FUNCTIONAL SERVICING/ STORMWATER MANAGEMENT REPORT

484 & 490 Plains Road East Residential Development

City of Burlington
City File #:

Halton Region
Region File #:

Prepared for:

National Homes (Plains Road) LP

Project #: 17-527

October 17, 2017

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1. INTRODUCTION

Urbantech Consulting has been retained by National Homes (Plains Road) LP, herein referred to as NH, to prepare a Functional Servicing/Stormwater Management Report in support of a zoning by-law amendment application associated with their combined 1.84 Ha. property comprised of #484 & #490 Plains Road East in the City of Burlington, Halton Region.

The current site plan concept proposes development of:

- 2 residential condominium towers 8 storeys in height and containing 280 residential suites;
- 7 residential condominium townhouse stacked back to back blocks 3 storeys in height and containing 117 residential suites;
- Surface parking (including lay-by parking on Plains Road East) as well as an underground parking level.

Refer to the current **Site Plan** by Kirkor Architects + Planners for additional details.

This report provides an assessment of the impact of the current site plan concept on existing infrastructure. The concepts presented in this report are in general conformance with the latest standards and criteria prepared by the City of Burlington (roads, grading and storm drainage) and Halton Region (water distribution and sanitary drainage).

2. BACKGROUND INFORMATION

The NH property is located on the south side of Plains Road East between Falcon Boulevard & Sanford Drive. Fronting Plains Road East, existing commercial developments neighbour the property to the west and east and Maplehurst Public School is located directly across. Existing residential development (off Glen Acres Court, Nora Drive & Atkins Place) abut the flankages and rear of the property.

The property is understood to be outside of Conservation Halton's Regulated Area.

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3. EXISTING CONDITIONS

Since the 1970's, the NH property has been occupied by a commercial development consisting of three large buildings with extensive surface parking. Three (3) separate vehicular access points exist, including a central, signalized intersection with Plains Road East that is proposed to be maintained.

Much of the existing infrastructure within the MG property is not compatible with the current site plan concept and is proposed to be removed.

Drawing REM illustrates the overall existing conditions as well as proposed removals.

WSP has conducted a Geotechnical Investigation of the NH property. The following section summarizes its conclusions and recommendations.

3.1. Soil/Subsurface Conditions

The stratigraphy of the site is generally uniform, comprised of an existing pavement structure overlying loose silty sand fill material. Native soil consists of silty sand underlain by silty clay (till).

Groundwater was recorded at depths of 3.0 – 4.6m, fluctuating seasonally and during storm events.

WSP has recommended the removal/engineering of all existing loose fill material where settlement cannot be tolerated.

4. SANITARY SERVICING

Sanitary servicing is proposed to consist of a single reconstructed connection from the parking garage to the existing manhole (#13534) & 250mm sanitary main located in the south boulevard of Plains Road East and leading west to Falcon Boulevard and onward south ultimately to the Burlington Skyway Wastewater Treatment Plant.

The depth of this existing main is not anticipated to be sufficient to support gravity flows in which case private sanitary pumping will be required from the underground parking level.

Sanitary servicing will be internally distributed within the underground parking level in accordance with detailed mechanical design.

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Based upon the latest standards and criteria prepared by Halton Region, the current site plan concept projects a population of 774 and peak residential flow of 10.10 L/s calculated as follows:

- 1.84 Ha. * 420 equivalent residential persons/Ha. = 774 persons @ 275 L/person/day + peaking factor and infiltration allowances = 10.10 L/s.

(Where 420 equivalent residential persons/Ha. represents the combination of Halton Region standard 6 storey apartment and townhouse flows.

No connection is proposed to the existing 200mm sanitary main located in the north boulevard of Plains Road East.

To assess the impact of the proposed increase in sanitary flow, an approximate sanitary sewer design sheet has been prepared to Falcon Boulevard and enclosed in **Appendix A**. This design sheet also reflects the latest standards and criteria prepared by Halton Region for generating sanitary flows. The design sheet confirms that the existing sanitary outfall has capacity to accept the proposed flow increase for conveyance to Falcon Boulevard. We request the Region review their sanitary sewer system from Falcon Boulevard downstream to confirm same based upon the above projected flows.

The pre-consultation meeting request for Closed Circuit Television (CCTV) condition assessment inspection of the proposed sanitary outfall to Falcon Boulevard is acknowledged and will be addressed at the site plan approval stage.

Drawing SP illustrates the proposed sanitary servicing scheme for the proposed NH development.

5. WATER SERVICING

The NH property is located within the Halton Region zone B1A pressure district. Water servicing is proposed to consist of a 200mm fire & domestic watermain service connection to the existing 150mm water service to #484 Plains Road East.

This existing water service is connected to an existing 300mm local watermain in the north boulevard of Plains Road East with cross-connection to an existing 400mm trunk watermain located in the southernmost driving lane of Plains Road East.

No connection is proposed to the existing 600mm trunk watermain located along the centerline of Plains Road East.

Water servicing will be internally distributed within the underground parking level in accordance with detailed mechanical design.

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Municipal Engineering Solutions (MEP) has completed a preliminary Water Analysis of the NH property enclosed in **Appendix B**.

MEP's analysis indicates that satisfactory operating pressures and fire flows are available to service the proposed development under average day, maximum day, peak hour and maximum day + fire demand scenarios.

MEP's analysis, including existing hydrant flow testing, will be updated at detailed design stage in support of the site plan concept. We request the Region confirm additional requirements (if any) associated with connection to their distribution system.

In accordance with the Region's Multiple Unit Servicing Policy, individual metered water service connections with backflow prevention will be provided to residential customers as dictated by billing requirements. It is currently anticipated that a single condominium corporation is to handle all billing.

It is anticipated that the two towers will include a sprinkler system and fire department connections. Existing hydrant coverage on Plains Road East requires supplemental coverage by multiple private hydrants to satisfy Ontario Building Code criteria for separation from proposed building faces (90m) and fire department connections (45m).

Drawing SP illustrates the proposed water distribution scheme for the proposed NH development.

6. STORMWATER MANAGEMENT

Storm servicing is proposed to consist of a single reconstructed connection from the parking garage to the existing catchbasin manhole & 525mm storm main located within a 10' easement between #945 & #946 Nora Drive and leading south on Nora Drive to Townsend Avenue and onward ultimately to a regulated watercourse within the Burlington Golf & Country Club.

Storm servicing will be internally distributed within the underground parking level in accordance with detailed mechanical design.

No connection is proposed to the existing storm main located in the south boulevard of Plains Road East.

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6.1. Existing Conveyance

Currently, minor system flows are primarily directed to Nora Drive, with only an approximately 0.16 Ha. portion in the northwest corner of the property directed to an existing 375mm storm connection to Plains Road East.

Major system flows are directed by surface grading to the 10' easement.

Both existing minor and major system conveyance appears to be undersized by present day standards.

Drawing STM-1 illustrates existing, pre-development storm servicing and drainage for the proposed NH development.

6.2. Minor & Major Systems, Quantity/Quality Control

Primarily, minor & major system flows is proposed to be captured by catchbasins/area drains and conveyed through the underground parking level to the proposed outfall. Only the southernmost portion of the proposed development is proposed to by-pass the underground parking level and contribute directly to the outfall.

Suitable enhanced level quality (long-term average removal of 80% Total Suspended Solids) is proposed; this can be accomplished by an oil/grit separator (STC-9000 or equivalent).

Quantity control during all storm events will be required within the underground parking level (assumed 'Tank' to be in accordance with detailed mechanical design). The depth of this existing main is not anticipated to be sufficient to support gravity flows in which case private pumping will be required from the underground parking level.

Quantity control requirements are based upon control of all events to the lesser of the 5-year existing flow or the capacity of the existing outfall. Based on VO5 hydrologic modelling included in **Appendix C**, it is found that existing 5-year flow to the Nora Drive outfall exceeds the capacity of the existing 525mm storm sewer (based on Manning's equation). The overall target for the site is therefore equal to the capacity of the existing 525mm storm main, and the target for the pumped tank discharge is the capacity of the 525mm sewer less the uncontrolled flows by-passing the underground parking level:

- Q_{target} (525mm STM. @ 0.70%) = 0.374 m^3/s;
- $Q_{uncontrolled}$ (southernmost portion of proposed development) = 0.062 m^3/s;
- $Q_{max\ controlled}$ (from underground parking level) = 0.312 m^3/s;
- $Q_{release}$ (from the proposed development during all events) <=0.374 m^3/s.

The modelling of the 'tank' assumed that the pump can discharge a constant flow at all stages/volumes. The resulting storage requirement to meet the target flow is

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approximately 230m^3. This storage will be provided within the underground parking level in accordance with detailed mechanical design.

The existing overland flow route within a 10' easement between #945 & #946 Nora Drive is proposed to be abandoned.

6.3. External Drainage

Currently, the NH property receives surface drainage from the south boulevard of Plains Road East. It is proposed to re-grade the City's boulevard such that public drainage is entirely directed towards the right-of-way. In addition, a small (0.05 Ha.) landscaped portion of private drainage (surface drainage between buildings A & B and Plains Road East) is also to be directed to the Town's right-of-way as it is not practical to capture this drainage internally.

This proposed drainage area is considerably less than the existing drainage area draining to Plains Road via the existing 375mm storm sewer.

6.4. Infiltration Measures

WSP's Geotechnical Investigation suggests that existing soils exhibit infiltration rates suitable for infiltration of storm water runoff and therefore suitable to the implementation of lot-level grading and low-impact development (LID) strategies to mitigate post-development surface runoff. However, implementing such strategies within the NH property is challenged by the large underground parking level footprint.

If necessary, subject to detailed design and detailed geotechnical and hydrogeological support, the following LID techniques could potentially be implemented within perimeter landscaping:

- Bioretention swales – Rear yard swales could be designed as bioswales to infiltrate lawn runoff. The conventional rear yard drainage system would still be required to ensure adequate conveyance;
- Soakaway pits/infiltration trenches;
- Cistern storage/stormwater re-use for irrigation;
- Increased topsoil depth – Could be utilized to increase the infiltration capability of the native soil in landscaped areas.

Controlled rooftop drainage anticipated to be available and is the most suitable source of runoff to direct to LID features as it is considered to be clean water not requiring pre-treatment for quality control.

Drawing STM-2 illustrates the proposed storm servicing and drainage scheme for the proposed NH development.

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7. GRADING DESIGN

Proposed grading will take into consideration the following requirements and constraints:

- Conform to City grading criteria.
- Match existing boundary grading conditions.
- Maintaining existing drainage boundaries.
- Provide minimum cover on existing and proposed servicing as well as proposed parking garages.
- Provide major system stormwater detention.
- To retain and protect boundary trees in accordance with proposed tree preservation.

The existing south municipal boulevard along Plains Road East will be extended to the building from back of curb at 2%.

Drawing GR illustrates the proposal grading scheme for the proposed NH development.

8. EROSION AND SEDIMENTATION CONTROLS DURING CONSTRUCTION

An erosion and sedimentation control plan for the site will be designed in general conformance with City of Burlington and Conservation Halton guidelines and implemented for all construction activities. Due to the footprint of proposed parking garage construction in relation to the property size, most typical erosion and sedimentation control measures are not practical.

The following erosion and sediment control measures will be installed and maintained during construction:

- Temporary construction/sediment control fencing will be placed around the site perimeter prior to commencement of construction activities.
- Temporary pumping of stormwater from the parking garage excavation will be discharged via a sediment filter bag.
- Existing road catchbasins in the vicinity of construction activities and sediment tracking will be provided Siltation protection.
- The downstream storm sewer system will be regularly inspected during construction and maintenance will be performed as required.
- All temporary erosion and sediment control measures will be routinely inspected and repaired as required during construction. Temporary controls will not be removed until the areas they serve are restored and stable.

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- Gravel mud mats will be provided at construction vehicle access points to minimize off-site tracking of sediment.

Erosion and sediment control drawings will be completed as part of the detailed design.

9. CONCLUSIONS

This Functional Servicing/Stormwater Management Report has been prepared in support of National Homes (Plains Road) LP's zoning by-law amendment application. This report demonstrates that appropriate municipal services, including connection to existing City and Region infrastructure on Plains Road West and Nora Drive, are feasible to support the development proposed by the current site plan concept without adverse impact to existing infrastructure or the surrounding community, and in general accordance with the latest standards and criteria prepared by the City of Burlington and Halton Region.

Report prepared by:

Urbantech Consulting



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Appendix A

Preliminary Sanitary Sewer Design Sheet

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SANITARY SEWER DESIGN SHEET

PRELIMINARY

484 & 490 Plains Road East

City of Burlington, Region of Halton

PROJECT DETAILS

Project No: 17-539
Date: 18-Sep-17
Designed by: OS
Checked by: OS

DESIGN CRITERIA

Min Diameter =	200	mm	Avg. Domestic Flow =	275.0	l/c/d
Mannings 'n'=	0.013		Infiltration =	0.286	l/s/ha
Min. Velocity =	0.60	m/s	Max. Peaking Factor =	4.00	
Max. Velocity =	3.00	m/s	Min. Peaking Factor=	2.00	
Factor of Safety =	15	%			

NOMINAL PIPE SIZE USED

STREET	FROM MH	TO MH	RESIDENTIAL AREA (ha)	RESIDENTIAL ACC. AREA (ha)	RESIDENTIAL UNITS (#)	RESIDENTIAL DENISTY (P/ha)	RESIDENTIAL DENSITY (P/unit)	RESIDENTIAL POP	RESIDENTIAL ACCUM. RES. POP.	COMMERCIAL/INDUSTRIAL/INSTITUTIONAL AREA (ha)	COMMERCIAL/INDUSTRIAL/INSTITUTIONAL ACC. AREA (ha)	COMMERCIAL/INDUSTRIAL/INSTITUTIONAL EQUIV. POP. (p/ha)	FLOW CALCULATIONS FLOW RATE (l/s/ha)	FLOW CALCULATIONS EQUIV. POP.	FLOW CALCULATIONS ACCUM. EQUIV. POP.	FLOW CALCULATIONS INFILTRATION (l/s)	FLOW CALCULATIONS TOTAL ACCUM. POP.	FLOW CALCULATIONS PEAKING FACTOR	FLOW CALCULATIONS RES. FLOW (l/s)	FLOW CALCULATIONS COMM. FLOW (l/s)	FLOW CALCULATIONS ACCUM. COMM. FLOW (l/s)	FLOW CALCULATIONS TOTAL FLOW (l/s)	PIPE DATA SLOPE (%)	PIPE DATA PIPE DIAMETER (mm)	PIPE DATA FULL FLOW CAPACITY (l/s)	PIPE DATA FULL FLOW VELOCITY (m/s)	PIPE DATA ACTUAL VELOCITY (m/s)	PIPE DATA PERCENT FULL (%)
2 X 8 STOREY		PLUG	1.84	1.84		285		525	525							0.5	525	3.96	6.6			7.1						
7 X TOWNHOUSE		PLUG	1.84	1.84		135		249	249							0.5	249	4.00	3.2			3.7						
NATIONAL HOMES	PLUG	13534		1.84					774							0.5	774	3.87	9.5			10.1	0.50	250	42.0	0.86	0.7	24%
PLAINS ROAD EAST	13534	13519		1.84					774			90				0.5	774	3.87	9.5			10.1	0.43	250	39.0	0.79	0.7	26%
PLAINS ROAD EAST	13519	13676		1.84					774	0.14	0.14	90		13	13	0.6	787	3.86	9.7			10.2	0.43	250	39.0	0.79	0.7	26%
PLAINS ROAD EAST	13676	13502		1.84					774	0.20	0.34	90		18	31	0.6	805	3.86	9.9			10.5	0.43	250	39.0	0.79	0.7	27%

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Appendix B

Water Analysis (Municipal Engineering Solutions)

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Municipal Engineering Solutions

September 22, 2017 Project No. 17003-04

Sent via email
Mr. David Leighton
Urbantech Consulting.
3760 14th Avenue, Suite 301
Markham, ON
L3R 3T7

Subject: Plains Road Burlington -Draft
Water Distribution Modeling
City of Burlington, Region of Halton

Dear Mr. Leighton,

We are pleased to submit our report entitled "Plains Road Development Watermain Analysis" outlining the results of our water distribution analysis for the proposed residential development in the City of Burlington, Region of Halton.

This development was incorporated into the Region of Halton's existing Infowater water models dated September 2017 and modeled utilizing the design information provided to Municipal Engineering Solutions. The findings of our analysis are summarized in the following report.

We trust you find this report satisfactory. Should you have any questions or require further clarification, please call.

Yours truly,

Municipal Engineering Solutions

Per: John C. Bourrie, P.Eng.

/LMC

File Location: D:\Projects\2017\17-020 Plains Road Halton 17003-04\3.0 Report\Final Sept 2017\17003-04 Plains Road Watermain Analysis_20170925.docx

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PLAINS ROAD DEVELOPMENT

WATER ANALYSIS

PREPARED BY:

MUNICIPAL ENGINEERING SOLUTIONS

FOR:

URBANTECH CONSULTING
September 2017

Project Number: 17003-04

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Section 1 – INTRODUCTION

Municipal Engineering Solutions ("MES") was retained by Urbantech Consulting to conduct a hydraulic water analysis for the proposed Plains Road development located in the City of Burlington in the Region of Halton. As part of this hydraulic assessment MES was requested to undertake the following:

1. Calculate/verify water demands for the proposed development using Region of Halton, provincial and industry design standards;
2. Add the subject watermains/development to the Region's existing water model;
3. Run the model to size the subject mains to achieve service criteria during Average Day, Peak Hour and fire flow during Maximum Day demand; and
4. Prepare a Report summarizing the modeling results for agency review and design purposes.

1.1 Development Background

The Plains Road development is located at 484 Plains Road East between King Road and Waterdown Road in the City of Burlington. The development consists of 117 townhomes,276 condominium units plus 971 m^2 of commercial area within two apartment buildings that are replacing the existing commercial buildings. The proposed development is shown below on **Figure 1**.



Figure 1 - Proposed Plains Road Development

Section 2 – WATERMAIN DESIGN CRITERIA

The design criteria utilized to estimate the water demands for the hydraulic water model follows general industry standards and is calculated using the design criteria and guidelines outlined in the Region of Halton's 2015 Water and Wastewater Linear Design Manual, the Ministry of the Environment and Climate Change (MOECC) Watermain Design Criteria, and the Fire Underwriters Survey.

The following sections summarize the specific design criteria used to carry out the hydraulic watermain assessment for this development.

2.1 Equivalent Population Densities & Water Design Factors

To calculate the equivalent population and water design factors for this development MES used Region of Halton standard population densities as noted in the *"Region of Halton Water and Wastewater Linear Design Manual, April 2015 Version 3.00"*. **Table 1** summarizes the population densities and **Table 2** summarizes the average daily demand and peaking factors used for this analysis.

Table 1 – Equivalent Population Density

Type of Development	Equivalent Population (Persons/Ha)	Equivalent Population (Persons/Unit)
Single Family	55	3.52
Semi-Detached	100	3.52
Townhouse	135	2.664
Apartment	285	1.579
Light Commercial	90	
Community Services	40	

Source: Region of Halton Water and Wastewater Linear Design Manual, April 2015 and 2017 Development Charges Update October 2016

Table 2 - Water Design Factors

Type of Development	Average Daily Demand (m^3 per capita)	Maximum Daily Demand Peaking Factor	Peak Hourly Demand Peaking Factor
Residential	0.275	2.25	4.00
Industrial	0.275	2.25	2.25
Commercial	0.275	2.25	2.25
Community Services	0.275	2.25	2.25

Source: Region of Halton Water and Wastewater Linear Design Manual, April 2015

Section 3 –FLOW DEMANDS

Utilizing the equivalent population data from Table 1 and the corresponding Average Day, Maximum Day and Peak Hour data from Table 2 the water demands for this development were calculated.

3.1 Equivalent Population Flow Demands

The calculated demands for the development are summarized in **Table 3** and were assigned to an existing node, WFT18600.

Table 3 – Water Demand for Plains Road Development

Development	Average Day Demand (L/S)	Maximum Day Demand (L/S)	Peak Hour Demand (L/S)
Plains Road Node WFT18600	2.41	5.42	9.58

Fire Flow Demands

The fire demands for this development were calculated using the Fire Underwriters Survey ("FUS") formula outlined in the *'Water Supply For Public Fire Protection Guideline',* dated 1999. The largest calculated flow for each type of unit was utilized as appropriate for the site plan layout. The fire flows shown in **Table 4**. Details on the calculations are in **Appendix A**.

Table 4 - Fire Flow Requirements

Type of Development	Fire Flow (L/S)
Condominiums	233
Townhomes	233

Source: Fire Underwriters Survey

As noted, the fire flows in Table 4 above are calculated using the FUS formula. Table 5 below summarizes the criteria utilized to develop the fire flow requirements as well as the assumptions made. The largest townhome block, building E, was used to calculate the fire flow requirement for townhomes and assumes a firewall in the middle of the unit but no sprinkler system. For the apartments, the west building was considered. The gross floor areas were taken from the conceptual site plan drawing by Kirkor Architects and Planners. Once the detailed design data (specifics) for these building(s) are finalized the assumptions noted in Table 5 must be reviewed and confirmed by the appropriate designer (architect or sprinkler system designer) and any design/criteria changes required are to be reported to MES.

Table 5 – FUS Criteria/Assumptions

	Type of Development	
	Townhomes	Condominium
Type of Construction	Wood Frame Construction	Fire Resistive
Occupancy Type	Limited Combustible	Limited Combustible
Fire Protection (Sprinkler/Firewalls)	Firewall between units 12 & 13 (50% of total GFA) Assumes No Sprinklers Present.	No Firewalls Building will be sprinklered
Area Considered	Townhome Block Used & Maximum # of Units: Building E – 12 Units (24 Units in total) (Total GFA (50% total) ~1,192 m^2 Footprint of 397 m^2)	Building Used & # Units: Building A– 152 Units (Total GFA ~14,346 m^2 Footprint of 1769 m^2)

Note: For Additional Information on FUS Criteria Refer to Water Supply for Public Protection Guide, Fire Underwriters Survey, 1999

3.2 External Demands

The Region of Halton InfoWater models that was provided by the Region to MES included water demands for existing and known future developments within the Region.

Section 4 – OTHER SYSTEM REQUIREMENTS

4.1 System Pressure Requirements

In addition to meeting the various flow requirements, the system must also satisfy minimum and maximum pressure requirements as outlined by the Region of Halton. The Region's pressure requirements are outlined in the Water and Wastewater Linear Design Manual and stipulate the following:

1. The water system shall be designed to maintain as close as possible to a maximum working pressure of 690 kPa (100 psi) as a best management practice.
2. The minimum system pressure shall not be less than 140 kPa (20 psi) at any point in the water system under fire flow conditions.
3. Under normal operating conditions, the water system shall have a target minimum static pressure of 310 kPa. (45 psi). Under no operating conditions shall the static pressure within a distribution main fall below 275 kPa (40 psi).
4. The normal method of reduction of pressures to comply with the Ontario Building Code (reduction of pressures to 550 kPa, 80 psi) is by pressure reducing valves to be installed on individual services.

4.2 Watermain Sizing

The Region of Halton also stipulates minimum pipe sizes and requires that all watermains are adequately sized to maintain demand flows at the required pressures without causing excessive energy loss or result in water quality decay. The watermain system must therefore be designed to accommodate the greater of the following:

- Maximum day plus fire demand
- Peak hour demand

The minimum pipe size for commercial and industrial areas shall be 300 mm diameter and for residential areas the minimum pipe size shall be 150 mm diameter. For distribution systems providing fire protection the minimum pipe size shall be 150 mm diameter in accordance with Ministry of the Environment and Climate Change (MOECC) and NFPA requirements.

To provide appropriate fire protection, reliable supply and pressures the water distribution system should be looped wherever possible to improve supply security and water quality.

4.3 Watermain C-Factor

In designing and modeling of the pipes the Coefficient of Roughness (C-Factor) factors from the Region's design manual and as suggested by the MOECC were utilized. The Coefficient of Roughness assigned to each pipe size in summarized in **Table 6** below.

Table 6 - Hazen-Williams Coefficient of Roughness (C-Factors)

Size of Pipe (Diameter in mm)	Coefficient of Roughness (C)
150 mm	100
200 mm to 250 mm	110
300 mm to 600 mm	120
Greater Than 600 mm	130

Source: Region of Halton Water and Wastewater Linear Design Manual, April 2015

Section 5 – ANALYSIS & MODELING RESULTS

To conduct the hydraulic water analysis for the proposed development the water demands were estimated by MES using the design criteria previously discussed and incorporated the demands into the existing Region of Halton InfoWater models (May 2017) which was provided by the Region in June 2017. The following sections discusses the model setup and results.

5.1 Model Setup

The Plains Road development is located within pressure zone B1A (TWL 140.2 m). The Zone B1A is supplied by the Kingsway Drive Booster Pumping Station with storage in the Waterdown Reservoir. The B1A services elevations up to 107 m. The development site elevations are below 98.0 m and therefore should be adequately supplied by B1A.

The building site will have one supply connection that will then feed the entire development. The model shows there are three (3) existing B1A watermains located within the Plains Road road allowance – 300 mm, 600 mm and 400 mm. The Region's model shows that the existing site has connections to the 300 mm and the 400 mm watermains as shown in a clip from the model in **Figure 2.**

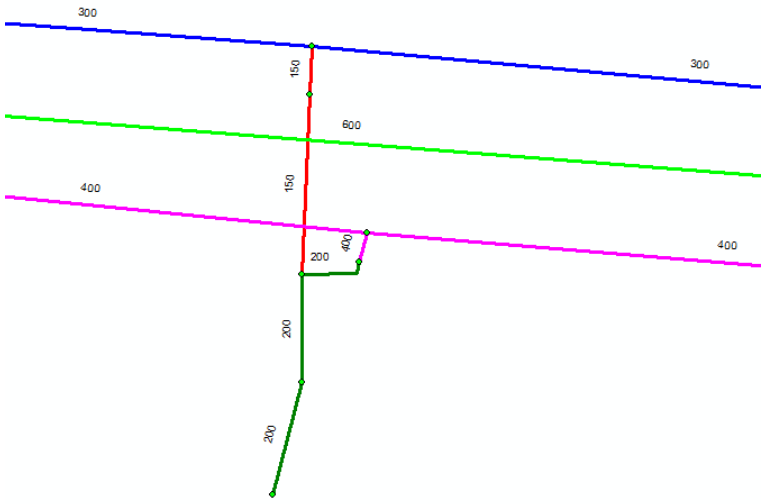


Figure 2 - Existing Plains Road Watermains Model Schematic

It was found that the diameters in the model for the connection to the 400 mm were incorrect. The model notes that the diameters were assumed. The as-built drawings obtained show a 150 mm connection as shown in **Figure 3.**

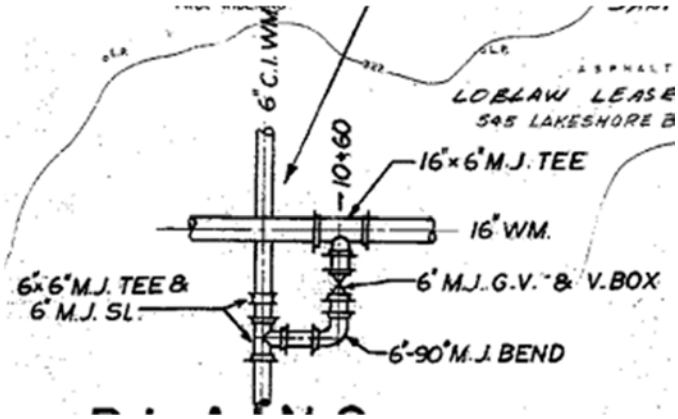


Figure 3 - As-Built Drawing V1-2 Connection Detail

Since the as-built drawings and water model show different size watermains the actual diameters servicing this block should be confirmed in the field.

The Region provided 2 models, one with the existing pressure districts; the other with the revised proposed pressure districts. The development was modeled under the 2016 planning scenario in the existing pressure district model and under the 2031 planning scenario in the future pressure district model to confirm that the development could be serviced adequately under existing and ultimate conditions.

The flow demands and service elevation information from the development were placed on an existing model node, WFT18600, that was the connection to the existing commercial development. The node was relocated to a more appropriate location for the new building and demands for losses removed in both existing and future water models to reflect future conditions and the system analysis was carried out. Friction factor for the pipes were assigned according to Table 5.

5.2 Watermain Sizing and System Pressures

The analysis was conducted under 2016 with the existing zone boundaries and 2031 servicing conditions with the future zone boundaries for Average Day, Maximum Day, Peak Hour and Maximum day plus Fire demands to size the watermains and meet the pressure requirements. The pipe size and layout are shown in **Appendix B**.

The supply was sized at 200 mm from the connection to the 400 mm watermain according to the results of average day, maximum day, maximum day plus fire, and peak hour scenarios. The 200 mm supply should replace the 150 mm connections on the south side of the road and connect to the 400 mm pipe. Replacing the 150 mm with a 200 mm pipe across Plains Road is also an option but would require open cutting of the road to connect to the 300 mm diameter watermain on the north side of the road.

It should be noted that the fire flow demands are based on the FUS calculation but the sprinkler system design requirements may be different as sprinkler systems tend to require lower flows at pressures above 20 psi (140 kPa). When the sprinkler design is completed, this analysis should be updated to confirm that the sprinkler requirements can be met.

Modeled service pressures at the development connection point, Node WFT18600, are summarized in **Table 6**. All pressures lie within the required operating range under average day, maximum day, maximum day plus fire flow and peak hour demands. Detailed pipe and node tables for the various scenarios modelled are attached to this report in **Appendix B**. The results of the immediately surrounding nodes and pipes are included in addition to the connection node WFT18600.

Table 7 - Modeled Service Pressures

Scenario	Average Day	Maximum Day	Peak Hour	Max. Day + Fire
2016	58.97 psi (406.6 kPa)	59.01 psi (406.8 kPa)	58.65 psi (404.4 kPa)	340 L/s@ 20 psi
2031	58.97 psi (406.6 kPa)	59.02 psi (406.9 kPa)	58.64 psi (404.3 kPa)	342.5 L/s@ 20 psi

Section 6 – CONCLUSIONS/RECOMMEDATIONS

The proposed watermain connection for the Plains Road development can achieve hydraulic requirements as prescribed by the Region of Halton watermain design criteria as summarized below.

- The service pressures from the watermain are expected to range between 59 psi to 58.6 psi (404 kPa to 448 kPa) under interim conditions and between 59 psi to 58.6 psi (404 kPa to 407 kPa) under ultimate conditions.
- The available fire flow meets or exceeds the required fire flow demands at the minimum pressure of 20 psi (140 kPa) based on the proposed watermain configuration and assumptions made within this report.
- The FUS criteria summarized in Table 5 and Appendix A, including all assumptions and building configurations, must be reviewed and confirmed by the designer(s), architect and mechanical consultant when additional information becomes available to ensure the criteria used to calculate the fire flows within this report are still valid prior to implementation and construction.
- When the sprinkler design is completed, the results of this report should be reviewed to confirm that the sprinkler requirements can be met.
- This report, including all modeling assumptions used, is to be submitted to and reviewed by the water operating authority (municipality) to confirm that the modeling parameters used are acceptable to the operating authority and/or confirm if modified domestic or fire flow requirements are required or should be implemented for this particular development.

Appendix A

Demands

Equivalent Population by Unit

(2017 Development Charges Update, October 2016)

Type of Development	Equivalent Population Density *(Person/Unit)*
Single Family or Semi-Detached	3.5
Townhouse	2.7
Apartment	1.6

Equivalent Population by Area

Type of Development	Equivalent Population Density *(Person/Hectare)*	Average Day Demands *(m3/ha/day)*
Single Family	55	15.13
Semi-detached duplex and 4-plex	100	27.50
Townhouse, Maisonette (<6 stories)	135	37.13
Apartments (>6 stories)	285	78.38
Light Commercial Areas	90	24.75
Community Services	40	11.00
Light Industrial Areas	125	34.38
Hospitals (persons/bed)	4	

Water Design Factors

Average Daily Demand (m3/capita)	0.275
Maximum Daily Demand P.F.	2.25
Maximum Hourly Demand P.F.	
Residential	*4*
I/C/I	*2.25*

Cofficient of Roughness

Size of Pipe (mm Dia.)	Coefficient of Roughness (C)
150	100
200-250	110
300-600	120
Over 600	130

Minimum Pipe Size

Type of Development	Size of Pipe (mm Dia.)
Residential	150
Commercial/Industrial/Community	300

Working Pressures

Parameter	Pressure
Normal Condition	
Minimum Pressure	275 kPa (40 psi)
Target Pressure	310 kPa (45 psi)
Maximum (Building Code)	550 kPa (80 psi)
Maximum (Halton)	690 kPa (100 psi)
Fire Flow Conditions	
Minimum Pressure	140 kPa (20 psi)

Water Demand
Plains Road Development, Burlington On
September 19, 2017

Node	Phase	Elevation	Type of Development							Equivalent Population		Demands			Fire Flow Demands
			Single Family	Semi-Detached	Townhouse	Apartment	Commercial	Schools	Industrial	Total Population	Total Population	ADD	MDD	PHD	
		(m)	*(units)*	*(units)*	*(units)*	*(units)*	*(ha)*	*(ha)*	*(ha)*	*(Residential)*	*(ICI)*	*(L/s)*	*(L/s)*	*(L/s)*	*(L/s)*
WFT18600					*117*	*276*	*0.097*			747	9	2.41	5.42	9.58	233
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
										0	0	0.00	0.00	0.00	
Total			**0**	**0**	**117**	**276**	**0.10**	**0.00**	**0**	**747**	**9**	**2.41**	**5.42**	**9.58**	

Calculations are based on "Water Supply for Public Fire Protection Guide" by Fire Underwriters Survey

Municipal Engineering Solutions

FUS CALCULATION

Project:	Plains Road	Building Type/Block #	**Building A**
Project Number:	17003-04	Firewalls/Sprinkler:	**Sprinklers**
Project Location:	Halton Region	Number of Units/Unit #'s	**152**

1.0 FUS Formula

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

where: F = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the total floor area in square metres (including all storeys but excluding basements at least 50% below grade)[a]

NBC Occupancy	Group C
Type of Construction[b]	fire-resistive construction
Foot Print Area	1769.5 sq metres
Storeys	8
C =	0.6
A =	14346
F =	**16000 L/min**

2.0 Occupancy Adjustment

Type of Occupancy[c]	limited combustible
Hazard Allowance	-0.15
	-2400 L/min
Adjusted Fire Flow	**13600 L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	30%	50%
Standard Water Supply	NO	10%	
Fully Supervised system	NO	10%	

Sprinkler Credit **6800 L/min**

4.0 Exposure Adjustment

		Percent	Total*
North Side			50%
Distance to Building (m)	over 45	0%	
Length (ft) by height in storeys	over 120		
South Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
East Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
West Side			
Distance to Building (m)	3.1 to 10	20%	
Length (ft) by height in storeys	over 120		

*max 75%

Exposures Surcharge **6800 L/min**

Total Required Fire Flow (rounded)	**14000 L/min**
	233 L/sec

a) For fire-resistive buildings, consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to 8, when vertical openings are inadequately protected. If the vertical openings and and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors

b) Wood frame=1.5, Ordinary=1.0, Non-combustible=0.8, Fire-resistive=0.6

c) Non-combustible=-25%, Limited combusitble=-15%, Combustible=0, Free burning=+15%, Rapid burning=+25%

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Calculations are based on "Water Supply for Public Fire Protection Guide" by Fire Underwriters Survey

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FUS CALCULATION

Project:	Plains Road	Building Type/Block #	**Building B**
Project Number:	17003-04	Firewalls/Sprinkler:	**Sprinklers**
Project Location:	Halton Region	Number of Units/Unit #'s	**124**

1.0 FUS Formula

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

where: F = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the total floor area in square metres (including all storeys but excluding basements at least 50% below grade)[a]

NBC Occupancy	Group C	
Type of Construction[b]	fire-resistive construction	
Foot Print Area	1719.6	sq metres
Storeys	8	
C =	0.6	
A =	12284.9	
F =	**15000**	**L/min**

2.0 Occupancy Adjustment

Type of Occupancy[c]	limited combustible	
Hazard Allowance	-0.15	
	-2250	L/min
Adjusted Fire Flow	**12750**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	30%	50%
Standard Water Supply	NO	10%	
Fully Supervised system	NO	10%	

Sprinkler Credit **6375 L/min**

4.0 Exposure Adjustment

		Percent	Total*
North Side			45%
Distance to Building (m)	over 45	0%	
Length (ft) by height in storeys	over 120		
South Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
East Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
West Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		

*max 75%

Exposures Surcharge **5740 L/min**

Total Required Fire Flow	**12000**	**L/min**
(rounded)	**200**	**L/sec**

a) For fire-resistive buildings, consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to 8, when vertical openings are inadequately protected. If the vertical openings and and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors

b) Wood frame=1.5, Ordinary=1.0, Non-combustible=0.8, Fire-resistive=0.6

c) Non-combustible=-25%, Limited combusitble=-15%, Combustible=0, Free burning=+15%, Rapid burning=+25%

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FUS CALCULATION

Project:	Plains Road	Building Type/Block #	**Building C**
Project Number:	17003-04	Firewalls/Sprinkler:	**Firewall**
Project Location:	Halton Region	Number of Units/Unit #'s	**12 (middle firewall)**

1.0 FUS Formula

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

where: F = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the total floor area in square metres (including all storeys but excluding basements at least 50% below grade)[a]

NBC Occupancy	Group C	
Type of Construction[b]	wood frame construction	
Foot Print Area	198.6	sq metres
Storeys	3	
C =	1.5	
A =	595.8	
F =	**8000**	**L/min**

2.0 Occupancy Adjustment

Type of Occupancy[c]	limited combustible	
Hazard Allowance	-0.15	
	-1200	L/min
Adjusted Fire Flow	**6800**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	0%	0%
Standard Water Supply	NO	0%	
Fully Supervised system	NO	0%	

Sprinkler Credit **0 L/min**

4.0 Exposure Adjustment

		Percent	Total*
North Side			
Distance to Building (m)	3.1 to 10	20%	75%
Length (ft) by height in storeys	over 120		
South Side			
Distance to Building (m)	0 to 3	25%	
Length (ft) by height in storeys	over 120		
East Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
West Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		

*max 75%

Exposures Surcharge **5100 L/min**

Total Required Fire Flow	**12000**	**L/min**
(rounded)	**200**	**L/sec**

a) For fire-resistive buildings, consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to 8, when vertical openings are inadequately protected. If the vertical openings and and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors

b) Wood frame=1.5, Ordinary=1.0, Non-combustible=0.8, Fire-resistive=0.6

c) Non-combustible=-25%, Limited combusitble=-15%, Combustible=0, Free burning=+15%, Rapid burning=+25%

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FUS CALCULATION

Project:	Plains Road	Building Type/Block #	**Building D**
Project Number:	17003-04	Firewalls/Sprinkler:	**Firewall**
Project Location:	Halton Region	Number of Units/Unit #'s	**15(firewall - 8 units)**

1.0 FUS Formula

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

where: F = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the total floor area in square metres (including all storeys but excluding basements at least 50% below grade)[a]

NBC Occupancy	Group C	
Type of Construction[b]	wood frame construction	
Foot Print Area	271.667	sq metres
Storeys	3	
C =	1.5	
A =	815	
F =	**9000**	**L/min**

2.0 Occupancy Adjustment

Type of Occupancy[c]	limited combustible	
Hazard Allowance	-0.15	
	-1350	L/min
Adjusted Fire Flow	**7650**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	0%	0%
Standard Water Supply	NO	0%	
Fully Supervised system	NO	0%	

Sprinkler Credit **0 L/min**

4.0 Exposure Adjustment

		Percent	Total*
North Side			65%
Distance to Building (m)	0 to 3	25%	
Length (ft) by height in storeys	over 120		
South Side			
Distance to Building (m)	20.1 to 30	10%	
Length (ft) by height in storeys	over 120		
East Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
West Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		

*max 75%

Exposures Surcharge **4970 L/min**

Total Required Fire Flow	**13000**	**L/min**
(rounded)	**217**	**L/sec**

a) For fire-resistive buildings, consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to 8, when vertical openings are inadequately protected. If the vertical openings and and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors

b) Wood frame=1.5, Ordinary=1.0, Non-combustible=0.8, Fire-resistive=0.6

c) Non-combustible=-25%, Limited combusitble=-15%, Combustible=0, Free burning=+15%, Rapid burning=+25%

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FUS CALCULATION

Project:	Plains Road	Building Type/Block #	**Building E**
Project Number:	17003-04	Firewalls/Sprinkler:	**Firewall**
Project Location:	Halton Region	Number of Units/Unit #'s	**24(middle firewall)**

1.0 FUS Formula

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

where: F = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the total floor area in square metres (including all storeys but excluding basements at least 50% below grade)[a]

NBC Occupancy	Group C
Type of Construction[b]	wood frame construction
Foot Print Area	397.2 sq metres
Storeys	3
C =	1.5
A =	1191.6
F =	**11000 L/min**

2.0 Occupancy Adjustment

Type of Occupancy[c]	limited combustible
Hazard Allowance	-0.15
	-1650 L/min
Adjusted Fire Flow	**9350 L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	0%	0%
Standard Water Supply	NO	0%	
Fully Supervised system	NO	0%	

Sprinkler Credit **0 L/min**

4.0 Exposure Adjustment

		Percent	Total*
North Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
South Side			
Distance to Building (m)	20.1 to 30	10%	
Length (ft) by height in storeys	over 120		
East Side			55%
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
West Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		

*max 75%

Exposures Surcharge **5140 L/min**

Total Required Fire Flow	**14000 L/min**
(rounded)	**233 L/sec**

a) For fire-resistive buildings, consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to 8, when vertical openings are inadequately protected. If the vertical openings and and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors

b) Wood frame=1.5, Ordinary=1.0, Non-combustible=0.8, Fire-resistive=0.6

c) Non-combustible=-25%, Limited combusitble=-15%, Combustible=0, Free burning=+15%, Rapid burning=+25%

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FUS CALCULATION

Project:	Plains Road	Building Type/Block #	**Building F**
Project Number:	17003-04	Firewalls/Sprinkler:	**Firewall**
Project Location:	Halton Region	Number of Units/Unit #'s	**18 (middle firewall)**

1.0 FUS Formula

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

where: F = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the total floor area in square metres (including all storeys but excluding basements at least 50% below grade)[a]

NBC Occupancy	Group C	
Type of Construction[b]	wood frame construction	
Foot Print Area	297.9	sq metres
Storeys	3	
C =	1.5	
A =	893.7	
F =	**10000**	**L/min**

2.0 Occupancy Adjustment

Type of Occupancy[c]	limited combustible	
Hazard Allowance	-0.15	
	-1500	L/min
Adjusted Fire Flow	**8500**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	0%	0%
Standard Water Supply	NO	0%	
Fully Supervised system	NO	0%	

Sprinkler Credit **0 L/min**

4.0 Exposure Adjustment

		Percent	Total*
North Side			65%
Distance to Building (m)	0 to 3	25%	
Length (ft) by height in storeys	over 120		
South Side			
Distance to Building (m)	20.1 to 30	10%	
Length (ft) by height in storeys	over 120		
East Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
West Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		

*max 75%

Exposures Surcharge **5530 L/min**

Total Required Fire Flow	**14000**	**L/min**
(rounded)	**233**	**L/sec**

a) For fire-resistive buildings, consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to 8, when vertical openings are inadequately protected. If the vertical openings and and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors

b) Wood frame=1.5, Ordinary=1.0, Non-combustible=0.8, Fire-resistive=0.6

c) Non-combustible=-25%, Limited combusitble=-15%, Combustible=0, Free burning=+15%, Rapid burning=+25%

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FUS CALCULATION

Project:	Plains Road	Building Type/Block #	**Building G**
Project Number:	17003-04	Firewalls/Sprinkler:	**Firewall**
Project Location:	Halton Region	Number of Units/Unit #'s	**12(middle firewall)**

1.0 FUS Formula

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

where: F = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the total floor area in square metres (including all storeys but excluding basements at least 50% below grade)[a]

NBC Occupancy	Group C	
Type of Construction[b]	wood frame construction	
Foot Print Area	582	sq metres
Storeys	3	
C =	1.5	
A =	595.8	
F =	**8000**	**L/min**

2.0 Occupancy Adjustment

Type of Occupancy[c]	limited combustible	
Hazard Allowance	-0.15	
	-1200	L/min
Adjusted Fire Flow	**6800**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	0%	0%
Standard Water Supply	NO	0%	
Fully Supervised system	NO	0%	

Sprinkler Credit **0 L/min**

4.0 Exposure Adjustment

		Percent	Total*
North Side			55%
Distance to Building (m)	30.1 to 45	0%	
Length (ft) by height in storeys	over 120		
South Side			
Distance to Building (m)	0 to 3	25%	
Length (ft) by height in storeys	over 120		
East Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
West Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		

*max 75%

Exposures Surcharge **3740 L/min**

Total Required Fire Flow	**11000**	**L/min**
(rounded)	**183**	**L/sec**

a) For fire-resistive buildings, consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to 8, when vertical openings are inadequately protected. If the vertical openings and and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors

b) Wood frame=1.5, Ordinary=1.0, Non-combustible=0.8, Fire-resistive=0.6

c) Non-combustible=-25%, Limited combusitble=-15%, Combustible=0, Free burning=+15%, Rapid burning=+25%

55 Gilbank Drive, Aurora, Ontario L4G 6H9
Tel: 905.726.1016 Cell: 416.434.0186 Fax: 905.726.1225

Calculations are based on "Water Supply for Public Fire Protection Guide" by Fire Underwriters Survey

Municipal Engineering Solutions

FUS CALCULATION

Project:	Plains Road	Building Type/Block #	**Building H**
Project Number:	17003-04	Firewalls/Sprinkler:	**Firewall**
Project Location:	Halton Region	Number of Units/Unit #'s	**18(middle firewall)**

1.0 FUS Formula

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

where: F = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the total floor area in square metres (including all storeys but excluding basements at least 50% below grade)[a]

NBC Occupancy	Group C	
Type of Construction[b]	wood frame construction	
Foot Print Area	582	sq metres
Storeys	3	
C =	1.5	
A =	893.7	
F =	**10000**	**L/min**

2.0 Occupancy Adjustment

Type of Occupancy[c]	limited combustible	
Hazard Allowance	-0.15	
	-1500	L/min
Adjusted Fire Flow	**8500**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	0%	0%
Standard Water Supply	NO	0%	
Fully Supervised system	NO	0%	

Sprinkler Credit **0 L/min**

4.0 Exposure Adjustment

		Percent	Total*
North Side			60%
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
South Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
East Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
West Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		

*max 75%

Exposures Surcharge **5100 L/min**

Total Required Fire Flow	**14000**	**L/min**
(rounded)	**233**	**L/sec**

a) For fire-resistive buildings, consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to 8, when vertical openings are inadequately protected. If the vertical openings and and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors

b) Wood frame=1.5, Ordinary=1.0, Non-combustible=0.8, Fire-resistive=0.6

c) Non-combustible=-25%, Limited combusitble=-15%, Combustible=0, Free burning=+15%, Rapid burning=+25%

55 Gilbank Drive, Aurora, Ontario L4G 6H9
Tel: 905.726.1016 Cell: 416.434.0186 Fax: 905.726.1225

Calculations are based on "Water Supply for Public Fire Protection Guide" by Fire Underwriters Survey

Municipal Engineering Solutions

FUS CALCULATION

Project:	Plains Road	Building Type/Block #	**Building J**
Project Number:	17003-04	Firewalls/Sprinkler:	**Firewall**
Project Location:	Halton Region	Number of Units/Unit #'s	**18(middle firewall)**

1.0 FUS Formula

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

where: F = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the total floor area in square metres (including all storeys but excluding basements at least 50% below grade)[a]

NBC Occupancy	Group C	
Type of Construction[b]	wood frame construction	
Foot Print Area	582	sq metres
Storeys	3	
C =	1.5	
A =	893.7	
F =	**10000**	**L/min**

2.0 Occupancy Adjustment

Type of Occupancy[c]	limited combustible	
Hazard Allowance	-0.15	
	-1500	L/min
Adjusted Fire Flow	**8500**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	0%	0%
Standard Water Supply	NO	0%	
Fully Supervised system	NO	0%	

Sprinkler Credit **0 L/min**

4.0 Exposure Adjustment

		Percent	Total*
North Side			55%
Distance to Building (m)	20.1 to 30	10%	
Length (ft) by height in storeys	over 120		
South Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
East Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	over 120		
West Side			
Distance to Building (m)	10.1 to 20	15%	
Length (ft) by height in storeys	91 to 120		

*max 75%

Exposures Surcharge **4680 L/min**

Total Required Fire Flow	**13000**	**L/min**
(rounded)	**217**	**L/sec**

a) For fire-resistive buildings, consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to 8, when vertical openings are inadequately protected. If the vertical openings and and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors

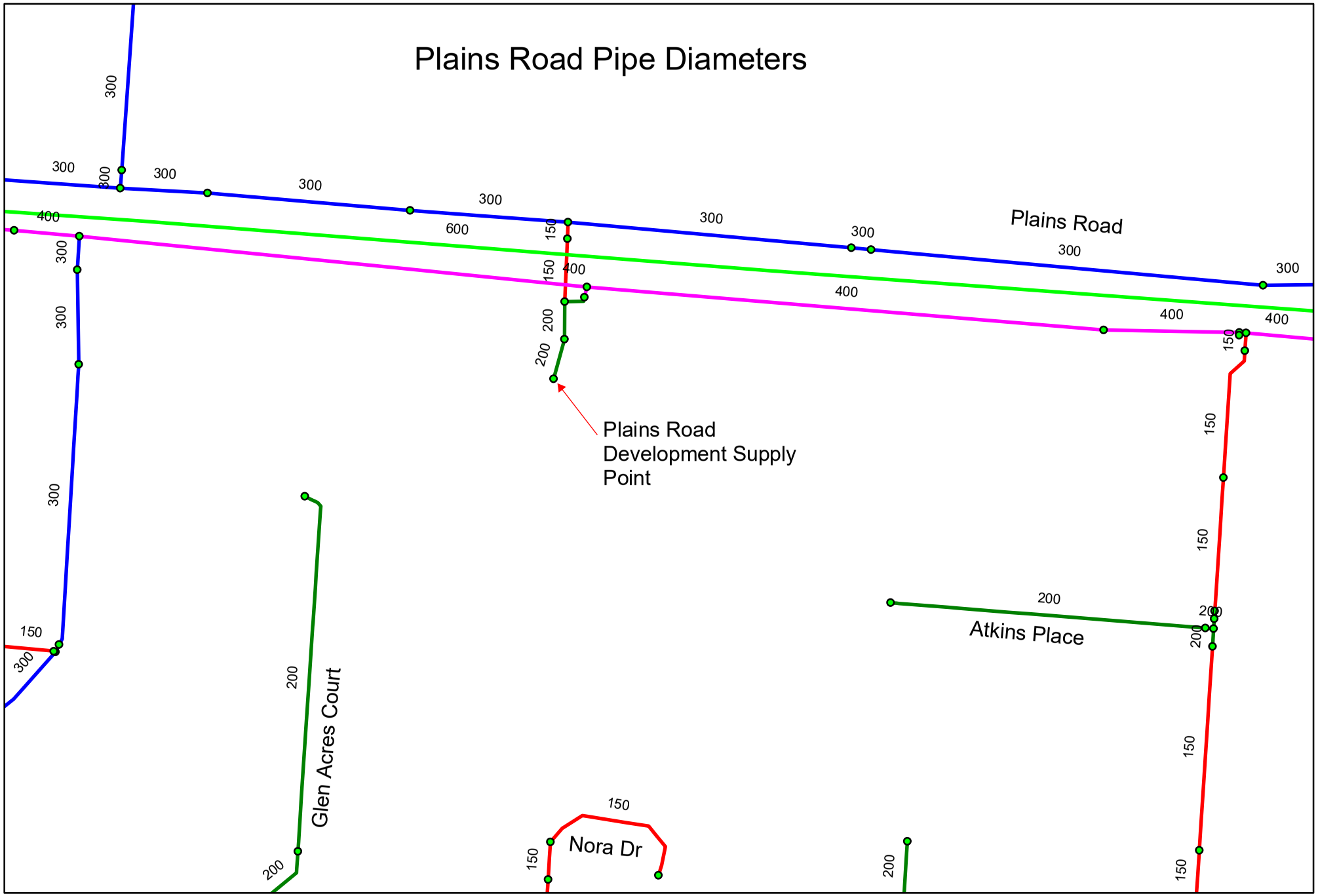
b) Wood frame=1.5, Ordinary=1.0, Non-combustible=0.8, Fire-resistive=0.6

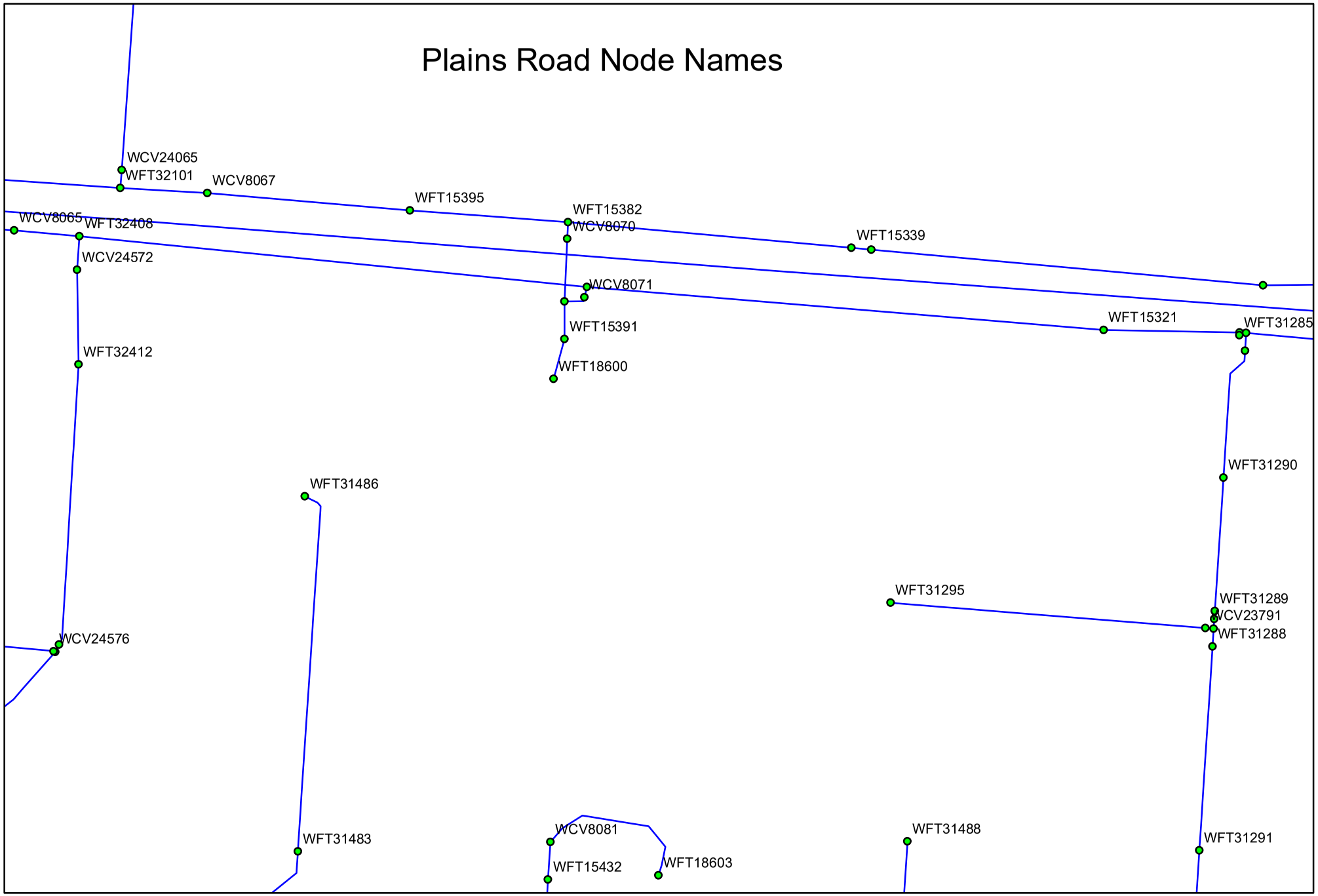
c) Non-combustible=-25%, Limited combusitble=-15%, Combustible=0, Free burning=+15%, Rapid burning=+25%

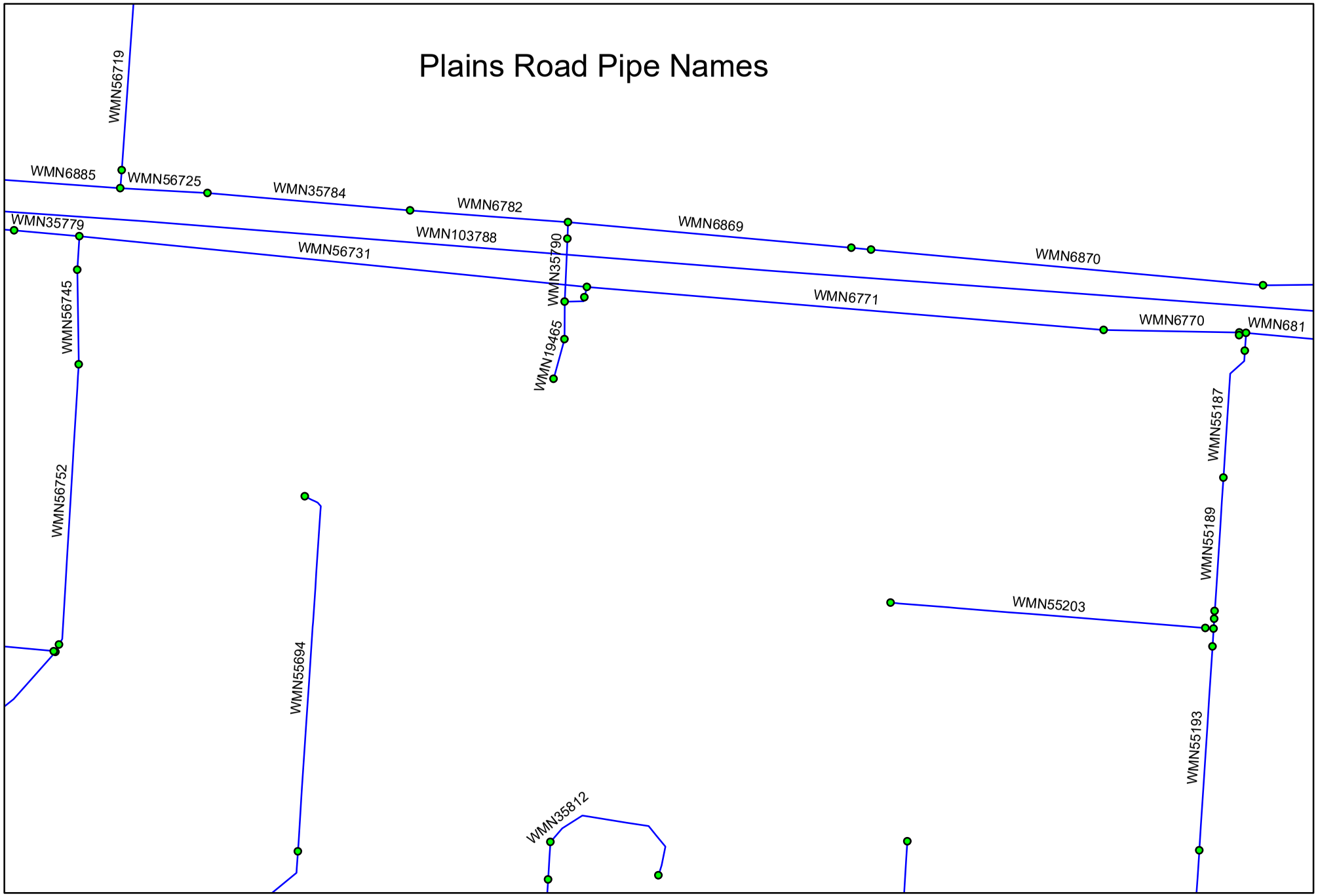
55 Gilbank Drive, Aurora, Ontario L4G 6H9
Tel: 905.726.1016 Cell: 416.434.0186 Fax: 905.726.1225

Appendix B

Model Results


Plains Road Pipe Diameters
Plains Road
Plains Road
Development Supply
Point
Glen Acres Court
Nora Dr
Atkins Place
300
400
600
200
150


Plains Road Node Names
WCV24065
WFT32101
WCV8067
WFT15395
WFT15382
WCV8070
WCV8065
WFT32408
WFT15339
WCV24572
WCV8071
WFT15321
WFT31285
WFT15391
WFT32412
WFT18600
WFT31290
WFT31486
WFT31295
WFT31289
WCV23791
WFT31288
WCV24576
WFT31483
WCV8081
WFT31488
WFT31291
WFT15432
WFT18603


Plains Road Pipe Names
WMN56719
WMN6885
WMN56725
WMN35784
WMN6782
WMN6869
WMN6870
WMN35779
WMN103788
WMN56731
WMN35790
WMN6771
WMN6770
WMN681
WMN56745
WMN19465
WMN55187
WMN56752
WMN55189
WMN55203
WMN55694
WMN35812
WMN55193

2016 Conditions
Plains Road Development, Burlington On
September 22, 2017

Municipal Engineering Solutions

Average Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(psi)*
WCV8070	0.01	98.33	139.22	58.14
WCV8071	0.01	98.22	139.23	58.29
WFT15321	0.04	97.70	139.23	59.04
WFT15339	0.05	98.07	139.23	58.51
WFT15382	0.05	98.25	139.22	58.25
WFT15385	0.06	98.16	139.23	58.37
WFT15387	0.01	98.25	139.22	58.26
WFT15391	0.08	98.13	139.22	58.41
WFT15395	0.01	98.24	139.22	58.26
WFT18600	2.41	97.74	139.22	58.97
WFT32408	0.03	98.31	139.22	58.16

MIN		**97.70**		**58.14**
MAX		**98.33**		**59.04**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(L/s)*	*(m/s)*
WMN19464	WFT15387	WFT15391	12.70	200	110	0.22	0.08
WMN19465	WFT15391	WFT18600	14.27	200	110	0.21	0.08
WMN35789	WFT15382	WCV8070	5.65	150	98	0.02	0.01
WMN35790	WCV8070	WFT15387	21.26	150	98	0.02	0.01
WMN35791	WFT15387	WCV8071	7.80	200	110	-0.20	0.07
WMN35792	WCV8071	WFT15385	3.60	200	110	-0.20	0.07
WMN56731	WFT15385	WFT32408	172.63	400	111	0.84	0.08
WMN6771	WFT15321	WFT15385	175.42	400	111	1.05	0.10
WMN6782	WFT15395	WFT15382	53.61	300	80	-0.24	0.04
WMN6869	WFT15382	WFT15339	96.30	300	89	-0.26	0.04

Maximum Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(psi)*
WCV8070	0.01	98.33	139.26	58.19
WCV8071	0.01	98.22	139.26	58.34
WFT15321	0.07	97.70	139.29	59.11
WFT15339	0.09	98.07	139.27	58.56
WFT15382	0.09	98.25	139.26	58.30
WFT15385	0.11	98.16	139.26	58.43
WFT15387	0.01	98.25	139.26	58.31
WFT15391	0.16	98.13	139.26	58.46
WFT15395	0.01	98.24	139.26	58.31
WFT18600	5.43	97.74	139.25	59.01
WFT32408	0.06	98.31	139.25	58.20

MIN		**97.70**		**58.19**
MAX		**98.33**		**59.11**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(L/s)*	*(m/s)*
WMN19464	WFT15387	WFT15391	12.70	200	110	0.48	0.18
WMN19465	WFT15391	WFT18600	14.27	200	110	0.47	0.17
WMN35789	WFT15382	WCV8070	5.65	150	98	0.06	0.04
WMN35790	WCV8070	WFT15387	21.26	150	98	0.06	0.04
WMN35791	WFT15387	WCV8071	7.80	200	110	-0.43	0.16
WMN35792	WCV8071	WFT15385	3.60	200	110	-0.43	0.16
WMN56731	WFT15385	WFT32408	172.63	400	111	1.51	0.14
WMN6771	WFT15321	WFT15385	175.42	400	111	1.95	0.18
WMN6782	WFT15395	WFT15382	53.61	300	80	-0.42	0.07
WMN6869	WFT15382	WFT15339	96.30	300	89	-0.48	0.08

Peak Hour

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(psi)*
WCV8070	0.02	98.33	139.03	57.86
WCV8071	0.02	98.22	139.03	58.01
WFT15321	0.11	97.70	139.06	58.79
WFT15339	0.15	98.07	139.03	58.23
WFT15382	0.15	98.25	139.03	57.97
WFT15385	0.18	98.16	139.03	58.10
WFT15387	0.02	98.25	139.02	57.97
WFT15391	0.25	98.13	139.01	58.11
WFT15395	0.02	98.24	139.03	57.98
WFT18600	9.58	97.74	139.00	58.65
WFT32408	0.09	98.31	139.02	57.87

MIN		**97.70**		**57.86**
MAX		**98.33**		**58.79**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(L/s)*	*(m/s)*
WMN19464	WFT15387	WFT15391	12.70	200	110	0.85	0.31
WMN19465	WFT15391	WFT18600	14.27	200	110	0.83	0.30
WMN35789	WFT15382	WCV8070	5.65	150	98	0.16	0.11
WMN35790	WCV8070	WFT15387	21.26	150	98	0.16	0.10
WMN35791	WFT15387	WCV8071	7.80	200	110	-0.69	0.26
WMN35792	WCV8071	WFT15385	3.60	200	110	-0.69	0.26
WMN56731	WFT15385	WFT32408	172.63	400	111	1.41	0.13
WMN6771	WFT15321	WFT15385	175.42	400	111	2.12	0.19
WMN6782	WFT15395	WFT15382	53.61	300	80	-0.20	0.03
WMN6869	WFT15382	WFT15339	96.30	300	89	-0.37	0.06

Fire Flow Table

ID	Total Demand	Available Flow	Fire Flow Met?
	(L/s)	*(L/s)*	
WFT18600	238.43	340.26	TRUE

2031 Conditions
Plains Road Development, Burlington On
September 22, 2017

Municipal Engineering Solutions

Average Day

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
WCV8070	0.01	98.33	139.22	58.14
WCV8071	0.01	98.22	139.22	58.29
WFT15321	0.04	97.70	139.23	59.04
WFT15339	0.05	98.07	139.23	58.51
WFT15382	0.05	98.25	139.22	58.25
WFT15385	0.06	98.16	139.22	58.37
WFT15387	0.01	98.25	139.22	58.26
WFT15391	0.09	98.13	139.22	58.41
WFT15395	0.01	98.24	139.22	58.26
WFT18600	2.41	97.74	139.22	58.97
WFT32408	0.03	98.31	139.22	58.16

MIN		**97.70**		**58.14**
MAX		**98.33**		**59.04**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (L/s)	Velocity (m/s)
WMN19464	WFT15387	WFT15391	12.70	200	110	0.22	0.08
WMN19465	WFT15391	WFT18600	13.84	200	110	0.21	0.08
WMN35789	WFT15382	WCV8070	5.65	150	98	0.01	0.01
WMN35790	WCV8070	WFT15387	21.26	150	98	0.01	0.01
WMN35791	WFT15387	WCV8071	7.80	200	110	-0.20	0.08
WMN35792	WCV8071	WFT15385	3.60	200	110	-0.21	0.08
WMN56731	WFT15385	WFT32408	172.63	400	111	0.83	0.08
WMN6771	WFT15321	WFT15385	175.42	400	111	1.04	0.10
WMN6782	WFT15395	WFT15382	53.61	300	80	-0.24	0.04
WMN6869	WFT15382	WFT15339	96.30	300	89	-0.25	0.04

Maximum Day

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
WCV8070	0.02	98.33	139.27	58.20
WCV8071	0.02	98.22	139.27	58.36
WFT15321	0.07	97.70	139.30	59.13
WFT15339	0.10	98.07	139.27	58.58
WFT15382	0.10	98.25	139.27	58.31
WFT15385	0.12	98.16	139.27	58.44
WFT15387	0.02	98.25	139.27	58.32
WFT15391	0.17	98.13	139.26	58.47
WFT15395	0.02	98.24	139.27	58.32
WFT18600	5.42	97.74	139.26	59.02
WFT32408	0.07	98.31	139.26	58.21

MIN		**97.70**		**58.20**
MAX		**98.33**		**59.13**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (L/s)	Velocity (m/s)
WMN19464	WFT15387	WFT15391	12.70	200	110	0.48	0.18
WMN19465	WFT15391	WFT18600	14.28	200	110	0.47	0.17
WMN35789	WFT15382	WCV8070	5.65	150	98	0.05	0.03
WMN35790	WCV8070	WFT15387	21.26	150	98	0.05	0.03
WMN35791	WFT15387	WCV8071	7.80	200	110	-0.44	0.16
WMN35792	WCV8071	WFT15385	3.60	200	110	-0.44	0.16
WMN56731	WFT15385	WFT32408	172.63	400	111	1.55	0.14
WMN6771	WFT15321	WFT15385	175.42	400	111	2.00	0.18
WMN6782	WFT15395	WFT15382	53.61	300	80	-0.44	0.07
WMN6869	WFT15382	WFT15339	96.30	300	89	-0.50	0.08

Peak Hour

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
WCV8070	0.03	98.33	139.02	57.85
WCV8071	0.03	98.22	139.02	58.00
WFT15321	0.12	97.70	139.05	58.78
WFT15339	0.16	98.07	139.03	58.22
WFT15382	0.16	98.25	139.02	57.96
WFT15385	0.19	98.16	139.03	58.09
WFT15387	0.03	98.25	139.02	57.96
WFT15391	0.26	98.13	139.01	58.10
WFT15395	0.03	98.24	139.02	57.97
WFT18600	9.58	97.74	139.00	58.64
WFT32408	0.10	98.31	139.01	57.86

MIN		**97.70**		**57.85**
MAX		**98.33**		**58.78**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (L/s)	Velocity (m/s)
WMN19464	WFT15387	WFT15391	12.70	200	110	0.85	0.31
WMN19465	WFT15391	WFT18600	14.28	200	110	0.83	0.30
WMN35789	WFT15382	WCV8070	5.65	150	98	0.14	0.09
WMN35790	WCV8070	WFT15387	21.26	150	98	0.13	0.09
WMN35791	WFT15387	WCV8071	7.80	200	110	-0.72	0.27
WMN35792	WCV8071	WFT15385	3.60	200	110	-0.72	0.27
WMN56731	WFT15385	WFT32408	172.63	400	111	1.45	0.13
WMN6771	WFT15321	WFT15385	175.42	400	111	2.19	0.20
WMN6782	WFT15395	WFT15382	53.61	300	80	-0.29	0.05
WMN6869	WFT15382	WFT15339	96.30	300	89	-0.44	0.07

Fire Flow Table

ID	Total Demand (L/s)	Available Flow (L/s)	Fire Flow Met?
WFT18600	238.42	340.71	TRUE

Appendix C

Stormwater Analysis

- Model Schematic
- 5-year Model Output
- 100-year Model Output
- Stormceptor Sizing Report
- STC-9000 Detail

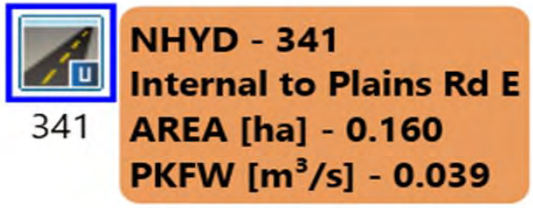
Urbantech® Consulting, A Division of Leighton-Zec Ltd.
3760 14th Avenue, Suite 301 Markham, Ontario L3R 3T7
TEL: 905.946.9461 FAX: 905.946.9595
www.urbantech.com

PRE-DEVELOPMENT MODEL (5YEAR)

urbantech

Project Name: 484 Plains Road East
Municipality: City of Burlington
Project No.: 17-589
Date: 19-Sep-17

Prepared by: D.L.
Checked by: A.F.
Submission #:



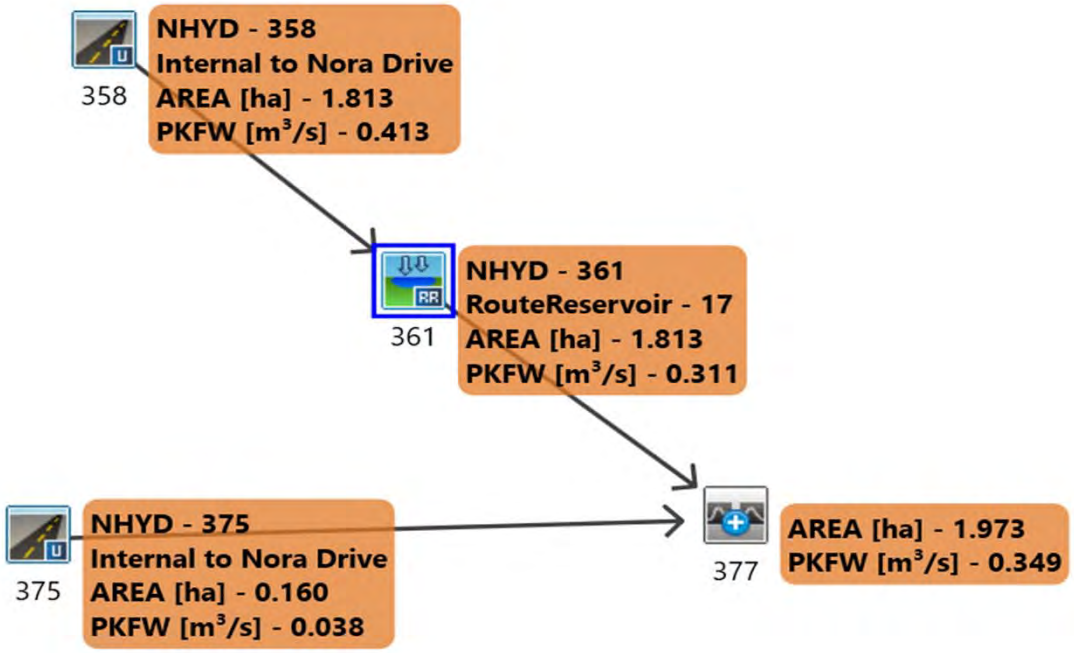


POST-DEVELOPMENT MODEL (5YEAR)

urbantech

Project Name: 484 Plains Road East
Municipality: City of Burlington
Project No.: 17-589
Date: 19-Sep-17

Prepared by: D.L.
Checked by: A.F.
Submission #:



PRE-DEVELOPMENT MODEL (100YEAR)

urbantech

Project Name: 484 Plains Road East
Municipality: City of Burlington
Project No.: 17-589
Date: 19-Sep-17

Prepared by: D.L.
Checked by: A.F.
Submission #:



341

NHYD - 341
Internal to Plains Rd E
AREA [ha] - 0.160
PKFW [m^3/s] - 0.063



343

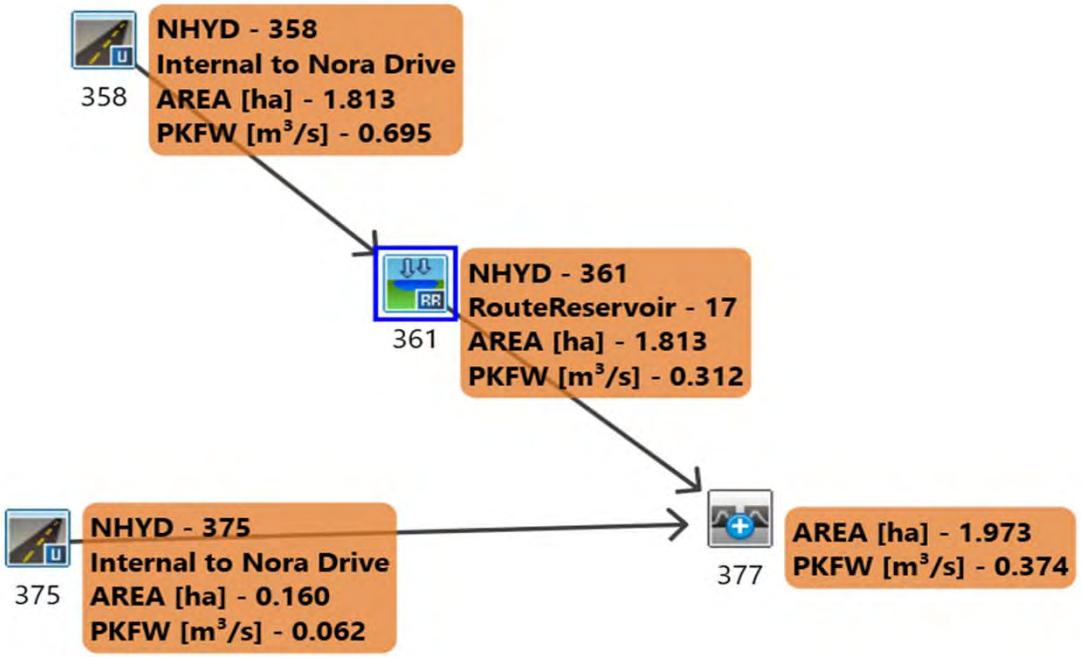
NHYD - 343
Internal to Nora Drive
AREA [ha] - 1.813
PKFW [m^3/s] - 0.706

POST-DEVELOPMENT MODEL (100YEAR)

urbantech

Project Name: 484 Plains Road East
Municipality: City of Burlington
Project No.: 17-589
Date: 19-Sep-17

Prepared by: D.L.
Checked by: A.F.
Submission #:



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================================================================================
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       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.0\VO2\voin.dat
  Output           filename:     C:\Users\dlee\AppData\Local\Civica\VH5\0c0133bc-
e9c3-42f8-8872-d355d58e7375\98e50788-b529-4cd5-a795-afc82f6bdcef\scenari
  Summary        filename:       C:\Users\dlee\AppData\Local\Civica\VH5\0c0133bc-
e9c3-42f8-8872-d355d58e7375\98e50788-b529-4cd5-a795-afc82f6bdcef\scenari


DATE: 09/19/2017                              TIME: 01:13:07

USER:



COMMENTS: _____________________________________________________________


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  ****************************
  ** SIMULATION NUMBER:   0 **
  ****************************



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|    READ STORM    |    Filename: C:\Users\dlee\AppD
|                  |              ata\Local\Temp\
|                  |              83a7d2ec-ce61-4f2e-99da-d82dc3884ac5\e2e892a4
| Ptotal= 41.69 mm |    Comments:
--------------------
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.17    2.98 |  1.17   21.37 |  2.17    6.78 |  3.17    3.52
                0.33    3.40 |  1.33   88.09 |  2.33    5.81 |  3.33    3.28
                0.50    3.97 |  1.50   27.73 |  2.50    5.11 |  3.50    3.08
                0.67    4.84 |  1.67   15.03 |  2.67    4.57 |  3.67    2.90
                0.83    6.29 |  1.83   10.53 |  2.83    4.15 |  3.83    2.74
                1.00    9.36 |  2.00    8.21 |  3.00    3.81 |  4.00    2.60

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--------------------
| CALIB            |
| STANDHYD (  0341)|   Area    (ha)=   0.16
```

|ID= 1 DT= 5.0 min | Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.16	0.00
Dep. Storage	(mm)=	0.00	0.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	32.66	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.98	1.083	21.37	2.083	6.78	3.08	3.52
0.167	2.98	1.167	21.37	2.167	6.78	3.17	3.52
0.250	3.40	1.250	88.09	2.250	5.81	3.25	3.28
0.333	3.40	1.333	88.09	2.333	5.81	3.33	3.28
0.417	3.97	1.417	27.73	2.417	5.11	3.42	3.08
0.500	3.97	1.500	27.73	2.500	5.11	3.50	3.08
0.583	4.84	1.583	15.03	2.583	4.57	3.58	2.90
0.667	4.84	1.667	15.03	2.667	4.57	3.67	2.90
0.750	6.29	1.750	10.53	2.750	4.15	3.75	2.74
0.833	6.29	1.833	10.53	2.833	4.15	3.83	2.74
0.917	9.36	1.917	8.21	2.917	3.81	3.92	2.60
1.000	9.36	2.000	8.21	3.000	3.81	4.00	2.60

Max.Eff.Inten.(mm/hr)=		88.09	64.62	
over (min)		5.00	5.00	
Storage Coeff. (min)=		1.37 (ii)	2.55 (ii)	
Unit Hyd. Tpeak (min)=		5.00	5.00	
Unit Hyd. peak (cms)=		0.33	0.29	
				TOTALS
PEAK FLOW	(cms)=	0.04	0.00	0.039 (iii)
TIME TO PEAK	(hrs)=	1.33	1.33	1.33
RUNOFF VOLUME	(mm)=	41.69	30.02	41.57
TOTAL RAINFALL	(mm)=	41.69	41.69	41.69
RUNOFF COEFFICIENT	=	1.00	0.72	1.00

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 94.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0343)

Area (ha)= 1.81

|ID= 1 DT= 5.0 min | Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.79	0.02
Dep. Storage	(mm)=	0.00	0.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	109.94	40.00
Mannings n	=	0.013	0.250

Max.Eff.Inten.(mm/hr)=		88.09	64.62
over (min)		5.00	5.00
Storage Coeff. (min)=		2.84 (ii)	4.03 (ii)

```
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.28         0.24
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.43         0.00          0.432 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33           1.33
     RUNOFF VOLUME    (mm)=      41.69        30.02          41.57
     TOTAL RAINFALL   (mm)=      41.69        41.69          41.69
     RUNOFF COEFFICIENT   =       1.00         0.72           1.00

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0358)|   Area    (ha)=   1.81
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.63         0.18
     Dep. Storage     (mm)=       0.00         0.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     109.94        40.00
     Mannings n             =     0.013        0.250

     Max.Eff.Inten.(mm/hr)=      88.09        64.62
               over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.84 (ii)    5.93 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.28         0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.39         0.02          0.413 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42           1.33
     RUNOFF VOLUME    (mm)=      41.69        30.02          40.52
     TOTAL RAINFALL   (mm)=      41.69        41.69          41.69
     RUNOFF COEFFICIENT   =       1.00         0.72           0.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR(  0361)|
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000    |   0.3120      0.0220
                         0.3110     0.0010    |   0.0000      0.0000

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0358)       1.813      0.413      1.33       40.52
   OUTFLOW: ID= 1 (  0361)       1.813      0.311      1.33       40.53
```

```
                    PEAK   FLOW   REDUCTION [Qout/Qin](%)= 75.34
                    TIME SHIFT OF PEAK FLOW          (min)=  0.00
                    MAXIMUM  STORAGE   USED        (ha.m.)=  0.0048

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0375)|   Area    (ha)=   0.16
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.14          0.02
     Dep. Storage     (mm)=       0.00          0.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=      32.66         40.00
     Mannings n             =     0.013         0.250

     Max.Eff.Inten.(mm/hr)=      88.09         64.62
               over (min)        5.00          5.00
     Storage Coeff.  (min)=      1.37 (ii)     4.46 (ii)
     Unit Hyd. Tpeak (min)=      5.00          5.00
     Unit Hyd. peak  (cms)=      0.33          0.23
                                                          *TOTALS*
     PEAK FLOW       (cms)=      0.04          0.00          0.038 (iii)
     TIME TO PEAK    (hrs)=      1.33          1.33           1.33
     RUNOFF VOLUME    (mm)=     41.69         30.02          40.51
     TOTAL RAINFALL   (mm)=     41.69         41.69          41.69
     RUNOFF COEFFICIENT   =      1.00          0.72           0.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD  (  0377)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0361):     1.81   0.311     1.33    40.53
      + ID2= 2 (  0375):     0.16   0.038     1.33    40.51
        ==========================================================
        ID = 3 (  0377):     1.97   0.349     1.33    40.53

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 5.0\VO2\voin.dat
  Output           filename:     C:\Users\dlee\AppData\Local\Civica\VH5\0c0133bc-
e9c3-42f8-8872-d355d58e7375\3bd3836a-fea4-4032-b88f-8be485384445\scenari
  Summary        filename:       C:\Users\dlee\AppData\Local\Civica\VH5\0c0133bc-
e9c3-42f8-8872-d355d58e7375\3bd3836a-fea4-4032-b88f-8be485384445\scenari


DATE: 09/19/2017                              TIME: 01:13:07

USER:



COMMENTS: _____________________________________________________________


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  ****************************
  ** SIMULATION NUMBER:   0 **
  ****************************



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|    READ STORM    |    Filename: C:\Users\dlee\AppD
|                  |              ata\Local\Temp\
|                  |              83a7d2ec-ce61-4f2e-99da-d82dc3884ac5\fab61043
| Ptotal=105.32 mm |    Comments:
--------------------
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.17    1.08 |  6.17    3.38 | 12.17    3.01 | 18.17    1.50
                0.33    1.10 |  6.33    3.65 | 12.33    2.91 | 18.33    1.48
                0.50    1.12 |  6.50    3.98 | 12.50    2.83 | 18.50    1.46
                0.67    1.14 |  6.67    4.39 | 12.67    2.75 | 18.67    1.45
                0.83    1.16 |  6.83    4.90 | 12.83    2.68 | 18.83    1.43
                1.00    1.18 |  7.00    5.58 | 13.00    2.61 | 19.00    1.41
                1.17    1.20 |  7.17    6.52 | 13.17    2.54 | 19.17    1.40
                1.33    1.22 |  7.33    7.92 | 13.33    2.48 | 19.33    1.38
                1.50    1.25 |  7.50   10.29 | 13.50    2.42 | 19.50    1.37
                1.67    1.27 |  7.67   15.27 | 13.67    2.36 | 19.67    1.35
                1.83    1.30 |  7.83   34.69 | 13.83    2.31 | 19.83    1.34
                2.00    1.33 |  8.00  141.89 | 14.00    2.26 | 20.00    1.32
```

2.17	1.36	8.17	44.96	14.17	2.21	20.17	1.31
2.33	1.39	8.33	24.46	14.33	2.17	20.33	1.29
2.50	1.42	8.50	17.17	14.50	2.12	20.50	1.28
2.67	1.45	8.67	13.40	14.67	2.08	20.67	1.27
2.83	1.49	8.83	11.09	14.83	2.04	20.83	1.26
3.00	1.53	9.00	9.51	15.00	2.00	21.00	1.24
3.17	1.57	9.17	8.37	15.17	1.97	21.17	1.23
3.33	1.61	9.33	7.50	15.33	1.93	21.33	1.22
3.50	1.66	9.50	6.80	15.50	1.90	21.50	1.21
3.67	1.71	9.67	6.24	15.67	1.87	21.67	1.20
3.83	1.76	9.83	5.78	15.83	1.84	21.83	1.18
4.00	1.82	10.00	5.39	16.00	1.81	22.00	1.17
4.17	1.88	10.17	5.05	16.17	1.78	22.17	1.16
4.33	1.95	10.33	4.76	16.33	1.75	22.33	1.15
4.50	2.02	10.50	4.50	16.50	1.72	22.50	1.14
4.67	2.10	10.67	4.28	16.67	1.70	22.67	1.13
4.83	2.19	10.83	4.08	16.83	1.67	22.83	1.12
5.00	2.28	11.00	3.90	17.00	1.65	23.00	1.11
5.17	2.39	11.17	3.73	17.17	1.63	23.17	1.10
5.33	2.51	11.33	3.58	17.33	1.60	23.33	1.09
5.50	2.64	11.50	3.45	17.50	1.58	23.50	1.09
5.67	2.79	11.67	3.32	17.67	1.56	23.67	1.08
5.83	2.96	11.83	3.21	17.83	1.54	23.83	1.07
6.00	3.15	12.00	3.10	18.00	1.52	24.00	1.06

CALIB STANDHYD (0341) ID= 1 DT= 5.0 min	Area (ha)= 0.16 Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.16	0.00
Dep. Storage	(mm)=	0.00	0.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	32.66	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.08	6.083	3.38	12.083	3.01	18.08	1.50
0.167	1.08	6.167	3.38	12.167	3.01	18.17	1.50
0.250	1.10	6.250	3.65	12.250	2.91	18.25	1.48
0.333	1.10	6.333	3.65	12.333	2.91	18.33	1.48
0.417	1.12	6.417	3.98	12.417	2.83	18.42	1.46
0.500	1.12	6.500	3.98	12.500	2.83	18.50	1.46
0.583	1.14	6.583	4.39	12.583	2.75	18.58	1.45
0.667	1.14	6.667	4.39	12.667	2.75	18.67	1.45
0.750	1.16	6.750	4.90	12.750	2.68	18.75	1.43
0.833	1.16	6.833	4.90	12.833	2.68	18.83	1.43
0.917	1.18	6.917	5.58	12.917	2.61	18.92	1.41
1.000	1.18	7.000	5.58	13.000	2.61	19.00	1.41
1.083	1.20	7.083	6.52	13.083	2.54	19.08	1.40
1.167	1.20	7.167	6.52	13.167	2.54	19.17	1.40
1.250	1.22	7.250	7.92	13.250	2.48	19.25	1.38
1.333	1.22	7.333	7.92	13.333	2.48	19.33	1.38
1.417	1.25	7.417	10.29	13.417	2.42	19.42	1.37
1.500	1.25	7.500	10.29	13.500	2.42	19.50	1.37
1.583	1.27	7.583	15.27	13.583	2.36	19.58	1.35

1.667	1.27	7.667	15.27	13.667	2.36	19.67	1.35
1.750	1.30	7.750	34.69	13.750	2.31	19.75	1.34
1.833	1.30	7.833	34.69	13.833	2.31	19.83	1.34
1.917	1.33	7.917	141.89	13.917	2.26	19.92	1.32
2.000	1.33	8.000	141.89	14.000	2.26	20.00	1.32
2.083	1.36	8.083	44.96	14.083	2.21	20.08	1.31
2.167	1.36	8.167	44.96	14.167	2.21	20.17	1.31
2.250	1.39	8.250	24.46	14.250	2.17	20.25	1.29
2.333	1.39	8.333	24.46	14.333	2.17	20.33	1.29
2.417	1.42	8.417	17.17	14.417	2.12	20.42	1.28
2.500	1.42	8.500	17.17	14.500	2.12	20.50	1.28
2.583	1.45	8.583	13.40	14.583	2.08	20.58	1.27
2.667	1.45	8.667	13.40	14.667	2.08	20.67	1.27
2.750	1.49	8.750	11.09	14.750	2.04	20.75	1.26
2.833	1.49	8.833	11.09	14.833	2.04	20.83	1.26
2.917	1.53	8.917	9.51	14.917	2.00	20.92	1.24
3.000	1.53	9.000	9.51	15.000	2.00	21.00	1.24
3.083	1.57	9.083	8.37	15.083	1.97	21.08	1.23
3.167	1.57	9.167	8.37	15.167	1.97	21.17	1.23
3.250	1.61	9.250	7.50	15.250	1.93	21.25	1.22
3.333	1.61	9.333	7.50	15.333	1.93	21.33	1.22
3.417	1.66	9.417	6.80	15.417	1.90	21.42	1.21
3.500	1.66	9.500	6.80	15.500	1.90	21.50	1.21
3.583	1.71	9.583	6.24	15.583	1.87	21.58	1.20
3.667	1.71	9.667	6.24	15.667	1.87	21.67	1.20
3.750	1.76	9.750	5.78	15.750	1.84	21.75	1.18
3.833	1.76	9.833	5.78	15.833	1.84	21.83	1.18
3.917	1.82	9.917	5.39	15.917	1.81	21.92	1.17
4.000	1.82	10.000	5.39	16.000	1.81	22.00	1.17
4.083	1.88	10.083	5.05	16.083	1.78	22.08	1.16
4.167	1.88	10.167	5.05	16.167	1.78	22.17	1.16
4.250	1.95	10.250	4.76	16.250	1.75	22.25	1.15
4.333	1.95	10.333	4.76	16.333	1.75	22.33	1.15
4.417	2.02	10.417	4.50	16.417	1.72	22.42	1.14
4.500	2.02	10.500	4.50	16.500	1.72	22.50	1.14
4.583	2.10	10.583	4.28	16.583	1.70	22.58	1.13
4.667	2.10	10.667	4.28	16.667	1.70	22.67	1.13
4.750	2.19	10.750	4.08	16.750	1.67	22.75	1.12
4.833	2.19	10.833	4.08	16.833	1.67	22.83	1.12
4.917	2.28	10.917	3.90	16.917	1.65	22.92	1.11
5.000	2.28	11.000	3.90	17.000	1.65	23.00	1.11
5.083	2.39	11.083	3.73	17.083	1.63	23.08	1.10
5.167	2.39	11.167	3.73	17.167	1.63	23.17	1.10
5.250	2.51	11.250	3.58	17.250	1.60	23.25	1.09
5.333	2.51	11.333	3.58	17.333	1.60	23.33	1.09
5.417	2.64	11.417	3.45	17.417	1.58	23.42	1.09
5.500	2.64	11.500	3.45	17.500	1.58	23.50	1.09
5.583	2.79	11.583	3.32	17.583	1.56	23.58	1.08
5.667	2.79	11.667	3.32	17.667	1.56	23.67	1.08
5.750	2.96	11.750	3.21	17.750	1.54	23.75	1.07
5.833	2.96	11.833	3.21	17.833	1.54	23.83	1.07
5.917	3.15	11.917	3.10	17.917	1.52	23.92	1.06
6.000	3.15	12.000	3.10	18.000	1.52	24.00	1.06

Max.Eff.Inten.(mm/hr)=	141.89	129.02	
over (min)	5.00	5.00	
Storage Coeff. (min)=	1.13 (ii)	2.11 (ii)	
Unit Hyd. Tpeak (min)=	5.00	5.00	
Unit Hyd. peak (cms)=	0.34	0.31	
			TOTALS
PEAK FLOW (cms)=	0.06	0.00	0.063 (iii)
TIME TO PEAK (hrs)=	8.00	8.00	8.00
RUNOFF VOLUME (mm)=	105.32	91.27	105.18
TOTAL RAINFALL (mm)=	105.32	105.32	105.32

```
     RUNOFF COEFFICIENT   =       1.00         0.87           1.00

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0343)|   Area    (ha)=   1.81
|ID= 1 DT= 5.0 min |   Total Imp(%)=  99.00   Dir. Conn.(%)=  99.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.79          0.02
     Dep. Storage     (mm)=       0.00          0.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     109.94         40.00
     Mannings n             =     0.013         0.250

     Max.Eff.Inten.(mm/hr)=     141.89        129.02
               over (min)         5.00          5.00
     Storage Coeff.  (min)=       2.35 (ii)     3.33 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.30          0.26
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.70          0.01          0.706 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.00           8.00
     RUNOFF VOLUME    (mm)=     105.32         91.27         105.18
     TOTAL RAINFALL   (mm)=     105.32        105.32         105.32
     RUNOFF COEFFICIENT   =       1.00          0.87           1.00

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD (  0358)|   Area    (ha)=   1.81
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.63          0.18
     Dep. Storage     (mm)=       0.00          0.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=     109.94         40.00
     Mannings n             =     0.013         0.250

     Max.Eff.Inten.(mm/hr)=     141.89        129.02
               over (min)         5.00          5.00
     Storage Coeff.  (min)=       2.35 (ii)     4.90 (ii)
     Unit Hyd. Tpeak (min)=       5.00          5.00
     Unit Hyd. peak  (cms)=       0.30          0.22
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.64          0.06          0.695 (iii)
     TIME TO PEAK    (hrs)=       8.00          8.00           8.00
```

```
     RUNOFF VOLUME    (mm)=     105.32        91.27         103.91
     TOTAL RAINFALL   (mm)=     105.32       105.32         105.32
     RUNOFF COEFFICIENT   =       1.00         0.87           0.99

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0361)|
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                         0.0000     0.0000   |   0.3120      0.0220
                         0.3110     0.0010   |   0.0000      0.0000

                                   AREA     QPEAK     TPEAK       R.V.
                                   (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0358)        1.813     0.695      8.00     103.91
   OUTFLOW: ID= 1 (  0361)        1.813     0.312      8.08     103.92

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 44.88
                  TIME SHIFT OF PEAK FLOW         (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.0215

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0375)|   Area    (ha)=   0.16
|ID= 1 DT= 5.0 min |   Total Imp(%)=  90.00   Dir. Conn.(%)=  90.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.14         0.02
     Dep. Storage     (mm)=       0.00         0.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      32.66        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=     141.89       129.02
               over (min)         5.00         5.00
     Storage Coeff.  (min)=       1.13 (ii)    3.68 (ii)
     Unit Hyd. Tpeak (min)=       5.00         5.00
     Unit Hyd. peak  (cms)=       0.34         0.25
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.06         0.01          0.062 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.00           8.00
     RUNOFF VOLUME    (mm)=     105.32        91.27         103.91
     TOTAL RAINFALL   (mm)=     105.32       105.32         105.32
     RUNOFF COEFFICIENT   =       1.00         0.87           0.99

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
```

```
--------------------
| ADD HYD  (  0377)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0361):     1.81   0.312     8.08   103.92
      + ID2= 2 (  0375):     0.16   0.062     8.00   103.91
        ================================================
        ID = 3 (  0377):     1.97   0.374     8.00   103.92

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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 FINISH
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Stormceptor Sizing Detailed Report

PCSWMM for Stormceptor

Project Information

Date	9/19/2017
Project Name	National Homes
Project Number	484 & 490 Plains Road East
Location	City of Burlington

Stormwater Quality Objective

This report outlines how Stormceptor System can achieve a defined water quality objective through the removal of total suspended solids (TSS). Attached to this report is the Stormceptor Sizing Summary.

Stormceptor System Recommendation

The Stormceptor System model STC 9000 achieves the water quality objective removing 83% TSS for a City of Toronto (clay, silt and sand) particle size distribution.

The Stormceptor System

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for all rainfall events, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.

Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Stormceptor is the only oil and sediment separator on the market sized to remove TSS for a wide range of particle sizes, including fine sediments (clays and silts), that are often overlooked in the design of other stormwater treatment devices.

Small storms dominate hydrologic activity, US EPA reports

"*Early efforts in stormwater management focused on flood events ranging from the 2-yr to the 100-yr storm. Increasingly stormwater professionals have come to realize that small storms (i.e. < 1 in. rainfall) dominate watershed hydrologic parameters typically associated with water quality management issues and BMP design. These small storms are responsible for most annual urban runoff and groundwater recharge. Likewise, with the exception of eroded sediment, they are responsible for most pollutant washoff from urban surfaces. Therefore, the small storms are of most concern for the stormwater management objectives of ground water recharge, water quality resource protection and thermal impacts control.*"

"*Most rainfall events are much smaller than design storms used for urban drainage models. In any given area, most frequently recurrent rainfall events are small (less than 1 in. of daily rainfall).*"

"Continuous simulation offers possibilities for designing and managing BMPs on an individual site-by-site basis that are not provided by other widely used simpler analysis methods. Therefore its application and use should be encouraged."

– US EPA Stormwater Best Management Practice Design Guide, Volume 1 – General Considerations, 2004

Design Methodology

Each Stormceptor system is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology from up-to-date local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective.

The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing (summary of analysis presented in Appendix 2):

- Site parameters
- Continuous historical rainfall, including duration, distribution, peaks (Figure 1)
- Interevent periods
- Particle size distribution
- Particle settling velocities (Stokes Law, corrected for drag)
- TSS load (Figure 2)
- Detention time of the system

The Stormceptor System maintains continuous positive TSS removal for all influent flow rates. Figure 3 illustrates the continuous treatment by Stormceptor throughout the full range of storm events analyzed. It is clear that large events do not significantly impact the average annual TSS removal. There is no decline in cumulative TSS removal, indicating scour does not occur as the flow rate increases.

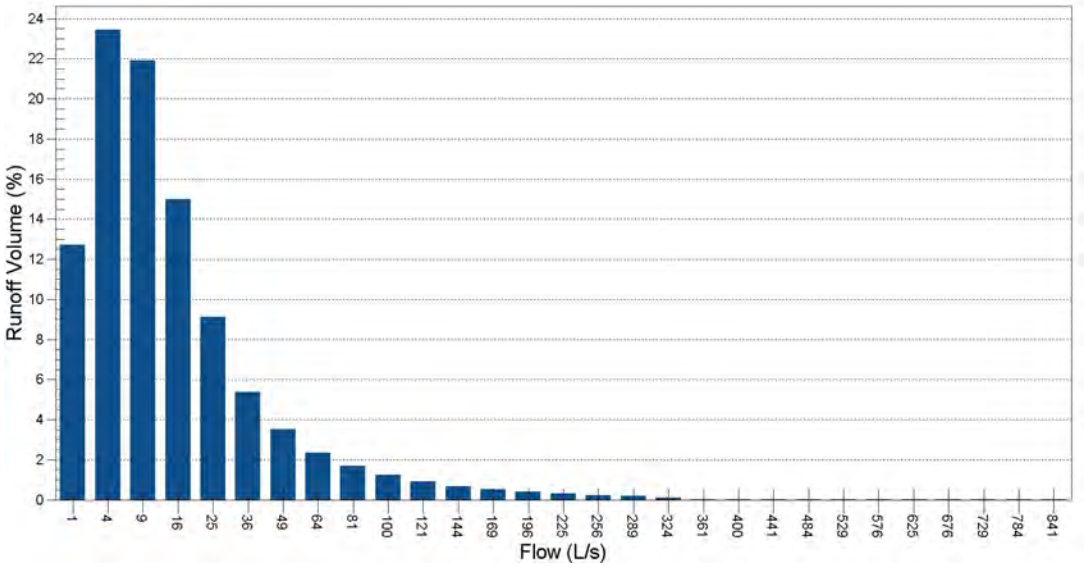


Figure 1. Runoff Volume by Flow Rate for TORONTO CENTRAL – ON 100, 1982 to 1999 for 1.973 ha, 90% impervious. Small frequent storm events represent the majority of annual rainfall volume. Large infrequent events have little impact on the average annual TSS removal, as they represent a small percentage of the total annual volume of runoff.

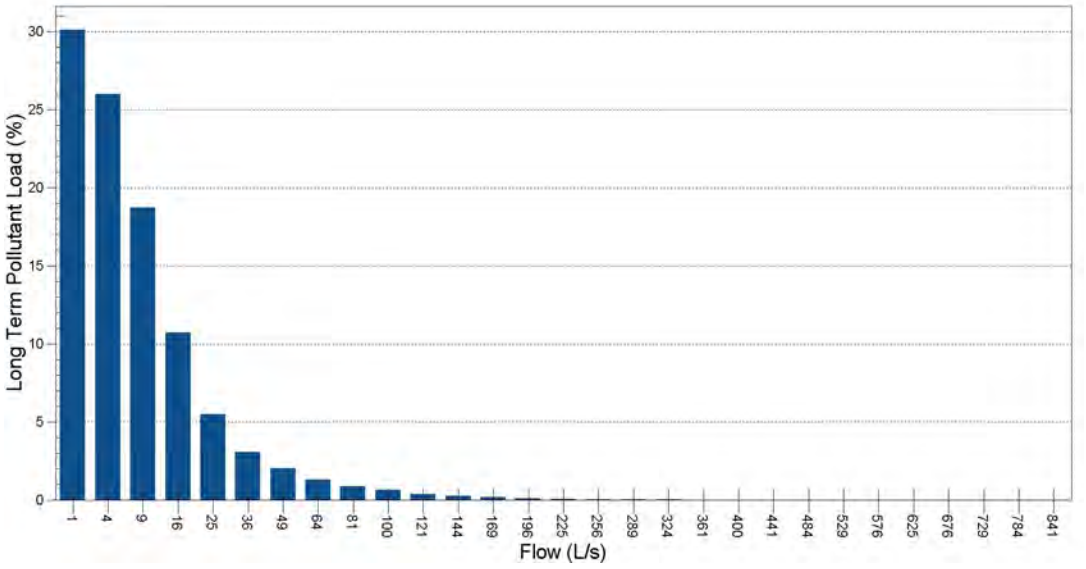
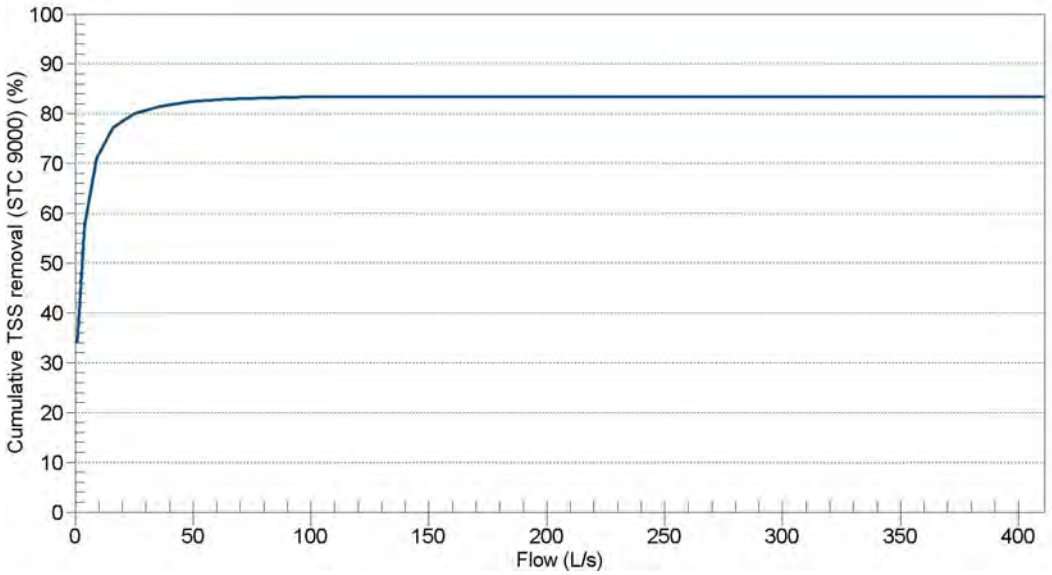


Figure 2. Long Term Pollutant Load by Flow Rate for TORONTO CENTRAL – 100, 1982 to 1999 for 1.973 ha, 90% impervious. The majority of the annual pollutant load is transported by small frequent storm events. Conversely, large infrequent events carry an insignificant percentage of the total annual pollutant load.



Stormceptor Model	STC 9000	Drainage Area (ha)	1.973
TSS Removal (%)	83	Impervious (%)	90

Figure 3. Cumulative TSS Removal by Flow Rate for TORONTO CENTRAL – 100, 1982 to 1999.
Stormceptor continuously removes TSS throughout the full range of storm events analyzed. Note that large events do not significantly impact the average annual TSS removal. Therefore no decline in cumulative TSS removal indicates scour does not occur as the flow rate increases.

Stormceptor®

Appendix 1
Stormceptor Design Summary

Project Information

Date	9/19/2017
Project Name	National Homes
Project Number	484 & 490 Plains Road East
Location	City of Burlington

Designer Information

Company	Urbantech
Contact	N/A

Notes

N/A

Drainage Area

Total Area (ha)	1.973
Imperviousness (%)	90

The Stormceptor System model STC 9000 achieves the water quality objective removing 83% TSS for a City of Toronto (clay, silt and sand) particle size distribution.

Rainfall

Name	TORONTO CENTRAL
State	ON
ID	100
Years of Records	1982 to 1999
Latitude	45°30'N
Longitude	90°30'W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0.000	00.000
0.001	311.000
0.022	312.000

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 300	52
STC 750	63
STC 1000	63
STC 1500	64
STC 2000	70
STC 3000	71
STC 4000	75
STC 5000	76
STC 6000	79
STC 9000	**83**
STC 10000	83
STC 14000	86

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

City of Toronto (clay, silt and sand)

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
10	20	2.65	0.0004					
30	10	2.65	0.0008					
50	10	2.65	0.0022					
95	20	2.65	0.0063					
265	20	2.65	0.0366					
1000	20	2.65	0.1691					

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.

Stormceptor®

Appendix 2
Summary of Design Assumptions

SITE DETAILS

Site Drainage Area

Total Area (ha)	1.973	Imperviousness (%)	90

Surface Characteristics

Width (m)	280.927
Slope (%)	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Infiltration Parameters

Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/h)	61.98
Min. Infiltration Rate (mm/h)	10.16
Decay Rate (s^{-1})	0.00055
Regeneration Rate (s^{-1})	0.01

Maintenance Frequency

Sediment build-up reduces the storage volume for sedimentation. Frequency of maintenance is assumed for TSS removal calculations.	
Maintenance Frequency (months)	12

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow

Dry Weather Flow (L/s)	No

Upstream Attenuation

Stage-storage and stage-discharge relationship used to model attenuation upstream of the Stormceptor System is identified in the table below.

Storage ha-m	Discharge L/s
0.000	00.000
0.001	311.000
0.022	312.000

PARTICLE SIZE DISTRIBUTION

Particle Size Distribution

Removing fine particles from runoff ensures the majority of pollutants, such as heavy metals, hydrocarbons, free oils and nutrients are not discharged into natural water resources. The table below identifies the particle size distribution selected to define TSS removal for the design of the Stormceptor System.

City of Toronto (clay, silt and sand)

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
10	20	2.65	0.0004					
30	10	2.65	0.0008					
50	10	2.65	0.0022					
95	20	2.65	0.0063					
265	20	2.65	0.0366					
1000	20	2.65	0.1691					

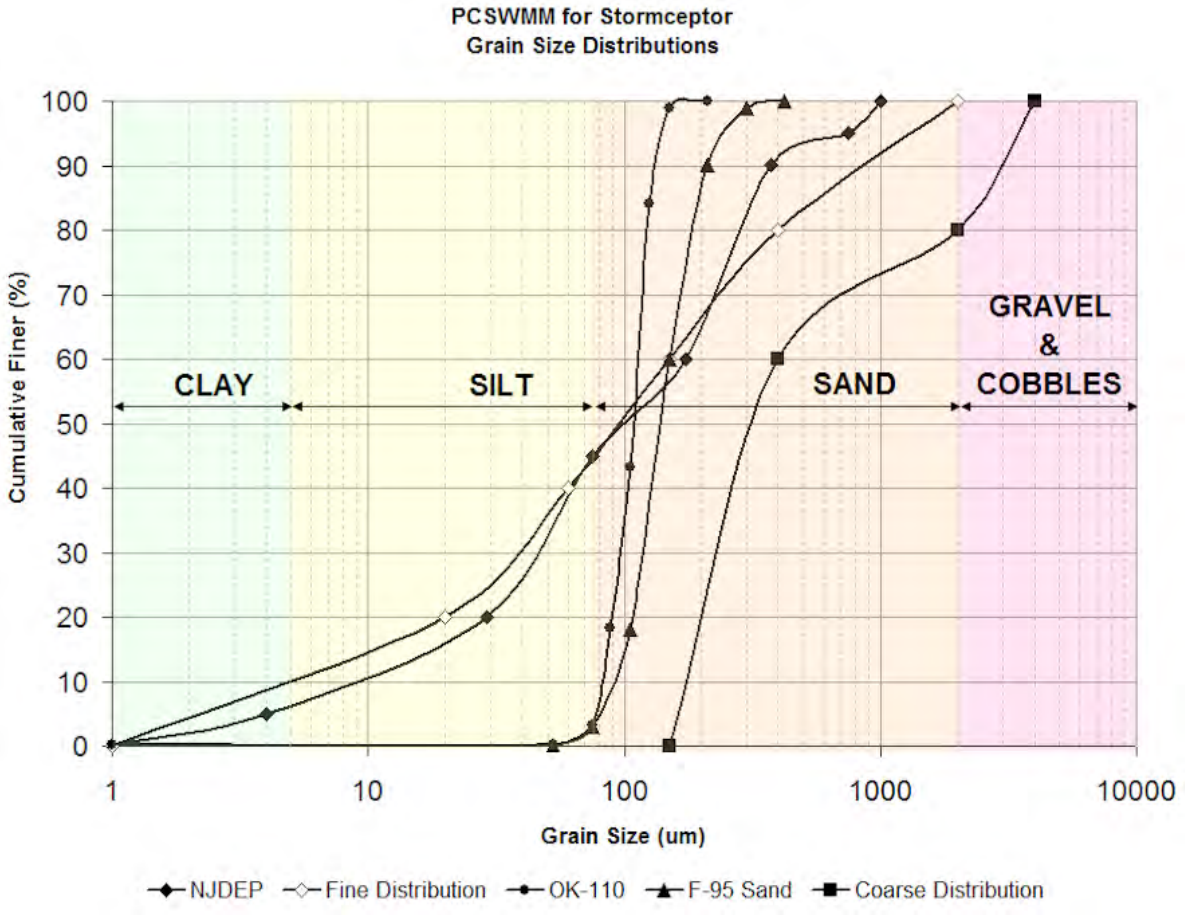


Figure 1. PCSWMM for Stormceptor standard design grain size distributions.

TSS LOADING

TSS Loading Parameters

TSS Loading Function	Buildup / Washoff

Parameters

Target Event Mean Concentration (EMC) (mg/L)	125
Exponential Buildup Power	0.4
Exponential Washoff Exponential	0.2

HYDROLOGY ANALYSIS

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of the Stormceptor System are based on the average annual removal of TSS for the selected site parameters. The Stormceptor System is engineered to capture fine particles (silts and sands) by focusing on average annual runoff volume ensuring positive removal efficiency is maintained during all rainfall events, while preventing the opportunity for negative removal efficiency (scour).

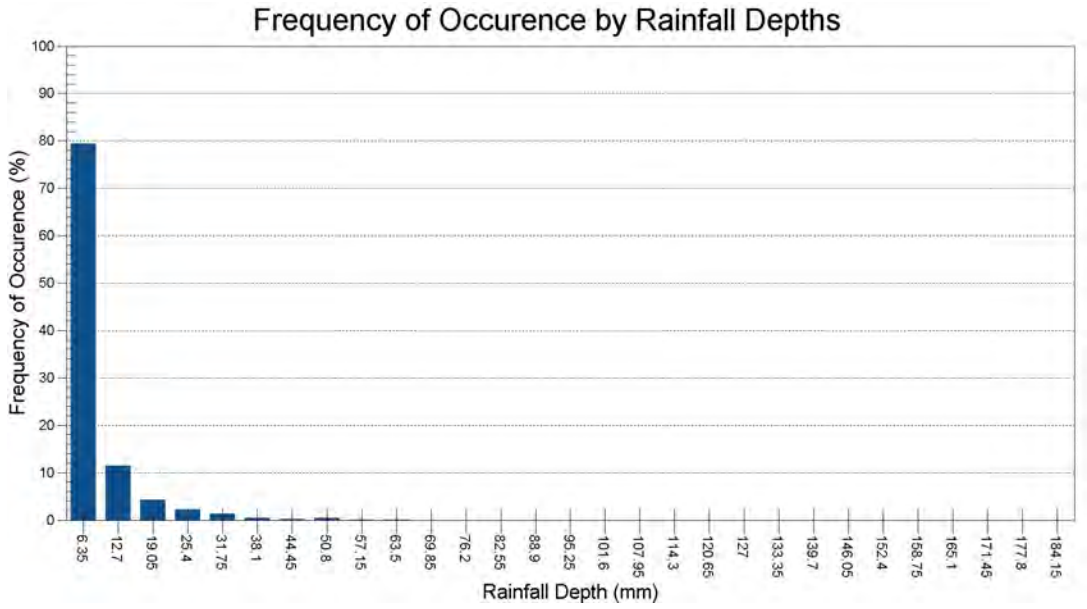
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

Rainfall Station	TORONTO CENTRAL		
Rainfall File Name	ON100.NDC	Total Number of Events	3019
Latitude	45°30'N	Total Rainfall (mm)	13189.7
Longitude	90°30'W	Average Annual Rainfall (mm)	732.8
Elevation (m)	328	Total Evaporation (mm)	1261.6
Rainfall Period of Record (y)	18	Total Infiltration (mm)	1312.4
Total Rainfall Period (y)	18	Percentage of Rainfall that is Runoff (%)	81.0

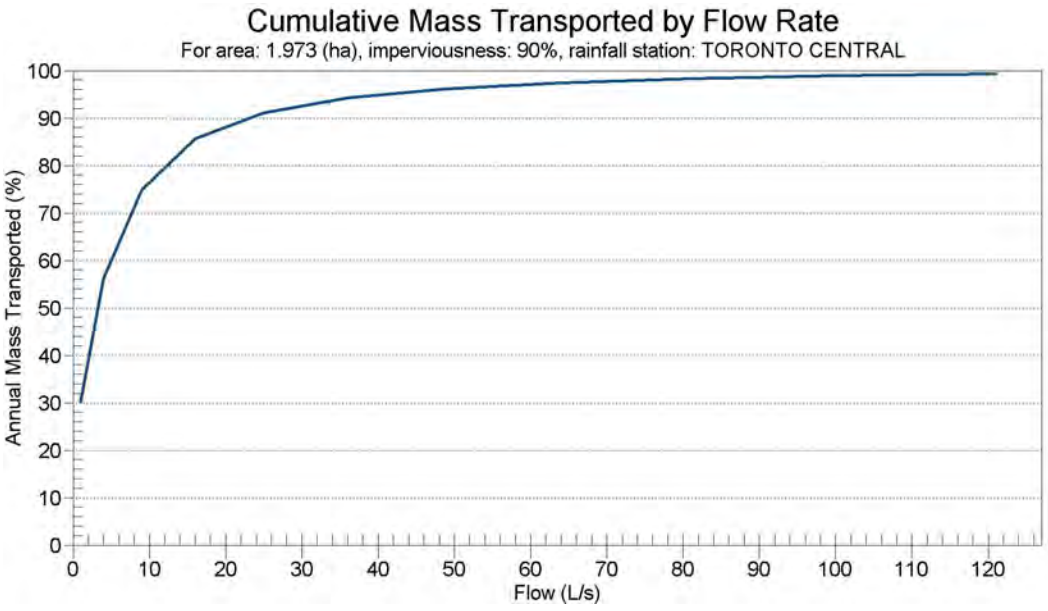
Rainfall Event Analysis

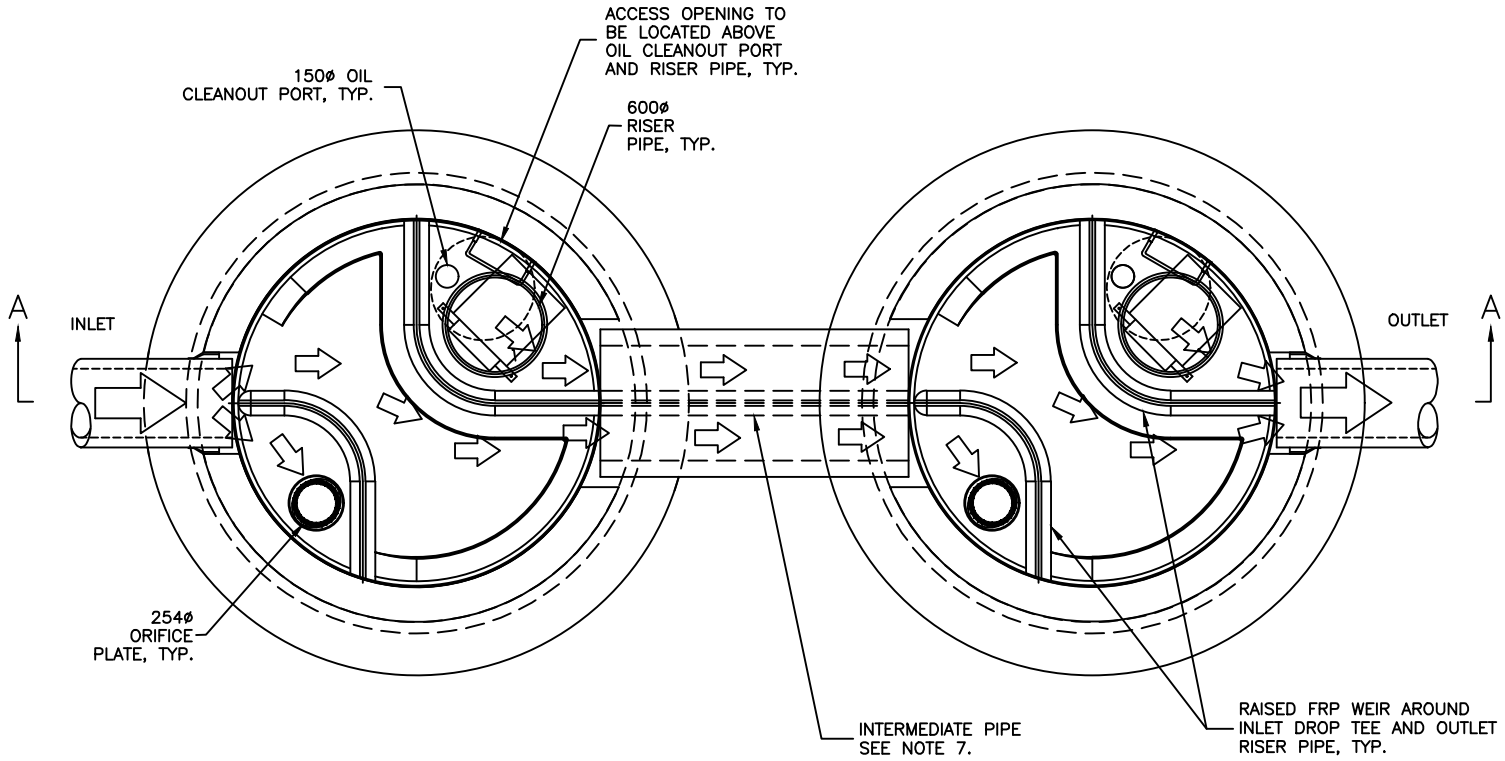
Rainfall Depth mm	No. of Events	Percentage of Total Events %	Total Volume mm	Percentage of Annual Volume %
6.35	2397	79.4	3625	27.5
12.70	346	11.5	3182	24.1
19.05	130	4.3	2037	15.4
25.40	66	2.2	1432	10.9
31.75	38	1.3	1075	8.2
38.10	16	0.5	545	4.1
44.45	7	0.2	292	2.2
50.80	13	0.4	611	4.6
57.15	2	0.1	106	0.8
63.50	2	0.1	121	0.9
69.85	0	0.0	0	0.0
76.20	0	0.0	0	0.0
82.55	1	0.0	79	0.6
88.90	1	0.0	85	0.6
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	0	0.0	0	0.0
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0
133.35	0	0.0	0	0.0
139.70	0	0.0	0	0.0
146.05	0	0.0	0	0.0
152.40	0	0.0	0	0.0
158.75	0	0.0	0	0.0
165.10	0	0.0	0	0.0
171.45	0	0.0	0	0.0
177.80	0	0.0	0	0.0
184.15	0	0.0	0	0.0
190.50	0	0.0	0	0.0
196.85	0	0.0	0	0.0
203.20	0	0.0	0	0.0
209.55	0	0.0	0	0.0
>209.55	0	0.0	0	0.0



Pollutograph

Flow Rate L/s	Cumulative Mass %
1	30.2
4	56.2
9	74.9
16	85.6
25	91.1
36	94.2
49	96.2
64	97.4
81	98.3
100	98.9
121	99.3
144	99.6
169	99.8
196	99.9
225	99.9
256	100.0
289	100.0
324	100.0
361	100.0
400	100.0
441	100.0
484	100.0
529	100.0
576	100.0
625	100.0
676	100.0
729	100.0
784	100.0
841	100.0
900	100.0





TOTAL INLET FLOW AND OUTLET FLOW

HALF OF INLET FLOW DIVERTED TO FIRST UNIT FOR TREATMENT

HALF OF INLET FLOW DIVERTED TO SECOND UNIT FOR TREATMENT

STC 9000 FLOWS AND CAPACITIES			
DROP/RISER PIPE (mm) (LP)	SEDIMENT CAPACITY (L)	OIL CAPACITY (L)	TOTAL CAPACITY [L (IMP GAL)]
1118	28530	10557	43538 (9578)

Stormceptor®

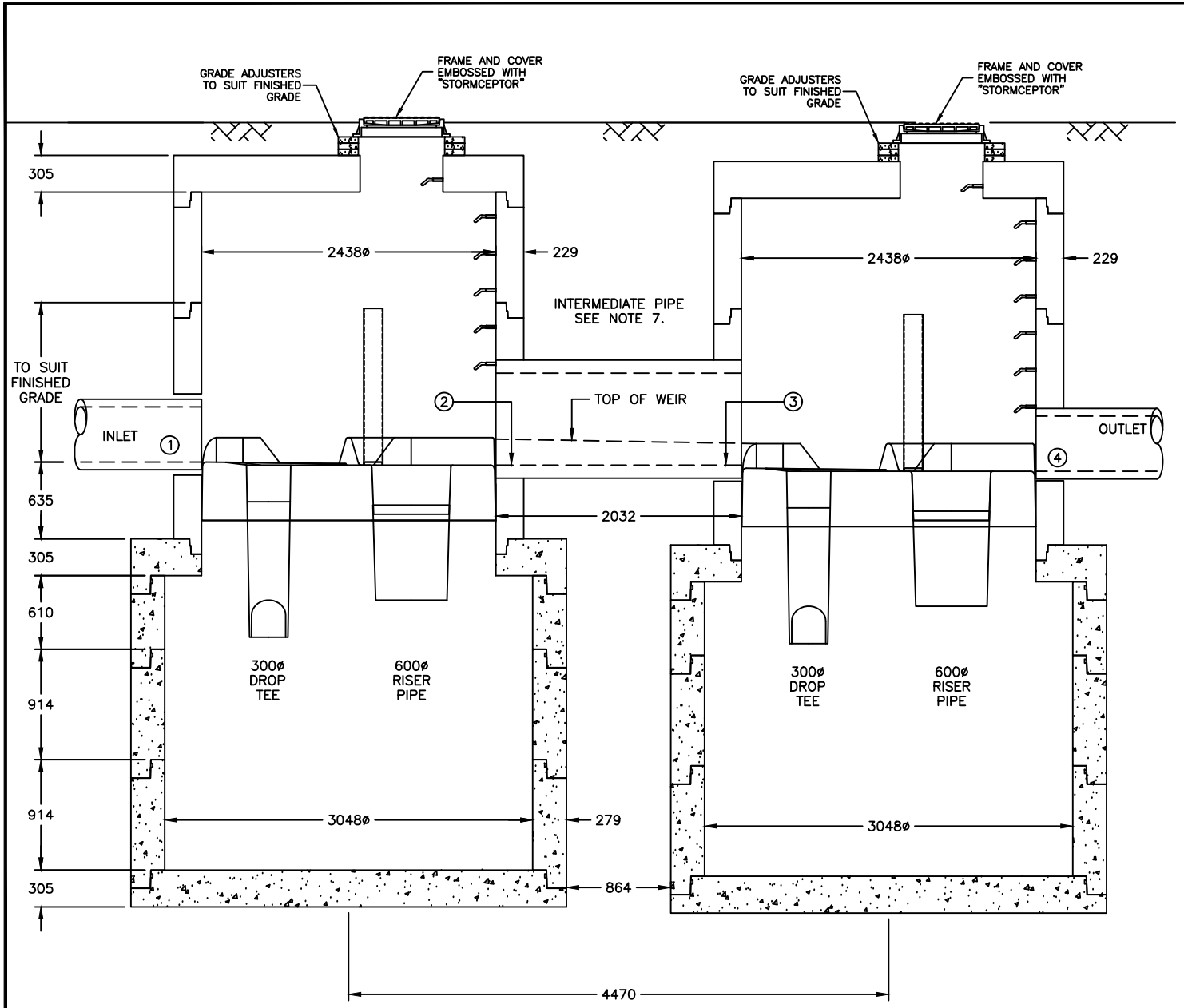
STC 9000 IN SERIES STORMCEPTOR

9000 GALLON CAPACITY

PLAN VIEW
PAGE 2 OF 2

15 JAN 01

B.L. | UNITS: METRIC | SCALE: 1:50



1. INLET PIPE INVERT = DATUM + 0mm
2. INTERMEDIATE PIPE INLET INVERT = DATUM – 25 mm
3. INTERMEDIATE PIPE OUTLET INVERT = DATUM – 50 mm
4. OUTLET PIPE INVERT = DATUM 0 – 75 MM

NOT FOR CONSTRUCTION:

Please contact local manufacturer for detailed construction drawings

Notes:

1. 610 mm OUTLET RISER PIPE TO BE USED FOR CLEANOUT ACCESS TO THE TREATMENT CHAMBER.
2. ACCESS WAY IS OFFSET TO ALLOW ACCESS TO THE FIBREGLASS BYPASS SLAB AND TO ALLOW FOR INSPECTION AND MAINTENANCE FROM THE SURFACE.
3. PIPE INSTALLATION BY NON–SHRINK GROUT OR FLEXIBLE BOOTS.
4. SAFETY GRATES FOR THE 610 mm OUTLET RISER PIPE ARE PROVIDED.
5. NITRILE GASKETS ARE PROVIDED FOR THE JOINTS.
6. TWIN INLET FLAT CAPS ARE PROVIDED FOR UNITS WITH TOP OF GRADE TO INVERT ELEVATIONS OF 2.134 m OR LESS. OPENINGS PROVIDE ACCESS TO THE OUTLET RISER PIPE AND INLET DROP TEE FOR INSPECTION AND MAINTENANCE.
7. INTERMEDIATE PIPE. ONE DIAMETER SIZE LARGER THAN INLET/OUTLET PIPE, MIN. 750ø MM. MANUFACTURED WITH A WEIR ALONG THE INVERT OF THE PIPE. SUPPLIED BY MANUFACTURER, 2.032 m LONG.

DESIGN SPECIFICATIONS:

1. MANUFACTURED TO CSA A257.4
2. CONCRETE STRENGTH: 30 MPa
3. REINFORCING STEEL: 448 MPa
4. WELDED WIRE FABRIC TO CSA G30.5
5. CONCRETE COVER TO STEEL: 25 mm MIN.
6. DESIGNED TO OHBDC '91, 3rd EDITION LOADING

STORMCEPTOR IS PROTECTED BY ONE OR MORE OF THE FOLLOWING PATENTS:
Canadian Patent No 2,009,208
Canadian Patent No. 2,137,942
Canadian Patent No. 2,175,277
Canadian Patent No. 2,180,305
Canadian Patent No. 2,180,383
Canadian Patent No. 2,206,338
U.S. Patent No. 4,985,148
U.S. Patent No. 5,498,331
U.S. Patent No. 5,725,760
U.S. Patent No. 5,753,115
U.S. Patent No. 5,849,181
U.S. Patent No. 6,068,765
U.S. Patent No. 6,371,690
Australia Patent No. 693,164
Australia Patent No. 707,133
Australia Patent No. 729,096
New Zealand Patent No. 314,646
China Patent No. ZL 97 1 13074.4
European Patent Treaty 95 307 996.9

Stormceptor®

STC 9000 SERIES STORMCEPTOR

9000 GALLON CAPACITY

SECTION A–A

DATE:		
15 JAN 01		
D.B. B.L.	UNITS: METRIC	SCALE: 1:50

DRAWINGS

Site Plan (Kirkor Architects + Planners)

Drawing REM – Existing Conditions & Removals Plan

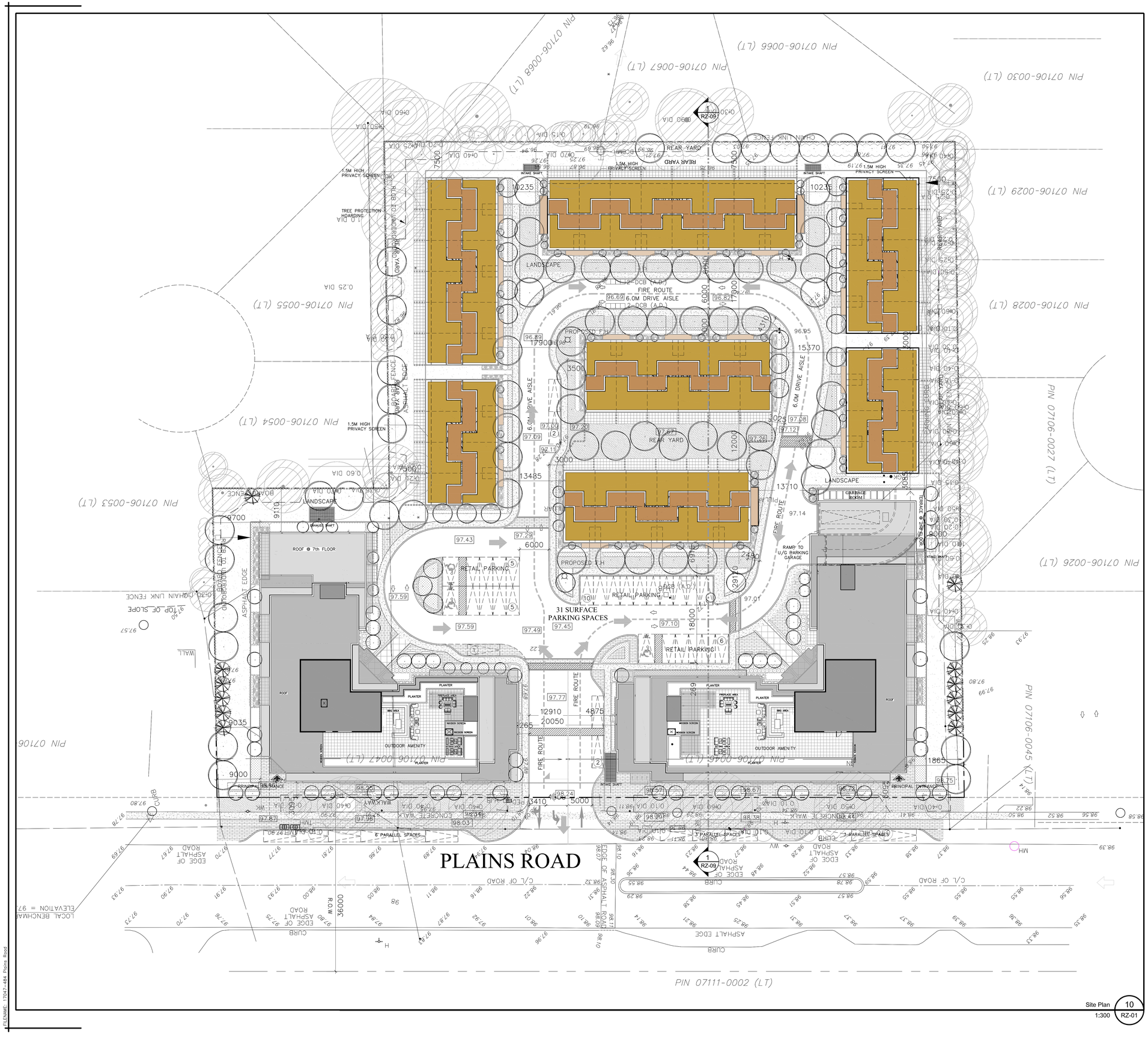
Drawing SP – Servicing Concept

Drawing STM-1 – Pre-Development Storm Drainage Plan

Drawing STM-2 – Post-Development Storm Drainage Concept

Drawing GR – Grading Plan

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Context Plan
N/A
3
RZ-01

PROJECT STATISTICS
Residential / Commercial Development
484 Plains Road, Burlington
September 14, 2017

1.0	LOT AREA				
	Total Site Area	m²	ha	acres	hectares
2.0	NOT USED				
3.0	PROJECT FLOOR AREAS				
3.1	RESIDENTIAL GFA PROPOSED (as permitted per By-Law 020-2014)				
3.1	Buildings A & B	No. of Floors	m² (per Floor)	m²	ft²
	Level 1	1	319.89	1,905.05	20,503
	Total GFA			1,905.05	20,503
	Building A	No. of Floors	m² (per Floor)	Total m²	Total ft²
	Level 1	1x	1,229.01	1,229.01	13,230
	Mezzanine	1x	349.58	349.58	3,763
	Level 2	1x	849.29	1,698.58	18,285
	Level 3	1x	849.29	1,698.58	18,285
	Level 4	1x	1,698.86	1,698.86	18,285
	Level 5	1x	1,697.60	1,697.60	18,272
	Levels 6-7	2x	1,559.84	3,119.68	33,580
	Level 8	1x	1,422.80	1,422.80	15,312
	Level 9 (Elevator Machine Room)	1x	422.81	422.81	4,551
	Total GFA	9		14,364.24	154,621
	Building B	No. of Floors	m² (per Floor)	Total m²	Total ft²
	Level 1	1x	1,276.70	1,276.70	13,743
	Commercial	1x	653.79	653.79	7,037
	Level 2	1x	1,610.95	1,610.95	17,340
	Level 3	1x	1,652.50	1,652.50	17,788
	Level 4	1x	1,636.50	1,636.50	17,616
	Level 5-6	2x	1,570.65	3,141.30	33,816
	Level 7	1x	1,712.65	1,712.65	18,436
	Level 8 (Elevator Machine Room)	1x	1,176.65	1,176.65	12,665
	Total GFA	9		14,384.74	154,840
3.2	Total GFA Buildings A&B			17,867.73	
	Building C Back to Back Townhouse	12 units			Total
	Total GFA	No. of Blocks		m²	ft²
				1,181.60	12,718
	Building D Back to Back Townhouse	13 units			Total
	Total GFA	No. of Blocks		m²	ft²
				1,486.36	16,000
	Building E Back to Back Townhouse	14 units			Total
	Total GFA	No. of Blocks		m²	ft²
				1,294.39	13,932
	Building F Back to Back Townhouse	16 units			Total
	Total GFA	No. of Blocks		m²	ft²
				1,787.46	19,239
	Building G Back to Back Townhouse	12 units			Total
	Total GFA	No. of Blocks		m²	ft²
				1,199.49	12,910
	Building H Back to Back Townhouse	18 units			Total
	Total GFA	No. of Blocks		m²	ft²
				1,787.46	19,239
	Building J Back to Back Townhouse	16 units			Total
	Total GFA	No. of Blocks		m²	ft²
				1,787.46	19,239
	Total GFA Back to Back Townhouses			1,443.10	15,536
3.4	TOTAL RESIDENTIAL GFA PROPOSED			m²	ft²
				19,307	207,753
4.0	LOT COVERAGE				
	Lot	m²	ha	%	
4.1	Coverage (Building)	7,180.02	22,304	45%	
4.2	Landscape Area	7,929.39	77,860	49%	
4.3	Paved Area (One-Action and Entrance Areas)	2,872.60	23,346	18%	
5.0	F.S.I			2.69:1	
6.0	UNIT COUNT				
6.1	Building A - Residential Condominium				Total Units
	1 Bedroom				73
	2 Bedroom				74
	3 Bedroom				5
	Total				152
6.2	Building B - Residential Condominium				Total Units
	1 Bedroom				55
	2 Bedroom				71
	3 Bedroom				2
	Total				128
6.3	TOTAL 1 BEDROOM				128
6.4	TOTAL 2 BEDROOM				145
6.5	TOTAL 3 BEDROOM				9
6.6	TOTAL UNIT COUNT (Residential Condominium A&B)				282
6.7	Back to Back Townhouse - Buildings C - J				
	Total				115
6.8	GRAND TOTAL UNIT COUNT (Residential Condominium & Back to Back Townhouses)				397
7.0	PARKING				
7.1	Required Parking Spaces				
7.1	Building A & B	Alloy	Space	Total	
	1 Bedroom	1.25	96	119	
	2 Bedroom	1.50	145	218	
	3 Bedroom	1.75	9	16	
	Visitor	0.25	282	70	
	Required Parking Spaces Building A & B			423	
7.2	Building C-J Back to Back Townhouse				
	2 Bedroom	1.50	111	166	
	3 Bedroom	1.75	114	51	
	Visitor	0.25	127	32	
	Required Parking Spaces Building C-J Back to Back Townhouses			317	
7.3	Commercial				
	Unit	Alloy		Total	
	653.50	10	Gross Area / 65m2	53	
	Retail Parking Spaces Required			793	
7.4	Provided Parking Spaces				
7.5	Parking Spaces Provided - Buildings A,B,E and Back to Back Townhouse C-J				
	Surface		31	31	
	P1		631	631	
	Plains Rd Parallel Parking		10	10	
	Parking Spaces Provided - Residential and Commercial		662	662	
7.7	Electronic Parking Space Provided Size				
	Min. Space Size			2.6(3m) 4.6m	
8.0	AMENITY				
8.1	Required Amenity Space - Buildings A & B and Back to Back Townhouse C-J				
	Building Dwelling Unit	units	Alloy	Space	Total
	1 Bedroom	55	4m²	4	220
	2 Bedroom / 3 Bedroom	71	10m²	10	710
	Back to Back Townhouse	72	10m²	10	1,150
	Total Required Amenity Space				1,930
8.2	Provided Amenity Space - Building A & B and Back to Back Townhouse C-J				
				m²	Square ft
	Buildings A&B				
	Indoor Amenity			454	
	Outdoor Amenity @ 7th Floor Terrace			163	
	Balcony and Terrace Area			2,958	
	Back To Back Townhouses				
	Ground Floor Patio			1,133	
	Balconies			782	
	Rooftop Terrace			2,257	
	Total Amenity Area Provided			7,462	
8.9	LOADING				
	TOTAL LOADING SPACES PROVIDED			1	
10.0	BUILDING HEIGHT				
			Storeys		
	Building A		8		
	Building B		8		

Site Statistics
1
RZ-01

Contractor Must Check And Verify All Dimensions On The Job.

Do Not Scale The Drawings.

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Date:

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No	Revision	Date

PRELIMINARY

No.	ISSUED	DATE

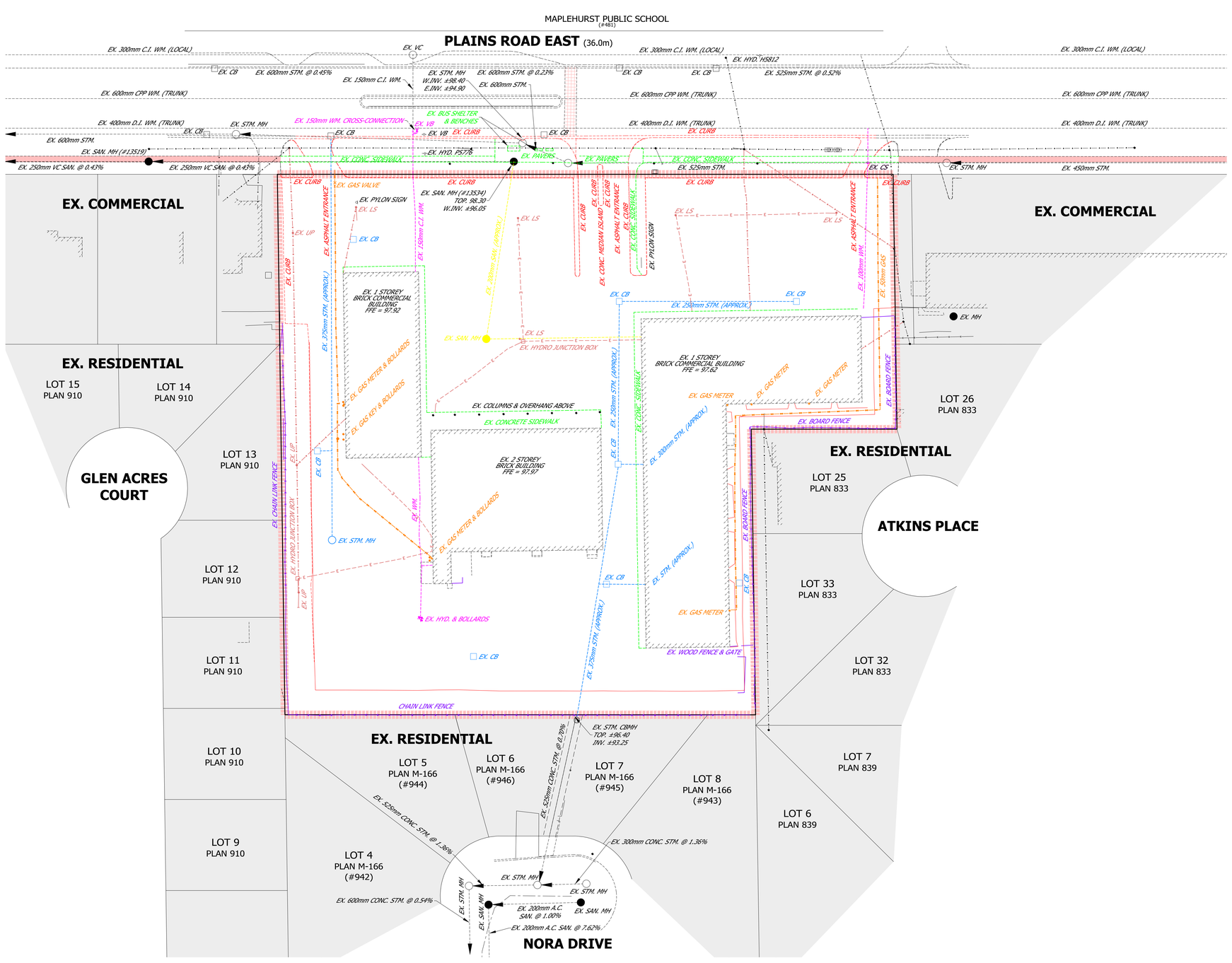
Drawing Title:
Site Plan
Site Statistics
O.B.C & Site Details

Phase 12
Project
NATIONAL HOMES
Proposed
484 PLAINS ROAD
Residential
Development
CITY OF BURLINGTON
ONTARIO

Scale: AS NOTED
Drawn by: Iliya.L
Checked by: SM
File No.: 17-047
Plot Date: Oct. 11, 2017

RZ-01

FILENAME: 17047 - 484 Plains Road



LEGEND

- EXISTING CURB, ASPHALT TO BE REMOVED
- EXISTING SIDEWALK TO BE REMOVED
- EXISTING SANITARY SEWER TO BE REMOVED
- EXISTING STORM SEWER TO BE REMOVED
- EXISTING WATERMAIN TO BE REMOVED
- EXISTING FENCING TO BE REMOVED
- EXISTING STRUCTURE TO BE REMOVED
- EXISTING GAS SERVICE TO BE REMOVED
- EXISTING OVERHEAD/UNDERGROUND HYDRO, BELL TO BE REMOVED
- LIMIT OF PROPERTY
- FUTURE/EXISTING DEVELOPMENT LANDS

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EXISTING CONDITIONS & REMOVALS PLAN

484 & 490 PLAINS ROAD EAST
CITY OF BURLINGTON, HALTON REGION

NATIONAL HOMES (PLAINS ROAD) LP

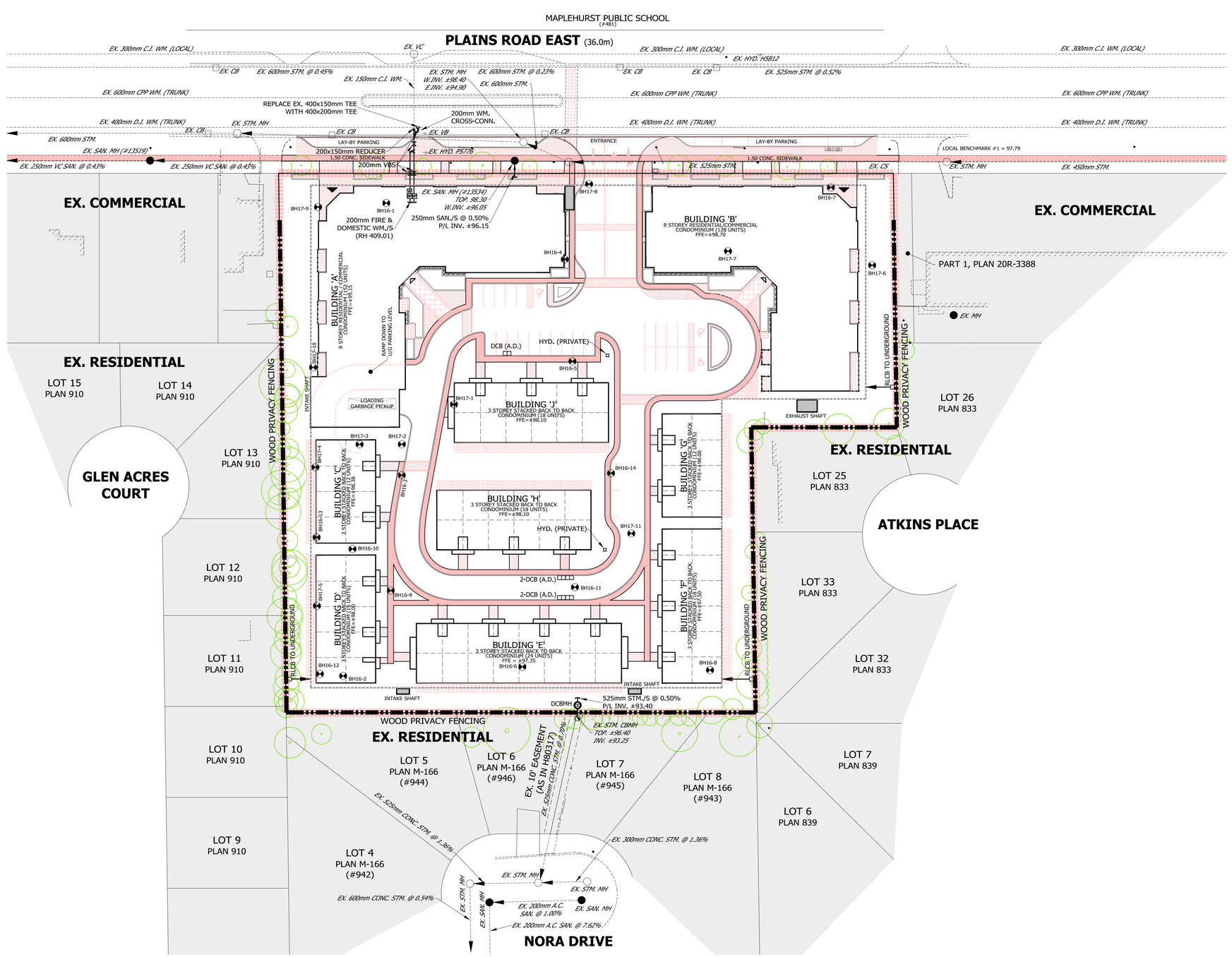
PROJECT No.: 17-539

DATE: SEPTEMBER 2017

SCALE:

FIGURE No.: **REM**

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LEGEND

- STORM SEWER AND MANHOLE
- SANITARY SEWER AND MANHOLE
- EXISTING STORM SEWER AND MANHOLE
- EXISTING SANITARY SEWER AND MANHOLE
- SINGLE, DOUBLE CATCHBASIN
- A.D. SINGLE, DOUBLE AREA DRAIN TO PARKING LEVEL
- HYDRANT & VALVE
- VALVE AND BOX
- WATER METER, BACK FLOW PREVENTION DEVICE (ALL WATER SERVICES TO BE PROVIDED WITH BACKFLOW PREVENTION WHERE ENTERING BUILDINGS)
- BARRIER CURB (OPSD 600.110)
- PRINCIPAL/BARRIER-FREE ENTRANCE, ENTRANCE
- LIMIT OF PROPERTY
- FIRE ROUTE
- FUTURE/EXISTING DEVELOPMENT LANDS

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SERVICING CONCEPT

484 & 490 PLAINS ROAD EAST
CITY OF BURLINGTON, HALTON REGION

NATIONAL HOMES (PLAINS ROAD) LP

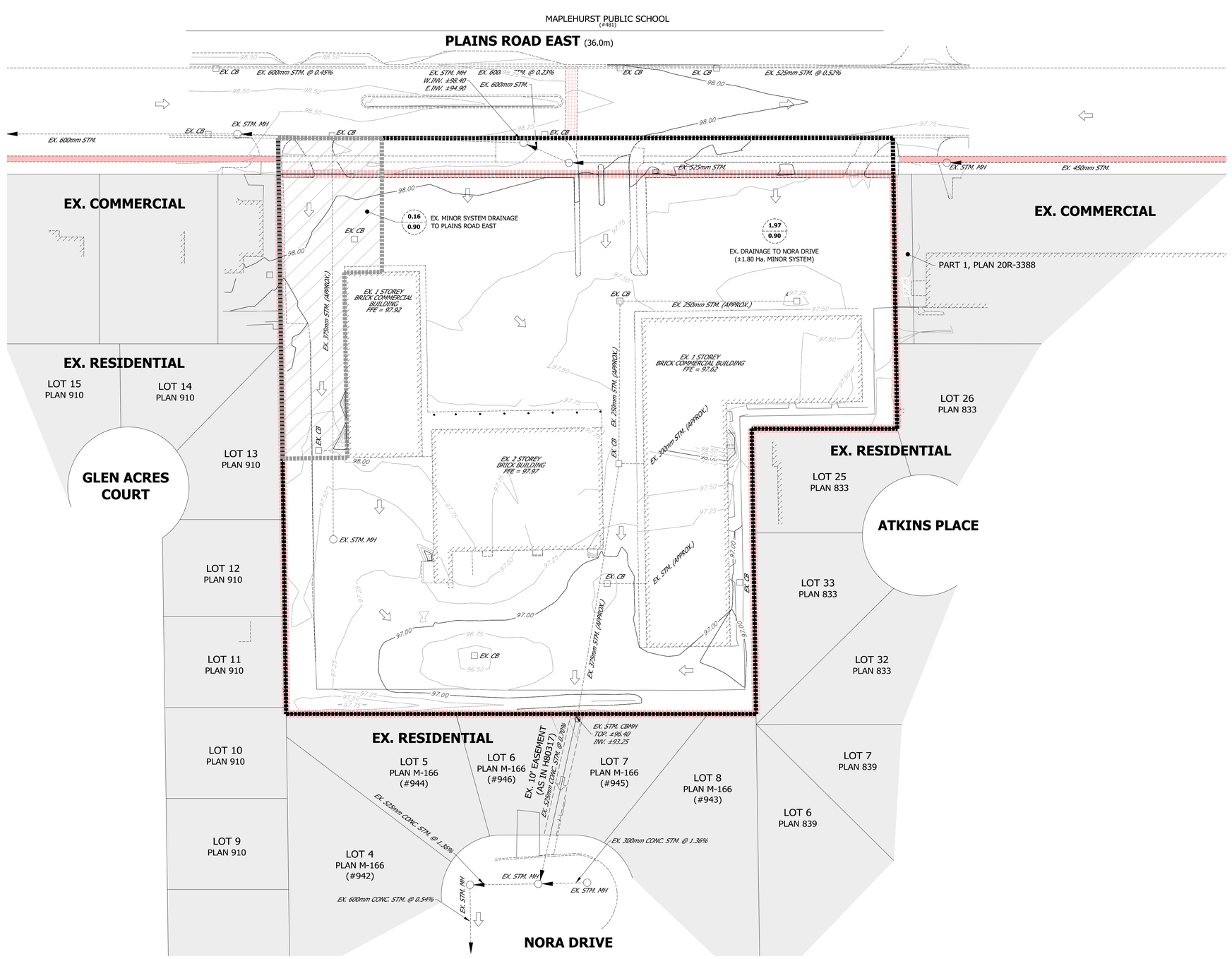
PROJECT No.: 17-539

DATE: SEPTEMBER 2017

SCALE:

FIGURE No.: **SP**

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LEGEND

- EXISTING CONTOUR AND ELEVATION
- EXISTING STORM SEWER AND MANHOLE
- EXISTING CATCHBASIN
- 0.25 / 0.90 — EXISTING DRAINAGE AREA (Ha.) / EXISTING RUNOFF COEFFICIENT
- EXISTING DRAINAGE AREA BOUNDARY
- EXISTING OVERLAND FLOW ROUTE
- LIMIT OF PROPERTY
- FUTURE/EXISTING DEVELOPMENT LANDS

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PRE-DEVELOPMENT STORM DRAINAGE PLAN

484 & 490 PLAINS ROAD EAST
CITY OF BURLINGTON, HALTON REGION

NATIONAL HOMES (PLAINS ROAD) LP

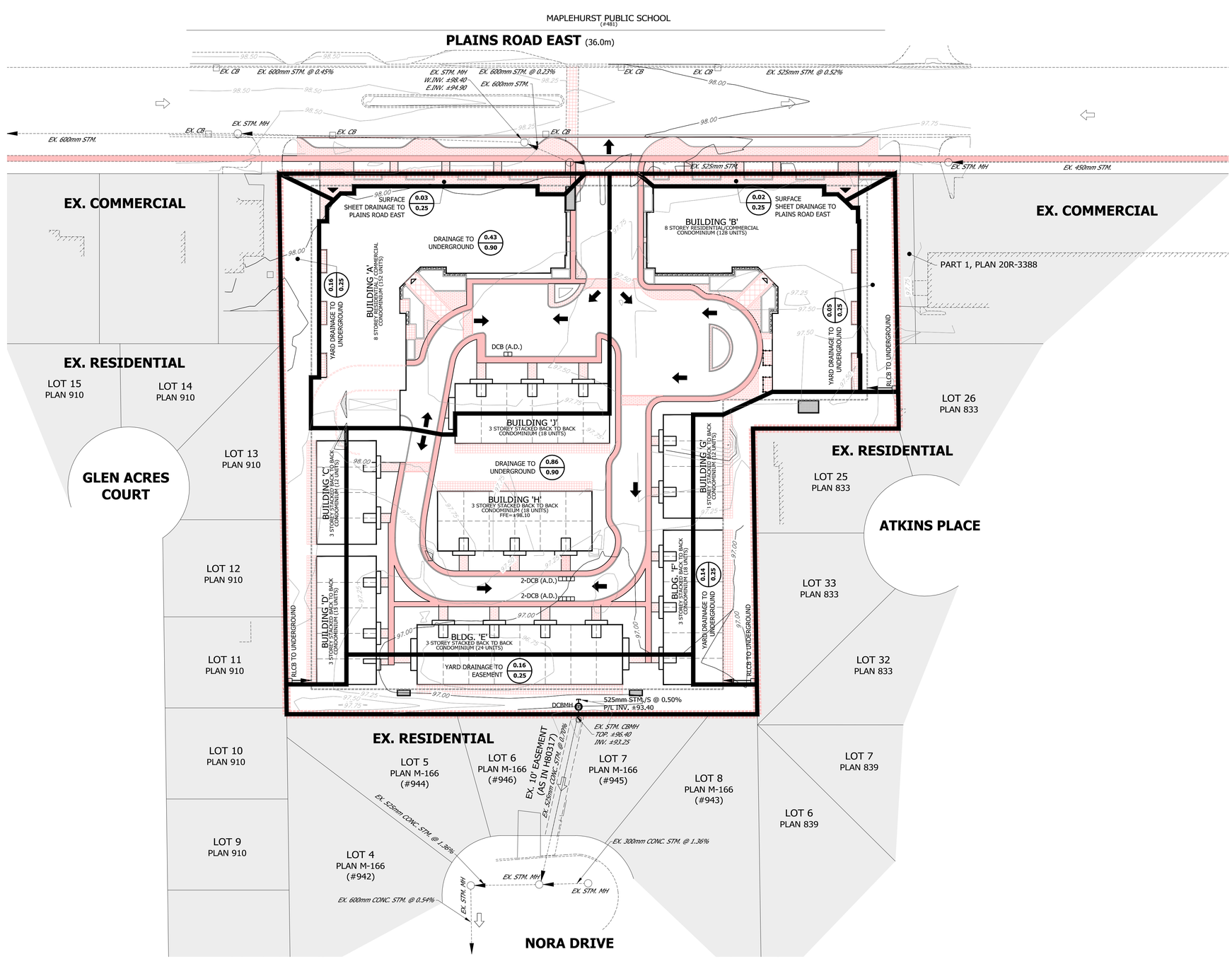
PROJECT No.: 17-539

DATE: SEPTEMBER 2017

SCALE:

FIGURE No.: **STM-1**

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LEGEND

- 247.00 — EXISTING ONTOUR AND ELEVATION
- STORM SEWER AND MANHOLE
- EXISTING STORM SEWER AND MANHOLE
- SINGLE, DOUBLE CATCHBASIN
- A.D. SINGLE, DOUBLE AREA DRAIN TO PARKING LEVEL
- 0.63 / 0.65 — PROPOSED DRAINAGE AREA (Ha.) / PROPOSED RUNOFF COEFFICIENT
- PROPOSED DRAINAGE AREA BOUNDARY
- PROPOSED OVERLAND FLOW ROUTE
- LIMIT OF PROPERTY
- FUTURE/EXISTING DEVELOPMENT LANDS

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POST-DEVELOPMENT STORM DRAINAGE CONCEPT

484 & 490 PLAINS ROAD EAST
CITY OF BURLINGTON, HALTON REGION

NATIONAL HOMES (PLAINS ROAD) LP

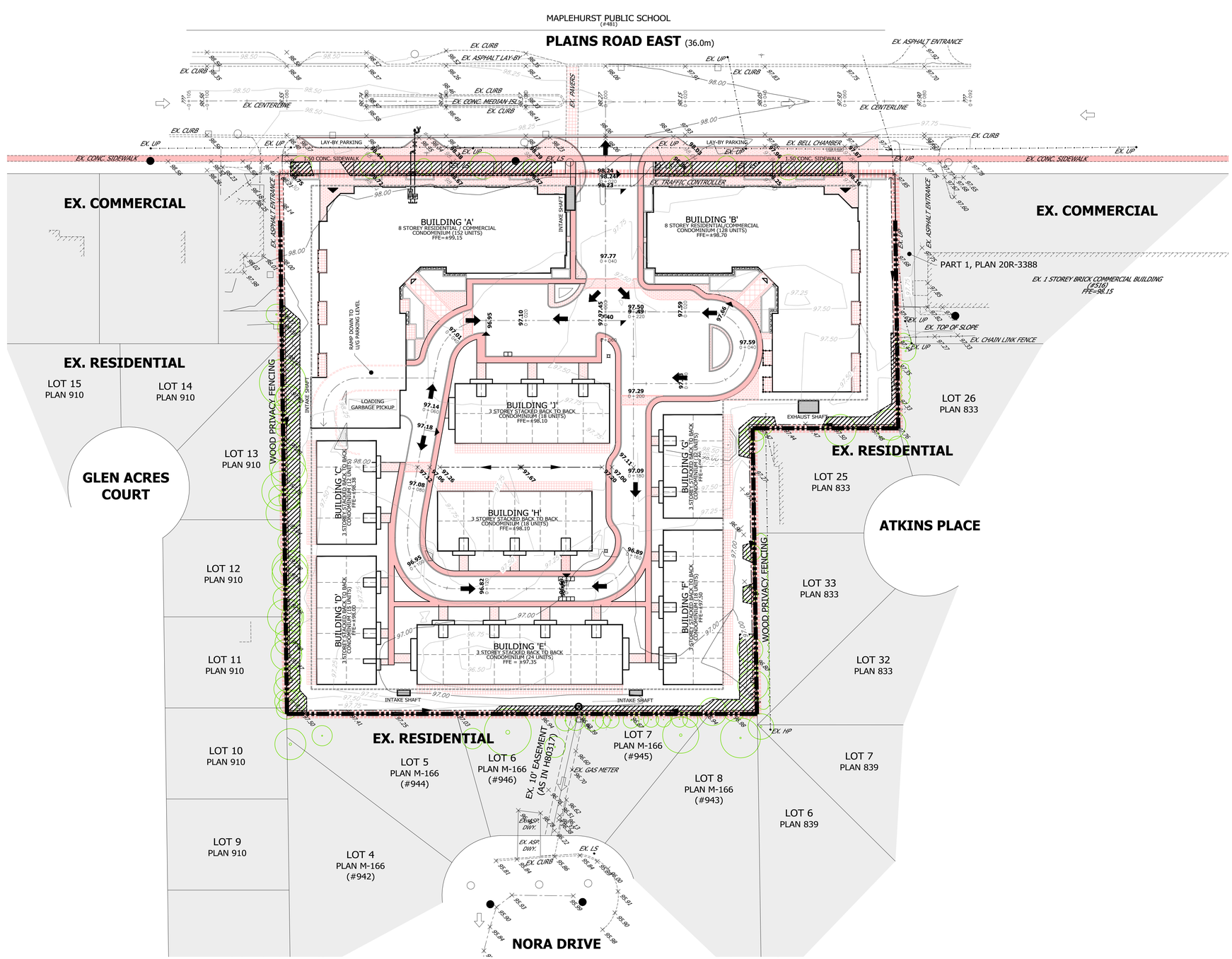
PROJECT No.: 17-539

DATE: SEPTEMBER 2017

SCALE:

FIGURE No.: **STM-2**

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LEGEND

242.00	EXISTING CONTOUR AND ELEVATION
+240.71	PROPOSED ELEVATION
+241.00	EXISTING ELEVATION
+(264.155)	FUTURE ELEVATION
+247.24TC/BC	TOP/BOTTOM OF CURB ELEVATION
	MAXIMUM 3:1 SLOPE
	PROPOSED SWALE
	PROPOSED OVERLAND FLOW DIRECTION
	EXISTING OVERLAND FLOW DIRECTION
	PROPOSED, EXISTING STORM MANHOLE
	PROPOSED, EXISTING SANITARY MANHOLE
	SINGLE CATCHBASIN/AREA DRAIN TO PARKING LEVEL
	DOUBLE CATCHBASIN/AREA DRAIN TO PARKING LEVEL
	HYDRANT & VALVE
	VALVE AND BOX
	LIMIT OF PROPERTY
	FUTURE/EXISTING DEVELOPMENT LANDS
	TREE PROTECTION ZONE (REFER TO TREE INVENTORY AND PRESERVATION PLAN FOR DETAILS)

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GRADING CONCEPT

484 & 490 PLAINS ROAD EAST
CITY OF BURLINGTON, HALTON REGION

NATIONAL HOMES (PLAINS ROAD) LP

PROJECT No.: 17-539

DATE: SEPTEMBER 2017

SCALE:

FIGURE No.: **GR**

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