95	598.93	155.72	428.49	0.00	17.48	36.42	0.00	52.25	54.43	519.33	675	685.8	2.87	127.00	1485.6	4.02	35%	675	685.8	1485.6	35%
Marksbury Rd	6	5	4	3.5	14	25418	107.09	2.5	272.90	0.40	599.32	155.82	428.72	0.00	17.48	36.42	0.00	52.25	54.43	519.56	675	685.8	0.27	70.00	455.7	1.23	114%	**825**	838.2	778.1	67%
Easement	5	4			0	25418	107.09	2.5	272.90		599.32	155.82	428.72	0.00	17.48	36.42	0.00	52.25	54.43	519.56	675	685.8	2.47	133.90	1376.8	3.73	38%	675	685.8	1376.8	38%
Lakecrest Dr	4	3	131	3.5	459	25877	109.02	2.5	276.98	15.62	614.94	159.89	436.86	0.00	17.48	36.42	0.00	52.25	54.43	527.70	675	685.8	0.94	58.80	850.2	2.30	62%	675	685.8	850.2	62%

GENERATION RATE = 364 L/cap/day
INFILTRATION RATE = 0.26 L/s/ha

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REGIONAL MUNICIPALITY OF DURHAM
SANITARY SEWER DESIGN SHEET
Post-Development Condition

Prepared By: J.P.
Checked By: K. Shahbikian, P. Eng.
Date: December 13, 2021
File No.: 5093 5093
Demand Flow: 364 L/c/day

LOCATION	MANHOLE		RESIDENTIAL											COMMERCIAL			IND. & INST.			Total	SEWER DESIGN									
	From MH	To MH	No. of Units	P.P.U.	Pop	Acc Pop	Avg Day (L/s)	Peaking Factor	Peak Day Flow (L/s)	Sect Area (ha)	Accum Area (ha)	Infilt. Flow (L/s)	Res. Flow (L/s)	Area (ha)	ACC Area (ha)	Peak Flow (L/s)	Area (ha)	ACC Area (ha)	Peak Flow (L/s)	Flow (L/s)	Pipe Dia (mm)	Actual Dia (mm)	Grade (%)	Length (m)	Cap. (L/s)	Full Velocity (m/s)	Ratio (%)	Proposed Upgrade Dia. (mm)	Proposed Upgrade Act. Dia. (mm)	Proposed Cap. (L/s)	Proposed Upgrade Ratio (%)
	3	2			0	25877	109.02	2.5	276.98		614.94	159.89	436.86	0.00	17.48	36.42	0.00	52.25	54.43	527.70	675	685.8	1.05	104.25	898.6	2.43	59%	675	685.8	898.6	59%
	2	1			0	25877	109.02	2.5	276.98		614.94	159.89	436.86	0.00	17.48	36.42	0.00	52.25	54.43	527.70	675	685.8	0.93	113.05	845.7	2.29	62%	675	685.8	845.7	62%
	1	19			0	25877	109.02	2.5	276.98		614.94	159.89	436.86	0.00	17.48	36.42	0.00	52.25	54.43	527.70	675	685.8	1.03	91.70	890.0	2.41	59%	675	685.8	890.0	59%
	19	18A			0	25877	109.02	2.5	276.98		614.94	159.89	436.86	0.00	17.48	36.42	0.00	52.25	54.43	527.70	900	914.4	0.10	24.30	600.2	0.91	88%	900	914.4	600.2	88%
	18A	18	3	3.5	11	25887	109.06	2.5	277.07	3.19	618.14	160.72	437.79	0.00	17.48	36.42	0.00	52.25	54.43	528.63	900	914.4	0.10	50.20	600.2	0.91	88%	900	914.4	600.2	88%
	18	17			5087	30974	130.49	2.5	321.48	123.51	741.65	192.83	514.31	2.01	19.49	40.61	9.01	61.26	63.81	618.72	900	914.4	0.10	25.00	597.2	0.91	104%	975	990.6	739.3	84%
	17	16			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.10	78.00	597.2	0.91	104%	975	990.6	739.3	84%
	16	15			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.10	83.50	597.2	0.91	104%	975	990.6	739.3	84%
	15	14			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.10	143.00	600.2	0.91	103%	975	990.6	743.0	83%
	14	13			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.10	130.00	597.2	0.91	104%	975	990.6	739.3	84%
	13	12			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.10	130.00	597.2	0.91	104%	975	990.6	739.3	84%
	12	11			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.10	123.50	597.2	0.91	104%	975	990.6	739.3	84%
	11	10			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.18	112.20	799.0	1.22	77%	900	914.4	799.0	77%
	10	9			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.15	88.90	724.1	1.10	85%	900	914.4	724.1	85%
	9	8			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.17	91.50	769.5	1.17	80%	900	914.4	769.5	80%
	8	7			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.17	66.60	783.3	1.19	79%	900	914.4	783.3	79%
	7	6			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.17	14.00	781.0	1.19	79%	900	914.4	781.0	79%
	6	5			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.17	14.00	776.4	1.18	80%	900	914.4	776.4	80%
	5	4			0	30974	130.49	2.5	321.48		741.65	192.83	514.31	0.00	19.49	40.61	0.00	61.26	63.81	618.72	900	914.4	0.15	14.00	741.1	1.13	83%	900	914.4	741.1	83%
	4	3	91	3	284	31258	131.69	2.5	323.91	4.73	746.38	194.06	517.97	5.98	25.48	53.08	0.00	61.26	63.81	634.86	900	914.4	0.17	14.00	774.1	1.18	82%	900	914.4	774.1	82%
	3	2			0	31258	131.69	2.5	323.91		746.38	194.06	517.97	0.00	25.48	53.08	0.00	61.26	63.81	634.86	900	914.4	0.10	14.00	597.2	0.91	106%	1050	1066.8	900.9	70%
	2	1			0	31258	131.69	2.5	323.91		746.38	194.06	517.97	0.00	25.48	53.08	0.00	61.26	63.81	634.86	900	914.4	0.10	14.00	603.2	0.92	105%	1050	1066.8	909.8	70%
Sub-total					***1096***	***31258***				***746.38***	***746.38***			***24.81***	***25.48***		***84.94***	***61.26***													

GENERATION RATE = 364 L/cap/day
INFILTRATION RATE = 0.26 L/s/ha

REGIONAL MUNICIPALITY OF DURHAM
SANITARY HGL ANALYSIS
Pre-Development Condition

LOCATION/	MANHOLES		INVERT ELEV		Calculated Slope	GROUND	COVER	BASEMENT	Circular Pipe Parameters				TOTAL	Qcap	Qin/	OBV(U/S)	OBV (D/S)	HGL(U/S)	HGL(D/S)	Freeboard
DESCRIPTION	To	From	U/S	D/S		U/S	U/S	U/S	Diameter	Actual Diameter	Length	'n'	FLOW		Qcap	(m)	(m)	(m)	(m)	(m)
			(m)	(m)		(m)	(m)	(m)	(mm)	(mm)	(m)		(cms)	(m^3/s)						
Kingston Rd	21	22	100.314	99.821	0.89	107.20	1.8	105.40	600	610	55.5	0.013	***0.2082***	6.05	0.03	100.91	100.42	100.91	100.37	**6.29**
	22	23	99.766	98.449	1.89	106.40	1.8	104.60	600	610	69.6	0.013	***0.2088***	8.82	0.02	100.37	99.05	100.37	99.00	**6.03**
	23	24	98.400	96.554	1.89	104.00	1.8	102.20	600	610	97.6	0.013	***0.2095***	8.82	0.02	99.00	97.15	99.00	95.61	**5.00**
	24	40	95.007	94.344	1.98	100.30	1.8	98.50	600	610	33.4	0.013	***0.2096***	9.02	0.02	95.61	94.94	95.61	94.60	**4.69**
	40	39	94.000	93.669	0.29	99.40	1.8	97.60	600	610	115.0	0.013	***0.2096***	3.45	0.06	94.60	94.27	94.60	94.27	**4.80**
	39	38	93.669	93.563	0.18	97.90	1.8	96.10	600	610	59.8	0.013	***0.2097***	2.72	0.08	94.27	94.16	94.27	94.16	**3.63**
	38	37	93.563	93.493	0.12	98.90	1.8	97.10	600	610	57.6	0.013	***0.2101***	2.22	0.09	94.16	94.09	94.16	94.09	**4.74**
	37	36	93.493	93.339	0.27	99.50	1.8	97.70	600	610	58.1	0.013	***0.2110***	3.33	0.06	94.09	93.94	94.09	93.94	**5.41**
	36	35	93.339	92.198	6.81	100.30	1.8	98.50	600	610	16.8	0.013	***0.2110***	16.74	0.01	93.94	92.80	93.94	93.91	**6.36**
Rosebank Rd	35	34	92.169	91.956	0.19	100.60	1.8	98.80	600	610	112.6	0.013	***0.3782***	2.80	0.14	92.77	92.56	93.91	93.48	**6.69**
	34	33	91.956	91.779	0.17	98.80	1.8	97.00	600	610	106.3	0.013	***0.3782***	2.64	0.14	92.56	92.38	93.48	93.48	**5.32**
	33	32	91.658	91.594	0.20	97.80	1.8	96.00	600	610	34.5	0.013	***0.3782***	2.87	0.13	92.26	92.19	93.48	93.28	**4.32**
Easement	32	31	91.597	91.509	0.16	97.60	1.8	95.80	600	610	59.0	0.013	***0.3782***	2.57	0.15	92.20	92.11	93.28	93.28	**4.32**
	31	30	91.493	91.347	0.32	97.59	1.8	95.79	600	610	58.0	0.013	***0.3782***	3.63	0.10	92.09	91.95	93.28	92.99	**4.31**
	30	29	91.283	91.116	0.27	97.22	1.8	95.42	600	610	96.0	0.013	***0.3782***	3.33	0.11	91.88	91.72	92.99	92.62	**4.22**
	29	28	90.972	90.963	0.14	95.80	1.8	94.00	675	686	54.0	0.013	***0.3814***	3.29	0.12	91.65	91.64	92.62	92.51	**3.18**
Lateral from Granite Ct	8A	9A	92.210	91.940	0.48	97.23	1.8	95.43	250	254	56.4	0.013	***0.0162***	0.43	0.04	92.46	92.19	92.51	92.51	**4.72**
	9A	10A	91.810	91.650	0.27	95.89	1.8	94.09	250	254	25.8	0.013	***0.0189***	0.32	0.06	92.06	91.90	92.51	92.51	**3.38**
	10A		89.500	89.190	0.40	95.90	1.8	94.10	250	254	5.8	0.013	***0.0189***	0.39	0.05	89.75	89.44	92.51	92.51	**3.39**
Easement	28	27	90.963	90.883	0.12	96.14	1.8	94.34	675	686	71.0	0.013	***0.4002***	3.04	0.13	91.64	91.56	92.51	92.35	**3.63**
	27	26	90.833	90.805	0.08	95.01	1.8	93.21	675	686	80.9	0.013	***0.4002***	2.48	0.16	91.51	91.48	92.35	92.16	**2.66**
	26	13A	90.790	90.723	0.19	93.12	1.8	91.32	675	686	47.0	0.013	***0.4002***	3.83	0.10	91.47	91.40	92.16	92.05	**0.97**
Lateral from Sandstone Manor		13A	91.700	90.650	0.46	96.00	1.8	94.20	250	254	110.4	0.013	***0.0058***	0.42	0.01	91.95	90.90	92.05	92.05	**3.95**
	13A	25	90.695	90.619	0.15	93.17	1.8	91.37	675	686	64.0	0.013	***0.4060***	3.40	0.12	91.37	91.29	92.05	91.90	**1.12**
	25	24	90.603	90.491	0.15	93.04	1.8	91.24	675	686	110.1	0.013	***0.4060***	3.40	0.12	91.28	91.17	91.90	91.64	**1.15**
	24	23	90.376	90.304	0.16	92.04	1.8	90.24	675	686	89.5	0.013	***0.4060***	3.51	0.12	91.05	90.98	91.64	91.42	**0.41**
	23	22	90.265	90.131	0.17	92.06	1.8	90.26	675	686	76.2	0.013	***0.4060***	3.62	0.11	90.94	90.81	91.42	91.24	**0.64**
	22	21	90.127	89.942	0.16	92.41	1.8	90.61	675	686	115.0	0.013	***0.4060***	3.51	0.12	90.80	90.62	91.24	90.97	**1.16**
	21	20	89.909	89.747	0.15	91.73	1.8	89.93	675	686	112.0	0.013	***0.4060***	3.40	0.12	90.58	90.42	90.97	90.71	**0.76**
	20	19	89.710	89.619	0.12	94.58	1.8	92.78	675	686	78.0	0.013	***0.4138***	3.04	0.14	90.39	90.29	90.71	90.51	**3.88**
	19	18	89.607	89.455	0.19	94.02	1.8	92.22	675	686	77.0	0.013	***0.4138***	3.83	0.11	90.28	90.13	90.51	90.32	**3.51**
	18	17	89.391	89.307	0.15	92.22	1.8	90.42	675	686	82.0	0.013	***0.4138***	3.40	0.12	90.07	89.98	90.32	90.12	**1.90**
	17	16	89.287	89.137	0.16	94.32	1.8	92.52	675	686	90.5	0.013	***0.4138***	3.51	0.12	89.96	89.81	90.12	89.90	**4.19**
	16	15	89.046	88.991	0.10	92.92	1.8	91.12	675	686	57.0	0.013	***0.4138***	2.78	0.15	89.72	89.67	89.90	89.76	**3.02**
	15	14	88.973	88.876	0.16	96.08	1.8	94.28	675	686	58.0	0.013	***0.4138***	3.51	0.12	89.65	89.55	89.76	89.61	**6.32**
	14	13	88.855	88.696	0.15	97.62	1.8	95.82	675	686	130.2	0.013	***0.4138***	3.40	0.12	89.53	89.37	89.61	89.30	**8.01**
	13	12	88.620	88.513	0.18	95.10	1.8	93.30	675	686	57.0	0.013	***0.4138***	3.72	0.11	89.30	89.19	89.30	89.14	**5.80**
	12	11	88.467	88.282	0.13	95.65	1.8	93.85	675	686	142.8	0.013	***0.4138***	3.17	0.13	89.14	88.96	89.14	88.93	**6.51**

REGIONAL MUNICIPALITY OF DURHAM
SANITARY HGL ANALYSIS
Pre-Development Condition

LOCATION/	MANHOLES		INVERT ELEV		Calculated Slope	GROUND	COVER	BASEMENT	Circular Pipe Parameters				TOTAL	Qcap	Qin/	OBV(U/S)	OBV (D/S)	HGL(U/S)	HGL(D/S)	Freeboard
DESCRIPTION	To	From	U/S (m)	D/S (m)		U/S (m)	U/S (m)	U/S (m)	Diameter (mm)	Actual Diameter (mm)	Length (m)	'n'	FLOW (cms)	(m^3/s)	Qcap	(m)	(m)	(m)	(m)	(m)
	11	10	88.257	88.084	0.14	96.80	1.8	95.00	675	686	120.8	0.013	***0.4138***	3.29	0.13	88.93	88.76	88.93	88.67	**7.87**
	10	9	87.996	86.545	1.30	90.86	1.8	89.06	675	686	111.9	0.013	***0.4138***	10.01	0.04	88.67	87.22	88.67	87.14	**2.19**
	9	8	86.469	85.962	1.33	90.09	1.8	88.29	675	686	38.0	0.013	***0.4138***	10.13	0.04	87.14	86.64	87.14	85.91	**2.94**
Park Cres	8	7	85.236	84.992	0.32	89.37	1.8	87.57	675	686	75.9	0.013	***0.5106***	4.97	0.10	85.91	85.67	85.91	85.59	**3.46**
Easement	7	6	84.919	81.280	2.87	89.85	1.8	88.05	675	686	127.0	0.013	***0.5110***	14.87	0.03	85.59	81.96	85.59	81.91	**4.25**
Marksbury Rd	6	5	81.237	81.048	0.27	83.95	1.8	82.15	675	686	70.0	0.013	***0.5112***	4.56	0.11	81.91	81.72	81.91	81.64	**2.04**
Easement	5	4	80.963	77.662	2.47	84.60	1.8	82.80	675	686	133.9	0.013	***0.5112***	13.78	0.04	81.64	78.34	81.64	78.26	**2.96**
Lakecrest Dr	4	3	77.580	77.062	0.94	81.41	1.8	79.61	675	686	58.8	0.013	***0.5194***	8.51	0.06	78.26	77.74	78.26	77.71	**3.15**
	3	2	77.032	75.928	1.05	80.52	1.8	78.72	675	686	104.3	0.013	***0.5194***	9.00	0.06	77.71	76.60	77.71	76.57	**2.81**
	2	1	75.891	74.852	0.93	79.64	1.8	77.84	675	686	113.1	0.013	***0.5194***	8.47	0.06	76.57	75.53	76.57	75.49	**3.07**
	1	19	74.810	72.762	1.03	77.96	1.8	76.16	675	686	91.7	0.013	***0.5194***	8.91	0.06	75.49	73.44	75.49	72.99	**2.47**
	19	18A	72.080	72.092	0.10	76.20	1.8	74.40	900	914	24.3	0.013	***0.5194***	6.01	0.09	72.98	72.99	72.99	72.99	**3.21**
	18A	18	72.092	72.005	0.10	75.80	1.8	74.00	900	914	50.2	0.013	***0.5203***	6.01	0.09	72.99	72.91	72.99	72.88	**2.81**
	18	17	71.975	71.950	0.10	76.00	1.8	74.20	900	914	25.0	0.013	***0.6107***	5.98	0.10	72.88	72.85	72.88	72.82	**3.13**
	17	16	71.921	71.843	0.10	76.00	1.8	74.20	900	914	78.0	0.013	***0.6107***	5.98	0.10	72.82	72.74	72.82	72.74	**3.18**
	16	15	71.843	71.760	0.10	76.30	1.8	74.50	900	914	83.5	0.013	***0.6107***	5.98	0.10	72.74	72.66	72.74	72.66	**3.56**
	15	14	71.760	71.616	0.10	76.70	1.8	74.90	900	914	143.0	0.013	***0.6107***	6.01	0.10	72.66	72.52	72.66	72.52	**4.04**
	14	13	71.616	71.486	0.10	76.70	1.8	76.70	900	914	130.0	0.013	***0.6107***	5.98	0.10	72.52	72.39	72.52	72.39	**4.18**
	13	12	71.486	71.356	0.10	76.80	1.8	76.80	900	914	130.0	0.013	***0.6107***	5.98	0.10	72.39	72.26	72.39	72.26	**4.41**
	12	11	71.356	71.233	0.10	76.50	1.8	76.50	900	914	123.5	0.013	***0.6107***	5.98	0.10	72.26	72.13	72.26	72.09	**4.24**
	11	10	71.193	69.949	0.18	76.50	1.8	74.70	900	914	112.2	0.013	***0.6107***	8.00	0.08	72.09	70.85	72.09	70.81	**4.41**
	10	9	69.913	69.782	0.15	76.30	1.8	74.50	900	914	88.9	0.013	***0.6107***	7.25	0.08	70.81	70.68	70.81	70.63	**5.49**
	9	8	69.732	69.580	0.17	76.20	1.8	74.40	900	914	91.5	0.013	***0.6107***	7.70	0.08	70.63	70.48	70.63	70.44	**5.57**
	8	7	69.540	69.382	0.17	76.30	1.8	74.50	900	914	66.6	0.013	***0.6107***	7.84	0.08	70.44	70.28	70.44	70.23	**5.86**
	7	6	69.331	69.307	0.17	76.30	1.8	74.50	900	914	14.0	0.013	***0.6107***	7.82	0.08	70.23	70.21	70.23	70.17	**6.07**
	6	5	69.271	69.164	0.17	75.90	1.8	74.10	900	914	14.0	0.013	***0.6107***	7.77	0.08	70.17	70.06	70.17	70.01	**5.73**
	5	4	69.106	68.956	0.15	75.80	1.8	74.00	900	914	14.0	0.013	***0.6107***	7.42	0.08	70.01	69.86	70.01	69.80	**5.79**
	4	3	68.902	68.811	0.17	76.50	1.8	74.70	900	914	14.0	0.013	***0.6269***	7.75	0.08	69.80	69.71	69.80	69.66	**6.70**
	3	2	68.761	68.706	0.10	76.80	1.8	75.00	900	914	14.0	0.013	***0.6269***	5.98	0.10	69.66	69.61	69.66	69.56	**7.14**
	2	1	68.657	68.630	0.10	76.8	1.8	75	900	914	14.0	0.013	***0.6269***	6.04	0.10	69.56	69.53	69.56	0.00	**7.24**

REGIONAL MUNICIPALITY OF DURHAM
SANITARY HGL ANALYSIS
Post-Development Condition

LOCATION/	MANHOLES		INVERT ELEV		Calculated Slope	GROUND	COVER	BASEMENT	Circular Pipe Parameters		Length	'n'	TOTAL	Qcap	Qin/	OBV(U/S)	OBV (D/S)	HGL(U/S)	HGL(D/S)	Freeboard
DESCRIPTION	To	From	U/S (m)	D/S (m)		U/S (m)	U/S (m)	U/S (m)	Diameter (mm)	Actual Diameter (mm)	(m)		FLOW (cms)	(m^3/s)	Qcap	(m)	(m)	(m)	(m)	(m)
Kingston Rd	21	22	100.314	99.821	0.89	107.20	1.8	105.40	600	610	55.5	0.013	***0.2184***	6.05	0.04	100.91	100.42	100.91	100.37	**6.29**
	22	23	99.766	98.449	1.89	106.40	1.8	104.60	600	610	69.6	0.013	***0.2190***	8.82	0.02	100.37	99.05	100.37	99.00	**6.03**
	23	24	98.400	96.554	1.89	104.00	1.8	102.20	600	610	97.6	0.013	***0.2197***	8.82	0.02	99.00	97.15	99.00	95.61	**5.00**
	24	40	95.007	94.344	1.98	100.30	1.8	98.50	600	610	33.4	0.013	***0.2198***	9.02	0.02	95.61	94.94	95.61	94.60	**4.69**
	40	39	94.000	93.669	0.29	99.40	1.8	97.60	600	610	115.0	0.013	***0.2198***	3.45	0.06	94.60	94.27	94.60	94.27	**4.80**
	39	38	93.669	93.563	0.18	97.90	1.8	96.10	600	610	59.8	0.013	***0.2199***	2.72	0.08	94.27	94.16	94.27	94.20	**3.63**
	38	37	93.563	93.493	0.12	98.90	1.8	97.10	600	610	57.6	0.013	***0.2203***	2.22	0.10	94.16	94.09	94.20	94.12	**4.70**
	37	36	93.493	93.339	0.27	99.50	1.8	97.70	600	610	58.1	0.013	***0.2213***	3.33	0.07	94.09	93.94	94.12	94.12	**5.38**
	36	35	93.339	92.198	6.81	100.30	1.8	98.50	600	610	16.8	0.013	***0.2213***	16.74	0.01	93.94	92.80	94.12	94.12	**6.18**
Rosebank Rd	35	34	92.169	91.956	0.19	100.60	1.8	98.80	600	610	112.6	0.013	***0.3871***	2.80	0.14	92.77	92.56	94.12	93.67	**6.48**
	34	33	91.956	91.779	0.17	98.80	1.8	97.00	600	610	106.3	0.013	***0.3871***	2.64	0.15	92.56	92.38	93.67	93.67	**5.13**
	33	32	91.658	91.594	0.20	97.80	1.8	96.00	600	610	34.5	0.013	***0.3871***	2.87	0.13	92.26	92.19	93.67	93.46	**4.13**
Easement	32	31	91.597	91.509	0.16	97.60	1.8	95.80	600	610	59.0	0.013	***0.3871***	2.57	0.15	92.20	92.11	93.46	93.46	**4.14**
	31	30	91.493	91.347	0.32	97.59	1.8	95.79	600	610	58.0	0.013	***0.3871***	3.63	0.11	92.09	91.95	93.46	93.16	**4.13**
	30	29	91.283	91.116	0.27	97.22	1.8	95.42	600	610	96.0	0.013	***0.3871***	3.33	0.12	91.88	91.72	93.16	92.77	**4.06**
	29	28	90.972	90.963	0.14	95.80	1.8	94.00	675	686	54.0	0.013	***0.3903***	3.29	0.12	91.65	91.64	92.77	92.65	**3.03**
Lateral from Granite Ct	8A	9A	92.210	91.940	0.48	97.23	1.8	95.43	250	254	56.4	0.013	***0.0162***	0.43	0.04	92.46	92.19	92.65	92.65	**4.58**
	9A	10A	91.810	91.650	0.27	95.89	1.8	94.09	250	254	25.8	0.013	***0.0189***	0.32	0.06	92.06	91.90	92.65	92.65	**3.24**
	10A		89.500	89.190	0.40	95.90	1.8	94.10	250	254	5.8	0.013	***0.0189***	0.39	0.05	89.75	89.44	92.65	92.65	**3.25**
Easement	28	27	90.963	90.883	0.12	96.14	1.8	94.34	675	686	71.0	0.013	***0.4092***	3.04	0.13	91.64	91.56	92.65	92.48	**3.49**
	27	26	90.833	90.805	0.08	95.01	1.8	93.21	675	686	80.9	0.013	***0.4092***	2.48	0.16	91.51	91.48	92.48	92.28	**2.53**
	26	13A	90.790	90.723	0.19	93.12	1.8	91.32	675	686	47.0	0.013	***0.4092***	3.83	0.11	91.47	91.40	92.28	92.17	**0.84**
Lateral from Sandstone Manor		13A	91.700	90.650	0.46	96.00	1.8	94.20	250	254	110.4	0.013	***0.0058***	0.42	0.01	91.95	90.90	92.17	92.17	**3.83**
	13A	25	90.695	90.619	0.15	93.17	1.8	91.37	675	686	64.0	0.013	***0.4150***	3.40	0.12	91.37	91.29	92.17	92.01	**1.00**
	25	24	90.603	90.491	0.15	93.04	1.8	91.24	675	686	110.1	0.013	***0.4150***	3.40	0.12	91.28	91.17	92.01	91.74	**1.03**
	24	23	90.376	90.304	0.16	92.04	1.8	90.24	675	686	89.5	0.013	***0.4150***	3.51	0.12	91.05	90.98	91.74	91.52	**0.30**
	23	22	90.265	90.131	0.17	92.06	1.8	90.26	675	686	76.2	0.013	***0.4150***	3.62	0.11	90.94	90.81	91.52	91.33	**0.54**
	22	21	90.127	89.942	0.16	92.41	1.8	90.61	675	686	115.0	0.013	***0.4150***	3.51	0.12	90.80	90.62	91.33	91.04	**1.08**
	21	20	89.909	89.747	0.15	91.73	1.8	89.93	675	686	112.0	0.013	***0.4150***	3.40	0.12	90.58	90.42	91.04	90.77	**0.68**
	20	19	89.710	89.619	0.12	94.58	1.8	92.78	675	686	78.0	0.013	***0.4227***	3.04	0.14	90.39	90.29	90.77	90.57	**3.82**
	19	18	89.607	89.455	0.19	94.02	1.8	92.22	675	686	77.0	0.013	***0.4227***	3.83	0.11	90.28	90.13	90.57	90.37	**3.45**
	18	17	89.391	89.307	0.15	92.22	1.8	90.42	675	686	82.0	0.013	***0.4227***	3.40	0.12	90.07	89.98	90.37	90.16	**1.85**
	17	16	89.287	89.137	0.16	94.32	1.8	92.52	675	686	90.5	0.013	***0.4227***	3.51	0.12	89.96	89.81	90.16	89.93	**4.16**
	16	15	89.046	88.991	0.10	92.92	1.8	91.12	675	686	57.0	0.013	***0.4227***	2.78	0.15	89.72	89.67	89.93	89.78	**2.99**
	15	14	88.973	88.876	0.16	96.08	1.8	94.28	675	686	58.0	0.013	***0.4227***	3.51	0.12	89.65	89.55	89.78	89.63	**6.30**
	14	13	88.855	88.696	0.15	97.62	1.8	95.82	675	686	130.2	0.013	***0.4227***	3.40	0.12	89.53	89.37	89.63	89.30	**7.99**
	13	12	88.620	88.513	0.18	95.10	1.8	93.30	675	686	57.0	0.013	***0.4227***	3.72	0.11	89.30	89.19	89.30	89.14	**5.80**
	12	11	88.467	88.282	0.13	95.65	1.8	93.85	675	686	142.8	0.013	***0.4227***	3.17	0.13	89.14	88.96	89.14	88.93	**6.51**
	11	10	88.257	88.084	0.14	96.80	1.8	95.00	675	686	120.8	0.013	***0.4227***	3.29	0.13	88.93	88.76	88.93	88.67	**7.87**
	10	9	87.996	86.545	1.30	90.86	1.8	89.06	675	686	111.9	0.013	***0.4227***	10.01	0.04	88.67	87.22	88.67	87.14	**2.19**

REGIONAL MUNICIPALITY OF DURHAM
SANITARY HGL ANALYSIS
Post-Development Condition

LOCATION/	MANHOLES		INVERT ELEV		Calculated Slope	GROUND	COVER	BASEMENT	Circular Pipe Parameters				TOTAL	Qcap	Qin/	OBV(U/S)	OBV (D/S)	HGL(U/S)	HGL(D/S)	Freeboard
DESCRIPTION	To	From	U/S	D/S		U/S	U/S	U/S	Diameter	Actual Diameter	Length	'n'	FLOW		Qcap	(m)	(m)	(m)	(m)	(m)
			(m)	(m)		(m)	(m)	(m)	(mm)	(mm)	(m)		(cms)	(m^3/s)						
	9	8	86.469	85.962	1.33	90.09	1.8	88.29	675	686	38.0	0.013	***0.4227***	10.13	0.04	87.14	86.64	87.14	85.91	**2.94**
Park Cres	8	7	85.236	84.992	0.32	89.37	1.8	87.57	675	686	75.9	0.013	***0.5190***	4.97	0.10	85.91	85.67	85.91	85.59	**3.46**
Easement	7	6	84.919	81.280	2.87	89.85	1.8	88.05	675	686	127.0	0.013	***0.5193***	14.87	0.03	85.59	81.96	85.59	81.91	**4.25**
Marksbury Rd	6	5	81.237	81.048	0.27	83.95	1.8	82.15	675	686	70.0	0.013	***0.5196***	4.56	0.11	81.91	81.72	81.91	81.64	**2.04**
Easement	5	4	80.963	77.662	2.47	84.60	1.8	82.80	675	686	133.9	0.013	***0.5196***	13.78	0.04	81.64	78.34	81.64	78.26	**2.96**
Lakecrest Dr	4	3	77.580	77.062	0.94	81.41	1.8	79.61	675	686	58.8	0.013	***0.5277***	8.51	0.06	78.26	77.74	78.26	77.71	**3.15**
	3	2	77.032	75.928	1.05	80.52	1.8	78.72	675	686	104.3	0.013	***0.5277***	9.00	0.06	77.71	76.60	77.71	76.57	**2.81**
	2	1	75.891	74.852	0.93	79.64	1.8	77.84	675	686	113.1	0.013	***0.5277***	8.47	0.06	76.57	75.53	76.57	75.49	**3.07**
	1	19	74.810	72.762	1.03	77.96	1.8	76.16	675	686	91.7	0.013	***0.5277***	8.91	0.06	75.49	73.44	75.49	72.99	**2.47**
	19	18A	72.080	72.092	0.10	76.20	1.8	74.40	900	914	24.3	0.013	***0.5277***	6.01	0.09	72.98	72.99	72.99	72.99	**3.21**
	18A	18	72.092	72.005	0.10	75.80	1.8	74.00	900	914	50.2	0.013	***0.5286***	6.01	0.09	72.99	72.91	72.99	72.88	**2.81**
	18	17	71.975	71.950	0.10	76.00	1.8	74.20	900	914	25.0	0.013	***0.6187***	5.98	0.10	72.88	72.85	72.88	72.82	**3.13**
	17	16	71.921	71.843	0.10	76.00	1.8	74.20	900	914	78.0	0.013	***0.6187***	5.98	0.10	72.82	72.74	72.82	72.74	**3.18**
	16	15	71.843	71.760	0.10	76.30	1.8	74.50	900	914	83.5	0.013	***0.6187***	5.98	0.10	72.74	72.66	72.74	72.66	**3.56**
	15	14	71.760	71.616	0.10	76.70	1.8	74.90	900	914	143.0	0.013	***0.6187***	6.01	0.10	72.66	72.52	72.66	72.52	**4.04**
	14	13	71.616	71.486	0.10	76.70	1.8	76.70	900	914	130.0	0.013	***0.6187***	5.98	0.10	72.52	72.39	72.52	72.39	**4.18**
	13	12	71.486	71.356	0.10	76.80	1.8	76.80	900	914	130.0	0.013	***0.6187***	5.98	0.10	72.39	72.26	72.39	72.26	**4.41**
	12	11	71.356	71.233	0.10	76.50	1.8	76.50	900	914	123.5	0.013	***0.6187***	5.98	0.10	72.26	72.13	72.26	72.09	**4.24**
	11	10	71.193	69.949	0.18	76.50	1.8	74.70	900	914	112.2	0.013	***0.6187***	8.00	0.08	72.09	70.85	72.09	70.81	**4.41**
	10	9	69.913	69.782	0.15	76.30	1.8	74.50	900	914	88.9	0.013	***0.6187***	7.25	0.09	70.81	70.68	70.81	70.63	**5.49**
	9	8	69.732	69.580	0.17	76.20	1.8	74.40	900	914	91.5	0.013	***0.6187***	7.70	0.08	70.63	70.48	70.63	70.44	**5.57**
	8	7	69.540	69.382	0.17	76.30	1.8	74.50	900	914	66.6	0.013	***0.6187***	7.84	0.08	70.44	70.28	70.44	70.23	**5.86**
	7	6	69.331	69.307	0.17	76.30	1.8	74.50	900	914	14.0	0.013	***0.6187***	7.82	0.08	70.23	70.21	70.23	70.17	**6.07**
	6	5	69.271	69.164	0.17	75.90	1.8	74.10	900	914	14.0	0.013	***0.6187***	7.77	0.08	70.17	70.06	70.17	70.01	**5.73**
	5	4	69.106	68.956	0.15	75.80	1.8	74.00	900	914	14.0	0.013	***0.6187***	7.42	0.08	70.01	69.86	70.01	69.80	**5.79**
	4	3	68.902	68.811	0.17	76.50	1.8	74.70	900	914	14.0	0.013	***0.6349***	7.75	0.08	69.80	69.71	69.80	69.66	**6.70**
	3	2	68.761	68.706	0.10	76.80	1.8	75.00	900	914	14.0	0.013	***0.6349***	5.98	0.11	69.66	69.61	69.66	69.56	**7.14**
	2	1	68.657	68.630	0.10	76.8	1.8	75	900	914	14.0	0.013	***0.6349***	6.04	0.11	69.56	69.53	69.56	0.00	**7.24**

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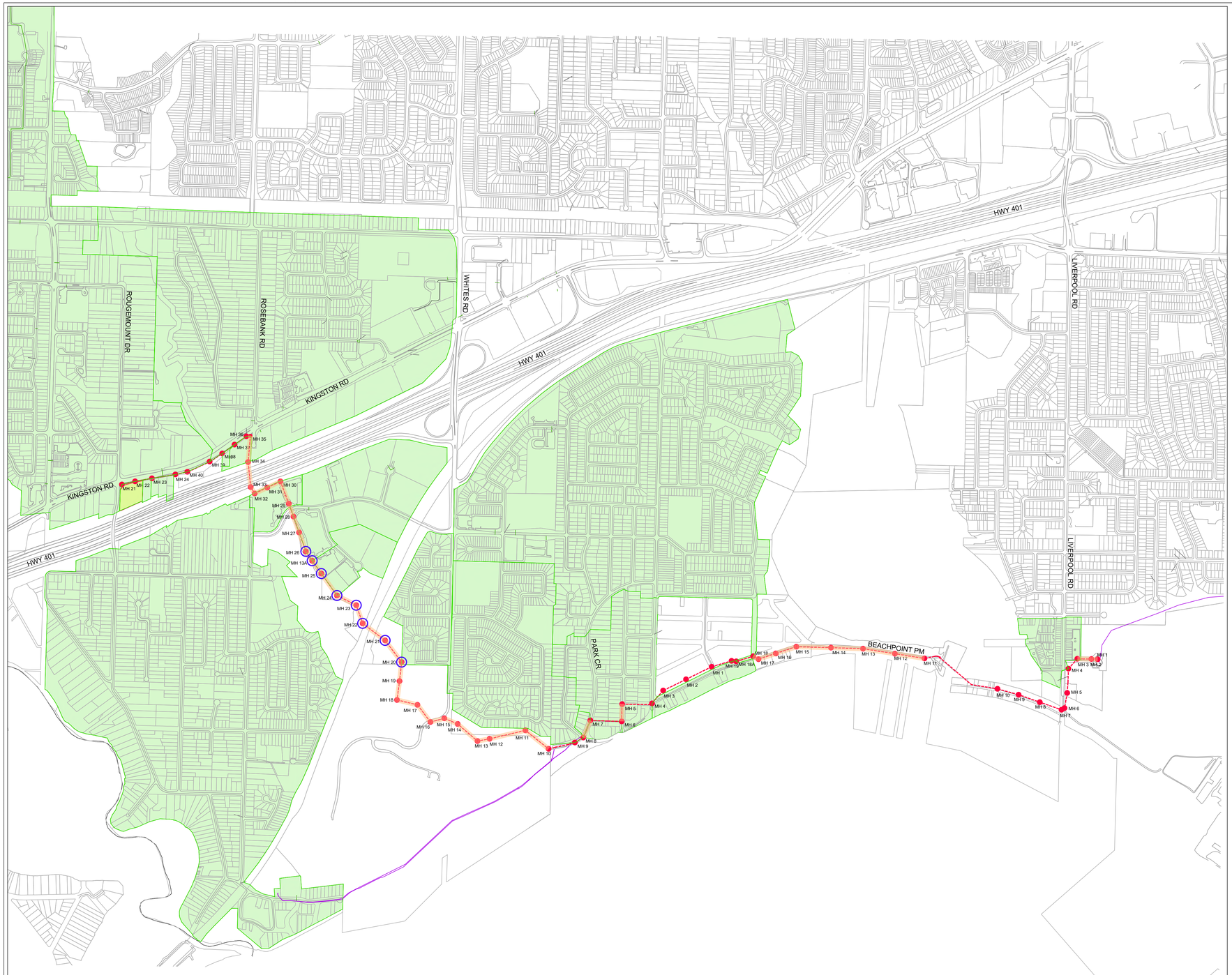
Janaani Pathmanapan



375 KINGSTON ROAD
CITY OF PICKERING

LEGEND

- SUBJECT SITE
- SUBSEWERSHED AREA
- EXISTING DOWNSTREAM SANITARY SEWER
- MANHOLE
- SURCHARGING PIPE
- HGL CONSTRAINTS

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE B-1
PRE-DEVELOPMENT
SANITARY SEWER CONDITIONS

2021-5093	DECEMBER 2021	SCALE: N.T.S.

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Janaani Pathmanapan

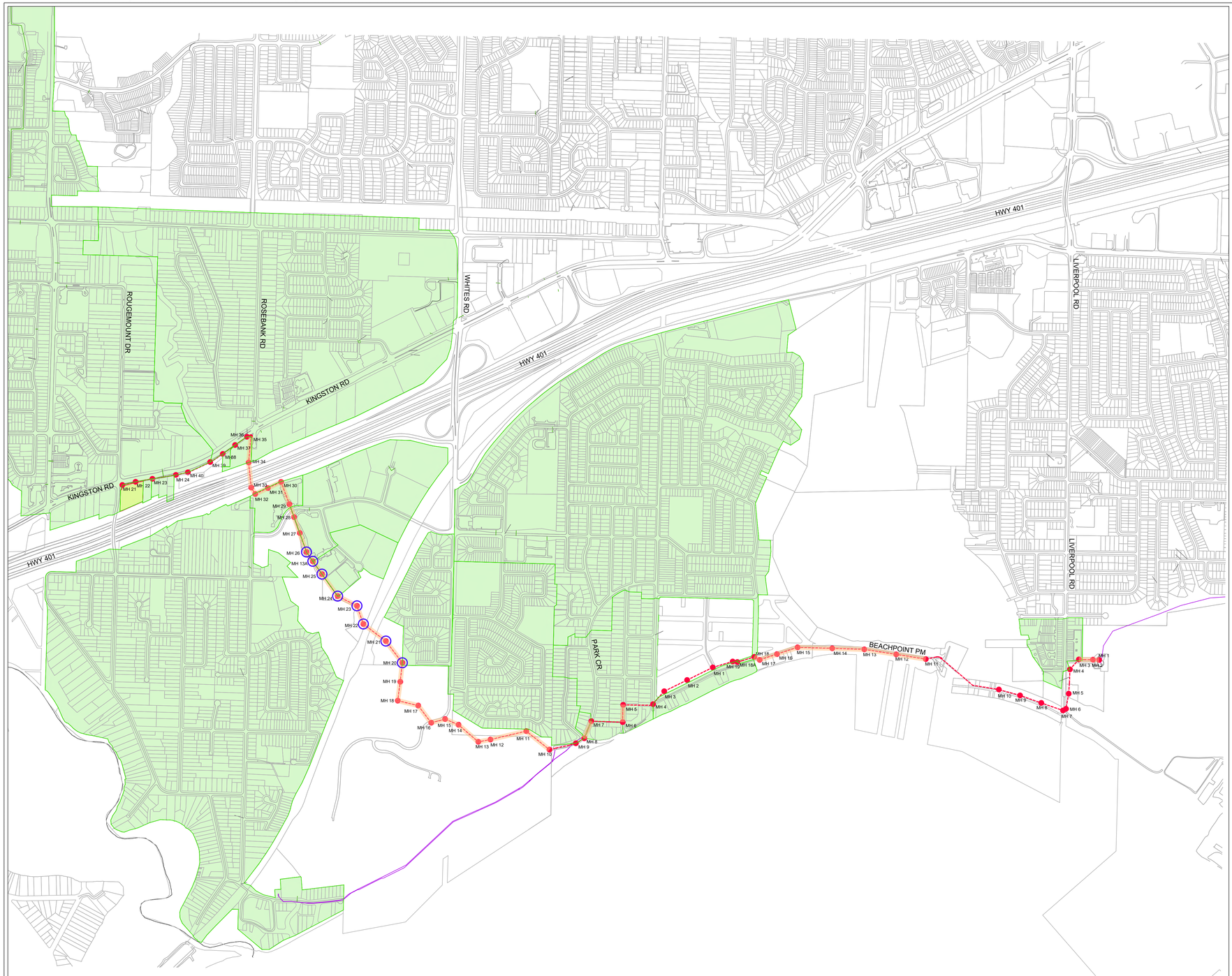

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FIGURE B-2
POST-DEVELOPMENT
SANITARY SEWER CONDITIONS

2021-5093	DECEMBER 2021	SCALE: N.T.S.

Appendix C

Water Supply Servicing

Water Supply Calculation Total Site

Project: 375 Pickering

Project No: 5093

Municipality: City of Pickering

Fire Protection:	10000	litres/minute
Average Shopping Center Demand:	5000	L / day / 1000m^2
Average Residential Daily Demand:	450	litres/capita/day

Average Daily Demand

Land Use	Population / Area(ha)	Average Day Demand (l/s)
Residential	1096	**5.71**
Commercial	0.15	**0.09**
	Total	**5.80**

Max Daily Demand*

Land Use	Population / Area(ha)	Peaking Factor	Max Day Demand (L/s)
Residential	1096	2.75	**15.70**
Commercial	0.15	2.75	**0.24**
		Total	**15.94**

Peak Hour Demand*

Land Use	Population / Area(ha)	Peaking Factor	Max Hour Demand (L/s)
Residential	1096	4.13	**23.58**
Commercial	0.15	4.13	**0.37**
		Total	**23.94**

*Peaking factors based on MOE 2008 Drinking Water System Guidelines

Max Day + Fire Flow

Land Use	Average Day Demand (L/s)	Max Hour Demand (L/s)	Max Day Demand (L/s)	Fire Flow (L/s)	Total Flow (L/s)
Total	5.80	**23.94**	**15.94**	150.00	**165.94**

As per City of Pickering Design Criteria for Sewers and Watermains.
Commercial Water Supply Demand assumed to be equivalent to Sanitary Demand.

FUS Fire Flow 375 Kingston Road

A = Type of Construction

Type of Construction:	C	Description
Wood Frame	1.5	(essentially all combustible)
Ordinary	1	(brick/masonry walls, combustible interior)
Non-Combustible	0.8	(unprotected metal structure, masonry/metal walls)
Fire-Resistive	0.6	(fully protected frame, roof, floors)

Construction Coefficient: **0.8**

B = Largest Floor

Area: 2540 square metres (of largest floor)

C = Height (storeys)

Height: 31 Storeys

D = Fire Flow (000's)

GFA*	3,561	square metres
Construction Type	0.8	
Fire Flow	10,503	L/min.

*Above ground GFA = See Architect Drawing A1-01 and Site Statistics

-> Fire Flow **11,000 L/min.**

Note: FUS guide specifically states round off to 1000's

E = Occupancy Factor

Fire Hazard of Contents	**Charge**
Non-Combustible	-25%
Limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Burning	25%

Occupancy Factor -15%

Fire Flow **9,350 L/min.**

F = Sprinkler Factor

Sprinkler System	**Charge**
n/a	0%
NFPA 13 System	-30%
Fully Supervised System	-50%

Sprinkler Factor: -30%

G = Exposure Factor As per FUS, Water Supply for Public Fire Protection (2019)

Separation	**Maximum Charge**
0 to 3 m	25%
3.1 to 10 m	20%
10.1 to 20 m	15%
20.1 to 30 m	10%
Over 30m	0%

Category	Separation	Exposed Face Area	Construction Type	Charge
North	>30 meters			0%
West	25 meters	1-storey 32m => Length:Height Ratio > 100	Type V - Wood Frame	10%
South	>30 meters			0%
East	16 meters	1-storey 15m => Length:Height Ratio = 60	Type V - Wood Frame	12%

*See attached Exposure Factor Table for detailed selection

Exposure Factor 22% (no more than 75%)

H - Net Fire Flow Required

	Charge
F + G Factors	-8%

8602 L/min.

Fire Flow: 9000 L/min.

Note: FUS guide specifically states round off to 1000's

150 L/s

2378 USGPM

FUS Exposure Table

Location:

Project:

Table 6 Exposure Adjustment Charges for Subject Building considering Construction type of exposed building face

Distance (m) to the Exposure	Length-height factor of exposing building face	Type V	Type III-IV[2]	Type III-IV[3]	Type I-II[2]	Type I-II[3]
0 to 3	0-20	20%	15%	5%	10%	0%
	21-40	21%	16%	6%	11%	1%
	41-60	22%	17%	7%	12%	2%
	61-80	23%	18%	8%	13%	3%
	81-100	24%	19%	9%	14%	4%
	Over 100	25%	20%	10%	15%	5%
3.1 to 10	0-20	15%	10%	3%	6%	0%
	21-40	16%	11%	4%	7%	0%
	41-60	17%	12%	5%	8%	1%
	61-80	18%	13%	6%	9%	2%
	81-100	19%	14%	7%	10%	3%
	Over 100	20%	15%	8%	11%	4%
10.1 to 20	0-20	10%	5%	0%	3%	0%
	21-40	11%	6%	1%	4%	0%
	41-60	12%	7%	2%	5%	0%
	61-80	13%	8%	3%	6%	1%
	81-100	14%	9%	4%	7%	2%
	Over 100	15%	10%	5%	8%	3%
20.1 to 30	0-20	0%	0%	0%	0%	0%
	21-40	2%	1%	0%	0%	0%
	41-60	4%	2%	0%	1%	0%
	61-80	6%	3%	1%	2%	0%
	81-100	8%	4%	2%	3%	0%
	Over 100	10%	5%	3%	4%	0%
Over 30 m	all sizes	0%	0%	0%	0%	0%

Note:

- **Type V** Wood Frame Construction
- **Type IV** Heavy Timber Construction
- **Type III** Ordinary Construction
- **Type II** Noncombustible Construction
- **Type I** Fire Resistive Construction

Reference : *Water Supply for Public Fire Protection, A Guide to Recommended Practice in Canada,* FUS, 2019

375 Kingston Road

Project No. 5093

Test 1 - Durham Region

Flow Test Results of October 29, 2021

Location: Residual: PE29

Flow: PE30

Test Results			
Flow US. GPM	Residual Pressure psi	Flow L/s	Residual Presure kPa
0	93.2	0	643
502.3	91.2	32	629
648.5	87.3	41	602
1108	85.3	70	589

For a total required flow demand of **150 l/s** the equivalent residual pressure is

419 **kPa**

61 **psi**

For a residual pressure of **20 psi** or **140 kPa** the equivalent flow is

232 **L/s**

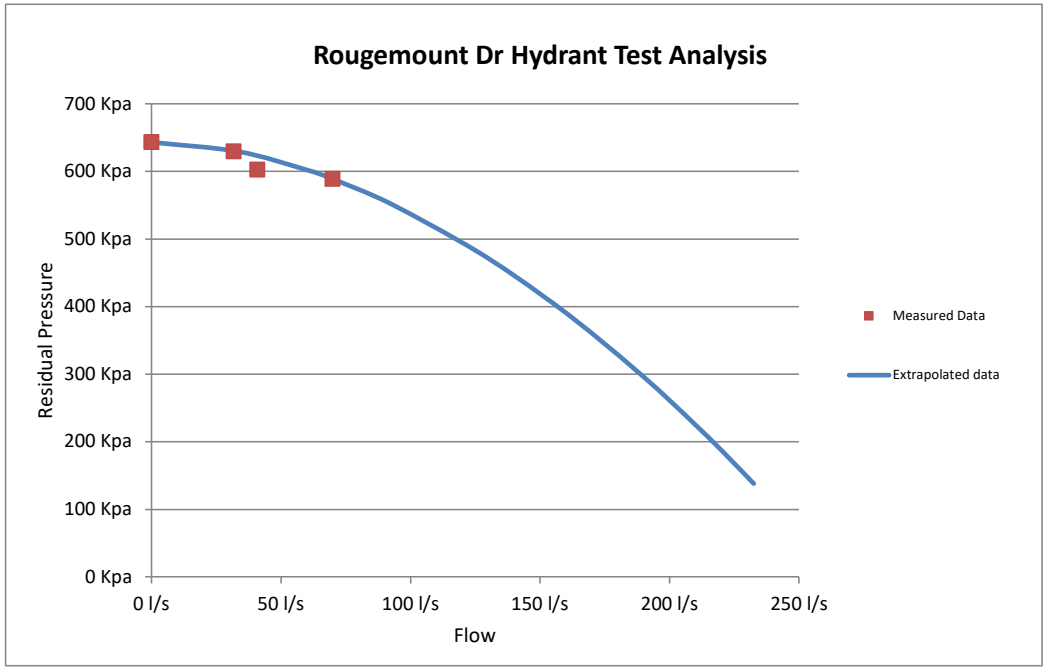
3678 **USGPM**

3062 **IGPM**

1 USG = 3.785 litres

1 IG = 4.546 litres

1 psi = 6.9 kpa



Appendix D

Background Reports

DESIGN CALCULATION

Stormwater Detention Facilities
Rougemount Drive - Commercial Development
Town of Pickering

Design Criteria : Zero increase in stormwater runoff
(10 - Year predevelopment flow condition)

Stormwater Detention methods :

1. Roof Top Detention
2. Surface Detention
3. Underground Detention

Pre-development Flow For Ex. CB on HYw 2

Drainage Area = 0.082 ha (0.203 acres)
Runoff Coefficient (asphalt paved) C = 0.90
Assume t_c = 5 min, I_{10} = 138 mm/hr
Apply Q = 0.0028 CIA

$\therefore$ Q = 0.0028 (0.90) (138) (0.082)
= 0.0285 m^3/s (1.01 cfs)

Roof Top Storage

The drainage for the commercial building will be designed on the basis of using controlled flow roof drains.

Site area : 1.86 acres
Roof area : 23,570 sq. ft.

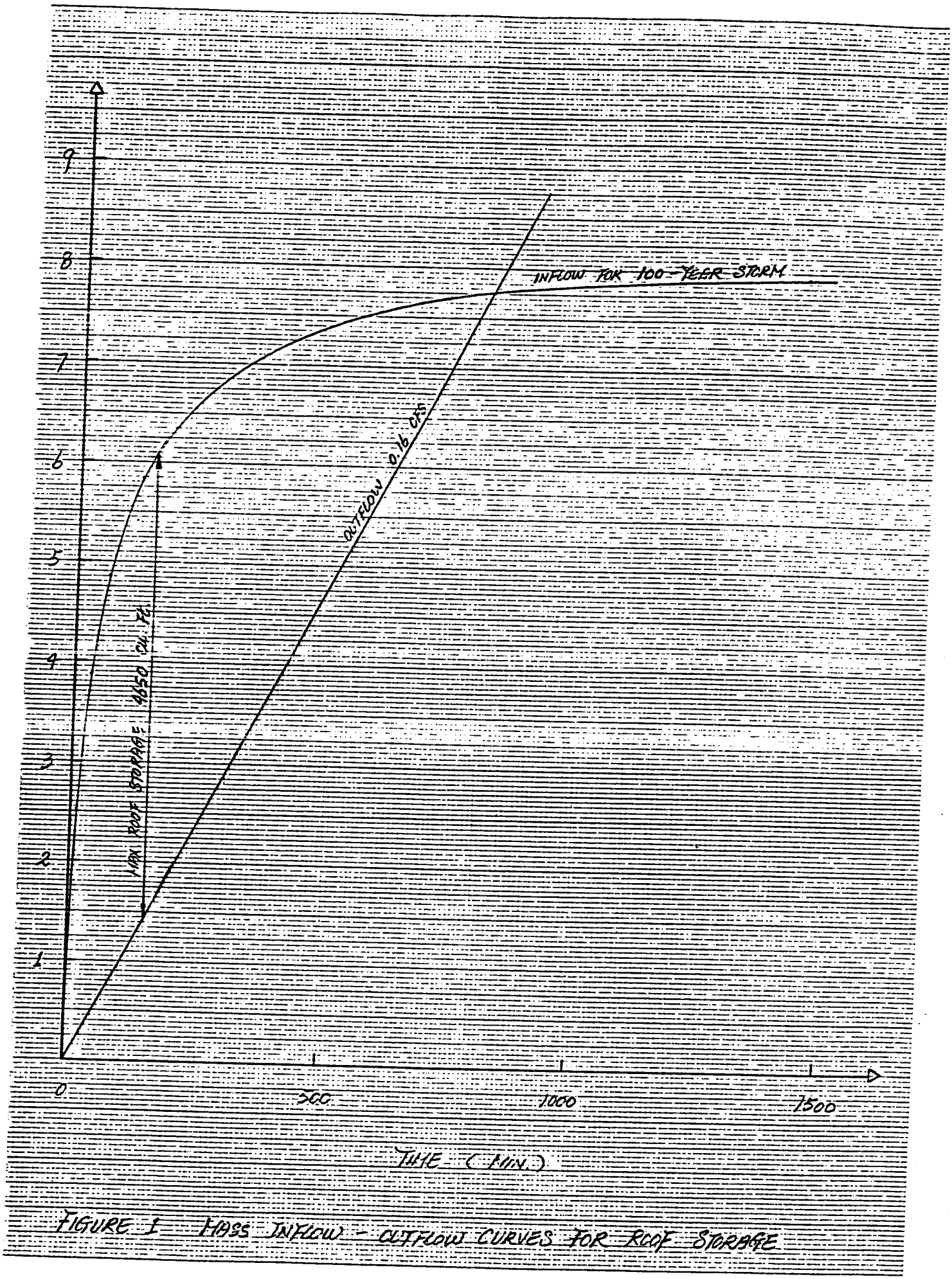
$$A \times R = \frac{23,570}{43,560} \times 1.0 = 0.54$$

Mass Inflow Curve Determination

The development of the mass inflow curve for the 100-year storm followed the method used by the Engineering Research and Development Bureau, New York State Department of Transportation, Research Report 69-2.

This method makes use of the intensity duration curves and the simple rainfall-runoff relationship $Q = CIA$. This method when used in combination with the Rational method should be restricted to small catchment areas, such as roof tops and parking lots and areas should not exceed 20 acres [2].

Time (min)	AR	I (in/hr)	Time (Sec.)	Volume (Cu. ft.)
5	0.54	11.25	300	1,822
10	0.54	7.90	600	2,560
15	0.54	6.10	900	2,964
30	0.54	4.00	1800	3,888
60	0.54	2.50	3600	4,860
120	0.54	1.50	7200	5,832
360	0.54	0.60	21600	6,998
720	0.54	0.33	43200	7,698
1440	0.54	0.17	86400	7,931



METRIC

FIGURE 1 MASS INFLOW - OUTFLOW CURVES FOR ROOF STORAGE

These volumes are plotted on the mass inflow-outflow diagram for roof storage (Figure 1). In order to meet the Plumbing Code, four roof drains are required for this roof area. Based on a common type of controlled flow roof drain, a flow rate of 18 gpm (u.s.) per weir is selected. Minimum outflow rate is therefore 4×18 gpm = 72 gpm = 0.16 cfs. This rate is plotted on the diagram (Figure 1) as mass outflow. The maximum ordinate between the two curves is scaled to be 4,650 cu. ft. equivalent to a maximum of 2.37 inches of depth, safely below the 7.7 inches maximum, equivalent to a 40 psf snow load.

In order to establish the effect of this storage on the total commercial site, particularly as it relates to "zero increase in peak runoff", the following calculations are made:

		A	R	AR
Site area	=	1.86 acres		
Roof area	=	0.54 acres		
Parking area	=	1.206 acres	0.90	1.085
Landscaped areas	=	0.114 acres	0.25	0.028
				1.113

Maximum release rate = 1.01 cfs (10 yr. storm predevelopment conditions)

Volume Calculations

Time (min)	BR	I (in/hr)	Time (Sec.)	Volume (cu.ft.)	Roof Disch. 0.16 cfs	Total Disch. (cu.ft.)	Permitted Release (cu.ft.)
5	1.113	11.25	300	3756	48	3804	303
10	1.113	7.90	600	5275	96	5371	606
15	1.113	6.10	900	6110	144	6254	909
30	1.113	4.00	1800	8013	288	8301	1818
60	1.113	2.50	3600	10017	576	10593	3636
120	1.113	1.50	7200	12020	1152	13172	7272
360	1.113	0.60	21600	14424	3456	17880	21816
720	1.113	0.33	43200	15867	6912	22779	43632
1440	1.113	0.17	86400	16348	13824	30172	87264

The total discharge volume, when compared to the equivalent discharge from a 10-year storm for predevelopment conditions, indicates a maximum storage requirement of about 7,000 cu.ft. (See Figure 2) at 50 minutes.

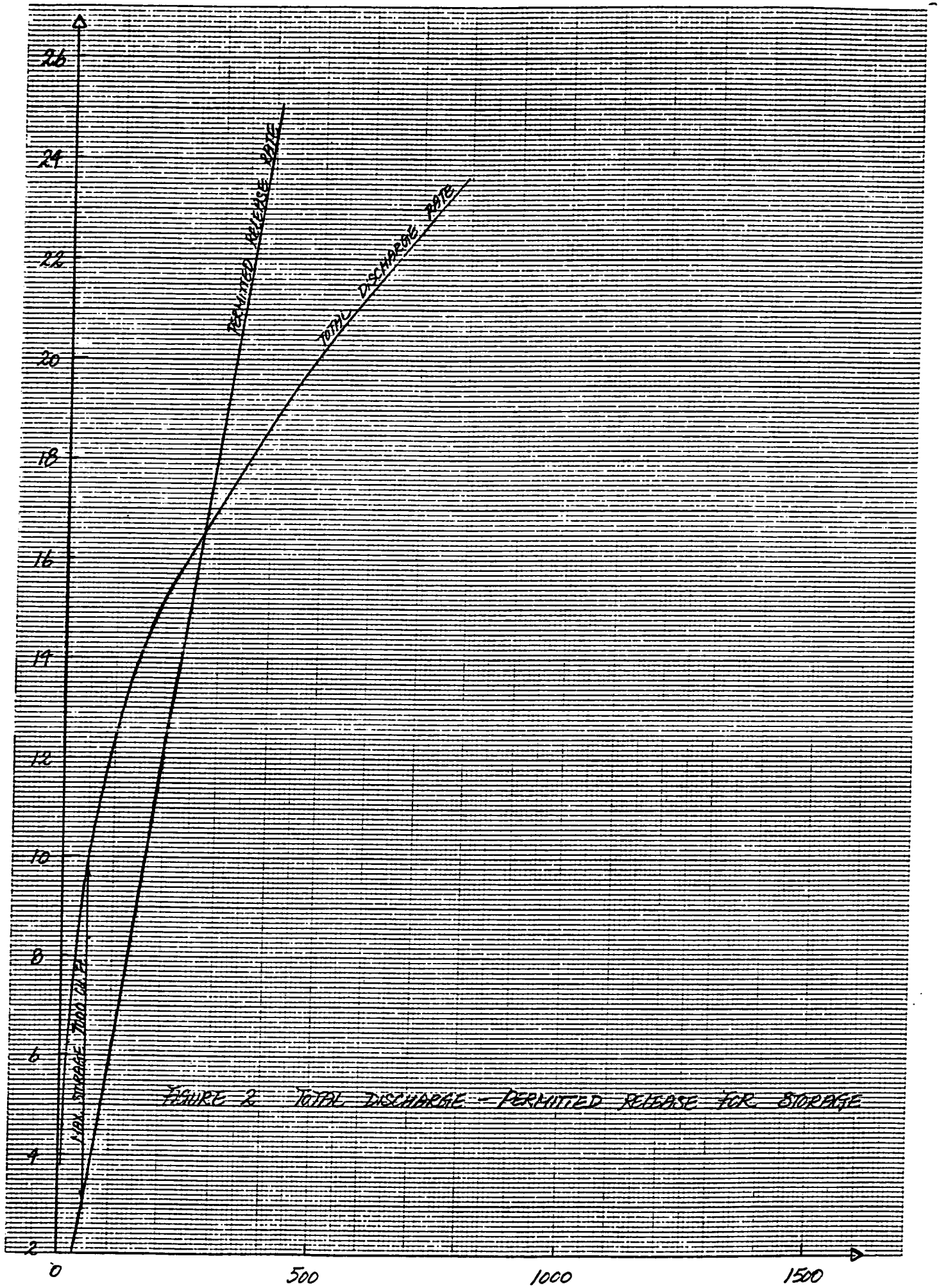


FIGURE 2 TOTAL DISCHARGE - PERMITTED RELEASE FOR STORAGE

Surface Detention

The storage capacity of the parking lot is evaluated and summarized as follows:

Depth of Ponding (in)	Storage Volume (cu. ft.)
4"	570
6"	1,600
8"	3,740
12"	12,225

The parking lot is graded with a minimum gradient of 0.7% and the depth of ponding would vary with the distance from the inlet catchbasins. A maximum ponding depth of about 9.75" on the parking lot would provide the required storage of 7,000 cu.ft. Therefore, no underground storage is required in this case.

MAIN PARKING AREA

METRIC

8" PONDING.

STA	AREA	AVG AREA	VOLUME
0+025	0.0		
		0.346	1.730
0+020	0.692		
		1.034	5.168
0+015	1.375		
		1.780	8.900
0+010	2.185		
		2.491	12.455
0+005	2.797		
		3.079	15.393
0+000	3.360		
		2.987	14.935
0-005	2.614		
		1.667	8.333
0-010	0.719		
		0.360	1.798
0-015	0.0		
			68.709 m³ (2426.44 ft³)

6" PONDING

AREA	AVG AREA	VOLUME
0.0		
	0.140	0.700
0.280		
	0.572	2.858
0.863		
	1.174	5.868
1.484		
	1.672	8.360
1.860		
	1.516	7.580
1.172		
	0.586	2.930
0.0		
		28.296 m³ (999.3 ft³)

4" PONDING

AREA	AVG AREA	VOLUME
0.0		
	0.054	0.270
0.107		
	0.346	1.730
0.585		
	0.715	3.575
0.845		
	0.725	3.625
0.604		
	0.302	1.510
0.0		
		10.710 m³ (378.22 ft³)

South Parking Area.

METRIC

STA	8" Ponding. Area	Avg. Area	Volume	6" Ponding. Area	Avg. Area	Volume	4" Ponding. Area	Avg. Area	Volume
0+030	0.0								
		0.039	0.195						
0+025	0.078			0.0					
		0.238	1.188		0.008	0.040			
0+020	0.397			0.016					
		0.488	2.438		0.088	0.440			
0+015	0.578			0.160			0.0		
		0.718	3.590		0.276	1.380		0.029	0.143
0+010	0.858			0.392			0.057		
		1.024	5.120		0.539	2.695		0.163	0.813
0+005	1.190			0.686			0.268		
		1.328	6.640		0.811	4.053		0.373	1.865
0+000	1.466			0.935			0.478		
		1.315	6.575		0.801	4.003		0.362	1.808
0-005	1.164			0.666			0.245		
		0.996	4.980		0.514	2.570		0.148	0.738
0-010	0.828			0.362			0.050		
		0.691	3.455		0.256	1.280		0.025	0.125
0-015	0.554			0.150			0.0		
		0.399	1.993		0.105	0.525			
0-020	0.243			0.006					
		0.152	0.758		0.003	0.015			
0-025	0.060			0.0					
		0.030	0.150						
0-030	0.0								
			37.082			17.001 m^3			5.492 m^3
			(1309.5 ft^3)			(600.4 ft^3)			(193.9 ft^3)

DATE
PROJECT
PROJECT NO.

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SOUTH PARKING AREA.

STA.	AREA.	AVG. AREA	VOLUME
0+035	0		
		0.369	1.845
0+030	0.738		
		0.875	4.375
0+025	1.012		
		1.232	6.158
0+020	1.451		
		1.567	7.835
0+015	1.683		
		1.848	9.240
0+010	2.013		
		2.188	10.940
0+005	2.363		
		2.514	12.568
0+000	2.664		
		2.502	12.510
0-005	2.340		
		2.160	10.800
0-010	1.980		
		1.821	9.103
0-015	1.661		
		1.465	7.323
0-020	1.268		
		1.107	5.533
0-025	0.945		
		0.756	3.778
0-030	0.566		

MAIN PARKING AREA.

STA.		
0		
	0.840	4.198
1.679		
	2.290	11.450
2.901		
	3.693	18.465
4.485		
	4.751	23.753
5.016		
	5.366	26.828
5.715		
	6.192	30.958
6.668		
	6.949	34.745
7.230		
	6.843	34.213
6.455		
	5.919	29.593
5.382		
	4.013	20.063
2.643		
	1.322	6.608
0		
		240.874 m³
		(8506 ft³)

CONT'D SHEET 3

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ENGINEERS

DATE _____

PROJECT _____

PROJECT NO. _____

STA.	AREA.	AVG. AREA	VOLUME
0-030	0.566		
		0.438	2.188
0-035	0.309		
		0.191	0.953
0-040	0.072		
		0.036	0.180
0-045	0		

105.329 m^3
(3719.7 ft^3)

FIGURE 3 PARKING LOT STORAGE - PONDING DEPTH RELATIONSHIP

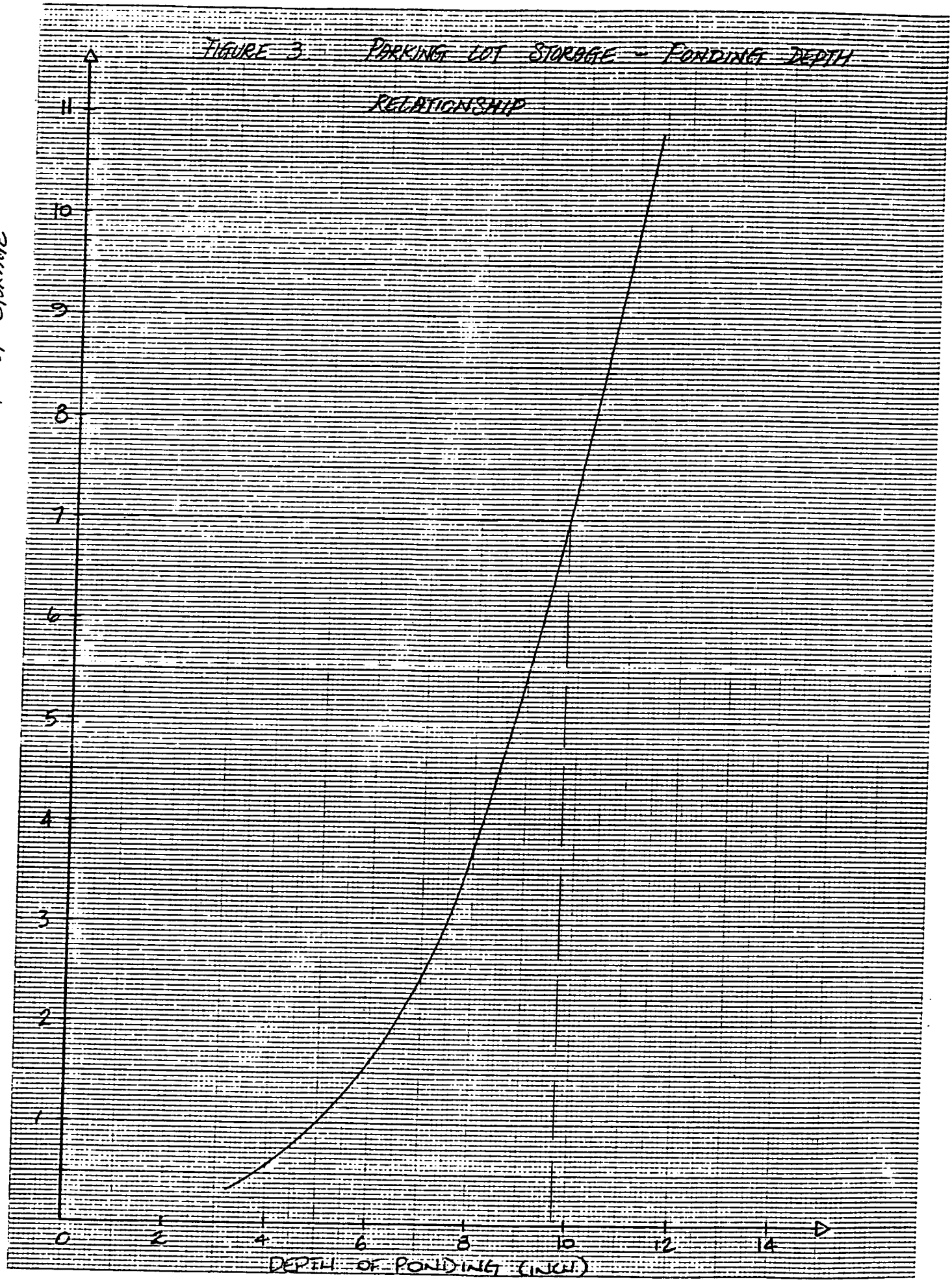
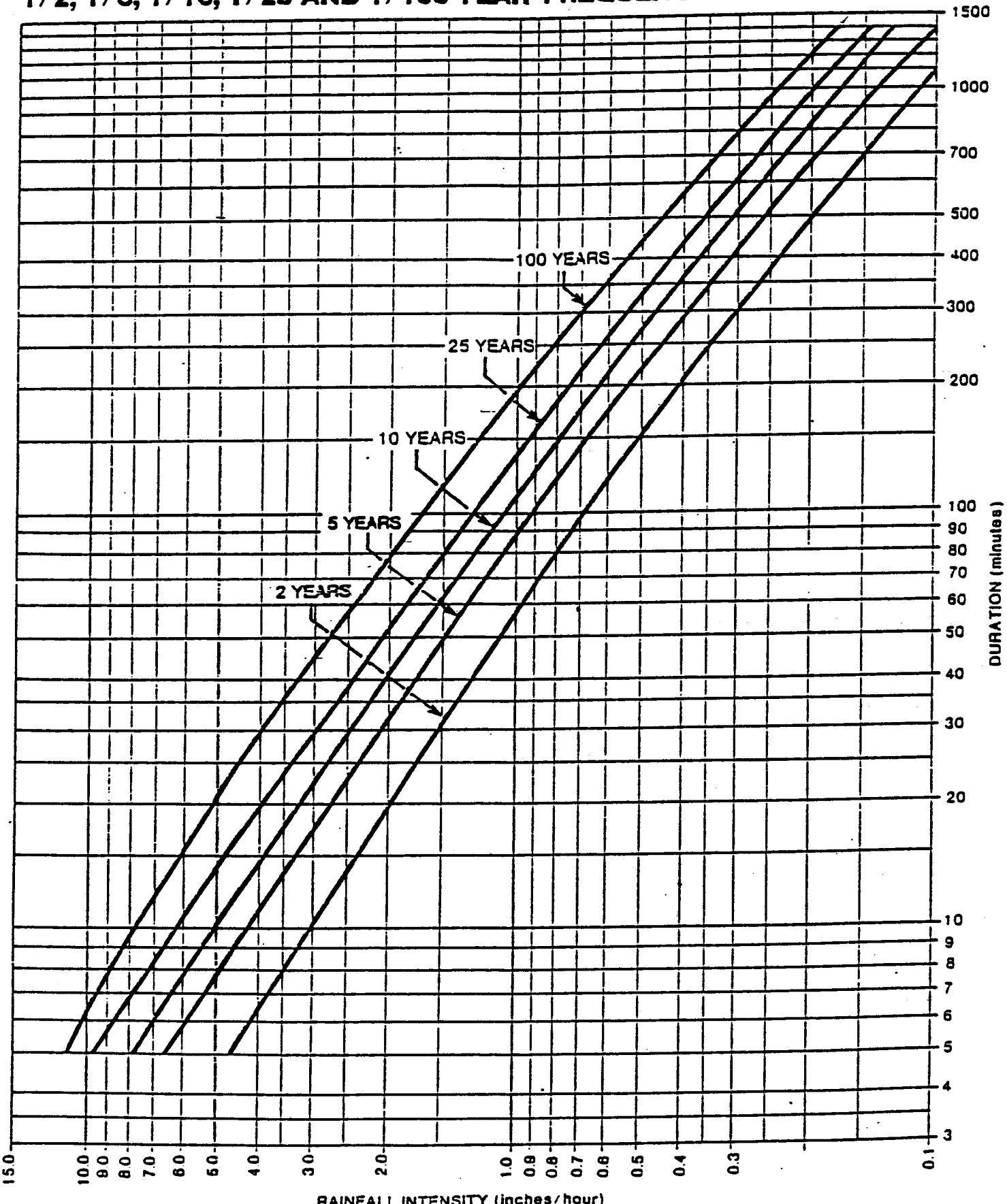


TABLE 1 RAINFALL INTENSITY DURATION FREQUENCY

Time (min)	100 - YEAR RETURN (in/hr)
5	11.25
10	7.90
15	6.10
20	5.11
25	4.50
30	4.00
35	3.57
40	3.28
45	3.00
50	2.75
55	2.62
60	2.50
65	2.30
70	2.20
75	2.10
80	2.00
85	1.86
90	1.80
95	1.77
100	1.74
125	1.45
150	1.28
175	1.12
200	0.99

Figure A1

INTENSITY-DURATION-FREQUENCY CURVE FOR 1/2, 1/5, 1/10, 1/25 AND 1/100 YEAR FREQUENCIES



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1. Paul Theil Associates Limited : "Urban Drainage Design For New Development". Modern Concepts in Urban Drainage Conference Proceedings No. 5, 1977.

2. H. B. Poertner : A.P.W.A. Special Report No. 43.

Appendix E

Engineering Drawings